

SHOP MANUAL

KOMATSU *advance* **LOADER** **WA470-3**

MACHINE MODEL

WA470-3

SERIAL NUMBER

50001 and up

- This shop manual may contain attachments and optional equipment that are not available in your area. Please consult your local Komatsu distributor for those items you may require. Materials and specifications are subject to change without notice.
- WA470-3 mount the S6D125 engine.
For details of the engine, see the 125 Series Engine Shop Manual.

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	30-181	②		30-216	④		30-257	②		40-32	⑤			
	30-182	②		30-217	④		30-258	②		40-33				
	30-183	②		30-218	②		30-259	②		40-34				
	30-184	②		30-219	②		30-260	②		40-35				
	30-185	②		30-220	②		30-261	②		40-36	③			
	30-186	②		30-221	②					40-37	③			
	30-187	②		30-222	②					40-38	③			

U42403

SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

Proper service and repair is extremely important for safe machine operation. The service and repair techniques recommended by Komatsu and described in this manual are both effective and safe. Some of these techniques require the use of tools specially designed by Komatsu for the specific purpose.

To prevent injury to workers, the symbol  is used to mark safety precautions in this manual. The cautions accompanying these symbols should always be followed carefully. If any dangerous situation arises or may possibly arise, first consider safety, and take the necessary actions to deal with the situation.

GENERAL PRECAUTIONS

Mistakes in operation are extremely dangerous. Read the Operation and Maintenance Manual carefully BEFORE operating the machine.

1. Before carrying out any greasing or repairs, read all the precautions given on the decals which are fixed to the machine.
2. When carrying out any operation, always wear safety shoes and helmet. Do not wear loose work clothes, or clothes with buttons missing.
 - Always wear safety glasses when hitting parts with a hammer.
 - Always wear safety glasses when grinding parts with a grinder, etc.
3. If welding repairs are needed, always have a trained, experienced welder carry out the work. When carrying out welding work, always wear welding gloves, apron, hand shield, cap and other clothes suited for welding work.
4. When carrying out any operation with two or more workers, always agree on the operating procedure before starting. Always inform your fellow workers before starting any step of the operation. Before starting work, hang UNDER REPAIR signs on the controls in the operator's compartment.
5. Keep all tools in good condition and learn the correct way to use them.

6. Decide a place in the repair workshop to keep tools and removed parts. Always keep the tools and parts in their correct places. Always keep the work area clean and make sure that there is no dirt or oil on the floor. Smoke only in the areas provided for smoking. Never smoke while working.

PREPARATIONS FOR WORK

7. Before adding oil or making any repairs, park the machine on hard, level ground, and block the wheels or tracks to prevent the machine from moving.
8. Before starting work, lower blade, ripper, bucket or any other work equipment to the ground. If this is not possible, insert the safety pin or use blocks to prevent the work equipment from falling. In addition, be sure to lock all the control levers and hang warning signs on them.
9. When disassembling or assembling, support the machine with blocks, jacks or stands before starting work.
10. Remove all mud and oil from the steps or other places used to get on and off the machine. Always use the handrails, ladders or steps when getting on or off the machine. Never jump on or off the machine. If it is impossible to use the handrails, ladders or steps, use a stand to provide safe footing.

PRECAUTIONS DURING WORK

11. When removing the oil filler cap, drain plug or hydraulic pressure measuring plugs, loosen them slowly to prevent the oil from spurting out. Before disconnecting or removing components of the oil, water or air circuits, first remove the pressure completely from the circuit.
12. The water and oil in the circuits are hot when the engine is stopped, so be careful not to get burned.
Wait for the oil and water to cool before carrying out any work on the oil or water circuits.
13. Before starting work, remove the leads from the battery. Always remove the lead from the negative (–) terminal first.
14. When raising heavy components, use a hoist or crane.
Check that the wire rope, chains and hooks are free from damage.
Always use lifting equipment which has ample capacity.
Install the lifting equipment at the correct places.
Use a hoist or crane and operate slowly to prevent the component from hitting any other part.
Do not work with any part still raised by the hoist or crane.
15. When removing covers which are under internal pressure or under pressure from a spring, always leave two bolts in position on opposite sides. Slowly release the pressure, then slowly loosen the bolts to remove.
16. When removing components, be careful not to break or damage the wiring. Damaged wiring may cause electrical fires.
17. When removing piping, stop the fuel or oil from spilling out. If any fuel or oil drips onto the floor, wipe it up immediately. Fuel or oil on the floor can cause you to slip, or can even start fires.
18. As a general rule, do not use gasoline to wash parts. In particular, use only the minimum of gasoline when washing electrical parts.
19. Be sure to assemble all parts again in their original places.
Replace any damaged parts with new parts.
 - When installing hoses and wires, be sure that they will not be damaged by contact with other parts when the machine is being operated.
20. When installing high pressure hoses, make sure that they are not twisted. Damaged tubes are dangerous, so be extremely careful when installing tubes for high pressure circuits. Also, check that connecting parts are correctly installed.
21. When assembling or installing parts, always use the specified tightening torques. When installing protective parts such as guards, or parts which vibrate violently or rotate at high speed, be particularly careful to check that they are installed correctly.
22. When aligning two holes, never insert your fingers or hand. Be careful not to get your fingers caught in a hole.
23. When measuring hydraulic pressure, check that the measuring tool is correctly assembled before taking any measurements.
24. Take care when removing or installing the tracks of track-type machines.
When removing the track, the track separates suddenly, so never let anyone stand at either end of the track.

FOREWORD

GENERAL

This shop manual has been prepared as an aid to improve the quality of repairs by giving the serviceman an accurate understanding of the product and by showing him the correct way to perform repairs and make judgments. Make sure you understand the contents of this manual and use it to full effect at every opportunity.

This shop manual mainly contains the necessary technical information for operations performed in a service workshop. For ease of understanding, the manual is divided into the following chapters; these chapters are further divided into the each main group of components.

STRUCTURE AND FUNCTION

This section explains the structure and function of each component. It serves not only to give an understanding of the structure, but also serves as reference material for troubleshooting.

In addition, this section may contain hydraulic circuit diagrams, electric circuit diagrams, and maintenance standards.

TESTING AND ADJUSTING

This section explains checks to be made before and after performing repairs, as well as adjustments to be made at completion of the checks and repairs.

Troubleshooting charts correlating "Problems" with "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the procedures for removing, installing, disassembling and assembling each component, as well as precautions for them.

MAINTENANCE STANDARD

This section gives the judgment standards for inspection of disassembled parts.

The contents of this section may be described in STRUCTURE AND FUNCTION.

OTHERS

This section mainly gives hydraulic circuit diagrams and electric circuit diagrams.

In addition, this section may give the specifications of attachments and options together.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Use the specifications given in the book with the latest date.

HOW TO READ THE SHOP MANUAL

VOLUMES

Shop manuals are issued as a guide to carrying out repairs. They are divided as follows:

Chassis volume: Issued for every machine model

Engine volume: Issued for each engine series

Electrical volume: } Each issued as one
Attachments volume: } volume to cover all
 models

These various volumes are designed to avoid duplicating the same information. Therefore, to deal with all repairs for any model, it is necessary that chassis, engine, electrical and attachment volumes be available.

DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to KOMATSU distributors. Get the most up-to-date information before you start any work.

FILING METHOD

1. See the page number on the bottom of the page. File the pages in correct order.
2. Following examples show how to read the page number.
 Example 1 (Chassis volume):

10 - 3

Item number (10. Structure and Function)
 Consecutive page number for each item.

Example 2 (Engine volume):

12 - 5

Unit number (1. Engine)
 Item number (2. Testing and Adjusting)
 Consecutive page number for each item.

3. Additional pages: Additional pages are indicated by a hyphen (-) and number after the page number. File as in the example.

Example:

10-4		12-203
10-4-1	Added pages	12-203-1
10-4-2		12-203-2
10-5		12-204

REVISED EDITION MARK

When a manual is revised, an edition mark (①②③....) is recorded on the bottom of the pages.

REVISIONS

Revised pages are shown in the LIST OF REVISED PAGES next to the CONTENTS page.

SYMBOLS

So that the shop manual can be of ample practical use, important safety and quality portions are marked with the following symbols.

Symbol	Item	Remarks
	Safety	Special safety precautions are necessary when performing the work.
	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.
	Weight	Weight of parts of systems. Caution necessary when selecting hoisting wire, or when working posture is important, etc.
	Tightening torque	Places that require special attention for the tightening torque during assembly.
	Coat	Places to be coated with adhesives and lubricants, etc.
	Oil, water	Places where oil, water or fuel must be added, and the capacity.
	Drain	Places where oil or water must be drained, and quantity to be drained.

HOISTING INSTRUCTIONS

HOISTING

! Heavy parts (25 kg or more) must be lifted with a hoist, etc. In the **DISASSEMBLY AND ASSEMBLY** section, every part weighing 25 kg or more is indicated clearly with the symbol .

- If a part cannot be smoothly removed from the machine by hoisting, the following checks should be made:
 - 1) Check for removal of all bolts fastening the part to the relative parts.
 - 2) Check for existence of another part causing interference with the part to be removed.

WIRE ROPES

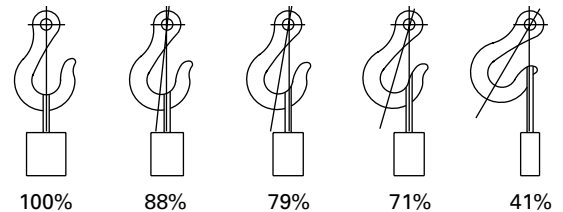
- 1) Use adequate ropes depending on the weight of parts to be hoisted, referring to the table below:

Wire ropes
(Standard "Z" or "S" twist ropes
without galvanizing)

Rope diameter	Allowable load	
	kN	tons
mm		
10	9.8	1.0
11.5	13.7	1.4
12.5	15.7	1.6
14	21.6	2.2
16	27.5	2.8
18	35.3	3.6
20	43.1	4.4
22.4	54.9	5.6
30	98.1	10.0
40	176.5	18.0
50	274.6	28.0
60	392.2	40.0

- ★ The allowable load value is estimated to be one-sixth or one-seventh of the breaking strength of the rope used.
- 2) Sling wire ropes from the middle portion of the hook.

Slinging near the edge of the hook may cause the rope to slip off the hook during hoisting, and a serious accident can result. Hooks have maximum strength at the middle portion.



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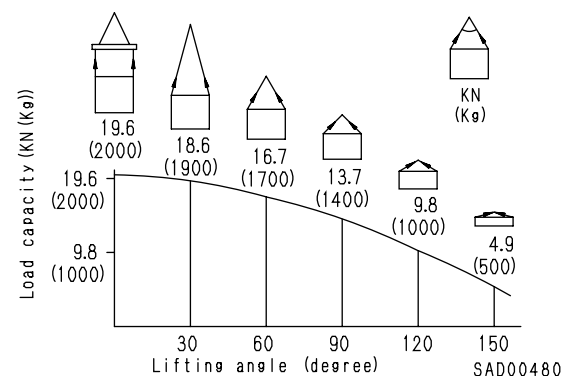
- 3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound onto the load.

! Slinging with one rope may cause turning of the load during hoisting, untwisting of the rope, or slipping of the rope from its original winding position on the load, which can result in a dangerous accident.

- 4) Do not sling a heavy load with ropes forming a wide hanging angle from the hook.

When hoisting a load with two or more ropes, the force subjected to each rope will increase with the hanging angles. The table below shows the variation of allowable load kN {kg} when hoisting is made with two ropes, each of which is allowed to sling up to 9.8 kN {1000 kg} vertically, at various hanging angles.

When two ropes sling a load vertically, up to 19.6 kN {2000 kg} of total weight can be suspended. This weight becomes 9.8 kN {1000 kg} when two ropes make a 120° hanging angle. On the other hand, two ropes are subjected to an excessive force as large as 39.2 kN {4000 kg} if they sling a 19.6 kN {2000 kg} load at a lifting angle of 150°.



METHOD OF DISASSEMBLING, CONNECTING PUSH-PULL TYPE COUPLER

! Before carrying out the following work, release the residual pressure from the hydraulic tank. For details, see TESTING AND ADJUSTING, Releasing residual pressure from hydraulic tank.

! Even if the residual pressure is released from the hydraulic tank, some hydraulic oil flows out when the hose is disconnected. Accordingly, prepare an oil receiving container.

Disconnection

- 1) Release the residual pressure from the hydraulic tank. For details, see TESTING AND ADJUSTING, Releasing residual pressure from hydraulic tank.
- 2) Hold adapter (1) and push hose joint (2) into mating adapter (3). (See Fig. 1)
 - ★ The adapter can be pushed in about 3.5 mm.
 - ★ Do not hold rubber cap portion (4).
- 3) After hose joint (2) is pushed into adapter (3), press rubber cap portion (4) against (3) until it clicks. (See Fig. 2)
- 4) Hold hose adapter (1) or hose (5) and pull it out. (See Fig. 3)
 - ★ Since some hydraulic oil flows out, prepare an oil receiving container.

Connection

- 1) Hold hose adapter (1) or hose (5) and insert it in mating adapter (3), aligning them with each other. (See Fig. 4)
 - ★ Do not hold rubber cap portion (4).
- 2) After inserting the hose in the mating adapter perfectly, pull it back to check its connecting condition. (See Fig. 5)
 - ★ When the hose is pulled back, the rubber cap portion moves toward the hose about 3.5 mm. This does not indicate abnormality, however.

Type 1

Fig. 1

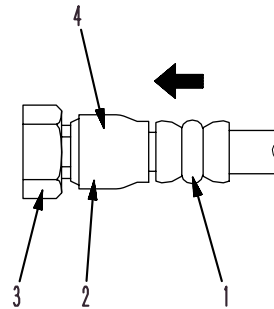


Fig. 2

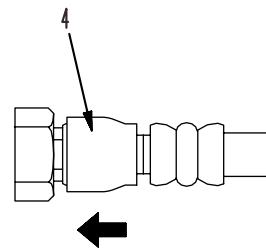


Fig. 3

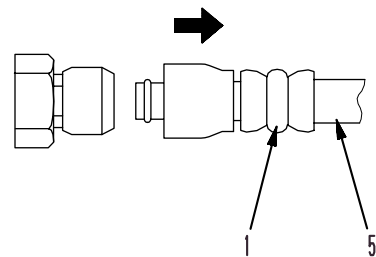


Fig. 4

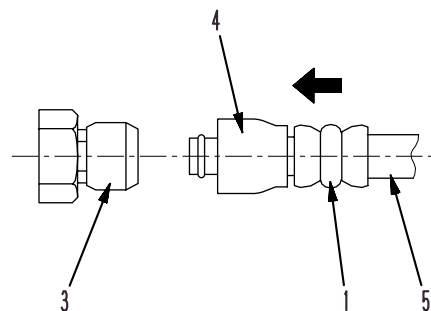
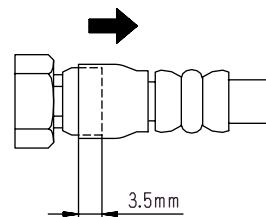


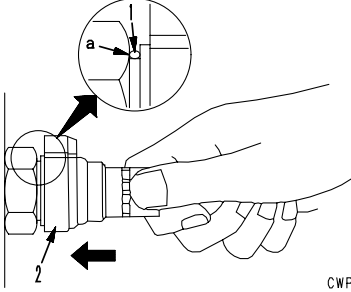
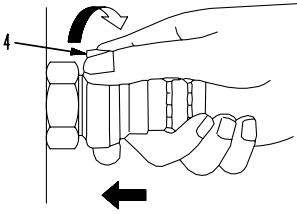
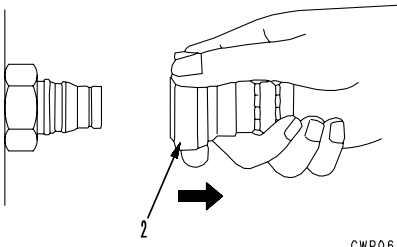
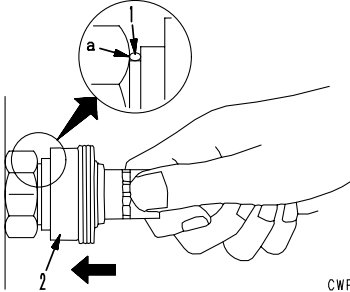
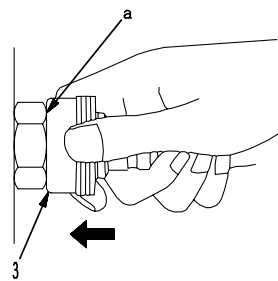
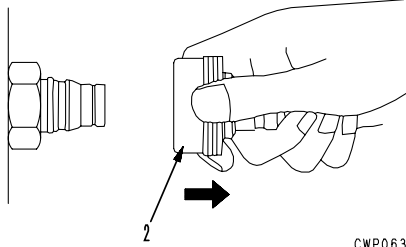
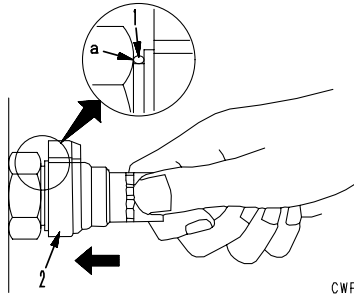
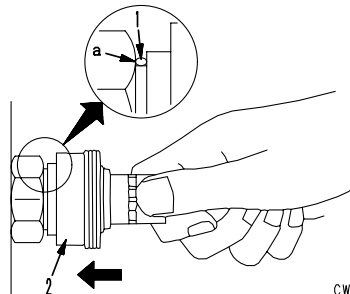
Fig. 5



CWP10701

FOREWORD

METHOD OF DISASSEMBLING, CONNECTING PUSH-PULL TYPE COUPLER

	Type 2	Type 3
Disassembly	1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end.  CWP06392 2) Hold in the condition in Step 1), and turn lever (4) to the right (clockwise).  CWP06394 3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.  CWP06396	1) Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end.  CWP06391 2) Hold in the condition in Step 1), and push until cover (3) contacts contact surface a of the hexagonal portion at the male end.  CWP06393 3) Hold in the condition in Steps 1) and 2), and pull out whole body (2) to disconnect it.  CWP06395
Connection	• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end to connect it.  CWP06392	• Hold the mouthpiece of the tightening portion and push body (2) in straight until sliding prevention ring (1) contacts contact surface a of the hexagonal portion at the male end to connect it.  CWP06391

COATING MATERIALS

- ★ The recommended coating materials such as adhesives, gasket sealants and greases used for disassembly and assembly are listed below.
- ★ For coating materials not listed below, use the equivalent of products shown in this list.

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, features
Adhesives	LT-1A	790-129-9030	150 g	Tube	Used to prevent rubber gaskets, rubber cushions, and cock plug from coming out.
	LT-1B	790-129-9050	20 g (2 pcs.)	Polyethylene container	Used in places requiring an immediately effective, strong adhesive. Used for plastics (except polyethylene, polypropylene, tetrafluoroethylene and vinyl chloride), rubber, metal and non-metal.
	LT-2	09940-00030	50 g	Polyethylene container	- Features: Resistance to heat and chemicals - Used for anti-loosening and sealant purpose for bolts and plugs.
	LT-3	790-129-9060 (Set of adhesive and hardening agent)	Adhesive: 1 kg Hardening agent: 500 g	Can	Used as adhesive or sealant for metal, glass and plastic.
	LT-4	790-129-9040	250 g	Polyethylene container	Used as sealant for machined holes.
	Holtz MH 705	790-126-9120	75 g	Tube	Used as heat-resisting sealant for repairing engine.
	Three bond 1735	790-129-9140	50 g	Polyethylene container	- Quick hardening type adhesive - Cure time: within 5 sec. to 3 min. - Used mainly for adhesion of metals, rubbers, plastics and woods.
	Aron-alpha 201	790-129-9130	2 g	Polyethylene container	- Quick hardening type adhesive - Quick cure type (max. strength after 30 minutes) - Used mainly for adhesion of rubbers, plastics and metals.
	Loctite 648-50	79A-129-9110	50 cc	Polyethylene container	- Resistance to heat, chemicals - Used at joint portions subject to high temperatures.
Gasket sealant	LG-1	790-129-9010	200 g	Tube	Used as adhesive or sealant for gaskets and packing of power train case, etc.
	LG-5	790-129-9070	1 kg	Can	- Used as sealant for various threads, pipe joints, flanges. - Used as sealant for tapered plugs, elbows, nipples of hydraulic piping.
	LG-6	790-129-9020	200 g	Tube	- Features: Silicon based, resistance to heat, cold - Used as sealant for flange surface, tread. - Used as sealant for oil pan, final drive case, etc.

FOREWORD
COATING MATERIALS

Category	Komatsu code	Part No.	Q'ty	Container	Main applications, features
Adhesives	LG-7	790-129-9070	1 g	Tube	• Features: Silicon based, quick hardening type • Used as sealant for flywheel housing, intake manifold, oil pan, thermostat housing, etc.
	Three bond 1211	790-129-9090	100 g	Tube	• Used as heat-resisting sealant for repairing engine.
Molybdenum disulphide lubricant	LM-G	09940-00051	60 g	Can	• Used as lubricant for sliding portion (to prevent from squeaking).
	LM-P	09940-00040	200 g	Tube	• Used to prevent seizure or scuffing of the thread when press fitting or shrink fitting. • Used as lubricant for linkage, bearings, etc.
Grease	G2-LI	SYG2-400LI SYG2-350LI SYG2-400LI-A SYG2-160LI SYGA-160CNLI	Various	Various	• General purpose type
	G2-CA	SYG2-400CA SYG2-350CA SYG2-400CA-A SYG2-160CA SYGA-160CNCA	Various	Various	• Used for normal temperature, light load bearing at places in contact with water or steam.
	Molybdenum disulphide lubricant	SYG2-400M	400 g (10 per case)	Belows type	• Used for places with heavy load

STANDARD TIGHTENING TORQUE

STANDARD TIGHTENING TORQUE TABLE (WHEN USING TORQUE WRENCH)

★ In the case of metric nuts and bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter of bolt	Width across flats	    	
mm	mm	Nm	kgm
6	10	13.2 ± 1.4	1.35 ± 0.15
8	13	31 ± 3	3.2 ± 0.3
10	17	66 ± 7	6.7 ± 0.7
12	19	113 ± 10	11.5 ± 1
14	22	177 ± 19	18 ± 2
16	24	279 ± 30	28.5 ± 3
18	27	382 ± 39	39 ± 4
20	30	549 ± 59	56 ± 6
22	32	745 ± 83	76 ± 8.5
24	36	927 ± 103	94.5 ± 10.5
27	41	1320 ± 140	135 ± 15
30	46	1720 ± 190	175 ± 20
33	50	2210 ± 240	225 ± 25
36	55	2750 ± 290	280 ± 30
39	60	3290 ± 340	335 ± 35

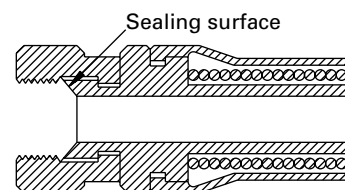
CDL00372

Thread diameter of bolt	Width across flats		
mm	mm	Nm	kgm
6	10	7.85 ± 1.95	0.8 ± 0.2
8	13	18.6 ± 4.9	1.9 ± 0.5
10	14	40.2 ± 5.9	4.1 ± 0.6
12	27	82.35 ± 7.85	8.4 ± 0.8

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TABLE OF TIGHTENING TORQUES FOR FLARED NUTS

★ In the case of flared nuts for which there is no special instruction, tighten to the torque given in the table below.



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Thread diameter	Width across flat	Tightening torque	
mm	mm	Nm	kgm
14	19	24.5 ± 4.9	2.5 ± 0.5
18	24	49 ± 19.6	5 ± 2
22	27	78.5 ± 19.6	8 ± 2
24	32	137.3 ± 29.4	14 ± 3
30	36	176.5 ± 29.4	18 ± 3
33	41	196.1 ± 49	20 ± 5
36	46	245.2 ± 49	25 ± 5
42	55	294.2 ± 49	30 ± 5

FOREWORD
STANDARD TIGHTENING TORQUE
TABLE OF TIGHTENING TORQUES FOR SPLIT FLANGE BOLTS

★ In the case of split flange bolts for which there is no special instruction, tighten to the torque given in the table below.

Thread diameter	Width across flat	Tightening torque	
mm	mm	Nm	kgm
10	14	65.7 ± 6.8	6.7 ± 0.7
12	17	112 ± 9.8	11.5 ± 1
16	22	279 ± 29	28.5 ± 3

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PIPING JOINTS

★ Unless there are special instructions, tighten the O-ring boss piping joints to the torque below.

Nominal No.	Thread diameter	Width across flat	Tightening torque	
	mm	mm	Nm	kgm
02	14	Varies depending on type of connector.	34.3 ± 4.9	3.5 ± 0.5
03, 04	20		93.1 ± 9.8	9.5 ± 1
05, 06	24		142.1 ± 19.6	14.5 ± 2
10, 12	33		421.4 ± 58.8	43 ± 6
14	42		877.1 ± 132.3	89.5 ± 13.5

TABLE OF TIGHTENING TORQUES FOR O-RING BOSS PLUGS

★ Unless there are special instructions, tighten the O-ring boss plugs to the torque below.

Nominal No.	Thread diameter	Width across flat	Tightening torque	
	mm	mm	Nm	kgm
08	08	14	7.35 ± 1.47	0.75 ± 0.15
10	10	17	11.27 ± 1.47	1.15 ± 0.15
12	12	19	17.64 ± 1.96	1.8 ± 0.2
14	14	22	22.54 ± 1.96	2.3 ± 0.2
16	16	24	29.4 ± 4.9	3 ± 0.5
18	18	27	39.2 ± 4.9	4 ± 0.5
20	20	30	49 ± 4.9	5 ± 0.5
24	24	32	68.6 ± 9.8	7 ± 1
30	30	32	107.8 ± 14.7	11 ± 1.5
33	33	n	127.4 ± 19.6	13 ± 2
36	36	36	151.9 ± 24.5	15.5 ± 2.5
42	42	n	210.7 ± 29.4	21.5 ± 3
52	52	n	323.4 ± 44.1	33 ± 4.5

FOREWORD**STANDARD TIGHTENING TORQUE****TIGHTENING TORQUE FOR 102 ENGINE SERIES (BOLT AND NUTS)**

Use these torques for bolts and nuts (unit: mm) of Cummins Engine.

Thread diameter	Tightening torque	
mm	Nm	kgm
6	10 ± 2	1.02 ± 0.20
8	24 ± 4	2.45 ± 0.41
10	43 ± 6	4.38 ± 0.61
12	77 ± 12	7.85 ± 1.22

TIGHTENING TORQUE FOR 102 ENGINE SERIES (EYE JOINTS)

Use these torques for eye joints (unit: mm) of Cummins Engine.

Thread diameter	Tightening torque	
mm	Nm	kgm
6	8 ± 2	0.81 ± 0.20
8	10 ± 2	1.02 ± 0.20
10	12 ± 2	1.22 ± 0.20
12	24 ± 4	2.45 ± 0.41
14	36 ± 5	3.67 ± 0.51

TIGHTENING TORQUE FOR 102 ENGINE SERIES (TAPERED SCREWS)

Use these torques for tapered screws (unit: inch) of Cummins Engine.

Thread diameter	Tightening torque	
mm	Nm	kgm
1 / 16	3 ± 1	0.31 ± 0.10
1 / 8	8 ± 2	0.81 ± 0.20
1 / 4	12 ± 2	1.22 ± 0.20
3 / 8	15 ± 2	1.53 ± 0.41
1 / 2	24 ± 4	2.45 ± 0.41
3 / 4	36 ± 5	3.67 ± 0.51
1	60 ± 9	6.12 ± 0.92

ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires.

This wire code table will help you understand WIRING DIAGRAMS.

Example: 5WB indicates a cable having a nominal number 5 and white coating with black stripe.

CLASSIFICATION BY THICKNESS

Nominal number	Copper wire			Cable O.D. (mm)	Current rating (A)	Applicable circuit
	Number of strands	Dia. of strands (mm ²)	Cross section (mm ²)			
0.85	11	0.32	0.88	2.4	12	Starting, lighting, signal etc.
2	26	0.32	2.09	3.1	20	Lighting, signal etc.
5	65	0.32	5.23	4.6	37	Charging and signal
15	84	0.45	13.36	7.0	59	Starting (Glow plug)
40	85	0.80	42.73	11.4	135	Starting
60	127	0.80	63.84	13.6	178	Starting
100	217	0.80	109.1	17.6	230	Starting

CLASSIFICATION BY COLOR AND CODE

Priority	Circuits Classification		Charging	Ground	Starting	Lighting	Instrument	Signal	Other
1	Primary	Code	W	B	B	R	Y	G	L
		Color	White	Black	Black	Red	Yellow	Green	Blue
2	Auxiliary	Code	WR	—	BW	RW	YR	GW	LW
		Color	White & Red	—	White & Black	Red & White	Rellow & Red	Green & White	Blue & White
3		Code	WB	—	BY	RB	YB	GR	LR
		Color	White & Black	—	Black & Yellow	Red & Black	Yellow & Black	Green & Red	Blue & Yellow
4		Code	WL	—	BR	RY	YG	GY	LY
		Color	White & Blue	—	Black & Red	Red & Yellow	Yellow & Green	Green & Yellow	Blue & Yellow
5		Code	WG	—	—	RG	YL	GB	LB
		Color	White & Green	—	—	Red & Green	Yellow & Blue	Green & Black	Blue & Black
6		Code	—	—	—	RL	YW	GL	—
		Color	—	—	—	Red & Blue	Yellow & White	Green & Blue	—

CONVERSION TABLE

METHOD OF USING THE CONVERSION TABLE

The Conversion Table in this section is provided to enable simple conversion of figures. For details of the method of using the Conversion Table, see the example given below.

EXAMPLE

- Method of using the Conversion Table to convert from millimeters to inches

1. Convert 55 mm into inches.

- Locate the number 50 in the vertical column at the left side, take this as ①, then draw a horizontal line from ①.
- Locate the number 5 in the row across the top, take this as ②, then draw a perpendicular line down from ②.
- Take the point where the two lines cross as ③. This point ③ gives the value when converting from millimeters to inches. Therefore, 55 mm = 2.165 inches.

2. Convert 550 mm into inches.

- The number 550 does not appear in the table, so divide by 10 (move the decimal point one place to the left) to convert it to 55 mm.
- Carry out the same procedure as above to convert 55 mm to 2.165 inches.
- The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (move the decimal point one place to the right) to return to the original value. This gives 550 mm = 21.65 inches.

Millimeters to inches

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

FOREWORD**CONVERSION TABLE****Millimeters to Inches**

1 mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
0	0	0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
40	1.575	1.614	1.654	1.693	1.732	1.772	1.811	1.850	1.890	1.929
50	1.969	2.008	2.047	2.087	2.126	2.165	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1 kg = 2.2046 lb

	0	1	2	3	4	5	6	7	8	9
0	0	2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.53	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

FOREWORD**CONVERSION TABLE****Liter to U.S. Gallon**

1ℓ = 0.2642 U.S. Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.361	25.625	25.889	26.153

Liter to U.K. Gallon

1ℓ = 0.21997 U.K. Gal

	0	1	2	3	4	5	6	7	8	9
0	0	0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.699	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

FOREWORD**CONVERSION TABLE****kgm to ft. lb**

1 kgm = 7.233 ft. lb

	0	1	2	3	4	5	6	7	8	9
0	0	7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	296.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	1005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

FOREWORD**CONVERSION TABLE****kg/cm² to lb/in²**1kg/cm² = 14.2233 lb/in²

	0	1	2	3	4	5	6	7	8	9
0	0	14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	1863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	2603	2617	2631	2646	2660	2674	2688
190	2702	2717	2731	2745	2759	2773	2788	2802	2816	2830
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

FOREWORD

CONVERSION TABLE

Temperature

Fahrenheit-Centigrade Conversion ; a simple way to convert a Fahrenheit temperature reading into a Centigrade temperature reading or vice versa is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

$$1^{\circ}\text{C} = 33.8^{\circ}\text{F}$$

°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-7.2	19	66.2	12.2	54	129.2	31.7	89	192.2
-26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	0	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	30	86.0	18.3	65	149.0	37.8	100	212.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	175	347.0

UNITS

In this manual, the measuring units are indicated with International System of units (SI).
As for reference, conventionally used Gravitational System of units are indicated in parentheses { }.

Example:

N {kg}
Nm {kgm}
MPa {kg/cm²}
kPa {mmH₂O}
kPa {mmHg}
kW/rpm {HP/rpm}
g/kWh {g/HPh}

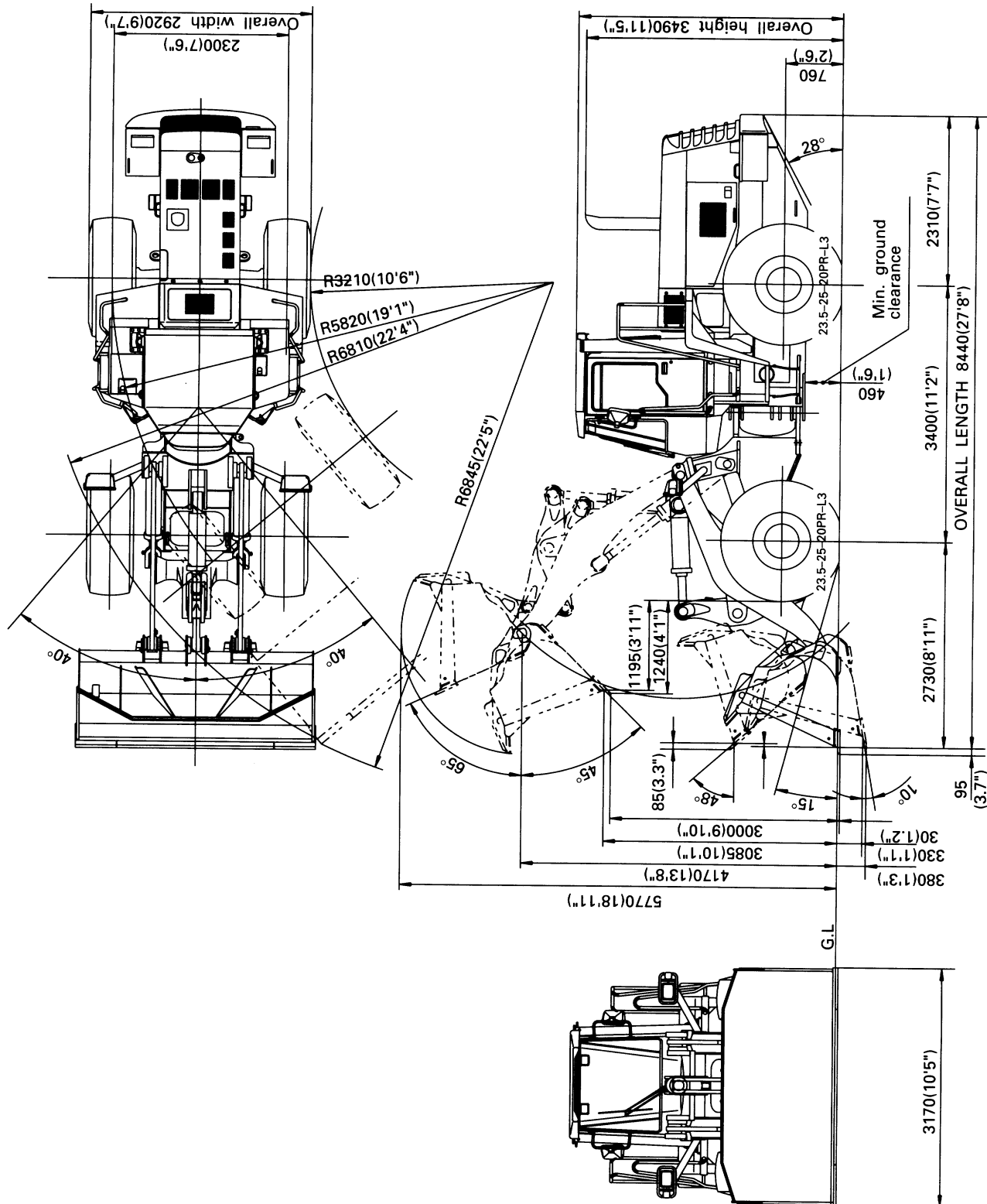
01 GENERAL

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U42103

GENERAL ASSEMBLY DRAWING

Serial No.: 50001 – 52999



U42103

AD074500

U42103



SPECIFICATIONS

Machine model			WA470-3		
Serial No.			50001 – 52999	53001 – 53999	54001 and up
Weight	Operating weight	kg	21,450	21,880	21,920
	Distribution (front)	kg	10,780	10,600	10,615
	Distribution (rear)	kg	10,670	11,280	11,305
Performance	Bucket capacity (piled)	m ³	4.2 (with BOC)	4.2 (with BOC)	4.2 (with BOC)
	Rated load	kg	6,720	6,720	6,720
	Travel speed				
	FORWARD 1st	km/h	6.2	6.2	6.2
	FORWARD 2nd	km/h	11.2	11.2	11.2
	FORWARD 3rd	km/h	19.8	19.8	19.8
	FORWARD 4th	km/h	31.5	31.5	31.5
	REVERSE 1st	km/h	6.4	6.4	6.4
	REVERSE 2nd	km/h	11.7	11.7	11.7
	REVERSE 3rd	km/h	20.7	20.7	20.7
	REVERSE 4th	km/h	32.7	32.7	32.7
	Max. rimpull	kN {kg}	203 {20,700}	203 {20,700}	203 {20,700}
	Gradeability	deg	25.0	25.0	25.0
	Min. turning radius	Center of outside wheel	mm	5,820	5,820
		Outside portion of chassis (with BOC)	mm	6,485	6,890
Dimensions	Overall length	mm	8,535 (with BOC)	8,690 (with BOC)	8,690 (with BOC)
	Overall width (chassis)	mm	2,920	2,920	2,920
	Bucket width (with BOC)	mm	3,170	3,170	3,170
	Overall height (top of cab)	mm	3,395	3,395	3,395
	(Bucket raised)	mm	5,770	5,895	5,895
	Wheelbase	mm	3,400	3,400	3,400
	Tread	mm	2,300	2,300	2,300
	Min. ground clearance	mm	460	460	460
	Height of bucket hinge pin	mm	4,170	4,295	4,295
	Dumping clearance (tip of BOC)	mm	3,000	3,120	3,120
	Dumping reach (tip of BOC)	mm	1,240	1,255	1,255
	Bucket dump angle	deg	46	46	46
	Bucket tilt angle (travel posture)	deg	48	50	50
	Digging depth (10° dump) (with BOC)	mm	380	380	380

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GENERAL

SPECIFICATIONS

Machine model			WA470-3		
Serial No.			50001 – 52999	53001 – 53999	54001 and up
Engine	Model		Komatsu S6D125		
	Type		4-cycle, water-cooled, in-line,		
	No. of cylinders – bore x stroke	mm	6-cylinder, direct injection, with turbocharger		
	Piston displacement	ℓ {cc}	6 – 125 mm x 150 mm		
			11.04 {11,040}		
	Flywheel horsepower	kW {HP}/rpm	196 {259}/2,200		
	Maximum torque	Nm {kgm}/rpm	1,050 {107}/1,400		
	Fuel consumption ratio	g/kWh {g/HPh}	224 {169}		
	High idling speed	rpm	2,400 ± 50		
	Low idling speed	rpm	700 – 750		
Power train	Starting motor		24 V 7.5 kW		
	Alternator		24 V 50 A		
	Battery		12 V 150 Ah x 2		
	Torque converter		3-element, 1-stage, single-phase (Komatsu TCA38-8A)		
	Transmission		Spur gear, constant-mesh multiple-disc, hydraulically actuated, modulation type		
Axle, wheel	Reduction gear		Spiral bevel gear, splash lubrication		
	Differential		Straight bevel gear, torque proportioning		
	Final drive		Planetary gear single stage, splash lubrication		
	Drive type		Front-, rear-wheel drive		
	Front wheel		Fixed frame, full-floating type		
Brakes	Rear wheel		Center pin support full-floating type		
	Tire		23.5-25-20PR		
	Wheel rim		19.5 x 25WTB		
	Inflation pressure Front tire	kPa {kg/cm ² }	392 {4.0}		
	Rear tire	kPa {kg/cm ² }	314 {3.2}		
Brakes	Service brake brake		Front-, rear-wheel independent system control, sealed multiple-disc wet-type disc brake With hydraulic booster		
	Parking brake brake		Drive shaft, wet type disc brake Hydraulically released spring type		

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GENERAL
SPECIFICATIONS

Machine model				WA470-3		
Serial No.				50001 – 52999	53001 – 53999	54001 and up
Steering system	Type			Articulated steering		
	Structure			Fully hydraulic power steering		
Hydraulic system	Hydraulic pump type			Gear pump		
	Delivery	Hydraulic pump	ℓ/min.	302		
		Switch pump		122		
		Steering pump		168		
		PPC pump		62		
	Control valve	Set pressure for work equipment	MPa (kg/cm ²)	2-spool type 20.58 {210}		
		Set pressure for steering	MPa (kg/cm ²)	Spool type 20.58 {210}		
Work equipment	Cylinder	Boom cylinder No. – bore x stroke	mm	Reciprocating piston 2 – 180 x 764		
		Bucket cylinder No. – bore x stroke	mm	Reciprocating piston 1 – 200 x 550		
		Steering cylinder No. – bore x stroke	mm	Reciprocating piston 2 – 100 x 440		
Work equipment	Link type			Single link		
	Bucket edge type			Flat edge with BOC		

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WEIGHT TABLE

⚠ This weight table is a guide for use when transporting or handling components.

Unit: kg

Machine model	WA470-3		
Serial No.	50001 – 52999	53001 – 53999	54001 and up
Engine	1120	1120	1120
Radiator	168	220	220
Transmission (including torque converter)	1000	1000	1000
Center drive shaft	36	36	36
Front drive shaft	40	40	40
Rear drive shaft	19	19	19
Front axle	1455	1455	1455
Rear axle	1466	1466	1466
Front differential	235	235	235
Rear differential	244	244	244
Planetary carrier (each)	525	525	525
Axle pivot (rear axle)	148	148	148
Wheel (each)	216	216	218
Tire (each)	335	335	335
Steering valve	24	24	24
Steering cylinder (each)	38	38	38
Brake valve (R.H.)	8.5	8.5	8.5
Hydraulic tank	231	231	231
Hydraulic, PPC pump (tandem pump)	27	27	27
Steering, switch pump (tandem pump)	20	20	20
PPC valve	3	3	3
Main control valve	90	90	95
Lift cylinder (each)	192	192	192
Bucket cylinder	222	222	222
Engine hood	184	184	186
Front frame	1820	1838	1833
Rear frame	1510	1586	1605
Bucket link	89	89	89
Bellcrank	415	415	415
Lift arm (including bushing)	1440	1540	1540
Bucket (with BOC)	2095	2095	2095

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GENERAL**WEIGHT TABLE**

Unit: kg

Machine model	WA470-3		
	50001 – 52999	53001 – 53999	54001 and up
Counterweight	1309	1600	1600
Fuel tank	250	250	250
Battery (each)	45	45	45
Floor frame assembly	–	375	383
Floor, cab assembly	–	677	707
Cab	300	302	324
Air conditioner unit	12.5	12.5	12.5
Operator's seat	38	38	38
Floor board	140	264	272
ROPS canopy	–	398	404
ROPS cab	–	635	629

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LIST OF LUBRICANT AND WATER

Serial No.: 50001 – 52999

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE									CAPACITY	
		-22 -30	-4 -20	14 -10	32 0	50 10	68 20	86 30	104 40	122°F 50°C	Specified	Refill
Engine oil pan	Engine oil										47 ℓ	38 ℓ
Transmission case	Engine oil										65 ℓ	60 ℓ
Hydraulic system											294 ℓ	206 ℓ
Axle (with standard differential) (Front and rear) (Each)	Axle oil	See Note 2									65 ℓ	65 ℓ
Axle (with limited slip differential) (Front and rear) (Each) (See Note 1)											65 ℓ	65 ℓ
Pins	Grease										–	–
Pins (with auto-greasing system)											–	–
Fuel tank	Diesel fuel										390 ℓ	–
Cooling system	Water	Add antifreeze									68 ℓ	–

※ ASTM D975 No. 1

★: NLGI No. 0

When operating a machine with the auto-greasing system at temperatures below –20°C, set the greasing time to 20 minutes. See the Operation & Maintenance Manual.

Note 1: Do not use CLASS-CD SAE30 engine oil for the limited slip differential. An abnormal noise will be generated from the differential.

Note 2: For axle oil, use only recommended oil as follows.

SHELL: DONAX TT or TD

CALTEX: RPM TRACTOR HYDRAULIC FLUID

CHEVRON: TRACTOR HYDRAULIC FLUID

TEXACO: TDH OIL

MOBIL: MOBILAND SUPER UNIVERSAL

It is possible to substitute engine oil CLASS-CD SAE30 for axle oil.

If noise comes from the brake, it is no problem of durability.

GENERAL

LIST OF LUBRICANT AND WATER

Serial No.: 53001 – 53999

Serial No.: 54001 and up

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE										CAPACITY	
		-22 -30	-4 -20	14 -10	32 0	50 10	68 20	86 30	104 40	122 50	F C	Specified	Refill
Engine oil pan	Engine oil											47 ℓ	38 ℓ
Transmission case	Engine oil											65 ℓ	60 ℓ
Hydraulic system	Engine oil											280 ℓ	192 ℓ
Axle (Front and rear) (Each)	Axle oil	See Note 1										65 ℓ	65 ℓ
Pins	Grease											–	–
Fuel tank	Diesel fuel											390 ℓ	–
Cooling system	Water	Add antifreeze										68 ℓ	–

※ ASTM D975 No. 1

Note 1: For axle oil, use only recommended oil as follows.

SHELL: DONAX TT or TD

CALTEX: RPM TRACTOR HYDRAULIC FLUID

CHEVRON: TRACTOR HYDRAULIC FLUID

TEXACO: TDH OIL

MOBIL: MOBILAND SUPER UNIVERSAL

It is possible to substitute engine oil CLASS-CD SAE30 for axle oil.

If noise comes from the brake, it is no problem of durability.

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GENERAL

LIST OF LUBRICANT AND WATER

REMARK

- When fuel sulphur content is less than 0.5%, change oil in the oil pan every periodic maintenance hours described in this manual.

Change oil according to the following table if fuel sulphur content is above 0.5%.

Fuel sulphur content	Change interval of oil in engin oil pan
0.5 to 1.0%	1/2 of regular interval
Above 1.0%	1/4 of regular interval

- When starting the engine in an atmospheric temperature of lower than 0°C, be sure to use engine oil of SAE10W, SAE10W-30 and SAE15W-40, even though an atmospheric temperature goes up to 10°C more or less in the day time.
- Use API classification CD as engine oil and if API classification CC, reduce the engine oil change interval to half.
- There is no problem if single grade oil is mixed with multigrade oil (SAE10W-30, 15W-40), but be sure to add single grade oil that matches the temperature in the table.
- We recommend Komatsu genuine oil which has been specifically formulated and approved for use in engine and hydraulic work equipment applications.

Specified capacity: Total amount of oil including oil for components and oil in piping.

Refill capacity: Amount of oil needed to refill system during normal inspection and maintenance.

ASTM: American Society of Testing and Material

SAE: Society of Automotive Engineers

API: American Petroleum Institute

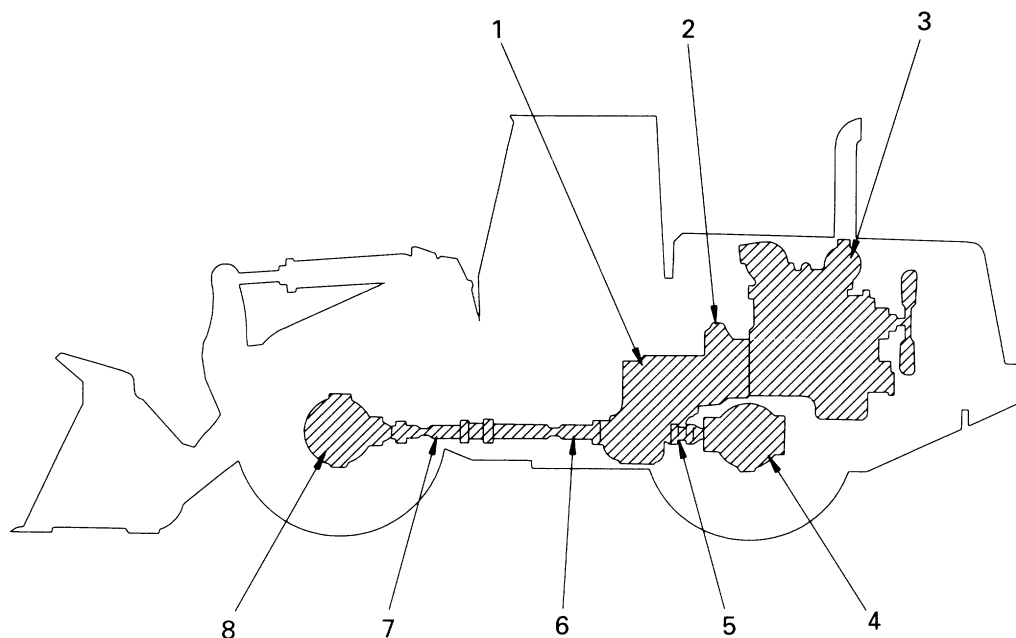
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10 STRUCTURE AND FUNCTION

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POWER TRAIN

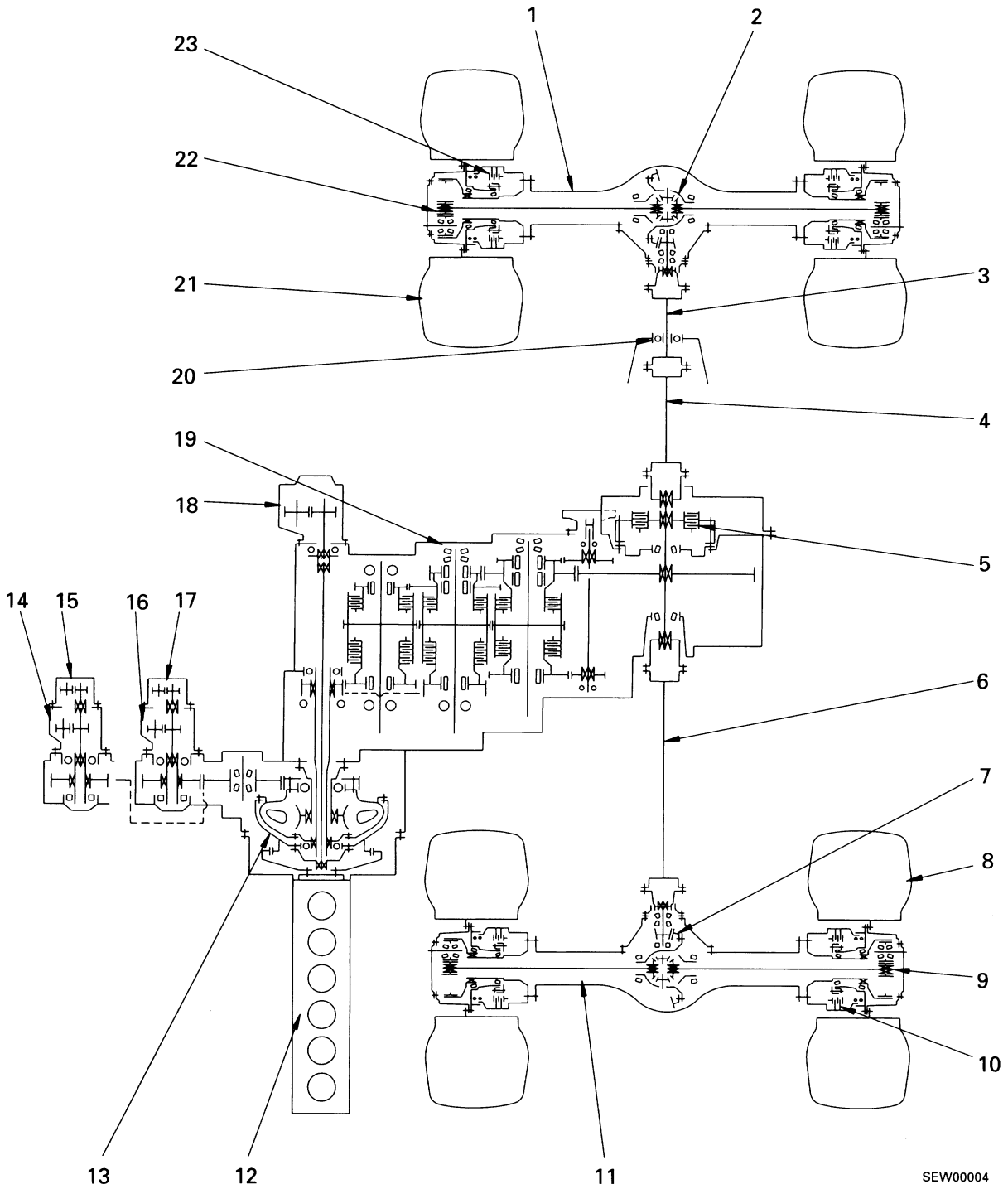


- | | | |
|---------------------------------------|-----------------------|----------------------|
| 1. Transmission (multiple shaft type) | 4. Rear axle | 7. Front drive shaft |
| 2. Torque converter | 5. Rear drive shaft | 8. Front axle |
| 3. Engine (S6D125) | 6. Center drive shaft | |

Outline

- The motive force from engine (3) passes through the engine flywheel and is transmitted to torque converter (2), which is connected to the input shaft of transmission (1).
- The transmission has six hydraulically actuated clutches, and these provide four speed ranges for both FORWARD and REVERSE. The transmission speed ranges are selected manually.
- The motive force from the output shaft of the transmission passes through center drive shaft (6), front drive shaft (7) and rear drive shaft (5), and is then transmitted to front axle (8) and rear axle (4) to drive the wheels.

POWER TRAIN SYSTEM



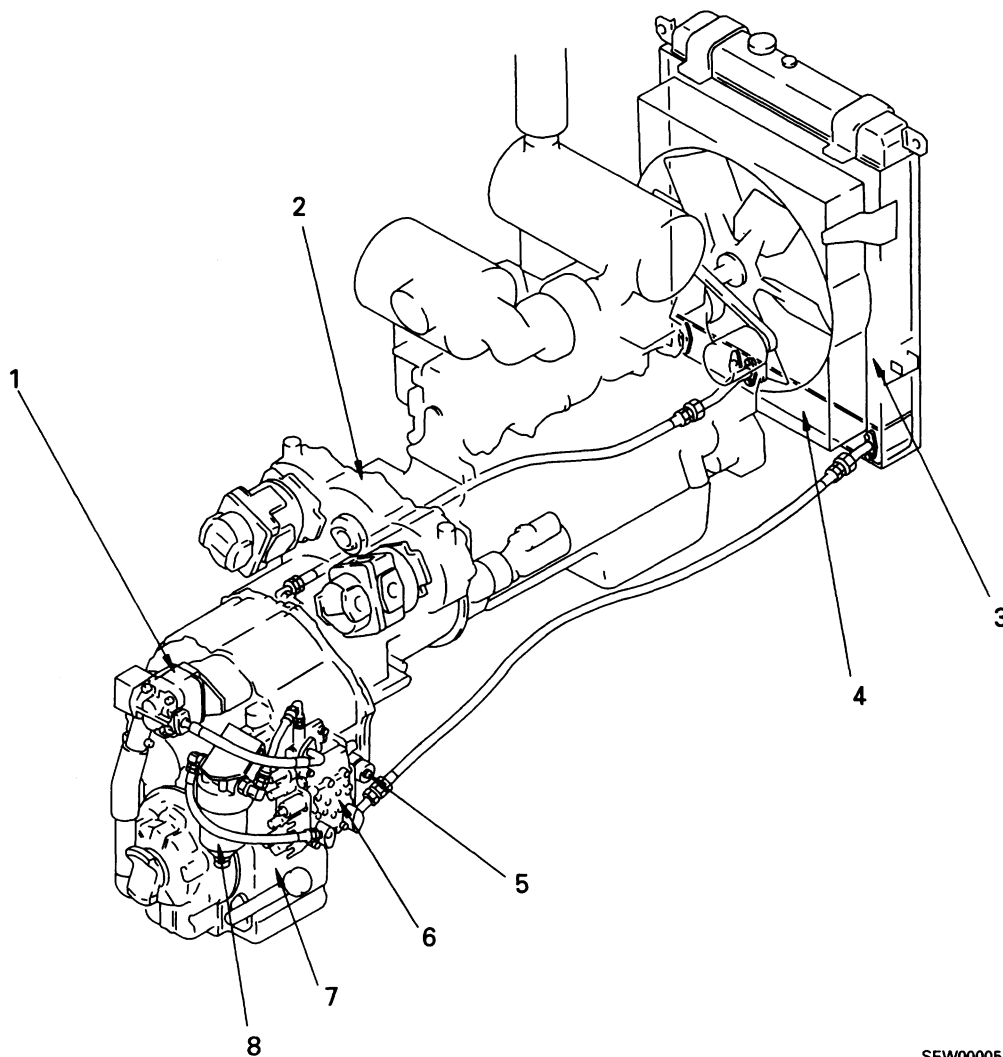
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1. Front axle
2. Differential
3. Front drive shaft
4. Center drive shaft
5. Parking brake (wet type multiple disc)
6. Rear drive shaft
7. Differential
8. Rear tire
9. Final drive
10. Wet type multiple disc brake
11. Rear axle
12. Engine (S6D125)
13. Torque converter
14. Hydraulic pump
15. PPC pump
16. Steering pump
17. Switch pump
18. Transmission, torque converter charging pump
19. Transmission (multiple shaft type)
20. Flange bearing
21. Front tire
22. Final drive
23. Wet type multiple disc brake

Outline

- The motive force from engine (12) passes through the flywheel and is transmitted to torque converter (13).
The torque converter uses oil as a medium. It converts the transmitted torque in accordance with the change in the load, and transmits the motive force to the input shaft of the transmission.
In addition, the motive force of the engine passes through the pump drive gear of the torque converter, and is transmitted to steering pump (16), switch pump (17), hydraulic pump (14) and PPC pump (15) to drive each pump.
- Transmission (19) operates the directional spool and speed spool of the transmission valve through the solenoid valves, and actuates the six hydraulically actuated clutches to select one of the four FORWARD or REVERSE speeds.
The transmission speed range is selected manually.
- Parking brake (5) is installed to the front output shaft, and acts to stop the machine through the solenoid valve and hydraulically actuated clutches when the parking brake switch is operated.
- The output shaft of transmission (19) transmits the power to the front and rear axles. At the front, the power is transmitted to front axle (1) through center drive shaft (4), flange bearing (20), and front drive shaft (3). At the rear, the power is transmitted to rear axle (11) through rear drive shaft (6).
- The motive force transmitted to front axle (1) and rear axle (11) has its speed reduced by the bevel gear and pinion gear of differentials (2) and (7), and is then transmitted to the sun gear shaft through the differential mechanism.
- The motive force of the sun gear is reduced further by the planetary mechanism and is transmitted to the wheels through the axle shaft.

TORQUE CONVERTER, TRANSMISSION PIPING



SEW00005

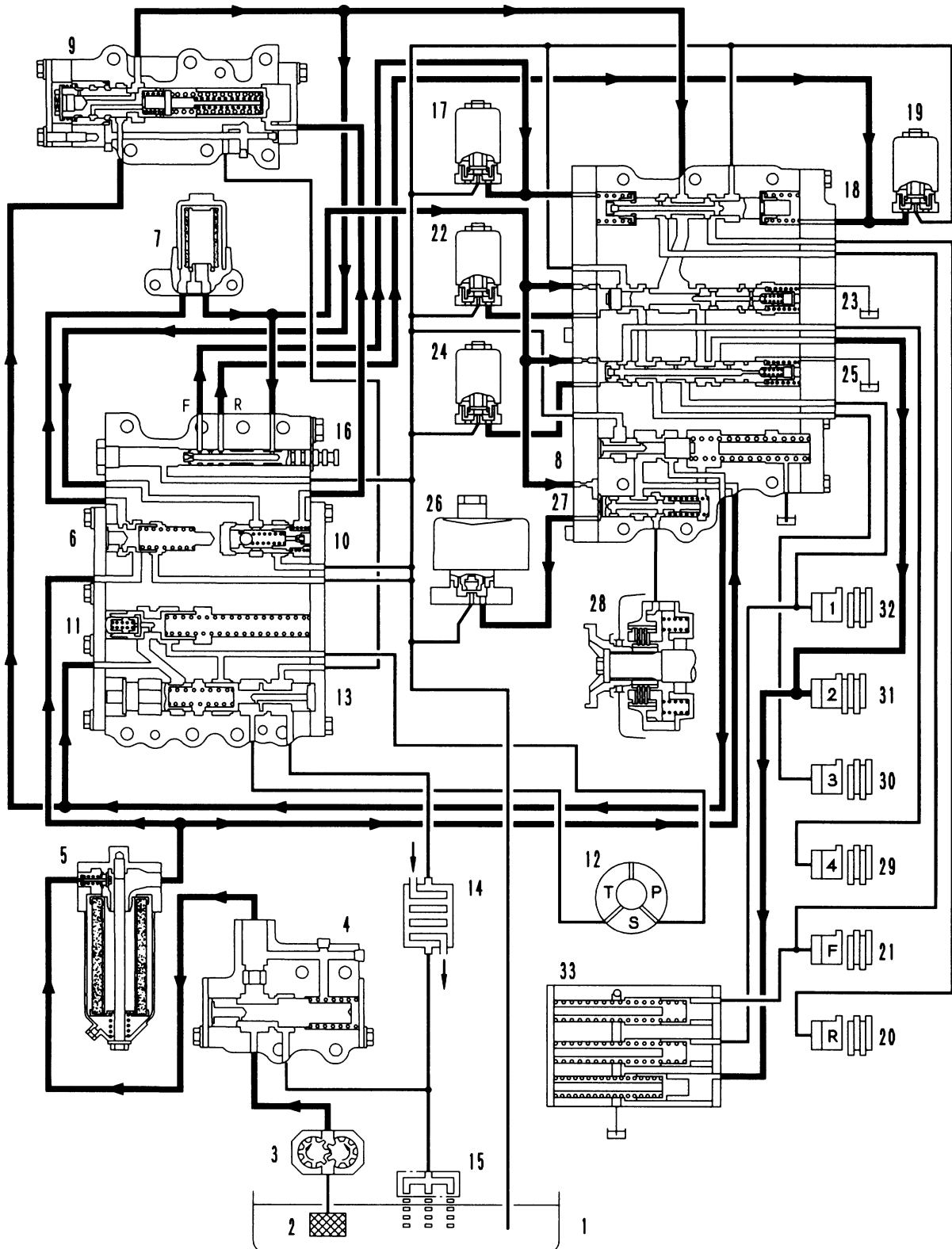
1. Torque converter charging pump
2. Torque converter
3. Radiator
4. Oil cooler
5. Pilot oil filter

6. Transmission control valve
7. Transmission
8. Oil filter
 - Center bolt type (Serial No.: 50001 – 53999)
 - Spin-on type (Serial No.: 54001 and up)

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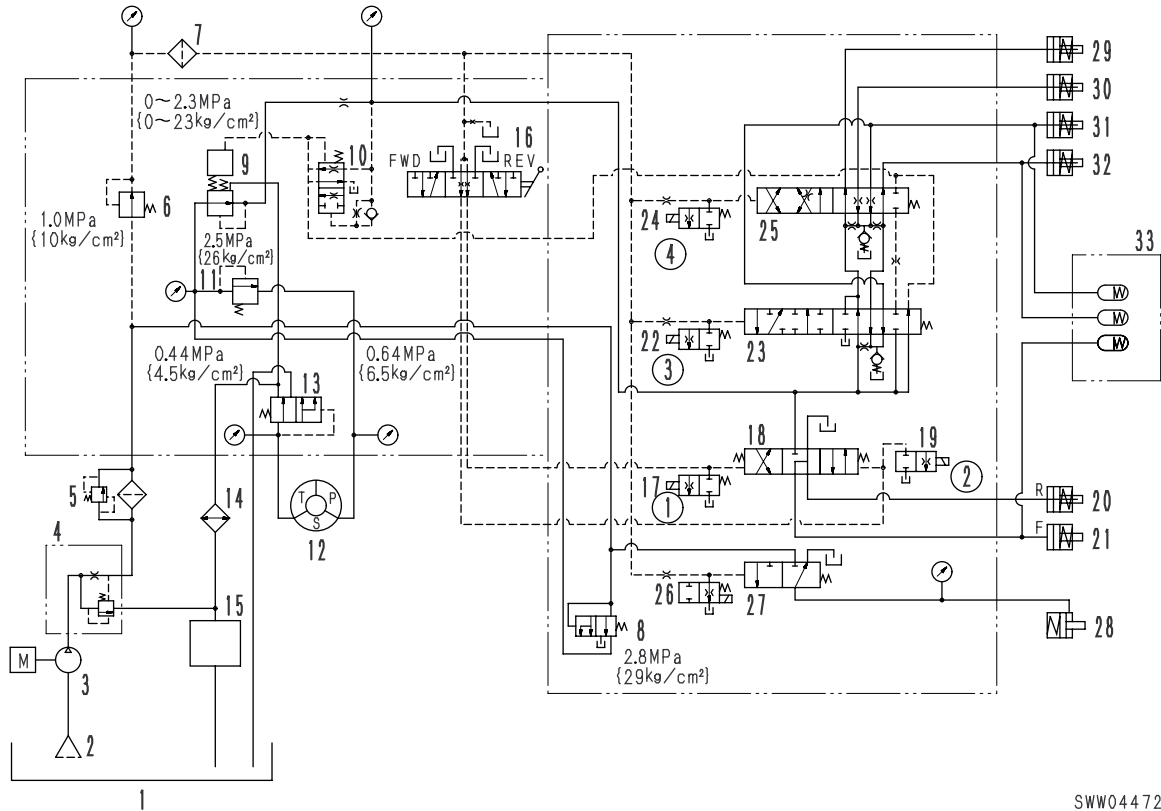
TRANSMISSION HYDRAULIC SYSTEM DIAGRAM

(Conditions: Engine at low idling, transmission shift lever at neutral)



U42103

TRANSMISSION HYDRAULIC CIRCUIT DIAGRAM



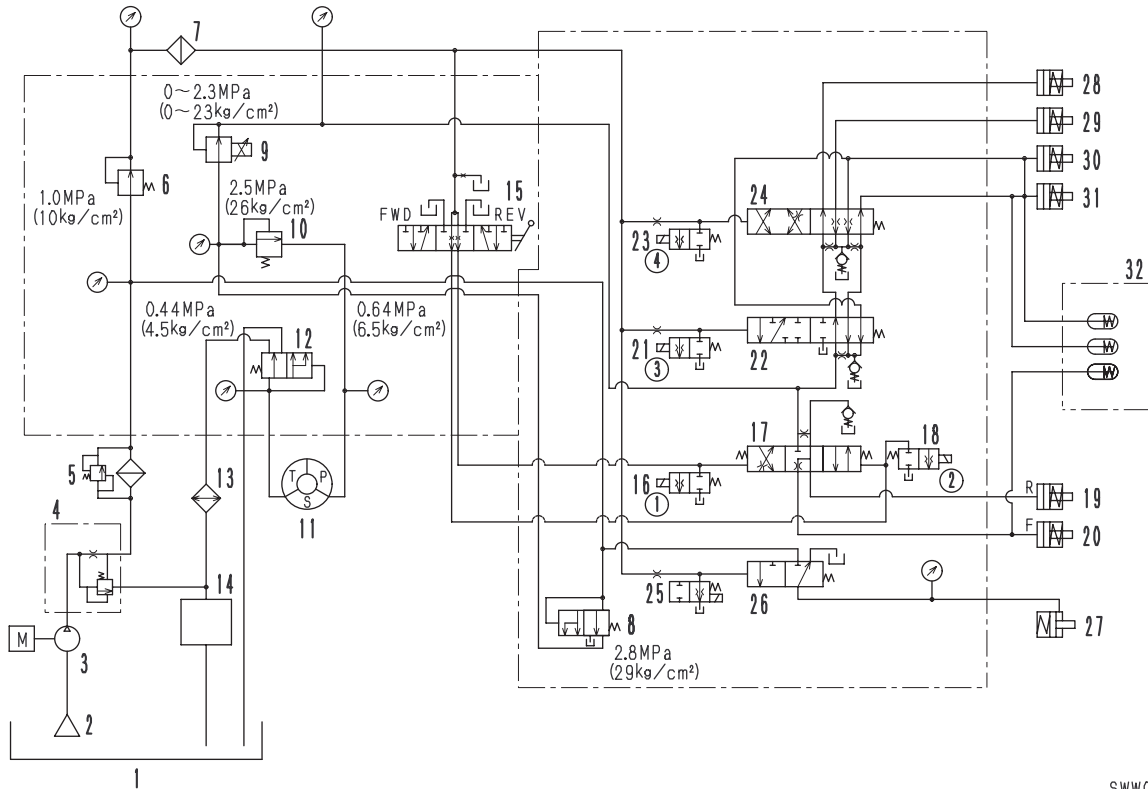
SWW04472

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- | | | |
|-----------------------------------|------------------------------------|--------------------------------------|
| 1. Transmission case | 12. Torque converter | 24. Solenoid valve (range selection) |
| 2. Strainer | 13. Torque converter outlet valve | 25. Range selector valve |
| 3. Torque converter charging pump | 14. Oil cooler | 26. Solenoid valve (parking brake) |
| 4. Flow valve | 15. Transmission lubrication | 27. Parking brake valve |
| 5. Oil filter | 16. Emergency manual spool | 28. Parking brake |
| 6. Pilot reducing valve | 17. Solenoid valve (FORWARD) | 29. 4th clutch |
| 7. Pilot oil filter | 18. Directional selector valve | 30. 3rd clutch |
| 8. Priority valve | 19. Solenoid valve (REVERSE) | 31. 2nd clutch |
| 9. Modulation valve | 20. REVERSE clutch | 32. 1st clutch |
| 10. Quick return valve | 21. FORWARD clutch | 33. Accumulator |
| 11. Main relief valve | 22. Solenoid valve (H-L selection) | |
| | 23. H-L selector valve | |

For auto-shift transmission (Optional)

Serial No.: 53001 and up

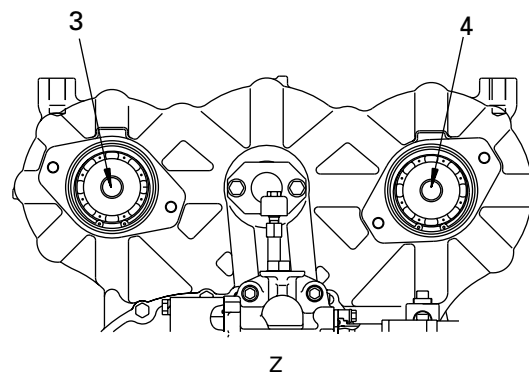
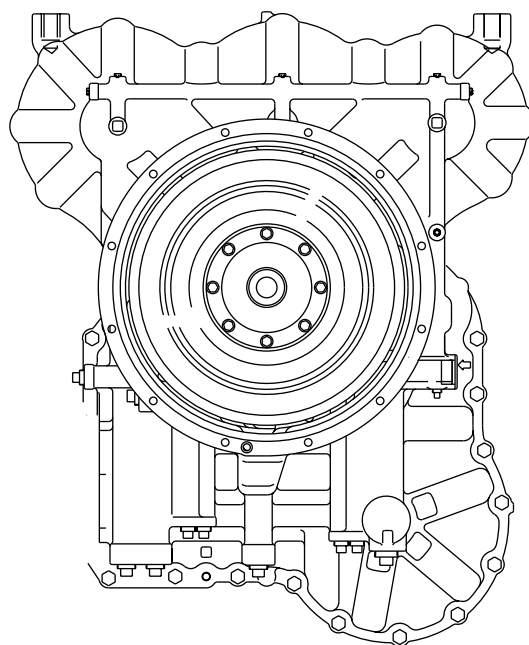
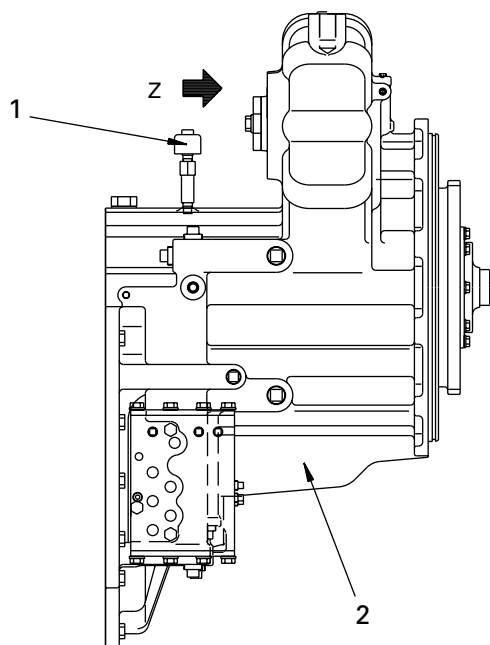


SWW04166

U42103

- | | |
|--|--------------------------------------|
| 1. Transmission case | 17. Forward-Reverse selector valve |
| 2. Strainer | 18. Solenoid valve (Reverse) |
| 3. Torque converter charging pump | 19. Reverse clutch |
| 4. Flow valve | 20. Forward clutch |
| 5. Oil filter | 21. Solenoid valve (H-L selection) |
| 6. Pilot pressure reducing valve | 22. H-L selector valve |
| 7. Pilot oil filter | 23. Solenoid valve (Range selection) |
| 8. Priority valve | 24. Range selector valve |
| 9. Electronic control modulation valve | 25. Solenoid valve (Parking brake) |
| 10. Main relief valve | 26. Parking brake valve |
| 11. Torque converter | 27. Parking brake |
| 12. Torque converter outlet valve | 28. 4th speed clutch |
| 13. Oil cooler | 29. 3rd speed clutch |
| 14. Transmission lubrication | 30. 2nd speed clutch |
| 15. Emergency manual operation spool | 31. 1st speed clutch |
| 16. Solenoid valve (Forward) | 32. Accumulator |

TORQUE CONVERTER



SDW00010

1. Breather
2. Housing
3. Steering, switch tandem pump mount
4. Hydraulic, PPC tandem pump mount

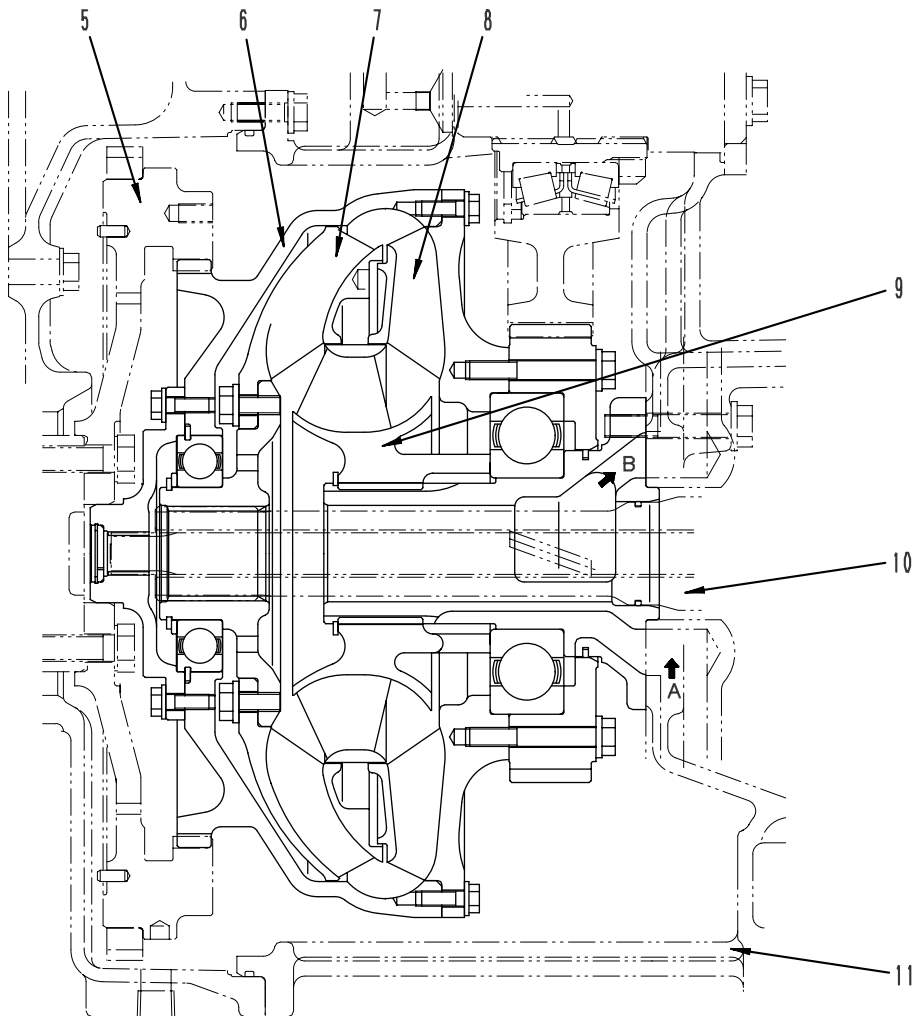
Specifications

Model: TCA38-8A

Type: 3 element, 1 stage, 1 phase

Stall torque ratio: 3.19

U42103



SXW04473

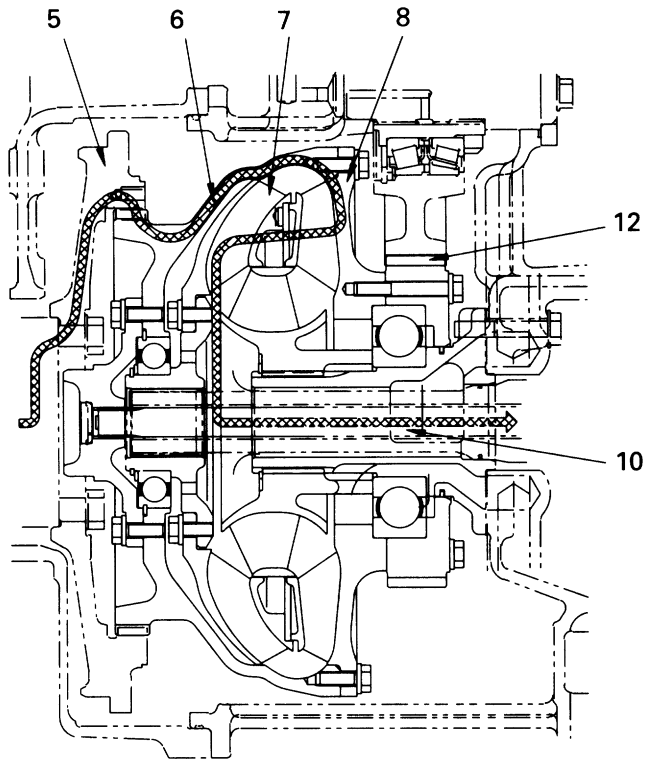
- 5. Flywheel
- 6. Drive case
- 7. Turbine
- 8. Pump

- 9. Stator
- 10. Transmission input shaft
- 11. Housing

- A. Inlet port
- B. Outlet port

Path of motive force

- The torque converter is installed between the engine and the transmission. The motive force from the engine enters drive case (6) from flywheel (5). Drive case (6), pump (8), and PTO gear (drive) (12) are each secured by bolts and are rotated directly by the rotation of the engine. The motive force of pump (8) uses oil as a medium to rotate turbine (7) and transmit the motive force to transmission input shaft (10).
- The motive force of drive case (6) is used as the motive force to drive the gear pump through PTO gear (drive) (12).

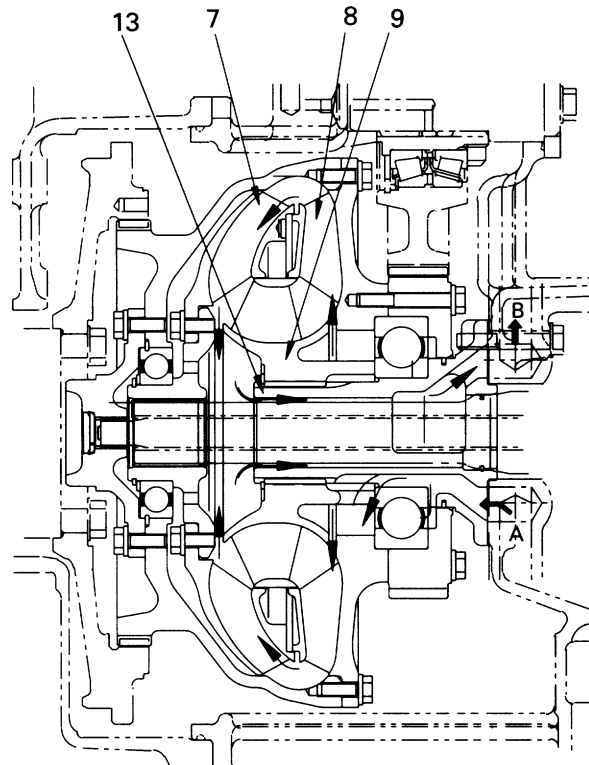


SDW00012

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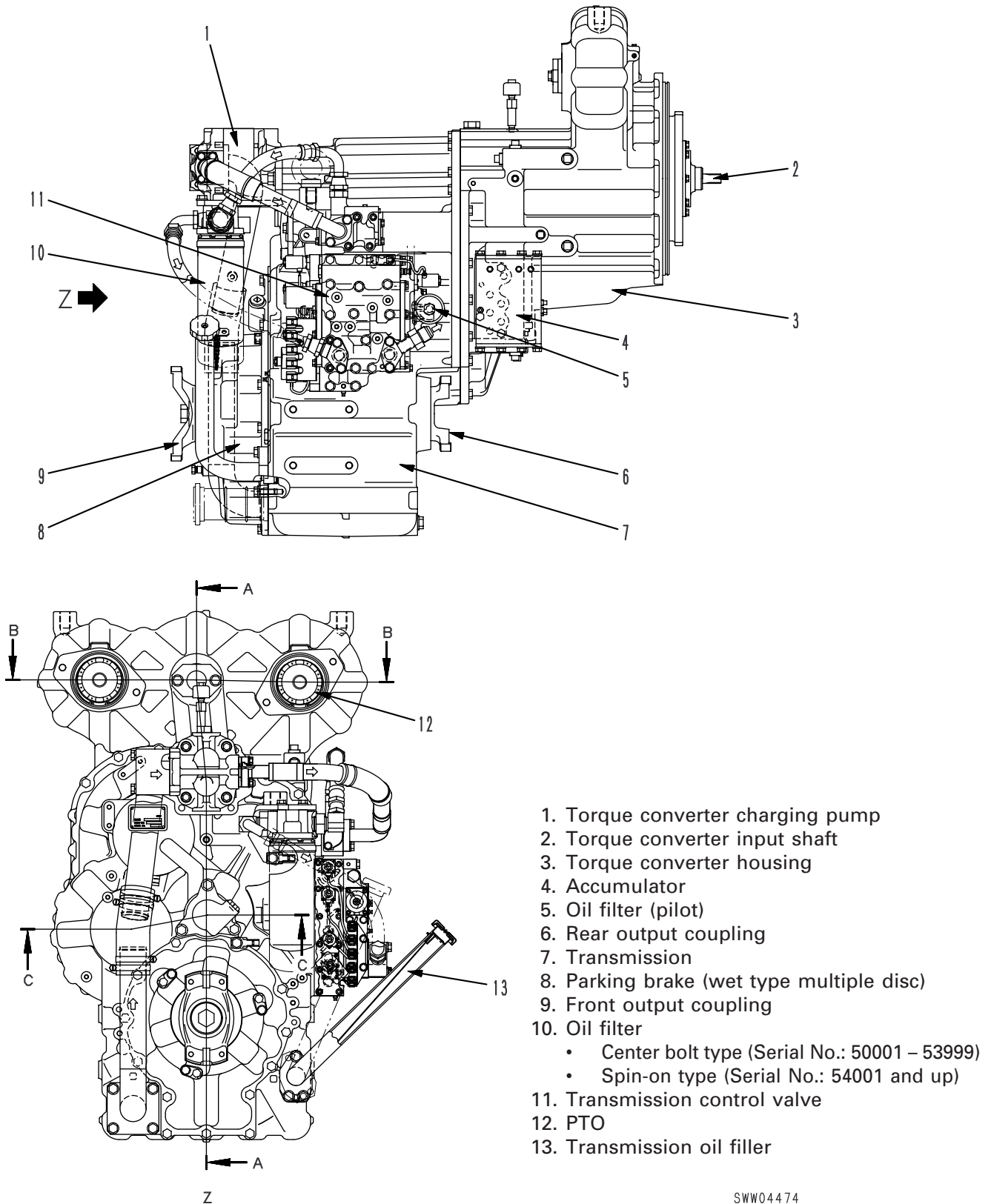
Flow of oil

- The oil supplied from the torque converter charging pump enters inlet port **A**, passes through the oil passage of stator shaft (13), and flows to pump (8). The oil is given centrifugal force by pump (8), enters turbine (7), and transmits the energy of the oil to the turbine. Turbine (7) is fixed to transmission input shaft (10), so the motive force is transmitted to the transmission input shaft. The oil from turbine (7) is sent to stator (9), and enters the pump again. However, part of the oil is sent from the stator through outlet port **B** to the cooler.



SDW00013

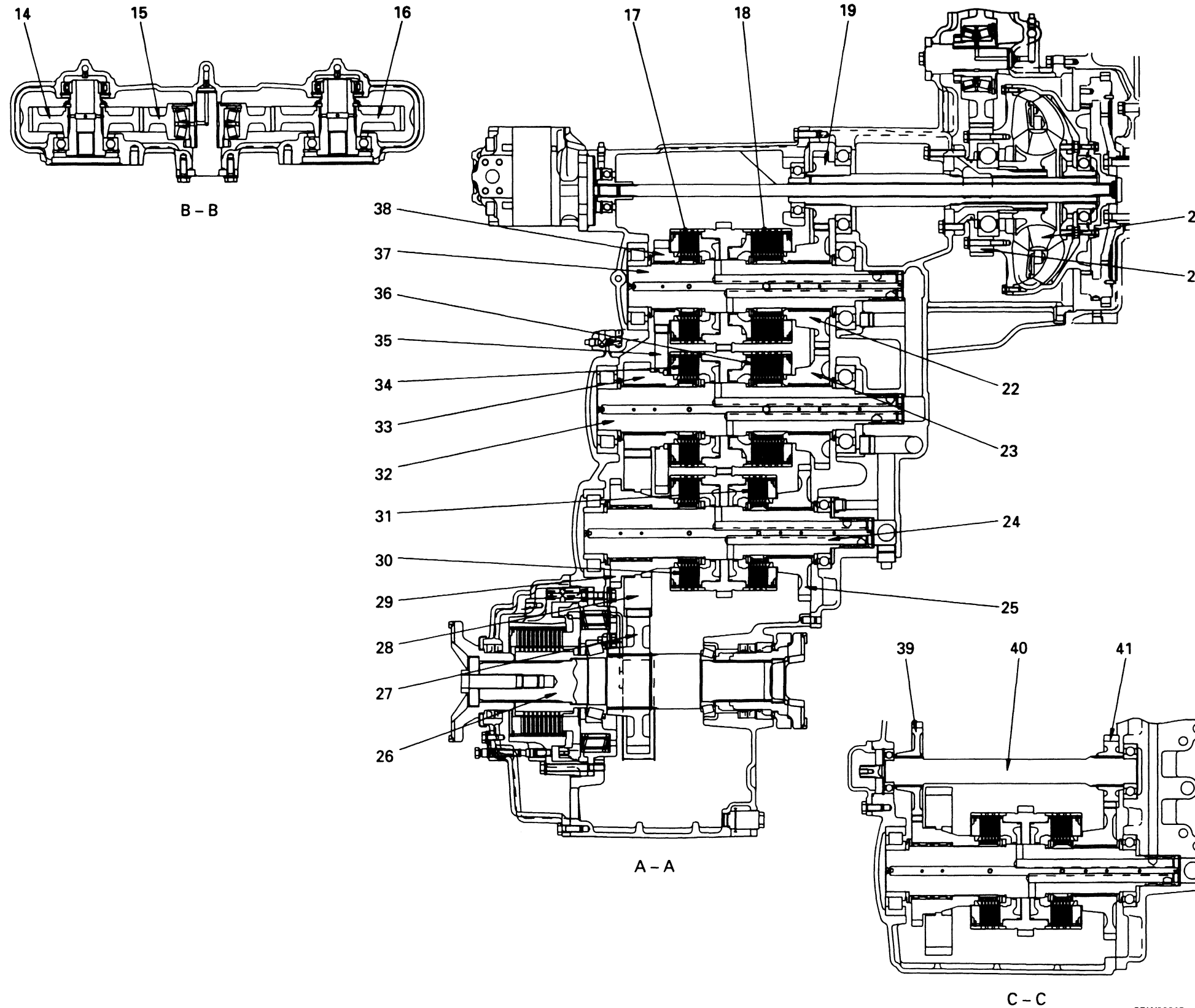
TRANSMISSION



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SWW04474

Note: This illustration is for the auto-shift transmission.



- 14. PTO gear (No. of teeth: 65)
- 15. PTO gear (No. of teeth: 76)
- 16. PTO gear (No. of teeth: 74)
- 17. 1st clutch
- 18. FORWARD clutch
- 19. Input gear (No. of teeth: 30)
- 20. Torque converter
- 21. PTO drive gear (No. of teeth: 74)
- 22. FORWARD gear (No. of teeth: 48)
- 23. REVERSE gear (No. of teeth: 46)
- 24. 3rd, 4th shaft (No. of teeth: 50)
- 25. 4th gear (No. of teeth: 53)
- 26. Output shaft
- 27. Output gear (No. of teeth: 41)
- 28. 3rd gear (No. of teeth: 49)
- 29. 3rd gear (No. of teeth: 43)
- 30. 3rd clutch
- 31. 4th clutch
- 32. REVERSE, 2nd shaft (No. of teeth: 51)
- 33. 2nd gear (No. of teeth: 26)
- 34. 2nd clutch
- 35. 2nd gear (No. of teeth: 50)
- 36. REVERSE clutch
- 37. FORWARD, 1st shaft (No. of teeth: 50)
- 38. 1st gear (No. of teeth: 26)
- 39. 3rd gear (No. of teeth: 38)
- 40. Countershaft
- 41. 4th gear (No. of teeth: 27)

SDW00018

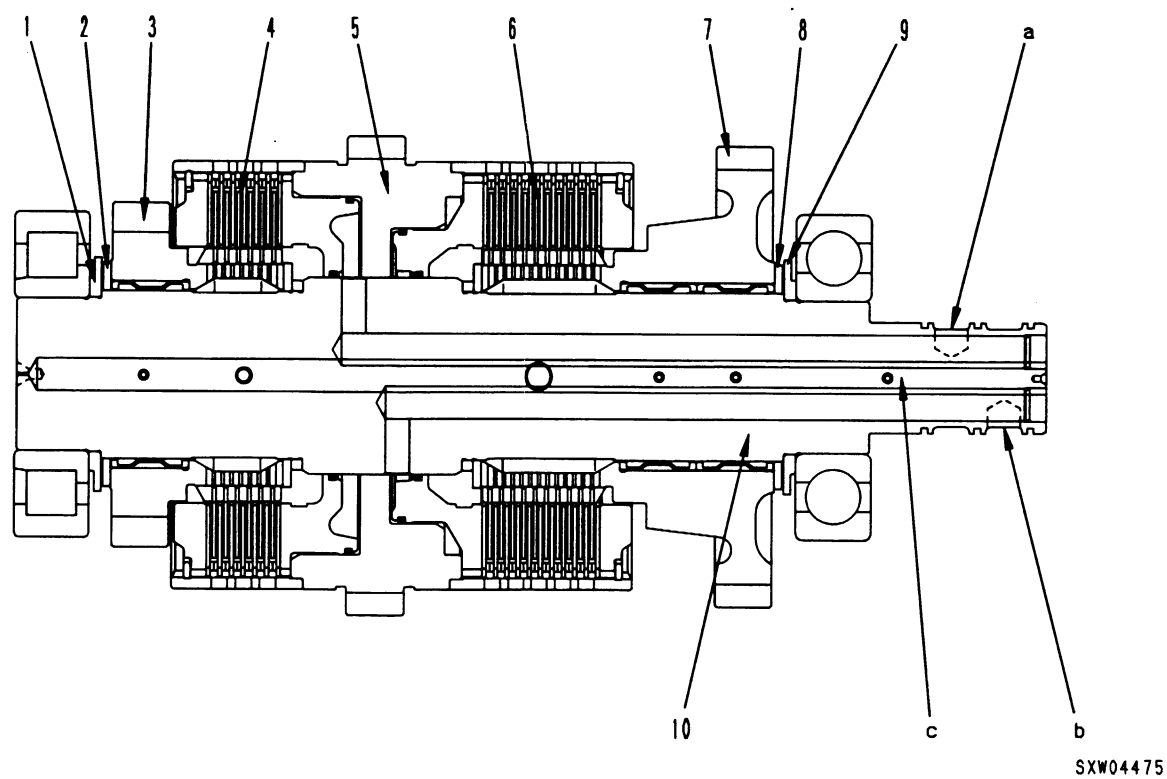
STRUCTURE AND FUNCTION

TRANSMISSION

Outline

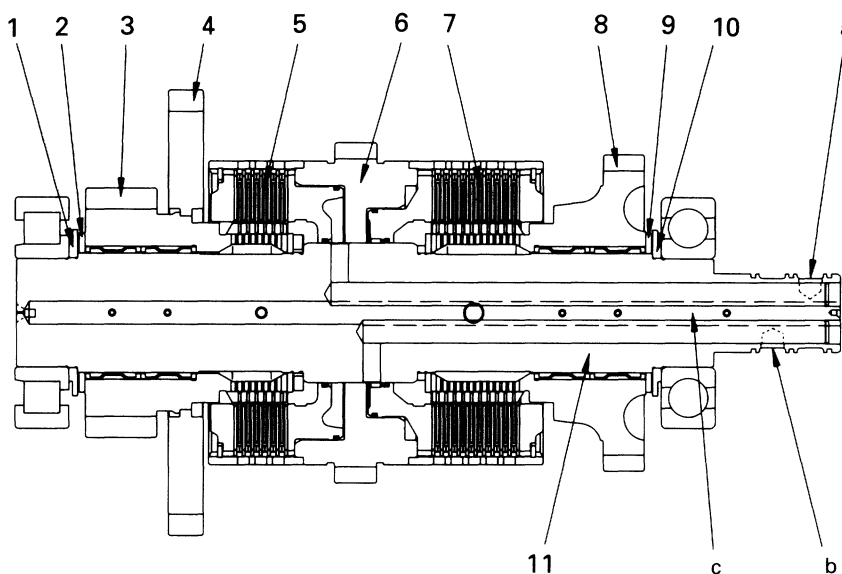
- The transmission is installed behind the torque converter. The motive force from the torque converter passes through the transmission input shaft and enters the transmission.
- The transmission uses the combination of the forward or reverse clutches and the four speed clutches to shift to F1 – 4 or R1 – 4, and transmits the motive force from the input shaft to the output shaft.

CLUTCH
FORWARD, 1ST CLUTCH



- | | | |
|--------------------------|------------------------|----------------------------|
| 1. Spacer | 6. FORWARD clutch | a. 1st clutch oil port |
| 2. Thrust washer | 7. FORWARD gear | b. FORWARD clutch oil port |
| 3. 1st gear | 8. Thrust washer | c. Lubrication oil port |
| 4. 1st clutch | 9. Spacer | |
| 5. FORWARD, 1st cylinder | 10. FORWARD, 1st shaft | |

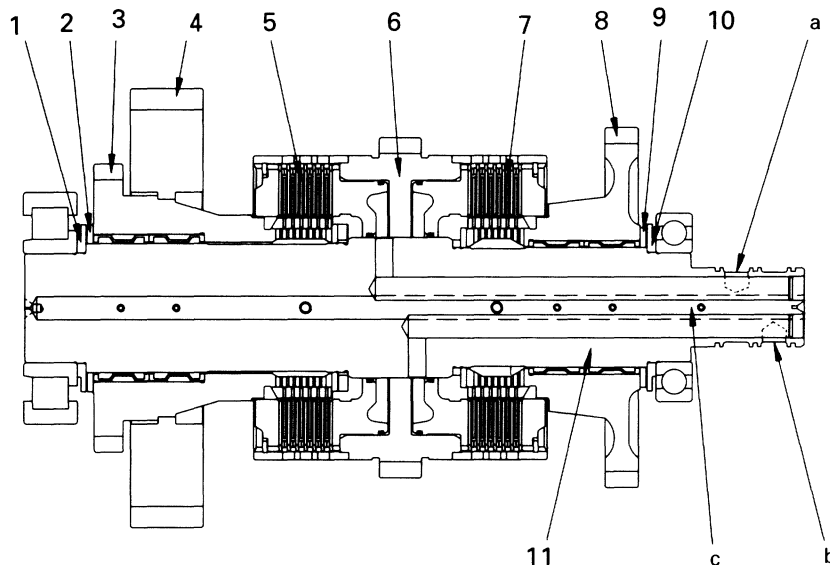
REVERSE, 2ND CLUTCH



SDW00020

- | | | | |
|------------------|--------------------------|------------------------|----------------------------|
| 1. Spacer | 5. 2nd clutch | 9. Thrust washer | a. 2nd clutch oil port |
| 2. Thrust washer | 6. 2nd, REVERSE cylinder | 10. Spacer | b. REVERSE clutch oil port |
| 3. 2nd gear | 7. REVERSE clutch | 11. 2nd, REVERSE shaft | c. Lubrication oil port |
| 4. 2nd gear | 8. REVERSE gear | | |

3RD, 4TH CLUTCH



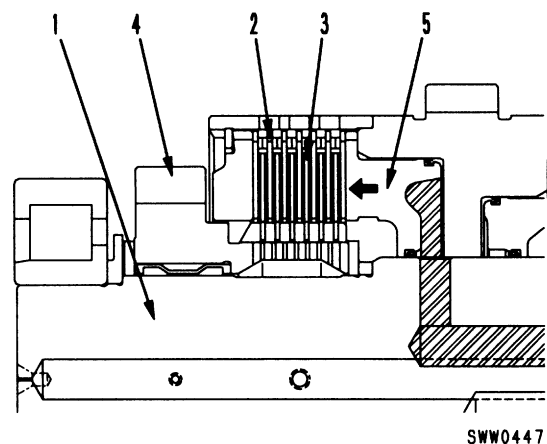
SDW00021

- | | | | |
|------------------|----------------------|--------------------|-------------------------|
| 1. Spacer | 5. 3rd clutch | 9. Thrust washer | a. 3rd clutch oil port |
| 2. Thrust washer | 6. 3rd, 4th cylinder | 10. Spacer | b. 4th clutch oil port |
| 3. 3rd gear | 7. 4th gear | 11. 3rd, 4th shaft | c. Lubrication oil port |
| 4. 3rd gear | 8. 4th clutch | | |

Operation of clutch

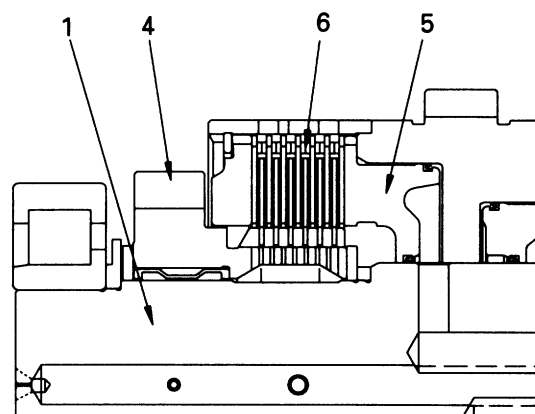
When operated

- The oil sent from the transmission valve passes through the oil passage inside shaft (1), and goes to the rear face of piston (5) to actuate the piston.
- When piston (5) is actuated, separator plate (2) is pressed against clutch disc (3) and forms shaft (1) and clutch gear (4) into one unit to transmit the motive force.

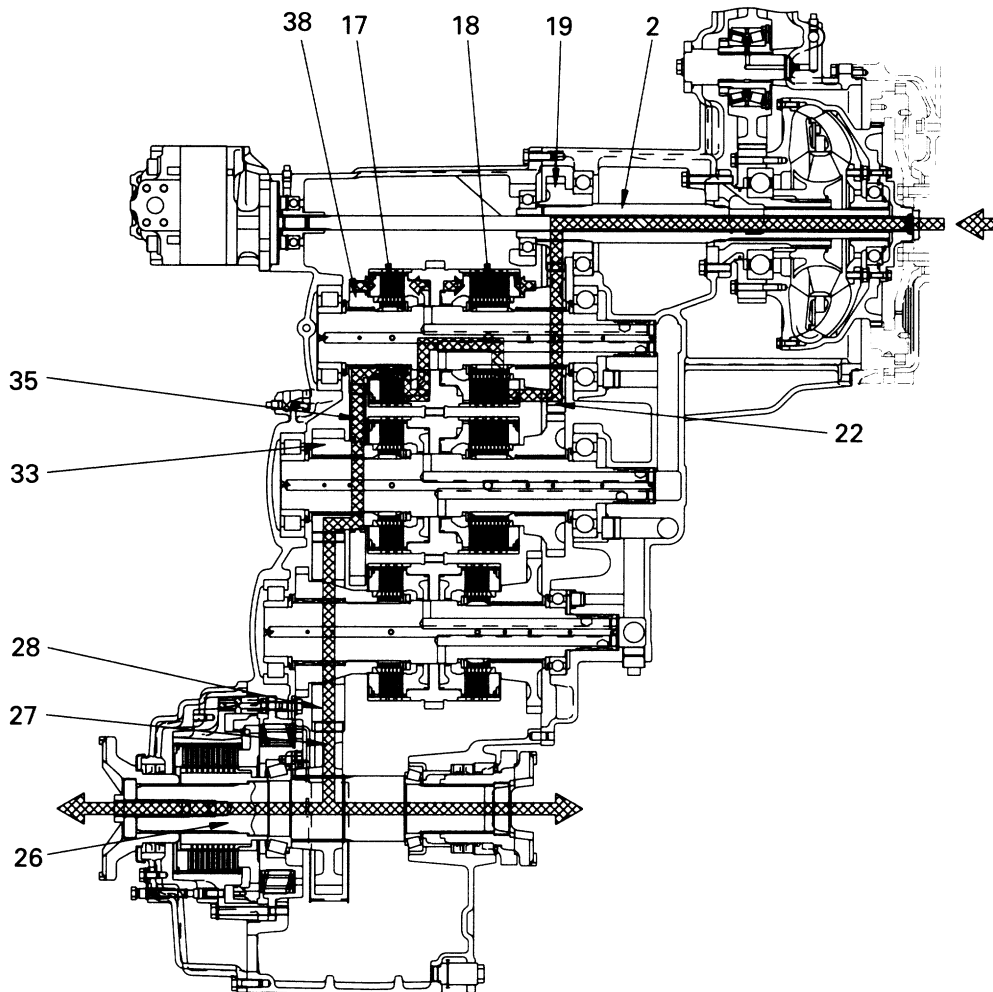


When not actuated

- If the oil from the transmission valve is shut off, the pressure of the oil acting on the rear face of piston (5) drops. The piston is returned to its original position by wave spring (6), so shaft (1) and clutch gear (4) are separated.



FORWARD 1ST

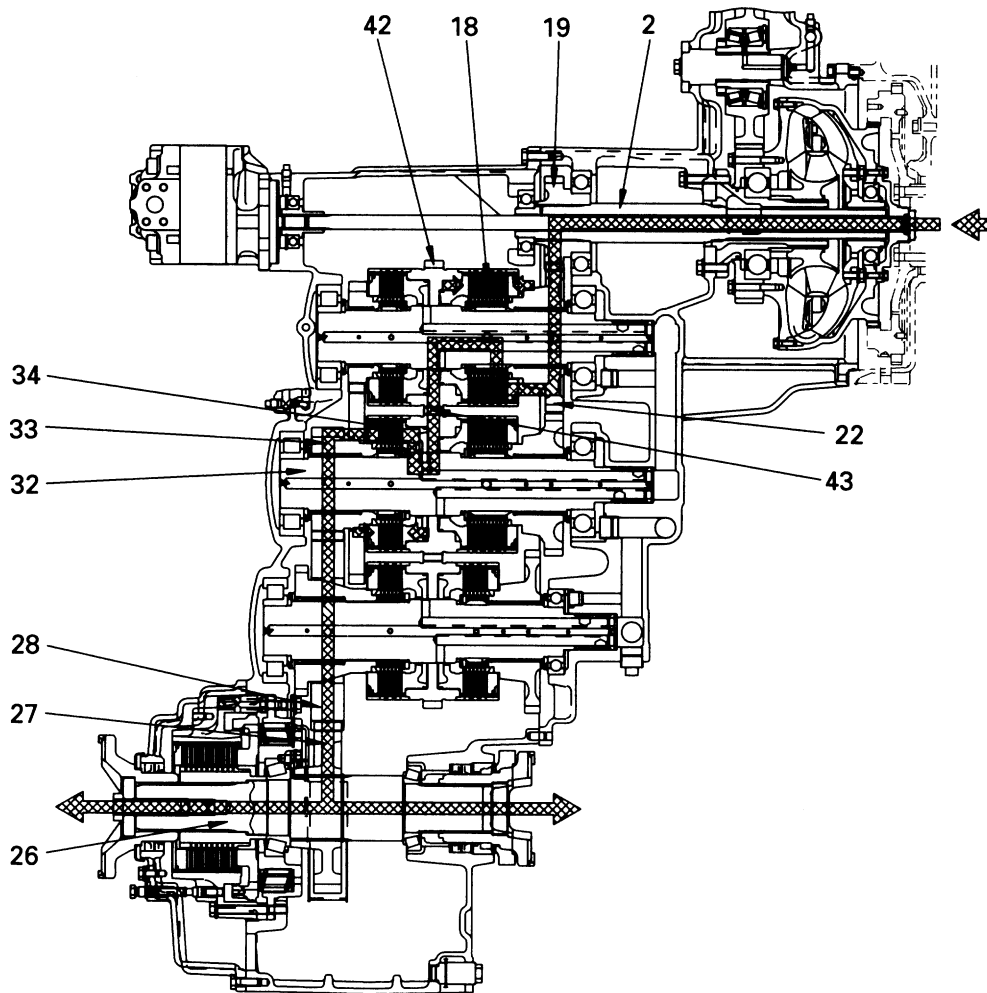


SDW00024

Operation

- In the case of FORWARD 1st, FORWARD clutch (18) and 1st clutch (17) are engaged. The motive force transmitted from the torque converter to input shaft (2) is transmitted to gear (19), which is installed to the input shaft.
- Each clutch disc of FORWARD clutch (18) and 1st clutch (17) is engaged by the oil pressure applied to the piston.
- The motive force from the torque converter passes from input shaft (2) through gear (19) and is transmitted to FORWARD gear (22). When FORWARD clutch (18) is engaged, the motive force is transmitted to the FORWARD 1st cylinder.
- The 1st clutch is engaged, so the motive force transmitted to the FORWARD 1st cylinder passes through 1st clutch (17) and is transmitted from 1st gear (38) to 2nd clutch gears (35, 33). It then passes through 3rd clutch gear (28) and output gear (27) and is transmitted to output shaft (26).

FORWARD 2ND



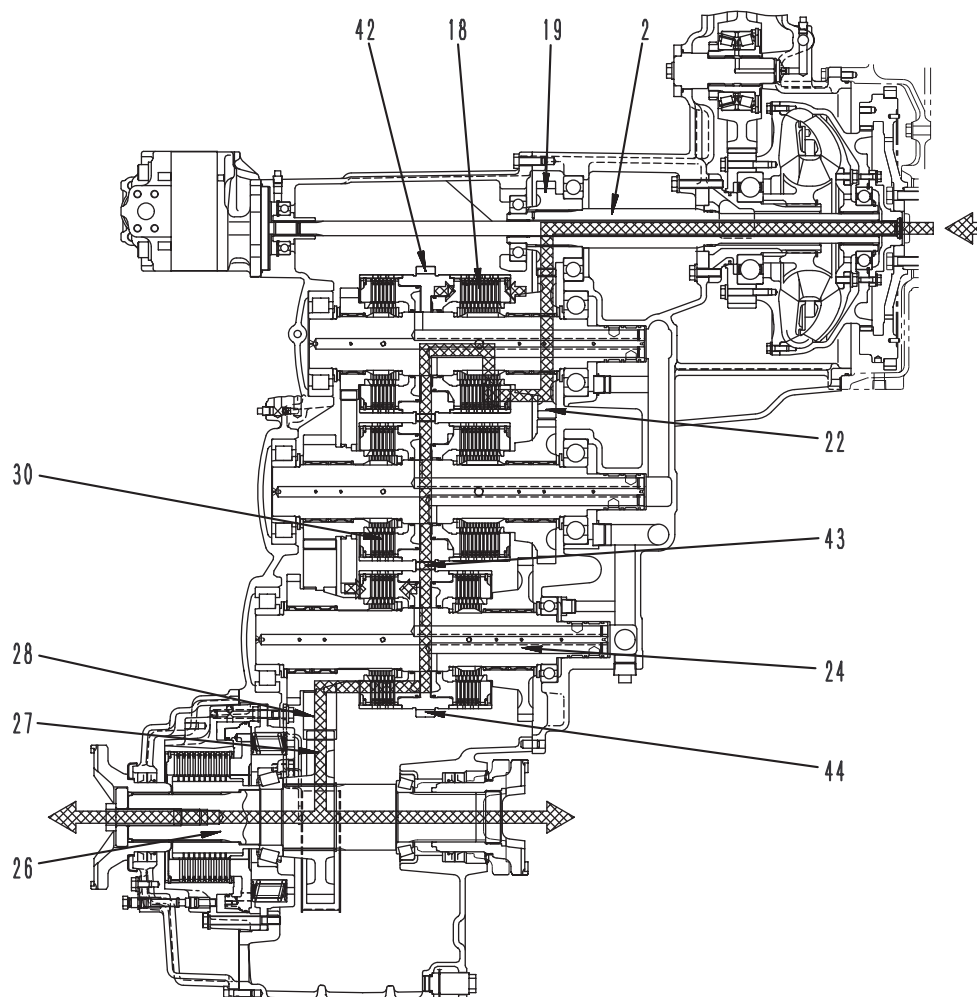
SDW00025

U42103

Operation

- In the case of FORWARD 2nd, FORWARD clutch (18) and 2nd clutch (34) are engaged. The motive force transmitted from the torque converter to input shaft (2) is transmitted to gear (19), which is installed to the input shaft.
- The clutch discs of FORWARD clutch (18) and 2nd clutch (34) are engaged by the oil pressure applied to the piston.
- The motive force from the torque converter passes from input shaft (2) through gear (19) and is transmitted to FORWARD gear (22). FORWARD clutch (18) is engaged, so the motive force is transmitted to FORWARD 1st cylinder gear (42).
- The motive force is transmitted to REVERSE 2nd cylinder gear (43), which is meshed with the FORWARD 1st gear. 2nd clutch (34) is engaged, so the transmitted motive force passes through the 2nd clutch and goes from 2nd gear (33) through 3rd gear (28) and output gear (27), and is transmitted to output shaft (26).

FORWARD 3RD



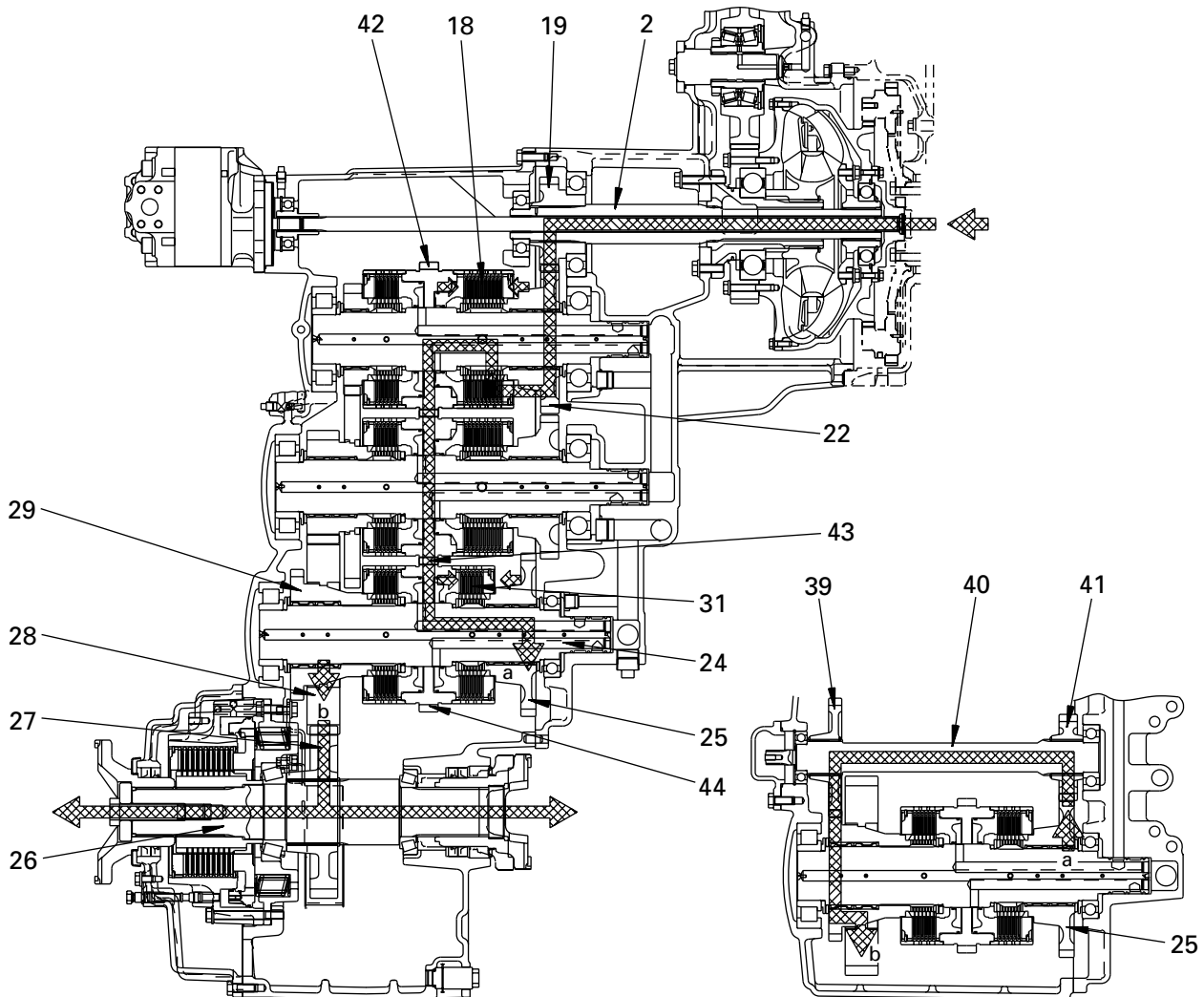
SJW05301

Operation

- In the case of FORWARD 3rd, FORWARD clutch (18) and 3rd clutch (30) are engaged. The motive force transmitted from the torque converter to input shaft (2) is transmitted to gear (19), which is installed to the input shaft.
- The clutch discs of FORWARD clutch (18) and 3rd clutch (30) are engaged by the oil pressure applied to the piston.
- The motive force from the torque converter passes from input shaft (2) through gear (19) and is transmitted to FORWARD gear (22). FORWARD clutch (18) is engaged, so the motive force is transmitted to FORWARD 1st cylinder gear (42).
- The motive force is transmitted through REVERSE 2nd cylinder gear (43), which is meshed with the FORWARD 1st cylinder gear, and is transmitted to 3rd, 4th cylinder gear (44). 3rd clutch (30) is engaged, so the transmitted motive force passes through the 3rd clutch and goes from 3rd gear (28) through output gear (27), and is transmitted to output shaft (26).

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FORWARD 4TH



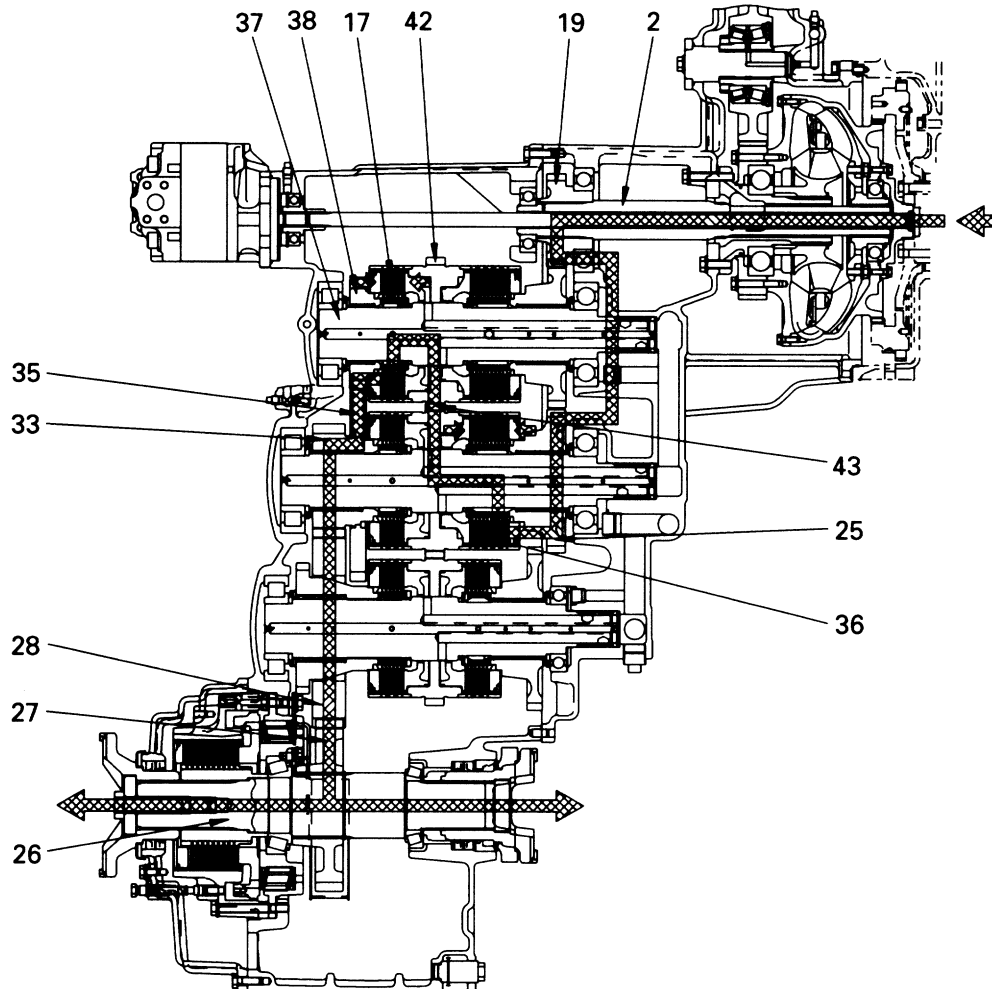
SDW00027

Operation

- In the case of FORWARD 4th, FORWARD clutch (18) and 4th clutch (31) are engaged. The motive force transmitted from the torque converter to input shaft (2) is transmitted to gear (19), which is installed to the input shaft.
- The clutch discs of FORWARD clutch (18) and 4th clutch (31) are engaged by the oil pressure applied to the piston.
- The motive force from the torque converter passes from input shaft (2) through gear (19) and is transmitted to FORWARD gear (22). FORWARD clutch (18) is engaged, so the motive force is transmitted to FORWARD 1st cylinder gear (42).
- The motive force is transmitted through REVERSE 2nd cylinder gear (43), which is meshed with the FORWARD 1st cylinder gear, and is transmitted to 3rd, 4th cylinder gear (44). 4th clutch (31) is engaged, so the transmitted motive force passes through the 4th clutch and goes from 4th gear (25) through 4th counter gear (41), countershaft (40), and 3rd counter gear (39), and is transmitted to 3rd gears (29) and (28). It then passes through output gear (27) and is transmitted to output shaft (26).

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REVERSE 1ST



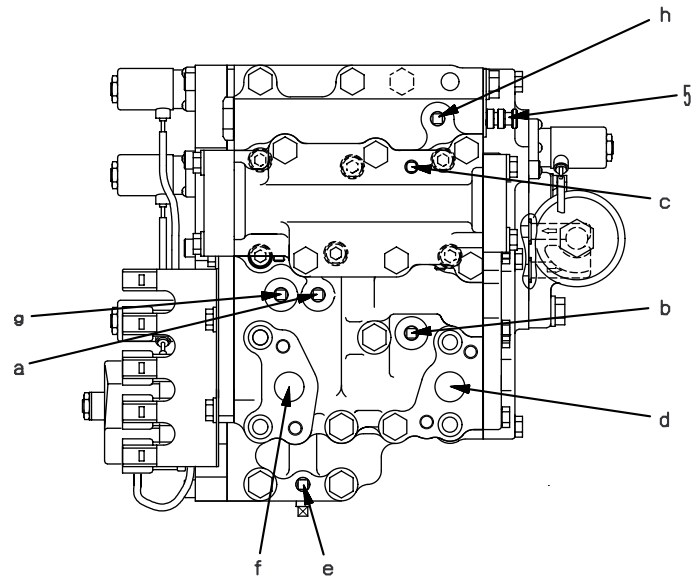
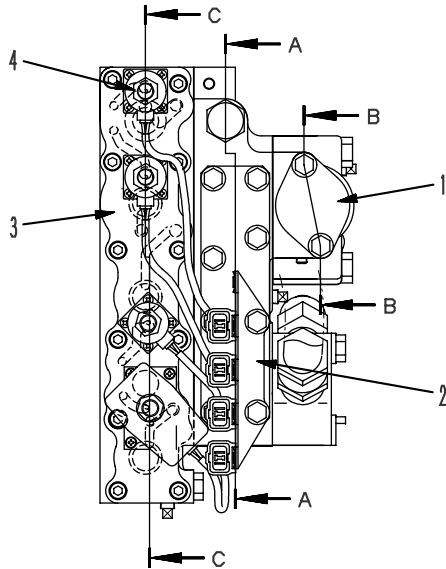
SDW00028

Operation

- In the case of REVERSE 1st, REVERSE clutch (36) and 1st clutch (17) are engaged. The motive force transmitted from the torque converter to input shaft (2) is transmitted to gear (19), which is installed to the input shaft.
- With reverse clutch (36) and 1st clutch (17), each clutch disc is engaged by the oil pressure applied to the piston.
- The motive force from the torque converter passes from input shaft (2) through gear (19) and is transmitted to REVERSE gear (25). When REVERSE clutch (36) is engaged, the motive force is transmitted to the REVERSE 2nd cylinder.
- The motive force is transmitted through FORWARD 1st cylinder gear (42), which is meshed with REVERSE 2nd cylinder gear (43). 1st clutch (17) is engaged, so the transmitted motive force passes through 1st clutch (17) and goes from 1st gear (38) to 2nd gears (35) and (33). It then passes through 3rd gear (28) and output gear (27), and is transmitted to output shaft (26).

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TRANSMISSION CONTROL VALVE FOR MECHANICAL SHIFT



SWW04477

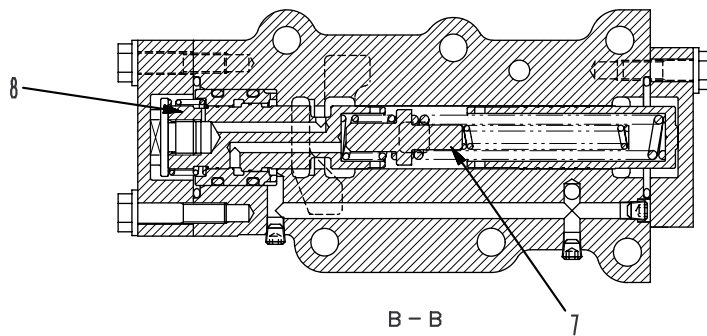
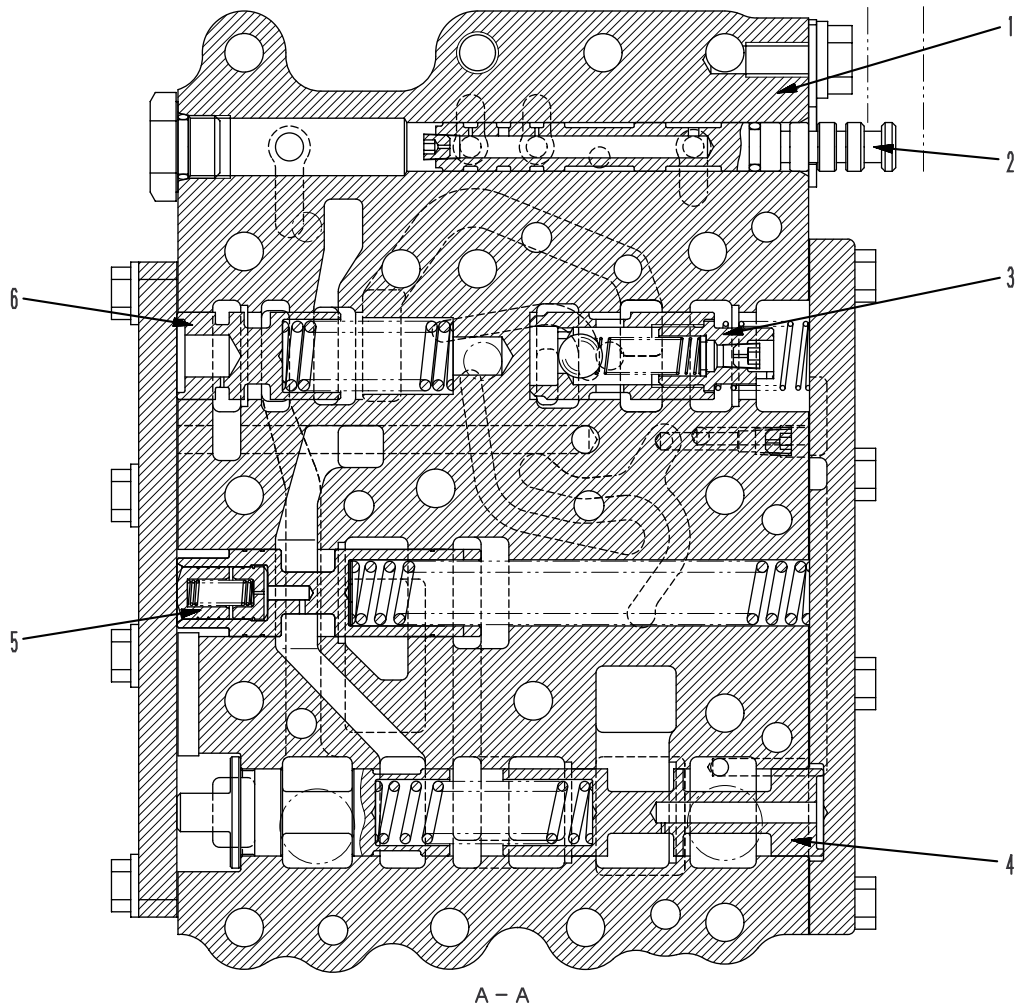
U42103

- | | | |
|--------------------------------|---|--|
| 1. Mechanical modulation valve | a. Torque converter inlet port oil pressure measurement port | e. Parking brake oil pressure measurement port (priority measurement port) |
| 2. Upper valve | b. Torque converter outlet port oil pressure measurement port | f. From pump |
| 3. Lower valve | c. Clutch oil pressure measurement port | g. Main oil pressure measurement port |
| 4. Solenoid valve | d. To oil cooler | h. Pilot oil pressure measurement port |
| 5. Emergency manual spool | | |

Outline

- The oil from the pump passes through the flow valve and oil filter, enters the transmission valve, and is divided into the pilot circuit and clutch actuation circuit. The priority valve adjusts the delivery pressure of the pump and ensures the pilot pressure and oil pressure used to release the parking brake.
- The pressure of the oil flowing to the clutch actuation circuit is regulated by the main relief valve, and actuates the clutch. The oil relieved by the main relief valve is supplied to the torque converter.
- The quick return valve and modulation valve are interconnected when shifting gear. This allows the clutch pressure to rise smoothly and reduces the shock when shifting gear. In addition, when the machine is traveling, the clutch pressure is kept constant. The pressure of the oil flowing to the pilot valve is regulated by the pilot reducing valve, and actuates the directional and range spools as the solenoid valves are switched ON or OFF.
- When the directional and range spools are switched, the oil, whose pressure is regulated by the modulation valve, is supplied to the selected clutch to provide the necessary speed range.

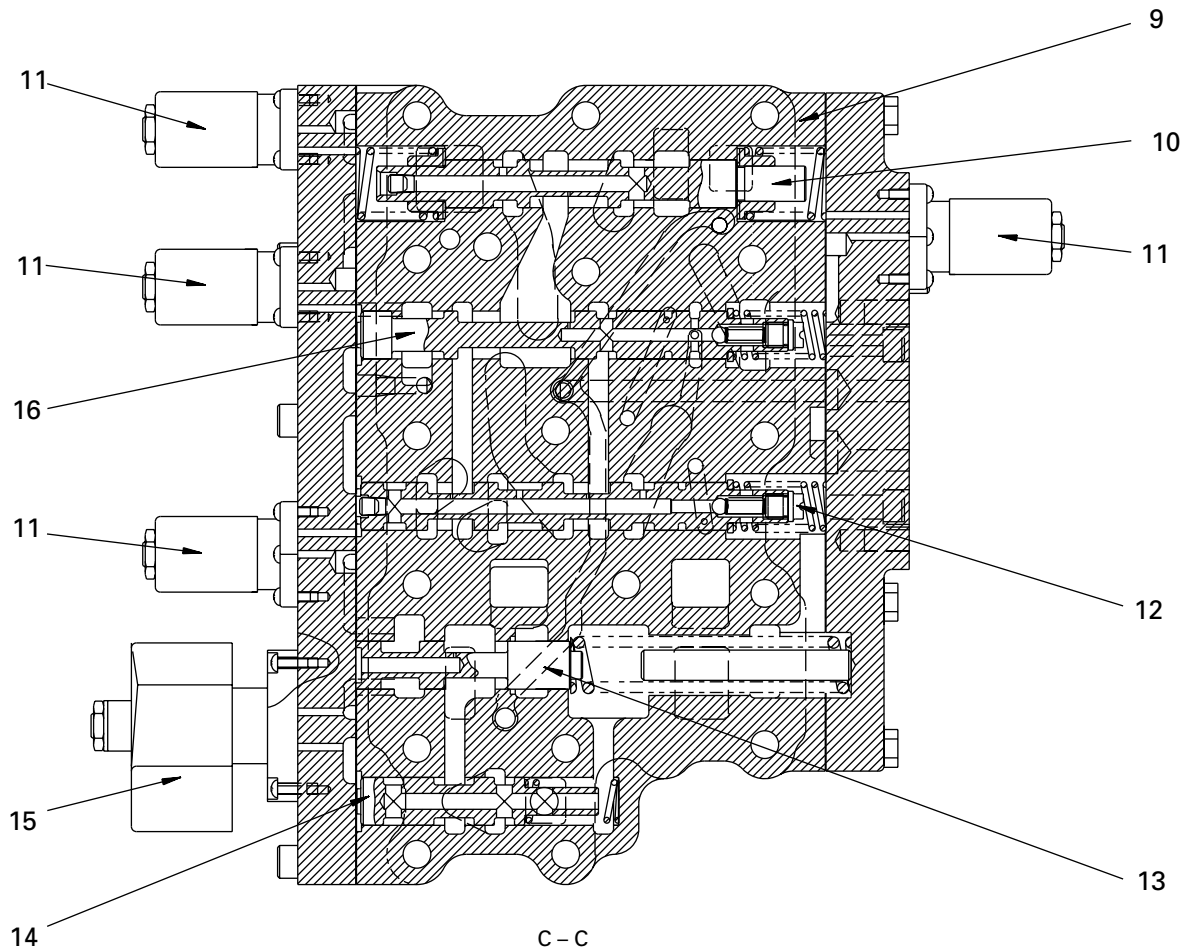
UPPER VALVE



U42103

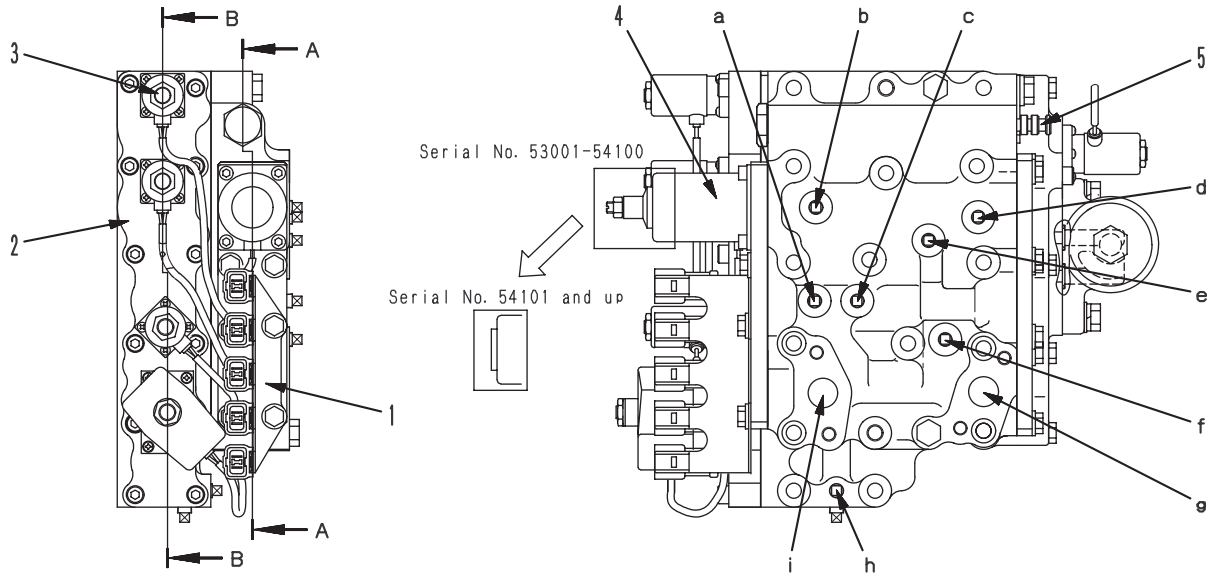
SWW04478

LOWER VALVE



SDW00031

- | | |
|---------------------------------------|----------------------------------|
| 1. Upper valve body | 9. Lower valve body |
| 2. Emergency manual spool | 10. Directional selector valve |
| 3. Quick return valve | 11. Solenoid valve |
| 4. Torque converter outlet port valve | 12. Range selector valve |
| 5. Main relief valve | 13. Priority valve |
| 6. Pilot reducing valve | 14. Parking brake valve |
| 7. Accumulator | 15. Parking brake solenoid valve |
| 8. Fill valve | 16. H-L selector valve |

FOR AUTO-SHIFT (OPTIONAL)**Serial No.: 53001 and up**

1. Upper valve
2. Lower valve
3. Solenoid valve
4. Electronic control modulation valve
5. Emergency manual operation valve

- a. Main oil pressure pickup port
- b. Clutch oil pressure pickup port
- c. Torque converter inlet oil pressure pickup port
- d. Priority oil pressure pickup port
- e. Pilot oil pressure pickup port
- f. Torque converter outlet oil pressure pickup port
- g. To oil cooler
- h. Parking brake oil pressure pickup port
- i. From pump

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Outline

- The oil from the pump flows through the flow valve and oil filter into the transmission valve and then is divided into the pilot circuit and clutch operation circuit. The priority valve regulates the discharge pressure of the pump to secure the pilot pressure and parking brake releasing pressure.
- The pressure of the oil sent to the clutch operation circuit is regulated by the main relief valve and used to operate the clutch. The oil released from the main relief valve is supplied to the torque converter.
- The electronic control modulation valve (ECMV) senses the machine travel speed and engine speed and operates the proportional solenoid valve to control the oil flow and oil

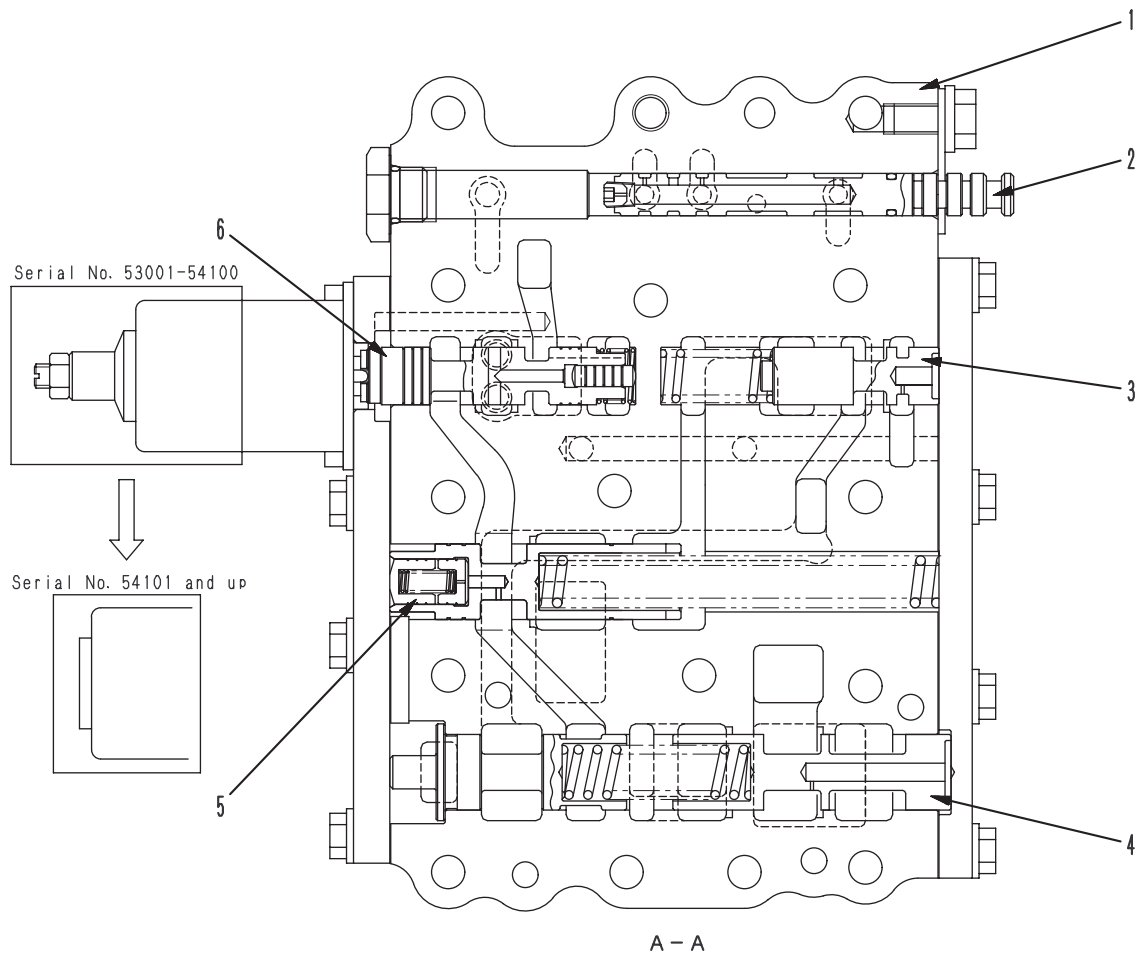
pressure according to the command current from the transmission controller so that less shocks will be made when gear speed is changed and the clutch will be engaged smoothly. It keeps the clutch pressure constant during travel, too.

The pressure of the oil sent to the pilot circuit is regulated by the pilot pressure reducing valve and used to operate the forward, reverse, and range spools when the gear speed is changed and the solenoid valve is turned on or off.

- If the forward, reverse, or range spools is selected, the pressure of the oil is regulated by the electronic control modulation valve and the oil is supplied to the clutch to select the desired gear speed.

UPPER VALVE (For auto-shift: electronic modulation)

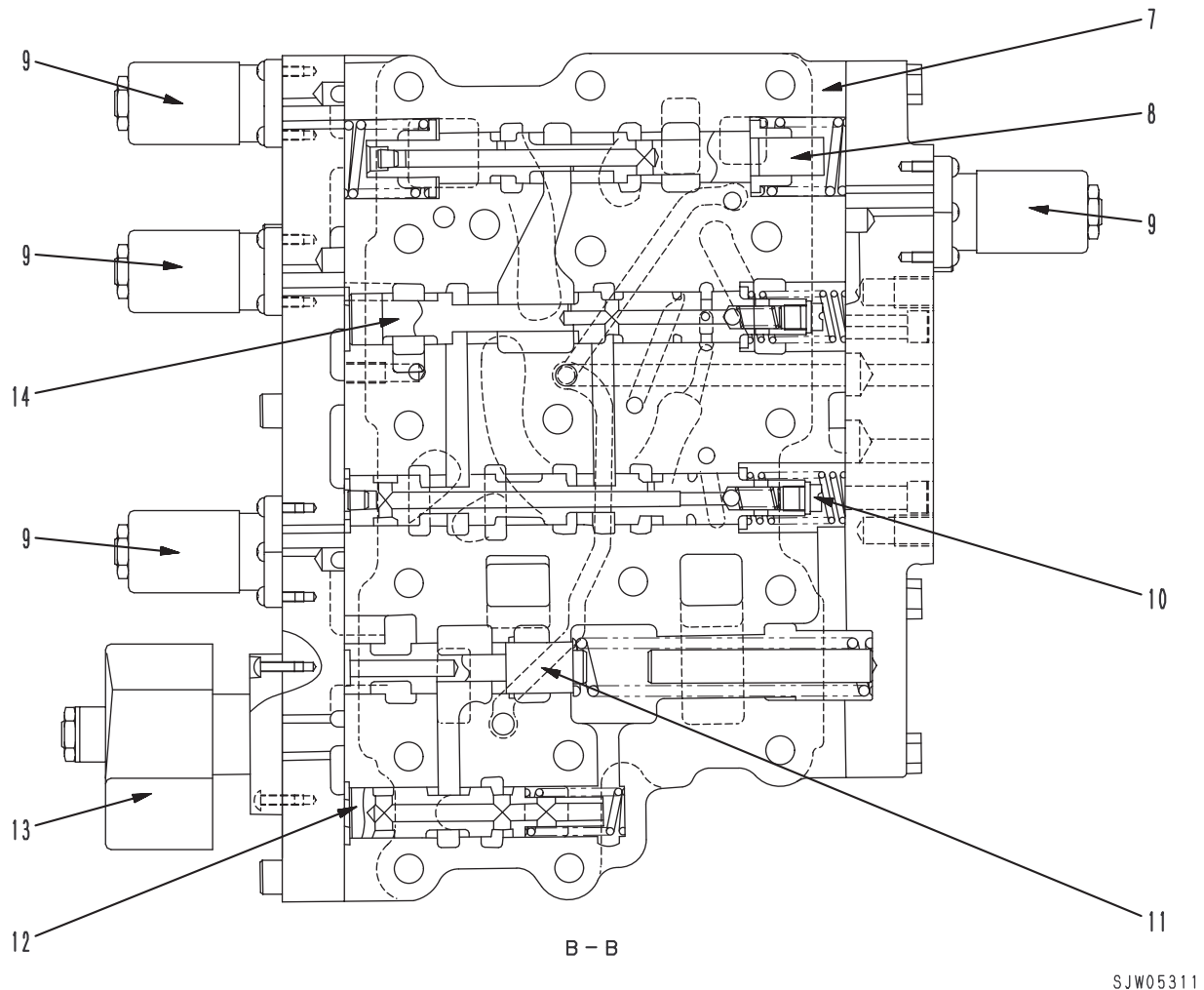
Serial No.: 53001 and up



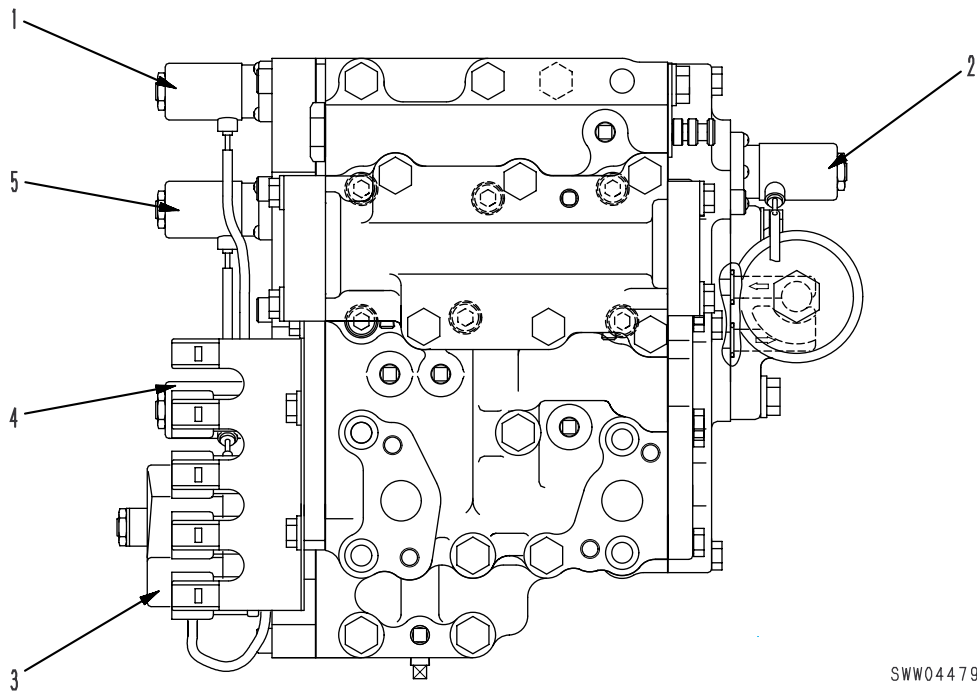
SJW05303

1. Upper valve body
2. Emergency manual spool
3. Pilot pressure reducing valve
4. Torque converter outlet valve
5. Main relief valve
6. Electronic modulation valve (ECMV)

LOWER VALVE (For auto-shift)



- 7. Lower valve body
- 8. Directional selector valve
- 9. Solenoid valve
- 10. Range selector valve
- 11. Priority valve
- 12. Parking brake valve
- 13. Parking brake solenoid valve
- 14. H-L selector valve

TRANSMISSION SOLENOID VALVE (For mechanical shift and auto-shift)

Note: This illustration shows the control valve for the mechanical shift transmission.

- | | |
|--|--|
| 1. Solenoid valve [①] for FORWARD selector | 4. Solenoid valve [④] for range selector |
| 2. Solenoid valve [②] for REVERSE selector | 5. Solenoid valve [③] for H-L selector |
| 3. Solenoid valve [⑤] for parking brake | |

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Actuation table for solenoid valve and clutch

Solenoid valve	①	②	③	④	⑤
F • 1	○			○	
F • 2	○				
F • 3	○		○		
F • 4	○		○	○	
R • 1		○		○	
R • 2		○			
R • 3		○	○		
R • 4		○	○	○	
N • 1				○	
N • 2					
N • 3			○		
N • 4			○	○	
Parking brake operated					
Parking brake released					○

Structure

- The transmission solenoid valve is installed to the lower valve of the transmission valve. When the speed lever is operated, the movement is converted to electricity, and this opens or closes each solenoid valve to move the spool inside the transmission valve.
- The parking brake solenoid valve is installed to the transmission lower valve. When the parking brake switch is operated, the solenoid valve is opened or closed by an electric signal to move the parking brake spool.

STRUCTURE AND FUNCTION

TRANSMISSION CONTROL VALVE

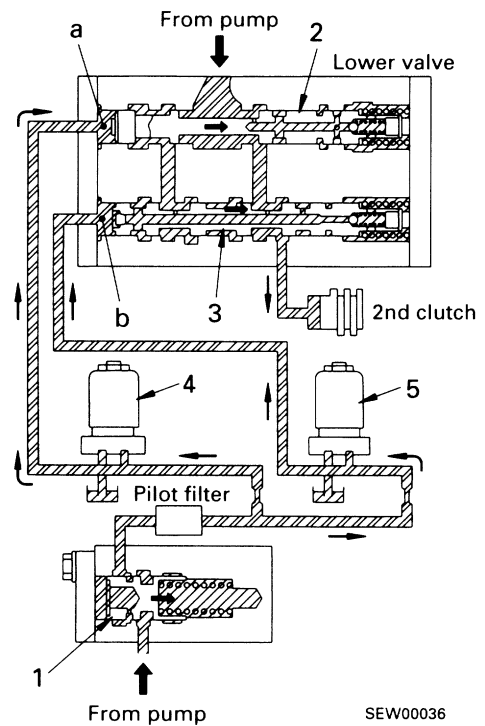
Function

- When the speed lever in the operator's compartment is operated, the four solenoid valves installed to the transmission control valve are switched ON or OFF to actuate the directional selector spool, H-L selector spool and range selector spool.

Operation

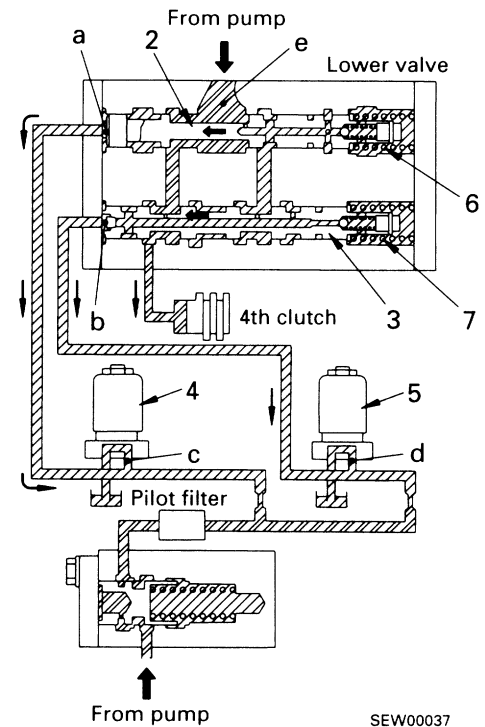
1. Solenoid valve OFF

The oil from pilot reducing valve (1) flows to ports **a** and **b** of H-L selector spool (2) and range selector spool (3). The oil at **a** and **b** is blocked by solenoid valves (4) and (5), so selector spools (2) and (3) are moved to the right in the direction of arrow. As a result, the oil from the pump flows to the 2nd clutch.

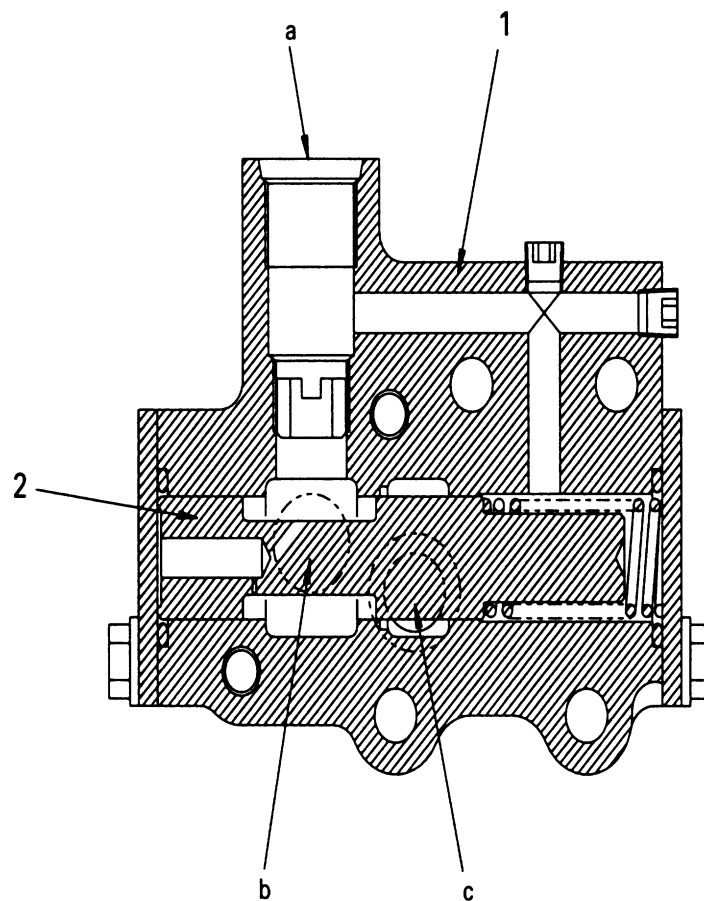


2. Solenoid valve ON

When the speed lever is operated, the drain ports of solenoid valves (4) and (5) open. The oil at ports **a** and **b** of selector spools (2) and (3) flows from ports **c** and **d** to the drain circuit. Therefore, the pressure in the circuits at ports **a** and **b** drops, and the spools are moved to the left in the direction of the arrow by return springs (6) and (7). As a result, the oil at port **e** flows to the 4th clutch and switches from 2nd to 4th.



FLOW VALVE



SDW00038

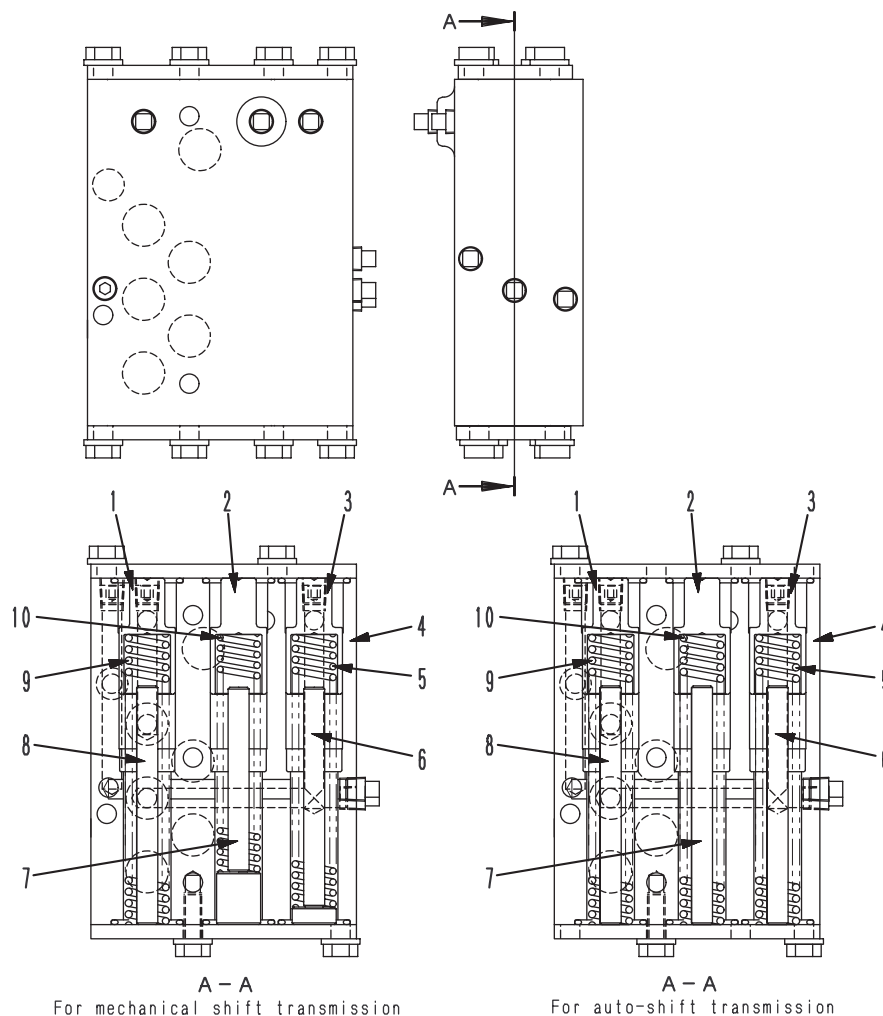
- 1. Valve body
- 2. Valve spool

- a. To transmission valve circuit
- b. From pump
- c. To transmission lubrication circuit

Operation

- The oil from the pump flows to the transmission valve circuit but when it becomes greater than the specified flow, the flow valve acts to send oil to the transmission lubrication circuit.
- When the oil from the pump becomes greater than the specified flow, valve spool (2) moves and part of the oil from the oil pump flows to the transmission lubrication circuit.

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ACCUMULATOR VALVE (For mechanical shift and auto-shift)

SJW05304

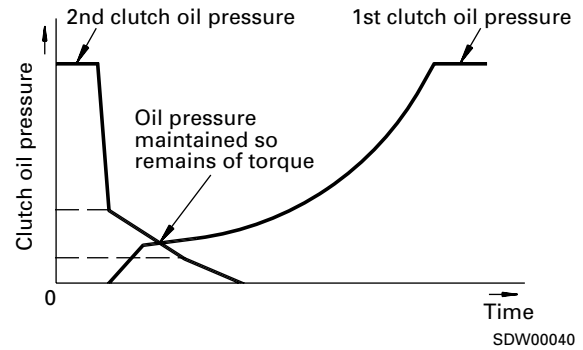
1. Piston (FORWARD clutch)
2. Piston (1st clutch)
3. Piston (2nd clutch)
4. Body accumulator
5. Spring (2nd clutch)
6. Stopper (2nd clutch)
7. Stopper (1st clutch)
8. Stopper (FORWARD clutch)
9. Spring (FORWARD clutch)
10. Spring (1st clutch)

Outline

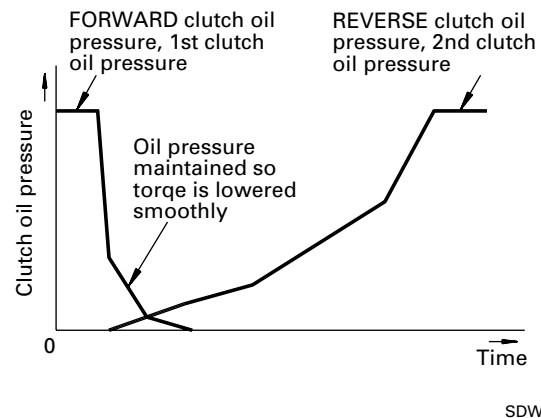
- The accumulator valve is installed in the FORWARD, 1st, 2nd clutch circuit. When the transmission shifts gear, the accumulator valve slowly reduces the oil pressure to the clutch that was first engaged in order to prevent loss of torque and to reduce the transmission shock when shifting gear. It temporarily stores the clutch oil pressure in order to allow gear shifting to be carried out smoothly without any time lag. (To make it possible to reduce the oil pressure to the clutch slowly, there are throttles installed in the directional spool and selector spool of the transmission control valve.)

Operation**1. Shifting down when digging (kick-down F2 → F1)**

When the transmission is in F2, oil pressure is stored in the 2nd clutch accumulator. When the kick-down is operated, the F1 clutch is engaged, but the oil pressure in the accumulator is maintained for the 2nd clutch until the torque is transmitted to the 1st clutch. In this way, it is possible to shift gear smoothly without losing the torque.

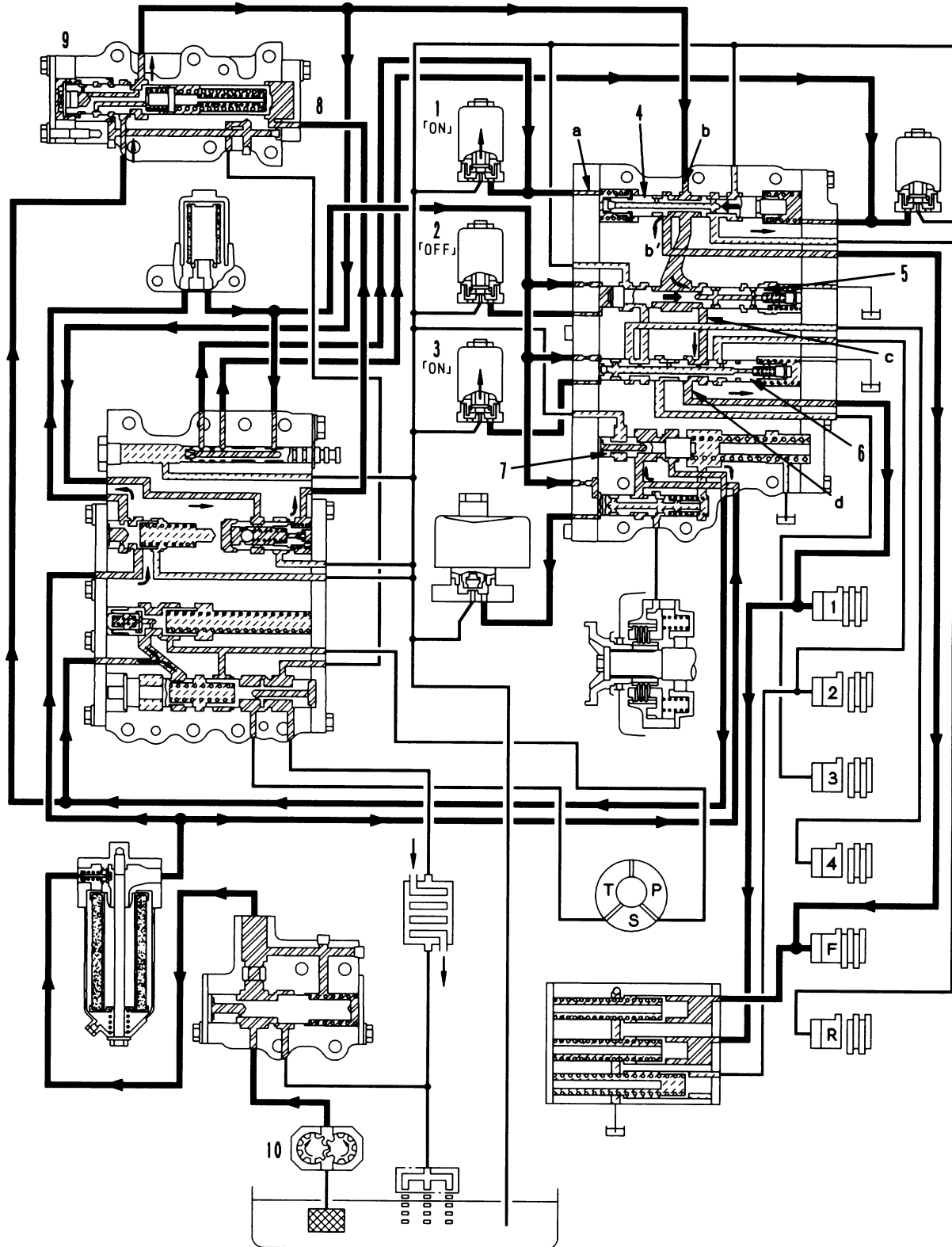
**Moving out after digging (F1 → R2)**

When the transmission is in F1, oil pressure is stored in the accumulator for the FORWARD clutch and 1st clutch. When shifting to R2 after completing digging operations, the R2 clutch is engaged, but the oil pressure for the FORWARD clutch and 1st clutch is maintained in the accumulator. This makes it possible to reduce the loss of torque due to the reaction force to the product being handled, and to move back smoothly without shock.



TRANSMISSION OIL PRESSURE SYSTEM DIAGRAM

Operation of FORWARD 1st



U42103

SWW04480

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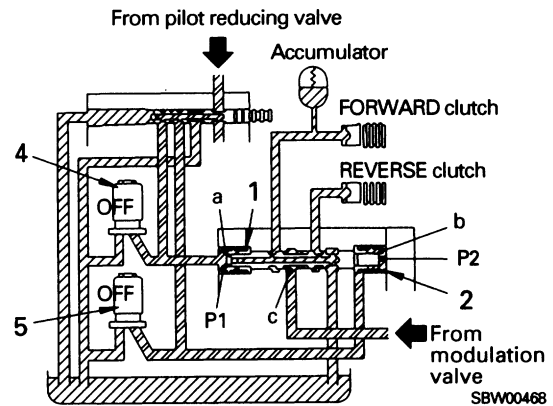
- The oil from the pump passes through the filter, then passes through the pilot circuit and priority valve, and is divided to the clutch actuation circuit and the torque converter circuit.
- When the speed lever is operated to F1, FORWARD solenoid valve (1) is actuated. The oil which was filling port **a** is drained, directional spool (4) is moved to the left, and clutch oil pressure port **b** and FORWARD clutch oil pressure port **b'** are connected. At the same time, oil fills the circuit and pushes the H-L selector spool (5) fully to the right to prevent H-L selector solenoid valve (2) from being actuated. In addition, the oil is drained and range selector spool (6) is pushed fully to the left to actuate range selector solenoid valve (3). In this condition, 1st clutch oil pressure port **d** is connected to oil pressure port **c** of the H-L selector valve and the range selector valve.
- At the same time, the oil flowing through priority valve (7) to the clutch actuation circuit passes through the modulation valve, and then flows to the FORWARD clutch and 1st clutch through directional spool (4), H-L selector spool (5), and range selector spool (6).
- When the oil completely fills the clutch cylinder, the pressure rises gradually because of the action of accumulator (8) and modulation valve (9). When it reaches the set pressure, the FORWARD and 1st clutches are completely engaged.

DIRECTIONAL SELECTOR VALVE

Operation

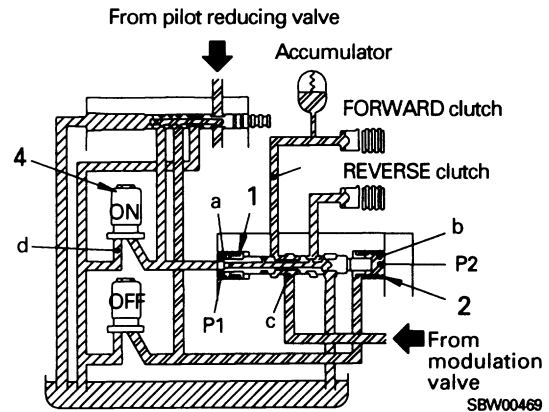
1. When at neutral

- Solenoid valves (4) and (5) are OFF and the drain port is closed. The oil from the pilot circuit passes through the oil hole in the emergency manual spool and fills ports **a** and **b** of the directional spool.
- In this condition, $P_1 + \text{spring force (1)} = P_2 + \text{spring force (2)}$, so the balance is maintained. Therefore, the oil at port **c** does not go to the FORWARD or REVERSE clutch.



2. When at FORWARD

- When the directional lever is placed at the FORWARD position, solenoid valve (4) is switched ON and drain port **d** opens. The oil which is filling port **a** is drained, so $P_1 + \text{spring force (1)} < P_2 + \text{spring force (2)}$. When this happens, the directional spool moves to the left, and the oil at port **c** flows to port **e** and is supplied to the FORWARD clutch.



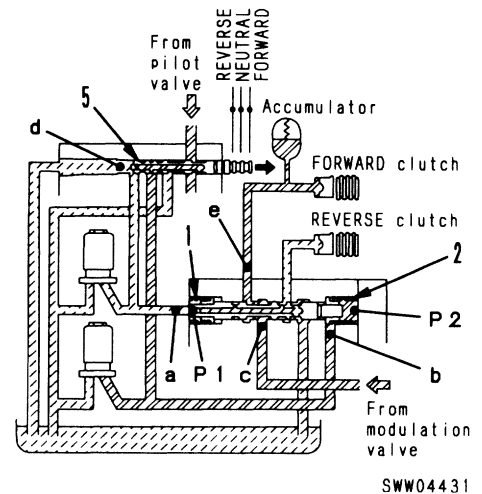
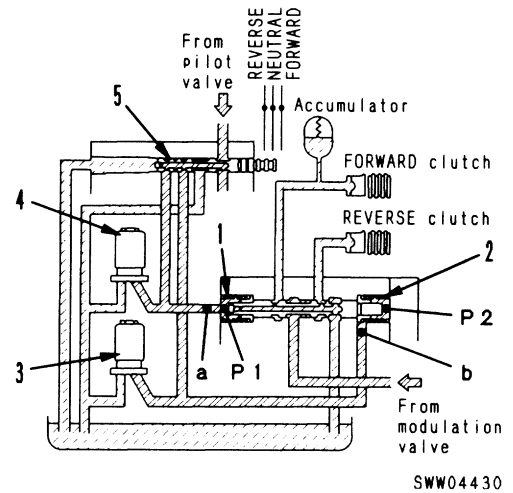
EMERGENCY MANUAL SPOOL

Function

- Should the electric system malfunction and the forward/reverse solenoid valves cannot be actuated, the emergency manual spool is used to actuate the forward and reverse clutches manually.

Operation

- When the emergency manual spool is at neutral (during normal operation)
 - The oil from the pilot valve flows through the oil hole of emergency manual spool (5) and fills ports **a** and **b** of the directional spool.
 - Under this condition, $P1 + \text{spring force (1)} = P2 + \text{spring force (2)}$. Accordingly, the oil in port **c** does not flow to the forward and reverse clutches.
- When the emergency manual spool is actuated (to the forward side)
 - When the emergency manual spool (5) is pulled out, drain port **d** opens and the oil filled in port **a** is drained. Accordingly, $P1 + \text{spring force (1)} < P2 + \text{spring force (2)}$. As a result, the directional spool moves to the left and the oil in port **c** flows through port **e** to the forward clutch.



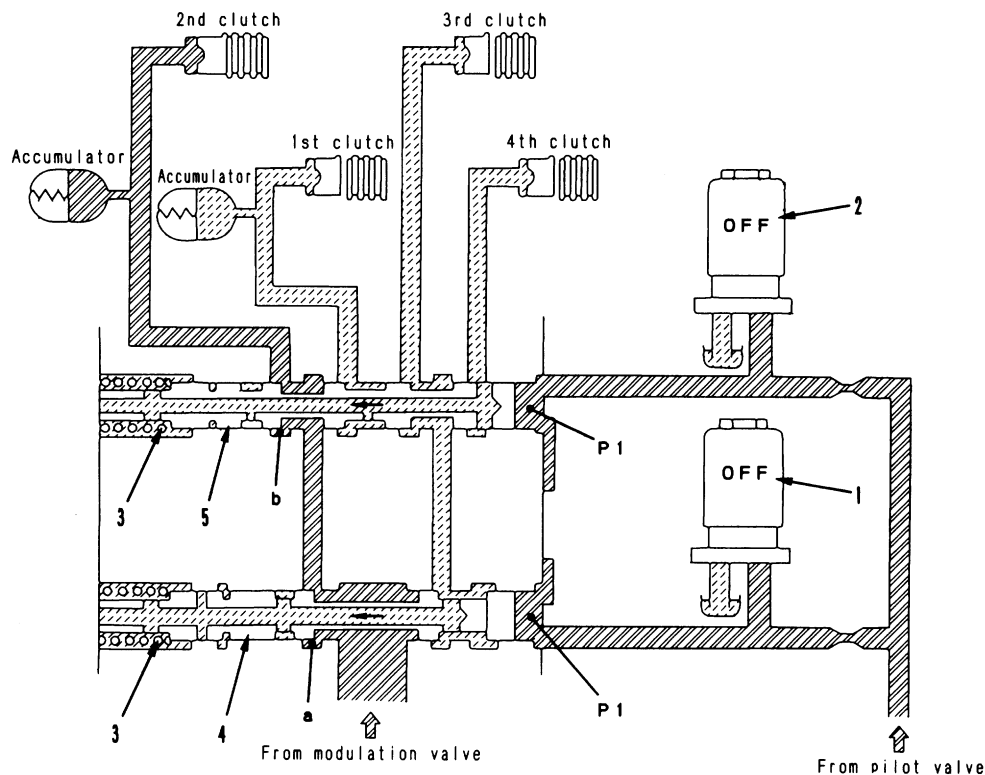
H-L SELECTOR VALVE AND RANGE SELECTOR VALVE

Function

- When the gear shift lever is operated, electric signals are sent to the solenoid valves paired with the H-L selector valve and range selector valve.

- The H-L and range selector valves are operated according to the combination of the solenoid valves, making it possible to select the speed (1st to 4th).

Operation



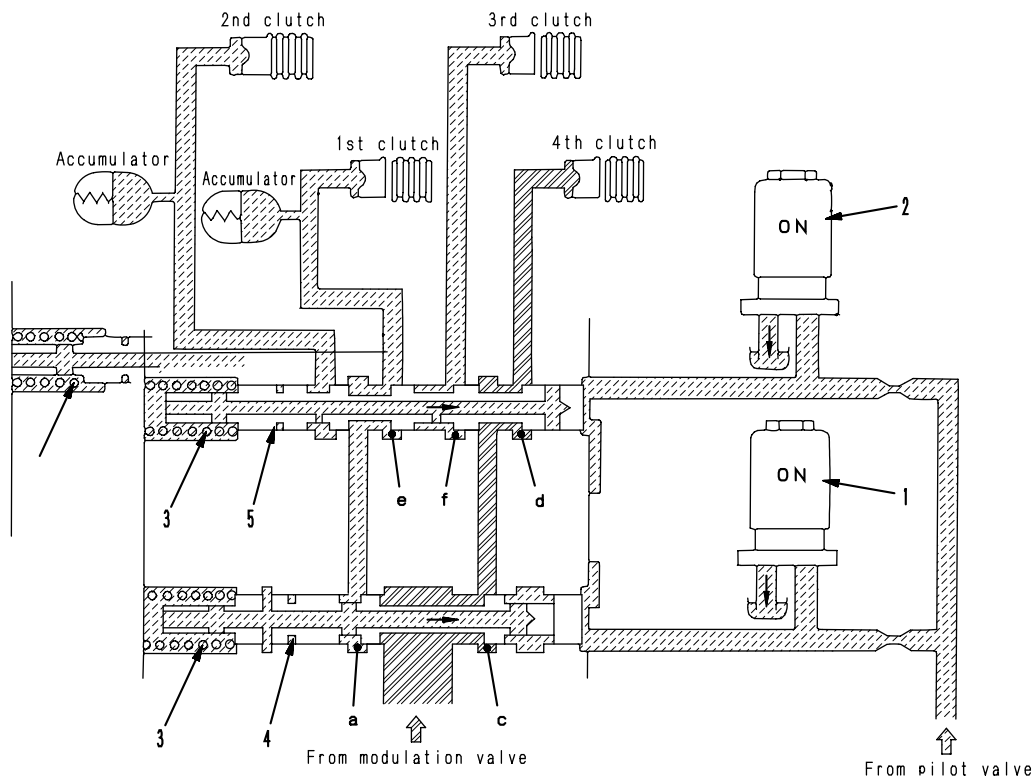
SWW04401

U42103

1. 2nd speed

- When solenoid valves (1) and (2) are **OFF**, the drain port is closed. The oil **P1** from the pilot circuit overcomes the force of springs (3) of H-L selector spool (4) and range selector spool (5) and moves spools (4) and (5) to the left. The oil in the clutch circuit passes from H-L selector spool (4) port **a** through range selector spool (5) port **b** and is supplied to the 2nd clutch.

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SWW04402

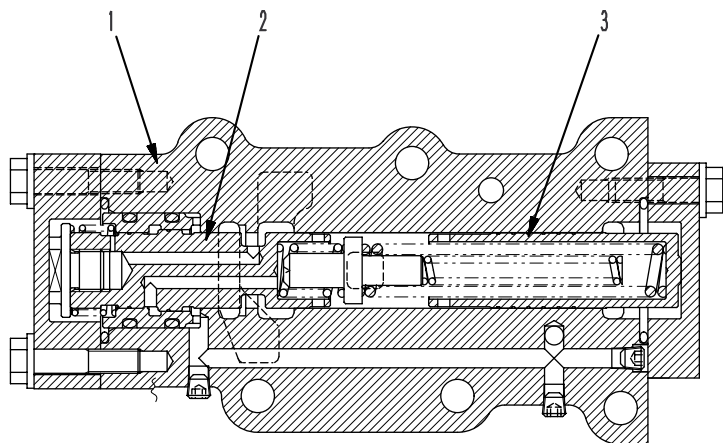
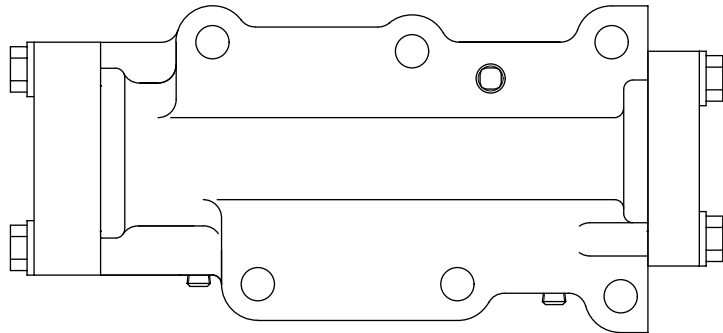
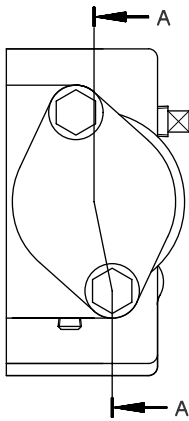
2. 4th speed

- When solenoid valves (1) and (2) are **ON**, the drain port is open. The oil from the pilot circuit passes through solenoid valves (1) and (2) and is drained, so H-L selector spool (4) and range selector spool (5) are moved to the right by the force of springs (3). The oil in the clutch circuit passes from H-L selector spool (4) port **c** through range selector spool (5) port **d** and is supplied to the 4th clutch.

3. 1st and 3rd speeds

- For the 1st speed, solenoid valve (1) is **OFF**, solenoid valve (2) is **ON**, and the oil in the clutch circuit passes from H-L selector spool (4) port **a** through range selector spool (5) port **e** and is supplied to the 1st clutch.
- For the 3rd speed, solenoid valve (1) is **ON**, solenoid valve (2) is **OFF**, and the oil in the clutch circuit passes from H-L selector spool (4) port **c** through range selector spool (5) port **f** and is supplied to the 3rd clutch.

MODULATION VALVE
For mechanical shift



A - A

SWW04403

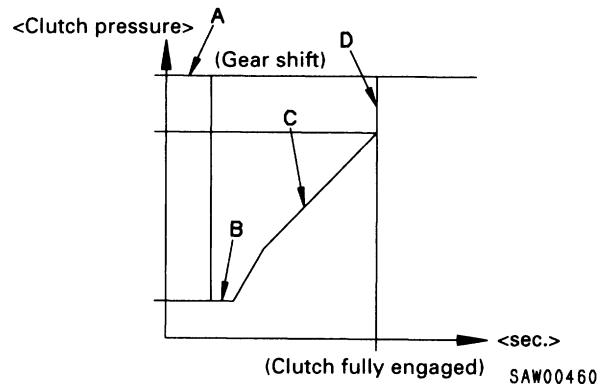
1. Valve body
2. Fill valve
3. Accumulator

U42103

MODULATION VALVE

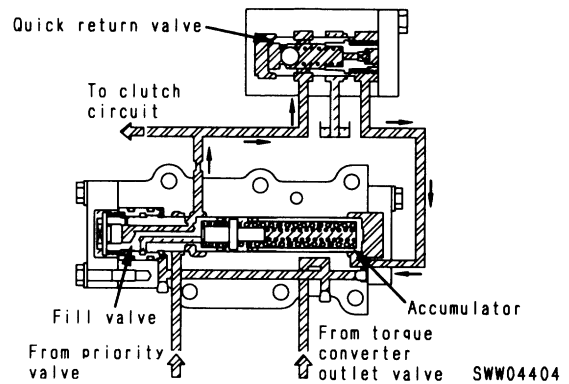
Function

- The modulation valve consists of a fill valve and an accumulator. It controls the pressure and flow of the oil flowing to the clutch and increases the clutch pressure.



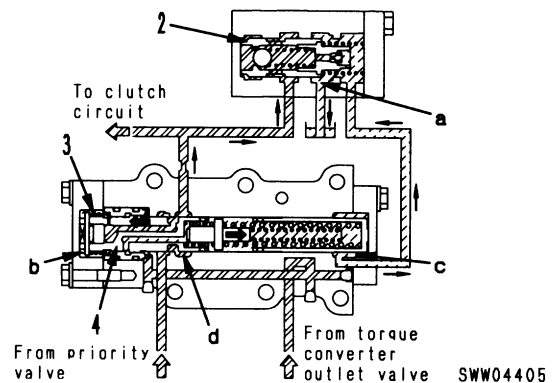
Operation

- The diagram shows the clutch fully engaged (point A).



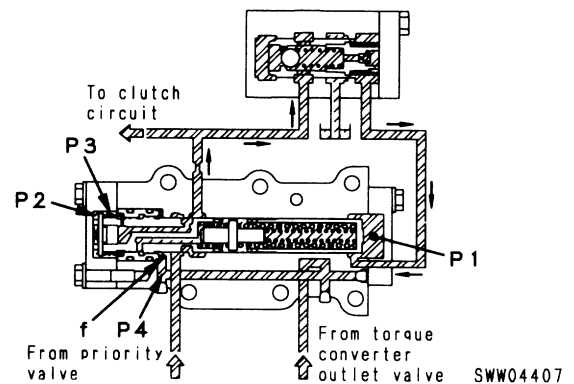
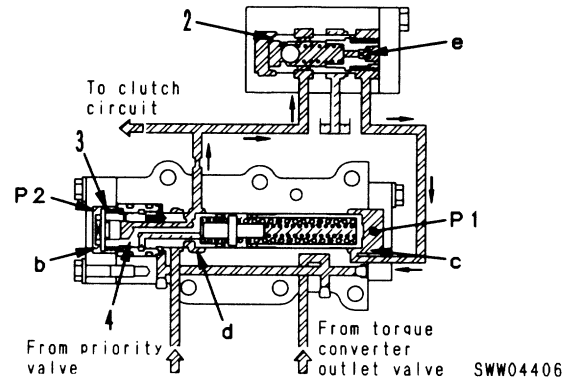
- When shifted from forward to reverse (point B)

- When the directional lever is switched from forward to reverse, the pressure of the clutch circuit decreases while oil is filling the reverse clutch, so quick return valve (2) moves to the left.
- This causes the oil in the accumulator to drain from quick return valve (2) port a. At this time, the pressure in chamber b and chamber c decreases, the force of spring (3) moves fill valve (4) to the left, and port d opens.



3. Beginning of rise in clutch pressure (point C → Point D)

- The pressure in the clutch circuit begins to rise when the oil from the priority valve fills the clutch piston.
- Quick return valve (2) moves to the right, and the drain circuit in the accumulator is closed.
- When the quick return valve's drain circuit closes, the oil which has passed through port d passes through fill valve (4) and enters port b, and pressure **P2** of chamber b begins to rise. At this time, the relationship between pressures **P1** and **P2** of the accumulator section is $P2 > P1 + P3$ (oil pressure equivalent to spring (3) tension). Fill valve (4) moves to the right, shutting off port d and preventing the clutch pressure from rising suddenly.
- The oil at port d flows into the clutch circuit, and since $P2 > P1 + P3$, it simultaneously passes through quick return valve (2) orifice e and flows into accumulator chamber c. Both pressures **P1** and **P2** increases. This action is repeated, while maintaining the relationship $P2 = P1 + P3$ (oil pressure equivalent to spring (3) tension), and the clutch pressure gradually rises.
- The pressure at the torque converter outlet is released to fill valve port f. The pressure at the torque converter outlet changes according to the engine speed.
- Thus, because of the relationship $P2 = P1 + P3 + P4$ (the pressure at port f which varies according to the engine speed), pressure **P2** changes by the same amount as pressure **P4**. Since pressure **P2** increases by the amount of increase of pressure **P4**, it is possible to create oil pressure characteristics corresponding to the engine speed.



QUICK RETURN VALVE

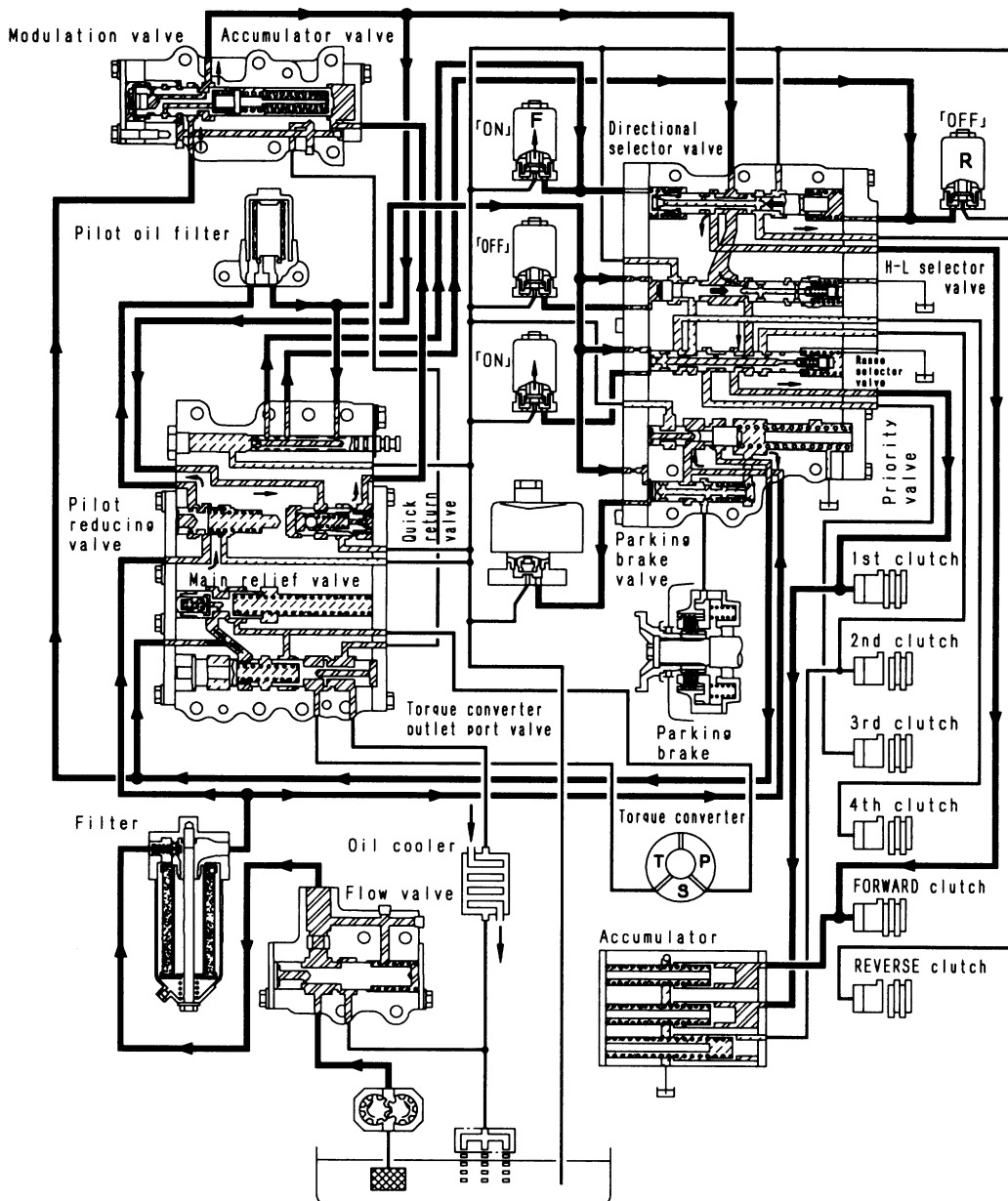
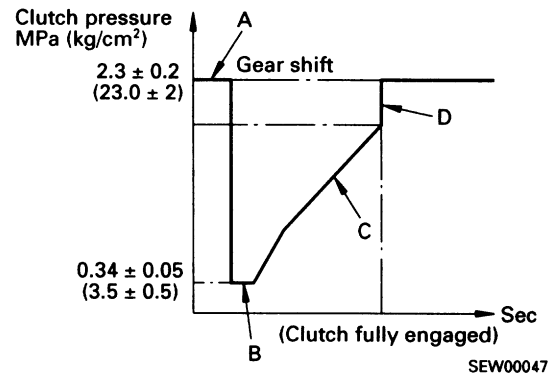
Function

- To allow the modulation valve to raise the clutch pressure smoothly, the quick return valve sends the pressure in the accumulator acting on the modulation valve spool momentarily to the drain circuit when the transmission is shifted.

Operation

- After engine is started, clutch completely engaged (clutch pressure at point A)

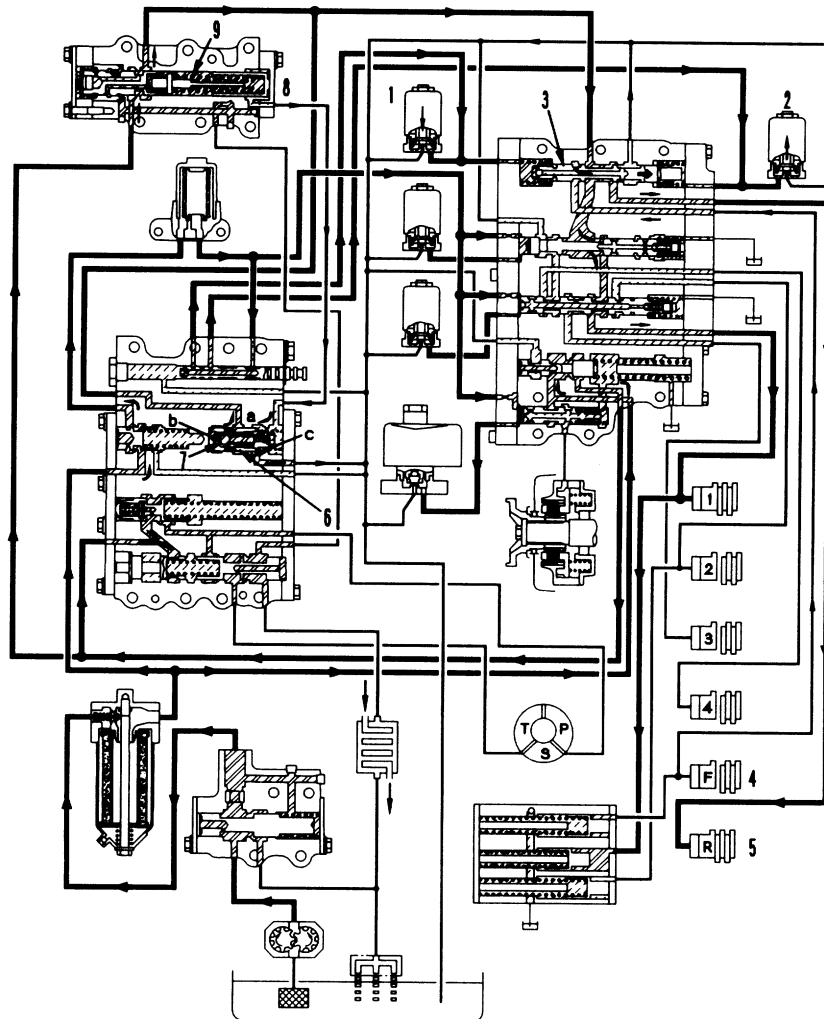
(FORWARD 1st)



U42103

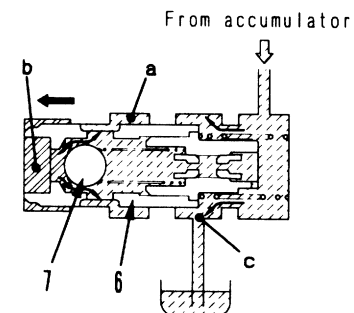
SWW04481

2. When switching from FORWARD to REVERSE (clutch pressure at point B)



SWW04274

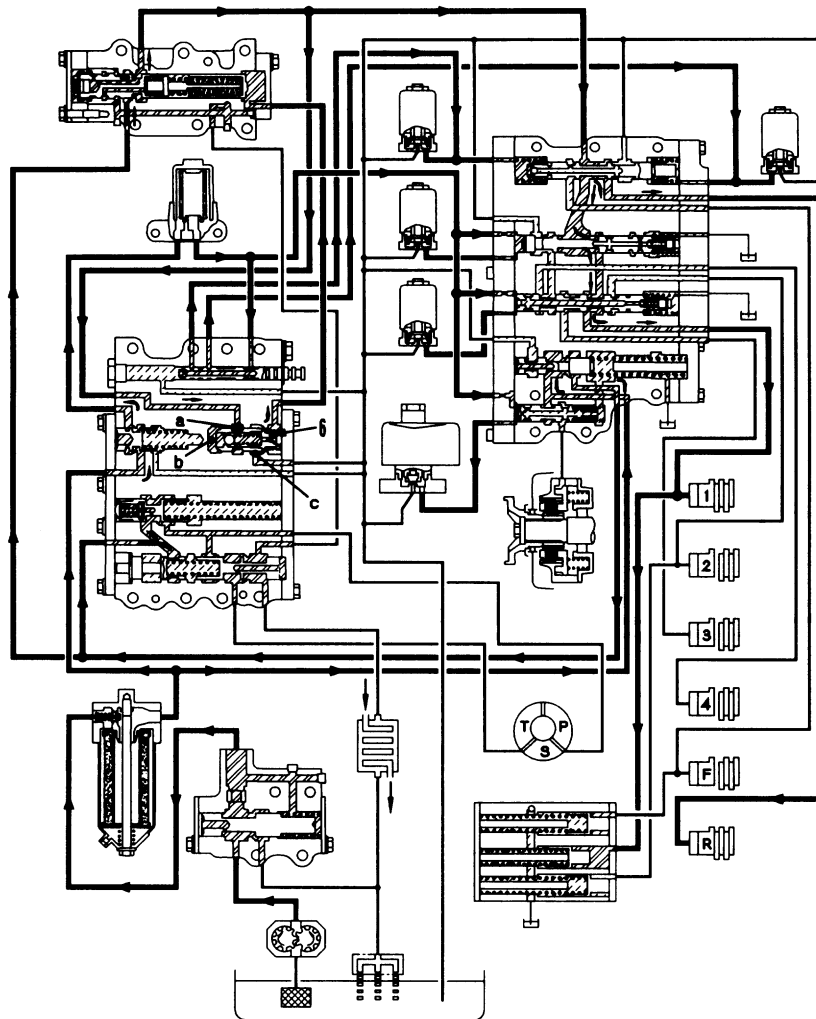
- When the directional lever is shifted from FORWARD to REVERSE, FORWARD solenoid (1) closes and REVERSE solenoid (2) opens. Directional spool (3) is moved to the right in the direction of the arrow and the oil at FORWARD clutch (4) is drained from the drain circuit.
- At the same time, the oil from the pump flows to REVERSE clutch (5), but while the oil is filling the inside of the clutch, the clutch oil pressure drops. As a result, the oil pressure at port **a** of quick return valve (6) drops, check valve (7) opens, and the oil at port **b** flows to port **a**. At the same time, quick return valve (6) is moved to the left in the direction of the ar-



SXW04482

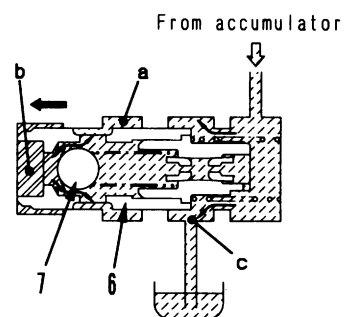
- row by the accumulator oil pressure, and the oil in accumulator (8) is drained suddenly from port **e**.
- Accumulator (8) is returned to the left end by the force of spring (9).

3. Clutch pressure beginning to rise (clutch pressure at point C)



SWW04275

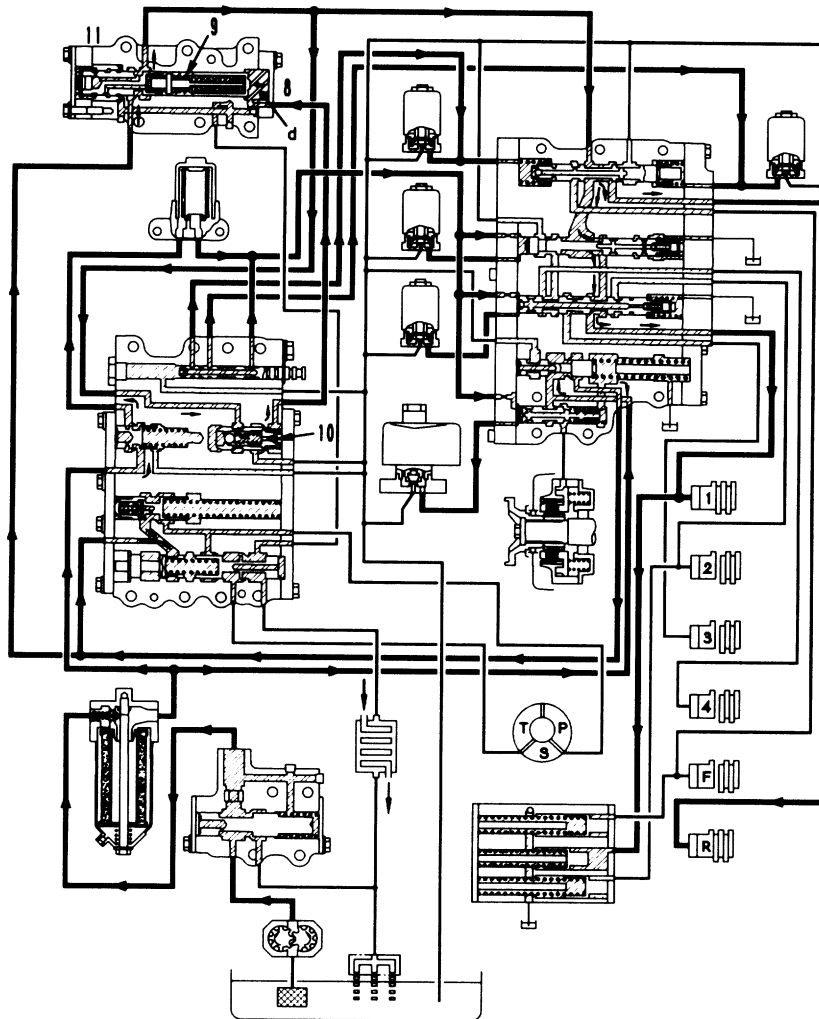
- The oil from the pump fills the REVERSE clutch and the clutch circuit pressure starts to rise. As a result, the pressure at port a rises and quick return valve (6) is moved to the right in the direction of the arrow to close drain port c.



SXW04482

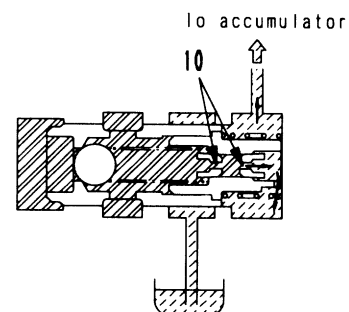
U42103

4. Start of accumulator operation, clutch completely engaged (clutch pressure at point D)



SWW04277

- Because of the differential pressure created by modulation valve (11), the oil passing through orifice (10) of the quick return valve flows as a constant amount into accumulator (8). When this oil flows in, the accumulator moves to the left in the direction of the arrow and compresses spring (9), so the accumulator pressure rises. The clutch oil pressure also rises because of this rise in the accumulator pressure.
- When the piston in accumulator (8) moves to the end of its stroke, the rise in the oil pressure at port d is completed and the specified pressure is maintained to completely engage the REVERSE clutch.

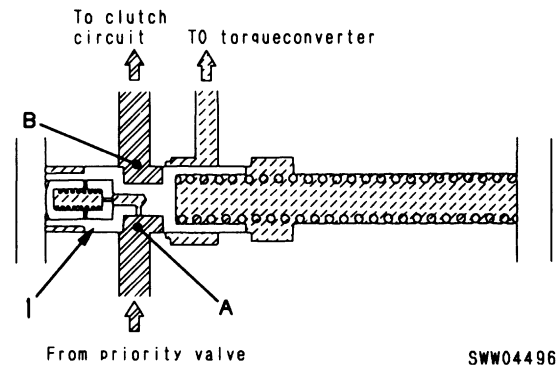


SXW04483

MAIN RELIEF VALVE

Function

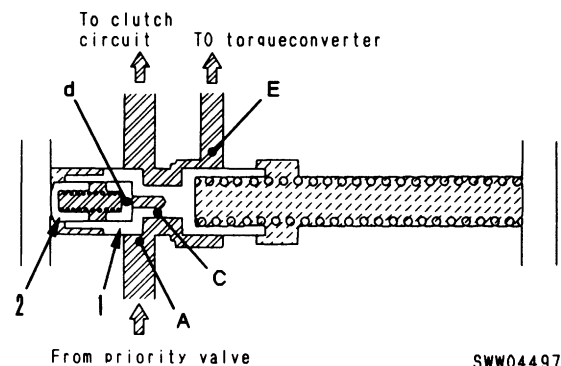
- The main relief valve regulates the pressure of the oil flowing to the clutch circuit and distributes the oil flow between the clutch circuit and the torque converter.



SWW04496

Operation

- The oil from the pump passes through the priority valve, then through ports A and B of main relief valve (1) until specified pressure is reached, and flows to the clutch circuit.
- If the pressure is above the specified value, the oil which has passed through main relief valve (1) orifices c and d presses poppet (2), moving main relief valve (1) to the right, and is released to port E, maintaining the pressure at the specified value. The oil released from port E flows to the torque converter.



SWW04497

U42103

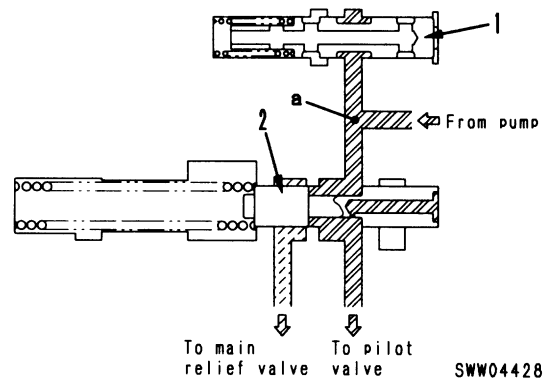
PRIORITY VALVE

Function

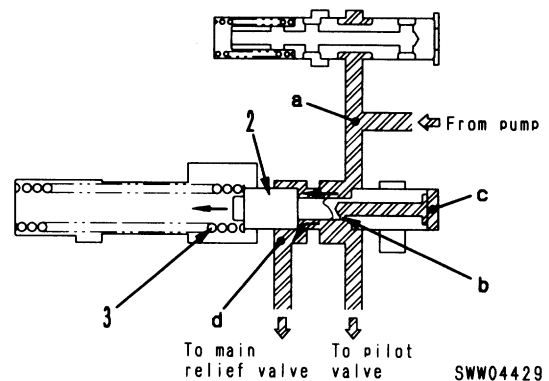
- The priority valve regulates the pump's discharge pressure and provides the pilot oil pressure and parking brake release oil pressure.
- If the pressure in the circuit reaches specified level, the priority valve acts as a relief valve, releasing the pressure to protect the hydraulic circuit.

Operation

- The oil from the pump enters port **a**, then separates into the oil flowing to parking brake valve (1), priority valve (2) and the pilot circuit.



- The oil at port **a** flows through orifice **b** of priority valve (2) to port **c**. When the oil pressure at port **a** rises to the set level, the oil pressure at port **c** overcomes the force of return spring (3), then priority valve (2) moves to the left and the oil flows to port **d**. While the oil pressure at port **a** is below the set level, the oil does not flow in port **d**. Accordingly, the pilot oil pressure and parking brake release oil pressure are secured.



U42103

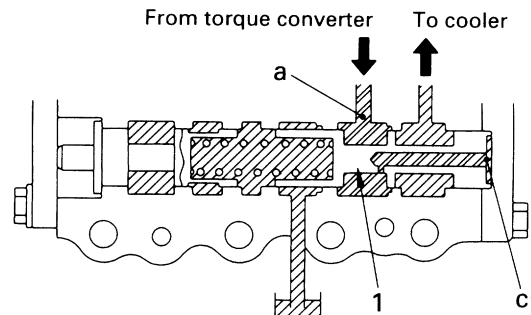
TORQUE CONVERTER OUTLET PORT VALVE

Function

- The torque converter outlet port valve is installed in the outlet line of the torque converter and adjusts the maximum pressure of the torque converter.

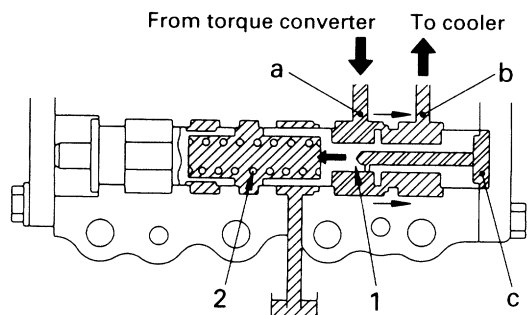
Operation

- The oil at port **a** passes through the orifice in spool (1) and flows to port **c**.



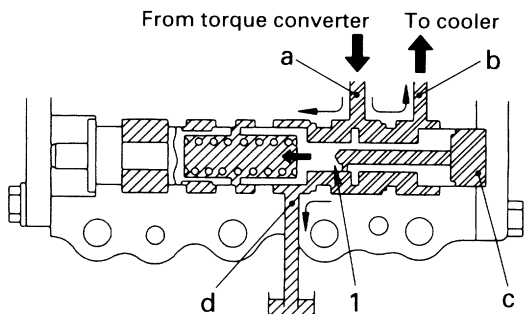
SEW00058

- When the pressure at port **a** rises, the pressure at port **c** also rises. This overcomes the tension of spring (2) and moves spool (1) to the left in the direction of the arrow to allow oil to flow from port **a** to port **b**.



SEW00059

- If the pressure at port **a** becomes even higher, spool (1) is moved further to the left in the direction of the arrow, and the oil flows from port **a** to port **b** and drain port **d**. (Cold relief)



SEW00060

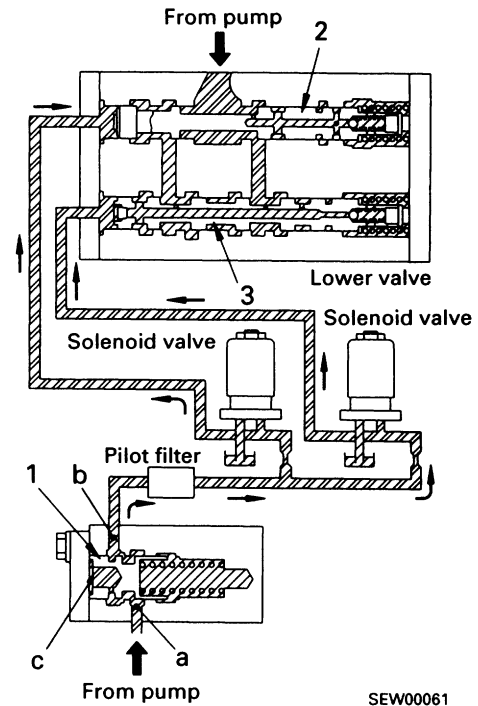
PILOT REDUCING VALVE

Function

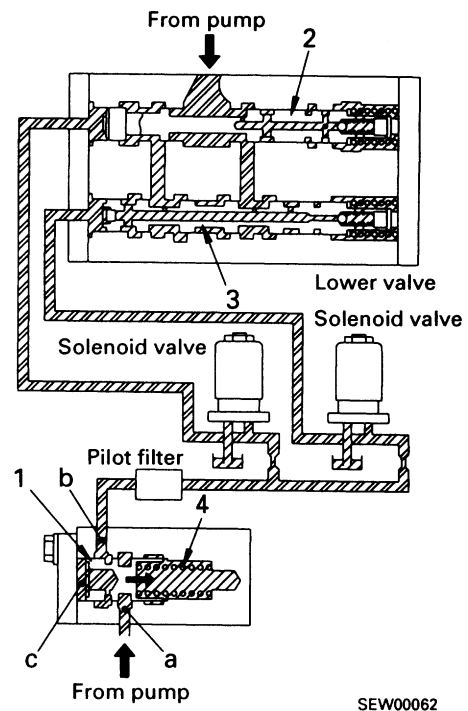
- The pilot reducing valve controls the pressure used to actuate the directional selector spool, H-L selector spool, range selector spool, and parking brake spool.

Operation

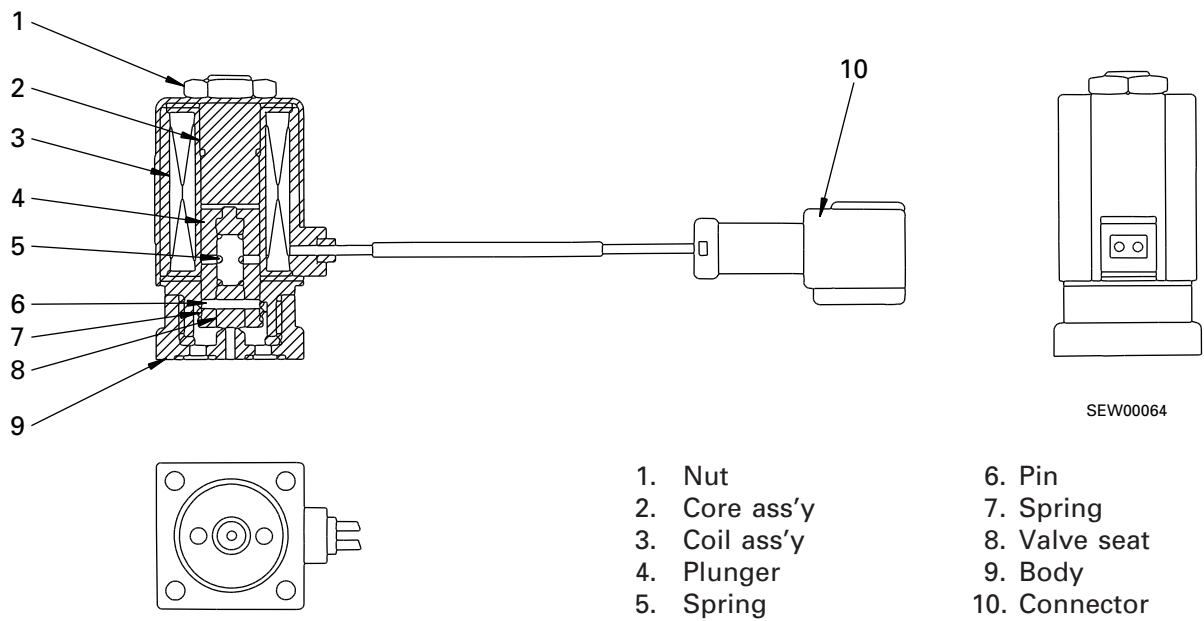
- The oil from the pump enters port **a**, passes through port **b** of pilot reducing spool (1), enters spools (2) and (3) in the lower valve, and fills the pilot circuit. The oil at port **b** passes through the orifice and flows to port **c**.



- When the pressure in the pilot circuit rises, the pressure at port **c** also rises. Then, pilot reducing spool (1) moves in the direction of the arrow to a position at which the pressure at **c** is balanced with the tension of spring (4). Accordingly, the pressure at port **b** is maintained at the specified level.



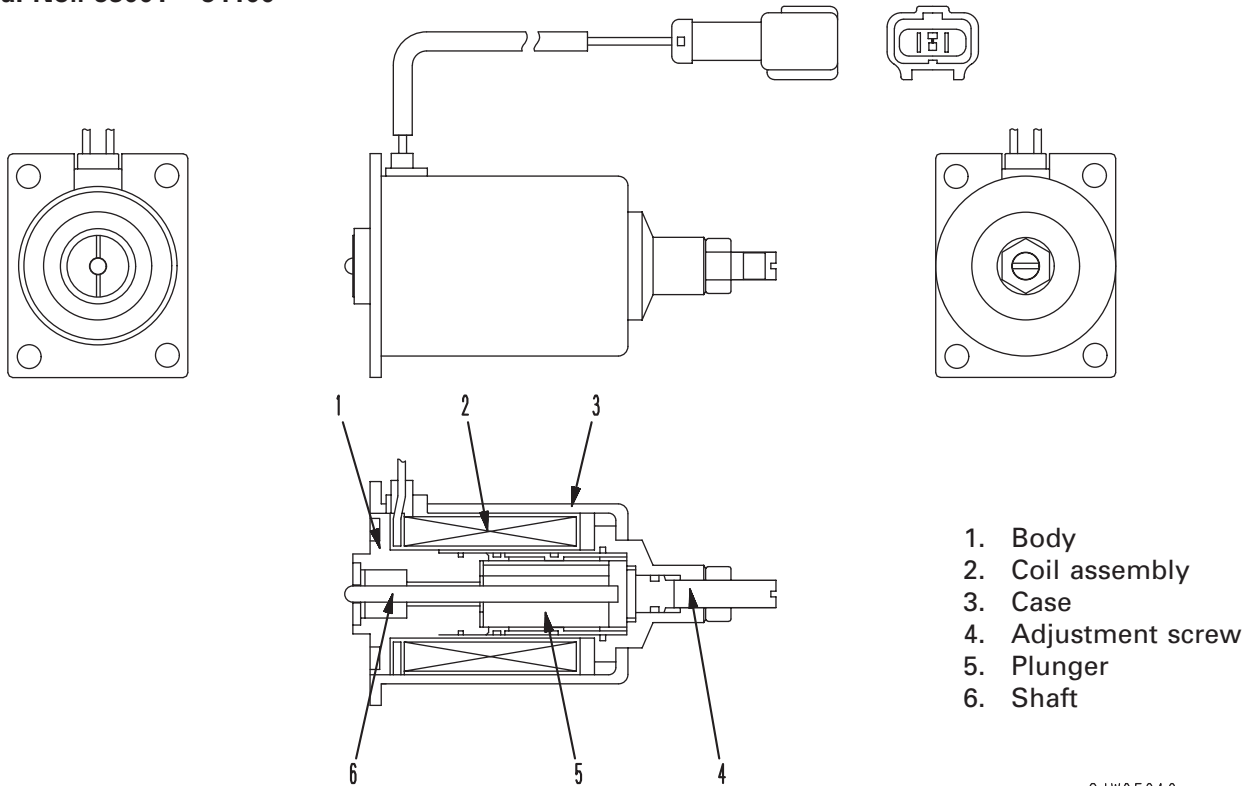
TRANSMISSION SOLENOID VALVE



U42103

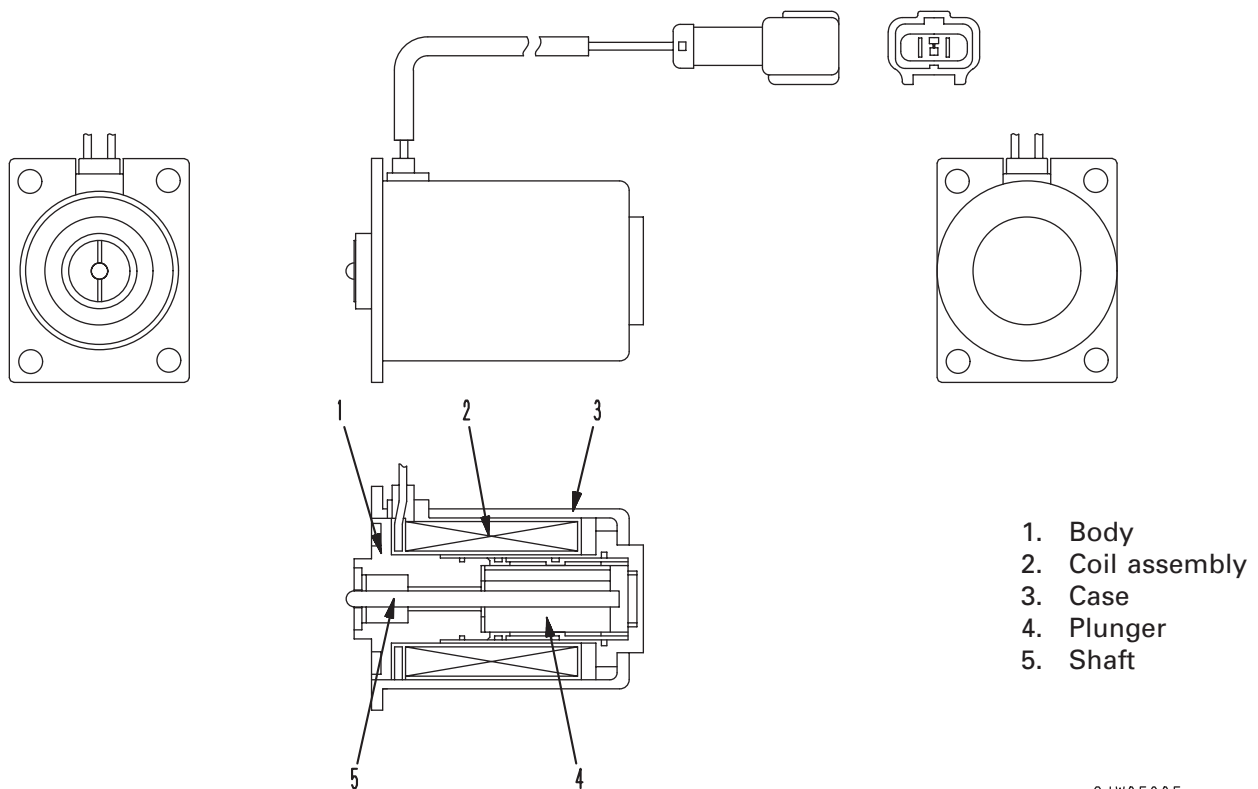
PROPORTIONAL SOLENOID VALVE (For auto-shift: electronic modulation)

Serial No.: 53001 – 54100



SJW05312

Serial No.: 54101 and up



SJW05305

U42103

ELECTRONIC CONTROL MODULATION VALVE (ECMV)

Auto-shift transmission (Optional)

Serial No.: 53001 and up

Configuration of ECMV

- The ECMV (Electronic Control Modulation Valve) consists of a proportional solenoid valve and an ECMV spool.

Proportional solenoid valve and ECMV

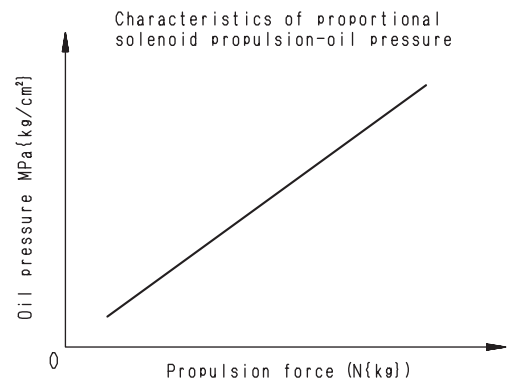
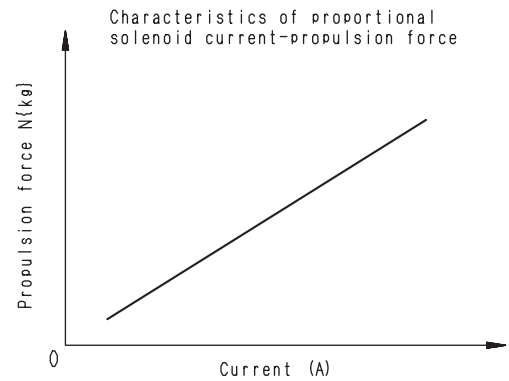
The proportional solenoid generates the thrust shown in the figure at right according to the command current from the transmission controller.

The thrust generated by the proportional solenoid is applied to the pressure control spool to generate the oil pressure shown in the figure at right.

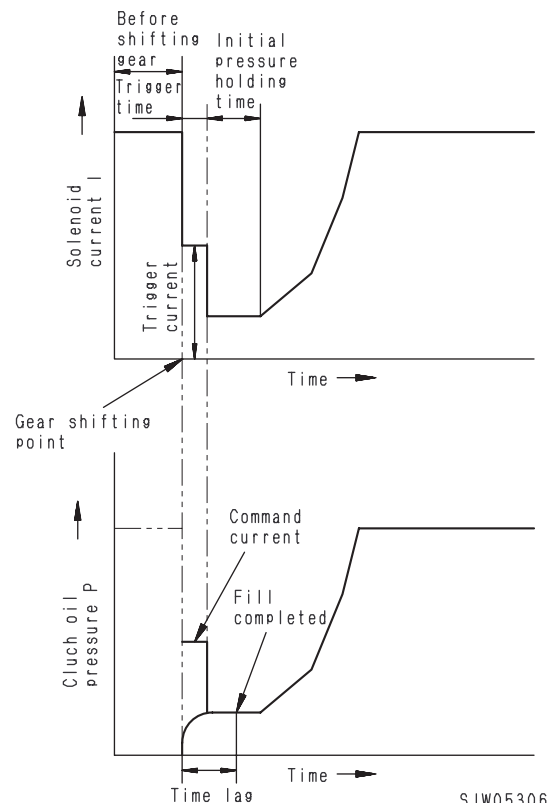
Accordingly, the thrust is changed by controlling the command current to operate the pressure control valve to control the flow and pressure of the oil.

Operation of ECMV

The ECMV is controlled with the command current sent from the transmission controller to the proportional solenoid. The relationship between the command current for the proportional solenoid of the ECMV and the clutch oil pressure is shown in the figure at right.



SDW02288



SJW05306

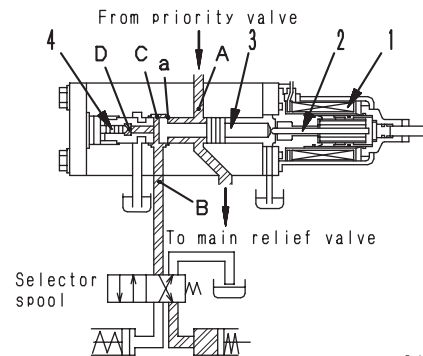
STRUCTURE AND FUNCTION

ELECTRONIC CONTROL MODULATION VALVE (ECMV)

1. Before gear is not shifted

Whether the machine is traveling or in neutral, one of the clutches is engaged and the command current is flowing from the transmission controller to proportional solenoid (1). The oil from the priority valve enters chamber **A** and flows through throttle **a** into chamber **B**. The oil in chamber **B** flows through port **C** into chamber **D**.

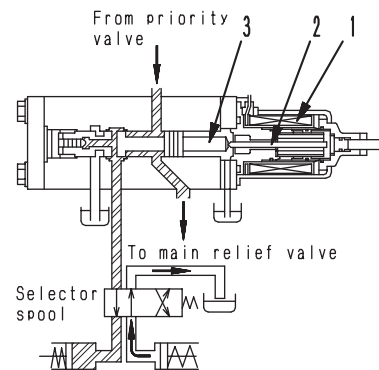
The oil in chamber **D** pushes piston (4). The reaction force of (4) moves spool (3) to the right and closes throttle **a**. Then, oil pressure is so maintained that the thrust of shaft (2) of proportional solenoid (1) will be balanced with the reaction force (oil pressure) of spool. (The clutch holding pressure is maintained.)



SJW05307

2. When gear is shifted (Just after gear is shifted)

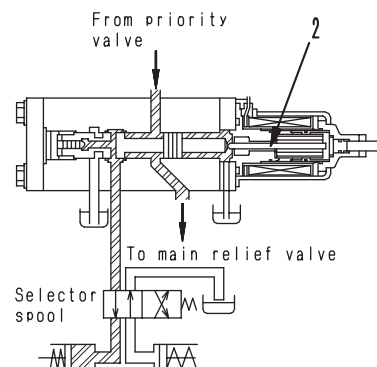
Since the gear is shifted, the selector spool is changed and the clutch oil pressure which has been applied is released and the port to the clutch to be connected is opened. Just after the gear is shifted, the command current to proportional solenoid (1) keeps pressing spool (3) toward the left as a trigger current and starts filling the clutch chamber with the oil.



SJW05308

3. When gear is shifted (Setting of initial pressure)

Just before the clutch chamber is filled up with the oil, the command current to the solenoid is lowered to the level for setting the initial pressure. Accordingly, the thrust of shaft (2) of the proportional solenoid is reduced and the clutch oil pressure is adjusted to the initial set pressure.

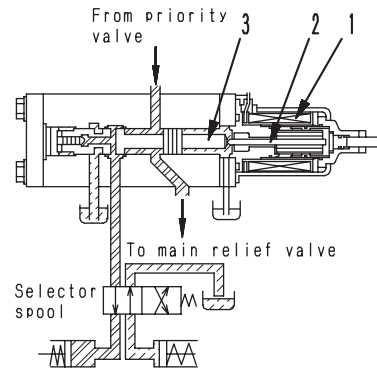


SJW05309

U42103

4. Regulation of oil pressure

If a current flows in proportional solenoid (1), the latter generates thrust in proportion to the current. Since the thrust of shaft (2) of solenoid (1) is balanced with the reaction force of the clutch port oil pressure applied to spool (3), the oil pressure is regulated. In other words, the clutch modulation pressure is controlled by controlling the command current supplied to solenoid (1).



SJW05310

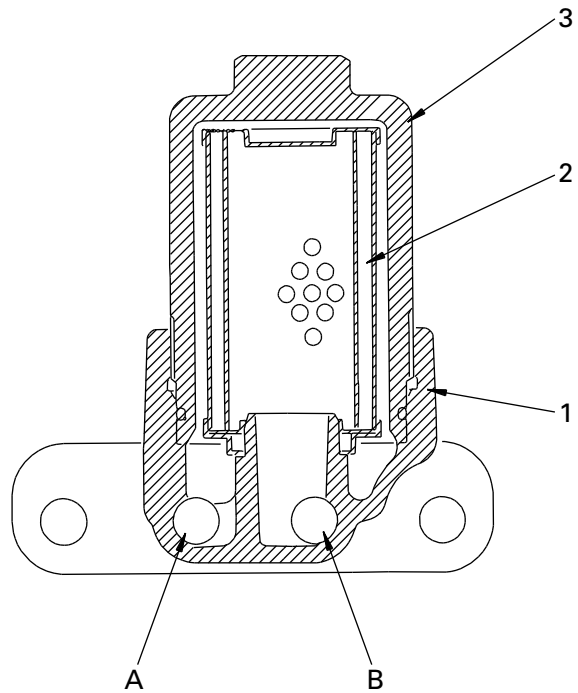
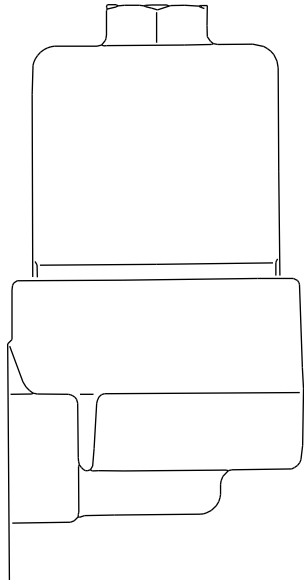
Manual operation of ECMV

Even if the electric system of the transmission control system has a trouble, the transmission gears can be meshed manually to move the machine to a safe place.

Meshing method

- (1) Disconnect the all connectors from the transmission control valve.
- (2) Remove the lock plate of the manual selector and push in or pull out the spool.
Forward travel: Pull out the spool.
Reverse travel: Push in the spool.
- (3) Push in the adjustment screw of the proportional solenoid valve to the end.
Meshed gear: 2nd gear

PILOT OIL FILTER



SEW00071

1. Oil filter heat
2. Element
3. Case

- A. Inlet port
- B. Outlet port

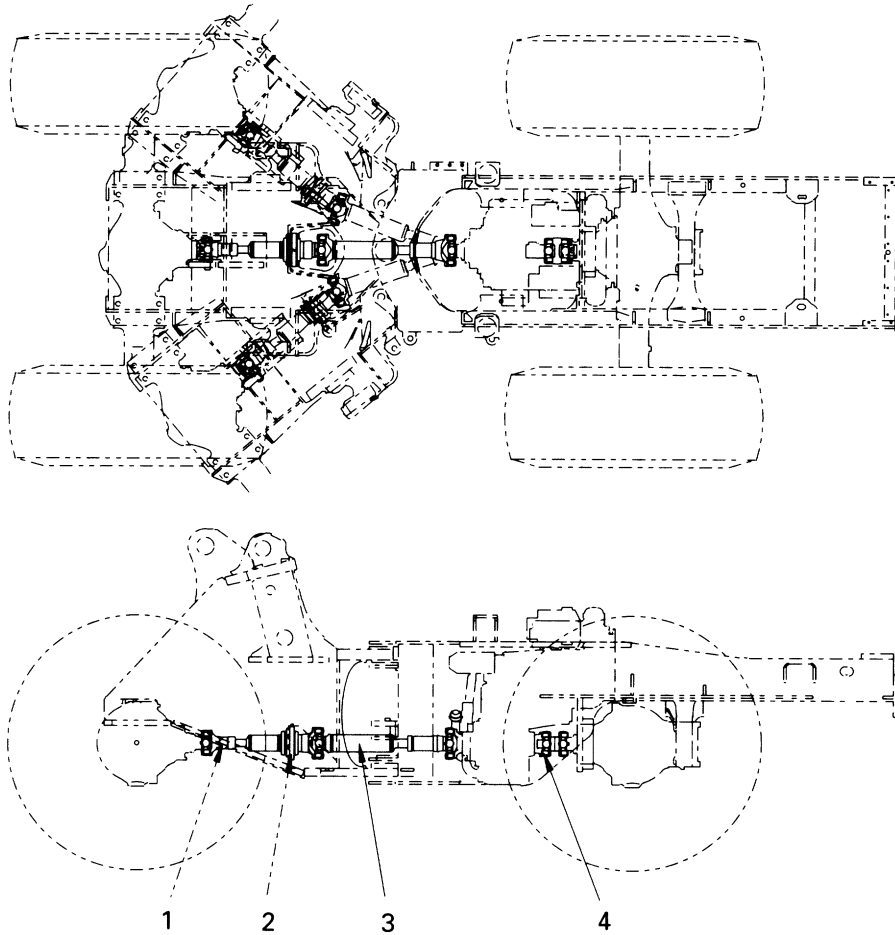
Specifications

Filtering area: 170 cm²

Filter mesh size: 105 μ

U42103

DRIVE SHAFT



SDW00072

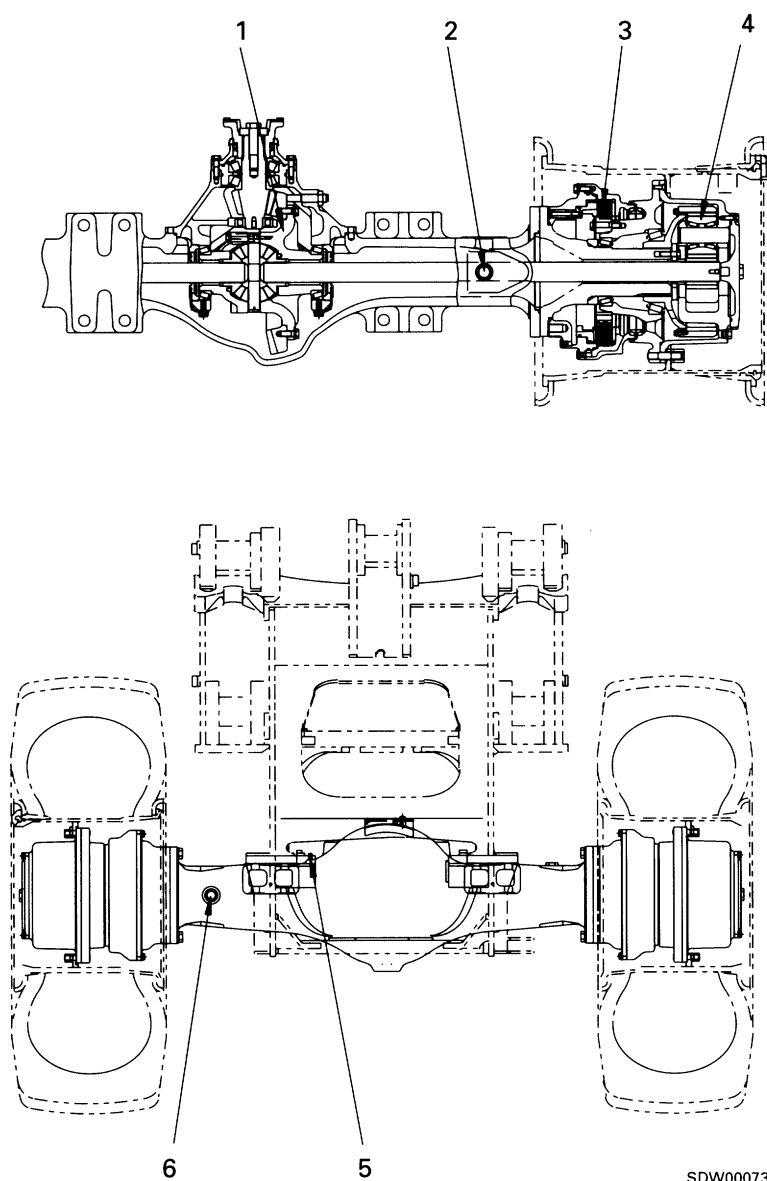
1. Front drive shaft
2. Flange bearing
3. Center drive shaft
4. Rear drive shaft

Outline

- The motive force from the engine passes through the torque converter and the transmission. Some of it is transmitted from rear drive shaft (4) to the rear axle, while the rest goes from center drive shaft (3) through flange bearing (2) and front drive shaft (1) to the front axle.
- The drive shaft has the following purpose in addition to simply transmitting the power. The drive shaft has a universal joint and sliding joint to enable it to respond to changes in the angle and length. This enables the drive shaft to transmit the motive force when the machine is articulated and to protect the components from damage from shock when the machine is being operated or shock from the road surface when the machine is traveling.

AXLE

FRONT AXLE



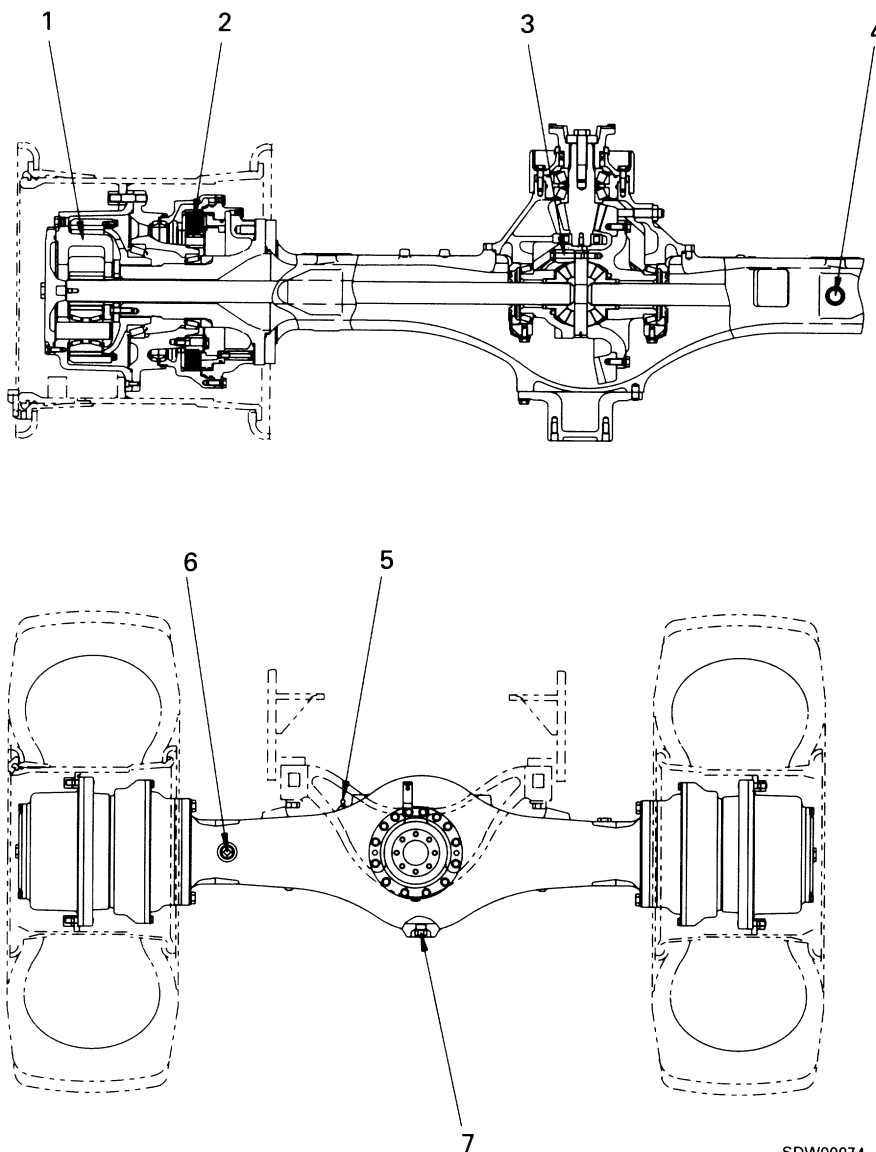
SDW00073

- 1. Differential
- 2. Oil filler
- 3. Brake

- 4. Final drive
- 5. Breather
- 6. Level plug

U42103

REAR AXLE



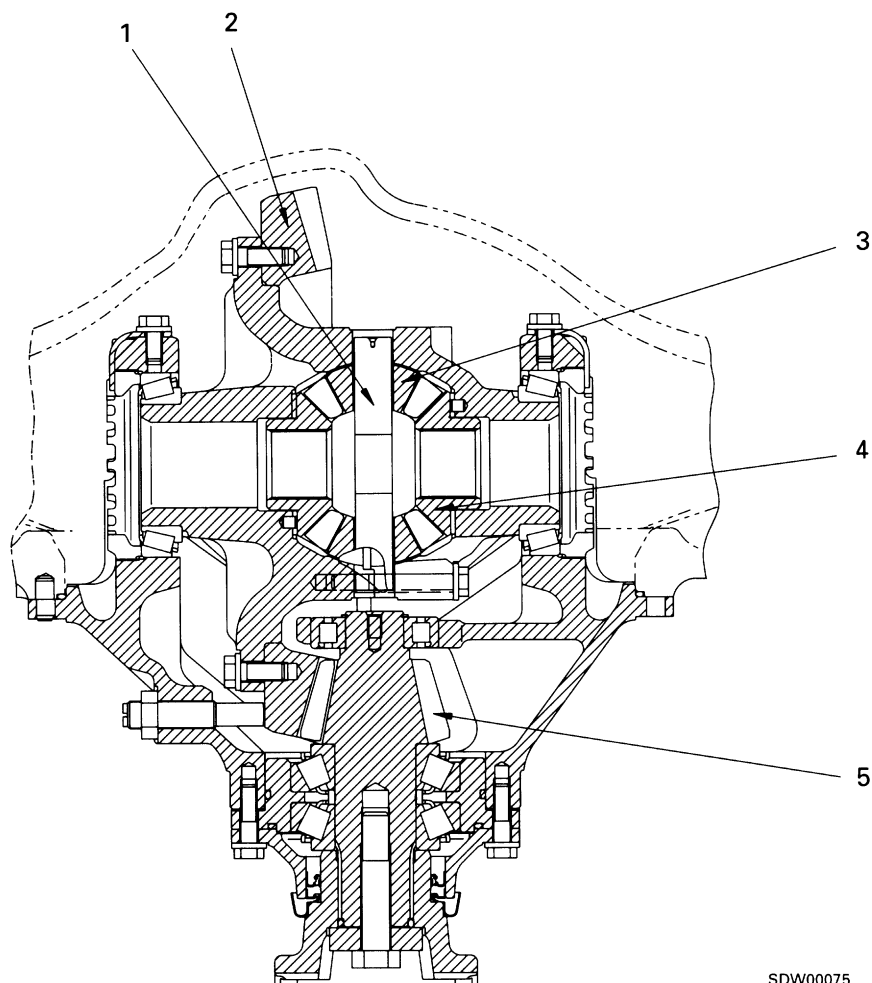
SDW00074

- 1. Final drive
- 2. Brake
- 3. Differential
- 4. Oil filler

- 5. Breather
- 6. Level plug
- 7. Drain plug

DIFFERENTIAL

FRONT DIFFERENTIAL



U42103

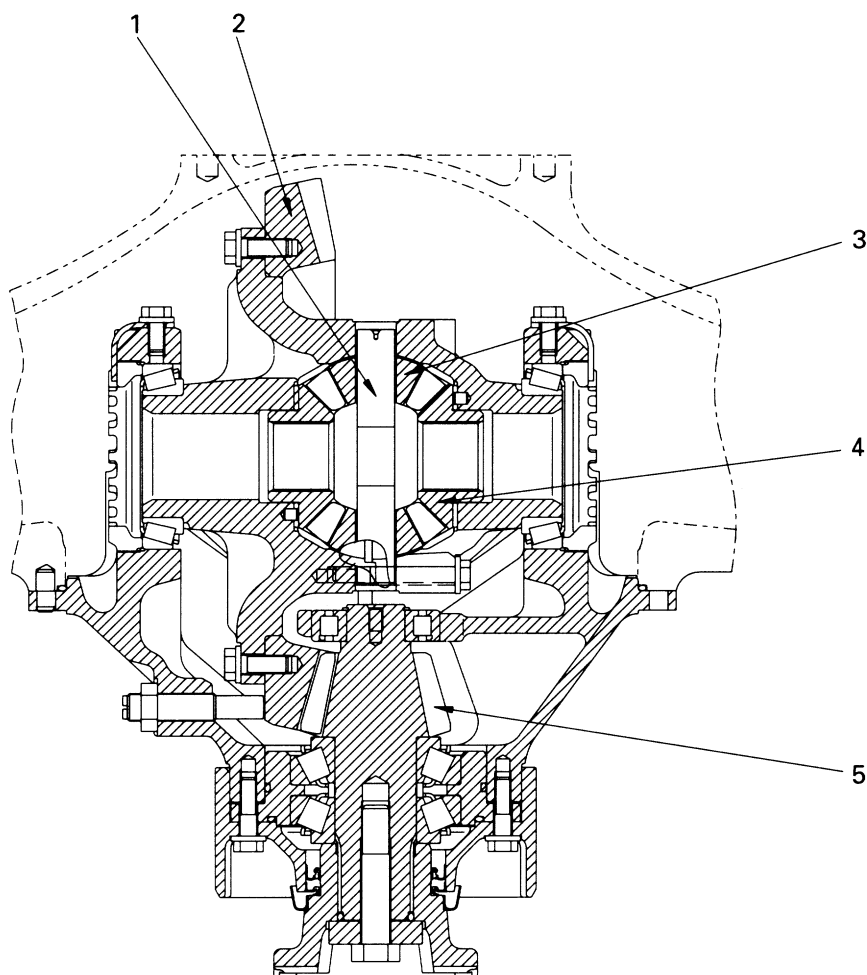
SDW00075

1. Shaft
2. Bevel gear (No. of teeth: 42)
3. Bevel pinion (No. of teeth: 9)
4. Side gear (No. of teeth: 12)
5. Pinion (No. of teeth: 9)

Specifications

Type: Spiral bevel gear, splash lubrication
Reduction ratio: 4.667
Differential type: Torque proportioning, splash lubrication

REAR DIFFERENTIAL



SDW00076

1. Shaft
2. Bevel gear (No. of teeth: 42)
3. Bevel pinion (No. of teeth: 9)
4. Side gear (No. of teeth: 12)
5. Pinion (No. of teeth: 9)

Specifications

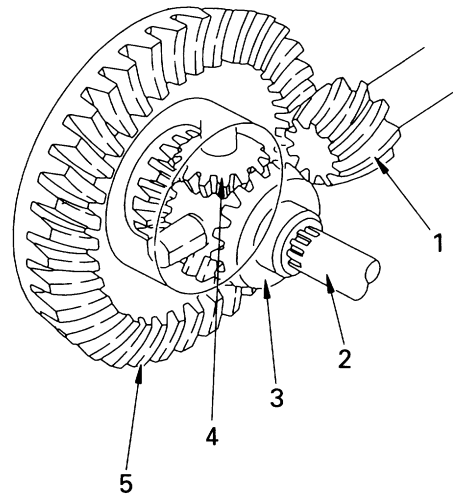
Type:	Spiral bevel gear, splash lubrication
Reduction ratio:	4.667
Differential type:	Torque proportioning, splash lubrication

STRUCTURE AND FUNCTION

DIFFERENTIAL

Outline

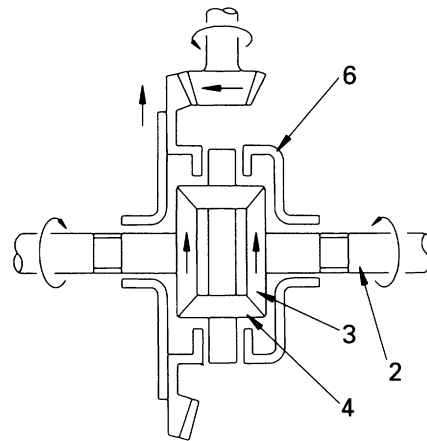
- The motive force from the drive shaft passes through bevel pinion (1) and is transmitted to bevel gear (5). The bevel gear changes the direction of the motive force by 90°, and at the same time reduces the speed. It then transmits the motive force through differential (4) to sun gear shaft (2).



SEW00077

When driving straight forward

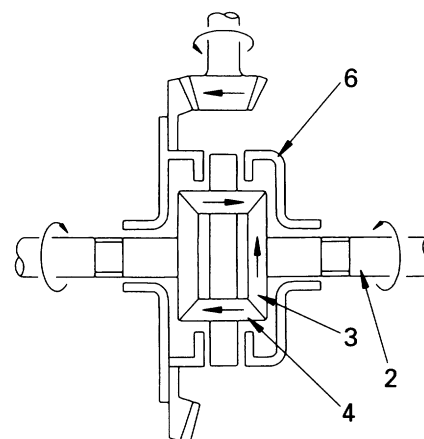
- When the machine is driven straight forward, the rotating speed of the left and right wheels is the same, so pinion gear (4) inside the differential assembly is sent through pinion gear (4) and side gear (3) and is transmitted equally to left and right sun gear shafts (2).



SEW00078

When turning

- When turning, the rotating speed of the left and right wheels is different, so pinion gear (4) and side gear (3) inside the differential assembly rotate in accordance with the difference between the rotating speed of the left and right wheels. The motive force of carrier (6) is then transmitted to sun gear shafts (2).



SEW00079

U42103

TORQUE PROPORTIONING DIFFERENTIAL

Function

- Because of the nature of their work, 4-wheel-drive loaders have to work in places where the road surface is bad. In such places, if the tires slip, the ability to work as a loader is reduced, and also the life of the tire is reduced. The torque proportioning differential is installed to overcome this problem.
- In structure it resembles the differential of an automobile, but differential pinion gear (3) has an odd number of teeth. Because of the difference in the resistance from the road surface, the position of meshing of pinion gear (3) and side gear (4) changes, and this changes the traction of the left and right tires.

Operation

When traveling straight (equal resistance from road surface to left and right tires)

- If the resistance from the road surface to the left and right wheels is the same, the distance between pinion gear (2) and meshing point "a" of left side gear (1) is the same as the distance between pinion gear (2) and meshing point "b" of right side gear (3).
- Therefore the left side traction TL and the right side traction TR are balanced.

When traveling on soft ground (resistance from road surface to left and right tires is different)

- On soft ground, if the tire on one side slips, the side gear of the tire on the side which has least resistance from the road surface tries to rotate forward. Because of this rotation, the meshing of pinion gear (2) and side gear changes.
- If left side gear (1) rotates slightly forward, the distance between the pinion gear and the meshing point "a" of the left side gear becomes longer than the distance between the pinion gear and the meshing point "b" of the right side gear. The position is balanced as follows.

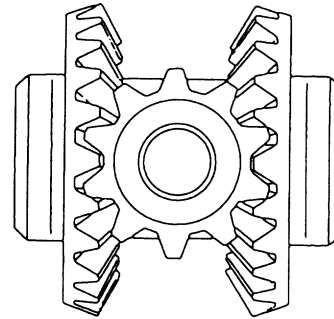
$$a \times TL = b \times TR$$

The ratio between the distances to "a" and "b" can change to 1 : 1.38.

- Therefore when the ratio of the distances to "a" and "b" is less than 1 : 1.38 (that is, the difference between the resistance from the road surface to the left and right tires is less than 38%), the pinion gear will not rotate freely, so drive force will be given to both side gears, and the tires will not slip.

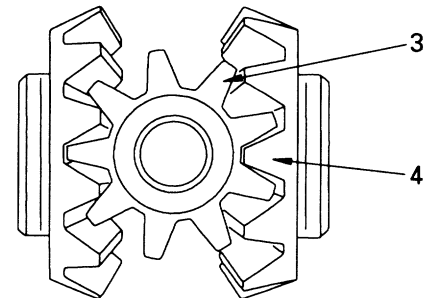
Because of this effect, the tire life can be increased by 20 – 30%, and at the same time the operating efficiency is also increased.

Ordinary differential

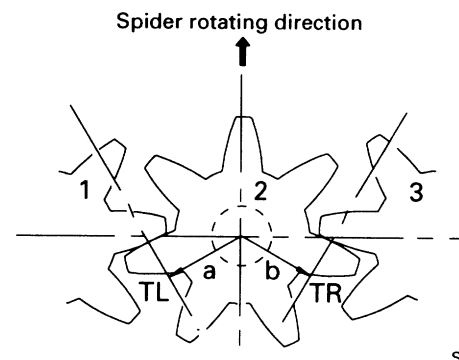


SEW00080

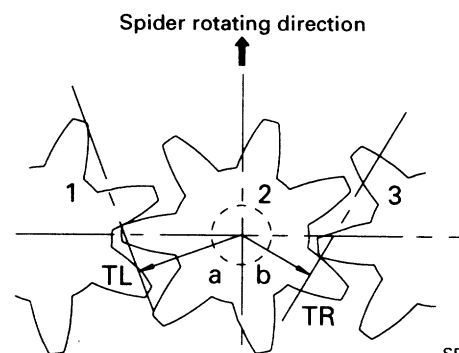
Torque proportioning differential



SEW00081

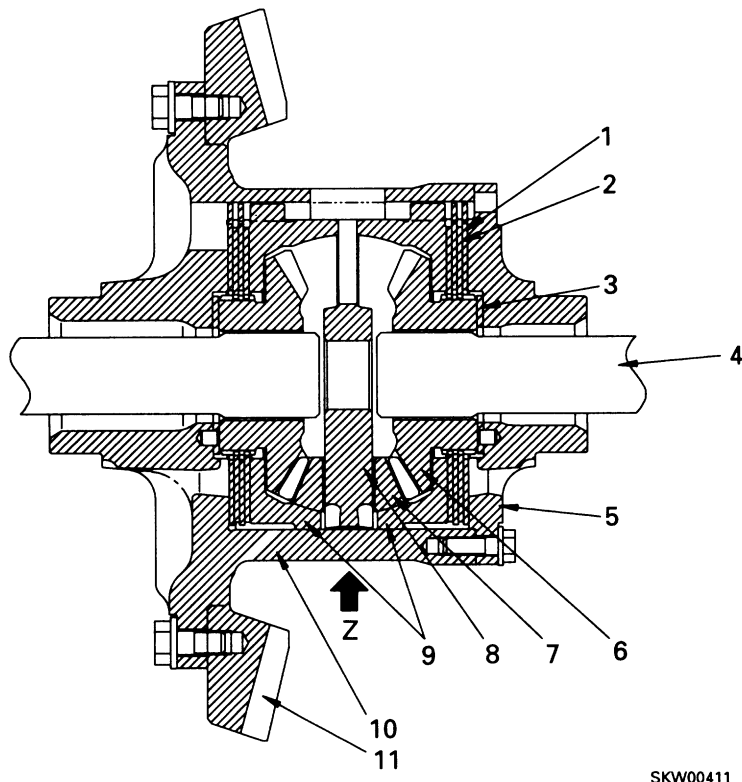


SEW00082



SEW00083

LIMITED SLIP DIFFERENTIAL



SKW00411

1. Plate
2. Disc
3. Washer
4. Shaft
5. Cover
6. Side gear
7. Pinion
8. Shaft
9. Pressure ring
10. Case
11. Bevel pinion

Operation of limited slip differential

The power transmitted from the transmission goes from bevel gear (11) to case (10), pressure ring (9), shaft (8), pinion (7), and gear (6), and is then divided and sent to left and right shafts (4). A brake mechanism consisting of disc (2) and plate (1) is assembled at the rear face of side gear (6), and the brake torque is generated in proportion to the torque transmitted from pressure ring (9) to shaft (8).

In order for this brake torque to act to suppress the rotation in relation to side gear (6) and case (10), it is made difficult for left and right side gears (6) to rotate mutually, and the action of the differential is suppressed.

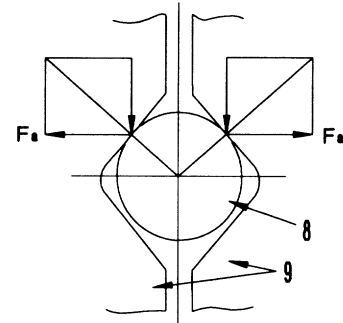
U42103

<Mechanism for generation of brake torque of left and right side gears (6)>

Shaft (8) is supported by the cam surface cut into the mating surfaces of left and right pressure rings (9).

The power (=torque) transmitted from pressure ring (9) to shaft (8) is transmitted by the cam surface, but force F_a to separate left and right pressure rings (9) is generated in proportion to the torque transmitted by the angle of this cam surface.

This separation load F_a acts as a brake on the rear face of left and right side gears (6) and generates brake torque.



View Z from previous page

SLW02800

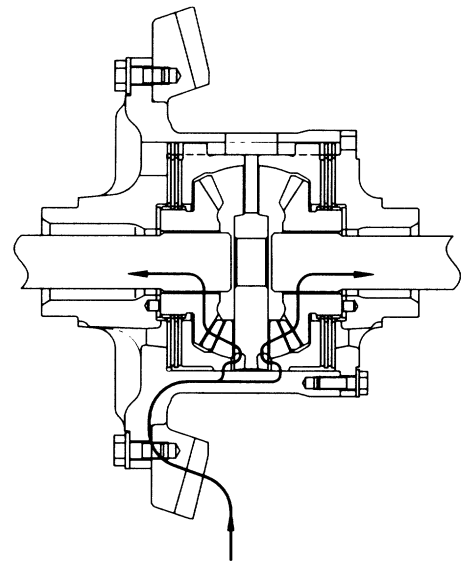
<When traveling in straight line>

1. When there is no imbalance between drive force of left and right wheels

[The road surface condition (friction coefficient) for the left and right wheels and the load on the wheels are uniform, so there is no misalignment of the center line of the load to the bucket]

The power from the transmission is divided uniformly to the left and right by the limited slip differential. Under these conditions, the limit for wheel slip for the left and right wheels is the same, so even if the power from the transmission exceeds the wheel slip limit, the wheels on both sides slip and the differential is not actuated.

No load is applied to the brake at the rear surface of the side gear.



From transmission

SKW02801

STRUCTURE AND FUNCTION**LIMITED SLIP DIFFERENTIAL****2. When there is imbalance between drive force of left and right wheels**

[The road surface condition (friction coefficient) for the left and right wheels and the load on the wheels are not uniform and the wheel on one side tends to slip more than the wheel on the other side.]

Example 1:

When wheel on one side is on soft ground surface during digging operations

Example 2:

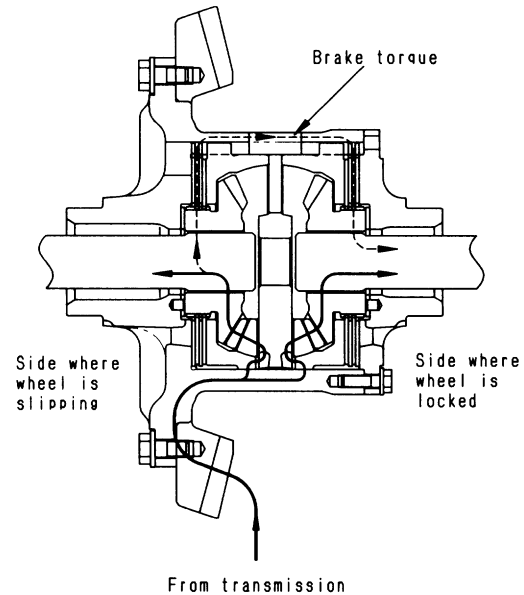
When wheel on one side is on asphalt surface and wheel on other side is on snow during snow-clearing operations

Example 3:

When imbalance is created in load on left and right wheels by traveling on slope

The power from the transmission is divided uniformly to the left and right by the actuating gear. However, if the divided drive force exceeds the wheel slip limit on the side where the wheel is slipping, a drive force equal to the excess is sent through the brake at the rear face of the side gear and the case to the brake on the opposite side (side where wheel is locked), and is supplied to the wheel on the side which is locked.

If this excess drive force becomes greater than the braking force, the differential starts to be actuated.



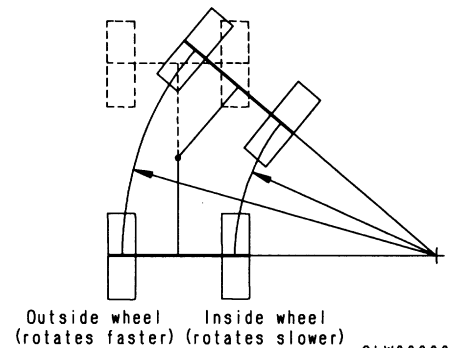
SKW02802

U42103

Difference in wheel drive force for each type of differential when wheel on one side is slipping

	Wheel drive force (taken as 1 for wheel that is slipping)		
	Slipping wheel	Locked wheel	Total (proportional)
Limited slip differential (option)	1	2.64	3.64 (1.53)
Torque proportioning differential (standard)	1	1.38	2.38 (1)
Normal differential	1	1	2 (0.84)

On road surfaces where the wheel on one side is likely to slip, the limited slip differential increases the drive force 1.53 times that of the torque proportioning differential supplied as standard.



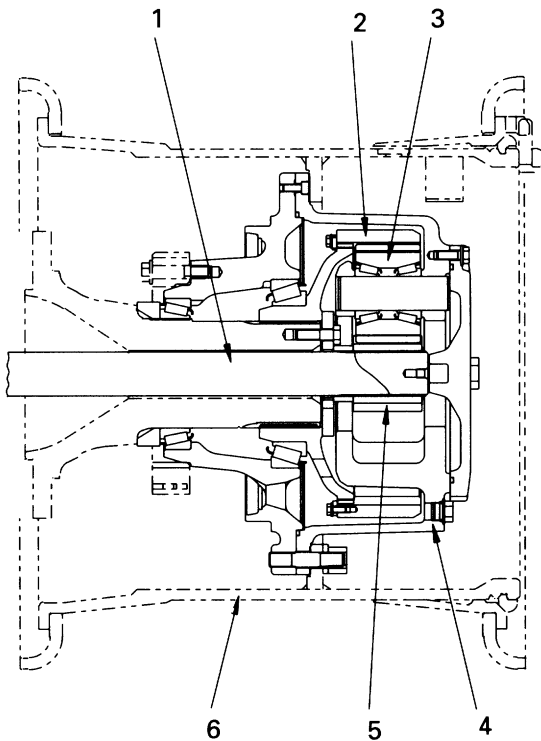
SLW02803

<When turning>

The actuating gear built into the limited slip differential is the same as the gear used on the normal differential, so the difference in rotation of the inside and outside wheels generated when turning can be generated smoothly.

U42103

FINAL DRIVE



SDW00084

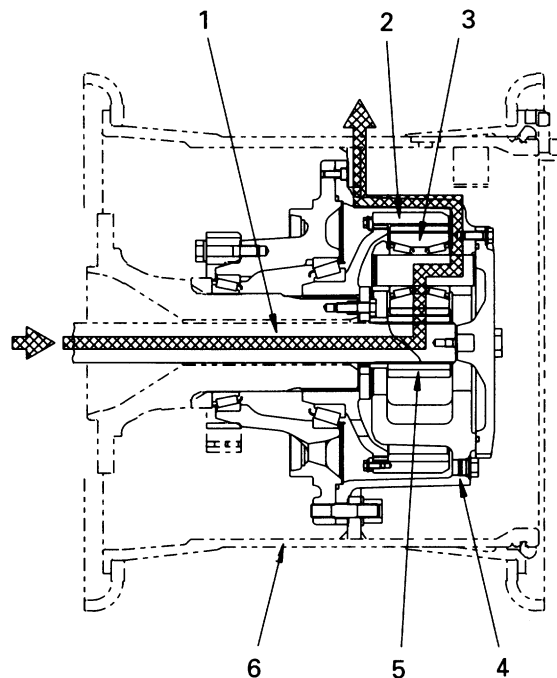
1. Axle shaft
2. Ring gear (No. of teeth: 67)
3. Planet gear (No. of teeth: 24)
4. Planetary carrier
5. Sun gear (No. of teeth: 17)
6. Wheel

Outline

- The final drive uses a planetary gear mechanism to obtain a large drive force, and transmits the drive force to the tires.

Operation

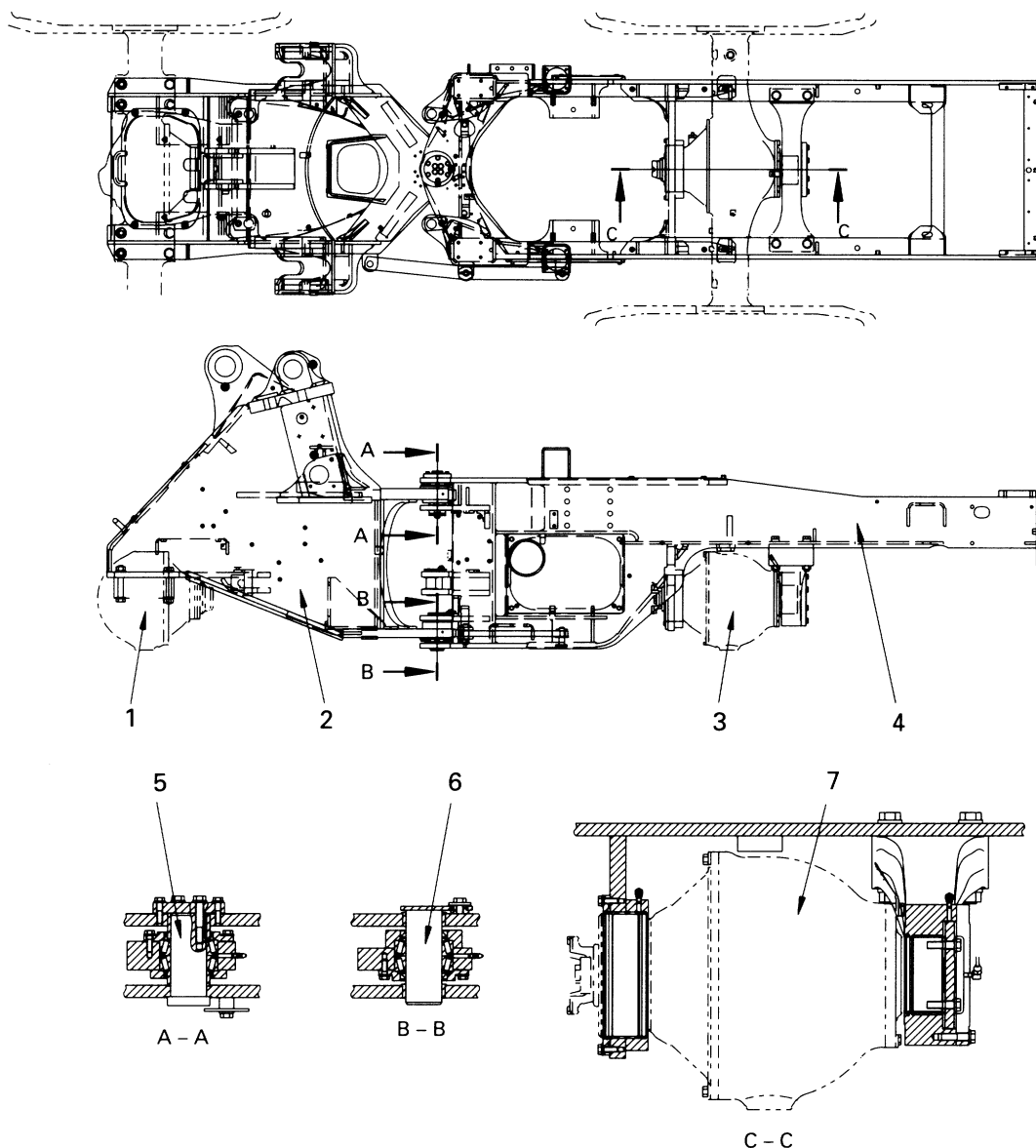
- The motive force transmitted to sun gear (5) from the differential through axle shaft (1) is transmitted to planet gear (3). The planet gear rotates inside ring gear (2), which is fixed, and transmits the motive force to wheel (6), which is installed to the planetary carrier.



SDW00085

U42103

AXLE MOUNT, CENTER HINGE PIN



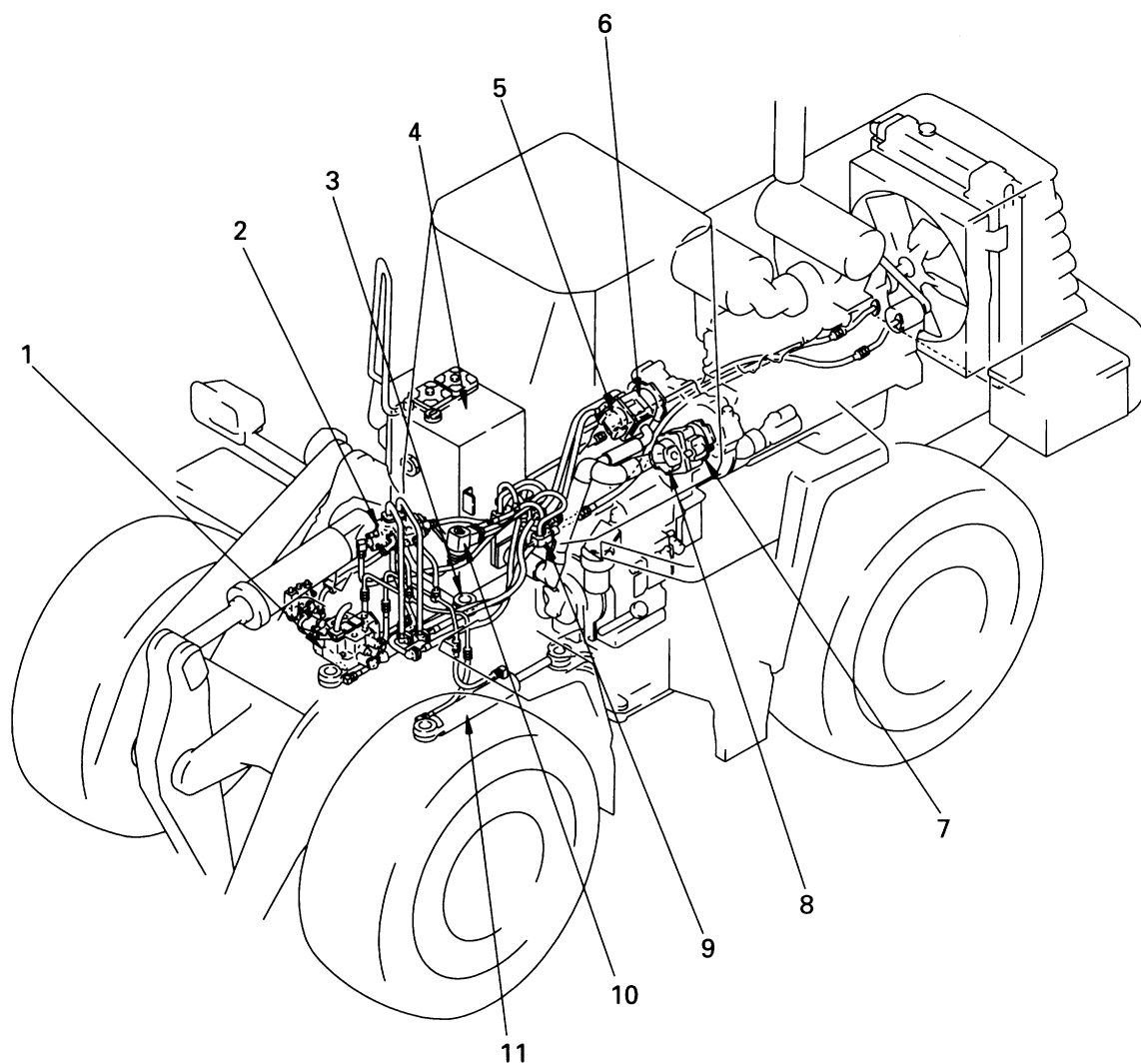
SDW00086

1. Front axle
2. Front frame
3. Rear axle
4. Rear frame
5. Upper hinge pin
6. Lower hinge pin
7. Rear axle

Outline

- Front frame (2) and rear frame (4) are joined by hinge pins (5) and (6) through the bearings. In addition, the steering cylinders are connected to the left and right front and rear frames, and the angle of articulation of the frame (the turning angle) is adjusted according to the movement of the cylinders.

STEERING PIPING

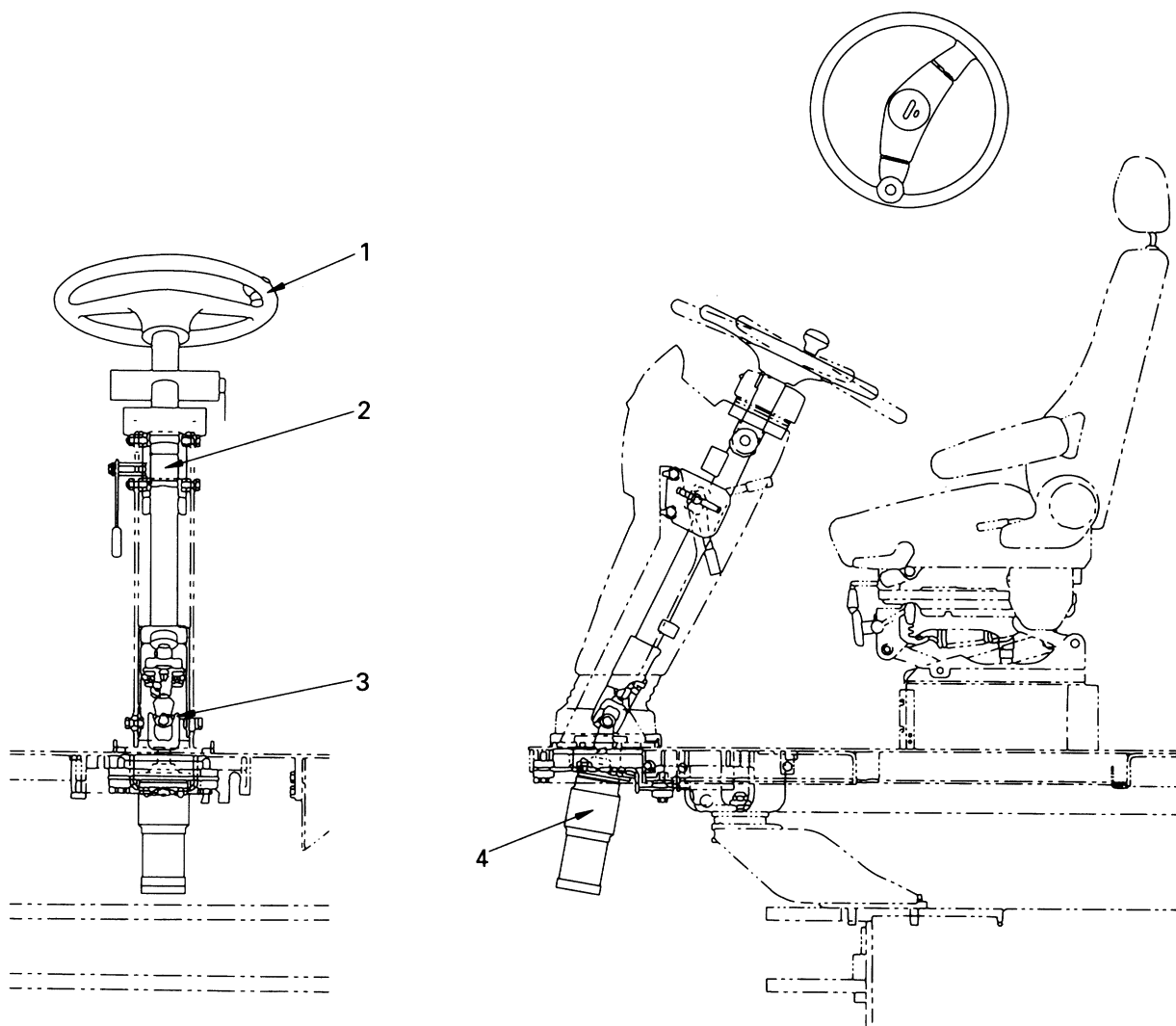


U42103

SNW01282

- | | |
|------------------------------|------------------------------|
| 1. Main control valve | 7. Hydraulic pump |
| 2. Steering valve | 8. PPC pump |
| 3. Steering cylinder (right) | 9. Stop valve |
| 4. Hydraulic tank | 10. Orbit-roll valve |
| 5. Switch pump | 11. Steering cylinder (left) |
| 6. Steering pump | |

STEERING COLUMN

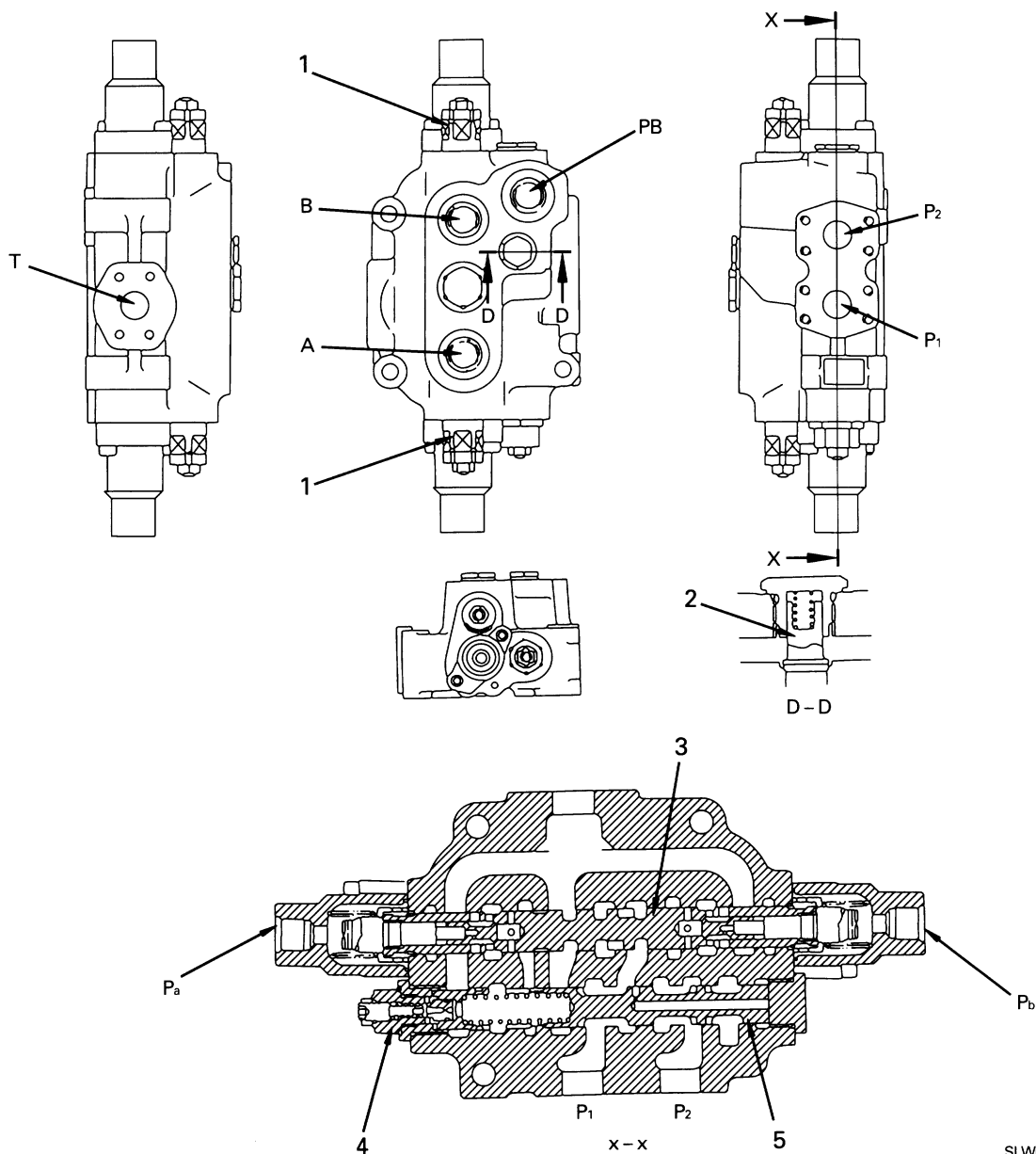


U42103

SEW01221

1. Steering wheel
2. Steering column
3. Joint
4. Orbit-roll

STEERING VALVE



1. Safety valve (with suction)
2. Check valve
3. Steering spool
4. Relief valve
5. Demand spool

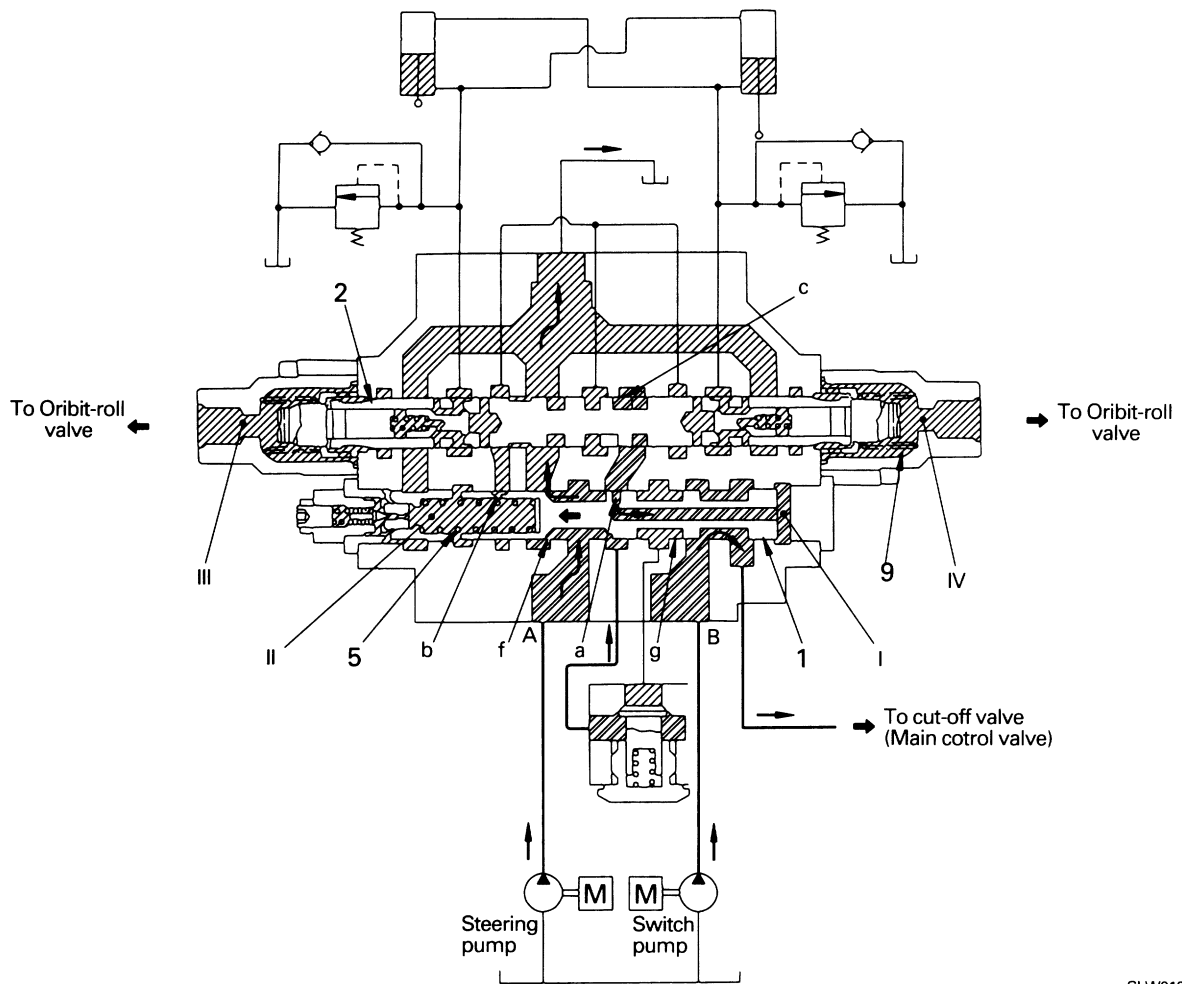
- A: To steering cylinder
 B: To steering cylinder
 Pa: From orbit-roll
 Pb: From orbit-roll
 P1: From steering pump
 P2: From switch pump
 PB: To main control valve
 T: Drain (to oil cooler)

SLW01222

U42103

OPERATION OF DEMAND VALVE

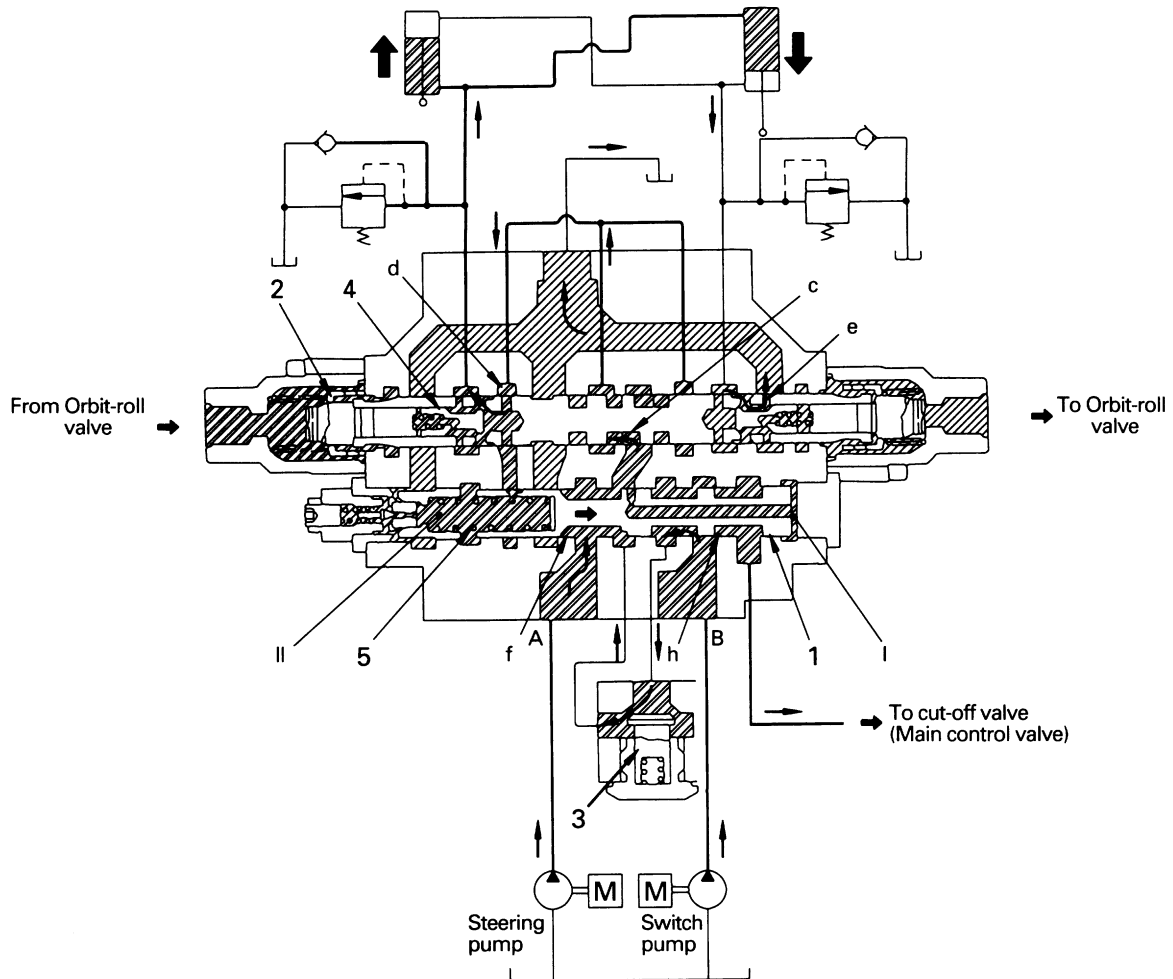
STEERING SPOOL AT NEUTRAL



- The oil from the steering pump enters port **A**, and the oil from the switch pump enters port **B**.
- When steering spool (2) is at neutral, pressure-receiving chamber (II) is connected to the drain circuit through orifice (b), and notch (c) is closed.
- Notch (c) is closed, so the pressure of the oil at port **A** and port **B** rises. This pressure passes through orifice (a), goes to pressure-receiving chamber (I), and moves demand spool (1) to the left in the direction of the arrow.
- When the pressure at pressure-receiving chamber (I) reaches a certain value (set by spring (5)), notch (f) opens, and the oil from the steering pump flows to the drain circuit. At the same time, notch (g) closes, and the oil from the switch pump all flows to the main control valve.

STEERING SPOOL OPERATED

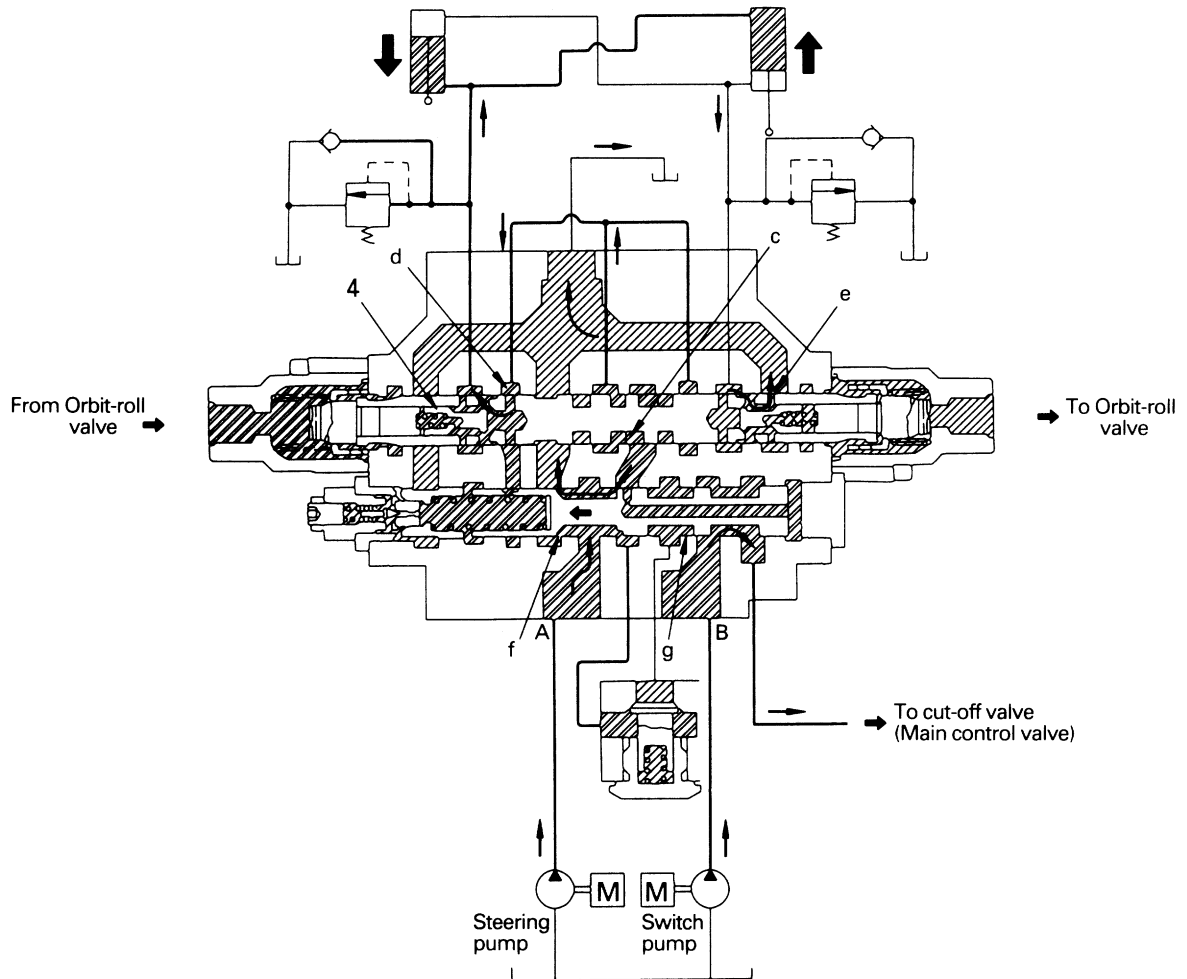
- Engine at low speed



SLW01224

- When steering spool (2) is pushed (operated), pressure-receiving chamber (II) and the drain circuit are shut off, and at the same time notch (c) opens.
- When this happens, the pressure in pressure-receiving chamber (II) rises, and demand spool (1) moves to the right in the direction of the arrow until notch (h) closes.
- The passage from port B to the main control valve is shut off, so the oil from the switch pump pushes up merge check valve (3), and merges with the oil at port A from the steering pump.
- The merged oil passes through notch (c) and notch (d), pushes up load check valve (4), and flows to the cylinder. The oil returning from the cylinder passes through notch (e) and enters the drain circuit.
- In this condition, the pressure before passing through notch (c) goes to pressure-receiving chamber (II), and the pressure after passing notch (c) goes to pressure-receiving chamber (II). Demand spool (1) moves to maintain the pressure difference on the two sides of notch (c) at a constant value. Therefore, a flow corresponding to the amount of opening notch (c) is discharged from the cylinder port. These pressure differences (control pressure) are set by spring (5).

- Engine at high speed



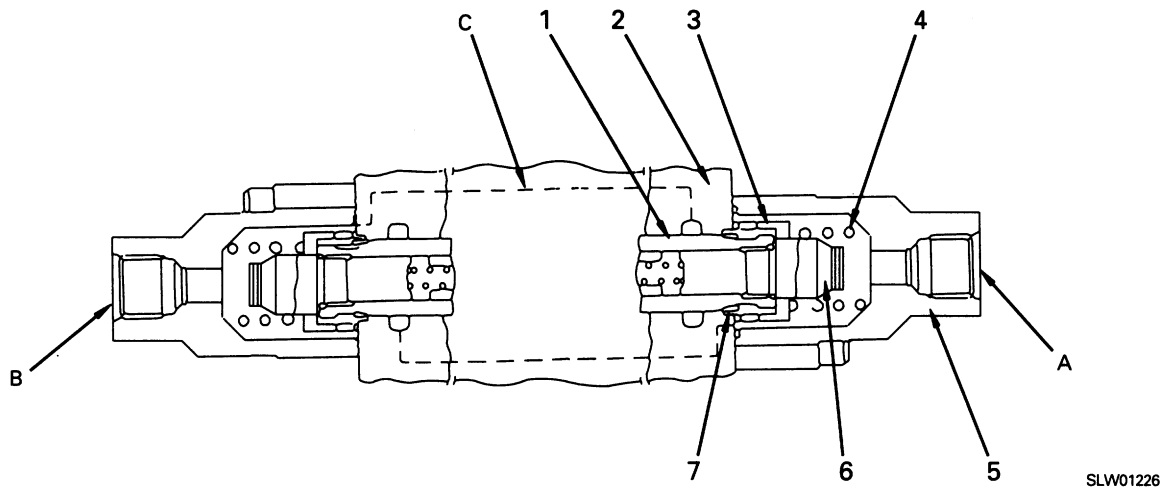
SLW01225

- The extra oil from the switch pump is not needed, so the steering pump pressure rises until notch (g) closes, and shuts off the merge passage at port **B**.
- The pressure difference on the two sides of notch (c) is controlled only by notch (f), so the excess oil from the steering pump is drained from notch (f) to the drain circuit (when this happens, notch (g) is completely closed).
- The oil from the steering pump passes through notch (c) and notch (d), pushes up load check valve (4), and flows to the cylinder. The oil returning from the cylinder passes through notch (e) and flows to the drain circuit.
- Notch (g) is closed, so the oil from the switch pump is sent from port **B** to the main control valve.

STRUCTURE AND FUNCTION

STEERING VALVE

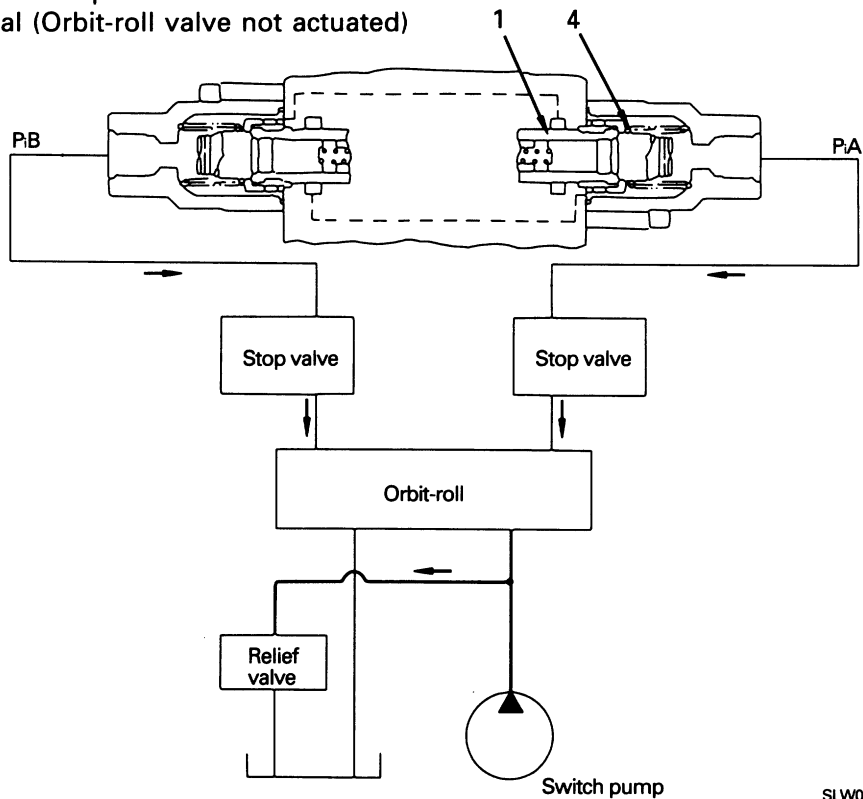
FLOW AMP



- | | | |
|-------------------------|-------------------|-----------------------------|
| 1. Steering spool | 5. Cap | A: From Orbit-roll valve |
| 2. Valve housing (body) | 6. Capscrew | B: From Orbit-roll valve |
| 3. Spring seat | 7. Flow amp notch | C: Passage (inside housing) |
| 4. Return spring | | |

• Operation of flow amp

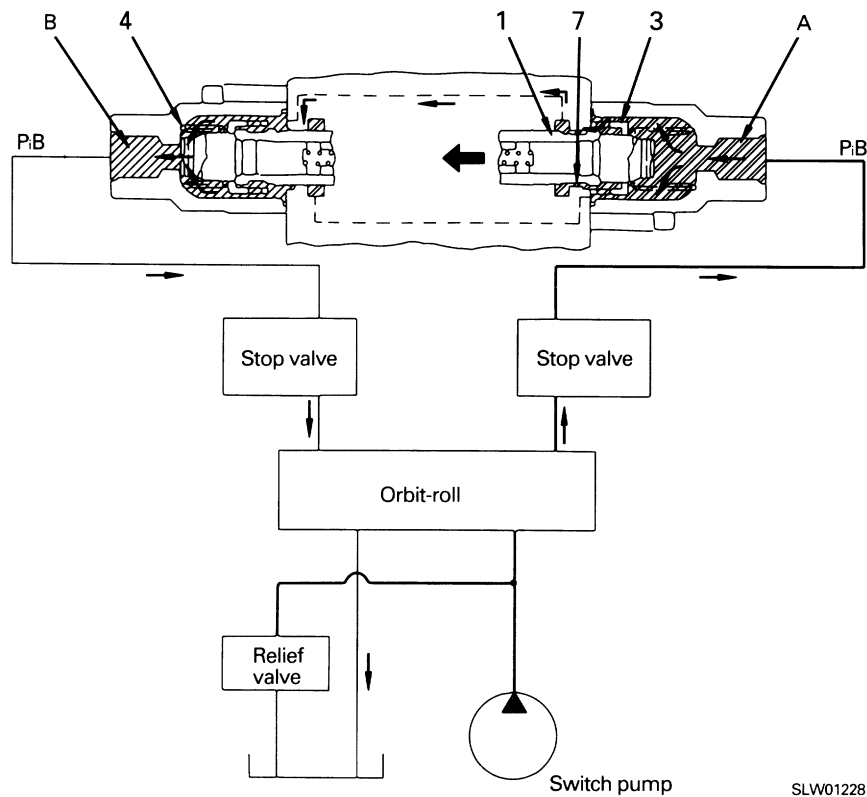
1. Spool at neutral (Orbit-roll valve not actuated)



- When the Orbit-roll valve is not actuated, both pilot port **PiA** and pilot port **PiB** are connected through the Orbit-roll to the drain (return) circuit, so steering spool (1) is kept at neutral by return spring (4).

U42103

2. Spool actuated (oil flows to port **PiA**)

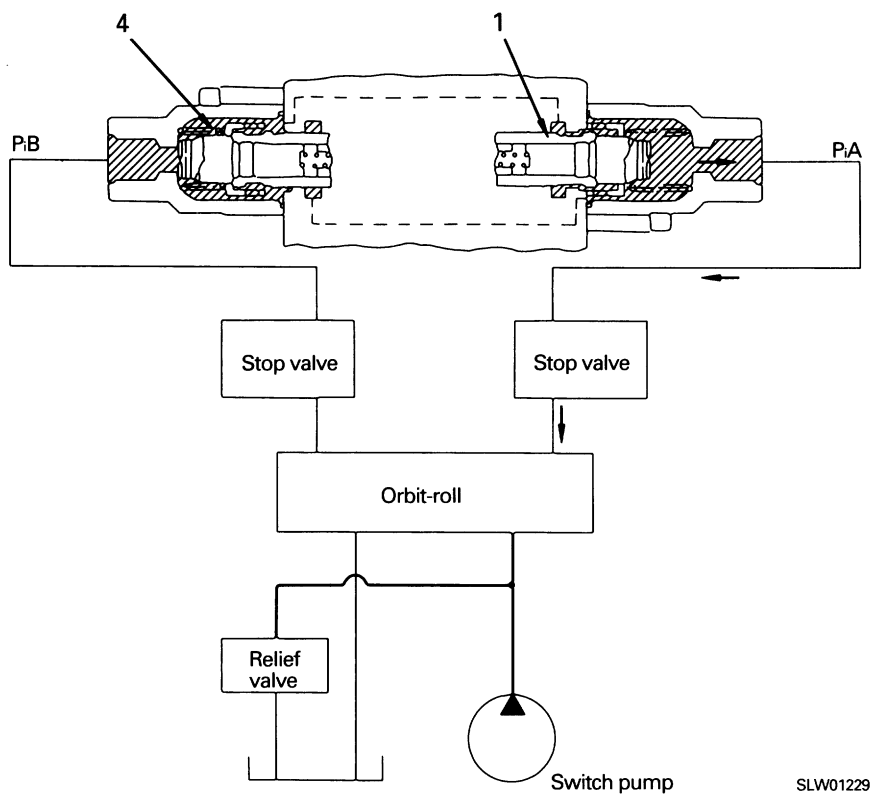


- When oil flows to port **PiA**, the pressure inside the cap at end **A** rises and moves steering spool (1) in the direction of the arrow.
- The oil entering from port **PiA** passes through the hole in spring seat (3), through flow amp notch (7) in steering spool (1), and then flows to the opposite end (**B** end).
- Port **PiB** is connected to the drain circuit through the Orbit-roll valve, so the oil flowing to end **B** is drained.
- The pressure generated at port **PiA** is proportional to the amount of oil flowing in, so steering spool (1) moves to a position where the opening of the flow amp notch balances the pressure generated with the force of return spring (4).

STRUCTURE AND FUNCTION

STEERING VALVE

3. Spool returning (steering wheel stopped, flow of oil to port **PiA** cut)



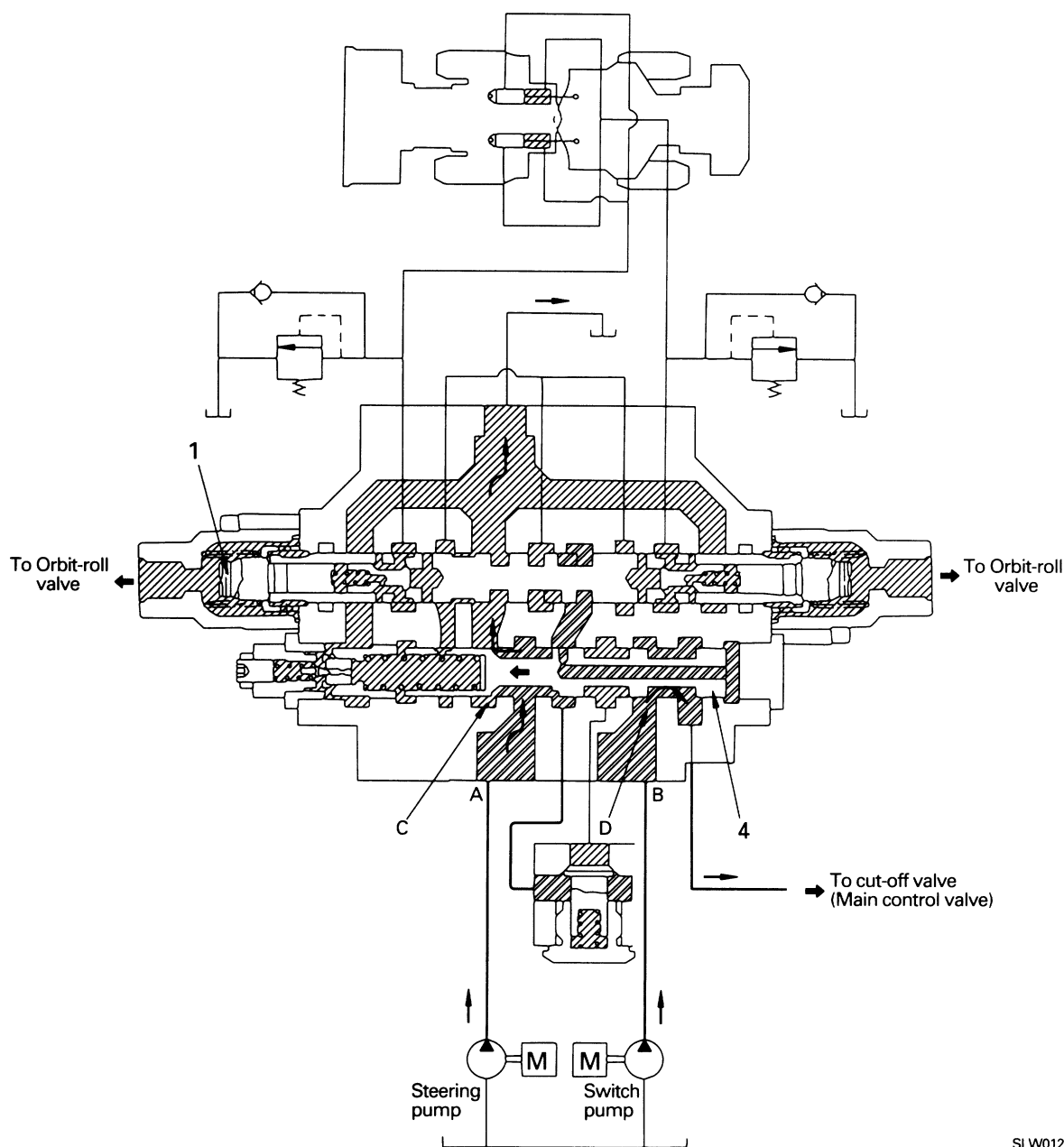
- When the steering wheel (Orbit-roll valve) is stopped, ports **PiA** and **PiB** are both connected to the drain circuit through the Orbit-roll valve. For this reason, steering spool (1) is returned to the neutral position by return spring (4).

U42103

SLW01229

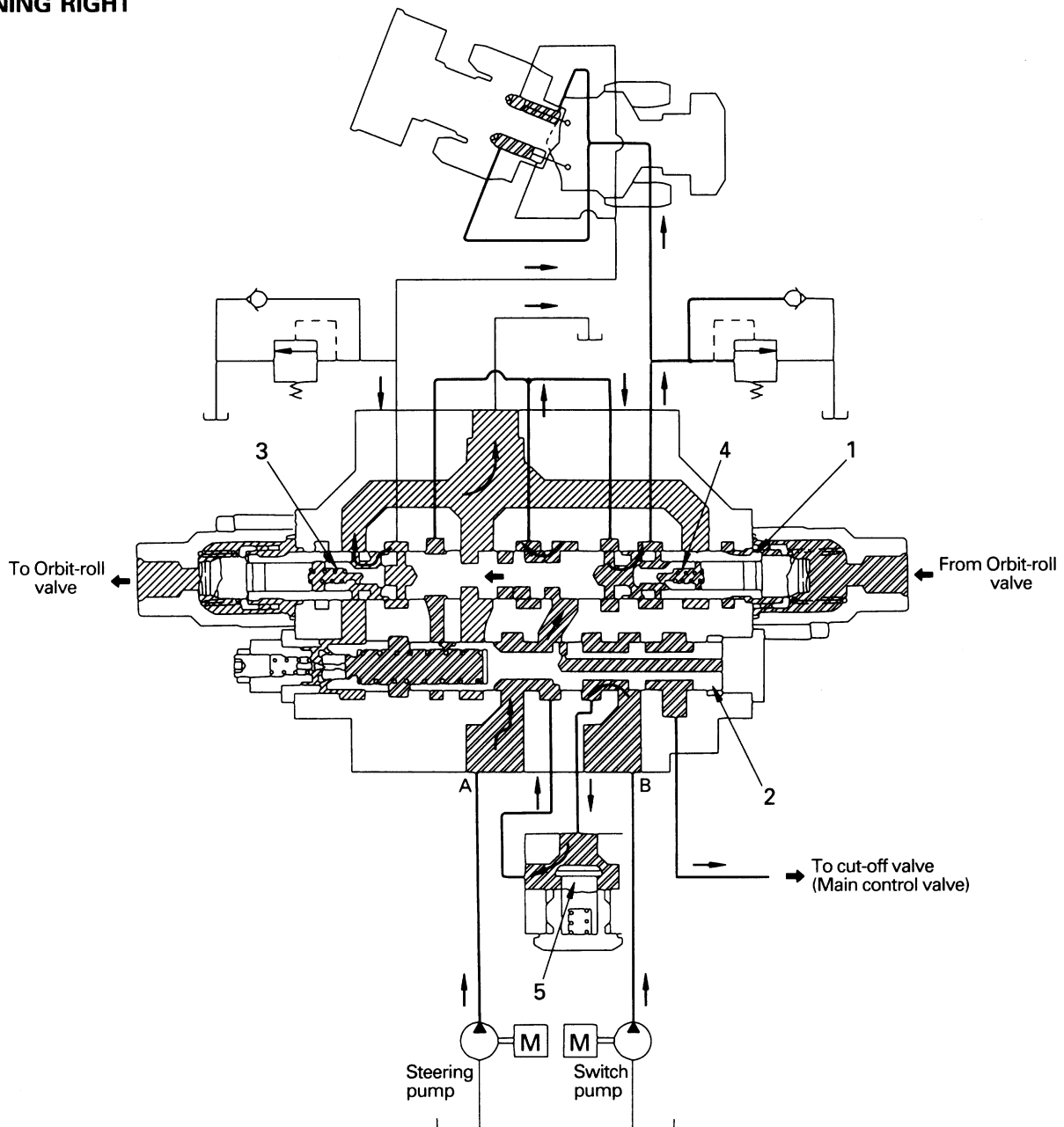
OPERATION OF STEERING VALVE

NEUTRAL



- The steering wheel is not being operated, so steering spool (1) does not move.
- The oil from the steering pump enters port A; the oil from the switch pump enters port B.
- When the pressure at ports A and B rises, demand spool (4) moves to the left in the direction of the arrow. The oil from the steering pump passes through port C of the spool and is drained. The oil from the switch pump passes through port D and all flows to the main control valve.

TURNING RIGHT



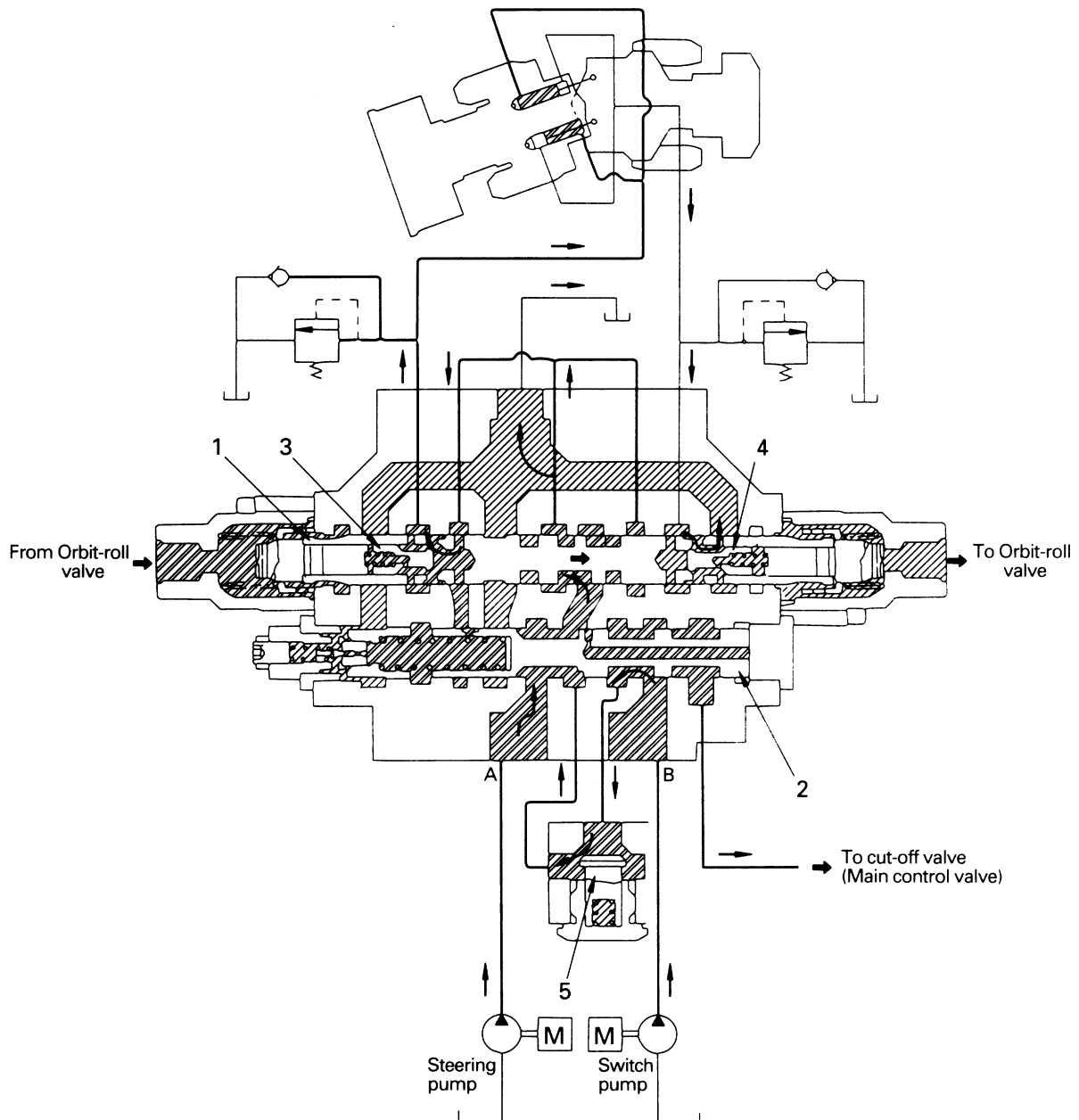
SLW01231

- When the steering wheel is turned to the right, the pressure oil from the Orbit-roll valve acts on steering spool (1), and steering spool (1) moves to the left in the direction of the arrow. The oil from the steering pump enters port A, passes through demand spool (2), and flows to steering spool (1). It pushes open load check valve (4) of the spool, and the oil flows to the bottom end of the left cylinder and the rod end of the right cylinder to turn the machine to the right.

The oil from the left and right cylinders passes through load check valve (3) of the steering spool, and is drained. The oil from the switch pump enters port B, flows through demand spool (2), pushes open check valve (5), and merges with the oil from the steering pump.

U42103

TURNING LEFT



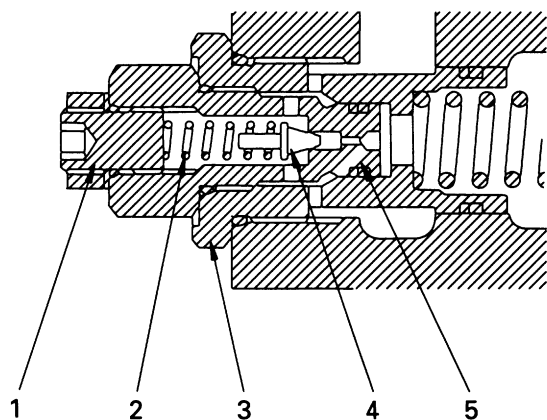
SLW01232

- When the steering wheel is turned to the left, the pressure oil from the Orbit-roll valve acts on steering spool (1), and steering spool (1) moves to the right in the direction of the arrow. The oil from the steering pump enters port A, passes through demand spool (2), and flows to steering spool (1). It pushes open load check valve (3) of the spool, and the oil flows to the rod end of the left cylinder and the bottom end of the right cylinder to turn the machine to the right.

The oil from the left and right cylinders passes through load check valve (4) of the steering spool, and is drained.

The oil from the switch pump enters port B, flows through demand spool (2), pushes open check valve (5), and merges with the oil from the steering pump.

STEERING RELIEF VALVE



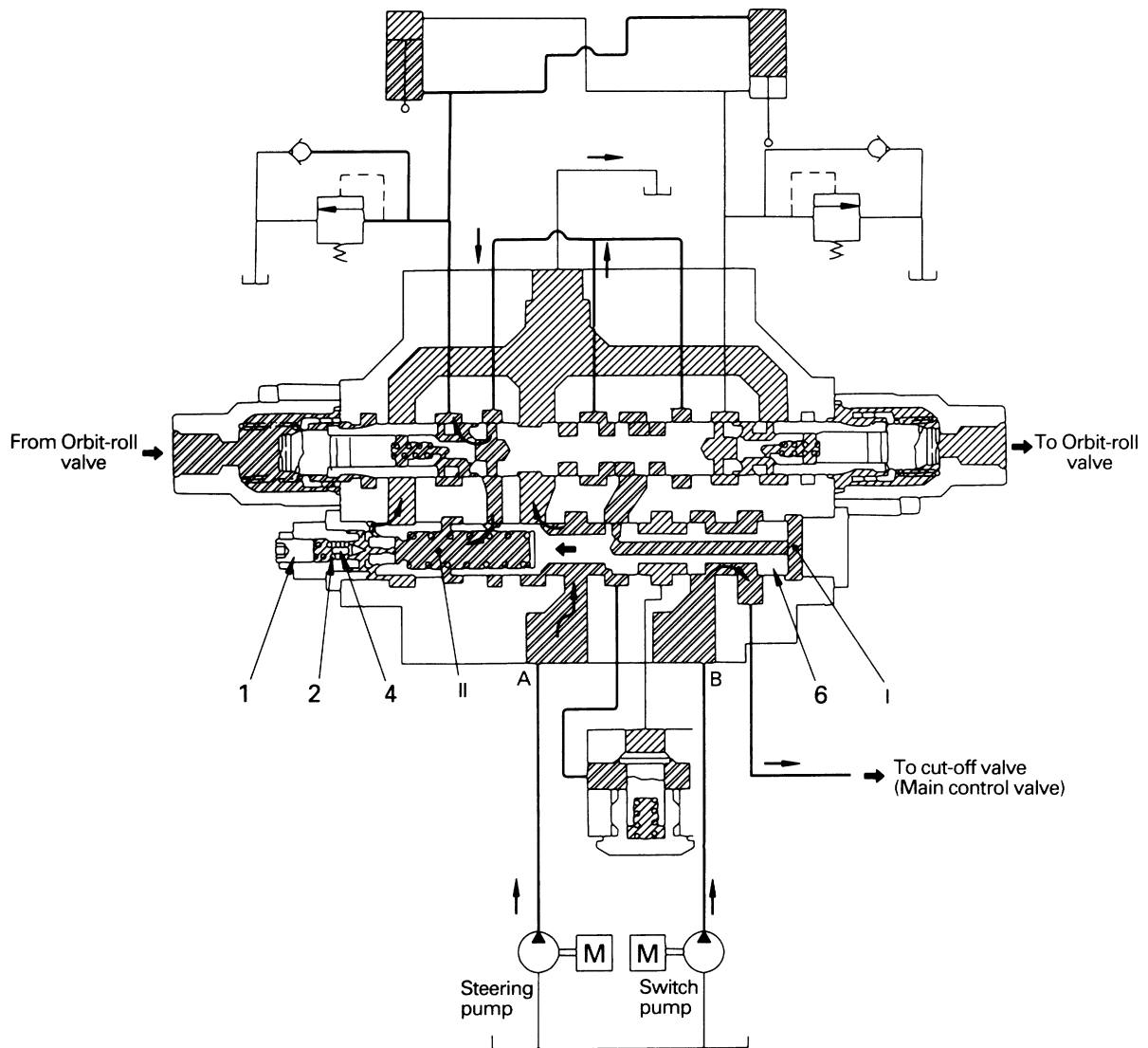
SEW00097

1. Adjustment screw
2. Spring
3. Plug
4. Pilot poppet
5. Valve seat

Function

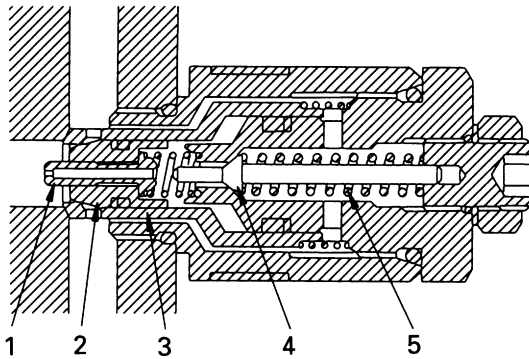
- The steering relief valve is inside the steering valve, and sets the maximum circuit pressure of the steering circuit when the steering valve is actuated. When the steering valve is being actuated, if the steering circuit goes above the set pressure of this valve, oil is relieved from this valve. When the oil is relieved, the flow control spool of the demand valve is actuated, and the oil is drained to the steering circuit.

OPERATION OF RELIEF VALVE



- When the pressure in the circuit rises, and it reaches the pressure set by adjustment screw (1) and spring (2), pilot poppet (4) opens, and the oil is drained.
- When this happens, the balance in pressure between pressure-receiving chamber (I) and pressure-receiving chamber (II) is lost, so demand spool (6) moves to the left in the direction of the arrow.
- When demand spool (6) moves, the oil from the steering pump is drained, and the oil from the switch pump is released to the main control valve. This prevents the pressure in the steering circuit from going above the set value.

SAFETY VALVE(WITH SUCTION)



SEW00091

1. Poppet
2. Relief valve poppet
3. Check valve poppet
4. Pilot poppet
5. Spring

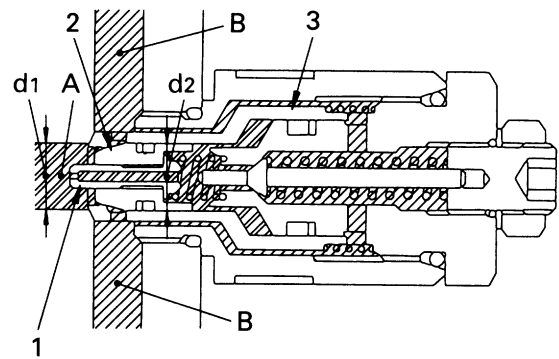
Function

¥ The overload relief valve is installed to the steering valve. It has the following two functions: When the steering valve is at neutral, if any shock is applied to the cylinder, and an abnormal pressure is generated, the oil is relieved from this valve. In this way, it functions as a safety valve to prevent damage to the cylinder or hydraulic piping. On the other hand, if negative pressure is generated at cylinder end, it functions as a suction valve to prevent a vacuum from forming.

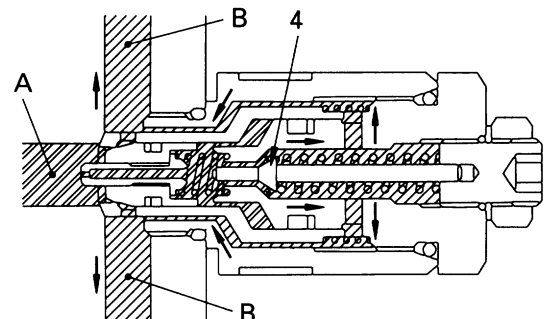
Operation

Acting as relief valve

- Port **A** is connected to the cylinder circuit and port **B** is connected to the drain circuit. Oil passes through the hole in poppet (1) and acts on the different areas of diameters **d1** and **d2**, so check valve poppet (3) and relief valve poppet (2) are firmly seated in position.
- When the pressure at port **A** reaches the set pressure of the relief valve, pilot poppet (4) opens. The oil flows around pilot poppet (4), passes through the drill hole, and flows to port **B**.



SEW00092

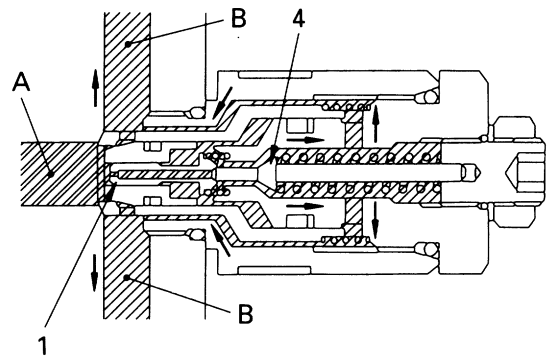


SEW00093

STRUCTURE AND FUNCTION

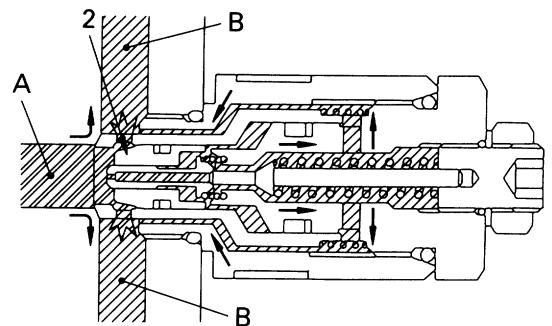
STEERING VALVE

- When pilot poppet (4) opens, the pressure at the back of poppet (1) drops, so poppet (1) moves and is seated with pilot poppet (4).



SEW00094

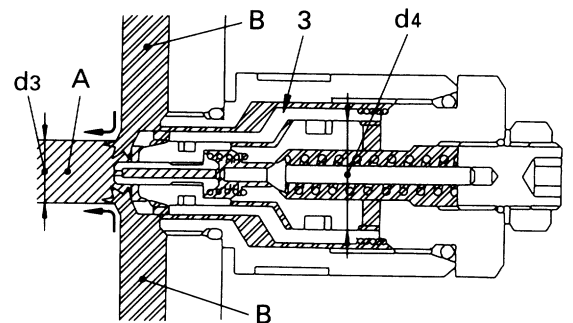
- Compared with the pressure at port **A**, the internal pressure is low, so relief valve poppet (2) opens. When this happens, the oil flows from port **A** to port **B**, and prevents any abnormal pressure from forming.



SEW00095

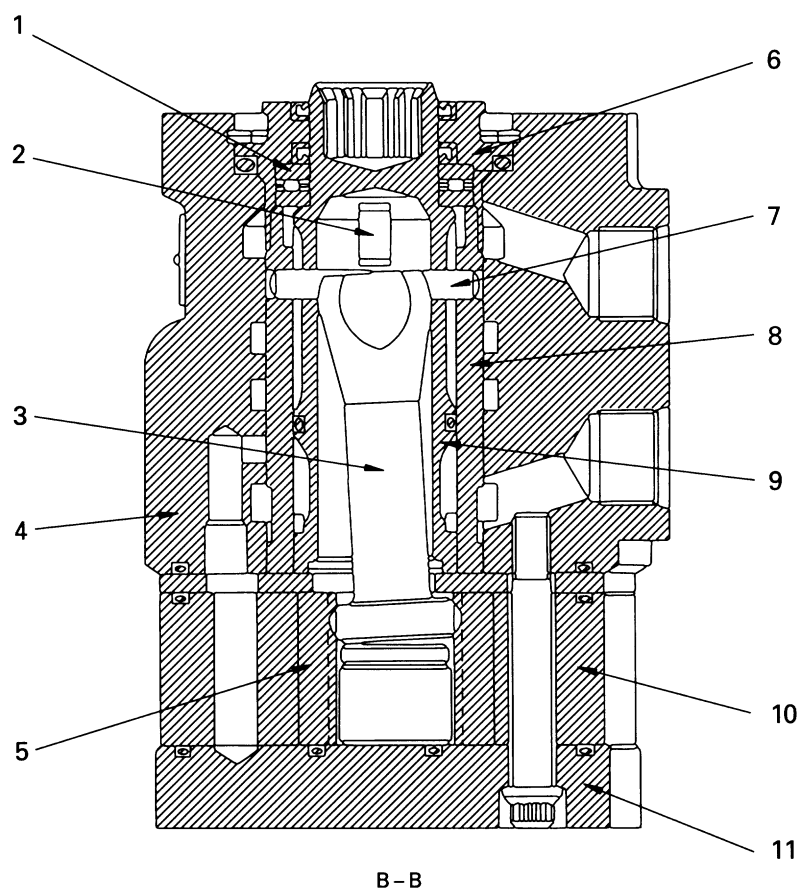
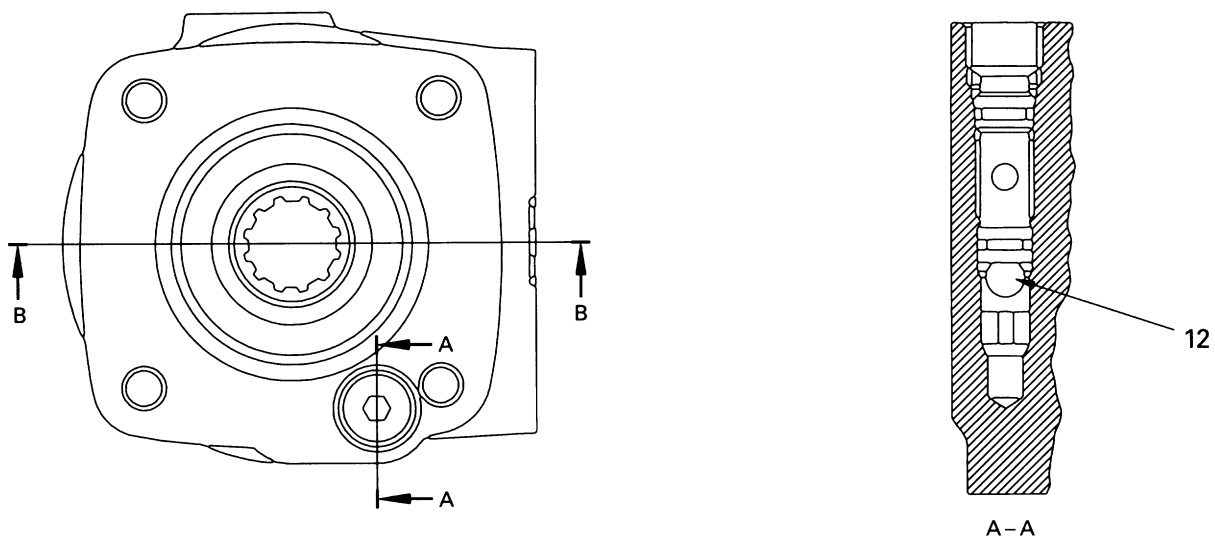
Acting as suction valve

- When negative pressure is formed at port **A**, the difference in area of diameters **d3** and **d4** causes check valve poppet (3) to open. When this happens, the oil from port **B** flows to port **A**, and prevents any vacuum from forming.



SEW00096

ORBIT-ROLL VALVE



- 1. Needle bearing
- 2. Center spring
- 3. Drive shaft
- 4. Valve body

- 5. Rotor
- 6. Cover
- 7. Center pin
- 8. Sleeve

- 9. Spool
- 10. Stator
- 11. Lower cover
- 12. Check valve

SEW01234

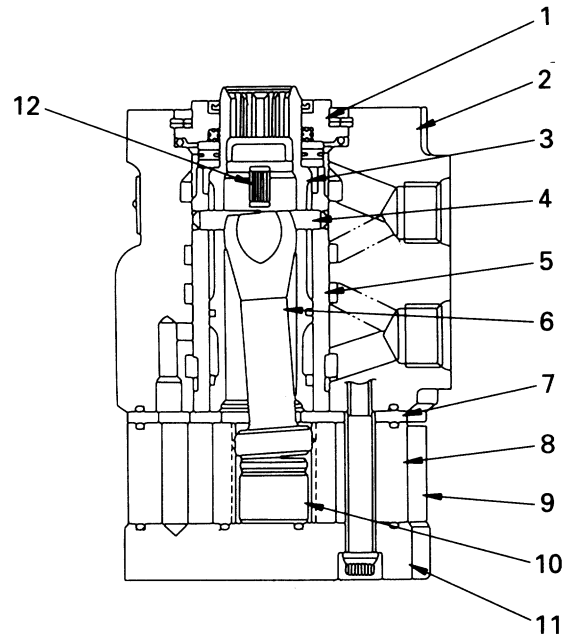
U42103

STRUCTURE AND FUNCTION

ORBIT-ROLL VALVE

Outline

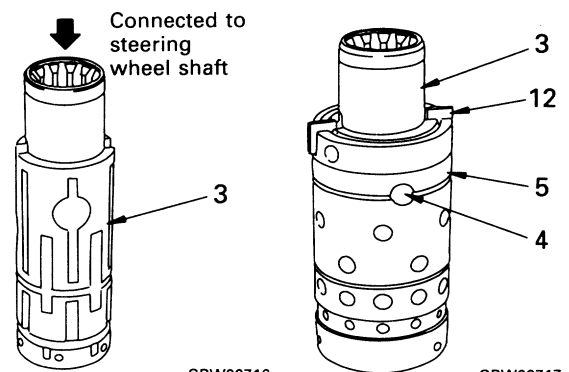
- The steering valve is connected directly to the shaft of the steering wheel. It switches the flow of oil from the steering pump to the left and right steering cylinders to determine the direction of travel of the machine.
- The steering valve, broadly speaking, consists of the following components: rotary type spool (3) and sleeve (5), which have the function of selecting the direction, and the Girotor set (a combination of rotor (8) and stator (9)), which acts as a hydraulic motor during normal steering operations, and as a hand pump (in fact, the operating force of the steering wheel is too high, so it cannot be operated) when the steering pump or engine have failed and the supply of oil has stopped.



SBW00715

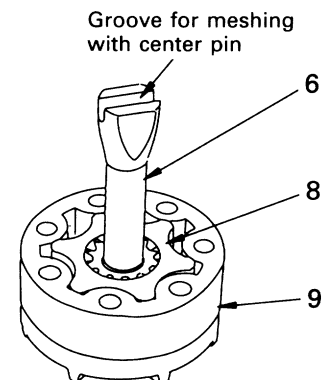
Structure

- Spool (3) is directly connected to the drive shaft of the steering wheel, and is connected to sleeve (5) by center pin (4) (it does not contact the spool when the steering wheel is at neutral) and centering spring (12).
- The top of drive shaft (6) is meshed with center pin (4), and forms one unit with sleeve (5), while the bottom of the drive shaft is meshed with the spline of rotor (8) of the Girotor.
- There are four ports in valve body (2), and they are connected to the pump circuit, tank circuit, and the circuits at the head end and bottom end of the steering cylinders. The pump port and tank port are connected by the check valve inside the body. If the pump or engine fail, the oil can be sucked in directly from the tank by this check valve.



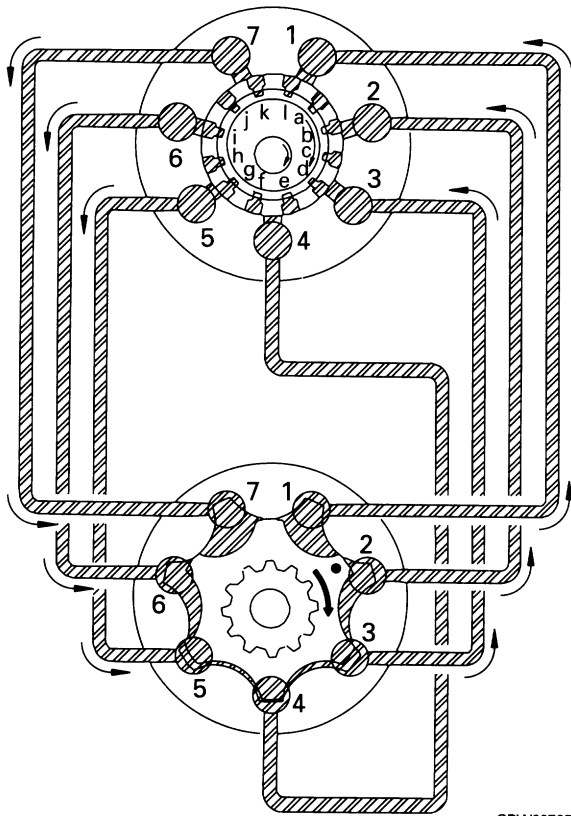
SBW00716

SBW00717

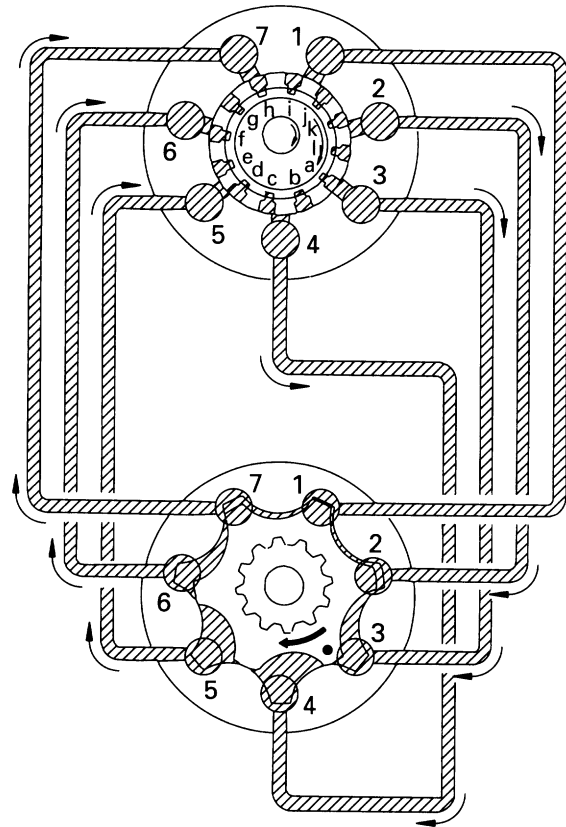


SBW00718

CONNECTION BETWEEN HAND PUMP AND SLEEVE

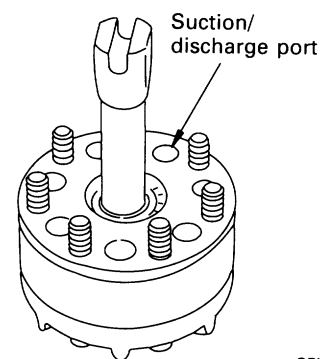


SBW00725

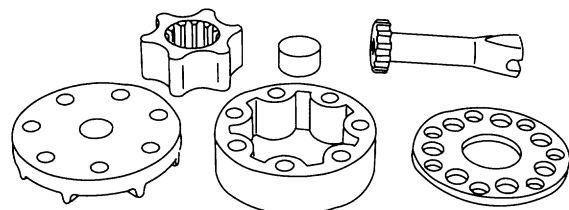


SBW00726

- The diagrams above show the connections with the sleeve ports used to connect the suction and discharge ports of the Girotor.
- If the steering wheel has been turned to the right, ports **a, c, e, g, i, and k** are connected by the vertical grooves in the spool to the pump side. At the same time, ports **b, d, f, h, j, and l** are connected to the head end of the left steering cylinder in the same way. In the condition in Fig. 1, ports **1, 2, and 3** are the discharge ports of the Girotor set. They are connected to ports **l, b, and d**, so the oil is sent to the cylinder. Ports **5, 6, and 7** are connected and the oil flows in from the pump. If the steering wheel is turned 90°, the condition changes to the condition shown in Fig. 2. In this case, ports **1, 2, and 3** are the suction ports, and are connected to ports **i, k, and c**. Ports **5, 6, and 7** are the discharge ports, and are connected to ports **d, f, and h**.



SBW00727



SBW00728

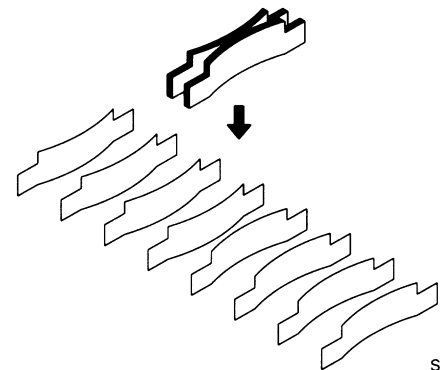
U42103

STRUCTURE AND FUNCTION**ORBIT-ROLL VALVE**

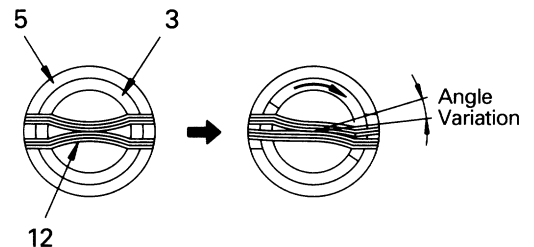
- In this way, the ports of the Girotor acting as delivery ports are connected to ports which are connected to the end of the steering valve spool. The ports acting as suction ports are connected to the pump circuit.
- Adjusting delivery in accordance with angle of steering wheel:
For every $1/7$ turn of the steering wheel, the inner teeth of the Girotor gear advance one position so the oil flow from the pump is adjusted by this movement. In this way, the oil delivered from the pump is directly proportional to the amount the steering wheel is turned.

FUNCTION OF CENTER SPRING

- Centering spring (12) consists of four layers of leaf springs crossed to form an X shape. The springs are assembled in spool (3) and sleeve (5) as shown in the diagram on the right. When the steering wheel is turned, the spring is compressed and a difference in rotation (angle variation) arises between the spool and the sleeve. Because of this, the ports in the spool and sleeve are connected and oil is sent to the cylinder. When the turning of the steering wheel is stopped, the Girotor also stops turning, so no more oil is sent to the cylinder and the oil pressure rises. To prevent this, when the turning of the steering wheel is stopped, the action of the centering spring only allows it to turn by an amount equal to the difference in angle of rotation (angle variation) of the sleeve and spool, so the steering wheel returns to the NEUTRAL position.

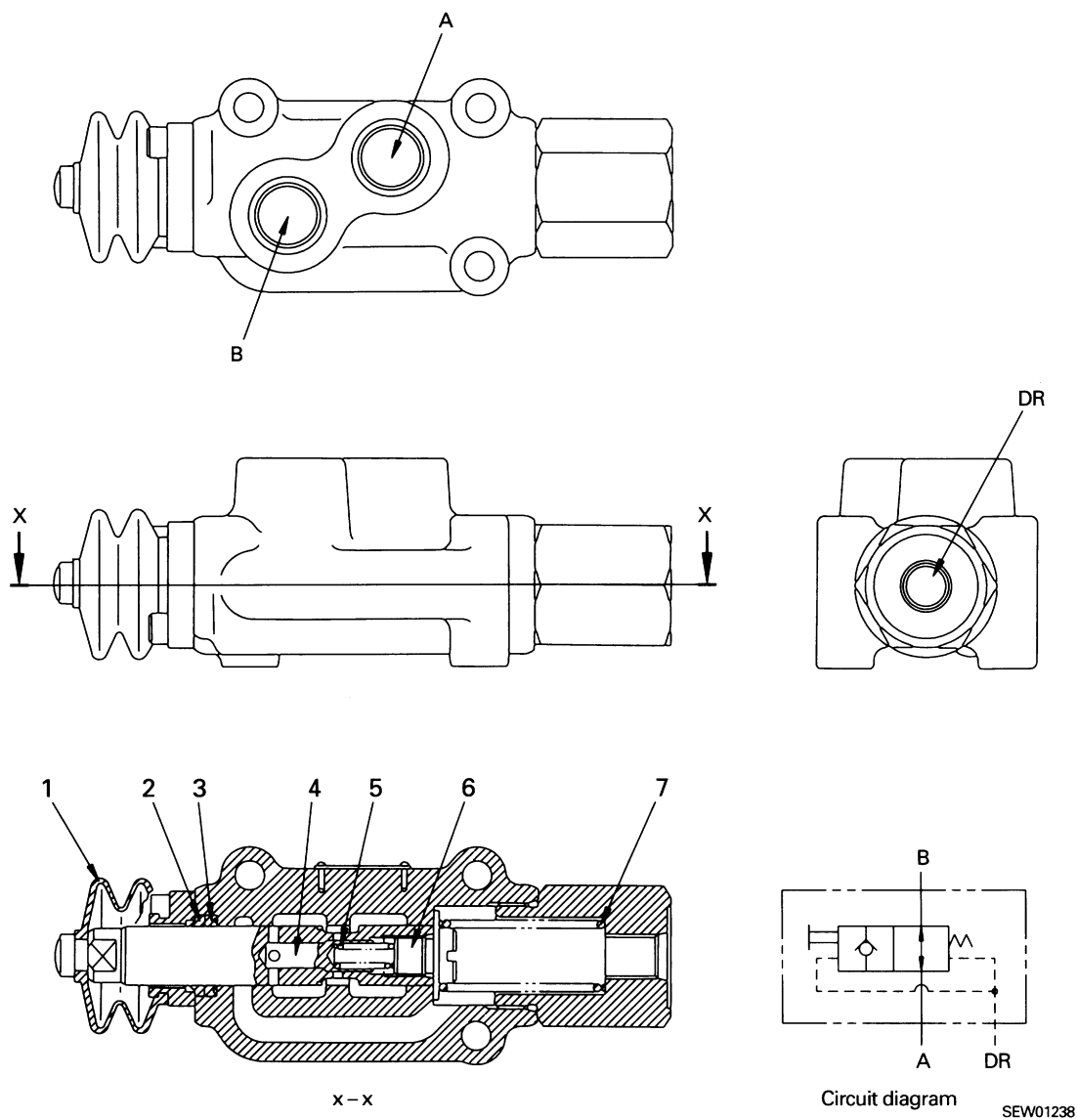


SDW01236



SDW01237

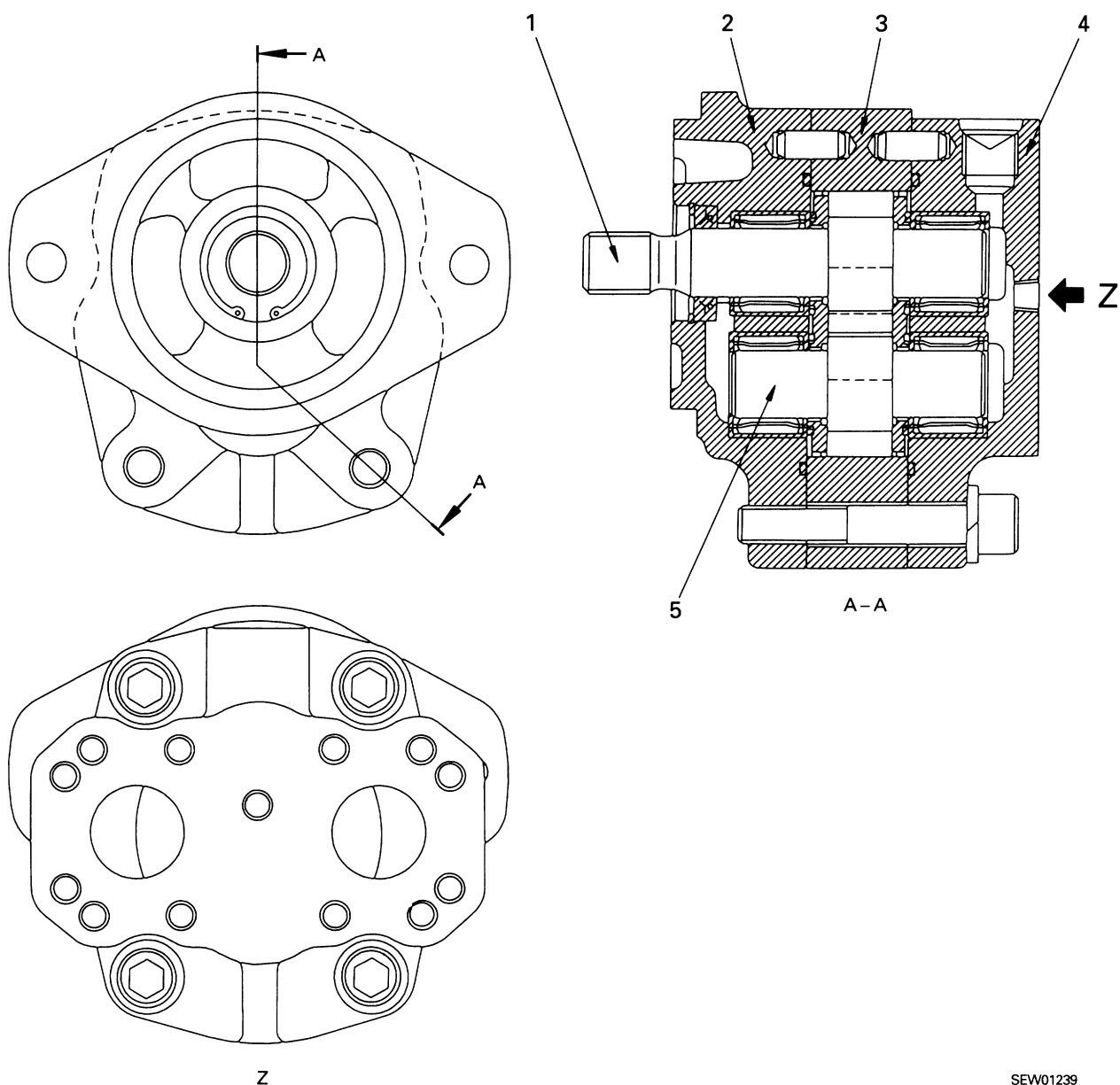
STOP VALVE



1. Boot
2. Wiper
3. Seal
4. Poppet
5. Spring
6. Spool
7. Spring

A: From orbit-roll
 B: To steering valve
 DR: To drain

EMERGENCY STEERING PUMP



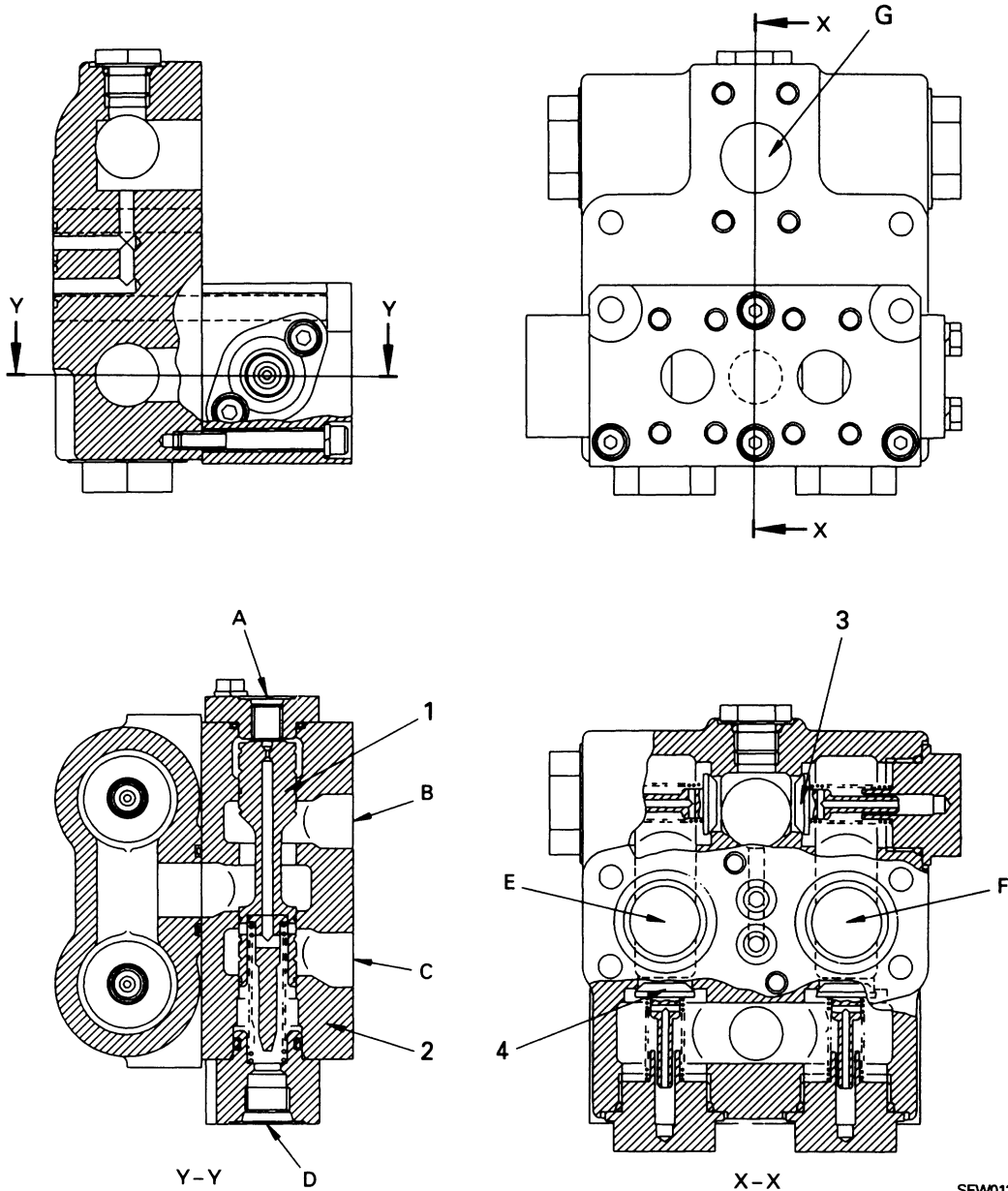
SEW01239

1. Drive gear (Teeth 12)
2. Front cover
3. Gear case
4. Rear cover
5. Driven gear (Teeth 12)

Specifications

- Model: SAM(2)-050
- Direction of revolution: Possible to rotate both direction
- Theoretical delivery: 50.8 cc/rev
- Max. delivery pressure: 20.6 MPa (210 kg/cm²)

DIVERTER VALVE



1. Diverter valve
2. Valve body
3. Check valve
4. Check valve

- A. From steering pump
- B. To steering valve
- C. To hydraulic tank
- D. Sensor mounting port
- E. Emergency pump port
- F. Emergency pump port
- G. From hydraulic tank

FUNCTION

- If the engine stops or the pump seizes during machine traveling, and it becomes impossible to steer, the rotation of the transmission is used to turn the emergency steering pump to make steering possible.

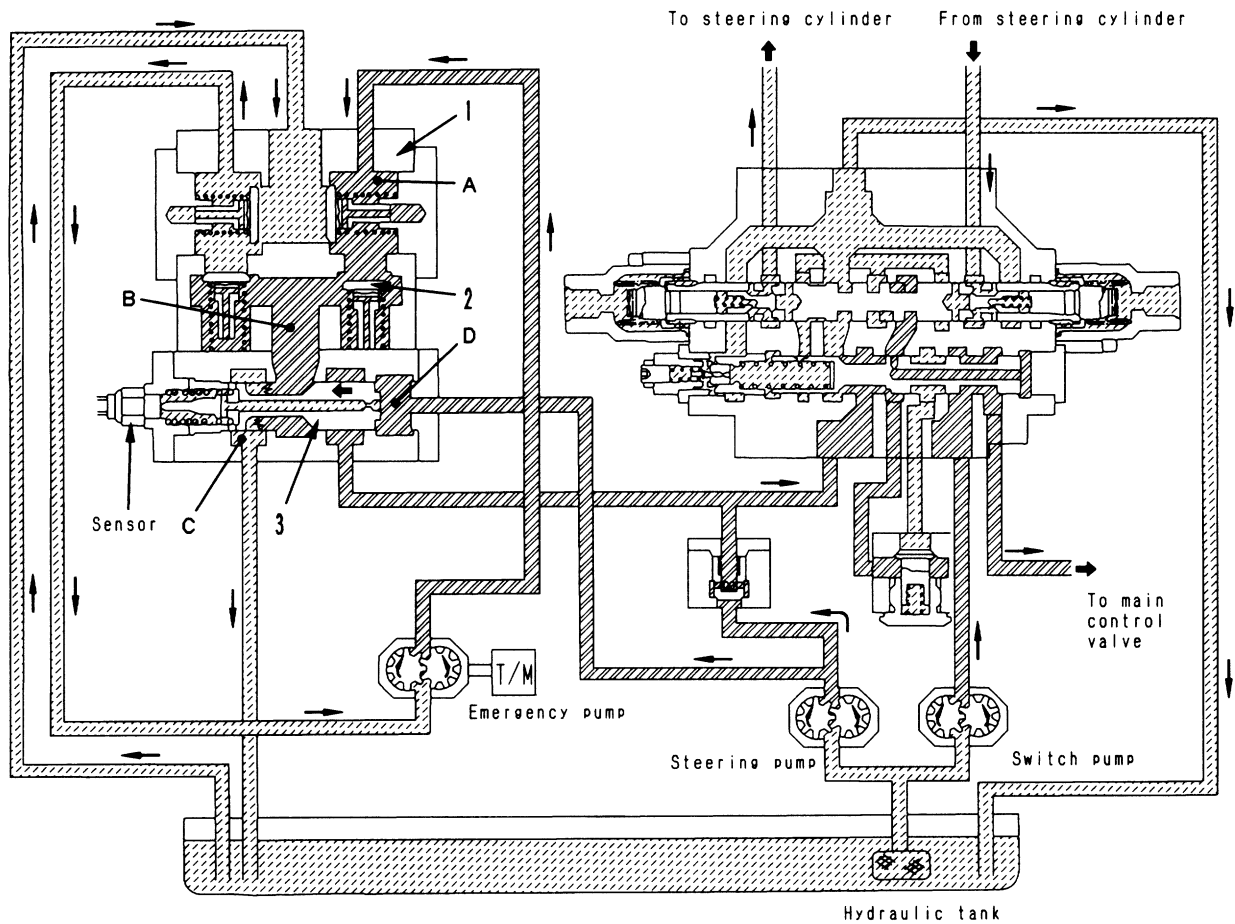
U42103

STRUCTURE AND FUNCTION

DIVERTER VALVE

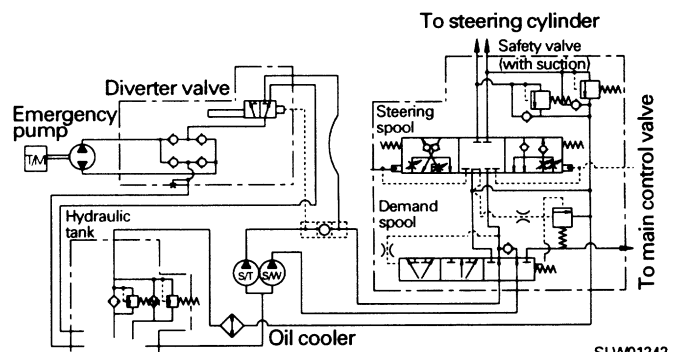
OPERATION

- Pump and engine are working normally.



SVW02908

- When the steering pump and engine are working normally, the hydraulic pump, steering pump, and switch pump are rotated by the engine. Therefore, oil is sent to the steering valve, and the machine can be steered. In addition, the emergency steering pump is rotated by the transmission, so oil from port **A** of the diverter valve pushes open check valve (2) and enters port **B**. Pressure oil from the steering pump is flowing to port **D**, so it pushes spool (3) in the direction of the arrow. As a result, the oil from port **B** flows to port **C** and is drained to the hydraulic tank.

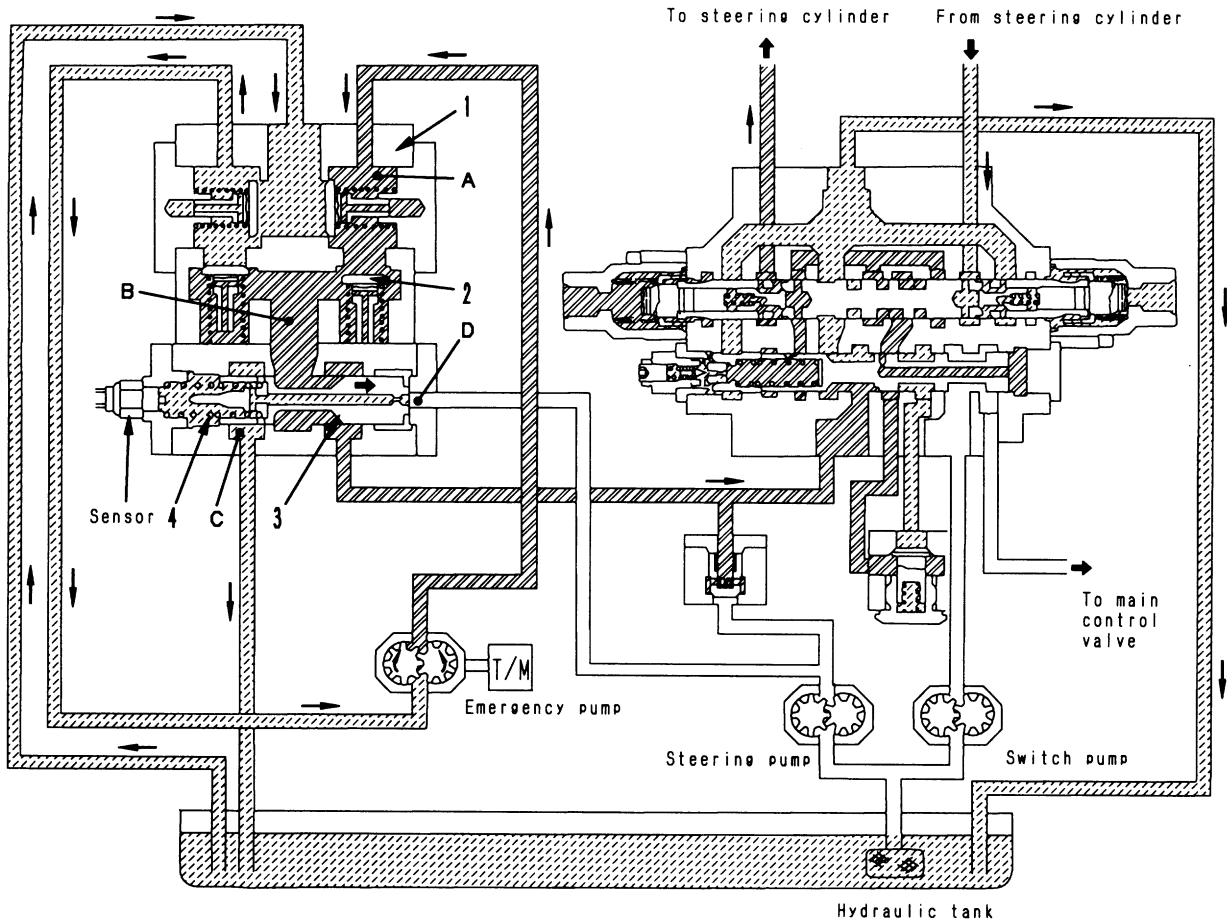


SLW01242

STRUCTURE AND FUNCTION

DIVERTER VALVE

Failure in pump or engine when machine is traveling.



U42103

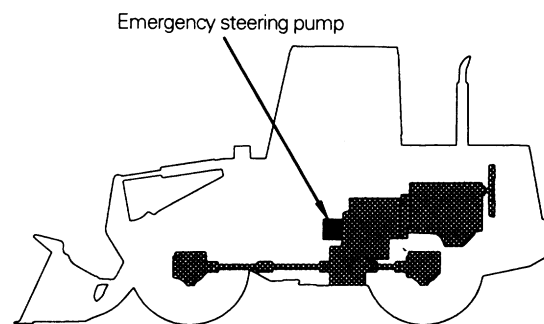
SVW02909

If there is a failure in the pump or engine when the machine is traveling, the rotation of the wheels is transmitted through the transfer to rotate the emergency steering pump.

The steering pump is not rotating, so no pressure oil is formed at port D. As a result, spool (3) is pushed in the direction of the arrow by spring (4).

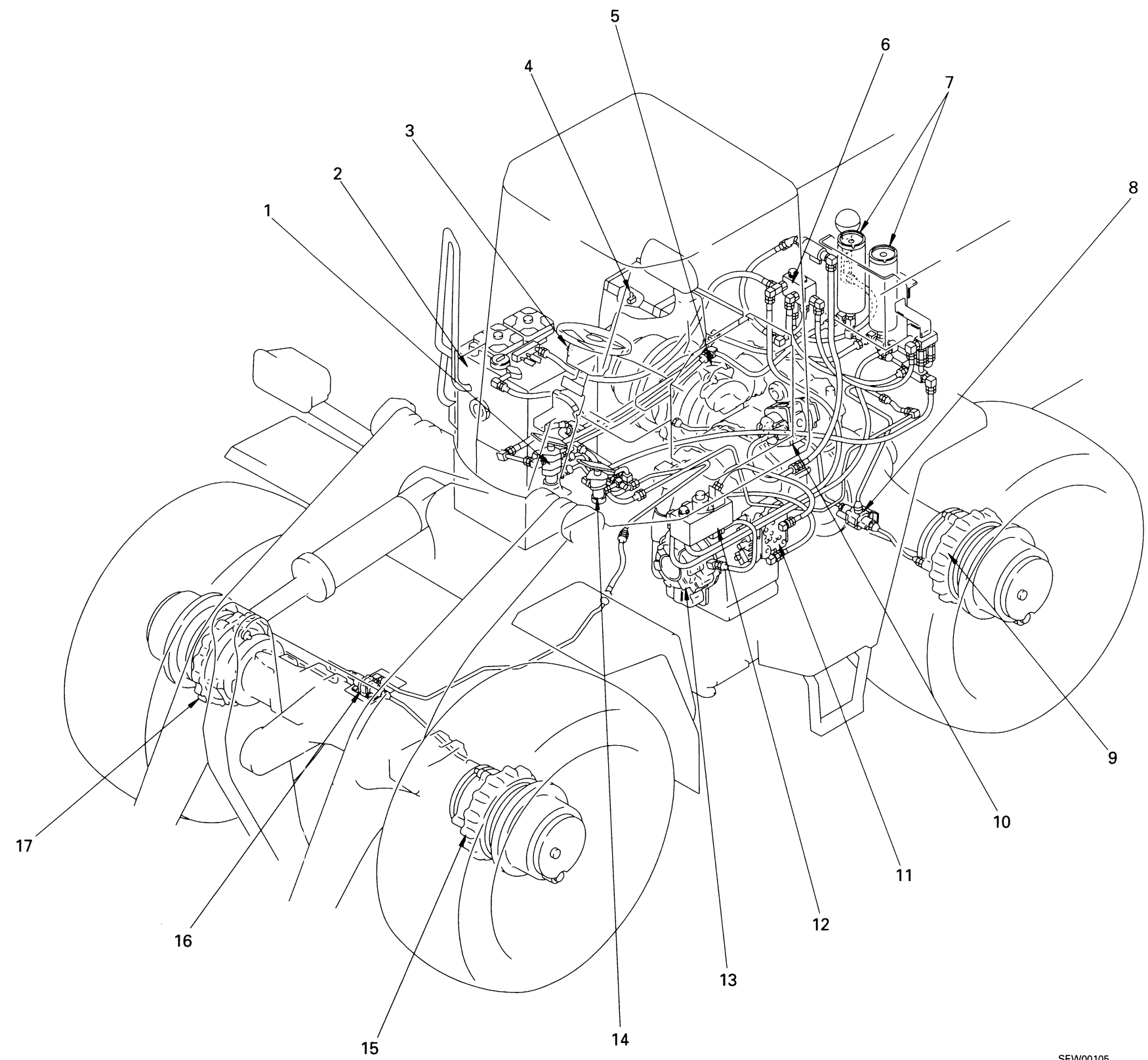
The oil from the emergency steering pump passes from port A through port B and flows to the steering valve to make steering possible.

★ The emergency steering pump is designed so that it can rotate both directions.



SLW01244

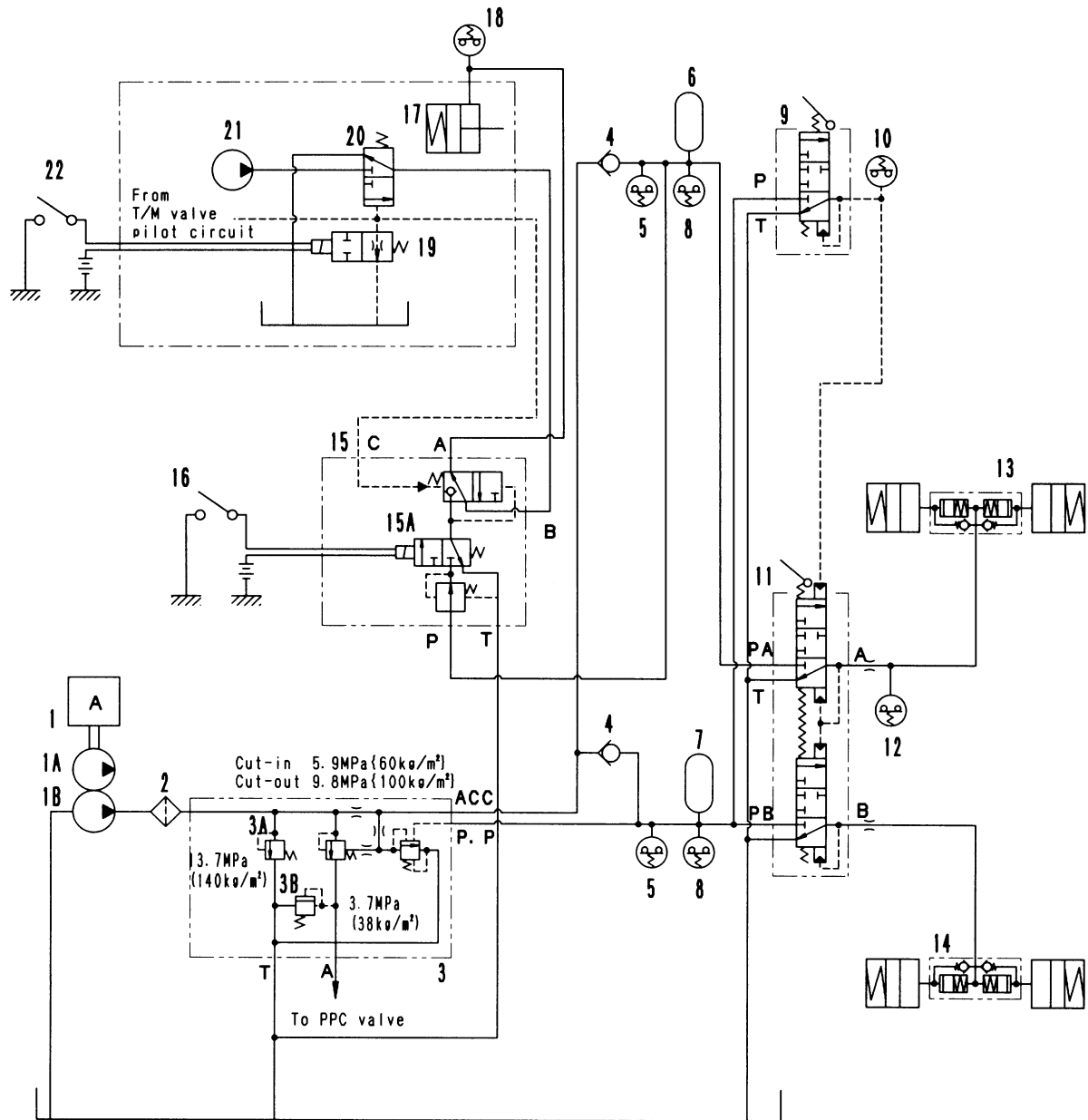
BRAKE PIPING



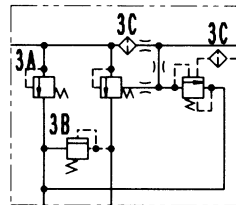
- 1. Brake valve (right)
- 2. Hydraulic tank
- 3. Parking brake switch
- 4. Parking brake emergency cancel switch
- 5. Rear brake
- 6. Charge valve
- 7. Accumulator
- 8. Slack adjuster
- 9. Rear brake
- 10. PPC brake pump
- 11. Transmission control valve
- 12. Parking brake valve
- 13. Parking brake
- 14. Brake valve (left)
- 15. Front brake
- 16. Slack adjuster
- 17. Front brake

SEW00105

BRAKE HYDRAULIC CIRCUIT DIAGRAM



Serial No. :50043 and up



U42103

SVW02925

STRUCTURE AND FUNCTION

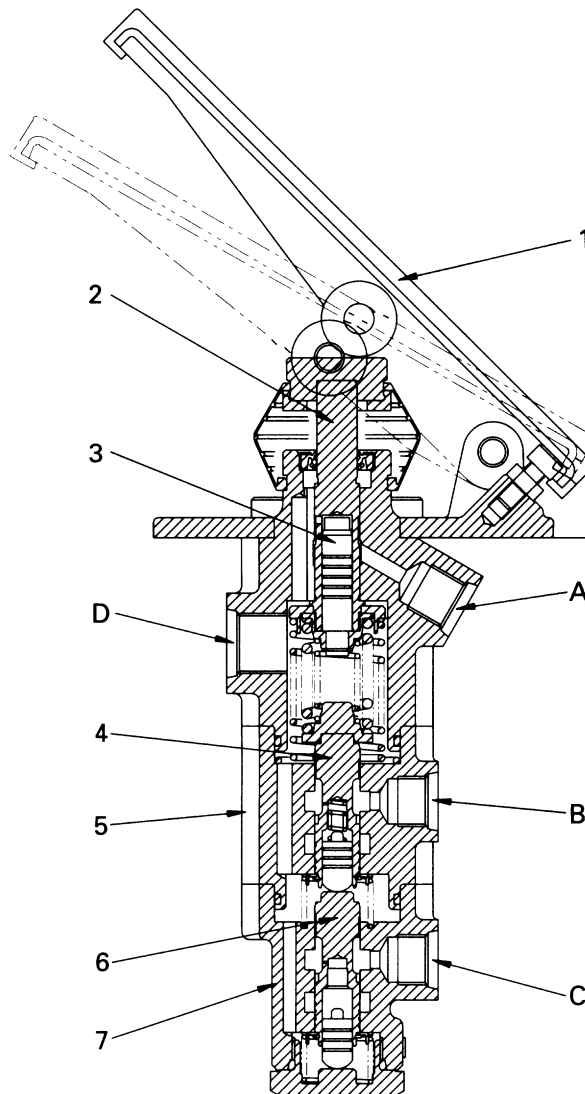
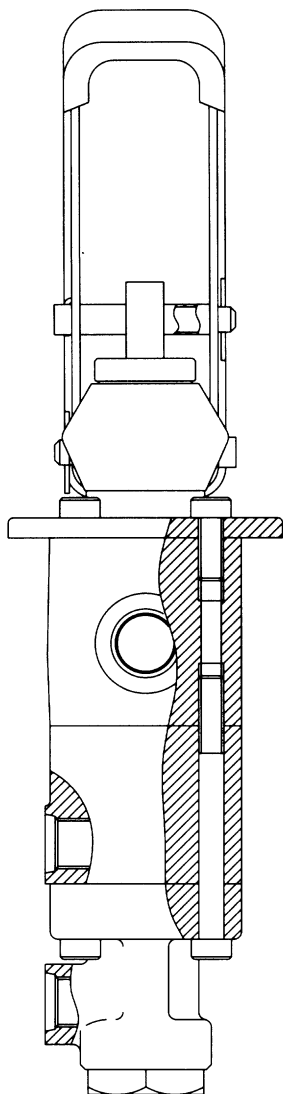
BRAKE HYDRAULIC CIRCUIT DIAGRAM

U42103

1. Hydraulic pump
 - 1A. Work equipment pump
 - 1B. PPC and brake pump
2. Strainer
3. Accumulator charge valve
 - 3A. Safety relief valve
 - 3B. PPC relief valve
 - 3C. Filter
4. Check valve
5. Low pressure switch
6. Rear brake accumulator
7. Front brake accumulator
8. Emergency brake switch
9. Left brake valve
10. Transmission cut-off switch
11. Right brake valve
12. Pilot lamp switch
13. Rear slack adjuster
14. Front slack adjuster
15. Emergency parking brake valve
 - 15A. Parking brake emergency release solenoid
16. Parking brake emergency release switch
17. Parking brake
18. Parking brake pilot lamp switch
19. Parking brake solenoid
20. Parking brake valve
21. Transmission pump
22. Parking brake switch

BRAKE VALVE

BRAKE VALVE (RIGHT)



SDW00107

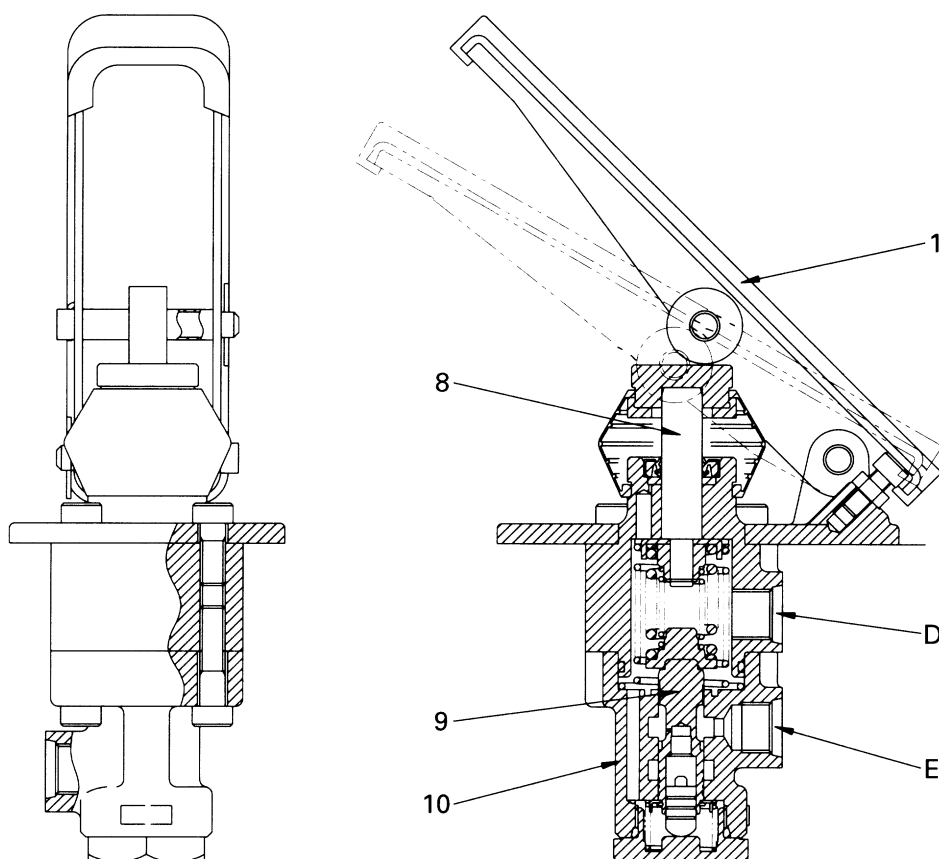
1. Brake pedal (left, right brake)
2. Rod (right brake)
3. Pilot piston (right brake)
4. Spool (right brake)
5. Upper cylinder (right brake)
6. Spool (right brake)
7. Lower cylinder (right brake)
8. Rod (left brake)

9. Spool (left brake)
10. Cylinder (left brake)

- A. Pilot port (right brake)
- B. To rear brake (right brake)
- C. To front brake (right brake)
- D. Drain (left, right brake)
- E. To pilot port (left brake)

U42103

BRAKE VALVE (LEFT)



SDW00108

Outline

- There are two brake valves installed in parallel under the front of the operator's cab, and these are actuated by depressing the pedal.
- When the right pedal is depressed, oil is sent to the brake cylinder to apply the brakes.
- When the left pedal is depressed, oil is sent to the right pedal to apply the brakes in the same way as when the right pedal is depressed.

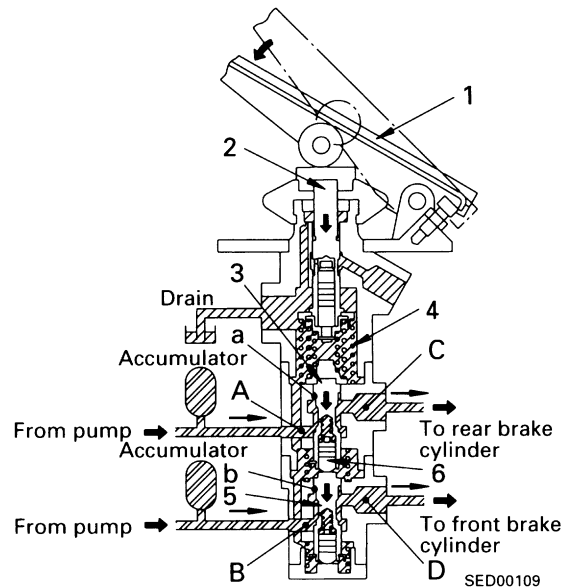
In addition, the left brake pedal operates the transmission cut-off switch to actuate the transmission solenoid valve electrically and set the transmission to neutral.

STRUCTURE AND FUNCTION**BRAKE VALVE****Operation****Brake applied (right brake valve)****Upper portion**

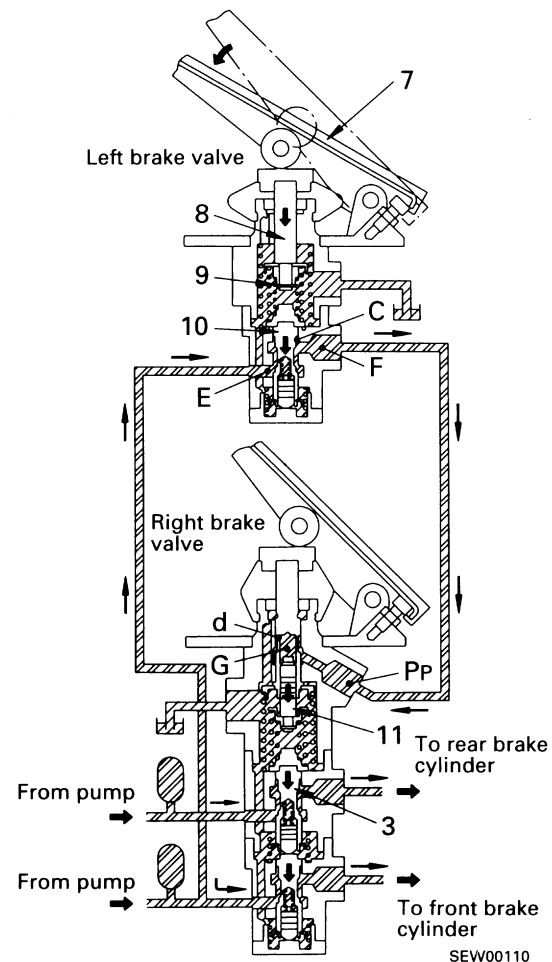
- When brake pedal (1) is depressed, the operating force is transmitted to spool (3) through rod (2) and spring (4). When spool (3) goes down, drain port **a** is closed, and the oil from the pump and accumulator flows from port **A** to port **C** and actuates the rear brake cylinders.

Lower portion

- When brake pedal (1) is depressed, the operating force is transmitted to spool (3) through rod (2) and spring (4). When spool (3) goes down, spool (5) is also pushed down by plunger (6). When this happens, drain port **b** is closed, and the oil from the pump and accumulator flows from port **B** to port **D** and actuates the front brake cylinders.

**Brake applied (left brake pedal)**

- When pedal (7) is depressed, spool (10) is pushed up by rod (8) and spring (9), and drain port **c** is closed. The oil from the pump and the accumulator flows from port **E** to port **F**.
- Port **F** of the left brake valve and port **Pp** of the right brake valve are connected by a hose, so the oil flowing to port **F** flows to pilot port **Pp** of the right brake valve.
- The oil entering pilot port **Pp** enters port **G** from orifice **d**, and pushes piston (11). The spring pushes spool (3) down, so the operation is the same as when the right brake valve is depressed.



U42103

STRUCTURE AND FUNCTION**BRAKE VALVE****Applying brake when upper valve fails (right brake valve)**

- Even if there is leakage of oil in the upper piping, spool (5) is moved down mechanically when pedal (1) is depressed, and the lower portion is actuated normally. The upper brake is not actuated.

Applying brake when lower valve fails (right brake valve)

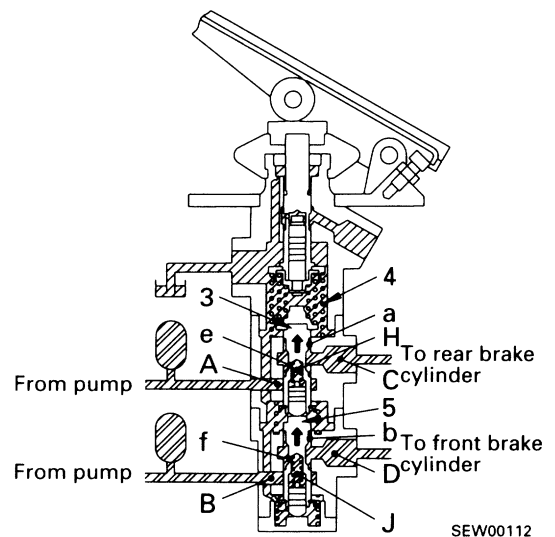
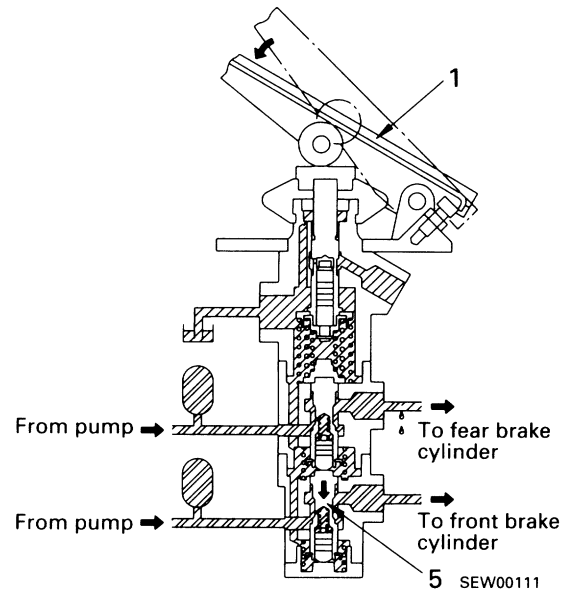
- Even if there is leakage of oil in the lower piping, the upper portion is actuated normally.

When actuation is balanced**Upper portion**

- When oil fills the rear brake cylinder and the pressure between port **A** and port **C** becomes high, the oil entering port **H** from orifice **e** of spool (3) pushes against spring (4). It pushes up spool (3) and shuts off the circuit between port **A** and port **C**. When this happens, drain port **a** stays closed, so the oil entering the brake cylinder is held and the brake remains applied.

Lower portion

- When spool (3) in the upper portion moves up and the circuit between port **A** and port **C** is shut off, oil also fills the front brake cylinder at the same time, so the pressure in the circuit between port **B** and port **D** rises. The oil entering port **J** from orifice **f** of spool (5) pushes up spool (5) by the same amount that spool (3) moves, and shuts off port **B** and port **D**. Drain port **b** is closed, so the oil entering the brake cylinder is held, and the brake is applied.
- The pressure in the space in the upper portion is balanced with the operating force of the pedal, and the pressure in the space in the lower portion is balanced with the pressure in the space in the upper portion. When spools (3) and (5) move to the end of their stroke, the circuits between ports **A** and **C** and between ports **B** and **D** are fully opened, so the pressure in the space in the upper and lower portions and the pressure in the left and right brake cylinders is the same as the pressure from the pump. Therefore, up to the point where the piston moves to the end of its stroke, the effect of the brake can be adjusted by the amount that the pedal is depressed.



STRUCTURE AND FUNCTION

BRAKE VALVE

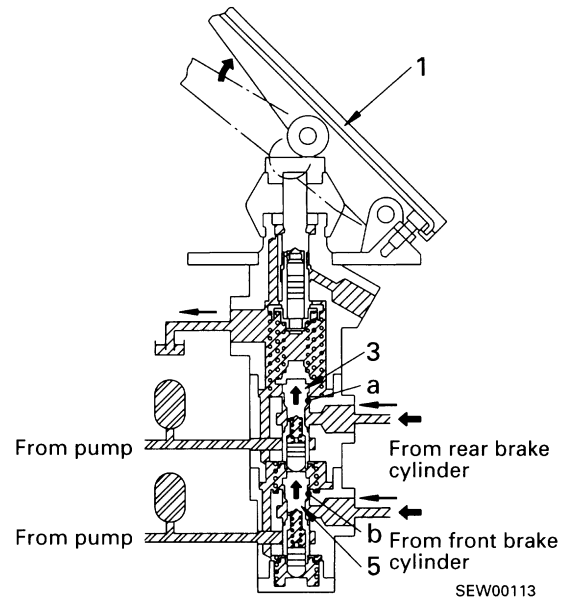
Brake released (right brake valve)

Upper portion

- When pedal (1) is released and the operating force is removed from the top of the spool, the back pressure from the brake cylinder and the force of the spool return spring move spool (3) up. Drain port **a** is opened and the oil from the brake cylinder flows to the hydraulic tank return circuit to release the rear brake.

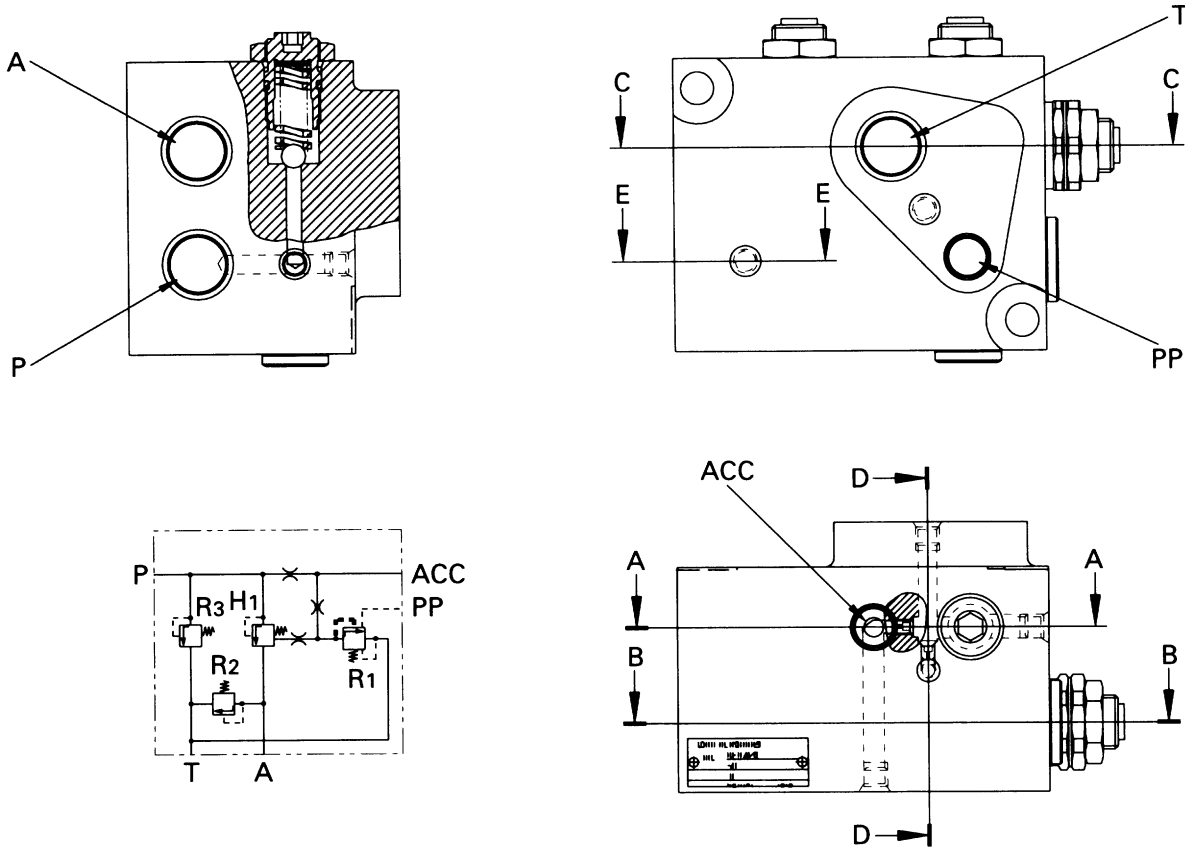
Lower portion

- When the pedal is released, spool (3) in the upper portion moves up. At the same time, the back pressure from the brake cylinder and the force of the spool return spring move spool (3) up. Drain port **b** is opened and the oil from the brake cylinder flows to the hydraulic tank return circuit to release the front brake.



CHARGE VALVE

Serial No.: 50001 – 50042



SDW00114

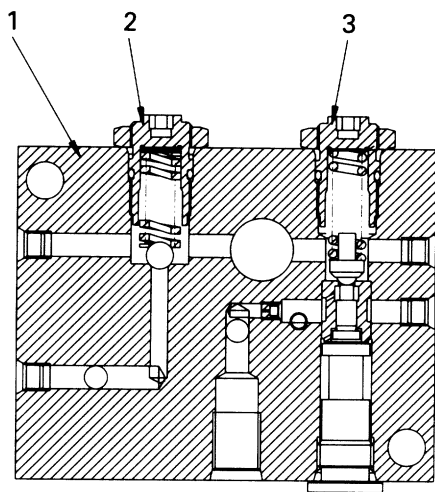
- A. To PPC valve
- ACC. To brake valve
- PP. To brake valve
- P. From pump
- T. Drain

Function

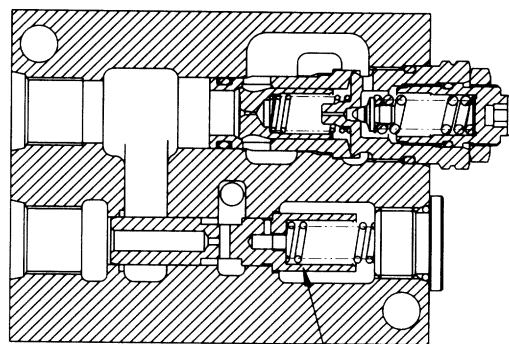
- The charge valve is actuated to maintain the oil pressure from the pump at the specified pressure and to store it in the accumulator.
- When the oil pressure reaches the specified pressure, the oil from the pump is connected to the drain circuit to reduce the load on the pump.

STRUCTURE AND FUNCTION

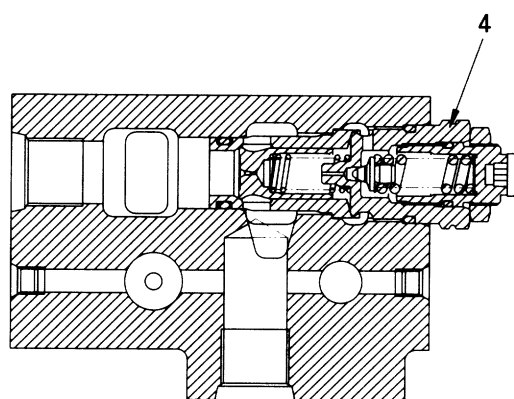
CHARGE VALVE



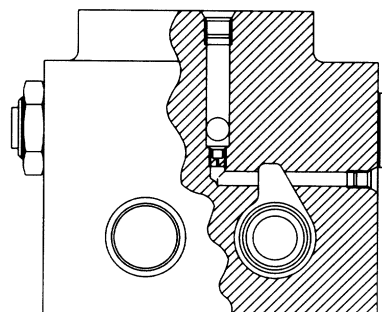
A - A



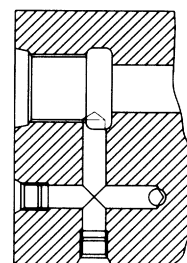
B - B



C - C



D - D



E - E

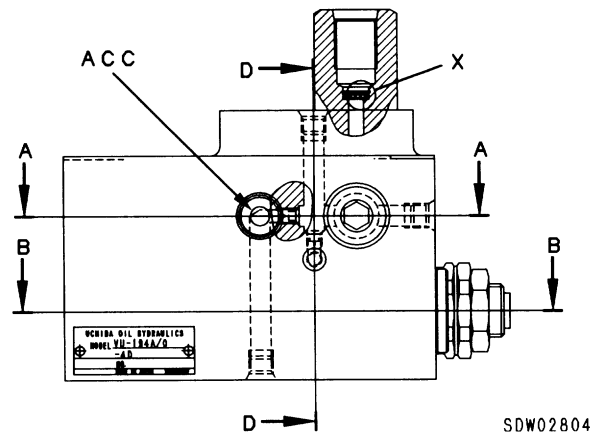
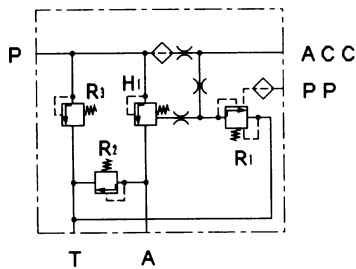
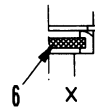
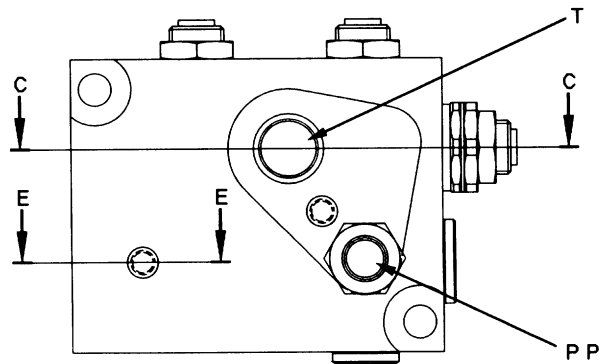
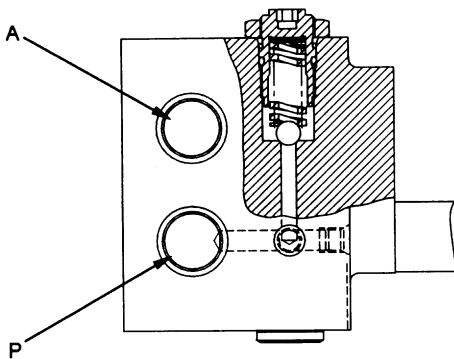
1. Valve body
2. Main relief valve (R3)
3. Relief valve (R1)
4. PPC relief valve (R2)
5. Relief valve (H1)

SDW00115

STRUCTURE AND FUNCTION

CHARGE VALVE

Serial No.: 50043 and up



U42103

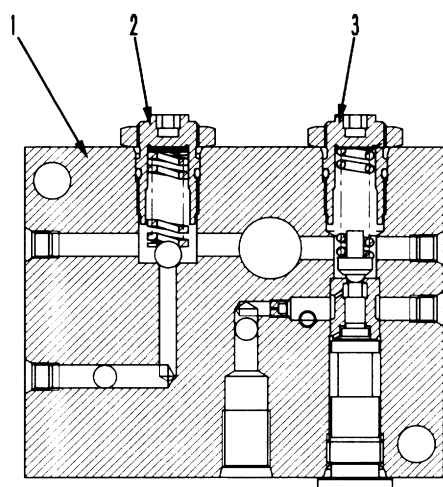
- A. To PPC valve
- ACC. To brake valve
- PP. To brake valve
- P. From pump
- T. Drain

Function

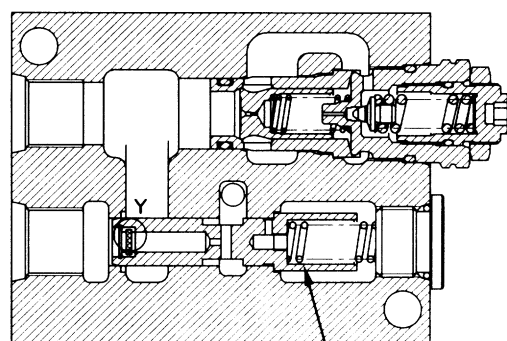
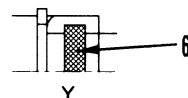
- The charge valve is actuated to maintain the oil pressure from the pump at the specified pressure and to store it in the accumulator.
- When the oil pressure reaches the specified pressure, the oil from the pump is connected to the drain circuit to reduce the load on the pump.

STRUCTURE AND FUNCTION

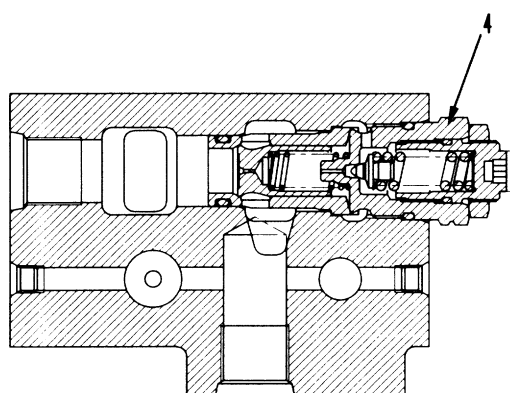
CHARGE VALVE



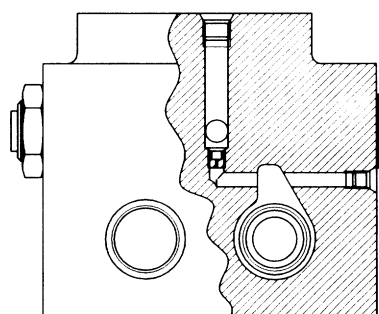
A - A



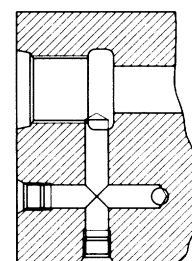
B - B



C - C



D - D



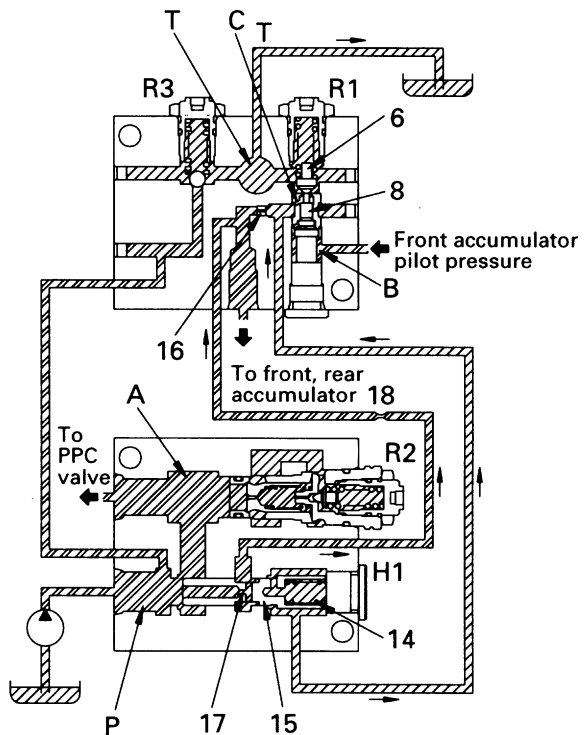
E - E

1. Valve body
2. Main relief valve (**R₃**)
3. Relief valve (**R₁**)
4. PPC relief valve (**R₂**)
5. Relief valve (**H₁**)
6. Filter

SDW02805

STRUCTURE AND FUNCTION**CHARGE VALVE****Operation****Serial No.: 50001 and up****1. When no oil is being supplied to accumulator (cut-out condition)**

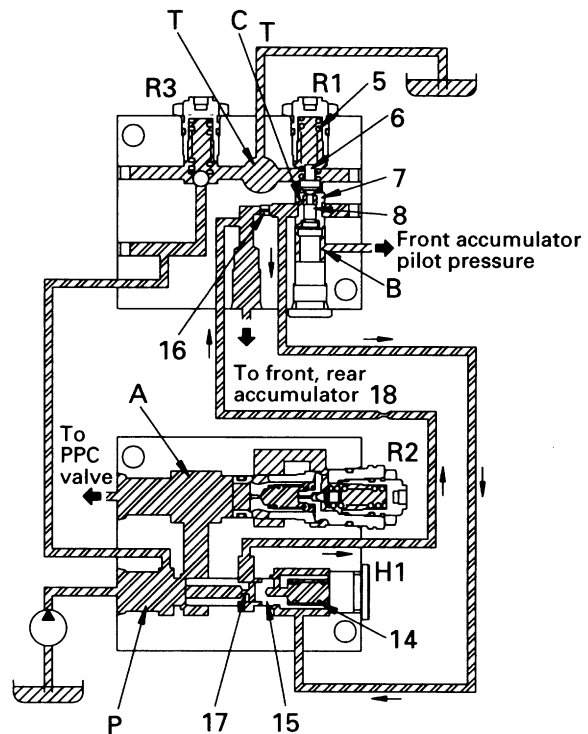
- The pressure at port **B** is higher than the set pressure of the relief valve (R1), so piston (8) is forcibly pushed up by the oil pressure at port **B**. Poppet (6) is opened, so port **C** and port **T** are short circuited.
- The spring chamber at the right end of spool (15) is connected to port **C** of the relief valve (R1), so the pressure becomes the tank pressure. The oil from the pump enters port **P**, pushes spool (15) to the right at a low pressure equivalent to the load on spring (14), and flows from port **A** to the PPC valve. At the same time, it also passes through orifices (17), (18), and (16), and flows to the tank.



SDW00116

2. When oil is supplied to accumulator**1) Cut-in condition**

- When the pressure at port **B** is lower than the set pressure of the relief valve (R1), piston (8) is pushed back down by spring (5). Valve seat (7) and poppet (6) are brought into tight contact, and port **C** and port **T** are shut off.
- The spring chamber at the right end of spool (15) is also shut off from port **T**, so the pressure rises, and the pressure at port **P** also rises in the same way.
- When the pressure at port **P** goes above the pressure at port **B** (accumulator pressure), the supply of oil to the accumulator starts immediately. In this case, it is decided by the size (area) of orifice (17) and the pressure difference (equivalent to the load on spring (14)) generated on both sides of the orifice. A fixed amount is supplied regardless of the engine speed, and the remaining oil flows to port **A**.

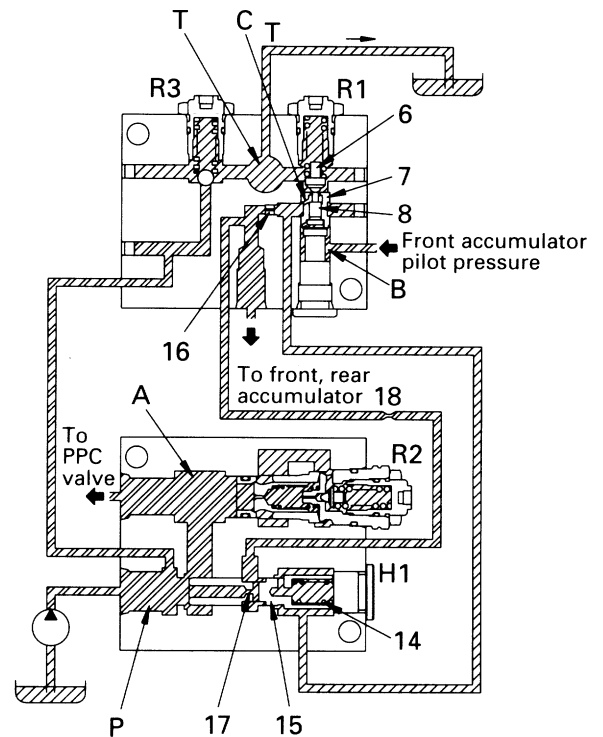


SDW00117

U42103

2) When cut-out pressure is reached

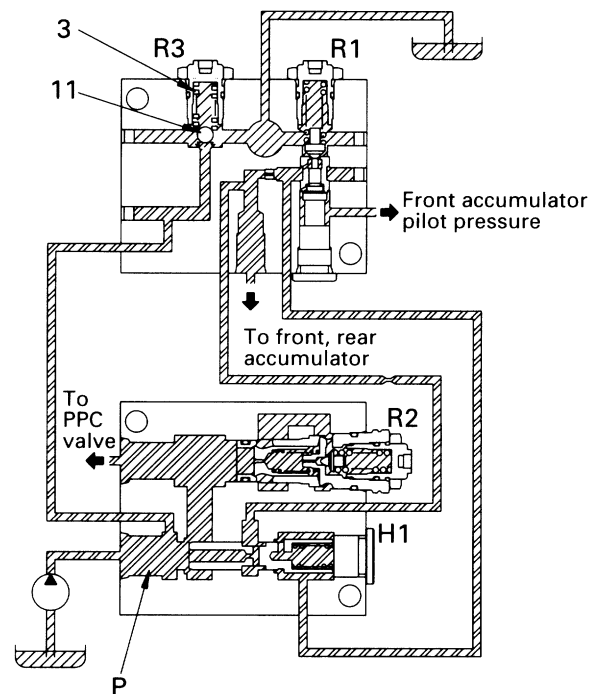
- When the pressure at port **B** (accumulator pressure) reaches the set pressure of the relief valve (R1), poppet (6) separates from valve seat (7), so an oil flow is generated and the circuit is relieved.
- When the circuit is relieved, a pressure difference is generated above and below piston (8), so piston (8) moves up, poppet (6) is forcibly opened, and port **C** and port **T** are short circuited.
- The spring chamber at the right end of spool (15) is connected to port **C** of the relief valve (R1), so the pressure becomes the tank pressure.
- The pressure at port **P** drops in the same way to a pressure equivalent to the load on spring (14), so the supply of oil to port **B** is stopped.



SDW00118

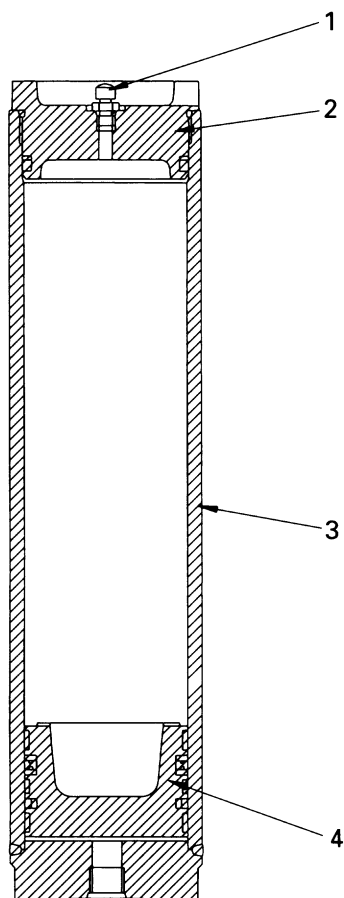
3. Safety relief valve (R3)

- If the pressure at port **P** (pump pressure) goes above the set pressure of the relief valve (R3), the oil from the pump pushes spring (3). Ball (11) is pushed up and the oil flows to the tank circuit, so this sets the maximum pressure in the brake circuit and protects the circuit.



SDW00119

ACCUMULATOR (FOR BRAKE)



1. Valve
2. Top cover
3. Cylinder
4. Piston

SEW00120

U42103

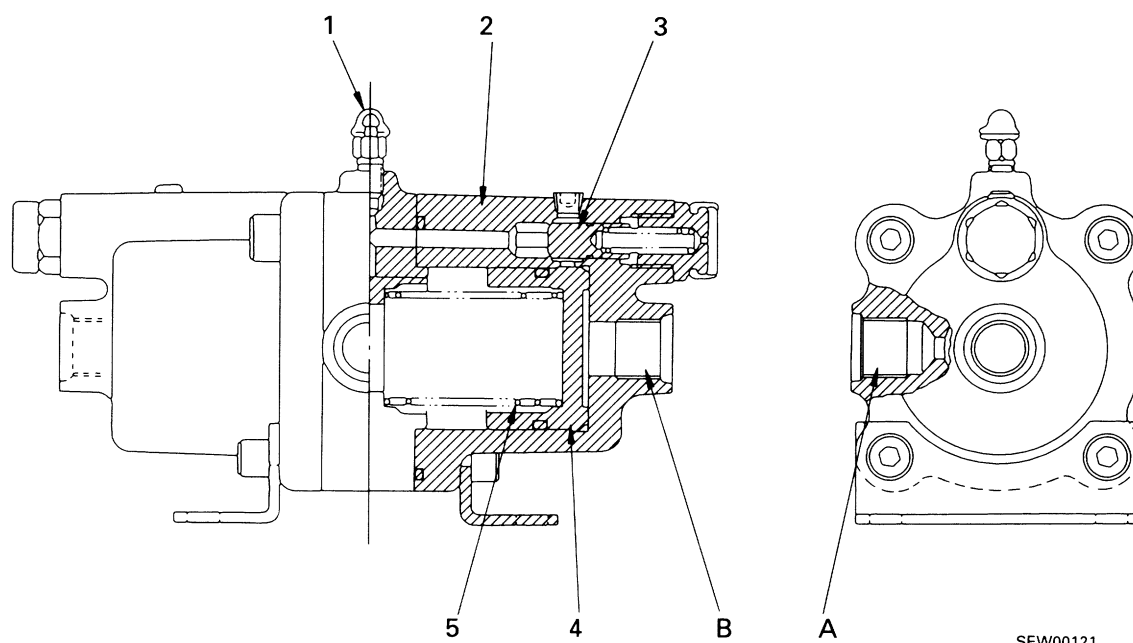
Function

- The accumulator is installed between the charge valve and the brake valve. It is charged with nitrogen gas between cylinder (3) and free piston (4), and uses the compressibility of the gas to absorb the pulse of the hydraulic pump or to maintain the braking force and to make it possible to operate the machine if the engine should stop.

Specifications

Gas used:	Nitrogen gas
Charge amount:	3000 cc
Charging pressure:	3.4 ± 0.15 MPa (35 ± 1.5 kg/cm ²) (at 50°C)

SLACK ADJUSTER



SEW00121

1. Bleeder
2. Cylinder
3. Check valve
4. Piston
5. Spring

- A. Inlet port
B. Outlet port

Function

- The slack adjuster is installed in the brake oil line from the brake valve to the brake piston. It acts to provide a fixed time lag when the brake is applied.

Specifications

- Piston actuation pressure:
 $0.01^{+0.01}_0$ MPa ($0.1^{+0.1}_0$ kg/cm²)
- Check valve cracking pressure:
 0.93 ± 0.05 MPa (9.5 ± 0.5 kg/cm²)
- Check valve closing pressure:
 0.6 ± 0.05 MPa (6.0 ± 0.5 kg/cm²)

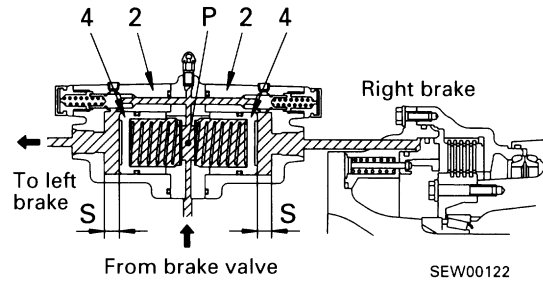
STRUCTURE AND FUNCTION

SLACK ADJUSTER

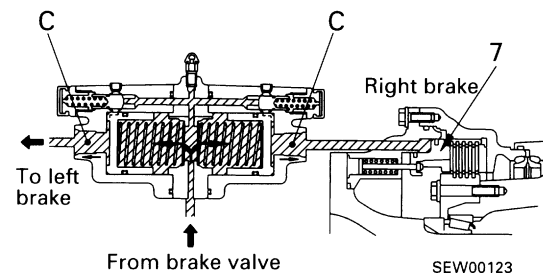
Operation

1. When brake pedal is depressed

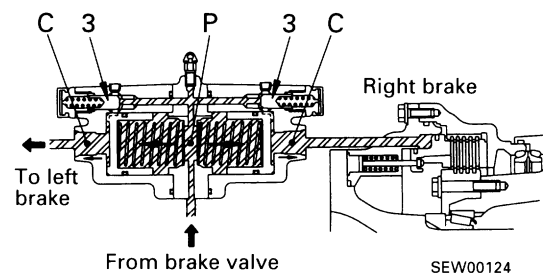
- Before the brake is depressed, piston (4) is returned by the distance of stroke **S** (full stroke). When the brake pedal is depressed, the oil discharged from the brake valve flows from port **P** of the slack adjuster and is divided to left and right cylinders (2), where it moves piston (4) by stroke **S** to the left and right.



- When this is done, brake piston (7) moves by a distance of stroke **S**. In this condition, the closer the clearance between the brake piston and disc is to 0, the greater the braking force becomes.



- If the brake pedal is depressed further, and the oil pressure discharged from the brake valve goes above the set pressure, check valve (3) opens and the pressure is applied to port **C** to act as the braking force. Therefore, when the brake is applied, the time lag is a fixed value.

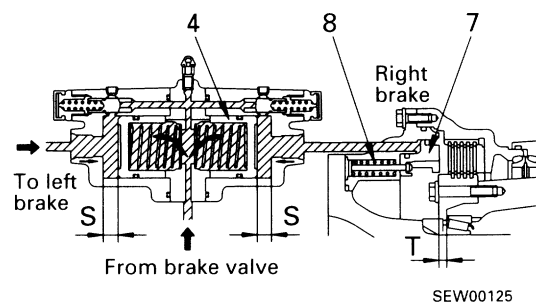


U42103

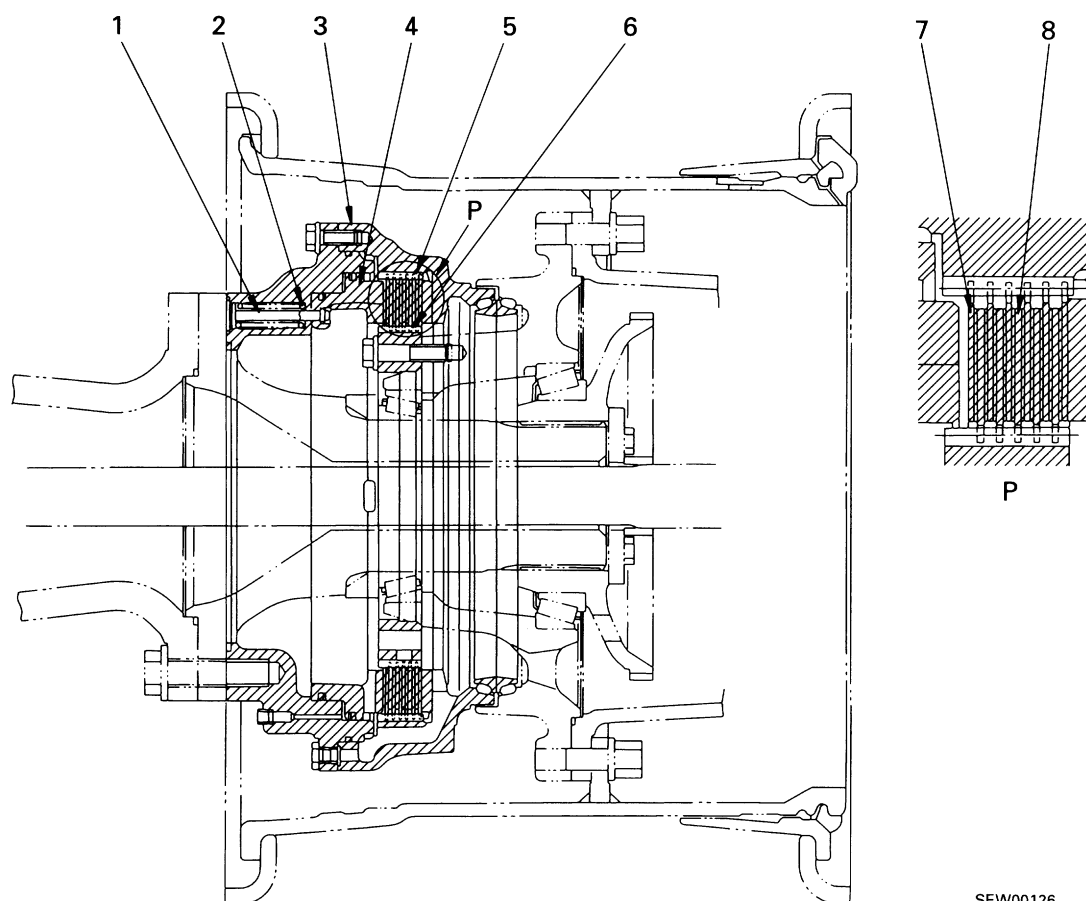
2. When brake pedal is released

- When the brake is released, piston (4) is returned by brake return spring (8) by an amount equivalent to the oil for stroke **S**, and the brake is released.

In other words, return stroke **T** of brake piston (7) is determined by the amount of oil for stroke **S** of the slack adjuster. The time lag of the brake is always kept constant regardless of the wear of the brake disc.



BRAKE



1. Guide pin
2. Return spring
3. Cylinder
4. Brake piston
5. Outer gear (No. of teeth: 138)
6. Inner gear (No. of teeth: 105)
7. Plate
8. Disc

SEW00126

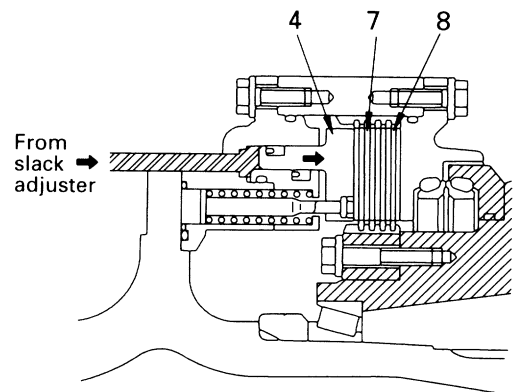
U42103

Function

- Service brakes are wet-type multiple-disc brakes and are installed to all four wheels.

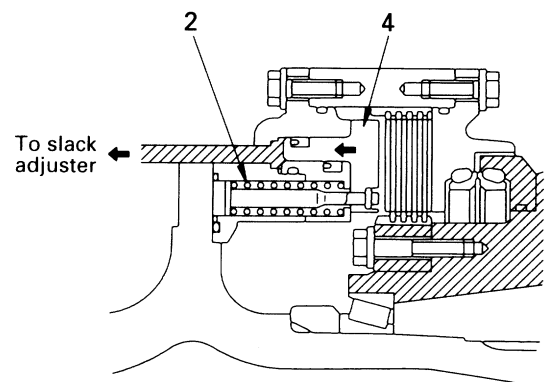
Operation

- When the brake pedal is depressed, the pressure oil from the brake valve moves brake piston (4) to the right in the direction of the arrow. This brings disc (8) and plate (7) into contact, and friction is generated between the disc and plate. The wheel is rotating together with the disc, so the machine speed is reduced and the machine is stopped by this friction.



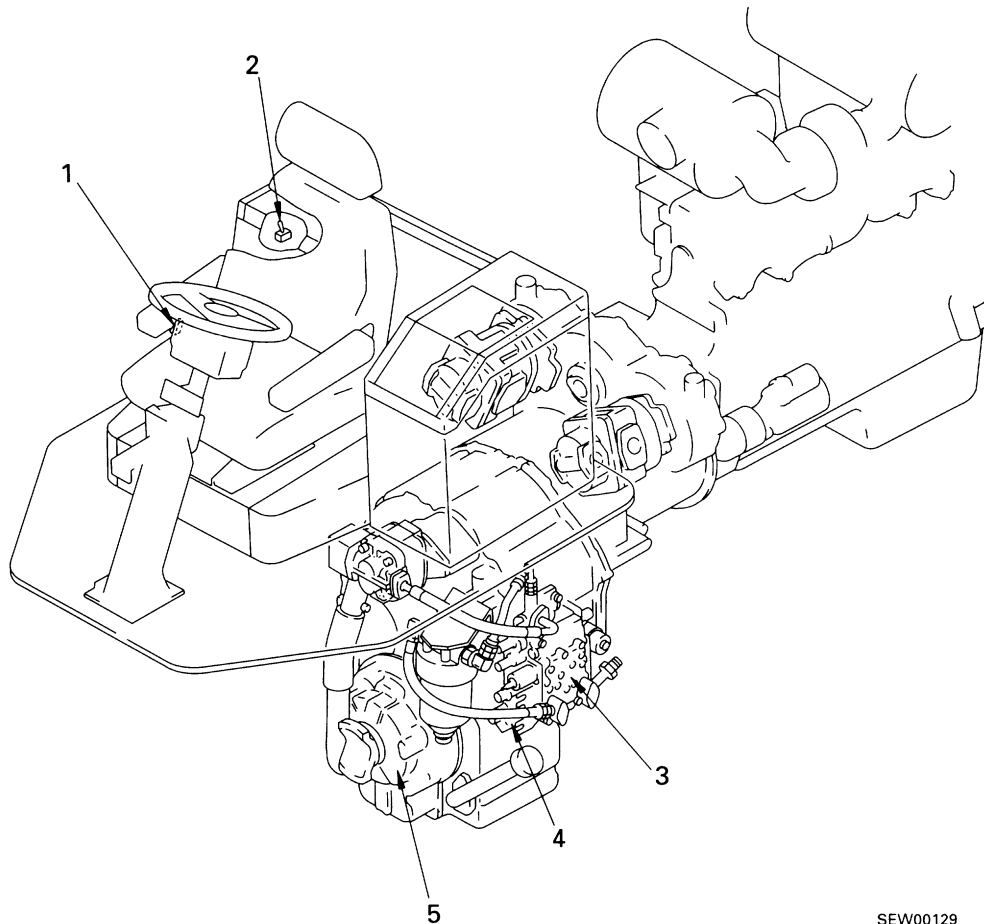
SEW00127

- When the brake pedal is released, the pressure at the back face of brake piston (4) is released, so the piston is moved to the left in the direction of the arrow by the force of return spring (2), and the brake is released.



SEW00128

PARKING BRAKE CONTROL



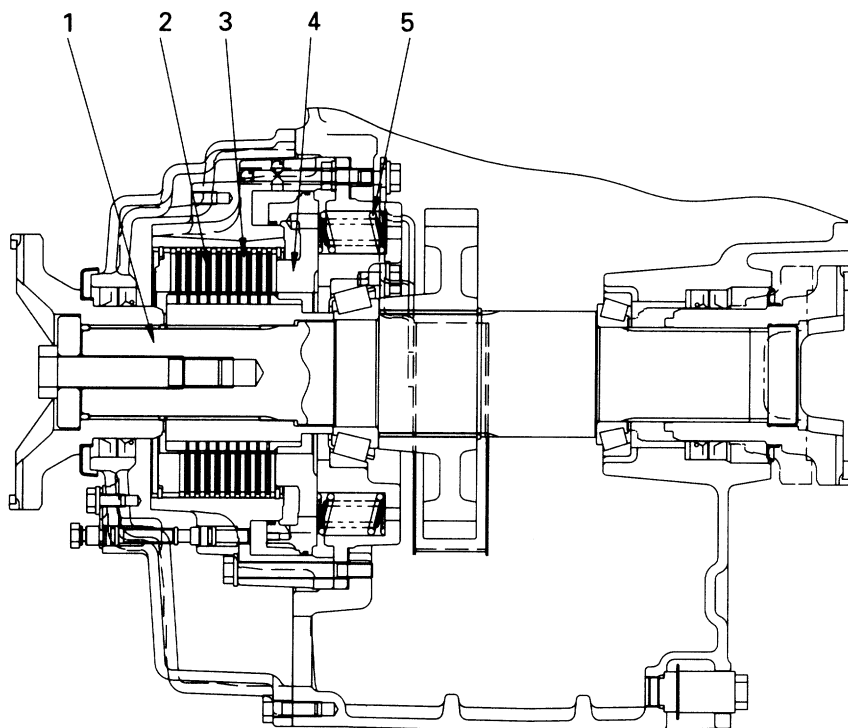
1. Parking brake switch
2. Parking brake emergency release switch
3. Transmission control valve

4. Parking brake solenoid valve
5. Transmission (built-in parking brake)

Outline

- The parking brake is a wet-type multiple-disc brake built into the transmission. It is installed to the output shaft bearing, and uses the pushing force of a spring to apply the brake mechanically and hydraulic power to release the brake.
- When parking brake switch (1) installed in the operator's compartment is switched ON, parking brake solenoid valve (4) installed to transmission control valve (3) shuts off the oil pressure and applies the parking brake. When the parking brake switch is turned OFF, the oil pressure in the cylinder releases the parking brake.
- When the parking brake is applied, the neutralizer relay shuts off the electric current to the transmission solenoid valve and keeps the transmission at neutral.
- Emergency release switch (2) for the parking brake is installed for use when moving the machine if the machine has stopped (the parking brake is automatically applied) because of trouble in the engine or drive system.

PARKING BRAKE



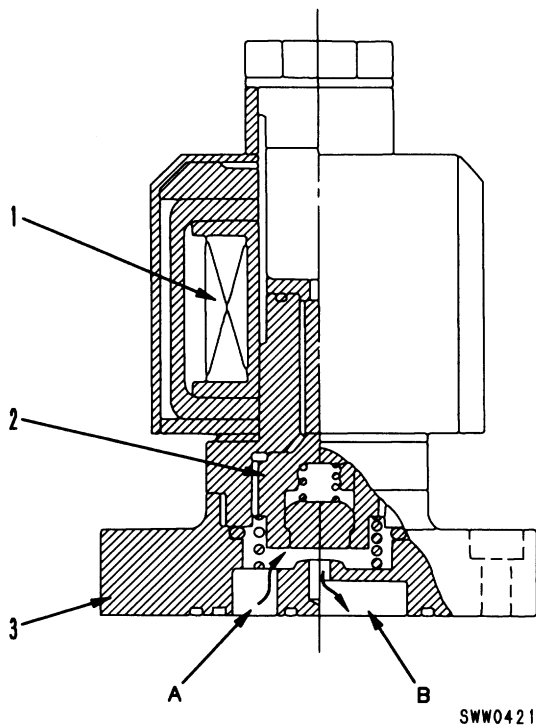
SDW00130

1. Output shaft
2. Disc
3. Plate
4. Piston
5. Spring

Outline

- The parking brake is a wet-type multiple-disc brake. It is actuated mechanically by a spring and applies the braking force to output shaft (1) of the transmission.
- The pushing force of spring (5) pushes piston (4) and plate (3) and disc (2) into contact and applies the braking force to stop output shaft (1).

PARKING BRAKE SOLENOID VALVE



1. Coil
2. Valve ass'y
3. Body
- A. IN port
- B. OUT port

Function

- This solenoid valve is controlled by the parking brake switch in the operator's compartment and acts to switch the flow of oil to the parking brake.

Operation

- **Parking brake applied**
When the parking brake switch in the operator's compartment is turned ON, the solenoid valve is turned OFF (electric current is cut), and the oil in the pilot circuit from the transmission pump flows from the IN port to the OUT port and opens the drain circuit.
- **Parking brake released**
When the parking brake switch in the operator's compartment is turned OFF, the solenoid valve is turned ON (electric current flows). The valve closes and the flow of oil in the pilot circuit to the drain circuit is shut off.

U42103

PARKING BRAKE VALVE

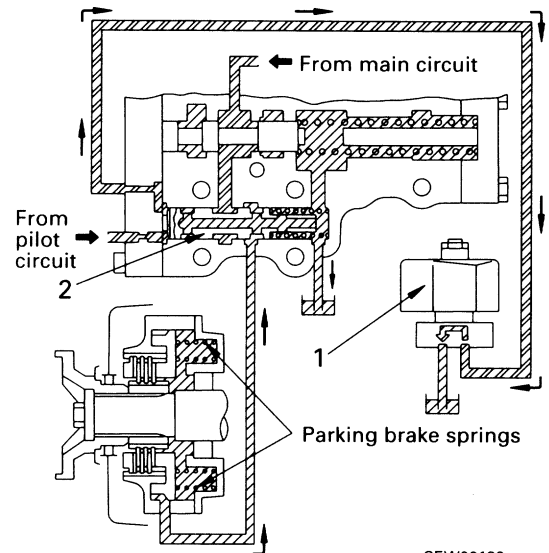
Function

- The parking brake valve is installed inside the transmission control valve and lower valve, and controls the parking brake cylinder.

Operation

1. Parking brake applied

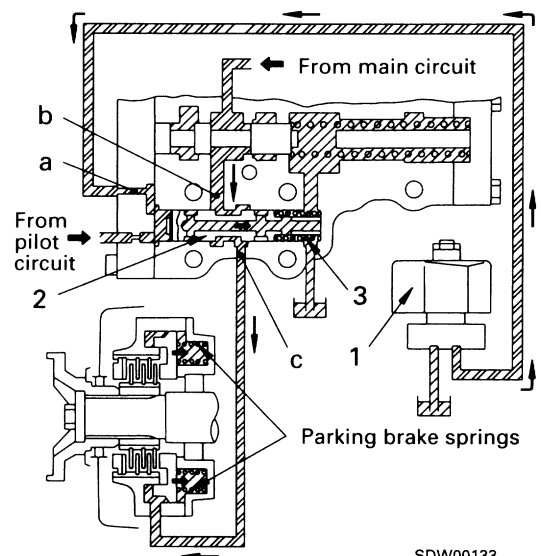
- When the parking brake switch is turned ON, solenoid valve (1) is turned OFF and the drain circuit is opened. The oil in the pilot circuit from the pump then flows to drain circuit.
- The oil in the main circuit is shut off by spool (2), and the oil in the brake cylinder flows to the drain circuit. Therefore, the parking brake is applied by the force of the spring in the parking brake cylinder.



SEW00132

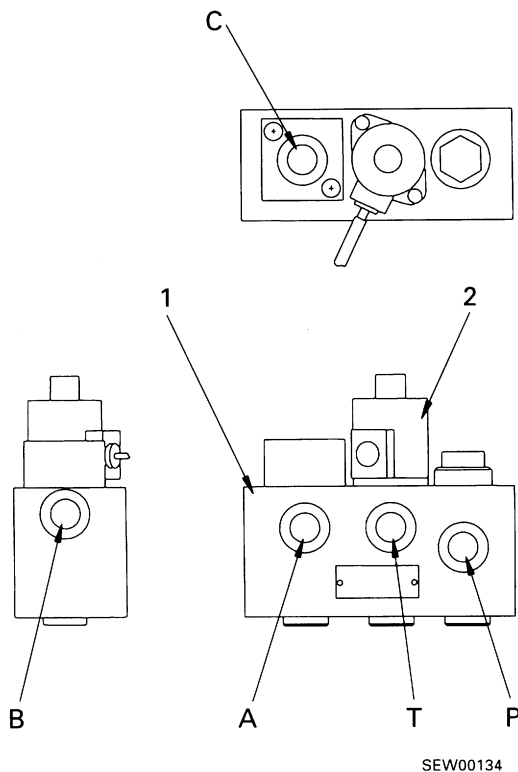
2. Parking brake released

- When the parking brake switch is turned OFF, solenoid valve (1) is turned ON, and the drain circuit is closed.
- When the oil pressure at port **a** rises, it pushes against spring (3) and moves spool (2) to the right in the direction of the arrow. This shuts off the drain circuit of the brake cylinder, so the oil from the main circuit flows from port **b** to port **c** to actuate the brake cylinder and release the parking brake.



SDW00133

PARKING BRAKE EMERGENCY RELEASE SOLENOID VALVE



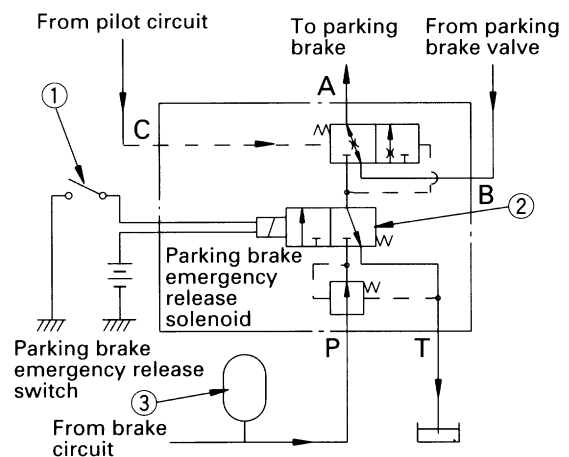
1. Valve ass'y
 2. Solenoid valve
- A: To parking brake
B: From parking brake valve
C: From pilot circuit
T: Drain
P: From brake (accumulator circuit)

Function

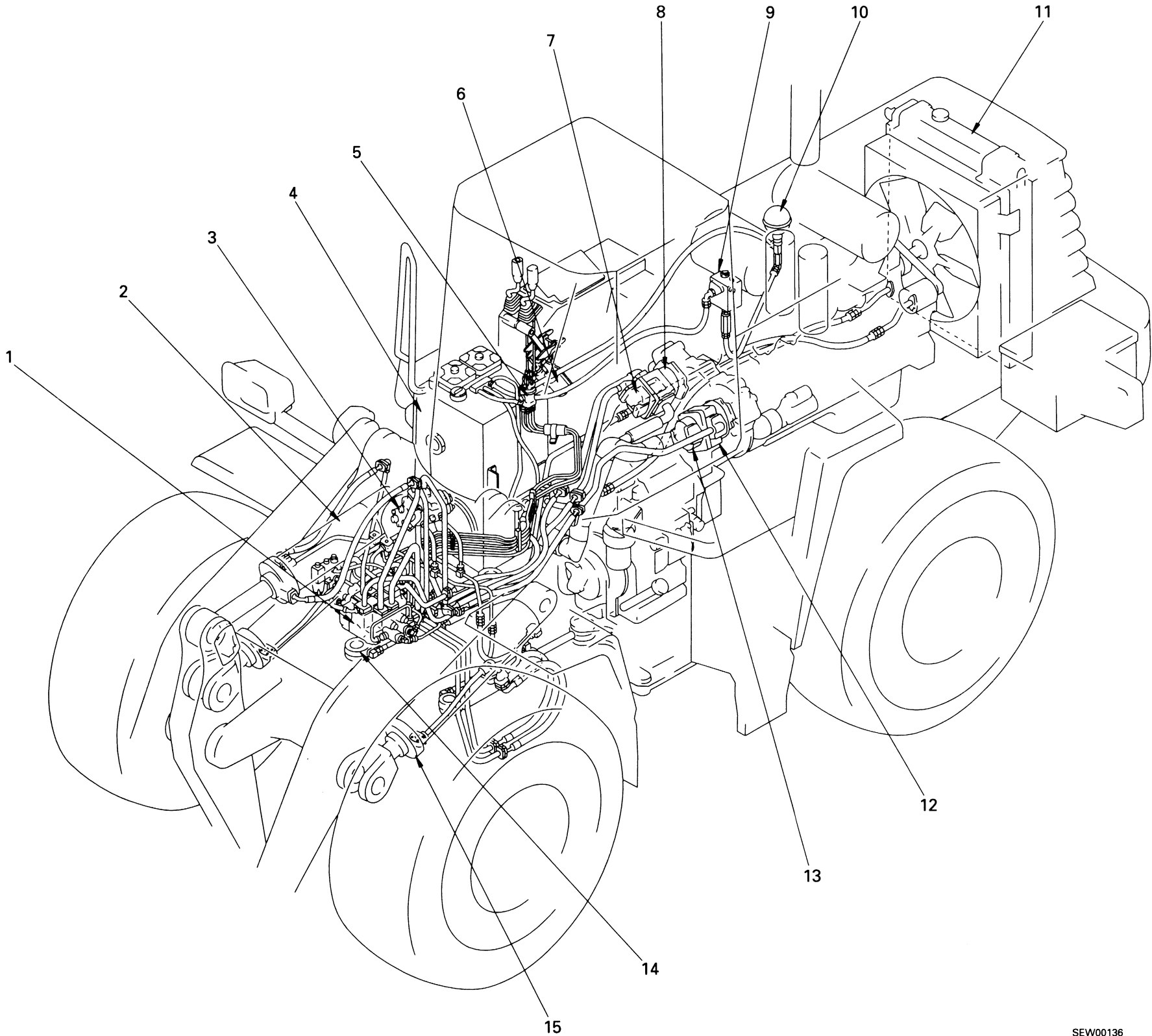
- The emergency release solenoid valve is installed between the transmission and the transmission control valve. If the engine breaks down and no oil pressure is supplied from the transmission pump, it is possible to actuate the solenoid for the parking brake release switch in the operator's compartment. This allows the accumulator charge pressure in the brake circuit to flow to the parking brake cylinder.

Operation

- When parking brake emergency release switch ① is turned ON, solenoid valve ② is actuated and the pressure stored in accumulator ③ enters from port P. The circuit is switched by the pilot pressure, so the oil flows from port A to the parking brake to release the parking brake.



HYDRAULIC PIPING



Outline

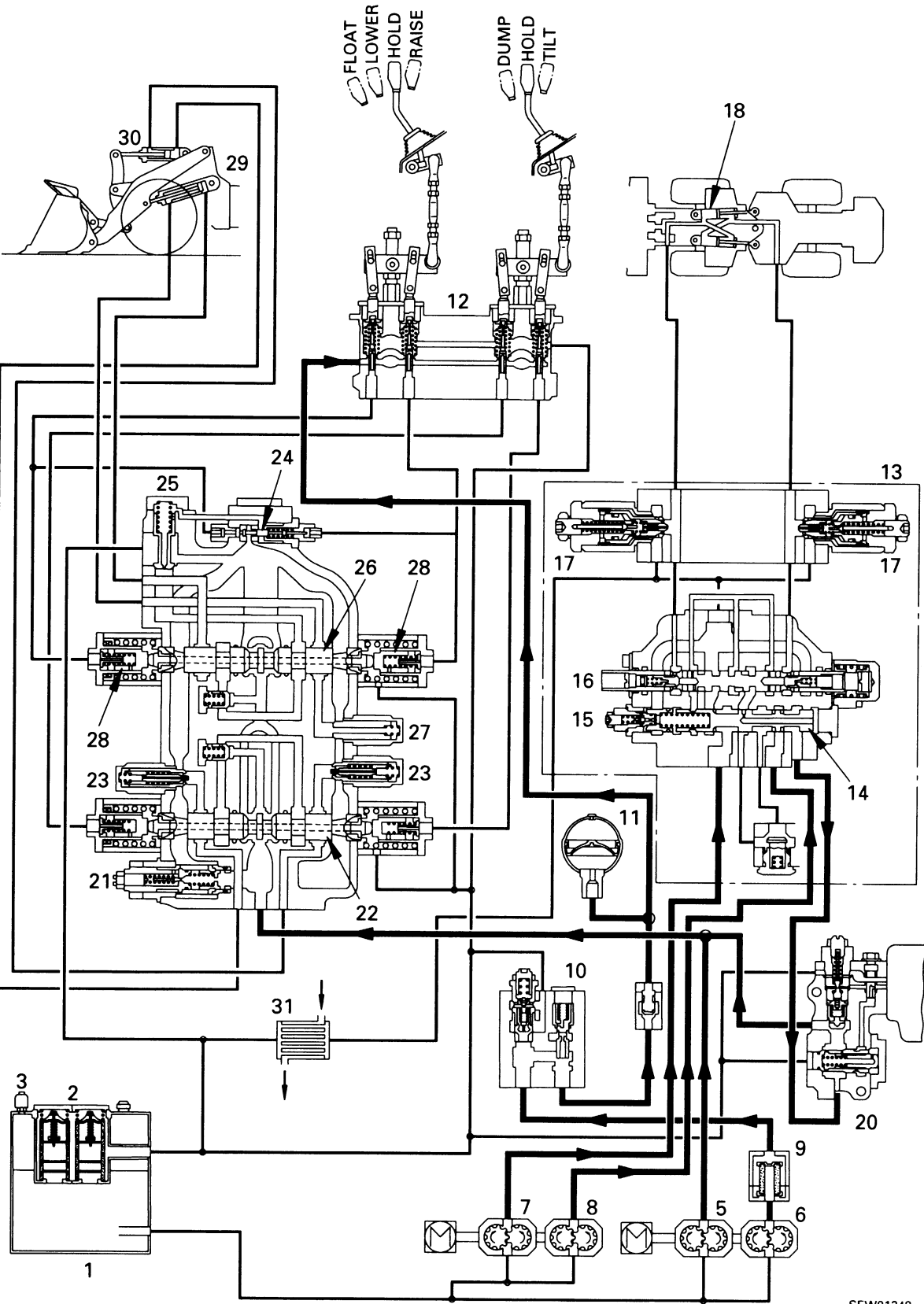
- The hydraulic system consists of the work equipment circuit and the steering circuit. The work equipment circuit controls the actuation of the bucket and attachments.
- The oil in hydraulic tank (4) is sent to main control valve (1) by hydraulic pump (12). If the spools for the bucket and boom in the main control valve are at the HOLD position, the oil flows to the drain circuit of the main control valve, is filtered by the filter inside the hydraulic tank, and then returns to the tank.
- When the work equipment control levers are operated, the PPC valve bucket spool or boom spool is actuated, and the spools of the main control valve are actuated by hydraulic pressure to send the oil from the main control valve to boom cylinder (15) or bucket cylinder (2) to operate the boom or bucket.
- Control of the maximum pressure in the hydraulic circuit is carried out by the relief valve inside the main control valve. A safety valve (with suction) is installed in the bucket cylinder circuit to protect the circuit.
- Accumulator (10) is installed in the PPC pilot circuit, and makes it possible to lower the boom to the ground even when the engine has stopped.
- Hydraulic tank (4) is a pressurized sealed type and has a breather equipped with a relief valve. This makes it possible to pressurize the inside of the tank and also to prevent any negative pressure, thereby preventing any cavitation of the pump.

- | | |
|-----------------------|-----------------------|
| 1. Main control valve | 9. Check valve |
| 2. Bucket cylinder | 10. Accumulator |
| 3. Steering valve | 11. Radiator |
| 4. Hydraulic tank | 12. Hydraulic pump |
| 5. PPC valve | 13. PPC, brake pump |
| 6. Solenoid valve | 14. Steering cylinder |
| 7. Switch pump | 15. Boom cylinder |
| 8. Steering pump | |

SEW00136

WORK EQUIPMENT HYDRAULIC SYSTEM DIAGRAM

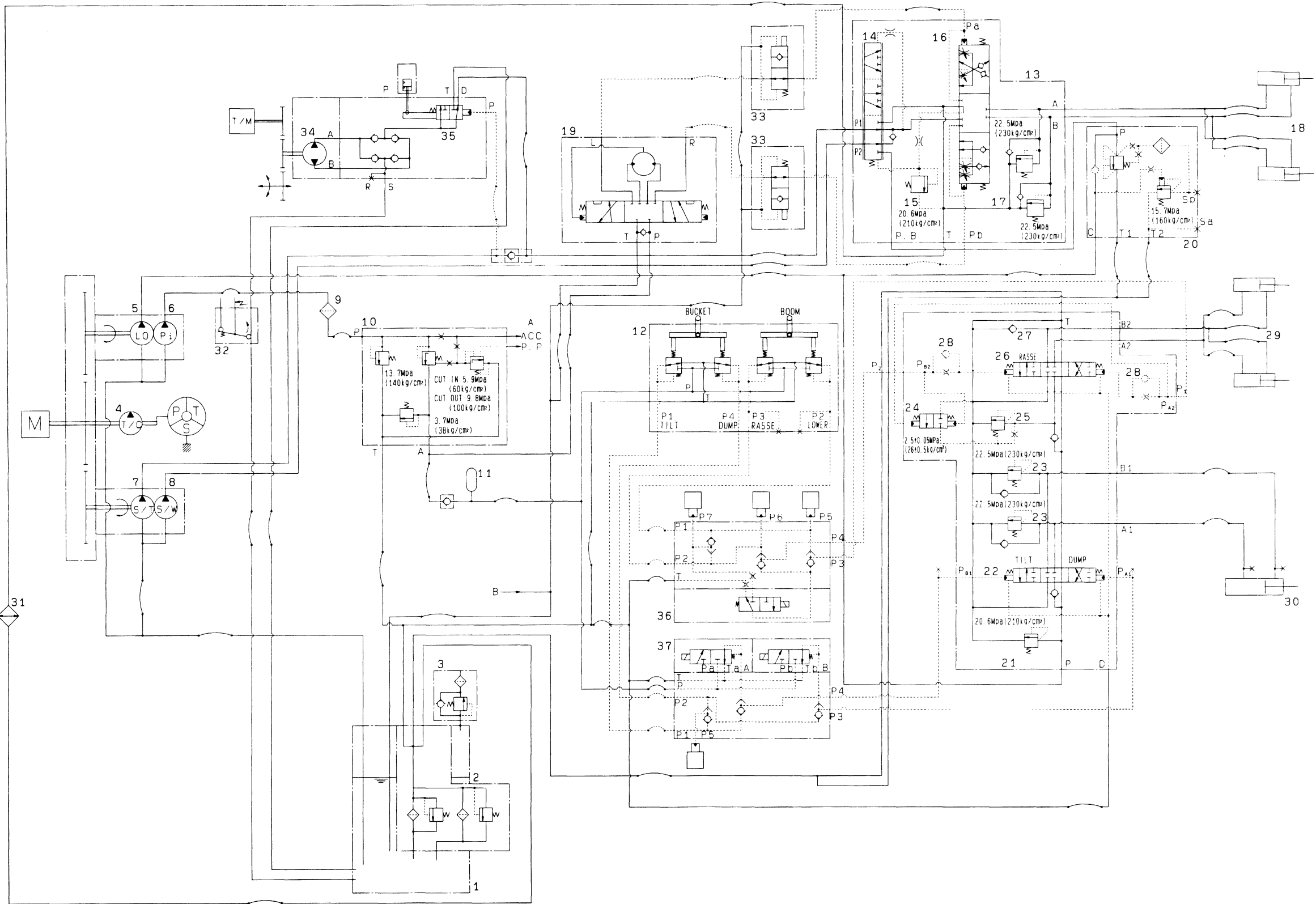
(Conditions: Engine at low idling, work equipment control levers at HOLD)
Serial No.: 50001 – 53999



SEW01248

WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

Serial No.: 50001 – 50042

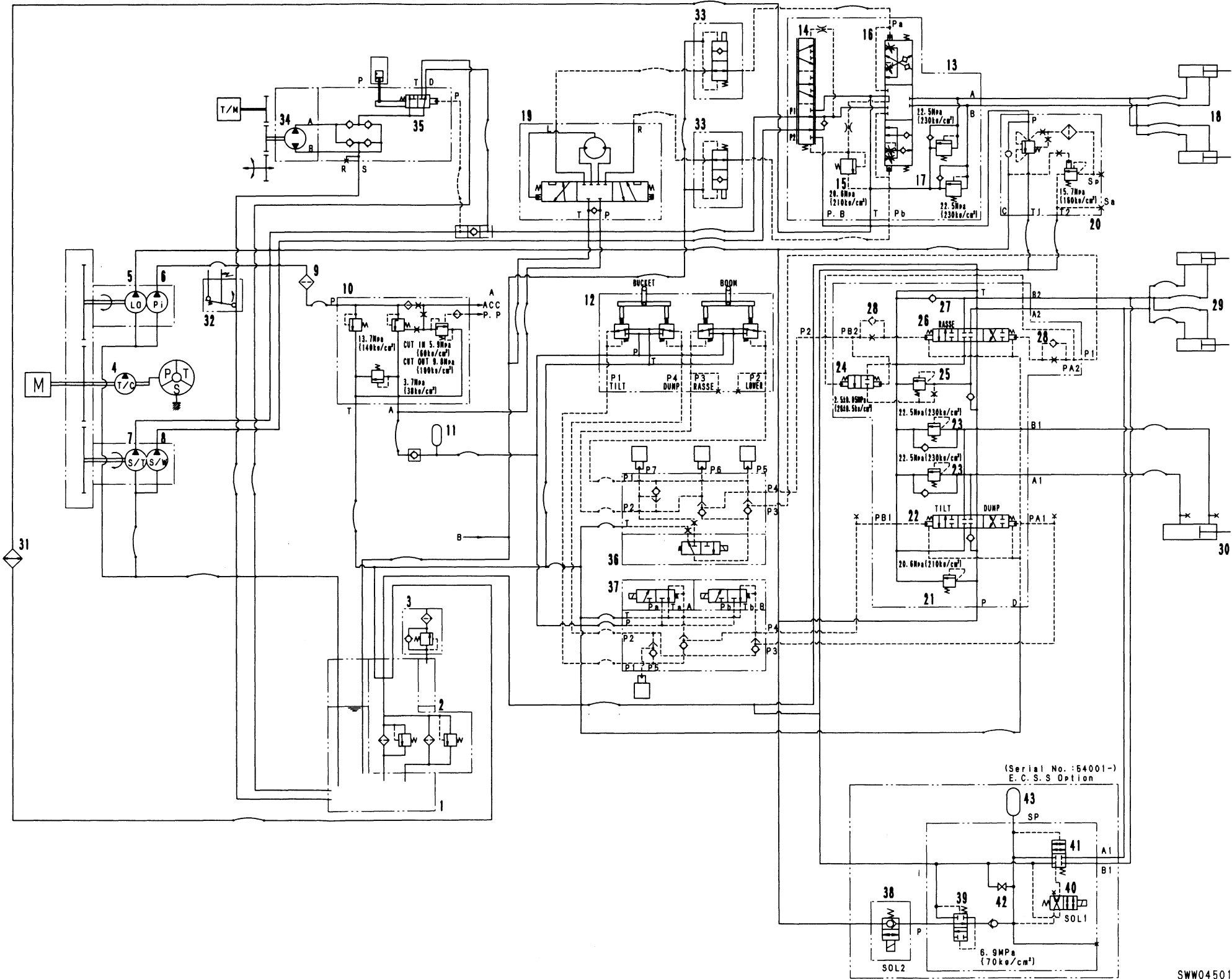


- 1. Hydraulic tank
- 2. Oil filter
- 3. Breather
- 4. Torque converter charging pump
- 5. Hydraulic pump
- 6. PPC, brake pump
- 7. Steering pump
- 8. Switch pump
- 9. Filter
- 10. Accumulator charge valve
- 11. Accumulator
- 12. PPC valve
- 13. Steering valve assembly
- 14. Flow control valve
- 15. Relief valve
- 16. Steering spool
- 17. Overload relief valve with suction
- 18. Steering cylinder
- 19. Orbit-roll valve
- 20. Cut-off valve
- 21. Relief valve
- 22. Bucket spool
- 23. Safety valve with suction
- 24. Float selector valve
- 25. Unload valve
- 26. Boom spool
- 27. Suction valve
- 28. Slow return valve
- 29. Boom cylinder
- 30. Bucket cylinder
- 31. Oil cooler
- 32. Flow switch
- 33. Stop valve
- 34. Emergency steering pump
- 35. Divider valve
- 36. Remote positioner shuttle valve
- 37. Auto leveling shuttle valve

SMW01279

WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

Serial No.: 50043 – 53999
Serial No.: 54001 and up

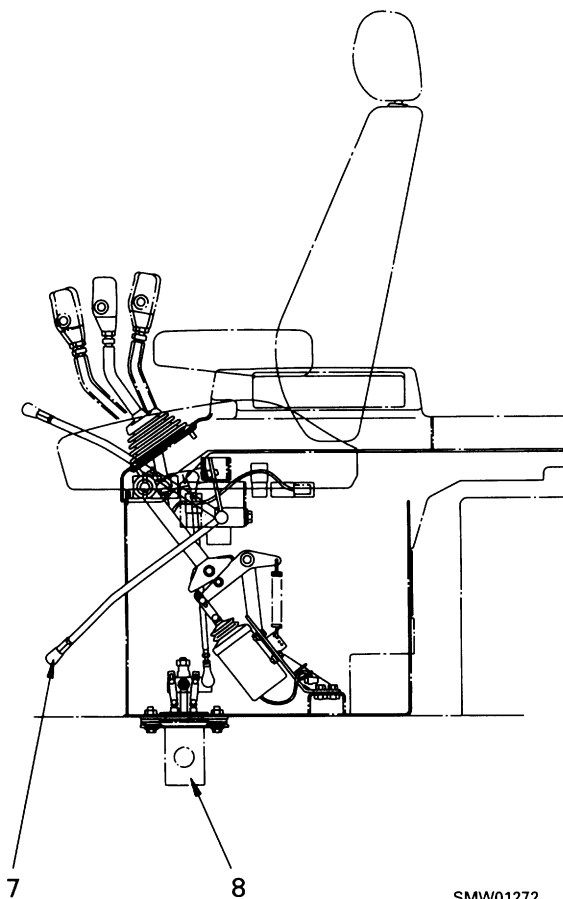
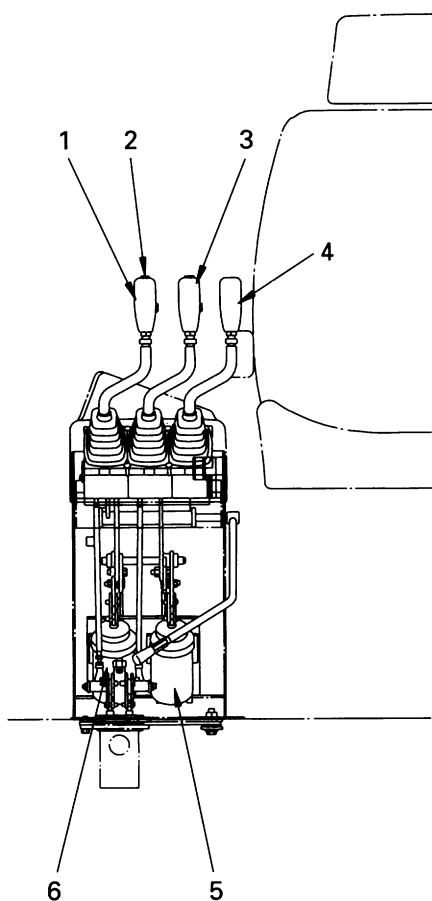


- 1. Hydraulic tank
- 2. Oil filter
- 3. Breather
- 4. Torque converter charging pump
- 5. Hydraulic pump
- 6. PPC, brake pump
- 7. Steering pump
- 8. Switch pump
- 9. Filter
- 10. Accumulator charge valve
- 11. Accumulator
- 12. PPC valve
- 13. Steering valve assembly
- 14. Flow control valve
- 15. Relief valve
- 16. Steering spool
- 17. Overload relief valve with suction
- 18. Steering cylinder
- 19. Orbit-roll valve
- 20. Cut-off valve
- 21. Relief valve
- 22. Bucket spool
- 23. Safety valve with suction
- 24. Float selector valve
- 25. Unload valve
- 26. Boom spool
- 27. Suction valve
- 28. Slow return valve
- 29. Boom cylinder
- 30. Bucket cylinder
- 31. Oil cooler
- 32. Flow switch
- 33. Stop valve
- 34. Emergency steering pump
- 35. Divider valve
- 36. Remote positioner shuttle valve
- 37. Auto leveling shuttle valve
- 38. Charge control solenoid valve (sol 2)
- 39. Charge valve
- 40. Solenoid valve (sol 1)
- 41. Main spool
- 42. Shut off valve
- 43. Accumulator

for E.C.S.S.
(option)

U42103

WORK EQUIPMENT LEVER LINKAGE



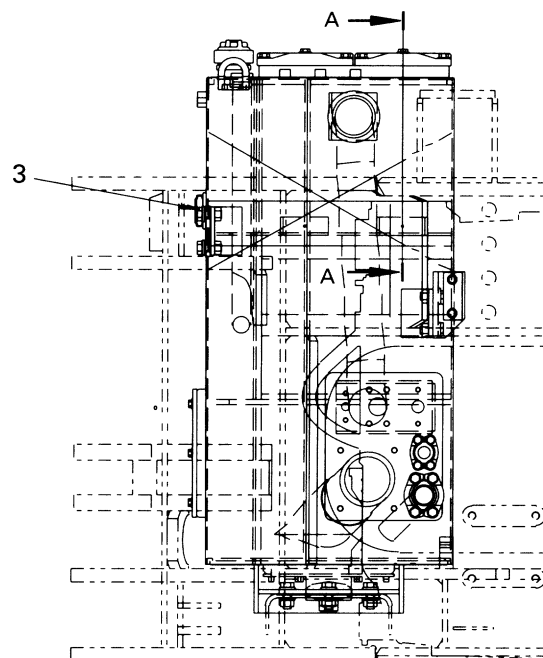
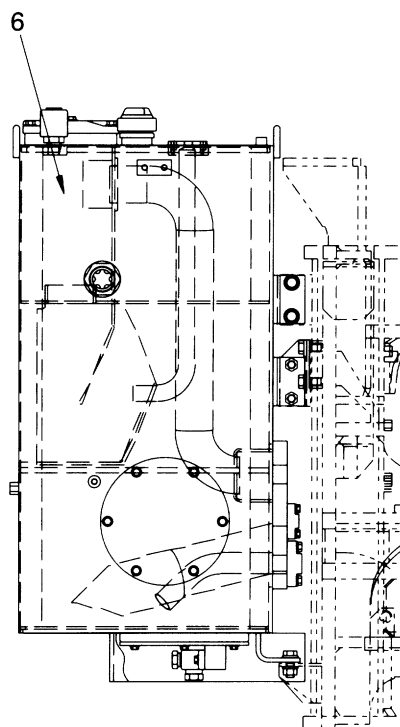
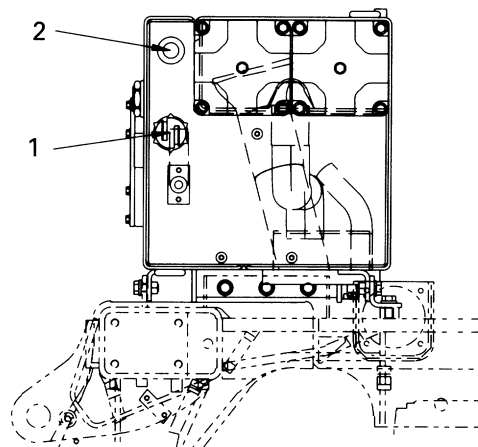
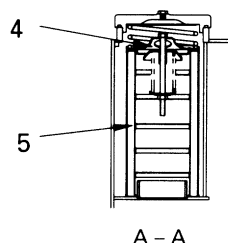
SMW01272

- 1. Boom lever
- 2. Kick-down switch
- 3. Bucket lever
- 4. Attachment lever

- 5. Solenoid valve for bucket lever
- 6. Solenoid valve for boom lever
- 7. Safety lever
- 8. PPC valve

U42103

HYDRAULIC TANK

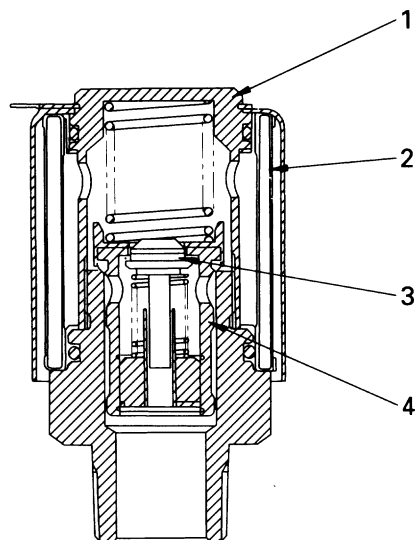


SDW00140

- 1. Oil filler
- 2. Breather
- 3. Sight gauge

- 4. Filter suction valve
- 5. Oil filter
- 6. Hydraulic tank

BREATHER



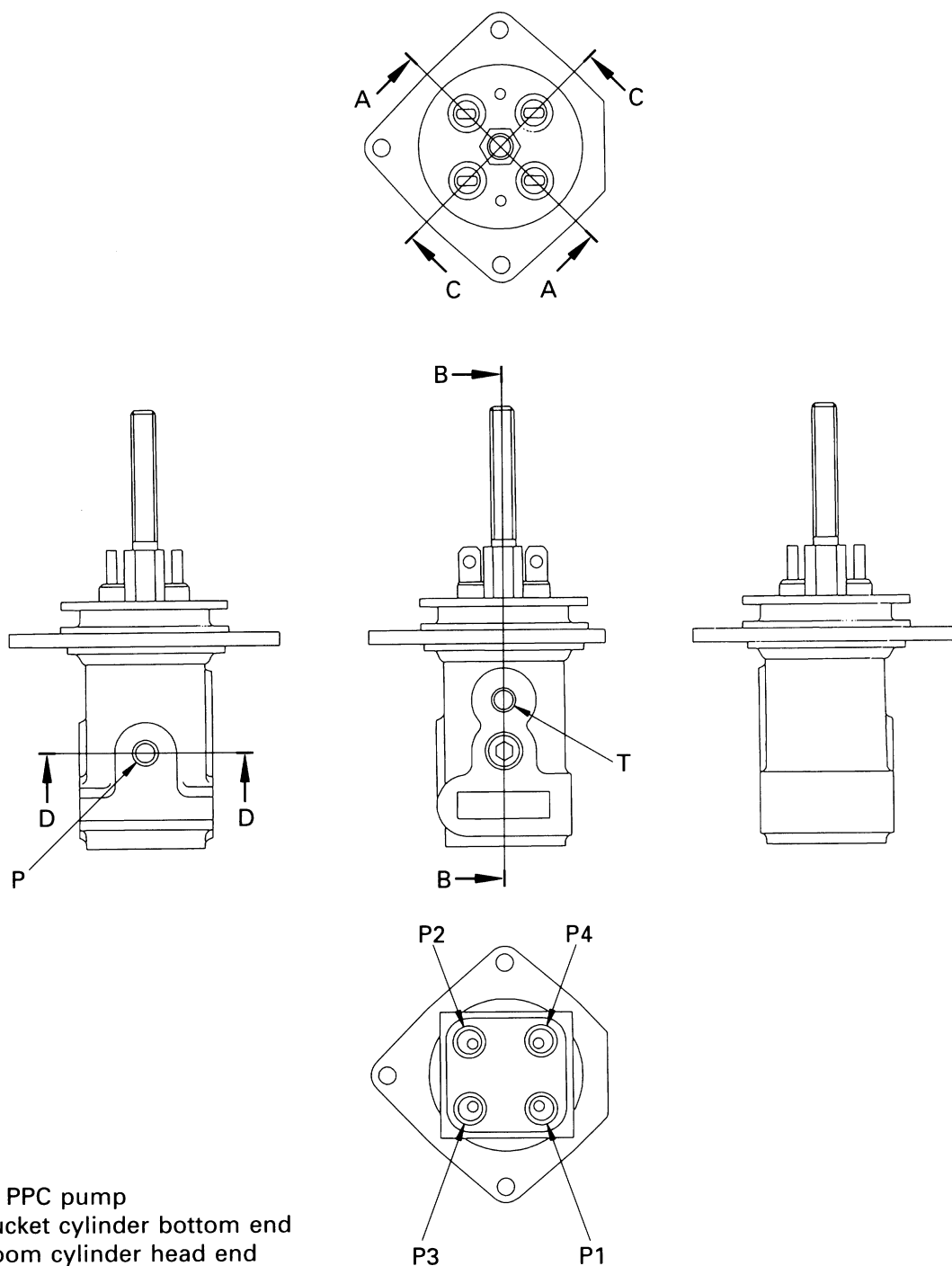
SEW00141

1. Body
2. Filter element
3. Poppet
4. Sleeve

- **Preventing negative pressure inside tank**
The tank is a pressurized sealed type, so if the oil level inside the hydraulic tank goes down, there will be negative pressure in the tank. If this happens, a poppet is opened by the difference between the pressure inside the tank and the atmospheric pressure, and air is let in to prevent negative pressure from forming inside the tank.

- **Preventing rise in pressure inside tank**
If the pressure in the circuit rises above the set pressure during operations because of the change in the oil level in the hydraulic cylinders or the rise in the temperature, the sleeve is actuated to release the pressure inside the hydraulic tank.

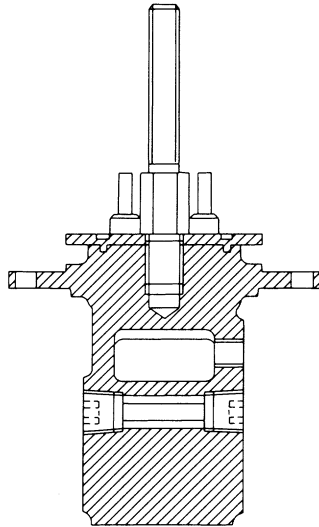
PPC VALVE



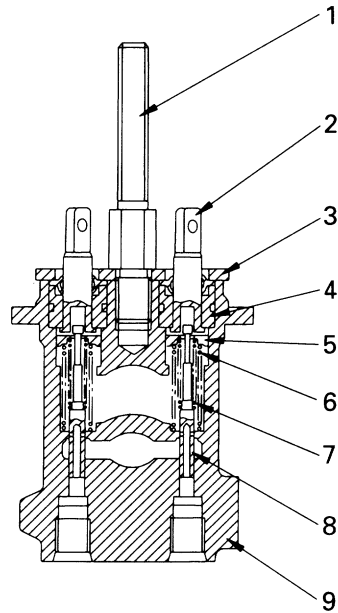
- P. From PPC pump
- P1. To bucket cylinder bottom end
- P2. To boom cylinder head end
- P3. To boom cylinder bottom end
- P4. To bucket cylinder head end
- T. Drain

SEW00142

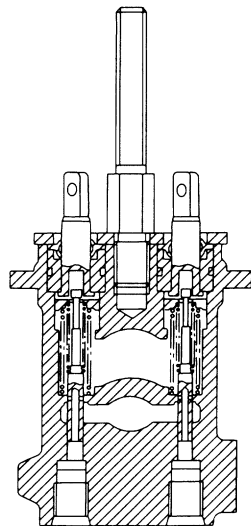
U42103



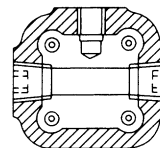
B - B



A - A



C - C



D - D

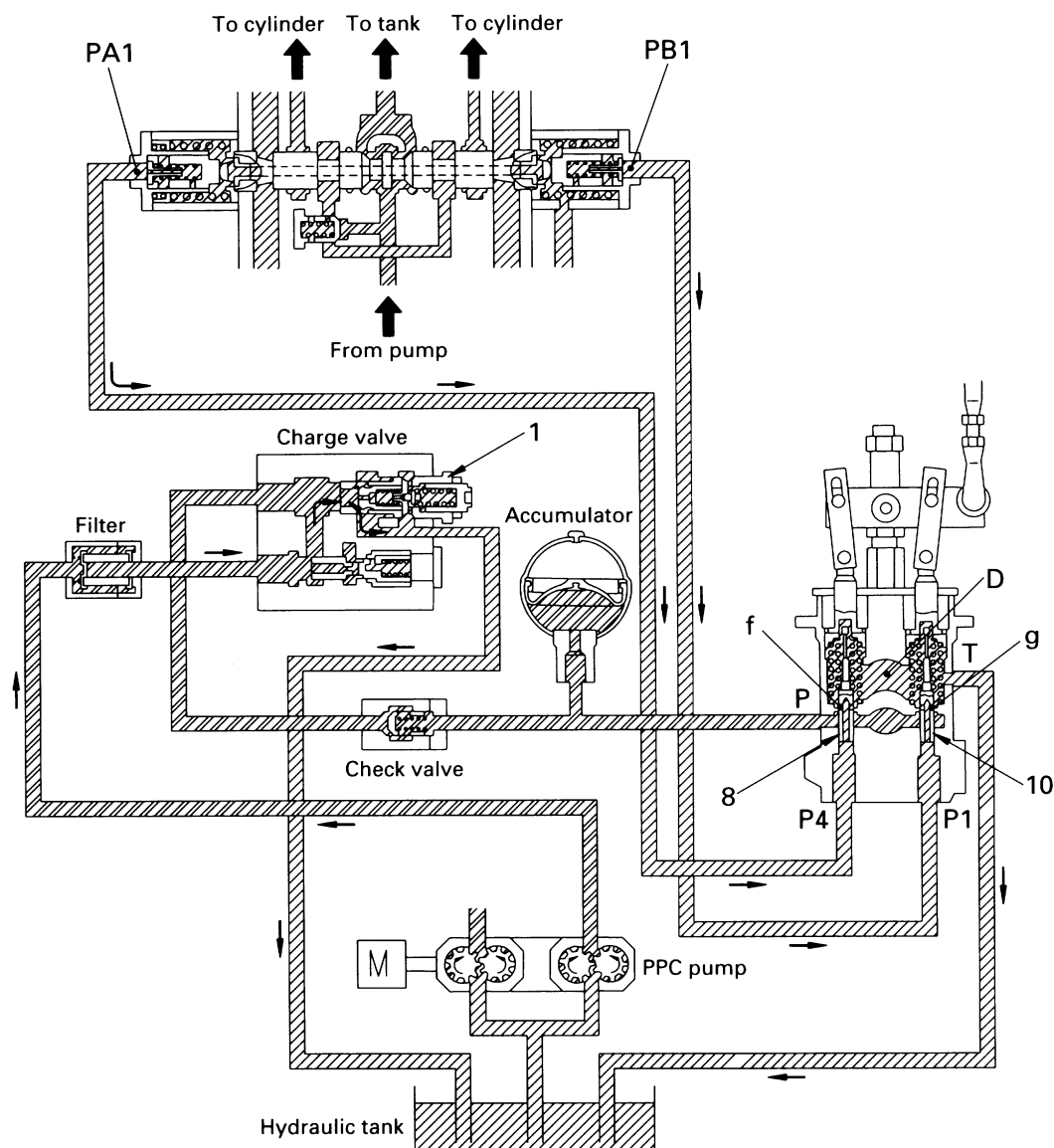
SEW00143

1. Bolt
2. Piston
3. Plate
4. Collar
5. Retainer
6. Centering spring
7. Metering spring
8. Valve
9. Body

Function

- The PPC valve is installed at the bottom of the work equipment control lever and is connected by a linkage to the control lever.
- The oil from the PPC pump is supplied to the end of each spool of the main control valve in accordance with the movement of the control lever, and this actuates the spool. For this reason, the operating force of the control lever is small and this helps to reduce operator fatigue.

OPERATION OF PPC VALVE [At neutral]



SEW00144

- The oil from the pump enters port **P**. The circuit is closed by spool (8), so the oil is drained from relief valve (1).
At the same time, the oil at port **PA1** of the main control valve is drained from port **f** of spool (8).
In addition, the oil at port **PB1** is drained from port **g** of spool (10).

U42103

FUNCTION OF PPC VALVE

The PPC valve supplies pressure oil from the charging pump to the side face of the spool of each control valve according to the amount of travel of the control lever.

This pressure oil actuates the spool.

Operation

1. Control lever at "hold" (Fig. 1)

Ports **PA₁**, **P₄**, **PB₁** and **P₁** are connected to drain chamber **D** through fine control hole (**f**) in valve (8).

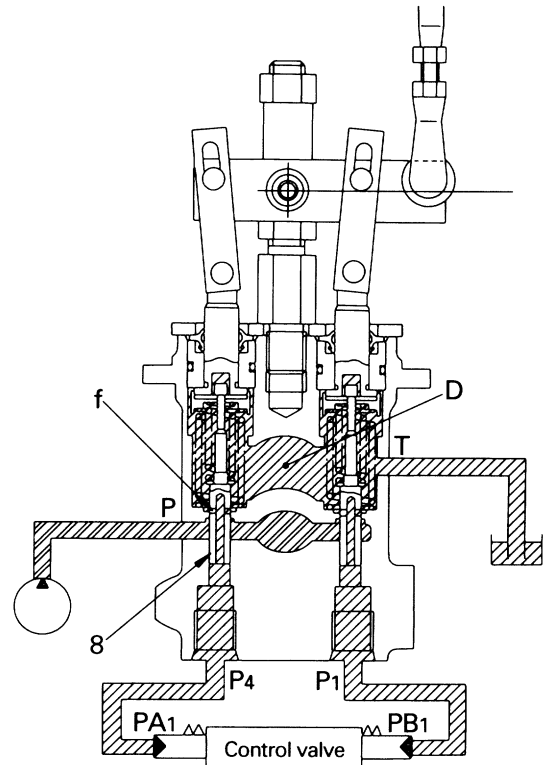
2. Control lever operated slightly (fine control) (Fig. 2):

When piston (2) starts to be pushed by plate (10), retainer (5) is pushed. Valve (8) is also pushed by spring (7) and moves down.

When this happens, fine control hole (**f**) is shut off from drain chamber **D**. At almost the same time it is connected to pump pressure chamber **P_P**, and the pilot pressure of the control valve is sent through fine control hole (**f**) to port **P₄**. When the pressure at port **P₄** rises, valve (8) is pushed back. Fine control hole (**f**) is shut off from pump pressure chamber **P_P**. At almost the same time it is connected to drain chamber **D**, so the pressure at port **P₄** escapes to drain chamber **D**. Valve (8) moves up and down until the force of spring (7) is balanced with the pressure of port **P₄**.

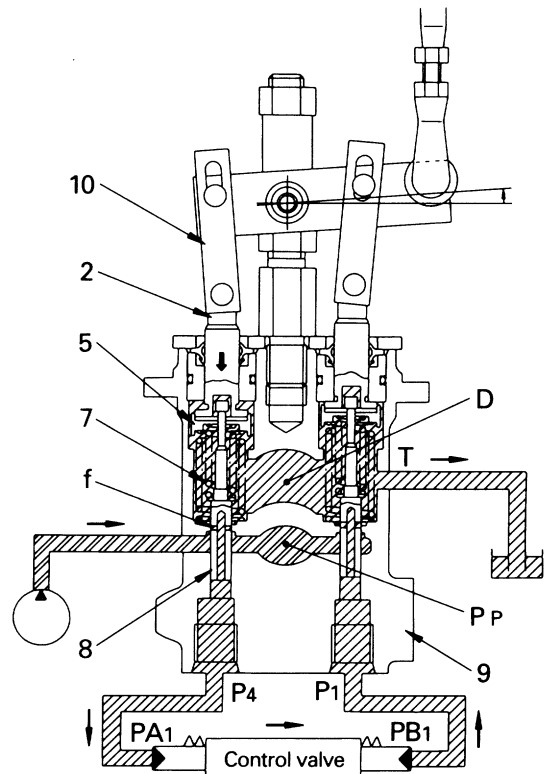
The position of valve (8) and body (9) (when fine control hold (**f**) is midway between drain chamber **D** and pump pressure chamber **P_P**) does not change until the head of valve (8) contacts the bottom of piston (2).

Therefore, spring (7) is compressed in proportion to the travel of the control lever, so the pressure at port **P₄** also rises in proportion to the travel of the control lever. The spool of the control valve moves to a position where the pressure of port **PA₁** (same as pressure at port **P₄**) and the force of the return spring of the control valve are balanced.



(Fig. 1)

SEW00145



(Fig. 2)

SEW00146

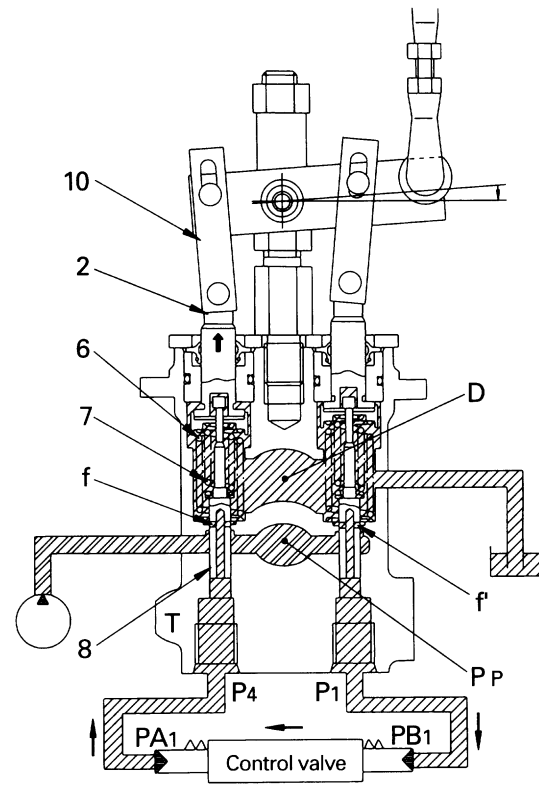
STRUCTURE AND FUNCTION**PPC VALVE****3. Control lever moved back from slightly operated position to hold (Fine control) (Fig. 3):**

When plate (10) starts to be pushed back, piston (2) is pushed up by a force corresponding to the force of centering spring (6) and the pressure at port **P₄**.

At the same time, fine control hole (**f**) of valve (8) is connected to drain chamber **D**, so the oil at port **P₄** escapes.

If the pressure at port **P₄** drops too far, valve (8) is pushed down by spring (7). Fine control hole (**f**) is shut off from drain chamber **D**, and at almost the same time it is connected to pump pressure chamber **P_P**. The pump pressure is supplied until the pressure at port **PA₁** returns to a pressure equivalent to the position of the lever.

When the spool of the control valve returns, the oil in drain chamber **D** flows in from fine control hole (**f'**) of the valve which has not moved. The extra oil then flows through port **P₁** to chamber **PB₁**.



(Fig. 3)

SEW00147

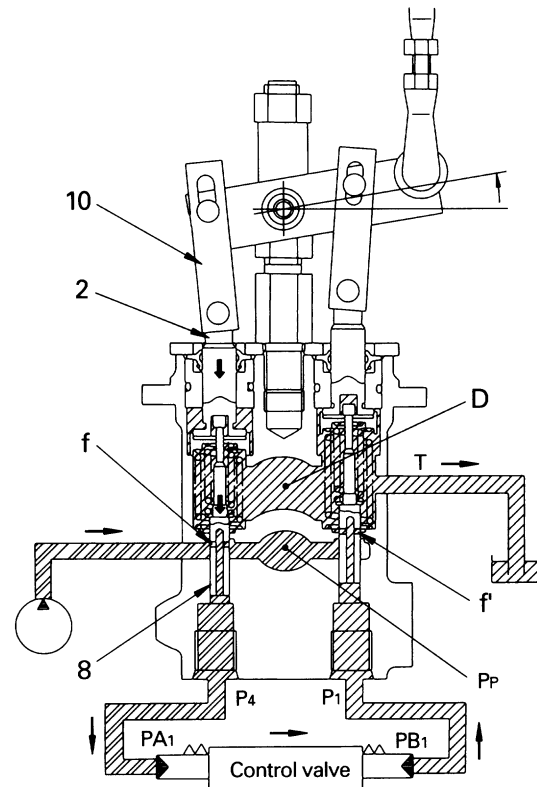
4. Control lever operated to end of travel (Fig. 4):

Plate (10) pushes piston (2) down, and piston (2) forcibly pushes in valve (8).

Fine control hole (**f**) is shut off from drain chamber **D**, and is connected to pump pressure chamber **P_P**.

Therefore, pressure oil from the charging pump passes through fine control hole (**f**), and flows from port **P₄** to chamber **PA₁** to push the spool of the control valve.

The oil returning from chamber **PB₁** flows from port **P₁** through fine control hole (**f'**) to drain chamber **D**.

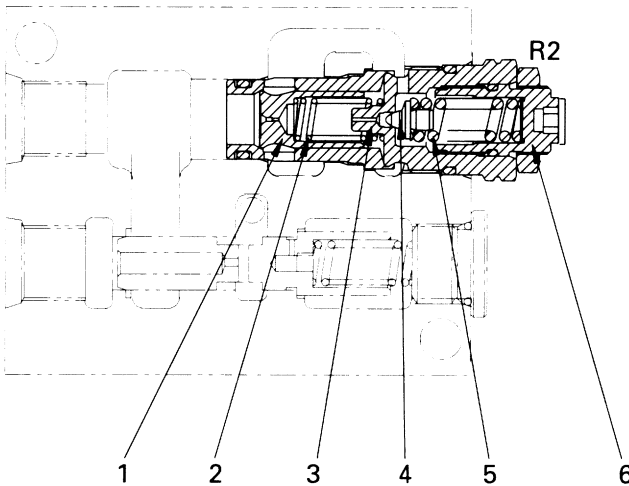


(Fig. 4)

SEW00148

U42103

PPC RELIEF VALVE



1. Main valve
2. Spring
3. Valve seat
4. Pilot poppet
5. Spring
6. Screw

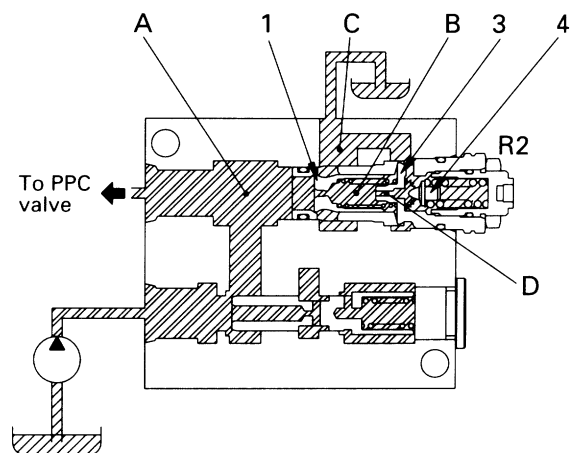
SDW00149

Function

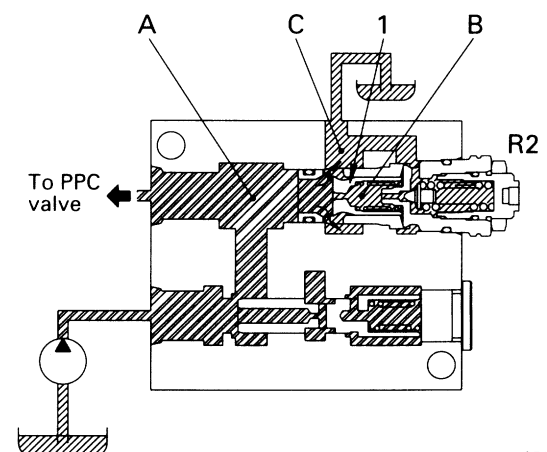
- The PPC relief valve is between the PPC, brake pump and the PPC valve. When the PPC pump is not being actuated, or when any abnormal pressure is generated, the oil sent from the pump is relieved from this valve to prevent any damage to the pump or circuit.

Operation

- The relief valve is installed to the charge valve. Port **A** is connected to the pump circuit and port **C** is connected to the drain circuit. The oil passes through the orifice in main valve (1) and fills port **B**. In addition, pilot poppet (4) is seated in valve seat (3).
- When the pressure at port **A** and port **B** reaches the set pressure, pilot poppet (4) opens and the oil pressure at port **B** escapes from port **D** to port **C** to lower the pressure at port **B**.
- When the pressure at port **B** goes down, a difference in pressure is generated at ports **A** and **B** by the orifice of main valve (1). Main valve (1) is opened by the pressure at port **A** and the oil at port **A** is drained to port **C** to relieve the circuit.

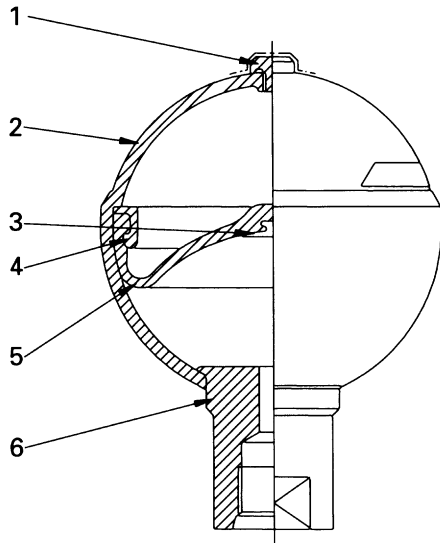


SDW00150



SDW00151

ACCUMULATOR (FOR PPC VALVE)



SEW00152

1. Gas plug
2. Shell
3. Poppet
4. Holder
5. Bladder
6. Oil port

Specifications

Type of gas: Nitrogen gas

Gas amount: 500 cc

Max. actuation pressure: 3.4 MPa (35 kg/cm²)

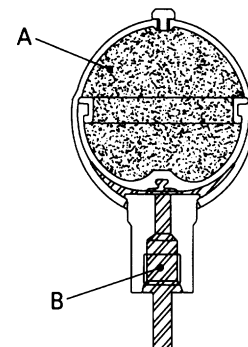
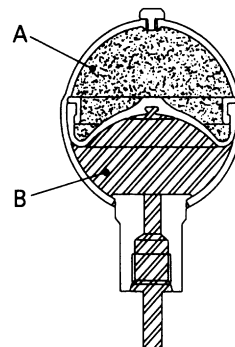
Min. actuation pressure: 1.2 MPa (12 kg/cm²)

Function

- The accumulator is installed between the hydraulic pump and the PPC valve. Even if the engine stops when the boom is raised, it is possible to lower the boom and bucket under their own weight by using the pressure of the nitrogen gas compressed inside the accumulator to send the pilot oil pressure to the main control valve to actuate it.

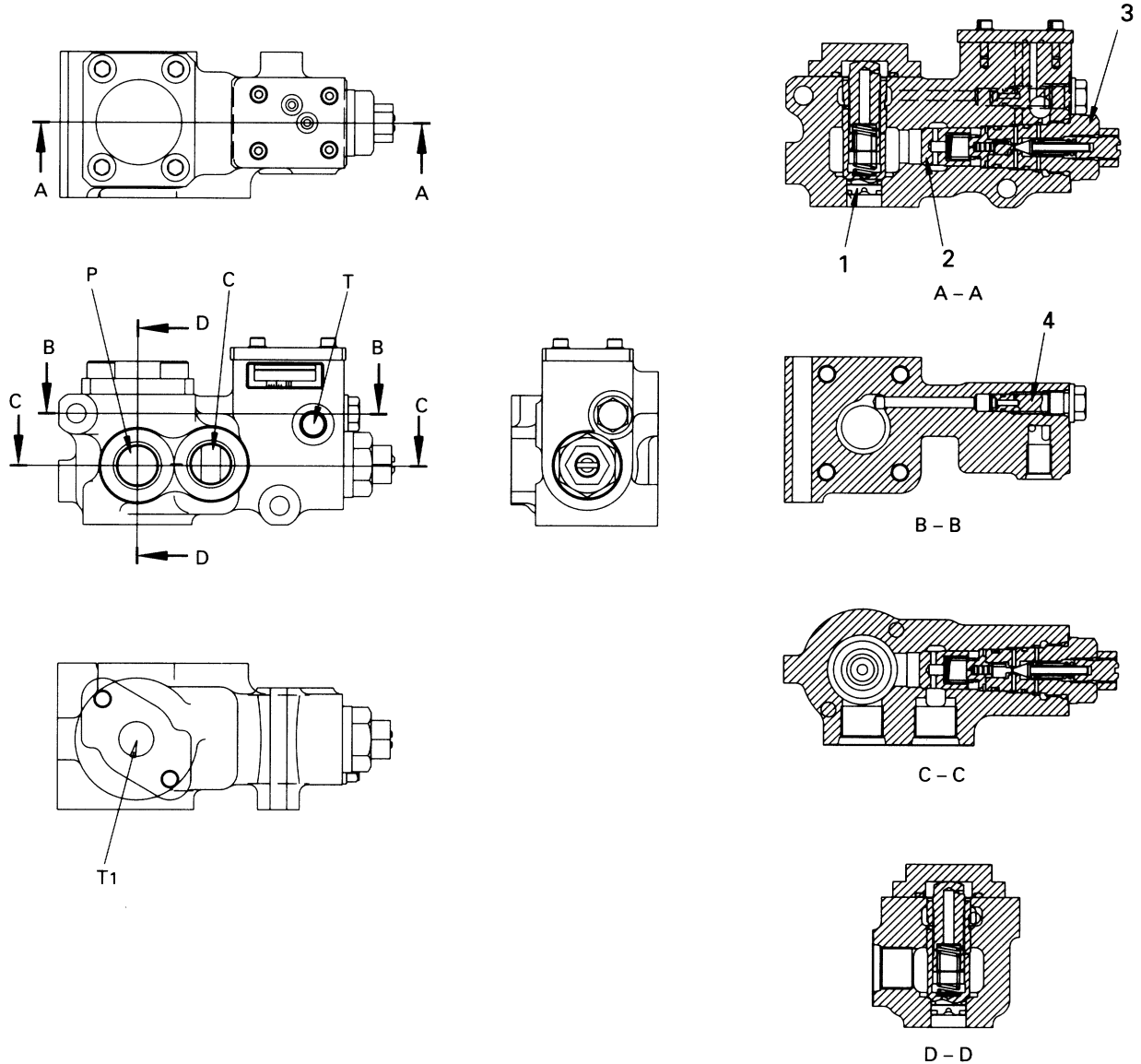
Operation

- After the engine stops, if the PPC valve is at hold, chamber **A** inside the bladder is compressed by the oil pressure in chamber **B**.
- When the PPC valve is operated, the oil pressure in chamber **B** goes below 2.9 MPa (30 kg/cm²). When this happens, the bladder is expanded by the pressure of the nitrogen gas in chamber **A**, and the oil inside chamber **B** is used as the pilot pressure to actuate the main control valve.



SEW00153

CUT-OFF VALVE



SDW00154

1. Unload valve
2. Check valve
3. Cut-off relief valve
4. Screen
- C. Port C (from hydraulic pump)
- P. Port P (from steering valve)
- T1. Port T1 (to tank)
- T2. Port T2 (to tank)

Function

- The cut-off valve is installed between the switch pump and the main control valve. Depending on the operating condition, it switches the oil from the switch pump to the main control valve or to the drain circuit.
- The cut-off valve is operated by hydraulic pressure on the standard specification machine and by the engine throttle controller on the HYPER specification machine.

OPERATION OF CUT-OFF VALVE

• Cut-off operation conditions

○: Cut-off (drain)

x: Not actuated (to main control valve)

More than 13.6 MPa (140 kg/cm ²)	Less than 13.6 MPa (140 kg/cm ²)
○	x

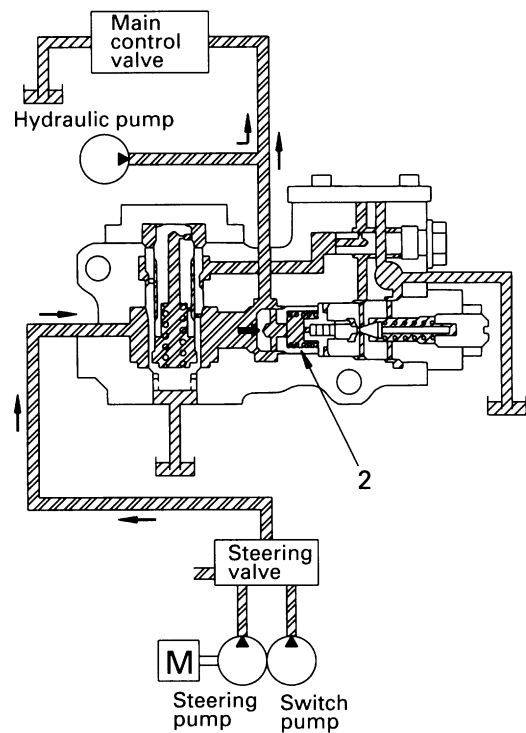
1. Main control valve at HOLD

The oil from the switch pump (the oil from the steering valve) pushes up check valve (2), merges with the oil from the hydraulic pump, and flows to the main control valve.

2. Main control valve operated

- 1) When hydraulic pump pressure is lower than cut-off pressure

In the same way as when the main control valve is at HOLD, the oil from the switch pump (the oil from the steering valve) pushes up check valve (2), merges with the oil from the hydraulic pump, and flows to the main control valve.



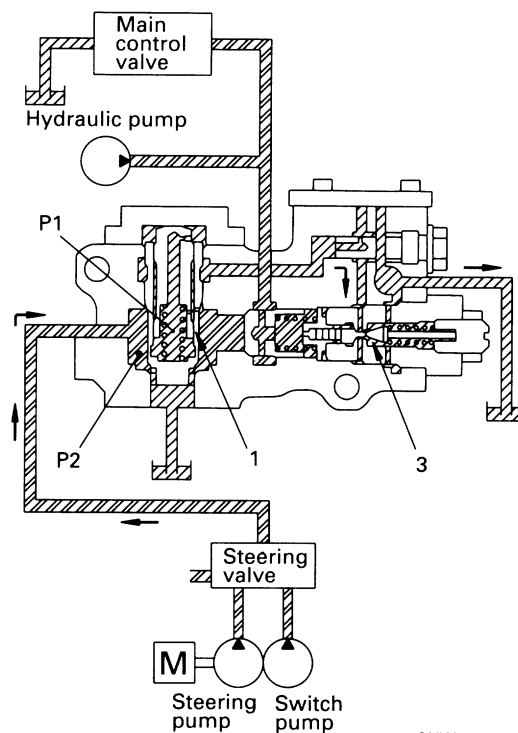
SNW01280

U42103

STRUCTURE AND FUNCTION

CUT-OFF VALVE

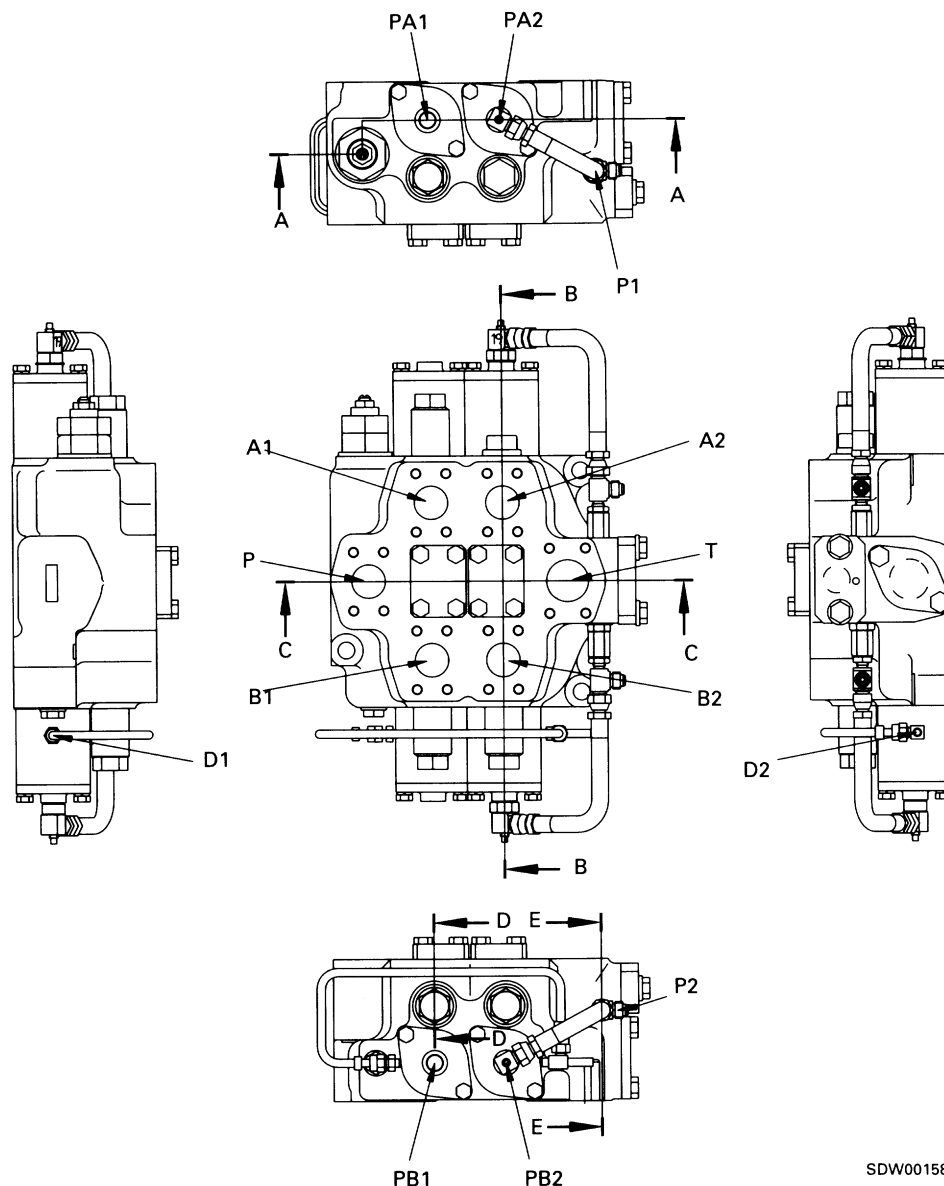
- 2) When hydraulic pump pressure is higher than cut-off pressure
Cut-off relief valve (3) opens and the pilot oil flows in the direction shown by the arrow.
When this happens, a difference in pressure is generated between P_2 and P_1 , so unload valve (1) opens. Therefore, the oil from the switch pump (the oil from the steering valve) is drained.



SNW01281

MAIN CONTROL VALVE

2-SPOOL



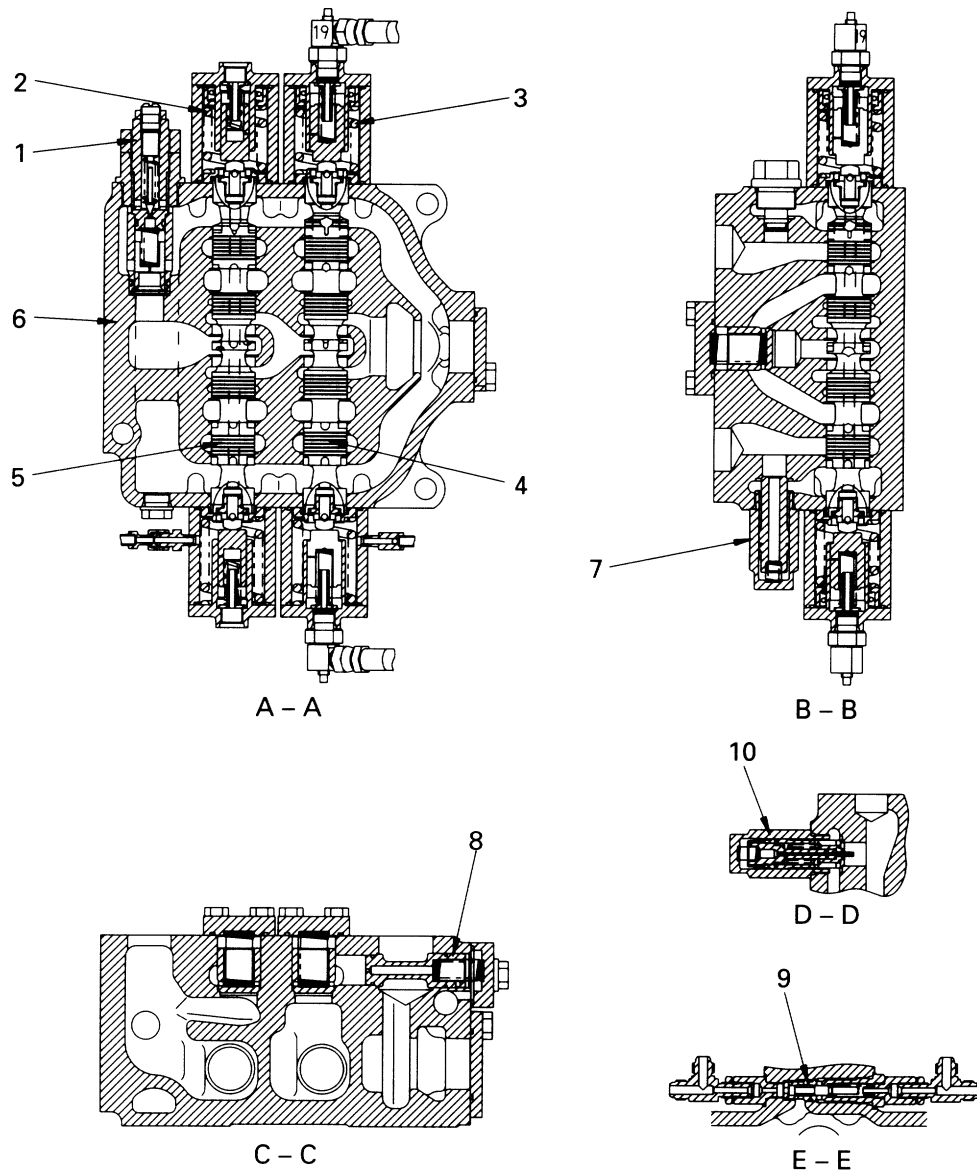
- PA1. From PPC valve P4
- PA2. From PPC valve P2
- PB1. From PPC valve P1
- PB2. From PPC valve P3
- P. From pump
- P1. From PPC valve P2
- P2. From PPC valve P3

- A1. To bucket cylinder bottom end
- A2. To boom cylinder bottom end
- B1. To bucket cylinder head end
- B2. To boom cylinder head end
- D1. Drain port
- D2. Drain port
- T. Drain port

U42103

STRUCTURE AND FUNCTION

MAIN CONTROL VALVE

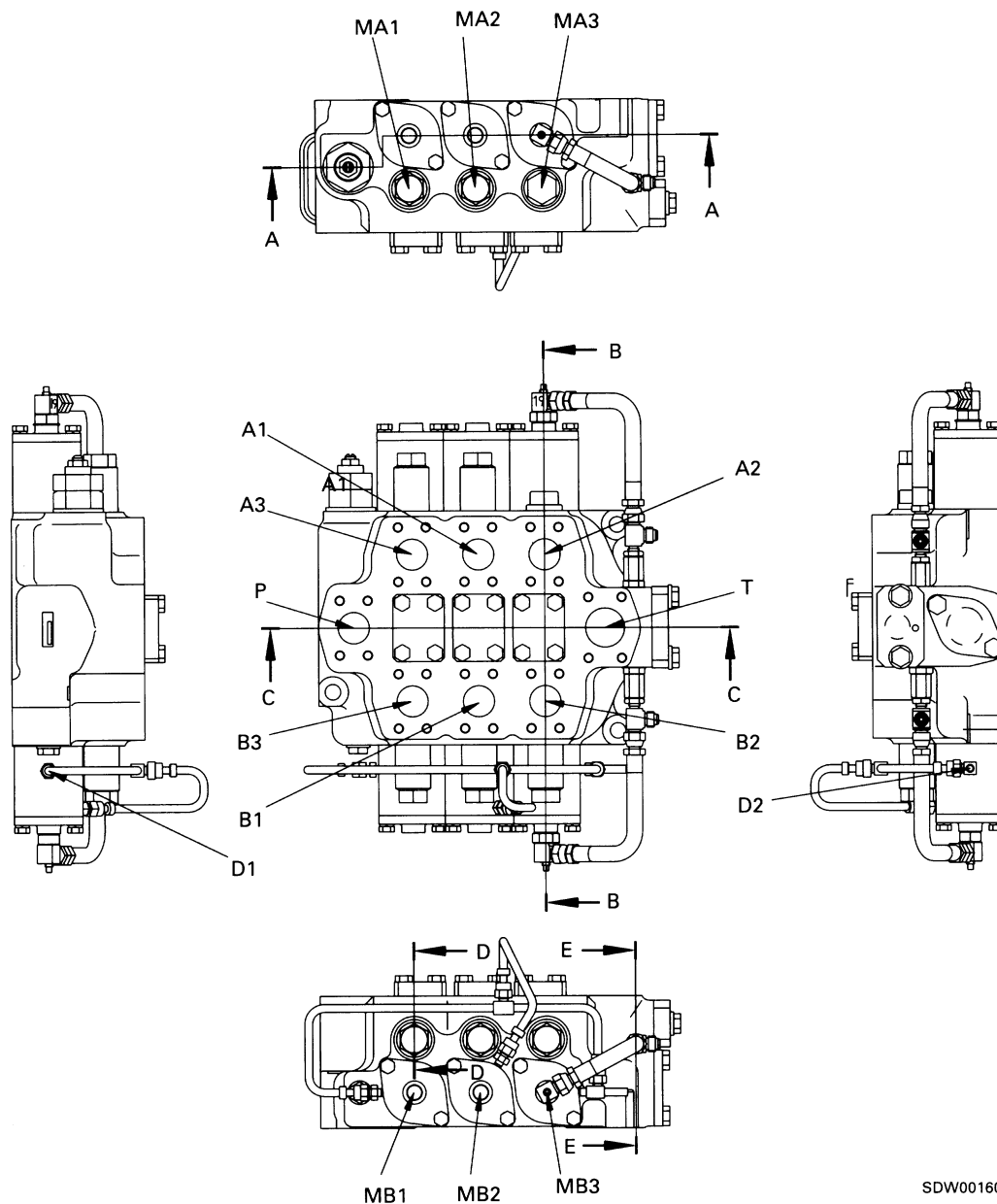


SDW00159

1. Main relief valve
2. Bucket spool return spring
3. Boom spool return spring
4. Boom spool
5. Bucket spool

6. Body
7. Suction valve
8. Unload valve
9. Float selector valve
10. Safety valve with suction

3-SPOOL



MA1: From PPC valve
 MA2: From PPC valve
 MA3: From PPC valve
 MB1: From PPC valve
 MB2: From PPC valve
 MB3: From PPC valve

A1: To bucket cylinder bottom end
 A2: To boom cylinder bottom end
 A3: To attachment cylinder
 B1: To bucket cylinder head end
 B2: To boom cylinder head end
 B3: To attachment cylinder

P: Pump port
 T: Drain port (to hydraulic tank)
 D1: Drain port
 D2: Drain port

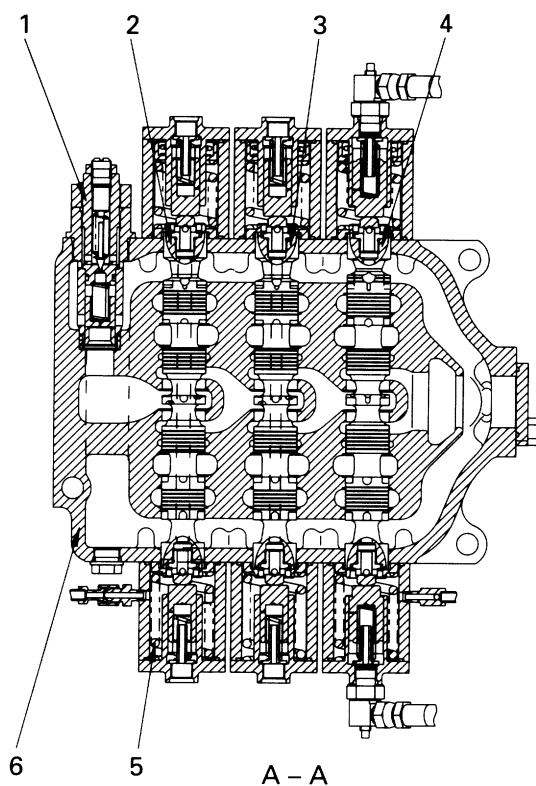
SDW00160

U42103

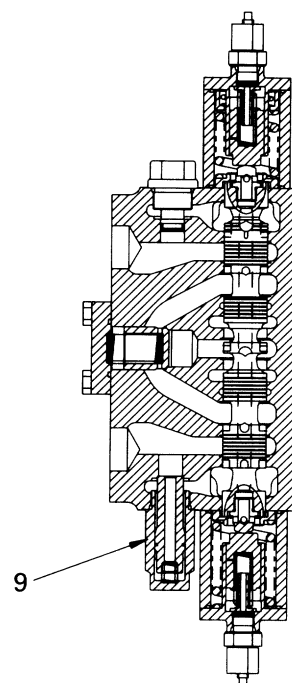
STRUCTURE AND FUNCTION

MAIN CONTROL VALVE

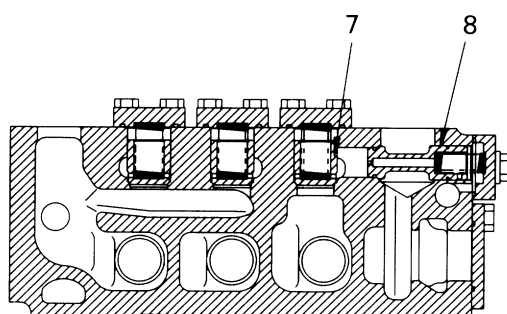
U42103



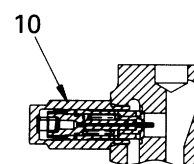
A - A



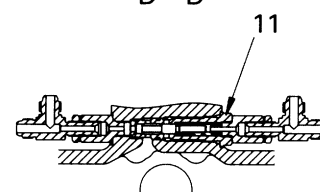
B - B



C - C



D - D



E - E

SDW00161

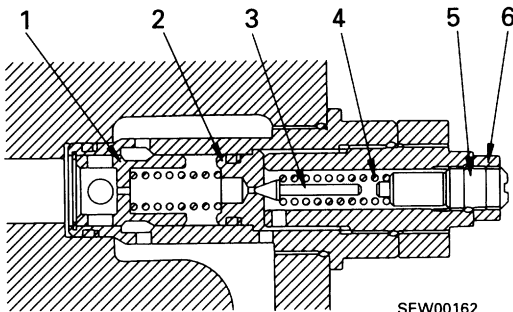
1. Main relief valve
2. Attachment spool
3. Dump spool
4. Lift spool
5. Return spring
6. Body

7. Check valve
8. Unload valve
9. Suction valve
10. Safety valve with suction
11. Float selector valve

STRUCTURE AND FUNCTION

MAIN CONTROL VALVE

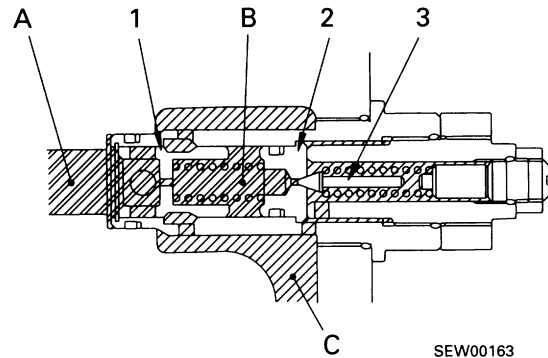
RELIEF VALVE



1. Main valve
2. Valve seat
3. Pilot poppet
4. Spring
5. Adjustment screw
6. Locknut

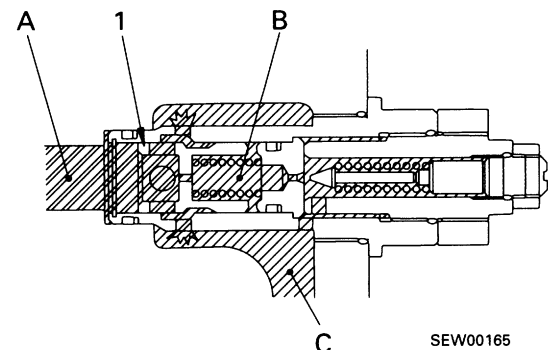
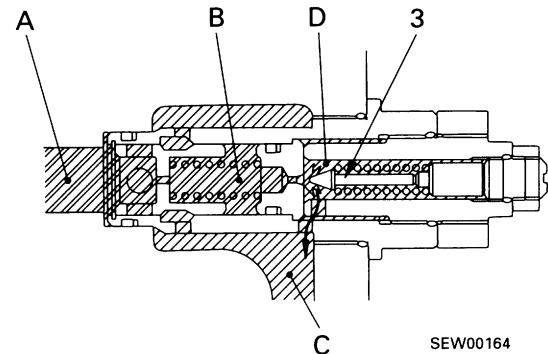
Function

The relief valve is installed to the inlet portion of the main control valve. If the oil goes above the set pressure, the relief valve drains the oil to the tank to set the maximum pressure for the work equipment circuit, and to protect the circuit.



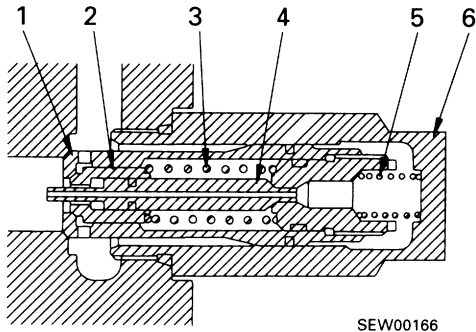
Operation

- Port **A** is connected to the pump circuit and port **C** is connected to the drain circuit. The oil passes through the orifice in main valve (1), and fills port **B**. Pilot poppet (3) is seated in valve seat (2).
- If the pressure inside ports **A** and **B** reaches the set pressure of pilot poppet spring (4), pilot poppet (3) opens and the oil pressure at port **B** escapes from port **D** to port **C**, so the pressure at port **B** drops.
- When the pressure at port **B** drops, a difference in pressure between ports **A** and **B** is created by the orifice of main valve (1). The main valve is pushed open and the oil at port **A** passes through port **C**, and the abnormal pressure is released to the drain circuit.
- The set pressure can be changed by adjusting the tension of pilot poppet spring (4). To change the set pressure, remove the cap nut, loosen the locknut, then turn adjustment screw (5) to adjust the set pressure as follows.
TIGHTEN to INCREASE pressure
LOOSEN to DECREASE pressure



U42103

SAFETY VALVE (WITH SUCTION)



1. Suction valve
2. Main valve
3. Main valve spring
4. Pilot piston
5. Suction valve spring
6. Valve body

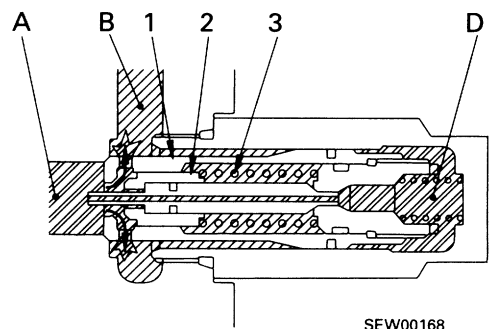
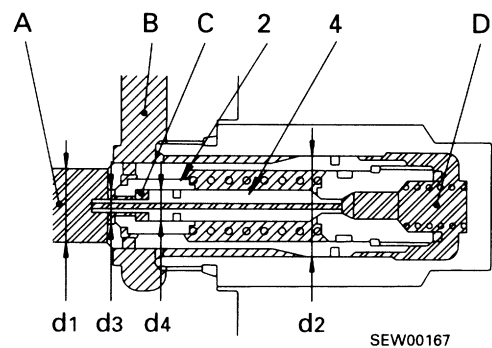
Function

- The safety valve is in the bucket cylinder circuit inside the main control valve. If any abnormal pressure is generated by any shock to the cylinder when the main control valve is at the neutral position, this valve relieves the abnormal pressure to prevent damage to the cylinder.

Operation

Operation as safety valve

- Port **A** is connected to the cylinder circuit and port **B** is connected to the drain circuit. The oil pressure at port **A** is sent to port **D** from the hole in pilot piston (4). It is also sent to port **C** by the orifice formed from main valve (2) and pilot piston (4). Pilot piston (4) is secured to the safety valve, and the size of the cross-sectional surface (cross-sectional area) has the following relationship: $d_2 > d_1 > d_3 > d_4$.
- If abnormal pressure is created at port **A**, suction valve (1) is not actuated because of relationship $d_2 > d_1$, but relationship between port **A** and port **C** is $d_3 > d_4$, so main valve (2) receives oil pressure equivalent to the difference between the areas of d_3 and d_4 . If the oil pressure reaches the force (set pressure) of main valve spring (3), main valve (2) is actuated, and the oil from port **A** flows to port **B**.



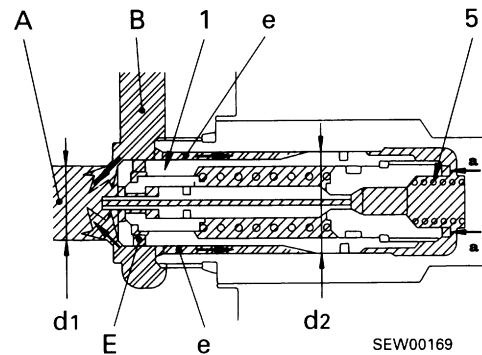
STRUCTURE AND FUNCTION

MAIN CONTROL VALVE

Operation as suction valve

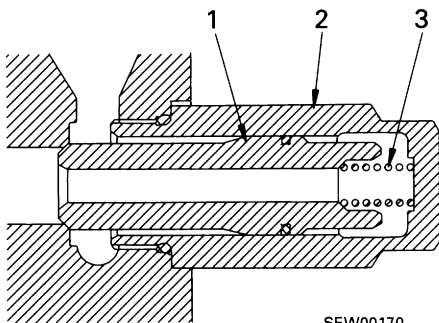
- If any negative pressure is generated at port **A**, port **D** is connected with port **A**, so there is also negative pressure at port **D**. The tank pressure of port **B** is applied to port **E**, so the safety valve receives oil pressure **a**, which is equal to the difference in the area of **d₂** and **d₁** because of the tank pressure at port **E**. Therefore, oil pressure **e** moves the valve in the direction of opening, and oil pressure **a** acts to move suction valve (1) in the direction of closing.

When the pressure at port **A** drops (and comes close to negative pressure), it becomes lower than hydraulic pressure **e**. The relationship becomes oil pressure **e** > oil pressure **a** + force of valve spring (5), and suction valve (1) opens to let the oil from port **B** flow into port **A** and prevent any negative pressure from forming at port **A**.



SEW00169

SUCTION VALVE



SEW00170

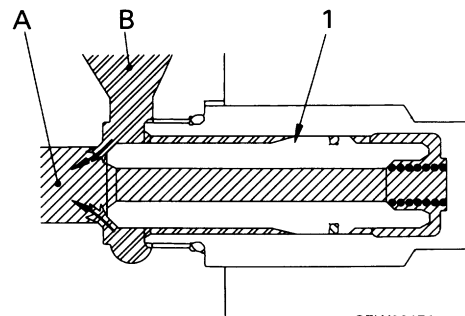
1. Main poppet
2. Sleeve
3. Spring

Function

- This valve acts to prevent any negative pressure from forming in the circuit.

Operation

- If any negative pressure is generated at port **A** (boom cylinder rod end) (when a pressure lower than tank circuit port **B** is generated), main poppet (1) is opened because of the difference in area between **d₁** and **d₂**, and oil flows from port **B** at the tank end to port **A** at the cylinder port end.



SEW00171

U42103

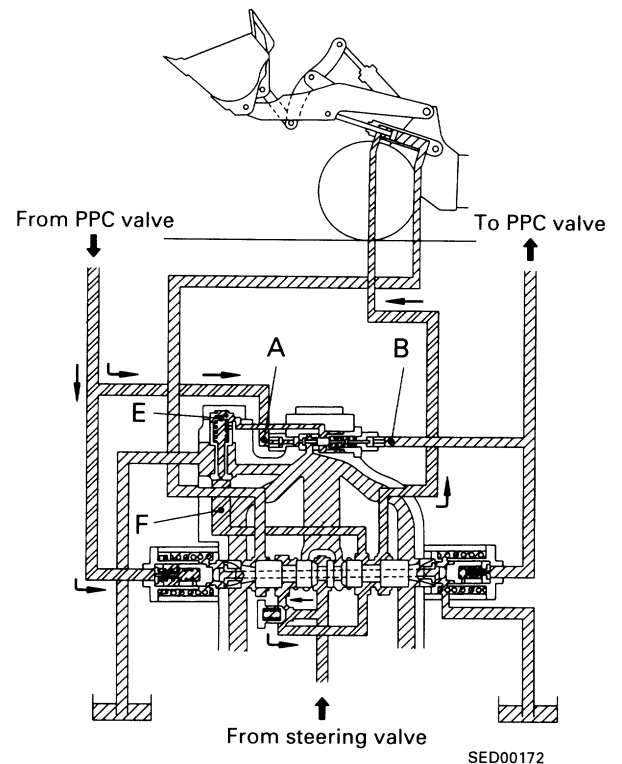
FLOAT SELECTOR VALVE AND UNLOAD VALVE

Function

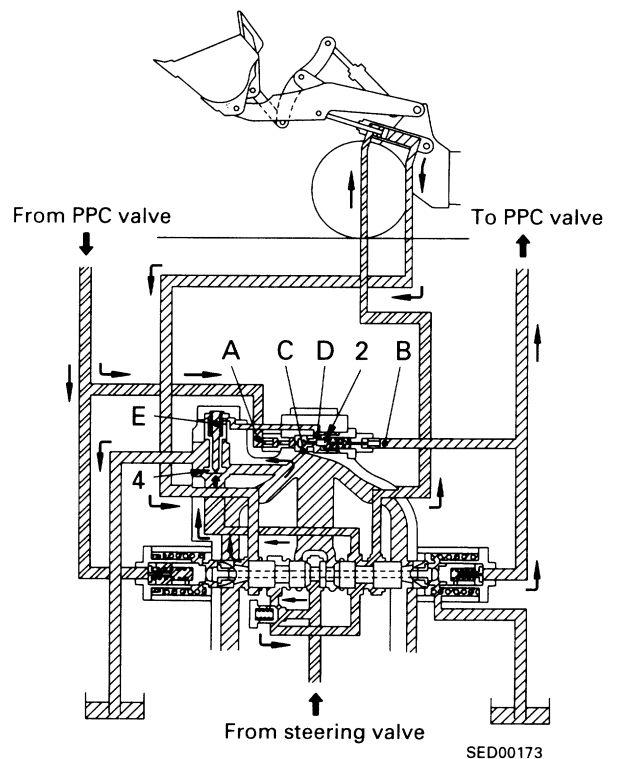
- The float selector valve and unload valve are inside the main control valve. When the boom lever is operated to the FLOAT position, the float selector valve detects this, and it is actuated to actuate the unload valve and set the boom to the FLOAT position.

Operation

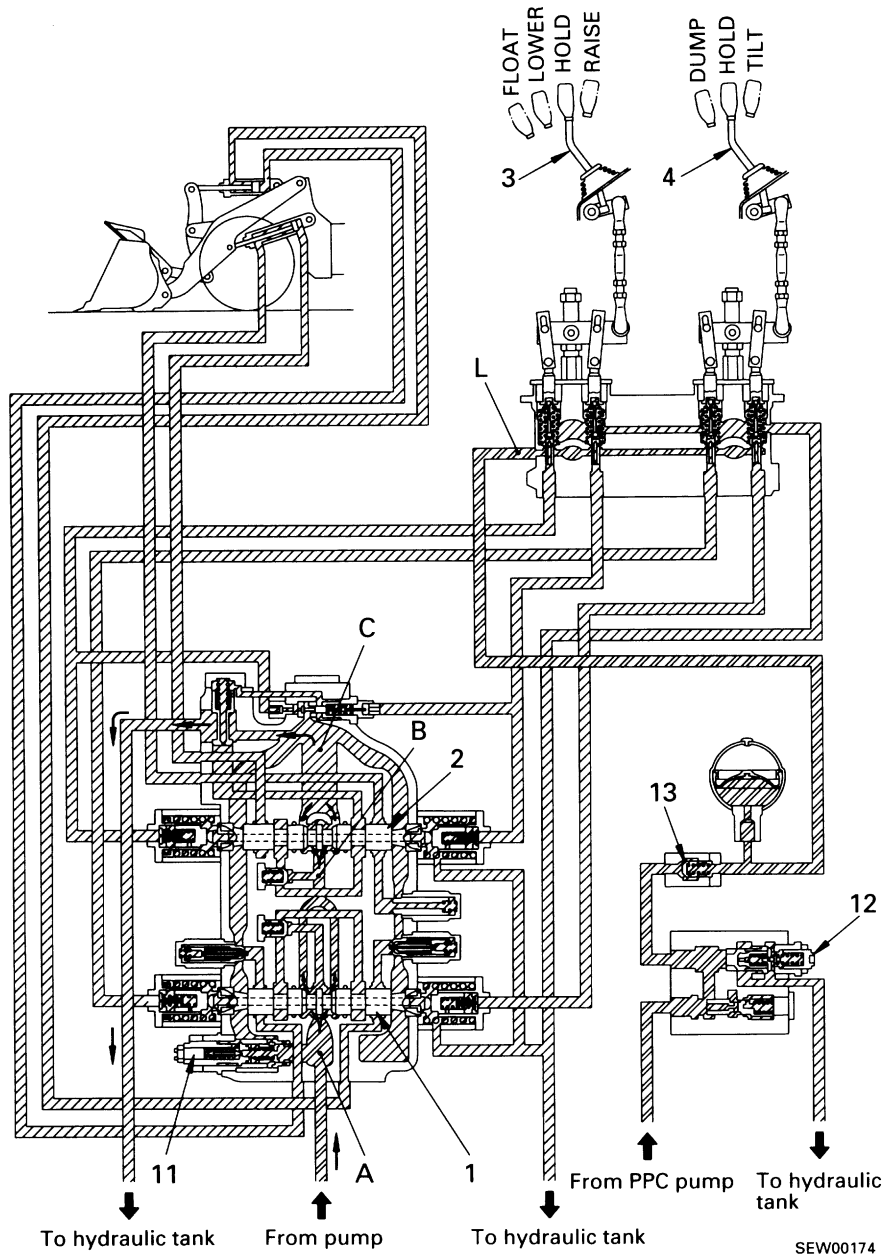
- If the boom lever is pushed further from the LOWER position, it is set to the FLOAT position and the PPC valve is set to the same condition as for the LOWER position. The pressure at port **A** becomes high pressure and the pressure at port **B** becomes low pressure.
- The oil from the steering valve fills chamber **F** and chamber **E**.



- If the difference in pressure between port **A** and port **B** becomes greater than the specified pressure, float selector valve (2) is moved to the right, and port **C** and port **D** open.
- When port **C** is opened, the oil pressure in chamber **E** drops, unload valve (4) is moved up in the direction of the arrow, and the oil from the steering valve flows to the drain circuit, and also flows to the rod end of the lift cylinder. The oil at the bottom end of the lift cylinder is connected to the drain circuit and forms the FLOAT position.



BOOM AND BUCKET SPOOL HOLD POSITION

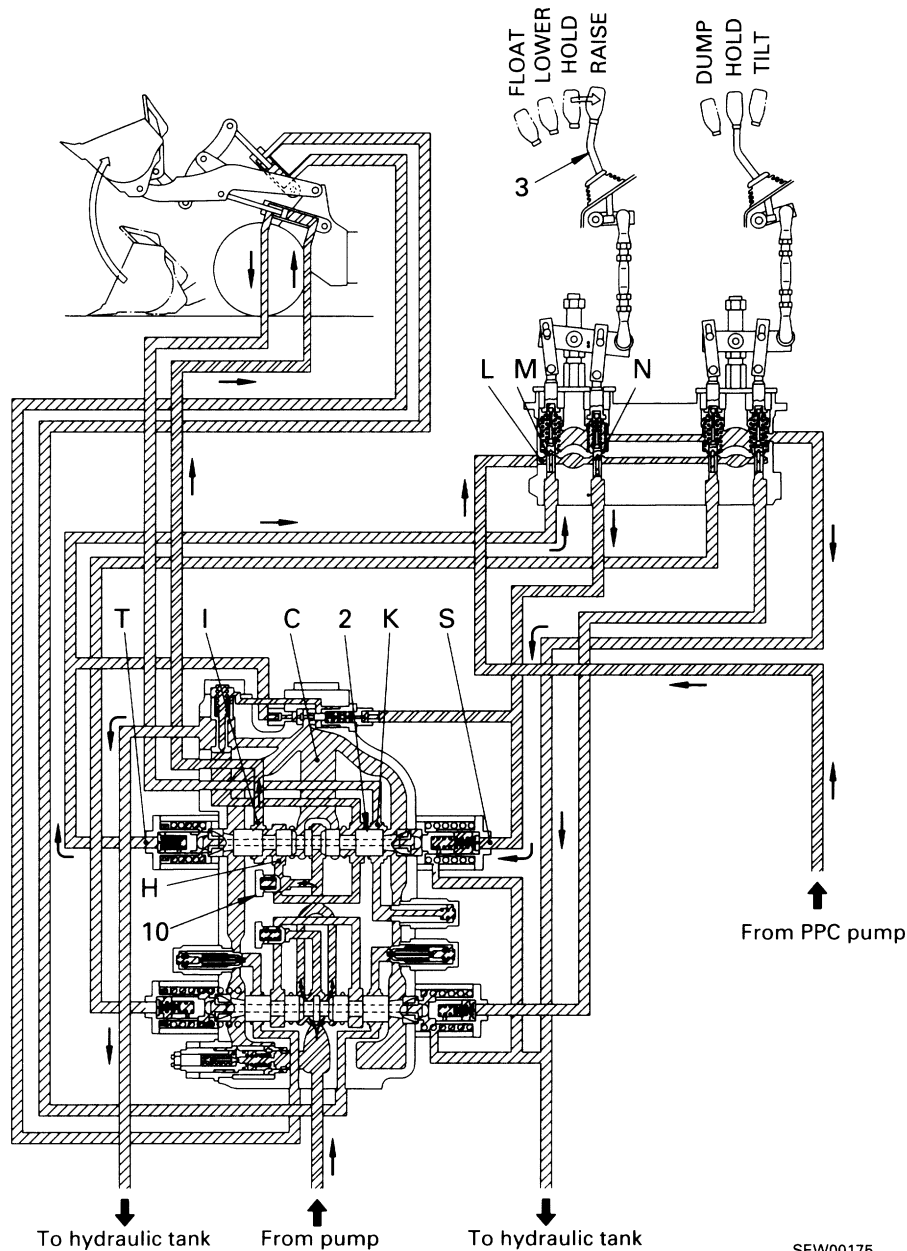


U42103

Operation

- The oil enters port **A** from the pump, and the maximum pressure is set by relief valve (11).
- Bucket spool (1) is at the **HOLD** position, so the bypass circuit is open and the oil at port **A** passes around the spool and flows to port **B**. Boom spool (2) is also at **HOLD**, so the bypass circuit is open and the oil at port **B** passes around the spool, enters port **C** of the drain circuit, passes through the filter, and returns to the tank.
- The oil from the PPC pump passes through check valve (13), and enters port **L** of the PPC valve. However, the boom and bucket levers are at the **HOLD** position, so the oil returns to the hydraulic tank from PCC relief valve (12).

BOOM SPOOL AT RAISE POSITION



Operation

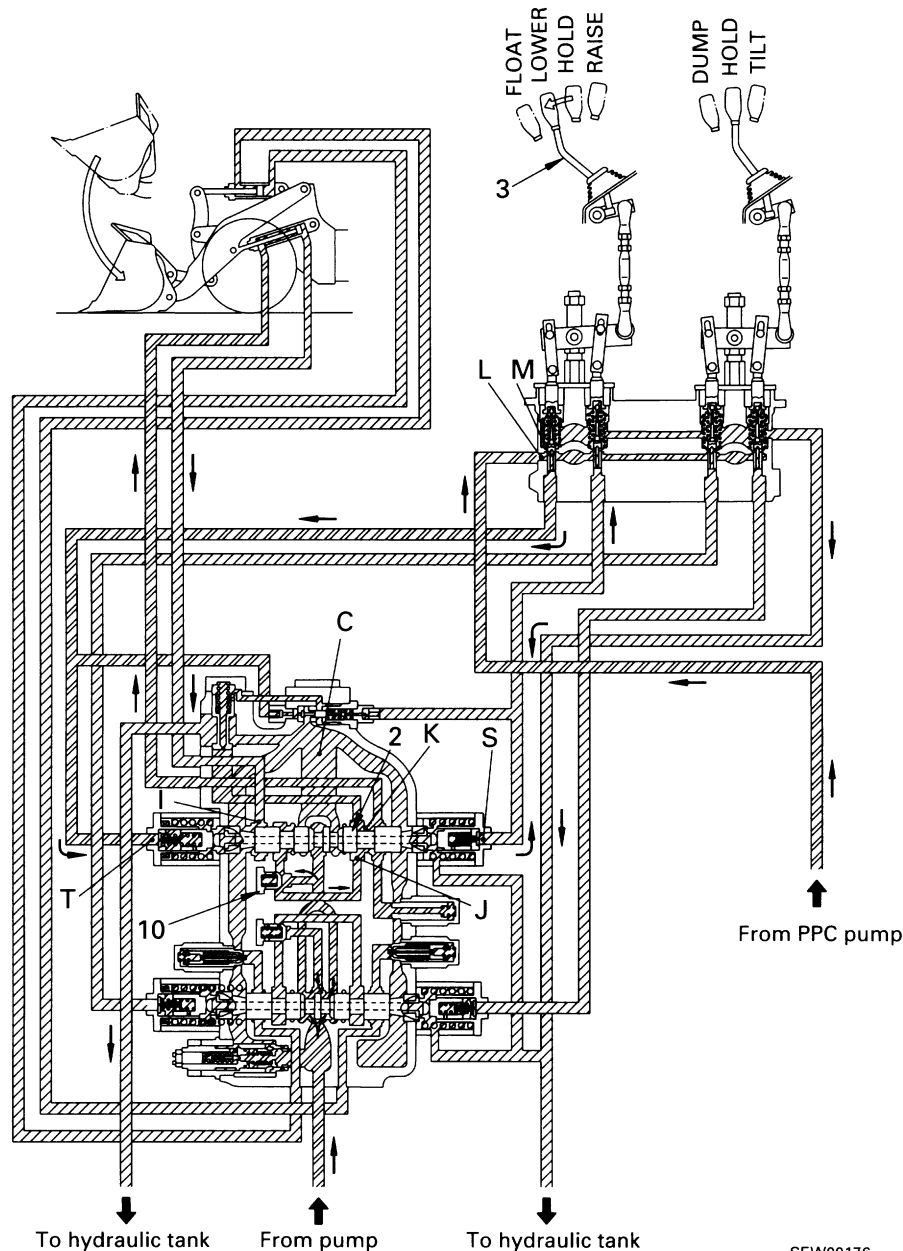
- When boom lever (3) is pulled, the oil flows from port L of the PPC valve to port N and port S. In addition, the oil at port T passes through port M and flows to the drain circuit. The oil pressure at port S pushes boom spool (2) and moves it to the RAISE position.
- The oil from the pump passes through the bypass circuit of the bucket spool and flows

to the bypass circuit of boom spool (2). The bypass circuit is closed by the spool, so the oil pushes open check valve (10). The oil flows from port H to port I, and flows to the cylinder bottom.

- At the same time, the oil at the cylinder rod end enters drain port C from port K and returns to the tank. Therefore, the boom rises.

SEW00175

BOOM SPOOL AT LOWER POSITION



SEW00176

U42103

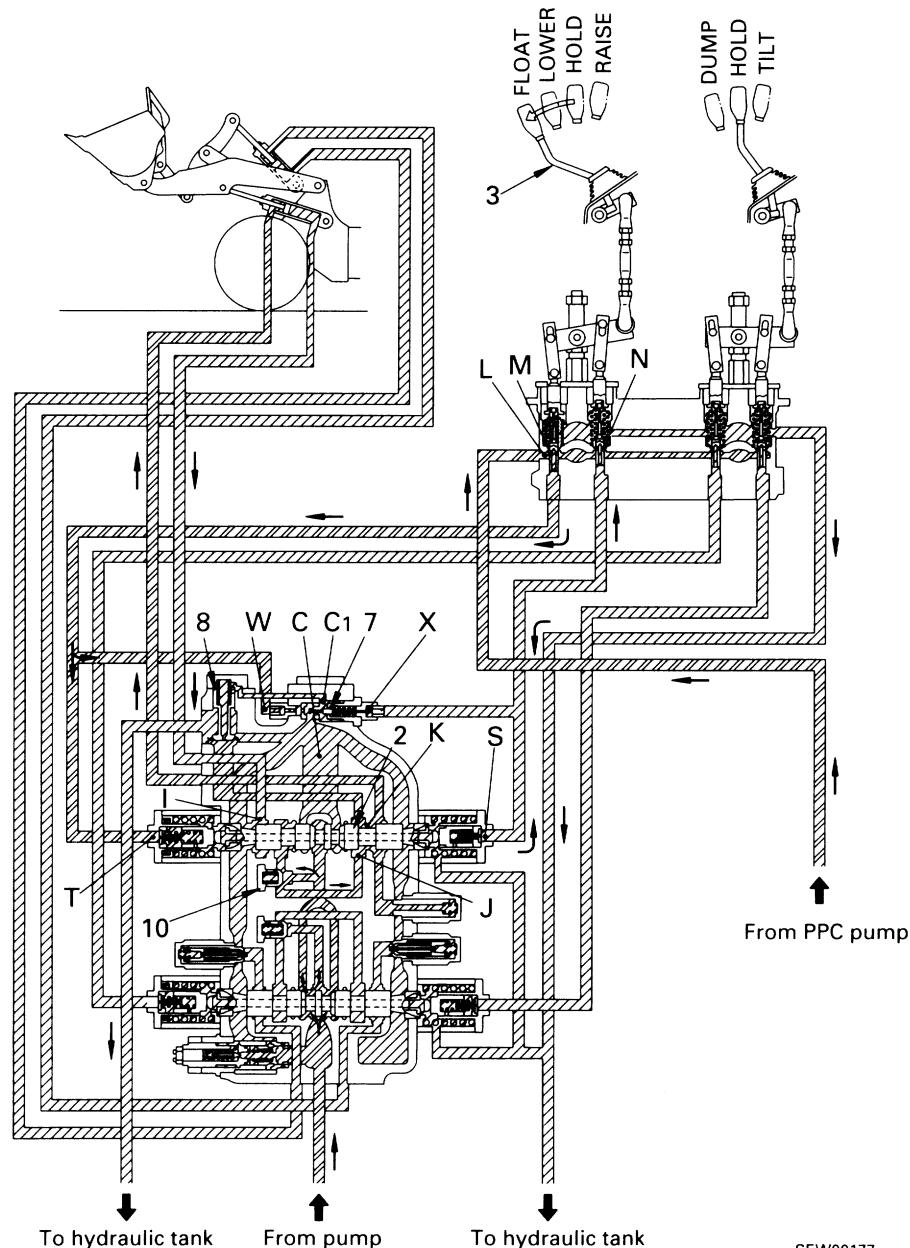
Operation

- When boom lever (3) is pushed, the oil flows from port L of the PPC valve to port M and port T. In addition, the oil at port S flows to the drain circuit. The oil pressure at port T pushes boom spool (2) and moves it to the LOWER position.
- The oil from the pump passes through the bypass circuit of the bucket spool and flows to the bypass circuit of boom spool (2). The

bypass circuit is closed by the spool, so the oil pushes open check valve (10). The oil flows from port J to port K, and flows to the cylinder rod end.

- At the same time, the oil at the cylinder bottom enters drain port C from port I and returns to the tank. Therefore, the boom goes down.

BOOM SPOOL AT FLOAT POSITION

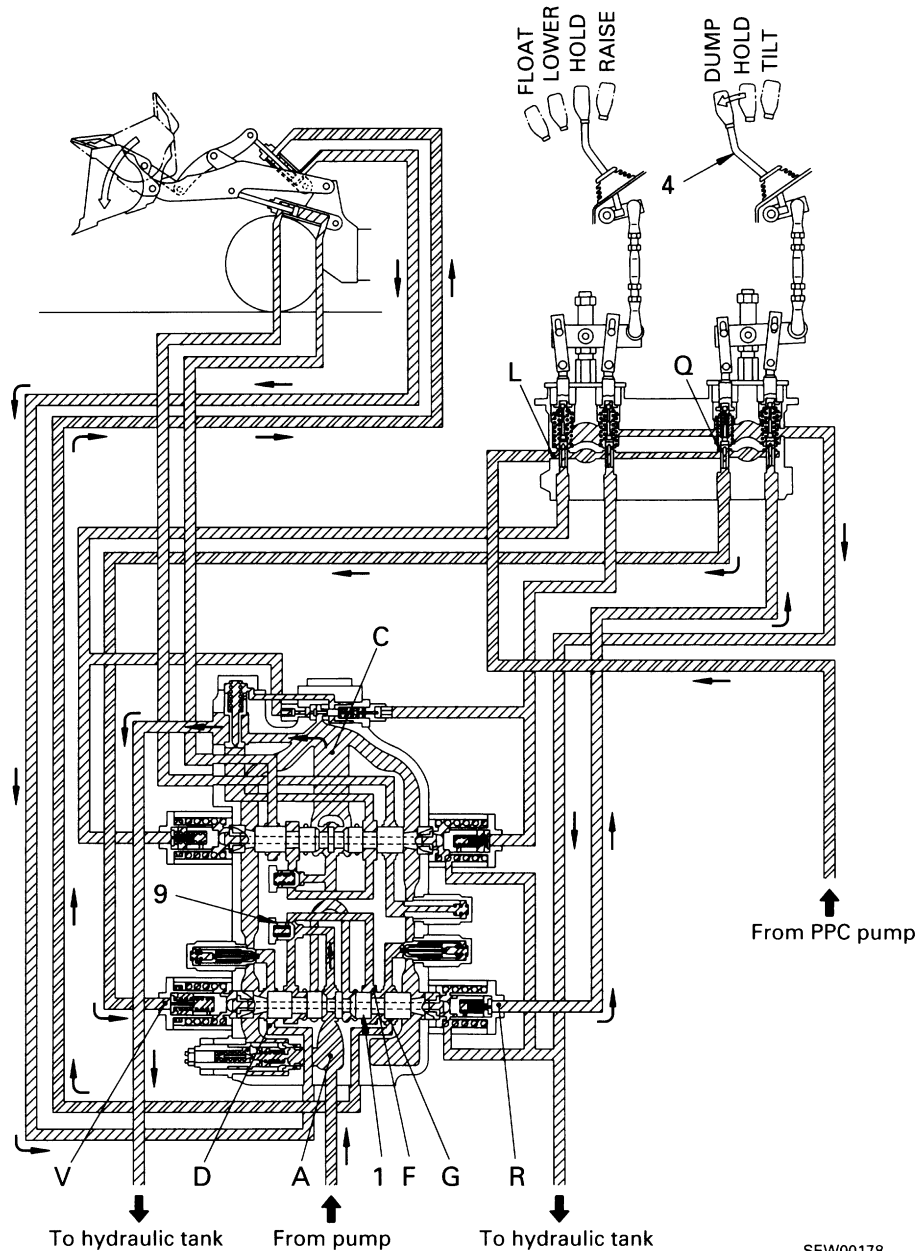
**Operation**

- When boom lever (3) is pushed to the FLOAT position, the PPC valve spool moves beyond the LOWER position to the FLOAT position. The pressure oil at port L flows to port M, and at the same time, it also flows to port T and port W. In addition, the pressurized oil at port S flows to port N.
- The pressurized oil at port T pushes boom spool (2) to the LOWER position.
- If a difference in pressure greater than the specified pressure is generated at port W and port X, valve (7) moves to the right, opens port C₁ and port C, and connects to

the drain circuit. When port C₁ is connected to the drain circuit, unload valve (8) moves up and the oil from the pump flows to the drain circuit.

- Therefore, the oil at the cylinder rod end passes from port K through unload valve (8) and flows to the drain circuit. The oil at the cylinder bottom flows from port I to port C, and then flows to the drain circuit. Therefore, the boom is set to the FLOAT condition.

BUCKET SPOOL AT DUMP POSITION



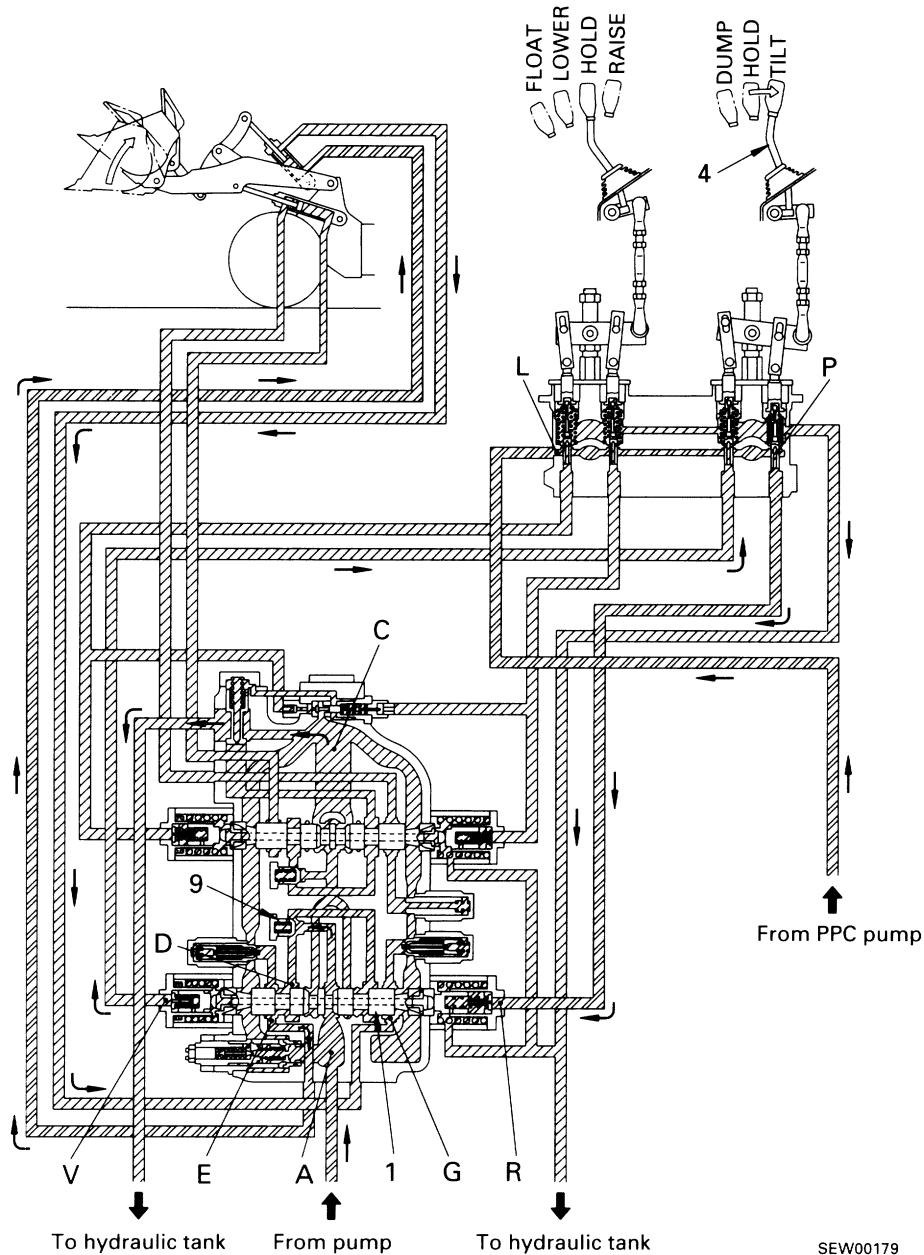
SEW00178

U42103

Operation

- When bucket lever (4) is pushed, the pressure oil at port L of the PPC valve flows from port Q to port V. In addition, the oil at port R flows to the drain circuit. The pressure oil at port V moves bucket spool (1) to the DUMP position.
- The bypass circuit is closed by bucket spool (1), so the oil from port A pushes open check valve (9). The oil from check valve (9) flows from port F to port G, and then flows to the cylinder rod end.
- At the same time, the oil at the cylinder bottom flows from port D to drain port C, and returns to the tank, so the bucket is dumped.

BUCKET SPOOL AT TILT POSITION

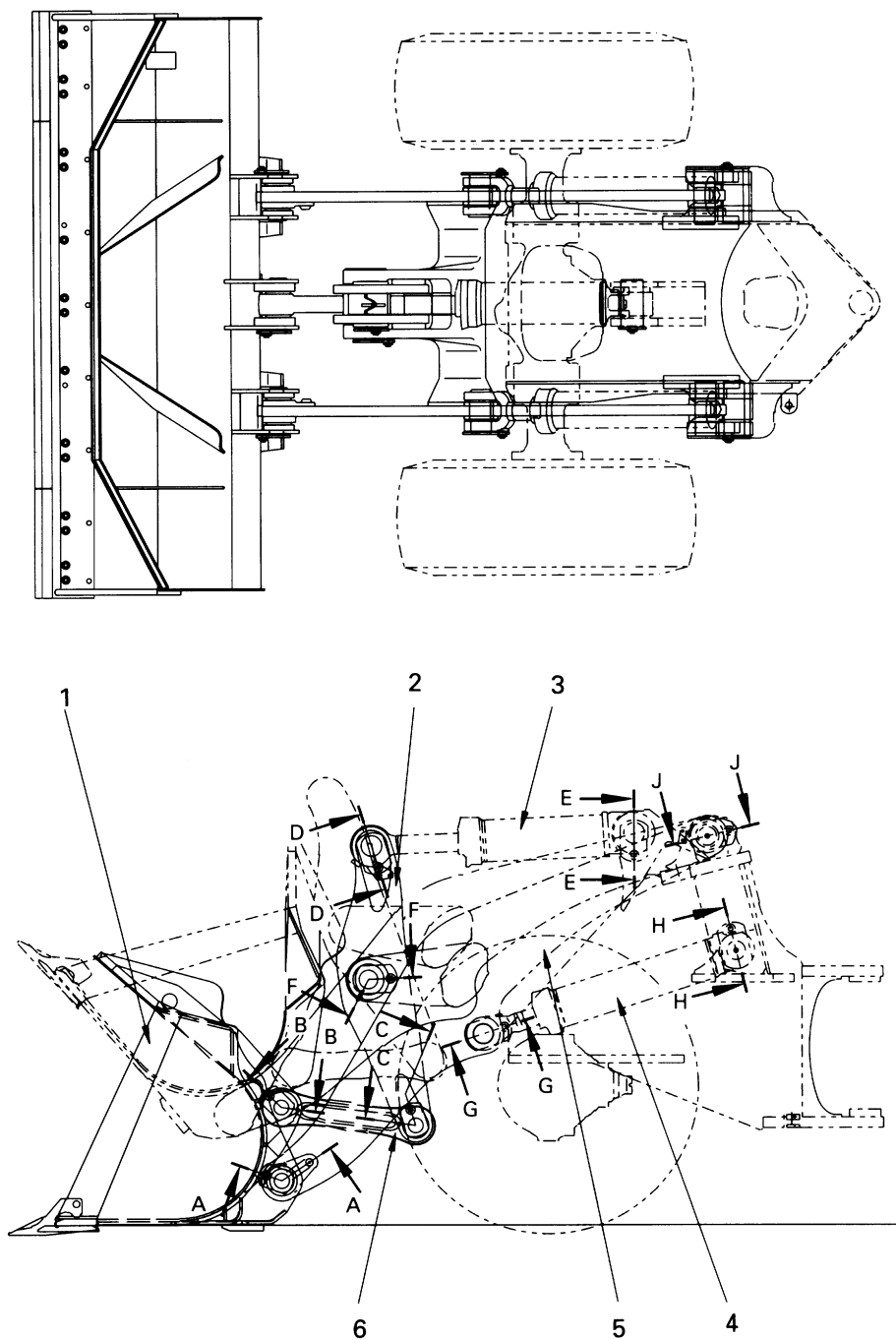


SEW00179

Operation

- When bucket lever (4) is pulled, the pressure oil at port L of the PPC valve flows from port P to port R. In addition, the oil at port V flows to the drain circuit. The pressure oil at port R moves bucket spool (1) to the TILT position.
- The bypass circuit is closed by bucket spool (1), so the oil from port A pushes open check valve (9). The oil from check valve (9) flows from port D to port E, and then flows to the cylinder bottom.
- At the same time, the oil at the cylinder rod end flows from port G to drain port C, and returns to the tank, so the bucket is tilted.

WORK EQUIPMENT LINKAGE



SDW00180

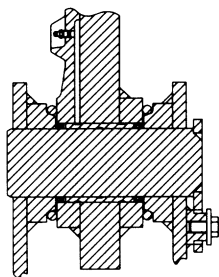
U42103

1. Bucket
2. Bellcrank
3. Bucket cylinder

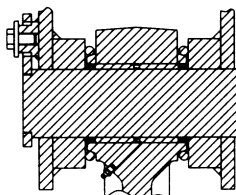
4. Boom cylinder
5. Boom
6. Bucket link

STRUCTURE AND FUNCTION

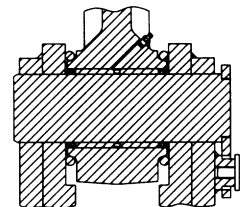
WORK EQUIPMENT LINKAGE



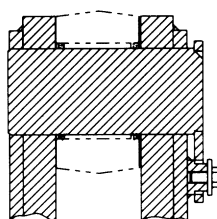
A - A



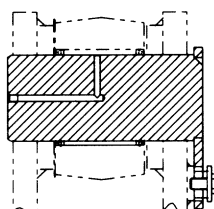
B - B



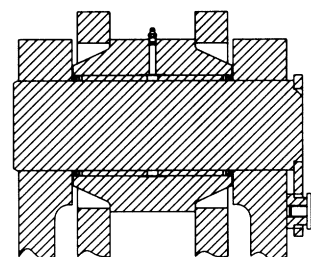
C - C



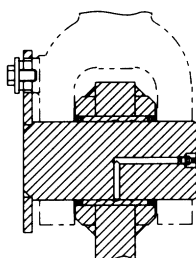
D - D



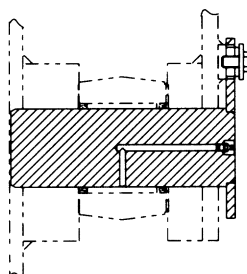
E - E



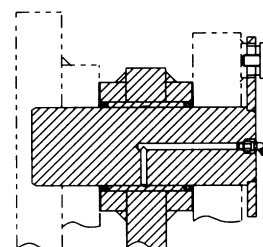
F - F



G - G



H - H

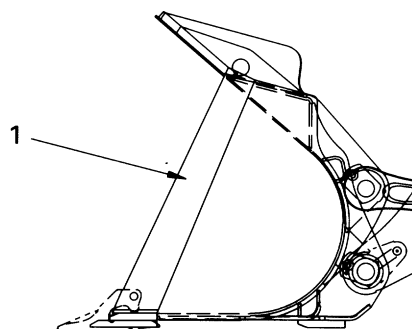
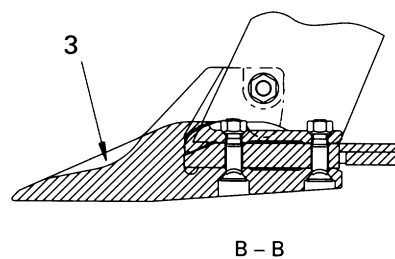
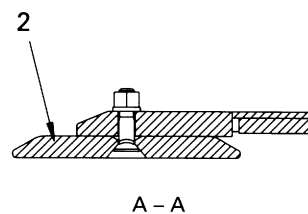
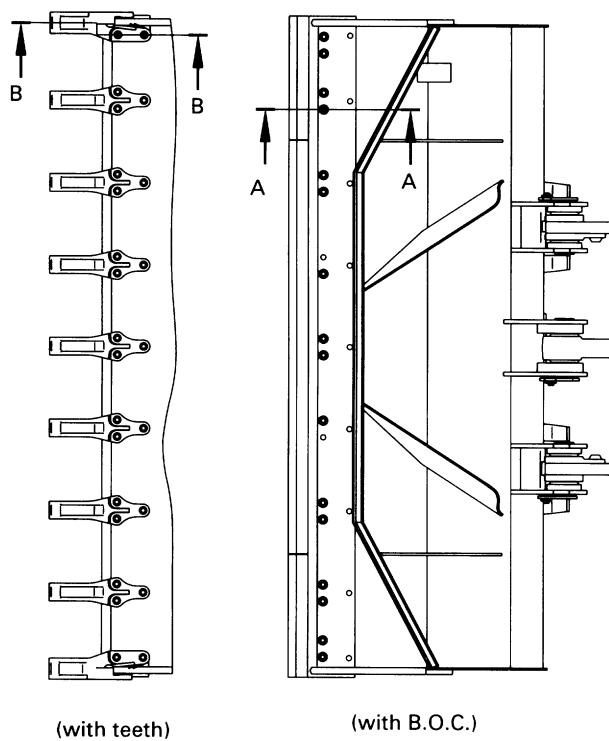


J - J

SDW00181

U42103

BUCKET

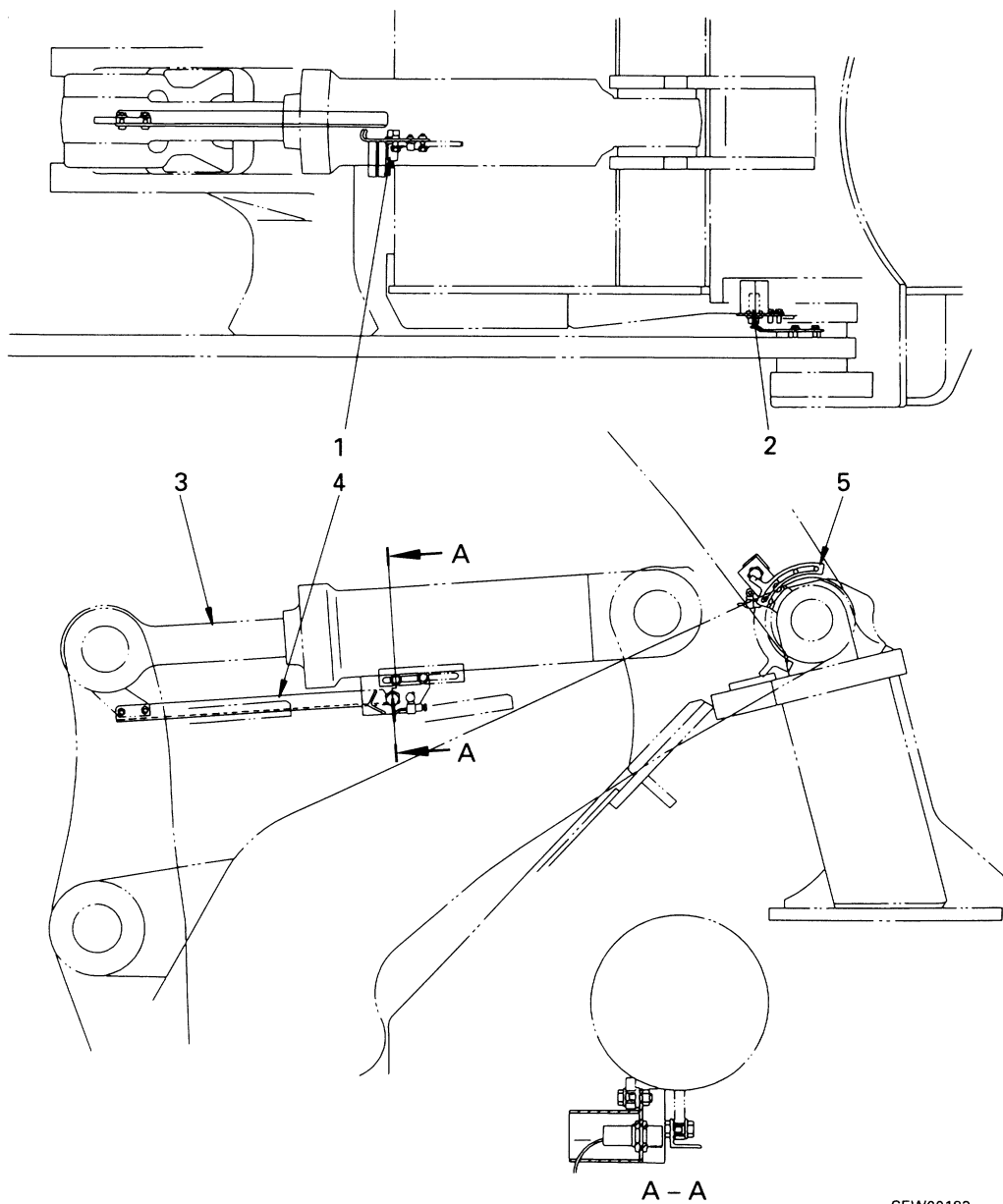


SDW00182

U42103

1. Bucket
2. Bolt-on cutting edge
3. Bucket tooth

BUCKET POSITIONER AND BOOM KICK-OUT

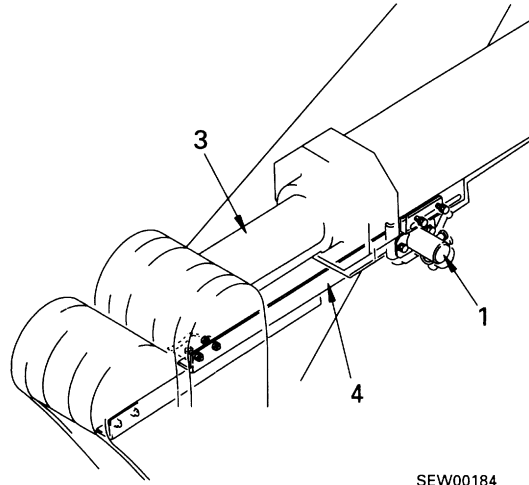


STRUCTURE AND FUNCTION

BUCKET POSITIONER AND BOOM KICK-OUT

BUCKET POSITIONER

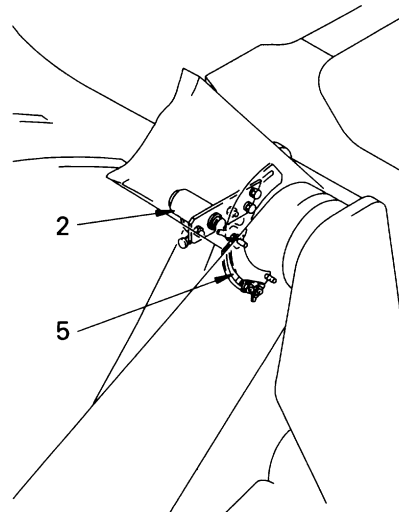
- The bucket positioner is an electrically actuated system which is used to set the bucket to the desired angle when the bucket is moved from the DUMP position to the TILT position. When the bucket reaches the desired position, the bucket lever is returned from the TILT position to the HOLD position, and the bucket is automatically set to the suitable digging angle.
- Lever (4) is secured to bucket cylinder rod (3) by bolts. In addition, proximity switch (1) is fixed to the cylinder by bolts.
- When the bucket is moved from the DUMP position to the TILT position, the bucket cylinder rod moves to the left, and at the same time, lever (4) also moves to the left. Proximity switch (1) separates from lever (4) at the desired position, and the bucket lever is returned to neutral.



SEW00184

BOOM KICK-OUT

- The boom kick-out is an electrically actuated system. It acts to move the boom lever to the HOLD position and stop the boom at the desired position before the boom reaches the maximum height.
- Plate (5) is fixed to the boom. In addition, proximity switch (2) is fixed to the frame. When the boom is moved from the LOWER position to the RAISE position, the boom rises, and when it reaches the desired position, the proximity switch and lever come together and the system is actuated to return the boom lever to the HOLD position.



SEW00185

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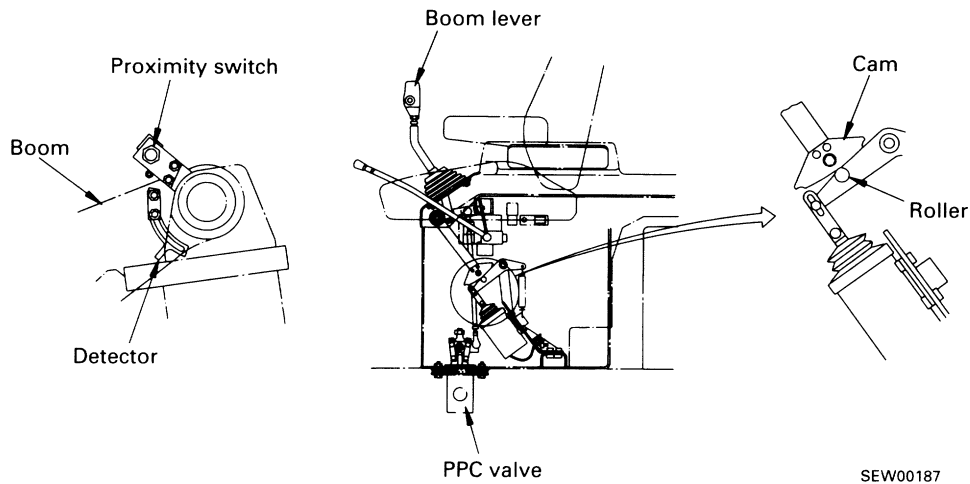
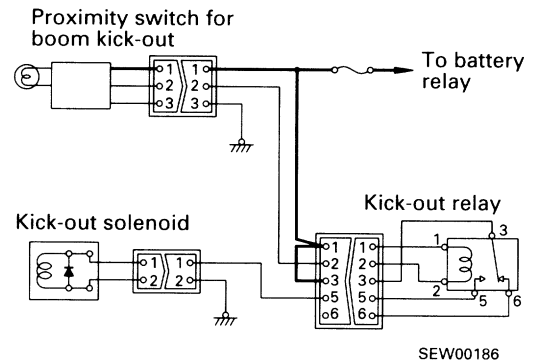
STRUCTURE AND FUNCTION

BUCKET POSITIONER AND BOOM KICK-OUT

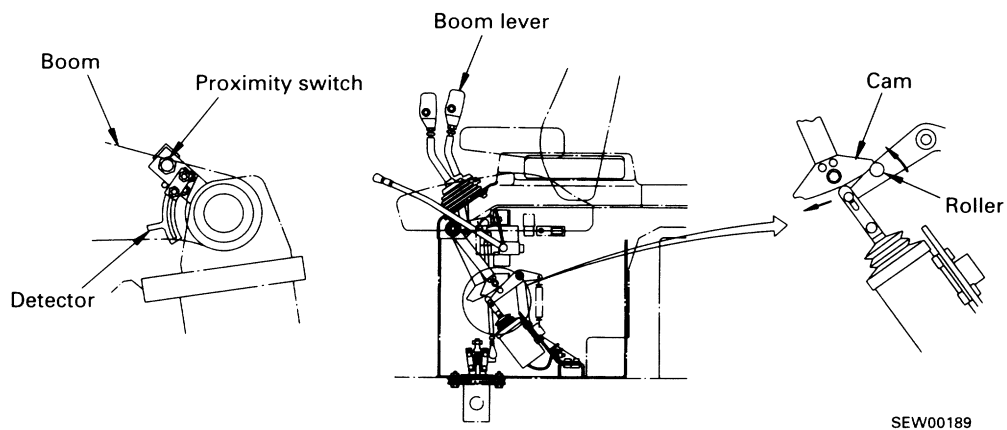
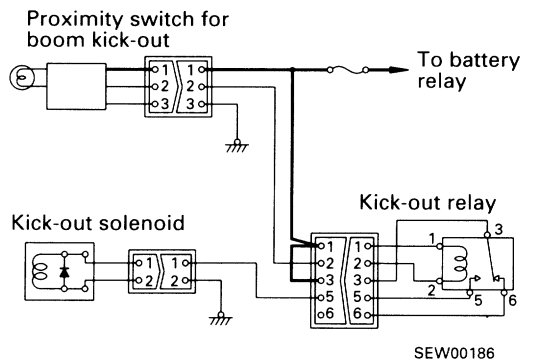
Operation of proximity switch

Boom RAISE

- When the boom is lower than the set position for the kick-out, the detector (steel plate) is not above the detection surface of the proximity switch, so the proximity switch load circuit is shut off. The relay switch is turned OFF and the current for the solenoid is shut off.

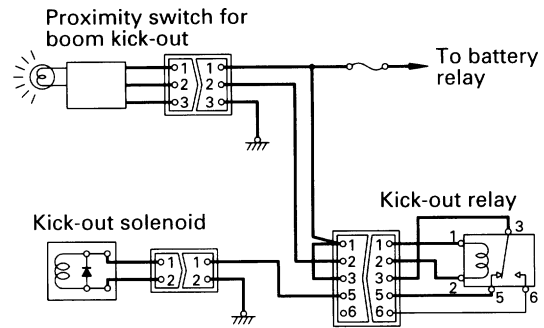


- When the boom lever is moved to the RAISE position, the boom spool is held at the RAISE position by the cam follower and cam on the lever, and the boom rises.

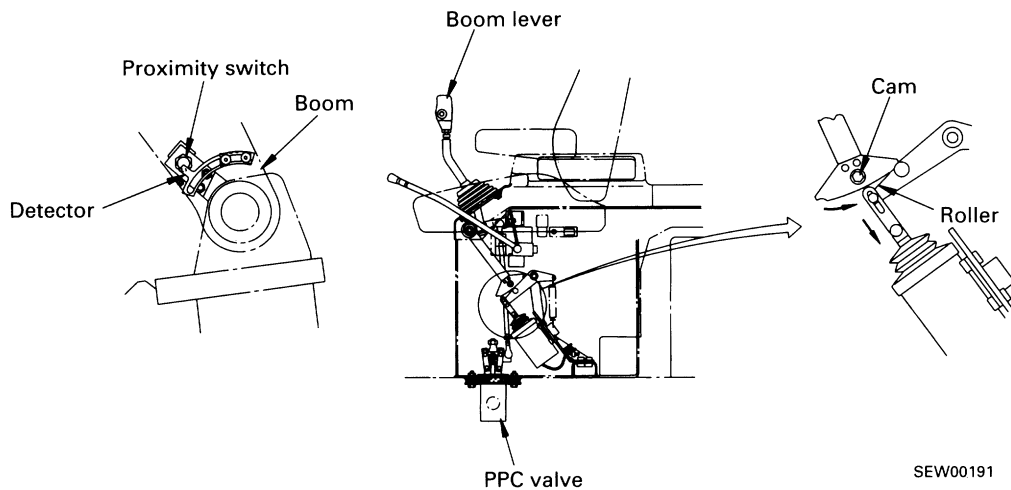


STRUCTURE AND FUNCTION**BUCKET POSITIONER AND BOOM KICK-OUT**

- When the boom rises and reaches the set position for the kick-out, in other words, the detector (steel plate) is in position on the detection surface of the proximity switch, an electric current is sent to the solenoid by the action of the proximity switch and relay circuit. As a result, the solenoid is actuated, and the cam is pulled away from the cam detent, so the lift spool is returned to the HOLD position by the return spring.



SEW00190



SEW00191

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Action of proximity switch

Position	When detector is in position at detection surface of proximity switch	When detector is separated from detection surface of proximity switch
Proximity switch actuation display	Lights up	Goes out
Proximity switch load circuit (relay switch circuit)	Current flows	Current is shut off
Relay switch load circuit (solenoid circuit)	Current flows	Current is shut off

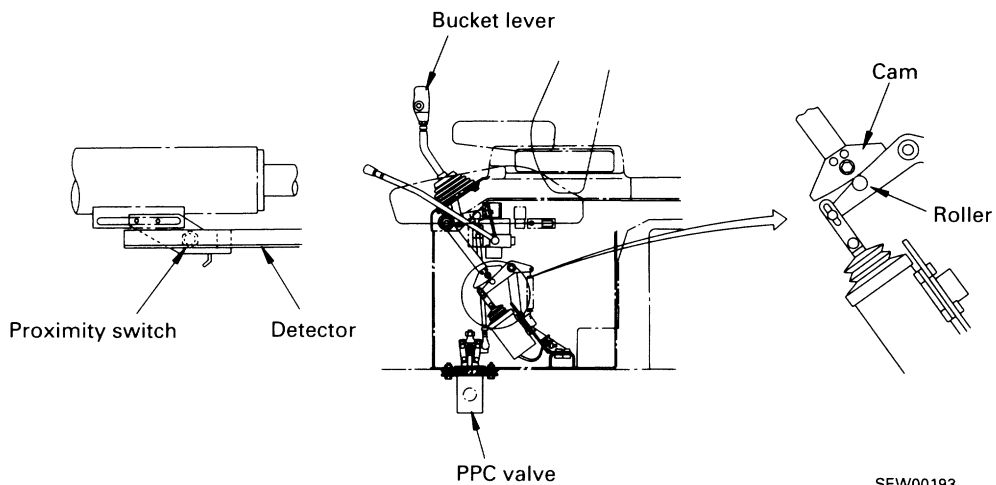
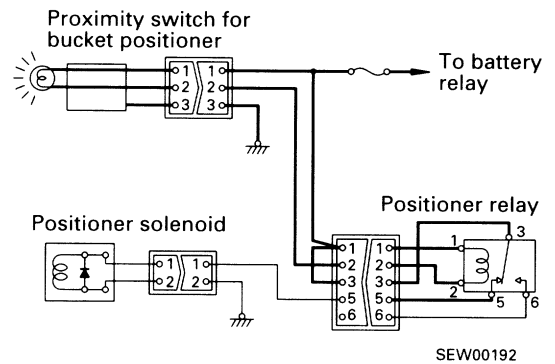
STRUCTURE AND FUNCTION

BUCKET POSITIONER AND BOOM KICK-OUT

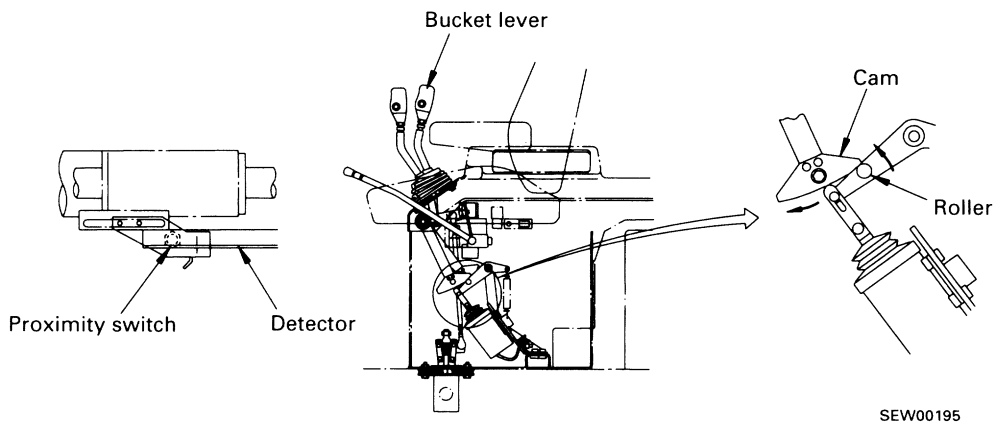
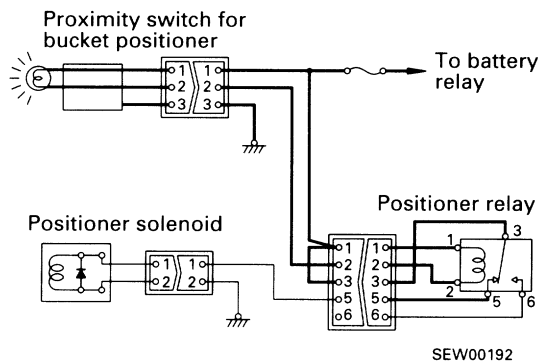
Operation of proximity switch

Bucket TILT

- When the bucket is lower than the set position for the auto-leveler, the detector (steel plate) is not above the detection surface of the bucket proximity switch, so electric current flows in the proximity switch load circuit. The relay switch is turned OFF and the current for the solenoid is shut off.



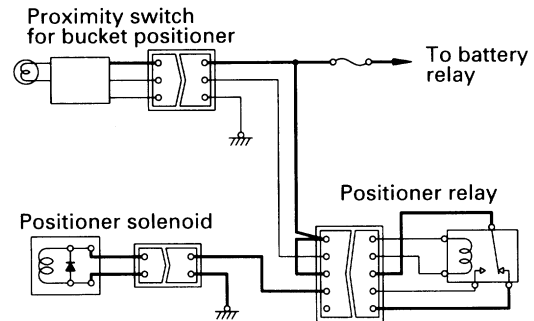
- When the bucket lever is moved to the TILT position, the DUMP spool is held at the TILT position by the cam follower and cam on the lever, and the bucket tilts.



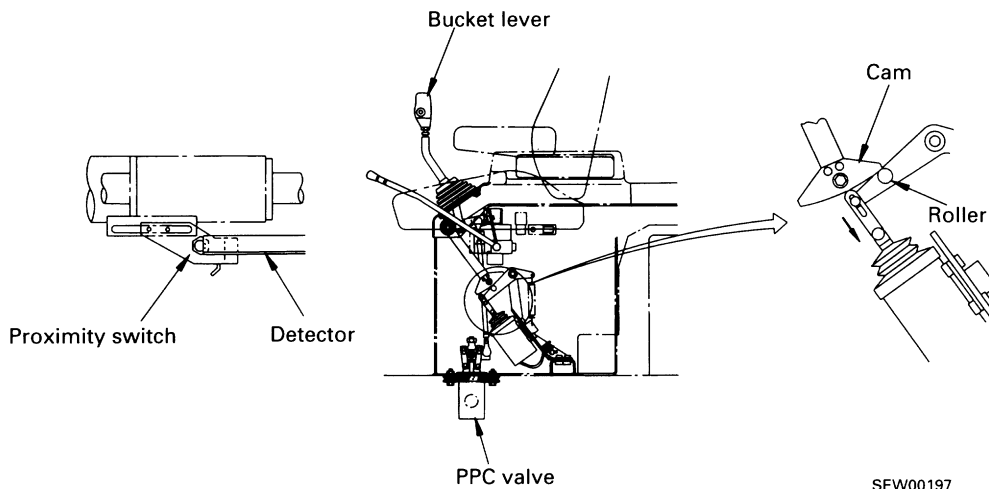
STRUCTURE AND FUNCTION**BUCKET POSITIONER AND BOOM KICK-OUT**

- When the bucket tilts and reaches the set position for the bucket leveler, in other words, the detector (steel plate) separates from the detection surface of the proximity switch, electric current is sent to the solenoid by the action of the proximity switch and relay circuit.

As a result, the solenoid is actuated, and the cam is pulled away from the cam detent, so the DUMP spool is returned to the HOLD position by the return spring.



SEW00196



SEW00197

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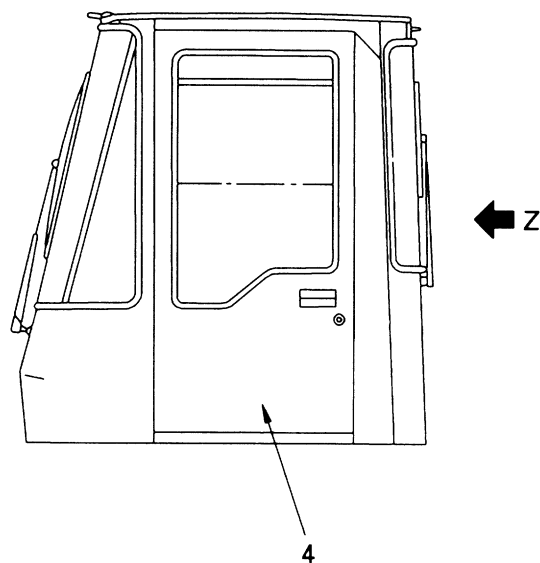
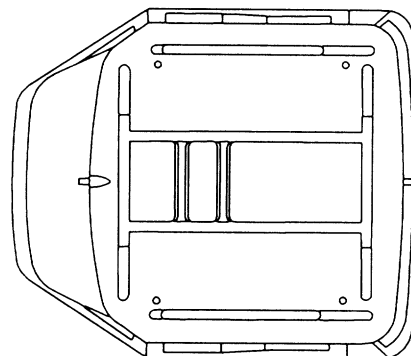
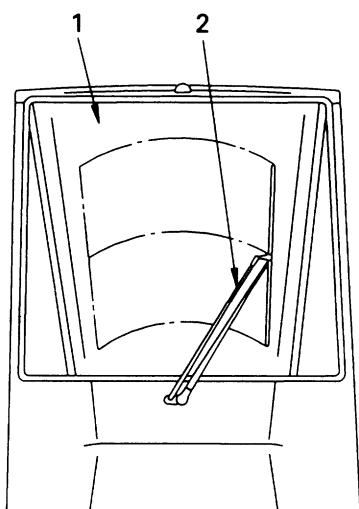
Action of proximity switch

Position	When detector is in position at detection surface of proximity switch	When detector is separated from detection surface of proximity switch
Proximity switch actuation display	Lights up	Goes out
Proximity switch load circuit (relay switch circuit)	Current flows	Current is shut off
Relay switch load circuit (solenoid circuit)	Current is shut off	Current flows

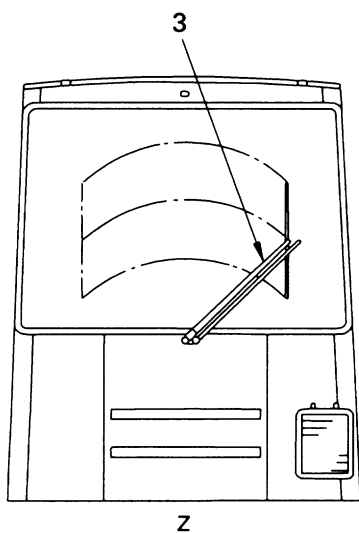
CAB

Serial No.: 50001 – 52999

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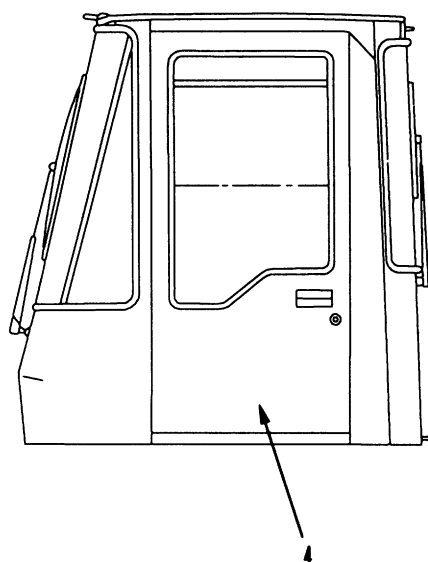
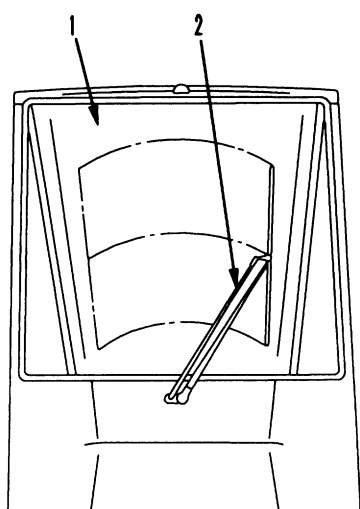
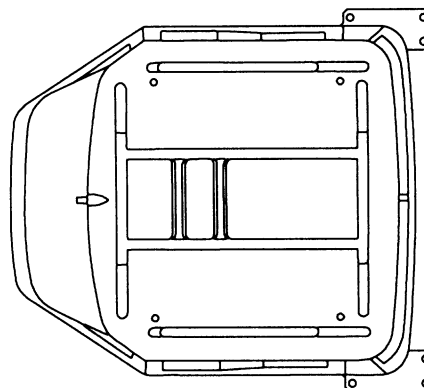


SEW00198

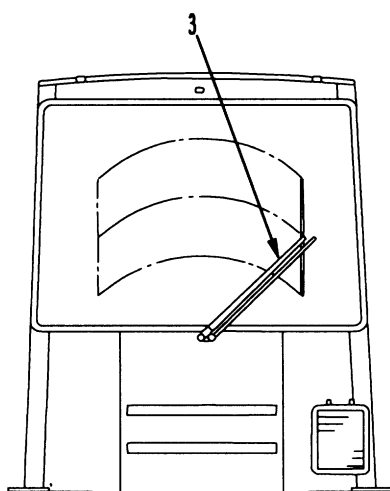


- 1. Front glass
- 2. Front wiper
- 3. Rear wiper
- 4. Door

Serial No.: 53001 – 53999



← Z



Z

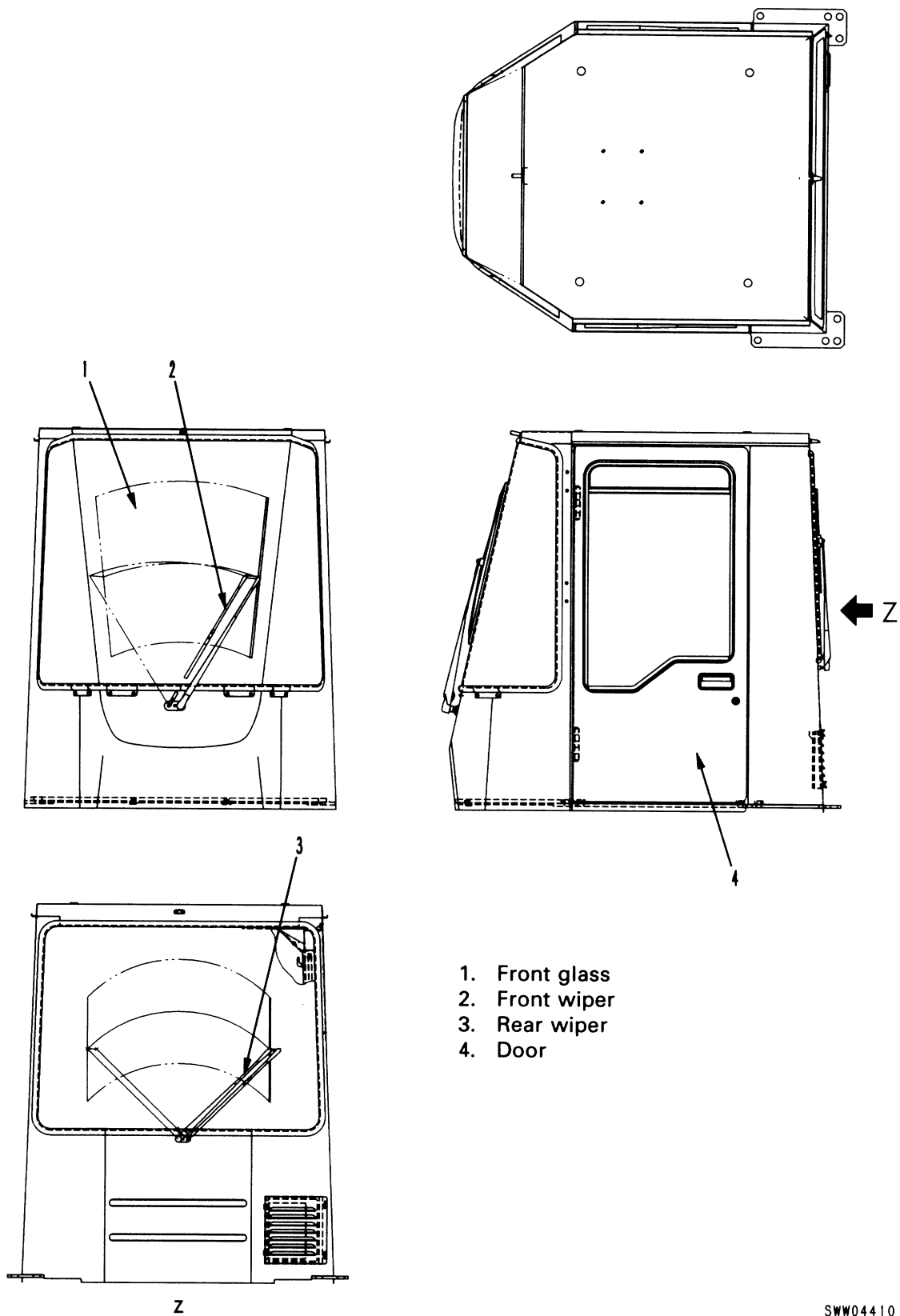
- 1. Front glass
- 2. Front wiper
- 3. Rear wiper
- 4. Door

U42103

SDW02807

Serial No.: 54001 and up

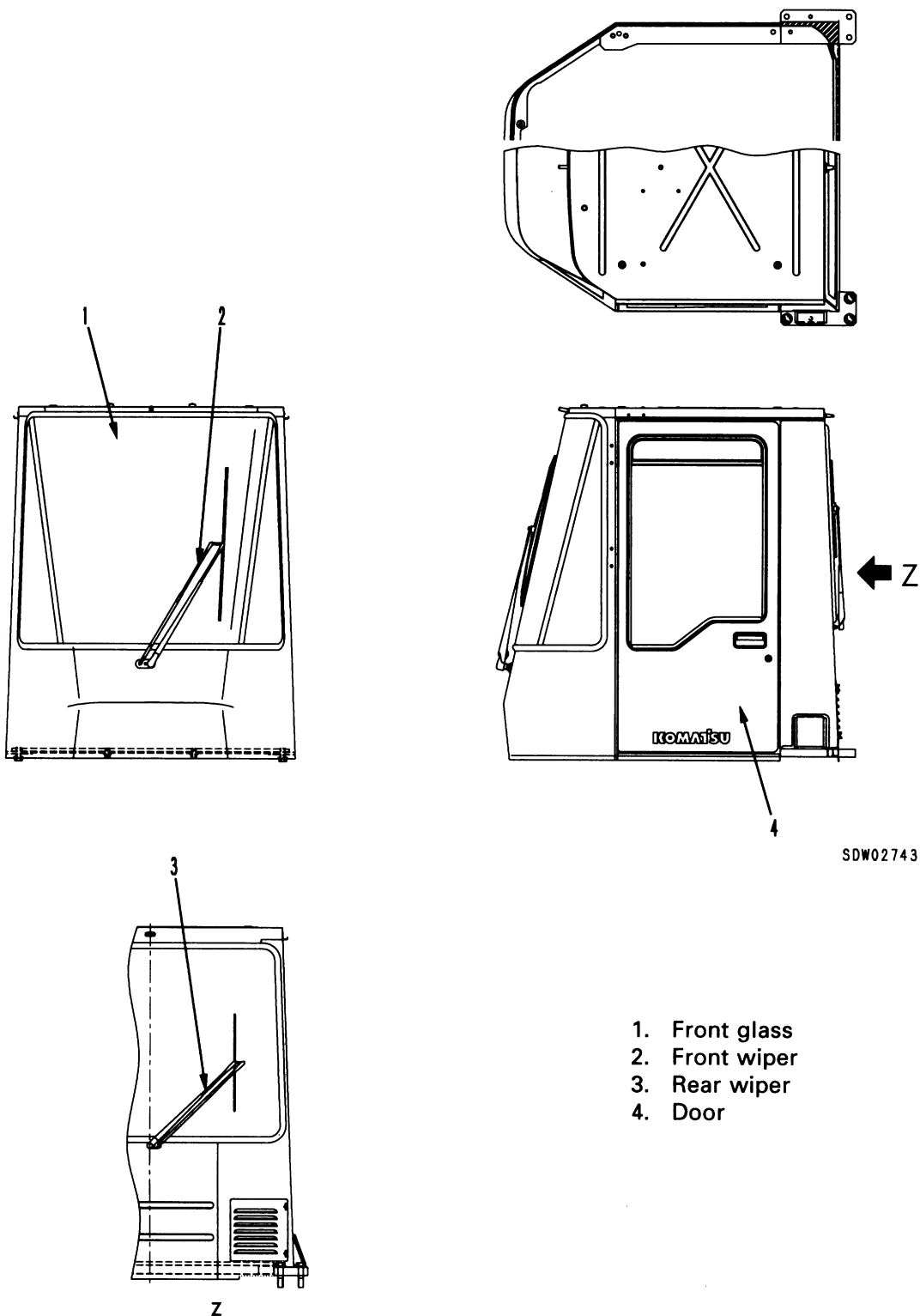
U42103



SWW04410

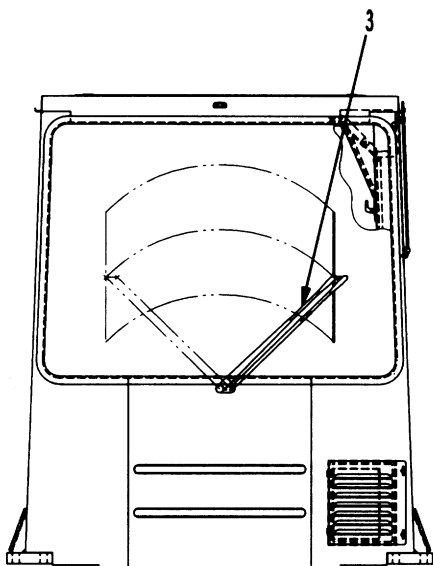
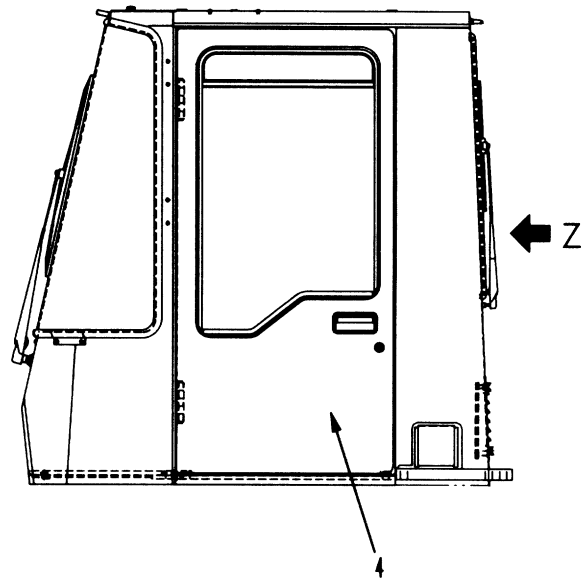
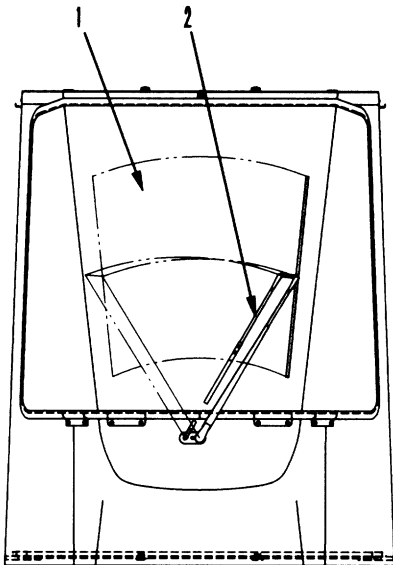
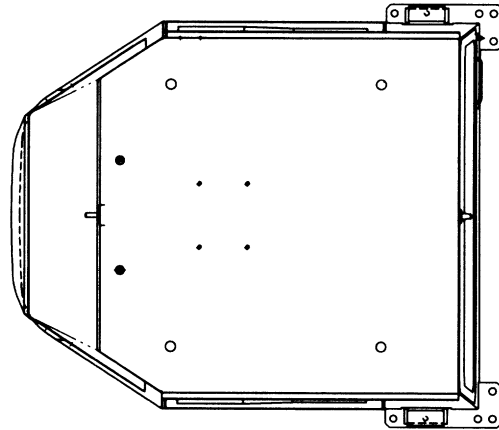
ROPS CAB

Serial No.: 53001 – 53999



Serial No.: 54001 and up

U42103



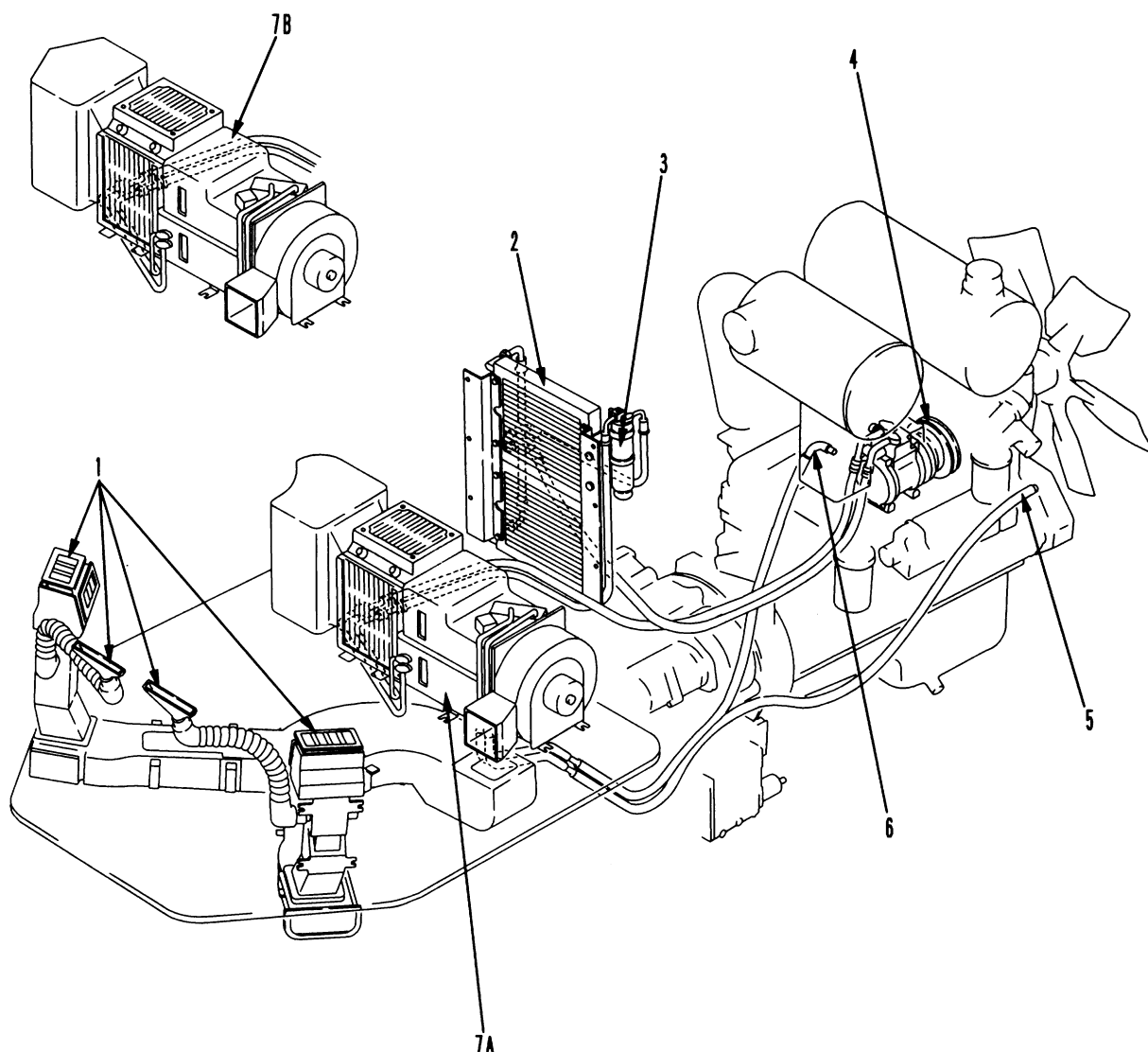
- 1. Front glass
- 2. Front wiper
- 3. Rear wiper
- 4. Door

Z

SWW04412

AIR CONDITIONER

AIR CONDITIONER PIPING



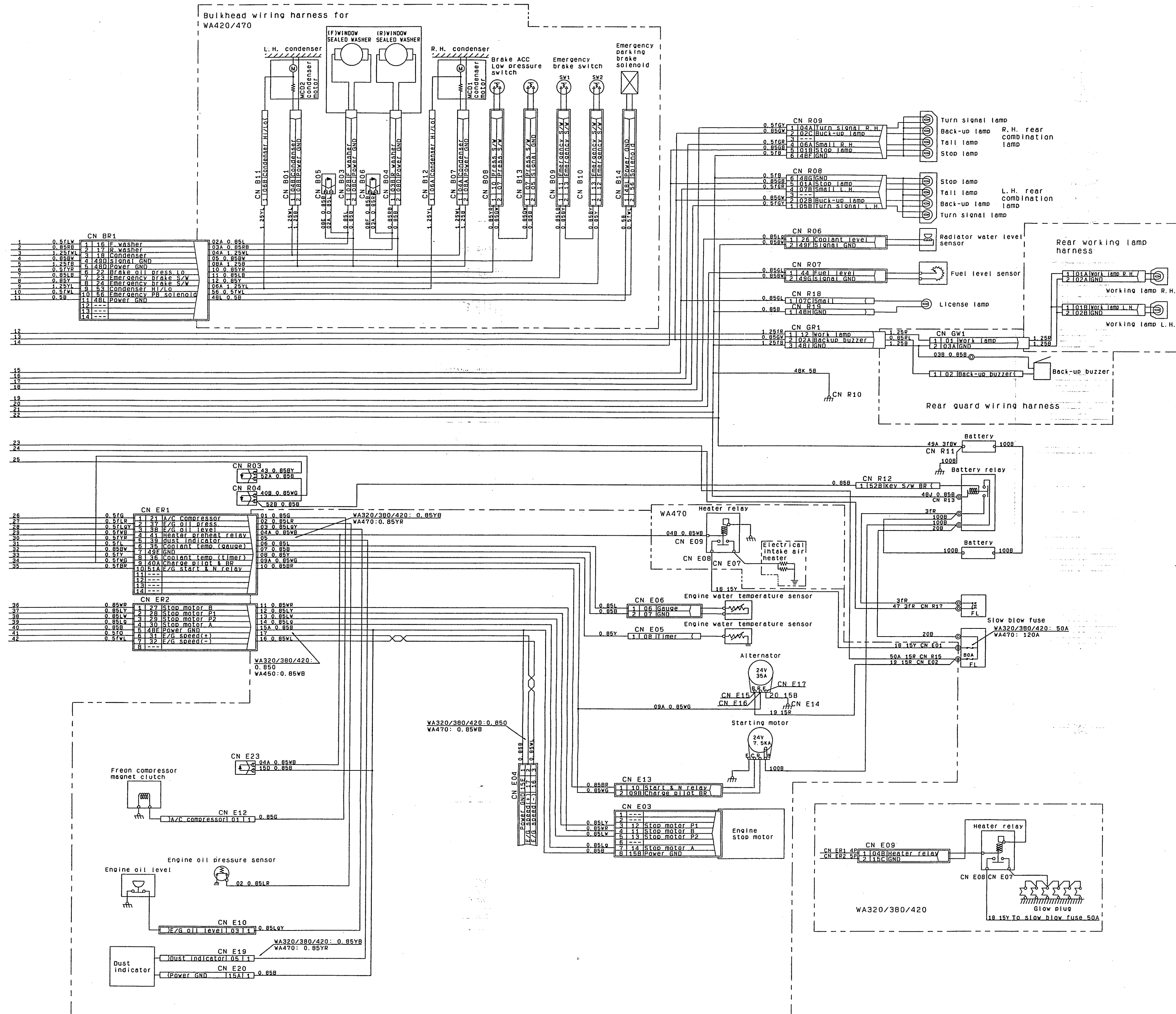
1. Vent
2. Air conditioner condenser
3. Dry receiver
4. Compressor
5. Hot water inlet port
6. Hot water outlet port

- 7A. Air conditioner unit
Serial No.: 50001 – 52999 (ROPS CAB)
Serial No.: 50001 – 53999 (CAB)
- 7B. Air conditioner unit
Serial No.: 53001 and up (ROPS CAB)
Serial No.: 54001 and up (CAB)

SXW04486

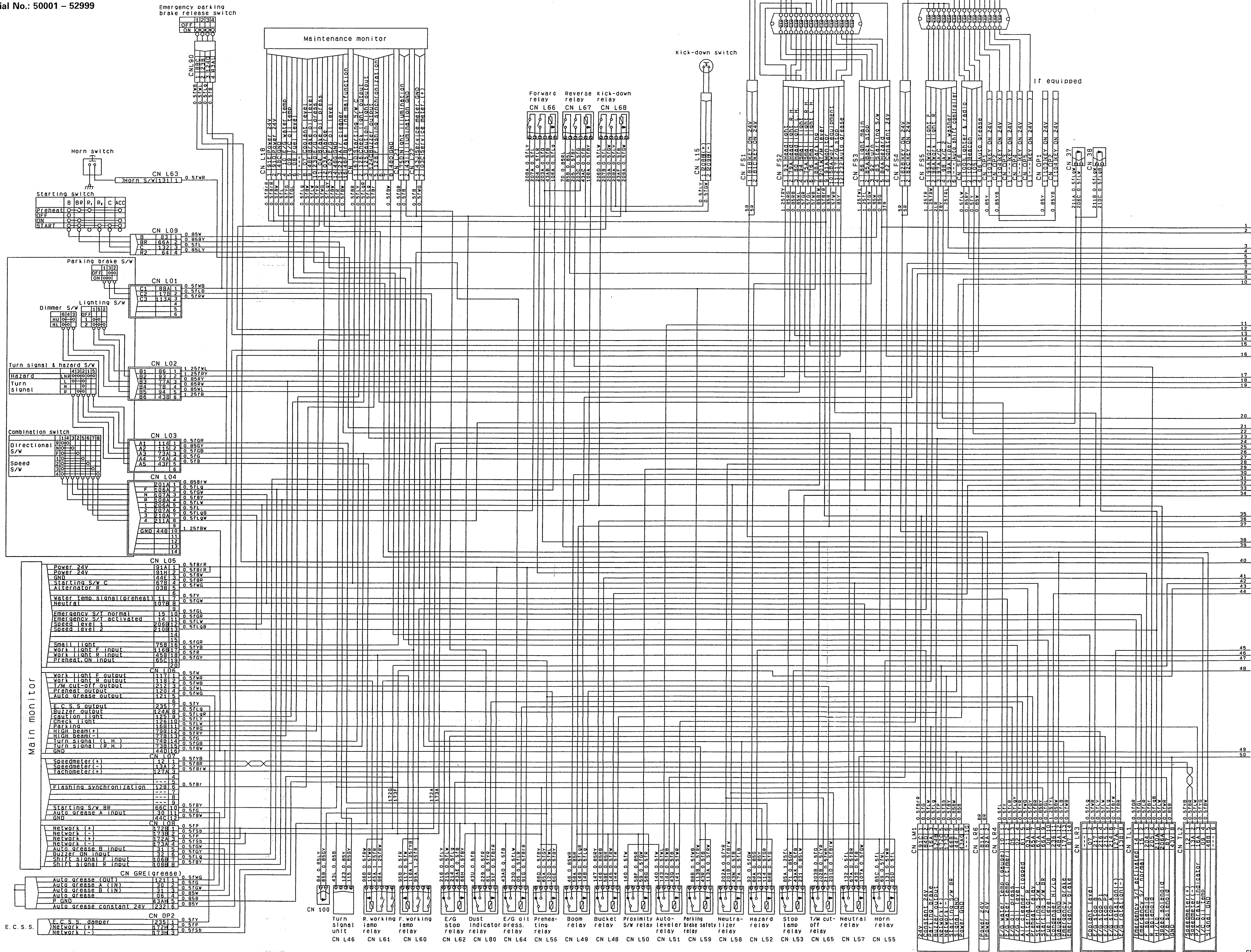
U42103



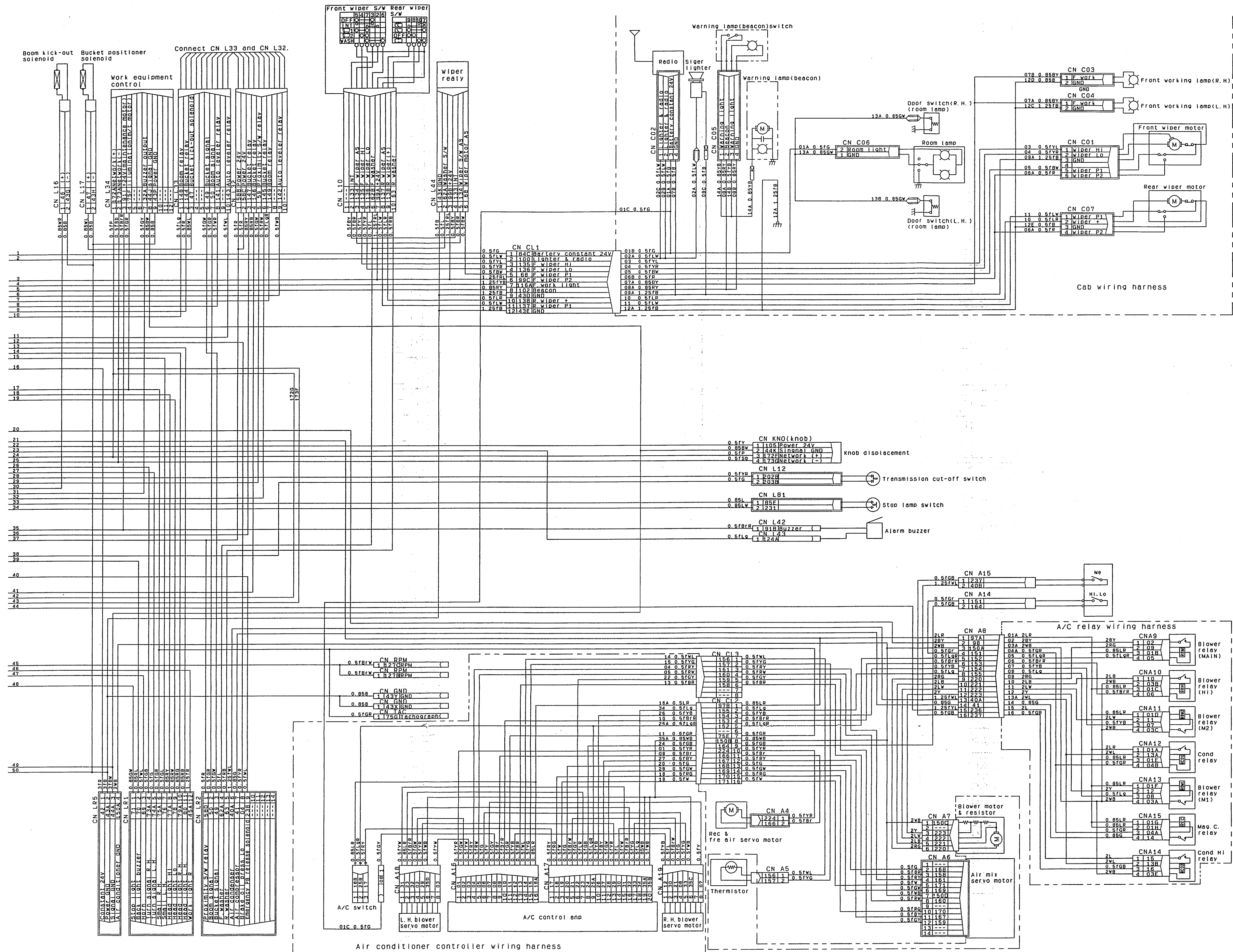


(2/2)

Serial No.: 50001 – 52999



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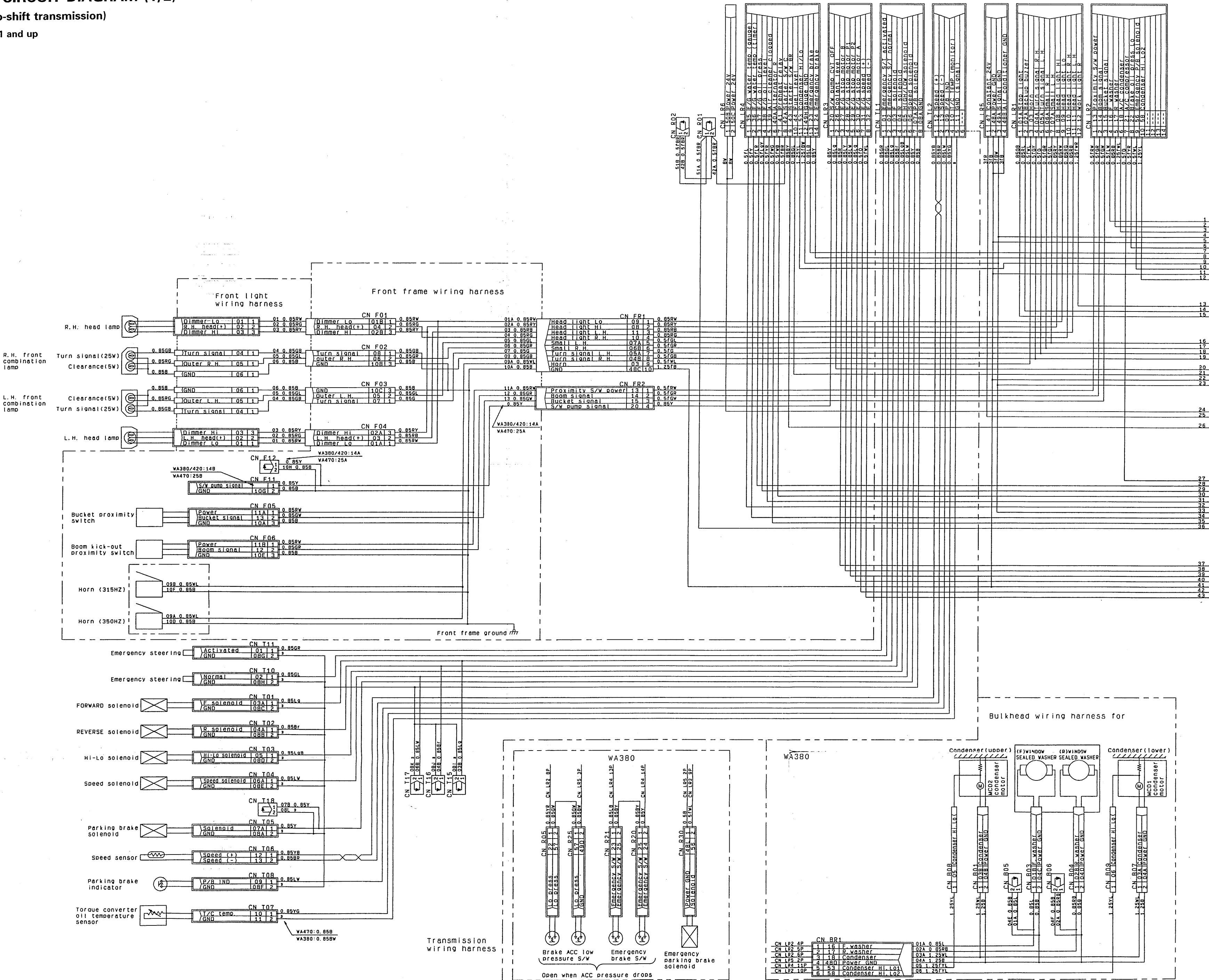


SDW01264

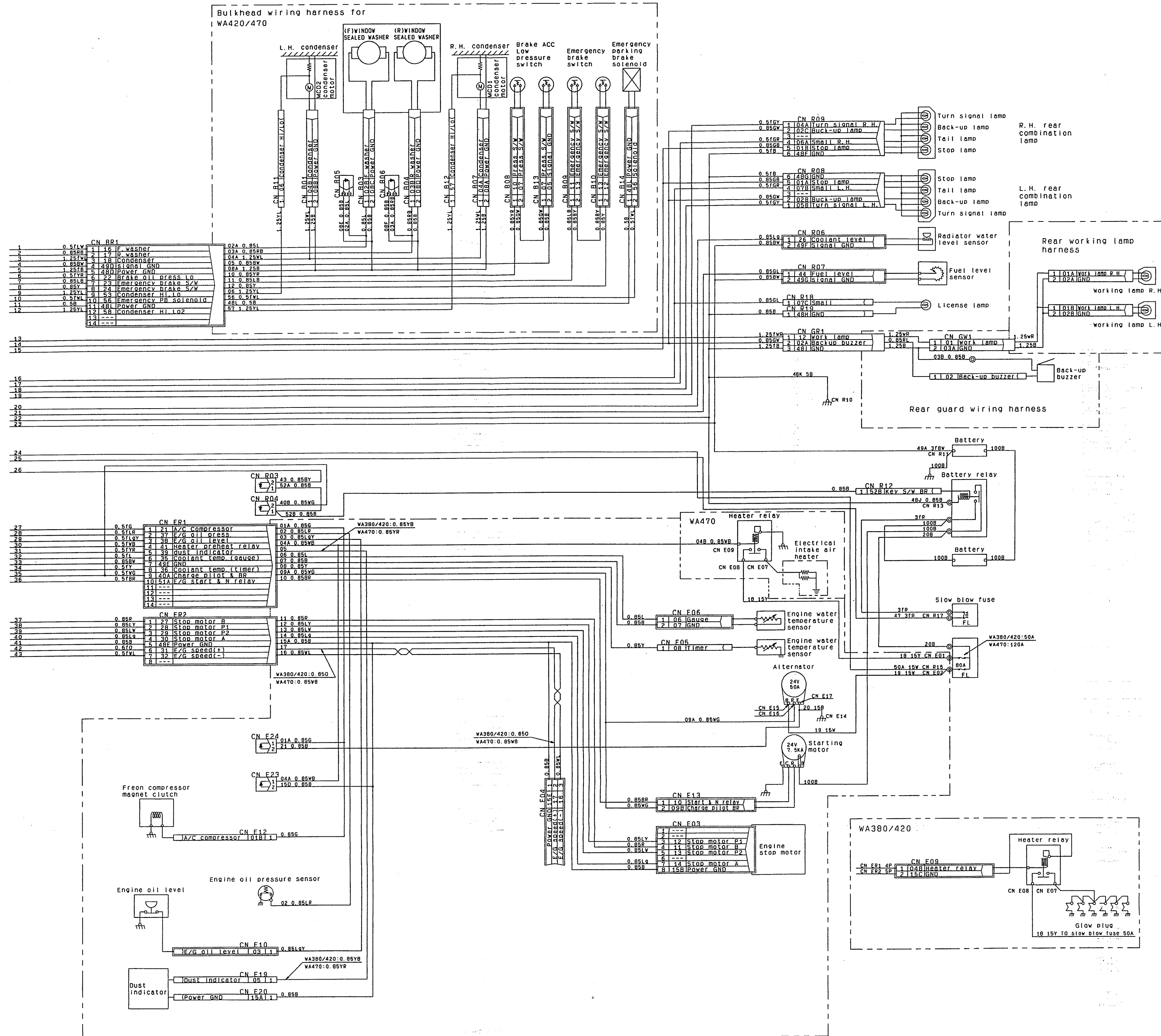
ELECTRIC CIRCUIT DIAGRAM (1/2)

(Without auto-shift transmission)

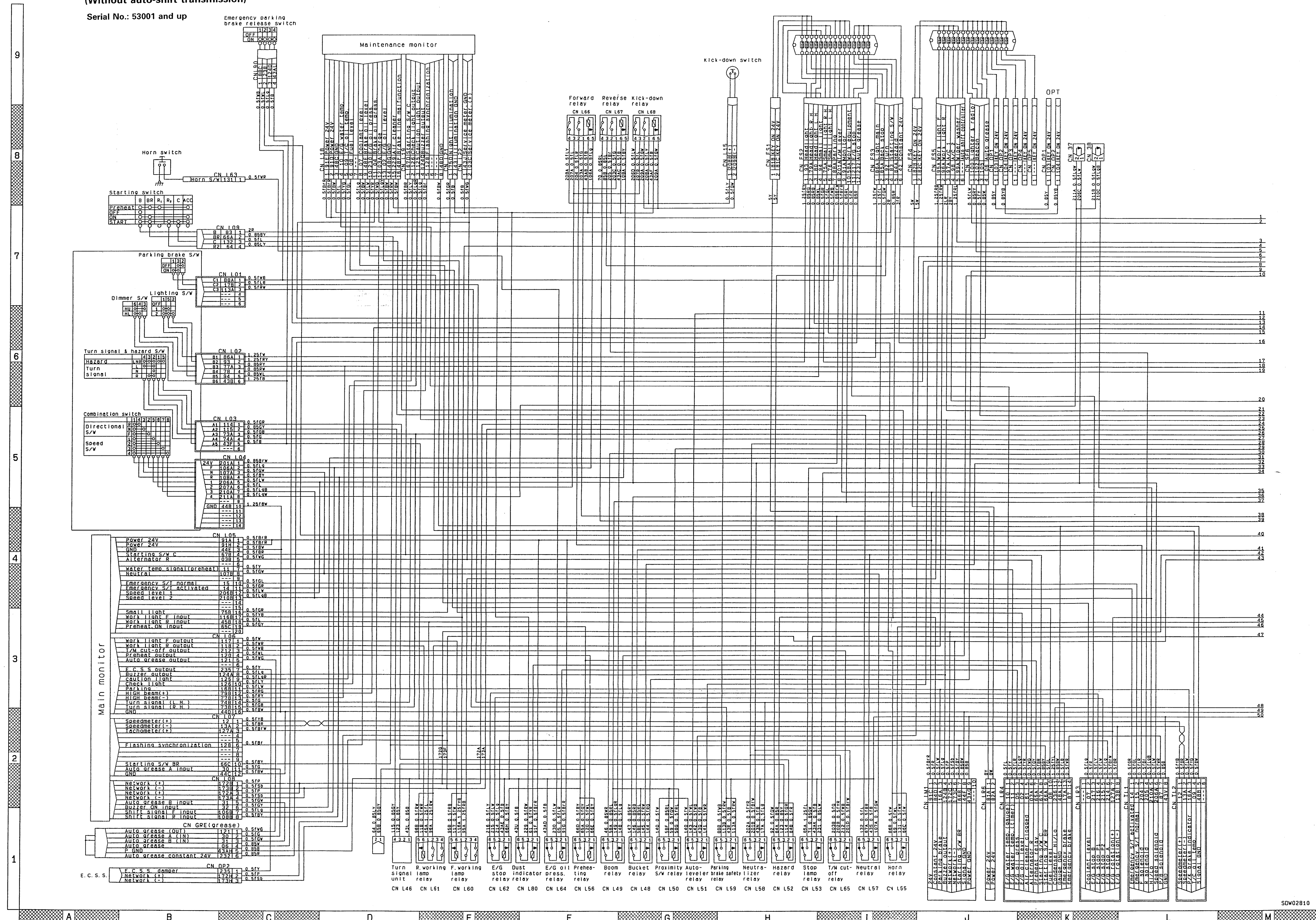
Serial No.: 53001 and up

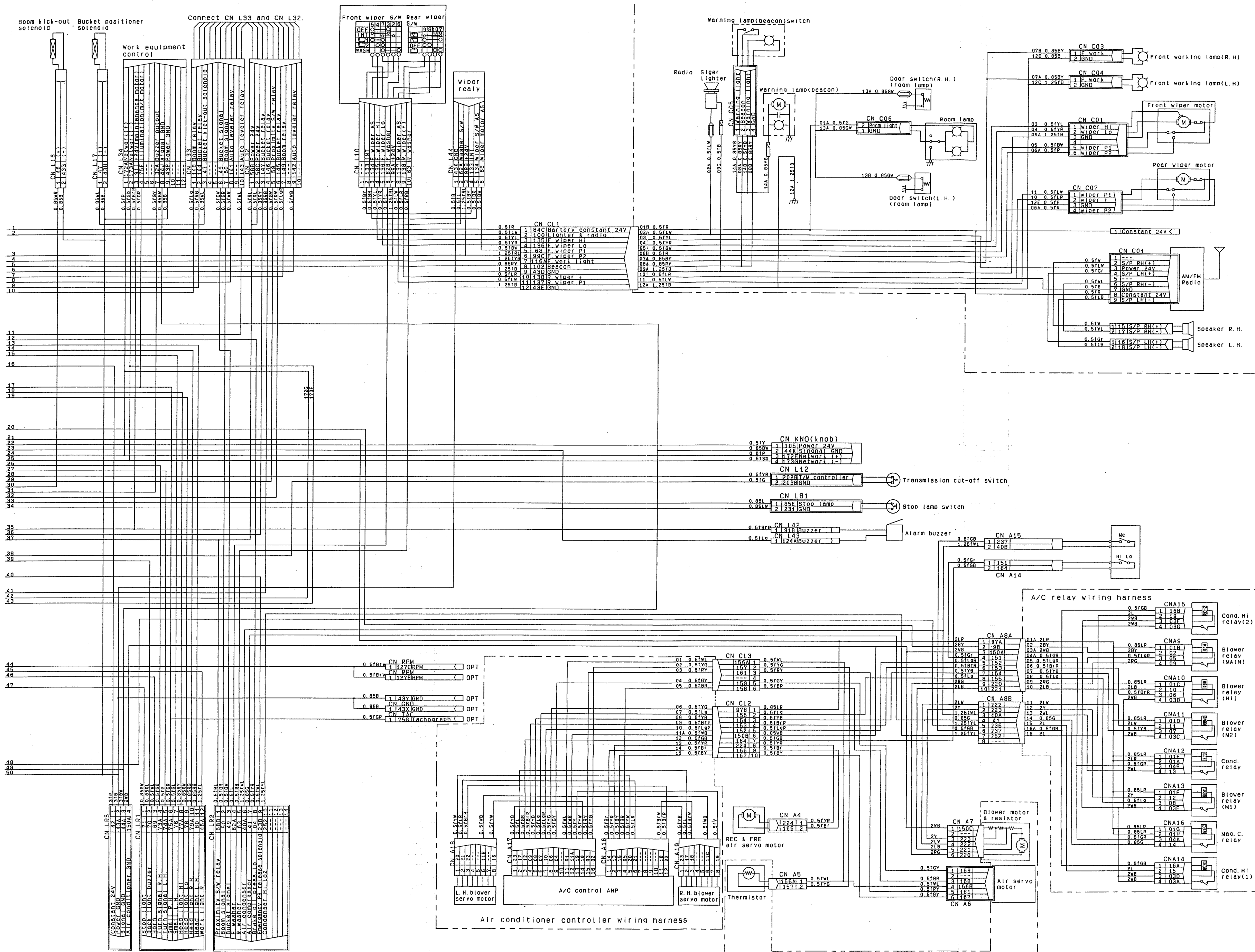


U42103



SDW02809

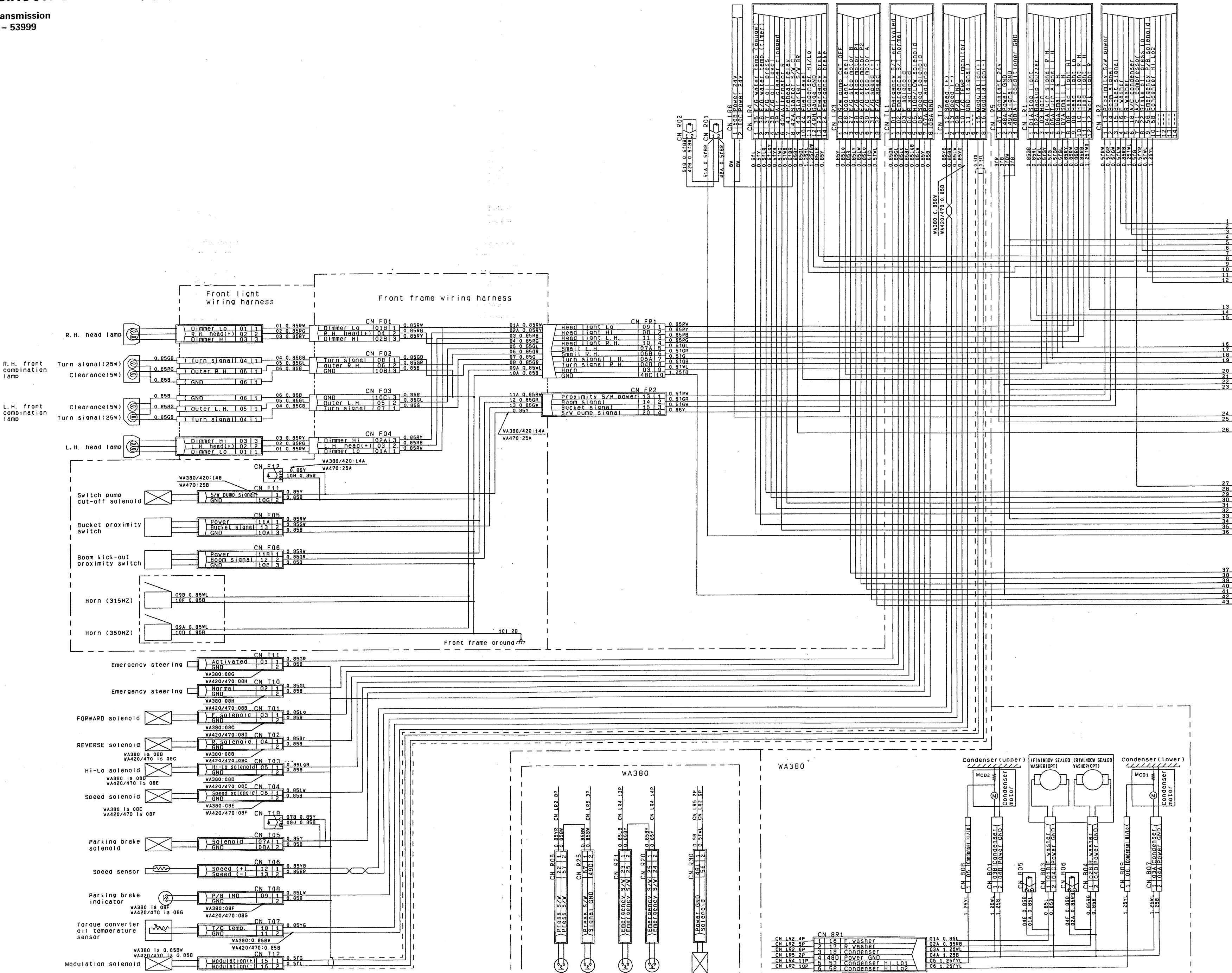


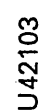


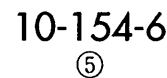
U42103

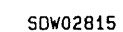
ELECTRIC CIRCUIT DIAGRAM (1/2)

With auto shift transmission
Serial No.: 53001 – 53999







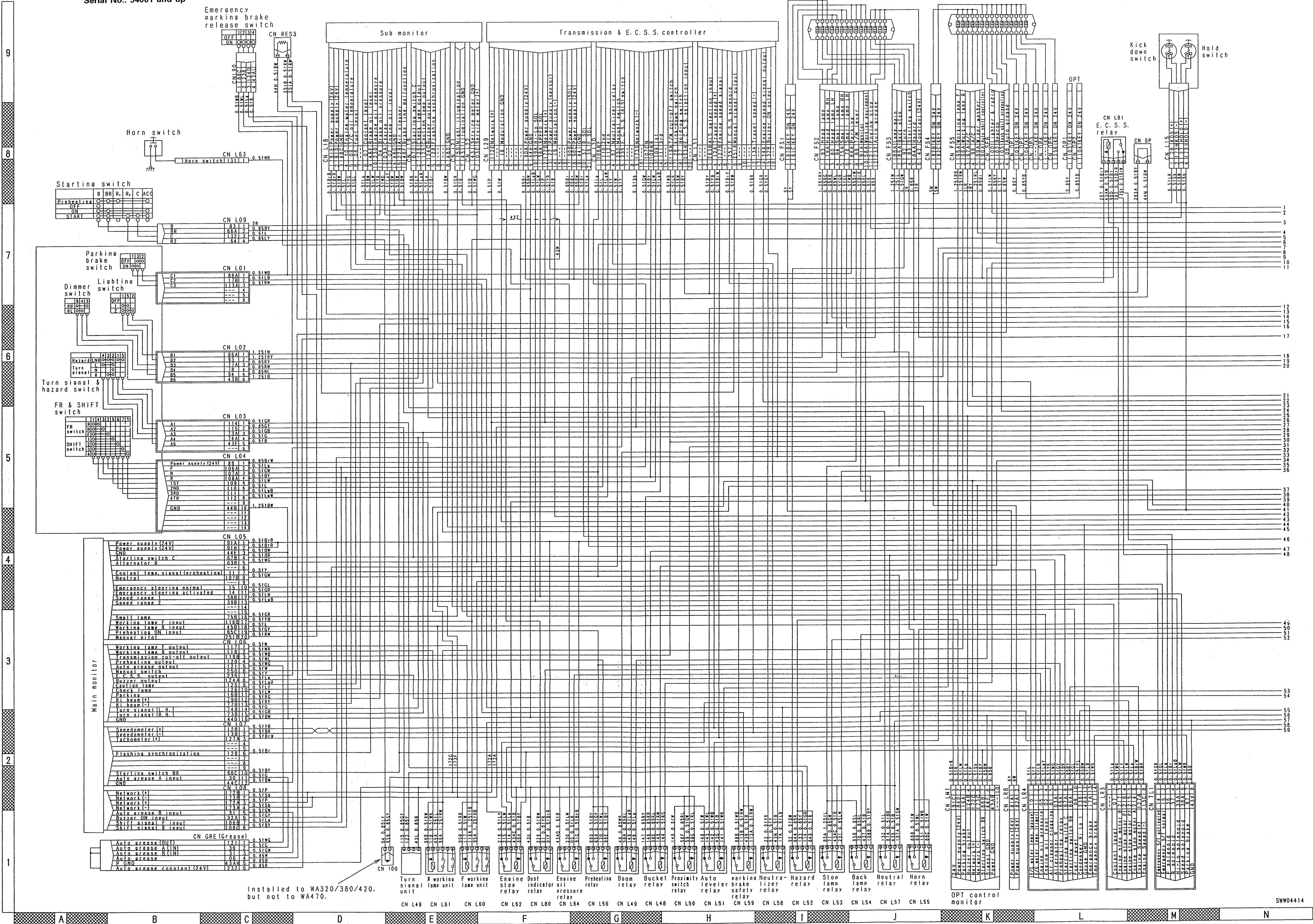


ELECTRIC CIRCUIT DIAGRAM (1/4)

With auto shift and new E.C.S.S. (Option)

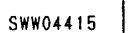
Serial No.: 54001 and up

https://truckmanualshub.com/



Serial No.: 54001 and up

<https://truckmanualshub.com/>

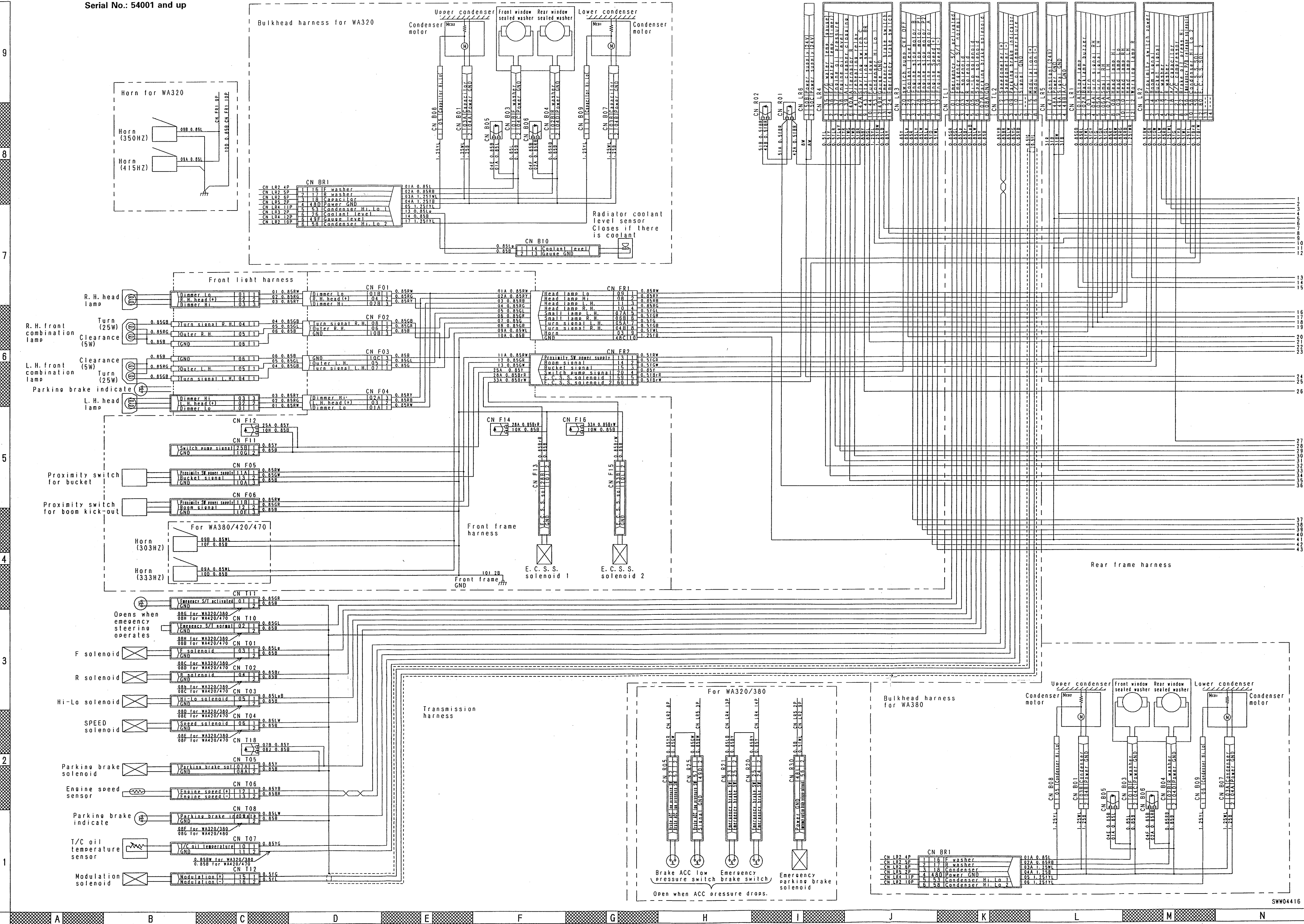


ELECTRIC CIRCUIT DIAGRAM (3/4)

With auto shift and new E.C.S.S. (Option)

Serial No.: 54001 and up

https://truckmanualshub.com/



Serial No.: 54001 and up

9



7 |

6 |

5

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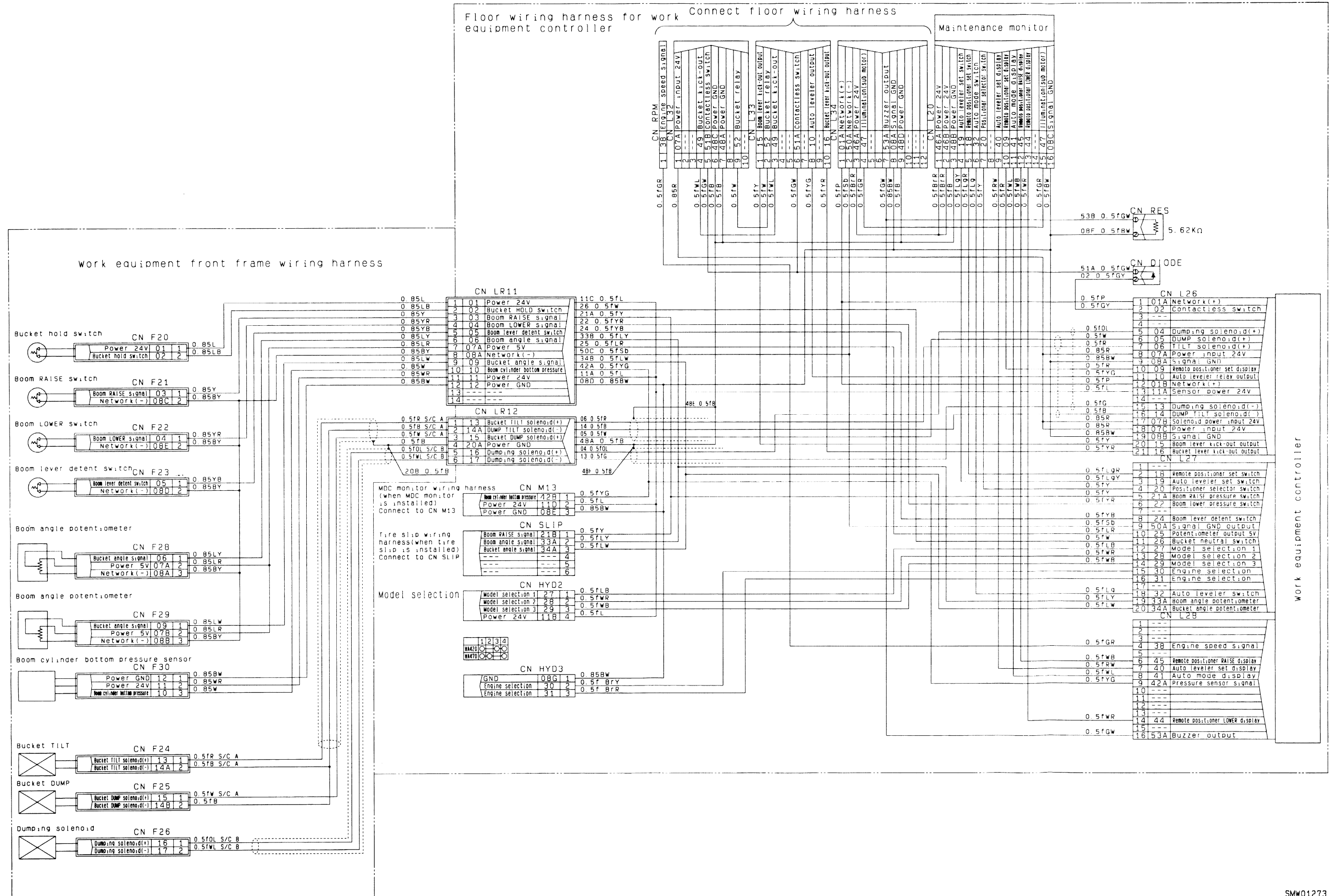
2 |

11

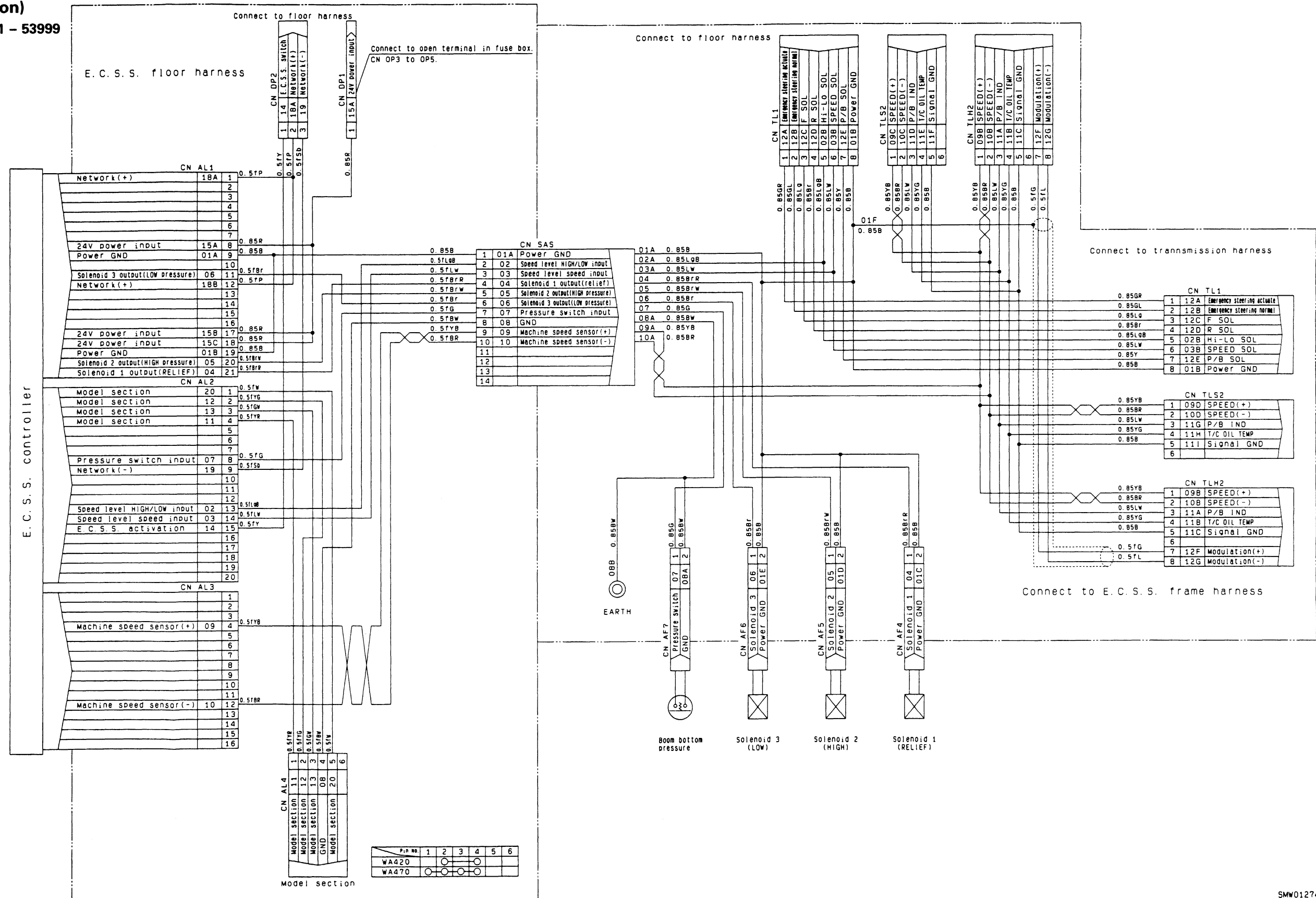
⑤

ELECTRIC CIRCUIT DIAGRAM

WORK EQUIPMENT CONTROLLER

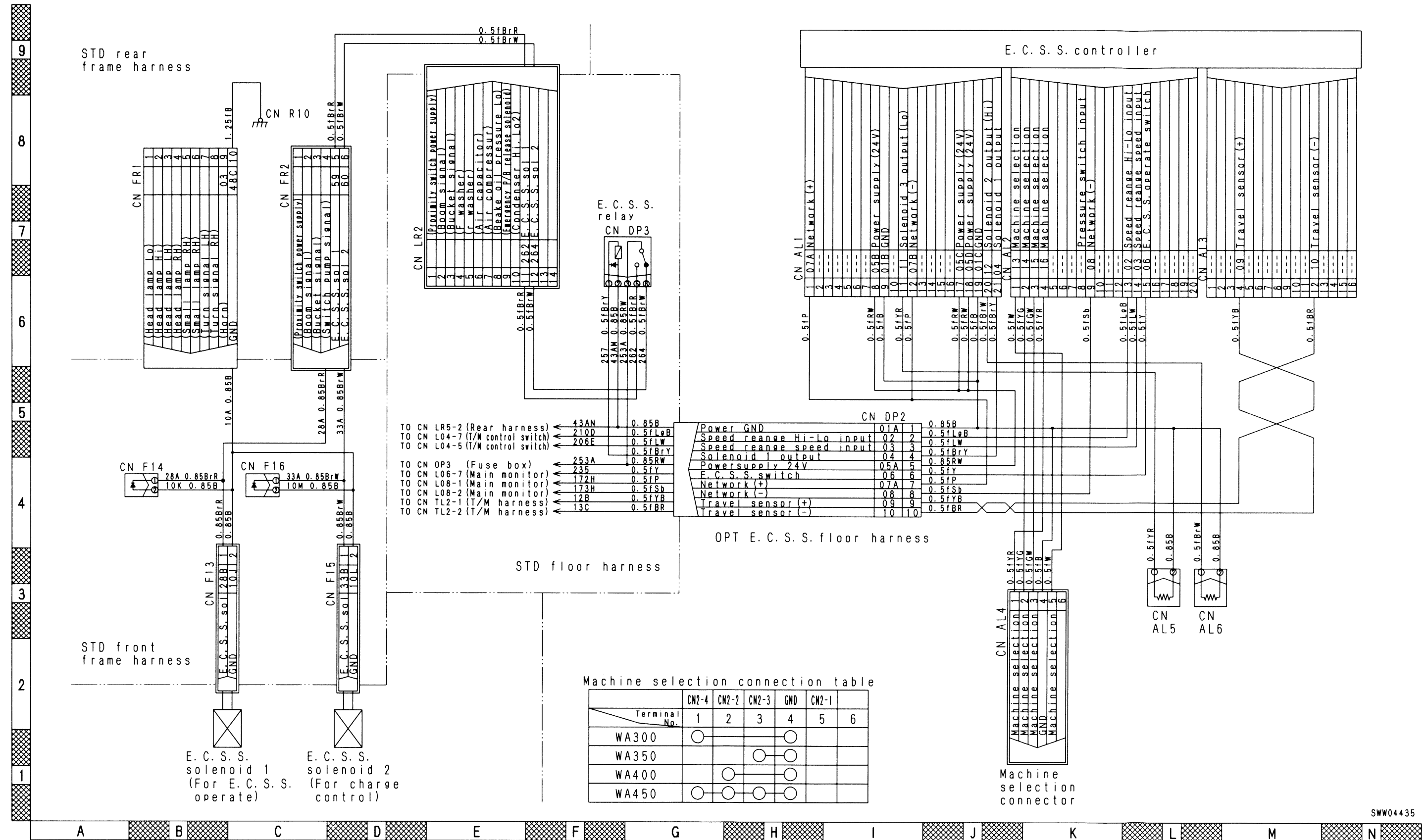


Serial No.: 50001 – 53999



Serial No.: 54001 and up

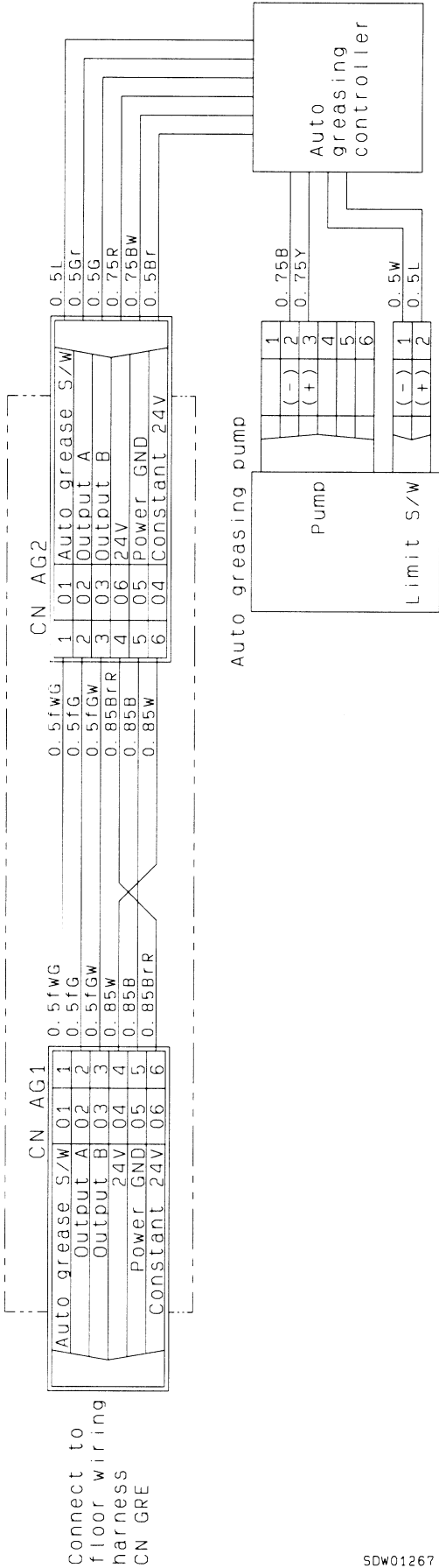
U42103



SWW04435

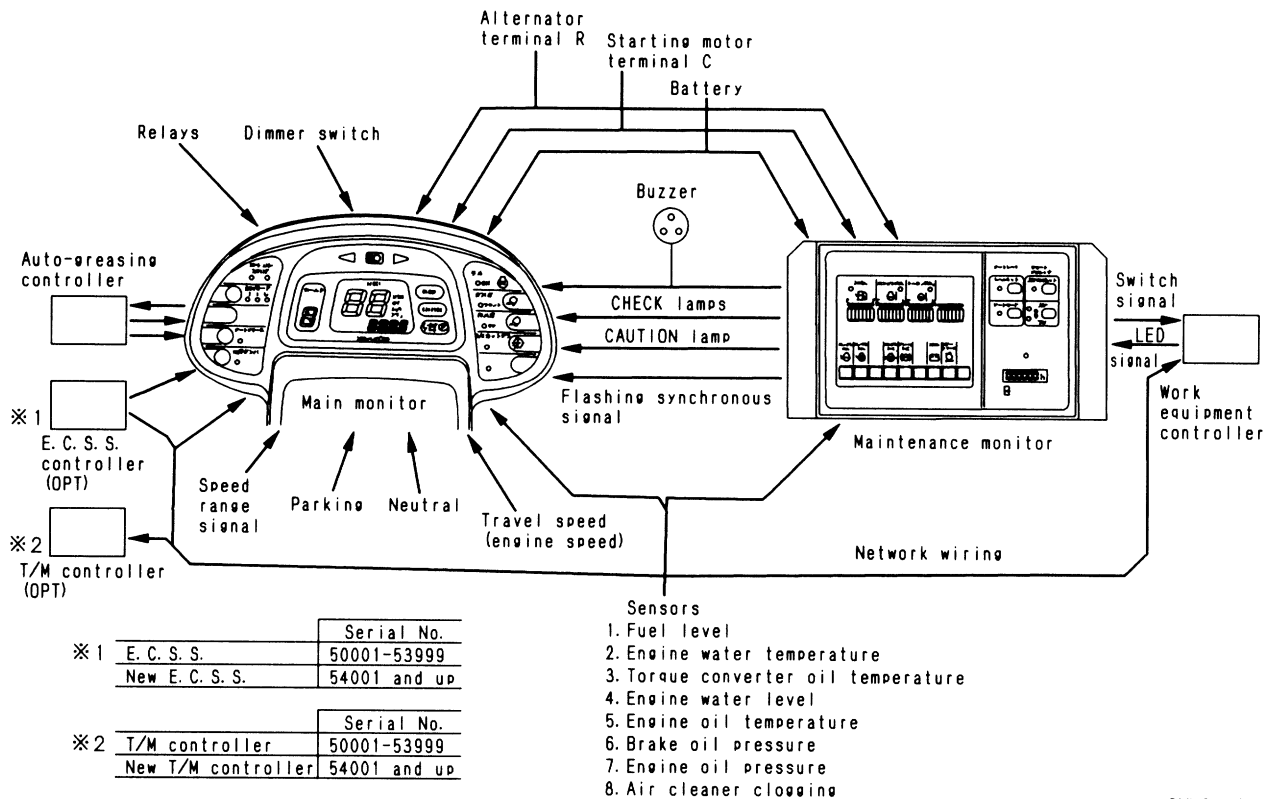
ELECTRIC CIRCUIT DIAGRAM
AUTO-GREASING

U42103



SDW01267

MACHINE MONITOR SYSTEM

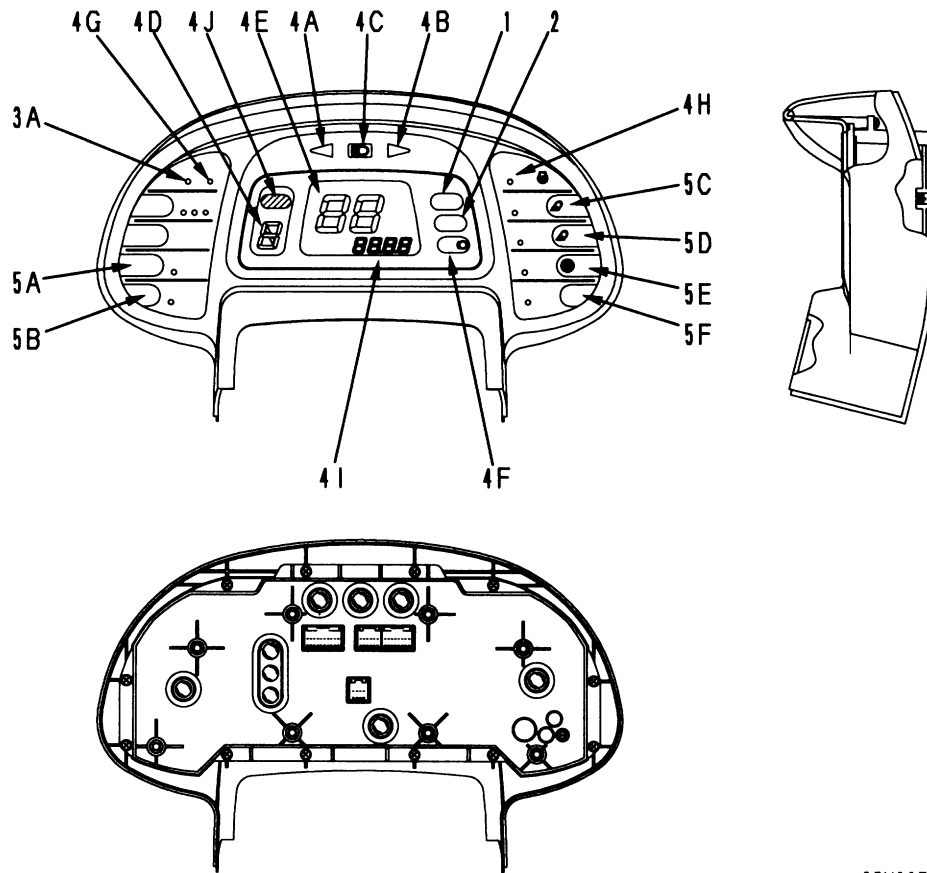


SWW04427

Outline

- The machine monitor system uses the sensors and other devices installed to various parts of the machine to observe the condition of the machine. It processes this information swiftly and displays it on the monitor panel to inform the operator of the condition of the machine.
- The machine monitor system consists of the main monitor, maintenance monitor, sensors, switches, relays, alarm buzzer, and power source.
- The displays can be broadly divided into the following: Cautions displayed on the monitors (abnormalities in the machine where an alarm is given) and normal conditions which are always displayed on the instrument panel (pilot lamps and readings for the gauges, speedometer, and service meter).
- There are also various switches built into the monitor panel which function to operate the machine.
- ★ When the optional controller are installed, the main monitor communicates with the controller through the network wiring and functions to display the controller failure action code and failure code together with the time elapsed since the failure (trouble data display mode).

MAIN MONITOR



SBW02706

- | | | |
|---------------------------------|-------------------------------|--|
| 1. CHECK lamp | 4C. Hi beam | 5. Switches |
| 2. CAUTION lamp | 4D. Shift indicator | 5A. Auto-greasing switch (option) |
| 3. Caution item | 4E. Speedometer | 5B. E.C.S.S. switch (option) |
| 3A. Emergency steering actuated | 4F. Parking brake | 5C. Working lamp (front) switch |
| 4. Pilot item | 4G. Emergency steering normal | 5D. Working lamp (rear) switch |
| 4A. Turn signal (left) | 4H. Preheating | 5E. Transmission cut-off switch |
| 4B. Turn signal (right) | 4I. Failure action code | 5F. Auto-shift/manual selector switch (Only for machine with auto-shift transmission) (option) |

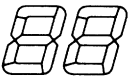
Outline

- The main motor has a display function for the speedometer and other gauges and a switching function to control the electric components and controllers.
- There is one CPU (Central Processing Unit) installed internally, and this processes the

signals from the sensors and outputs the display.

- A liquid crystal display and LEDs are used for the display. The switches are embossed sheet switches.

MAIN MONITOR DISPLAY FUNCTION

Display category	Symbol	Display item	Display range	Display method
Check		Check	When there is abnormality display on maintenance monitor	Display flashes (for details, see MAINTENANCE MONITOR DISPLAY FUNCTION)
Caution		Emergency steering actuated (option)	When actuated	Display flashes
		Caution	Parking brake actuated, transmission not at neutral	Display flashes and buzzer sounds
			When there is abnormality display on maintenance monitor	Display flashes (buzzer may also sound) (for details, see MAINTENANCE MONITOR DISPLAY FUNCTION)
Pilot		Hi beam	When operated	Display lights up
		Turn signal (left, right)	When operated	Display lights up
		Parking brake	When operated	Display lights up Buzzer sounds when parking brake is applied and shift lever is not at N
		Emergency steering normal (option)	When normal (oil is flowing in hydraulic circuit)	Display lights up
		Preheating	When preheating	Lights up Lighting up time changes according to engine water temperature when starting switch is turned ON (for details, see PREHEATING OUTPUT FUNCTION)
Speedometer		Travel speed	0 – 99 km/h	Digital display (display switches between tachometer and speedometer)
Shift indicator		Shift indicator	1 – 4 N	Digital display
Failure action code		Failure action code	When controller detects failure and action by operator is needed, CALL is displayed, or CALL and E ☐ ☐ (action code) are displayed in turn	Digital display Buzzer sounds (For details of the travel data display mode, see TROUBLE DATA DISPLAY MODE)

MAIN MONITOR SWITCH FUNCTION

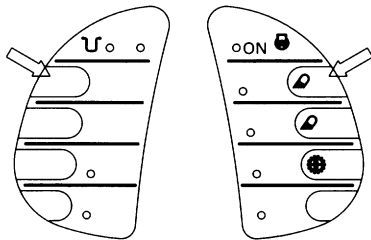
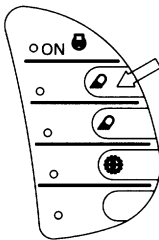
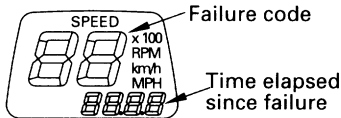
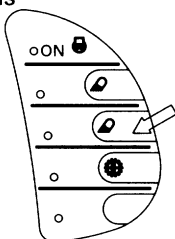
Item	Function	Display	Actuation
Auto-greasing (option)	Forced greasing is carried out while switch is being pressed when display is lighted up	Lights up (goes out momentarily when switch is turned ON)	Auto-greasing control actuated (automatic greasing carried out at fixed interval)
		Flashes (slowly)	Grease empty
		Flashes (rapidly)	Abnormality in auto-greasing controller system
		Goes out	Auto-greasing controller not installed
E.C.S.S. (option)	E.C.S.S. function is actuated or stopped each time switch is pressed	Lights up	E.C.S.S. function actuated
		Goes out	E.C.S.S. function stopped
Working lamp (front)	Front working lamp lights up or goes out each time switch is pressed when side lamps are lighted up	Lights up	Front working lamp lights up
		Goes out	Front working lamp goes out
Working lamp (rear)	Rear working lamp lights up or goes out each time switch is pressed when side lamps are lighted up	Lights up	Rear working lamp lights up
		Goes out	Rear working lamp goes out
Transmission cut-off	Transmission cut-off function is actuated or stopped each time switch is pressed	Lights up	Cut-off function actuated
		Goes out	Cut-off function stopped
Manual mode (Only for machine with auto-shift transmission) (option)	Switches auto-shift mode to manual mode when switch is pressed	Lights up	Manual mode
		Goes out	Auto-shift mode

PREHEATING OUTPUT FUNCTION

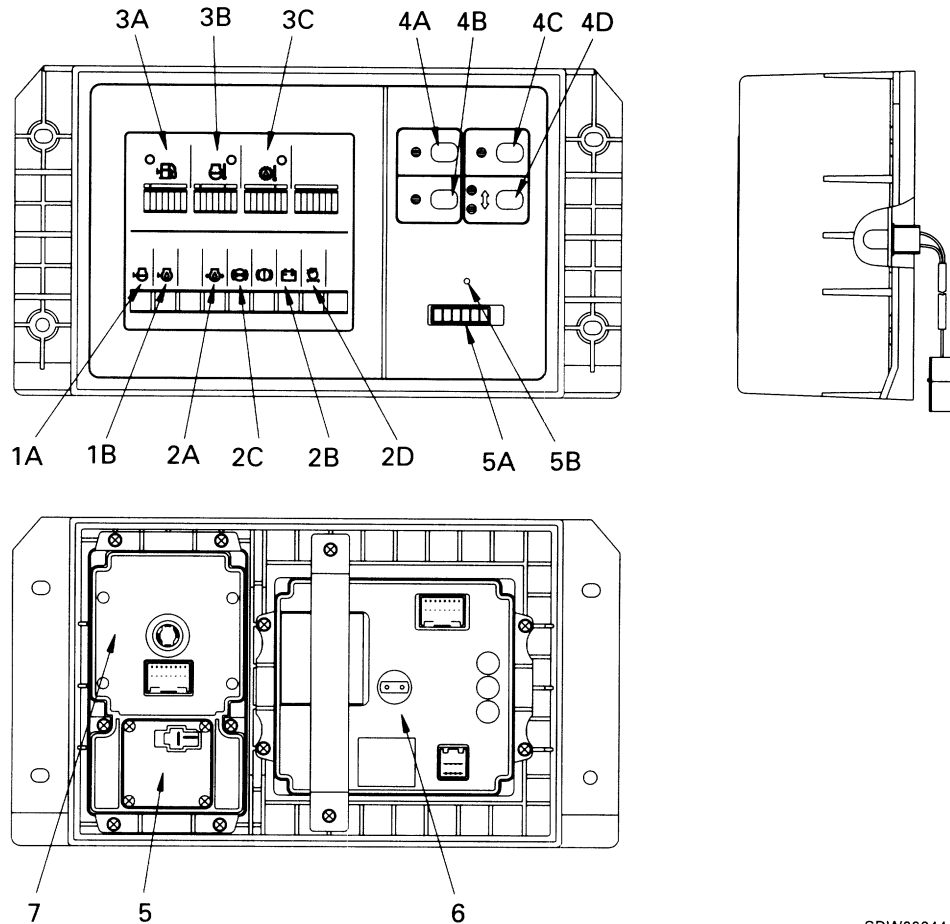
Item	Actuation
Electrical intake air heater	Power source ON OFF Starting signal (terminal C) ON OFF Display ON OFF T1 Output ON OFF T2 Relationship between engine water temperature and display and output time Display time: T1 (sec) Output time: T2 (sec) 45 -30 0 Engine water temperature (°C)

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TROUBLE DATA DISPLAY MODE (when optional controller are installed)

Item	Switch operation	Actuation
Method of switching to trouble data display mode	With engine stopped and starting switch turned ON, press 2nd switch from top on left side of main monitor (switch below emergency steering display) and working lamp (front) switch simultaneously for at least 5 seconds.  SDW00241	All switch displays (LEDs) go out, and failure code is displayed on speedometer display and time elapsed since failure is displayed on failure action code display. (1) Failure code is a two-digit display given in numbers or letters. The display for the failure now occurring flashes and the display for past failures lights up. If there is no failure, CC is displayed (000 is displayed for time elapsed since failure) (2) The time elapsed since failure is displayed as a three-digit number to show how long ago the failure occurred (the oldest failure time is displayed. Any time greater than 999H is displayed as 999H). (3) A maximum of 9 items are stored in memory for the failure code.
Method of sending failure code	Press working lamp (front) switch  SDW00242	Failure code and time elapsed since failure change to next item.  SDW01254
Clearing failure code	Press working lamp (rear) switch for at least 2 seconds  SDW00243	Failure code and time elapsed since failure being displayed are cleared. Failure code for problem now occurring (flashing display) cannot be cleared.
Resetting from travel data display mode	Press 2nd switch from top on left side of main monitor (switch below emergency steering display) and working lamp (front) switch simultaneously for at least 5 seconds, or start the engine.	Changes to normal display

MAINTENANCE MONITOR



SDW00244

1. Check items (Checks before starting)
 - 1A. Engine water level
 - 1B. Engine oil level
2. Caution items (warning items)
 - 2A. Engine oil pressure
 - 2B. Battery charge
 - 2C. Brake oil pressure
 - 2D. Air cleaner
 - (1A. Engine water level)
3. Gauge items
 - 3A. Fuel level
 - 3B. Engine water temperature
 - 3C. Torque converter oil temperature
4. Work equipment control switches
 - 4A. Bucket auto-leveler set switch
 - 4B. Bucket auto-leveler auto-mode switch
- 4C. Remote boom positioner RAISE position set switch
- 4D. Remote boom positioner RAISE/LOWER selector switch
5. Service meter
 - 5A. Service meter numeric display
 - 5B. Service meter RUN pilot lamp
6. Monitor module
7. Switch module

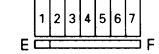
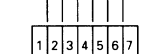
Outline

- The maintenance monitor has a display function for the caution items and gauges, and switch functions to control the work equipment controller.
- The maintenance monitor consists of the monitor module, switch module, service meter, case, and other mechanisms.
- The monitor module has a built-in CPU (Central Processing Unit). It processes the signal from the sensors, and carries out the display and output.
- A liquid crystal display and LEDs are used for the display portions. The switches are embossed sheet switches.

STRUCTURE AND FUNCTION

MAINTENANCE MONITOR

MAINTENANCE MONITOR DISPLAY FUNCTION

Display category	Symbol	Display item	Display range	Display method
Check		Engine water level	Below low level	Displays when engine is stopped and starting switch is ON Display when normal: OFF Display when abnormal: Flashes CHECK lamp flashes
		Engine oil level	Below low level	
Caution		Engine water level	Below low level	Displays when engine is running Display when normal: OFF Display when abnormal: Flashes CAUTION lamp flashes Buzzer sounds
		Engine oil pressure	Below specified pressure	
		Brake oil pressure	Below specified pressure	
		Engine water temperature	Above 102°C	Buzzer sounds if above 105°C
		Torque converter oil temperature	Above 120°C	Buzzer sounds if above 130°C
		Fuel level	Below low level	Displays when engine is running Display when normal: OFF Display when abnormal: Flashes CAUTION lamp flashes
		Battery charge	When charge is defective	
		Air cleaner	Above specified negative pressure	
Service meter		Service meter	0 – 9999.9h	Actuated when charge is normal Advances 1 for every hour
		Service meter indicator		Lights up when service meter is running
Gauges		Fuel level	EMPTY FULL  E F Red Green	All lamps light up below applicable level Flashes when level is 1
		Engine water temperature	67 80 90 97 102 105°C  C H White Green Red	One place lights up to show applicable level Flashes when level is 6 or 7
		Torque converter oil temperature	50 70 90 110 120 130°C  C H Green Red	One place lights up to show applicable level Flashes when level is 6 or 7

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MAINTENANCE MONITOR SWITCH FUNCTION

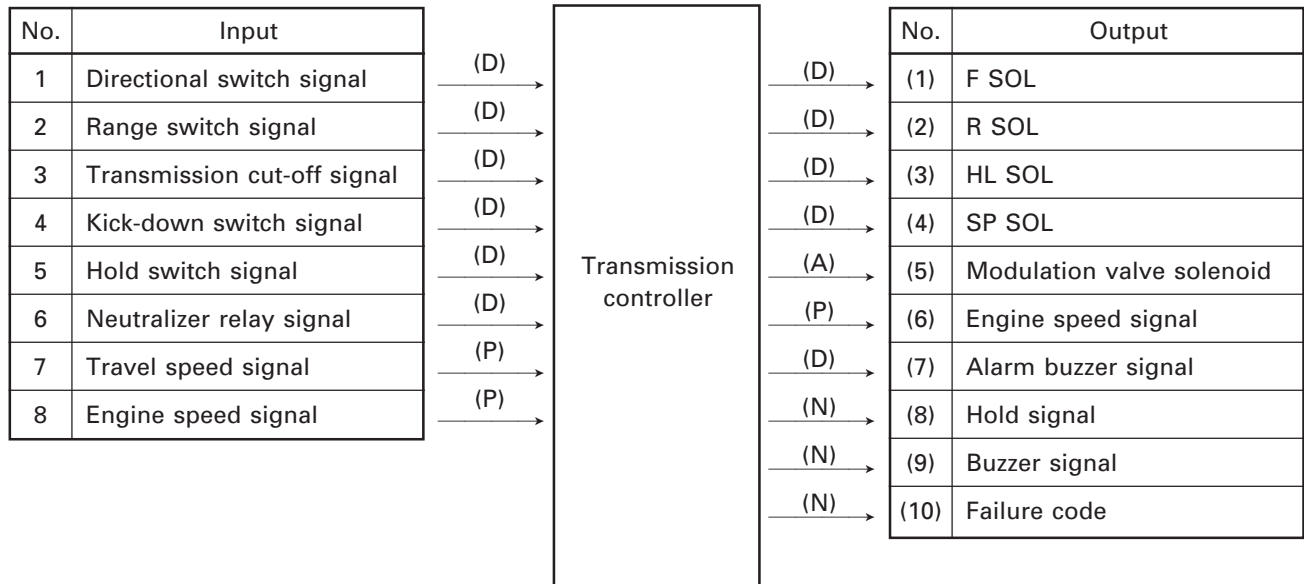
Item	Function	Display	Actuation
Bucket auto-leveler setting	Setting automatic stopping angle for bucket or fork (bucket angle when switch is pressed is recorded)	Flashes (2.5 sec)	Sets stopping angle
		Goes out	–
Bucket auto-leveler auto mode	Switches auto mode between ON and OFF each time switch is pressed	Lights up	Bucket auto-leveler auto mode ON
		Goes out	Bucket auto-leveler auto mode OFF
Remote boom positioner RAISE position setting	Sets stopping position in RAISE direction for remote boom positioner (boom position when switch is pressed is recorded)	Flashes (2.5 sec)	Sets stopping position
		Goes out	–
Selection of remote boom positioner RAISE/LOWER	Sets remote boom positioner in stopping direction (switches function each time switch is pressed)	Goes out	Remote boom positioner function OFF
		RAISE lights up	Remote boom positioner RAISE stop function ON
		LOWER lights up	Remote boom positioner LOWER stop function ON
		RAISE, LOWER light up	Remote boom positioner RAISE/LOWER stop function ON

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TRANSMISSION AUTO-SHIFT CONTROL SYSTEM

(With auto-shift transmission) Serial No.: 50001 – 53999

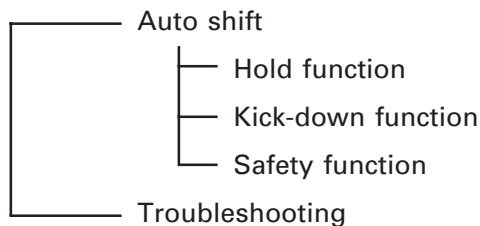
SYSTEM STRUCTURE DIAGRAM



A: Analog signal
 D: Digital signal
 P: Pulse signal
 N: Network signal

CONTROL FUNCTION

Outline



The auto-shift control system receives the position signals from the directional lever and range lever, the engine speed signal, travel speed signal, and signals from other switches. The transmission controller drives the speed solenoid valve and automatically carries out shift control to select the optimum speed range for the transmission.

SHIFT CONTROL SYSTEM FUNCTION

INPUT SIGNALS

1. Directional lever
This selects F (FORWARD), R (REVERSE), and N (Neutral).
2. Speed lever
This selects the optimum speed range when using auto-shift FORWARD or REVERSE. Normally, if the speed lever is at position 2 or above, the transmission will be set to 2nd when the machine starts.
When the auto shift used, and the gear shift lever is moved 4 → 3 → 2 → 1 when the machine is traveling with the transmission in force, the transmission will also shift down immediately 4 → 3 → 2 → 1. (Priority given to speed lever)
3. Engine speed sensor
When the engine is running at low speed (less than 1450 rpm), the auto shift is stopped. When shifting between forward and reverse or when coasting, the present speed range is maintained and the shift shock is reduced.
When the machine is traveling in 2nd, and the engine speed changes from low speed (less than 1450 rpm) to high speed (more than 1450 rpm), the speed range is kept at 2nd to allow the machine to accelerate more easily.
4. Travel speed sensor
The speed range is determined according to the travel speed. In addition, the change in speed is determined from the pulse count to decide whether to shift up or down.
5. Neutralizer
The parking brake actuation signal is input to the controller and the transmission is shifted to neutral.
6. Transmission cut-off signal
When the controller receives the transmission cut-off signal, it shifts the transmission to neutral. After the signal is canceled, it selects a speed range that matches the travel speed at that point.

OUTPUT SIGNALS

1. Transmission solenoid output
The F and R solenoids correspond to the F and R positions of the directional lever. Positions 1 to 4 of the speed lever actuate the H-L solenoid and speed solenoid to select the clutches to give the 1st to 4th transmission speeds. This combination is then output to the transmission. (See Table 1)

Table 1 Transmission solenoid output

Speed range	Solenoid				Clutch					
	F	R	HL	SP	F	R	1	2	3	4
N								○		
F1	○			○	○		○			
F2	○				○			○		
F3	○		○		○				○	
F4	○		○	○	○					○
R1		○		○		○	○			
R2		○				○		○		
R3		○	○			○			○	
R4		○	○	○		○				○

2. Modulation output
There is a data map for each shift pattern, and the solenoid command current is controlled according to the data to reduce the shift shock when engaging the clutches. (See Table 2)
3. Hold function (maintaining present speed range)
When the hold switch is turned ON, the existing speed range is held, and even if the travel speed goes down, the transmission does not shift down. However, if the direction of travel is shifted between forward and reverse, the transmission shifts down, and then it shifts up to the speed range according to the change in the conditions. (This prevents any unnecessary shift down on level ground or unnecessary shift up when traveling downhill.) (See Table 2, Item 4)

STRUCTURE AND FUNCTION**TRANSMISSION AUTO-SHIFT CONTROL SYSTEM****4. Kick-down function**

If the operator wishes, he can override all the automatic conditions and shift down forcibly to 1st (when traveling at below 12.1 km/h in 4th or 3rd, or when traveling at any speed in 2nd). (See Table 2, Item 5)

When the transmission has been shifted to 1st by the kick-down, the switch pump cut-off signal to the electronic governor controller is switched ON.

When the travel speed increases, the transmission is shifted up in accordance with the auto shift up conditions, or it is shifted to 2nd when the direction is shifted between forward and reverse.

This function is also available when holding the speed range (hold, engine at low speed).

SHIFT CHARACTERISTICS**1. Auto shift (see Table 2, Item 1)**

When the engine speed is above 1450 rpm, the transmission is shifted as follows according to the travel speed.

a) FORWARD

Directional lever at F, speed lever at 4

Shift up

(i) When starting, the transmission is set to the F2 torque converter range.

(ii) When the accelerator pedal is depressed, the engine speed rises and the machine travels faster. If the engine speed continues to rise and the travel speed reaches 10.2 km/h (10.7 km/h), the transmission is shifted up to F3.

If there is insufficient acceleration, the transmission shifts up when the travel speed reaches the figure shown in ().

(iii) Immediately after the transmission shifts up, the engine speed will drop momentarily, but if the machine continues to travel faster and the travel speed reaches 18 km/h, the transmission is shifted up to F4.

Shift down

(i) If the machine is traveling in F4 and the load increases, the transmission will shift down F3 if the travel speed drops below 16 km/h.

(ii) If the travel speed drops further to 10.7 km/h (10.2 km/h), the transmission is shifted down to F2.

If there is insufficient deceleration, the transmission shifts down when the travel speed reaches the figure shown in (). With the auto shift, the transmission does not shift down to 1st even if the travel speed drops.

Normally, the transmission shifts to 1st only if the speed lever is placed at 1 or if the kick-down switch is pressed.

b) REVERSE

Directional lever at R, speed lever at 4

The transmission range is shifted according to the travel speed in the same way as for a).

2. Changing direction (switching between forward and reverse)

(When the directional lever is shifted to the opposite direction from the direction of travel)

If the travel speed and engine speed are in area I in Fig. 2, the transmission output shifts to 2nd speed in the same direction as the directional lever regardless of the speed range. Following this, the transmission shifts up to match the travel speed. (See Table 2, Item 6)

Example:

Directional lever: F → N → R

Transmission output:

F4 → N → R2 → R3 → R4

In area II in Fig. 2, the transmission output reverses, but the speed range shifts down to 2nd in accordance with the travel speed. Then, after the actual direction of travel of the machine changes to the same direction as the directional lever, the transmission shifts up in accordance with the travel speed. (To prevent damage to the clutch) (See Table 2, Item 7)

However, when the hold function is ON, the transmission does not shift down.

Example:

Directional lever: F → N → R

Transmission output:

F4 → N → R4 → R3 → R2

(The transmission shifts down while the machine is coasting in forward)

R2 → R3 → R4

(The machine shifts up when traveling in reverse)

However, if the speed lever is at 1, the transmission remains in 1st.

3. Switching F – N – F (R – N – R) (lever returned)

A speed range that matches the speed is selected. (See Table 2, Item 8)

4. Skip shift

When the machine is coasting in 3rd or 4th (engine speed below 1400 rpm), and the accelerator pedal is depressed (engine speed above 1400 rpm), the speed range is held if the travel speed is more than 8 km/h. If the

STRUCTURE AND FUNCTION**TRANSMISSION AUTO-SHIFT CONTROL SYSTEM**

travel speed is less than 8 km/h, the transmission is shifted down to 2nd to make it easier to accelerate. (See Table 2, Item 3)

5. No-shift time

This is the time that the speed range is held after shifting. The speed cannot be shifted until this time has elapsed. (To prevent shift hunting) No-shift time differs according to the shift conditions. (See Table 2)

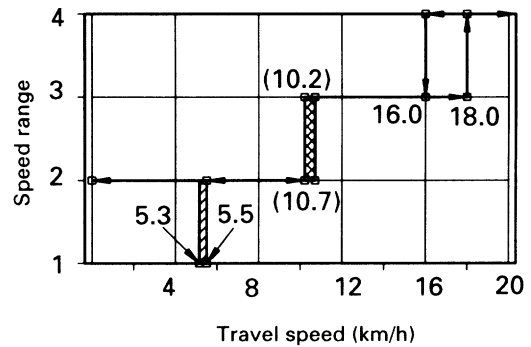


Fig. 1 Automatic gear shift graph

SDW00260

Table 2 Gear shift characteristics

Item	Clutch	Speed (km/h)	No-shift time (sec)
1. Normal gear shift	1 → 2	Min. 5.3 (5.5)	2
	2 → 3	Min. 10.2 (10.7)	2
	3 → 4	Min. 18.0	1
	4 → 3	Less than 16.0	1
	3 → 2	Less than 10.7 (10.2)	2
2. Engine speed (less than 1450 rpm)	4 → 2	Less than 1.0	0
	3 → 2	Less than 1.0	0
3. Engine speed (less than 1450 rpm → more than 1450 rpm)	4 → 2	Less than 8.0	2
	3 → 2	Less than 8.0	2
4. Shifting up when hold is ON	1 → 2	Min. 5.3	0
	2 → 3	Min. 10.2	0
	3 → 4	Min. 18.0	0
5. Kick-down OFF → ON	2 → 1	Whole range	5
	3 → 1	Less than 12.1	5
	4 → 1	Less than 12.1	5
6. Directional lever (Area I) (F →) N → R (R →) N → F	4 → 2	Note 1)	2
	3 → 2	-----	2
	1 → 2		2
7. Directional lever (Area II) (F →) N → R (R →) N → F	→ 4	Min. 18.0	0
	→ 3	Less than 16.0 – 18.0	0
		Note 2)	0
8. Directional lever F → N → F R → N → R	→ 4	Min. 18.0	0
	→ 3	Less than 10.2 – 18.0	0
	→ 2	Less than 10.2	0

Note 1: Engine speed less than 2000 rpm and travel speed less than 16 km/h, or travel speed less than 13 km/h

Note 2: When engine speed is more than 2000 rpm → 3 if travel speed is 13 km/h to 18.0 km/h
See Fig. 2, for details of Area I and Area II.

SAFETY FUNCTION

1. Alarm buzzer
If the direction of travel is switched between forward and reverse in area III in Fig. 3 (travel speed above 13 km/h and engine speed above 1800 rpm, or travel speed above 14 km/h), the alarm buzzer will sound to prevent damage to the clutch.
2. N priority for directional lever
The controller is equipped with an interlock function which always gives the neutral output when the lever is at N.
3. Neutral safety
When the directional lever is at any position other than N, the transmission is set in neutral and the machine does not start even if the starting switch is turned ON. This condition is canceled if the directional lever is returned to the N position. (To prevent unexpected movement of the machine when the engine is started)
4. Speed lever priority
If the speed lever is shifted down when traveling downhill, the transmission is shifted down immediately to make use of the braking force of the engine.
5. Manual shift
If there should be any disconnection in the travel speed sensor or any other failure, and the input of the travel speed stops, the lever operation becomes manual.

Example:

Directional lever F, speed lever 4 → F4

Directional lever R, speed lever 2 → R2

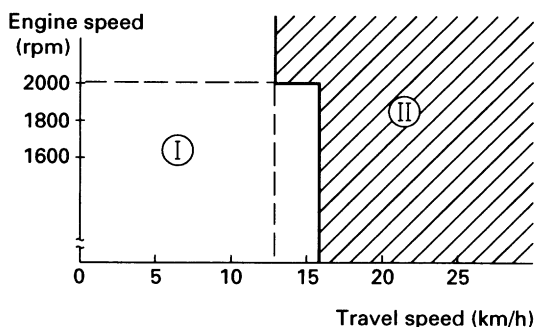


Fig.2 Shift pattern when shifting between F and R

SDW00261

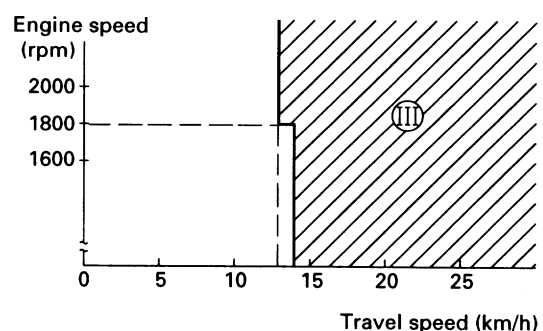
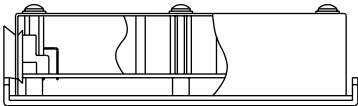
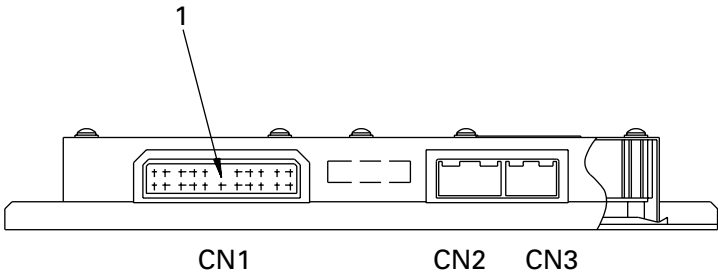
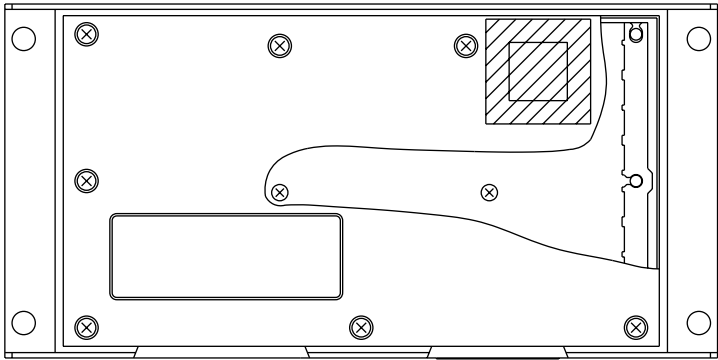


Fig.3 Alarm buzzer range when shifting between F and R

SDW00262

TRANSMISSION CONTROLLER

1. Connector



SDW00263

CONNECTOR SIGNALS

CN1

1	NETWORK signal
2	
3	Modulation valve, Sol (+)
4	
5	
6	
7	
8	Power source input (+24V)
9	GND
10	HL, Sol
11	SP, Sol
12	NETWORK signal
13	Sensor power source (+24V)
14	Modulation valve, Sol (-)
15	
16	
17	Solenoid power source input (+24V)
18	Power source input (+24V)
19	GND
20	R, Sol
21	F, Sol

CN2

1	Directional switch F
2	Range switch 2
3	Range switch 4
4	Neutralizer relay signal
5	
6	
7	
8	
9	Signal GND output
10	
11	Directional switch N
12	Directional switch R
13	Range switch 1
14	Range switch 3
15	
16	Transmission cut-off switch
17	Kick-down switch
18	Hold switch
19	
20	

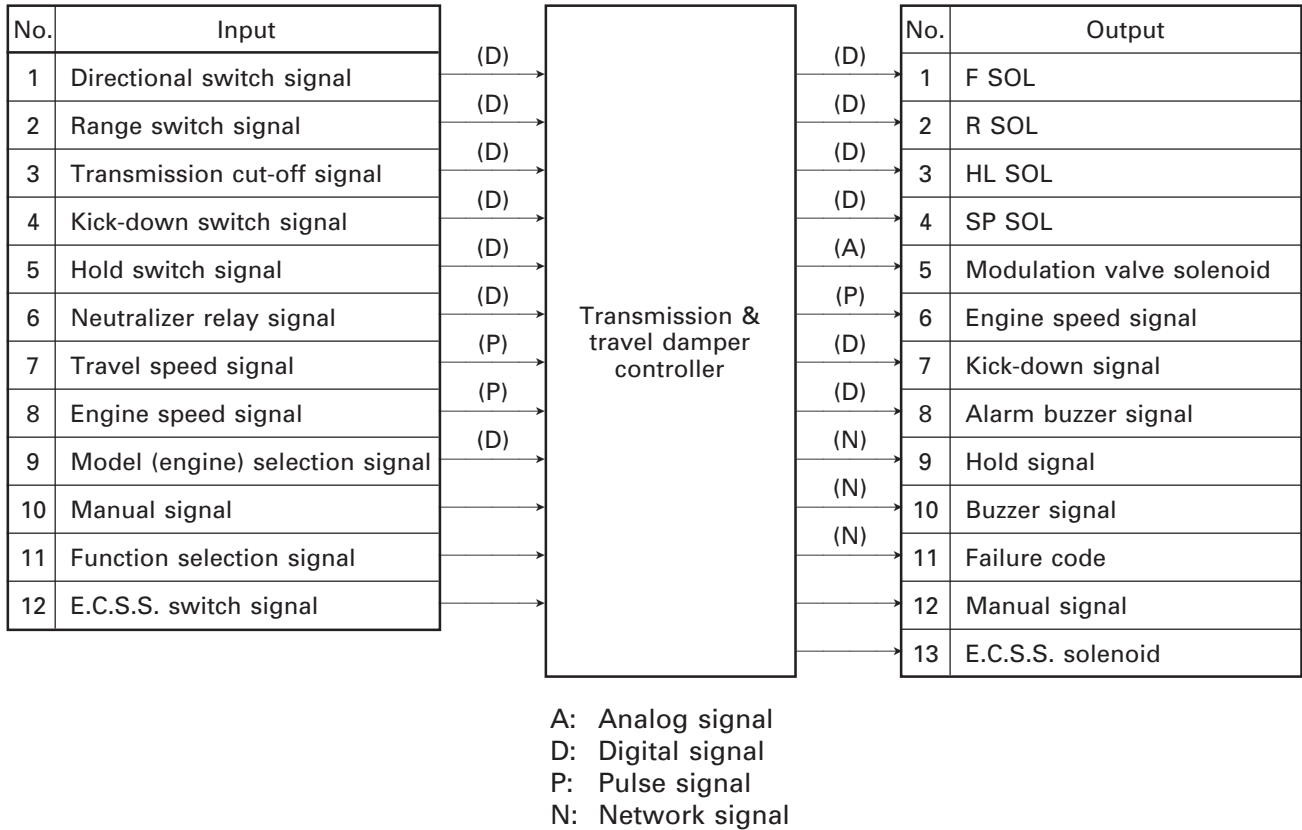
CN3

1	
2	
3	
4	Travel speed signal (+)
5	Engine speed signal
6	
7	
8	
9	
10	
11	
12	Travel speed signal (-)
13	
14	Engine speed signal output
15	Buzzer signal output
16	

TRANSMISSION AUTO-SHIFT CONTROL SYSTEM

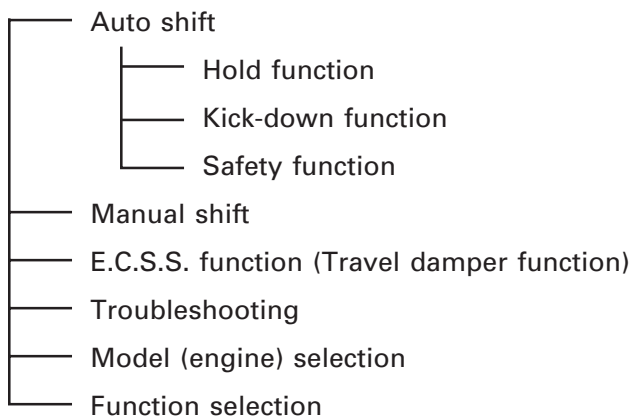
Serial No.: 54001 and up

SYSTEM STRUCTURE DIAGRAM



U42103

CONTROL FUNCTION



Outline

The auto-shift control system receives the position signals from the directional lever and range lever, the engine speed signal, travel speed signal, and signals from other switches.

The transmission controller drives the gear shifting solenoid valve and automatically carries out shift control to select the optimum speed range for the transmission.

SHIFT CONTROL SYSTEM FUNCTION

INPUT SIGNALS

1. Directional lever
This selects F (FORWARD), R (REVERSE), and N (Neutral).
2. Speed lever
This selects the optimum speed range when using auto-shift FORWARD or REVERSE. Normally, if the speed lever is at position 2 or above, the transmission will be set to 2nd when the machine starts.
When the auto shift used, and the gear shift lever is moved 4 → 3 → 2 → 1 when the machine is traveling with the transmission in 4th, the transmission will also shift down immediately 4 → 3 → 2 → 1. (Priority given to speed lever)
3. Engine speed sensor
When the engine is running at low speed (less than 1450 rpm), the auto shift is stopped. When shifting between forward and reverse or when coasting, the present speed range is maintained and the shift shock is reduced.
When the machine is traveling in 2nd and the engine speed changes from low speed (less than 1450 rpm) to high speed (more than 1450 rpm), the speed range is kept at 2nd to allow the machine to accelerate more easily.
4. Travel speed sensor
The speed range is determined according to the travel speed. In addition, the change in speed is determined from the pulse count to decide whether to shift up or down.
5. Neutralizer relay
The parking brake actuation signal is input to the controller and the transmission is shifted to neutral.
6. Transmission cut-off signal
When the controller receives the transmission cut-off signal, it shifts the transmission to neutral. After the signal is canceled, it selects a speed range that matches the travel speed at that point.

OUTPUT SIGNALS

1. Transmission solenoid output
The F and R solenoids correspond to the F and R positions of the directional lever. Positions 1 to 4 of the speed lever actuate the H-L solenoid and speed solenoid to select the clutches to give the 1st to 4th transmission speeds. This combination is then output to the transmission. (See Table 1)

Table 1 Transmission solenoid output

Speed range	Solenoid				Clutch					
	F	R	HL	SP	F	R	1	2	3	4
N								○		
F1	○			○	○		○			
F2	○				○			○		
F3	○		○		○				○	
F4	○		○	○	○					○
R1		○		○		○	○			
R2		○				○		○		
R3		○	○			○			○	
R4		○	○	○		○				○

2. Modulation output
There is a data map for each shift pattern, and the solenoid command current is controlled according to the data to reduce the shift shock when engaging the clutches. (See Table 2)
3. Hold function (maintaining present speed range)
When the hold switch is turned ON, the existing speed range is held, and even if the travel speed goes down, the transmission does not shift down. However, if the direction of travel is shifted between forward and reverse, the transmission shifts down, and then it shifts up to the speed range according to the change in the conditions. (This prevents any unnecessary shift down on level ground or unnecessary shift up when traveling downhill.) (See Table 2, Item 4)

4. Kick-down function

If the operator wishes, he can override all the automatic conditions and shift down forcibly to 1st (when traveling at below 12.1 km/h in 4th or 3rd, or when traveling at any speed in 2nd). (See Table 2, Item 5)

When the transmission has been shifted to 1st by the kick-down, the switch pump cut-off signal to the electronic governor controller is switched ON.

When the travel speed increases, the transmission is shifted up in accordance with the auto shift up conditions, or it is shifted to 2nd when the direction is shifted between forward and reverse.

This function is also available when holding the speed range (hold, engine at low speed).

SHIFT CHARACTERISTICS

1. Auto shift (see Table 2, Item 1)

When the engine speed is above 1450 rpm, the transmission is shifted as follows according to the travel speed.

a) FORWARD

Directional lever at F, speed lever at 4

Shift up

- (1) When starting, the transmission is set to the F2 torque converter range.
- (2) When the accelerator pedal is depressed, the engine speed rises and the machine travels faster. If the engine speed continues to rise and the travel speed reaches 10.2 km/h (10.7 km/h), the transmission is shifted up to F3. If there is insufficient acceleration, the transmission shifts up when the travel speed reaches the figure shown in ().
- (3) Immediately after the transmission shifts up, the engine speed will drop momentarily, but if the machine continues to travel faster and the travel speed reaches 18 km/h, the transmission is shifted up to F4.

Shift down

- (1) If the machine is traveling in F4 and the load increases, the transmission will shift down F3 if the travel speed drops below 16 km/h.
- (2) If the travel speed drops further to 10.7 km/h (10.2 km/h), the transmission is shifted down to F2. If there is insufficient deceleration, the transmission shifts down when the travel speed reaches the figure shown in ().

With the auto shift, the transmission does

not shift down to 1st even if the travel speed drops.

Normally, the transmission shifts to 1st only if the speed lever is placed at 1 or if the kick-down switch is pressed.

b) REVERSE

Directional lever at R, speed lever at 4

The transmission range is shifted according to the travel speed in the same way as for a).

2. Changing direction (switching between forward and reverse)

(When the directional lever is shifted to the opposite direction from the direction of travel)

If the travel speed and engine speed are in area I in Fig. 2, the transmission output shifts to 2nd speed in the same direction as the directional lever regardless of the speed range. Following this, the transmission shifts up to match the travel speed. (See Table 2, Item 6)

Example:

Directional lever: F → N → R

Transmission output:

F4 → N → R2 → R3 → R4

In area II in Fig. 2, the transmission output reverses, but the speed range shifts down to 2nd in accordance with the travel speed. Then, after the actual direction of travel of the machine changes to the same direction as the directional lever, the transmission shifts up in accordance with the travel speed. (To prevent damage to the clutch) (See Table 2, Item 7)

However, when the hold function is ON, the transmission does not shift down.

Example:

Directional lever: F → N → R

Transmission output:

F4 → N → R4 → R3 → R2

(The transmission shifts down while the machine is coasting in forward)

R2 → R3 → R4

(The machine shifts up when traveling in reverse)

However, if the speed lever is at 1, the transmission remains in 1st.

3. Switching F – N – F (R – N – R) (lever returned)

A speed range that matches the speed is selected. (See Table 2, Item 8)

4. Skip shift

When the machine is coasting in 4th (engine speed below 1400 rpm), or the accelerator pedal is depressed (engine speed above 1400 rpm), the speed range is held if the travel speed is more than 8 km/h. If the travel speed is less than 8 km/h, the transmission is shifted down to 2nd to make it easier to accelerate. This judgement is made at 7.6 km/h when in 3rd. (See Table 2, Item 3)

5. No-shift time

This is the time that the speed range is held after shifting. The speed cannot be shifted until this time has elapsed. (To prevent shift hunting) The no-shift time differs according to the shift conditions. (See Table 2)

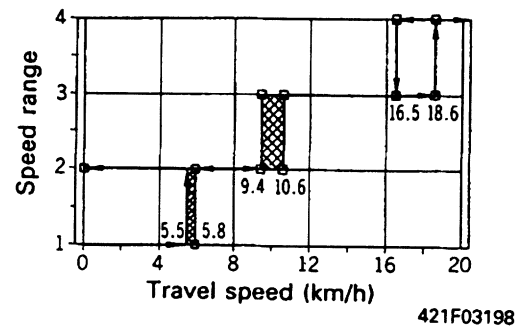


Fig. 1 Automatic gear shift graph

Table 2 Gear shift characteristics

Item	Clutch	Speed (km/h)	No-shift time (sec)
1. Normal gear shift	1 → 2	Min. 5.3 (5.5)	2
	2 → 3	Min. 10.2 (10.7)	2
	3 → 4	Min. 18.0	1
	4 → 3	Less than 16.0	1
	3 → 2	Less than 10.7 (10.2)	2
2. Engine speed (less than 1450 rpm)	4 → 2	Less than 1.0	0
	3 → 2	Less than 1.0	0
3. Engine speed (less than 1450 rpm → more than 1450 rpm)	4 → 2	Less than 8.0	2
	3 → 2	Less than 8.0	2
4. Shifting up when hold is ON	1 → 2	Min. 5.3	0
	2 → 3	Min. 10.2	0
	3 → 4	Min. 18.0	0
5. Kick-down OFF → ON	2 → 1	Whole range	5
	3 → 1	Less than 12.1	5
	4 → 1	Less than 12.1	5
6. Directional lever (Area I) (F →) N → R (R →) N → F	4 → 2	Note 1	2
	3 → 2	— — — — —	2
	1 → 2		2
7. Directional lever (Area II) (F →) N → R (R →) N → F	→ 4	Min. 18.0	0
	→ 3	Less than 16.0 – 18.0	0
		Note 2	0
8. Directional lever F → N → F R → N → R	→ 4	Min. 18.0	0
	→ 3	Less than 10.2 – 18.0	0
	→ 2	Less than 10.2	0

Note 1: Engine speed less than 2000 rpm and travel speed less than 16 km/h, or travel speed less than 13 km/h

Note 2: When engine speed is more than 2000 rpm → 3 if travel speed is 13 km/h to 18.0 km/h
See Fig. 2, for details of Area I and Area II.

SAFETY FUNCTION

1. Alarm buzzer

If the direction of travel is switched between forward and reverse in area III in Fig. 3 (travel speed above 13 km/h and engine speed above 1800 rpm, or travel speed above 14 km/h), the alarm buzzer will sound to prevent damage to the clutch.

2. N priority for directional lever

The controller is equipped with an interlock function which always gives the neutral output when the lever is at N.

3. Neutral safety

When the directional lever is at any position other than N, the transmission is set in neutral and the machine does not start even if the starting switch is turned ON. This condition is canceled if the directional lever is returned to the N position. (To prevent unexpected movement of the machine when the engine is started)

4. Speed lever priority

If the speed lever is shifted down when traveling downhill, the transmission is shifted down immediately to make use of the braking force of the engine.

5. Manual shift

If there should be any disconnection in the travel speed sensor or any other failure, and the input of the travel speed stops, the lever operation changes to manual shift.

Example:

Directional lever F, speed lever 4 → F4

Directional lever R, speed lever 2 → R2

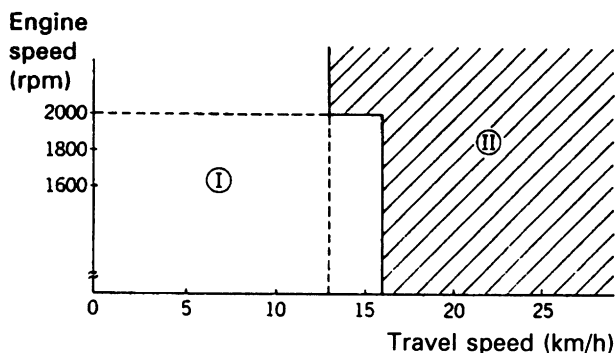


Fig. 2 Shift pattern when shifting between F and R

421F03199

TROUBLESHOOTING

The controller always observes if the electronic devices (the solenoids which receive the controller output signals, and the engine speed sensor and travel speed sensor which take in the input signals) are functioning normally.

If there is any abnormality in any of these devices, the controller judges the condition and functions to inform the operator of the decision with the alarm buzzer, and at the same time, to display the abnormality as a failure code on the main monitor.

MODEL SELECTION FUNCTION

This controller has two types of data table. When the starting switch is turned ON, it can take action according to the selection signal shown below.

Model \ Pin	CN2 ⑧	CN2 ⑦
WA450-3	OPEN	OPEN
WA470-3	GND	GND

GND: connected to CN2 ⑨ (signal GND)

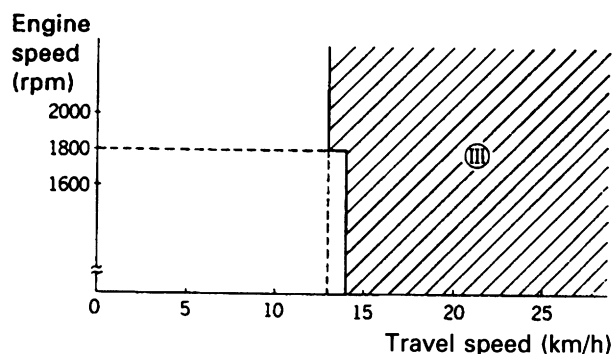


Fig. 3 Alarm buzzer range when shifting between F and R

421F03200

TRANSMISSION CONTROLLER LED DISPLAY

⚠ Read the display with the controller connector facing you.

1. When normal

After the key is turned to the ON position, the program number is displayed for 6 seconds, then the display changes to the output speed range.

In addition, while the number is being displayed, the selection condition of the travel damper (dot ①) and 20 km/h max. speed mode (dot ②) is displayed.

(The dot lights up when it is selected.)

- | | |
|------------------------------|---|
| | ② ① |
| | ↓ ↓ |
| (1) Program number display | |
| WA450-3/WA470-3: | ' A 0 1 ' → ' 0 0 6 ' → (Speed range) ' 0 2 ' |
| (2) Speed range display mode | |
| ' 0 2 ' | : Neutral, 2nd |
| ' F 1 ' | : FORWARD 1st |
| ' A 3 ' | : REVERSE 3rd |
| ' X. X. ' | : Hold function in operation (auto mode) |
| ' X 0 X. ' | : Manual mode in operation |

2. When failure is detected

' E - ' and the code for the failure are displayed in turn for 1 second each.

A maximum of 8 failures can be displayed in order of detection. When the key is turned to the OFF position, they are cleared and are not displayed again.

However, the trouble data is retained in the main monitor.

Example:

' E - ' → ' d 0 ' → ' E - ' → ' 1 4 ' → Repeat

In the above display, an abnormality has been detected in travel damper sol 1 and auto shift HL sol system.

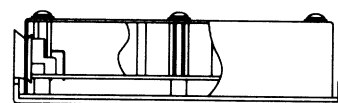
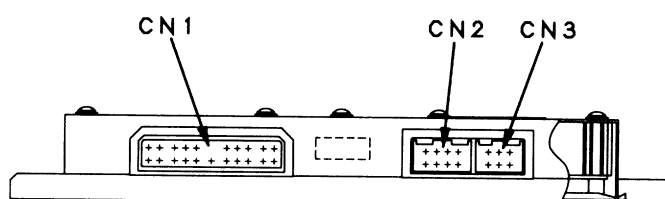
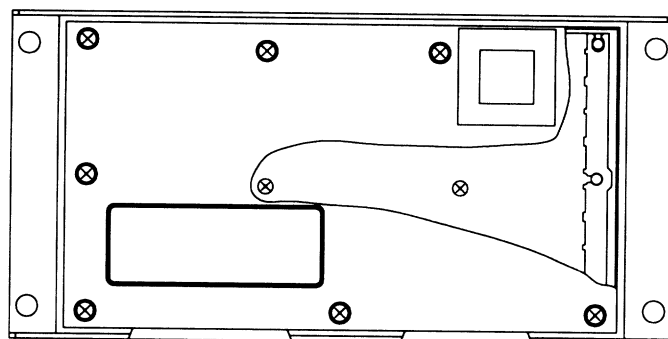
SYSTEM
TRANSMISSION AUTO-SHIFT CONTROL SYSTEM
FAILURE CODE FOR TRANSMISSION CONTROLLER

Code	Item	System		Main monitor
		Short circuit	Disconnection	Action code
10	Modulation solenoid	○	○	CALL
11	Modulation solenoid	Power source end	—	CALL
12	F Sol.	○	○	CALL
13	R Sol.	○	○	CALL
14	HL Sol.	○	○	CALL
15	None	—	—	—
16	SP Sol.	○	○	CALL
17	None	—	—	—
18	None	—	—	—
19	None	—	—	—
20 in	Direction switch signal	○	○	CALL
21 in	Range switch signal	○	○	None
22 in	Travel speed sensor	X	○	E00
23 in	Engine speed sensor	X	○	E00

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FAILURE CODE FOR TRAVEL DAMPER SYSTEM

Code	Item	System		Main monitor
		Short circuit	Disconnection	Action code
d0	Travel damper relay	○	○	None

SYSTEM**TRANSMISSION AUTO-SHIFT CONTROL SYSTEM****TRANSMISSION CONTROLLER**

SWW04436

Connector signals**CN1**

1	NETWORK signal
2	NC
3	Modulation valve, Sol (+)
4	NC
5	NC
6	NC
7	Sol 3 (Low voltage) (+)
8	Power source input (+24V)
9	GND
10	HL, Sol
11	SP, Sol
12	NETWORK signal
13	Sensor power source (+24V)
14	Modulation valve, Sol (-)
15	NC
16	Sol 3 (Low voltage) (-)
17	Solenoid power source input (+24V)
18	Power source input (+24V)
19	GND
20	R, Sol
21	F, Sol

Connector signals**CN2**

1	Directional switch F
2	Range switch 2
3	Range switch 4
4	Neutralizer relay signal
5	※ Manual switch
6	• E.C.S.S./ALS switch
7	Engine selection 2
8	Engine selection 1
9	Signal GND output
10	NC
11	Directional switch N
12	Directional switch R
13	Range switch 1
14	Range switch 3
15	• Pressure switch
16	Transmission cut-off switch
17	Kick-down switch
18	※ Holding switch
19	• E.C.S.S. selection input
20	• 20km/h max. speed input selection

CN3

1	NC
2	NC
3	• ALS selection input
4	Travel speed signal (+)
5	Engine speed signal (+)
6	Kick-down signal output
7	• Solenoid 1 (Relief)
8	※ Manual signal output
9	NC
10	NC
11	NC
12	• Travel speed, engine speed signal (-)
13	NC
14	Engine speed signal output
15	Buzzer signal output
16	• Sol 2 (High voltage)

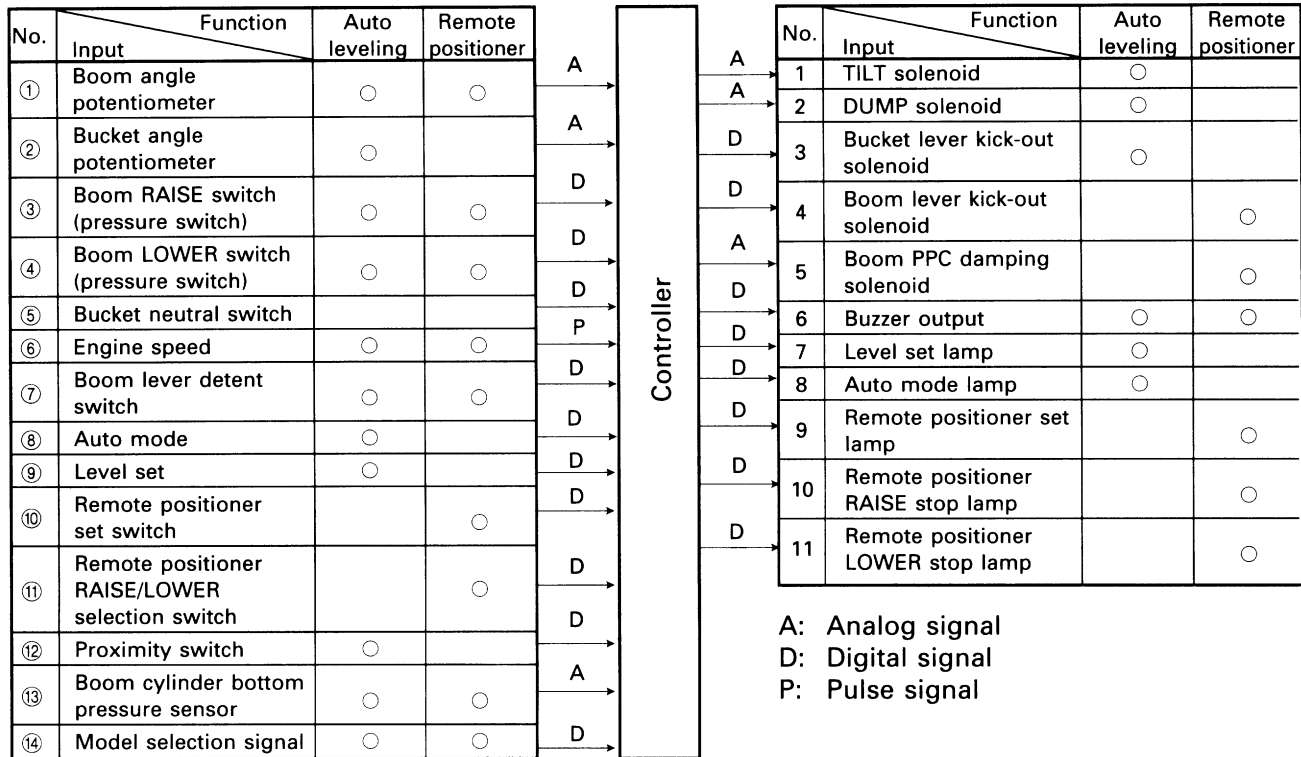
(•) E.C.S.S.

(※) Auto shift

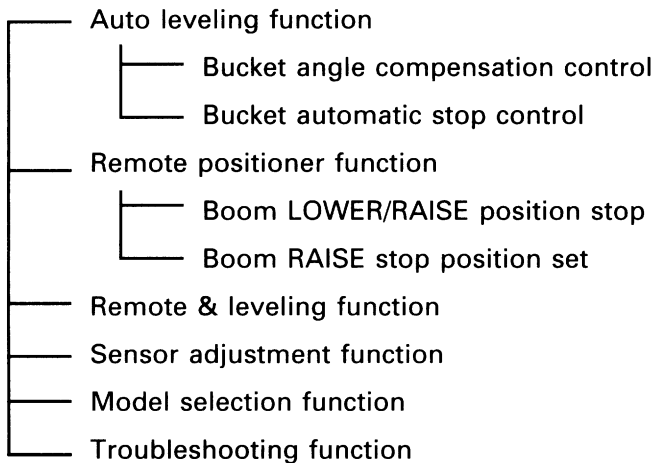
U42103

WORK EQUIPMENT CONTROL SYSTEM

SYSTEM STRUCTURE DIAGRAM



CONTROL FUNCTIONS



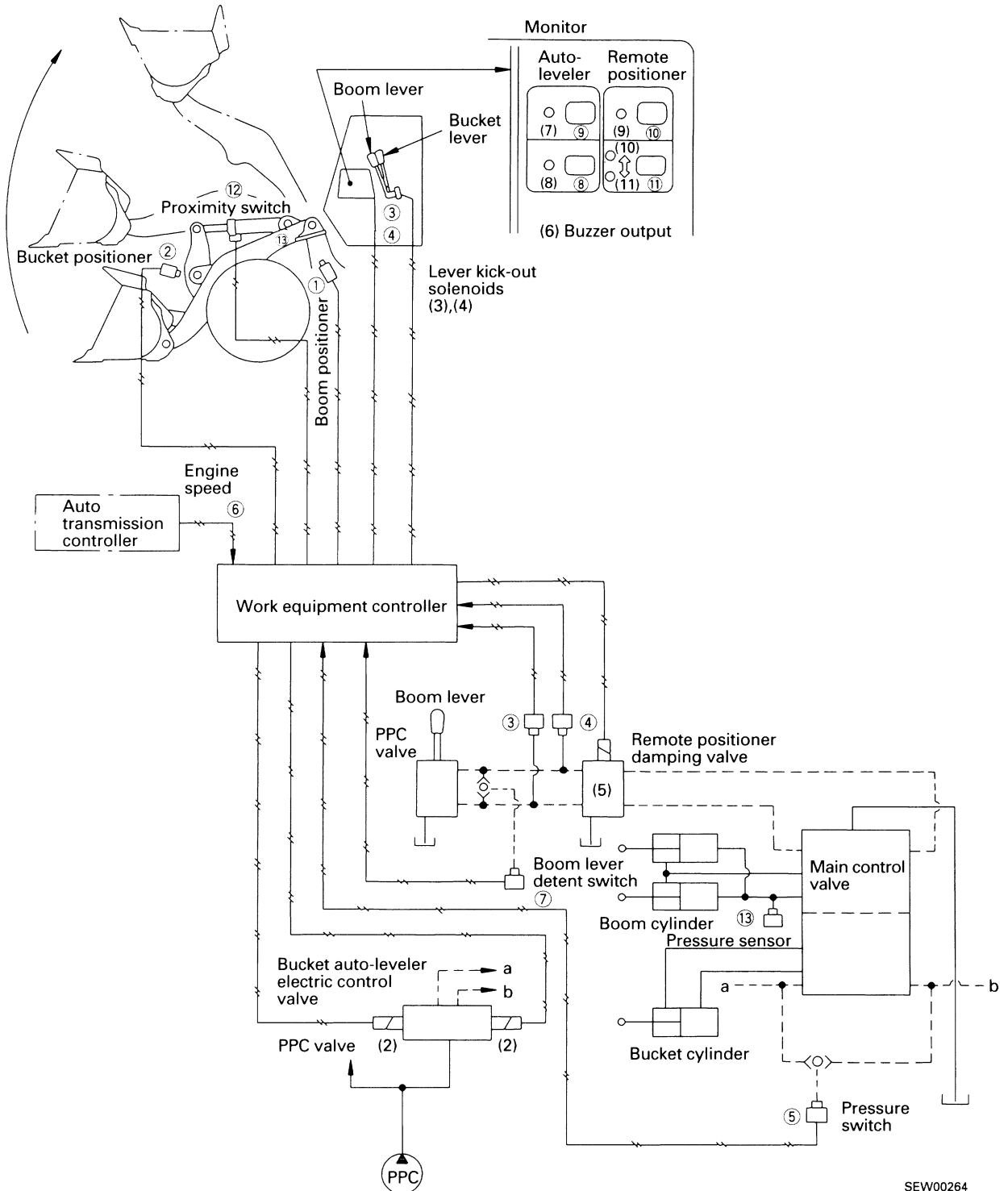
Outline

Because of the structure of the Z-bar link work equipment, the angle of the work equipment to the ground changes according to the height.

The auto-leveling control keeps the angle to the ground constant regardless of the height of the work equipment. This makes it easy to control operations such as removing the load from the bucket.

With the remote positioner control, the operator can set the boom stopping (lever kick-out) position to the desired position. This makes the movement smooth when starting or stopping the boom, and makes it safer and easier to operate the machine when moving back, carrying out digging operations, or approaching dump trucks.

STRUCTURE OF WORK EQUIPMENT CONTROL CIRCUIT



SEW00264

WORK EQUIPMENT CONTROL SYSTEM FUNCTION

Auto-leveling function

1. Bucket angle compensation control

- The controller always calculates the angle of the work equipment to the ground from the value of the voltage of the potentiometer (angle sensor) installed to the rotating part of the bucket and boom.
- The range for the control is limited, and if the work equipment is within the range, this control is carried out by setting to the auto mode. The control range is determined by the position of the bucket and boom, and if they are outside the range, the control is not carried out.
- The control is carried out to keep the angle constant by automatically controlling the bucket tilt and dump solenoids according to the angle to the ground (which changes in comparison with the angle (position) of the boom).
- Control range (from horizontal 0°)

Angle of bucket to ground	-30° — +15°
Boom angle	Above horizontal

- Manual (lever control) priority: If the bucket lever is operated during this control and the bucket is set to the desired angle, the angle to the ground when the lever is returned to neutral will become the new control target angle. (However, this is only if the work equipment is within the control range.)

2. Bucket automatic stop control

- Set the bucket to the maximum dump and place the bucket lever in the detent. When the bucket reaches the horizontal position (or the desired set position), the lever detent is released and the bucket stops. The set position is retained even if the key is turned OFF.
 - 1) Setting desired stop position
 - i) Operate the bucket lever to determine the position (-30° — +15°), then set the lever to HOLD.
 - ii) Press the auto-leveler set switch.
 - iii) When the auto-leveler lamp goes out, the auto-leveler set lamp will flash. (2.5 sec)

- iv) When the auto-leveler set lamp goes out and the auto-leveler lamp lights up, the stop position is written to memory.
- 2) Setting horizontal position stop
 - i) Operate the bucket lever to determine the position (-30° — +15°), then set the lever to HOLD.
 - ii) Press the auto-leveler set switch.
 - iii) When the auto-leveler lamp goes out, the auto-leveler set lamp will flash.
 - iv) Press the auto-leveler set switch while the lamp is flashing.
 - v) The auto-leveler set lamp goes out immediately, the auto-leveler lamp lights up, and the horizontal angle is set. (This horizontal angle is the standard for the machine, so the work equipment may not necessarily be horizontal to the ground for reasons such as the weight of the work equipment or the angle of the machine.)

REMOTE POSITIONER FUNCTION

1. Boom RAISE/LOWER position stop

- The controller always detects the direction of operation of the lever from the pressure switch installed to the boom PPC valve and the angle (position) of the boom from the boom angle potentiometer.

1) RAISE kick-out (RAISE lamp ON)

When the boom lever is placed in the RAISE detent and the boom rises to the set position, it slows down and then stop, and at the same time, the detent is released. If the boom is at any position other than the RAISE detent, it will rise as normal.

2) LOWER boom stop (LOWER lamp ON)

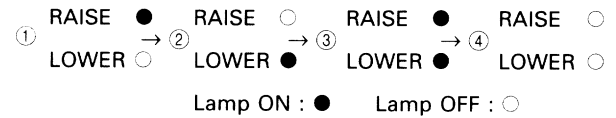
If the boom lever is placed at the FLOAT or LOWER position and the boom goes down to the set position, it will slow down and stop. If the lever is placed at HOLD, the boom will stay stopped. If the lever is moved back slightly, the boom will go down again.

The RAISE position (which the operator can set to the desired position) and the LOWER stop position differ according to the model. For details, see Table 1.

Table 1

Stop position Model	RAISE	LOWER
WA320-3	0° – 44.8°	-27°
WA380-3	0° – 40.5°	-27°
WA420-3	0° – 39°	-26°
WA470-3	0° – 38°	-26°

The setting of the control can be changed in the order given below by pressing the mode positioner RAISE/LOWER selector switch. When the lamp is lighted up, the boom will automatically stop at that position.



2. Setting remote positioner (setting RAISE stop position)

When the RAISE lamp is ON, set the stop position as desired. The setting position is retained even when the key is turned OFF.

1) Setting stop position

- Operate the boom lever to decide the position (above horizontal), then return the lever to the neutral.
- Press the remote positioner set switch.
- The RAISE lamp will go out and the remote positioner set lamp will flash. (2.5 sec)
- When the remote positioner set lamp goes out and the RAISE lamp lights up, the stop position is written to memory.

2) Setting horizontal stop position

- Operate the boom lever to move the boom to a position above horizontal, then return the lever to the neutral.
- Press the remote positioner set switch.
- The RAISE lamp will go out and the remote positioner set lamp will flash.
- While the lamp is flashing, press the remote positioner set switch.
- The remote positioner set lamp goes out immediately and the RAISE lamp lights up, and the horizontal angle is set. (This horizontal angle is the standard for the machine, so the work equipment may not necessarily be horizontal to the ground for reasons such as the weight of the work equipment or the angle of the machine.)

REMOTE LEVELING FUNCTION

When using the auto mode with the remote positioner LOWER lamp ON, the following bucket control can be carried out by operating the boom lever.

- 1) Boom lever LOWER detent
When the boom is lower than the horizontal position, the bucket tilt is controlled and the bucket stops at the LOWER position with the bucket horizontal to the ground.
- 2) Boom lever FLOAT detent
 - The boom will fall under its own weight, so the work equipment moves quickly. The bucket tilt control is started regardless of the position, the boom is stopped at the LOWER stop position, and the bucket is set horizontal to the ground.
 - For both Items 1) and 2), a damping solenoid is used to reduce the boom speed from just before the set stopping point in order to reduce the shock when the work equipment stops.

SENSOR ADJUSTMENT FUNCTION

- This function offsets any error caused by the installation of the potentiometer and makes it possible to detect the correct position data for the work equipment.
Always carry out the adjustment when the controller, potentiometer, or work equipment are replaced.
(For details, see TESTING AND ADJUSTING.)

MODEL SELECTION FUNCTION

- This controller has data tables for four models, and can handle these by means of the following selection signals when the key is turned ON. (See Table 2)
- When the key is turned ON, the selected model is displayed for 2 seconds on the controller LED.
- If there is any error in the model selection, [8.8] is displayed.

Table 2

Pin Model	CN2 ^⑫	CN2 ^⑬	CN2 ^⑭	CN2 ^⑮	CN2 ^⑯	LED display
WA470	Hi	Hi	OPEN	OPEN	GND	47
WA420	Hi	OPEN	Hi	OPEN	GND	42
WA380	OPEN	Hi	Hi	GND	OPEN	37
WA320	OPEN	OPEN	OPEN	GND	OPEN	32

Hi: Connect to CN1 ^⑬ (Sensor power source)

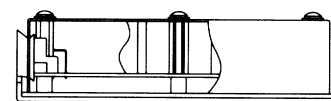
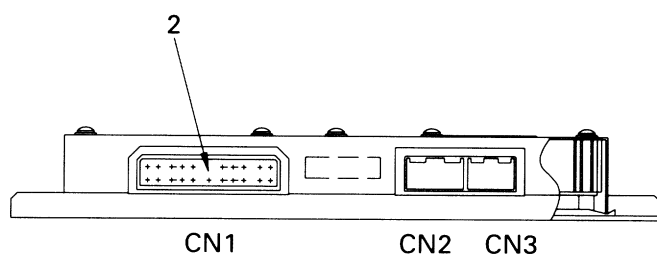
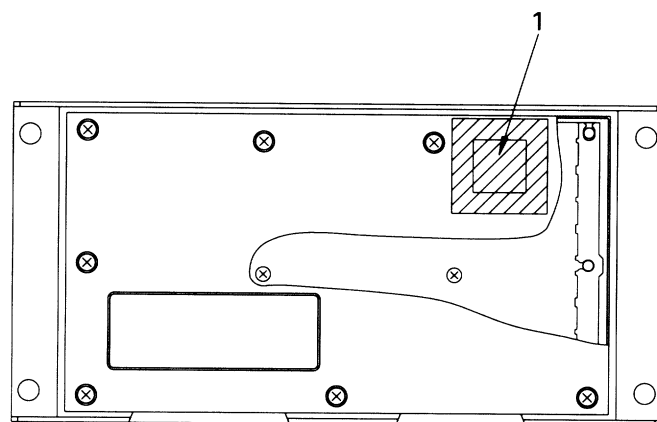
GND: Connect to CN ^⑨ (Signal ground)

TROUBLESHOOTING FUNCTION

- The controller always observes if the electronic devices (the potentiometers which receive the input signals, and the solenoids which receive the output signals) are functioning normally.
- If any abnormality should occur in these devices, the controller judges that there is an abnormality, displays the abnormality as a failure code on the main monitor, and warns the operator of the abnormality.
(For details, see TROUBLESHOOTING OF WORK EQUIPMENT CONTROLLER SYSTEM.)

CONTROLLER

1. Model selection display portion
2. Connector



SDW00265

CONNECTOR SIGNALS
CN1

1	NETWORK signal
2	Proximity switch signal
3	
4	
5	Damping solenoid (+)
6	DUMP solenoid (+)
7	TILT solenoid (+)
8	Power source input (+24V)
9	GND
10	Remote positioner set LED
11	Auto-leveler, relay
12	NETWORK signal
13	Sensor signal (+24V)
14	
15	Damping solenoid (-)
16	DUMP, TILT solenoid (-)
17	Solenoid power source input (+24V)
18	Power source input (+24V)
19	GND
20	Boom lever kick-out output
21	Bucket lever kick-out output

CN2

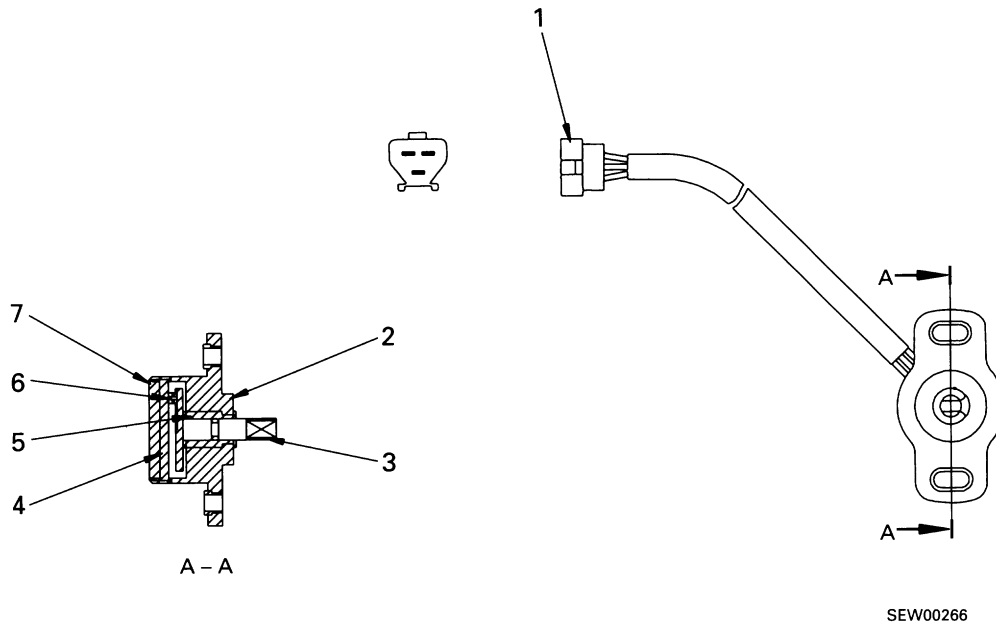
1	
2	Remote positioner set switch
3	Auto-leveler set switch
4	Remote positioner switch
5	Boom RAISE pressure switch
6	Boom LOWER pressure switch
7	
8	Boom lever detent switch
9	Signal GND output
10	Potentiometer power source (+5V)
11	Bucket neutral switch
12	Model selection switch 3
13	Model selection switch 2
14	Model selection switch 1
15	Engine selection 1
16	Engine selection 2
17	
18	Auto-leveler switch
19	Boom angle potentiometer
20	Bucket angle potentiometer

CN3

1	
2	
3	
4	Engine speed signal
5	
6	Remote positioner LED
7	Auto-leveler set LED
8	Auto-leveler LED
9	Pressure sensor signal
10	
11	
12	
13	
14	Remote positioner LOWER LED
15	
16	Buzzer output

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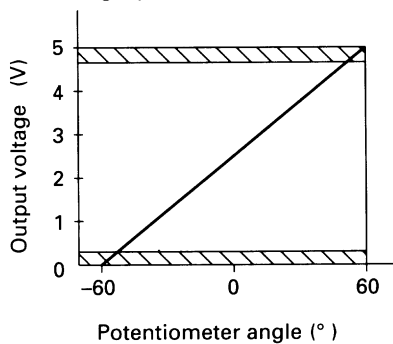
POTENTIOMETER



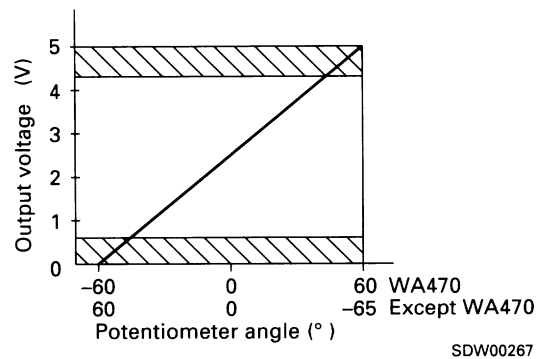
SEW00266

- | | |
|--------------|------------|
| 1. Connector | 5. Bearing |
| 2. Case | 6. Contact |
| 3. Shaft | 7. Mold |
| 4. Element | |

Boom angle potentiometer output



Bucket angle potentiometer output



SDW00267

Function

The boom angle potentiometer is installed to the front frame boom mount and the bucket angle potentiometer is installed to the boom bellcrank mount. They act to detect the angle of the work equipment.

Inside the potentiometer the 5V power source voltage from the angle is converted to a signal voltage by the resistance value of the variable resistor, and this is sent to the controller.

In the diagrams above, the hatched area is the abnormal detection area, and if the controller receives this signal, it judges that there is a disconnection, short circuit, or other abnormality in the potentiometer system. In addition, if the correct position cannot be detected, the controller shuts off the control output and displays a failure code on the main monitor.

E.C.S.S. (Electronic Controlled Suspension System) (option)

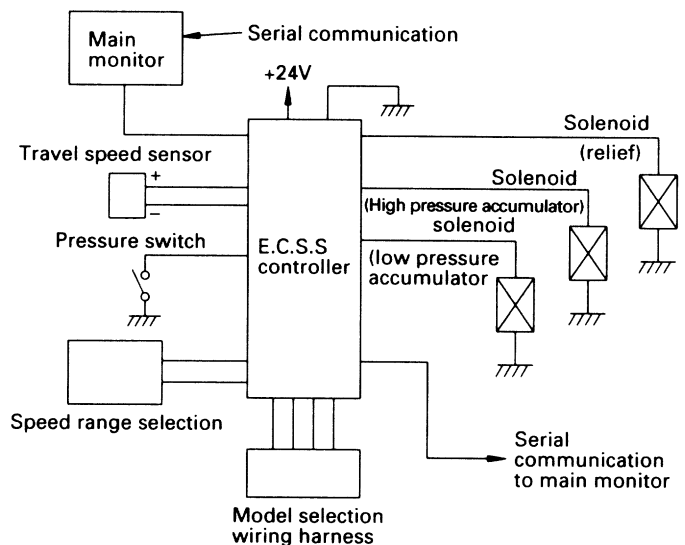
Serial No.: 50001 – 53999

1. E.C.S.S. (Electronic Controlled Suspension System)

- This system uses a combination of relieving the hydraulic oil from the work equipment and switching ON/OFF an accumulator which is charged with high pressure gas. The controller carries out automatic control of these in accordance with the travel condition of the machine to give resilience to the up and down movement of the work equipment and to suppress the vibration of the chassis when traveling at high speed. In this way, it improves the ride for the operator, prevents spillage of the load, and improves the operating efficiency.
- Special solenoid valves (ON-OFF valves) are used to control the ON-OFF switching of the accumulator (high pressure, low pressure) and the opening and closing of the relief valves.
- With this system, it is possible to handle four models (WA320, WA380, WA420, and WA470) with the same system simply by changing the connections of the model selection wiring harness.

2. Structure of system

- The E.C.S.S. consists of the following electronic devices.
 - 1) E.C.S.S controller (M type controller)
 - 2) Input devices: E.C.S.S switch (system switch), pressure switch (boom cylinder bottom pressure), travel speed sensor, model selection wiring harness, speed range selection wiring harness
 - 3) Output devices: solenoid valves (relief valve, high pressure accumulator, low pressure accumulator)



SEW00268

3. Content of control

- In response to the input on the left side of the table below, the controller carries out the output on the right side to control the system.

○: ON
x: OFF

	Input					Output		
	E.C.S.S switch (system ON-OFF) [Note 1]	Speed range [Note 2]		Travel speed [Note 3]	Pressure switch	Solenoid (1) (relief)	Solenoid (2) (high pressure)	Solenoid (3) (low pressure)
		H-L	Speed					
1	OFF	–	–	–	–	X	X	X
2	ON	OFF	OFF	Min. 5 km/h	ON	○	○	X
3		ON	OFF					
		ON	ON					
		OFF	OFF	Min. 5 km/h	OFF	○	○	○
4		ON	OFF					
		ON	ON					
5		OFF	ON	–	–	X	X	X
		–	–	Min. 5 km/h [Note 4]	–	X	X	X

Note 1: The E.C.S.S system is switched ON-OFF by operating the E.C.S.S switch on the main monitor.

When the system is ON, the E.C.S.S LED display on the main monitor lights up.

The ON-OFF condition of the system is retained even after the engine stops or the starting switch is turned OFF. The next time that the starting switch is turned ON, the system is set to the same condition as before it was turned OFF.

(Main monitor function)

Starting switch OFF → Machine stops

→ Starting switch ON

[When system is ON → System ON
When system is OFF → System OFF]

Note 2: Relationship between speed range signal and shift position

Shift position	Speed range	
	H-L	Speed
1st	OFF	ON
2nd	OFF	OFF
3rd	ON	OFF
4th	ON	ON

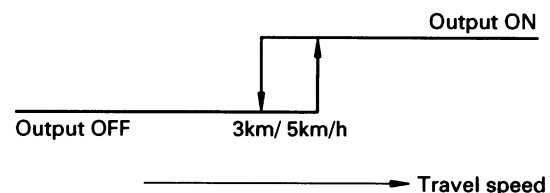
ON: +24V, OFF: OPEN

Note 3: Input pulse frequency when travel speed is 1 km/h

Model	Pulse frequency (Hz)
WA320	54.41
WA380	47.70
WA420	40.96
WA470	44.46

Note 4: If the travel speed exceeds 5 km/h when the output is OFF, the output is turned ON.

When the output is ON, the output stays ON until the travel speed reaches 3 km/h, and when the travel speed goes below 3 km/h, the output is turned OFF.



SEW00269

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4. Self-diagnostic function

- This system always observes the condition of the system, and displays the condition of the system (LED code, see table below) in the controller self-diagnostic display portion.
- If there is any abnormality in the controller itself or in the input or output devices, the controller carries out troubleshooting of the abnormality. It turns all the output OFF and displays the error code (failure code) in the self-diagnostic display portion and the main monitor.

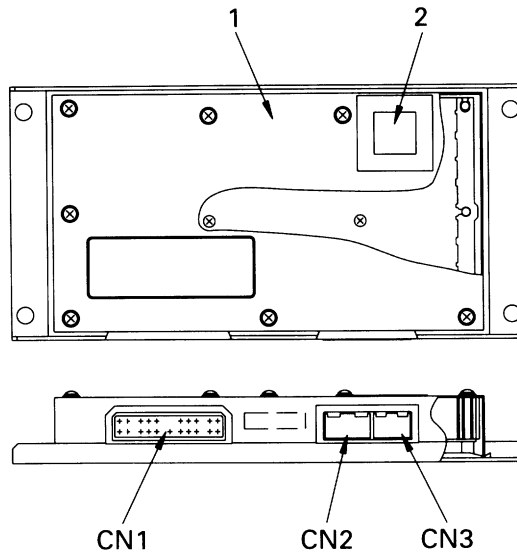
LED codes

LED display		Content	Condition of system
	01	Selects model as WA320	Normal
	02	Selects model as WA380	
	03	Selects model as WA420	
	04	Selects model as WA470	
	55	Pressure switch ON (displays only when ON)	
Error code	d0	Error in solenoid (relief) system	Abnormal
	d1	Error in solenoid (high pressure) system	
	d2	Error in solenoid (low pressure) system	
	d3	Abnormality in travel speed sensor system	
	d4	Abnormality in model selection (non-available combination is selected)	

- 1) Displays on controller
 - Error code displays [E] → [dx] (where x is a numeral from 0 to 4 in the table above) repeatedly in turn.
 - If more than one abnormality occurs at the same time, all the appropriate error codes are displayed in turn.
 - When the starting switch is turned OFF (controller power OFF, the error codes are reset and not written to memory.
 - When checking the LED display, read the code with the connector facing down.
- 2) Displays on main monitor
 - For details, see MAIN MONITOR TROUBLE DATA DISPLAY.

5. Controller

1. Controller
2. Self-diagnostic display



SDW00270

Input/output signals CN1

No.	Name of signal	Input/output
1	Serial signal	-
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	Power source input (+24V)	-
9	GND	-
10	-	-
11	Solenoid (low pressure)	Output
12	Serial signal	-
13	-	-
14	-	-
15	-	-
16	-	-
17	Solenoid power source input (+24V)	-
18	Power source input (+24V)	-
19	GND	-
20	Solenoid (high pressure)	Output
21	Solenoid (relief)	Output

CN2

No.	Name of signal	Input/output
1	Model selection	Input
2	Model selection	Input
3	Model selection	Input
4	Model selection (Parity)	Input
5	-	-
6	-	-
7	-	-
8	Pressure switch	Input
9	-	-
10	-	-
11	-	-
12	-	-
13	Travel speed H-L	Input
14	Travel speed SPEED	Input
15	SAS SW	Input
16	-	-
17	-	-
18	-	-
19	-	-
20	-	-

CN3

No.	Name of signal	Input/output
1	-	-
2	-	-
3	-	-
4	Travel speed sensor (+)	Input
5	-	-
6	-	-
7	-	-
8	-	-
9	-	-
10	-	-
11	-	-
12	Travel speed sensor (-)	Input
13	-	-
14	-	-
15	-	-
16	-	-

Model selection table

	CN2-1	CN2-2	CN2-3	CN2-4
WA320	X	X	X	○
WA380	X	X	○	X
WA420	X	○	X	X
WA470	X	○	○	○

○: GND
X: OPEN

Serial No. 54001 and up



- | | | |
|------------------------|--|--|
| 1. Main monitor | 6. E.C.S.S. valve assembly | 7. Charge control solenoid valve (Sol 2) |
| 2. E.C.S.S. switch | 6A. Main spool | 8. Accumulator |
| 3. Combination switch | 6B. Solenoid valve (Sol 1) | 9. Work equipment control valve |
| 4. Controller | 6C. Charge valve | 10. Boom cylinder |
| 5. Travel speed sensor | 6D. Shut-off valve (For manual pressure release) | |

- An accumulator charged with high-pressure gas in this system is turned ON and OFF automatically by the controller according to the travel condition of the machine to give vertical elasticity to the work equipment. With this system, rolling of the machine body is reduced during high-speed travel to improve the operator comfort and prevent spill of the load. As a result, the working efficiency is heightened.

2. System

- E.C.S.S. consists of the following electronic devices.
 - 1) E.C.S.S. controller (Transmission E.C.S.S. controller)
 - 2) Input devices: E.C.S.S. switch (System switch), travel speed sensor, speed range signal switch
 - 3) Output devices: Solenoid valve (Accumulator) 1, charge control solenoid valve 2

- E.C.S.S. is turned on and off with the E.C.S.S. switch on the main monitor. If this system (switch) is turned on, the E.C.S.S. LED on the main monitor lights up.

- E.C.S.S. circuit

Operation:

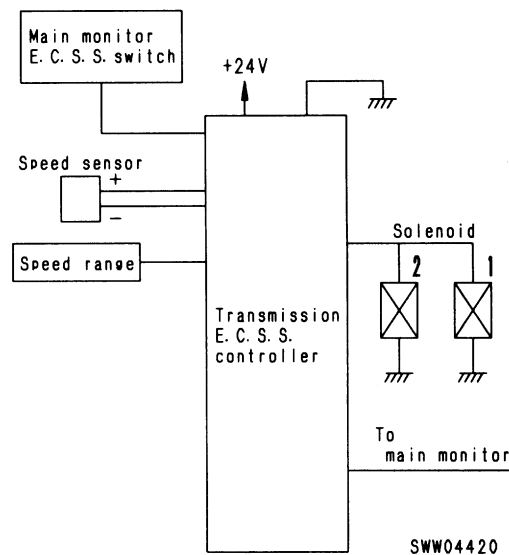
If the E.C.S.S. switch is turned on, the solenoid valve (Sol 1) is excited and the valve is changed, then the main spool is pushed and the circuits between the lift cylinder bottom and accumulator and between the lift cylinder head and tank are connected.

Operating condition:

This system operates when the speed range is 2nd through 4th and the travel speed is 5 km/h or higher.

Stopping of operation:

When the travel speed is lowered to 3 km/h or the transmission is shift in 1st or the E.C.S.S. switch is turned off, the main spool is returned by the spring, and the circuits between the lift cylinder bottom and accumulator and between the lift cylinder head and tank are disconnected.



- Accumulator charge circuit**
The accumulator charge circuit of E.C.S.S. prevents the boom from falling.
Charging of accumulator:
The accumulator is charged by utilizing the oil pressure in the line between the pump and work equipment valve when the lift arm or bucket is operated. The charge pressure of the accumulator is 70kg/cm², which is regulated with the charge valve in the E.C.S.S. valve.

No-charging of accumulator:

While E.C.S.S. is working, the accumulator cannot be charged since the charge control solenoid valve (Sol 2) is turned off. The reason for this setting is to prevent the lift arm from rising when the accumulator is charged while the bucket is operated.

3. Contents of control

- The controller receives the inputs in the left columns of the following table and gives the outputs in the right columns to control the system.

	Inputs				Outputs		
	E.C.S.S. switch (to turn on/off system) [Note 1]	Speed range	Travel speed [Note 2] (): With small tires		Solenoid ① (Accumulator)	Solenoid ② (Charge control)	
1	OFF	All ranges	—		X	○	
2	ON	2nd or higher	Min. 5 (4.6)km/h		○	X	
3							
4		1	—		X	○	
5		2nd or higher	Max. 5 (4.6)km/h [Note 3]		X	○	

[Note 1]

- E.C.S.S. is turned on and off with the E.C.S.S. switch on the main monitor. If this system is turned on, the red E.C.S.S. LED on the main monitor lights up.
- The ON-OFF condition of the system is kept even after the engine is stopped and starter switch is turned off. When the starter switch is turned on next time, the system is set in the previous condition.

(Main monitor function)

Starter switch OFF → Machine stops →
Starter switch ON

[When system is turned ON → System ON]

[When system is turned OFF → System OFF]

[Note 2]

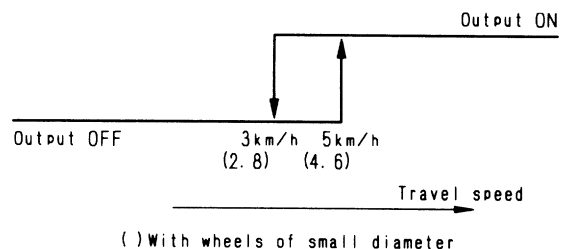
Number of input pulses when travel speed is 1km/h

Model	Number of pulses (Hz) with large tires	Number of pulses (Hz) with small tires
WA320-3	54.41	59.55
WA380-3	47.70	52.16
WA420-3	40.96	44.47
WA470-3	44.46	48.26

[Note 3]

While the output is turned off, if the travel speed exceeds 5km/h (4.6km/h), the output is turned on.

While the output is turned on, it is kept turned on until the travel speed lowers to 3km/h (2.8km/h), then turned off when the travel speed lowers below 3km/h (2.8km/h).



SWW04421

4. Self-diagnosis function

- This system always observes the condition of the system and displays the condition of the system (see LED code in table below) on the controller self-diagnostic display.
- If any abnormality occurs in either the controller itself or in the input or output devices, the controller diagnoses this, turns all outputs OFF and displays the error code (failure code) on the self-diagnostic display and main monitor.

LED code

LED display		Content	System condition
Error code	d0	Abnormality in solenoid 1, 2 (relief) system	Abnormality

- 1) Display on controller
 - See the section on the transmission controller.
- 2) Display on main monitor
 - See the section on the trouble data display on the main monitor.

5. Controller

The new travel damper controller is included inside the transmission controller from Serial No. 54001 and up.

SENSORS

Function

- The sensors are a contact type sensor with one end grounded to the chassis. The signal from the sensor is input directly to the monitor panel, and when the contacts are closed, the panel judges the signal to be normal. However, the engine oil pressure uses a relay to reverse the sensor signal.

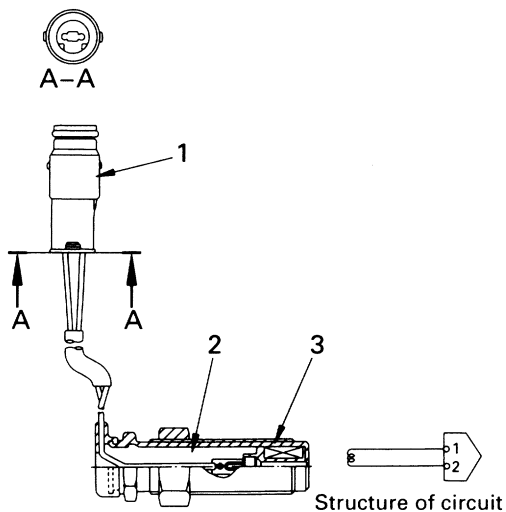
Sensor detection item	Sensor method	When normal	When abnormal
Speed sensor	Electro-magnetic		
Engine oil level	Contact	ON	OFF
Radiator water level	Contact	ON	OFF
Engine oil pressure	Contact	OFF	ON
Engine water temperature	Resistance		
Torque converter oil temperature	Resistance		
Engine speed sensor	Electro-magnetic		
Fuel level sensor	Resistance		

SPEEDOMETER SENSOR

Function

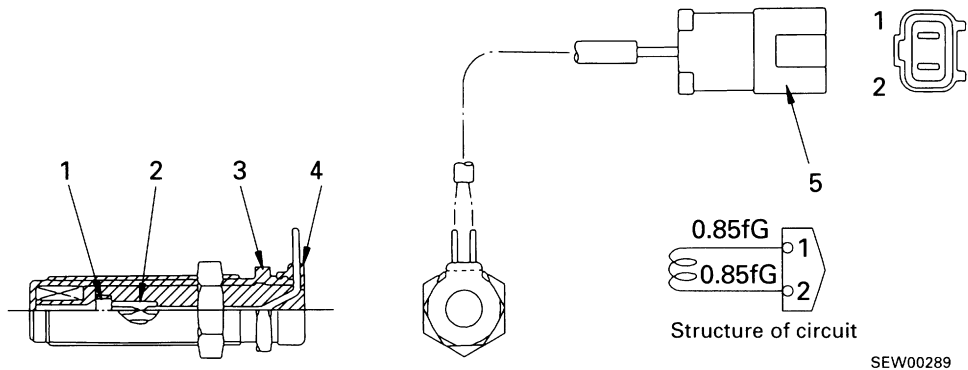
- The speedometer sensor is installed to the transmission output gear. A pulse voltage is generated by the rotation of the gear teeth, and the signal is sent to the machine monitor to display the travel speed.

- Connector
- Magnet
- Case



SEW00288

ENGINE SPEED SENSOR

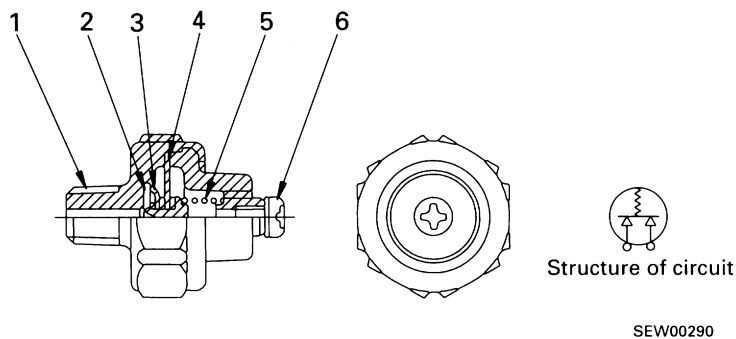


1. Magnet
2. Terminal
3. Case
4. Boot
5. Connector

Function

- The engine speed sensor is installed to the ring gear portion of the flywheel housing. A pulse voltage is generated by the rotation of the gear teeth, and a signal is sent to the controller and monitor panel.

ENGINE OIL PRESSURE SENSOR

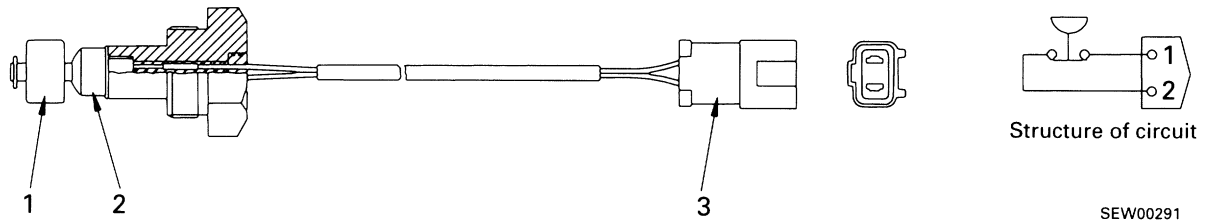


1. Plug
2. Contact ring
3. Contact
4. Diaphragm
5. Spring
6. Terminal

Function

- This sensor is installed to the engine block and the diaphragm detects the oil pressure. If the pressure goes below the specified pressure, the switch is turned ON, and a relay is actuated to turn the output OFF. This makes the maintenance monitor flash to warn of the abnormality. The caution lamp and alarm buzzer are also actuated at the same time to warn of the abnormality.

RADIATOR WATER LEVEL SENSOR

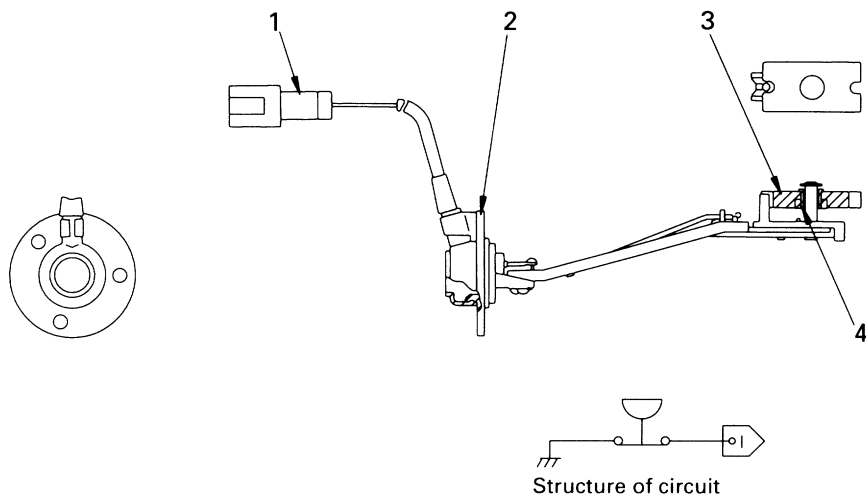


1. Float
2. Sensor
3. Connector

Function

- This sensor is installed to the top of the radiator. If the coolant goes below the specified level, the float goes down and the switch is turned OFF. The caution lamp and alarm buzzer are also actuated at the same time to warn of the abnormality.

ENGINE OIL LEVEL SENSOR

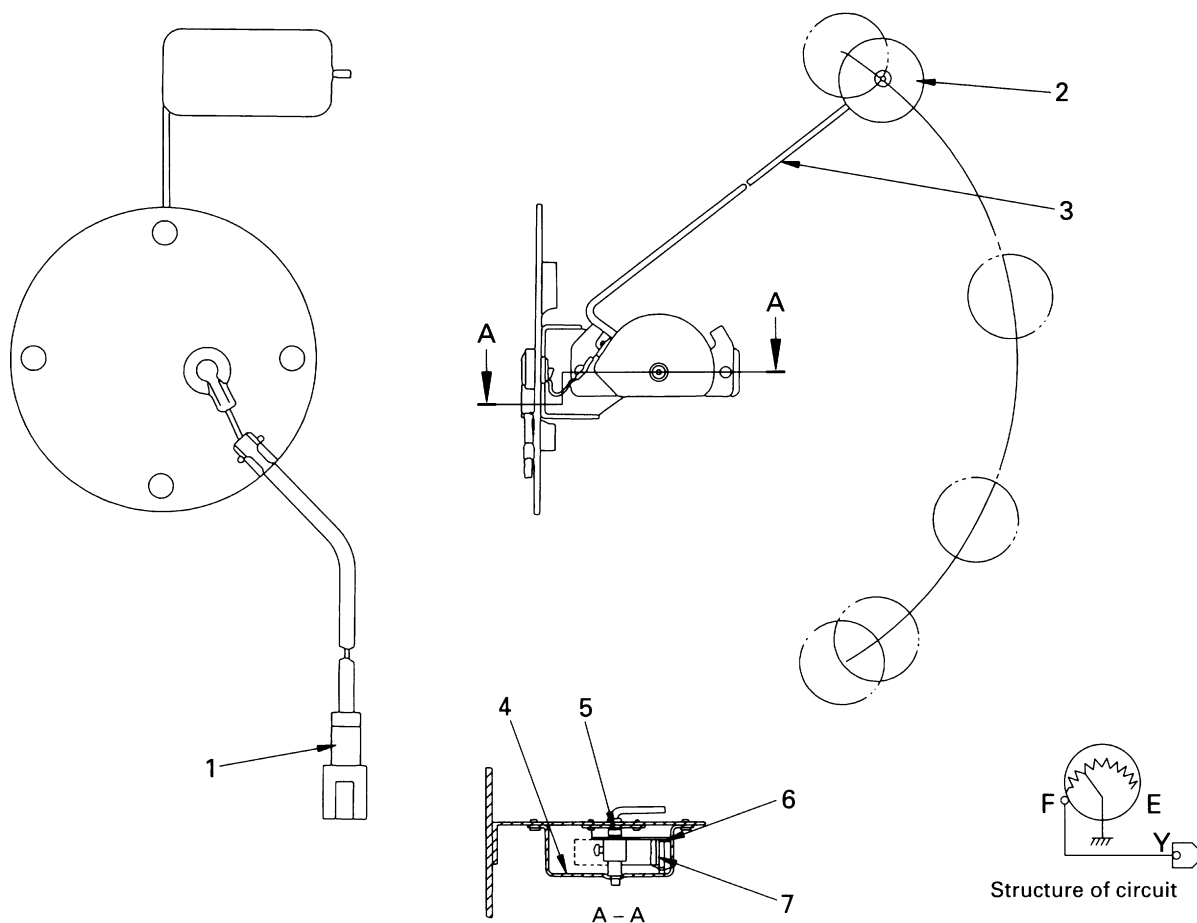


1. Connector
2. Bracket
3. Float
4. Switch

Function

- This sensor is installed to the side face of the oil pan. When the oil goes below the specified level, the float goes down and the switch is turned OFF. This makes the maintenance monitor flash to warn of the abnormality. The check lamp also lights up at the same time to warn of the abnormality.

FUEL LEVEL SENSOR



U42103

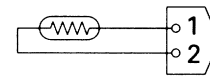
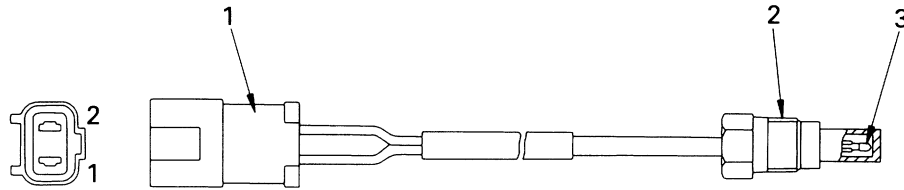
SEW00293

1. Connector
2. Float
3. Arm
4. Body
5. Spring
6. Contact
7. Spacer

Function

- The fuel level sensor is installed to the side face of the fuel tank. The float moves up and down as the level of the fuel changes. As the float moves up and down, the arm actuates a variable resistance, and this sends a signal to the sub monitor to display the fuel level. When the display on the maintenance monitor reaches the specified level, the warning lamp flashes.

ENGINE WATER TEMPERATURE SENSOR TORQUE CONVERTER OIL TEMPERATURE SENSOR



Structure of circuit

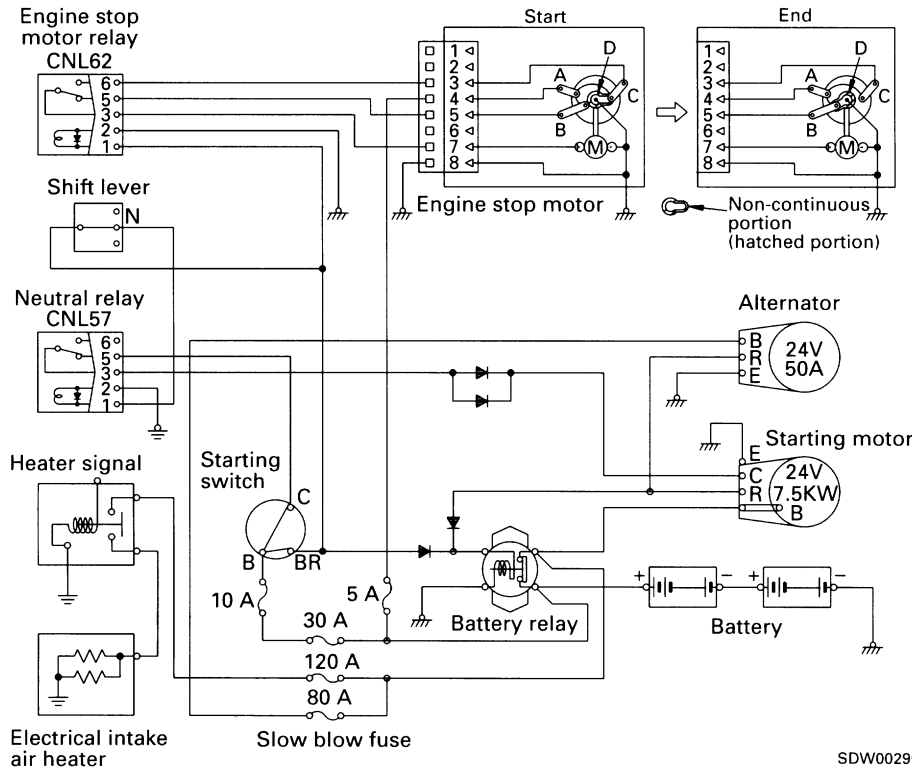
SEW00294

1. Connector
2. Plug
3. Thermistor

Function

- These sensors are installed to the engine cylinder block and transmission case. The change in the temperature changes the resistance of the thermistor, and a signal is sent to the maintenance monitor to display the temperature. If the display on the sub monitor reaches the specified position, the lamp flashes and the buzzer sounds to warn of the abnormality.

ENGINE STARTING CIRCUIT



SDW00295

U42103

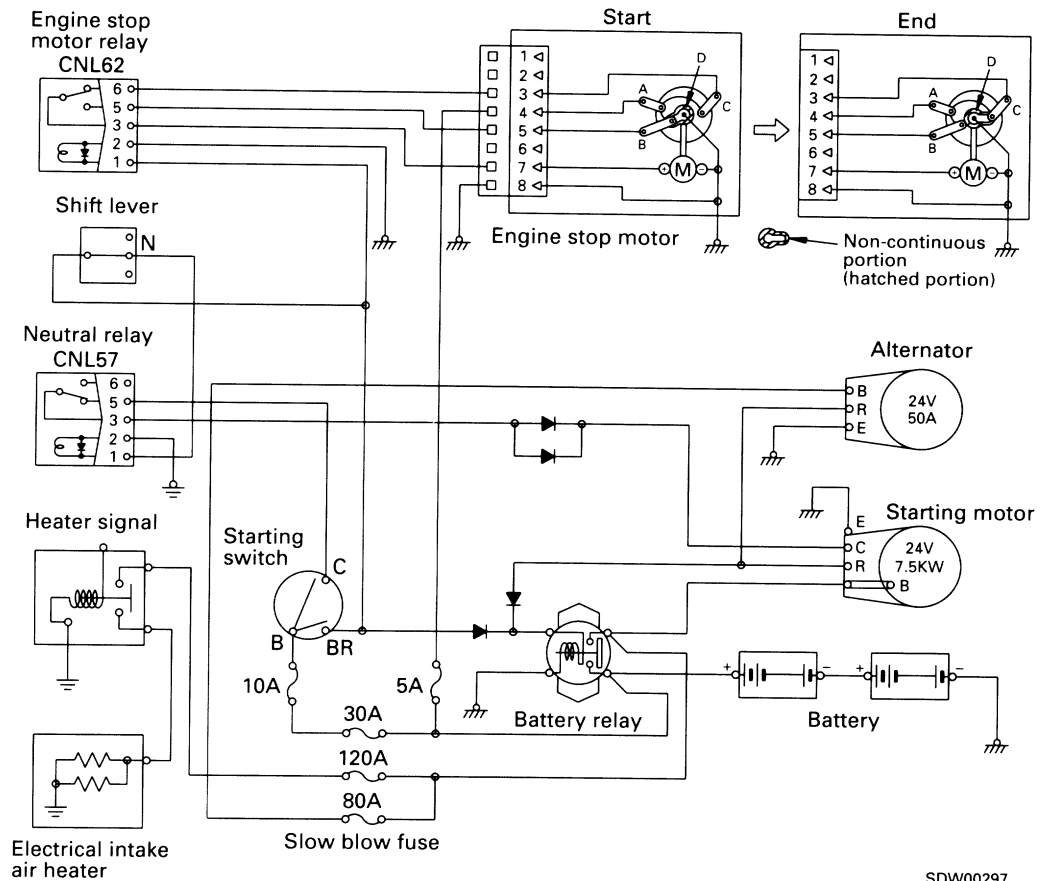
Function

- There is neutral safety circuit which prevents the engine from being started if the directional lever is not at the N position. This is to ensure safety when starting the engine.

Operation

- When the directional lever is placed at the N position, the neutral contacts of the directional lever switch are closed. In this condition, if the starting switch is turned to the START position, electric current flows in circuit ① from the battery (+) → starting switch terminal B → starting switch terminal C → starting motor terminal C → starting motor terminal E → directional lever switch terminal N → ground.
- In addition, electric current flows from starting switch terminal BR → stop motor relay terminal 1 – 2 → ground, and the relay coil is excited.
- The electric current from the battery flows from engine stop motor terminal A – B → relay terminal 5 – 3 → terminal → motor, and rotates the motor. (The cable extends)
- When the motor rotates, terminal D also rotates at the same time. When the non-continuous portion of terminal D reaches terminal B, the circuit from terminal A to B opens, and the current from the battery to the motor is shut off. The motor attempts to continue rotating under inertia, but when the continuous portion of terminal D contacts terminal B, both poles of the motor are connected to the ground, and the motor stops rotating.
- In this condition, the stop motor cable is completely extended, and the fuel injection pump lever is set to the FULL position to place it in the operating condition.
- In addition, the current flows from starting switch terminal BR → battery relay coil → ground, and the battery relay switch is closed.
- A circuit is formed from the battery → battery relay → starting motor terminal B, so the engine starts. If the directional lever is not at the N position, circuit ① is not formed, so the engine does not start.

ENGINE STOP CIRCUIT



SDW00297

Function

- The system is equipped with an electrical fuel cut device (engine stop motor) which makes it possible to start or stop the engine by turning the starting switch ON or OFF. This improves the ease of operation.

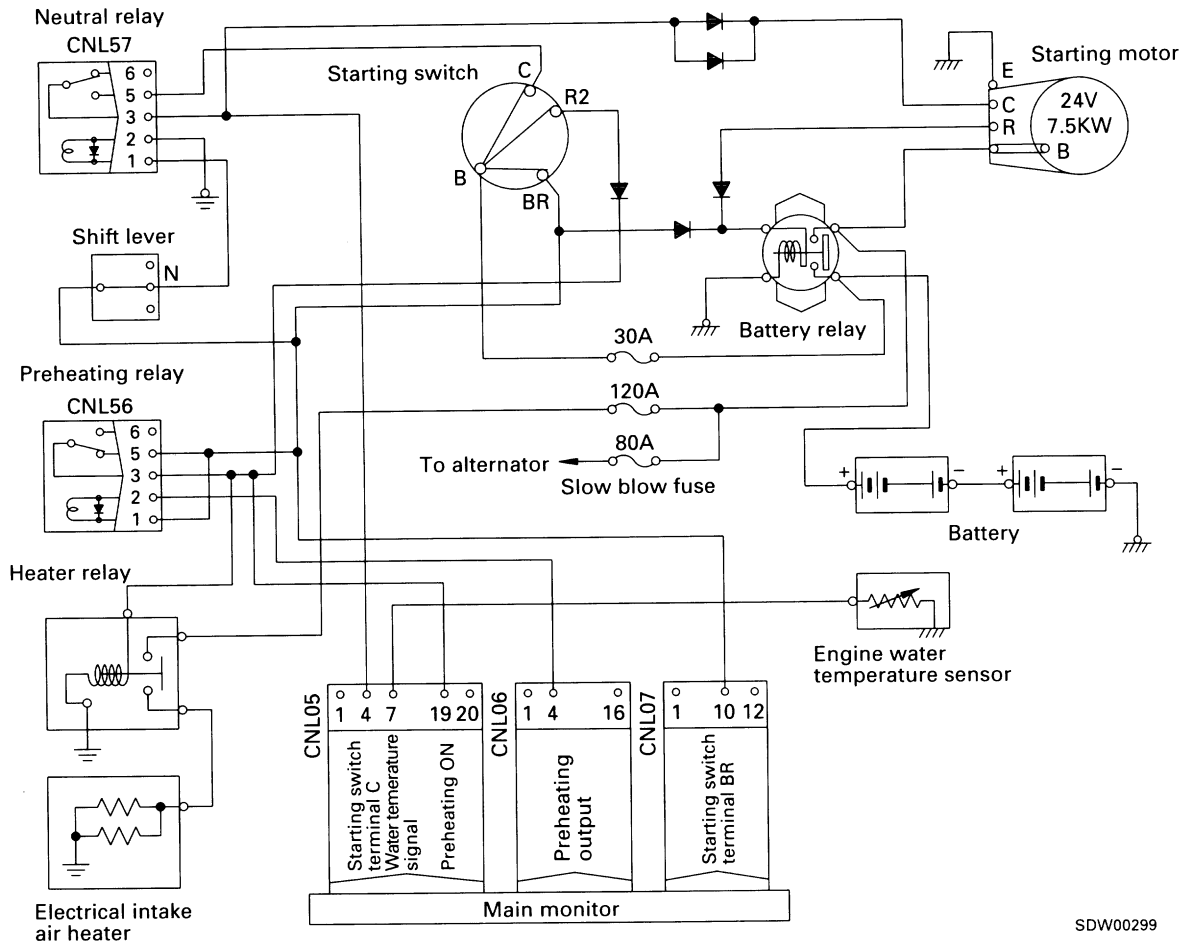
Operation

- When the starting switch is turned OFF, starting switch terminals B, BR and C are opened.
- The current in the stop motor relay is shut off by the starting switch, so the coil is not excited. Therefore, terminals 3 and 6 are closed.
- The current from the battery flows from engine stop motor terminals A - C → relay terminals 6 - 3 → motor to rotate the motor. (The cable is pulled in)

- When the motor rotates, terminal D also rotates at the same time. When the non-continuous portion of terminal D reaches terminal C, the circuit from terminal A to C opens, and the current from the battery to the motor is shut off. The motor attempts to continue rotating under inertia, but when the continuous portion of terminal D contacts terminal C, both poles of the motor are connected to the ground, and the motor stops rotating.
- In this condition, the stop motor cable is completely pulled in, and the fuel injection pump lever is set to the STOP position to stop the engine.

PREHEATING CIRCUIT

(AUTOMATIC PREHEATING SYSTEM)



SDW00299

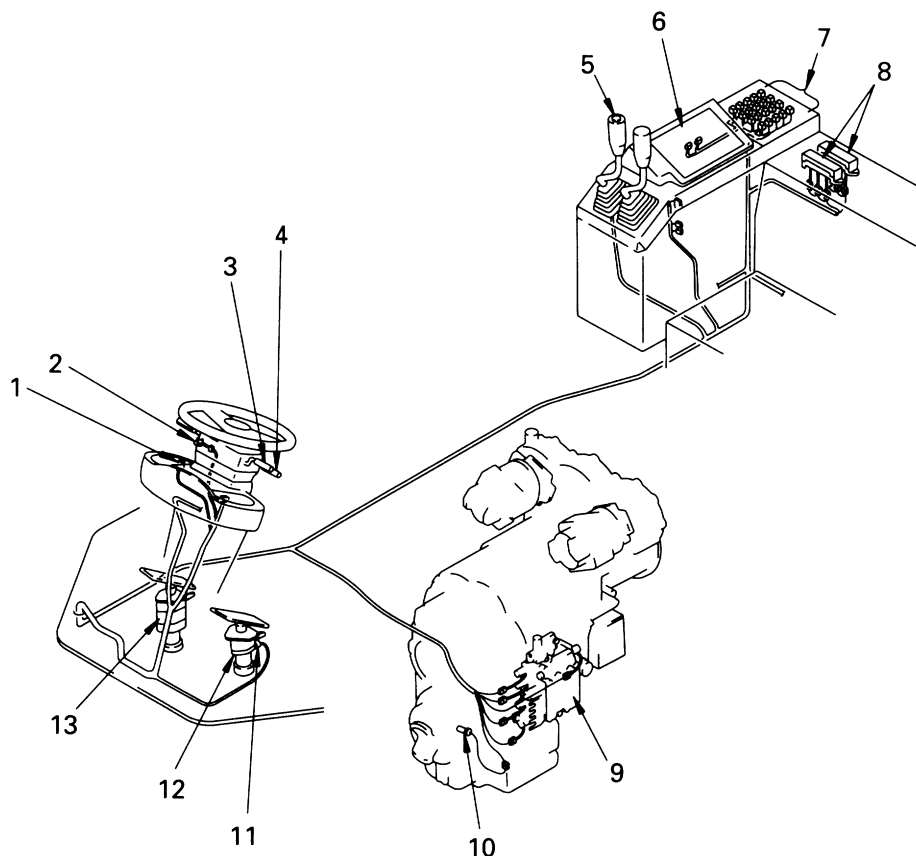
Outline

- To improve the ease of starting in cold areas, an automatic preheating system is installed. This system helps to reduce the preheating time and also automatically sets the preheating time to match the engine water temperature when the starting switch is operated.
- When the starting switch is turned to the ON (ACC) position, the preheating pilot lamp on the main monitor lights up and preheating is carried out on the intake air for the electric intake air heater. The engine water temperature is detected by the water temperature sensor, and the preheating time is set by the controller built into the main monitor.
- While the pilot lamp is lighted up, preheating is being carried out, so the starting switch must be kept at the ON position. If the starting switch is turned to the START position while the pilot lamp is ON, the preheating is canceled.

Operation

- When the starting switch is turned to the ON (ACC) position, a circuit is formed from starting switch terminal **BR** → controller inside main motor → preheating output → ground. The preheating relay coil is excited, so the preheating relay is actuated to actuate the heater relay.
- Current flow from the battery → battery relay → heater relay → electrical intake air heater to carry out preheating. When the preheating completion signal is sent from the controller, the preheating relay and heater relay are turned OFF and the preheating is completed.

ELECTRIC TRANSMISSION CONTROL



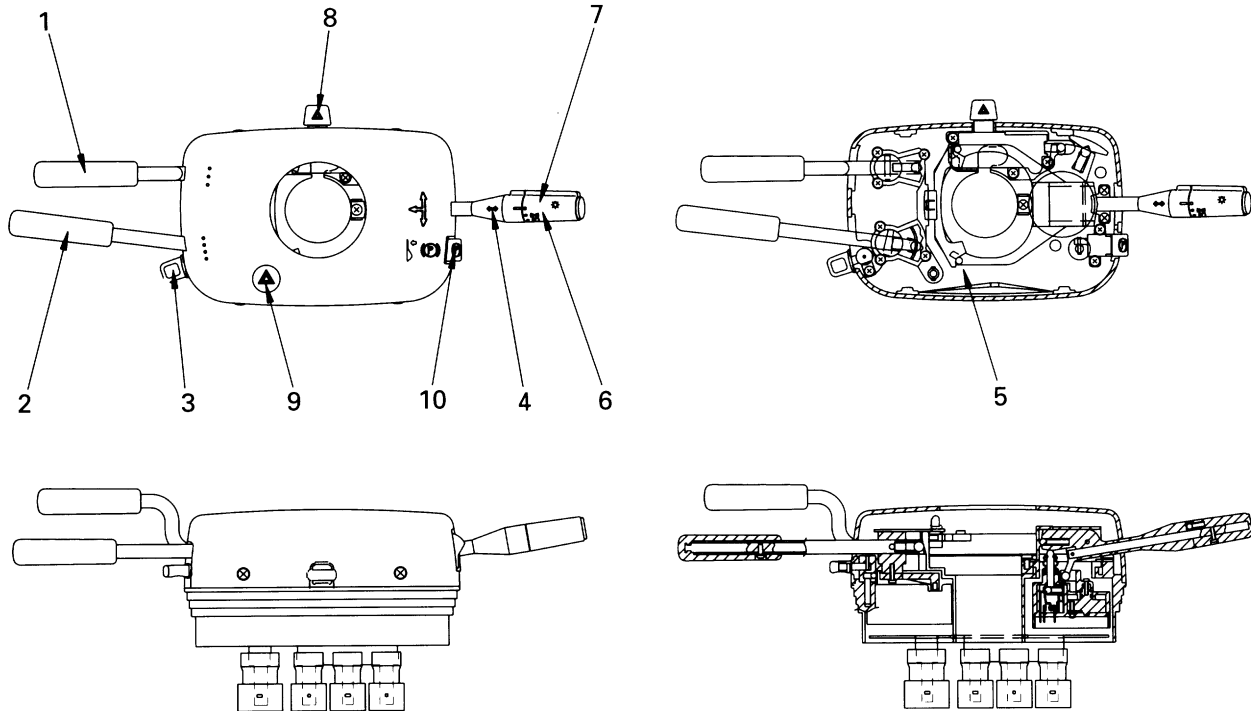
SNW01277

- | | |
|---|---------------------------------|
| 1. Transmission cut-off selector switch | 8. Fuse boxes |
| 2. Parking brake switch | 9. Transmission control valve |
| 3. Directional lever | 10. Speed sensor |
| 4. Speed lever | 11. Transmission cut-off switch |
| 5. Kick-down switch | 12. Brake valve (left) |
| 6. Maintenance monitor | 13. Brake valve (right) |
| 7. Relays | |

Function

1	Selection of F, R, and N positions	Using directional lever
2	Selection of speed range	Using speed lever
3	Kick-down switch	When traveling in F2, it is possible to shift down to 1st using this switch without using the speed lever. If directional lever is operated to R or N, speed range automatically returned to 2nd.
4	Transmission cut-off function	Transmission is shifted to neutral when left brake is operated
5	Transmission cut-off selector function	It is possible to select whether to actuate or not actuate the transmission cut-off function. In this way, it is possible to obtain the same or greater ease of operation as on conventional loaders with the left brake when carrying out scooping work or when loading or unloading the machine from a trailer.
6	Neutralizer	To prevent seizure of the parking brake when traveling with the parking brake applied, the transmission is shifted to neutral when the parking brake is applied.
7	Neutral safety function	If the directional lever is not at the N position, the engine will not start when the starting switch is turned. This prevents the machine from starting suddenly. (For details, see STARTING CIRCUIT.)
8	Warning function	When traveling in reverse, the backup lamp lights up and the backup horn sounds to warn people in the area.

COMBINATION SWITCH



SDW00301

U42103

Outline

- The directional lever has three positions and the speed lever switch has four positions. As an individual part, the switch does not have a detent mechanism; the detent mechanism is in the combination switch. Each switch is positioned by two pins, and is secured to the

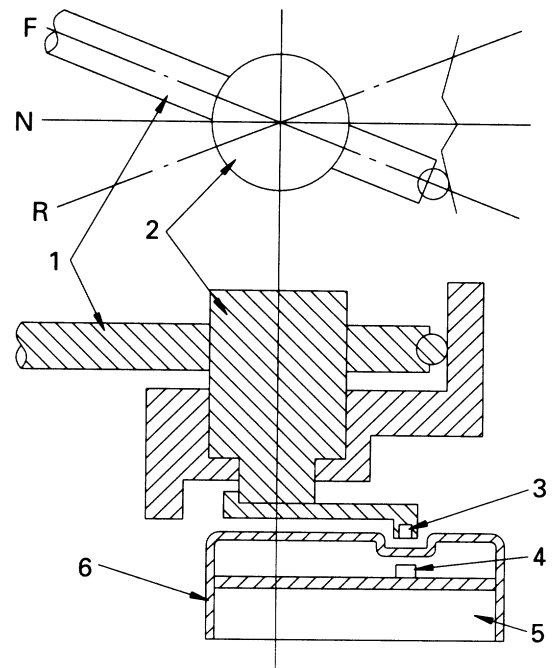
body by three screws. When each lever is operated to the desired position, the switch, which is interconnected by a shaft, acts to allow electric current to flow to that circuit only.

General locations, function

1	Directional lever switch	Switches between F, R, and N
2	Speed lever switch	Selects speed range
3	Speed lever stopper	Stopper used to prevent speed lever from entering 3rd or 4th during operations
4	Turn signal indicators	Direction indicator lamps used when turning left or right
5	Self cancel	Turn signal indicator lever automatically returns to central position after machines turns left or right
6	Lamp switch	Switches on clearance lamp, head lamp, parking lamp, etc.
7	Dimmer switch	Selects high beam for travel and low beam for passing
8	Hazard switch	Makes both left and right turn signal indicator lamps flash at the same time
9	Emergency flashing pilot lamp	Flashes at the same time as the emergency flashing lamp flashes
10	Parking brake switch	Applies or releases parking brake

Operation

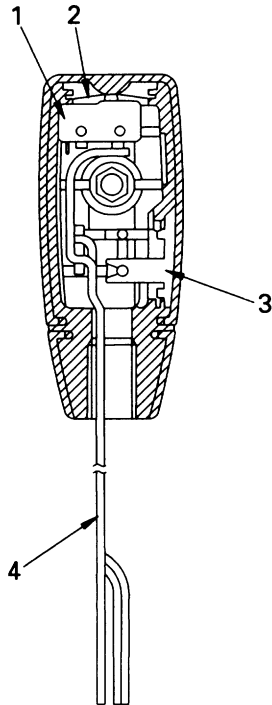
- Directional lever (1) and shaft (2) of the speed lever of the combination switch form one unit with magnet (3), and magnet (3) also moves together with lever (1).
- Control switch (5) with built-in hole IC (4) is installed at the bottom of magnet (3), and hole IC (4) is positioned on the board to match each position.
- When directional lever (1) is operated to the F position, magnet (3) is immediately above hole IC (4) for the F position of the control switch. The magnetism from magnet (3) passes through the gap and case (6), and magnetism is applied to hole IC (4).
- When this happens, hole IC (4) is inside a magnetism detection circuit, so it detects the magnetism of magnet (3) and sends the F position signal to the electric current amplification circuit. In the electric current amplification circuit, a signal is output to actuate the transmission.



SEW00302

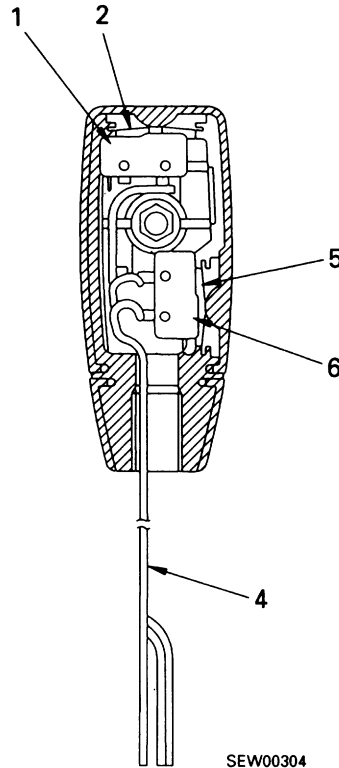
KICK-DOWN SWITCH

Without auto-shift transmission



SEW00303

With auto-shift transmission (option)



SEW00304

1. Kick-down switch
2. Spring
3. Side cap
4. Wiring harness
5. Spring
6. Holding switch

U42103

KICK-DOWN SWITCH

Operation

- The kick-down (shifting down from 2nd → 1st) is actuated only when traveling in F2.
- When traveling in F2, if it is desired to shift down to 1st without operating the speed lever, operate the kick-down switch on the boom lever to ON to shift down to F1.
- After this, even if the kick-down switch is pressed, the transmission is kept at F1.

Cancellation (or not actuated)

- When directional lever is at N
- When directional lever is at R
- When speed lever is not at 2nd
- When starting switch is OFF

HOLDING SWITCH (With auto-shift transmission) (option)

Operation

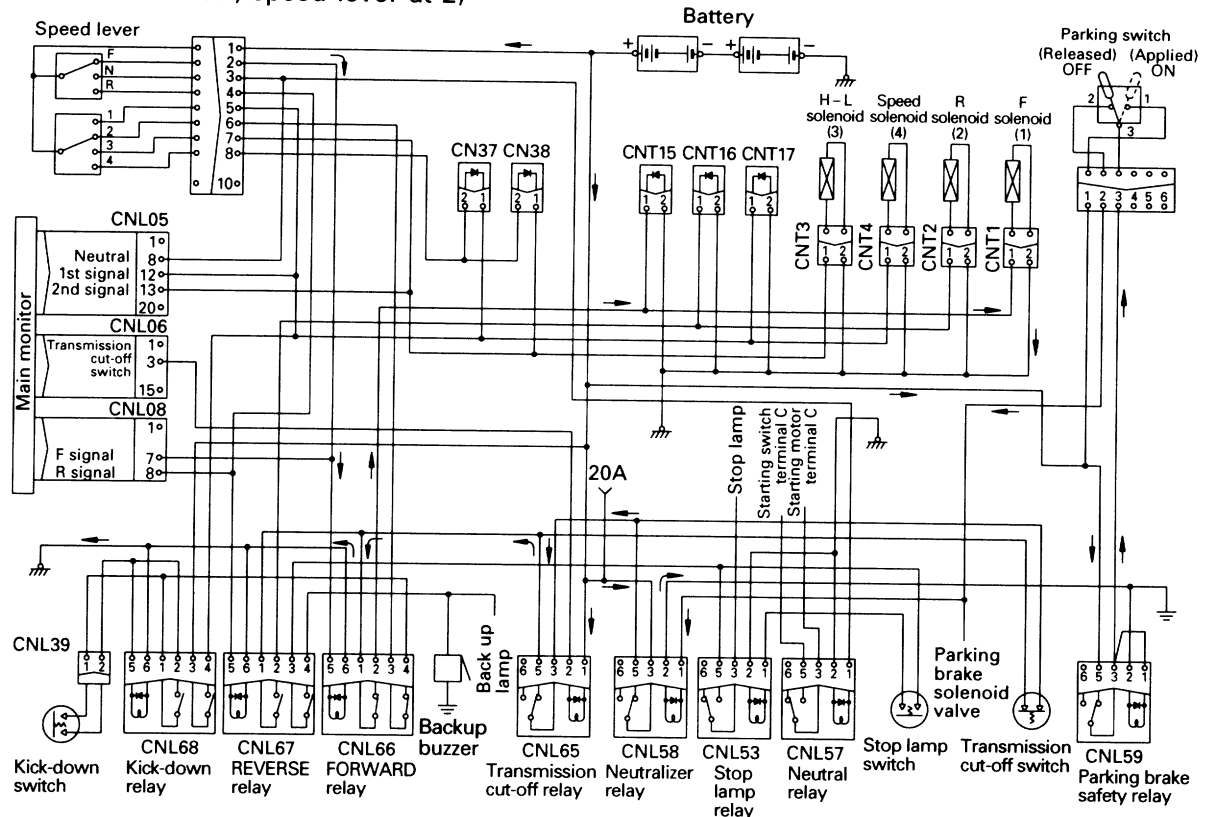
- The holding switch is installed to the boom lever, and when the holding switch is pressed, the speed range displayed on the main monitor transmission indicator is held.
- Press the holding switch again to cancel.

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM

(Without auto-shift transmission)

Normal operation

(directional lever at F, speed lever at 2)



SDW00305

1) Directional lever set to F

- When the directional lever is set to the F position, electric current flows from the battery $\oplus$ → directional lever switch terminal 1 – 2 → FORWARD relay terminal 5 – 6 → ground.

As a result, the FORWARD relay is actuated and terminals 1 and 2 and terminals 3 and 4 are connected.

- Next, the current flows from the battery $\oplus$ → parking brake safety relay terminal 5 – 3 → parking brake switch terminal 3 – 2 → neutralizer relay terminal 1 – 2 → ground, and neutralizer relay terminal 3 – 5 are connected. In addition, electric current flows from the battery $\oplus$ → transmission cut-off relay terminal 1 – 2 → monitor, and transmission cut-off relay terminals 3 – 5 are connected.

- Electric current flows from the battery $\oplus$ → neutralizer terminal 3 – 5 → transmission cut-off relay terminal 3 – 5 → FORWARD relay terminal 1 – 2 → solenoid 1 → ground, and solenoid (1) is actuated.

2) Speed lever set to 2

- When the speed lever is at position 2, no electric current flows to solenoids (2), (3), or (4). In this condition, the transmission valve is set to F2 by the action of solenoid (1). No current flows to the coil (relay terminals 5 – 6) of the kick-down relay if the kick-down is not pressed. Therefore, the kick-down relay is not actuated, and the transmission is held in F2.

Solenoid actuation table

Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	○	●	○	○				
REVERSE	(2)					○	○	○	○
H-L select	(3)		○	○				○	○
Speed select	(4)	○		○		○			○

U42103

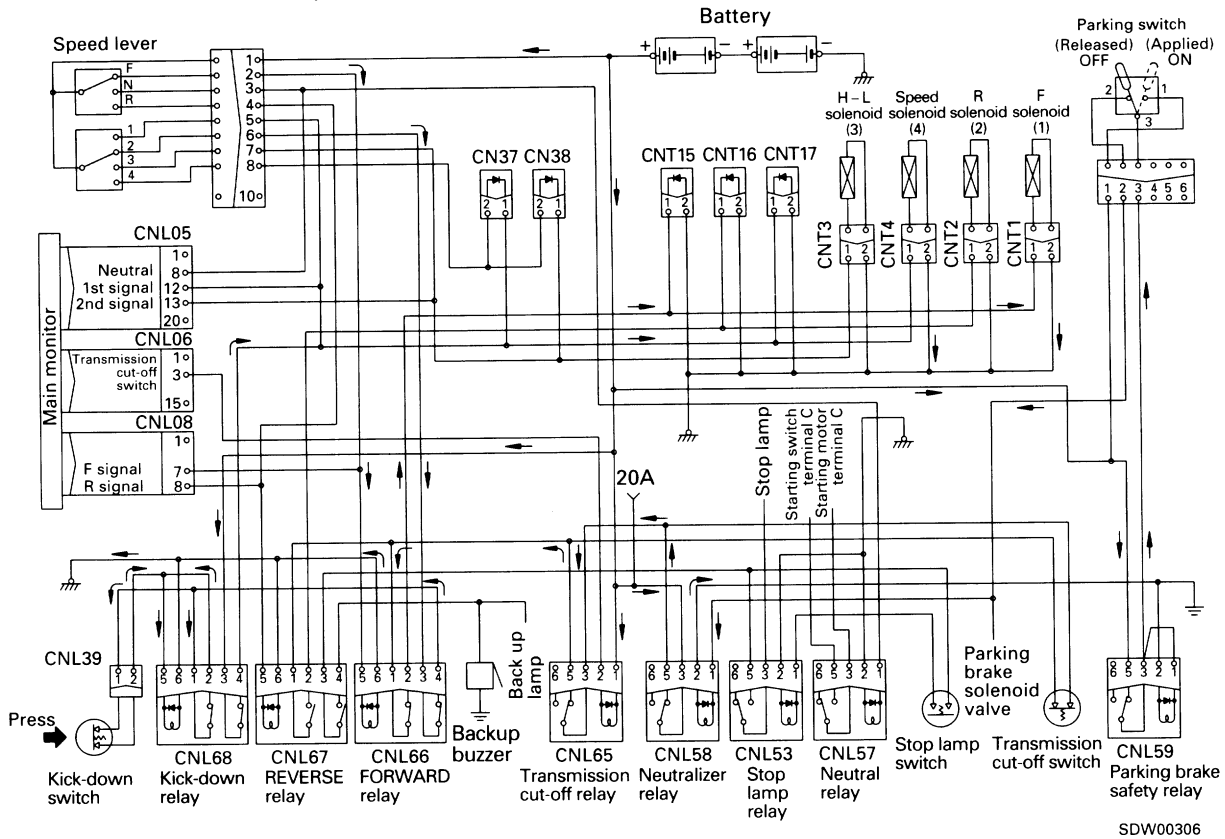
STRUCTURE AND FUNCTION

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM

Kick-down switch operated (case 1)

(When operating or traveling in F2)

(When kick-down switch is pressed ON)



SDW00306

- When the kick-down switch is pressed, electric current flows from the battery (+) → speed lever 2 → FORWARD relay terminal 3 – 4 → kick-down switch → kick-down relay terminal 5 – 6 → ground. As a result, the kick-down is actuated, and kick-down relay terminals 1 and 2 and terminals 3 and 4 are closed. A circuit from kick-down relay terminal 1 – 2 → kick-down relay terminal 5 – 6 → ground is formed, so the kick-down relay continues to be actuated even if the kick-down switch is returned. (Self-hold circuit of kick-down relay)

- When the kick-down relay is actuated and terminals 3 and 4 are closed, electric current flows from the battery (+) → kick-down relay terminal 3 – 4 → solenoid 4 → ground, and solenoid (4) is actuated. Solenoids (1) and (4) are actuated, so the transmission is set to F1.

In this way, if the kick-down switch is pressed when the speed lever is at F2, the transmission will shift to F1. At the same time, it will be held in F1 by the self-hold function of the kick-down relay even when the kick-down switch is released. However many times the kick-down switch is pressed, the transmission will stay in F1.

Solenoid actuation table

Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD (1)	●	○	○	○					
REVERSE (2)						○	○	○	○
H-L select (3)			○	○				○	○
Speed select (4)	●			○		○			○

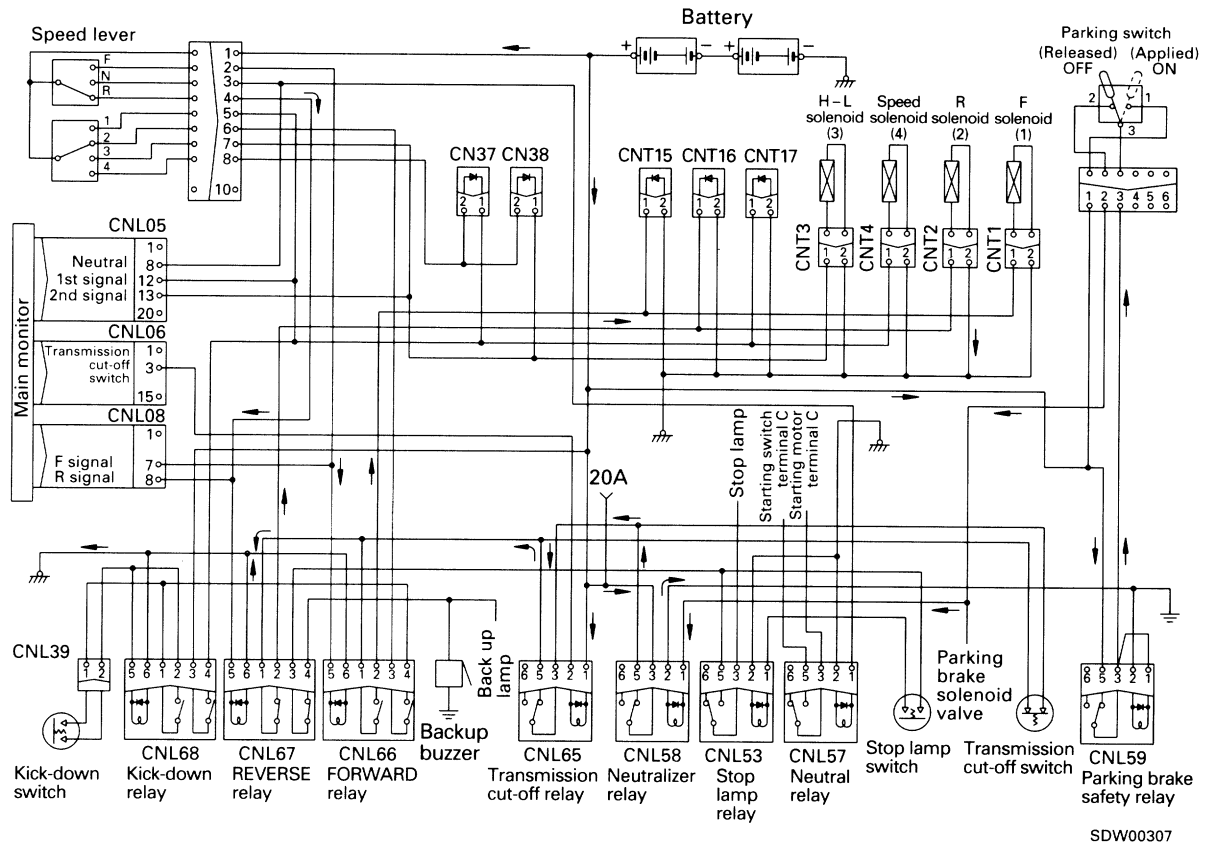
U42103

STRUCTURE AND FUNCTION

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM

Canceling actuation of kick-down switch (Case 1)

(Directional lever moved to N or R)



SDW00307

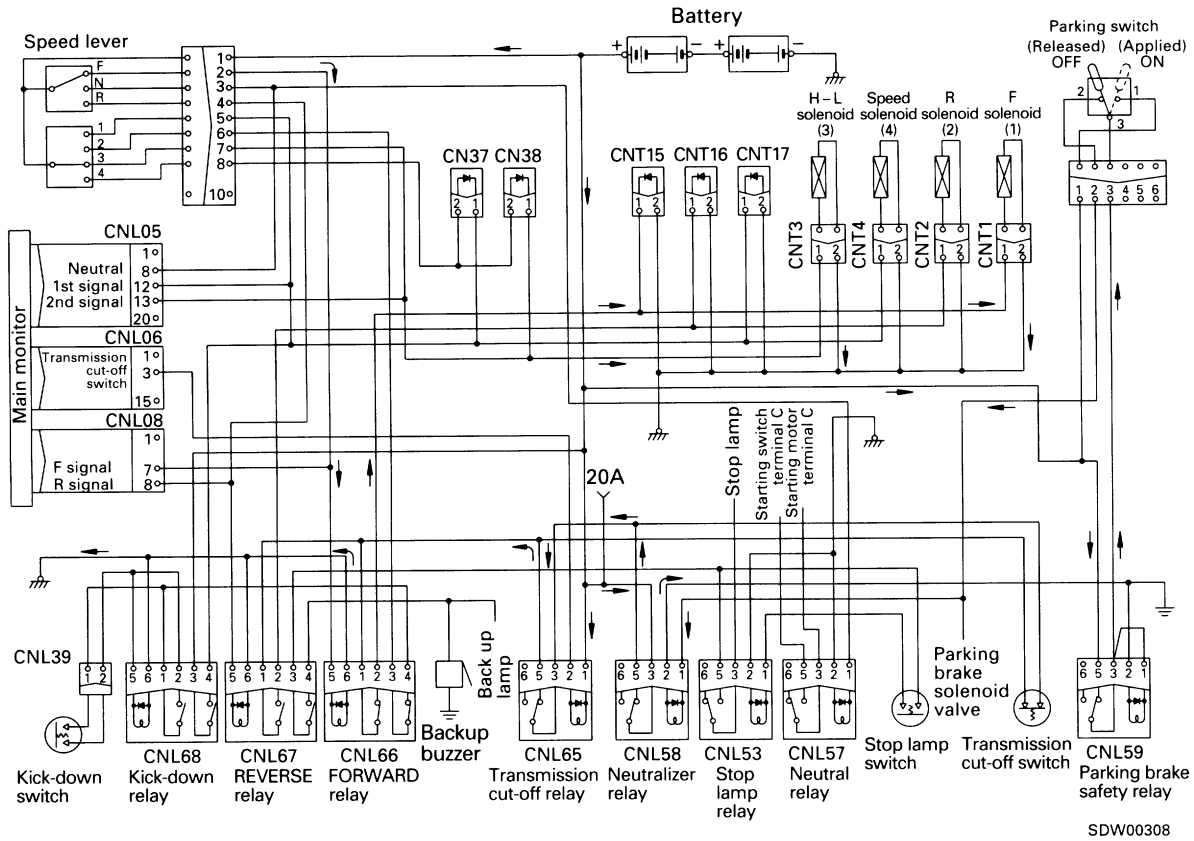
- When the directional lever is moved to the R position, the F terminal contacts are turned OFF, so the electric current stops flowing from the battery (+) → directional lever F → FORWARD relay terminal 5 – 6 → ground, and the FORWARD relay is reset.
- FORWARD relay terminals 1 and 2 and terminals 3 and 4 are opened, so the electric current stops flowing to the solenoid of the kick-down relay, and the kick-down relay is reset.
- In this way, the self-hold circuit of the kick-down relay is canceled, and terminals 3 and 4 are opened, so solenoid (4) is no longer actuated. (When the directional lever is moved to the N position, the actuation is the same as above and the kick-down relay is canceled.)
In addition, FORWARD relay terminal 1 and 2 are opened, so solenoid (1) is no longer actuated.
- When the directional lever is moved to the R position, current flows from the battery (+) → directional lever R → REVERSE relay terminal 5 – 6 → ground, so the REVERSE relay is actuated and REVERSE terminals 1 and 2 and terminals 3 and 4 are closed.
- As a result, electric current flows from the battery (+) → REVERSE relay terminal 1 – 2 → solenoid 2 → ground, and solenoid (2) is actuated. Therefore, only solenoid (2) is actuated, and the transmission is set to the R2 position.

Solenoid actuation table

Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	○	○	○					
REVERSE	(2)					○	●	○	○
H-L select	(3)		○	○				○	○
Speed select	(4)	○		○		○			○

STRUCTURE AND FUNCTION**KICK-DOWN ELECTRIC CIRCUIT DIAGRAM**

Canceling actuation of kick-down switch (Case II)
(speed lever moved to position other than 2)



U42103

- If the speed lever is moved to any position other than 2, the electric current stops flowing from the battery (+) → speed lever 2 → FORWARD relay terminals 3 – 4, and the current to the kick-down relay is also shut off.
- Therefore, the kick-down relay is canceled, and solenoid (4) is no longer actuated.
- If the speed lever is moved to 3, solenoid (3) is actuated. In addition, the directional lever is at the F position, so solenoid (1) is actuated. Therefore, solenoids (1) and (3) are actuated and the transmission is set to **F3**.

Solenoid actuation table

Solenoid		F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	○	○	●	○					
REVERSE	(2)						○	○	○	○
H-L select	(3)			●	○				○	○
Speed select	(4)	○			○		○			○

Canceling actuation of kick-down switch (Case III)

(starting switch turned OFF)

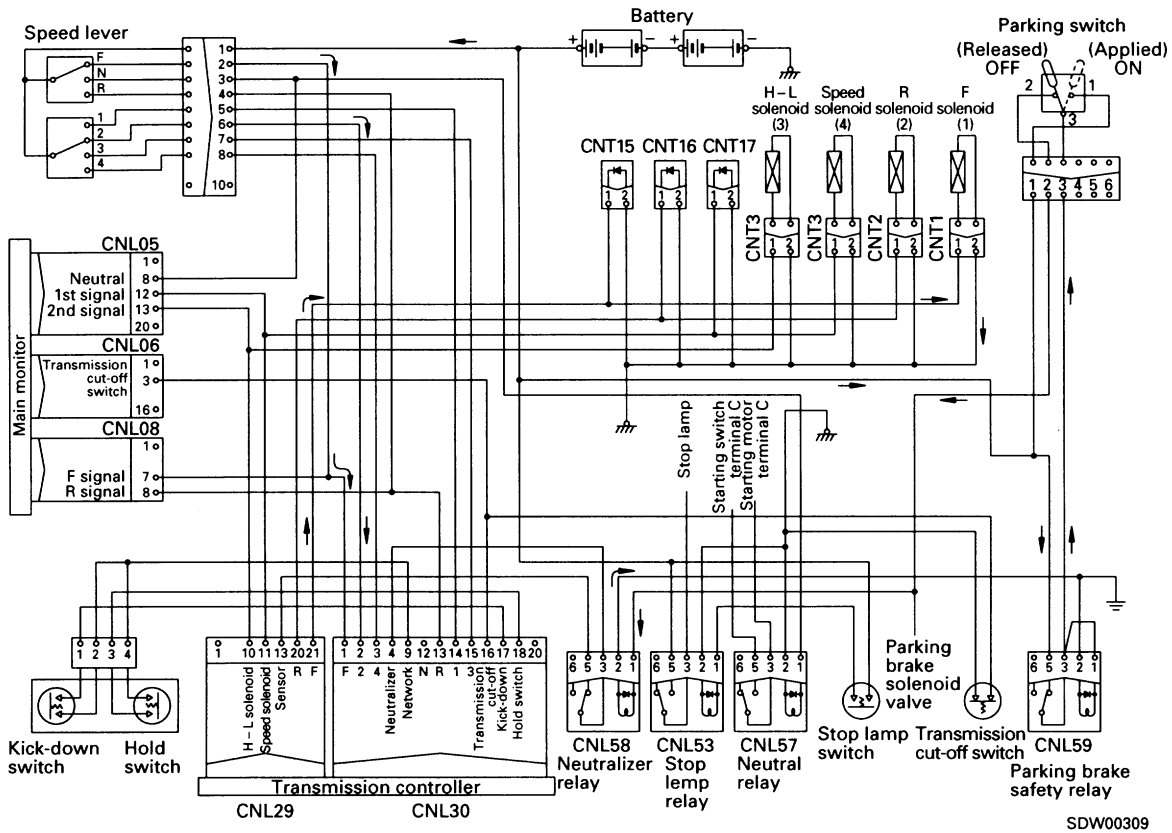
- When the starting switch is turned OFF, the electric current stops flowing from the battery (+) → speed lever 2 → FORWARD relay terminal 5 – 6 → ground, and the kick-down relay is reset.
- Therefore, the kick-down relay is canceled.
- If the starting switch is turned ON again, the self-hold circuit of the kick-down relay has been canceled, so the transmission will work as normal.

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM

(With auto-shift transmission)

Normal operation

(directional lever at F, speed lever at 2)



- 1) Directional lever set to F
 - When the directional lever is set to the F position, electric current flows from the battery (+) → directional lever switch terminal 1 – 2 → transmission controller FORWARD terminal 1, and flows as the FORWARD output signal from terminal 21 → FORWARD solenoid (1) → ground, and the solenoid valve is actuated.
 - When the parking brake is moved to the RELEASE position, the electric current flows from the battery (+) → parking brake safety relay terminal 5 – 3 → parking brake switch terminal 3 – 2 → neutralizer relay terminal 1 – 2 → ground, and terminals 3 – 5 of the neutralizer relay are connected.

- 2) Speed lever set to 2
 - When the speed lever is at position 2, no electric current flows to H-L solenoid (3), R solenoid (2) and speed solenoid (4). In this condition, the transmission control valve is set to F2 by the action of F solenoid (1).
 - No current flows if the kick-down switch is not pressed. Therefore, the kick-down is not actuated, and the transmission is held in F2.

Solenoid actuation table

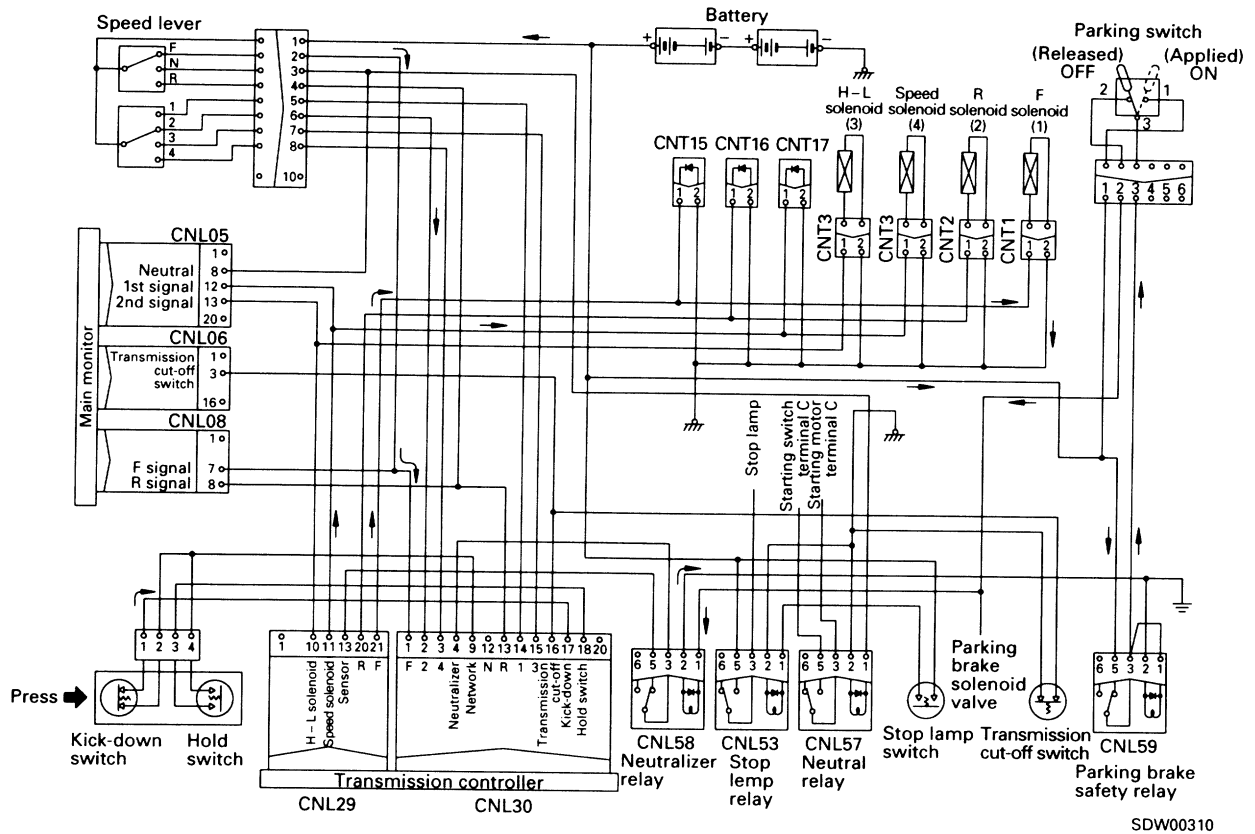
Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	○	●	○	○				
REVERSE	(2)					○	○	○	○
H-L select	(3)			○	○			○	○
Speed select	(4)	○			○	○			○

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STRUCTURE AND FUNCTION**KICK-DOWN ELECTRIC CIRCUIT DIAGRAM****Kick-down switch operated**

(When operating in F2)

(When kick-down switch is pressed ON)



SDW00310

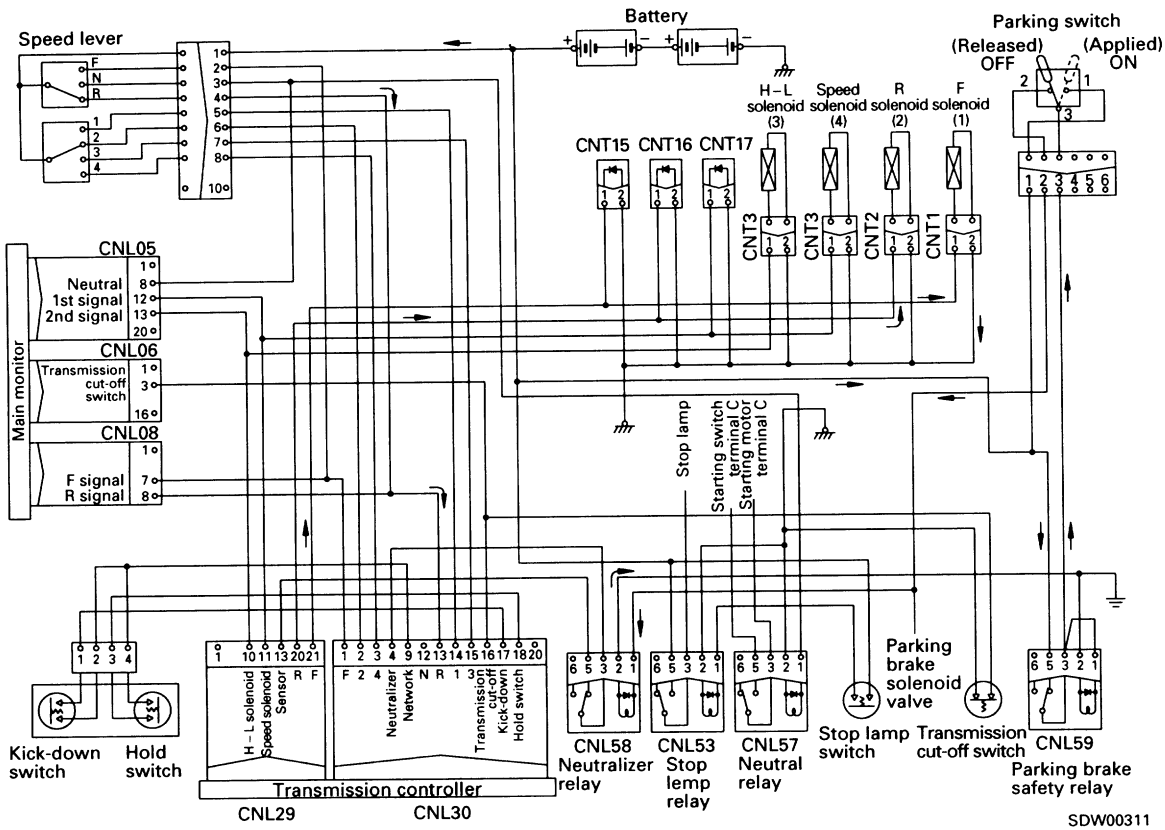
- When the kick-down switch is pressed, electric current flows from the transmission controller kick-down terminal (17) and enters the controller. The kick-down circuit is formed inside the controller, so the solenoid output signal flows from terminals 21 and 11 to FORWARD solenoid (1) and speed solenoid (4). The solenoid valves are actuated and the transmission is set to F1.
- This kick-down circuit continues to be actuated from this point even if the kick-down switch is returned. (Self-hold circuit)
- In this way, when the speed lever is at F2, the transmission is automatically shifted to F1 when the kick-down switch is pressed. At the same time, it will be held in F1 by the self-hold function of the kick-down relay even when the kick-down switch is released. However many times the kick-down switch is pressed, the transmission will stay in F1.

Solenoid actuation table

Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1) ●	○	○	○					
REVERSE	(2)					○	○	○	○
H-L select	(3)		○	○				○	○
Speed select	(4) ●			○		○			○

STRUCTURE AND FUNCTION**KICK-DOWN ELECTRIC CIRCUIT DIAGRAM!**

Canceling actuation of kick-down switch (Case 1)
 (Directional lever moved to **N** or **R**)



- When the directional lever is moved to the **R** position, the **F** terminal contacts of the lever are turned off, so the electric current stops flowing from the battery (+) → speed lever switch terminal 1 – 2 → transmission controller.
- The FORWARD circuit inside the transmission controller is opened, so no electric current flows to the kick-down circuit. In this way, the self-hold circuit of the kick-down is canceled and solenoid (4) is no longer actuated.

(When the directional lever is moved to **N** position, the actuation is the same as above and the kick-down circuit is canceled.) In addition, the FORWARD circuit is also opened, so solenoid (1) is no longer actuated.

- When the directional lever is moved the **R** position, the REVERSE circuit is formed from the battery (+) → speed lever terminal 1 – 4 → transmission controller REVERSE terminal 12 → inside of controller. Current flows from the output signal terminal (20) → REVERSE solenoid 2 → ground, and the REVERSE solenoid valve is actuated. Therefore, only REVERSE solenoid (2) is actuated, and the transmission is set to **R2**.

Solenoid actuation table

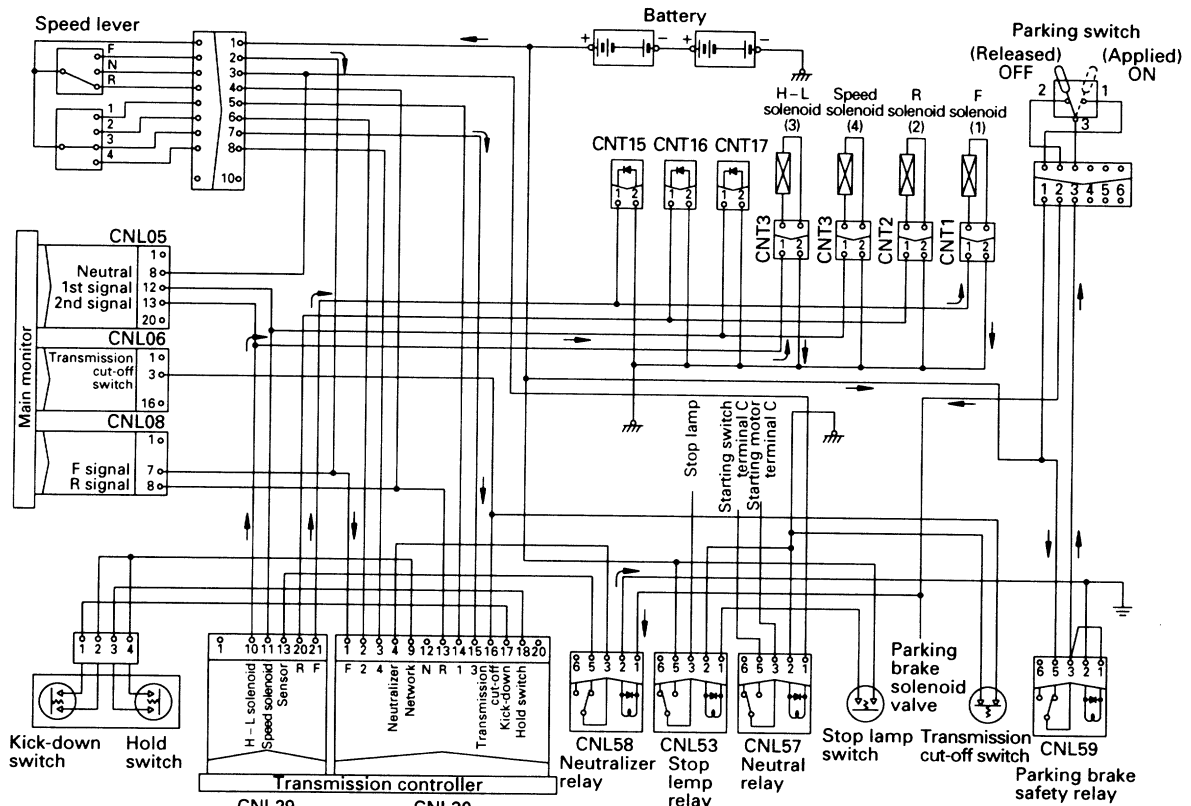
Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	○	○	○	○				
REVERSE	(2)					○	●	○	○
H-L select	(3)			○	○			○	○
Speed select	(4)	○			○	○			○

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STRUCTURE AND FUNCTION

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM

Canceling actuation of kick-down switch (Case II) (speed lever moved to position other than 2)



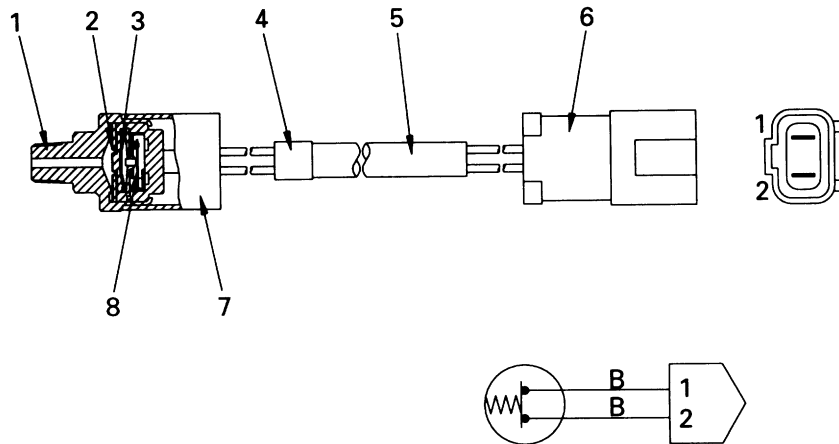
SDW00312

- If the speed lever is operated to any position other than 2, terminal contact 2 of the lever is switched OFF, so the current stops flowing from the battery (+) → speed lever switch terminal 1 – 6 → transmission controller.
- Therefore, the kick-down circuit connected to the 2nd circuit is also shut off inside the transmission controller, and solenoid (4) is no longer actuated.
- When the speed lever is moved to position 3, solenoid (3) is actuated. In addition, the directional lever is at the F position, so solenoid (1) is actuated. Therefore, solenoids (1) and (3) are actuated and the transmission is set to F3.

Solenoid actuation table

Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	○	○	●	○				
REVERSE	(2)					○	○	○	○
H-L select	(3)			●	○			○	○
Speed select	(4)	○			○	○			○

TRANSMISSION CUT-OFF SWITCH



SDW00313

1. Case
2. Seal film
3. Disc
4. Vinyl tape
 - Green: Without auto-shift transmission
 - Red: With auto-shift transmission

5. Tube
6. Connector
7. Cover
8. Spring

Outline

- When the left brake pedal is operated, the switch detects the oil pressure in the brake circuit, shuts off the electric power to the solenoid valve circuit for the directional clutch, and shifts the transmission to neutral.

Specifications

		Without auto-shift transmission	With auto-shift transmission
Voltage value	Min.	18 V	18 V
	Max.	32 V	30 V
Current value	Min.	10 mA	5 mA
	Max.	2.3 A	0.1 A

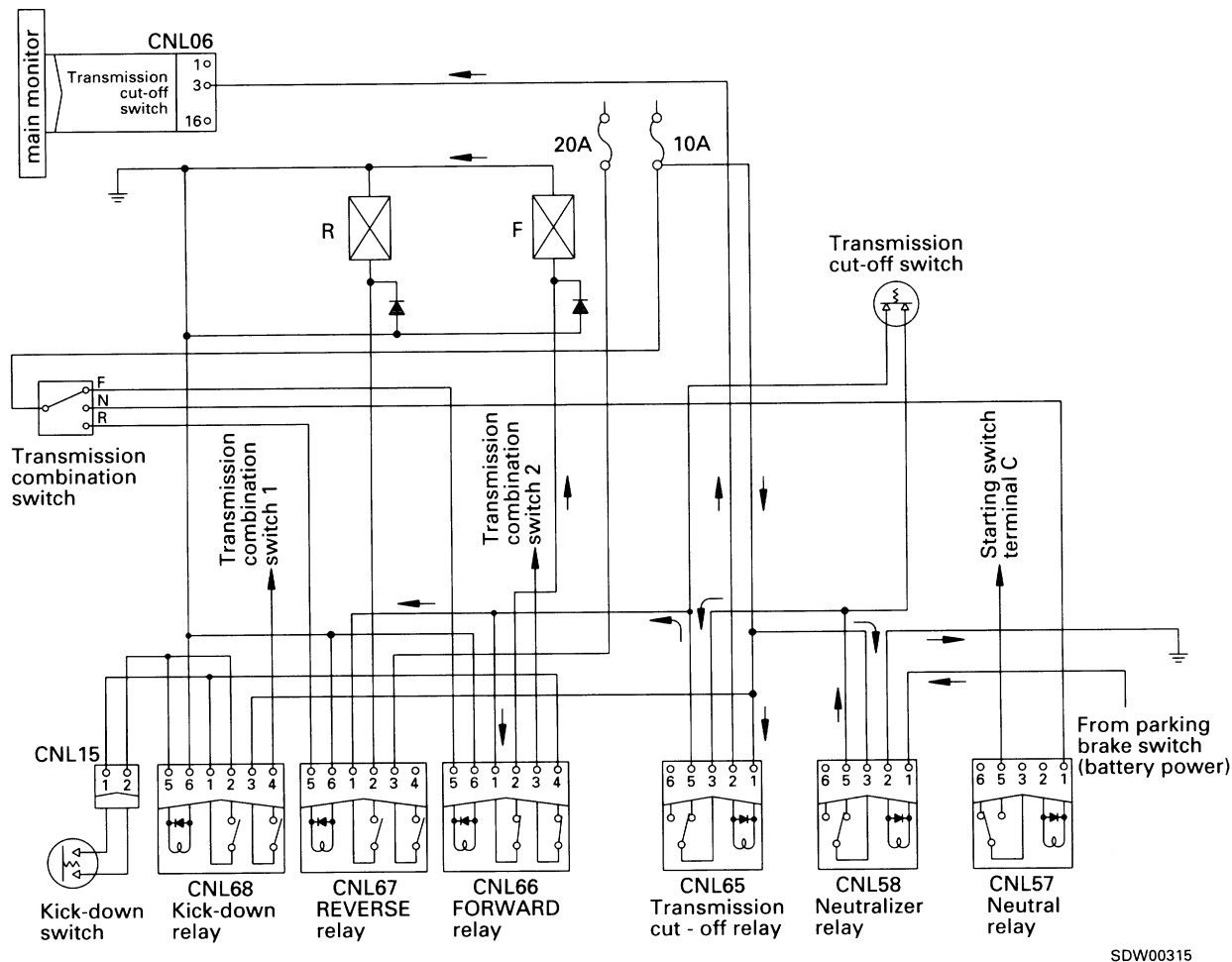
(Without auto-shift transmission)



- If the transmission cut-off selector switch on the main monitor is turned ON (pilot lamp lights up), the transmission cut-off switch installed to the left brake pedal is actuated. When the left brake pedal is operated, the brakes are applied, and the transmission is shifted to neutral at the same time. If the transmission cut-off selector switch is set to the OFF position (pilot lamp goes out), the transmission is not shifted to neutral even when the brake is operated, so the left brake functions only as a brake in the same way as the right brake.

1. Transmission cut-off selector switch ON

- If the transmission cut-off selector switch is turned ON, the transmission cut-off relay solenoid is not excited, so transmission cut-off relay terminals 3 – 5 are not connected. In this condition, +24V voltage is applied through only the transmission cut-off switch to transmission control valve solenoids **R** and **F**.
- When the left brake pedal is depressed, the contacts of the transmission cut-off switch are opened, so the voltage to solenoids **R** and **F** is shut off. As a result, the brakes are applied as normal, and the transmission is also shifted to neutral at the same time.



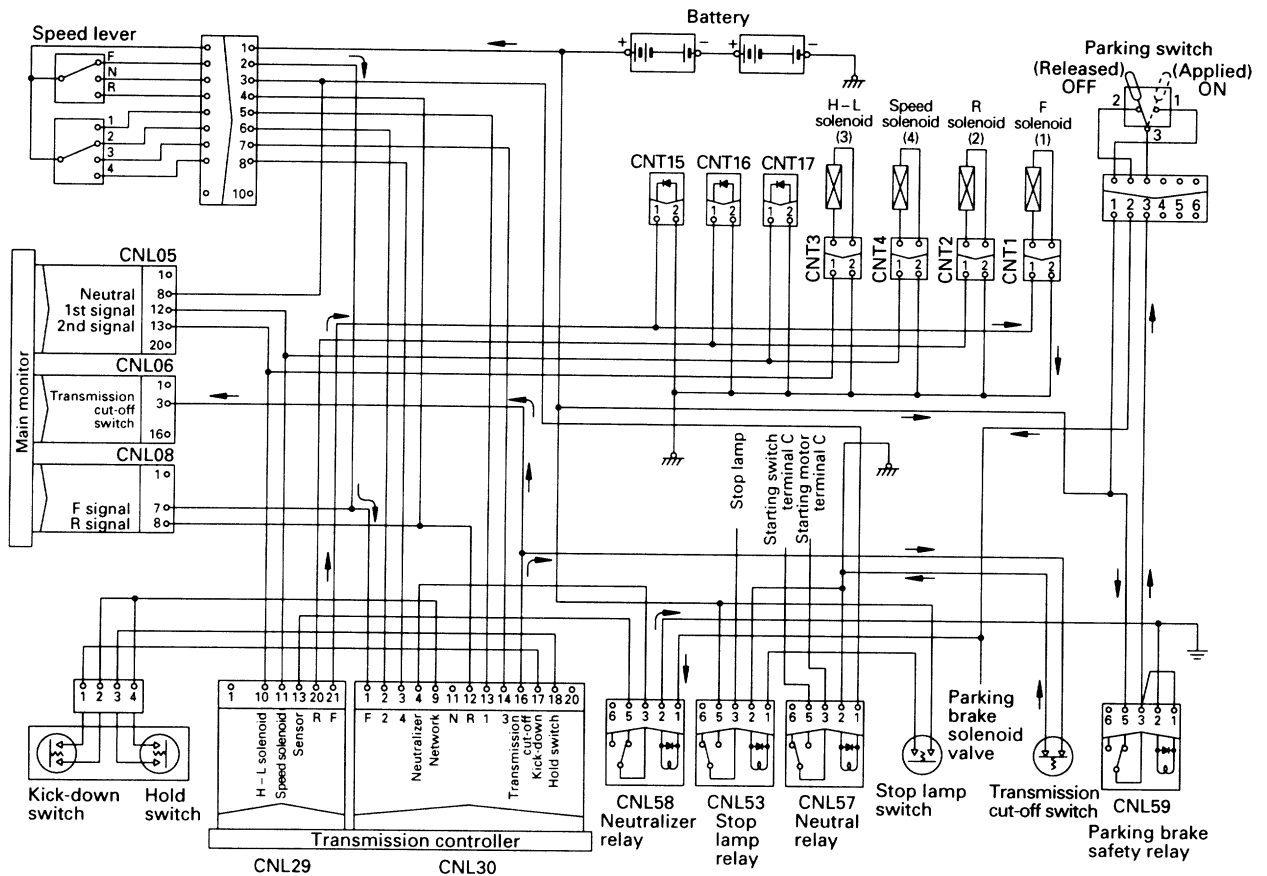
2. Transmission cut-off selector switch OFF

If the transmission cut-off selector switch is turned OFF, the transmission cut-off relay solenoid is excited, and transmission cut-off relay terminals 3 – 5 are connected. In this condition, +24V voltage is applied to transmission solenoids **R** and **F** regardless of the position of the transmission cut-off switch. As a result, even when the left brake pedal is depressed, the transmission is not shifted to neutral.

STRUCTURE AND FUNCTION

TRANSMISSION CUT-OFF FUNCTION

(With auto-shift transmission)



SDW00316

Outline

- If the transmission cut-off selector switch on the main monitor is turned ON (pilot lamp lights up), the transmission cut-off switch installed to the left brake pedal is actuated. When the left brake pedal is operated, the brakes are applied, and the transmission is shifted to neutral at the same time. If the transmission cut-off selector switch is set to the OFF position (pilot lamp goes out), the transmission is not shifted to neutral even when the brake is operated, so the left brake functions only as a brake in the same way as the right brake.

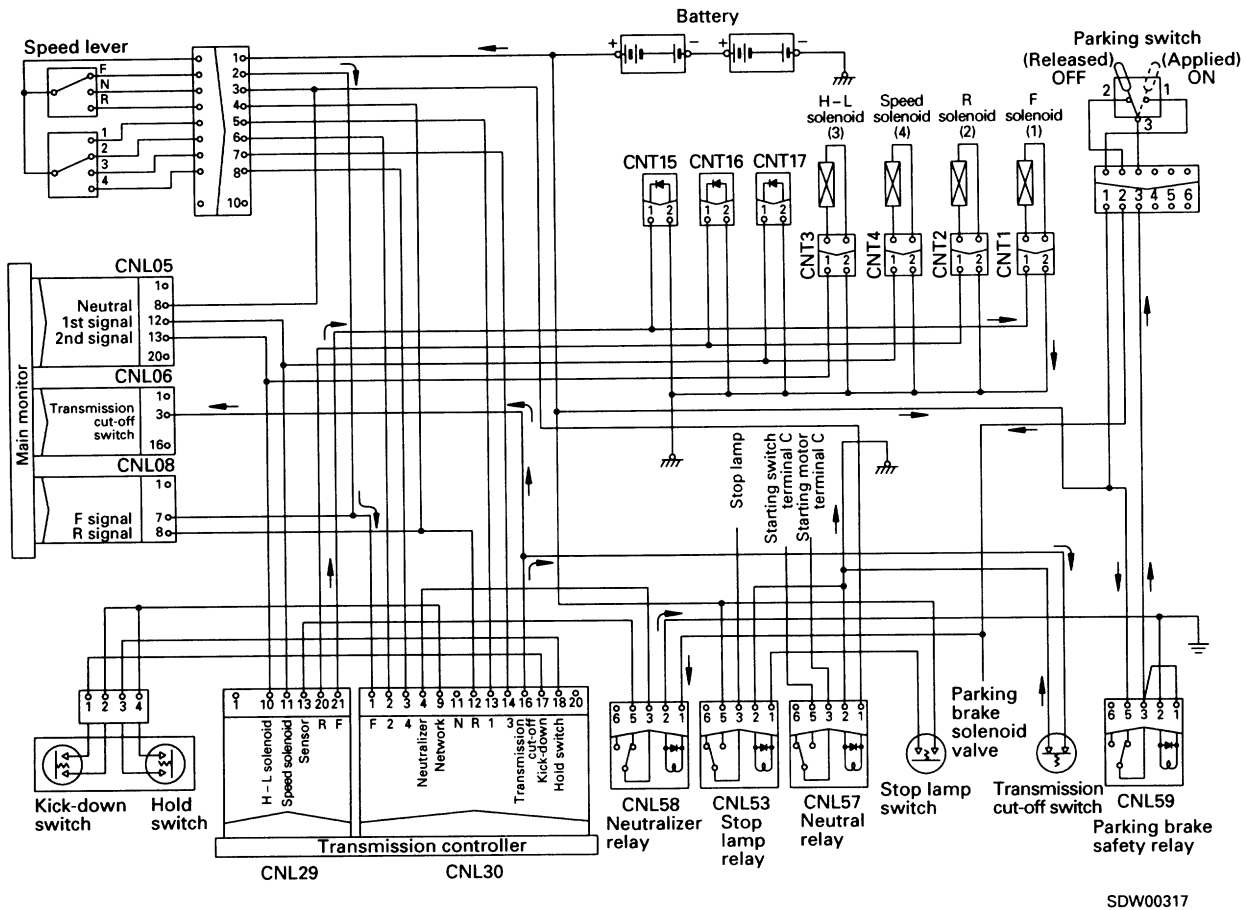
Operation

1. Transmission cut-off selector switch ON

- If the transmission cut-off selector switch is turned ON, the current from the transmission cut-off switch (main monitor) is shut off, and current flows only from the transmission cut-off switch to terminal 16 of the transmission cut-off circuit in the transmission controller. Voltage is applied to transmission control valve solenoids F and R.
- When the left brake pedal is depressed, the contacts of the transmission cut-off switch are opened, so the voltage to solenoids R and F is shut off. As a result, the brakes are applied as normal, and the transmission is also shifted to neutral at the same time.

STRUCTURE AND FUNCTION

TRANSMISSION CUT-OFF FUNCTION



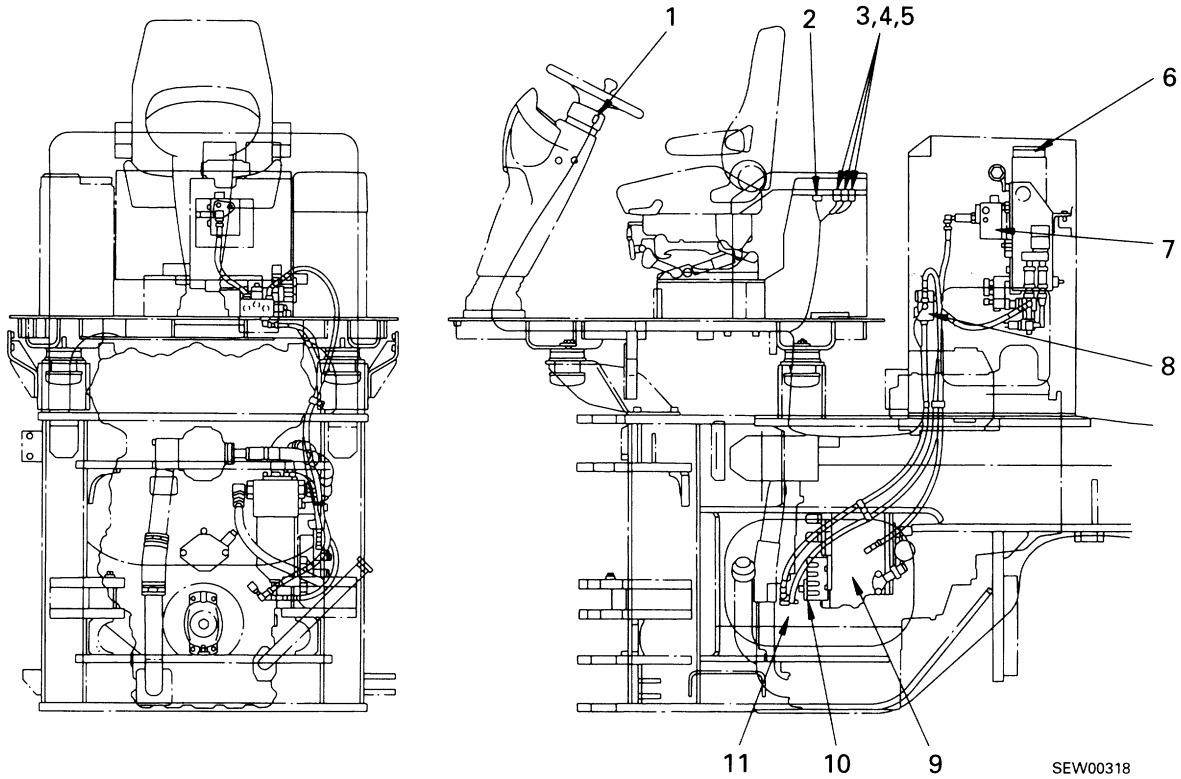
SDW00317

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2. Transmission cut-off selector switch OFF

- If the transmission cut-off selector switch is turned OFF, the current flows from the transmission cut-off switch (main monitor) to terminal 16 of the transmission cut-off circuit in the transmission controller. In this condition, voltage is applied to transmission solenoids F and R regardless of the position of the transmission cut-off switch. As a result, even when the left brake pedal is depressed, the transmission is not shifted to neutral.

ELECTRIC PARKING BRAKE CONTROL



SEW00318

Outline

- The parking brake is a wet-type multiple-disc brake built into the transmission. When an electric current flows to the parking brake valve (solenoid valve), the oil pressure from the transmission pump is applied to the parking brake cylinder and the parking brake is released.
- When the electric current is cut, the oil pressure from the transmission pump is shut off, and the oil pressure inside the parking brake cylinder passes through the parking brake valve and is drained. The parking brake is then applied by the force of the brake spring.

1. Parking brake switch
2. Parking brake emergency release switch
3. Parking brake safety switch
4. Neutralizer relay
5. Parking brake emergency release relay
6. Accumulator
7. Charge valve
8. Parking brake emergency release valve
9. Transmission control valve
10. Parking brake solenoid valve
11. Parking brake

Function

1. Applying and releasing parking brake

The parking brake is applied or released by using the parking brake switch (combination switch).

2. Automatic parking brake

When the engine stops (when the starting switch is OFF), the parking brake is automatically applied to prevent the machine from running away when the operator is away from his seat.

3. Emergency brake

If the pressure in the oil pump should drop because of damage to the hydraulic circuit and the braking force can not be ensured, the parking brake is applied automatically to act as an emergency brake.

4. Parking brake safety

It is dangerous if the parking brake can be released simply by turning the starting switch ON after the automatic parking brake has been applied. Therefore, to ensure safety, the system is designed so the brake cannot be released unless the starting switch is turned ON and then the parking brake switch is also turned ON.

5. Neutralizer

The parking brake may seize if the machine is driven with the parking brake still applied. To prevent this problem, the caution lamp lights up and the alarm buzzer sounds to warn the operator of the mistaken operation. In addition to this, when the parking brake is applied, the transmission is forcibly shifted to neutral to make it impossible to drive the machine. However, the braking distance will become longer if the transmission is shifted to neutral when the emergency brake is applied. It may also be necessary to move the machine if it stops in places where it is prohibited to stop (such as on railway crossings). To overcome this, the circuit is designed so that the transmission is not shifted to neutral when the emergency brake is applied.

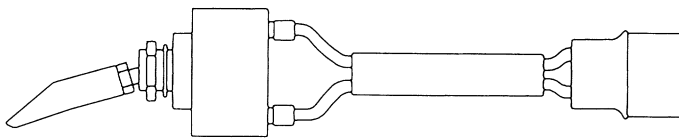
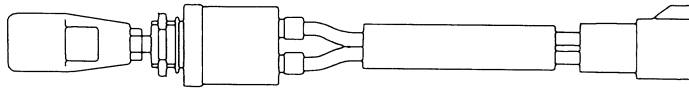
6. Parking brake emergency release solenoid valve

If the supply of pressure oil from the transmission pump should stop because of some failure, it is possible to actuate the emergency relief solenoid valve with the parking brake emergency release switch in the operator's compartment. This sends the accumulator charge pressure in the brake piping to the parking brake cylinder to release the parking brake.

STRUCTURE AND FUNCTION

ELECTRIC PARKING BRAKE CONTROL

PARKING BRAKE EMERGENCY RELEASE SWITCH



Connection table

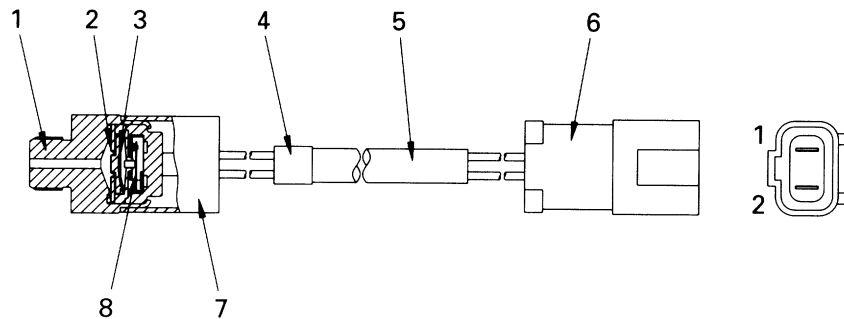
Terminal No.	1	2	3	4
Lever position				
OFF				
ON	●	●	●	●



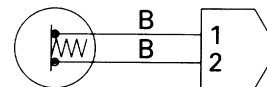
SEW00319

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EMERGENCY BRAKE SWITCH

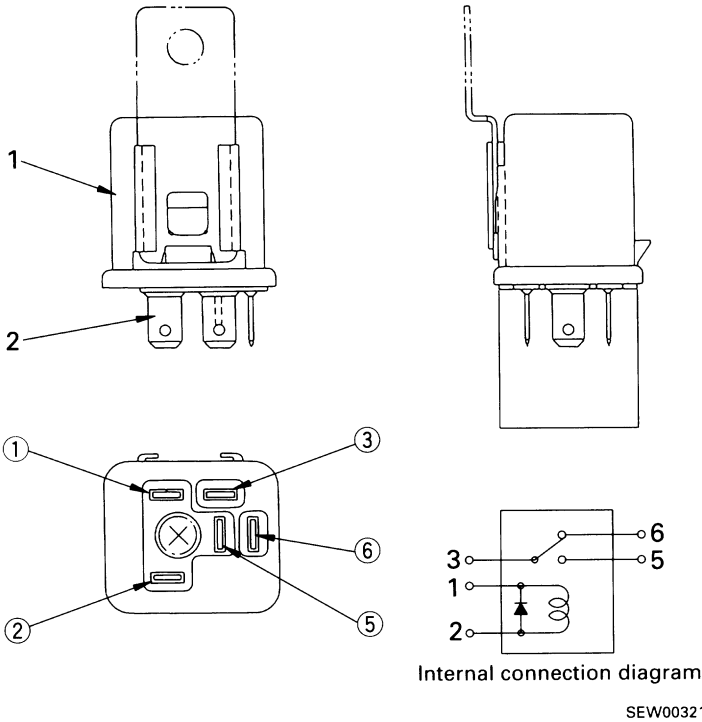


1. Case
2. Seal film
3. Disc
4. Vinyl tape
5. Tube
6. Connector
7. Cover
8. Spring



SDW00320

PARKING SAFETY RELAY
NEUTRALIZER RELAY



Relay actuation table

Terminal No.	3	5	6
Current between 1 and 2			
ON	○	○	
OFF	○		○

- 1. Case
- 2. Base

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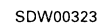
1. Starting switch OFF



- When the starting switch is turned OFF, the battery relay is opened, so electricity does not flow to the parking brake circuit. For this reason, if the starting switch is at the OFF position, no electric current flows to the parking brake solenoid valve, regardless of whether the parking brake switch is ON (applied) or OFF (released), so the parking brake is actuated. (Automatic parking brake)

J42103

2-1 When parking brake switch is ON (actuated) before starting switch is turned ON

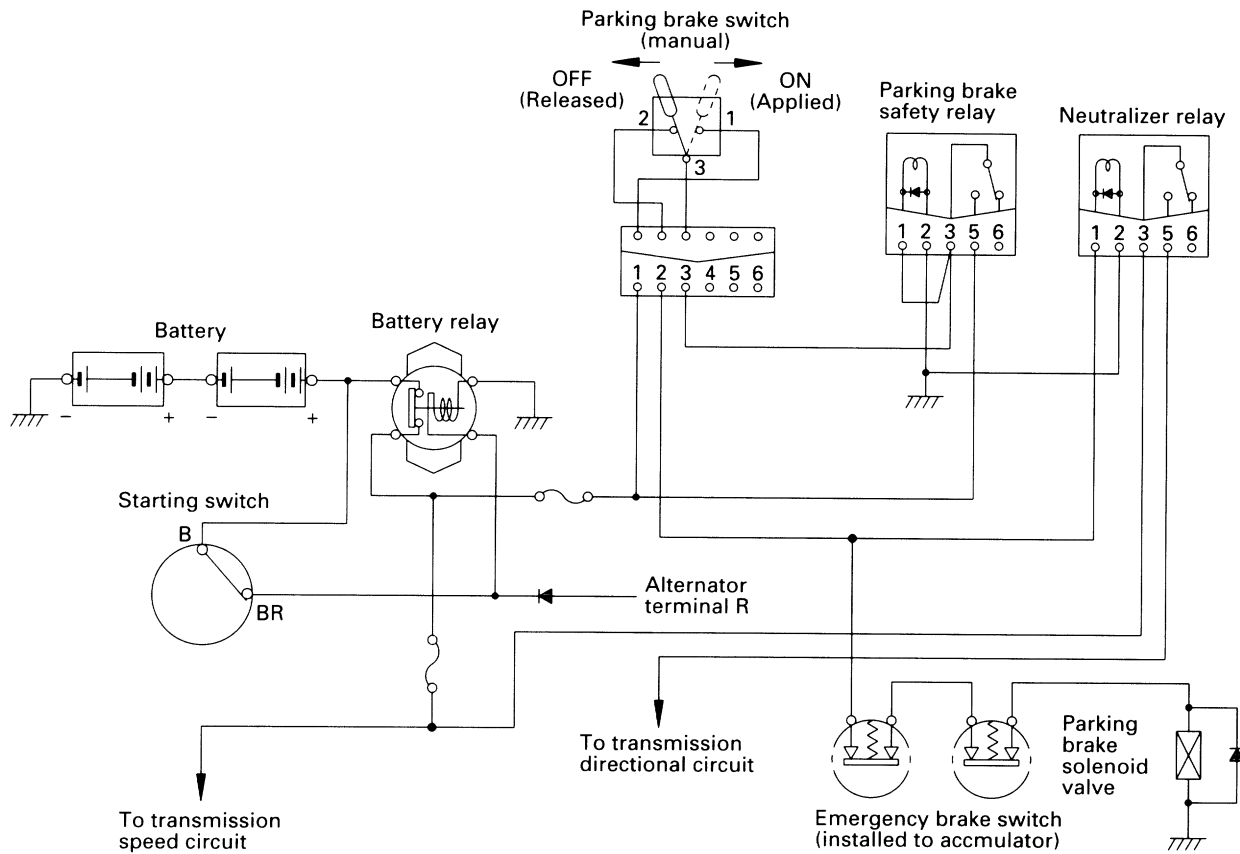


- The electric current flows in circuit ① from the battery $\oplus$ $\rightarrow$ starting switch $\rightarrow$ battery relay coil $\rightarrow$ ground, so the battery relay is closed. When this happens, electric current flows in circuit ② from the battery $\oplus$ $\rightarrow$ battery relay $\rightarrow$ parking brake switch terminal 1 – 3 $\rightarrow$ parking brake safety relay terminal 1 – 2 $\rightarrow$ ground. In this way, the parking safety relay is actuated and safety relay terminals 3 – 5 are closed.
- When this happens, circuit ③ is formed from the battery $\oplus$ $\rightarrow$ battery relay $\rightarrow$ parking safety relay terminal 5 – 3 $\rightarrow$ parking safety relay terminal 1 – 2 $\rightarrow$ ground. From this point, the parking safety relay is in the condition of circuit ③ until the starting switch is turned OFF.
- In this condition, electric current does not flow to the parking brake solenoid valve, so the parking brake is actuated.
- In addition, in this condition, neutralizer relay terminals 3 and 5 are open, so electric current does not flow to the transmission directional circuit, and the transmission is shifted to neutral.

STRUCTURE AND FUNCTION

ELECTRIC PARKING BRAKE CONTROL

2-2 When parking brake switch is OFF (actuated) before starting switch is turned ON

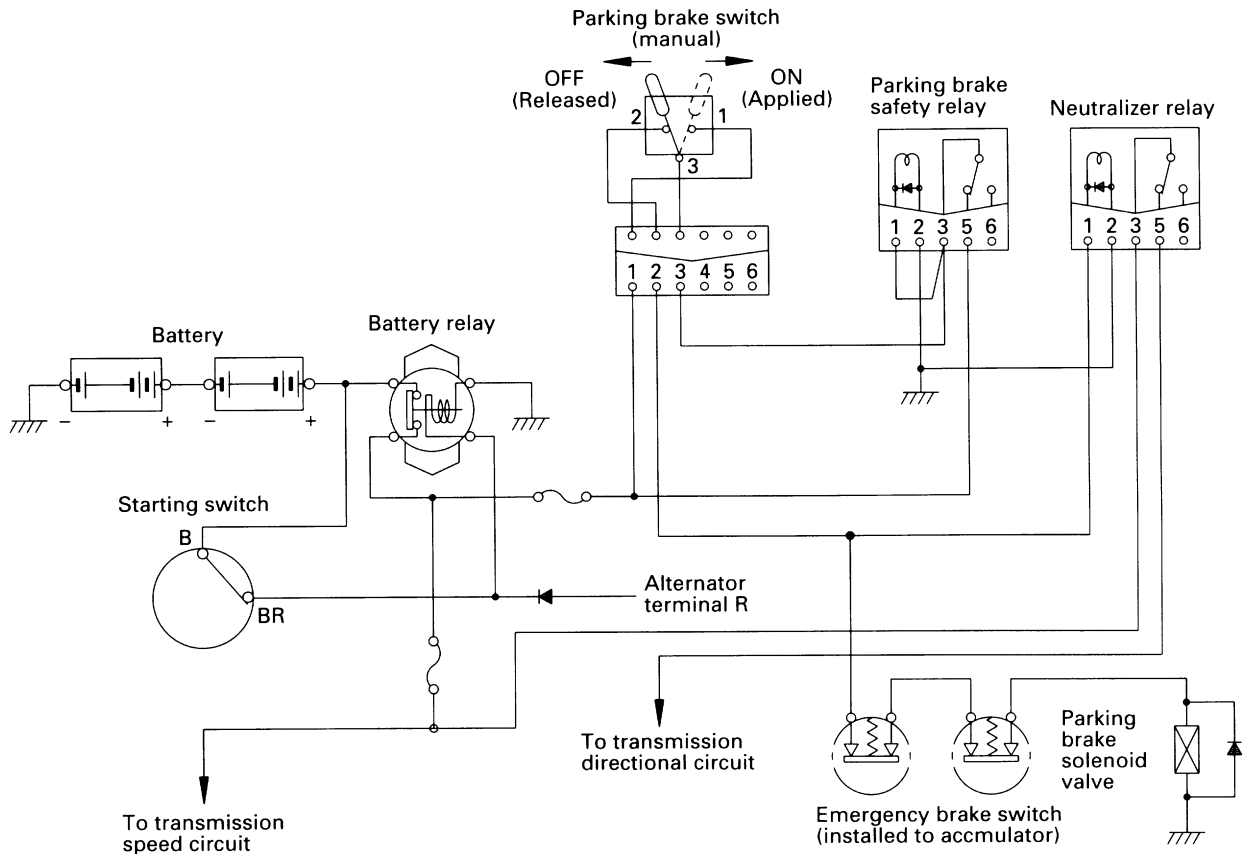


SDW00324

- Electric current flows in circuit ① from the battery ⊕ → starting switch → battery relay coil → ground, so the battery relay is closed. However, in this case, the parking brake switch is OFF (released), so the parking safety relay is not actuated. For this reason, the electric current does not flow to the parking brake solenoid valve, so after the automatic parking brake is applied, the parking brake is not released automatically even when the starting switch is turned ON.
- In addition, the electric current does not flow to the transmission directional circuit, so the machine does not move.

3. Parking brake switch OFF (released)

When the parking brake switch is turned from ON to OFF after the starting switch is turned ON



SDW00325

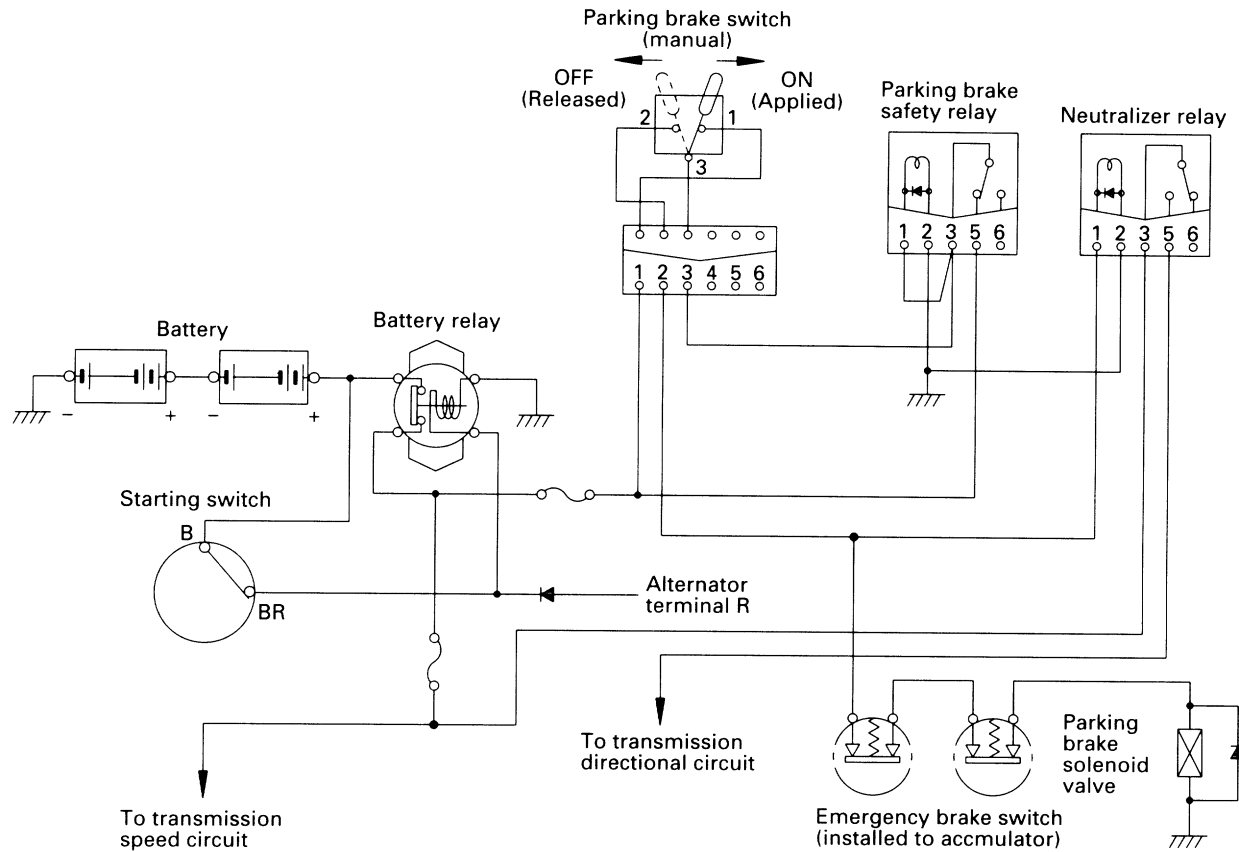
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- If the parking brake switch is turned from ON (actuated) to OFF (released), the circuit for terminals 2 and 3 of the parking brake switch is connected, and the parking brake safety relay is also actuated. For this reason, electric current flows in circuit ① from the battery $\oplus$ $\rightarrow$ battery relay $\rightarrow$ parking brake safety relay $\rightarrow$ parking brake switch, and then flows to circuits ② and ③ given below.

② This circuit is formed from the emergency brake switch $\rightarrow$ parking brake solenoid valve $\rightarrow$ ground, and the parking brake is released.

③ This circuit is formed from the battery $\oplus$ $\rightarrow$ battery relay $\rightarrow$ neutralizer relay terminal 3 - 5 $\rightarrow$ transmission directional circuit, so when the directional lever is operated, the machine will move.

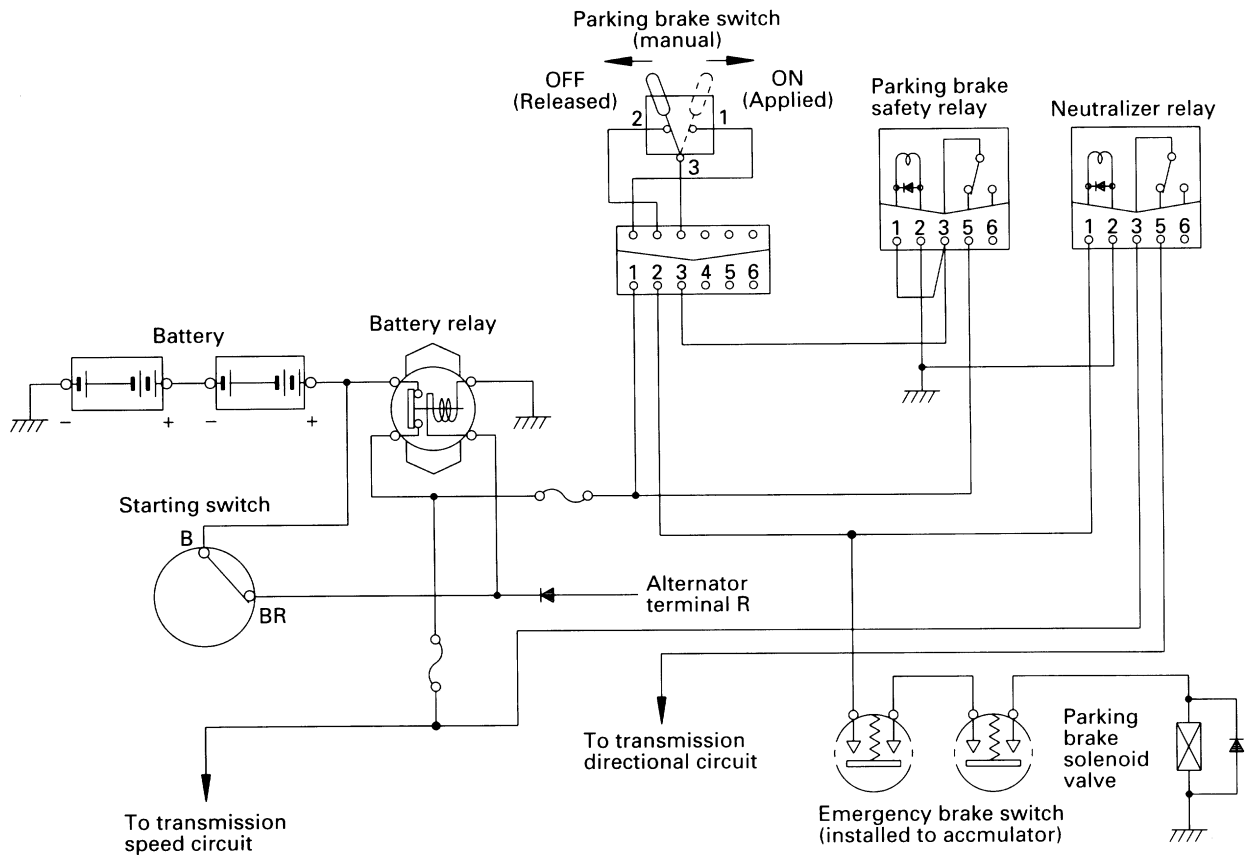
4. Parking brake switch ON (actuated)



SDW00326

- If the parking brake switch is turned ON (applied) after carrying out operations with the parking brake switch OFF (released), the circuit in the diagram above is formed.
- Electric current does not flow to the parking brake solenoid valve, so the oil pressure from the transmission pump to the parking brake cylinder is shut off. At the same time, the oil pressure inside the parking brake cylinder passes through the parking brake valve and is drained, so the parking brake is applied by the force of the spring.
- In addition, at the same time, the neutralizer relay is reset, so the circuit between terminals 3 and 5 is opened, and no electricity flows to the transmission directional circuit, so the transmission is shifted to neutral. This kind of neutralizer relay shuts off the electric current going to the transmission solenoid valve when the parking brake is applied and shifts the transmission to neutral to prevent seizure of the parking brake if the operator should drive the machine with the parking brake still applied.

5. When main brake oil pressure drops (emergency brake actuated)



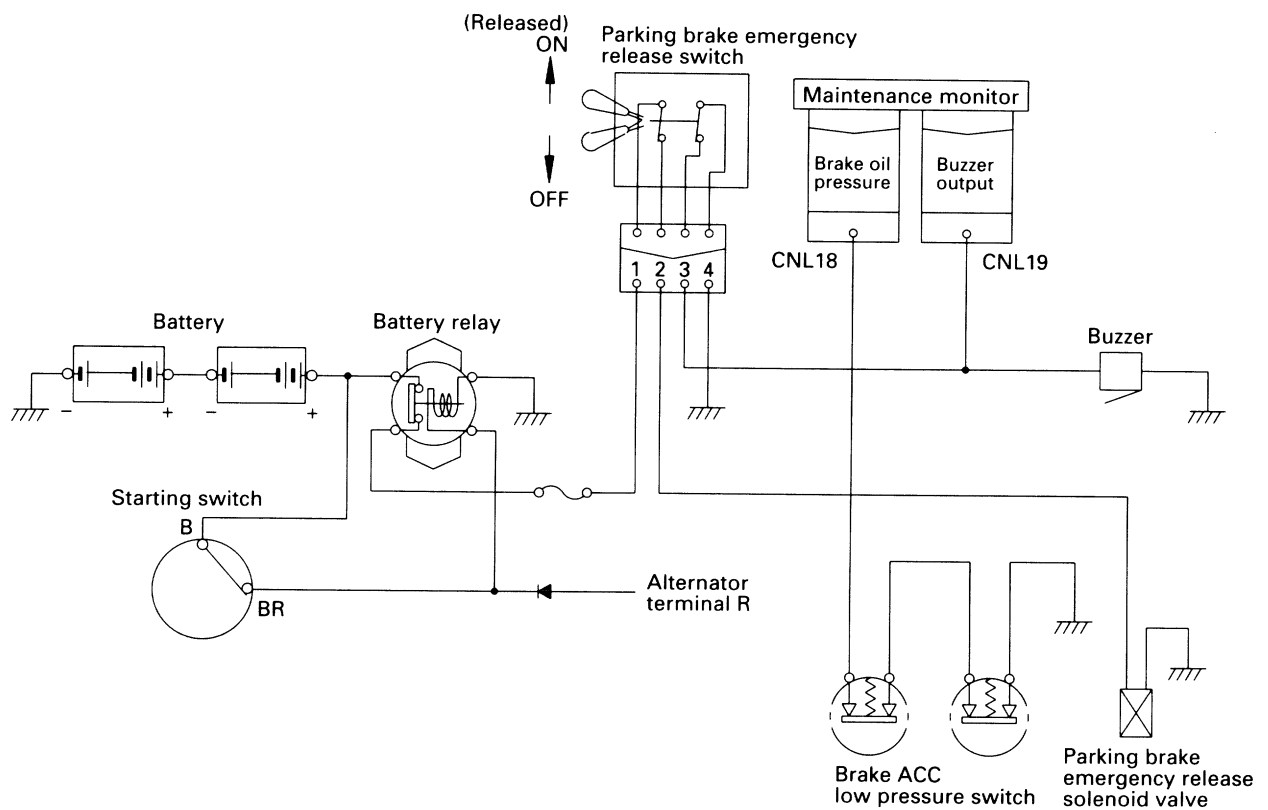
SDW00327

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Operation

- If the oil pressure in the main brake line drops, the emergency brake switch installed to the accumulator is opened. For this reason, the electric current stops flowing to the parking brake solenoid valve, so the oil pressure inside the parking brake cylinder is drained and the parking brake is applied. However, in this case, the condition is different from the case where the parking brake switch is ON (applied), because there is electric current flowing to the neutralizer relay coil.
- For this reason, electric current flows to the transmission directional circuit, and it is possible to engage the transmission clutch. In this way, it is possible to use the engine brake when the emergency brake is applied, so the braking distance becomes shorter. At the same time, if the emergency brake has been applied and it is necessary to move the machine (for example, if the emergency brake is applied when the machine is on a railway crossing), it is possible to move the machine by operating the transmission lever.

6. Parking brake emergency release



SDW00328

Operation

- If the machine should stop because of engine trouble, the oil pressure from the transmission pump to the parking brake cylinder is shut off and the parking brake is applied. When this happens, the oil pressure in the main brake line is stored in the accumulator. When the emergency release switch is turned on (released), the buzzer sounds, and at the same time, electric current flows to the emergency parking brake release solenoid valve.

The oil pressure stored in the accumulator in the main brake line then flows to the parking brake cylinder to release the parking brake.

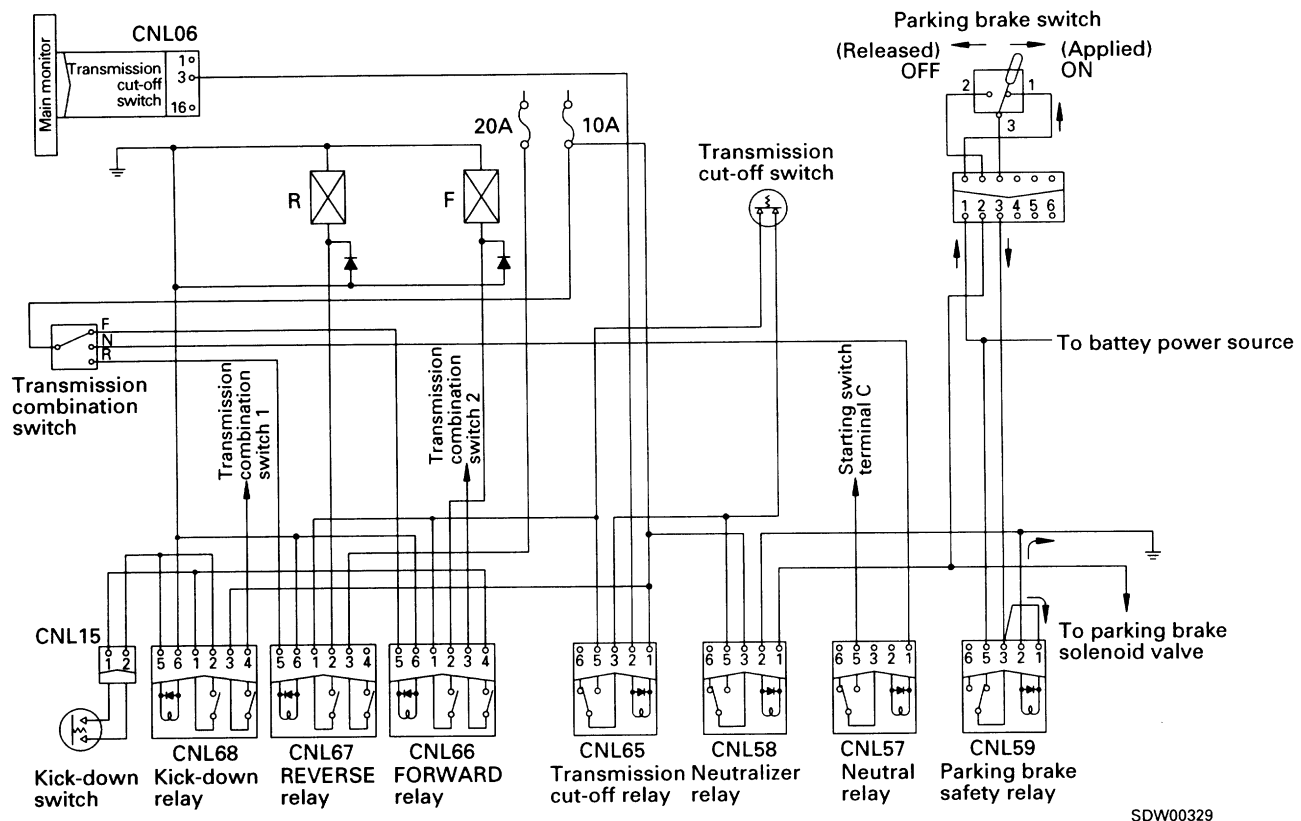
- The emergency release switch should normally be kept at the OFF position and should be returned to the OFF position after the emergency release.

FUNCTION OF PARKING BRAKE NEUTRALIZER RELAY

Outline

- When the parking brake is applied, this relay keeps the transmission at neutral to prevent dragging of the parking brake due to mistaken operation.

(Without auto-shift transmission)



SDW00329

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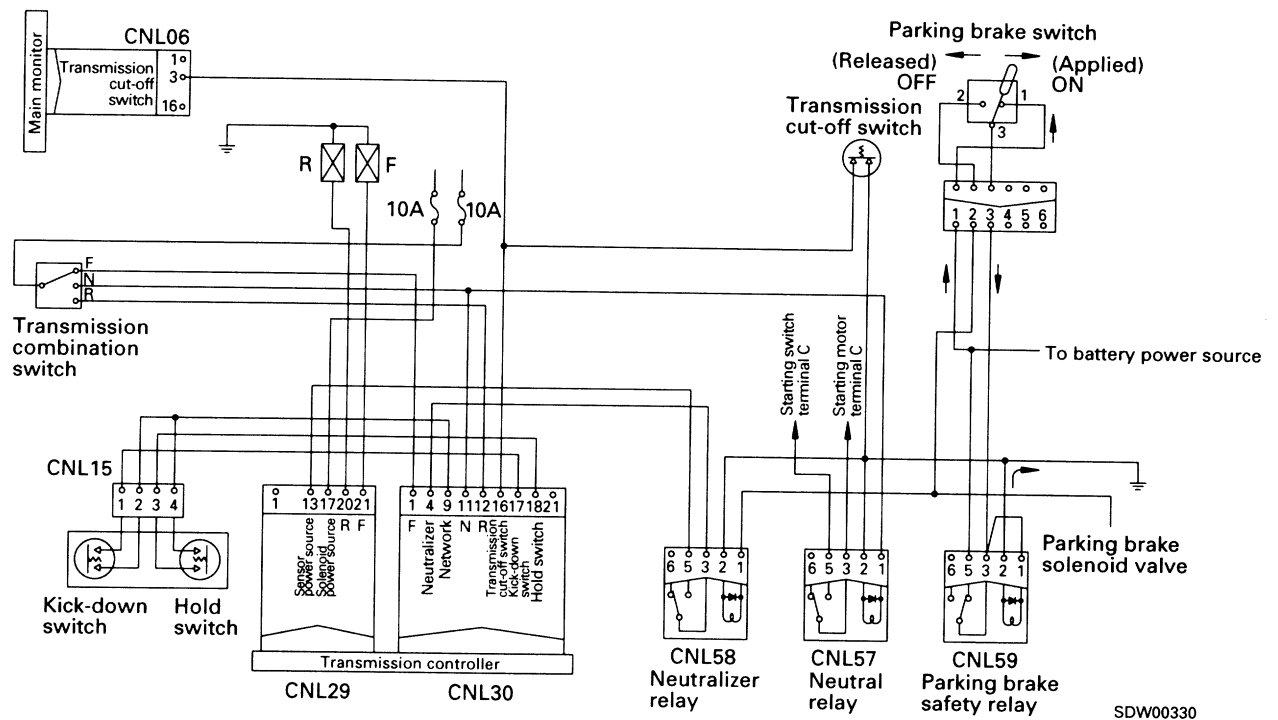
Operation

- When the parking brake is actuated (ON), electric current flows from the battery relay → parking brake switch terminal 1 – 3 → parking brake safety relay terminal 1 → ground. For this reason, the safety relay coil is actuated, terminals 3 and 5 of the safety relay are connected, and this circuit is formed.
- When the parking brake is actuated, no electric current flows to the neutralizer relay coil, so terminal 3 and terminal 5 of the neutralizer relay are separated. No electric current flows to the transmission directional circuit, so when the parking brake is applied, the transmission is kept at neutral.
- When the engine is started with the parking brake switch OFF (released), the circuit in Item 1 is not formed, so it is necessary to turn the parking brake switch ON to form the circuit.

STRUCTURE AND FUNCTION

ELECTRIC PARKING BRAKE CONTROL

(With auto-shift transmission)

**Operation**

1. When the parking brake is actuated (ON), electric current flows from the battery relay → parking brake switch terminal 1 – 3 → parking brake safety relay terminal 1 → ground. For this reason, the safety relay coil is actuated, terminals 3 and 5 of the safety relay are connected, and this circuit is formed.
2. When the parking brake is actuated, no electric current flows to the neutralizer relay coil, so terminal 3 and terminal 5 of the neutralizer relay are separated. No electric current flows to the transmission directional circuit, so when the parking brake is applied, the transmission is kept at neutral.
3. When the engine is started with the parking brake switch OFF (released), the circuit in Item 1 is not formed, so it is necessary to turn the parking brake switch ON to form the circuit.

20 TESTING AND ADJUSTING

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fi When using the standard value table to make judgement for testing and adjusting, and troubleshooting, the following precautions are necessary.

1. The standard values in the table are the values for a new machine and are given as reference values for the time when the machine is shipped from the factory. These values should be used as a guide when estimating wear and tear after the machine is operated, and when carrying out repairs.
2. The permissible values given in the table are values estimated based on the results of various tests carried out on the machines shipped from the factory, so they should be used together with the information on the repair condition and other information such as the operating history of the machine when judging the condition of the machine.
3. These standard values do not form a basis for judging claims.

⚠ When carrying out testing, adjusting, or troubleshooting, park the machine on level ground and use the safety pins and blocks to prevent the machine from moving.

⚠ When carrying out work together with other workers, always use signals and do not let unauthorized people near the machine.

⚠ When checking the water level, always wait for the water to cool down. If the radiator cap is removed when the water is still hot, the water will spurt out and cause burns.

⚠ Be careful not to get caught in the fan, fan belt, or other rotating parts.

STANDARD VALUE TABLE FOR ENGINE

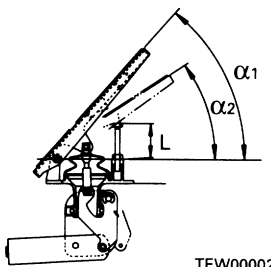
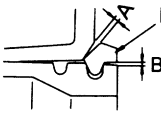
Machine model			WA470-3	
Engine			S6D125-1	
Item	Measurement conditions	Unit	Standard value	Permissible value
Engine speed	High idling	rpm	2,400 ± 50	2,400 ± 100
	Low idling		725 ± 25	725 ± 50
	Rated speed		2,200	—
Exhaust gas color	At sudden acceleration	Bosch index	Max. 6.0	8.0
	At high idling		Max. 1.0	2.0
Valve clearance (cold)	Intake valve	mm	0.33	—
	Exhaust valve		0.71	—
Compression pressure (SAE30 oil)	Oil temperature: 40 – 60°C (engine speed: 200 – 250 rpm)	MPa (kg/cm ²)	Min. 3.1 (Min. 32)	2.2 (22)
Blowby pressure (SAE30 oil)	(Water temperature: Operating range) At rated output	mmH ₂ O	Max. 80	160
Oil pressure	(Water temperature: Operating range)	MPa (kg/cm ²)		
	At high idling (SAE30)		0.3 – 0.5 (3.0 – 5.0)	0.21 (2.1)
	At low idling (SAE30)		Min. 0.14 (Min. 1.5)	0.07 (0.7)
	At high idling (SAE10W)		0.25 – 0.44 (2.5 – 4.5)	0.18 (1.8)
	At low idling (SAE10W)		Min. 0.1 (Min. 1.0)	0.07 (0.7)
Oil temperature	Whole speed range (inside oil pan)	°C	80 – 110	120
Fuel injection timing	Before top dead center	° (degree)	24 ± 1	24 ± 1
Belt tension	Deflection when pressed with finger force of approx. 58.8 N (6 kg.)	mm	10	7 – 13

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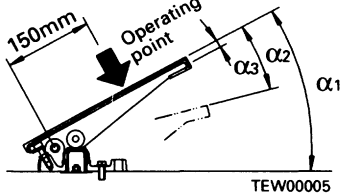
STANDARD VALUE TABLE FOR CHASSIS

STANDARD VALUE TABLE FOR CHASSIS

Category	Item		Measurement conditions	Unit	Standard value	Permissible value
Accelerator pedal	Operating force		 TEW00002	N (kg)	68.6 – 73.6 (7 – 7.5)	Max. 112.8 (Max. 11.5)
	Operating angle	α1		deg.	48	—
		α2			30	—
	Stopper height			L	mm	49.5 ± 5
Directional lever	Operating force	N – FORWARD	Engine stopped Torque converter oil temperature: 60 – 80°C	N (kg)	5.9^{+5}_{-3} (0.6 $^{+0.5}_{-0.3}$)	Max. 16.7 (Max.1.7)
		N – REVERSE			5.9^{+5}_{-3} (0.6 $^{+0.5}_{-0.3}$)	Max. 16.7 (Max.1.7)
	Travel	N – FORWARD		mm	35 ± 10	35 ± 20
		N – REVERSE			35 ± 10	35 ± 20
Speed lever	Operating force	1st – 2nd		N (kg)	5.9^{+5}_{-3} (0.6 $^{+0.5}_{-0.3}$)	Max. 16.7 (Max.1.7)
		2nd – 3rd			5.9^{+5}_{-3} (0.6 $^{+0.5}_{-0.3}$)	Max. 16.7 (Max.1.7)
		3rd – 4th			Max. 10.8 (Max. 1.1)	Max. 16.7 (Max.1.7)
	Travel	1st – 2nd		mm	35 ± 10	35 ± 20
		2nd – 3rd			35 ± 10	35 ± 20
		3rd – 4th			35 ± 10	35 ± 20
Engine	Torque converter stall		rpm	2,250 ± 100	2,250 ± 200	
	Hydraulic stall			2,260 ± 100	2,260 ± 200	
	Full stall			1,970 ± 200	1,970 ± 300	
Transmission valve	Priority pressure	Rated speed	Torque converter oil temperature: 60 – 80°C	MPa (kg/cm ²)	2.8 ± 0.15 (29 ± 1.5)	$2.8^{+0.15}_{-0.44}$ (29 $^{+1.5}_{-4.5}$)
		Low idling			2.5 ± 0.15 (25 ± 1.5)	$2.5^{+0.15}_{-0.39}$ (25 $^{+1.5}_{-4.0}$)
	Torque converter outlet port pressure	Rated speed			0.44 ± 0.05 (4.5 ± 0.5)	$0.44^{+0.05}_{-0.1}$ (4.5 $^{+0.5}_{-1.0}$)
		Low idling			0.34 ± 0.05 (3.5 ± 0.5)	$0.34^{+0.05}_{-0.09}$ (3.5 $^{+0.5}_{-0.9}$)
	Pilot pressure				1.0 ± 0.1 (10.0 ± 1.0)	$1.0^{+0.1}_{-0.2}$ (10.0 $^{+1.0}_{-2.0}$)
	Clutch pressure				2.3 ± 0.2 (23 ± 2.0)	$2.3^{+0.2}_{-0.39}$ (23 $^{+2.0}_{-4.5}$)
	Parking brake pressure	Rated speed			2.8 ± 0.15 (29 ± 1.5)	$2.8^{+0.15}_{-0.44}$ (29 $^{+1.5}_{-4.5}$)
		Low idling			2.5 ± 0.15 (25 ± 1.5)	$2.5^{+0.15}_{-0.39}$ (25 $^{+1.5}_{-4.0}$)
Tire	Fitting of wheel lock ring	A	 Lock ring  TEW00003 TEW00004	mm	Max. 2.5	—
		B			Max. 4.0	—
	Clearance of wheel lock ring	C			2 – 10	—

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TESTING AND ADJUSTING
STANDARD VALUE TABLE FOR CHASSIS

Category	Item		Measurement conditions	Unit	Standard value	Permissible value
Steering wheel	Play		Engine stopped, machine facing straight to front	mm	Max. 20	Max. 50
	Operating force		Flat, horizontal, straight, dry paved road surface	N (kg)	11.8 – 19.6 (1.2 – 2.0)	Max. 34.3 (Max. 3.5)
	Operating time	Low idling	Hydraulic oil temperature: 45 – 55°C	Sec.	Max. 3.7	Max. 5.6
		High idling			Max. 2.5	Max. 3.8
Frame	Clearance between front frame and rear frame		Hydraulic oil temperature: 45 – 55°C Engine speed: 1200 rpm	mm	40 ± 5	—
Steering valve	Relief pressure		Engine speed: High idling Hydraulic oil temperature: 45 – 55°C	MPa (kg/cm ²)	20.58 ^{+0.5} _{-0.4} (210 ⁺⁵ ₋₄)	20.58 ^{+1.0} _{-0.6} (210 ⁺¹⁰ ₋₆)
Brakes	Operating force		Engine speed: Low idling Hydraulic oil temperature: 45 – 55°C	N (kg)	294.2 ± 29.4 (30 ± 3)	Max. 421.7 (Max. 43)
	Operating angle	α1		deg.	45	—
		α2			15 ⁺¹ ₋₀	—
	Play	α3			5 ± 0.5	—
	Performance		Flat, horizontal, straight, dry paved road surface Speed when applying brake: 20 km/h, braking delay: 0.1 sec. Brake pedal operating force: Specified operating force Tire inflation pressure: Specified pressure	m	Max. 5	Max. 5
	Drop in hydraulic pressure		4.9 MPa (50 kg/cm ²) in 5 minutes	MPa (kg/cm ²)	Max. 0.5 (Max. 5)	Max. 0.5 (Max. 5)
	Disc wear		Piston stroke	mm	1.2 – 4.7	Max. 6.2
Accumulator	Charge cut-in pressure		• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C	MPa (kg/cm ²)	60 ⁺² ₀	60 ⁺² ₋₁₀
	Charge cut-out pressure		• Point where brake oil pressure warning lamp goes out • Point where oil pressure is going up and then starts to go down		100 ⁺¹⁰ ₀	100 ± 10
Parking brake	Performance		Tire inflation pressure: Specified pressure Flat paved road with 1/5 (11°20') grade Dry road surface Machine at operating condition	—	Stopped	—
	Disc thickness			mm	3.2 ± 0.08	Max. 2.83

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STANDARD VALUE TABLE FOR ENGINE

Category	Item			Measurement conditions	Unit	Standard value	Permissible value	
Work equipment control lever	Operating force	Boom	HOLD → RAISE	Engine speed: Low idling Hydraulic oil temperature: 45 – 55°C	N (kg)	Max. 23.5 (Max. 2.4)	Max. 35.3 (Max. 3.6)	
			RAISE → HOLD			Max. 15.7 (Max. 1.6)	Max. 23.5 (Max. 2.4)	
			HOLD → LOWER			Max. 24.5 (Max. 2.5)	Max. 37.3 (Max. 3.8)	
			LOWER → HOLD			—	—	
			LOWER → FLOAT			Max. 34.3 (Max. 3.5)	Max. 60.0 (Max. 5.3)	
			FLOAT → HOLD			Max. 14.7 (Max. 1.5)	Max. 22.6 (Max. 2.3)	
		Bucket	HOLD → DUMP		N (kg)	Max. 23.5 (Max. 2.4)	Max. 35.3 (Max. 3.6)	
			HOLD → TILT			Max. 23.5 (Max. 2.4)	Max. 35.3 (Max. 3.6)	
			TILT → HOLD			Max. 14.7 (Max. 1.5)	Max. 22.6 (Max. 2.3)	
		Travel	Boom	HOLD → RAISE	Engine speed: Low idling Hydraulic oil temperature: 45 – 55°C	mm	67 ± 15	67 ± 30
				HOLD → LOWER			53 ± 15	53 ± 30
				HOLD → FLOAT			67 ± 15	67 ± 30
	Bucket		HOLD → DUMP	60 ± 15			60 ± 30	
			HOLD → TILT	60 ± 15			60 ± 30	
	Main control valve	Relief pressure			Hydraulic oil temperature: 45 – 55°C Engine speed: High idling	MPa (kg/cm ²)	20.58 ^{+1.0} _{-0.3} (210 ⁺¹⁰ ₋₃)	20.58 ^{+1.0} _{-1.3} (210 ⁺¹⁰ ₋₁₃)
PPC valve	Relief pressure			Hydraulic oil temperature: 45 – 55°C Engine speed: High idling	MPa (kg/cm ²)	3.7 ^{+0.2} ₀ (38 ⁺² ₀)	3.7 ^{+0.4} _{-0.2} (38 ⁺⁴ ₋₂)	
Boom	Work equipment speed	Boom lifting time		Hydraulic oil temperature: 45 – 55°C Engine speed: High idling Steering valve: Neutral No load	Sec.	5.5 ± 0.3	Max. 7.0	
		Boom lowering time				3.7 ± 0.3	Max. 5.1	
		Bucket dumping time				1.4 ± 0.3	Max. 2.1	
		Bucket tilting time	At full stroke			1.9 ± 0.3	Max. 2.7	
			Bucket horizontal			1.2 ± 0.3	Max. 1.8	
	Hydraulic drift	Retraction of boom cylinder rod		Hydraulic oil temperature: 45 – 55°C Leave for 5 minutes after stopping engine then measure for next 15 minutes Bucket empty, boom, bucket horizontal	mm	Max. 30	Max. 36	
		Retraction of bucket cylinder rod				Max. 20	Max. 24	
Proximity switch	Clearance of bucket positioner switch			Hydraulic oil temperature: 45 – 55°C	mm	3 – 7	—	
	Clearance of boom kick-out switch					3 – 7	—	

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions				
Radiator water level sensor	CN R106	Short connector	If the condition is as shown in the table below, the sensor is defective. <table><tr><td>Short connector connected</td><td>Monitor goes off</td></tr><tr><td>CN R06 disconnected</td><td>Monitor lights up</td></tr></table>	Short connector connected	Monitor goes off	CN R06 disconnected	Monitor lights up	Turn starting switch ON.
		Short connector connected	Monitor goes off					
CN R06 disconnected	Monitor lights up							
		Check continuity	If the condition is as shown in the table below, the sensor is normal. <table><tr><td>Oil level, water level normal</td><td>Continuity</td></tr><tr><td>Oil level, water level abnormal</td><td>No continuity</td></tr></table>	Oil level, water level normal	Continuity	Oil level, water level abnormal	No continuity	Turn starting switch OFF.
Oil level, water level normal	Continuity							
Oil level, water level abnormal	No continuity							
Engine oil level sensor	CN E10	Connect to chassis ground	If the condition is as shown in the table below, the sensor is defective. <table><tr><td>Chassis ground connected</td><td>Monitor goes off</td></tr><tr><td>CN E10 disconnected</td><td>Monitor lights up</td></tr></table>	Chassis ground connected	Monitor goes off	CN E10 disconnected	Monitor lights up	Turn starting switch ON.
		Chassis ground connected	Monitor goes off					
CN E10 disconnected	Monitor lights up							
		Check continuity	If the condition is as shown in the table below, the sensor is normal. <table><tr><td>Engine oil level normal</td><td>Continuity</td></tr><tr><td>Engine oil level abnormal</td><td>No continuity</td></tr></table>	Engine oil level normal	Continuity	Engine oil level abnormal	No continuity	Turn starting switch OFF.
Engine oil level normal	Continuity							
Engine oil level abnormal	No continuity							
Torque converter oil temperature sensor Engine water temperature sensor	CN T07	Measure resistance	If the condition is as shown in the table below, the sensor is normal. <table><tr><td>Normal temperature (25°C)</td><td>Approx. 38 – 48 kΩ</td></tr><tr><td>100°C</td><td>Approx. 3.6 – 3.9 kΩ</td></tr></table>	Normal temperature (25°C)	Approx. 38 – 48 kΩ	100°C	Approx. 3.6 – 3.9 kΩ	Turn starting switch OFF.
	Normal temperature (25°C)		Approx. 38 – 48 kΩ					
100°C	Approx. 3.6 – 3.9 kΩ							
CN E06								
Fuel level sensor	CN R07	Measure resistance	If the condition is as shown in the table below, the sensor is normal. <table><tr><td>Full</td><td>Approx. 10⁺¹₋₃ Ω</td></tr><tr><td>Empty</td><td>Approx. 85 – 95 kΩ</td></tr></table>	Full	Approx. 10 ⁺¹ ₋₃ Ω	Empty	Approx. 85 – 95 kΩ	Turn starting switch OFF.
Full	Approx. 10 ⁺¹ ₋₃ Ω							
Empty	Approx. 85 – 95 kΩ							
Alternator	—	Measure voltage	When engine is running (half throttle or above) → 27.5 – 29.5 V ★ If the battery is old, or after starting in cold areas, the voltage may not rise for some time.	Start engine				

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions		
Engine oil pressure sensor	—	Connect to chassis ground	If the condition is as shown in the table below, the sensor is defective.	Turn starting switch ON.		
			<table><tr><td>Terminal wiring harness disconnected</td><td>Monitor goes off</td></tr><tr><td>Connected to chassis ground</td><td>Monitor lights up</td></tr></table>		Terminal wiring harness disconnected	Monitor goes off
		Terminal wiring harness disconnected	Monitor goes off			
		Connected to chassis ground	Monitor lights up			
Check continuity	If the condition is as shown in the table below, the sensor is normal.	Start engine.				
	<table><tr><td>Oil pressure above 70 KPa (0.7 kg/cm²)</td><td>No continuity</td></tr><tr><td>Oil pressure below 30 KPa (0.3 kg/cm²)</td><td>Continuity</td></tr></table>		Oil pressure above 70 KPa (0.7 kg/cm ²)	No continuity	Oil pressure below 30 KPa (0.3 kg/cm ²)	Continuity
Oil pressure above 70 KPa (0.7 kg/cm ²)	No continuity					
Oil pressure below 30 KPa (0.3 kg/cm ²)	Continuity					
Parking brake switch	CN T08	Short connector	If the condition is as shown in the table below, the sensor is defective.	Turn starting switch ON.		
			<table><tr><td>Short connector connected</td><td>Monitor goes off</td></tr><tr><td>CN T08 disconnected</td><td>Monitor lights up</td></tr></table>		Short connector connected	Monitor goes off
		Short connector connected	Monitor goes off			
		CN T08 disconnected	Monitor lights up			
Check continuity	If the condition is as shown in the table below, the sensor is normal.	Turn starting switch OFF.				
	<table><tr><td>Oil pressure above 0.6 MPa (6.1 kg/cm²)</td><td>Continuity</td></tr><tr><td>Oil pressure below 0.34 MPa (3.5 kg/cm²)</td><td>No continuity</td></tr></table>		Oil pressure above 0.6 MPa (6.1 kg/cm ²)	Continuity	Oil pressure below 0.34 MPa (3.5 kg/cm ²)	No continuity
Oil pressure above 0.6 MPa (6.1 kg/cm ²)	Continuity					
Oil pressure below 0.34 MPa (3.5 kg/cm ²)	No continuity					
Brake ACC Low pressure switch	CN B08 CN B13	Short connector	If the condition is as shown in the table below, the sensor is defective.	Turn starting switch ON.		
			<table><tr><td>Short connector connected</td><td>Monitor goes off</td></tr><tr><td>CN B08, CN B13 disconnected</td><td>Monitor lights up</td></tr></table>		Short connector connected	Monitor goes off
		Short connector connected	Monitor goes off			
		CN B08, CN B13 disconnected	Monitor lights up			
Check continuity	If the condition is as shown in the table below, the sensor is normal.	Turn starting switch OFF.				
	<table><tr><td>Oil pressure above 5.9 MPa (60 kg/cm²)</td><td>Continuity</td></tr><tr><td>Oil pressure below 3.9 MPa (40 kg/cm²)</td><td>No continuity</td></tr></table>		Oil pressure above 5.9 MPa (60 kg/cm ²)	Continuity	Oil pressure below 3.9 MPa (40 kg/cm ²)	No continuity
Oil pressure above 5.9 MPa (60 kg/cm ²)	Continuity					
Oil pressure below 3.9 MPa (40 kg/cm ²)	No continuity					
Emergency brake switch	CN B09 CN B10	Short connector	If the condition is as shown in the table below, the sensor is defective.	Turn starting switch ON.		
			<table><tr><td>Short connector connected</td><td>Monitor goes off</td></tr><tr><td>CN B09, CN B10 disconnected</td><td>Monitor lights up</td></tr></table>		Short connector connected	Monitor goes off
		Short connector connected	Monitor goes off			
		CN B09, CN B10 disconnected	Monitor lights up			
Check continuity	If the condition is as shown in the table below, the sensor is normal.	Turn starting switch OFF.				
	<table><tr><td>Oil pressure above 4.3 MPa (45 kg/cm²)</td><td>Continuity</td></tr><tr><td>Oil pressure below 3.1 MPa (32 kg/cm²)</td><td>No continuity</td></tr></table>		Oil pressure above 4.3 MPa (45 kg/cm ²)	Continuity	Oil pressure below 3.1 MPa (32 kg/cm ²)	No continuity
Oil pressure above 4.3 MPa (45 kg/cm ²)	Continuity					
Oil pressure below 3.1 MPa (32 kg/cm ²)	No continuity					

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

System	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions					
Main monitor	Alternator	Between alternator terminal R and chassis	Measure voltage	When engine is running (half throttle or above) → 27.5 – 29.5 V ※ If the battery is old, or after starting in cold areas, the voltage may not rise for some time.	1) Start engine.					
	Engine water temperature sensor	CNE 05 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. <table><tr><td>Normal temperature (25°C)</td><td rowspan="2">Between CNE05 (male) – GND</td><td>Approx. 2 kΩ</td></tr><tr><td>5°C</td><td>Approx. 4 kΩ</td></tr></table>	Normal temperature (25°C)	Between CNE05 (male) – GND	Approx. 2 kΩ	5°C	Approx. 4 kΩ	1) Turn starting switch OFF. 2) Disconnect CNE05.
	Normal temperature (25°C)	Between CNE05 (male) – GND	Approx. 2 kΩ							
5°C	Approx. 4 kΩ									
Speed sensor	CNT06 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>500 – 1000 Ω</td></tr></table>	Between (1) – (2)	500 – 1000 Ω	1) Turn starting switch OFF. 2) Disconnect CNE06.				
Between (1) – (2)	500 – 1000 Ω									
E.C.S.S. controller	Relief solenoid	CNAF4 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>20 – 40 Ω</td></tr></table>	Between (1) – (2)	20 – 40 Ω	1) Turn starting switch OFF. 2) Disconnect CNAF4.			
	Between (1) – (2)	20 – 40 Ω								
	High pressure solenoid	CNAF5 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>20 – 40 Ω</td></tr></table>	Between (1) – (2)	20 – 40 Ω	1) Turn starting switch OFF. 2) Disconnect CNAF5.			
	Between (1) – (2)	20 – 40 Ω								
	Low pressure solenoid	CNAF6 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>20 – 40 Ω</td></tr></table>	Between (1) – (2)	20 – 40 Ω	1) Turn starting switch OFF. 2) Disconnect CNAF6.			
Between (1) – (2)	20 – 40 Ω									
Pressure switch	CNAF7 (male)	Measure resistance	If the condition is as shown in the table below, it is normal. <table><tr><td>Oil pressure above 5.4 MPa (55 kg/cm²)</td><td rowspan="2">Between (1) – (2)</td><td>Continuity</td></tr><tr><td>Oil pressure below 4.4 MPa (45 kg/cm²)</td><td>No continuity</td></tr></table>	Oil pressure above 5.4 MPa (55 kg/cm ²)	Between (1) – (2)	Continuity	Oil pressure below 4.4 MPa (45 kg/cm ²)	No continuity	1) Turn starting switch OFF. 2) Disconnect CNAF7.	
Oil pressure above 5.4 MPa (55 kg/cm ²)	Between (1) – (2)	Continuity								
Oil pressure below 4.4 MPa (45 kg/cm ²)		No continuity								
Speed sensor	CNT06 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>500 – 1000 Ω</td></tr></table>	Between (1) – (2)	500 – 1000 Ω	1) Turn starting switch OFF. 2) Disconnect CNT06.				
Between (1) – (2)	500 – 1000 Ω									

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STANDARD VALUE TABLE FOR ELECTRICAL PARTS

Sys-tem	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions					
Work equipment controller	Bucket DUMP solenoid	CNF25 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>7.5 – 9.5 Ω</td></tr><tr><td>Between (1) – chassis</td><td>Min. 1 MΩ</td></tr></table>	Between (1) – (2)	7.5 – 9.5 Ω	Between (1) – chassis	Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.	
	Between (1) – (2)	7.5 – 9.5 Ω								
	Between (1) – chassis	Min. 1 MΩ								
	Bucket TILT solenoid	CNF24 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>7.5 – 9.5 Ω</td></tr><tr><td>Between (1) – chassis</td><td>Min. 1 MΩ</td></tr></table>	Between (1) – (2)	7.5 – 9.5 Ω	Between (1) – chassis	Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.	
	Between (1) – (2)	7.5 – 9.5 Ω								
	Between (1) – chassis	Min. 1 MΩ								
	Dumping solenoid	CNF26 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>18.8 – 20.8 Ω</td></tr><tr><td>Between (1) – chassis</td><td>Min. 1 MΩ</td></tr></table>	Between (1) – (2)	18.8 – 20.8 Ω	Between (1) – chassis	Min. 1 MΩ	1) Turn starting switch OFF. 2) Disconnect connector.	
Between (1) – (2)	18.8 – 20.8 Ω									
Between (1) – chassis	Min. 1 MΩ									
Boom angle potentiometer	CNF28 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>0 – 5 Ω</td></tr><tr><td>Between (2) – (3)</td><td>4 – 5 Ω</td></tr><tr><td>Between (3) – (1)</td><td>0 – 5 Ω</td></tr></table>	Between (1) – (2)	0 – 5 Ω	Between (2) – (3)	4 – 5 Ω	Between (3) – (1)	0 – 5 Ω	1) Turn starting switch OFF. 2) Disconnect connector.
Between (1) – (2)	0 – 5 Ω									
Between (2) – (3)	4 – 5 Ω									
Between (3) – (1)	0 – 5 Ω									
Bucket angle potentiometer	CNF29 (male)	Measure resistance	If the condition is within the range shown in the table below, it is normal. <table><tr><td>Between (1) – (2)</td><td>0 – 5 Ω</td></tr><tr><td>Between (2) – (3)</td><td>4 – 5 Ω</td></tr><tr><td>Between (3) – (1)</td><td>0 – 5 Ω</td></tr></table>	Between (1) – (2)	0 – 5 Ω	Between (2) – (3)	4 – 5 Ω	Between (3) – (1)	0 – 5 Ω	1) Turn starting switch OFF. 2) Disconnect connector.
Between (1) – (2)	0 – 5 Ω									
Between (2) – (3)	4 – 5 Ω									
Between (3) – (1)	0 – 5 Ω									
Boom lever RAISE pressure switch	CNF21	Measure resistance	If the condition is within the range shown in the table below, it is normal. Operate boom lever between (1) – (2) <table><tr><td>Other than RAISE</td><td>Max. 1 Ω</td></tr><tr><td>RAISE</td><td rowspan="2">Min. 1 MΩ</td></tr><tr><td>Between (1) – chassis</td></tr></table>	Other than RAISE	Max. 1 Ω	RAISE	Min. 1 MΩ	Between (1) – chassis	1) Turn starting switch OFF. 2) Disconnect connector.	
Other than RAISE	Max. 1 Ω									
RAISE	Min. 1 MΩ									
Between (1) – chassis										
Boom lever LOWER pressure switch	CNF22	Measure resistance	If the condition is within the range shown in the table below, it is normal. Operate boom lever between (1) – (2) <table><tr><td>Other than LOWER</td><td>Max. 1 Ω</td></tr><tr><td>LOWER</td><td rowspan="2">Min. 1 MΩ</td></tr><tr><td>Between (1) – chassis</td></tr></table>	Other than LOWER	Max. 1 Ω	LOWER	Min. 1 MΩ	Between (1) – chassis	1) Turn starting switch OFF. 2) Disconnect connector.	
Other than LOWER	Max. 1 Ω									
LOWER	Min. 1 MΩ									
Between (1) – chassis										

STANDARD VALUE TABLE FOR ELECTRICAL PARTS

TESTING AND ADJUSTING

System	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions				
Transmission controller (With auto-shift transmission)	F. solenoid	CNT01 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>46 to 58 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	46 to 58 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF. 2) Connector disconnected.
	Between ① and ②	46 to 58 Ω							
	Between ① and chassis	1 MΩ or greater							
	R. solenoid	CNT02 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>46 to 58 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	46 to 58 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF. 2) Connector disconnected.
	Between ① and ②	46 to 58 Ω							
Between ① and chassis	1 MΩ or greater								
HL. solenoid	CNT03 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>46 to 58 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	46 to 58 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF. 2) Connector disconnected.	
Between ① and ②	46 to 58 Ω								
Between ① and chassis	1 MΩ or greater								
Speed solenoid	CNT04 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>46 to 58 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	46 to 58 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF. 2) Connector disconnected.	
Between ① and ②	46 to 58 Ω								
Between ① and chassis	1 MΩ or greater								
Modulation valve solenoid	CNT12 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>12 to 15 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	12 to 15 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF. 2) Connector disconnected.	
Between ① and ②	12 to 15 Ω								
Between ① and chassis	1 MΩ or greater								

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TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING

Check or measurement item	Symbol	Part No.	Part Name	Remarks
Engine speed	A	799-203-9000	Multi-tachometer	Digital display L: 60 – 2,000 rpm H: 60 – 19,999 rpm
Oil pressure	B	799-101-5002	Analog hydraulic tester	Pressure gauge 2.45, 5.88, 39.2, 58.8 MPa (25, 60, 400, 600 kg/cm ²)
		790-261-1203	Digital hydraulic tester	Pressure gauge 49.0 MPa (500 kg/cm ²)
		799-401-2320	Hydraulic gauge	1.0 MPa (10 kg/cm ²)
Intake air pressure	C	799-401-2310	Pressure gauge	1,500 mmHg
Valve clearance	D	Commercially available	Feeler gauge	
Exhaust color	E	1 799-201-9000	Handy smoke checker	Discoloration 0 – 70% (with standard color) (Discoloration % x 1/10 = Bosch index)
		2 Commercially available	Smoke meter	—
Coolant, oil, and exhaust temperatures	F	1 799-101-1502	Digital temperature gauge	—
		2 799-201-1110	Wiring harness	Measure exhaust temperature
Blowby pressure	G	1 799-201-1511	Tool	Kit Part No. 799-201-1504
		2 799-201-1541	Gauge	
		3 799-201-1571	Tube	
		4 799-201-1450	Adapter	
Compression pressure	H	1 795-502-1590	Compression gauge	0 – 6.9 MPa (0 – 70 kg/cm ²) Kit Part No. 795-502-1205
		2 795-502-1360	Adapter	—
Operating force	I	1 79A-264-0090	Push-pull scale	0 – 490 N (0 – 50 kg)
		2 79A-264-0020	Push-pull scale	0 – 294 N (0 – 30 kg)
Stroke, hydraulic drift	J	Commercially available	Scale	—
Work equipment speed	K	Commercially available	Stop watch	—
Troubleshooting of wiring harnesses and sensors	L	799-601-8000	T-adapter	—
Measuring voltage and resistance values	M	Commercially available	Tester	—
Clearance	O	Commercially available	Feeler gauge	
Wear of parking brake	P	Commercially available	Calipers	
Brake oil pressure	Q	1 793-520-1803	Brake test kit	
		2 170-21-11190	Nipple	
Boom drop prevention tool	R	793-463-1100	Stopper	

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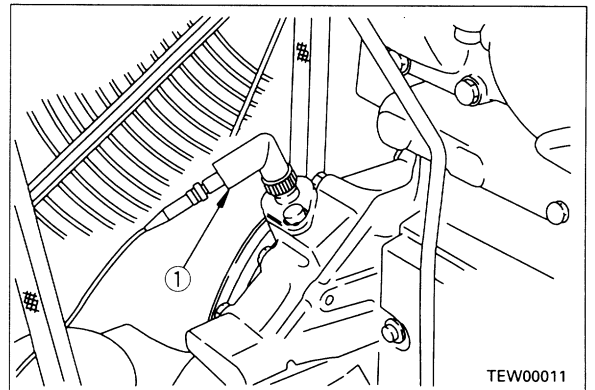
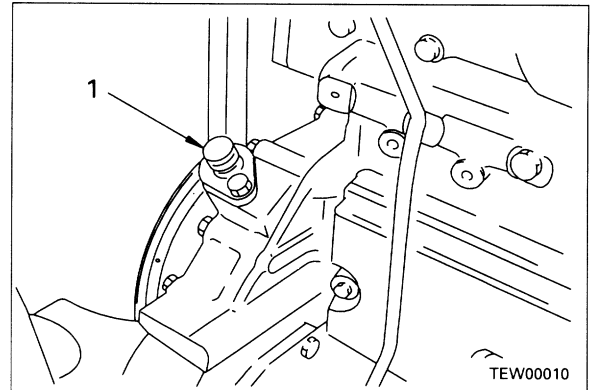
MEASURING ENGINE SPEED

⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature parts.

★ Measure the engine speed under the following conditions.

- 1) Coolant temperature: Within operating range
- 2) Power train oil temperature : 70 – 90°C
- 3) Hydraulic oil temperature : 45 – 55°C

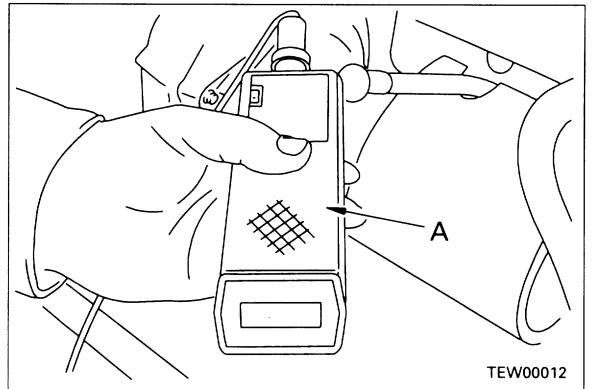
1. Remove cap (1) from speed pick-up port, then install adapter ① of tachometer **A**.



2. Connect tachometer **A** and the adapter with the cable.

⚠ When carrying out the measurement, be careful not to touch any high temperature parts or rotating parts.

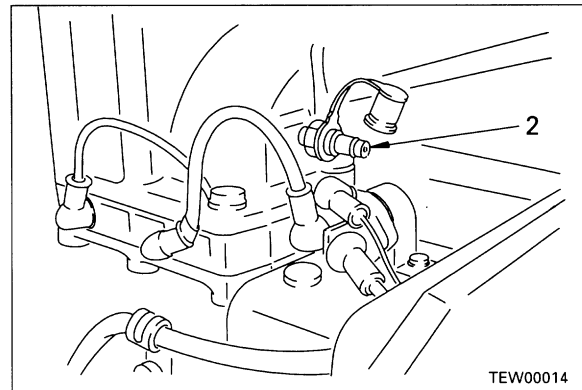
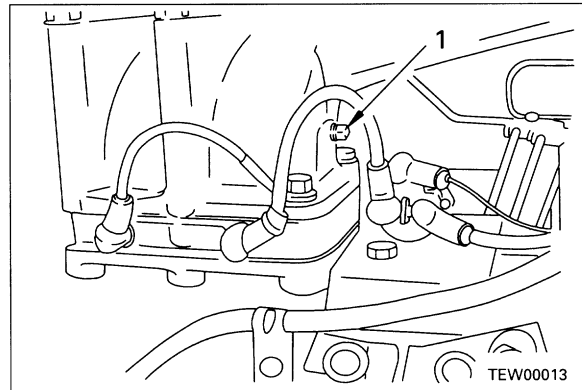
3. Start the engine, and measure the engine speed when the engine is at low idling and high idling.
 - ★ When measuring items other than the above (during torque converter stall), see the procedure for each item.



MEASURING INTAKE AIR PRESSURE (BOOST PRESSURE)

⚠ When removing or installing the measuring equipment, be careful not to touch any high temperature parts.

1. Remove intake air pressure measurement plug (1) (PT 1/8) and install coupler (2) of oil pressure gauge kit **B**.



2. Connect oil pressure measurement hose (3) to coupler (2) and pressure gauge **C** (1500 mmHg).

⚠ When carrying out the measurement, be careful not to touch any high temperature parts or rotating parts.

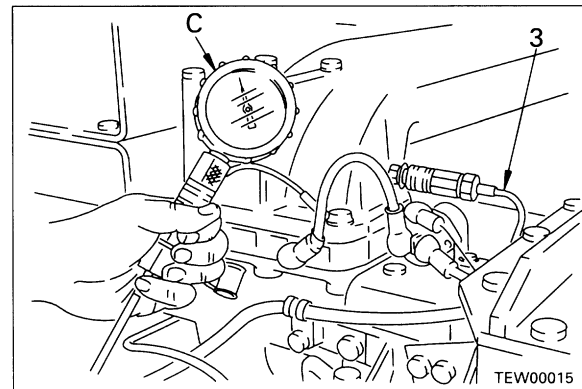
Note:

Run the engine at a mid-range speed or above, and use the self-seal portion of the gauge to bleed the oil from inside the hose.

- Insert the gauge about half way, and repeatedly open the self-seal portion to bleed the oil.

★ The gauge does not work if there is any oil inside the hose, so always be sure to bleed all the oil.

3. Run the engine at the rated speed and measure the pressure indicated by the gauge.



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ADJUSTING VALVE CLEARANCE

- ★ When adjusting the valve clearance, use the following procedure to adjust the clearance between the valve and rocker lever to the value.

1. Remove cylinder head cover (1).
2. Rotate the crankshaft in the normal direction to align the TOP 1.6 line on the crankshaft pulley with pointer (2) when No. 1 cylinder is at top dead center. When rotating, check the movement of the valves.
3. When No. 1 cylinder is at compression top dead center, adjust the valves marked ●; when No. 6 cylinder is at compression top dead center, adjust the valves marked ○.

★ **Valve arrangement**

Cylinder No.	1	2	3	4	5	6
Intake valve	●	●		●		
Exhaust valve		●	●		●	○

4. To adjust the valve clearance, loosen locknut (6), then insert feeler gauge **D** between rocker lever (3) and crosshead (4), and turn adjustment screw (5) until the clearance is a sliding fit. Then tighten locknut (6) to hold the adjustment screw in position.

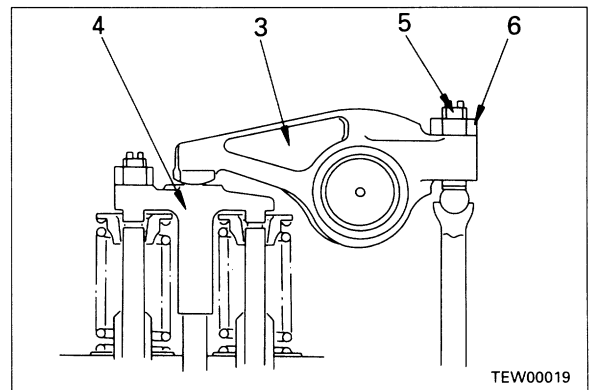
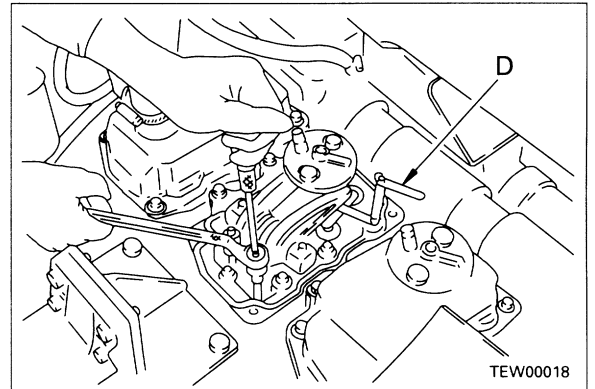
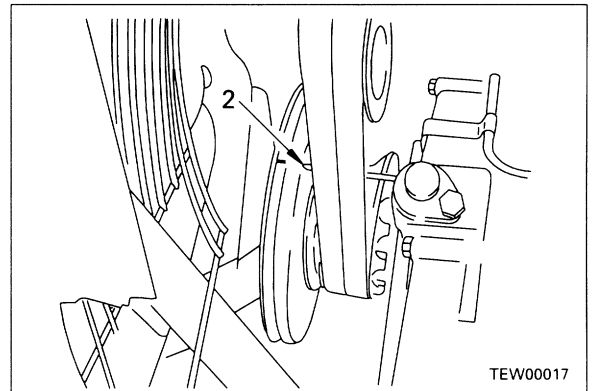
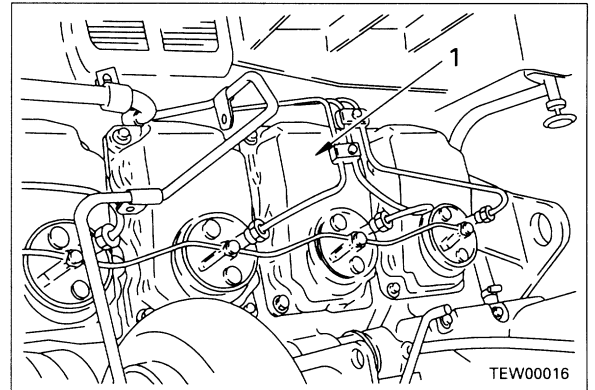
 **kgm** Locknut : $66.7 \pm 7.9 \text{ Nm}$ ($6.8 \pm 0.8 \text{ kgm}$)

5. Next, rotate the crankshaft one turn (360°) in the normal direction and adjust the valve clearance of the remaining valves marked ○.

- ★ After adjusting No. 1 cylinder at compression top dead center, it is also possible to turn the crankshaft 120° each time and adjust the valve clearance of each cylinder according to the firing order.

• Firing order : 1 – 5 – 3 – 6 – 2 – 4

- ★ After tightening the locknut, check the valve clearance again.

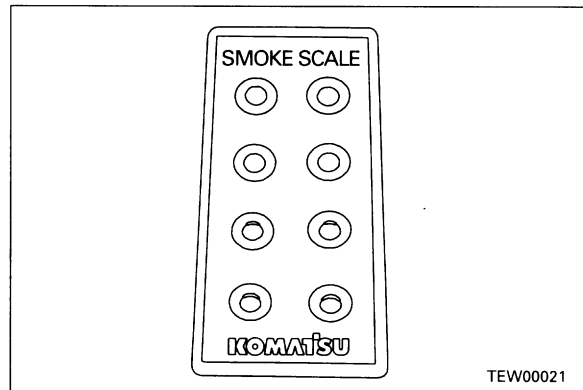
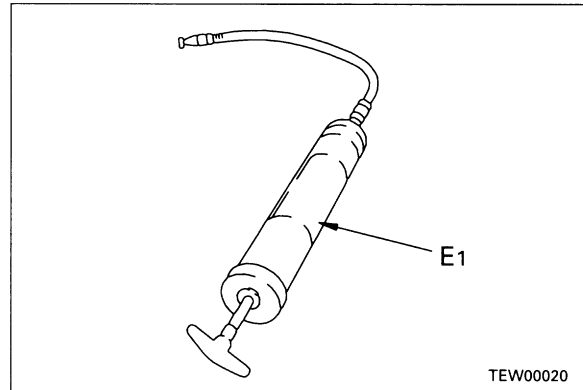


MEASURING EXHAUST COLOR

- ★ When measuring in the field when there is no air or power supply, use smoker the checker; when recording official data, use the smoke meter.

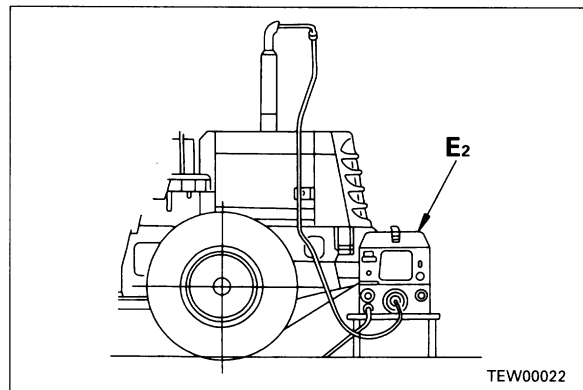
Measuring with handy smoke checker E1

- ⚠ When measuring the exhaust gas color, be careful not to touch the exhaust pipe or any other high temperature part.
- ★ Warm up the engine (oil temperature: 60°C) before measuring the exhaust gas color.
 - 1) Fit filter paper in tool **E1**.
 - 2) Insert the exhaust gas intake port into the exhaust pipe, accelerate the engine suddenly, and at the same time operate the handle to catch the exhaust gas on the filter paper.
 - 3) Remove the filter paper and compare it with the scale provided to judge the condition.



Measuring with smoke meter E2

- ⚠ When measuring the exhaust gas color, be careful not to touch the exhaust pipe or any other high temperature part.
- ★ Warm up the engine (oil temperature: 60°C) before measuring the exhaust gas color.
 - 1) Insert the probe into the outlet port of the exhaust pipe, then tighten the clip to secure it to the exhaust pipe.
 - 2) Connect the probe hose, accelerator switch plug, and air hose to tool **E2**.
 - ★ The pressure of the air supply should be less than 1.5 MPa (15 kg/cm²).
 - 3) Connect the power cord to the AC100V outlet.
 - ★ When connecting the cord, check first that the power switch is OFF.
 - 4) Loosen the cap nut of the suction pump, then fit the filter paper.
 - ★ Fit the filter paper securely so that the exhaust gas does not leak.
 - 5) Turn the power switch.
 - 6) Accelerate the engine suddenly, and at the same time, depress the accelerator pedal and operate the relief valve to catch the exhaust gas color on the filter paper.
 - 7) Lay the filter paper used to catch the exhaust gas color on top of unused filter papers (10 sheets or more) inside the filter paper holder, and read the indicated value.



MEASURING EXHAUST GAS TEMPERATURE

! The temperature sensor is installed to the exhaust manifold, so if the machine has been operated, wait for the manifold to cool down before installing the sensor.

★ Raise the coolant temperature to the operating range before measuring.

1. Remove plug (1) from the exhaust manifold, then install temperature sensor (2).

- Temperature sensor : 6215-11-8180 (cable length: 610 mm), or 6215-11-8170 (cable length: 490 mm)

2. Connect to digital temperature gauge **F1** with wiring harness **F2**.

Measurement procedure

1) Measuring at torque converter stall

★ If the exhaust gas temperature is measured only at torque converter stall, and this is continued until the sensor core heats up and a stable value is obtained, the torque converter will overheat.

(i) Use the full stall (torque converter stall + hydraulic relief) to raise the exhaust gas temperature (see standard value).

(ii) From the above condition, cancel the hydraulic relief, and carry out only torque converter stall.

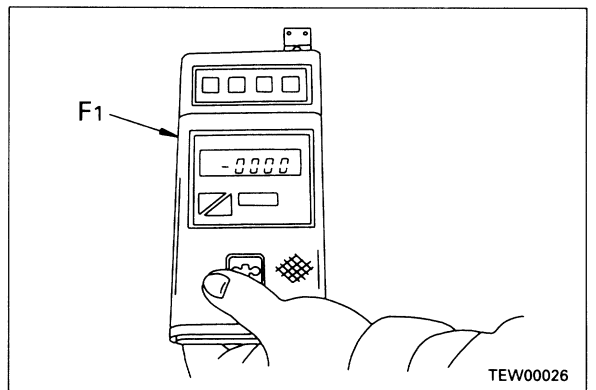
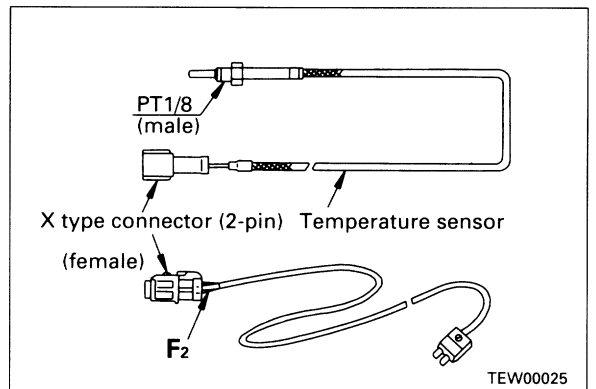
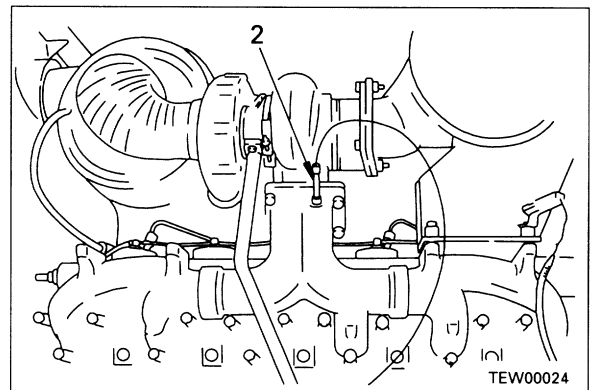
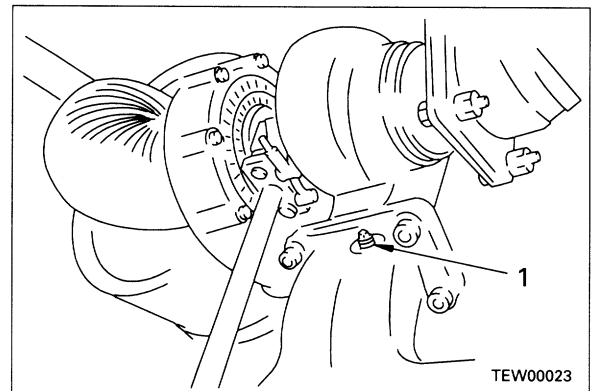
(The temperature will start to go down. If it does not go down and continues to go up, make the temperature setting at (i) higher.)

(iii) When the temperature starts to go down, record the stable temperature.

2) When measuring maximum value for exhaust gas temperature

Carry out actual work and measure the maximum value when operating.

★ Use the PEAK mode function (the maximum value can be recorded) of the temperature gauge.

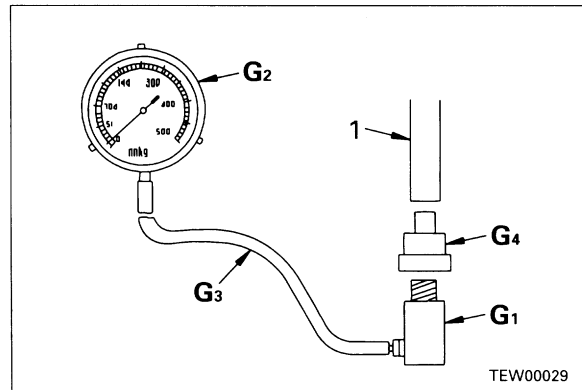
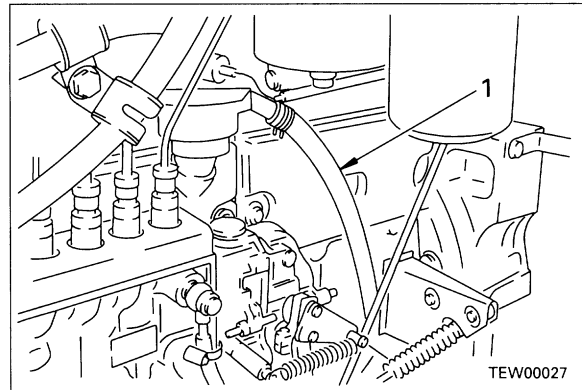


MEASURING BLOW-BY PRESSURE

- ★ Raise the coolant temperature to the operating range before measuring the blow-by pressure.
- 1. Install tools **G4** and **G1** to the tip of engine breather hose (1), then connect tools **G2** and **G3**.
- 2. Run the engine at the rated output and measure the blow-by pressure.

! When measuring the blow-by pressure, be careful not to touch any high temperature parts or rotating parts.

- ★ The blow-by should be measured with the engine running at rated output.
 - When measuring in the field, a similar value can be obtained at stall speed.
 - If it is impossible to check at rated output or stall speed, measure at high idling. In this case, the blow-by value will be about 80% of the value at rated output.
- ★ Blow-by varies greatly according to the condition of the engine. Therefore, if the blow-by value is considered abnormal, check for problems connected with defective blow-by, such as excessive oil consumption, defective exhaust gas color, and prematurely dirty or deteriorated oil.



MEASURING COMPRESSION PRESSURE

⚠ When measuring the compression pressure, be careful not to touch the exhaust manifold or muffler, or to get your clothes caught in the fan, fan belt or other rotating parts.

★ Warm up the engine (oil temperature: 40 – 60°C) before measuring the compression pressure.

1. Adjust the valve clearance.
For details, see ADJUSTING VALVE CLEARANCE.
2. Remove spill tube (1) and disconnect fuel injection pipe (2).

3. Remove nozzle holder assembly (3) from each cylinder to be measured.

★ When removing nozzle holder assembly (3), assemble bolt ① to the spill tube mount and twist with bar ② to remove.

★ Be careful not to let dirt or dust get in.

4. Install adapter **H₂** in the mount of the nozzle holder of the cylinder to be measured, and tighten to the specified torque.

⚙ **kgm** Torque : $21.6 \pm 2.9 \text{ Nm}$ ($2.2 \pm 0.3 \text{ kgm}$)

5. Connect compression gauge **H₁** to adapter **H₂**.

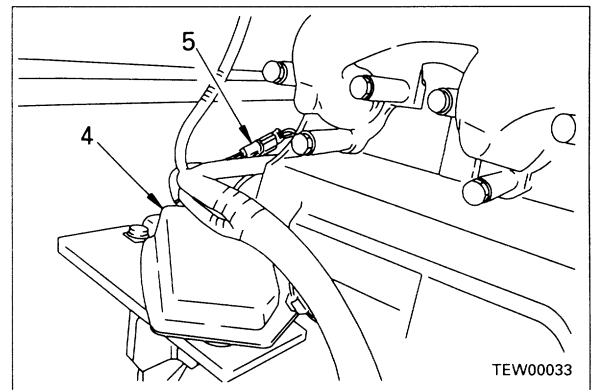
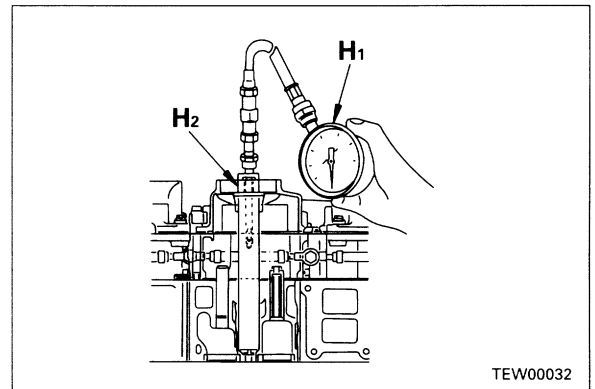
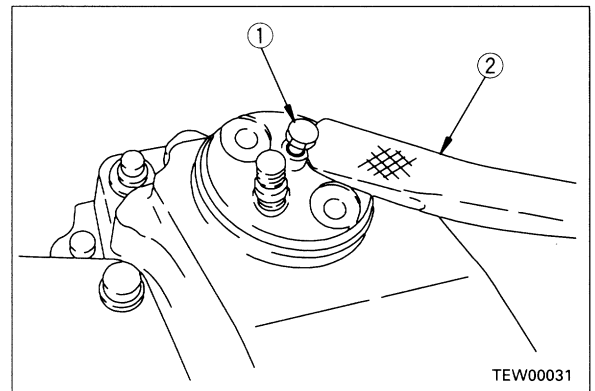
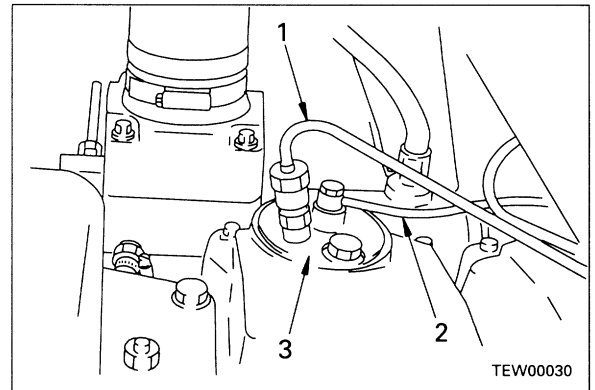
6. Disconnect connector (5) of stop motor (4), set to the NO INJECTION position, then crank the engine with the starting motor and measure the compression pressure at the point where the pressure gauge indicator remains steady.

★ If the fuel control lever is not set to the NO INJECTION position, fuel will spurt out.

★ If the adapter mount is coated with a small amount of oil, it will reduce leakage.

★ For details of the standard value for the compression pressure, see STANDARD VALUE TABLE FOR ENGINE.

★ If the measurement is carried out with the manual emergency stop cable disconnected, an error message will light up on the monitor panel, so delete the error message after measuring.



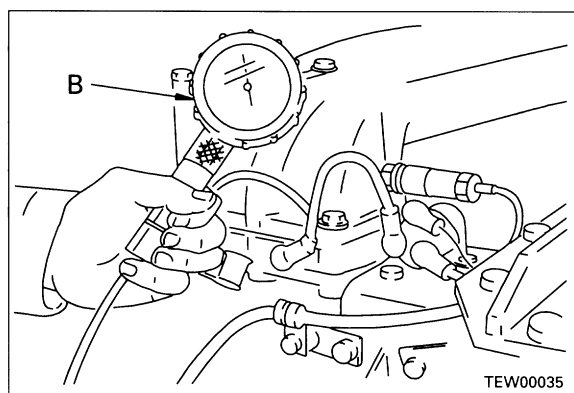
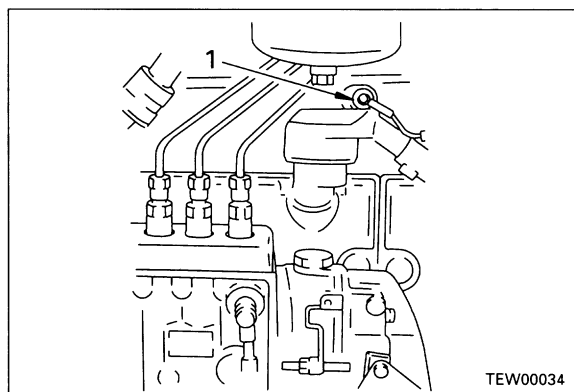
MEASURING ENGINE OIL PRESSURE

⚠ When measuring, be careful not to let your clothes get caught in any rotating part.

★ Always stop the engine before removing or installing any oil pressure sensor or oil pressure gauge.

★ When measuring the oil pressure, always measure at the specified oil temperature.

- 1) Remove oil pressure sensor (1).
- 2) Install tool **B** (gauge: 1.0 MPa (10 kg/cm²)).
- 3) Start the engine, and measure the oil pressure.



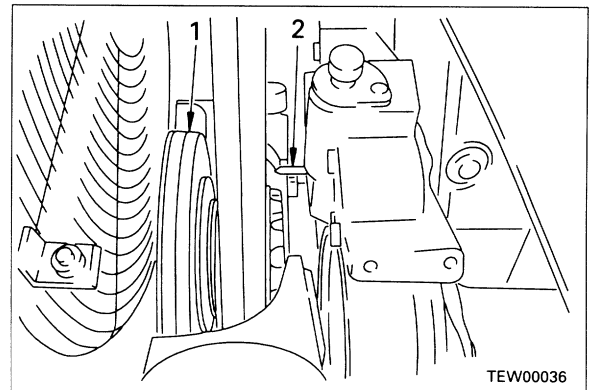
TESTING AND ADJUSTING FUEL INJECTION TIMING

The following methods can be used for testing and adjusting the fuel injection timing of the injection pump.

- Match mark alignment method
This method is used when assembling the injection pump to the original engine without making any repairs.
- Delivery valve method
This method is used when assembling and injection pump that has been repaired or replaced.
- ★ Set the No. 1 cylinder to the compression top dead center position before carrying out testing and adjusting.
For details, see ADJUSTING VALVE CLEARANCE.

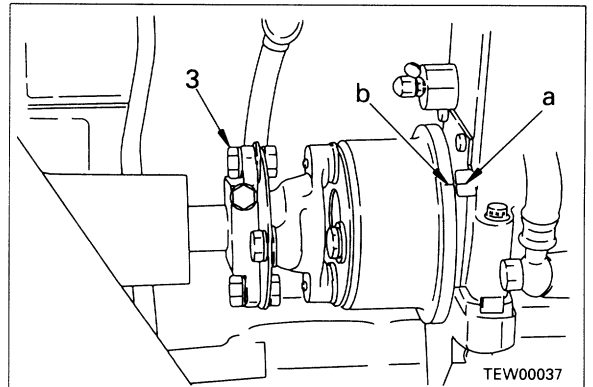
Testing and adjusting using match mark alignment method

1. Rotate the crankshaft 30 – 40° in the reverse direction from the No. 1 cylinder TOP position.
2. Rotate the crankshaft slowly in the normal direction to align pointer (2) with the injection timing line on crankshaft damper (1).



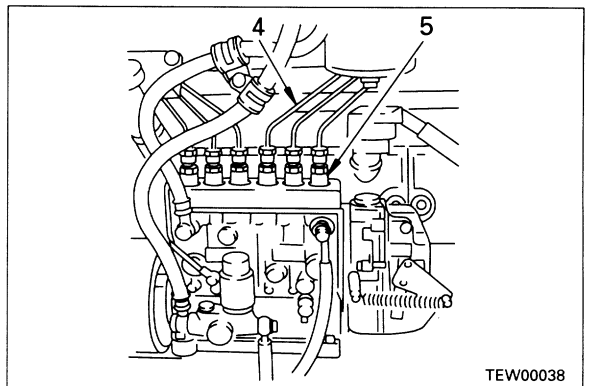
3. Check that line **a** on the injection pump and line **b** on the coupling are aligned.
★ If the lines are not aligned, loosen nut (3), move the coupling to align the lines, then tighten the nut.

 **Nut: 60.8 ± 2 Nm (6.2 ± 0.2 kgm)**



Testing and adjusting using delivery valve method

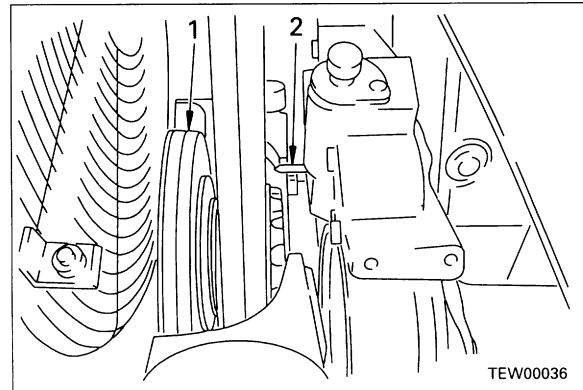
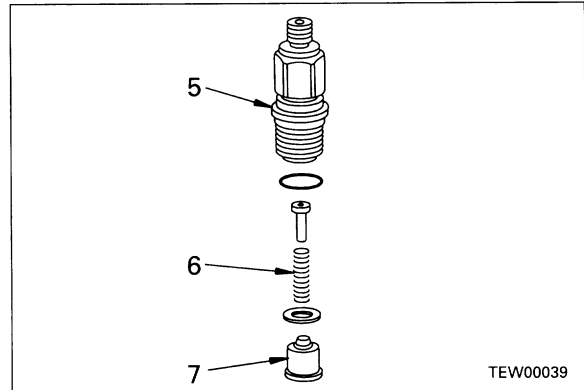
1. Disconnect fuel injection pipe (4) of No. 1 cylinder.
2. Remove delivery valve holder (5).



TESTING AND ADJUSTING

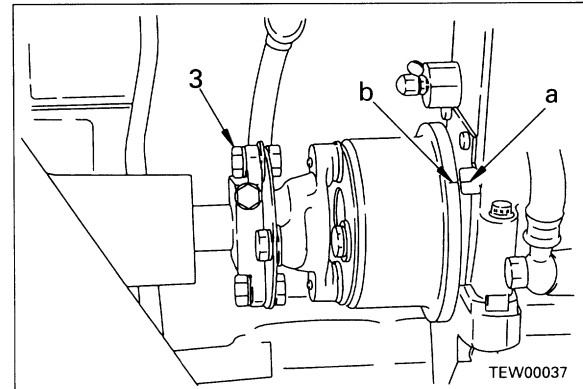
TESTING AND ADJUSTING FUEL INJECTION TIMING

3. Take out delivery valve stopper spring (6) and delivery valve (7) from the delivery valve holder, then install the delivery valve holder again.
4. Place the fuel control lever at the FULL position, then rotate the crankshaft in the normal direction while operating the priming pump, and stop at the point where the fuel stops flowing from the delivery valve holder.
5. Check that the pointer and the injection timing line on the crankshaft damper are aligned at the point where the fuel stops flowing.
 - ★ Beyond injection timing line: Injection timing is retarded
 - ★ Before injection timing line: Injection timing is advanced
- ★ If the check shows that the injection timing is not correct, adjust the fuel injection timing as follows.
- ★ After testing and adjusting, do not forget to assemble the spring and delivery valve again.



- 1) Rotate the crankshaft 30 – 40° in the reverse direction from the No. 1 cylinder TOP position.
- 2) Rotate the crankshaft slowly in the normal direction to align pointer (2) with the injection timing line on crankshaft damper (1).
- 3) Loosen nut (3) in the oblong hole of the injection pump mounting flange, then rotate the flange at the pump end a little at a time while operating the priming pump, and stop at the point where the fuel stops flowing from the delivery valve holder.
- 4) Tighten the nut in the oblong hole of the injection pump mount flange.
 - ★ Check the injection timing again to confirm that the injection timing is correctly adjusted.

 Nut: **60.8 ± 2 Nm (6.2 ± 0.2 kgm)**

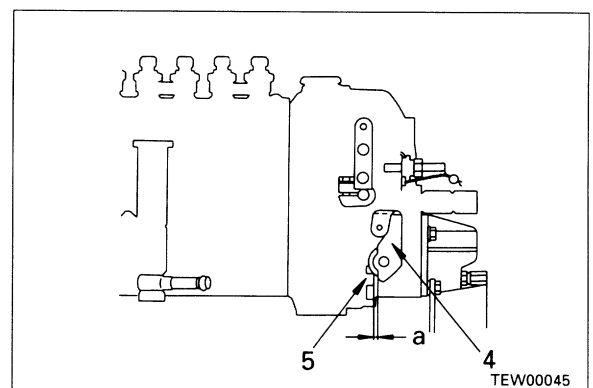
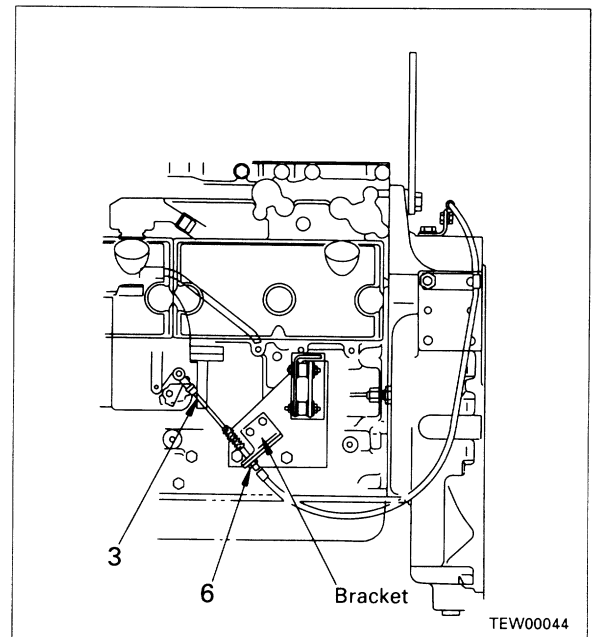
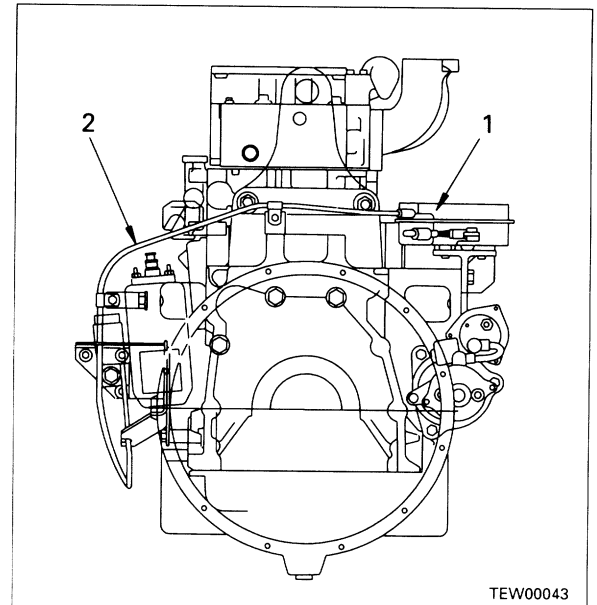


- 5) Align match mark **a** with match mark **b** and cut a line.

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METHOD FOR ADJUSTING ENGINE STOP MOTOR CABLE

1. Temporarily install ball joint (3) to cable (2) of engine stop motor (1) (screw in fully, then turn back approx. 1/2 turns), then install the ball joint to the stop lever of the injection pump.
2. Pull stop lever (4) of the injection pump by hand to the engine stop position (no injection of fuel), and temporarily assemble the cable to the bracket.
When this is done, secure the cable at a point where stop lever (4) contacts engine STOP stopper (5), and temporarily assemble to the bracket with locknut (6).
 - ★ Engine stop motor (1) is at the engine STOP position with cable (2) pulled.
 - ★ Stop lever (4) of the fuel injection pump is at the RUN position when the lever is free (it is pulled by a spring to the RUN side).
3. Adjust stop lever (4) of the injection pump and STOP stopper (5) at the stop end so that clearance *a* is 1 – 2 mm.
Adjust with nut (6) which secures the cable to the bracket or carry out fine adjustment by changing the depth that ball joint (3) is screwed in.



TESTING AND ADJUSTING**METHOD FOR ADJUSTING ENGINE STOP MOTOR CABLE****4. Tighten all nuts and bolts.****5. Turn the engine starting switch repeatedly to the ON and OFF positions, and check that the engine stop motor and cable work smoothly, then carry out the following checks again.**

1) Check visually that there is slack in the engine stop motor cable when the engine is running, and that the stop lever of the fuel injection pump has returned fully to the RUN position.

2) Check that the clearance between the stop lever and stopper at the STOP end is 1 – 2 mm when the engine is stopped.

★ With the engine stop motor, there are built-in limit switches at both ends of the cable stroke.

★ Engine stop motor stroke: 35 mm
Fuel injection pump stop lever stroke: 30 mm

★ When the engine is running, there is slack in the engine stop motor cable, and the RUN position is maintained by the action of a spring (this is frequently built into the fuel injection pump).

★ There is a loose spring inside the engine stop motor, and this absorbs the error in the stop motor when the engine is stopped.

However, if this is absorbed by the loose spring in the engine stop motor, force is brought to bear on the injection pump, so depending on the machine model, this system may not be possible to use.

With such models, there is a danger of problems arising with the injection pump if the clearance between the stop lever and the stopper at the STOP end is set to 0 when the engine is stopped.

★ Problems caused by improper adjustment of engine stop motor cable

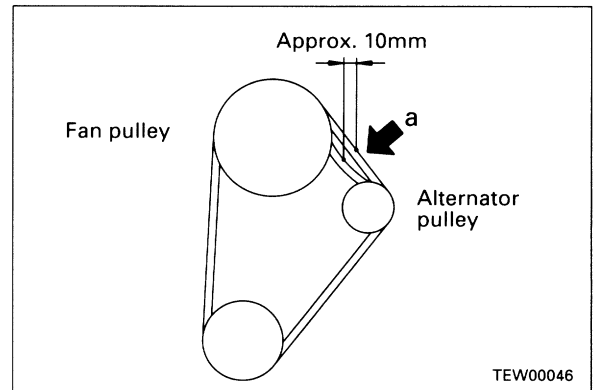
• When engine stop motor cable is pulled and clearance between stop lever and STOP stopper is too large	• Engine does not stop
• When cable is free and clearance between stop lever and RUN stopper is too large	• Engine does not give full output because of drop in amount of fuel injected

TESTING AND ADJUSTING FAN BELT TENSION

1. Testing fan belt tension

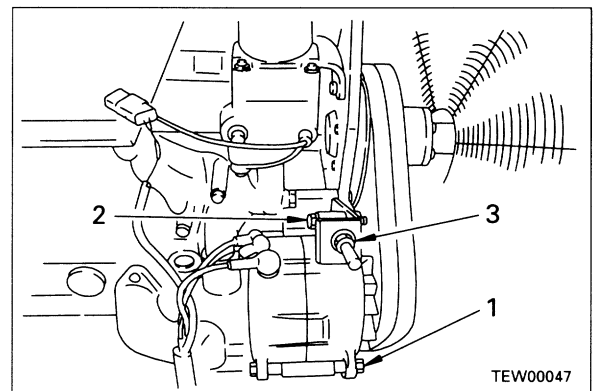
Measure the deflection of the belt when it is pushed with a finger force (approx. 58.8 N (6 kg)) at point **a** midway between the fan pulley and the alternator pulley.

★ Deflection of V-belt: Approx. 10 mm



2. Adjusting belt

- 1) Loosen alternator mount bolt (1) and adjust plate mounting bolt (2).
- 2) Loosen the locknut, then tighten adjustment nut (3) to adjust the tension of the belt.
- 3) After adjusting the belt tension to the standard value, tighten the locknut, then tighten adjust plate mounting bolt (2) and alternator mount bolt (1).



MEASURING ACCELERATOR PEDAL

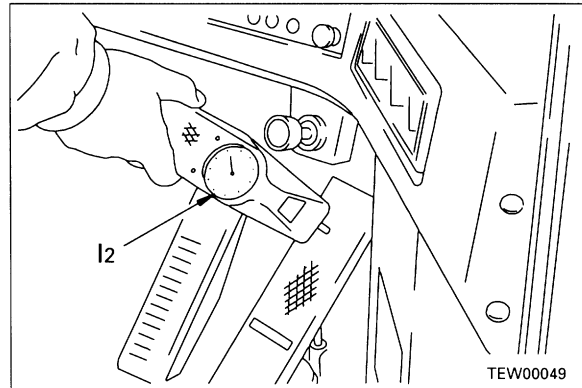
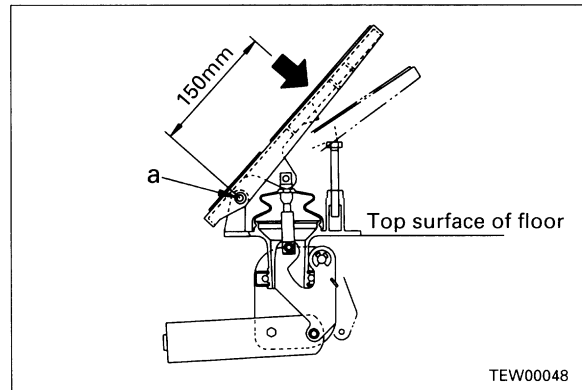
★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge

OPERATING FORCE OF ACCELERATOR PEDAL

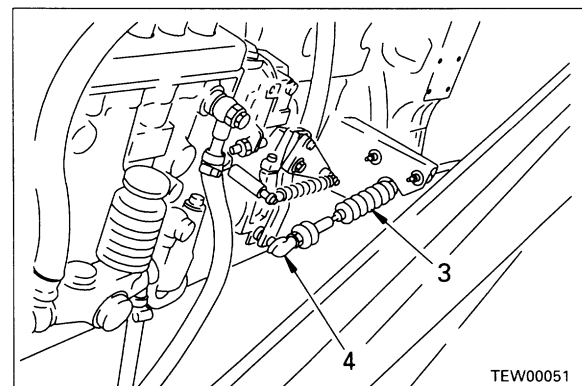
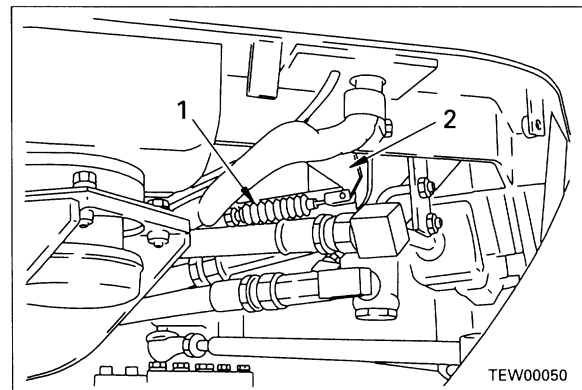
Measuring

1. Set push-pull scale **l2** at a position 150 mm from pedal fulcrum **a**.
 - ★ Put the center of push-pull scale **l2** in contact with a point 150 mm from the pedal fulcrum.
2. Start the engine, then measure the maximum value when the pedal is moved from the pushed position (low idling) to the end of its travel (high idling).



Testing and adjusting

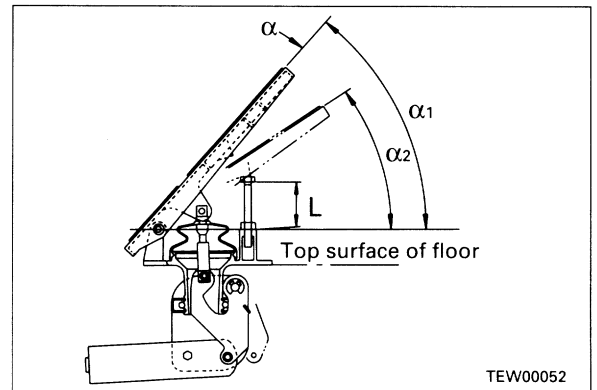
1. Stop the engine.
2. Remove cable (1) at the bottom of the accelerator pedal, and check that there is no stiffness in plate (2) or any other part under the pedal.
3. Connect cable (1) at the bottom of the pedal, disconnect it again at the injection pump connection, and check that there is no stiffness in rod (3) or ball joint (4).
 - ★ Carry out the above inspection, and adjust or replace parts if necessary. Then carry out the measurement of the operating force again to check that it is within the standard value.



OPERATING ANGLE OF ACCELERATOR PEDAL

1. Measuring

- 1) Stop the engine.
- 2) Put angle gauge ① in contact with the accelerator pedal, and measure operating angle α ($\alpha = \alpha_1 - \alpha_2$) when the pedal is operated from low idling position α_1 to high idling position α_2 .

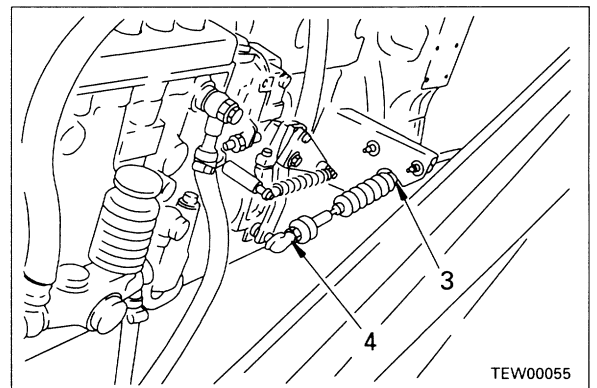
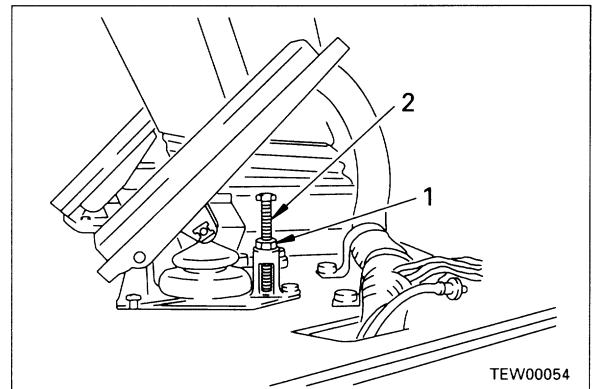
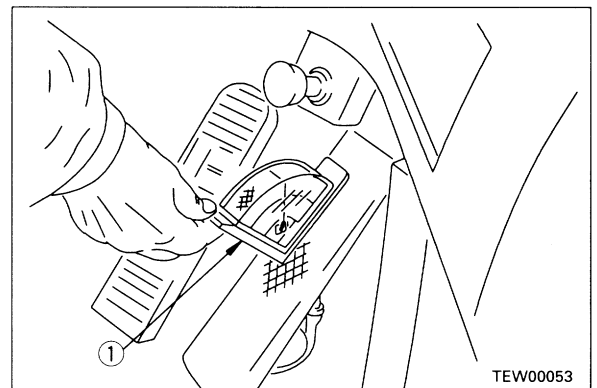


2. Adjusting

- 1) Remove the cover at the bottom of the cab, and open the inspection cover of the engine hood.
- 2) Loosen nut (1), and adjust bolt (2) so that installed height L of the accelerator pedal stopper is within a range of 49.5 ± 5 mm.
- 3) Loosen locknut (3) and adjust the length of the cable so that the injection pump governor lever contacts the high idling stopper when the accelerator pedal is depressed (high idling).
 - ★ Check that the injection pump governor contacts the low idling stopper when the accelerator pedal is let back to the low idling position.
 - ★ Adjust the travel of the governor lever with joint (4).

⚙️ Cable joint nut: 13.7 ± 1 Nm
(1.4 ± 0.1 kgm)

- ★ After carrying out the above adjustment, measure each part again and check that it is within the standard value.



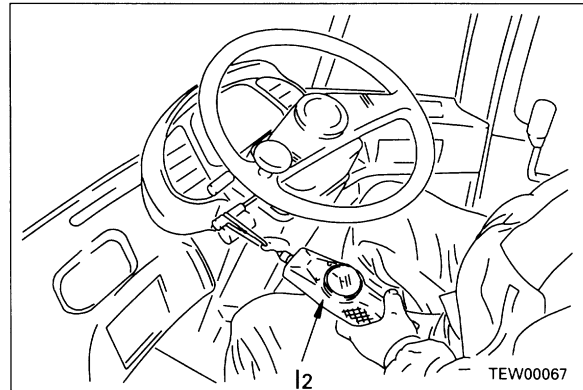
MEASURING OPERATING FORCE, TRAVEL OF SPEED LEVER

★ Measurement conditions

- Engine stopped
- Torque converter oil temperature: 60 – 80°C

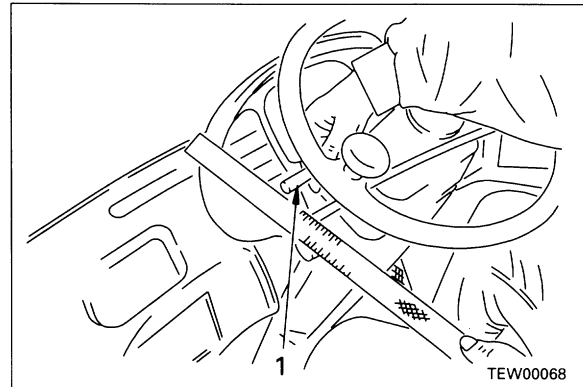
OPERATING FORCE OF SPEED LEVER

- Install push-pull scale I2 or a spring balance to the center of the control lever knob, and measure the operating force when the lever is pulled in the direction of operation.
 - ★ Carry out the measurement for each speed range.



TRAVEL OF SPEED LEVER

- Make mark (1) at the center of the control lever knob, and measure the travel when the lever is operated in the direction of operation.



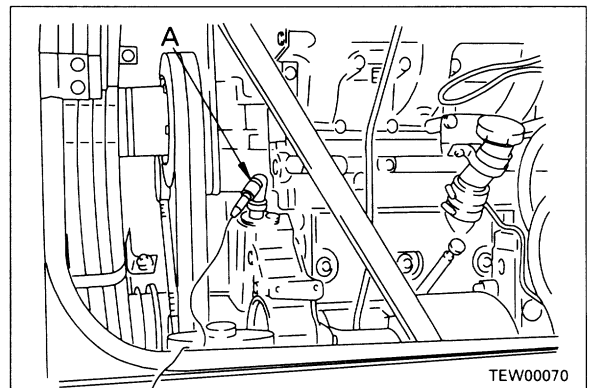
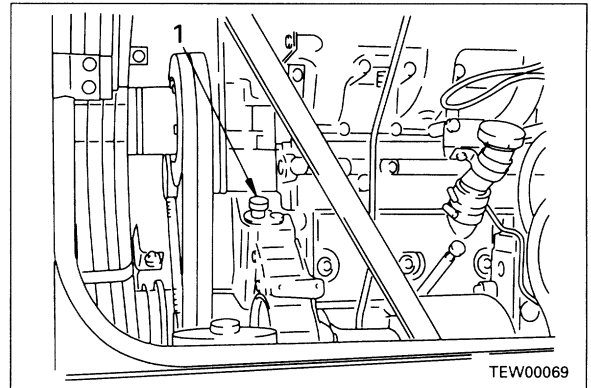
MEASURING STALL SPEED

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Engine speed: High idling
- Torque converter oil temperature: 60 – 80°C

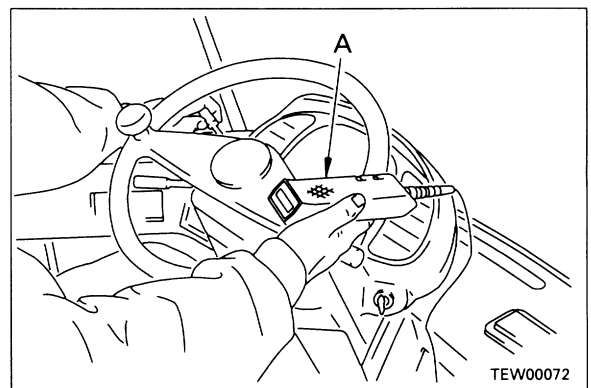
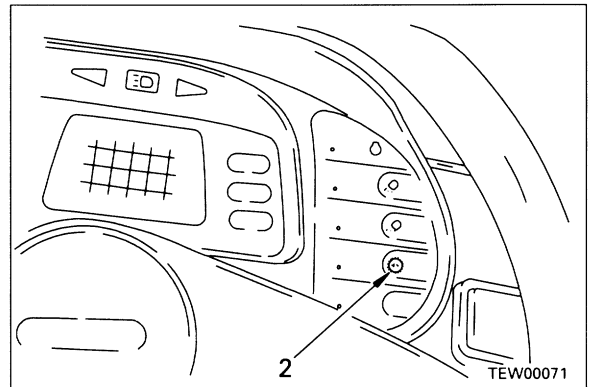
- ★ Check that low idling and high idling are the standard values.
- ★ Before measuring each stall speed, install multi-tachometer **A** to speed pickup port (1) on the engine block.
- ★ Check that the engine speed is the standard value. If it is not within the standard range, check for loose linkage or play.

⚠ Apply the parking brake and put blocks under the tires.



TORQUE CONVERTER STALL SPEED

1. Start the engine and run at low idling.
2. Release the parking brake.
3. Place the speed lever at the highest position for FORWARD or REVERSE.
4. Use the brakes to stop the machine, then use multi-tachometer **A** to measure the speed when the engine is run at high idling.
 - ★ Turn transmission cut-off selector switch (2) OFF and use the left brake. (Check that the pilot lamp goes out.)
 - ★ Do not keep the stall condition for more than 20 seconds. Make sure that the torque converter oil temperature does not exceed 120°C.



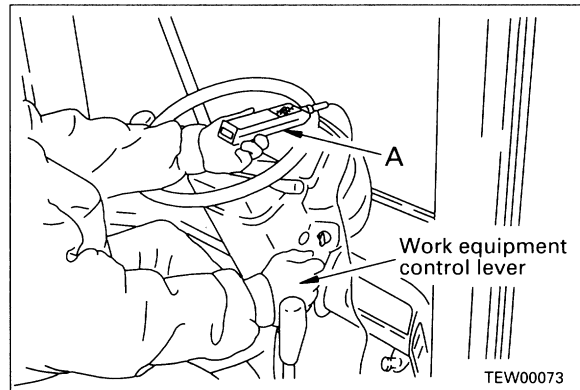
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TESTING AND ADJUSTING

MEASURING STALL SPEED

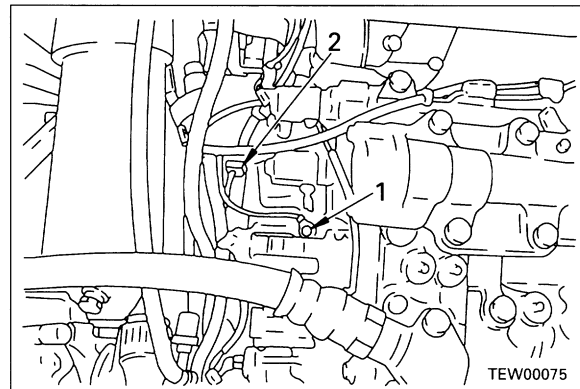
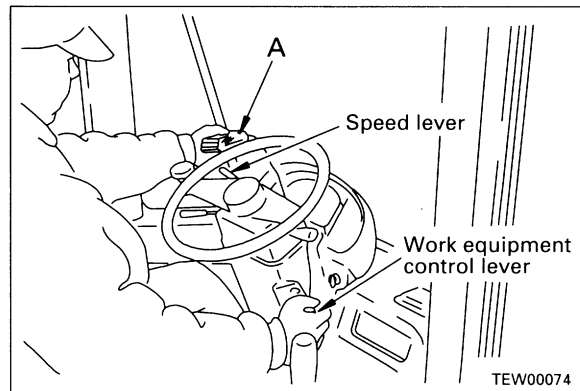
HYDRAULIC STALL SPEED

1. Start the engine and run at high idling.
2. Operate the lever to the DUMP or LIFT position to operate the cylinder to the end of its stroke and actuate the relief valve in the main control valve.
3. Use multi-tachometer **A** to measure the engine
 - ★ Do not keep the stall condition for more than 20 seconds. Operate the control lever quickly.



FULL STALL SPEED

- Measure the engine speed when the torque converter stall and hydraulic stall are both carried out at the same time.
 - ★ Before measuring the full stall, check that the torque converter stall and hydraulic stall speeds are normal. If either of the stall speeds are abnormal, correct the problem and measure again.



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MEASURING TORQUE CONVERTER, TRANSMISSION, PARKING BRAKE OIL PRESSURE

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Torque converter oil temperature: 60 – 80°C

Apply the parking brake and put blocks under the tires.

Preparatory work

- ★ The following preparatory work is necessary when measuring all oil pressures.
 - Remove cover (1) on the left side of the rear frame.
 - Turn transmission cut-off selector switch (2) OFF and use the left brake. (Check that the pilot lamp is OFF.)
 - Remove the plug from the measurement port of the transmission valve.
 - Install hydraulic tester kit **B** to the measurement port, extend the gauge to the operator's compartment, then start the engine and measure the pressure.
- ★ Check that no oil is leaking from any connection.

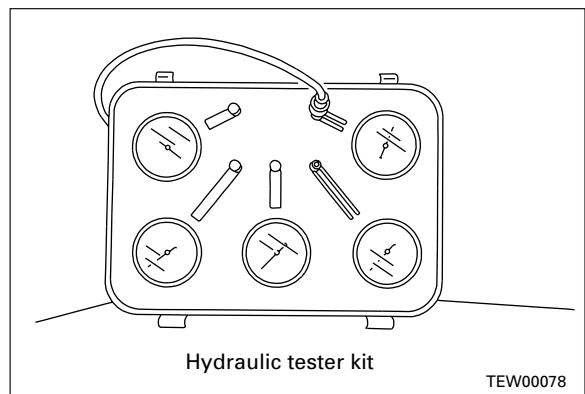
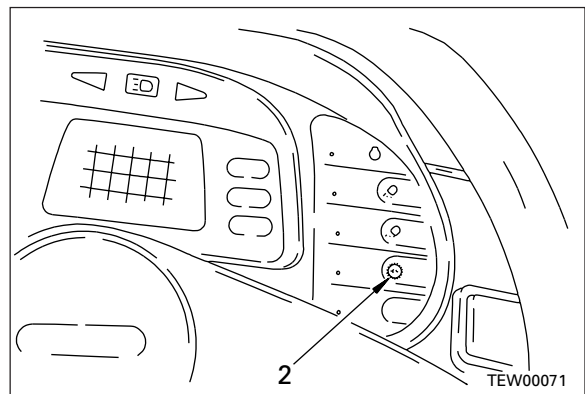
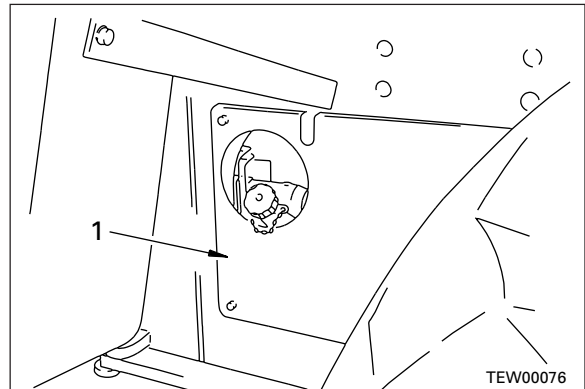
Measurement method

1. Priority pressure

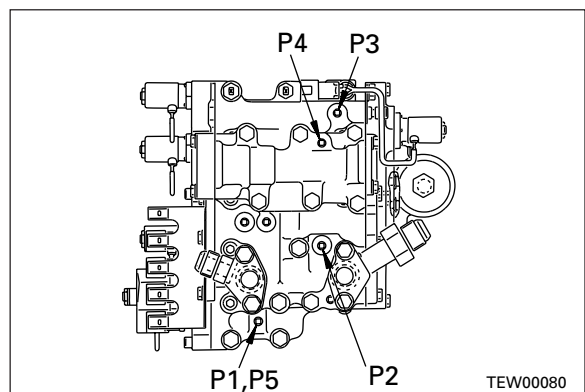
- 1) Measurement port (P1, PT 1/8)
- 2) Start the engine, run at low idling, and measure the pressure at the rated speed.

2. Torque converter outlet port pressure

- 1) Measurement port (P2, PT 1/8)
- 2) Start the engine, run at low idling, and measure the pressure at the rated speed.



Mechanical modulation



3. Pilot pressure

- 1) Measurement port (P3, PT 1/8)
- 2) Start the engine and measure the pressure.

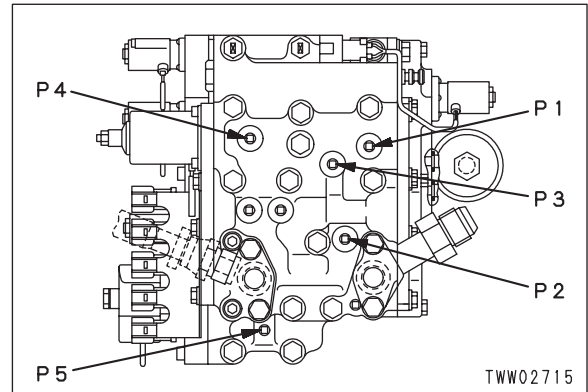
4. Clutch pressure

- 1) Measurement port (P4, PT 1/8)
- 2) Start the engine.
- 3) Release the parking brake.
- 4) Place the directional lever at neutral, and measure the pressure when the speed lever is operated.

5. Parking brake pressure

- 1) Measurement port (P5, PT 1/8)
- 2) Start the engine, and measure the pressure when the parking brake is released.

Electronic modulation (Auto-shift Transmission)



METHOD OF OPERATING EMERGENCY MANUAL SPOOL

Outline

The transmission valve is controlled electrically, but if there should be any failure in the electrical system, or if there is any failure in the solenoid valve or spool and the machine cannot move, it is possible to operate the emergency manual spool to move the machine.

! This operation of the spool is designed only for use if the machine cannot be moved because of a failure in the transmission control, and it is necessary to move the machine from a dangerous working area to a safe place where repairs can be carried out.

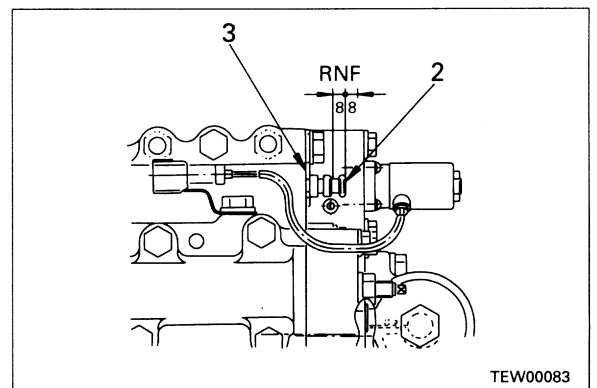
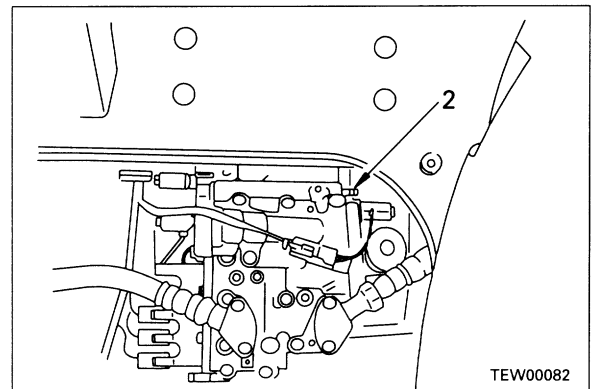
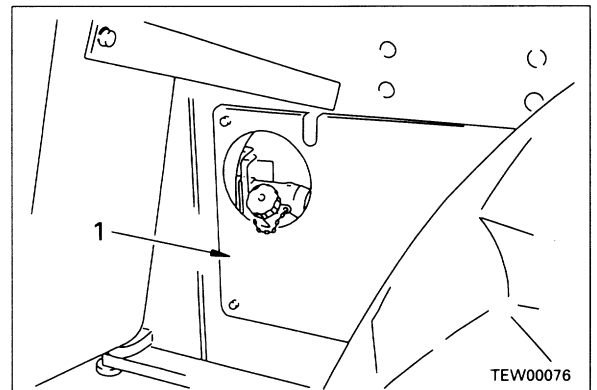
This spool must not be operated except when there has been a failure.

! When carrying out this operation, keep strictly to the order of operation and pay careful attention to safety when moving the machine.

! To prevent the machine from moving, lower the bucket to the ground, apply the parking brake, and put blocks under the tires.

! Always stop the engine before operating the spool.

1. Remove cover (1) from the left side of the rear frame.
2. Remove lock plate (3) from emergency manual spool (2) of the transmission valve.
 - ★ The lock plate can be removed simply by loosening the mounting bolts.
3. Operate emergency spool (2) to the operating position according to the direction of movement of the machine (forward or reverse).
 - REVERSE: Push in the spool until it enters the detent. (Approx. 8 mm)
 - FORWARD: Pull the spool until it enters the detent. (Approx. 8 mm)
4. Check that the area around the machine is safe, then remove the blocks from under the tires.
5. Sit in the operator's seat and depress the left brake pedal fully.



6. Start the engine, then release the parking brake and slowly let the brake pedal out to start the machine.

 When the engine is started, the transmission is also engaged and the machine will start, so always check carefully that the area around the machine and in the direction of travel is safe, and keep the brake pedal depressed fully when starting the engine.

7. After moving the machine, stop the engine, then apply the parking brake and put blocks under the tires.
8. Return the manual spool to the neutral position and install the lock plate.

MEASURING CLEARANCE BETWEEN TIRE AND WHEEL

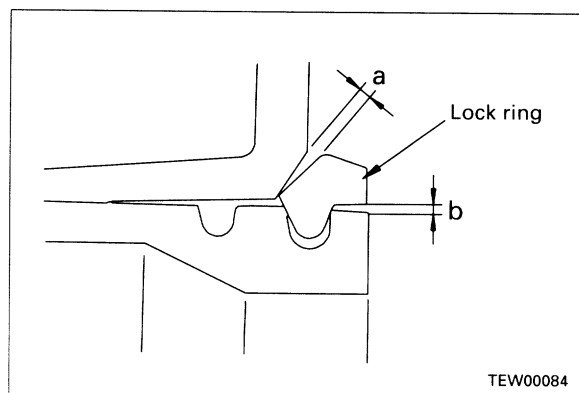
★ Measurement conditions

- Tire inflation pressure: Specified pressure

Method of measuring

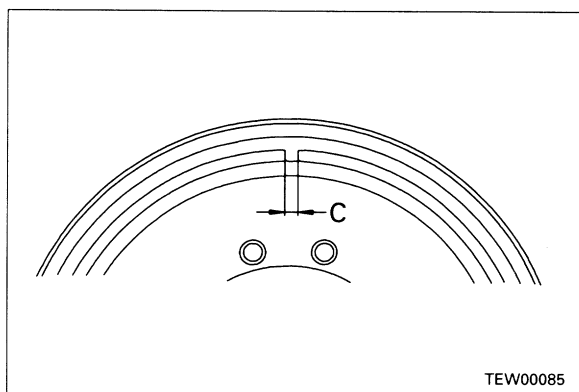
1. Fitting of wheel lock ring

Using feeler gauge **O**, measure dimensions **a** and **b** at four places around the circumference.



2. Clearance of wheel lock ring

Measure dimension **c**.



TESTING AND ADJUSTING STEERING WHEEL

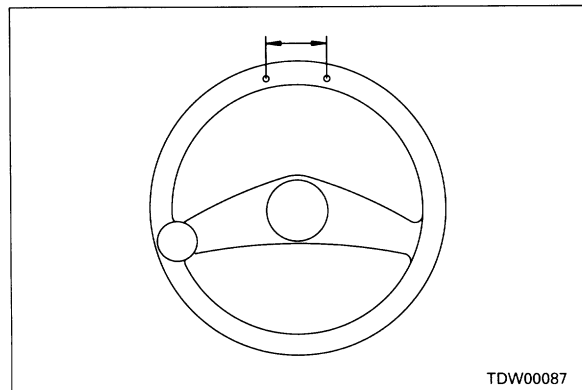
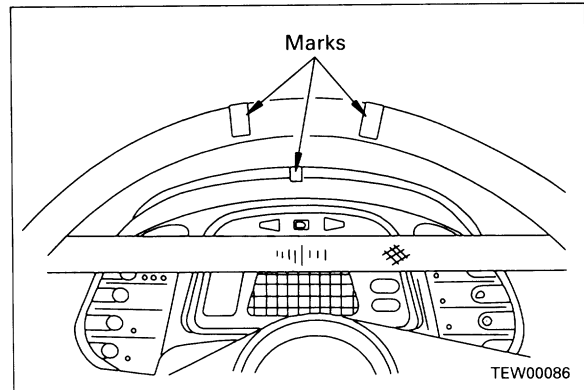
MEASURING PLAY OF STEERING WHEEL

★ Measurement conditions

- Engine speed: Stopped
- Machine posture: Facing straight forward

Method of measurement

1. Move the steering wheel 2 or 3 times lightly to the left and right, check that the steering mechanism is at the neutral position, then make a mark on the outside frame of the machine monitor.
2. Turn the steering wheel to the right, and make a mark at the position where the operating force starts to become heavy (when the steering valve lever starts to move).
3. Turn the steering wheel to the left in the opposite direction from Step 2, and make a mark at the point where the operating force becomes heavy (when the steering valve lever starts to move). Then measure the distance in a straight line between the marks made in Step 2 and Step 3.



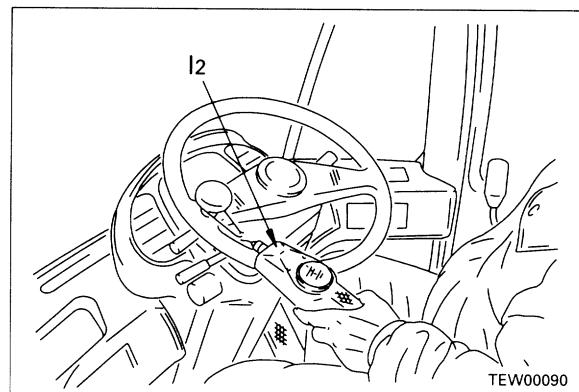
MEASURING OPERATING FORCE OF STEERING WHEEL

★ Measurement conditions

- Road surface: Flat, horizontal, dry paved surface
- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Tire inflation pressure: Specified pressure
- Engine speed: Low idling (bucket empty)

Measurement method

1. Install push-pull scale **l2** to the steering wheel knob.
2. Start the engine.
 - ★ After starting the engine, raise the bucket approx. 400 mm and remove the safety bar.
3. Pull push-pull scale **l2** in the tangential direction and measure the value when the steering wheel moves smoothly.
 - ★ Avoid measuring when the steering wheel starts to move.



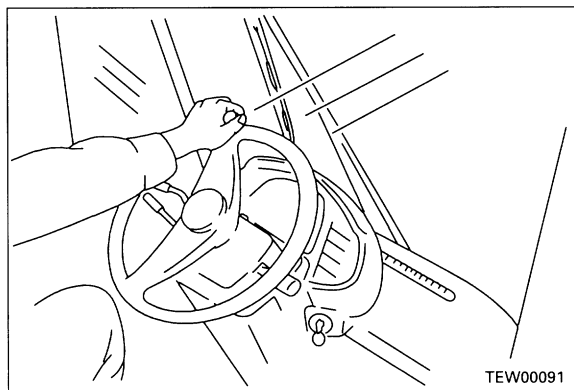
MEASURING OPERATING TIME FOR STEERING WHEEL

★ Measurement conditions

- Road surface: Flat, horizontal, dry paved surface
- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Tire inflation pressure: Specified pressure
- Engine speed: Low and high idling

Measurement method

1. Start the engine.
 - ★ After starting the engine, raise the bucket approx. 400 mm and remove the safety bar.
2. Operate the steering wheel to the end of its stroke to turn the machine to the left or right.
3. Measure the time taken to operate the steering wheel to the end of the stroke to the right (left).
 - ★ Operate the steering wheel as quickly as possible without using force.
 - ★ Carry out the measurements both at low idling and high idling, and to both the left and right.



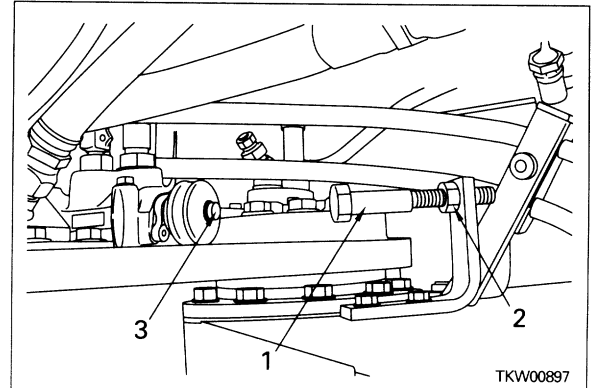
TESTING AND ADJUSTING STEERING CONTROL

★ Measurement conditions

- Hydraulic oil temperature: 45 – 55°C
- Engine speed: 1,200 rpm
- Road surface: Flat, horizontal, dry paved surface
- Tire inflation pressure: Standard pressure

Testing

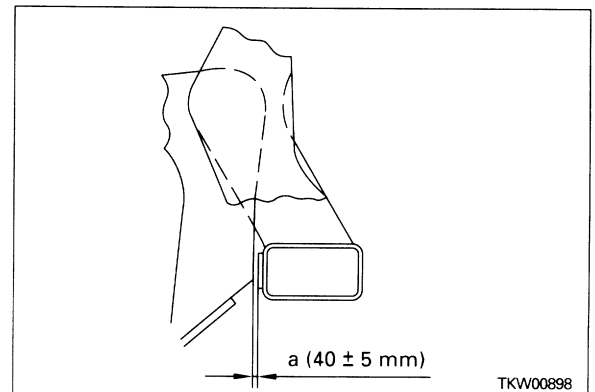
1. Start the engine and operate the steering to set the front and rear frames straight.
2. Check the looseness of locknut (2) of stopper bolt (1).
3. Start the engine and measure clearance between the front frame and rear frame stopper when the steering wheel is turned fully to the left and right.
 - ★ When measuring the clearance, check that the end face of the spool of stop valve (3) is in contact with the head of the stopper bolt.



TKW00897

Adjusting

1. Adjust the stopper bolt.
 - 1) Screw in stopper bolt (1) to make it the minimum length.
 - 2) Run the engine at low idling and operate the steering slowly to contact the frame stopper.
 - 3) Turn the stopper bolt until the head of stopper bolt (1) contacts the end face of the spool of stop valve (3).
 - 4) Set the machine facing straight, and stop the engine.
 - 5) Loosen stopper bolt (1) 8.5 turns, then lock it in position with locknut (2).
 - 6) Carry out steps 1) – 5) for both the left and right sides.
2. Start the engine and measure clearance "a" between the front frame and rear frame stopper when the steering wheel is turned fully to the left and right.
 - ★ When measuring the clearance, check that the end face of the spool of stop valve (3) is in contact with the head of the stopper bolt.



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MEASURING STEERING OIL PRESSURE

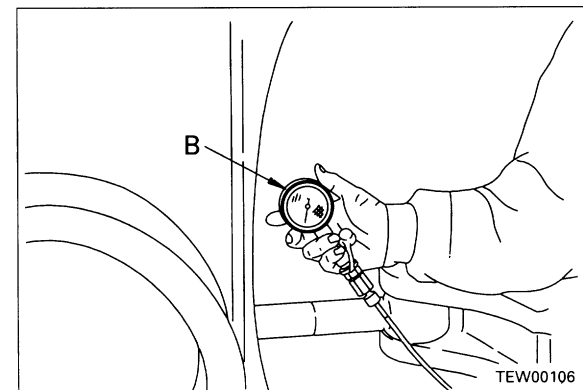
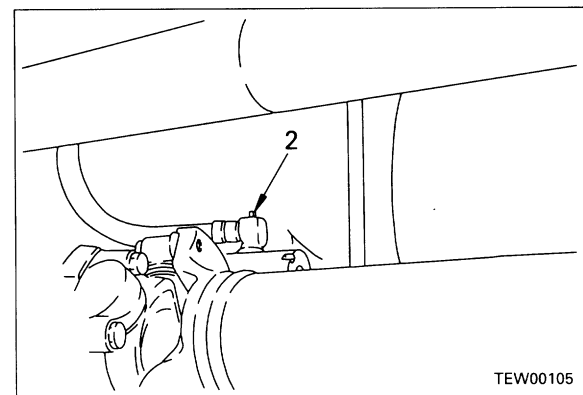
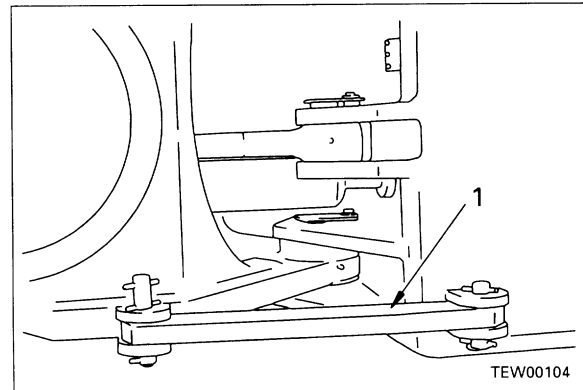
★ Measurement conditions

- Hydraulic oil: 45 – 55°C
- Engine speed: High idling

METHOD OF MEASURING MAIN RELIEF PRESSURE

⚠ Loosen the oil filler cap to release the pressure inside the hydraulic tank, then turn the steering wheel several times to release the remaining pressure inside the piping.

1. Apply safety bar (1) to the frame.
2. Remove measurement plug (2) for the right turn steering circuit.
3. Install hydraulic tester kit **B** to the measurement port.
4. Start the engine, run the engine at high idling, then turn the steering wheel to the right and measure the pressure when the relief valve is actuated.
 - ★ To measure the pressure when turning the steering wheel to the left, remove the plug for the left turn steering circuit.

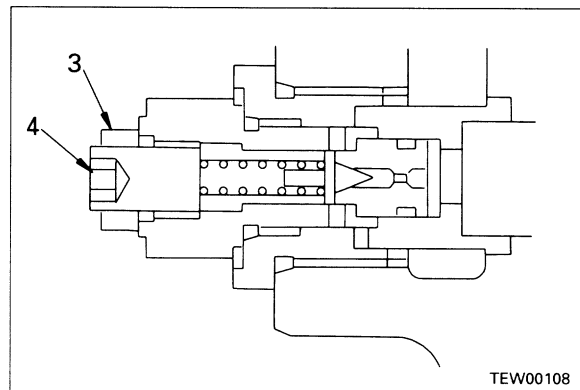


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Adjusting

! Always stop the engine before adjusting the pressure.

1. Stop the engine.
2. Loosen locknut (3) of steering relief valve in steering valve then turn adjustment screw (4) to adjust.
 - ★ Pressure adjustment for one turn of adjustment screw: Approx. 14.8 MPa (151 kg/cm²)
 - ★ Turn the adjustment screw to adjust the set pressure as follows.
TIGHTEN to INCREASE pressure
LOOSEN to DECREASE pressure
 - ★ Do not carry out any adjustment if the relief pressure cannot be measured accurately.



MEASURING OPERATING FORCE, TRAVEL OF BRAKE PEDAL

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Engine speed: Low idling

Operating force of pedal

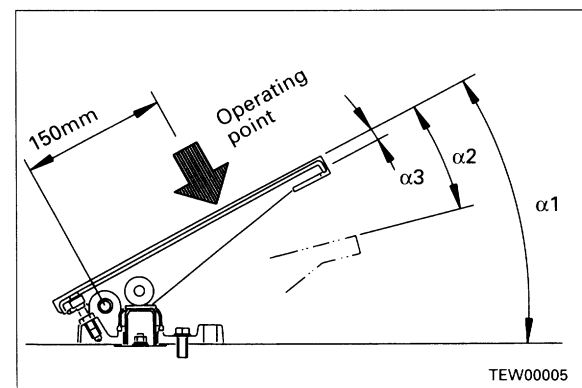
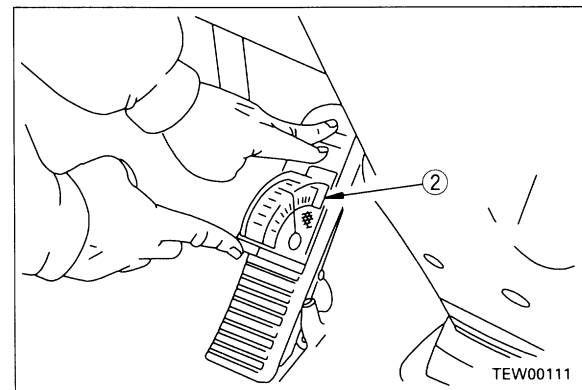
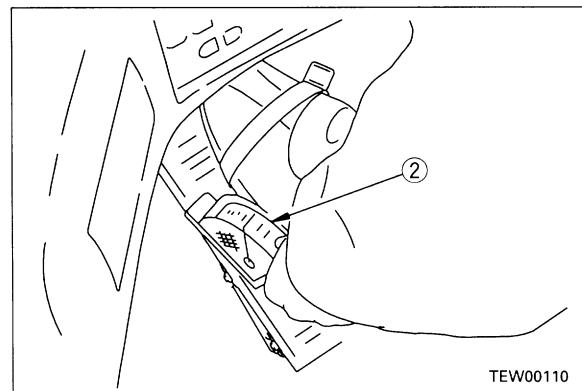
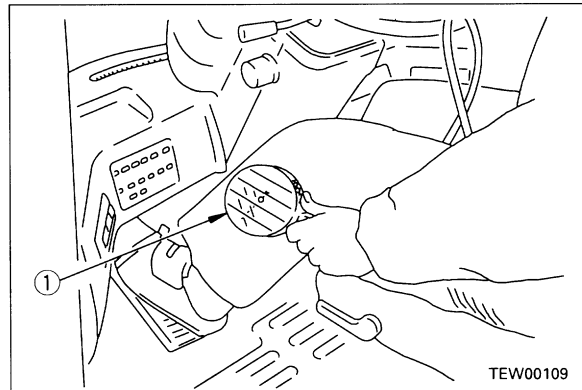
1. Install push gauge ① to the operator's foot.
 - ★ Align the center of the push gauge with the center of the pedal.
2. Start the engine, run at low idling, and measure the operating force when the pedal is depressed.

Travel of pedal

1. Install push gauge ① to the operator's foot.
 - ★ Align the center of the push gauge with the center of the pedal.
2. Start the engine, and measure pedal angle α_1 when running at low idling, and pedal angle α_2 when the pedal is depressed with a force of 30 kg.
 - ★ Install angle gauge ② to the brake pedal when measuring.

Pedal play

1. Start the engine.
2. Push the brake pedal lightly by hand, and measure pedal angle α_3 when the pedal starts to become heavy.



TESTING BRAKE OIL PRESSURE

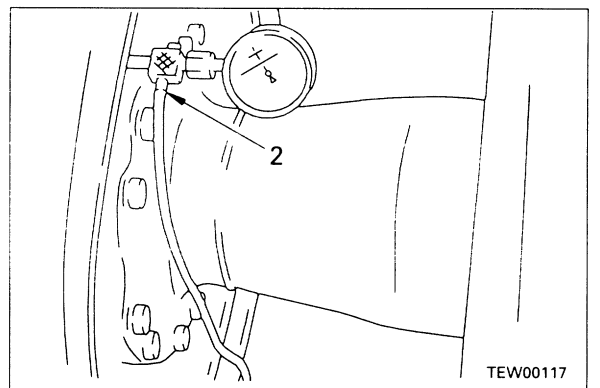
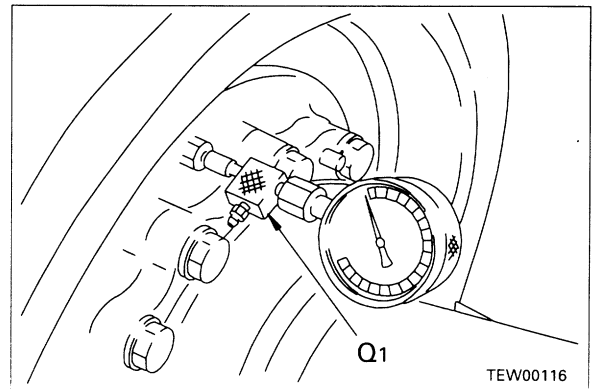
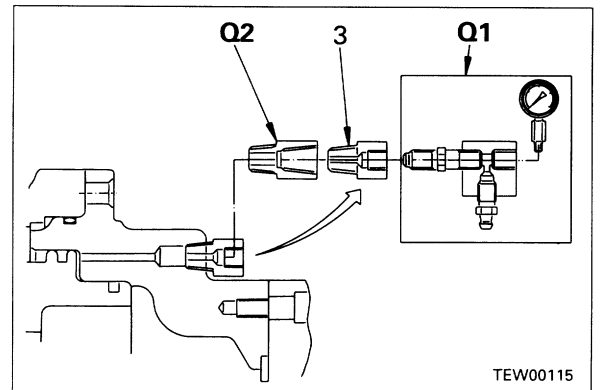
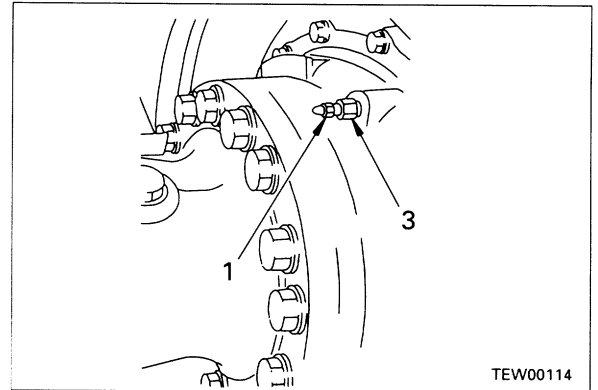
★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Brake oil pressure: 4.9MPa (50kg/cm²)

⚠ Put blocks securely under the tires.

Testing

1. Remove bleeder screw (1) and nipple (3), then install tool **Q2**, nipple (3), and tool **Q1** in order in the mount of bleeder screw (1).
2. Start the engine and bleed the air.
 - ★ This operation is carried out with two workers. One worker operates the brake pedal while the other worker bleeds the air from bleeder screw (2).
 - ★ Turn the transmission cut-off switch ON.
3. Depress the left brake, set the gauge reading to 4.9 MPa (50 kg/cm²), then leave for 5 minutes and measure the drop in the pressure.
4. After measuring, stop the engine, loosen the bleeder screw to lower the pressure, then remove tool **Q1**.
 - ★ Remove tool **Q2** also.
 - ★ After completing the operation, bleed the air from the brake circuit again.



MEASURING BRAKE PERFORMANCE

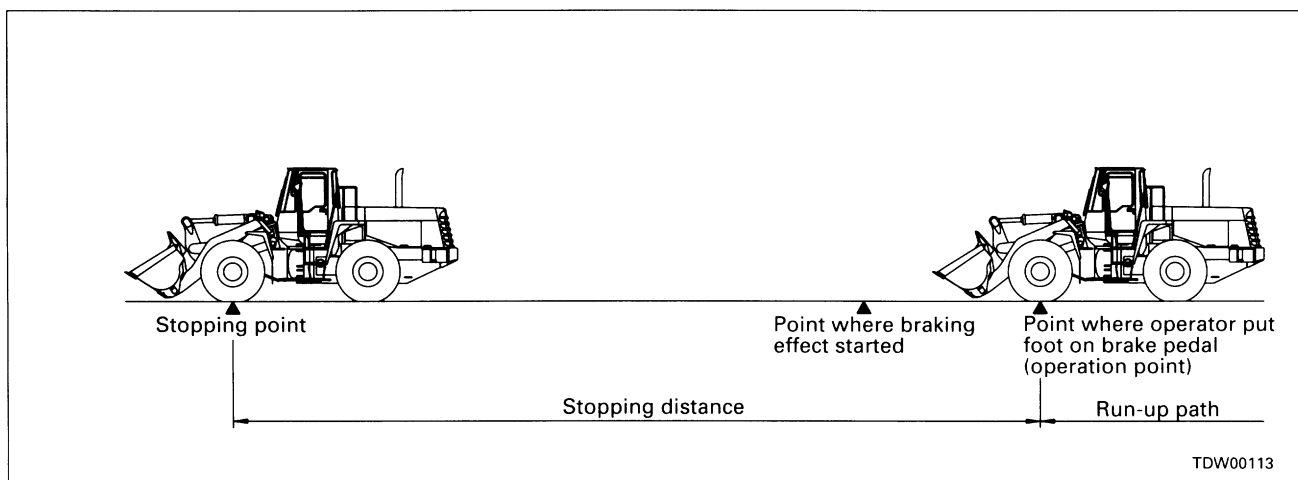
★ Measurement conditions

- Road surface: Flat, horizontal, dry paved surface
- Travel speed: 20 km/h when brakes are applied
- Delay in applying brakes: 0.1 sec
- Tire inflation pressure: Specified pressure

Measurement method

1. Start the engine and move the machine.
2. Set the speed lever to the highest speed position and drive the machine.
3. When the travel speed reaches 20 km/h, depress the left brake pedal with the specified operating force.
 - ★ Before carrying out this operation, determine the run-up path and the point for applying the brakes, then apply the brakes when the machine reaches that point.
 - ★ Switch the transmission cut-off switch ON when carrying out this operation.
4. Measure the distance from the point where the brakes were applied to the point where the machine stopped.
 - ★ Repeat this measurement three times and take the average.

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MEASURING BRAKE DISC WEAR

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Brake oil pressure:
Specified (4.9 MPa (50 kg/cm²))

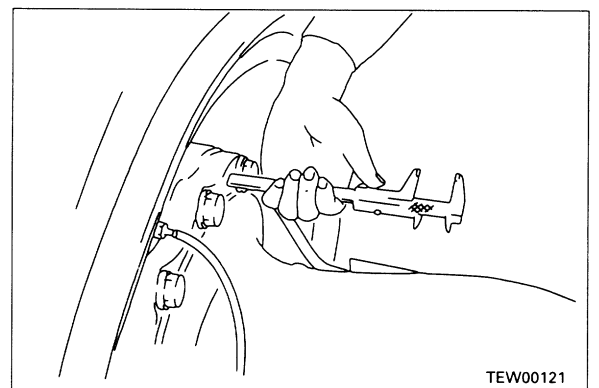
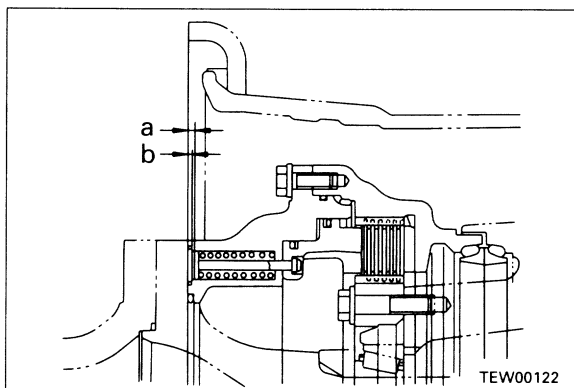
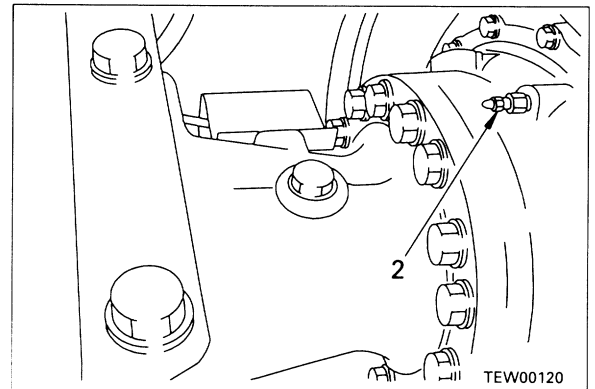
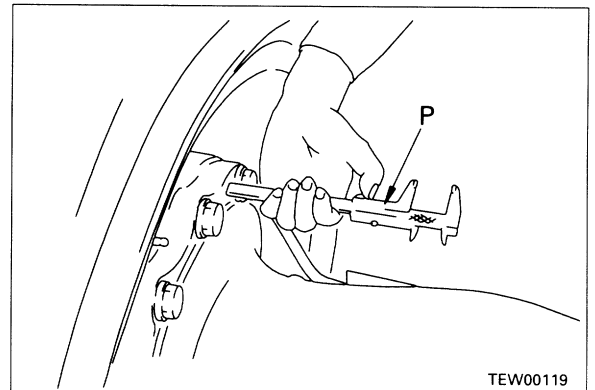
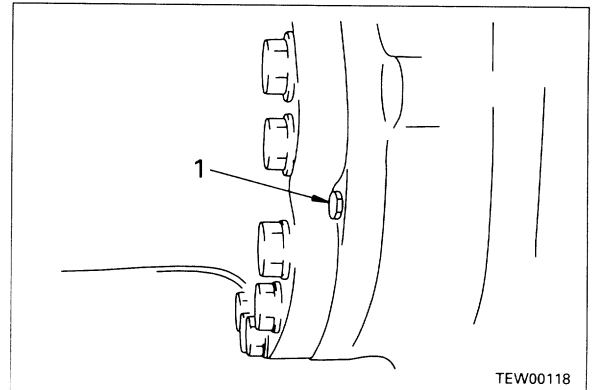
⚠ Park the machine on horizontal ground and put blocks securely under the tires.

Measurement method

1. Remove plug (1).
2. Depress the brake pedal fully.
3. Use calipers **P** to measure depth **a** from the end face of the housing to the spring guide.
 - ★ When measuring, keep the brake pedal depressed.
4. Install a vinyl hose to bleeder (2), then loosen the bleeder and drain the brake oil.
 - ★ After draining the brake oil, check that the brake piston has returned to the end of its stroke.
5. Measure depth **b** from the end face of the housing to the spring guide pin.

Calculating piston stroke

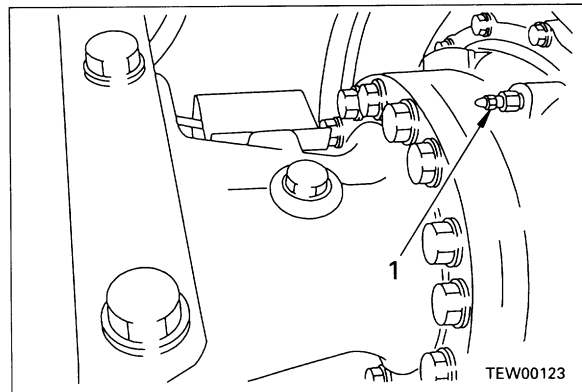
- $S = a - b$ $S = \text{Max. } 6.2 \text{ mm}$



BLEEDING AIR FROM BRAKE SYSTEM

⚠ Put blocks securely under the tires.

1. Remove cap (1) of the bleeder screw, insert a vinyl hose into the screw, and insert the other end in a container.
2. Start the engine.
3. Depress the brake pedal, then loosen the bleeder screw and bleed the air.
 - ★ This operation is carried out with two workers. One worker operates the brake pedal while the other worker bleeds the air from the bleeder screw.
 - ★ When depressing the brake pedal, use the left pedal.
4. When no more bubbles come out with the fluid from the hose, depress the pedal fully and tighten the bleeder screw while the oil is still flowing.
 - ★ Repeat the operation to bleed the air from the other cylinders, and after completing the operation, check the level in the oil tank and add more oil if necessary.
 - ★ To bleed the air completely, bleed the air first from the cylinder which is farthest from the brake pedal.



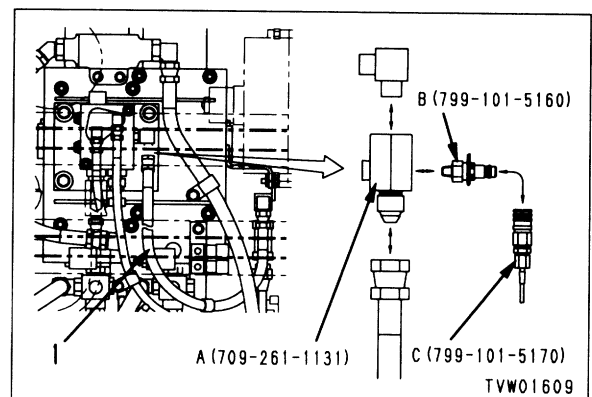
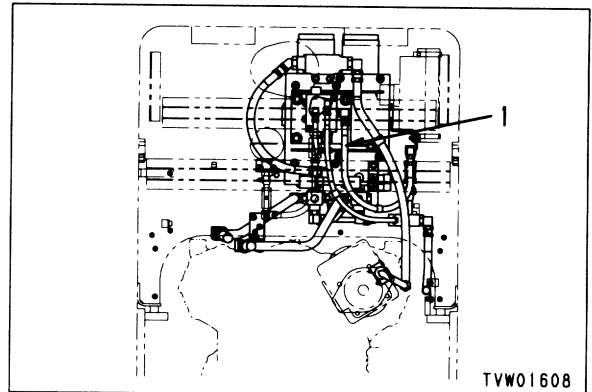
TESTING AND ADJUSTING ACCUMULATOR CHARGE PRESSURE

Measuring

- ★ Hydraulic oil temperature: 45 – 55°C

⚠ Stop the engine, then depress the brake pedal at least 100 times to release the pressure inside the accumulator circuit.

1. Disconnect accumulator inlet port hose (1), then install tools **A**, **B**, and **C** and oil pressure gauge (39.2 MPa {400 kg/cm²}).
2. Measure the accumulator charge cut-in pressure. Start the engine, run at low idling, and measure the oil pressure when the brake oil pressure warning pilot lamp on the maintenance monitor goes out.
3. Measure the accumulator charge cut-out pressure. After the accumulator charge cut-in, the pressure rises. Measure the oil pressure at the point where the oil pressure gauge indicator suddenly drops after rising.



Adjusting

- ★ When the accumulator charge cut-out pressure is adjusted, the cut-in pressure also changes because of the valve area ratio. For this reason, there is no cut-in pressure adjustment screw.

1. Loosen locknut (3) of accumulator charge cut-out valve (2), then turn adjustment screw (4) to adjust.

- ★ Turn the adjustment screw to adjust as follows.

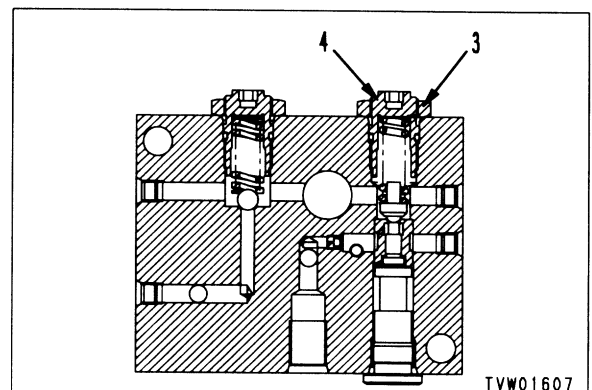
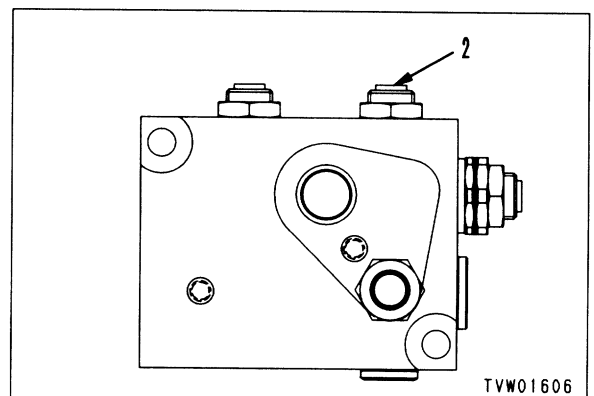
- To INCREASE the pressure, turn CLOCKWISE.
- To DECREASE the pressure, turn COUNTERCLOCKWISE.

- ★ Amount of adjustment for one turn of adjustment screw: 5.6 MPa {57 kg/cm²}

Locknut:

10.78 ± 0.98 Nm {1.1 ± 0.1 kgm}

- ★ After completion of the adjustment, repeat the above procedure for testing to check the accumulator charge cut-in pressure and cut-out pressure again.



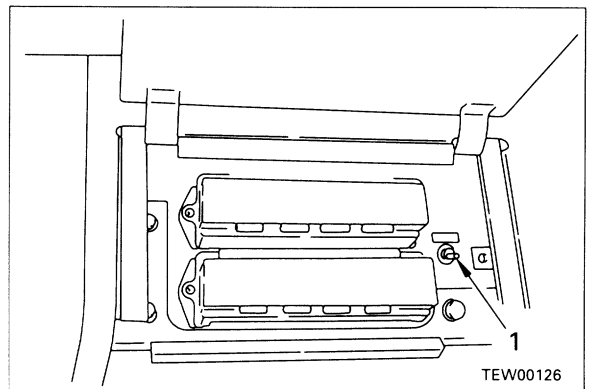
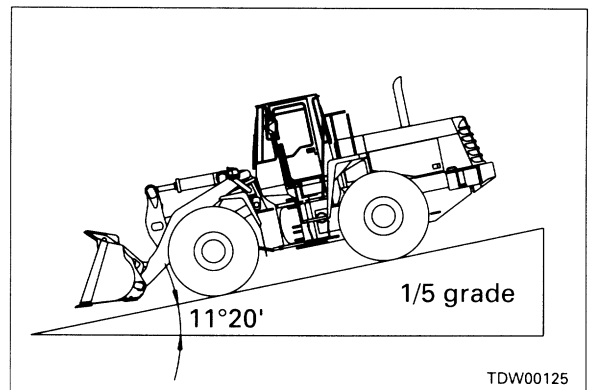
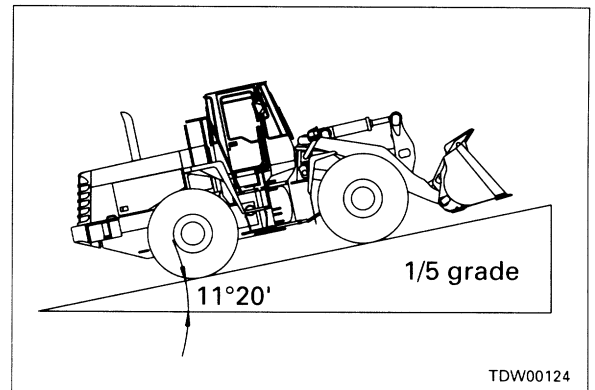
MEASURING PARKING BRAKE PERFORMANCE

★ Measurement conditions

- Tire inflation pressure: Specified pressure
- Road surface: Flat, dry paved road surface with slope of 1/5 grade (11°20').
- Machine: Operating condition
- ★ Keep parking forced release switch (1) at the rear of the operator's seat at the OFF position.

Measurement method

1. Start the engine, set the machine facing in a straight line, then drive the machine up a 1/5 grade slope with the bucket empty.
2. Depress the brake, stop the machine, set the directional lever to the neutral position, then stop the engine.
3. Turn the parking brake switch ON, then gradually release the brake pedal and check that the machine is held in position.
 - ★ When the engine is stopped, the parking brake is automatically switched ON.
 - ★ Carry out the measurement in two ways: Once with the machine facing uphill, and once more with the machine facing downhill.



MANUAL RELEASE METHOD FOR PARKING BRAKE

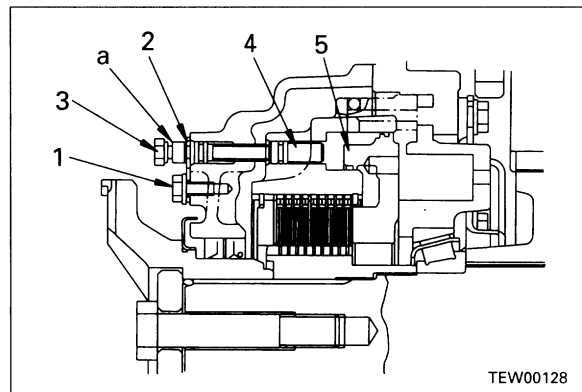
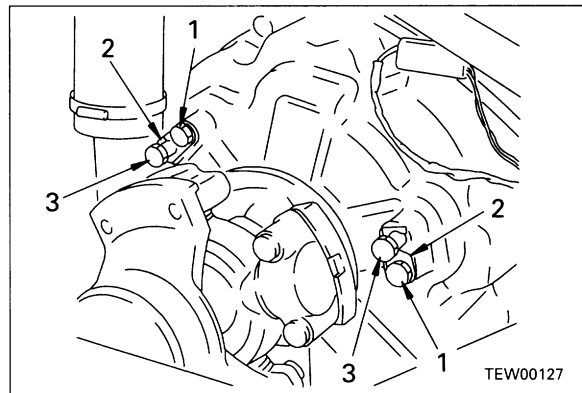
★ The parking brake is controlled by hydraulic pressure, so if there should be any failure in the transmission and it becomes impossible to release the parking brake, it is possible to release it manually to move the machine.

⚠ The manual release of the parking brake is designed only to move the machine from a dangerous working area to a safe place where repairs can be carried out. This method must not be used except when there has been a failure.

⚠ To prevent the machine from moving, lower the bucket to the ground and put blocks under the tires.

⚠ Always stop the engine before carrying out this procedure.

1. Loosen bolt (1), then remove lock plate (2) from bolt (3) (3 places).
2. Tighten bolts (3) at 3 places in turn as far as the mounting position for the plate at portion "a", then install lock plate (2) at portion "a".
 - ★ Tighten all three bolts uniformly a little at a time.
 - ★ Bolt (3) pushes piston (4) and (5) and releases the parking brake.
3. Tighten bolt (1) to secure lock plate (2) in position.



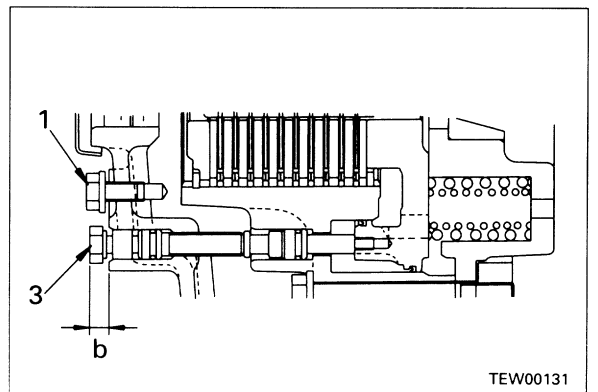
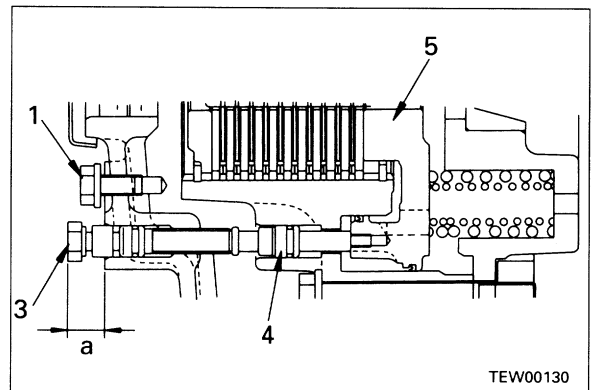
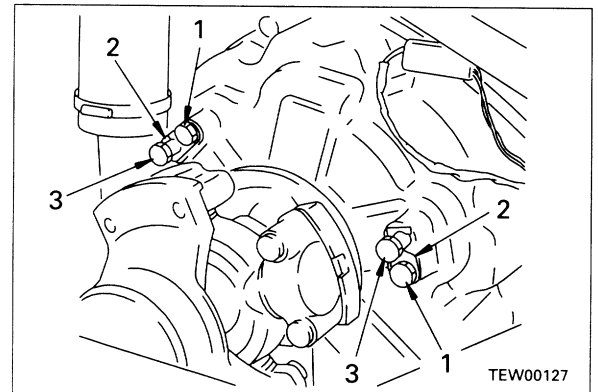
TESTING WEAR OF PARKING BRAKE DISC

★ If the parking brake becomes weak, measure the piston stroke as follows.

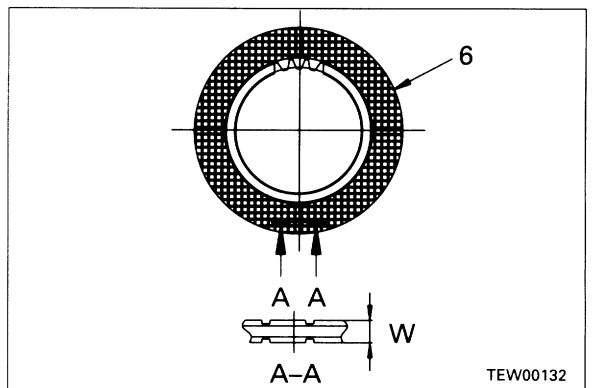
⚠ To prevent the machine from moving, lower the bucket to the ground and put blocks under the tires.

⚠ Always stop the engine before carrying out this procedure.

1. Loosen bolt (1), then remove lock plate (2) from parking brake manual release bolt (3) (3 places).
2. Measure dimension "a" with the three manual release bolts (3) in contact lightly with brake pistons (4) and (5).
3. Tighten the three manual release bolts (3) in turn and measure dimension "b" when brake pistons (4) and (5) are pushed in fully.
 - ★ Piston stroke (L) = a - b
 - L = Max. 9.9



- ★ If the piston stroke is greater than 9.9 mm, check thickness **W** of brake disc (6). For details, see DISASSEMBLY AND ASSEMBLY, REMOVAL OF PARKING BRAKE DISC.
- Dimension **W**: Min 2.83 mm



MEASURING WORK EQUIPMENT CONTROL LEVER

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Engine speed: Low idling

⚠ Install the safety bar to the frame.

Measurement method

1. Operating force of work equipment control lever

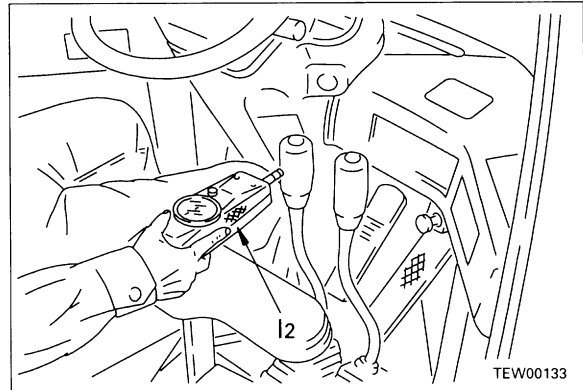
Install push-pull scale **I2** to the work equipment control lever and measure the operating force.

- ★ Install the push-pull scale to the center of the knob.
- ★ Operate the control lever at the same speed as for normal operations, and measure the minimum value for the force needed to operate the knob.

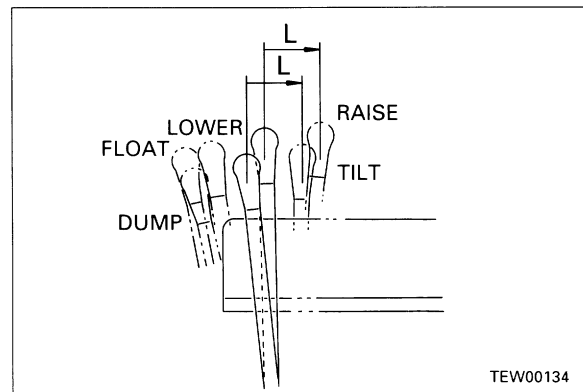
2. Travel of work equipment control lever

Measure travel **L** at each position when operating the work equipment control lever.

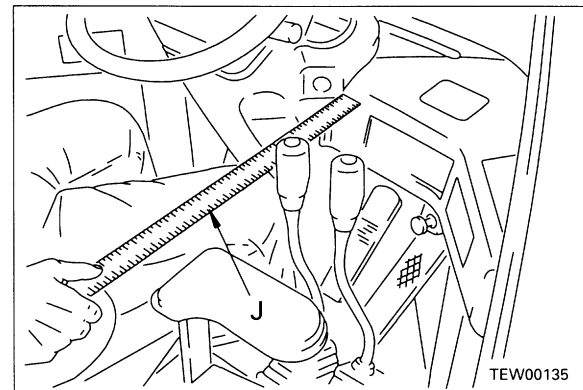
- ★ Mark the lever knob and use scale **J** to measure.



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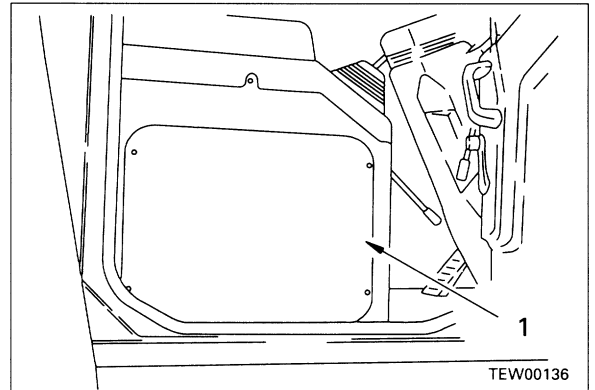
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TESTING AND ADJUSTING

MEASURING WORK EQUIPMENT CONTROL LEVER

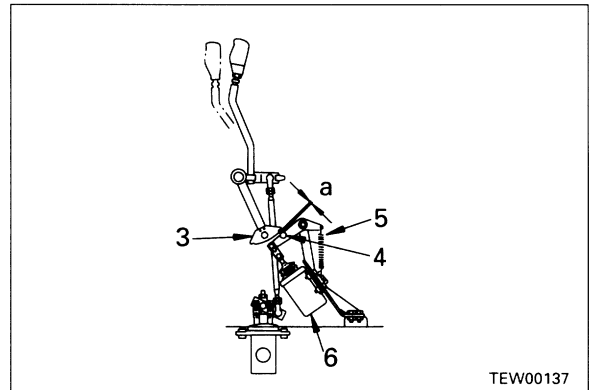
Adjusting

1. Remove cover (1).
2. With solenoid (6) pulled, fix the solenoid in position so that the clearance between cam (3) and roller (4) is dimension **a**.
Dimension **a**: 0 – 0.5 mm
 - ★ Set the bucket lever and lift lever at the HOLD position.
 - ★ If cam (3), roller (4), or spring (5) are broken, replace them before adjusting.



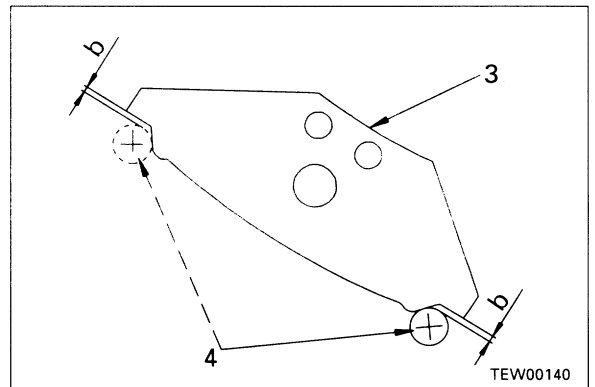
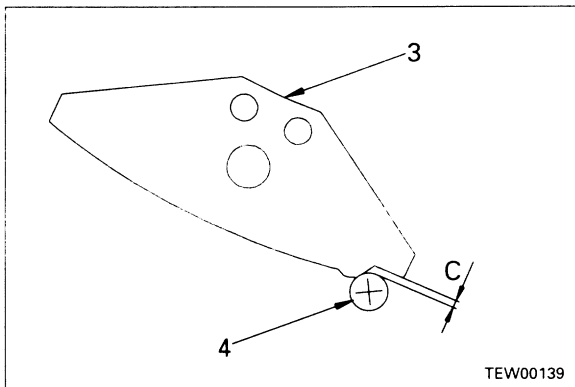
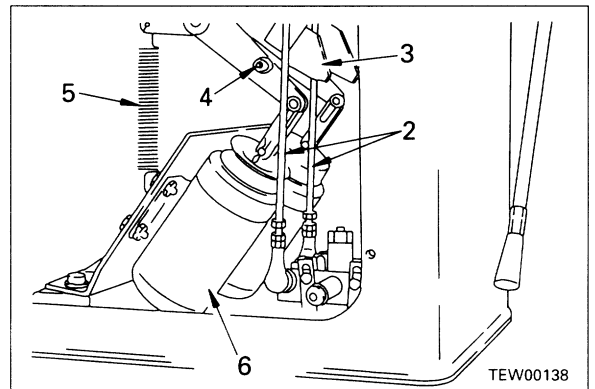
3. Boom lever

Operate the boom lever and adjust the length of rod (2) so that roller (4) is dimension **b** at the notch at both ends of cam (3).
Dimension **b**: 0 – 1 mm



4. Bucket lever

Operate the lift lever and adjust the length of rod (2) so that roller (4) is dimension **C** at the notch at both ends of cam (3).
Dimension **C**: 0 – 1 mm



MEASURING WORK EQUIPMENT HYDRAULIC PRESSURE

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Engine speed: High idling

⚠ Apply the parking brake and put blocks under the tires.

1. PPC relief valve pressure

Measuring

- 1) Raise boom (1), set support (2) or stopper **R** in position under the lift arm, then remove cover (3).

⚠ Loosen the oil filler cap to release the pressure inside the hydraulic tank, then operate the bucket control lever at least 40 times between TILT and HOLD to completely release the pressure in the accumulator.

- ★ After operating the bucket lever, operate the bucket lever to the DUMP position and check that the bucket does not dump.
- ★ Always stop the engine before operating the lever.

- 2) Remove plug (4) for measuring the hydraulic pressure in the dump cylinder circuit of the main control valve.

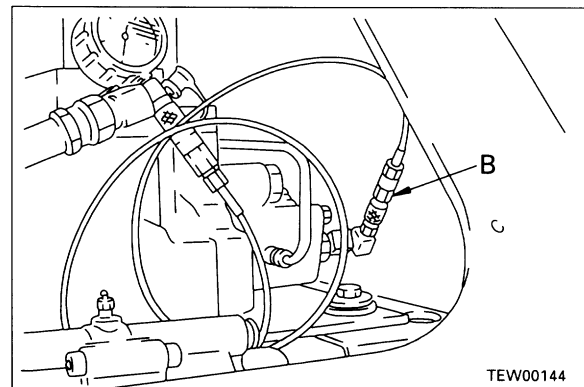
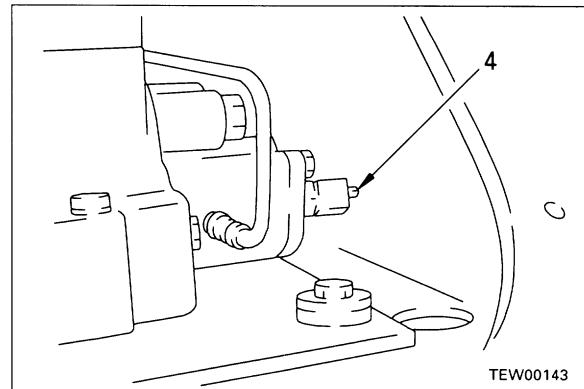
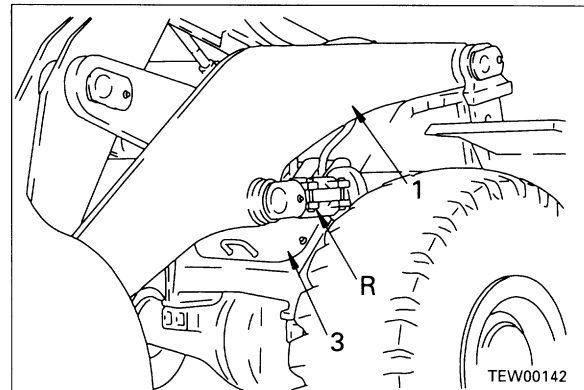
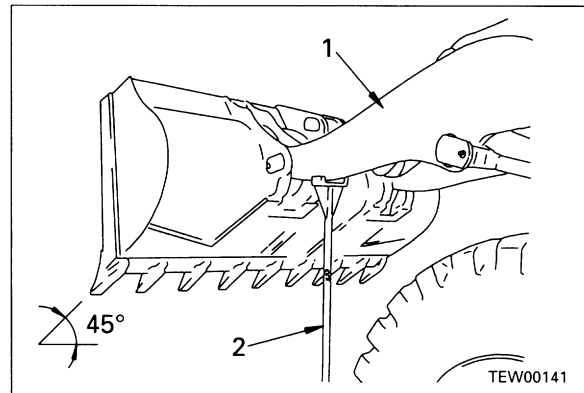
- 3) Install hydraulic tester kit **B** to the measurement port.

- ★ Install the 90° elbow in the hydraulic tester kit to the measurement port, then connect the hose.
- ★ Check that there is no oil leakage from any joint.
- ★ Use a hose which is long enough to reach the operator's compartment.

- 4) Start the engine, raise the lift arm approx. 400 mm, then operate the control lever to tilt back the bucket, and measure the pressure when the relief valve is actuated.

- ★ Be careful not to apply pressure suddenly to the oil pressure gauge.

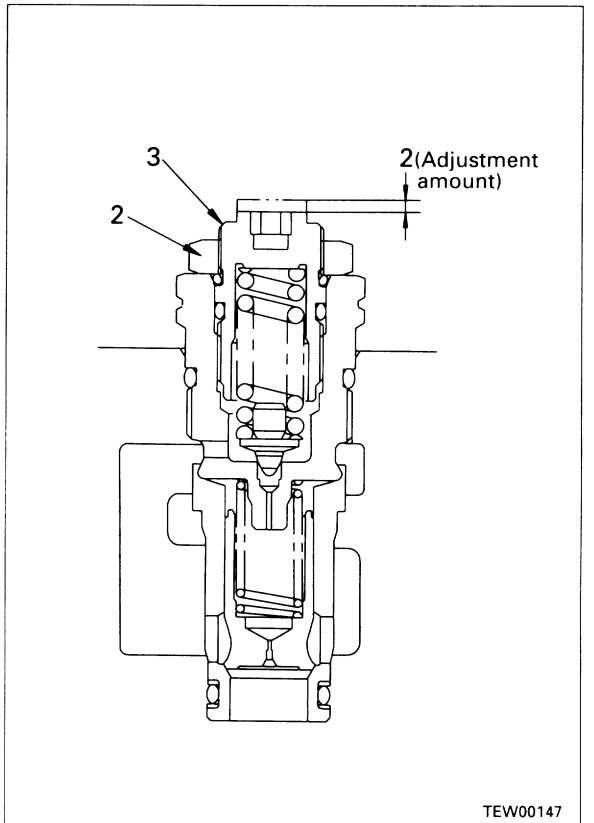
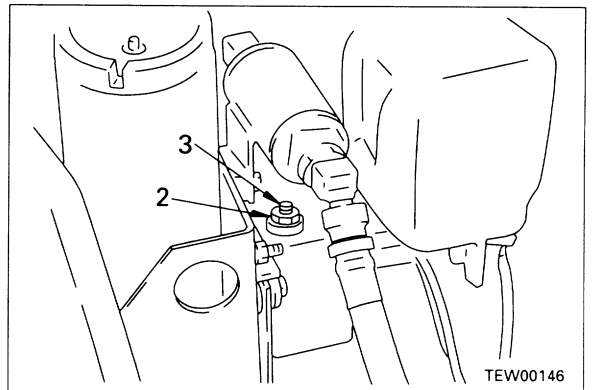
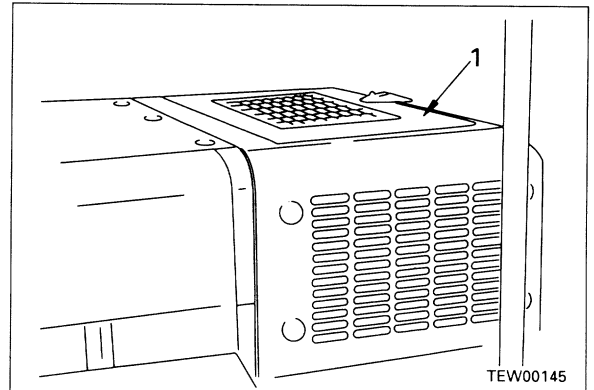
⚠ When removing the oil pressure gauge, release the pressure inside the circuit in the same way as when installing the gauge.



Adjusting

! Always stop the engine when adjusting the oil pressure.

- 1) Stop the engine and remove cover (1).
- 2) Loosen locknut (2), then turn adjustment screw (3) to adjust.
 - ★ Pressure adjustment for one turn of adjustment screw:
Approx. 1.79 MPa (18.3 kg/cm²)
 - ★ Turn the adjustment screw to adjust the set pressure as follows.
TIGHTEN to INCREASE pressure
LOOSEN to DECREASE pressure
 - ★ Do not carry out any adjustment if the relief pressure cannot be measured accurately.



2. Work equipment relief valve pressure

Measurement method

⚠ Loosen the oil filler cap to release the pressure inside the hydraulic tank, then operate the control lever several times to release the remaining pressure inside the piping.

★ When operating each lever, set the bucket so that portion **a** is raised 30 mm – 50 mm, then lower portion **b** to the ground and stop the engine.

★ After operating each lever, check that both bottom surfaces of the bucket (portions **a** and **b**) contact the ground surface.

1) Remove oil pressure measurement plug (1) from the bucket cylinder circuit.

2) Install hydraulic tester kit **B** to the measurement port.

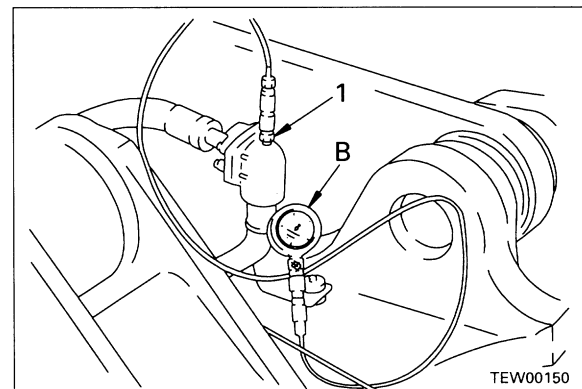
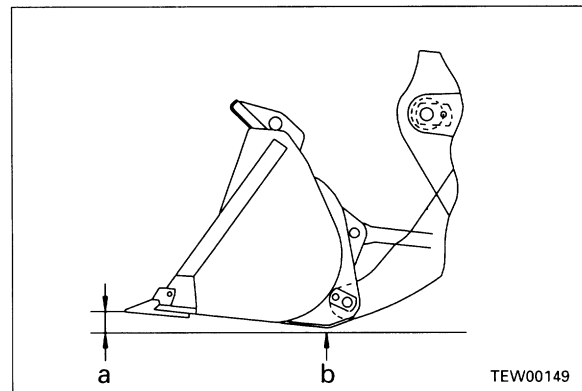
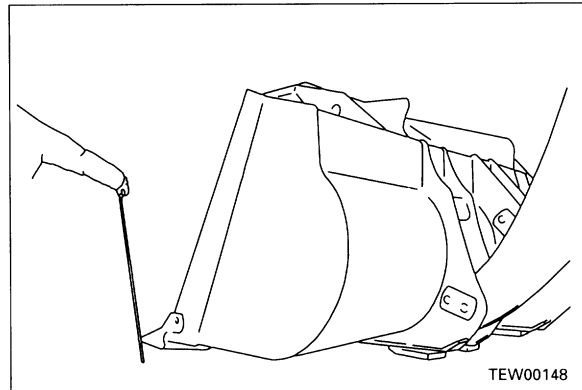
★ Check that there is no oil leakage from any joint.

★ Use a hose which is long enough to reach the operator's compartment.

3) Start the engine, raise the lift arm approx. 400 mm, then operate the control lever to tilt back the bucket, and measure the pressure when the relief valve is actuated.

★ Be careful not to apply pressure suddenly to the oil pressure gauge.

⚠ When removing the oil pressure gauge, release the pressure inside the circuit in the same way as when installing the gauge.



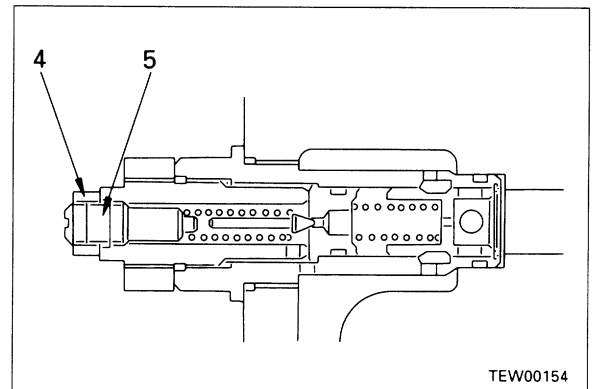
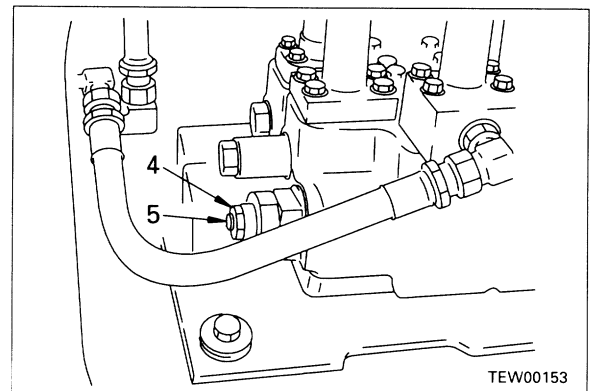
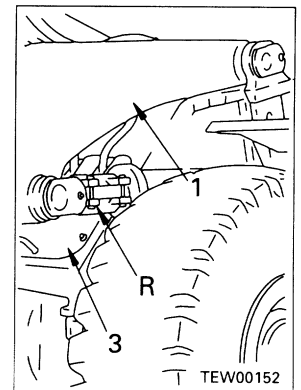
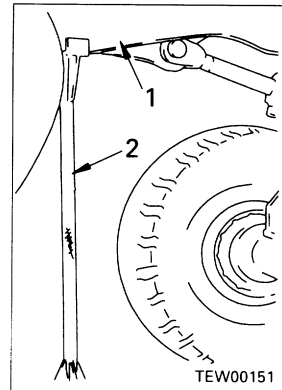
TESTING AND ADJUSTING

MEASURING WORK EQUIPMENT HYDRAULIC PRESSURE

Adjusting

! Always stop the engine when adjusting the oil pressure.

- 1) Raise boom (1), set support (2) or stopper **R** in position under the boom, then remove cover (3).
- 2) Remove locknut (4) of the relief valve.
- 3) Turn adjustment screw (5) to adjust.
 - ★ Pressure adjustment for one turn of adjustment screw:
Approx. 5.18 MPa (52.9 kg/cm²)
 - ★ Turn the adjustment screw to adjust the set pressure as follows.
TIGHTEN to INCREASE pressure
LOOSEN to DECREASE pressure
 - ★ Do not carry out any adjustment if the relief pressure cannot be measured accurately.



MEASURING WORK EQUIPMENT

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Engine speed: High idling
- Steering position: Neutral

Measurement method

1. Boom RAISE time

Set the bucket at the lowest position from the ground with the bucket tilted back fully, then raise it and measure the time taken for the bucket to reach the maximum boom height.

2. Boom LOWER time

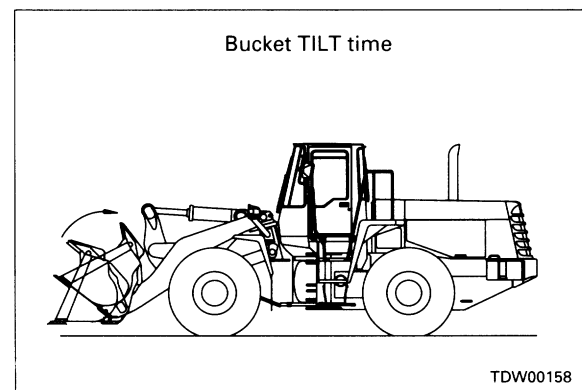
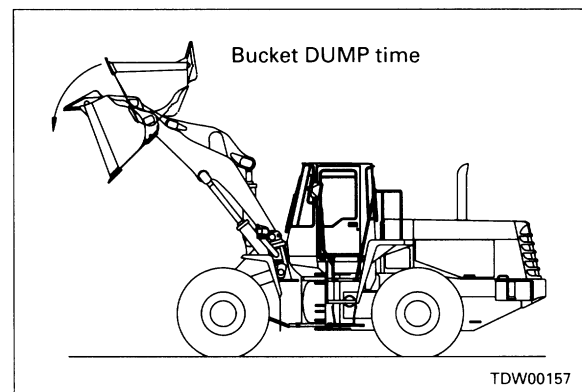
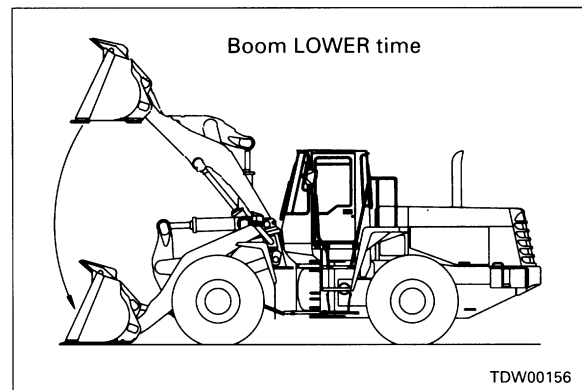
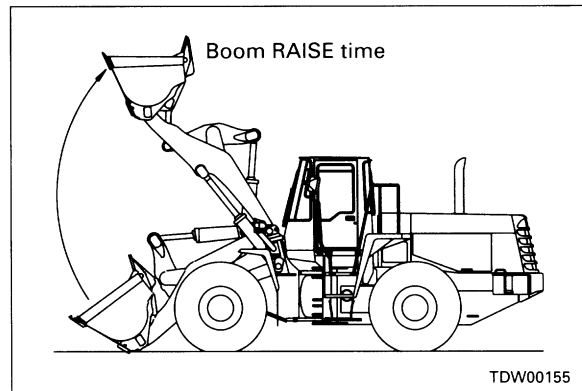
Set the bucket horizontal, then lower the boom from the maximum height and measure the time taken for the bucket to reach the lowest position from the ground.

3. Bucket DUMP time

Raise the boom to the maximum height, and measure the time taken to move the bucket from the tilt position (bucket fully tilted back) to the dump position (bucket fully tipped forward).

4. Bucket TILT time

- 1) Raise the boom to the maximum height, and measure the time taken to move the bucket to the tilt position (bucket fully tilted back).
- 2) Set the bucket horizontal to the ground and measure the time taken to move the bucket from the horizontal position to the tilt position (bucket fully tilted back).



MEASURING HYDRAULIC DRIFT WORK EQUIPMENT

★ Measurement conditions

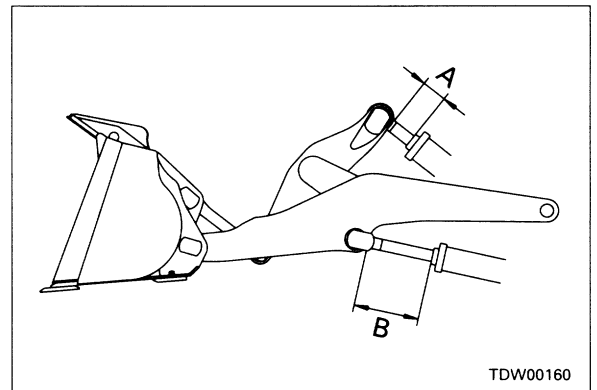
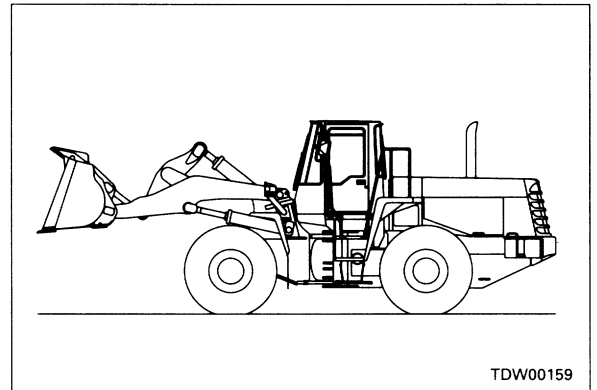
- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Stop the engine, leave for 5 minutes, then measure for 15 minutes.
- Boom: Horizontal
- Bucket: Horizontal
- No load

⚠ Apply the safety lock to the work equipment control levers.

⚠ Never go under the work equipment.

Measurement method

1. Set the boom and bucket in a horizontal position, then stop the engine.
2. Leave for 5 minutes, then start the measurement.
3. Wait for 15 minutes, then measure retraction amount **A** of the bucket cylinder rod and retraction amount **B** of the boom cylinder rod.



TESTING AND ADJUSTING BUCKET POSITIONER

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C

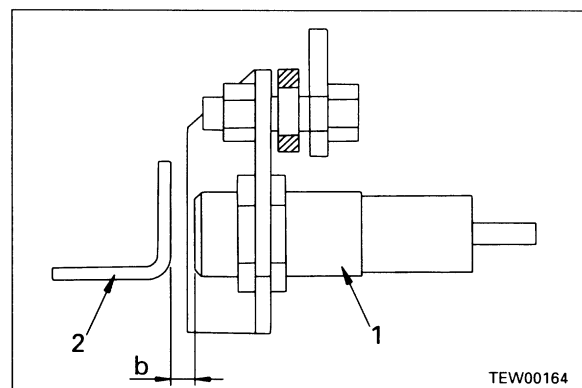
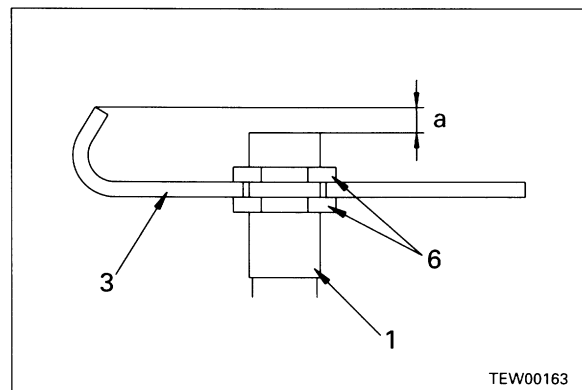
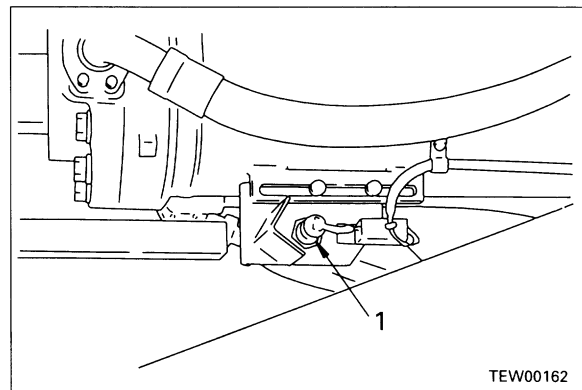
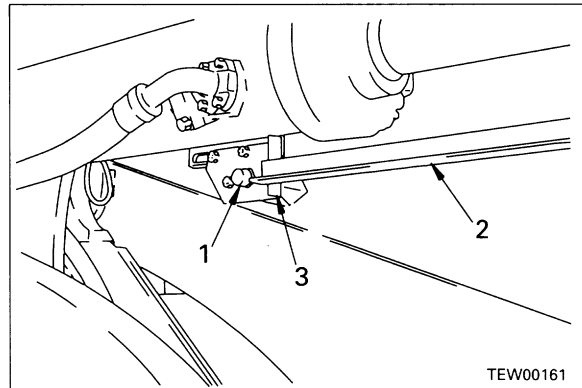
Testing

1. Stop the engine and check that the clearance between switch (1) and angle (2) is the standard value.
2. Start the engine, run at idling and check the actuation position.
(Check three times and take the average value.)

Adjusting

1. Lower the bucket to the ground, operate the bucket to the desired digging angle, then return the lever to HOLD and stop the engine.
2. Adjust nut (6) of switch (1) so that clearance **a** from the tip of switch protector (3) to the switch sensing surface is the standard value, then secure the switch in position.
 - ★ Clearance **a**: 0.5 – 1.0 mm
 - ★ Switch mounting nut: $17.7 \pm 2 \text{ Nm}$
($1.8 \pm 0.2 \text{ kgm}$)

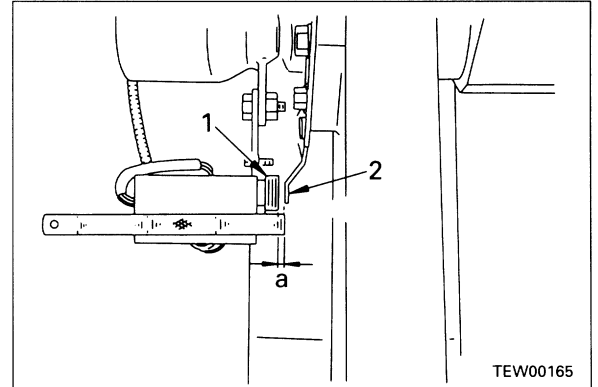
3. Using shims, adjust clearance **b** between the sensing surface of switch (1) and angle (2) to the standard value, then secure in position.
 - ★ Use shims to adjust the angle so that the clearance between the switch sensing surface and the angle is within the standard value for the whole stroke of the angle, then secure in position.
 - ★ Check that the center of the switch sensing surface and the angle do not move, then secure in position.
 - ★ After adjusting, operate the bucket lever, check that the positioner is actuated at the desired position, then secure in position.
 - ★ Clearance **b**: 3 – 5 mm



TESTING AND ADJUSTING BOOM KICK-OUT

Testing

1. Stop the engine, and check that the clearance between switch (1) and plate (2) is the standard value.
2. Start the engine, run at high idling, and check the actuation position.
(Check three times and take the average value.)



Adjusting

1. Raise the boom to the desired height, return the boom lever to the HOLD position, then stop the engine.

! Always apply the safety lock to the work equipment control lever.

2. Adjust the position of the plate so that the center of switch (1) is aligned with the top of plate (2), then secure in position.
3. Secure the switch in position so that clearance **a** between the sensing surface of the switch and plate (2) is the standard value.

★ Clearance **a**: 3 – 5 mm

 **kgm** Switch mounting nut: **17.7 ± 2 Nm**
(1.8 ± 0.2 kgm)

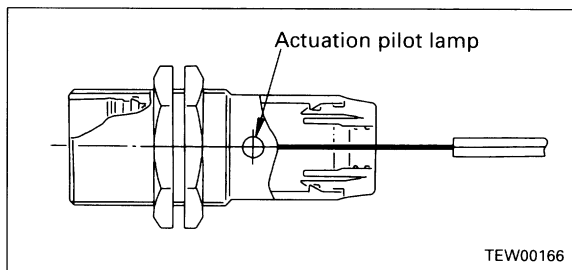
- ★ After adjusting, operate the boom lever and check that the kick-out is actuated at the desired position.

TESTING AND ADJUSTING

TESTING AND ADJUSTING BOOM KICK-OUT

Proximity switch actuation pilot lamp (red)

The proximity switch is equipped with a pilot lamp which shows when it is being actuated, so use this when adjusting.



Proximity switch actuation pilot lamp	Lights up	Goes out
Detector position	When detector is positioned at detection surface of proximity switch	When detector has moved away from detection surface of proximity switch
Bucket positioner		
Boom kick-out		

U42103

ADJUSTING MAIN MONITOR (SPEEDOMETER MODULE)

- The speedometer on the main monitor is a common part for all machines, and the input signal for the travel speed differs according to the machine, so it is necessary to adjust the monitor for use with the particular model.
- In addition, the tire diameter also differs according to the type of tire fitted, so it is necessary to adjust to give the correct travel speed.
- It is also necessary to change the switches if the optional E.C.S.S. (Electronically Controlled Suspension System) is installed.

Adjustment procedure

- Turn off the power, then remove the machine monitor and adjust the switches at the back of the speedometer.

1. Setting machine model

- Remove the rubber caps from dipswitches (1), (2), (3), and (4) at the back of the speedometer.
- When the rubber cap is removed, a rotary switch can be seen inside. Using a flat-headed screwdriver, turn this switch to adjust it to the settings in the table below.

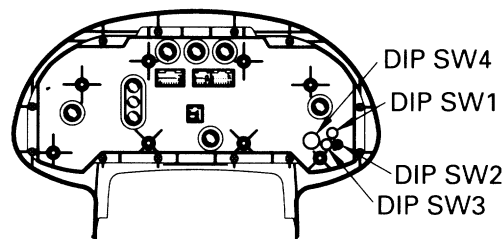
Tire size	Switch 1 (model selection)	Switch 2 (speedom- eter cor- rection)	Switch 3 (tachom- eter input selection)
26.5-25-16PR	4	7	0
23.5-25-20PR	4	C	0

- When the cap is removed from dipswitch (4) at the back of the speedometer, an ON/OFF switch can be seen. Adjust the setting if the E.C.S.S. (Electronically Controlled Suspension System) is installed.

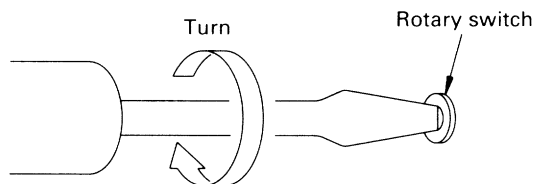
Switch No.	Switch 4	
	Without E.C.S.S.	With E.C.S.S.
1	ON	ON
2	ON	ON
3	ON	OFF
4	ON	ON

- After completing the adjustment, fit the rubber caps securely and install the main monitor.

Rear of main monitor

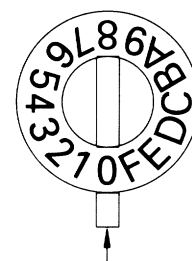


TDW00173



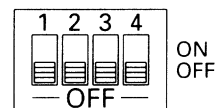
TDW00174

DIP SW 1, 2, 3



Adjustment position TDW00175

DIP SW 4



TDW00176

Reference

Amount of correction for switch (2)

Switch position	0	1	2	3	4	5	6	7
Amount of correction (%)	+14	+12	+10	+8	+6	+4	+2	+0

Switch position	8	9	A	B	C	D	E	F
Amount of correction (%)	0	-2	-4	-6	-8	-10	-12	-14

CHECKING FOR ABNORMALITY IN FUEL LEVEL SENSOR

- If there is a marked difference between the actual amount of fuel remaining in the fuel tank and the display on the fuel gauge (the fuel tank is full but the fuel gauge does not indicate FULL), check the fuel level sensor as an individual part and measure the resistance at the three positions for the float.

Measurement method

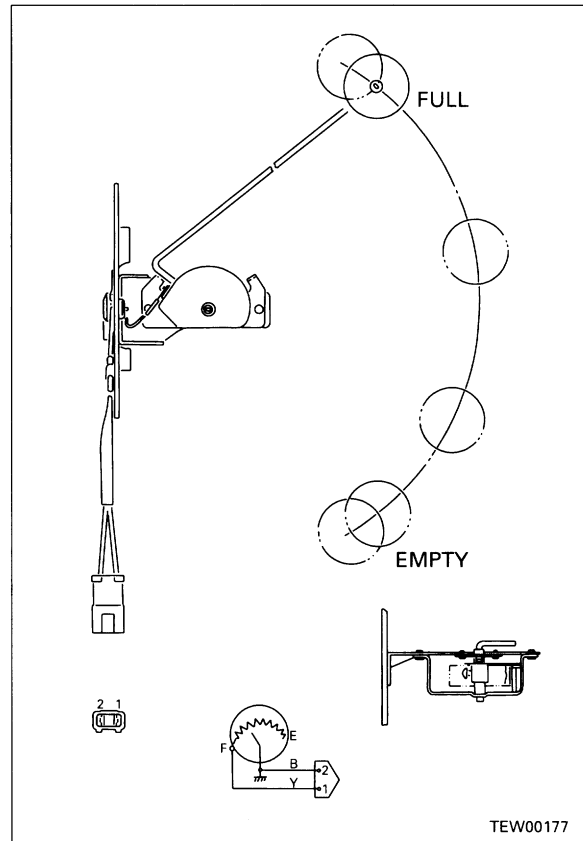
- Connect one end of the probe of terminal (1), contact the other probe with terminal (2), and measure the resistance.

Resistance for fuel level sensor at each point

Unit: Ω

FULL (top)	1/2 (horizontal)	EMPTY (bottom)
10^{+1}_{-3}	32	85^{+10}_0

- ★ The resistance values are only given as a guideline.



ADJUSTING BOOM, BUCKET ANGLE POTENTIOMETER

- The work equipment control system is equipped with a sensor adjustment function to compensate for any error in the mounting of the potentiometer and to make it possible to detect the correct position data for the work equipment.

Always carry out adjustment when the controller, potentiometer, or work equipment are replaced.

1. Potentiometer output voltage range

When correctly installed

Boom angle signal input (CNL27 (9) – (19)):
0.3 – 4.7 V

Bucket angle signal input (CNL27 (9) – (20)):
0.6 – 4.3 V

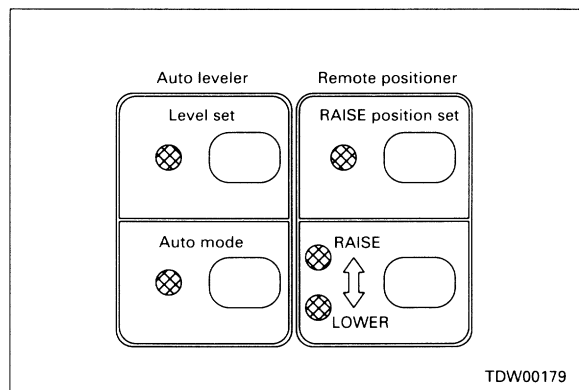
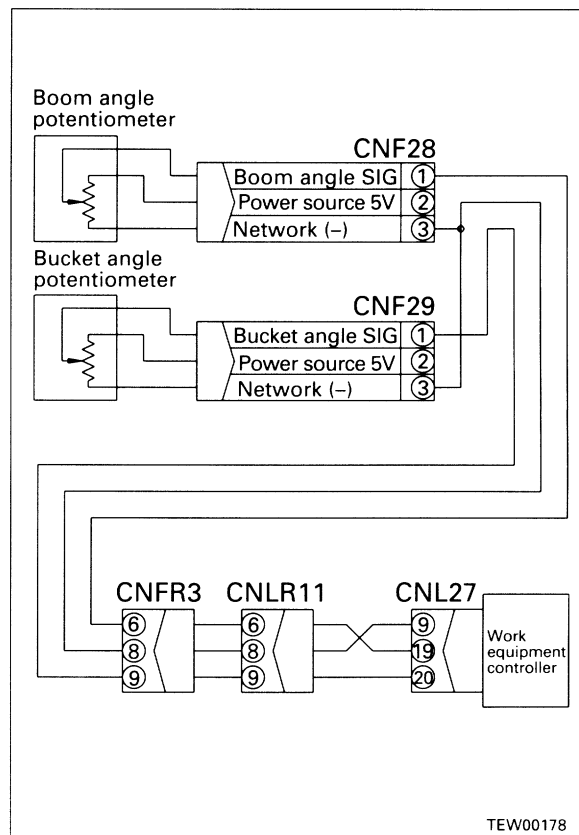
2. Method of adjusting sensor

- Set the work equipment to the following posture.
Boom: Max. height
Bucket: Max. dump
- Keep the remote positioner set switch and auto leveler set switch pressed continuously for at least 3 seconds at the same time. When the remote positioner set lamp and auto leveler set lamp light up, release the switch. (Sensor adjustment mode)
- The remote positioner set lamp and auto leveler set lamp will light up for 2 seconds and then both lamps will go out. (Offset written to memory)

3. If the lamps flash in Step 2-3)

The potentiometer output is not within the range that can be offset, so adjust the installation of the potentiometer. The range which can be adjusted is as shown in the table with the posture in Step 2-1). In addition, the condition of the lamp corresponds to each potentiometer.

- If the potentiometers have been adjusted from the condition in Step 3, always carry out Step 2 again and check that the lamps are actuated as in Step 3) (set lamps light up for 2 seconds and then go out).



Unit: V

Model	Boom angle potentiometer (between CNL27 (9) – (19))	Bucket angle potentiometer (between CNL27 (9) – (20))
WA320	0.51 – 0.72	3.34 – 3.95
WA380	0.51 – 0.75	3.41 – 4.02
WA420	0.45 – 0.75	3.35 – 3.96
WA470	0.66 – 0.86	1.12 – 1.72

TROUBLESHOOTING

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Troubleshooting of work equipment (W mode)	20-551

POINTS TO REMEMBER WHEN TROUBLESHOOTING

- ⚠ Stop the machine in a level place, and check that the safety pin, blocks, and parking brake are securely fitted.
- ⚠ When carrying out the operation with two or more workers, keep strictly to the agreed signals, and do not allow any unauthorized person to come near.
- ⚠ If the radiator cap is removed when the engine is hot, hot water may spurt out and cause burns, so wait for the engine to cool down before starting troubleshooting.
- ⚠ Be extremely careful not to touch any hot parts or to get caught in any rotating parts.
- ⚠ When disconnecting wiring, always disconnect the negative (–) terminal of the battery first.
- ⚠ When removing the plug or cap from a location which is under pressure from oil, water, or air, always release the internal pressure first. When installing measuring equipment, be sure to connect it properly.

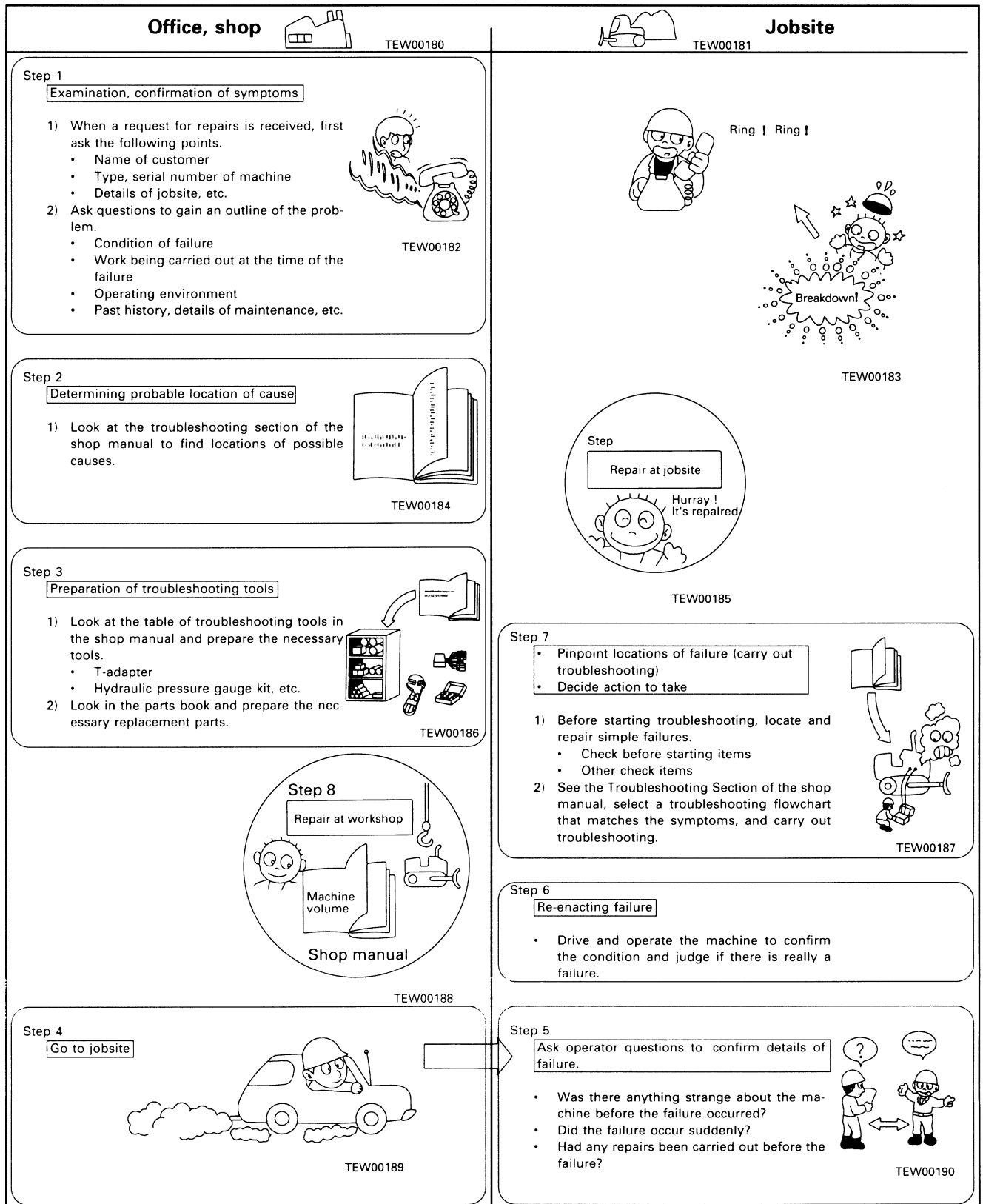
The aim of troubleshooting is to pinpoint the basic cause of the failure, to carry out repairs swiftly, and to prevent reoccurrence of the failure.

When carrying out troubleshooting, an important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

1. When carrying out troubleshooting, do not hurry to disassemble the components.
If components are disassembled immediately any failure occurs:
 - Parts that have no connection with the failure or other unnecessary parts will be disassembled.
 - It will become impossible to find the cause of the failure.

It will also cause a waste of manhours, parts, or oil or grease, and at the same time, will also lose the confidence of the user or operator.
For this reason, when carrying out troubleshooting, it is necessary to carry out thorough prior investigation and to carry out troubleshooting in accordance with the fixed procedure.
2. Points to ask user or operator
 - 1) Have any other problems occurred apart from the problem that has been reported?
 - 2) Was there anything strange about the machine before the failure occurred?
 - 3) Did the failure occur suddenly, or were there problems with the machine condition before this?
 - 4) Under what conditions did the failure occur?
 - 5) Had any repairs been carried out before the failure?
When were these repairs carried out?
 - 6) Has the same kind of failure occurred before?
3. Check before troubleshooting
 - 1) Check the oil level
 - 2) Check for any external leakage of oil from the piping or hydraulic equipment.
 - 3) Check the travel of the control levers.
 - 4) Check the stroke of the control valve spool.
 - 5) Other maintenance items can be checked externally, so check any item that is considered to be necessary.
4. Confirming failure
 - Confirm the extent of the failure yourself, and judge whether to handle it as a real failure or as a problem with the method of operation, etc.
 - ★ When operating the machine to reenact the troubleshooting symptoms, do not carry out any investigation or measurement that may make the problem worse.
5. Troubleshooting
 - Use the results of the investigation and inspection in Items 2 – 4 to narrow down the causes of failure, then use the troubleshooting flowchart to locate the position of the failure exactly.
 - ★ The basic procedure for troubleshooting is as follows.
 - 1) Start from the simple points.
 - 2) Start from the most likely points.
 - 3) Investigate other related parts or information.
6. Measures to remove root cause of failure
 - Even if the failure is repaired, if the root cause of the failure is not repaired, the same failure will occur again.
To prevent this, always investigate why the problem occurred. Then, remove the root cause.

SEQUENCE OF EVENTS IN TROUBLESHOOTING



PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics and is aimed at improving the quality of repairs. For this purpose, it gives sections on "Handling electric equipment" and "Handling hydraulic equipment" (particularly hydraulic oil).

1. PRECAUTIONS WHEN HANDLING ELECTRIC EQUIPMENT

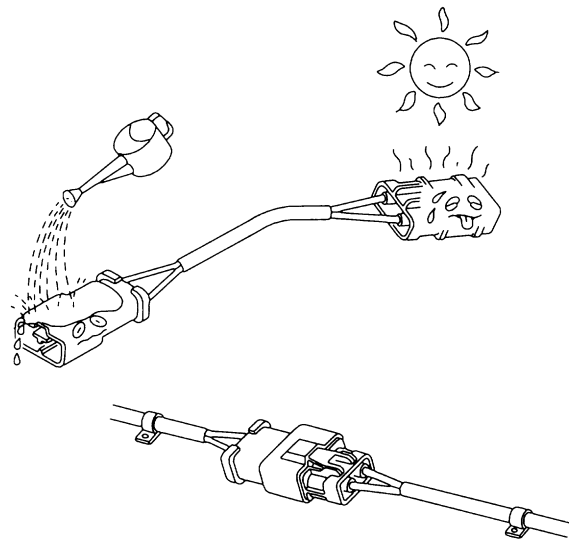
1) Handling wiring harnesses and connectors

Wiring harnesses consist of wiring connecting one component to another component, connectors used for connecting and disconnecting one wire from another wire, and protector or tubes used for protecting the wiring. Compared with other electrical components fitted in boxes or cases, wiring harnesses are more likely to be affected by the direct effects of rain, water, heat, or vibration. Furthermore, during inspection and repair operations they are frequently removed and installed again, so they are likely to suffer deformation or damage. For this reason, it is necessary to be extremely careful when handling wiring harnesses.

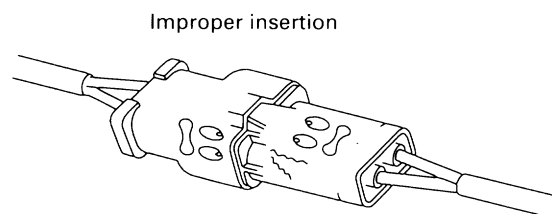
Main failures occurring in wiring harness

(1) Defective contact of connectors (defective contact between male and female)

Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces.



TEW00191



TEW00192

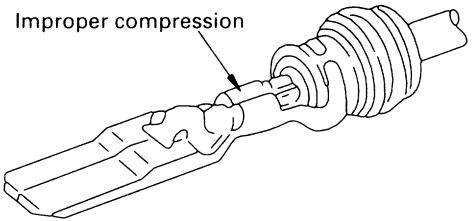
U42103

TROUBLESHOOTING

PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

- (2) Defective compression or soldering of connectors

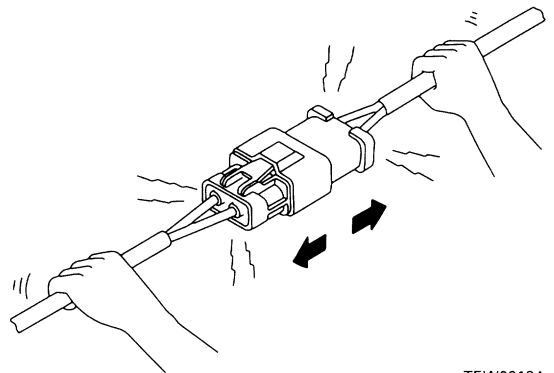
The pins of the male and female connectors are in contact at the compressed terminal or soldered portion, but there is excessive force on the wiring, and the plating peels to cause improper correction or breakage.



- (3) Disconnections in wiring

If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the compression of the connector may be lost, or the soldering may be damaged, or the wiring may be broken.

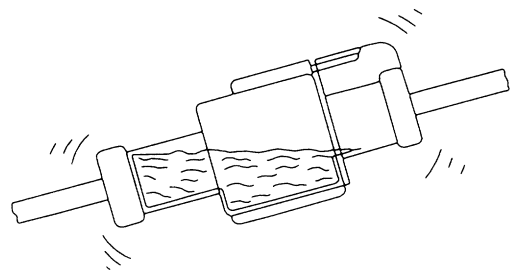
TEW00193



TEW00194

- (4) High pressure water entering connector
The connector is designed to make it difficult for water to enter (drip-proof structure), but if high-pressure water is sprayed directly on the connector, water may enter the connector depending on the direction of the water jet.

The connector is designed to prevent water from entering, but at the same time, if the water does enter, it is difficult for it to be drained. Therefore, if water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.

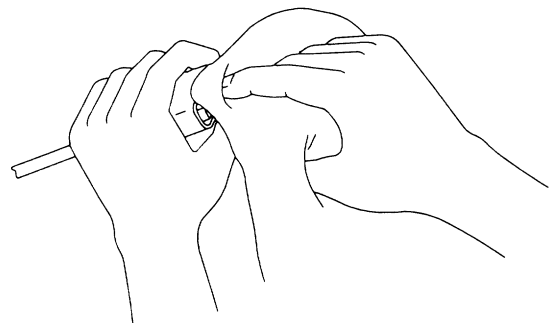


TEW00195

- (5) Oil or dirt stuck to connector

If oil or grease are stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease or dirt stuck to the connector, wipe it off with a dry cloth or blow dry with air, and spray it with a contact restorer.

- ★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
- ★ If there is water or oil in the air, it will increase the contamination of the points, so clean with air from which all the water and oil has been removed.



TEW00196

U42103

TROUBLESHOOTING

PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

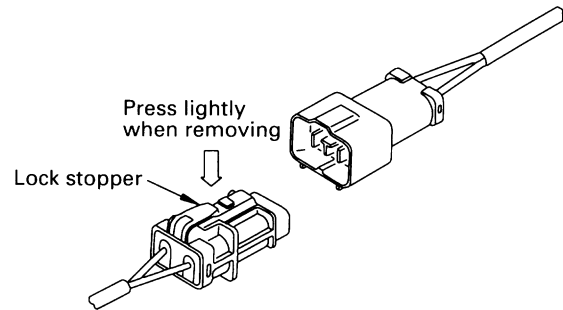
2) Removing, installing, and drying connectors and wiring harnesses

Disconnecting connectors

- (1) Hold the connectors when disconnecting.

When disconnecting the connectors, hold the connectors and not the wires.

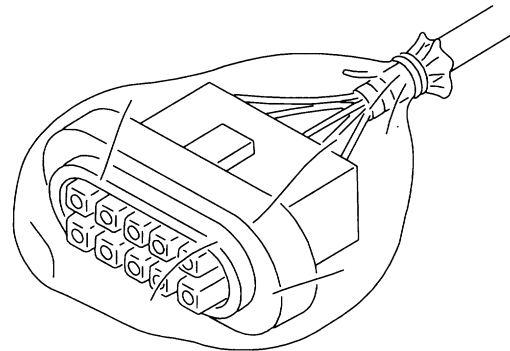
For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.



TEW00197

- (2) Action to take after removing connectors

After removing any connector, cover it with a vinyl bag to prevent any dust, dirt, oil, or water from getting in the connector portion.



TEW00198

Connecting connectors

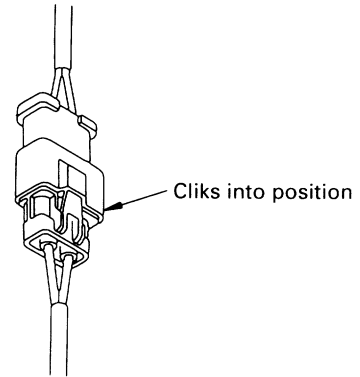
- (1) Check the connector visually.
 - a. Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
 - b. Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
 - c. Check that there is no damage or breakage to the outside of the connector.
- ★ If there is any oil, water, or dirt stuck to the connector, wipe it off with a dry cloth. If any water has got inside the connector, warm the inside of the wiring with a dryer, but be careful not to make it too hot as this will cause short circuits.
- ★ If there is any damage or breakage, replace the connector.

U42103

TROUBLESHOOTING

PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

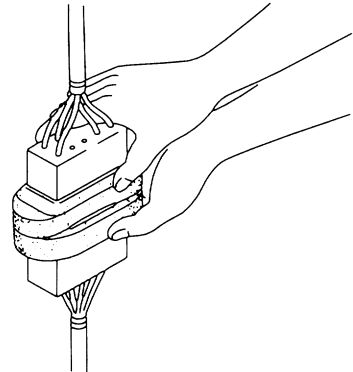
- (2) Fix the connector securely.
Align the position of the connector correctly, then insert it securely.
For connectors with lock stopper
Push in the connector until the stopper clicks into position.



TEW00199

- (3) Correct any protrusion of the boot and any misalignment of the wiring harness.
For connectors fitted with boots, correct any protrusion of the boot. In addition, if the wiring harness is misaligned, or the clamp is out of position, adjust it to its correct position.

- ★ When blowing with dry air, there is danger that the oil in the air may cause improper contact, so clean with air from which all the water and oil has been removed.



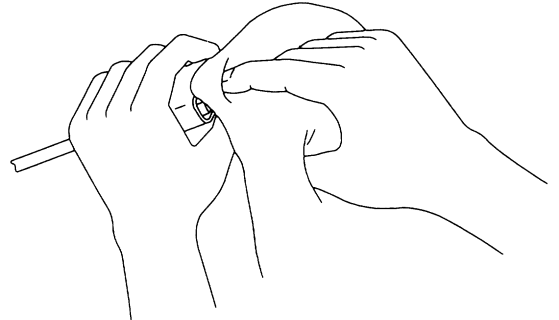
TEW00200

Drying wiring harness

If there is any oil or dirt on the wiring harness, wipe it off with a dry cloth. Avoid washing it in water or using steam. If the connector must be washed in water, do not use high pressure water or steam directly on the wiring harness. If water gets directly on the connector, do as follows.

- (1) Disconnect the connector and wipe off the water with a dry cloth.

- ★ If the connector is blown dry with air, there is the risk that oil in the air may cause defective contact, so avoid blowing with air.

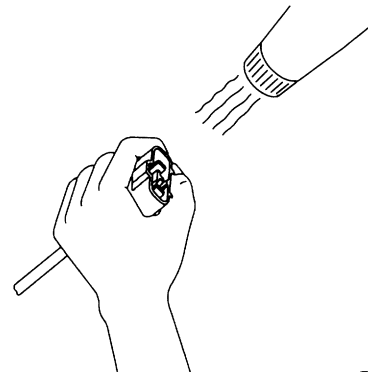


TEW00196

- (2) Dry the inside of the connector with a dryer.

If water gets inside the connector, use a dryer to dry the connector.

- ★ Hot air from the dryer can be used, but be careful not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.



TEW00202

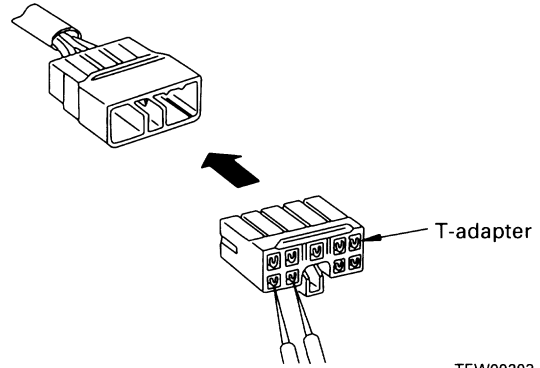
TROUBLESHOOTING

PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

- (3) Carry out a continuity test on the connector.

After drying, leave the wiring harness disconnected and carry out a continuity test to check for any short circuits between pins caused by water.

- ★ After completely drying the connector, blow it with contact restorer and reassemble.

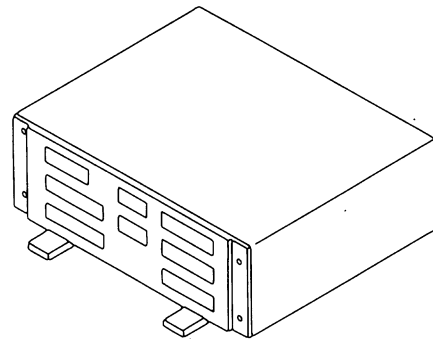


TEW00203

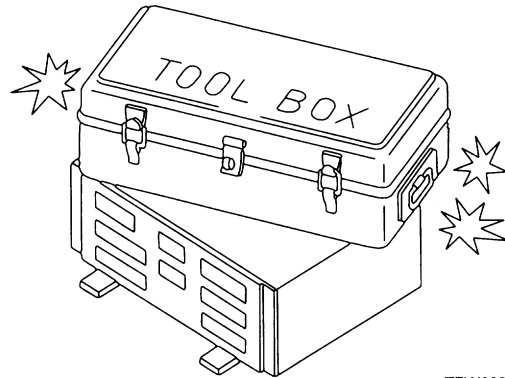
3) Handling control box

- (1) The control box contains a microcomputer and electronic control circuits. These control all of the electronic circuits on the machine, so be extremely careful when handling the control box.
- (2) Do not open the cover of the control box unless necessary.
- (3) Do not place objects on top of the control box.
- (4) Cover the control connectors with tape or a vinyl bag.
- (5) During rainy weather, do not leave the control box in a place where it is exposed to rain.
- (6) Do not place the control box on oil, water, or soil, or in any hot place, even for a short time. (Place it on a suitable dry stand)
- (7) Precautions when carrying out arc welding

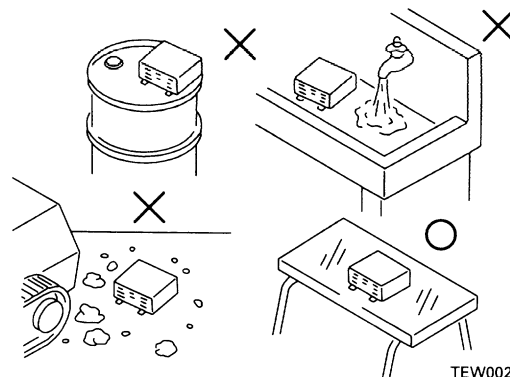
When carrying out arc welding on the body, disconnect all wiring harness connectors connected to the control box. Fit an arc welding ground close to the welding point.



TEW00204



TEW00205



TEW00206

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2. POINTS TO REMEMBER WHEN HANDLING HYDRAULIC EQUIPMENT

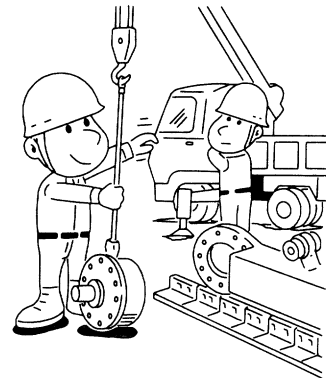
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

1) Be careful of the operating environment.

Avoid adding hydraulic oil, replacing filters, or repairing the machine in rain or high winds, or places where there is a lot of dust.

2) Disassembly and maintenance work in the field

If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic equipment should be carried out in a specially prepared dustproof workshop, and the performance should be confirmed with special test equipment.



TEW00207

3) Sealing openings

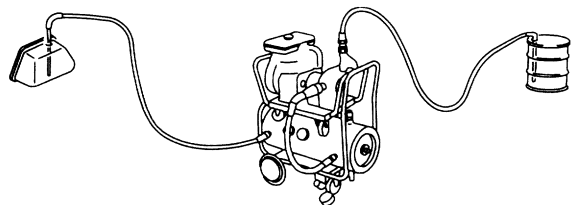
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never do this. Do not simply drain oil out on to the ground, collect it and ask the customer to dispose of it, or take it back with you for disposal.



TEW00208

4) Do not let any dirt or dust get in during refilling operations.

Be careful not to let any dirt or dust get in when refilling with hydraulic oil. Always keep the oil filler and the area around it clean, and also use clean pumps and oil containers. If an oil cleaning device is used, it is possible to filter out the dirt that has collected during storage, so this is an even more effective method.



TEW00209

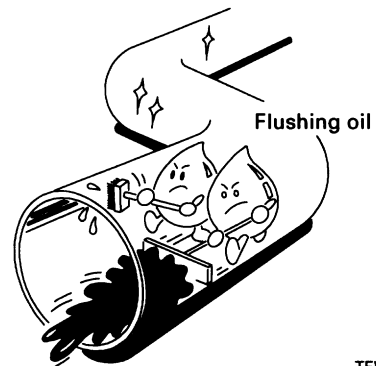
5) Change hydraulic oil when the temperature is high.

When hydraulic oil or other oil is warm, it flows easily. In addition, the sludge can also be drained out easily from the circuit together with the oil, so it is best to change the oil when it is still warm. When changing the oil, as much as possible of the old hydraulic oil must be drained out. (Drain the oil from the hydraulic tank; also drain the oil from the filter and from the drain plug in the circuit.) If any old oil is left, the contaminants and sludge in it will mix with the new oil and will shorten the life of the hydraulic oil.

6) Flushing operations

After disassembling and assembling the equipment, or changing the oil, use flushing oil to remove the contaminants, sludge, and old oil from the hydraulic circuit.

Normally, flushing is carried out twice: primary flushing is carried out with flushing oil, and secondary flushing is carried out with the specified hydraulic oil.

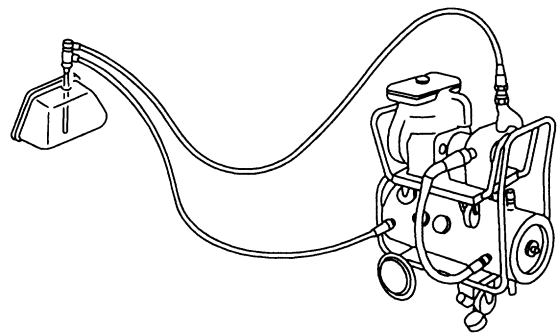


TEW00210

7) Cleaning operations

After repairing the hydraulic equipment (pump, control valve, etc.) or when running the machine, carry out oil cleaning to remove the sludge or contaminants in the hydraulic oil circuit.

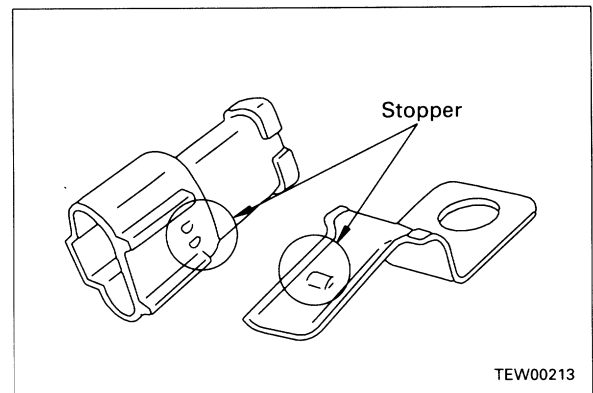
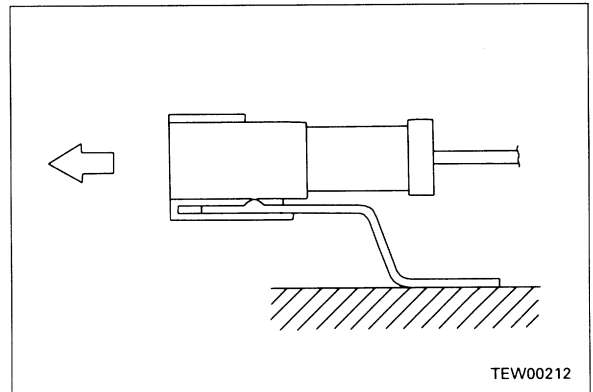
The oil cleaning equipment is used to remove the ultrafine (about 3μ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



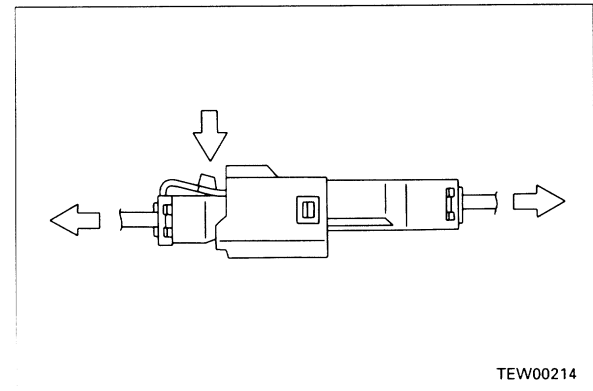
TEW00211

HANDLING CONNECTORS

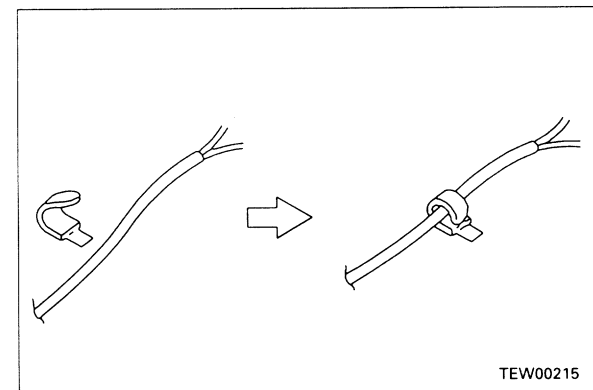
1. When removing the connectors from the clips, pull the connector in a parallel direction to the clip.
 - ★ If the connector is twisted to the left and right or up and down, the housing may break.



2. When disconnecting male and female connectors, release the lock and pull in parallel with both hands.
 - ★ Never try to pull out with one hand.



3. When the wiring harness clamp of the connector has been removed, always return it to its original condition and check that there is no looseness of the clamp.



TROUBLESHOOTING

CHECKS BEFORE TROUBLESHOOTING

CHECKS BEFORE TROUBLESHOOTING

	Item	Judgement standard	Remedy
Checks before starting	Lubricant, coolant	1. Check fuel level, type of fuel	— Add fuel
		2. Check for dirt or water in fuel	— Clean, drain
		3. Check hydraulic oil level	— Add oil
		4. Check filter (hydraulic, transmission, torque converter)	— Replace
		5. Check oil level	— Add oil
		6. Check engine oil	— Add oil
		7. Check coolant level	— Add water
		8. Check clogging of dust indicator	— Clean or check
	Electrical components	9. Check for loose or corroded battery terminals or wiring	— Tighten or replace
		10. Check for loose or corroded alternator terminals or wiring	— Tighten or replace
		11. Check for loose or corroded starting motor terminals or wiring	— Repair or replace
		12. Check operation of gauges	— Repair or replace
Other check items	Hydraulic, mechanical components	13. Check for abnormal noise or smell	— Repair
		14. Check for oil leakage	— Repair
		15. Bleed air from system	— Bleed air
		16. Check effect of brakes	— Adjust or repair
	Electrical components	17. Check battery voltage (engine stopped)	24 – 26V Repair or replace
		18. Check battery electrolyte level	— Add electrolyte or replace
		19. Check for discolored, burned, or bare wiring	— Replace
		20. Check for missing wiring clamps, hanging wires	— Repair
		21. Check for water on wiring (check carefully for water at connectors and terminals)	— Dry place affected by water
		22. Check for broken or corroded fuses	— Replace
		23. Check alternator voltage (engine running at over half throttle) (If the battery charge is low, it may reach approx. 25 V immediately after starting)	— 28.5 – 29.5V Repair or check
		24. Noise when battery relay is operated (turn starting switch ON-OFF)	— Replace

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METHOD OF USING TROUBLESHOOTING CHARTS

1. Category of troubleshooting code number

Troubleshooting code No.	Component
S-○○	Troubleshooting of engine
M-○○	Troubleshooting of main monitor
K-○○	Troubleshooting of maintenance monitor
E-○○	Troubleshooting of electrical system
T-○○	Troubleshooting of hydraulic and mechanical system
D-○○	Troubleshooting of ECSS (Electronically Controlled Suspension System)
W-○○	Troubleshooting of work equipment

2. Method of using troubleshooting table for each troubleshooting mode

1) Troubleshooting code number and problem

The title of the troubleshooting chart gives the troubleshooting code, service code, and failure mode (problem with the machine). (See Example (1))

2) Distinguishing conditions

Even with the same failure mode (problem), the method of troubleshooting may differ according to the model, component, or problem. In such cases, the failure mode (problem) is further divided into sections marked with small letters (for example, (a)), so go to the appropriate section to carry out troubleshooting.

If the troubleshooting table is not divided into sections, start troubleshooting from the first check item in the failure mode. (See Example (2))

3) Method of following troubleshooting chart

- Check or measure the item inside ☐ ^{YES}/_{NO}, and according to the answer follow either the YES line or the NO line to go to the next ☐. (Note: The number written at the top right corner of the ☐ is an index number; it does not indicate the order to follow.)
- Following the YES or NO lines according to the results of the check or measurement will lead finally to the Cause column. Check the cause and take the action given in the Remedy column on the right. (See Example (3))
- Below the [] there are the methods for inspection or measurement, and the judgement values.
If the judgement values below the ☐ are correct or the answer to the question inside the ☐ is YES, follow the YES line; if the judgement value is not correct, or the answer to the question is NO, follow the NO line.
- Below the ☐ is given the preparatory work needed for inspection and measurement, and the judgement values. If this preparatory work is neglected, or the method of operation or handling is mistaken, there is danger that it may cause mistaken judgement, or the equipment may be damaged. Therefore, before starting inspection or measurement, always read the instructions carefully, and start the work in order from Item 1).

4) General precautions

When carrying out troubleshooting for the failure mode (problem), precautions that apply to all items are given at the top of the page and marked with ★. (See Example (4))

The precautions marked ★ are not given in the ☐, but must always be followed when carrying out the check inside the ☐.

5) Troubleshooting tools

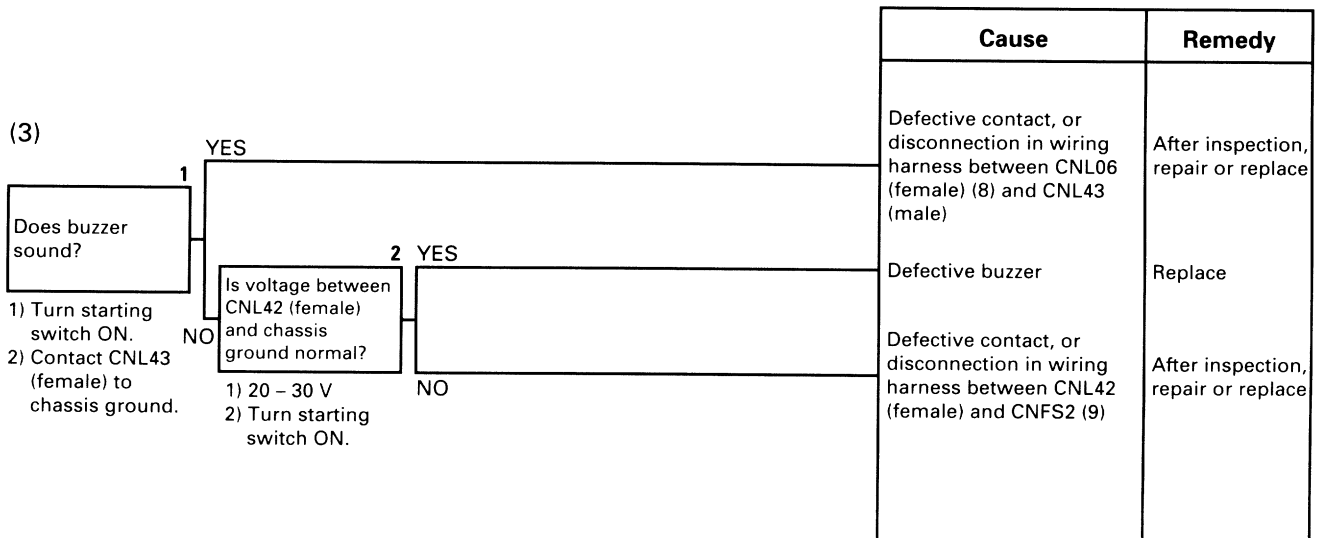
When carrying out the troubleshooting, prepare the necessary troubleshooting tools. For details, see TOOLS FOR TESTING, ADJUSTING, AND TROUBLESHOOTING.

6) Installation position, pin number

A diagram or chart is given for the connector type, installation position, and connector pin number connection. When carrying out troubleshooting, see this chart for details of the connector pin number and location for inspection and measurement of the wiring connector number appearing in the troubleshooting flow chart for each failure mode (problem).

TROUBLESHOOTING**METHOD OF USING TROUBLESHOOTING CHARTS**

< Example >

(1) **M-15 Abnormality in buzzer**(2) (a) **Buzzer does not sound when starting switch is turned ON (during self-check)**

(4)

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

TROUBLESHOOTING**METHOD OF USING TROUBLESHOOTING CHARTS****3. Using troubleshooting chart for engine-related failure**

This troubleshooting chart is divided into three sections: **questions, check items, and troubleshooting**. The questions and check items are used to pinpoint high probability causes that can be located from the failure symptoms or simple inspection without using troubleshooting tools.

Next, troubleshooting tools or direct inspection are used to check the high probability causes to make final confirmation.

[Questions]

Sections **(A) + (B)** in the chart on the right corresponds to the items where answers can be obtained from the user. The items in **(B)** are items that can be obtained from the user, depending on the user's level.

[Check items]

The serviceman carries out simple inspection to narrow down the causes. The items under **(C)** in the chart on the right correspond to this.

The serviceman narrows down the causes from information **(A)** that he has obtained from the user and the results of **(C)** that he has obtained from his own inspection.

[Troubleshooting]

Troubleshooting is carried out in the order of probability, starting with the causes that have been marked as having the highest probability from information gained from **[Questions]** and **[Check items]**.

		Causes		
		(1)	(2)	(3)
Questions	(a)	○		
	(b)			○
	(c)		○	
	(d)	○		
	(e)			○
Check items				
Trouble-shooting	i	●		
	ii		●	
	iii			●

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TROUBLESHOOTING

METHOD OF USING TROUBLESHOOTING CHARTS

The basic method of using the troubleshooting chart is as follows.

Items listed for **[Questions]** and **[Check items]** that have a relationship with the Cause items are marked with ○, and of these, causes that have a high probability are marked with ⊙.

Check each of the **[Questions]** and **[Check items]** in turn, and marked the ○ or ⊙ in the chart for items where the problem appeared. The vertical column (Causes) that has the highest number of points is the most probable cause, so start troubleshooting for that item to make final confirmation of the cause.

※1. For **[Confirm recent repair history]** in the **[Questions]** Section, ask the user, and mark the Cause column with △ to use as reference for locating the cause of the failure. However, do not use this when making calculations to narrow down the causes.

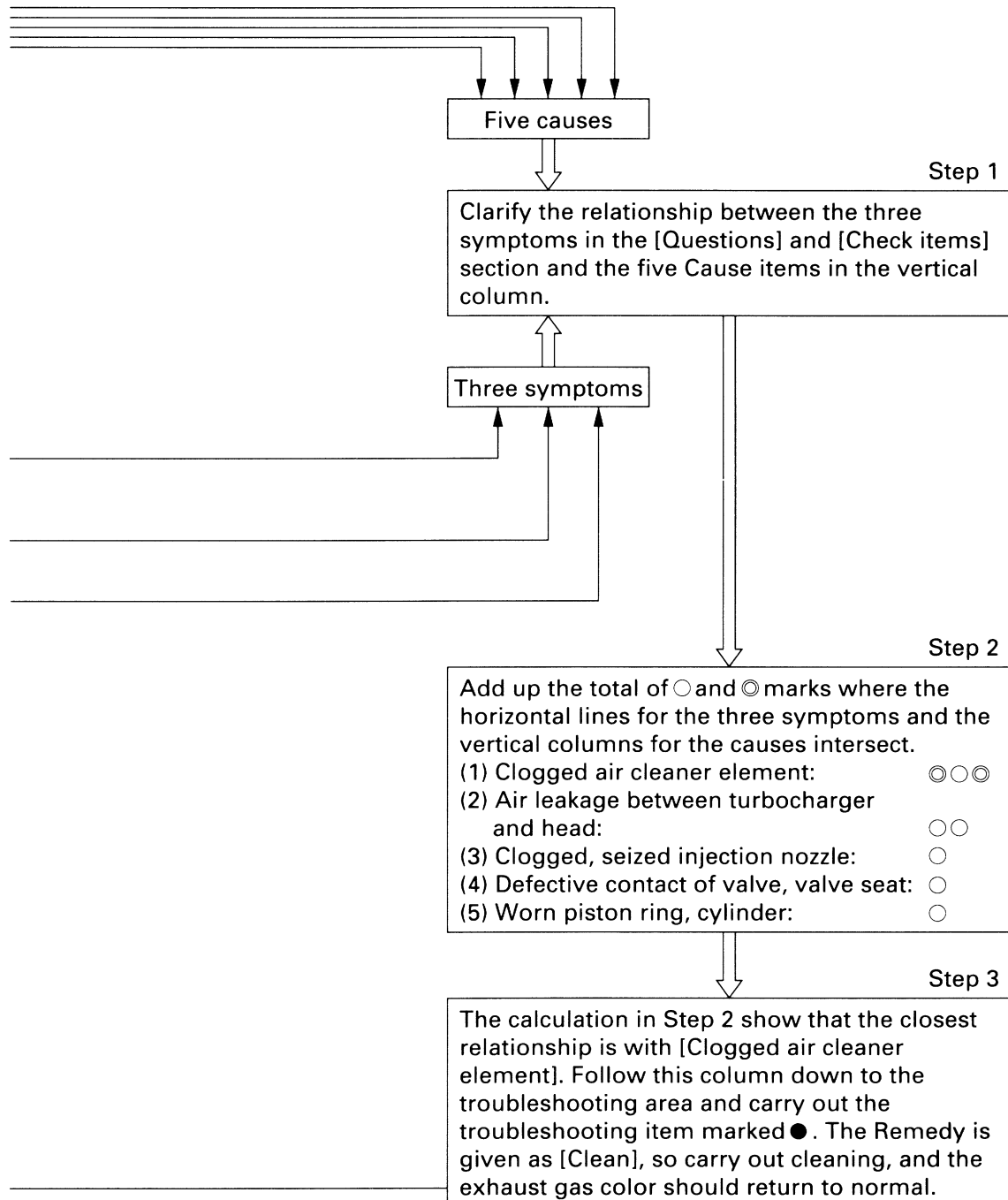
※2. Use the △ in the Cause column as reference for **[Degree of use (Operated for long period)]** in the **[Questions]** section as reference. As a rule, do not use it when calculating the points for locating the cause, but it can be included if necessary to determine the order for troubleshooting.

		Causes					
		Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)
※1	Confirm recent repair history						
※2	Degree of use						
	Operated for long period	△	△	△			

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TROUBLESHOOTING

METHOD OF USING TROUBLESHOOTING CHARTS



TROUBLESHOOTING**METHOD OF USING TROUBLESHOOTING CHARTS****4. Method of using matrix troubleshooting tables**

The troubleshooting tables use the same method as for other troubleshooting table (YES/NO type) to locate the causes of failures in the machine. The troubleshooting tables are divided broadly into categories for the main components, such as the steering system and work equipment hydraulic system. Follow the procedure given below and carry out troubleshooting to locate the problems accurately and swiftly.

Step 1. Questioning the operator

The questions to ask the operator are given below the failure symptom. If the answers to the questions match the information given, follow the arrow to reach the probable cause of the failure.

Consider the contents of the questions and consult the table while proceeding to Steps 2 and 3 to grasp the true cause.

1. Steering does not work ← Symptom [Example]

Ask the operator about the following points.

- Did the steering suddenly stop working? → Breakage in steering equipment
- Had the steering gradually been becoming heavy? → Internal wear of steering equipment, defective seal

Step 2. Checks before troubleshooting

Before starting the main troubleshooting and measuring the hydraulic pressure, first check the Checks before Starting items, and check for oil leakage and loose bolts. These checks may avoid time wasted on unnecessary troubleshooting.

The items given under Checks before Starting are items which must be considered particularly for that symptom before starting troubleshooting.

Checks before starting [Example]

- Is the oil level and type of oil in the hydraulic tank correct?
- Is there any leakage of oil from the steering control valve?

Step 3. Using cross-reference table

- 1) Operate the machine to carry out the checks in the troubleshooting item column.

Mark the items where the results match the symptom.

★ It is not necessary to follow the troubleshooting checks in order; follow an order which is easiest to carry out troubleshooting.

- 2) Find the appropriate cause from the cause column. If the symptom appears, the ○ marks on that line indicate the possible causes. (For item No. 2 in the table on the right, the possible causes are **c** or **e**.)

If there is only one ○:

Carry out the other troubleshooting items (where the same cause is marked with ○), check if the symptom appears, then repair.

If there are two ○s:

Go on to Step 3) to narrow down the possible causes.

[Example 1]

No.	Problems	Remedy
1	Steering does not work to the left or right	
2	Same as Item 1, but abnormality in actuation of work equipment	
3	Steering can only be operated to one side.	
4	Steering wheel is heavy and cannot be turned.	

[Example 2]

Problems	Causes				
	a	b	c	d	e
1	○	○	○	○	○
2	○	○	●	○	○
3	○	○	○	○	○
4	○	○	○	○	○
5	○	○	○	○	○

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TROUBLESHOOTING

METHOD OF USING TROUBLESHOOTING CHARTS

- 3) Operate the machine and check the troubleshooting items other than those in 1). Operate the machine and check the items in the same way as in 1), and if the symptom appears, mark that item. (In the chart on the right, the symptom appears again for item 5).
- 4) Find the appropriate cause from the cause column. In the same way as in Step 2), if the symptom appears, the $\bigcirc$ marks on that line indicate the possible causes. (For item No.5 in the table on the right, the possible causes are **b** or **e**.)

	Causes				
	a	b	c	d	e
Remedy	X	C	Δ	A	X
Problems					
1	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$	
2			$\bigcirc$		$\bullet$
3		$\bigcirc$		$\bigcirc$	
4	$\bigcirc$			$\bigcirc$	
5		$\bullet$			$\bullet$

Applicable troubleshooting item located in Step 3).
Applicable troubleshooting item located in Step 1).

- 5) Narrow down the possible causes. There is one common cause among the causes located in Steps 2) and 4). (One cause marked $\bigcirc$ appears on the line for both items.) This cause is common to both the symptoms in troubleshooting Steps 1) and 3).

★ The causes which are not common to both troubleshooting items (items which are not marked $\bigcirc$ for both symptoms) are unlikely causes, so ignore them. (In the example given on the right, the causes for Troubleshooting Item 2 are **c** or **e**, and the causes for Troubleshooting Item 5 are **b** or **e**, so cause **e** is common to both.)

	Causes				
	a	b	c	d	e
Remedy	X	C	Δ	A	X
Problems					
1	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$	
2			$\bullet$		$\bullet$
3		$\bigcirc$		$\bigcirc$	
4	$\bigcirc$			$\bigcirc$	
5		$\bullet$			$\bullet$

Ignore these causes
Common causes

- 6) Repeat the operations in Steps 3), 4) and 5) until one cause (one common cause) remains.

★ If the causes cannot be narrowed down to one cause, narrow the causes down as far as possible.

- 7) Remedy
If the causes are narrowed down to one common cause, take the action given in the remedy column.

The symbols given in the remedy column indicate the following:

X: Replace, Δ : Repair, A: Adjust, C: Clean

	Causes				
	a	b	c	d	e
Remedy	X	C	Δ	A	X
Problems					
1	$\bigcirc$	$\bigcirc$	$\bigcirc$	$\bigcirc$	
2			$\bigcirc$		$\bullet$
3		$\bigcirc$		$\bigcirc$	
4	$\bigcirc$			$\bigcirc$	
5		$\bigcirc$			$\bullet$

Action to take

TROUBLESHOOTING

CONNECTOR TYPES AND MOUNTING LOCATIONS

CONNECTOR TYPES AND MOUNTING LOCATIONS

★ The Address column in the table below shows the address in the connector arrangement drawing (3-dimensional drawing).

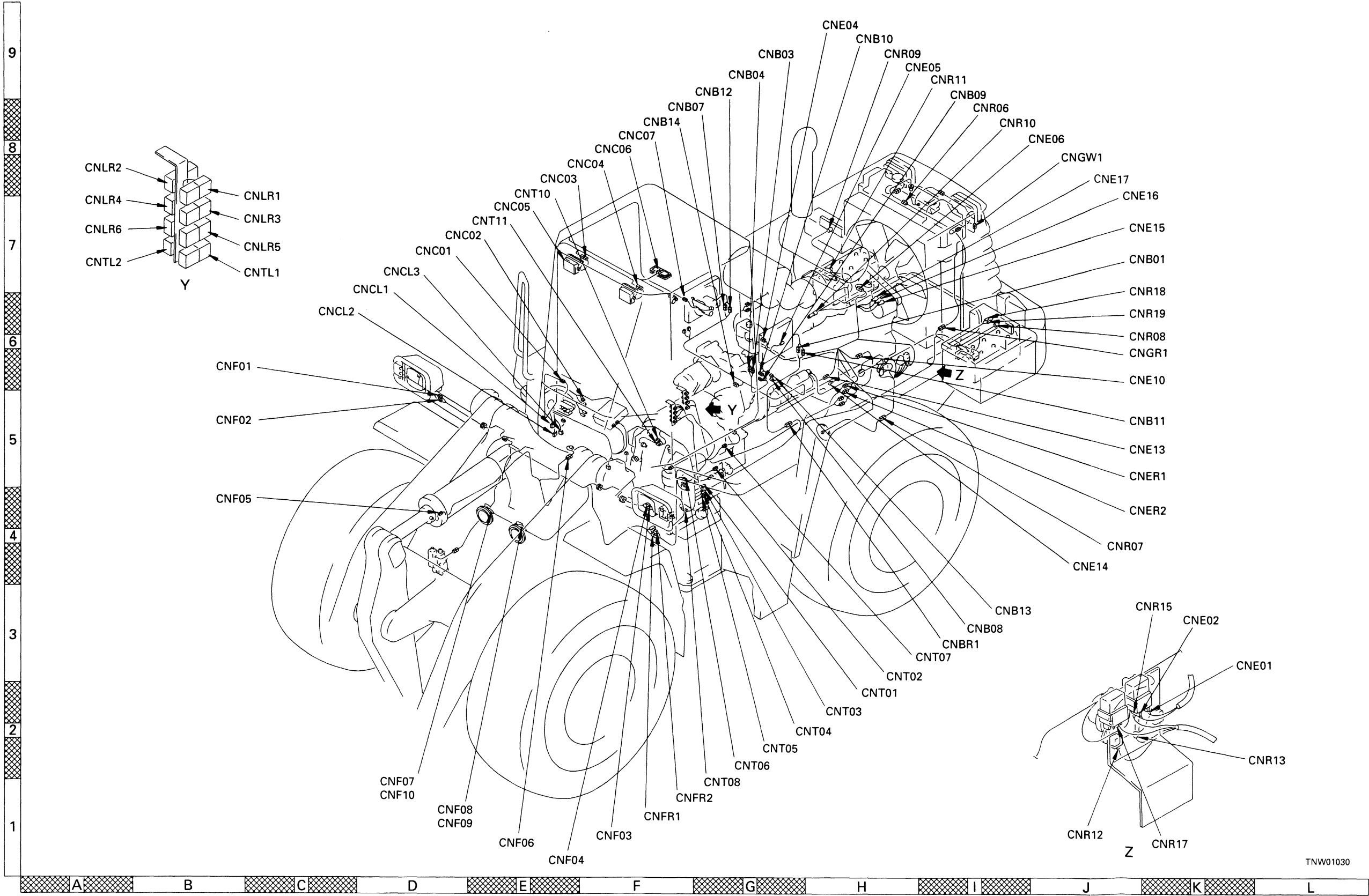
(1/3)

Con- nector No.	Con- nector Type	No. of pins	Mounting location	Add- ress	Con- nector No.	Con- nector Type	No. of pins	Mounting location	Add- ress
CNB01	X type	2	Condenser motor left	K7	CNLR2	SWP type	14	Floor wiring harness	B8
CNB03	(Con- nector)	2	Front washer tank	H9	CNLR3	SWP type	8	Floor wiring harness	C7
CNB04	(Con- nector)	2	Rear washer tank	G9	CNLR4	SWP type	14	Floor wiring harness	B7
CNB07	X type	2	Condenser motor right	G9	CNLR5	X type	4	Floor wiring harness	C7
CNBR1	SWP type	14	Bulkhead wiring harness	I3	CNLR6	L type	2	Floor wiring harness	B7
CNC01	M type	6	Front wiper motor	D7	CNR06	X type	2	Radiator level sensor	J9
CNC02	M type	4	Radio	E7	CNR07	X type	2	Fuel level sensor	K4
CNC03	M type	2	Working lamp right	F8	CNR08	M type	6	L.H. rear combination lamp	K6
CNC04	M type	2	Working lamp left	F8	CNR09	M type	6	R.H. rear combination lamp	I9
CNC06	(Con- nector)	2	Room lamp	F8	CNR18	(Con- nector)	1	License lamp	K7
CNC07	M type	4	Rear wiper motor	F8	CNR19	(Con- nector)	1	License lamp	K7
CNE06	X type	2	Water temperature sensor	J8	CNT01	X type	2	F solenoid	H2
CNER1	SWP type	14	Engine wiring harness	K5	CNT02	X type	2	R solenoid	I3
CNER2	SWP type	8	Engine wiring harness	K4	CNT03	X type	2	Hi-Lo solenoid	H2
CNF01	M type	3	Head lamp right	B6	CNT04	X type	2	Speed solenoid	H2
CNF02	M type	3	Combination lamp right	B5	CNT05	X type	2	Parking brake solenoid	G2
CNF03	M type	3	Combination lamp left	F1	CNT06	X type	2	Speed sensor	G2
CNF04	M type	3	Head lamp left	F1	CNT07	X type	2	Torque converter oil temperature sensor	I3
CNF05	X type	3	Bucket positioner	B5	CNT08	X type	2	Parking brake indicator sensor	G2
CNF06	X type	3	Boom kick-out	E1	CNT10	X type	2	Float switch (if equipped)	E8
CNFR1	S type	10	Rear frame wiring harness	F1	CNT11	X type	2	Emergency steering switch (if equipped)	E8
CNFR2	X type	4	Rear frame wiring harness	G2	CNTL1	SWP type	8	Floor wiring harness	C7
CNGR1		3	Intermediate connector	K6	CNTL2	SWP type	6	Floor wiring harness	B7
CNGW1	M type	2	Working lamp	J8					
CNLR1	S type	12	Floor wiring harness	C7					

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Connector pin arrangement diagram (1/3)

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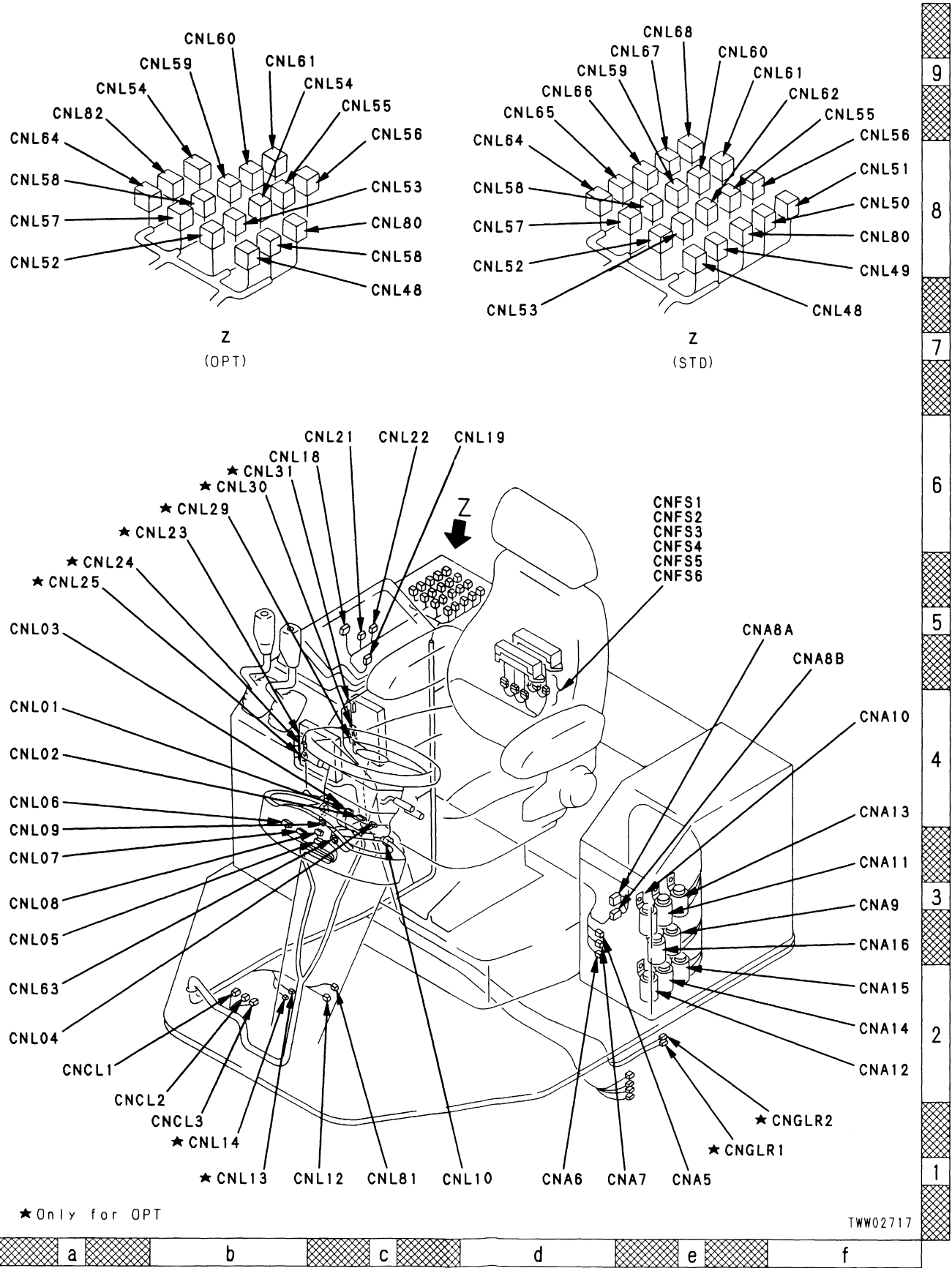
Serial No.: 53001 and up

(2/3)

Con- nector No.	Con- nector Type	No. of pins	Mounting location	Add- ress
CNA5	M	2	Thermistor	e1
CNA6	SBP	6	AIR MIC servo motor	d1
CNA7	M	6	Blower motor resistor	e1
CNA8A	S	10	Air conditioner relay	f5
CNA8B	S	4	Air conditioner relay	f5
CNA9	—	4	Blower relay (MAIN)	f3
CNA10	—	4	Blower relay (Hi)	f4
CNA11	—	4	Blower relay (M2)	f3
CNA12	—	4	Blower relay (MAIN)	f2
CNA13	—	4	Blower relay (Mi)	f4
CNA14	—	4	Blower relay LH (Hi)	f2
CNA15	—	4	Blower relay RH (Hi)	f2
CNA16	—	4	Condenser relay	f3
CNCL1	S	12	Cab harness	a2
CNCL2	S	16	Air conditioner	b2
CNCL3	S	8	Air conditioner	b1
CNDP	KES1	2	Travel damper	
CNFS1	L	2	Fuse box	e6
CNFS2	S	12	Fuse box	e6
CNFS3	M	6	Fuse box	e6
CNFS4	L	2	Fuse box	e6
CNFS5	M	6	Fuse box	e5
CNFS6	M	4	Fuse box	e5
CNGLR1	SWP	8	Intermediate connector	e1
CNGLR2	SWP	6	Intermediate connector (OP)	f1
CNL01	SWP	6	Transmission combination switch	a4
CNL02	SWP	6	Transmission combination switch	a4
CNL03	SWP	6	Transmission combination switch	a5
CNL04	SWP	14	Transmission combination switch	a2
CNL05	AMP040	20	Main motor	a3
CNL06	AMP040	16	Main motor	a4
CNL07	AMP040	12	Main motor	a3
CNL08	AMP040	8	Main motor	a3
CNL09	M	4	Starting switch	a3
CNL10	S	10	Wiper switch	d1
CNL12	X	2	Transmission cutoff switch	c1
CNL13	X	3	Accelerator potentiometer (OP)	b1
CNL14	X	3	Accelerator limit switch (OP)	b1

(2/3)

Con- nector No.	Con- nector Type	No. of pins	Mounting location	Add- ress
CNL15	M	4	Kick-down & holding switch	—
CNL16	KES1	2	Boom kickout solenoid	—
CNL17	KES1	2	Bucket positioner solenoid	—
CNL18	AMP040	16	Sub-monitor	c6
CNL19	AMP040	8	Sub-monitor	d6
CNL21	KES1	2	Sub-monitor	c6
CNL22	AMP040	2	Sub-monitor	c6
CNL23	—	10	Electronic engine throttle controller (OP)	b6
CNL24	—	18	Electronic engine throttle controller (OP)	a5
CNL25	—	24	Electronic engine throttle controller (OP)	a5
CNL29	MIC	21	Transmission controller	b6
CNL30	AMP040	20	Transmission controller	b6
CNL31	AMP040	16	Transmission controller	b6
CNL48	—	5	Bucket relay	c7,f7
CNL49	—	5	Boom relay	f8
CNL50	—	5	Proximity switch relay (OP)	f8
CNL51	—	5	Auto-leveler relay (OP)	f8
CNL52	—	5	Hazard relay	a8,d8
CNL53	—	5	Stop lamp relay	c8,d7
CNL54	—	5	Backup lamp relay	a9,c9
CNL55	—	5	Horn relay	c9,f9
CNL56	—	5	Preheating relay	c9,f9
CNL57	—	5	Neutral relay	a8,d8
CNL58	—	5	Neutralizer relay	a8,d8
CNL59	—	5	Parking safety relay	b9,d9
CNL60	—	6	Front working lamp relay	b9,c9
CNL61	—	6	Rear working lamp relay	b9,f9
CNL62	—	5	Engine stop relay	f9
CNL63	—	1	Horn switch	a2
CNL64	—	5	Engine oil pressure relay	a8,d9
CNL65	—	6	Transmission cutoff relay	d9
CNL66	—	6	Front travel relay	d9
CNL67	—	6	Reverse travel relay	e9
CNL68	—	6	Kick-down relay	e9
CNL80	—	5	Air cleaner clogging indicator relay	c8,f8
CNL81	X	2	Stop lamp switch	c1
CNL81	—	5	Travel damper relay	
CNL82	—	5	Switching pump cutoff relay	a9

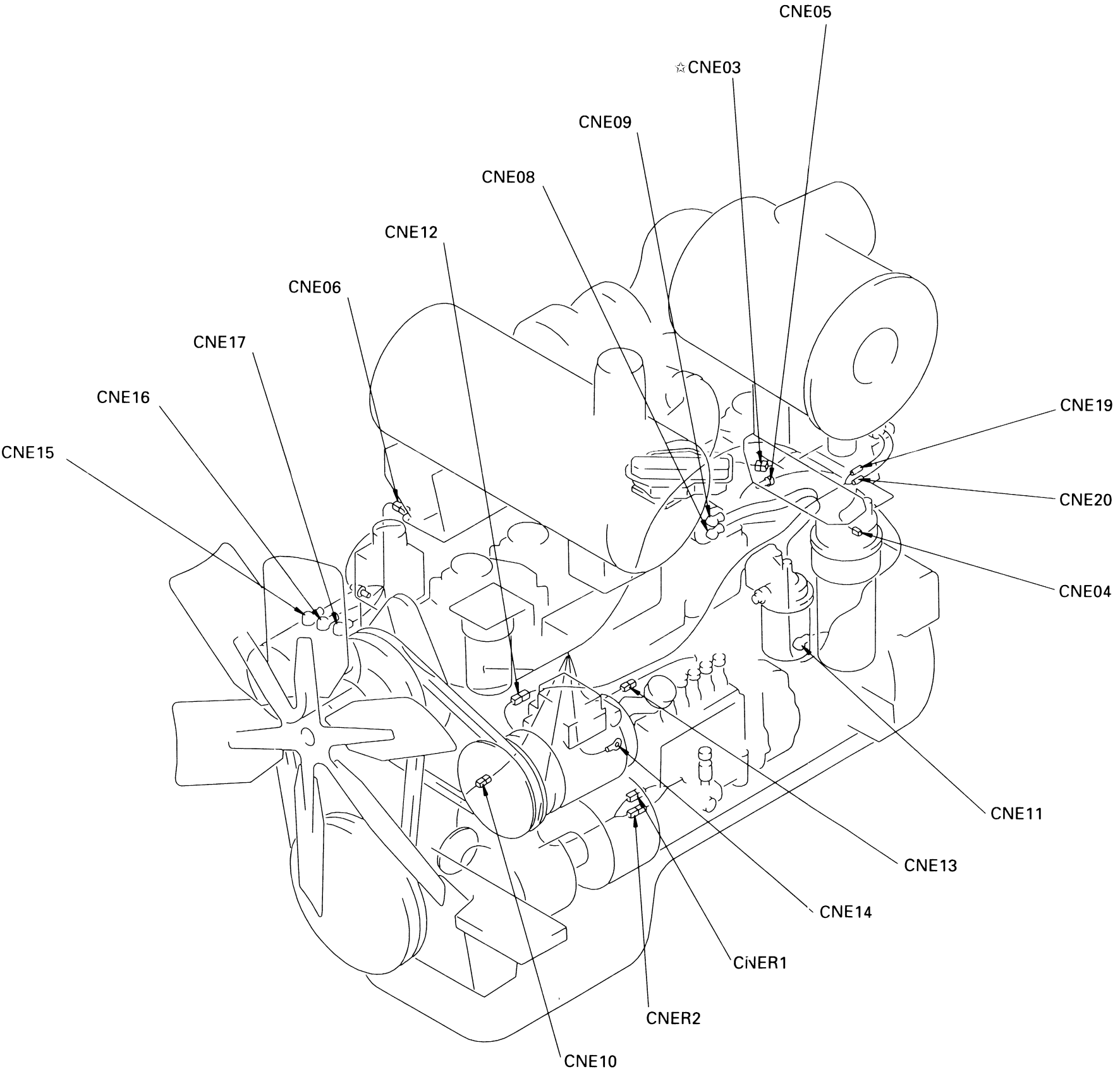


Connector pin arrangement diagram (3/3)

U42103

(3/3)

Con- nector No.	Con- nector Type	No. of pins	Mounting location	Add- ress
CNE03	SWP type	8	Engine stop motor (standard specifica- tion machine)	a9
CNE04	X type	3	RPM sensor	c5
CNE05	(Con- nector)	1	Water temperature sensor	b9
CNE06	X type	2	Water temperature sensor	Y6
CNE09		1	Heater relay	Z8
CNE10	X type	1	Engine oil level sensor	Z1
CNE12	X type	1	Compressor clutch	Y8
CNE13	X type	2	Starting motor	b3
CNE15	—	1	Alternator	W6
CNE16	—	1	Alternator	W6
CNE17	—	1	Alternator	X7
CNE19	(Con- nector)	1	Dust indicator	c6
CNE20	(Con- nector)	1	Dust indicator	c5
CNER1	SWP type	14	Engine wiring harness	a2
CNER2	SWP type	8	Engine wiring harness	a1

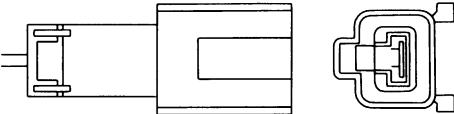
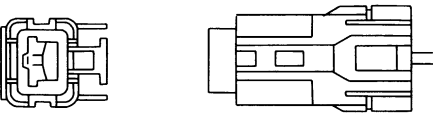
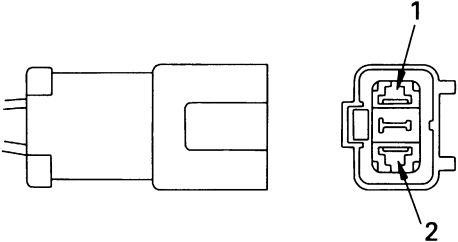
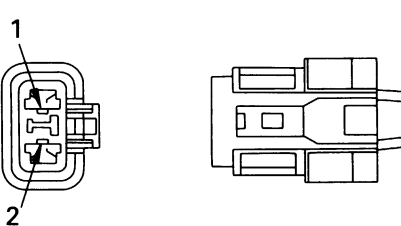
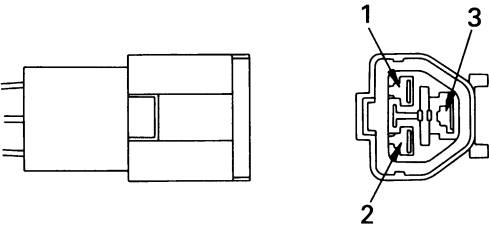
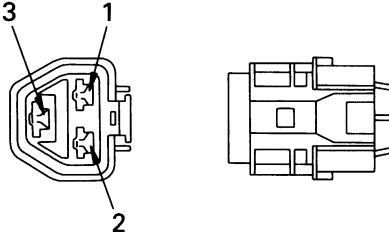
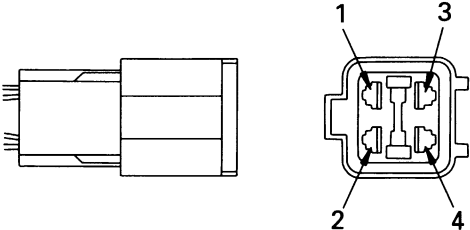
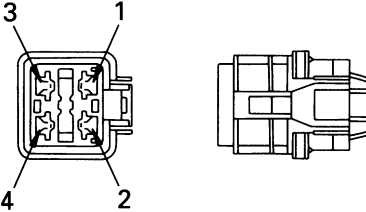


☆: Standard specification machine only

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CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

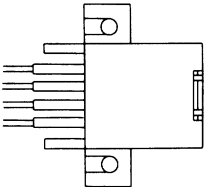
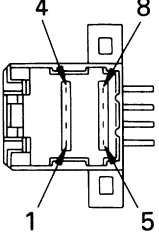
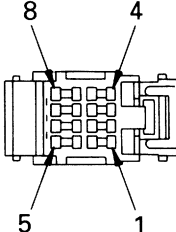
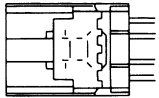
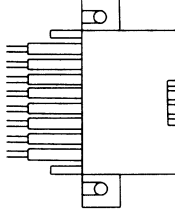
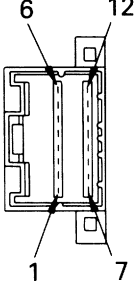
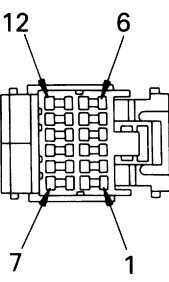
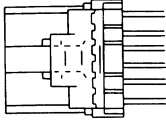
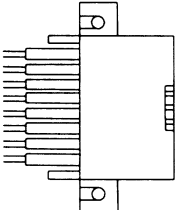
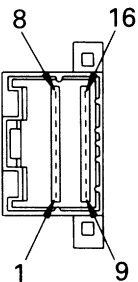
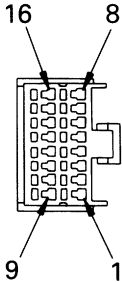
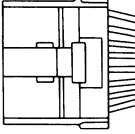
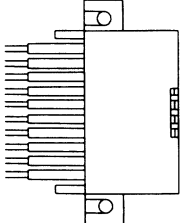
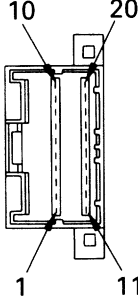
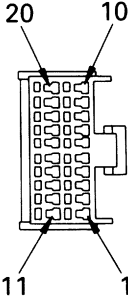
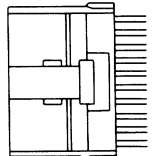
★ The terms male and female refer to the pins, while the terms male housing and female housing refer to the mating portion of the housing.

No. of pins	X type connector	
	Male (female housing)	Female (male housing)
1	 TEW00219	 TEW00220
2	 TEW00221	 TEW00222
3	 TEW00223	 TEW00224
4	 TEW00225	 TEW00226

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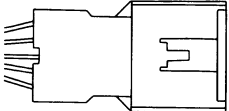
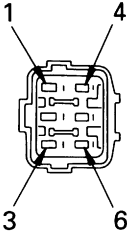
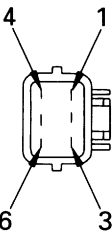
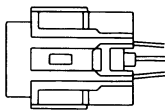
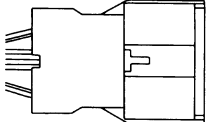
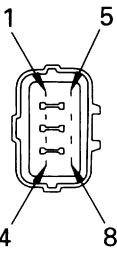
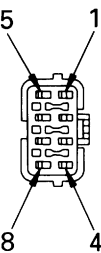
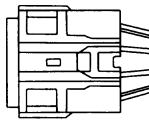
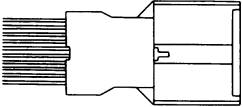
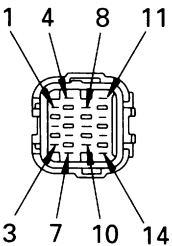
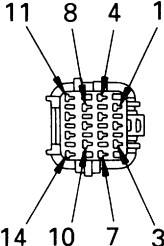
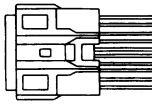
TROUBLESHOOTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	AMP040 type connector			
	Male (female housing)		Female (male housing)	
8		 TEW00227	 TEW00228	
12		 TEW00229	 TEW00230	
16		 TEW00231	 TEW00232	
20		 TEW00233	 TEW00234	

TROUBLESHOOTING

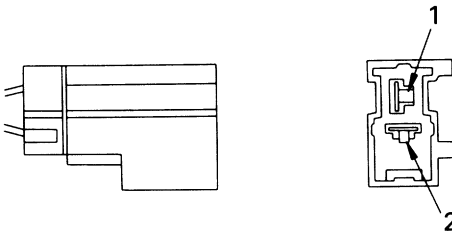
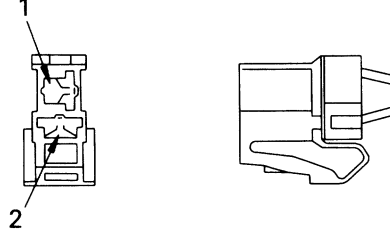
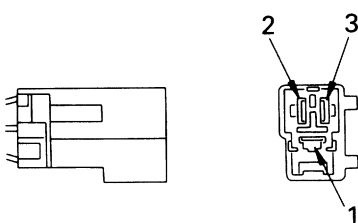
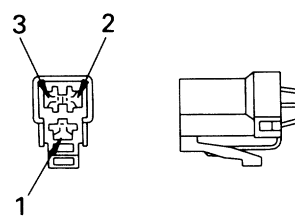
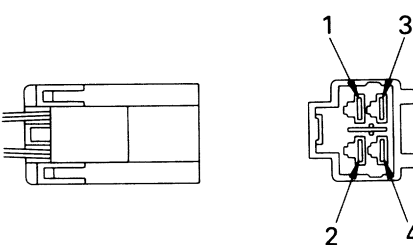
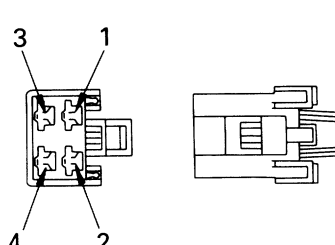
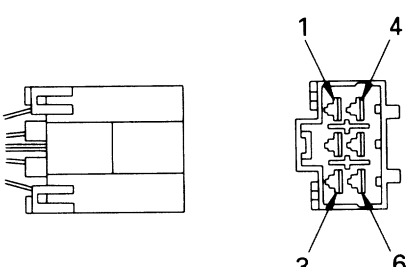
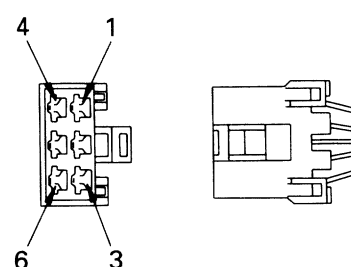
CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	SWP type connector	
	Male (female housing)	Female (male housing)
6	  TEW00235	  TEW00236
8	  TEW00237	  TEW00238
14	  TEW00239	  TEW00240

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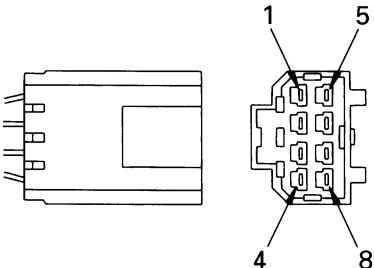
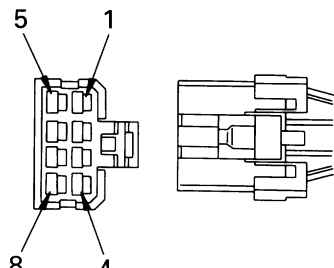
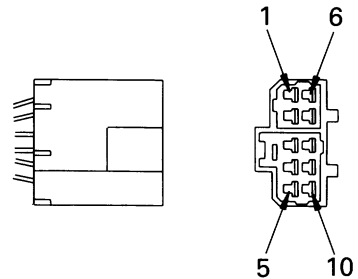
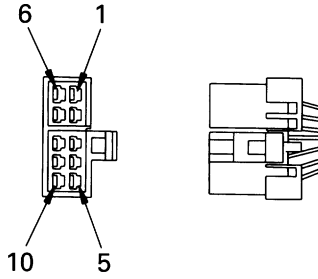
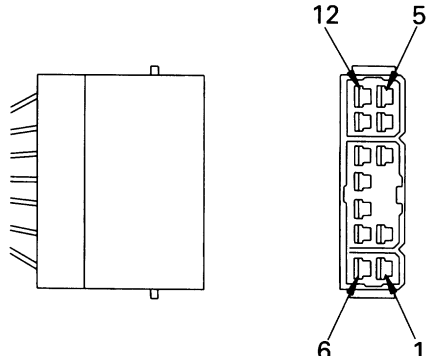
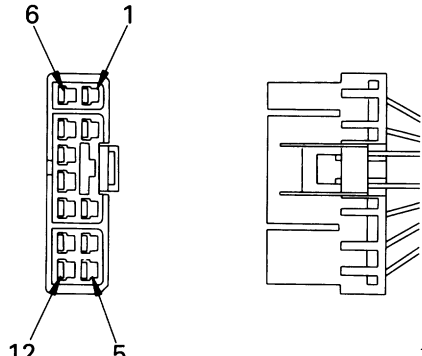
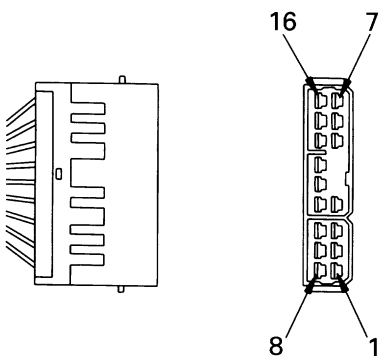
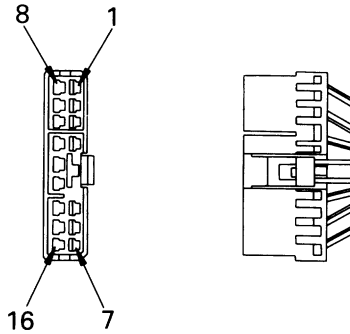
TROUBLESHOOTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	M type connector	
	Male (female housing)	Female (male housing)
2	 TEW00241	 TEW00242
3	 TEW00243	 TEW00244
4	 TEW00245	 TEW00246
6	 TEW00247	 TEW00248

TROUBLESHOOTING

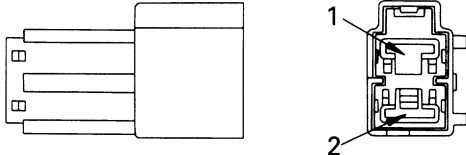
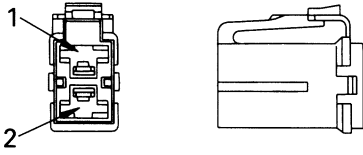
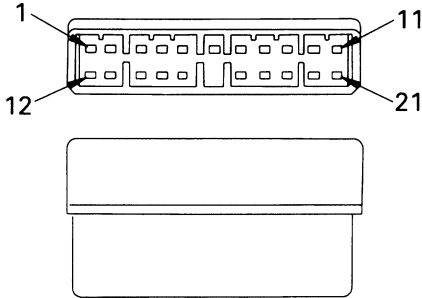
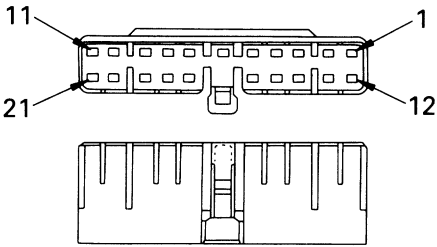
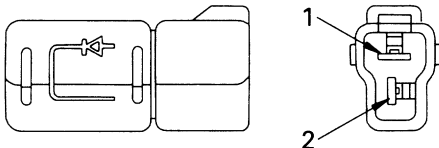
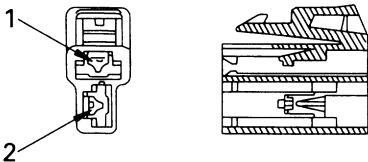
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No. of pins	S type connector	
	Male (female housing)	Female (male housing)
8	 TEW00249	 TEW00250
10	 TEW00251	 TEW00252
12	 TEW00253	 TEW00254
16	 TEW00255	 TEW00256

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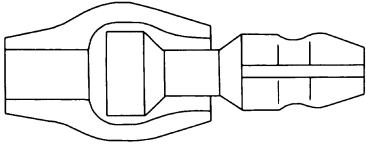
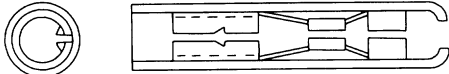
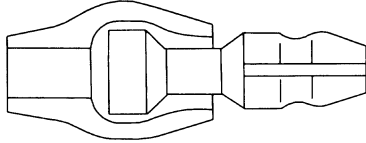
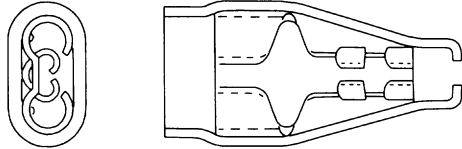
TROUBLESHOOTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	L type connector	
	Male (male housing)	Female (female housing)
6	 TEW00257	 TEW00258
No. of pins	MIC type connector	
	Male (female housing)	Female (male housing)
21	 TEW00259	 TEW00260
No. of pins	Diode type connector	
	Male (male housing)	Female (female housing)
2	 TEW00261	 TEW00262

TROUBLESHOOTING

CONNECTION TABLE FOR CONNECTOR PIN NUMBERS

No. of pins	Simple connector (ring connector)	
	Male (male housing)	Female (female housing)
1	 TEW00263	 TEW00264
2	 TEW00263	 TEW00265

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TROUBLESHOOTING OF ENGINE SYSTEM (S MODE)

S- 1	Starting performance is poor (Starting always takes time)	20-202
S- 2	Engine does not start	20-203
	(1) Engine does not turn	20-203
	(2) Engine turns but to exhaust gas comes out (Fuel is not being injected)	20-204
	(3) Exhaust gas comes out but engine does not start (Fuel is being injected)	20-205
S- 3	Engine does not pick up smoothly (Follow-up is poor)	20-206
S- 4	Engine stops during operations	20-207
S- 5	Engine does not rotate smoothly (hunting).....	20-208
S- 6	Engine lacks output(no power)	20-209
S- 7	Exhaust gas is black (incomplete combustion)	20-210
S- 8	Oil consumption is excessive (or exhaust gas is blue)	20-211
S- 9	Oil becomes contaminated quickly	20-212
S-10	Fuel consumption is excessive	20-213
S-11	Oil is in cooling water, or spurts back, or water level goes down	20-214
S-12	Oil pressure lamp lights up (drop in oil pressure)	20-215
S-13	Oil level rises	20-216
S-14	Water temprautre becomes too high (overheating)	20-217
S-15	Abnormal noise is made	20-218
S-16	Vibration is excessive	20-219

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S-1 Starting performance is poor (Starting always takes time)

General causes why starting performance is poor

- Defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel
(At ambient temperature of – 10°C or below, use ASTM D975 No. 1, and – 10°C or above, use ASTM D975 No. 2 diesel fuel.)
- ★ Battery charging rate.

Charging rate Ambient temperature	100%	90%	80%	75%	70%
20°C	1.28	1.26	1.24	1.23	1.22
0°C	1.29	1.27	1.25	1.24	1.23
–10°C	1.30	1.28	1.26	1.25	1.24

- The specific gravity should exceed the value for the charging rate of 70% in the above table.
- In cold weather the specific gravity must exceed the value for the charging rate of 75% in the above table.

Legend

- : Possible causes (judging from Questions and check items)
- ◉ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause

		Causes									
		Worn piston ring, cylinder	Defective contact of valve, valve seat	Clogged air cleaner, element	Clogged fuel filter, strainer	Clogged feed pump strainer	Defective intake pump strainer	Defective regulator	Defective heater (ribbon type)	Defective or deteriorated battery	Defective injection timing
		Leakage, clogging, air in fuel system	Clogged fuel tank air breather hole								
Questions	Confirm recent repair history										
	Degree of use										
	Operated for long period										
	Gradually became worse	○	○	○	○						
	Ease of starting										
	Starts when warm										
	Indicator lamp does not light up										
	Engine oil must be added more frequently	○									
	Replacement of filters has not been carried out according to operation manual			○	○	○			○	○	
	Dust indicator is red			○							
Check items	Non-specified fuel has been used			○	○				○	○	
	Battery charge lamp is ON						○	○			
	Starting motor cranks engine slowly							○			
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low								○		
	Engine does not pick up smoothly, and combustion is irregular	○	○					○			
	Blow-by gas is excessive	○									
	Match marks on fuel injection pump are out of alignment								○		
	Mud is stuck to fuel tank cap										○
	When engine is cranked with starting motor										
	1) Little fuel comes out even when injection pump sleeve nut is loosened									○	
Troubleshooting	2) Little fuel comes out even when fuel filter air bleed plug is loosened				○	○				○	
	Leakage from fuel piping									○	○
	There is hunting from engine (rotation is irregular)			○	○					○	○
	When compression pressure is measured, it is found to be low	●	●								
	When air element is inspected directly, it is found to be clogged			●							
	When fuel filter, strainer are inspected directly, they are found to be clogged				●						●
	When feed pump strainer is inspected directly, it is found to be clogged					●					
	Heater mount does not become warm						●				
	Voltage is 26 – 30V between alternator terminal B and terminal E with engine at low idling							●			
	Either specific gravity of electrolyte or voltage of battery is low								●		
Remedy	Speed of some cylinders does not change when operating on reduced cylinders									●	
	When check is made using delivery method, injection timing is found to be incorrect										●
	When control rack is pushed, it is found to be heavy or does not return (when blind plug at rear of pump is removed, it can be seen that plunger control sleeve does not move)										●
	When fuel cap is inspected directly, it is found to be clogged										●
		Replace	Repair	Clean	Clean	Clean	Replace	Replace	Replace	Adjust	Replace

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S-2 Engine does not start

(1) Engine does not turn

General causes why engine does not turn

- Internal parts of engine seized
 - ★ If internal parts of the engine are seized, carry out troubleshooting for "Engine stops during operations".
- Failure in power train
- Defective electrical system

Legend

- : Possible causes (judging from Questions and check items)
- ◎ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

Engine does not start			Causes									
Engine does not turn			Defective wiring of starting circuit	Defective or deteriorated battery	Defective starting motor	Broken ring gear	Defective safety relay or safety switch	Defective battery relay	Defective battery terminal connection	Defective adjustment of engine stop motor wire	Defective engine stop motor	Defective starting switch
Questions	Confirm recent repair history											
	Degree of use	Operated for long period	△		△							
	Condition of horn when starting switch is turned ON	Horn does not sound	◎					○				○
		Horn sound level is low	◎									
	When starting switch is turned to START, pinion moves out, but	Rotating speed is slow	◎									
		Makes grating noise		◎	◎							
		Soon disengages again				◎						
		Makes rattling noise and does not turn		○	○		○					
	When starting switch is turned to START, pinion does not move out		◎	○								○
	When starting switch is turned to ON, there is no clicking sound			○				◎				
Check items	Battery terminal is loose							◎				
	When starting switch is turned to ON, linkage does not move								◎	◎		
	When battery is checked, battery electrolyte is found to be low		◎									
	Troubleshooting	Specific gravity of electrolyte, voltage of battery is low		●								
For the following conditions 1) – 5), turn the starting switch OFF, connect the cord, and carry out troubleshooting at ON											●	
1) When terminal B and terminal C of starting switch are connected, engine starts												
2) When terminal B and terminal C of starting motor are connected, engine starts			●									
3) When terminal B and terminal C of safety relay are connected, engine starts					●							
4) When terminal of safety switch and terminal B of starting motor are connected, engine starts					●							
5) There is no 24V voltage between battery relay terminal B and terminal E						●						
When ring gear is inspected directly, tooth surface is found to be chipped				●								
Does not move even when engine stop motor linkage is disconnected								●	●			
Remedy			-	Replace	Replace	Replace	Replace	Replace	Adjust	Replace	Replace	Replace

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(2) Engine turns but no exhaust gas comes out (Fuel is not being injected)

General causes why engine turns but no exhaust gas comes out

- Supply of fuel impossible
- Supply of fuel is extremely small
- Improper selection of fuel (particularly in winter)

Standards for use of fuel

Type of fuel	Ambient temperature									
	-22 -30	-4 -20	14 -10	32 0	50 10	68 20	86 30	104 40	122°F 50°C	
Diesel fuel				ASTM D975 No.2						
				ASTM D975 No.1						

Legend

- : Possible causes (judging from Questions and check items)
- ⊙ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

		Causes									
		Broken injection pump drive shaft, key Defective injection pump (rack, plunger seized) Seized, broken feed pump piston Clogged fuel filter, strainer Clogged feed pump strainer Lack of fuel Clogged, leaking fuel piping Clogged fuel tank air breather hole Defective engine stop motor Improper fuel used									
Questions	Confirm recent repair history										
	Degree of use										
	Operated for long period										
	Exhaust gas suddenly stops coming out (when starting again)	⊙	⊙	⊙							
	Replacement of filters has not been carried out according to operation manual					○	○				
	Fuel tank is found to be empty							○			
	There is leakage from fuel piping							○			
	Mud is stuck to fuel tank cap							○			
	When starting switch is turned ON, linkage does not move								○		
	When fuel filter is drained, fuel does not come out									○	
Check items	When engine is cranked with starting motor, 1) Injection pump coupling dose not rotate	○									
	2) No fuel comes out even when fuel filter air bleed plug is loosened	○				○	○				○
	3) No fuel spurts out even when injection pipe sleeve nut is loosened	○	○	○							
	Rust and water are found when fuel is drained					○	○				
Troubleshooting	Check injection pump directly	●									
	When control rack is pushed, it is found to be heavy, or does not return		●								
	Check feed pump directly			●							
	When fuel filter, strainer are inspected directly, they are found to be clogged				●						●
	When feed pump strainer is inspected directly, it is found to be clogged					●					
	When fuel cap is inspected directly, it is found to be clogged							●			
	Does not move even when engine stop motor linkage is disconnected								●		
Remedy		Replace	Replace	Replace	Clean	Clean	Add	Repair	Repair	Replace	Replace

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(3) Exhaust gas comes out but engine does not start (Fuel is being injected)

General causes why exhaust gas comes out but engine does not start

- Lack of rotating force due to defective electrical system
- Insufficient supply of fuel
- Insufficient intake of air
- Improper selection of fuel

Legend

- : Possible causes (judging from Questions and check items)
- ⊙ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

		Causes										
		Defective broken valve system (valve, rocker lever, etc.)	Defective injection pump (rack, plunger, stuck)	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged air cleaner element	Defective intake heater (ribbon heater type)	Leakage, clogging, air in fuel system	Clogged injection nozzle	Defective spray	Improper fuel used
Questions	Confirm recent repair history											
	Degree of use											
	Operated for long period			△	△	△				△		
	Suddenly failed to start	⊙	⊙									
	When engine is cranked, abnormal noise is heard from around head	⊙										
	Engine oil must be added more frequently		⊙									
	Non-specified fuel has been used	○							○			
	Replacement of filters has not been carried out according to operation manual			⊙	⊙	⊙						
	Rust is found when fuel is drained			⊙	⊙							
	Dust indicator is red					⊙						
	Indicator lamp does not light up						⊙					
	Starting motor cranks engine slowly						⊙					
	Mud is stuck to fuel tank cap								○			
Check items	When fuel lever is placed at FULL position, it does not contact stopper	○										
	When engine is cranked with starting motor, 1) Little fuel comes out even when injection pump sleeve nut is loosened	⊙										
	2) Little fuel comes out even when fuel filter air bleed plug is loosened			⊙	⊙					○		
	There is leakage from fuel piping							⊙				
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinder is low								⊙			
	When fuel filter is drained, no fuel comes out										⊙	
Troubleshooting	Remove head cover and check directly	●										
	When control rack is pushed, it is found to be heavy, or does not return		●									
	When compression pressure is measured, it is found to be low			●								
	When fuel filter, strainer are inspected directly, they are found to be clogged				●							●
	When feed pump strainer is inspected directly, it is found to be clogged					●						
	When air element is inspected directly, it is found to be clogged						●					
	Heater mount does not become warm							●				
	Either specific gravity of electrolyte or voltage of battery is low								●			
	When feed pump is operated, there is no response, or pump is heavy									●		
	Speed of some cylinders does not change when operating on reduced cylinders										●	
	When fuel cap is inspected directly, it is found to be clogged											●
Remedy		Replace	Replace	Replace	Clean	Clean	Clean	Repair	Replace	Repair	Clean	Clean

S-3 Engine does not pick up smoothly (Follow-up is poor)

General causes why engine does not pick up smoothly

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used

Legend

- : Possible causes (judging from Questions and check items)
- ⊙ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

		Causes											
		Clogged air cleaner element	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged injection nozzle, defective spray	Worn piston ring, cylinder	Seized turbocharger, interference	Improper valve clearance	Clogged fuel tank air breather hole	Clogged, leaking fuel piping	Defective contact of valve, valve seat		
Questions	Confirm recent repair history												
	Degree of use												
	Operated for long period	△	△	△		△						△	
	Replacement of filters has not been carried out according to operation manual	○	○	○									
	Non-specified fuel has been used		○	○	○								
	Engine oil must be added more frequently				○								
	Rust and water are found when fuel is drained		○	○									
	Dust indicator is red	○											
	Noise of interference is heard from around turbocharger					○							
	Engine pick-up suddenly became poor			○		○		○	○				
	Color of exhaust gas					○							
	Blue under light load					○							
	Black	○		○		○						○	
Check items	Clanging sound is heard from around cylinder head							○					
	Mud is stuck to fuel tank cap							○					
	There is leakage from fuel piping								○				
	High idling speed under no load is normal, but speed suddenly drops when load is applied		○	○				○					
	There is hunting from engine (rotation is irregular)		○	○				○					
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			○	○								
	Blow-by gas is excessive				○								
Troubleshooting	When air element is inspected directly, it is found to be clogged	●											
	When fuel filter, strainer are inspected directly, they are found to be clogged		●										
	When feed pump strainer is inspected directly, it is found to be clogged			●									
	Speed of some cylinders does not change when operating on reduced cylinders				●								
	When control rack is pushed, it is found to be heavy, or does not return				●								
	When compression pressure is measured, it is found to be low					●						●	
	When turbocharger is rotated by hand, it is found to be heavy						●						
	When valve clearance is checked directly, it is found to be outside standard value							●					
	When fuel cap is inspected directly, it is found to be clogged								●				
	When feed pump is operated, operation is too light or too heavy									●			
Remedy		Clean	Clean	Clean	Repair	Replace	Replace	Adjust	Clean	Repair	Replace		

S-4 Engine stops during operations

General causes why engine stops during operations

- Seized parts inside engine
- Insufficient supply of fuel
- Overheating
 - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.
- Failure in power train
 - ★ If the engine stops because of a failure in the power train, carry out troubleshooting for the chassis.

Legend

- : Possible causes (judging from Questions and check items)
- ◎ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

		Causes											
		Broken, seized piston connecting rod	Broken, seized crankshaft bearing	Broken valve system (valve, rocker lever, etc.)	Broken, seized gear train	Broken pump auxiliary equipment	Lack of fuel	Clogged fuel filter, strainer	Clogged feed pump strainer	Clogged, seized feed pump piston	Clogged, leaking fuel piping	Defective fuel tank air breather hole	Failure in chassis power train
Questions	Confirm recent repair history												
	Degree of use												
	Condition when engine stopped	Operated for long period						△	△				
		Abnormal noise was heard and engine stopped suddenly		◎	◎	◎	◎	◎		○		○	◎
		Engine overheated and stopped		◎	○		○						
		Engine stopped slowly					◎	○	○				
	There was hunting and engine stopped						◎	○	○		○		
	Fuel gauge lamp lights up						◎						
	Fuel tank is found to be empty						◎						
	Replacement of filters has not been carried out according to operation manual							◎	◎				
	Non-specified fuel has been used							○	○	○		○	
Check items	When feed pump is operated, there is no response or it is heavy							○	○	◎			
	Mud is stuck to fuel tank cap										◎		
	Engine turns, but stops when transmission control lever is operated												◎
	Try to turn by hand using barring tool	Does not turn at all		◎	◎								
		Turns in opposite direction			◎								
		Moves amount of backlash				◎	◎						
		Shaft does not turn					◎						
	Rust and water are found when fuel is drained							◎	◎				
	Metal particles are found when oil is drained	◎	◎					○	○				
	Remove oil pan and check directly	●	●										
Troubleshooting	Remove head cover and check directly		●										
	When gear train is inspected, it does not turn			●									
	Turns when pump auxiliary equipment is removed				●								
	When fuel filter, strainer are inspected directly, they are found to be clogged						●						
	When feed pump strainer is inspected directly, it is found to be clogged							●					
	Check feed pump directly								●				
	When control rack is pushed, it is found to be heavy or does not return											●	
		Carry out troubleshooting in chassis volume											
Remedy		Replace	Replace	Replace	Replace	Replace	Add	Clean	Clean	Replace	Repair	Clean	Replace

S-5 Engine does not rotate smoothly (hunting)

General causes why engine does not rotate smoothly

- Air in fuel system
- Defective governor mechanism

Legend

- : Possible causes (judging from Questions and check items)
- ⊙ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

		Causes									
		Defective operation of governor	Defective adjustment of governor	Defective operation of control rack	Low speed is too low	Lack of fuel	Clogged feed pump strainer	Clogged fuel filter, strainer	Clogged, air in circuit between fuel tank and feed pump	Clogged, air in circuit between feed pump and nozzle	Clogged fuel tank air breather hole
Questions	Confirm recent repair history										
	Degree of use										
	Operated for long period					△	△				
	Occurs at certain speed range	⊙	⊙	⊙	○						
	Occurs at low idling	○		⊙		○	○	○	○		
	Occurs even when speed is raised	○	○	○						○	
	Occurs on slopes				⊙						
	Fuel tank is found to be empty				⊙						
	Replacement of filters has not been carried out according to operation manual					⊙	⊙				
	Rust is found when fuel is drained					○	○				
Check items	Leakage from fuel piping							⊙	⊙		
	When feed pump is operated,										
	1) No response, light, return is quick							⊙	⊙		
	2) No response, light, return is normal							⊙			
	Engine speed sometimes rises too high	⊙	⊙								
	Engine is sometimes difficult to stop	⊙		⊙							
	Seal on injection pump has come off		⊙	⊙							
	When governor lever is moved it is found to be stiff	●		●							
	When injection pump is tested, governor is found to be improperly adjusted		●								
	When control rack is pushed, it is found to be heavy, or does not return			●							
Troubleshooting	When fuel cap is inspected directly, it is found to be clogged				●						●
	When feed pump strainer is inspected directly, it is found to be clogged					●					
	When fuel filter, strainer are inspected directly, they are found to be clogged						●				
Remedy		Adjust	Adjust	Adjust	Adjust	Add	Clean	Clean	Repair	Repair	Clean

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S-6 Engine lacks output (no power)

General causes why engine lacks output

- Insufficient intake of air
- Insufficient supply of fuel
- Improper condition of fuel injection
- Improper fuel used
(if non-specified fuel is used, output drops)
- Lack of output due to overheating
 - ★ If there is overheating and insufficient output, carry out troubleshooting for overheating.

Legend

- : Possible causes (judging from Questions and check items)
- ◎ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

		Causes											
		Clogged air cleaner element	Seized turbocharger, interference	Worn piston ring, cylinder	Clogged fuel filter, strainer	Clogged feed pump strainer	Seized injection nozzle, defective spray	Improper valve clearance	Defective contact of valve, valve seat	Bent fuel lever linkage, defective adjustment	Clogged, leaking fuel piping	Clogged fuel tank air breather hole	
Questions	Confirm recent repair history												
	Degree of use												
	Operated for long period	△	△	△	△				△				
	Power was lost												
	Suddenly	◎											
	Gradually	○	○	○	○			○					
	Engine oil must be added more frequently		◎										
	Replacement of filters has not been carried out according to operation manual	◎		◎	◎								
	Non-specified fuel has been used			◎	◎	◎							
	Dust indicator is red	◎											
	Color of exhaust gas	◎	◎										
	Black												
	Blue under light load		◎										
Check items	Noise of interference is heard from around turbocharger	◎											
	Blow-by gas is excessive		◎										
	Engine pickup is poor and combustion is irregular	◎			○					○	○		
	High idling speed under no load is normal, but speed suddenly drops when load is applied			◎	◎						○		
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low				◎	○							
	There is hunting from engine (rotation is irregular)			○	○					○	○		
	Clanging sound is heard from around cylinder head						◎						
	High idling speed of engine is low					○			◎				
	Leakage from fuel piping									◎			
Troubleshooting	When air element is inspected directly, it is found to be clogged	●											
	When turbocharger is rotated by hand, it is found to be heavy		●										
	When compression pressure is measured, it is found to be low			●					●				
	When fuel filter, strainer are inspected directly, they are found to be clogged				●								
	When feed pump strainer are inspected directly, it is found to be clogged					●							
	Speed of some cylinders does not change when operating on reduced cylinders						●						
	When control rack is pushed, it is found to be heavy, or dose not return							●					
	When valve clearance is checked directly, it is found to be outside standard value								●				
	When lever is placed at FULL position, it does not contact stopper									●			
	When feed pump is operated, operation is too light or too heavy										●		
	When fuel cap is inspected directly, it is found to be clogged											●	
Remedy		Clean	Replace	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Adjust	Repair	Clean

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black

- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

		Causes									
		Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Defective injection pump (rack, plunger seized)
Legend											
○ : Possible causes (judging from Questions and check items)											
⊙ : Most probable causes (judging from Questions and Check items)											
△ : Possible causes due to length of use (used for a long period)											
● : Items to confirm the cause.											
Questions	Confirm recent repair history										
	Degree of use										
	Operated for long period		△	△	△					△	
	Color of exhaust gas										
	Suddenly became black	⊙			○						○
	Gradually became black	⊙		○				○			
	Blue under light load			⊙							
	Engine oil must be added more frequently			⊙							
	Power was lost										
	Suddenly	⊙		○			○			○	
	Gradually		○	○				○	○		
Check items	Non-specified fuel has been used			○							○
	Noise of interference is heard from around turbocharger	⊙									
	Dust indicator is red		⊙								
	Blow-by gas is excessive			⊙							
	Engine pickup is poor and combustion is irregular	○		⊙		○	○	○		○	
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			⊙						○	
	Match marks on fuel injection pump are out of alignment				⊙						
	Seal on injection pump has come off				⊙						
	Clanging sound is heard from around cylinder head					⊙					
	Exhaust noise is abnormal	○		○			⊙				
Troubleshooting	Muffler is crushed						⊙				
	Leakage of air between turbocharger and head, loose clamp							⊙			
	When turbocharger is rotated by hand, it is found to be heavy	●									
	When air cleaner is inspected directly, it is found to be clogged		●								
	When compression pressure is measured, it is found to be low			●						●	
	Speed of some cylinders does not change when operating on reduced cylinders				●						
	When check is made using delivery method, injection timing is found to be incorrect					●					
	Injection pump test shows that injection amount is incorrect						●				
	When valve clearance is checked directly it is found to be outside standard value							●			
	When muffler is removed, exhaust gas color returns to normal								●		
Remedy	When control rack is pushed, it is found to be heavy, or does not return										●
		Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace

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S-8 Oil consumption is excessive (or exhaust gas is blue)

- ★ Do not run the engine at idling for more than 20 minutes continuously. (Both low and high idling)

General causes why oil consumption is excessive

- Abnormal combustion of oil
- External leakage of oil
- Wear of lubrication system

		Causes											
		Broken piston ring	Worn piston ring	Clogged breather or breather liner	Leakage from oil filter, oil cooler	Leakage from oil piping	Leakage from oil drain plug	Broken oil cooler	Worn oil cooler	Worn seal at turbine end	Worn, broken rear end	Turbocharger	
Questions	Confirm recent repair history												
	Degree of use												
	Operated for long period												
	Oil consumption suddenly increased												
	Engine oil must be added more frequently												
	Engine oil becomes contaminated quickly												
	Exhaust gas is blue under light load												
	Amount of blow-by gas												
	Abnormally excessive												
	None												
Check items	Area around engine is dirty with oil												
	There is oil in engine cooling water												
	When exhaust pipe is removed, inside is found to be dirty with oil												
	Inside of turbocharger intake pipe is dirty with oil												
	Oil level in clutch or TORQFLOW transmission damper chamber rises												
	Clamps for intake system are loose												
Troubleshooting	When compression pressure is measured, it is found to be low												
	When breather element is inspected, it is found to be clogged with dirty oil												
	There is external leakage of oil from engine												
	Pressure-tightness test of oil cooler shows there is leakage												
	Excessive play of turbocharger shaft												
	Check rear seal directly												
	When intake manifold is removed, dust is found inside												
	When intake manifold is removed, inside is found to be dirty with oil												
Remedy		Replace	Replace	Clean	Repair	Repair	Repair	Replace	Replace	Replace	Repair	Repair	Repair

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S-9 Oil becomes contaminated quickly

General causes why oil becomes contaminated quickly

- Intake of exhaust gas due to internal wear
- Clogging of lubrication passage
- Improper combustion
- Improper oil used
- Operation under excessive load

			Causes								
			Worn piston ring, cylinder	Clogged breather, breather tube	Clogged oil filter	Worn valve, valve guide	Clogged oil cooler	Defective turbocharger drain pipe	Defective seal at turbocharger turbine end	Exhaust gas is black	
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	△		△			△			
	Engine oil must be added more frequently		◎								
	Non-specified fuel has been used				○						
	Color of exhaust gas	Blue under light load	◎								
		Black								◎	
	Amount of blow-by gas	Abnormally excessive	◎		○		○	○			
		None		◎							
	Oil filter caution lamp stays on even when oil pressure rises				◎				○		
	When oil filter is inspected, metal particles are found			○	◎	○					
Check items	When exhaust pipe is removed, inside is found to be dirty with oil				◎						
	Engine oil temperature rises quickly					◎					
Troubleshooting	When compression pressure is measured, it is found to be low		●			●					
	When breather element is inspected directly, it is found to be clogged with dirty oil, or hose is broken			●							
	When oil filter is inspected directly, it is found to be clogged				●						
	When oil cooler is inspected directly, it is found to be clogged					●					
	Turbocharger drain tube is clogged						●				
	Excessive play of turbocharger shaft							●			
	When safety valve is directly inspected, spring is found to be catching or broken								●		
			Carry out troubleshooting for "Exhaust is black"								

Carry out troubleshooting for "Exhaust is black"

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S-10 Fuel consumption is excessive

General causes why fuel consumption is excessive

- Leakage of fuel
- Improper condition of fuel injection
- Excessive injection of fuel

Legend

- : Possible causes (judging from Questions and check items)
- ⊙ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

			Causes							
			Defective injection pump (excessive injection)	Defective injection nozzle spray	Defective injection pump plunger	Improper fuel injection timing	External leakage from fuel piping	Leakage of fuel inside head cover	Defective oil seal inside feed pump (piston)	Defective adjustment of fuel lever linkage
Questions	Confirm recent repair history									
	Degree of use	Operated for long period		△	△				△	
	Condition of fuel consumption	More than for other machines of same model	⊙			○				
		Gradually increased		○	○					
		Suddenly increased				○	○			
	Exhaust gas color	Black	⊙	○		○				○
		White					○			
	Seal on injection pump has come off		⊙							
	There is irregular combustion			⊙						
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			⊙	○					
Check items	Match mark on injection pump is misaligned				⊙					
	There is external leakage of fuel from engine					⊙				
	Engine oil level rises and smells of diesel fuel		○				⊙	⊙		
	Engine low idling speed is high		○							⊙
	Injection pump test shows that injection amount is excessive		●							
	Speed of some cylinders does not change when operating on reduced cylinders			●						
	When control rack is pushed, it is found to be heavy, or does not return				●					
	When check is made using delivery method, injection timing is found to be incorrect					●				
Troubleshooting	Remove head cover and check directly						●			
	Remove feed pump and check directly							●		
	When engine speed is measured, low idling speed is found to be high									●
	Remedy		Adjust	Replace	Replace	Adjust	Repair	Repair	Repair	Adjust

S-11 Oil is in cooling water, or water spurts back, or water level goes down

General causes why oil is in cooling water

- Internal leakage in lubrication system
- Internal leakage in cooling system

			Causes					
			Broken oil cooler core, O-ring	Broken head, head gasket	Insufficient protrusion of liner	Broken oil cooler for power train	Broken liner O-ring, holes caused by pitting	Internal cracks in cylinder block
								</

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S-12 Oil pressure lamp lights up (drop in oil pressure)

General causes why oil pressure lamp lights up

- Leakage, clogging, wear of lubricating system
- Defective oil pressure control
- Improper oil used (improper viscosity)
- Deterioration of oil due to overheating

Standards for engine oil selection

Type of oil	Selection of oil SAE number according to ambient temperature							
	-22 -30	-4 -20	14 -10	32 0	50 10	68 20	86 30	104 122°F 40 50°C
Engine oil								

Causes

Clogged oil filter	Worn bearing journal	Clogged strainer inside oil pan	Clogged, broken oil pipe inside oil pan	Defective suction pipe brazing	Insufficient oil pump	Defective oil in oil pan	Defective regulator valve	Leaking relief valve	Defective, crushed hydraulic piping	Defective oil level sensor	Defective oil pressure sensor	Water, fuel in oil
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Legend

- : Possible causes (judging from Questions and check items)
- ⊙ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

Questions	Confirm recent repair history												
	Degree of use	Operated for long period	△	△				△					
	Replacement of filter has not been carried out according to operation manual		⊙										
	Caution lamp lights up		⊙						○				
	Non-specified fuel has been used		○	○									
	Condition when oil pressure lamp lights up	Lights up at low idling	⊙						○				
		Lights up at low, high idling		⊙	⊙	⊙	⊙	○	○				
		Lights up on slopes						⊙					
		Sometimes lights up						⊙	⊙		○	○	
	There is clogging, leakage from hydraulic piping (external)								⊙				
Check items	Oil level sensor lamp lights up							⊙		⊙			
	When oil level in oil pan is checked, it is found to be low							⊙					
	Metal particles are found when oil is drained		⊙										
	Metal particles are stuck to oil filter element		⊙				○						
	Oil is cloudy white or smells of diesel oil											⊙	
Troubleshooting	When oil filter is inspected directly, it is found to be clogged		●	●									
	Remove oil pan and check directly			●	●	●							
	Oil pump rotation is heavy, there is play						●						
	There is catching of relief valve, regulator valve, spring, or valve guide is broken							●	●				
	When oil level sensor is replaced, oil pressure sensor lamp goes out									●			
	When oil pressure is measured, it is found to be within standard value										●		
Remedy		Clean	Clean	Clean	Clean	Repair	Replace	Add	Adjust	Adjust	Repair	Replace	Replace

Carry out troubleshooting for "Oil level rises"

S-13 Oil level rises

- ★ If there is oil in the cooling water, carry out troubleshooting for "Oil is in cooling water".

General causes why oil level rises

- Water in oil (cloudy white)
- Fuel in oil (diluted, and smells of diesel fuel)
- Entry of oil from other component

Legend

- : Possible causes (judging from Questions and check items)
 ◎ : Most probable causes (judging from Questions and Check items)
 △ : Possible causes due to length of use (used for a long period)
 ● : Items to confirm the cause.

		Cause									
		Broken oil cooler core, O-ring	Defective nozzle holder sleeve	Broken head, head gasket (including precombustion chamber)	Clogged water pump breather hole, defective seal	Worn, damaged rear seal surface	Defective seal of pump or auxiliary equipment	Leakage of fuel from piping inside head cover	Defective inside injection pump (flange type)	Damaged liner O-ring, holes made by pitting	Cracks inside cylinder block
Questions	Confirm recent repair history										
	Degree of use										
	Operated for long period		△	△	△	△				△	
	There is oil in radiator cooling water	◎	○	○						○	○
	Exhaust gas is white		◎				○	○			
	When engine is first started, drops of water come from muffler		◎								
	Leave radiator cap open. When engine is run at idling, an abnormal number of bubbles appear, or water spurts back			◎					○		
	Water pump breather hole is clogged with mud			◎							
	When water pump breather hole is clean, water comes out			◎							
	Oil level goes down in clutch, TORQFLOW transmission, or damper chamber				◎						
Check items	Oil level goes down in hydraulic tank					◎					
	Engine oil smells of diesel fuel						◎	◎	◎		
	Fuel is added more frequently						◎	◎	◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage	●									
	Pressure-tightness test of cylinder head shows there is leakage		●								
	When compression pressure is measured, it is found to be low			●							
	Remove water pump and check directly				●						
	Check rear seal directly					●					
	When pump auxiliary equipment is removed, seal is found to be broken						●				
	Remove head cover and check directly							●			
	Remove injection pump and check directly								●		
	There is improper contact of thermostat seat valve									●	
	Remove oil pan and check directly										●
Remedy		Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace

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S-14 Water temperature becomes too high (overheating)

General causes why water temperature becomes too high

- Lack of cooling water (deformation, damage of fan)
- Drop in heat dissipation efficiency
- Defective cooling circulation system
- Rise in oil temperature of power train
- ★ Carry out troubleshooting for chassis.

Legend

- : Possible causes (judging from Questions and check items)
- ⊙ : Most probable causes (judging from Questions and Check items)
- △ : Possible causes due to length of use (used for a long period)
- : Items to confirm the cause.

4 Water temperature becomes too high (overheating)			Causes											
General causes why water temperature becomes too high														
Lack of cooling water (deformation, damage of fan)														
Drop in heat dissipation efficiency														
Defective cooling circulation system														
Rise in oil temperature of power train														
★ Carry out troubleshooting for chassis.														
Legend														
○ : Possible causes (judging from Questions and check items)														
◎ : Most probable causes (judging from Questions and Check items)														
△ : Possible causes due to length of use (used for a long period)														
● : Items to confirm the cause.														
Questions	Confirm recent repair history													
	Degree of use	Operated for long period		△	△							△	△	
	Condition of overheating	Suddenly overheated	◎					○	○					
		Always tends to overheat		◎	◎	○			○					
	Water temperature gauge	Rises quickly			◎		○							
		Does not go down from red range					◎							
	Radiator water level sensor lights up							◎						
	Fan belt whines under sudden load								◎					
	Cloudy white oil is floating on cooling water									◎				
	Cooling water flows out from overflow hose										◎			
	Excessive air bubbles inside radiator, water spurts back											◎		
	Engine oil level has risen, oil is cloudy white									○			◎	
	There is play when fan pulley is rotated		◎											
Check items	Radiator shroud, inside of underguard are clogged with dirt or mud			◎					◎					
	When light bulb is held behind radiator, no light passes through			◎										
	Water is leaking because of cracks in hose or loose clamps							◎						
	Belt tension is found to be slack								◎					
	Power train oil temperature enters red range before engine water temperature												◎	
Troubleshooting	Temperature difference between top and bottom radiator tank is excessive		●											
	Temperature difference between top and bottom radiator tank is slight			●										
	When water filler port is inspected, the core is found to be clogged				●									
	When a function test is carried out on the thermostat, it does not open even at the cracking temperature					●								
	When water temperature is measured, it is found to be normal						●							
	When oil cooler is inspected directly, it is found to be clogged								●					
	When measurement is made with radiator cap tester, set pressure is found to be low									●				
	When compression pressure is measured, it is found to be low										●			
	Remove oil pan and check directly											●		
Remedy		Replace	Repair	Repair	Replace	Replace	Add	Repair	Replace	Replace	Replace	Replace		

S-15 Abnormal noise is made

- ★ Judge if the noise is an internal noise or an external noise.

General causes why abnormal noise is made

- Abnormality due to defective parts
- Abnormal combustion noise
- Air sucked in from intake system

Legend

- : Possible causes (judging from Questions and check items)
 ⊙ : Most probable causes (judging from Questions and Check items)
 △ : Possible causes due to length of use (used for a long period)
 ● : Items to confirm the cause.

		Causes											
		Worn piston ring, cylinder liner	Seized turbocharger, interference	Missing, seized bushing	Clogged, seized injection nozzle	Defective injection pump (rack, plunger seized)	Deformed fan, interference of fan belt	Improper adjustment of valve clearance	Broken valve system (valve, rocker lever, etc.)	Improper gear train backlash	Leakage of air between turbocharger and head	Defect inside muffler (dividing board out of position)	
Questions	Confirm recent repair history												
	Degree of use												
	Condition of abnormal noise												
	Operated for long period	△											
	Gradually occurred	○					○						
	Suddenly occurred		○	○				○					
	Non-specified fuel has been used			○	○								
	Engine oil must be added more frequently	⊙											
	Color or exhaust gas												
	Blue under light load	⊙											
Check items	Black		⊙				○			○			
	Metal particles are found in oil filter	⊙	⊙										
	Blow-by gas is excessive	⊙											
	Noise of interference is heard from around turbocharger		⊙										
	Engine pickup is poor and combustion is irregular			⊙									
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low			⊙	○								
	Seal on injection pump has come off				⊙								
	Abnormal noise is loud when accelerating engine			○	○	○	○		○				
	Clanging sound is heard from around cylinder head						⊙	⊙					
	Leakage of air between turbocharger and head, loose clamp									⊙			
Troubleshooting	Vibrating noise is heard from around muffler										⊙		
	When compression pressure is measured, it is found to be low	●											
	When turbocharger is rotated by hand, it is found to be heavy		●										
	Remove gear cover and check directly			●					●				
	Speed of some cylinders does not change when operating on reduced cylinders				●								
	When control rack is pushed, it is found to be heavy or does not return				●								
	Injection pump test shows that injection amount is incorrect					●							
	Fan is deformed, or belt is loose						●						
	When valve clearance is checked directly, it is found to be outside standard value							●					
	Remove cylinder head cover and check directly								●				
Remedy	When muffler is removed, abnormal noise disappears											●	
		Replace	Replace	Replace	Replace	Adjust	Repair	Adjust	Replace	Repair	Repair	Replace	

S-16 Vibration is excessive

- ★ If there is abnormal noise together with the vibration, carry out troubleshooting for "Abnormal noise is made".

General causes why vibration is excessive

- Defective parts (abnormal wear, breakage)
- Improper alignment
- Abnormal combustion

Legend

- : Possible causes (judging from Questions and check items)
 ⊙ : Most probable causes (judging from Questions and Check items)
 △ : Possible causes due to length of use (used for a long period)
 ● : Items to confirm the cause.

		Causes									
		Worn connecting rod, main bearing	Worn balancer, cam bushing	Worn support pilot	Loose engine mounting bolts	Broken part inside output shaft (damper)	Misalignment between engine and power train	Improper gear train backlash	Valve system (valve, rocker lever, etc) stuck	Defective injection pump (excessive injection)	
Questions	Confirm recent repair history										
	Degree of use										
	Operated for long period	△	△	△	△						
	Condition of vibration										
	Suddenly increased				○				○		
	Gradually increased	○	○	○	○						
	Non-specified fuel has been used	○	○								
	Metal particles are found in oil filter	⊙	⊙								
	Metal particles are found when oil is drained	⊙	⊙								
	Oil pressure is low at low idling	○	○								
Check items	Vibration occurs at mid-range speed				○	○					
	Vibration follows engine speed			○	○	○	○				
	Exhaust gas is black							⊙	○		
	Seal on injection pump has come off								⊙		
	Remove oil pan and check directly	●									
	Remove side cover and check directly		●								
Troubleshooting	Check directly for worn support pilot, play			●							
	Check directly for loose engine mounting bolts, broken cushion				●						
	Check inside of output shaft (damper) directly					●					
	When radial runout, face runout are measured, they are found to be outside standard value						●				
	Remove front cover and check directly							●			
	Remove head cover and check directly								●		
	Injection pump test shows that injection amount is incorrect									●	
	Remedy	Replace	Replace	Replace	Replace	Replace	Repair	Repair	Replace	Adjust	

TROUBLESHOOTING OF MAIN MONITOR SYSTEM (M MODE)

Trouble data display	20-303
M- 1 Main monitor does not work	20-306
M- 2 When starting switch is turned ON and engine is started immediately, all lamps stay lighted up	20-307
M- 3 Speedometer display does not work properly	20-308
M- 4 Abnormality in shift indicator	
(a) Stays at N even when directional lever is at F	20-309
(b) Stays at N even when directional lever is at R	20-309
(c) Does not display N even when directional lever is at N and displays R when directional lever is at F	20-309
(d) Does not display N even when directional lever is at N and displays F when directional lever is at R	20-310
(e) Does not display 1st, 4th	20-310
(f) Does not display 3rd, 4th (standard specification machine)	20-311
(g) Does not display 2nd, 3rd (standard specification machine)	20-311
(h) Does not display 1st, 2nd (standard specification machine)	20-312
M- 5 High beam does not light up	20-313
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(a) L.H. turn signal does not light up	20-314
(b) R.H. turn signal does not light up	20-314
M- 7 Abnormality in parking display	
(a) Parking lamp does not light up	20-315
(b) Parking lamp stays lighted up	20-315
M- 8 Abnormality in preheating system (QGS)	
(a) Does not carry out preheating	20-316
(b) Always carries out preheating for 1 minute	20-317
(c) Preheating stays on	20-317
(d) Preheating time becomes shorter, or is unstable	20-318
M- 9 Night lighting does not light up	20-319
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(a) Neither monitor display nor front working lamp light up	20-320
(b) Working lamp lights up but monitor display does not light up	20-320
(c) Monitor lights up but working lamp does not light up	20-320
M-11 Abnormality in rear working lamp	
(a) Neither monitor display nor rear working lamp light up	20-321
(b) Working lamp lights up but monitor display does not light up	20-321
(c) Monitor lights up but working lamp does not light up	20-321
M-12 Abnormality in transmission cut-off	
(a) When monitor switch is pressed, cut-off function is not switched and display is not given	20-323
(b) Monitor display goes out but cut-off function stays on	20-323
(c) Monitor display lights up but cut-off function is not actuated	20-324

M-13	Abnormality in parking brake dragging warning	
	(a) When parking brake is applied, buzzer sounds (intermittently) even when directional lever is at N, and caution lamp flashes.....	20-325
	(b) When parking brake is applied, buzzer does not sound and caution lamp does not light up even when directional lever is at position other than N	20-325
M-14	When parking brake dragging warning is given, buzzer and caution lamp are actuated continuously, or they are not actuated	
	(a) Actuated continuously	20-326
	(b) Not actuated.....	20-326
M-15	Abnormality in buzzer	
	(a) Buzzer does not sound when starting switch is turned ON (during self-check).....	20-327
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M-16	Condition of monitor switches is not stored in memory	20-328
M-17	Abnormality in failure display mode	
	(a) Does not enter failure display mode	20-329
	(b) Time for time elapsed since failure on failure display mode does not advance	20-329
M-18	Abnormality in emergency steering normal display	
	(a) Emergency steering normal display does not light up	20-330
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M-19	Abnormality in emergency steering actuation display	
	(a) Emergency steering actuation display does not light up	20-331
	(b) Emergency steering actuation display stays lighted up	20-331
M-20	Abnormality in auto-greasing system	
	(a) Forced greasing cannot be carried out.....	20-332
	(b) Monitor display flashes rapidly (2 times/sec)	20-332
	(c) When no more grease remains, monitor display flashes rapidly (2 times/sec)	20-332
	(d) Monitor display flashes slowly (1 time/sec)	20-333
	(e) Monitor display goes out	20-333
M-21	Abnormality in travel damper system	
	(a) Display does not change when switch is pressed	20-334
	(b) Monitor display lights up but travel damper function does not work.....	20-334
M-22	Buzzer does not sound when auto-leveling switch is actuated	20-334
M-23	Failure code is not sent to main monitor (abnormality in network)	20-335

TROUBLE DATA DISPLAY

1. Outline

The speedometer display on the main monitor is used to display the troubleshooting for each control system. The nature of the troubleshooting is displayed as the failure action code, failure code, and the time elapsed since failure.

The signals between the main monitor and each controller are transmitted in serial through the network circuit. (Only the engine controller uses a special parallel signal.)

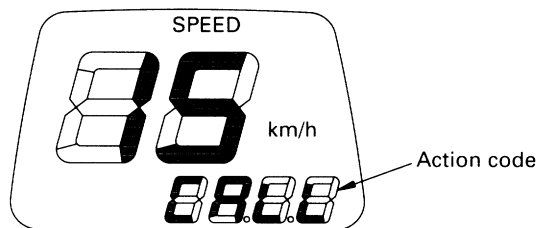
2. Abnormality in failure action code

This code informs the operator directly of the abnormality, and takes action, such as stopping the machine immediately.

There are four types of action code: E00, E01+CALL (E01 and CALL are displayed alternately), E03+CALL, and CALL. If a failure occurs suddenly, one of these codes is shown on the speedometer display.

For details of the action taken by operator for the action codes, see Item 4.

Example: When action code CALL is displayed



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3. Failure code and time elapsed since failure

The failures detected by each controller are changed to a code and displayed. It is possible to tell from this code which system in which controller has failed, so carry out troubleshooting for the applicable controller. For failures that have occurred and been reset, the failure code and the time elapsed since failure are displayed to make it easy to check failures that are not occurring at present.

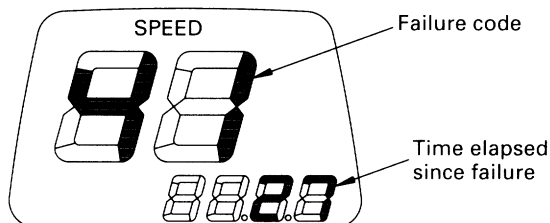
The failure codes for failures that are now occurring flash, and the codes for failures that are not occurring light up.

For details of the method of operating and transferring data to the trouble data display mode, see STRUCTURE AND FUNCTION for the main monitor.

Note: If the engine is not stopped, it is impossible to switch to the trouble data display mode, so the codes for failures which can only be detected when the engine is operating light up.

For the correspondence between the failure codes for each controller and the failed system, see Item 5.

Example: When failure code "41" has occurred 27 hours before



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TROUBLESHOOTING**TROUBLE DATA DISPLAY****4. Action code table**

Action code: "E□□+CALL" means that E□□ and CALL are displayed alternately

Action code	Work equipment control system		Alarm buzzer	Action by operator
	Problem system	Action of machine		
E00	–	–	No	Normal operation possible using manual gear shifting
E01+CALL	Dumping solenoid is short circuited to + terminal of power source 24V	Boom movement is slow	Yes	Travel under own power possible, call for service after moving to safe place
E03+CALL	–	–	Yes	Actuate emergency manual spool, open modulation solenoid manually. This action makes it possible to travel under own power.
CALL	Wiring harness on return side of damping solenoid is short circuiting with power source	Stops remote positioner function, possible that controller is burnt out	Yes	Stop machine immediately, turn starting switch OFF.
	Wiring harness on return side of bucket (tilt, dump) solenoid short circuiting with power source	Stops auto leveling function, bucket moves, possible that controller is burnt out		

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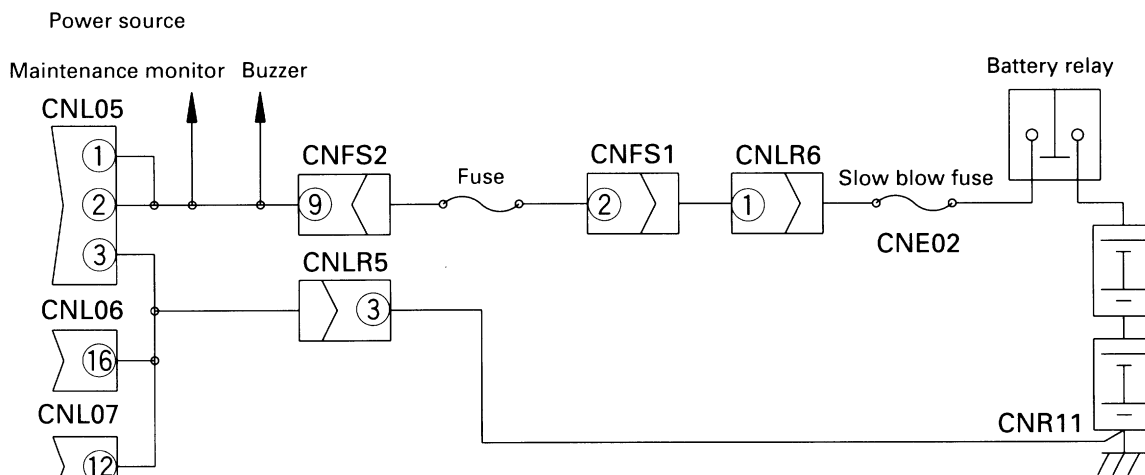
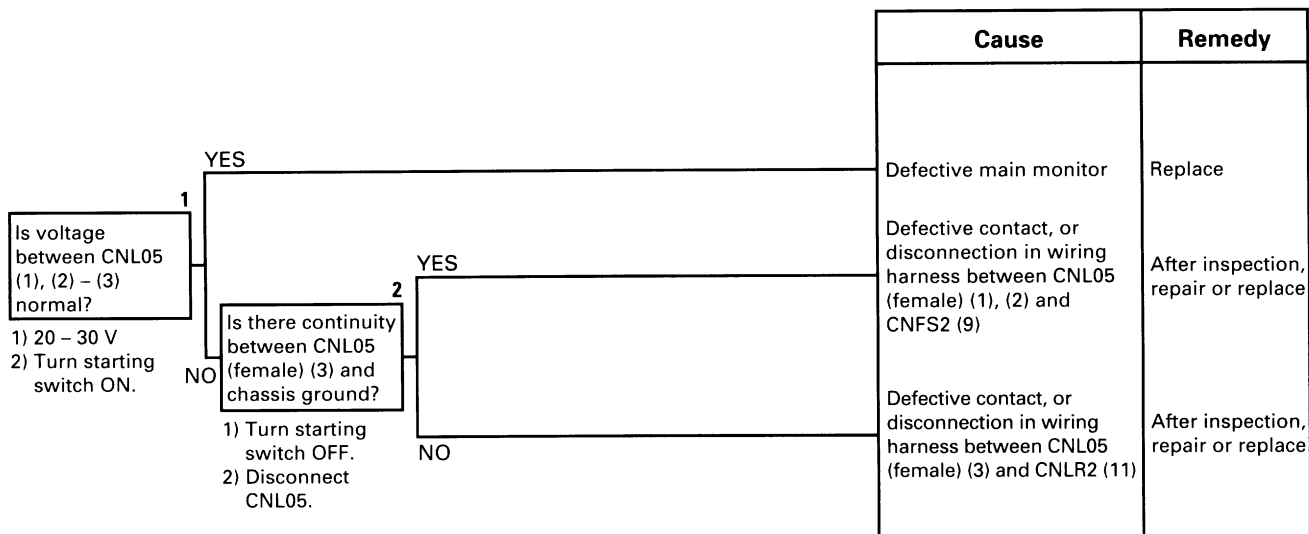
5. Failure code chart

Work equipment control system	
40	Bucket dump solenoid system
41	Dump/tilt solenoid system
42	Bucket tilt solenoid system
43	Damping solenoid system
44	Damping solenoid system
45	Damping solenoid system
48	Bucket kickout relay system
49	Boom kickout relay system
50	Auto leveler relay system
51	Boom RAISE-LOWER switch system
52	Boom angle sensor system
53	Bucket angle sensor system
54	Abnormality in model selection

ECSS control system	
d0	Relief solenoid system
d1	High pressure solenoid system
d2	Low pressure solenoid system
d3	Speed sensor system
d4	Abnormality in model selection

M-1 Main monitor does not work

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



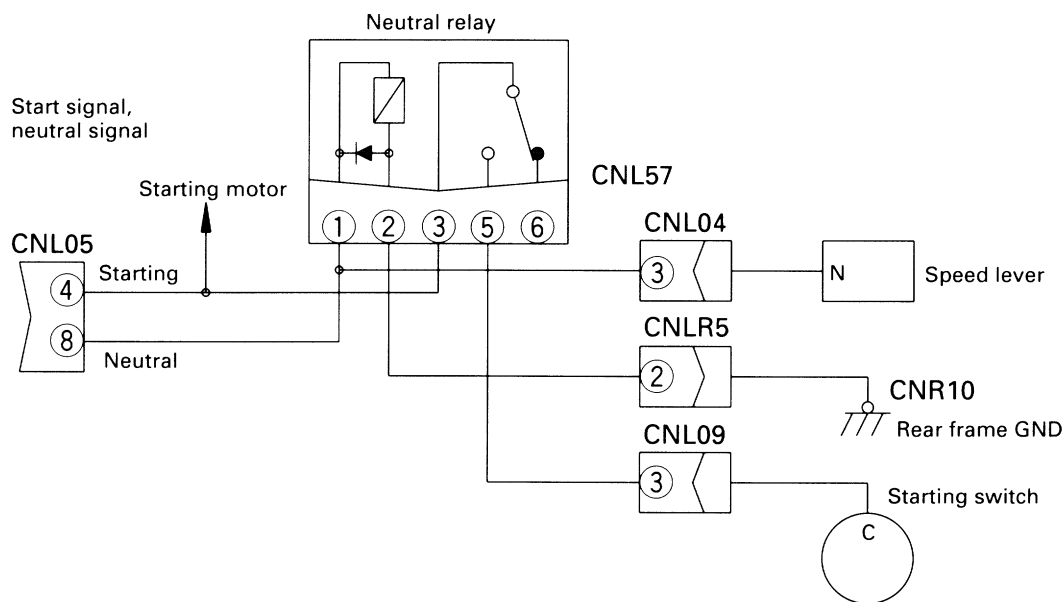
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M-2 When starting switch is turned ON and engine is started immediately, all lamps stay lighted up

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

		Cause	Remedy
1 YES Is voltage between CNL05 (4) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch START.	YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (4) and CNL57 (3)	After inspection, repair or replace



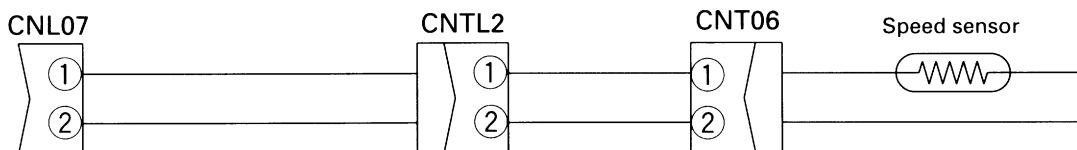
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M-3 Speedometer display does not work properly

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Check that the gap between the speed sensor and gear is normal.

		Cause	Remedy	
1 Is resistance between CNT06 (male) (1) and (2) normal? 1) 500 Ω – 1 kΩ 2) Turn starting switch OFF. 3) Disconnect CNT06.	YES			
	2 Is resistance between CNL07 (female) (1) and (2) normal? 1) 500Ω – 1 kΩ 2) Turn starting switch OFF. 3) Disconnect CNL07.	YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL07 (female) (1), (2) – CNTL2 (1), (2) – CNT06 (1), (2)	After inspection, repair or replace	
	NO	Defective speed sensor	Replace	

Speedometer



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M-4 Abnormality in shift indicator

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Check that the transmission shifts.

(a) Stays at N even when directional lever is at F

1 YES Is voltage between CNL08 (7) and chassis ground normal?		Defective main monitor	Replace
NO 1) 20 – 30 V 2) Turn starting switch ON. 3) Directional lever: F		Defective contact, or disconnection in wiring harness between CNL08 (female) (7) and CNL04 (2)	After inspection, repair or replace

(b) Stays at N even when directional lever is at R

1 YES Is voltage between CNL08 (8) and chassis ground normal?		Defective main monitor	Replace
NO 1) 20 – 30 V 2) Turn starting switch ON. 3) Directional lever: R		Defective contact, or disconnection in wiring harness between CNL08 (female) (8) and CNL04 (4)	After inspection, repair or replace

(c) Does not display N even when directional lever is at N and displays R when directional lever is at F

1 YES Is voltage between CNL08 (8) and chassis ground normal?		Defective main monitor	Replace
NO 1) 0 – 5 V 2) Turn starting switch ON. 3) Directional lever: N		Contact of power source with wiring harness between CNL08 (female) (8) and CNL04 (4), or defective control lever	After inspection, repair or replace

TROUBLESHOOTING

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(d) Does not display N even when directional lever is at N and displays F when directional lever is at R

		Cause	Remedy
Is voltage between CNL08 (7) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON. 3) Directional lever: N	1 YES	Defective main monitor	Replace
	NO	Contact of power source with wiring harness between CNL08 (female) (7) and CNL04 (2), or defective control lever	After inspection, repair or replace
(e) Does not display 1st, 4th			
Is voltage between CNL05 (12) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. 3) Speed lever: 1	1 YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (12) and CNL04 (5)	After inspection, repair or replace

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(f) Does not display 3rd, 4th

(f) Does not display 3rd, 4th		Cause	Remedy
1 YES Is voltage between CNL05 (13) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. 3) Speed lever: 3		Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (13) and CNL04 (7)	After inspection, repair or replace

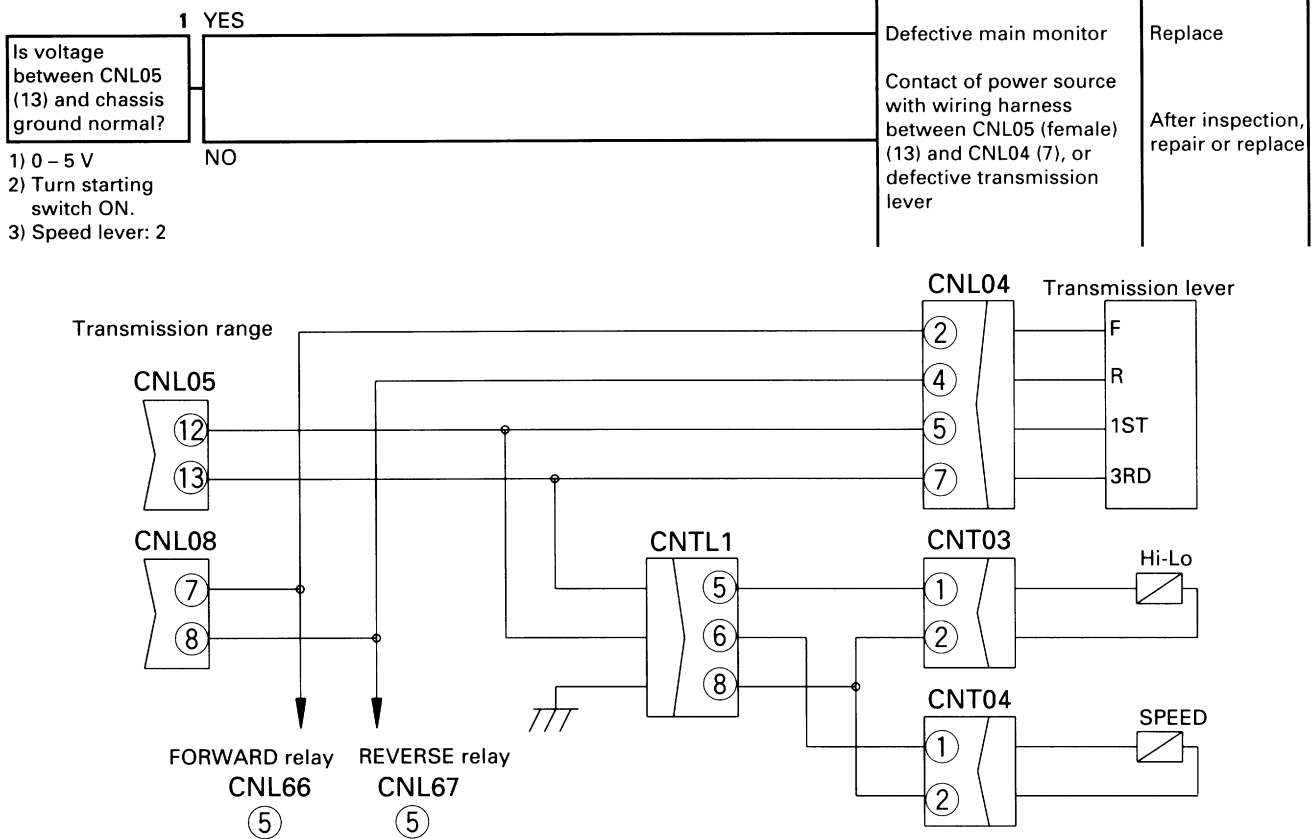
(g) Does not display 2nd, 3rd

1 Is voltage between CNL05 (12) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON. 3) Speed lever: 2	YES NO	Defective main monitor Contact of power source with wiring harness between CNL05 (female) (12) and CNL04 (5), or defective control lever	Replace After inspection, repair or replace
--	----------------------	--	---

Relationship between monitor input signal and display

CNL05(12)	CNL05(13)	Display
H	L	1
L	L	2
L	H	3
H	H	4

Cause	Remedy
Defective main monitor	Replace
Contact of power source with wiring harness between CNL05 (female) (13) and CNL04 (7), or defective transmission lever	After inspection, repair or replace



TDW00288

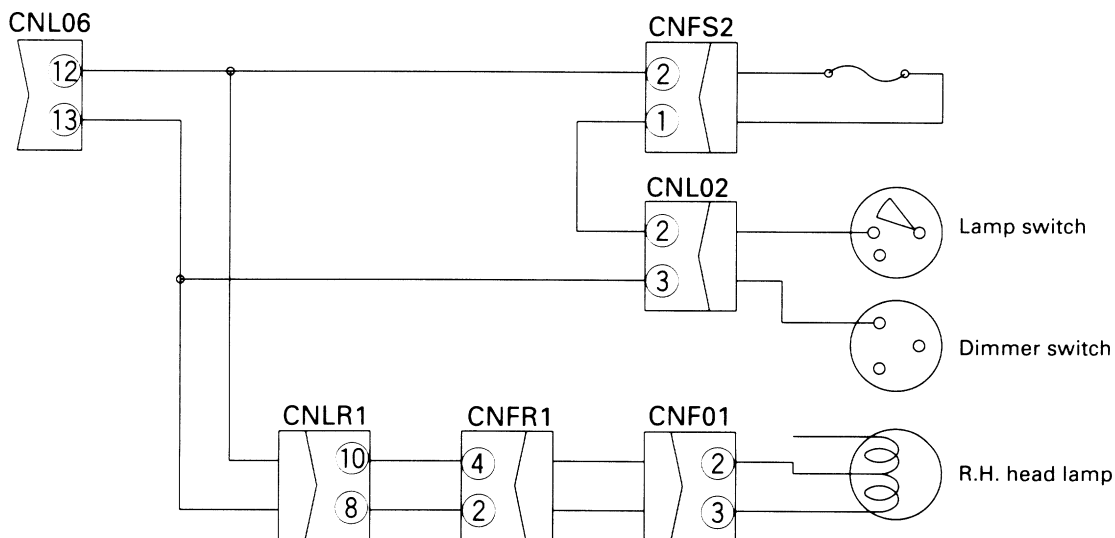
U42103

M-5 High beam does not light up

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Before starting troubleshooting, check that the lamp bulb is not blown.

		Cause	Remedy
1 Is voltage between CNL06 (12) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	YES	Is there continuity between CNL06 (female) (13) and chassis ground?	
	2 YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL06 (female) (13) and CNL02 (3)	After inspection, repair or replace
	NO	Defective contact, or disconnection in wiring harness between CNL06 (female) (12) and CNFS2 (2)	After inspection, repair or replace

Hi beam



TDW00290

M-6 Turn signal display does not light up

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Before starting troubleshooting, check that the lamp bulb of the turn signal indicator on the monitor is not blown.

(a) L.H. turn signal does not light up

1 YES
Is voltage between CNL06 (14) and chassis ground normal?

- 1) Repeat 0V and 20 – 30 V.
2) Turn starting switch ON.

NO

Cause	Remedy
Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL06 (female) (14) and CNL03 (4)	After inspection, repair or replace

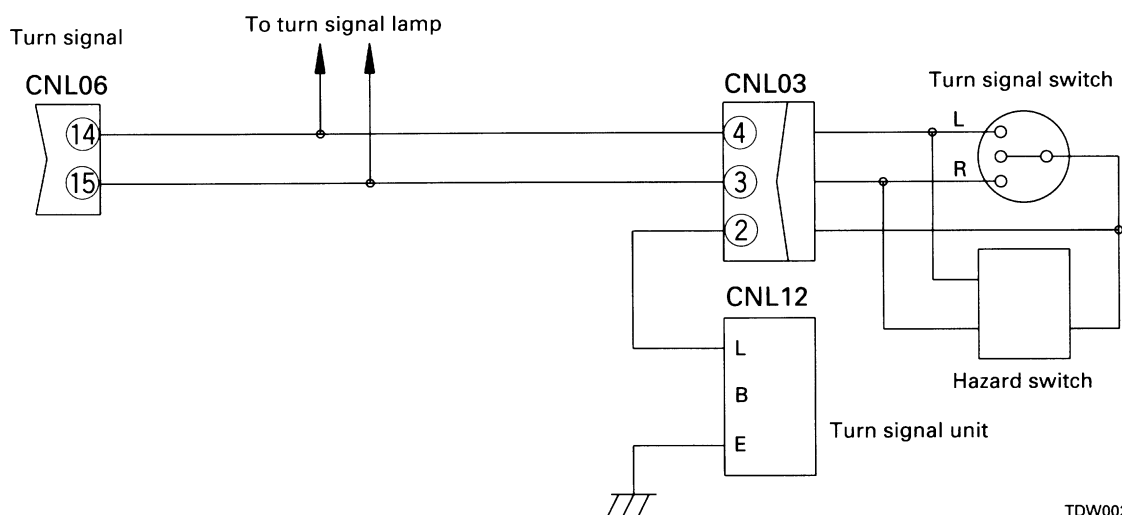
(b) R.H. turn signal does not light up

1 YES
Is voltage between CNL06 (15) and chassis ground normal?

- 1) Repeat 0 V and 20 – 30 V.
2) Turn starting switch ON.

NO

Cause	Remedy
Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL06 (female) (15) and CNL03 (3)	After inspection, repair or replace



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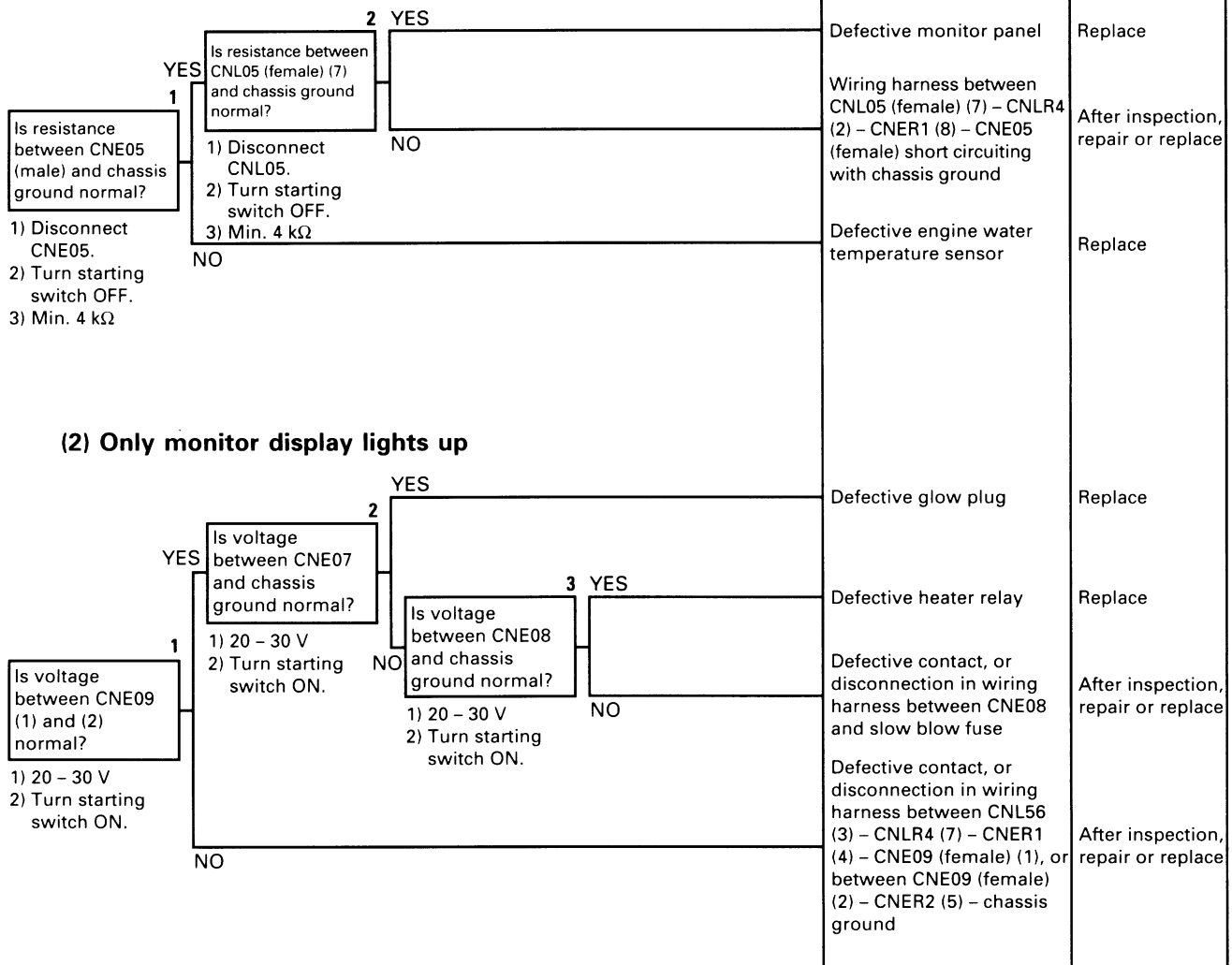
M-8 Abnormality in preheating system (QGS)

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

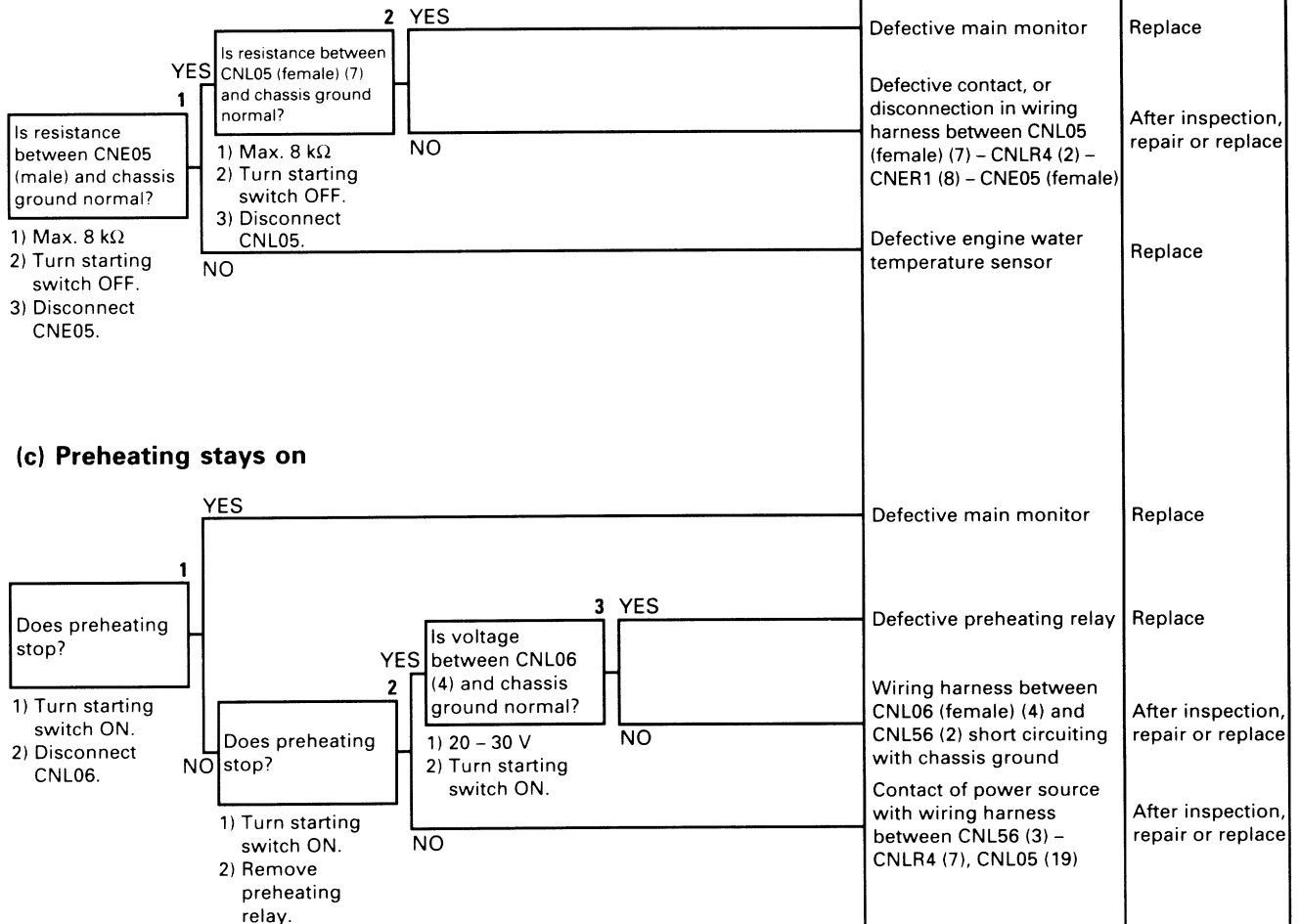
(a) Does not carry out preheating

- ★ Check that the water temperature is below 5°C.

(1) Monitor display also does not light up

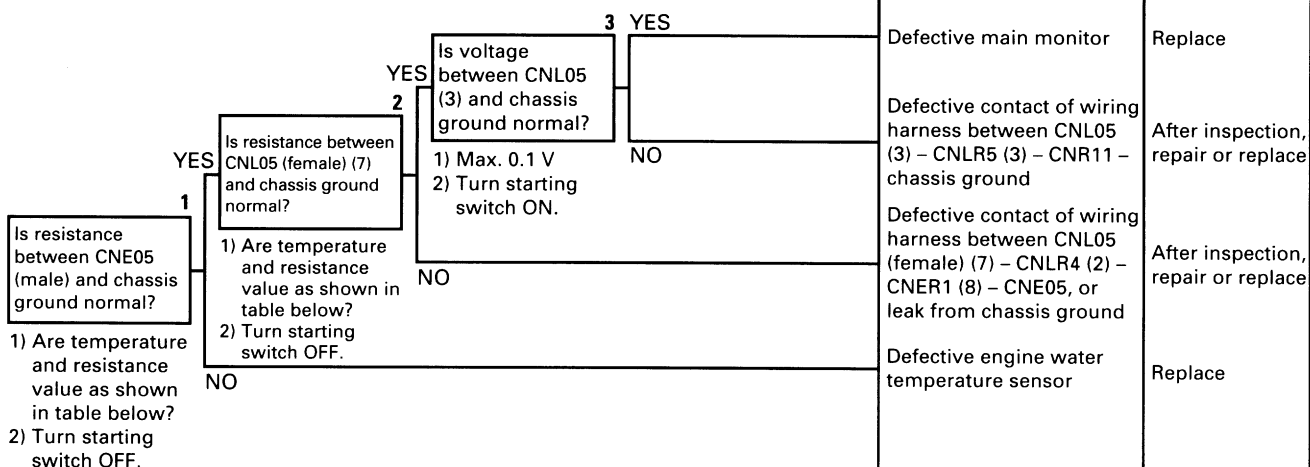


U42103

(b) Always carries out preheating for 1 minute★ Check that the water temperature is below -10°C .

U42103

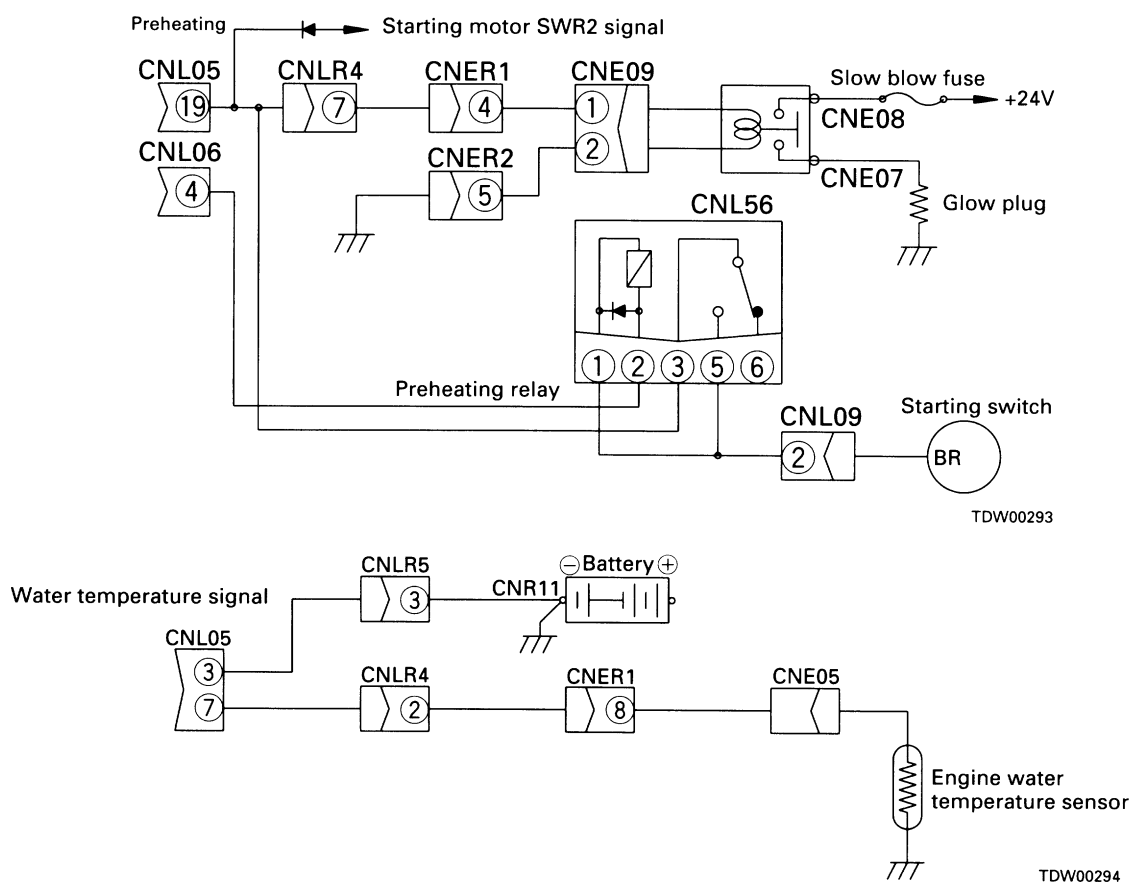
(d) Preheating time becomes shorter, or there is variation



Table

(Tolerance $\pm 0.5 \text{ k}\Omega$)

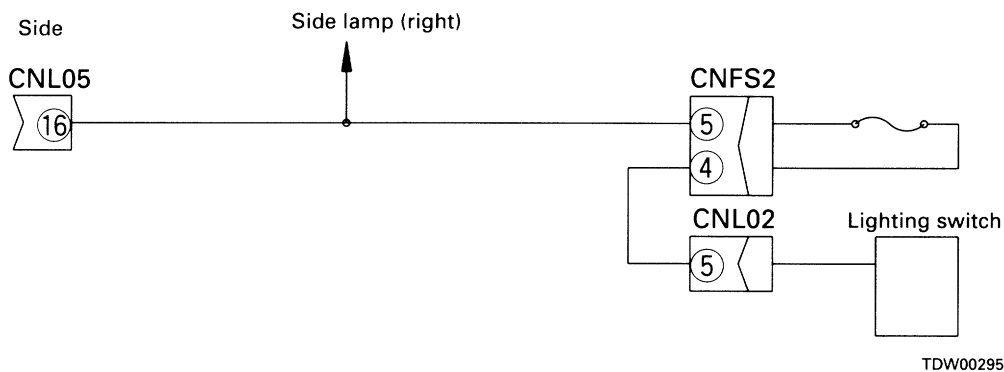
Temperature(°C)	-10	-8	-6	-4	-2	0	2	4
Resistance value(kΩ)	7.7	7.1	6.5	6.0	5.5	5.1	4.7	4.3



M-9 Night lighting does not light up

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Before starting troubleshooting, check that the lamp bulb is not blown.

		Cause	Remedy
Is voltage between CNL05 (16) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. 3) Turn side lamp switch ON.	1 YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (16) and CNFS2 (5)	After inspection, repair or replace

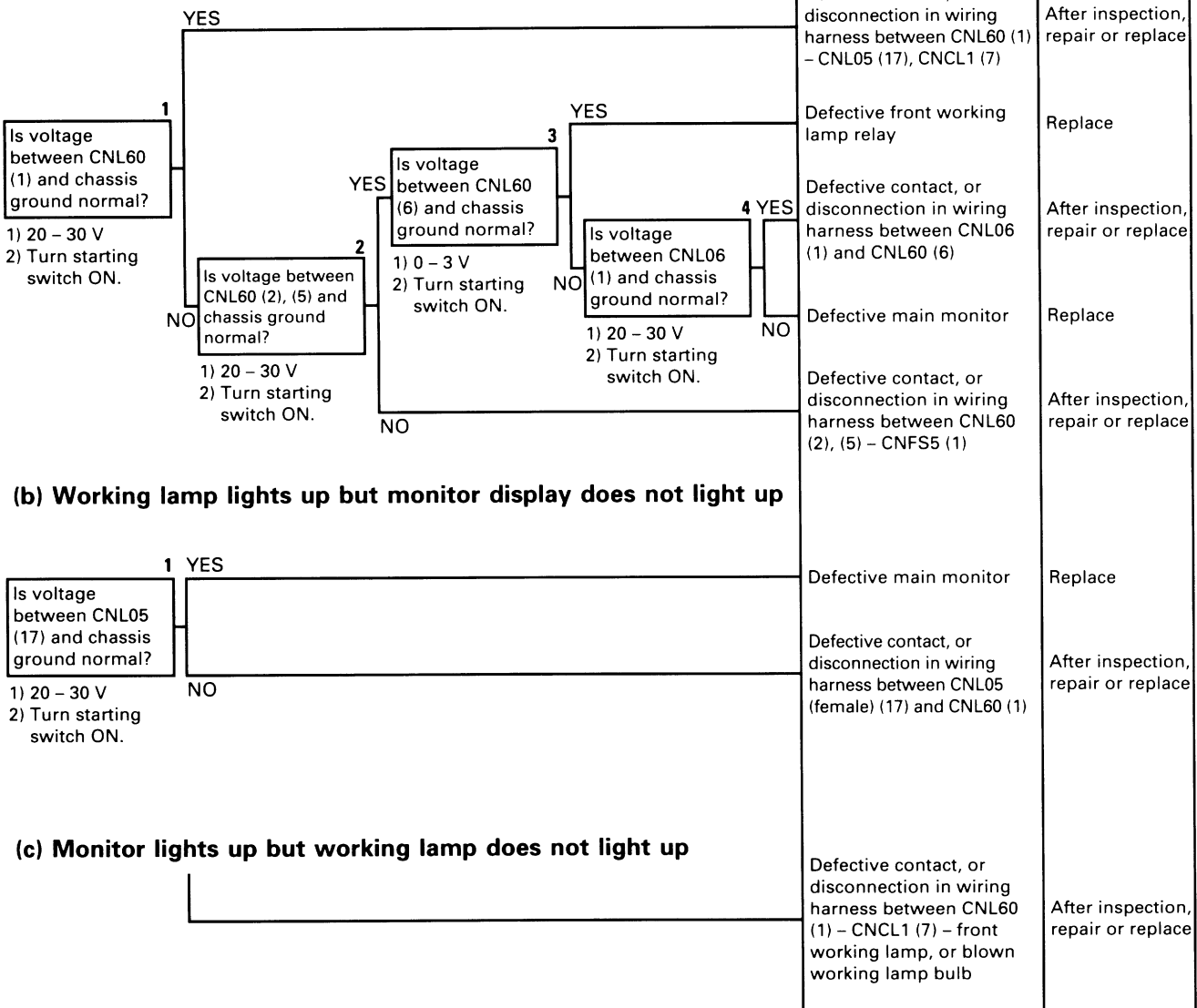


U42103

M-10 Abnormality in front working lamp

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Before starting troubleshooting, check that the monitor lighting is lighted up.

(a) Neither monitor display nor front working lamp light up

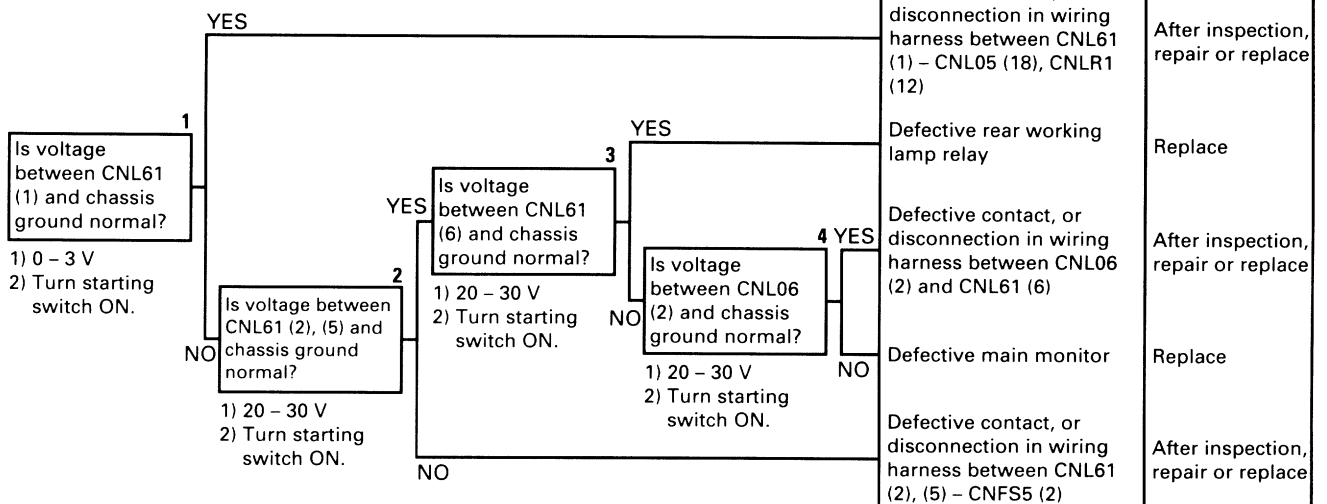


U42103

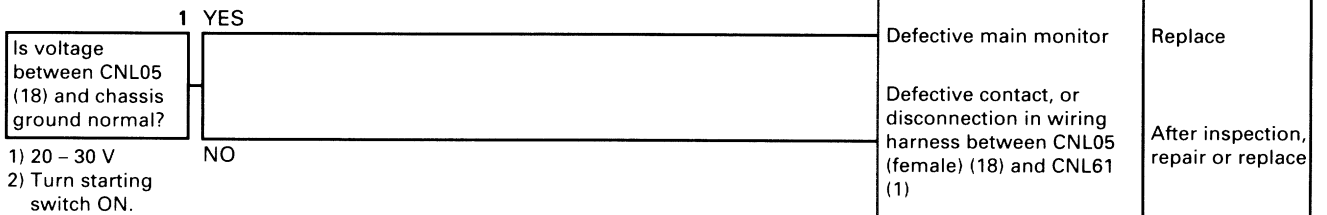
M-11 Abnormality in rear working lamp

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Before starting troubleshooting, check that the monitor lighting is lighted up.

(a) Neither monitor display nor rear working lamp light up

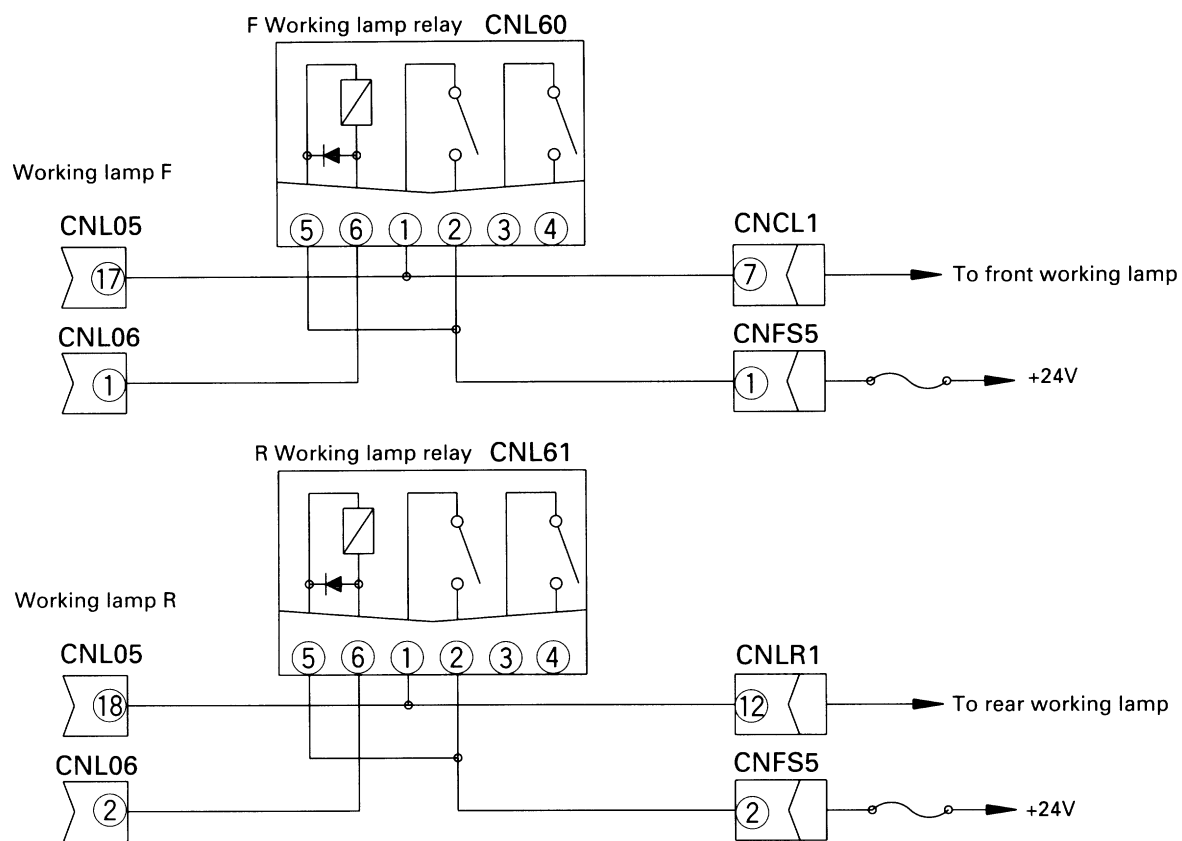


(b) Working lamp lights up but monitor display does not light up



(c) Monitor lights up but working lamp does not light up

	Defective contact, or disconnection in wiring harness between CNL61 (1) – CNLR1 (12) – rear working lamp, or blown working lamp bulb	After inspection, repair or replace
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TDW00296

U42103

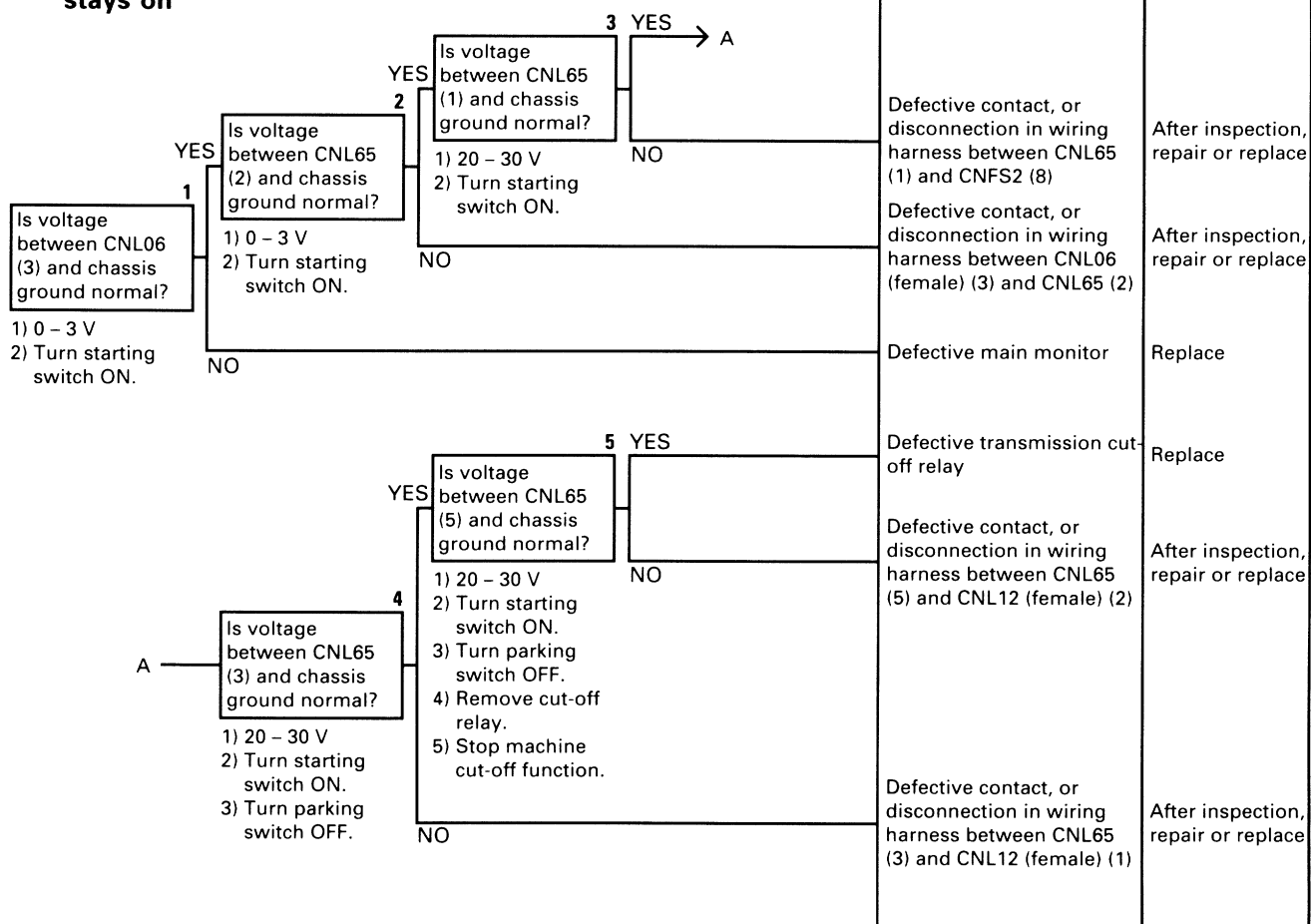
M-12 Abnormality in transmission cut-off

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) When monitor switch is pressed, cut-off function is not switched and display is not given



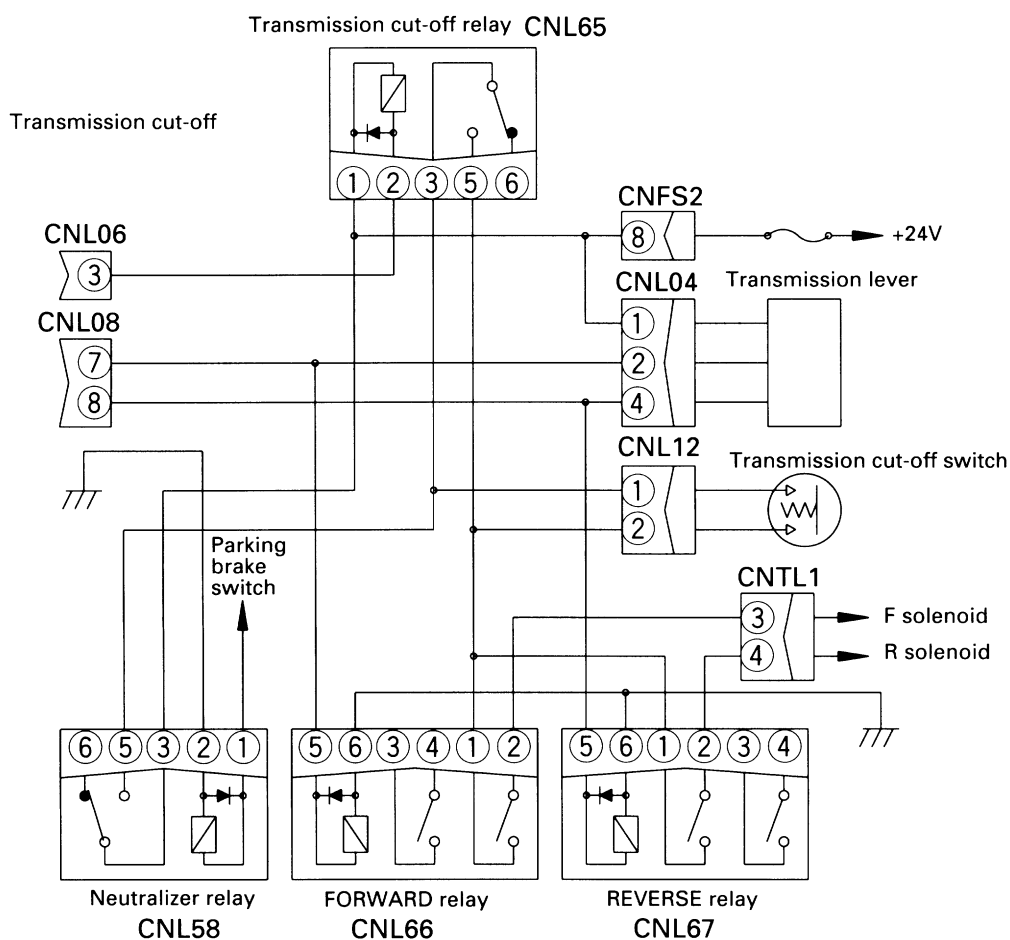
(b) Monitor display goes out but cut-off function stays on



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(c) Monitor display lights up but cut-off function is not actuated

	Cause	Remedy
1 Does cut-off function work? 1) Turn starting switch ON. 2) Remove cut-off relay. YES 2 Is voltage between CNL65 (2) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. YES	Defective cut-off relay	Replace
NO 3 Does cut-off function work? 1) Turn starting switch ON. 2) Disconnect CNL06. YES	Defective main monitor	Replace
NO	Wiring harness between CNL06 (female) (3) and CNL65 (2) short circuiting with chassis ground Contact of wiring harness between CNL65 (3) and (5), or defective cut-off switch	After inspection, repair or replace After inspection, repair or replace



TDW00297

U42103

M-13 Abnormality in parking brake dragging warning

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

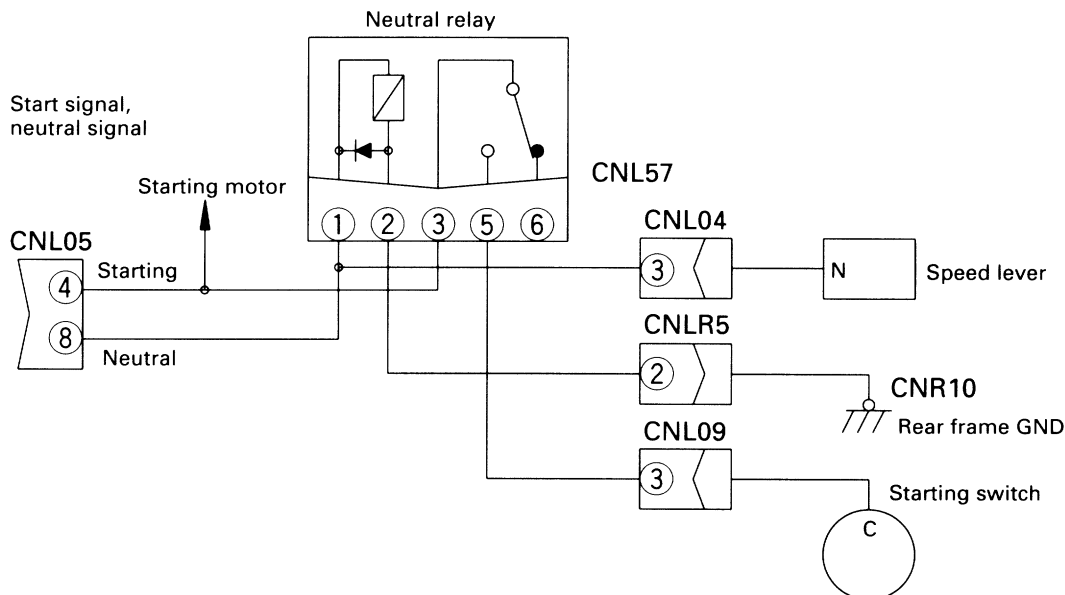
(a) When parking brake is applied, buzzer sounds (intermittently) even when directional lever is at N, and caution lamp flashes

1 YES Is voltage between CNL05 (8) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.		Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (8) and CNL04 (3)	After inspection, repair or replace

(b) When parking brake is applied, buzzer does not sound and caution lamp does not light up even when directional lever is at position other than N

- ★ Check that the synchronous flash signal is normal.

1 YES Is voltage between CNL05 (8) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON.	2 YES Is resistance between CNL05 (male) (8) and (3) normal? 1) 3 kΩ – 4 kΩ 2) Turn starting switch OFF. 3) Disconnect CNL05.	Defective main monitor	Replace
	NO	Contact of power source with wiring harness between CNL05 (female) (8) and CNL04 (female) (3)	After inspection, repair or replace
		Defective main monitor	Replace



TDW00286

M-14 When parking brake dragging warning is given, buzzer and caution lamp are actuated continuously, or they are not actuated

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

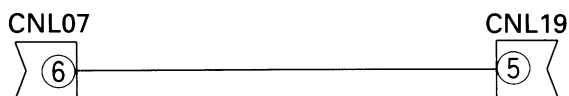
(a) Actuated continuously

		Cause	Remedy
1 Does buzzer stop and lamp go out? 1) Turn starting switch ON. 2) Connect CNL07 (female) (6) to chassis ground.	YES	Defective maintenance monitor	Replace
	2 YES	Defective contact, or disconnection in wiring harness between CNL07 (female) (6) and CNL19 (female) (5)	After inspection, repair or replace
	NO	Defective main monitor	Replace
2 Does buzzer stop and lamp go out? 1) Turn starting switch ON. 2) Connect CNL19 (female) (5) to chassis ground.			
YES			
NO			

(b) Not actuated

		Cause	Remedy
1 Do buzzer and lamp work? 1) Turn starting switch ON. 2) Disconnect CNL07.	YES	Defective maintenance monitor	Replace
	2 YES	Wiring harness between CNL07 (female) (6) and CNL19 (female) (5) short circuiting with chassis ground	After inspection, repair or replace
	NO	Defective main monitor	Replace
2 Do buzzer and lamp work? 1) Turn starting switch ON. 2) Disconnect CNL19.			
YES			
NO			

Synchronous flashing signal



TDW00300

U42103

M-15 Abnormality in buzzer

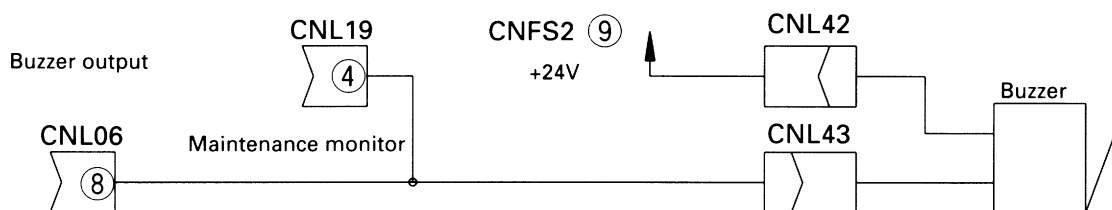
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Buzzer does not sound when starting switch is turned ON (during self-check)

		Cause	Remedy
1 Does buzzer sound? 1) Turn starting switch ON. 2) Contact CNL43 (female) to chassis ground.	YES	Defective contact, or disconnection in wiring harness between CNL06 (female) (8) and CNL43 (male)	After inspection, repair or replace
	NO	Defective buzzer	Replace
2 Is voltage between CNL42 (female) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	YES	Defective contact, or disconnection in wiring harness between CNL42 (female) and CNFS2 (9)	After inspection, repair or replace
	NO		

(b) Buzzer always sounds

		Cause	Remedy
1 Does buzzer stop? 1) Turn starting switch ON. 2) Disconnect CNL06.	YES	Defective main monitor.	Replace
	NO	Go to Troubleshooting for maintenance monitor	–
2 Does buzzer stop? 1) Turn starting switch ON. 2) Disconnect CNL19.	YES	Wiring harness between CNL06 (female) (8) and CNL43 (male) short circuiting with chassis ground	After inspection, repair or replace
	NO	Defective buzzer	Replace
3 Does buzzer stop? 1) Turn starting switch ON. 2) Disconnect CNL43.	YES		
	NO		



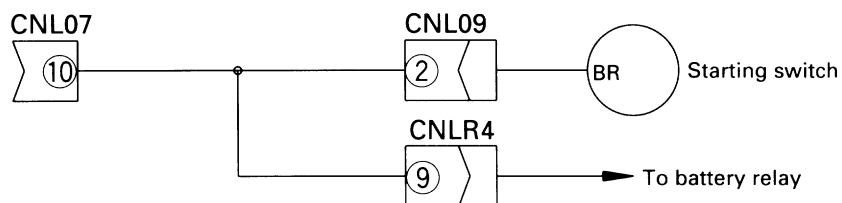
TDW00301

M-16 Condition of monitor switches is not stored in memory

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

		Cause	Remedy
Is voltage between CNL07 (10) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	1 YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL07 (female) (10) and CNL09 (2)	After inspection, repair or replace

Starting switch ACC



TDW00302

U42103

M-17 Abnormality in failure display mode

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Does not enter failure display mode

1 YES
Is voltage
between CNL05
(5) and chassis
ground normal?

- 1) 0 – 5 V
2) Turn starting
switch ON.

NO

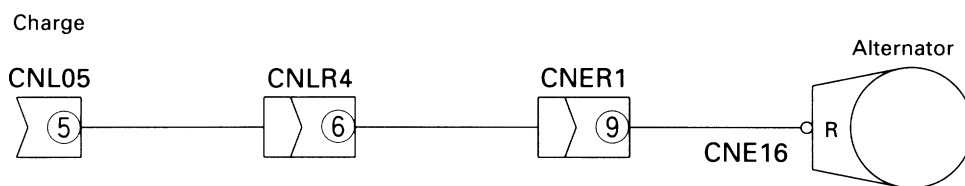
(b) Time for time elapsed since failure on failure display mode does not advance

1 YES
Is voltage
between CNL05
(5) and chassis
ground normal?

- 1) 20 – 30 V
2) Start engine.

NO

Cause	Remedy
Defective main monitor	Replace
Contact of power source with wiring harness between CNL05 (female) (5) – CNLR4 (6) – CNER1 (9) – alternator terminal R, or defective alternator	After inspection, repair or replace
Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL05 (female) (5) – CNLR4 (6) – CNER1 (9) – alternator terminal R, or defective alternator	After inspection, repair or replace



TDW00303

M-18 Abnormality in emergency steering normal display

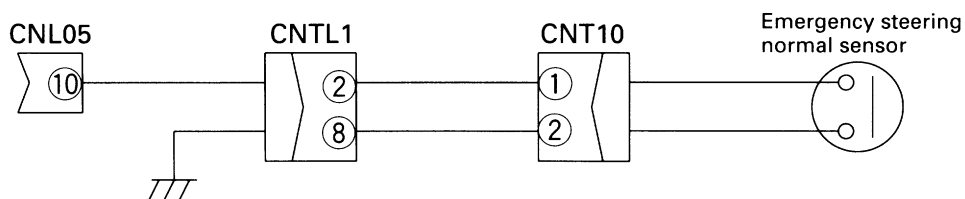
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Emergency steering normal display does not light up

		Cause	Remedy
1 Is there continuity between CNT10 (male) (1) and (2)? 1) Disconnect CNT10. 2) Turn starting switch ON.	YES	Defective emergency steering normal sensor	Replace
	NO	Defective main monitor	Replace
	2 YES	Wiring harness between CNL05 (female) (10) – CNTL1 (2) – CNT10 (female) (1) short circuiting with chassis ground	After inspection, repair or replace
	2 NO		
2 Is voltage between CNL05 (10) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.			
3 Is voltage between CNL05 (10) and chassis ground normal? 1) 0 – 2 V 2) Turn starting switch ON.			
1 Is there continuity between CNT10 (female) (2) and chassis ground? 1) Disconnect CNT10.			
YES		Defective main monitor	Replace
NO		Defective contact, or disconnection in wiring harness between CNL05 (female) (10) – CNTL1 (2) – CNT10 (female) (1)	After inspection, repair or replace
YES		Defective contact, or disconnection in wiring harness between CNT10 (female) (2) – CNTL1 (8) – chassis ground	After inspection, repair or replace
NO		Defective emergency steering normal sensor	Replace

U42103

Emergency steering normal

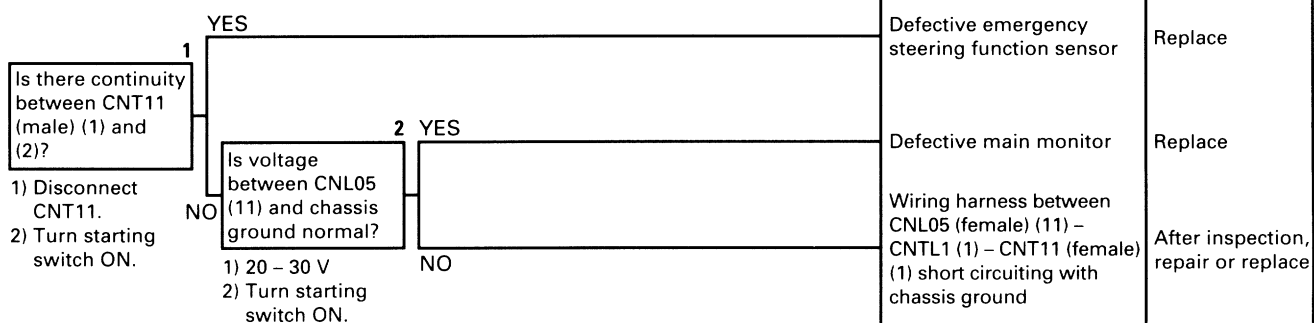


TDW00307

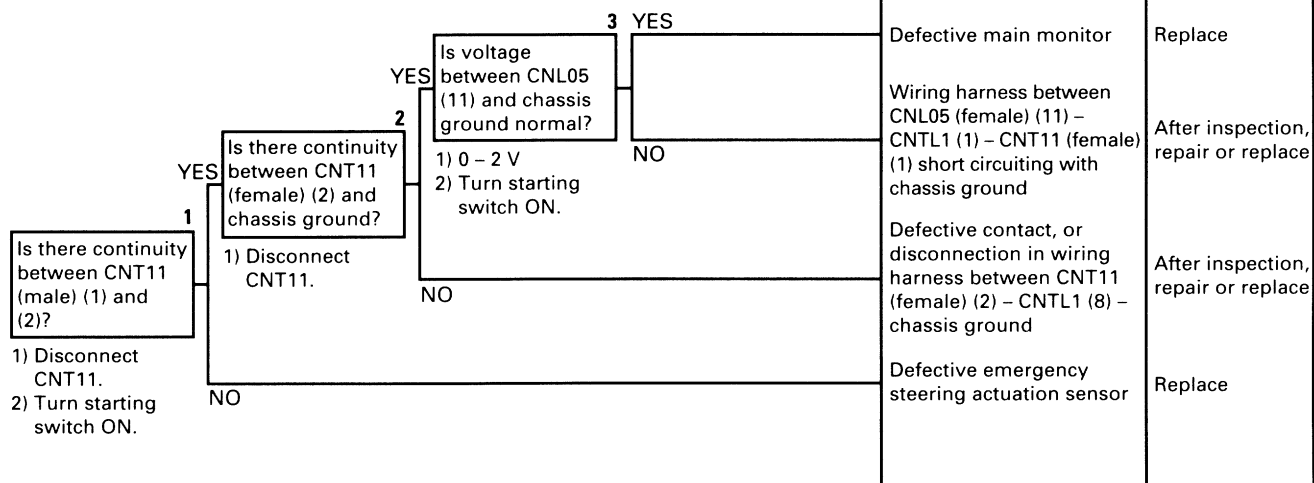
M-19 Abnormality in emergency steering actuation display

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

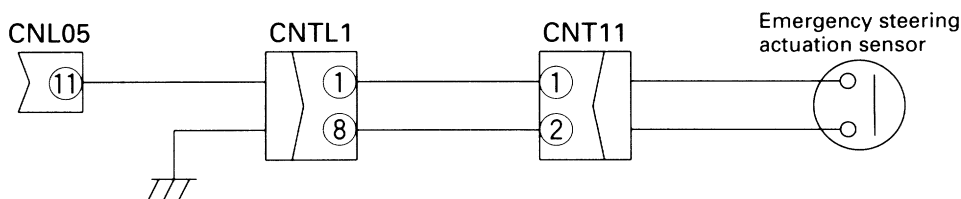
(a) Emergency steering actuation display does not light up



(b) Emergency steering actuation display stays lighted up



Emergency steering actuation



TDW00308

M-20 Abnormality in auto-greasing system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Forced greasing cannot be carried out

		Cause	Remedy
1 Is voltage between CNL06 (5) and chassis ground normal? 1) 0 – 3 V 2) Turn starting switch ON. 3) Turn auto-greasing switch ON.	YES	See operation and maintenance manual for handling auto-greasing system	–
	2 YES Is voltage between CNGRE (1) and chassis ground normal? 1) 0 – 3 V 2) Turn starting switch ON. 3) Turn auto-greasing switch ON.	Defective contact, or disconnection in wiring harness between CNL06 (female) (5) and CNGRE (1)	After inspection, repair or replace
	NO	Defective main monitor	Replace

(b) Monitor display flashes rapidly (2 times/sec)

1 Is voltage between CNL08 (5) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	YES	Defective main monitor	Replace
	2 YES Is voltage between CNGRE (3) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	Defective contact, or disconnection in wiring harness between CNL08 (female) (5) and CNGRE (3)	After inspection, repair or replace
	NO	See operation and maintenance manual for handling auto-greasing system	–

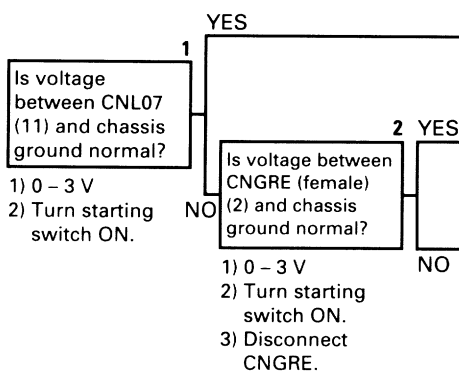
(c) When no more grease remains, monitor display flashes rapidly (2 times/sec)

1 Is voltage between CNL07 (11) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	YES	Defective main monitor	Replace
	2 YES Is voltage between CNGRE (2) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	Defective contact, or disconnection in wiring harness between CNL07 (female) (11) and CNGRE (2)	After inspection, repair or replace
	NO	See operation and maintenance manual for handling auto-greasing system	–

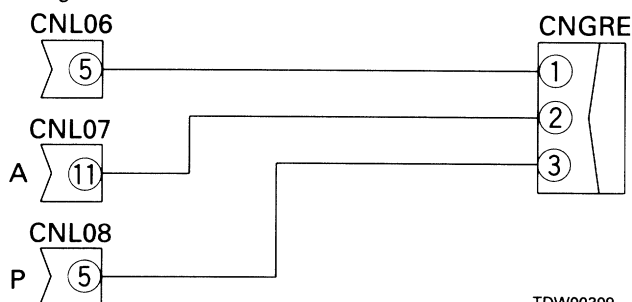
U42103

(d) Monitor display flashes slowly (1 time/sec)

Cause	Remedy
See operation and maintenance manual for handling auto-greasing system	-
Defective main monitor	Replace
Contact of power source with wiring harness between CNL07 (female) (11) and CNGRE (female) (2)	After inspection, repair or replace
See operation and maintenance manual for handling auto-greasing system	-

(e) Monitor display goes out**Relationship between input signal and display**

CNL07(11)	CNL08(5)	Display
L	L	Rapid flashing (2 times/sec)
H	L	Slow flashing (1 time/sec)
H	H	OFF
L	H	ON

Auto-greasing

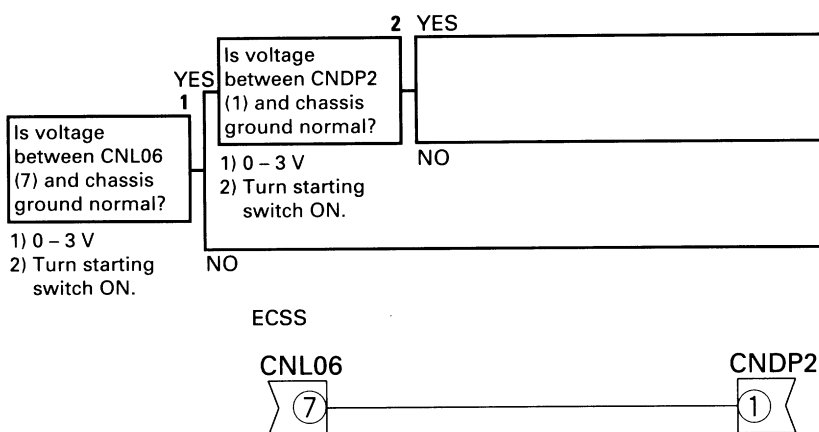
M-21 Abnormality in ECSS system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Display does not change when switch is pressed

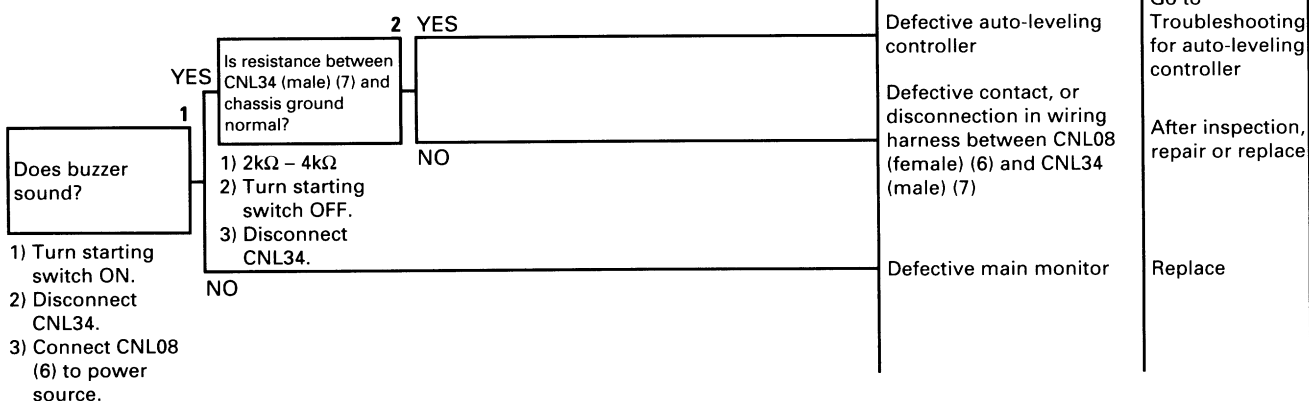
Cause	Remedy
Defective main monitor	Replace
Defective ECSS controller	Go to Troubleshooting for ECSS controller
Defective contact, or disconnection in wiring harness between CNL06 (7) and CNDP2 (1)	After inspection, repair or replace
Defective main monitor	Replace

(b) Monitor display lights up but ECSS function does not work

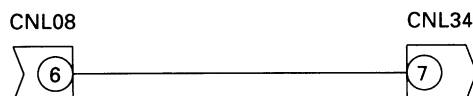


TDW00310

M-22 Buzzer does not sound when auto-leveling switch is actuated



Auto-leveling buzzer



TMW00909

U42103

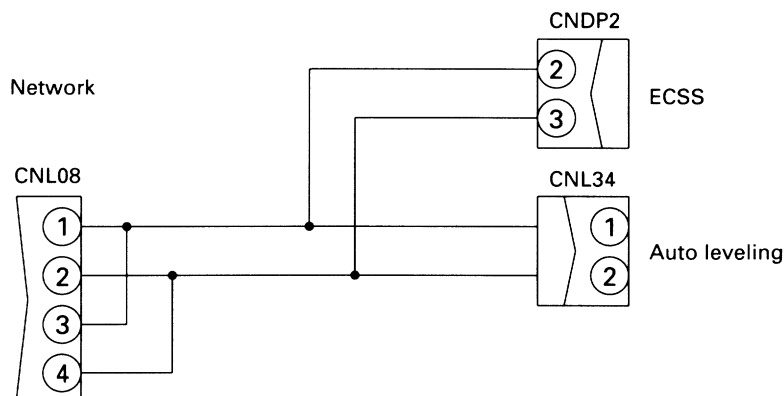
M-23 Failure code is not sent to main monitor (abnormality in network)

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Set dipswitch 3 at the rear of the main monitor to "F".

		Cause	Remedy
1 Is voltage between CNL08 (male) (1) and (2) normal? 1) Repeat 0V and 12V? 2) Turn starting switch ON. 3) Disconnect CNL08.	YES	Is voltage normal between pins of connectors in table below?	
	2 YES	Applicable controller is defective	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL08 (female) (1)(3), CNL08 (female) (2)(4) – applicable connector pins	After inspection, repair or replace
	NO	Defective main monitor	Replace

Table

Connector	Pin No.
CNL34(female)	Between (1) – (2)
CNDP2(female)	Between (2) – (3)
CNKN0(male)	Between (3) – (4)
CNTIR(male)	Between (1) – (2)



TMW00910

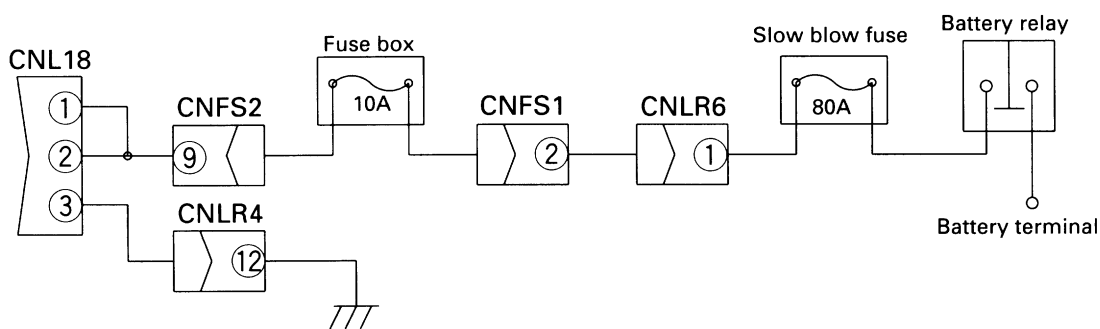
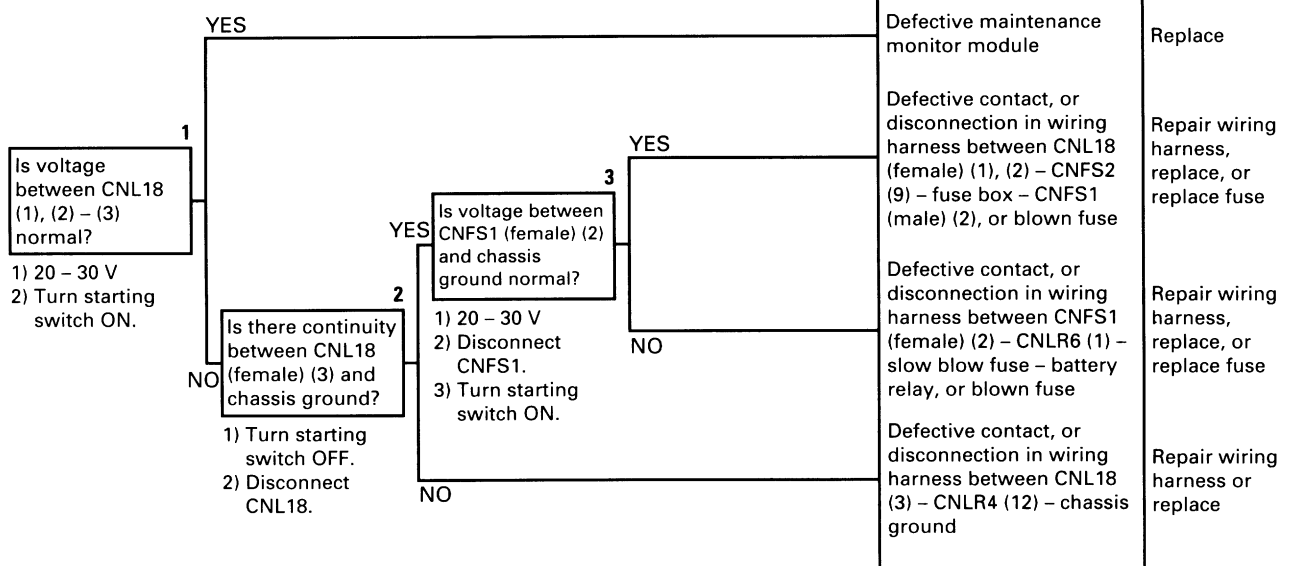
TROUBLESHOOTING OF MAINTENANCE MONITOR SYSTEM (K MODE)

K- 1	When starting switch is turned ON, all lamps on maintenance monitor do not light up for 3 seconds, maintenance monitor does not work	20-352
	(a) All lamps on maintenance monitor do not light up for 3 seconds.....	20-352
	(b) Some lamps do not light up	20-353
K- 2	When starting switch is turned ON, all lamps on maintenance monitor light up but do not go out	20-353
K- 3	When engine is started immediately after starting switch is turned ON (within 3 seconds), all lamps on maintenance monitor do not go out.....	20-354
K- 4	When starting switch is turned ON (engine stopped), CHECK items flash	20-355
	(a) Engine oil level display flashes	20-355
	(b) Engine water level display flashes	20-356
K- 5	When starting switch is turned ON (engine started), CAUTION items flash	20-357
	(a) Engine oil pressure display flashes.....	20-357
	(b) Battery charge level display flashes.....	20-358
	(c) Brake oil pressure display flashes	20-359
	(d) Air cleaner display flashes	20-360
K- 6	CAUTION items are flashing but alarm buzzer does not sound	20-361
K- 7	There is no abnormality in monitor display but alarm buzzer sounds	20-362
K- 8	CAUTION items are flashing but warning lamp (CHECK lamp, CAUTION lamp) does not light up.....	20-363
	(a) CHECK lamp	20-363
	(b) CAUTION lamp	20-363
K- 9	There is no abnormality in maintenance monitor display but warning lamp (CHECK lamp, CAUTION lamp) lights up.....	20-364
	(a) CHECK lamp	20-364
	(b) CAUTION lamp	20-364
K-10	Night lighting does not light up when lamp switch is turned ON (only lighting of maintenance monitor does not light up)	20-365
K-11	Night lighting lights up even when lamp switch is OFF, night lighting stays lighted up	20-366
K-12	Service meter does not work	20-367
K-13	Service meter is running even when engine is stopped	20-367
K-14	Abnormality in gauge items	20-368
	(a) Abnormality in fuel gauge	20-368
	(b) Abnormality in engine water temperature gauge	20-369
	(c) Abnormality in torque converter oil temperature gauge	20-370

K-1 When starting switch is turned ON, all lamps on maintenance monitor do not light up for 3 seconds, maintenance monitor does not work

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) All lamps on maintenance monitor do not light up for 3 seconds



TDW00314

U42103

TROUBLESHOOTING

K-1, K-2

(b) Some lamps do not light up

Cause	Remedy
Defective maintenance monitor module	Replace

K-2 When starting switch is turned ON, all lamps on maintenance monitor light up but do not go out

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

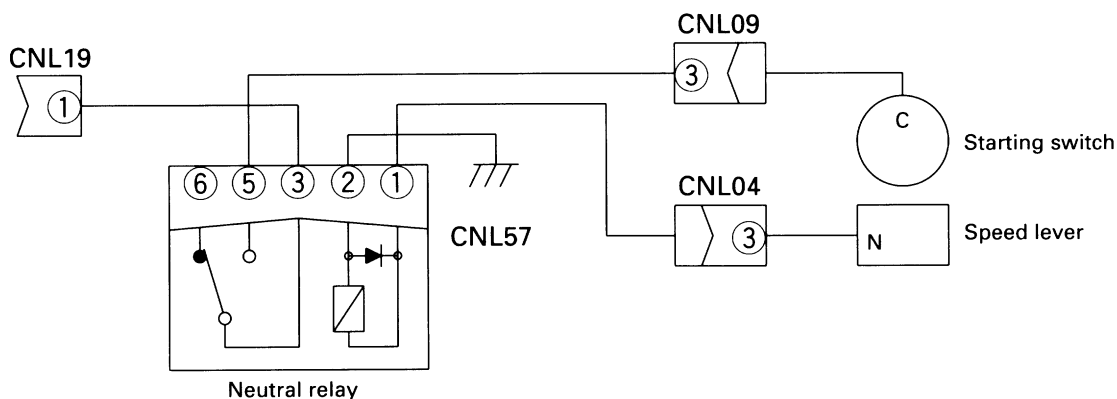
Cause	Remedy
Defective maintenance monitor module	Replace

U42103

K-3 When engine is started immediately after starting switch is turned ON (within 3 seconds), all lamps on maintenance monitor do not go out

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

		Cause	Remedy
When starting engine, is voltage between CNL19 (female) (1) and chassis ground normal? 1) 20 – 30 V 2) Disconnect CNL19. 3) Start engine. 4) Measure when starting motor is turning.	YES	Defective maintenance monitor module	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL19 (female) (1) and neutral relay	Repair wiring harness or replace



TDW00315

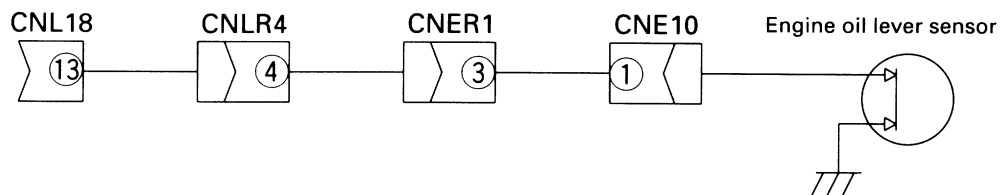
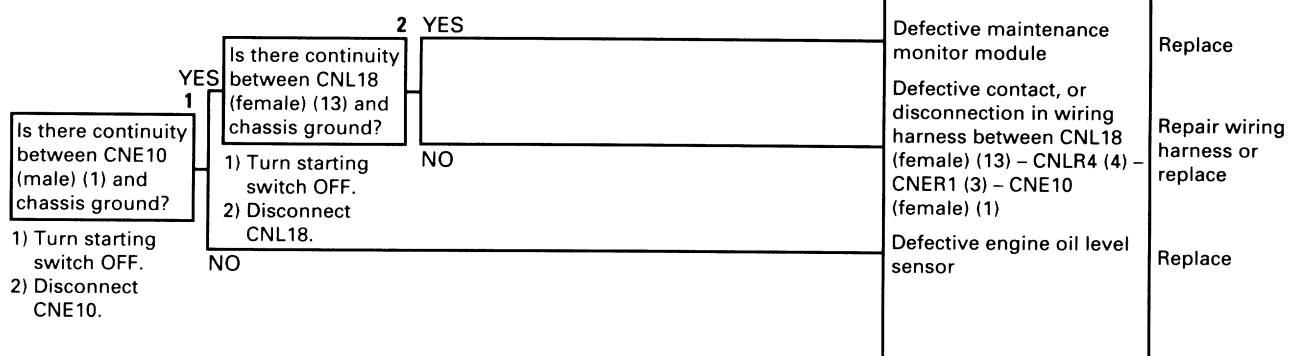
U42103

K-4 When starting switch is turned ON (engine stopped), CHECK items flash

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Engine oil level display flashes

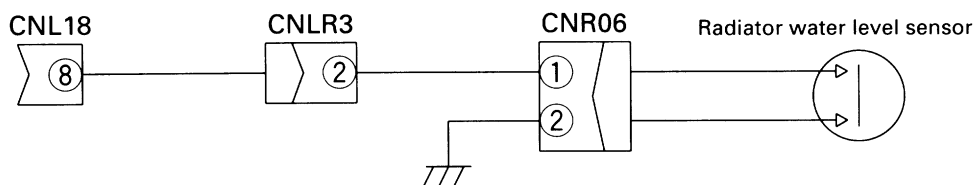
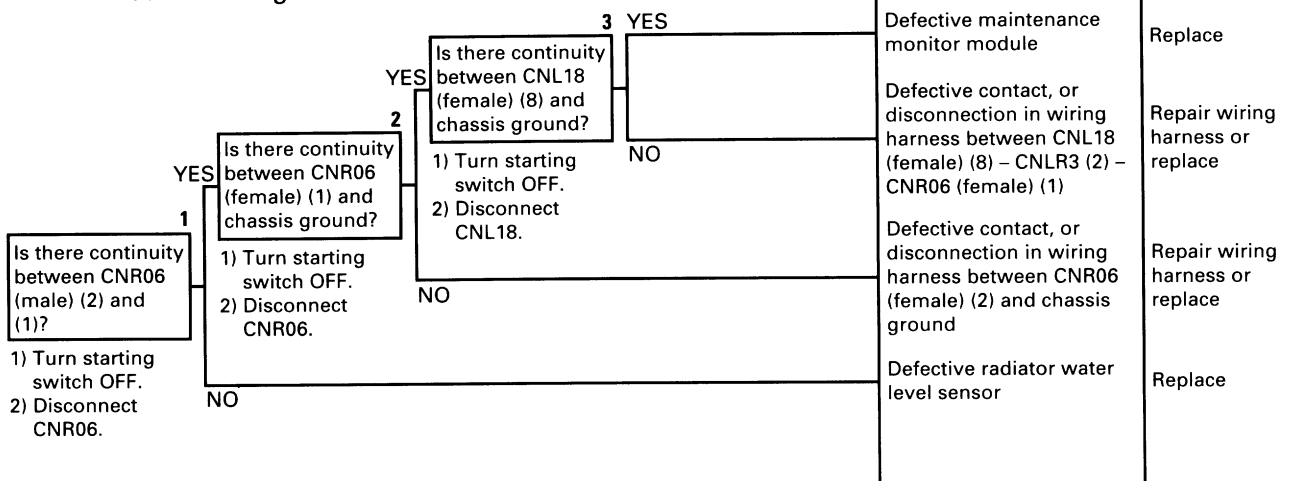
- ★ Before starting troubleshooting, check the engine oil level again.



TDW00316

(b) Engine water level display flashes

- ★ Before starting troubleshooting, check the engine water level again.



TDW00317

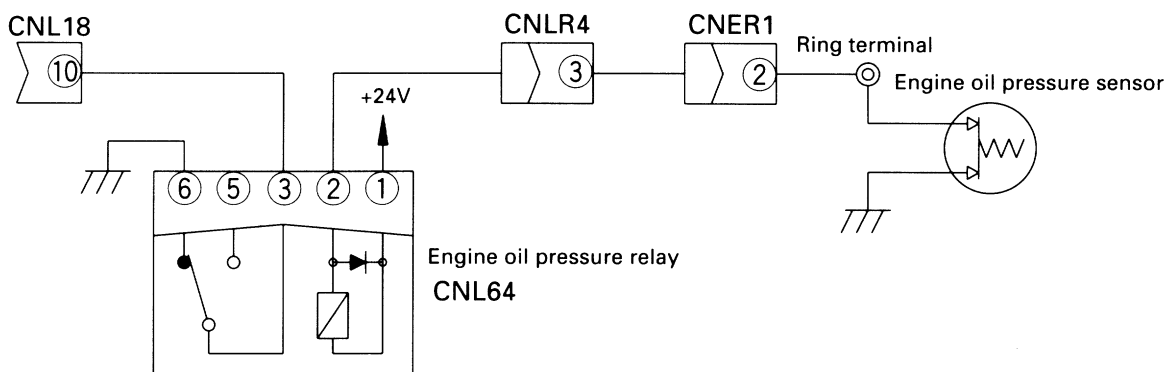
U42103

K-5 When starting switch is turned ON (engine started), CAUTION items flash

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Engine oil pressure display flashes

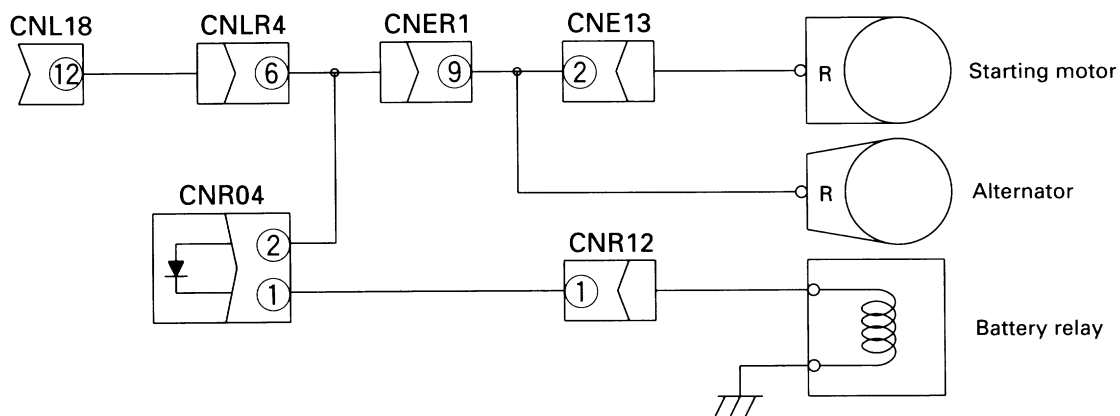
		Cause	Remedy
1) Start engine. Does display go out when ring terminal is removed? 1) Start engine. 2) Remove ring terminal. 3) Start engine.	YES	Defective engine oil pressure sensor	Replace
	NO	Is there continuity between CNL18 (female) (10) and chassis ground?	
	YES	Defective maintenance monitor module	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL18 (female) (10) – engine oil pressure relay – chassis ground, or defective relay	Repair wiring harness, replace, or replace relay
		Contact of ground with wiring harness between ring terminal – CNER1 (2) – CNLR4 (3) – engine oil pressure relay, or defective relay	Repair wiring harness, replace, or replace relay



TDW00318

(b) Battery charge level display flashes

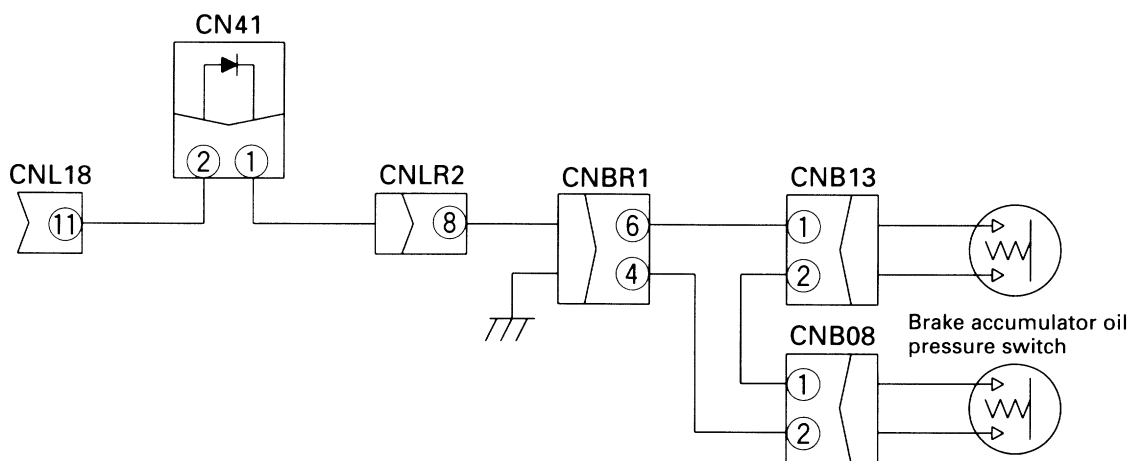
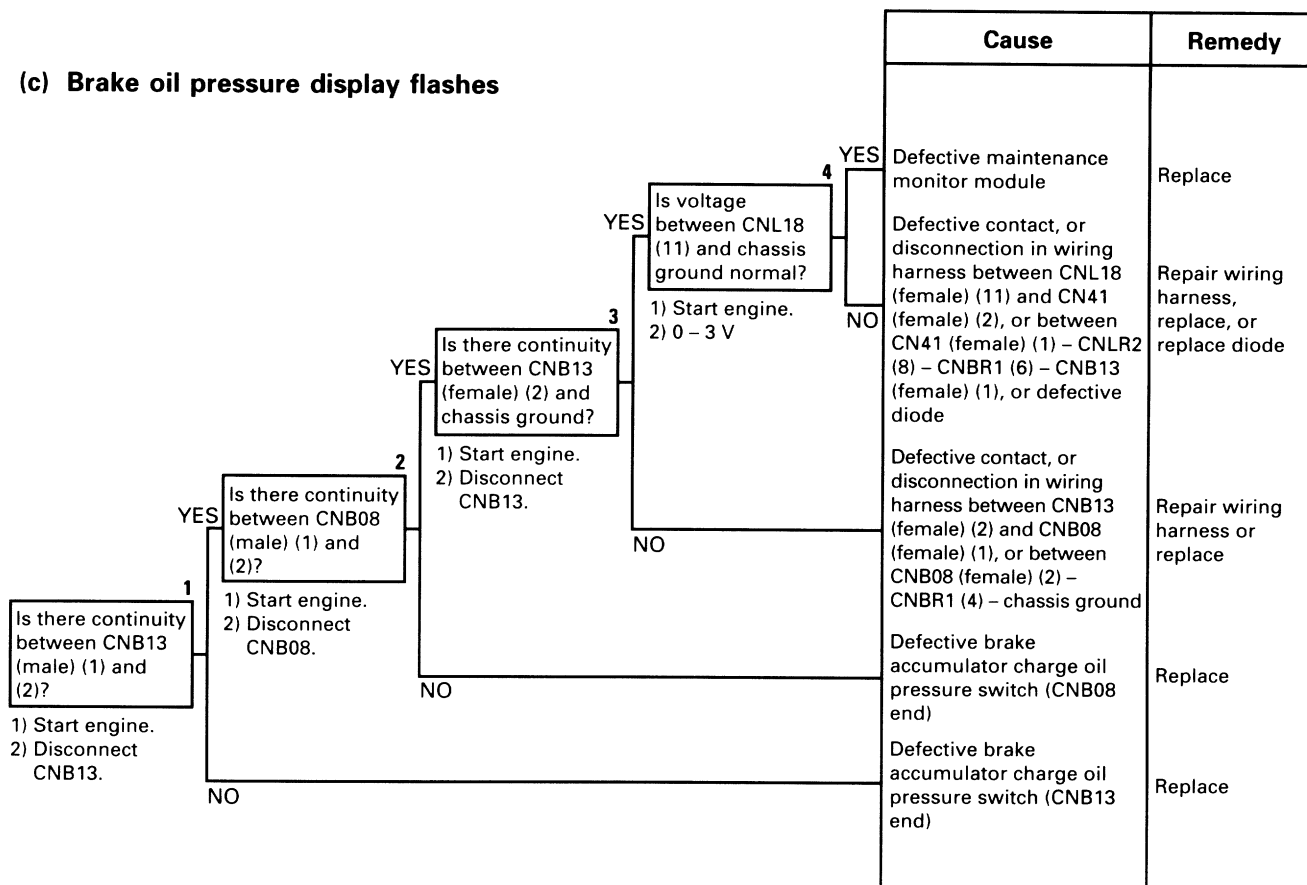
		Cause	Remedy
Is voltage between alternator terminal R and chassis ground normal? 1) 20 – 30 V 2) Start engine.	1 YES	Defective maintenance monitor module	Replace
	2 YES	Disconnection in wiring harness between CNL18 (female) (12) – CNLR4 (6) – CNER1 (9) – alternator terminal R	Repair wiring harness or replace
	NO	Defective alternator	Replace



TDW00319

U42103

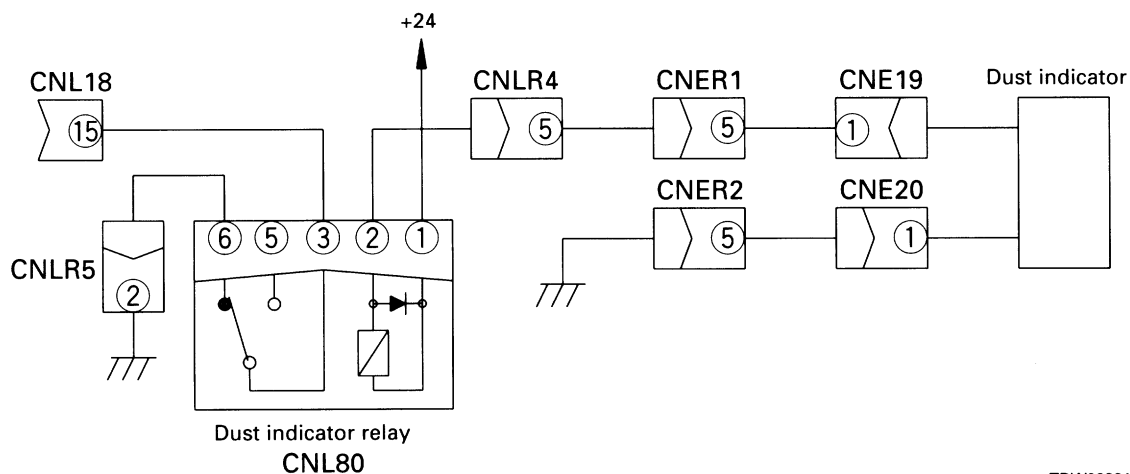
(c) Brake oil pressure display flashes



TDW00320

(d) Air cleaner display flashes

		Cause	Remedy
1 Does display go out? 1) Start engine. 2) Disconnect CNE19. 2 Is voltage between CNE19 (female) (1) and chassis ground normal? 1) Turn starting switch ON. 2) Disconnect CNE19. 3) 20 – 30 V 3 Is there continuity between CNL18 (female) (15) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNL18.	YES	Defective dust indicator sensor	Replace
	YES	Defective maintenance monitor module	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL18 (female) (15) and CNL80 (female) (3), or between CNL80 (female) (6) – CNLR5 (2) – chassis ground, or defective dust indicator relay	Repair wiring harness, replace, or replace relay
	NO	Short circuit, or contact of wiring harness between CNE19 (female) (1) – CNER1 (5) – CNLR4 (5) – CNL80 (female) (2) with chassis ground, or defective dust indicator relay	Repair wiring harness, replace, or replace relay



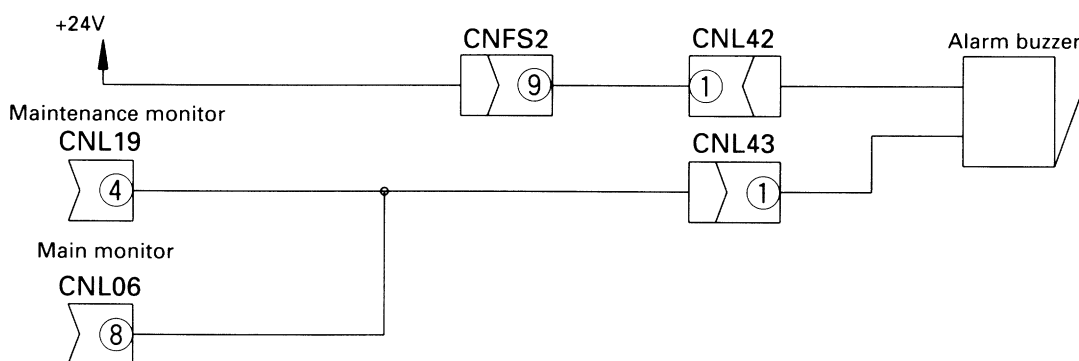
TDW00321

U42103

K-6 CAUTION items are flashing but alarm buzzer does not sound

- ★ The buzzer does not sound for CHARGE or ENGINE OIL LEVEL.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

		Cause	Remedy
1) 20 - 30 V 2) Disconnect CNL42. 3) Turn starting switch ON.	1	Is voltage between CNL42 (female) (1) and chassis ground normal?	
	2	Does buzzer sound when CNL19 (female) pin (4) is connected to chassis ground?	
	3	Does buzzer sound when CNL43 (female) pin (1) is connected to chassis ground?	

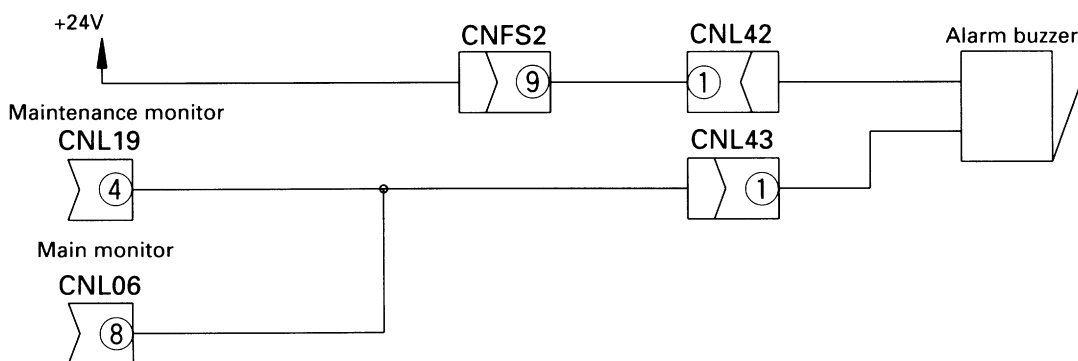


TDW00322

K-7 There is no abnormality in monitor display but alarm buzzer sounds

- ★ Before carrying out troubleshooting, check that there is no abnormality display on the main monitor.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

		Cause	Remedy
Is there continuity between CNL43 (female) (1) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNL43.	YES	Defective buzzer	Replace
	NO	Is there continuity between CNL19 (female) (4) and chassis ground?	
	NO	Defective maintenance monitor module	Replace
	2 YES	Contact of chassis ground with wiring harness between CNL19 (female) (4) and CNL43 (male) (1)	Repair wiring harness or replace
	2 NO		



TDW00322

U42103

K-8 CAUTION items are flashing but warning lamp (CHECK lamp, CAUTION lamp) does not light up

- ★ Before carrying out troubleshooting, check that there are no blown lamp bulbs.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) CHECK lamp

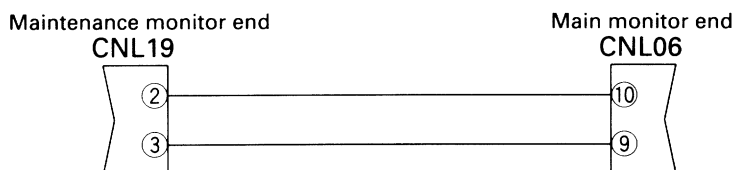
		Defective maintenance monitor module	Replace
1 Does check lamp light up when CNL19 (female) pin (2) is connected to chassis ground? 1) Disconnect CNL19. 2) Turn starting switch ON.	YES	Defective contact, or disconnection in wiring harness between CNL19 (female) (2) and CNL06 (female) (10)	Repair wiring harness or replace
	2 Does check lamp light up when CNL06 (male) pin (10) is connected to chassis ground? 1) Disconnect CNL06. 2) Turn starting switch ON.		
		NO	NO

(b) CAUTION lamp

		Defective maintenance monitor module	Replace
1 Does caution lamp light up when CNL19 (female) pin (3) is connected to chassis ground? 1) Disconnect CNL19. 2) Turn starting switch ON.	YES	Defective contact, or disconnection in wiring harness between CNL19 (female) (3) and CNL06 (female) (10)	Repair wiring harness or replace
	2 Does caution lamp light up when CNL06 (male) pin (9) is connected to chassis ground? 1) Disconnect CNL06. 2) Turn starting switch ON.		
		NO	NO

(b) CAUTION lamp

		Cause	Remedy	
Does caution lamp light up when CNL19 (female) pin (3) is connected to chassis ground? 1) Disconnect CNL19. 2) Turn starting switch ON.	1 YES	Defective maintenance monitor module	Replace	
	Does caution lamp light up when CNL06 (male) pin (9) is connected to chassis ground? 1) Disconnect CNL06. 2) Turn starting switch ON.	2 YES	Defective contact, or disconnection in wiring harness between CNL19 (female) (3) and CNL06 (female) (10)	Repair wiring harness or replace
		NO	Defective main monitor	Replace



TDW00324

K-9 There is no abnormality in maintenance monitor display but warning lamp (CHECK lamp, CAUTION lamp) lights up

- ★ Before carrying out troubleshooting, check that there is no abnormality display on the main monitor.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) CHECK lamp

1 YES
Is there continuity between CNL19 (female) (2) and chassis ground?

- 1) Turn starting switch OFF.
2) Disconnect CNL19.

NO

(b) CAUTION lamp

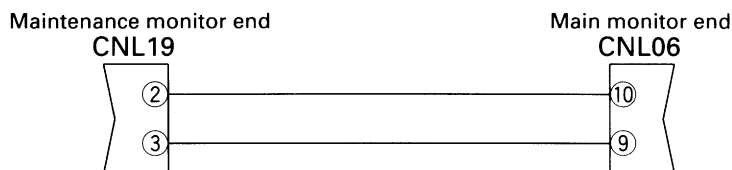
1 YES
Is there continuity between CNL19 (female) (3) and chassis ground?

- 1) Turn starting switch OFF.
2) Disconnect CNL19.

NO

Cause	Remedy
Contact of chassis ground with wiring harness between CNL19 (female) (2) and CNL06 (female) (10)	Repair wiring harness or replace
Defective maintenance monitor module	Replace
Contact of chassis ground with wiring harness between CNL19 (female) (3) and CNL06 (female) (9)	Repair wiring harness or replace
Defective maintenance monitor module	Replace

U42103

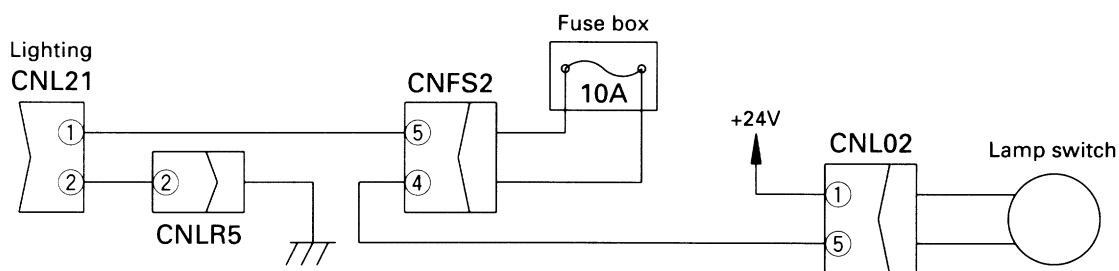


TDW00324

K-10 Night lighting does not light up when lamp switch is turned ON (only lighting of maintenance monitor does not light up)

- ★ Before carrying out troubleshooting, check that there are no blown lamp bulbs.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

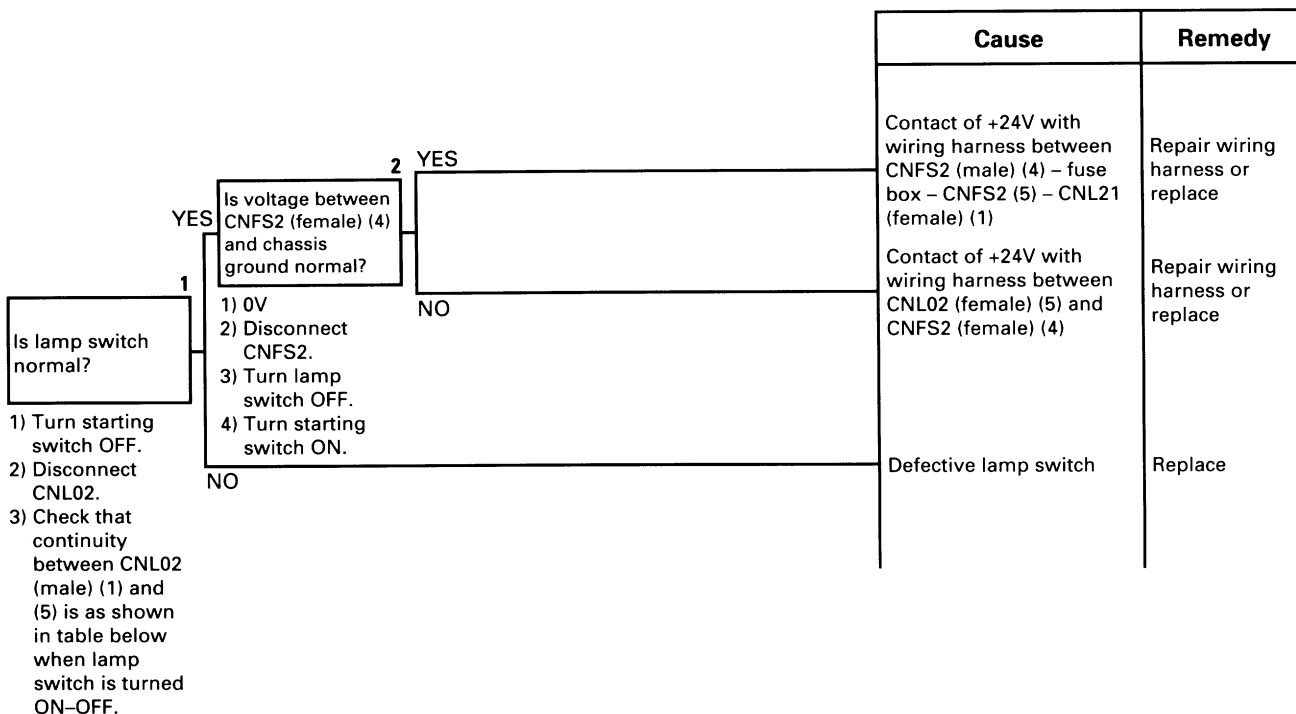
		Cause	Remedy
Is voltage between CNL21 (female) (1) and (2) normal? 1) 20 – 30 V 2) Disconnect CNL21. 3) Turn starting switch ON. 4) Turn lamp switch ON.	1 YES	Disconnection in wiring harness of lamp holder	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL21 (female) (1) and CNFS2 (5)	Repair wiring harness or replace



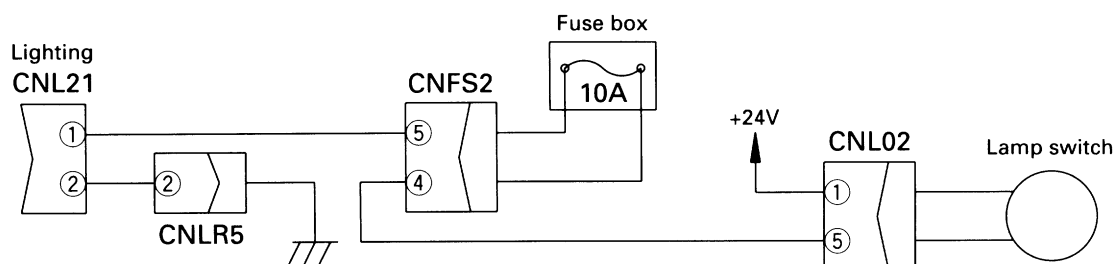
TDW00326

K-11 Night lighting lights up even when lamp switch is OFF, night lighting stays lighted up

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



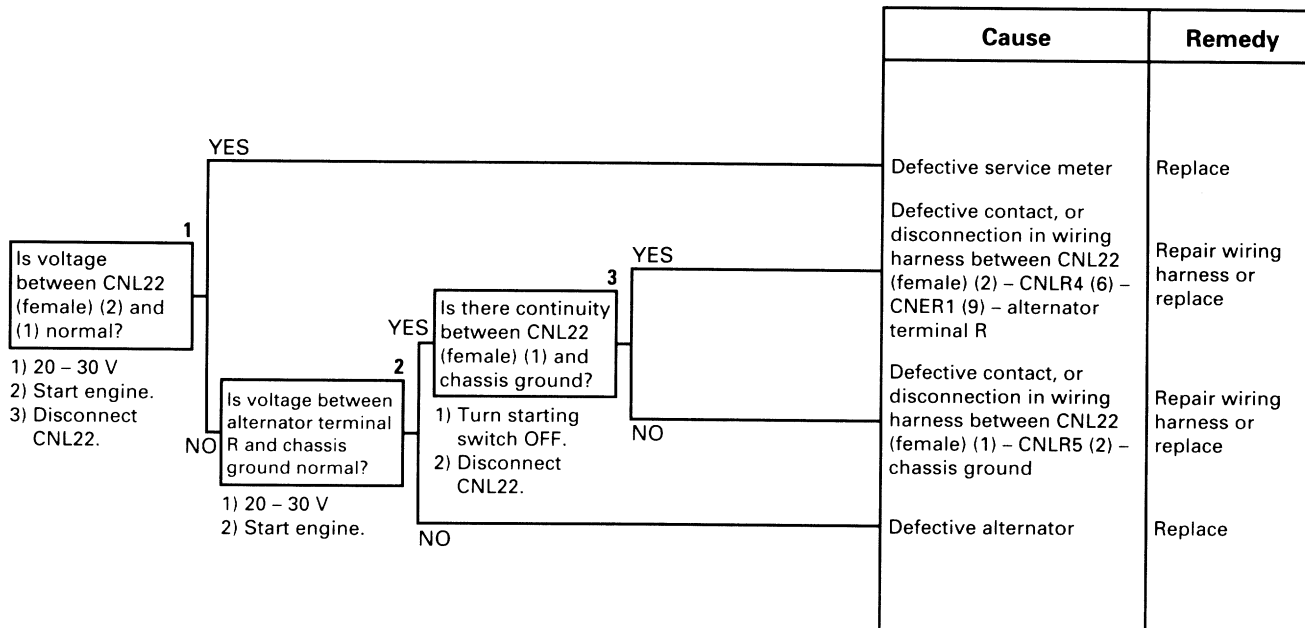
Switch	Continuity
ON	Continuity
OFF	NO continuity



U42103

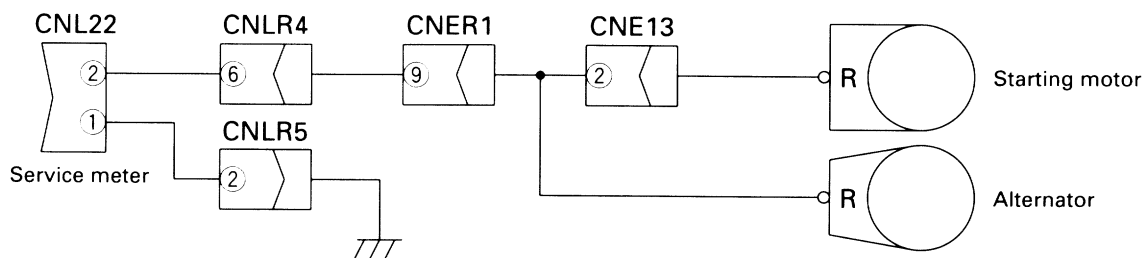
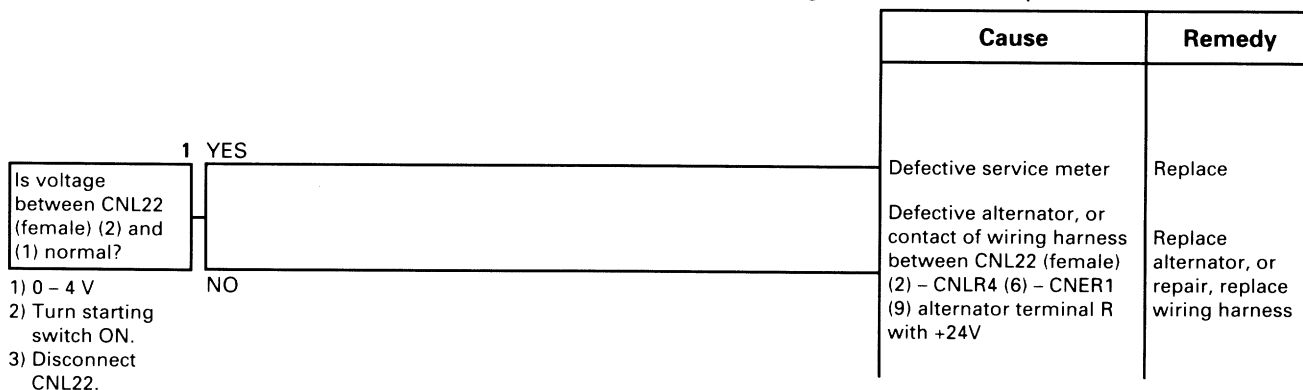
K-12 Service meter does not work

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



K-13 Service meter is running even when engine is stopped

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



TDW00328

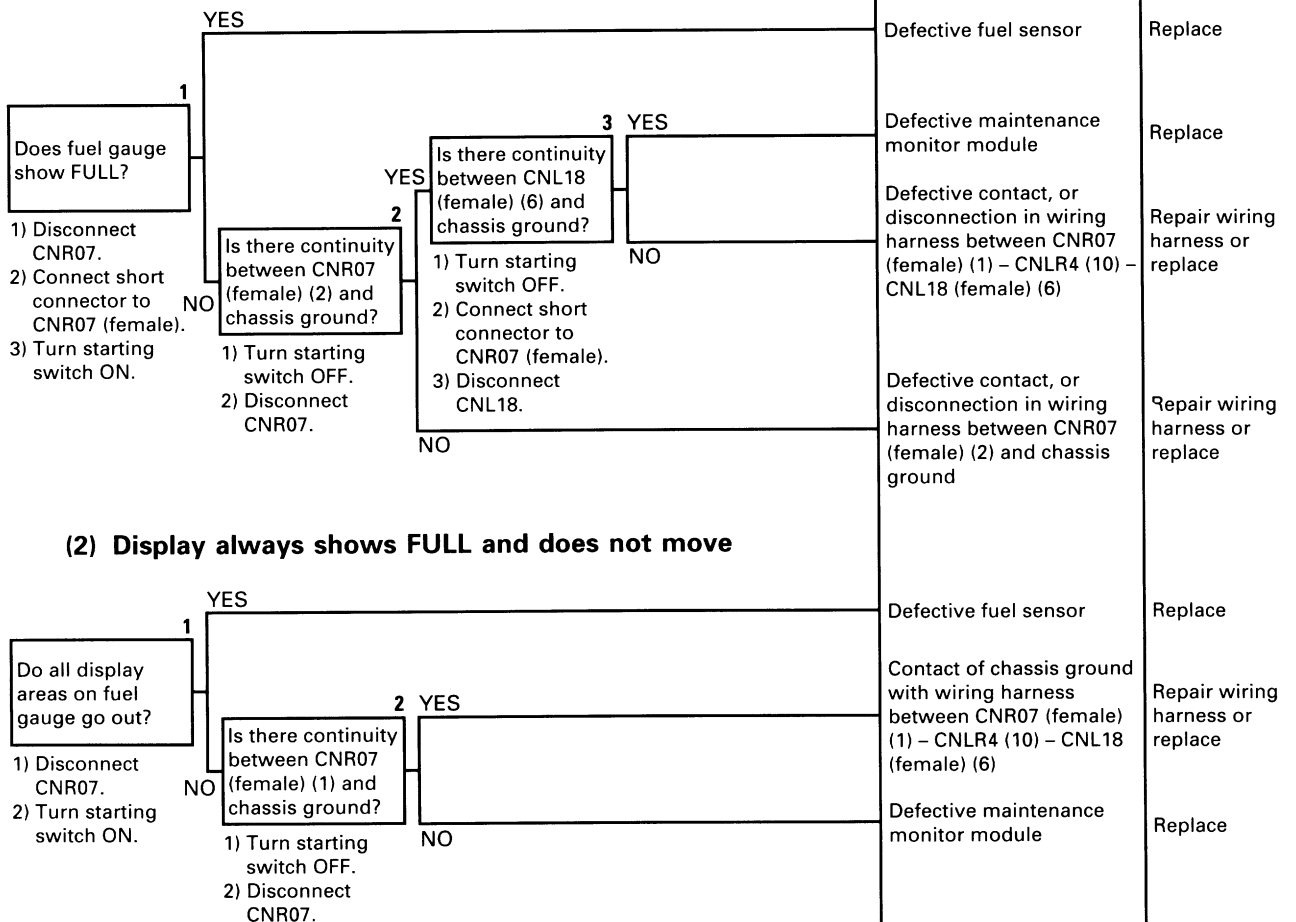
K-14 Abnormality in gauge items

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

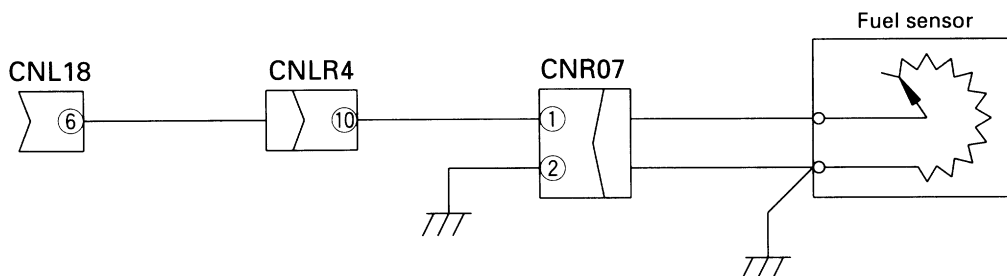
(a) Abnormality in fuel gauge

- ★ Before carrying out troubleshooting, check the fuel level again.

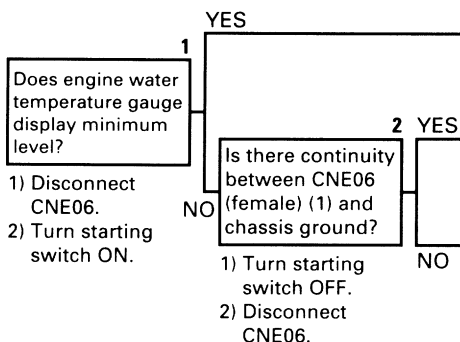
(1) Little or nothing is displayed in the display area



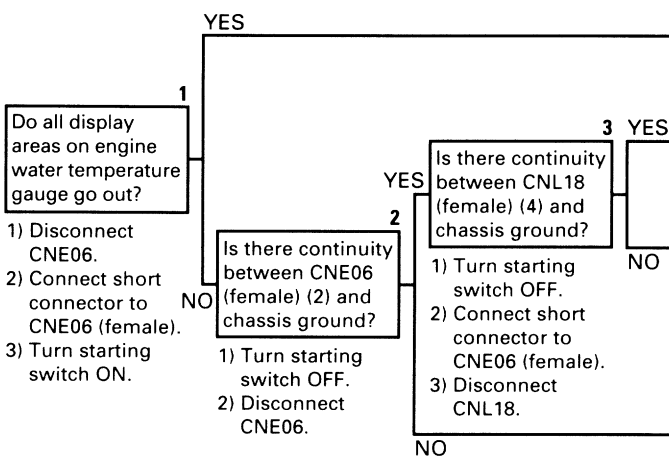
U42103



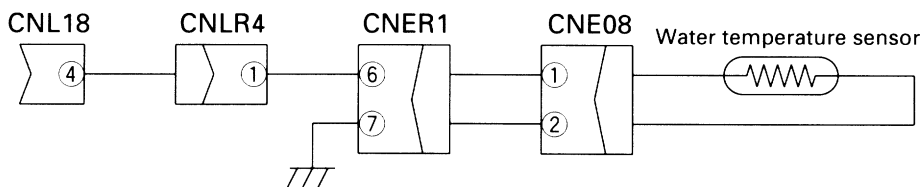
TDW00329

(b) Abnormality in engine water temperature gauge**(1) Nothing is displayed in the display area**

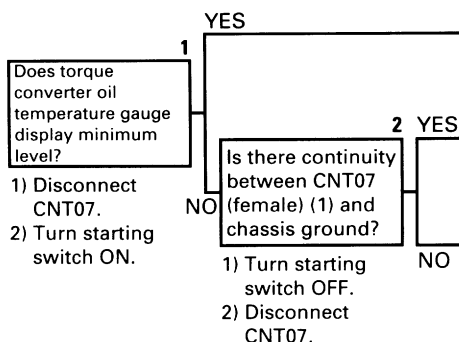
Cause	Remedy
Defective engine water temperature sensor	Replace
Contact of chassis ground with wiring harness between CNE06 (female) (1) – CNER1 (6) – CNLR4 (1) – CNL18 (female) (4)	Repair wiring harness or replace
Defective maintenance monitor module	Replace

(2) Display shows lowest level and does not move

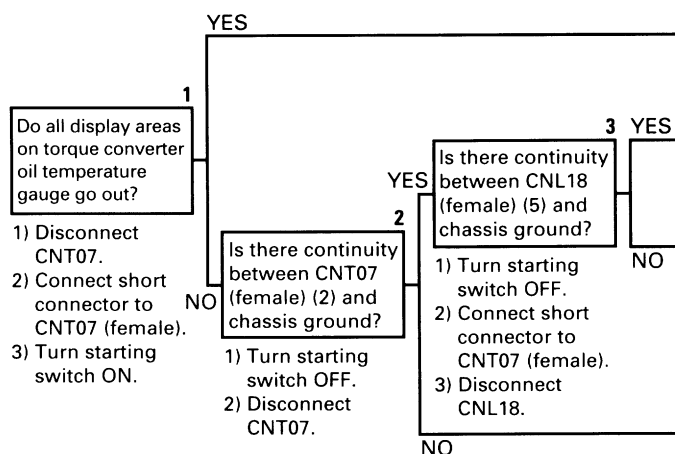
Defective engine water temperature sensor	Replace
Defective maintenance monitor module	Replace
Defective contact, or disconnection in wiring harness between CNE06 (female) (1) – CNER1 (6) – CNLR4 (1) – CNL18 (female) (4)	Repair wiring harness or replace
Defective contact, or disconnection in wiring harness between CNE06 (female) (2) – CNER1 (7) – chassis ground	Repair wiring harness or replace



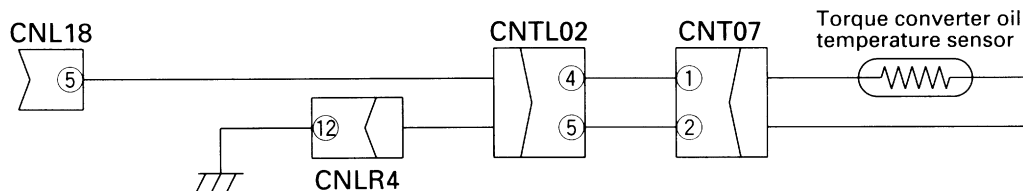
TDW00330

(c) Abnormality in torque converter oil temperature gauge**(1) Nothing is displayed in the display area**

Cause	Remedy
Defective torque converter oil temperature sensor	Replace
Contact of chassis ground with wiring harness between CNT07 (female) (1) – CNTL2 (4) – CNL18 (female) (5)	Repair wiring harness or replace
Defective maintenance monitor module	Replace

(2) Display shows lowest level and does not move

Defective torque converter oil temperature sensor	Replace
Defective maintenance monitor module	Replace
Defective contact, or disconnection in wiring harness between CNT07 (female) (1) – CNTL2 (4) – CNL18 (female) (5)	Repair wiring harness or replace
Defective contact, or disconnection in wiring harness between CNT07 (female) (2) – CNTL2 (5) – CNL4 (12) – chassis ground	Repair wiring harness or replace



TDW00331

U42103

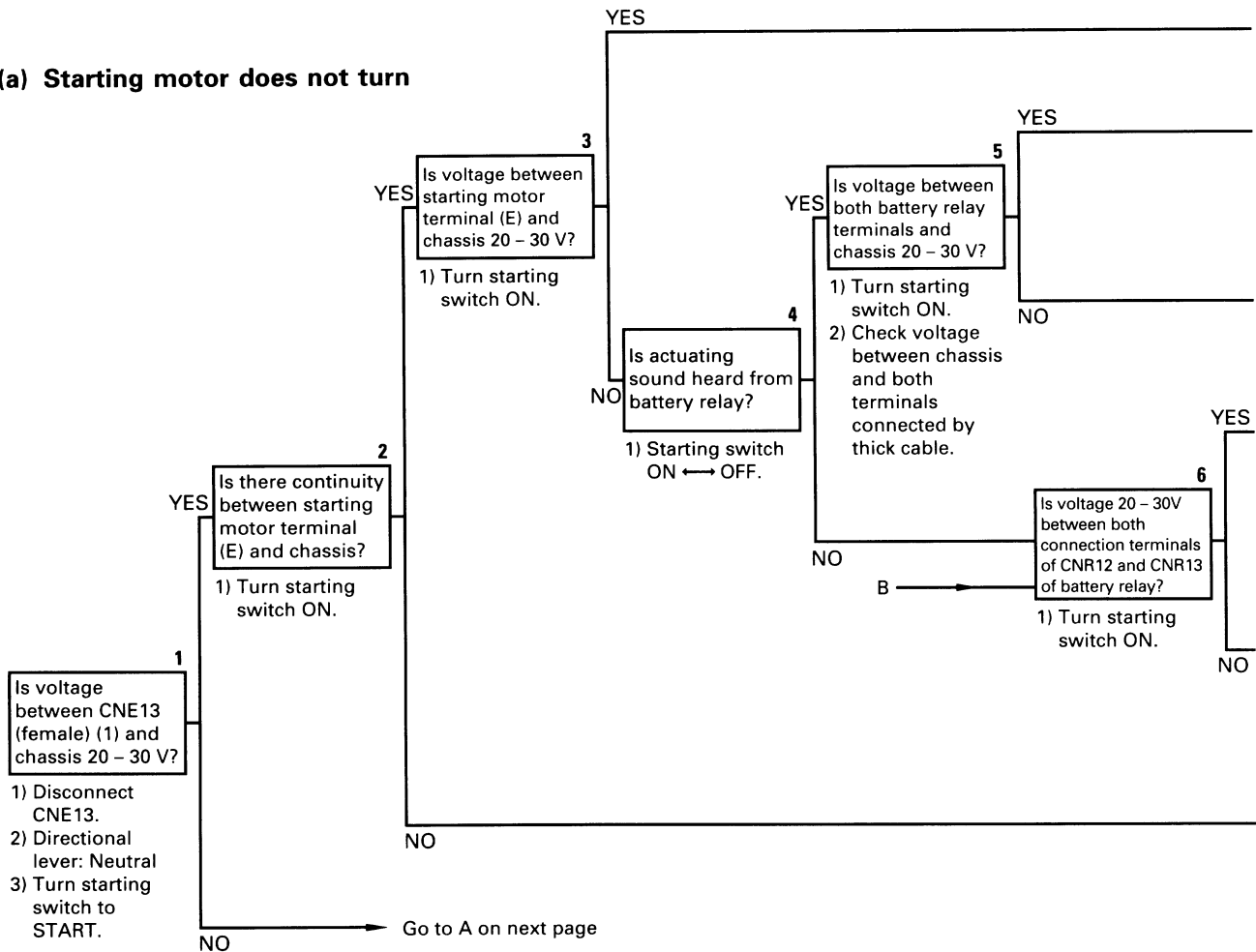
TROUBLESHOOTING OF ELECTRICAL SYSTEM (E MODE)

E- 1	Engine does not start	20-402
	(a) Starting motor does not turn	20-402
	(b) Starting motor turns	20-406
E- 2	Engine does not stop	20-408
E- 3	Engine stops when machine is traveling	20-408
E- 4	Parking brake does not work.....	20-409
	(a) Parking brake has no effect when parking brake switch is turned on.....	20-409
	(b) Parking brake has no effect when brake pressure drops	20-409
E- 5	Parking brake is applied when machine is traveling	20-410
E- 6	Parking brake is released when starting switch is turned ON	20-412
E- 7	Transmission does not change to neutral when parking brake is applied.....	20-412
E- 8	Transmission does not work normally.....	20-414
	(a) Problem in common circuit for transmission (always stays in 2nd).....	20-416
	(b) Problem in H-L circuit	20-416
	(c) Problem in speed circuit	20-417
	(d) Problem in 4th circuit (does not enter 4th)	20-417
	(e) Contact in H-L circuit	20-418
	(f) Contact in speed circuit	20-420
	(g) Contact in 4th circuit (always stays in 4th)	20-422
	(h) Problem in FORWARD circuit (REVERSE is normal)	20-424
	(i) Problem in REVERSE circuit (FORWARD is normal)	20-426
	(j) Problem in common circuit for FORWARD and REVERSE (does not travel forward, parking brake is normal)	20-428
	(k) Contact in FORWARD circuit	20-430
	(l) Contact in REVERSE circuit	20-432
	(m) Problem in common circuit for FORWARD and REVERSE	20-434
E- 9	Kick-down switch does not work	20-436
E-10	Kick-down works only when kick-down switch is ON	20-438
E-11	Kick-down operation cannot be canceled	20-438
	(a) Not canceled even when directional lever is moved from F to N or R.....	20-438
	(b) Not canceled even when speed lever is moved from 2nd to other position (becomes 4th)	20-440
E-12	Kick-down switch is actuated by mistake when traveling in 2nd	20-442

E-1 Engine does not start

- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.

(a) Starting motor does not turn



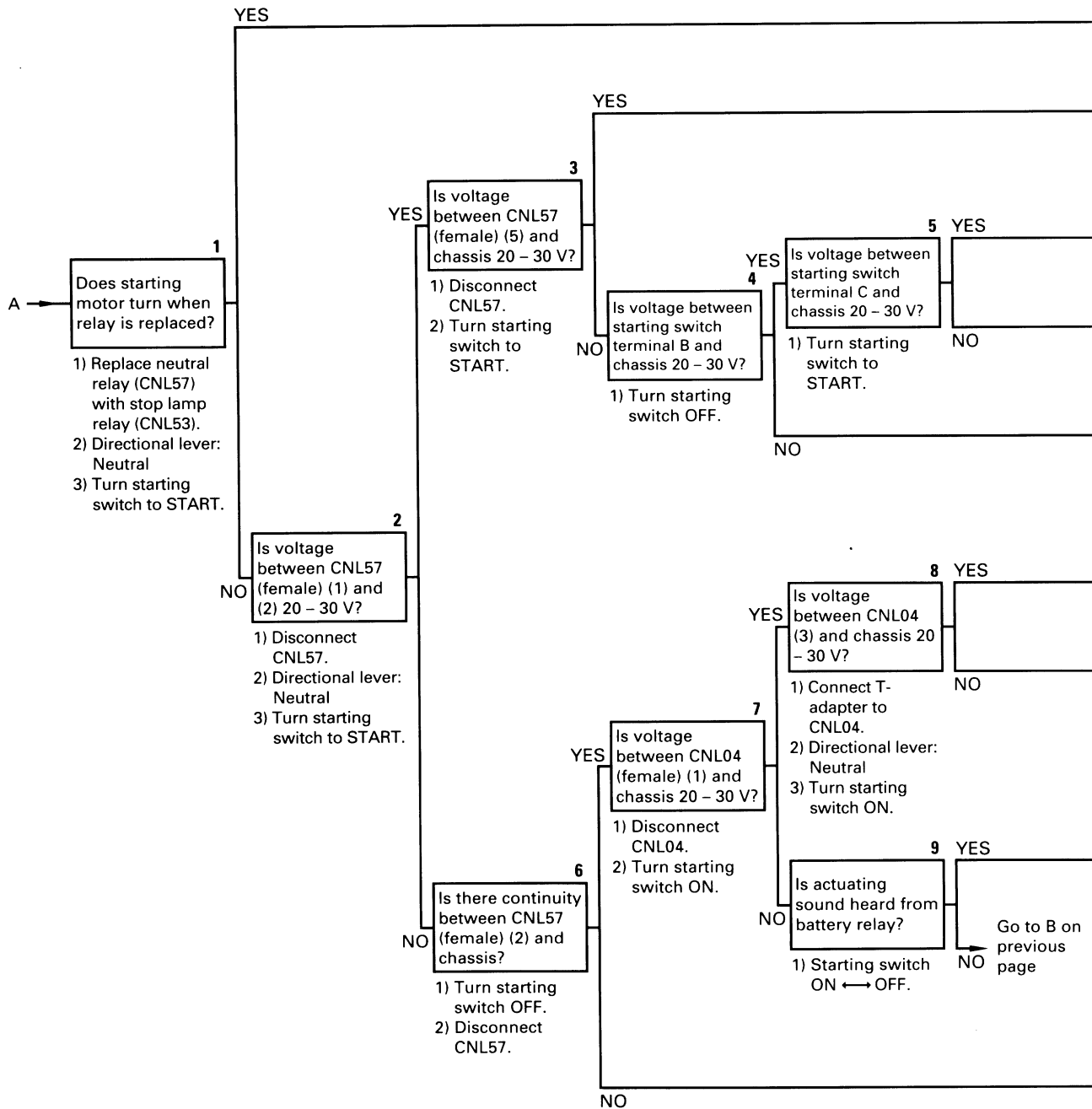
U42103

TROUBLESHOOTING

E-1

U42103

		Cause	Remedy
Is voltage between starting switch terminal BR and chassis 20 – 30 V? 1) Turn starting switch ON.	YES	Defective starting motor assembly	Replace
	NO	Defective contact, or disconnection in cable between battery relay and starting motor	After inspection, repair or replace
		• If answer is NO for both terminals: Defective contact or disconnection in wiring harness between battery and battery relay	After inspection, repair or replace
		• If answer is NO for one terminal: Defective battery relay	Replace
		Defective battery relay	Replace
		Defective contact, or disconnection in wiring harness between starting switch terminal BR – CNL09 (2) – CNLR4 (9) – CNR03 (diode) – CNR12 (female), or defective contact, or disconnection in wiring harness between CNR13 and chassis ground	After inspection, repair or replace
		Defective starting switch	Replace
		Defective contact, or disconnection in starting motor ground cable	After inspection, repair or replace



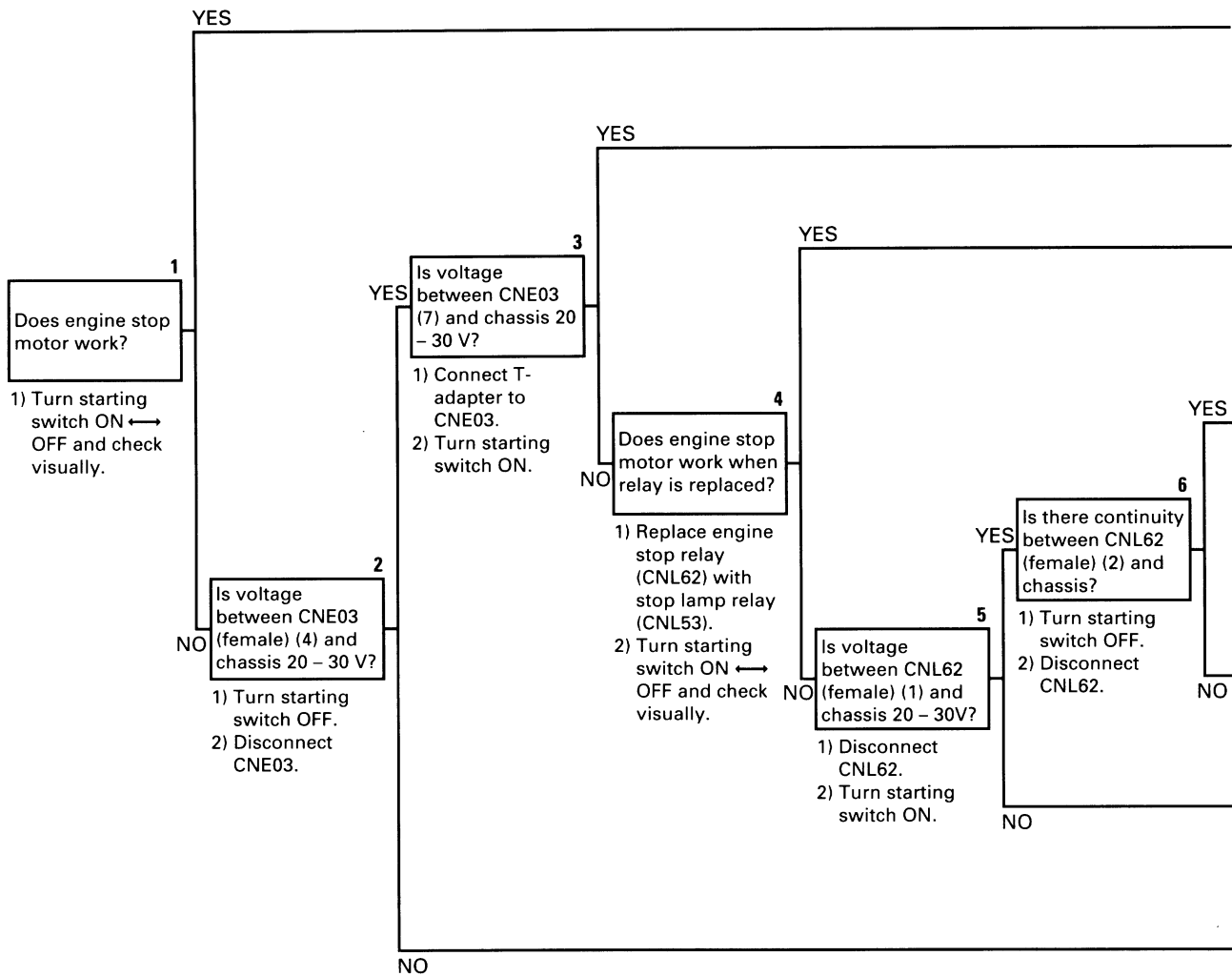
TROUBLESHOOTING

E-1

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		Cause	Remedy
10 Is voltage between both battery relay terminals and chassis 20 – 30 V? 1) Turn starting switch ON. 2) Check voltage between chassis and both terminals connected by thick cable.	YES NO	Defective neutral relay	Replace
		Defective contact, or disconnection in wiring harness between CNL57 (female) (3) – CNLR4 (8) – CNR01, 02 (diode) – CNER1 (10) – CNE13 (female) (1)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between starting switch terminal C – CNL09 (3) – CNL57 (female) (5)	After inspection, repair or replace
		Defective starting switch	Replace
		Defective contact, or disconnection in wiring harness between starting switch terminal B – CNL09 (1) – CNFS3 (4) – fuse – CNFS3 (6) – CNLR5 (1) – CNR17 – slow blow fuse 30A – battery relay	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL04 (female) (3) and CNL57 (female) (1)	After inspection, repair or replace
		Defective directional lever switch	Replace
		Defective contact, or disconnection in wiring harness between battery relay – slow blow fuse 80A – CNR15 – CNLR6 (1) – CNFS1 (2) – fuse – CNFS2 (8) – CNL04 (female) (1)	After inspection, repair or replace
		- If answer is NO for both terminals: Defective contact or disconnection in wiring harness between battery and battery relay - If answer is NO for one terminal: Defective battery relay	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL57 (female) (2) and chassis ground	After inspection, repair or replace

(b) Starting motor turns



U42103

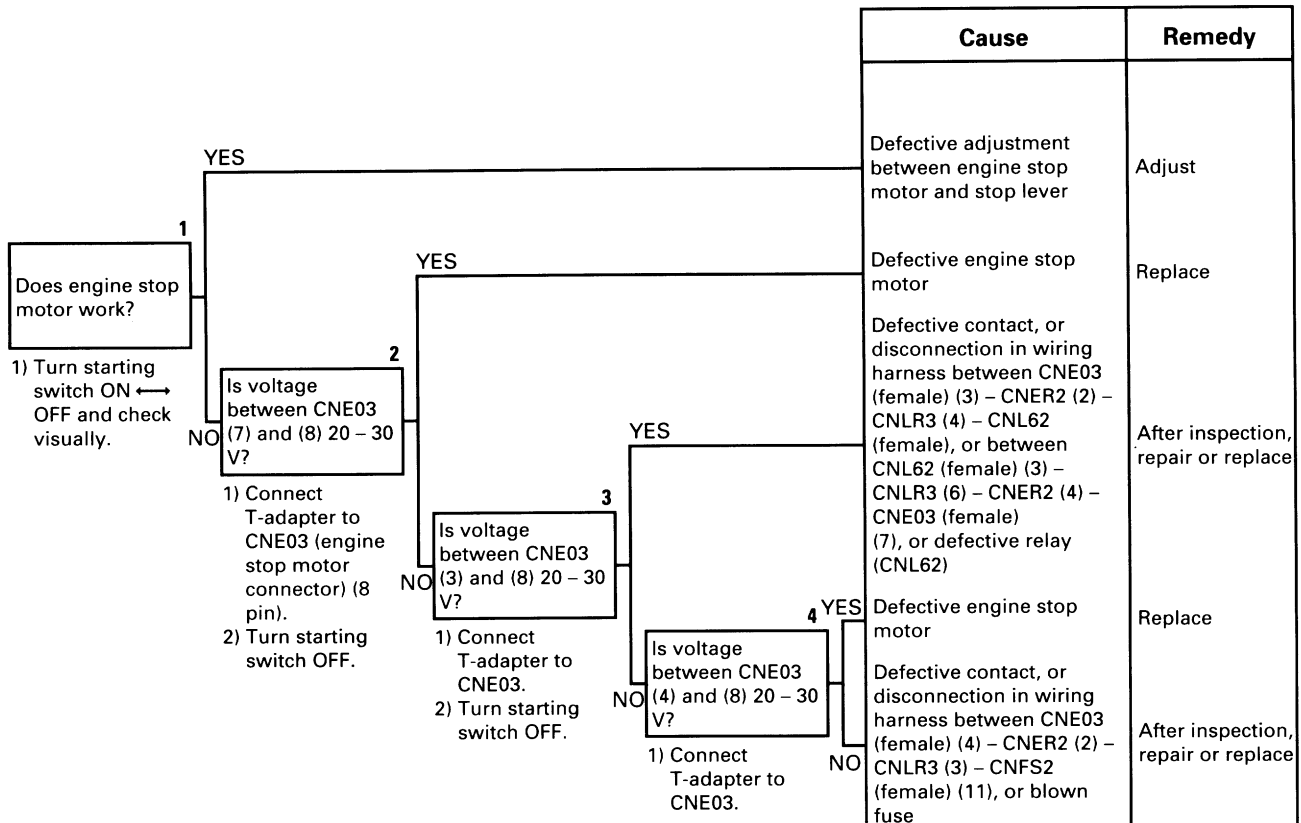
TROUBLESHOOTING

E-1

		Cause	Remedy
U42103 Is there continuity between CNE03 (female) (5) and (7)? 1) Disconnect CNE03. 2) Turn starting switch ON.	7	Defective adjustment of wire between engine stop motor and lever	Adjust
		Defective engine stop motor, or defective contact, or disconnection in wiring harness between CNE03 (female) (8) – CNER2 (5) – chassis ground	After inspection, repair or replace
		Defective engine stop relay	Replace
	YES	Defective engine stop motor	Replace
		Defective contact, or disconnection in wiring harness between CNE03 (female) (5) – CNER2 (3) – CNLR3 (5) – CNL62 (female) (5), or between CNE03 (female) (7) – CNER2 (4) – CNLR3 (6) – CNL62 (female) (3)	After inspection, repair or replace
	NO	Defective contact, or disconnection in wiring harness between CNL62 (female) (2) and chassis ground	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL62 (female) (1) and CNL09 (female) (2)	After inspection, repair or replace
		Blown fuse, or defective contact, or disconnection in wiring harness between CNF2 (female) (11) – CNLR (3) – CNER2 (1) – CNE03 (female) (4)	After inspection, repair or replace

E-2 Engine does not stop

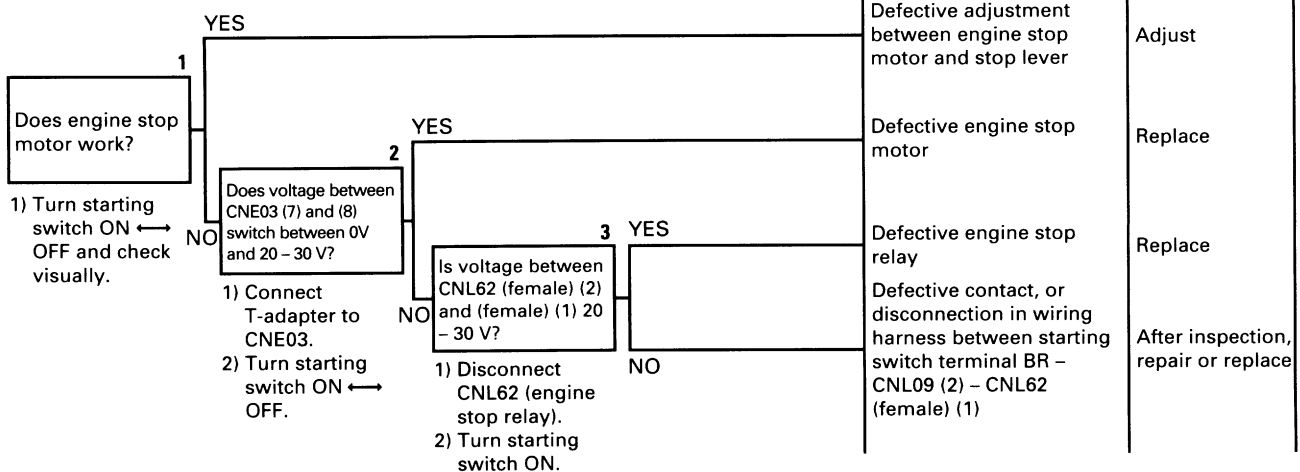
- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CNO△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.



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E-3 Engine stops when machine is traveling

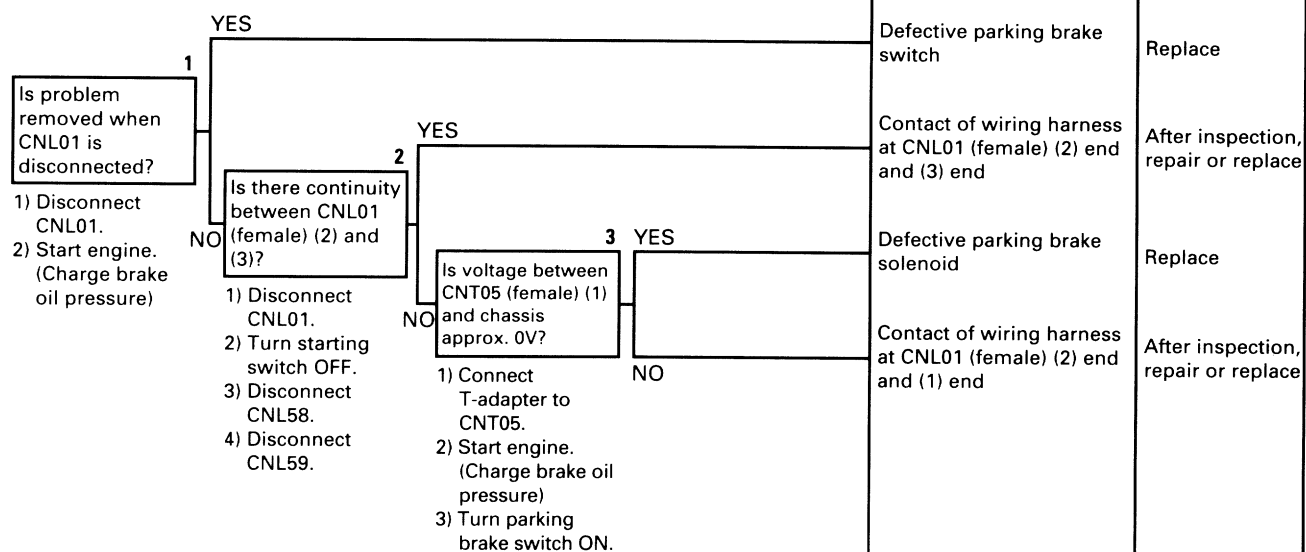
- ★ Check if the starting motor turns. If it does not turn, check E-1(a) (Engine does not start).



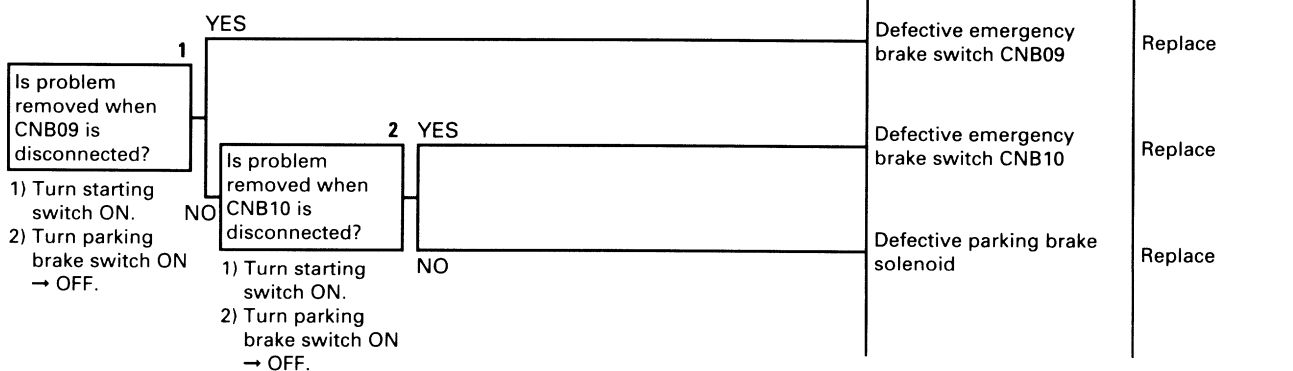
E-4 Parking brake does not work

- ★ When carrying out troubleshooting of the brake system, stop the machine on flat ground.
- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.

(a) Parking brake has no effect when parking brake switch is turned ON (parking)

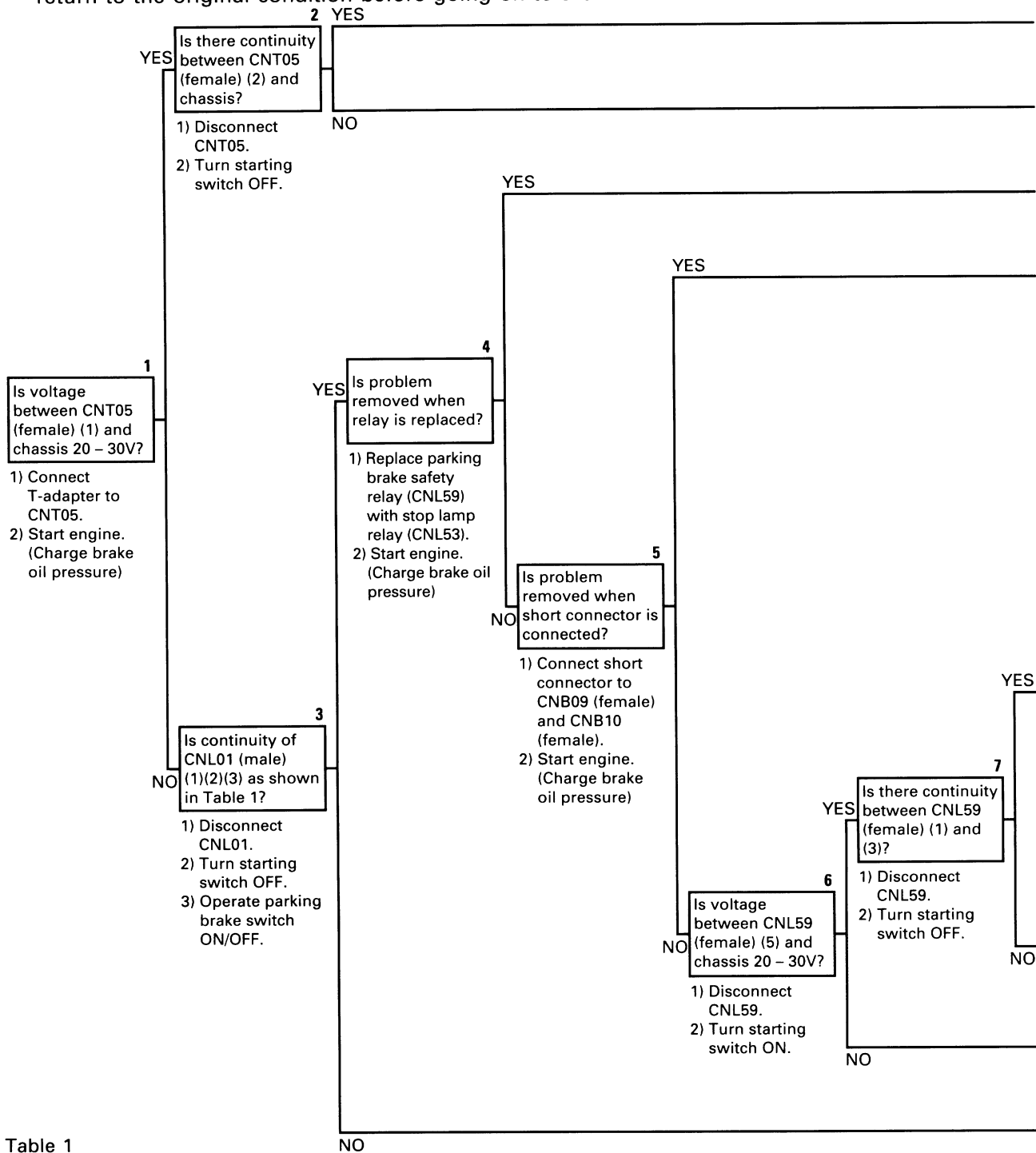


(b) Parking brake has no effect when brake pressure drops (Does not work as emergency brake)



E-5 Parking brake is applied when machine is traveling

- ★ When carrying out troubleshooting of the brake system, stop the machine on flat ground.
- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.



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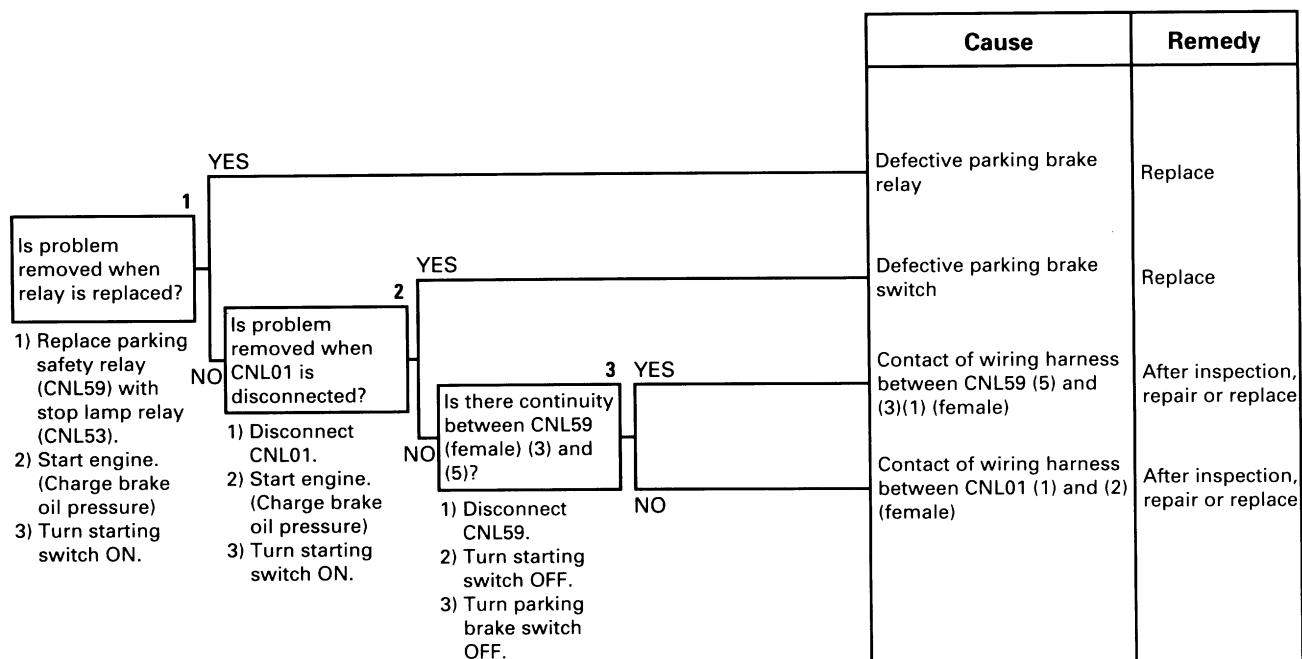
Table 1

Operation	Between terminal (2) - (3)	Between terminal (1) - (3)
ON (parking)	No continuity	Continuity
OFF (travel)	Continuity	No continuity

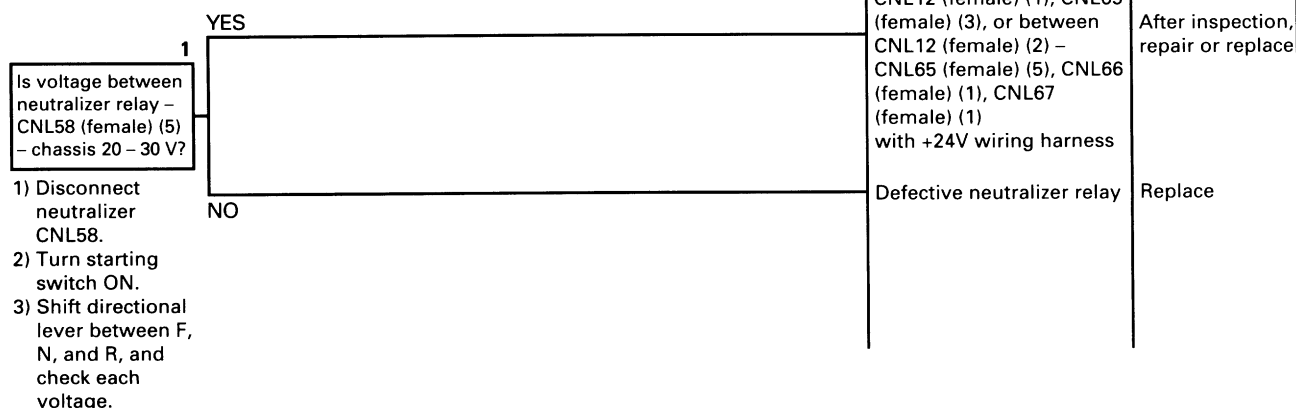
		Cause	Remedy
U42103 <pre> graph TD 8[Is voltage between CNL59 (female) (1) and chassis 20 - 30 V?] -- YES --> 9[Is there continuity between CNL59 (female) (2) and chassis?] 8 -- NO --> C1[Defective contact, or disconnection in wiring harness between CNL59 (female) (1) and CNL01 (female) (3), or between FS2 (female) (7) and L01 (female) (1)] 9 -- YES --> 10[Is voltage between CNB09 (female) (1) and chassis 20 - 30 V?] 9 -- NO --> C2[Defective contact, or disconnection in wiring harness between CNL59 (female) (2) and chassis] 10 -- YES --> 11[Is voltage between CNB10 (female) (1) and chassis 20 - 30 V?] 10 -- NO --> C3[Defective contact, or disconnection in wiring harness between CNB09 (female) (1) and CNL01 (female) (2)] 11 -- YES --> C4[Defective contact, or disconnection in wiring harness between CNB10 (female) (2) and CNT05 (female) (1)] 11 -- NO --> C5[Defective contact, or disconnection in wiring harness between CNB09 (female) (2) and CNB10 (female) (1)] C1 --> R1[After inspection, repair or replace] C2 --> R2[After inspection, repair or replace] C3 --> R3[After inspection, repair or replace] C4 --> R4[After inspection, repair or replace] C5 --> R5[After inspection, repair or replace] C6[Defective parking brake solenoid] --> R6[Replace] C7[Defective contact, or disconnection in wiring harness between CNT05 (female) (2) and chassis] --> R7[After inspection, repair or replace] C8[Defective parking brake safety relay] --> R8[Replace] C9[Defective emergency brake switch] --> R9[Replace] </pre>		Defective parking brake solenoid	Replace
		Defective contact, or disconnection in wiring harness between CNT05 (female) (2) and chassis	After inspection, repair or replace
		Defective parking brake safety relay	Replace
		Defective emergency brake switch	Replace
		Defective contact, or disconnection in wiring harness between CNB10 (female) (2) and CNT05 (female) (1)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNB09 (female) (2) and CNB10 (female) (1)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNB09 (female) (1) and CNL01 (female) (2)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL59 (female) (2) and chassis	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL59 (female) (1) and CNL01 (female) (3), or between FS2 (female) (7) and L01 (female) (1)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL59 (female) (5) - CNFS2 (7) - fuse	After inspection, repair or replace
		Defective parking brake switch	Replace

E-6 Parking brake is released when starting switch is turned ON

- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.



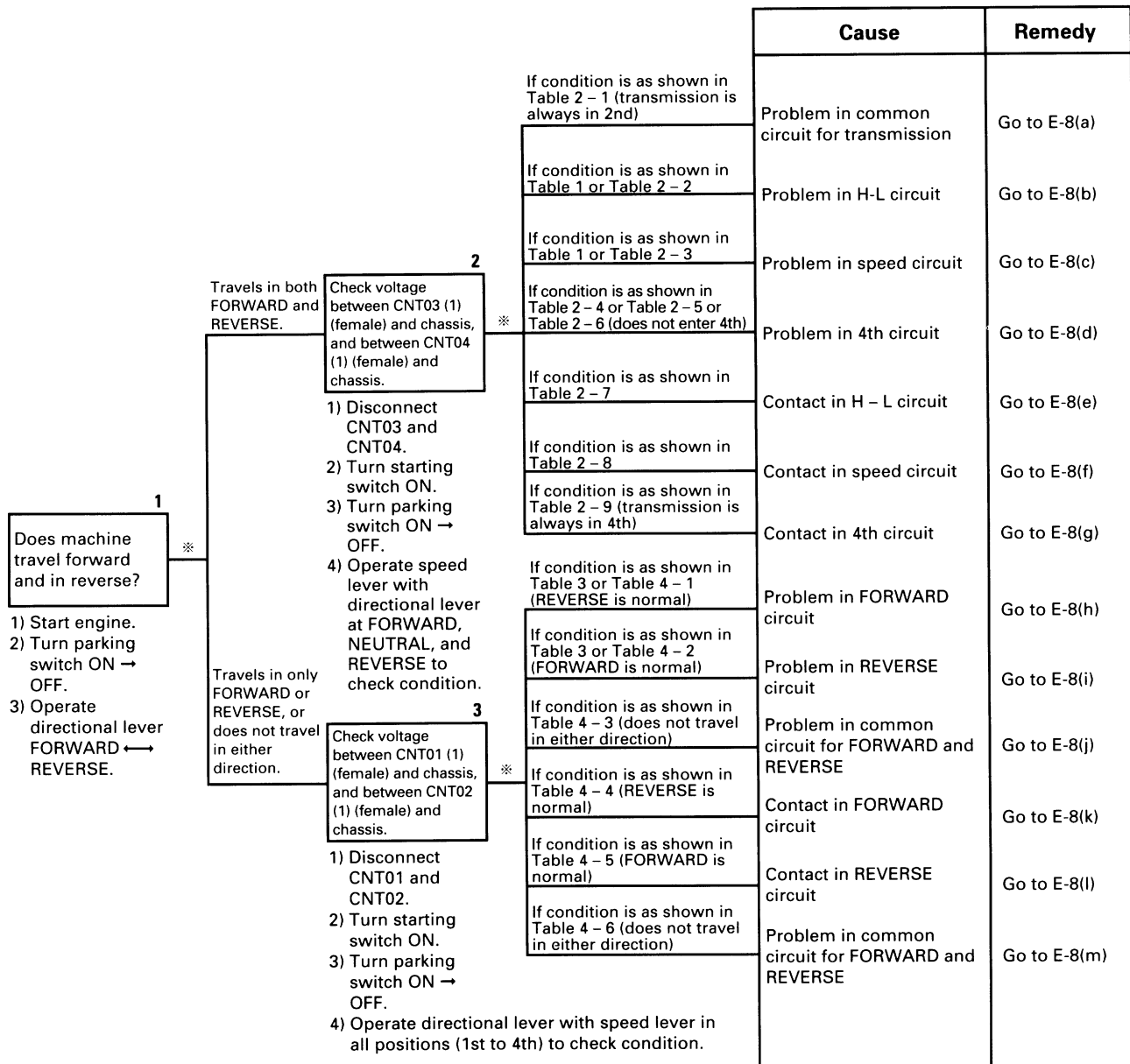
E-7 Transmission does not change to neutral when parking brake is applied (but parking brake works normally)



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E-8 Transmission does not work normally

- ★ When carrying out troubleshooting of the transmission system, stop the machine on flat ground.
- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.



※ Go to applicable item.

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○ : 0 - 0.5 V
● : 20 - 30 V

(H - L) (Speed)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	●
2	○	○
3	●	○
4	●	●

Table 1 (normal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	○
2	○	○
3	○	○
4	○	○

Table 2-1 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	●
2	○	○
3	○	○
4	○	●

Table 2-2 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	○
2	○	○
3	●	○
4	●	○

Table 2-3 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	●
2	○	○
3	●	○
4	○	○

Table 2-4 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	●
2	○	○
3	●	○
4	●	○

Table 2-5 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	●
2	○	○
3	●	○
4	○	●

Table 2-6 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	●	●
2	●	○
3	●	○
4	●	●

Table 2-7 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	○	●
2	○	●
3	●	●
4	●	●

Table 2-8 (abnormal)

Trans- mission range	Between CNT03 (female) (1) chassis ground	Between CNT04 (female) (1) chassis ground
1	●	●
2	●	●
3	●	●
4	●	●

Table 2-9 (abnormal)

(F) (R)

Dirrec- tional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	○
REVERSE	○	●

Table 3 (normal)

Dirrec- tional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	○	○
REVERSE	○	●

Table 4-1 (abnormal)

Dirrec- tional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	○
REVERSE	○	○

Table 4-2 (abnormal)

Dirrec- tional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	○	○
REVERSE	○	○

Table 4-3 (abnormal)

Dirrec- tional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	●
REVERSE	○	●

Table 4-4 (abnormal)

Dirrec- tional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	○
REVERSE	●	●

Table 4-5 (abnormal)

Dirrec- tional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	●
REVERSE	●	●

Table 4-6 (abnormal)

(a) Problem in common circuit for transmission (always stays in 2nd)

		Cause	Remedy
1 YES Is voltage between CNL04 (5)(6)(7)(8) and chassis as shown in table? 1) Connect T-adapter to CNL04. 2) Turn starting switch ON. 3) Shift speed lever and check.	YES	Problem in H-L circuit and speed circuit • Go to E-8 (b), E-8 (c)	–
	NO	Defective speed lever switch	Replace

● : 20 – 30 V

○ : 0 – 0.5 V

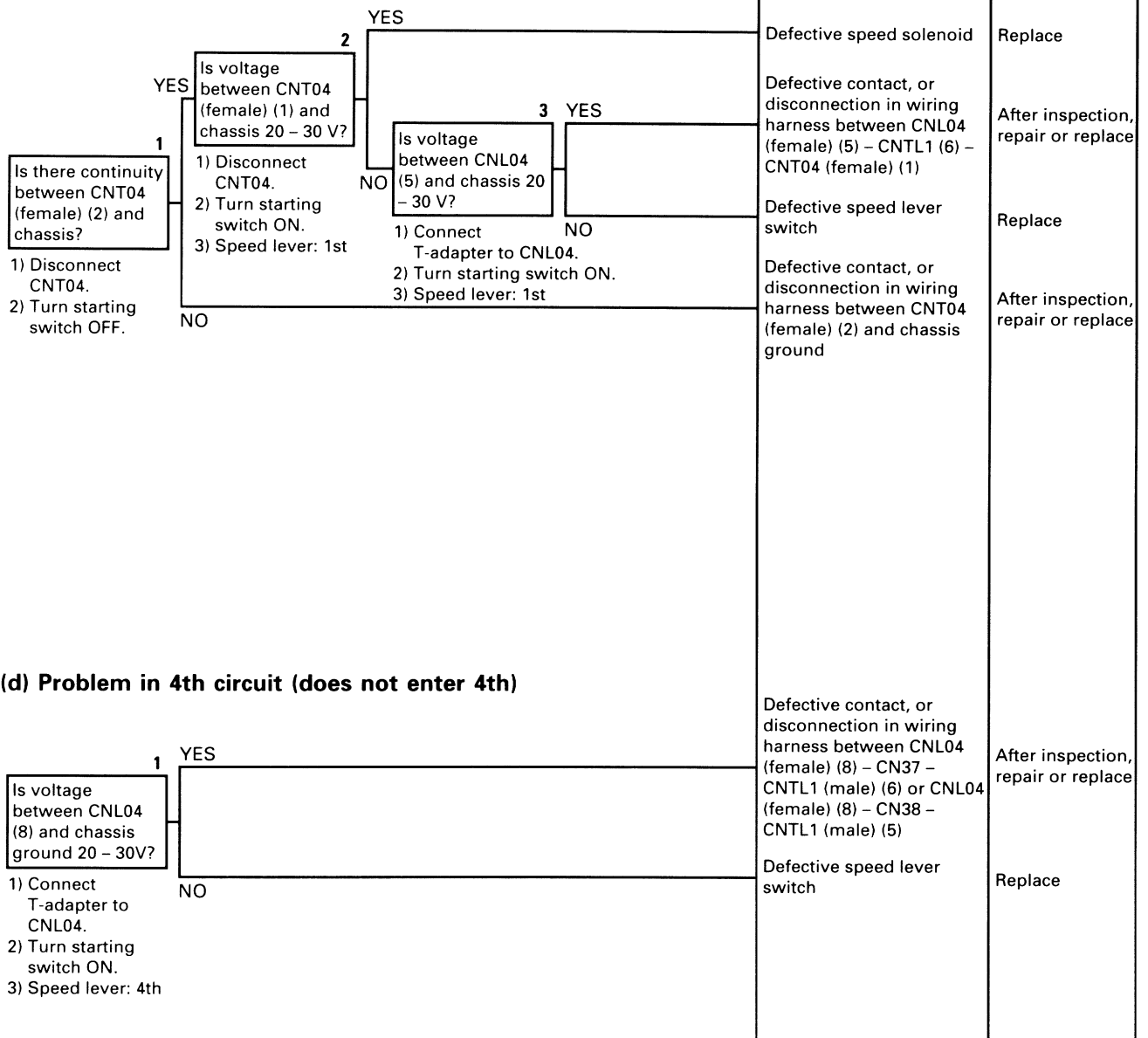
Transmission range	Between CN04(5) – chassis	Between CN04(6) – chassis	Between CN04(7) – chassis	Between CN04(8) – chassis
1	●	○	○	○
2	○	●	○	○
3	○	○	●	○
4	○	○	○	●

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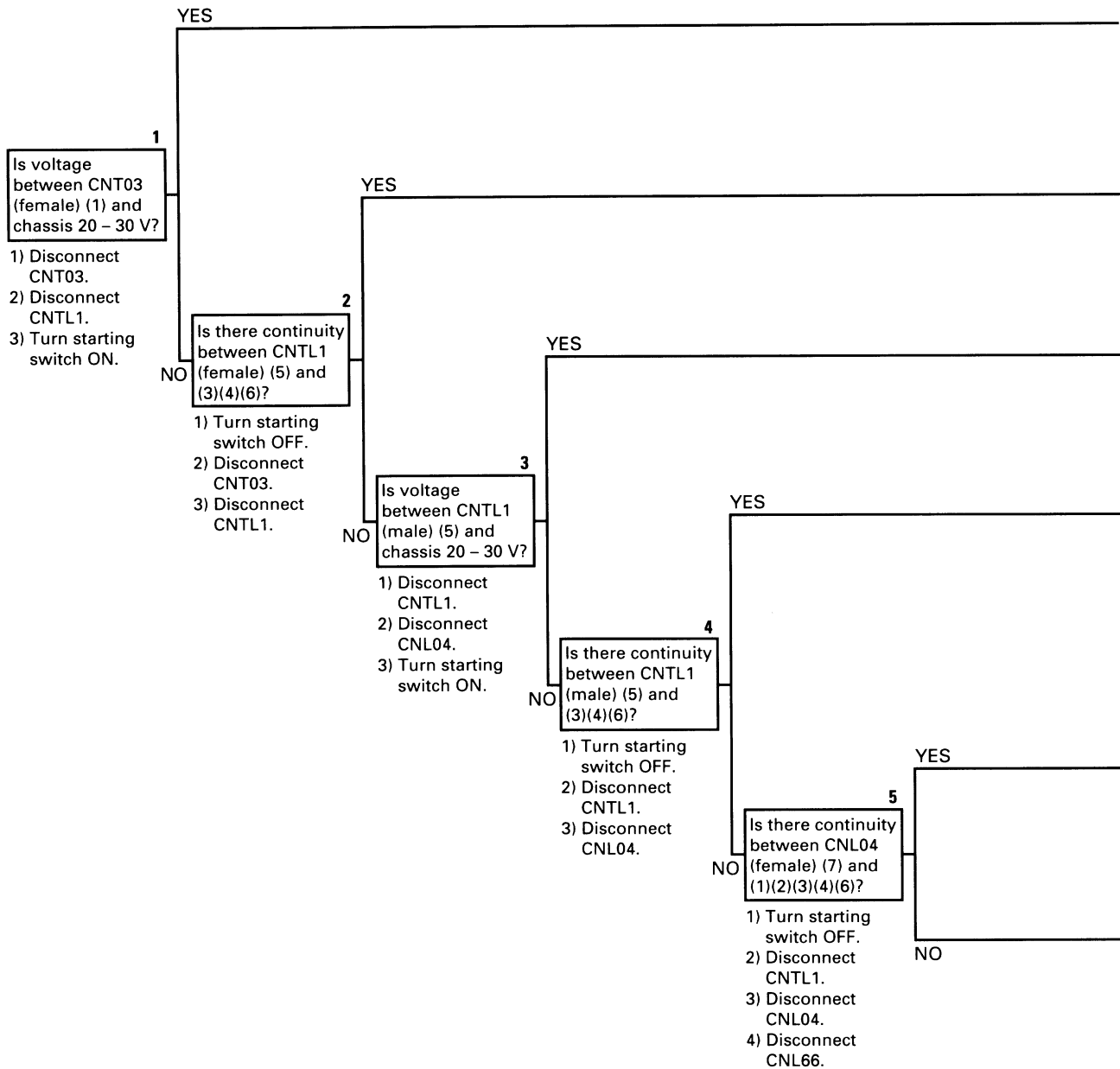
(b) Problem in H-L circuit

		Cause	Remedy
1 YES Is there continuity between CNT03 (female) (2) and chassis? 1) Disconnect CNT03. 2) Turn starting switch OFF.	YES	Defective H – L solenoid	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL04 (female) (7) – CNTL1 (5) – CNT03 (female) (1)	After inspection, repair or replace
	YES	Defective speed lever switch	Replace
	NO	Defective contact, or disconnection in wiring harness between CNT03 (female) (2) and chassis ground	After inspection, repair

(c) Problem in speed circuit



(e) Contact in H-L circuit



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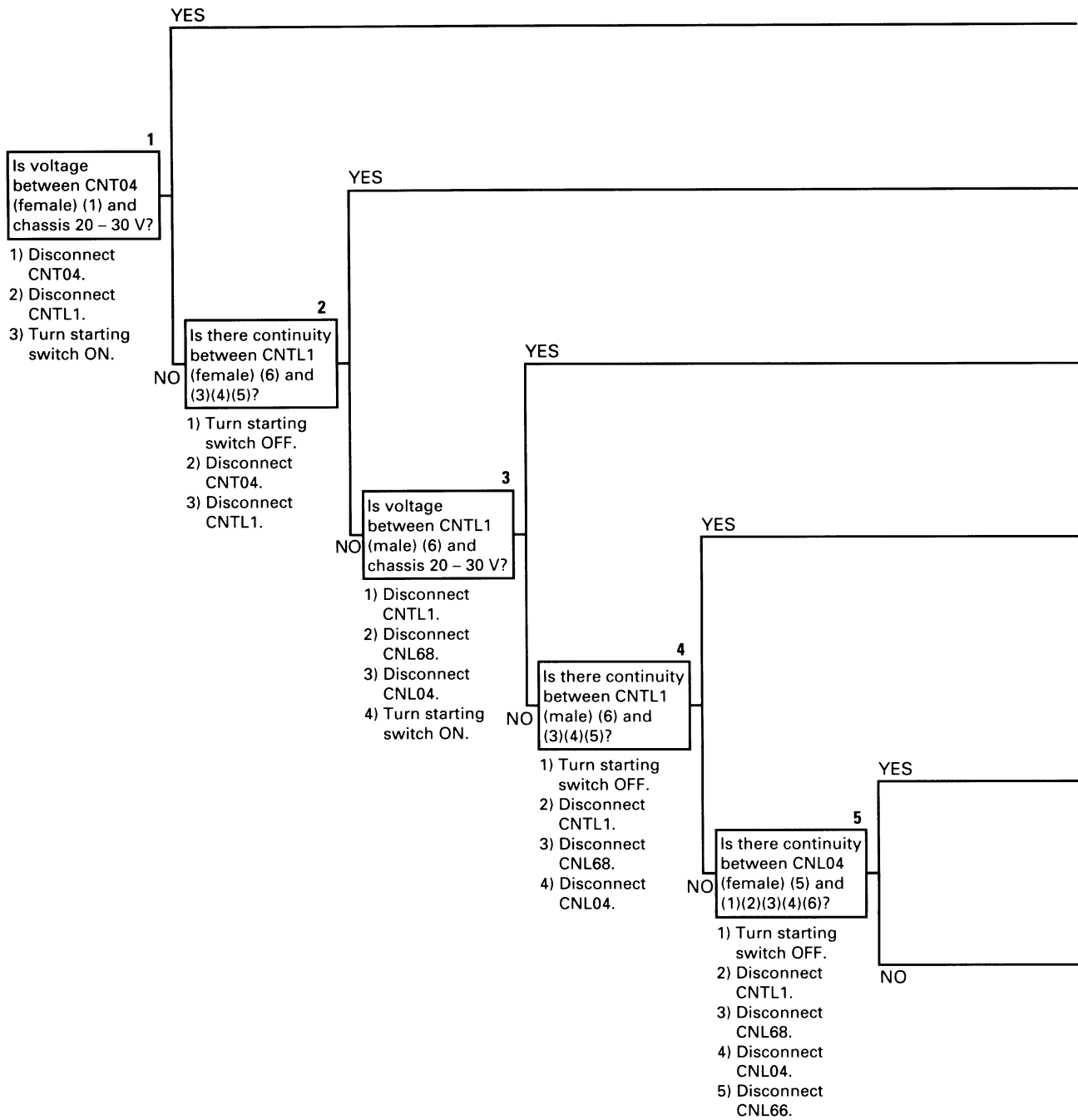
TROUBLESHOOTING

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	Cause	Remedy
	Abnormal contact of wiring harness between CNT03 (female) (1) and CNTL1 (female) (5) with +24V wiring harness	After inspection, repair or replace
	Abnormal contact of wiring harness between CNTL1 (female) (5) and CNT03 (female) (1) with wiring harness between CNTL1 (female) (3) – CNT01 (female) (1), CNTL1 (female) (4) – CNT02 (female) (1), CNTL1 (female) (6) – CNT04 (female) (1)	After inspection, repair or replace
	Abnormal contact of wiring harness between CNTL1 (male) (5) and CNL04 (male) (7) with +24V wiring harness	After inspection, repair or replace
	Abnormal contact of wiring harness between CNTL1 (male) (5) and CNL04 (female) (7) with wiring harness between CNTL1 (male) (3) – CNL66 (female) (2), CNTL1 (male) (4) – CNL67 (female) (2), CNTL1 (male) (6) – CNL04 (female) (5)	After inspection, repair or replace
	Abnormal contact of wiring harness between CNL04 (female) (7) and CNTL1 (male) (5) with wiring harness between CNL04 (male) (1) – CNFS2 (female) (8) or CNL04 (female) (2) – CNL66 (female) (5) or CNL04 (female) (3) – CNL57 (female) (1) or CNL04 (female) (4) – CNL67 (female) (5) or CNL04 (female) (6) – CNL66 (3)	After inspection, repair or replace
	Defective transmission control switch	Replace

(f) Contact in speed circuit



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TROUBLESHOOTING

E-8

Cause	Remedy
Abnormal contact of wiring harness between CNT04 (female) (1) and CNTL1 (female) (6) with +24V wiring harness	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (female) (6) and CNT04 (female) (1) with wiring harness between CNTL1 (female) (3) – CNT01 (female) (1), CNTL1 (female) (4) – CNT02 (female) (1), CNTL1 (female) (5) – CNT03 (female) (1)	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (male) (6) and CNL04 (female) (5), CNL68 (female) (4) with +24V wiring harness	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (male) (6) and CNL04 (female) (5) with wiring harness between CNTL1 (male) (3) – CNL66 (female) (2), CNTL1 (male) (4) – CNL67 (female) (2), CNTL1 (male) (5) – CNL04 (female) (7)	After inspection, repair or replace
Abnormal contact of wiring harness between CNL04 (female) (5) and CNTL1 (male) (6) with wiring harness between CNL04 (female) (1) – CNFS2 (female) (8) or CNL04 (female) (2) – CNL66 (female) (5) or CNL04 (female) (3) – CNL57 (female) (1) or CNL04 (female) (4) – CNL67 (female) (5) or CNL04 (female) (6) – CNL66 (female) (3)	After inspection, repair or replace
Defective transmission control switch, or abnormal contact of CNL68 (3)(4) (male)	After inspection, repair or replace

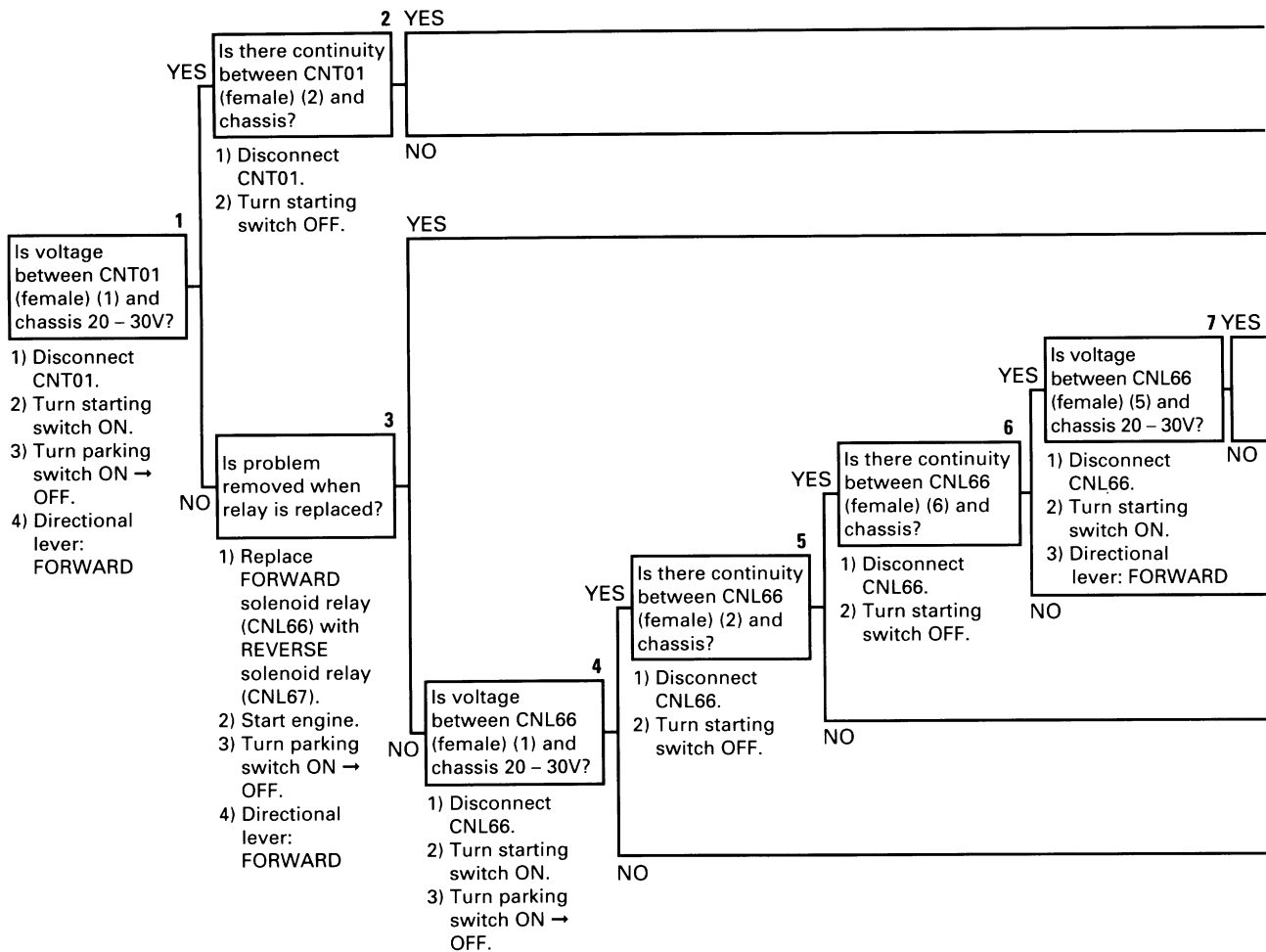
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(g) Contact in 4th circuit (always stays in 4th)

		Cause	Remedy
Is voltage between CNL04 (female) (8) and chassis 20 – 30V? 1) Disconnect CNL04. 2) Turn starting switch ON.	1 YES	Abnormal contact of CNL04 (female) (8) – CN37 (female) (2), CN38 (female) (2) with +24V wiring harness	After inspection, repair or replace
	NO	Defective speed lever switch	Replace

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(h) Problem in FORWARD circuit (REVERSE is normal)



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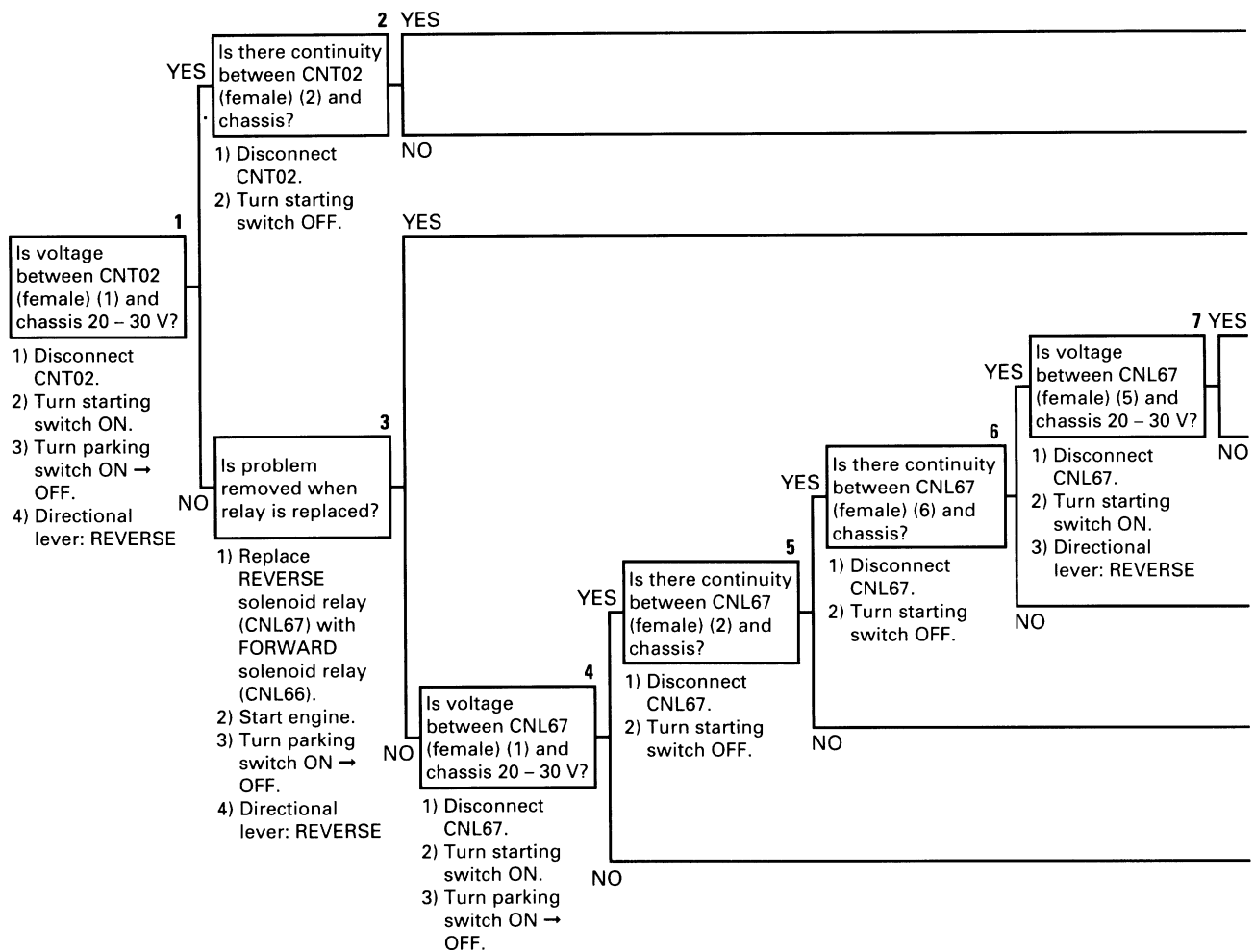
TROUBLESHOOTING

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	Cause	Remedy
	Defective contact, or disconnection in wiring harness between CNT01 (female) (2) and chassis	After inspection, repair or replace
	Defective FORWARD solenoid	Replace
	Defective FORWARD relay	Replace
	Defective contact, or disconnection in wiring harness between CNL04 (female) (2) and CNL66 (female) (5)	After inspection, repair or replace
	Defective directional lever switch	Replace
	Defective contact, or disconnection in wiring harness between CNL66 (female) (6) and chassis	After inspection, repair or replace
	Defective contact, or disconnection in wiring harness between CNL66 (female) (2) – CNTL1 (3) – CNT01 (female) (1)	After inspection, repair or replace
	Defective contact, or disconnection in wiring harness between CNL66 (female) (1) and CNL67 (female) (1)	After inspection, repair or replace

(i) Problem in REVERSE circuit (FORWARD is normal)



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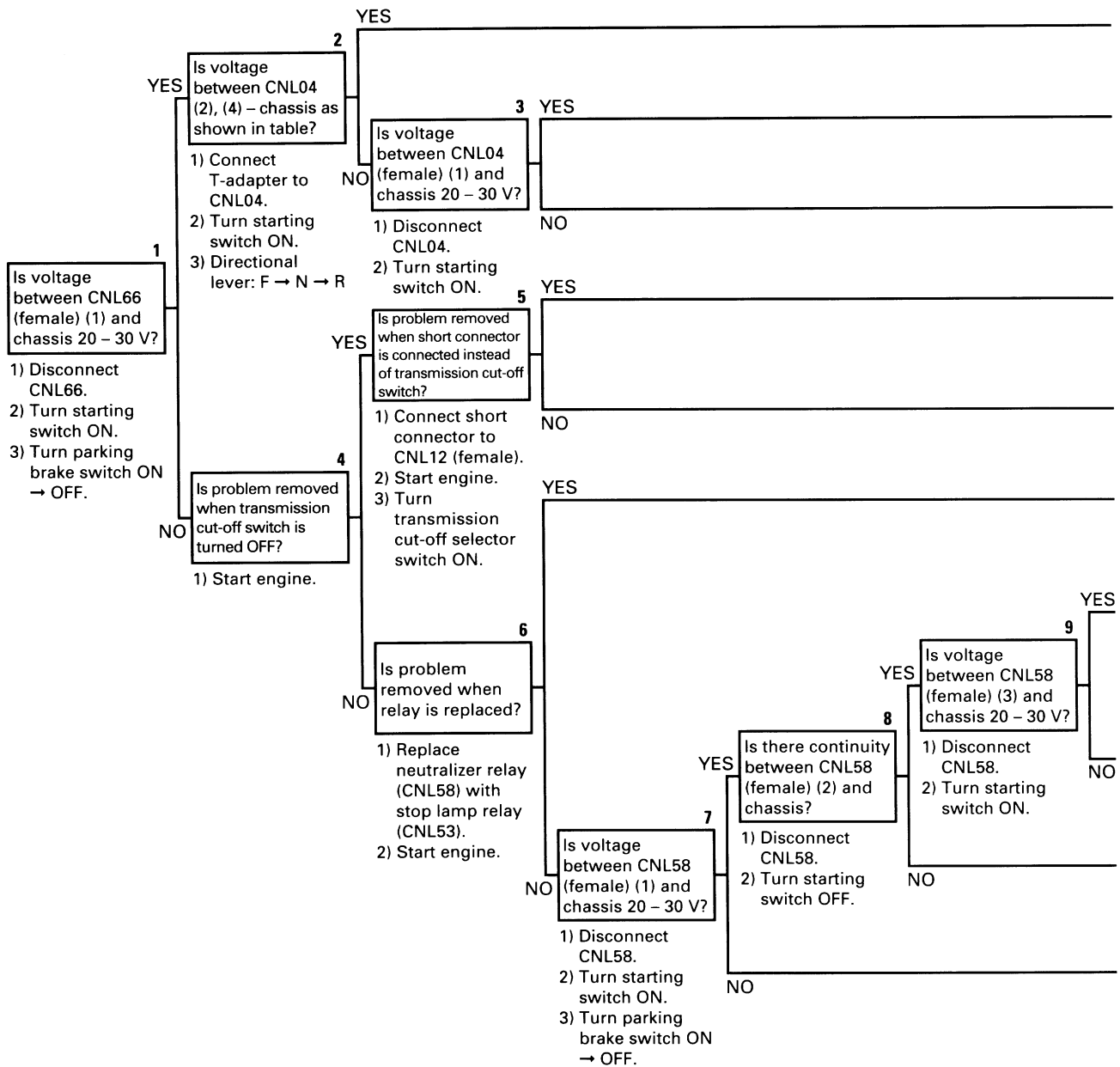
TROUBLESHOOTING

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	Cause	Remedy
	Defective contact, or disconnection in wiring harness between CNT02 (female) (2) and chassis	After inspection, repair or replace
	Defective REVERSE solenoid	Replace
	Defective REVERSE relay	Replace
	Defective contact, or disconnection in wiring harness between CNL04 (female) (4) and CNL67 (female) (5)	After inspection, repair or replace
	Defective directional lever switch	Replace
	Defective contact, or disconnection in wiring harness between CNL67 (female) (6) and chassis	After inspection, repair or replace
	Defective contact, or disconnection in wiring harness between CNL67 (female) (2) – CNTL1 (4) – CNT02 (female) (1)	After inspection, repair or replace
	Defective contact, or disconnection in wiring harness between CNL66 (female) (1) and CNL67 (female) (1)	After inspection, repair or replace

(j) Problem in common circuit for FORWARD and REVERSE
(does not travel forward, parking brake is normal)



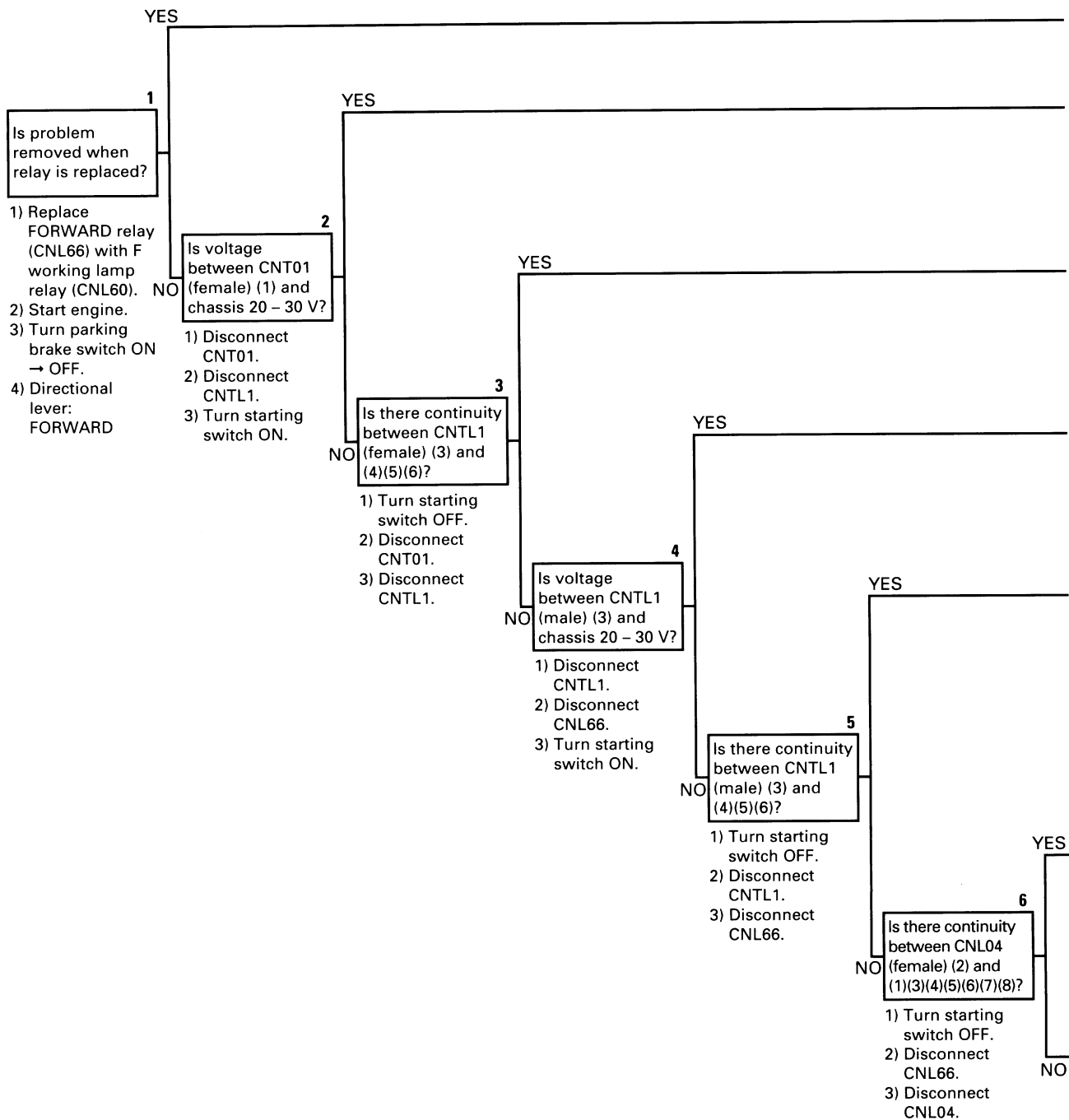
● : 20 - 30 V
○ : 0 - 0.5 V

Directional lever	Between CN04(2) - chassis	Between CN04(4) - chassis
F	●	○
N	○	○
R	○	●

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Cause	Remedy
Go to E-8 (h) and (i)	–
Defective directional lever switch	Replace
Defective contact, or disconnection in wiring harness between CNFS2 (female) (8) and CNL04 (female) (1)	After inspection, repair or replace
Defective transmission cut-off switch	Replace
Defective contact, or disconnection in wiring harness between CNL65 (female) (3) and CNL12 (female) (1), or between CNL12 (female) (12) and CNL65 (female) (5)	After inspection, repair or replace
Defective neutralizer relay	Replace
Defective contact, or disconnection in wiring harness between CNL58 (female) (5) and CNL12 (female) (1), or between CNL12 (female) (2) – CNL66 (female) (1), CNL67 (female) (1)	After inspection, repair or replace
Defective contact, or disconnection in wiring harness between CNL58 (female) (3) – CNFS2 (8) – fuse – CNFS1 (male) (2)	After inspection, repair or replace
Defective contact, or disconnection in wiring harness between CNL58 (female) (2) and chassis	After inspection, repair or replace
Defective contact, or disconnection in wiring harness between CNL58 (female) (1) and CNL01 (female) (2)	After inspection, repair or replace

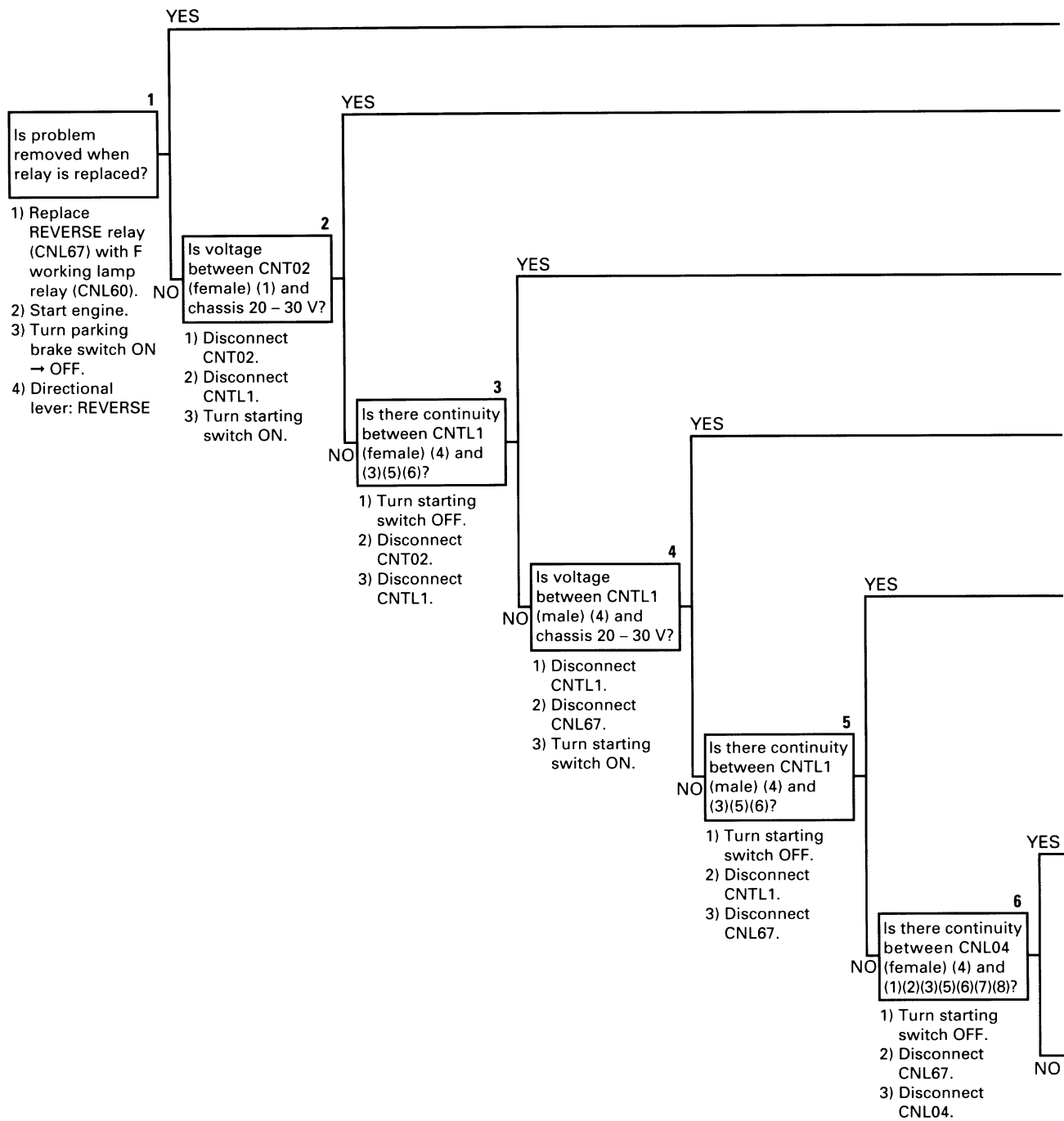
(k) Contact in FORWARD circuit



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Cause	Remedy
Defective FORWARD relay	Replace
Abnormal contact of wiring harness between CNT01 (female) (1) and CNTL1 (female) (3) with +24V wiring harness	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (female) (3) and CNT01 (female) (1) with wiring harness between CNTL1 (female) (4) – CNT02 (female) (1), CNTL1 (female) (5) – CNT03 (female) (1), CNTL1 (female) (6) – CNT04 (female) (1)	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (female) (3) and CNL66 (female) (2) with +24V wiring harness	After inspection, repair or replace
Abnormal contact of wiring harness between CNTL1 (male) (3) and CNL66 (female) (2) with wiring harness between CNTL1 (male) (4) – CNL67 (female) (2), CNTL1 (male) (5) – CNL04 (female) (7), CNTL1 (male) (6) – CNL04 (female) (5)	After inspection, repair or replace
Abnormal contact of wiring harness between CNL04 (female) (2) and CNL66 (female) (5) with wiring harness between CNL04 (female) (1) – CNFS2 (female) (8), CNL04 (female) (3) – CNL57 (female) (1), CNL04 (female) (4) – CNL67 (female) (5), CNL04 (female) (5) – CNTL1 (male) (6), CNL04 (female) (6) – CNL66 (female) (3), CNL04 (female) (7) – CNTL1 (male) (5), CNL04 (female) (6) – CN37 (2) or CN38 (2)	After inspection, repair or replace
Defective transmission control switch	Replace

(II) Contact in REVERSE circuit



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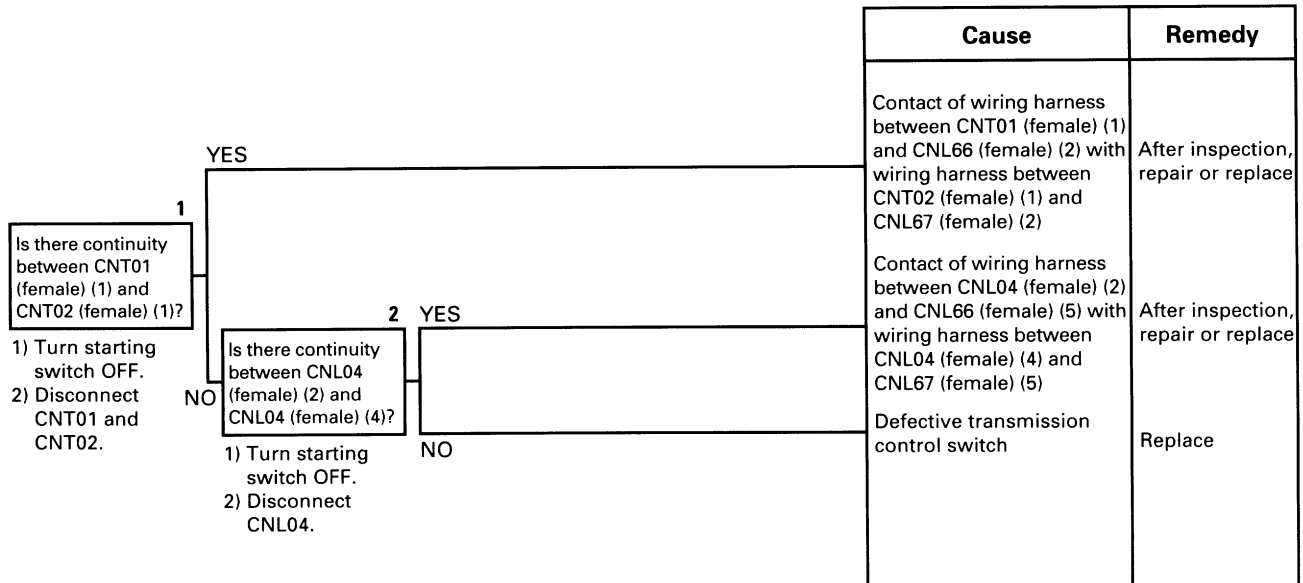
TROUBLESHOOTING

E-8

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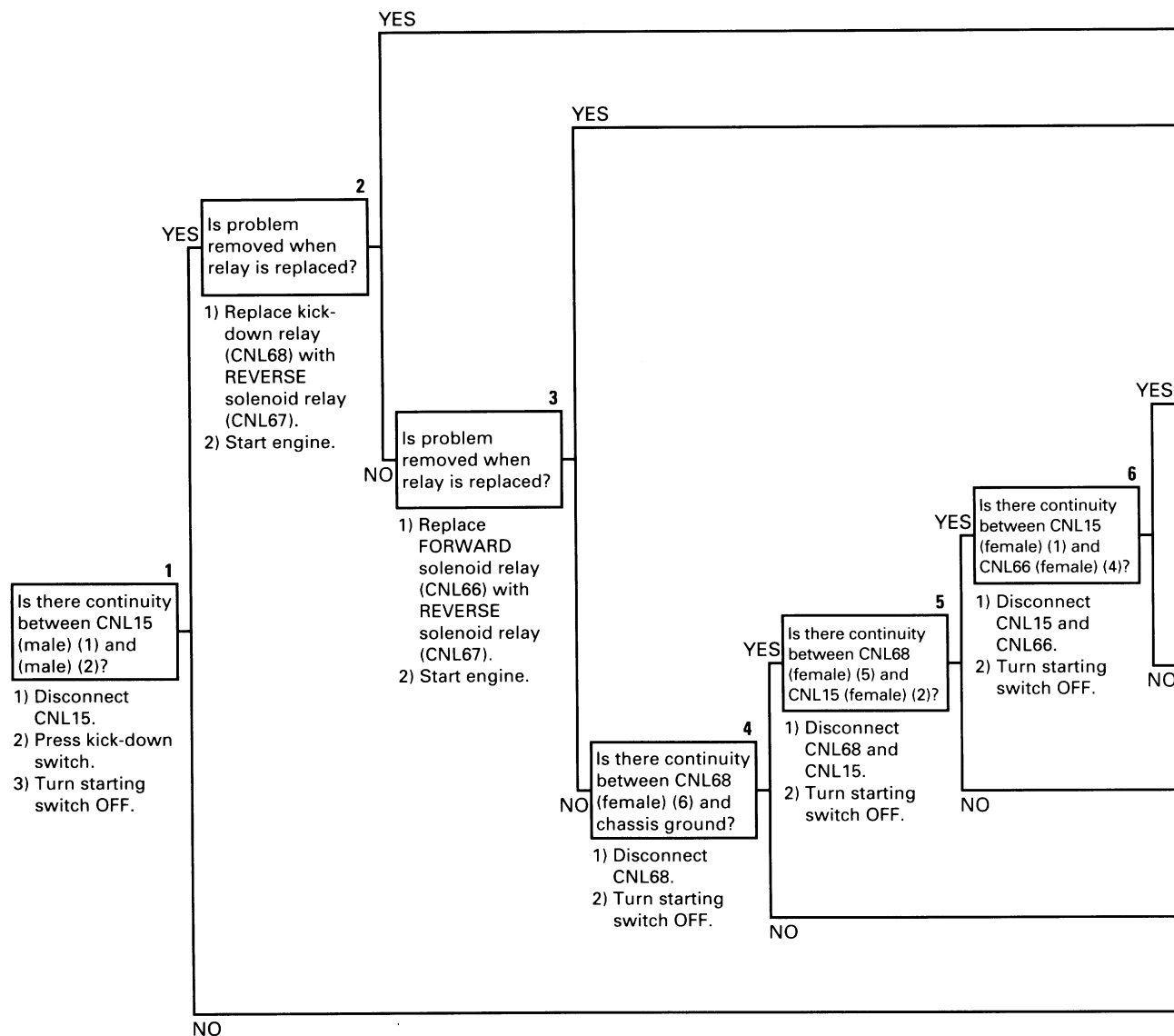
	Cause	Remedy
	Defective REVERSE relay	Replace
	Abnormal contact of wiring harness between CNT02 (female) (1) and CNTL1 (female) (4) with +24V wiring harness	After inspection, repair or replace
	Abnormal contact of wiring harness between CNTL1 (female) (4) and CNT02 (female) (1) with wiring harness between CNTL1 (female) (3) – CNT01 (female) (1), CNTL1 (female) (5) – CNT03 (female) (1), CNTL1 (female) (6) – CNT04 (female) (1)	After inspection, repair or replace
	Abnormal contact of wiring harness between CNTL1 (female) (4) and CNL67 (female) (2) with +24V wiring harness	After inspection, repair or replace
	Abnormal contact of wiring harness between CNTL1 (male) (4) and CNL67 (female) (2) with wiring harness between CNTL1 (male) (3) – CNL66 (female) (2), CNTL1 (male) (5) – CNL04 (female) (7), CNTL1 (male) (6) – CNL04 (female) (5)	After inspection, repair or replace
	Abnormal contact of wiring harness between CNL04 (female) (4) and CNL67 (female) (5) with wiring harness between CNL04 (female) (1) – CNFS2 (female) (8), CNL04 (female) (3) – CNL57 (female) (1), CNL04 (female) (2) – CNL66 (female) (5), CNL04 (female) (5) – CNTL1 (male) (6), CNL04 (female) (6) – CNL66 (female) (3), CNL04 (female) (7) – CNTL1 (male) (5), CNL04 (female) (6) – CN37 (2) or CN38 (2)	After inspection, repair or replace
	Defective transmission control switch	Replace

(m) Problem in common circuit for FORWARD and REVERSE



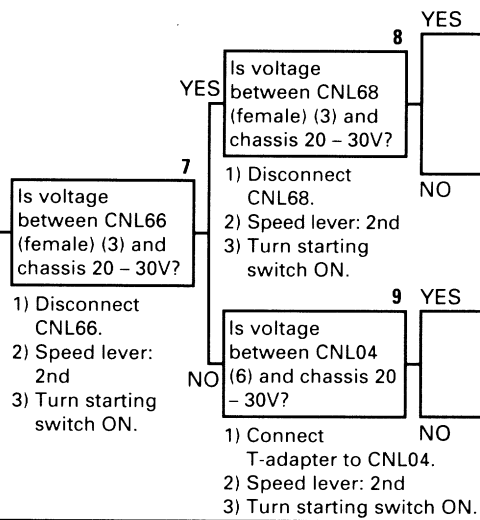
E-9 Kick-down switch does not work (the regular F1 to F4 shifts normally)

- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.



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		Cause	Remedy
		Defective kick-down relay	Replace
		Defective FORWARD solenoid relay	Replace
		Defective contact, or disconnection in wiring harness between CNL68 (female) (4) and CNL04 (female) (5)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL68 (female) (3) and CNL04 (female) (6)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL66 (female) (3) and CNL04 (female) (6)	After inspection, repair or replace
		Defective speed lever switch	Replace
		Defective contact, or disconnection in wiring harness between CNL15 (female) (1) and CNL66 (female) (4)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL68 (female) (5) and CNL15 (female) (2)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNL68 (female) (6) and chassis ground	After inspection, repair or replace
		Defective kick-down switch	Replace



E-10 Kick-down works only when kick-down switch is ON (Kick-down switch relay does not hold in position (self-holding function))

- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.

		Cause	Remedy
Is problem removed when relay is replaced? 1) Replace kick-down relay (CNL68) with REVERSE solenoid relay (CNL67). 2) Start engine.	1 YES	Defective kick-down relay	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL66 (female) (4) – CNL68 (female) (1) or CNL68 (female) (2) – CNL68 (female) (5)	After inspection, repair or replace

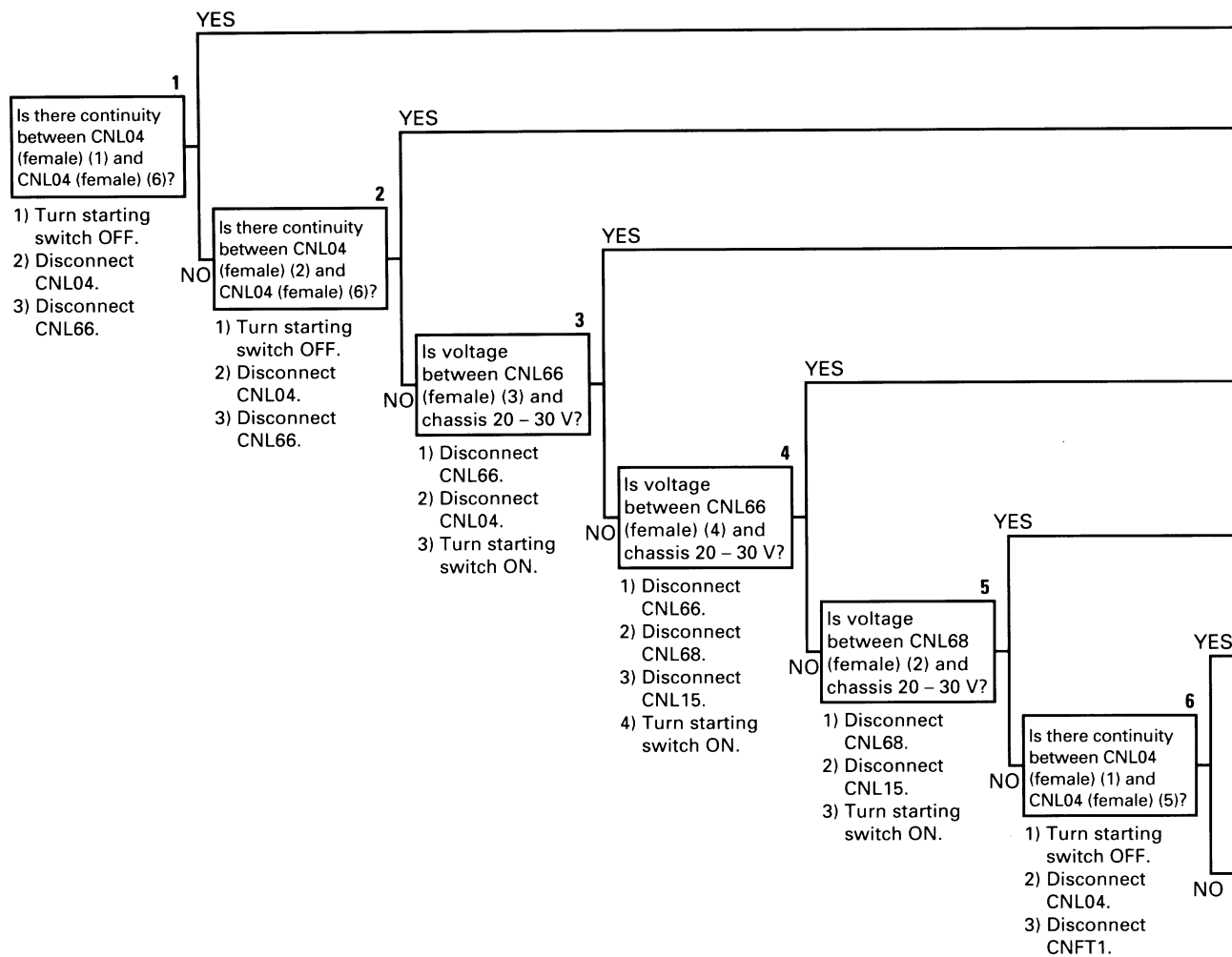
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E-11 Kick-down operation cannot be canceled

(a) Not canceled even when directional lever is moved from F to N or R

		Cause	Remedy
Is problem removed when relay is replaced? 1) Replace FORWARD solenoid relay (CNL66) with REVERSE solenoid relay (CNL67). 2) Start engine.	1 YES	Defective FORWARD solenoid relay	Replace
	NO	Contact of wiring harness between CNL66 (female) (3) and (4)	After inspection, repair or replace

(b) Not canceled even when speed lever is moved from 2nd to other position (becomes 4th)



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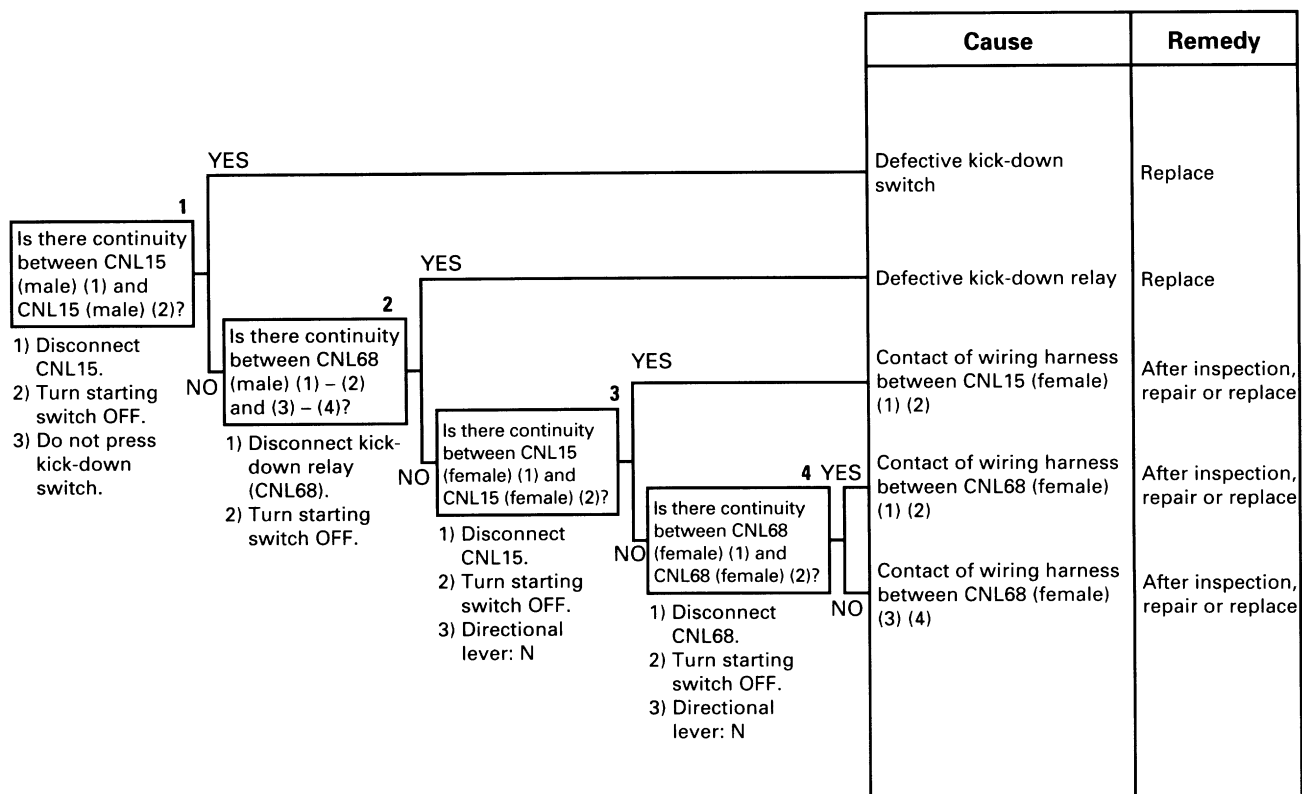
TROUBLESHOOTING

E-11

		Cause	Remedy
U42103		Abnormal contact of wiring harness between CNL04 (female) (1) (6)	After inspection, repair or replace
		Abnormal contact of wiring harness between CNL04 (female) (2) (6), or defective speed lever switch	After inspection, repair or replace
		Abnormal contact of wiring harness between CNL04 (6) and CNL66 (3) with +24V wiring harness	After inspection, repair or replace
		Abnormal contact of wiring harness between CNL66 (female) (4) – CNL68 (female) (1), CNL15 (female) (1) with +24V wiring harness	After inspection, repair or replace
		Abnormal contact of wiring harness between CNL68 (female) (2) – CNL68 (female) (5), CNL15 (female) (2) with +24V wiring harness	After inspection, repair or replace
		Abnormal contact of wiring harness between CNL04 (female) (1) (5)	After inspection, repair or replace
		Abnormal contact of wiring harness between CNL04 (female) (5) – CNL68 (female) (4), CN37 (female) (1), CNTL1 (male) (6) with +24V wiring harness, or defective speed lever switch	After inspection, repair or replace
7 Is voltage between CNL68 (female) (4) and chassis 20 – 30V? 1) Disconnect CNL68. 2) Disconnect CNTL1. 3) Disconnect CNL04. 4) Starting switch ON.			
YES			
NO		Abnormal contact of wiring harness between CNTL1 (6) and CNT04 (1) with +24V wiring harness	After inspection, repair or replace

E-12 Kick-down switch is actuated by mistake when traveling in 2nd

- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected connectors and disconnect the T-adapter immediately to return to the original condition before going on to the next check.



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TROUBLESHOOTING OF HYDRAULIC AND MECHANICAL SYSTEM (CHASSIS RELATED) (T MODE)

POWER TRAIN

T- 1	Machine does not start	20-452
T- 2	Travel speed is slow, thrusting power is weak, lacks power on slopes	20-454
T- 3	Excessive shock when starting machine or shifting gear	20-456
T- 4	Excessive time lag when starting machine or shifting gear	20-457
T- 5	Torque converter oil temperature is high	20-458

STEERING SYSTEM

T- 6	Steering wheel does not turn.....	20-459
T- 7	Steering is heavy	20-460
T- 8	Steering wheel shakes or there is excessive shock.....	20-461
T- 9	Machine deviates to one side when traveling	20-461
T-10	Turning radius is different between left and right.....	20-461

BRAKE SYSTEM

T-11	Brakes do not work or braking effect is poor	20-462
T-12	Brakes are not released or brakes drag	20-463
T-13	Parking brake is not released or brake drags.....	20-464

WORK EQUIPMENT

T-14	Boom does not rise	20-465
T-15	Boom movement is slow or boom lacks lifting power	20-466
T-16	When boom is raised, it moves slowly at a certain height	20-467
T-17	Bucket cannot be pushed with boom cylinder (bucket floats)	20-467
T-18	Excessive hydraulic drift of boom	20-467
T-19	Boom shakes during operation	20-468
T-20	Boom drops momentarily when control lever is operated from HOLD to RAISE	20-468
T-21	Bucket does not tilt back.....	20-469
T-22	Bucket movement is slow or tilt back lacks power	20-470
T-23	Bucket movement becomes slow during tilt-back operation	20-471
T-24	Bucket cannot be pushed with bucket cylinder	20-471
T-25	Excessive hydraulic drift of bucket	20-471
T-26	Bucket shakes during loading operation.....	20-472
T-27	Bucket dumps momentarily when control lever is operated from HOLD to TILT	20-472
T-28	Boom, bucket control levers are heavy or do not move smoothl.....	20-473

Explanation of symbols in Table

The following symbols are used on the Cause column to show the action to be taken to remove the cause.

X: Replace, △: Correct, A: Adjust, C: Clean

POWER TRAIN

T-1 Machine does not start

Ask the operator the following questions.

- Did the problem suddenly start?
Yes = Internal part seized or broken
- Was there any abnormal noise when this happened?
Yes = Component broken.

Checks before troubleshooting

- Does the machine monitor function properly?
- Is the transmission oil level correct?
Is the type of oil correct?
- Is the transmission filter or strainer clogged?
- Does the electrical circuit of the transmission control work properly?
- Is the transmission oil deteriorated?
Does the oil smell of burning?
- Is there any damage or leakage of oil that can be seen externally?
- Is the drive shaft broken?
- Is the wheel brake or parking brake locked?

		Causes									
		Charging pump			Torque converter		Transmission control valve				
		a	b	c	d	e	f	g	h	i	j
No.	Problems	△	×	△	△	△	×	△	△	△	C
1	Does not start in any transmission range	○	○	○	○	○	○	○	○	○	
2	Does not start in certain transmission ranges					○		○	○		
3	Does not start when oil temperature rises		○								
4	Torque converter stall speed does not go down to specified speed in any transmission range				○	○	○				○
5	Torque converter stall speed does not go down to specified speed in certain transmission ranges										
6	Torque converter charging pressure does not rise	○	○	○	○						
7	Transmission clutch pressure does not rise in any speed range	○	○	○			○	○			○
8	Transmission clutch pressure does not rise in certain speed ranges										
9	Metal particles (aluminium, copper, iron, etc.) stuck to filter or strainer		○		○						

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Transmission					Accumulator valve
k	l	m	n	o	
△	△	△	△	△	
×	×	×	×	×	
		○	○		
○	○	○		○	
○	○		○		
○	○	○			
			○		
○	○	○		○	
○	○				

T-2 Travel speed is slow, thrusting power is weak, lacks power on slopes

Checking for abnormalities

- Measure digging operations and speed when traveling on level ground and on slopes, and check if there is actually an abnormality or whether it is just the feeling of the operator.

Checks before troubleshooting

- Is the transmission oil level correct?
Is the type of oil correct?
- Is the transmission filter or strainer clogged?
- Is there any oil leaking from the joints of the piping or valves?
- Is there any dragging of the wheel brake or parking brake?
- Is the tire inflation pressure and tread pattern normal?
- Is the method of operation correct?

No. Problems		Causes						
		Charging pump		Torque converter			Transmission control valve	
		a	b	c	d	e	f	g
Remedy		△ ×	△ ×	△ ×	△ ×	△ ×	△ ×	△ ×
1	Abnormality in all transmission ranges	○	○	○	○	○	○	○
2	Abnormality in certain transmission ranges						○	
3	When oil temperature is low, abnormal noise comes from charging pump	○						
4	Torque converter oil overheats	○	○		○	○		
5	Abnormality in high idling and low idling speeds					○		
6	Abnormality in each stall engine speed		○	○	○	○		
7	Torque converter relief pressure is low	○	○	○	○	○		○
8	Transmission clutch pressure	○	○					○
9							○	
10		○						
11	Transmission oil level changes							
12	Metal particles stuck to transmission strainer or torque converter filter		○		○			
13	Cut-off valve does not cut-off even when hydraulic pressure in work equipment circuit is high.							

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TROUBLESHOOTING

T-2

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Control valve													Torque converter, transmission circuit				Accumulator valve		Others		Cut-off valve	
h													i	j	k	l	m	n	o	p	q	r
C													C									
△													△				△		△		△	
X													X				X		X		X	
○													○				○		○		○	
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T-3 Excessive shock when starting machine or shifting gear

Checking for abnormalities

It is difficult to measure if the shock is excessive or normal, so judge that the shock is excessive in the following cases.

- When it is clear that the shock has become greater than before.
- When the machine is compared with another machine of the same class and the shock is found to be greater.

Checks before troubleshooting

- Is the engine idling speed too high?
- Is there play in any of the drive shafts?

		Causes						
		Control valve				Transmission	Accumulator valve	
		a	b	c	d	e	f	g
No.	Problems	Remedy						
		△ ×	△ ×	△ ×	△ ×	△ ×	C △	△ ×
1	Shock is excessive in every transmission range	○	○	○	○	○		
2	Shock is excessive in certain transmission ranges						○	○
3	Clutch pressure is too high	○						

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T-4 Excessive time lag when starting machine or shifting gear

Ask the operator the following questions.

- Was there excessive time lag? Was there any abnormality in the travel speed or thrusting force? Was there any lack of power when traveling up slopes?
Yes = Go to T-2 Travel speed is slow, thrusting power is weak, lacks power on slopes

Checks before troubleshooting

- Is the transmission oil level correct?
Is the type of oil correct?
- Is there any oil leaking from the joints of the piping or valves?

any abnormality in the travel speed or thrusting force? Was there any lack of power when traveling up slopes?

Yes = Go to T-2 Travel speed is slow, thrusting power is weak, lacks power on slopes

Checks before troubleshooting

- Is the transmission oil level correct?
- Is the type of oil correct?
- Is there any oil leaking from the joints of the piping or valves?

		Causes							
		Transmission control valve				Transmission		Accumulator valve	
		a	b	c	d	e	f	g	h
		△	C	△	△	△	△	△	△
No.	Problems	△	×	△	×	×	×	×	×
1	Time lag is excessive in every transmission range	○	○	○	○				
2	Time lag is excessive in certain transmission ranges						○		○
3	Clutch pressure is low in every transmission range		○		○				
4	Clutch oil pressure is low in transmission ranges where time lag is excessive				○		○		○

		Causes							
		Transmission control valve				Transmission		Accumulator valve	
		a	b	c	d	e	f	g	h
		△	C	△	△	△	△	△	△
Remedy		△	×	△	×	×	×	×	×
		△	×	△	×	×	×	×	×
		△	×	△	×	×	×	×	×
		△	×	△	×	×	×	×	×
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</									

Defective operation of accumulator
Clogged orifice
Defective operation of quick return valve
Leakage of oil due to wear of piston, spool, or bore
Leakage of oil from transmission clutch pack, piston seal
Leakage of oil from joint of transmission housing and valve
Breakage inside accumulator valve (broken spring, worn spool)

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T-5 Torque converter oil temperature is high

Ask the operator the following questions.

- Does oil temperature rise during torque converter stall and go down when there is no load?
Yes = Selection of transmission range
- Does oil temperature rise only when carrying out scooping work?
Yes = Improvement in method of operation

Checks before troubleshooting

- Are the radiator water level and fan belt tension correct?
- Is the transmission oil level correct?
Is the type of oil correct?
- Is the transmission filter or strainer clogged?

Checking for abnormalities

- Measure the torque converter oil temperature. Is it actually high?
Yes = Defective oil transmission gauge

No. Problems		Causes										
		Charging pump		Torque converter			Trans- mission		Torque converter, transmission circuit		Others	
		a	b	c	d	e	f	g	h	i	j	k
Remedy		△ X	△ X	△ X	△ X	△ X	△ X	△ X	C △	△ X	△ X	△ X
1	When oil temperature is low, abnormal noise comes from charging pump	○										
2	Abnormality in high idling and low idling speeds					○		○	○			○
3	Abnormality in each stall engine speed		○	○	○	○						○
4	Abnormality in travel speed, thrusting force, and gradeability in all transmission ranges	○	○	○	○	○	○	○	○	○		○
5	Abnormality in travel speed, thrusting force, and gradeability in certain transmission ranges						○					
6	Torque converter relief pressure is low	○	○	○	○	○						
7	Transmission clutch pressure	○	○				○	○				
8							○					
9		○										
10	Transmission oil level changes								○	○	○	
11	Metal particles stuck to transmission strainer or torque converter filter	○			○	○						

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STEERING SYSTEM

T-6 Steering does not turn

Ask the operator the following questions.

- Did the problem suddenly happen?
→ Part broken in steering related equipment
- Had the steering been heavy before, or had there been any other symptom?
→ Internal wear or defective seal in steering related equipment

Checks before troubleshooting

- Is the oil level and type of oil in the hydraulic tank correct?
- Has the safety bar been removed from the frame?

I-6 Steering does not turn

Ask the operator the following questions.

- Did the problem suddenly happen?
→ Part broken in steering related equipment
- Had the steering been heavy before, or had there been any other symptom?
→ Internal wear or defective seal in steering related equipment

Checks before troubleshooting

- Is the oil level and type of oil in the hydraulic tank correct?
- Has the safety bar been removed from the frame?

		Causes									
		Hydraulic pump PTO or pump broken			Defect inside steering valve			Defect inside steering cylinder (leakage of oil from piston seal)			
		Hydraulic pump			Valves			Others			
		a	b	c	d	e	f	g	h	i	
No.	Problems	△	△	△	△	△	△	△	△	△	
1	Steering does not turn to in either direction	×	×	×	×	×	×	×	×	×	
2	Same as Item 1, but there is abnormality in movement of workequipment	○									
3	Steering does not turn in one direction (left or right)					○			○		
4	Steering wheel is heavy and does not turn	○	○		○			○	○		
5	There is no rise at all in steering circuit pressure	○	○					○	○		
6	Steering wheel turns, but steering does not turn in either direction	○	○		○	○					
7	Steering wheel turns, but steering turns only in one direction (left or right)			○			○				

- ★ There is a close relationship between the steering circuit and work equipment circuit, so if any abnormality is felt in the steering, check also the operating condition of the work equipment.

T-7 Steering wheel is heavy

Ask the operator the following questions.

- Did the problem suddenly happen?
→ Part broken in steering related equipment
- Had the steering been heavy before, or had there been any other symptom?
→ Internal wear or defective seal in steering related equipment

Checks before troubleshooting

- Is the oil level and type of oil in the hydraulic tank correct?
- Is there any abnormality in the column?
- Is there any oil leakage from the hydraulic hoses, valves, or cylinders?
- Is there any oil leakage from the hydraulic hoses, valves, or cylinders?
- Is there any scuffing or the center hinge pin bearing and steering cylinder pin or bushing?
- Tire inflation pressure

Checking for abnormalities.

- Measure the operating force of the steering wheel and the time taken for the steering to turn, and compare with the Standard Values Table to judge if there is any abnormality.

Causes

Oil divided at steering valve	Steering switch, pilot pump broken	Steering relief valve	Safety valve	Demand spool	Pilot pressure load portion	Internal defect	Internal defect	Defect inside steering cylinder	Filter clogged on hydraulic oil return side	Oil cooler clogged
Hydraulic pump defective	Defect inside steering valve	Stop valve								
Tank - pump	Valves	Others								
a	b	c	d	e	f	g	h	i	j	k

No.	Problems	Remedy										
		a	b	c	d	e	f	g	h	i	j	k
1	Steering wheel is heavy when turned in either direction (left and right)	○	○		○	○			○			
2	Steering is heavy when turned in one direction (left and right)			○			○	○	○			
3	Steering is particularly heavy when engine is running at low speed	○							○			
4	Boom RAISE lacks speed with engine at full throttle	○										
5	Steering wheel is heavy and there is jerking	○										
6	Hydraulic oil overheats											○
7	Pressure in steering circuit is low			○	○	○			○			
8	Pressure rises in steering cylinder return piping									○	○	

- ★ There is a close relationship between the steering circuit and work equipment circuit, so if any abnormality is felt in the steering, check also the operating condition of the work equipment.

T-8 Steering wheel wobbles or there is excessive shock

Checks before troubleshooting

- Is the oil level and type of oil in the hydraulic tank correct?
- Is there any abnormality in the column?
- Is there any play in the center hinge pin bearing and steering cylinder pin bushing?
- Is there any variation in the inflation pressure of the tires?
- Is there any play in the steering?

Checking for abnormalities

Drive the wheel loader in a safe place, and check how the steering wheel wobbles and under what conditions.

- ★ If there is wobble of the steering wheel, and in addition the steering wheel is heavy or there are other problems, go to "2. Steering wheel is heavy."

No.	Problems	Remedy	Causes			
			Safety valve	Steering valve selector spool out of position	Internal defect in orbital (relief) valve	Defect inside steering cylinder (inside surface of cylinder, piston seal, nut, bolt)
			Steering valve defective	Valves	Cylinder	
			a	b	c	d
			△ A	△	△	△
			×	×	×	×
1	Steering wheel wobbles when traveling on rough road surfaces		○	○		○
2	Steering wheel wobbles or suddenly turns when operating or traveling					○
3	Steering wheel wobbles when traveling at speed		○	○	○	○
4	Body wobbles when engine is started			○		

T-9 Machine steers to one side when traveling

Cause: Defective steering valve

- Spool out of position
- Leakage of oil inside steering cylinder
- Variation in tire inflation pressure

T-10 Turning radius to left and right is different

Cause: Dividing of steering to left and right, lock position of stopper (At end of steering, relief noise can be heard from valve)

BRAKE SYSTEM

T-11 Brakes do not work or braking effect is poor

Ask the operator the following questions.

- Did the problem suddenly start?
Yes = Brake equipment broken
- Did the problem gradually appear?
Yes = Deterioration of seal, wear of lining, disc

Checks before troubleshooting

- Is the hydraulic oil level correct?
- Is the brake pedal play correct?
- Is there any leakage of oil from the brake tube or connector?
Is there any deformation of the tube?
- Is the tire inflation pressure and tread pattern normal?

Checking for abnormalities

- Measure the braking force and compare with the Standard Value Table to check if the braking effect is poor.

		Causes									
		Defective brake piston seal inside axle Defective operation of brake piston inside axle Defective brake portion inside axle Wear or other abnormality of brake lining inside axle Contact with metal portion of brake lining inside axle Air in brake circuit Defect inside brake valve Defective accumulator piston seal, insufficient gas pressure Defective pilot pump (for charge), scuffing									
		a	b	c	d	e	f	g	h	i	j
Remedy		△ X	△ X	△ X	△ X	△ X	△ X	△ X	△ X	△ X	△ X
No.	Problems										
1	Resistance is low when brake pedal is depressed	○					○	○		○	
2	Brake pedal is heavy when it is depressed						○				
3	Abnormal operating force is needed to obtain specified braking force		○		○	○	○	○			
4	Abnormal noise is heard from axle brake when brake is applied			○	○						
5	Machine cannot travel (lacks rimpull)						○				
6	Jack up 4 wheels and set axles on stand. In F1, when brakes are applied, only certain wheels rotate quickly	○	○	○	○	○	○				
7	Air can be seen flowing out when air is bled from brake circuit. Returns to normal after air is bled.					○					
8	Abnormal oil leakage is found when checking leakage of oil inside axle.	○									
9	Many metal particles are found in axle oil				○						
10	No abnormality in operating force or travel of brake pedal, but braking effect is poor		○	○	○	○					
11	Number of times of braking effect is small when engine is stopped	○						○	○	○	
12	Accumulator is not charged, buzzer sounds								○	○	○
13	There is a time lag in effect of brake					○					

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T-12 Brakes are not released or brakes drag

Checks before troubleshooting

- Does the brake pedal come back fully?
- Is the parking brake fully released?

Checking for abnormalities

- Is there any abnormal heat from the brakes?
- Does the machine travel smoothly under inertia on level ground?

		Causes		
		Defect inside brake valve (piston stuck)	Abnormality in brake lining inside axle	Defective operation of brake piston inside axle
		a	b	c
Remedy		△	△	△
No.	Problems	×	×	×
1	Brake remains applied even when brake pedal is released	○	○	○
2	When brake pedal is released and oil is bled from air bleeder, circuit pressure goes down and brake is released	○		
3	Jack up 4 wheels and set axles on stand. When engine is stopped and parking brake is released, certain wheels are heavy when they are rotated by hand		○	○

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T-13 Parking brake is not released or brake drags

Checks before troubleshooting

- Is the emergency parking brake cancel switch OFF?
(it is always canceled when this switch is ON)
- Is the parking brake always applied automatically when the engine is stopped?

		Causes					
		Defect inside parking brake solenoid valve Insufficient oil pressure due to defective transmission valve Catching due to peeling of parking brake disc lining Broken wiring harness in parking brake switch line Defective operation of parking brake switch line Defective operation of emergency parking brake cancel valve					
		a	b	c	d	e	f
No.	Problems	△	△	△	△	△	△
		×	×	×		×	×
1	When parking brake switch is turned OFF, parking brake is not released	○	○	○	○	○	○
2	When parking brake switch is OFF and engine is stopped, parking brake is not applied				○	○	
3	When parking brake switch is ON, parking brake effect is weak		○	○			

- When emergency parking brake switch is turned ON, parking brake is not released
In such a case, the probable cause is following.
 - Defective operation of emergency parking brake cancel valve
 - Breakage in wiring harness in line for emergency parking brake cancel switch
 - Insufficient gas pressure in brake accumulator, damaged piston seal

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WORK EQUIPMENT

T-14 Boom does not rise

Ask the operator the following questions.

- Did the problem suddenly start?
Yes = Equipment seized, damaged
Was there any abnormal noise when this happened? (from where?)
- Was there previously any symptom, such as the speed becoming slow?
Yes = Wear of internal parts, deterioration in spring

Checks before troubleshooting

- Is the hydraulic oil level correct?
- Is the travel of the boom control lever and spool properly adjusted?

		Causes									
		Tank - pump				Steering valve	PPC valve	Main control valve	Cylinder		
		a	b	c	d	e	f	g	h	i	j
Remedy		C	△	△	△	△	△	△	△	△	△
No.	Problems	△	×	×	×	×	×	×	×	×	×
1	Bucket cannot be operated and boom cannot be raised	○	○	○	○	○	○	○	○		
2	Chassis can be raised with boom but boom cannot be raised, or bucket can be operated but boom cannot be raised						○		○	○	
3	Boom can be raised when there is no load but cannot be raised when there is a load	○		○				○			
4	Abnormal noise comes from hydraulic pump	○		○	○						
5	Excessive hydraulic drift of boom cylinder								○	○	
6	When engine is running at full throttle, steering operation is too light and fast					○					
7	When engine is running at full throttle, steering operation is heavy and slow	○		○							

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T-16 When boom is raised, it moves slowly at a certain height

Checks before troubleshooting

- Can any deformation be seen in the boom cylinder?

Cause

- Swelling or internal damage to boom cylinder tube
- ★ For other abnormalities when the boom is raised, go to **"T-15 Boom movement is slow or boom lacks lifting power."**

T-17 Bucket cannot be pushed with boom cylinder (bucket floats)

See **"T-15 Boom movement is slow or boom lacks lifting power."**

Checks before troubleshooting

- Is the stroke of the boom spool in the main control valve properly adjusted?

Cause

- Defective seating of suction valve at boom cylinder rod end of main control valve
- Oil leakage from boom cylinder piston seal

T-18 Excessive hydraulic drift of boom

Ask the operator the following questions.

- Did the problem suddenly start?
Yes = Dirt caught in valve, broken part
- Did the problem gradually appear?
Yes = Worn parts

Checks before troubleshooting

- Is the boom spool at the neutral position?
Yes = Seized link bushing, defect in spool detent

Troubleshooting and Cause

- When measuring the hydraulic drift, is there any sound of oil leakage from inside the boom cylinder?
Yes = Defective cylinder packing

T-19 Boom shakes during operation

When digging or leveling operations are carried out with the boom control lever at HOLD, the bucket and boom move up and down to follow the shape of the ground.

Troubleshooting and Cause

Measure the hydraulic drift of the boom and check if it is possible to lift the chassis with the boom cylinder.

1. If the hydraulic drift of the boom cylinder is outside the standard value, go to **"T-18 Excessive hydraulic drift of boom."**
 2. If the chassis cannot be raised with the boom cylinder, go to **"T-17 Bucket cannot be pushed with boom cylinder."**
 3. If the hydraulic drift of the boom is normal, operate the boom several times, and operate the boom cylinder to the end of its stroke. Is it now possible to raise the chassis with the boom cylinder?
Yes = Vacuum had formed inside cylinder
- ★ However, if this problem appears frequently, the suction valve at the boom cylinder rod end is defective.

T-20 Boom drops momentarily when control lever is operated from HOLD to RAISE

Checking problem

- When the engine is run at low idling and the boom control lever is operated slowly from HOLD to RAISE, the boom goes down under its own weight. When the lever is operated fully to the RAISE position, the condition returns to normal.

Cause

- Defective seating of check valve for boom spool in main control valve

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T-21 Bucket does not tilt back

Ask the operator the following questions.

- Did the problem suddenly start?
Yes = Equipment seized, damaged
Was there any abnormal noise when this happened? (from where?)
- Was there previously any symptom, such as the speed becoming slow?
Yes = Wear of internal parts, deterioration in spring

Checks before troubleshooting

- Is the travel of the bucket control lever and spool properly adjusted?

		Causes Clogged suction port of pump or excessive air in oil No PTO drive for pump Defective hydraulic pump and switch pump Defective PPC pump Defective operation of demand pump Defective relief valve Defective spool Breakage inside valve body (bucket spool) Damaged bucket cylinder piston seal									
		Tank - pump		Steering valve		PPC valve		Main control valve		Cylinder	
		a	b	c	d	e	f	g	h	i	j
		△	△	△	△	△	△	△	△	△	△
No.	Problems	△	△	△	△	△	△	△	△	△	△
1	Boom cannot be operated and bucket cannot be tilted back	○	○	○	○	○	○	○	○	○	○
2	Chassis can be raised with bucket but bucket cannot be tilted back, or boom can be operated but bucket cannot be tilted back						○		○	○	
3	Bucket can be tilted back when there is no load but cannot be tilted back during digging or scooping operations	○	○								
4	Abnormal noise comes from hydraulic pump	○	○	○							
5	Excessive hydraulic drift of bucket cylinder								○	○	
6	When engine is running at full throttle, steering operation is too light and fast				○						
7	When engine is running at full throttle, steering operation is heavy and slow	○									

T-22 Bucket movement is slow or tilt-back lacks power

Checks before troubleshooting

- Is the travel of the bucket control lever and main control valve spool properly adjusted?
- Is there any seizure of the work equipment linkage? (Is there any abnormal noise?)

Checking for abnormalities

- Check if there is lack of tilt-back power during actual operations.
- Measure the operating speed of the bucket and use the Standard Value Table to check if there is any abnormality

		Causes									
		Tank - pump		Steering valve		PPC valve		Main control valve		Cylinder	
		a	b	c	d	e	f	g	h	i	j
No.	Problems	Remedy									
		C	△	△	△	△	△	A	△	△	△
1	Boom lifting power and speed are abnormal and bucket tilt-back power or speed are abnormal	○	○	○	○	○	○	○	○	○	○
2	Boom lifting power and speed are normal but bucket tilt-back power or speed are abnormal					○		○	○	○	
3	As in Item 1, but problem is particularly bad when oil temperature rises		○								
4	Abnormal noise comes from hydraulic pump	○	○								
5	When engine is running at full throttle, steering operation is too light and fast			○							
6	When engine is running at full throttle, steering operation is heavy and slow	○									
7	Excessive hydraulic drift of bucket cylinder							○	○	○	
8	Relief pressure of relief valve in main control valve is low						○	○	○	○	
9	Relief pressure of relief valve in main control valve is too high						○				○

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T-23 Bucket movement becomes slow during tilt-back operation

Checks before troubleshooting

- Can any deformation be seen in the bucket cylinder?

Cause

- Swelling or internal damage to bucket cylinder tube
- For other abnormalities when the bucket is operated, go to **"T- 22 Bucket movement is slow or tilt back lacks power."**

T-24 Bucket cannot be pushed with bucket cylinder

See "T-22 Bucket movement is slow or tilt back lacks power."

Checks before troubleshooting

- Is the stroke of the bucket spool in the main control valve properly adjusted?

Cause

- Defective seating of safety valve (with suction valve) at bucket cylinder rod end of main control valve
- Oil leakage from bucket cylinder piston seal

T-25 Excessive hydraulic drift of bucket

Ask the operator the following questions.

- Did the problem suddenly start?
Yes = Dirt caught in valve, broken part
- Did the problem gradually appear?
Yes = Worn parts

Checks before troubleshooting

- Is the bucket spool at the neutral position?
Yes = Seized link bushing, defect in spool detent

Checking for abnormalities

- Use the Standard Value Table to check if the hydraulic drift of the bucket is actually excessive.

Cause

- Oil leakage inside bucket cylinder
- Defective seating of safety valve (with suction valve) at bottom end
- Defective oil tightness of bucket spool

T-26 Bucket shakes during loading operation (Main control valve at HOLD)

Checks before troubleshooting

- Is there play in the work equipment linkage pin, bushing? (Is there any abnormal noise?)

Cause

- Defective bucket cylinder piston seal
- Defective operation of safety valve (with suction valve) at bucket cylinder rod end. If any other problem occurs at the same time, carry out troubleshooting according to the nature of the problem.

T-27 Bucket dumps momentarily when control lever is operated from HOLD to TILT

Checking problem

- When the engine is run at low idling and the bucket control lever is operated slowly from **HOLD** to **TILT**, the bucket dumps momentarily under its own weight. When the lever is operated fully to the **TILT** position, the condition returns to normal.

Cause

- Defective seating of check valve for bucket spool in main control valve

T-28 Boom, bucket control levers are heavy or do not move smoothly

Checking for abnormalities

- Check the values in the Standard Value Table to check if the operating force of the lever is actually excessive.

No.	Problems	Remedy	Causes										
			Lever	PPC valve			Main control valve						
			a	b	c	d	e	f	g	h	i	j	k
			X	X	△	△	C						
1	Levers are heavy when there is a load and oil pressure is high			○	○		○			○	○		
2	Levers become heavy as oil temperature changes			○	○		○			○	○		
3	Levers become heavy at places during operation regardless of oil pressure or temperature								○				
4	Levers are always heavy during operation regardless of oil pressure or temperature	○	○			○	○	○				○	
5	Levers are still heavy after control lever link is disconnected at valve connection	○											

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TROUBLESHOOTING OF ECSS (ELECTRONICALLY CONTROLLED SUSPENSION SYSTEM) (D MODE)

Judgement Table for controller electrical system	20-502
D- 1 ECSS does not work	20-503
(a) Error code [d0] is displayed	20-504
(b) Error code [d1] is displayed	20-504
(c) Error code [d2] is displayed	20-505
(d) Error code [d3] is displayed	20-505
(e) Error code [d4] is displayed	20-506
(f) No abnormality display is given	20-506
D- 2 ECSS cannot be canceled	20-510
D- 3 Output is turned ON (travel speed does not become 5 km/h) (deviates around 5 km/h)	20-511
D- 4 Output is turned ON when transmission is in 1st	20-511
D- 5 Output is turned ON when transmission is in 4th	20-512
D- 6 Controller LED code is not displayed	20-513
D- 7 ECSS is abnormal but main monitor does not give abnormality display	20-513

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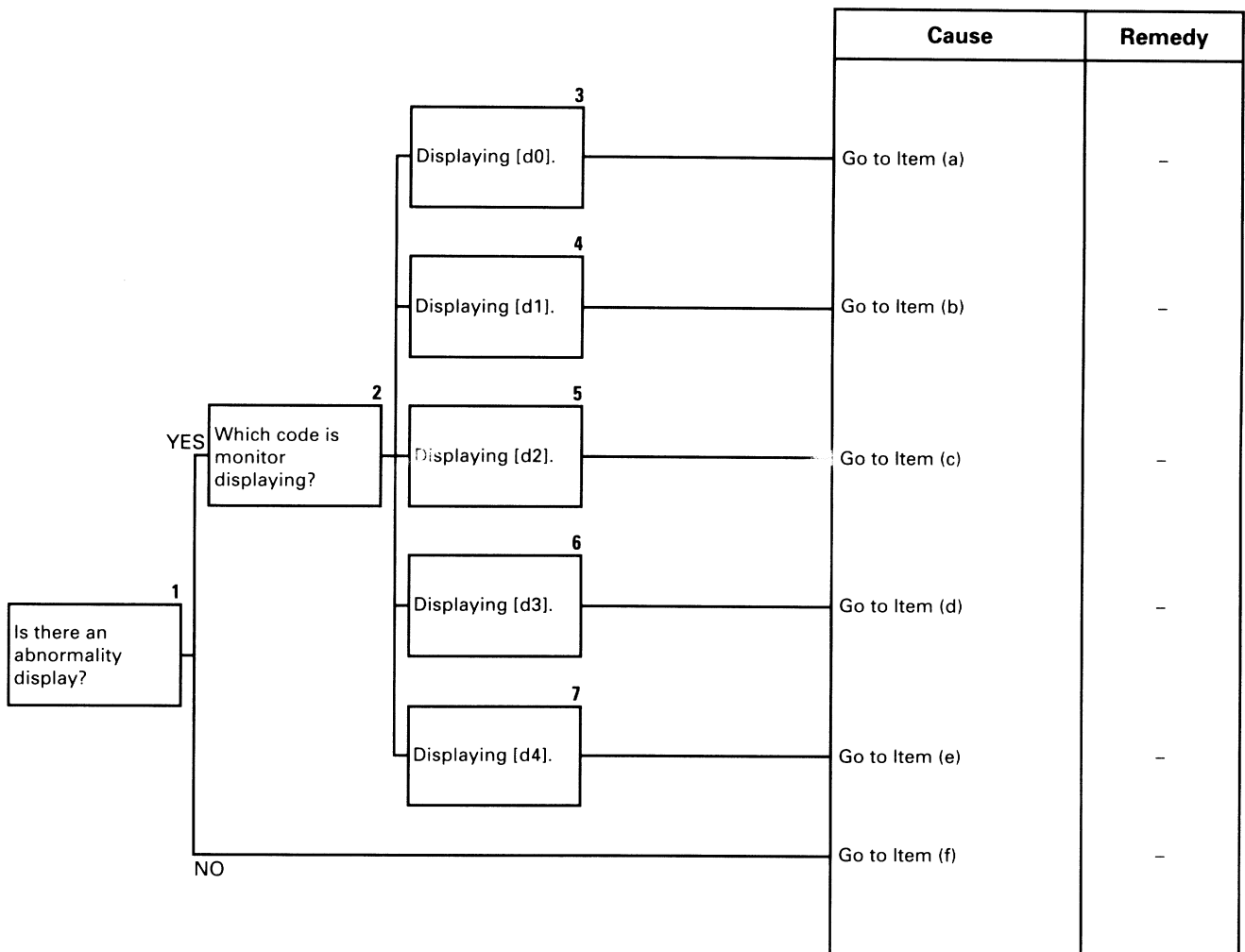
TROUBLESHOOTING
JUDGEMENT TABLE FOR CONTROLLER ELECTRICAL SYSTEM
JUDGEMENT TABLE FOR CONTROLLER ELECTRICAL SYSTEM

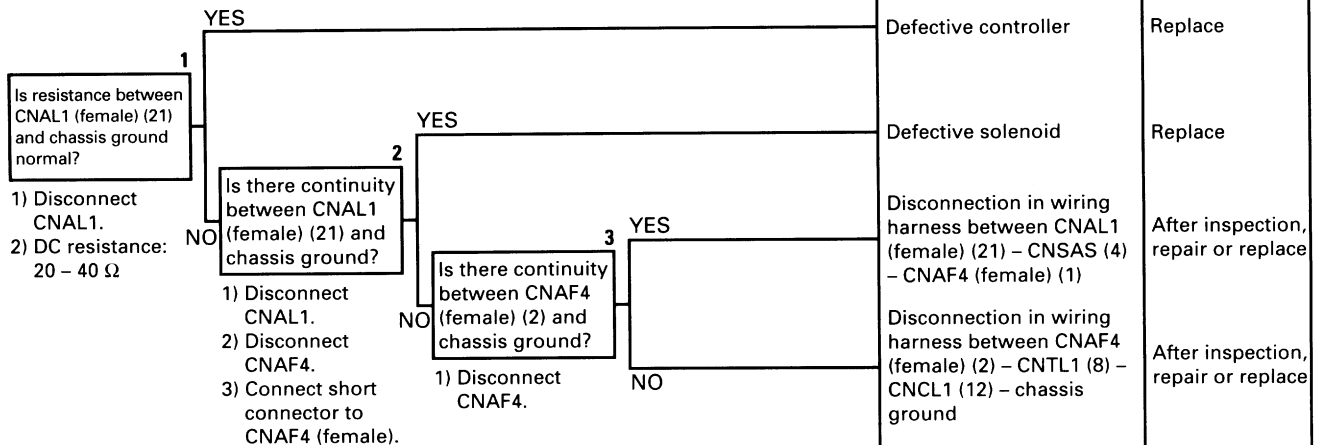
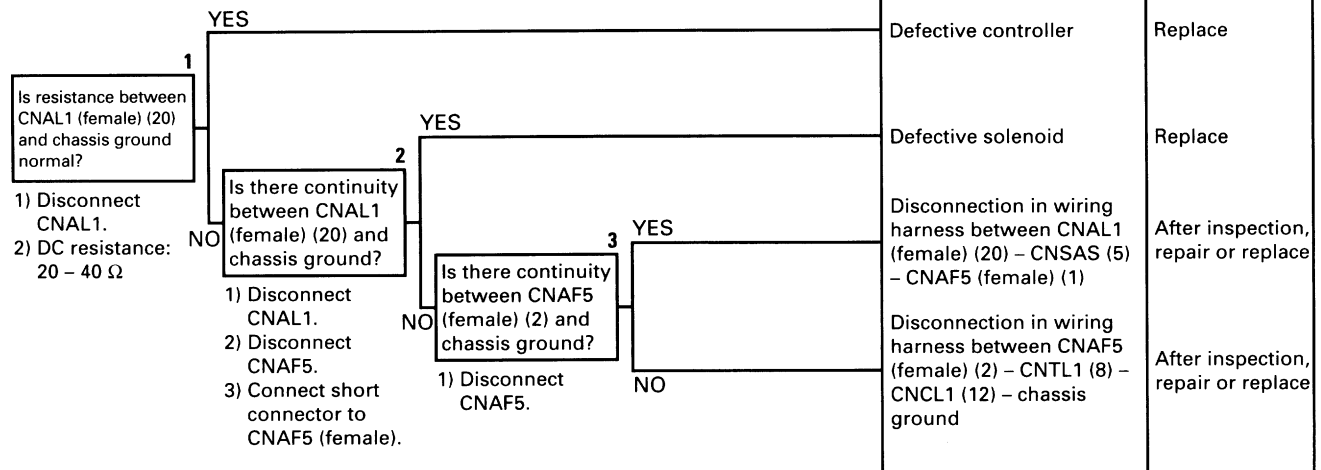
Error code	Self-diagnosis table (abnormality display)					
	Solenoid (relief) system	Solenoid (high pressure) system	Solenoid (low pressure) system	Travel speed sensor system	Model selection abnormality	Troubleshooting code when no abnormality display is given
	d0	d1	d2	d3	d4	
Failure mode						
ECSS does not work or does not work properly	D-1 (a)	D-1 (b)	D-1 (c)	D-1 (d)	D-1 (e)	D-1 (f)
ECSS cannot be canceled						D-2
Output is turned ON but travel speed does not become 5 km/h (deviates)						D-3
Output is turned ON when transmission is in 1st						D-4
Output is turned ON when transmission is in 4th						D-5
LED code display is not given						D-6
ECSS is abnormal but main monitor does not give abnormality display						D-7

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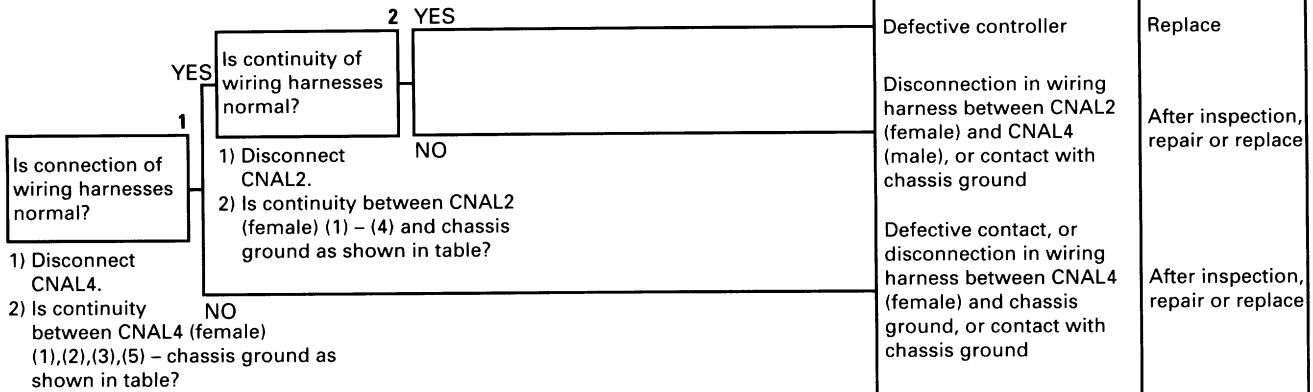
D-1 ECSS does not work

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Carry out troubleshooting with the starting switch ON.
- ★ Check that the ECSS switch on the main monitor is ON.



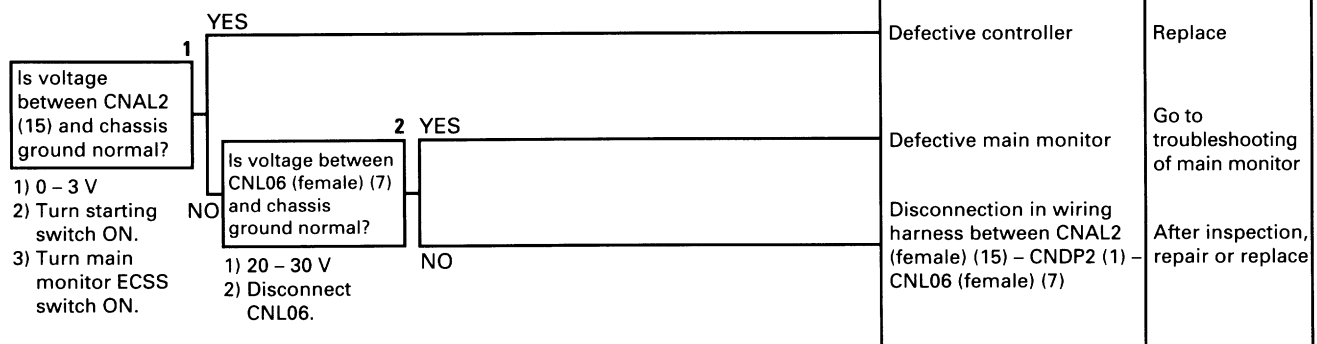
(a) Error code [d0] is displayed**(b) Error code [d1] is displayed**

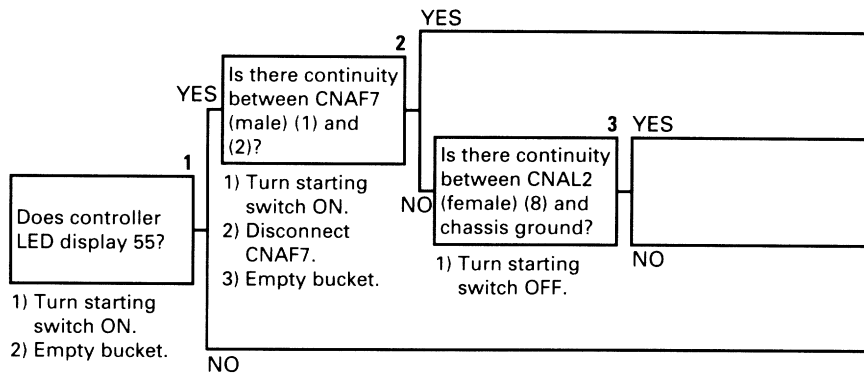
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(e) Error code [d4] is displayed

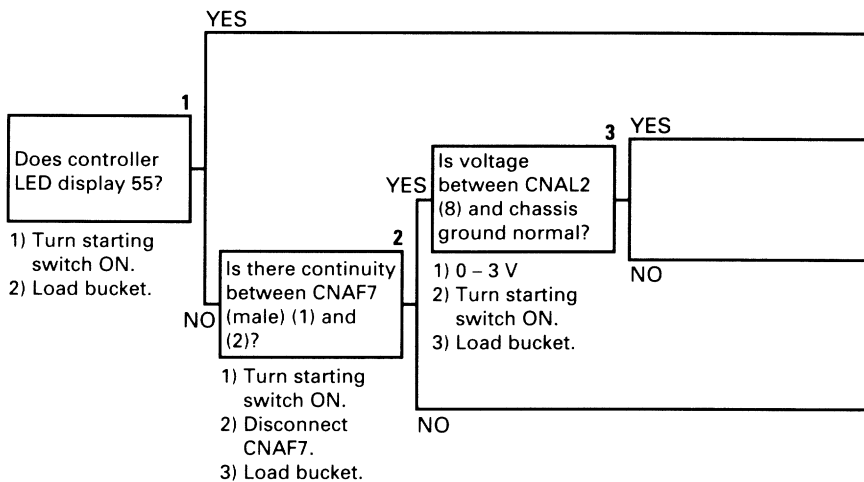
Table

Connector Model	CNAL4(female)				CNAL2(female)			
	(5)	(2)	(3)	(1)	(1)	(2)	(3)	(4)
WA320	No	No	No	Yes	No	No	No	Yes
WA380	No	No	Yes	No	No	No	Yes	No
WA420	No	Yes	No	No	No	Yes	No	No
WA470	No	Yes	Yes	Yes	No	Yes	Yes	Yes

(f) No abnormality display is given**(1) Does not work at all**

(2) Works when bucket is loaded but not when empty

Cause	Remedy
Defective pressure switch or defective chassis hydraulic system	Replace
Contact of chassis ground with wiring harness between CNAL2 (female) (8) – CNSAS (7) – CNAF7 (female) (1)	After inspection, repair or replace
Defective controller	Replace
Defective chassis hydraulic system	–
Defective chassis hydraulic system	–
Defective controller	Replace
Defective contact, or disconnection in wiring harness between CNAL2 (female) (8) – CNSAS (7) – CNAF7 (female) (1), or between CNAF7 (female) (2) – CNSAS (8) – CNAL4 (4) – chassis ground	After inspection, repair or replace
Defective pressure switch or defective chassis hydraulic system	Replace

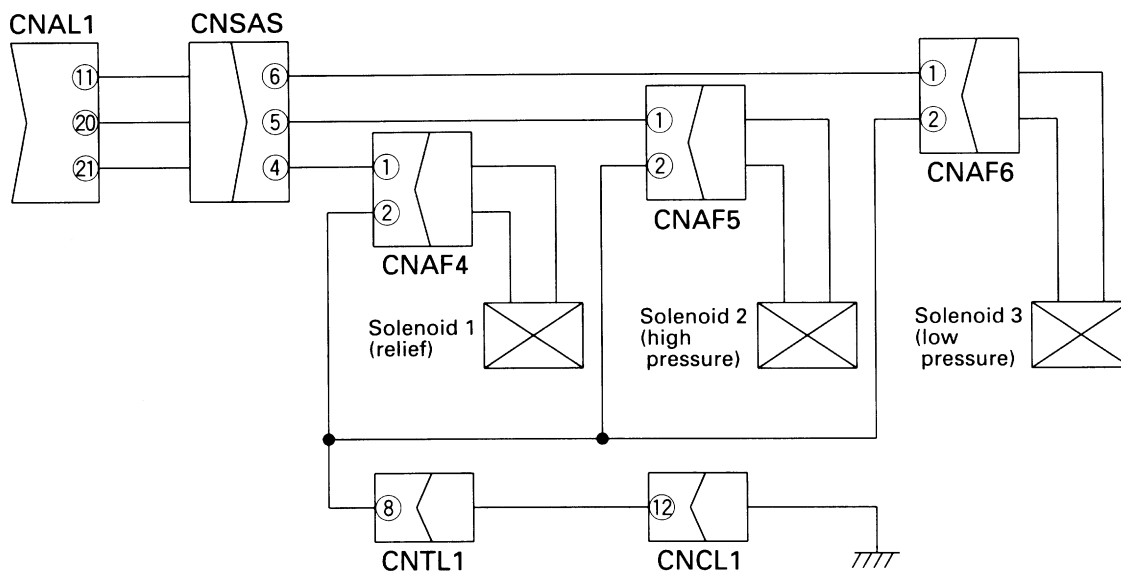
(3) Works when bucket is empty but not when loaded

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TROUBLESHOOTING

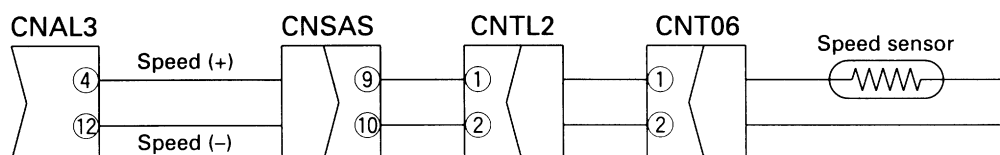
D-1

D-1 (a), (b), (c) Related electric circuit diagram
Solenoid system



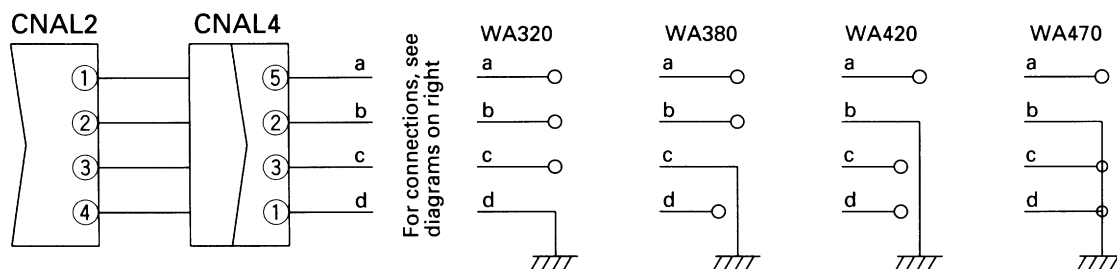
TDW00349

D-1 (d) Related electric circuit diagram
Speed sensor system



TDW00350

D-1 (e) Related electric circuit diagram
Model selection system

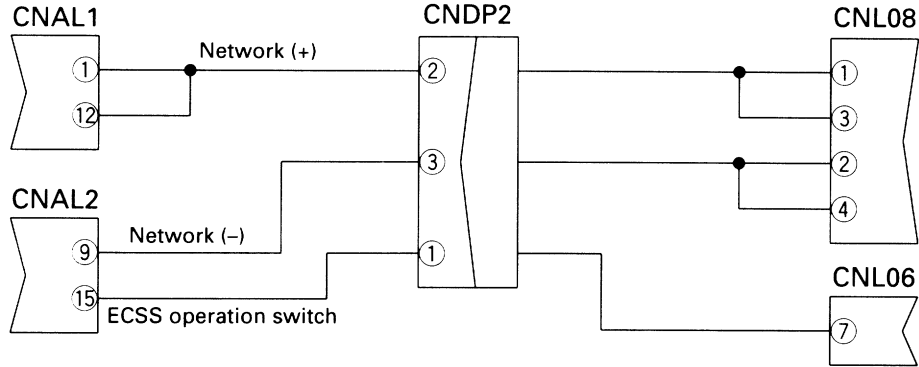


TDW00351

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D-1 (f-(1)) Related electric circuit diagram

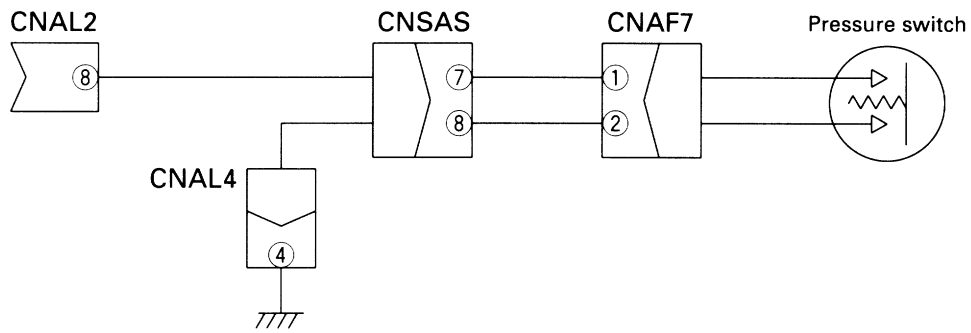
ECSS operation switch and network



TDW00352

D-1 (f-(2)), (f-(3)) Related electric circuit diagram

Pressure switch system

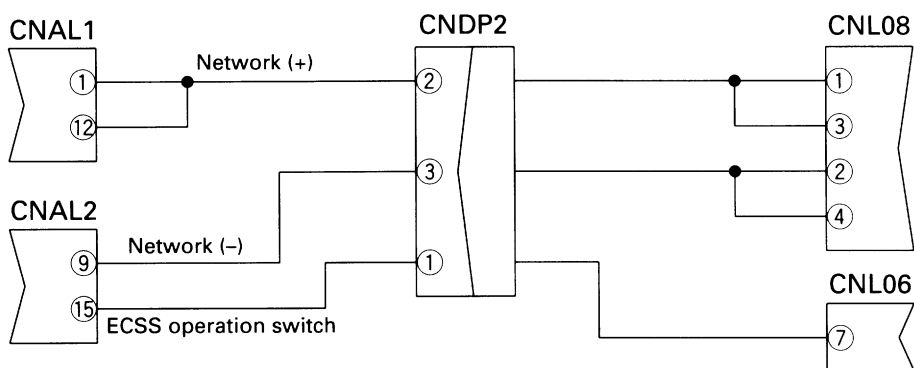


TDW00353

D-2 ECSS cannot be canceled

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Carry out troubleshooting with the starting switch ON.
- ★ Check that the ECSS switch on the main monitor is OFF.

		Cause	Remedy
Is voltage between CNAL2 (15) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. 3) Turn main monitor ECSS switch OFF.	1 YES	Defective controller	Replace
	2 YES	Contact of chassis ground with wiring harness between CNAL2 (female) (15) – CNDP2 (1) – CNL06 (female) (7)	After inspection, repair or replace
	NO	Defective main monitor	Go to troubleshooting of main monitor

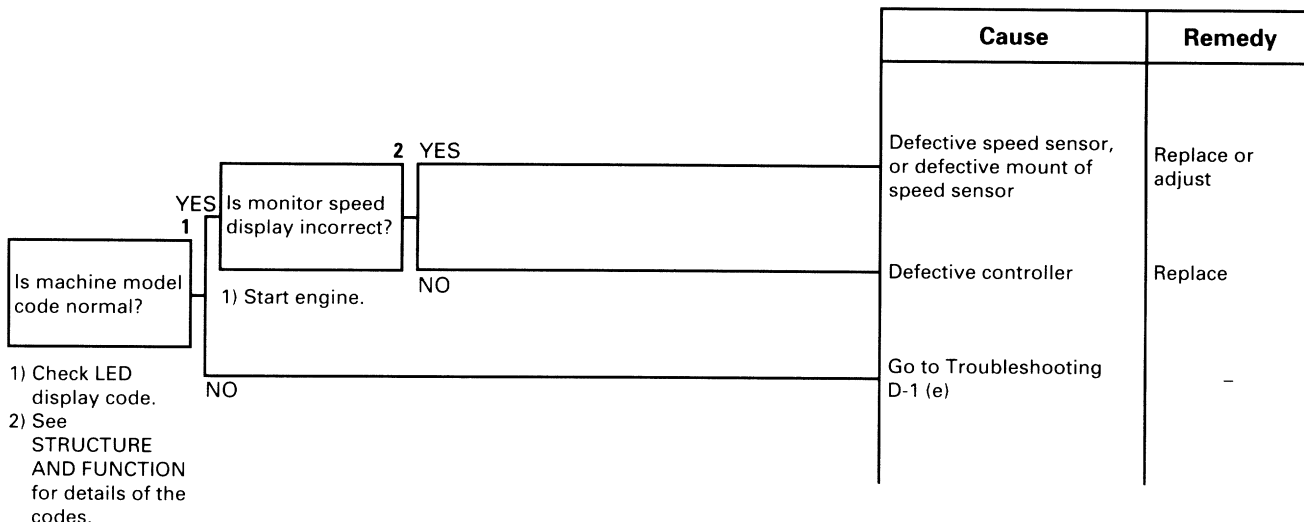


TDW00352

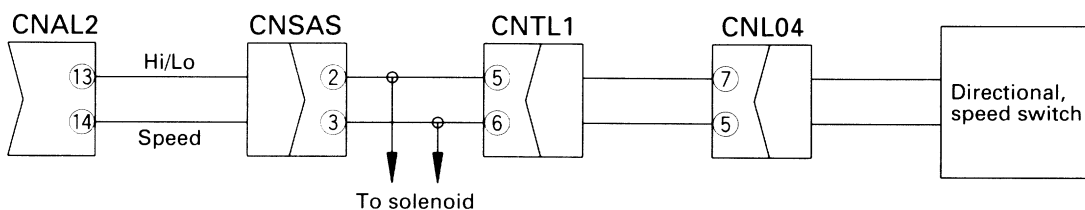
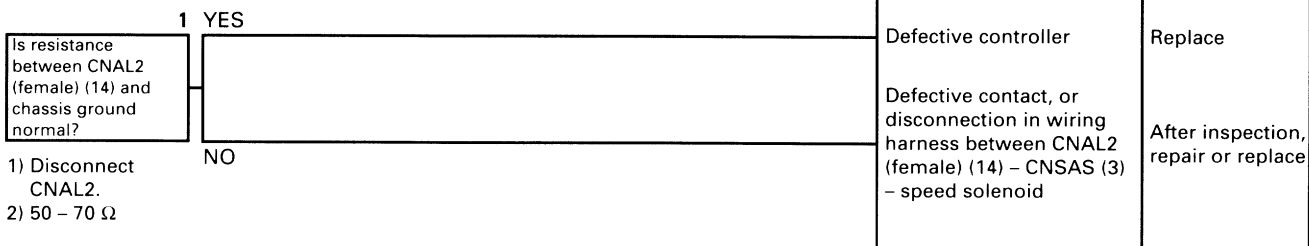
U42103

D-3 Output is turned ON (travel speed does not become 5 km/h) (deviates around 5 km/h)

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Carry out troubleshooting with the starting switch ON.
- ★ Check that the ECSS switch on the main monitor is OFF.



D-4 Output is turned ON when transmission is in 1st

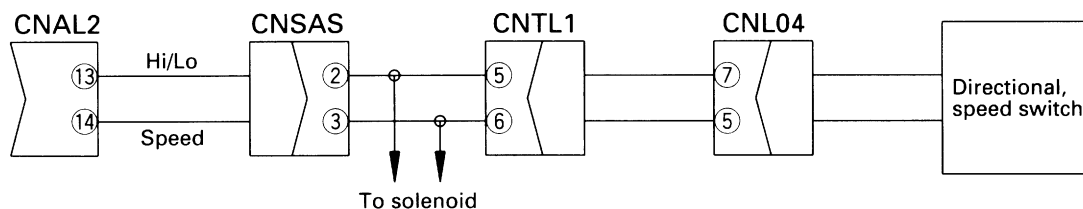


TDW00355

D-5 Output is turned ON when transmission is in 4th

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Carry out troubleshooting with the starting switch ON.
- ★ Check that the ECSS switch on the main monitor is OFF.

		Cause	Remedy
Is resistance between CNAL2 (female) (13) and chassis ground normal? 1) Disconnect CNAL2. 2) 50 – 70 Ω	1 YES	Defective controller	Replace
	NO	Defective contact, or disconnection in wiring harness between CNAL2 (female) (13) – CNSAS (3) – Hi/Lo solenoid	After inspection, repair or replace

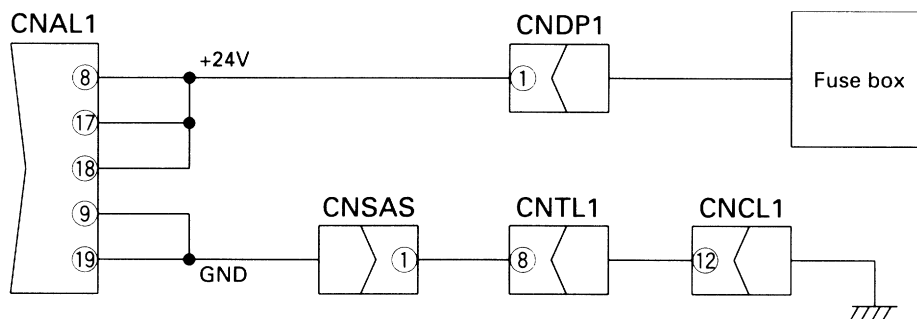
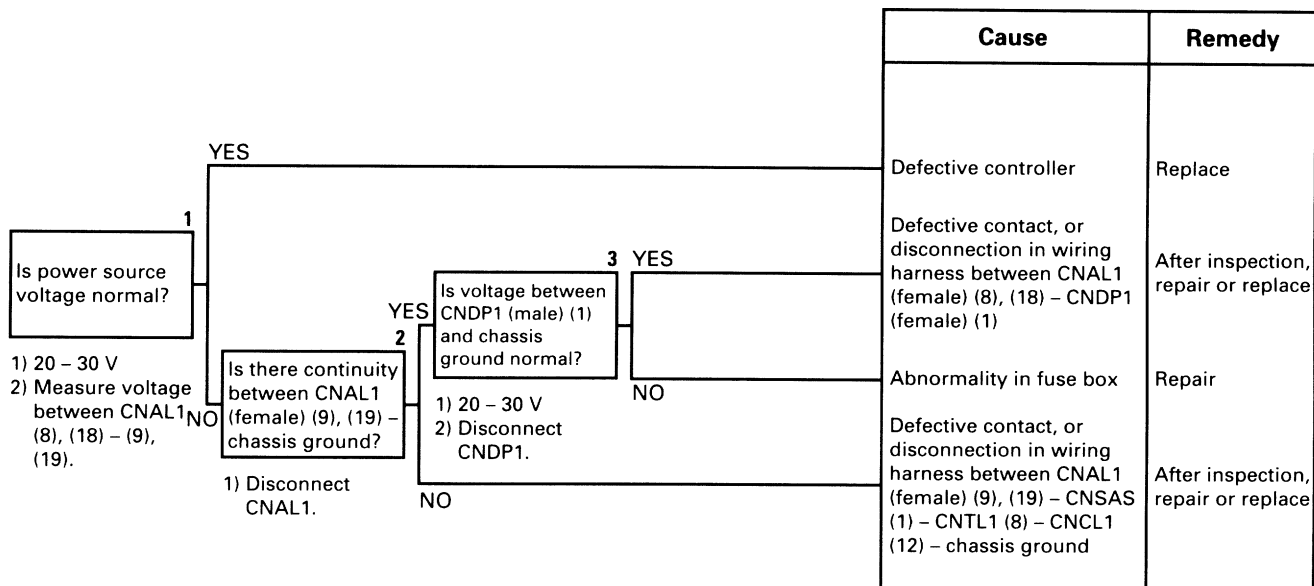


TDW00355

U42103

D-6 Controller LED code is not displayed

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Carry out troubleshooting with the starting switch ON.
- ★ Check that the ECSS switch on the main monitor is OFF.



TDW00359

D-7 ECSS is abnormal but main monitor does not give abnormality display

Cause	Remedy
Check that the ECSS controller is displaying an error code.	
Go to troubleshooting of main monitor	–

TROUBLESHOOTING OF WORK EQUIPMENT CONTROLLER SYSTEM (W MODE)

OUTLINE	20-553
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W-16	Auto-leveler cannot be set	
	(a) Auto-leveler set switch system	20-573
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W-17	Remote positioner set LEDs do not light up	
	(a) Remote positioner switch system	20-574
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	(a) Remote positioner switch system	20-575
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W-23	Failure code is not displayed on main monitor	20-582
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OUTLINE

1. Function

The control mechanism of the work equipment controller consists of the controller, input switches, potentiometer input, solenoid output, and buzzer output. It is used mainly for control of auto-leveling.

The controller receives the data from the potentiometer, processes it according to the input signal for each switch and carries out control of the solenoid.

2. When carrying out troubleshooting

The controller has a troubleshooting function, and when a failure from failure code W-1 to W-13 is detected, the failure code is displayed on the main monitor to inform the operator that there has been a failure (trouble data mode).

However, failure codes number W-14 to W-23 do not have any detection function and are for use when there is an abnormality in the movement of the work equipment.

3. Failure code table

No.	Failure code	Failure	No.	Failure code	Failure
W-1	40	Abnormality in bucket dump solenoid system	W-14	–	Sensor cannot be adjusted
W-2	41	Short circuit in power source when bucket DUMP, TILT solenoids are OFF	W-15	–	Does not carry out auto-leveling
W-3	42	Abnormality in bucket tilt solenoid system	W-16	–	Auto-leveler cannot be set
W-4	43	Abnormality in damping solenoid system	W-17	–	Remote positioner RAISE, LOWER LEDs do not light up
W-5	44	Short circuit in power source at hot end of damping solenoid	W-18	–	Remote positioner RAISE, LOWER LEDs do not flash
W-6	45	Short circuit in power source at return end of damping solenoid	W-19	–	Bucket does not tilt immediately at boom FLOAT detent when remote positioner is at RAISE and auto mode is ON
W-7	48	Abnormality in bucket lever kick-out relay system	W-20	–	Buzzer for switch operation does not sound
W-8	49	Abnormality in boom lever kick-out relay system	W-21	–	Bucket correction, boom stop response are slow
W-9	50	Abnormality in auto-leveler relay system	W-22	–	Bucket (lever) control
W-10	51	Disconnection in boom RAISE, LOWER detection pressure switch	W-23	–	Failure code is not displayed on main monitor
W-11	52	Abnormality in boom angle potentiometer system	W-24	–	Maintenance monitor check
W-12	53	Abnormality in bucket angle potentiometer system			
W-13	54	Abnormality in model selection wiring harness			

4. Table of troubleshooting modes and causes

Cause of failure Failure mode	Related equipment													
	Bucket DUMP solenoid system	Bucket TILT solenoid system	Damping solenoid system	Bucket lever kick-out	Boom lever kick-out	Auto-leveler relay system	Boom RAISE, LOWER detection switch system	Boom angle potentiometer system	Bucket angle potentiometer system	Model selection wiring harness system	Bucket neutral switch system	Engine speed signal system	Auto-leveler switch system	Auto-leveler LED system
Reference item	1	3	4	7	8	9	10	11	12	13	15	15	15	15
Main monitor display failure code	40	42	43	48	49	50	51	52	53	-	-	-	-	-
	41		44											
			45											
Model selection cannot be carried out										○				
Sensor adjustment cannot be carried out														
Does not carry out auto-leveling	○	○				○		○	○		○	○	○	○
Auto-leveler setting cannot be carried out														
Remote positioner does not function							○							
Remote positioner setting cannot be carried out							○							
There is hunting of bucket	○	○												
Bucket moves suddenly in DUMP direction	○													
Bucket moves suddenly in TILT direction		○												
Excessive shock when starting or stopping boom when remote positioner is being actuated			○											
Bucket does not tilt if boom lever is at FLOAT when remote positioner and auto mode are actuated														
Bucket lever kick-out does not work				○										
Bucket lever detent does not work														
Boom lever kick-out does not work					○									
Buzzer does not sound when switch is operated														
Bucket correction, boom stop control is slow														

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TROUBLESHOOTING

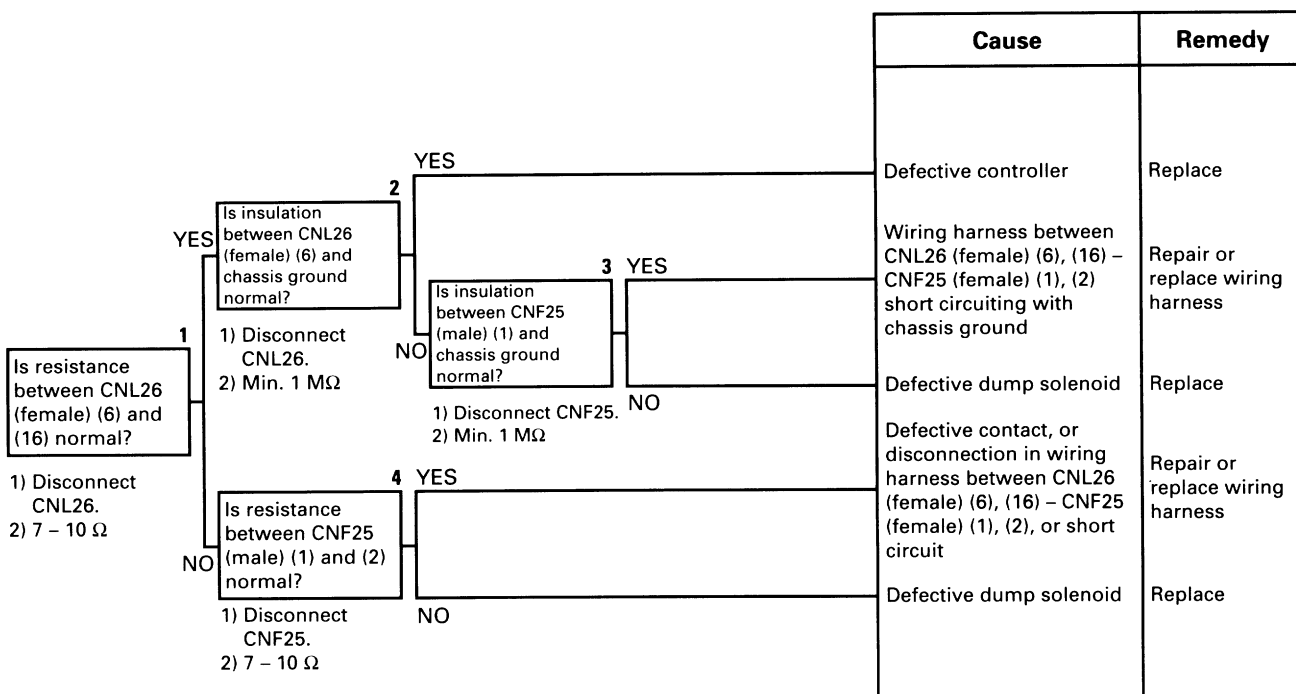
OUTLINE

Related equipment											
											Leveler set switch system
											Leveler set LED system
											Remote positioner switch system
											Remote positioner LED system
											Remote positioner set switch system
											Remote positioner set LED system
											Boom lever detent switch system
											Buzzer signal system
											Boom pressure sensor signal system
											Proximity switch system

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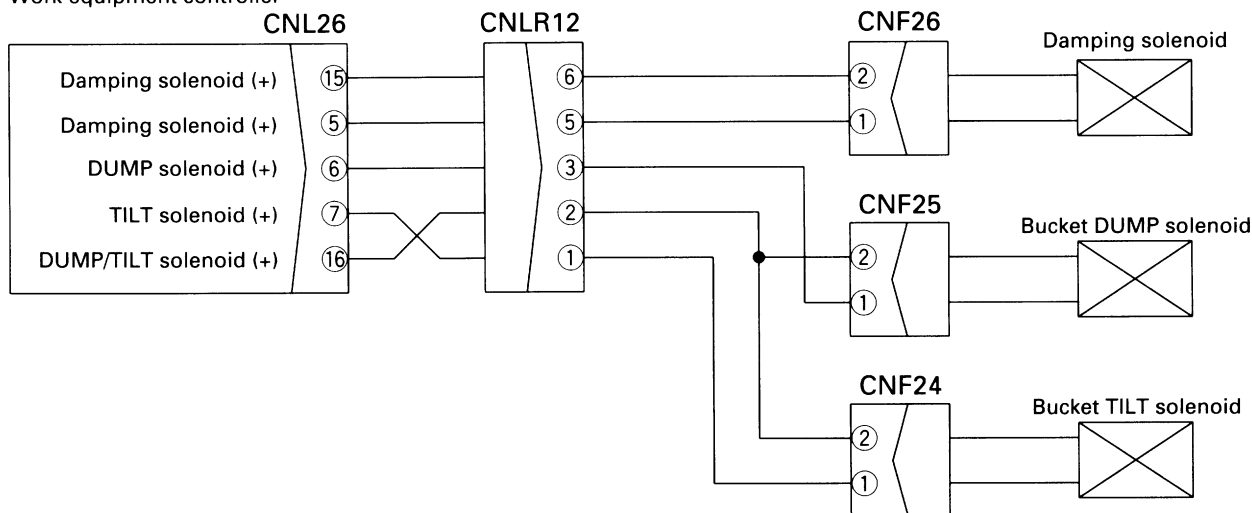
W-1 Failure code [40] Abnormality in bucket dump solenoid system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



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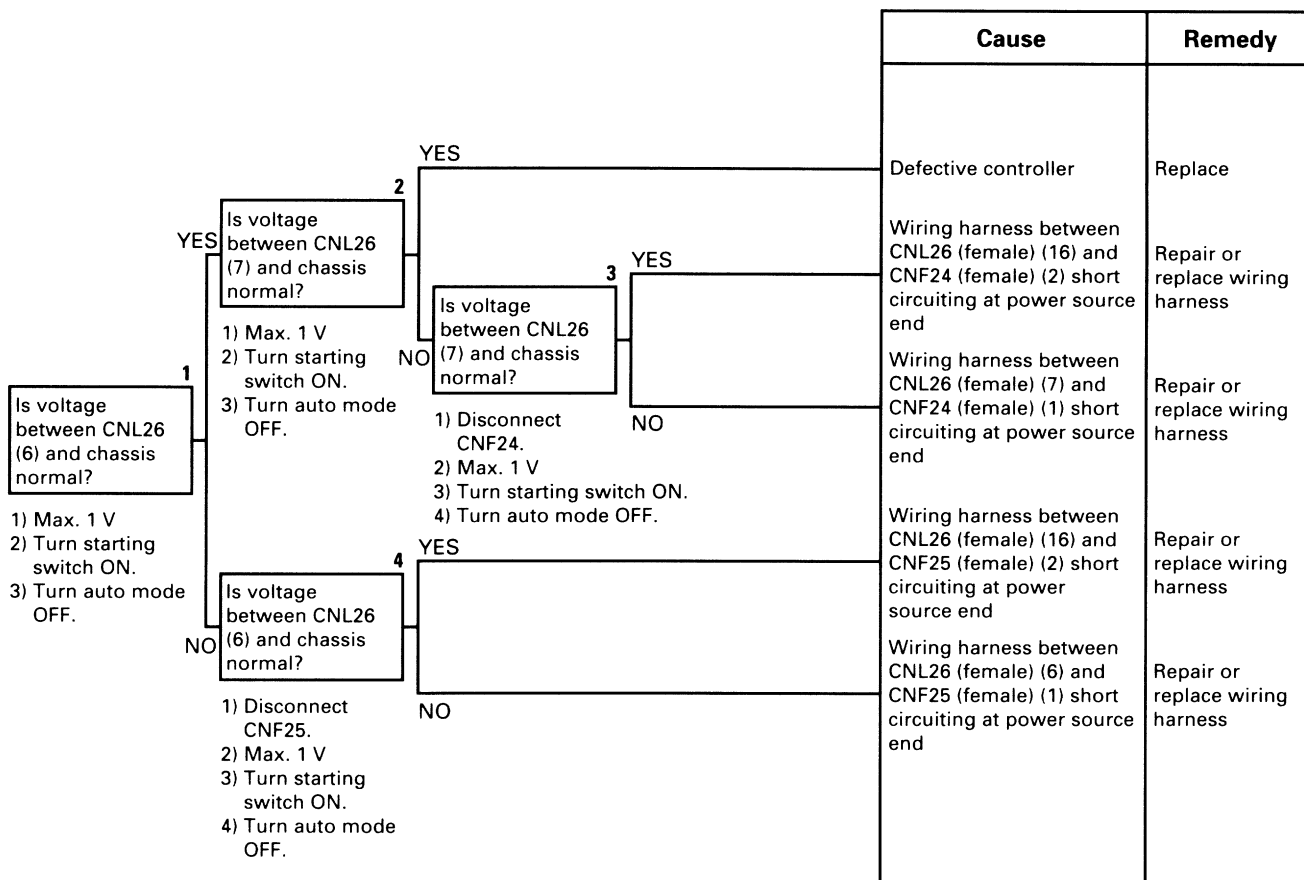
Work equipment controller



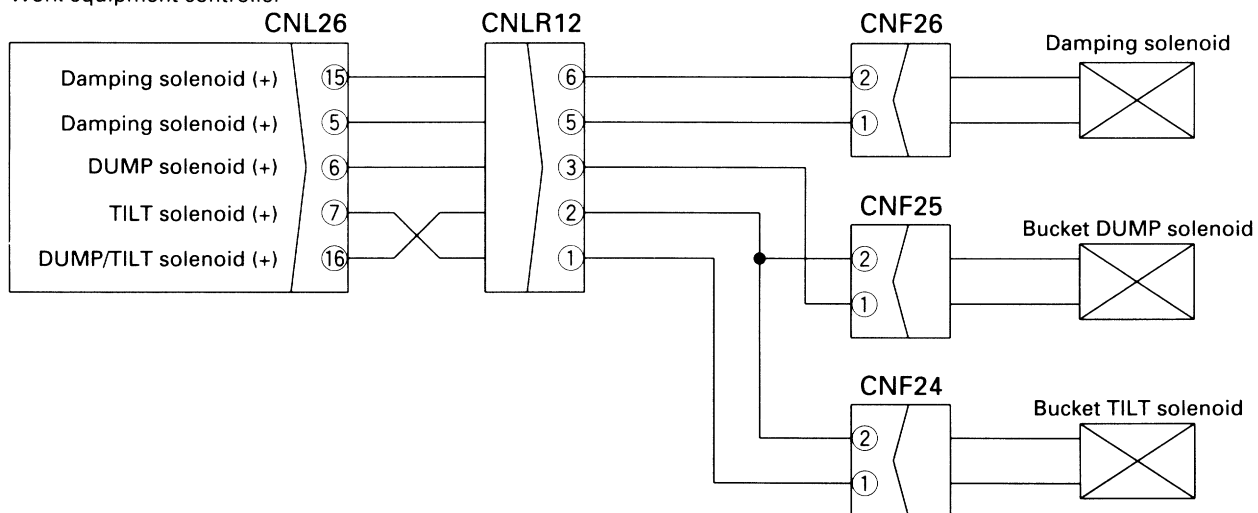
TDW00360

W-2 Failure code [41] Short circuit in power source when bucket DUMP, TILT solenoids are OFF

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.



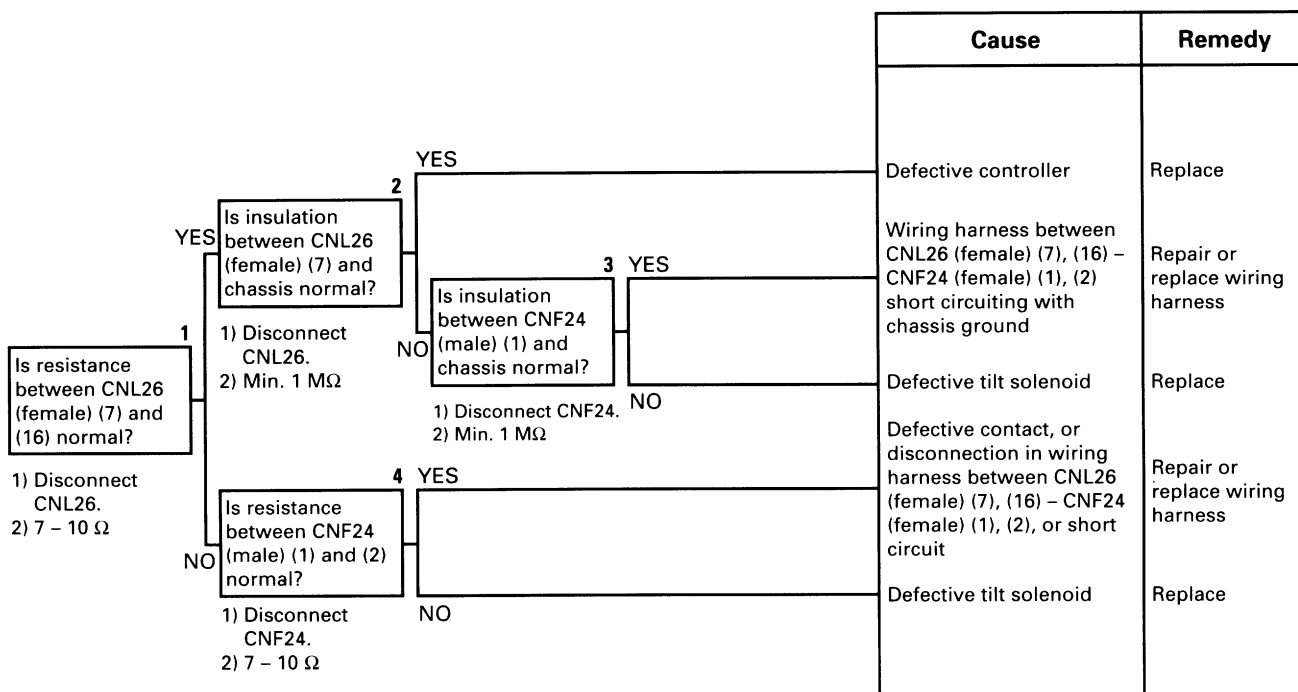
Work equipment controller



TDW00360

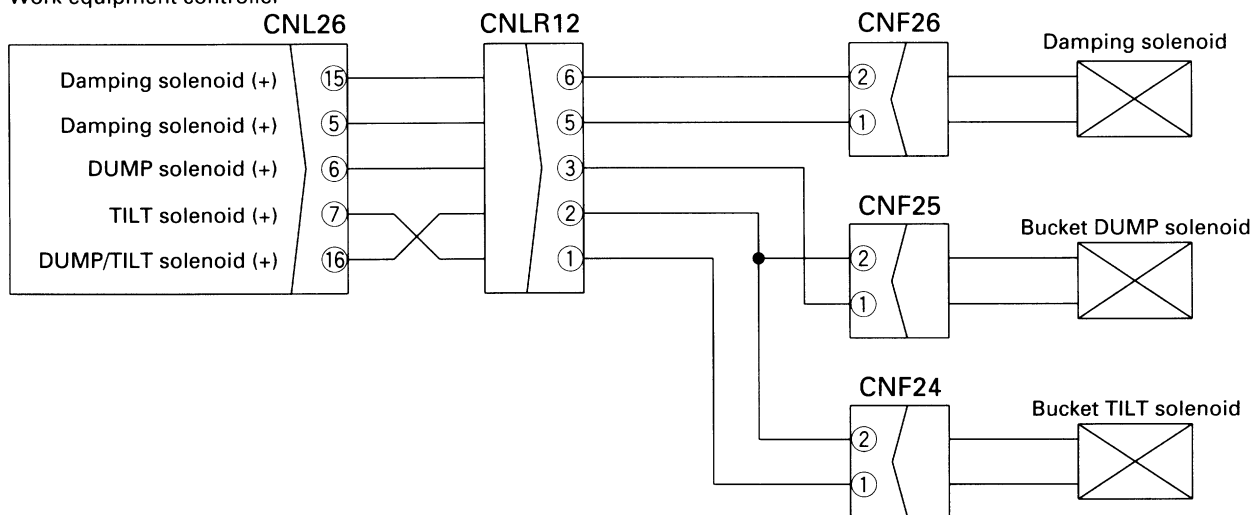
W-3 Failure code [42] Abnormality in bucket tilt solenoid system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



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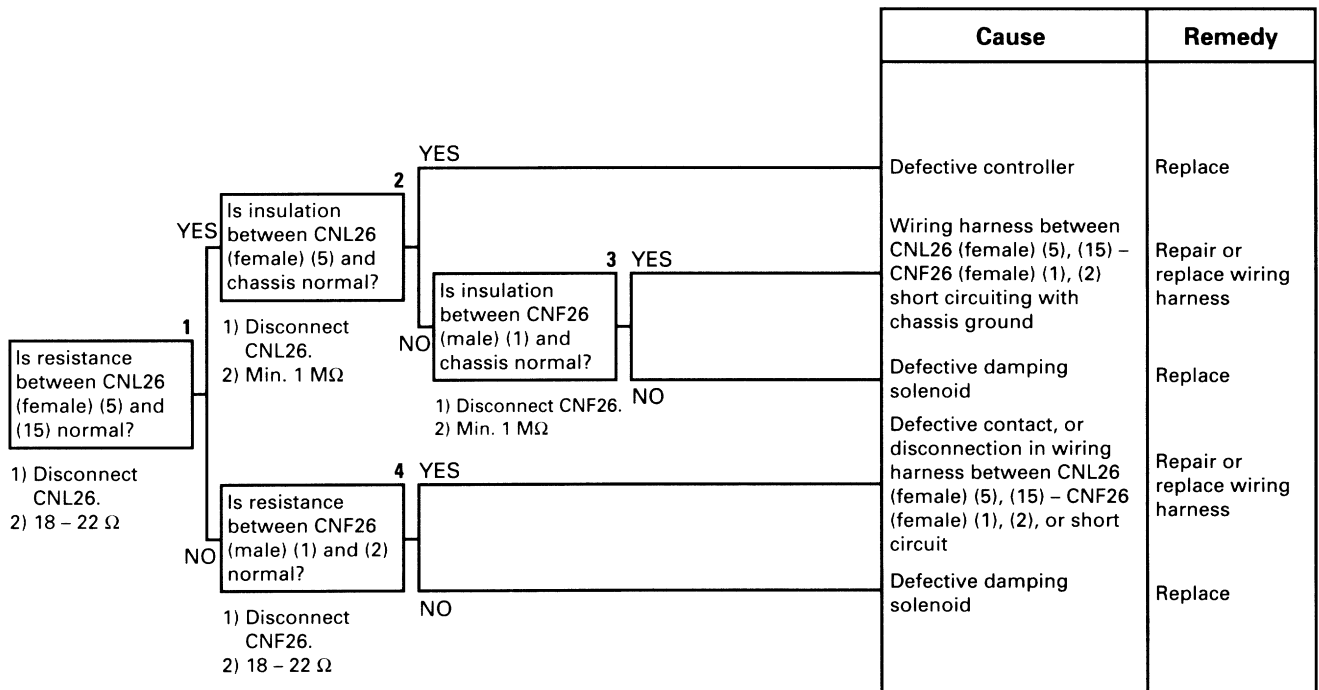
Work equipment controller



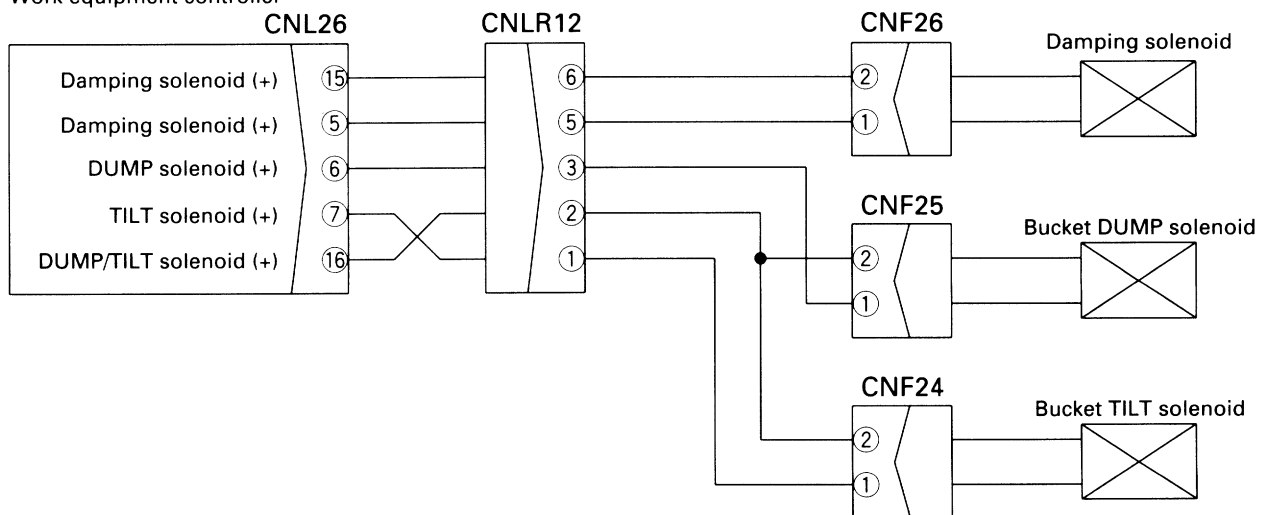
TDW00360

W-4 Failure code [43] Abnormality in damping solenoid system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



Work equipment controller



TDW00360

W-5 Failure code [44] Short circuit in power source at hot end of damping solenoid

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.

Cause	Remedy
Defective controller	Replace
Wiring harness between CNL26 (female) (5) and CNF26 (female) (1) short circuiting with power source	Repair or replace wiring harness

1 YES
Is voltage between CNL26 (female) (5) and chassis normal?

- NO
- 1) Disconnect CNF26.
 - 2) Turn starting switch ON.
 - 3) Max. 1 V

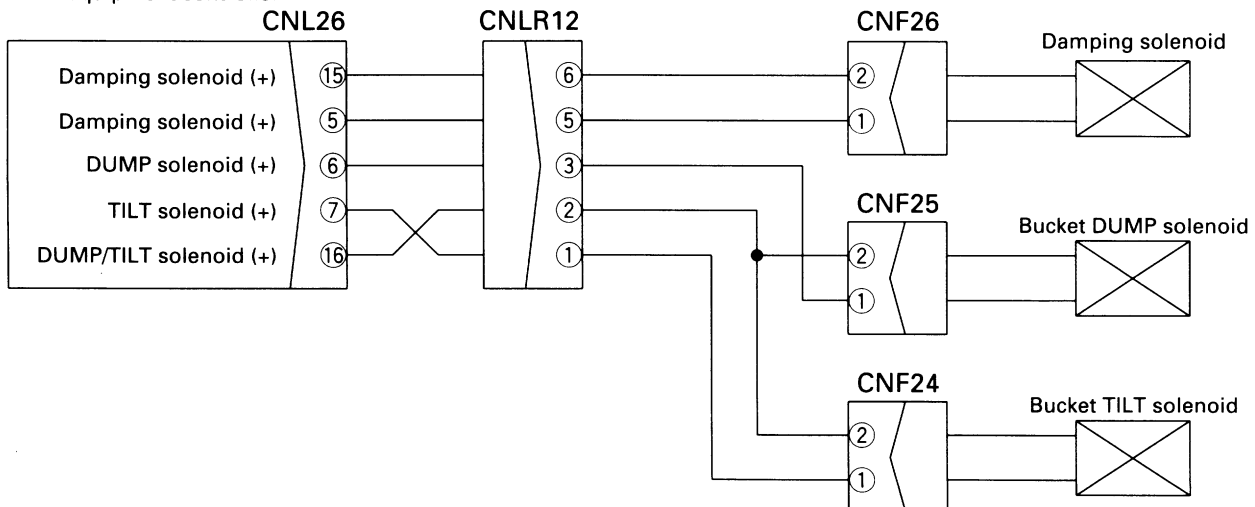
W-6 Failure code [45] Short circuit in power source at return end of damping solenoid

Cause	Remedy
Defective controller	Replace
Wiring harness between CNL26 (female) (15) and CNF26 (female) (2) short circuiting with power source	Repair or replace wiring harness

1 YES
Is voltage between CNL26 (female) (15) and chassis normal?

- NO
- 1) Disconnect CNF26.
 - 2) Turn starting switch ON.
 - 3) Max. 1 V

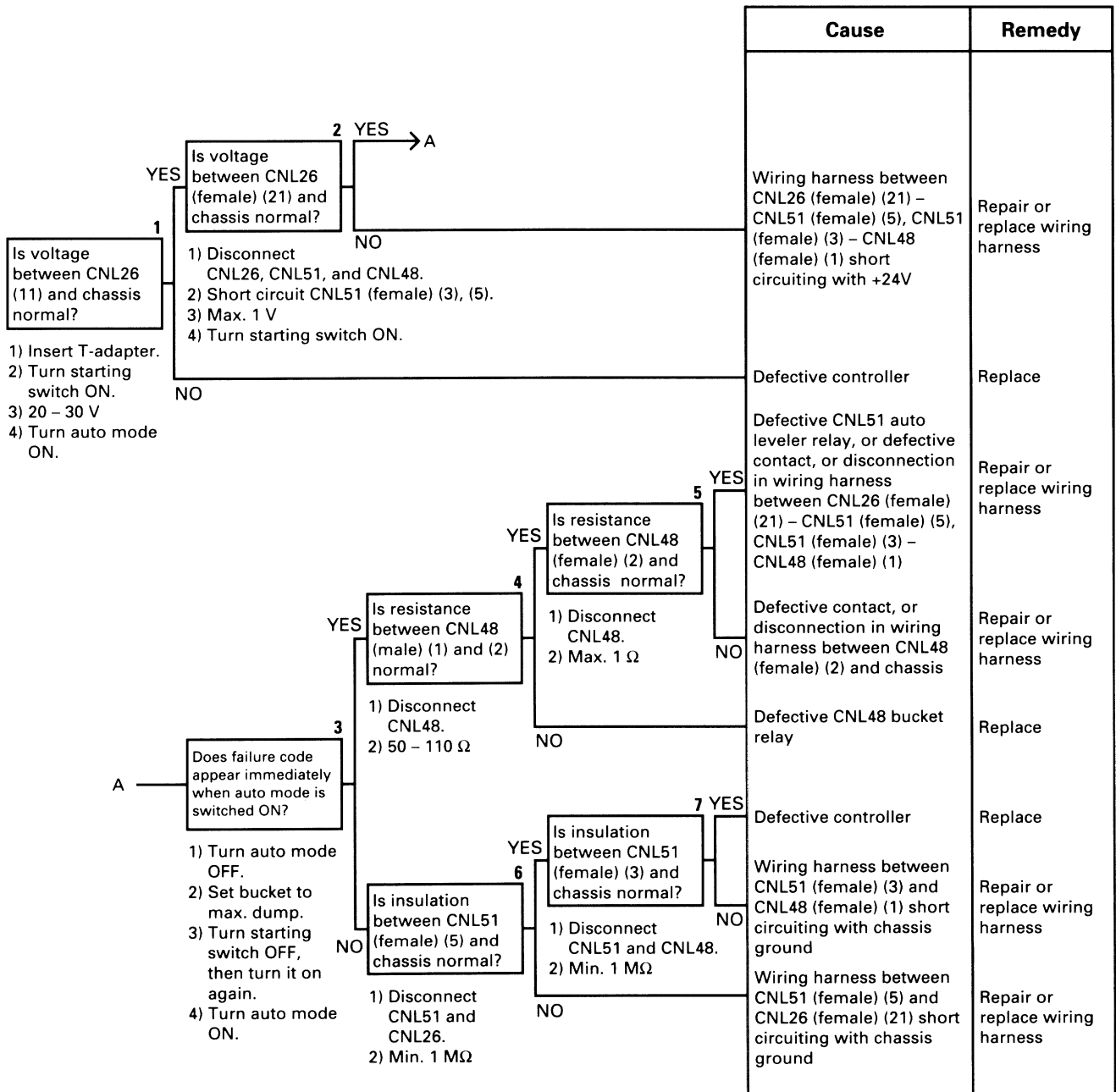
Work equipment controller

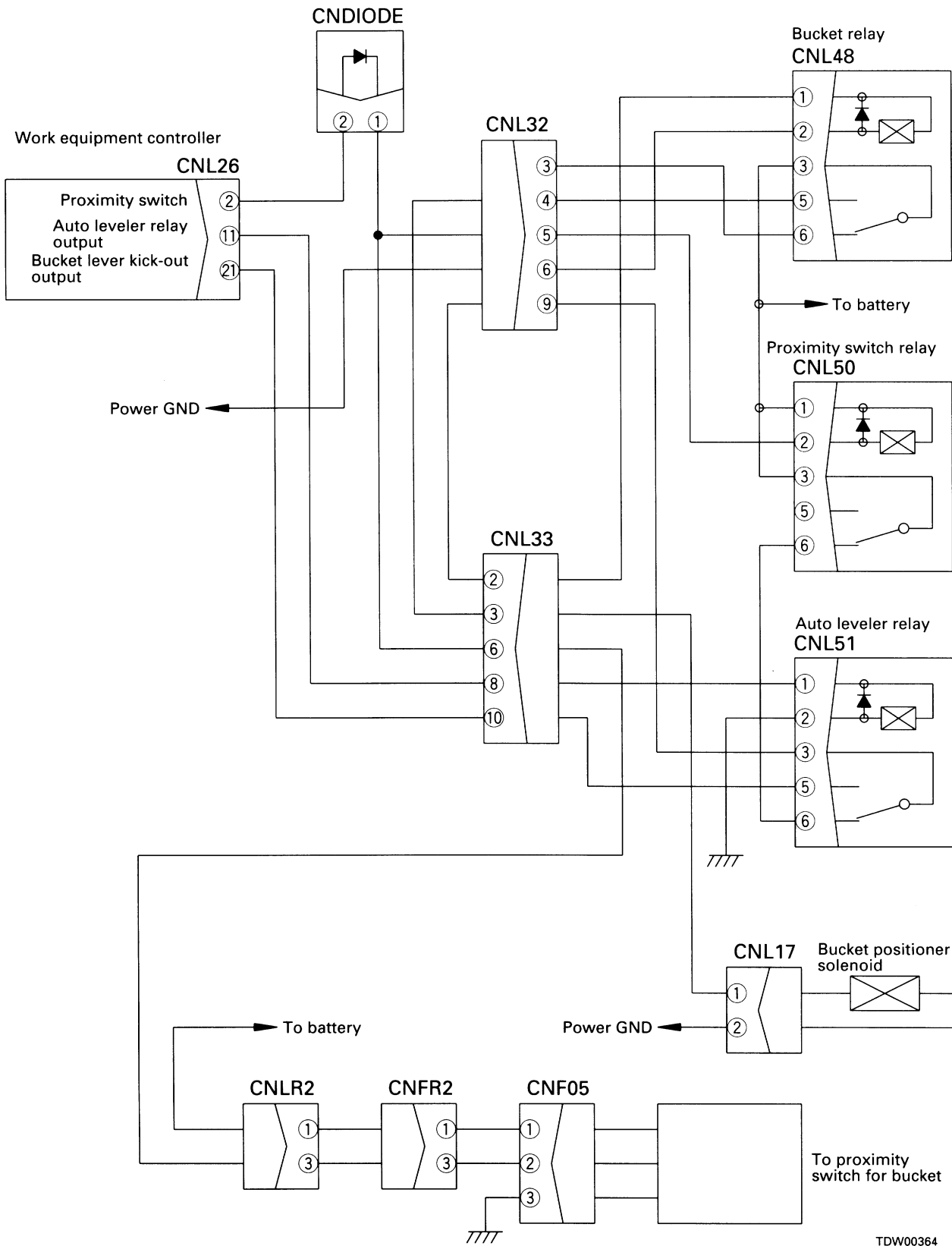


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W-7 Failure code [48] Abnormality in bucket lever kick-out relay system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adapter (or socket adapter), always turn the starting switch OFF.





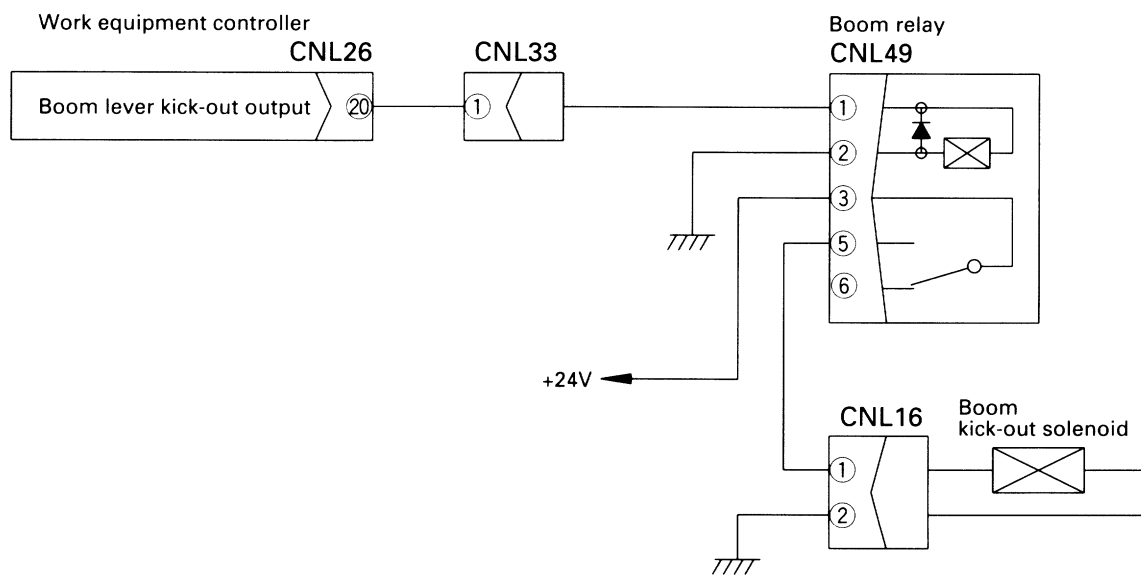
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TDW00364

W-8 Failure code [49] Abnormality in boom lever kick-out relay system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adapter (or socket adapter), always turn the starting switch OFF.

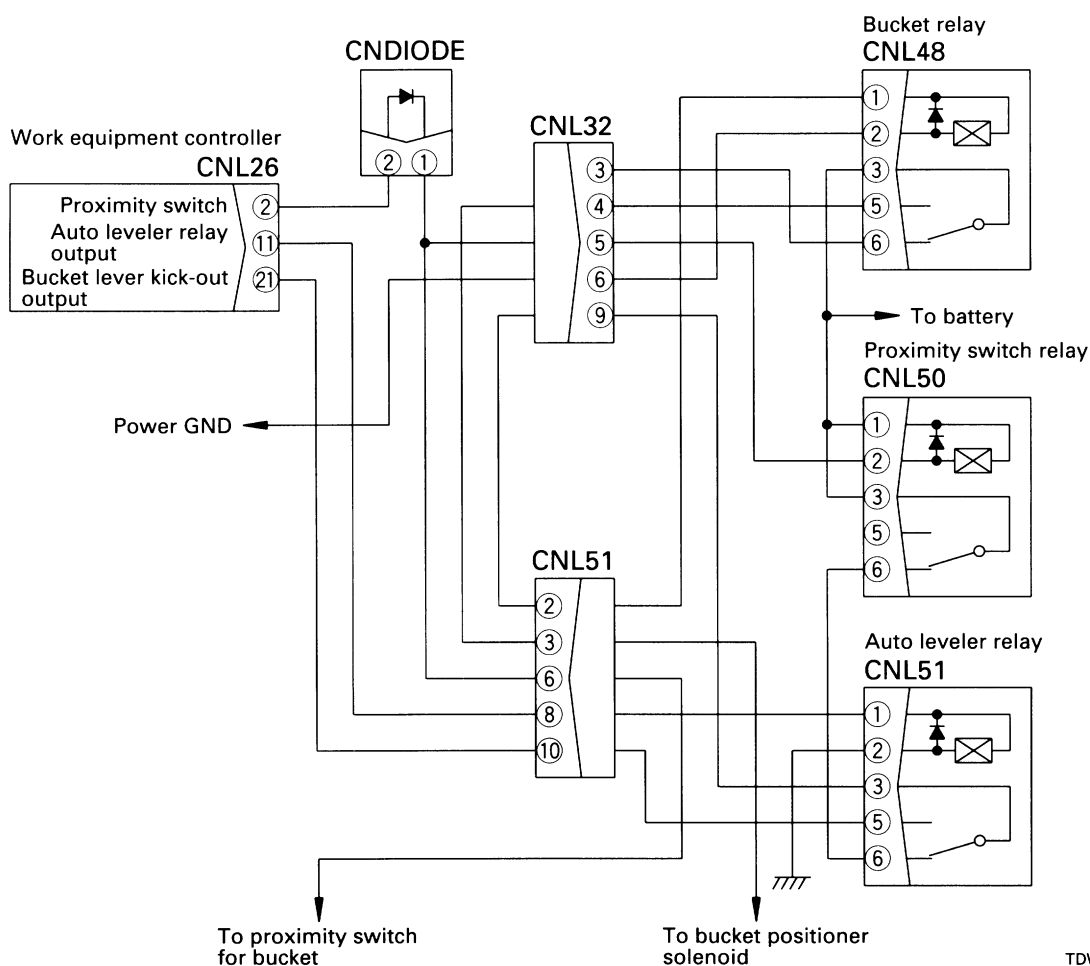
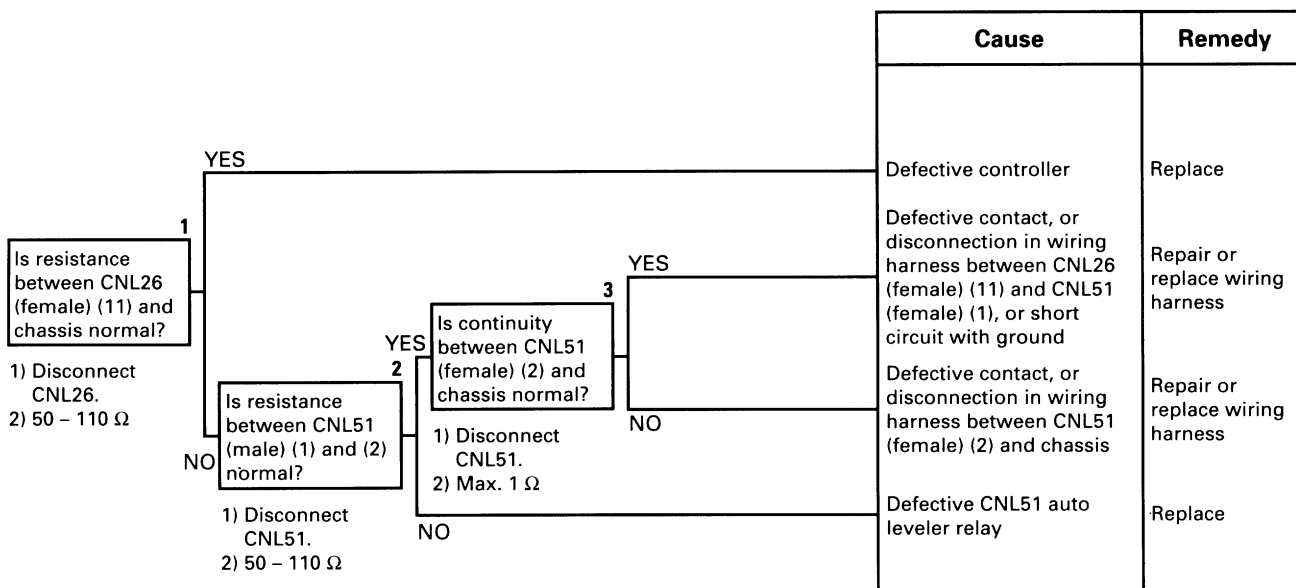
		Cause	Remedy
1) Disconnect CNL26. 2) 50 – 110 Ω Is resistance between CNL26 (female) (20) and chassis normal? 1) Disconnect CNL49. 2) Min. 1 MΩ Is insulation between CNL26 (female) (20) and chassis normal?	YES	Defective controller	Replace
	NO	Disconnection in wiring harness between CNL26 (female) (20) and CNL49 (female) (1)	Repair or replace wiring harness
	NO	Wiring harness between CNL26 (female) (20) and CNL49 (female) (1) short circuiting with chassis ground	Repair or replace wiring harness



TDW00365

W-9 Failure code [50] Abnormality in auto-leveler relay system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adapter (or socket adapter), always turn the starting switch OFF.

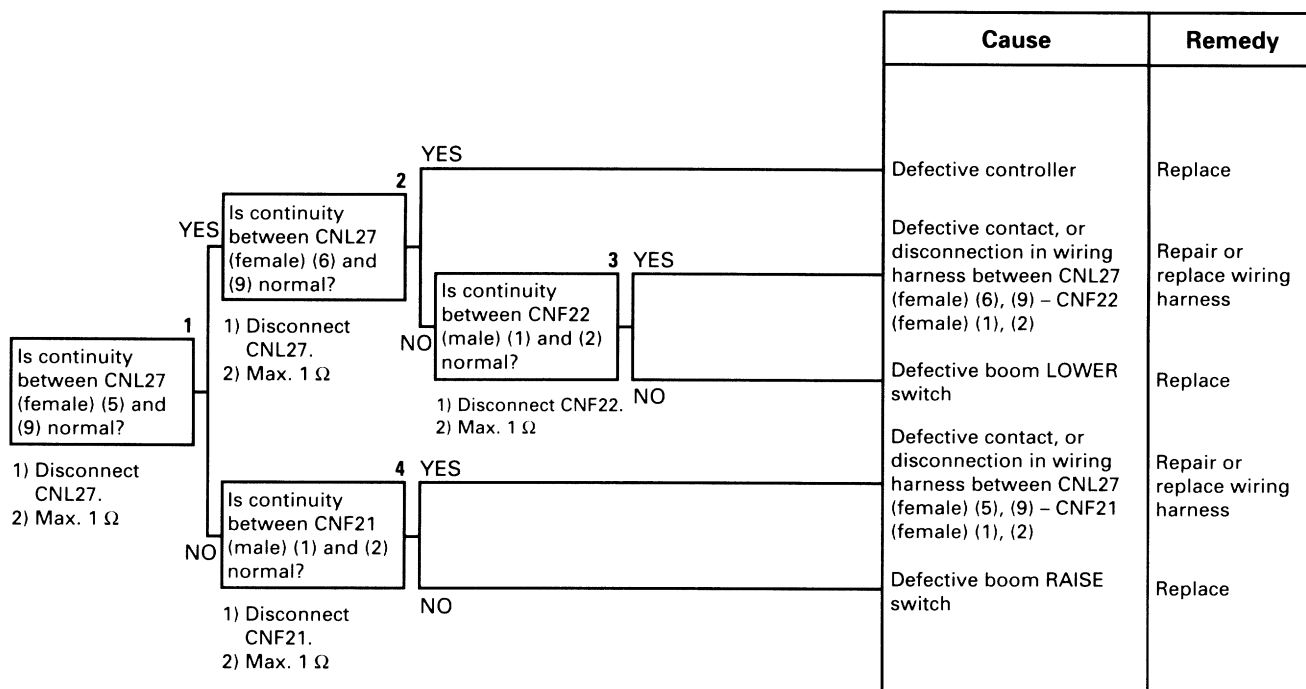


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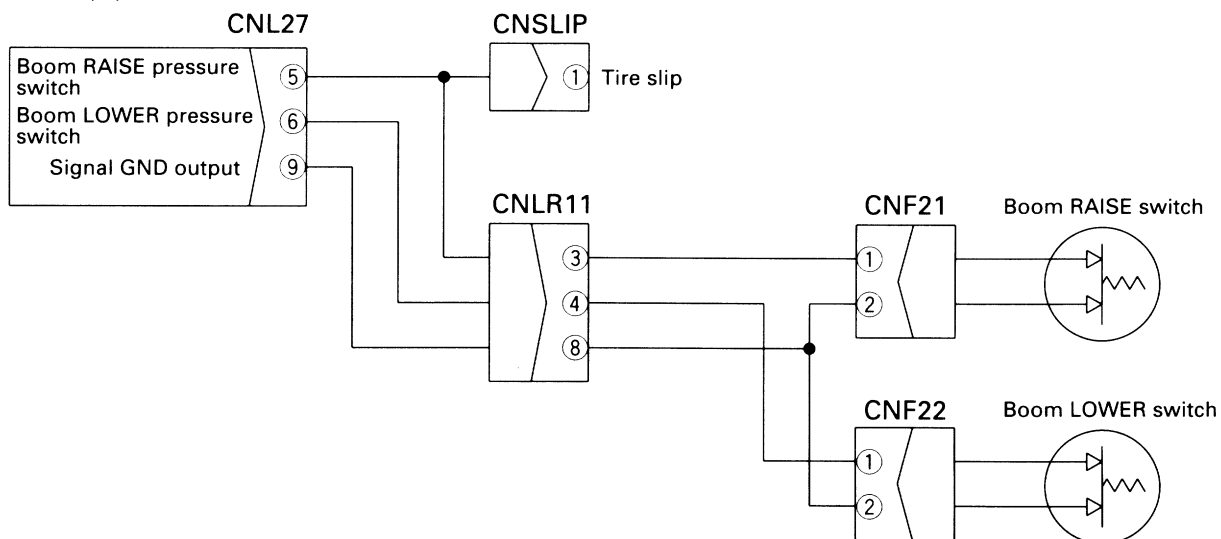
TDW00366

W-10 Failure code [51] Disconnection in boom RAISE, LOWER detection pressure switch

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



Work equipment controller



TDW00367

W-11 Failure code [52] Abnormality in boom angle potentiometer system

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.

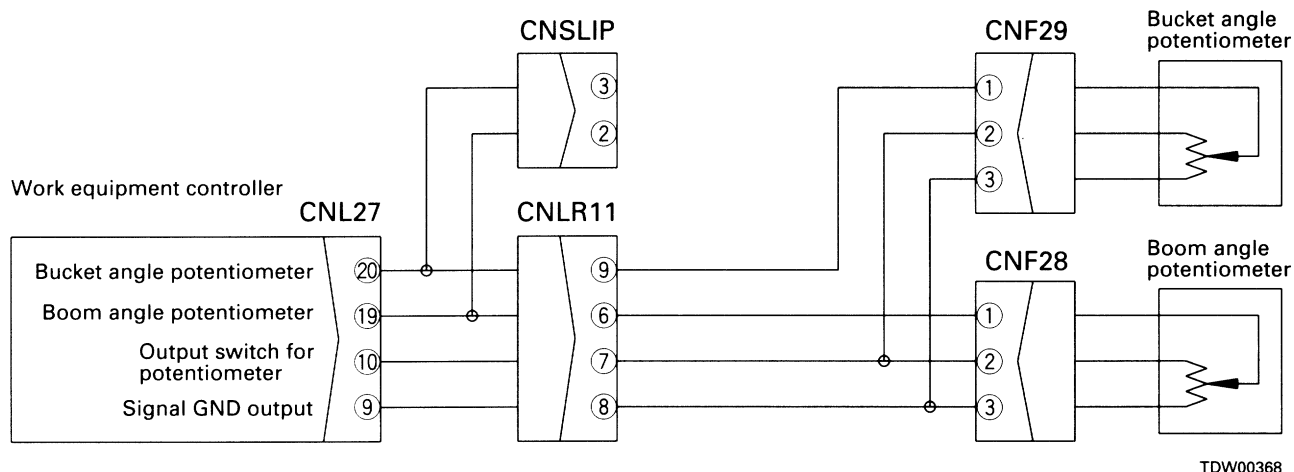
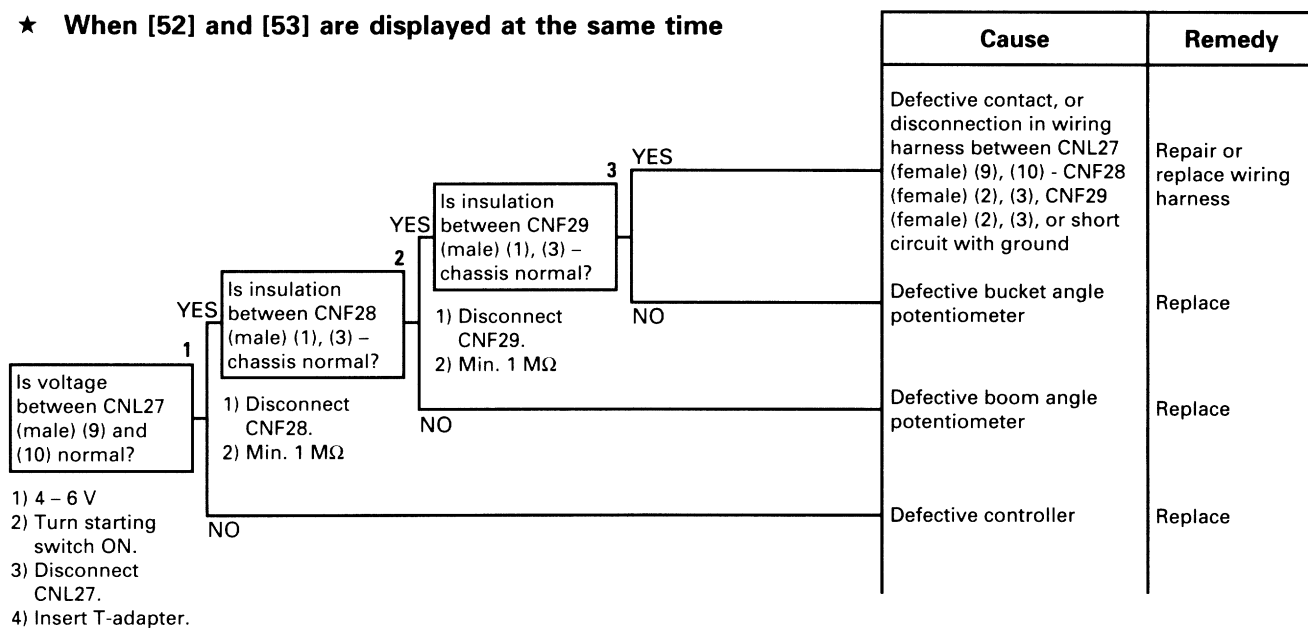
		Cause	Remedy
1 Is voltage between CNL27 (9) and (19) normal? 1) 0.3 – 4.7 V 2) Turn starting switch ON. 3) Insert T-adaptor.	YES	Is failure code 52 displayed in condition for measuring Item 1?	
		2 YES	Defective controller Replace
		NO	Already reset –
	NO	3 YES	Defective contact, or disconnection in wiring harness between CNF28 (female) (1) and CNL27 (female) (19), or short circuit with ground Repair or replace wiring harness
		NO	Defective boom angle potentiometer Replace
		Is resistance between CNF28 (male) (1) – (2), (2) – (3) normal? 1) Between (1) and (2): 0.2 – 5 kΩ 2) Between (2) and (3): 4 – 5 kΩ 3) Disconnect CNF28.	

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W-12 Failure code [53] Abnormality in bucket angle potentiometer system

		Cause	Remedy
1 Is voltage between CNL27 (9) and (20) normal? 1) 0.3 – 4.7 V 2) Turn starting switch ON. 3) Insert T-adaptor.	YES	Is failure code 53 displayed in condition for measuring Item 1?	
		2 YES	Defective controller Replace
		NO	Already reset –
	NO	3 YES	Defective contact, or disconnection in wiring harness between CNF28 (female) (1) and CNL27 (female) (20), or short circuit with ground Repair or replace wiring harness
		NO	Defective boom angle potentiometer Replace
		Is resistance between CNF28 (male) (1) – (2), (2) – (3) normal? 1) Between (1) and (2): 0.2 – 5 kΩ 2) Between (2) and (3): 4 – 5 kΩ 3) Disconnect CNF28.	

★ When [52] and [53] are displayed at the same time



TDW00368

W-13 Failure code [54] Abnormality in model selection wiring harness

- ★ Check that the model selection connector has been properly selected (see STRUCTURE AND FUNCTION)
- ★ Insert a T-adapter, then turn the starting switch ON.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adapter (or socket adapter), always turn the starting switch OFF.

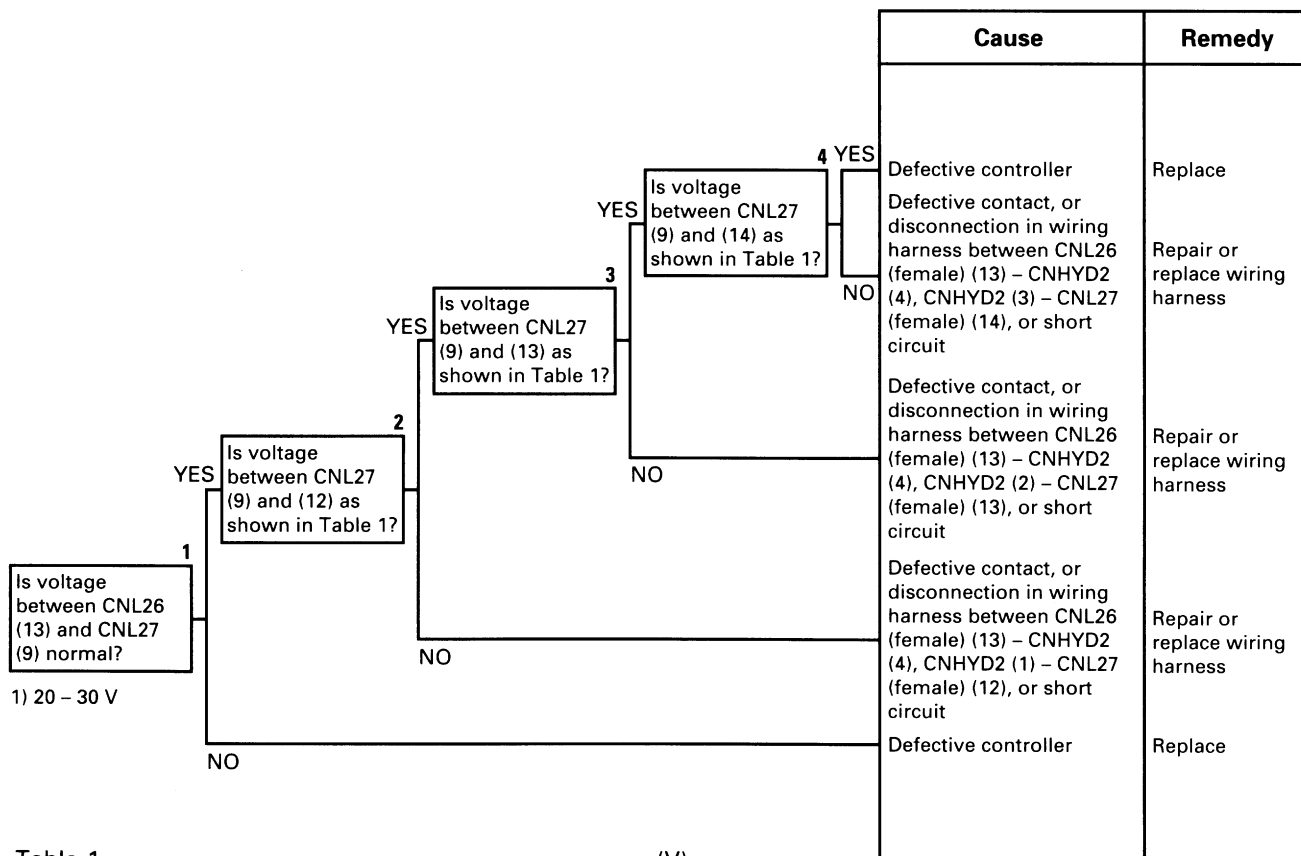
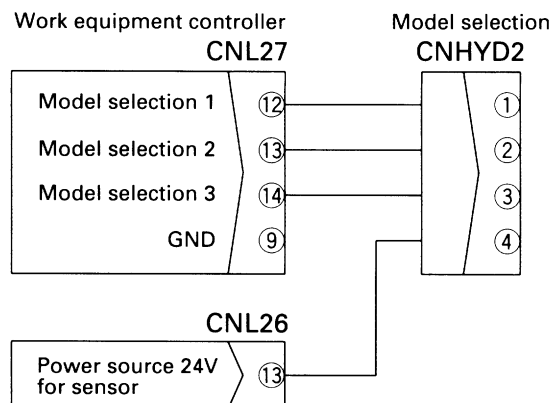


Table 1 (V)

Model Connector	WA300	WA350	WA400	WA450
Between CNL27 (12) and (9)	Max. 1	Max. 1	20 – 30	20 – 30
Between CNL27 (13) and (9)	Max. 1	20 – 30	Max. 1	20 – 30
Between CNL27 (14) and (9)	Max. 1	20 – 30	20 – 30	Max. 1

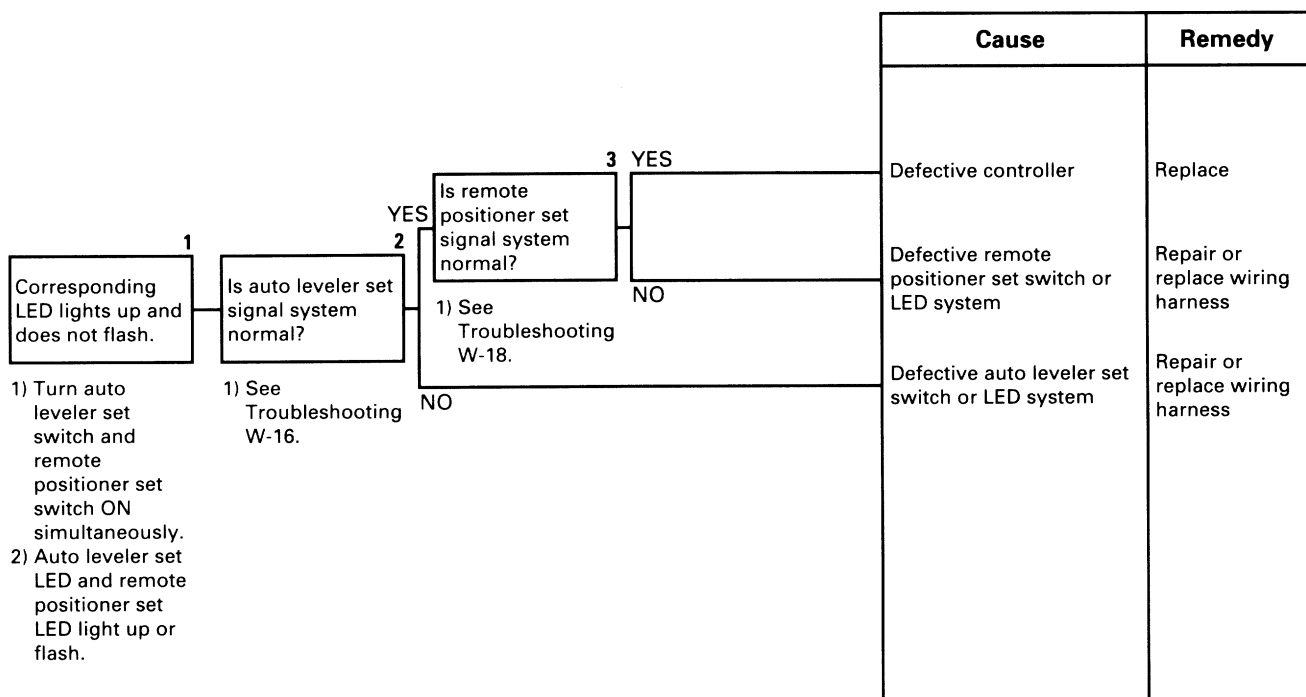


TDW00369

U42103

W-14 Sensor cannot be adjusted

- ★ For details of the method of operation, see STRUCTURE AND FUNCTION.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



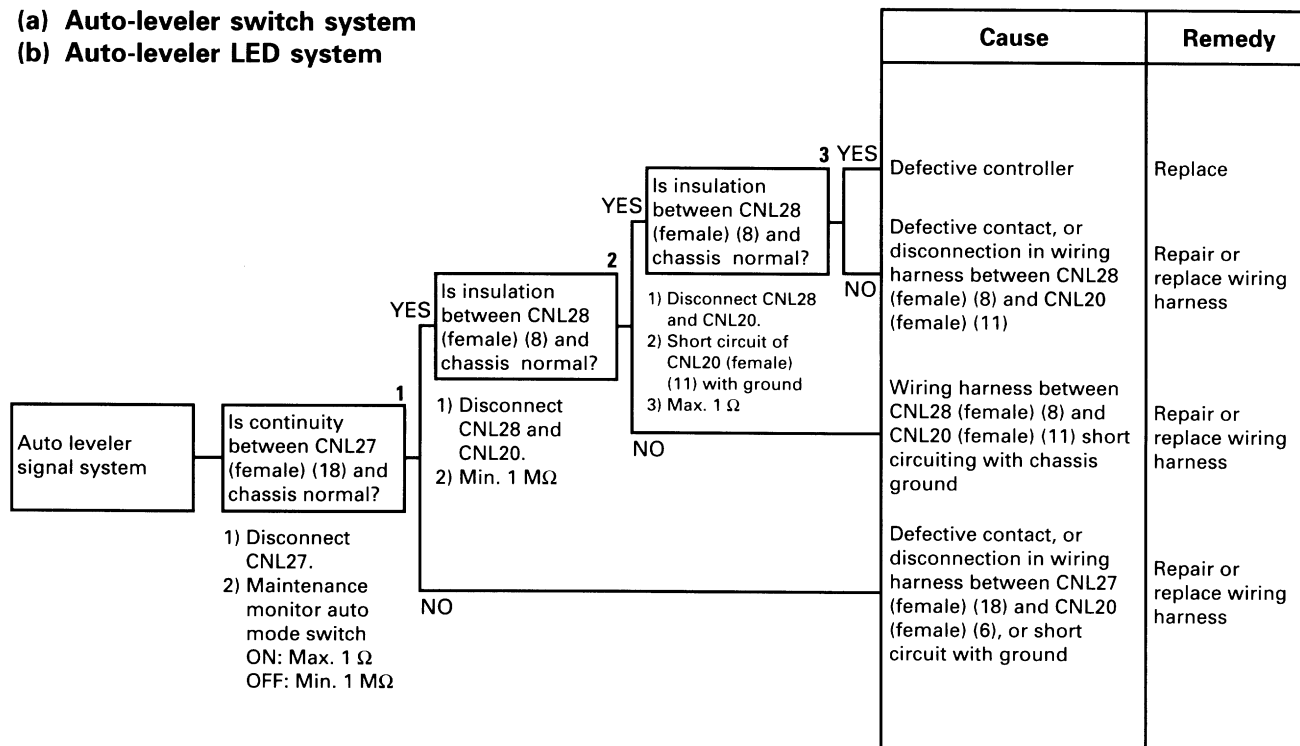
U42103

W-15 Does not carry out auto-leveling

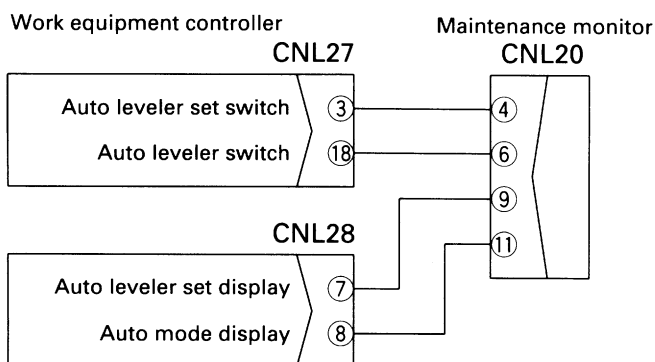
- ★ Check that the maintenance monitor works properly in Troubleshooting W-24 [Maintenance monitor check].
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.

(a) Auto-leveler switch system

(b) Auto-leveler LED system



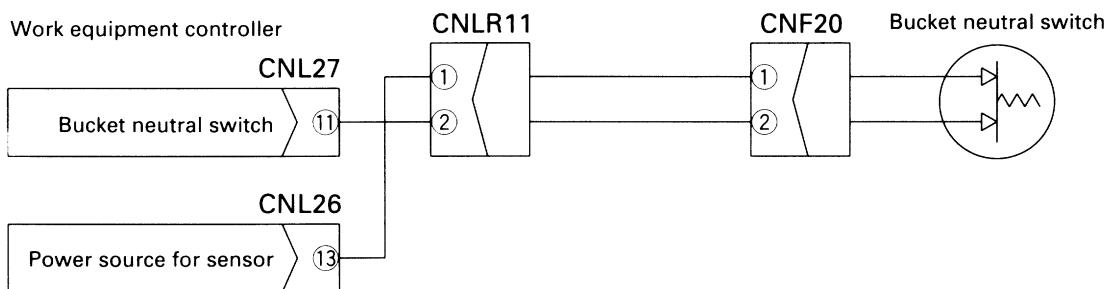
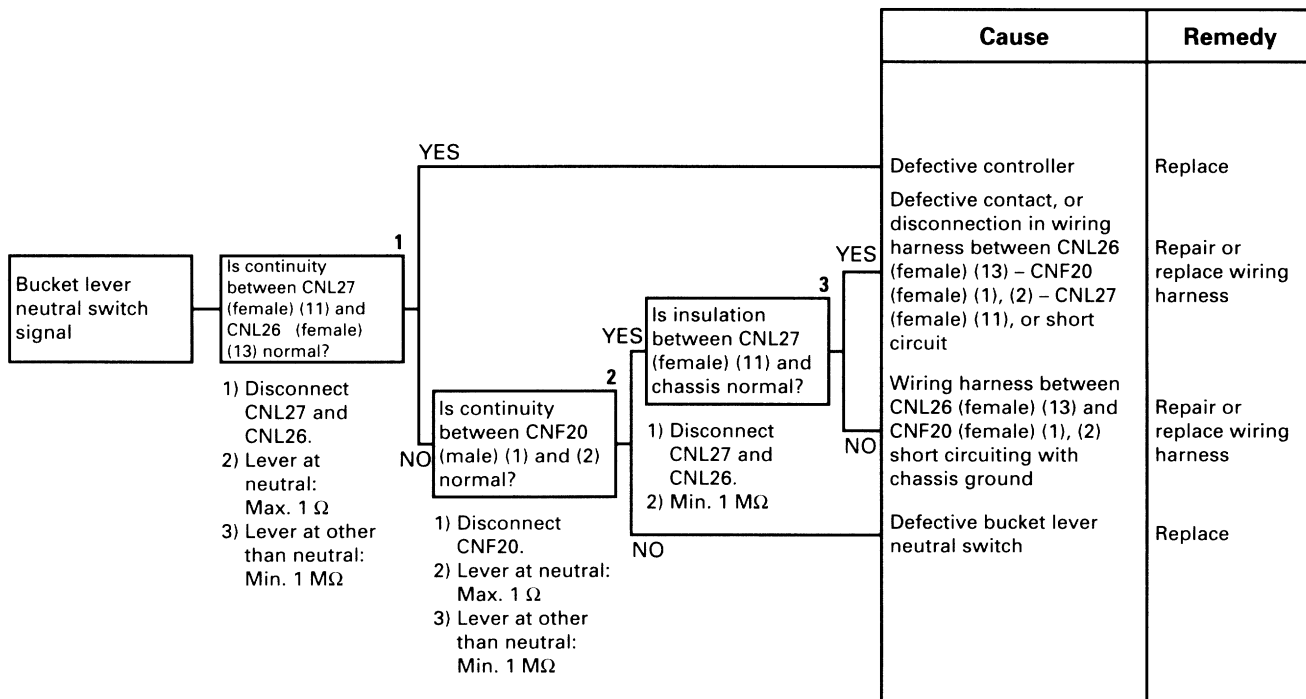
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TDW00370

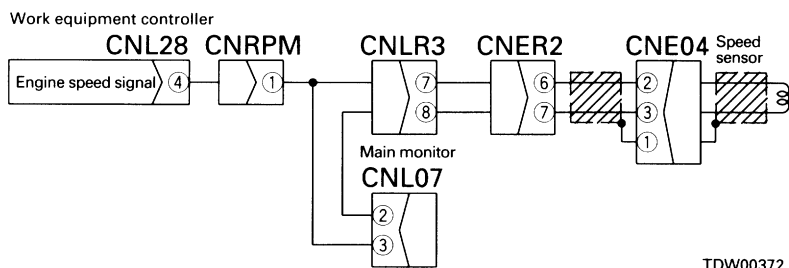
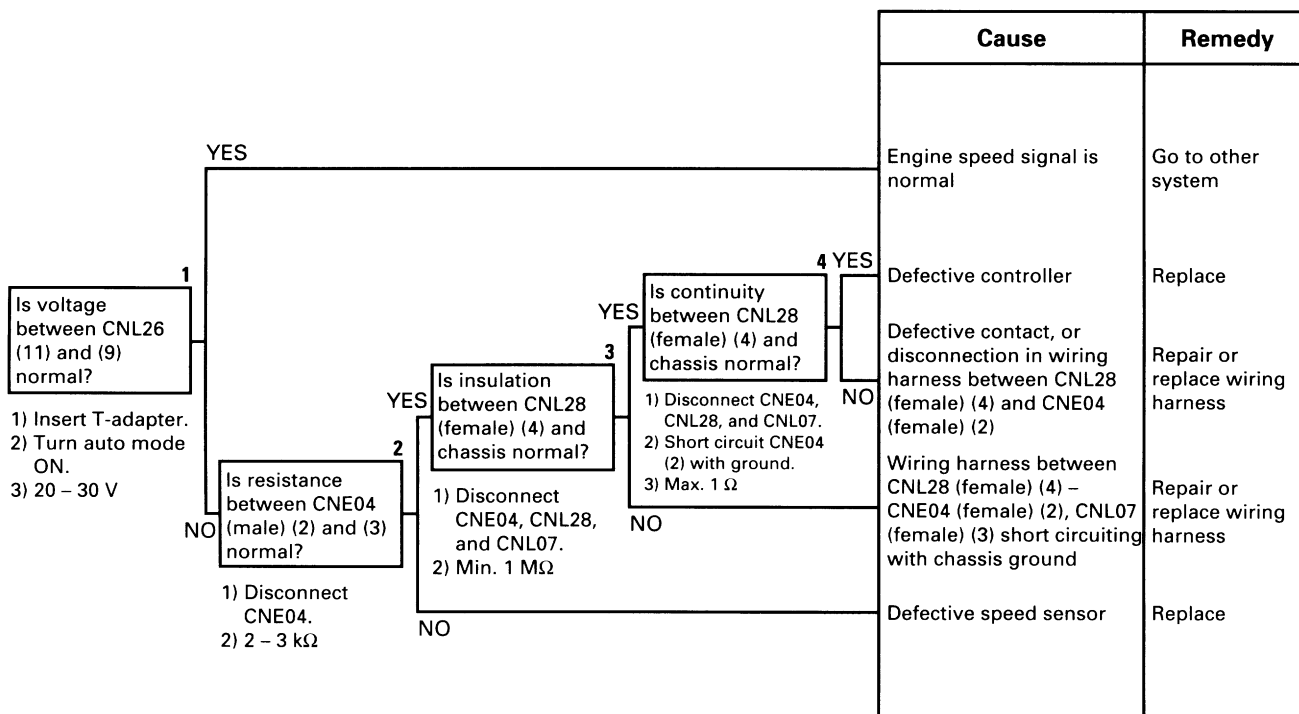
(c) Bucket lever neutral switch system

- Insert the T-adapter into CNL26, turn the starting switch ON, and check that the voltage between CNL26 (11) and (9) is 20 – 30 V.



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(d) Engine speed signal system

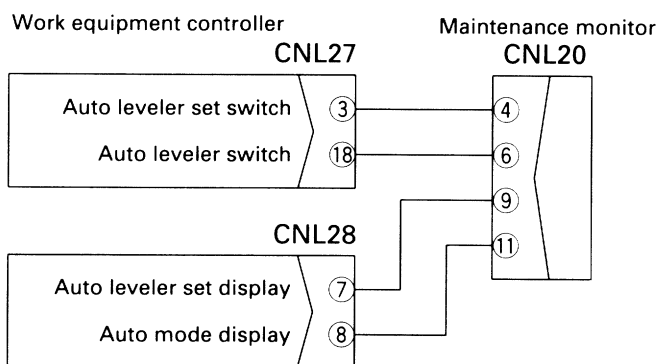
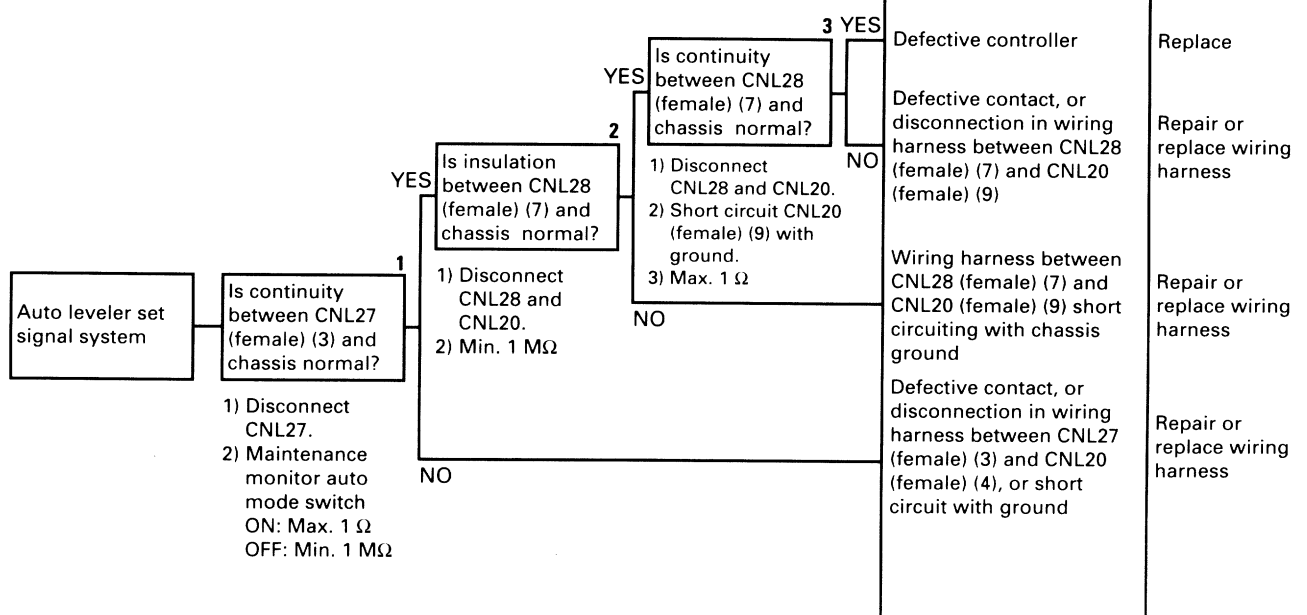


W-16 Auto-leveler cannot be set

- ★ Check that the maintenance monitor works properly in Troubleshooting W-24 [Maintenance monitor check].
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.

(a) Auto-leveler set switch system

(b) Auto-leveler set LED system

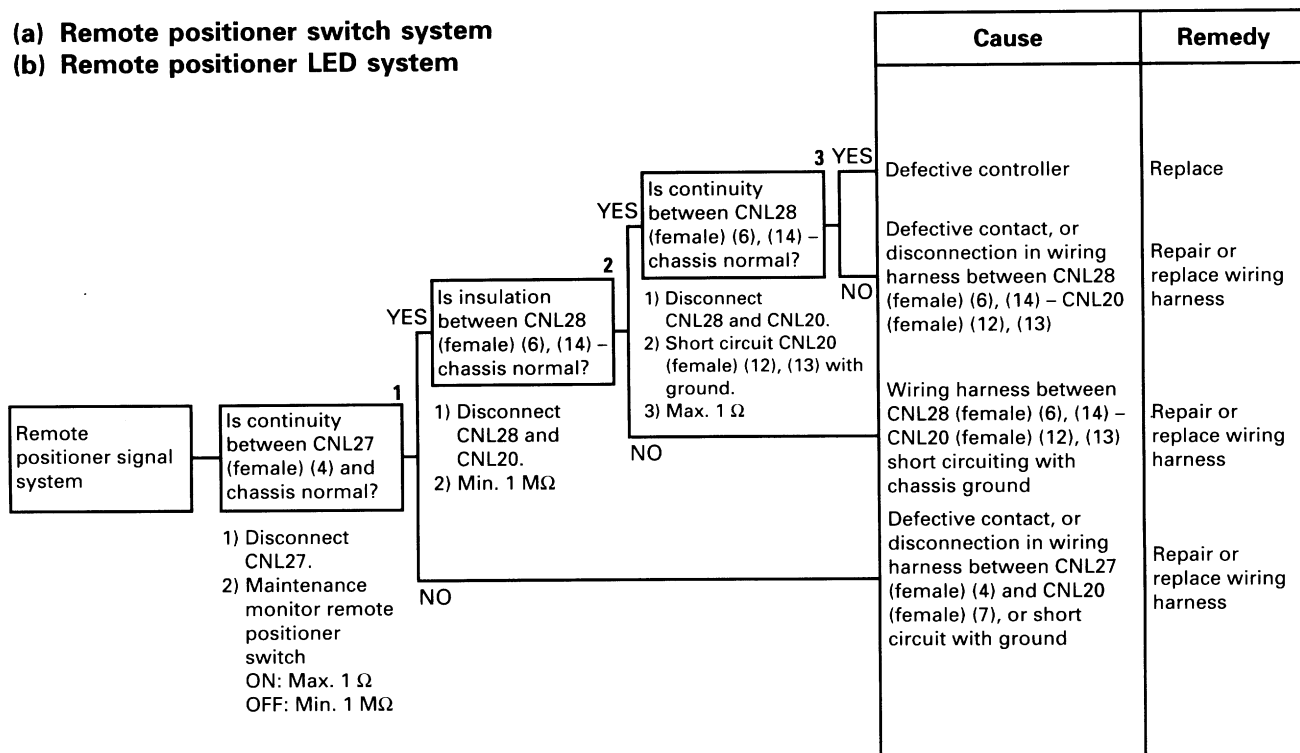


W-17 Remote positioner RAISE, LOWER LEDs do not light up

- ★ Check that the maintenance monitor works properly in Troubleshooting W-24 [Maintenance monitor check].
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.

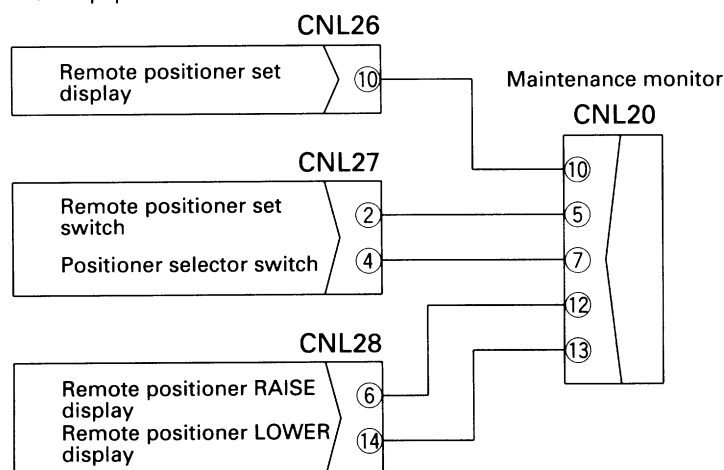
(a) Remote positioner switch system

(b) Remote positioner LED system



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Work equipment controller



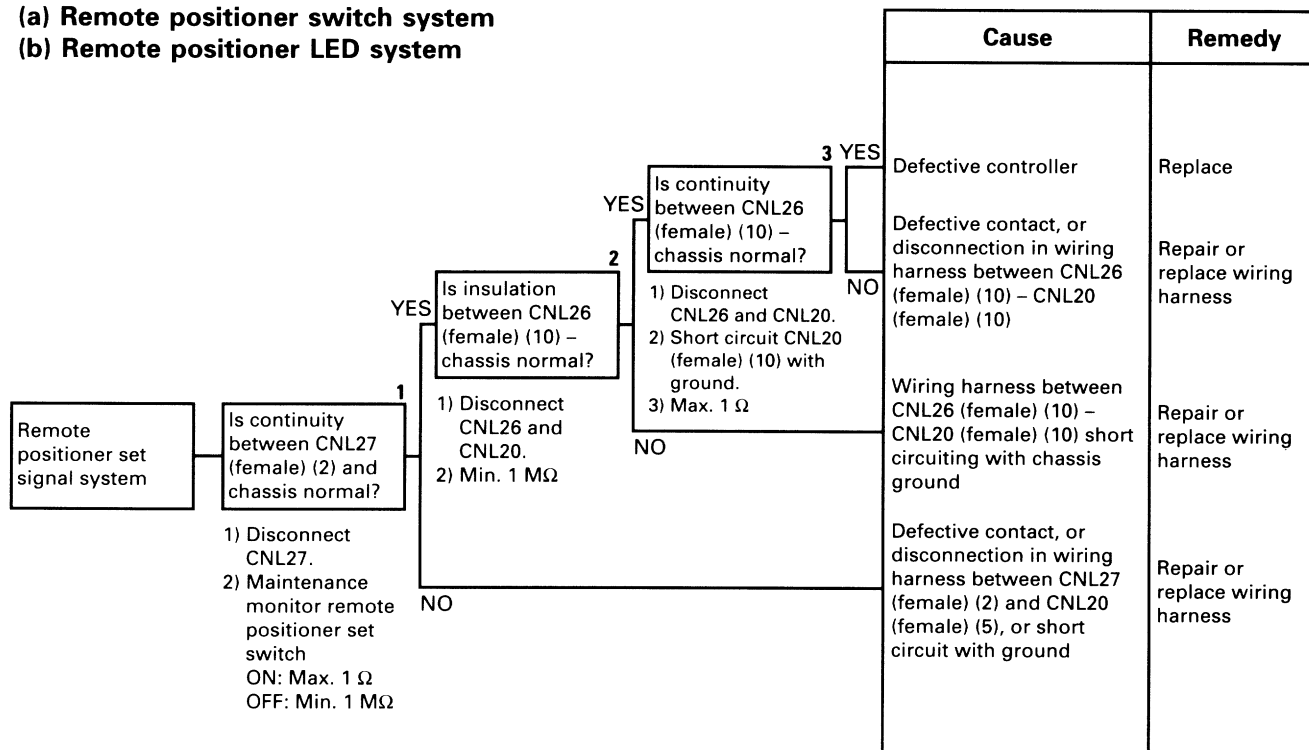
TDW00375

W-18 Remote positioner set LEDs do not flash

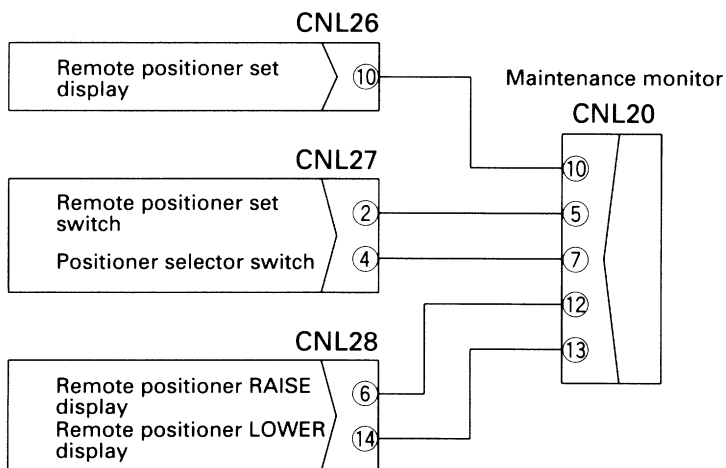
- ★ Check that the maintenance monitor works properly in Troubleshooting W-24 [Maintenance monitor check].
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.

(a) Remote positioner switch system

(b) Remote positioner LED system



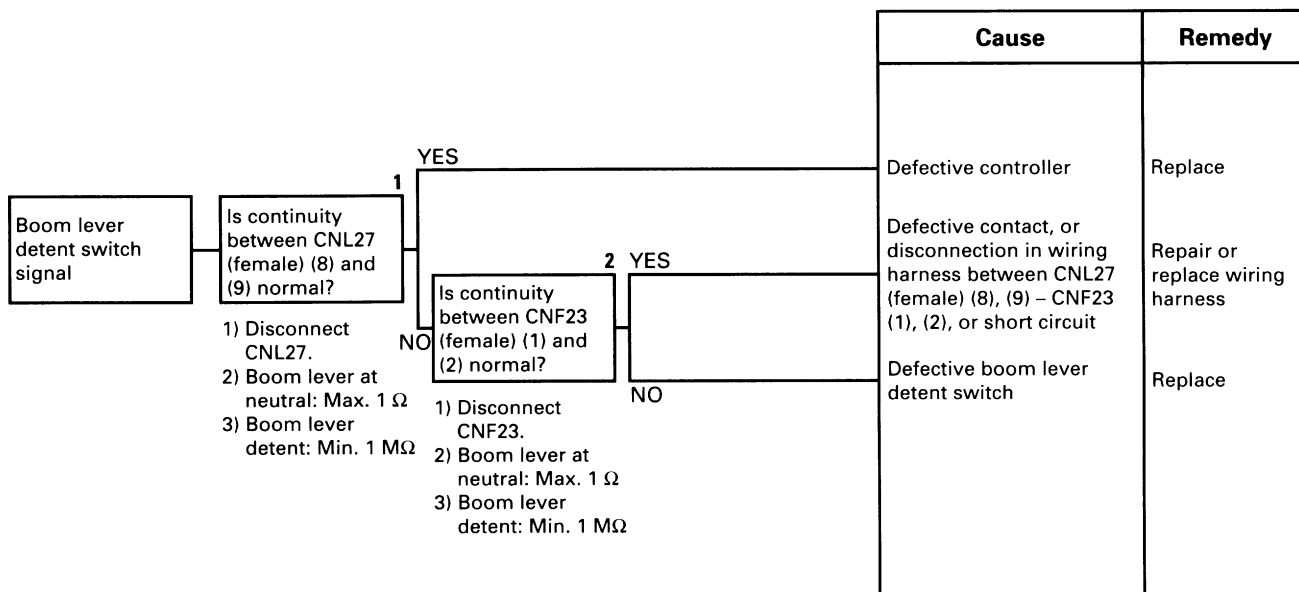
Work equipment controller



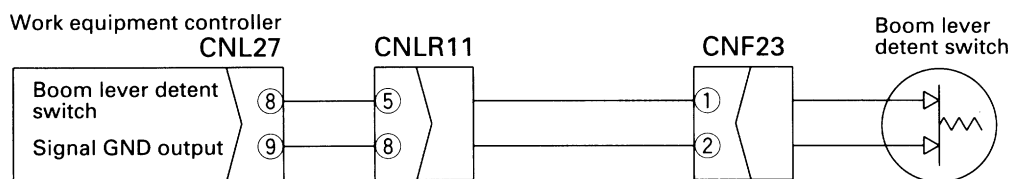
TDW00375

W-19 Bucket does not tilt immediately at boom FLOAT detent when remote positioner is at RAISE and auto mode is ON

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adapter (or socket adapter), always turn the starting switch OFF.

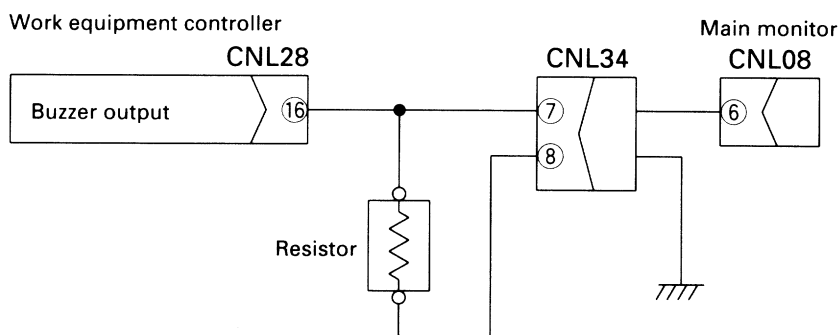
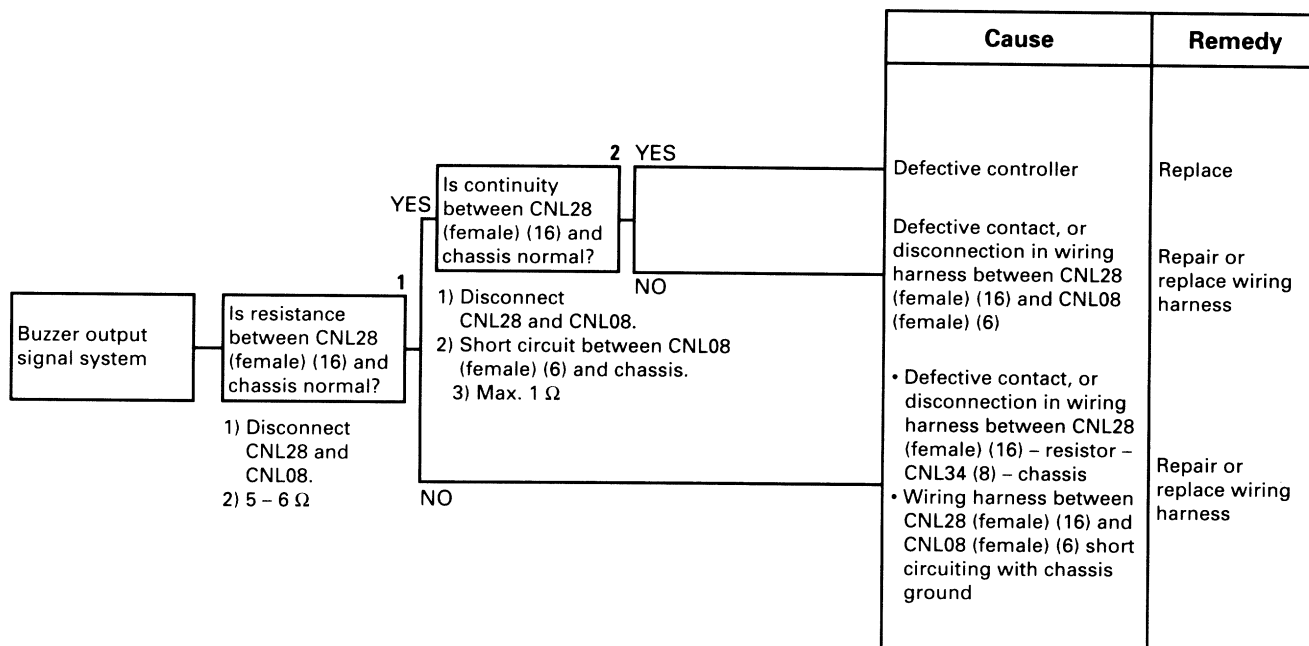


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W-20 Buzzer for switch operation does not sound

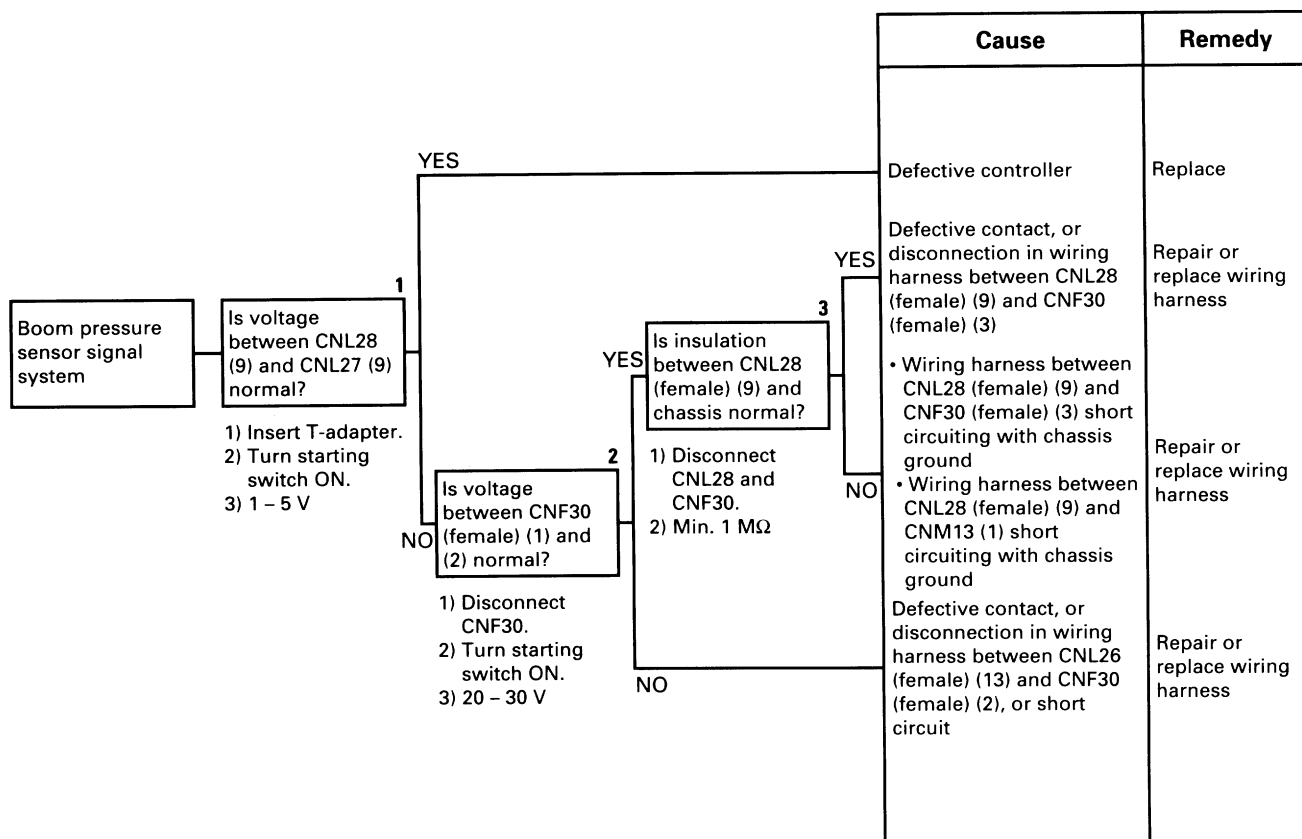
- ★ Check that the main monitor and alarm buzzer work properly.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



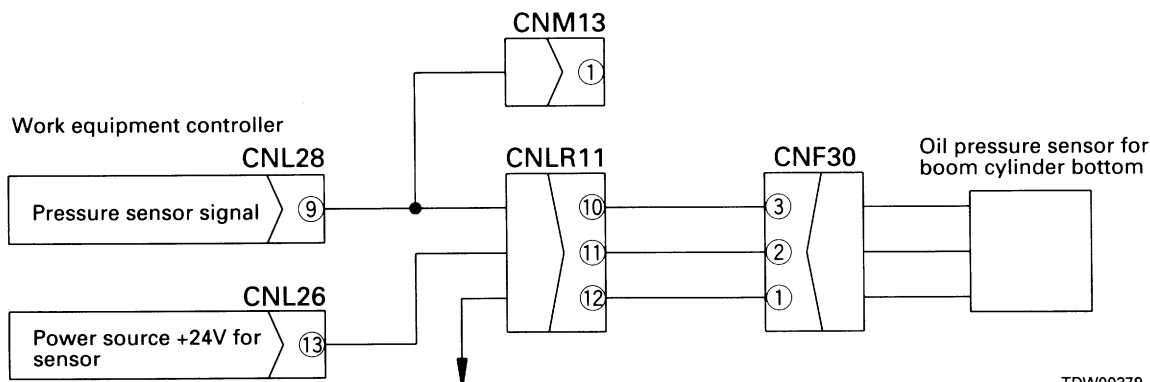
TDW00378

W-21 Bucket correction, boom stop response are slow

- ★ Check that the boom cylinder bottom pressure sensor works properly.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



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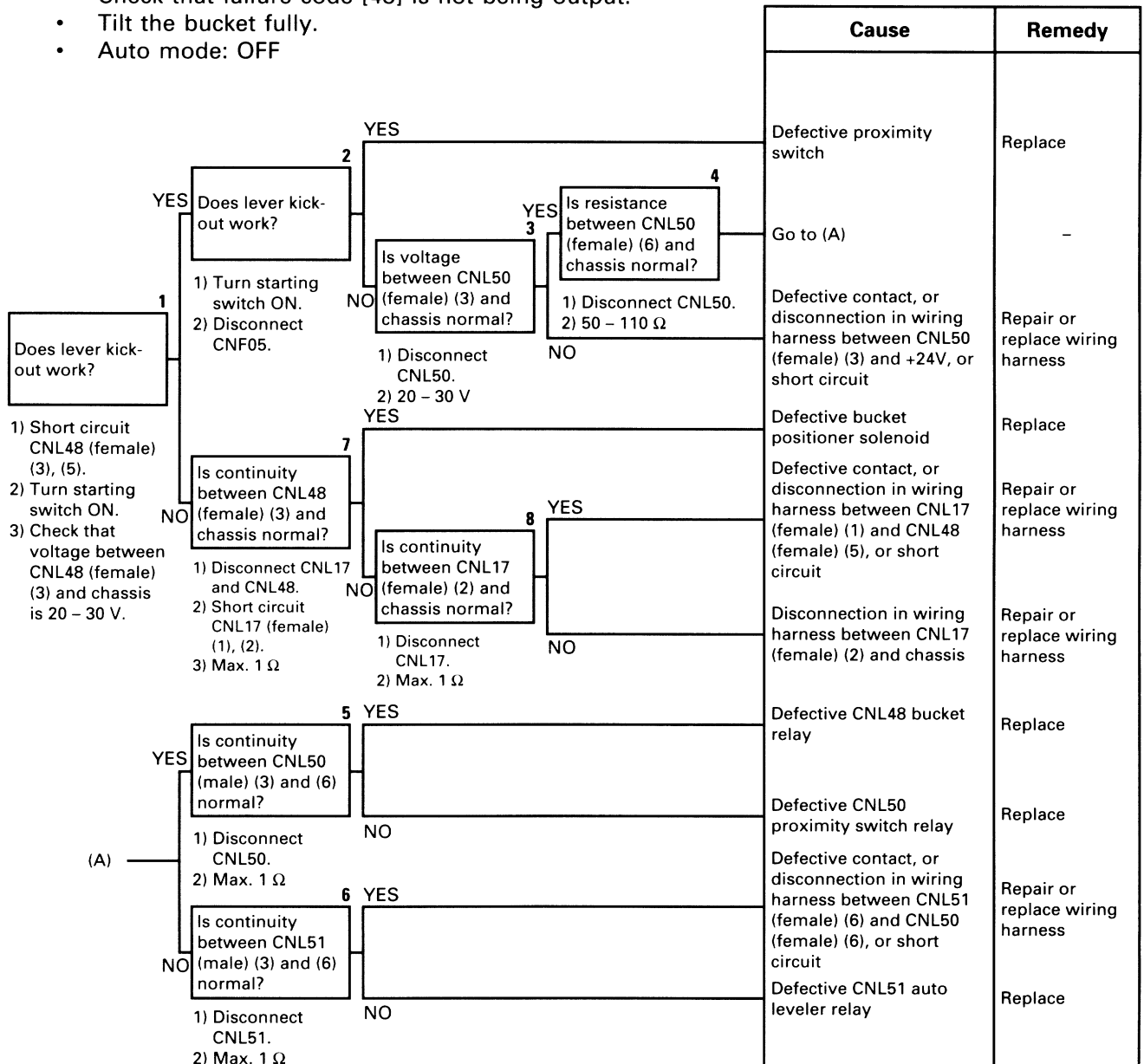
TDW00379

W-22 Bucket (lever) control

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.

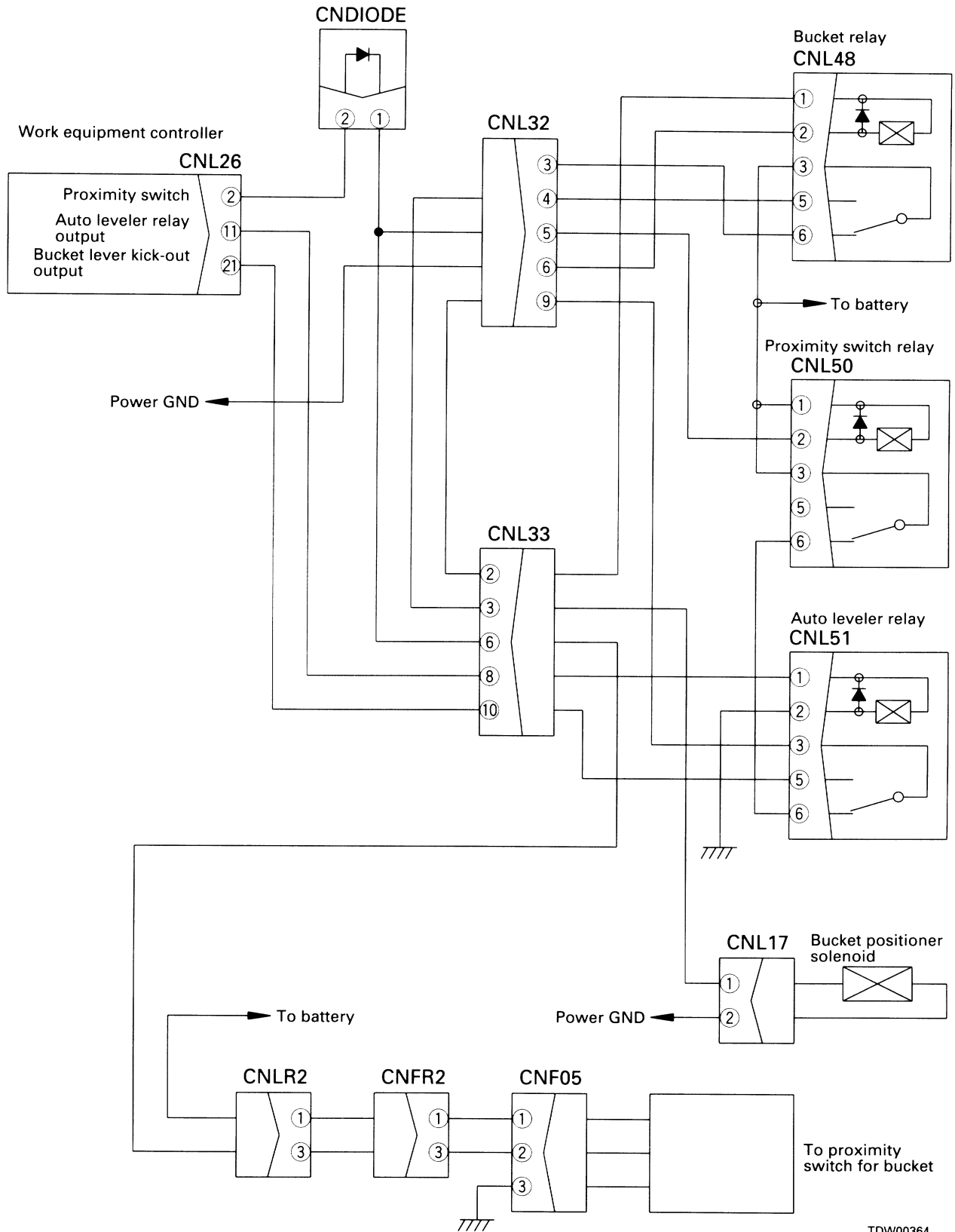
(a) Bucket kick-out does not work even when bucket is at maximum tilt

- Check that failure code [48] is not being output.
- Tilt the bucket fully.
- Auto mode: OFF



- Check that failure code [48] is not being detected.

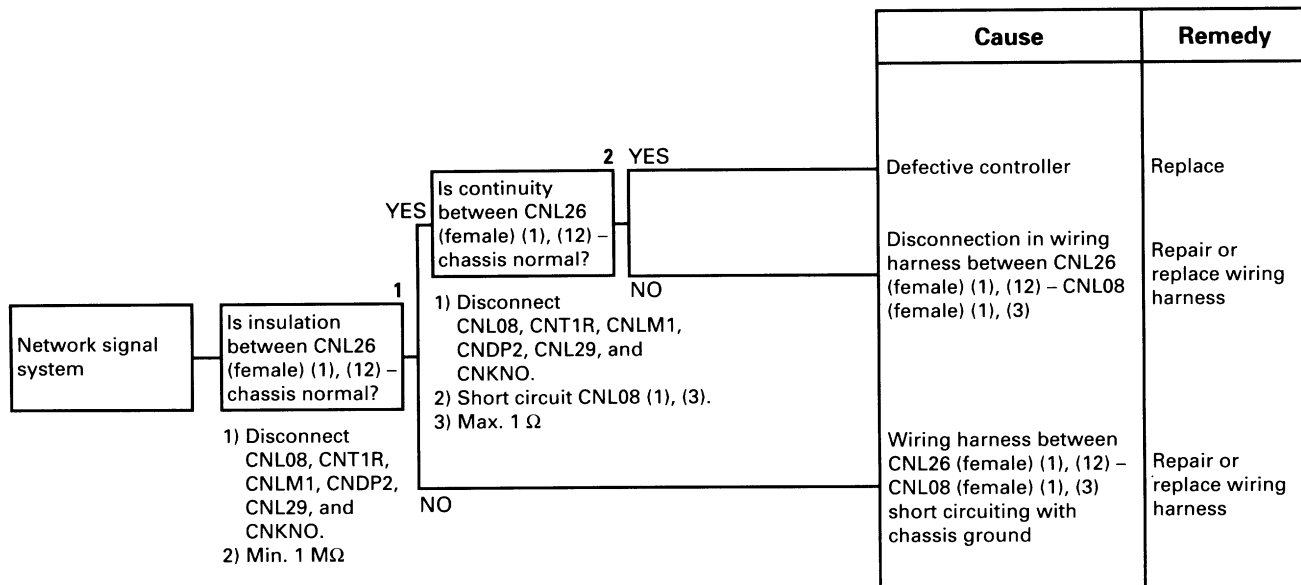
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TDW00364

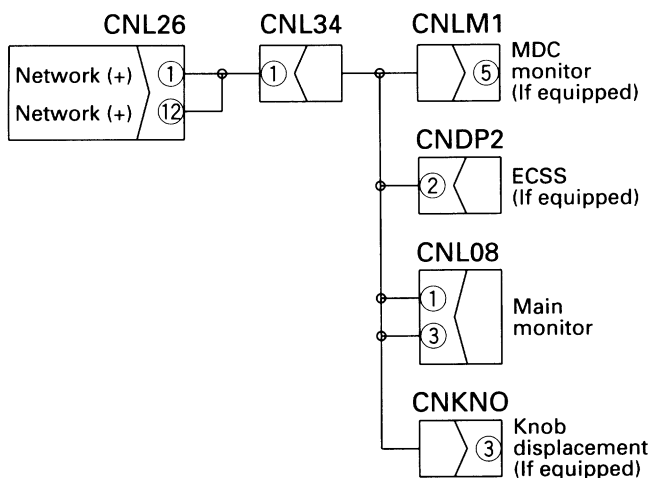
W-23 Failure code is not displayed on main monitor

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.



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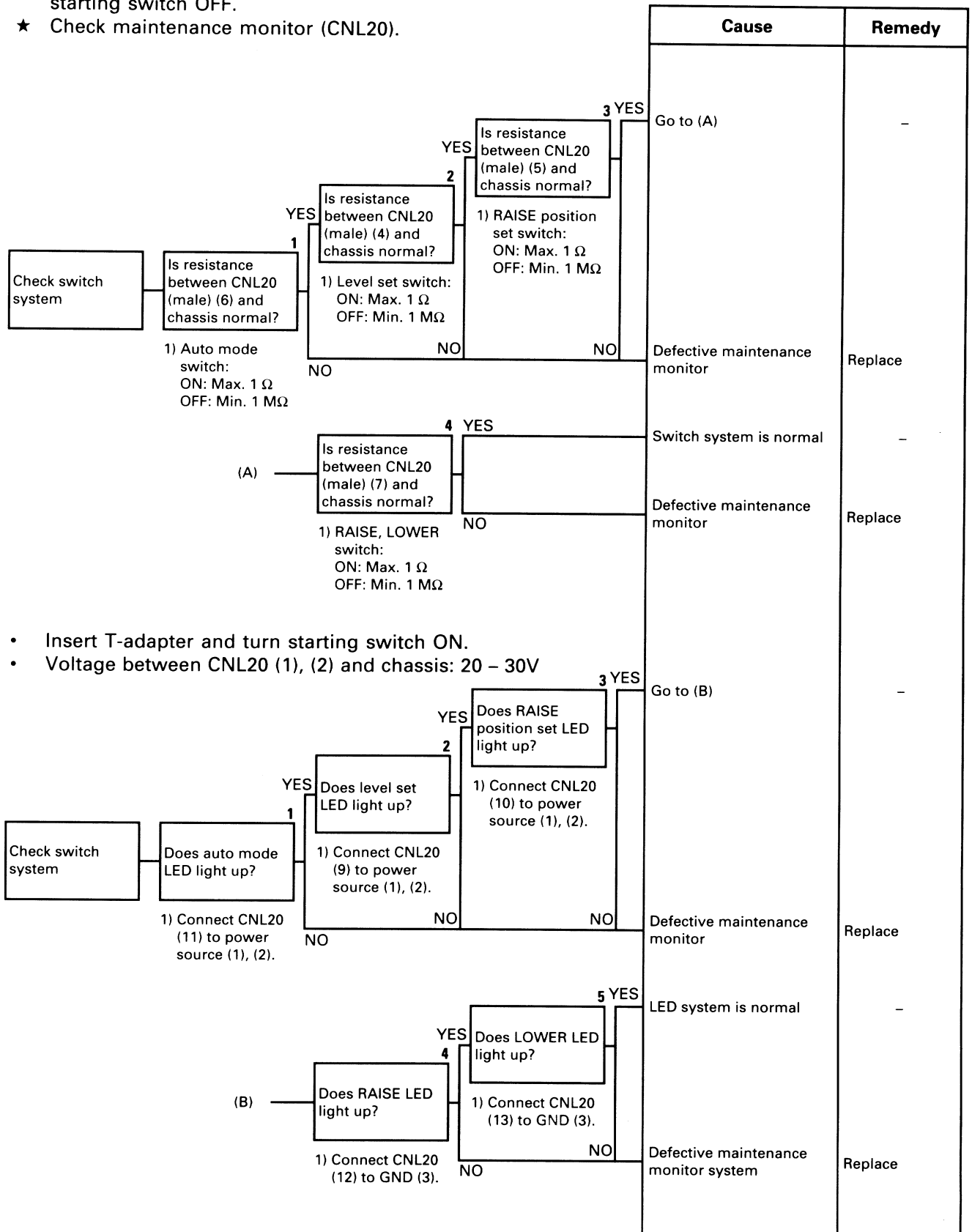
Work equipment controller



TDW00376

W-24 Maintenance monitor check

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.
- ★ Check maintenance monitor (CNL20).



30 DISASSEMBLY AND ASSEMBLY

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METHOD OF USING MANUAL

1. When removing or installing unit assemblies

- (1) When removing or installing a unit assembly, the order of work and techniques used are given for the removal operation; the order of work for the installation operation is not given.
- (2) Any special techniques applying only to the installation procedure are marked , and the same mark is placed after the relevant step in the removal procedure to indicate which step in the installation procedure it applies to.

(Example)

REMOVAL OF ○○○ ASSEMBLY



..... Title of operation
Precautions related to safety when carrying out the operation

1. XXXX (1)

Step in operation



..... Technique or important point to remember when removing XXXX (1).

2. △△△ (2):

 Indicates that a technique is listed for use during installation

3. □□□□ assembly (3)



..... See Lubricant and Coolant Table

INSTALLATION OF ○○○ ASSEMBLY

Title of operation

- Carry out installation in the reverse order to removal.



..... Technique used during installation

..... Technique or important point to remember when installing △△△ (2).

- Adding water, oil

Step in operation



..... Point to remember when adding water or oil



..... Quantity of filling oil and water

2. General precautions when carrying out installation or removal (disassembly or assembly) of units are given together as PRECAUTION WHEN CARRYING OUT OPERATION, so be sure to follow these precautions when carrying out the operation.

3. Listing of special tools

- (1) For details of the description, part number, and quantity of any tools (A1, etc.) that appear in the operation procedure, see the SPECIAL TOOLS LIST given in this manual.

PRECAUTIONS WHEN CARRYING OUT OPERATION

[When carrying out removal or installation (disassembly or assembly) of units, be sure to follow the general precautions given below when carrying out the operation.]

1. Precautions when carrying out removal work

- If the coolant contains antifreeze, dispose of it correctly.
- After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
- When draining oil, prepare a container of adequate size to catch the oil.
- Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
- To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
- Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
- Check the number and thickness of the shims, and keep in a safe place.
- When raising components, be sure to use lifting equipment of ample strength.
- When using forcing screws to remove any components, tighten the forcing screws alternately.
- Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

★ Precautions when handling piping during disassembling

Fit the following blind plugs into the piping after disconnecting it during disassembly operations.

1) Hoses and tubes using sleeve nuts

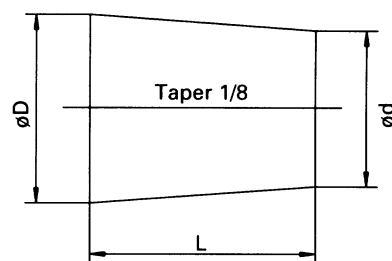
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	07376-50628	07221-20628 (Nut), 07222-00616 (Plug)
10	07376-51034	07221-21034 (Nut), 07222-01018 (Plug)
12	07376-51234	07221-21234 (Nut), 07222-01219 (Plug)

2) Split flange type hoses and tubes

Nominal number	Flange (hose end)	Sleeve head (tube end)	Split flange
04	07379-00400	07378-10400	07371-30400
05	07379-00500	07378-10500	07371-30500

3) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Part number	Dimensions		
		D	d	L
06	07049-00608	6	5	8
08	07049-00811	8	6.5	11
10	07049-01012	10	8.5	12
12	07049-01215	12	10	15
14	07049-01418	14	11.5	18
16	07049-01620	16	13.5	20
18	07049-01822	18	15	22
20	07049-02025	20	17	25
22	07049-02228	22	18.5	28
24	07049-02430	24	20	30
27	07049-02734	27	22.5	34



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2. Precautions for installation operations

- Tighten all bolts and nuts (sleeve nuts) to the specified (KES) torque.
- Install the hoses without twisting or interference.
- Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.
- Bend the cotter pin or lock plate securely.
- When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2 – 3 drops of adhesive.
- When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.
- Clean all parts, and correct any damage, dents, burrs, or rust.
- Coat rotating parts and sliding parts with engine oil.
- When press fitting parts, coat the surface with antifriction compound (LM-P).
- After fitting snap rings, check that the snap ring is fitted securely in the ring groove.
- When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.
- When using eyebolts, check that there is no deformation or deterioration, screw them fully, and align the direction of the hook.
- When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.
- ★ When operating the hydraulic cylinders for the first time after reassembling cylinders, pumps and other hydraulic equipment removed for repair, always bleed the air as follows:
 1. Start the engine and run at low idling.
 2. Operate the work equipment control lever to operate the hydraulic cylinder 4 – 5 times, stopping 100 mm from the end of its stroke.
 3. Next, operate the hydraulic cylinder 3 – 4 times to the end of its stroke.
 4. After doing this, run the engine at normal speed.
- ★ When using the machine for the first time after repair or long storage, follow the same procedure.

3. Precautions when completing the operations

- If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
- If the hydraulic equipment has been removed and installed again, add engine oil to the specified level.
Run the engine to circulate the oil through the system. Then check the oil level again.
- If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add the specified amount of grease (molybdenum disulphide grease) to the work equipment related parts.

DISASSEMBLY AND ASSEMBLY

SPECIAL TOOL LIST

SPECIAL TOOL LIST

Nature of work	Symbol		Part No.	Part Name	Q'ty	Remarks	
Disassembly, assembly of transmission assembly, transmission clutch pack assembly	A	1	793-615-1310	Lifting tool (A)	1	For FORWARD/ 1st clutch	Installation, removal of clutch pack
		2	793-615-1320	Lifting tool (B)	2	For REVERSE/ 2nd, 3rd/ 4th clutch	
		3	793-615-1330	Pin	3		Jig for settling piston seal ring
		4	793-615-1220	Holder	1	For FORWARD, REVERSE piston	
		5	793-615-1210	Holder	1	For 1st – 4th piston	
Removal of front differential assembly	B	793-520-2410	Bracket	1			
	C	793-520-2510	Bracket	1			
Disassembly, assembly of differential assembly	D	790-520-2620	Plate	1			
Disassembly, assembly of final drive assembly	E	790-425-1620	Fixture	3			
	F	790-425-1630	Fixture	3			
	G	793-520-2320	Fixture	2			
Installation of center hinge pin	H	790-101-1002	Pump	1			
	I	790-101-2102	Puller	1			
	J	790-101-2300	Push-puller	1			
	K	1	793-520-2370	Push tool	1		
		2	793-520-2350	Push tool	1		
		3	793-520-2540	Guide	1		
		4	793-520-2360	Bar	2		
Removal of slack adjuster assembly	L	793-463-1110	Stopper	2			
		01011-51845	Bolt	4			
		01643-31845	Washer	8			
		01580-11815	Nut	4			
Removal of parking brake disc	M	1	793-415-1150	Plate	1		
		2	01010-51085	Bolt	4		
		3	01580-11008	Nut	4		

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DISASSEMBLY AND ASSEMBLY

SPECIAL TOOL LIST

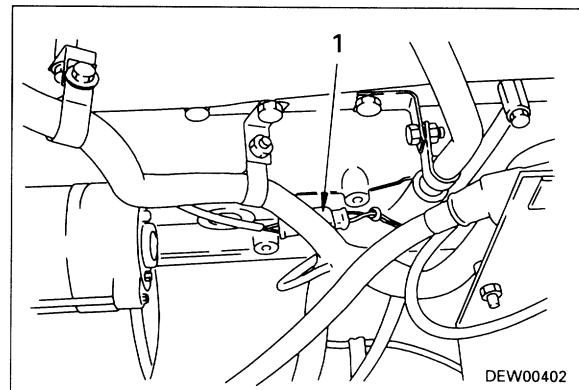
Nature of work	Symbol	Part No.	Part Name	Q'ty	Remarks	
Disassembly, assembly of hydraulic cylinder	N	790-502-1003 or 790-502-2000	Cylinder repair stand	1		
		790-101-1102	Pump	1		
	O	790-330-1100	Wrench ass'y	1	Steering cylinder	Removal, installation of round head
	P	799-302-1280	Socket (width across flats: 55)	1	Steering cylinder	Removal, installation of nylon nut
	Q	790-101-5021	Grip	1	Press fitting of coil bushing Kit Part No.: 790-201-1702	
		01010-50816	Bolt	1		
		790-201-1930	Push tool	1	Boom cylinder	
		790-201-1850	Push tool	1	Bucket cylinder	
		790-201-1761	Push tool	1	Steering cylinder	
	R	1	790-720-1000	Expander	1	Installation of piston ring
		2	796-720-1690	Ring	1	Boom cylinder
			07281-01919	Clamp	1	
			796-720-1690	Ring	1	Bucket cylinder
			07281-02169	Clamp	1	
			796-720-1660	Ring	1	Steering cylinder
			07281-01159	Clamp	1	
	S	790-101-5021	Grip	1	Insertion of dust seal Kit Part No.: 790-201-1500	
		01010-50816	Bolt	1		
		790-201-1660	Plate	1	Bucket cylinder	
		790-201-1570	Plate	1	Steering cylinder	
		790-201-1990	Plate	1	Boom cylinder	
Disassembly, assembly of brake assembly	T	1	793-520-2680	Installer	1	
		2	790-425-1640	Eye bolt	2	
		3	793-570-1010	Push plate	1	
		4	790-425-1620	Fixture	3	
		5	790-425-1630	Fixture	3	

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REMOVAL OF STARTING MOTOR ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Open engine hood left side cover.
2. Disconnect starting motor wiring connector (1).
3. Disconnect wiring (2).
4. Remove starting motor assembly (3).

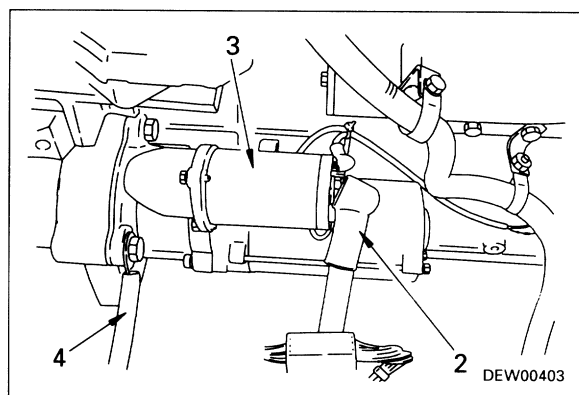


INSTALLATION OF STARTING MOTOR ASSEMBLY

- Carry out installation in the reverse order to removal.

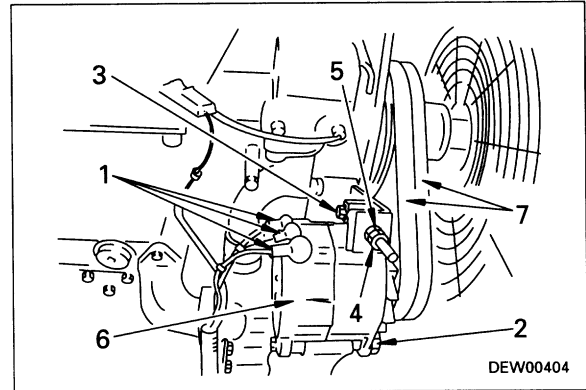
※ 1

- ★ When installing the starting motor assembly, install ground connection (4) securely.



REMOVAL OF ALTERNATOR ASSEMBLY

- ⚠** Disconnect the cable from the negative (-) terminal of the battery.
1. Open engine hood left side cover and lock in position.
 2. Disconnect 3 set of wiring (1).
★ Mark the wiring with tags to prevent mistakes when assembling.
 3. Loosen mounting bolt and nut (2), and adjustment plate mounting bolt (3).
 4. Loosen locknut (4) and adjustment nut (5), and move alternator assembly (6) towards engine, then remove fan belt (7) from alternator assembly (6).
※ 1
 5. Remove mount bolt and nut (2), and adjustment plate mounting bolt (3), then remove alternator assembly (5).



INSTALLATION OF ALTERNATOR ASSEMBLY

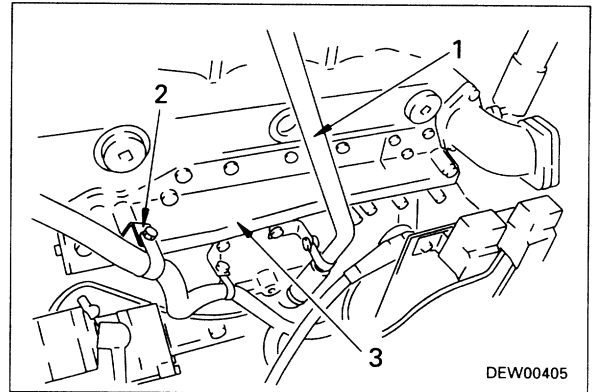
- Carry out installation in the reverse order to removal.

※ 1

- ★ Adjust the belt tension. For details, see TESTING AND ADJUSTING, Testing and adjusting fan belt tension.

REMOVAL OF ENGINE OIL COOLER ASSEMBLY

1. Lift off engine hood assembly.
2. Drain engine coolant.
3. Remove turbocharger lubrication return tube (1).
4. Disconnect wiring harness clamp (2).
5. Remove oil cooler assembly (3).
6. Remove nut (4), then remove core (6) from cover (5).



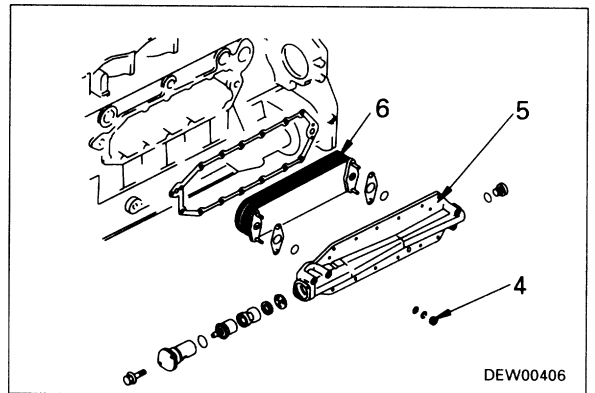
INSTALLATION OF ENGINE OIL COOLER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ I



Core mounting nut:

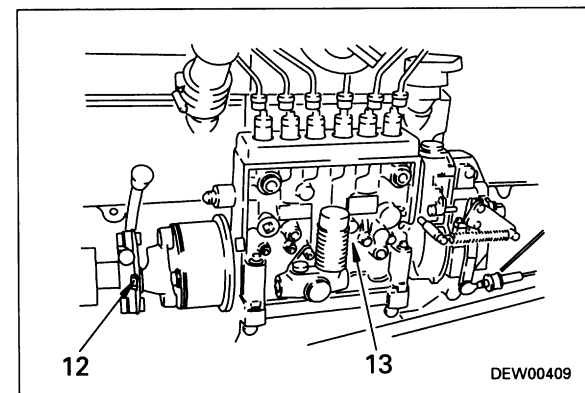
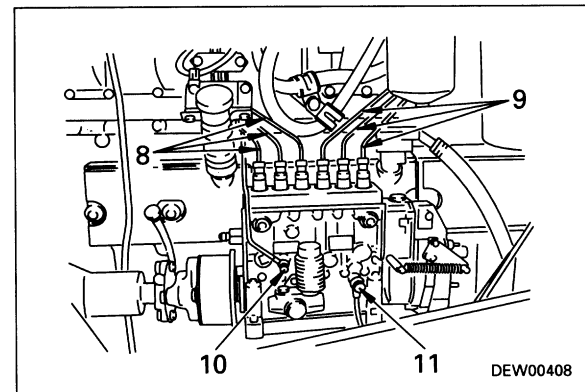
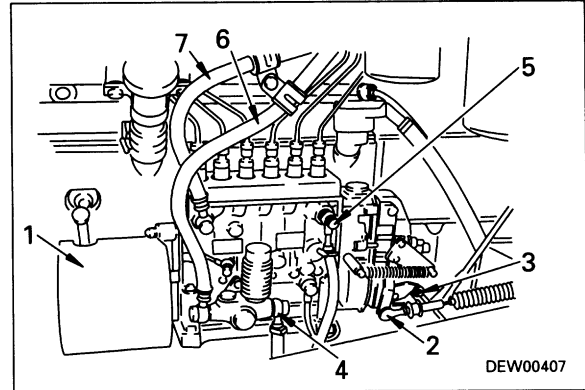
 $43.2 \pm 15.7 \text{ Nm}$ ($4.4 \pm 1.6 \text{ kgm}$)

- **Refilling with water**

Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then check the water level again.

REMOVAL OF FUEL INJECTION PUMP ASSEMBLY

1. Remove coupling cover (1) of fuel injection pump.
2. Disconnect accelerator cable (2) and stop motor cable (3).
3. Disconnect fuel hoses (4), (5), (6), and (7).
★ After disconnecting fuel supply hose (4), bend it and tie it with wire to prevent the fuel from leaking.
4. Disconnect fuel injection pipes (8) and (9). ※ 1
5. Remove lubrication tubes (10) and (11).
6. Remove 2 lock bolts (12) of cross coupling and laminate coupling. ※ 2
★ Before removing the bolts, mark the mounting position of the laminate coupling and cross coupling.
7. Remove fuel injection pump assembly (13). ※ 3



INSTALLATION OF FUEL INJECTION PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 **kgm** Injection tube sleeve nut:
 $23.5 \pm 1 \text{ Nm}$ ($2.4 \pm 0.1 \text{ kgm}$)

※ 2

 **kgm** Laminate coupling mounting bolt:
 $61.8 \pm 3 \text{ Nm}$ ($6.3 \pm 0.3 \text{ kgm}$)

※ 3

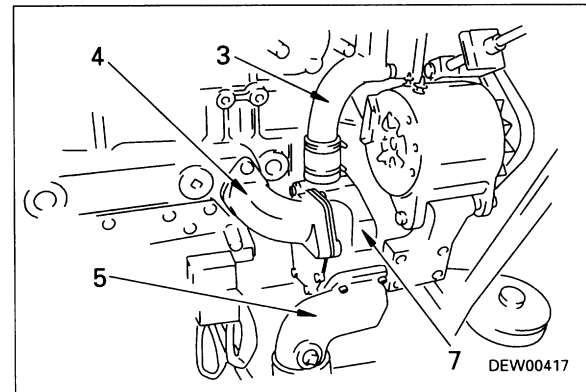
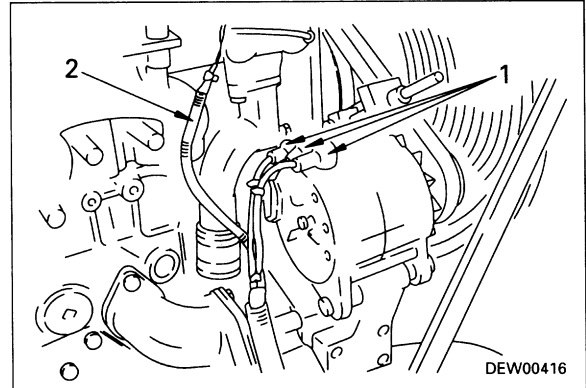
- ★ Install the injection pump. For details, see TESTING AND ADJUSTING, Testing and adjusting fuel injection timing.

 **kgm** Injection pump mounting bolt:
 $29.4 \pm 5 \text{ Nm}$ ($3.0 \pm 0.5 \text{ kgm}$)

REMOVAL OF WATER PUMP ASSEMBLY

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Lift off engine hood.
2. Drain engine coolant.
3. Disconnect alternator wiring (1) and water temperature sensor wiring harness (2), loosen mounting bolt and adjustment bolt of alternator assembly, then remove fan belt. ※ 1
4. Remove water pump tubes (3), (4), and (5).
5. Remove mounting bolts (6), then remove water pump assembly (7). ※ 2



INSTALLATION OF WATER PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

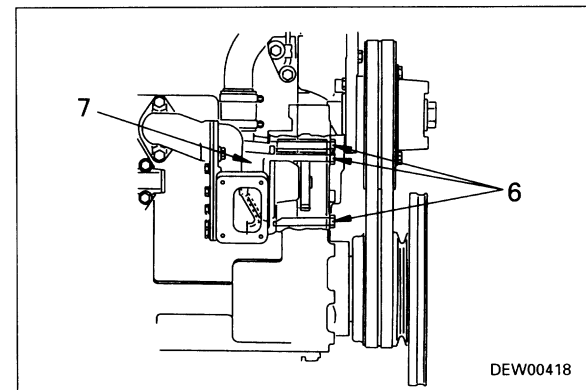
※ 1

- ★ Adjust the belt tension. For details, see TESTING AND ADJUSTING, Testing and adjusting fan belt tension.

※ 2

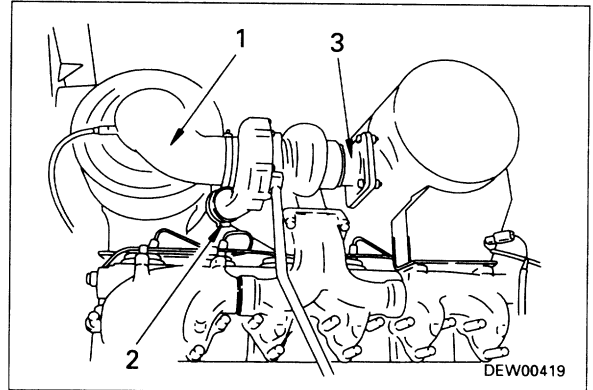
- kgm Mounting bolt:
 $66.7 \pm 7.9 \text{ Nm } (6.8 \pm 0.8 \text{ kgm})$

- **Refilling with water**
 Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then check the water level again.



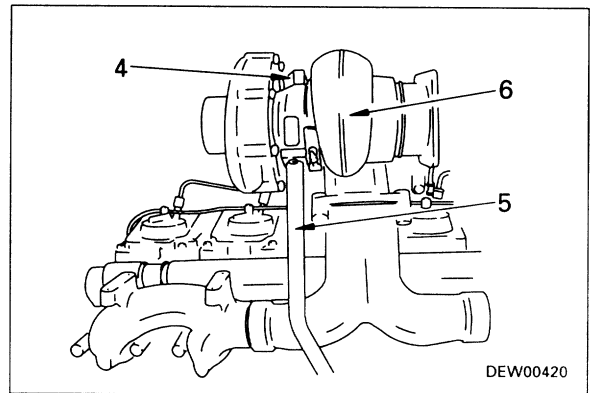
REMOVAL OF TURBOCHARGER ASSEMBLY

1. Lift off engine hood.
2. Remove intake connector (1), and loosen belt clamp (2) of intake connector joint hose.
3. Remove 4 mounting bolts of flange (3) between muffler assembly and turbocharger.
4. Remove turbocharger lubrication inlet tube (4) and return tube (5).
5. Remove mounting bolts of turbocharger assembly (6), then pull out turbocharger assembly from air intake connector, and remove.



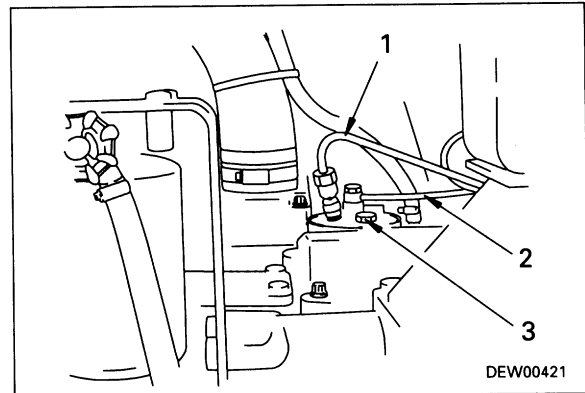
INSTALLATION OF TURBOCHARGER ASSEMBLY

- Carry out installation in the reverse order to removal.



REMOVAL OF NOZZLE HOLDER ASSEMBLY

1. Disconnect fuel injection pipe (1) and spill tube (2). ※ 1
2. Remove 2 mounting bolts (3) of nozzle holder. ※ 2
3. Screw bolt ① (ø10 mm) in to mount of spill tube, then lever with bar ② and remove nozzle holder assembly (4).
★ Be careful not to let dirt or dust get inside.



INSTALLATION OF NOZZLE HOLDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

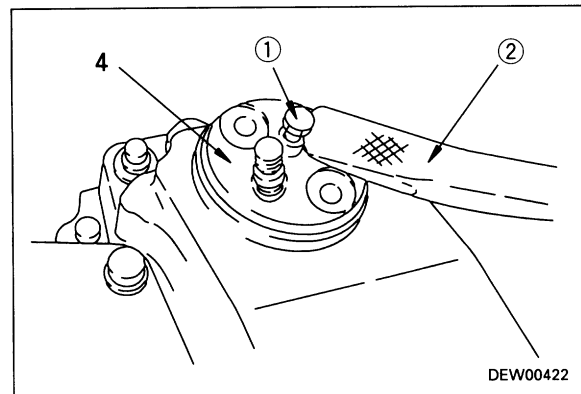
 **Spill pipe mounting joint bolt:**
24.5 ± 5 Nm (2.5 ± 0.5 kgm)

 **Injection pipe mounting sleeve nut:**
23.5 ± 1 Nm (2.4 ± 0.1 kgm)

※ 2

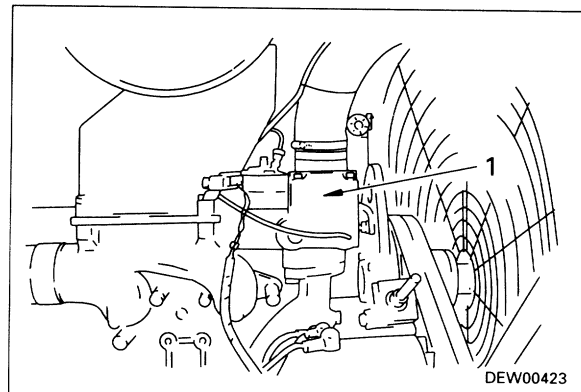
- ★ Tighten the nozzle holder mounting bolts in turn uniformly.

 **Nozzle holder assembly mounting bolt:**
21.6 ± 3 Nm (2.2 ± 0.3 kgm)



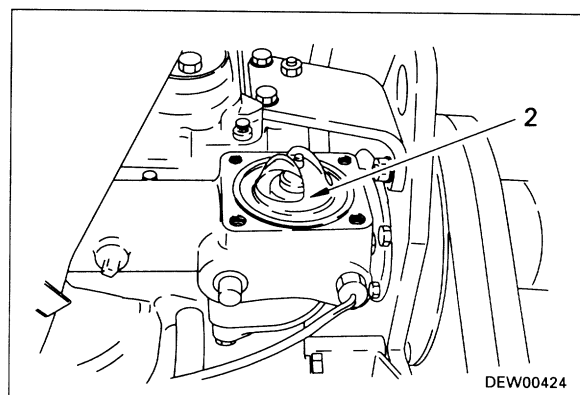
REMOVAL OF THERMOSTAT ASSEMBLY

1. Open engine hood left side cover and lock in position.
2. Drain engine coolant.
3. Disconnect block (1).
★ Do not disconnect the hose.
4. Remove thermostat (2).



INSTALLATION OF THERMOSTAT ASSEMBLY

- Carry out installation in the reverse order to removal.
- **Refilling with water**
Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then check the water level again.

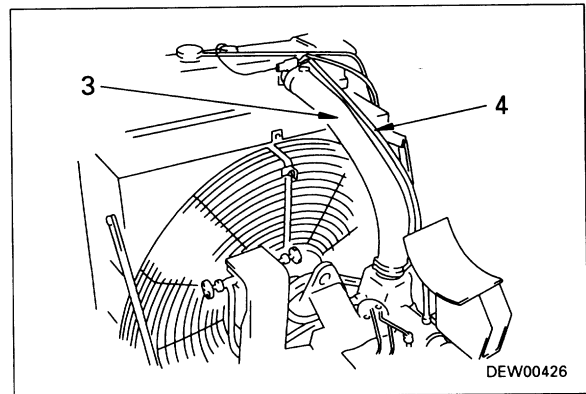
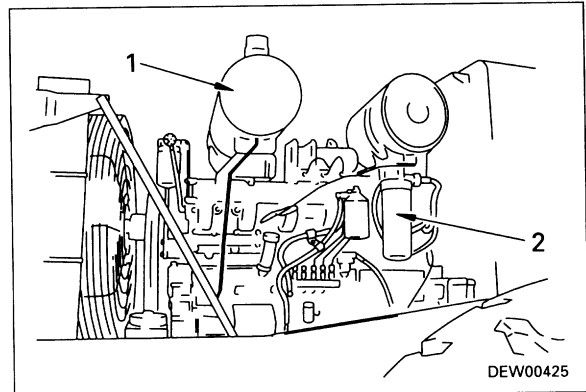


REMOVAL OF CYLINDER HEAD ASSEMBLY

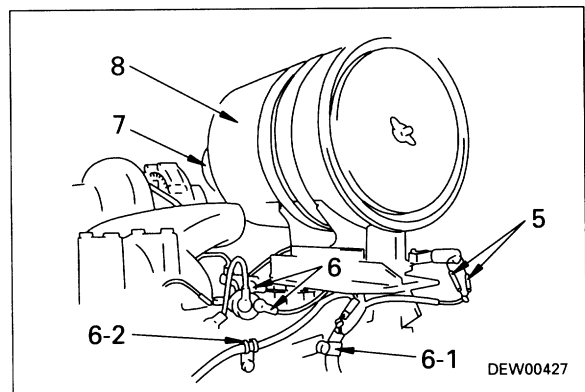
⚠ Disconnect the cable from the negative (-) terminal of the battery.

- Drain engine coolant.

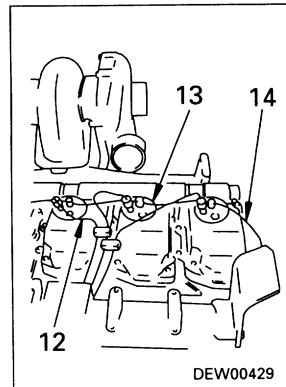
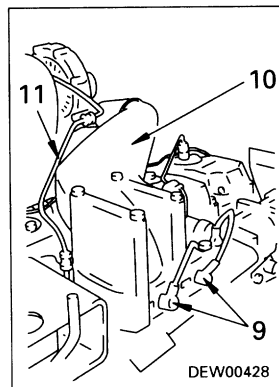
1. Remove engine hood assembly.
2. Remove exhaust muffler assembly (1) and oil filter assembly (2).
 - ★ Remove oil filter assembly (2) together with the filter head and 2 tubes.
 - ★ When removing the muffler assembly, be careful not to bend the drain tube.
3. Disconnect radiator upper hose (3) and aeration tube (4).



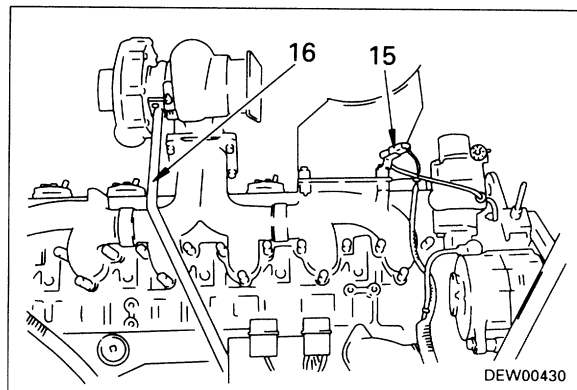
4. Disconnect dust indicator wiring (5) and heater relay wiring (6).
 - ★ Disconnect wiring clamps (6-1) and (6-2).
5. Remove intake connector (7), then remove air cleaner assembly (8). ※ 1



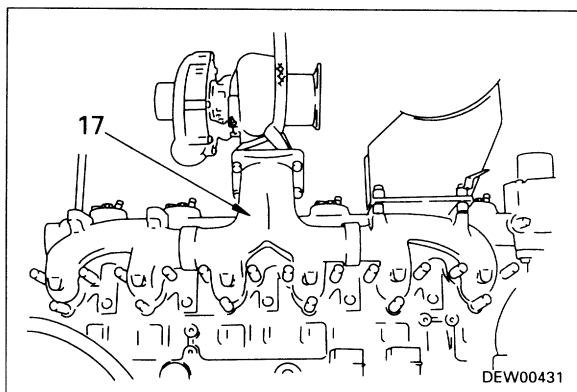
6. Disconnect heater relay wiring (9), remove intake connector (10), then remove turbocharger lubrication inlet tube (11).
7. Remove 6 fuel injection pipes (12), 5 fuel spill pipes (13), and return hose (14). ※ 2



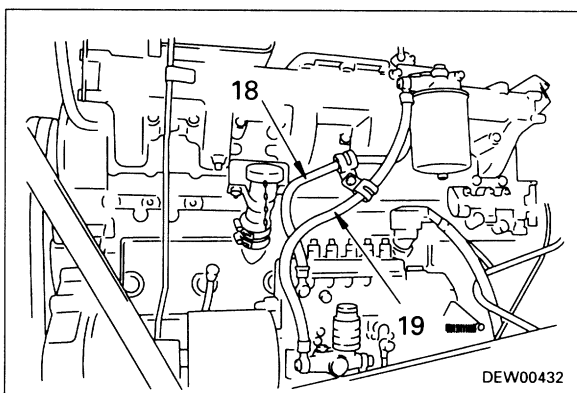
8. Remove water temperature sensor connector (15) from holder, then disconnect.
9. Remove turbocharger lubrication return tube (16).



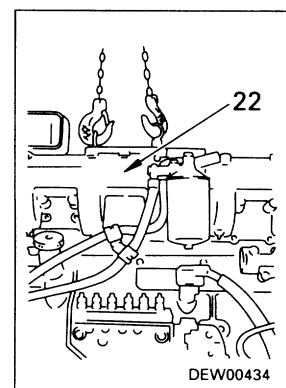
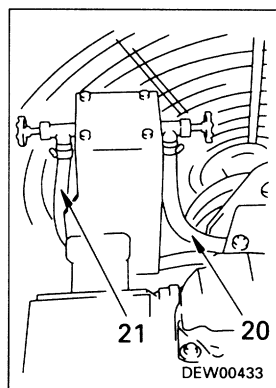
10. Lift off turbocharger and exhaust manifold assembly (17). ※ 3
 ★ Remove together with the air cleaner assembly mounting bracket.



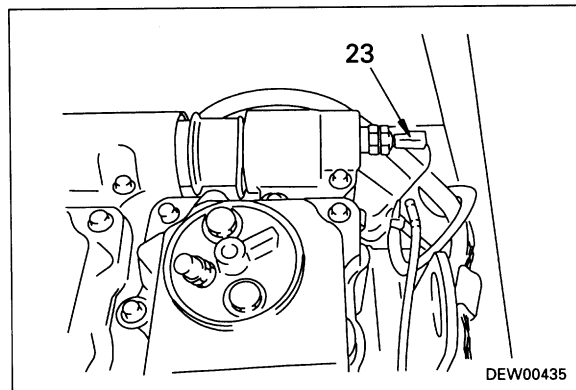
11. Disconnect fuel filter hoses (18) and (19).



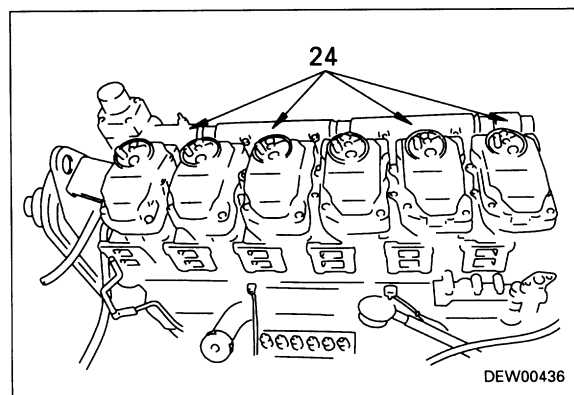
12. Disconnect corrosion resistor hoses (20) and (21) at filter end.
13. Lift off intake manifold assembly (22).
 ★ Remove with the corrosion resistor and fuel filter assembly still installed to the intake manifold.



- 14. Disconnect connector (23) from water manifold.**

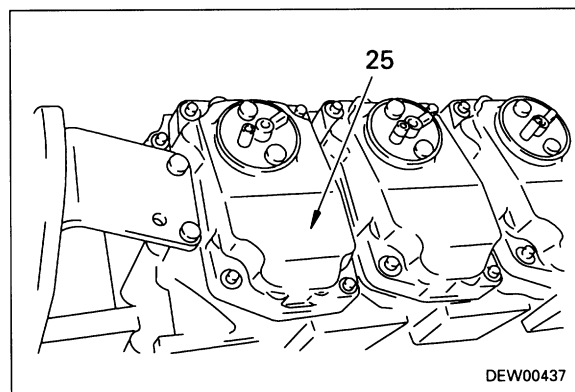


- 15. Remove water manifolds (24).**



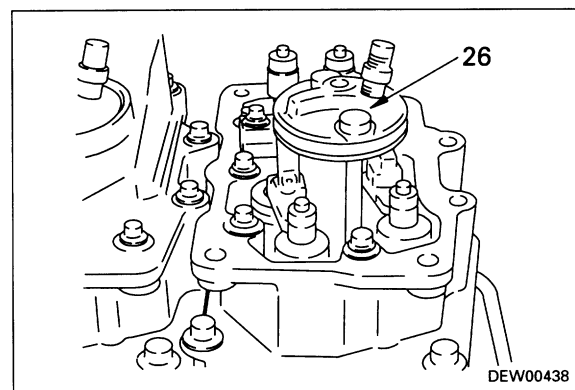
- 16. Remove head cover (25).**

※ 4

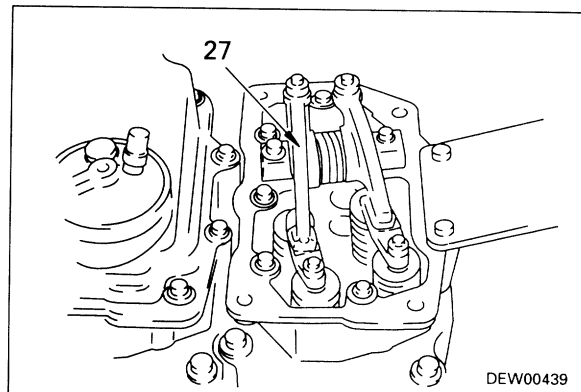


- 17. Remove nozzle holder assembly (26).**

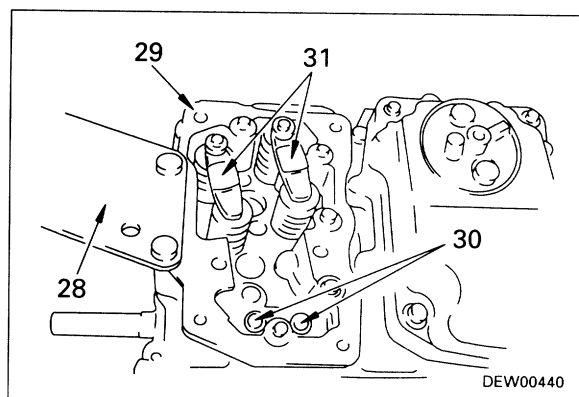
※ 5



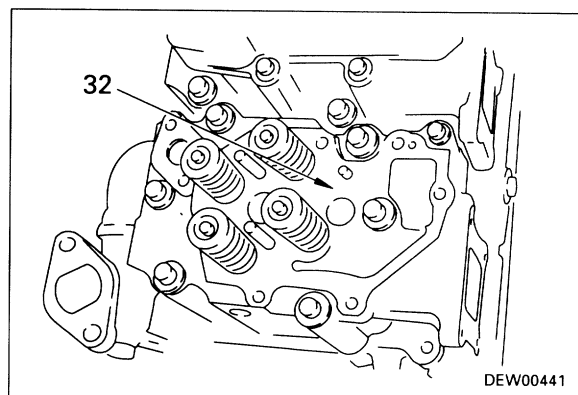
18. Remove rocker arm assembly (27). ※ 6
★ Loosen the locknut, then loosen the adjustment screw 2 – 3 turns.



19. Remove bracket (28), rocker arm housing (29), push rods (30), and crossheads (31). ※ 7
★ Remove bracket (28) from the No. 1 cylinder only.



20. Remove cylinder head assembly (32). ※ 8



INSTALLATION OF CYLINDER HEAD ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 Air cleaner intake connector clamp:
 $8.3 \pm 0.5 \text{ Nm}$ ($0.85 \pm 0.05 \text{ kgm}$)

※ 2

 Fuel injection pipe sleeve nut:
 $29.4 \pm 5 \text{ Nm}$ ($3.0 \pm 0.5 \text{ kgm}$)

 Spill pipe mounting bolt:
 $24.5 \pm 5 \text{ Nm}$ ($2.5 \pm 0.5 \text{ kgm}$)

※ 3

- ★ Screw in the exhaust manifold mounting bolts 2 – 3 threads by hand, tighten mounting bolts ① – ③, then tighten the other mounting bolts.

 Exhaust manifold mounting bolt:
 $66.7 \pm 7.9 \text{ Nm}$ ($6.8 \pm 0.8 \text{ kgm}$)

※ 4

 Head cover mounting bolt:
 $9.8 \pm 1 \text{ Nm}$ ($1.0 \pm 0.1 \text{ kgm}$)

※ 5

- ★ Tighten the nozzle holder mounting bolts in turn uniformly.

 Nozzle holder mounting bolt:
 $21.6 \pm 3 \text{ Nm}$ ($2.2 \pm 0.3 \text{ kgm}$)

※ 6

- ★ Check that the ball of the adjustment screw is fitted securely in the socket of the push rod.
- ★ Adjust the valve clearance. For details, see TESTING AND ADJUSTING, Adjusting valve clearance.

 Rocker arm assembly mounting bolt:
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)

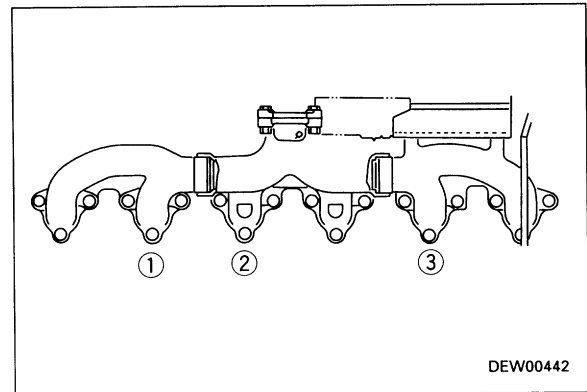
 Locknut:
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)

※ 7

 Rocker arm housing mounting bolt:
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)

- ★ Adjust the crosshead as follows.
 - i) Loosen the locknut and turn the adjustment screw back.
 - ii) Press the top of the crosshead lightly and screw in the adjustment screw.
 - iii) When the adjustment screw contacts the valve stem, screw it in a further 20°.
 - iv) Tighten the locknut to hold it in position.

 Locknut:
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)



U42103

※ 8

- ★ If any rust of more than 5 mm square is found on the shaft or the thread of the bolt, replace the head bolt with a new bolt.
- ★ Be careful to check that there is no dirt or dust on the mounting surface of the cylinder head or inside the cylinder.
- ★ When installing the gasket, check that the grommets have not come out.
- ★ Coat the thread and seat of the bolt and the seat of the cylinder head holes completely with molybdenum disulphide (LM-P).
- ★ Tighten the cylinder head mounting bolts 2 – 3 turns by hand, then tighten in the order given in the diagram.



Mounting bolt:

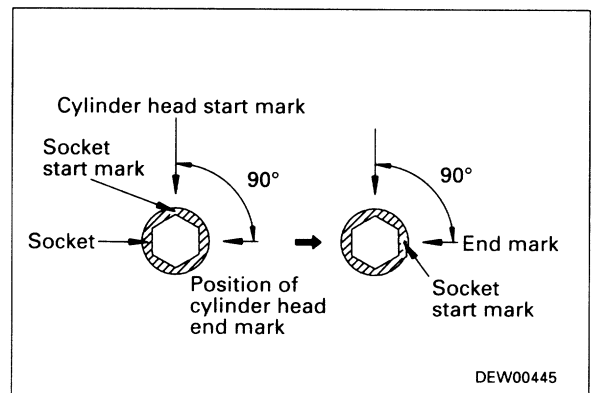
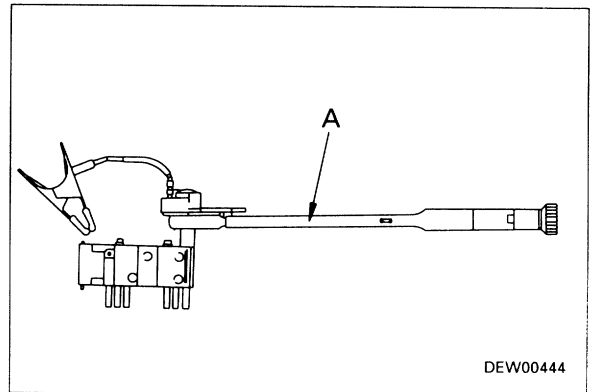
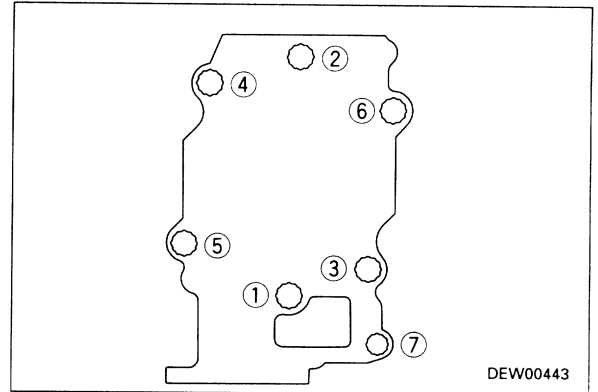
Anti-friction compound (LM-P)

kgm Cylinder head mounting bolt:

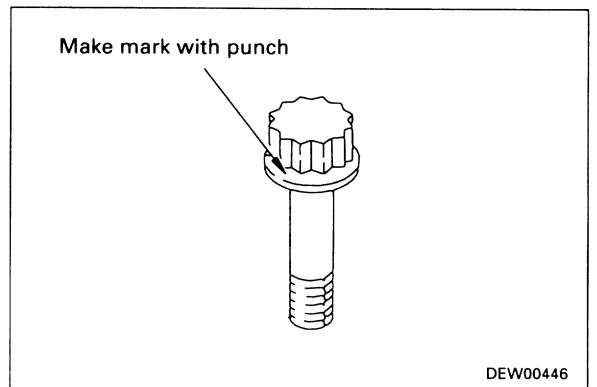
1st pass: **Tighten to 68.6 ± 9.8 Nm**
(7.0 ± 1.0 kgm)

2nd pass: **Tighten to 107.9 ± 5 Nm**
(11.0 ± 0.5 kgm)

- 3rd pass:
1. When using tool A.
 - Using an angle tightening wrench, tighten bolt 90^{+30}_{0} .
 2. When not using tool A.
 - 1) Using the angle of the bolt head as the base, make start marks on the cylinder head and socket.
 - 2) Make an end mark at a point 90^{+30}_{0} from the start mark.
 - 3) Tighten so that the start mark on the socket is aligned with the end mark on the cylinder head at the 90^{+30}_{0} position.



- ★ After tightening, make one punch mark on the bolt head to indicate the number of times it has been tightened.
- If any bolt already has five punch marks, do not reuse it. Replace it with a new bolt.
- **Refilling with water**
Add water through the water filler to the specified level. Run the engine to circulate the water through the system. Then check the water level again.

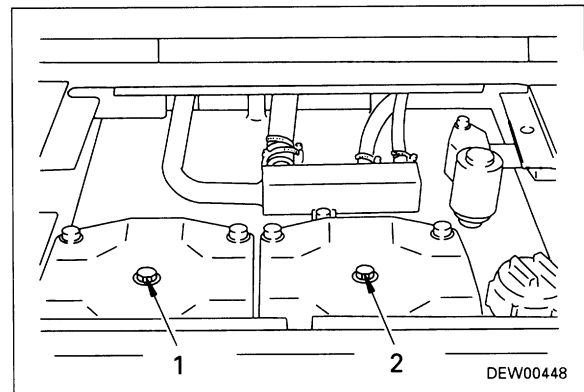
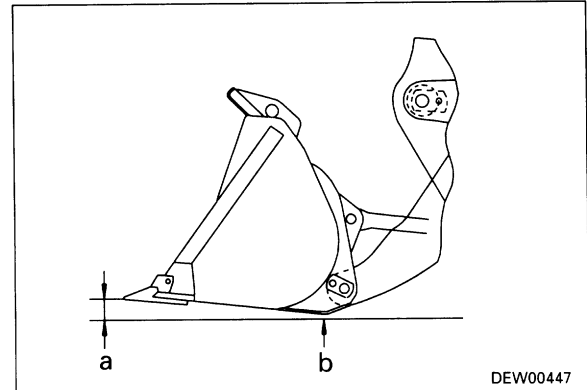


REMOVAL OF RADIATOR ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping.

- ★ When operating the levers, raise portion **a** of the bucket 30 – 50 mm and lower portion **b** to the ground, then stop the engine.
- ★ After operating the levers, check that the whole bottom surface of the bucket (both portion **a** and portion **b**) are in contact with the ground.
- ★ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.
- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing.



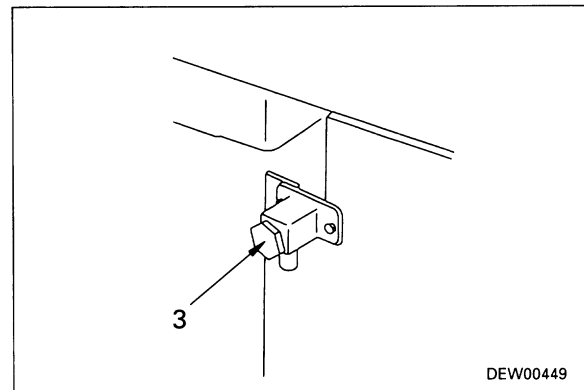
1. Drain

Loosen drain valve (3) and drain coolant.

- ★ If the coolant contains antifreeze, dispose of it correctly.

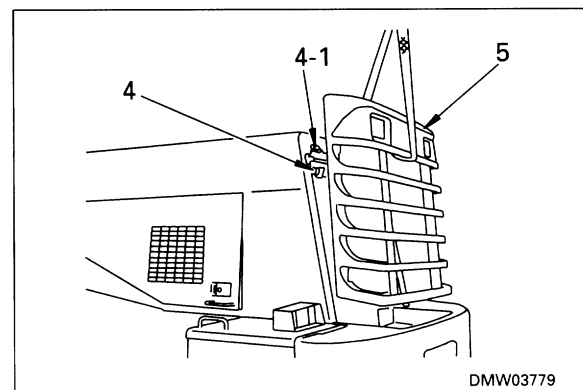


Coolant: **43ℓ (including sub-tank)**



2. Radiator guard

- 1) Remove 4 mounting bolts of radiator guard, and disconnect wiring connector (4) of working lamp and radiator water level sensor (4-1) at radiator end.
- 2) Lift off radiator guard (5).



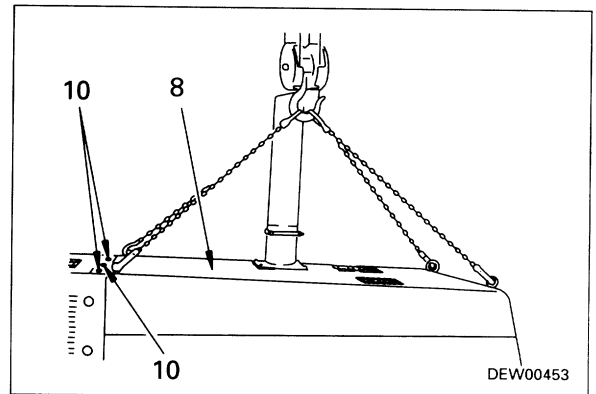
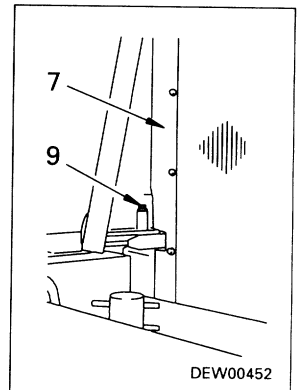
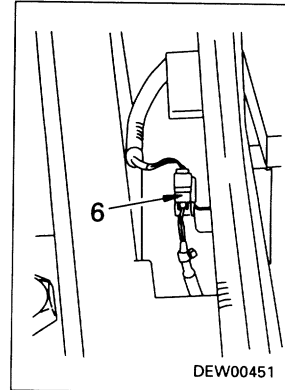
3. Hood

- 1) Disconnect connector (6) of electric wiring at inside of rear left of hood.
- 2) Remove left and right radiator baffles (7).
- 3) Sling hood (8), then remove front and rear, left and right mounting bolts (9) and 3 top front mounting bolts (10), and lift off hood.

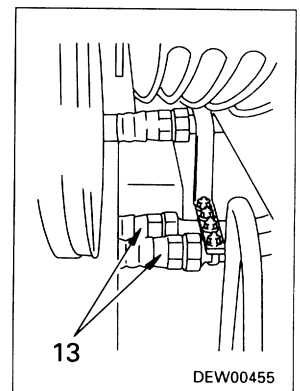
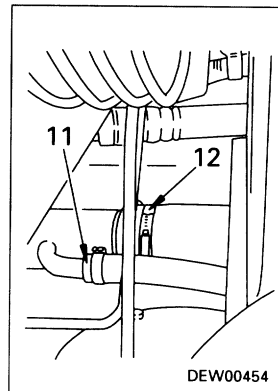
Hood assembly:

230 kg (without rear fender)

305 kg (with rear fender)

**4. Hoses**

- 1) Disconnect radiator drain hose (11) from radiator.
- 2) Disconnect radiator lower hose (12) at radiator end.
- 3) Disconnect oil cooler hoses (13) at radiator end.
★ After removing the hoses, fit plugs to prevent the entry of dirt or dust.
- 4) Disconnect upper hoses (14) and (15), and radiator spill pipe (16) at radiator end.

**5. Fan guard, stay**

Remove radiator fan guard (17) and radiator stay (18).

6. Fan

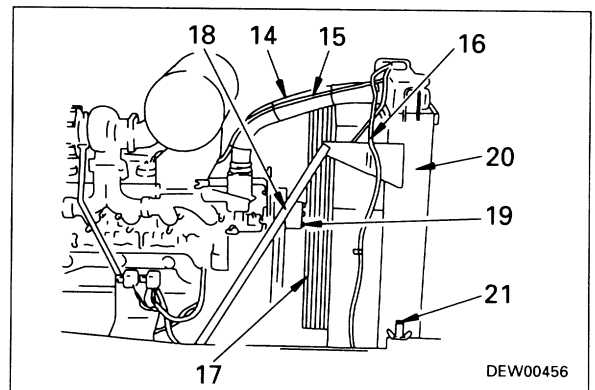
Remove mounting bolts (19) of engine fan, then remove fan.

7. Radiator

Sling radiator assembly (20), then remove mounting bolts (21), and lift off radiator.



Radiator assembly: **168 kg**



INSTALLATION OF RADIATOR ASSEMBLY

- Carry out installation in the reverse order to removal.
- Tighten drain plug and add water through the radiator water filler to the specified level.



Coolant: **40 ℓ (radiator)**
3 ℓ (sub-tank)

- ★ Run the engine to circulate the water through the system. Then check the water level again.

REMOVAL OF ENGINE ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

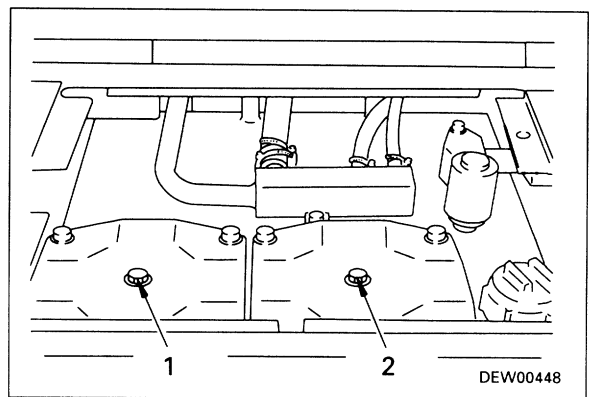
- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing.

⚠ Operate the bucket control lever at least 40 times TILT ÷ HOLD to release the pressure inside the accumulator.

⚠ Depress the brake pedal at least 17 times to release the pressure inside the brake accumulator.

⚠ When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

⚠ Disconnect the cable from the negative (–) terminal of the battery.



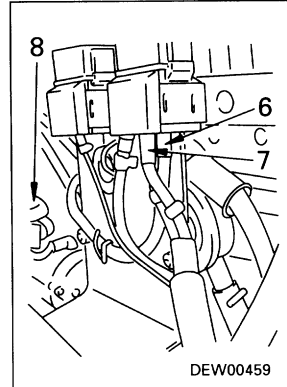
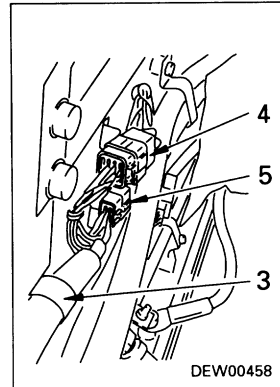
1. Radiator

Remove radiator.

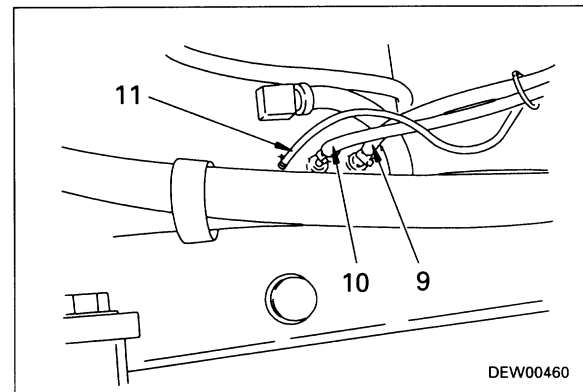
For details, see REMOVAL OF RADIATOR.

2. Electric wiring

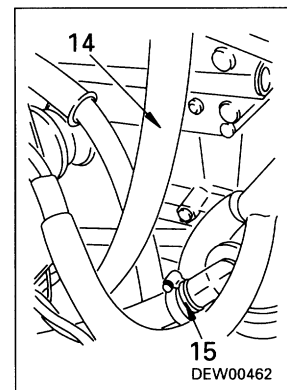
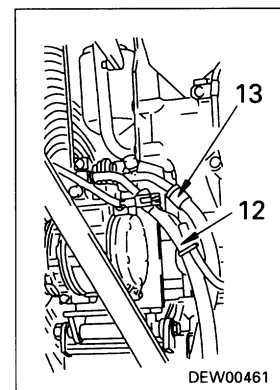
- 1) Disconnect CNER1 connector (4) and CNER2 connector (5) of engine wiring harness (3).
- 2) Disconnect slow blow fuse 120A connector (6) and 80A connector (7).
- 3) Disconnect cable (8) between starting motor and battery relay.
- 4) Disconnect starting motor ground cable.

**3. Fuel hose**

- 1) Disconnect hose (9) between fuel tank and feed pump at feed pump end.
- 2) Disconnect fuel return hose (10) at injection pump end.
- 3) Disconnect spill hose (11) at fuel tank end.
- ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

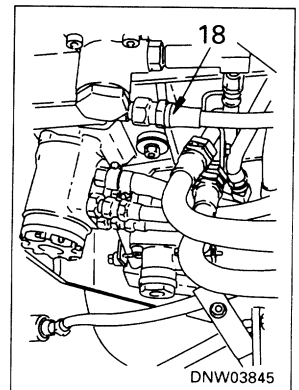
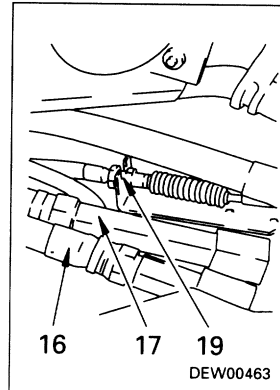
**4. Air conditioner, heater hoses**

- 1) Disconnect air conditioner hoses (12) and (13) from compressor. ※ 1
- 2) Disconnect heater hoses (14) and (15) from engine.
- ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

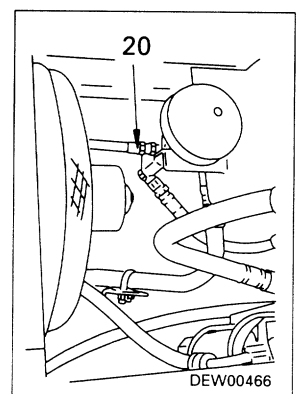
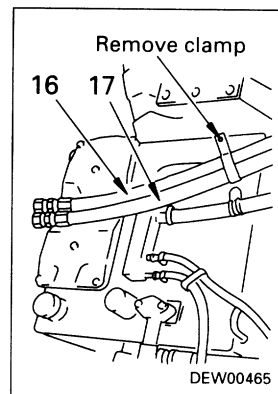


5. Brake piping, accelerator cable

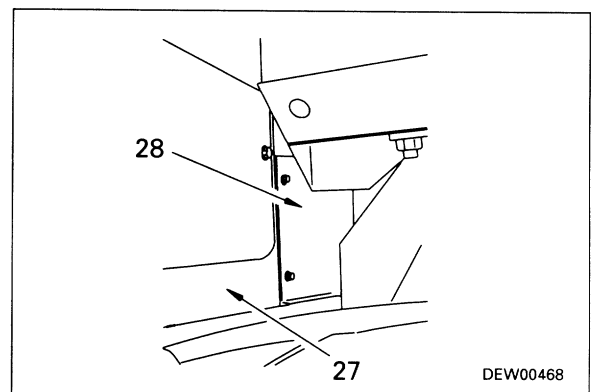
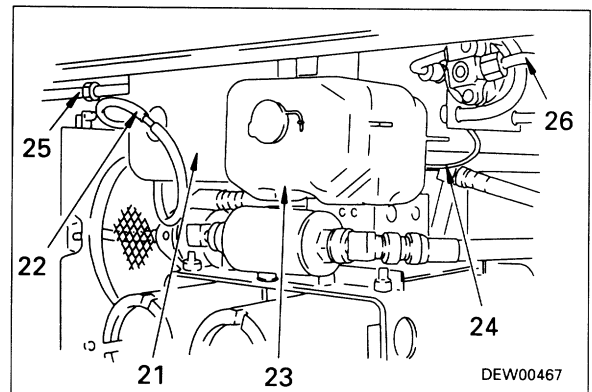
- 1) Disconnect hoses (16) and (17) between right brake valve and accumulator at pedal end.
★ Remove the clamps (2 places) of the brake hoses under the floorboard.
- 2) Disconnect hose (18) between left brake valve and accumulator at pedal end. ※ 2
- 3) Disconnect accelerator cable (19) at bottom of pedal.
★ Remove the cable clamp under the floor board.



- 4) Disconnect hose (20) between PPC accumulator and PPC valve inside bulkhead at accumulator end.



- 5) Disconnect hose (22) of radiator sub-tank (21) and hose (24) of window washer tank (23) at tank end.
★ Remove the hoses from the hose clamp.
- 6) Air conditioner hoses
 - Disconnect hose (25) between compressor and condenser at condenser end. ※ 3
★ Remove the hose clamp inside the bulkhead.
 - Disconnect hose (26) between air conditioner unit and receiver at receiver end. ※ 4
★ Remove the hose clamp inside the bulkhead.
★ After removing the hoses, fit plugs to prevent the entry of dirt or dust.

**6. Bulkhead**

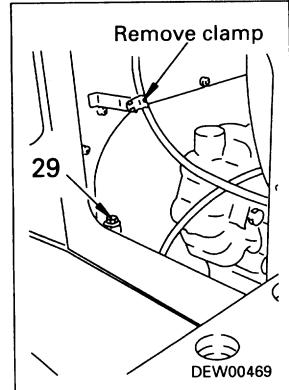
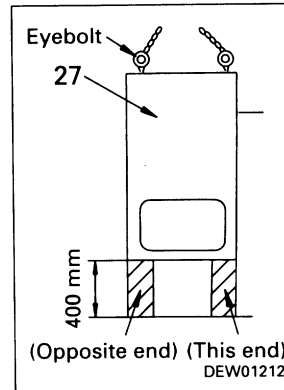
- 1) Remove cover (28) at bottom front of bulkhead (27).

- 2) Install eyebolts at top 4 corners of bulkhead (27), then sling and remove bottom mounting bolts (29).



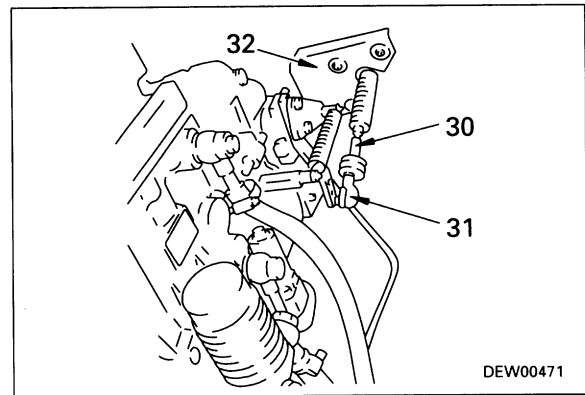
Bulkhead: 135 kg
(including accumulator charge valve)

- 3) Raise bulkhead (27) straight up for approx. 400 mm.
 - ★ The bulkhead comes near the cab when it is lifted, so be careful not to hit anything.
 - ★ To prevent the bulkhead from falling after it is raised, place blocks to the left and right on opposite sides.



7. Fuel control cable

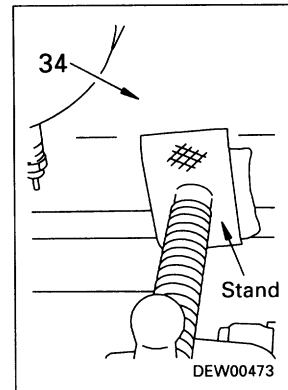
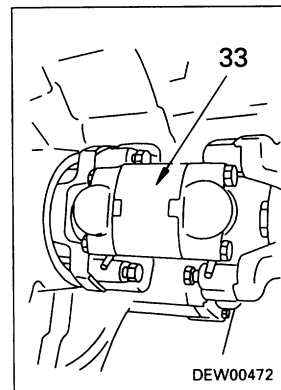
- 1) Disconnect fuel control cable (30) from ball joint (31). ※ 5
- 2) Remove fuel control cable from bracket (32).



8. Transmission support stand

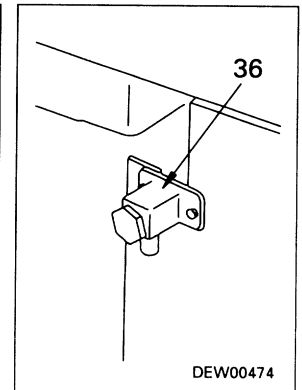
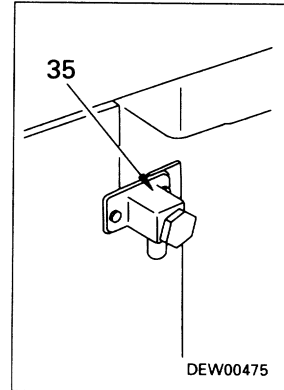
Remove rear drive shaft (33), and set support stand under transmission (34). ※ 6

- ★ Use a stand with adjustable height, and fit it securely in position so that it does not come out.



9. Engine assembly

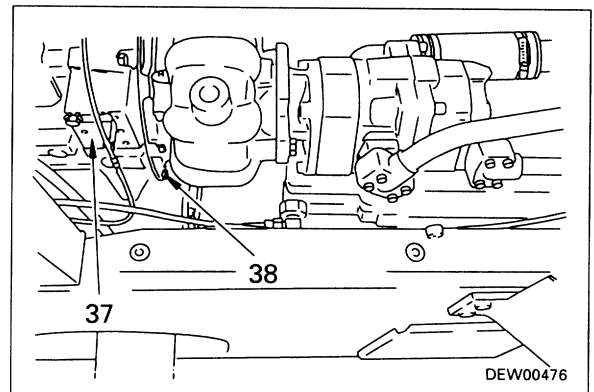
- 1) Remove engine oil drain valve (35) and radiator coolant drain valve (36) from fuel tank.



- 2) Sling engine assembly (37), and remove mounting bolts (38) of engine flywheel portion and torque converter housing
 - ★ Depending on the lifting tool, remove the muffler and then sling.

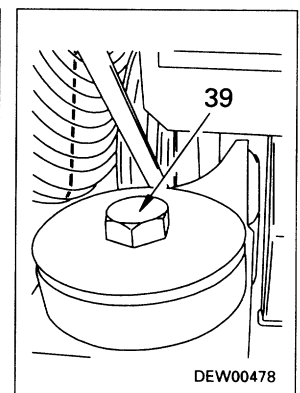
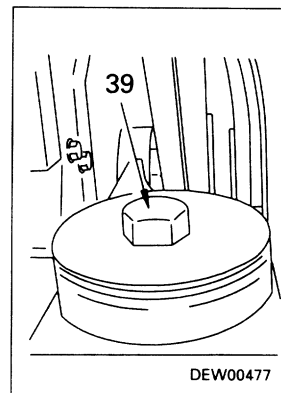


Engine assembly: **1,120 kg**



- 3) Remove engine mount bolt (39), and lift off engine assembly (37). ※ 7

- ★ Be careful of the direction of installation of the cushions and spacers.
- ★ The engine flywheel ring gear and torque converter ring gear and shaft are mated, so set in a horizontal position before raising the engine assembly, and keep horizontal while carrying out the operation.
- ★ When lifting off the engine assembly, check first that all the wiring and piping have been removed before continuing with the operation. ※ 8



INSTALLATION OF ENGINE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



Compressor hose:

7.9 – 11.8 Nm (0.8 – 1.2 kgm)

※ 2

※ 5



Accelerator cable mounting bolt:

53.9 ± 5 Nm (5.5 ± 0.5 kgm)

※ 3



Condenser hose:

19.6 – 24.5 Nm (2.0 – 2.5 kgm)

※ 4



Receiver hose:

3.9 – 6.9 Nm (0.4 – 0.7 kgm)

※ 6

- ★ Clean the connection and mating surface of the drive shaft before installing.



Drive shaft mounting bolt:

112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

※ 7

- ★ Be careful of the direction of installation of the cushions and spacers at the engine mount when assembling.



Mount bolt:

926.7 ± 103 Nm (94.5 ± 10.5 kgm)

※ 8

- ★ When connecting the engine to the torque converter, adjust the height so that the torque converter shaft and ring gear go in smoothly.

Never try to use force when connecting.

- ★ Use new parts for the torque converter and flywheel housing O-rings.



O-ring at mating surface of torque converter and engine flywheel:

Soapy water

• Refilling with oil

Tighten drain plugs (1) and (2) at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.



Plug at top of filter:

11.8 ± 1 Nm (1.2 ± 0.1 kgm)

- **Bleeding air**
 - 1) Bleed air from brake line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.
 - 2) Bleed air from steering line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.
- Fill the air conditioner with new refrigerant.
 - ★ **Precautions when filling air conditioner line with new refrigerant**
 - 1) Keep the temperature inside the room at above 3°C.
(If the temperature is below 3°C, the system will not work.)
 - 2) Use R134a as the refrigerant.
 - 3) When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min.750 mmHg.)
 - 4) Charge with 1.5 – 1.6 kg of refrigerant.
 - 5) Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
 - 6) Do not operate the compressor before charging with refrigerant.

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REMOVAL OF TORQUE CONVERTER, TRANSMISSION ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY

- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing.

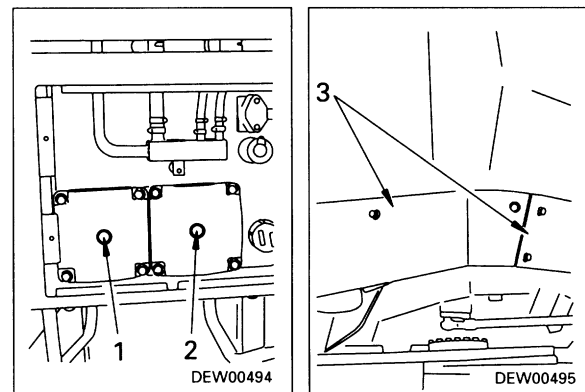
! Operate the bucket control lever at least 40 times TILT÷ HOLD to release the pressure inside the accumulator.

! Depress the brake pedal at least 17 times to release the pressure inside the brake accumulator.

! When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

1. Cover

Remove covers (3) at bottom of cab.



2. Ladders

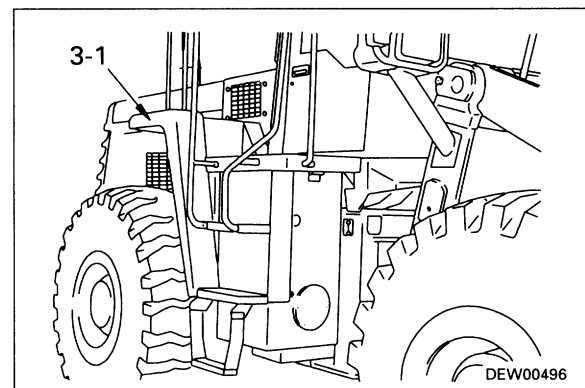
Remove left and right ladders (3-1).



Ladder rail (right): **64.5 kg**



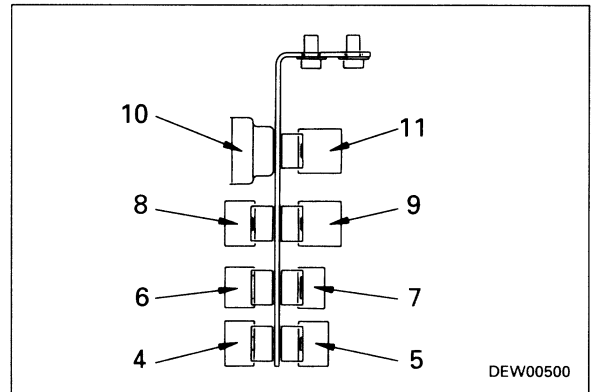
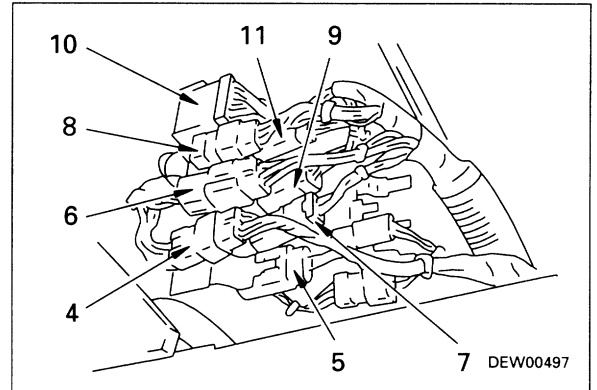
Ladder rail (left): **59.5 kg**



3. Electric wiring

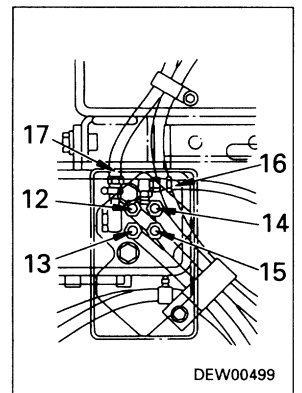
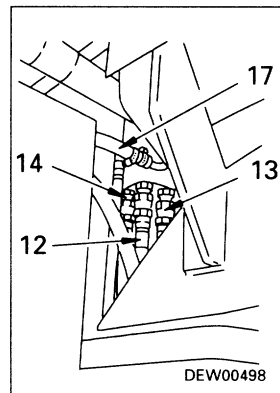
Disconnect the following electric wiring.

- 1) Disconnect transmission wiring TL1 (4) and TL2 (5).
 - 2) Disconnect floor wiring harnesses LR5 (6), LR6 (7), LR3 (8), LR4 (9), LR1 (10), and LR2 (11).
- ★ After disconnecting the connectors, mark with a tag to distinguish when installing.



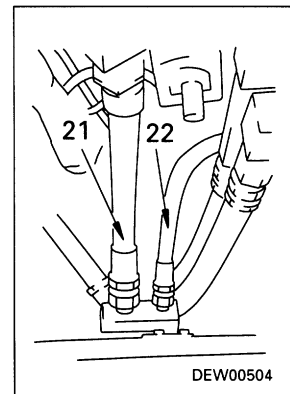
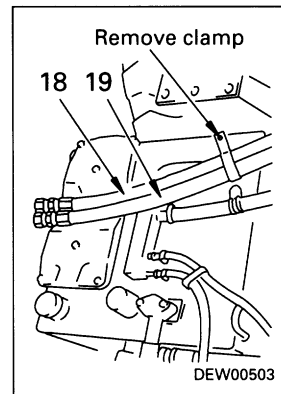
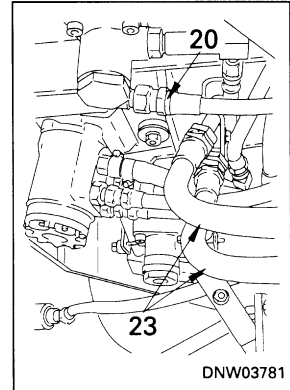
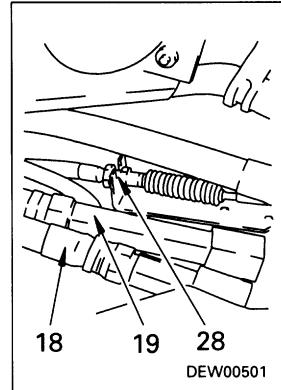
4. PPC piping

- 1) Disconnect hose (12) of PPC valve port "P2", hose (13) of port "P4", hose (14) of port "P3", and hose (15) of port "P1" at valve end.
 - 2) Disconnect hose (16) between PPC accumulator and PPC valve at valve end.
 - 3) Disconnect hose (17) of PPC valve drain port at valve end.
- ★ After disconnecting the hoses, mark with a tag to distinguish when installing.
- ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.



5. Brake piping

- 1) Disconnect hoses (18) and (19) between right brake valve and accumulator at pedal end.
★ Remove 2 brake hose clamps under floor board.
- 2) Disconnect hose (20) between left brake valve and accumulator at pedal end.
- 3) Disconnect right brake valve drain hose (21) and left brake valve drain hose (22) at rear frame portion.
- 4) Disconnect hose (23) between front brake and right brake valve at center hinge pin.

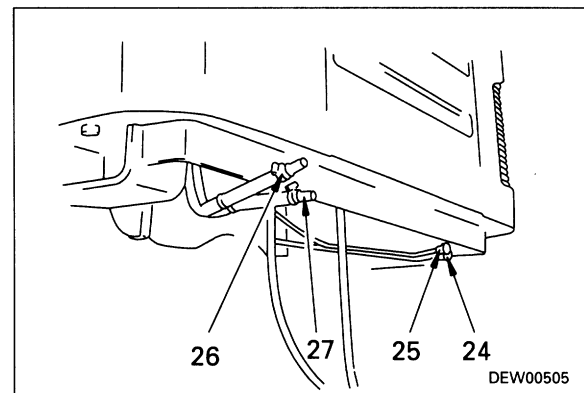


6. Air conditioner piping

- 1) Disconnect hose (24) between compressor and air conditioner unit at unit end. ※ 1
- 2) Disconnect hose (25) between receiver and air conditioner unit at unit end. ※ 2
- 3) Disconnect heater piping (26) and (27) at air conditioner unit end.

7. Accelerator cable

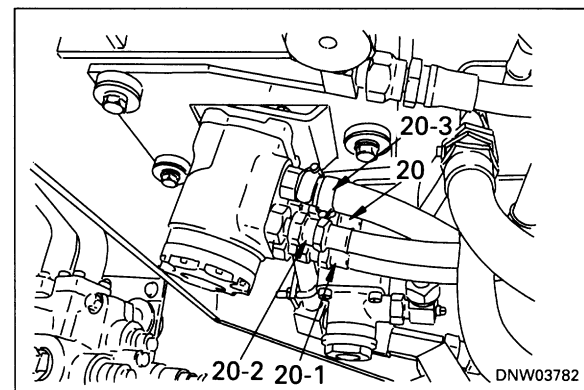
- Disconnect accelerator cable (28) under pedal.
★ Remove the cable clamp at the floor board.



8. Steering valve piping

Disconnect the following pipings from the steering valve.

- 1) Hose (20) between steering valve (L port) and stop valve (L.H.)
- 2) Hose (20-1) between steering valve (R port) and stop valve (R.H.)
- 3) Hose (20-2) between steering valve (P port) and accumulator charge valve
- 4) Hose (20-3) between steering valve (T port) and drain line



9. Cab, floor board

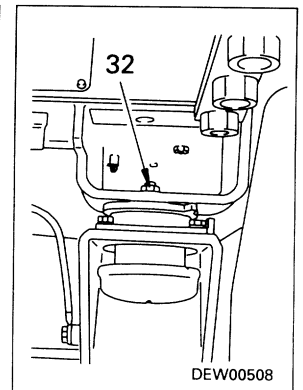
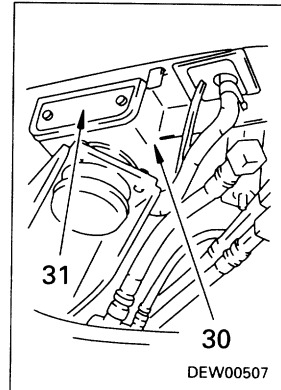
- 1) Remove mounting cover (31) of floor board (30), then remove 4 viscous damper mounting nuts (32) holding floor board.
- 2) Fit lifting tool to cab (33) and lift off cab.

※ 4

- ★ Raise the cab slowly and check that all parts have been removed before lifting off.



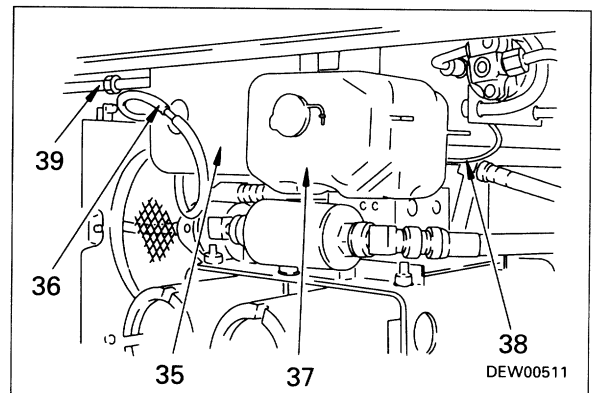
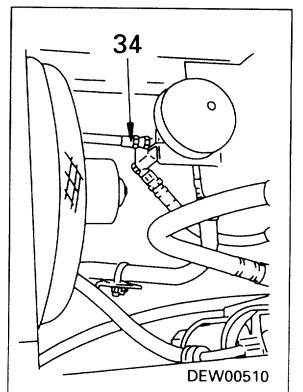
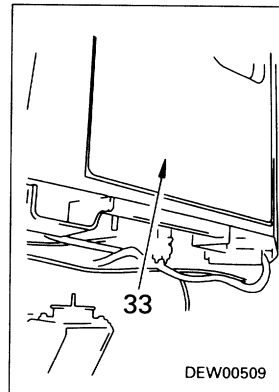
Cab, floor assembly: **470 kg**



10. Bulkhead

- 1) Disconnect piping inside bulkhead.
 - i) Disconnect hose (39) between air conditioner compressor and condenser at condenser end.
 - ★ After disconnecting the hose, fit plugs in the hose and condenser connector to prevent the entry of dirt or dust.
 - ii) Disconnect hose (34) between PPC accumulator and PPC valve inside bulkhead.
 - iii) Disconnect hose (36) of radiator sub-tank (35) and hose (38) of window washer tank (37) at tank end.
 - ★ Remove the hose from the hose clamp.
 - ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

※ 5

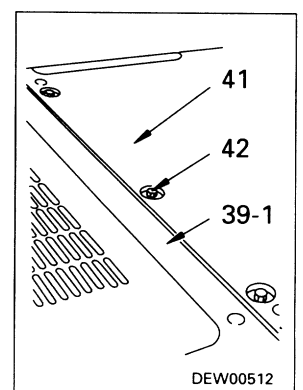
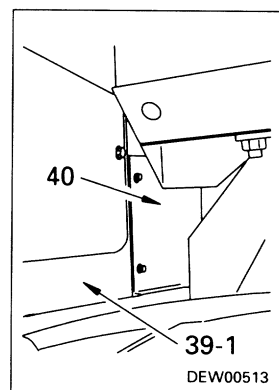


2) Bulkhead

- i) Remove cover (40) at bottom front of bulkhead (39-1).
- ii) Remove mounting bolts (42) at top of hood (41) and bulkhead (39-1).
 - ★ Be careful not to lose the washers and rubber of the mounting portion.
- iii) Install eyebolts at the top 4 corners of bulkhead (39-1), then sling and remove the bottom mounting bolts.



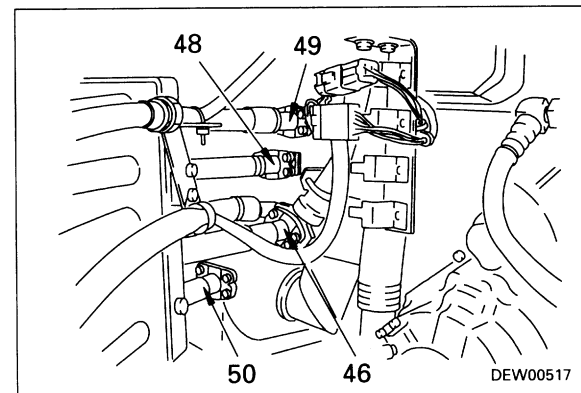
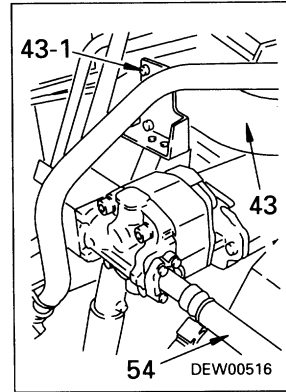
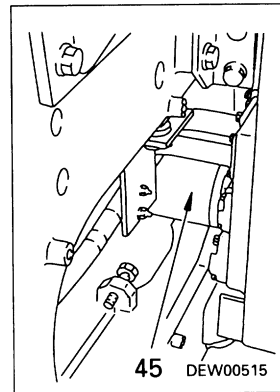
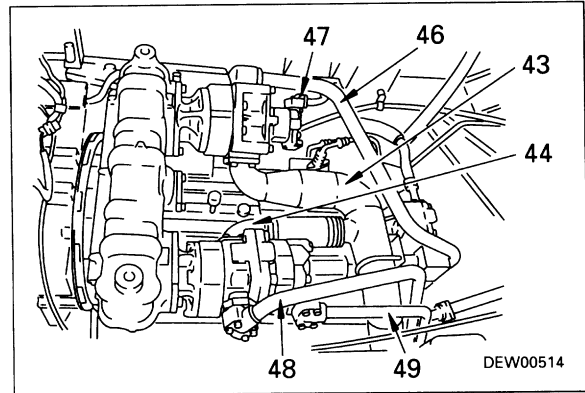
Bulkhead: **135 kg**
(including accumulator and charge pump)



11. Hydraulic piping

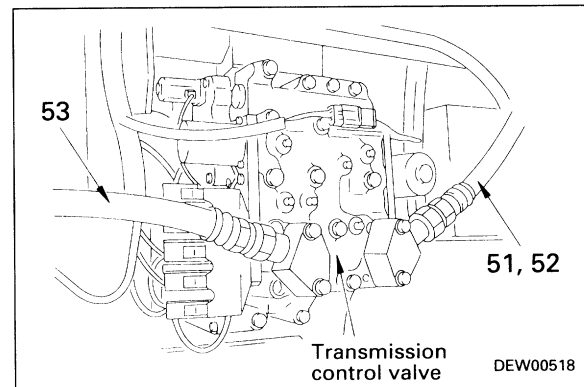
※ 6

- 1) Disconnect loader pump suction tube (43) and steering pump suction tube (44) at pump end. Remove hydraulic tank hose (45), remove tube mounting bolts (43-1), then remove tube (43).
 - 2) Disconnect tube (46) between loader pump and main control valve at pump end and center hinge pin end, then remove tube.
 - 3) Disconnect PPC pump tube (47) at pump end.
 - 4) Disconnect tube (48) between steering pump and steering valve at pump end and center hinge pin end, then remove tube.
 - 5) Disconnect tube (49) between switch pump and steering valve at pump end and center hinge pin end, then remove tube.
 - 6) Disconnect tube (50) between steering valve and cooler at center hinge pin.
- ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.
 - ★ After disconnecting the connectors, mark with a tag to distinguish when installing.

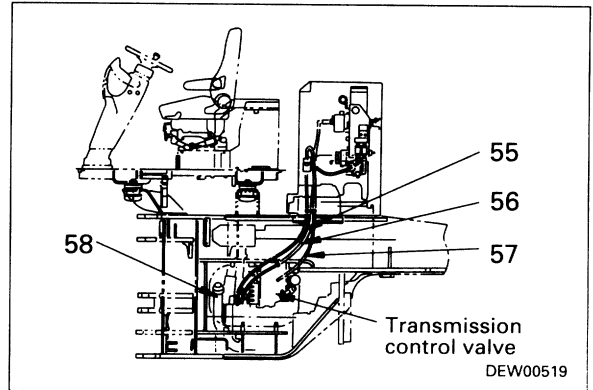
**12. Transmission, cooler piping**

※ 7

- 1) Disconnect hose (51) between transmission control valve and cooler and hose (52) between cooler and transmission at valve and transmission ends.



- 2) Disconnect hose (53) between transmission oil filter and control valve at valve end.
- 3) Disconnect transmission pump outlet hose (54) at pump end.
- 4) Disconnect hoses (55), (56), and (57) between parking brake emergency release valve and parking brake at parking brake control valve hose end.
 - ★ Remove the clamps mounted at the transmission and rear frame.
- 5) Remove mounting bolts of transmission filler tube (58), and rotate to transmission side, then lock with mounting bolts.
 - ★ After disconnecting the connectors, mark with a tag to distinguish when installing.
 - ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

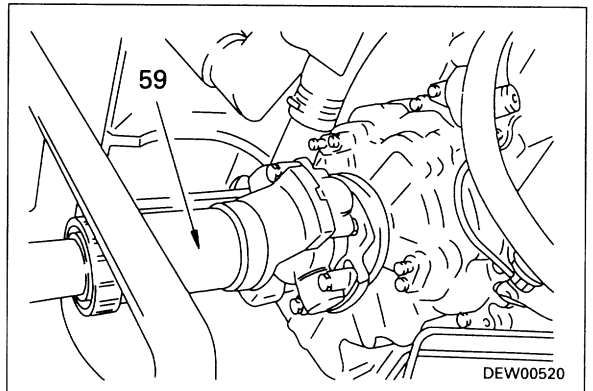


13. Drive shafts

- 1) Disconnect center drive shaft (59) at transmission end.
 - ※ 8
 - ★ Move the disconnected drive shaft to the side.



Center drive shaft: **36 kg**



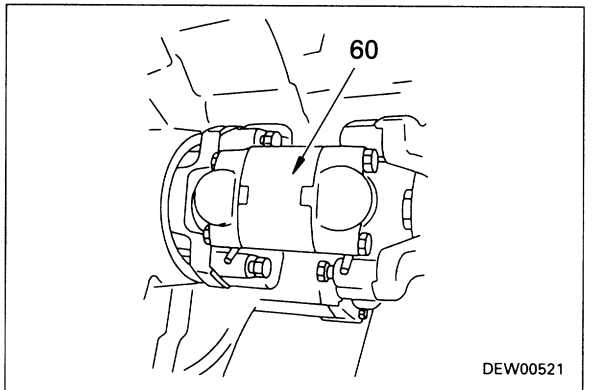
- 2) Remove rear drive shaft (60).

※ 9



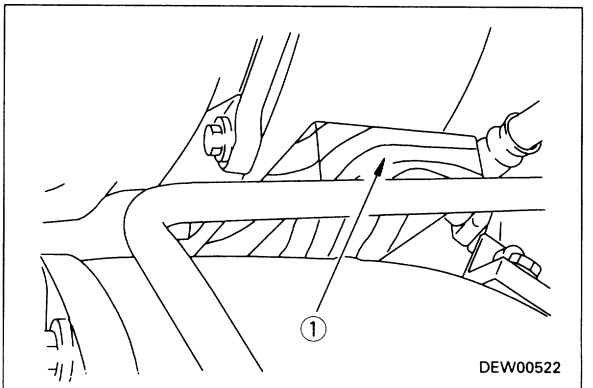
Rear drive shaft: **19 kg**

- ★ Make match marks on both the center and rear couplings.



14. Torque converter, transmission assembly

- 1) Install block ① between bottom of engine flywheel and rear axle to prevent engine from falling when transmission and torque converter are removed.
 - ※ 10



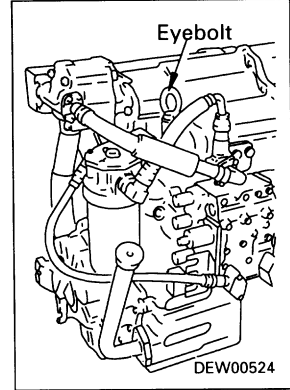
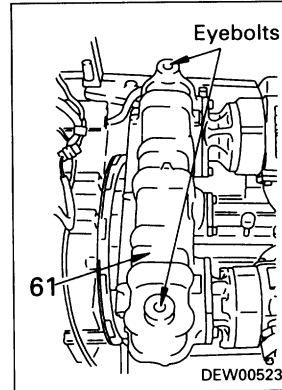
DISASSEMBLY AND ASSEMBLY

TORQUE CONVERTER, TRANSMISSION

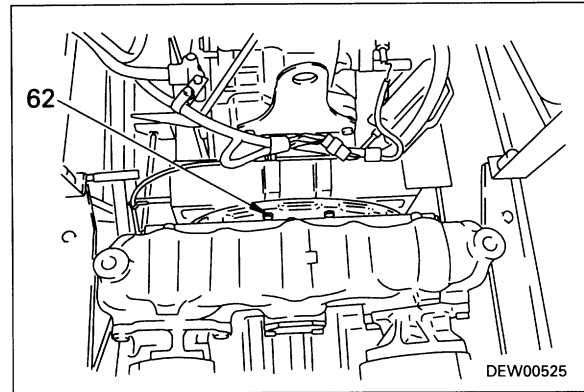
- 2) Install eyebolts to top of transmission oil filter and top of pump mounting gear case of torque converter and transmission assembly (61).



Torque converter, transmission assembly: **1,070 kg**
(including pump, filter, etc.)



- 3) Remove mounting bolts (62) of torque converter and transmission case, and engine fly-wheel housing. ※ 11



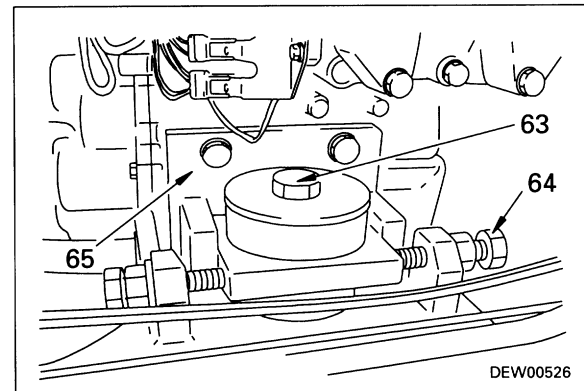
- 4) Remove mount bolts (63) and (64) of torque converter and transmission assembly, and raise approx. 200 mm, then remove mount bracket (65).

★ Do this on both the left and right. ※ 12

- 5) Lift off torque converter and transmission assembly (61).

★ Check that it does not hit against any other parts, and lift off slowly.

★ Check that all parts have been removed before lifting off.



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INSTALLATION OF TORQUE CONVERTER, TRANSMISSION ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 **kgm** Air conditioner unit hose:
29.4 – 34.3 Nm (3.0 – 3.5 kgm)

 Receiver hose:
New refrigerant compressor oil (ND-OILB)

※ 2

 **kgm** Receiver hose:
11.8 – 14.7 Nm (1.2 – 1.5 kgm)

 Receiver hose:
New refrigerant compressor oil (ND-OILB)

※ 3

 **kgm** Cable locknut:
53.9 ± 5 Nm (5.5 ± 0.5 kgm)

※ 4

★ Align securely with the notch hole of the viscous damper washer, then tighten.

※ 5

 Air conditioner condenser hose:
New refrigerant compressor oil (ND-OILB)

 **kgm** Air conditioner condenser hose:
19.6 – 24.5 Nm (2.0 – 2.5 kgm)

※ 6

※ 7

- ★ Replace the O-rings with new parts.
- ★ Install the clamps before connecting the hoses and tubes.

※ 8

※ 9

 **kgm** Mounting bolt:
112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

- ★ Check that the match mark is aligned.

※ 10

- ★ Remove block ① at the bottom of the fly-wheel housing.

※ 11

- ★ Replace the O-rings with new parts.

 **kgm** Mounting bolt:
68.6 ± 5 Nm (7.0 ± 0.5 kgm)

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※ 12

- ★ Align the pin hole securely.

 Mounting bolt of bracket (65):
 $279.5 \pm 29.4 \text{ Nm}$ ($28.5 \pm 3.0 \text{ kgm}$)

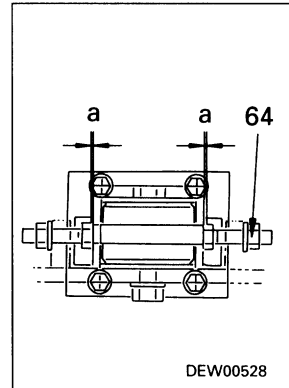
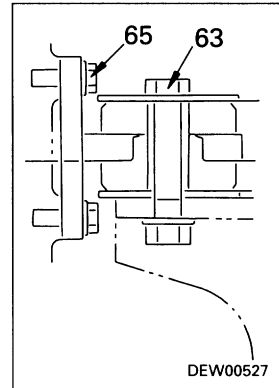
 Mount bolt (63):
 $926.7 \pm 103 \text{ Nm}$ ($94.5 \pm 10.5 \text{ kgm}$)

- Adjust so that the clearance at center bolt (64) is clearance a.

★ Clearance a: 1.0 – 1.5 mm

 Set bolt (64):
 $122.6 \pm 24.5 \text{ Nm}$ ($12.5 \pm 2.5 \text{ kgm}$)

 Set bolt: **Thread tightener (LT-2)**



- **Refilling with oil**

Tighten drain plugs (1) and (2) at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.

 Plug at top of filter:
 $11.8 \pm 1 \text{ Nm}$ ($1.2 \pm 0.1 \text{ kgm}$)

- **Bleeding air**

- 1) Bleed air from brake line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.
- 2) Bleed air from steering line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.

- Fill the air conditioner with new refrigerant.

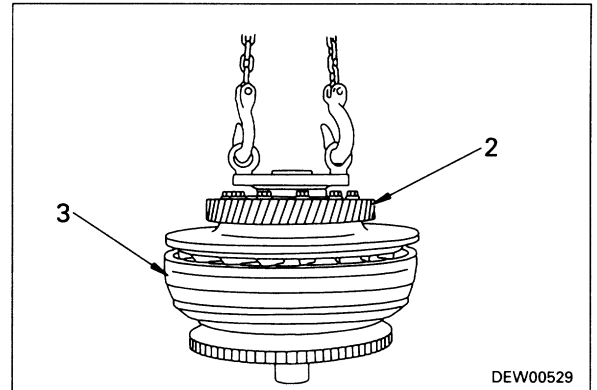
★ **Precautions when filling air conditioner line with new refrigerant**

- 1) Keep the temperature inside the room at above 3°C.
(If the temperature is below 3°C, the system will not work.)
- 2) Use R134a as the refrigerant.
- 3) When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min.750 mmHg.)
- 4) Charge with 1.5 – 1.6 kg of refrigerant.
- 5) Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
- 6) Do not operate the compressor before charging with refrigerant.

DISASSEMBLY OF TORQUE CONVERTER ASSEMBLY

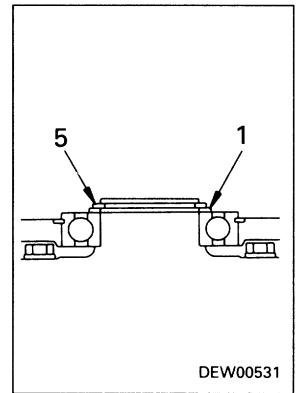
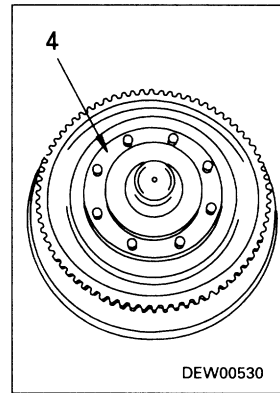
1. Turbine, case assembly

- 1) Remove stator shaft and pump assembly (2) from turbine and case assembly (3).

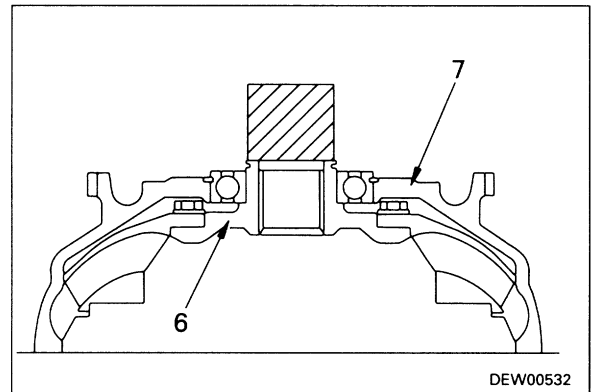


- 2) Disassemble turbine and case assembly as follows.

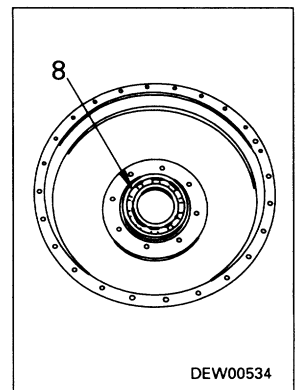
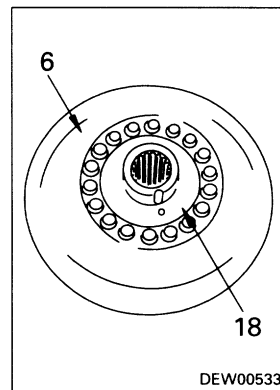
- i) Remove pilot (4).
- ii) Remove snap ring (5), then remove plate (1).



- iii) Push boss portion of turbine (6) and remove from case (7).

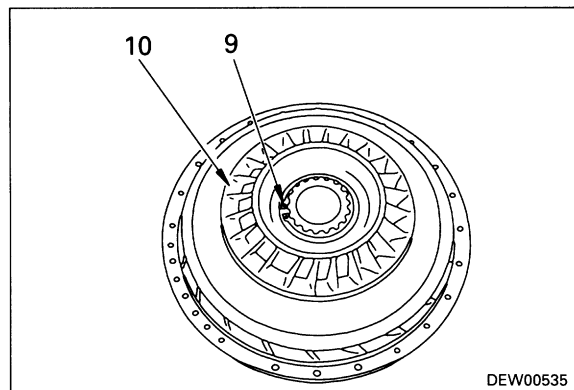


- iv) Remove mounting bolts and disconnect turbine (6) and boss (18).
- v) Remove bearing (8) from case.



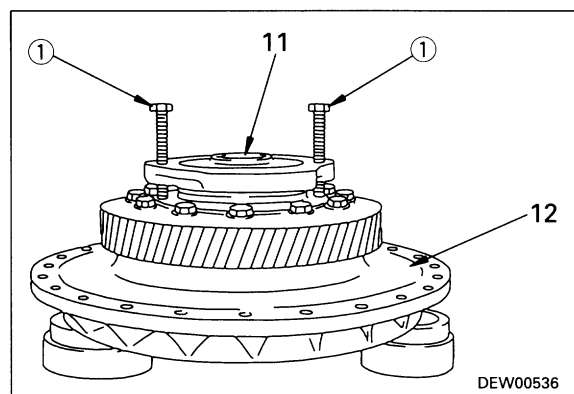
2. Stator

- 1) Remove snap ring (9).
- 2) Remove stator (10).



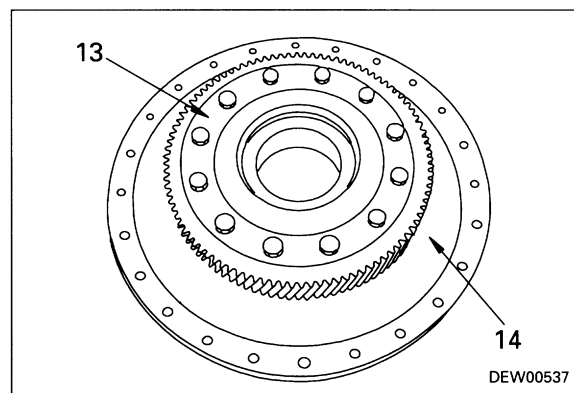
3. Stator shaft

Using forcing screws ①, push from stator shaft (11) end and disconnect from pump assembly (12).



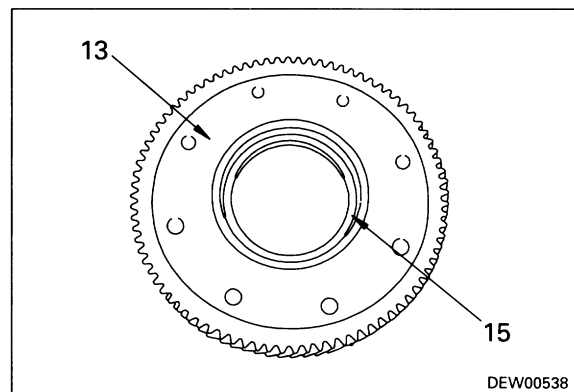
4. Gear

Remove gear (13) from pump (14).



5. Bearing

Remove bearing (15) from gear (13).

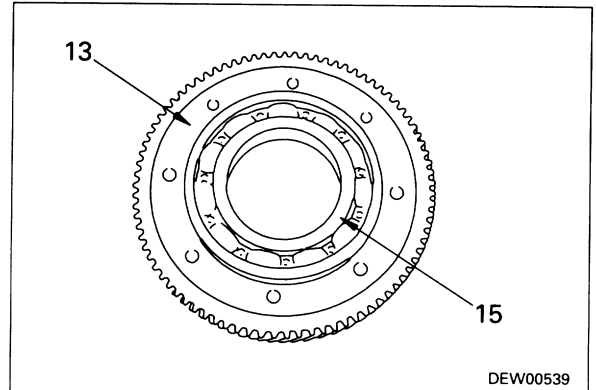


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ASSEMBLY OF TORQUE CONVERTER ASSEMBLY

1. Bearing

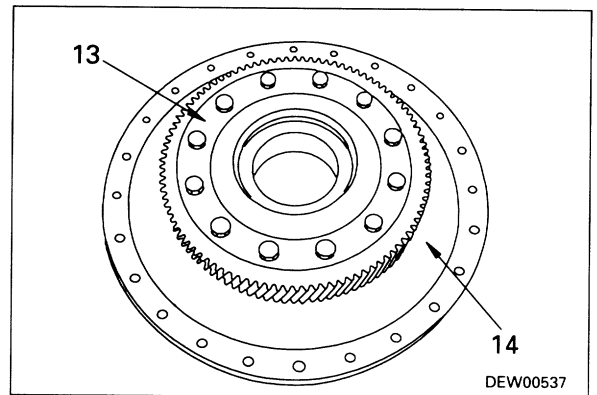
Install bearing (15) to gear (13).



2. Gear

Install gear (13) to pump (14).

 **kgm** Mounting bolt:
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)

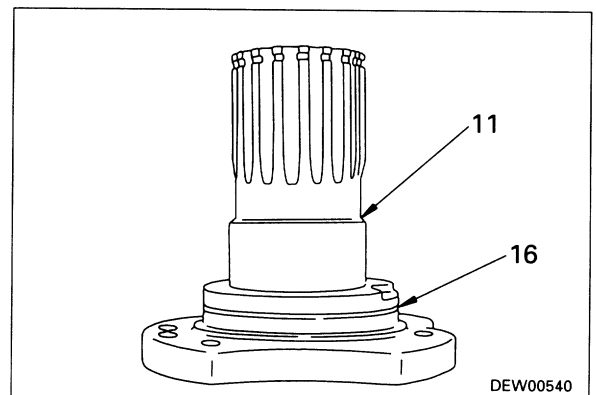


3. Stator shaft

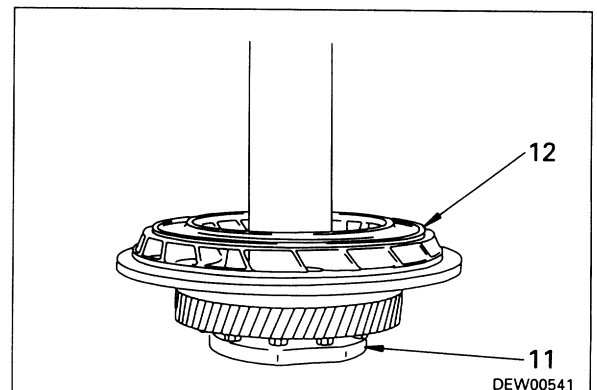
1) Install seal ring (16) to stator shaft (11).

 Seal ring: **Grease (G2-LI)**

★ Make the protrusion of the seal ring uniform.

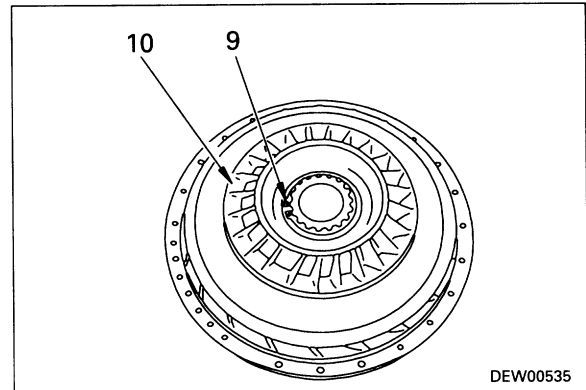


2) Push inner race of bearing and install pump assembly (12) to shaft (11).



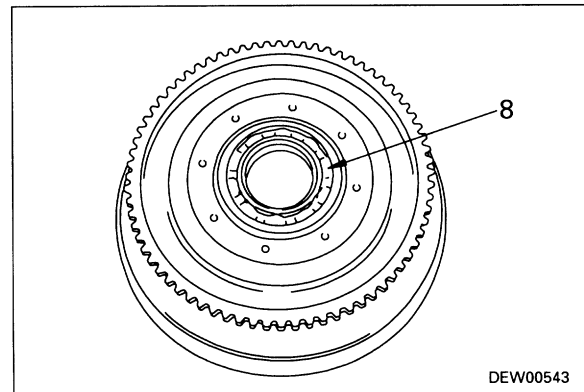
4. Stator

- 1) Install stator (10).
- 2) Install snap ring (9).



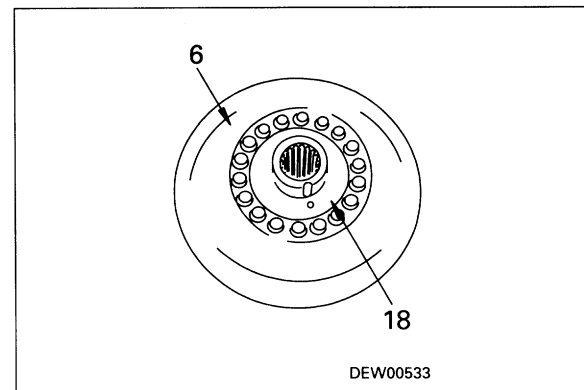
5. Turbine, case assembly

- 1) Assemble turbine and case assembly as follows.
 - i) Install bearing (8) to case.
 - ★ Press fit the bearing until it contacts the case.

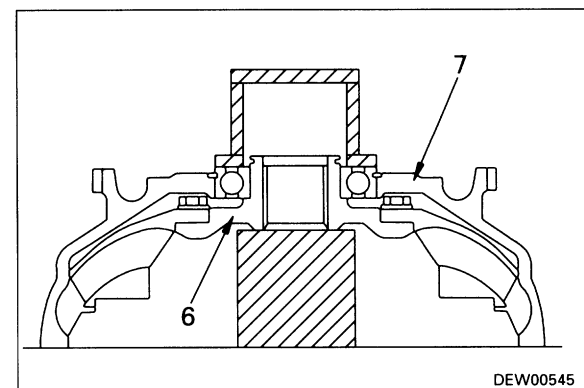


- ii) Install boss (18) to turbine (6).

 Mounting bolt:
Thread tightener (LT-2)
 Mounting bolt:
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)



- iii) Push inner race of bearing and install turbine (6) to case (7).



iv) Fit plate (1) and install snap ring (5).

v) Install pilot (4).



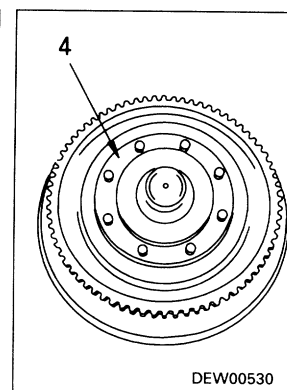
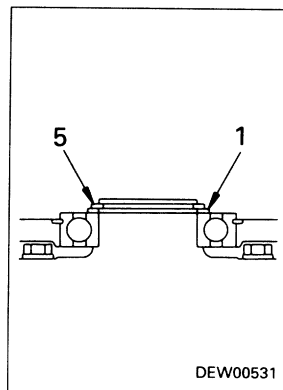
Mounting bolt:

Thread tightener (LT-2)



Mounting bolt:

$30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)



2) Install turbine and case assembly (3) to stator shaft and pump assembly (2).



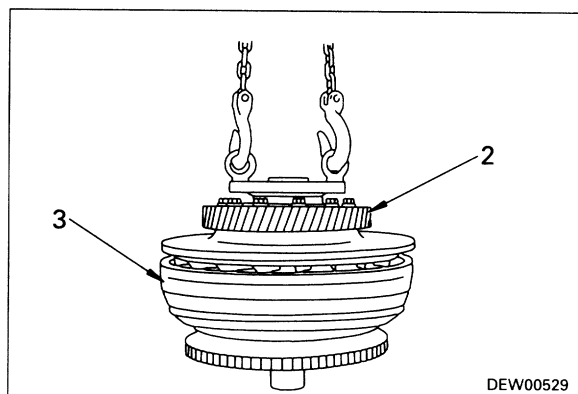
Mounting bolt:

Thread tightener (LT-2)



Mounting bolt:

$30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)



DISASSEMBLY OF TRANSMISSION ASSEMBLY

1. Coupling

- 1) Pull out lower rear coupling (1).
- 2) Remove lower front coupling (2) and mounting bolt (3), then remove coupling.
- 3) Remove sensors.

2. Accumulator valve

Remove mounting bolts (5) of accumulator valve (4), then remove accumulator valve and gasket.

- ★ After removing, cover with tape to prevent the entry of dirt or dust.

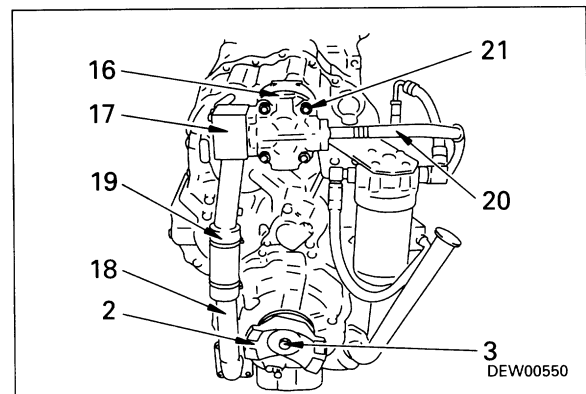
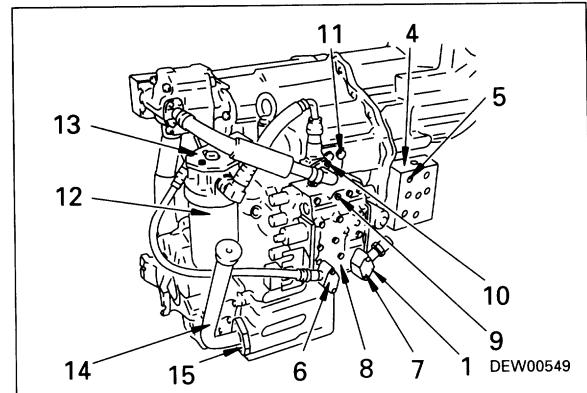
3. Transmission control valve

- 1) Remove control valve inlet elbow (6) and elbow (7) which goes to cooler.
- 2) Remove mounting bolts (9) (marked with ※) of control valve (8), install eyebolts (M:12mm), then sling.



Transmission control valve: **55 kg**

- 3) Remove mounting bolts (9) and remaining bolts (marked with ▲), then lift off control valve assembly.
- ★ After removing, cover with tape to prevent the entry of dirt or dust.



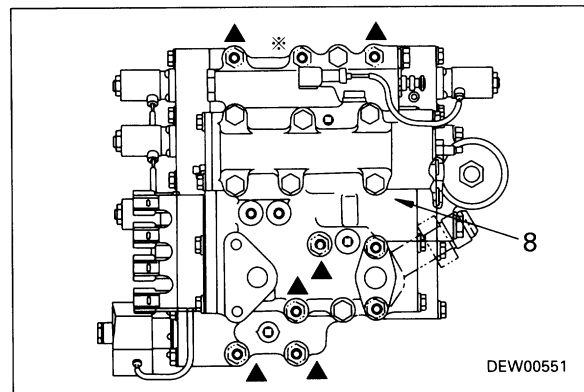
4. Flow valve

Remove mounting bolts (11) of flow valve (10), then remove flow valve and O-ring.

- ★ Remove the hose from the pump and the hose from the oil filter.
- ★ After removing, cover with tape to prevent the entry of dirt or dust.

5. Transmission oil filter

- 1) Remove inlet and outlet hoses of oil filter (12).
- 2) Remove mounting bolt of bracket (13), then remove together with oil filter.

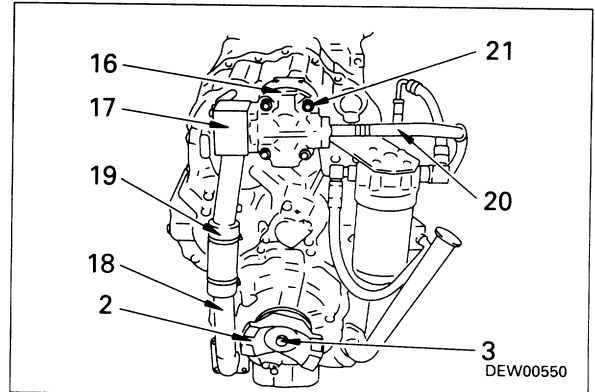


6. Filler tube

Remove mounting bolts (15) of filler tube (14), then remove filler tube.

7. Transmission, torque converter charging pump

- 1) Remove delivery hose (20) and hose (19), and tubes (18) and (17) at suction end of charging pump (16).
- ★ After removing, cover with tape to prevent the entry of dirt or dust.
- 2) Remove mounting bolts (21) of charging pump (16), then remove pump and O-ring.

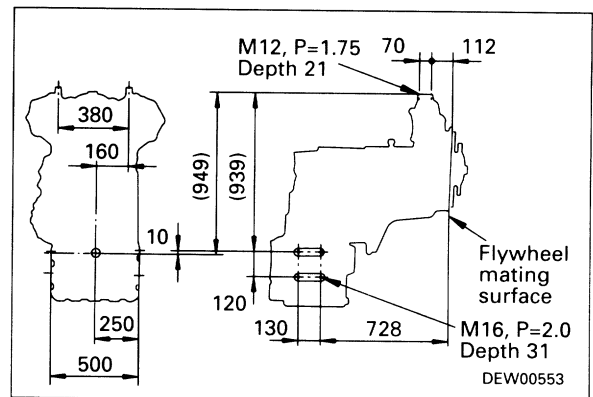
**8. Transmission assembly**

Install transmission assembly to stand.



Transmission assembly: **950 kg**

- ★ Support the transmission at the position shown in the diagram on the right.

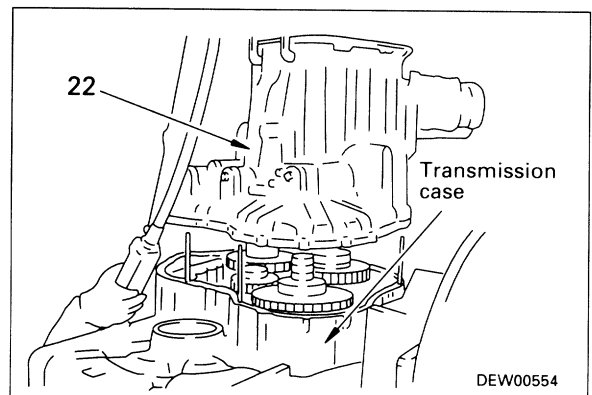
**9. Torque converter case**

Remove mounting bolts of torque converter case (22), then remove from transmission case.

- ★ When removing the case, slowly remove it perpendicularly to the mounting surface.



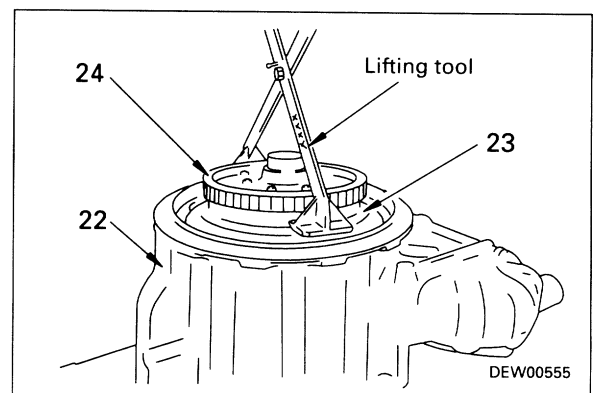
Torque converter case: **160 kg**

**[TORQUE CONVERTER]****1. Torque converter**

- i) Remove 6 bolts installing torque converter case (22) and torque converter.
- ii) Fit lifting tool to gear portion of drive case (24) of torque converter assembly (23) and lift off from torque converter case (22).



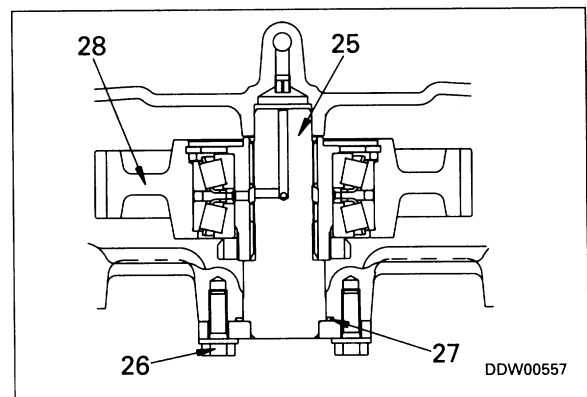
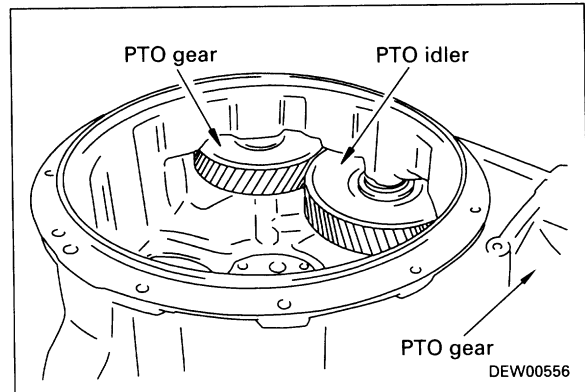
Torque converter assembly: **56 kg**



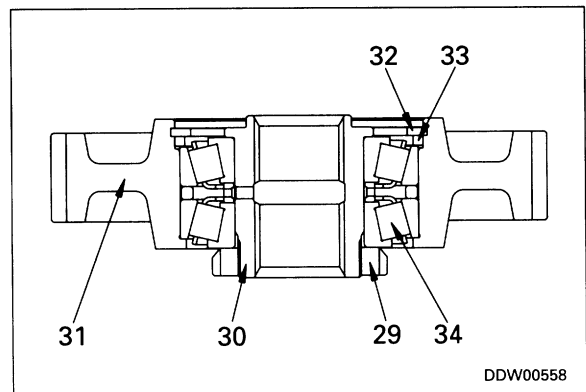
2. PTO gear

1) PTO idler assembly

- i) Remove lock bolts (26) of idler shaft (25), then remove idler shaft, O-ring (27), and gear assembly (28).

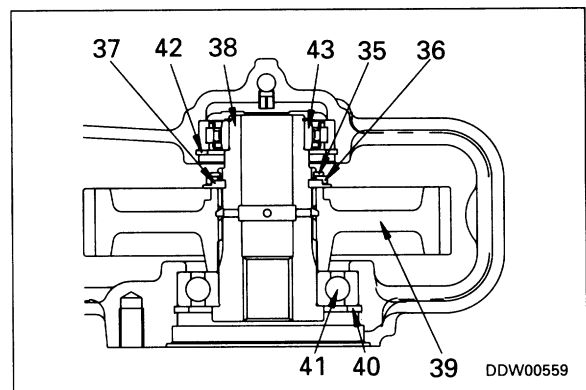


- ii) Remove nut (29) from gear assembly (31), then remove idler hub (30).
- iii) Remove snap ring (32) and spacer (33) from gear (31), then remove bearing (34).



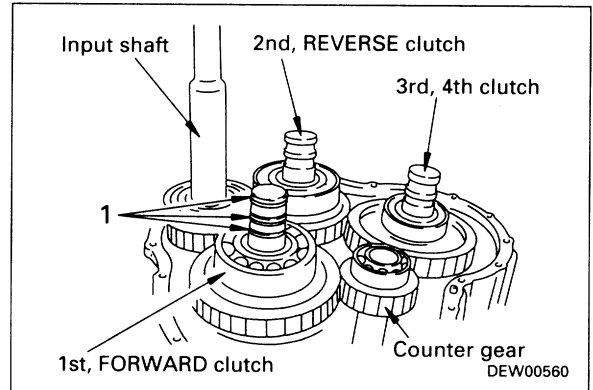
2) PTO gear

- i) Remove snap ring (35), then lower ring (35), and remove split spacer (37).
 - ii) Pull out shaft (38) and remove gear (39).
 - iii) Remove snap rings (40) and (42), then remove bearings (41) and (43).
- ★ Remove the PTO gear on the opposite side in the same way.

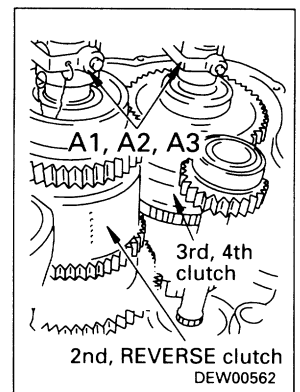
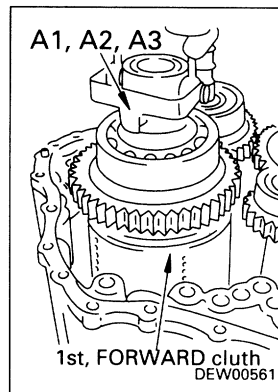


[TRANSMISSION]

1. Remove input shaft assembly.
2. **1st, FORWARD clutch**
 - 1) Remove seal rings (1) from clutch shaft.
 - 2) Set lifting tools **A1**, **A2**, and **A3** to 1st, FORWARD clutch shaft, and lift off clutch.

1st, FORWARD clutch: **76.5 kg**

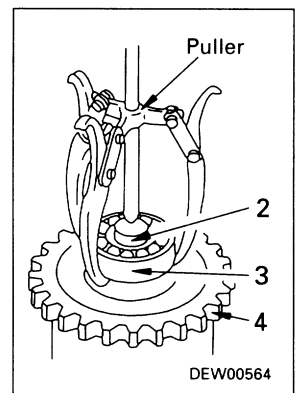
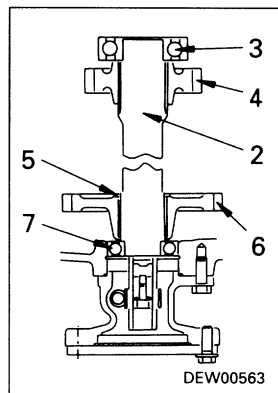
3. **2nd, REVERSE clutch, 3rd, 4th clutch**
Set lifting tools **A1**, **A2**, and **A3** to 2nd, REVERSE clutch shaft and 3rd, 4th clutch shaft, then raise clutches at same time and remove.

2nd, REVERSE clutch: **91 kg**3rd, 4th clutch: **96 kg**

4. **Driven gear**
 - 1) Install puller to countershaft (2) and bearing (3) and remove bearing, then remove gear (4) from shaft.
 - 2) Remove snap ring (5), then remove gear (6).
 - 3) Remove shaft (2), then remove bearing (7) with puller.

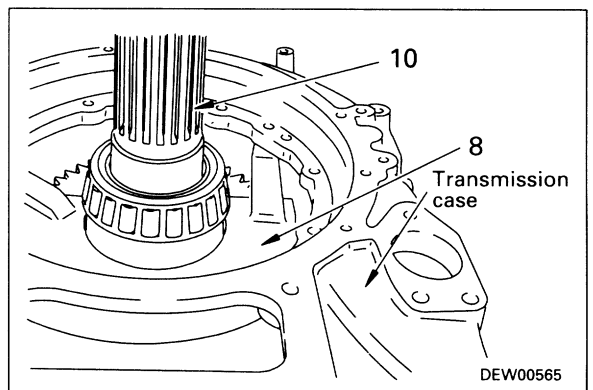
★ When setting the puller in position, use a block at the end face of the clutch shaft when carrying out the operation.

⚠ There is oil on the shaft and gears, so be careful not to let them slip.



5. **Parking brake**
Disassemble parking brake.
For details, see DISASSEMBLY OF PARKING BRAKE ASSEMBLY.

6. **Output shaft**
 - 1) Remove mounting bolts (9) of gear cover (8), then remove cover.



- 2) Install eyebolt to output shaft (10) and lift off output shaft.



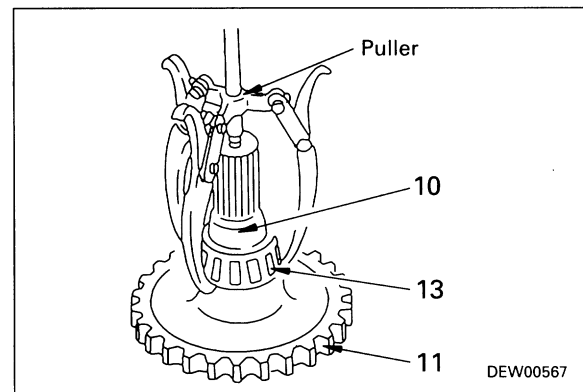
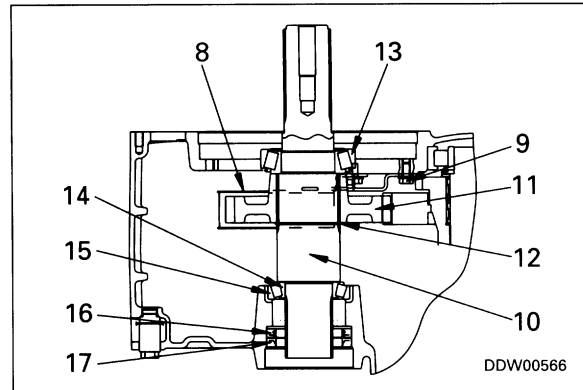
Output shaft (including gear): **33 kg**

- 3) Remove snap ring (12) of output gear (11), then remove inner bearing (13) using puller, and remove output gear from shaft.
- 4) Using puller, remove inner bearing (14) on opposite side of output shaft.
★ When setting the puller in position, use a block at the end face of the clutch shaft when carrying out the operation.



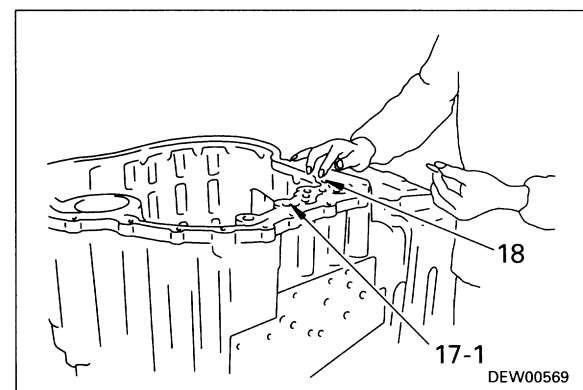
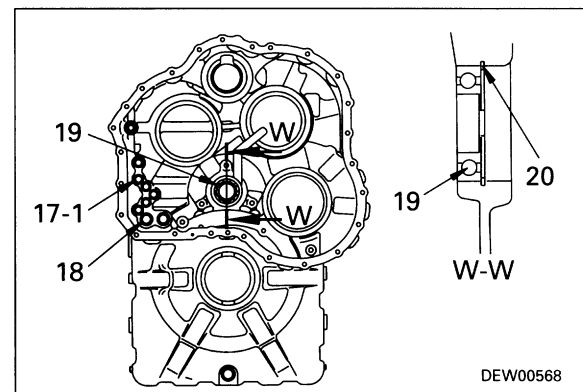
There is oil on the shaft and gears, so be careful not to let them slip.

- 5) Remove bearing outer race (15) from transmission case.
- 6) Remove oil seal (16) and dust seal (17) of rear coupling.



7. Transmission case

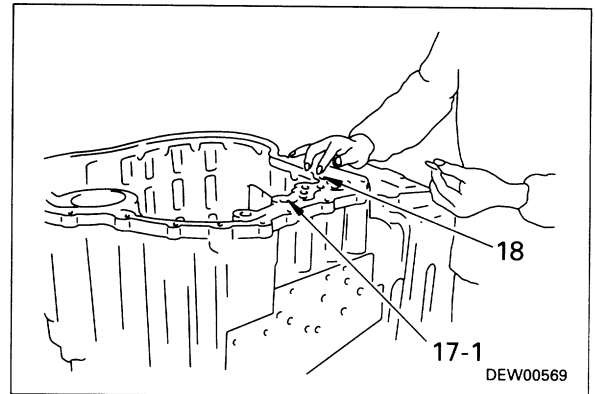
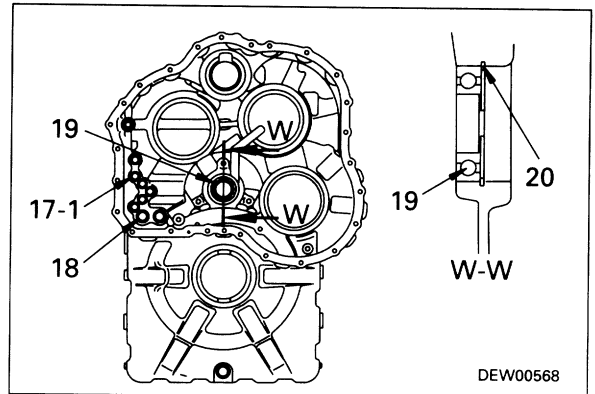
- 1) Remove O-rings (17-1) and (18) from transmission case.
- 2) Remove bearing (19) and snap ring (20) of driven gear from case.



ASSEMBLY OF TRANSMISSION ASSEMBLY

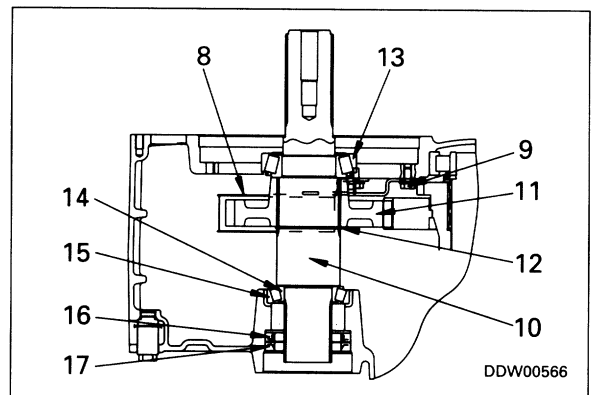
1. Transmission case

- 1) Press fit bearing (19) of driven gear to transmission case, and install snap ring (20).
- 2) Install O-rings (17-1) and (18) to transmission case.



2. Output shaft

- 1) Press fit bearing outer race (15) to transmission case.
- 2) Press fit bearing inner (14) at output shaft rear coupling end.
 - ★ Press fit securely so that there is no clearance at the end face of the bearing.
- 3) Install snap ring (12) to output shaft (10), then install output gear (11), and press fit inner bearing (13).
 - ★ Press fit securely so that there is no clearance at the end face of the bearing.
- 4) Install eyebolt to output shaft (10), then install shaft to transmission case.
- 5) Install gear cover (8) to case with mounting bolt (9).



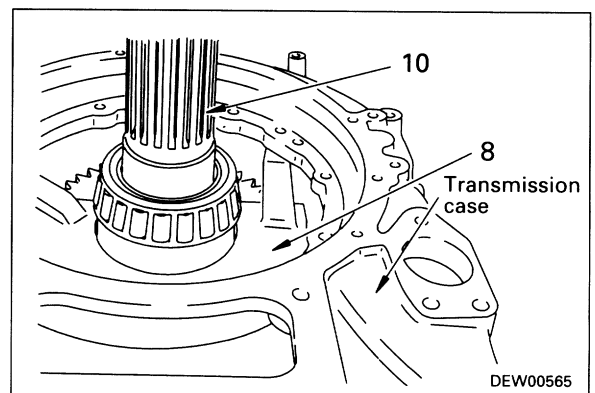
Mounting bolt:

Thread tightener (LT-2)



Mounting bolt:

112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)



3. Parking brake

Assemble parking brake.

For details, see ASSEMBLY OF PARKING BRAKE ASSEMBLY.

4. Rear coupling oil seal

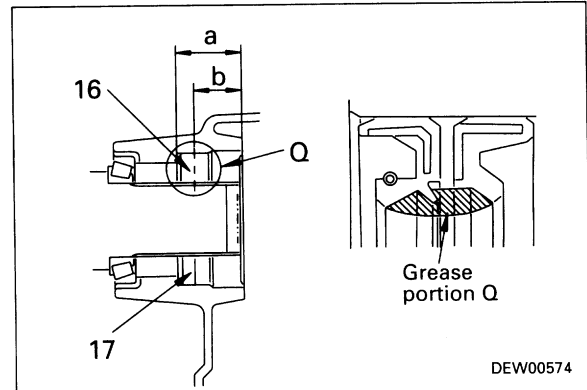
Install oil seal (16) and dust seal (17) to transmission case so that they are at position given below.

★ a: 50 ± 0.2 mm

★ b: 35 ± 0.2 mm



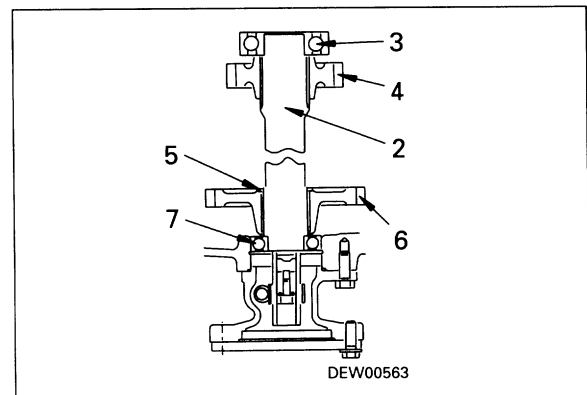
Oil seal, lip of dust seal: **Grease (G2-LI)**

**5. Counter gear**

1) Install snap ring (5) and gear (6) to shaft (2), and press fit bearing (7).

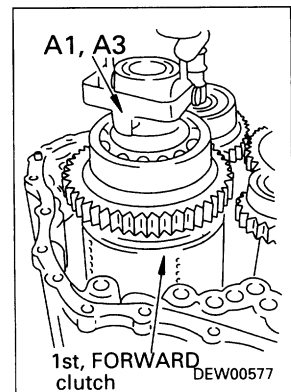
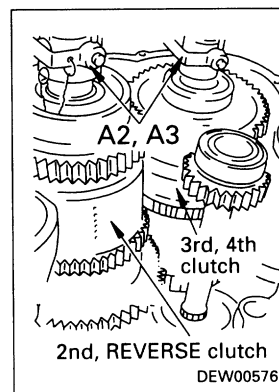
2) Install snap ring and gear (4) to opposite end of shaft (2), and press fit bearing (3).

★ Press fit securely so that there is no clearance at the end face of the bearing.

**6. 2nd, REVERSE clutch, 3rd, 4th clutch**

Install lifting tools **A2** and **A3** to 2nd, REVERSE clutch shaft and 3rd, 4th clutch shaft, raise clutches at same time, and install to transmission case.

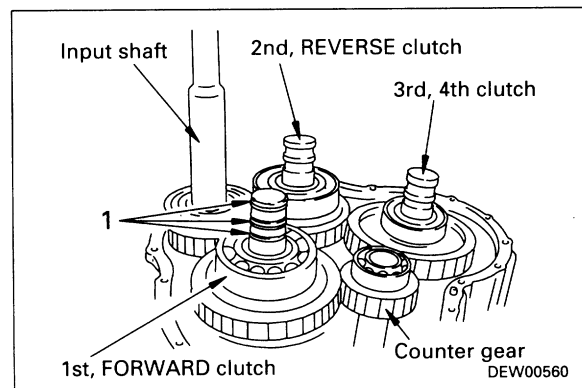
★ Raise 2nd, REVERSE and 3rd, 4th clutches at the same time with the lifting tool, and turn the 3rd, 4th clutch at an angle to assemble.

**7. 1st, FORWARD clutch**

Install lifting tools **A1** and **A3** to 1st, FORWARD clutch shaft, and assemble clutch in transmission case.

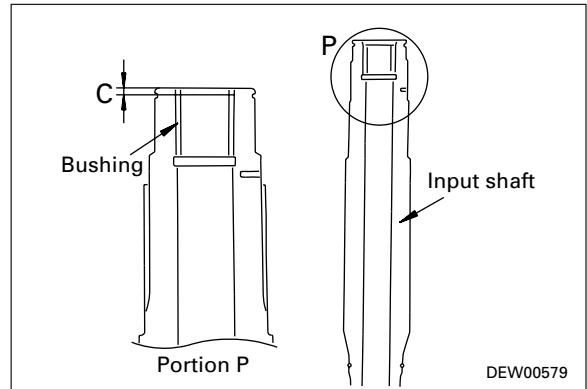
8. Seal rings

Install seal rings (1) to shafts of 1st, FORWARD clutch, 2nd, REVERSE clutch, and 3rd, 4th clutch.



9. Assemble input shaft assembly and gear to transmission case.

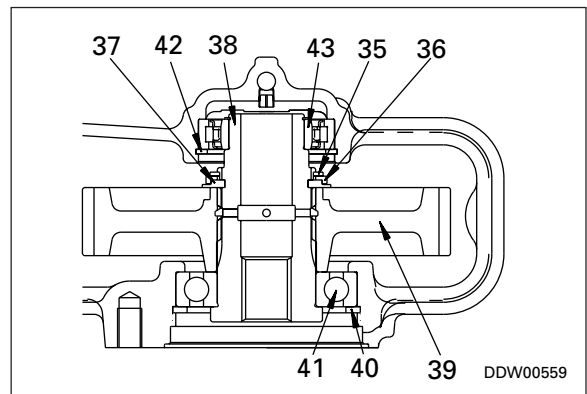
- ★ The installed dimension of the input shaft bushing is as follows.
 - ★ $c = 2.0 \pm 0.5 \text{ mm}$
- ★ Press fit securely so that there is no clearance at the end face of the bearing.



10. Torque converter

1) PTO gear

- i) Install bearings (41) and (43) to case, and secure with snap rings (40) and (42).
 - ★ Press fit securely so that there is no clearance at the end face of the bearing.
- ii) Set gear (39) inside case, and insert shaft (38) from outside of case.
 - ★ Be careful of the gear mounting position.
- iii) Set split spacer (37) in position, then install ring (36) and secure with snap ring (35).



2) PTO idler assembly

- i) Press fit bearing (34) to gear (31), then install spacer (33) and secure with snap ring (32).
 - ★ Be careful not to forget to assemble spacer (33).
 - ★ Press fit securely so that there is no clearance at the end face of the bearing.
- ii) Install idler hub (30) to gear assembly and tighten with nut (29).



Nut: **Thread tightener (LT-2)**

Nut:

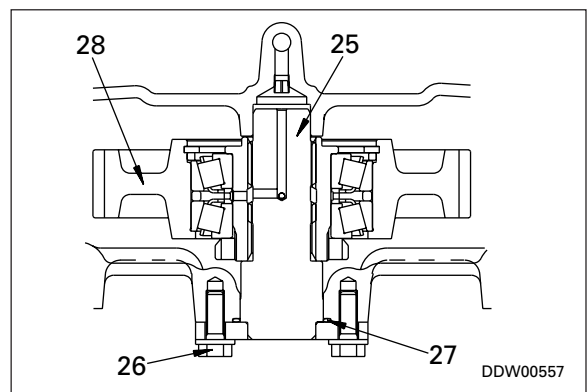
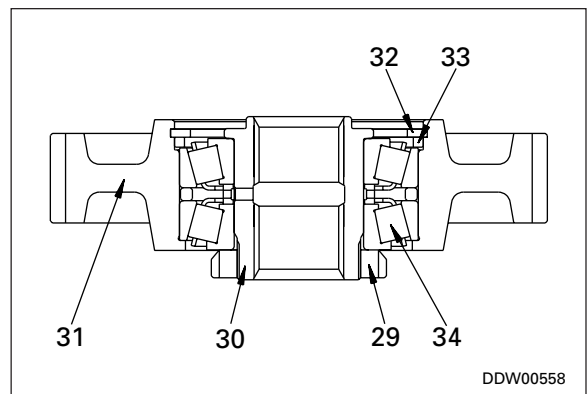
$417 \pm 24.5 \text{ Nm}$ ($42.5 \pm 2.5 \text{ kgm}$)

- iii) Set gear assembly (28) inside case, insert O-ring in case, install idler shaft (25), and tighten with lock bolts (26).



Idler shaft mounting bolt:

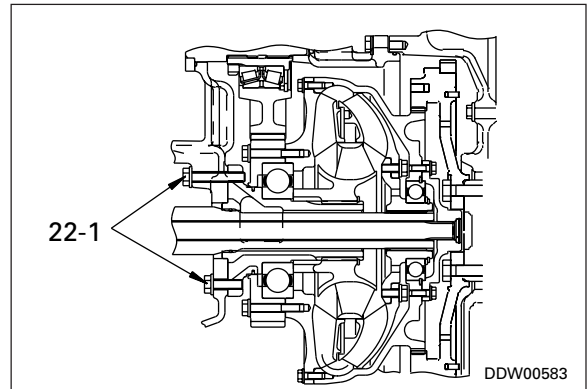
$112.8 \pm 4.9 \text{ Nm}$ ($11.5 \pm 0.5 \text{ kgm}$)



3) Torque converter

- i) Fit lifting tool to gear portion of drive case (24) of torque converter assembly (23), and set to torque converter case (22).
- ii) Tighten bolts (22-1) installing torque converter case (22) and torque converter.

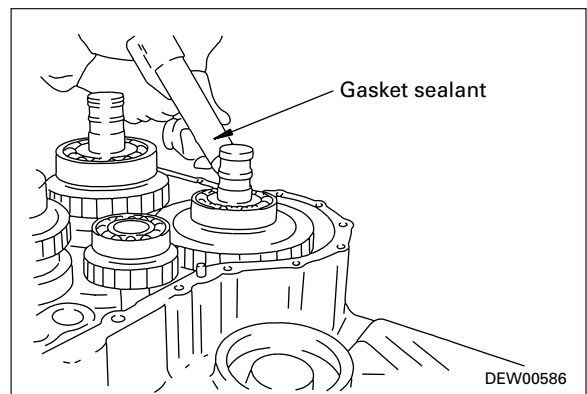
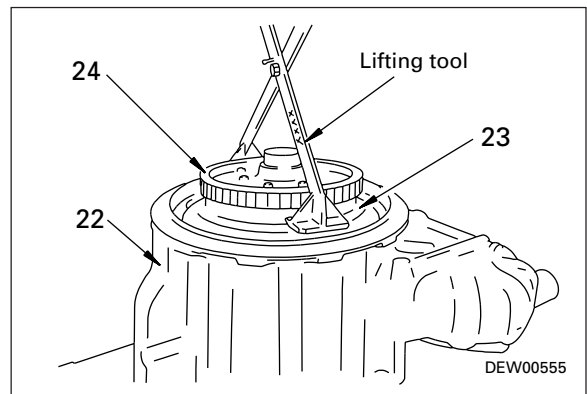
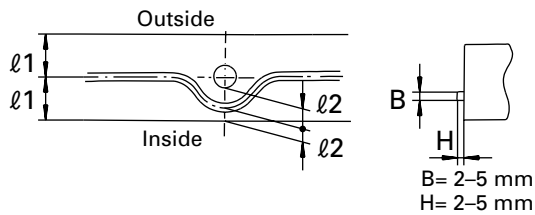
 **Torque converter mounting bolt:**
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)



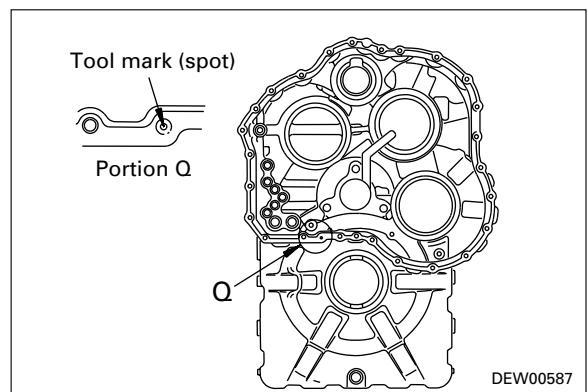
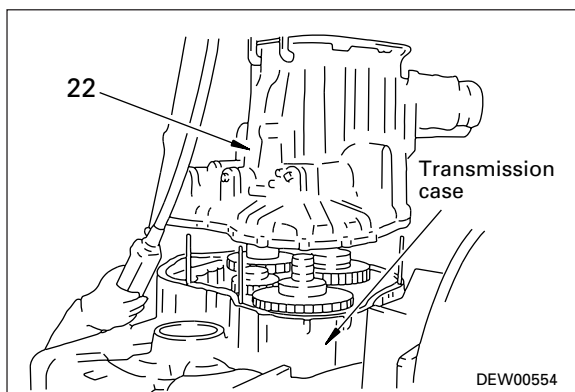
11. Torque converter case

Coat transmission case with gasket sealant, then set torque converter case (22) in position and tighten with mounting bolts.

 Transmission case flange surface:
Gasket sealant (Three Bond 1207B)



 **Torque converter case mounting bolt:**
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)



12. Transmission, torque converter charging pump

- 1) Install O-ring to charging pump (16), then set to transmission case and tighten with mounting bolts (21).

★ Before installing the pump, insert the pump drive shaft inside the torque converter input shaft assembly.

 Pump mounting bolt:

$279.4 \pm 29.4 \text{ Nm}$ ($28.5 \pm 3.0 \text{ kgm}$)

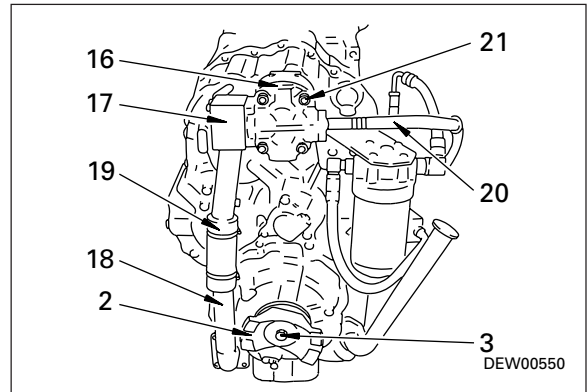
- 2) Fit O-rings to tubes (17) and (18) at suction side of charging pump (16), then connect hose (19) and tighten. Install O-ring to hose (20) at discharge side also, then tighten.

 Tube (17), (18) mounting bolt:

$112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

 Clamp of hose (19):

$4.4 \pm 0.5 \text{ Nm}$ ($0.45 \pm 0.05 \text{ kgm}$)

**13. Filler tube**

Fit filler tube (14) with mounting bolt (15) temporarily, and move towards inside of transmission.

★ After mounting the transmission on the machine, install the filler tube at the specified position.

14. Transmission oil filter

- 1) Install bracket (13) and oil filter to transmission.

Serial No.: 50001 – 54000

 Oil filter mounting bolt:

$68.6 \pm 4.9 \text{ Nm}$ ($7.0 \pm 0.5 \text{ kgm}$)

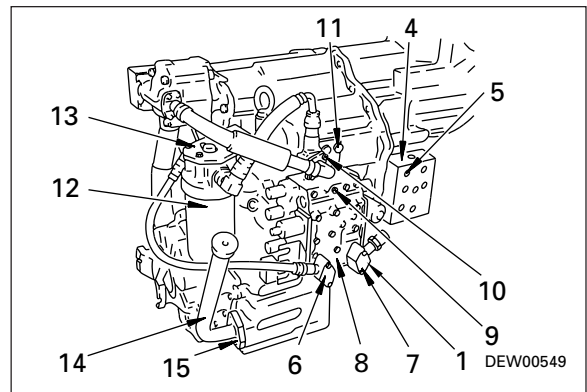
 Filter bracket mounting bolt:

$112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

- 2) Install inlet and outlet hoses of oil filter (12).

 Hose connection:

$176.5 \pm 29.4 \text{ Nm}$ ($18.0 \pm 3.0 \text{ kgm}$)



15. Transmission control valve

- 1) Install gasket to transmission end, then install eyebolt to portion of control valve (8) marked ※, and set to transmission.
- 2) Install to portions marked ▲ and ※ with mounting bolts (9), then tighten.

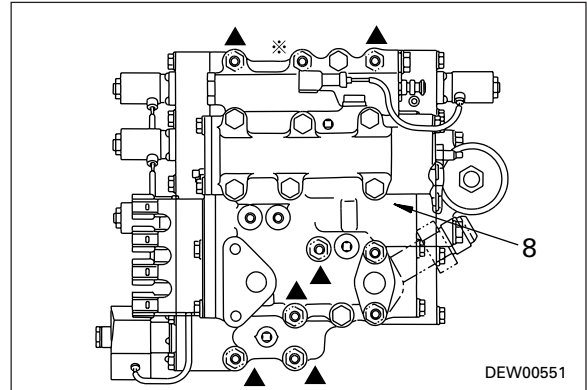
 Mounting bolt:

Thread tightener (LT-2)

 Mounting bolt:

$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

- 3) Install elbow (7) which goes to cooler and inlet elbow (6) to control valve.

**16. Flow valve**

Install O-ring to flow valve (10), then install to transmission case with mounting bolts (11).

 Flow valve mounting bolt:

Thread tightener (LT-2)

 Flow valve mounting bolt:

$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

17. Accumulator valve

Install O-ring to accumulator valve (4) and tighten with mounting bolts (5).

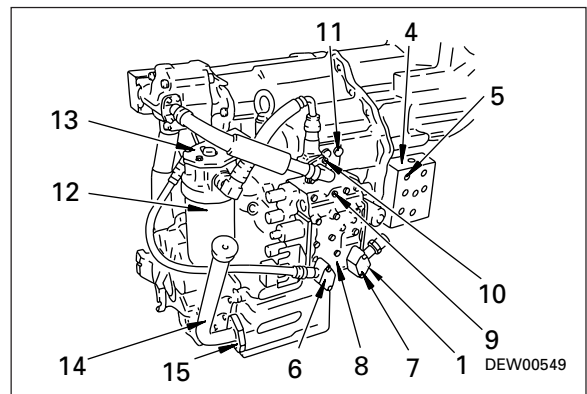
18. Couplings

- 1) Front coupling
Install front coupling (2) to output shaft, and tighten O-ring and washer with coupling mounting bolt (3).

 Mounting bolt:

$926.7 \pm 98.1 \text{ Nm}$ ($94.5 \pm 10.0 \text{ kgm}$)

- 2) Rear coupling
Install rear coupling (1) to rear end of output shaft.



DISASSEMBLY OF TRANSMISSION CLUTCH PACK ASSEMBLY

FORWARD, 1ST CLUTCH ASSEMBLY

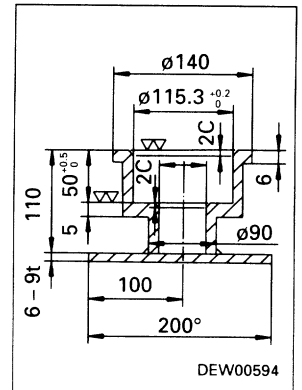
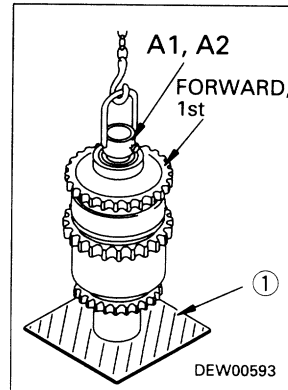
1. Assembly of FORWARD clutch pack assembly

- ★ Lift the clutch pack assembly with lifting tools A1 and A2, and install to lifting stand ①.

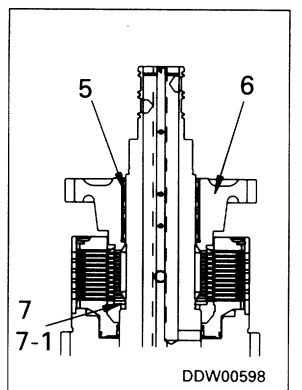
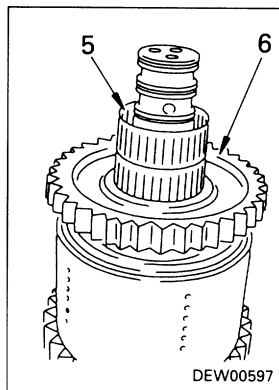
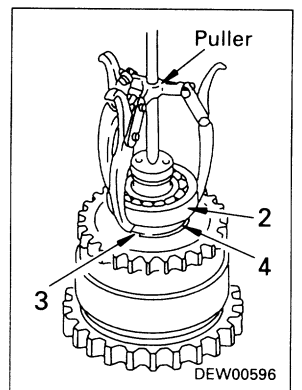
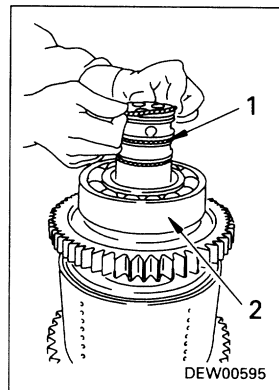


FORWARD, 1st clutch assembly:

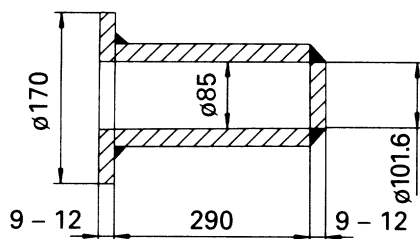
76.5 kg



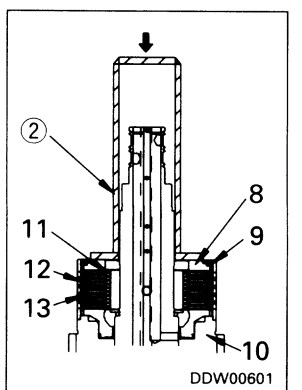
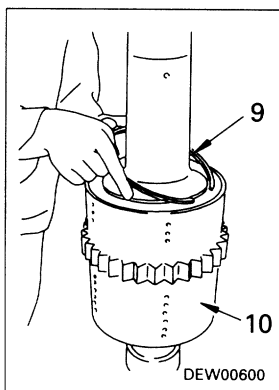
- 1) Seal rings
Remove 3 seal rings (1) installed to shaft.
- 2) Bearing, thrust washer
 - i) Install puller to end face of shaft, and remove bearing (2).
 - ★ When setting the puller in position, install a block to the end face of the clutch shaft before carrying out the operation.
 - ii) Remove thrust washer (3) and spacer (4) from shaft.
- 3) Needle bearing, FORWARD gear
 - i) Remove needle bearing (5) and FORWARD gear (6) from shaft.
 - ii) Remove thrust washer (7) and spacer (7-1).



- 4) End plate
Push end plate (8) with tool ② in diagram below, remove snap ring (9), then remove end plate (8) from clutch case (10).



Tool ②



DEW00599

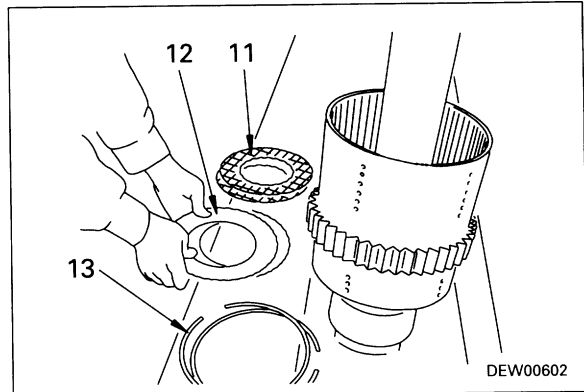
DISASSEMBLY AND ASSEMBLY

TRANSMISSION CLUTCH PACK

5) Clutch plates

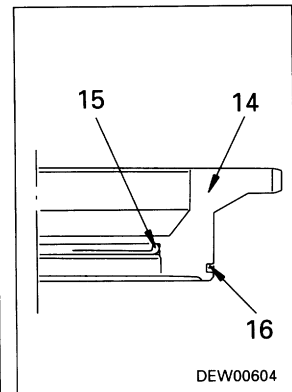
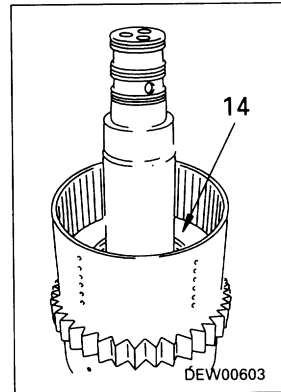
Remove separator plates (12), disc plates (11), and wave springs (13) from inside clutch (10).

- ★ Be careful not to let the separator plates or disc plates catch in the clutch case ring groove.



6) FORWARD piston

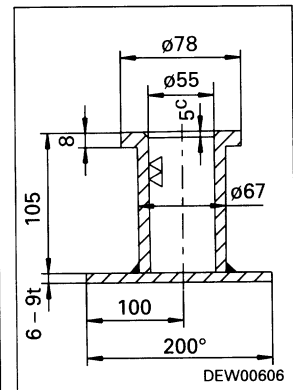
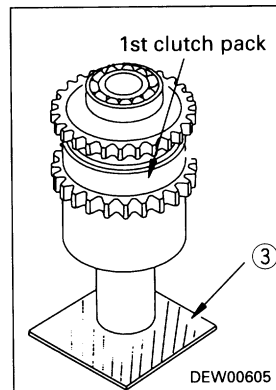
Remove FORWARD piston (14) from inside clutch case, then remove piston seals (15) and (16) from piston.



2. Disassembly of 1st clutch pack

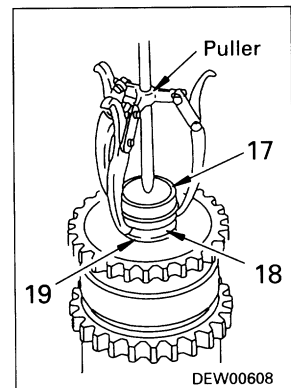
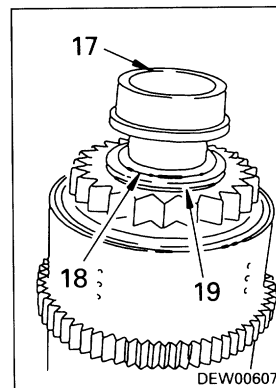
- ★ Turn over the FORWARD clutch case and set to stand ③.

⚠ There is oil on the clutch pack, so be careful not to let it slip when turning it over.



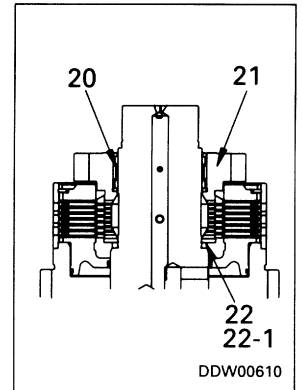
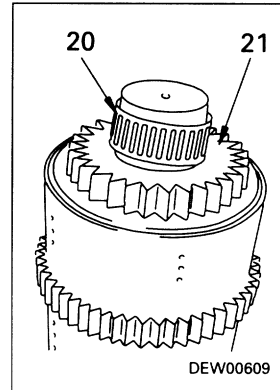
1) Bearing, thrust washer

- i) Remove roller bearing and outer race, then install puller to end face of shaft, and remove bearing inner (17).
- ★ When setting the puller in position, install a block to the end face of the clutch shaft before carrying out the operation.
- ii) Remove thrust washer (18) and spacer (19) from shaft.



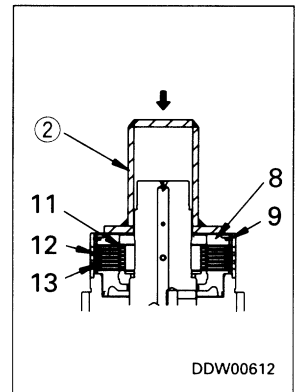
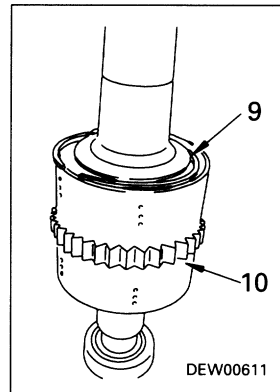
U42103

- 2) Needle bearing, 1st gear
 - i) Remove needle bearing (20) and 1st gear (21) from shaft.
 - ii) Remove thrust washer (22) and spacer (22-1).



- 3) End plate

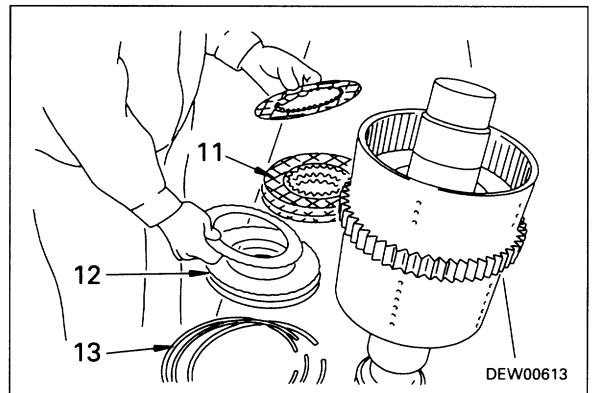
Push end plate (8) at 1st clutch end with tool ②, remove snap ring (9), then remove end plate from clutch case (10).



- 4) Clutch plates

Remove separator plates (12), disc plates (11), and wave springs (13) from inside clutch case (10).

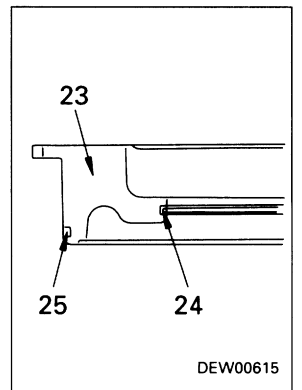
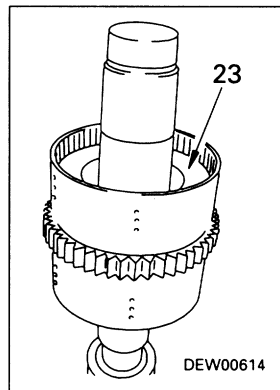
★ Be careful not to let the separator plates or disc plates catch in the clutch case ring groove.



- 5) 1st piston

Remove 1st piston (23) from inside clutch case, then remove piston seals (24) and (25) from piston.

★ The shape of the 1st piston is different from the shape of the FORWARD piston on the opposite side.



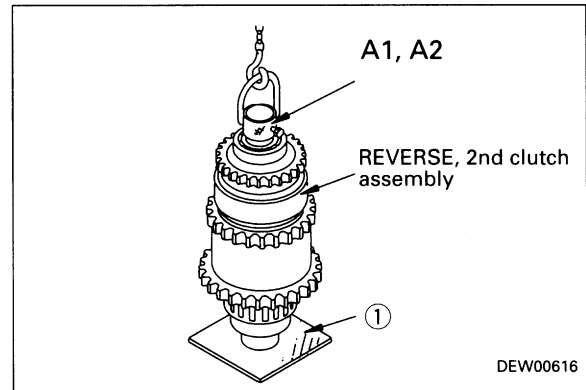
REVERSE, 2ND CLUTCH ASSEMBLY

1. Disassembly of REVERSE clutch pack

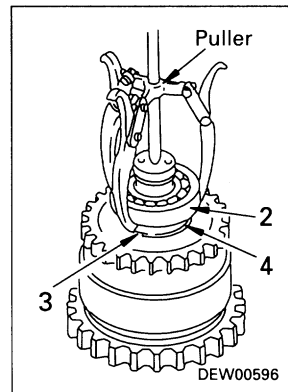
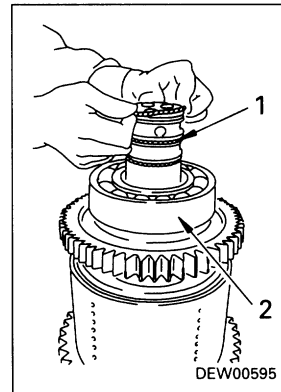
- ★ Lift the clutch pack assembly with lifting tools **A1** and **A2**, and install to stand ①.



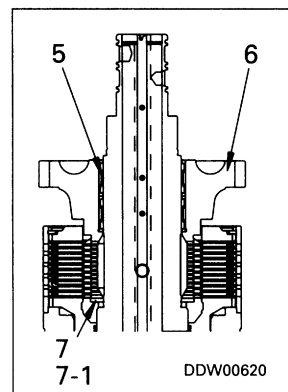
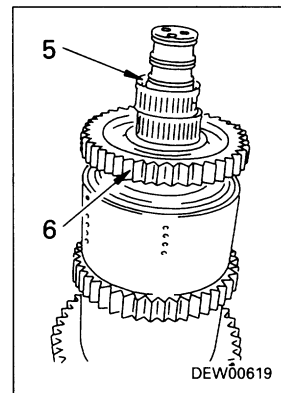
REVERSE, 2nd clutch assembly: **90 kg**



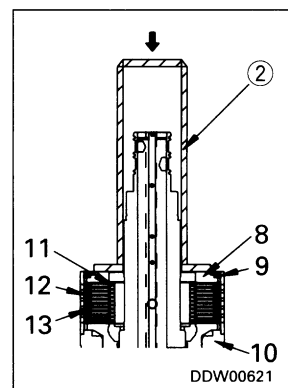
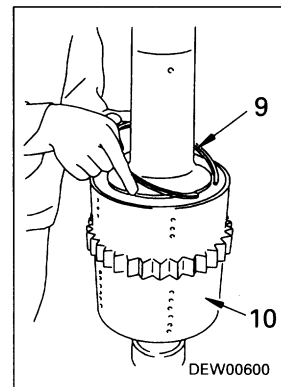
- 1) Seal rings
Remove 3 seal rings (1) installed to shaft.
- 2) Bearing, thrust washer
 - i) Install puller to end face of shaft, and remove bearing (2).
★ When setting the puller in position, install a block to the end face of the clutch shaft before carrying out the operation.
 - ii) Remove thrust washer (3) and spacer (4) from shaft.



- 3) Needle bearing, REVERSE gear
 - i) Remove needle bearing (5) and REVERSE gear (6) from shaft.
 - ii) Remove thrust washer (7) and spacer (7-1).



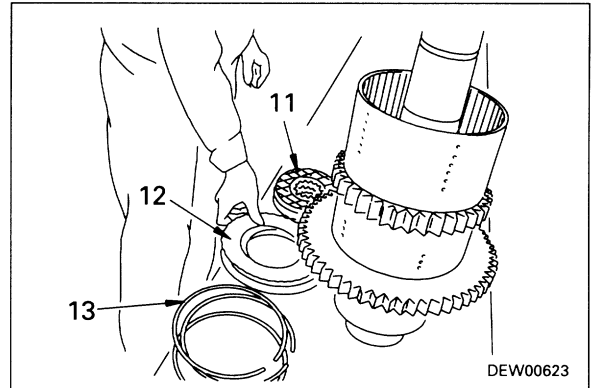
- 4) End plate
Push end plate (8) with tool ②, remove snap ring (9), then remove end plate from clutch case (10).



5) Clutch plates

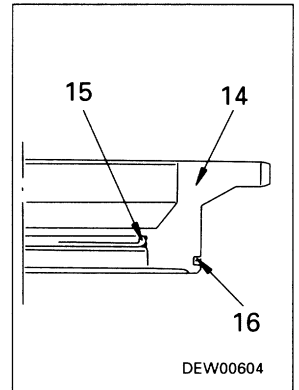
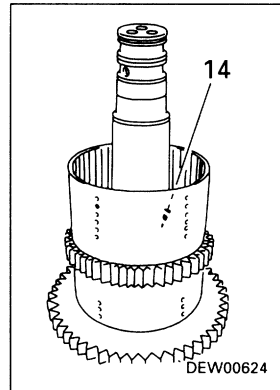
Remove separator plates (12), disc plates (11), and wave springs (13) from inside clutch case.

- ★ Be careful not to let the separator plates or disc plates catch in the clutch case ring groove.



6) REVERSE piston

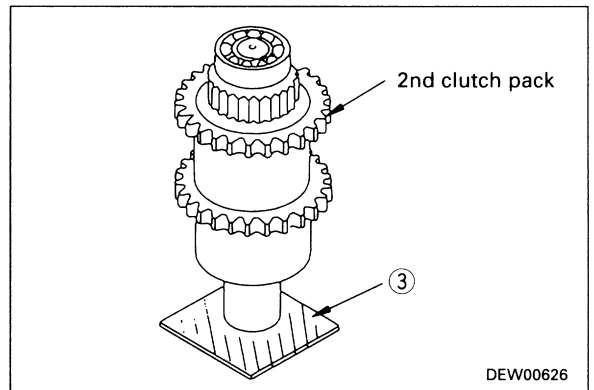
Remove REVERSE piston (14) from inside clutch case, then remove piston seals (15) and (16) from piston.



2. Disassembly of 2nd clutch pack

- ★ Turn over the REVERSE clutch case and set to stand ③.

⚠ There is oil on the clutch pack, so be careful not to let it slip when turning it over.

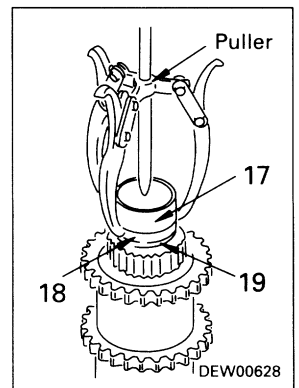
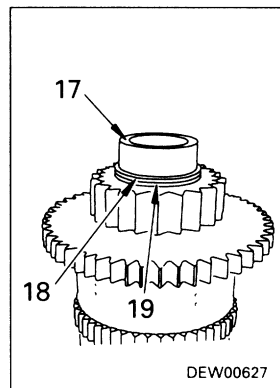


1) Bearing, thrust washer

- i) Remove roller bearing and outer race, then install puller to end face of shaft, and remove bearing inner (17).

- ★ When setting the puller in position, install a block to the end face of the clutch shaft before carrying out the operation.

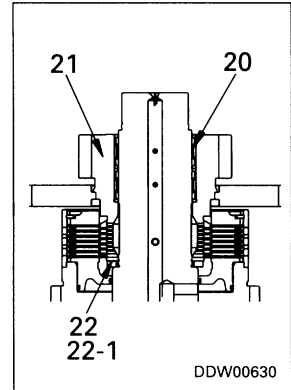
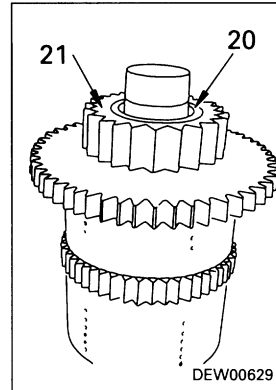
- ii) Remove thrust washer (18) and spacer (19) from shaft.



DISASSEMBLY AND ASSEMBLY

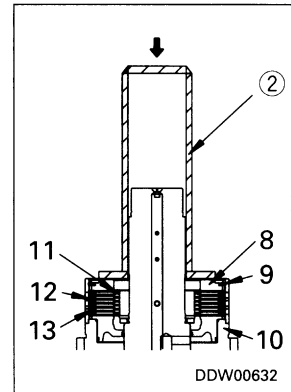
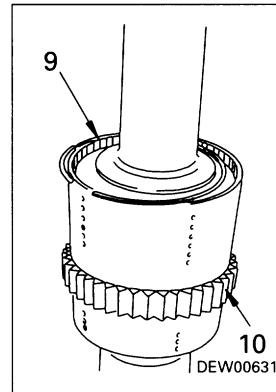
TRANSMISSION CLUTCH PACK

- 2) Needle bearing, 2nd gear
 - i) Remove needle bearing (20) and 2nd gear (21) from shaft.
 - ii) Remove thrust washer (22) and spacer (22-1).



- 3) End plate

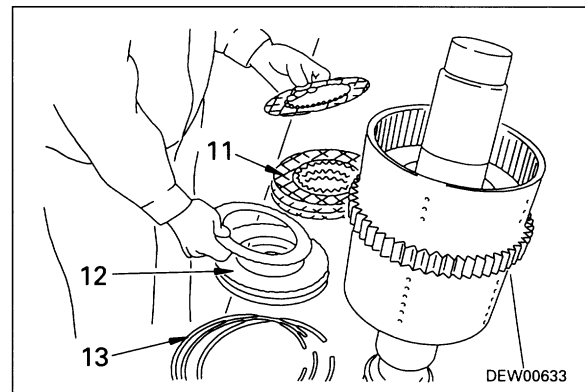
Push end plate (8) at 2nd clutch end with tool ②, remove snap ring (9), then remove end plate from clutch case (10).



- 4) Clutch plates

Remove separator plates (12), disc plates (11), and wave springs (13) from inside clutch case (10).

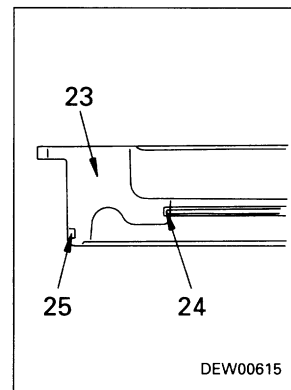
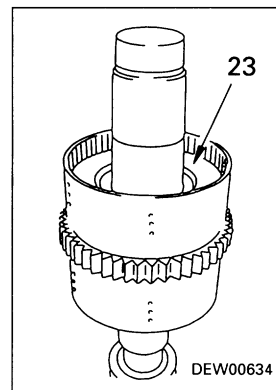
★ Be careful not to let the separator plates or disc plates catch in the clutch case ring groove.



- 5) 2nd piston

Remove 2nd piston (23) from inside clutch case, then remove piston seals (24) and (25) from piston.

★ The shape of the 2nd piston is different from the shape of the REVERSE piston on the opposite side.



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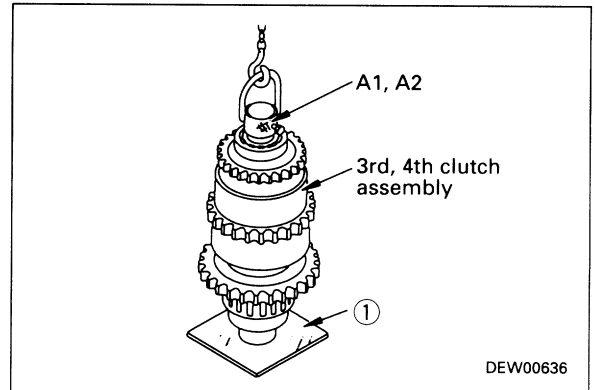
3RD, 4TH CLUTCH ASSEMBLY

1. Disassembly of 4th clutch pack

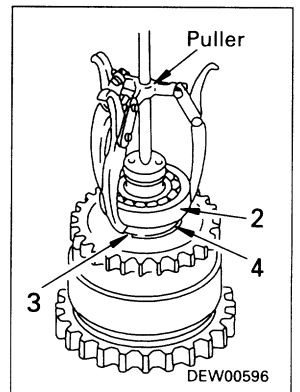
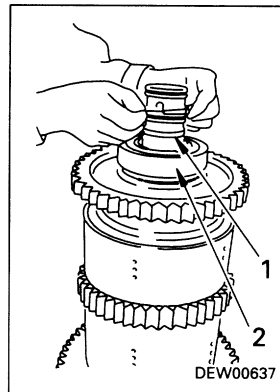
- ★ Lift the clutch pack assembly with lifting tools A1 and A2, and install to stand ①.



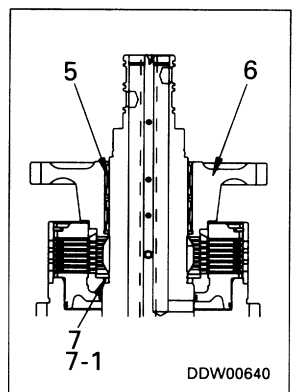
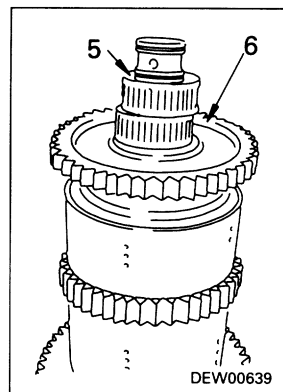
3rd, 4th clutch assembly: **96 kg**



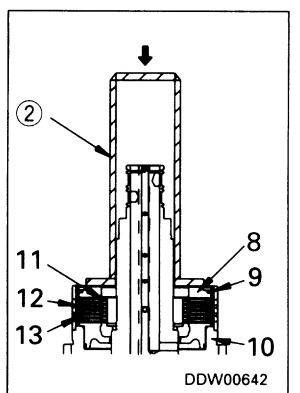
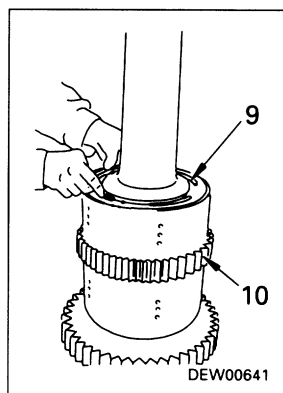
- 1) Seal rings
Remove 3 seal rings (1) installed to shaft.
- 2) Bearing, thrust washer
 - i) Install puller to end face of shaft, and remove bearing (2).
★ When setting the puller in position, install a block to the end face of the clutch shaft before carrying out the operation.
 - ii) Remove thrust washer (3) and spacer (4) from shaft.



- 3) Needle bearing, 4th gear
 - i) Remove needle bearing (5) and 4th gear (6) from shaft.
 - ii) Remove thrust washer (7) and spacer (7-1).



- 4) End plate
Push end plate (8) with tool ②, remove snap ring (9), then remove end plate from clutch case (10).



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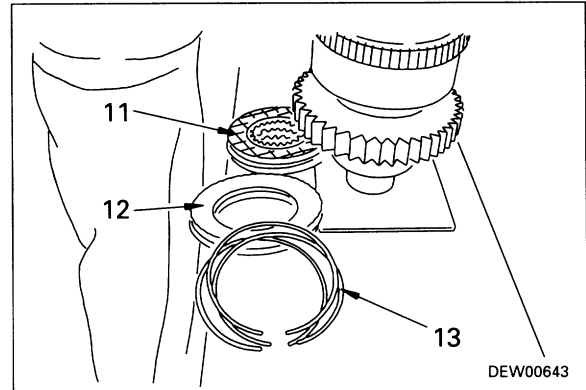
DISASSEMBLY AND ASSEMBLY

TRANSMISSION CLUTCH PACK

5) Clutch plates

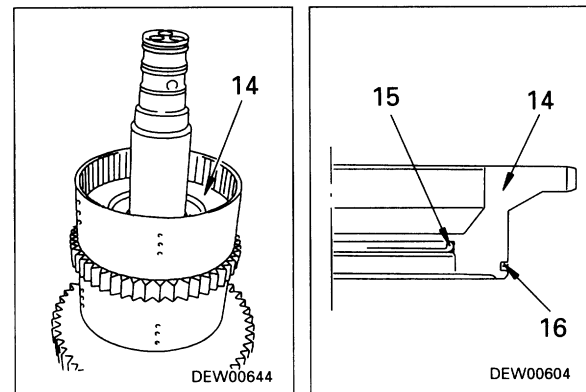
Remove separator plates (12), disc plates (11), and wave springs (13) from inside clutch case (10).

- ★ Be careful not to let the separator plates or disc plates catch in the clutch case ring groove.



6) 4th piston

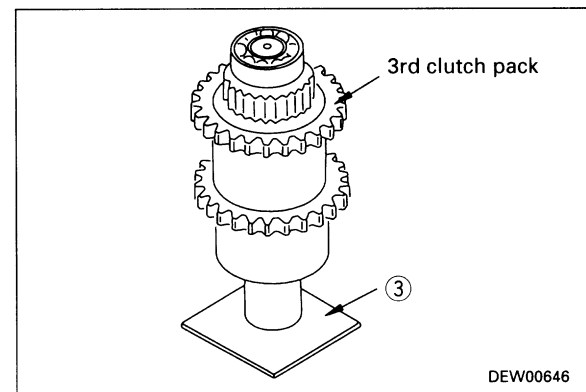
Remove 4th piston (14) from inside clutch case, then remove piston seals (15) and (16) from piston.



2. Disassembly of 3rd clutch pack

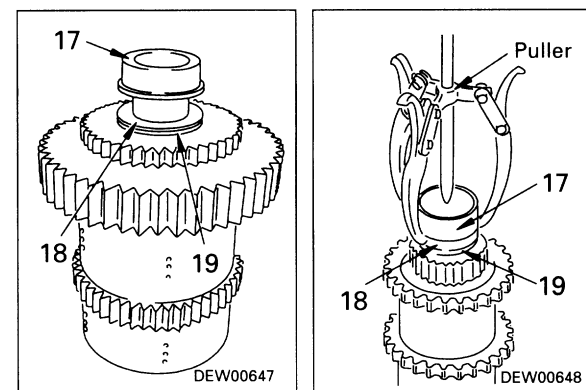
- ★ Turn over the 4th clutch case and set to stand ③.

⚠ There is oil on the clutch pack, so be careful not to let it slip when turning it over.



1) Bearing, thrust washer

- i) Remove roller bearing and outer race, then install puller to end face of shaft, and remove bearing inner (17).
 - ★ When setting the puller in position, install a block to the end face of the clutch shaft before carrying out the operation.
- ii) Remove thrust washer (18) and spacer (19) from shaft.



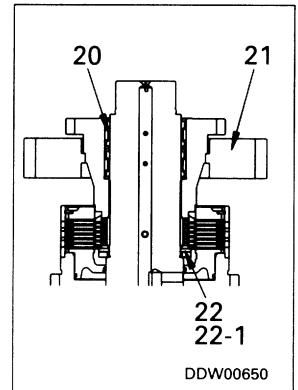
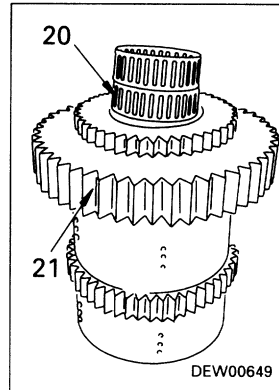
U42103

- 2) Needle bearing, 3rd gear
i) Remove needle bearing (20) and 3rd gear (21) from shaft.

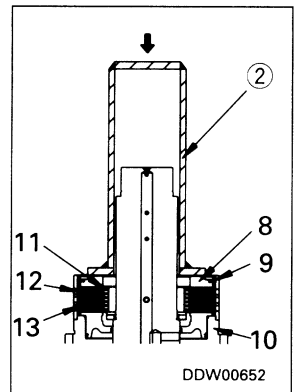
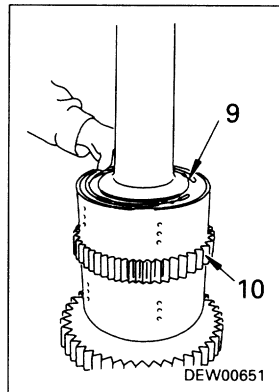


3rd gear: **29 kg**

- ii) Remove thrust washer (22) and spacer (22-1).

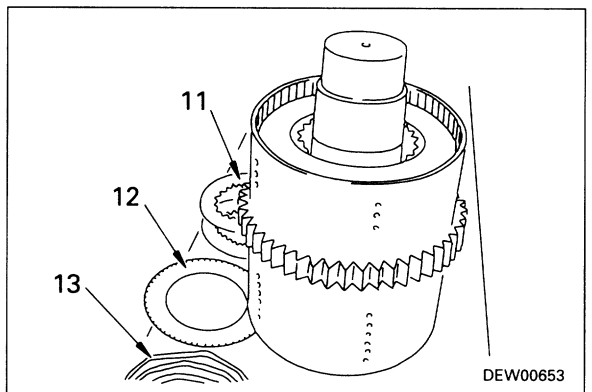


- 3) End plate
Push end plate (8) at 3rd clutch end with tool ②, remove snap ring (9), then remove end plate from clutch case (10).



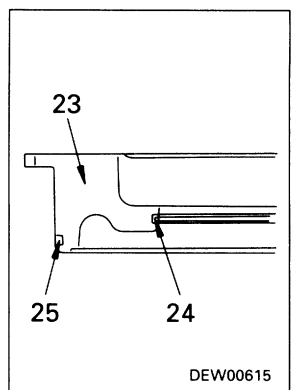
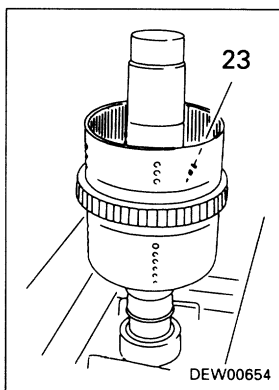
- 4) Clutch plates
Remove separator plates (12), disc plates (11), and wave springs (13) from inside clutch case (10).

★ Be careful not to let the separator plates or disc plates catch in the clutch case ring groove.



- 5) 3rd piston
Remove 3rd piston (23) from inside clutch case, then remove piston seals (24) and (25) from piston.

★ The shape of the 3rd piston is different from the shape of the 4th piston on the opposite side.

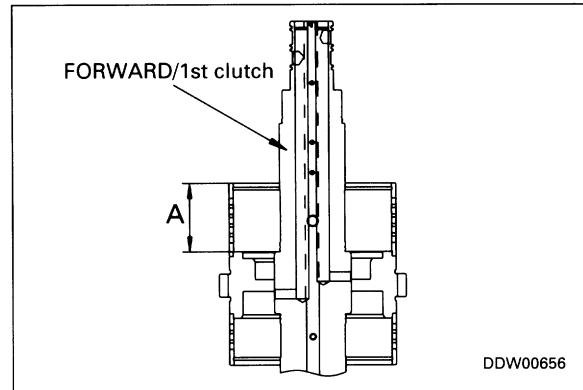


ASSEMBLY OF TRANSMISSION CLUTCH PACK ASSEMBLY

FORWARD, 1ST CLUTCH ASSEMBLY

When assembling the FORWARD, 1st clutch, always check dimension "A" of the FORWARD clutch case.

★ A: 90.5 mm

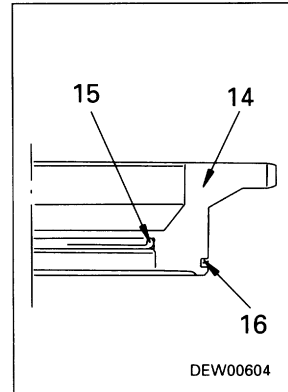
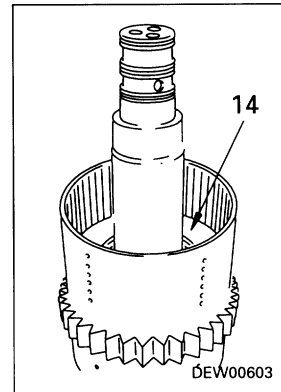


1. Assembly of FORWARD clutch pack

1) FORWARD piston

Install piston seals (15) and (16) to FORWARD piston (14), then install inside clutch case.

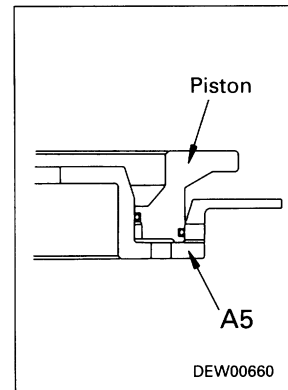
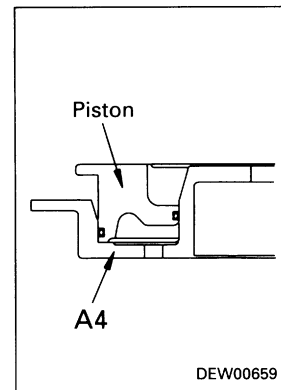
★ Replace the piston seal rings with new parts.



★ After assembling the seal rings to piston, set to tools A4 and A5 and settle for at least 5 seconds.

★ Carry out the settling operation for each piston.

 Outer circumference of seal ring, contact surface: Oil (EO10-CD)



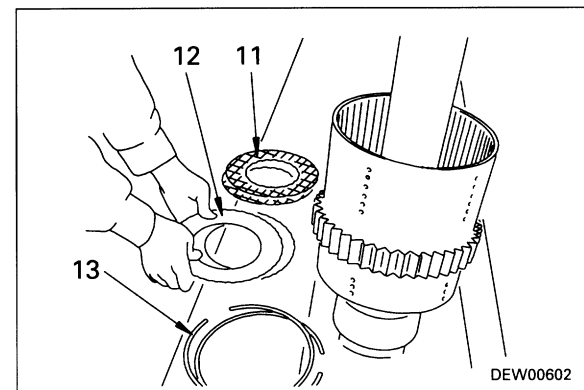
2) Clutch plates

Install separator plates (12), disc plates (11), and wave springs (13) inside clutch case (10).

★ Before assembling the clutch disc plates, put them in a soaking bath for at least 2 minutes.

Oil: EO10-CD

(API 10W-CD Class or above)

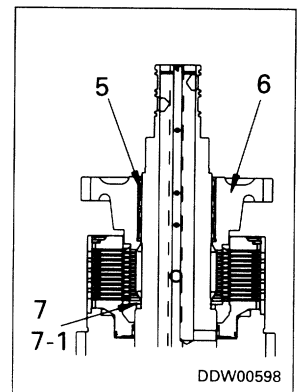
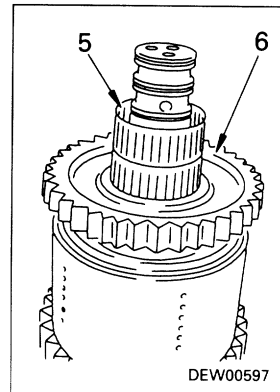
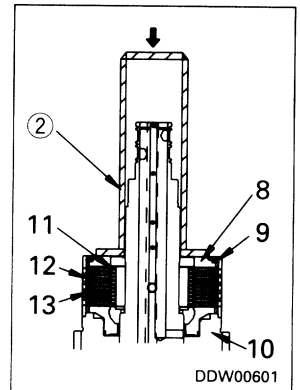
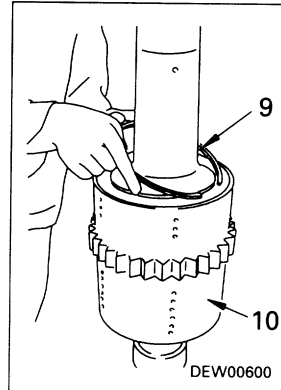


- 3) End plate
Assemble end plate (8) to clutch case (10), then push with tool ②, and secure with snap ring (9).

- 4) Needle bearing, FORWARD gear
i) Assemble spacer (7-1) and thrust washer (7) inside clutch case in order.
★ Before assembling the spacer, warm it up at 80°C – 120°C for 80 minutes.

 Thrust washer (7): **Oil (EO10-CD)**

- ii) Install FORWARD gear (6) to shaft, and assemble needle bearing (5).



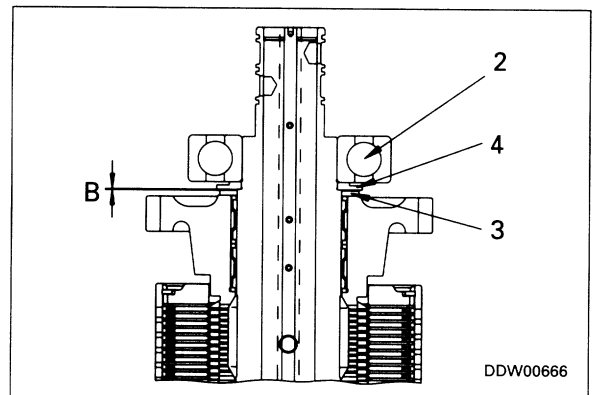
- 5) Bearing, thrust washer
i) Assemble thrust washer (3) and spacer (4) to shaft in order.

- ★ Before assembling bearing (2) and spacer (4), warm them up at 80°C – 120°C for 80 minutes.
★ When press fitting the bearing, check that there is no clearance.

 Thrust washer (3): **Oil (EO10-CD)**

- ii) Press fit bearing (2) to shaft.
★ After press fitting the bearing, check the dimension of clearance **B** between spacer (4) and thrust washer (3).

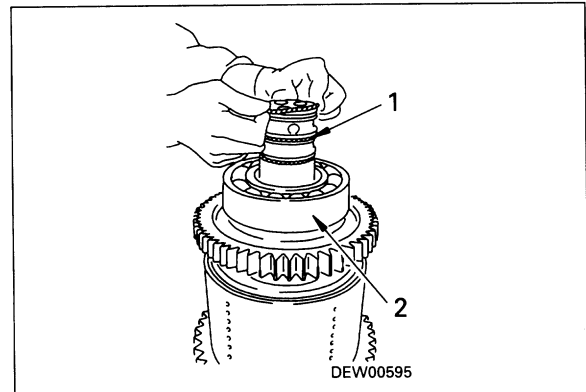
- ★ **B:** 0.27 – 1.23 mm
(FORWARD clutch end)



DISASSEMBLY AND ASSEMBLY

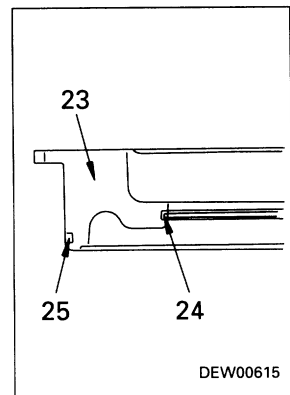
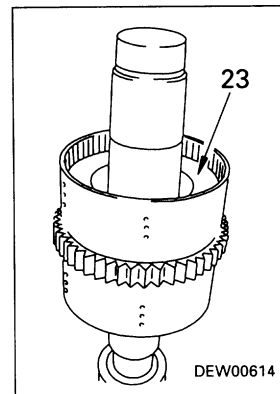
TRANSMISSION CLUTCH PACK

- 6) Seal rings
Install 3 seal rings (1) to shaft.



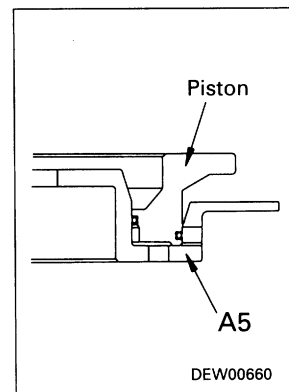
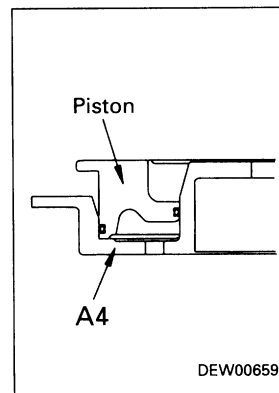
2. Assembly of 1st clutch pack

- 1) 1st piston
Install piston seals (24) and (25) to 1st piston (23), then install inside clutch case.
★ Replace the piston seal rings with new parts.

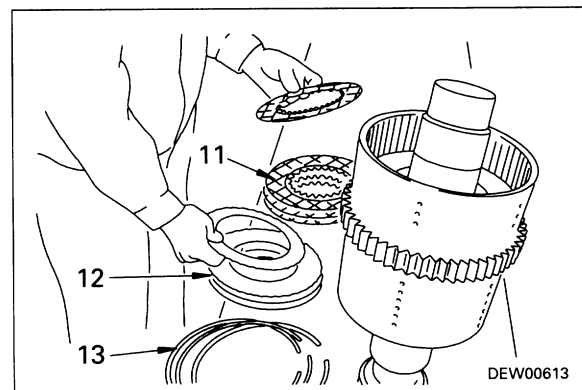


- ★ After assembling the seal rings to piston, set to tools **A4** and **A5** and settle for at least 5 seconds.
★ Carry out the settling operation for each piston.

 Outer circumference of seal ring, contact surface: **Oil (EO10-CD)**



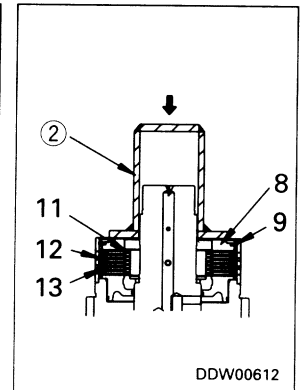
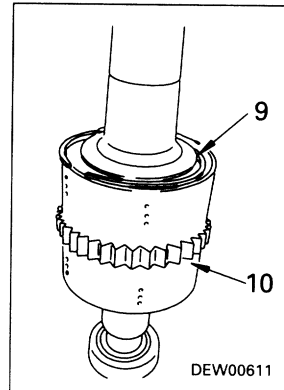
- 2) Clutch plates
Install separator plates (12), disc plates (11), and wave springs (13) inside clutch case (10).
★ Before assembling clutch disc plates (1), put them in a soaking bath for at least 2 minutes.
Oil: EO10-CD (API 10W-CD Class or above)



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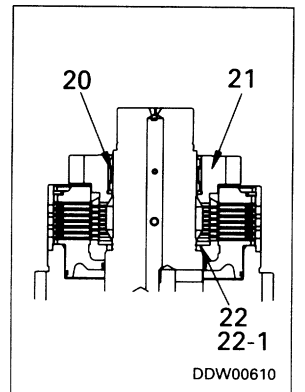
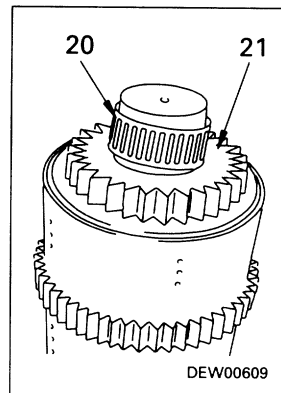
3) End plate

Assemble end plate (8) to clutch case (10), then push with tool ②, and secure with snap ring (9).



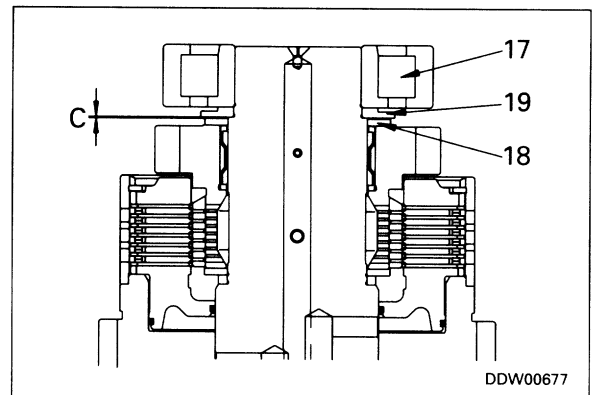
4) Needle bearing, 1st gear

- i) Assemble spacer (22-1) and thrust washer (22) inside clutch case in order.
 - ★ Before assembling the spacer, warm it up at 80°C – 120°C for 80 minutes.
 - Thrust washer (7): **Oil (EO10-CD)**
- ii) Install 1st gear (21) to shaft, and assemble needle bearing (20).



5) Bearing, thrust washer

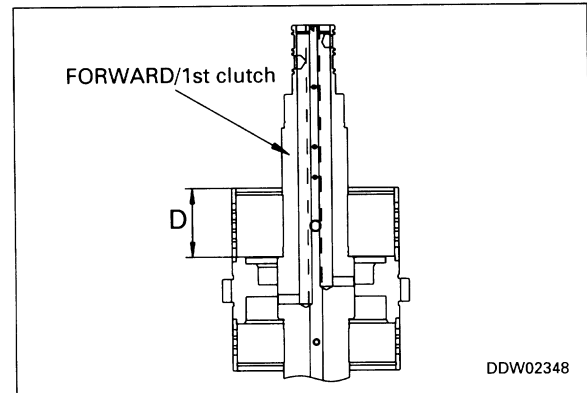
- i) Assemble thrust washer (18) and spacer (19) to shaft in order.
 - ★ Before assembling bearing (17) and spacer (19), warm them up at 80°C – 120°C for 80 minutes.
 - ★ When press fitting the bearing, check that there is no clearance.
 - Thrust washer (3): **Oil (EO10-CD)**
- ii) Press fit bearing (17) to shaft.
 - ★ After press fitting the bearing, check the dimension of clearance **C** between spacer (19) and thrust washer (18).
 - ★ **C**: 0.14 – 1.36 mm (1st clutch end)



REVERSE, 2ND CLUTCH ASSEMBLY

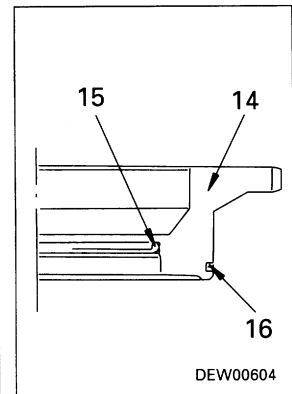
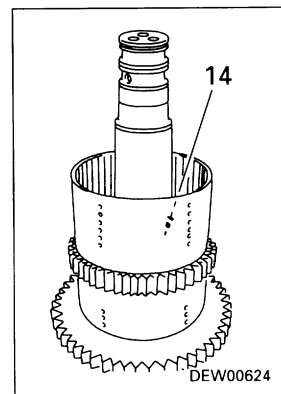
When assembling the REVERSE, 2nd clutch, always check dimension "D" of the REVERSE clutch case.

★ D: 90.5 mm

**1. Assembly of REVERSE clutch pack****1) REVERSE piston**

Install piston seals (15) and (16) to REVERSE piston (14), then install inside clutch case.

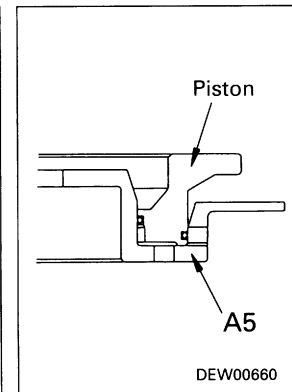
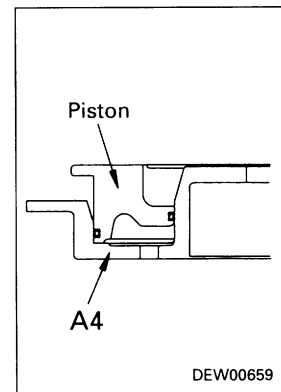
★ Replace the piston seal rings with new parts.



★ After assembling the seal rings to piston, set to tools A4 and A5 and settle for at least 5 seconds.

★ Carry out the settling operation for each piston.

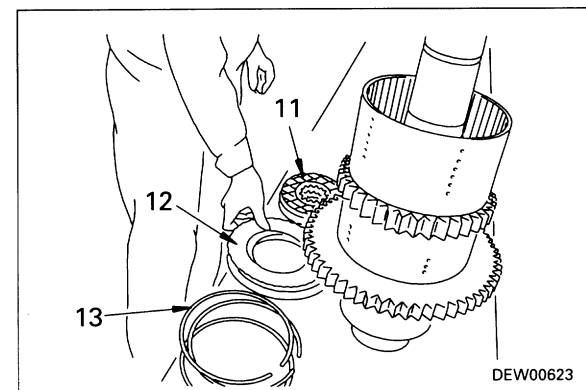
 Outer circumference of seal ring, contact surface: **Oil (EO10-CD)**

**2) Clutch plates**

Install separator plates (12), disc plates (11), and wave springs (13) inside clutch case (10).

★ Before assembling clutch disc plates (11), put them in a soaking bath for at least 2 minutes.

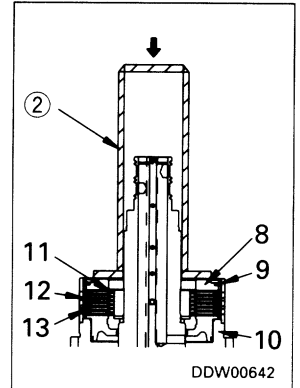
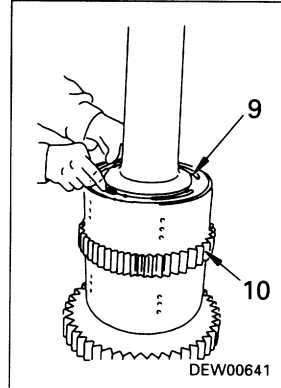
Oil: EO10-CD (API 10W-CD Class or above)



3) End plate

Assemble end plate (8) to clutch case (10), then push with tool ②, AND secure with snap ring (9).

 Thrust washer: **Oil (EO10-CD)**



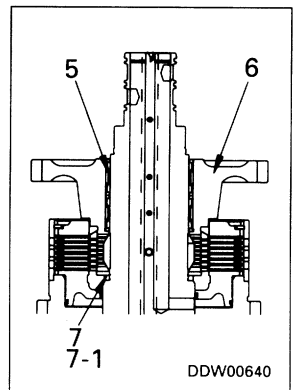
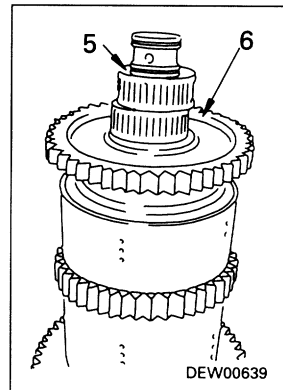
4) Needle bearing, REVERSE gear

i) Assemble spacer (7-1) and thrust washer (7) inside clutch case in order.

★ Before assembling the spacer, warm it up at 80°C – 120°C for 80 minutes.

 Thrust washer: **Oil (EO10-CD)**

ii) Install REVERSE gear (6) to shaft, and assemble needle bearing (5).



5) Bearing, thrust washer

i) Assemble thrust washer (3) and spacer (4) to shaft in order.

★ Before assembling bearing (2) and spacer (4), warm them up at 80°C – 120°C for 80 minutes.

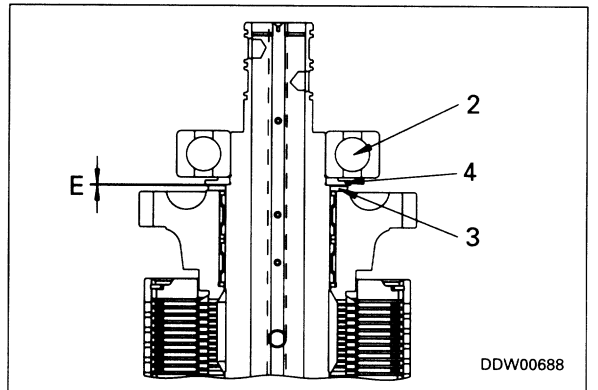
★ When press fitting the bearing, check that there is no clearance.

 Thrust washer (3): **Oil (EO10-CD)**

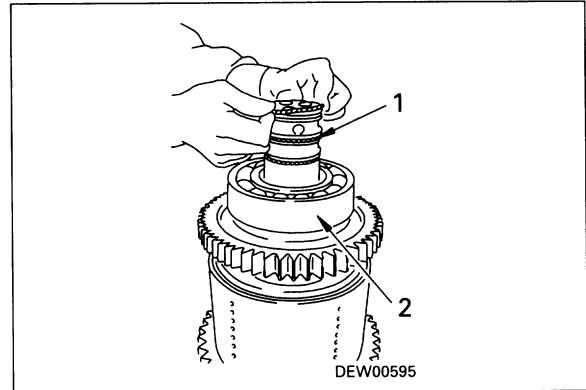
ii) Press fit bearing (2) to shaft.

★ After press fitting the bearing, check the dimension of clearance **E** between spacer (4) and thrust washer (3).

★ **E: 0.27 – 1.23 mm**
(REVERSE clutch end)

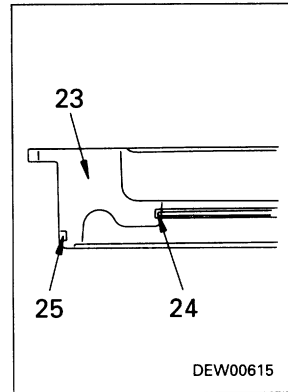
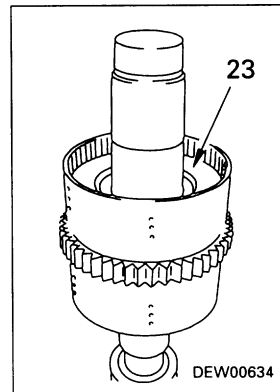


- 6) Seal rings
Install 3 seal rings (1) to shaft.



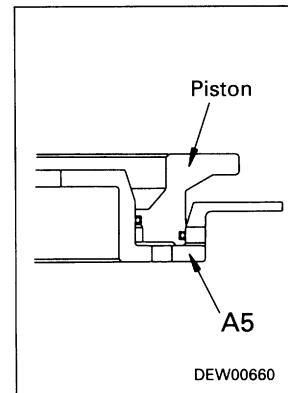
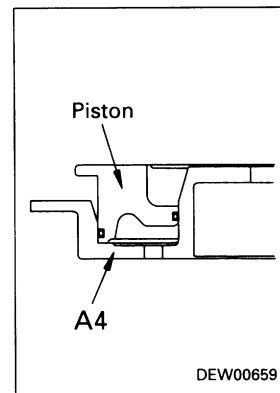
2. Assembly of 2nd clutch pack

- 1) Install piston seals (24) and (25) to 2nd piston (23), then install to clutch case.
★ Replace the piston seal rings with new parts.

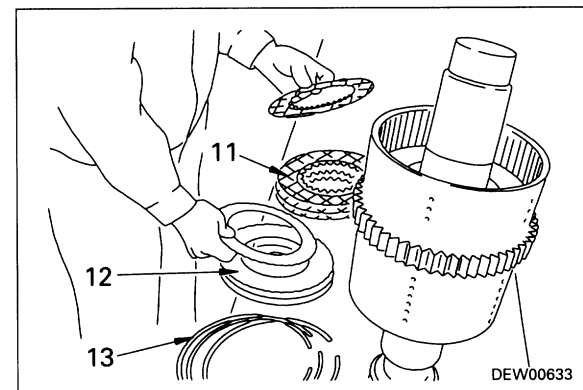


- ★ After assembling the seal rings to piston, set to tools **A4** and **A5** and settle for at least 5 seconds.
★ Carry out the settling operation for each piston.

 Outer circumference of seal ring, contact surface: **Oil (EO10-CD)**

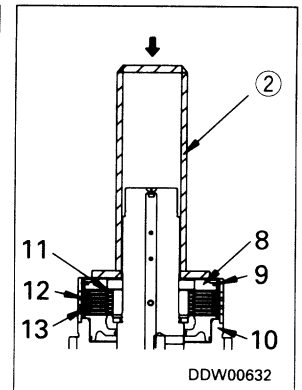
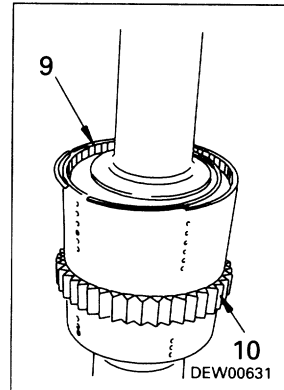


- 2) Clutch plates
Install separator plates (12), disc plates (11), and wave springs (13) inside clutch case (10).
★ Before assembling clutch disc plates (11), put them in a soaking bath for at least 2 minutes.
Oil: EO10-CD
(API 10W-CD Class or above)



3) End plate

Assemble end plate (8) to clutch case (10), then push with tool ②, and secure with snap ring (9).



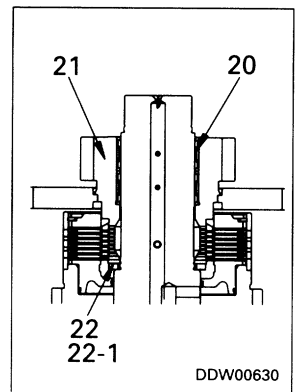
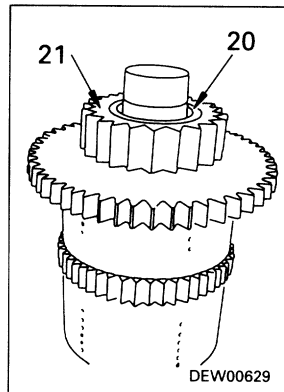
4) Needle bearing, 2nd gear

i) Assemble spacer (22-1) and thrust washer (22) inside clutch case in order.

★ Before assembling the spacer, warm it up at 80°C – 120°C for 80 minutes.

Thrust washer: **Oil (EO10-CD)**

ii) Install 2nd gear (21) to shaft, and assemble needle bearing (20).



5) Bearing, thrust washer

i) Assemble thrust washer (18) and spacer (19) to shaft in order.

★ Before assembling bearing (17) and spacer (19), warm them up at 80°C – 120°C for 80 minutes.

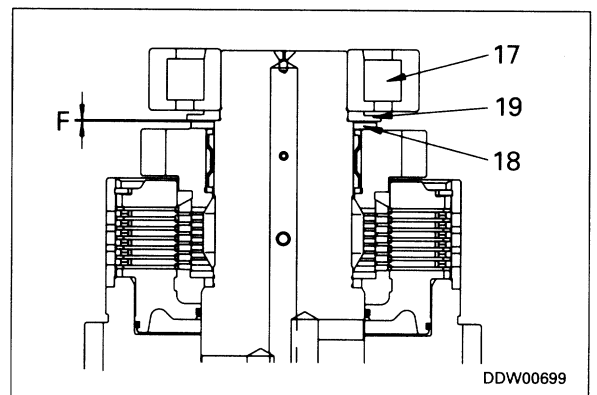
★ When press fitting the bearing, check that there is no clearance.

Thrust washer: **Oil (EO10-CD)**

ii) Press fit bearing (17) to shaft.

★ After press fitting the bearing, check the dimension of clearance **F** between spacer (19) and thrust washer (18).

★ **F: 0.34 – 1.56 mm**
(2nd clutch end)



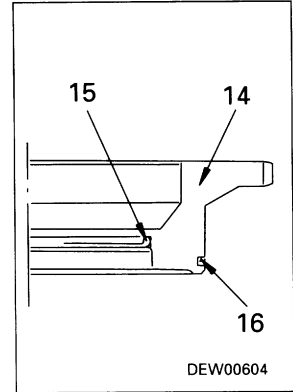
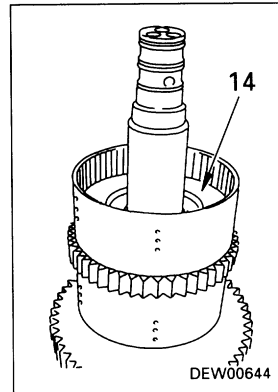
3RD, 4TH CLUTCH ASSEMBLY

1. Assembly of 4th clutch pack

1) 4th piston

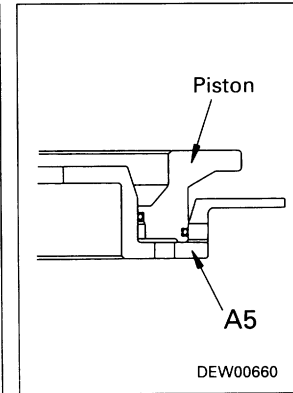
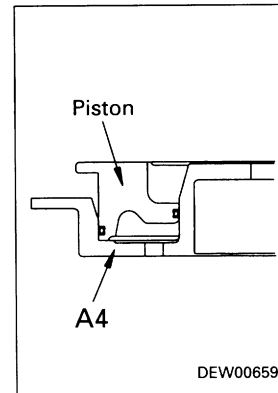
Install piston seals (15) and (16) to 4th piston (14), then install inside clutch case.

- ★ Replace the piston seal rings with new parts.



- ★ After assembling the seal rings to piston, set to tools **A4** and **A5** and settle for at least 5 seconds.
- ★ Carry out the settling operation for each piston.

Outer circumference of seal ring, contact surface: **Oil (EO10-CD)**



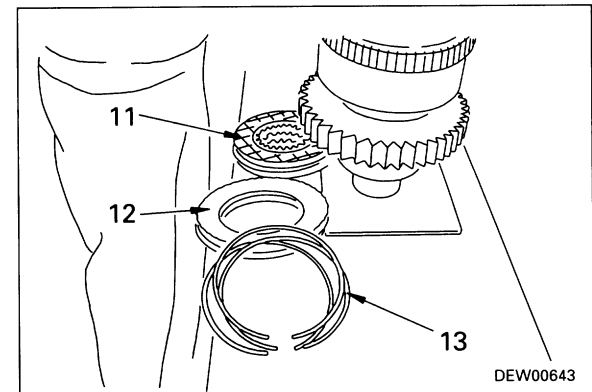
2) Clutch plates

Install separator plates (12), disc plates (11), and wave springs (13) inside clutch case (10).

- ★ Before assembling clutch disc plates (11), put them in a soaking bath for at least 2 minutes.

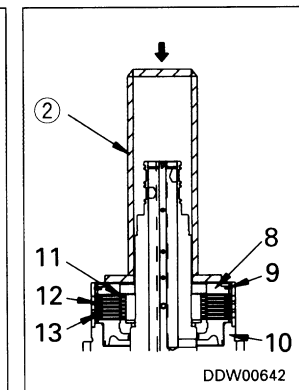
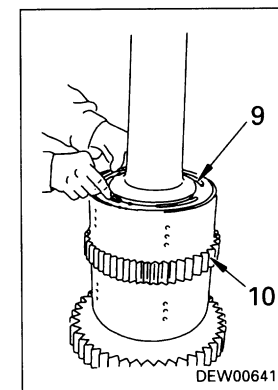
Oil: EO10-CD

(API 10W-CD Class or above)

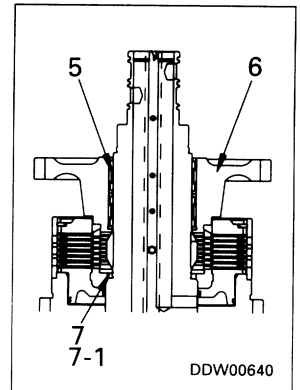
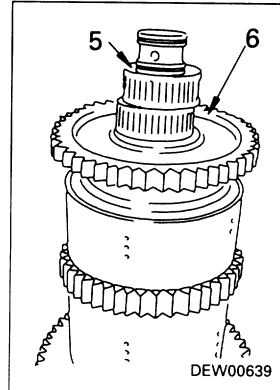


3) End plate

Assemble end plate (8) to clutch case (10), then push with tool ②, and secure with snap ring (9).



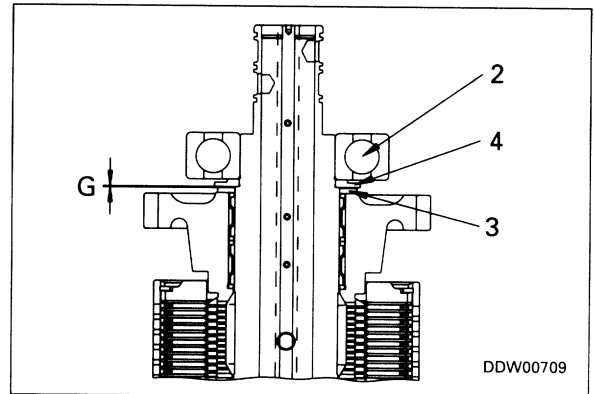
- 4) Needle bearing, 4th gear
- Assemble spacer (7-1) and thrust washer (7) inside clutch case in order.
 - ★ Before assembling the spacer, warm it up at 80°C – 120°C for 80 minutes.
 - Install 4th gear (6) to shaft, and assemble needle bearing (5).



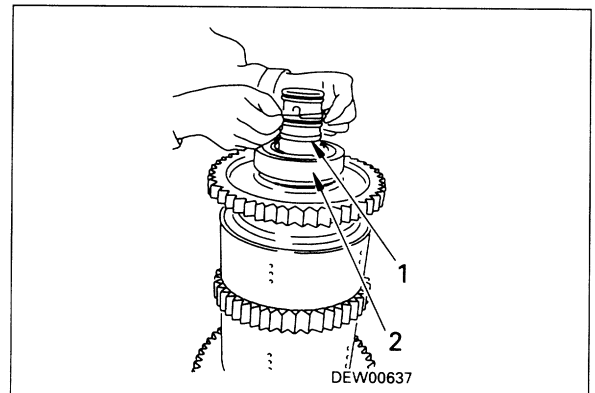
- 5) Bearing, thrust washer
- Assemble thrust washer (3) and spacer (4) to shaft in order.
 - ★ Before assembling bearing (2) and spacer (4), warm them up at 80°C – 120°C for 80 minutes.
 - ★ When press fitting the bearing, check that there is no clearance.

 Thrust washer (3): **Oil (EO10-CD)**

- Press fit bearing (2) to shaft.
 - ★ After press fitting the bearing, check the dimension of clearance **G** between spacer (4) and thrust washer (3).
 - ★ **G: 0.37 – 1.33 mm**
(4th clutch end)



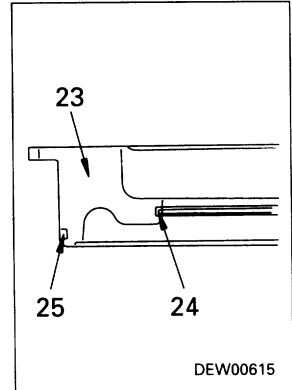
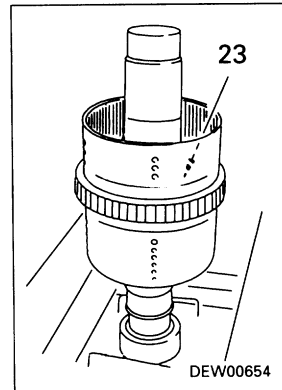
- 6) Seal rings
- Install 3 seal rings (1) to shaft.



2. Assembly of 3rd clutch pack

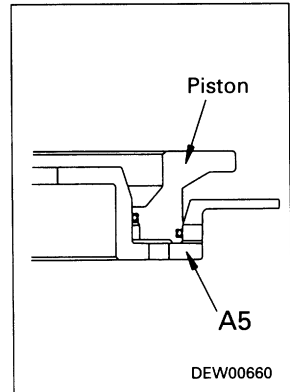
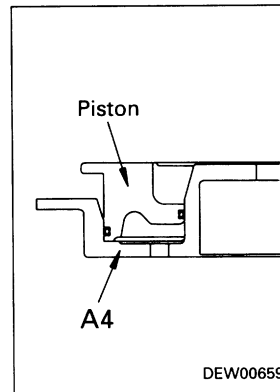
Install piston seals (24) and (25) to 3rd piston (23), then install to clutch case.

- ★ Replace the piston seal rings with new parts.



- ★ After assembling the seal rings to piston, set to tools **A4** and **A5** and settle for at least 5 seconds.
- ★ Carry out the settling operation for each piston.

 Outer circumference of seal ring, contact surface: **Oil (EO10-CD)**

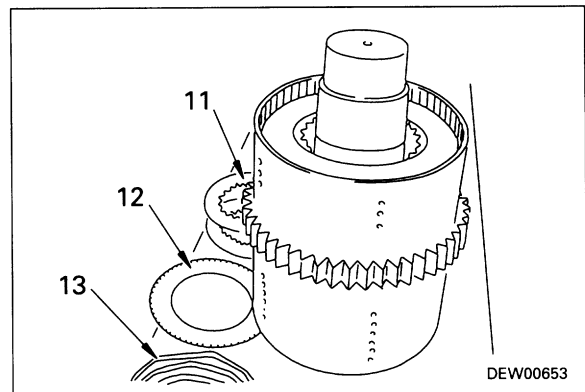


2) Clutch plates

Install separator plates (12), disc plates (11), and wave springs (13) inside clutch case (10).

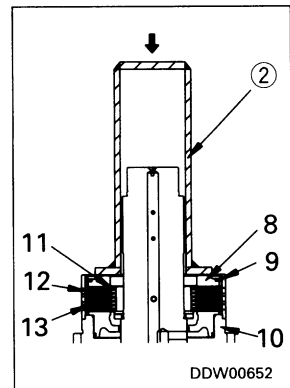
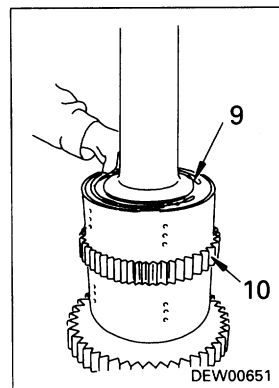
- ★ Before assembling clutch disc plates (11), put them in a soaking bath for at least 2 minutes.

Oil: EO10-CD (API 10W-CD Class or above)



3) End plate

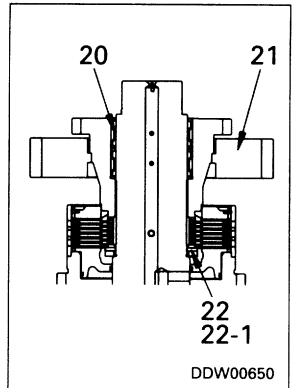
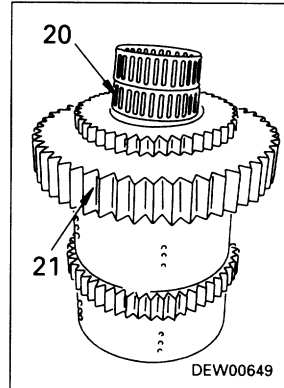
Assemble end plate (8) to clutch case (10), then push with tool ②, and secure with snap ring (9).



- 4) Needle bearing, 3rd gear
 i) Assemble spacer (22-1) and thrust washer (22) inside clutch case in order.
 ★ Before assembling the spacer, warm it up at 80°C – 120°C for 80 minutes.

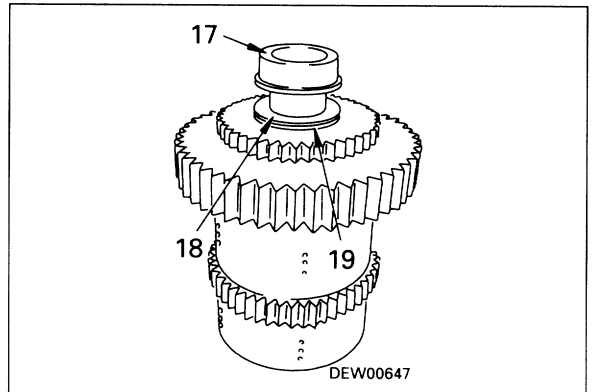
 Thrust washer: **Oil (EO10-CD)**

- ii) Install 3rd gear (21) to shaft, and assemble needle bearing (20).

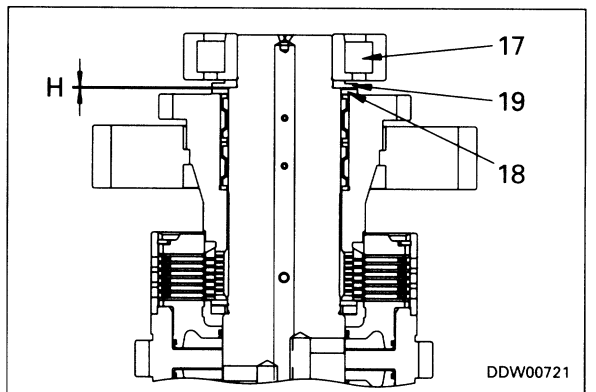


- 5) Bearing, thrust washer
 i) Assemble thrust washer (18) and spacer (19) to shaft in order.
 ★ Before assembling bearing (17) and spacer (19), warm them up at 80°C – 120°C for 80 minutes.
 ★ When press fitting the bearing, check that there is no clearance.

 Thrust washer (18): **Oil (EO10-CD)**



- ii) Press fit bearing (17) to shaft.
 ★ After press fitting the bearing, check the dimension of clearance **H** between spacer (19) and thrust washer (18).
 ★ **H**: 0.34 – 0.56 mm
 (3rd clutch end)



DISASSEMBLY OF PARKING BRAKE ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

★ Release the parking brake.

1. Loosen drain plug and drain transmission oil.



Transmission: 40 ℓ

2. **Drive shaft**

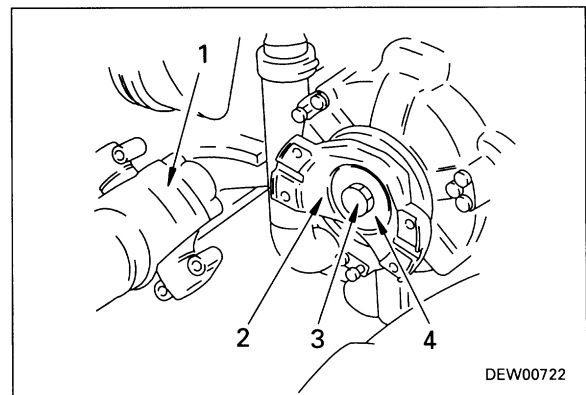
Remove guard of drive shaft, and disconnect lower front drive shaft (1) at transmission end.

★ Move the disconnected drive shaft to the right end.

3. **Suction tube**

1) Remove mounting bolt (3) and washer (4) of coupling (2) at front end of transmission, then remove coupling.

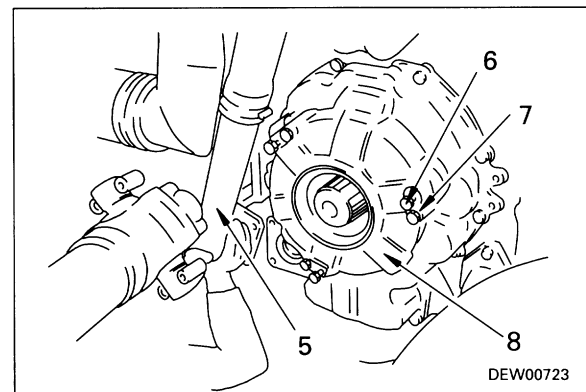
2) Remove suction tube (5) at transmission end.



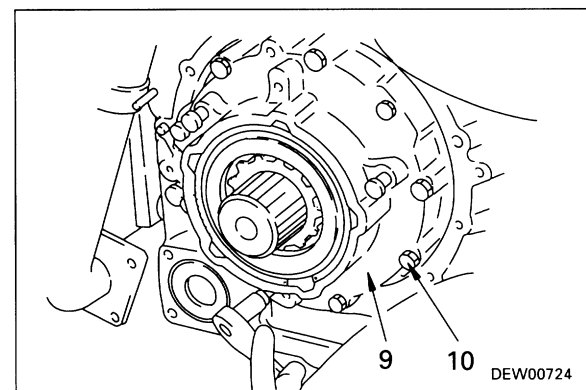
4. **Parking brake**

1) Remove lock plates (7) of manual release bolts (6) and parking brake, then remove 3 release bolts (6).

2) Remove parking brake case (8).

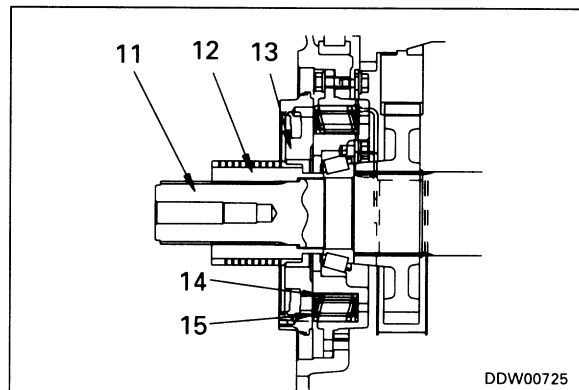


3) Remove mounting bolts (10) of housing (9), then remove housing.

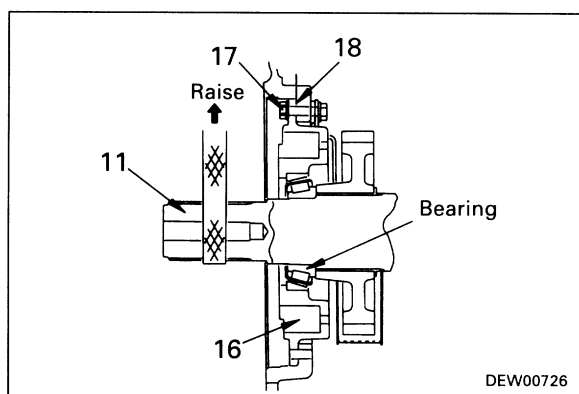


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- 4) Remove spline hub (12) and piston (13) from output shaft (11), then remove springs (14) and (15).



- 5) Remove mounting bolts (17) of retainer (16), then remove retainer and shim (18).
★ Check the number and thickness of the shims, and keep in a safe place.
★ Sling the output shaft to prevent it from falling.
- 6) Remove bearing race from retainer (16), then remove bearing inner race from output shaft (11).

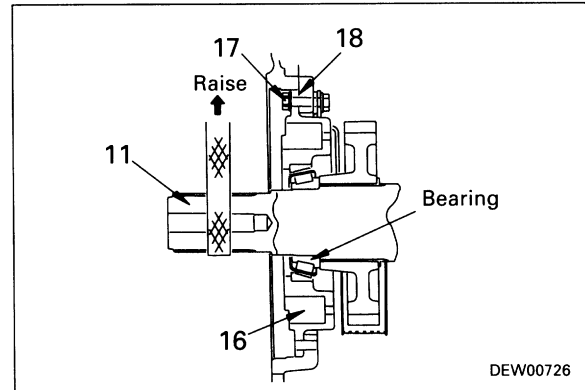


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ASSEMBLY OF PARKING BRAKE ASSEMBLY

1. Parking brake

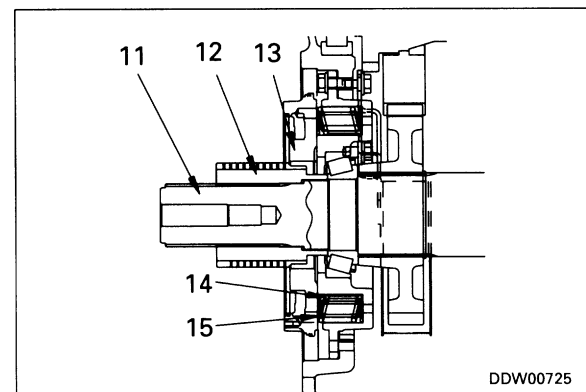
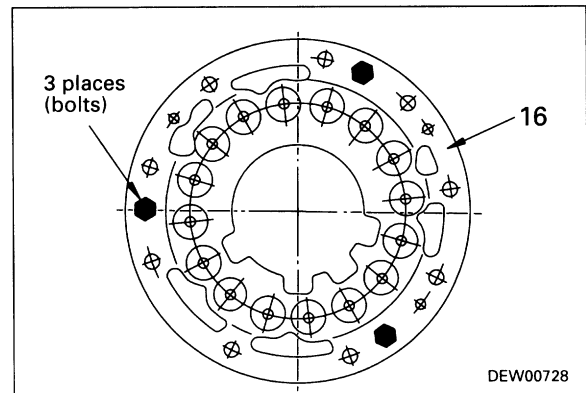
- 1) Press fit bearing outer race to retainer (16), and bearing inner race to output shaft (11).
- 2) Install output shaft to transmission case, then insert shim (18) in retainer (16), and tighten with mounting bolts (17).
 - ★ Keep the output shaft horizontal when raising it.



- 3) Adjusting shim
 - i) Assemble shim of standard value, then tighten retainer (16) with 3 bolts.
 - ★ Standard shim thickness: 1.2 mm

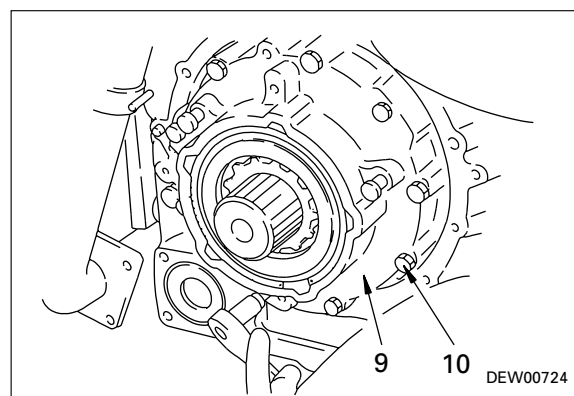
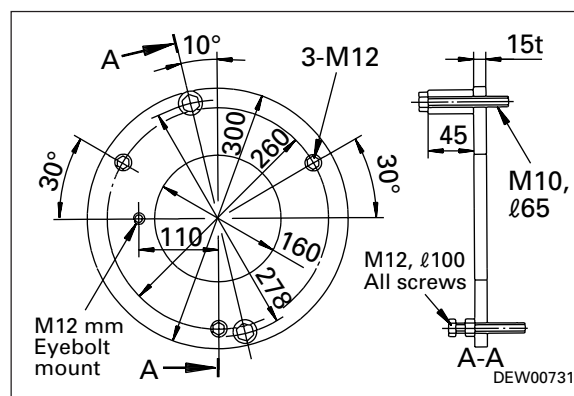
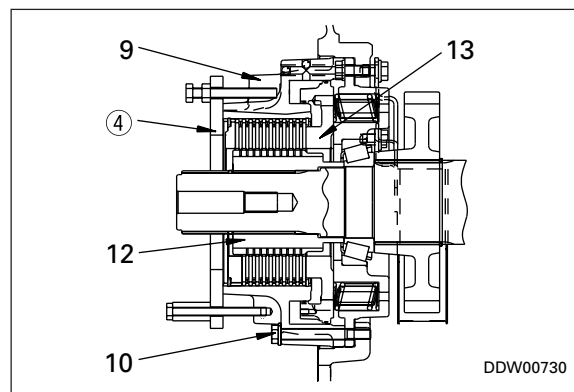
 **kgm** Mounting bolt:
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

- ★ Assemble retainer (16) so that the 4 casting holes are at the bottom.
- ii) Adjust shim so that rotating torque of output shaft is 9.8 – 98.1 Ncm (1 – 10 kgcm).
 - ★ When doing this, check that there is no end play.
- 4) Install springs (14) and (15) to retainer, then install piston (13) and spline hub (12) to output shaft (11).
 -  Tip of spline hub: **Grease (LM-G)**



- 5) Set brake housing assembly (9) to transmission front case, and install brake piston pushing tool (4).
- 6) Push in piston (13) with bolt of pushing tool, and tighten with 3 housing mounting bolts (10).
 - ★ Mesh the spline hub and disc before starting.

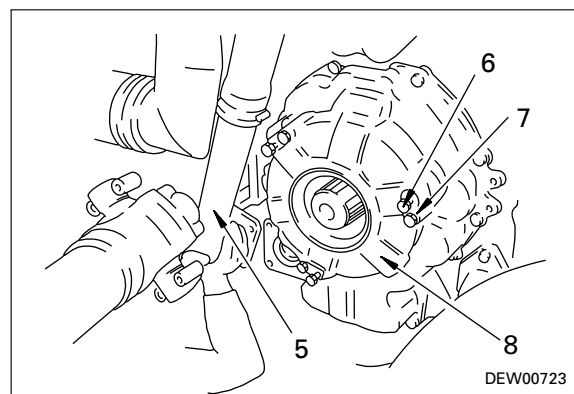
 **kgm** Mounting bolt:
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)



- 7) Install parking brake case (8).
- 8) Install parking brake manual release bolts (6), and secure with lock plates (7).

2. Suction tube

- 1) Install suction tube (5).
 - ★ Use a new part for the O-ring.



3. Coupling

Tighten transmission front coupling (2), O-ring and washer (4) with mounting bolt (3).

★ Use a new part for the O-ring.

 End face of coupling:

Anti-friction compound (LM-G)

 Mounting bolt:

$921.8 \pm 98.1 \text{ Nm}$ ($94.0 \pm 10.0 \text{ kgm}$)

4. Drive shaft

1) Connect front drive shaft (1).

★ Clean the connection and mating surface of the drive shaft before installing.

 Drive shaft:

$112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

2) Install drive shaft guard.

5. Refilling with oil

1) Tighten drain plug and add transmission oil.

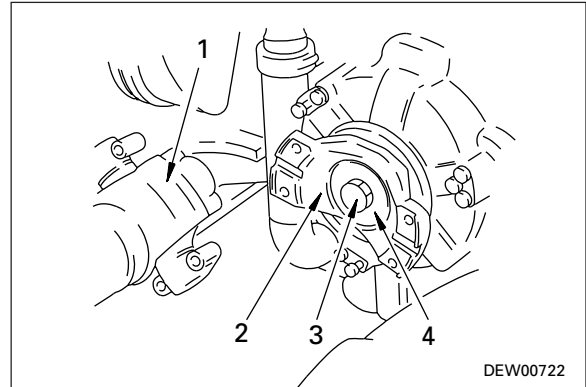


Transmission:

40 ℓ (Serial No.: 50001 – 53000)

65 ℓ (Serial No.: 53000 and up)

★ Run the engine to circulate the oil through the system. Then check the oil level again.



REMOVAL OF TRANSMISSION CONTROL VALVE ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Disconnect the cable from the negative (-) terminal of the battery.

1. Ladder

Remove left ladder (1).



Ladder (left): **59.5 kg**

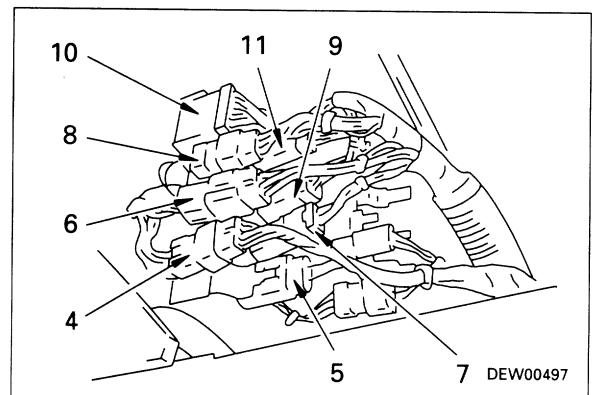
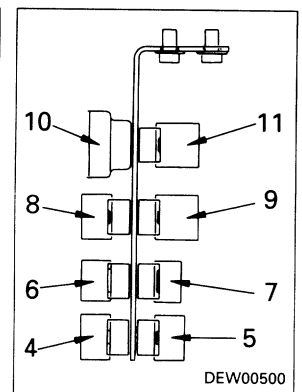
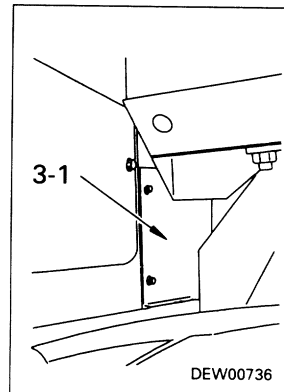
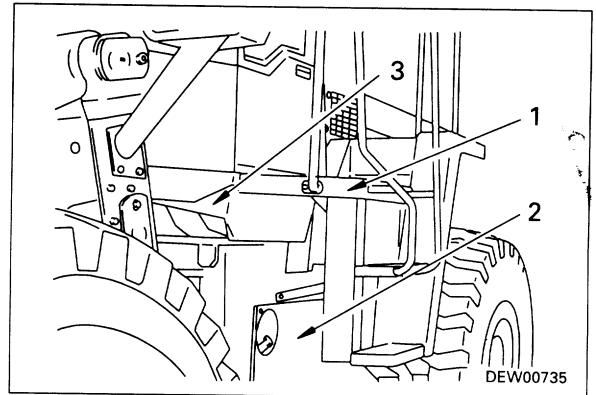
2. Covers

- 1) Remove left side cover (2) of rear frame.
- 2) Remove bottom cover (3) of cab.
- 3) Remove front cover (3-1) of bulkhead.

3. Electric wiring

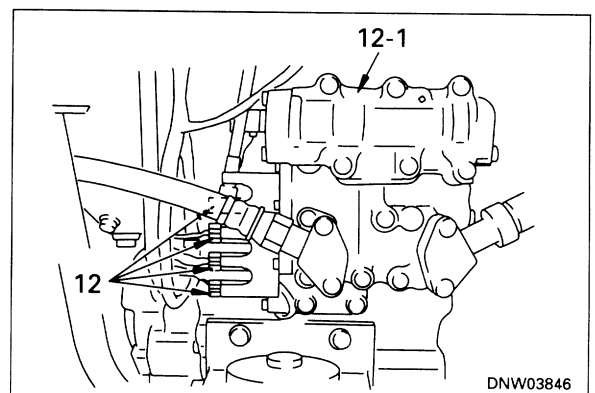
Disconnect following electric wiring.

- 1) Disconnect wiring TL1 (4) and TL2 (5) for transmission.
- 2) Disconnect floor wiring harnesses LR5 (6), LR6 (7), LR3 (8), LR4 (9), LR1 (10), and LR2 (11).



4. Modulating valve

- ★ Remove mounting bolts of modulating valve (12-1), then remove valve.



DISASSEMBLY AND ASSEMBLY

TRANSMISSION CONTROL VALVE

5. Hydraulic piping

- 1) Disconnect hose (13) between transmission, torque converter charging pump and flow valve at flow valve end. ※ 1
- 2) Disconnect hose (14) between flow valve and transmission oil filter at flow valve end. ※ 2
- 3) Disconnect hose (15) between transmission oil filter and transmission control valve at control valve end. ※ 3
- 4) Disconnect hose (16) between transmission control valve and cooler at control valve end. ※ 4

★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

6. Remove flow valve (17) from transmission case. ※ 5

7. Transmission control valve

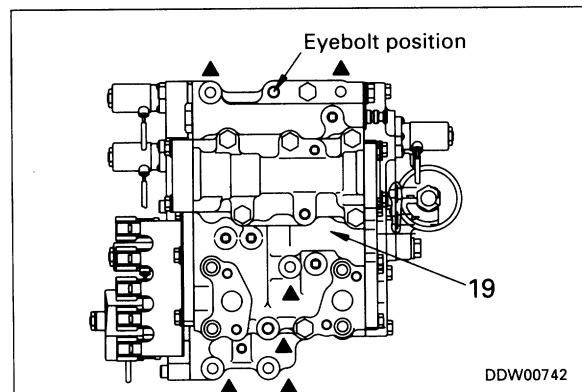
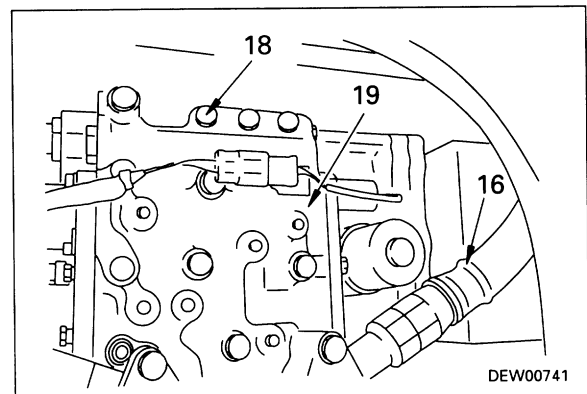
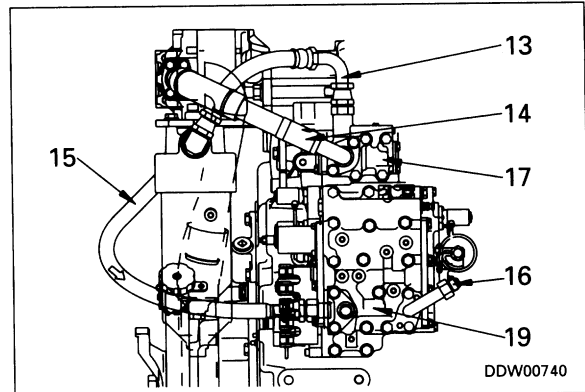
- 1) Remove mounting bolts (18) of control valve, and install eyebolts (M:12mm), then sling. ※ 6



Transmission control valve: 55 kg

- 2) Remove mounting bolts (18) of transmission control valve (19), and remaining bolts (marked with ▲) and lift off control valve assembly. ※ 7

★ Remove the gasket from the control valve.



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INSTALLATION OF TRANSMISSION CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1 ※ 3



Hose connection:

176.5 ± 29.4 Nm (18.0 ± 3.0 kgm)

※ 2 ※ 4

- ★ Use a new part for the O-ring.

※ 5

- ★ Use a new part for the O-ring.



Mounting bolt: **Thread tightener (LT-2)**



Mounting bolt:

34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)

※ 6

- ★ When installing the control valve, be careful not to hit the solenoid valve or other parts.

※ 7

- ★ Use a new part for the gasket.



Mounting bolt (marked with ▲):

Thread tightener (LT-2)



Mounting bolt:

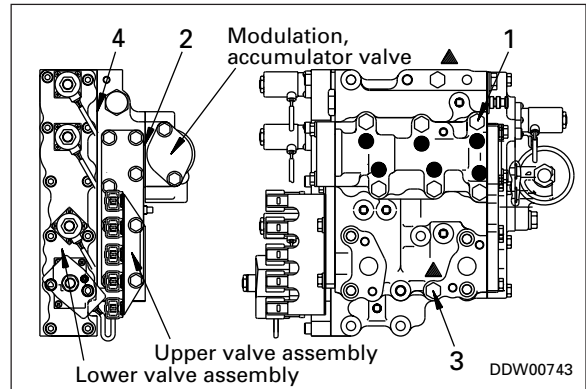
34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)

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DISASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

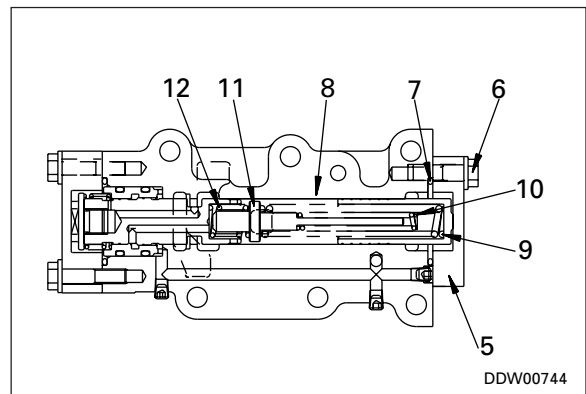
1. Disassembly of modulation, accumulator, upper, lower valve

- 1) Remove mounting bolts (1)(marked with ●) of modulation and accumulator valve, then remove gasket (2). (WA450-3S only)
- 2) Remove mounting bolts (3)(marked with ▲) of upper valve assembly, then remove gasket (4).
- ★ After removing, cover with tape to prevent dirt or dust from entering the valve.

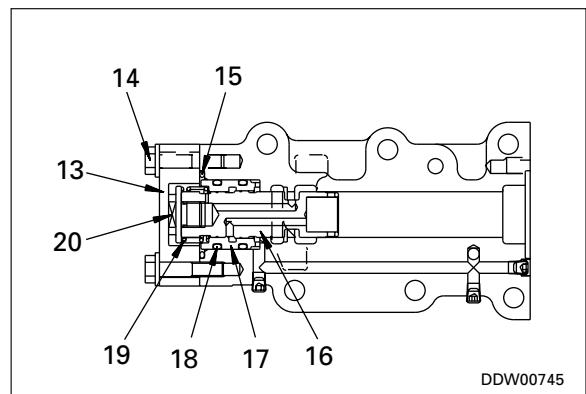


2. Disassembly of modulation, accumulator valve (Only for mechanical modulation)

- 1) Remove mounting bolts (6) of accumulator cover (5), then remove O-ring (7), accumulator valve (8), outer spring (9), inner spring (10), stopper (11), and spring (12) from valve body.

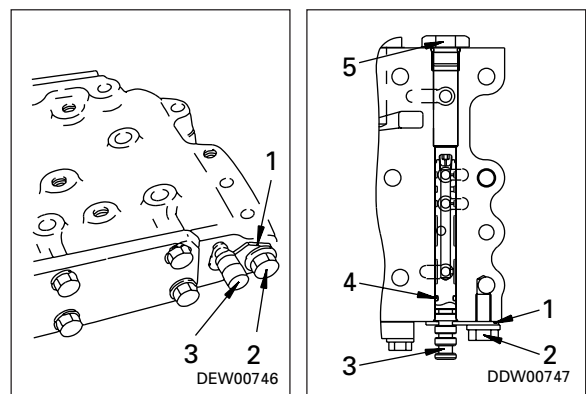


- 2) Remove mounting bolts (14) of modulation valve cover (13), then remove O-ring (15), fill valve (16), sleeve (17), O-ring (18), fill spring (19), and plug (20) from valve body.
- ★ After removing, cover with tape to prevent dirt or dust from entering the valve.



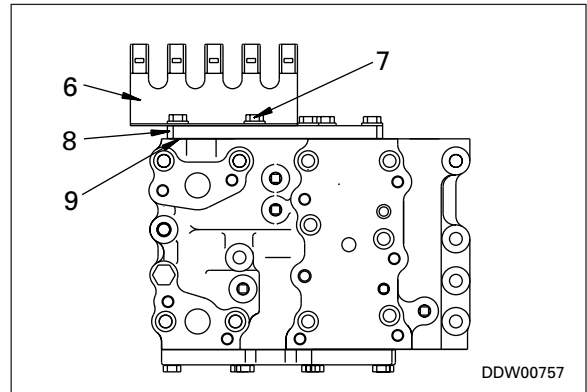
3. Disassembly of upper valve assembly

- 1) Manual valve
 - i) Loosen mounting bolt (2) of lock plate (1), remove lock plate, pull out manual valve spool (3), then remove O-ring (4).
 - ii) Remove plug (5) from valve body.



- 2) Upper L cover
 - i) Remove mounting bolts (7) of connector bracket (6), then remove bracket.
 - ii) Remove remaining mounting bolts (7) of upper L cover (8), then remove cover and gasket (9).

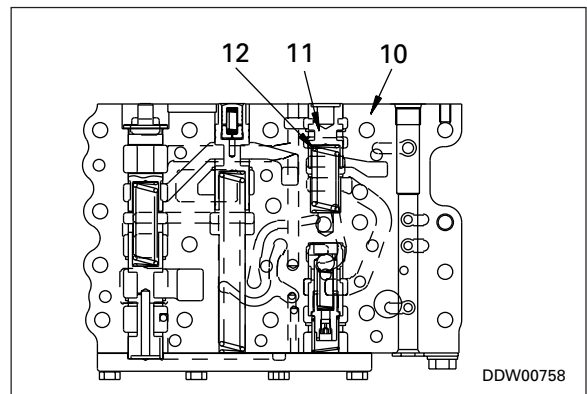
★ After removing, cover with tape to prevent dirt or dust from entering the valve.



- 3) Pilot valve

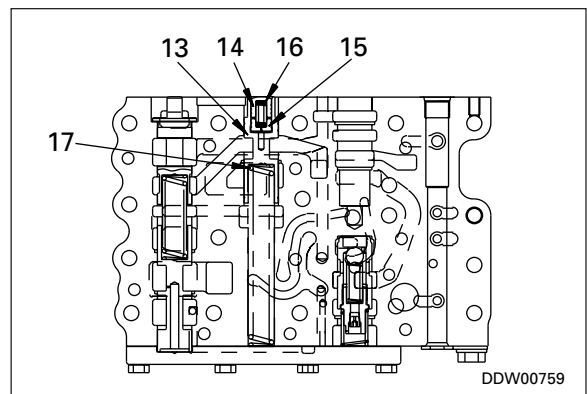
Remove pilot valve (11) and pilot spring (12) from valve body (10).

★ After removing, cover with tape to prevent dirt or dust from entering the valve.



- 4) Main relief valve
 - i) Remove valves (14) and (15), and spring (16) from main relief valve (13), then remove main relief valve from valve body.
 - ii) Remove main relief spring (17).

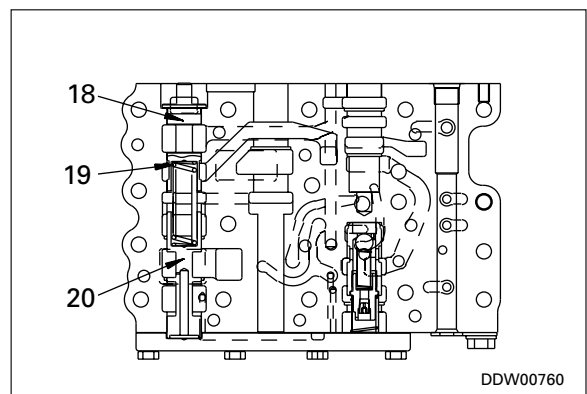
★ After removing, cover with tape to prevent dirt or dust from entering the valve.



- 5) Torque converter outlet valve

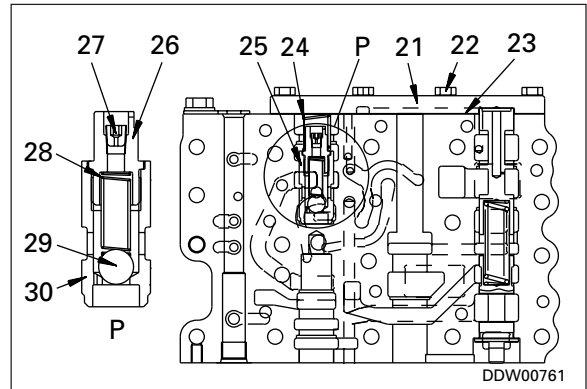
Remove dummy spool (18), torque converter outlet spring (19) and torque converter outlet valve (20) from valve body.

★ After removing, cover with tape to prevent dirt or dust from entering the valve.



6) Quick return valve

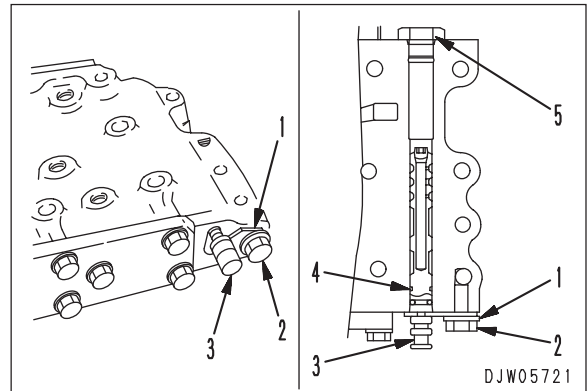
- i) Remove mounting bolts (22) of upper R cover (21), then remove cover and gasket (23).
 - ii) Remove quick return spring (24) from valve body, then remove quick return valve (25).
 - iii) Remove valve plug (26) of quick return valve, then remove orifice plug (27), spring (28), ball (29), and valve (30).
- ★ After removing, cover with tape to prevent dirt or dust from entering the valve.



4. Disassembly of upper valve assembly
(For electronic modulation)

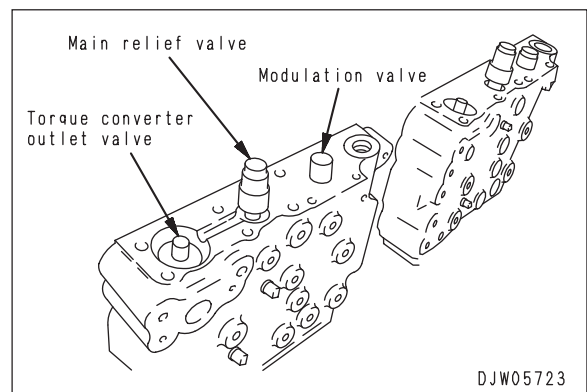
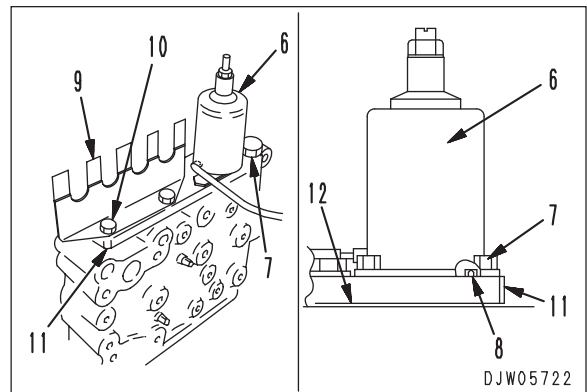
1) Manual valve

- i) Loosen mounting bolt (2) of lock plate (1) to remove the lock plate and then pull out manual valve spool (3) and remove O-ring (4).
- ii) Remove plug (5) from the valve body.

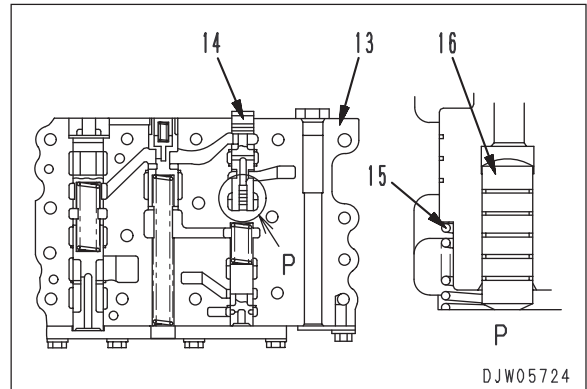


2) Electronic control modulation valve (ECMV)

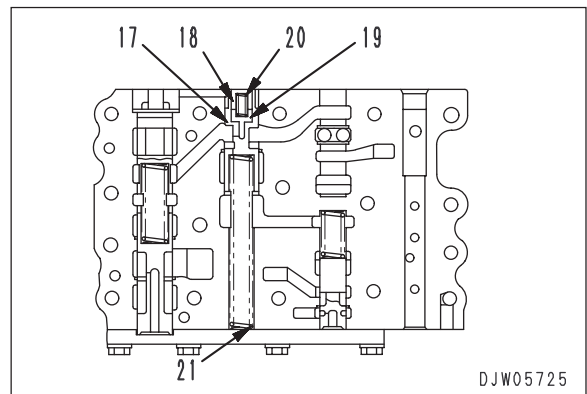
- i) Remove mounting bolt (7) of ECMV (6) and then remove the valve and O-ring (8).
 - ii) Remove mounting bolt (10) of connector bracket (9) to remove connector bracket.
 - iii) Remove remaining mounting bolt (10) of upper L-cover (11) to remove the cover and gasket (12).
- ★ After removing the valve, cover it with a tape, etc. to prevent dust from entering the valve.



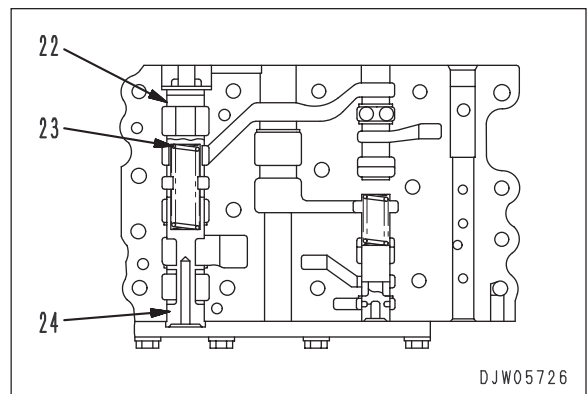
- 3) Modulation valve
 - i) Remove modulation valve (14) from upper valve body (13).
 - ii) Remove spring (15) and modulation piston (16) from modulation valve (14).
 - ★ After removing the valve, cover it with a tape, etc. to prevent dust from entering the valve.



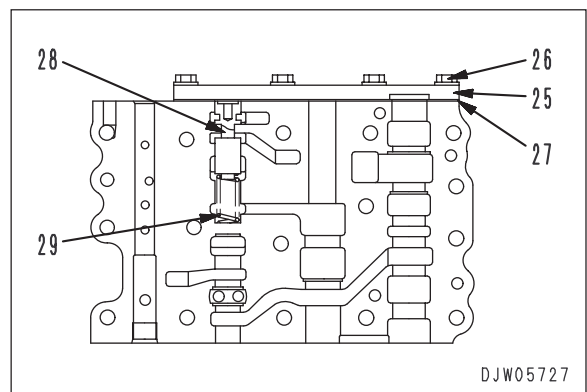
- 4) Main relief valve
 - i) Remove valves (18) and (19) and spring (20) from main relief valve (17), then remove the main relief valve from the valve body.
 - ii) Remove main relief spring (21).
 - ★ After removing the valve, cover it with a tape, etc. to prevent dust from entering the valve.



- 5) Torque converter outlet valve
Remove dummy spool (22), torque converter outlet spring (23), and torque converter outlet valve (24) from the valve body.
 - ★ After removing the valve, cover it with a tape, etc. to prevent dust from entering the valve.

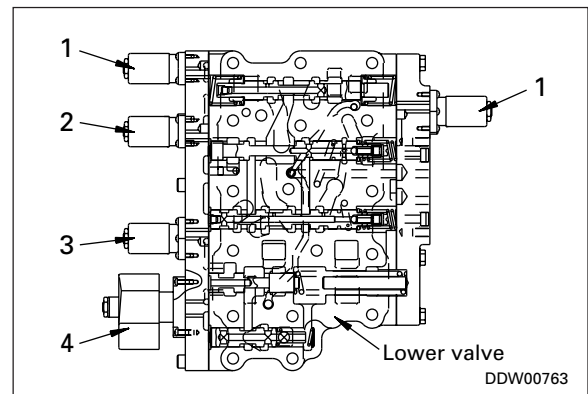
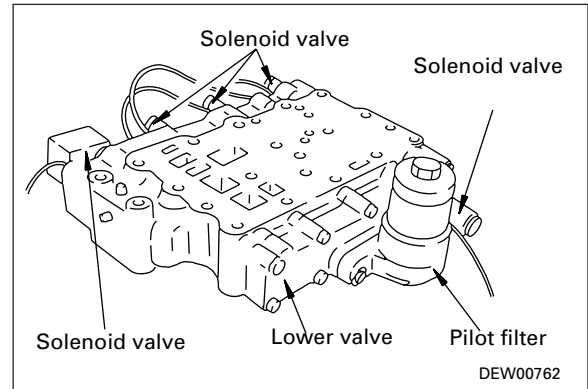


- 6) Pilot valve
 - i) Remove mounting bolts (26) of upper R-cover (25) to remove the cover and gasket (27).
 - ii) Remove pilot valve (28) and pilot spring (29) from valve body.
 - ★ After removing the valve, cover it with a tape, etc. to prevent dust from entering the valve.



5. Disassembly of lower valve assembly

- 1) Solenoid valve, pilot filter
 - i) Remove directional selector solenoid valve (1) and O-ring from lower valve.
 - ii) Remove H-L selector solenoid valve (2), range selector solenoid valve (3), and O-ring from lower valve.
 - iii) Remove parking brake solenoid valve (4) and O-ring from lower valve.
 - iv) Remove pilot filter from lower valve.



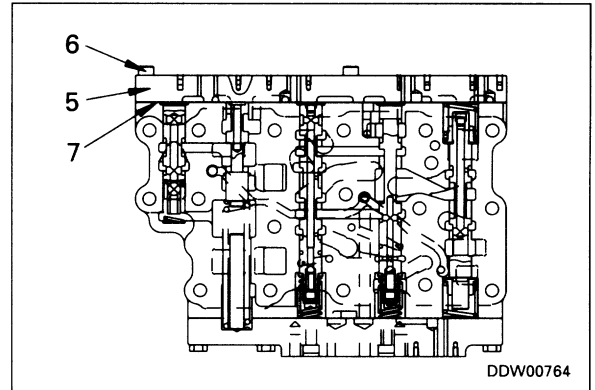
DISASSEMBLY AND ASSEMBLY

TRANSMISSION CONTROL VALVE

2) Lower L cover

Remove mounting bolts (6) of lower L cover (5), then remove cover and gasket (7).

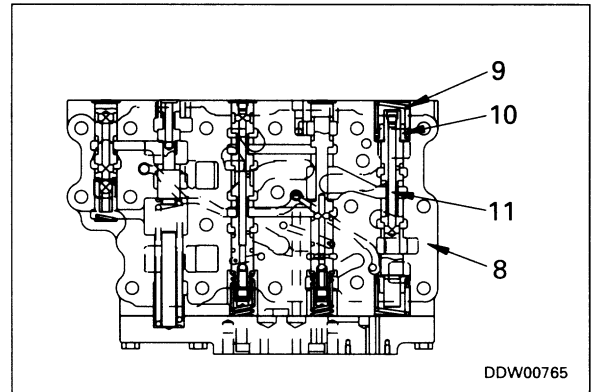
★ After removing, cover with tape to prevent dirt or dust from entering the valve.



3) Directional selector valve

Remove F return spring (9) and sleeve (10) of directional valve from valve body (8), then remove valve spool (11).

★ After removing, cover with tape to prevent dirt or dust from entering the valve.

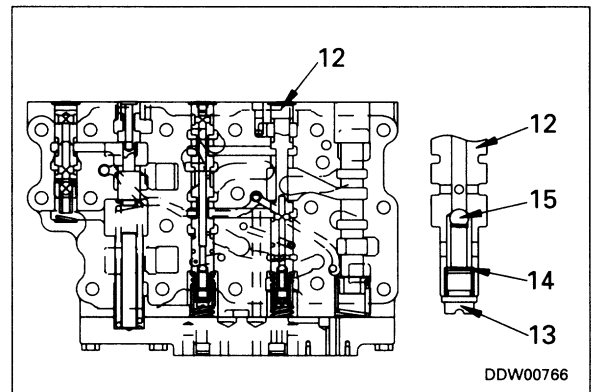


4) H-L selector valve

i) Remove spool (12) of H-L valve from valve body.

ii) Remove plug (13) from spool (12), then remove spring (14) and ball (15).

★ After removing, cover with tape to prevent dirt or dust from entering the valve.

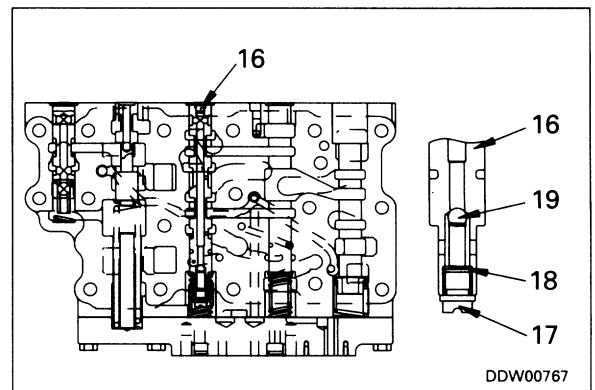


5) Range selector valve

i) Remove spool (16) of range selector valve from valve body.

ii) Remove plug (17) from spool (16), then remove spring (18) and ball (19).

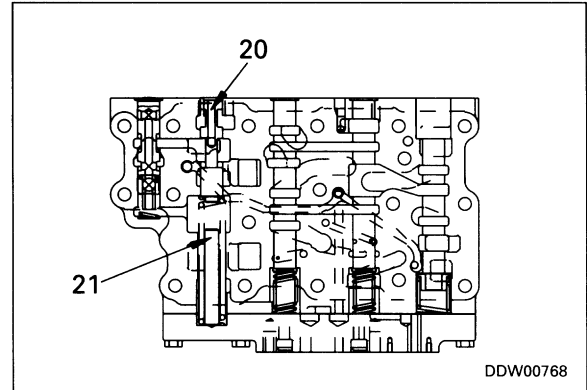
★ After removing, cover with tape to prevent dirt or dust from entering the valve.



6) Priority valve

Remove spool (20) and stopper (21) of priority valve from valve body.

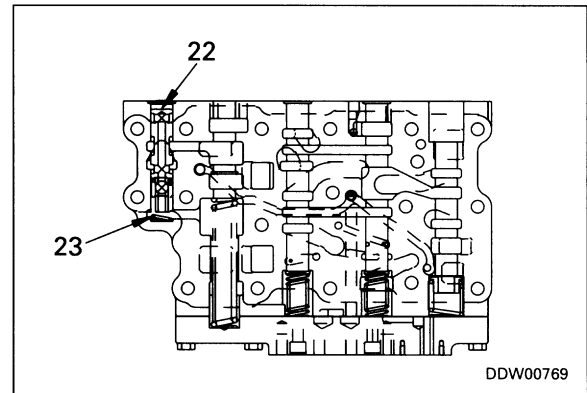
- ★ After removing, cover with tape to prevent dirt or dust from entering the valve.



7) Parking brake valve

Remove spool (22) and return spring (23) of parking brake valve from valve body.

- ★ After removing, cover with tape to prevent dirt or dust from entering the valve.

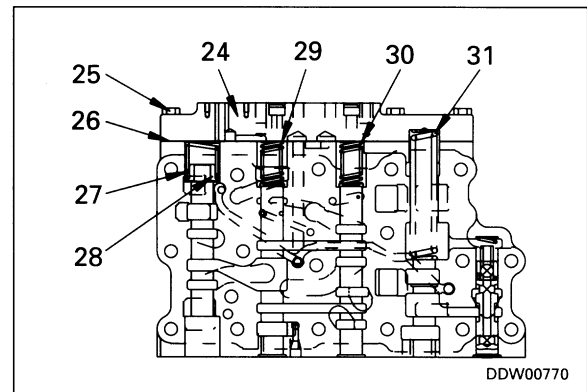


8) Lower R cover

i) Remove mounting bolts (25) of lower R cover (24), then remove cover and gasket (26).

ii) Remove R return spring (27) and sleeve (28) of directional valve, return springs (29) and (30) of H-L selector valve and range selector valve, and spring (31) of priority valve from valve body.

- ★ After removing, cover with tape to prevent dirt or dust from entering the valve.

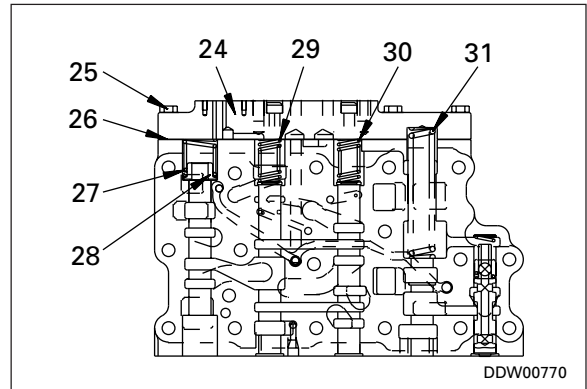


ASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

1. Assembly of lower valve assembly

- 1) Lower R cover
 - i) Install R return spring (27) and sleeve (28) of directional valve, return springs (29) and (30) of H-L selector valve and range selector valve, and spring (31) of priority valve to valve body.
 - ★ Free height of spring:
 - 42 mm (27)
 - 48 mm (29), (30)
 - 150 mm (31)
 - ii) Install gasket (26), and tighten lower R cover (24) with mounting bolts (25).
 - ★ Use a new part for the O-ring.

 kgm Lower R cover mounting bolt:
 $31.4 \pm 2.9 \text{ Nm}$ ($3.2 \pm 0.3 \text{ kgm}$)

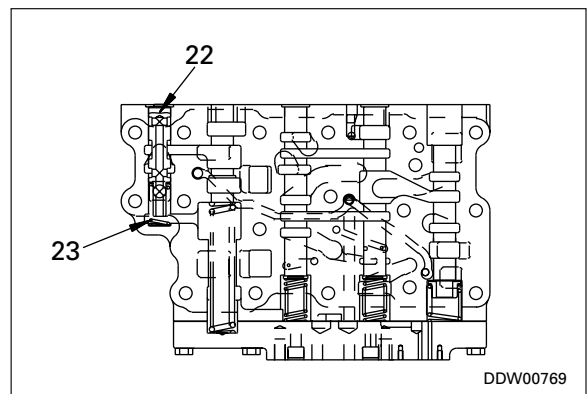


- 2) Parking brake valve

Install spool (22) and return spring (23) of parking brake valve to valve body.

 - ★ Free height of spring: 46 mm (23)

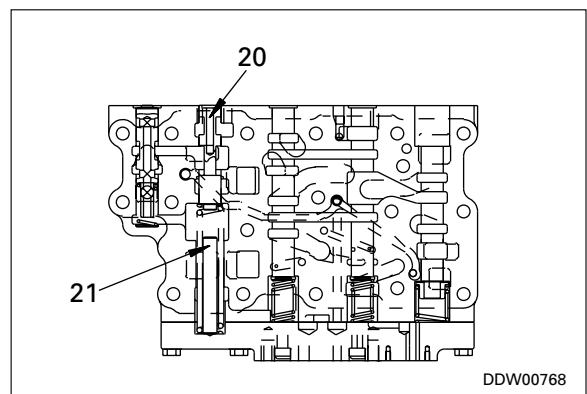
 Outside circumference of parking brake valve spool: **Oil (EO10-CD)**



- 3) Priority valve

Install spool (20) and stopper (21) of priority valve in valve body.

 Outside circumference of priority valve spool: **Oil (EO10-CD)**



4) Range selector valve

- i) Install spring (18), ball (19), and plug (17) to spool (16).

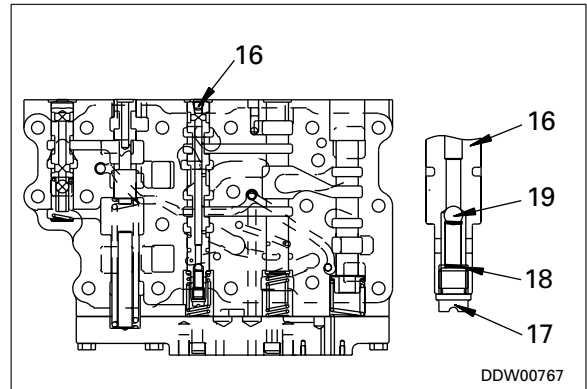
★ Free height of spring: 23.5 mm

 Range selector spool plug (17):
9.8 – 12.8 Nm (1.0 ± 1.3 kgm)

 Range selector spool plug (17):
Thread tightener (LT-2)

- ii) Install spool (16) of range selector valve to valve body.

 Outside circumference of range selector spool: **Oil (EO10-CD)**



5) H-L selector valve

- i) Install spring (14), ball (15), and plug (13) to spool (12).

★ Free height of spring: 23.5 mm

 H-L selector spool plug (13):
9.8 – 12.8 Nm (1.0 – 1.3 kgm)

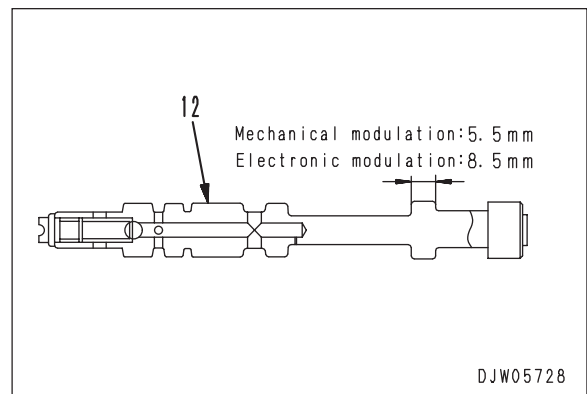
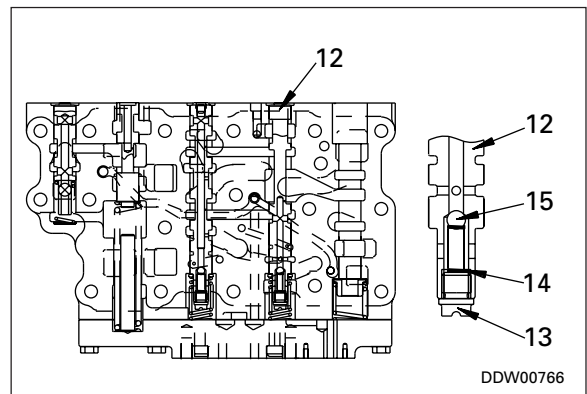
 H-L selector spool plug (13):
Thread tightener (LT-2)

- ii) Install spool (12) of H-L valve to valve body.

★ Note that the mechanical control modulation valve and the electronic control modulation valve are different in a part of the shape of spool (12).

 Outside circumference of H-L selector spool: **Oil (EO10-CD)**

H-L selector valve

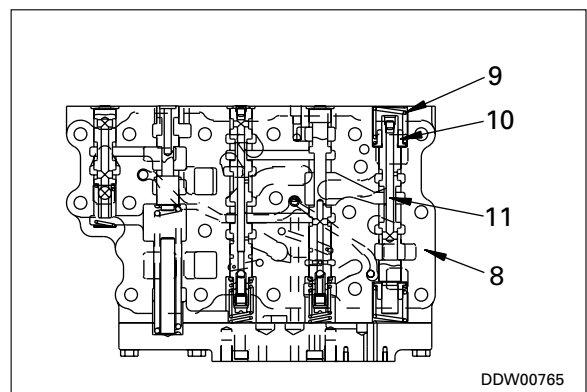


6) Directional selector valve

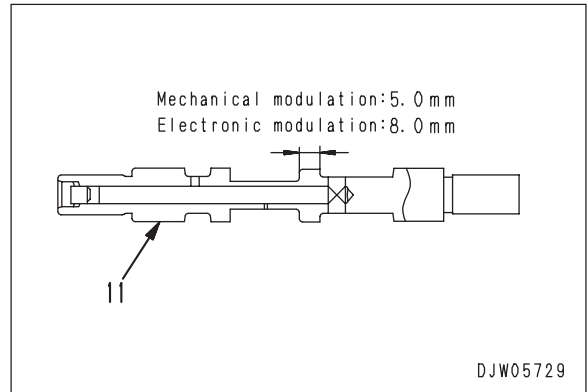
Install F return spring (9) and sleeve (10) of directional valve to valve body (8), then install valve spool (11).

★ Free height of spring: 42 mm

 Outside circumference of directional selector valve spool:
Oil (EO10-CD)



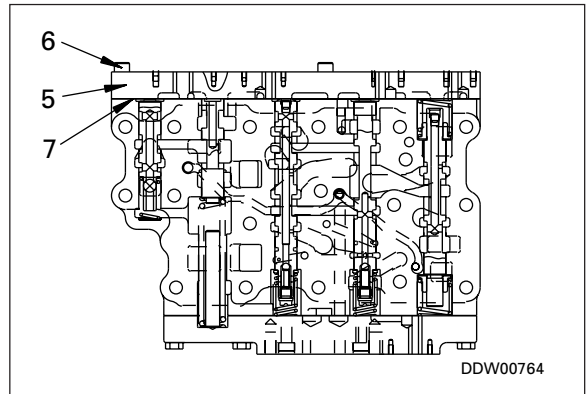
- ★ Note that the mechanical control modulation valve and the electronic control modulation valve are different in a part of the shape of spool (11).



- 7) Lower L cover
Install gasket (7) to valve body, and set lower L cover (5) in position, then tighten with mounting bolts (6).

★ Use a new part for the gasket.

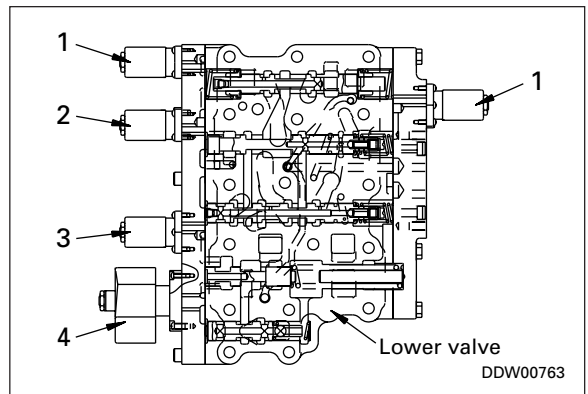
 Lower L cover mounting bolt:
 $31.4 \pm 2.9 \text{ Nm}$ ($3.2 \pm 0.3 \text{ kgm}$)



- 8) Solenoid valve, pilot filter
 - i) Install pilot filter to lower valve.

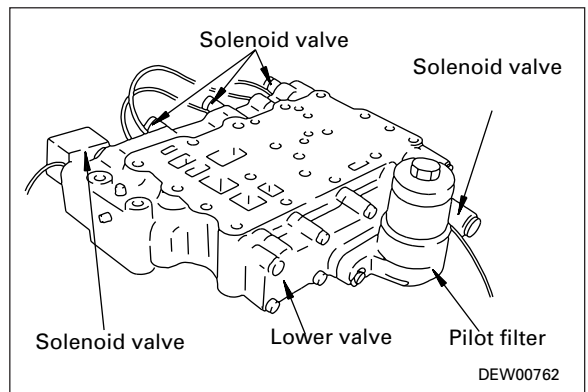
 Filter mounting bolt:
 $68.6 \pm 4.9 \text{ Nm}$ ($7.0 \pm 0.5 \text{ kgm}$)

- ii) Install O-ring to lower valve, then install parking brake solenoid valve (4).
- iii) Install O-ring to lower valve, then install H-L selector solenoid valve (2) and range selector solenoid valve (3).



- iv) Install O-ring to lower valve, then install directional selector solenoid valve (1).
 - ★ Check that the O-ring is fitted securely.
 - ★ Assemble the part of parking brake solenoid valve (4) with the OUT stamp.

 Solenoid valve (1) – (4):
 $1.7 \pm 1 \text{ Nm}$ ($0.17 \pm 0.1 \text{ kgm}$)



2. Assembly of upper valve assembly (For mechanical modulation)

1) Quick return valve

- i) Assemble orifice plug (27), spring (28), ball (29), and valve (30) to quick return valve, then install valve plug (26).
 - ★ Free height of spring (28): 40 mm

 Quick return valve plug (26):
 $34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

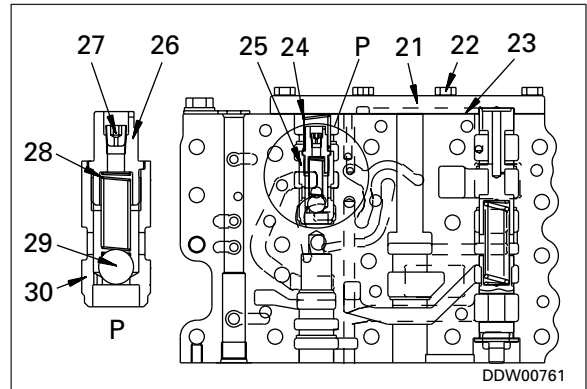
- ii) Install quick return valve (25) to valve body, then install quick return spring (24).
 - ★ Free height of spring (24): 31.5 mm

 Outside circumference of quick return valve spool:

Oil (EO10-CD)

- iii) Install gasket (23), and set upper cover (21) in position, then tighten with mounting bolts (22).
 - ★ Use a new part for the gasket.

 Upper R cover mounting bolt:
 $31.4 \pm 2.9 \text{ Nm}$ ($3.2 \pm 0.3 \text{ kgm}$)

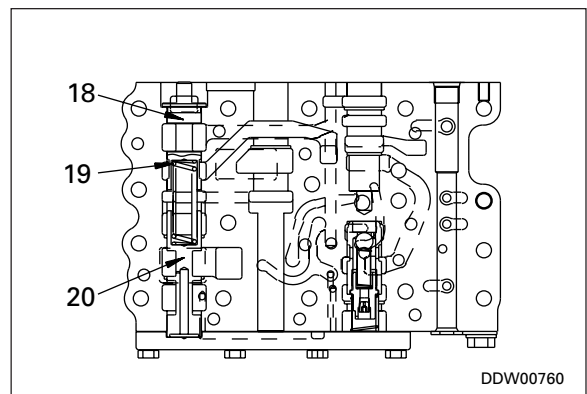


2) Torque converter outlet valve

Install torque converter outlet valve (20), torque converter outlet spring (19), and dummy spool (18) to valve body.

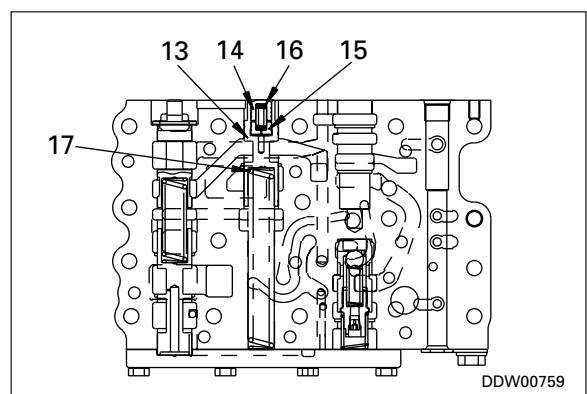
- ★ Free height of spring (19): 65 mm

 Outside circumference of valve spool, dummy spool: **Oil (EO10-CD)**



3) Main relief valve

- i) Install main valve spring (17).
- ii) Install valves (14) and (15), and spring (16) to main relief valve (13), then install main relief valve (13) to valve body.

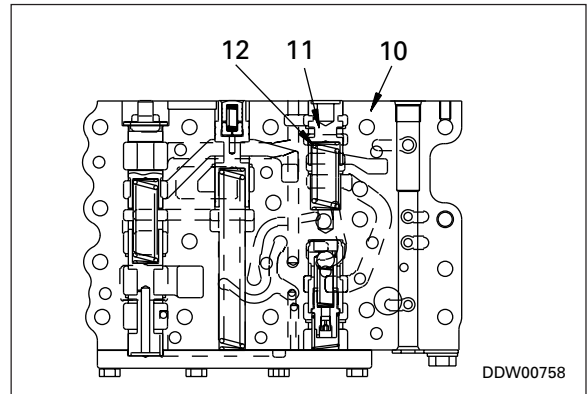


- ★ Free height of spring (16): 26 mm
- ★ Free height of spring (17): 171 mm

-  Outside circumference of valves (14), (15): **Oil (EO10-CD)**
-  Outside circumference of main relief valve spool: **Oil (EO10-CD)**

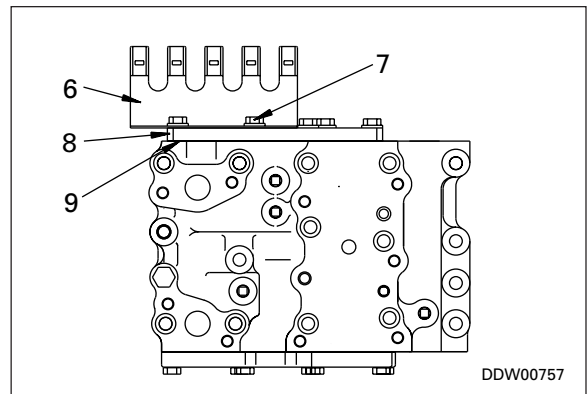
- 4) Pilot valve
Install pilot valve (11) and pilot spring (12) to valve body (10).
- ★ Free height of spring (12): 74.2 mm

-  Outside circumference of pilot valve spool: **Oil (EO10-CD)**



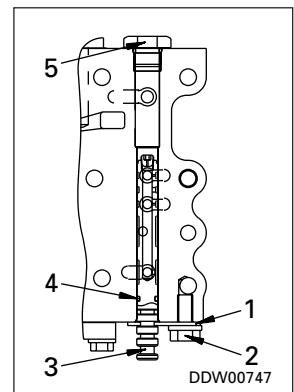
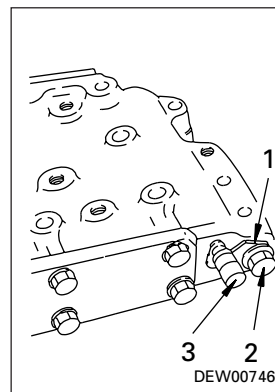
- 5) Upper L cover
Install gasket (9), and set upper L cover (8) in position, then tighten with mounting bolts (7) together with connector bracket (6).
- ★ Use a new part for the gasket.

-  Upper L cover mounting bolt:
 $31.4 \pm 2.9 \text{ Nm}$ ($3.2 \pm 0.3 \text{ kgm}$)



- 6) Manual valve
- i) Install plug (5) to valve body.
 - ii) Assemble manual valve spool (3), and install O-ring (4), then secure lock plate (1) with mounting bolt (2).

-  Outside circumference of manual valve spool: **Oil (EO10-CD)**
-  Plug (4):
 $39.2 \pm 4.9 \text{ Nm}$ ($4.0 \pm 0.5 \text{ kgm}$)
-  Lock plate mounting bolt:
 $53.9 \pm 19.6 \text{ Nm}$ ($5.5 \pm 2.0 \text{ kgm}$)



3. Assembly of upper valve assembly (For electronic modulation)

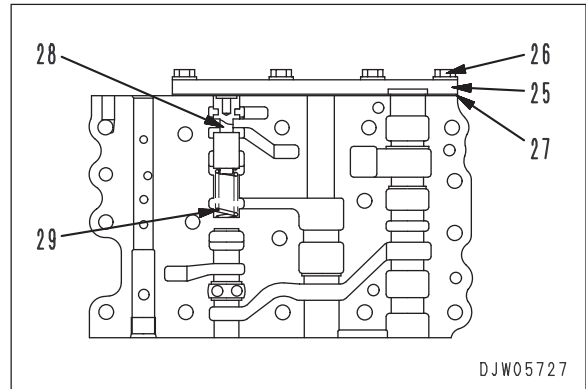
1) Pilot valve

- i) Install pilot valve (28) and pilot spring (29) to the valve body.
★ Free height of spring (29): 60 mm

 Periphery of pilot valve spool:
Apply oil (EO10-CD)

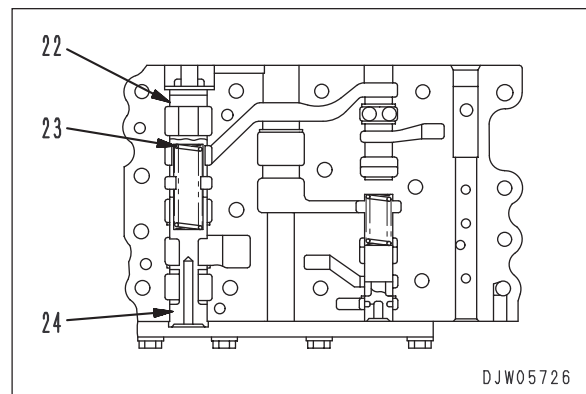
- ii) Fit gasket (27) and set upper R-cover (25) and tighten mounting bolts (26).
★ Use a new gasket.

 Upper R-cover mounting bolt:
 $31.4 \pm 2.9 \text{ Nm}$ { $3.2 \pm 0.3 \text{ kgm}$ }



- 2) Torque converter outlet valve
Install torque converter outlet valve (24), torque converter outlet spring (23), and dummy spool (22) to the valve body.
★ Free height of spring: 65 mm (23)

 Periphery of torque converter outlet valve spool and dummy spool: **Apply oil (EO10-CD)**

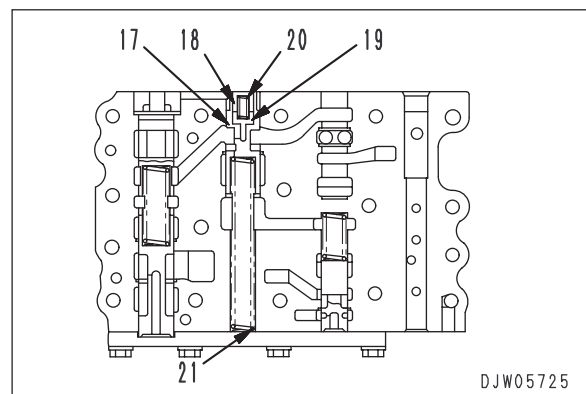


3) Main relief valve

- i) Install main valve spring (21).
- ii) Install valves (18) and (19) and spring (20) to main relief valve (17) and then install main relief valve (17) to the valve body.
★ Free height of spring (20): 26 mm
★ Free height of spring (21): 171 mm

 Periphery of valves (18) and (19):
Apply oil (EO10-CD)

 Periphery of main relief valve spool: **Apply oil (EO10-CD)**

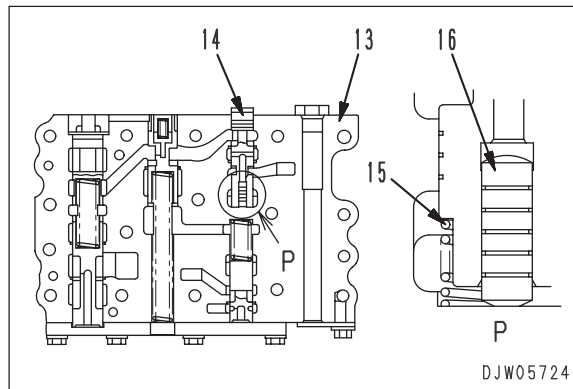


- 4) Modulation valve
- Install spring (15) and modulation piston (16) to modulation valve (14).
 - Install modulation valve (14) to valve body (13).
- ★ Free height of spring (15): 24 mm



Periphery of modulation valve spool and piston:

Apply oil (EO10-CD)



- 5) Electronic control modulation valve (ECMV)
- Fit gasket (12) and set upper L-cover (11) and secure them with connector bracket (9) and bolts (10).
- ★ Use a new gasket.



Upper L-cover mounting bolt:

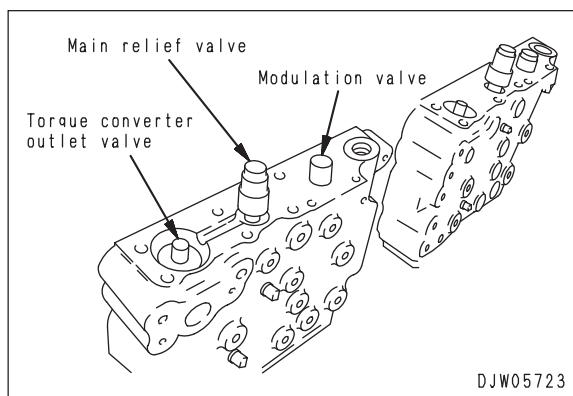
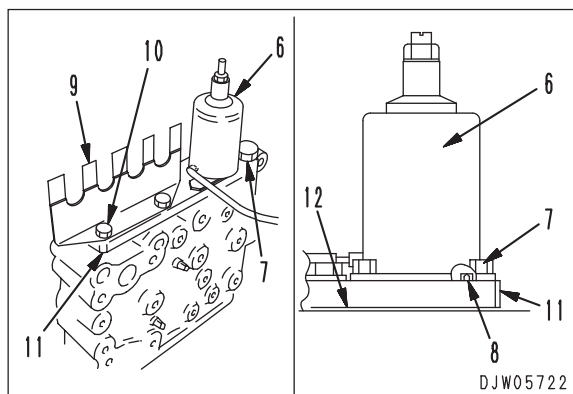
$31.4 \pm 2.9 \text{ Nm}$ { $3.2 \pm 0.3 \text{ kgm}$ }

- Install O-ring (8) and secure ECMV (6) with mounting bolt (7).
- ★ Check that the O-ring is installed securely.



ECMV mounting bolt (7):

$11.8 - 14.7 \text{ Nm}$ { $1.2 - 1.5 \text{ kgm}$ }



- 6) Manual valve
- Install plug (5) to the valve body.
 - Install manual valve spool (3) and O-ring (4) and then secure lock plate (1) with mounting bolt (2).



Periphery of manual valve spool:
Apply oil (EO10-CD).



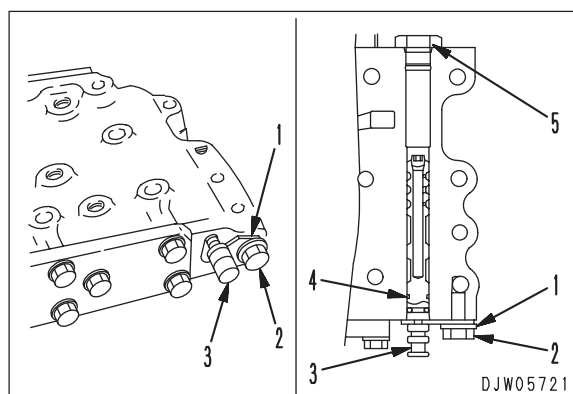
Plug (4):

$39.2 \pm 4.9 \text{ Nm}$ { $4.0 \pm 0.5 \text{ kgm}$ }



Lock plate mounting bolt:

$53.9 \pm 19.6 \text{ Nm}$ { $5.5 \pm 2.0 \text{ kgm}$ }



DISASSEMBLY AND ASSEMBLY

TRANSMISSION CONTROL VALVE

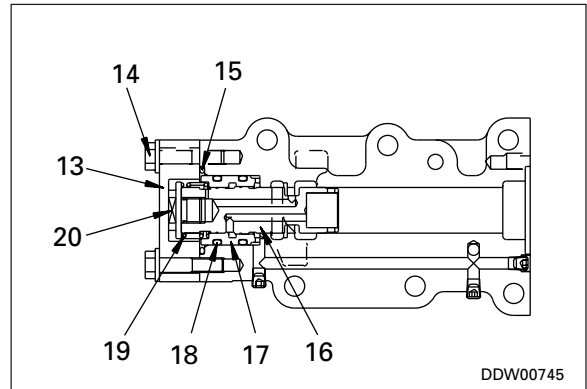
4. Assembly of modulation, accumulator valve (For mechanical modulation)

- 1) Install plug (20), fill spring (19), O-ring (18), sleeve (17), fill valve (16), and O-ring (15) to valve body, and tighten modulation valve cover (13) with mounting bolts (14).

★ Free length of spring (19): 29 mm

 Outside circumference of fill valve spools (16), (17): **Oil (EO10-CD)**

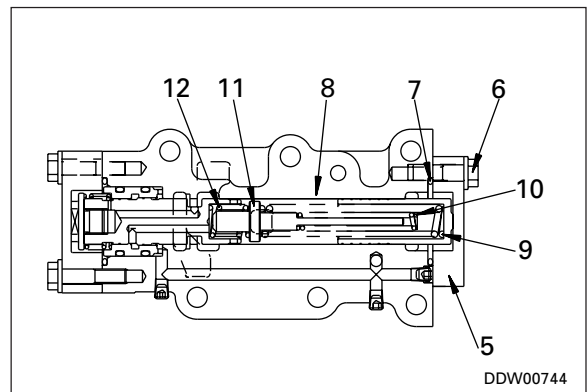
 Fill valve cover mounting bolt:
 $31.4 \pm 2.9 \text{ Nm}$ ($3.2 \pm 0.3 \text{ kgm}$)



- 2) Install spring (12), stopper (11), inner spring (10), outer spring (9), accumulator valve (8), and O-ring (7) to valve body, and tighten accumulator cover (5) with mounting bolts (6).

★ Free length of spring: 100 mm (9)
66 mm (10)
22 mm (12)

 Cover mounting bolt at accumulator end:
 $31.4 \pm 2.9 \text{ Nm}$ ($3.2 \pm 0.3 \text{ kgm}$)

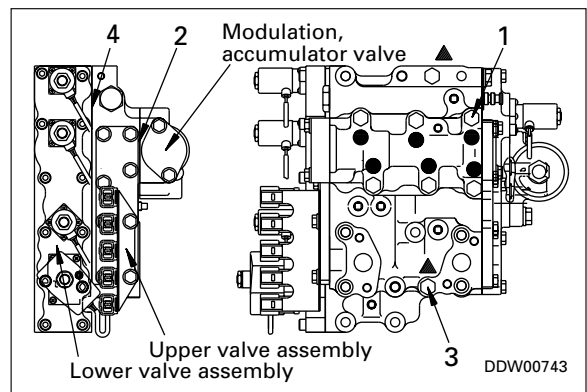


5. Assembly of modulation, accumulator, upper, lower valve

- 1) Install gasket (4), then install upper valve assembly with mounting bolts (3) (marked with ▲).
 - 2) Install gasket (2), and tighten modulation, accumulator valve with mounting bolts (1) (marked with ●). (WA450-3S)
- ★ Use a new part for the gasket.

 Mounting bolt:
 $49.0 \pm 4.9 \text{ Nm}$ ($5.0 \pm 0.5 \text{ kgm}$)

 Modulation, accumulator valve mounting bolt:
 $49.9 \pm 4.9 \text{ Nm}$ ($5.0 \pm 0.5 \text{ kgm}$)



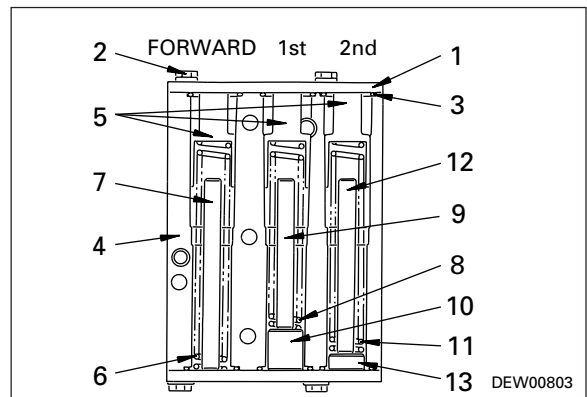
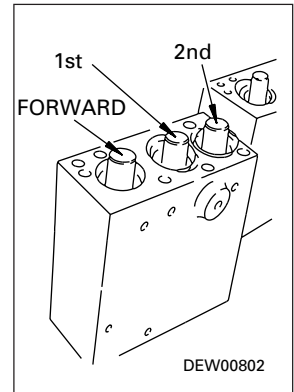
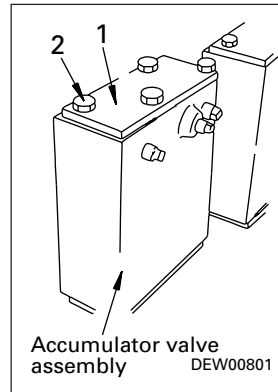
U42103

DISASSEMBLY OF TRANSMISSION ACCUMULATOR VALVE ASSEMBLY

1. Remove mounting bolts (2) of cover (1) from accumulator valve assembly, then remove cover and O-ring (3).

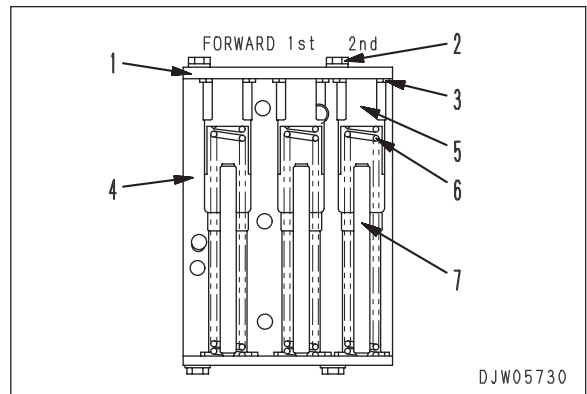
2. Accumulator valve (For mechanical modulation)

- 1) Remove accumulator valves (5) from FORWARD, 1st, and 2nd ports in accumulator body (4).
- 2) Remove accumulator spring (6) and stopper (7) from FORWARD port.
- 3) Remove accumulator spring (8), stopper (9), and spacer (10) from 1st port.
- 4) Remove accumulator spring (11), stopper (12), and spacer (13) from 2nd port.



3. Accumulator valve (For electronic modulation)

- 1) Remove accumulator valves (5) from accumulator body (4) through the FORWARD, 1st, and 2nd ports.
- 2) Remove accumulator spring (6) and stopper (7) through the FORWARD port.
- 3) Remove accumulator spring (6) and stopper (7) through the 1st port.
- 4) Remove accumulator spring (6) and stopper (7) through the 2nd port.



4. Remove mounting bolts (2) of the lower cover (1) from accumulator body (4) to remove the cover and O-ring (3).

ASSEMBLY OF TRANSMISSION ACCUMULATOR VALVE ASSEMBLY

1. Install bottom cover (1) and O-ring (3) to accumulator body (4), and tighten with mounting bolts (2).



Mounting bolt: **Thread tightener (LT-2)**

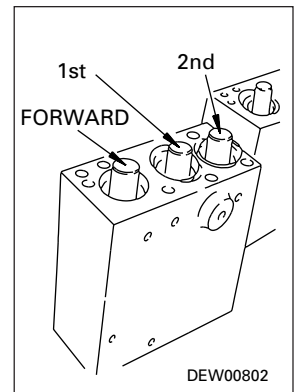
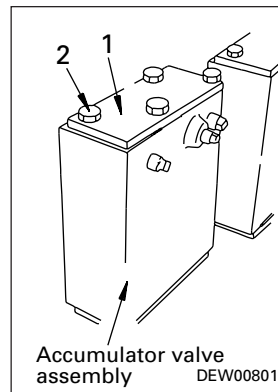
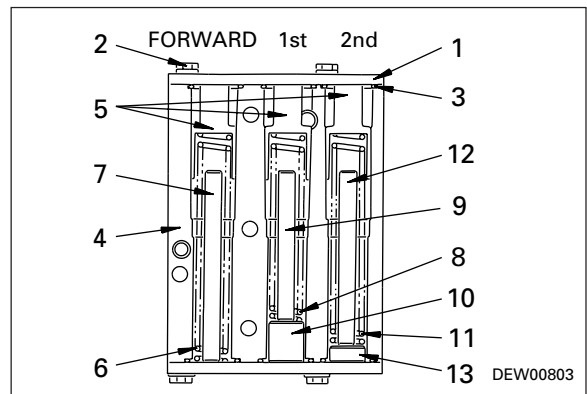


Mounting bolt:

34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)

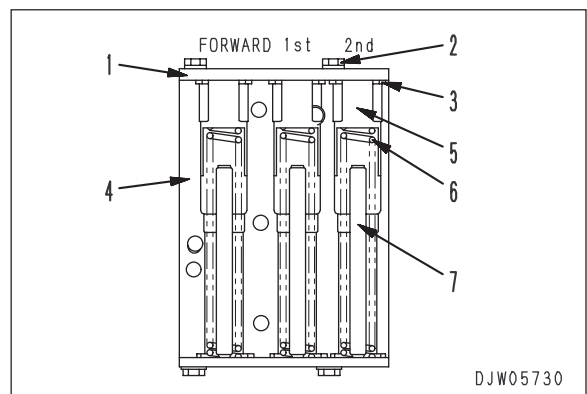
2. Accumulator valve (For mechanical modulation)

- 1) Install accumulator spring (11), stopper (12), and spacer (13) to 2nd port.
- 2) Install accumulator spring (8), stopper (9), and spacer (10) to 1st port.
- 3) Install accumulator spring (6) and stopper (7) to FORWARD port.
 - ★ Free height of accumulator spring:
 - 158 mm (2nd)
 - 145 mm (1st)
 - 185 mm (FORWARD)
 - ★ Length of accumulator stopper:
 - 125 mm (2nd)
 - 105 mm (1st)
 - 136 mm (FORWARD)
 - ★ Thickness of accumulator spacer:
 - 10 mm (2nd)
 - 30 mm (1st)
- 4) Install accumulator valves (5) to each port.
 - ★ Outside circumference of accumulator valve: **Oil (EO10-CD)**



3. Accumulator valve (For electronic modulation)

- 1) Install accumulator spring (6) and stopper (7) to the FORWARD, 1st, and 2nd ports.
 - ★ Free height of accumulator spring: 185 mm
 - ★ Length of stopper: 136 mm
- 2) Install accumulator valves (5) to each port.
 - ★ Periphery of accumulator valve: **Apply oil (EO10-CD)**



4. Install top cover (1) and O-ring (3) to accumulator body (4), and tighten with mounting bolts (2).



Mounting bolt: **Thread tightener (LT-2)**



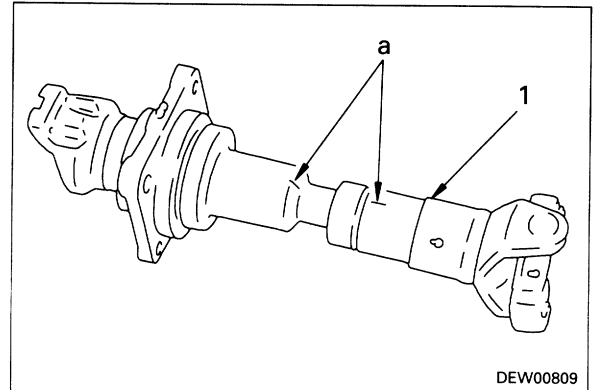
Cover mounting bolt:

$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

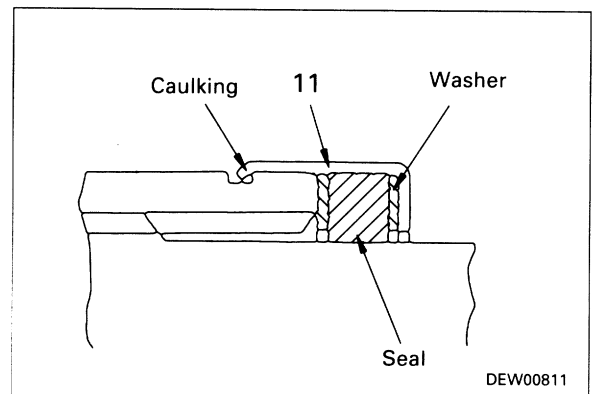
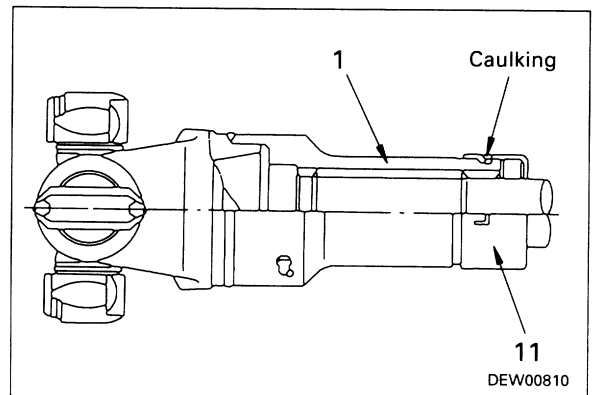
DISASSEMBLY OF DRIVE SHAFT ASSEMBLY

1. Front drive shaft

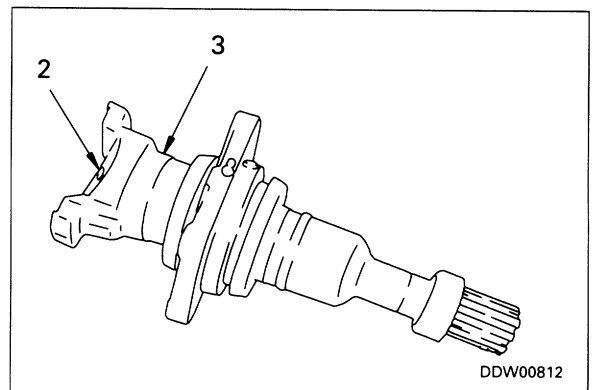
- 1) Remove coupling and tube (1).
 - ★ Make match marks **a** to prevent the coupling from being installed in the opposite direction.



- ★ Cover (11) is caulked at 4 places with a punch, so do not remove it unless necessary.
- ★ When removing cover (11), be careful not to damage cover (11) or tube (1).
- ★ When removing the caulking, use a screwdriver to raise the caulked portion.



- 2) Loosen bolt (2), and remove coupling (3) and retainer.
 - ★ Make match marks to prevent the coupling from being installed in the opposite direction.
- 3) Using press, pull out flange bearing (4).

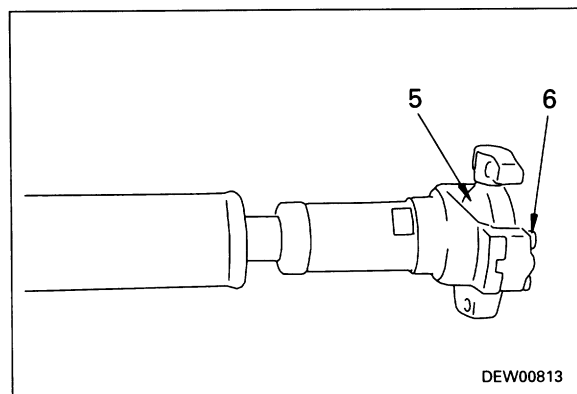


2. Center drive shaft, rear drive shaft

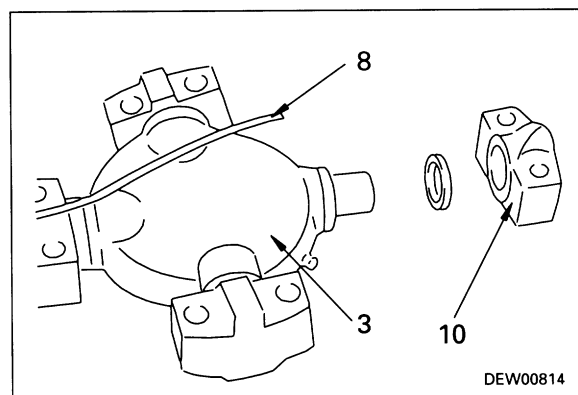
- ★ Carry out the same operation as in Step 1) for the front drive shaft.
- ★ When removing the rear drive shaft, push it in towards the transmission.

3. Spider, bearing

- 1) Remove bolts (6) of spider and bearing assembly (5), and tap with plastic hammer to remove.



- 2) Remove strap (8) of spider (7), and pull out bearing cap (10).
 - ★ Use the same procedure for the front, center, and rear drive shafts.

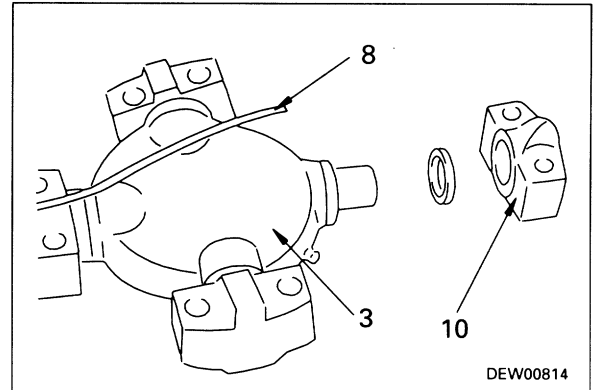


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ASSEMBLY OF DRIVE SHAFT

1. Spider, bearing

- 1) Insert bearing cap (10) in mount of spider (7).
 - ★ If the spider and bearing cap is worn, replace the spider and bearing as a set.
 - ★ When welding strap (8) of the cap, be careful not to damage the bearing with the heat.
 - ★ Assemble so that the grease nipples are facing in the same direction.
 - ★ Use the same procedure for the front, center, and rear drive shafts.

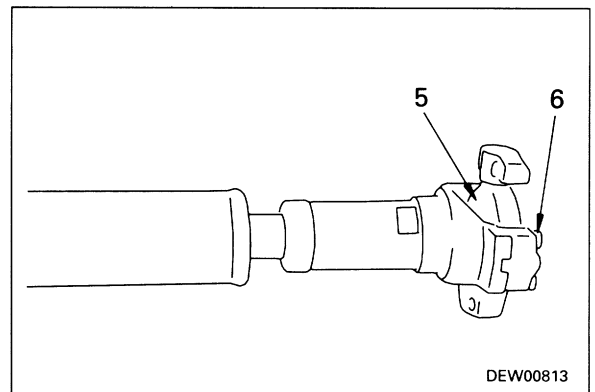


- 2) Set spider and bearing assembly (5) to drive shaft mount, and lock with bolt (6).

 **kgm** Mounting bolt:

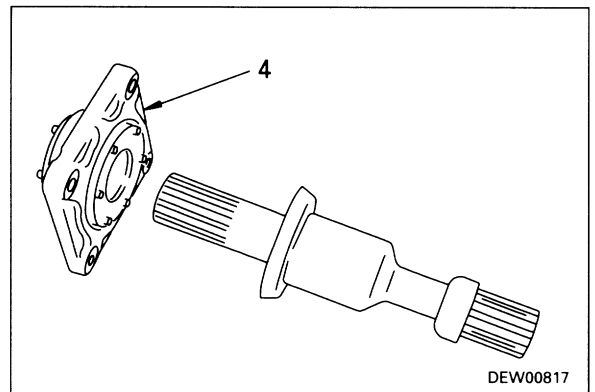
$112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

 Bearing cap: **Grease (G2-LI)**



2. Front drive shaft

- 1) Press fit flange bearing (4).
 - ★ Do not knock the flange bearing in directly with a hammer.

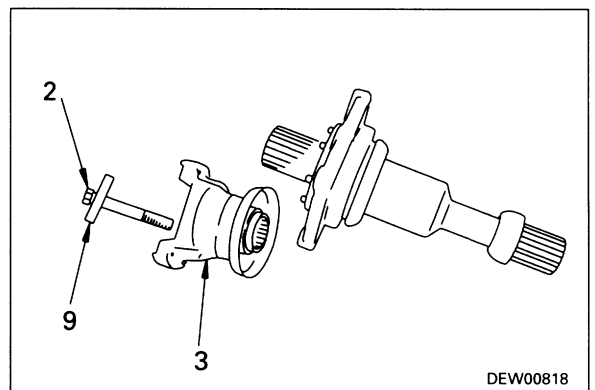


- 2) Align match marks, and tighten coupling (3) and retainer (9) with mounting bolt (2).

★ Tighten the bolt to the specified tightening torque after installing to the machine.

 Spline portion: **Grease (G2-LI)**

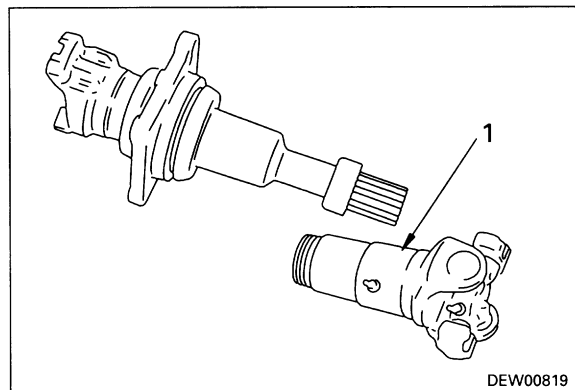
 **kgm** Mounting bolt: **$926.7 \pm 98.1 \text{ Nm}$ ($94.5 \pm 10.0 \text{ kgm}$)**



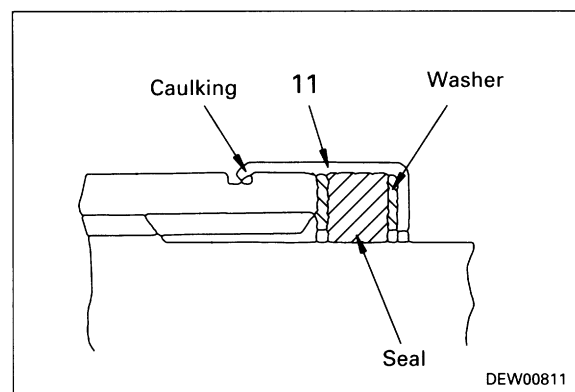
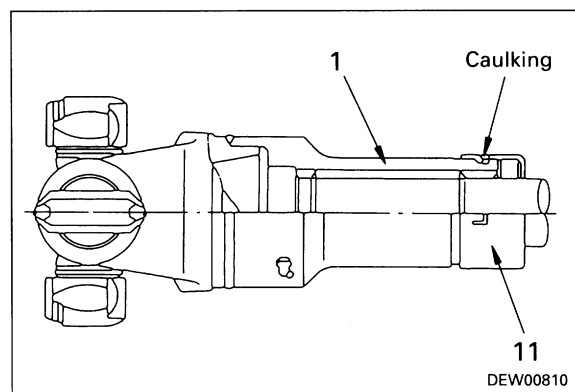
- 3) Align match marks, and install coupling and tube (1).

- ★ Check that the couplings are facing in the same direction.
- ★ If the spline is worn, replace the whole drive shaft assembly.

 Spline portion: **Grease (G2-LI)**



- ★ If cover (11) has been removed, carry out the operation in the following order.
- i) Insert seal and washer in cover (11) and tube (1), assemble cover (11), then caulk with a punch at points on diametrically opposite sides.



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3. Center, rear drive shaft

- ★ Carry out the same operation as in Step 3) for the front drive shaft.

REMOVAL OF FRONT AXLE ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure inside piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Jack up the axle, and set block ① under the front frame.

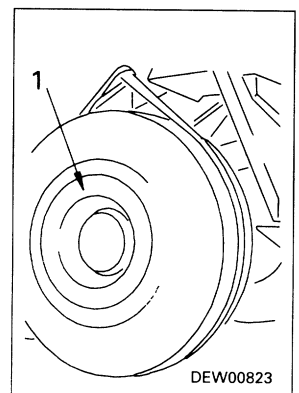
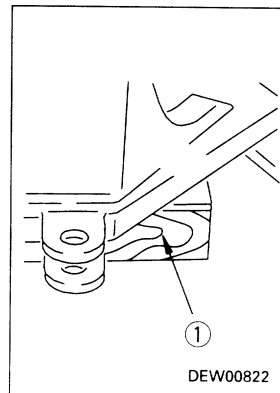
1. Tire, wheel

Sling left and right tires and wheels (1) of front axle, then remove mounting nuts and lift off.



Tire, wheel: **550 kg (23.5-25 tire)**
647 kg (26.5-25 tire)

※ 1



2. Drive shaft

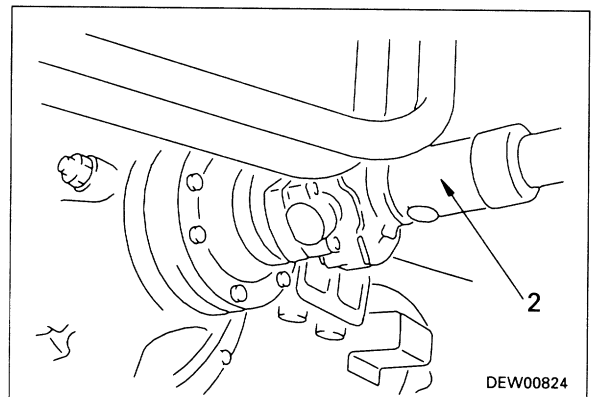
Disconnect front drive shaft (2) from front axle.



Front drive shaft: **40 kg**

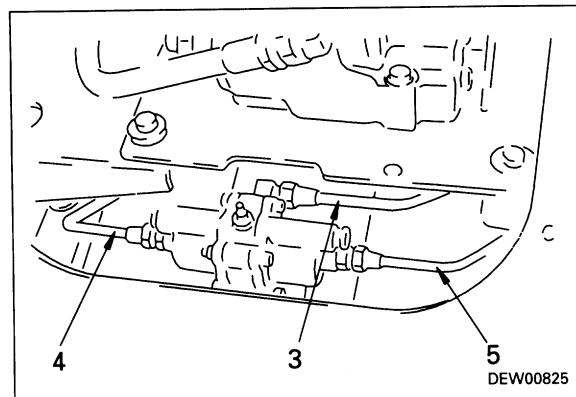
※ 2

- ★ Make match marks on the drive shaft and the coupling.



3. Brake piping

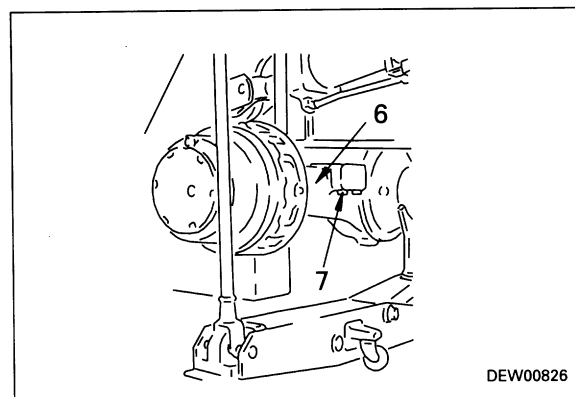
- 1) Remove cover of plate at front of front frame, disconnect front brake piping and tube (3) between brake valve and slack adjuster at slack adjuster end.
 - 2) Remove tubes (4) and (5) between slack adjuster and left and right wheel cylinders.
- ★ After disconnecting the piping, fit plugs to prevent the entry of dirt or dust.

**4. Front axle**

- 1) Sling one end of front axle housing and fit a jack under other end.
- 2) Fit jack under differential case.
- 3) Remove mounting bolts (7), then use hoist and jack to maintain balance and lift off.

※ 3

★ Be careful not to let slack adjuster on top of axle housing hit frame.

Front axle: **1455 kg**

- 4) Pull out front axle from chassis.

INSTALLATION OF FRONT AXLE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 kgm Tire mounting nut:
 $470.7 \pm 49.0 \text{ Nm}$ ($48.0 \pm 5.0 \text{ kgm}$)

- ★ Remove the block from under the front frame.

※ 2

- ★ Clean the connections and mating surface of the drive shaft.

 kgm Drive shaft mounting bolt:
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

※ 3

 kgm Front axle mounting bolt:
 $1618.1 \pm 166.7 \text{ Nm}$ ($165.0 \pm 17.0 \text{ kgm}$)

- Bleed the air from the brake system and carry out an actuation check.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add hydraulic oil through the oil filler of the hydraulic tank to the specified level.

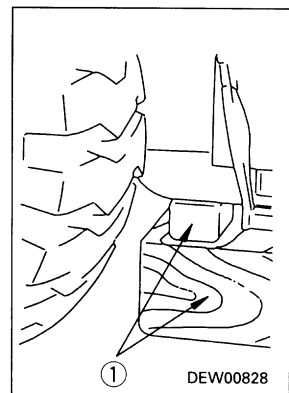
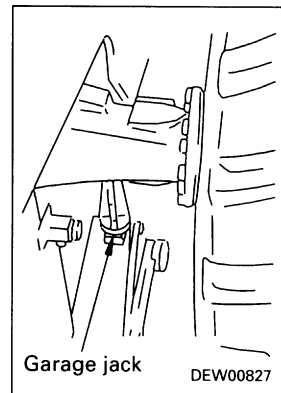
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REMOVAL OF REAR AXLE ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure inside piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Jack up the axle, and set block ① under the rear frame.



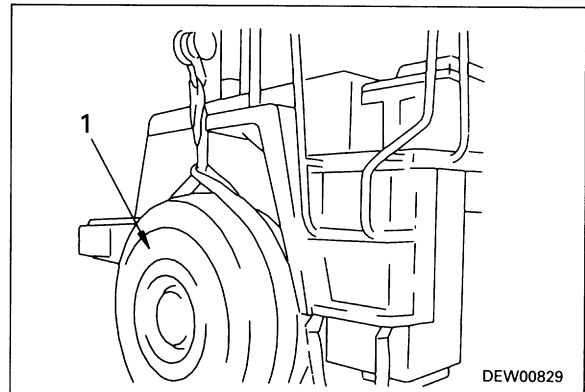
1. Tire, wheel

Sling left and right tires and wheels (1) of rear axle, then remove mounting nuts and lift off.



Tire, wheel: **550 kg (23.5-25 tire)**
647 kg (26.5-25 tire)

※ 1



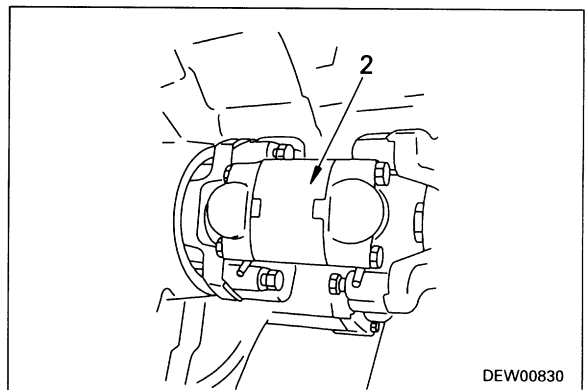
2. Drive shaft

Disconnect rear drive shaft (2) from rear axle.



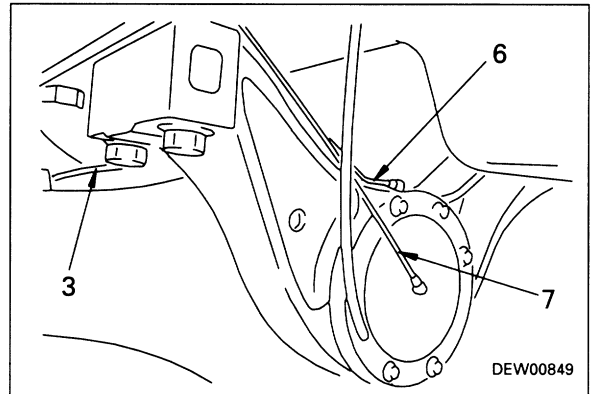
Rear drive shaft: **19 kg**

※ 2

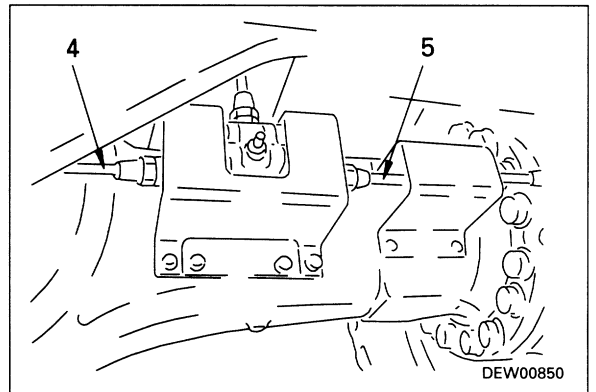


3. Brake piping

- 1) Disconnect rear brake piping and hose (3) between brake valve and slack adjuster at slack adjuster end.
- 2) Remove tubes (4) and (5) between slack adjuster and left and right wheel cylinders.
 - ★ Always remove the brake tubes before removing the axle. There is danger that they may be crushed when the axle is lifted off.
 - ★ After disconnecting the piping, fit plugs to prevent the entry of dirt or dust.

**4. Grease tubes**

Disconnect grease tubes (6) and (7) from rear axle support.

**5. Rear axle, support**

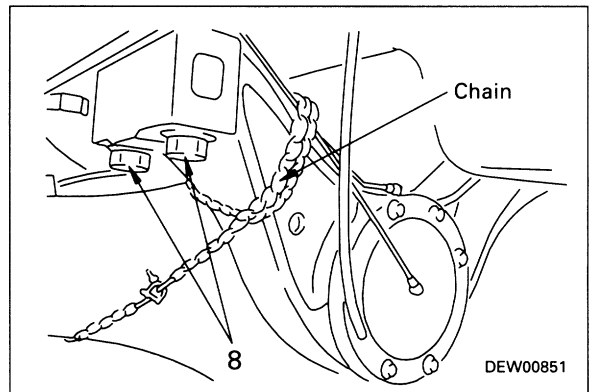
- 1) Secure axle support and rear axle with chain.
- 2) Sling rear axle housing with nylon lifting tool, and remove both left and right mounting bolts (8).

※ 3

Rear axle, support: **1600 kg**

- 3) Pull out rear axle and support together from chassis, then lower.
 - ★ Maintain the balance of the axle when lowering it.
 - ★ Remove the axle after removing the fuel tank.
 - ★ For details, see REMOVAL OF FUEL TANK.

※ 4



6. Rear support

- 1) Sling rear support of rear axle and support assembly, and remove thrust cap (9). ※ 5
- 2) Remove thrust washer (10), thrust plate (11), and thrust washer (12) from rear axle. ※ 6
- 3) Lift off rear support. ※ 7

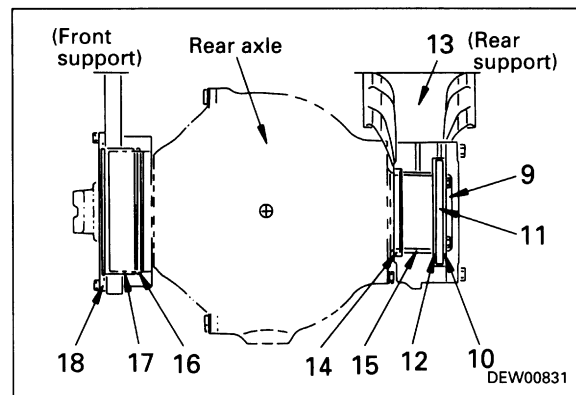


Rear support: **148 kg**

- 4) Remove packing (14) and bushing (15) from rear support. ※ 8

7. Front support

- 1) Remove retainer (18) of front support, then remove O-ring and packing. ※ 9
- 2) Remove packing (16) and bushing (17) from front support. ※ 10



INSTALLATION OF REAR AXLE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



kgm Tire mounting nut:

 $470.7 \pm 49 \text{ Nm}$ ($48.0 \pm 5.0 \text{ kgm}$)

- ★ Remove the block from under the rear frame.

※ 2

- ★ Clean the connections and mating surface of the drive shaft.



kgm Drive shaft mounting bolt:

 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

※ 3



kgm Axle support mounting bolt:

 $1029.7 \pm 98.7 \text{ Nm}$ ($105.0 \pm 10.0 \text{ kgm}$)

- ★ After installing the rear axle, install the fuel tank.
- ★ For details, see INSTALLATION OF FUEL TANK.

※ 4

- ★ Secure the rear axle and the axle support (rear support) with a chain.
- ★ Be careful not to damage the packing with the rear axle coupling.

Rear axle front mount: **Grease (G2-LI)**

※ 5



kgm Thrust cap mounting bolt:

 $279.5 \pm 29.4 \text{ Nm}$ ($28.5 \pm 3.0 \text{ kgm}$)

kgm Thrust cap mounting bolt:

Thread tightener (LT-2)

※ 6

Thrust washer: **Grease (G2-LI)**

kgm Thrust plate mounting bolt:

 $279.5 \pm 29.4 \text{ Nm}$ ($28.5 \pm 3.0 \text{ kgm}$)

Thrust plate mounting bolt:

Thread tightener (LT-2)

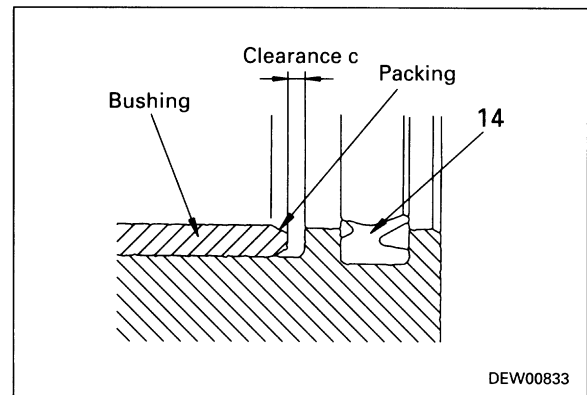
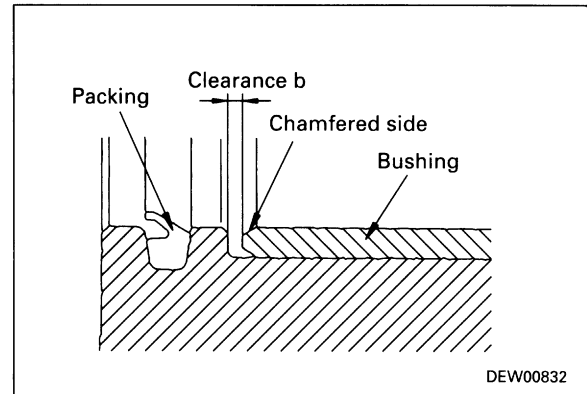
※ 7

- ★ Pay attention to the direction of the packing, fit it securely in the groove, and assemble so that the lip is not turned over.
- ★ Check that the slit in the bushing is facing the side.

 Rear axle mount: **Grease (G2-LI)**

※ 8 ※ 10

- ★ Set so that the chamfered side of the bushing is on the axle housing side, and assemble so that the clearance is clearance **b**.
 - ★ Clearance **b**: Min. 0.5 mm
- ★ Pay attention to the direction of the packing, fit it securely in the groove, and assemble so that the lip is not turned over.
- ★ Install the bushing and packing to the front support in the same way as for the rear support.
 - ★ Clearance **c**: Min. 0.5 mm



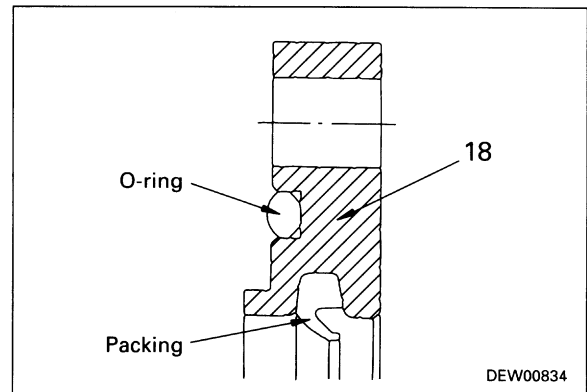
※ 9

- ★ Use new parts for the O-rings and packing.
- ★ Pay attention to the direction of the packing, fit it securely in the groove, and assemble so that the lip is not turned over.

 Retainer mounting bolt:

Thread tightener (LT-2)

- Bleed the air from the brake system and carry out an actuation check.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air.
- Add hydraulic oil through the oil filler of the hydraulic tank to the specified level.



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REMOVAL OF FRONT DIFFERENTIAL ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Jack up the axle, and set block ① under the front frame.

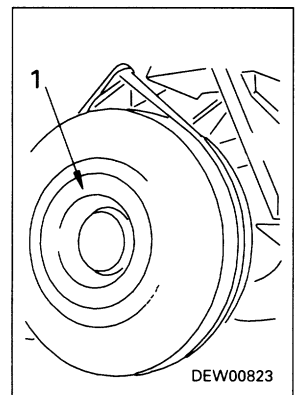
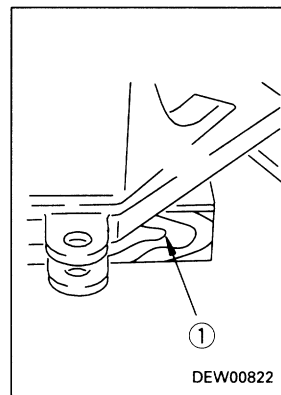
1. Tires, wheels

Sling left and right tires and wheels (1) of front axle, then remove mounting nuts, and lift off.



Tire, wheel: **550 kg (23.5-25 tire)**
647 kg (26.5-25 tire)

※ 1



2. Drive shaft

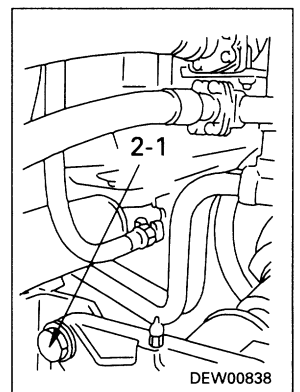
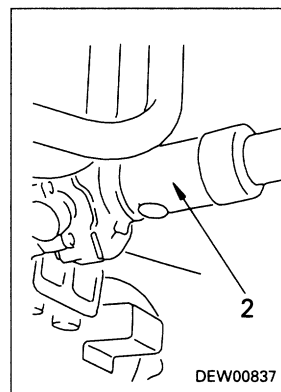
- 1) Disconnect front drive shaft (2) from front axle. ※ 2



Front drive shaft: **40 kg**

★ Make match marks on the drive shaft and coupling.

- 2) Remove flange bearing (2-1), and move front drive shaft towards right side.



DISASSEMBLY AND ASSEMBLY**FRONT DIFFERENTIAL****3. Draining oil**

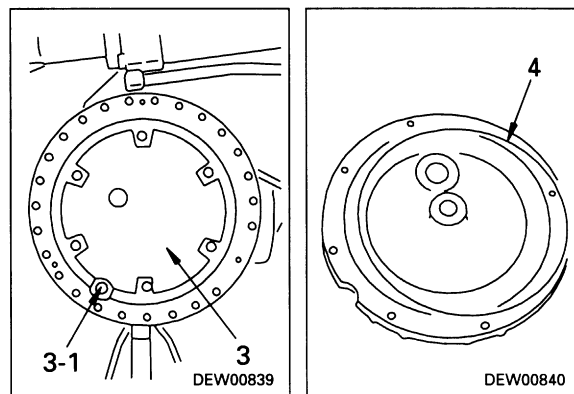
Set plug (3-1) immediately at bottom, then remove it and drain oil.



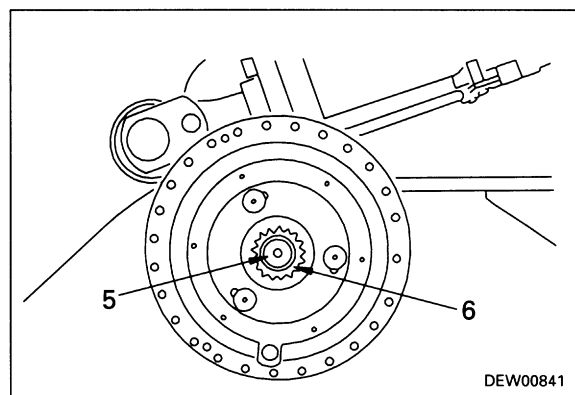
Axle oil: 65 ℓ

4. Cover

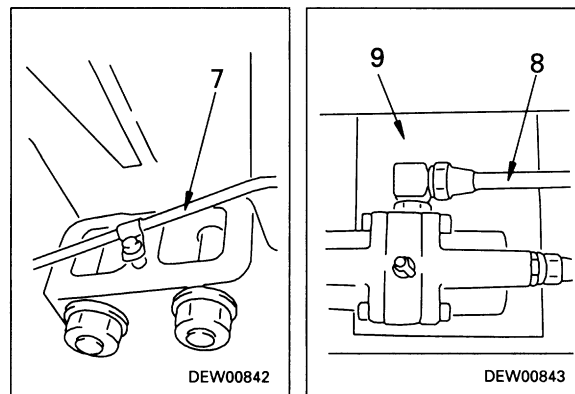
Remove cover (3), then remove O-ring (4). ※ 3

**5. Axle shaft**

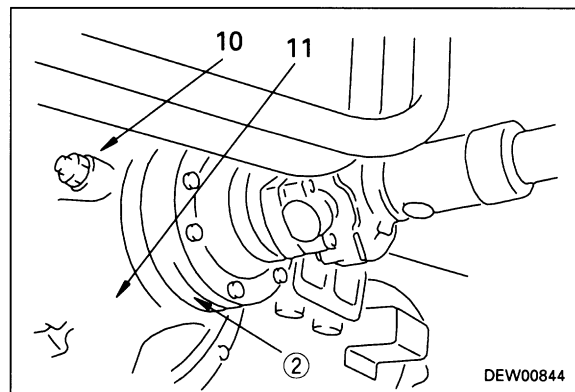
Using forcing screws (Thread dia.=12mm, Pitch=1.75mm), pull out axle shaft (5) approx. 200 mm together with sun gear (6).

**6. Slack adjuster**

- 1) Remove following hydraulic piping clamps.
 - Clamps for tube (7) between slack adjuster and axle.
 - ★ Remove both the left and right clamps.
 - Clamp for tube (8) between slack adjuster and brake chamber.
- 2) Remove mounting bolts of slack adjuster bracket (9), and insert block between slack adjuster and axle.
 - ★ When removing the differential, set the bracket at a height where there is no interference.

**7. Differential**

- 1) Remove 2 mounting bolts of differential (10), and install guide bolts (Thread Dia.=14mm, Pitch=2mm, Length=50mm).
 - ★ Screw in the thread of the guide bolts fully.
 - ★ First, screw in the guide bolts, then remove the remaining mounting bolts.
- 2) Fit lifting tool ② to differential case (11).

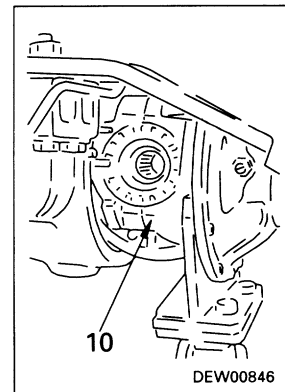
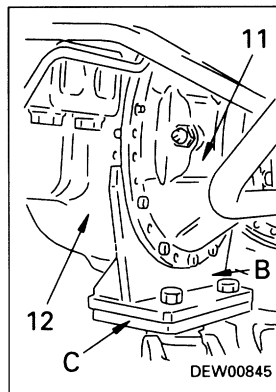


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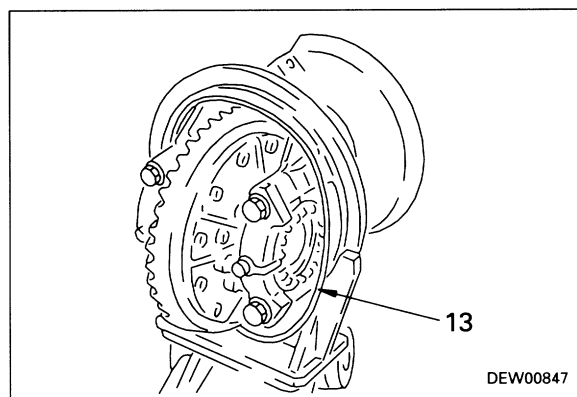
- 3) Install forcing screws, and pull differential (10) along guide bolt to pull it out approx. 20 mm from axle housing. ※ 4
★ Be careful not to damage the O-ring of the differential.
- 4) Install tools **B** and **C** to jack, and insert between differential and axle housing, then install differential (10) to tool **B**.
- 5) Adjust height of lifting tool and jack, and remove differential (10) slowly.



Differential: 235 kg



- 6) Operate jack, and pull differential out from chassis, then remove O-ring (13). ※ 5



INSTALLATION OF FRONT DIFFERENTIAL ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 **Tire mounting nut:**
 $470.7 \pm 49 \text{ Nm}$ ($48.0 \pm 5.0 \text{ kgm}$)

※ 2

- Fit flange bearing (2-1) temporarily.
- Connect front drive shaft (2) to the differential and the center drive shaft ends.
- Tighten flange bearing (2-1) fully.
 - ★ When connecting the drive shaft, clean the mating surface of the spider and the coupling, then install.

 **Mounting bolt:**
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

 **Flange bearing mounting bolt:**
 $549.2 \pm 58.8 \text{ Nm}$ ($56.0 \pm 6.0 \text{ kgm}$)

※ 3

- ★ Use a new part for the O-ring.

※ 4

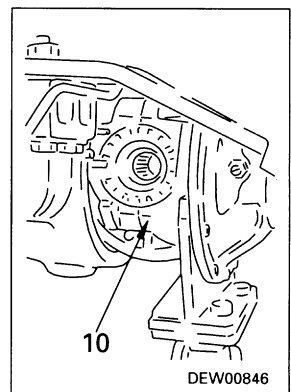
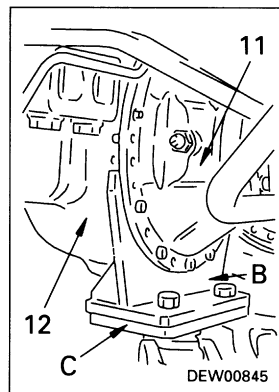
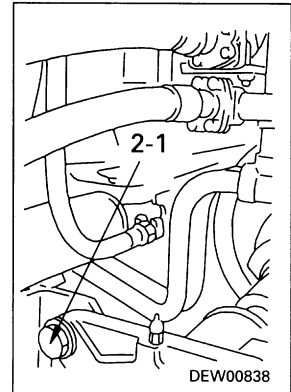
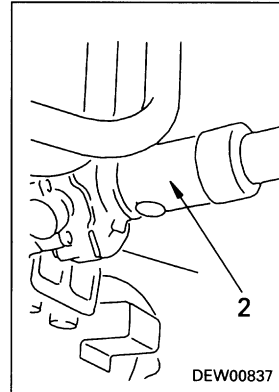
- Adjust the lifting tool and the height of the jack for the differential, and assemble the differential along the guide bolt.
 - ★ Fit the O-ring securely in the groove, and be careful that it does not get caught when installing.
- When the clearance between axle housing (12) and differential (10) is approx. 20 mm, remove installation tool **B** and tighten the mounting bolts uniformly.

 **Differential mounting bolt:**
 $176.5 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2.0 \text{ kgm}$)

 **Differential mounting bolt:**
 $176.5 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2.0 \text{ kgm}$)

※ 5

- ★ Use a new part for the O-ring.



- **Refilling with oil**

- Tighten the drain plug and add oil through the level plug to the specified level.

- ★ Set the machine with the drain plug immediately at the bottom, then add oil through the level plug.



Axle oil: **65 ℓ**

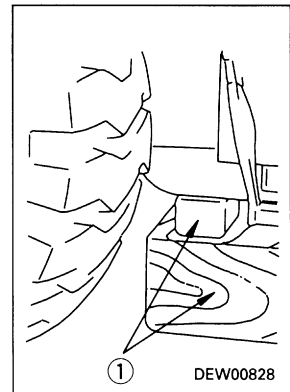
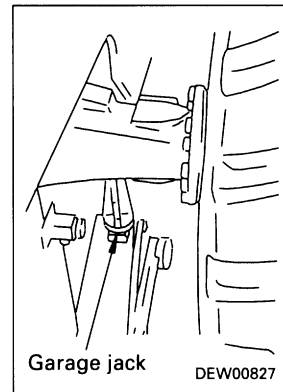
- Add hydraulic oil through the oil filler of the hydraulic tank to the specified level.
- Bleed the air from the brake system and carry out an actuation check.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air.

REMOVAL OF REAR DIFFERENTIAL ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Jack up the axle, and set block ① under the rear frame.



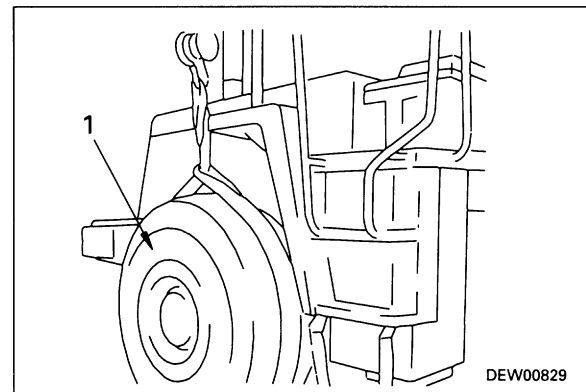
1. Tires, wheels

Sling left and right tires and wheels (1) of rear axle, then remove mounting nuts, and lift off.



Tire, wheel: **550 kg (23.5-25 tire)**
647 kg (26.5-25 tire)

※ 1



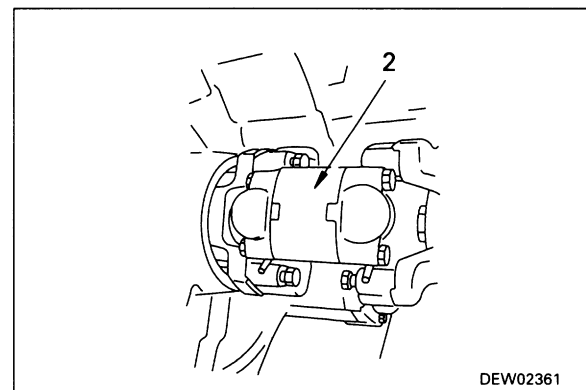
2. Drive shaft

Disconnect rear drive shaft (2) from rear axle.



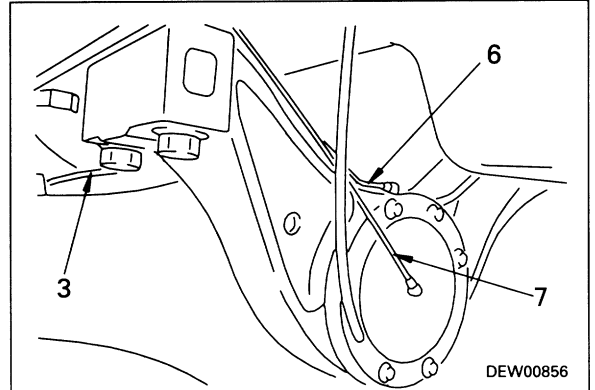
Rear drive shaft: **19 kg**

※ 2

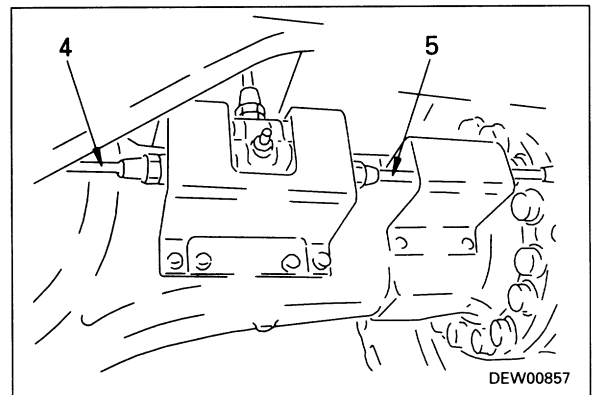


3. Brake piping

- 1) Disconnect hose (3) (between brake valve and slack adjuster) of rear brake piping at slack adjuster end.
- 2) Remove tubes (4) and (5) between slack adjuster and left and right wheel cylinders.
 - ★ Always remove the brake tubes before removing the axle. There is danger that they may be crushed when the axle is lifted off.
 - ★ After disconnecting the piping, fit plugs to prevent the entry of dirt or dust.

**4. Grease tubes**

Disconnect grease tubes (6) and (7) from rear axle support.

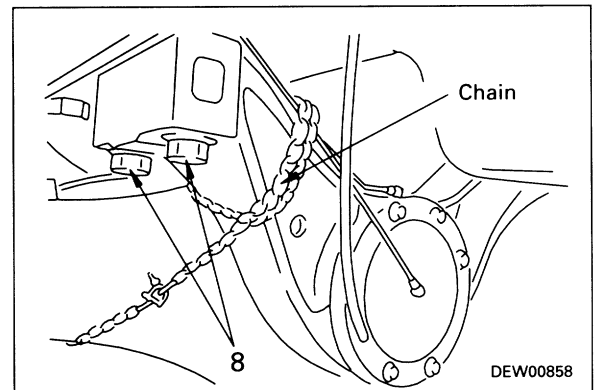
**5. Rear axle support**

- 1) Secure axle support and rear axle with chain.
- 2) Sling rear axle housing with nylon lifting tool, and remove both left and right mounting bolts (8). ※ 3



Rear axle and support: **120kg**

- 3) Pull out both rear axle and support from chassis, then lower. ※ 4
 - ★ Maintain the balance of the axle when lowering it.
 - ★ Remove the axle after removing the fuel tank.
 - ★ For details, see REMOVAL OF FUEL TANK.



6. Draining oil

Set plug (9-1) immediately at bottom, then remove it and drain oil.

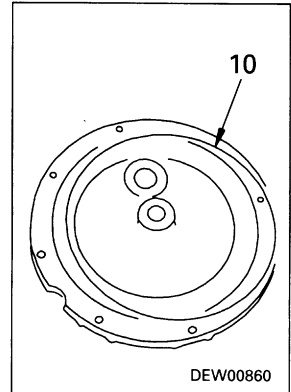
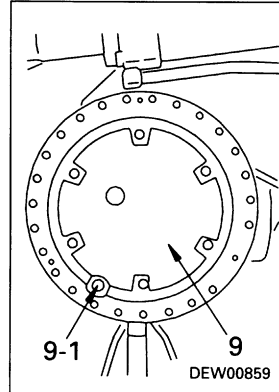


Axle oil: 65 ℓ

7. Cover

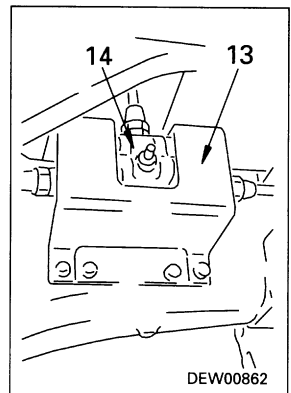
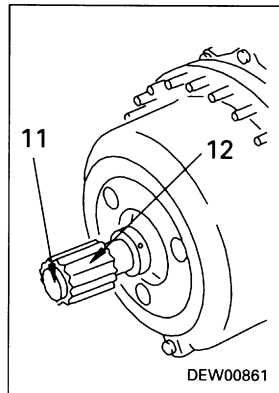
Remove cover (9), then remove O-ring (10).

※ 5

**8. Axle shaft**

Using forcing screws (Thread dia.=12mm, Pitch=1.75mm), pull out axle shaft (11) and sun gear (12) approx. 200 mm.

※ 6

**9. Slack adjuster**

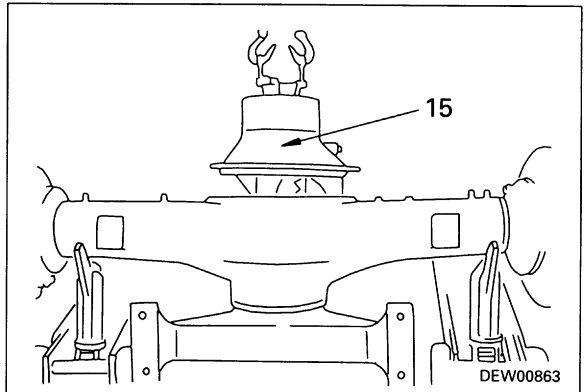
Remove cover (13) from axle, then remove slack adjuster (14) together with bracket.

10. Rear differential

Using forcing screws, lift off rear differential (15), then remove O-ring from rear differential. ※ 7



Rear differential: 244 kg



INSTALLATION OF REAR DIFFERENTIAL ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



Tire mounting nut:

 $470.7 \pm 49 \text{ Nm}$ ($48.0 \pm 5.0 \text{ kgm}$)

- ★ Remove the block from under the rear frame.

※ 2

- ★ Clean the connections and mating surface of the drive shaft.



Drive shaft mounting bolt:

 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

※ 3



Axle support mounting bolt:

 $1029.7 \pm 98.1 \text{ Nm}$ ($105.0 \pm 10 \text{ kgm}$)

- ★ After installing the rear axle, install the fuel tank.
- ★ For details of the installation of the fuel tank, see INSTALLATION OF FUEL TANK.

※ 4

- ★ When installing the rear axle to the chassis, be extremely careful not to damage the bushing and packing of the front support with the differential coupling.
- ★ Secure the rear axle and the support (rear end) with a chain, then install to the chassis.



Rear axle front support portion:

Grease (G2-LI)

※ 5

- ★ Use a new part for the O-ring.

※ 6

- ★ When inserting axle shaft (11), rotate the differential coupling lightly by hand to install.
Do not push it in by force.

※ 7

- ★ Use a new part for the O-ring.
- ★ Fit the O-ring securely in the groove, and be careful that it does not get caught when installing.



Differential mounting bolt:

Thread tightener (LT-2)



Differential mounting bolt:

176.5 ± 19.6 Nm (18.0 ± 2.0 kgm)

• **Refilling with oil**

- Tighten the drain plug and add oil through the level plug to the specified level.
 - ★ Set the machine with the drain plug immediately at the bottom, then add oil through the level plug.



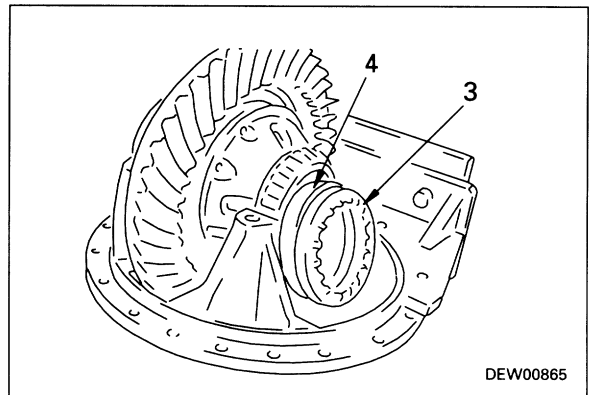
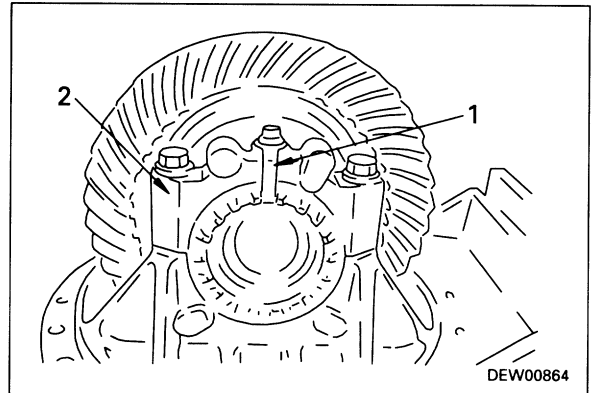
Axle oil: **65 ℓ**

- Add hydraulic oil through the oil filler of the hydraulic tank to the specified level.
- Bleed the air from the brake system and carry out an actuation check.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air.

DISASSEMBLY OF DIFFERENTIAL ASSEMBLY

1. Differential gear

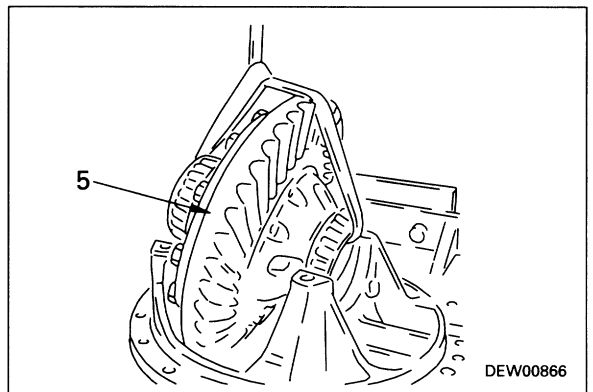
- 1) Remove ring gear adjustment bolt.
- 2) Loosen adjustment ring lock bolt, and remove lock plate (2).
 - ★ Rotate the adjustment ring, and separate the differential gear from the pinion gear.
- 3) Remove bearing cap (2).
 - ★ Check the match marks on the left and right bearing caps. Make new match marks if the old match marks cannot be seen.
- 4) Remove adjustment ring (3) and bearing cup (4).



- 5) Remove differential gear (5) from differential case.
 - ★ The pilot bearing will hit the carrier, so tip it over slightly to the right when lifting it off.

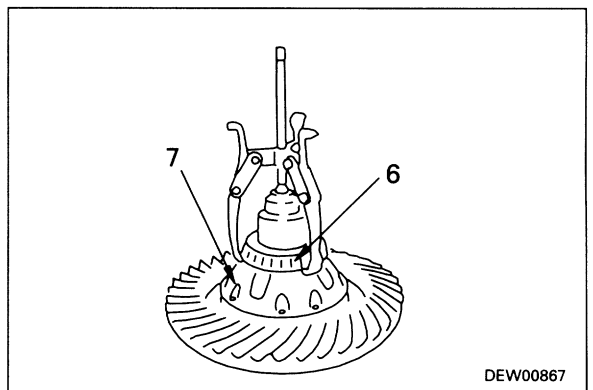


Differential gear assembly: **75 kg**

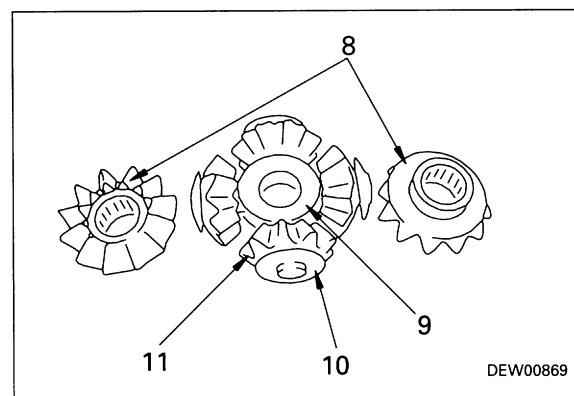
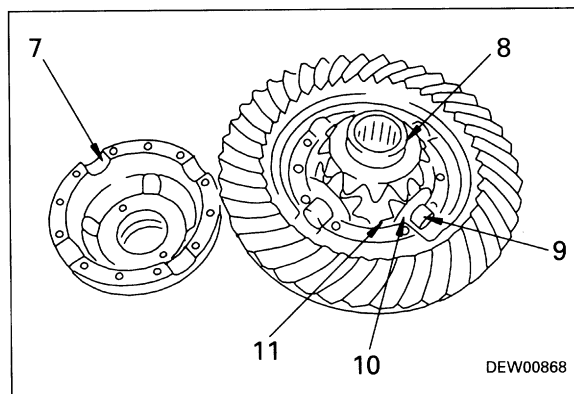


2. Plain half

- 1) Remove bearing (6).
- 2) Remove plain half (7).
 - ★ Check the match marks. Make new match marks if the old match marks cannot be seen.



- 3) Remove side gear (8), cross shaft (9), thrust washer (10), and pinion gear (11).

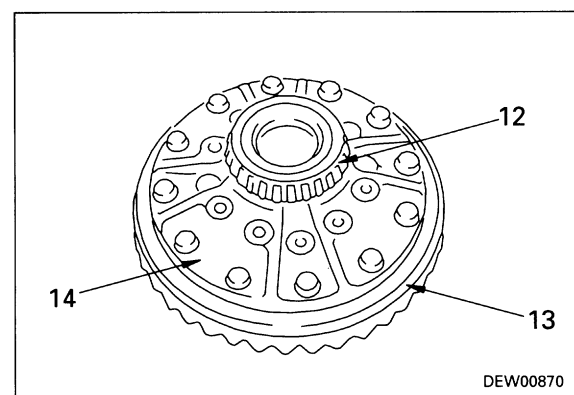


3. Ring gear, flange half

- 1) Remove bearing (12).
- 2) Remove mounting bolts, then remove ring gear (13) and flange half (14).

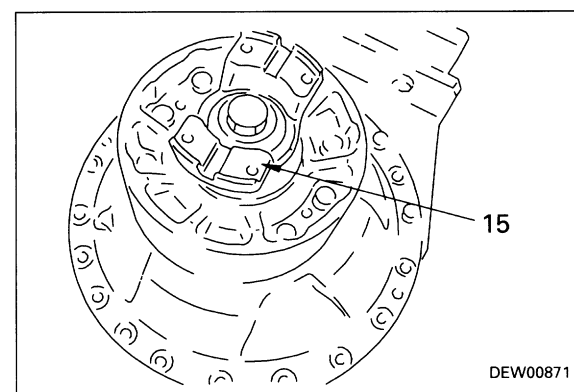
4. Turning over

Turn over differential gear.



5. Pinion gear

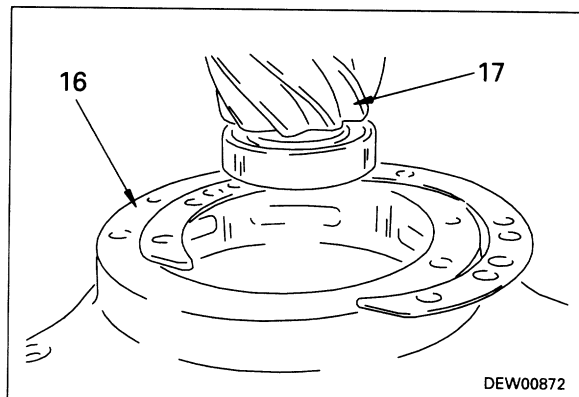
- 1) Loosen mounting bolts of coupling (15).
★ Leave the coupling temporarily fitted.



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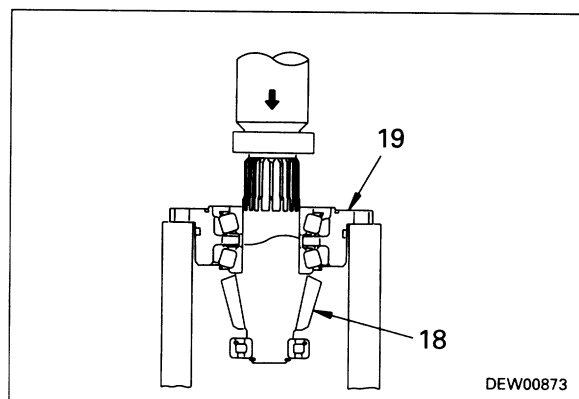
- 2) Remove pinion gear (17) from differential case (16).

★ Check the shim thickness and use as a guide when assembling.

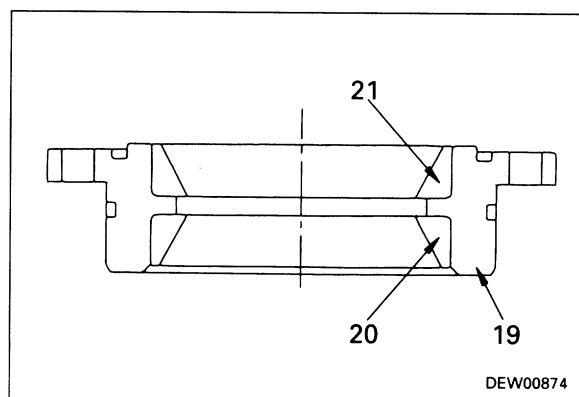


6. Pinion shaft

- 1) Using press, pull out pinion shaft (18).



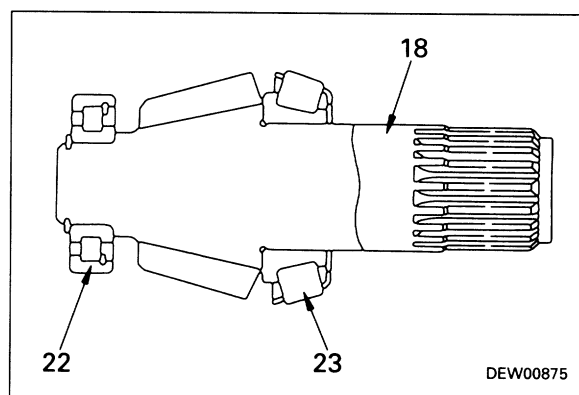
- 2) Remove bearing cups (20) and (21) from cage (19).



- 3) Remove pilot bearing (22) and bearing (23) from pinion shaft (18).

★ Do not remove pilot bearing (22) and bearing (23) unless necessary.

★ Use the same procedure to disassemble the front differential.

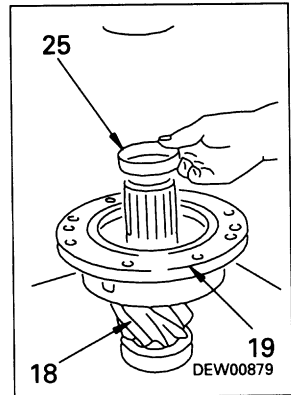
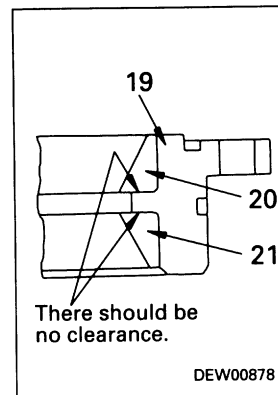
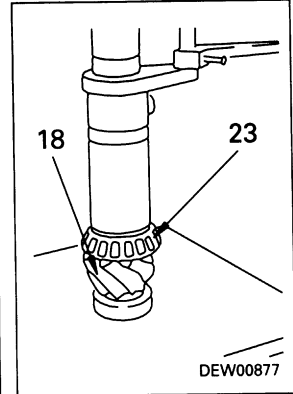
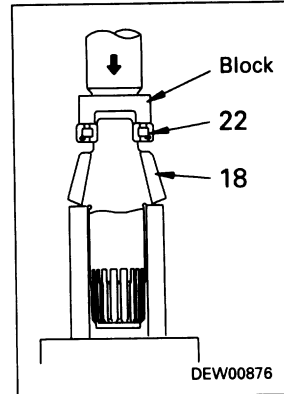


ASSEMBLY OF DIFFERENTIAL ASSEMBLY

- ★ When replacing the pinion or ring gear, always replace them as a set, and be careful not to mix them with other sets.
Replace the flange half and plain half also as a set.

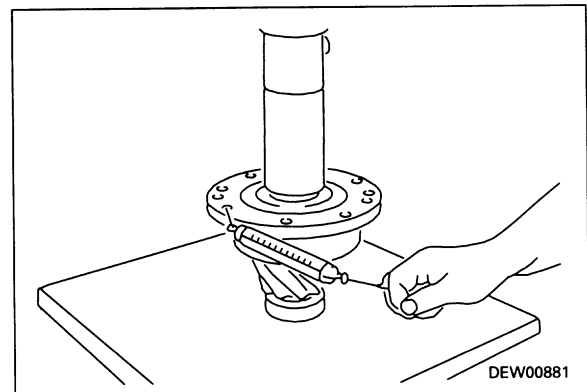
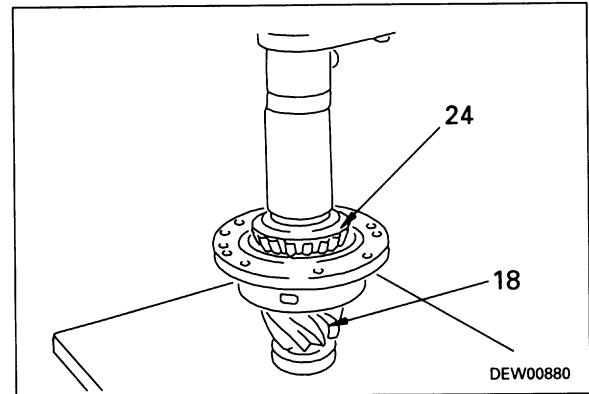
1. Pinion shaft

- 1) Press fit pilot bearing (22) to pinion shaft (18).
- 2) Press fit bearing (23) to pinion shaft (18).
★ Press-fitting force for bearing (23), pilot bearing (22): 49 kN (5 ton)
- 3) Press fit bearing cups (20) and (21) to cage (19).
★ Press-fitting force for bearing cup: 49 kN (5 ton)
 Inside diameter of cage, outside diameter of cup: **Axle oil**
- 4) Assemble cage (19) to pinion shaft (18), then assemble spacer (25).

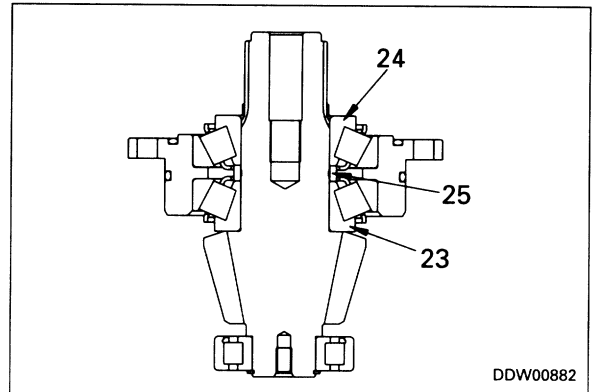


2. Adjusting preload

- 1) Press fit bearing (24) to pinion shaft (18).
- 2) Push bearing with press, and measure rotating force of cage with a spring balance.
 Bearing portion: **Axle oil**
★ Coat the bearing portion fully with oil, and settle it before measuring.
★ Press force: 202 kN (20.6 ton)
★ Reading of spring balance:
Max. 14.7 N (1.5 kg)

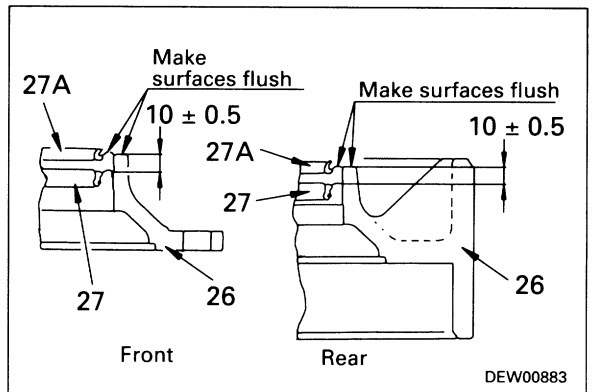


- 3) If the measured value is not within the standard value, replace bearings (23) and (24) and spacer (25) with new parts, then adjust again.
- 4) If the measured value is within the standard value, check that the end play of cage is also within the standard value.
★ End play: Max. 0.212 mm

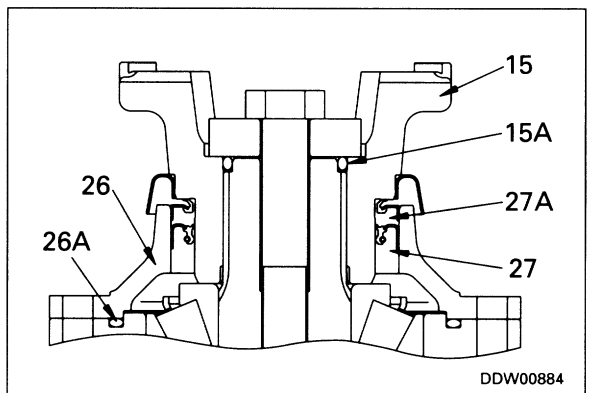


3. Pinion gear

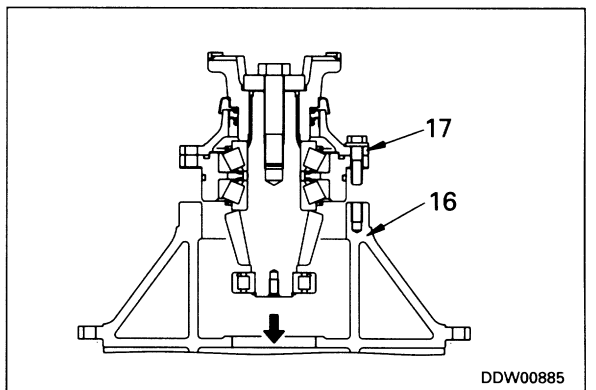
- 1) Press fit oil seal (27) and dust seal (27A) to cage (26).
★ Use new parts for the oil seal and dust seal, and be careful to install facing in the correct direction.
 Lip of oil seal, lip of dust seal:
Grease (G2-LI)
 Press-fitting portion of oil seal, dust seal: **Thread tightener (LT-2)**



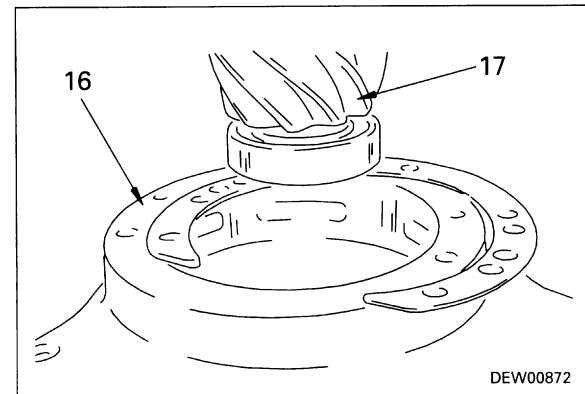
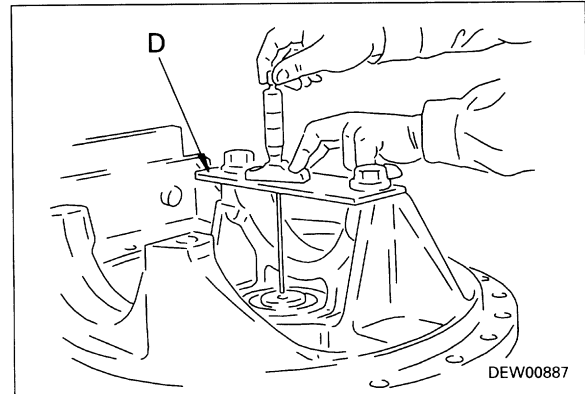
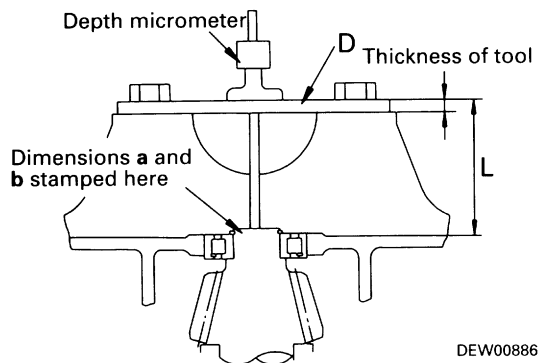
- 2) Install O-rings (26A) and (15A), then install cage (26) and coupling (15).
 Coupling mounting bolt:
 $926.7 \pm 103 \text{ Nm}$ ($94.5 \pm 10.5 \text{ kgm}$)



- 3) Assemble pinion gear assembly (17) to differential case (16) without installing shims.
 Cage mounting bolt:
 $176.5 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2.0 \text{ kgm}$)



- 4) Install tool **D** to differential case (16).
- 5) Measure distance "**L**" from tool **D** to pinion gear, and calculate shim thickness.
 - ★ When replacing the bearing, pinion gear, and ring gear, use the above procedure to adjust the shim.
 - Shim thickness:
Standard value – (**L** – thickness of tool)
 - ★ Standard value: $(243 + a) - (115 + b)$



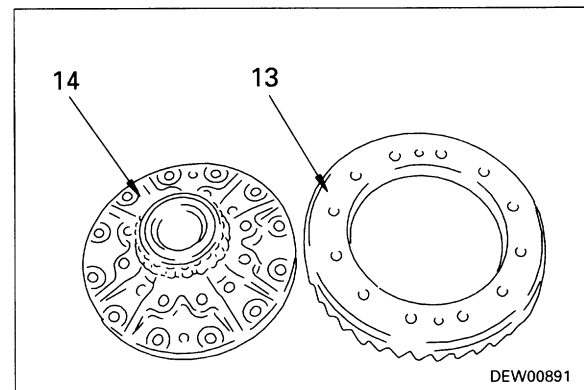
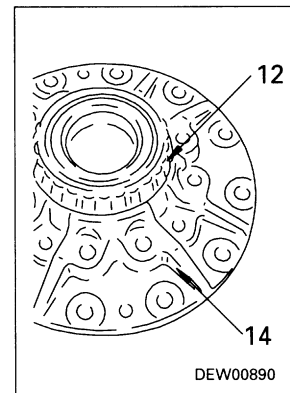
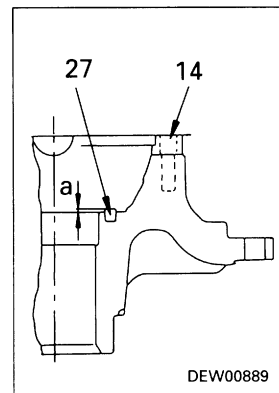
- 6) Assemble pinion gear (17) and shim to differential case (16), and tighten mounting bolts.

 Mounting bolt:
Thread tightener (LT-2)
 Mounting bolt:
 $176.5 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2 \text{ kgm}$)

4. Ring gear

- 1) Knock pin (27) into flange half (14) so that it protrudes distance **a** from case.
 - ★ **a** = 3.5 mm
- 2) Press fit bearing (12) to flange half (14).
- 3) Install flange half (14) to ring gear (13).

 Mounting bolt:
Thread tightener (LT-2)
 Mounting bolt:
 $279.5 \pm 29.4 \text{ Nm}$ ($28.5 \pm 3.0 \text{ kgm}$)

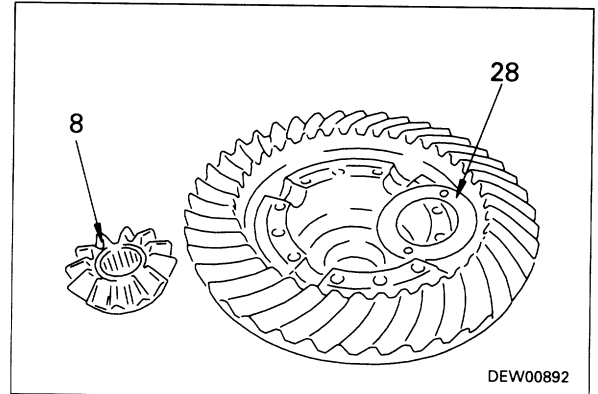


5. Side gear

Install washer (28), and assemble side gear (8).

- ★ Insert the washer securely to the pin inside the case.

Washer: **Grease (G2-LI) (both faces)**

**6. Pinion gear**

Assemble pinion gear (11) and thrust washer (10) to cross shaft (9).

- ★ Align the stopper position of the thrust washer when assembling.

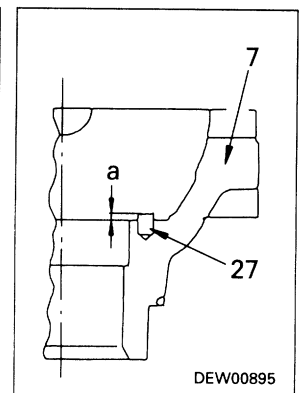
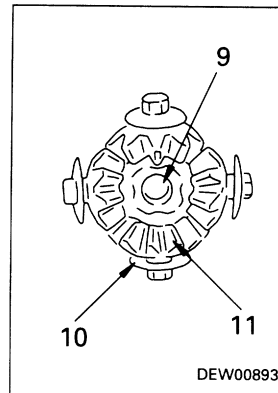
 Thrust washer (gear contact surface):

Axle oil

7. Plain half

- 1) Knock pin (27) into plain half (7) so that it protrudes distance **a** from plain half.

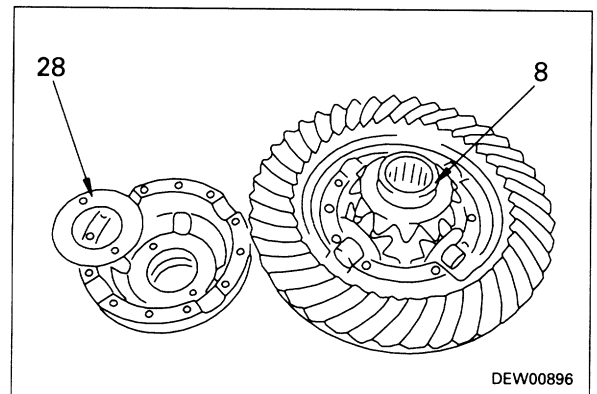
★ **a** = 3.5 mm



- 2) Install washer (28), and assemble side gear (8).

- ★ Insert the washer securely to the pin inside the case.

 Washer: **Grease (G2-LI) (both faces)**



- 3) Press fit bearing (6) to plain half (7).

- 4) Install plain half (7).

- ★ Insert cross shaft (9) securely in the groove of the case and plain half.

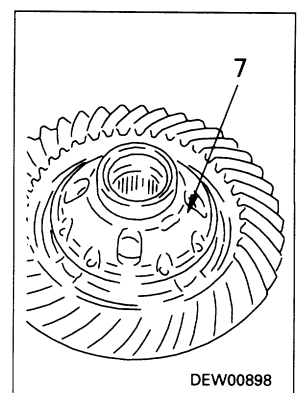
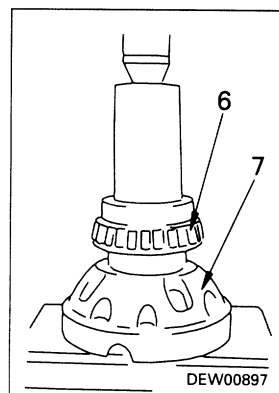
- ★ Check match marks, then set in position and install.

 Mounting bolt:

Thread tightener (LT-2)

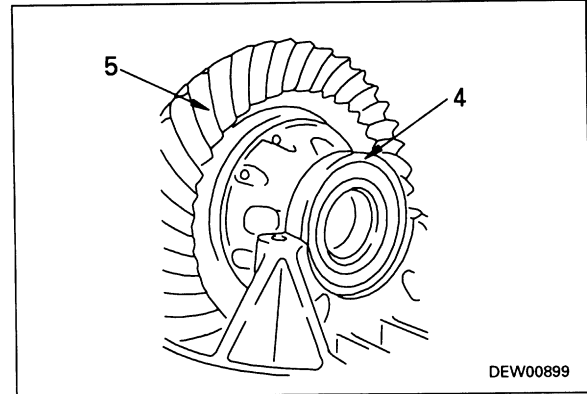
 Mounting bolt:

176.5 ± 19.6 Nm (18.0 ± 2 kgm)

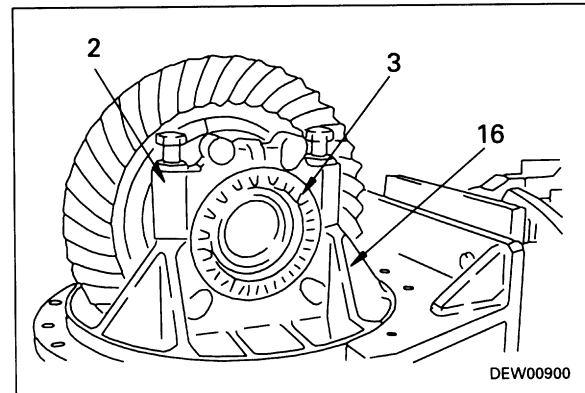


8. Differential gear

- 1) Raise gear (5), and assemble bearing cup (4) to bearing, then install to case.



- 2) Align with thread of differential case (16), and install adjustment ring (3).
- 3) Align match mark and install bearing cap (2).
 - ★ Be careful not to damage the thread of the cap.



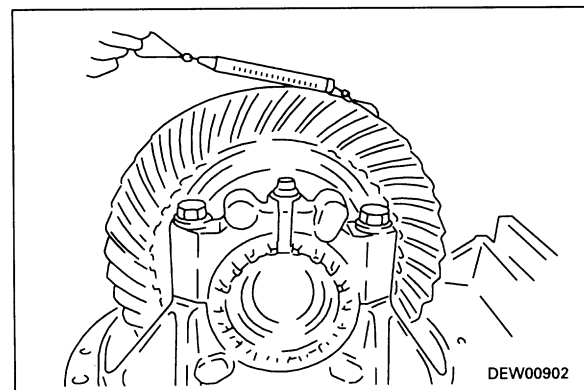
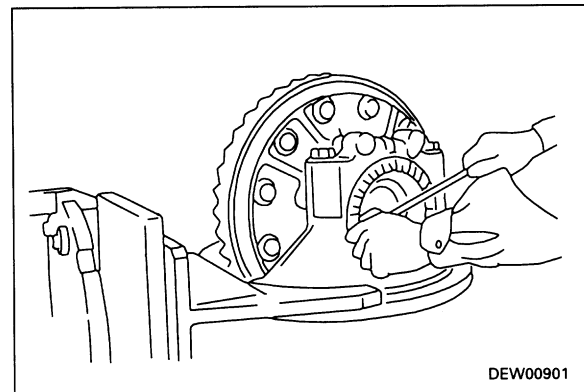
9. Adjusting preload of bearing

- 1) Turn adjustment ring with a bar until ring gear contacts pinion gear, and adjust until there is no more backlash.
 - ★ Rotate the bearing sufficiently to give complete contact between the bearing and other contact parts, then tap the ring gear with a copper hammer.
 - ★ Coat the bearing well with oil.
 - ★ If the adjustment ring on one side is loosened one turn, tighten the adjustment ring on the other side by one turn.
- 2) Install spring balance to ring gear, and measure free rotation torque.

Free rotation torque:

19.6 – 24.5 N (2.0 – 2.5 kg)

 - ★ Target value: 24.5 N (2.5 kg)

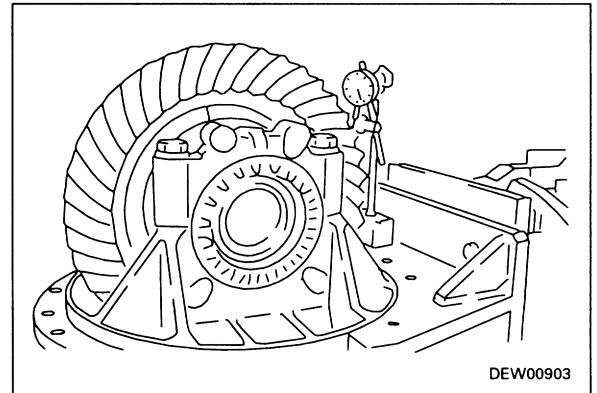


10. Adjusting tooth contact, backlash

• **Adjust the backlash as follows.**

- 1) Adjust the ring gear with the adjustment ring.
 - ★ When doing this, turn the adjustment rings on both sides by the same amount in the same direction.

- 2) Put a dial gauge in contact with tooth face of outside edge of ring gear, then turn adjustment ring to adjust.
 - ★ Keep the pinion gear fixed in position and measure at 3 or 4 places.
 - ★ Backlash: 0.30 – 0.41 mm



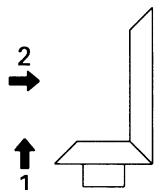
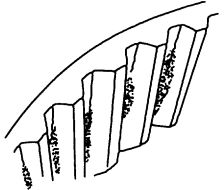
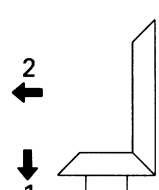
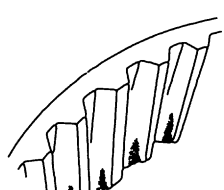
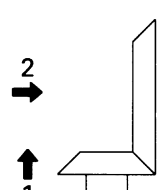
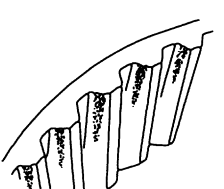
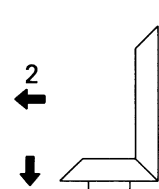
• **Adjust the tooth contact as follows.**

- 1) Mix red lead (minium)with oil, then coat the tooth face of 7 or 8 teeth of the ring gear.
- 2) Rotate the pinion gear forward and in reverse and check the tooth contact.
 - ★ Use the following procedure to judge the tooth contact and carry out adjustment.

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11. Adjusting tooth contact

Coat face of 7 or 8 teeth of bevel gear lightly with red lead (minimum). Hold the bevel gear by hand to act as a brake, rotate the pinion gear forward and backward and inspect the pattern left on the teeth.

Tooth contact	Cause	Procedure for adjustment
 DEW00910	The tooth contact pattern should start from about 5 mm from the toe of the bevel gear and cover about 50% of the length of the tooth. It should be in the center of the tooth height.	Adjust the pinion gear by adjusting the shims at the cage. Adjust the bevel gear in the same way as when adjusting backlash.
 DEW00904	Bevel pinion gear is too far from bevel gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly.  DEW00908
 DEW00905	Bevel pinion gear is too close to bevel gear.	1. Increase shims at pinion gear to move away from bevel gear. 2. Move bevel gear closer to pinion gear and adjust backlash correctly.  DEW00909
 DEW00906	Bevel gear is too close to pinion gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly.  DEW00908
 DEW00907	Bevel gear is too far from pinion gear.	1. Increase shims at pinion gear to move away from bevel gear. 2. Move bevel gear closer to pinion gear and adjust backlash correctly.  DEW00909

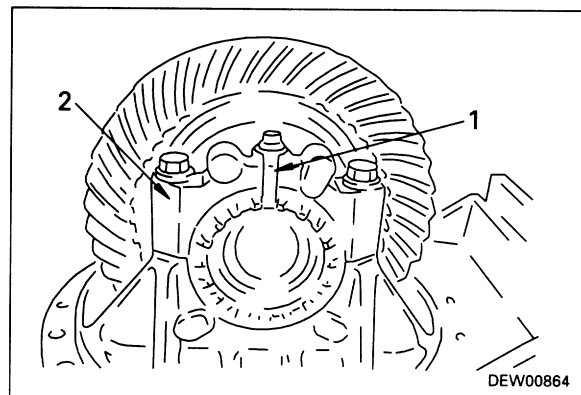
★ When adjusting the bevel gear, do not change the preload of the bearing. Adjust by moving shims between the left and right. Always keep the same total thickness of shims.

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12. Lock plate

After completing the adjustment of the tooth contact, wipe off the red lead and install lock plate (1).

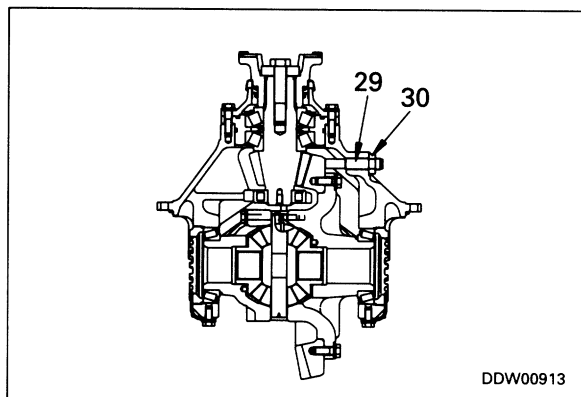
 **kgm** Mounting bolt:
 $176.5 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2 \text{ kgm}$)

**13. Adjusting bolt**

After carrying out all adjustments, screw in bolt (29) until it contacts rear face of the ring gear, then turn back 1/2 turns and tighten locknut (30).

 **kgm** Adjustment bolt: **Gasket sealant (LG-5)**

 **kgm** Locknut: **$225.6 \pm 19.6 \text{ Nm}$ ($23.0 \pm 2.0 \text{ kgm}$)**

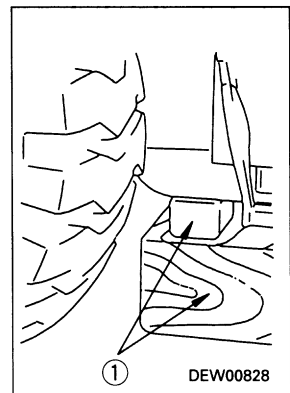
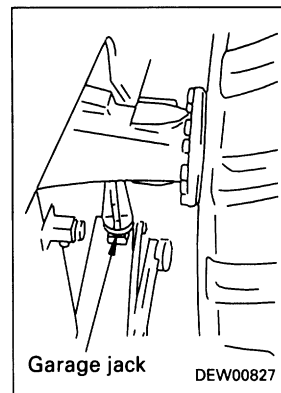


DISASSEMBLY OF FINAL DRIVE ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Jack up the axle, and set block ① under the front frame.



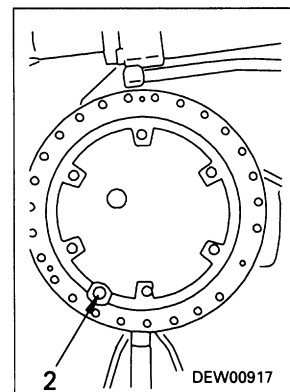
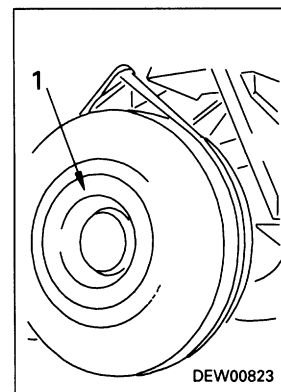
1. Tire, wheel

Jack up axle, and insert support stand under axle, then lift off tire and wheel (1).

★ After removing the tire and wheel, set the support stand under the axle housing portion.



Tire, wheel: **550 kg (23.5-25 tire)**
647 kg (26.5-25 tire)



2. Draining oil

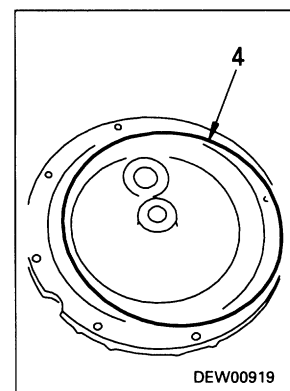
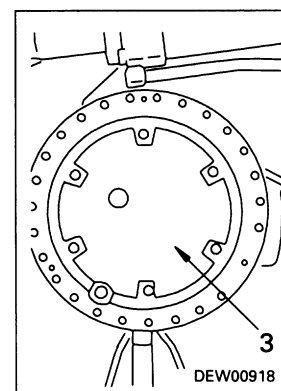
Set plug (2) immediately at bottom, then remove it and drain oil.



Axle oil: **65 ℓ**

3. Cover

Remove cover (3), then remove O-ring (4).



4. Axle shaft

Using forcing screws (Thread dia.=12mm, Pitch=1.75mm), pull out axle shaft (5) approx. 200 mm.

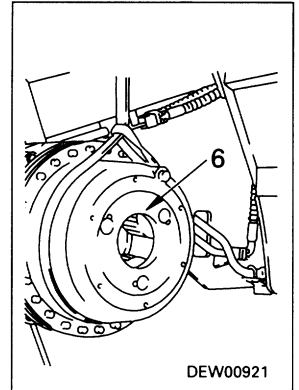
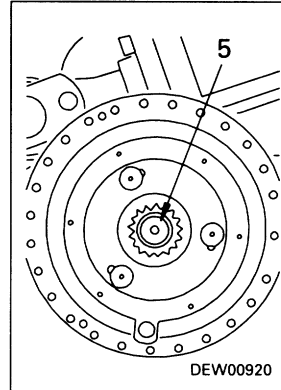
5. Planetary carrier

Remove 3 mounting bolts, and lift off planetary carrier (6).

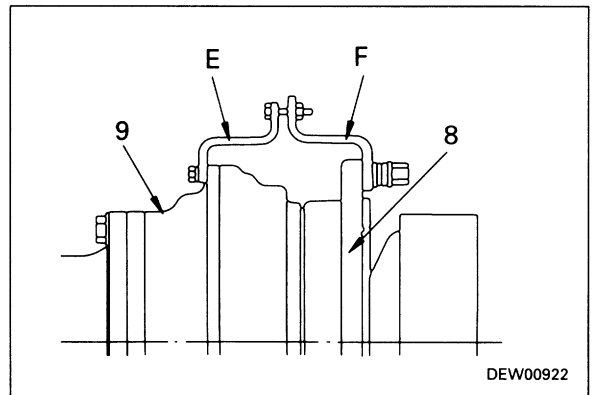
- ★ Make match marks to use as a guide when assembling.
- ★ Be careful of the center of gravity, and remove slowly.



Planetary carrier: **86 kg**

**6. Ring gear**

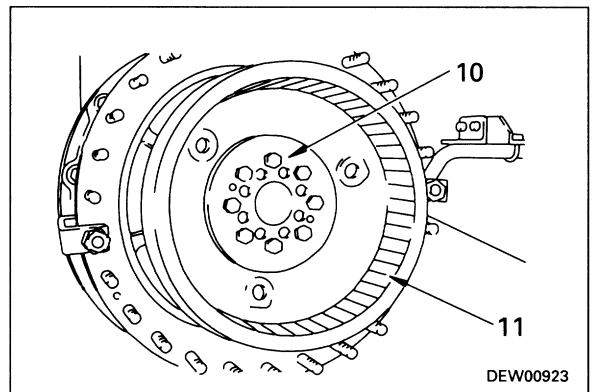
- 1) Using tools E and F, secure wheel hub (8) and brake (9) in position.
 - ★ Install tools E and F at three equally spaced places, then use a washer to adjust the clearance.



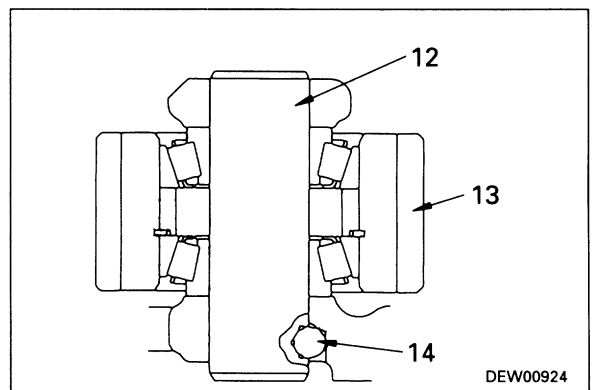
- 2) Remove mounting bolts of retainer (10), then remove ring gear (11).
 - ★ Check the number and thickness of the shims between the retainer and axle housing, and keep in a safe place.



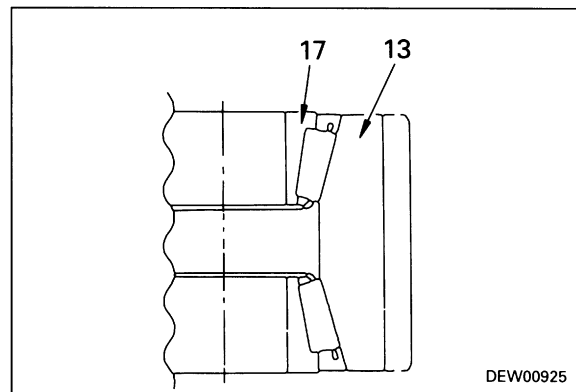
Ring gear: **35 kg**

**7. Disassembly of planetary carrier**

- 1) Using press, pull out shaft (12), and remove pinion gear (13).
 - ★ Lock ball (14) is inserted in the shaft, so be careful not to lose the ball.
 - ★ Write the number on the case and distinguish the parts to prevent the removed parts from being mixed with other parts.

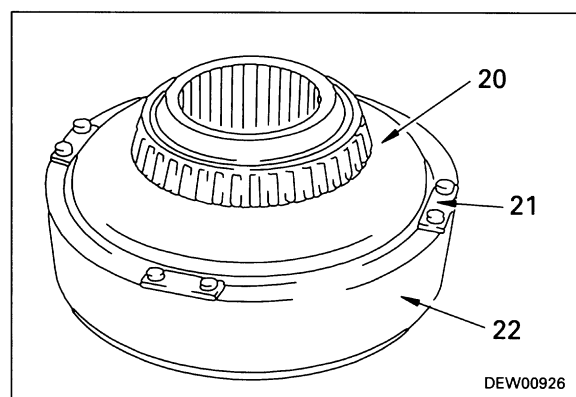


- 2) Remove bearing (17) from pinion gear (13).
 - ★ The bearings are settled in sets, so distinguish them to prevent them from being mixed with other sets.

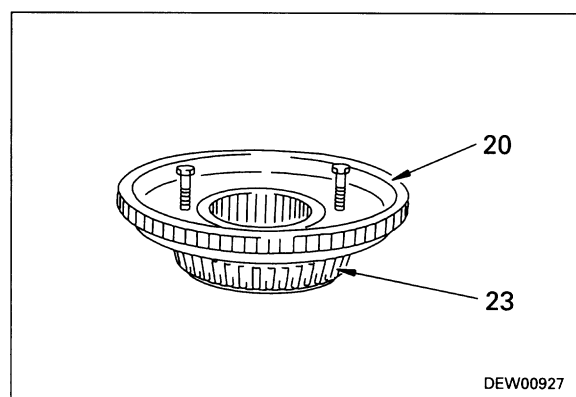


8. Disassembly of ring gear

- 1) Remove lock plate (21) from ring gear hub (20), then remove ring gear (22).



- 2) Using forcing screws (Thread dia.=12mm, Pitch=1.75mm, Length=70mm), remove bearing (23) from ring gear hub (20).

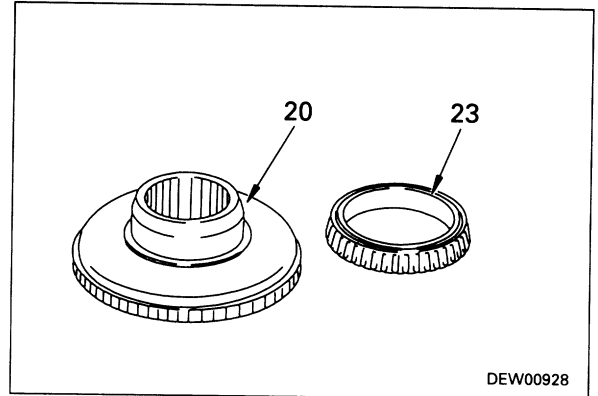


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ASSEMBLY OF FINAL DRIVE ASSEMBLY

1. Assembly of ring gear

- 1) Press fit bearing (23) to ring gear hub (20).
 - ★ After press fitting, check that there is no clearance from the rib.



- 2) Set ring gear hub (20) to ring gear (22), and install lock plate (21).
 - ★ Assemble the lock plates with the wide lock plates on the inside.
 - ★ Remove all oil and grease from the tap holes for the bolts.

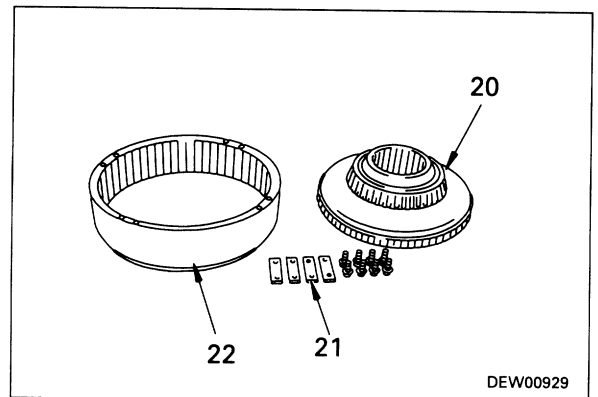
Mounting bolt:

Thread tightener (LT-2)



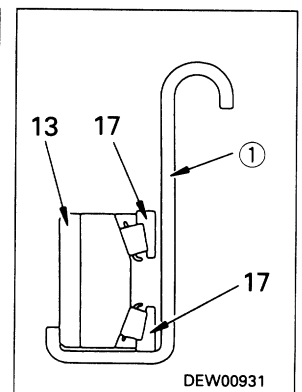
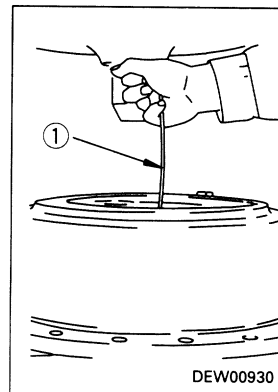
Mounting bolt:

$31.4 \pm 3 \text{ Nm}$ ($3.2 \pm 0.3 \text{ kgm}$)



2. Assembly of planetary carrier

- 1) Assemble bearing (17) to pinion gear (13), and insert from bottom of carrier, then use lifting bar ① to set to carrier mount.
 - ★ There are 3 pinion gears. Assemble them all to the carrier.

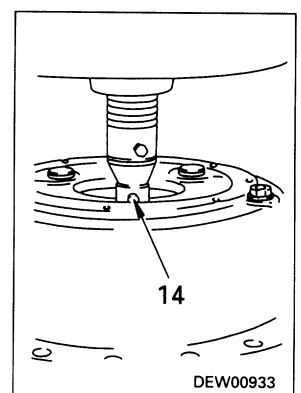
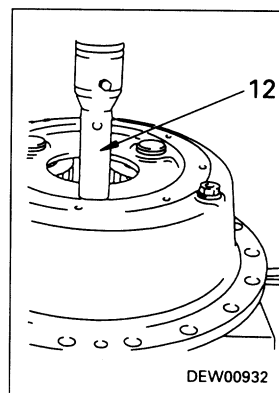


- 2) Align carrier and gear hole, then press fit cooled shaft (12).

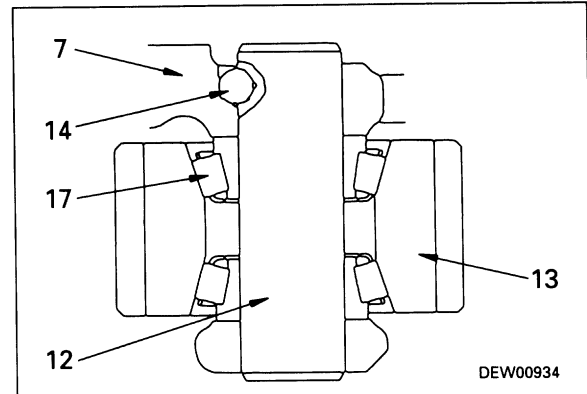


Do not touch the cooled shaft directly by hand.

- ★ Press fit so that the lock ball hole is on the outside. Stop just before the hole and align the hole.
- ★ Cool the shaft at -30°C for 20 minutes.

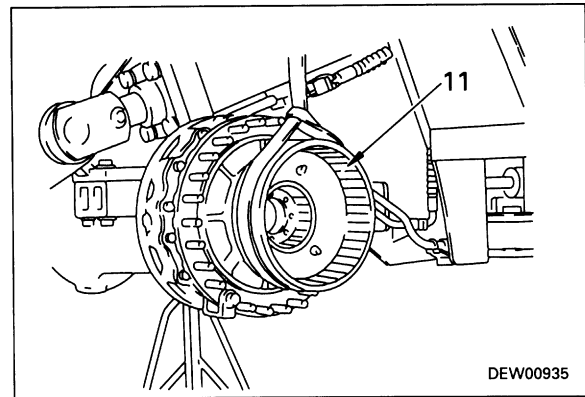


- 2) Assemble lock ball (14) to shaft, and press fit shaft again.
 ★ After press fitting the shaft, check that the gear rotates smoothly.



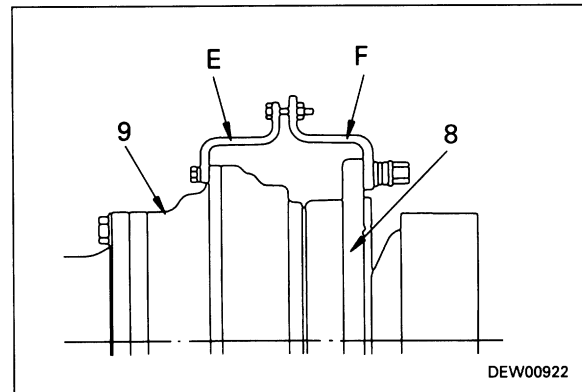
3. Ring gear

- 1) Raise ring gear (11), and insert in axle housing.
 ★ Align the spline groove and insert slowly.

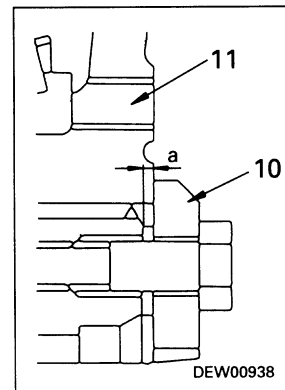
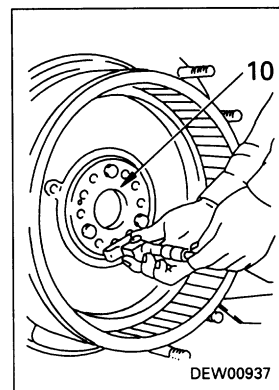


- 2) Tighten retainer (10) temporarily with 3 mounting bolts, and remove tools **E** and **F**.
 ★ Remove all oil and grease from the retainer mounting bolt holes.
 ★ Tighten the retainer temporarily without fitting any shim.
 ★ Rotate wheel hub (8) to settle the bearing, and tighten so that the torque is constant.

 **kgm** Retainer mounting bolt:
 $72.6 \pm 1 \text{ Nm}$ ($7.5 \pm 0.1 \text{ kgm}$)



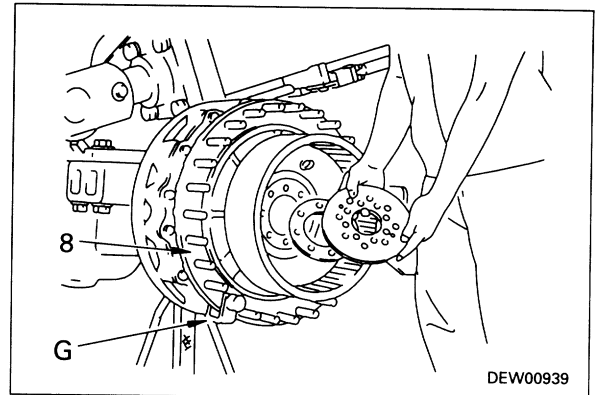
- 3) Use depth micrometer from measurement hole of retainer (10) to measure clearance **a** between end face of retainer and end face of housing.
 ★ Measure at two places and take the average.
 ★ Shim thickness = Clearance **a** + 0.3 mm.
 • Select the shim thicknesses to give the minimum number of shims.
 • Shim thickness: 1.0 mm, 0.5 mm, 0.2 mm, 0.05 mm



- 4) Install tool **G** to brake and wheel hub (8), then remove retainer, install selected shim, and install retainer again.

- ★ When assembling the shim, always install tool **G** first.
- ★ Rotate wheel hub (8) and tighten uniformly until the torque is the specified torque.

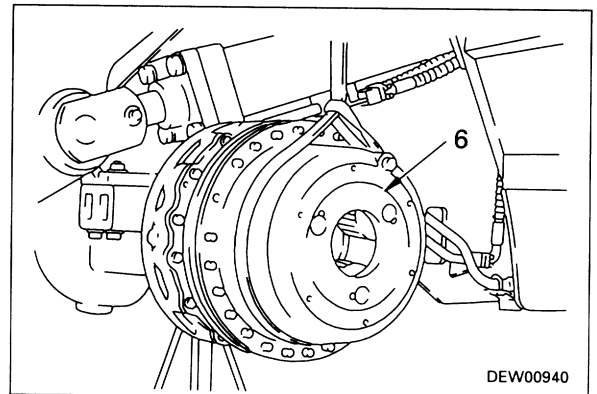
 Mounting bolt: **Thread tightener (LT-2)**
 Mounting bolt: **176.5 ± 19.6 Nm (18.0 ± 2.0 kgm)**



4. Planetary carrier

Assemble O-ring to wheel hub (8), then raise planetary carrier (6), and install.

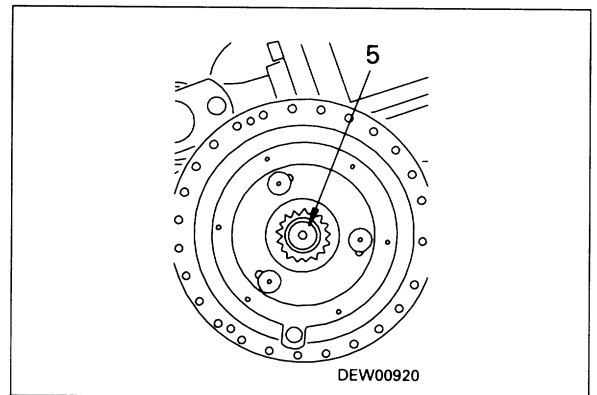
- ★ Align the mounting holes and install slowly so that the O-ring does not come out of position.



5. Axle shaft

Install axle shaft (5).

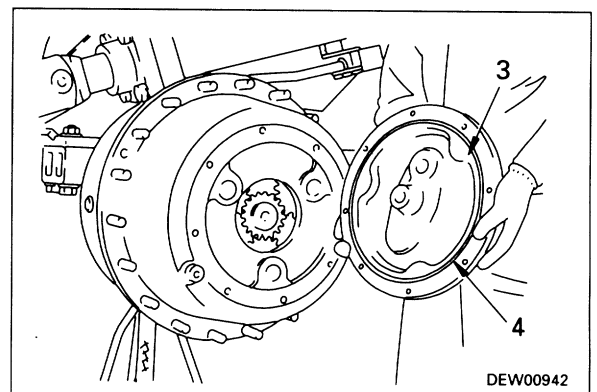
- ★ If the sun gear is not aligned, rotate the wheel hub to align the position.



6. Cover

Insert O-ring (4) in groove of cover, and install cover (3).

 Mounting bolt: **112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)**



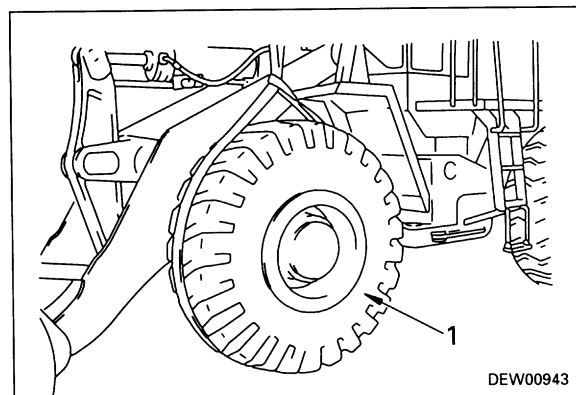
7. Tire, wheel

Install tire and wheel, then remove support.

 **kgm** Mounting nut:

$470.7 \pm 49 \text{ Nm}$ ($48.0 \pm 5.0 \text{ kgm}$)

(Width across flats: 30 mm)

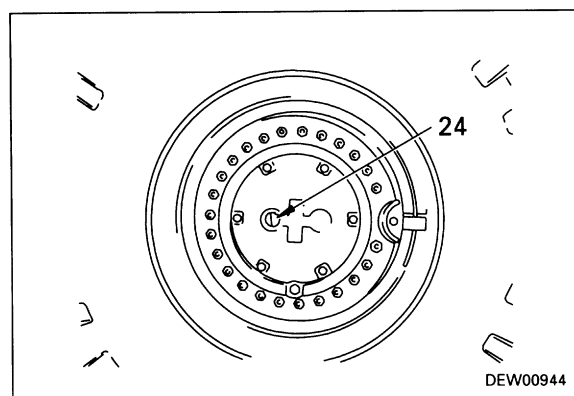
**8. Refilling with oil**

Tighten drain plug and add oil through level plug (24) to specified level.

- ★ Set the machine with the drain plug immediately at the bottom, then add oil through the level plug.



Axle oil: 65 ℓ (both front and rear)



REMOVAL OF CENTER HINGE PIN

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing.

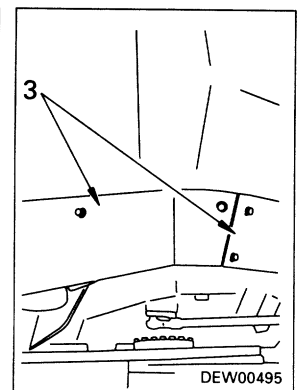
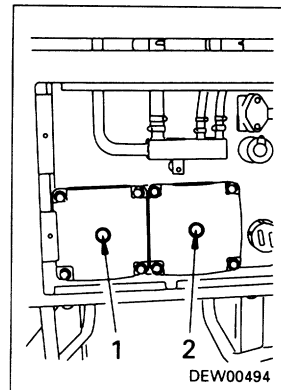
! Operate the bucket control lever at least 40 times TILT ↔ HOLD to release the pressure inside the accumulator.

! Depress the brake pedal at least 17 times to release the pressure inside the brake accumulator.

! When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

1. Covers

Remove covers (3) at bottom of cab.



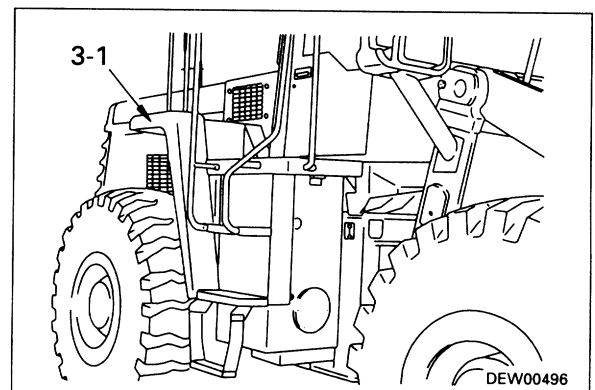
2. Ladders

Remove left and right ladders (3-1).



Ladder rail (right): **64.5 kg**

Ladder rail (left): **59.5 kg**

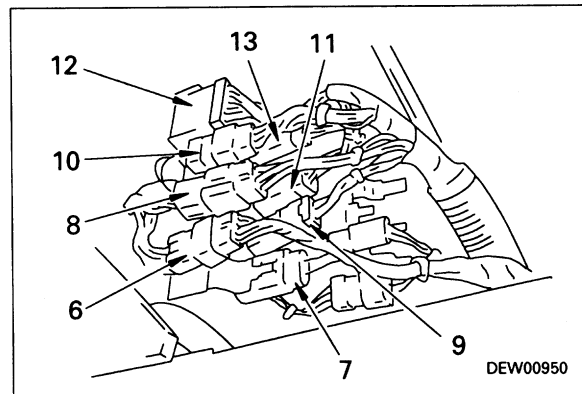
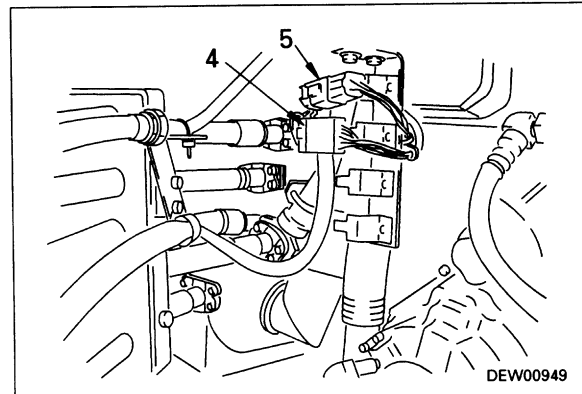
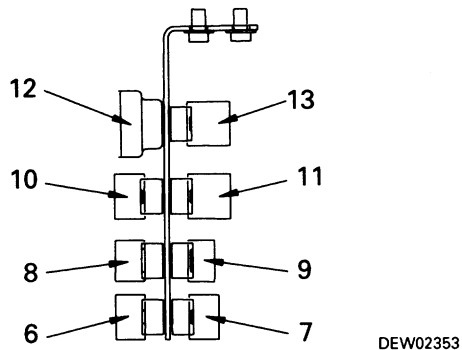


DISASSEMBLY AND ASSEMBLY**CENTER HINGE PIN****3. Electric wiring**

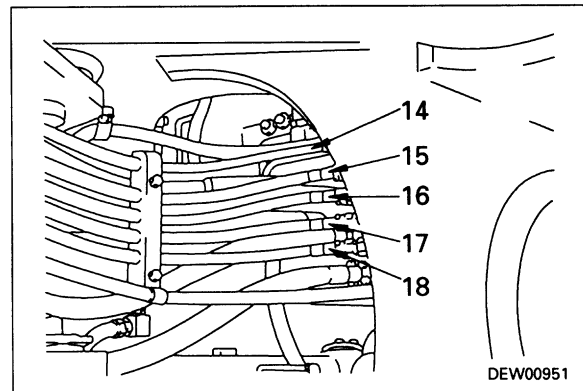
Disconnect the following electric wiring.

- 1) Disconnect front frame wiring FR1 (4) and FR2 (5).
- 2) Disconnect transmission wiring TL1 (6) and TL2 (7).
- 3) Disconnect floor wiring harnesses LR5 (8), LR6 (9), LR3 (10), LR4 (11), LR1 (12), and LR2 (13).

★ After disconnecting the connectors, mark with a tag to distinguish when installing.

**4. PPC piping**

- 1) Disconnect hoses (14), (15), (16), (17), and (18) between PPC valve and main control at connection inside front frame.

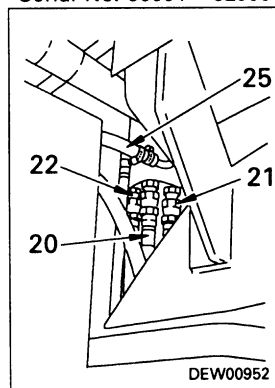


- 2) Disconnect hose (20) of PPC valve port "P2", hose (21) of port "P4", hose (22) of port "P3", and hose (23) of port "P1" at valve end.
 - Disconnect hose (24) between PPC accumulator and PPC valve at valve end.
 - Disconnect hose (25) of PPC valve drain port at valve end.

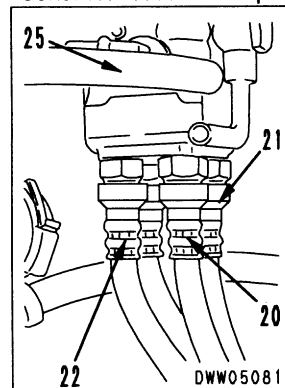
★ After disconnecting the hoses, mark with a tag to distinguish when installing.

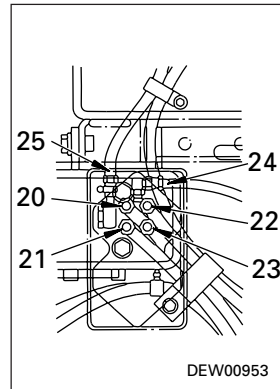
★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

Serial No. 50001 – 52999



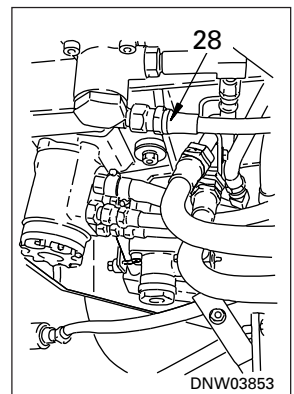
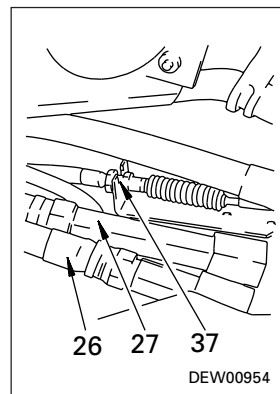
Serial No. 53001 and up



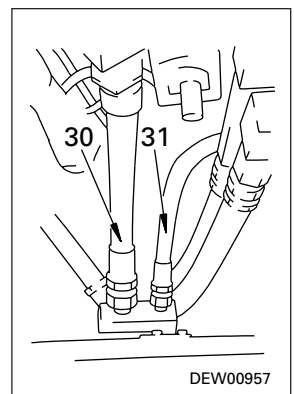
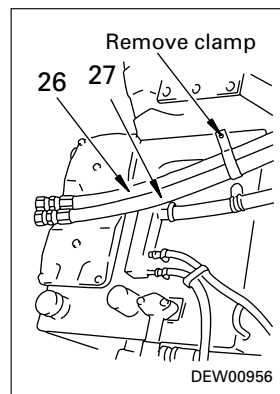


5. Brake piping

- 1) Disconnect hoses (26) and (27) between right brake valve and accumulator at pedal end.
★ Remove 2 brake hose clamps under floor board.
- 2) Disconnect hose (28) between left brake valve and accumulator at pedal end.



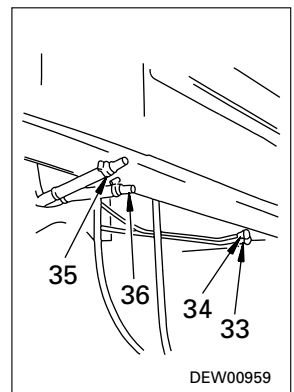
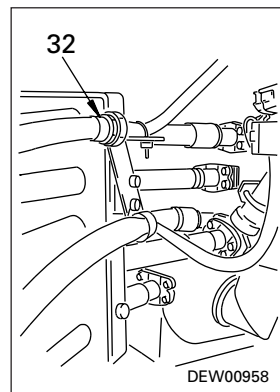
- 3) Disconnect right brake valve drain hose (30) and left brake valve drain hose (31) at rear frame.



- 4) Disconnect hose (32) between front brake and right brake valve at center hinge pin.

6. Air conditioner piping

- 1) Disconnect hose (33) between compressor and air conditioner unit at unit end. ※ 1
- 2) Disconnect hose (34) between receiver and air conditioner unit at unit end. ※ 2
- 3) Disconnect heater piping (35) and (36) at air conditioner unit end.



7. Accelerator cable

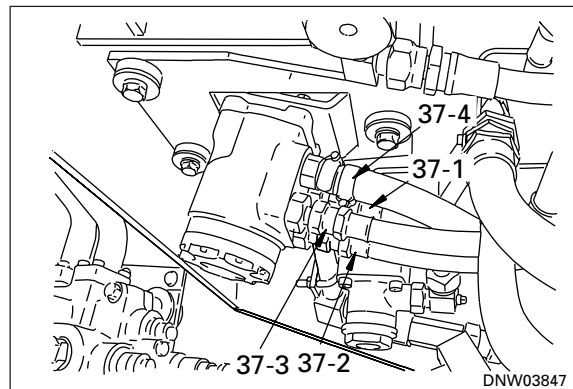
※ 3

- Disconnect accelerator cable (37) under pedal.
★ Remove the cable clamp under the floor board.

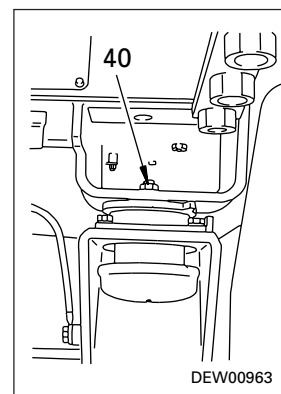
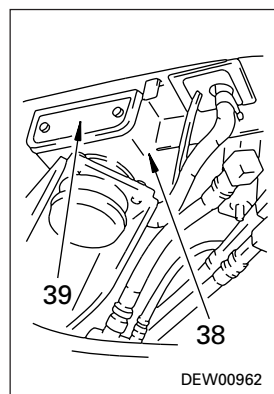
8. Steering valve piping

Disconnect following pipings from steering valve.

- 1) Hose (37-1) between steering valve (L port) and stop valve (L.H.)
- 2) Hose (37-2) between steering valve (R port) and stop valve (R.H.)
- 3) Hose (37-3) between steering valve (P port) and accumulator charge valve
- 4) Hose (37-4) between steering valve (T port) and drain line

**9. Cab, floor board**

- 1) Remove mounting cover (39) of floor board (38), then remove 4 viscous damper mounting nuts (40) holding floor board.

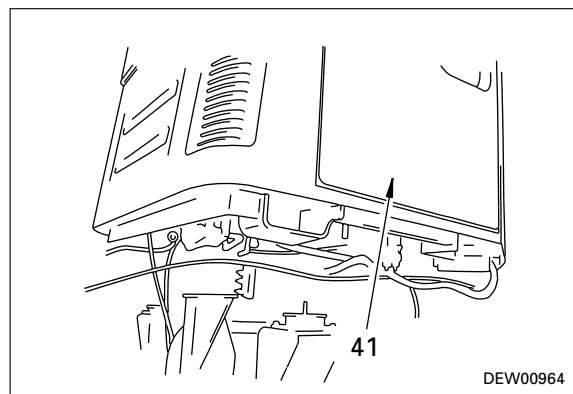


- 2) Fit lifting tool to cab (41) and lift off cab.

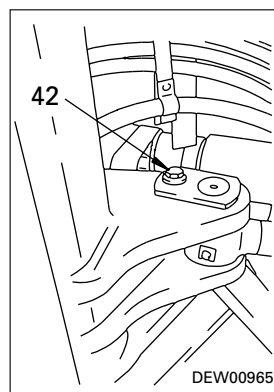
- ★ Raise the cab slowly and check that all parts have been removed before lifting off.



Cab, floor assembly: **1,100 kg**

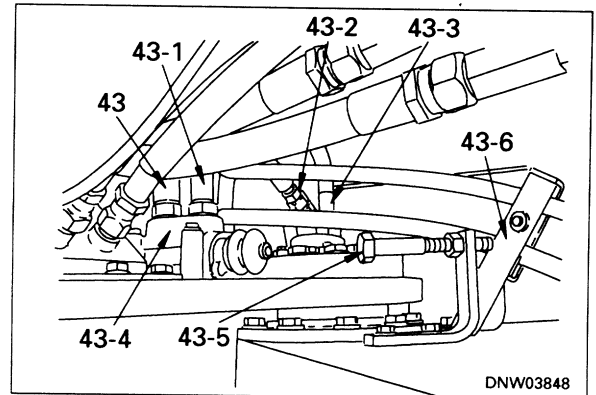
**10. Steering cylinder pins**

- 1) Remove left and right steering cylinder pins (42) at rod end.

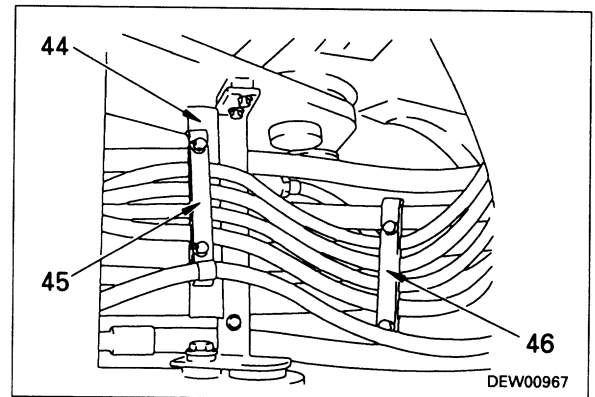


11. Stop valve

- 1) Disconnect hose (43) between steering valve and stop valve (R.H.), and hose (43-1) between stop valve (R.H.) and steering valve at stop valve side.
- 2) Disconnect hose (43-2) between steering valve and stop valve (L.H.), and hose (43-3) between stop valve (L.H.) and steering valve at stop valve side.
- 3) Remove stop valve (left and right side) (43-4) and stop bolt (left and right side) (43-5).
- 4) Remove fitting bracket (43-6) for hose between steering valve and stop valve at frame side.

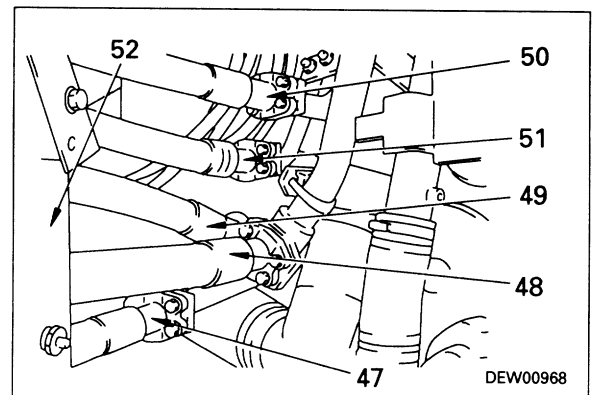
**12. PPC hoses**

Remove PPC hoses, bracket (44), and clamps (45) and (46) at center pin, and move towards rear frame.

**13. Hydraulic hoses**

※ 6

- 1) Disconnect hose (47) between steering valve and cooler.
- 2) Disconnect hose (48) between hydraulic pump and main control valve.
- 3) Disconnect main control valve drain hose (49).
- 4) Disconnect hose (50) between switch pump and steering valve and hose (51) between steering pump and steering valve.
- 5) Remove hose mount bracket (52).
 - ★ After disconnecting the hoses, mark with a tag to distinguish when installing.
 - ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

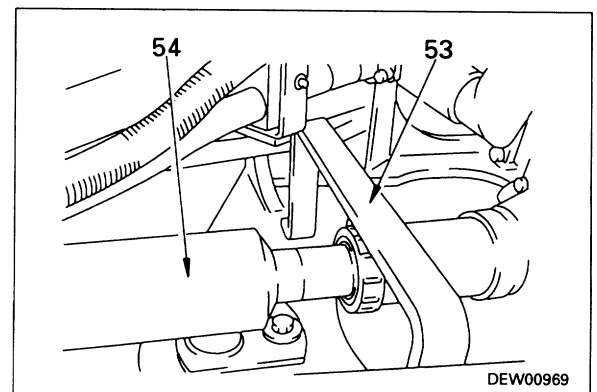
**14. Drive shaft**

※ 7

Remove drive shaft guard (53), disconnect center drive shaft (54) at flange bearing end, then move drive shaft to side.

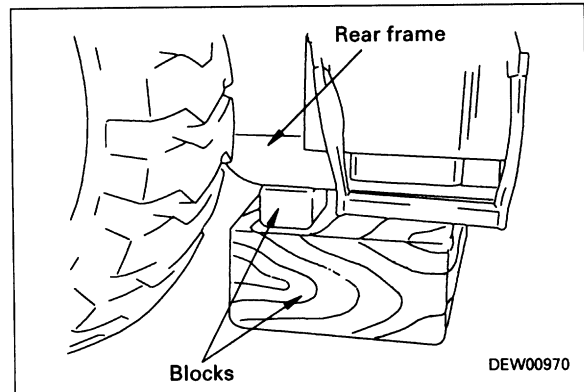


Center drive shaft: **36 kg**

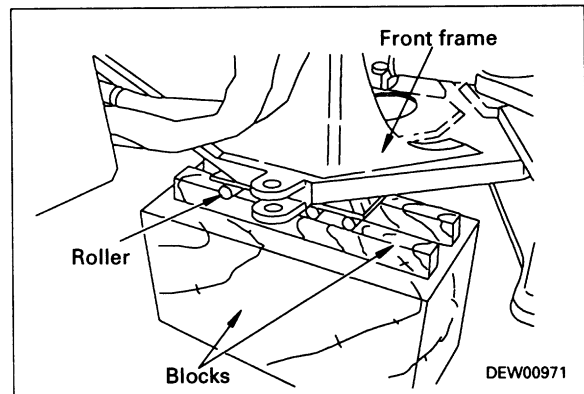


15. Supporting frame

- 1) Jack up rear frame to adjust height, then insert blocks.
 - ★ Insert blocks under the rear frame on the left and right sides.



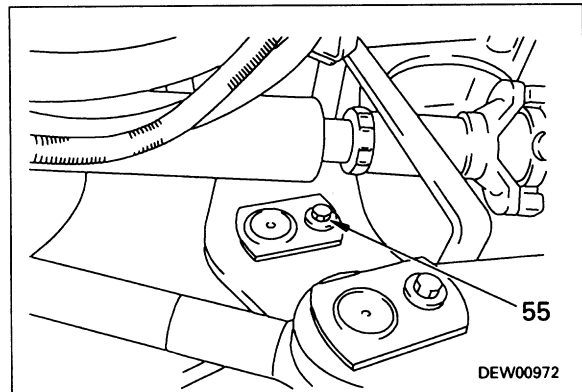
- 2) Jack up front frame to adjust height, then insert blocks. Put rollers between block and frame so that front frame can be pulled out.
 - ★ Insert blocks under the front frame on the left and right sides.



16. Lower hinge pin

※ 8

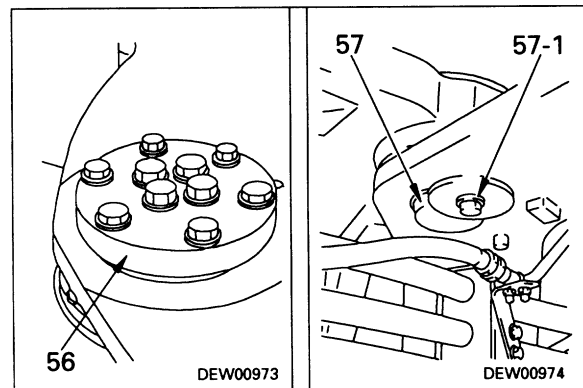
Remove lock bolt, then remove lower hinge pin (55).



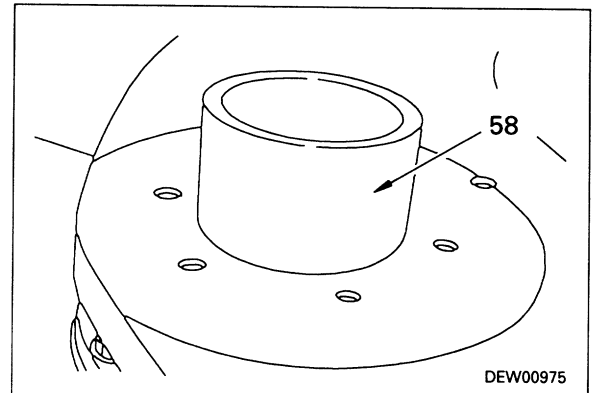
17. Upper hinge pin

※ 9

- 1) Remove mounting bolts, then remove retainer (56).
 - ★ Check the number and thickness of the shims between the retainer and frame, and keep in a safe place.
- 2) Remove lock bolt (57-1), then adjust height and remove upper hinge pin (57).
 - ★ Adjust the height carefully and make it possible to remove the pin by hand.



- 3) Remove spacer (58).

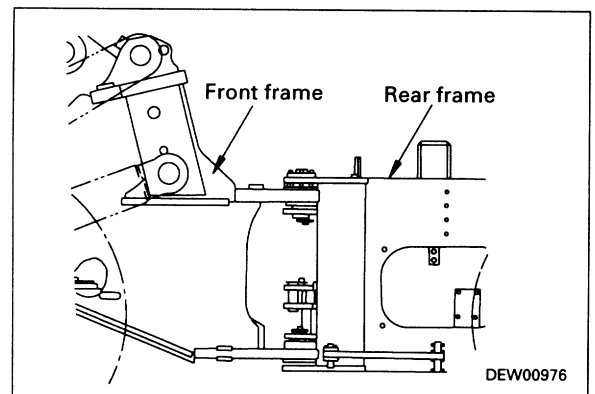


18. Disconnection of frame

※ 10

Pull out front frame towards front slowly, and disconnect frame.

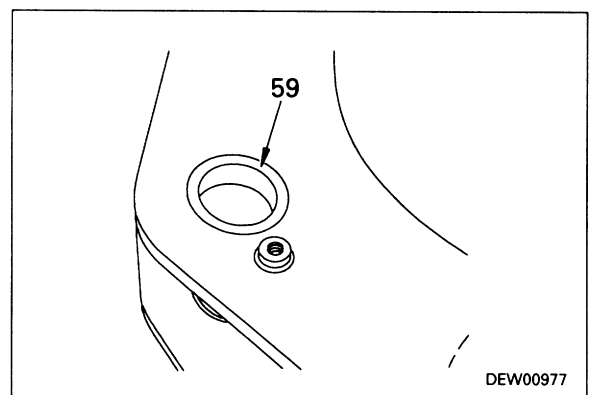
- ★ Be careful that the spacer at the bottom of the upper hinge does not catch in the rear frame.
- ★ Be careful of the balance when disconnecting.
- ★ Be careful not to forget to disconnect any part.
- ★ Remove the safety bar.



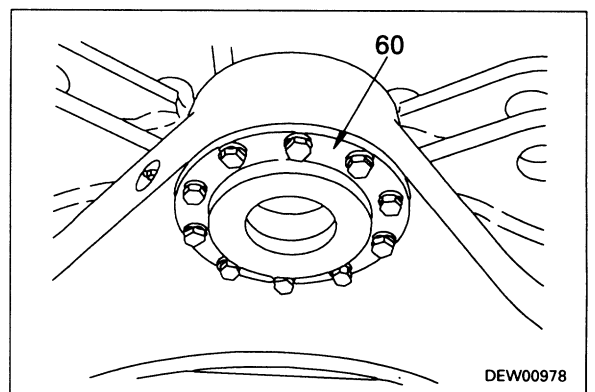
19. Lower hinge

※ 11

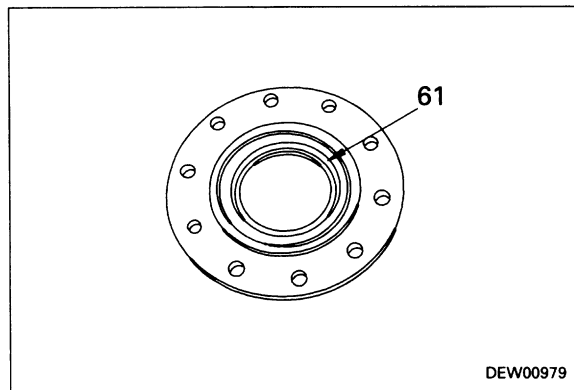
- 1) Pull out bushing (59) from rear frame.
 - ★ Remove the lower hinge bushings at both the top and bottom.



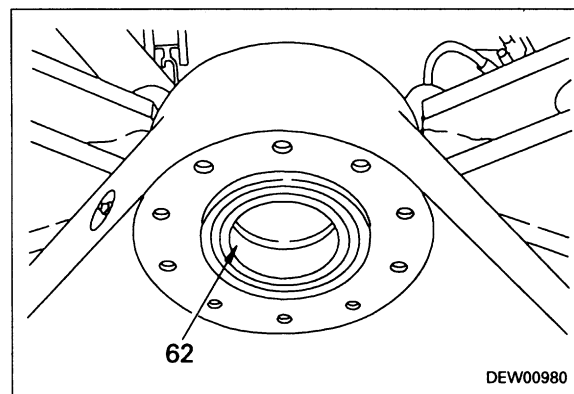
- 2) Remove retainer (60).
 - ★ Check the number and thickness of the shims between the retainer and axle housing, and keep in a safe place.



- 3) Remove dust seal (61) from retainer.
★ Remove the dust seal at the frame end also.



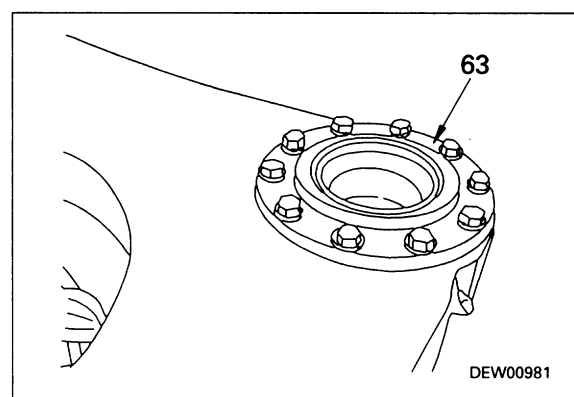
- 4) Remove bearing (62).



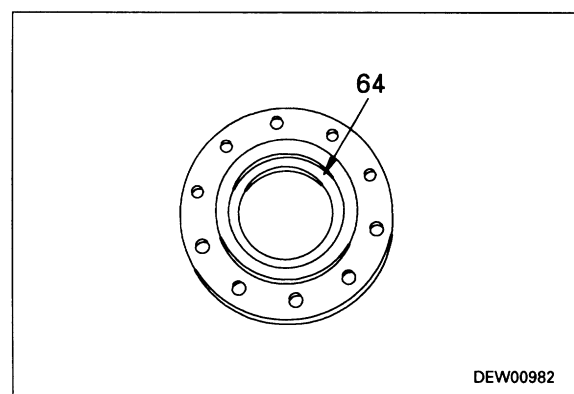
20. Upper hinge pin

※ 12

- 1) Remove mounting bolts, then remove retainer (63).
★ Check the number and thickness of the shims between the retainer and axle housing, and keep in a safe place.

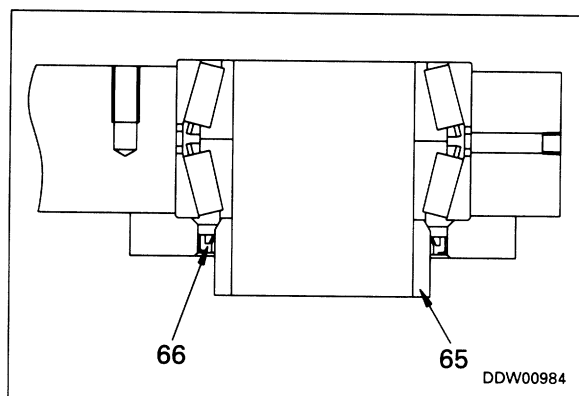
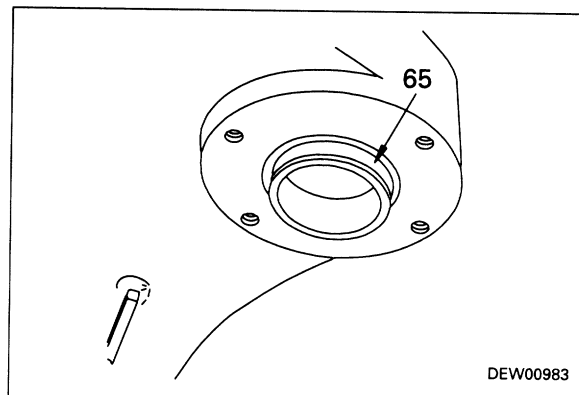


- 2) Remove dust seal (64) from retainer.

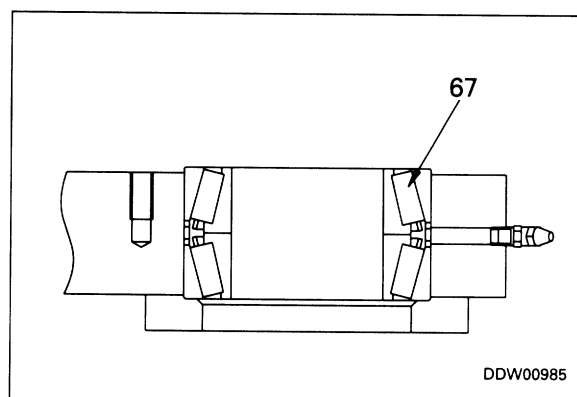


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- 3) Remove spacer (65) and dust seal (66) from front frame.



- 4) Remove bearing (67).



INSTALLATION OF CENTER HINGE PIN

- Carry out installation in the reverse order to removal.

※ 1

-  **kgm** Air conditioner unit hose:
29.4 – 34.3 Nm (3.0 – 3.5 kgm)
-  Air conditioner hose: **New refrigerant compressor oil (ND-OILB)**

※ 2

-  **kgm** Receiver hose:
11.8 – 14.7 Nm (1.2 – 1.5 kgm)
-  Receiver hose: **New refrigerant compressor oil (ND-OILB)**

※ 3

-  **kgm** Cable locknut:
53.9 ± 4.9 Nm (5.5 ± 0.5 kgm)

※ 4

- ★ Align securely with the notch hole of the viscous damper washer, then tighten.

※ 5

- Install stop bolt (left and right) at the position shown in the right figure.
- ★ For bolt adjustment procedure, see the related portion of "TESTING AND ADJUSTING" section.

※ 6

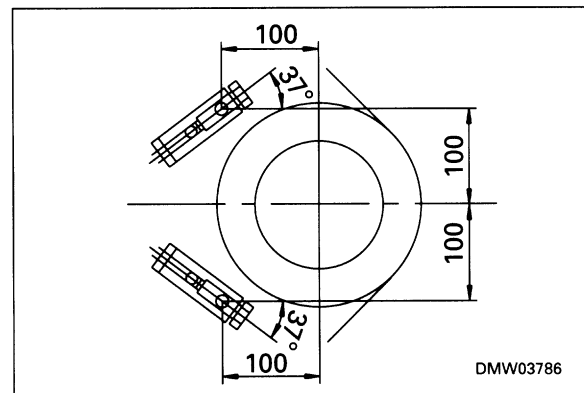
- ★ Use a new part for the O-ring.

※ 7

- ★ Align the match marks exactly.
-  **kgm** Drive shaft mounting bolt:
112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

※ 8

-  Outside circumference of lower hinge pin: **Grease (G2- LI)**



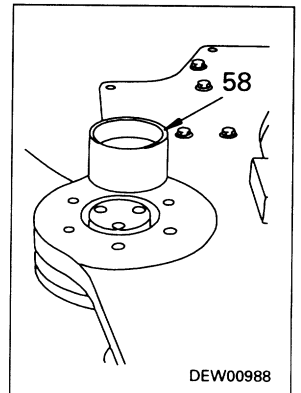
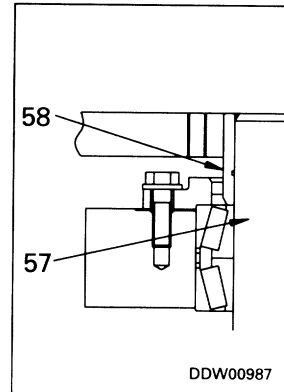
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※ 9

Upper hinge

- 1) Insert upper hinge pin (57), and assemble spacer (58).

 Outside circumference of hinge pin:
Grease (G2-LI)



- 2) Install retainer (56) to upper hinge pin, tighten with 3 bolts, then select shims so that clearance **a** between hinge and retainer is below 0.2 mm, and assemble.

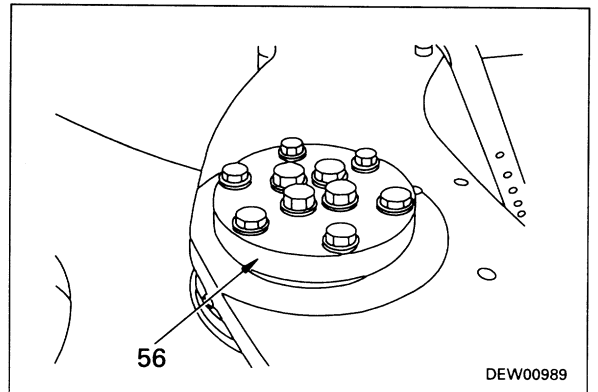
★ When adjusting the shims, tighten retainer mounting bolts temporarily to prevent from turning.

★ Tighten the retainer mounting bolts to the specified torque, then tighten the pin mounting bolts.

 Pin mounting bolt:
 $205.9 \pm 19.6 \text{ Nm}$ ($21.0 \pm 2.0 \text{ kgm}$)
(when adjusting shims)

 Pin mounting bolt:
 $205.9 \pm 19.6 \text{ Nm}$ ($21.0 \pm 2.0 \text{ kgm}$)

 Retainer mounting bolt:
 $107.9 \pm 9.8 \text{ Nm}$ ($11.0 \pm 1.0 \text{ kgm}$)

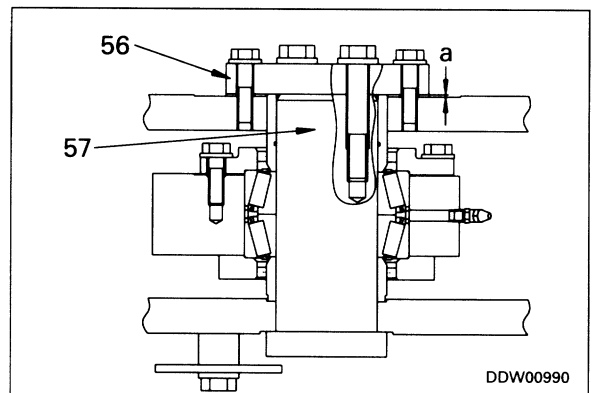


※ 10

Connection of frame

 Always use a bar when aligning the pin holes. Never insert your fingers.

★ Align the pin holes exactly.



※ 11

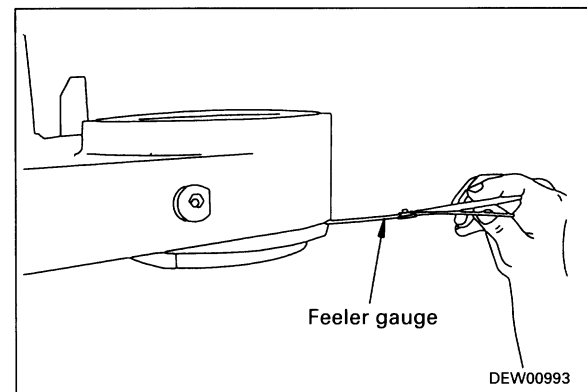
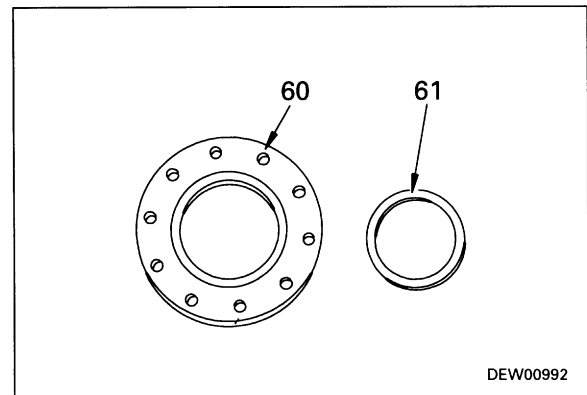
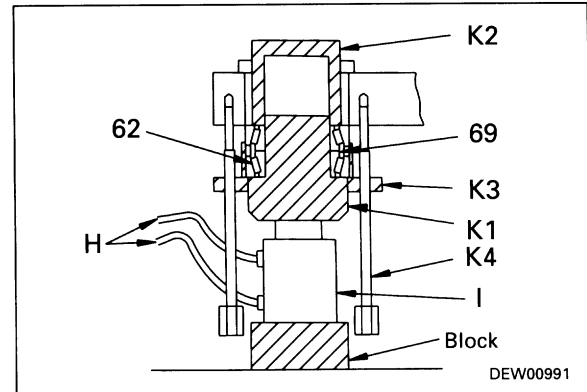
Lower hinge

- 1) Using tools **H**, **I**, **K1**, **K2**, and **K3**, press fit bearing (62) and spacer (69) to front frame.
 - ★ When press fitting, use tool **K3** as a guide.
 - ★ Be careful not to fit the bearing at an angle.
 - ★ Fill the inside of the bearing with grease.
 - ★ When assembling the bearing, be careful not to forget to assemble the spacer.
 - ★ The bearing clearance is adjusted, so do not change the combination with the spacer.

When replacing, always replace as a set.

- 2) Press fit dust seal (61) to retainer(60).
 - ★ Press fit so that the dust seal lip surface is facing the outside.

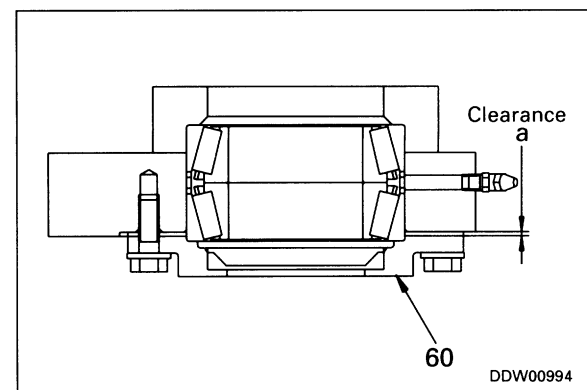
 Lip of oil seal: **Grease (G2-LI)**



- 3) Tighten retainer (60) with 3 mounting bolts, select shims so that maximum clearance **a** between retainer and hinge is less than 0.1 mm, then assemble.

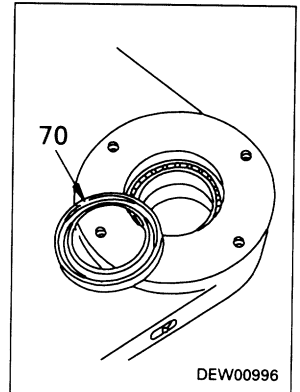
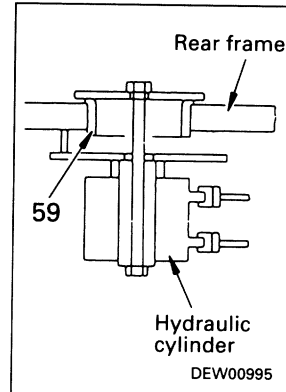
 **kgm** Mounting bolt:
 $19.6 \pm 2 \text{ Nm}$ ($2.0 \pm 0.2 \text{ kgm}$)
 (when adjusting shims)

 **kgm** Mounting bolt:
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)



- 4) Press fit dust seal (70) to frame.
 - ★ Press fit so that the dust seal lip surface is facing the outside.
 -  Lip of oil seal: **Grease (G2-LI)**
- 5) Bushing

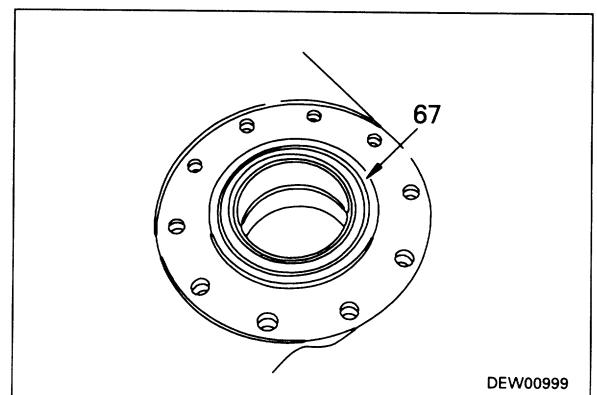
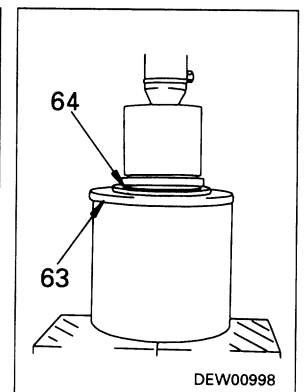
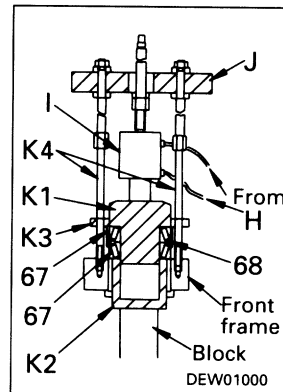
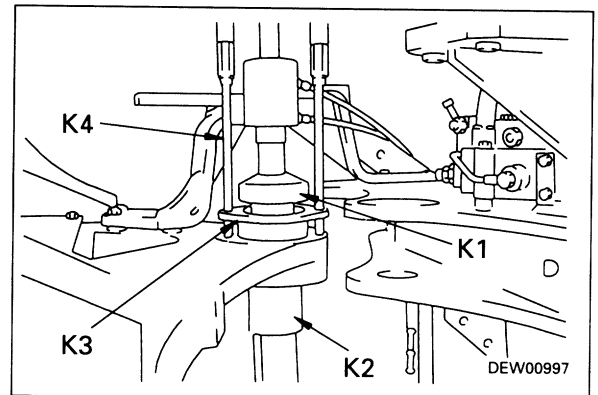
Press fit bushing (59) to lower hinge of rear frame with press.



※ 12

Upper hinge

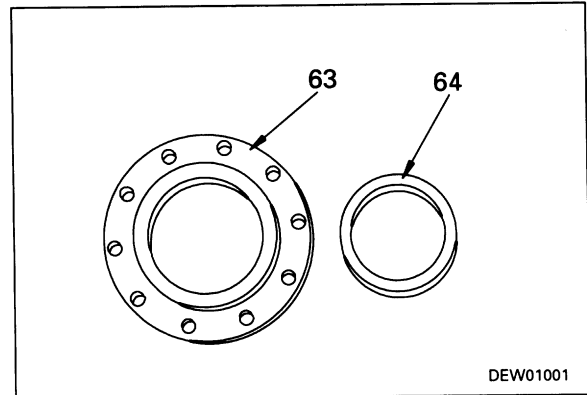
- 1) Assemble tools **H, I, J, K2, K3, and K4** to top of front frame upper hinge. Set bearing (67) in tool **K1**, then set to press-fitting portion from above and press fit.
 - ★ When press fitting, use tool **K3** as a guide.
 - ★ Be careful not to fit the bearing at an angle.
 - ★ Fill the inside of the bearing with grease.
 - ★ When assembling the bearing, be careful not to forget to assemble spacer (68).
 - ★ The bearing clearance is adjusted, so do not change the combination with spacer (68).
- When replacing, always replace as a set.



DISASSEMBLY AND ASSEMBLY

CENTER HINGE PIN

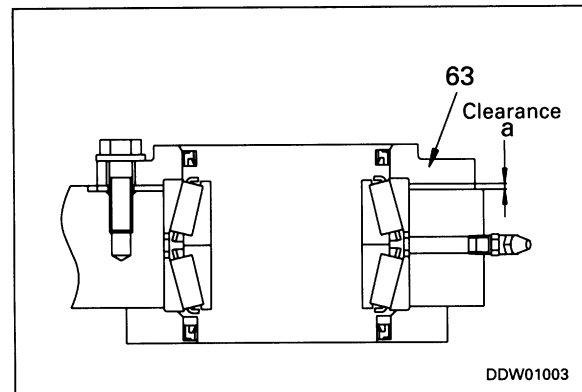
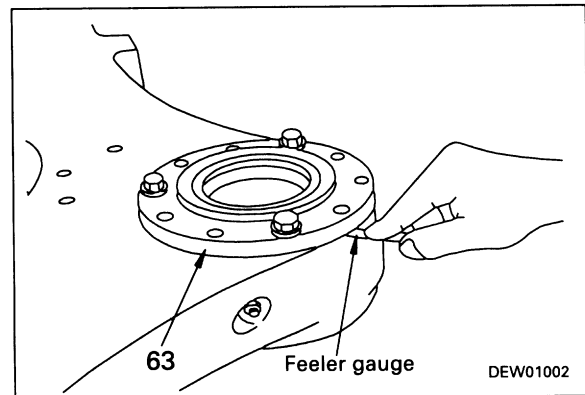
- 2) Press fit dust seal (64) to retainer (63).
 ★ Press fit so that the dust seal lip surface is facing the outside.
 Lip of oil seal: **Grease (G2-LI)**



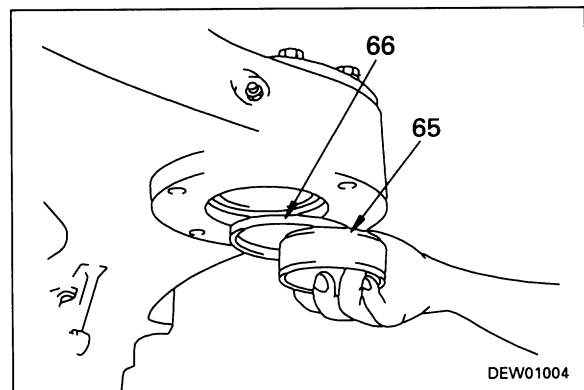
- 3) Tighten retainer (63) with 3 mounting bolts, select shims so that maximum clearance a between retainer and hinge is less than 0.1 mm, then assemble.

 **kgm** Mounting bolt:
 $19.6 \pm 2 \text{ Nm}$ ($2.0 \pm 0.2 \text{ kgm}$)
 (when adjusting shims)

 **kgm** Mounting bolt:
 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)



- 4) Assemble dust seal (66) and spacer (65) from under front frame.
 ★ Press fit so that the dust seal lip surface is facing the outside.
 ★ Assemble from below so that the large chamfered side of spacer (65) is on the bearing side.



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- **Refilling with oil**

Tighten drain plugs (1) and (2) at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.

 **kgm** Plug at top of filter:

$11.8 \pm 1 \text{ Nm}$ ($1.2 \pm 0.1 \text{ kgm}$)

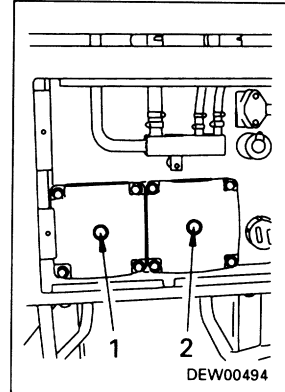
- **Bleeding air**

1) Bleed air from brake line.

For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.

2) Bleed air from steering line.

For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.



- **Fill the air conditioner with new refrigerant.**

★ Precautions when filling air conditioner line with new refrigerant

1) Keep the temperature inside the room at above 3°C.

(If the temperature is below 3°C, the system will not work.)

2) Use R134a as the refrigerant.

3) When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min. 750 mmHg.)

4) Charge with 1.5 – 1.6 kg of refrigerant.

5) Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.

6) Do not operate the compressor before charging with refrigerant.

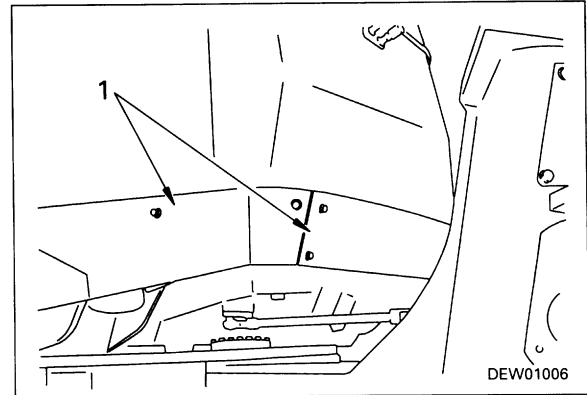
REMOVAL OF STEERING VALVE ASSEMBLY (ORBIT ROLL)

⚠ Park the wheel loader on level ground, install safety bar on frame. Lower the bucket on the ground, stop the engine, apply the parking brake and put blocks under the tires.

★ After the engine is stopped, operate the steering wheel two to three times leftward and rightward, and make the steering valve neutral.

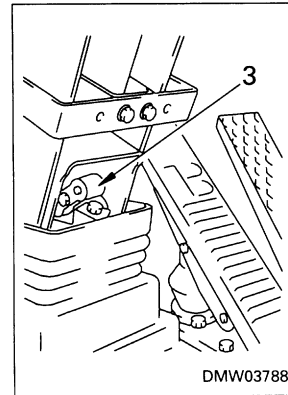
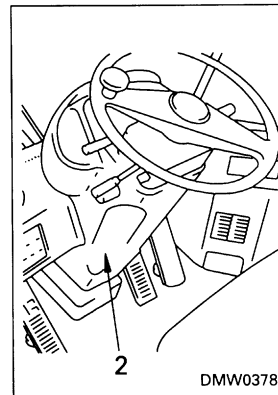
1. Cover

Remove cover (1) on the lower portion of cab.



2. Steering valve

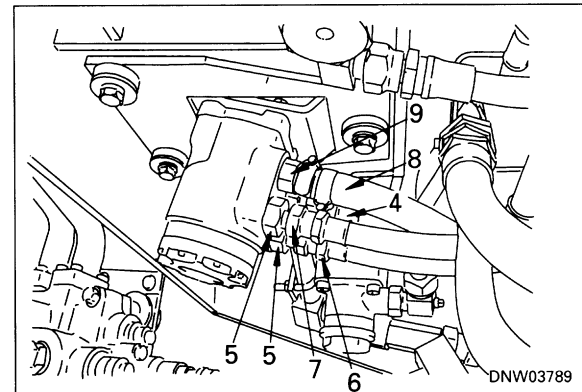
- 1) Remove cover (2) on the steering column.
- 2) Loosen the bolts and remove column joint (3) from the steering gear shaft. ※ 1
- ★ Mark the match mark on the joint and the steering valve.



3. Piping

Disconnect following pipings from the steering valve.

- 1) Disconnect hose (4) between steering valve (L port) and stop valve (L.H.) at the steering valve side, and remove nipple (5).
- 2) Disconnect hose (6) between steering valve (R port) and stop valve (R.H.) at the steering valve side, and remove nipple (5).
- 3) Disconnect hose (7) between steering valve (P port) and accumulator charge valve at the steering valve side, and remove nipple (5).
- 4) Disconnect hose (8) between steering valve (T port) and drain line, and remove nipple (9).

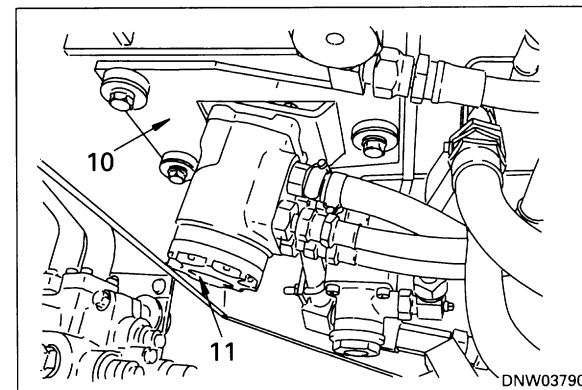


4. Steering valve

Remove mount bolts of bracket (10) and remove it with steering valve (11). ※ 2



Steering valve: 8 kg



INSTALLATION OF STEERING VALVE ASSEMBLY (ORBIT ROLL)

- Carry out installation in the reverse order to removal.

※ 1

 **kgm** Column connecting bolt:
55.9 ± 7.9 Nm (5.7 ± 0.8 kgm)

※ 2

 **kgm** Steering valve mounting bolt:
52.0 ± 6.9 Nm (5.3 ± 0.7 kgm)

 **kgm** Bracket mounting bolt:
88.3 ± 34.3 Nm (9.0 ± 3.5 kgm)

- ★ Align the spline of steering column side with the spline of steering valve side.
- Adding oil (hydraulic tank)
Add oil to the specified oil level through oil filler, start the engine and circulate oil through the piping. Check oil level again.

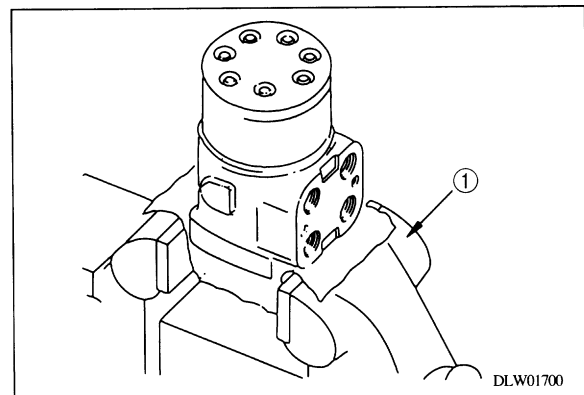
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DISASSEMBLY OF STEERING VALVE

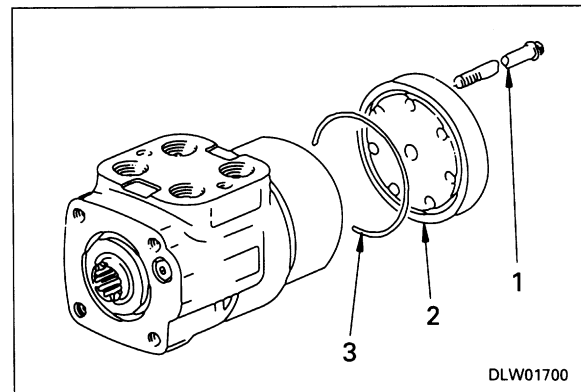
- ★ Use a wire brush to remove all the dirt and dust stuck to the joint around the outside circumference of the unit.
- ★ Carry out the operation in a clean place to prevent dirt or dust from sticking to the valve.
- ★ As far as possible, hold the valve in a vice when disassembling.

DISASSEMBLY OF ROTOR

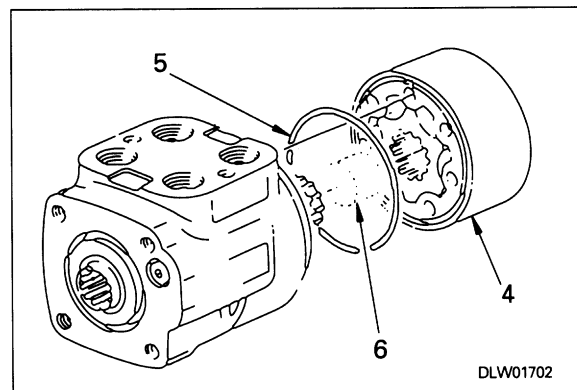
1. Set rotor side facing up, and hold mounting flange lightly in vice ①.
- ★ Put a copper plate in contact with the vice and be careful not to tighten the vice too hard.



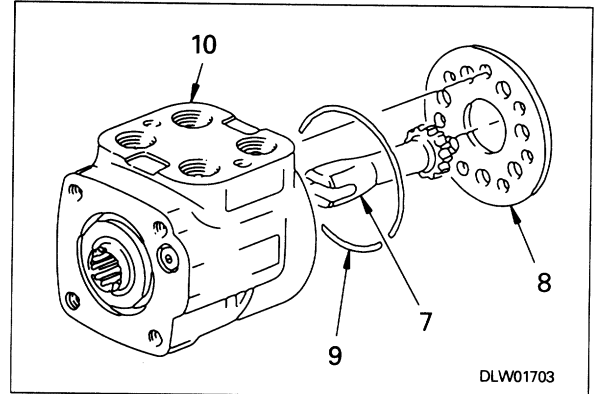
2. Remove screw (1), then remove end cap (2).
3. Remove O-ring (3) from end cap (2).



4. Pull out rotor set (4), then remove O-ring (5).
 - ★ Be careful not to drop the star inside the rotor set.
5. Remove spacer (6).

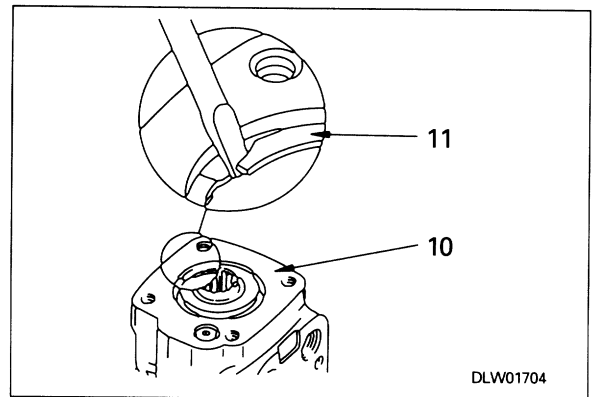


6. Remove drive shaft (7).
7. Remove spacer plate (8).
8. Remove O-ring (9) from housing (10).

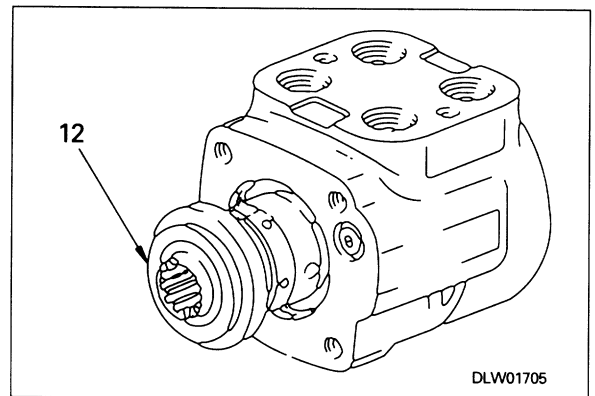


DISASSEMBLY OF CONTROL SIDE

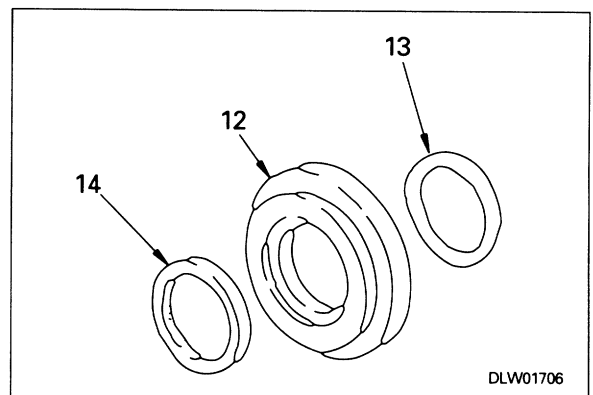
9. Remove housing (10) from vice, and place on a clean cloth. Be careful not to damage the finished surface.
10. Raise tip of snap ring (11) with screwdriver, and remove from housing.



11. Turn spool and sleeve to place pin in a horizontal position, then push in spool and sleeve with your thumb, and remove bushing (12) from housing.



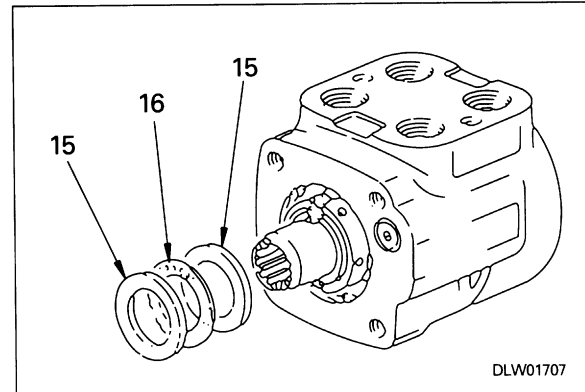
12. Remove X-ring seal (13) from bushing (12).
13. Remove dust seal (14) from bushing (12) with screwdriver.
 - ★ Be careful not to damage the bushing.



DISASSEMBLY AND ASSEMBLY

STEERING VALVE

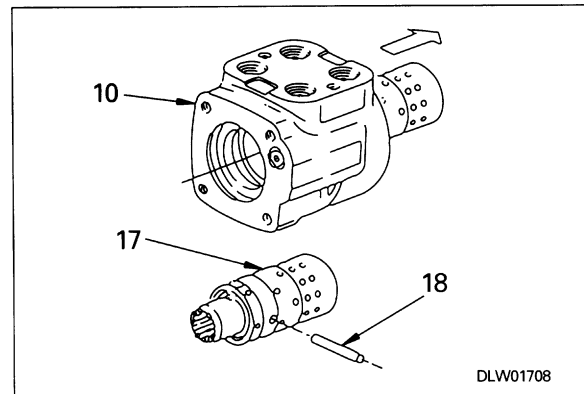
14. Remove 2 bearing races (15) and thrust needle (16) from spool and sleeve.



15. Pull out spool and sleeve assembly (17) from housing (10) in the direction of the arrow.

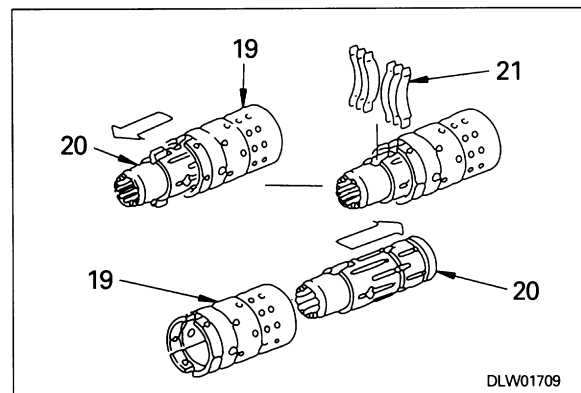
★ To prevent the spool and sleeve assembly from catching in the housing, rotate the spool and sleeve assembly slowly to the left and right when pulling out from the housing.

16. Pull out pin (18) from spool and sleeve assembly (17).



17. Push spool (20) inside sleeve (19) slightly to front, and remove 6 centering springs (21) from spool (20) carefully by hand.

18. Turn spool (20) slowly and pull out from rear of sleeve (19) (in the direction of the arrow).



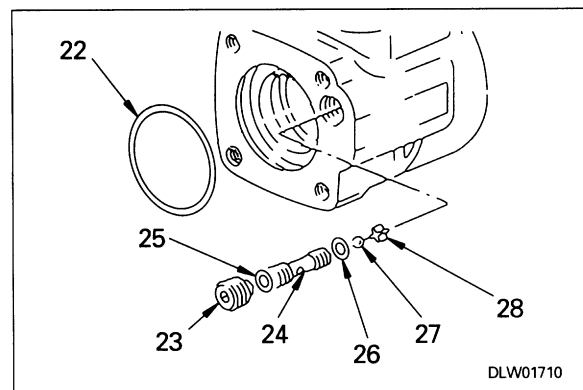
19. Remove O-ring (22) from housing.

20. Remove set screw (23) from housing.

21. Screw a threaded bar into check sheet (24), and pull out check sheet (24).

22. Remove O-rings (25) and (26) from check sheet (24).

23. Tap housing, and remove ball (27) and retainer (28).



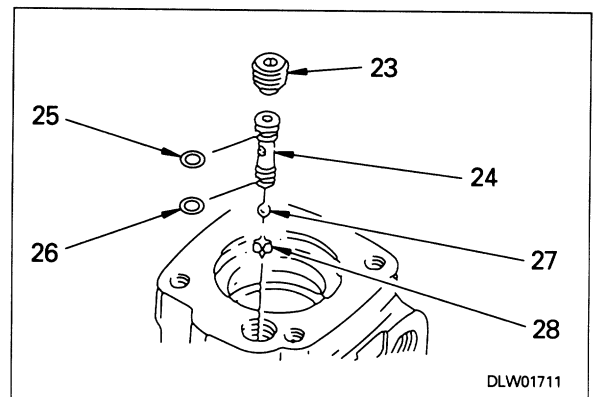
U42103

ASSEMBLY OF STEERING VALVE

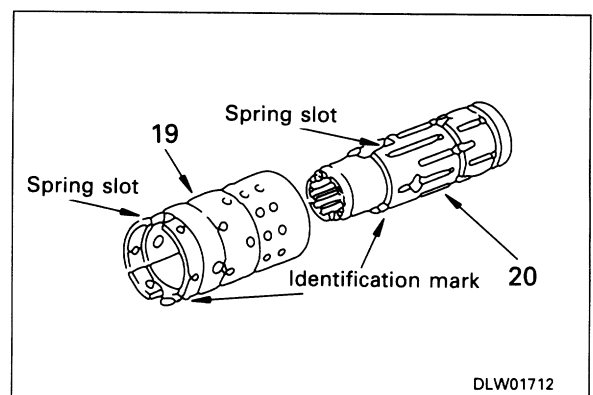
- ★ Check all parts for damage or burrs.
- ★ Wash all metal parts in clean solvent and blow dry with air.
- ★ Do not use a file or polish any part with rough sandpaper.
- ★ Coat the O-rings with clean grease. (No need to put grease on new X-ring seals)
- ★ Coat the O-ring for the rotor set with a small amount of grease.

ASSEMBLY OF CONTROL SIDE

1. Insert retainer (28) in housing with tweezers.
 - ★ Check that the retainer is not inserted at an angle.
2. Insert ball (27).
3. Fit O-rings (26) and (25) in check sheet (24), and push check sheet (24) into housing.
 - ★ Be careful to set the top and bottom of the check sheet facing in the correct direction.
4. Install set screw (23).
 - ★ Check that the set screw is set in slightly from the end face of the housing.
 -  **Set screw : 11.8 Nm (1.2 kgm)**
 -  **Set screw : adhesive (LT-2)**



5. Assemble spool (20) and sleeve (19) so that spring groove is on same side.
 - ★ Rotate the spool and slide it in.
 - ★ Grip the splined portion of the spool lightly and check that the spool rotates smoothly inside the sleeve.
 - ★ If there are match marks, check that the match marks are aligned.

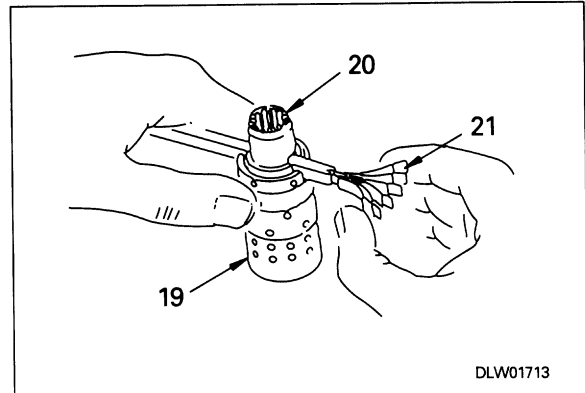


DISASSEMBLY AND ASSEMBLY

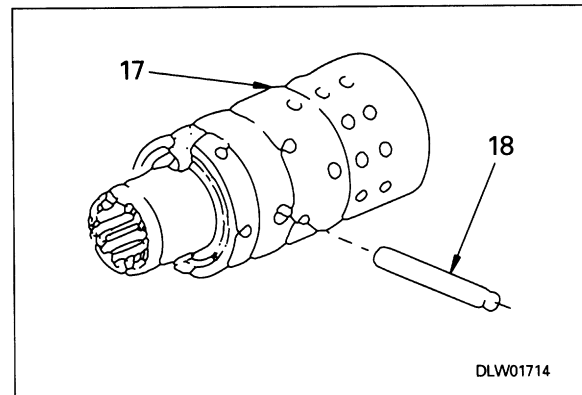
STEERING VALVE

6. Align spring groove positions of spool (20) and sleeve (19), and set on flat plate, then insert spring (21) in spring groove.

★ Set so that the notches at both ends are at the bottom.



7. Insert pin (18) in spool and sleeve assembly (17).



8. Insert spool and sleeve assembly (17) in housing (10) in the direction of the arrow.

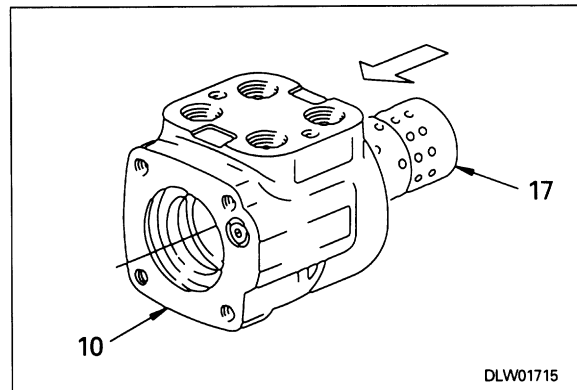
1) Keep pin horizontal and rotate to left and right a little at a time to insert.

★ Be extremely careful not to get it caught.

2) Make the spool and sleeve assembly flush with the rear end face of the housing.

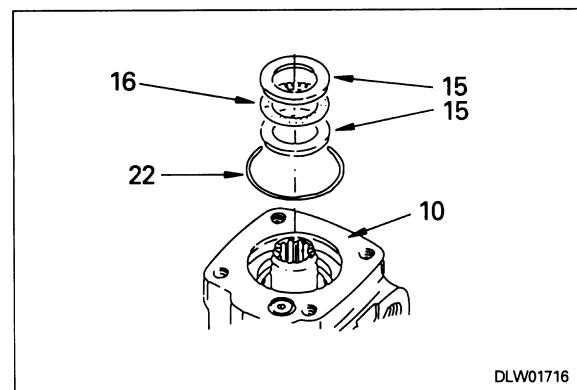
★ If it is inserted beyond the end face, the pin will fall out.

3) Check that spool and sleeve rotate smoothly inside housing.



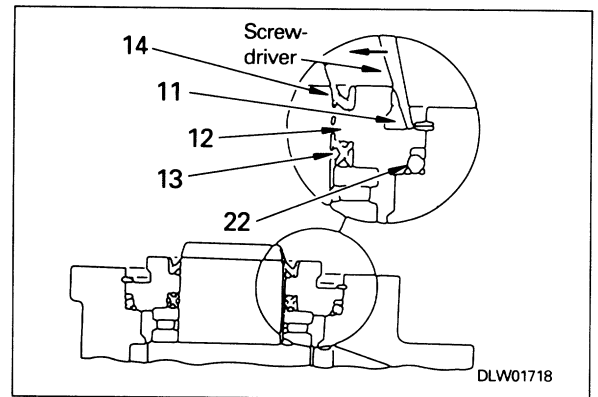
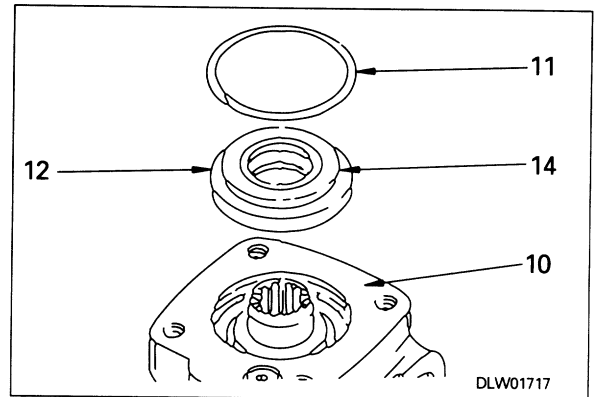
9. Install O-ring (22) to housing (10).

10. Fit 2 bearing races (15) and thrust needle (16) in case (10).



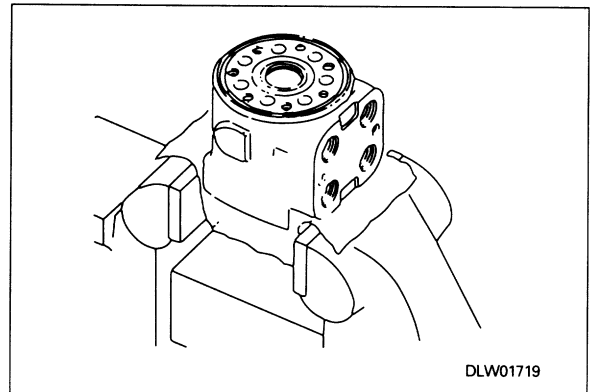
U42103

11. Insert dust seal (14) in bushing (12).
12. Insert X-ring seal (13) in bushing (12).
13. Insert bushing (12) in spool, and rotate to install.
 - Tap with a plastic hammer to assemble to the specified position.
 - It must be in contact horizontally with the bearing race.
14. Fit snap ring (11) in housing.

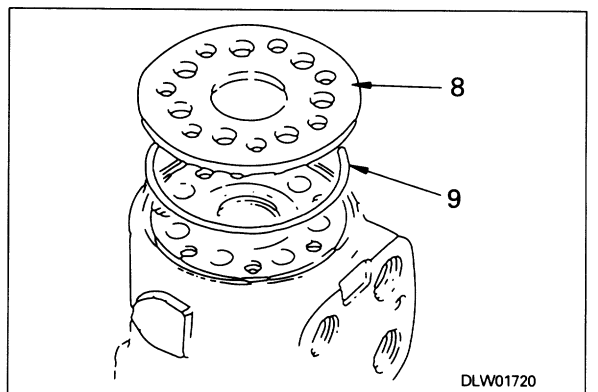


ASSEMBLY OF ROTOR

15. Hold flange of housing lightly in vice.
 - ★ Be careful not to tighten the vice too hard.
 - ★ Check that the spool and sleeve are set in slightly from the housing surface with fourteen holes.

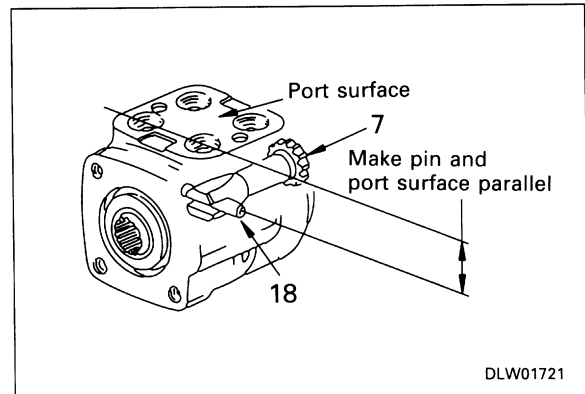


16. Insert O-ring (9) in housing.
17. Put on spacer plate (8), and align positions of bolt hole and tap hole of housing.

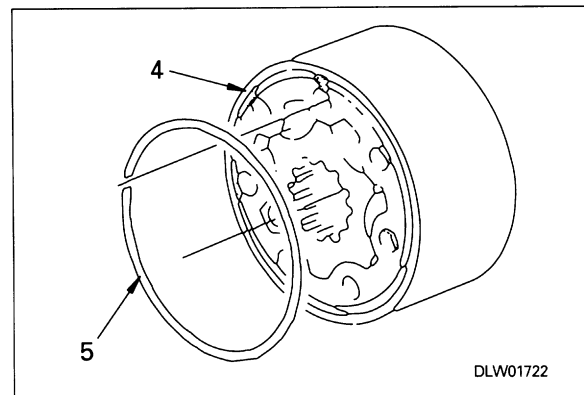


- 18.** Turn spool and sleeve assembly to make pin (18) and port surface of housing parallel, then mesh pin and yoke of drive shaft (7).

★ To position accurately, draw a line on the end face of the drive shaft spline.



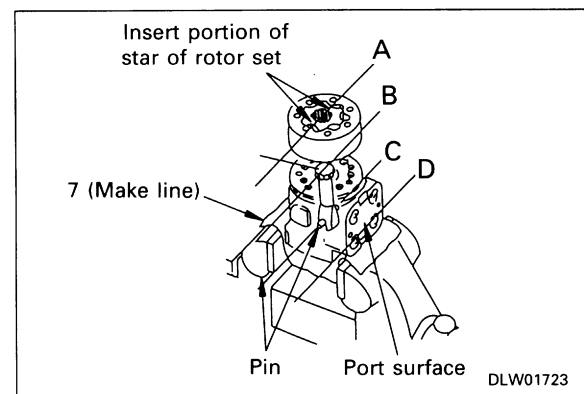
- 19.** Insert O-ring (5) in rotor set (4).



- 20.** Make O-ring (5) end of rotor set to spacer plate end, then align insert portion of star of rotor (4) with drive.

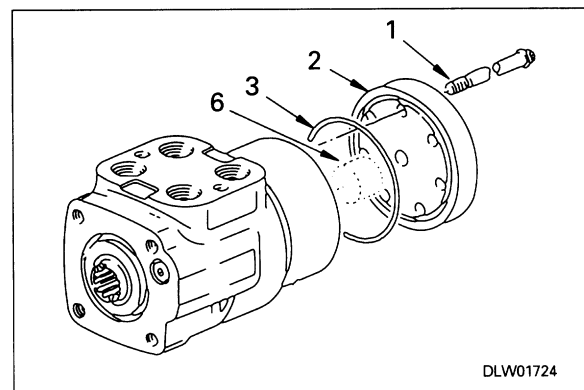
- 1) Check that lines **A, B, C, and D** are all parallel.
- 2) Without removing joint of drive (7), position bolt holes of rotor set.

★ This procedure is very important for determining the valve timing of unit.



- 21.** Insert spacer (6) inside rotor set.

- 22.** Set end cap (2) on rotor set, and align bolt hole.



23. Coat thread of screw with grease, and tighten end cap.

- ★ Install the handle to the spool, and check that the spool rotates.

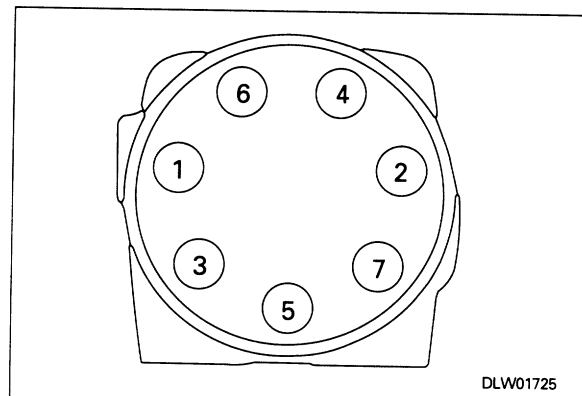


End cap mounting screw

First step : **14.7 Nm (1.5 kgm)**

Second step :

27.0 ± 1.5 Nm (2.75 ± 0.15 kgm)



DLW01725

REMOVAL OF STEERING VALVE ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing out.

1. Covers

Remove covers (3) under cab.

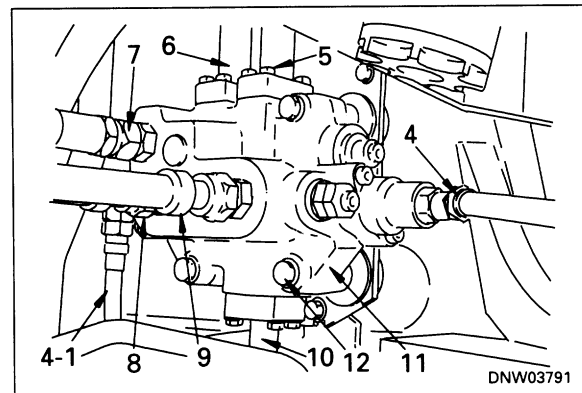
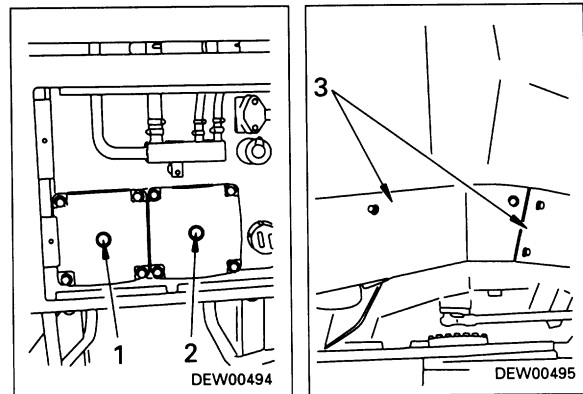
2. Hydraulic piping

※ 1

Disconnect following tubes and hoses at steering valve end.

- 1) Disconnect hose (4) between stop valve (R.H.) and steering valve at steering valve side.
- 2) Disconnect hose (4-1) between stop valve (L.H.) and steering valve at steering valve side.
- 3) Disconnect tube (5) between steering pump and steering valve port (P1).
- 4) Disconnect tube (6) between switch pump and steering valve port (P2).
- 5) Disconnect hose (7) from steering valve port (PB) to cut-off valve.
- 6) Disconnect tube (8) at steering valve port (A) and tube (9) at port (B).
- 7) Disconnect steering valve drain port tube (10).

★ After disconnecting the tubes and hoses, fit plugs to prevent the entry of dirt or dust.



3. Steering valve

Sling steering valve (11), then remove mounting bolt (12), and lift off steering valve.



Steering valve: **24 kg**

★ Carry out the removal operation with two people.

! The steering valve has oil on it so be careful not to let it slip.

INSTALLATION OF STEERING VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.



- ★ Use a new part for the O-ring.
- ★ When installing the tube, remove the clamp to prevent any force from being brought to bear on the tube.

- **Refilling with oil**

Tighten the plug at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.

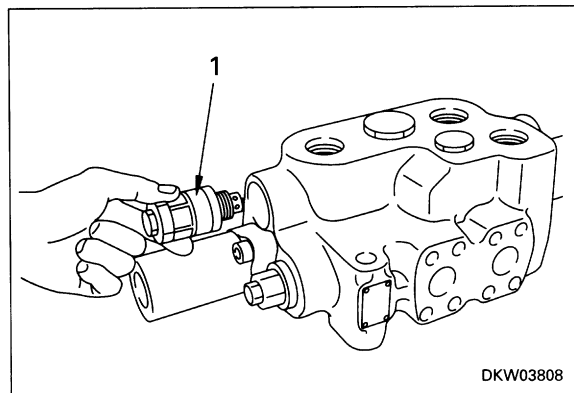


Plug at top of filter:

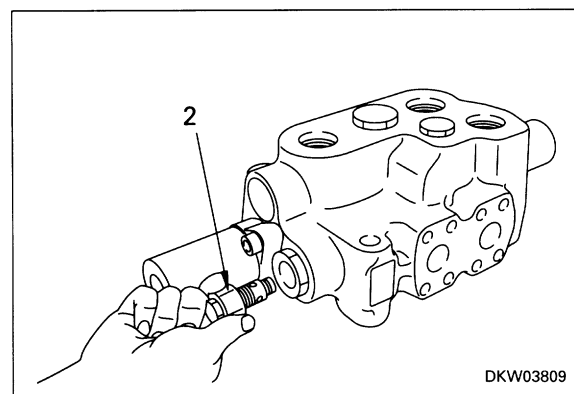
$11.8 \pm 1 \text{ Nm}$ ($1.2 \pm 0.1 \text{ kgm}$)

DISASSEMBLY OF STEERING DEMAND VALVE

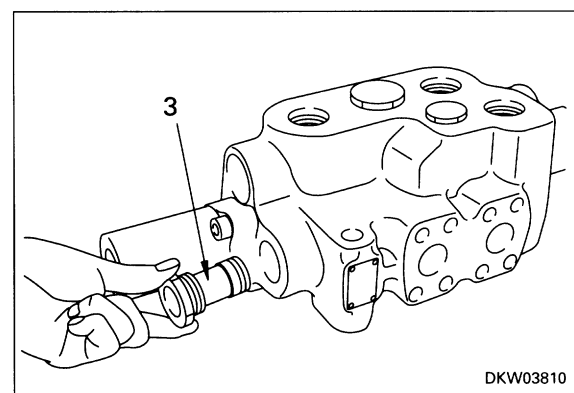
1. Remove safety valve assembly (1).
 - ★ The set pressure of the safety valve is fixed, so do not disassemble it.



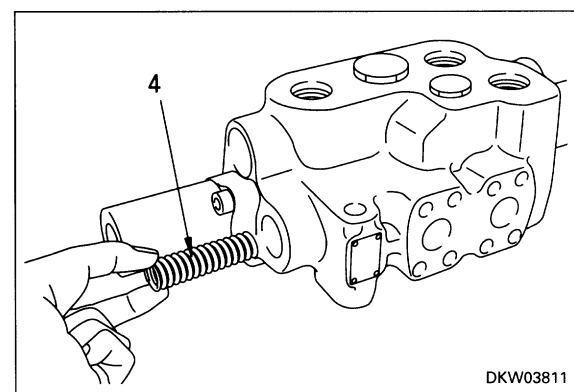
2. Remove main relief valve assembly (2).
 - ★ The set pressure of the main relief valve is fixed, so do not disassemble it.



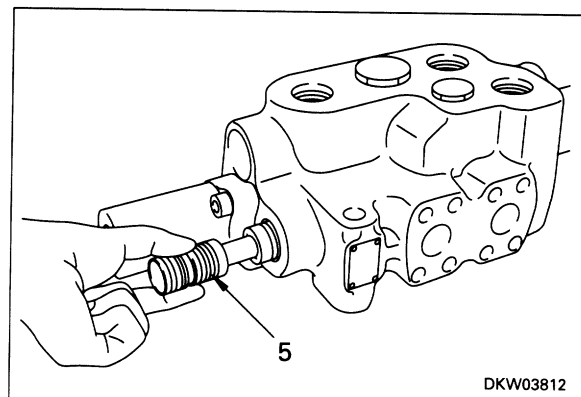
3. Removal of demand spool
 - 1) Remove plug (3).



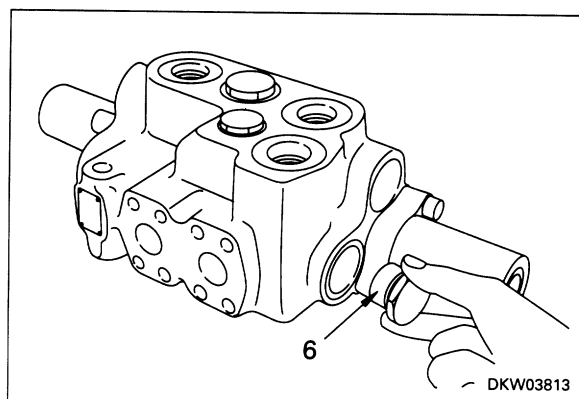
- 2) Remove spring (4).



- 3) Remove demand spool (5).
- ★ Remove slowly, taking care not to damage the spool.
 - ★ If shims are fitted, check the number and thickness of the shims, and keep in a safe place.

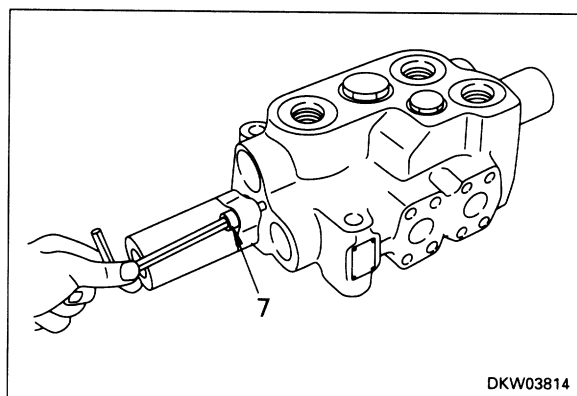


- 4) Remove plug (6).

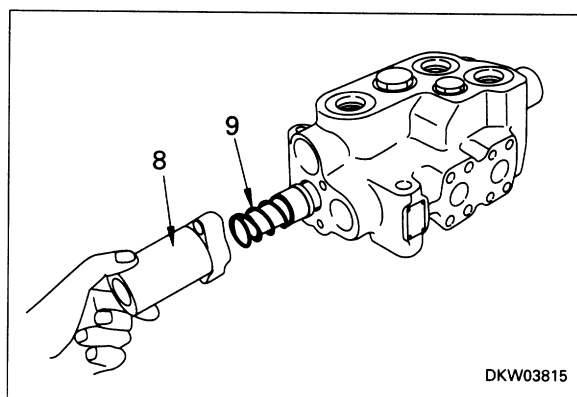


4. Removal of steering spool

- 1) Remove 2 bolts (7).
- ★ Remove on the opposite side in the same way.



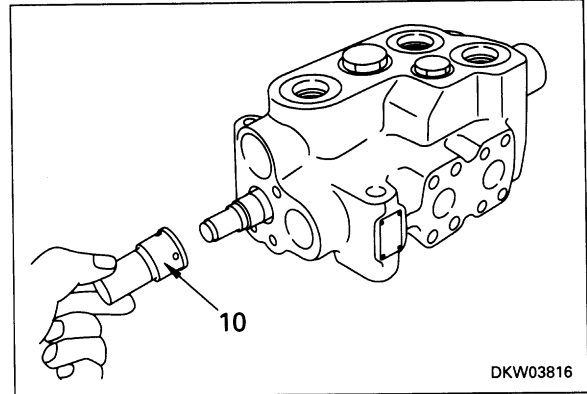
- 2) Remove case (8) and spring (9).
- ★ Remove on the opposite side in the same way.



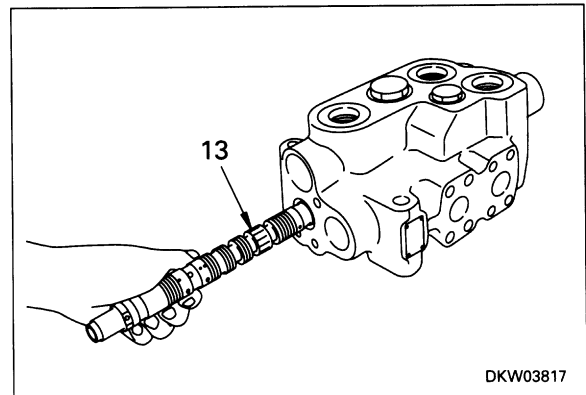
DISASSEMBLY AND ASSEMBLY

STEERING DEMAND VALVE

- 3) Remove spring seat (10).
 - ★ Remove slowly, taking care not to damage the spool.
 - ★ Remove on the opposite side in the same way.

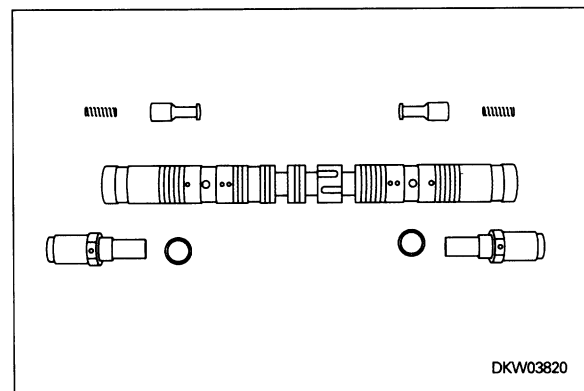
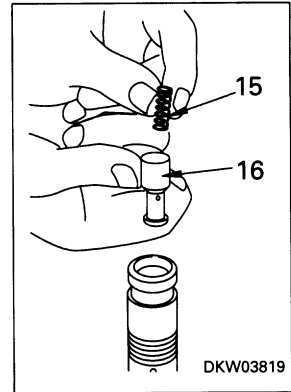
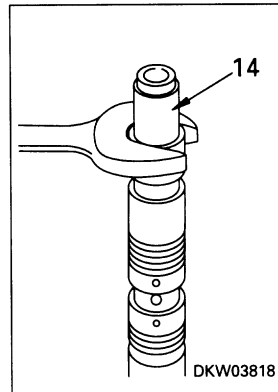


- 4) Remove steering spool assembly (13).
 - ★ Remove slowly, and be careful not to bend or damage the spool assembly.
 - ★ To prevent it from falling into the valve body, remove the poppets at both ends.



5. Disassembly of steering spool assembly

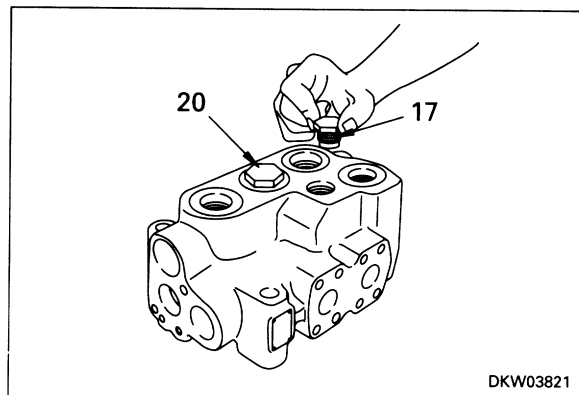
- 1) Remove cap screw (14).
 - ★ The cap screw is coated with adhesive (Loctite #271), so use an industrial dryer, and heat (200 – 250°C) before removing.
- 2) Remove spring (15) and poppet (16).
 - ★ Remove on the opposite side in the same way.



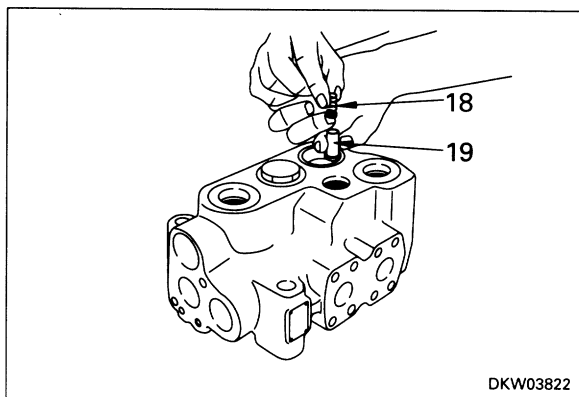
U42103

6. Disassembly of check valve

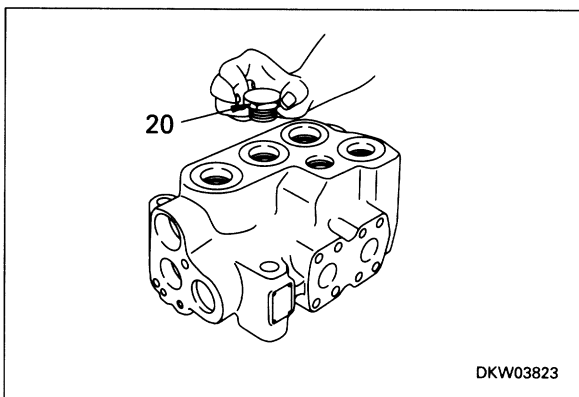
1) Remove plug (17).



2) Remove spring (18) and poppet (19).



7. Remove plug (20).

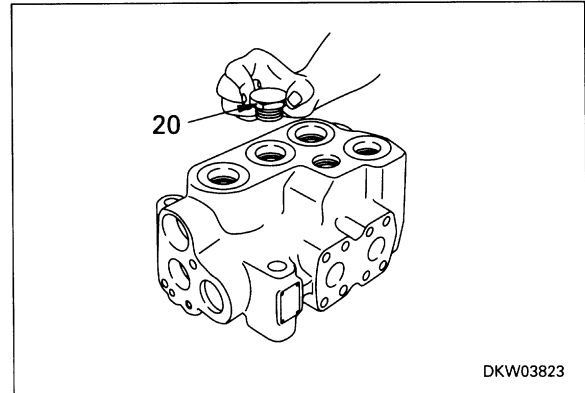


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ASSEMBLY OF STEERING DEMAND VALVE

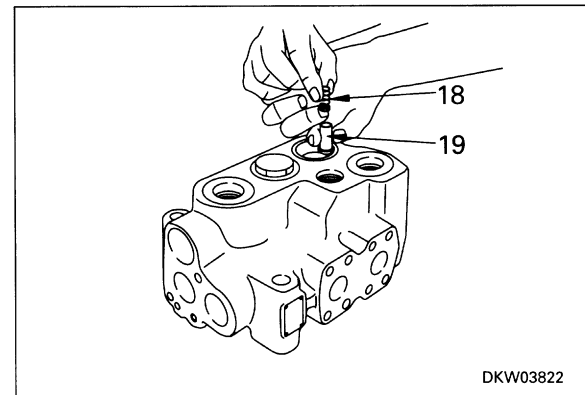
1. Fit O-ring to plug (20) and install to valve body.

 Plug: $93.2 \pm 4.9 \text{ Nm}$ ($9.5 \pm 0.5 \text{ kgm}$)



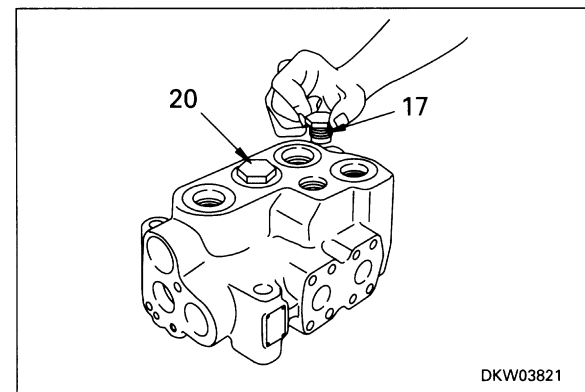
2. Assembly of check valve

- 1) Install poppet (19) and spring (18).



- 2) Fit O-ring (17) and install to valve body.

 Plug: $63.7 \pm 4.9 \text{ Nm}$ ($6.5 \pm 0.5 \text{ kgm}$)

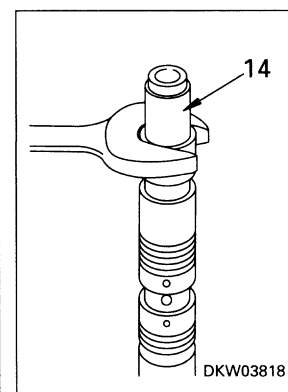
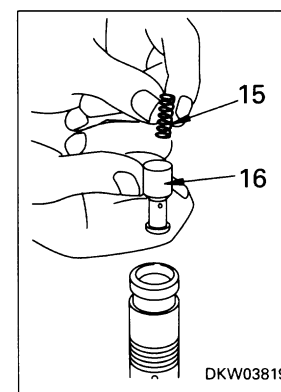


3. Assembly of steering spool

- 1) Install poppet (16) and spring (15) to spool.
2) Fit O-ring to cap screw (14) and install to spool.

 Spool thread: **Adhesive (Loctite #271)**

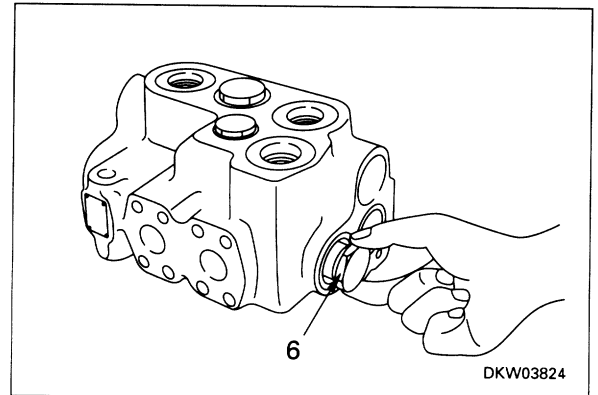
 Cap screw: $8.8 \pm 1.0 \text{ Nm}$ ($0.9 \pm 0.1 \text{ kgm}$)



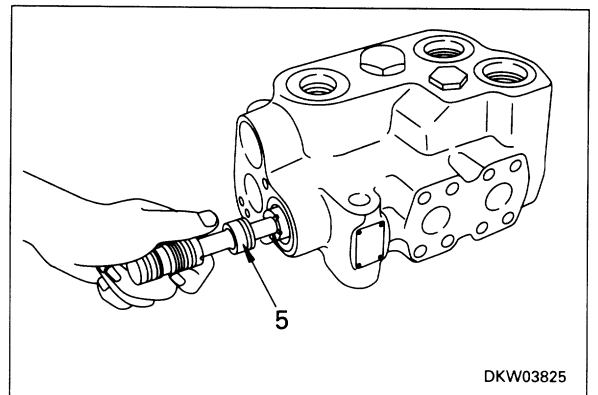
4. Installation of demand spool

- 1) Fit O-ring to plug (6) and install to valve body.

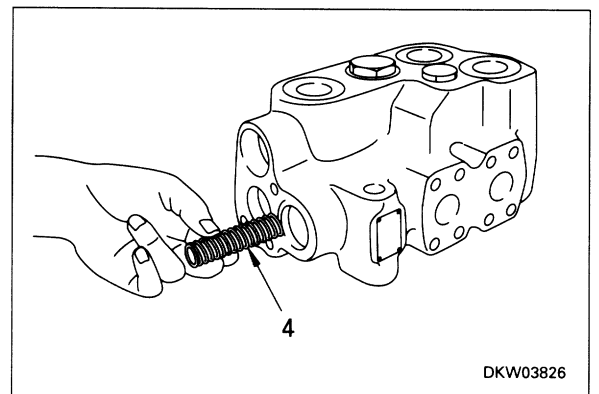
 Plug: $137.3 \pm 2.0 \text{ Nm}$ ($14.0 \pm 0.2 \text{ kgm}$)



- 2) Install demand spool (5) to valve body.
 - ★ If shims were fitted, assemble shims.
 - ★ Install slowly, taking care not to damage the spool.

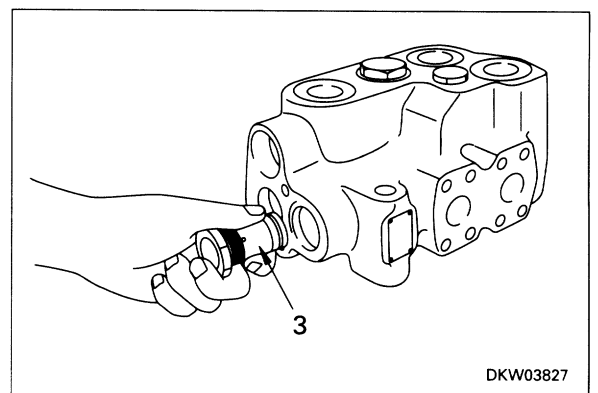


- 3) Install spring (4).



- 4) Fit O-ring and backup ring to plug (3), and install to valve body.

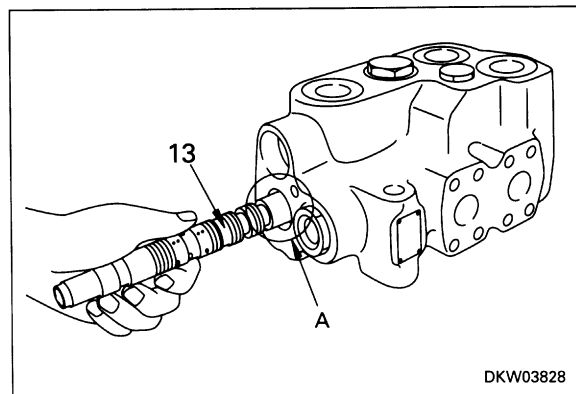
 Plug: $137.3 \pm 2.0 \text{ Nm}$ ($14.0 \pm 0.2 \text{ kgm}$)



5. Installation of steering spool assembly

- 1) Install steering spool assembly (13) to valve body.

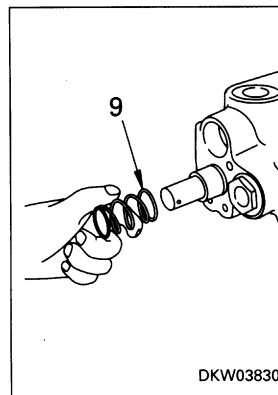
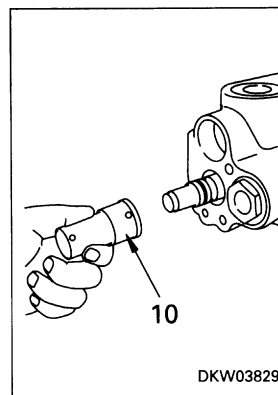
★ Be careful to install portion A of the spool facing in to the correct direction.



- 2) Install spring seat (10).

- 3) Install spring (9).

★ Install on the opposite side in the same way.

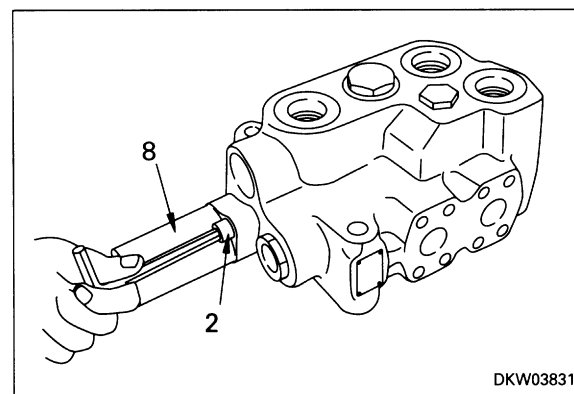


- 4) Fit O-ring to case (8) and install to valve body.

- 5) Tighten bolt (7).

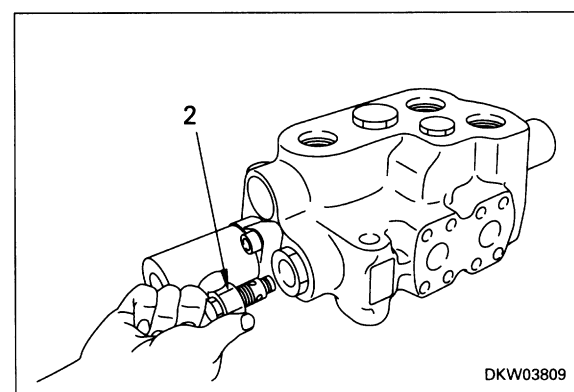
 Bolt: $41.2 \pm 2.0 \text{ Nm}$ ($4.2 \pm 0.2 \text{ kgm}$)

★ Install on the opposite side in the same way.

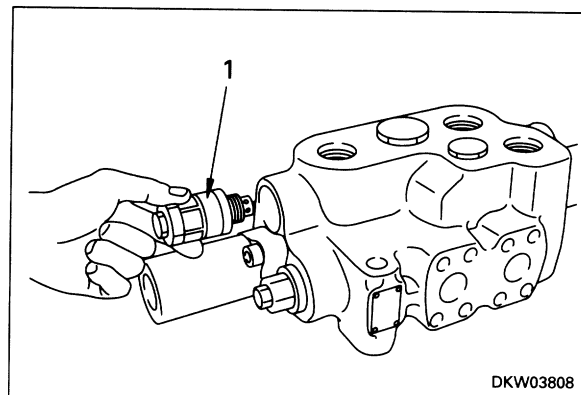


6. Install main relief valve assembly (2) to valve body.

 Main relief valve assembly:
 $73.5 \pm 4.9 \text{ Nm}$ ($7.5 \pm 0.5 \text{ kgm}$)



7. Install safety valve assembly (1) to valve body.
⌚  Safety valve assembly:
 $73.5 \pm 4.9 \text{ Nm}$ ($7.5 \pm 0.5 \text{ kgm}$)



REMOVAL OF STEERING, SWITCH PUMP ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY

- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing out.

! Operate the bucket control lever at least 40 times TILT ↔ HOLD to release the pressure inside the accumulator.

! Depress the brake pedal at least 17 times to release the pressure inside the brake accumulator.

! When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

1. Covers

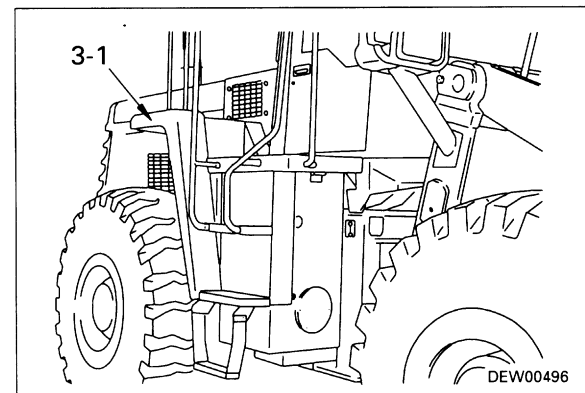
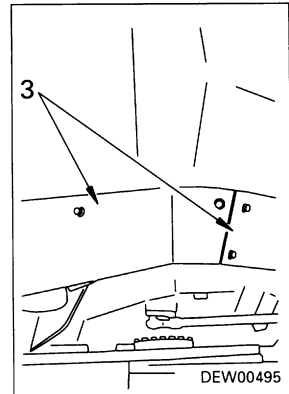
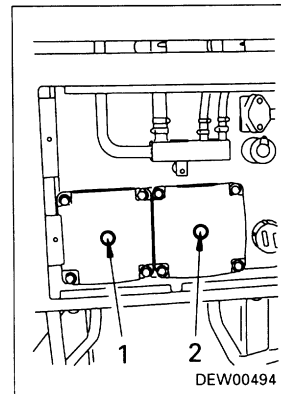
Remove covers (3) at bottom of cab.

2. Ladders

Remove left and right ladders (3-1).

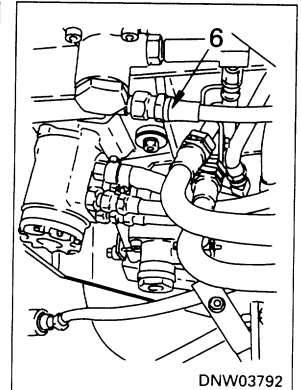
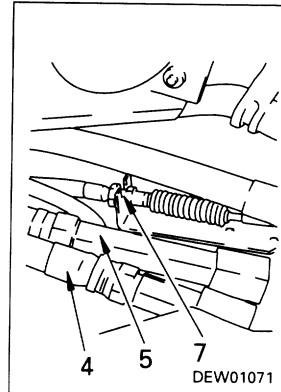


Ladder rail (right): **64.5 kg**
Ladder rail (left): **59.5 kg**

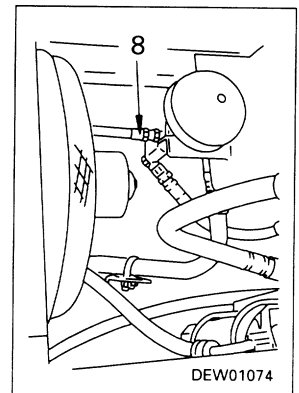
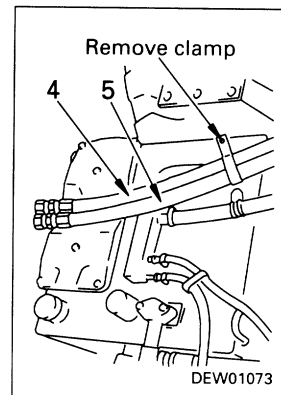


3. Brake piping, accelerator cable

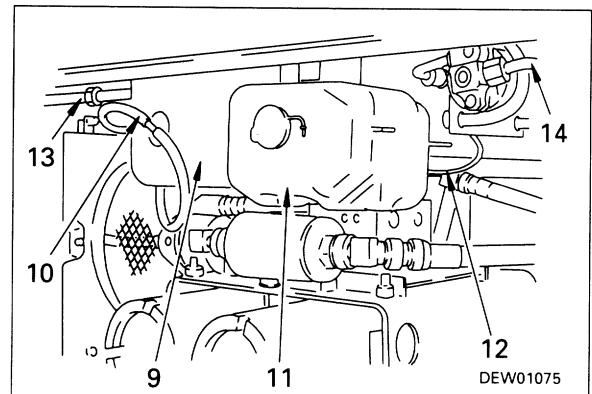
- 1) Disconnect hoses (4) and (5) between right brake valve and accumulator at pedal end.
★ Remove brake hose clamps at two points under floor board.
- 2) Disconnect hose (6) between left brake valve and accumulator at pedal end.
- 3) Disconnect accelerator cable (7) under pedal.
※ 1
★ Remove the cable clamp under the floor board.



- 4) Disconnect hose (8) between PPC accumulator and PPC valve inside bulkhead at accumulator end.

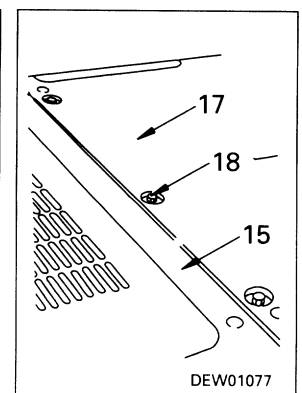
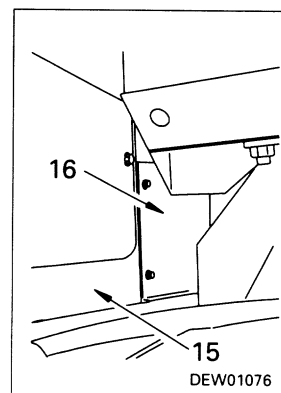


- 5) Disconnect hose (10) of radiator sub-tank (9) and hose (12) of window washer tank (11) at tank end.
★ Remove the hoses from the hose clamps.
- 6) Air conditioner hoses
 - i) Disconnect hose (13) between compressor and condenser at condenser end.
※ 2
★ Remove the hose clamps inside the bulkhead.
 - ii) Disconnect hose (14) between air conditioner unit and receiver at receiver end.
※ 3
★ Remove the hose clamps inside the bulkhead.
★ After removing the hoses, fit plugs to prevent the entry of dirt or dust.



4. Bulkhead

- 1) Remove cover (16) at bottom front face of bulkhead (15).
- 2) Remove top mounting bolts (18) holding bulkhead (15) and hood (17).
★ Be careful not to lose the rubber and washers of the mounting portion.

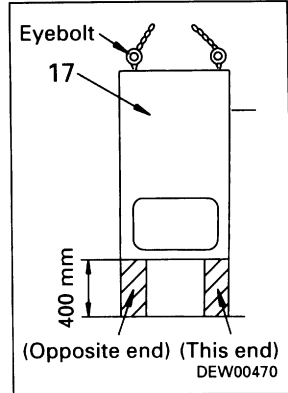
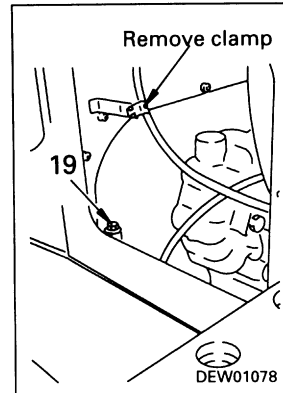


- 3) Install eyebolts at top 4 corners of bulkhead (17), then sling and remove bottom mounting bolts (19).



Bulkhead: 135 kg
(including accumulator, charge valve)

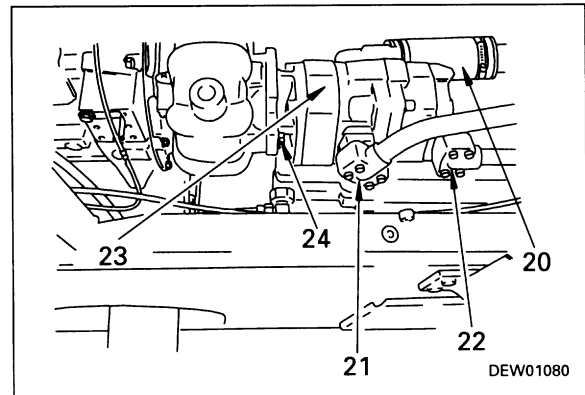
- 4) Raise bulkhead (17) straight up for approx. 400 mm.
 - ★ The bulkhead comes near the cab when it is lifted, so be careful not to hit anything.
 - ★ To prevent the bulkhead from falling after it is raised, place blocks on the left and right at opposite ends.



5. Pump piping

※ 4

- 1) Disconnect suction tube (20) between hydraulic tank and steering pump at pump end.
- 2) Disconnect tube (21) between steering pump and steering valve at pump end.
- 3) Disconnect tube (22) between switch pump and steering valve at pump end.
 - ★ After disconnecting the tubes, fit plugs to prevent the entry of dirt or dust.



6. Pump

※ 5

Remove mounting bolts (24) of steering and switch pump assembly (23), then remove pump assembly.



Steering, switch pump assembly: 20 kg

INSTALLATION OF STEERING, SWITCH PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 Accelerator cable mounting nut:
 $53.9 \pm 4.9 \text{ Nm}$ ($5.5 \pm 0.5 \text{ kgm}$)

※ 2

 Condenser hose:
 $19.6 - 24.5 \text{ Nm}$ ($2.0 - 2.5 \text{ kgm}$)

※ 3

 Receiver hose:
 $3.9 - 6.9 \text{ Nm}$ ($0.4 - 0.7 \text{ kgm}$)

※ 4

※ 5

★ Use a new part for the O-ring.

- Refilling with oil**

Tighten drain plugs (1) and (2) at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.

 Plug at top of filter:
 $11.8 \pm 1 \text{ Nm}$ ($1.2 \pm 0.1 \text{ kgm}$)

- Bleeding air**

- Bleed air from brake line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.
- Bleed air from steering line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.

- Fill the air conditioner with new refrigerant.

★ **Precautions when filling air conditioner line with new refrigerant**

- Keep the temperature inside the room at above 3°C.
(If the temperature is below 3°C, the system will not work.)
- Use R134a as the refrigerant.
- When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min. 750 mmHg.)
- Charge with 1.5 – 1.6 kg of refrigerant.
- Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
- Do not operate the compressor before charging with refrigerant.

REMOVAL OF STEERING CYLINDER ASSEMBLY

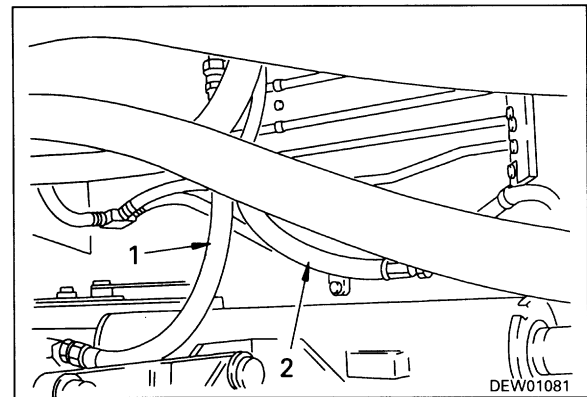
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

1. Hydraulic piping

Disconnect steering cylinder rod and bottom hoses (1) and (2) at cylinder end.

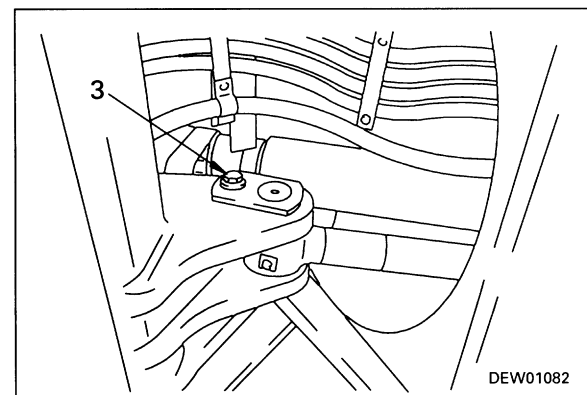
★ After removing the hoses, fit plugs to prevent the entry of dirt or dust.



2. Steering cylinder

1) Remove rod bolt, then remove pin (3).

※ 1



2) Disconnect bottom grease tube (4).

3) Remove bottom bolt, then remove pin (5).

★ Check the shim thickness and use as a guide when assembling.

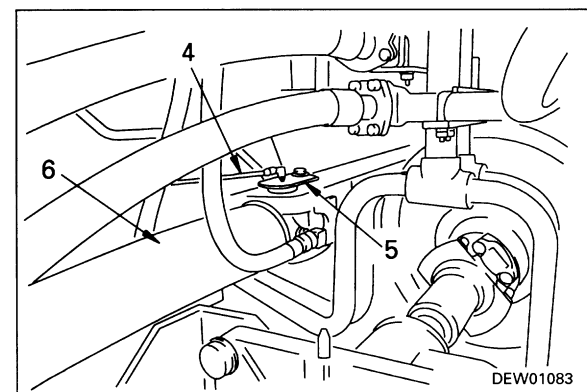
4) Remove steering cylinder (6).

★ Carry out the removal operation with two people.

★ Be careful not to scratch the cylinder rod.



Steering cylinder: 38 kg



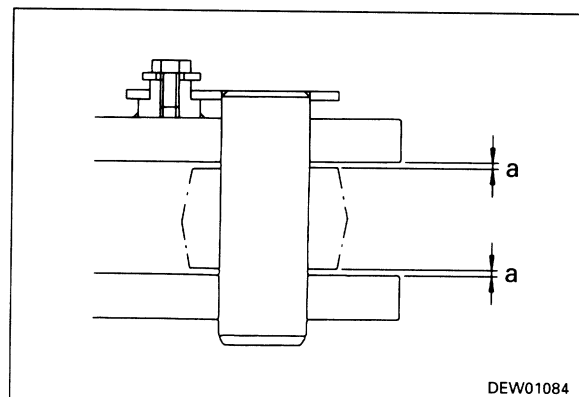
INSTALLATION OF STEERING CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.



- ⚠ Always use a bar when aligning the pin holes.
Never insert your fingers.

- ★ Adjust the shims so that clearance **a** is the standard value.
Clearance **a** = Max. 0.5 mm
- ★ Remove all grease and oil from the cylinder pin, and wipe off the grease that is pushed out.



REMOVAL OF BRAKE VALVE ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

⚠ Release the pressure inside the accumulator by depressing the brake pedal slowly and repeatedly (at least 17 times) until there is no more reaction when the brake pedal is depressed.

1. Covers

Remove covers (1) under cab.

2. Piping (right brake valve)

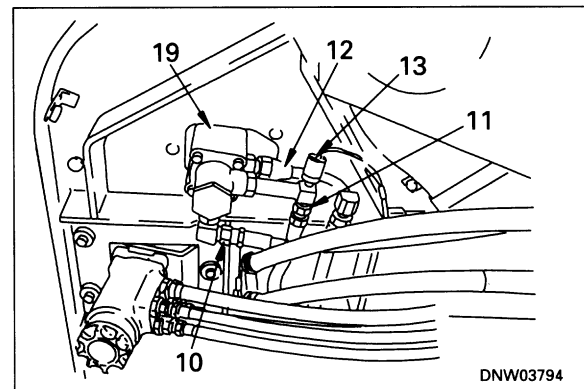
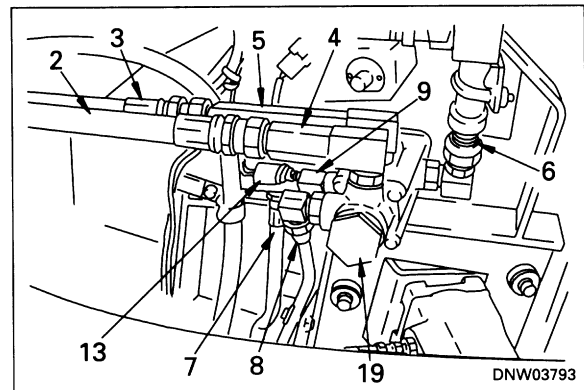
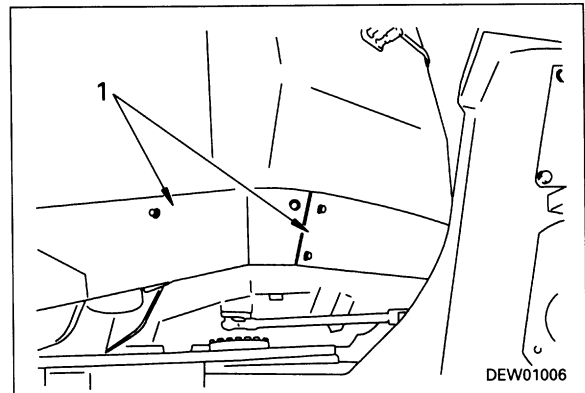
- 1) Disconnect hoses (2) and (3) between accumulator and brake valve, and adapters (4) and (5) at valve end. ※ 1
- 2) Disconnect brake valve drain hose and tube (6) at valve end.
- 3) Disconnect hose (7) going to left brake valve at valve end.
- 4) Disconnect tube (8) which goes to front brake and tube (9) going to rear brake at valve end. ※ 2

3. Piping (left brake valve)

- 1) Disconnect tube (10) and hose from accumulator to left brake valve at brake valve end. ※ 3
- 2) Disconnect left and right brake valve hoses and elbow (11) at brake valve end. ※ 4
- 3) Remove brake valve drain tube (12) and hose at valve end.
 - ★ After disconnecting the piping, make marks and fit plugs to prevent the entry of dirt or dust.

4. Wiring

Disconnect connector of brake valve switch sensor (13).



U42103

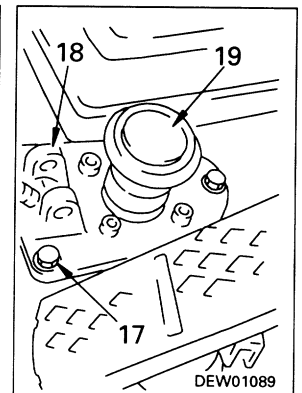
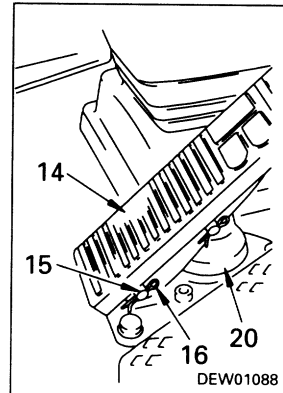
5. Pedals

Pull out cotter pin (26) from pin (15) of brake pedal (14), then pull out pin, and remove pedal.

★ Carry out the same operation for both the left and right brake pedals.

6. Brake valve

Remove brake valve mounting bolts (17), and disconnect mount flange (18) and body (19), then pull out cap (20).



INSTALLATION OF BRAKE VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1 ※ 2 ※ 3 ※ 4

- ★ Use a new part for the O-ring.
- ★ After completing the assembly, bleed the air from the brake line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.

U42103

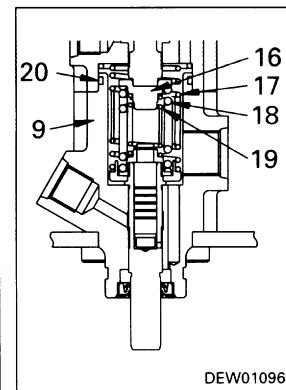
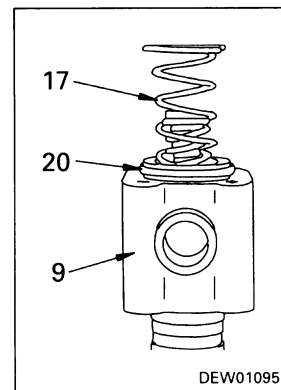
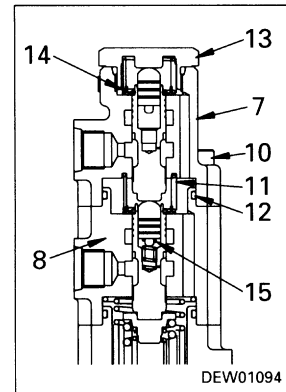
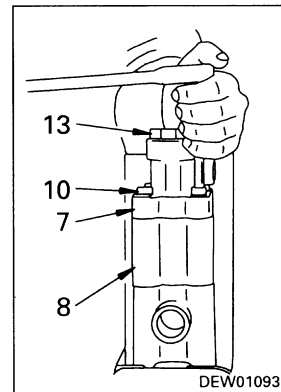
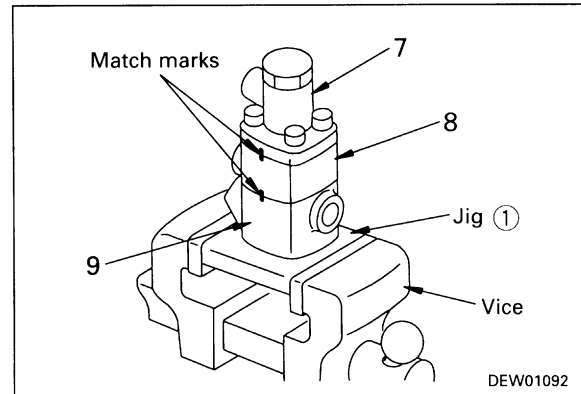
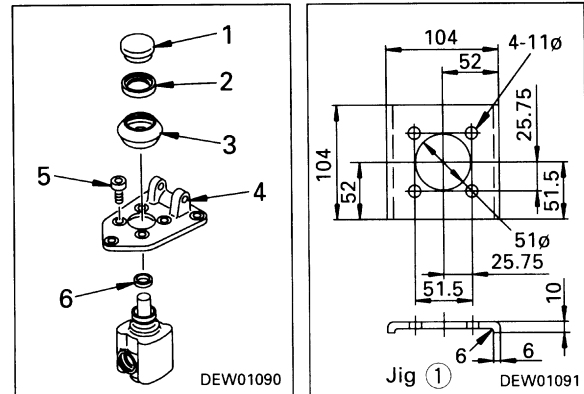
DISASSEMBLY OF RIGHT BRAKE VALVE ASSEMBLY (TANDEM)

1. Bracket assembly

- 1) Remove seat (1), pedal stopper (2), and boot (3) from brake valve.
- 2) Remove mounting bolts (5) of bracket assembly (4), then remove bracket assembly.
- 3) Remove oil seal (6) from upper portion of brake valve.

2. Valve

- 1) Install valve to jig ① with bolts (5), and secure jig in vice.
 - ★ Make match marks before disassembling the valve.
- 2) Remove valve mounting bolts (10), then remove S cylinder assembly (7).
- 3) Remove plug (13) of S cylinder assembly, then remove spring (14) and O-ring.
- 4) Remove spring (11) and O-ring (12), then remove P cylinder assembly (8).
 - ★ Remove spring (15) inside the plunger of the P cylinder assembly.
- 5) Remove holder (16), springs (17), (18), and (19) and O-ring (20) from T flange assembly (9).
 - ★ The cylinders, plungers, and spools inside the T flange assembly and the S and P cylinders form sets, so be careful not to mix the parts for any set.
 - ★ Fit seals to prevent dirt or dust from entering, and be careful not to damage the cylinders or flange assembly.



ASSEMBLY OF RIGHT BRAKE VALVE VALVE ASSEMBLY (TANDEM)

1. Valve

Install T flange assembly (9) to jig ① with bolts (5), and hold jig ① in vice.

- 1) Install springs (19), (18), and (17) to T flange assembly (9) in order, then install holder (16) on top of spring.

- 2) Install O-ring (20) to T flange assembly (9).

★ Use a new part for the O-ring.

 O-ring: **Lithium grease**

- 3) Set P cylinder assembly (8) to T flange assembly (9).

★ When setting in position, align the match marks.

- 4) Install spring (11) and spring (15) inside plunger of P cylinder assembly to P cylinder assembly (8).

- 5) Install O-ring (12) to P cylinder assembly (8).

★ Use a new part for the O-ring.

 O-ring: **Lithium grease**

- 6) Set S cylinder assembly (7) to P cylinder assembly (8), and tighten with mounting bolts (10).

★ When setting the S cylinder assembly in position, align the match marks.

 **kgm** Mounting bolt:

58.8 – 73.6 Nm (6.0 – 7.5 kgm)

- 7) Install spring (14) and O-ring to S cylinder assembly (7), and tighten with plug (13).

★ Use a new part for the O-ring.

 Thread of plug: **Thread tightener
(Thread lock 1303B)**

 **kgm** Plug:

152.0 ± 24.5 Nm (15.5 ± 2.5 kgm)

2. Bracket assembly

Remove valve from jig ①.

- 1) Set T flange assembly facing up, and install oil seal (6).

★ Use a new part for the oil seal.

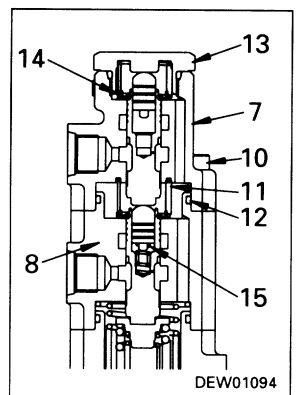
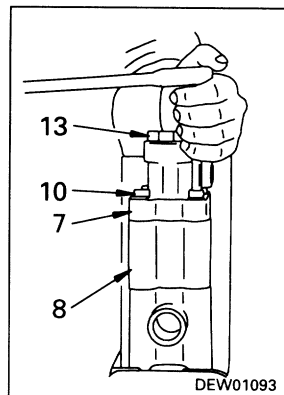
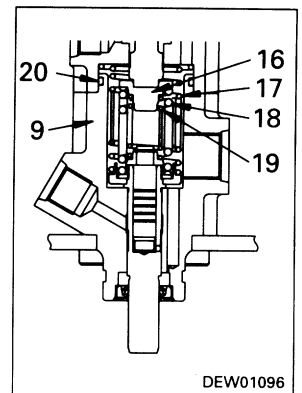
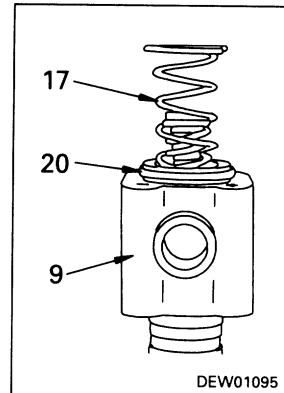
 Lip of oil seal: **Lithium grease**

- 2) Install bracket assembly (4), and tighten with mounting bolts (5).

 **kgm** Mounting bolt:

58.8 – 73.6 Nm (6.0 – 7.5 kgm)

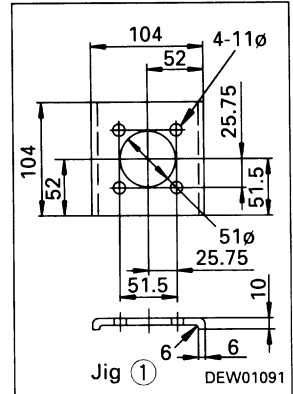
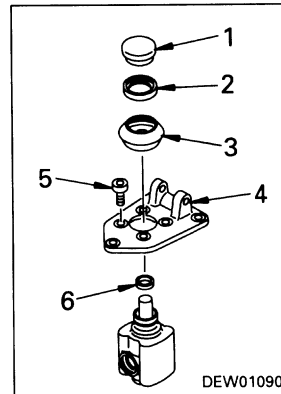
- 3) Install seat (1), pedal stopper (2), and boot (3) to valve.



DISASSEMBLY OF LEFT BRAKE VALVE ASSEMBLY (SINGLE)

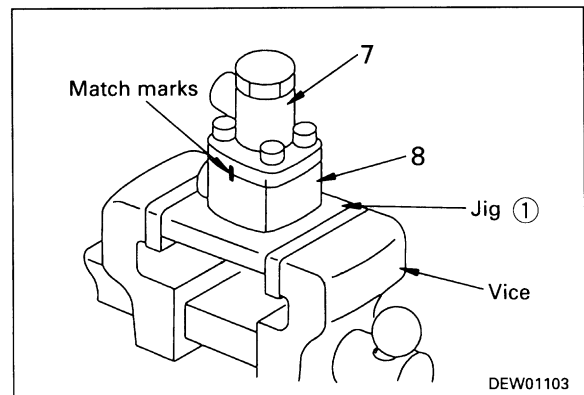
1. Bracket assembly

- 1) Remove seat (1), pedal stopper (2), and boot (3) from brake valve.
- 2) Remove mounting bolts (5) of bracket assembly (4), then remove bracket assembly.
- 3) Remove oil seal (6) from upper portion of brake valve.

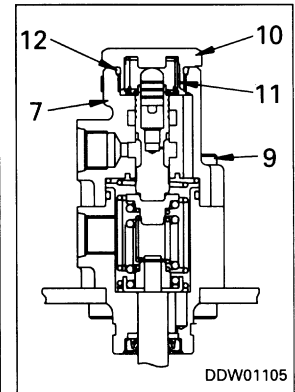
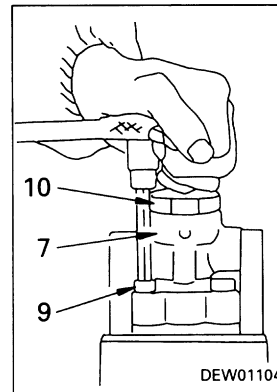


2. Valve

- 1) Install valve to jig ① with bolts (5), and secure jig in vice.
 - ★ Make match marks before disassembling the valve.

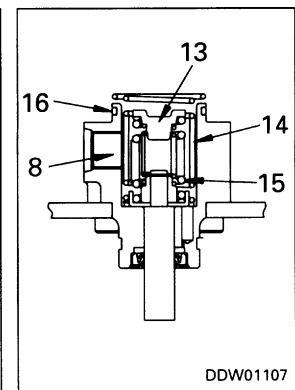
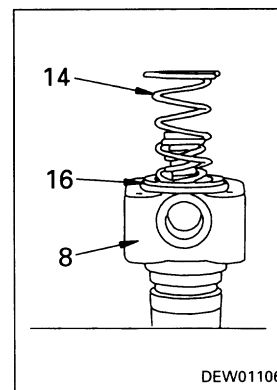


- 2) Remove valve mounting bolts (10), then remove S cylinder assembly (7).
- 3) Remove plug (10) of S cylinder assembly, then remove spring (11) and O-ring (12).



- 4) Remove holder (13), springs (14) and (15), and O-ring (16) from S flange assembly (8).

- ★ The cylinders, plungers, and spools inside the S flange and the S cylinder form sets, so be careful not to mix the parts for any set.
- ★ Fit seals to prevent dirt or dust from entering, and be careful not to damage the cylinders or flange assembly.



ASSEMBLY OF LEFT BRAKE VALVE VALVE ASSEMBLY (TANDEM)

1. Valve

Install S flange assembly (8) to jig ① with bolts (5), and hold jig ① in vice.

- 1) Install springs (14) and (15) to S flange assembly (8), then install holder (13) on top of spring.

- 2) Install O-ring (16) to S flange assembly (8).

★ Use a new part for the O-ring.

 O-ring: **Lithium grease**

- 3) Set S cylinder assembly (7) to S flange assembly (8), and tighten with mounting bolts (9).

★ When setting the S cylinder assembly in position, align the match marks.

 Mounting bolt:

58.8 – 73.6 Nm (6.0 – 7.5 kgm)

- 4) Install spring (11) and O-ring (12) to S cylinder assembly (7), and tighten with plug (10).

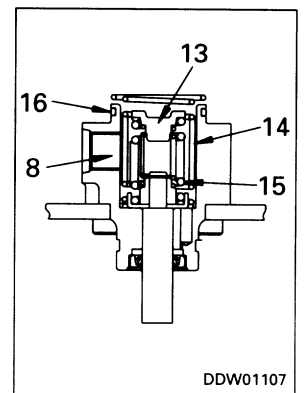
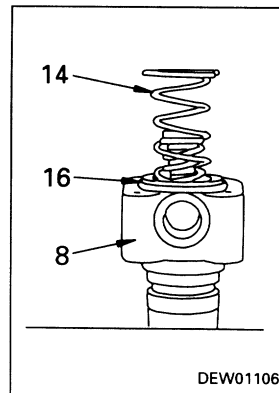
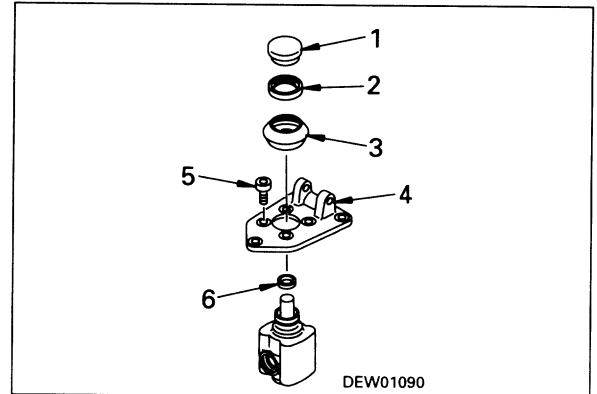
★ Use a new part for the O-ring.

 O-ring: **Lithium grease**

 Thread of plug: **Thread tightener (Thread lock 1303B)**

 Plug:

152.0 ± 24.5 Nm (15.5 ± 2.5 kgm)



2. Bracket assembly

Remove valve from jig ①.

- 1) Set S flange assembly facing up, and install oil seal (6).

★ Use a new part for the oil seal.

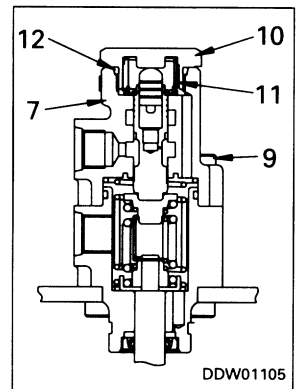
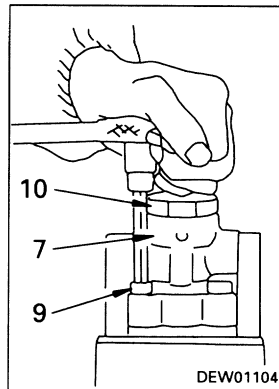
 Lip of oil seal: **Lithium grease**

- 2) Install bracket assembly (4), and tighten with mounting bolts (5).

 Mounting bolt:

58.8 – 73.6 Nm (6.0 – 7.5 kgm)

- 3) Install seat (1), pedal stopper (2), and boot (3) to valve.



REMOVAL OF SLACK ADJUSTER ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping.

⚠ Release the pressure inside the accumulator by depressing the brake pedal slowly and repeatedly (at least 17 times) until there is no more reaction when the brake pedal is depressed.

1. Raise lift arm and set tool L to lift arm cylinder rod.
★ When not using tool L, set a stand under the lift arm.

2. Remove cover (1) at front of front frame.

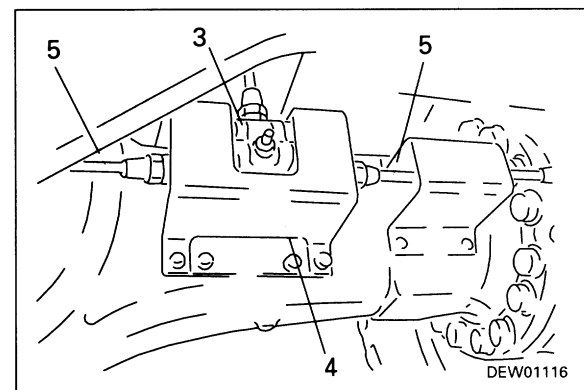
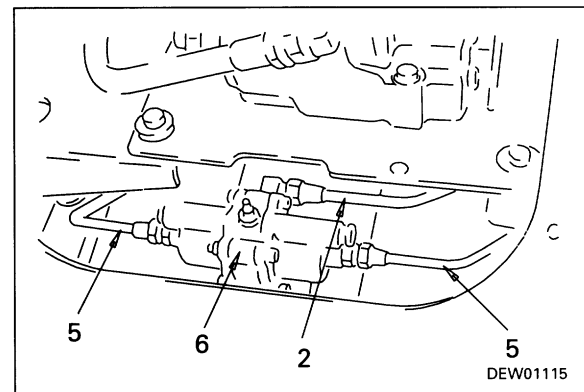
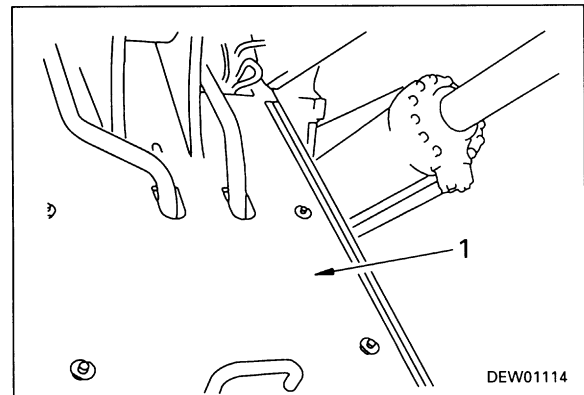
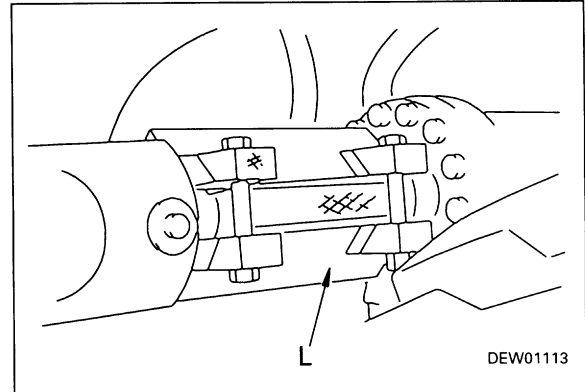
3. Brake piping

- 1) Disconnect tube (2) between slack adjuster and brake valve at adjuster end.
★ For the rear, remove slack adjuster cover (4) and disconnect tube (3).
- 2) Disconnect tubes (5) between slack adjuster and left and right brake pistons at slack adjuster end.

4. Slack adjuster

Remove mounting bolts, then remove slack adjuster (6).

※ 1



INSTALLATION OF SLACK ADJUSTER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Installation of the slack adjuster

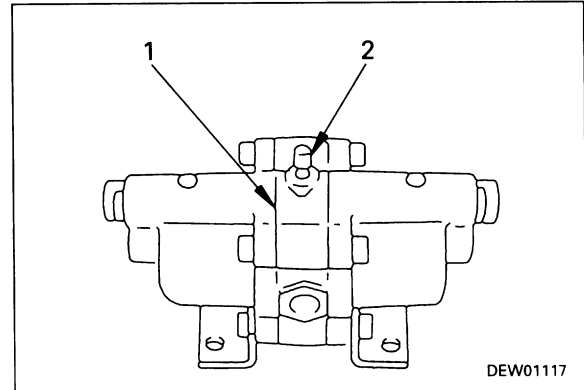
- ★ Tighten the mounting bolts temporarily, and tighten them fully after connecting the piping.
- **Refilling with oil**
Add oil through the oil filler of the hydraulic tank to the specified level.
- **Bleeding air from brake system**
Bleed the air from the brake line and check that there is no oil leakage from the connections.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air from brake system.
 - ★ When bleeding the air from the brake line, bleed the air at the slack adjuster end.

U42103

DISASSEMBLY OF SLACK ADJUSTER ASSEMBLY

1. Bleeder

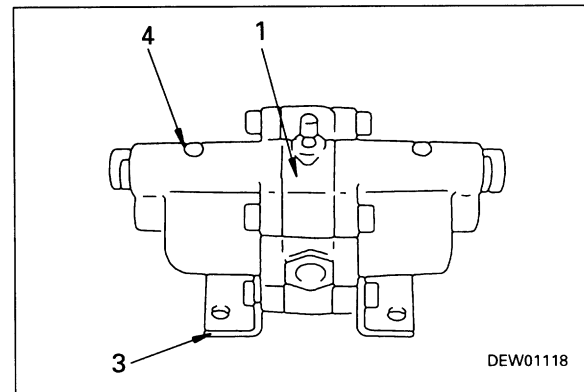
Remove bleeder (2) from body (1).



2. Cylinder

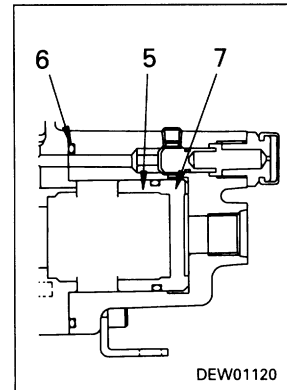
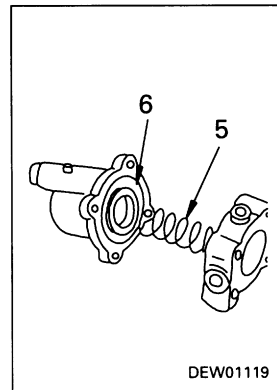
Remove mounting bolts, and disconnect body (1) and cylinder (4) together with bracket (3).

⚠ The internal parts are under the tension of the spring, so hold the mating surface down by hand and remove carefully.



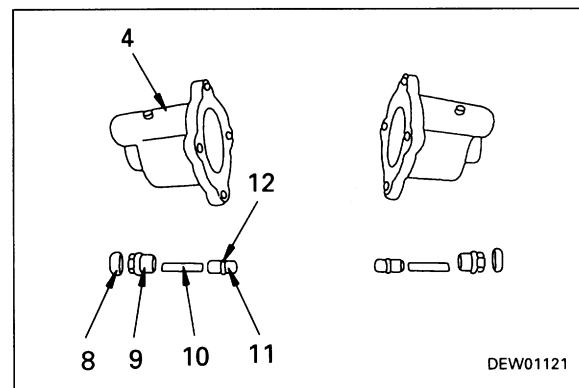
3. Piston

- 1) Remove spring (5) and O-ring (6).
- 2) Push out piston (7), and remove O-ring.
 - ★ When removing the piston, push out slowly with a 10 mm diameter rod.
 - ★ Be careful not to damage the thread with the rod.



4. Poppet

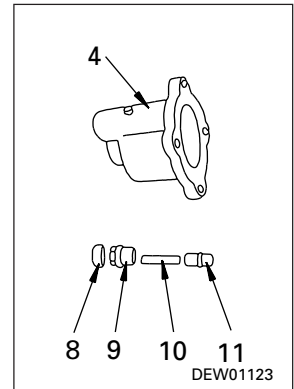
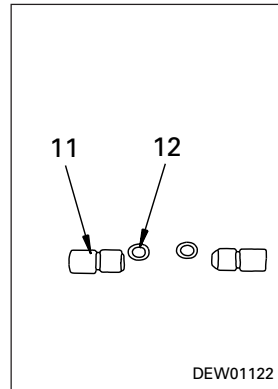
- 1) Remove cover (8) from cylinder (4), then remove plug (9), spring (10), and poppet (11).
 - ★ When removing the poppet, blow in air from the oil hole in the cylinder.
 - ★ Hold the cylinder oil port by hand and be careful not to blow the air in strongly.
- 2) Remove O-ring (12) from poppet.



ASSEMBLY OF SLACK ADJUSTER ASSEMBLY

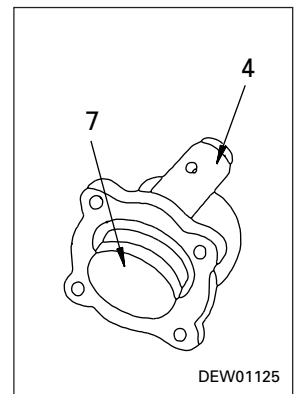
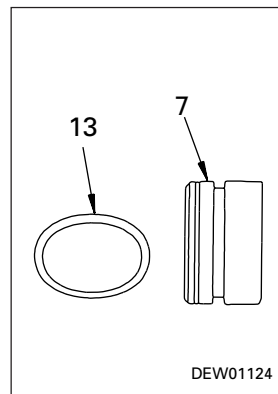
1. Poppet

- 1) Assemble O-ring (12) to poppet (11).
- 2) Assemble poppet (11), spring (10), plug (9), and cover (8), then assemble to cylinder (4).



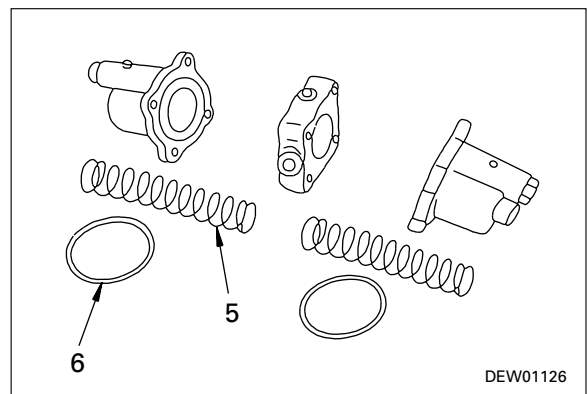
2. Piston

- 1) Install O-ring (13) to piston (7).
- 2) Insert piston (7) in cylinder (4).
- ★ Check that the piston moves smoothly.



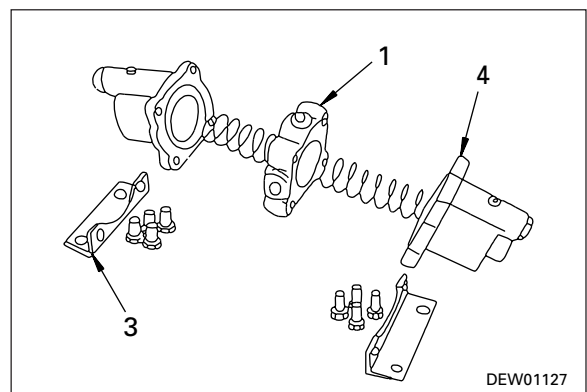
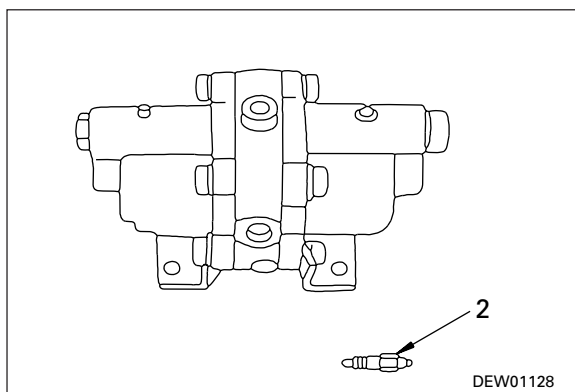
3. Cylinder

- 1) Install O-ring (6) and spring (5) to cylinder.
- ★ Installed load of spring: 4.4 kg
- 2) Install body (1) and cylinder (4) together with bracket (3).



4. Bleeder

- Install bleeder (2).



DISASSEMBLY OF BRAKE ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Jack up the axle, and set block ① under the front frame.

1. Tire, wheel

Jack up axle, and insert stand under axle, then lift off tire and wheel (1).

★ After removing the tire and wheel, set a stand under the axle housing.



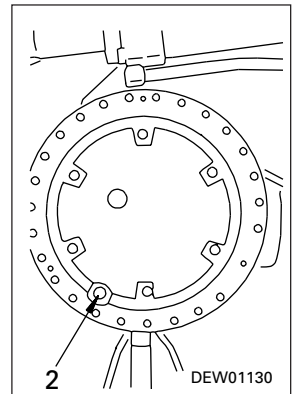
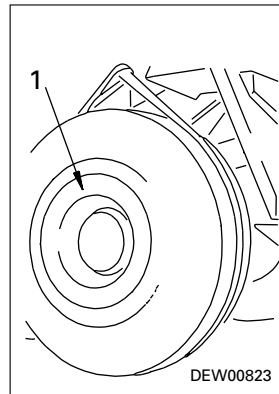
Tire, wheel: **550 kg (23.5-25 tire)**
644 kg (26.5-25 tire)

2. Draining oil

Set drain plug (2) immediately at bottom, then remove plug and drain oil from case.

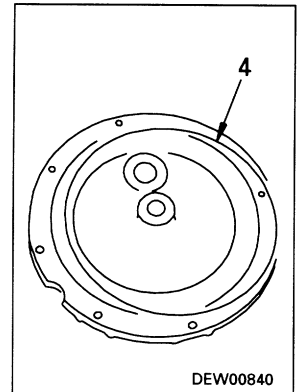
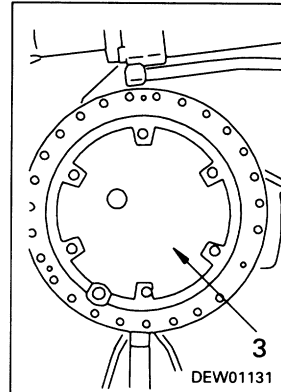


Axle oil: **65 ℓ**

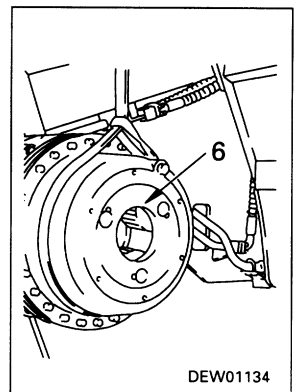
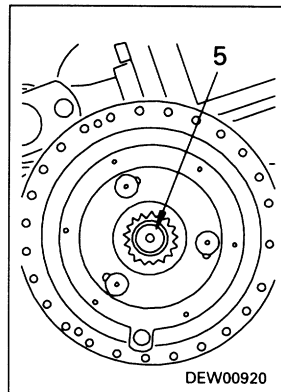


3. Cover

Remove cover (3), then remove O-ring (4).

**4. Axle shaft**

Using forcing screws (Thread dia.=12mm, Pitch=1.75mm), pull out axle shaft (5) approx. 200 mm.

**5. Planetary carrier**

Remove 3 mounting bolts, and lift off planetary carrier (6).

- ★ Make match marks and use as a guide when assembling.
- ★ Be careful of the center of gravity and remove slowly.

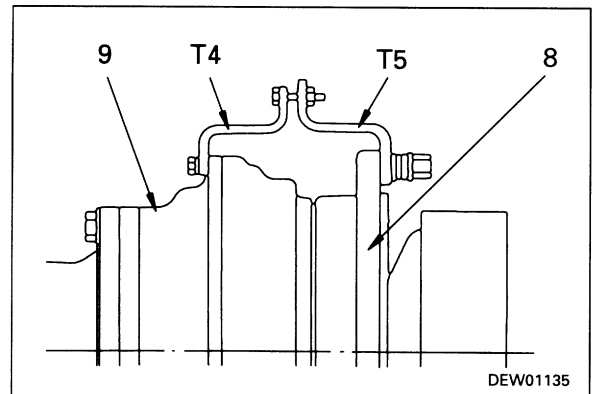


Planetary carrier: **86 kg**

6. Ring gear

1) Using tools **T4** and **T5**, secure wheel hub (8) and brake (9).

- ★ Install tools **T4** and **T5** at three equally spaced places, then use a washer to adjust the clearance.

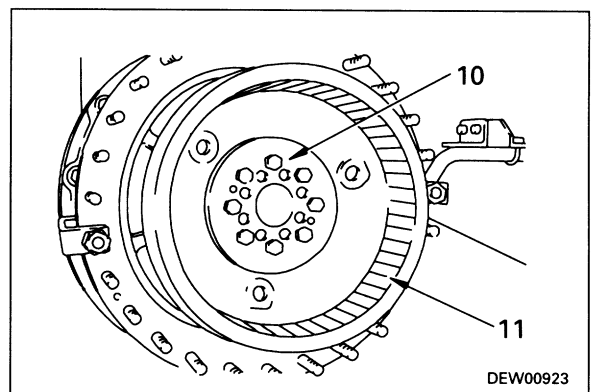


2) Remove mounting bolts of retainer (10), then remove ring gear (11).

- ★ Check the number and thickness of the shims between the retainer and the axle housing, and keep in a safe place.

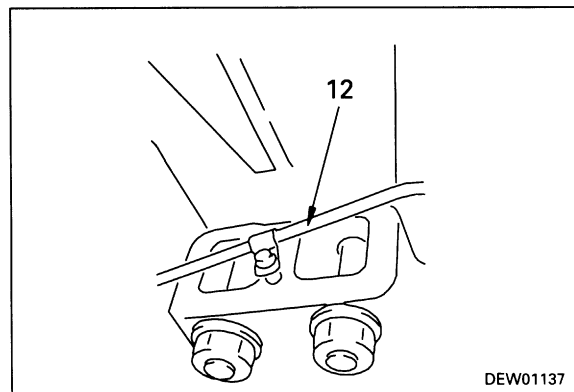


Ring gear: **35 kg**



7. Brake, wheel hub

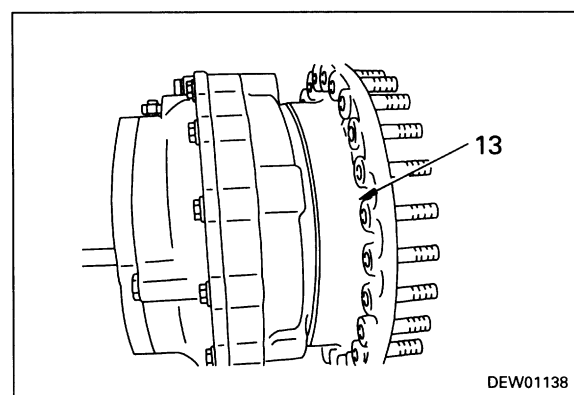
- 1) Remove brake tube (12).



- 2) Sling brake and wheel hub (13), then remove mounting bolts and lift off.



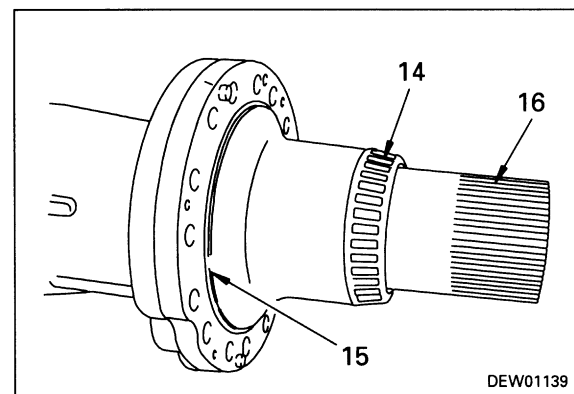
kg Brake, wheel hub: **195 kg**

**8. Axle housing**

Remove bearing (14), O-ring (15), trunnion (16), and O-ring of trunnion mount portion from axle housing.



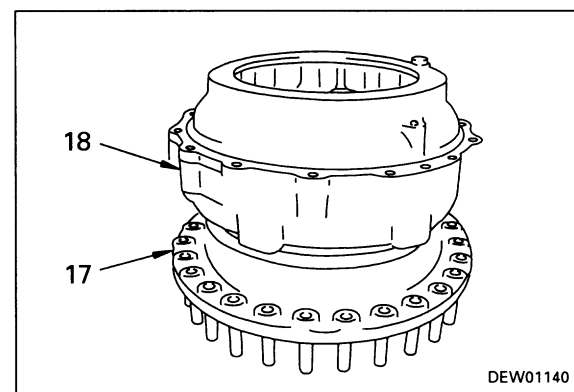
kg Trunnion: **54 kg**

**9. Piston, cylinder**

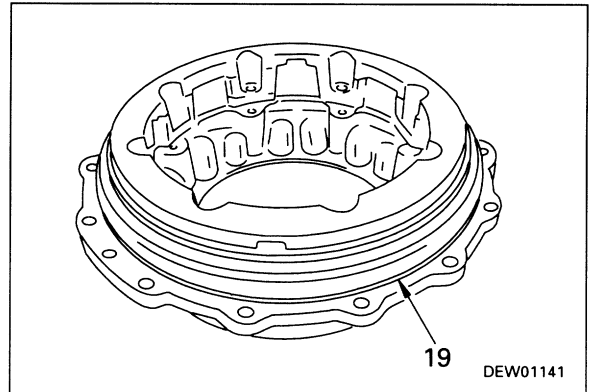
- 1) Set wheel hub (17) at bottom, and remove tool T4.
- 2) Using eyebolts, lift off cylinder assembly (18).



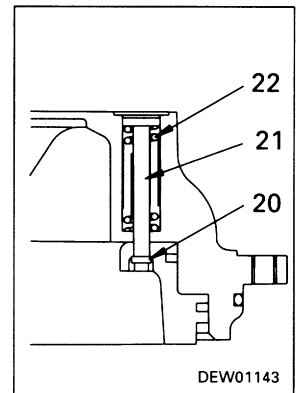
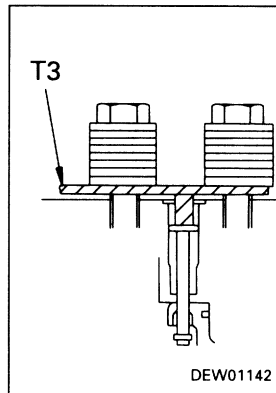
kg Cylinder assembly: **63 kg**



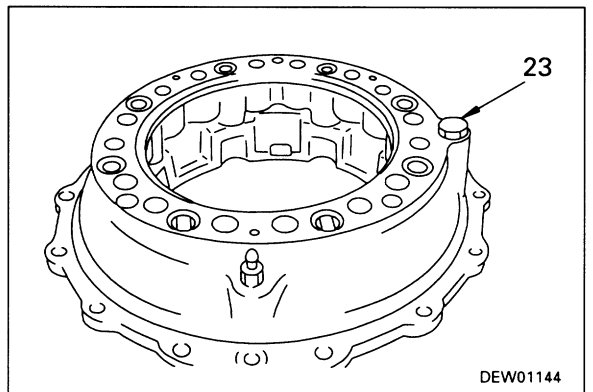
- 3) Remove O-ring (19) from cylinder assembly.



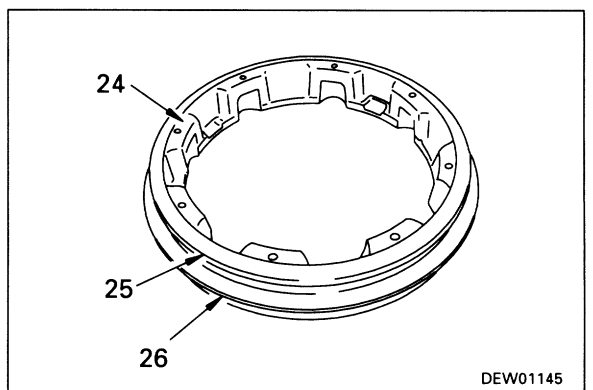
- 4) Using tool **T3**, pull out pin (20) from cylinder assembly, and remove rod (21) and piston return spring (22).
 ★ The pin is small, so be careful not to lose it.



- 5) Blow in air from brake oil filler (23) to push out piston (24).
 ★ Hold one end of the piston by hand, blow in air slowly, and be careful not to let the piston fly out.
 ★ Be careful not to damage the piston.

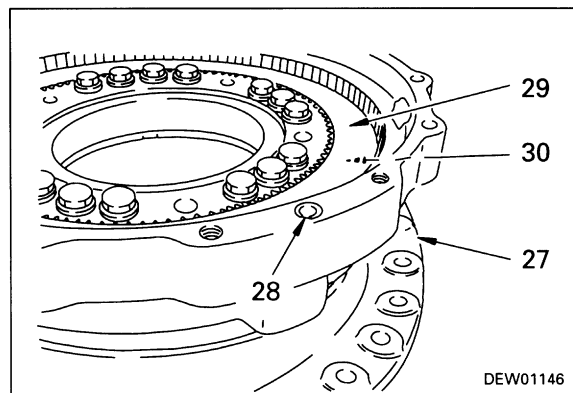


- 6) Remove seals (25) and (26) from piston (24).



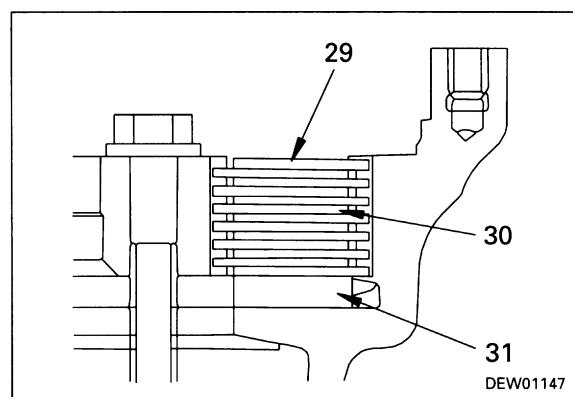
10. Outer gear

- 1) Remove O-ring (28) from outer gear (27).

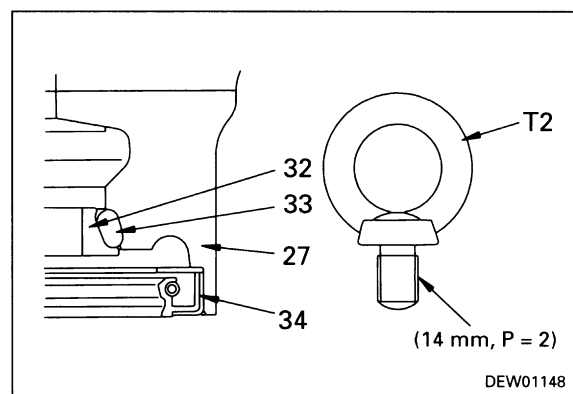


- 2) Remove plates (29) and discs (30) from outer gear in order, then remove spacer (31).

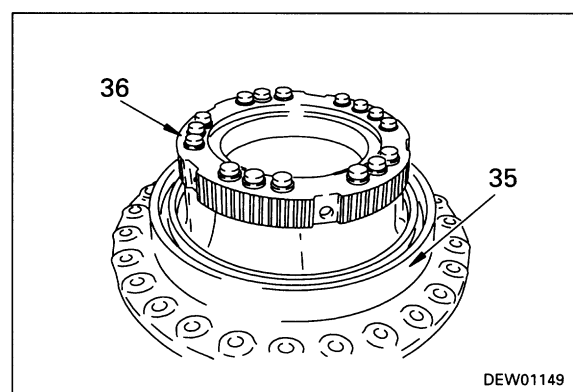
- ★ When removing the discs, make match marks on the inner gear and disc, outer gear and plate, and on the spacer.
- ★ The plates are made of a soft material, so remove them extremely carefully and be careful not to damage them.



- 3) Using tool **T2**, lift off outer gear (27) from wheel hub (35), and remove seal ring (32) and O-ring (33).
- 4) Remove oil seal (34) from outer gear (27).

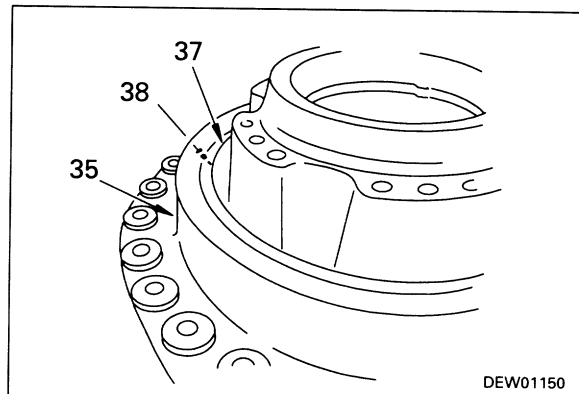
**11. Inner gear**

Remove mounting bolts, then remove inner gear (36) from wheel hub (35).

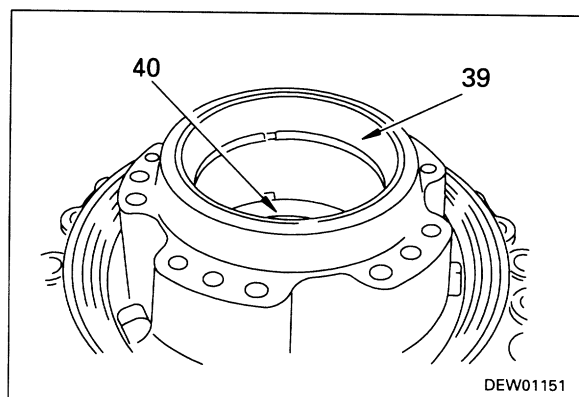


12. Wheel hub

- 1) Remove seal ring (37) and O-ring (38) from wheel hub (35).



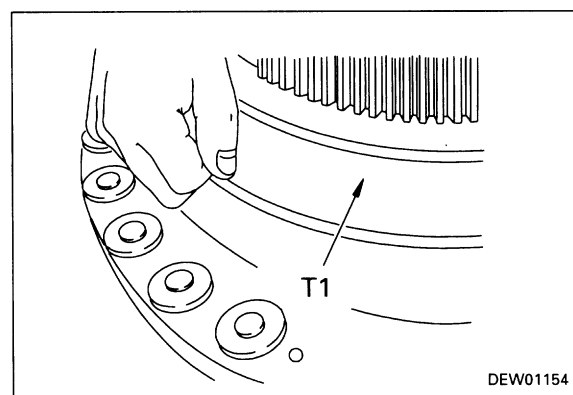
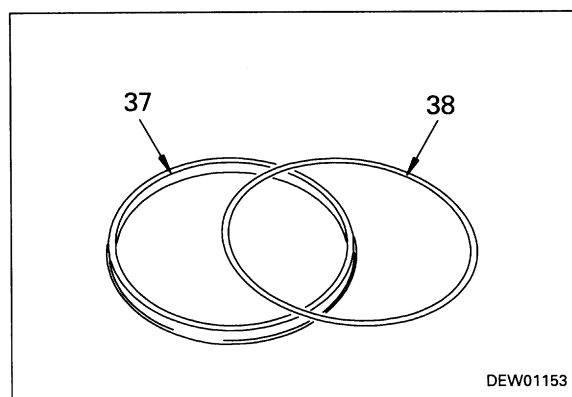
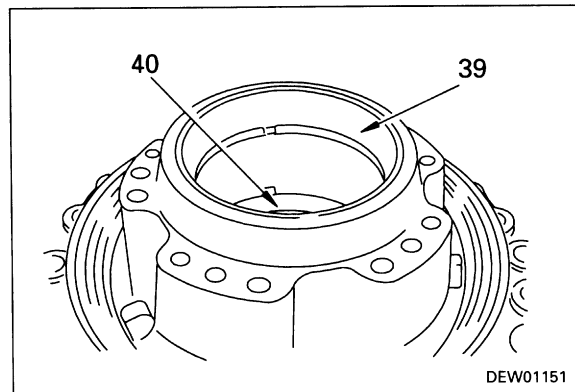
- 2) Remove bearing cups (39) and (40) from wheel hub.



ASSEMBLY OF BRAKE ASSEMBLY

1. Wheel hub

- 1) Press fit bearing cups (39) and (40) to wheel hub (35).
- 2) Install O-ring (38) to seal ring (37), and using tool **T1**, install to wheel hub.
 - ★ Use alcohol to completely remove the white powder from the surface of the O-ring.
 - ★ Remove all oil and grease from the O-ring contact surface of the seal ring and retainer.
 - ★ Be careful not to twist the O-ring when installing it.

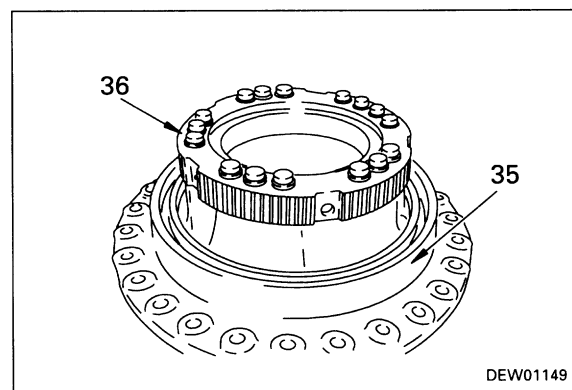


2. Inner gear

Install inner gear (36) to wheel hub (35).

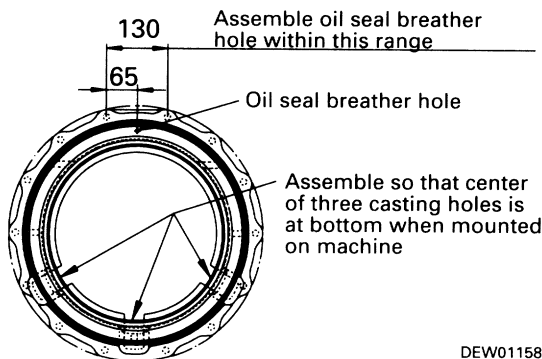
 Mounting bolt:

279.5 ± 29.4 Nm (28.5 ± 3.0 kgm)

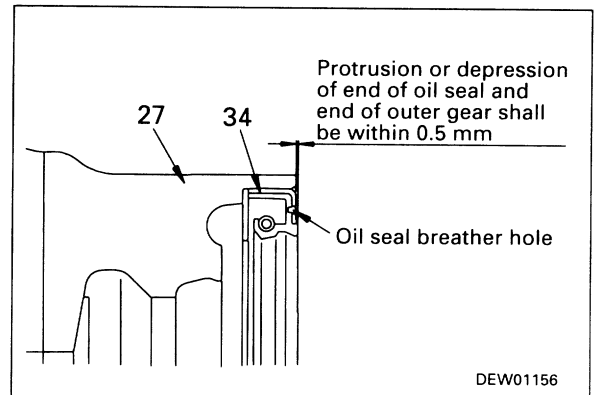


3. Outer gear

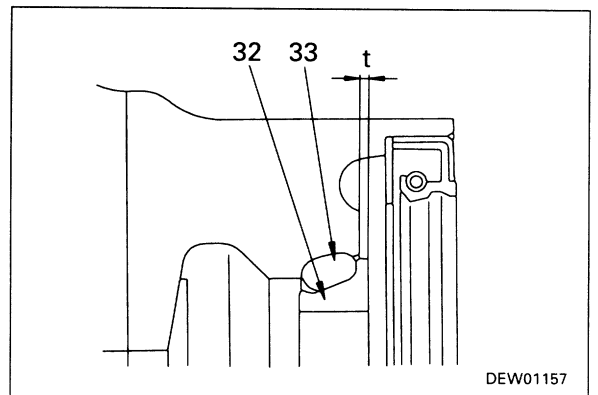
- 1) Press fit oil seal (34) to outer gear (27).
 - ★ When press fitting the oil seal, be careful of the direction of the oil seal breather hole.



DEW01158

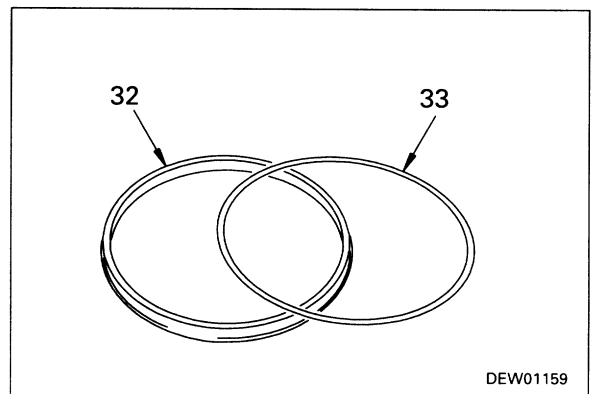


DEW01156

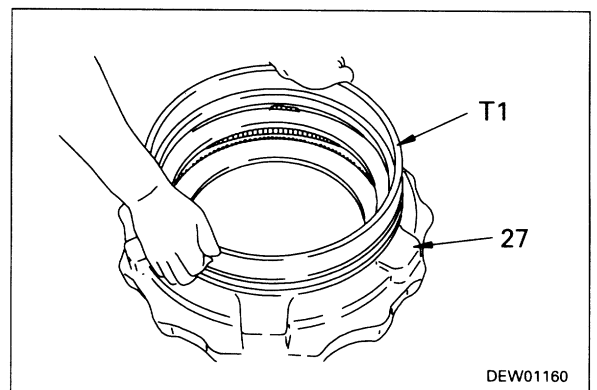


DEW01157

- 2) Install O-ring (33) to seal ring (32), and using tool **T1**, install to outer gear (27).
 - ★ Use alcohol to completely remove the white powder from the surface of the O-ring.
 - ★ Remove all oil and grease from the O-ring contact surface of the seal ring and outer gear.
 - ★ Tighten tool **T2** uniformly so that there is no twisting of the O-ring for the seal ring. After press fitting, measure height **t** at 4 places around the circumference and check that the difference in the measurements is within 1 mm.



DEW01159



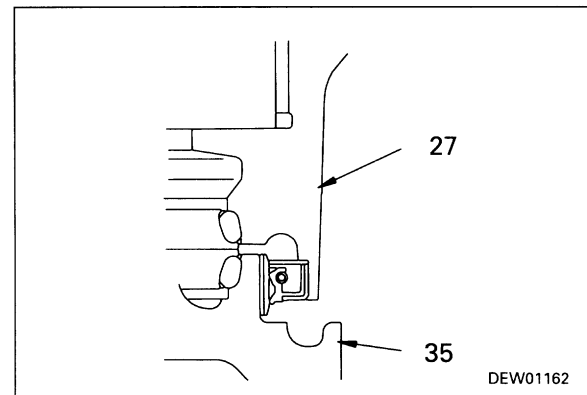
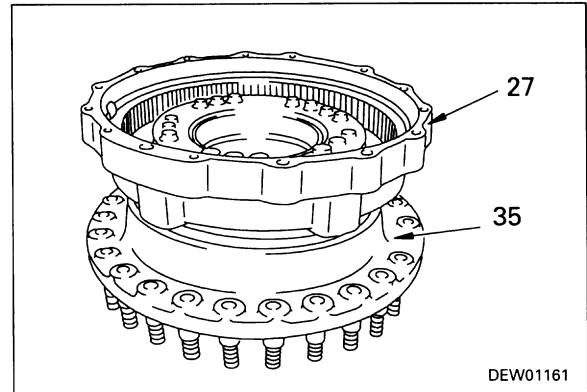
DEW01160

 Lip of oil seal: **Grease (G2-LI)**

- 3) Using tool **T2**, assemble outer gear (27) to wheel hub (35).

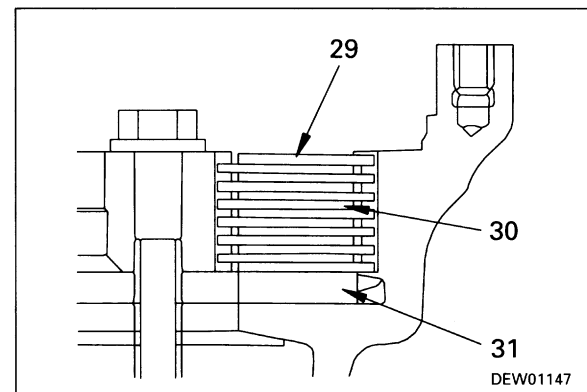
- ★ When assembling, check that there are no scratches on the seal ring mating surface.
- ★ Check that the seal ring is not installed at an angle.

 Mating surface of seal ring: **Axle oil**

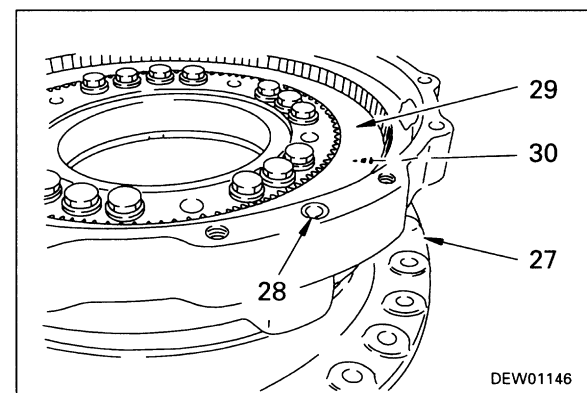


- 4) Align match marks on outer gear (27) and spacer (31), plates (29), and on discs (30) and inner gear, then assemble plates and discs in turn.

- ★ Set with the chamfered side of the spacer facing down.
- ★ Check that the final plate is meshed securely with the outer gear spline.
- ★ Soak the discs in brake oil for at least 30 minutes before assembling.
- ★ Align the match marks on the discs and inner gear when assembling.



- 5) Install O-ring (28) to outer gear (27).

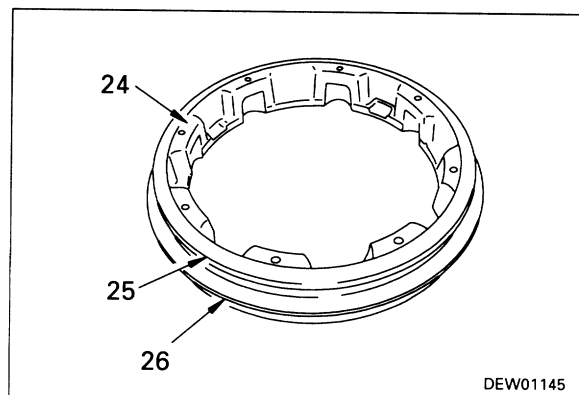


4. Piston, cylinder

- 1) Install seals (25) and (26) to piston (24).

★ Fit the seal in the groove securely.

 Seal: **Brake oil**



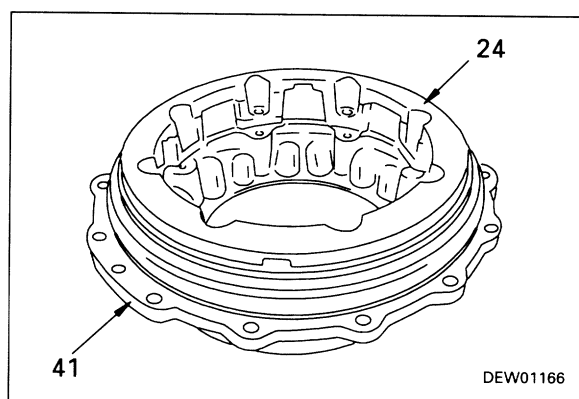
DEW01145

- 2) Press fit piston (24) to cylinder (41).

★ When press fitting the piston, tap with a plastic hammer. Do not use a steel or copper hammer.

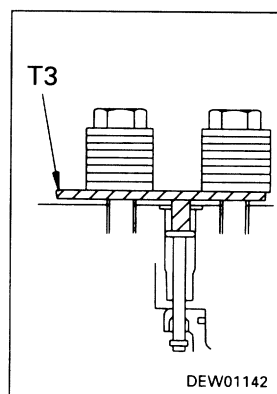
★ Coat the press-fitting portion of the piston and the outside circumference of the piston with brake oil.

 Sliding surface of piston: **Brake oil**

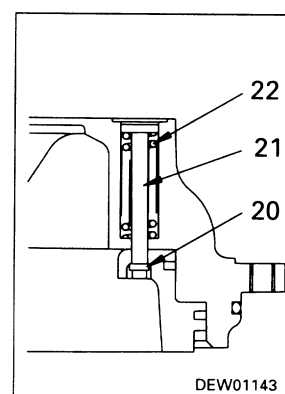


DEW01166

- 3) Using tool **T3**, insert piston return spring (22) and rod (21) in cylinder assembly, and lock with pin (20).

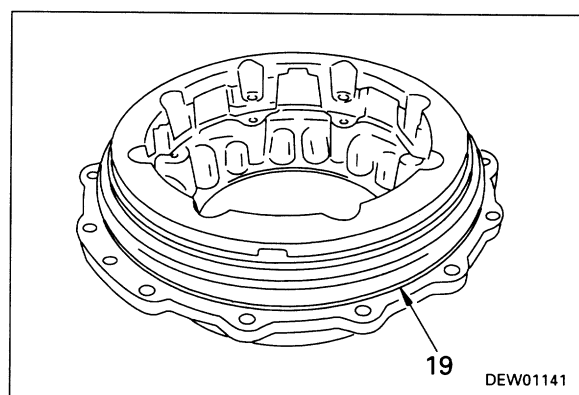


DEW01142



DEW01143

- 4) Install O-ring (19) to cylinder assembly.

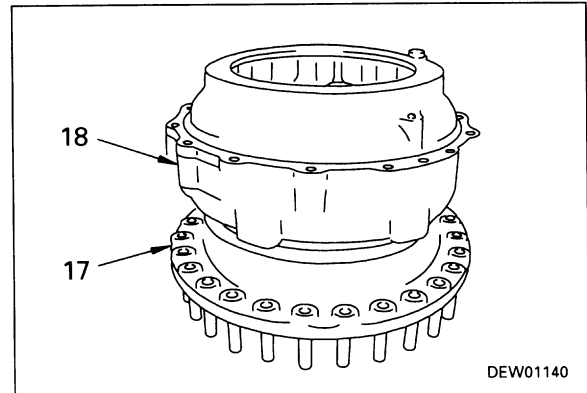


DEW01141

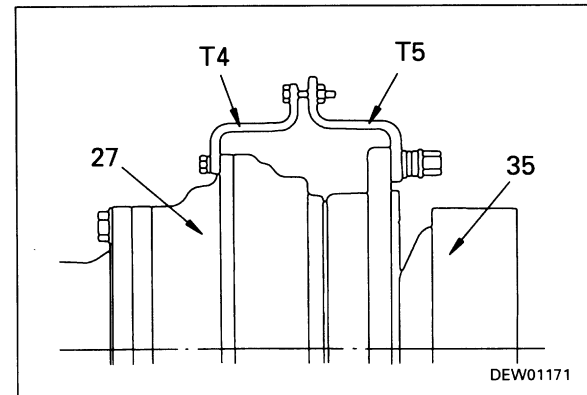
- 5) Using eyebolts, install cylinder assembly (18).

 Mounting bolt:

$176.5 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2.0 \text{ kgm}$)



- 6) Set wheel hub (35) at bottom, and using tools **T4** and **T5**, tighten uniformly so that it does not come out.



5. Axle housing

- 1) Install O-ring to trunnion and axle housing, and tighten with bolts.

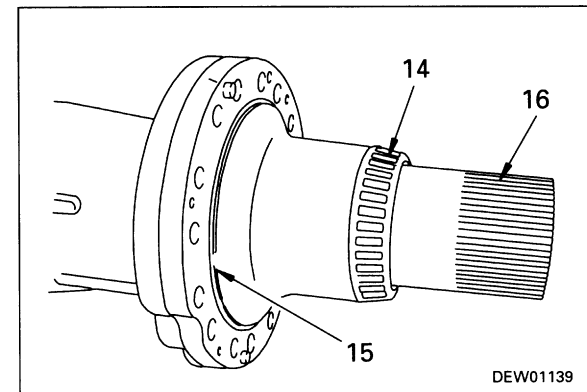
★ Use a new part for the O-ring.

 Mounting bolt:

$926.7 \pm 103 \text{ Nm}$ ($94.5 \pm 10.5 \text{ kgm}$)

- 2) Install O-ring (15) to trunnion (16), and press fit bearing (14).

★ Use a new part for the O-ring.



6. Brake, wheel hub

- 1) Raise brake and wheel hub (13), and set to axle housing mount, then tighten with mounting bolts.

★ Be careful of the center of gravity and raise the brake horizontally.

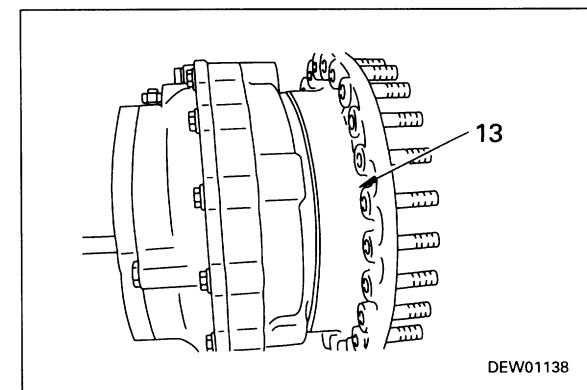
★ If it is forced in, the O-ring will be twisted and damaged, so align the center and install slowly.

 Mounting bolt:

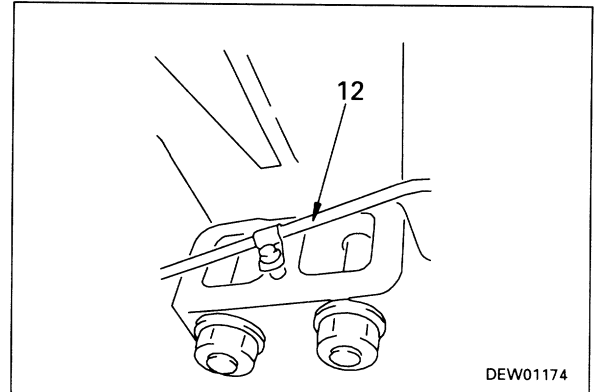
Thread tightener (LT-2)

 Mounting bolt:

$549.2 \pm 58.8 \text{ Nm}$ ($56.0 \pm 6.0 \text{ kgm}$)



- 2) Install brake tube (12).



7. Ring gear

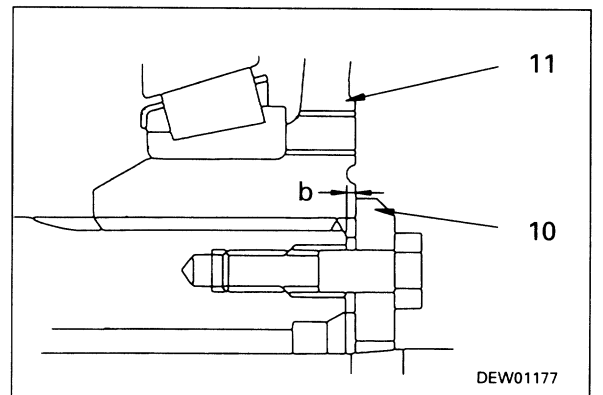
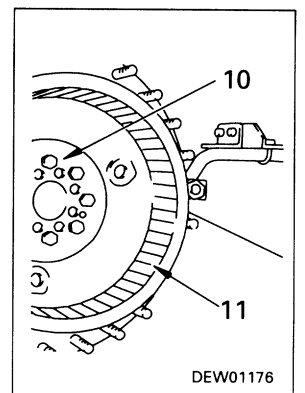
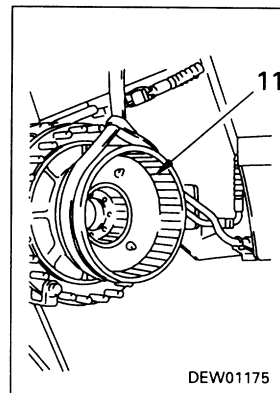
- 1) Raise ring gear (11) and set in mounting position, then install to axle housing.
 - ★ Align the spline groove and install slowly.
- 2) Tighten retainer (10) with 3 bolts temporarily, and remove tools **T4** and **T5**.
 - ★ Temporarily tighten the retainer without inserting shims.
 - ★ Rotate the wheel hub to settle the bearing and tighten uniformly until the torque is the specified torque.



Retainer mounting bolt:

$73.6 \pm 1 \text{ Nm}$ ($7.5 \pm 0.1 \text{ kgm}$)

- 3) Measure clearance **b** between end face of housing and end face of retainer from measurement hole of retainer (10) with depth micrometer.
 - ★ Measure at two places and take the average.
 - ★ Shim thickness = Clearance **b** + 0.3 mm.
 - ★ Select the shim thickness to give the minimum number of shims.
 - ★ Shim thickness: 1.0 mm, 0.5 mm, 0.2 mm, 0.05 mm



- 4) Install tools **T4** and **T5** to brake and wheel hub, remove retainer, install selected shims, then install retainer.

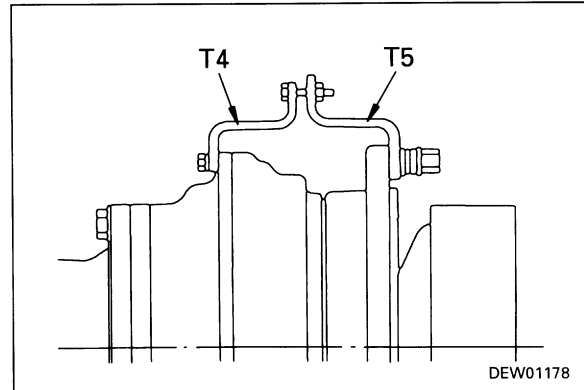
- ★ When assembling the shim, always install tools **T4** and **T5** first.
- ★ Rotate the wheel hub and tighten uniformly until the torque is the specified torque.

 Mounting bolt:

Thread tightener (LT-2)

 Mounting bolt:

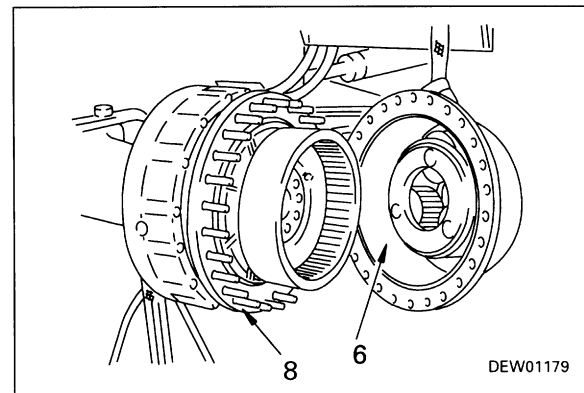
176.5 ± 19.6 Nm (18.0 ± 2.0 kgm)



8. Planetary carrier

Assemble O-ring to wheel hub (8), then raise planetary carrier (6), set in mounting position, and install.

- ★ Use a new part for the O-ring.
- ★ Align the mounting holes and install slowly so that the O-ring does not come out of position.



9. Axle shaft

Install axle shaft (5).

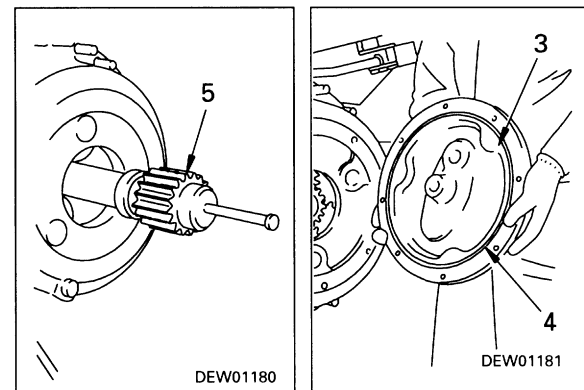
- ★ Rotate the wheel hub to align the position when installing the sun gear.

10. Cover

Fit O-ring into groove of cover, and install cover (3).

 Mounting bolt:

112.8 ± 9.8 Nm (11.5 ± 1.0 kgm)

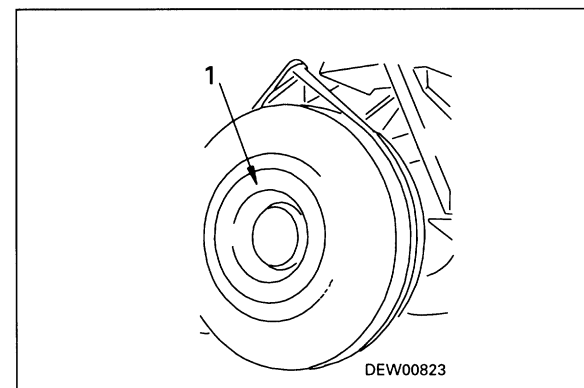


11. Tire, wheel

Install tire and wheel (1) and remove stand.

 Mounting nut:

476.7 ± 49.0 Nm (48.0 ± 5.0 kgm)



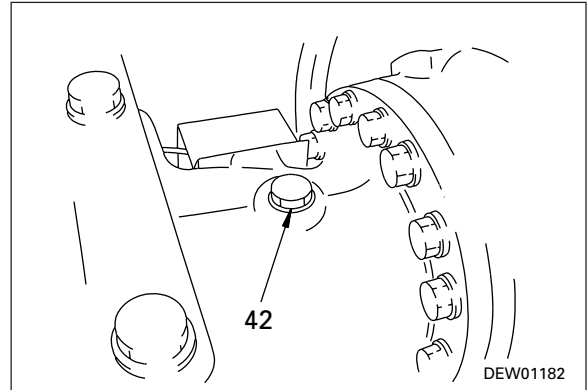
12. Refilling with oil

- 1) Tighten drain plug of axle, and add oil through oil filler (42) to specified level.
★ Set the machine with the drain plug immediately at the bottom, then add oil through the level plug.



Axle oil: **65 ℓ (both front and rear)**

- 2) Connect hose between hydraulic tank and brake chamber, and add hydraulic oil through oil filler of hydraulic tank to specified level.



13. Testing, adjusting brake

- 1) Bleed air from brake line and adjust brake.
For details, see TESTING AND ADJUSTING.
- 2) After completing all of the operations, check for any leakage of brake oil.
For details, see TESTING AND ADJUSTING.

REMOVAL OF PARKING BRAKE DISC

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then put blocks under the wheels to prevent the machine from moving.

★ Do not apply the parking brake.

1. Loosen drain plug and drain transmission oil.



Transmission:

40 ℓ (Serial No.: 50001 – 53000)

60 ℓ (Serial No.: 53001 and up)

2. **Drive shaft**

Remove guard of drive shaft, and disconnect lower front drive shaft (1) at transmission end.

※ 1

★ After disconnecting the drive shaft, move it to the right.

3. **Suction tube**

1) Remove mounting bolt (3) and washer (4) of coupling (2) at front of transmission, then remove coupling.

※ 2

2) Remove suction tube (5) at transmission end.

4. **Parking brake**

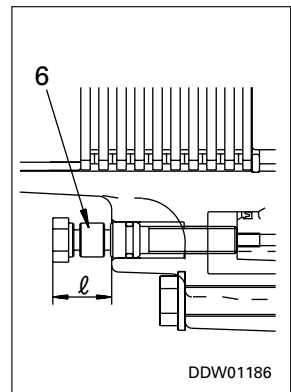
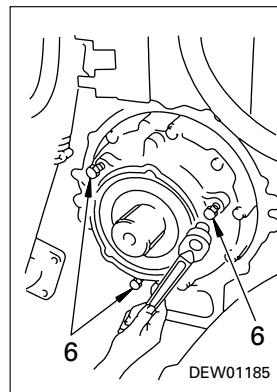
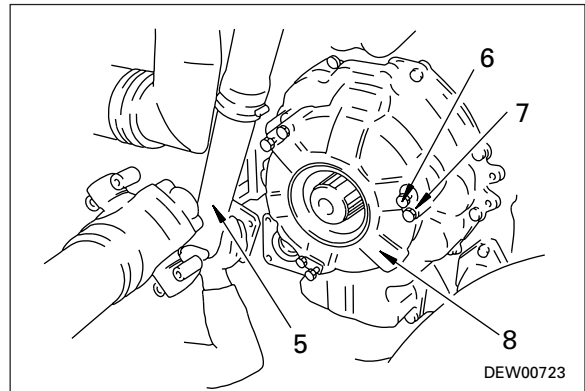
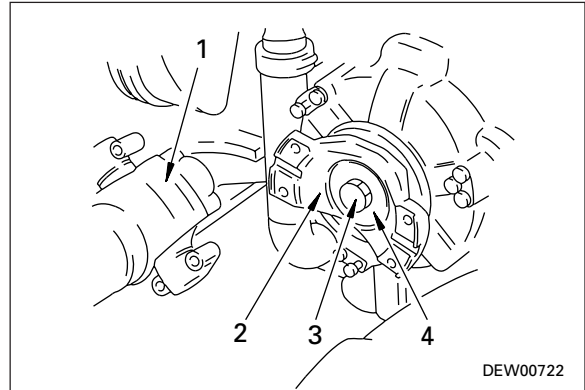
1) Remove lock plates (7) of parking brake manual release bolts (6), then remove 3 release bolts.

2) Remove parking brake case (8).

3) Screw in 3 manual release bolts (6), and release parking brake.

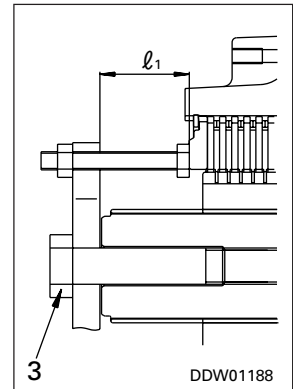
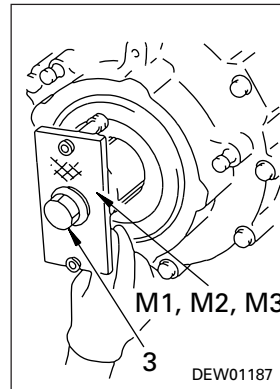
★ Distance ℓ to screw in bolt = 28 mm

Screw in all three bolts uniformly.

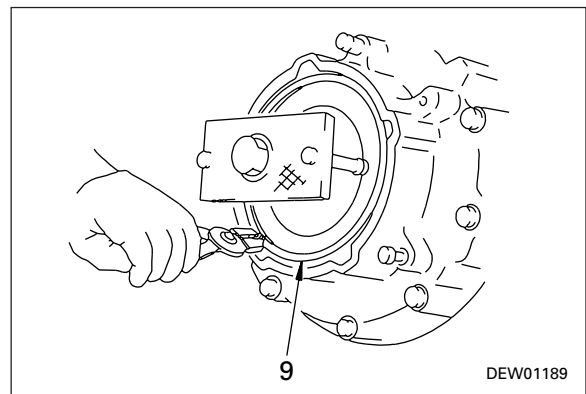


- 4) Set length of bolt of tools **M1**, **M2**, and **M3** to ℓ_1 , then tighten with coupling mounting bolt (3).

★ Length of bolt of tool ℓ_1 : 65 mm

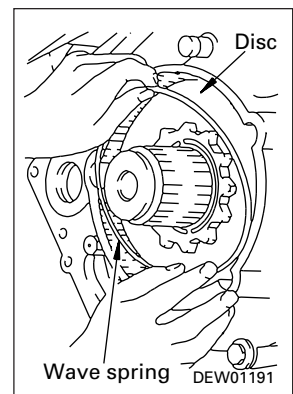
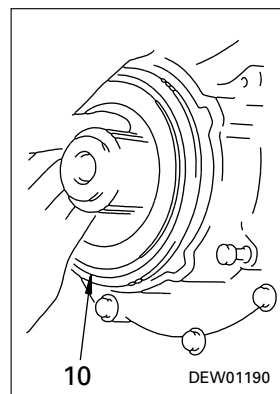


- 5) Remove snap ring (9) from case, then remove tools **M1**, **M2**, and **M3**.



- 6) Remove end plate (10), plate, disc, and wave spring from case.

※ 3



INSTALLATION OF PARKING BRAKE DISC

- Carry out installation in the reverse order to removal.

※ 1



Drive shaft:

 $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

※ 2



Coupling mounting bolt:

 $921.8 \pm 98.1 \text{ Nm}$ ($94.0 \pm 10.0 \text{ kgm}$)

End face of coupling:

Anti-friction compound (LM-G)

※ 3

Insert the plates and discs in the case in order, and assemble the wave springs between the plates.

- ★ When assembling end plate (10), pay attention to the tool mark (one groove) on the face.

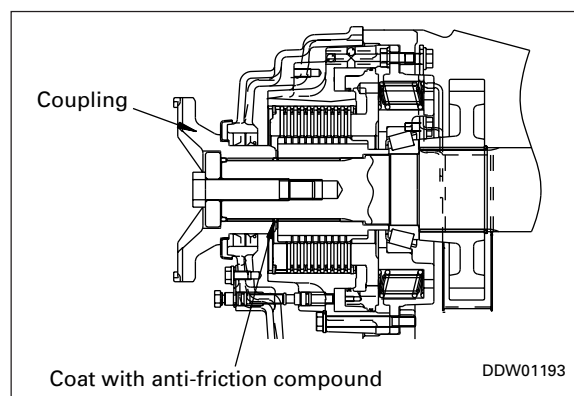
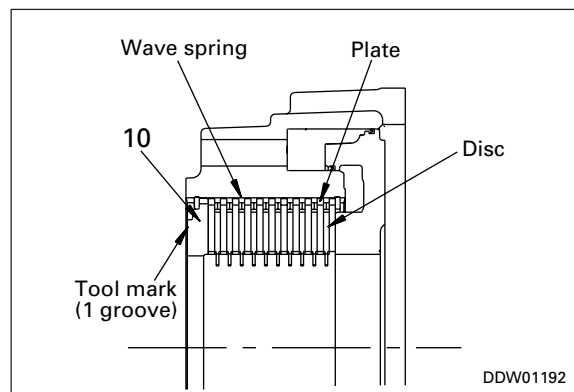
- Tighten the drain plug of the transmission, and add oil.



Transmission:

40 ℓ (Serial No.: 50001 – 53000)**60 ℓ (Serial No.: 53001 and up)**

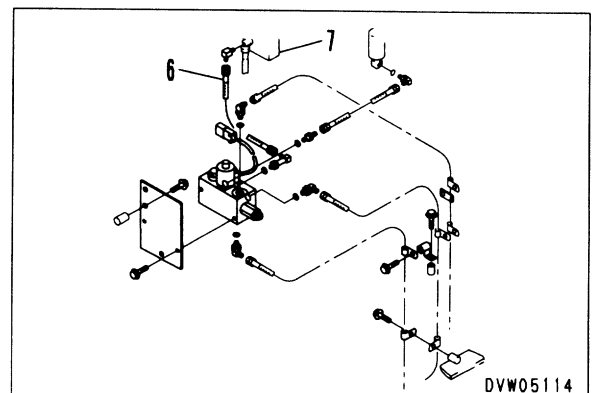
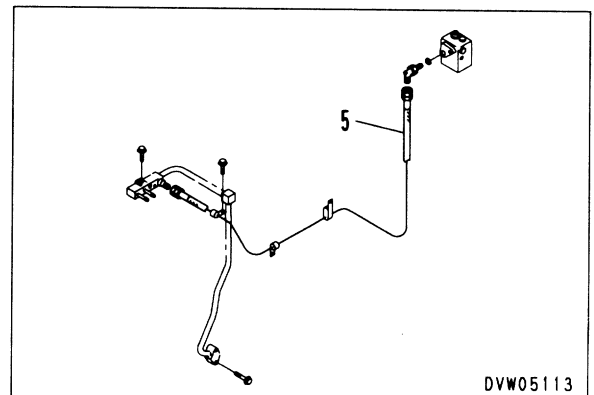
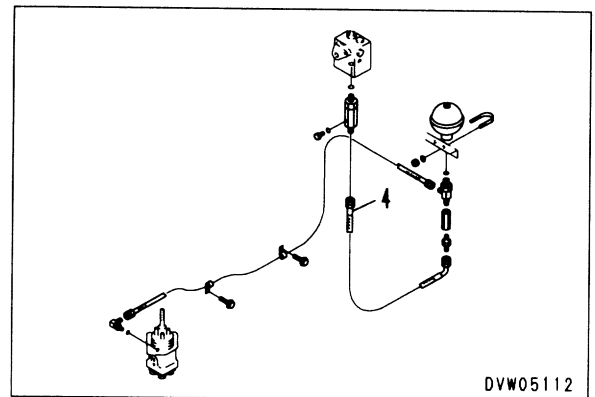
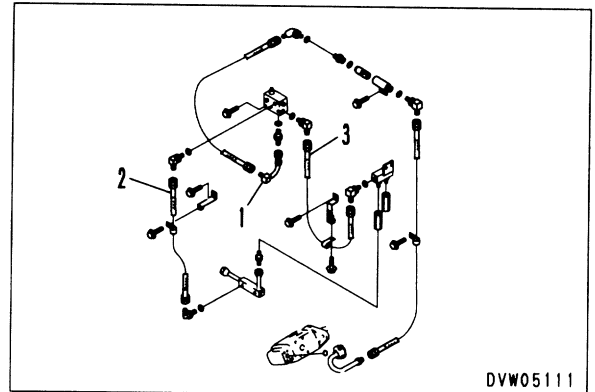
- ★ Run the engine to circulate the oil through the system. Then check the oil level again.



REMOVAL OF ACCUMULATOR CHARGE VALVE ASSEMBLY

! Stop the engine, then depress the brake pedal at least 100 times to release the pressure inside the accumulator circuit.

1. Disconnect **P** port hose (1).
2. Disconnect **PP** port hose (2).
3. Disconnect **ACC** port hose (3).
4. Disconnect **A** port hose (4).
5. Disconnect **T** port hose (5).
6. Disconnect **T** port hose (6).
7. Remove accumulator charge valve assembly (7).

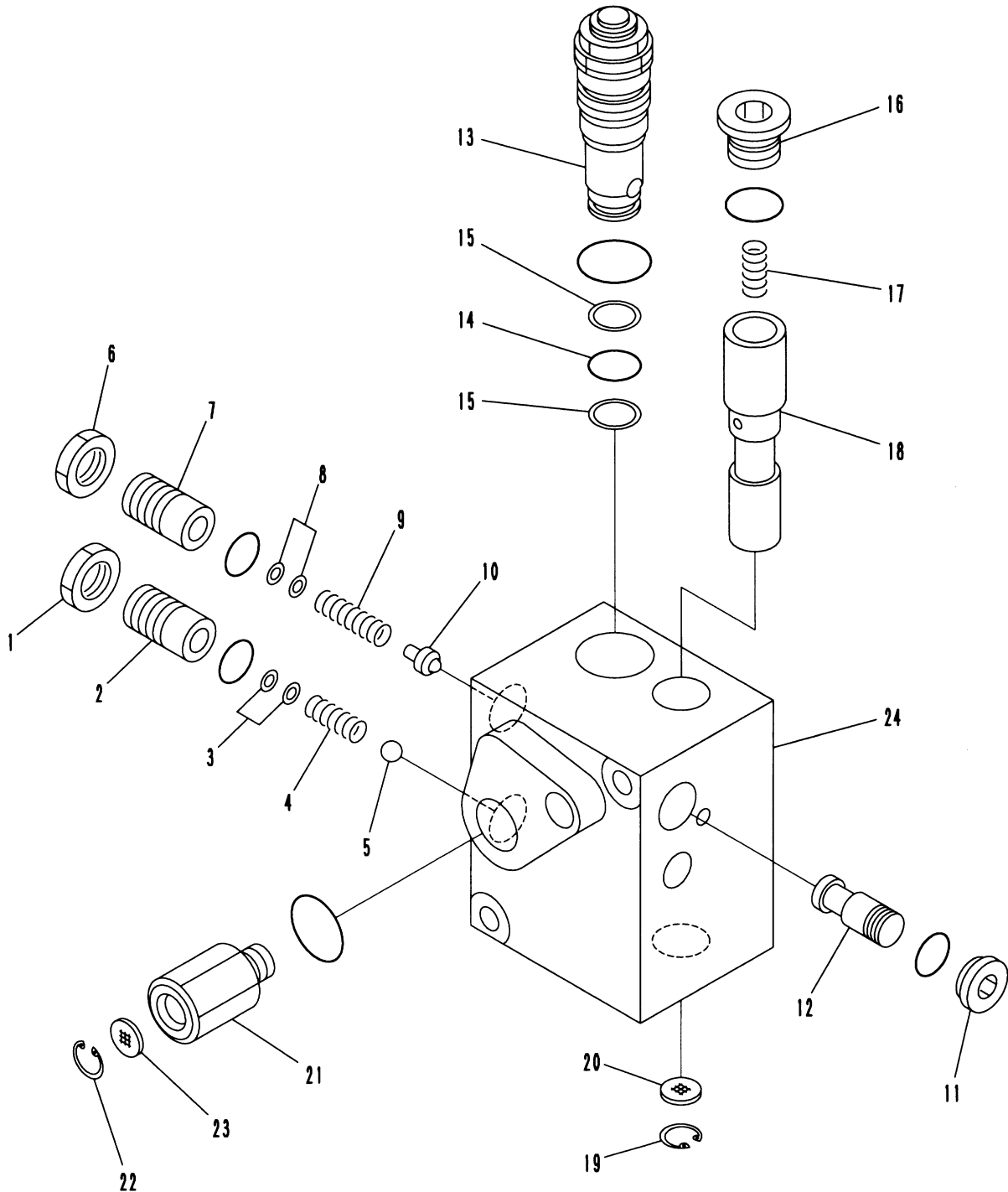


INSTALLATION OF ACCUMULATOR CHARGE VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.
- **Refilling with oil (hydraulic tank)**
Add oil through oil filler to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

U42103

DISASSEMBLY OF ACCUMULATOR CHARGE VALVE ASSEMBLY



U42103

DVW05102

1. R3 safety relief valve

- 1) Remove nut (1), then remove adjustment screw (2).
- 2) Remove shim (3), spring (4), and ball (5).
 - ★ Check the number and thickness of the shims, and keep in a safe place.

2. R1 relief valve

- 1) Remove nut (6), then remove adjustment screw (7).
- 2) Remove shim (8), spring (9), and retainer (10).
 - ★ Check the number and thickness of the shims, and keep in a safe place.
- 3) Remove plug (11), then remove retainer (12).

3. R2 PPC relief valve

- 1) Remove relief valve assembly (13).
- 2) Remove O-ring (14) and 2 backup rings (15) from relief valve assembly (13).

4. H1 relief valve

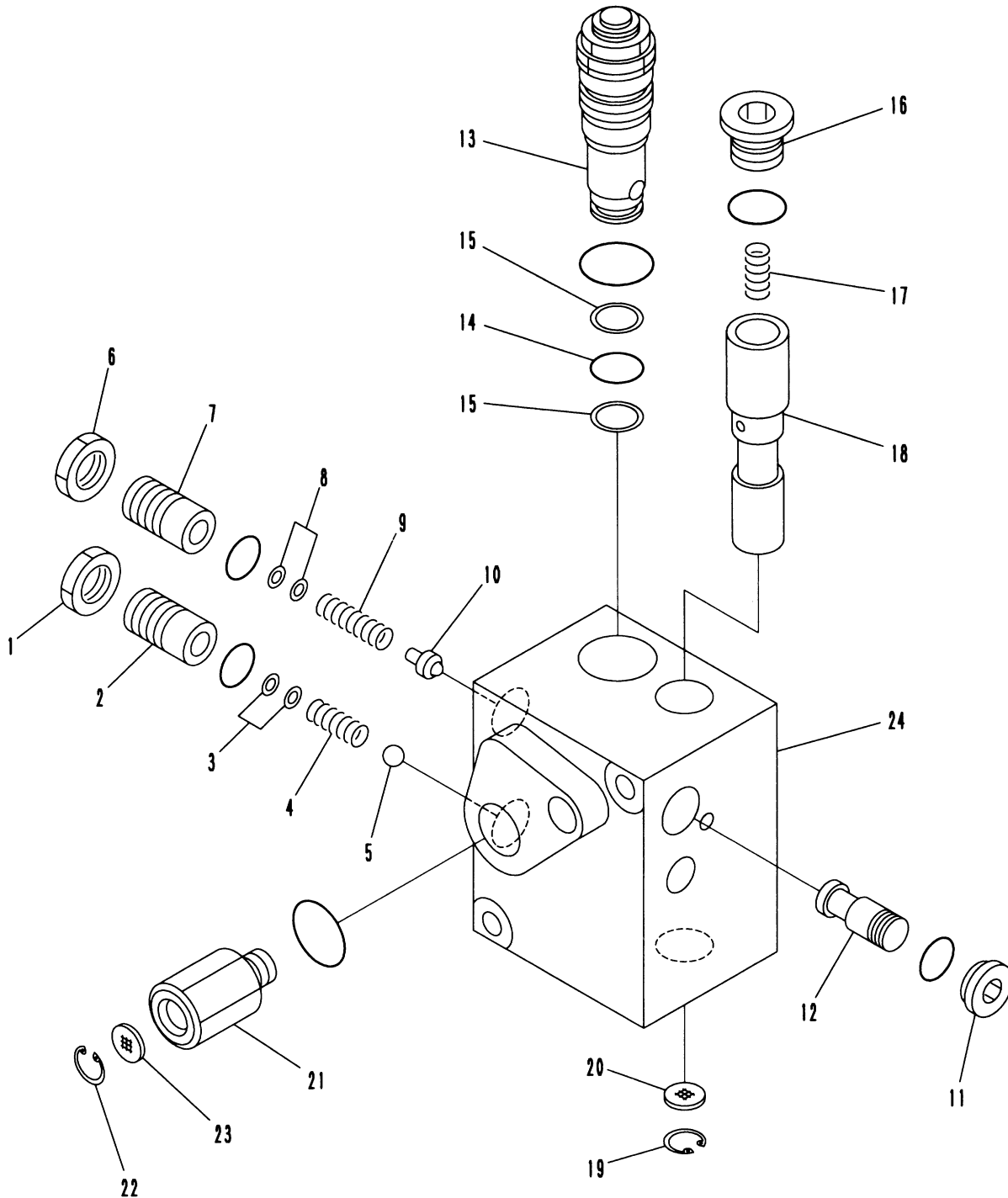
- 1) Remove plug (16), then remove spring (17).
- 2) Remove spool (18).
 - ★ The spool forms an assembly with the valve case, so if there is any abnormality, replace the whole valve assembly.
- 3) Remove snap ring (19), then remove filter (20) from spool (18).

5. Bushing

- 1) Remove bushing (21).
- 2) Remove snap ring (22), then remove filter (23) from bushing (21).

U42103

ASSEMBLY OF ACCUMULATOR CHARGE VALVE ASSEMBLY



U42103

DVW05102

1. Bushing

- 1) Fit filter (23) to bushing (21), and secure with snap ring (22).
 - ★ Assemble the filter so that the end where the outside circumference is not rounded faces the bushing.
- 2) Fit O-ring and install bushing (21) to valve body (24).
 -  Plug: **29.4 – 39.2 Nm {3.0 – 4.0 kgm}**

2. H1 relief valve

- 1) Fit filter (20) to spool (18), and secure with snap ring (19).
 - ★ Assemble the filter so that the end where the outside circumference is not rounded faces the bushing.
- 2) Assemble spool (18).
 - ★ The spool forms an assembly with the valve case, so if there is any abnormality, replace the whole valve assembly.
- 3) Assemble spring (17), then fit O-ring and install plug (16).
 -  Plug: **53.9 – 68.6 Nm {5.5 – 7.0 kgm}**

3. R2 PPC relief valve

- 1) Install O-ring (14) and 2 backup rings (15) to relief valve assembly (13).
- 2) Fit O-ring and install relief valve assembly (13).
 -  Relief valve assembly: **78.5 – 88.3 Nm {8 – 9 kgm}**

4. R1 relief valve

- 1) Assemble retainer (12), then fit O-ring and install plug (11).
 -  Plug: **30.4 – 37.3 Nm {3.1 – 3.8 kgm}**
- 2) Assemble retainer (10) and spring (9).
- 3) Assemble shim (8) to adjustment screw (7).
- 4) Fit O-ring, then fit adjustment screw (7) and secure with nut (6).
 -  Nut: **9.8 – 11.8 Nm {1.0 – 1.2 kgm}**

5. R3 safety relief valve

- 1) Assemble ball (5) and spring (4).
- 2) Assemble shim (3) to adjustment screw (2).
- 3) Fit O-ring, then fit adjustment screw (2) and secure with nut (1).
 -  Nut: **9.8 – 11.8 Nm {1.0 – 1.2 kgm}**

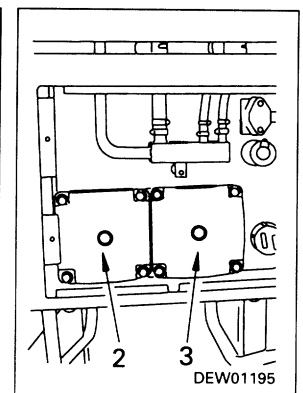
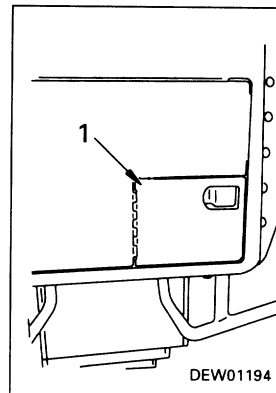
REMOVAL HYDRAULIC TANK ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

1. Draining oil

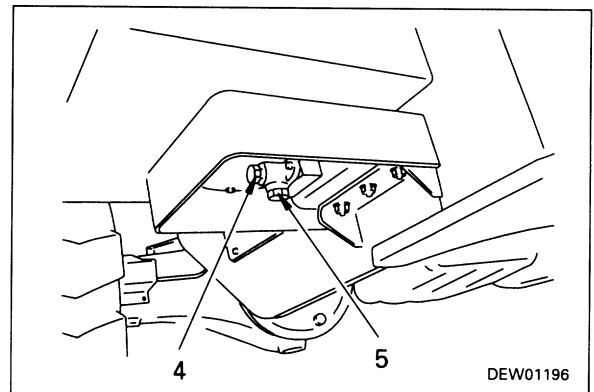
- 1) Remove cover (1) on top of ladder, then remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing out. ※ 1



- 2) Remove plug (4) under hydraulic tank, then loosen valve (5) and drain hydraulic oil.



Hydraulic tank: **206 ℓ**

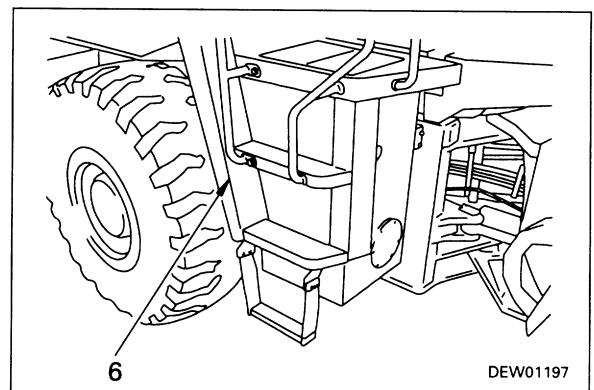


2. Ladder floor

- 1) Sling right ladder floor (6), then remove mounting bolts and lift off.
 - ★ Be careful of the center of gravity of the ladder floor when lifting off.

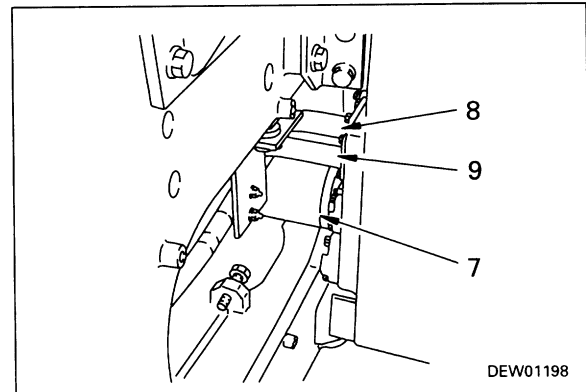


Ladder floor: **63 kg**

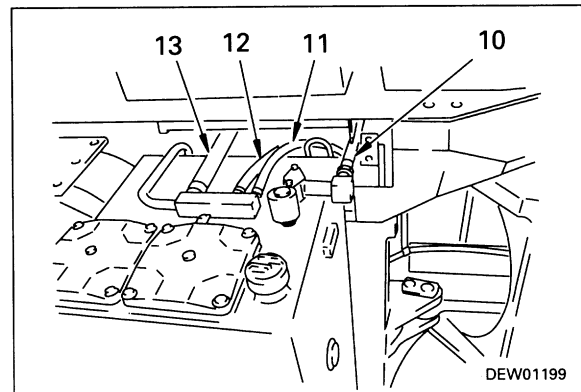


3. Hydraulic piping

- 1) Loosen clamp of hose (7) between hydraulic tank and hydraulic pump and disconnect at tank end.
- 2) Disconnect return tube (8) between main control valve and hydraulic tank at tank end. ※ 2
- 3) Disconnect tube (9) between steering valve, hydraulic cooler, and hydraulic tank at tank end. ※ 3



- 4) Disconnect hose (10) between hydraulic tank and brake valve at tank end.
- 5) Disconnect hose (11) between hydraulic tank and PPC valve at tank end.
- 6) Disconnect hose (12) between hydraulic tank and steering valve at tank end.
- 7) Disconnect hose (13) between hydraulic tank and PPC relief valve at tank end.
 - ★ After disconnecting the hoses and tubes, mark with a tag to distinguish when installing.
 - ★ After disconnecting the hoses and tubes, fit plugs to prevent the entry of dirt or dust.

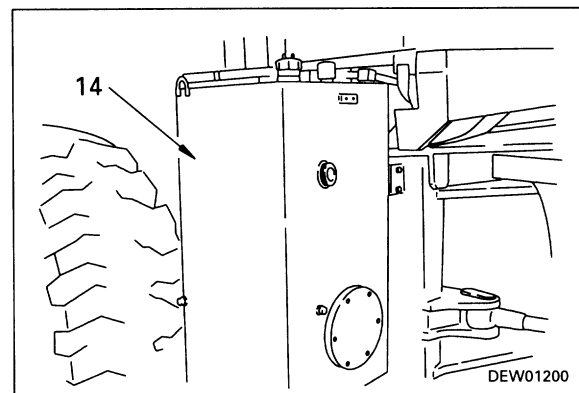
**4. Hydraulic tank**

Sling hydraulic tank (14), then remove mounting bolts and lift off.

- ★ Raise the hydraulic tank slightly and lift it off to the outside of the machine.



Hydraulic tank: **199 kg**



INSTALLATION OF HYDRAULIC TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Hydraulic tank filter plug



Plug on top of filter:

$11.8 \pm 1 \text{ Nm}$ ($1.2 \pm 0.1 \text{ kgm}$)

※ 2 ※ 3

Installation of tubes (8) and (9)

★ Use a new part for the O-ring.

- **Refilling with oil**

Tighten the plug on the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.



Hydraulic tank: **206 ℓ**

- **Bleeding air**

For details of the bleeding air from the brake system and the hydraulic line, see TESTING AND ADJUSTING.

U42103

REMOVAL OF WORK EQUIPMENT, PPC PUMP ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing out.

! Operate the bucket control lever at least 40 times TILT ↔ HOLD to release the pressure inside the accumulator.

! Depress the brake pedal at least 17 times to release the pressure inside the brake accumulator.

! When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

1. Covers

Remove covers (3) at bottom of cab.

2. Ladders

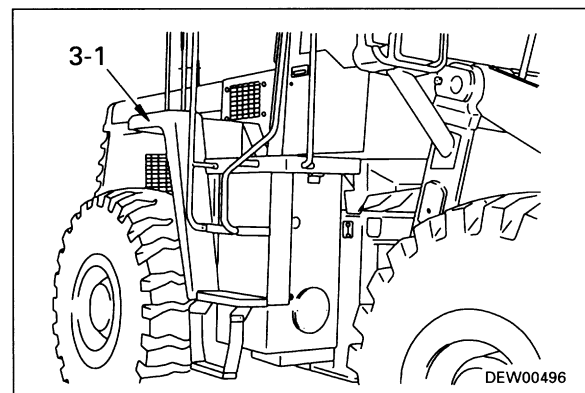
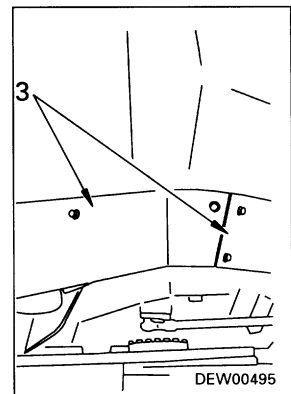
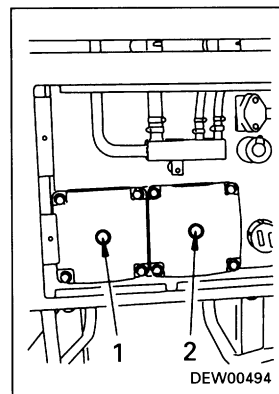
Remove left and right ladders (3-1).



Ladder rail (right): **64.5 kg**



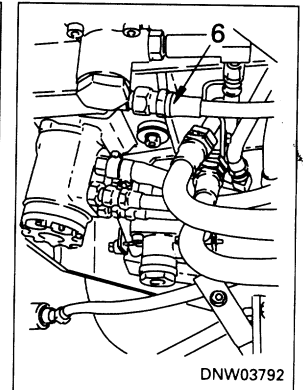
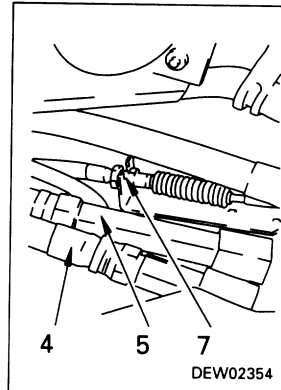
Ladder rail (left): **59.5 kg**



3. Brake piping, accelerator cable

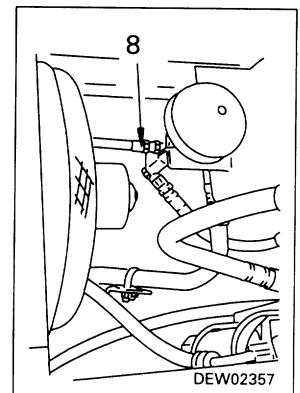
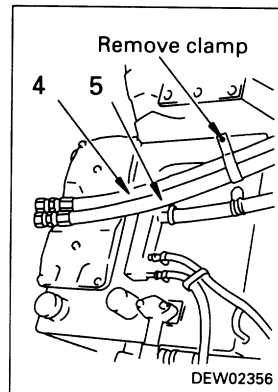
- 1) Disconnect hoses (4) and (5) between right brake valve and accumulator at pedal end.
★ Remove 2 brake hose clamps under floor board.
- 2) Disconnect hose (6) between left brake valve and accumulator at pedal end.
- 3) Disconnect accelerator cable (7) under pedal.

※ 1



- ★ Remove the cable clamp under the floor board.

- 4) Disconnect hose (8) between PPC accumulator and PPC valve inside bulkhead at accumulator end.



- 5) Disconnect hose (10) of radiator sub-tank (9) and hose (12) of window washer tank (11) at tank end.

- ★ Remove the hoses from the hose clamps.

- 6) Air conditioner hoses

- i) Disconnect hose (13) between compressor and condenser at condenser end.

※ 2

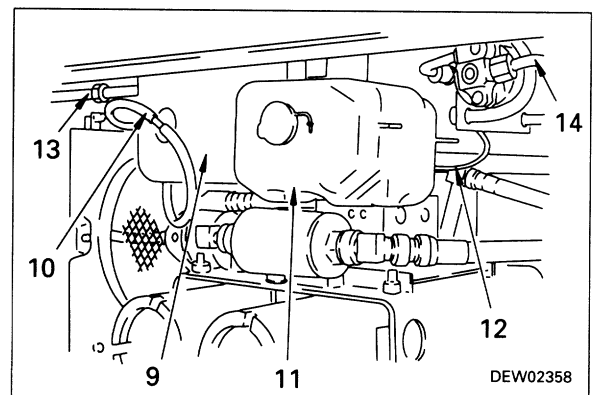
- ★ Remove the hose clamps inside the bulkhead.

- ii) Disconnect hose (14) between air conditioner unit and receiver at receiver end.

※ 3

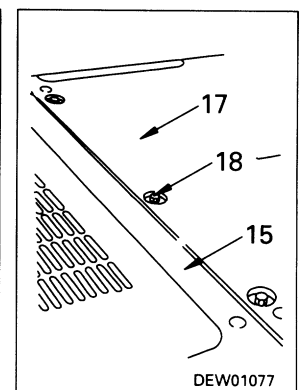
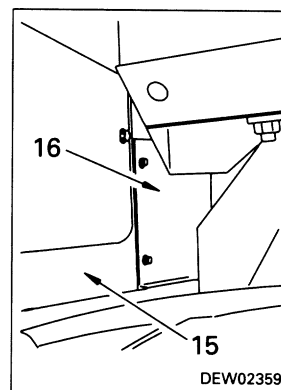
- ★ Remove the hose clamps inside the bulkhead.

- ★ After removing the hoses, fit plugs to prevent the entry of dirt or dust.



4. Bulkhead

- 1) Remove cover (16) at bottom front face of bulkhead (15).
- 2) Remove top mounting bolts (18) holding bulkhead (15) and hood (17).
★ Be careful not to lose the rubber and washers of the mounting portion.

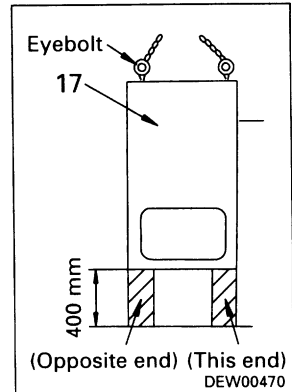
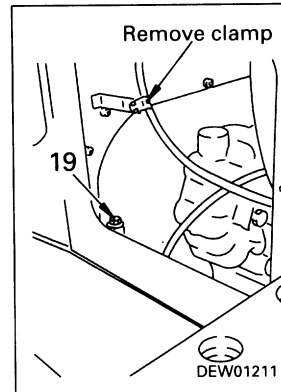


- 3) Install eyebolts at top 4 corners of bulkhead (17), then sling and remove bottom mounting bolts (19).



Bulkhead: 135 kg
(including accumulator, charge valve)

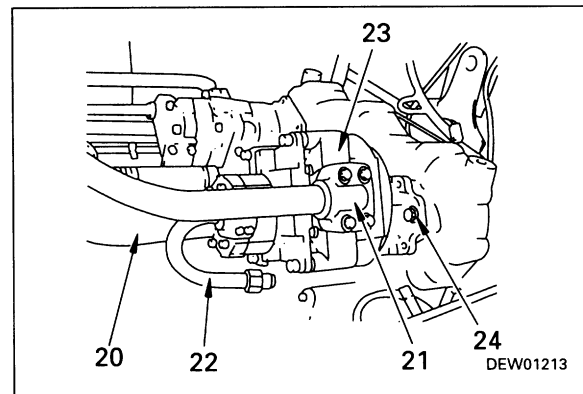
- 4) Raise bulkhead (17) straight up for approx. 400 mm.
- ★ The bulkhead comes near the cab when it is lifted, so be careful not to hit anything.
 - ★ To prevent the bulkhead from falling after it is raised, place blocks on the left and right at opposite ends.



5. Pump piping

※ 4

- 1) Disconnect suction tube (20) between hydraulic tank and hydraulic, PPC pump at pump end.
 - 2) Disconnect tube (21) between hydraulic pump and main control valve at pump end.
 - 3) Disconnect tube (22) between PPC pump and charge valve at pump end.
- ★ After disconnecting the tubes, fit plugs to prevent the entry of dirt or dust.



6. Pump

※ 5

Remove mounting bolts (24) of hydraulic and PPC pump assembly (23), then remove pump assembly.



Hydraulic, PPC pump assembly: 27 kg

INSTALLATION OF WORK EQUIPMENT, PPC PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1



Accelerator cable mounting nut:

53.9 ± 4.9 Nm (5.5 ± 0.5 kgm)

※ 2



Condenser hose:

19.6 – 24.5 Nm (2.0 – 2.5 kgm)

※ 3



Receiver hose:

3.9 – 6.9 Nm (0.4 – 0.7 kgm)

※ 4

※ 5

- ★ Use a new part for the O-ring.

- Refilling with oil**

Tighten drain plugs (1) and (2) at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.



Plug at top of filter:

11.8 ± 1 Nm (1.2 ± 0.1 kgm)

- Bleeding air**

- Bleed air from brake line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.
- Bleed air from steering line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.

- Fill the air conditioner with new refrigerant.

- ★ **Precautions when filling air conditioner line with new refrigerant**

- Keep the temperature inside the room at above 3°C. (If the temperature is below 3°C, the system will not work.)
- Use R134a as the refrigerant.
- When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min. 750 mmHg.)
- Charge with 1.5 – 1.6 kg of refrigerant.
- Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
- Do not operate the compressor before charging with refrigerant.

REMOVAL OF PPC VALVE ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing out.

⚠ Operate the bucket control lever at least 40 times TILT ↔ HOLD to release the pressure inside the accumulator.

1. Covers

Remove covers (3) at bottom of cab.

2. Ladders

Remove left and right ladders (3-1).



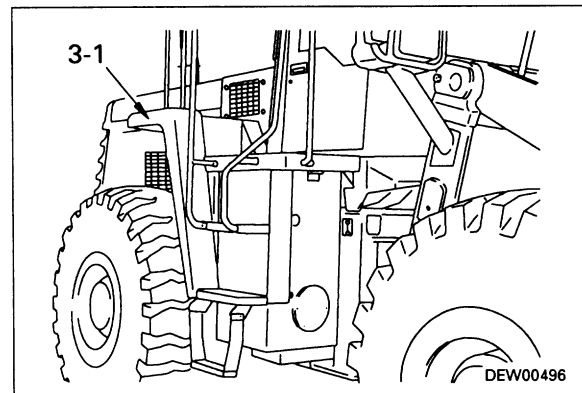
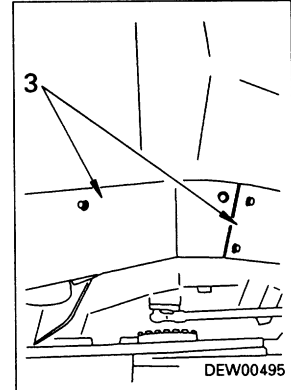
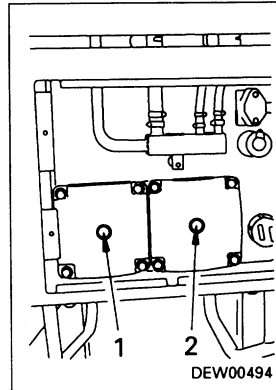
Ladder rail (right): **64.5 kg**



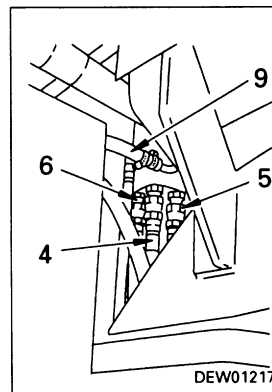
Ladder rail (left): **59.5 kg**

3. Hydraulic piping

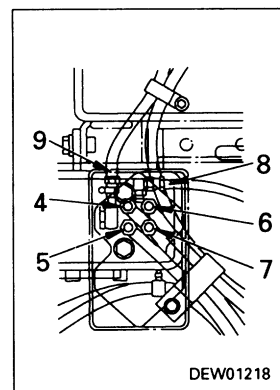
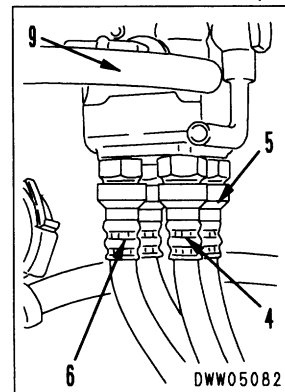
- Disconnect hose (4) of PPC valve port "P2", hose (5) of port "P4", hose (6) of port "P3", and hose (7) of port "P1" at valve end.
- Disconnect hose (8) between PPC accumulator and PPC valve at valve end.
- Disconnect hose (9) of PPC valve drain port at valve end.
 - ★ After disconnecting the hoses, mark with a tag to distinguish when installing.
 - ★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.



Serial No. 50001 – 52999

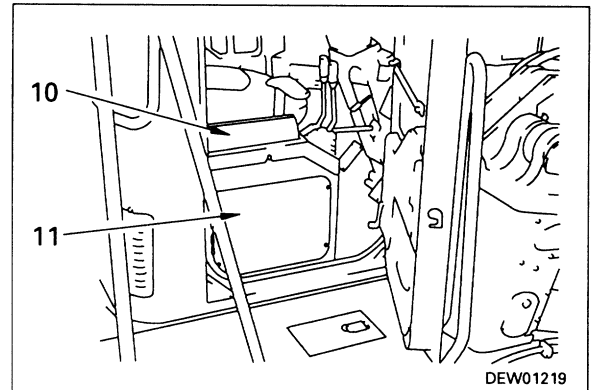


Serial No. 53001 and up



4. Cover

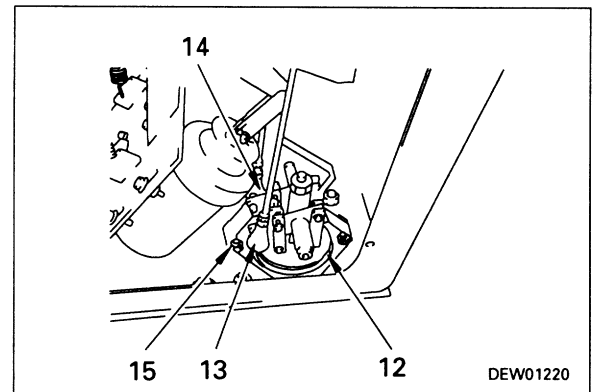
Remove side cover (11) of console box (10).

**5. PPC valve**

- 1) Remove joints (13) and (14) of rod installed to PPC valve assembly (12).
- 2) Remove mounting bolts (15) of PPC valve assembly, then remove valve assembly.



PPC valve assembly: **3 kg**

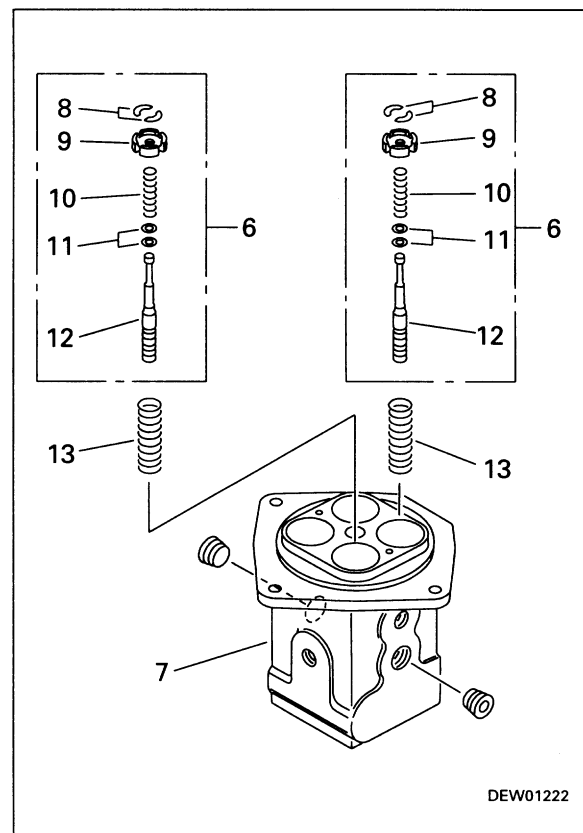
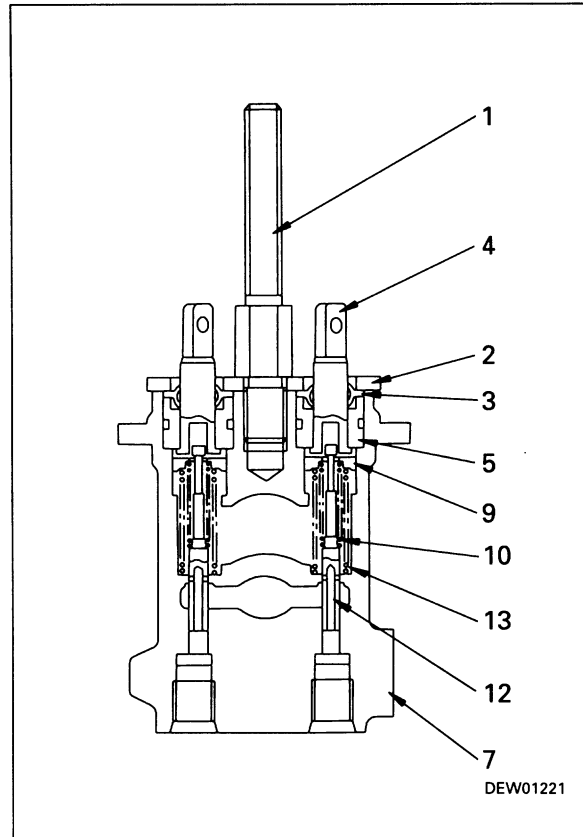


INSTALLATION OF PPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.
- **Refilling with oil**
Tighten drain plugs (1) and (2) at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.
 Plug at top of filter:
 $11.8 \pm 1 \text{ Nm}$ ($1.2 \pm 0.1 \text{ kgm}$)
- **Bleeding air**
Bleed air from PPC line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.

DISASSEMBLY OF PPC VALVE ASSEMBLY

1. Remove bolt (1).
2. Remove plate (2).
3. Remove seal (3), then remove spool (4).
★ Of the 4 spools (4), make a distinguishing mark on the boom LOWER spool and check the mounting position.
4. Remove collar (5) from spool (4).
5. Remove valve assembly (6) from body (7).
6. Remove collar (8), then remove retainer (9), spring (10), and shim (11) from valve (12).
★ Check the number and thickness of the shims, and keep in a safe place.
7. Remove spring (13) from body (7).
★ The number of coils of spring (13) differs for each hydraulic port, so check the mounting position of each spring and make distinguishing marks.



U42103

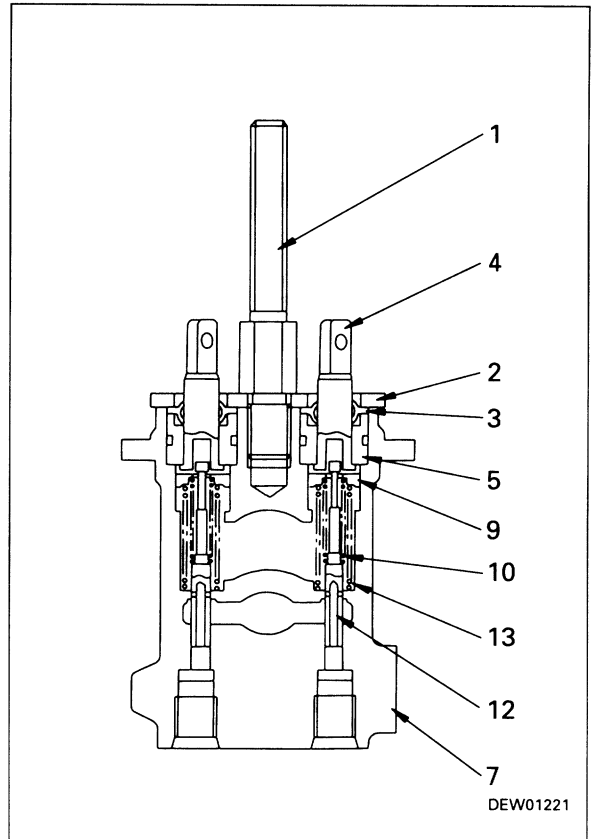
ASSEMBLY OF PPC VALVE

ASSEMBLY

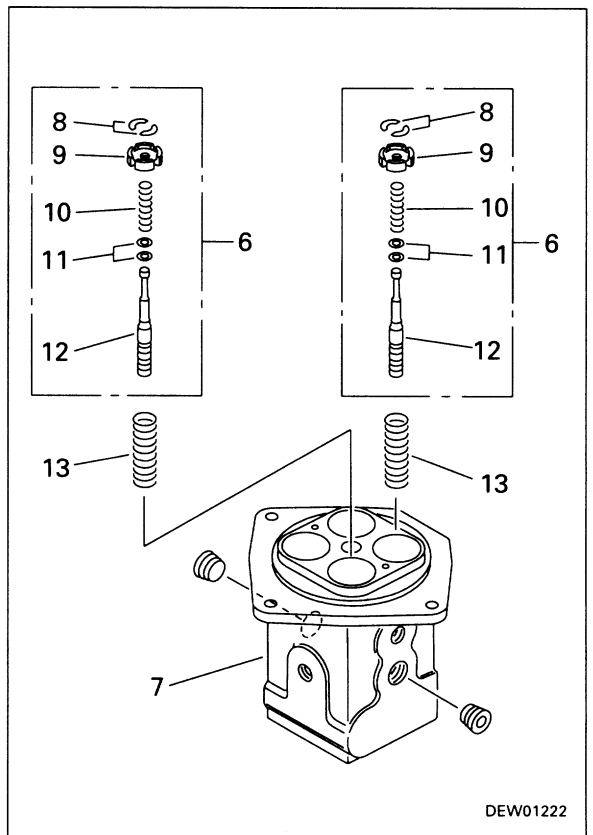
1. Assemble spring (13) to body (7).
 - ★ The number of coils of spring (13) differs for each hydraulic port as shown in the chart below, so check each spring and be sure to install in the correct position.

Port position	No. of coils of spring
P1 Bucket TILT	11
P2 Boom RAISE	
P3 Boom LOWER	
P4 Bucket DUMP	14

- ★ The position of each port is stamped on the valve body.
2. Assemble shim (11), spring (10), and retainer (9) to valve (12), and install collar (8).
 3. Assemble valve assembly (6) to body (7).
 4. Fit O-ring to collar (5), and assemble to spool (4), then install spool (4).
 - ★ For spools (4), check the mounting position of the boom LOWER spool which was marked with a distinguishing mark, then install the spools.
 5. Fit seal (3) and install plate (2).
 6. Install bolt (1).
 -  Bolt: $44.1 \pm 4.9 \text{ Nm}$ ($4.5 \pm 0.5 \text{ kgm}$)



DEW01221



DEW01222

REMOVAL OF MAIN CONTROL VALVE ASSEMBLY

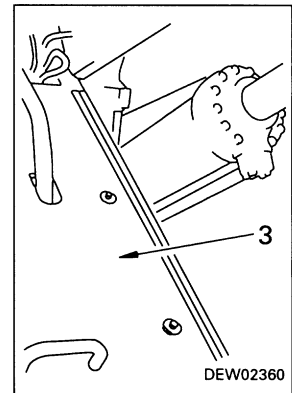
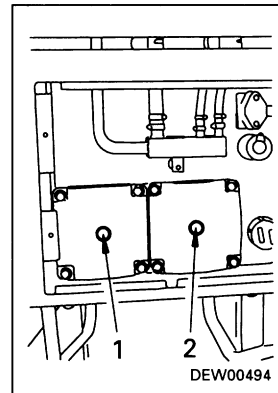
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

- Remove plugs (1) and (2) at the top of the hydraulic tank filter, and prevent the oil inside the tank from flowing out.

1. Cover

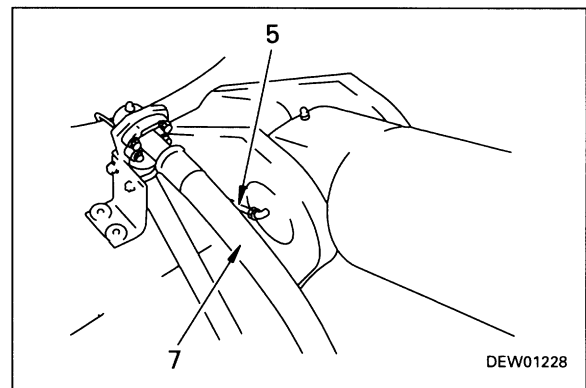
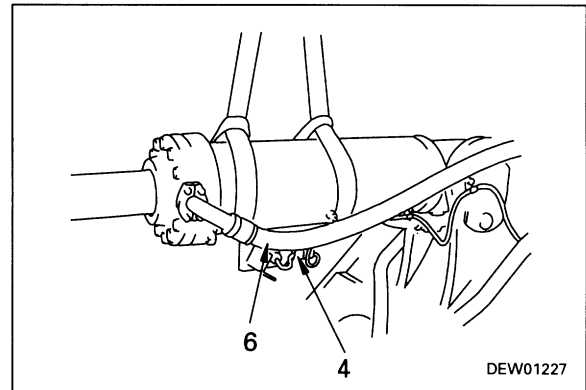
Remove inspection cover (3) of front frame.



2. Bucket cylinder

- 1) Disconnect connector (4) of bucket positioner wiring.
- 2) Disconnect grease hose (5) at front frame end.
- 3) Disconnect rod hose (6) at cylinder end. ※ 1
- 4) Disconnect bottom hose (7) at cylinder end. ※ 2

★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.

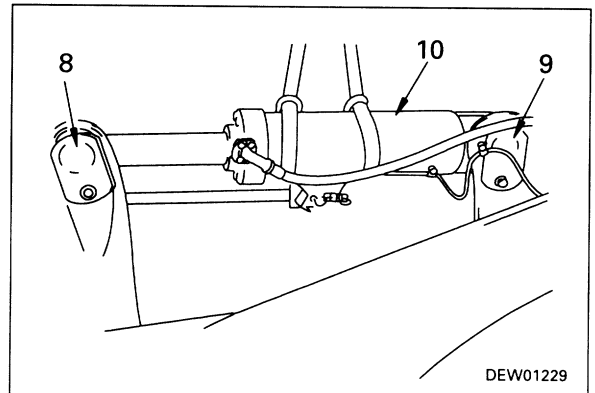


DISASSEMBLY AND ASSEMBLY**MAIN CONTROL VALVE**

- 4) Sling bucket cylinder (10), and remove lock bolt, then remove pins (8) and (9). ※ 3
 - ★ When slinging, be careful of the center of gravity and sling from two points.
 - ★ If there are shims installed, check the number and thickness of the shims, and keep in a safe place.
- 5) Lift off bucket cylinder (10).

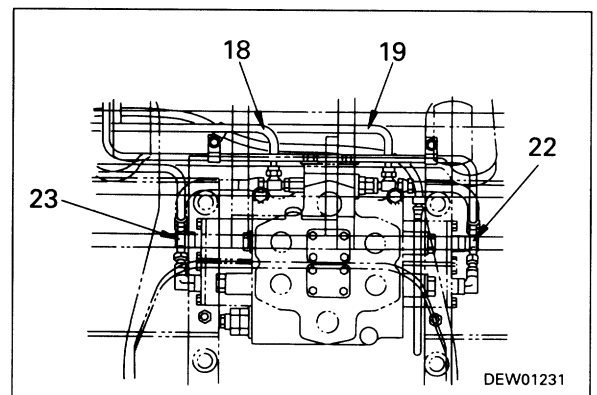
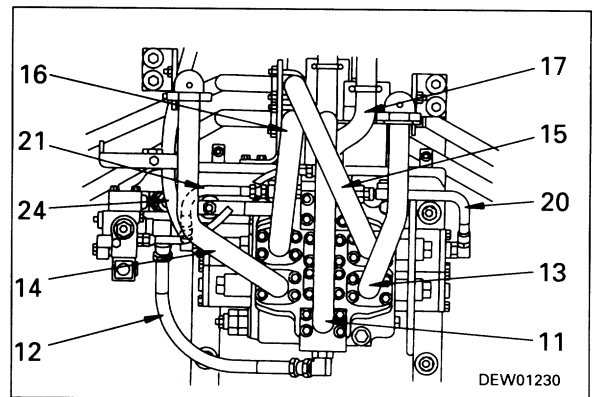


Bucket cylinder: **192.5 kg**

**3. Hydraulic piping**

Disconnect following hydraulic piping. ※ 4

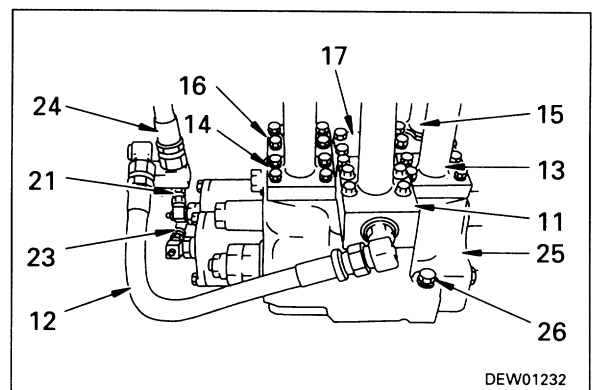
- 1) Disconnect tube (11) between hydraulic pump and valve at main control valve end.
- 2) Disconnect hose (12) between cut-off valve and main control valve at main control valve end.
- 3) Disconnect tubes (13) and (14) between main control valve and dump cylinder at valve end.
- 4) Disconnect tubes (15) and (16) between main control valve and lift cylinder at valve end.
- 5) Disconnect drain tube (17) of main control valve at valve end.
- 6) Disconnect tubes (18), (19), (20), (21), (22), and (23) between PPC valve and main control valve at main control valve end.
 - ★ After disconnecting the tubes and hoses, mark with a tag to distinguish when installing.
 - ★ After disconnecting the tubes and hoses, fit plugs to prevent the entry of dirt or dust.

**4. Main control valve**

Remove mounting bolt (26), then using eyebolts, lift off main control valve (25). ※ 5



Main control valve: **90 kg**



INSTALLATION OF MAIN CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1 ※ 2

- ★ Install the hoses without twisting or interference.
- ★ Use a new part for the O-ring.

※ 3

Bucket cylinder

- 1) Align the bottom pin hole, assemble shims so that the total for clearance **a** between the cylinder and frame is within the standard value, then install pin (9).
 - ★ Clearance **a**: 1.5 mm
- 2) Align the rod pin hole and assemble pin (8).



Always use a bar when aligning the pin holes. Never insert your fingers.

※ 4

- ★ Use a new part for the O-ring.
- ★ Be careful that the O-ring does not get caught when installing.
- ★ Before tightening fully, install the clamps that were removed.

※ 5

- ★ When setting the valve in the mounting position, pay attention to the balance and be careful not to hit any other part inside the frame.

• Refilling with oil

Tighten drain plugs (1) and (2) at the top of the hydraulic tank filter, and add hydraulic oil through the oil filler to the specified level.



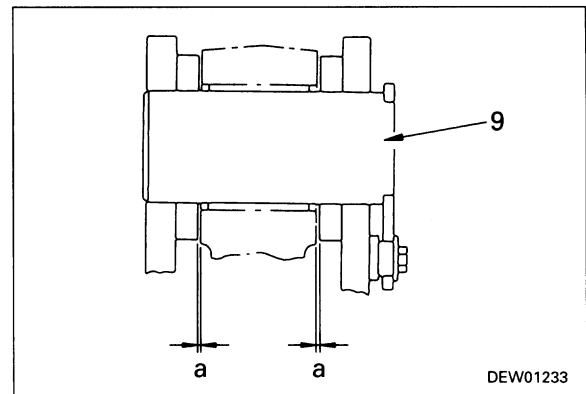
Plug at top of filter:

11.8 ± 1 Nm (1.2 ± 0.1 kgm)

• Bleeding air

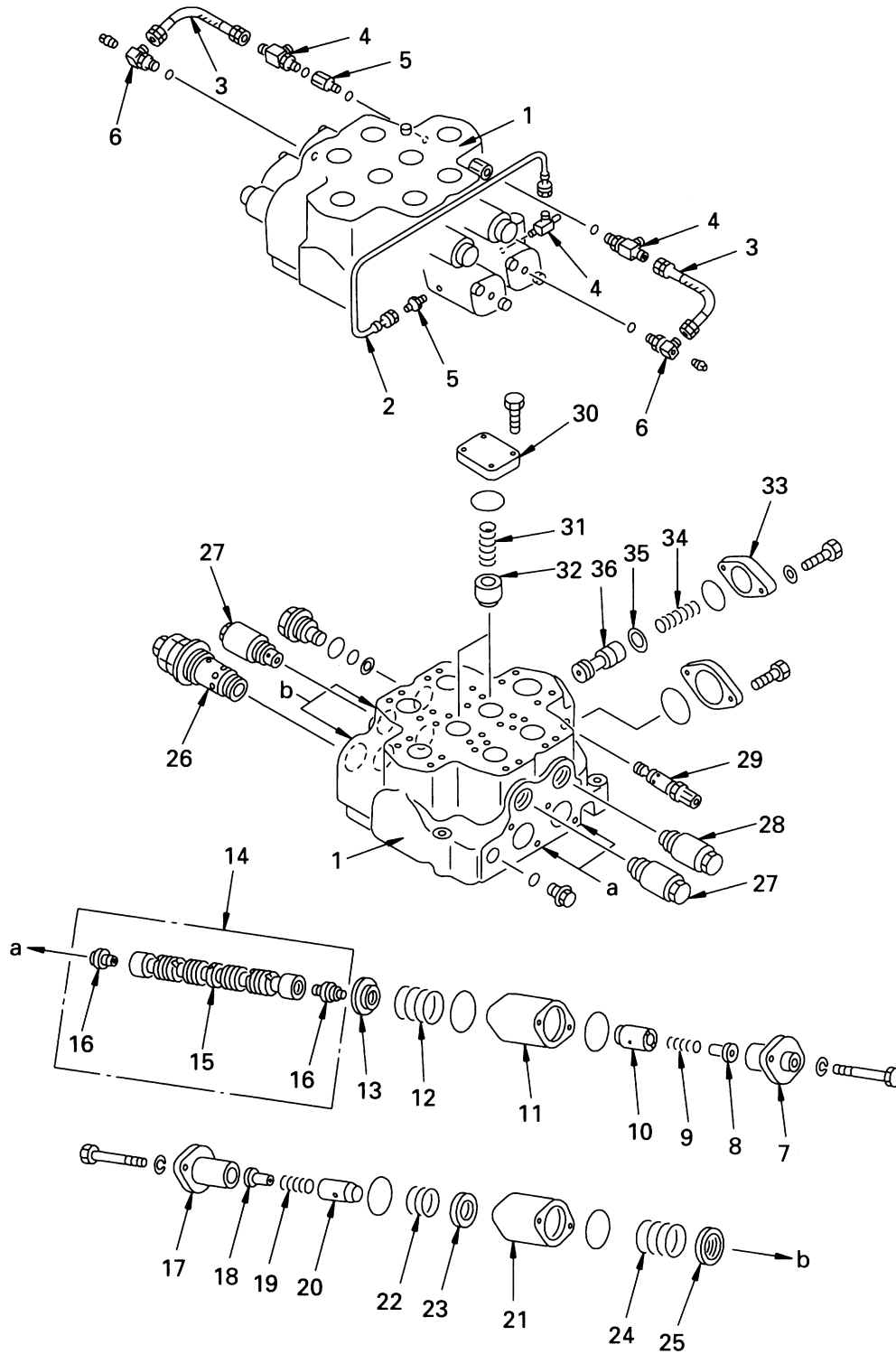
Bleed air from hydraulic line.

For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.



U42103

DISASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY



DEW01234

U42103

1. Tube, hose

- 1) Remove tube (2) and hose (3) from valve body (1).
- 2) Remove tee (4), nipple (5), and elbow (6).

2. Spool assembly

- 1) Remove sleeve (7), then remove spacer (8), spring (9), and piston (10).
- 2) Remove case (11), spring (12), and retainer (13), then remove spool assembly (14).
 - ★ Do not remove plug (16) from spool (15) unless necessary.
- 3) Remove sleeve (17), then remove spacer (18), spring (19), and piston (20).
- 4) Remove case (21), then remove spring (22), retainer (23), spring (24), and retainer (25).

3. Main relief valve assembly

Remove main relief valve assembly (26).

4. Safety valve assembly with suction

Remove safety valve assembly (27).

- ★ The safety valve cannot be adjusted when it is installed on the machine, so do not disassemble it.

5. Suction valve assembly

Remove suction valve assembly (28).

6. Selector valve assembly

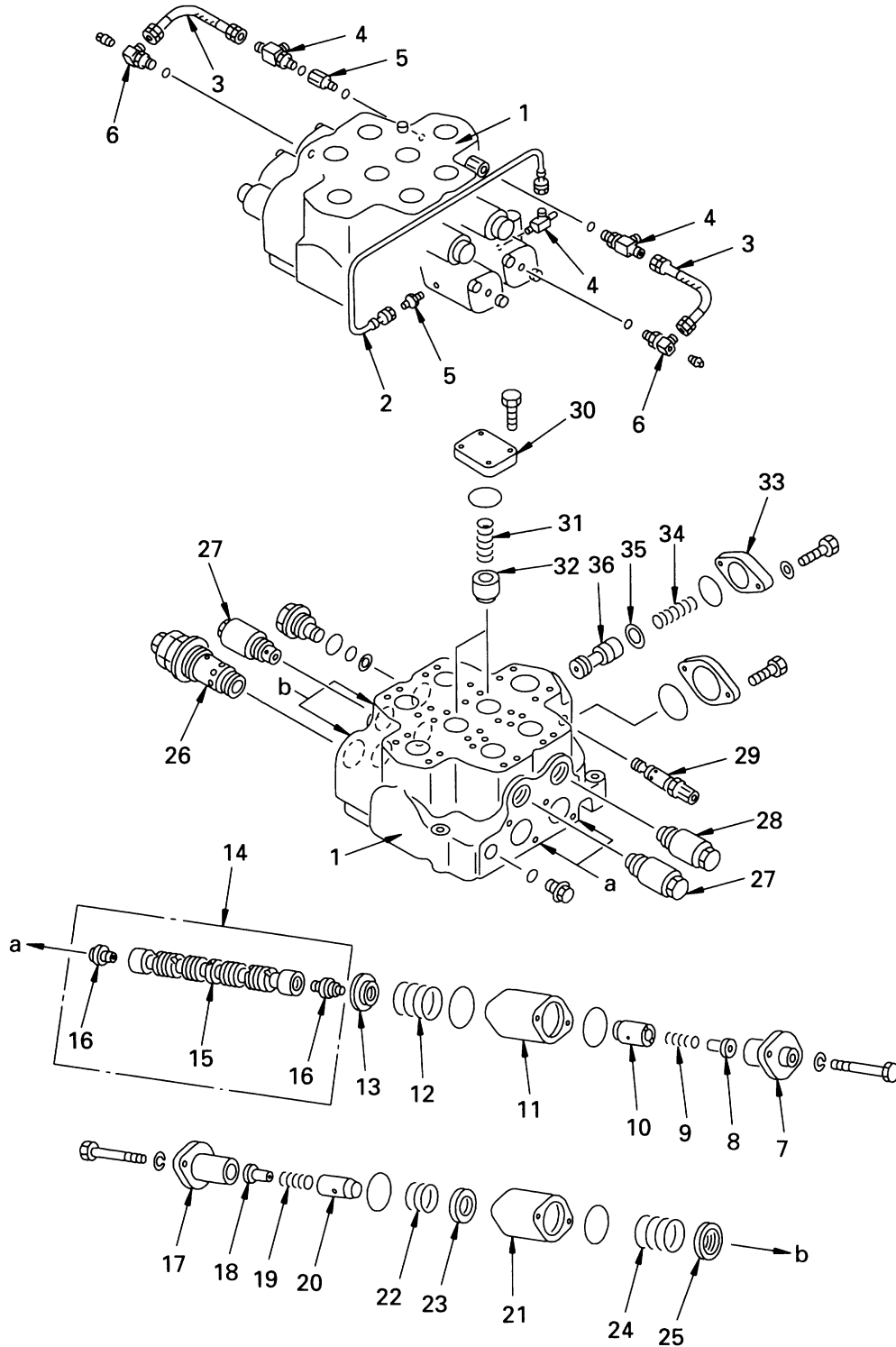
Remove selector valve assembly (29).

7. Check valve assembly

Remove plate (30), then remove spring (31) and valve (32).

8. Remove flange (33), then remove spring (34), seal (35), and valve (36).

ASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY



DEW01234

U42103

1. Assemble valve (36), seal (35), and spring (34) to body (1), then fit O-ring and install flange (33).
2. **Check valve assembly**
Assemble valve (32) and spring (31) to body (1), then fit O-ring and install plate (30).
 **Mounting bolt:**
 $88.3 \pm 9.8 \text{ Nm } (9.0 \pm 1.0 \text{ kgm})$
3. **Selector valve assembly**
Fit O-ring and install selector valve assembly (29).
4. **Suction valve assembly**
Fit O-ring and install suction valve (28).
 **Suction valve assembly:**
 $225.6 \pm 9.8 \text{ Nm } (23.0 \pm 1.0 \text{ kgm})$
5. **Safety valve assembly with suction**
Fit O-ring and install safety valve assembly (27).
 **Safety valve assembly:**
 $225.6 \pm 9.8 \text{ Nm } (23.0 \pm 1.0 \text{ kgm})$
6. **Main relief valve assembly**
Fit O-ring and install main relief valve assembly (26).
 **Main relief valve assembly:**
 $321.7 \pm 47.1 \text{ Nm } (32.8 \pm 4.8 \text{ kgm})$
7. **Spool assembly**
 - 1) Push spool (14) into body (1).
 - 2) Assemble retainer (25), spring (24), and retainer (23) to case (21).
 - 3) Assemble spacer (18), spring (19), piston (20), and spring (22) to sleeve (17), then fit O-ring and assemble to case (21).
 - 4) Fit O-ring to case (21) and install to body (1).
 - 5) Assemble retainer (13) and spring (12) to case (11), then fit O-ring.
 - 6) Assemble spacer (8), spring (9), and piston (10) to sleeve (7), then fit O-ring and assemble to case (11).
 - 7) Fit O-ring to case (11) and install to body (1).
8. **Tube, hose**
 - 1) Install elbow (6), nipple (5), and tee (4) to body (1).
 **Nipple:** $29.4 \pm 4.9 \text{ Nm } (3.0 \pm 0.5 \text{ kgm})$
 **Tee:** $29.4 \pm 4.9 \text{ Nm } (3.0 \pm 0.5 \text{ kgm})$
 - 2) Install hose (3) and tube (2).
 **Hose sleeve nut:**
 $91.2 \pm 12.8 \text{ Nm } (9.3 \pm 1.3 \text{ kgm})$
 **Tube sleeve nut:**
 $49.0 \pm 19.6 \text{ Nm } (5.0 \pm 2.0 \text{ kgm})$

REMOVAL OF BUCKET CYLINDER ASSEMBLY

! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

1. Disconnect connector (1) of bucket positioner wiring.

2. Disconnect grease hose (2) at front frame end.

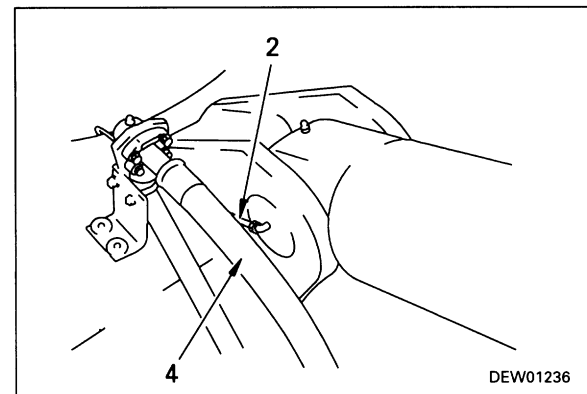
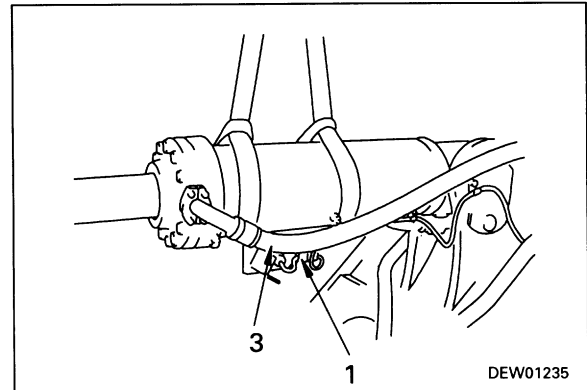
3. Hydraulic piping

※ 1

1) Disconnect rod hose (3) at cylinder end.

2) Disconnect bottom hose (4) at cylinder end.

★ After disconnecting the hoses, fit plugs to prevent the entry of dirt or dust.



4. Bucket cylinder

1) Sling bucket cylinder (7), then remove lock bolts, and remove pin (5) and pin (6). ※ 2

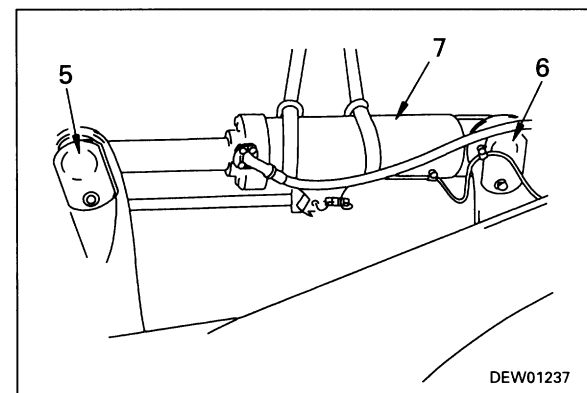
★ When slinging, be careful of the center of gravity and sling from two points.

★ If there are shims installed, check the number and thickness of the shims, and keep in a safe place.

2) Lift off bucket cylinder (1).



Bucket cylinder: **192.5 kg**



INSTALLATION OF BUCKET CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Use a new part for the O-ring.
- ★ Install the hoses without twisting or interference.

※ 2

Bucket cylinder

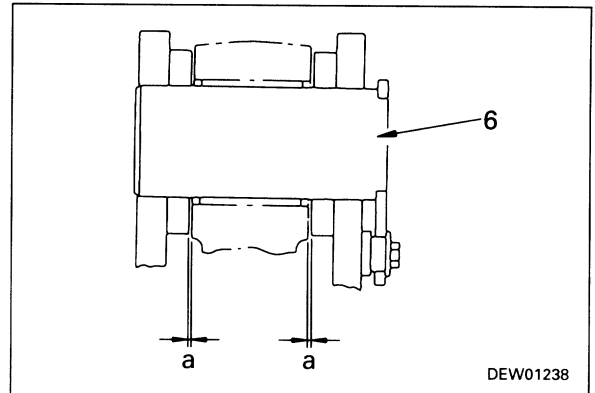
- 1) Align the bottom pin hole, assemble shims so that the total for clearance **a** between the cylinder and frame is within the standard value, then install pin (6).

- ★ Clearance **a**: 1.5 mm

- 2) Align the rod pin hole and assemble pin (5).

⚠ Always use a bar when aligning the pin holes. Never insert your fingers.

- After completing the assembly, add hydraulic oil through the oil filler of the hydraulic tank to the specified level.
- **Bleeding air**
Bleed air from hydraulic line.
For details of the procedure for bleeding the air, see TESTING AND ADJUSTING.



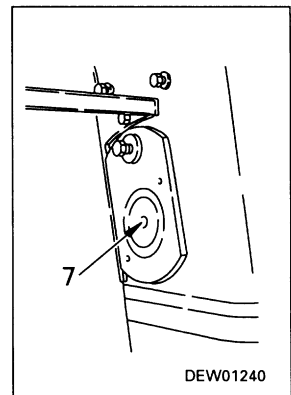
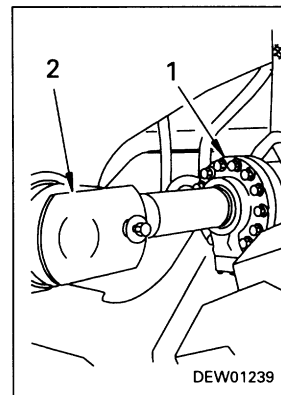
REMOVAL OF BOOM CYLINDER ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

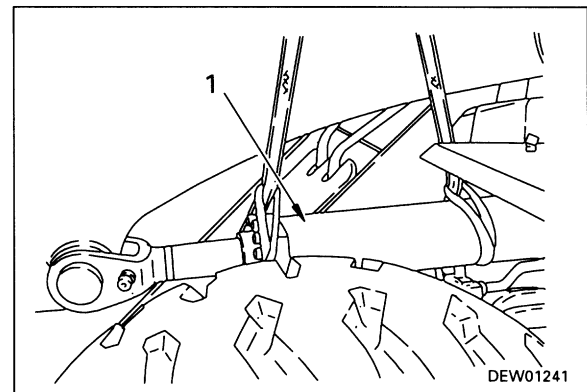
1. Rod pin

- 1) Sling boom cylinder (1), then remove lock bolt of rod pin, and remove pin (2). ※ 1
 - ★ If there are shims installed, check the number and thickness of the shims, and keep in a safe place.
- 2) Start engine, and use control lever to retract cylinder rod on side that was removed.
 - ★ Retract to a point 20 mm before the end of the stroke.



2. Hydraulic piping

- 1) Disconnect cylinder rod from connecting portion. ※ 2
- 2) Disconnect cylinder bottom tube (5) and hose (6) at connecting portion. ※ 3
 - ★ After disconnecting the tubes and hoses, fit plugs to prevent the entry of dirt or dust.

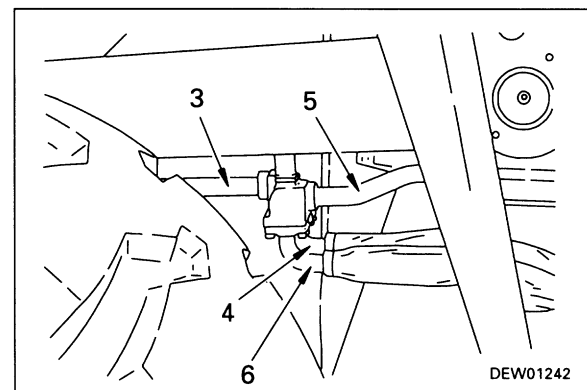


3. Boom cylinder

- 1) Remove lock bolt of cylinder bottom pin, then remove pin (7). ※ 4
 - ★ If there are shims installed, check the number and thickness of the shims, and keep in a safe place.
- 2) Lift off boom cylinder (1).
 - ★ Be careful of the center of gravity and lift off slowly.
 - ★ Be careful not to damage the cylinder portion.



Boom cylinder: **222 kg**



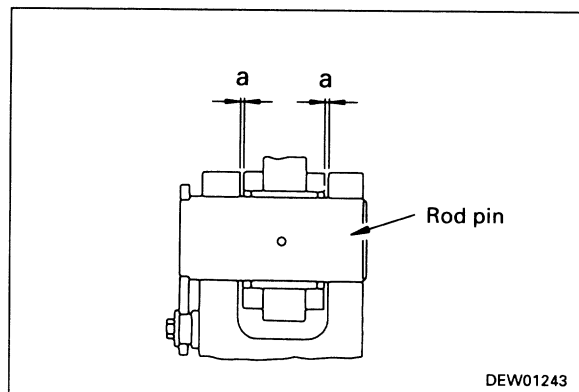
INSTALLATION OF BOOM CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

Start the engine, operate the control levers, and extend the rod. Align the pin holes and assemble shims so that clearance **a** is uniform on the left and right, then install the pin.

★ Clearance **a**: Max. 1.5 mm



※ 2 ※ 3

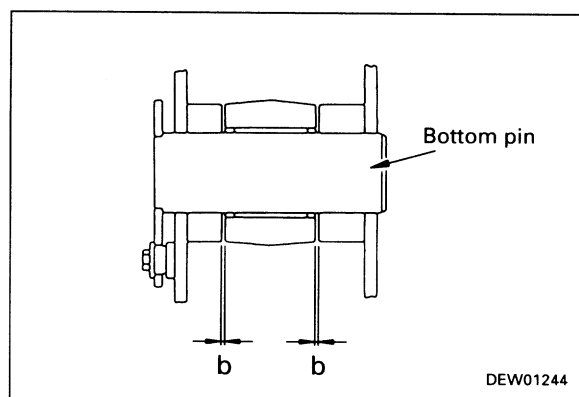
★ Use a new part for the O-ring.

※ 4

Align the pin at the cylinder bottom, assemble shims so that the total for clearance **b** between the cylinder and frame is within the standard value, then install the pin.

⚠ Always use a bar when aligning the pin holes. Never insert your fingers.

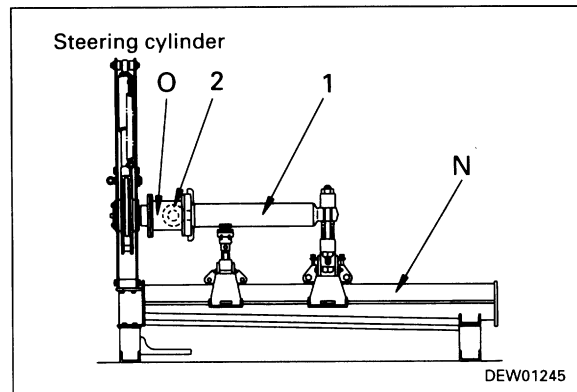
★ Clearance **b**: Max. 1.5 mm



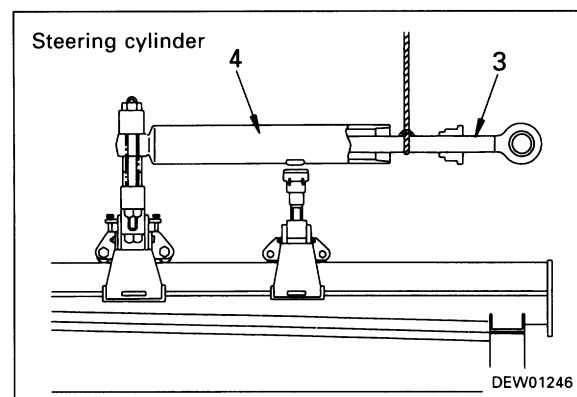
DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

(STEERING, BOOM, BUCKET CYLINDER ASSEMBLY)

1. Set cylinder assembly (1) to tool N.
2. **Cylinder head, piston rod assembly**
 - **Steering cylinder assembly**
 - 1) Using tool O, remove cylinder head (2) from cylinder.

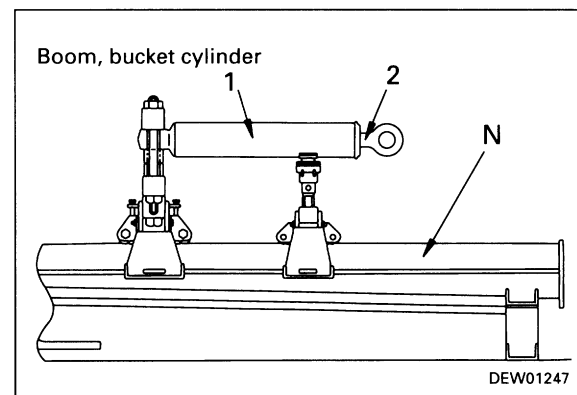


- 2) Pull out cylinder head and piston rod assembly (3) from cylinder (4), and lift off.
 - ★ Oil will flow out when the piston rod assembly is removed from the cylinder, so place a container under the cylinder to catch the oil.

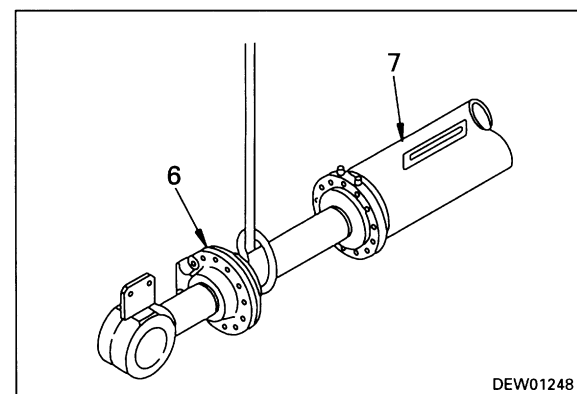


- **Boom, bucket cylinder assembly**
 - 1) Remove mounting bolts of cylinder head (2).

Cylinder	Width across flats of bolt (mm)
Boom cylinder	27
Bucket cylinder	30



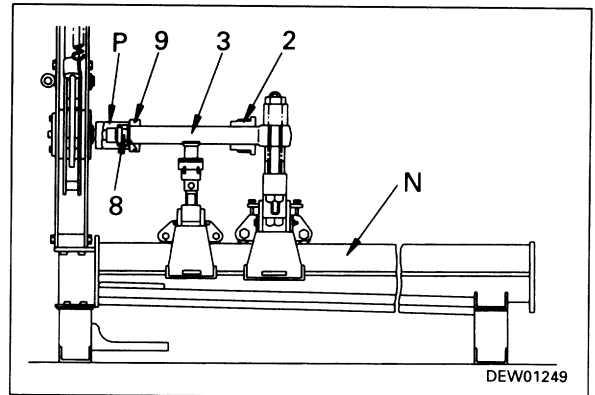
- 2) Pull out cylinder head and piston rod assembly (6) from cylinder (7), and lift off.
 - ★ Oil will flow out when the piston rod assembly is removed from the cylinder, so place a container under the cylinder to catch the oil.



3. Cylinder head

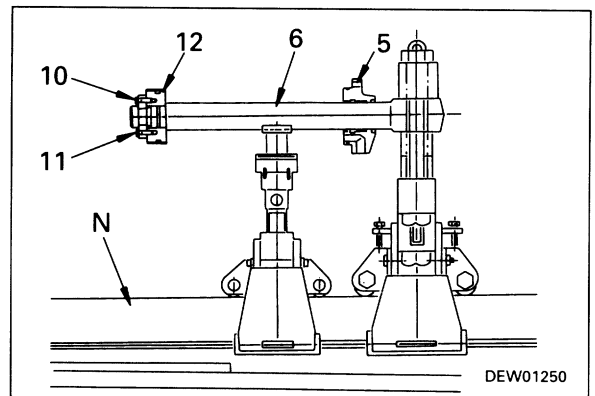
• Steering cylinder assembly

- 1) Set cylinder head and piston rod assembly (3) to tool **N**.
- 2) Using tool **P**, remove nut (8).
★ Width across flats of nut: 55 mm
- 3) Remove piston (9), then remove cylinder head (2).

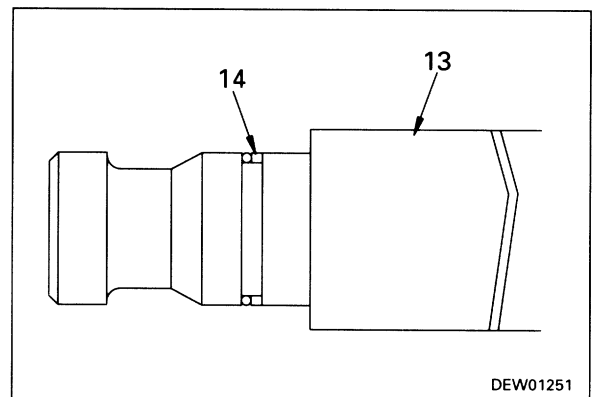


• Boom, bucket cylinder assembly

- 1) Set cylinder head and piston rod assembly (6) to tool **N**.
- 2) Remove piston mounting bolt (10), then remove spacer (11), piston (12), and cylinder head (5).

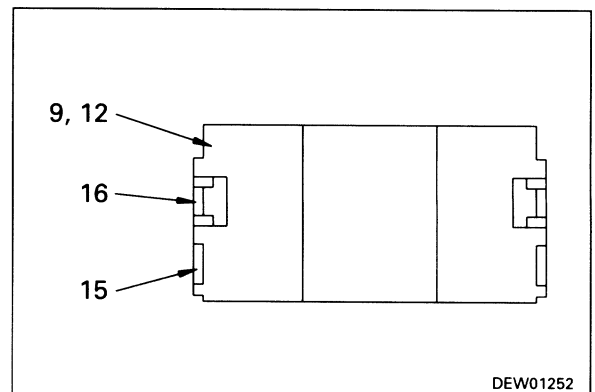


4. Remove O-ring and backup ring (14) from piston rod (13).
★ Rod of boom, bucket cylinder only.



5. Disassembly of piston assembly

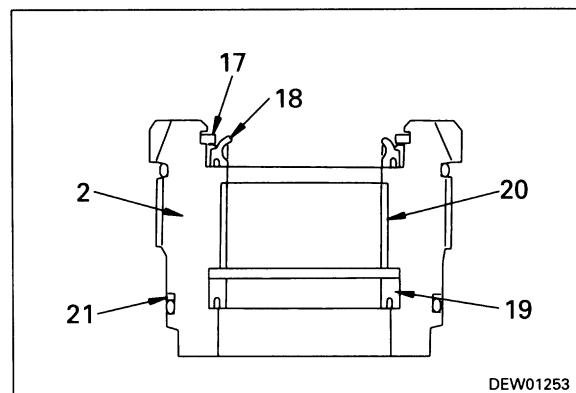
Remove wear ring (15) and piston ring (16) from pistons (9) and (12).



6. Disassembly of cylinder head assembly

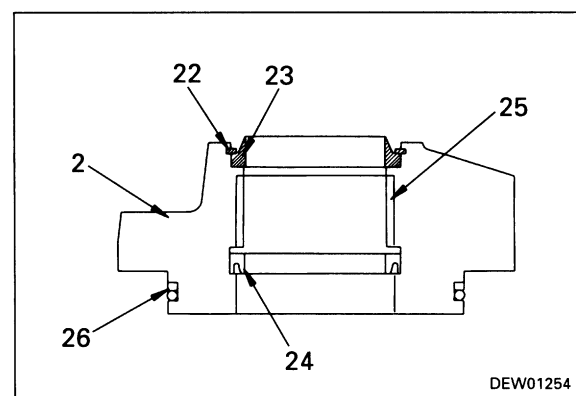
• **Steering cylinder assembly**

- 1) Remove snap ring (17), then remove dust seal (18).
- 2) Remove rod packing (19), then remove bushing (20) from cylinder head (2).
- 3) Remove O-ring and backup ring (21).



• **Boom, bucket cylinder assembly**

- 1) Remove snap ring (22), then remove dust seal (23).
- 2) Remove rod packing (24), then remove bushing (25) from cylinder head (2).
- 3) Remove O-ring and backup ring (26).



ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

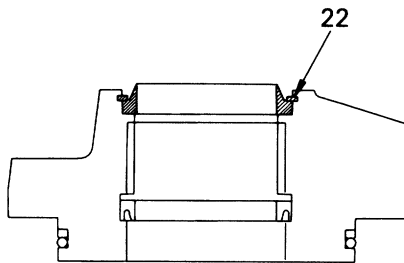
(STEERING, BOOM, BUCKET CYLINDER ASSEMBLY)

- ★ Clean all parts, and check for dirt or damage. Coat the sliding surfaces of all parts with engine oil before installing. Be careful not to damage the rod packing, dust seals or O-rings when assembling.

1. Assembly of cylinder head assembly

• Boom, bucket cylinder assembly

- 1) Using tool **Q**, press fit bushing (25) to cylinder head (2).
- 2) Install rod packing (24).
- 3) Using tool **S**, fit dust seal (23), then install snap ring (22).

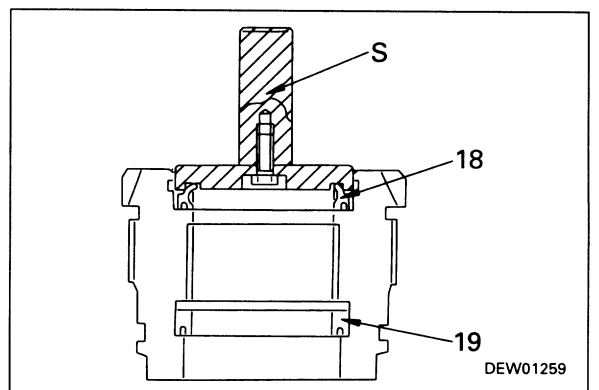
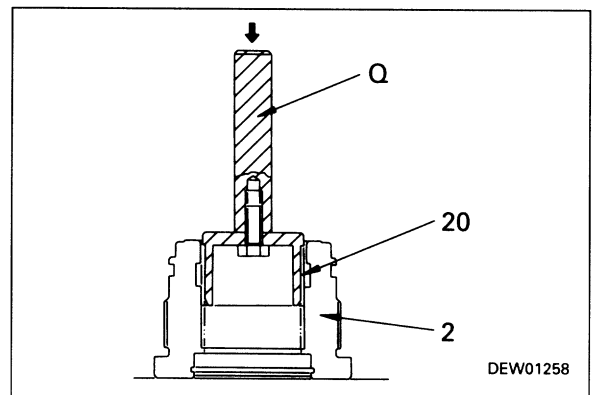
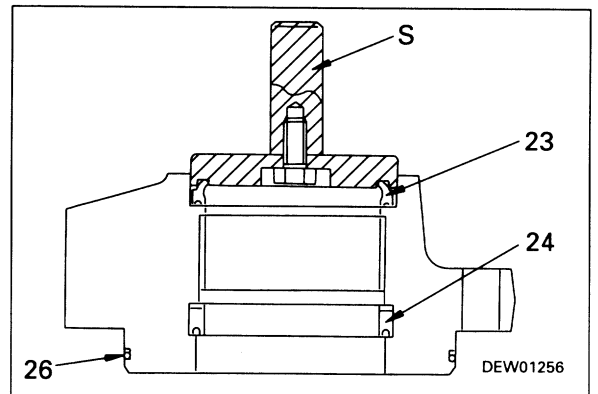
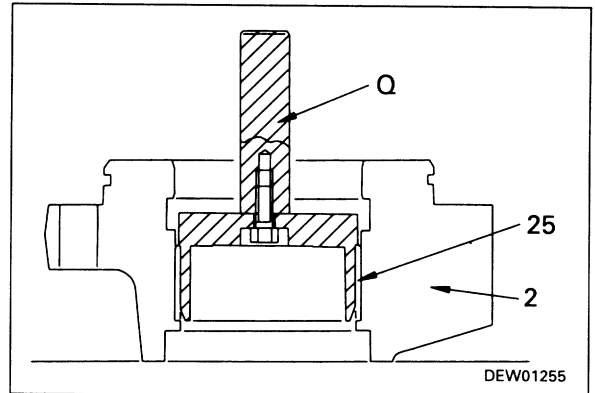


DEW01257

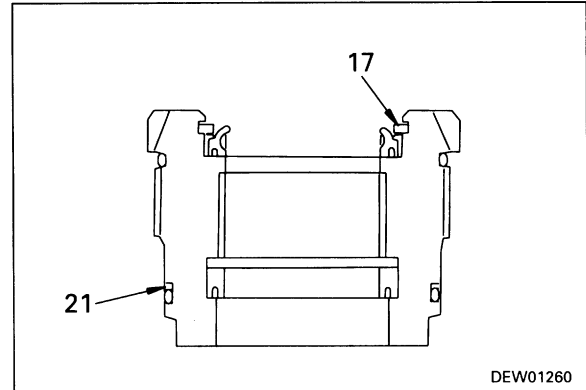
- 4) Install O-ring and backup ring (26).
 - ★ Do not try to force the backup ring into position. Warm it in warm water (50 – 60°C) before fitting it.

• Steering assembly

- 1) Using tool **Q**, press fit bushing (20) to cylinder head (2).

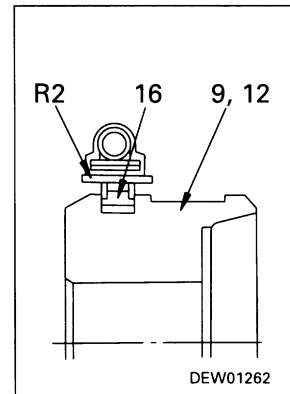
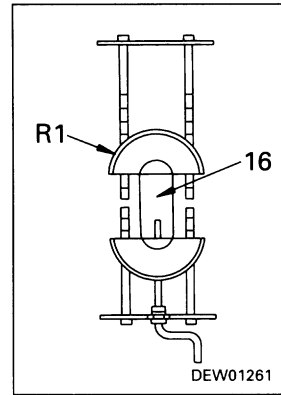


- 4) Install snap ring (17).
- 5) Install O-ring and backup ring (21).
 - ★ Do not try to force the backup ring into position. Warm it in warm water (50 – 60°C) before fitting it.

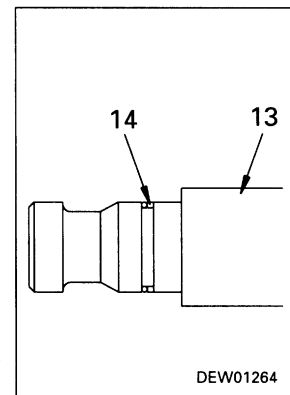
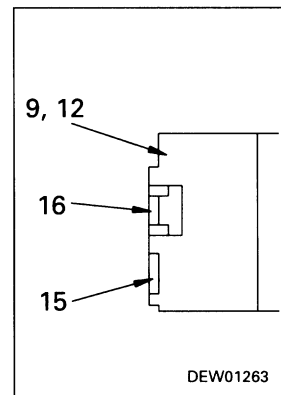


2. Assembly of piston assembly

- 1) Using tool **R1**, expand piston ring (16).
 - ★ Set the piston ring on the expander and turn the handle 8 – 10 times to expand the ring.
- 2) Remove piston ring (16) from tool **R1**, then assemble to pistons (12) and (9).
- 3) Using tool **R2**, compress piston ring (16).
- 4) Assemble wear ring (15).



3. Assemble O-ring and backup ring (14) to piston rod (13).
 - ★ Do not try to force the backup ring into position. Warm it in warm water (50 – 60°C) before fitting it.



4. Cylinder head, piston rod assembly

• Boom, bucket cylinder assembly

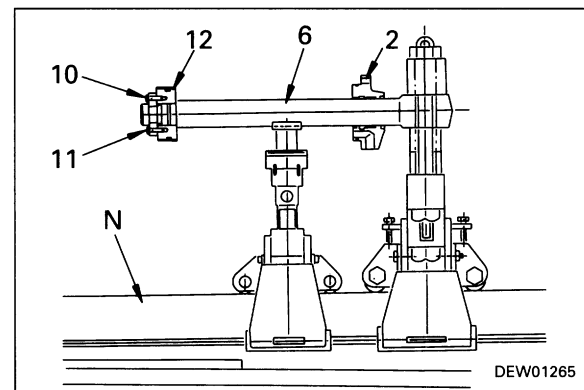
- 1) Set piston rod assembly (6) to tool **N**.
- 2) Assemble cylinder head (2), piston (12), and spacer (11) to piston rod, then tighten mounting bolt (10).

 Mounting bolt:

Thread tightener (LT-2)

 Mounting bolt:

Cylinder	Nm(kgm)
Boom cylinder	110.8 ± 12.8(11.3 ± 1.3)
Bucket cylinder	



• **Steering cylinder assembly**

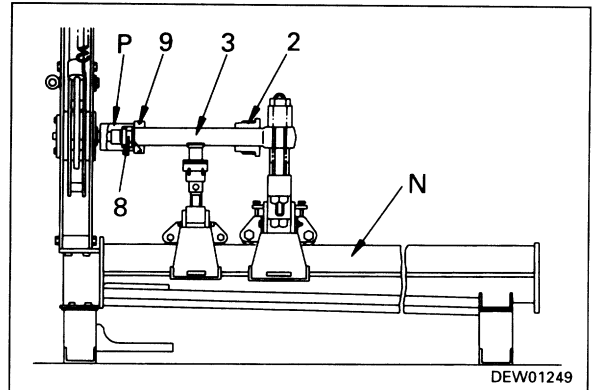
- 1) Set piston rod assembly (3) to tool **N**.
- 2) Assemble cylinder head (2) and piston (9) to piston rod.
- 3) Assemble nut (8), and using tool **P**, tighten nut (8).

 Thread of piston rod:

Thread tightener (LT-2)

 Nut:

Width across flats	Nm(kgm)
55	1422.0 ± 142.2(145 ± 14.5)



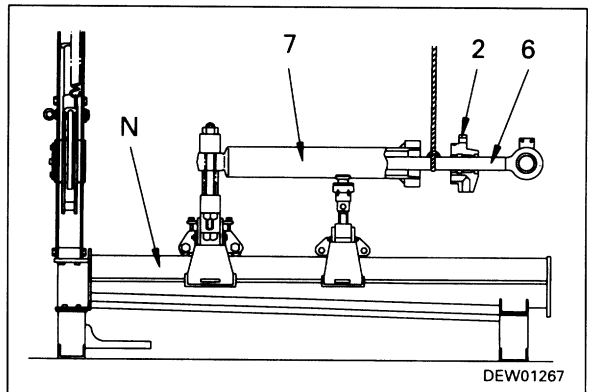
5. Cylinder head

• **Boom, bucket cylinder**

- 1) Set cylinder (7) to tool **N**.
- 2) Raise cylinder head and piston rod assembly (6) and assemble to cylinder (7).
- 3) Install cylinder head (2) to cylinder (7).

 Mounting bolt:

Cylinder	Nm(kgm)
Boom cylinder	343.2 ± 34.3(35 ± 3.5)
Bucket cylinder	490.3 ± 49.0(50 ± 5)



- 4) Remove cylinder assembly (1) from tool **N**.

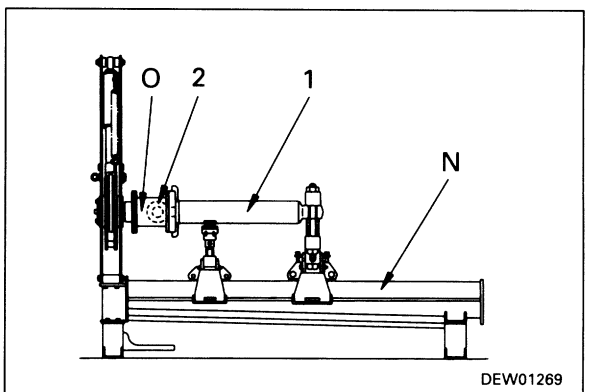
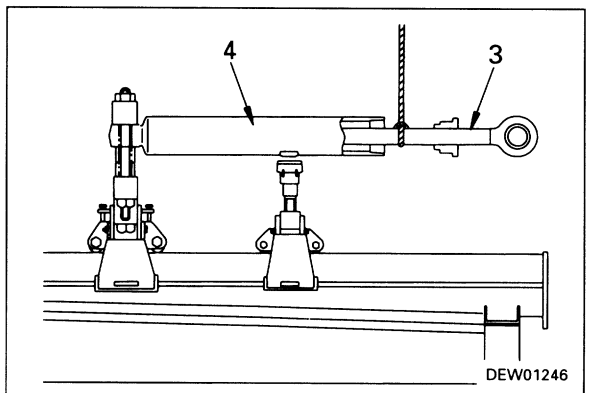
• **Steering cylinder assembly**

- 1) Set cylinder (4) to tool **N**.
- 2) Raise cylinder head and piston rod assembly (3) and assemble to cylinder (4).
- 3) Using tool **O**, install cylinder head (2) to cylinder (4).

 Cylinder head:

784.5 ± 78.5 Nm (80.0 ± 8.0 kgm)

- 4) Bend lock of cylinder head (2) into notch at cylinder end.
- 5) Remove cylinder assembly (1) from tool **N**.



REMOVAL OF WORK EQUIPMENT ASSEMBLY

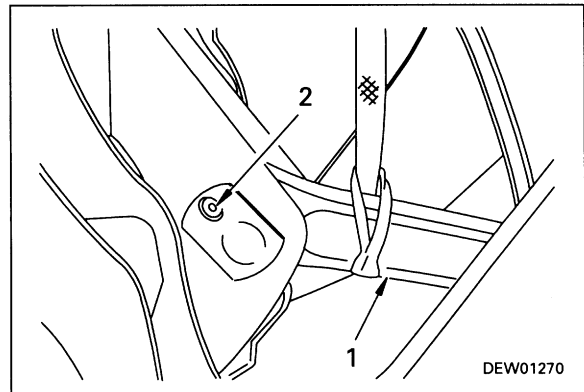
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

1. Bucket link, hinge pin

※ 1

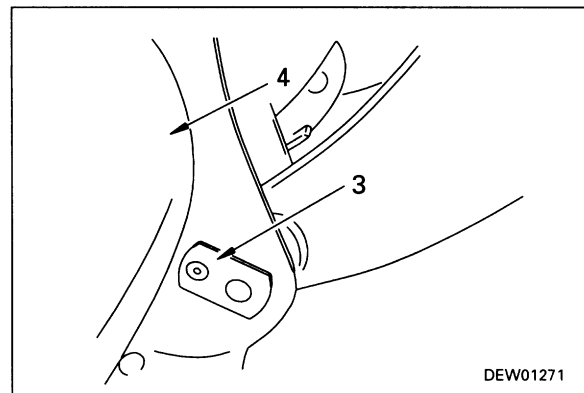
- 1) Sling bucket link (1), and remove mounting pin (2).
 - ★ Remove the cord ring.
 - ★ Secure bucket link (1) to the bellcrank with wire.



- 2) Remove bucket hinge mounting pin (3).
 - ★ Remove the cord ring.

⚠ Never insert your fingers in the pin hole.

- 3) Move machine to rear and disconnect bucket (4).



2. Bucket cylinder pin

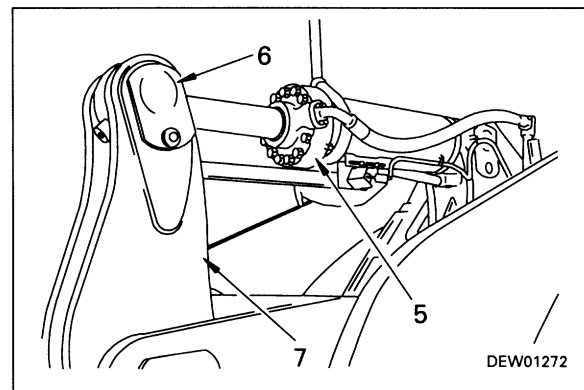
※ 2

Sling bucket cylinder (5), then remove mounting pin (6), and disconnect cylinder rod and bellcrank (7).

- ★ Fit a lifting tool to the bucket cylinder and fix it to the rear.



kg Bucket cylinder: **192.5 kg**



3. Boom cylinder pin

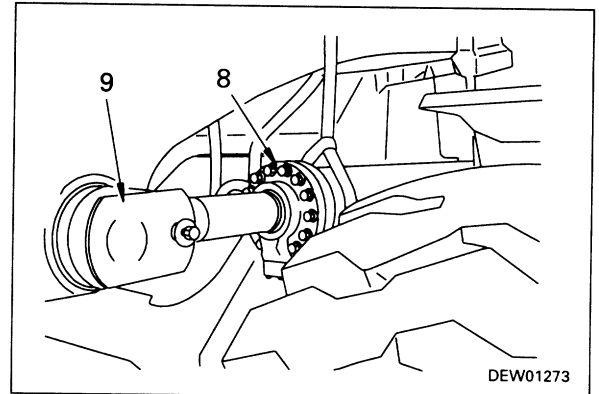
※ 3

Sling boom cylinder (8), and remove mounting pin (9).

- ★ Set a stand under the tip of the boom.
- ★ Insert a block on top of the axle, then lower the cylinder.
- ★ If there are shims installed, check the number and thickness of the shims, and keep in a safe place.



Boom cylinder: **222 kg**

**4. Boom, bellcrank, bucket link**

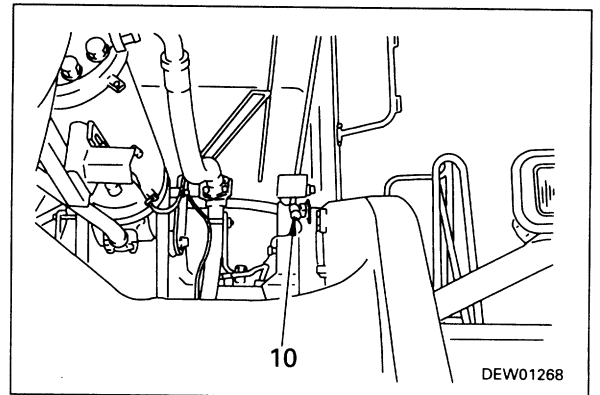
※ 4

- 1) Remove boom kick-out switch (10).
- 2) Sling boom assembly (11), then remove boom mounting pin (12), and lift off boom assembly.



Boom assembly: **1915 kg**
(including bellcrank, bucket link, bellcrank pin)

- ★ If there are shims installed at the connection of the front frame and boom, check the number and thickness of the shims, and keep in a safe place.

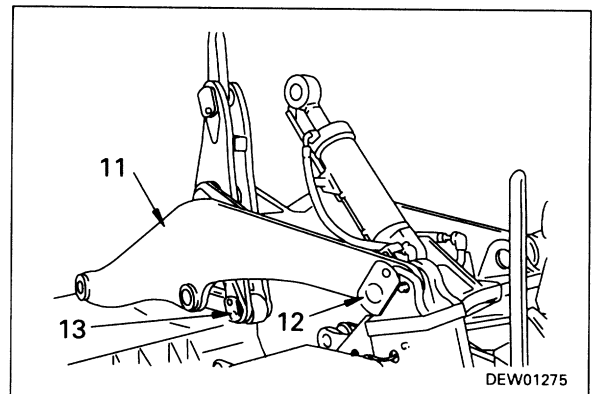
**5. Bellcrank, bucket link**

※ 5

- 1) Sling bucket link (1), then remove mounting pin (13), and lift off from bellcrank (7).
- ★ Remove the cord ring.



Bucket link: **86 kg**



- 2) Sling bellcrank (7), then remove mounting pin (14), and lift off from boom assembly (11).

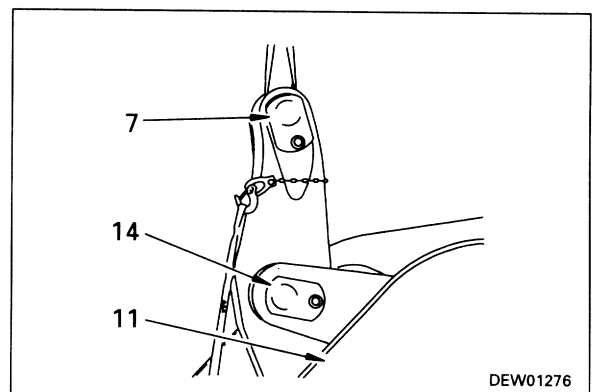
- ★ Carry out the mounting pin removal operation with two people.



Bellcrank: **415 kg**



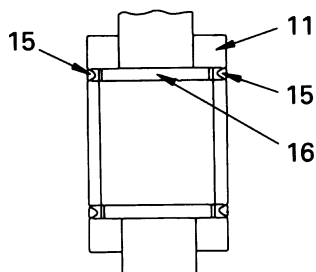
Mounting pin: **40 kg**



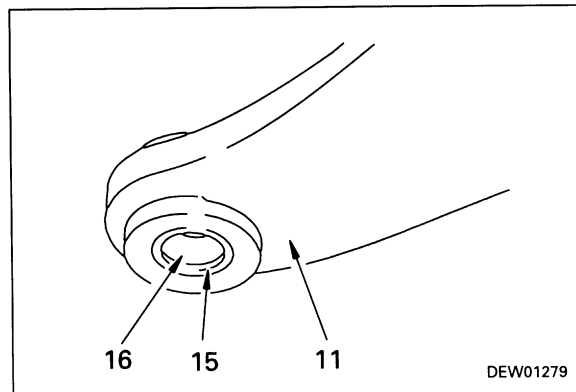
6. Dust seals, bushings

※ 6

- 1) Pull out dust seal (15) and bushing (16) from boom (11).

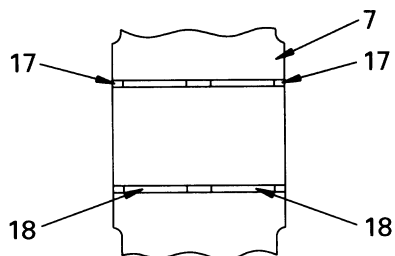


DEW01277

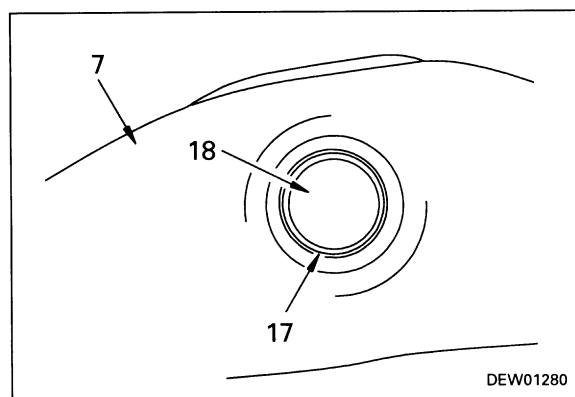


DEW01279

- 2) Pull out dust seal (17) and bushing (18) from bellcrank (7).

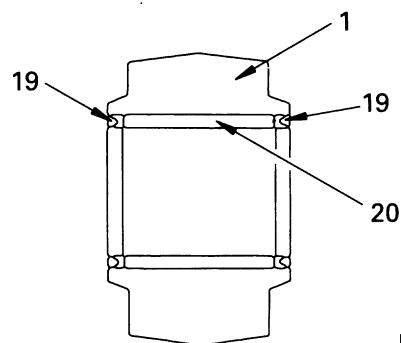


DEW01278



DEW01280

- 3) Pull out dust seal (19) and bushing (20) from bucket link (1).



DEW01266

U42103

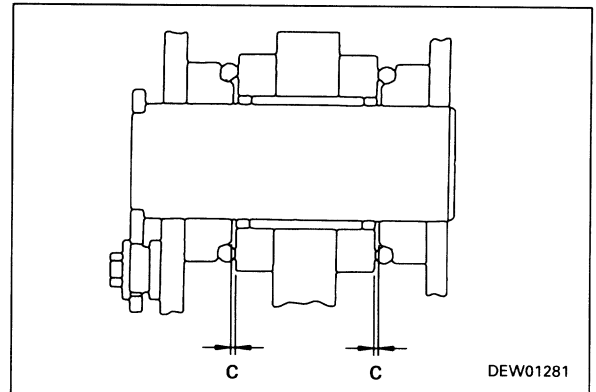
INSTALLATION OF WORK EQUIPMENT ASSEMBLY

- ⚠ Always use a bar when aligning the pin holes. Never insert your fingers.
- Carry out installation in the reverse order to removal.

※ 1

Bucket and bucket link

- ★ Be careful that the cord ring does not get caught.
- ★ Clearance **c** at mount portion: 1.5 mm
- Grease all the pins after completing the assembly.



※ 2

Bucket cylinder

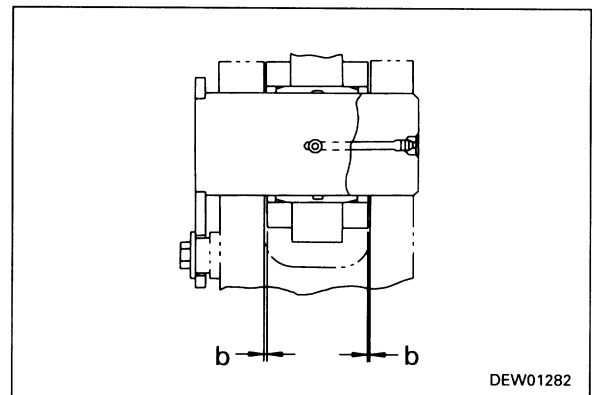
- ★ After assembling the mounting pin, remove the block.

※ 3

Boom cylinder

- ★ Clearance **b** at mount portion: Max. 1.5 mm

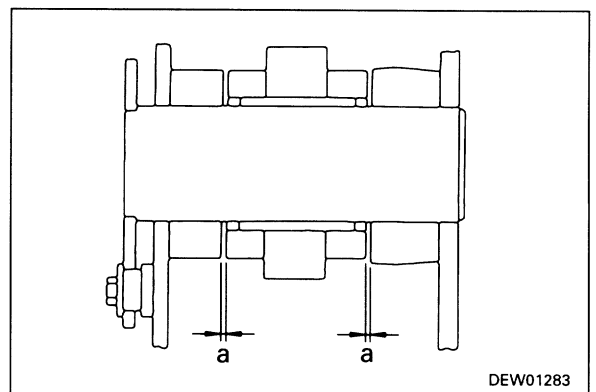
- ⚠ Before starting the engine, place the directional lever at the N position, and check that the parking brake is applied.



※ 4

Boom, bellcrank, bucket link

- ★ Clearance **a** at mount portion: Max. 1.5 mm
- ★ After assembling the pin, set a stand under the tip of the lift arm.



※ 5

Bellcrank, bucket link

- ★ Secure the bucket to the bellcrank with wire.
- ★ Be careful that the cord ring does not get caught.

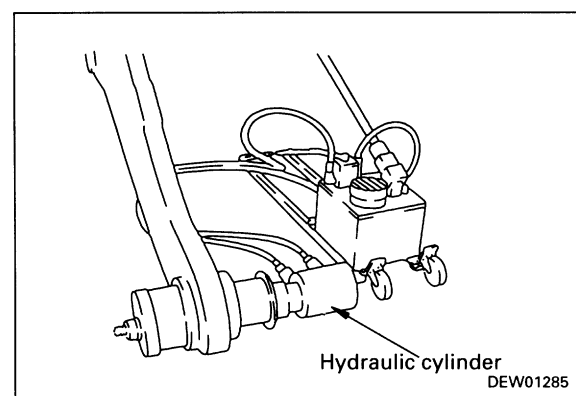
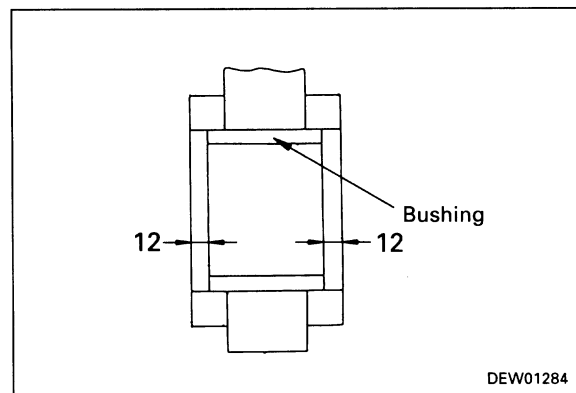
※ 6

Use a press to press fit the bushing to the bucket link, bellcrank, and boom. After press fitting, assemble the dust seal.



Inside surface of bushing:

Grease (G2-LI)



U42103

REMOVAL OF COUNTERWEIGHT

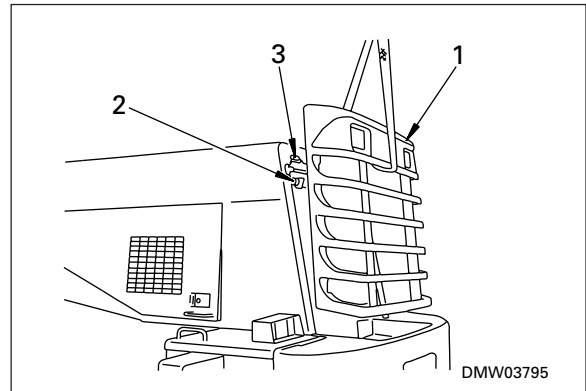
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Sling radiator guard, and remove 4 mounting bolts, then disconnect connector (2) of rear working lamp wiring and radiator water level sensor (3) at radiator end.
2. Lift off radiator guard (1).
3. Sling counterweight (4), then remove mounting bolts and lift off. ※ 1



Counterweight: **1,309 kg**

- ★ When removing the counterweight, be careful not to hit the battery box.



INSTALLATION OF COUNTERWEIGHT

- Carry out installation in the reverse order to removal.

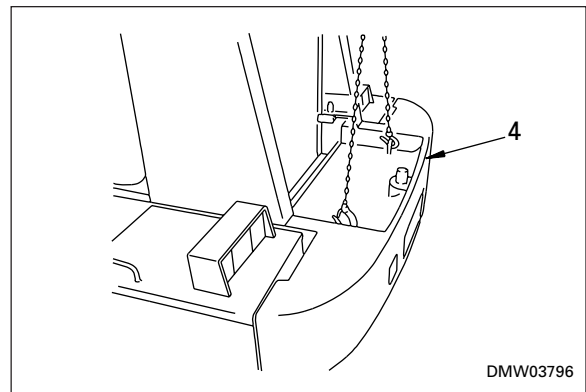
※ 1



Mounting bolt:

926.7 ± 104.9 Nm (94.5 ± 10.5 kgm)

- ★ When installing the counterweight, be careful not to hit the battery box.

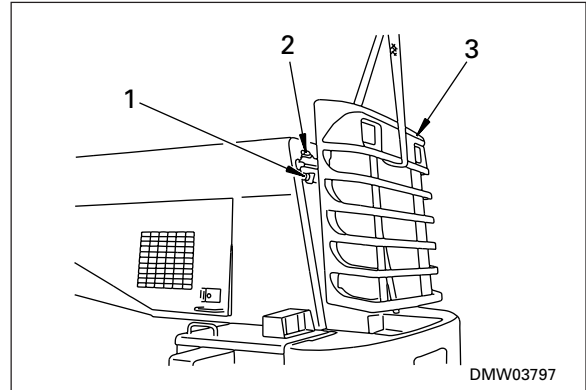


REMOVAL OF FUEL TANK ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Radiator guard

- 1) Remove 4 radiator guard mounting bolts, and disconnect connector (1) of rear working lamp wiring and radiator water level sensor (2) at radiator end.
- 2) Lift off radiator guard (3).



2. Draining fuel

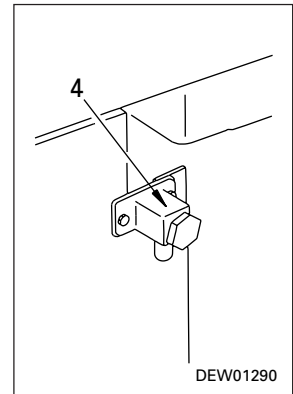
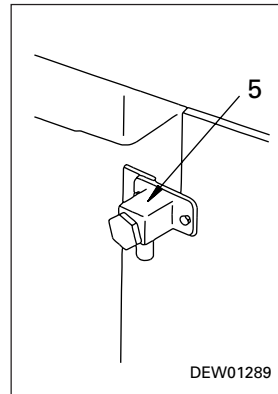
Loosen drain valve and drain fuel.



Fuel: 400 ℓ

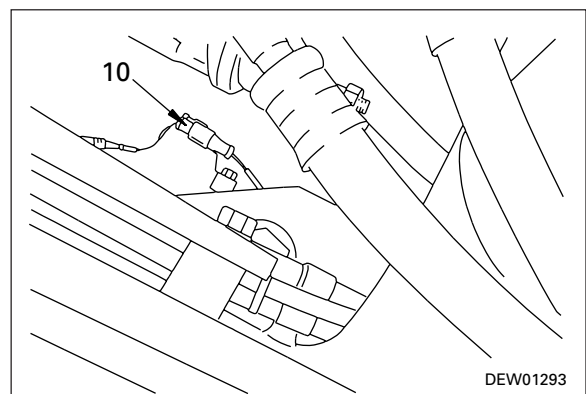
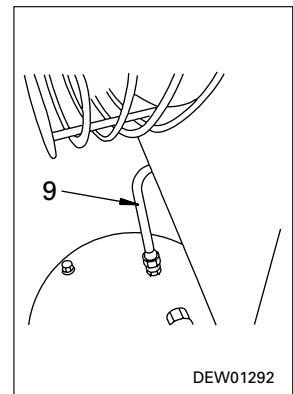
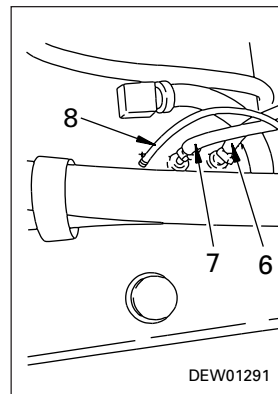
3. Drain valves

Remove engine oil drain valve (4) and radiator drain valve (5) from fuel tank.



4. Fuel tube, wiring clamp

- 1) Disconnect hose (6) between fuel tank and feed pump, fuel return hose (7), and spill hose (8) at tank end.
- 2) Disconnect wiring connector (10) for fuel sensor.
- 3) Remove clamps at fuel tank mounting bolt for steering oil cooler hose and hose going to transmission cooler.
- 4) Remove fuel tank air bleed tube (9).

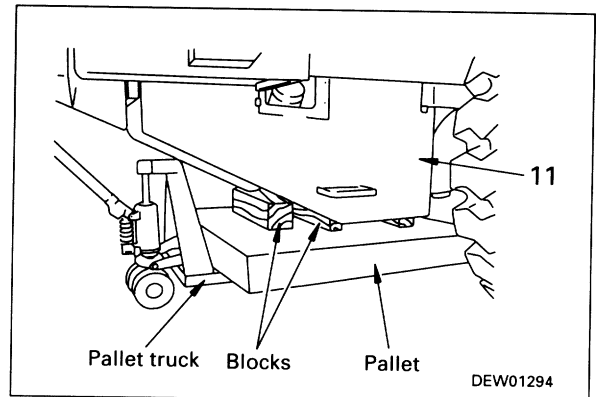


5. Fuel tank

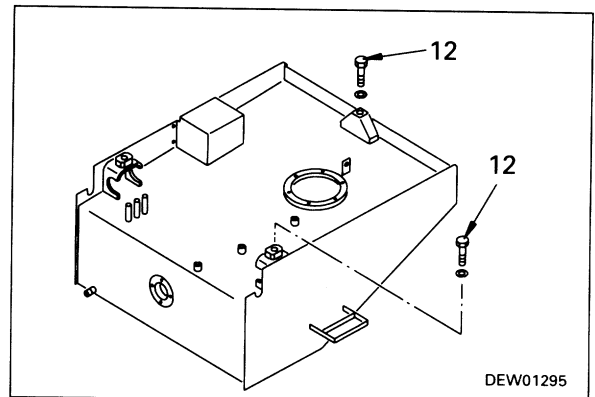
- 1) Put pallet under fuel tank (11), then put blocks so that tank does not tilt, and support tank with pallet truck.



Fuel tank: **250 kg**



- 2) Remove fuel tank mounting bolts (12). ※ I
- 3) Pull out fuel tank (11) from rear of chassis.
 - ★ Maintain the balance of the fuel tank, and operate the pallet truck to remove the tank.



INSTALLATION OF FUEL TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

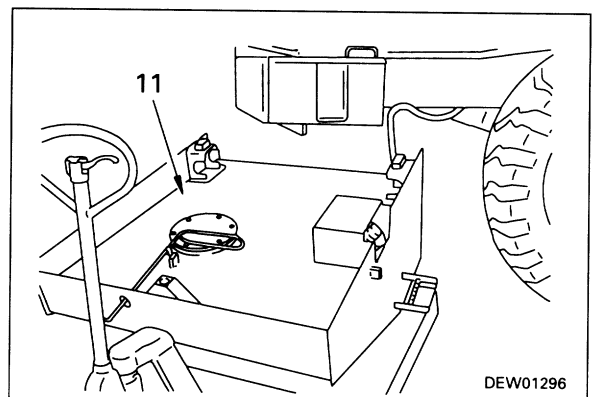
※ I

- ★ When installing the fuel tank, keep it horizontal, and set it in position on the machine.
- ★ Tighten the bolts in the following order: left, rear, right.

Fuel tank mounting bolt:

$926.7 \pm 104.9 \text{ Nm}$ ($94.5 \pm 10.5 \text{ kgm}$)

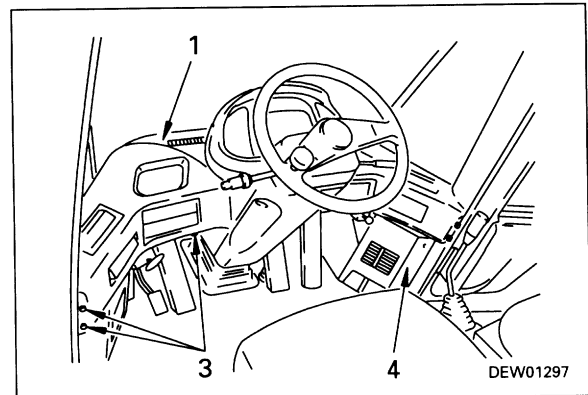
- Tighten the drain valve and add oil through oil filler.



REMOVAL OF CAB ASSEMBLY

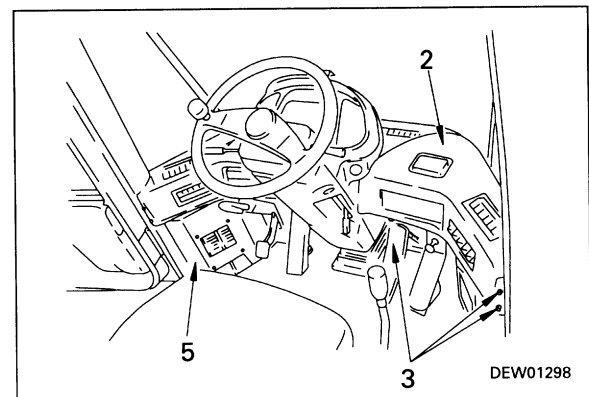
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Remove mounting bolts (3) of left and right dashboards (1) and (2).



2. Remove right cover (4).

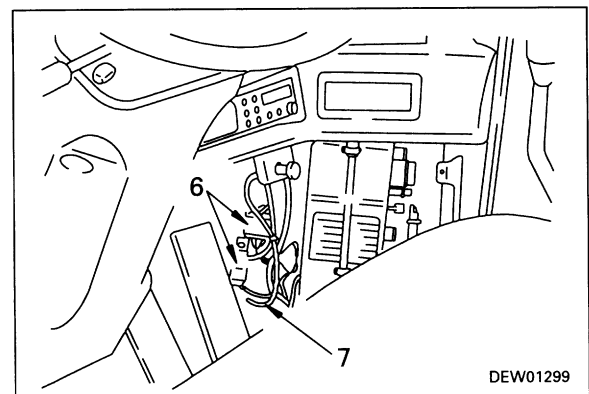
3. Remove left cover (5).



4. Disconnect electric wiring at connector (6).

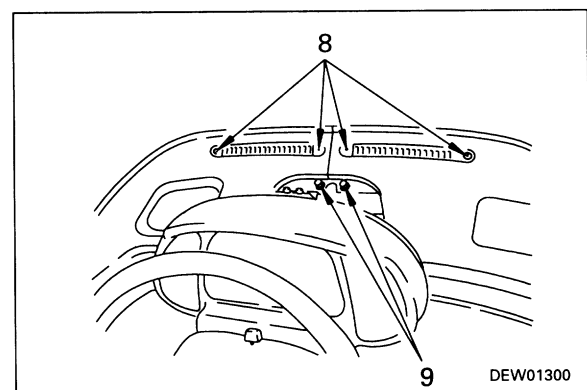
5. Disconnect window washer hose (7).

★ After disconnecting the hose, mark with a tag to distinguish when installing.

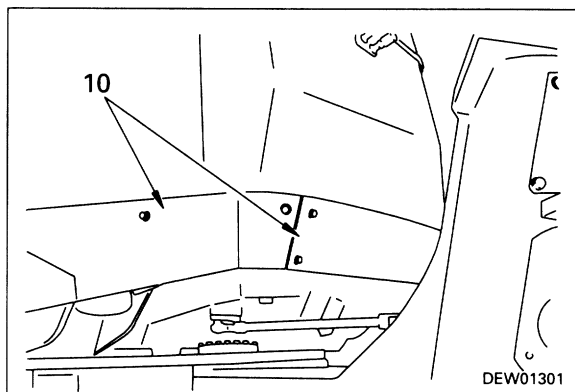


6. Remove mounting bolts (8) of left and right dashboards, then remove left and right dashboards (1) and (2).

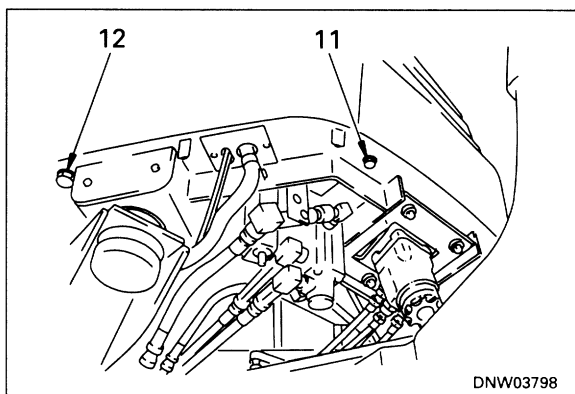
7. Remove steering post and cab mounting bolts (9).



8. Remove covers (10) under cab.

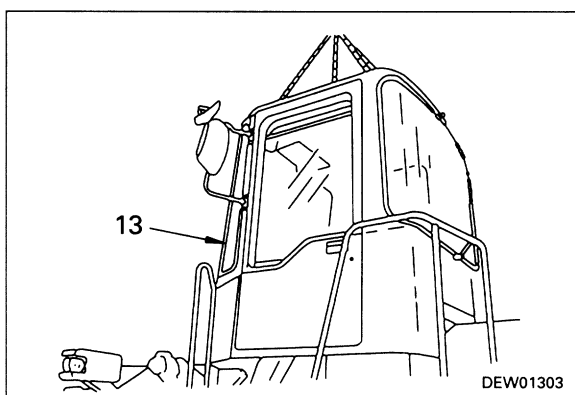


9. Remove 2 cab mounting bolts (11), 4 mounting bolts (12) in the middle, and 4 mounting bolts at the rear.



10. Lift off cab (13).
- ★ Keep the cab horizontal and lift it off slowly.
 - ★ Remove the plugs on top of the cab, and install eyebolts.

 Cab: 300 kg



INSTALLATION OF CAB ASSEMBLY

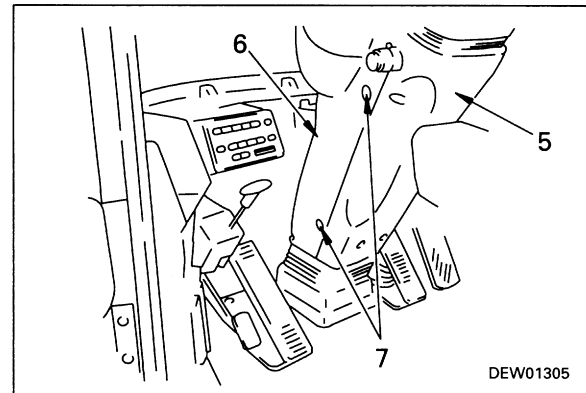
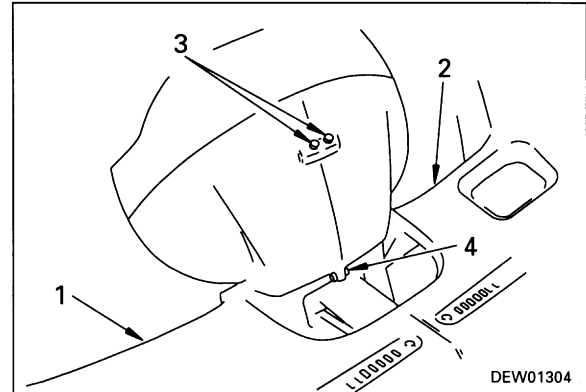
- Carry out installation in the reverse order to removal.

REMOVAL OF MAIN MONITOR ASSEMBLY

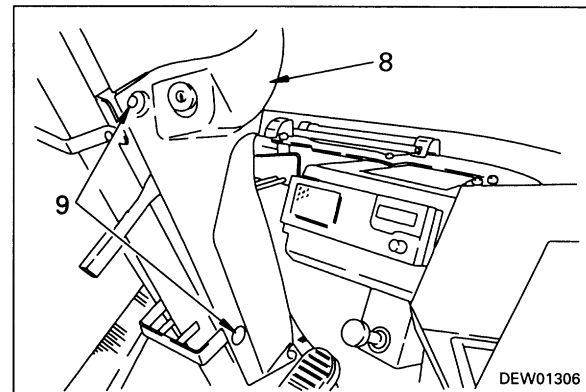
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Disconnect the cable from the negative (-) terminal of the battery.

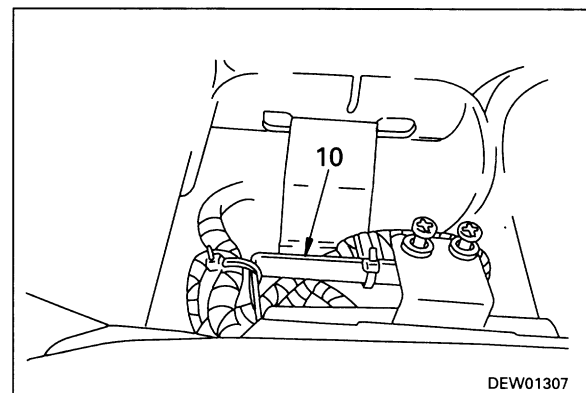
1. Remove dashboards (1) and (2).
2. Remove steering post cover mounting bolts (3) and (4).
3. Remove steering post cover (5).
4. Remove mounting bolt caps (7) of steering post cover (6), then remove bolts.



5. Remove mounting bolt caps from steering post cover (8), then remove mounting bolts (9).
★ Tip the steering post cover to the front.

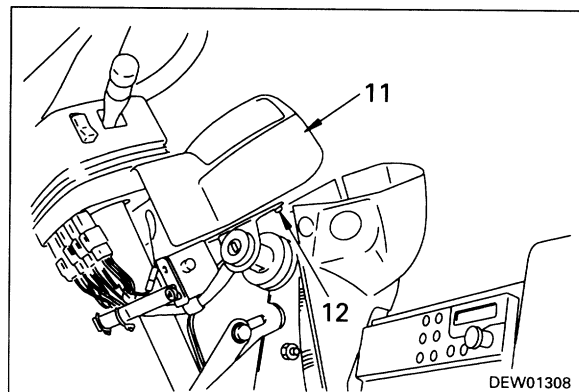


6. Remove bracket (10) at back of main monitor.



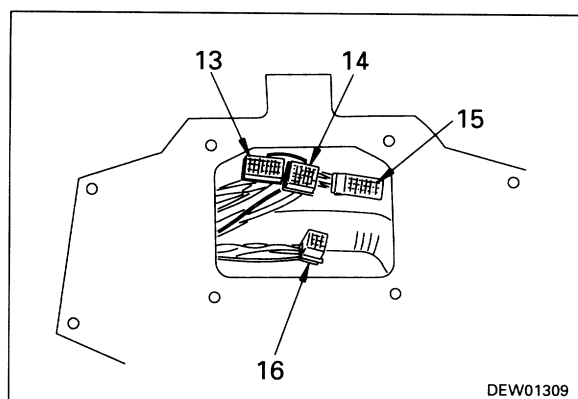
7. Remove 8 mounting bolts (12) of main monitor (11).

★ When removing the main monitor, be careful not to subject it to any strong shock.



8. Disconnect wiring connectors (13), (14), (15), and (16) from main monitor (11).

※ 1

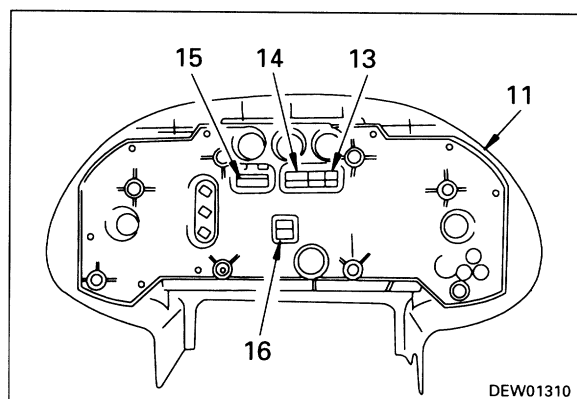


INSTALLATION OF MAIN MONITOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

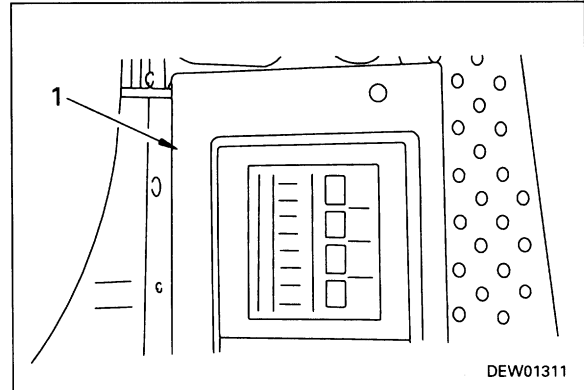
★ Fit the connector lock securely.



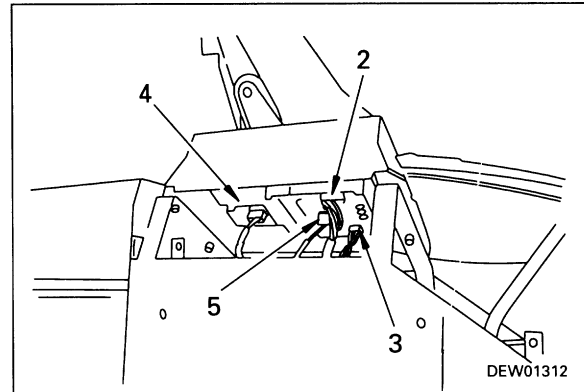
REMOVAL OF MAINTENANCE MONITOR ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

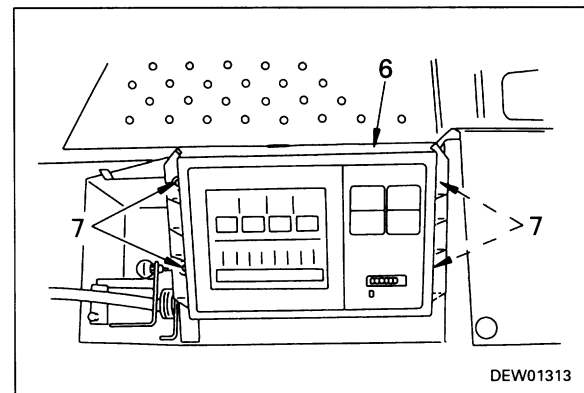
1. Remove cover (1) of right console box.



2. Disconnect connectors (2), (3), and (4) for maintenance monitor wiring and bulb wiring (5) from maintenance monitor.



3. Remove mounting bolts (7) of maintenance monitor (6), then remove maintenance monitor (6).



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INSTALLATION OF MAINTENANCE MONITOR ASSEMBLY

- Carry out installation in the reverse order to removal.

REMOVAL OF AIR CONDITIONER UNIT ASSEMBLY

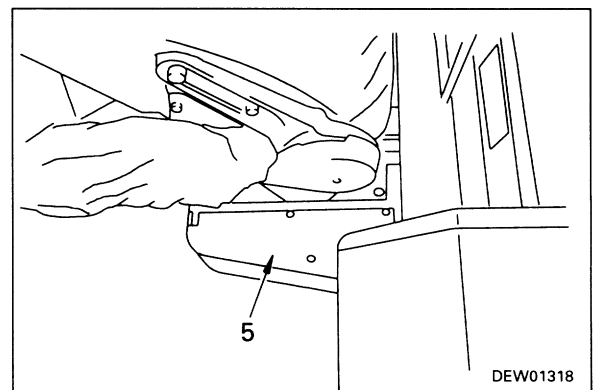
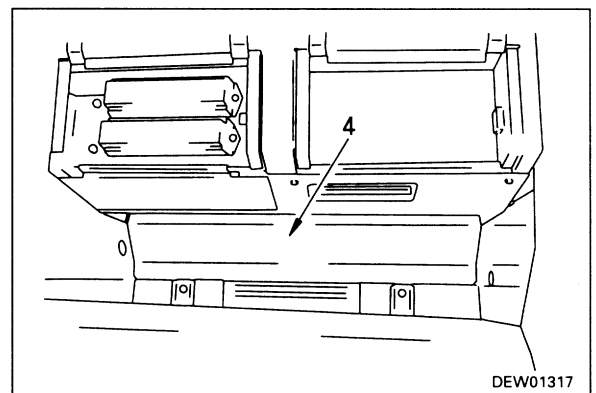
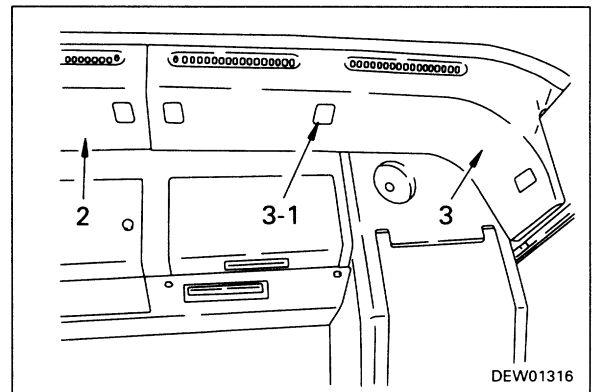
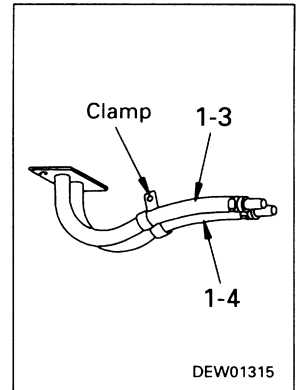
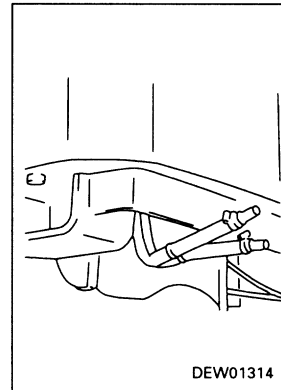
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Disconnect the cable from the negative (-) terminal of the battery.

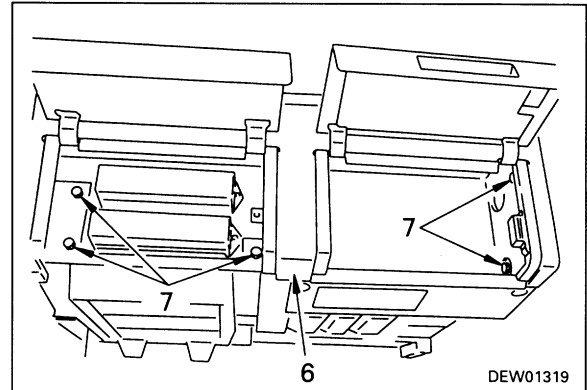
- Remove the cover under the cab.
- After carrying out the oil return operation for the compressor, use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.
- To carry out the oil return operation, set the fan switch to the maximum position, then run the engine at low idling and operate the air conditioner for 5 minutes.

⚠ If the refrigerant gets into your eyes, it may cause loss of sight, so always wear safety glasses.

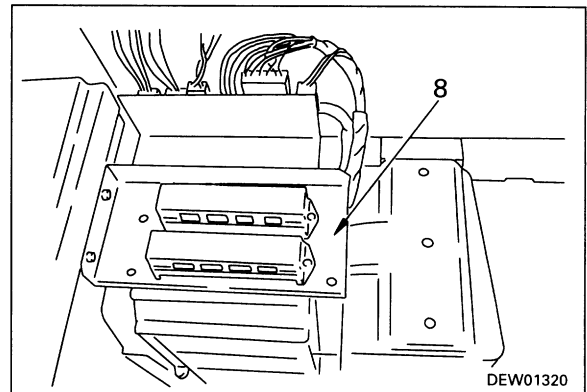
1. Loosen clamp of heater hoses (1-3) and (1-4), and disconnect hoses.
2. Remove cab rear covers (2) and (3).
 - ★ Slide the operator's seat forward and tip it to the front.
 - ★ Remove the blind cap (3-1).
 - ★ Remove 2 bolts and loosen 6 bolts.
3. Remove 5 mounting bolts of cover (4), then remove cover.
4. Remove seat support cover (5).



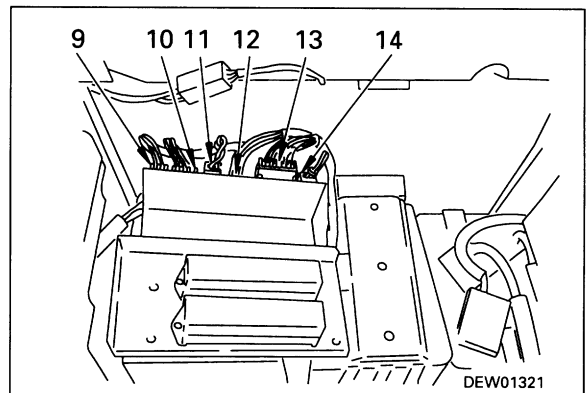
5. Remove cool and hot box assembly (6) and mounting bolts (7), then remove cool and hot box assembly.



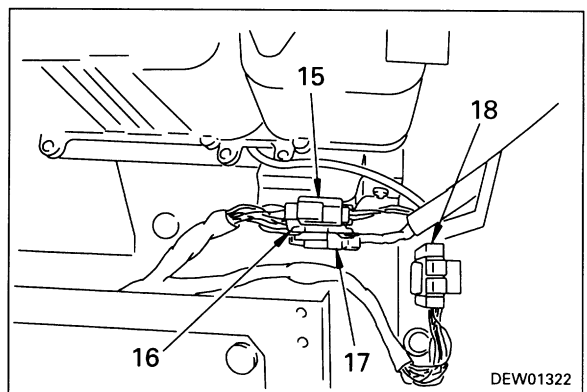
6. Remove fuse box assembly bracket (8) from right console box.



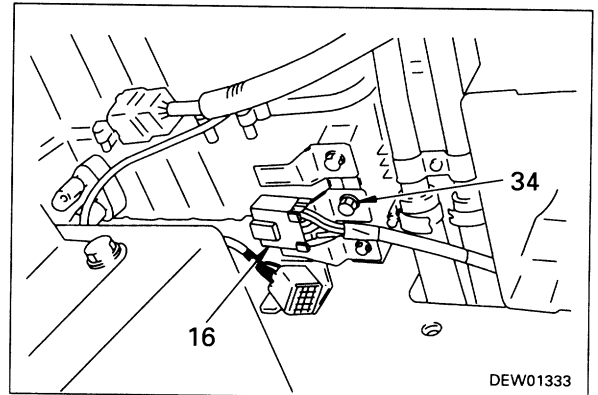
7. Remove connectors (9), (10), (11), (12), (13), and (14) from fuse box assembly bracket, and put fuse box assembly on right console box temporarily.
 - ★ Mark the connectors with a tag to distinguish when installing.



8. Disconnect floor wiring connectors (15), (16), and (17) from air conditioner unit wiring, then disconnect air conditioner relay wiring connector (18).



17. Remove clamp bolt (34) of air conditioner wiring connector (16).

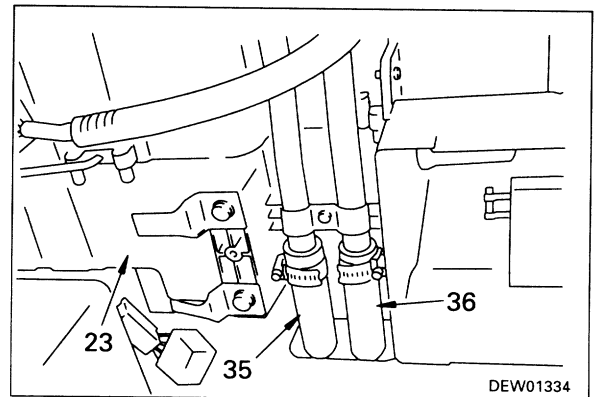


18. Disconnect heater hoses (35) and (36) from air conditioner unit (23).

※ 2

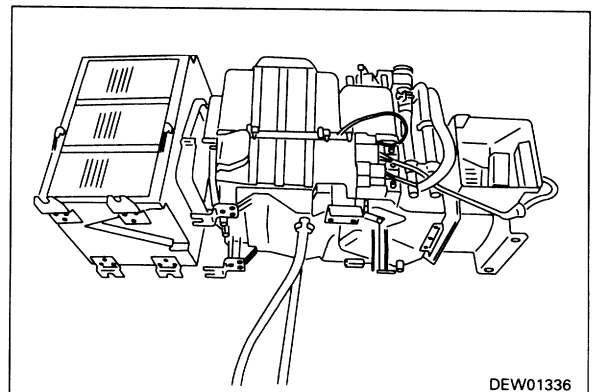
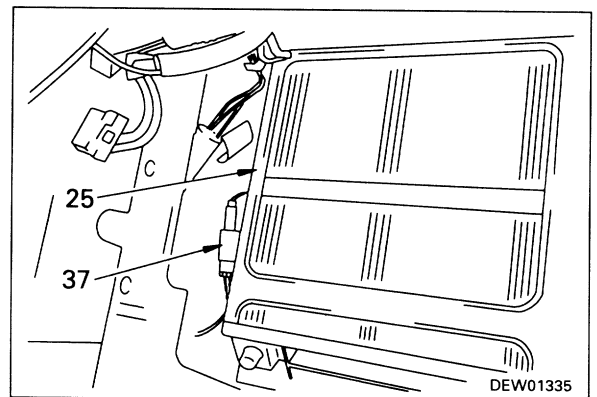


Air conditioner unit assembly: 38 kg



19. Disconnect air conditioner damper wiring connector (37) from floor wiring, then remove air conditioner damper (25).

★ After disconnecting, take steps to prevent the entry of dust or water.



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INSTALLATION OF AIR CONDITIONER UNIT ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 **kgm** Tube mounting bolt:
9.8 ± 2 Nm (1.0 ± 0.2 kgm)

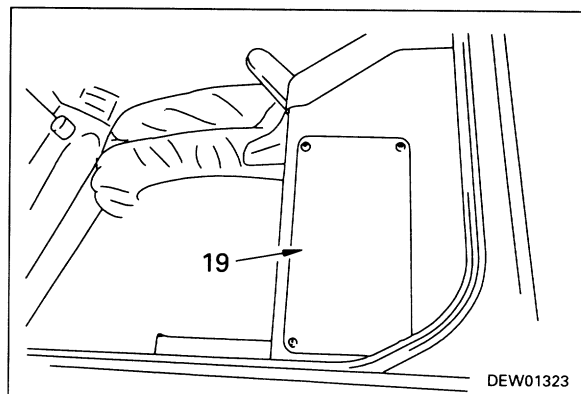
- ★ Coat the O-ring with compressor oil ND-OIL8.

※ 2

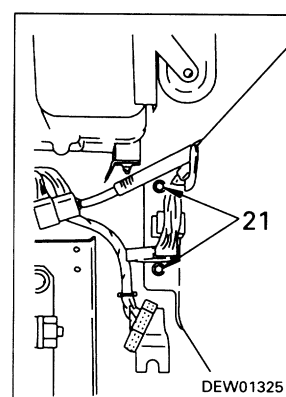
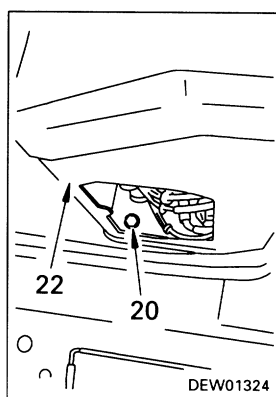
- ★ Pass the air conditioner drain hose through the floor support grommet.

- Fill the air conditioner with new refrigerant.
 - ★ **Precautions when filling air conditioner line with new refrigerant**
 - 1) Keep the temperature inside the room at above 3°C.
(If the temperature is below 3°C, the system will not work.)
 - 2) Use R134a as the refrigerant.
 - 3) When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min. 750 mmHg.)
 - 4) Charge with 1.5 – 1.6 kg of refrigerant.
 - 5) Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
 - 6) Do not operate the compressor before charging with refrigerant.
 - ★ Check the oil level in the compressor.
(Specified oil level: 150 ⁺¹⁴₀ cc ND-OIL8)

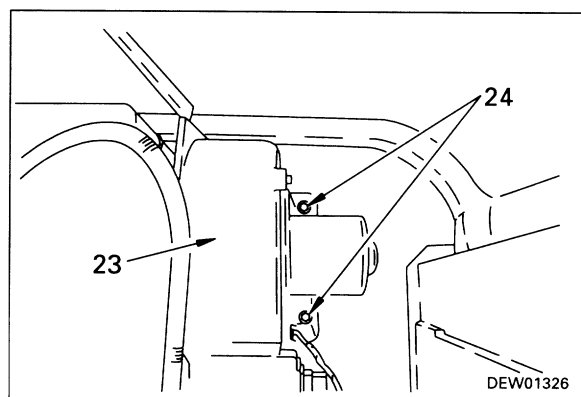
9. Remove left console box cover (19).



10. Remove left console box mounting bolts (20) and (21), then remove left console box (22).

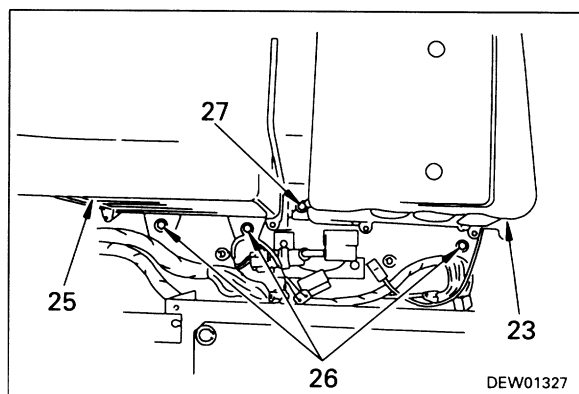


11. Remove mounting bolts (24) of air conditioner unit (23).



12. Remove mounting bolts (26) of air conditioner unit (23) and air conditioner damper (25).

- ★ Loosen mounting bolt (27).
- ★ Loosen the 4 mounting bolts at the cab end.

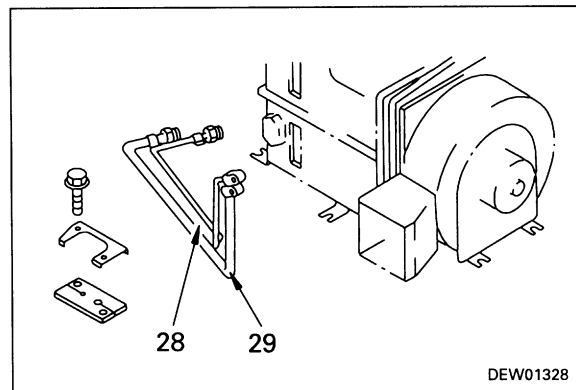


DISASSEMBLY AND ASSEMBLY

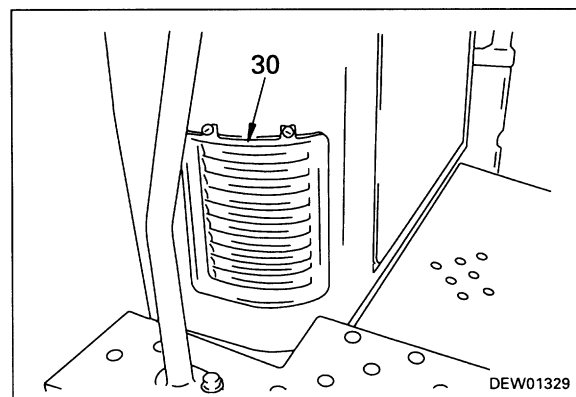
AIR CONDITIONER UNIT

- 13. Disconnect air conditioner tubes (28) and (29) from air conditioner unit.** ※ 1

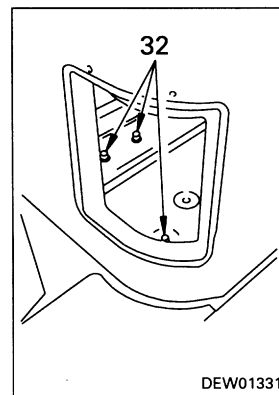
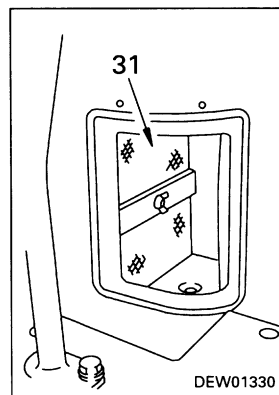
- ★ Check that the pressure has been reduced.
- ★ Remove the clamp.



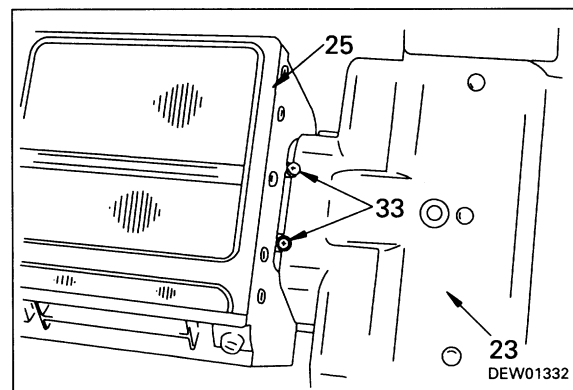
- 14. Remove cover (30) at rear right of cab.**



- 15. Remove air conditioner filter (31), then remove duct mounting bolts (32).**



- 16. Remove connecting bolts (33) of air conditioner unit (23) and air conditioner damper (25).**



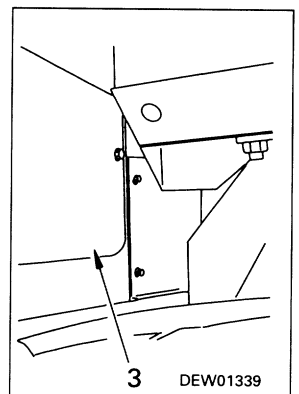
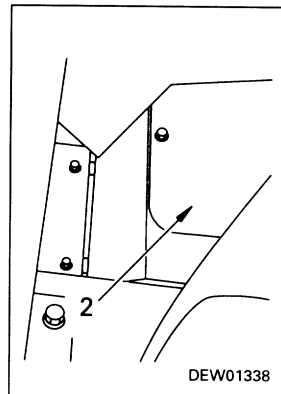
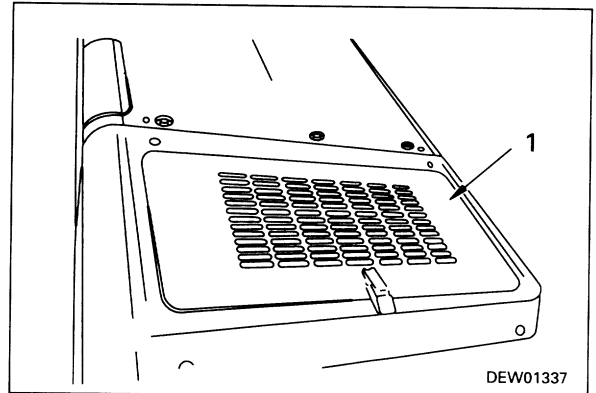
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REMOVAL OF AIR CONDITIONER CONDENSER ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

★ Open inspection cover (1) at the top of the bulkhead and covers (2) and (3) at both sides.

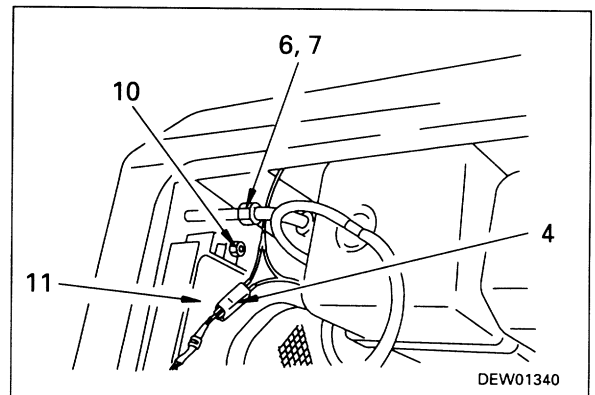


1. Disconnect electric wiring connectors (4) and (5) of condenser.

2. Disconnect left condenser hoses (6) and (7), and right condenser hoses (8) and (9).

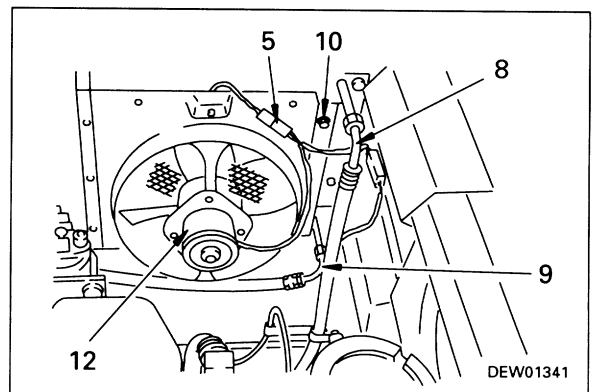
★ After disconnecting the hoses and condenser connections, fit plugs to prevent the entry of dirt or dust

※ 1



3. Remove condenser mounting bolts (10), then remove left condenser (11) and right condenser (12).

★ The space is confined, so be careful when carrying out the removal operation.



INSTALLATION OF AIR CONDITIONER CONDENSER ASSEMBLY

- Carry out installation in the reverse order to removal.



- ★ Do not remove the plugs from the hoses or condenser connections until immediately before installing.

- ★ Install the hoses without twisting.



Hose, connection:

**Compressor oil for new refrigerant
(ND-OIL8)**



Condenser top connection:

19.6 – 24.5 Nm (2.0 – 2.5 kgm)



Condenser bottom connection:

11.8 – 14.7 Nm (1.2 – 1.5 kgm)

- Fill the air conditioner with new refrigerant.

- ★ **Precautions when filling air conditioner line with new refrigerant**

- 1) Keep the temperature inside the room at above 3°C.
(If the temperature is below 3°C, the system will not work.)
- 2) Use R134a as the refrigerant.
- 3) When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min. 750 mmHg.)
- 4) Charge with 1.5 – 1.6 kg of refrigerant.
- 5) Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
- 6) Do not operate the compressor before charging with refrigerant.

REMOVAL OF DRY RECEIVER ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

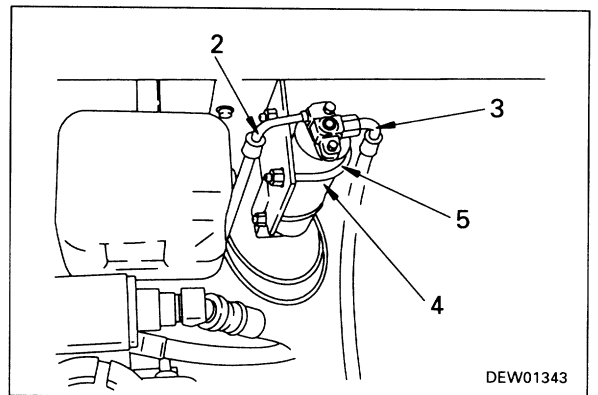
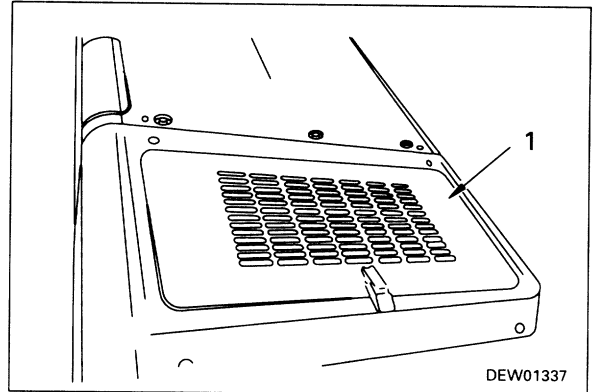
⚠ When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

★ Open inspection cover (1) at the top of the bulkhead.

1. Disconnect hoses (2) and (3) of dry receiver.

★ After disconnecting the hoses and dry receiver connections, fit plugs to prevent the entry of dirt or dust. ※ 1

2. Remove mounting U-bolt (5) of dry receiver, then remove receiver. ※ 2



INSTALLATION OF DRY RECEIVER ASSEMBLY

• Carry out installation in the reverse order to removal.

※ 1

★ Do not remove the plugs from the hoses or dry receiver connections until immediately before installing.

★ Install the hoses without twisting.

Hose, connection:

Compressor oil for new refrigerant (ND-OIL8)

Receiver connection:

4 – 6.8 Nm (0.4 – 0.7 kgm)

※ 2

Receiver mounting U-bolt:

10.8 – 26.5 Nm (1.1 – 2.7 kgm)

• Fill the air conditioner with new refrigerant.

★ **Precautions when filling air conditioner line with new refrigerant**

1) Keep the temperature inside the room at above 3°C.

(If the temperature is below 3°C, the system will not work.)

2) Use R134a as the refrigerant.

3) When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min. 750 mmHg.)

4) Charge with 1.5 – 1.6 kg of refrigerant.

5) Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.

6) Do not operate the compressor before charging with refrigerant.

REMOVAL OF AIR CONDITIONER COMPRESSOR ASSEMBLY

⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ When releasing the refrigerant from the air conditioner, carry out the oil return operation, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.

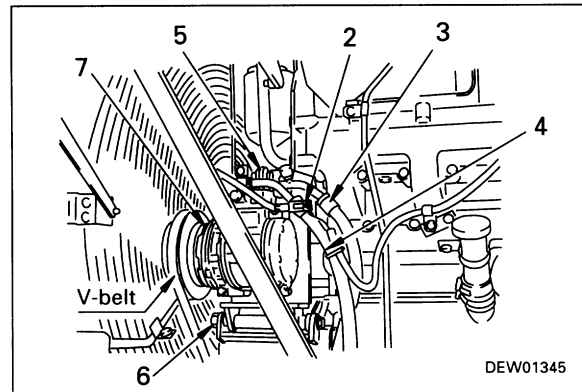
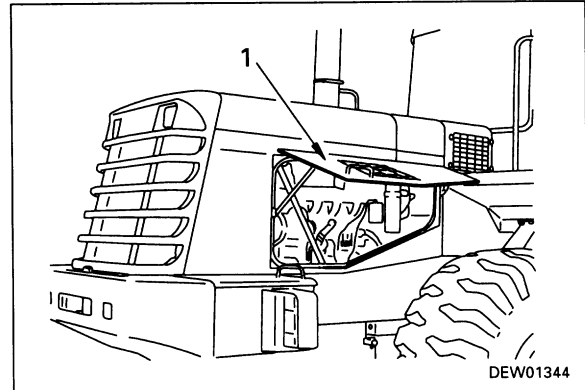
★ Open engine side cover (1) on the right side of the machine.

1. Disconnect electric wiring connector (2) of compressor clutch.

2. Disconnect hoses (3) and (4).

★ After disconnecting the hoses and compressor connections, fit plugs to prevent the entry of dirt or dust ※ 1

3. Remove compressor adjustment bolt (5) and mounting bolt (6), remove V-belt, then remove air conditioner compressor (7). ※ 2



INSTALLATION OF AIR CONDITIONER COMPRESSOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Do not remove the plugs in the hoses or connections until immediately before installing.
- ★ Install the hoses without twisting.



Hose, connection:

**Compressor oil for new refrigerant
(NB-OIL8).**



Connection nuts of hoses (3), (4):

7.9 – 11.8 Nm (0.8 – 1.2 kgm)

※ 1

Adjust the V-belt.

For details, see TESTING AND ADJUSTING.

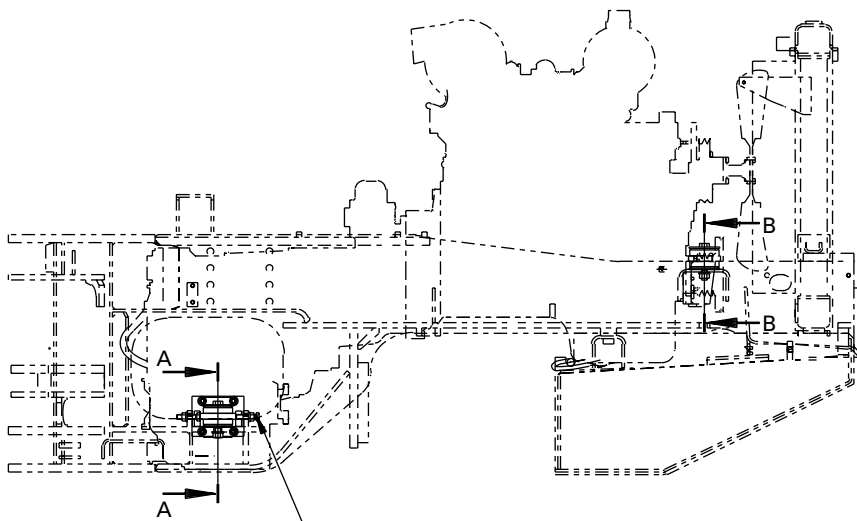
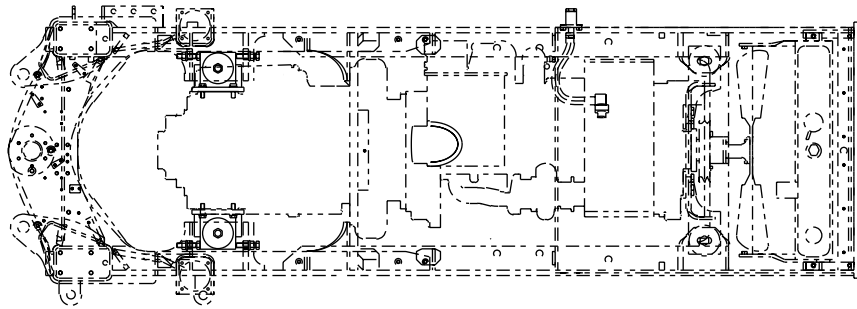
- Fill the air conditioner with new refrigerant.
 - ★ **Precautions when filling air conditioner line with new refrigerant**
 - 1) Keep the temperature inside the room at above 3°C.
(If the temperature is below 3°C, the system will not work.)
 - 2) Use R134a as the refrigerant.
 - 3) When filling with refrigerant, always use the repeat vacuum method to completely evacuate. (Attainment of vacuum: Min. 750 mmHg.)
 - 4) Charge with 1.5 – 1.6 kg of refrigerant.
 - 5) Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
 - 6) Do not operate the compressor before charging with refrigerant.

40 MAINTENANCE STANDARD

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Engine mount, transmission mount.....	40- 2
Torque converter	40- 3
Transmission	40- 4
Transmission control valve	40-11
Flow valve	40-15-1
Accumulator valve	40-15-2
Drive shaft	40-16
Differential	40-18
Final drive	40-20
Axle mount	40-21
Steering column	40-22
Steering valve	40-23
Steering cylinder mount	40-24
Slack adjuster	40-25
Brake valve	40-26
Brake	40-30
Parking brake	40-32
Torque converter, transmission pump	40-33
Steering, switch pump	40-34
Hydraulic, PPC pump	40-35
PPC valve	40-36
Cut-off valve	40-37
Main control valve	40-38
Boom cylinder	40-42
Bucket cylinder	40-43
Center hinge pin	40-44
Work equipment linkage	40-46
Bucket	40-48
Bucket positioner and boom kick-out	40-49

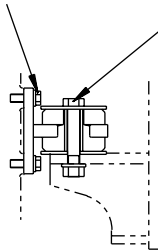
ENGINE MOUNT, TRANSMISSION MOUNT



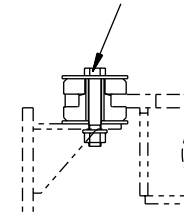
 Kg_m 123 ± 24 Nm
(12.5 ± 2.5 kg_m)

 Kg_m 279 ± 29 Nm (28.5 ± 3 kg_m)  Kg_m 927 ± 103 Nm (94.5 ± 10.5 kg_m)

 Kg_m 927 ± 103 Nm (94.5 ± 10.5 kg_m)



A - A



B - B

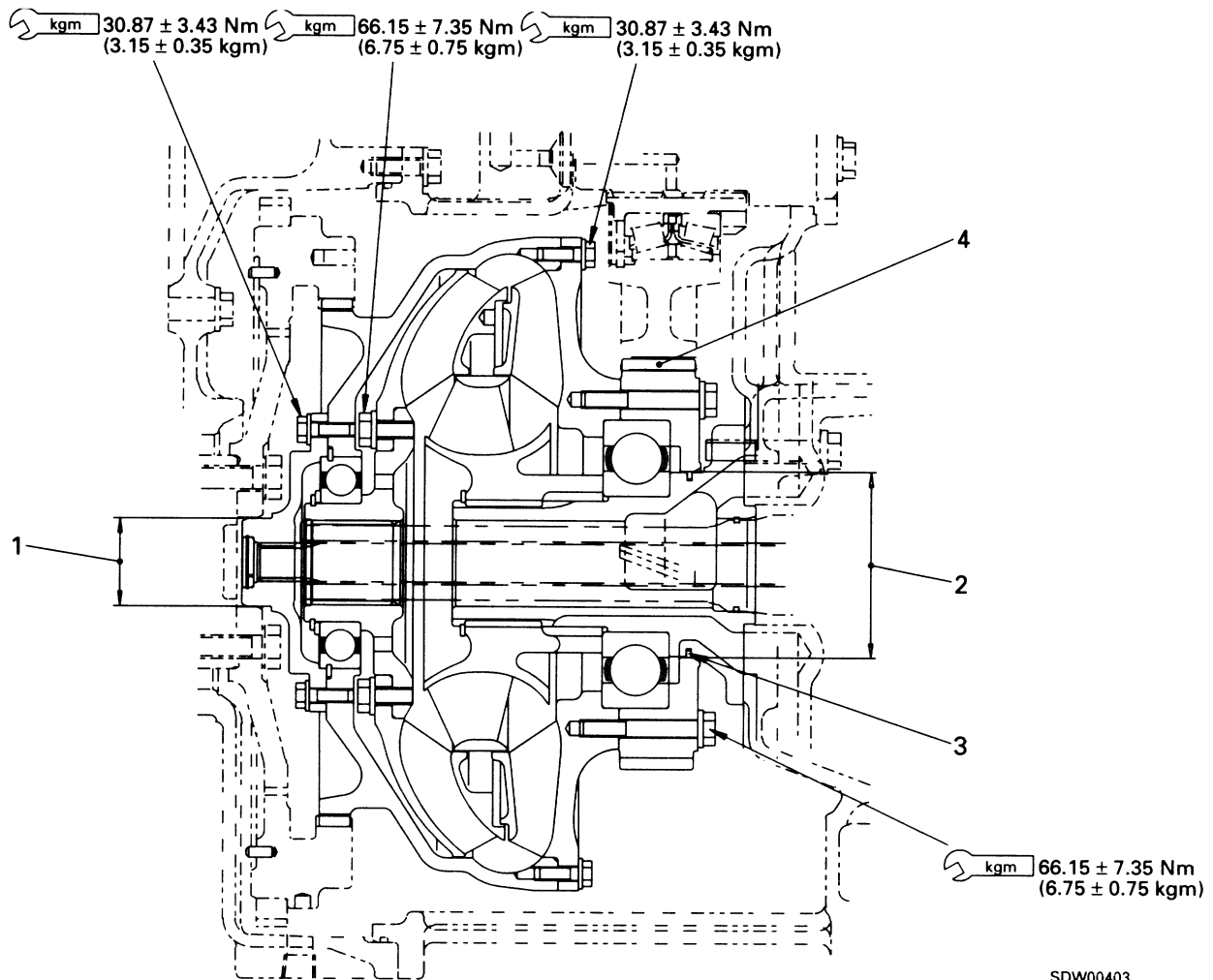
SDW00331

U42103

Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance between engine bracket and adjustment bolt	1 - 1.5	Adjust

TORQUE CONVERTER

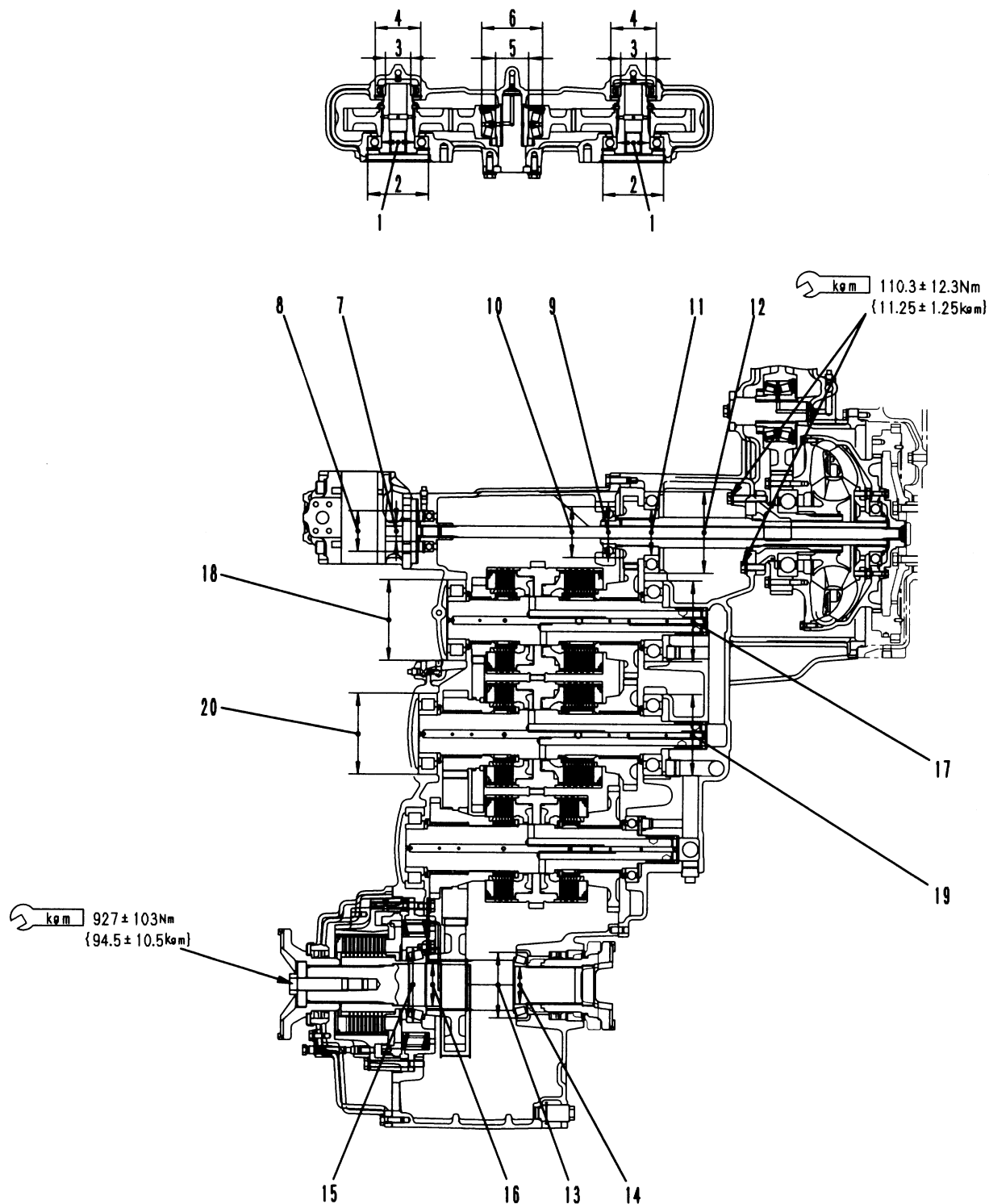


U42103

Unit: mm

No.	Check item		Criteria			Remedy
			Standard size	Tolerance	Repair limit	
1	Outside diameter of pilot		52	-0.010 -0.040	51.75	Replace
2	Inside diameter of retainer seal ring contact surface		110	$+0.035$ 0	110.5	
3	Wear of stator shaft seal ring	Width	3	-0.01 -0.03	2.7	
		Thickness	4.3	± 0.1	3.9	
4	Backlash between PTO drive gear and drive gear		0.18 – 0.49			

TRANSMISSION (1/2)



U42103

SDW02758

MAINTENANCE STANDARD

TRANSMISSION

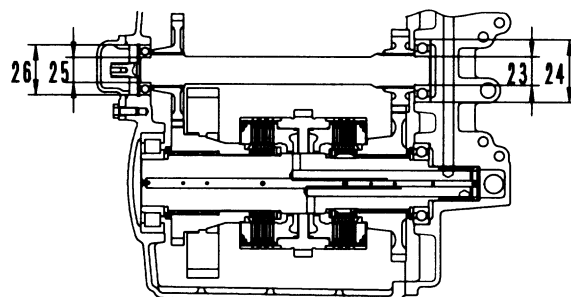
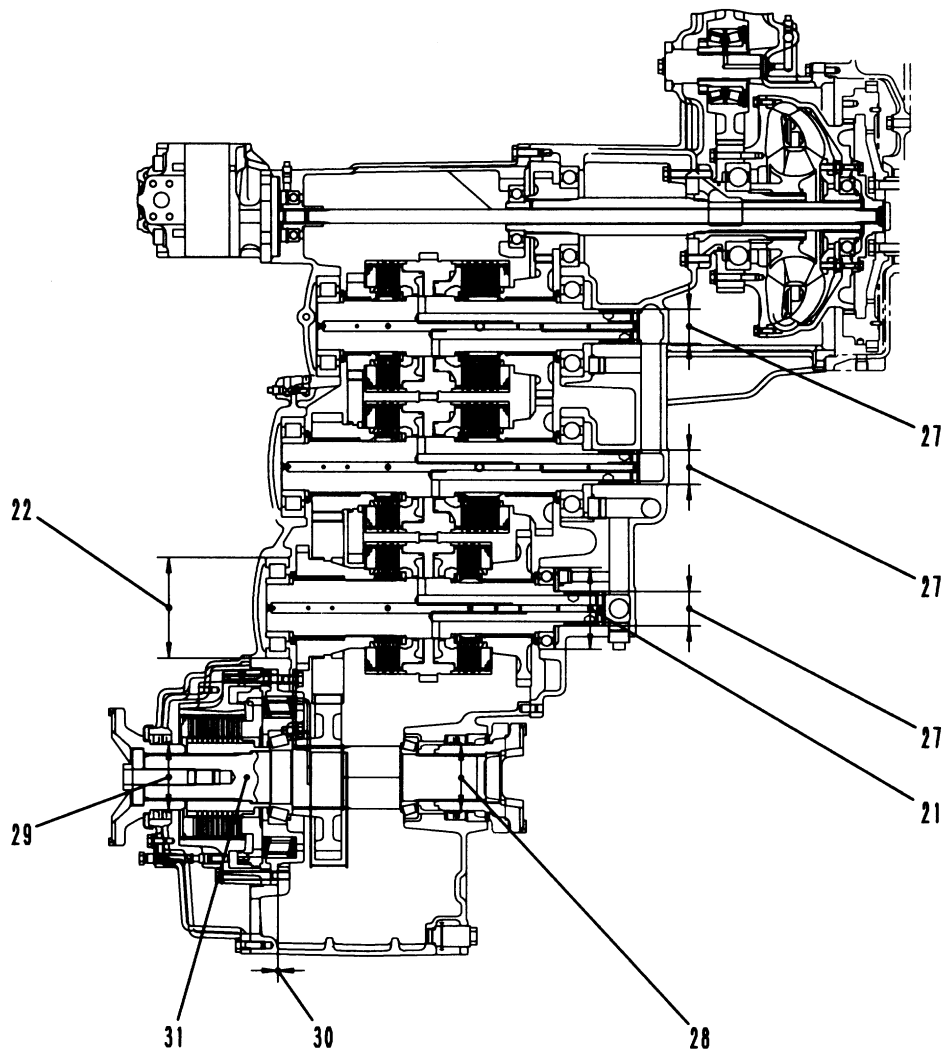
Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pump drive shaft and bearing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		65	+0.024 +0.011	0 -0.015	-0.039 – -0.011	—	
2	Clearance between pump drive gear bearing and housing	120	0 -0.015	+0.030 0	0 – 0.045	—	
3	Clearance between pump drive shaft and bearing	50	+0.020 +0.009	0 -0.012	-0.032 – -0.009	—	
4	Clearance between pump drive shaft bearing and housing	90	0 -0.015	+0.030 0	0 – 0.045	—	
5	Clearance between idler gear shaft and bearing	65	+0.012 -0.007	0 -0.015	-0.027 – -0.007	—	
6	Clearance between idler gear bearing and idler gear	120	0 -0.018	-0.030 -0.052	-0.052 – 0.012	—	
7	Clearance between pump drive shaft and bearing	40	+0.025 +0.009	0 -0.012	-0.037 – -0.009	—	
8	Clearance between pump drive gear bearing and housing	80	0 -0.013	+0.030 0	0 – 0.043	—	
9	Clearance between input shaft and housing	45	+0.025 +0.009	0 -0.012	-0.037 – -0.009	—	
10	Clearance between input shaft bearing and housing	100	0 -0.015	+0.030 0	0 – 0.045	—	
11	Clearance between input shaft gear and bearing	90	+0.035 +0.013	0 -0.020	-0.055 – -0.013	—	
12	Clearance between input shaft gear bearing and housing	160	0 -0.025	+0.030 0	0 – 0.055	—	
13	Clearance between output shaft bearing and housing	130	0 -0.018	-0.018 -0.058	-0.058 – 0	—	
14	Clearance between output shaft and bearing	75	+0.030 +0.011	0 -0.015	-0.045 – -0.011	—	
15	Clearance between output shaft gear bearing and housing	150	0 -0.018	-0.018 -0.058	-0.058 – 0	—	
16	Clearance between output shaft and bearing	85	+0.035 +0.013	0 -0.020	-0.055 – -0.013	—	
17	Clearance (R) between FORWARD, 1st clutch bearing and housing	160	0 -0.025	+0.030 0	0 – 0.055	—	
18	Clearance (F) between FORWARD, 1st clutch bearing and housing	160	0 -0.025	+0.030 0	0 – 0.055	—	
19	Clearance (R) between REVERSE, 2nd clutch bearing and housing	160	0 -0.025	+0.030 0	0 – 0.055	—	
20	Clearance (F) between REVERSE, 2nd clutch bearing and housing	160	0 -0.025	+0.030 0	0 – 0.055	—	

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(2/2)



SDW02759

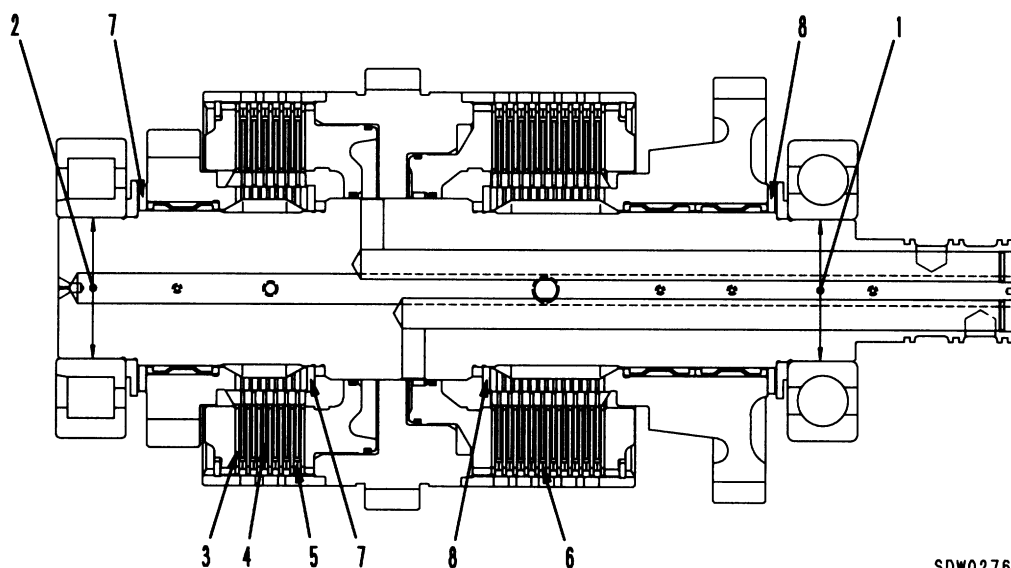
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy	
21	Clearance (R) between 3rd, 4th clutch bearing and housing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
22	Clearance (F) between 3rd, 4th clutch bearing and housing	130	0 −0.018	+0.030 0	0 − 0.048	—		
23	Clearance (R) between counter shaft and bearing	160	0 −0.025	+0.030 0	0 − 0.055	—		
24	Clearance (R) between counter shaft bearing and housing	45	+0.025 +0.009	0 −0.012	−0.037 − −0.009	—		
25	Clearance (F) between counter shaft and bearing	100	0 −0.015	+0.030 0	0 − 0.045	—		
26	Clearance (F) between counter shaft bearing and housing	40	+0.025 +0.009	0 −0.012	−0.037 − −0.009	—		
27	Clearance (F) between counter shaft bearing and housing	80	0 −0.013	+0.030 0	0 − 0.043	—		
28	Inside diameter of seal ring contact surface	Standard size		Tolerance		Repair limit		
		55		+0.05 0		55.1		
	Width of seal ring groove		3.2		+0.076 0	3.5		
	Width of seal ring		3.1		±0.05	2.8		
	Thickness of seal ring		2.29		0 −0.1	2.1		
29	Outside diameter (R) of coupling oil seal sliding surface	105		0 −0.087		104.8		
30	Outside diameter (F) of coupling oil seal sliding surface	105		0 −0.087		104.8		
31	Clearance between output shaft cover and housing	Standard clearance			Clearance limit		Adjust shim	
		0.5 − 1.4 (Standard shim thickness)			—			
32	Free rotating torque of output shaft	0.098 − 0.98 Nm {0.01 − 0.1 kgm}						

FORWARD, 1ST CLUTCH



SDW02760

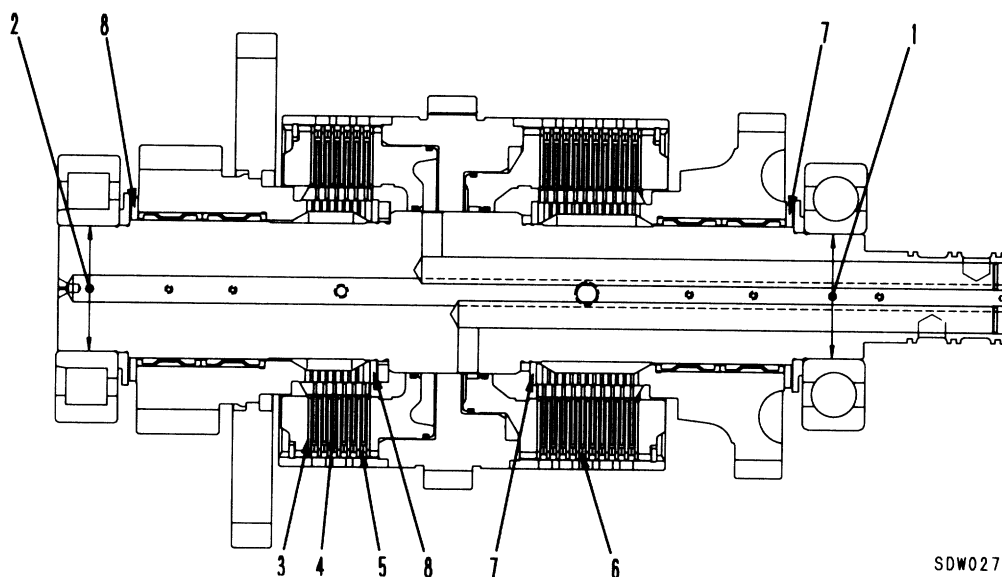
Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance (R) at bearing press-fitting portion of FORWARD, 1st clutch shaft	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		75	+0.030 +0.011	0 -0.015	-0.045 – -0.011	—	
2	Clearance (F) at bearing press-fitting portion of FORWARD, 1st clutch shaft	75	+0.049 +0.036	0 -0.015	-0.064 – -0.036	—	
3	Thickness of separator plate	Standard size		Tolerance		Repair limit	
		2.0		±0.05		1.8	
	Distortion of separator plate	—		0.05		0.15	
4	Thickness of friction plate	3.2		±0.08		2.75	
	Distortion of friction plate	—		0.1		0.25	
5	Load of wave spring (1st) (height 3.2 mm)	2481 N (253 kg)		±224 N {±22.8 kg}		2109 N {215.1 kg}	
6	Load of wave spring (FORWARD) (height 3.2 mm)	1106 N {112.8 kg}		±57 N {±5.8 kg}		940 N {95.9 kg}	
7	Thickness of 1st clutch thrust washer	4		±0.1		3.7	
8	Thickness of FORWARD thrust washer	4		±0.1		3.7	

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2ND, REVERSE CLUTCH



SDW02761

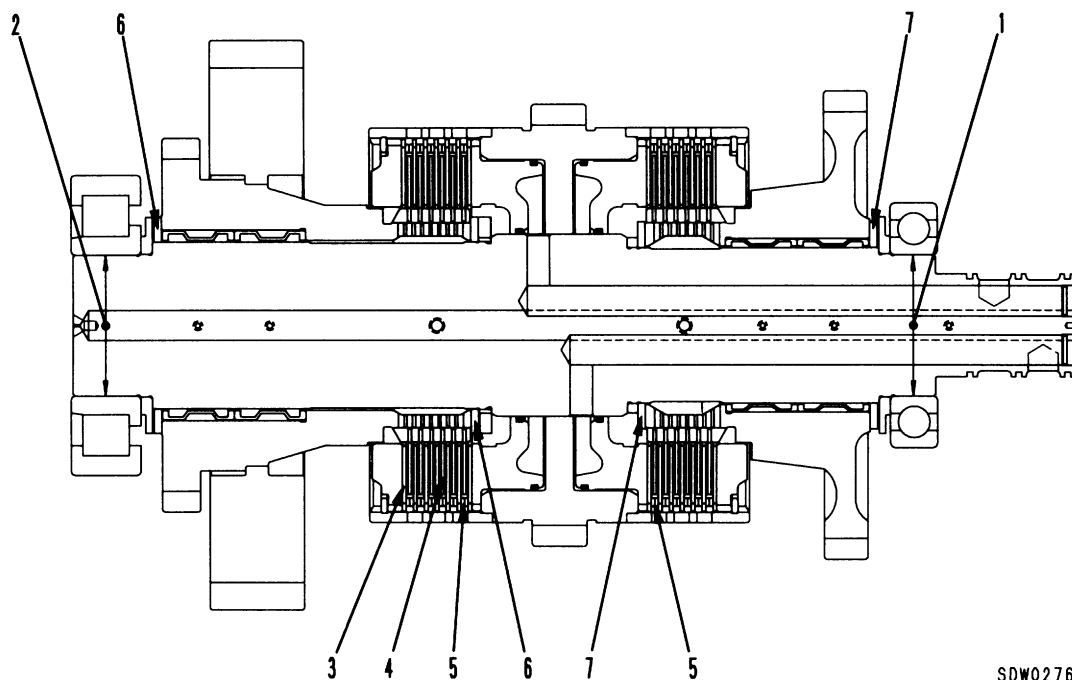
Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance (R) of press-fitting portion of REVERSE, 2nd clutch shaft	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance (F) of press-fitting portion of REVERSE, 2nd clutch shaft	75	+0.030 +0.011	0 -0.015	-0.045 – -0.011	—	
3	Thickness of separator plate	Standard size	Tolerance		Repair limit		
4	Distortion of separator plate	2.0	±0.05		1.8		
5	Thickness of friction plate	3.2	±0.08		2.75		
6	Distortion of friction plate	—	0.05		0.15		
7	Thickness of wave spring (2nd) (height 3.2 mm)	2481 N {253 kg}	±224 N {±22.8 kg}		2109 N {215.1 kg}		
8	Load of wave spring (REVERSE) (height 3.2 mm)	1106 N {112.8 kg}	±57 N {±5.8 kg}		940 N {95.9 kg}		
9	Thickness of REVERSE clutch thrust washer	4	±0.1		3.7		
10	Thickness of 2nd thrust washer	4	±0.1		3.7		

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3RD, 4TH CLUTCH



SDW02762

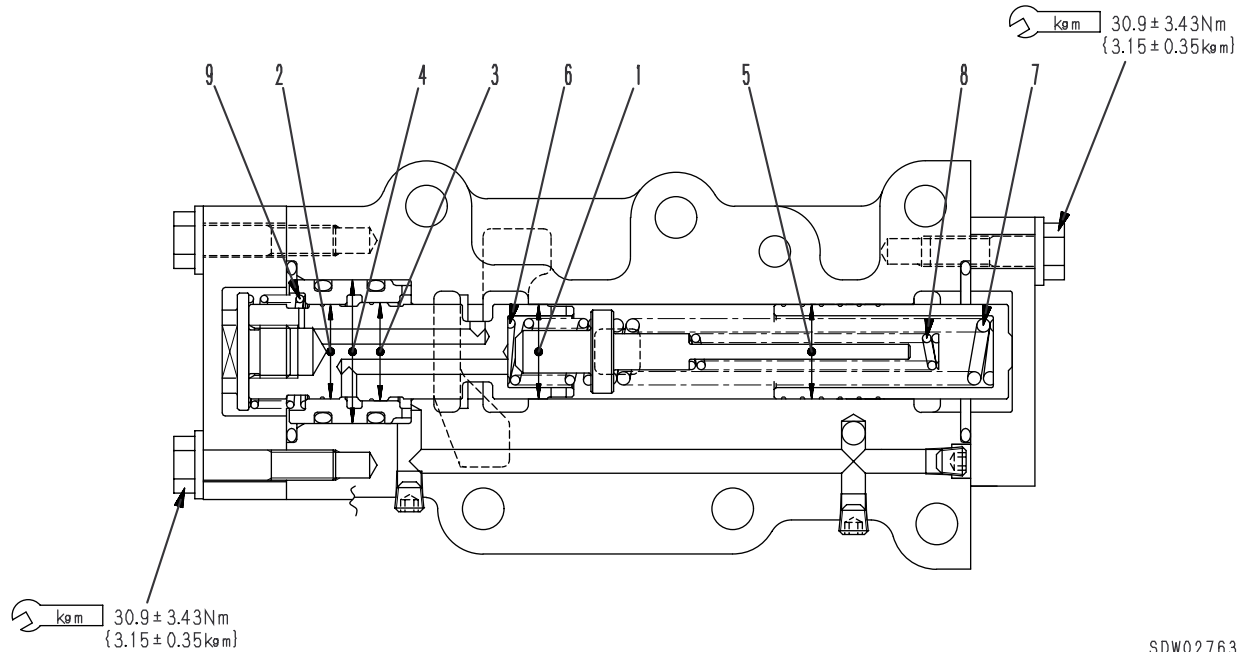
Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance (R) of press-fitting portion of 3rd, 4th clutch shaft	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance (F) press-fitting portion of 3rd, 4th clutch shaft	75	+0.030 +0.011	0 -0.015	-0.045 – -0.011	—	
3	Thickness of separator plate	Standard size	Tolerance		Repair limit		
4	Distortion of separator plate	—	0.05		0.15		
	Thickness of friction plate	3.2	±0.08		2.75		
5	Distortion of friction plate	—	0.1		0.25		
	Load of wave spring (3rd, 4th) (height 3.2 mm)	2481 N {253 kg}	±224 N {±22.8 kg}		2109 N {215.1 kg}		
6	Thickness of 3rd clutch thrust washer	4	±0.1		3.7		
7	Thickness of 4th clutch thrust washer	4	±0.1		3.7		

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TRANSMISSION CONTROL VALVE

MODULATION VALVE ASSEMBLY

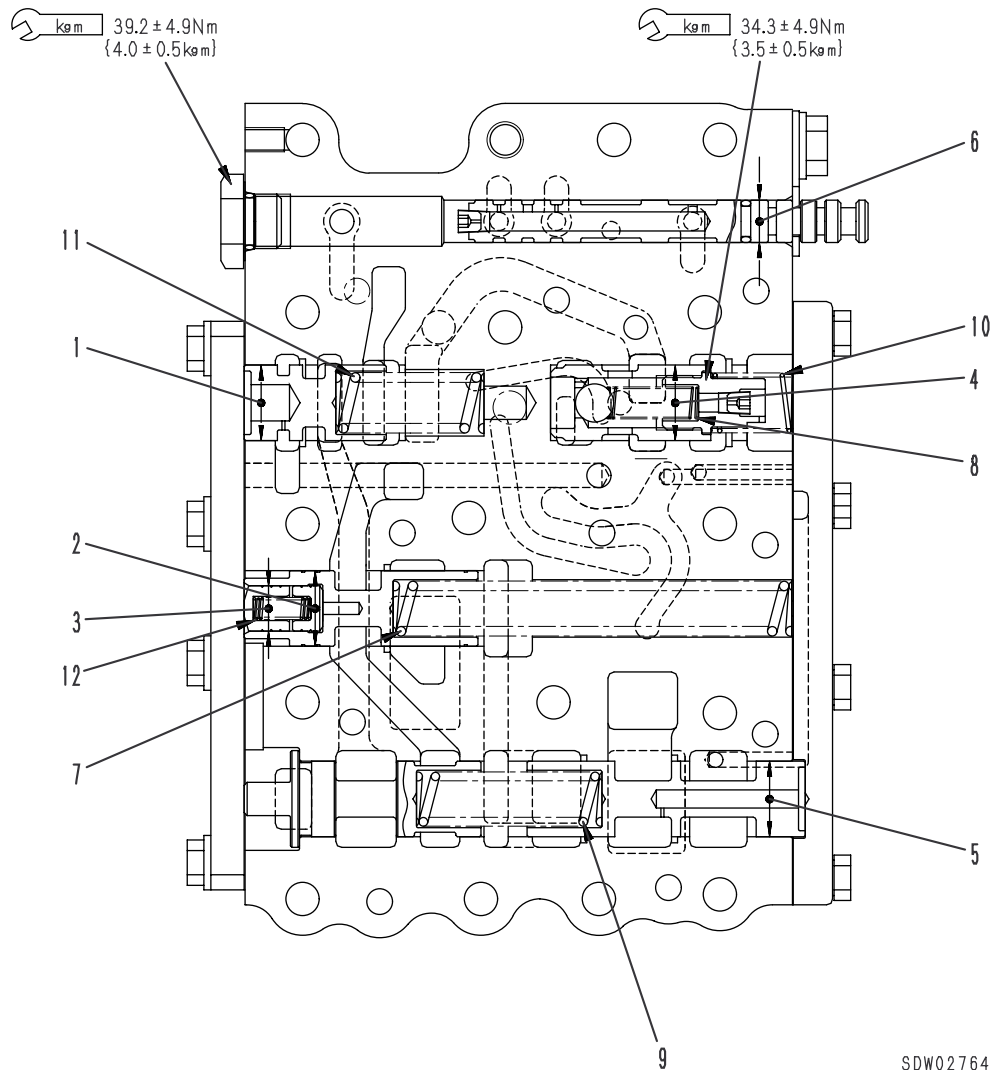


SDW02763

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance of fill valve body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance of fill valve sleeve	25	-0.020 -0.030	+0.013 0	0.02 – 0.043	0.06	
3	Clearance of fill valve sleeve	25	-0.020 -0.030	+0.033 +0.020	0.04 – 0.063	0.08	
4	Clearance of fill valve sleeve	26	-0.040 -0.050	+0.041 +0.025	0.065 – 0.091	0.11	
5	Clearance between sleeve and body	38	-0.025 -0.050	+0.025 0	0.025 – 0.075	0.10	
6	Clearance of accumulator valve body	25	-0.030 -0.040	+0.013 0	0.03 – 0.053	0.07	
6	Accumulator spring	Standard size			Repair limit		
		Free length	Installation height	Installation load	Free length	Installation load	
		22	20	9.41 N {9.6 kg}	21.3	89.2 N {9.1 kg}	
7	Accumulator spring	100	78.5	607 N {61.9kg}	97.0	577 N {58.8 kg}	
8	Accumulator spring	66	58.5	259 N {26.4 kg}	64.0	246 N {25.1 kg}	
9	Fill valve spring	29	15	35.0 N {3.57 kg}	28.1	33.2 N {3.39 kg}	

UPPER VALVE ASSEMBLY
(For mechanical shift)



SDW02764

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MAINTENANCE STANDARD

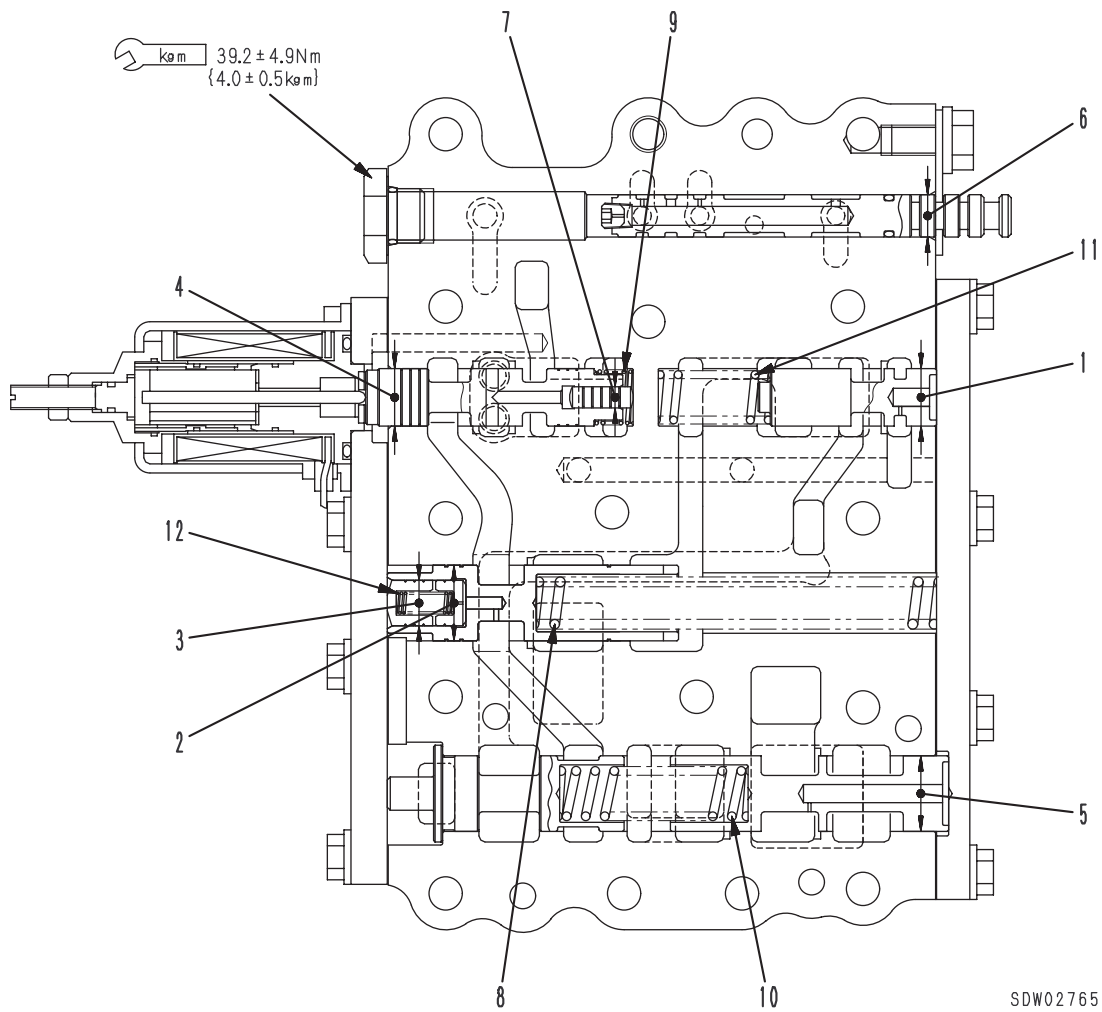
TRANSMISSION CONTROL VALVE

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pilot valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between main relief valve and body	25	-0.035 -0.045	+0.013 0	0.035 – 0.058	0.08	
3	Clearance between main relief valve and load piston	15	-0.020 -0.030	+0.018 0	0.02 – 0.048	0.07	
4	Clearance between quick return valve and body	25	-0.020 -0.028	+0.013 0	0.02 – 0.041	0.06	
5	Clearance between torque converter regulator valve and body	25	-0.035 -0.045	+0.013 0	0.035 – 0.058	0.08	
6	Clearance between emergency spool and body	14	-0.020 -0.030	+0.011 0	0.02 – 0.041	0.06	
7	Main relief valve spring	Standard size			Repair limit		
		Free length	Installation height	Installation load	Free length	Installation load	
		163.5	132.3	306 N {31.2 kg}	158.6	290 N {29.6 kg}	
8	Quick return valve spring	40	30.5	1.03 N {0.105 kg}	38.8	0.98 N {0.10 kg}	
9	Torque converter regulator valve spring	65	62	70.6 N {7.2 kg}	63.1	67.1 N {6.84 kg}	
10	Quick return valve spring	31.5	27	4.8 N {0.49 kg}	30.6	4.6 N {0.47 kg}	
11	Pilot valve spring	74.2	49	463 N {47.2 kg}	72.0	489 N {44.8 kg}	
12	Load piston spring	26.0	19	5.7 N {0.58 kg}	25.2	5.4 N {0.55 kg}	

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UPPER VALVE ASSEMBLY
(For auto-shift: electronic modulation)
Serial No.: 54001 and up



U42103

MAINTENANCE STANDARD

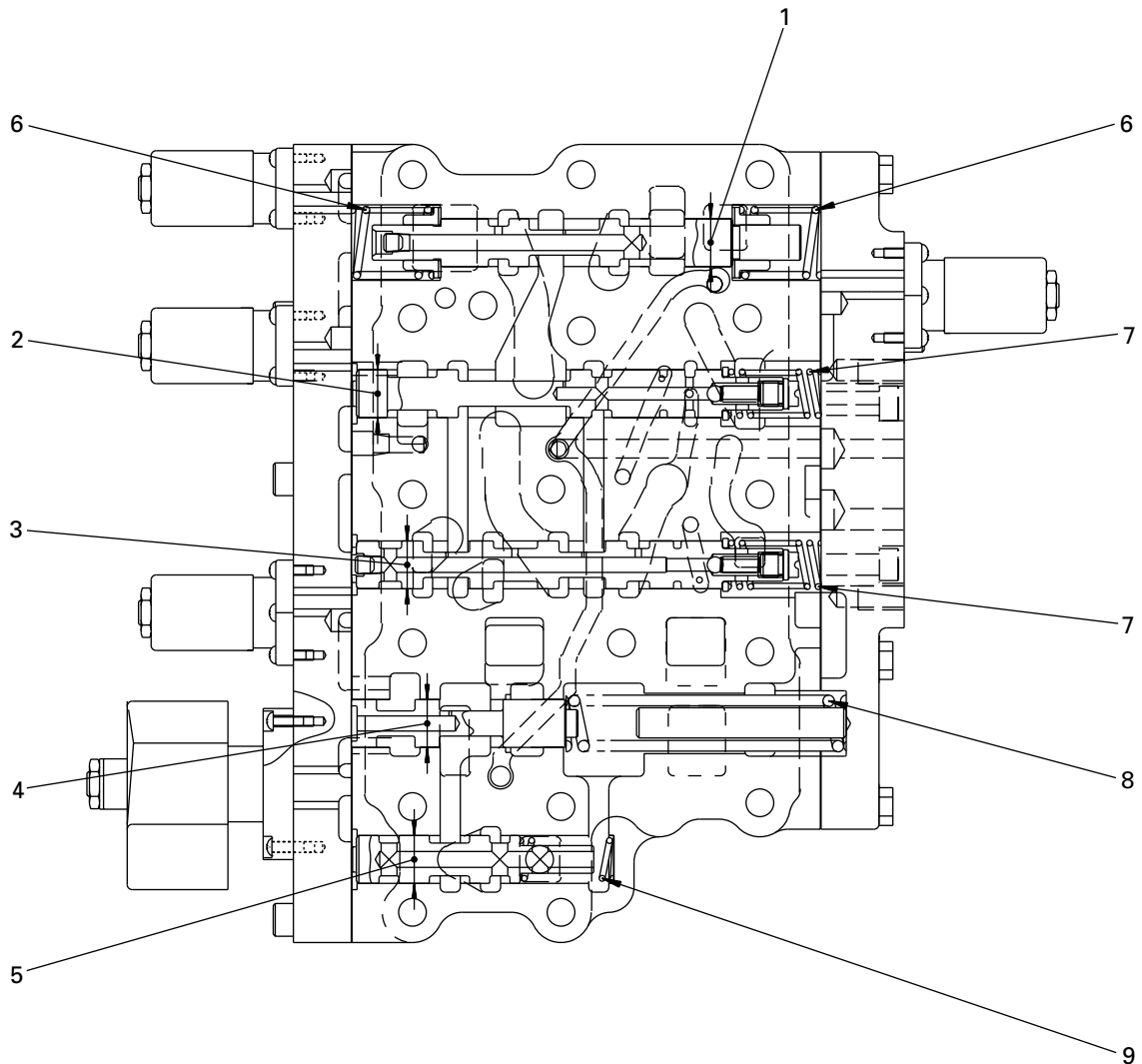
TRANSMISSION CONTROL VALVE

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pilot valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between main relief valve and body	19	-0.035 -0.045	+0.013 0	0.035 – 0.058	0.08	
3	Clearance between main relief valve and load piston	25	-0.035 -0.045	+0.013 0	0.035 – 0.058	0.08	
4	Clearance between main relief valve and load piston	15	-0.020 -0.030	+0.018 0	0.02 – 0.048	0.07	
5	Clearance between modulation valve and body	19	-0.035 -0.045	+0.013 0	0.035 – 0.058	0.08	
6	Clearance between torque converter regulator valve and body	25	-0.035 -0.045	+0.013 0	0.035 – 0.058	0.08	
7	Clearance between emergency spool and body	14	-0.020 -0.030	+0.011 0	0.02 – 0.041	0.06	
8	Clearance between modulation valve and load piston	6	-0.035 -0.045	+0.012 0	0.035 – 0.057	0.08	
8	Main relief valve spring	Standard size			Repair limit		
		Free length	Installation height	Installation load	Free length	Installation load	
		170.5	132	412 N {42.0 kg}	165.4	391 N {39.9 kg}	
9	Fill valve spring	23.8	13	8.8 N {0.91 kg}	23.1	8.4 N {0.86 kg}	
10	Torque converter regulator valve spring	65	62	70.6 N {7.2 kg}	63.1	67.1 N {6.84 kg}	
11	Pilot valve spring	59.8	37	267 N {27.2 kg}	58.0	253 N {25.8 kg}	
12	Load piston spring	26	19	5.7 N {0.58 kg}	25.2	5.4 N {0.55 kg}	

U42103

LOWER VALVE ASSEMBLY



SDW00340

U42103

MAINTENANCE STANDARD

TRANSMISSION CONTROL VALVE

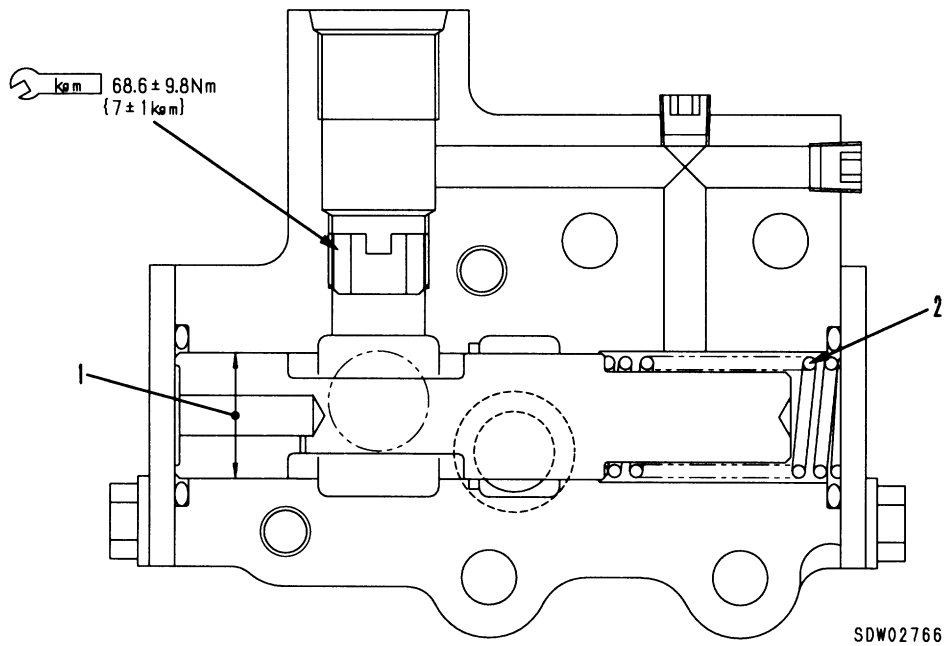
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between directional selector spool and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between H-L selector spool and body	19	-0.020 -0.030	+0.013 0	0.02 – 0.043	0.06	
3	Clearance between range selector spool and body	19	-0.020 -0.030	+0.013 0	0.02 – 0.043	0.06	
4	Clearance between priority valve and body	19	-0.035 -0.045	+0.013 0	0.035 – 0.058	0.08	
5	Clearance between parking brake valve and body	19	-0.020 -0.030	+0.013 0	0.02 – 0.043	0.06	
6	Directional selector spool spring	Standard size			Repair limit		
		Free length	Installation height	Installation load	Free length	Installation load	
		42	32	78.9 N {8.05 kg}	40.7	75 N {7.65 kg}	
7	H-L range selector spool return spring	48	36.7	69.8 N {7.12 kg}	46.6	66.3 N {6.76 kg}	
8	Priority valve spring	125.5	111.3	570 N {58.1 kg}	121.7	541 N {55.2 kg}	
9	Parking brake valve spring	46	37	81.4 N {8.3 kg}	44.6	77.4 N {7.89 kg}	

FLOW VALVE

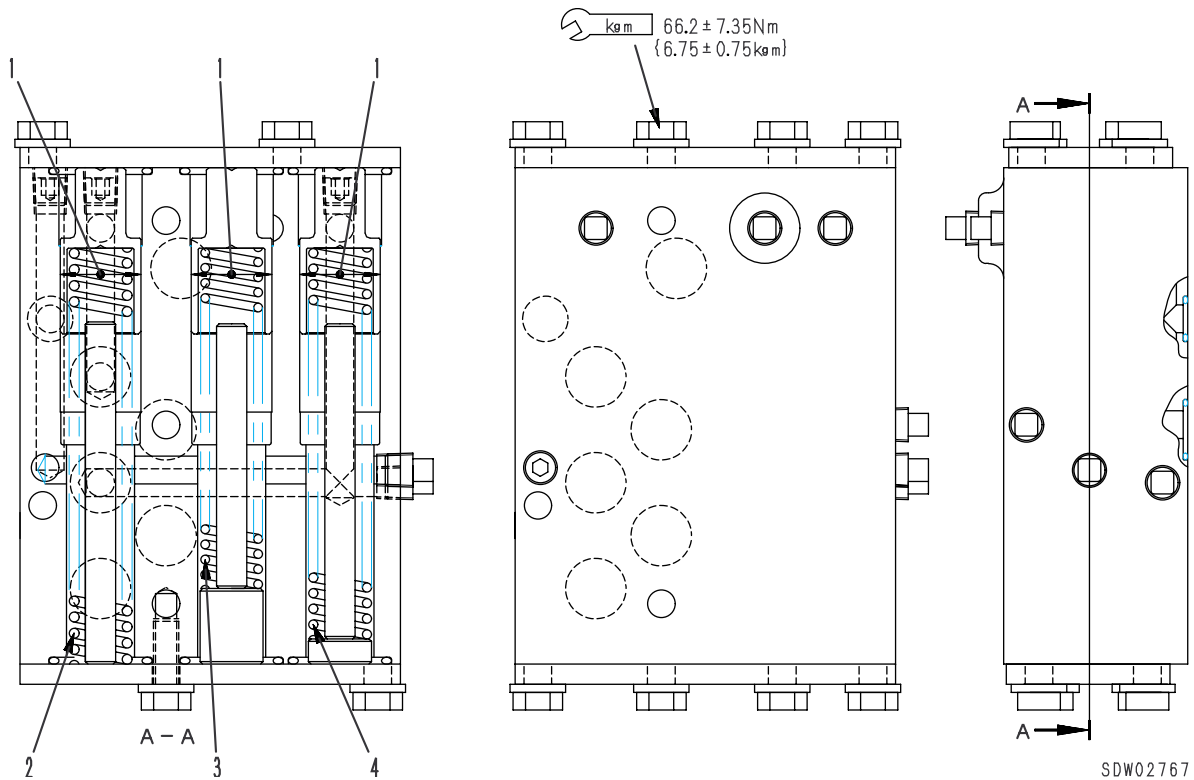


U42103

Unit: mm

No.	Check item	Criteria					Remedy	
1	Clearance between flow control valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
		25	-0.020 -0.030	+0.013 0	0.02 – 0.043	0.06		
2	Flow control valve spring	Standard size			Repair limit			
		Free length	Installation height	Installation load	Free length	Installation load		
		63.8	47	79.5 N {8.11 kg}	61.9	75.7 N {7.7 kg}		

ACCUMULATOR VALVE (For mechanical modulation)

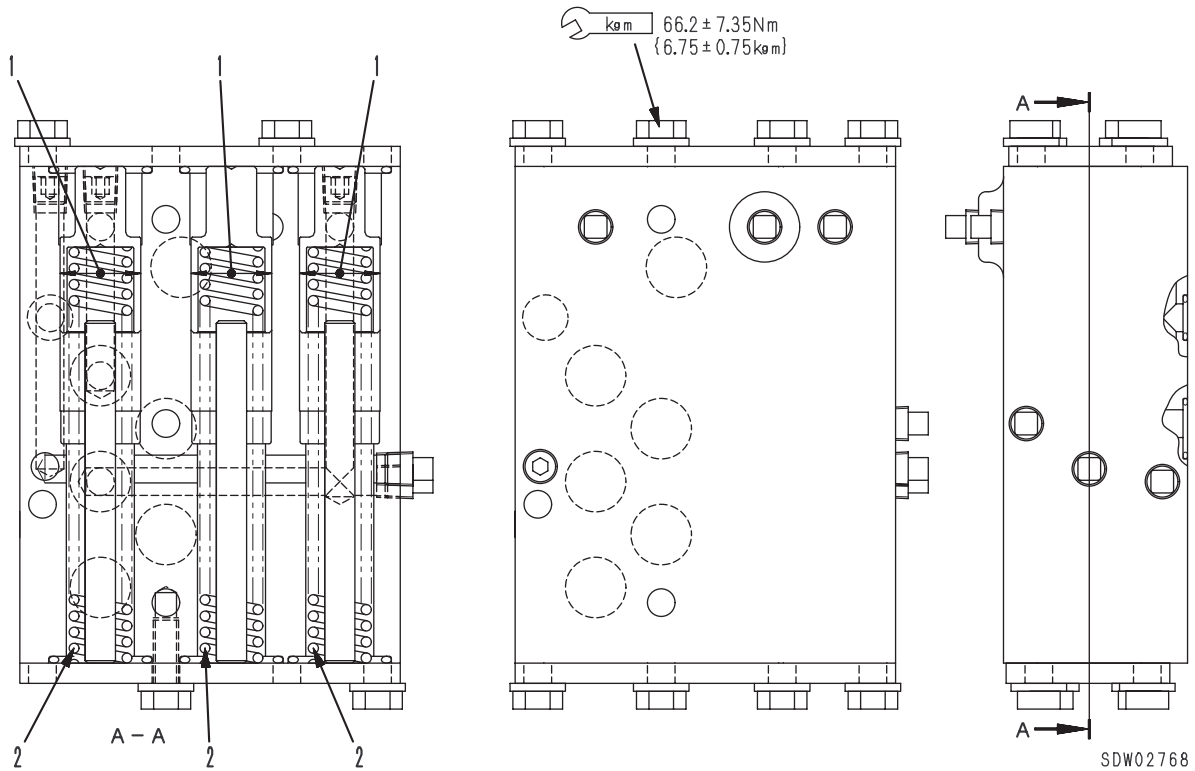


U42103

Unit: mm

No.	Check item	Criteria					Remedy	
1	Clearance between accumulator valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
		32	-0.035 -0.045	+0.025 0	0.035 – 0.07	0.09		
2	FORWARD accumulator valve spring	Standard size			Repair limit			Replace
		Free length	Installation height	Installation load	Free length	Installation load		
		184.8	165	319 N {32.5 kg}	179.3	303 N {30.9 kg}		
3	1st accumulator valve spring	145	135	78.5 N {8.0 kg}	140.7	74.5 N {7.60 kg}		
4	2nd accumulator valve spring	157.7	155	33.3 N {3.4 kg}	153.0	31.7 N {3.23kg}		

For electronic modulation



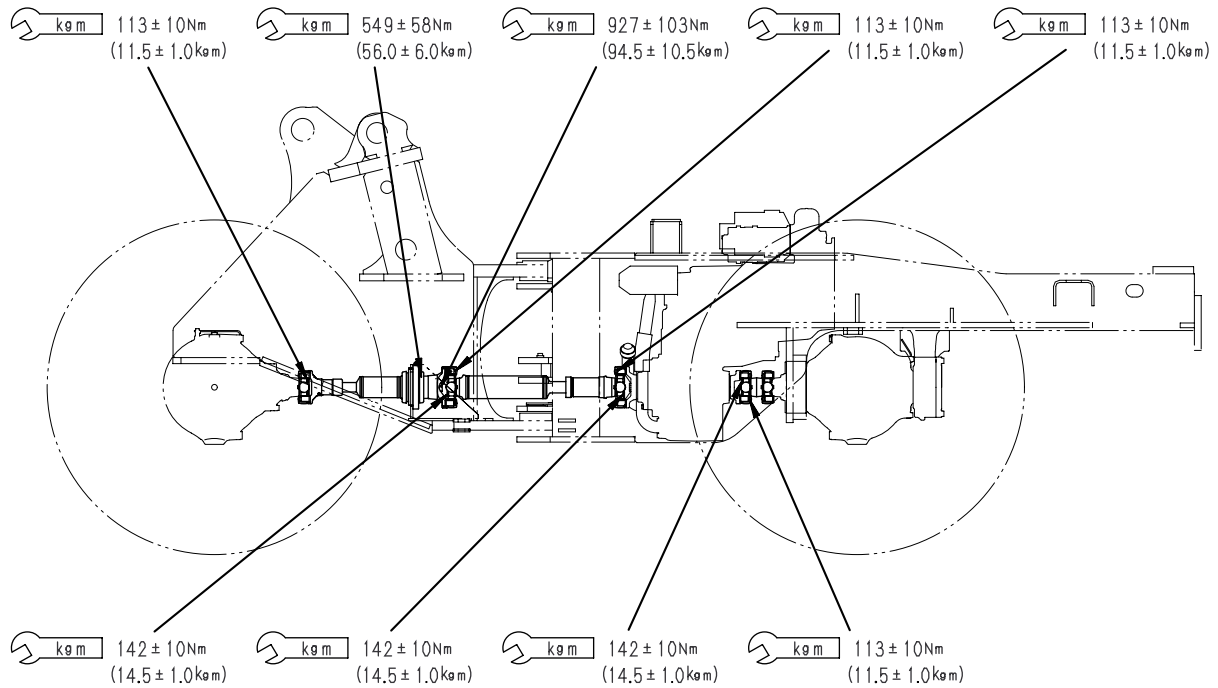
U42103

Unit: mm

No.	Check item	Criteria				Remedy
		Standard size	Tolerance		Standard clearance	
1	Clearance between accumulator valve and body	32	-0.035 -0.045	+0.025 0	0.035 - 0.07	0.09
2	Accumulator valve spring	Standard size			Repair limit	
		Free length	Installation height	Installation load	Free length	Installation load
		184.8	165	319 N {32.5 kg}	179.3	303 N {30.9 kg}

Replace

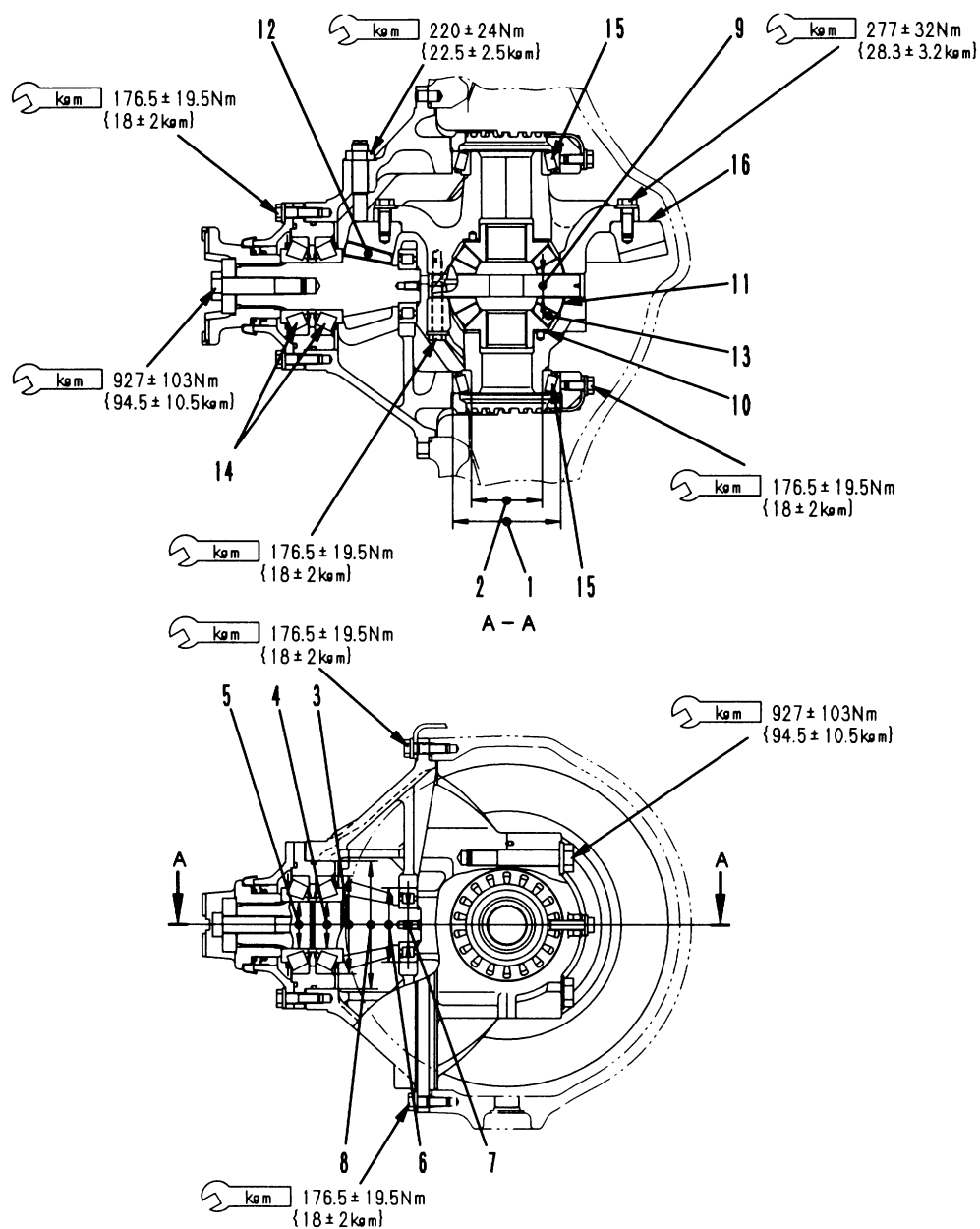
DRIVE SHAFT



SXW04487

U42103

DIFFERENTIAL



U42103

SWW04281

MAINTENANCE STANDARD

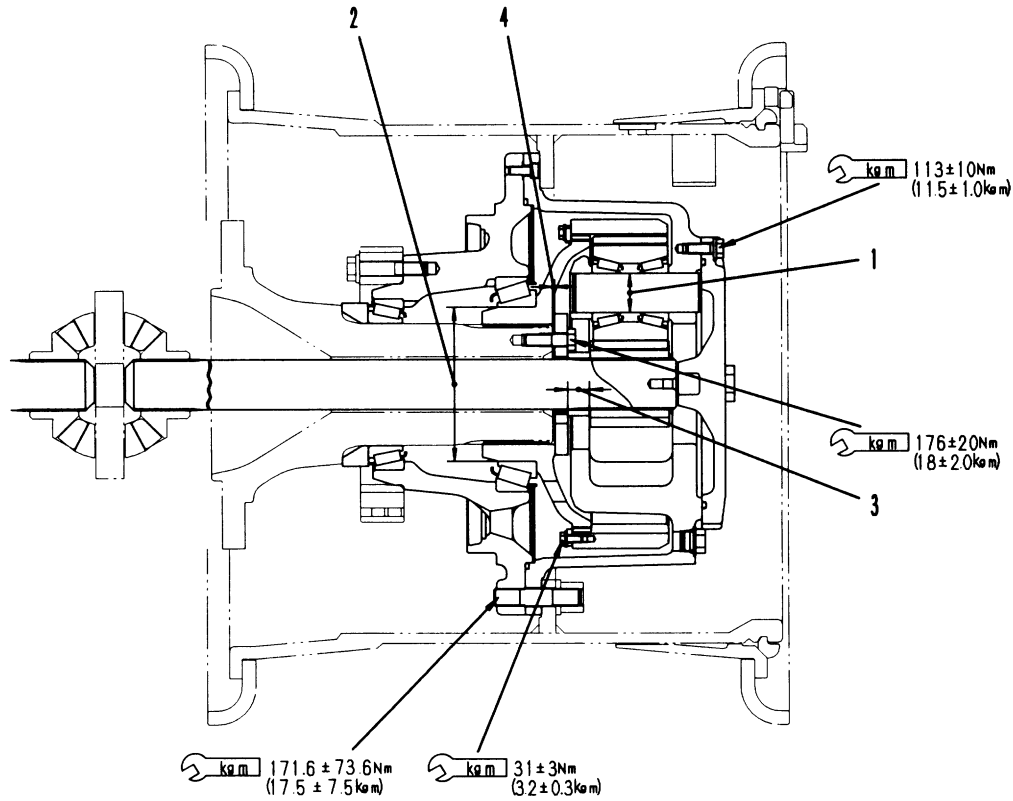
DIFFERENTIAL

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy	
1	Clearance of side bearing (outer race)	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
2	Clearance of side bearing (inner race)	160	0 -0.025	+0.054 +0.014	0.014 – 0.079	—		
3	Clearance of pinion shaft bearing (outer race)	105	+0.059 +0.037	0 -0.020	-0.079 – -0.037	—		
4	Clearance of pinion shaft bearing (inside of inner race)	146.05	+0.025 0	-0.025 -0.050	-0.075 – -0.025	—		
5	Clearance of pinion shaft bearing (outside of inner race)	69.85	+0.064 +0.051	+0.013 0	0.064 – 0.038	—		
6	Clearance of pinion shaft bearing (outer race)	69.85	+0.051 +0.038	+0.013 0	-0.051 – -0.025	—		
7	Clearance of pilot bearing (outer race)	110	0 -0.015	+0.030 +0.010	0.010 – 0.045	—		
8	Clearance of pilot bearing (inner race)	50	+0.050 +0.034	0 -0.012	-0.062 – -0.034	—		
9	Clearance between differential carrier and gauge	190	-0.020 -0.060	+0.046 +0.010	0.030 – 0.106	—		
10	Clearance between spider and differential pinion gear	34.93	-0.06 -0.11	+0.10 +0.05	0.11 – 0.21	—		
11	Thickness of side gear washer	Standard size		Tolerance		Repair limit		
		4		±0.05		3.8		
12	Thickness of pinion gear washer	1.5		+0.09 -0.01		1.35		
13	Backlash of bevel gear	Standard size			Repair limit			
		0.3 – 0.41			—			
14	Backlash of differential gear	0.25 – 0.55			—			
15	End play of pinion shaft	Max. 0.21						
	Preload of pinion shaft bearing	Rotating force: Max.147 N {15 kg} @Cage: φ 16 hole (PCD218)						
16	Preload of differential side bearing	Rotating force: 19.6 – 24.5 N {2.0 – 2.5 kg} [Target: 24.5 N {2.5 kg}] @Bevel gear major diameter						
17	Runout at rear face of bevel gear	Max. 0.1						

FINAL DRIVE



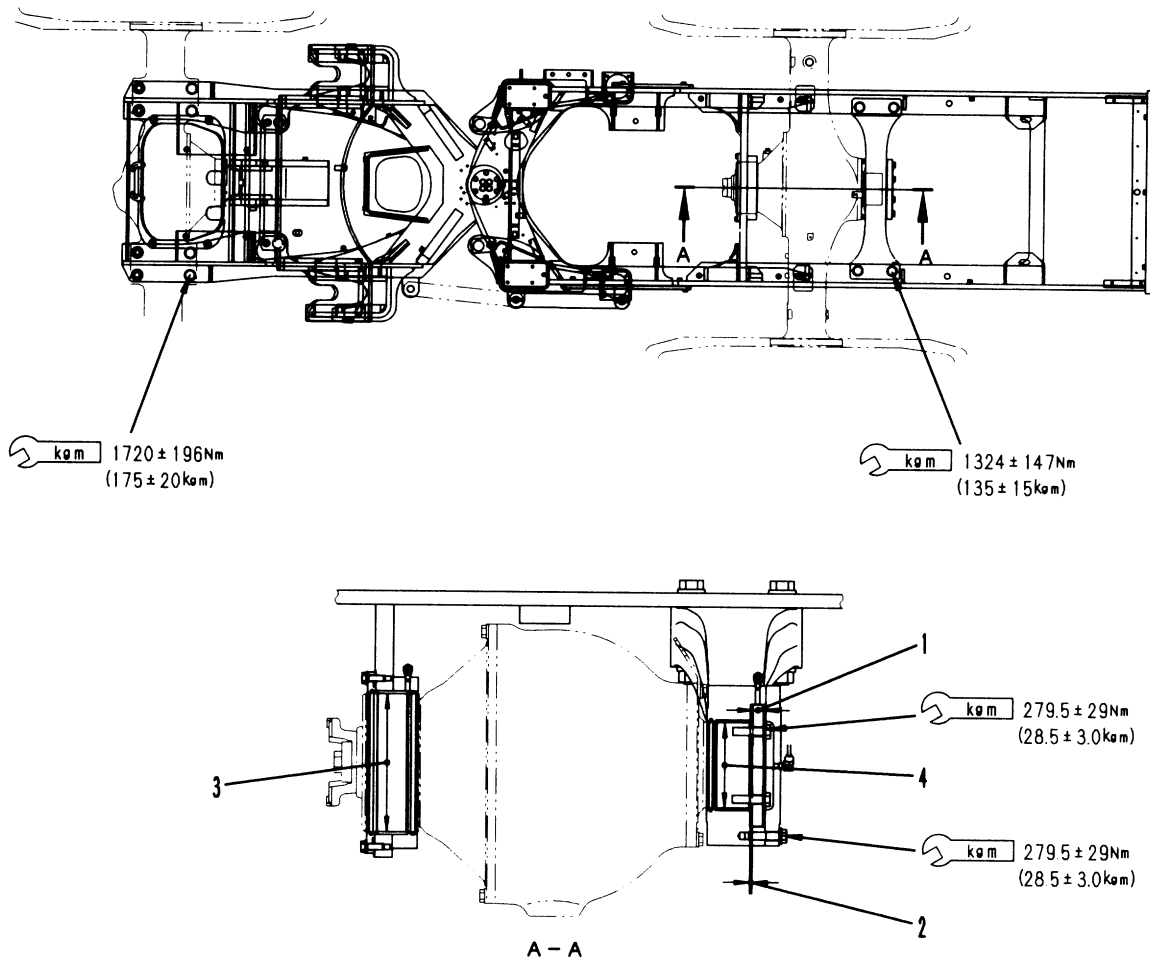
SXW04489

U42103

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between planetary shaft and bearing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
	45	+0.013 0	0 -0.012	-0.025 – 0	—		
2	Clearance between ring gear hub and bearing	180	+0.040 +0.015	0 -0.025	-0.065 – -0.015	—	
3	Thickness of spacer	Standard size		Tolerance	Repair limit		
		26		±0.1	25.5		
4	Thickness of wheel hub shim	2.025 ± 1.25					—

AXLE MOUNT

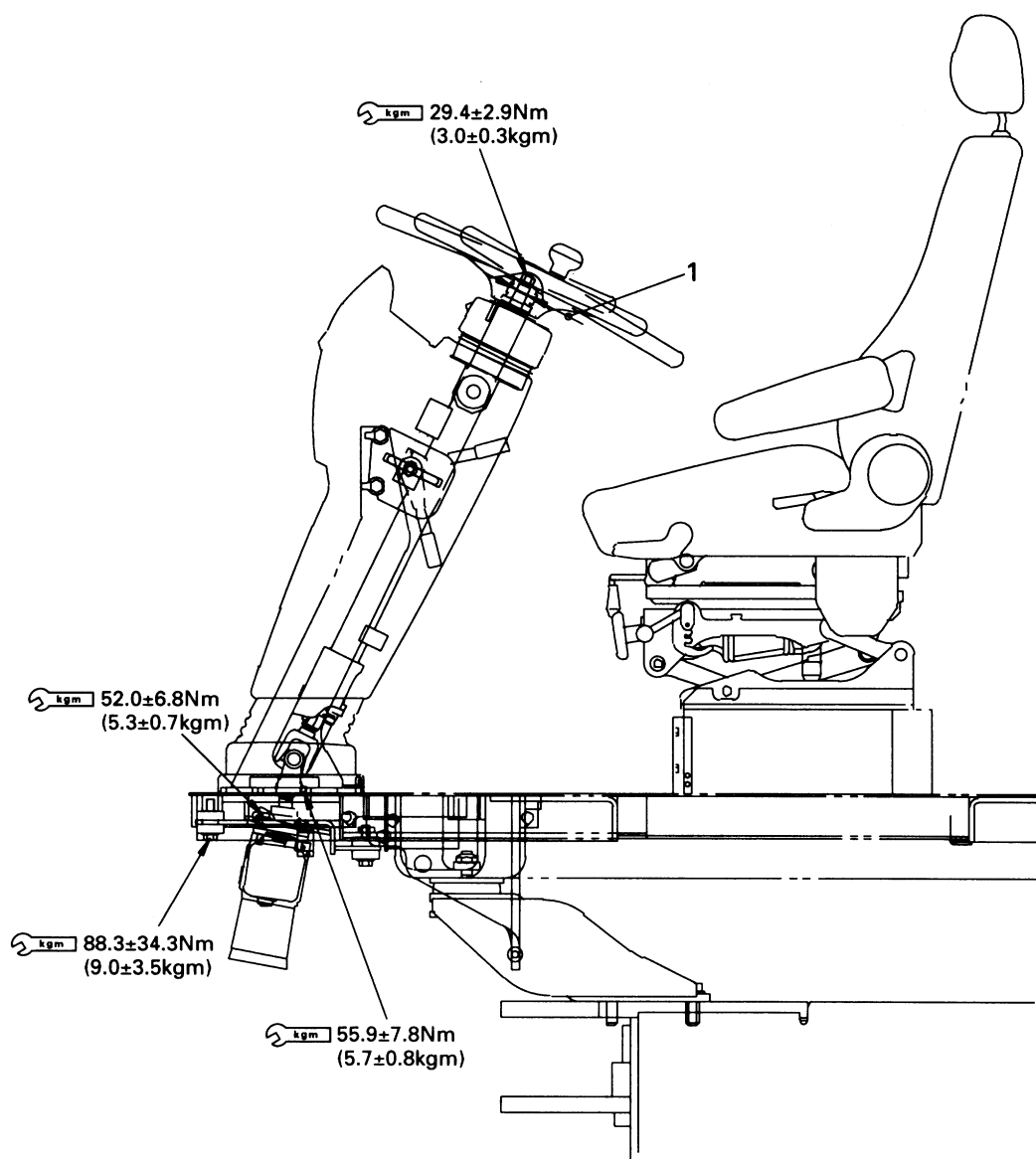


SXW04502

Unit: mm

No.	Check item	Criteria				Remedy
		Standard size	Tolerance		Repair limit	
1	Thickness of thrust plate	20	0 -0.15		—	Replace
2	Thickness of wear plate	5	+0.3 -0.1		—	
3	Clearance between hole and shaft at front support end	Standard size	Tolerance		Standard clearance	Clearance limit
		275	-0.056 -0.137	+0.439 +0.023	0.079 – 0.576	—
4	Clearance between hole and shaft at rear support end	170	-0.043 -0.106	+0.455 +0.027	0.070 – 0.561	—

STEERING COLUMN



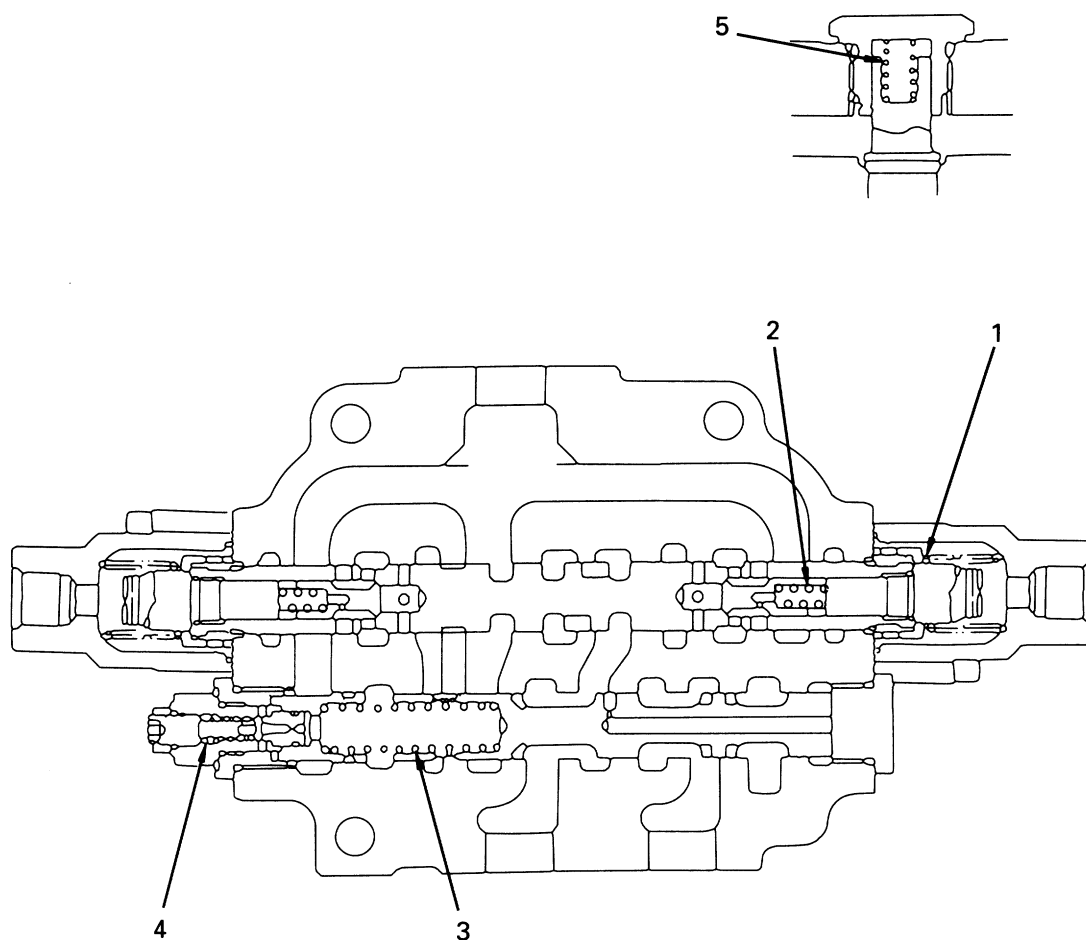
SAW00768

U42103

Unit: mm

Unit: mm							
No.	Check item	Criteria					Remedy
1	Clearance between steering shaft and column bearing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		19	0 -0.08	+0.15 +0.05	0.05 – 0.23	0.4	

STEERING VALVE



SLW01253

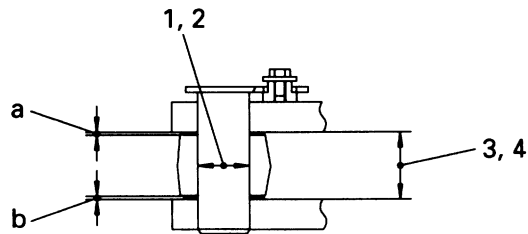
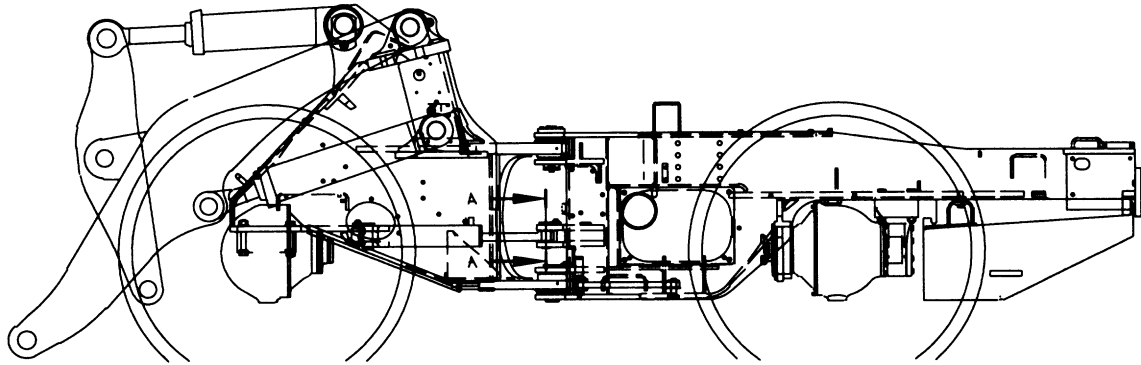
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Steering spool return spring	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		37.2	32.0	56.9 N (5.8 kg)	—	47.1 N (4.8 kg)	
2	Load check valve spring	20.9	13.2	9.3±4.9 N (0.95±0.5 kg)	—	7.8 N (0.8 kg)	
3	Demand spool return spring	75.1	68.5	136.1 N (13.88 kg)	—	114.7 N (11.7 kg)	
4	Relief valve spring	24.0	22.19	182.4 N (18.6 kg)	—	145.1 N (14.8 kg)	
5	Check valve return spring	21.6	17.0	2.3 N (0.23 kg)	—	1.8 N (0.18 kg)	

STEERING CYLINDER MOUNT



A - A

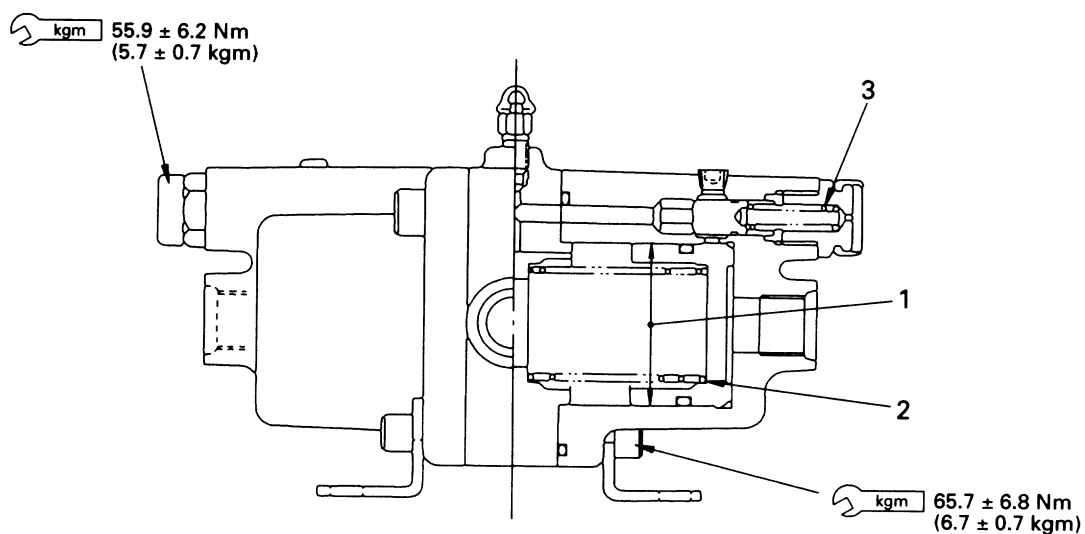
SDW00348

U42103

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Clearance between mounting pin and bushing at connection of steering cylinder rod and frame	55	0 -0.046	+0.174 +0.100	0.100 - 0.220	—	Replace
2	Clearance between mounting pin and bushing at connection of steering cylinder bottom and frame	55	0 -0.046	+0.174 +0.100	0.100 - 0.220	—	
3	Connection between steering cylinder and front frame	Width of boss		Width of hinge		Standard clearance (clearance a + b)	
4	Connection between steering cylinder and rear frame	65		67		Max. 0.5 (after adjusting with shim)	
		65		71.5		Max. 0.5 (after adjusting with shim)	

SLACK ADJUSTER



SEW00349

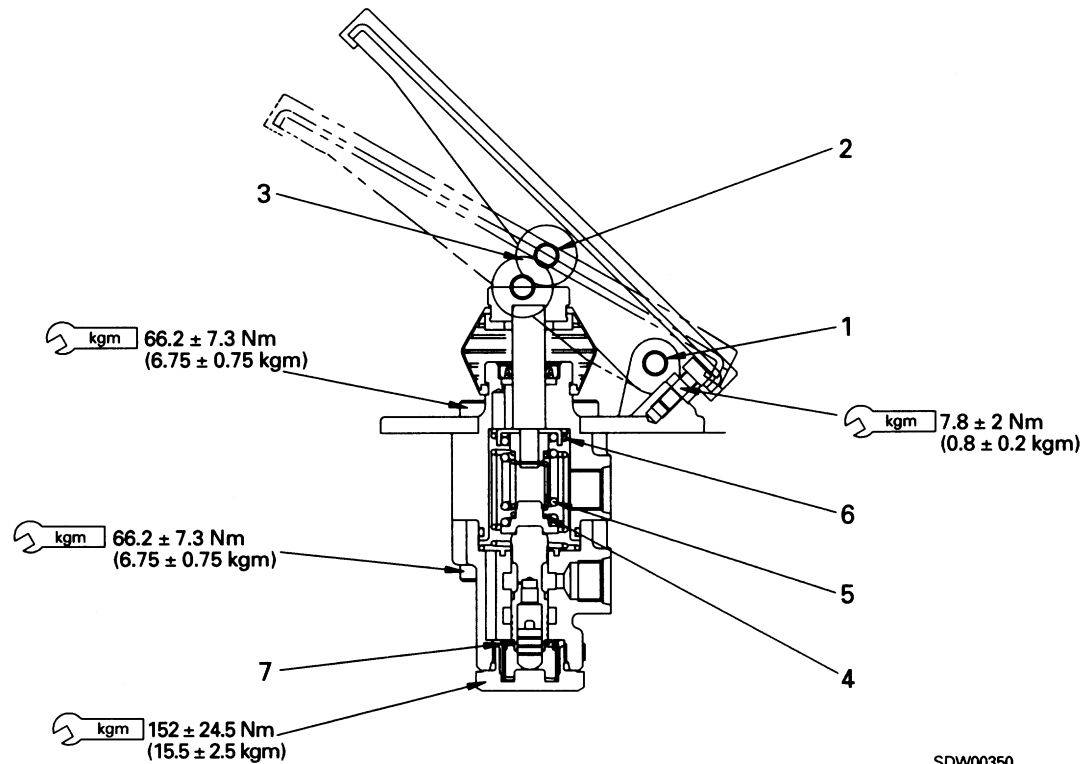
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy	
1	Clearance between body and piston	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
		55	-0.030 -0.076	+0.074 0	0.030 – 0.150	0.25		
2	Slack adjuster spring	Standard size			Repair limit			
		Free length	Test height	Test load	Free length	Test load		
		198	38	43.2 N (4.4 kg)				
3	Spring	38.8	33	66.7 N (6.8 kg)				

BRAKE VALVE (SINGLE)



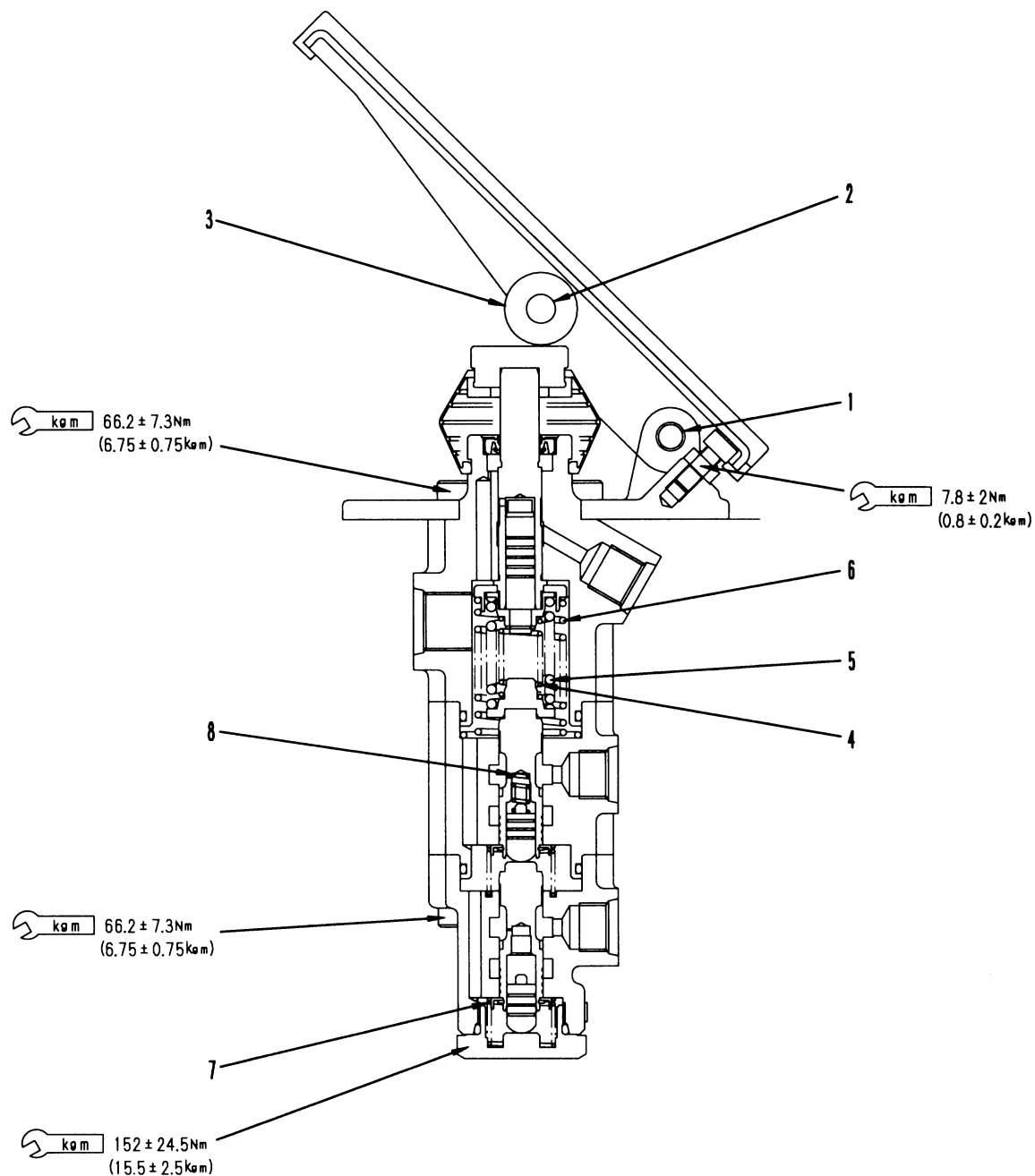
SDW00350

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pedal mount hole and bracket hole	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between roller and pin	10	-0.025 -0.075	+0.1 0	0.175 – 0.025	0.25	
3	Outside diameter of roller	10	-0.025 -0.075	+0.1 0	0.175 – 0.025	0.25	
3	Outside diameter of roller	Standard size		Tolerance		Repair limit	
		30		0 -0.5		29.2	
4	Control spring	Standard size			Repair limit		
		Free length	Test height	Test load	Free length	Test load	
		34	33.5	3.82 N (0.39 kg)	33		
5	Control spring	46.3	46	11.8 N (1.2 kg)	45.3		
6	Return spring	86.2	58	60.8 N (6.2 kg)	78		
7	Return spring	31.5	19.5	16.7 N (1.7 kg)	28		

U42103

BRAKE VALVE (TANDEM)



U42103

SXW04491

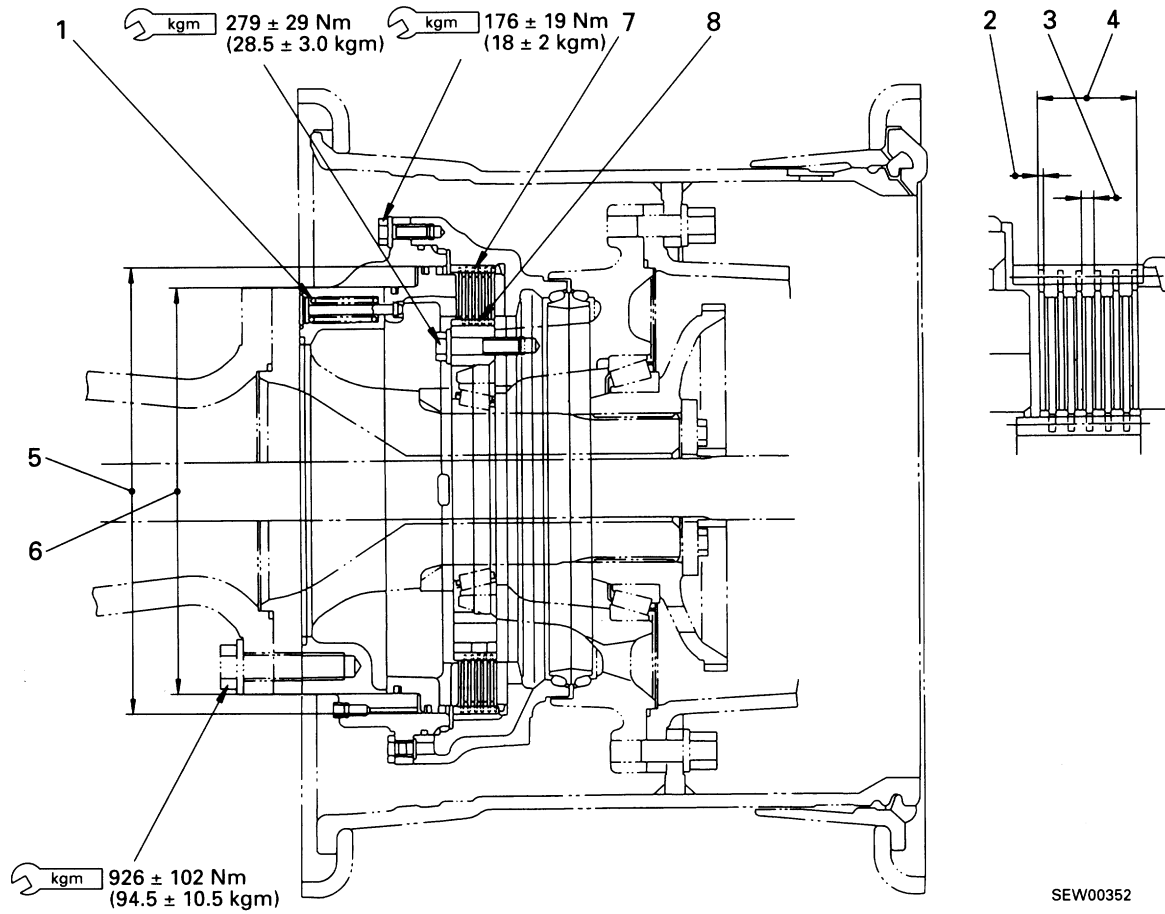
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pedal mount hole and bracket hole	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between roller and pin	10	-0.025 -0.075	+0.1 0	0.175 – 0.025	0.25	
3	Outside diameter of roller	Standard size	Tolerance		Repair limit		
		30	0 -0.5		29.2		
4	Control spring	Standard size			Repair limit		
		Free length	Test height	Test load	Free length	Test load	
		34	33.5	3.82 N (0.39 kg)	33		
5	Control spring	46.3	46	11.8 N (1.2 kg)	45.3		
6	Return spring	86.2	58	60.8 N (6.2 kg)	78		
7	Return spring	31.5	19.5	16.7 N (1.7 kg)	28		
8	Spring	17	16.5	17.7 N (1.8 kg)	—		

BRAKE



U42103

SEW00352

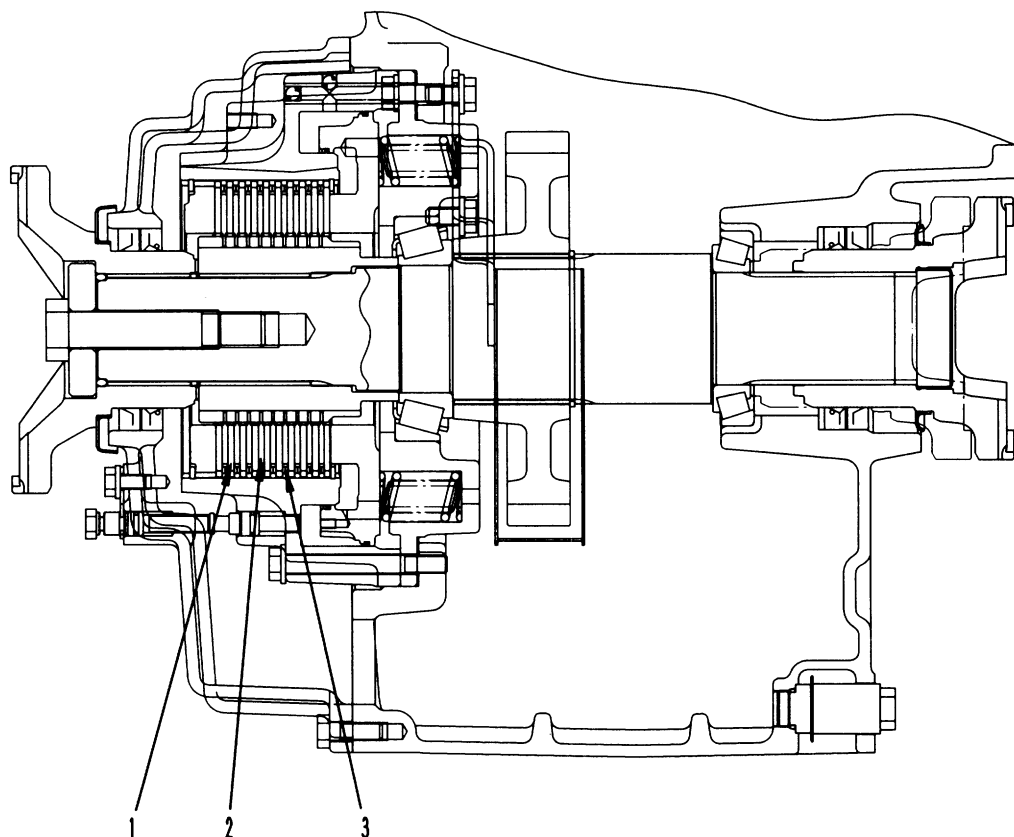
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria						Remedy
1	Return spring	Standard size			Repair limit			Replace
		Free length	Installed height	Installed load	Free length	Installed load		
		75.6	66.2	568.8 N (58 kg)	74.7	511.9 N (52.2 kg)		
2	Thickness of plate	Standard size		Tolerance		Repair limit		
		2.3		±0.08		2.0		
3	Thickness of disc	3.8		±0.1		3.5		
4	Overall assembly thickness of plates, discs	38.9		±1.16		35.0		
5	Wear of piston seal contact surface	420		+0.097 0		—		
6	Wear of piston seal contact surface	383		+0.089 0		—		
7	Backlash between outer gear and plate	0.21 – 0.65						
8	Backlash between inner gear and disc	0.31 – 0.74						

PARKING BRAKE



U42103

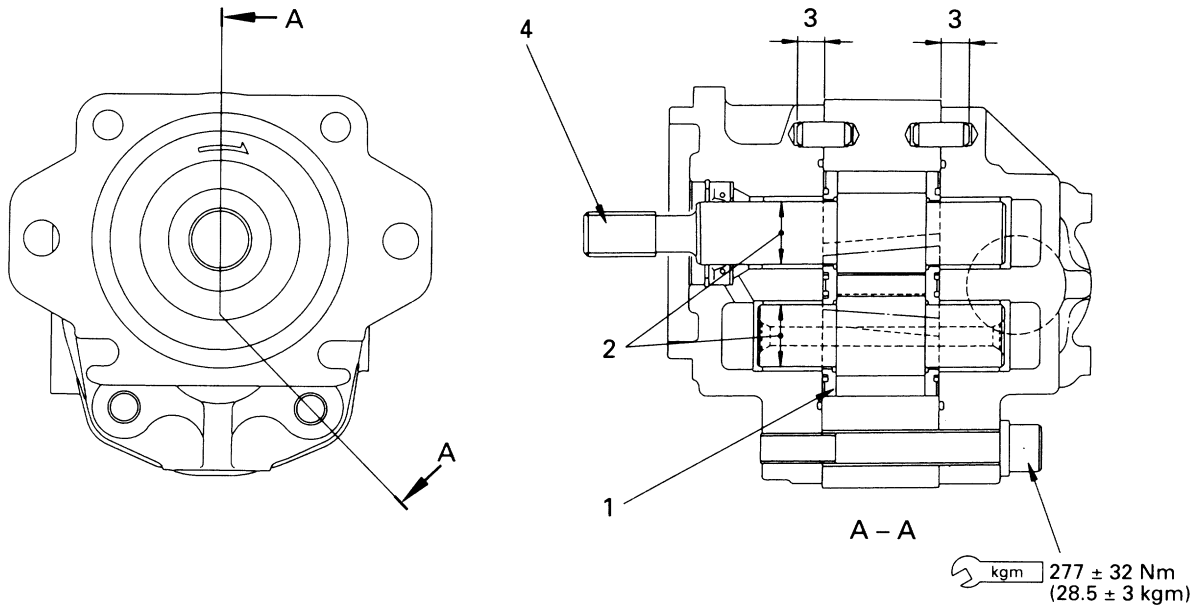
SXW04492

Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Thickness of plate	40	± 0.05	3.9	Replace
	Distortion	—	0.05	0.6	
2	Thickness	3.2	± 0.08	2.97	
	Depth of lining groove	0.45	$+0.175$ 0	0.3	
	Thickness of lining	0.7	± 0.075		
3	Load of wave spring	1103.2 N (112.5 kg) (Height 3.2 mm)	± 56.9 N (± 5.8 kg)	892.4 N (91 kg)	

TORQUE CONVERTER, TRANSMISSION PUMP

SAR(3)-100



SEW00354

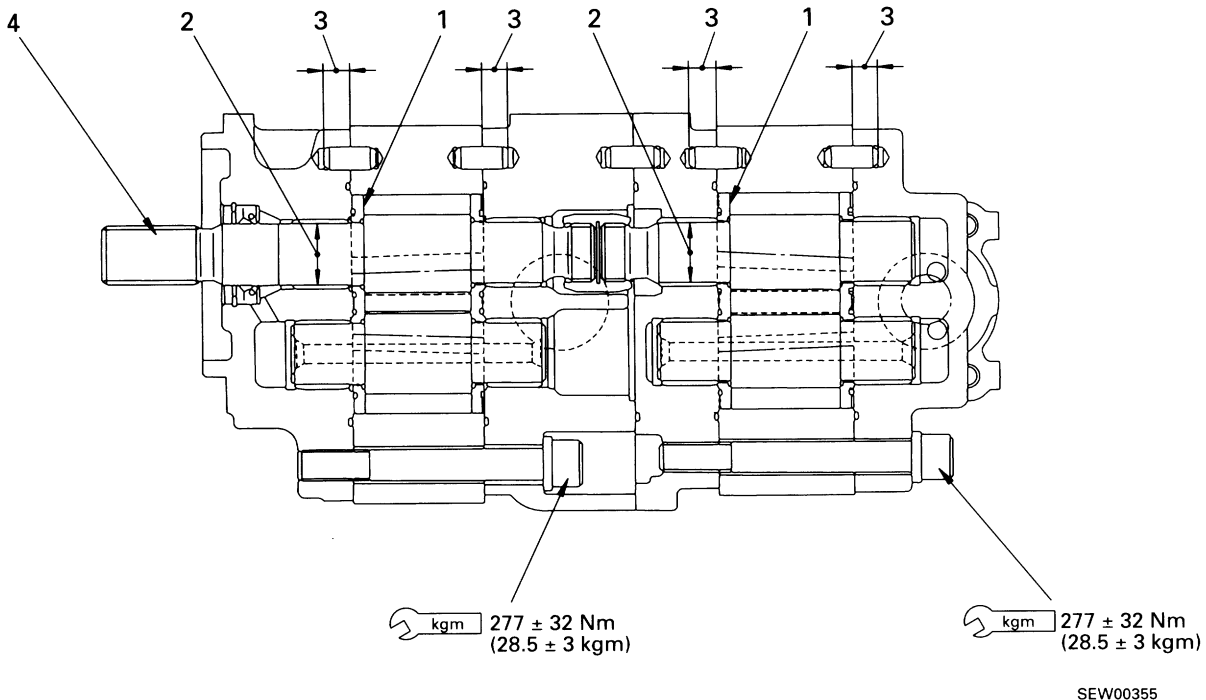
U42103

Unit: mm

Unit: mm							
No.	Check item	Criteria				Remedy	
1	Side clearance	Model	Standard clearance		Clearance limit		Replace
		SAR(3)-100	0.13 – 0.18		0.22		
2	Clearance between inside diameter of plain bearing and outside of diameter of gear shaft	SAR(3)-100	0.06 – 0.149		0.20		
3	Depth for knocking in pin	Model	Standard size	Tolerance		Repair limit	
		SAR(3)-100	14	0 –0.5		—	
4	Rotating torque of spline shaft	6.9 – 11.8 Nm (0.7 – 1.2 kgm)					
5	Discharge amount Oil: EO10-CD Oil temperature: 45 – 55°C	Model	Rotating speed (rpm)	Delivery pressure [MPa (kg/cm ²)]	Standard delivery amount (ℓ/min)	Delivery amount limit (ℓ/min)	—
		SAR(3)-100	2,500	2.9 (30)	241	221	

STEERING, SWITCH PUMP

SAR(3)71 + 50A



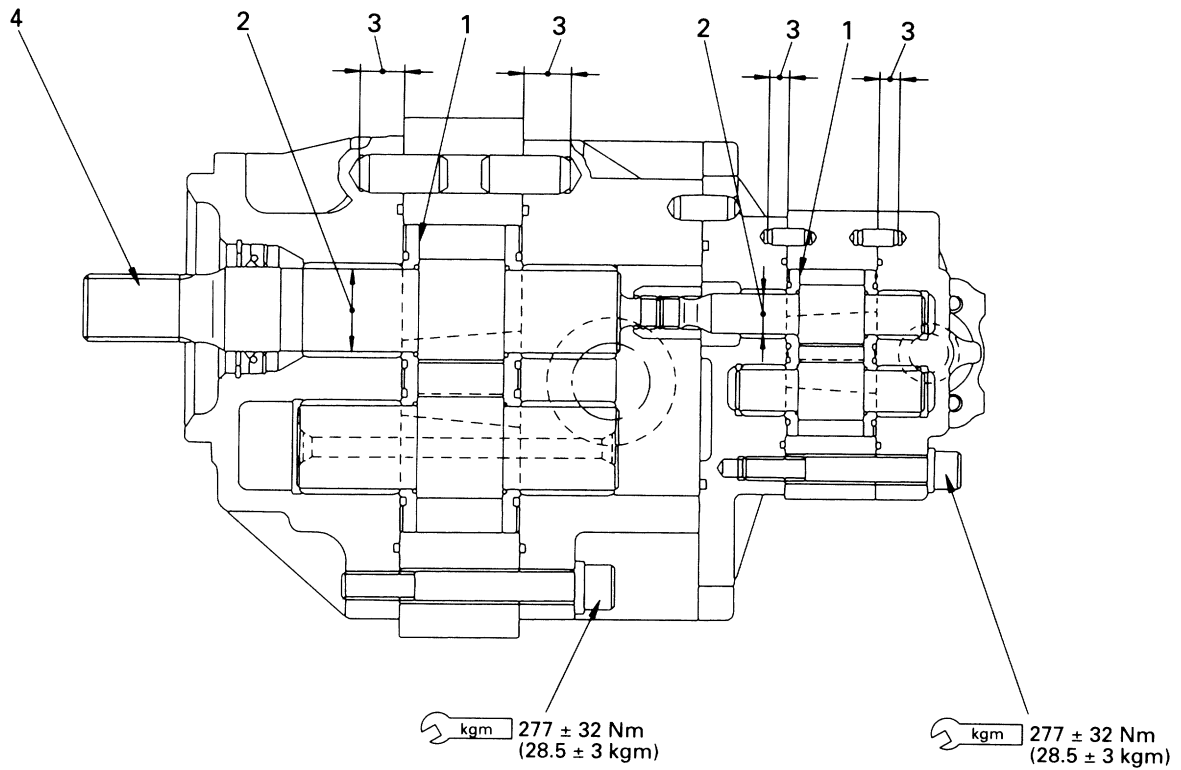
U42103

Unit: mm

No.	Check item	Criteria					Remedy	
1	Side clearance	Model		Standard clearance		Clearance limit	Replace	
		SAR(3)71		0.10 – 0.15		0.19		
		SAR(3)50						
2	Clearance between inside diameter of plain bearing and outside of diameter of gear shaft	SAR(3)71		0.06 – 0.149		0.20		
		SAR(3)50						
3	Depth for knocking in pin	Model		Standard size	Tolerance		Repair limit	
		SAR(3)71		14	0 –0.5	—		
		SAR(3)50						
4	Rotating torque of spline shaft	13.8 – 23.6 Nm (1.4 – 2.4 kgm)					—	
5	Discharge amount Oil: EO10-CD Oil temperature: 45 – 55°C	Model		Rotating speed (rpm)	Delivery pressure [MPa (kg/cm²)]	Standard delivery amount (ℓ/min)		Delivery amount limit (ℓ/min)
		SAR(3)71		2,500	20.6 (210)	158		146
		SAR(3)50				112		102

HYDRAULIC, PPC PUMP

SAR(4)140 + (1) + 28A



SEW00356

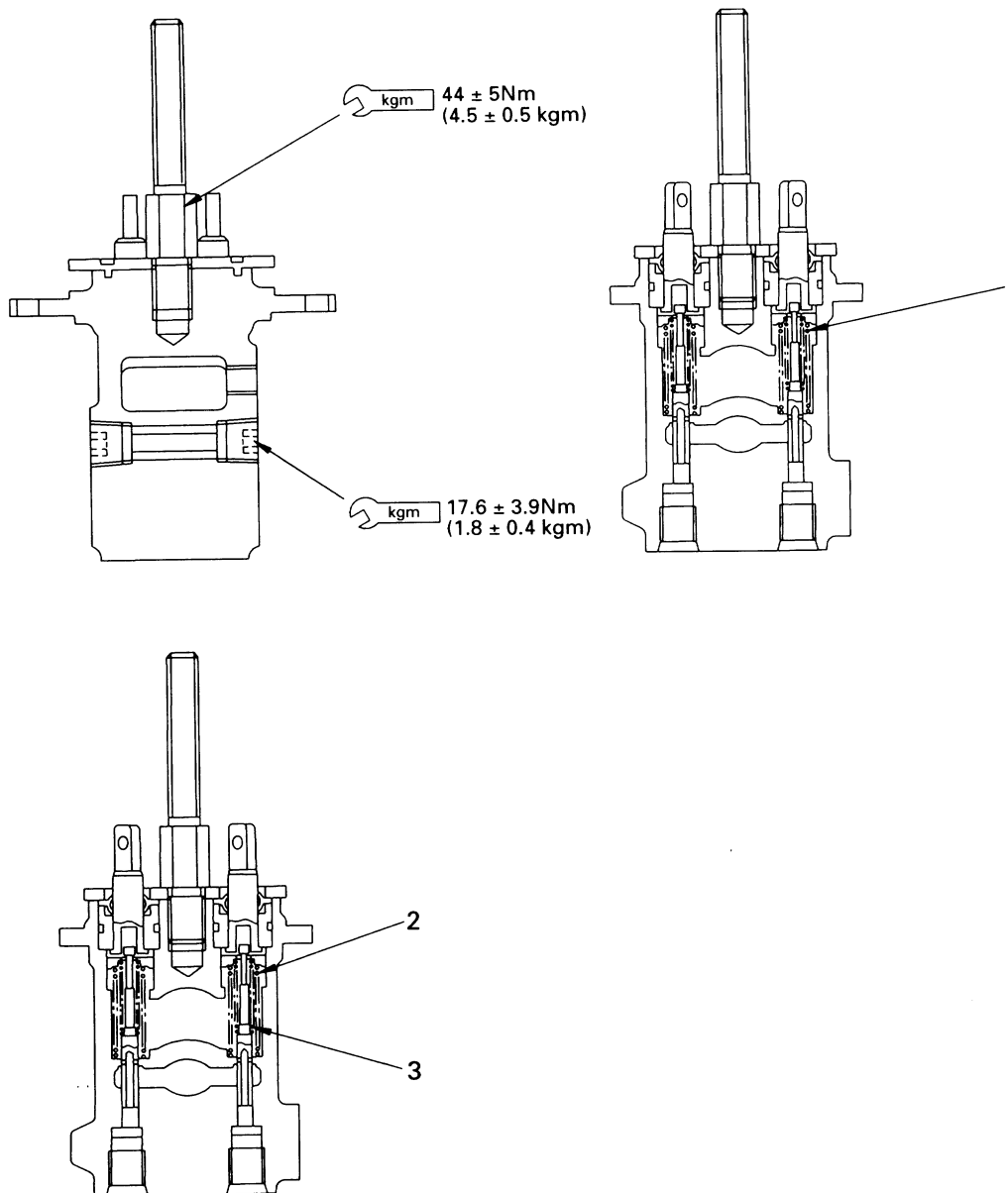
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Side clearance	Model		Standard clearance		Clearance limit	Replace
		SAR(4)140		0.11 – 0.16		0.19	
		SAR(1)28		0.10 – 0.15		0.19	
2	Clearance between inside diameter of plain bearing and outside of diameter of gear shaft	SAR(4)140		0.06 – 0.140		0.20	
		SAR(1)28		0.064 – 0.119		0.20	
3	Depth for knocking in pin	Model		Standard size	Tolerance	Repair limit	
		SAR(4)140		21	0 –0.5	—	
		SAR(1)28		10			
4	Rotating torque of spline shaft	11.8 – 19.6 Nm (1.2 – 2.0 kgm)					
5	Discharge amount Oil: EO10-CD Oil temperature: 45 – 55°C	Model	Rotating speed (rpm)	Delivery pressure [MPa (kg/cm ²)]	Standard delivery amount (ℓ/min)	Delivery amount limit (ℓ/min)	—
		SAR(4)140	2,200	20.6 (210)	287	266	
		SAR(1)28		2.9 (30)	59	52	

PPC VALVE

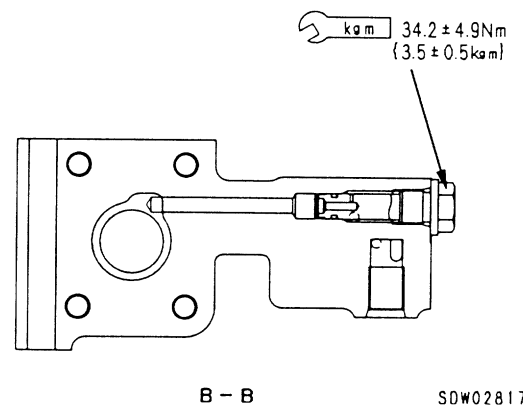
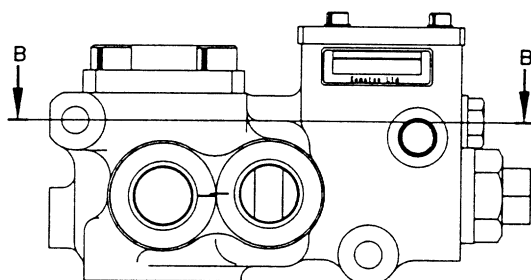
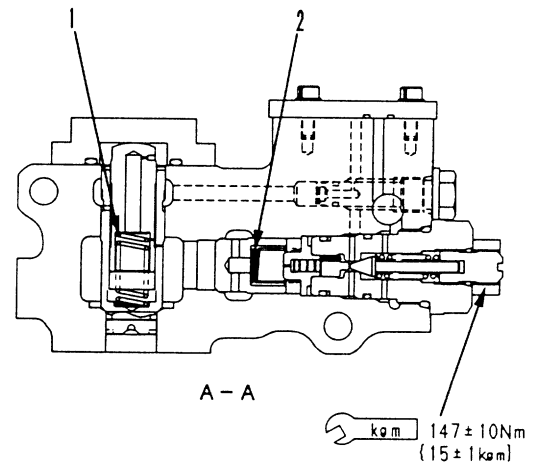
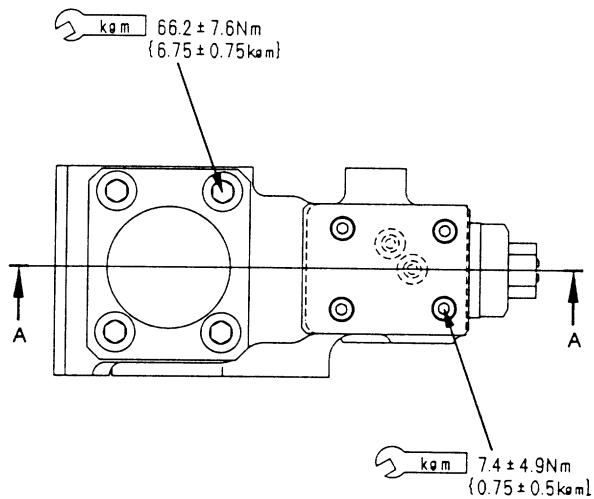


SEW00357

Unit: mm

No.	Check item	Criteria					Remedy
1	Centering spring (bucket DUMP, boom LOWER)	Standard size			Repair limit		Replace spring if damaged or deformed
		Free length x O.D.	Installed length	Installed load	Free length	Installed load	
		52.8 x 12.3	36.0	29.4 N {3.0 kg}	—	23.5 N {2.4 kg}	
2	Centering spring (bucket TILT, boom RAISE)	52.8 x 12.3	36.0	39.2 N {4.0 kg}	—	31.4 N {3.2 kg}	
3	Metering spring	31.4 x 7.4	29.4	16.7 N {1.7 kg}	—	13.7 N {1.4 kg}	

CUT-OFF VALVE

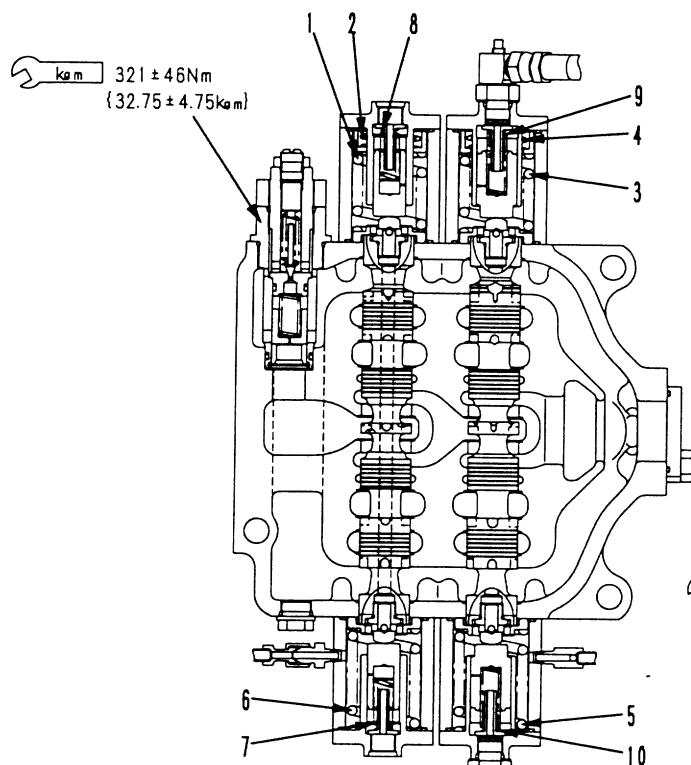


S0W02817

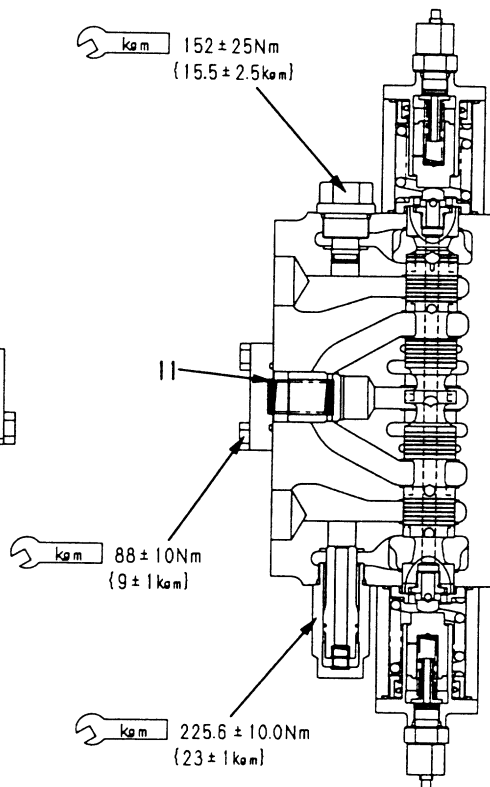
							Unit: mm
No.	Check item	Criteria					Remedy
1	Unload valve spring	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		37	30	35.3 N {3.6 kg}	—	28.4 N {2.9 kg}	
2	Check valve spring	33	20	1.7 N {0.17 kg}	—	1.4 N {0.14 kg}	

MAIN CONTROL VALVE

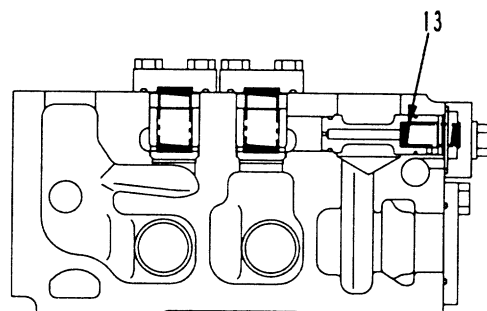
2-SPOOL VALVE



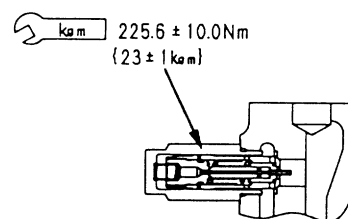
A - A



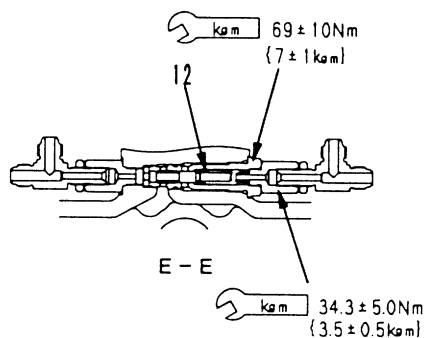
B - B



C - C



D - D



E - E

U42103

SDW02773

MAINTENANCE STANDARD

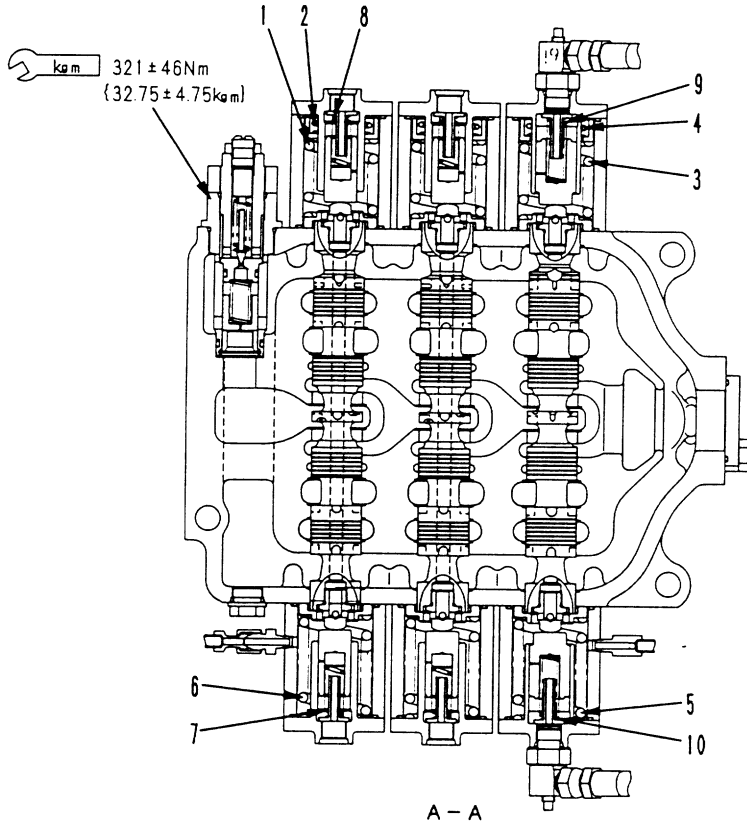
MAIN CONTROL VALVE

Unit: mm

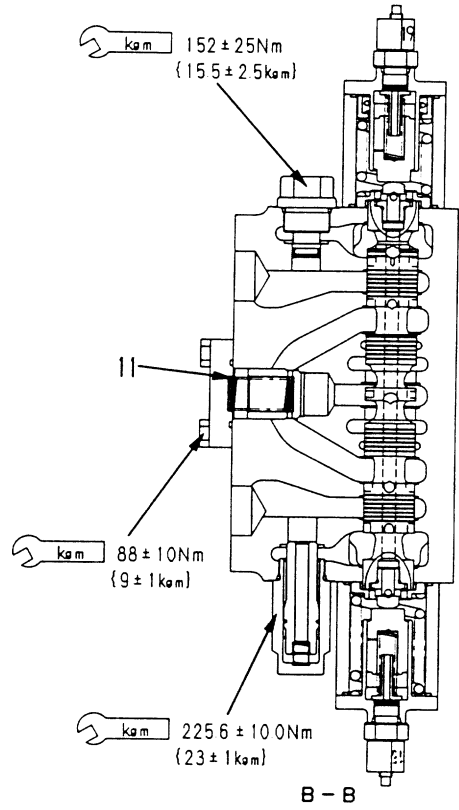
Unit: mm

No.	Check item	Criteria					Remedy	
1	Spool return spring (large)	Standard size			Repair limit		Replace	
		Free length	Installed length	Installed load	Free length	Installed load		
		64.4	62.2	190.2 N {19.4 kg}	—	152.0 N {15.5 kg}		
2	Spool return spring (small)	18.6	14.9	112.8 N {11.5 kg}	—	90.2 N {9.2 kg}		
3	Spool return spring (large)	64.4	62.7	223.6 N {22.8 kg}	—	178.5 N {18.2 kg}		
4	Spool return spring (small)	18.6	15.2	156.9 N {16 kg}	—	125.5 N {12.8 kg}		
5	Spool return spring (large)	85.5	82.0	283.4 N {28.9 kg}	—	226.5 N {23.1 kg}		
6	Spool return spring (large)	83.3	82.0	101 N {10.3 kg}	—	80.4 N {8.2 kg}		
7	Spool return spring (small)	42.0	42.0	0	—	—		
8	Spool return spring (small)	42.0	42.0	0	—	—		
9	Spool return spring (small)	62.6	52.0	31.4 N {3.2 kg}	—	25.5 N {2.6 kg}		
10	Spool return spring	62.6	52.0	31.4 N {3.2 kg}	—	25.5 N {2.6 kg}		
11	Check valve spring	78.2	52.0	18.8 N {1.92 kg}	—	14.7 N {1.5 kg}		
12	Float selector valve spring	53.0	42.1	137.3 N {14 kg}	—	109.8 N {11.2 kg}		
13	Unload valve spring	82.7	47.0	49.0 N {5.0 kg}	—	39.2 N {4.0 kg}		

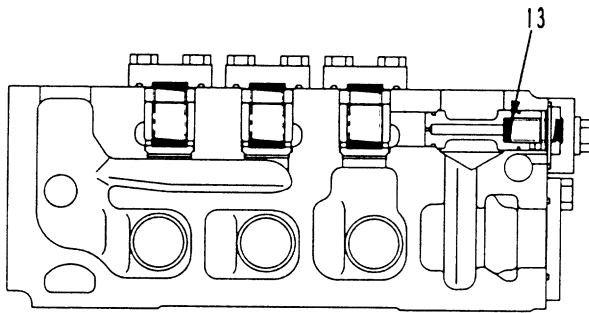
3-SPOOL VALVE



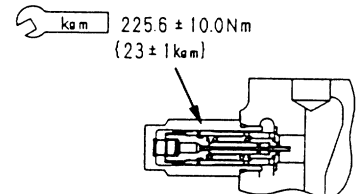
A - A



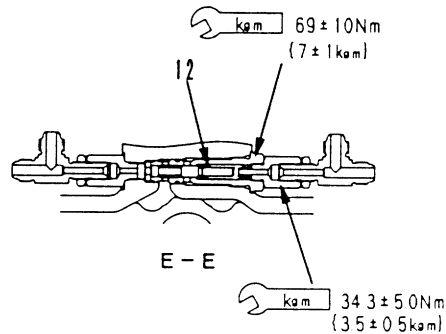
B - B



C - C



D - D



E - E

U42103

SDW02774

MAINTENANCE STANDARD

MAIN CONTROL VALVE

Unit: mm

No.	Check item	Criteria					Remedy
1	Spool return spring (large)	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		64.4	62.2	190.2 N {19.4 kg}	—	152.0 N {15.5 kg}	
2	Spool return spring (small)	18.6	14.9	112.8 N {11.5kg}	—	90.2 N {9.2 kg}	
3	Spool return spring (large)	64.4	62.7	223.6 N {22.8 kg}	—	178.5 N {18.2 kg}	
4	Spool return spring (small)	18.6	15.2	156.9 N {16 kg}	—	125.5 N {12.8 kg}	
5	Spool return spring (large)	85.5	82.0	283.4 N {28.9 kg}	—	226.5 N {23.1 kg}	
6	Spool return spring (large)	83.3	82.0	101 N {10.3 kg}	—	80.4 N {8.2 kg}	
7	Spool return spring (small)	42.0	42.0	0	—	—	
8	Spool return spring (small)	42.0	42.0	0	—	—	
9	Spool return spring (small)	62.6	52.0	31.4 N {3.2 kg}	—	25.5 N {2.6 kg}	
10	Spool return spring	62.6	52.0	31.4 N {3.2 kg}	—	25.5 N {2.6 kg}	
11	Check valve spring	78.2	52.0	18.8 N {1.92 kg}	—	14.7 N {1.5 kg}	
12	Float selector valve spring	53.0	42.1	137.3 N {14 kg}	—	109.8 N {11.2 kg}	
13	Unload valve spring	82.7	47.0	49.0 N {5.0 kg}	—	39.2 N {4.0 kg}	

U42103

MAINTENANCE STANDARD

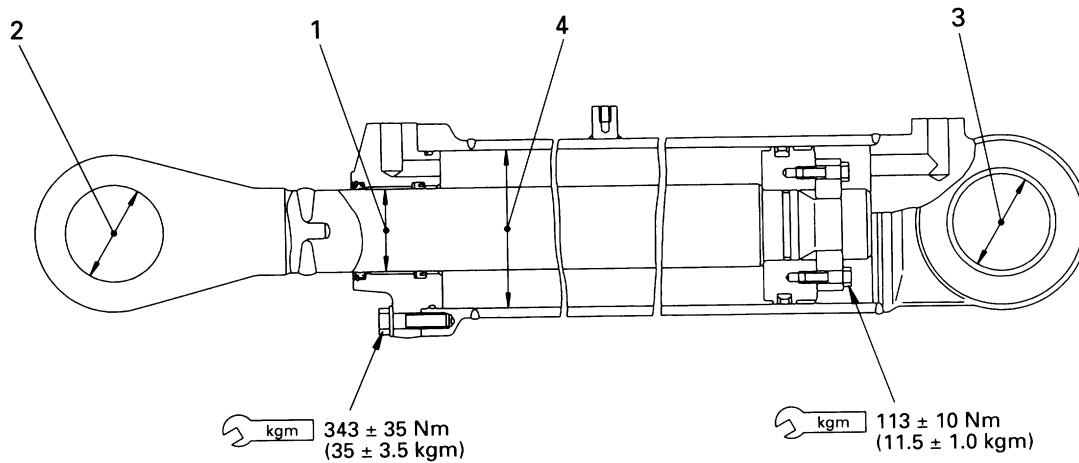
MAIN CONTROL VALVE

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy	
1	Spool return spring (large)	Standard size			Repair limit		Replace	
		Free length	Installed length	Installed load	Free length	Installed load		
		64.4	62.2	190.2 N {19.4 kg}	—	152.0 N {15.5 kg}		
2	Spool return spring (small)	18.6	14.9	112.8 N {11.5kg}	—	90.2 N {9.2 kg}		
3	Spool return spring (large)	64.4	62.7	223.6 N {22.8 kg}	—	178.5 N {18.2 kg}		
4	Spool return spring (small)	18.6	15.2	156.9 N {16 kg}	—	125.5 N {12.8 kg}		
5	Spool return spring (large)	85.5	82.0	283.4 N {28.9 kg}	—	226.5 N {23.1 kg}		
6	Spool return spring (large)	83.3	82.0	101 N {10.3 kg}	—	80.4 N {8.2 kg}		
7	Spool return spring (small)	42.0	42.0	0	—	—		
8	Spool return spring (small)	42.0	42.0	0	—	—		
9	Spool return spring (small)	62.6	52.0	31.4 N {3.2 kg}	—	25.5 N {2.6 kg}		
10	Spool return spring	62.6	52.0	31.4 N {3.2 kg}	—	25.5 N {2.6 kg}		
11	Check valve spring	78.2	52.0	18.8 N {1.92 kg}	—	14.7 N {1.5 kg}		
12	Float selector valve spring	53.0	42.1	137.3 N {14 kg}	—	109.8 N {11.2 kg}		
13	Unload valve spring	82.7	47.0	49.0 N {5.0 kg}	—	39.2 N {4.0 kg}		

BOOM CYLINDER



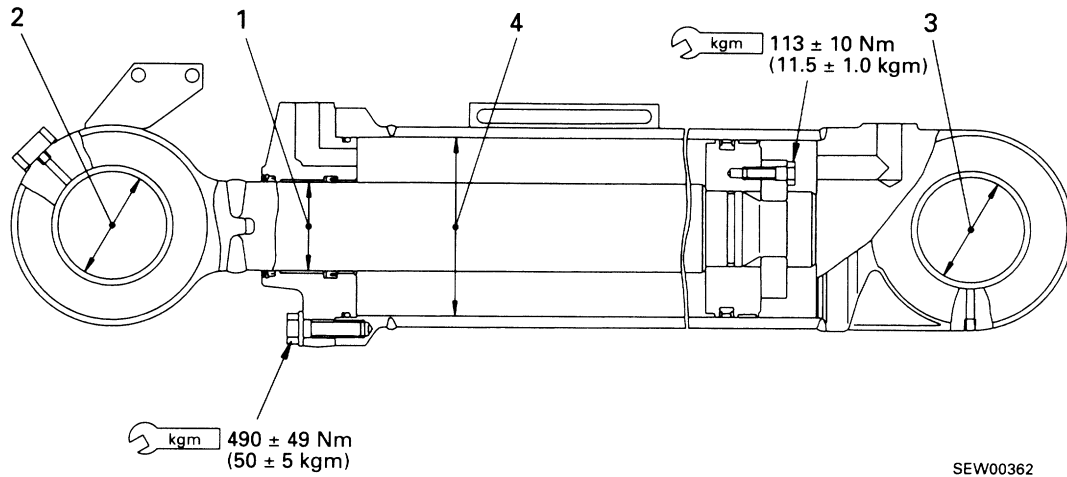
SEW00361

U42103

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between boom cylinder rod and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		95	-0.036 -0.123	+0.235 +0.060	0.096 – 0.358	0.658	
2	Clearance between piston rod mounting pin and inside diameter of insertion portion	110		+0.350 +0.200			
3	Clearance between cylinder bottom mounting pin and bushing	110		+0.207 +0.120			
4	Clearance at inside diameter of cylinder	Standard size		Tolerance		Repair limit	
		180		+0.30 0			

BUCKET CYLINDER



SEW00362

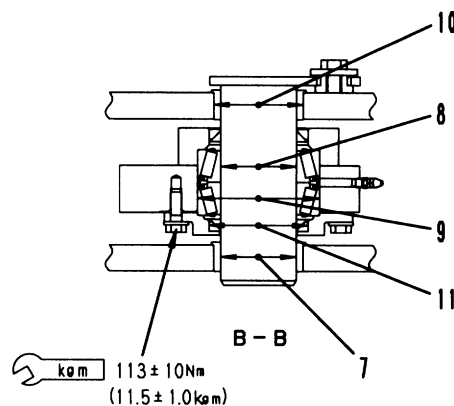
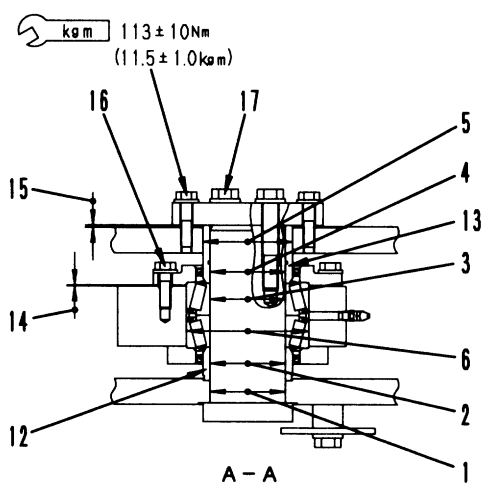
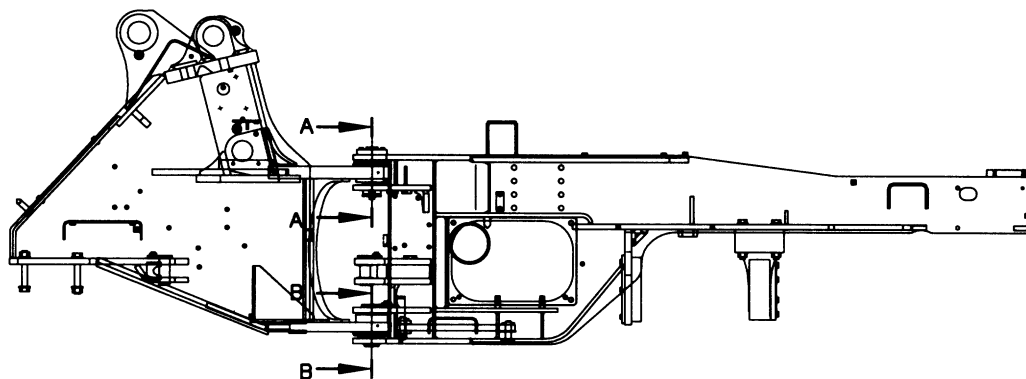
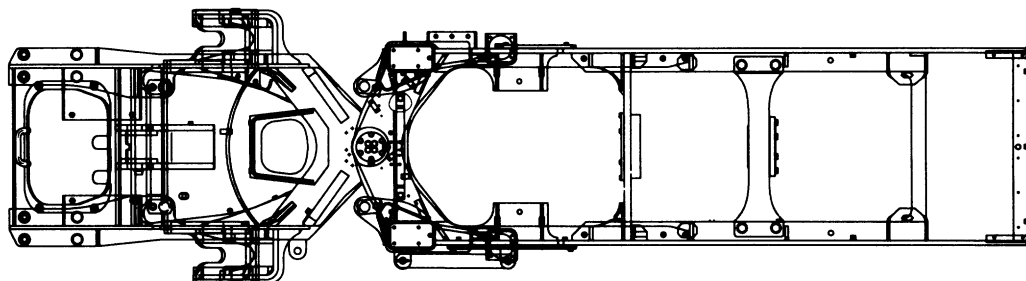
U42103

Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between bucket cylinder rod and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between piston rod mounting pin and bushing	100	-0.036 -0.123	+0.270 +0.060	0.096 – 0.393	0.693	
3	Clearance between cylinder bottom mounting pin and bushing	120	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
4	Clearance at inside diameter of cylinder	Standard size		Tolerance		Repair limit	
		200		+0.30 0		—	

CENTER HINGE PIN



U42103

SXW04503

MAINTENANCE STANDARD

CENTER HINGE PIN

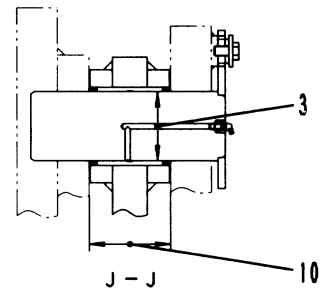
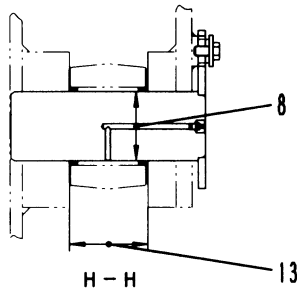
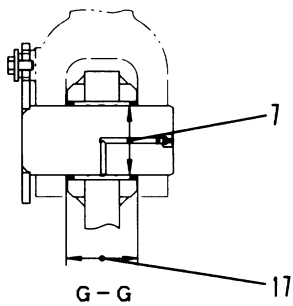
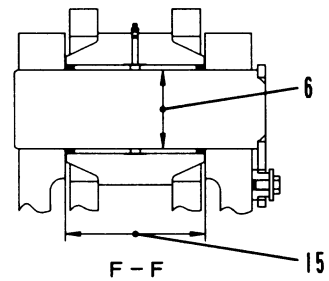
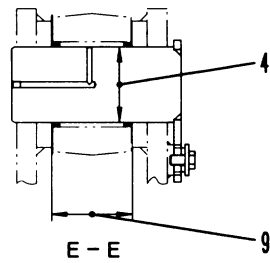
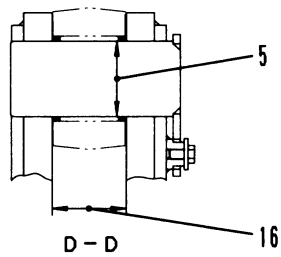
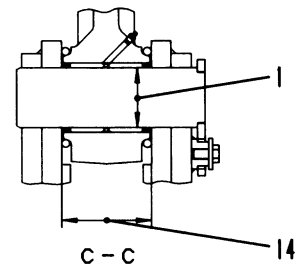
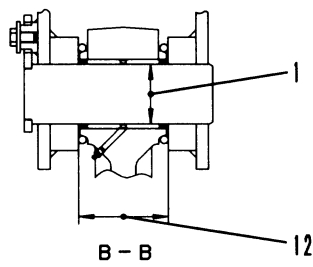
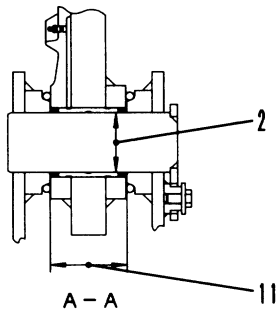
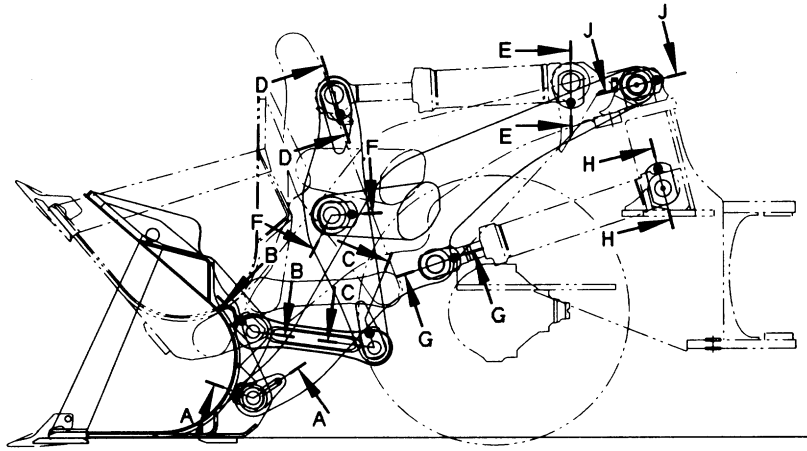
Unit: mm

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between upper hinge pin and rear frame	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between upper hinge pin and spacer (small)	80	-0.030 -0.076	+0.071 +0.036	0.066 – 0.147	—	
3	Clearance between upper hinge pin and bearing	80	-0.030 -0.076	0 -0.015	0.015 – 0.076	—	
4	Clearance between upper hinge pin and spacer (large)	80	-0.030 -0.076	+0.030 0	0.03 – 0.106	—	
5	Clearance between rear frame and spacer (large)	95	-0.036 -0.071	+0.071 +0.036	0.072 – 0.142	—	
6	Clearance between front frame and upper hinge bearing	130	0 -0.025	-0.048 -0.088	-0.088 – -0.023	—	
7	Clearance between lower hinge pin and rear frame bushing	80	-0.030 -0.076	+0.067 +0.027	0.057 – 0.143	—	
8	Clearance between lower hinge pin and bearing	80	-0.030 -0.076	0 -0.015	0.015 – 0.076	—	
9	Clearance between front frame and lower hinge bearing	130	0 -0.025	-0.048 -0.088	-0.088 – -0.023	—	
10	Clearance between rear frame and bushing	95	+0.089 +0.054	+0.054 0	-0.089 – 0	—	
11	Clearance at press-fitting portion of lower hinge pin seal	105	+0.17 +0.08	+0.054 0	-0.170 – -0.026	—	
12	Height of upper hinge spacer (small)	Standard size		Tolerance		Repair limit	
		36		±0.1			
13	Height of upper hinge spacer (large)	61.5		±0.1			
14	Value for shim between upper hinge and retainer	Standard size		Standard clearance		Clearance limit	
		1					
15	Value for shim between upper hinge and retainer	2					
16	Tightening torque of upper hinge retainer mounting bolt	19.6 ± 2 Nm (2.0 ± 0.2 kgm) (when adjusting with shim)					
		112.8 ± 9.8 Nm (11.5 ± 1.0 kgm) (final value)					
17	Tightening torque of upper hinge retainer mounting bolt	19.6 ± 2 Nm (2.0 ± 0.2 kgm) (when adjusting with shim)					
		205.9 ± 19.6 Nm (21 ± 2 kgm) (final value)					

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WORK EQUIPMENT LINKAGE



U42103

SXW04504

MAINTENANCE STANDARD

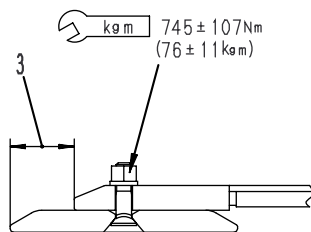
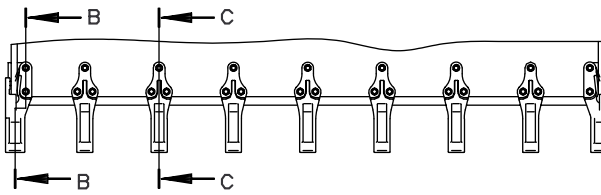
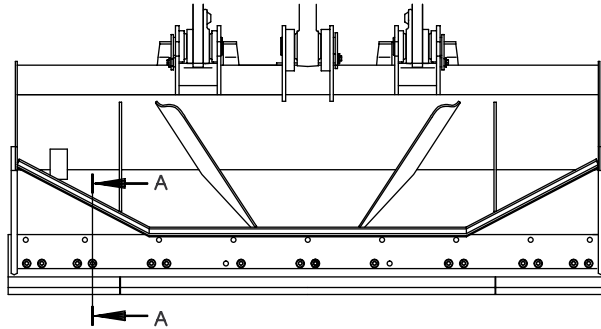
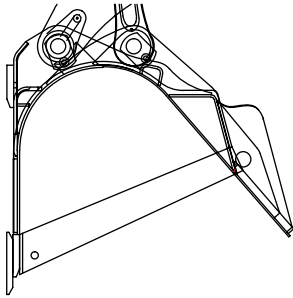
WORK EQUIPMENT LINKAGE

Unit: mm

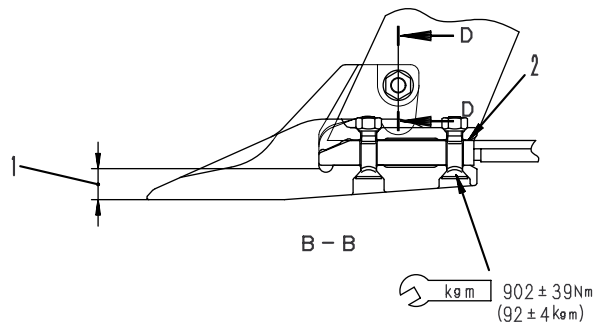
No.	Check item	Criteria					Remedy
1	Clearance between pin and bushing at both ends of bucket link	Standard size	Tolerance		Standard clearance	Clearance limit	Replace (replace if there is scuffing on pin)
			Shaft	Hole			
		95	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
2	Clearance between pin and bushing at connection of boom and bucket	95	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
3	Clearance between pin and bushing at connection of boom and frame	110	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
4	Clearance between pin and bushing at connection of bucket cylinder bottom and frame	120	-0.036 -0.090	+0.207 +0.120	0.156 – 0.299	1.0	
5	Clearance between pin and bushing at connection of bucket cylinder rod and frame	120	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
6	Clearance between pin and bushing at connection of bellcrank and boom	125	-0.043 -0.106	+0.395 +0.295	0.338 – 0.501	1.0	
7	Clearance between pin and bushing at connection of boom cylinder rod and frame	110	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
8	Clearance between pin and bushing at connection of boom cylinder bottom and frame	110	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
9	Connection of bucket cylinder and frame	Width of boss		Width of hinge		Standard clearance (clearance a + b)	Replace (insert shims on both sides so that clearance is less than 1.5 mm on both left and right)
		125 $^{+0.8}_0$		128 ± 0.8		1.4 – 3.8	
10	Connection of boom and frame	127 ± 2.3		130 $^{+2.5}_0$		0.7 – 7.8	
11	Connection of boom and bucket	119 ± 2.3		122 $^{+1.5}_0$		0.7 – 6.8	
12	Connection of bucket link and bucket	138 $^{+3}_{-0.5}$		143 ± 1.5		2 – 7	
13	Connection of boom cylinder and frame	120 $^{+0.8}_0$		125 $^{+2.5}_0$		2.2 – 7.5	
14	Connection of bellcrank and bucket link	138 $^{+3}_{-0.5}$		143 ± 1.5		1 – 5.5	Replace
15	Connection of bellcrank and boom	220 ± 0.5		223 ± 0.5		2 – 4	
16	Connection of bucket cylinder and bellcrank	115 $^{+0.8}_0$		118 ± 1.5		1.2 – 3.0	Adjust with shims so that clearance is less than 1.5 mm on both left and right
17	Connection of boom and boom cylinder	111 ± 2.5		114 ± 1.5		0 – 6	

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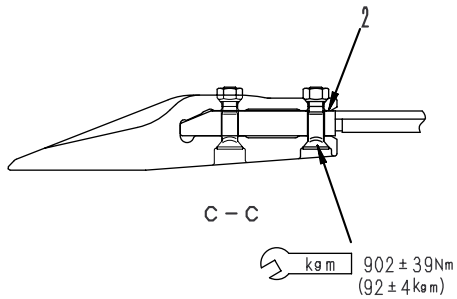
BUCKET



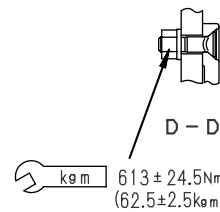
A - A



B - B



C - C



D - D

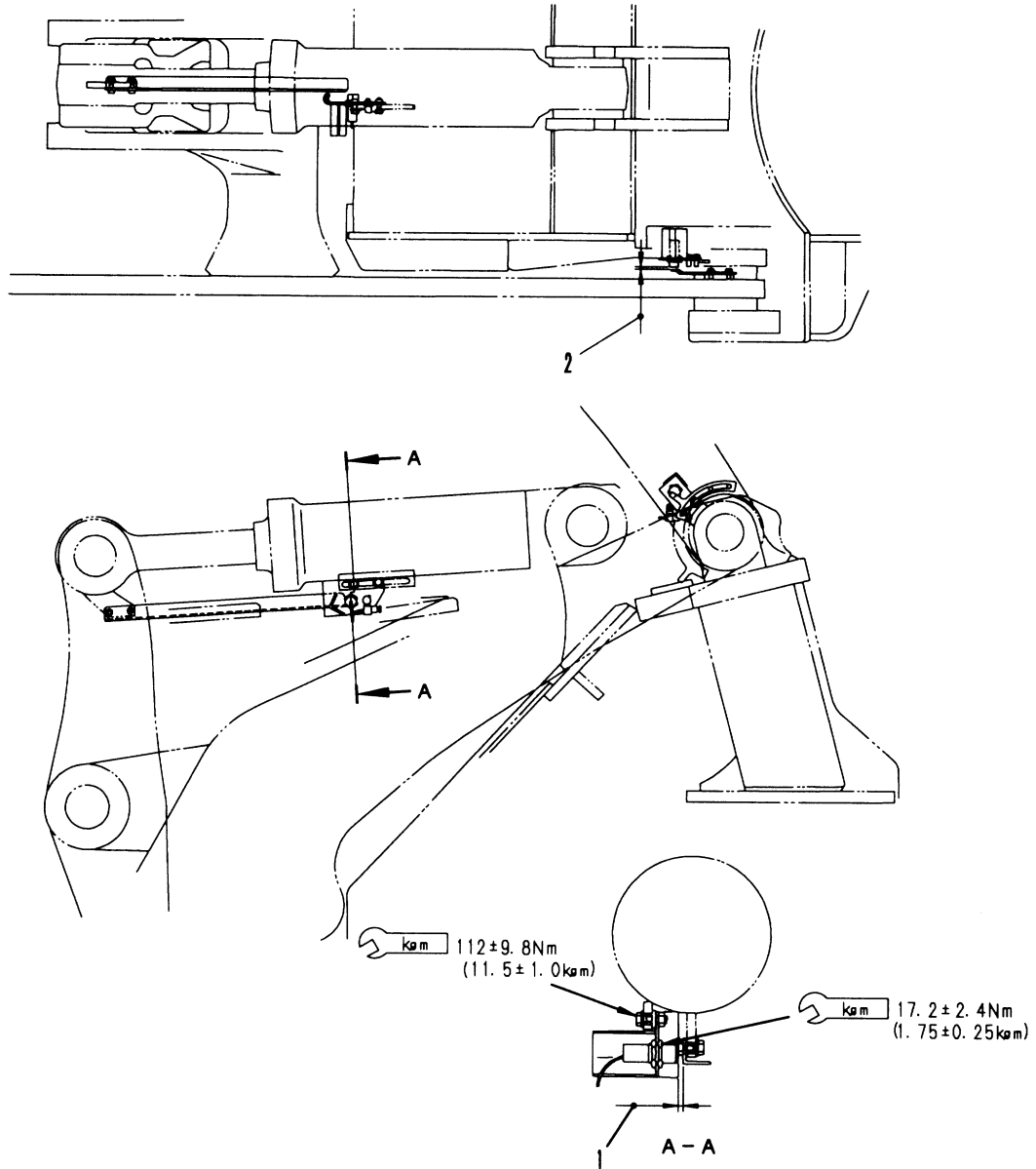
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SXW04505

Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Wear of bucket tooth	50	18.5	Replace
2	Clearance at bucket tooth mount	Max. 0.5		Adjust or replace
3	Wear of cutting edge	93		Turn or replace

BUCKET POSITIONER AND BOOM KICK-OUT



SXW04506

Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance at bucket positioner switch	3 - 5	Adjust
2	Clearance at boom kickout switch	3 - 5	