

Shop Manual

WA380-3

WHEEL LOADER

SERIAL NUMBERS **WA380-3LE - A50001** and up

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Due to this continuous program of research and development, periodic revisions may be made to this publication. It is recommended that customers contact their distributor for information on the latest revision.

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PRODUCT PUBLICATIONS INFORMATION

VARIOUS PRODUCT PARTS & SERVICE PUBLICATIONS ARE AVAILABLE TO ALL **KOMATSU** CONSTRUCTION EQUIPMENT OWNERS, INCLUDING OPERATION & MAINTENANCE MANUALS, PARTS BOOKS AND SHOP MANUALS.

SPECIAL PUBLICATIONS SUCH AS SERVICE TOOL, AIR CONDITIONING, AND TURBOCHARGER SHOP MANUALS ARE ALSO AVAILABLE AS WELL AS SELECTED OPERATION & MAINTENANCE AND SHOP MANUALS IN FOREIGN LANGUAGES.

THE PUBLICATIONS LISTED BELOW ARE AVAILABLE FOR THIS PARTICULAR MACHINE(S).

DESCRIPTION	FORM NUMBER
PARTS BOOK - PAPER:	
Engine and Chassis	BEPBW23090
PARTS BOOK - MICROFICHE:	
Engine and Chassis	BEPMW23090
OPERATION & MAINTENANCE MANUAL:	
Engine and Chassis	CEAMW23090
SHOP MANUAL:	
Chassis	CEBMW23091
Engine	CEBM000600
SAFETY MANUAL	WLT70-1

PARTS AND SERVICE PUBLICATIONS CAN *ONLY* BE ACQUIRED BY AUTHORIZED KOMATSU DISTRIBUTORS, USING THE KOMATSU AMERICA INTERNATIONAL COMPANY PARTS INFORMATION PROCESSING SYSTEM (PIPS).

IF THE PIPS SYSTEM IS NOT AVAILABLE AT THE DISTRIBUTOR LOCATION, THEN THE FOLLOWING REQUISITION FOR TECHNICAL SERVICE PUBLICATIONS AND SERVICE FORMS CAN BE USED. FORM KDC91D IS SHOWN ON THE REVERSE SIDE OF THIS PAGE.

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IMPORTANT - TO ASSURE SHIPMENT OF THE CORRECT PUBLICATION(S), THE MODEL NUMBER AND MACHINE SERIAL NUMBER MUST BE SHOWN.

[illegible]

SAFETY

SAFETY NOTICE

IMPORTANT SAFETY NOTICE

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

To prevent injury to workers, the symbols  and  are 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 & 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, glasses, 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 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 on to 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 part 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.

FOREWARD

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 judgements. 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 sections. These sections are further divided into each main group of components.

GENERAL

This section lists the general machine dimensions, performance specifications, component weights, and fuel, coolant and lubricant specification charts.

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.

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" to "Causes" are also included in this section.

DISASSEMBLY AND ASSEMBLY

This section explains the order to be followed when removing, installing, disassembling or assembling each component, as well as precautions to be taken for these operations.

MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

NOTICE

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your distributor for the latest information.

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 to cover all models

Attachment volume: Each issued as one to cover all models

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

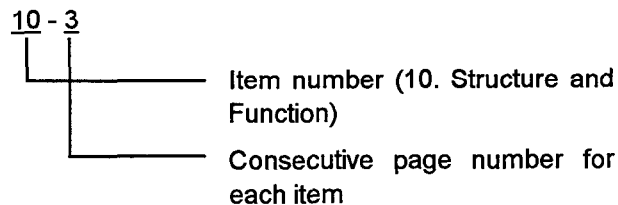
DISTRIBUTION AND UPDATING

Any additions, amendments or other changes will be sent to your 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):



Example 2 (Engine volume):

Refer to the pertinent engine manual.

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

Example:

10-4
 10-4-1 } Added pages
 10-4-2 }
 10-5

REVISED EDITION MARK

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

REVISIONS

Revised pages are shown at the LIST OF REVISED PAGES between the title page and SAFETY page.

SYMBOLS

So that the shop manual can be of ample practical use, important places for safety and quality 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 or systems. Caution necessary when selecting hoisting wire or when working posture is important, etc.
	Tightening torque	Places that require special attention for 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 interface with the part to be removed.

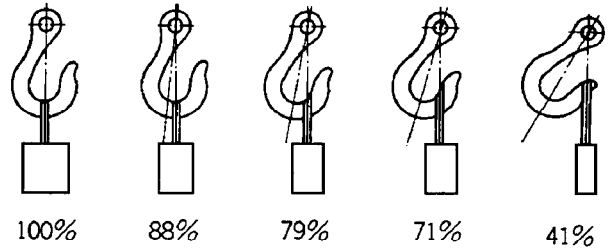
WIRE ROPES

- 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 (mm)	Allowable load (tons)
10.0	1.0
11.2	1.4
12.5	1.6
14.0	2.2
16.0	2.8
18.0	3.6
20.0	4.4
22.4	5.6
30.0	10.0
40.0	18.0
50.0	28.0
60.0	40.0

★ The allowable load value is estimated to be 1/6 or 1/7 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.



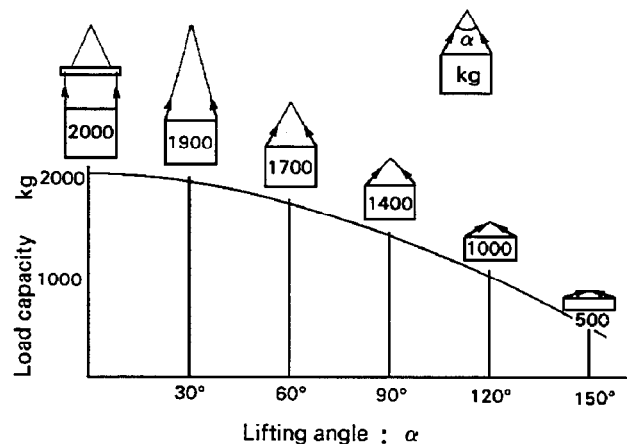
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- 3) Do not sling a heavy load with one rope alone, but sling with two or more ropes symmetrically wound on to the load.



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 (kg) when hoisting is made with two ropes, each of which is allowed to sling up to 1000 kg vertically, at various hanging angles. When two ropes sling a load vertically, up to 2000 kg of total weight can be suspended. This weight becomes 1000 kg when two ropes make a 120° hanging angle. On the other hand, two ropes are subject to an excessive force as large as 4000 kg if they sling a 2000 kg load at a lifting angle of 150°.



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COATING MATERIALS

The recommended coating materials prescribed in the shop manuals are listed below.

Category	Code	Part No.	Qty	Container	Main applications, features
Adhesive	LT-1A	790-129-9030	150 g	Tube	Used to prevent rubber gaskets, rubber cushions and cork plugs from coming out
	LT-1B	790-129-9050	20 g (x2)	Plastic 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	Plastic container	- Features: Resistance to heat, chemicals - Used for anti-loosening and sealant purposes for bolts and plugs.
	LT-3	790-129-9060 Set of adhesive and hardening agent	Adh 1 kg Hard agt 500 kg	Can	Used as adhesive or sealant for metal, glass or plastic.
	LT-4	790-129-9040	250 g	Plastic container	Used as sealant for machined holes.
	Loctite 648-50	79A-129-9110	50 cc	---	- Features: Resistance to heat, chemicals - Used at joint portions subject to high temperature.
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-3	790-129-9070	1 kg	Can	- Features: Resistance to heat - Used as sealant for flange surfaces and bolts at high temperature locations; used to prevent seizure. - Used as sealant for heat resistant gasket for at high temperature locations such as engine pre-combustion chamber, exhaust pipe.
	LG-4	790-129-9020	200 g	Tube	- Features: Resistance to water, oil - Used as sealant for flange surface, thread. - Also possible to use as sealant for flanges with large clearance. - Used as sealant for mating surfaces of final drive case, transmission case.
	LG-5	790-129-9080	1 kg	Plastic container	- Used as sealant for various threads, pipe joints, flanges. - Used as sealant for tapered plugs, elbows, nipples of hydraulic piping.
	LG-6	09940-00011	250 g	Tube	- Features: Silicon based, resistant to heat, cold. - Used as sealant for flange surface, thread. - Used as sealant for oil pan, final drive case, etc.
	LG-7	09920-00150	150 g	Tube	- Features: Silicon based, quick hardening type. - Used as sealant for flywheel housing, intake manifold, oil pan, thermostat housing, etc.
Rust prevention lubricant	---	09940-00051	60 g	Can	Used as lubricant for sliding parts (to prevent squeaking).
Molybdenum disulfide lubricant	---	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.
Lithium grease	G2-L1	SYG-350LI SYG-400LI SYG-400LI-A SYG-160LI SYGA-160CNLI	Various	Various	General purpose type
Calcium grease	G2-CA	SSG2-400CA 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 disulfide grease	---	SYG2-400M	400 g (10/case)	Bellows type	Used for places with heavy load.

STANDARD TORQUE REQUIREMENTS

STANDARD TORQUE REQUIREMENTS OF BOLTS AND NUTS

The following charts give the standard torques values of bolts and nuts. Exceptions are given in sections of **DISASSEMBLY AND ASSEMBLY**.

1 kgm = 9.806 Nm

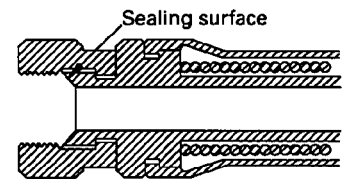
Thread diameter of bolt	Width across flat		
mm	mm	kgm	Nm
6	10	1.35 ±0.15	13.2 ±1.4
8	13	3.20 ±0.3	31.4 ±2.9
10	17	6.70 ±0.7	65.7 ±6.8
12	19	11.5 ±1.0	112 ±9.8
14	22	18 ±2.0	177 ±19
16	24	28.5 ±3	279 ±29
18	27	39 ±4	383 ±39
20	30	56 ±6	549 ±58
22	32	76 ±8	745 ±78
24	36	94.5 ±10	927 ±98
27	41	135 ±15	1320 ±140
30	46	175 ±20	1720 ±190
33	50	225 ±25	2210 ±240
36	55	280 ±30	2750 ±290
39	60	335 ±35	3280 ±340

★ This torque table does not apply to the bolts with which nylon packing or other non-ferrous metal washers are to be used, or which require torquing to otherwise specified values.

TORQUE REQUIREMENTS OF SPLIT FLANGE BOLTS

Use these torques values for split flange bolts.

Thread diameter of bolt	Width across flat	torque requirement values	
mm	mm	kgm	Nm
10	14	6.70 ± 0.7	65.7 ± 6.8
12	17	11.5 ± 1.0	112 ± 9.8
16	22	28.5 ± 3	279 ± 29

**TORQUE REQUIREMENTS FOR FLAIRED NUTS**

Use these torque values for flaired part of nut.

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

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: 05WB indicates a cable having a nominal number 05 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 strand (mm)	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	Classification	Circuits	Charging	Ground	Starting	Lighting	Instruments	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	---	Black/White	Red/White	Yellow/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/Red
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 TABLES

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.

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

2. Convert 550 mm into inches.

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

mm	0	1	2	3	4	5 ^(B)	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
^(A) 50	1.969	2.008	2.047	2.087	2.126	2.165	^(C) 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

Millimeters to Inches

1 mm = 0.03937 in

mm	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

kg	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

Liter to U.S. Gallon

1ℓ = 0.2642 U.S. Gal

ℓ	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

ℓ	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

kgm to ft. lb

1 kgm = 7.233 ft. lb

kgm	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

kg/cm² to lb/in²1kg/cm² = 14.2233 lb/in²

kg/cm ²	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

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.

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

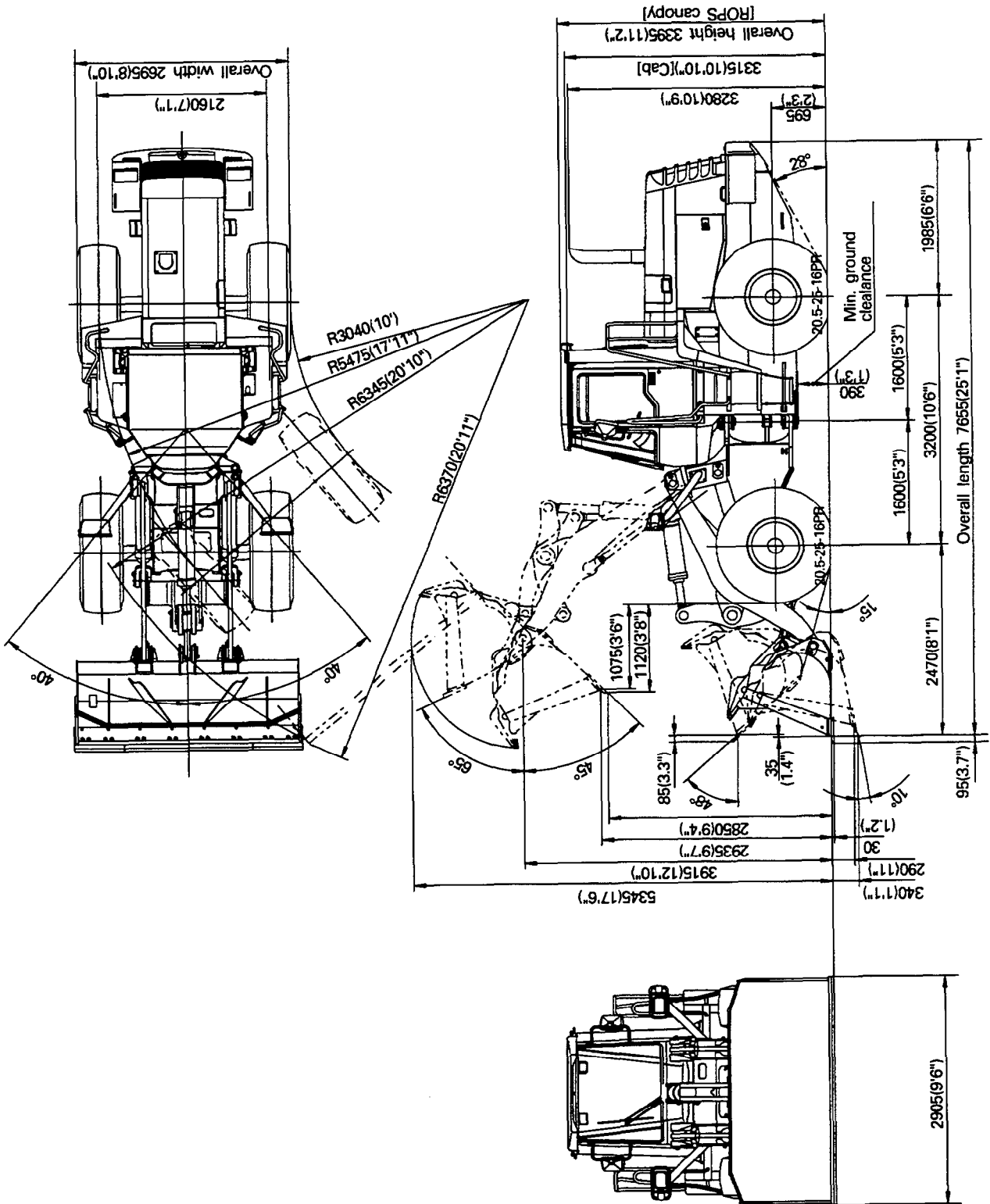
$^{\circ}\text{C}$		$^{\circ}\text{F}$	$^{\circ}\text{C}$		$^{\circ}\text{F}$	$^{\circ}\text{C}$		$^{\circ}\text{F}$	$^{\circ}\text{C}$		$^{\circ}\text{F}$
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	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	60	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

01 GENERAL

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SPECIFICATION DRAWINGS

WA380-3



AD063970

SPECIFICATIONS

Machine model		WA380-3
Serial number		A50001 and up
Weight	Operating weight	17585 kg
	Distribution (front)	8365
	Distribution (rear)	9220
Performance	Bucket capacity (piled)	3.1 m ³
	Rated load	4960 kg
	Travel speed FORWARD 1st	7.7 km/h
	FORWARD 2nd	12.3 km/h
	FORWARD 3rd	21.4 km/h
	FORWARD 4th	34.0 km/h
	REVERSE 1st	8.0 km/h
Dimensions	REVERSE 2nd	12.8 km/h
	REVERSE 3rd	22.6 km/h
	REVERSE 4th	35.0 km/h
	Grade-ability	25 deg
	Minimum Turning radius	5475 mm Center of outside wheel
		6370 mm Outside portion of chassis
	Overall length	7750 mm
Dimensions	Overall width (Chassis)	2695 mm
	Bucket width (with bolt on cutting edge)	2905 mm
	Overall height (top of cab)	3395 mm
	Overall height (bucket raised)	5345 mm
	Wheelbase	3200 mm
	Tread	2160 mm
	Minimum ground clearance	390 mm
	Height of bucket hinge pin	3915 mm
	Dumping clearance (tip of cutting edge)	2850 mm
	Dumping reach (tip of cutting edge)	1120 mm
	Bucket dump angle	45 deg
	Bucket tilt angle (SAE carrying position)	48 deg
	Digging depth (10° dump angle)	340 mm

GENERAL**SPECIFICATIONS**

Machine model		WA380-3
Serial number		A50001 and up
Engine	Model	Komatsu S6D114E-1
	Type	Direct injection (Aspiration--Turbo charged)
	No. of cylinders - bore x stroke	6 - 114 mm x 135 mm
	Piston displacement	8.27 ℓ (505 in³)
	Gross power @ 2200 rpm Maximum torque (gross) @ 1500 rpm High idle Low idle	153kW (205 HP) 862 N•m (636 lbf ft) 2450 ± 50 rpm 800 ± 25 rpm
Power train	Starting motor Alternator Battery	24V, 7.5 kW 24V, 50A 12V, 150Ah x 2
	Torque converter	3-element, 1-stage, single-phase (Komatsu TCA37-2A)
	Transmission	Spur gear, constant-mesh multiple-disc, hydraulic actuated, modulation type
	Reduction gear	Spiral bevel gear
	Differential	Straight bevel gear torque proportioning
Axle, wheel	Final drive	planetary gear, single reduction
	Drive type	Front/rear wheel drive
	Front axle	Fixed frame, semi-floating
	Rear axle	Center pin support type, semi-floating
	Tire	20.5-25-16pr (L32)
Brakes	Wheel rim	17.00 x 25-1.7
	Inflation pressure Front tire	343 Kpa (3.5kg/cm²)
	Inflation pressure Rear tire	343 Kpa (3.5kg/cm²)
	Main brake	Front/rear wheel independent braking wet-type sealed disc brakes with hydraulic power-double device
	Parking brake	Thrust shaft (transmission shaft) braking, wet-type disc brake

GENERAL
SPECIFICATIONS

	Machine model	WA380-3
	Serial number	A50001 and up
Steering system	Type Structure	Articulated type Fully hydraulic power steering
Hydraulic system	Hydraulic pump type (Hydraulic+Steering+Switch+PPC pump) Delivery	Gear type 224+112+81+57 ℓ/min
	Control valve Set pressure for work equipment Set pressure for steering	Spool type 20.59 Mpa (210 kg/cm ²) Orbit-roll valve type 20.59 Mpa 210 kg/cm ²)
	Cylinder Boom cylinder qty. - bore x stroke Bucket cylinder qty. - bore x stroke Steering cylinder qty. - bore x stroke	Reciprocating piston 2-160 x 713 Reciprocating piston 1-180 x 503 Reciprocating piston 2 - 80 x 442
Work equipment	Linkage type Bucket edge type	Single link (Z-bar linkage) Flat edge with bolt on cutting edge

WEIGHT TABLE

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

Machine model	WA380-3
Serial No.	A50001 and up
	kg
Engine	730
Radiator	78
Torque converter	42
Transmission with torque converter	680
Center drive shaft	19
Front drive shaft	15
Rear drive shaft	8
Front axle	724
Rear axle	714
Axle pivot	74
Wheel (each)	118
Tire (each)	193
Orbit-roll valve	8
Priority valve	6
Steering cylinder (each)	20
Hydraulic tank	134
Equipment, Steering, Switch, and PPC pump	44

Machine model	WA380-3
Serial No.	A50001 and up
	kg
Main control valve	75
Boom cylinder (each)	108
Bucket cylinder (each)	107
Engine hood with side panel	165
Front frame	1096
Rear frame	870
Bucket link	35
Bellcrank	230
Boom including bushings	852
Bucket with bolt on cutting edge	1230
Counterweight	1180
Fuel tank	150
Battery (each)	40
Floor, cab assembly	1086
Cab (ROPS)	526
Air conditioner unit	14
Operator's seat	38

LIST OF LUBRICANTS AND COOLANT

RESERVOIR	KIND OF FLUID	AMBIENT TEMPERATURE										CAPACITY	
		-22°F -30°C	-4 -20	14 -10	32 0	50 10	68 20	86 30	104 40	122° 50°		Specified	Refill
Engine oil pan	Engine oil					SAE 30W						22 ℓ	19 ℓ
						SAE 10W							
						SAE 10W-30							
						SAE 15W-40							
Transmission case	Engine oil					SAE 10W						42 ℓ	40 ℓ
Hydraulic system						SAE 10W						190 ℓ	138 ℓ
Axle (each) (Front and rear)	Axle oil					See note 1						37 ℓ	37 ℓ
Pins without auto-greasing system	Grease					NLGI No. 2						-	-
Pins with auto-greasing system						★ NLGU 2						-	-
Fuel tank	Diesel fuel					ASTM D975 No. 2						287 ℓ	-
		(★★)											
Cooling system	Coolant					See coolant specifications						53 ℓ	-

(★★): ASTM D975 No. 1

★: NLGI No. 0

When operating a machine with the auto-greasing system at temperatures below -20°C (-4°F), set the greasing time to 20 minutes. See the Operation & Maintenance Manual.

Note: 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: MOBIL AND SUPER UNIVERSAL

It is permissible to substitute engine oil SAE 30 API classification CD for axle. Although increase in brake noise may occur, durability should not be affected.

ENGINE OIL SPECIFICATIONS

Normal operation

Oil performance recommendations are as follows:

The use of a quality engine lubricating oil combined with appropriate oil and filter change intervals are critical factors in maintaining engine performance and durability.

SAE 15W-40 multi-viscosity oil meeting the American Petroleum Institute (API) performance classification of CF-4 or CG-4 is recommended.

★ CE oils may be used in areas where CF-4 or CG-4 oil is not yet available.

A sulfated ash limit of 1.0 mass percent is suggested for optimum valve and piston deposit and oil consumption control. the sulfated ash **must not** exceed 1.85 mass percent. The sulfated ash limit of 1.85 mass percent has been placed on all engine lubricating oils recommended for use in the engine. Higher ash oils can cause valve and/or piston damage and lead to excessive oil consumption.

The API service symbol displays the following information. The upper half of the symbol displays the appropriate oil categories; the lower half may contain words to describe oil energy conserving features. The center section identifies the SAE oil viscosity grade.

Oil viscosity recommendations are as follows:

The use of a multi-graded lubricating oil has been found to improve oil consumption control and improve engine cranking in cold temperatures while maintaining lubrication at high operating temperatures.

While SAE 15W-40 multi-viscosity oil is recommended for

most operating climates, refer to the previous table for oil viscosity recommendations for extreme climates.

Limited use of low viscosity oils, such as SAE 10W-30 may be used for easier starting and providing sufficient oil flow at ambient temperatures below -5°C (+23°F). However, continuous use of low viscosity oils can decrease engine life due to wear.

Special break-in lubricating oils are **not** recommended for a new or rebuilt engine. Use the same type of oil during the break-in as specified for normal operation.

Additional information regarding lubricating oil availability throughout the world is available in the "E.M.A. Lubricating Oils Data Book for Automotive and Industrial Engines". The data book may be ordered from the Engine Manufacturers Association, One Illinois Center, 111 East Wacker Drive, Chicago, IL U.S.A. 60601. The telephone number is (312) 644-6610.

Arctic Operation

If an engine is operated in ambient temperatures consistently below -23°C (-10°F) and there are no provisions to keep the engine warm when it is **not** in operation, use a synthetic API performance classification CE or CF-4 engine oil with adequate low temperature properties such as SAE 5W-20 or 5W-30.

The oil supplier **must** be responsible for meeting the performance service specifications.

★ The use of a synthetic base oil does not justify extended oil change intervals. Extended oil change intervals can decrease engine life due to factors such as; corrosion, deposits and wear.

DIESEL FUEL SPECIFICATIONS



Do not mix gasoline or alcohol with diesel fuel.
This mixture can cause an explosion.



Due to the precise tolerances of diesel injection systems, it is extremely important that the fuel be kept clean and free of dirt or water. Dirt or water in the system can cause severe damage to both the injection pump and nozzles.

For normal service above -12°C ($+10^{\circ}\text{F}$), the use of ASTM Grade No. 2-D diesel fuel with a minimum Cetane number of 40 is recommended. The use of No. 2-D diesel fuel will result in optimum engine performance under most operating conditions. Fuels with Cetane numbers higher than 40 may be needed in high altitudes or extremely low ambient temperatures to prevent misfires and excessive smoke.

At operating temperatures below -12°C ($+10^{\circ}\text{F}$), use ASTM Grade No. 1-D diesel fuel. The use of lighter fuels can reduce fuel economy.

Where a winterized blend of Grade No. 2-D and No. 1-D fuels is available, it may be substituted for Grade No. 1-D fuel. However, it is the supplier's responsibility to provide the fuel for the anticipated ambient temperature.

Use a low sulfur content fuel having a cloud point that is at least 10 degrees below the lowest expected fuel temperature. Cloud point is the temperature at which crystals begin to form in the fuel. The viscosity of the fuel **must** be kept above 1.3 cSt to provide adequate fuel system lubrication.

COOLANT SPECIFICATIONS

GENERAL

Selection and maintenance of the engine coolant is important to long engine life. The following information provides recommendations for selecting the engine coolant and maintaining the coolant inhibitors.

Heavy duty diesel engines require a balanced coolant mixture of water, antifreeze, and supplemental coolant additives. Supplemental coolant additive recommendations are included in the section entitled Inhibitors Conditioners. The coolant mixture **must** be drained and replaced at the specified service interval shown in the OPERATION & MAINTENANCE MANUAL, or every two years of operation, whichever comes first.

WATER

Use water which has a low mineral content. Water used in conjunction with antifreeze, coolant filters and inhibited water must meet the following standards:

Total Hardness - Not to exceed 170 parts per million (10 grains/gallon maximum) to prevent scale deposits. Water containing dissolved magnesium and calcium (the usual reason for water hardness) above the specified amount will cause scale deposits to develop in the engine.

Chlorides - Not to exceed 40 parts per million (2.5 grains/gallon maximum) to prevent corrosion.

Sulfites - Not to exceed 100 parts per million (5.8 grains/gallon maximum) to prevent corrosion.

Dissolved Solids - Not to exceed 340 parts per million (20 grains/gallon maximum) to minimize sludge deposits, scale deposits, corrosion or a combination of these.

If any of the above requirements cannot be met, use distilled, de-ionized, or de-mineralized water. To determine if local water supplies meet these standards, water samples can be tested by water treatment laboratories. Softened water that is prepared using common salt (sodium chloride) contains excessive amounts of chlorides and should not be used.

★ Never use water alone in the cooling system because corrosion will occur.

ANTIFREEZE

In climates where the temperature is above -37°C (-34°F), use a coolant mixture that contains 50 percent antifreeze. **Antifreeze is essential in any climate.** It broadens the operating temperature range by lowering the coolant freezing point and by raising its boiling point. Do **not** use more than 50 percent antifreeze in the mixture unless additional freeze protection is required. **Never** use more than 68 percent antifreeze under any condition.

An antifreeze concentration greater than 68% will adversely affect freeze protection and heat transfer rates. Antifreeze concentrations between 68 and 100% actually have a higher freezing point than a 68% antifreeze concentration and should not be used due to reduced heat transfer rates.

Low silicate ethylene glycol antifreeze is recommended. The antifreeze should contain no more than 0.1% anhydrous alkali metasilicate. Low silicate antifreeze is recommended to avoid the formation of silica-gel (hydro-gel). This gel formation can occur when the cooling system contains an over concentration of high silicate antifreeze and/or supplemental coolant additive. DO NOT use methanol or alcohol as an antifreeze because of its low boiling point.

Antifreeze may retain its freeze protection for more than one season but coolant conditioners must be added to maintain corrosion protection.

Antifreeze formulated with methoxy propanol, or propylene glycol, is not recommended for this system.

★ Do not mix types of antifreeze solutions. Mixed solutions make it impossible to determine the protection against freezing. Antifreeze containing sealer or anti-leak additives should NOT be used in this system. Sealer or anti-leak additives will cause plugging problems in the cooling system.

Check the solution periodically and at normal operating temperature, to be sure the cooling system has sufficient protection against freezing.

The following table shows the approximate percentage of antifreeze solution required for various temperatures.

Approximate Freezing Point	Percentage of Antifreeze Concentration by Volume	Specific Gravity at 16°C (60°F)
0°C (+32°F)	0	1.000
-7°C (+20°F)	15	1.025
-12°C (+10°F)	25	1.040
-18°C (0°F)	33	1.053
-23°C (-10°F)	40	1.062
-29°C (-20°F)	45	1.070
-34°C (-30°F)	48	1.074
-40°C (-40°F)	53	1.080
-46°C (-50°F)	56	1.083
-51°C (-60°F)	59	1.088
-57°C (-70°F)	62	1.092
-62°C (-80°F)	65	1.095
-68°C (-90°F)	67	1.097
-69°C (-92°F)	68	1.098

In tropical climates where antifreeze availability may be limited, use a corrosion inhibitor DCA4, to protect the engine cooling system.

INHIBITORS/CONDITIONERS

1. All cooling system inhibitors, including those in antifreeze solutions, become depleted through normal operation. If the inhibitors in antifreeze are allowed to become depleted, the antifreeze becomes corrosive and attacks and coats the metallic surfaces of the cooling system which reduces heat transfer. Cooling system conditioners which contain these inhibitors must be added to maintain corrosion protection.
2. Soluble oil is not recommended for use in this engine as its use will reduce heat transfer.
3. There are no miracle additives that will increase heat transfer or prevent overheating. Conditioned water is still the best coolant.
4. DCA4 is recommended to inhibit corrosion in the cooling system for the following reasons:
 - Improved compatibility with high silicate antifreezes to minimize hydro-gel formation if over concentration occurs.
 - Provides engine protection in the following areas:
 - Solder corrosion/bloom
 - Copper corrosion/erosion/stress cracking
 - Oil fouling
 - Cylinder liner cavitation corrosion
 - Aluminum cavitation corrosion
 - Seal and gasket degradation

Maintenance of Cooling System Inhibitors

Keeping the engine coolant properly inhibited will keep the engine and radiator free of rust, scale deposits and corrosion.

New machines are delivered with antifreeze protection.

Service at regular scheduled intervals specified in the OPERATION & MAINTENANCE MANUAL with a service DCA4 filter.

Each time the coolant is drained and replaced, the coolant must be recharged with DCA4. New coolant can be correctly charged with supplemental coolant additives by using DCA4 filters or DCA4 concentrate listed in the table entitled, DCA4 Unit Guide.

If coolant is added between drain intervals, additional DCA4 will be required.

Coolant Testing for Conditioner Concentration

When the cooling system is maintained as recommended, the conditioner concentration should be satisfactory. The DCA4 concentration must not fall below 1.0 unit per 3.8 ℓ (1 USgal) or exceed 2 units per 3.8 ℓ (1 USgal) of coolant. The only accurate method for testing chemical concentrations in coolant with mixed chemical compounds is a laboratory analysis. For this reason, the coolant inhibitor should be maintained as shown in the OPERATION & MAINTENANCE MANUAL.

★ Inadequate concentration of the coolant additive can result in major corrosive damage to cooling system components. Over concentration can cause formation of gel that can cause restriction, plugging of passages and overheating.

Replenishing Coolant Conditioner

Install a precharge DCA4 filter when the coolant is changed or a significant (more than 50%) coolant loss occurs. Install a service DCA4 filter as specified in the OPERATION & MAINTENANCE MANUAL. When antifreeze is added, add coolant conditioner equal to 1.0 unit per 3.8 ℓ (1 USgal) of antifreeze.

Mixing of DCA4 and other supplemental coolant additives is not recommended because there is currently no test kit available to measure concentration levels with mixed chemical

solutions.

DCA4 Unit Maintenance Guide

Use supplemental coolant additives (corrosion inhibitors) to protect the engine cooling system from corrosion. Antifreeze alone does **not** provide enough corrosion protection for a heavy duty diesel engine. Supplemental corrosion protection **must** be supplied through periodic additions of supplemental coolant additives to the coolant.

To protect against corrosion, a new coolant charge **must** be brought up to 0.26 DCA4 unit per liter (one unit per U.S. gal) of coolant (initial charge). Maintain the correct DCA4 concentration by changing the service coolant filter at each engine oil and filter change interval.

Each time the coolant is drained and replaced, the coolant **must** be recharged with supplemental coolant additives. Use the appropriate DCA4 spin-on filter listed in following table. The coolant mixture **must** be drained and replaced as defined under General.

The amount of replacement inhibitor is determined by the length of the service interval and the cooling system capacity. Refer to the DCA4 Unit Guide for the selection of the correct filter to replenish the DCA4.

If coolant is added between drain intervals, additional DCA4

will be required. Check the coolant DCA4 concentration level anytime make-up coolant is added to the system. The DCA4 concentration **must not** fall below 0.13 units per liter or exceed 0.5 units per liter (0.5 units per U.S. gallon or exceed 2 units per U.S. gallon).

DCA4 Unit Guide

Fleetguard Part No.	DCA4 Units
DCA4 Coolant Filter	
WF-2070	2
WF-2071	4
WF-2072	6
WF-2073	8
WF-2074	12
WF-2075	15
WF-2076	23
WF-2077	0
DCA4 Liquid	
DCA60L	4 (1 Pint)
DCA80L	1760 (55 USgal)
DCA4 Powder	
DCA95	20

DCA4 Precharge and Service Filters

System Capacity		Precharge Filter (See NOTE 1)	Service Filter (See NOTE 3)
Liters	US GALLONS		
19 to 26	5 to 7	WF-2072	WF-2070
26 to 38	7 to 10	WF-2073	WF-2071
38 to 57	10 to 15	WF-2074	WF-2071
57 to 76	15 to 20	WF-2075	WF-2071
76 to 114	20 to 30	WF-2076	WF-2072
114 to 190	30 to 50	(See NOTE 2)	WF-2073

GENERAL**COOLANT SPECIFICATIONS**

NOTE 1 - After draining and replacing coolant, always precharge the cooling system to maintain the DCA4 concentration between 1.0 and 2.0 units per 3.8 ℓ (1 US gal).

★ When performing service which requires draining the cooling system, discard the coolant. Reusing coolant can introduce contaminants or over concentrated chemicals, resulting in premature failure of cooling system components.

- Install appropriate service filter listed in the above table based on cooling system capacity.

Example: 95 gal (360 ℓ) cooling system capacity
-15 Units (1) WF-2075 Filter
 80 Units

- The answer represents the additional units

required to precharge the cooling system. Four bottles of powder, part number DCA95, will provide a sufficient amount of DCA4 units (80) to precharge the example cooling system.

- Install the appropriate service filter at the next and subsequent maintenance intervals.

NOTE 3 - Change the coolant filter at every engine oil and filter change interval to protect the cooling system.

Maintain a nominal concentration of 1.0 DCA4 unit per 3.8 ℓ (1 US gal) of coolant in the system. Less than 0.5 unit per 3.8 ℓ (1 US gal) indicates an under-concentrated coolant solution. More than 2.0 units per 3.8 ℓ (1 US gal) indicates an over-concentrated coolant solution.

To check the DCA4 concentration level, use the Fleetguard coolant test kit, CC2626. Instructions are included with the test kit.

DCA4 Unit Concentration Guide

Number of Solution A Drops to Cause Color Change	Coolant Condition	Action Required
0 to 10 Drops	Extremely under-concentrated - less than 0.4 DCA4 units per 3.8 ℓ (1 US gal)	Initially charge the system to a minimum of 1.0 DCA4 unit per 3.8 ℓ (1 US gal)
11 to 16 Drops	Marginally under-concentrated - 0.45 to 0.8 DCA4 units per 3.8 ℓ (1 US gal)	Add DCA4 liquid units to maintain 1.0 DCA4 unit per 3.8 ℓ (1 US gal) minimum or change the DCA4 coolant filter
17 to 25 Drops	Acceptable - 0.85 to 1.3 DCA4 units per 3.8 ℓ (1 US gal)	NONE
26 to 35 Drops	Highly acceptable - 1.35 to 2.0 DCA4 units per 3.8 ℓ (1 US gal)	NONE
36 to 55 Drops	Marginally over-concentrated - 2.1 to 3.3 DCA4 units per 3.8 ℓ (1 US gal)	Review maintenance practice
Over 55 Drops	Extremely over-concentrated	Drain 50% of the coolant and replace with water antifreeze mixture. Retest the system for correct DCA4 unit concentration.

GENERAL

COOLANT SPECIFICATIONS

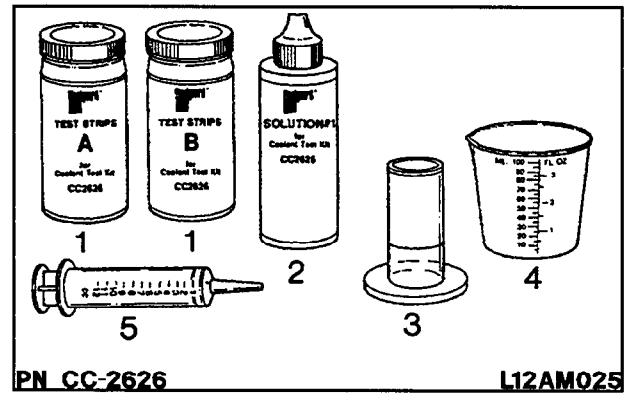
The following may be purchased from your Komatsu America Company distributor.

Cooling system test kit

The Fleetguard® Coolant Test Kit is used to check the coolant concentration of coolant additives in the cooling system.

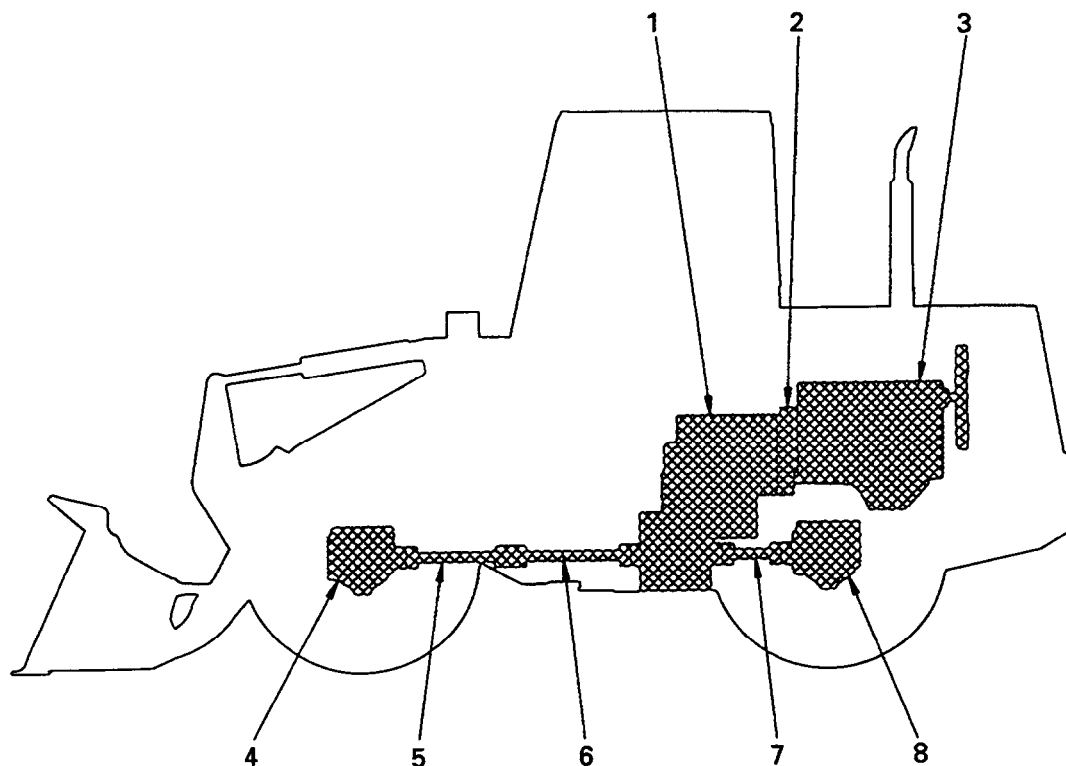
Part Number: CC-2626

1. Test strip bottles
2. Solution #1 bottle
3. Small plastic container
4. Large plastic cup
5. Syringe



10 STRUCTURE AND FUNCTION

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POWER TRAIN

- 1. Transmission
- 2. Torque converter
- 3. Engine **S6D114E-1**

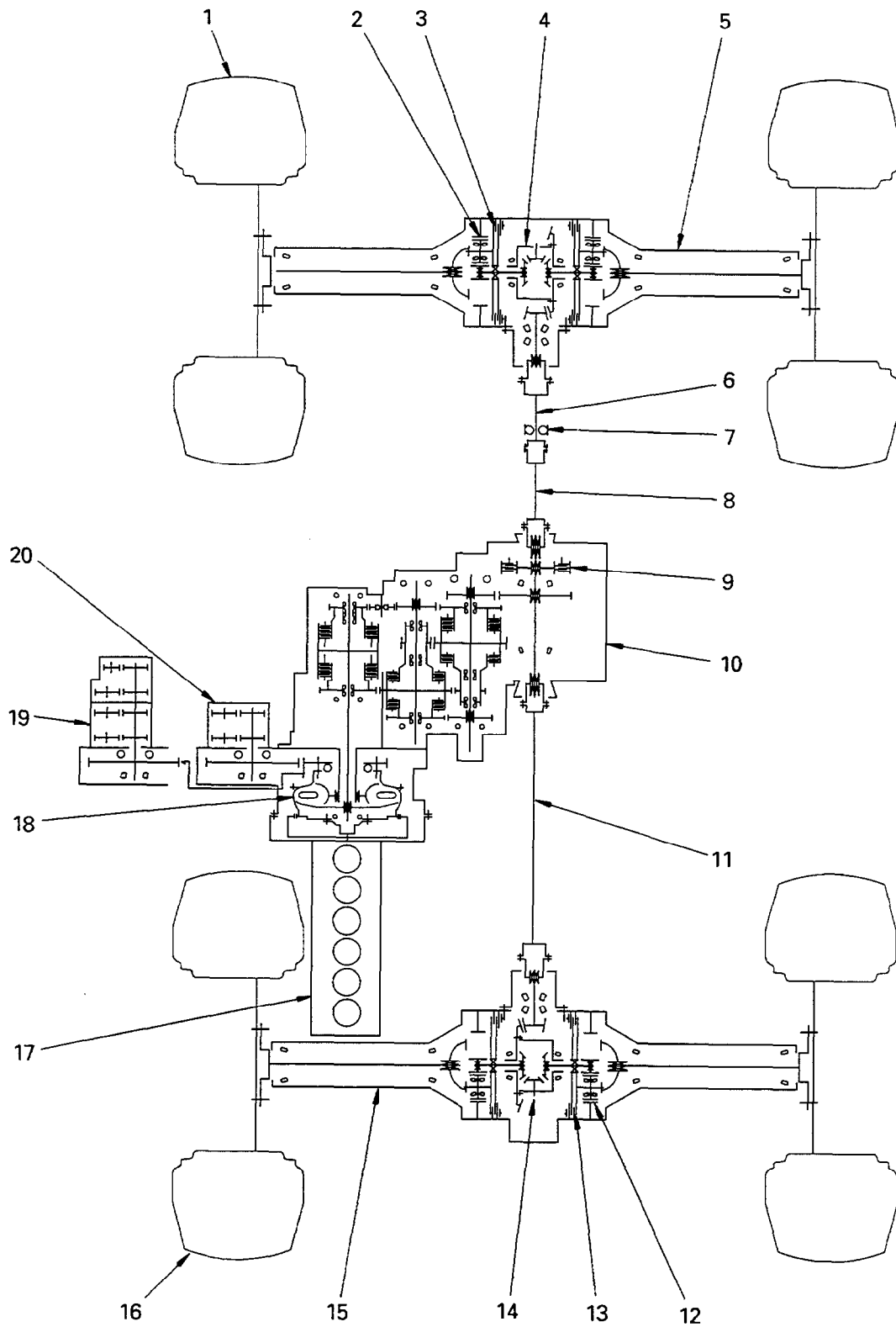
- 4. Front axle
- 5. Front drive shaft
- 6. Center drive shaft

- 7. Rear drive shaft
- 8. Rear axle

SBW00420**Outline**

- The motive force from engine (3) passes through the engine flywheel and is transmitted to the 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 (5) and rear drive shaft (7), and is then transmitted to front axle (4) and rear axle (8) to drive the wheels.

POWER TRAIN SYSTEM



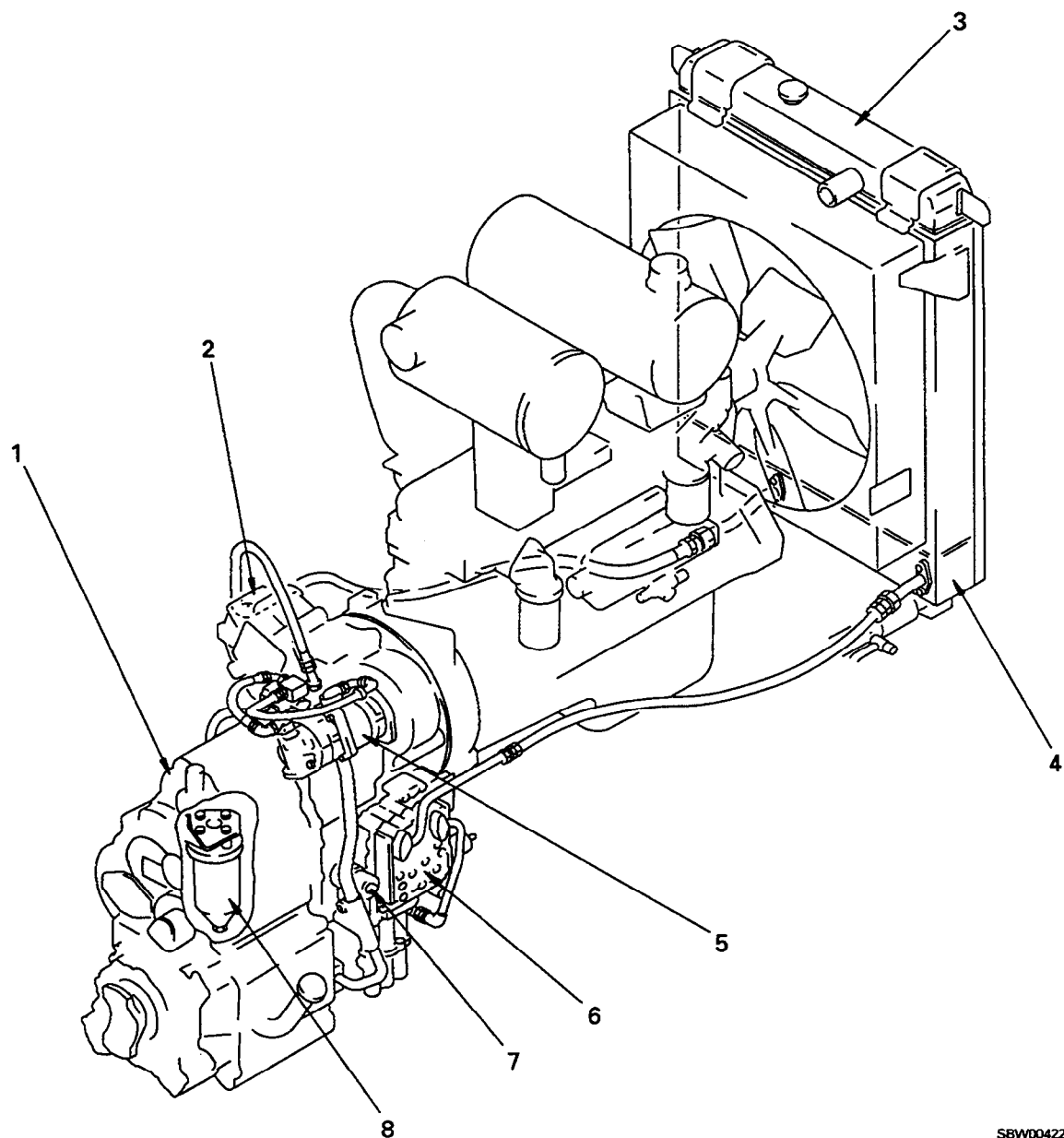
SAW00421

1. Front tire
2. Final drive
3. Wet type disc brake
4. Differential
5. Front axle
- 6.. Front drive shaft
7. Flange bearing
8. Center drive shaft
9. Parking brake
10. Transmission
11. Rear drive shaft
12. Final drive
13. Wet type disc brake
14. Differential
15. Rear axle
16. Rear tire
17. Engine (S6D114E-1)
18. Torque converter
19. Hydraulic steering switch, PPC pump
20. Torque converter charging pump

Outline

- The motive force from engine (17) passes through the flywheel and is transmitted to torque converter (18).
The torque converter uses oil as a medium. It converts the transmitted torque in accordance with the change in 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 hydraulic, steering switch, PPC Pump (19) and torque converter charging pump (20) to drive each pump.
- Transmission (10) 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.
- The output shaft of the transmission (10) transmit the power to the front and rear axles. At the front the power is transmitted to front axle (5) through center drive shaft (8), flange bearing (7), and front drive shaft (6).
At the rear, the power is transmitted to rear axle (15) through rear drive shaft (11).
- The motive force transmitted to front axle (5) and rear axle (15) has its speed reduced by the bevel gear and pinion gear of differentials (4) and (14), and is then transmitted to the sun gear shaft through the differential mechanism.
- The motive force of sun gear is reduce further by the planetary mechanism and is transmitted to the wheels through the axle shaft.

TORQUE CONVERTER, TRANSMISSION PIPING

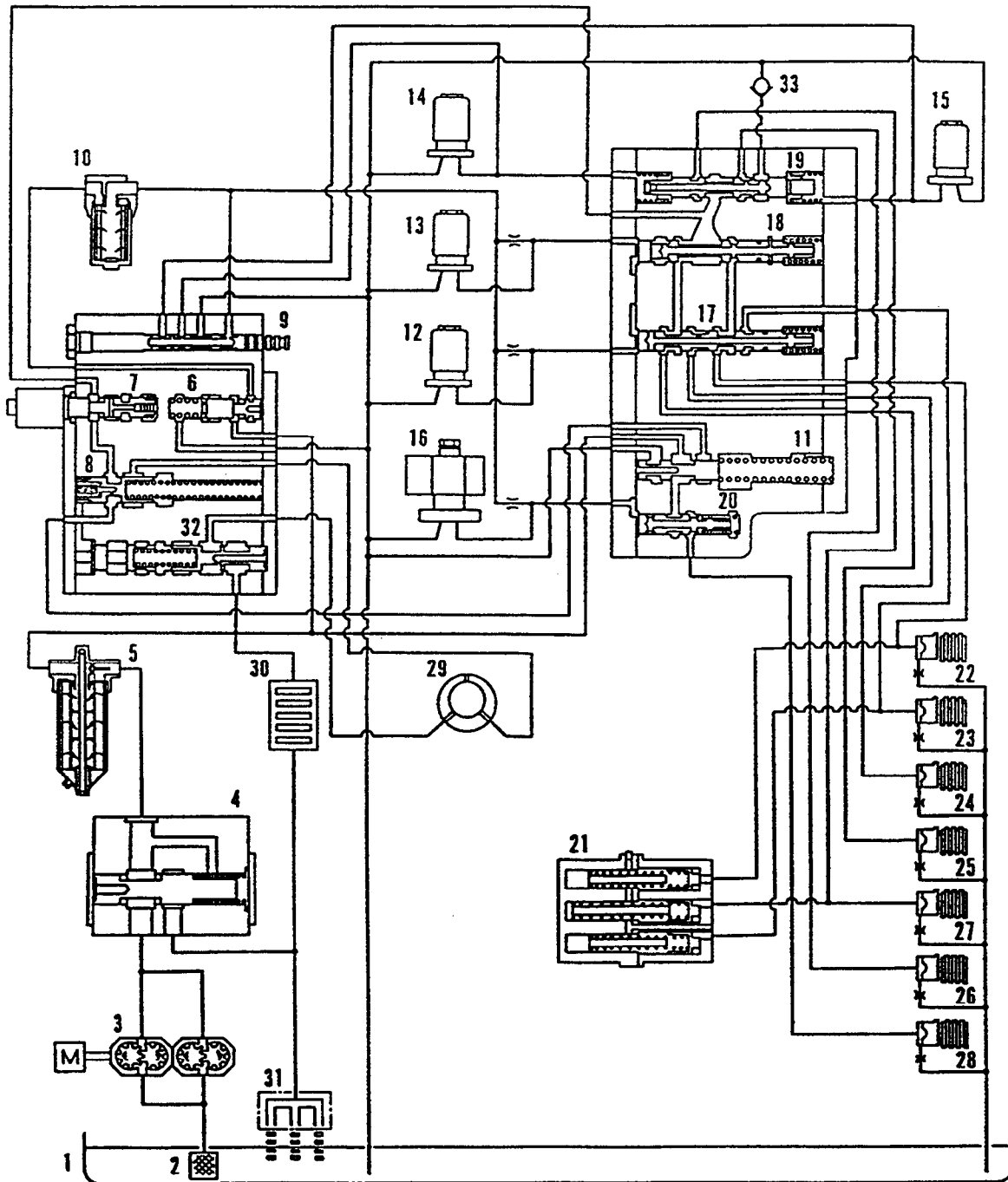


SBW00422

- | | |
|---------------------|-----------------------------------|
| 1. Transmission | 5. Torque converter charging pump |
| 2. Torque converter | 6. Transmission control valve |
| 3. Radiator | 7. Pilot oil filter |
| 4. Oil cooler | 8. Oil filter |

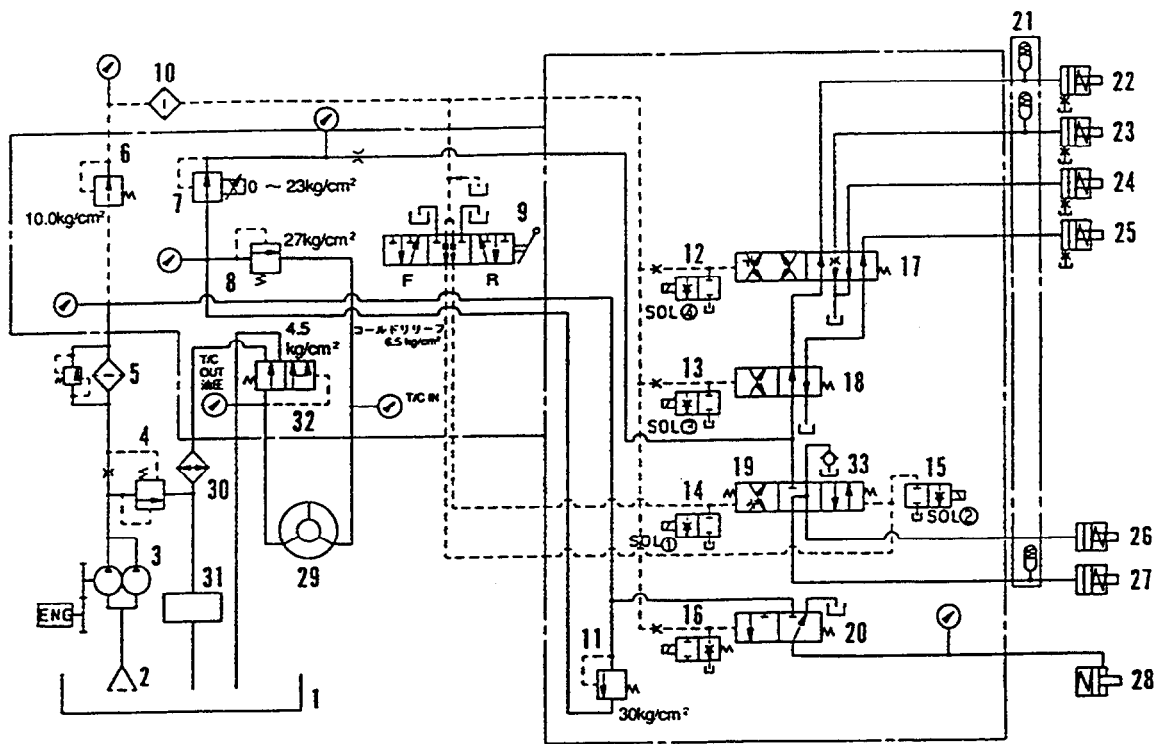
SBW00422

TRANSMISSION HYDRAULIC SYSTEM DIAGRAM (ENGINE STOPPED)



F03023

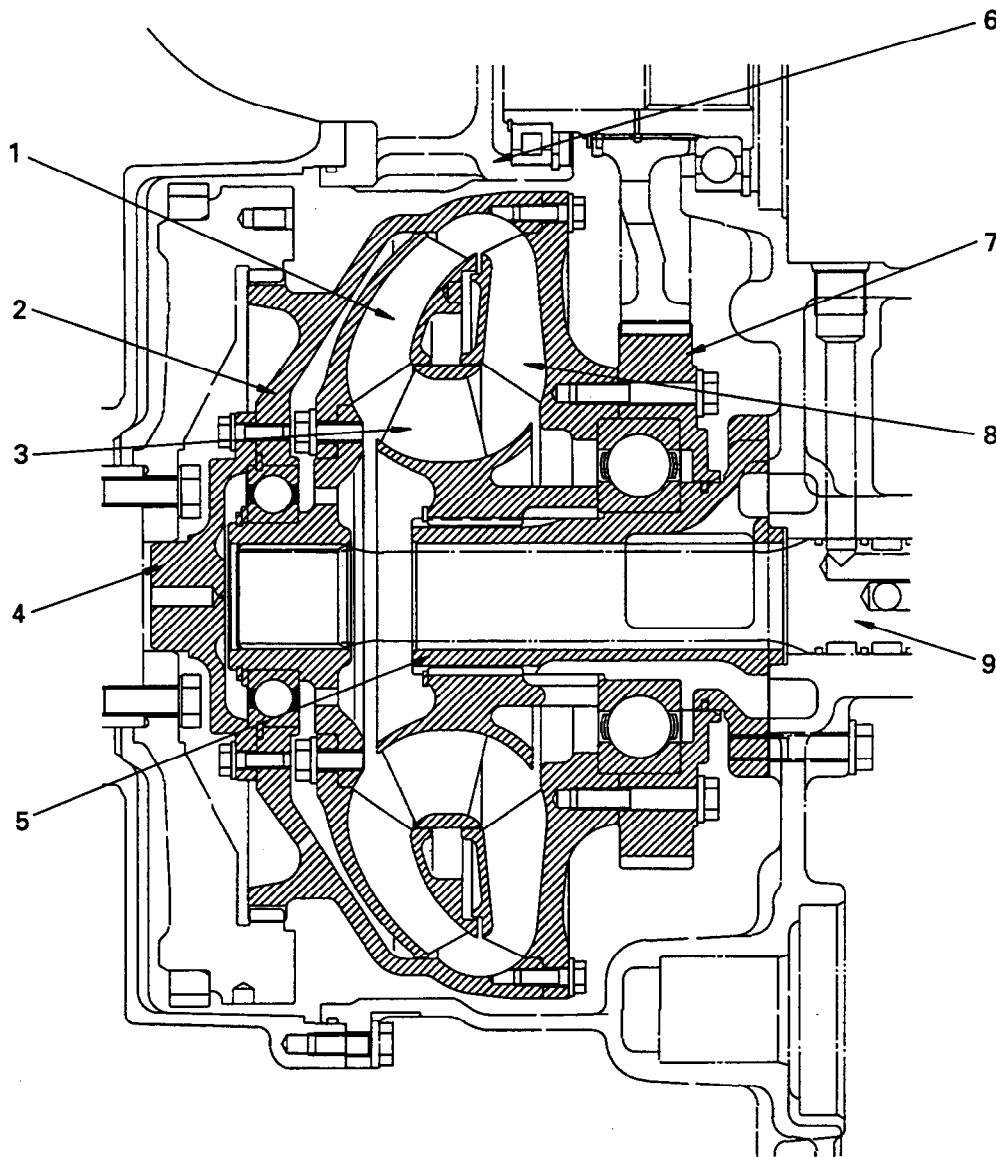
TRANSMISSION HYDRAULIC CIRCUIT DIAGRAM



F03024

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

TORQUE CONVERTER



SAW00472

1. Turbine
2. Drive case
3. Stator
4. Pilot
5. Stator shaft

6. Housing
7. PTO gear (drive)
8. Pump
9. Output shaft (Transmission input shaft)

Specifications

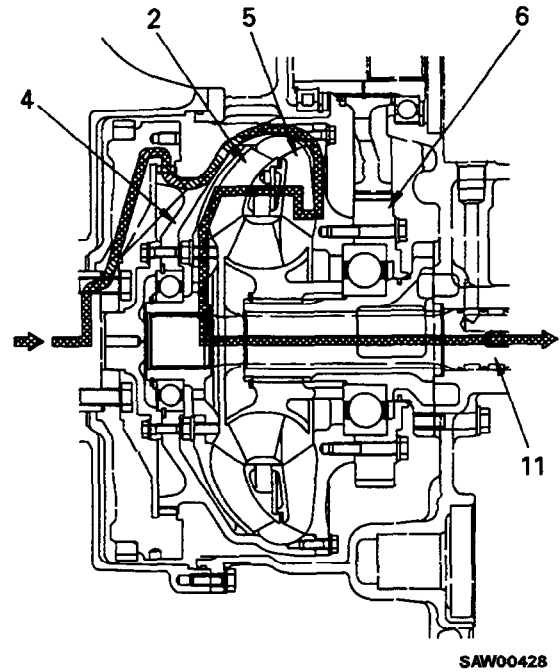
Model: TCA37-2A

Type: 3 element, 1 stage, 1 phase

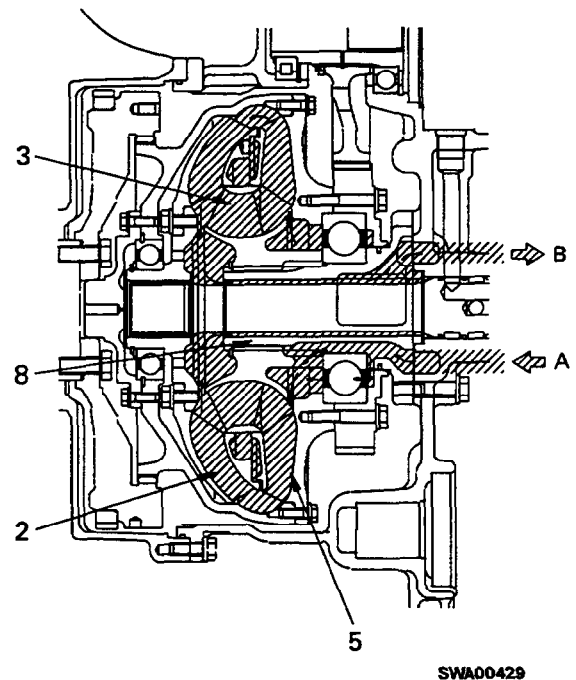
Stall torque ratio: 3.37

Path of motive force

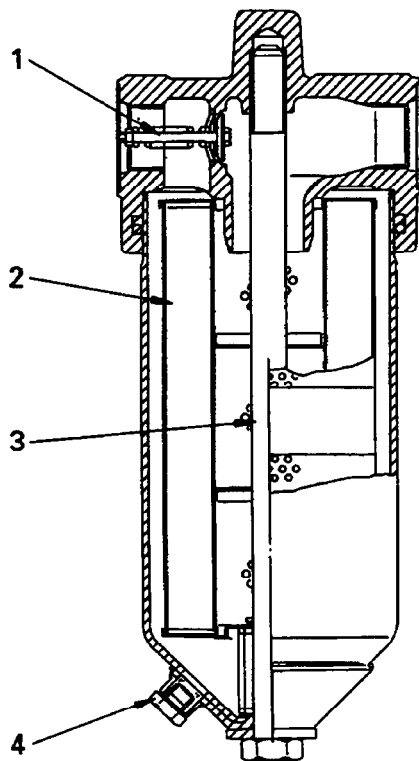
- The torque converter is installed between the engine and the transmission.
The motive force from the engine enters drive case (4) from flywheel.
Drive case (4), pump (5), and PTO gear (drive) (6) are each secured by bolts and are rotated directly by the rotation of the engine. The motive force of pump (5) uses oil as a medium to rotate turbine (2) and transmit the motive force to transmission input shaft (11).
The motive force of drive case (4) is used as the motive force to drive the gear pump through PTO gear (drive) (6).

**Flow of oil**

- the oil supplied from the torque converter charging pump enters inlet port **A**, passes through the oil passage of stator shaft (8), and flows to pump (5).
The oil is given centrifugal force by pump (5), enters turbine (2), and transmits the energy of the oil to the turbine. Turbine (2) is fixed to transmission input shaft (11), so the motive force is transmitted to the transmission input shaft.
The oil from turbine (2) is sent to stator (3), and enters the pump again. However, part of the oil is sent from the stator through outlet port **B** to the cooler.



TORQUE CONVERTER OIL FILTER



SEW00014

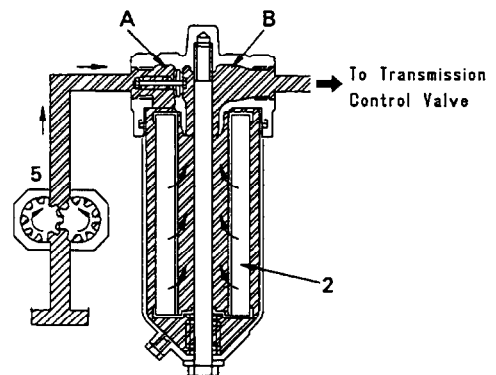
1. Relief valve
2. Element
3. Center bolt
4. Drain plug

Specifications

Filter mesh size: 10 microns

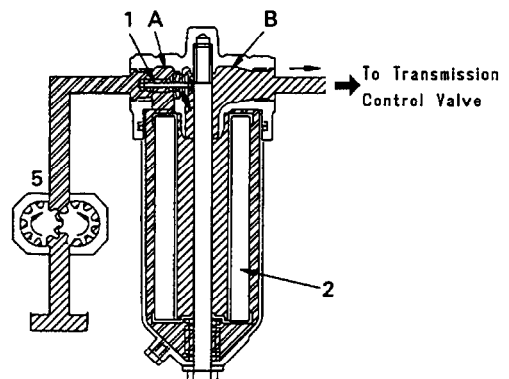
Filtering area: 8900 cm²Relief pressure: 0.34 Mpa (3.5 kg/cm²)**Operation**

- The oil from the torque converter charging pump enters filter inlet port **A**. It is filtered from outside of element (2) to the inside, and flows to outlet port **B**.



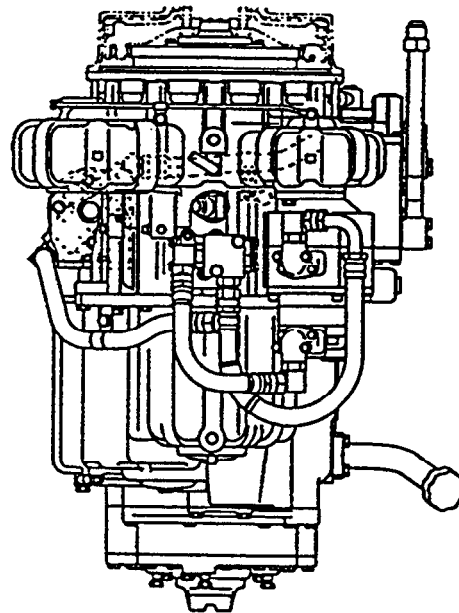
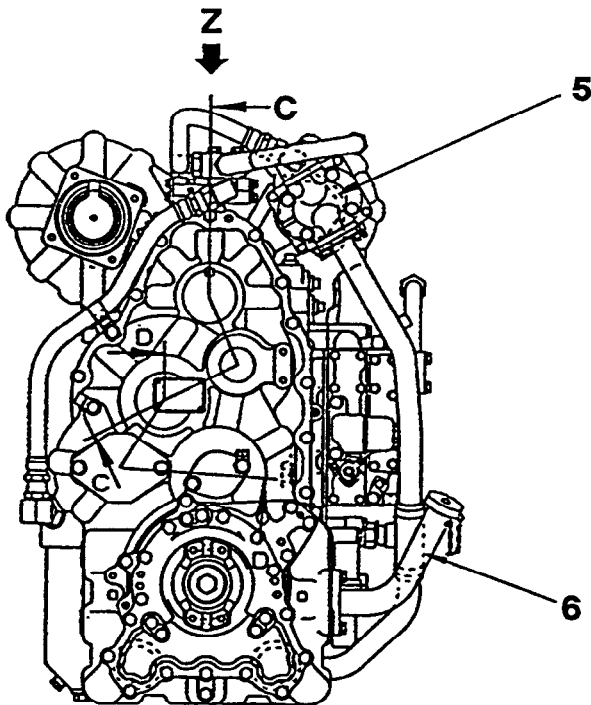
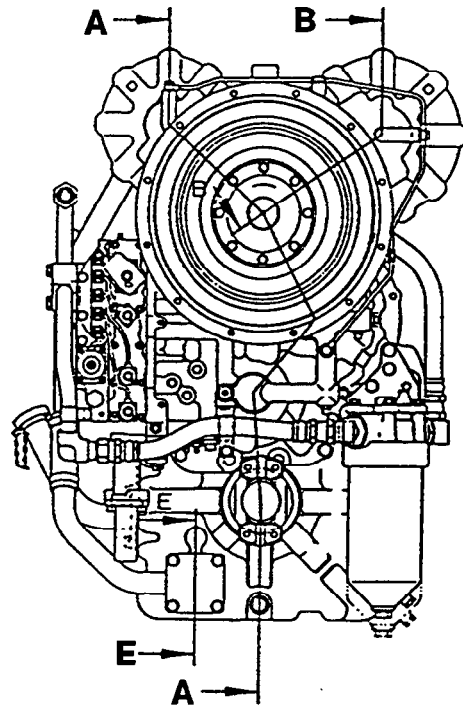
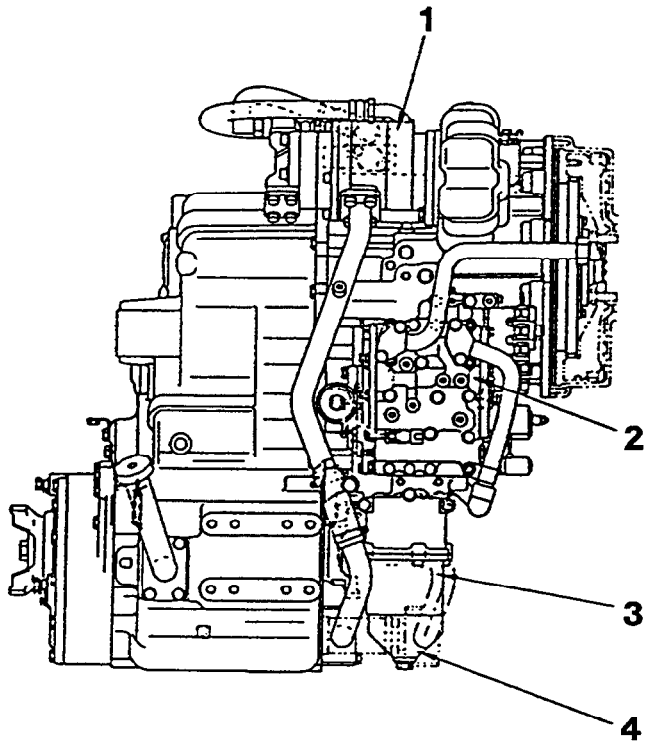
SEW00015

If element (2) becomes clogged with dirt, or the oil temperature is low and the pressure rises at inlet port **A**, the oil from inlet port **A** opens relief valve (1) and flows directly to outlet port **B** in order to prevent damage to the pump or element (2).



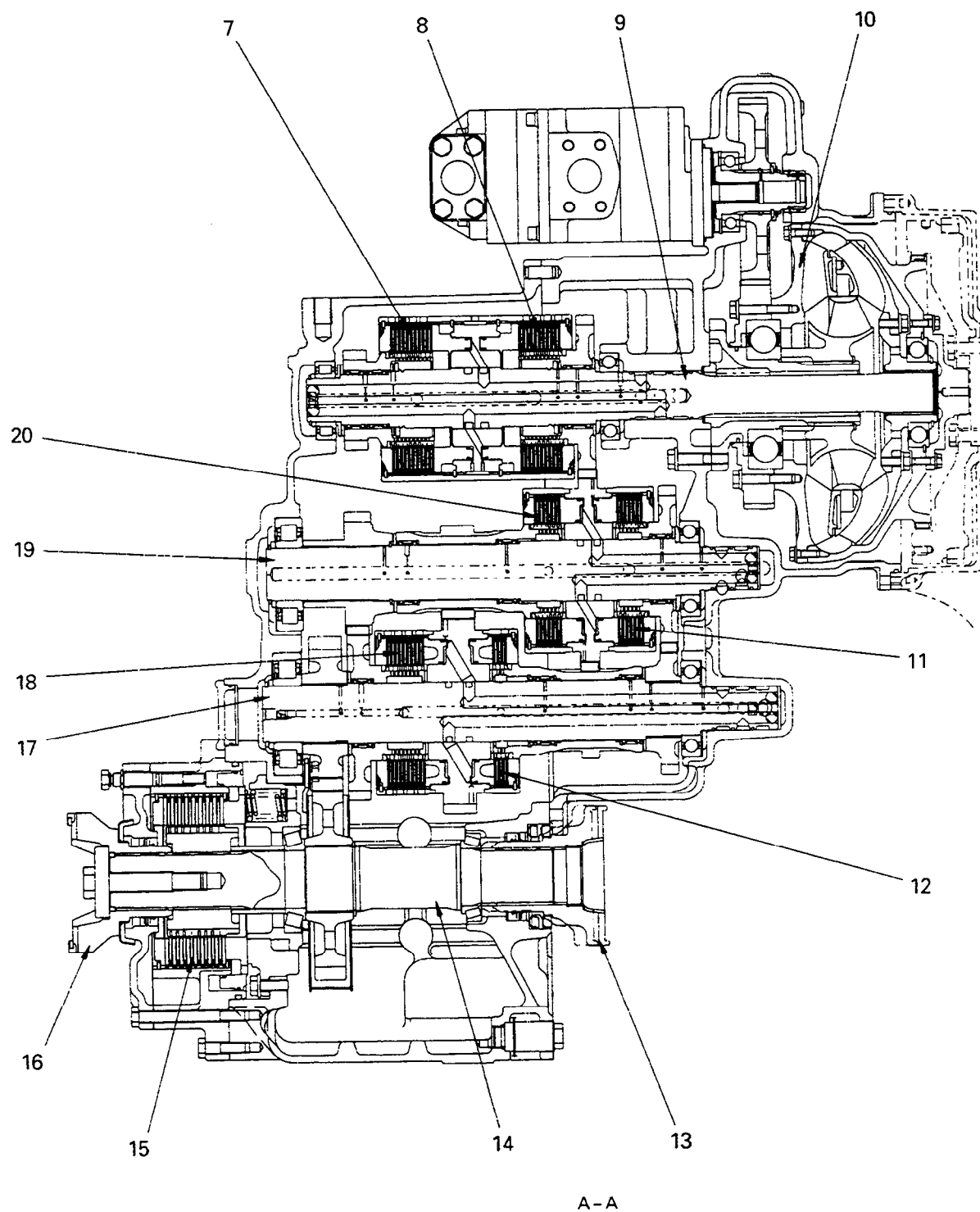
SEW00016

TRANSMISSION

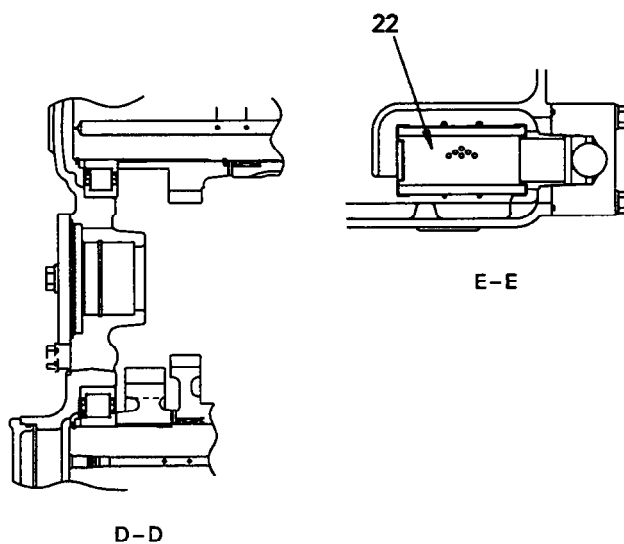
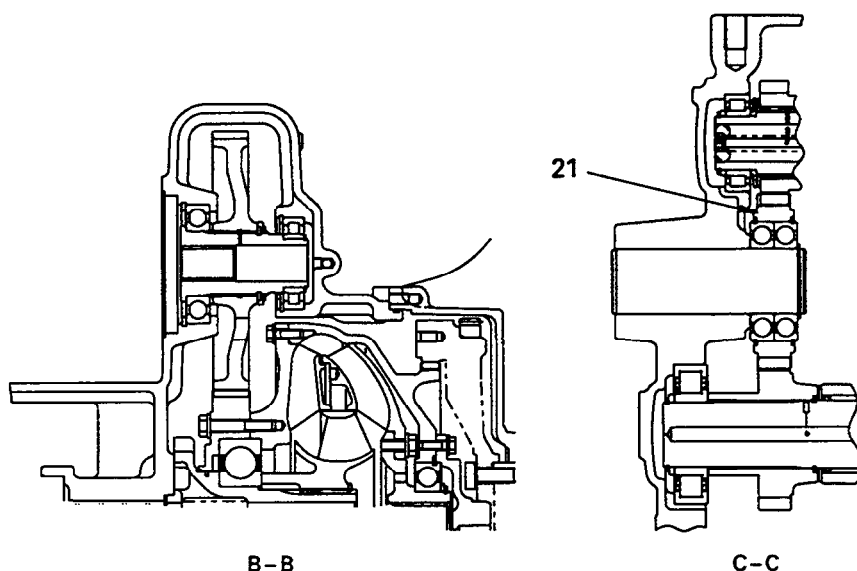


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CA03017



DW01218L

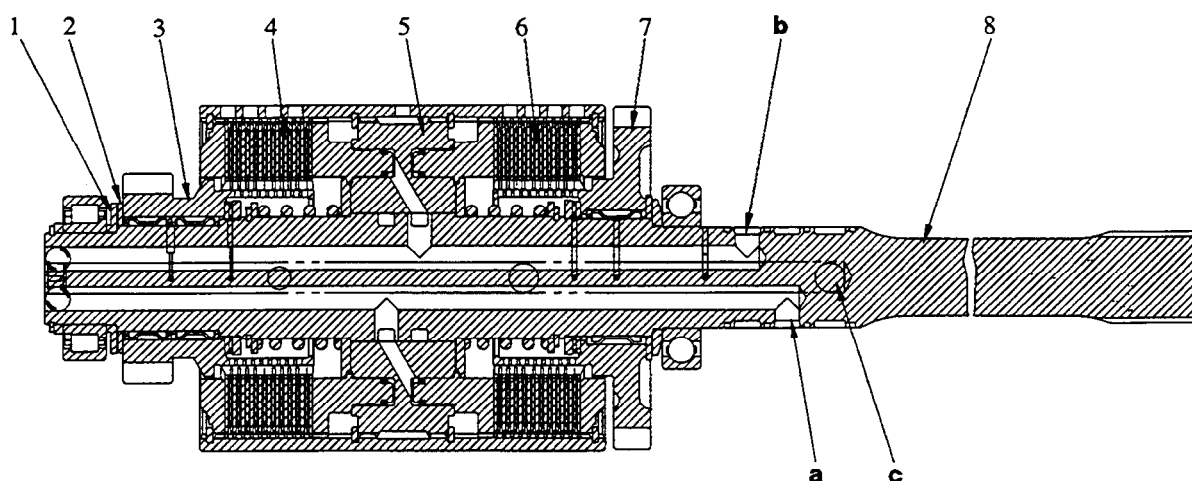


1. Transmission case
2. Transmission control valve
3. Accumulator valve
4. Oil filter
5. Torque converter charging pump (SAL (2) 45 + 20)
6. Transmission oil filler
7. REVERSE clutch
8. FORWARD clutch
9. Input shaft
10. Torque converter
11. 3rd clutch
12. 4th clutch
13. Rear coupling
14. Output shaft
15. Parking brake
16. Front coupling
17. 2nd, 4th shaft
18. 2nd clutch
19. 1st, 3rd shaft
20. 1st clutch
21. REVERSE idler gear
22. Strainer

DW01218R

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 F1 - 4 or R1 - 4. And transmits the motive force from the input shaft to the output shaft.

CLUTCH**FORWARD, REVERSE CLUTCH**

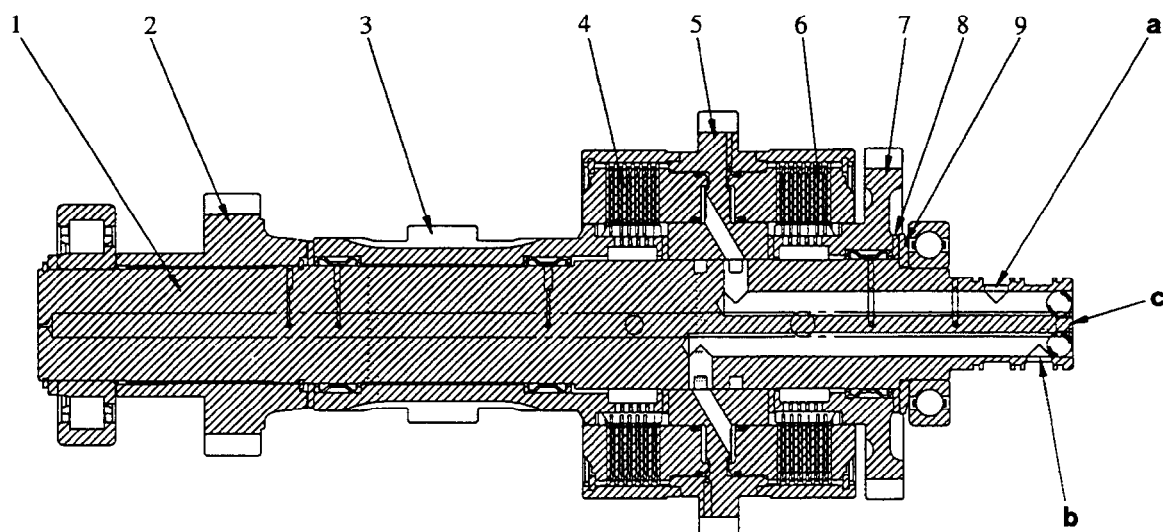
1. Spacer
2. Thrust washer
3. REVERSE gear
4. REVERSE clutch

5. FORWARD, REVERSE cylinder
6. FORWARD clutch
7. FORWARD gear
8. Input shaft

- a. FORWARD clutch oil port
- b. REVERSE clutch oil port
- c. Lubrication oil port

SAW00434

1ST, 3RD CLUTCH

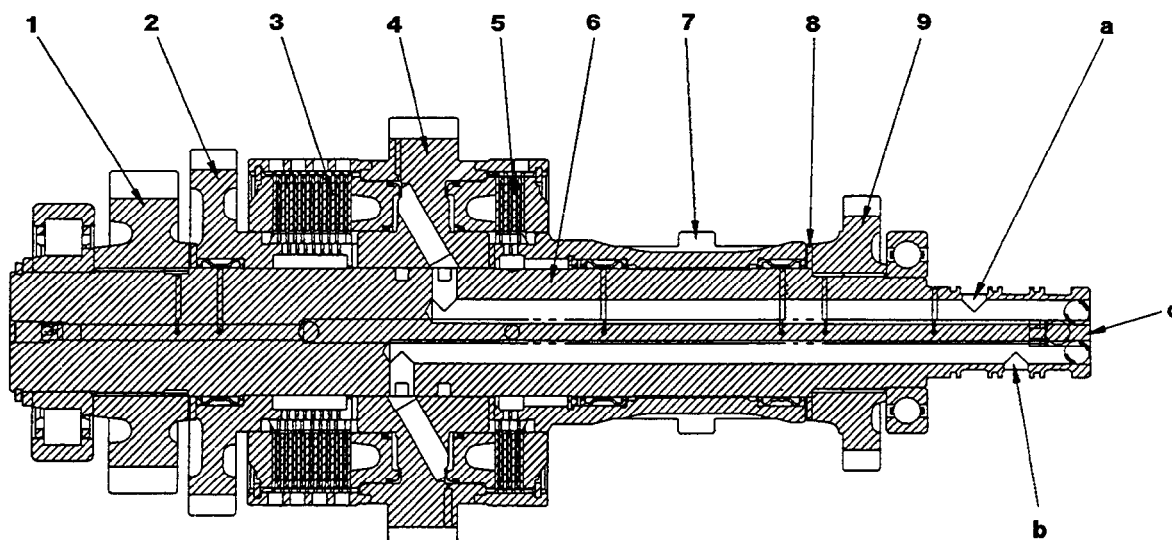


1. 1st, 3rd shaft
2. Idler gear
3. 1st gear
4. 1st clutch
5. 1st, 3rd cylinder

6. 3rd clutch
7. 3rd gear
8. Thrust washer
9. Spacer

- a. 1st clutch oil port
- b. 3rd clutch oil port
- c. Lubrication oil port

2ND, 4TH CLUTCH



1. Idler gear
2. 2nd gear
3. 2nd clutch
4. 2nd, 4th cylinder
5. 4th clutch

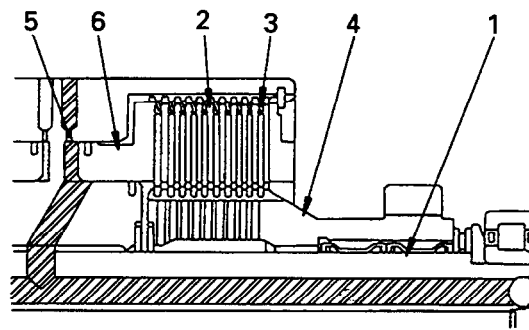
6. 2nd, 4th shaft
7. 4th gear
8. Thrust washer
9. Idler gear

- a. 2nd clutch oil port
- b. 4th clutch oil port
- c. Lubrication oil port

SAW00436

Operation of clutch**When operated**

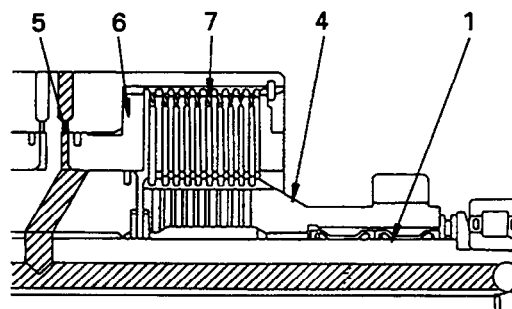
- The oil sent from the transmission valve passes through the oil passage inside shaft (1), and goes to the rear face of piston (6) to actuate the piston.
- When piston (6) is actuated, separator plate (2) is pressed against clutch disc (3) and forms shaft (1) clutch gear (4) into one unit to transmit the motive force
- Oil is drained from the oil drain hole (5) at this time, but this does not affect the clutch operation since less oil is drained than supplied.



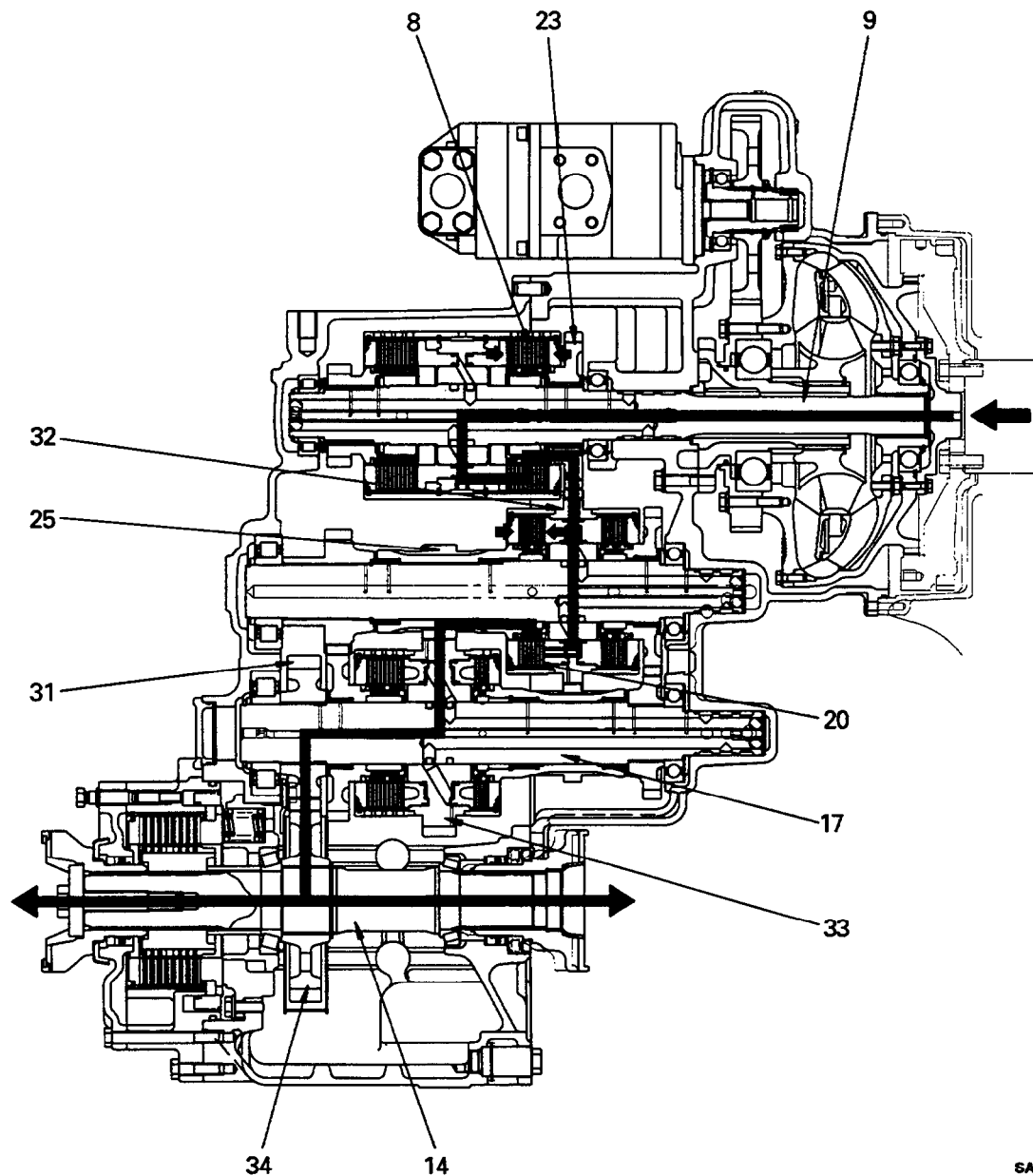
SBW00437

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 (6) drops.
 - The piston returns to its original position by wave spring (7), so shaft (1) and clutch gear (4) are separated.
-
- When the clutch is disengaged the oil at the rear face of the piston is drained by centrifugal force through oil drain hole (5) preventing the clutch from remaining partially engaged.



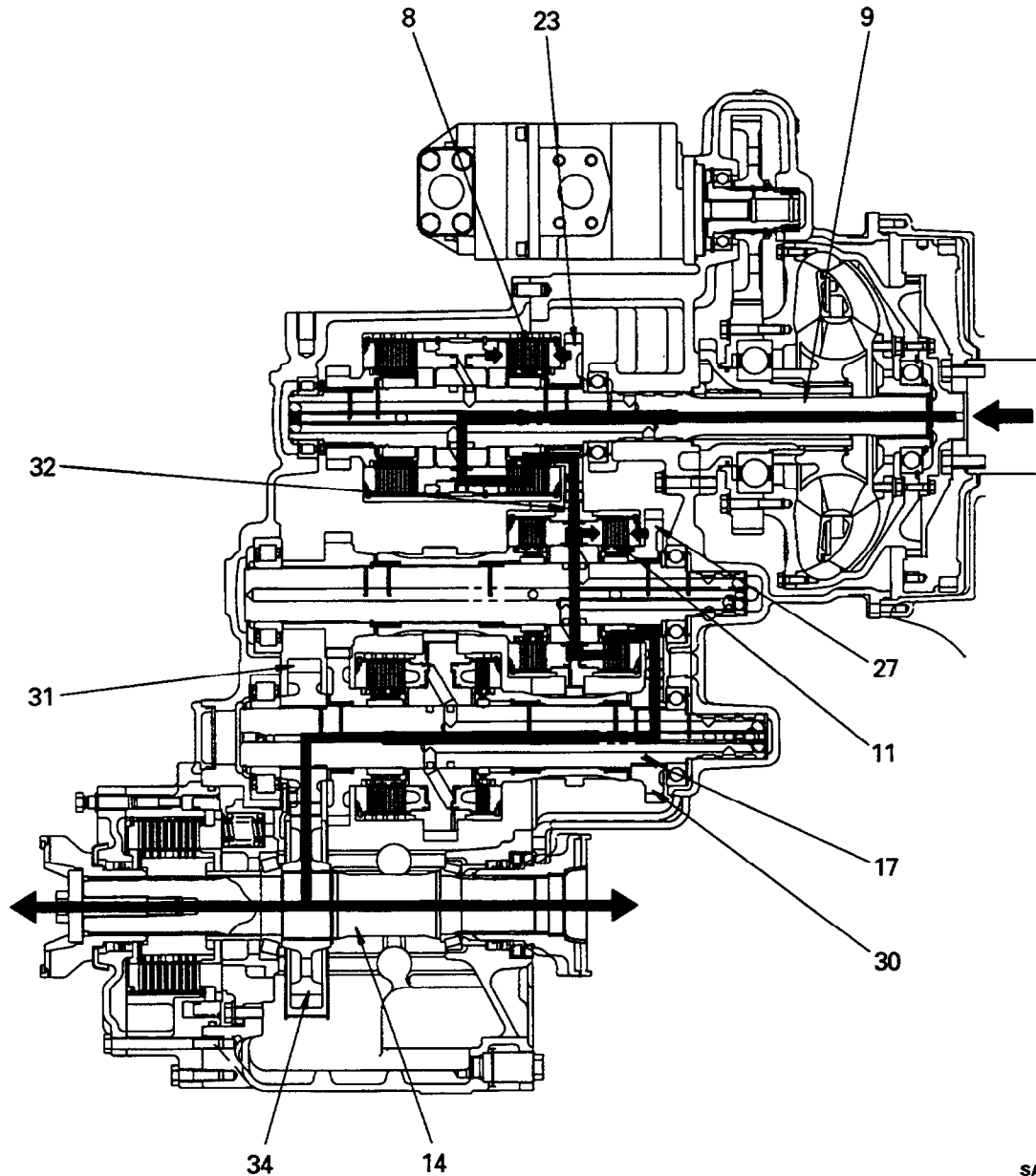
SBW00438

FORWARD 1ST

SAW00439

Operation

- In forward 1st, forward clutch (8) and 1st clutch (20) are engaged. The motive force from the torque converter transmitted to input shaft (9) is transmitted to output shaft (14).
- The clutch discs of forward clutch (8) and 1st (20) are held by hydraulic pressure applied to the piston.
- The motive force from the torque converter is transmitted to input shaft (9) via forward clutch (8) to forward gear (23), then transmitted to 1st and 3rd gear (32).
- Since the first clutch is engaged, the motive force transmitted to 1st and 3rd gear (32) is transmitted from 1st gear (25) via the 1st clutch to 2nd and 4th gear (33), then transmitted to output shaft (14) via 2nd and 4th shaft (17), idler gear (31) and output gear (34).

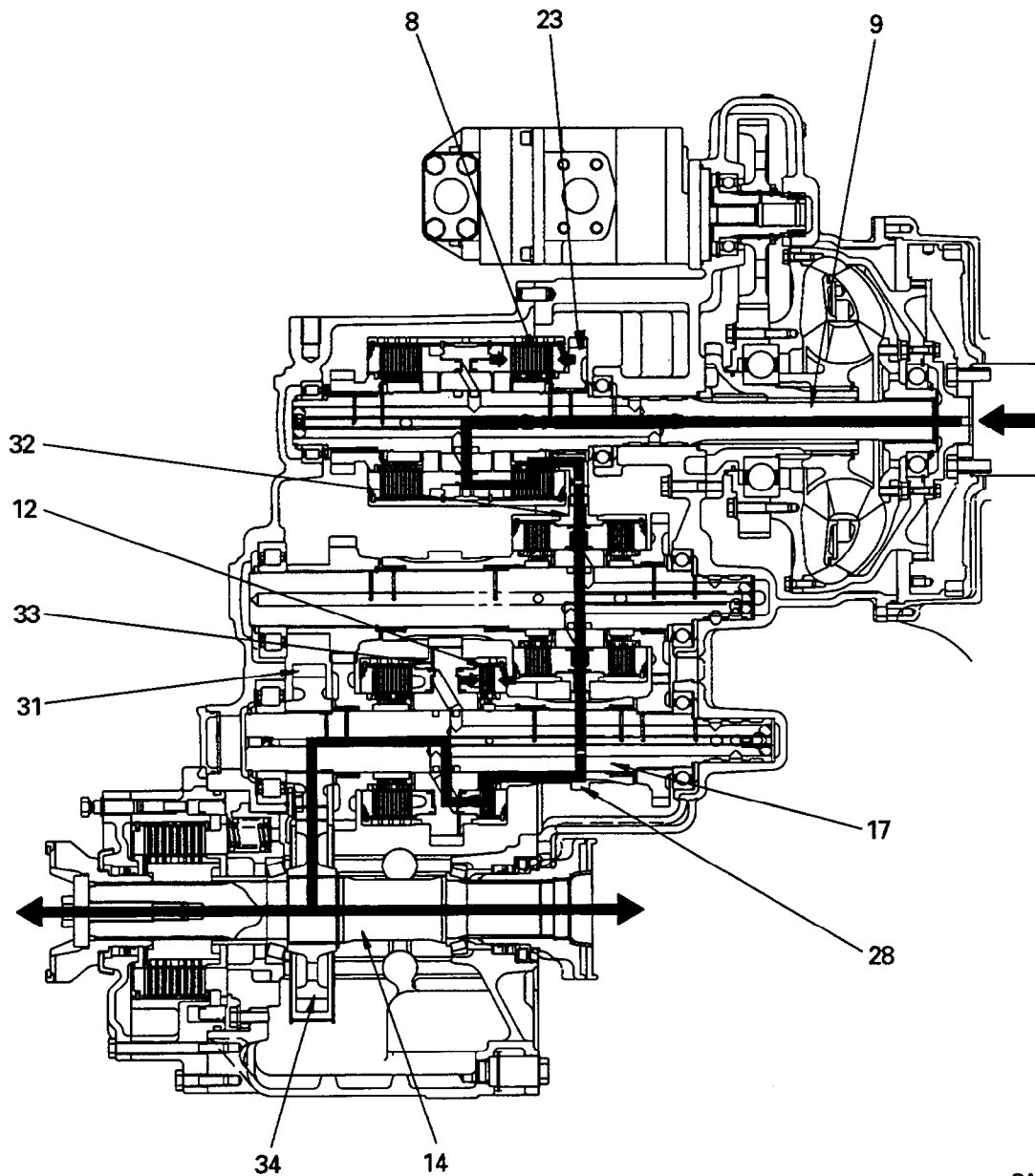
FORWARD 3RD

SAW00441

Operation

- In forward 3rd, forward clutch (8) and 3rd clutch (11) are engaged. The motive force from the torque converter transmitted to input shaft (9) is transmitted to output shaft (14).
- The clutch discs of forward clutch (8) and 3rd clutch (11) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from the torque converter is transmitted from input shaft (9) via forward clutch (8) to forward gear (23), then to 1st and 3rd gear (32).
- Since 3rd clutch (11) is engaged, the motive force transmitted to 1st and 3rd gear (32) is transmitted from 3rd gear (27) via the 3rd clutch, then to output shaft (14) via 2nd and 4th shaft (17), idler gear (31) and output gear (34).

FORWARD 4TH

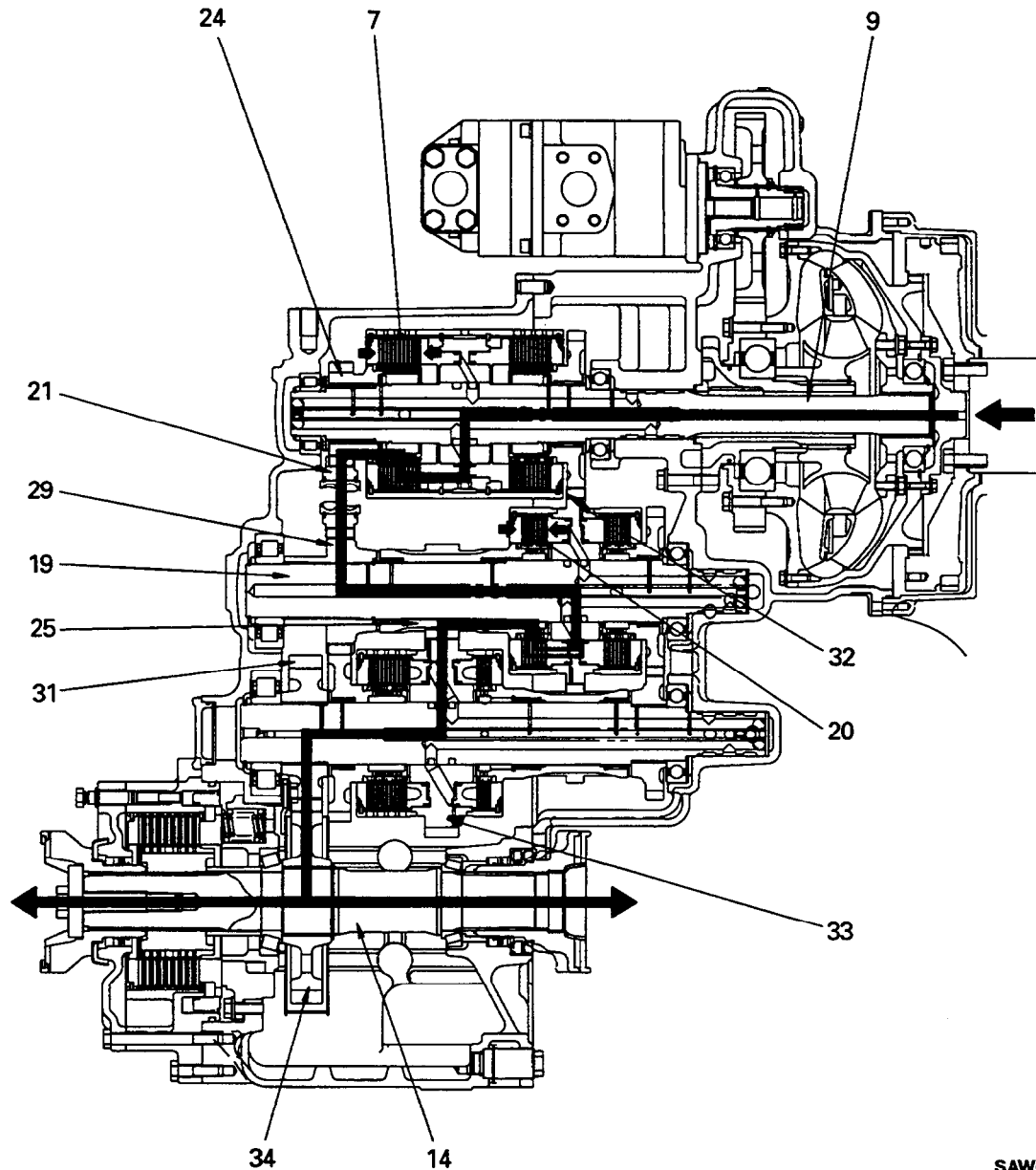


SAW00442

Operation

- In forward 4th, forward clutch (8) and 4th clutch (12) are engaged. The motive force from the torque converter transmitted to input shaft (9) is transmitted to output shaft (14).
- The clutch discs of forward clutch (8) and 4th clutch (12) are held by the hydraulic pressure applied to the clutch piston.
- The motive force from the torque converter is transmitted from input shaft (9) via forward clutch (8) to forward gear (23), then transmitted via 1st and 3rd gear (32) to 4th gear (28).
- Since 4th clutch is engaged, the motive force transmitted to 4th gear is transmitted from 2nd and 4th gear (33) via the 4th clutch, then to output shaft (14) via 2nd and 4th shaft (17), idler gear (31) and output gear (34).

REVERSE 1ST



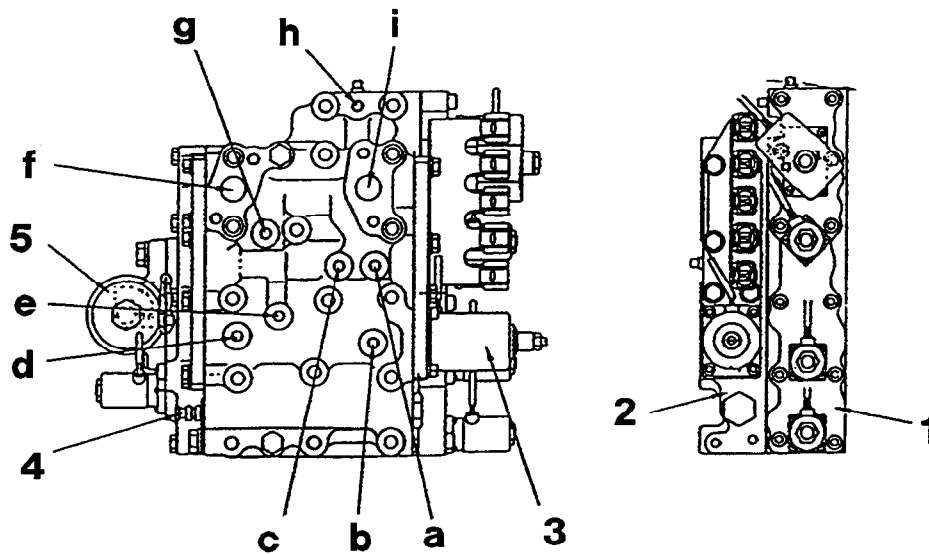
SAW00443

Operation

- In reverse 1st, reverse clutch (7) and 1st clutch (20) are engaged. The motive force from the torque converter transmitted to input shaft (9) is transmitted to output shaft (14).
- The clutch disc of reverse clutch (7) and 1st clutch (20) are held by the hydraulic pressure applied to the piston.
- the motive force from the torque converter is transmitted from the input shaft (9).via reverse clutch (7) to reverse gear (24).

The direction of rotation is reversed by idler gear (21), and the motive force is then transmitted to 1st and 3rd gear (32) via idler gear (29) and 1st and 3rd shaft (19). Since the 1st clutch is engaged, the motive force transmitted to 1st and 3rd gear (32) is transmitted from 1st gear (25) via the 1st clutch to 2nd and 4th gear (33), then transmitted to output shaft (14) via the 2nd and 4th shaft, idler gear (31) and output gear (34).

TRANSMISSION CONTROL VALVE



1. Lower valve
2. Upper valve
3. Electronic modulation valve
4. Emergency manual spool
5. Pilot oil filter

Solenoid valve

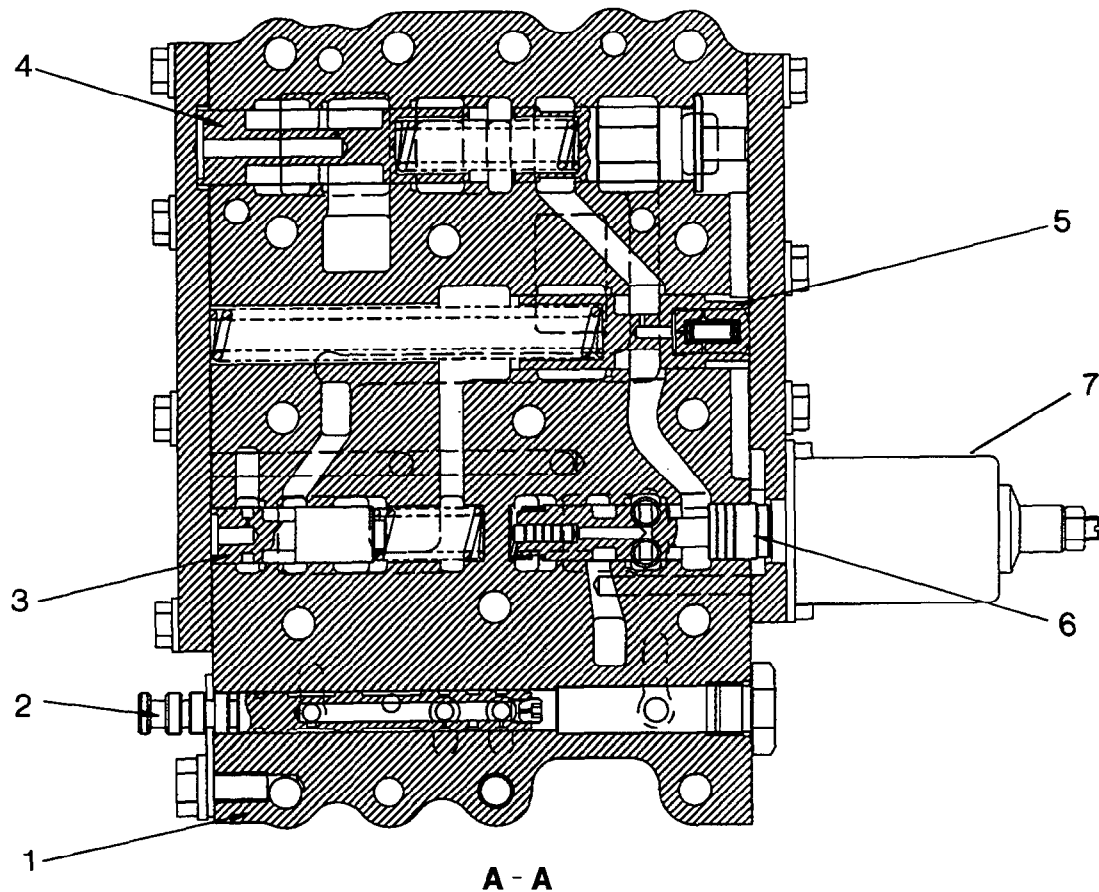
- a. Main oil pressure measurement port
- b. Clutch oil pressure measurement port
- c. Measurement port for torque converter inlet port oil pressure
- d. Priority pressure measurement port
- e. Pilot pressure measurement port
- f. To oil cooler
- g. Measurement port for torque converter outlet port oil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

TCV380

Outline

- The oil from the pump is divided by the flow control valve and passes through the oil filter and enters the transmission control valve. The oil is divided by the priority valve and passes into the pilot circuit, parking brake circuit and clutch operation circuit.
- The priority valve controls the flow so that the oil flows with priority into the pilot circuit and parking brake circuit to keep the oil pressure constant.
- The pressure of the oil which flows into the pilot circuit is regulated by the pilot pressure reducing valve, and this is the oil pressure which actuates the FORWARD/REVERSE, H/L range and parking brake spools when the solenoid turn **ON** and **OFF**.
- The oil which flows into the parking brake circuit controls the parking brake release oil pressure through the parking brake valve. The oil which flows into the clutch operation circuit passes through the main relief valve, its pressure is regulated with the electronic control modulation valve (ECMV) and this oil actuates the clutch. The oil released by the main relief valve is supplied to the torque converter.
- The electronic modulation valve (ECMV) will engage the clutch in the most suitable way by controlling the clutch hydraulic pressure and flow rate with instruction current from transmission controller, by feeding back the vehicle speed and the engine speed.
- An accumulator valve is installed to reduce time lag and shocks when shifting gears.

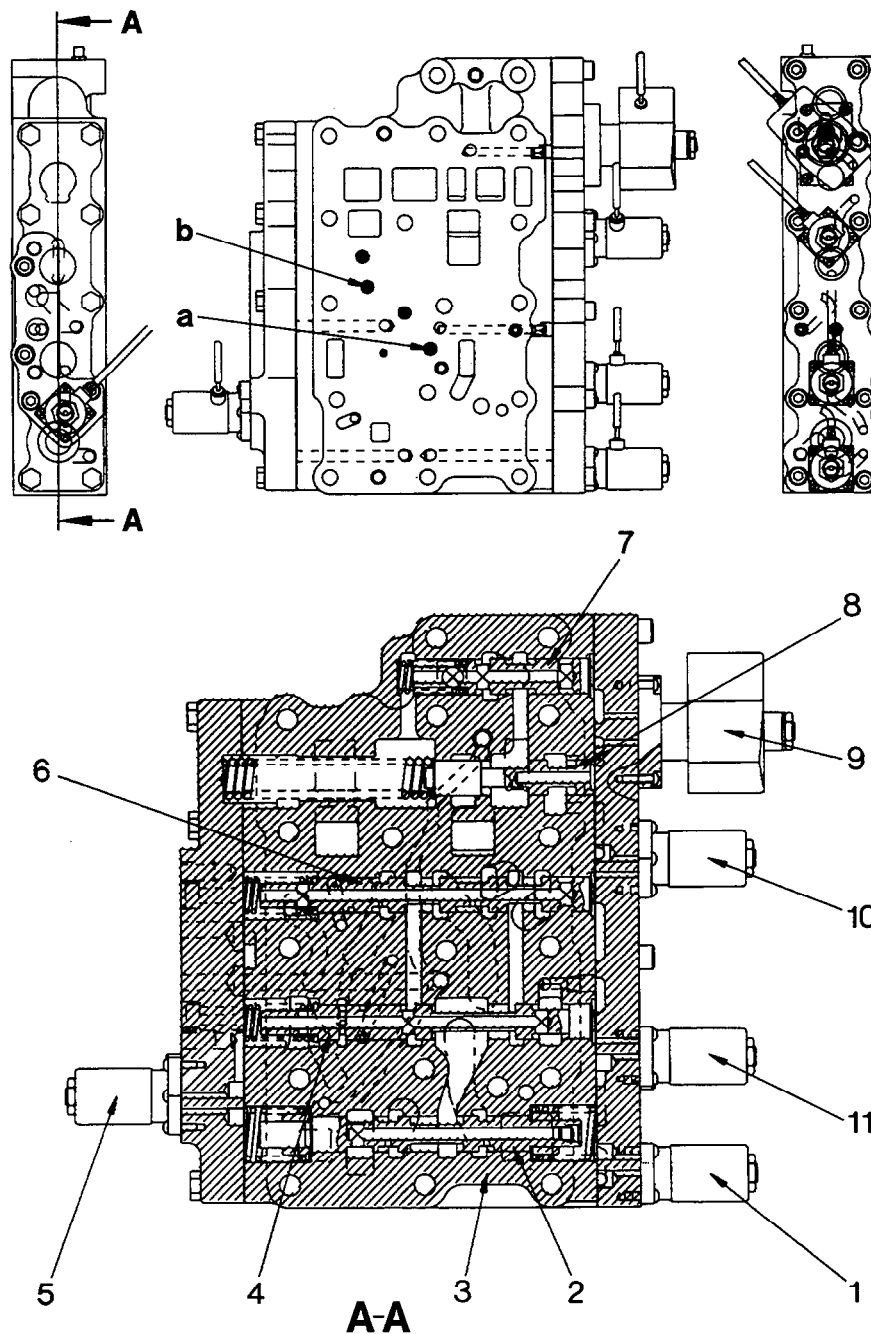
UPPER VALVE



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

CA03440

LOWER VALVE



SAW00446

- | | | |
|-------------------------------|-------------------------------------|---------------------|
| 1. Solenoid valve (FORWARD) | 8. Priority valve | a. 3rd, 4th orifice |
| 2. Directional selector valve | 9. Solenoid valve (parking brake) | b. 2nd orifice |
| 3. Lower valve body | 10. Solenoid valve (range selector) | |
| 4. H-L selector valve | 11. Solenoid valve (H-L selector) | |
| 5. Solenoid valve (REVERSE) | | |
| 6. Range selector valve | | |
| 7. Parking brake valve | | |

TRANSMISSION SOLENOID VALVE**Function**

- When the gear shift lever is operated to move in forward or reverse, electric signals are sent to four solenoid valves mounted on the transmission valve, activating the FORWARD/REVERSE, H-L or range spool, according to the combination of solenoid valves which are opened and closed.
- For the parking brake solenoid valve, refer to the section "Parking Brake Solenoid Valve".

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 direction of the arrow by return springs (6) and (7).

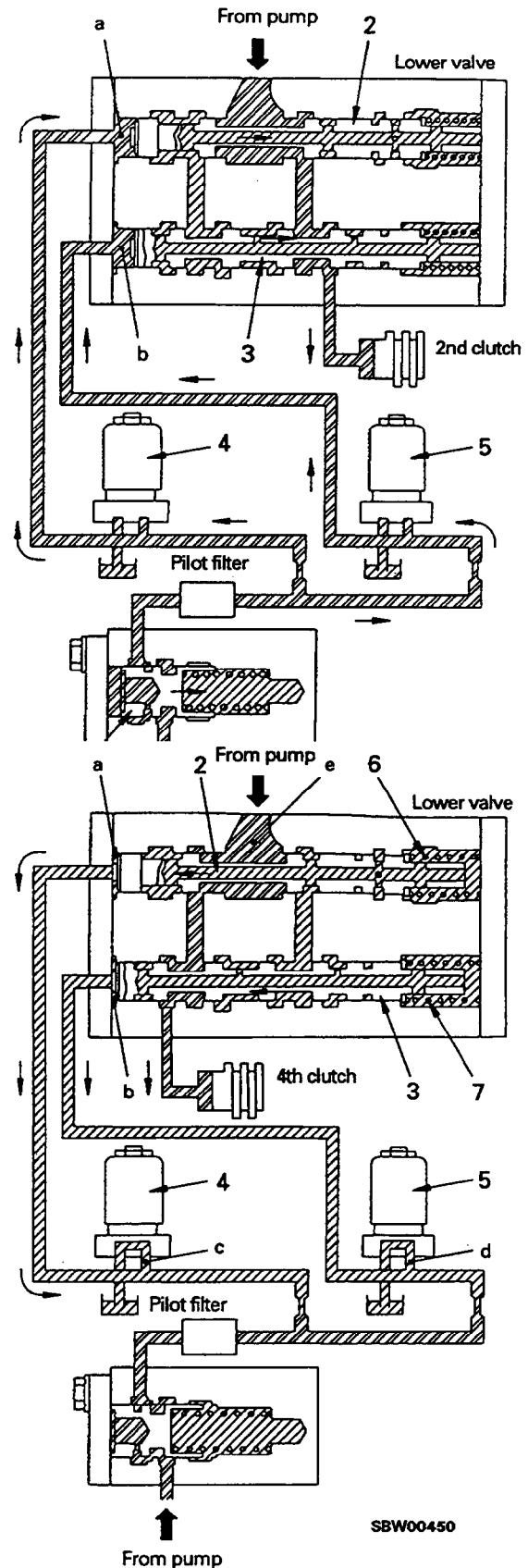
As a result, the oil at port **e** flows to the 4th clutch and switches from 2nd to 4th.

Actuation table for solenoid valve and clutch

O : CURRENT FLOWS

	FORWARD SOLENOID VALVE	REVERSE SOLENOID VALVE	H-L SOLENOID VALVE	RANGE SOLENOID VALVE
F-1	O			O
F-2	O			
F-3	O		O	
F-4	O		O	O
N				
R-1		O		O
R-2		O		
R-3		O	O	
R-4		O	O	O

ACTUATBL



PILOT REDUCING VALVE

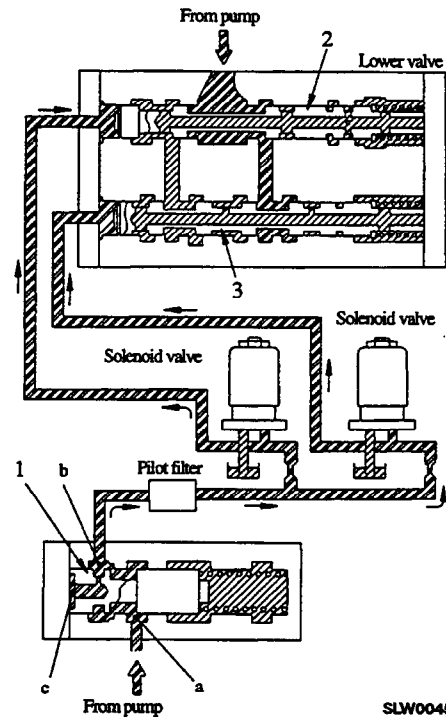
Function

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

Operation

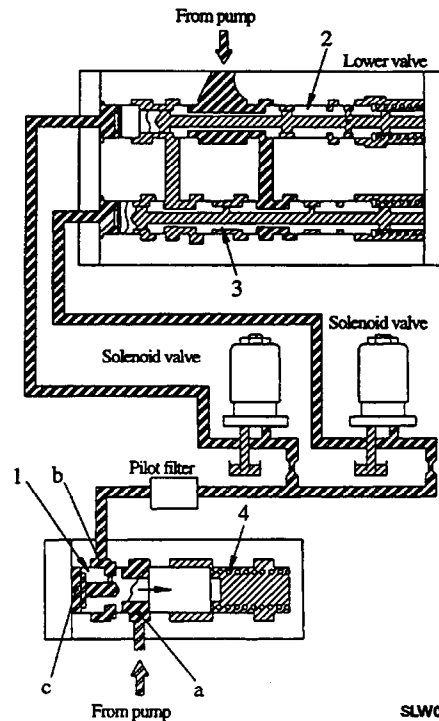
- The oil from the pump enters port **a**, passes through port **b** of pilot reducing spool (1), enters spools (2) and (3) in the lower valve, and fills the pilot circuit.

The oil at port **b** passes through the orifice and flows to port **c**.



SLW00453

- When the pressure in the pilot circuit rises, the pressure at port **c** also rises. This overcomes the tension of spring (4) and moves pilot reducing spool (1) to the right in the direction of the arrow. For this reason, port **a** at port **b** are shut off, so the pressure at port **c** is maintained.



SLW00454

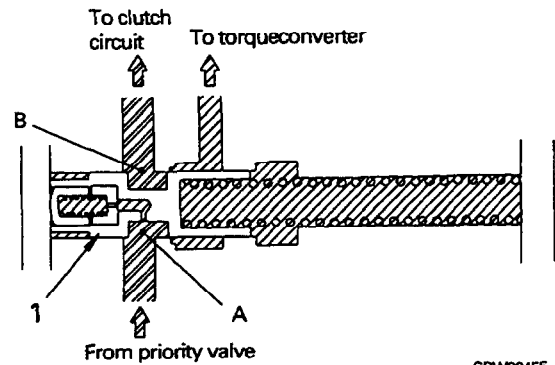
STRUCTURE AND FUNCTION

TRANSMISSION CONTROL VALVE

MAIN RELIEF VALVE

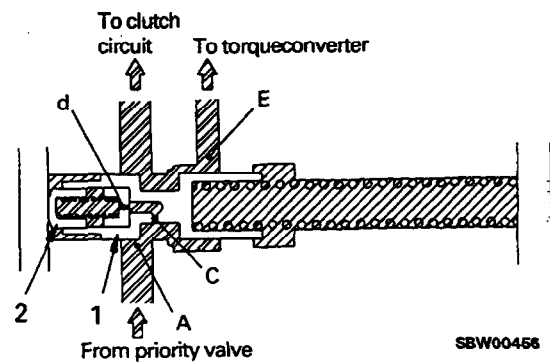
Function

- 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.



Operation

- The oil from the pump passes through the priority valve, the through ports A and B until the main relief valve (1) specified pressure is reached, and flows to the clutch valve.
- 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.



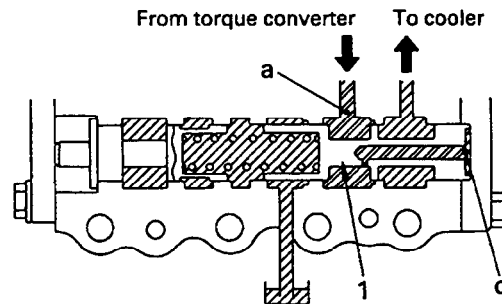
TORQUE CONVERTER OUTLET PORT VALVE

Function

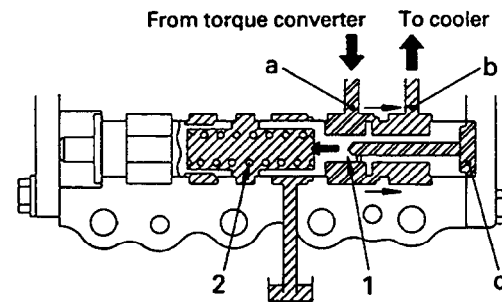
- The torque converter outlet port valve is installed in the outlet line of the torque converter and adjusts the maximum pressure of the torque converter.

Operation

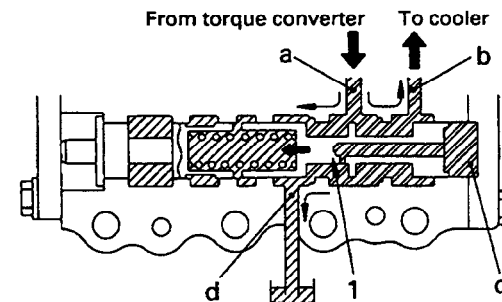
- The oil at port **a** passes through the orifice in spool (1) and flows to port **c**.



- 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**.



- 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)



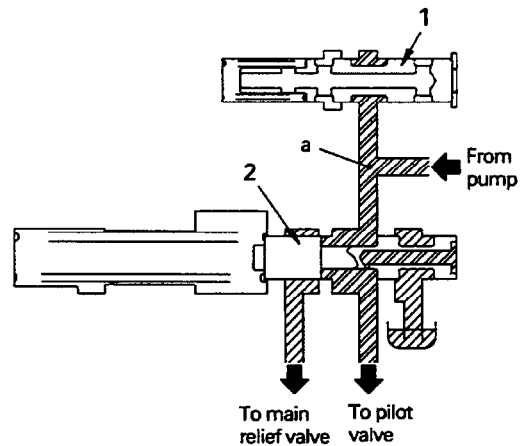
EW00060

PRIORITY VALVE**Function**

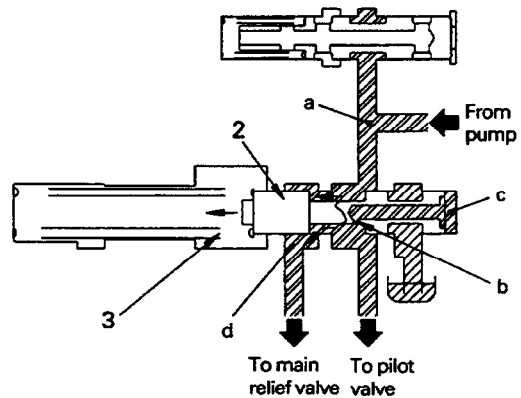
- The priority valve regulates the pump's discharge pressure and provides the pilot oil pressure and parking brake release oil pressure.
- If the pressure in the circuit reaches a level above the measured oil pressure, the priority valve acts as a relief valve, releasing the pressure to protect the hydraulic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

Operation

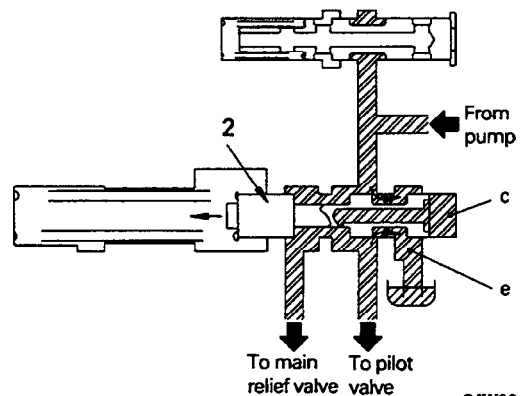
1. The oil from the pump enters port **a** and separates into the oil flowing to the parking brake valve (1), priority valve (2) and the pilot circuit.



2. The oil at port **a** passes through priority valve (2) orifice **b** and flows to port **c**. When the oil pressure at port **c** overcomes the force of the return spring (3), priority valve (2) moves to the left and the oil flows to port **d**.



3. If the oil pressure at port **c** reaches a level above the measured value, priority valve (2) moves further to the left and is connected to the drain circuit from port **e**, protecting the hydraulic circuitry.



SAW00459

STRUCTURE AND FUNCTION

TRANSMISSION CONTROL VALVE

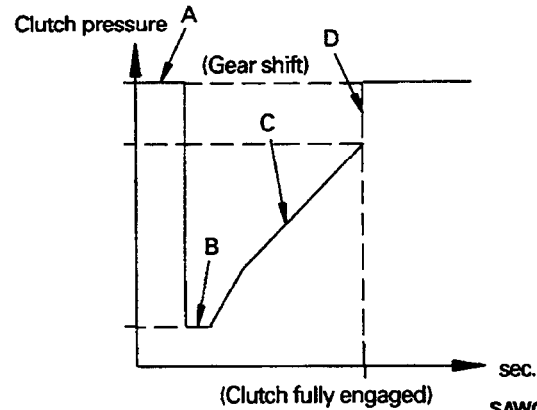
QUICK RETURN VALVE

- 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.

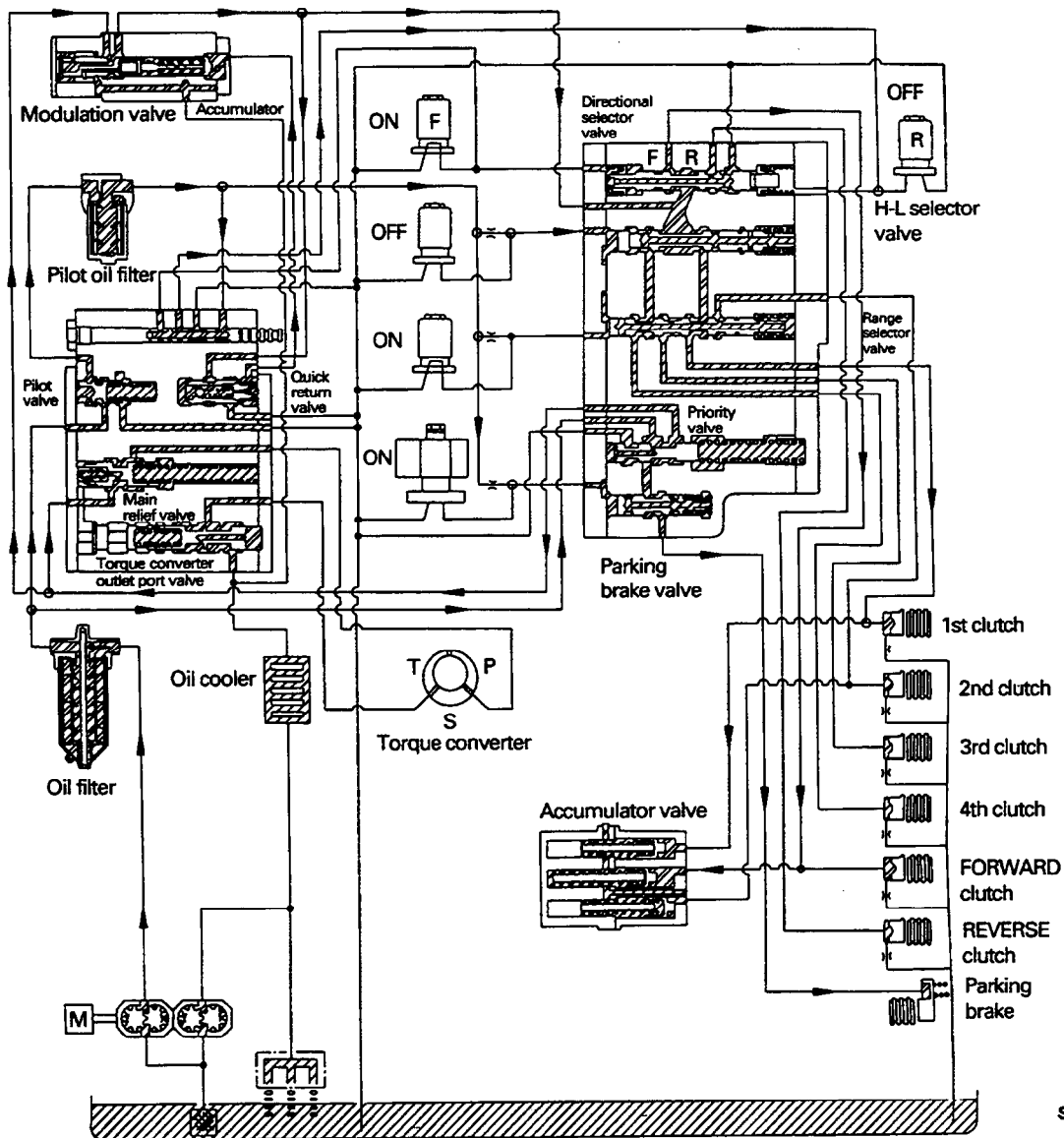
Operation

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

(FORWARD 1ST)

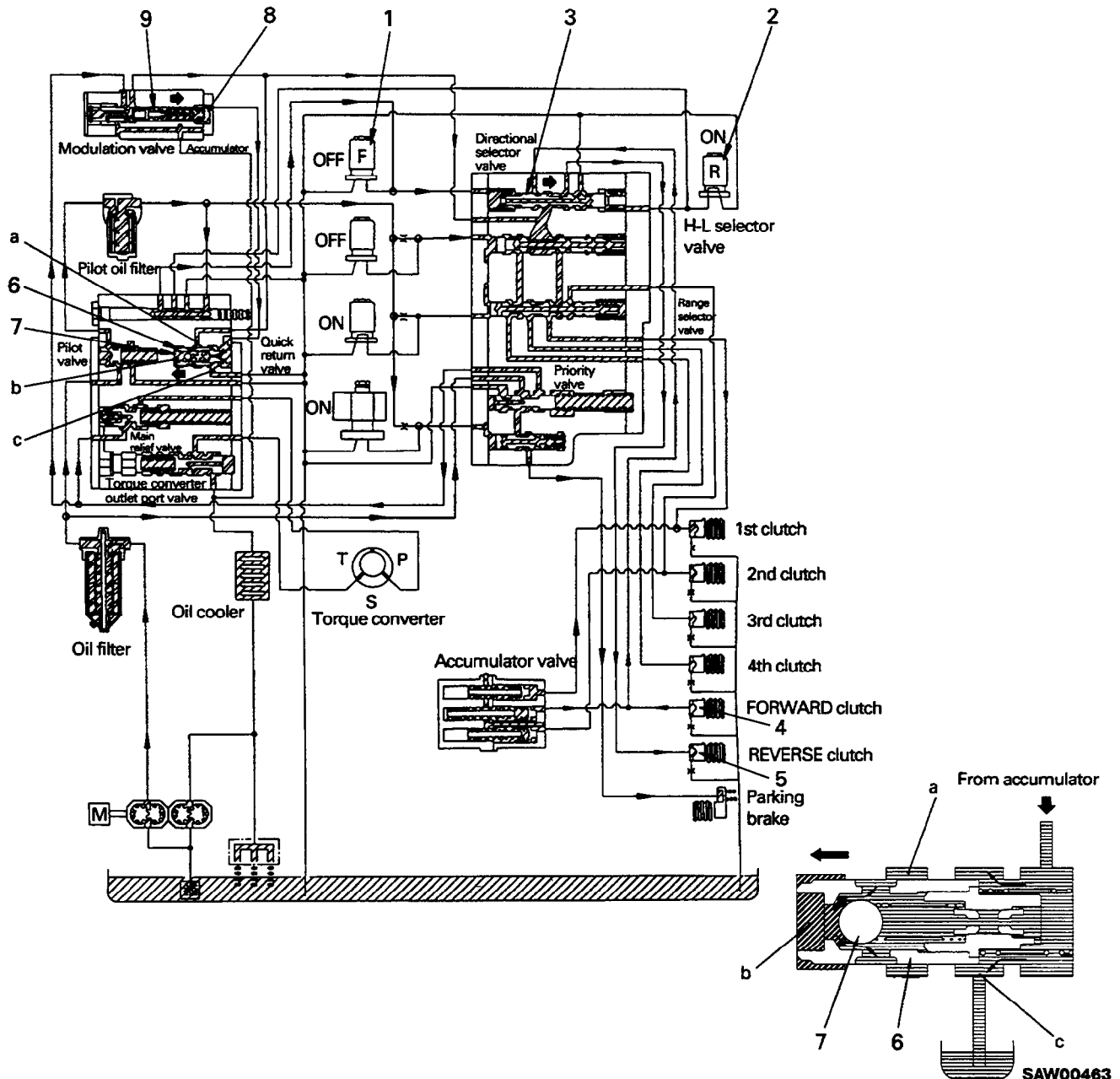


SAW00460



SBW00461

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

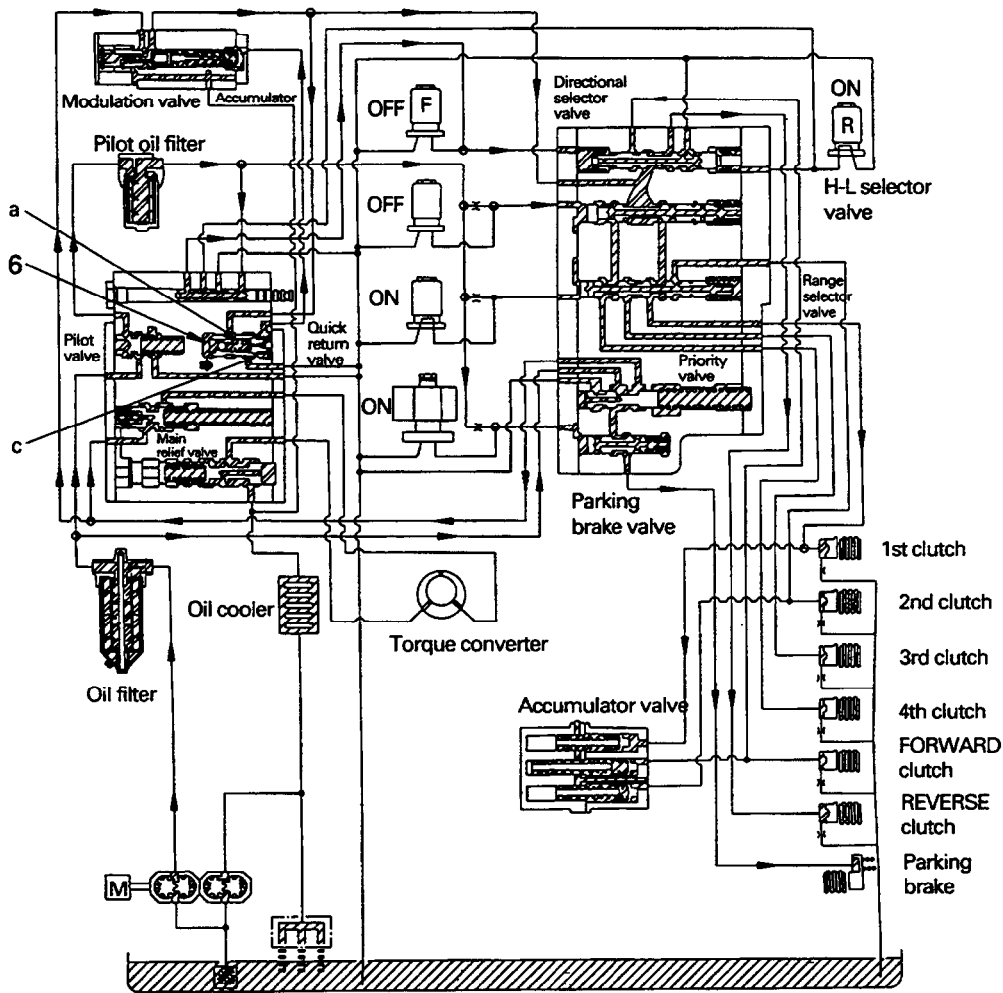


- When the directional lever is shifted from FORWARD to REVERSE, FORWARD solenoid (1) closes and REVERSE solenoid (2) opens. Directional spool (3) is moved to the right in the direction of the arrow and the oil at FORWARD clutch (4) is drained from the drain circuit.
- At the same time, the oil from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

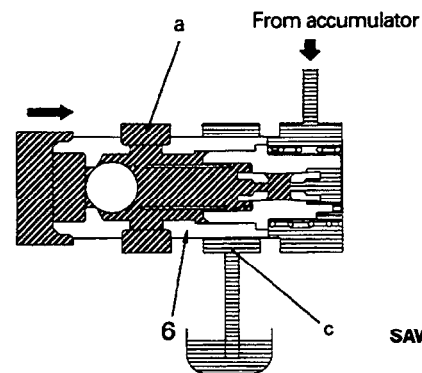
At the same time, quick return valve (6) is moved to the left in the direction of the arrow by the accumulator oil pressure, and the oil in accumulator (8) is drained suddenly from port **c**.

- Accumulator (8) is returned to the right end by force of spring (9).

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

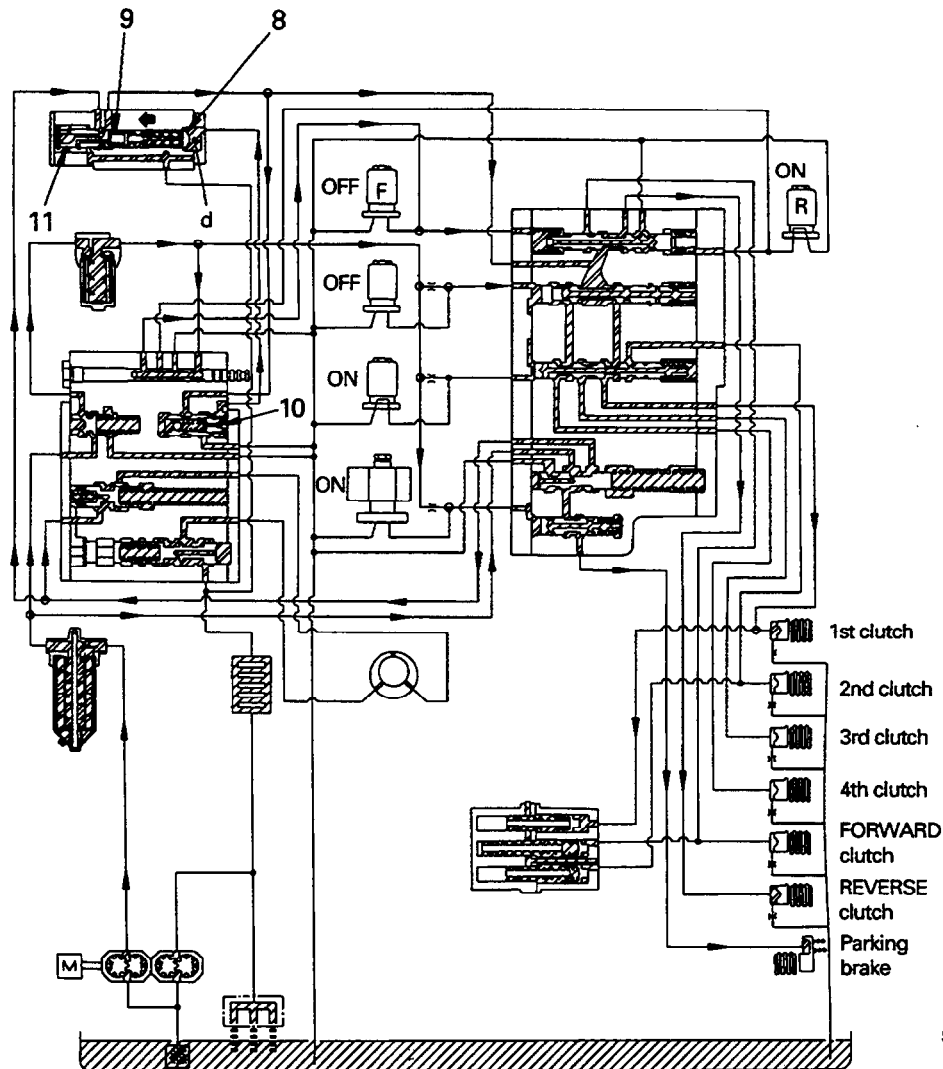
SBW00464

- 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**.



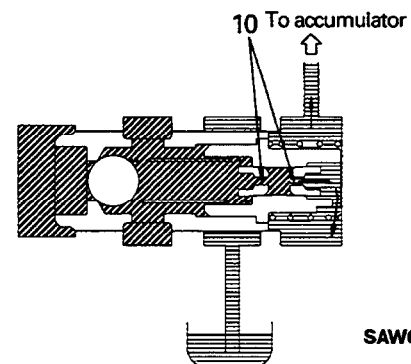
SAW00465

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



SBW00466

- 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 the 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.



SAW00467

STRUCTURE AND FUNCTION

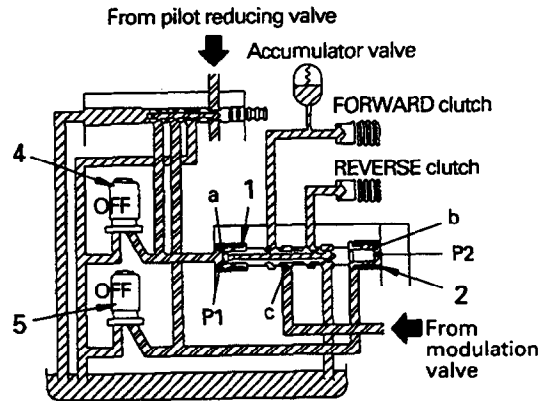
TRANSMISSION CONTROL VALVE

DIRECTIONAL SELECTOR VALVE

Operation

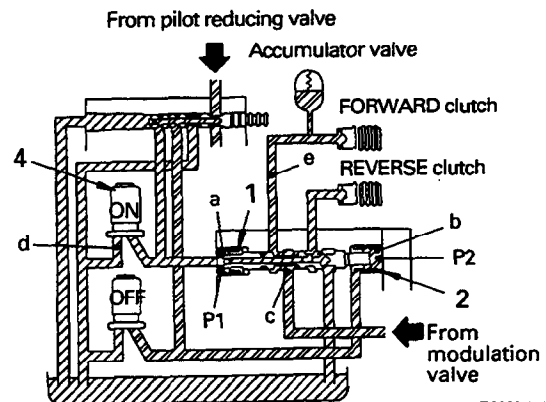
1. When at neutral

- Solenoid valve (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

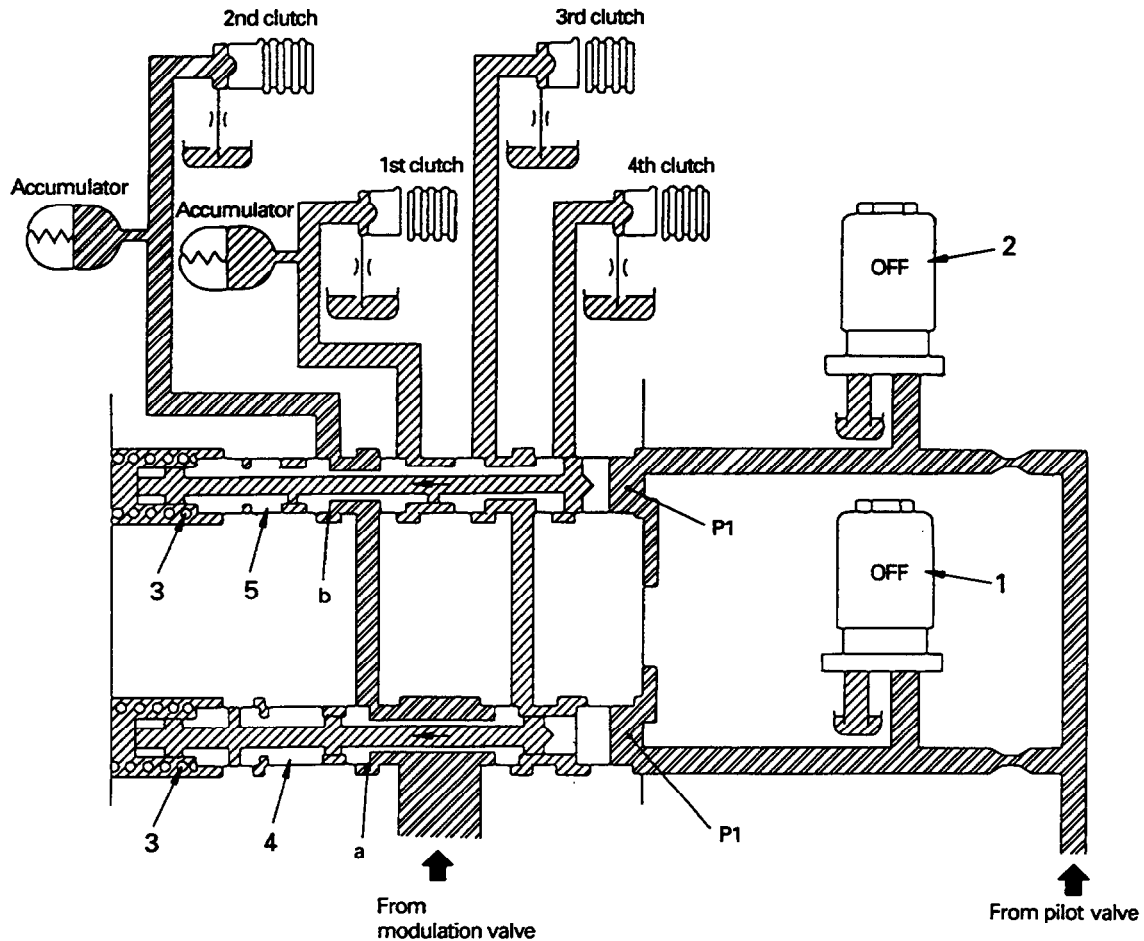
- When the directional lever is placed at the FORWARD position, solenoid valve (4) is switched ON and drain port **d** opens. The oil which is filling port **a** is drained, so $P_1 + \text{spring force (1)} < P_2 + \text{spring force (2)}$. When this happens, the directional spool moves to the left,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



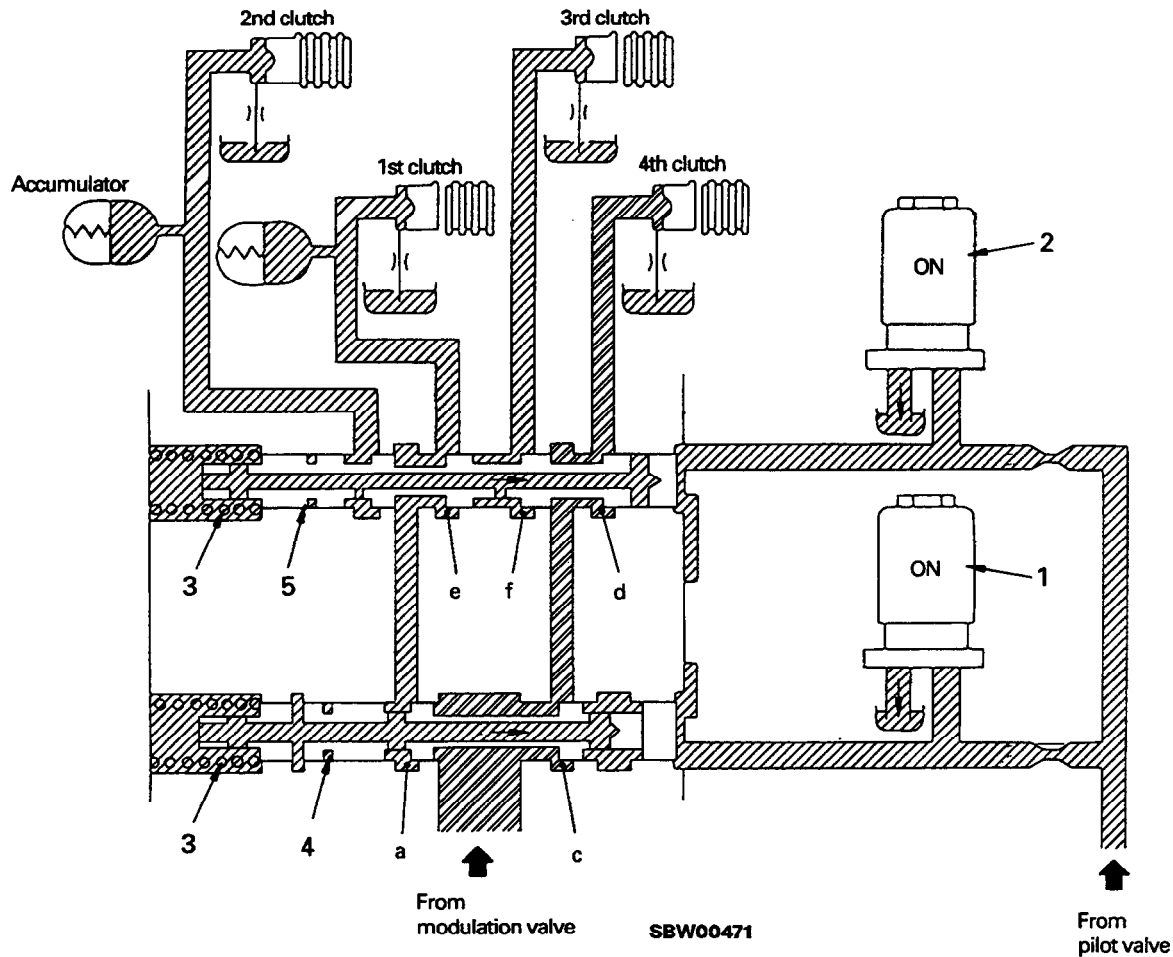
SBW00469

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**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 the H-L selector spool (4) and range selector spool (5) springs (3) and moves spools (4) and (5) to the left. The oil in 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.



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 (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 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 rang selector spool (5) port **f** and is supplied to the 3rd clutch.

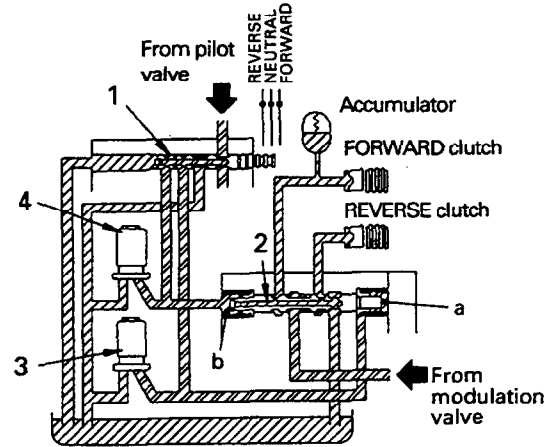
EMERGENCY MANUAL SPOOL

Function

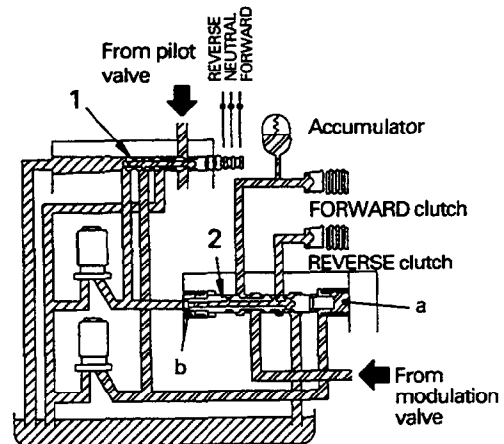
- Should the electric system malfunction and the forward/reverse solenoid valves cannot be actuated, the emergency manual spool actuates the forward and reverse clutches manually.

Operation

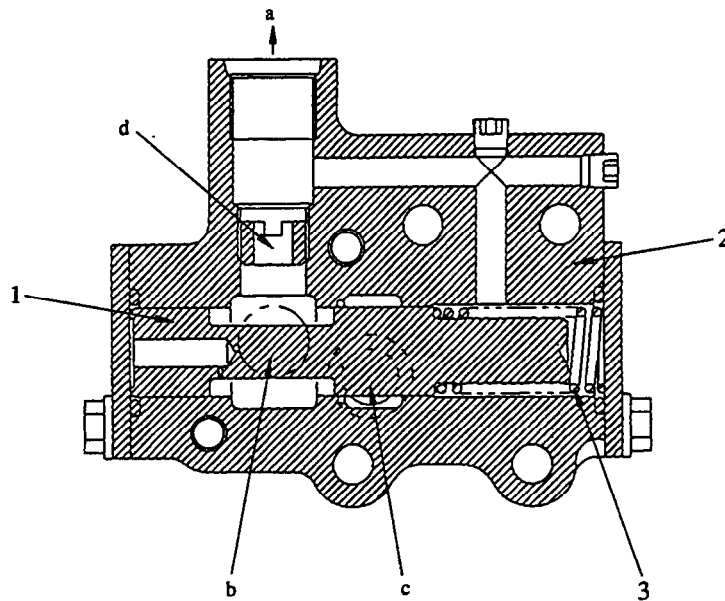
- When the emergency manual spool is at neutral (during normal operation)
 - The oil from the pilot valve passes through emergency manual spool (1), enters the lower valve directional spool (2) port "a", and "b" and is sealed by forward solenoid valve (3).



- When the emergency manual spool is actuated (to the forward side)
 - When emergency manual spool (1) is pulled out, the oil from the pilot valve passes through emergency manual spool (1) and flows only into directional spool (2) port "a", not into port "b". This generates a pressure difference between ports "a" and "b", directional spool (2) moves to the left, oil flows into the forward clutch and the clutch is engaged.



SBW00473

FLOW CONTROL VALVE

- 1. Spool
- 2. Body
- 3. Spring

- a. To transmission valve
- b. From pump
- c. To clutch lubricating circuit
- d. Orifice

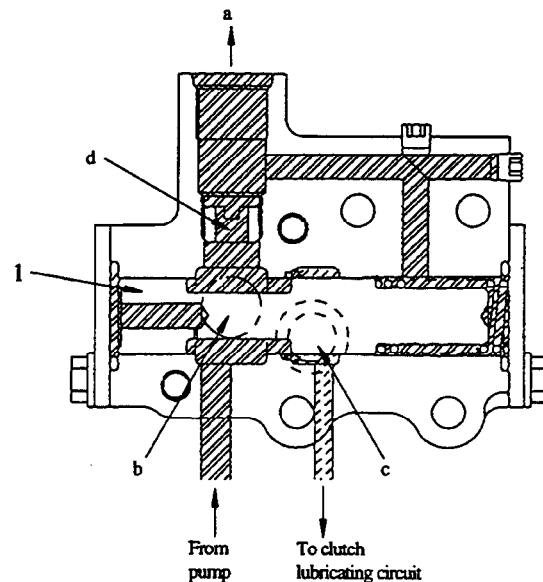
SBW00479

Outline

- The oil from the pump is distributed to the clutch lubricating circuit with the transmission valve circuit.
- When the engine speed is low and the pump's oil discharge is low, the oil is sent with priority to the transmission valve circuit, increasing the clutch oil pressure response.

Operation

- The oil from the pump passes from port **b** through orifice **d** and enters the transmission valve from port **a**.
- When the oil from the pump reaches a level above the specified oil pressure, spool (1) moves to the right, and the oil flows from port **c** to the clutch lubricating circuit.



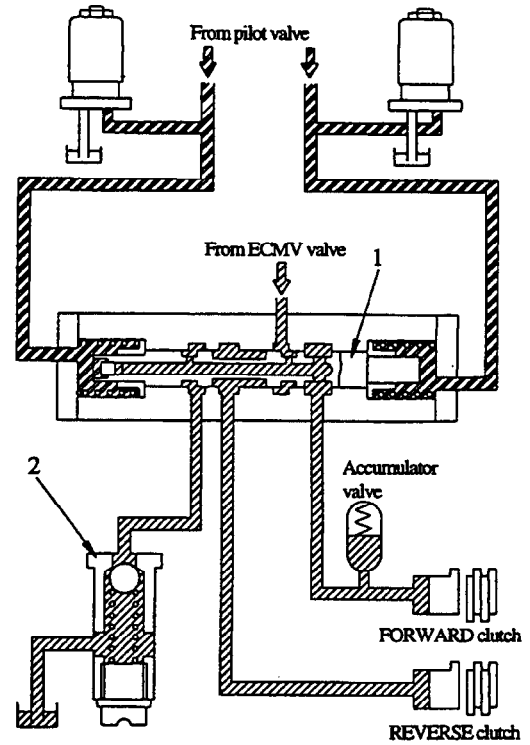
SBW00480

CHECK VALVE

Outline

- The check valve is mounted on the fitting surface of the transmission valve (lower valve) and transmission case.
- A check valve is provided in the forward/ reverse valve's drain circuit, stabilizing shifting performance when shifting between forward and reverse.

1. Directional spool
2. Check valve



SLW00481

ELECTRONIC CONTROL MODULATION VALVE (ECMV)

Structure of ECMV

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

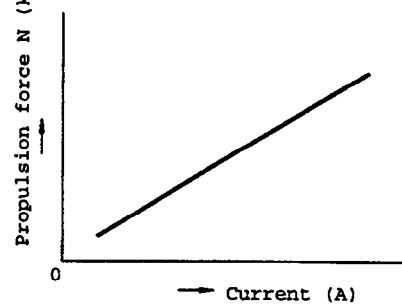
Proportional solenoid valve and ECMV

A propulsion force as shown in the diagram on the right is generated by the command current from the transmission controller.

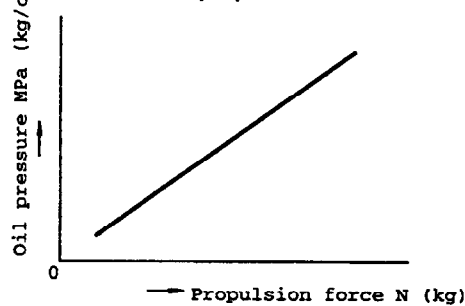
The propulsion force generated by the proportional solenoid acts on the pressure control spool and generates the oil pressure shown in the diagram on the right.

Therefore, by controlling the command current, it is possible to change the propulsion force, actuate the pressure control valve, and control the oil flow and oil pressure

Characteristics of propulsion force and electric current of proportional solenoid valve

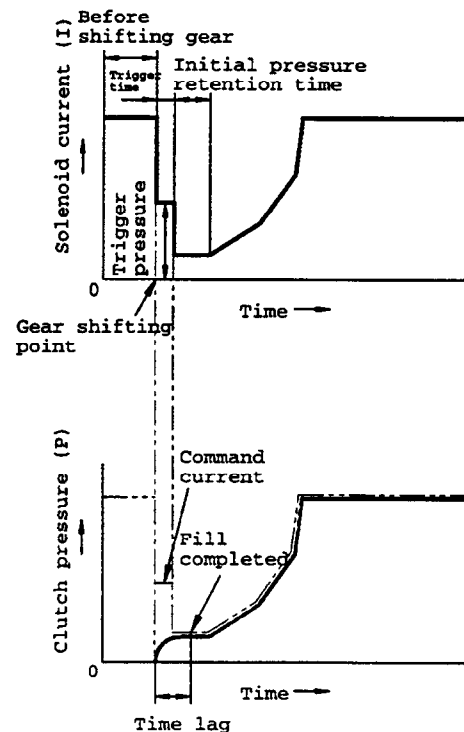


Characteristics of oil pressure and propulsion force of proportional solenoid valve



Operation of ECMV

The **ECMV** is controlled by the command current sent from the transmission controller to the proportional solenoid. The relationship between the clutch pressure and the command current for the proportional solenoid in the **ECMV** is as shown in the diagram on the right.



SDW00066

STRUCTURE AND FUNCTION

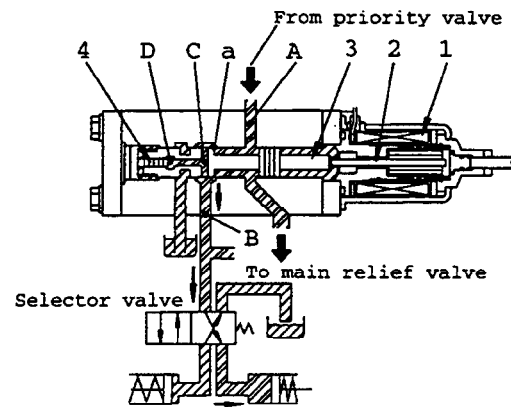
TRANSMISSION CONTROL VALVE

1. Before shifting gear

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

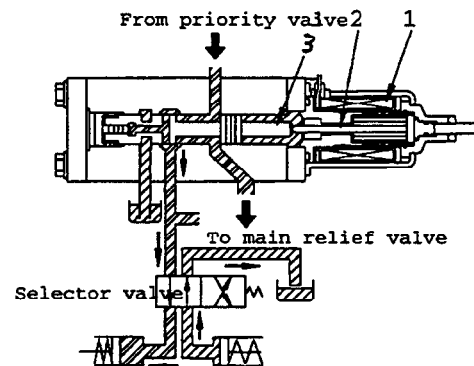
The oil in chamber D pushes out piston (4), and the reaction to this moves spool (3) to the right to try to close throttle a. In this way, the hydraulic pressure is maintained when the propulsion force of shaft (2) of proportional solenoid (1) and the reaction (hydraulic pressure) of spool (3) are in balance.

(Clutch retention pressure is maintained)



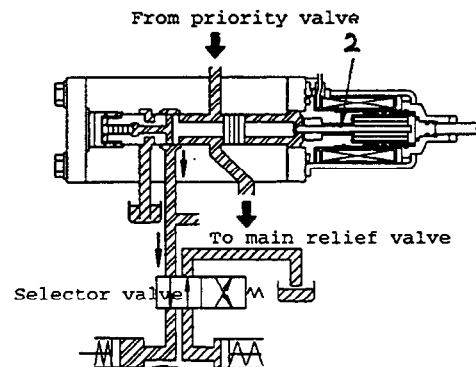
2. When shifting gear (immediately after shifting gear)

When the gear is shifted, the selector spool is switched. The oil pressure at the clutch which was previously engaged is drained, and the port opens to the clutch which is to be newly engaged. The command current to proportional solenoid (1) becomes the trigger current immediately after shifting gear. Spool (3) continues to be pushed to the left, and oil starts to fill the clutch chamber.



3. When shifting gear (setting initial pressure)

Immediately after oil fills the clutch chamber, the command current to the solenoid is dropped to the set value for the initial pressure. Therefore, the propulsion force of shaft (2) of the proportional solenoid valve becomes smaller, and the clutch pressure becomes the set value for the initial pressure.

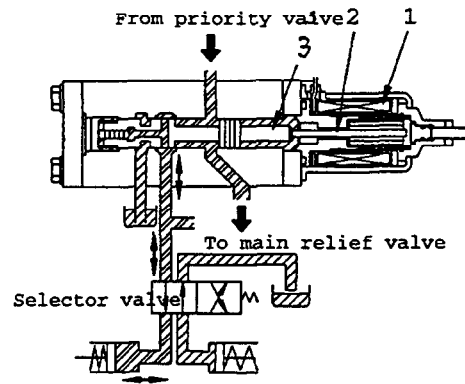


SEW00069

4. Adjusting pressure

When the electric current flows to proportional solenoid (1), a propulsion force proportional to the current is generated. This propulsion force of shaft (2) of solenoid (1) is adjusted by the oil pressure at the clutch port applied to spool (3) so that it is in balance with the reaction force.

In other words, the clutch pressure is controlled by controlling the command current sent to solenoid (1).



SEW00070

Manual operation of ECMV

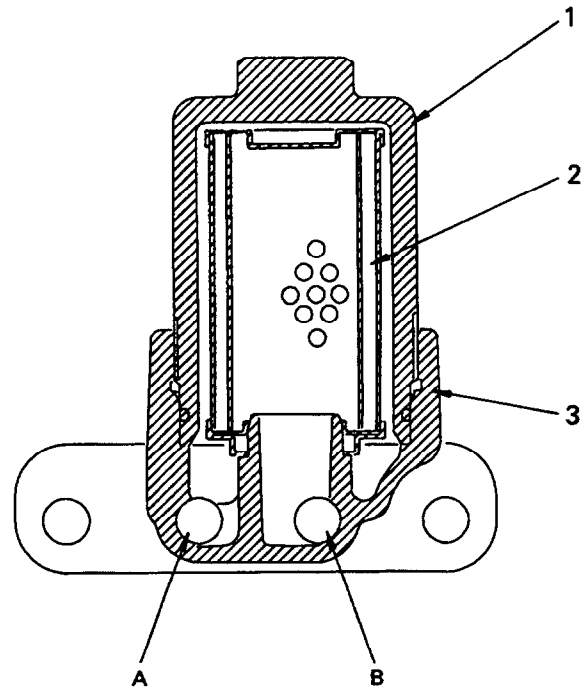
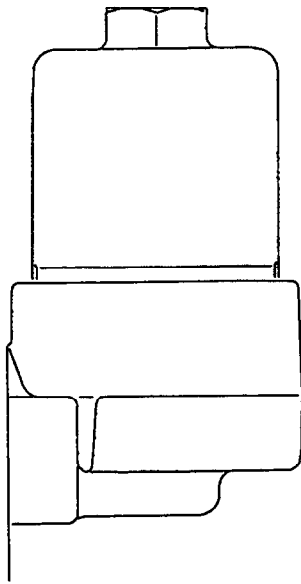
If the machine must be moved in an emergency, such as when there is any failure in the electrical system of the transmission control, it is possible to use manual operation to engage the transmission.

(For details, see the operation and maintenance manual.)

Method of engaging

- (i) Disconnect all connectors to the transmission control valve.
- (ii) Remove the manual selector lock plate, then push in or pull out the spool.
 FORWARD: Pull out
 REVERSE: Push in
- (iii) Push in the adjustment screw of the proportional solenoid valve to the end.
 Speed range when engaged: 2nd

PILOT OIL FILTER



1. Case
2. Element
3. Oil filter heat

- A. Inlet port
- B. Outlet port

Specifications

Filtering area: 170 cm²

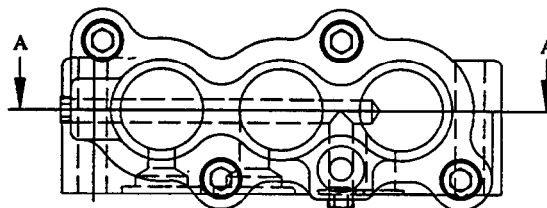
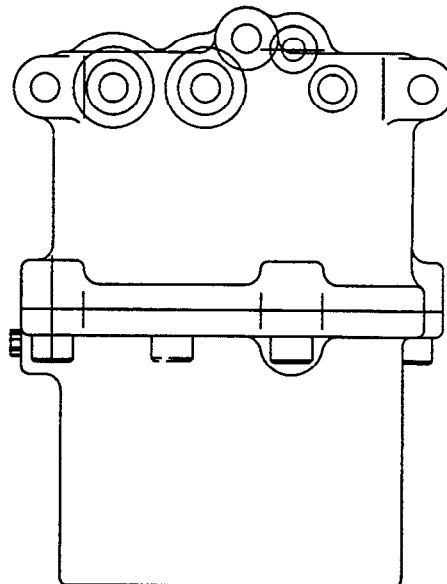
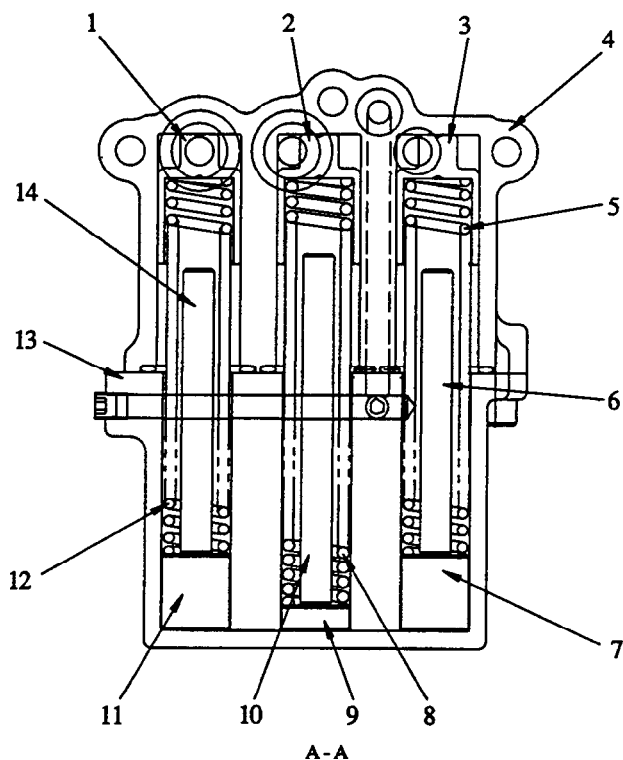
Filter mesh size: 105 μ

SBW00482

Outline

- The pilot oil filter is mounted on the transmission lower valve, and filters dirt from the oil flowing to the pilot circuit.

ACCUMULATOR VALVE



SAW00484

1. Piston (1st clutch)
2. Piston (FORWARD clutch)
3. Piston (2nd clutch)
4. Body
5. Spring (2nd clutch)
6. Stopper (2nd clutch)
7. Spacer (2nd clutch)
8. Spring (FORWARD clutch)
9. Stopper (FORWARD clutch)
10. Spacer (1st clutch)
11. Spring (1st clutch)
12. Cover
13. Stopper (1st clutch)

Outline

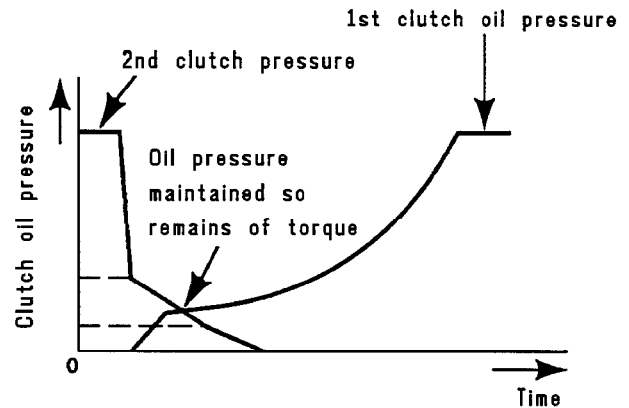
- The accumulator valve is installed in the FORWARD, 1st, 2nd, clutch circuit. When the transmission shifts gears, the accumulator valve slowly reduces the oil pressure to the clutch that was first engaged in order to prevent loss of torque and to reduce the transmission shock when shifting gears. It 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, H-L spool and range 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 gears smoothly without losing the torque.

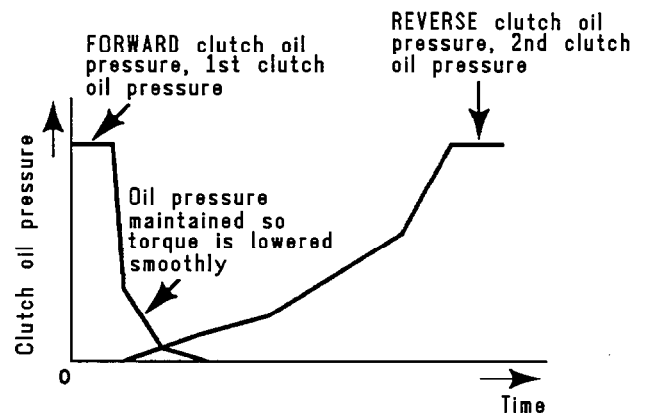


SDW00040

Moving out after digging (F1→R2)

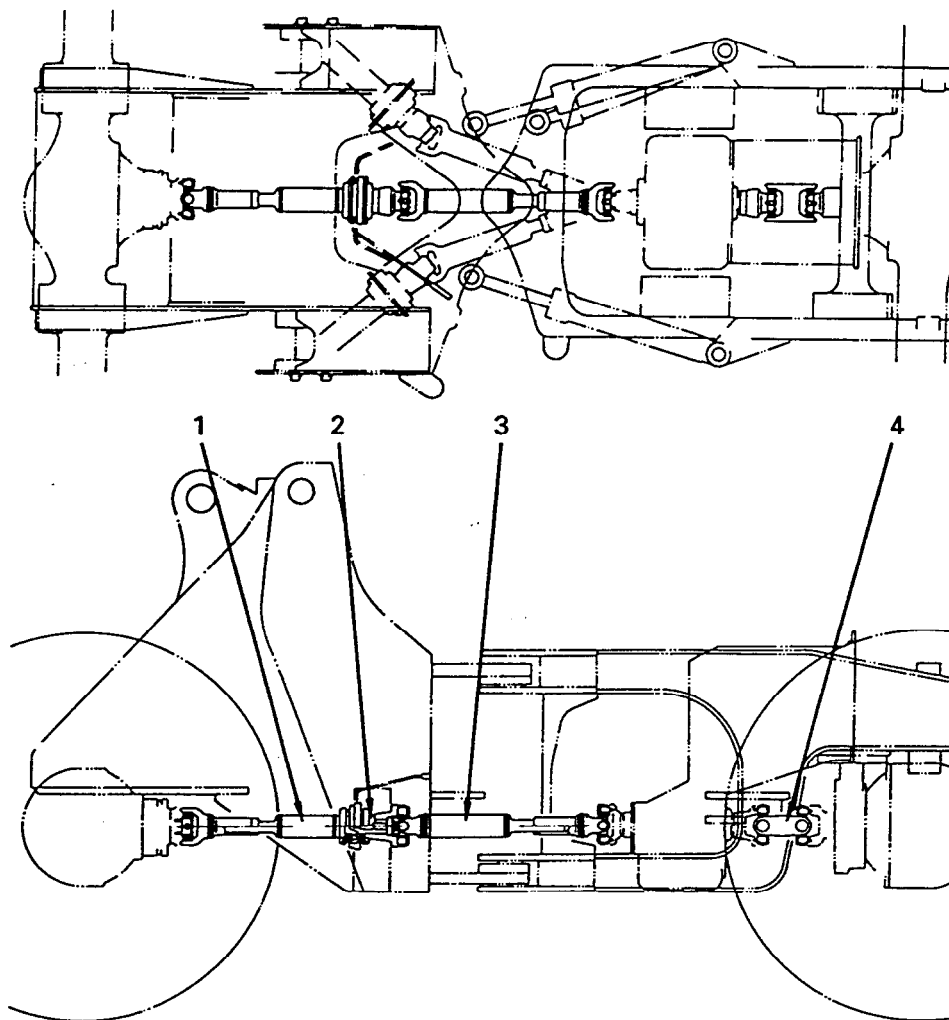
When the transmission is in F1, oil pressure is stored in the accumulator for the FORWARD clutch and 1st clutch.

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 reactionforce to the product being handled, and to move back smoothly without shock.



SDW00041

DRIVE SHAFT

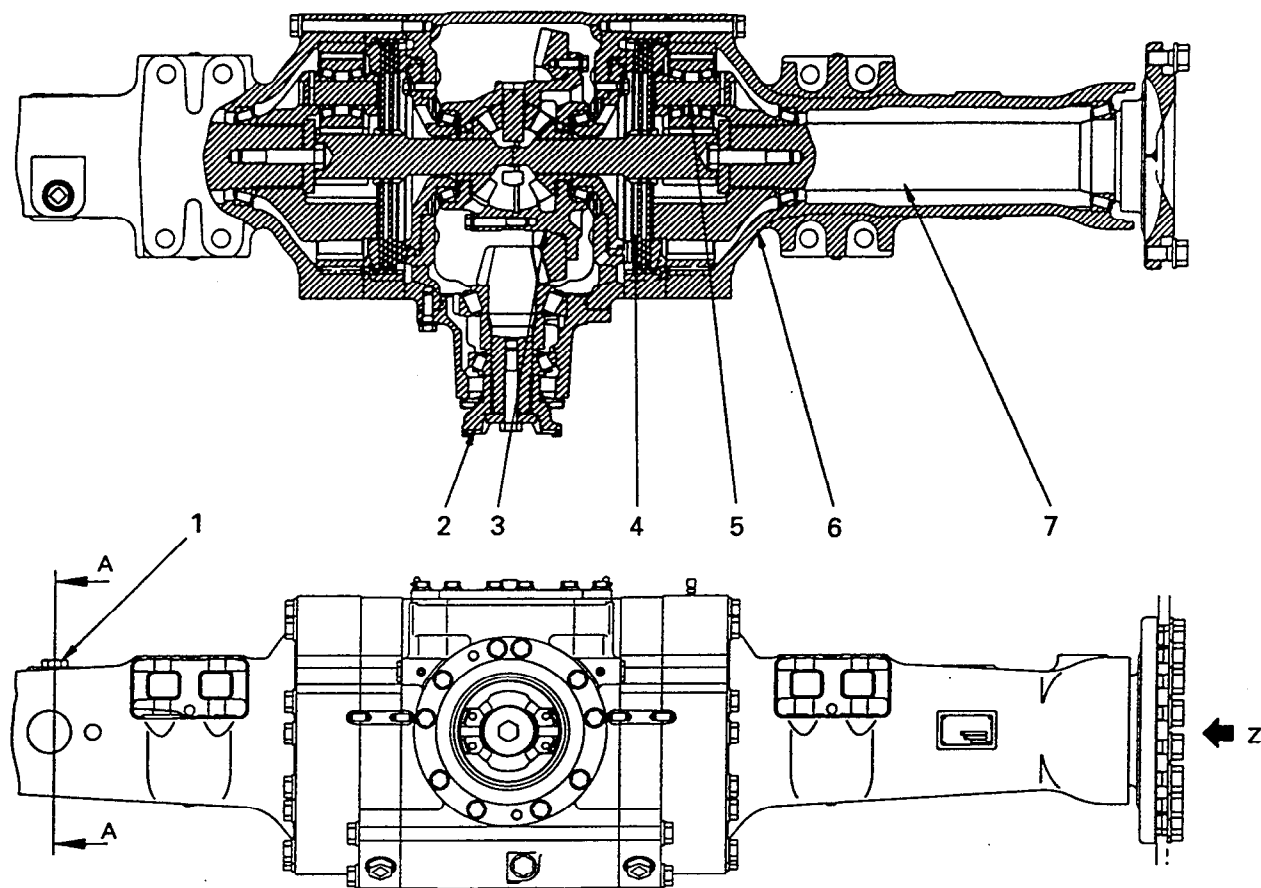


SLW01219

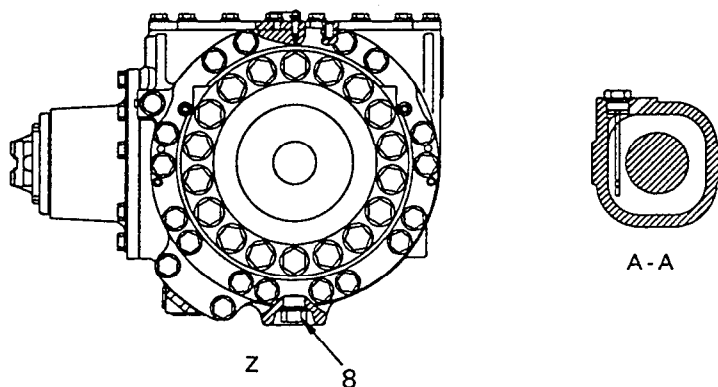
1. Front drive shaft
2. Flange bearing
3. Center drive shaft
4. Rear drive shaft

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.

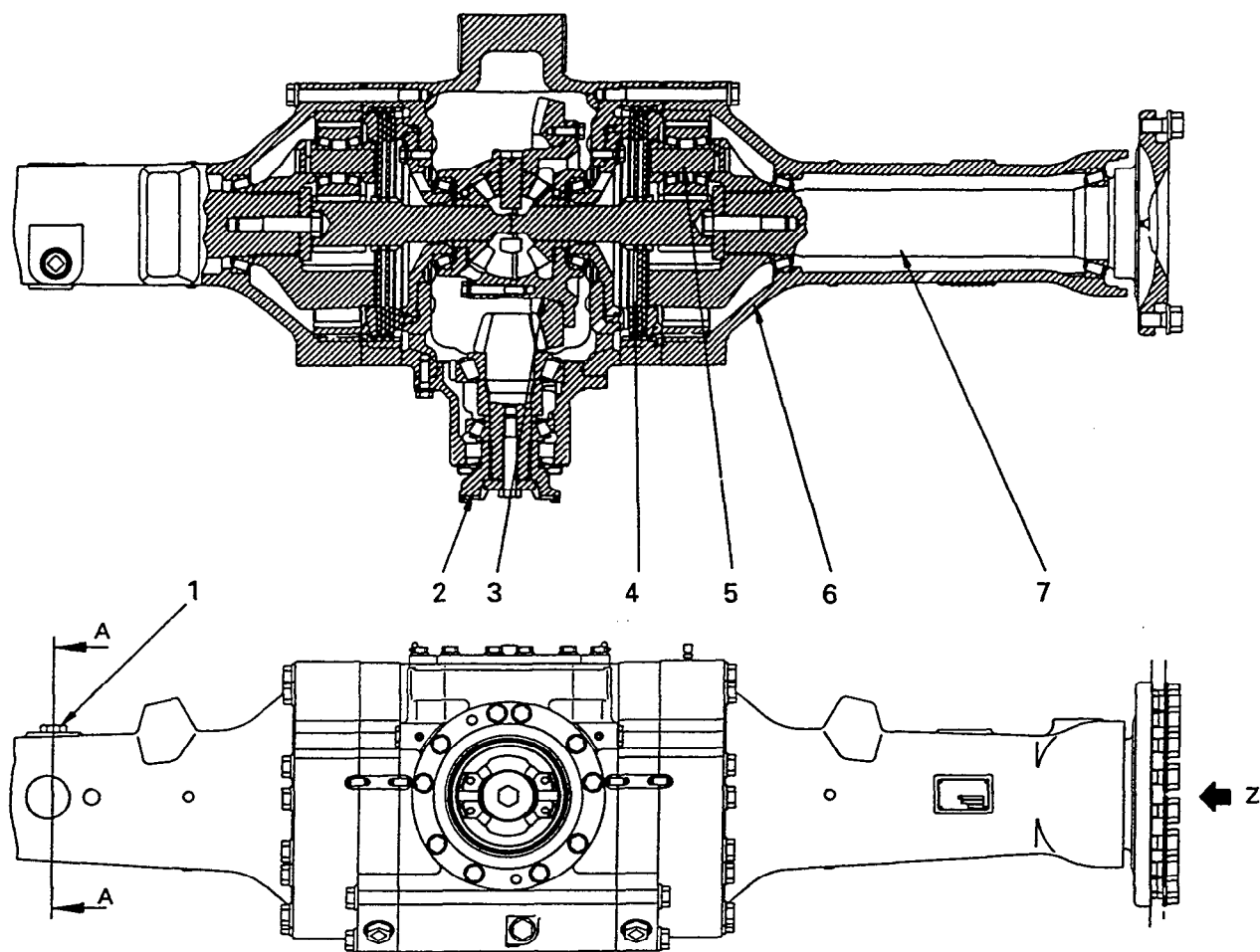
AXLE
FRONT AXLE

SAW00486

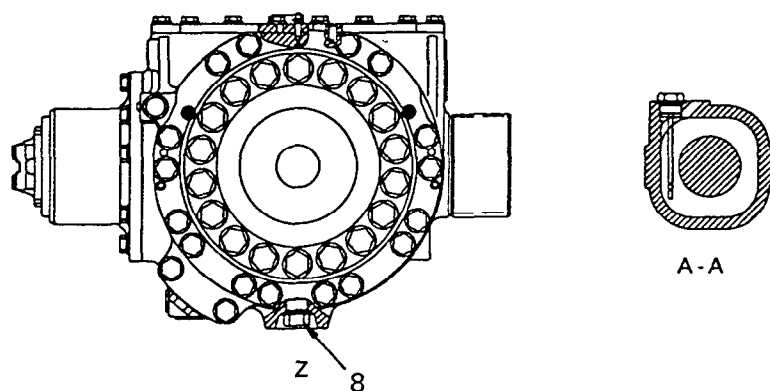


1. Oil supply port and level plug
2. Coupling
3. Differential
4. Wet-type multi-disc brake
5. Final drive
6. Axle housing
7. Axle shaft
8. Drain plug

REAR AXLE



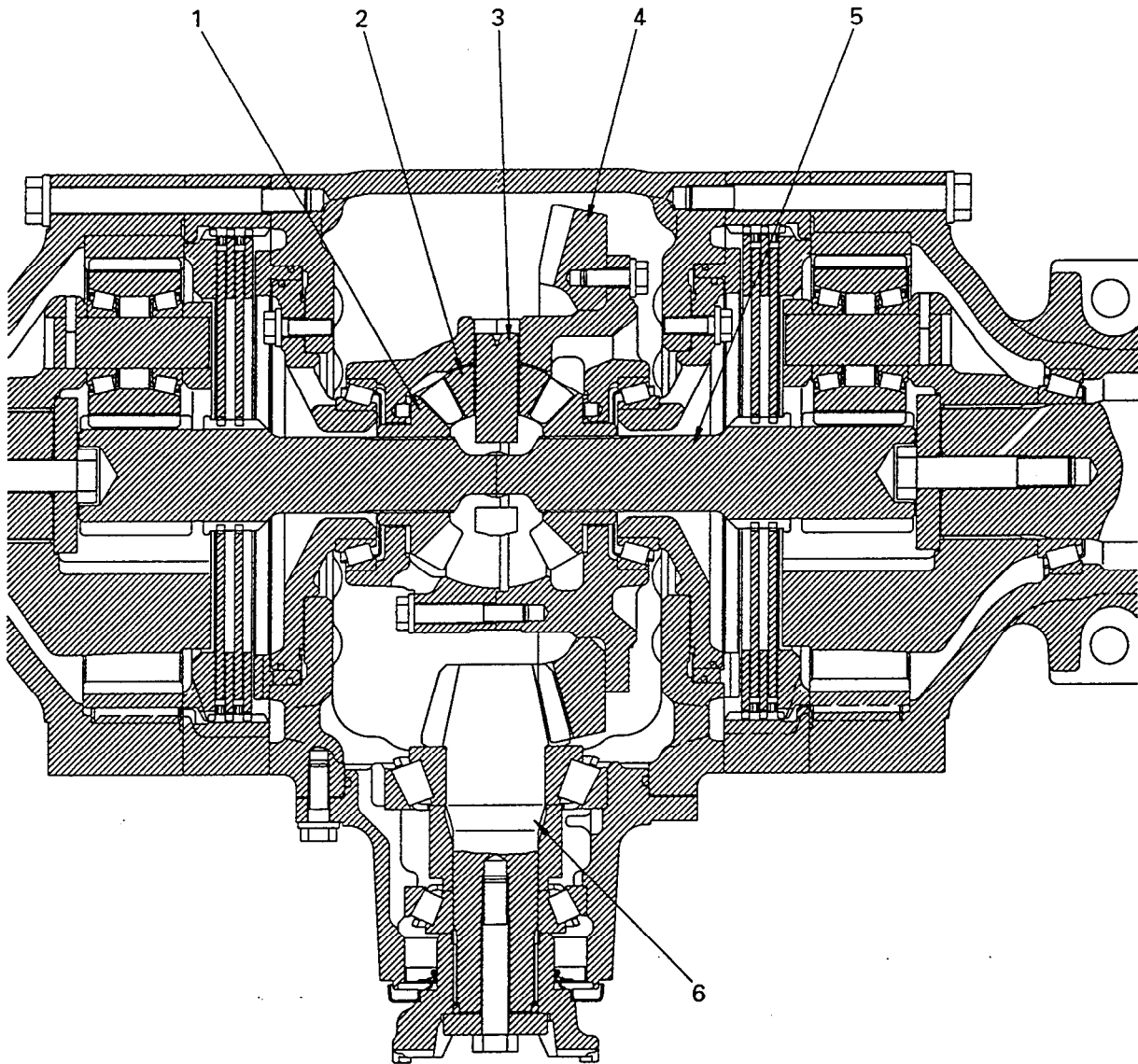
SAW00487



1. Oil supply port and level plug
2. Coupling
3. Differential
4. Wet-type multi-disc brake
5. Final drive
6. Axle housing
7. Axle shaft
8. Drain plug

DIFFERENTIAL

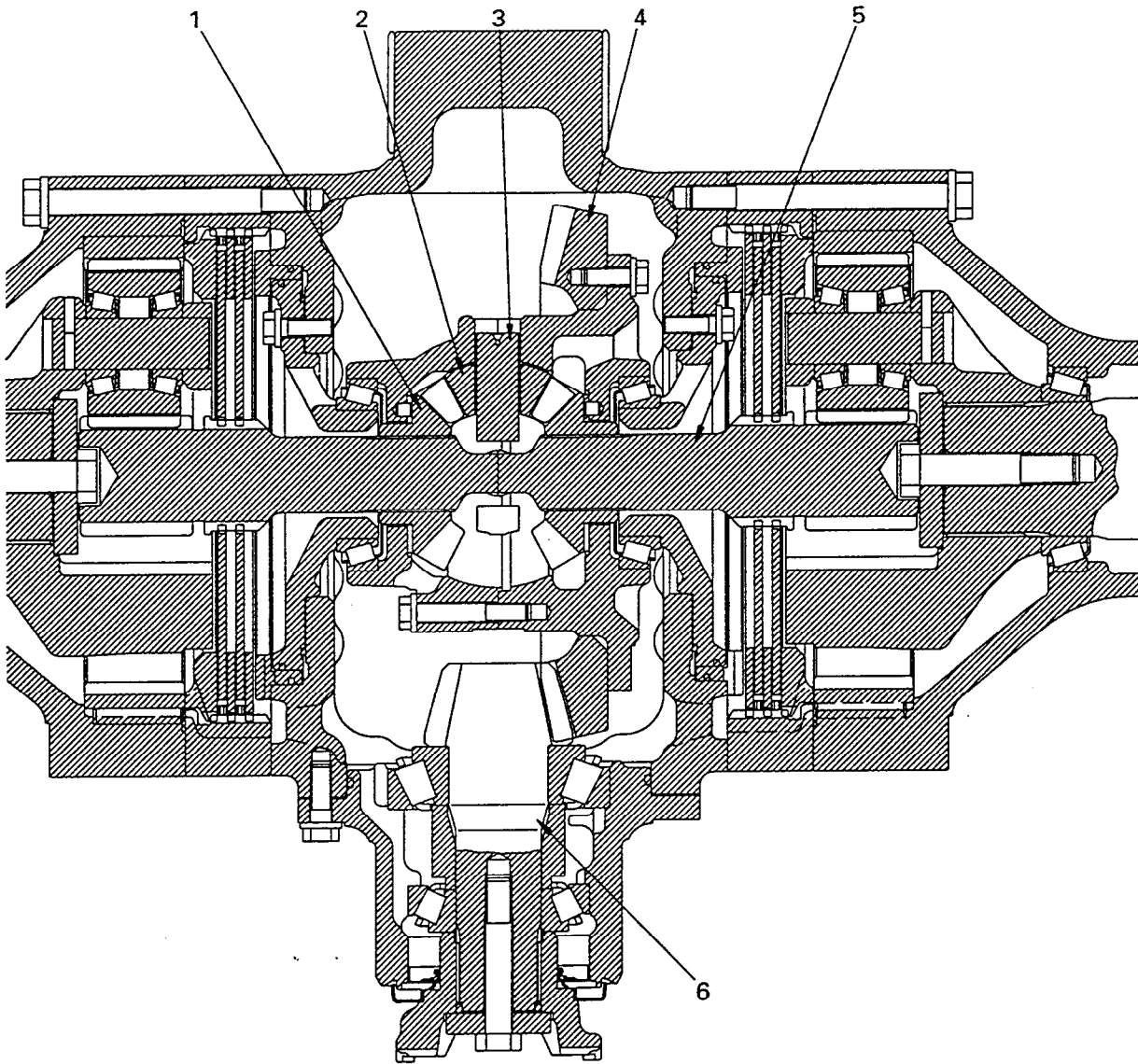
FRONT DIFFERENTIAL



SAW00488

1. Side gear (Teeth 12)
2. Pinion gear (Teeth 9)
3. Shaft
4. Bevel gear (Teeth 41)
5. Sun gear shaft
6. Bevel pinion (Teeth 9)

REAR DIFFERENTIAL

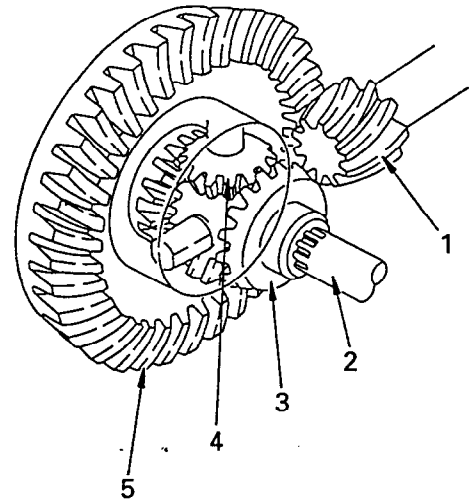


SAW00489

1. Side gear (Teeth 12)
2. Pinion gear (Teeth 9)
3. Shaft
4. Bevel gear (Teeth 41)
5. Sun gear shaft
6. Bevel pinion (Teeth 9)

Outline

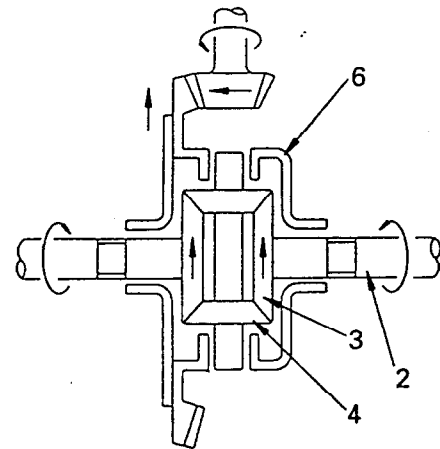
- The motive force from the engine is transmitted to the front and rear axles via the torque converter, the transmission and the propeller shaft.
- In the axle, the motive force is transmitted from bevel pinion (1) to bevel gear (5), shifted 90° and reduced, and transmitted to sun gear shaft (2) via pinion gear (4).
- The motive force of the sun gear is further reduced by planetary gear-type final drive, and transmitted to the axle shaft and wheel.



SEW00077

When moving straight forward

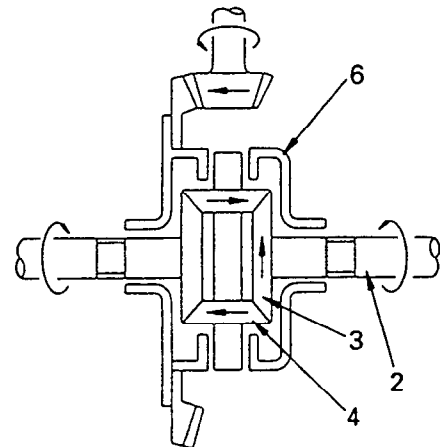
- When moving straight forward, the speed of rotation of the left and right wheels is equal, so pinion gear (4) in the differential assembly does not rotate, and the motive force of carrier (6) is transmitted equally to the left and right sun gear shafts (2) via the pinion gear (4) and side gear (3).



SEW00078

When slewing

- When slewing, the speed of rotation of the left and right wheels is unequal, so pinion gear (4) and side gear (3) in the differential assembly rotate according to the difference in the left and right rotation speeds, and the motive force of carrier (6) is transmitted to the sun gear shafts (2).



SEW00079

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 (4) has an odd number of teeth. Because of the difference in the resistance from the road surface, the position of meshing of pinion gear (4) and side gear (3) 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 (4) and meshing point "a" of left side gear (7) is the same as the distance between pinion gear (4) 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 (4) and side gear changes.
- If left side gear (7) 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.

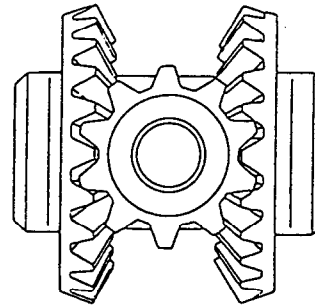
$$a \times TL = b \times TR$$

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.

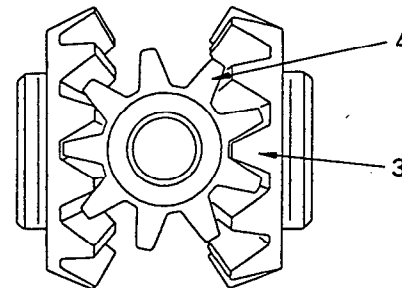
Because of this effect, the tire life can be increased by 20 - 30%, and at the same time the operating efficiency is also increased.

Ordinary differential

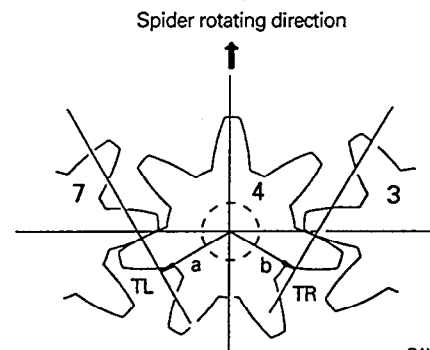


SEW00080

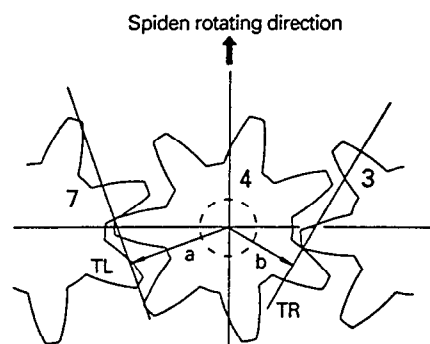
Torque proportioning differential



SAW00490

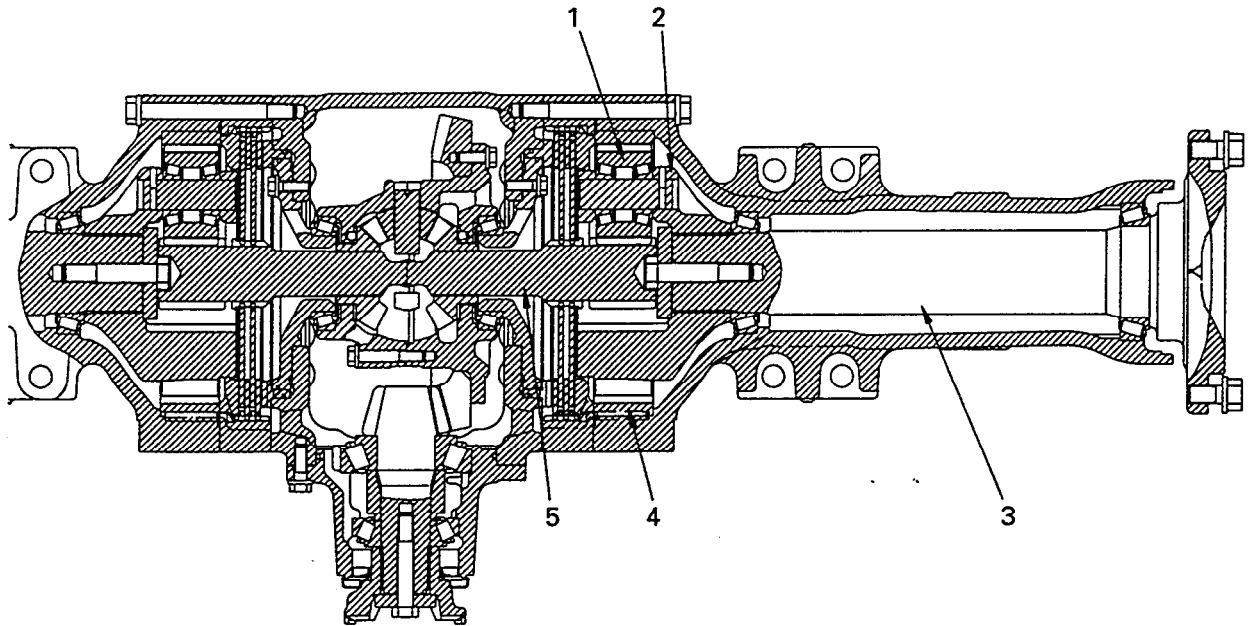


SAW00491



SAW00492

FINAL DRIVE

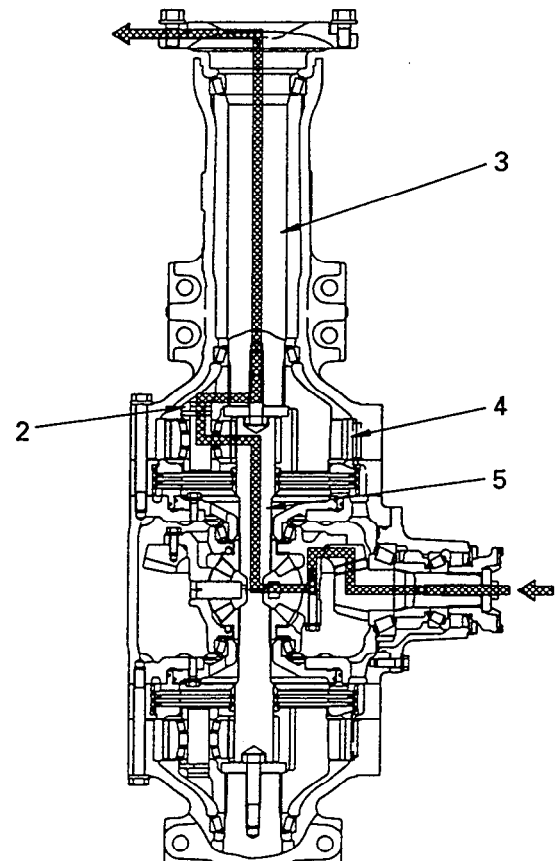


SAW00493

1. Planetary gear (Teeth 27)
2. Planetary carrier
3. Axle shaft
4. Ring gear (Teeth 72)
5. Sun gear shaft (Teeth 18)

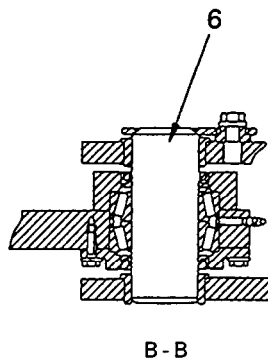
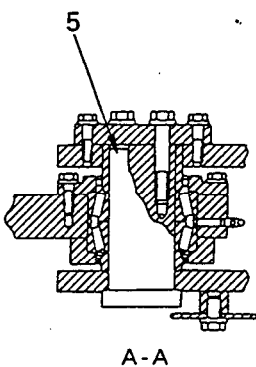
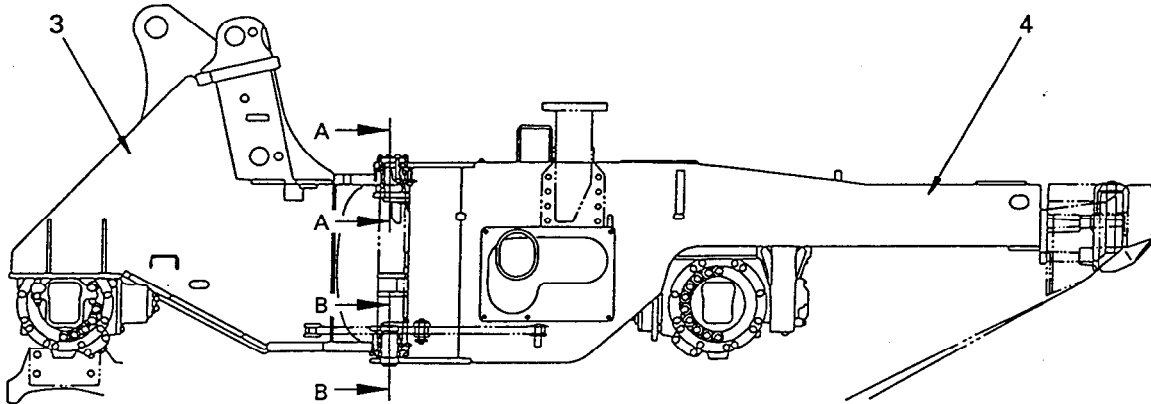
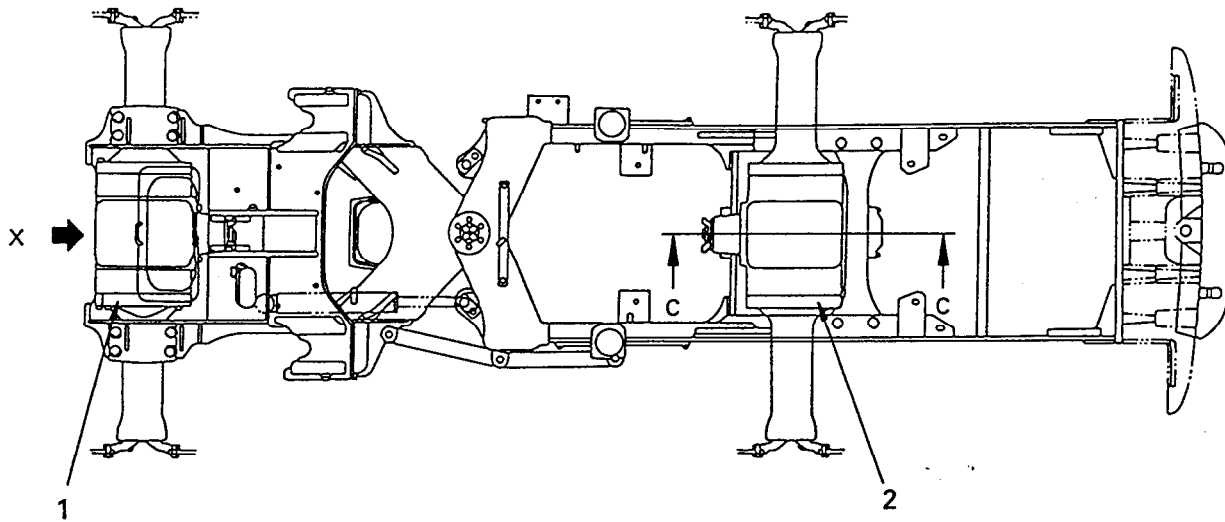
Outline

- As the final function the final drive operates to reduce the rotative speed of the motive force from the engine and increases the driving force.
 - Ring gear (4) is press-fitted in the axle housing and fixed in place by a pin.
 - The motive force transmitted from the differential to the sun gear shaft (5) is reduced using a planetary gear mechanism, increasing the driving force.
- The increased driving force is transmitted to the tires via planetary gear (2) and axle shaft (3).



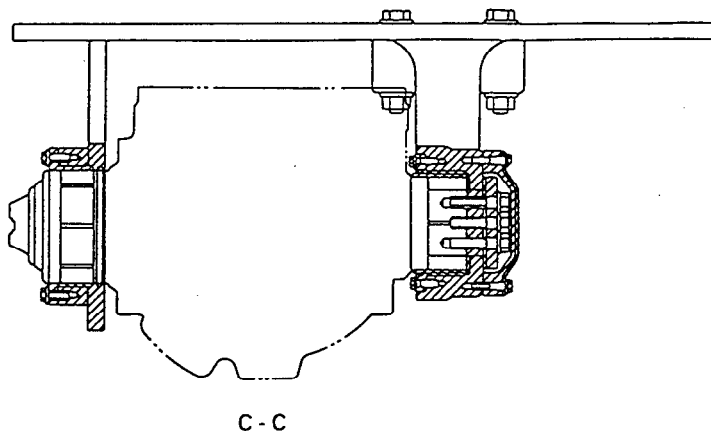
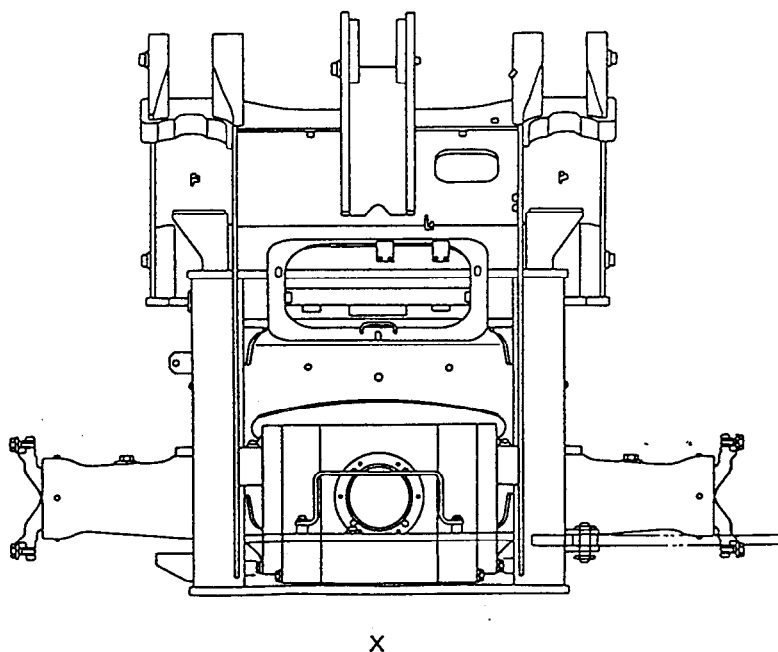
SAW00494

AXLE MOUNT, CENTER HINGE PIN



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

SBW00495



SLW00496

FRONT AXLE

- Front axle (1) is fixed directly to front frame (3) by tension bolts so that it receives the force during operations directly.

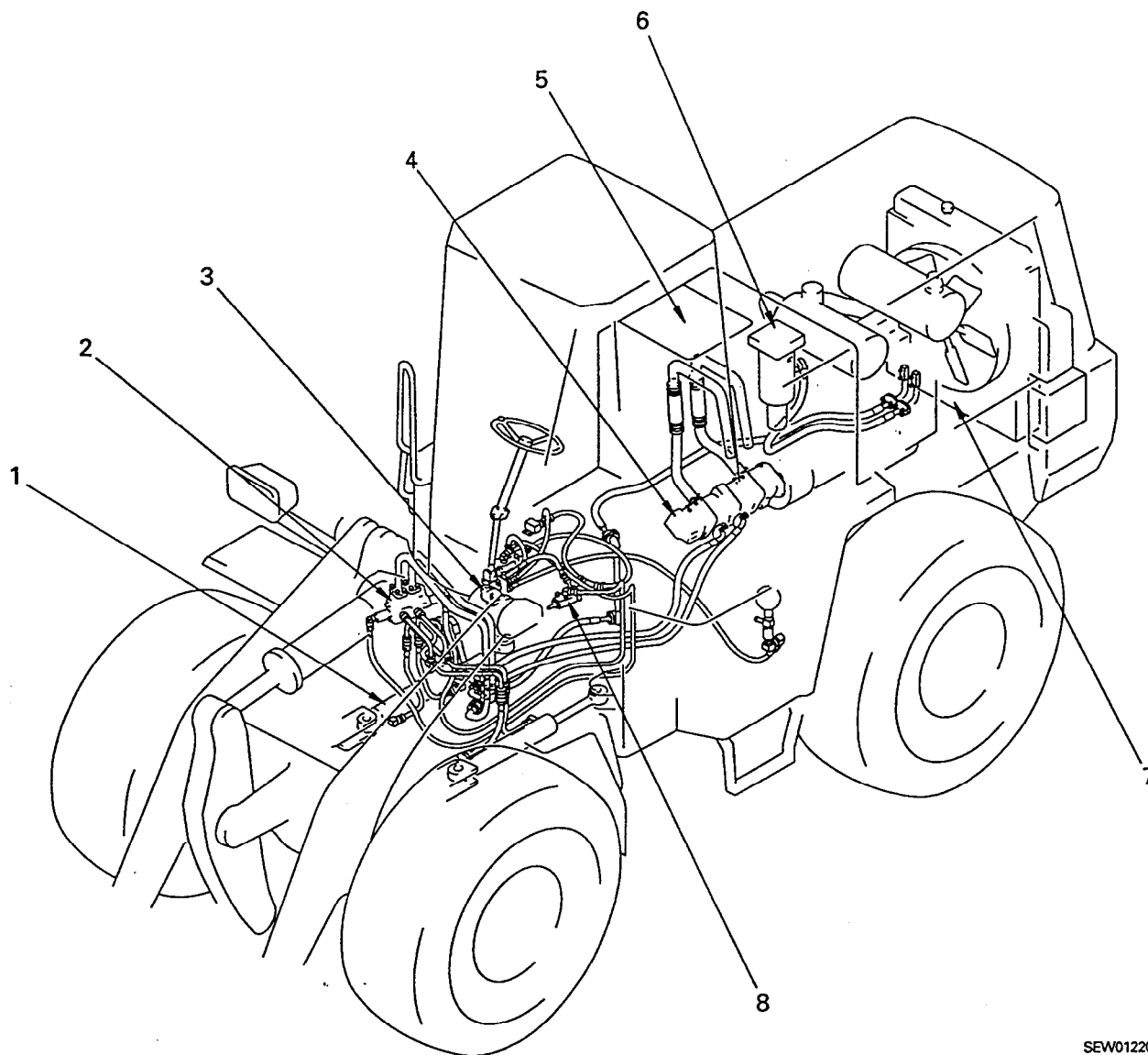
REAR AXLE

- Rear axle (2) has a structure which allows the center of rear frame (4) to float so that all the tires are in contact with the ground surface, even when traveling on soft ground.

CENTER HINGE PIN

- Front frame (3) 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.

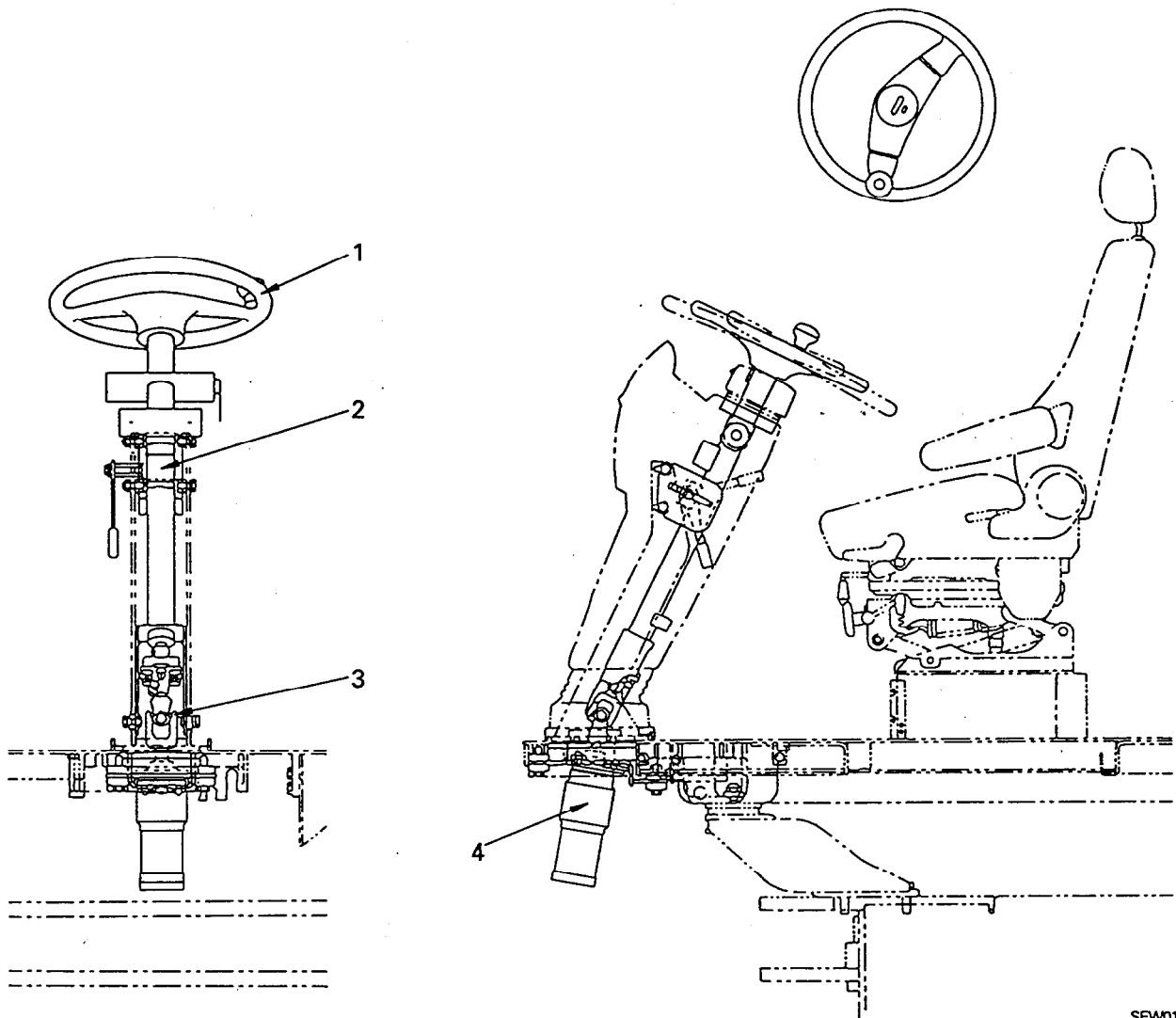
STEERING PIPING



SEW01220

1. Steering cylinder
2. Steering valve
3. Orbit-roll valve
4. Hydraulic pump
5. Hydraulic tank
6. Oil filter
7. Oil cooler
8. Stop valve

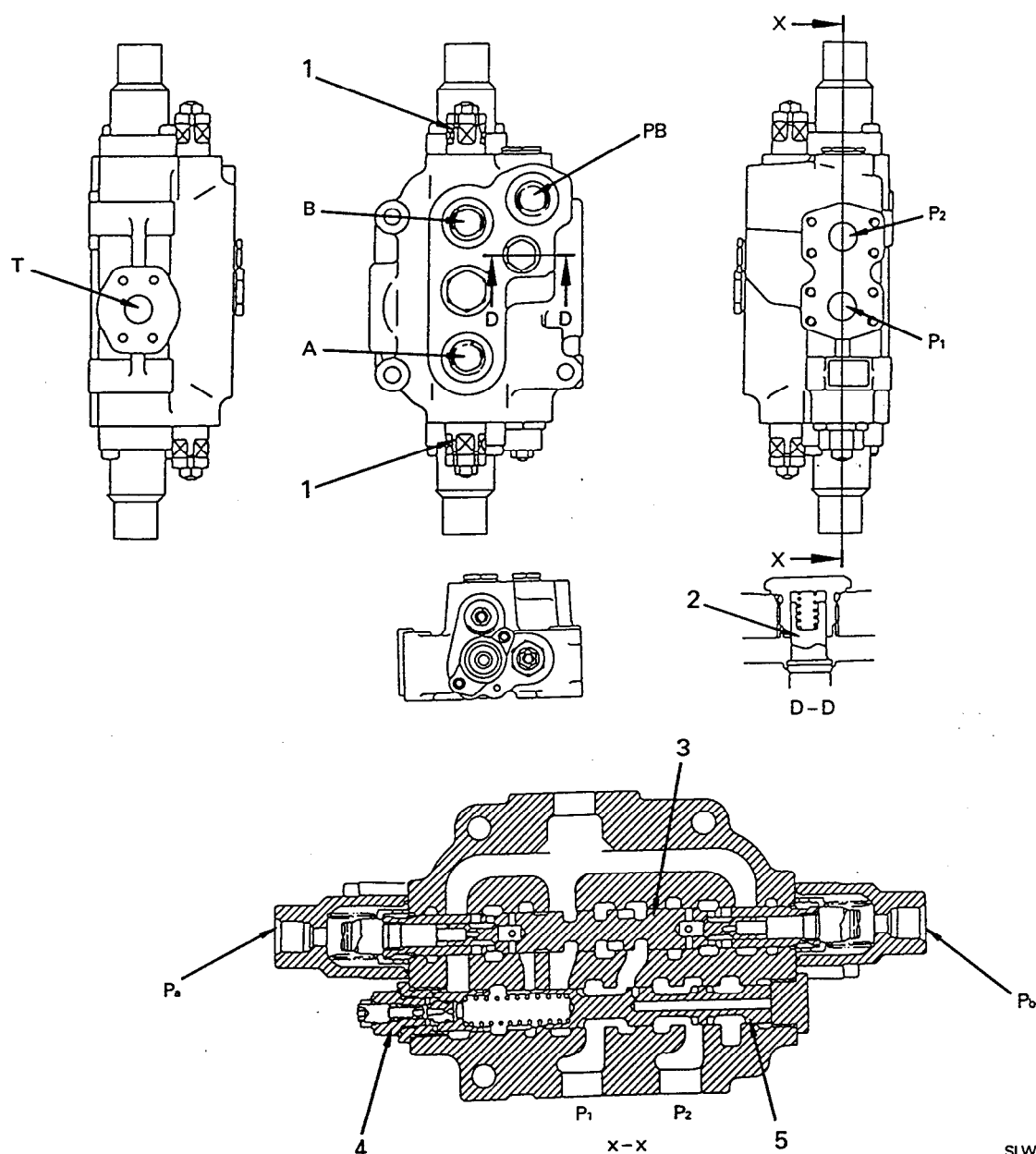
STEERING COLUMN



SEW01221

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

STEERING VALVE



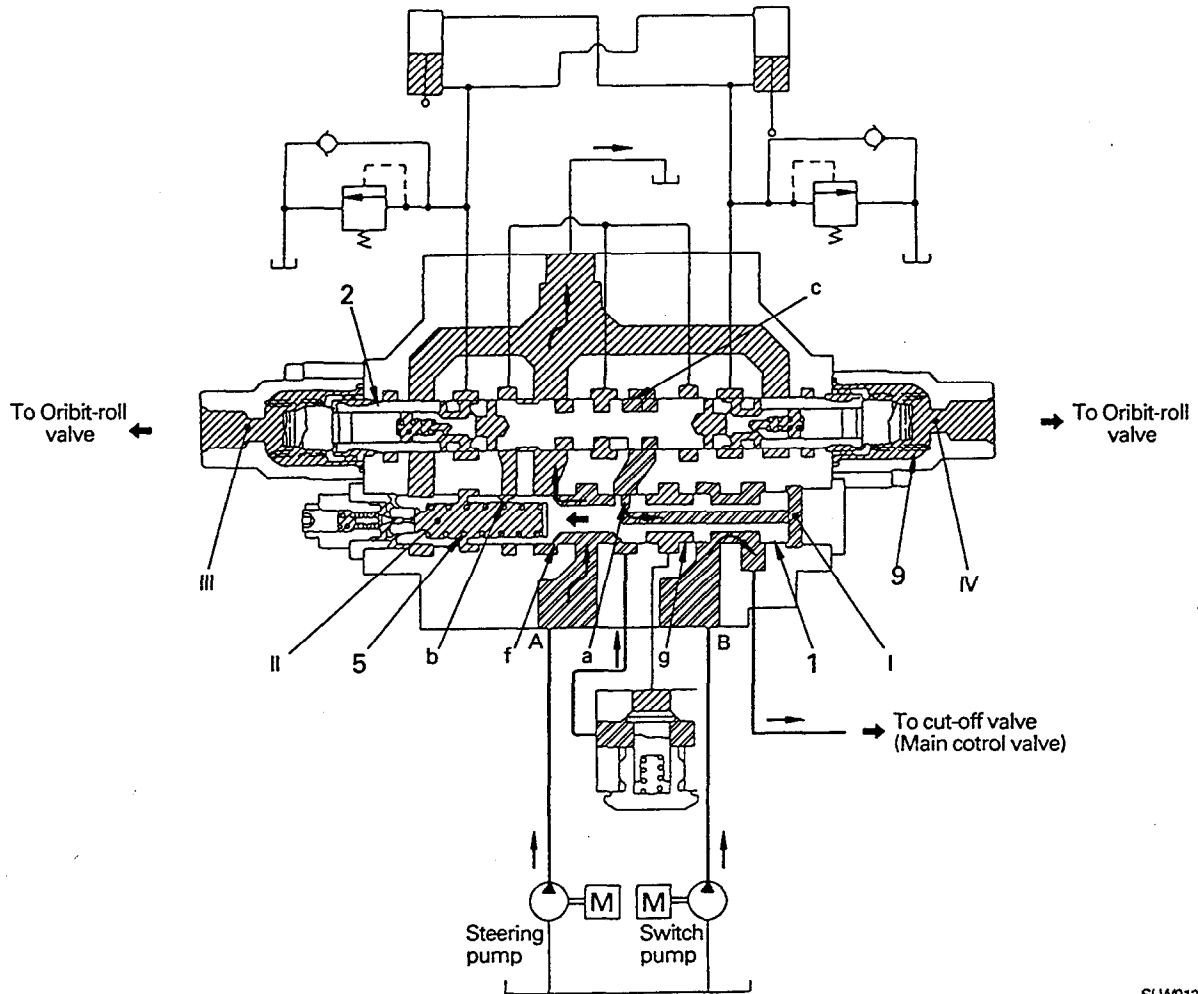
SLW01222

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)

OPERATION OF DEMAND VALVE

STEERING SPOOL AT NEUTRAL

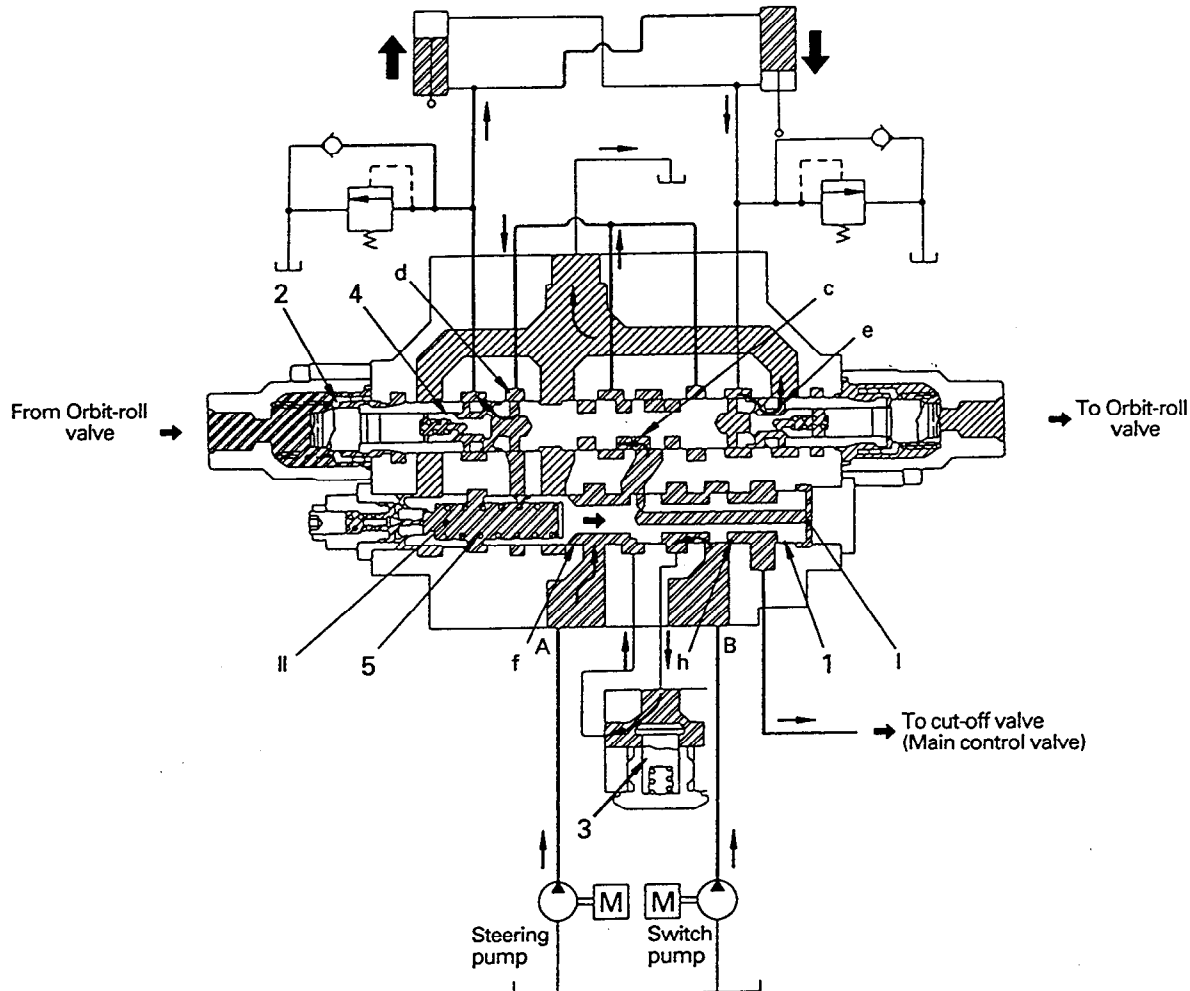


SLW01223

- 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

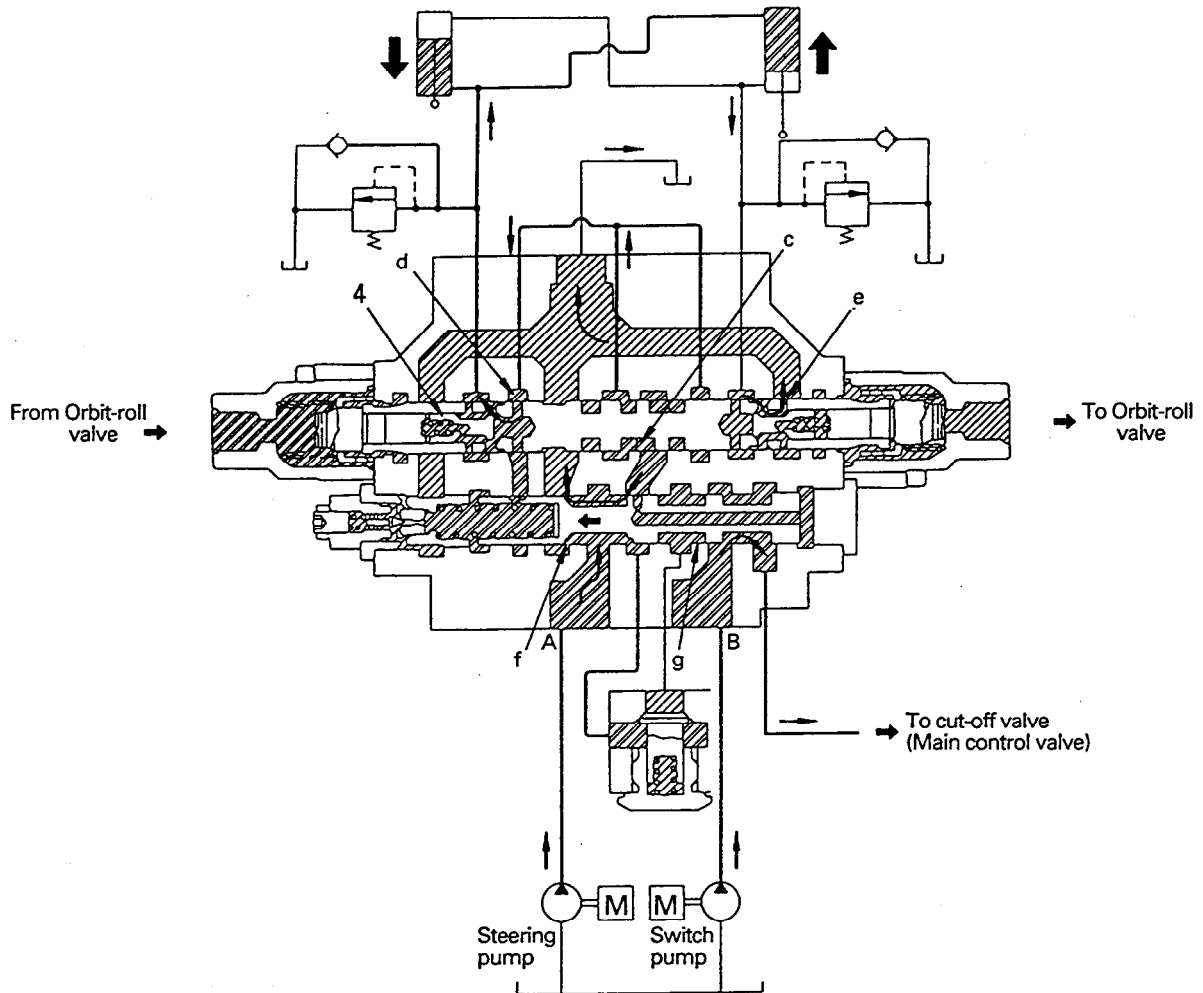
- Engine at low speed



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 (III). 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



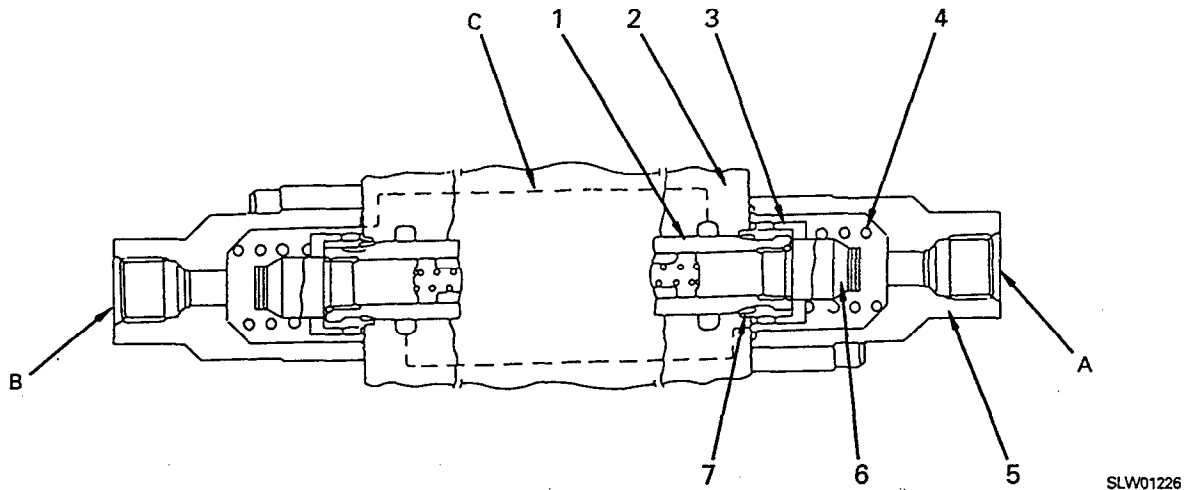
SLW01225

- 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

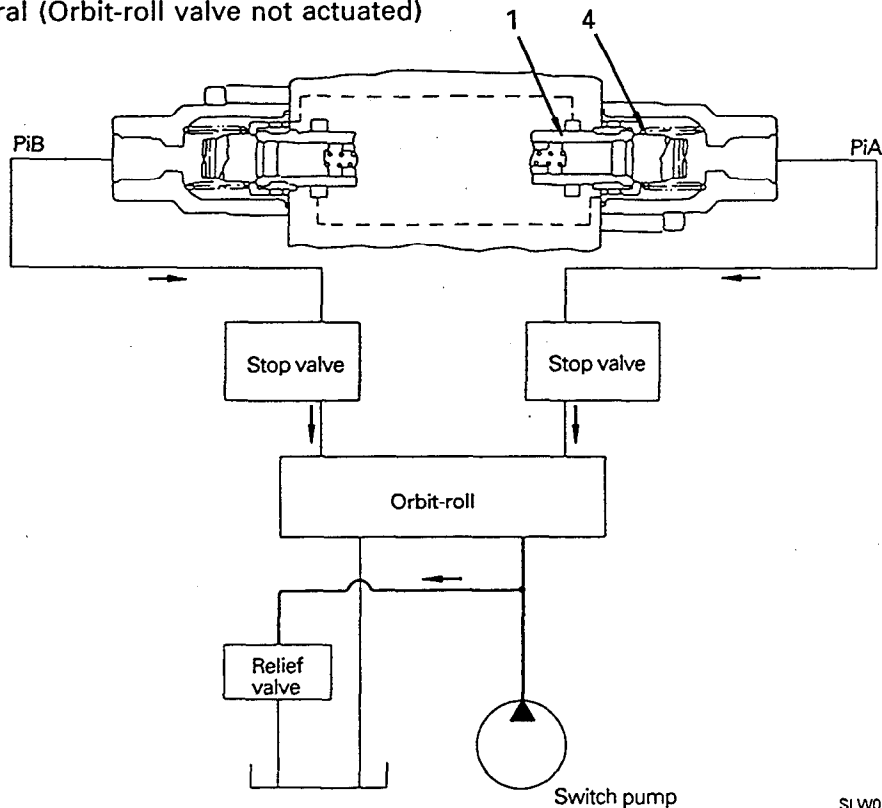
FLOW AMP



- | | | |
|-------------------------|-------------------|-----------------------------|
| 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 | | |

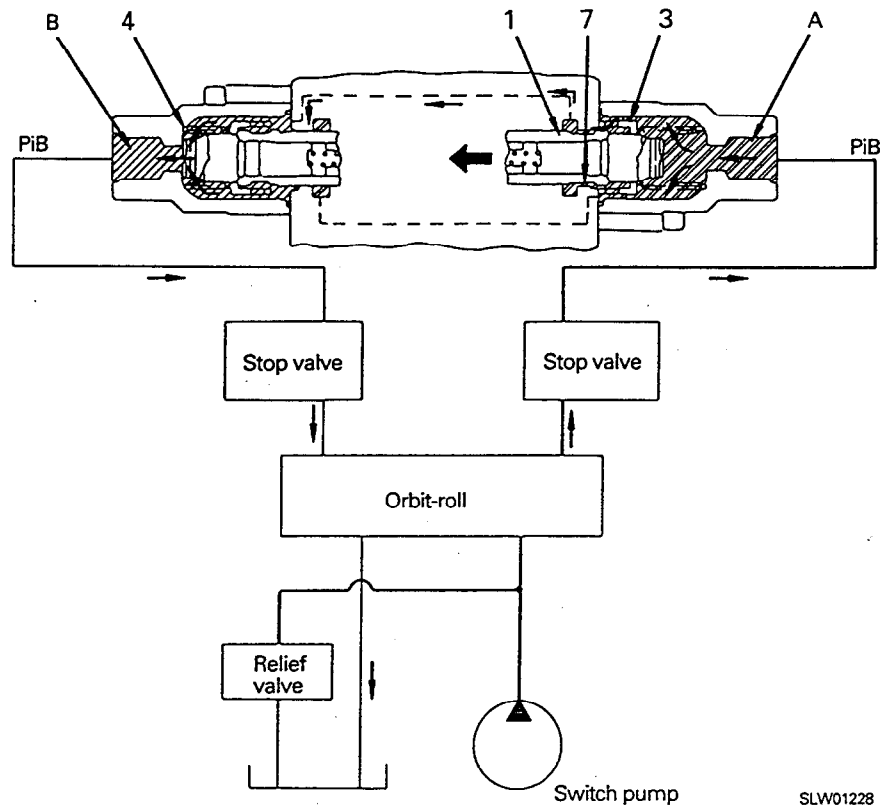
• Operation of flow amp

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).

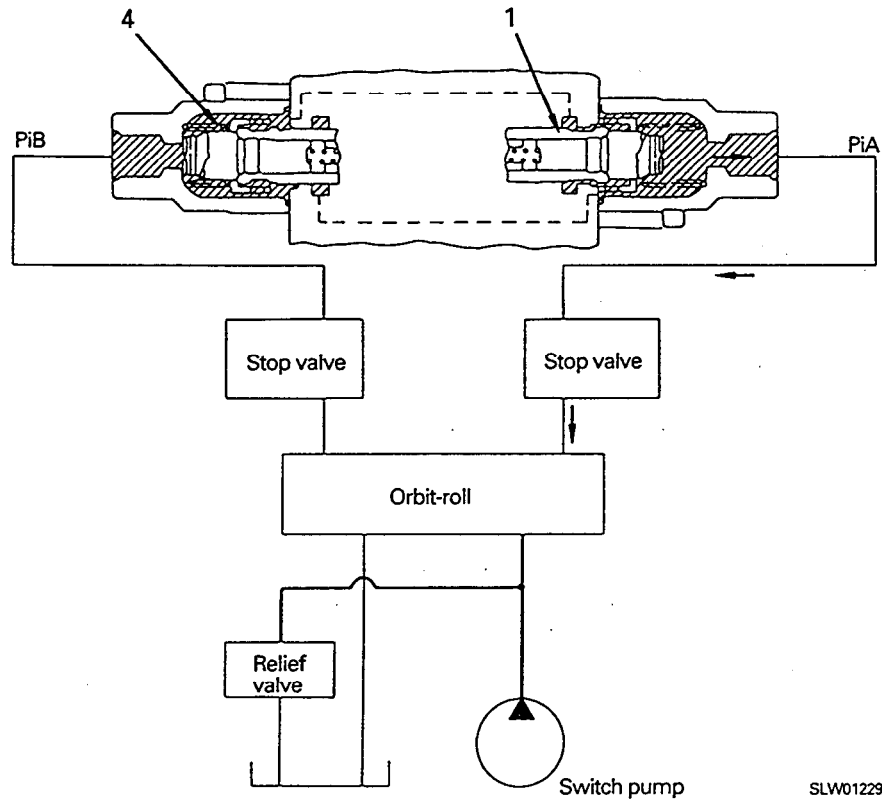
2. Spool actuated (oil flows to port **PiA**)



SLW01228

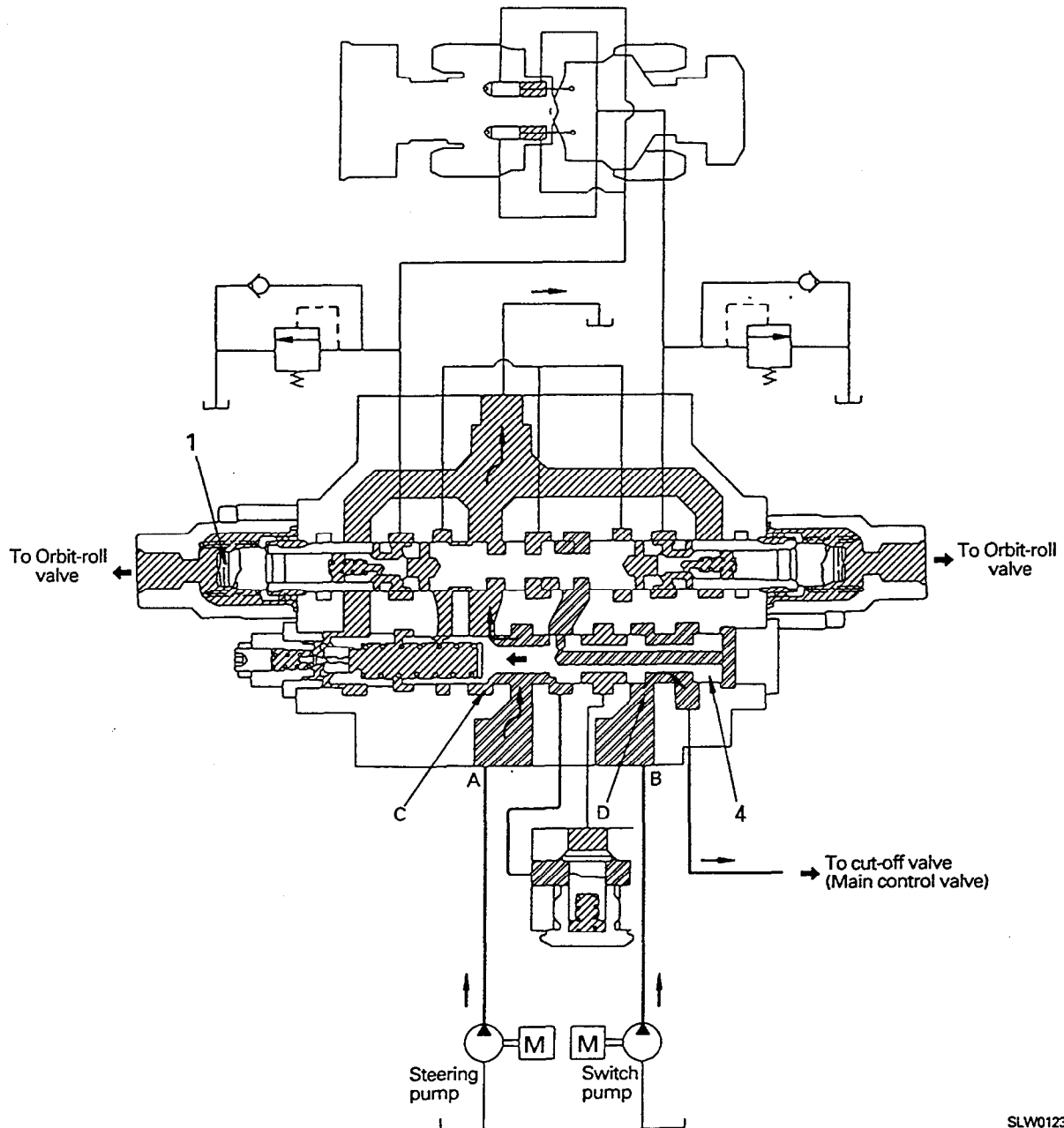
- When oil flows to port **PiA**, the pressure inside the cap at end **A** rises and moves steering spool (1) in the direction of the arrow.
- The oil entering from port **PiA** passes through the hole in spring seat (3), through flow amp notch (7) in steering spool (1), and then flows to the opposite 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).

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



SLW01229

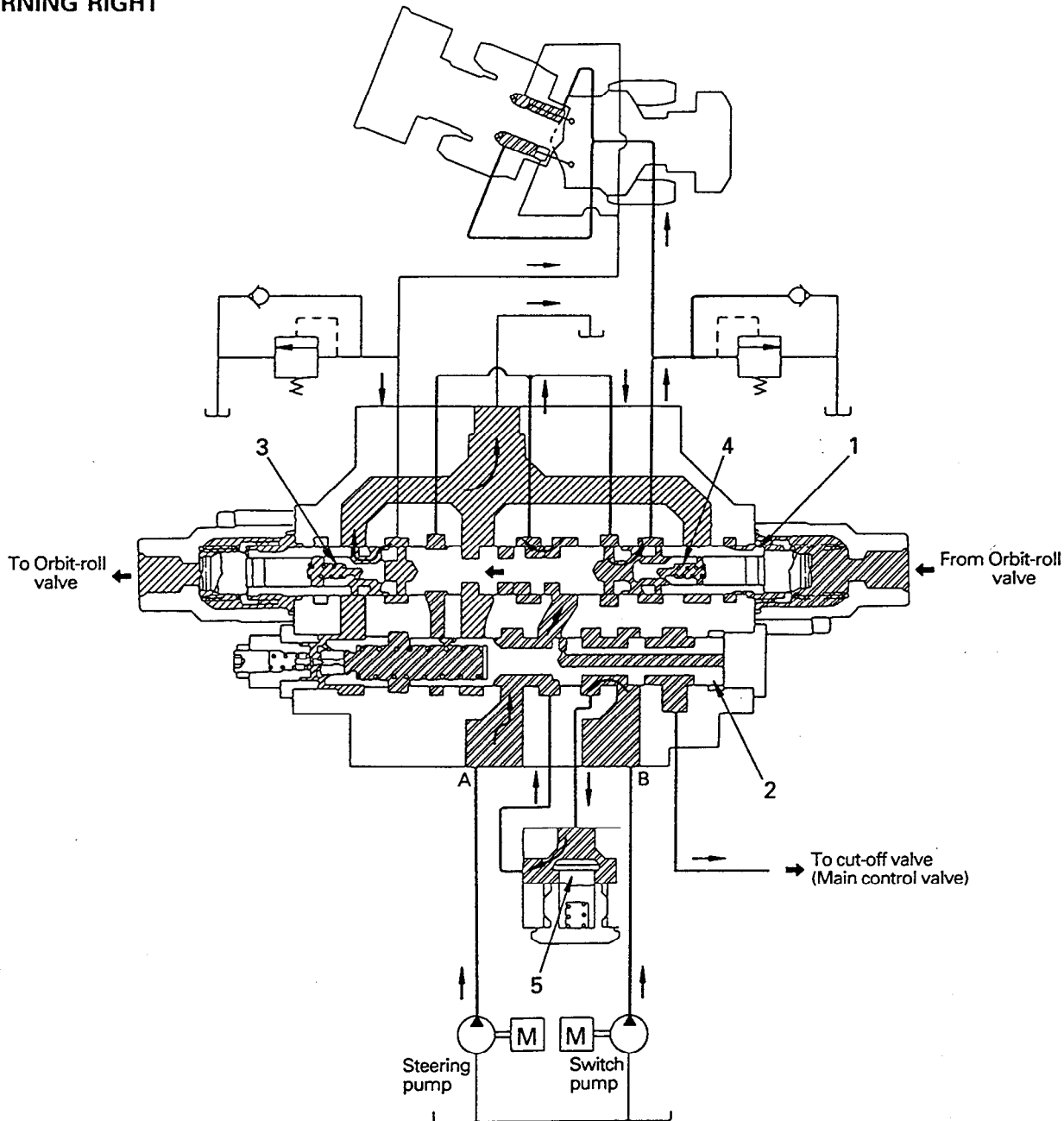
- When the steering wheel (Orbit-roll valve) is stopped, ports **PiA** and **PiB** are both connected to the drain circuit through the Orbit-roll valve. For this reason, steering spool (1) is returned to the neutral position by return spring (4).

OPERATION OF STEERING VALVE**NEUTRAL**

SLW01230

- 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

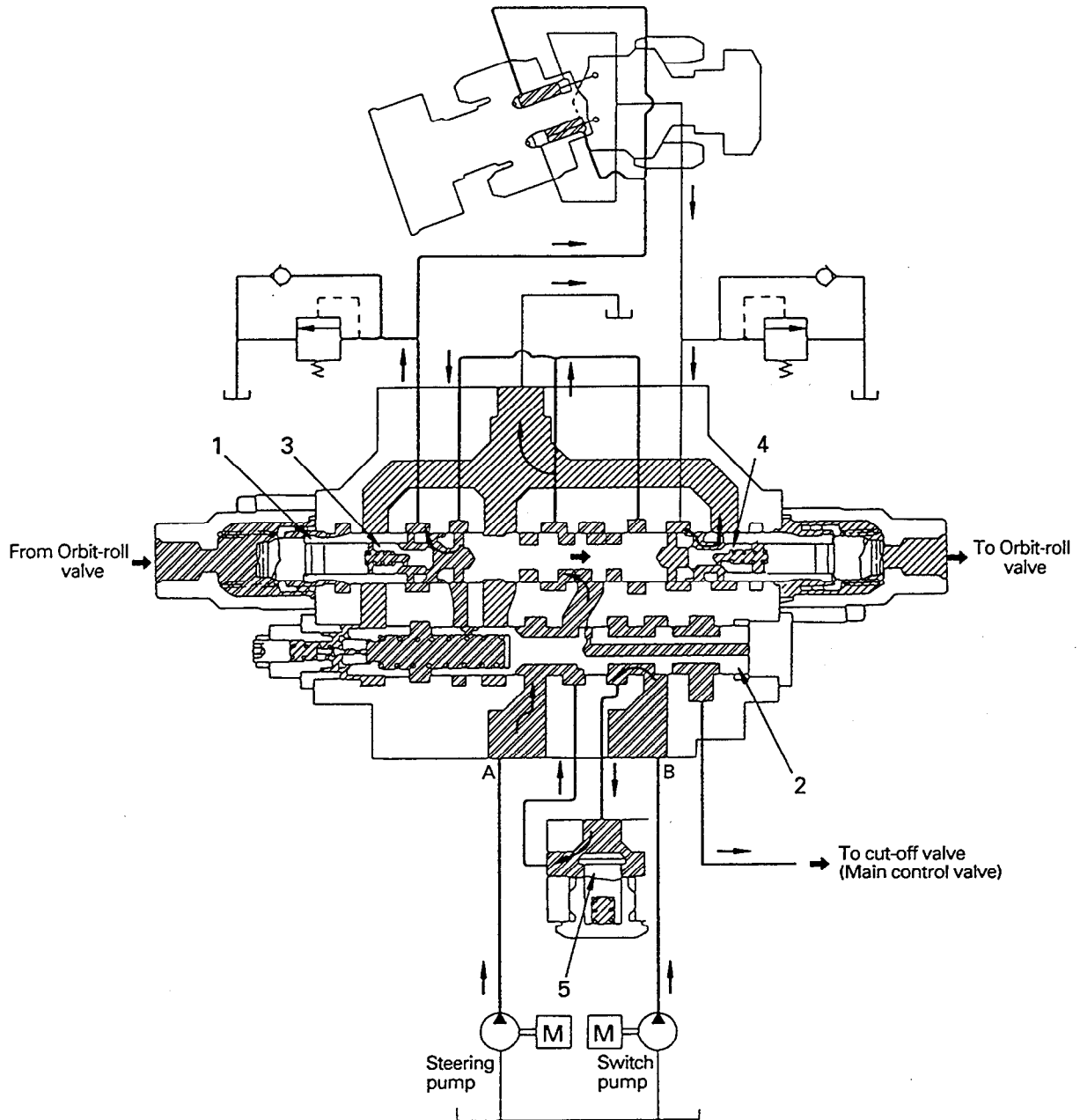


SLW01231

- 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.

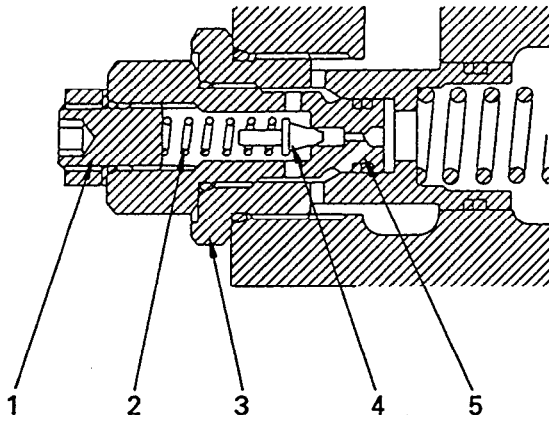
TURNING LEFT



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.

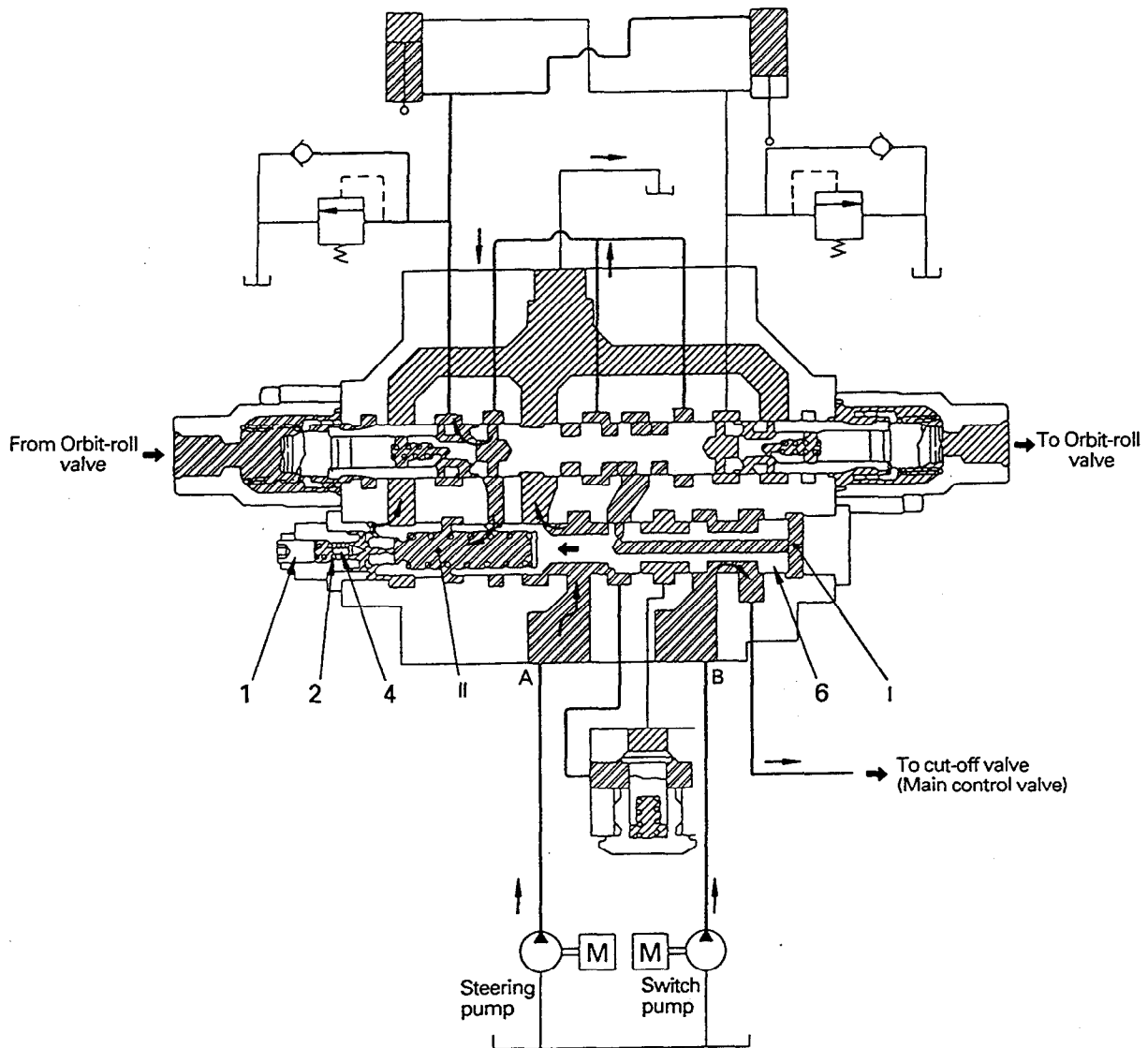
STEERING RELIEF VALVE

SEW00097

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

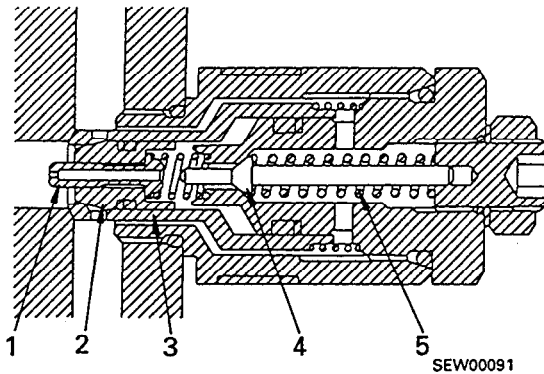
Function

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

SLW01233

- 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)

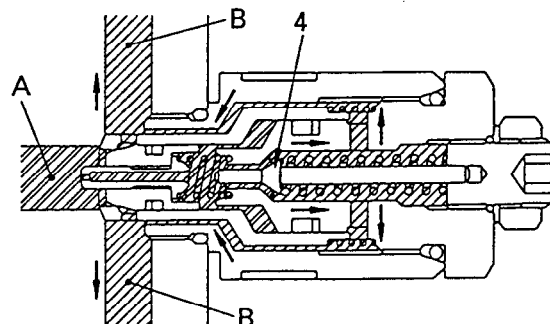
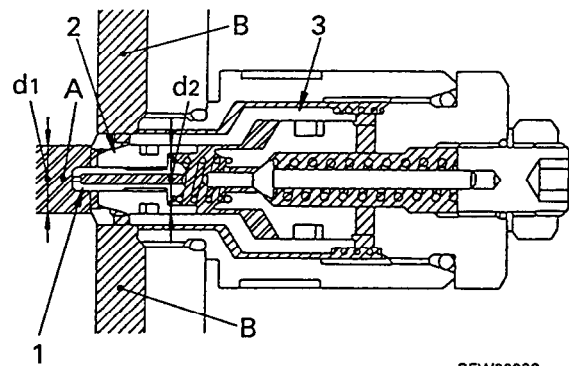
1. Poppet
2. Relief valve poppet
3. Check valve poppet
4. Pilot poppet
5. Spring

Function

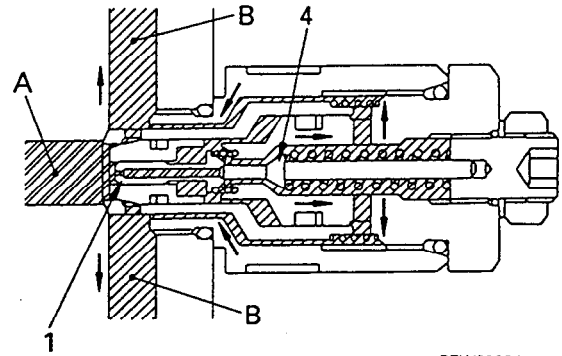
- The overload relief valve is installed to the steering valve. It has the following two functions: When the steering valve is at neutral, if any shock is applied to the cylinder, and an abnormal pressure is generated, the oil is relieved from this valve. In this way, it functions as a safety valve to 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 d_1 and d_2 , 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**.

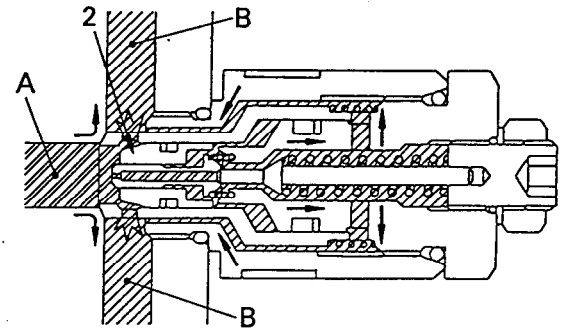


- When pilot poppet (4) opens, the pressure at the back of poppet (1) drops, so poppet (1) moves and is seated with pilot poppet (4).



SEW00094

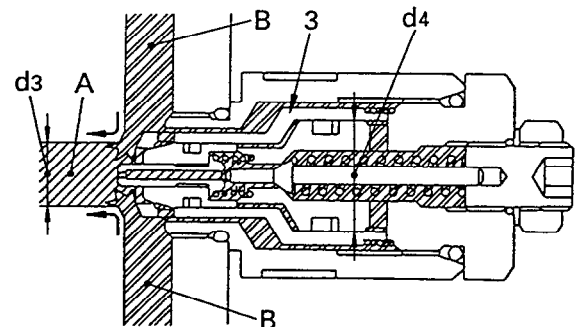
- Compared with the pressure at port A, the internal pressure is low, so relief valve poppet (2) opens. When this happens, the oil flows from port A to port B, and prevents any abnormal pressure from forming.



SEW00095

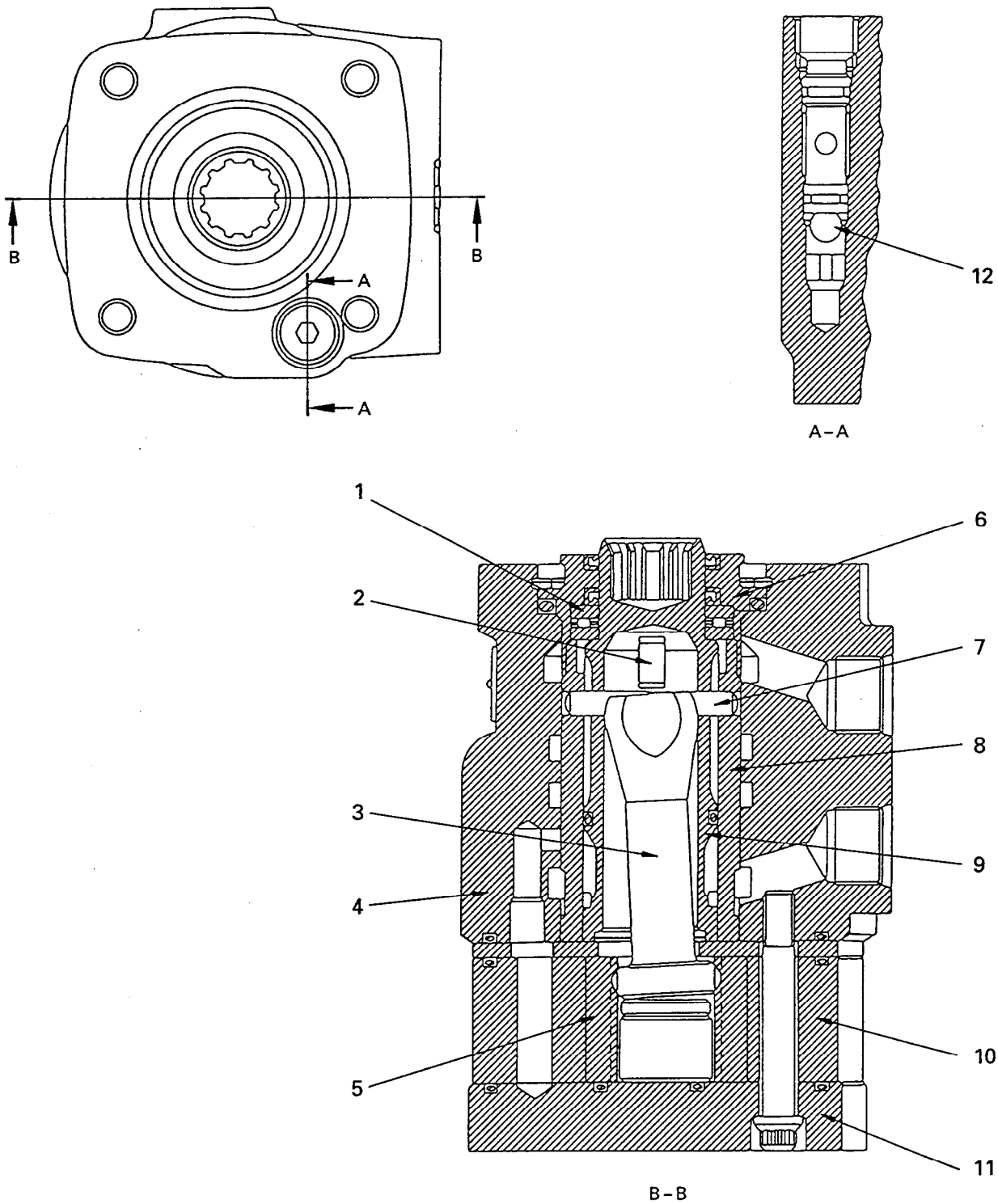
Acting as suction valve

- When negative pressure is formed at port A, the difference in area of diameters d_3 and d_4 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



SEW01234

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

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

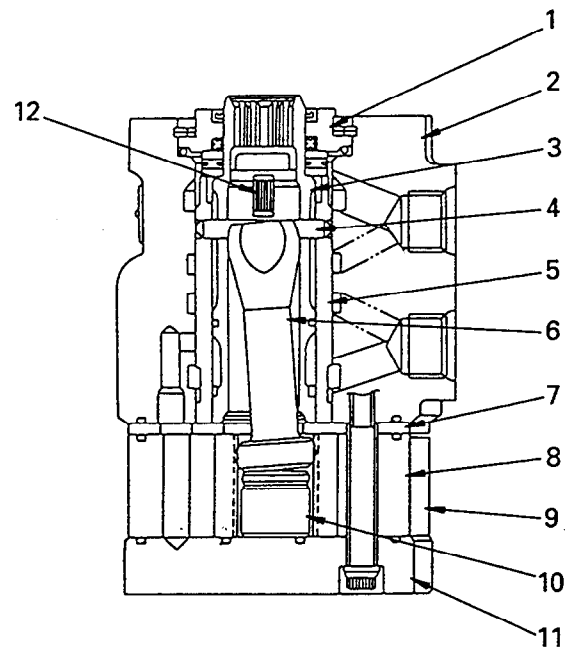
- 9. Spool
- 10. Stator
- 11. Lower cover
- 12. Check valve

Outline

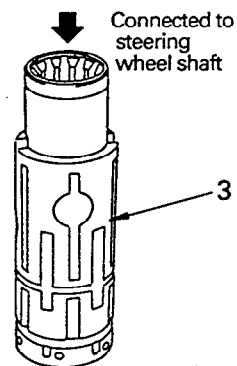
- The steering valve is connected directly to the shaft of the steering wheel. It switches the flow of oil from the steering pump to the left and right steering cylinders to determine the direction of travel of the machine.
- The steering valve, broadly speaking, consists of the following components: 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.

Structure

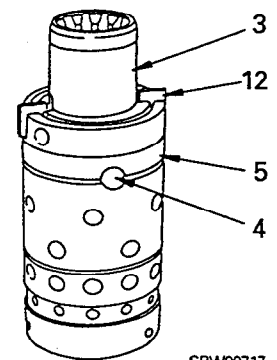
- Spool (3) is directly connected to the drive shaft of the steering wheel, and is connected to sleeve (5) by center pin (4) (it does not contact the spool when the steering wheel is at neutral) and centering spring (12).
- The top of drive shaft (6) is meshed with center pin (4), and forms one unit 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.



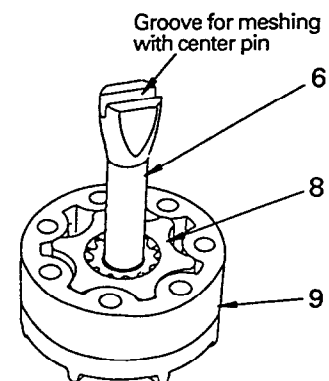
SBW00715



SBW00716

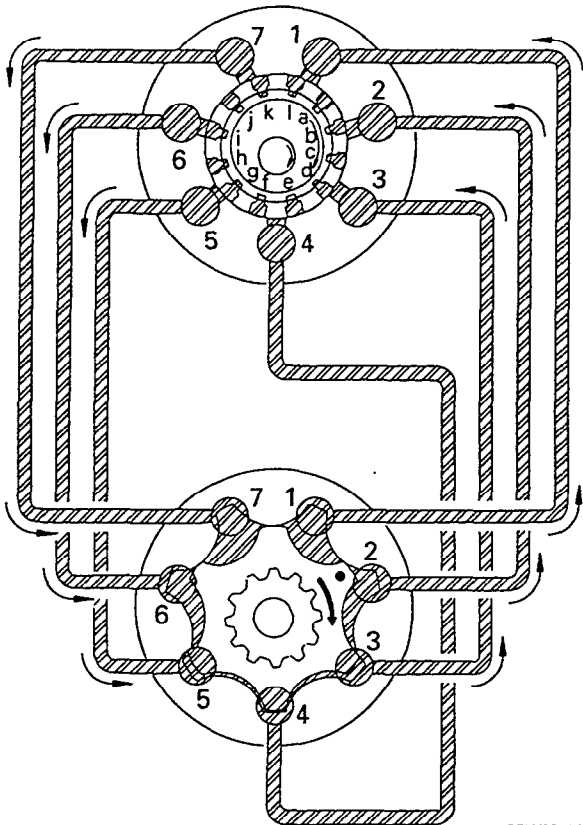


SBW00717

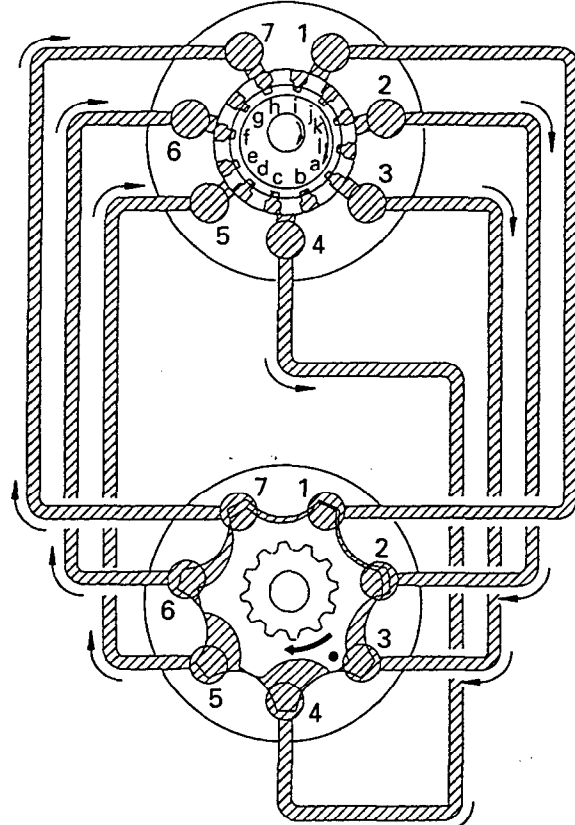


SBW00718

CONNECTION BETWEEN HAND PUMP AND SLEEVE

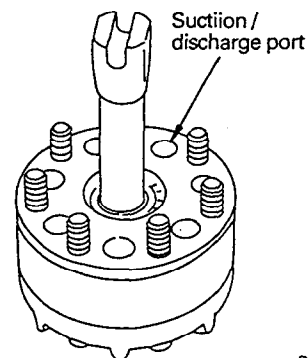


SBW00725

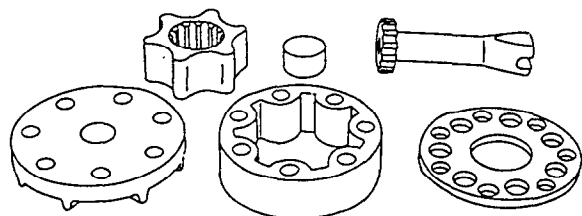


SBW00726

- 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

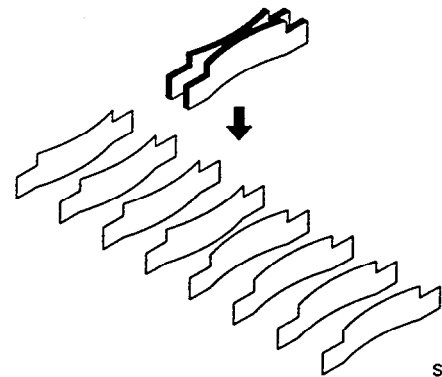


SBW00728

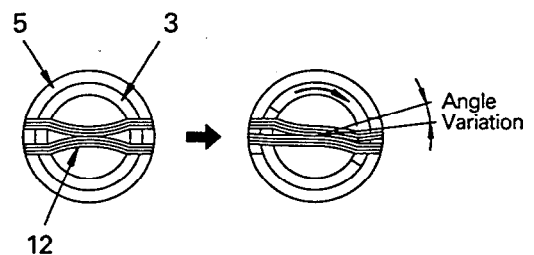
- In this way, the ports of the Girotor acting as delivery ports are connected to ports which are connected to the end of the steering valve spool. The ports acting as suction ports are connected to the pump circuit.
- Adjusting delivery in accordance with angle of steering wheel:
For every 1/7 turn 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.

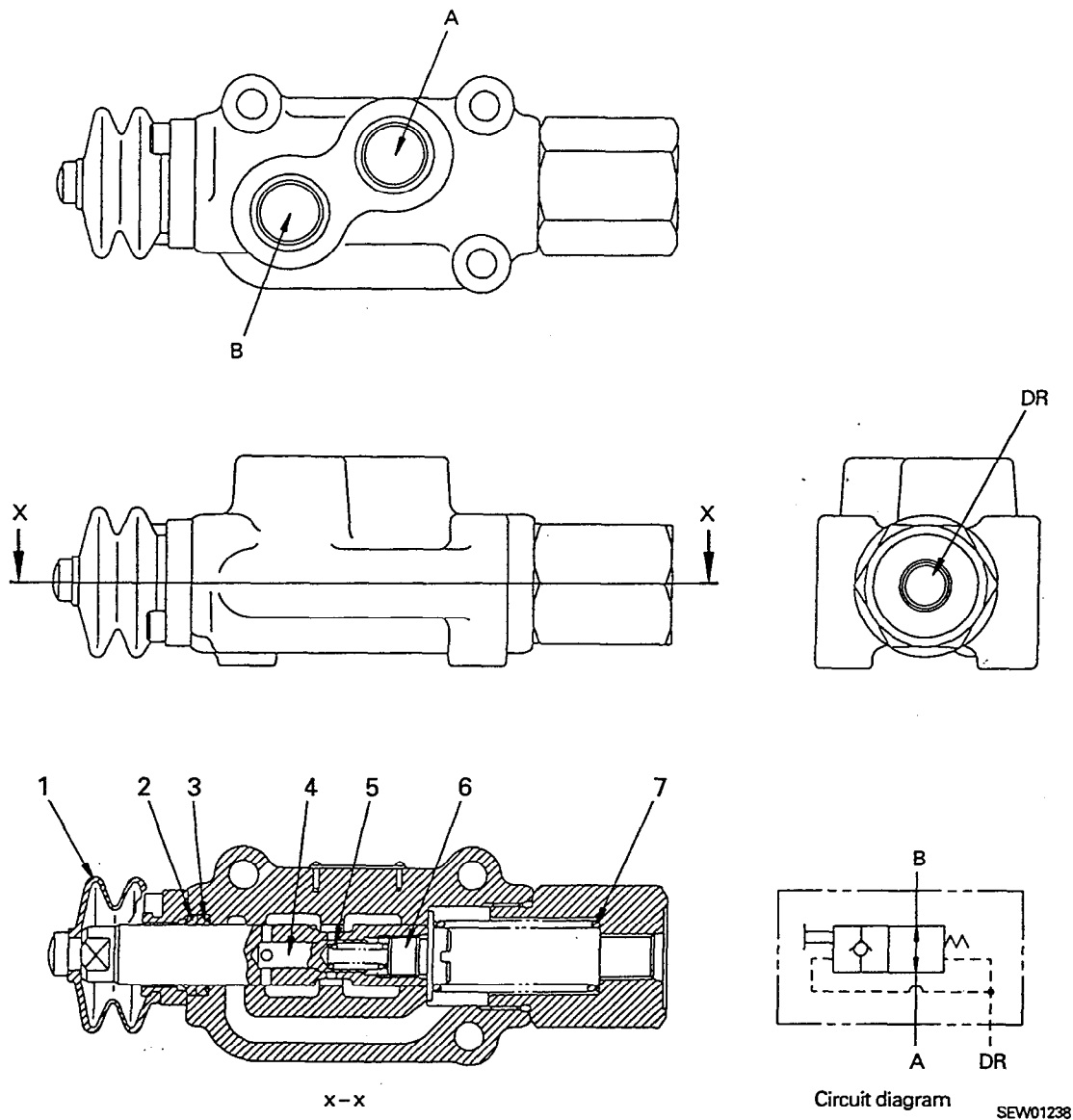


SDW01236



SDW01237

STOP VALVE

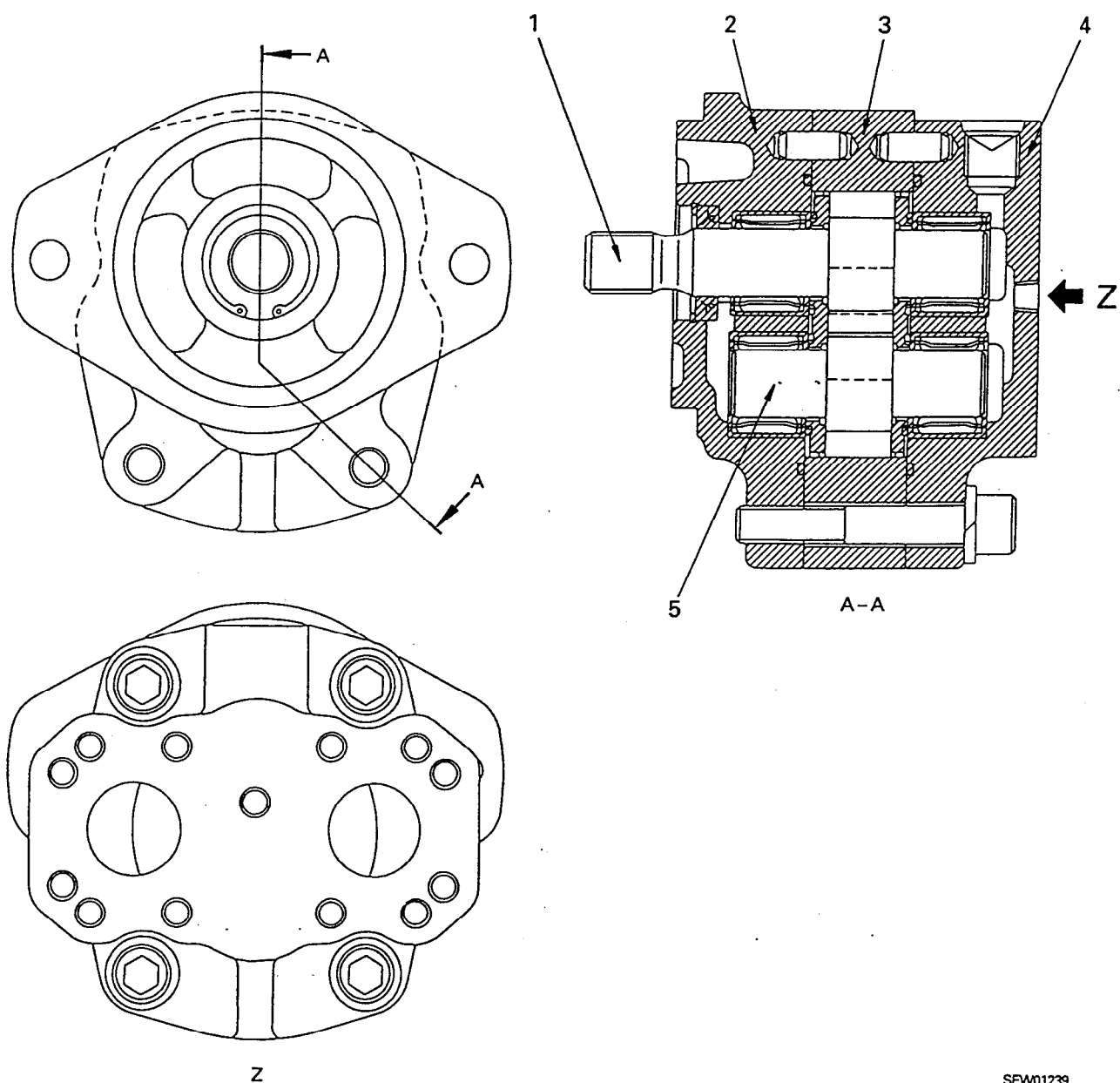


1. Boot
2. Wiper
3. Seal
4. Poppet
5. Spring
6. Spool
7. Spring

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

Circuit diagram SEW01238

EMERGENCY STEERING PUMP



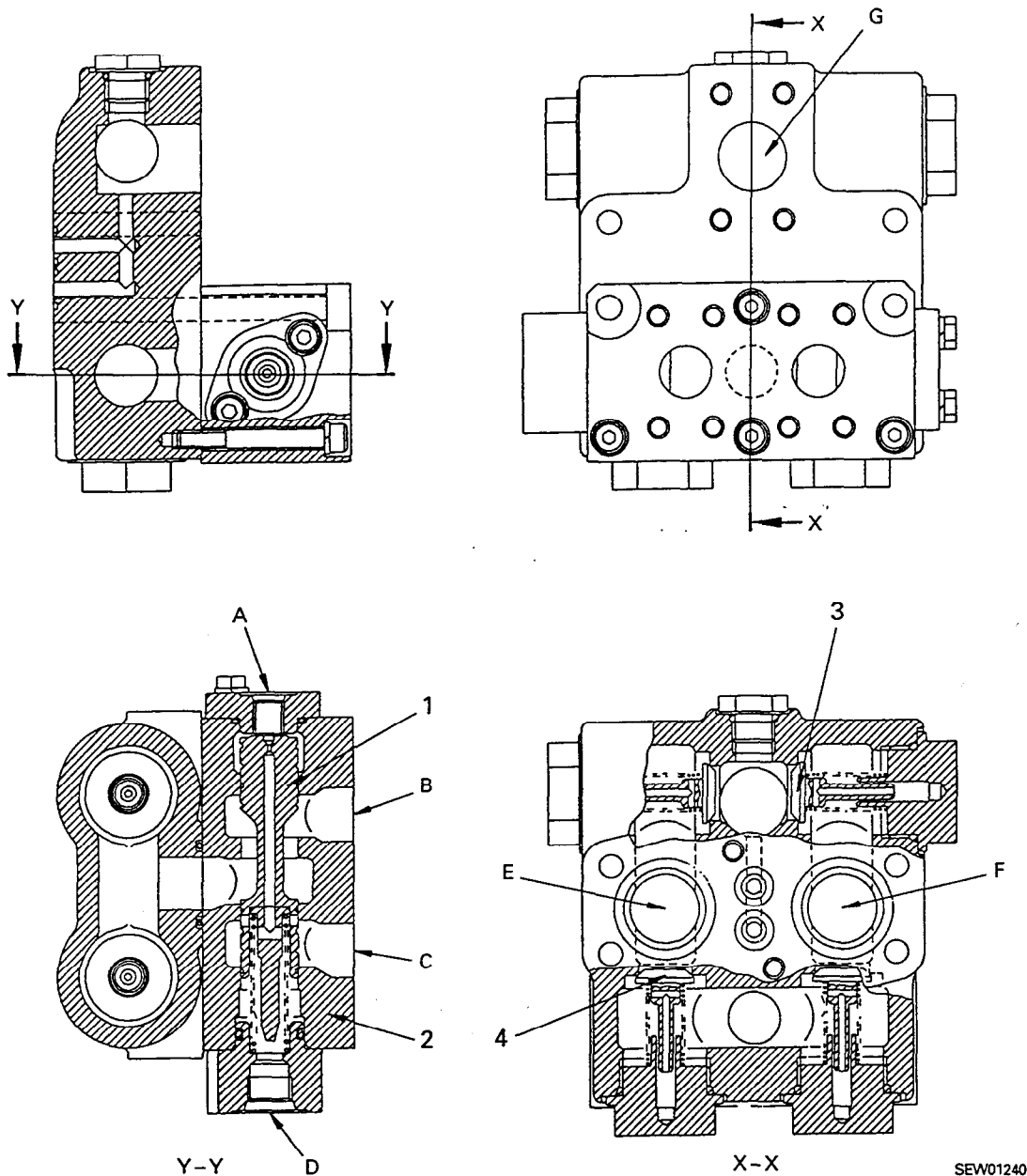
SEW01239

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

Specifications

- Model: SUM(2)-050
- Direction of revolution: Possible to rotate both direction
- Theoretical delivery: 40.2 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

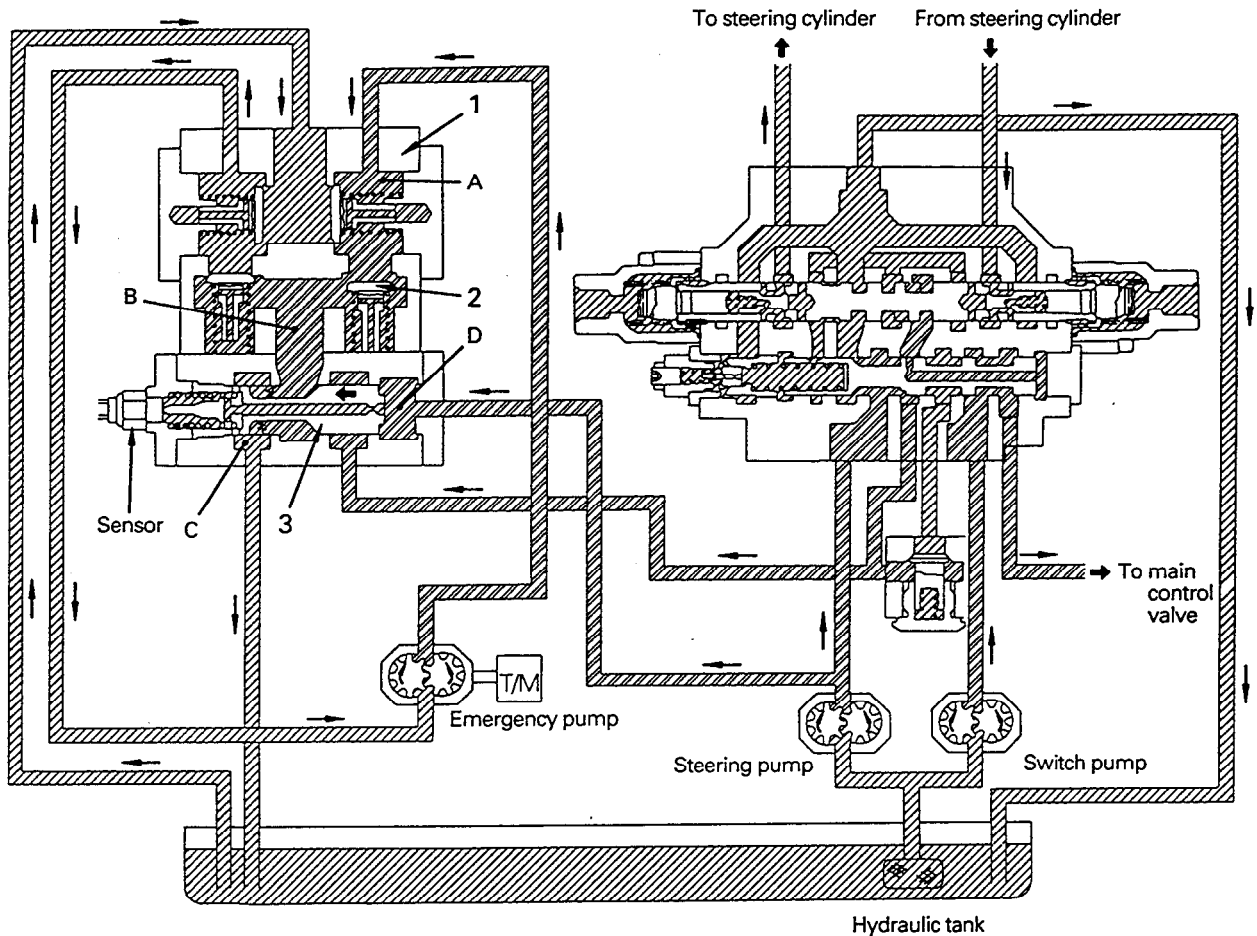
- A. From steering pump
- B. To steering valve
- C. To hydraulic tank
- D. Sensor mounting port
- E. Emergency pump port
- F. Emergency pump port
- G. From hydraulic tank

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.

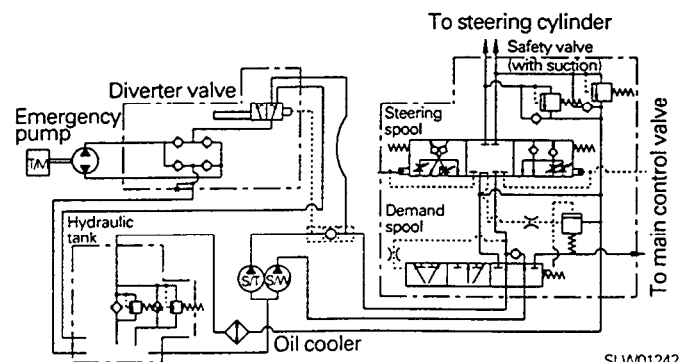
OPERATION

- Pump and engine are working normally.



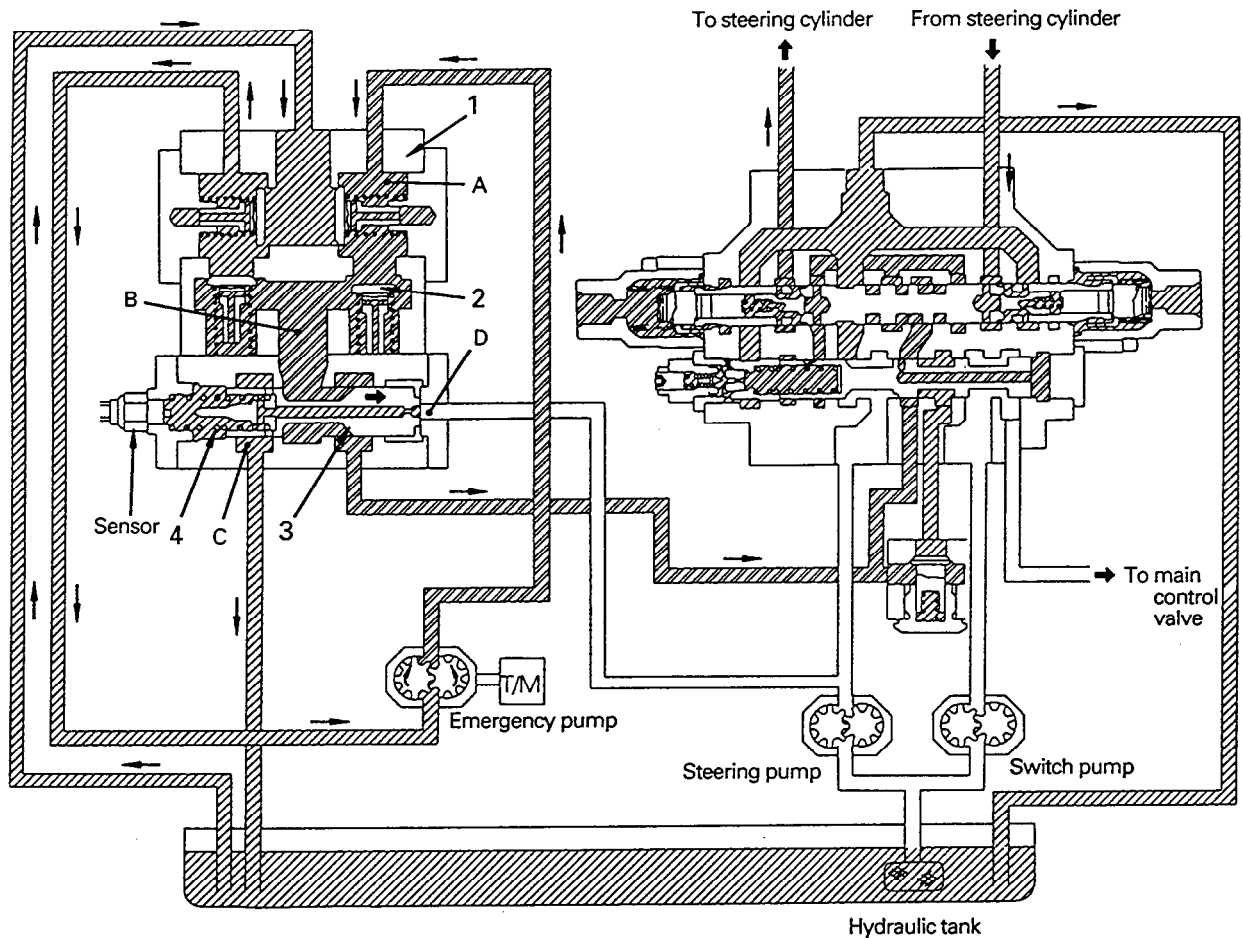
SLW01241

- 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.



SI W01242

Failure in pump or engine when machine is traveling.



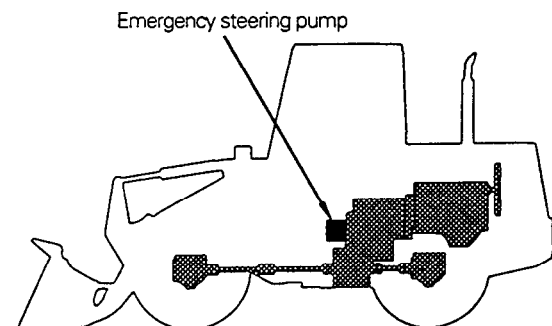
SLW01243

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).

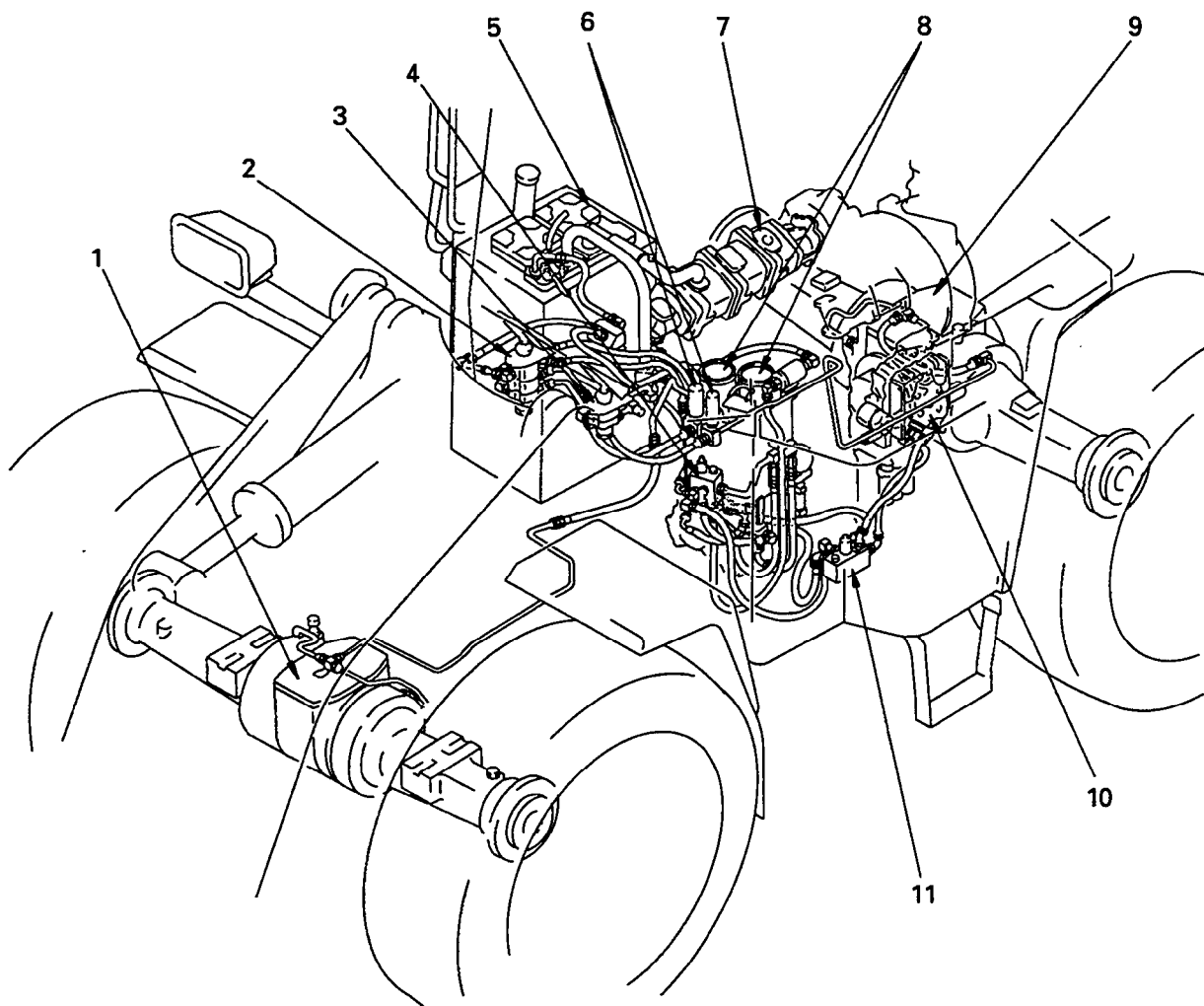
The oil from the emergency steering pump passes from port A through port B and flows to the steering valve to make steering possible.

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



SLW01244

BRAKE PIPING



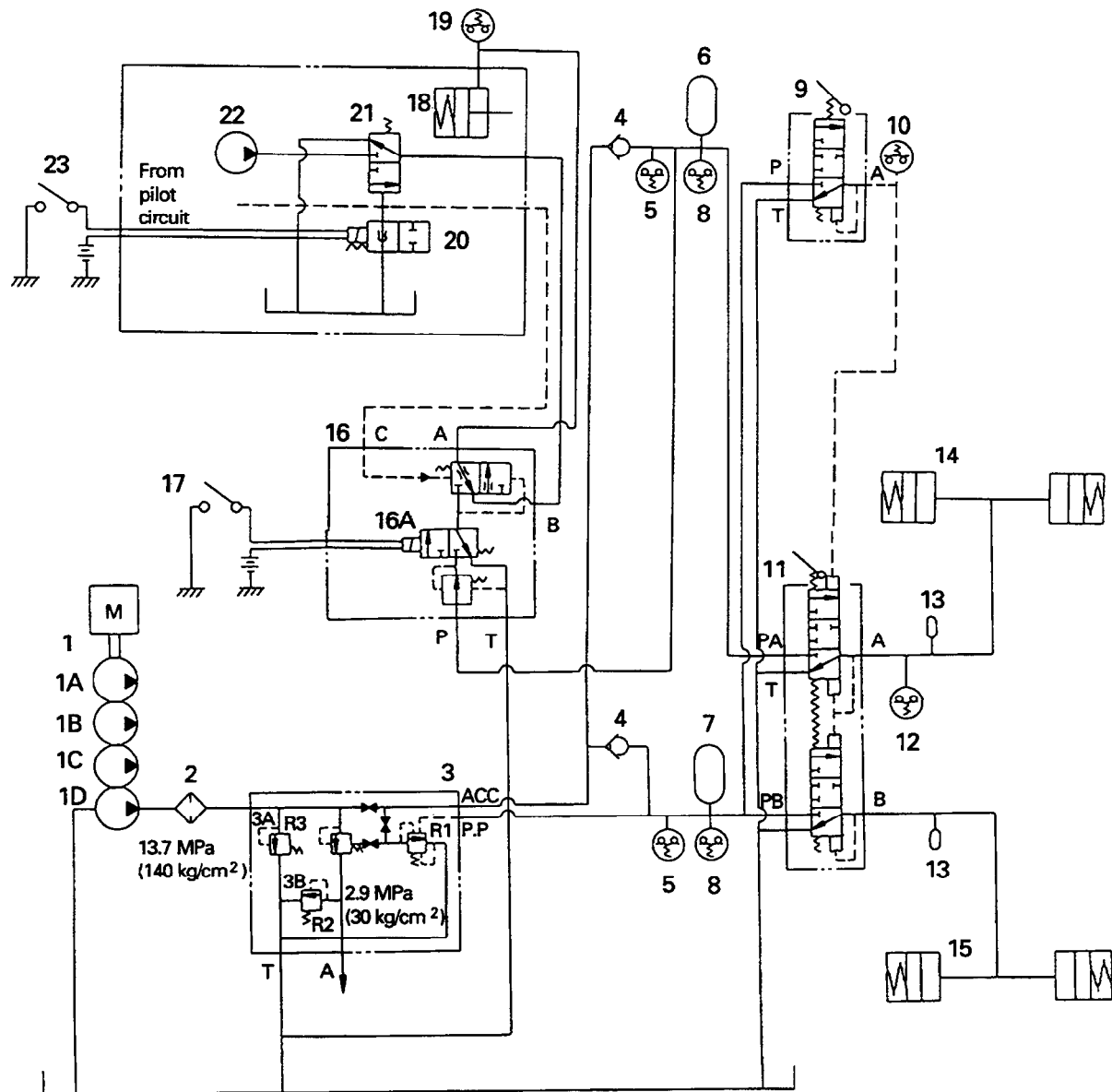
SBW00508

1. Front axle
2. Right brake valve
3. Left brake valve
4. Accumulator charge valve
5. Hydraulic oil tank
6. Accumulator
7. Hydraulic pump
8. Accumulator
9. Rear axle
10. Transmission valve
11. Emergency parking brake valve

Outline

- When the brake valve is activated, the oil sent from the pump passes through the accumulator charge valve, shuts off the drain circuit in the valve, actuates the piston, and activates the front and rear brakes.

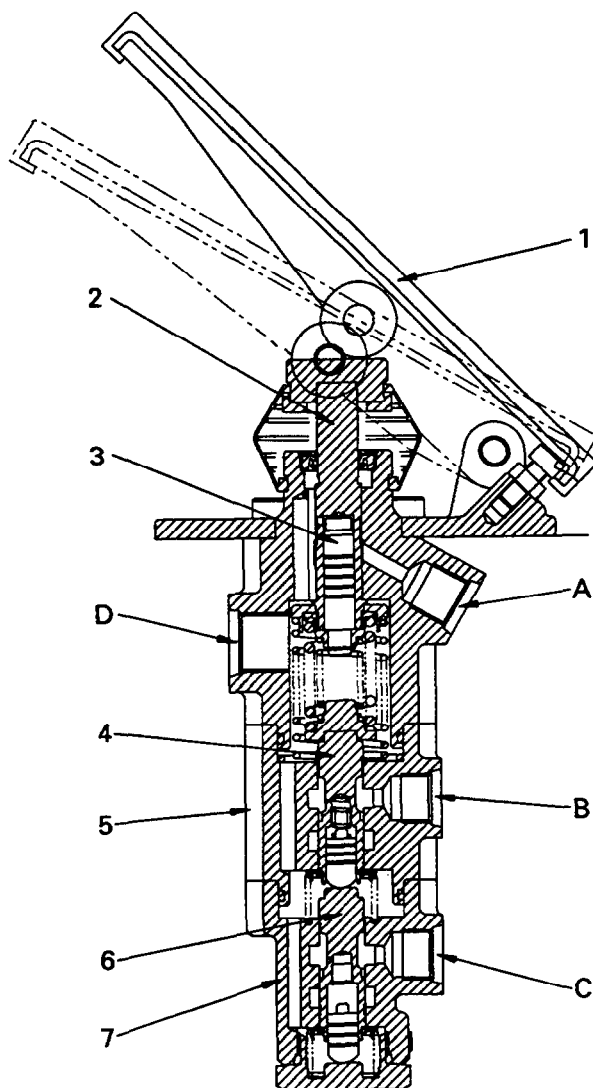
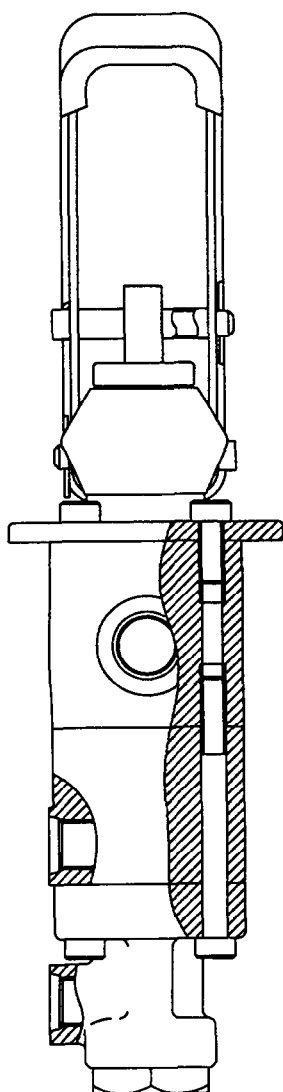
BRAKE HYDRAULIC CIRCUIT DIAGRAM



- | | | |
|-----------------------------|-----------------------------------|---|
| 1. Hydraulic pump | 6. Rear brake accumulator | 16A. Parking brake emergency release solenoid |
| 1A. Work equipment pump | 7. Front brake accumulator | 17. Parking brake emergency release switch |
| 1B. Steering pump | 8. Emergency brake switch | 18. Parking brake |
| 1C. Switch pump | 9. Left brake valve | 19. Parking brake pilot lamp switch |
| 1D. PPC and brake pump | 10. Transmission cut-off switch | 20. Parking brake solenoid |
| 2. Strainer | 11. Right brake valve | 21. Parking brake valve |
| 3. Accumulator charge valve | 12. Pilot lamp switch | 22. Transmission pump |
| 3A. Safety relief valve | 13. Accumulator | 23. Parking brake switch |
| 3B. PPC relief valve | 14. Rear brake cylinder | |
| 4. Check valve | 15. Front brake cylinder | |
| 5. Low pressure switch | 16. Emergency parking brake valve | |

SLW00509

BRAKE VALVE **BRAKE VALVE (RIGHT)**



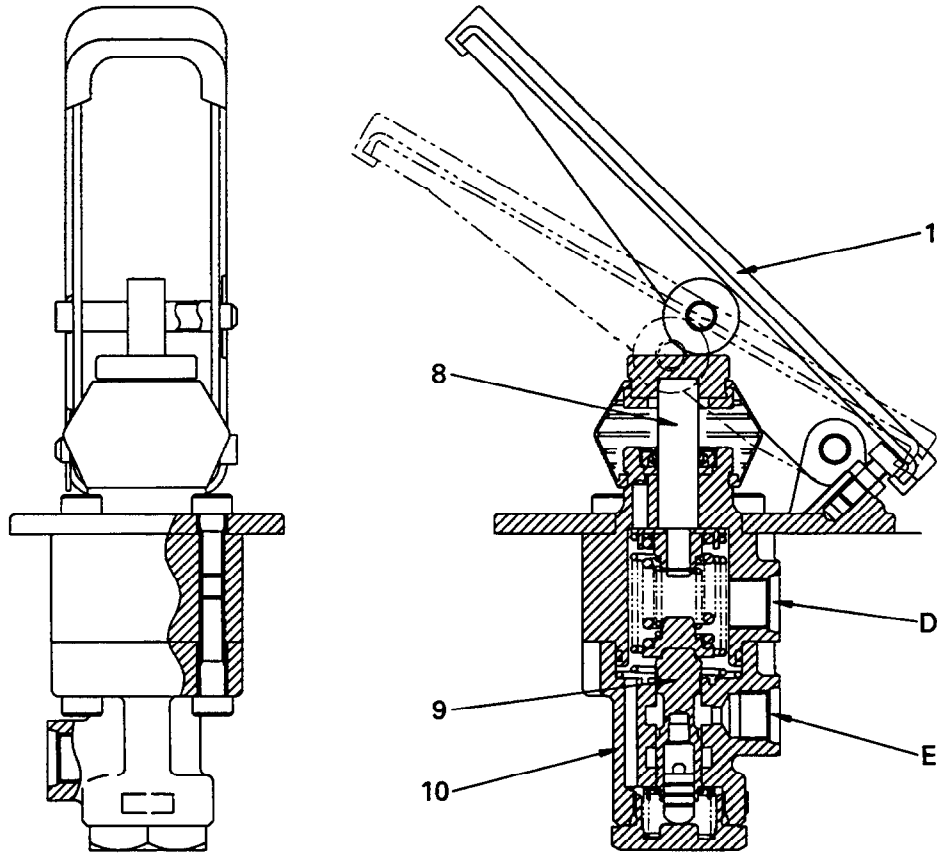
1. Brake pedal (left, right brake)
2. Rod (right brake)
3. Pilot piston (right brake)
4. Spool (right brake)
5. Upper cylinder (right brake)
6. Spool (right brake)
7. Lower cylinder (right brake)
8. Rod (left brake)

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)

SDW00107

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.

Operation

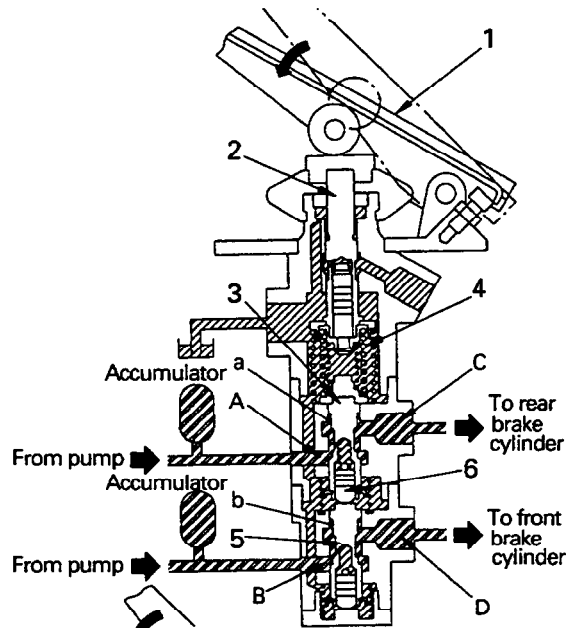
Brake applied (right brake valve)

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.

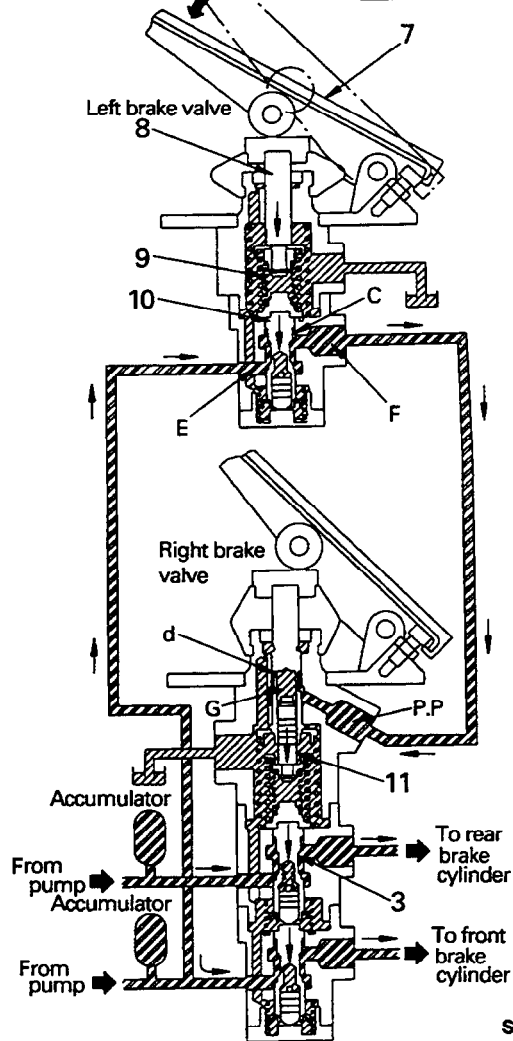
Lower portion

- 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.



SLW00511

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.

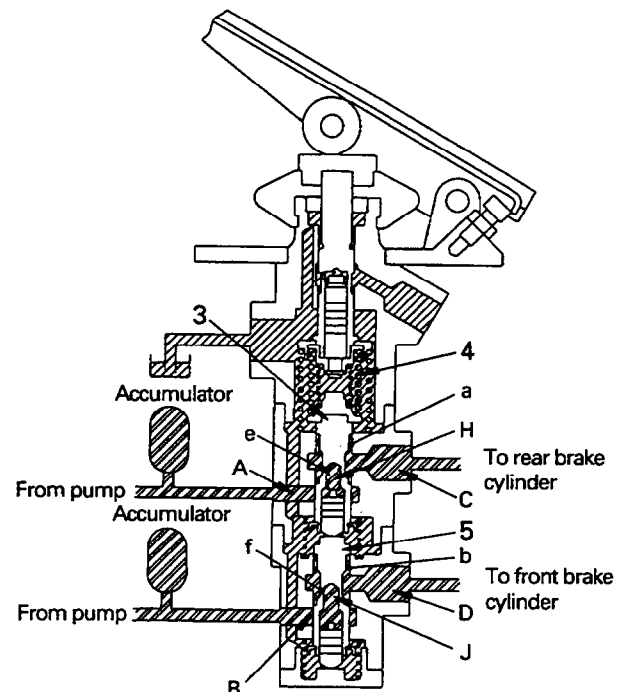
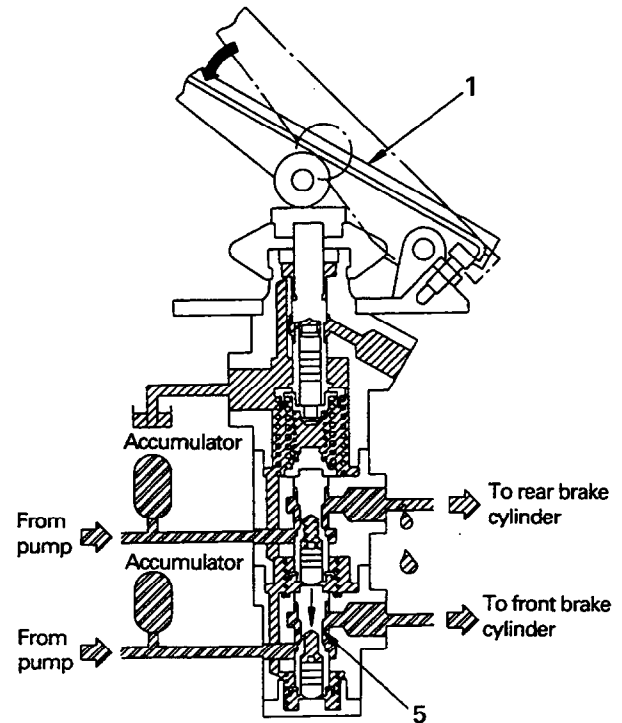
When actuation is balanced Upper portion

- 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.



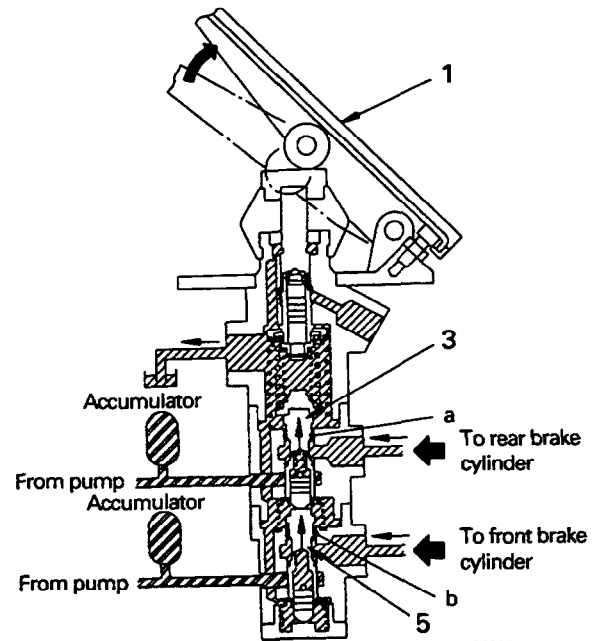
SLW00513

Brake released (right brake valve)**Upper portion**

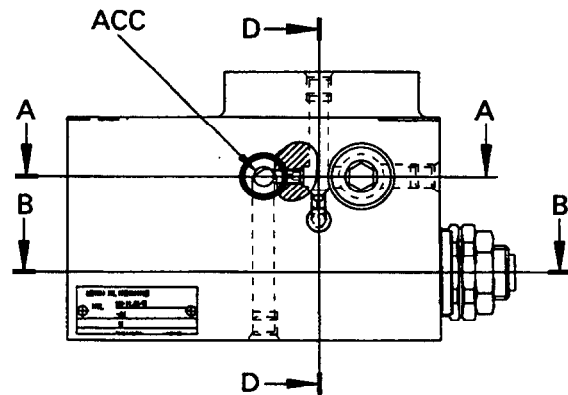
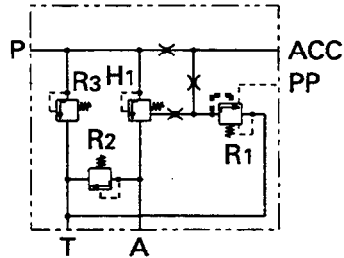
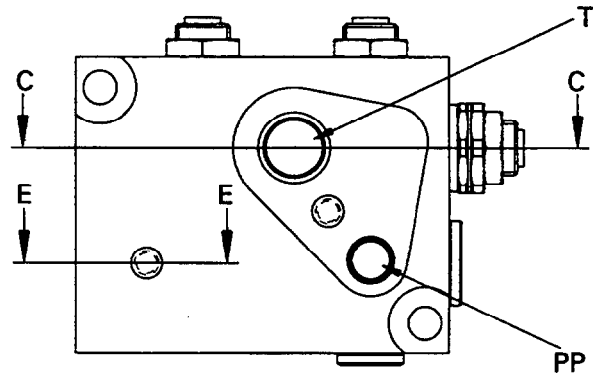
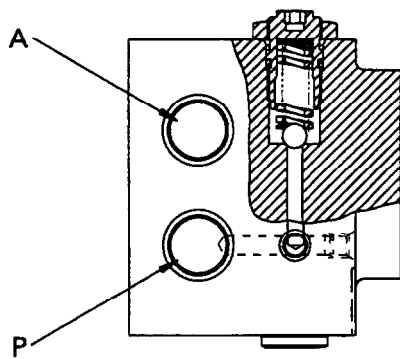
- When pedal (1) is released and the operating force is removed from the top of the spool, the back pressure from the brake cylinder and the force of the spool return spring move spool (3) up. Drain port **a** is opened and the oil from the brake cylinder flows to the hydraulic tank return circuit to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



ACCUMULATOR CHARGE VALVE



SDW00114

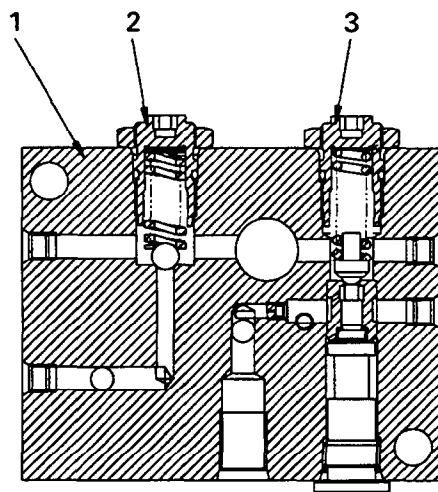
- A. To PPC valve
- ACC. To brake valve
- PP. To brake valve
- P. From pump
- T. Drain

Function

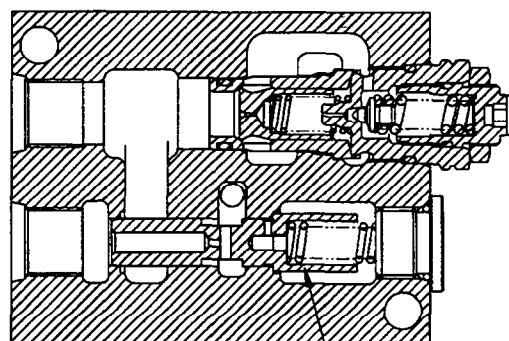
- The accumulator charge valve is actuated to maintain the oil pressure from the pump at the specified pressure and to store it in the accumulator.
- When the oil pressure reaches the specified pressure, the oil from the pump is connected to the drain circuit to reduce the load on the pump.

STRUCTURE AND FUNCTION

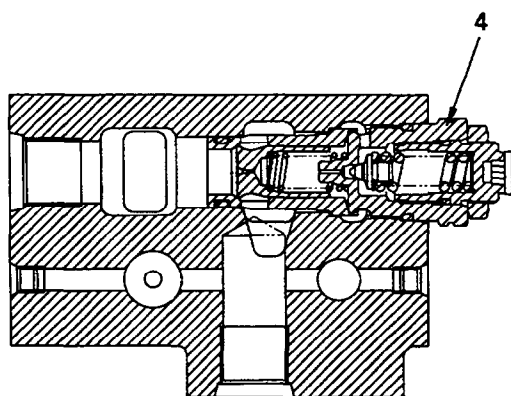
ACCUMULATOR CHARGE VALVE



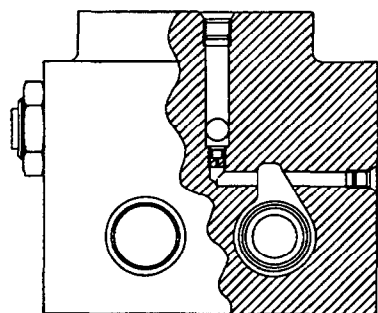
A - A



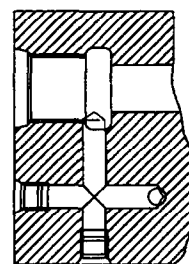
B - B



C - C



D - D



E - E

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

SDW00115

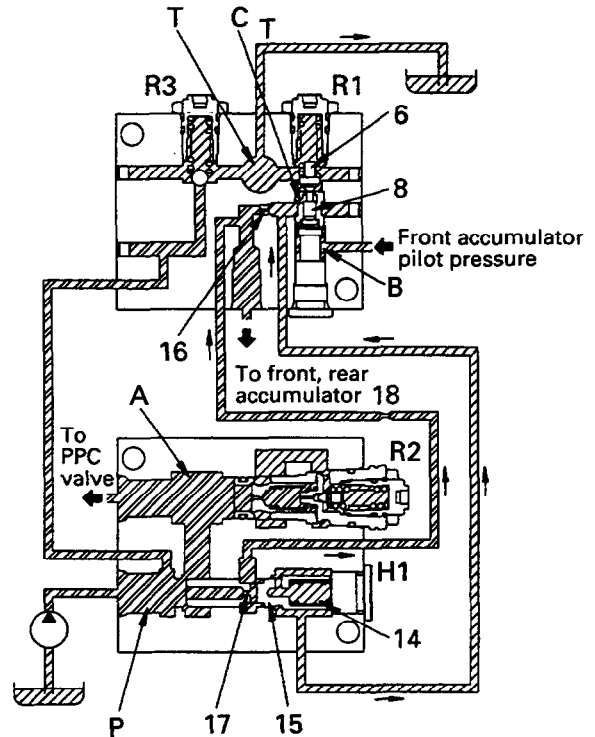
STRUCTURE AND FUNCTION

ACCUMULATOR CHARGE VALVE

Operation

1. When no oil is being supplied to accumulator (cut-out condition)

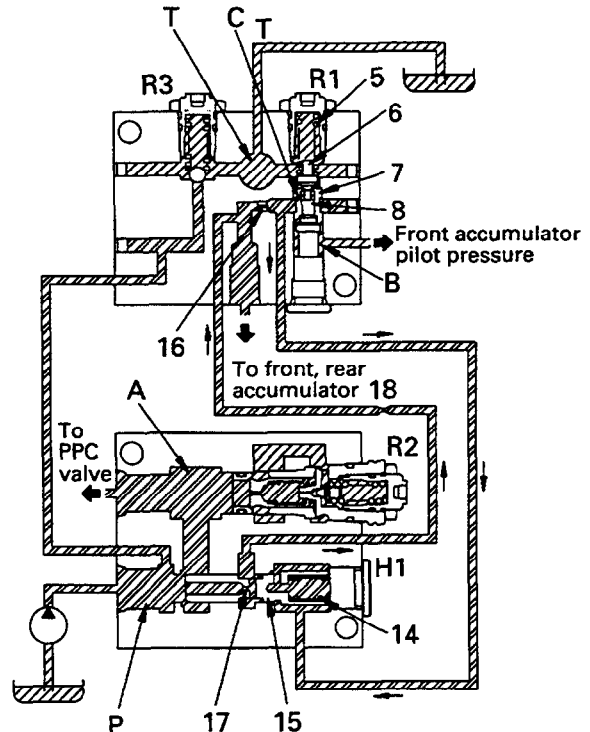
- The pressure at port B is higher than the set pressure of the relief valve (R1), so piston (8) is forcibly pushed up by the oil pressure at port B. Poppet (6) is opened, so port C and port T are short circuited.
- The spring chamber at the right end of spool (15) is connected to port C of the relief 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), and (16), and flows to the tank.



2. When oil is supplied to accumulator

1) Cut-in condition

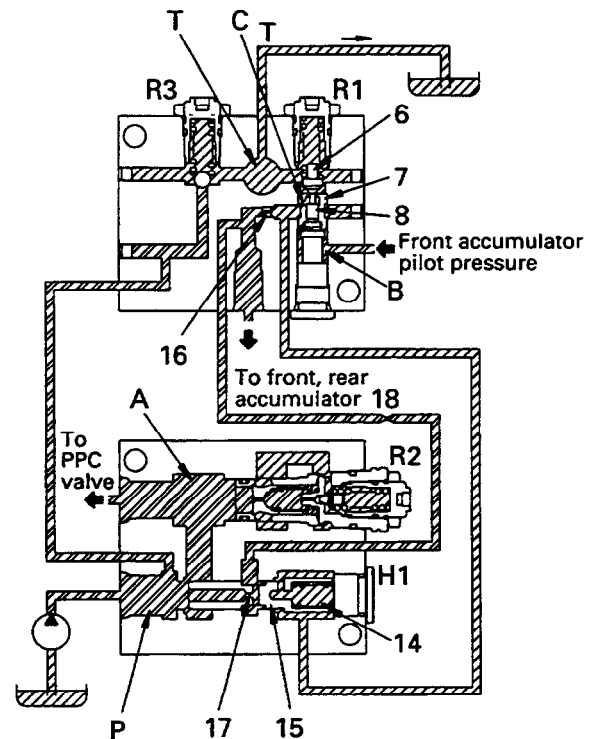
- When the pressure at port B is lower than the set pressure of the relief valve (R1), piston (8) is pushed back down by spring (5). Valve seat (7) and poppet (6) are brought into tight contact, and port C and port T are shut off.
- The spring chamber at the right end of spool (15) is also shut off from 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

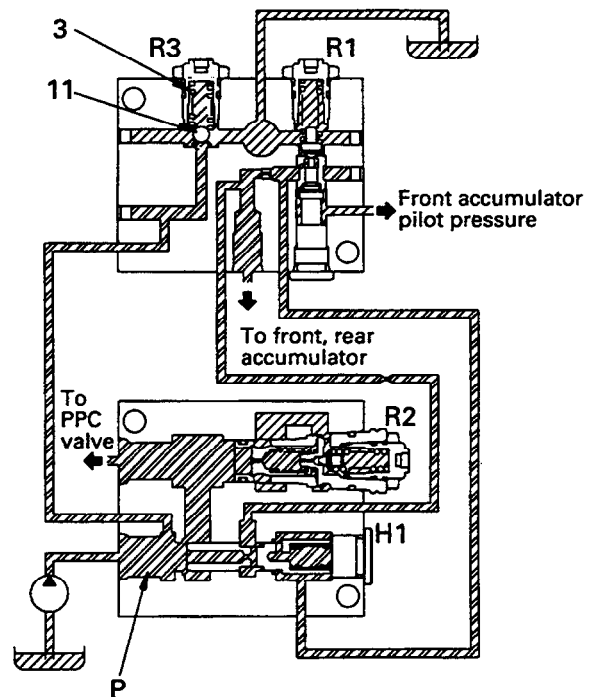
STRUCTURE AND FUNCTION**ACCUMULATOR CHARGE VALVE**

- 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.



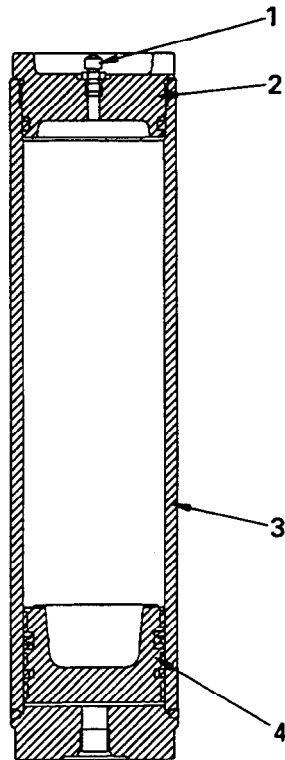
3. Safety relief valve (R3)

- 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

SLW00515

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:

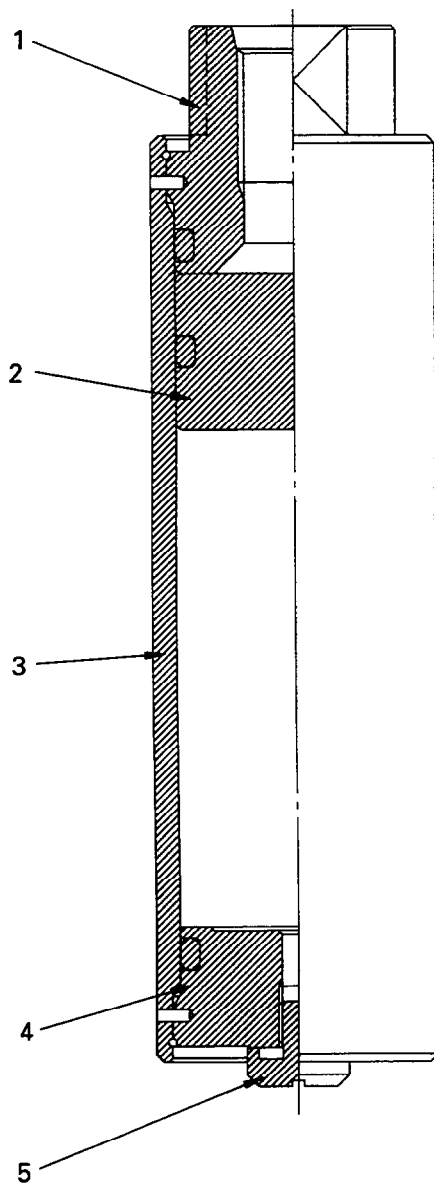
Nitrogen gas

Charge amount:

3000 cc

Charging pressure: 3.4 ± 0.15 MPa

$(35 \pm 1.5 \text{ kg/cm}^2)$ (at 50°C)



1. Top cover
2. Piston
3. Cylinder
4. End cover
5. Plug

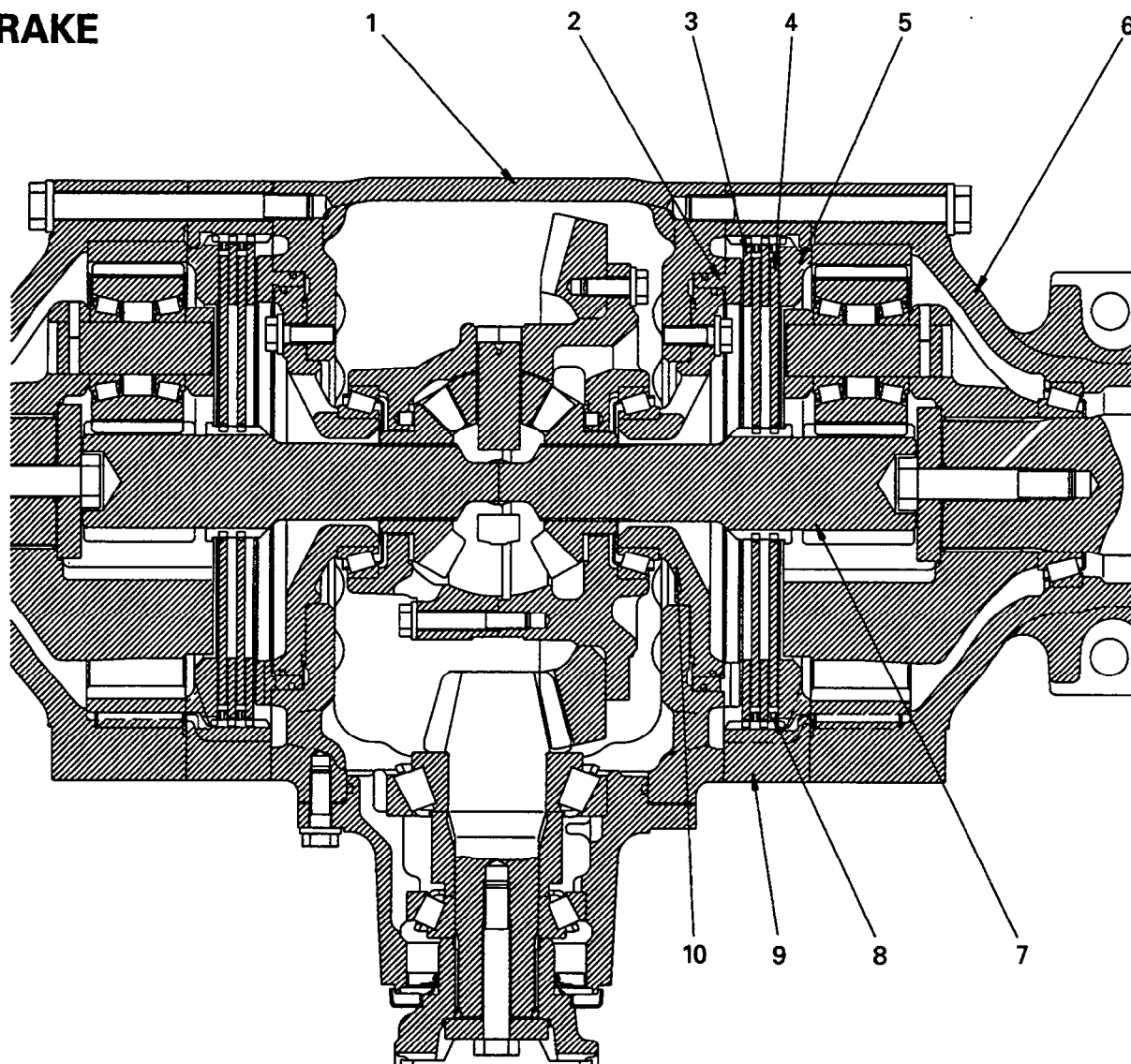
SAW00516**Function**

- The accumulator is installed between the brake valve and brake cylinder. Nitrogen gas is injected between cylinder (3) and free piston (2), and its compression is used to maintain braking force operability when the engine is stopped.

Specifications

Gas used: Nitrogen gas
Charge amount: 45 cc
Charging pressure: 0.3 ± 0.05 MPa
(3 ± 0.5 kg/c m²) (at 50°C)

BRAKE



1. Differential housing
2. Piston
3. Inner ring
4. Disc
5. Outer ring

6. Axle housing
7. Sun gear shaft
8. Spring
9. Brake housing
10. Bearing carrier

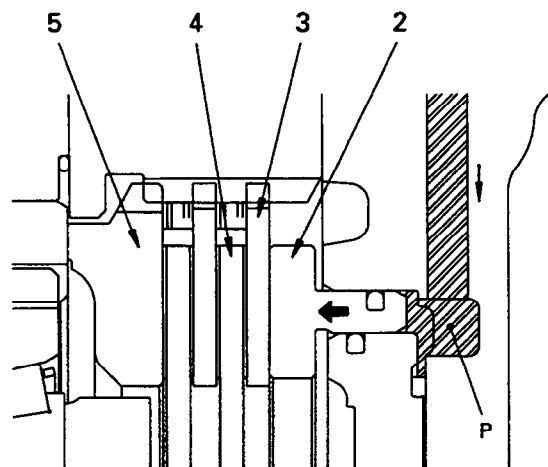
SAW00517

Outline

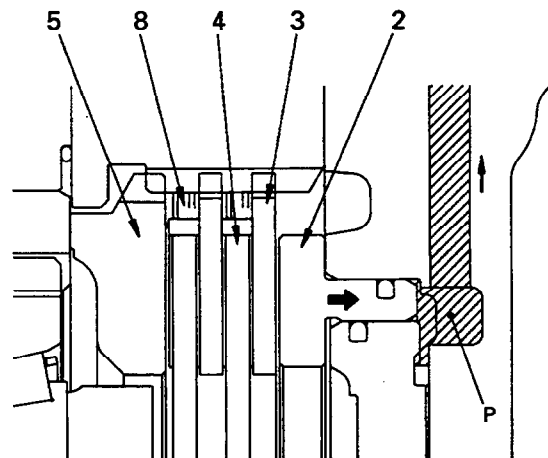
- The brakes have a wet-type multi-disc structure, and consist of piston (2), inner ring (3), disc (4), outer ring (5) and spring (8).
- The brake cylinder consists of differential housing (1) and bearing carrier (10), and incorporates piston (2). Inner ring (3) and outer ring (5) are coupled by the brake housing (9) spline.
- Linings are provided on both sides of disc (4). The disc is incorporated between inner ring (3) and outer ring (5), and is coupled by the sun gear shaft's spline.

Operation**When the brakes are activated**

- When the brake pedal is pressed, the oil which has passed from the hydraulic oil tank via the pump through the accumulator charge valve acts on the piston in the brake cylinder and piston (2) slides.
- Therefore, disc (4), which is between inner ring (3) and outer ring (5), stops rotating and the machine is braked.

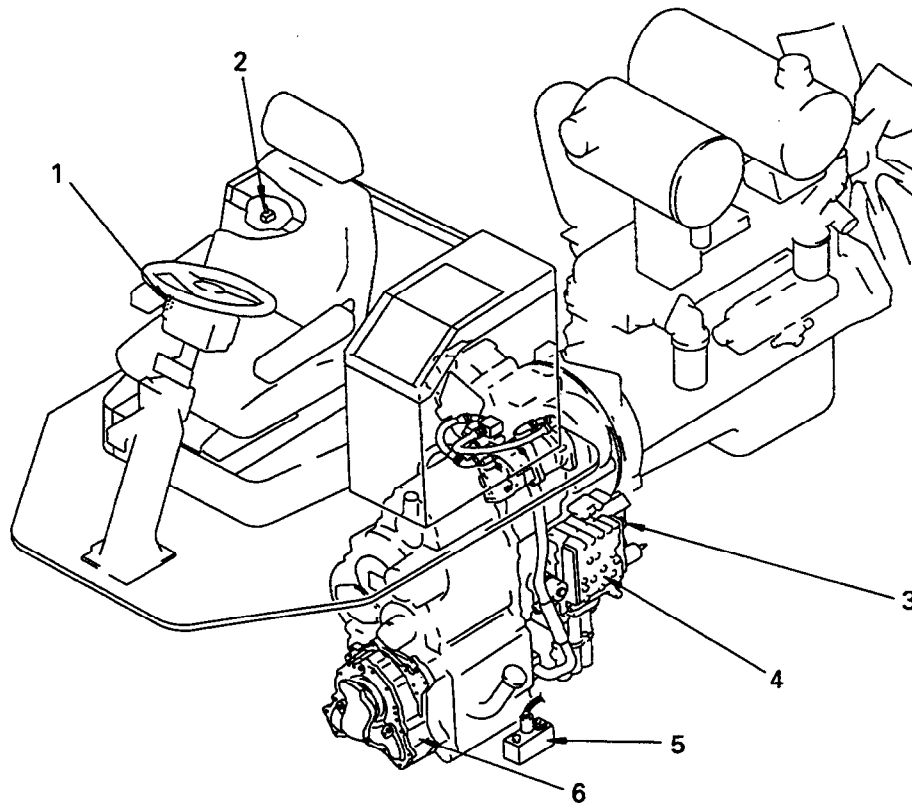
**When the brakes are released**

- When the oil pressure is released, piston (2) returns to its original position by the return force of spring (8), a gap is produced between inner ring (3) and outer ring (5), and disc (4) is freed. The linings attached to disc (4) are provided with latticed grooves. When the disc is turning, oil flows in these grooves, cooling the linings.



SAW00519

PARKING BRAKE CONTROL



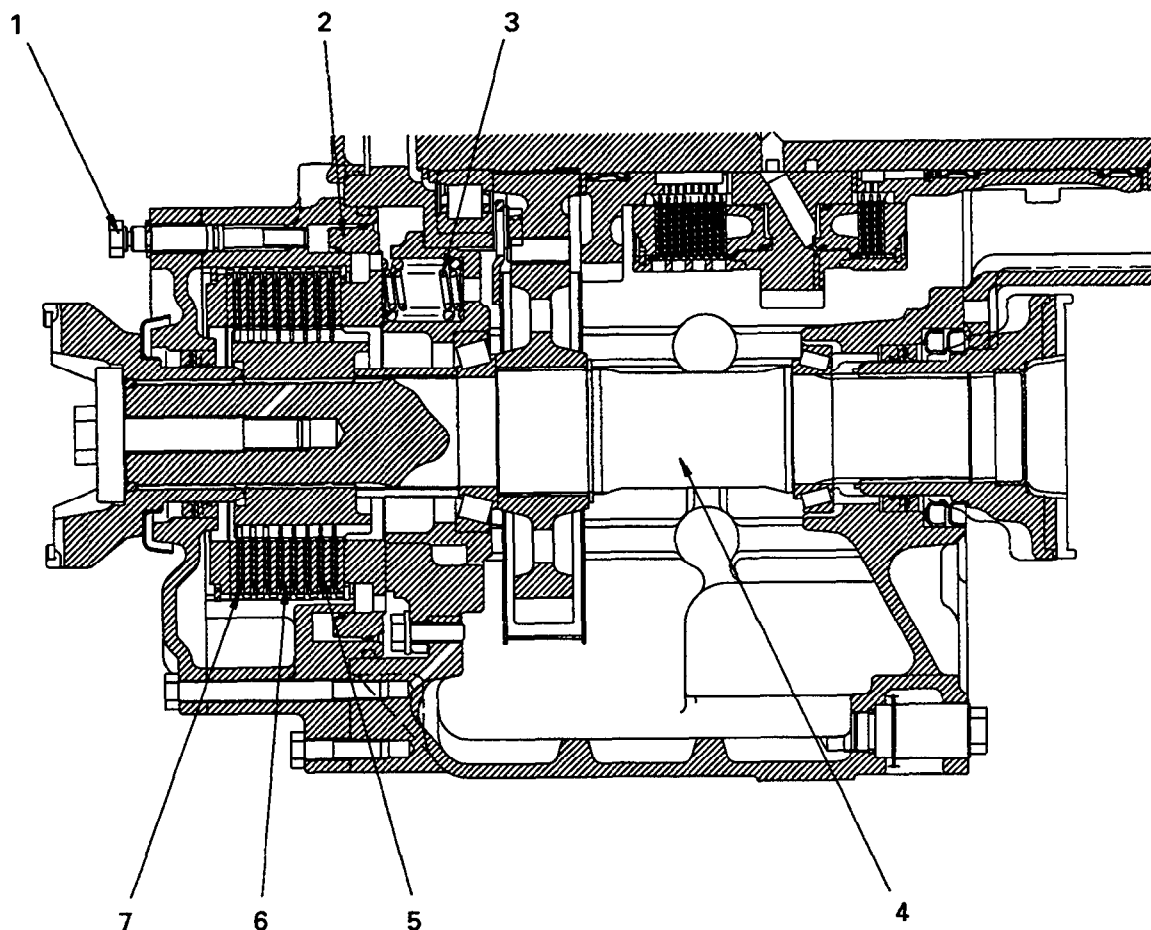
- | | |
|---|--|
| 1. Parking brake switch | 4. Transmission control valve |
| 2. Parking brake emergency release switch | 5. Emergency parking brake valve |
| 3. Parking brake solenoid valve | 6. Transmission (built-in parking brake) |

SBW00520

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 (3) installed to transmission control valve (4) 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



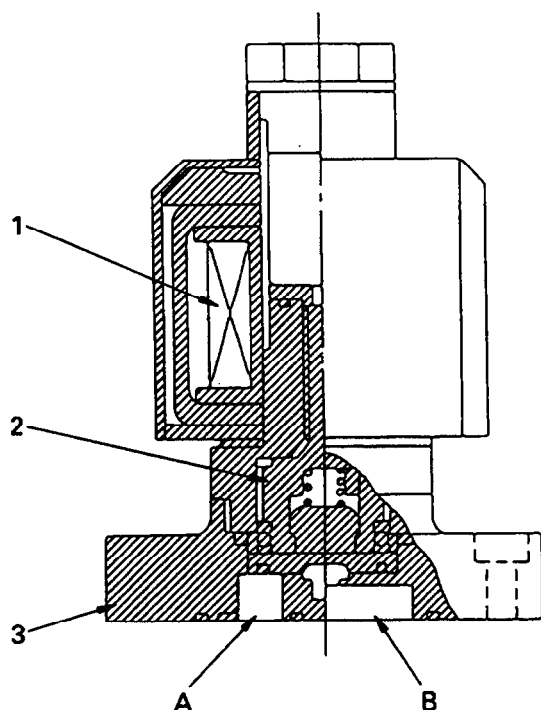
SAW00521

1. Parking brake manual release bolt
2. Piston
3. Spring
4. Transmission output shaft
5. Disc
6. Plate
7. Spring

Outline

- The parking brake is activated mechanically by spring (3). It is a wet-type multi-disc brake which brakes the transmission's output shaft (4).
- The pushing force of spring (3) pushes piston (2) against disc (5) and plate (6), braking output shaft (4).

PARKING BRAKE SOLENOID VALVE



- 1. Coil
- 2. Valve assembly
- 3. Body
- A. IN port
- B. OUT port

SLW00522

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.

PARKING BRAKE VALVE

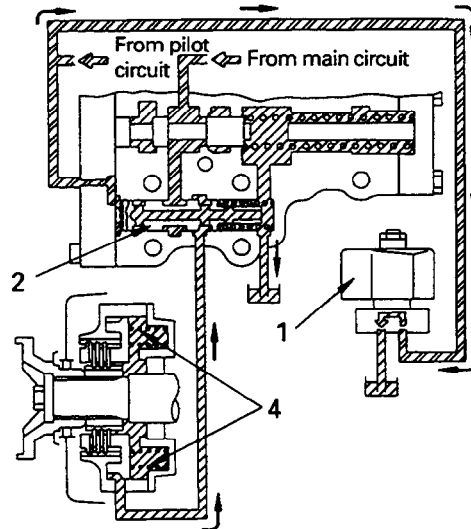
Function

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

Operation

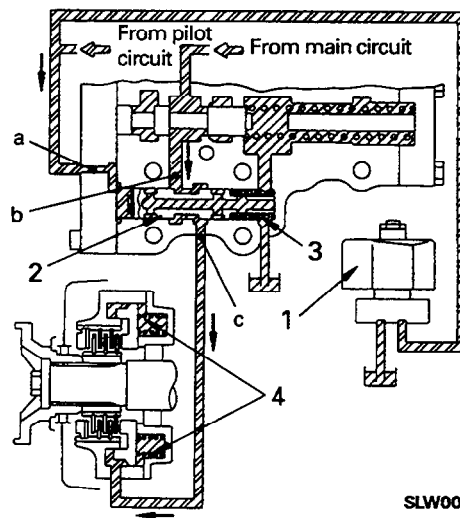
1. Parking brake applied

- 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 (4) in the parking brake cylinder.



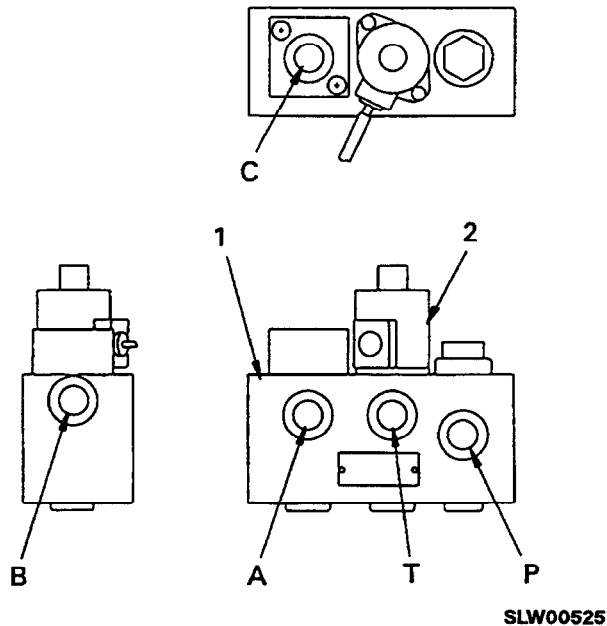
2. Parking brake released

- 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.



SLW00524

PARKING BRAKE EMERGENCY RELEASE SOLENOID VALVE



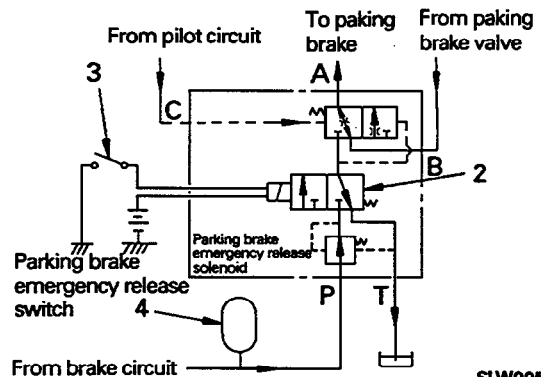
- 1. Valve assembly
- 2. Solenoid valve
- A: To parking brake
- B: From parking brake valve
- C: From pilot circuit
- T: Drain
- P: From brake (accumulator circuit)

Function

- The emergency release solenoid valve is installed between the transmission and the transmission control valve. If the engine fails, 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 (3) is turned ON, solenoid valve (2) is actuated and the pressure stored in accumulator (4) 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

1. Bucket cylinder
2. Steering valve
3. Hydraulic tank
4. PPC valve
5. Hydraulic pump
6. Oil cooler
7. Accumulator
8. Accumulator charge valve
9. Boom cylinder
10. Cut-off valve
11. Main control valve

Outline

The hydraulic system consists of work equipment circuit and the steering circuit. The work equipment circuit controls the actuation of in the bucket and attachments.

The oil in hydraulic tank (3) is sent to main control valve (11) by hydraulic pump (5). 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 (3), and then returns to the tank.

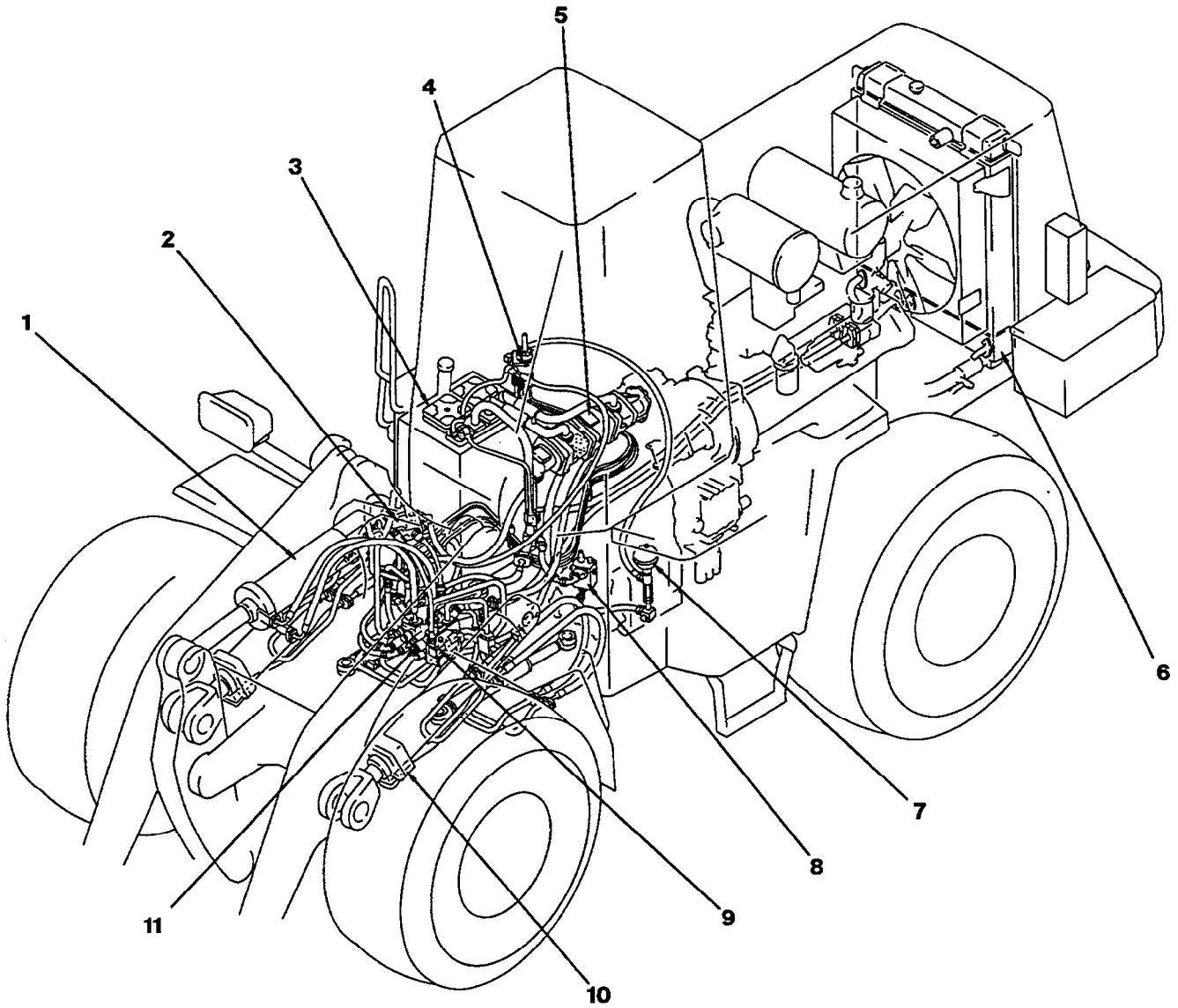
When the work equipment control levers are operated, the PPC valve bucket spool or boom spool is actuated, and the spools of the main control valve are actuated by hydraulic pressure to send the oil from the main control valve to boom cylinder (10) or bucket cylinder (1) to operate the boom or bucket.

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 (7) 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 (3) 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.

HYDRAULIC PIPING



SLW01260

This schematic diagram illustrates a complex hydraulic system, likely a vehicle's braking system. The diagram features numerous numbered components and their interconnections:

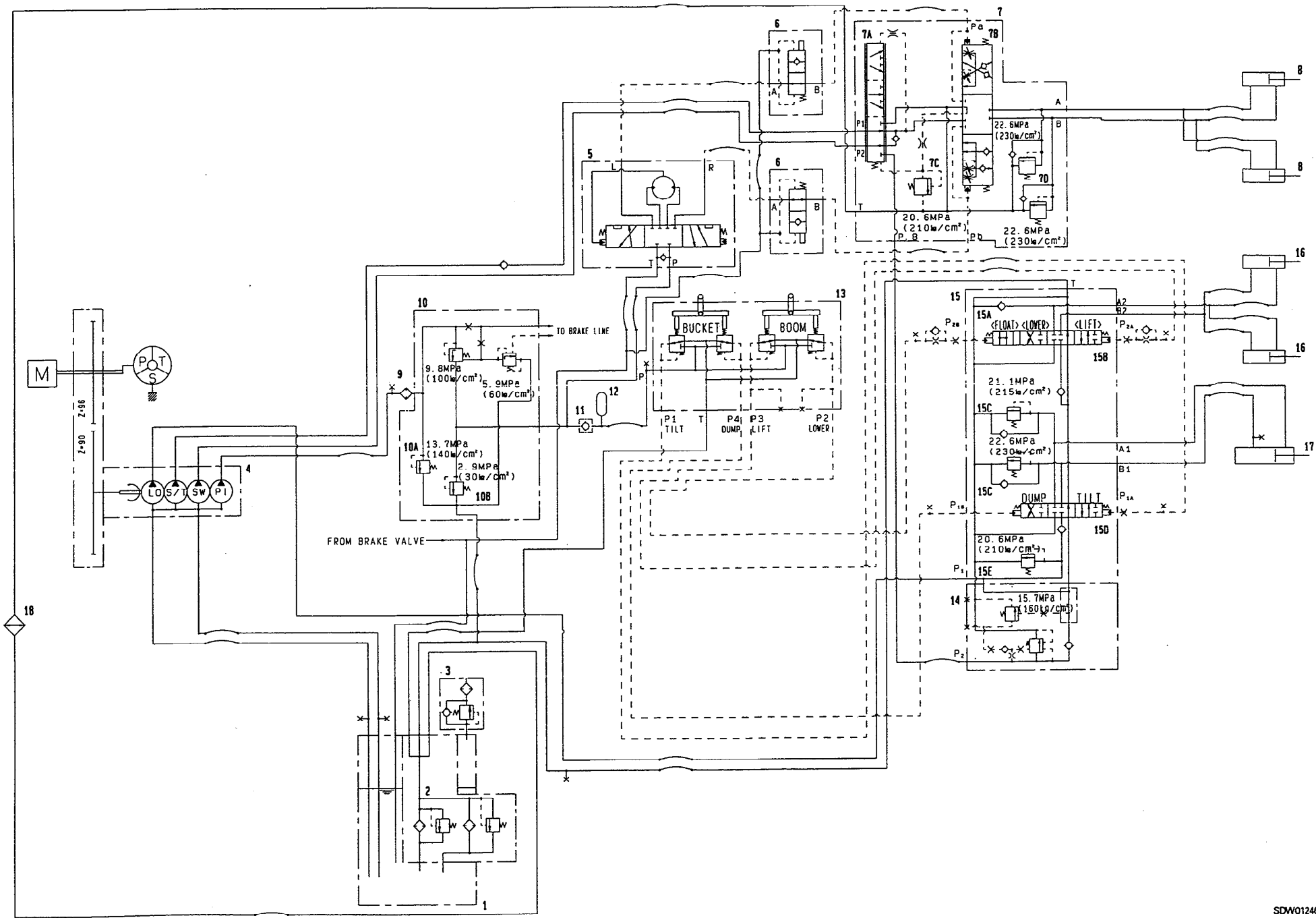
- Component 1:** A large hydraulic reservoir or master cylinder assembly at the bottom left.
- Component 2:** A smaller hydraulic component, possibly a booster or accumulator, located below component 1.
- Component 3:** A component with a piston and rod, located to the left of component 1.
- Component 4:** A multi-chambered hydraulic valve or manifold, located in the middle left.
- Component 5:** A large central component, possibly a master cylinder or a complex valve assembly, located in the upper center.
- Component 6:** Two smaller hydraulic components, possibly solenoids or valves, located to the right of component 5.
- Component 7:** A complex hydraulic assembly with multiple ports and internal valves, located in the upper right.
- Component 8:** A component with a piston and rod, located to the right of component 7.
- Component 9:** A component with a piston and rod, located to the left of component 4.
- Component 10:** Two hydraulic components, possibly solenoids or valves, located to the left of component 4.
- Component 11:** A component with a piston and rod, located to the right of component 4.
- Component 12:** A component with a piston and rod, located to the right of component 11.
- Component 13:** A complex hydraulic assembly with multiple ports and internal valves, located in the lower center.
- Component 14:** A component with a piston and rod, located to the right of component 13.
- Component 15:** A complex hydraulic assembly with multiple ports and internal valves, located in the lower right.
- Component 16:** A component with a piston and rod, located to the right of component 15.
- Component 17:** A component with a piston and rod, located to the right of component 16.
- Component 18:** A component with a piston and rod, located to the left of component 4.

The diagram shows the flow of hydraulic fluid through various lines and valves, with arrows indicating the direction of flow. Key labels include "To brake line" and "From brake valve".

FOLDOUT 10-111

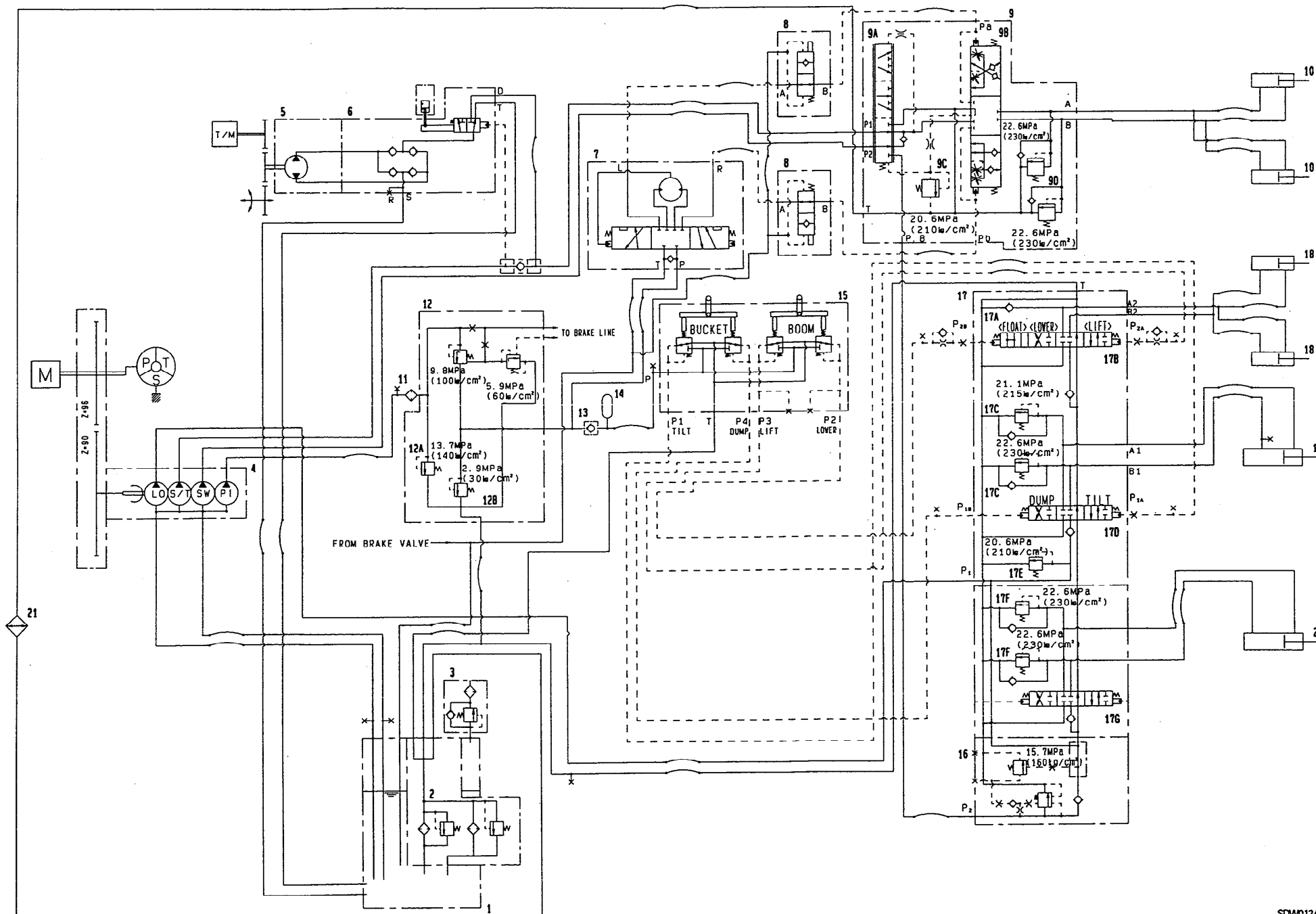
WORK EQUIPMENT HYDRAULIC CIRCUIT DIAGRAM

(For 2-spool)



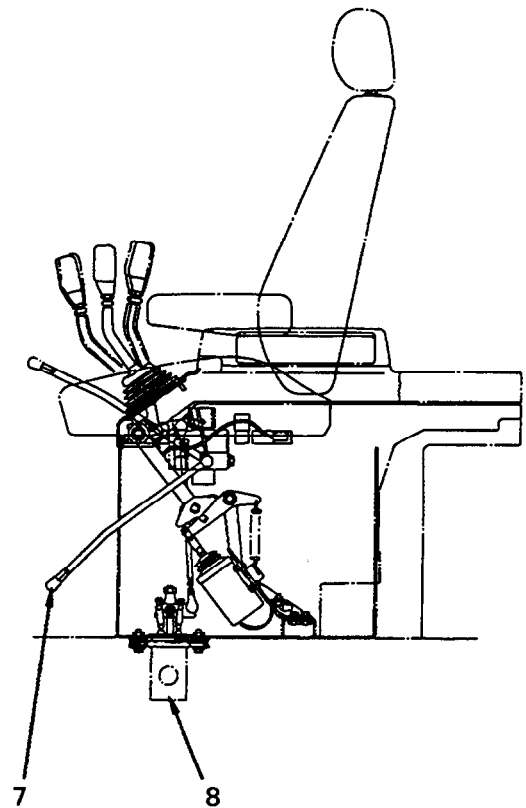
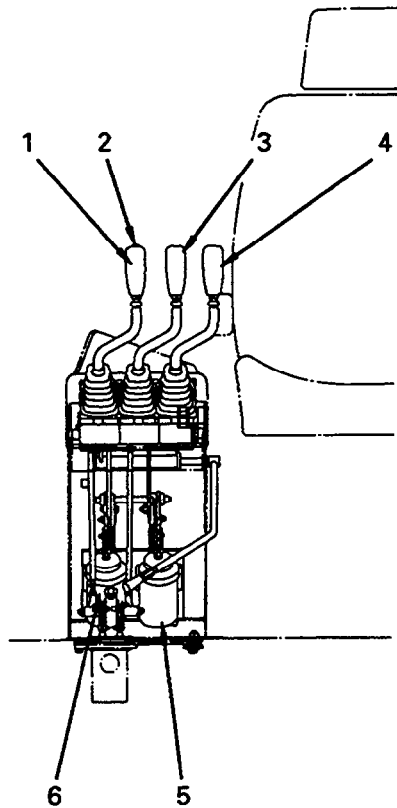
FOLDOUT 10-113

(For 3-spool)



1. Hydraulic tank
2. Filter
3. Breather
4. Hydraulic pump
5. Emergency steering pump)
6. Diverter valve
7. Orbit-roll valve
8. Stop valve
9. Steering control valve
 - 9A. Demand valve
 - 9B. Steering valve
 - 9C. Relief valve
 - 9D. Safety valve (with suction)
10. Steering cylinder
11. Strainer
12. Accumulator charge valve
 - 12A. Relief valve
 - 12B. PPC relief valve
13. Check valve
14. PPC Accumulator
15. PPC valve
16. Cut-off valve
17. Main control valve
 - 17A. Suction valve
 - 17B. Boom spool
 - 17C. Safety valve (with suction)
 - 17D. Bucket spool
 - 17E. Main relief valve
 - 17F. Safety valve (with suction)
 - 17G. Attachment spool
18. Boom cylinder
19. Bucket cylinder
20. Attachment cylinder
21. Oil cooler

WORK EQUIPMENT LEVER LINKAGE

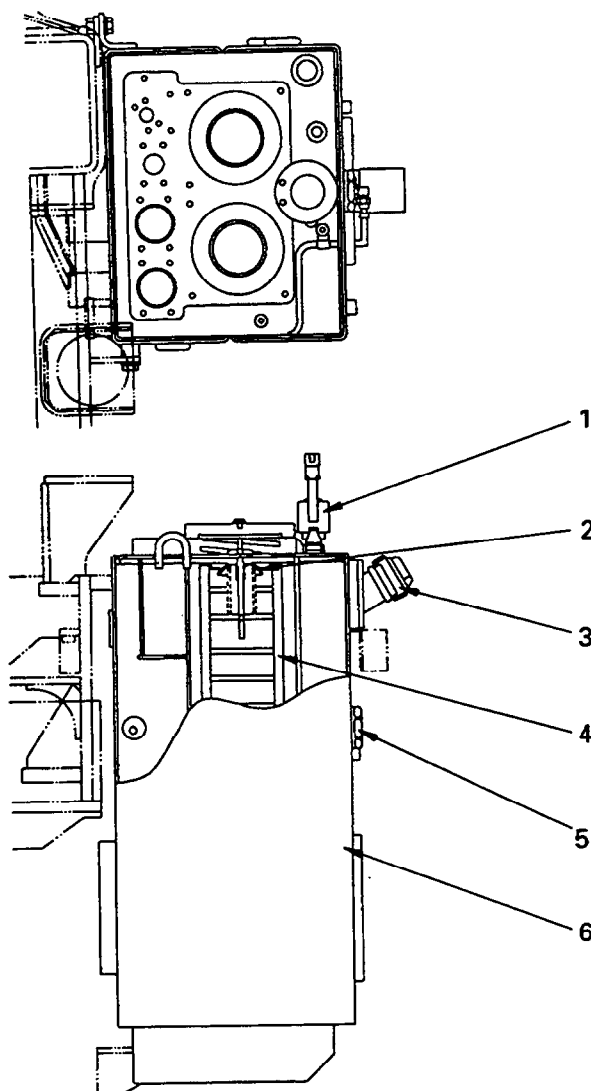


- 1. Boom lever
- 2. Kick-down switch
- 3. Bucket lever
- 4. Attachment lever

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

SLW01248

HYDRAULIC TANK



1. Breather
2. Filter bypass valve
3. Oil filler
4. Oil filter
5. Sight gauge
6. Hydraulic tank

SBW00532

Outline

- The oil sent to the cylinders from the hydraulic tank via the pump and through the work equipment control valve merges with the oil of the various parts in the return circuit. Some of this oil is cooled by the oil cooler, flows into the tank, is filtered by oil filter (4), and returns to hydraulic tank (6).

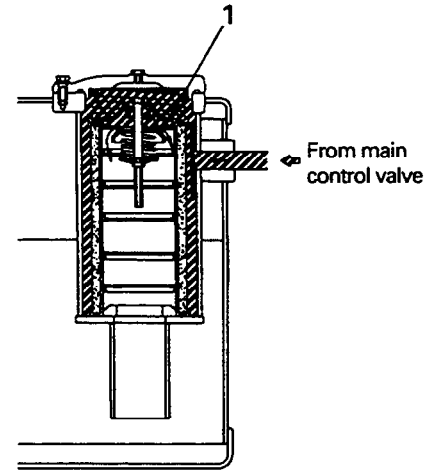
Oil filter (4) is of a type which filters all the oil in the circuit. If the oil filter is clogged, the filter bypass valve is activated, preventing the oil from returning directly to the tank and causing damage to the oil filter. In addition, the filter bypass valve is also activated when a vacuum is generated in the circuit.

OIL FILTER BYPASS VALVE

When the filter is clogged

Bypass valve (1) opens and the oil returns directly to the tank without passing through the filter.

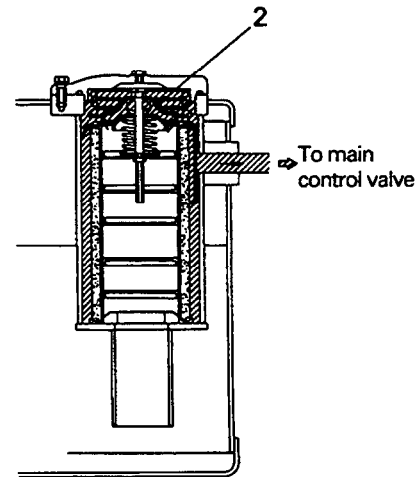
Bypass valve set pressure: 0.125 MPa (1.27 kg/cm²)



When negative pressure is formed in the return circuit.

Valve (2) moves up and acts check valve.

Check valve set pressure: 0.025 MPa (0.26 kg/cm²)



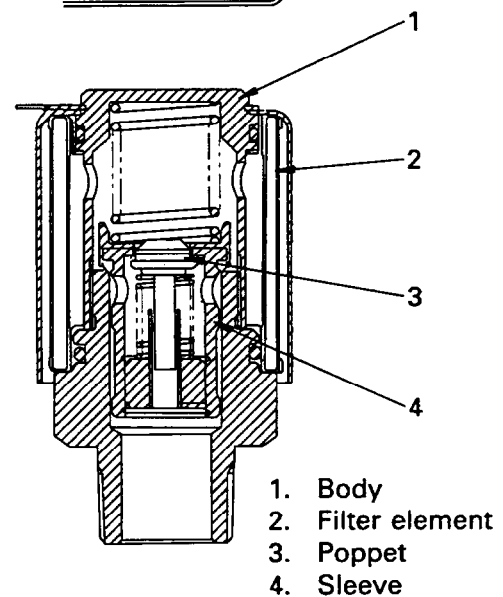
BREATHER

- **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.

★ Suction pressure: 3KMPa (0.03kg/cm²)

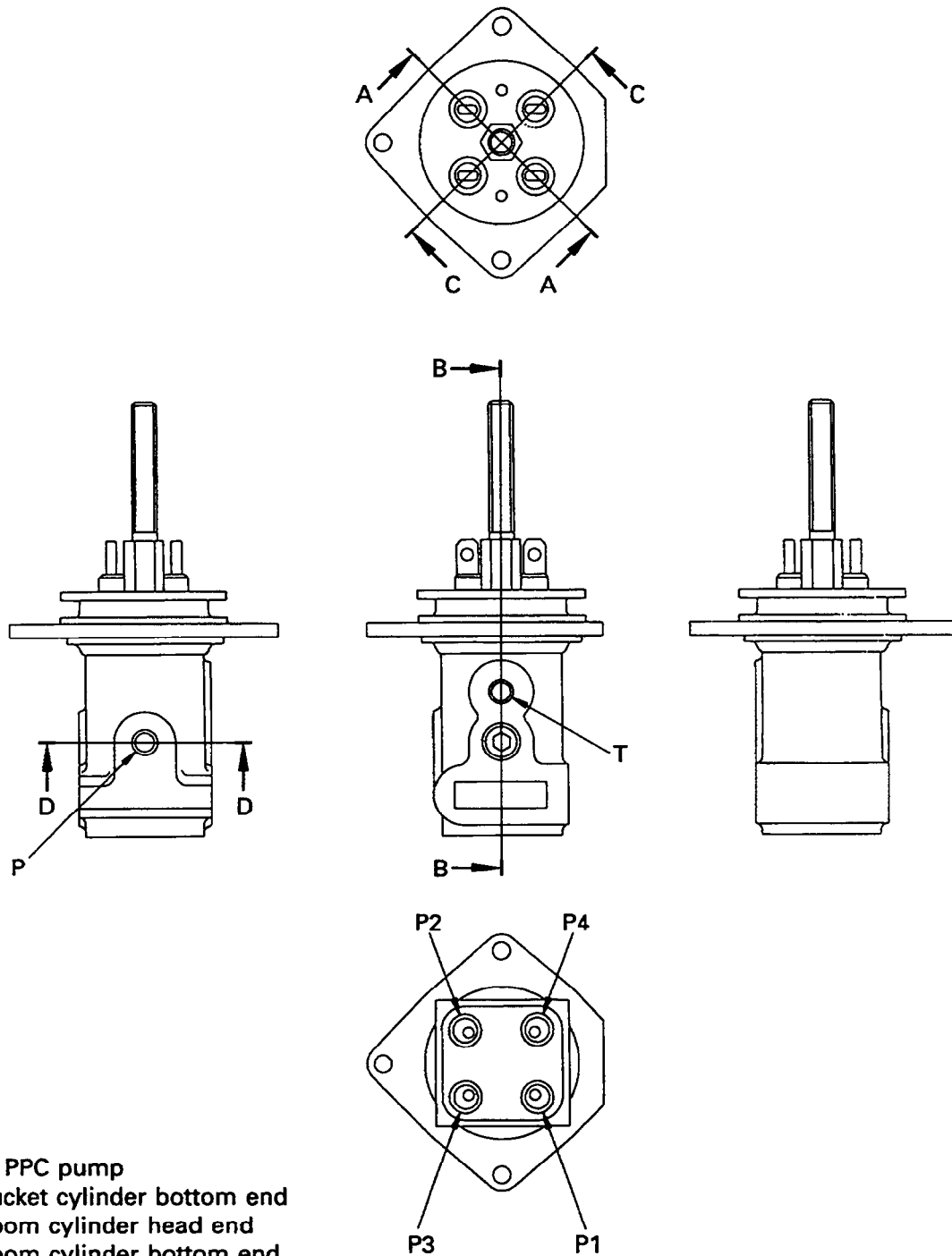
- **Preventing rise in pressure inside tank** If the pressure in the circuit rises above the set pressure during operations because of the change in the oil level in the hydraulic cylinders or the rise in the temperature, the sleeve is actuated to release the pressure inside the hydraulic tank.

★ Checking pressure: 0.16MPa (1.6kg/cm²)



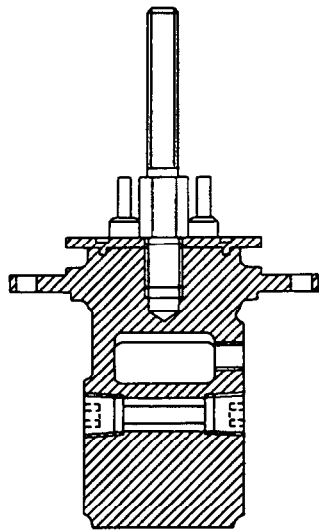
1. Body
2. Filter element
3. Poppet
4. Sleeve

SEW00141

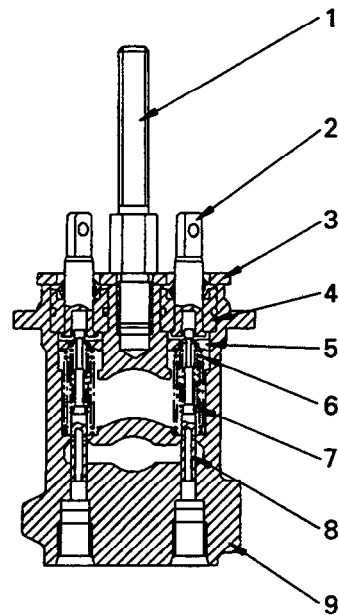
PPC VALVE

- 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

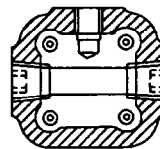
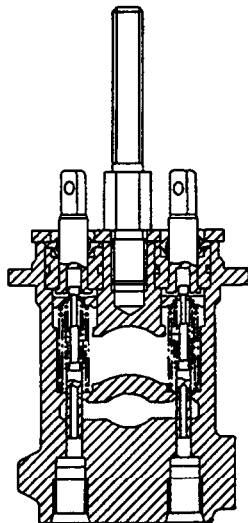
SEW00142



B - B



A - A

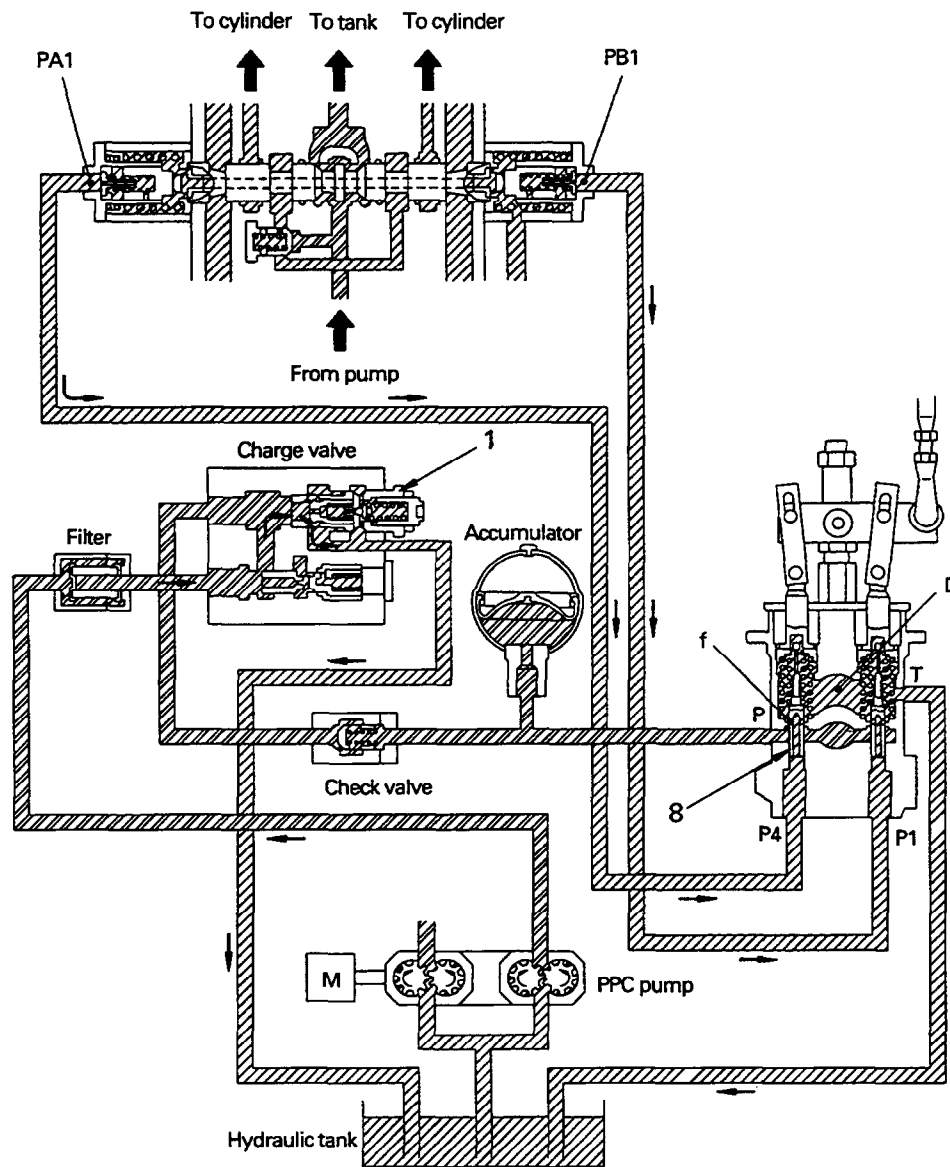


D - D

SEW00143

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

OPERATION OF PPC VALVE



SBW00535

Function

- 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 **f** of spool (8).

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

2. Control lever operated slightly (fine control)

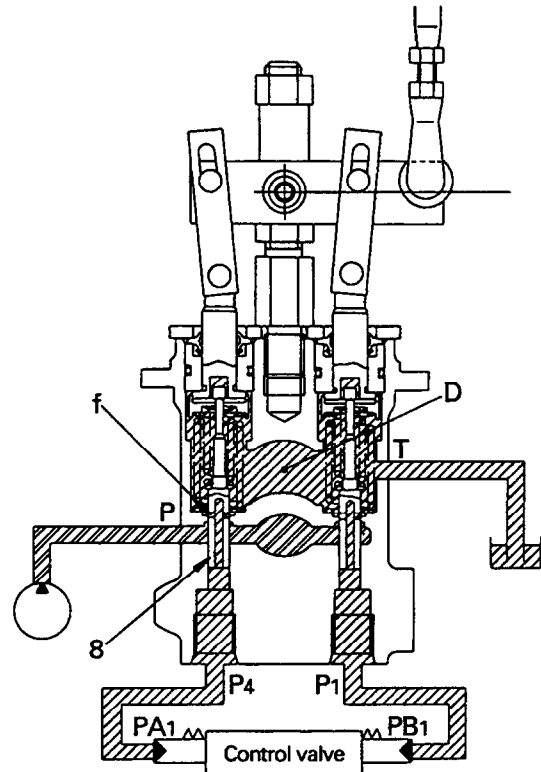
(Fig. 2):

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.

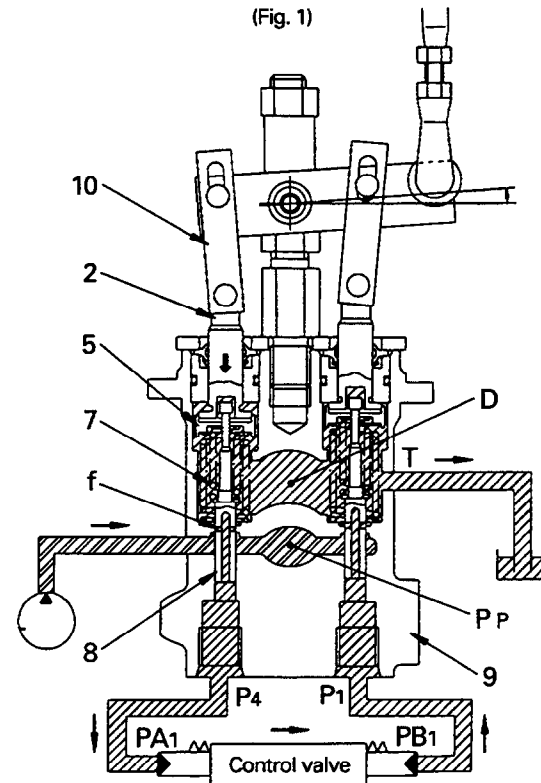
When this happens, fine control hole (**f**) is shut off from drain chamber **D**. At almost the same time it is connected to pump pressure chamber **Pp**, and the pilot pressure of the control valve is sent through fine control hole (**f**) to port **P4**. When the pressure at port **P4** rises, valve (8) is pushed back. Fine control hole (**f**) is shut off from pump pressure chamber **Pp**. 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 **Pp**) 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)



(Fig. 2)

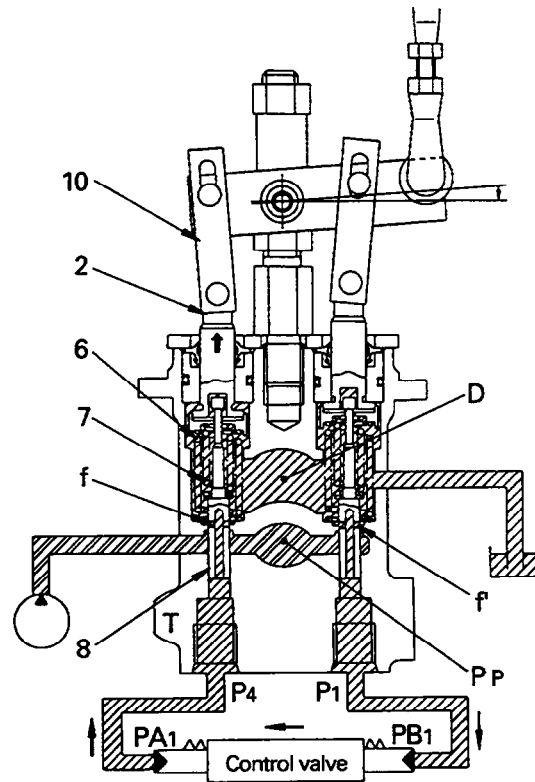
SEW00146

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 **Pp**. 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**.

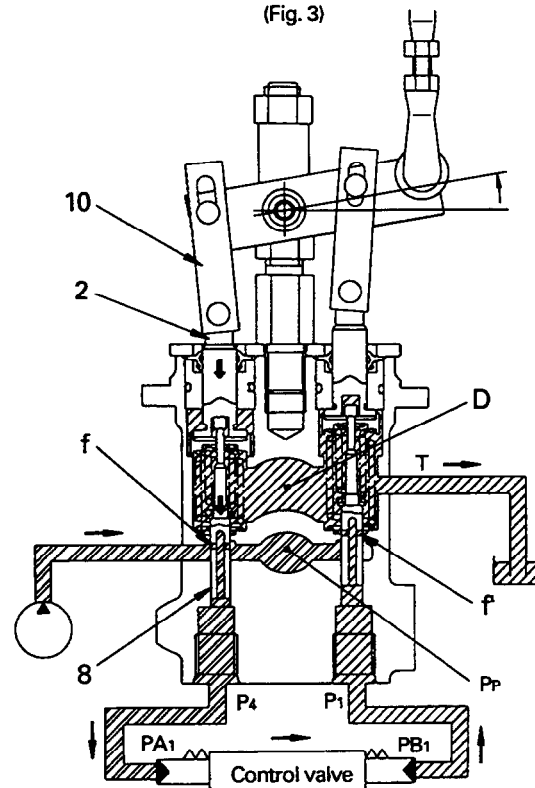


(Fig. 3)

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 **Pp**. 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.

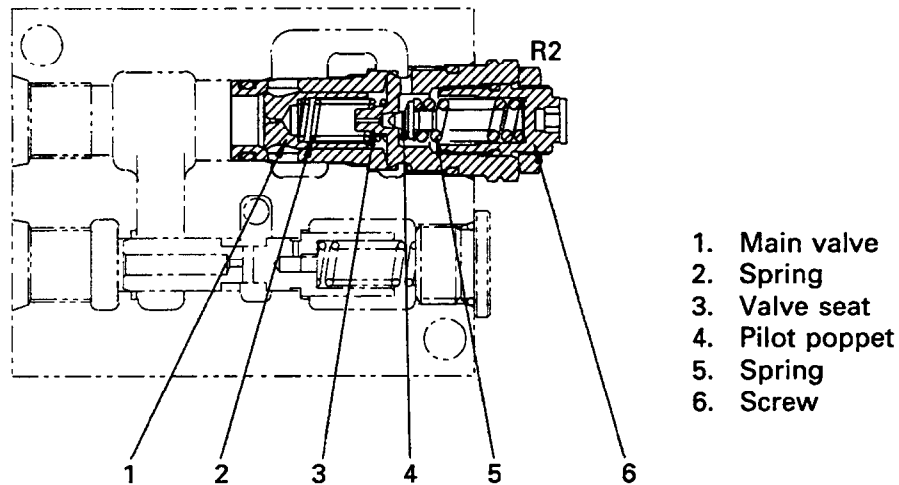
The oil returning from chamber **PB1** flows from port **P1** through fine control hole (**f'**) to drain chamber **D**.



(Fig. 4)

SEW00148

PPC RELIEF VALVE



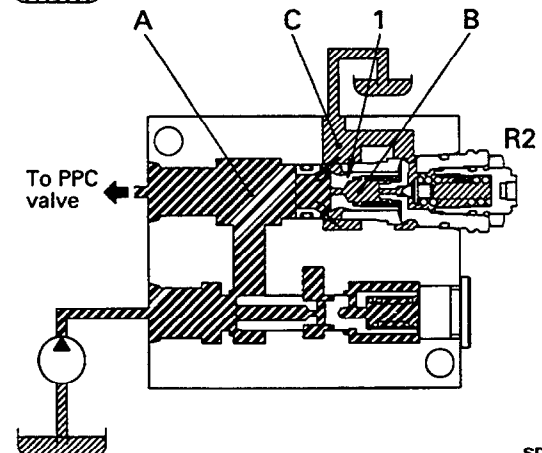
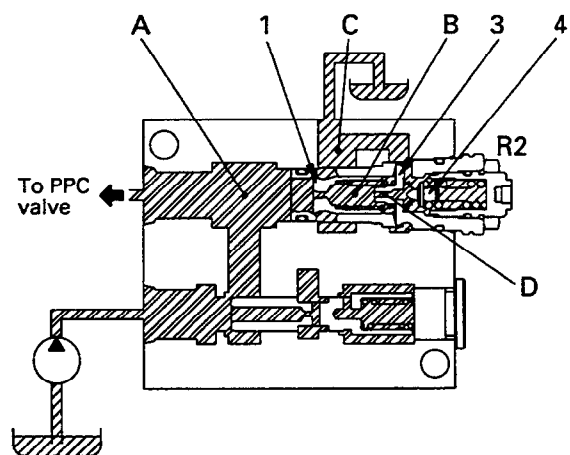
SDW00149

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.

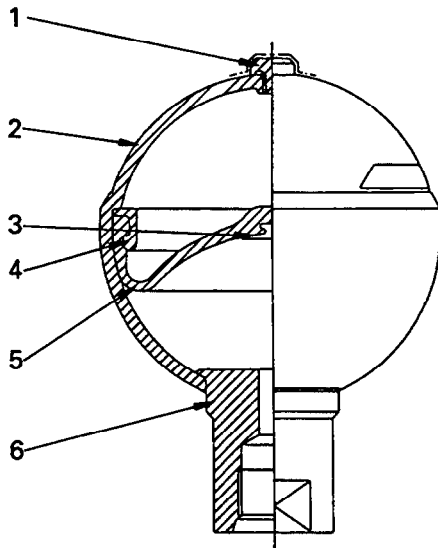
Operation

- 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.



SDW00151

ACCUMULATOR (FOR PPC VALVE)



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)

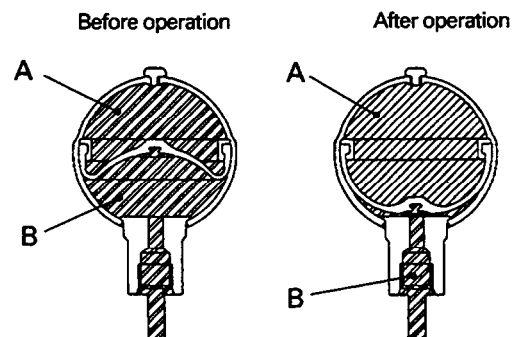
SEW00152

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.

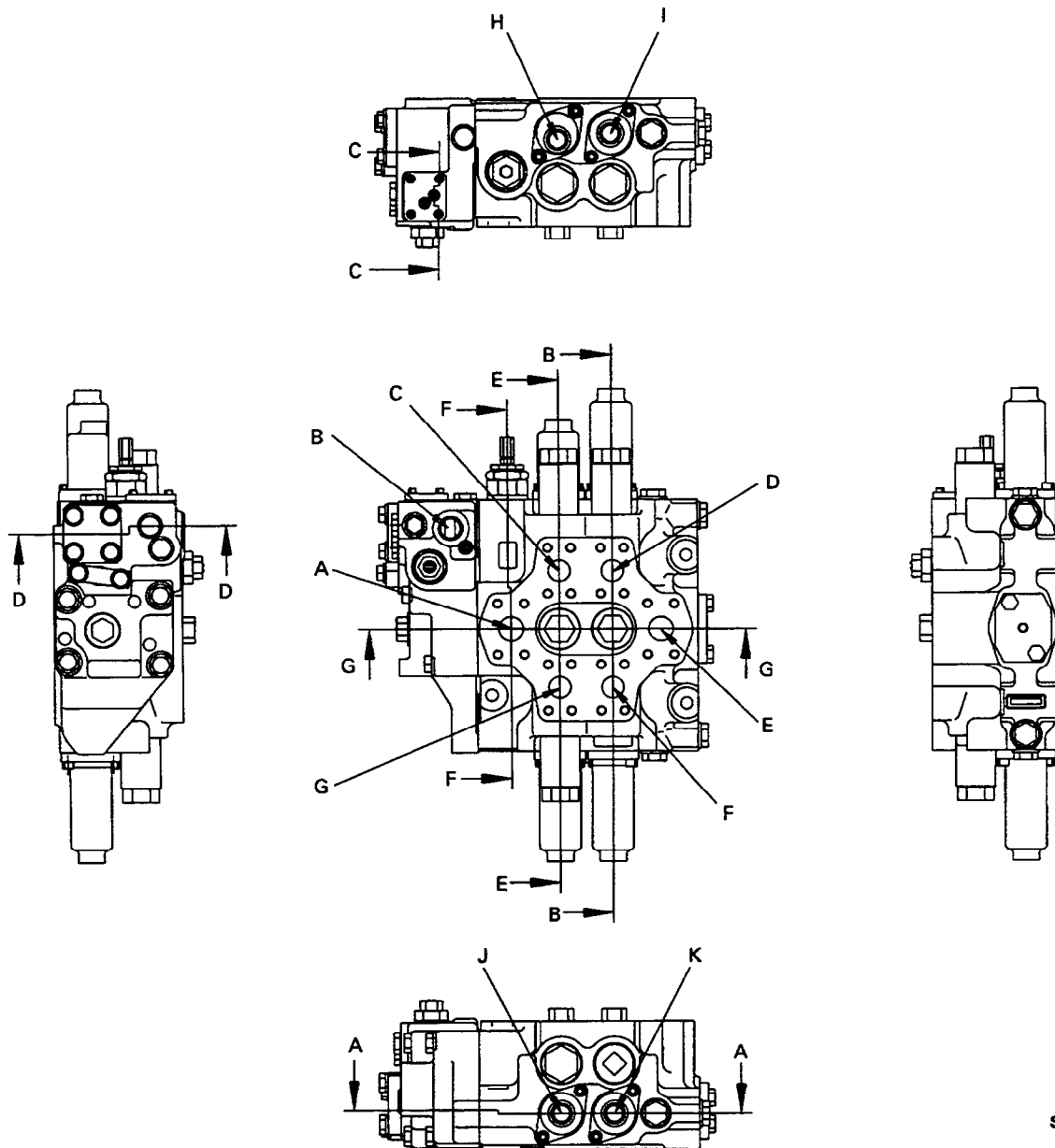
Operation

- 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.



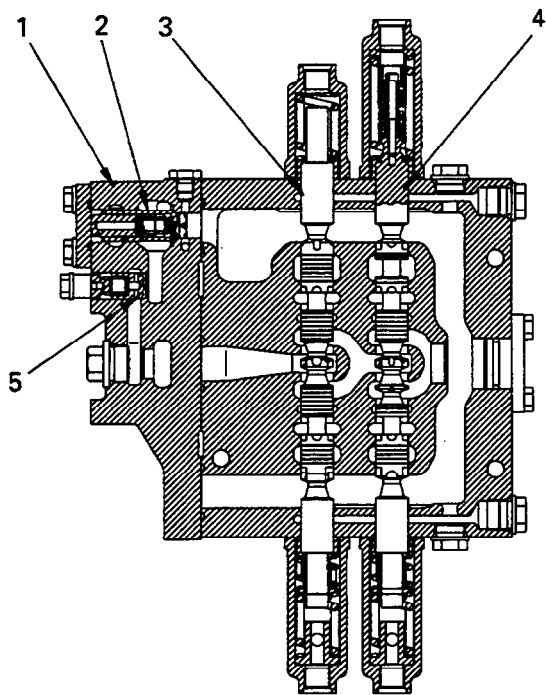
SLW00536

**MAIN CONTROL VALVE
2-SPOOL**

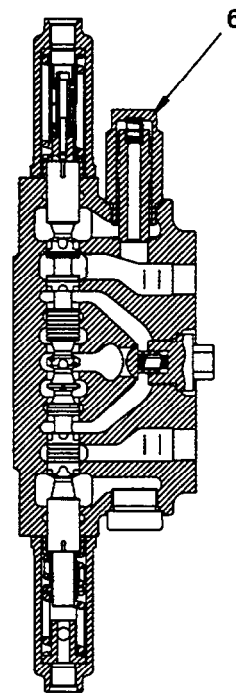


SAW00527

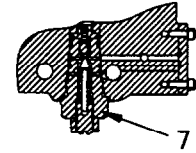
- | | |
|--|-----------------------------------|
| A. From work equipment pump | G. To bucket cylinder bottom side |
| B. From switch pump (via steering valve) | H. From PPC valve port P1 |
| C. To bucket cylinder rod side | I. From PPC valve port P3 |
| D. To boom cylinder rod side | J. From PPC valve port P4 |
| E. Drain port (to tank) | K. From PPC valve port P2 |
| F. To boom cylinder bottom side | |



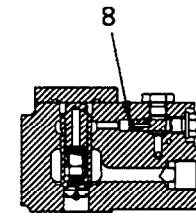
A - A



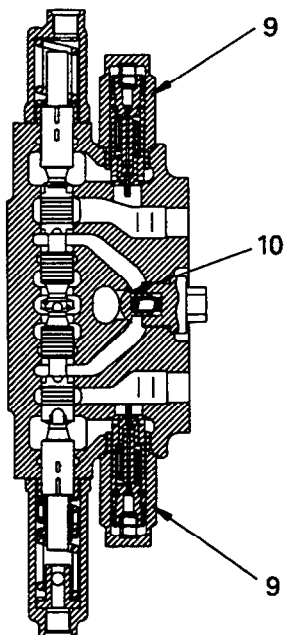
B - B



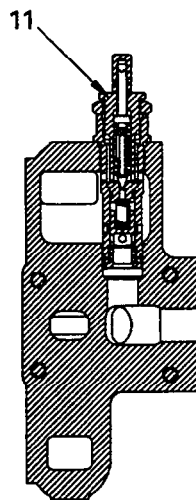
C - C



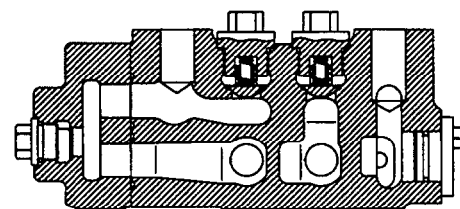
D - D



E - E



F - F

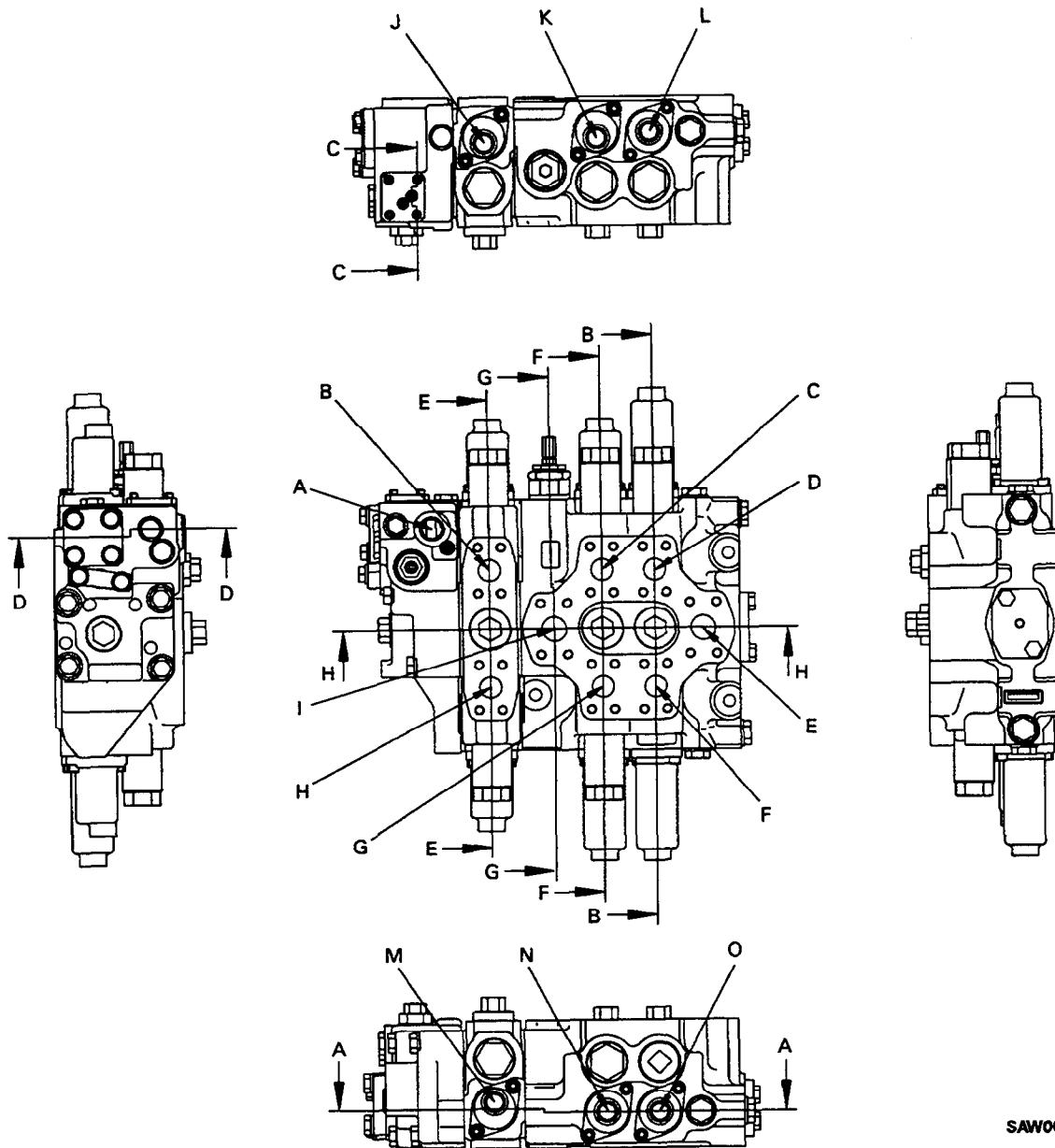


G - G

1. Cut-off valve assembly
2. Unload valve
3. Bucket spool
4. Boom spool
5. Check valve
6. Suction valve
7. Cut-off relief valve
8. Screen
9. Safety valve (with suction)
10. Check valve
11. Main relief valve

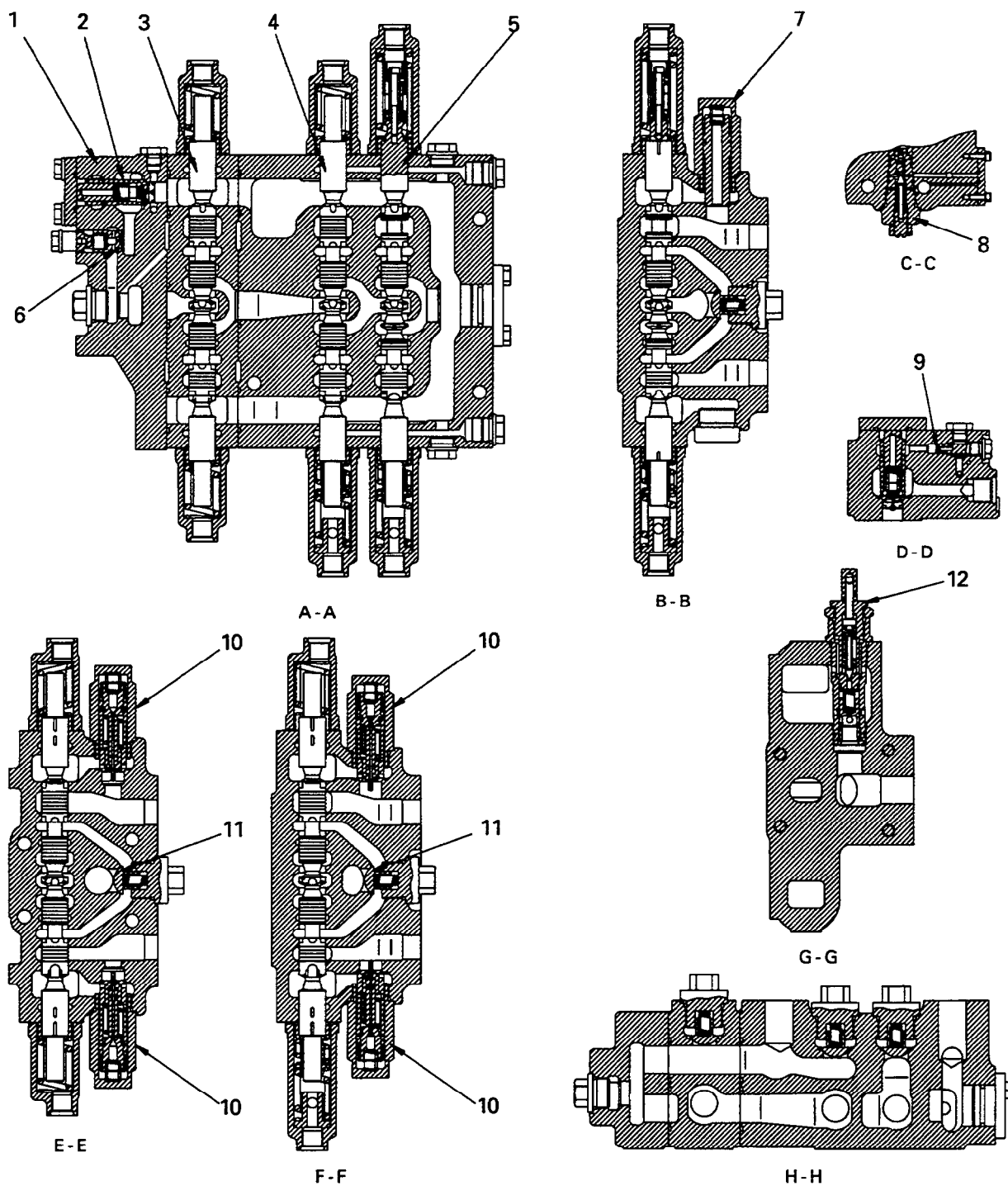
SAW00538

3-SPOOL



SAW00539

- | | |
|--|------------------------------|
| A. From switch pump (via steering valve) | I. From work equipment pump |
| B. To attachment cylinder | J. From attachment PPC valve |
| C. To bucket cylinder rod side | K. From PPC valve port P1 |
| D. To boom cylinder rod side | L. From PPC valve port P3 |
| E. Drain port (to tank) | M. From attachment PPC valve |
| F. To boom cylinder bottom side | N. From PPC valve port P4 |
| G. To bucket cylinder bottom side | O. From PPC valve port P2 |
| H. To attachment cylinder | |



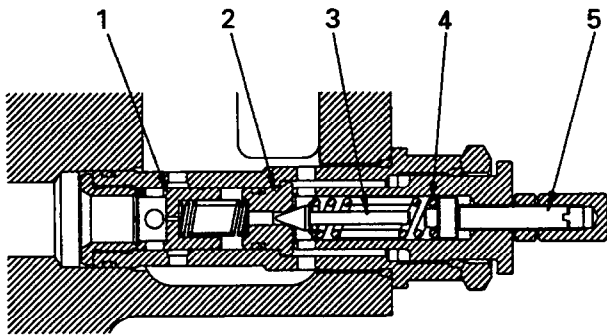
1. Cut-off valve assembly
2. Unload valve
3. Attachment spool
4. Bucket spool

5. Boom spool
6. Check valve
7. Suction valve
8. Cut-off relief valve

9. Screen
10. Safety valve (with suction)
11. Check valve
12. Main relief valve

SAW00540

RELIEF VALVE



SAW00541

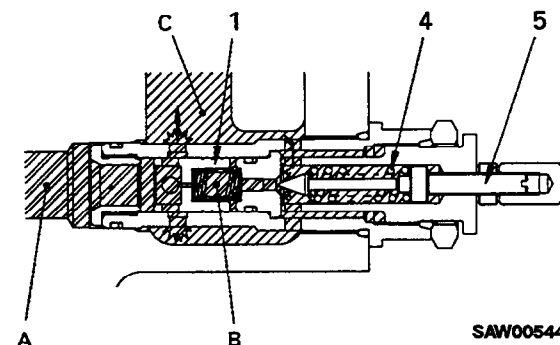
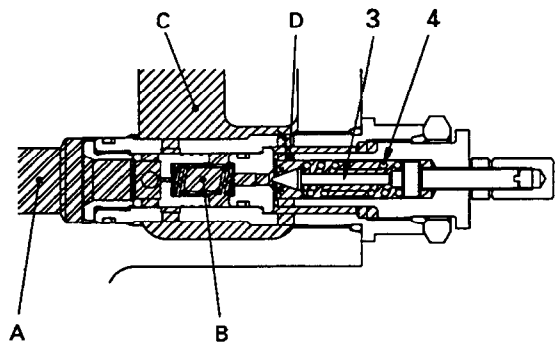
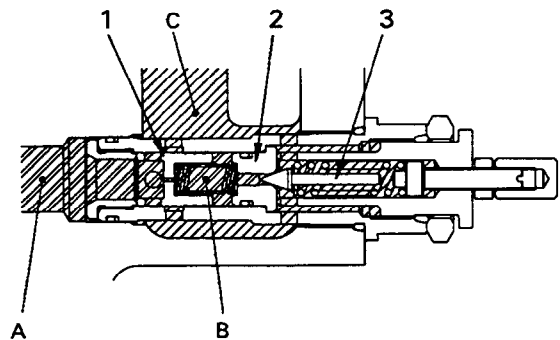
1. Main valve
2. Valve seat
3. Pilot poppet
4. Spring
5. Adjustment screw

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.

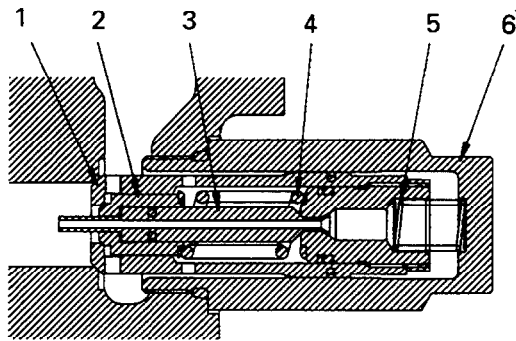
Operation

- 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



SAW00544

SAFETY VALVE (WITH SUCTION)



SAW00545

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

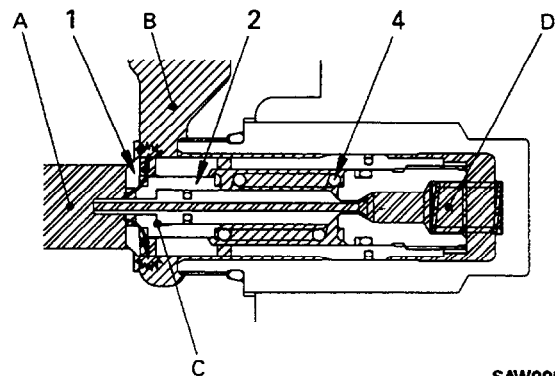
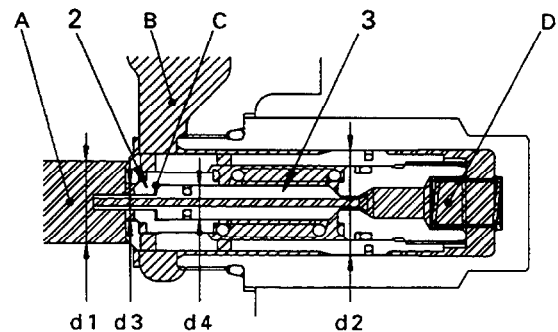
Function

- 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

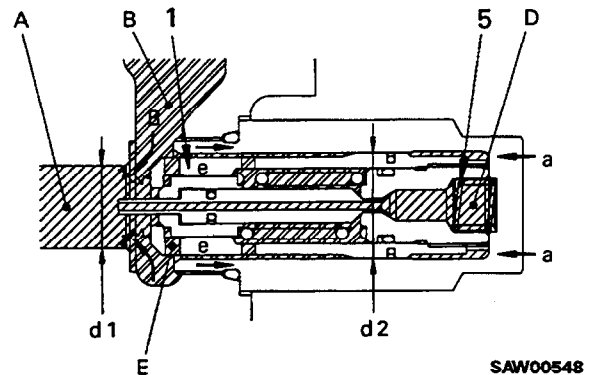
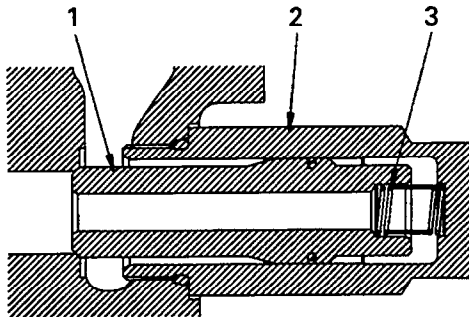
- Port **A** is connected to the cylinder circuit and port **B** is connected to the drain circuit. The oil pressure at port **A** is sent to port **D** from the hole in pilot piston (3). It is also sent to port **C** by the orifice formed from main valve (2) and pilot piston (3). Pilot piston (3) is secured to the safety valve, and the size of the cross-sectional surface (cross-sectional area) has the following relationship: $d_2 > d_3 > d_1$ $d_3 > d_4$.
- 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 (4), main valve (2) is actuated, and the oil from port **A** flows to port **B**.



SAW00547

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 suction valve (1) 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**.

**SUCTION VALVE**

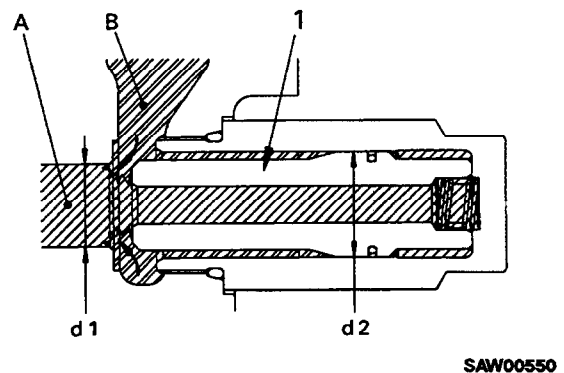
1. Main poppet
2. Sleeve
3. Spring

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.



OPERATION OF CUT-OFF VALVE**Function**

- The cut-off valve is mounted between the switch pump and work equipment valve. It switches the oil flow from the switch pump between the working equipment valve and the drain, according to operating conditions, and controls the speed of the work equipment.
- Cut-off operation conditions
 - O : Cut-off (drain)
 - X : Not actuated (to main control valve)

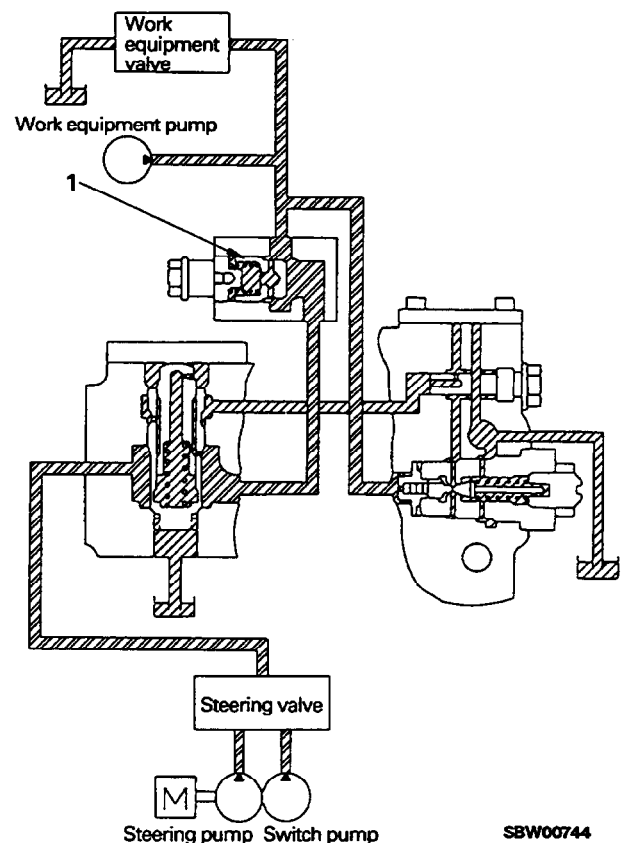
More than 15.7 Mpa (160 kg/cm ²)	Less than 15.7 Mpa (160 kg/cm ²)
O	X
O	X

Operation**1. When the work equipment valve is held**

The oil at the switch pump (the oil from the steering valve) presses up check valve (1), merges with the oil from the work equipment pump and flows to the work equipment valve.

2. When the work equipment valve is activated**1) When the work equipment pump pressure is lower than the cut-off pressure**

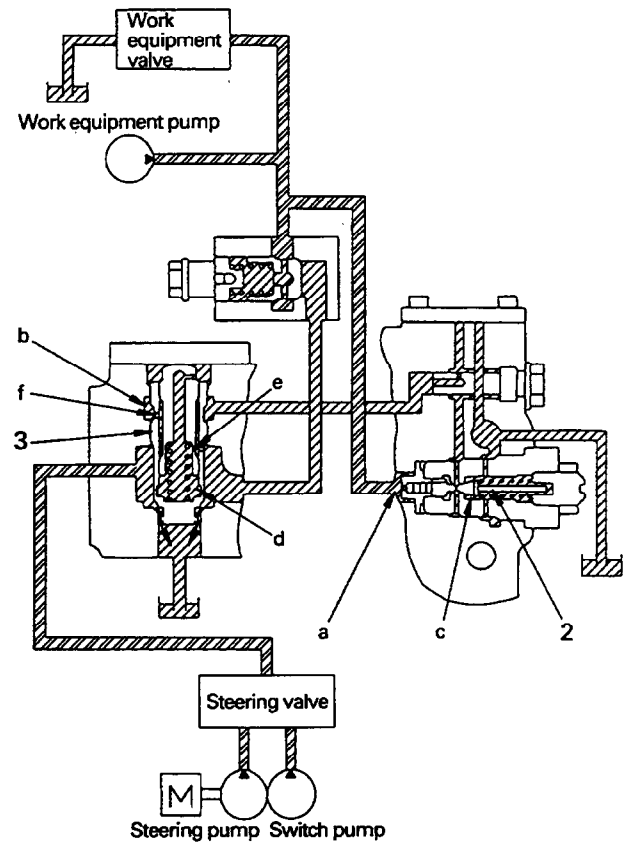
As when the work equipment valve is held, the oil at the switch pump (the oil from the steering valve) presses up check valve (1), merges with the oil from the work equipment pump and flows to the work equipment valve.



SBW00744

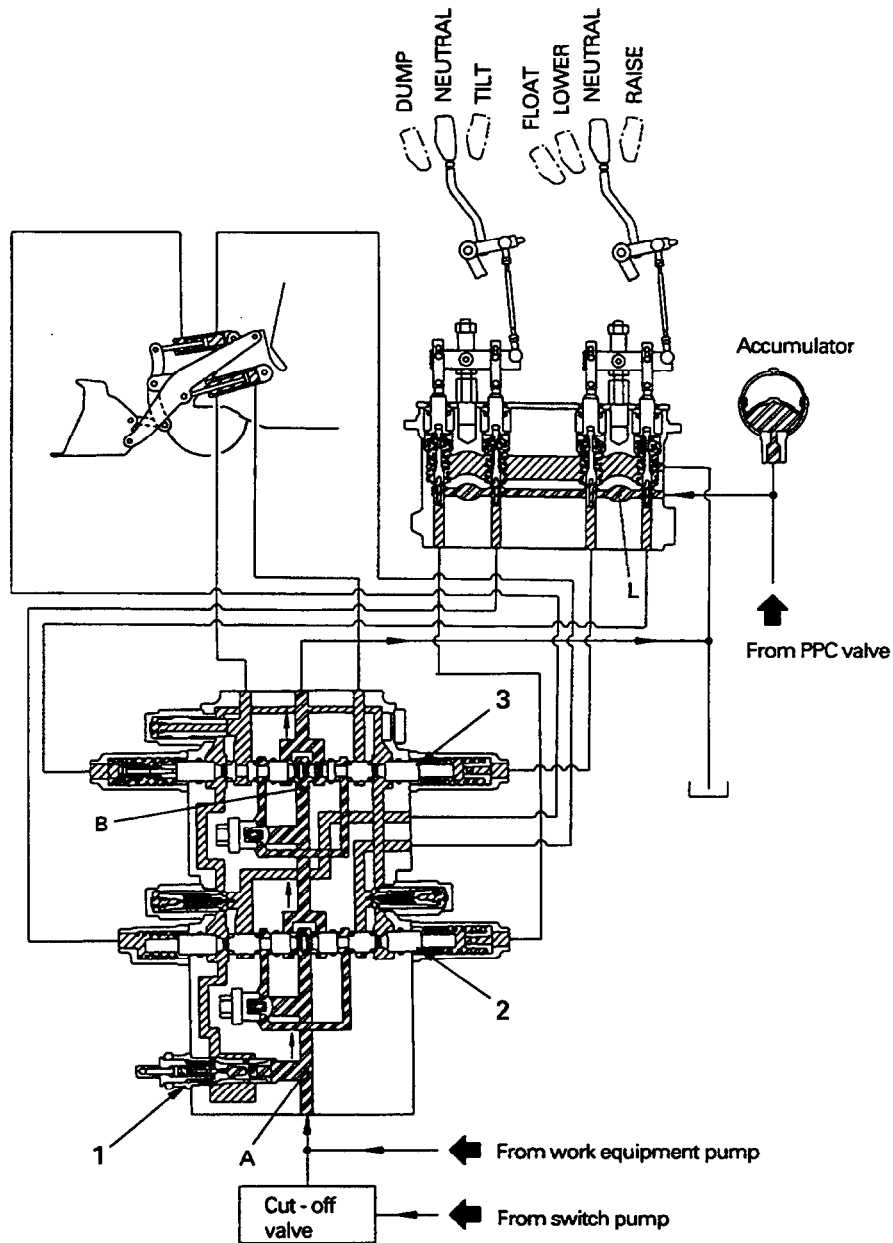
2) When the work equipment pump pressure is higher than the cut-off pressure

When the cut-off pressure is reached, the pressure of the oil in chamber **a** opens cut-off valve (2), and the oil in unload valve (3) chamber **b** passes through cut-off valve (2) chamber **c** and is drained. The oil in unload valve (3) chamber **d** passes through orifices **e** and **f**, and into chamber **b** causing the oil pressure in chamber **d** decrease, and unload valve (3) to open. Thus, the oil from the switch pump is drained.



SBW00745

MAIN CONTROL VALVE OPERATION BOOM AND BUCKET SPOOL HOLD POSITION

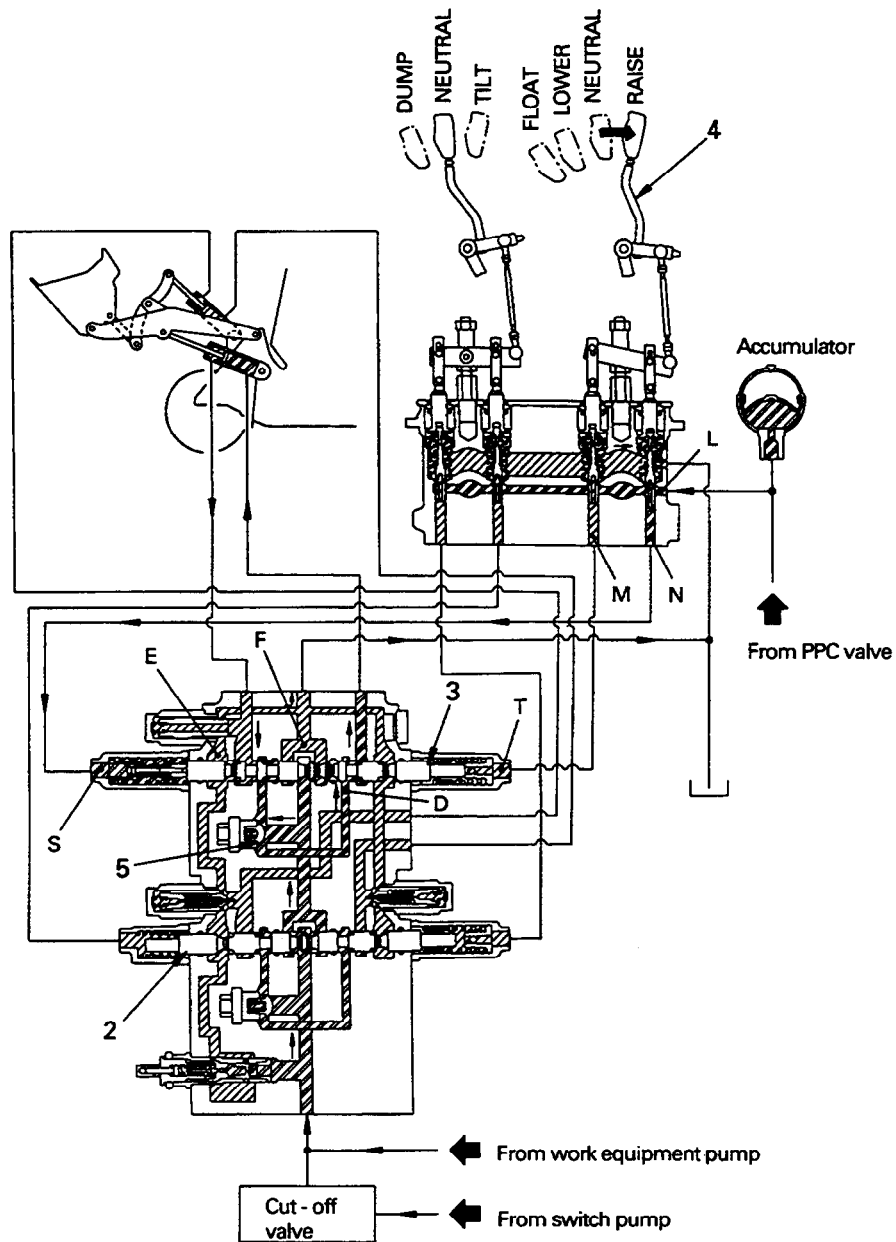


SLW00554

Operation

- The oil from the switch pump which has passed through the cut-off valve and the work equipment pump's oil enter port A and the maximum pressure is regulated by relief valve (1).
- Since the bucket spool (2) is at the neutral position, the bypass circuit is open, and the oil at port A passes around the spool and flows to port B. The boom spool (3) is also at the neutral position, so the bypass circuit is open, the oil at port B passes around the spool and returns to the tank from the drain circuit.
- The oil from the PPC pump enters PPC valve port L, but since the boom and bucket levers are at the neutral position, the oil returns to the tank from the PPC relief valve.

BOOM SPOOL AT RAISED POSITION



SLW00555

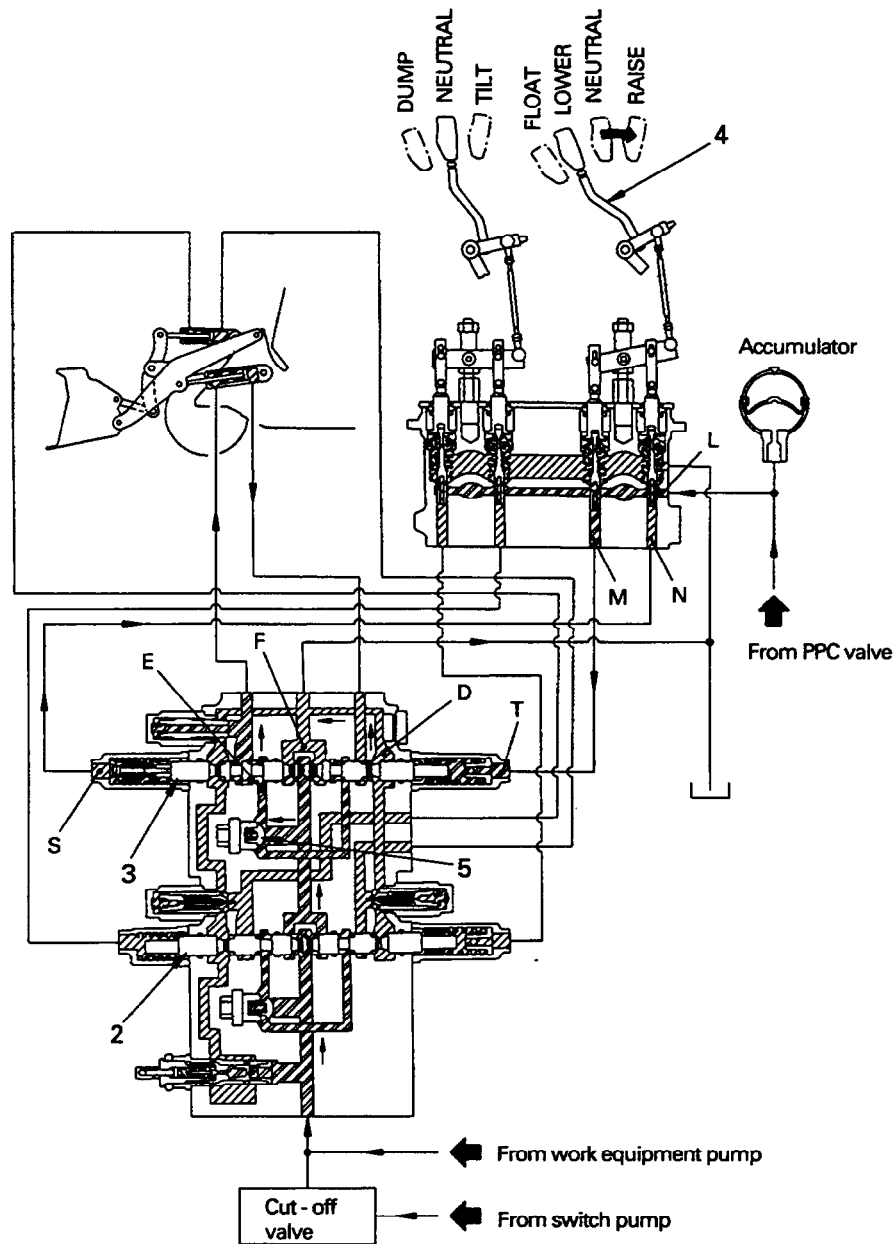
Operation

- When boom lever (4) is pulled, oil flows from PPC valve port L to port N and port S. The oil at port T passes through port M and flows to the drain circuit. The oil pressure at port S presses boom spool (3) and sets it to the RAISE position.
- The oil from the pump passes through the bucket spool (2) bypass circuit and flows to the boom spool

(3) bypass circuit. The bypass circuit is closed by boom spool (3), so the oil pushes open check valve (5). The oil from check valve (5) flows to port D and to the cylinder bottom side.

- The oil on the cylinder rod side enters drain port F from port E and returns to the tank, causing the boom to raise.

BOOM SPOOL AT LOWER POSITION

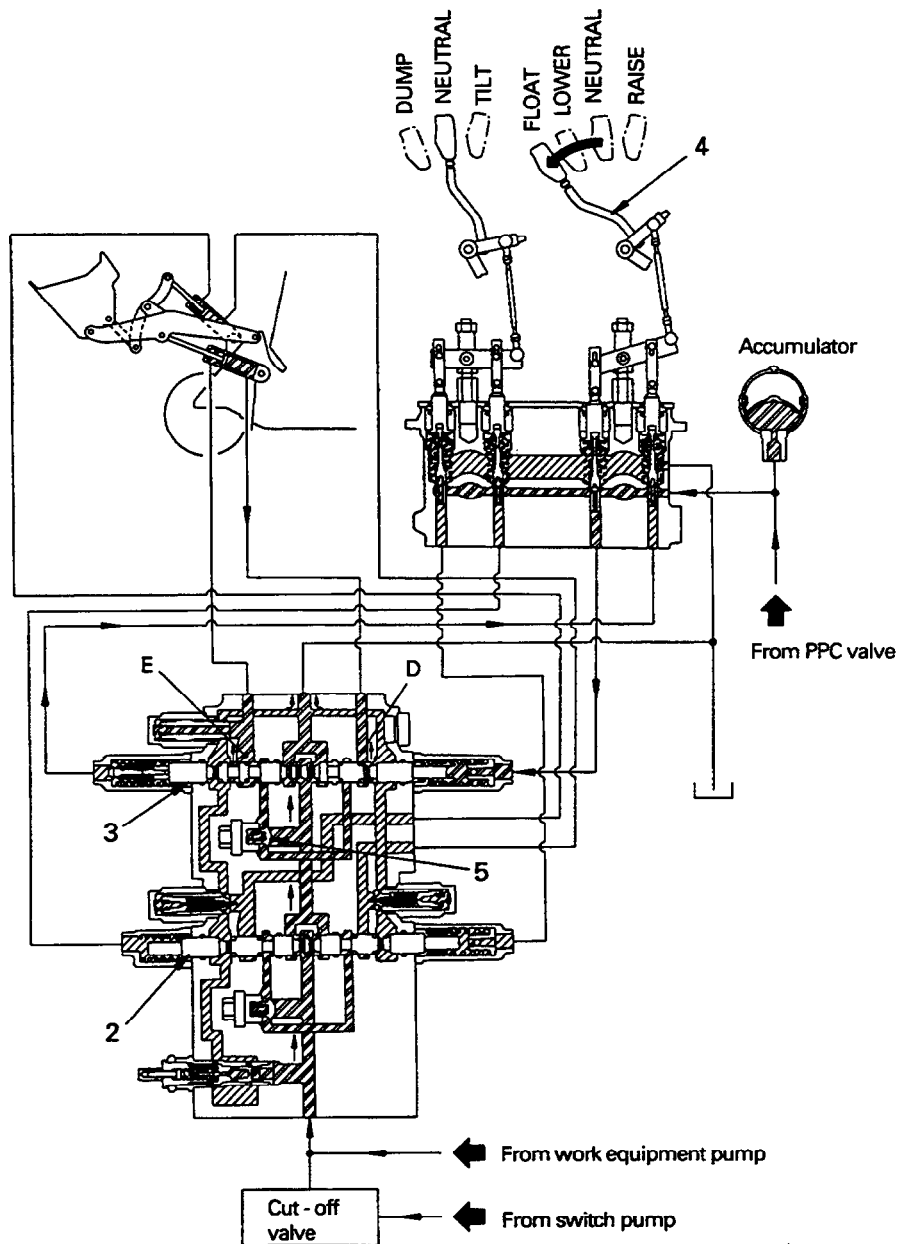


SLW00556

Operation

- When boom lever (4) is pushed, oil flows from PPC valve port L to port M and port T, and the oil at port S flows to the drain circuit. The oil pressure at port T pushes boom spool (3) and sets it to the LOWER position.
- The oil from the pump passes through the bucket spool (2) bypass circuit and flows to the boom spool (3) bypass circuit. The bypass circuit is closed by boom spool (3), so the oil pushes open check valve (5). The oil from check valve (5) flows to port E and to the cylinder rod side.
- The oil on the cylinder bottom side enters drain port F from port D and returns to the tank, causing the boom to lower.

BOOM SPOOL AT FLOAT POSITION



SLW00557

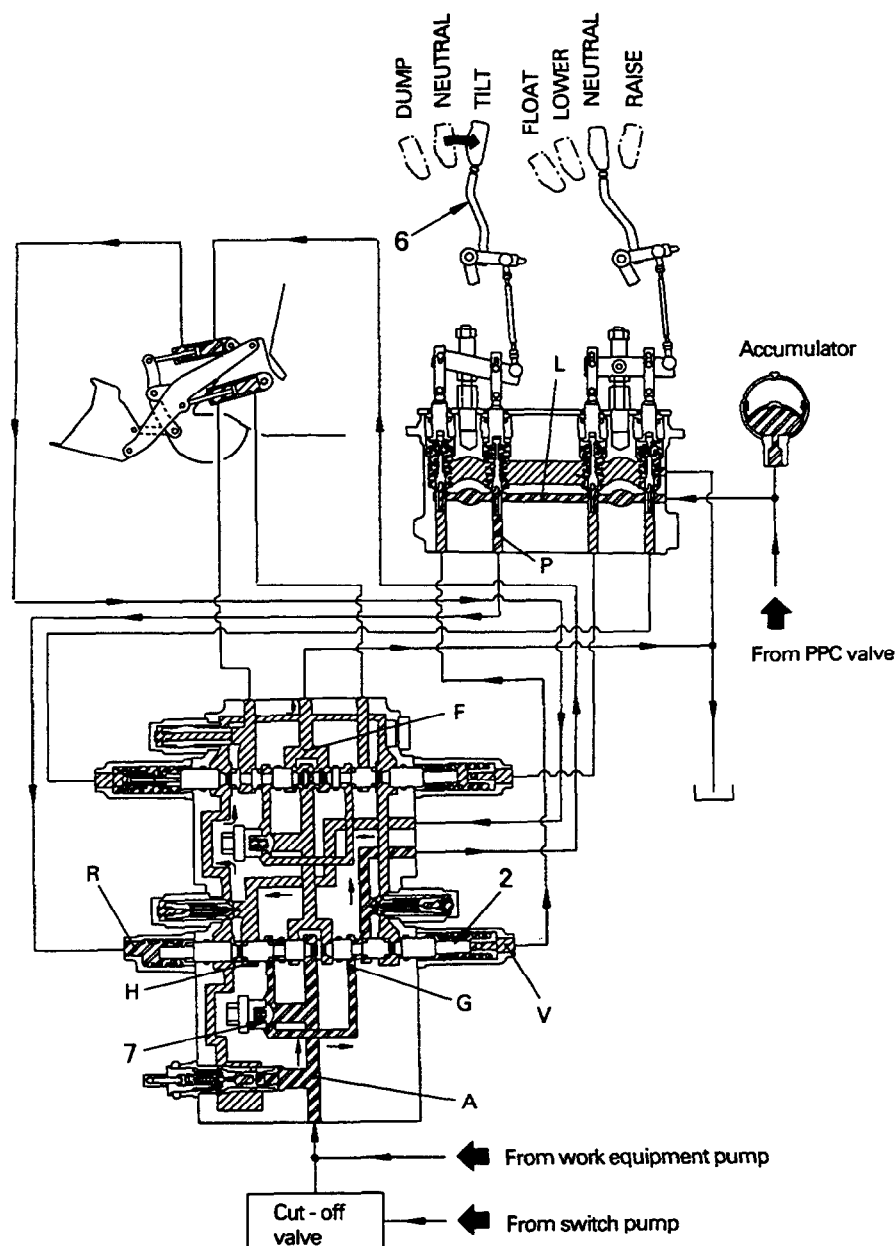
Operation

- When boom lever (4) is pressed in further from the LOWER position (to the FLOAT position), boom spool (3) moves further from the LOWER position and is set to the FLOAT position.
- The oil from the pump passes through the bucket spool (2) bypass circuit and flows to the boom spool (3) bypass circuit. Boom spool (3) causes the oil in the bypass circuit to flow to the drain circuit, so the

check valve (5) cannot be pushed open. In addition, boom cylinder raise circuit D and lower circuit E are both connected to the drain circuit, so the boom lowers under its own weight.

- When the bucket is touching the ground, it can move up and down in accordance with the ground surface contour.

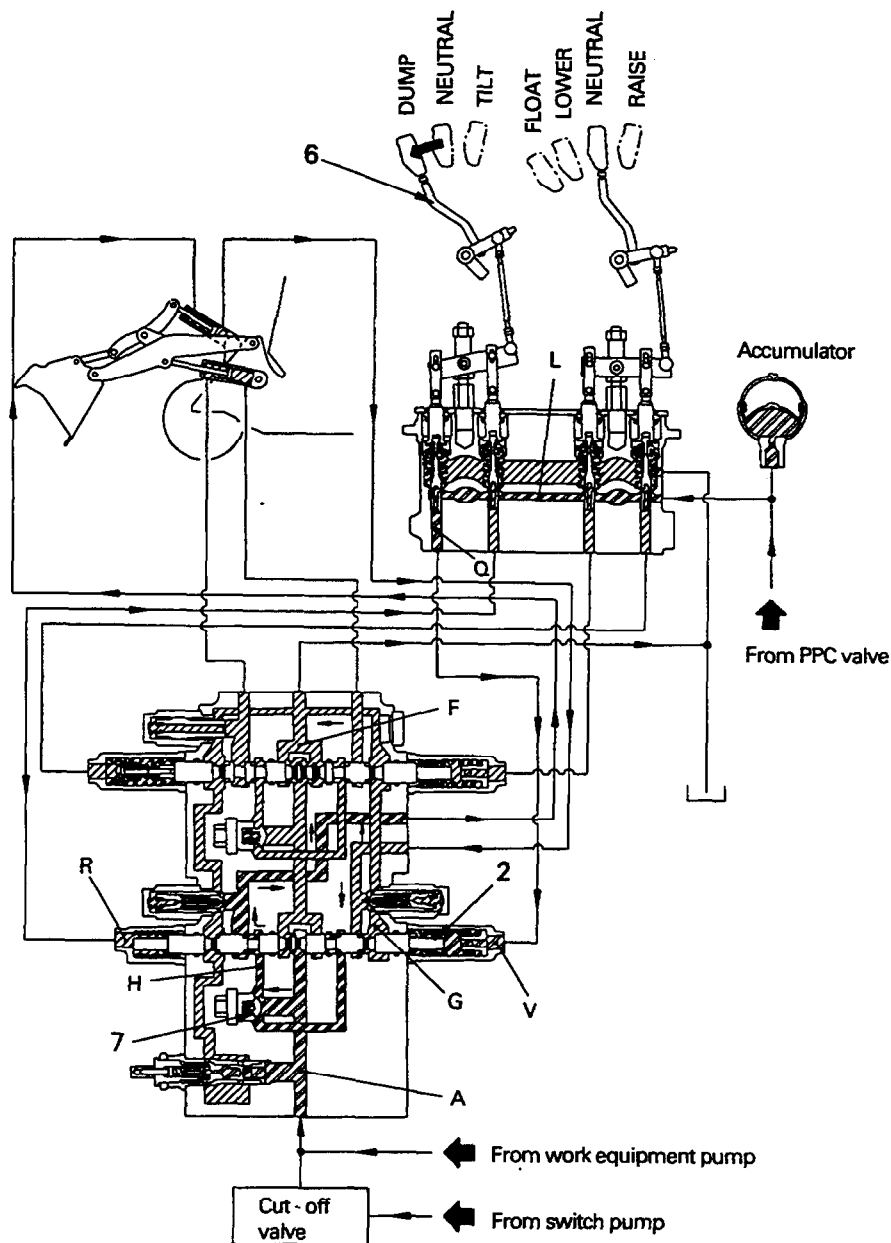
BUCKET SPOOL AT TILT POSITION



SLW00558

Operation

- When bucket lever (6) is pulled, the oil pressure at PPC valve port L is released from port P to port R, and the oil at port V flows to the drain circuit. The oil pressure at port R sets bucket spool (2) to the TILT position.
- Since the bypass circuit is closed by bucket spool (2), the oil at port A pushes open check valve (7).
- The oil from port A passes from check valve (7) through port G and to the bottom side of the bucket cylinder.
- The oil on the bucket cylinder's rod side flows from port H to drain port F and returns to the tank, causing the bucket to tilt.

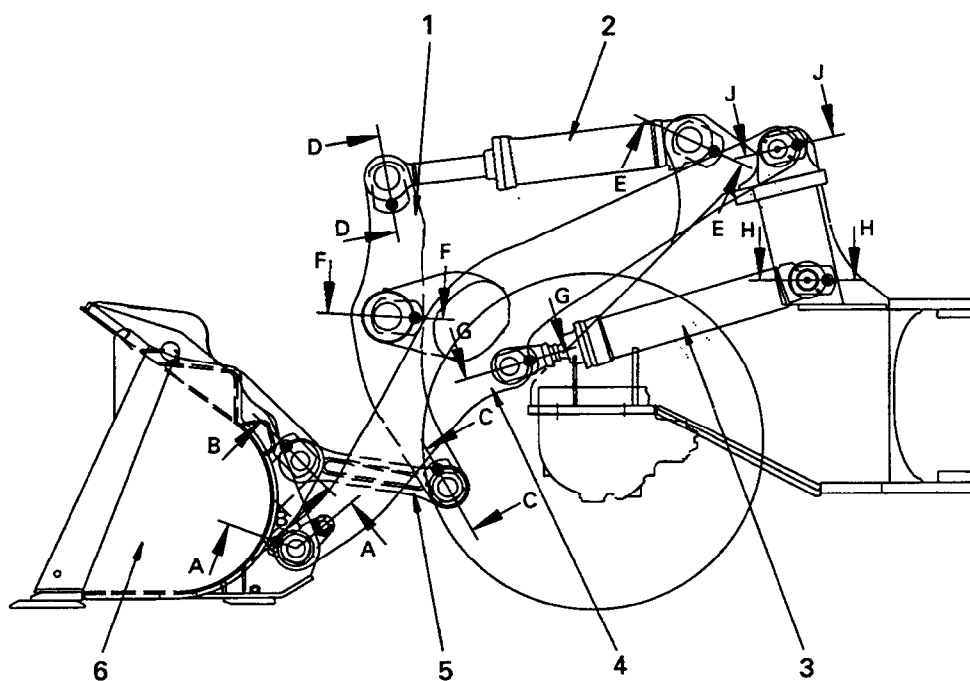
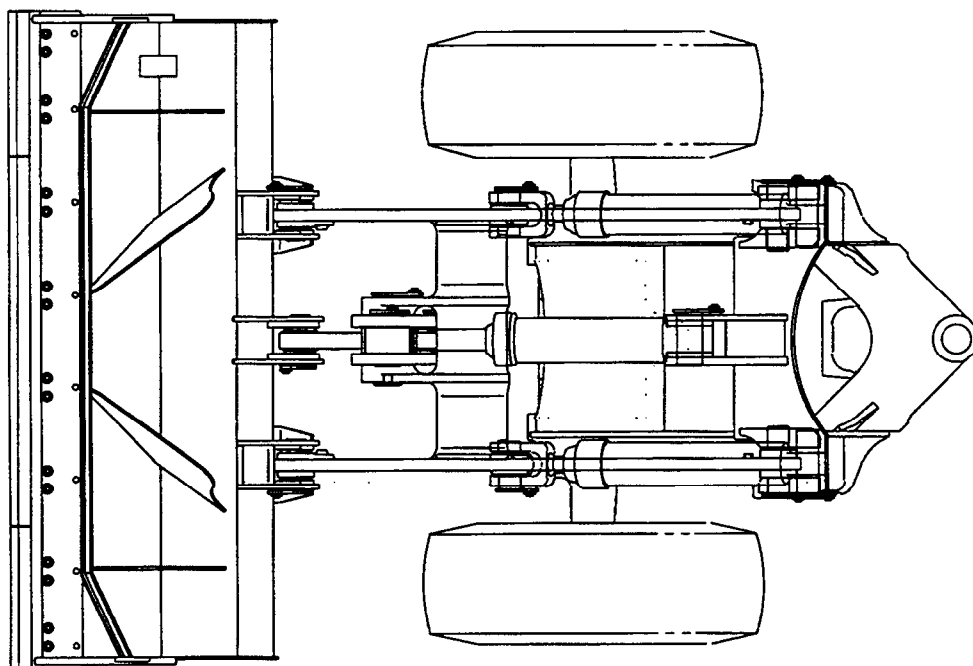
BUCKET SPOOL AT DUMP POSITION

SLW00559

Operation

- When bucket lever (6) is pushed, the oil pressure at PPC valve port L is released from port Q to port V, and the oil at port R flows to the drain circuit. The oil pressure at port V sets bucket spool (2) to the DUMP position.
- Since the bypass circuit is closed by bucket spool (2), the oil at port A pushes open check valve (7). The oil from port A passes from check valve (7) through port H and to the rod side of the bucket cylinder.
- The oil on the bucket cylinder's bottom side flows from port G to drain port F and returns to the tank, causing the bucket to dump.

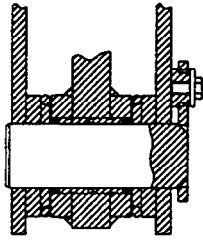
WORK EQUIPMENT LINKAGE



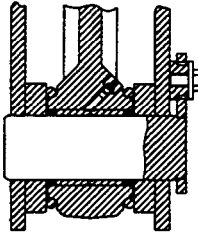
- 1. Bellcrank
- 2. Bucket cylinder
- 3. Boom cylinder

- 4. Boom
- 5. Bucket link
- 6. Bucket

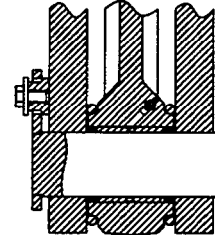
SAW00560



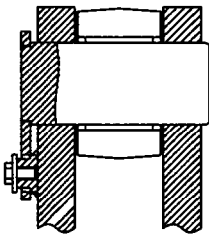
A-A



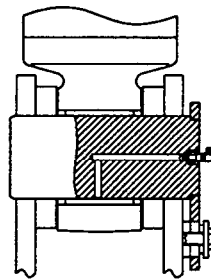
B-B



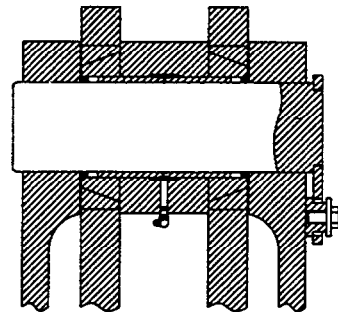
C-C



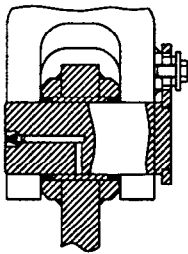
D-D



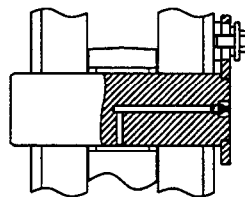
E-E



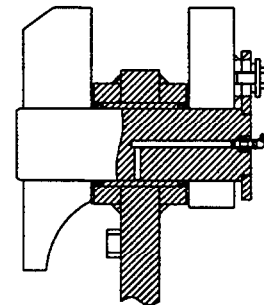
F-F



G-G



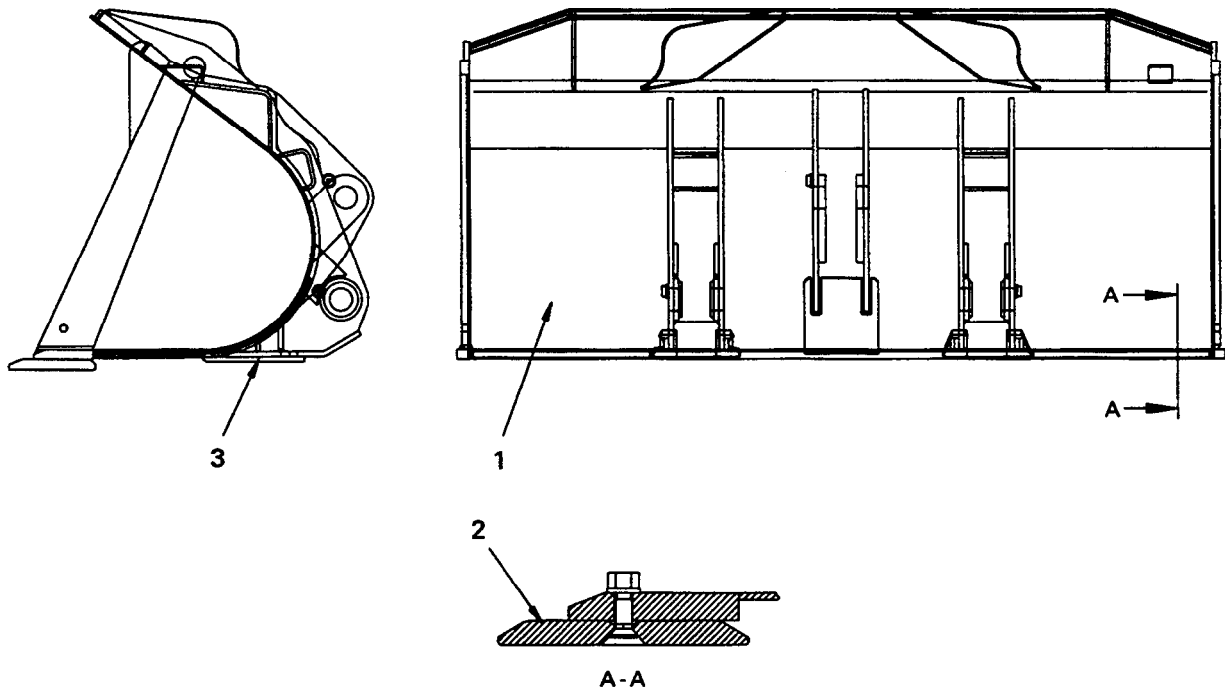
H-H



J-J

SAW00561

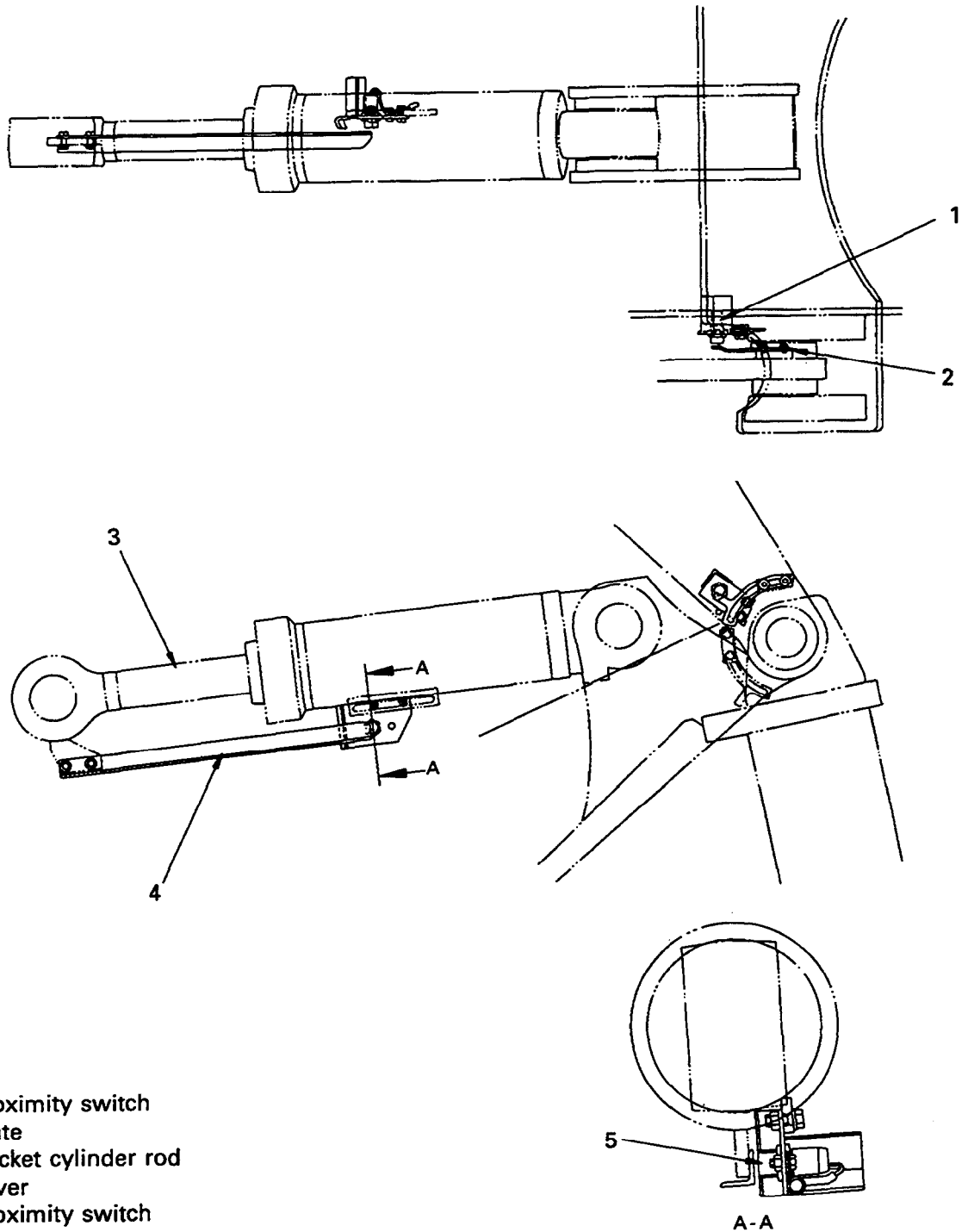
BUCKET



1. Bucket (3.1m³)
2. Bolt-on cutting edge (BOC)
3. Plate

SAW00562

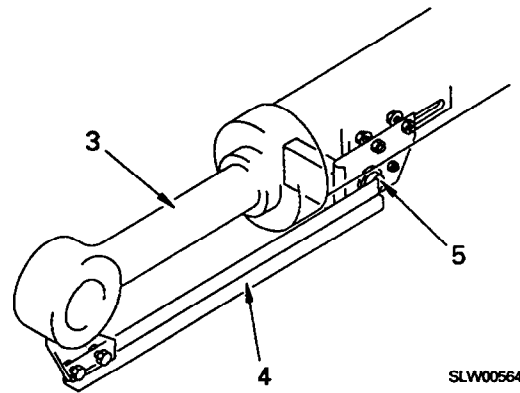
BUCKET POSITIONER AND BOOM KICK-OUT



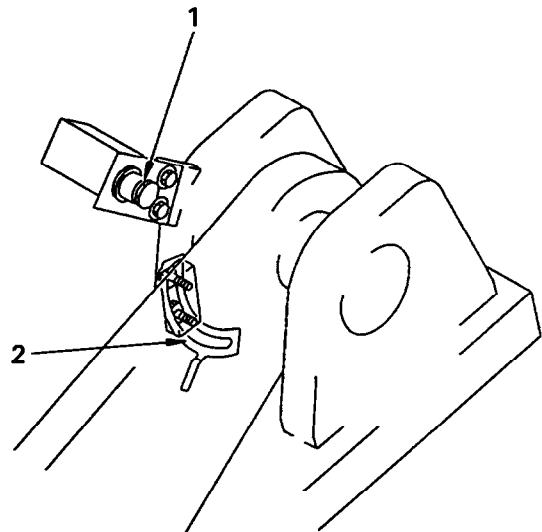
SBW00563

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 (5) 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 (5) separates from lever (4) at the desired position, and the bucket lever is returned to neutral.

**BOOM KICK-OUT**

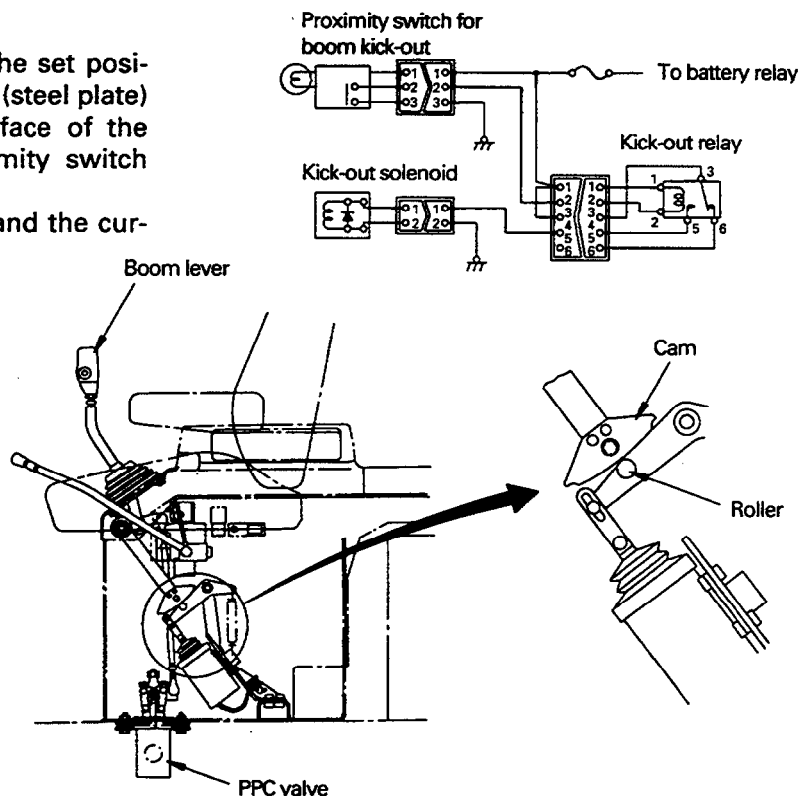
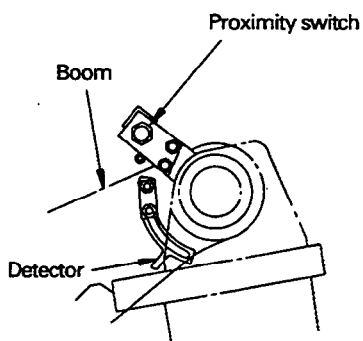
- The boom kick-out is an electrically actuated system. It acts to move the boom lever to the HOLD position and stop the boom at the desired position before the boom reaches the maximum height.
- Plate (2) is fixed to the boom. In addition, proximity switch (1) is fixed to the frame. When the boom is 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.



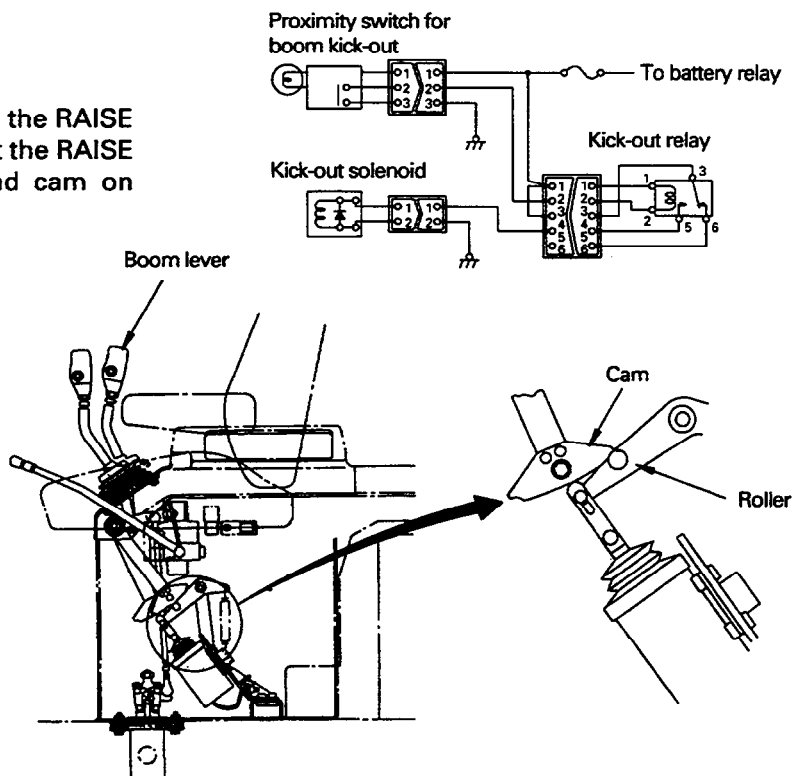
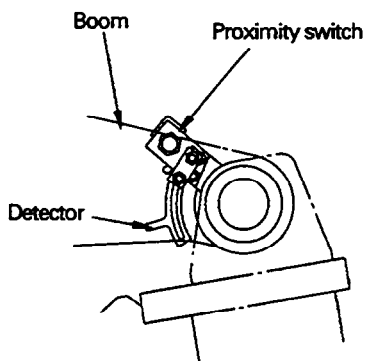
Operation of proximity switch

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.

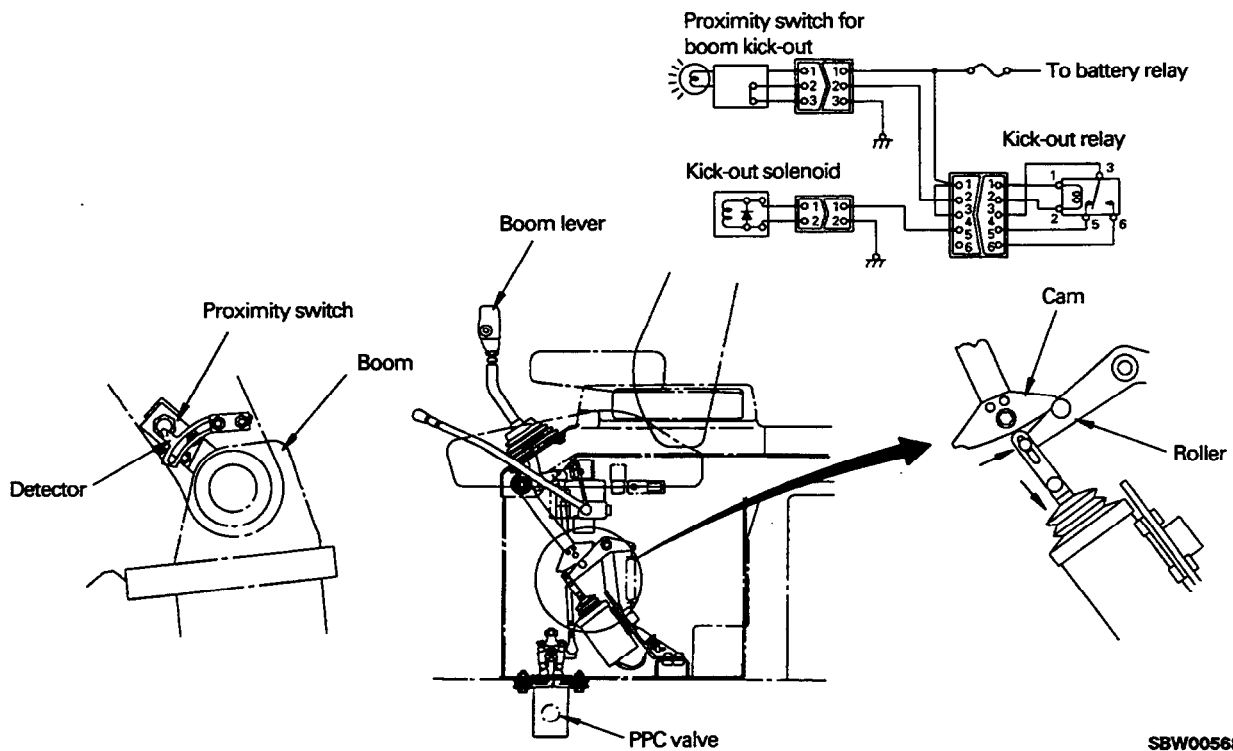


SBW00567

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 boom spool is returned to the HOLD position by the return spring.



SBW00568

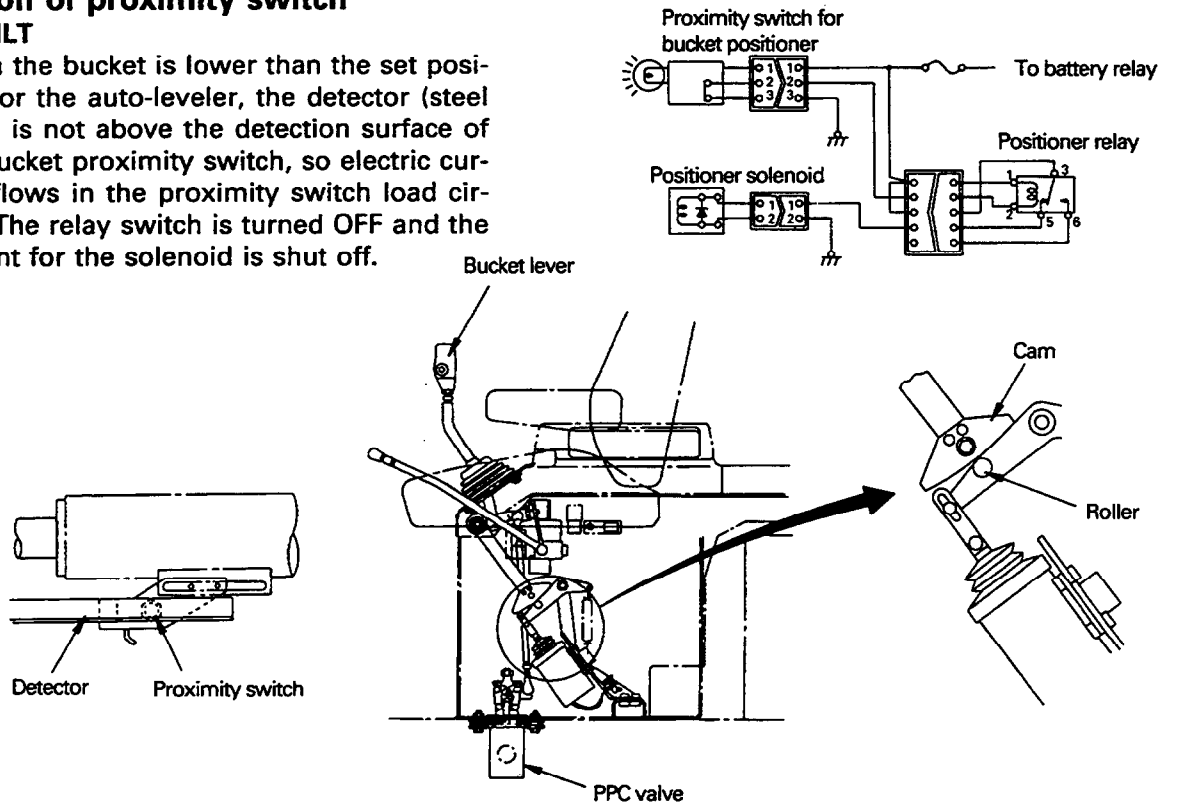
Action of proximity switch

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

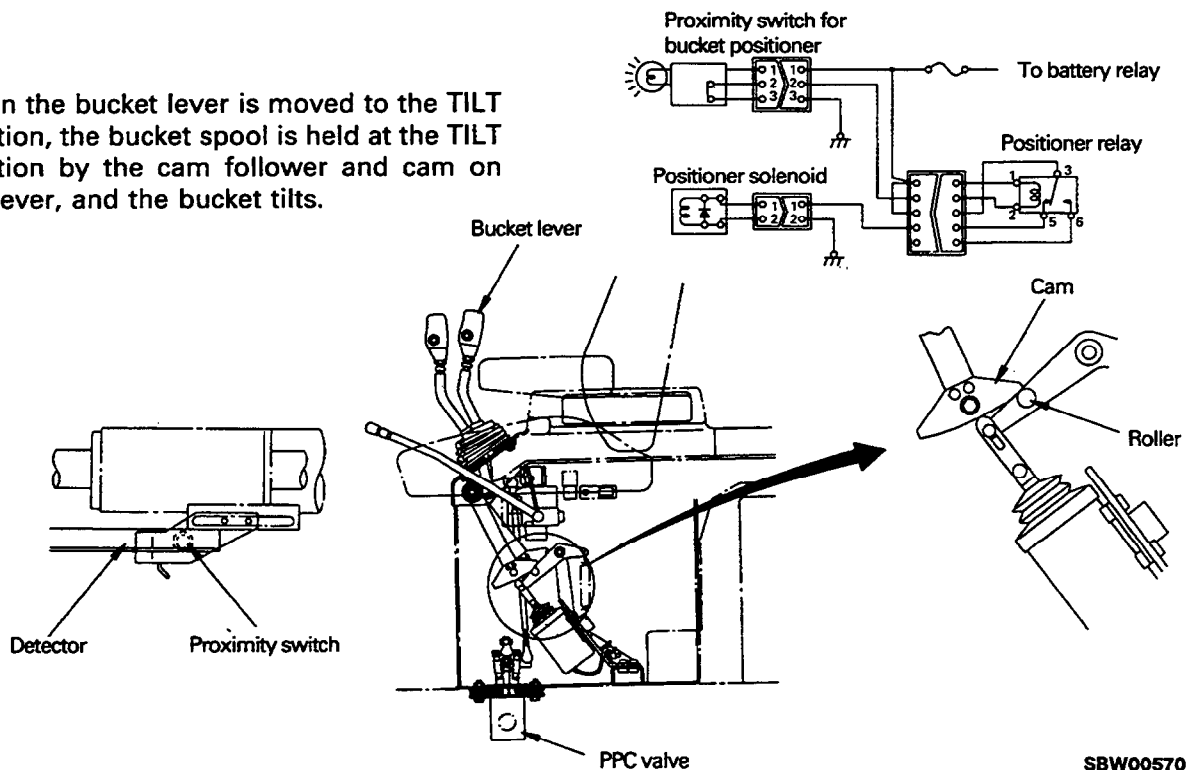
Operation of proximity switch

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 bucket spool is held at the TILT position by the cam follower and cam on the lever, and the bucket tilts.



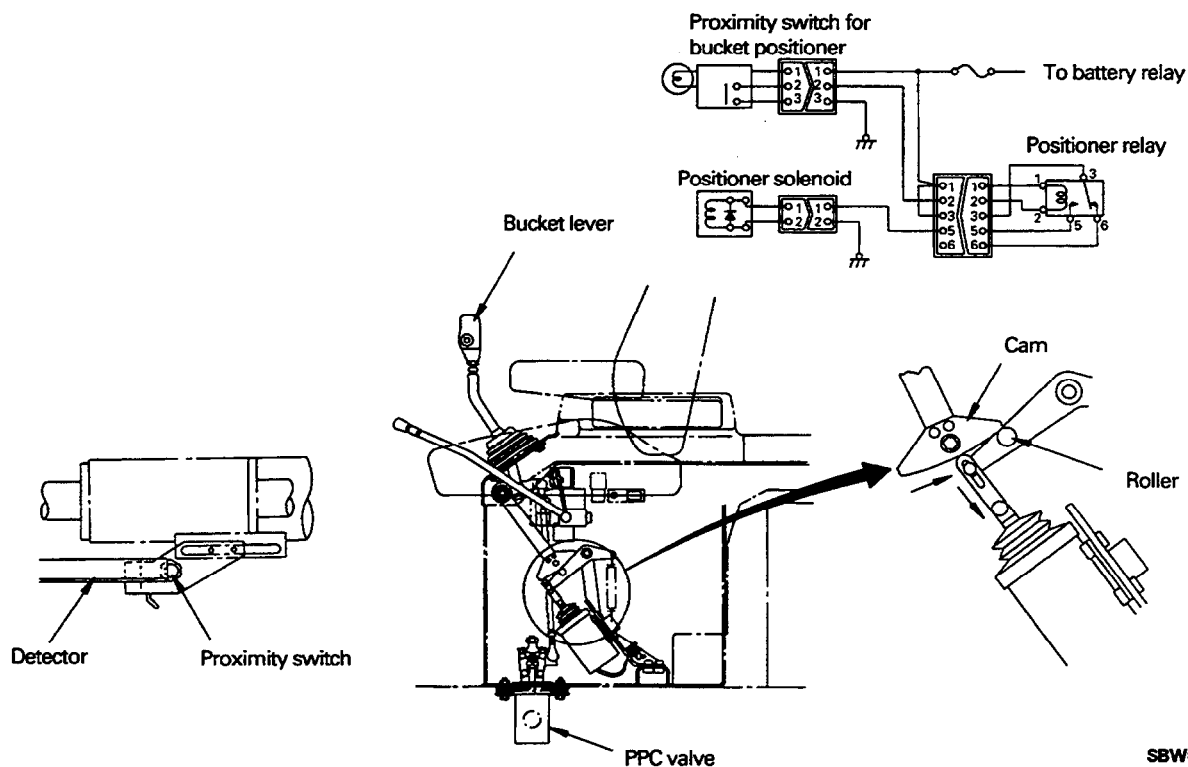
SBW00570

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 bucket spool is returned to the HOLD position by the return spring.

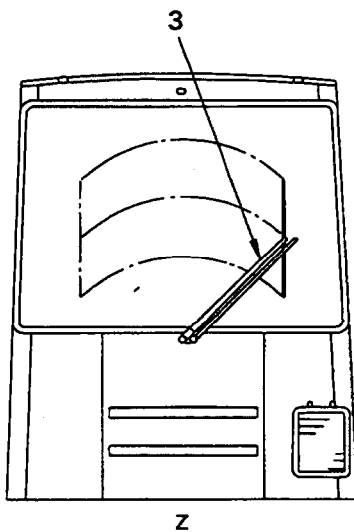
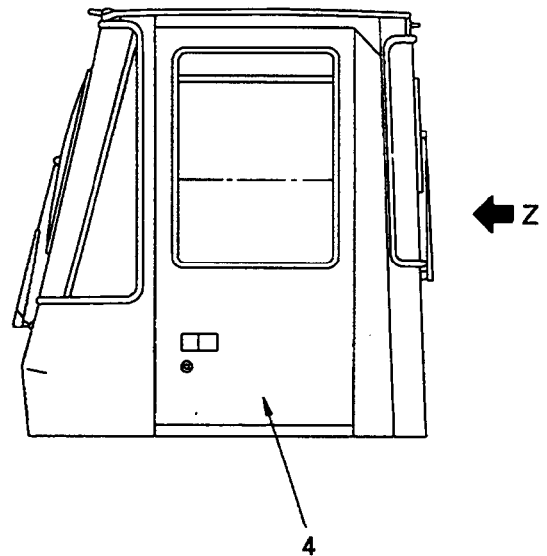
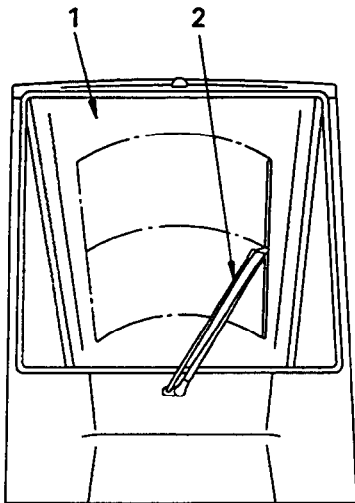
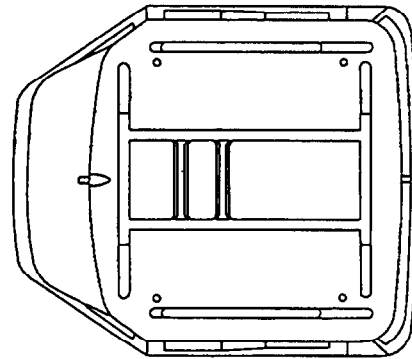


SBW00571

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

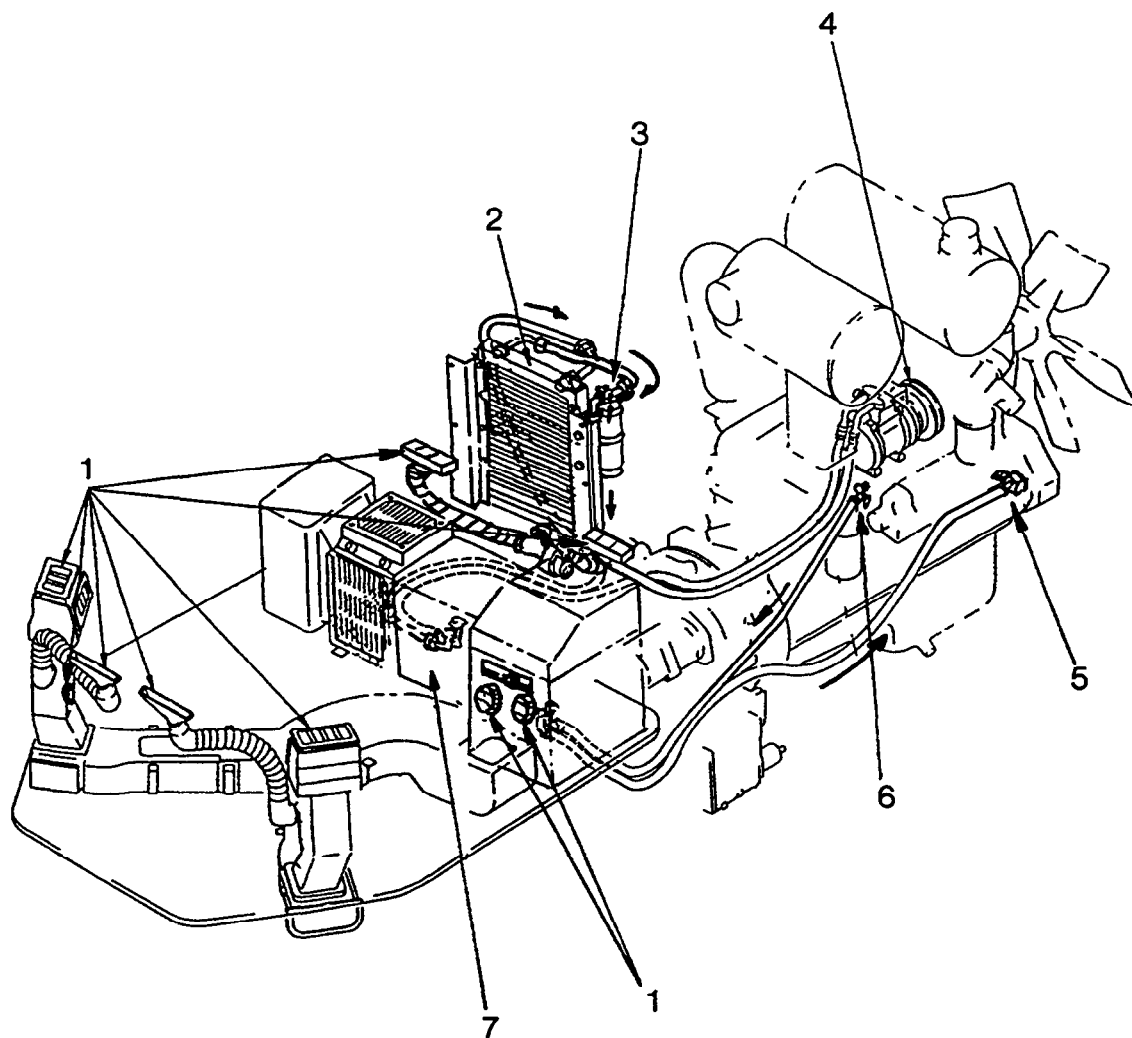
CAB



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

SEW00198

AIR CONDITIONER
AIR CONDITIONER PIPING



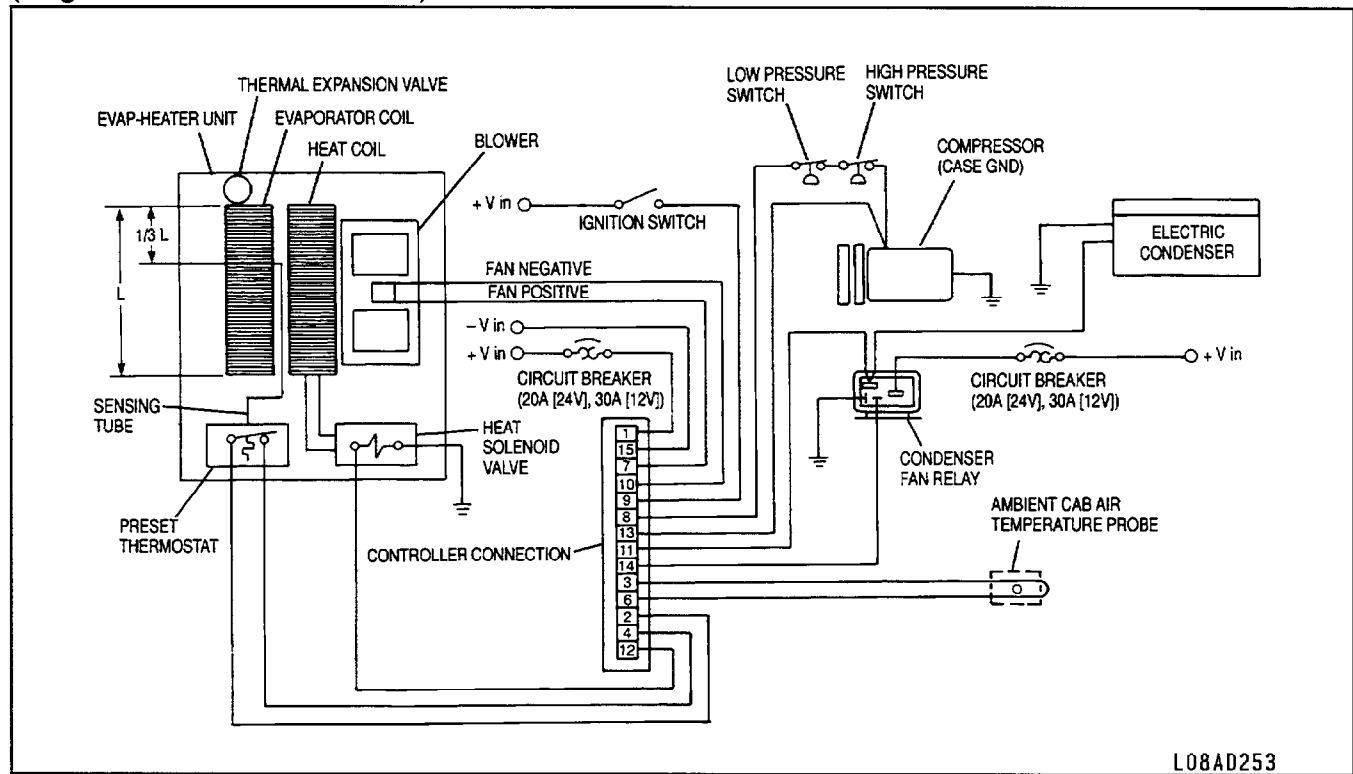
SBW00572

- 1. Vent
- 2. Air conditioner condenser
- 3. Dry receiver
- 4. Compressor

- 5. Hot water inlet port
- 6. Hot water outlet port
- 7. Air conditioner unit

WIRING DIAGRAM

(Eagle air conditioner/Heater)

**NOTES:**

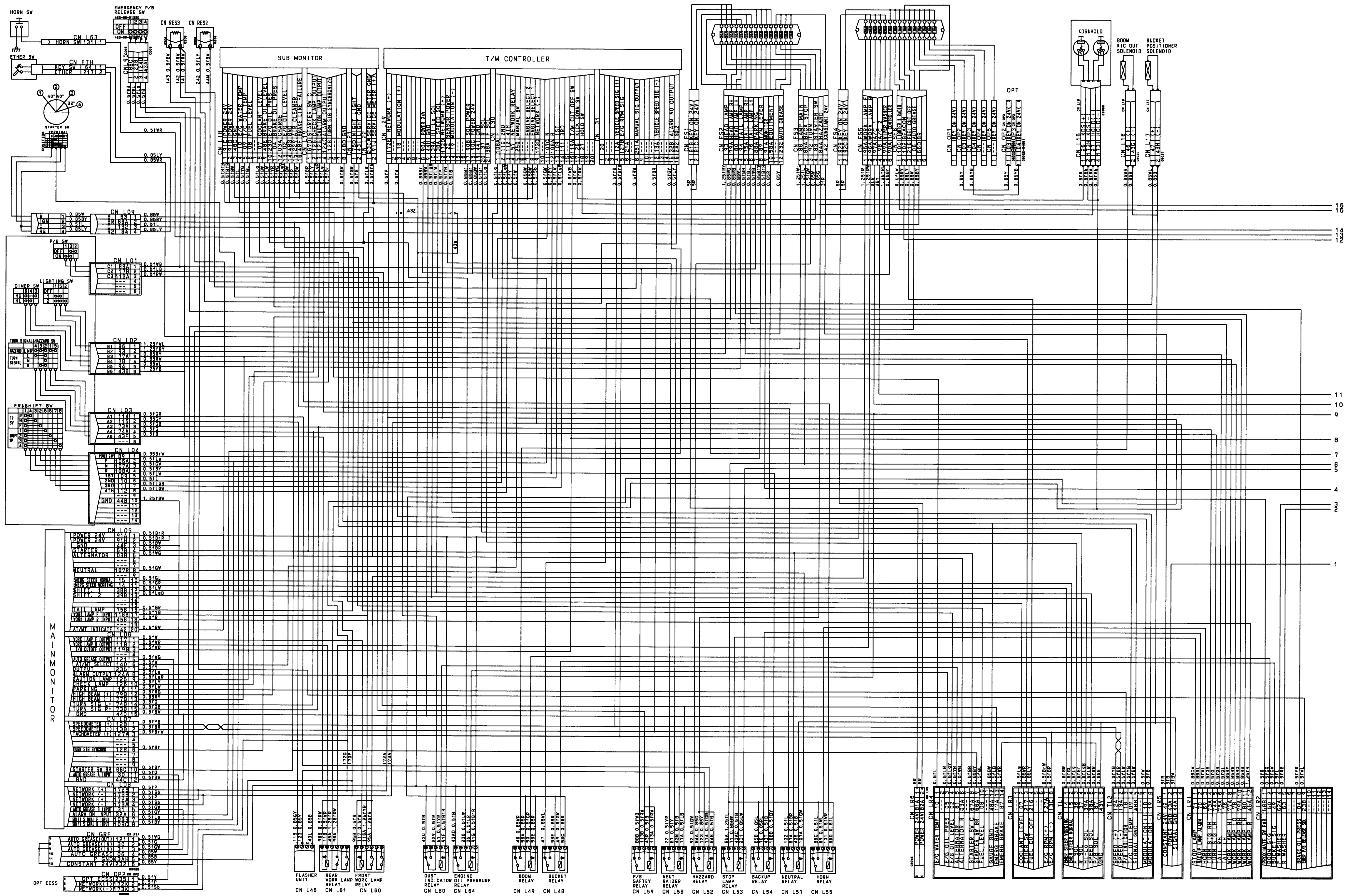
1. Position the ambient temperature probe near waist high level, out of air flow and sun load.
2. Insert the sensing tube from present thermostat down into the evaporator coil, parallel to the coil face, between the 1st and 2nd rows, to a depth of the coil height minus 1 inch.

Wire Chart

Scket	Size	Color	Wire function
1	10GA	Red	Battery positive in
2	18GA	Red	½ evap coil thermostat in
3	18GA	Black	½ ambient thermistor in
4	18GA	Red	½ evap coil thermostat in
5	N/A	N/A	Not used
6	18GA	Black	½ ambient thermistor in
7	14GA	Orange	Fan positive out
8	16GA	Dk. Green	Clutch out
9	18GA	Dk. Blue	Ignition switch in
10	14GA	Black	Fan negative out
11	18Ga	Brown	Condenser blown fuse in
12	16GA	White	Heat solenoid out
13	18GA	Tan	Pressure switch detect in
14	16GA	Yellow	Condenser fan relay out

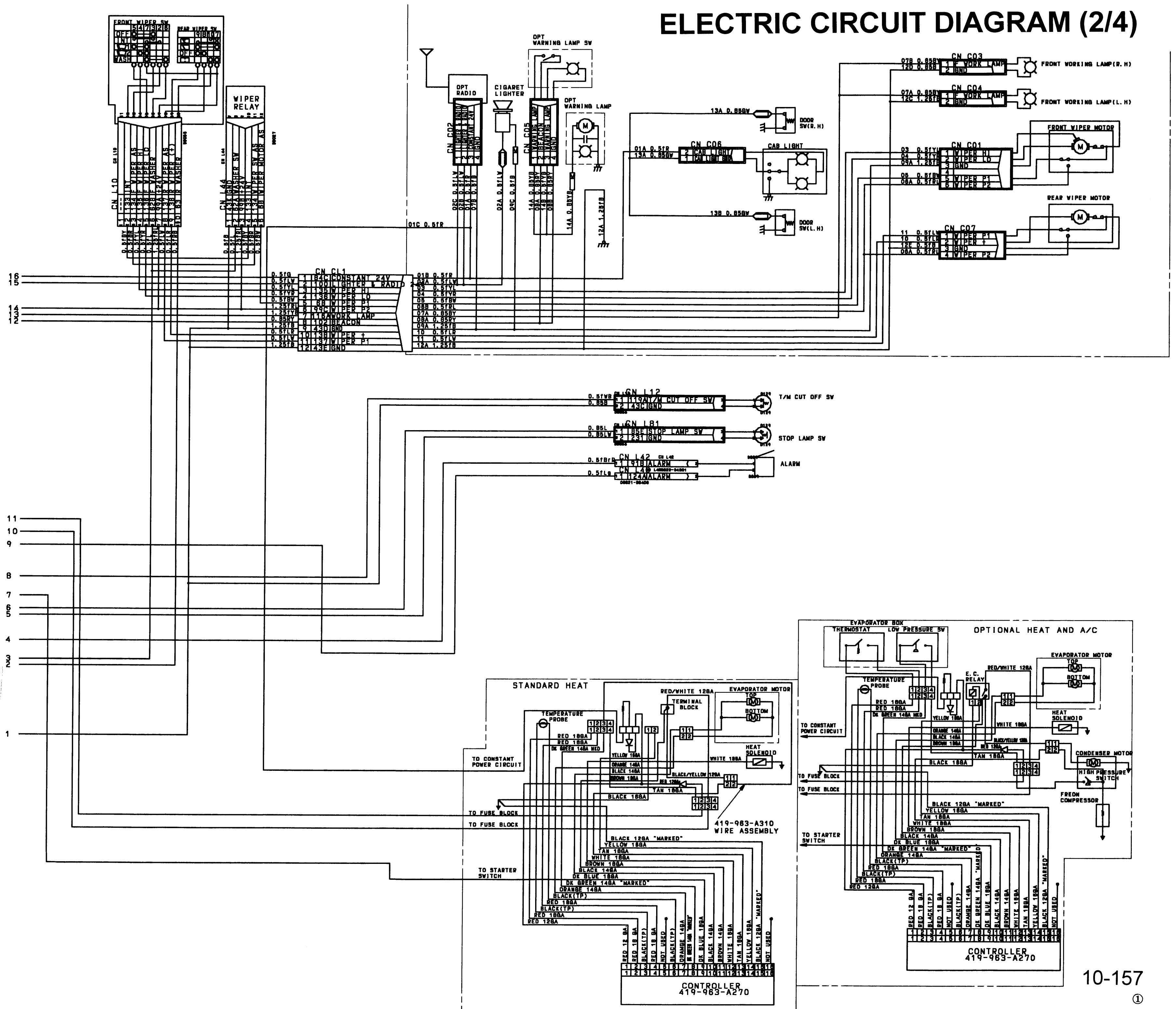
15	12GA	Black	Battery negative in
16	N/A	N/A	Not used

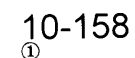
ELECTRIC CIRCUIT DIAGRAM (1/4)

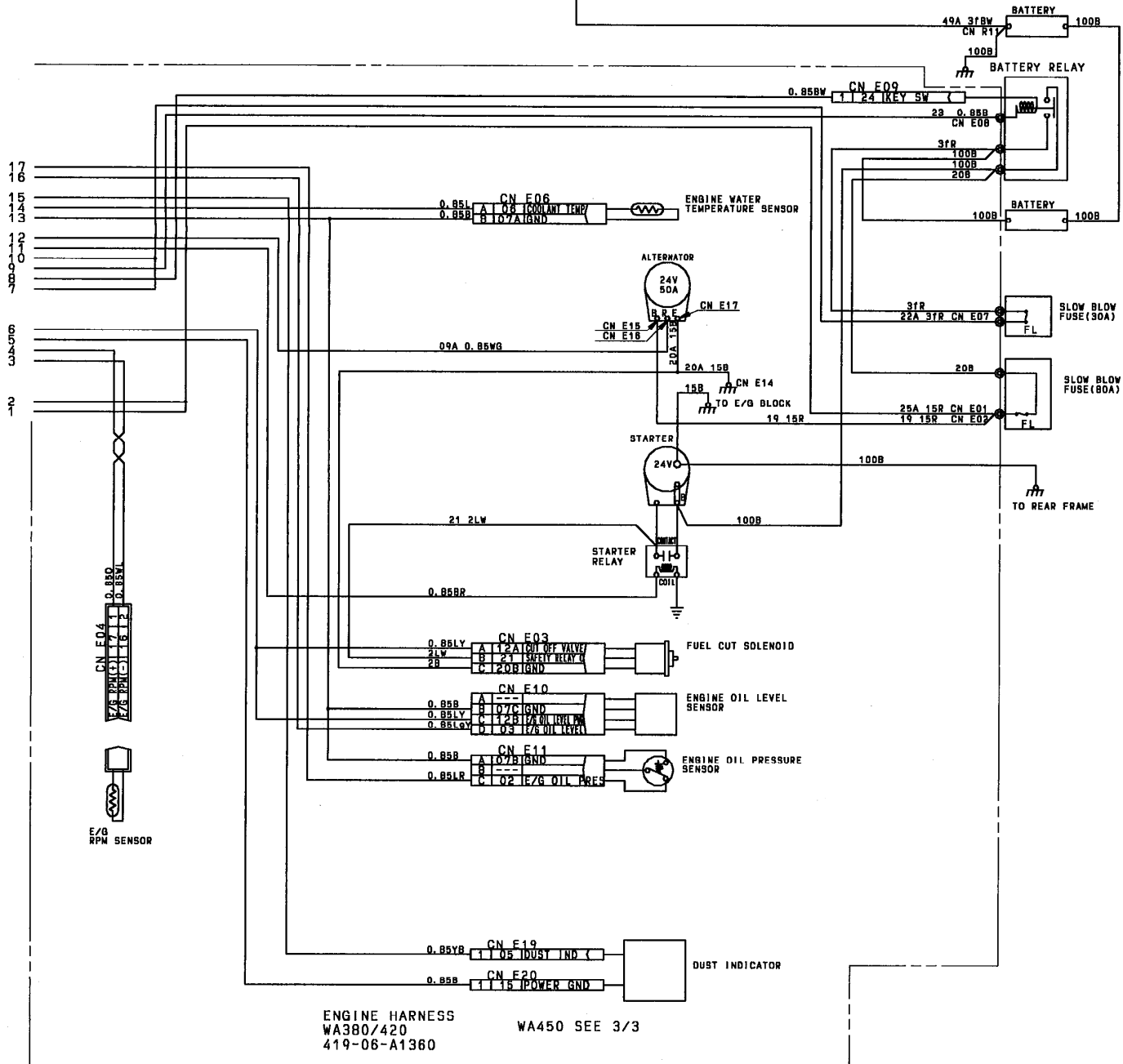


FOLDOUT 10-157

ELECTRIC CIRCUIT DIAGRAM (2/4)

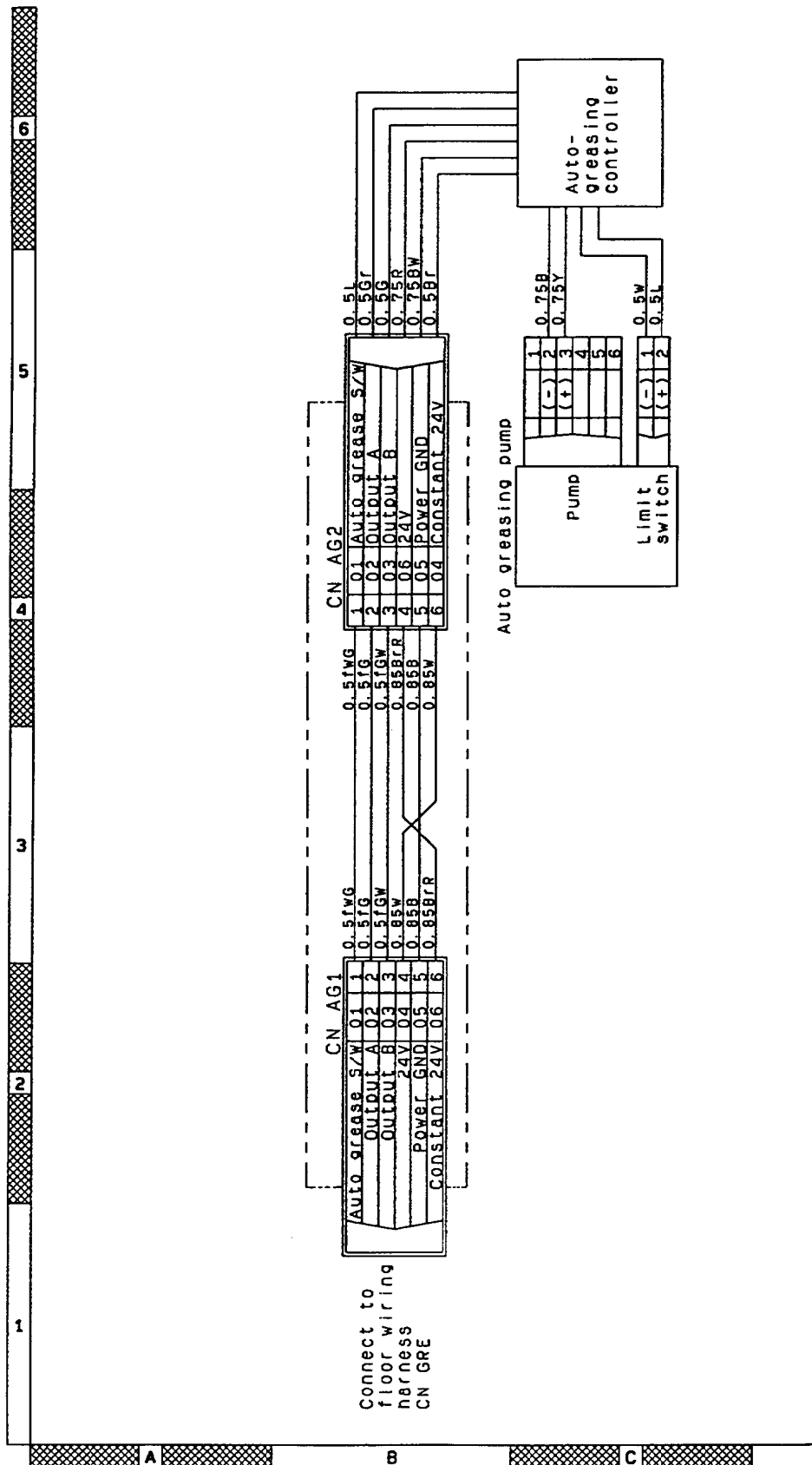






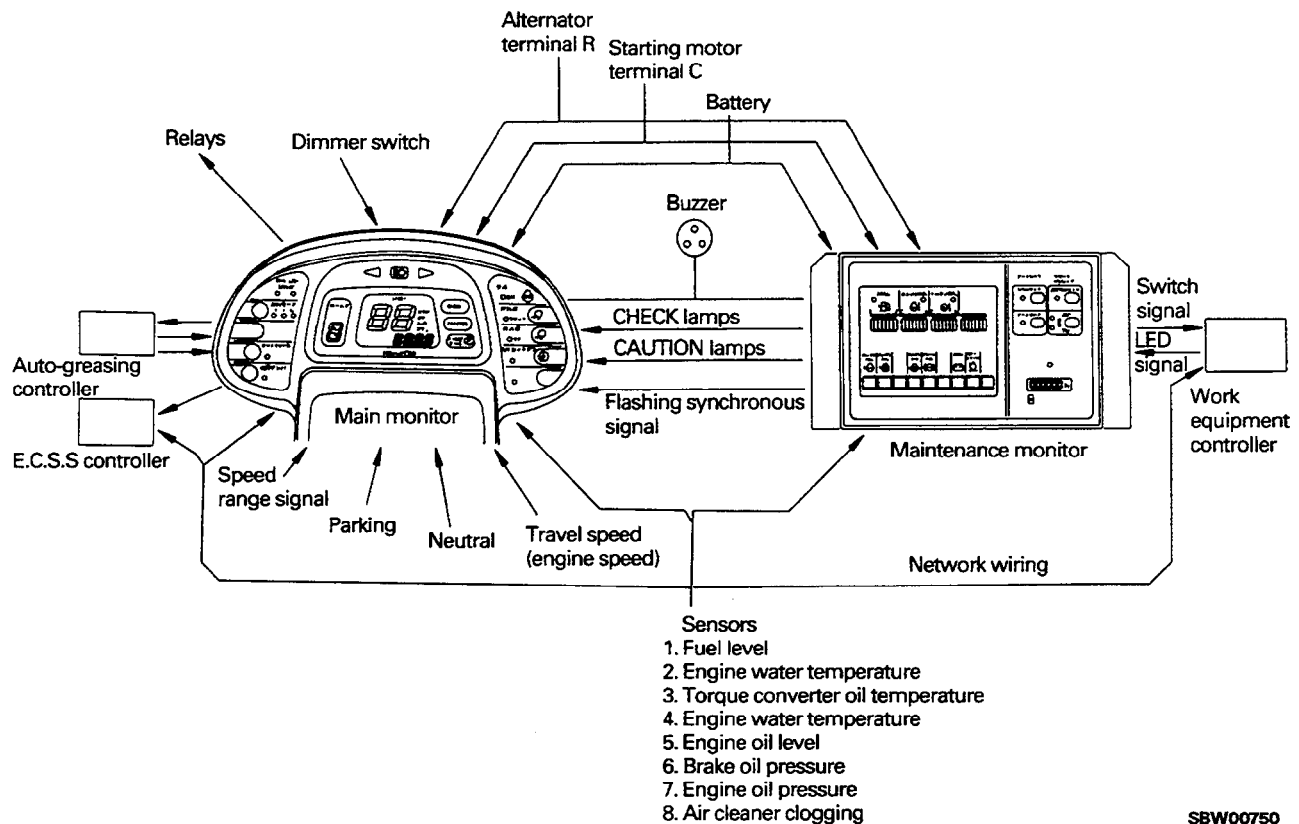
Pin No.	1	2	3	4	5	6
WA320	○	—	—	○		
WA380			○	○		

ELECTRIC CITCUIT DIAGRAM AUTO-GREASING



SDW01267

MACHINE MONITOR SYSTEM

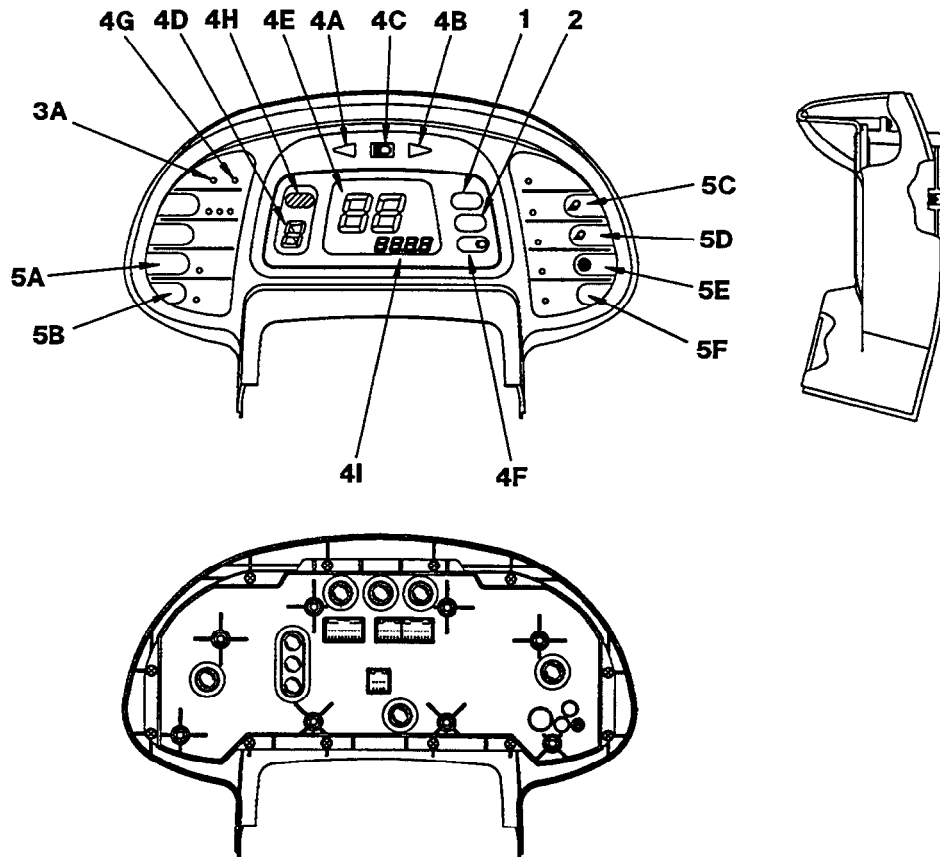


SBW00750

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 consist of the main monitor , maintenance monitor, sensors, switches, relays, alarm buzzer, and power source.
- The display 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



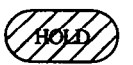
SDW00228-1

- | | | |
|---------------------------------|-------------------------------|---------------------------------|
| 1. CHECK lamp | 4C. Hi beam | 5. Switches |
| 2. CAUTION lamp | 4D. Shift indicator | 5A. Auto-greasing switch |
| 3. Caution item | 4E. Speedometer | 5B. E.C.S.S. switch |
| 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. Shift hold | 5E. Transmission cut-off switch |
| 4B. Turn signal (right) | 4I. Failure action code | 5F. Auto-shift select s/w |
| | | (Manual - auto shift) |
| | | Lamp ON - Manual |
| | | Lamp OFF - Auto Shift |

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	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	When normal (oil is flowing in hydraulic circuit)	Display lights up
		Shift hold	When shift is held	Display lights up
Speedometer		Travel speed	0 – 99 km/h (miles/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 M M (action code) are displayed in turn	Digital display Buzzer sounds (For details of the travel data display mode, see TROUBLE DATA DISPLAY MODE)

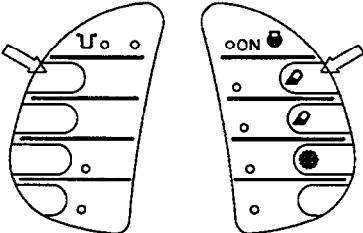
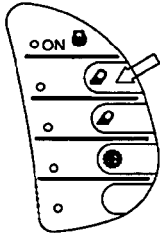
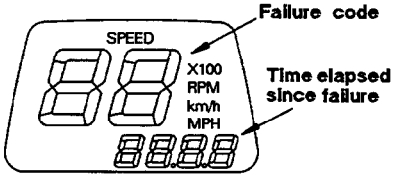
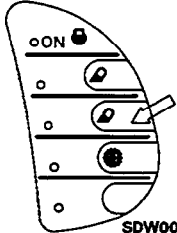
mmdf

MAIN MONITOR SWITCH FUNCTION

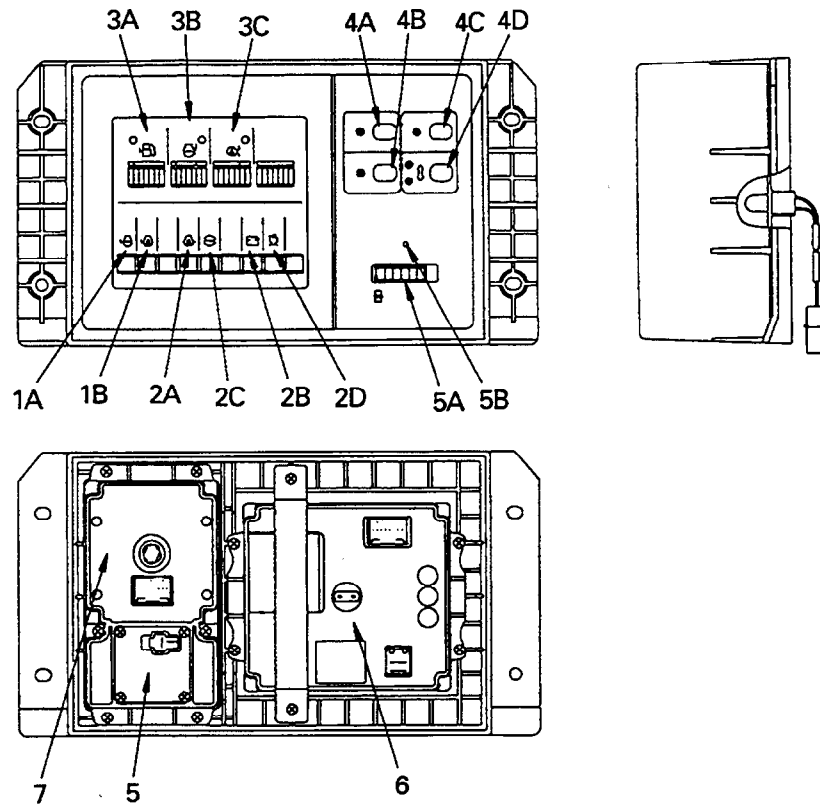
Item	Function	Display	Actuation
Auto-greasing	Forced greasing is carried out while switch is being pressed when display is lit up	Lights up (goes out momentarily when switch is turned ON)	Auto-greasing control actuated (automatic greasing carried out at fixed interval)
		Flashes (slowly)	Grease empty
		Flashes (rapidly)	Abnormality in auto-greasing controller system
		Goes out	Auto-greasing controller not installed
E. C. S. S.	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 lit 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 lit 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

TROUBLE DATA DISPLAY MODE

★ When the optional controller (auto grease, travel damper, work equipment controller) is 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.  SEW00239
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



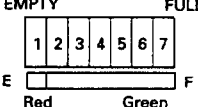
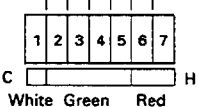
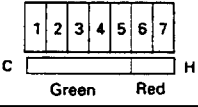
SLW00591

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

Outline

- The maintenance monitor has a display function for the caution items and gauges, and switch functions to control the work equipment controller (if equipped).
- 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.

MAINTENANCE MONITOR DISPLAY FUNTION

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	Displays when engine is running Display when normal: OFF Display when abnormal: Flashes CHECK lamp flashes
Service meter		Air cleaner	Above specified negative pressure	
		Service meter	0 – 9999.9h	Actuated when charge is normal Advances 1 for every hour
Gauges		Service meter indicator		Lights up when service meter is running
		Fuel level	EMPTY FULL 	All lamps light up below applicable level Flashes when level is 1
		Engine water temperature	67 80 90 97 102 106 °C 	One place lights up to show applicable level Flashes when level is 6 or 7
Gauges		Torque converter oil temperature	50 70 90 110 120 130 °C 	One place lights up to show applicable level Flashes when level is 6 or 7

MTRDSPFN

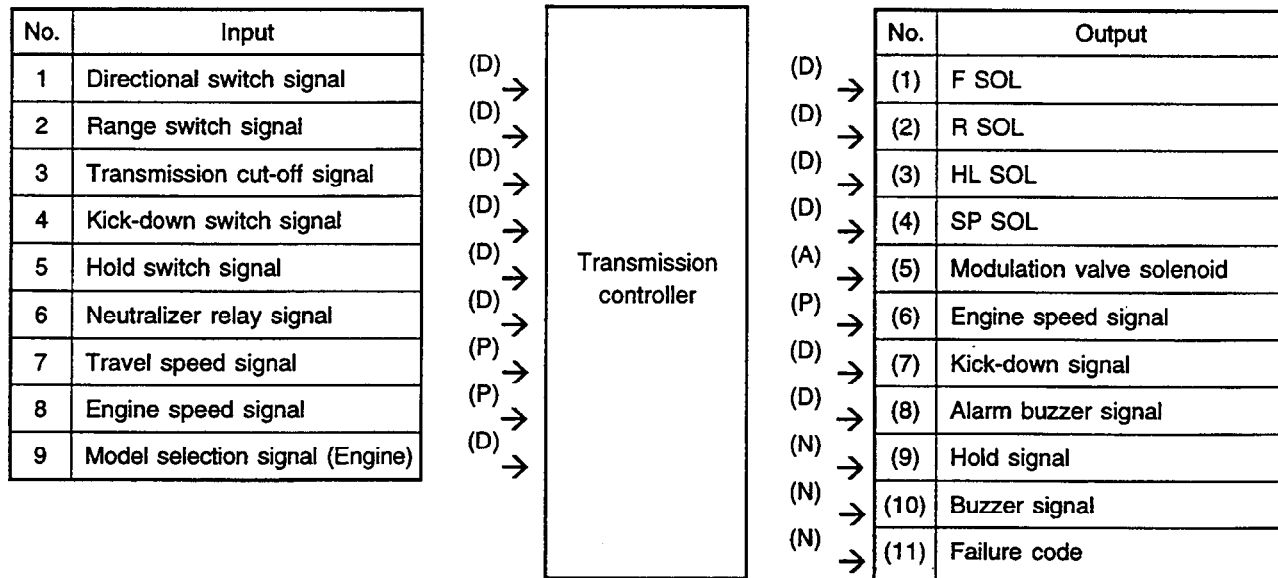
STRUCTURE AND FUNCTION**MAINTENANCE MONITOR****MAINTENANCE MONITOR SWITCH FUNCTION**

Item	Function	Display	Actuation
Bucket auto-leveler setting (if equipped)	Setting automatic stopping angle for bucket (bucket angle when switch is pressed is recorded)	Flashes (2.5 sec)	Sets stopping angle
		Goes out	–
Bucket auto-leveler auto mode (if equipped)	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 (if equipped)	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 (if equipped)	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

MMSF

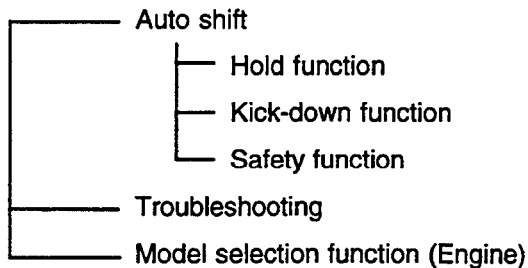
TRANSMISSION AUTO-SHIFT CONTROL SYSTEM

SYSTEM STRUCTURE DIAGRAM



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

CONTROL FUNCTION



TASCSSD

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		○	○	○		○				○

TTSO

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 11.6 km/h in 4th or 3rd, or when traveling at any speed in 2nd). (See Table 2. Item 7)

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 1,2)**

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

a) FORWARD (See Table 2. Item 1)

Shift up directional lever at F, speed lever at 4

- (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 10.0 km/h (10.5 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 17.5 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 15.5 km/h.
- (ii) If the travel speed drops further to 10.5 km/h (10.0 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 kickdown switch is pressed.

b) REVERSE (See Table 2. Item 2)

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 8)

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 9,10)

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 11,12)

4. Skip shift

When the machine is coasting in 3rd or 4th (engine speed below 1450 rpm), and the accelerator pedal is depressed (engine speed above 1450 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. (See table 2, Item 4)

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

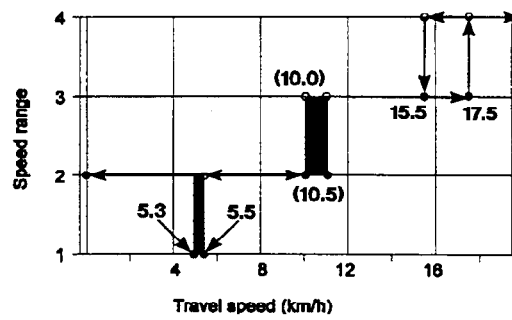


TABLE 2: GEAR SHIFT CHARACTERISTICS

ITEM	CLUTCH	TRAVEL SPEED Km/h	Shift inhibited period (sec)
1. Normal shift change Forward and Backward lever: F	1→2	more than 5.3 (5.5)	2
	2→3	more than 10.0 (10.5)	2
	3→4	more than 17.5	1
	4→3	less than 15.5	1
	3→2	less than 10.5 (10.0)	2
2. Normal shift change Forward and Backward lever: R	1→2	more than 5.3 (5.5)	2
	2→3	more than 10.0 (10.5)	2
	3→4	more than 18.2	1
	4→3	less than 16.2	1
	3→2	less than 10.5 (10.0)	2
3. Engine speed (Less than 1450 rpm)	4→2	less than 1.0	0
	3→2	less than 1.0	0
4. Engine speed (Less than 1450 rpm → or more)	4→2	less than 8.0	2
	3→2	less than 8.0	2
5. When hold switch is turned "ON" shift up Forward and Backward lever: F	1 →2	more than 5.3	0
	2 →3	more than 10.0	0
	3 →4	more than 17.5	0
6. When hold switch is turned "ON" shift up Forward and Backward lever: R	1 →2	more than 5.3	0
	2 →3	more than 10.0	0
	3 →4	more than 18.2	0
7. Kick Down switch OFF → ON	2 →1	all range	5
	3 →1	less than 11.6	5
	4 →1	less than 11.6	5
8. Forward and Backward lever (Area I) (F→) N→R (R→) N→F	4 →2	see note 1	2
	3 →2	----	2
	1 →2		2
9. Forward and Backward lever (Area)II (F→) N→R	→4	more than 18.2	0
	→3	16.0 - 18.2 or less see note 2	0
10. Forward and Backward lever (Area)II (R→) N→F	→4	more than 17.5	0
	→3	16.0 - 17.5 or less see note 3	0
11. Forward and Backward lever (F→) N→F	→4	more than 17.5	0
	→3	10.0 - 17.5 or less	0
	→2	less than 10.5	0
12. Forward and Backward lever (R→) N→R	→4	more than 18.2	0
	→3	10.0 - 18.2 or less	0
	→2	less than 10.5	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 and travel speed is 13 km/h to 18.2 km/h

Note 3: When engine speed is more than 2000 rpm and travel speed is 13 km/h to 17.5 km/h

See Fig. 2, for details of Area I and Area II.

SAFETY FUNCTION**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

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.

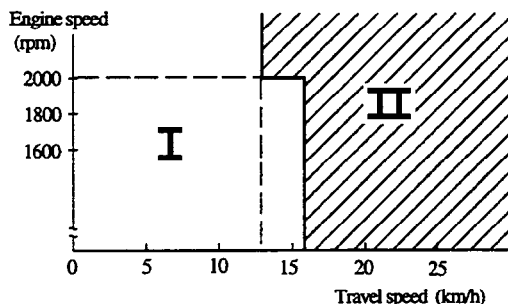


Fig. 2 Shift pattern
When shifting between F and R

SDW00261

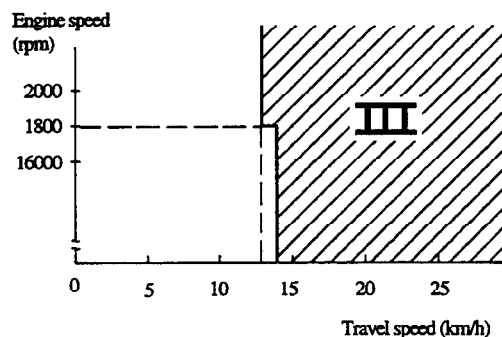
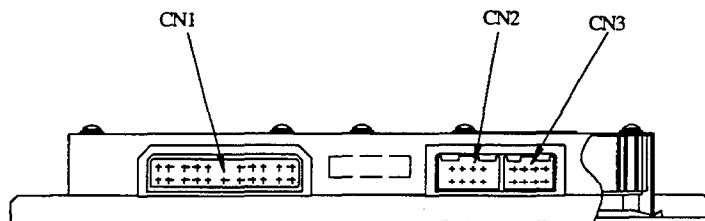
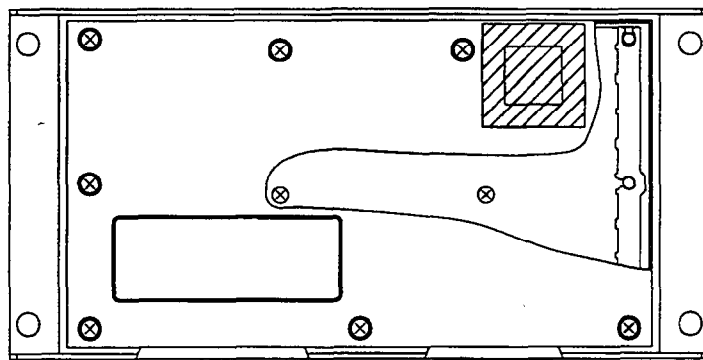


Fig. 3 Alarm buzzer area
When shifting between F and R

SDW00262

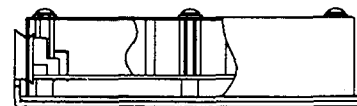
TRANSMISSION CONTROLLER



This controller has data tables for two models, and can handle these by means of the following selection signals when the key is turned ON.

Model \ Pin	CN2(8)	CN2(7)
WA350	OPEN	OPEN
WA380	GND	GND

GND: Connect to CN2(9) (Signal ground)



CONNECTOR SIGNALS

CN1

1	NETWORK signal
2	-
3	-
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	Manual switch
6	-
7	Engine selection 2
8	Engine selection 1
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	Kick-down signal output
7	-
8	Manual signal output
9	-
10	-
11	-
12	speed signal (-)
13	-
14	Engine speed signal output
15	Buzzer signal output
16	Brake signal output

SAW00593

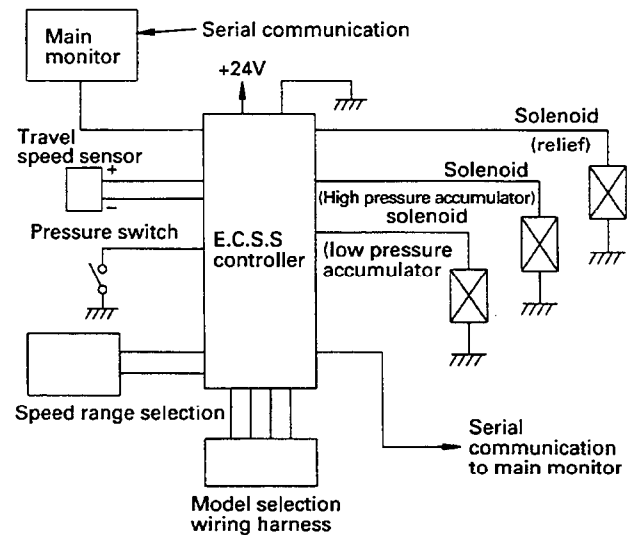
E.C.S.S. (ELECTRONICALLY CONTROL SUSPENSION SYSTEM)

1. E.C.S.S. (Electronically 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

STRUCTURE AND FUNCTION**E.C.S.S.****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.

O: ON
X: OFF

	Input					Output		
	E.C.S.S. switch (system ON-OFF) [Note 1]	Speed range (Note 2)		Travel speed [Noete 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	O	O	X
		OFF	ON					
		ON	ON					
3		OFF	OFF	Min. 5 km/h	OFF	O	O	O
		OFF	ON					
		ON	ON					
4		ON	OFF	--	--	X	X	X
5		--	--	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

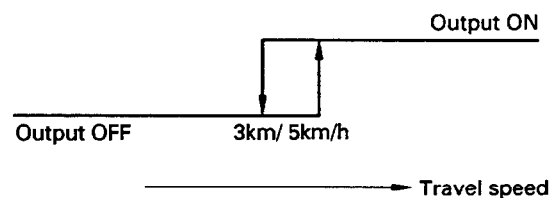
Shift position	Speed range	
	H-L	Speed
1st	OFF	ON
2nd	OFF	OFF
3rd	ON	OFF
4th	ON	ON

ON: +24, 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
WA450	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

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 WA450	
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

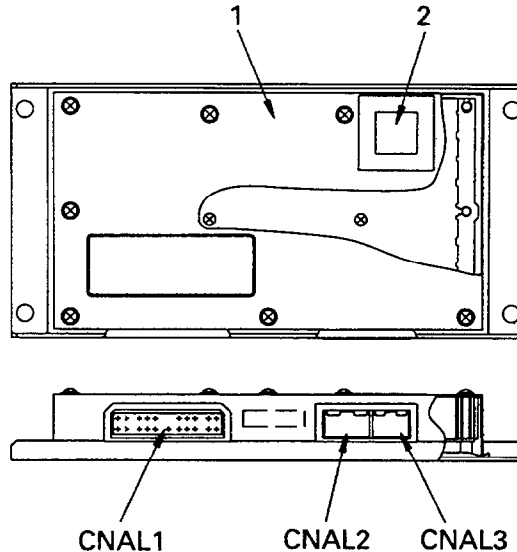
- Error code displays [E]→ [dx] (where x is a numeral from 0 to 4 in the table above) repeatedly in turn.
- If more than one abnormality occurs at the same time, all the appropriate error codes are displayed in turn.
- When the starting switch is turned OFF (controller power OFF, the error codes are 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



Input/output signals

CNAL1

No.	Name of signal	Input/output
1	Network (+)	-
2	-	-
3	-	-
4	-	-
5	-	-
6	-	-
7	-	-
8	Power source input (+24V)	-
9	GND	-
10	-	-
11	Solenoid (low pressure)	Output
12	Network (-)	-
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

CNAL2

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

CNAL3

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

	CNAL2-1	CNAL2-2	CNAL2-3	CNAL2-4
WA320	X	X	X	O
WA380	X	X	O	X
WA420	X	O	X	X
WA470	X	O	O	O

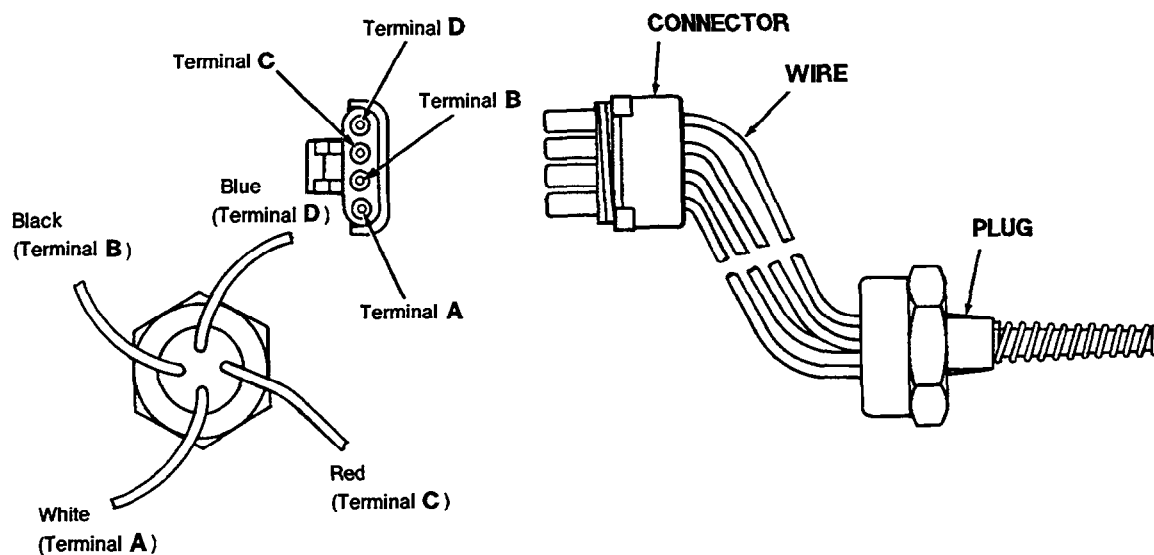
O: GND
X: OPEN

SDW00270

SENSORS**FUNCTION**

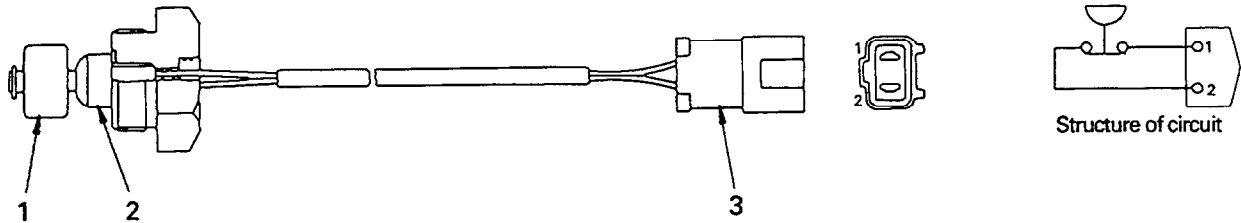
- The sensors are a contact type sensors with one end grounded to the chassis. The signal from the sensor input's directly to the monitor panel, and when the contacts are closed, the panel judges the signal to be normal. However, the engine oil pressure uses a relay to reverse the sensor signal.

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

ENGINE OIL LEVEL SENSOR

LO8CD011A

RADIATOR WATER LEVEL SENSORS

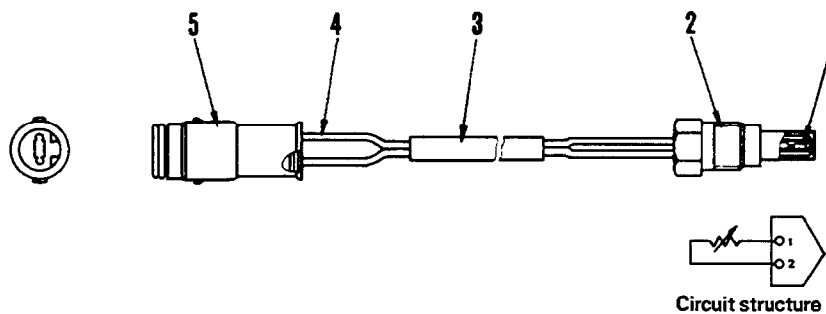


SBW00605

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 WATER TEMPERATURE SENSOR
TORQUE CONVERTER OIL TEMPERATURE SENSOR

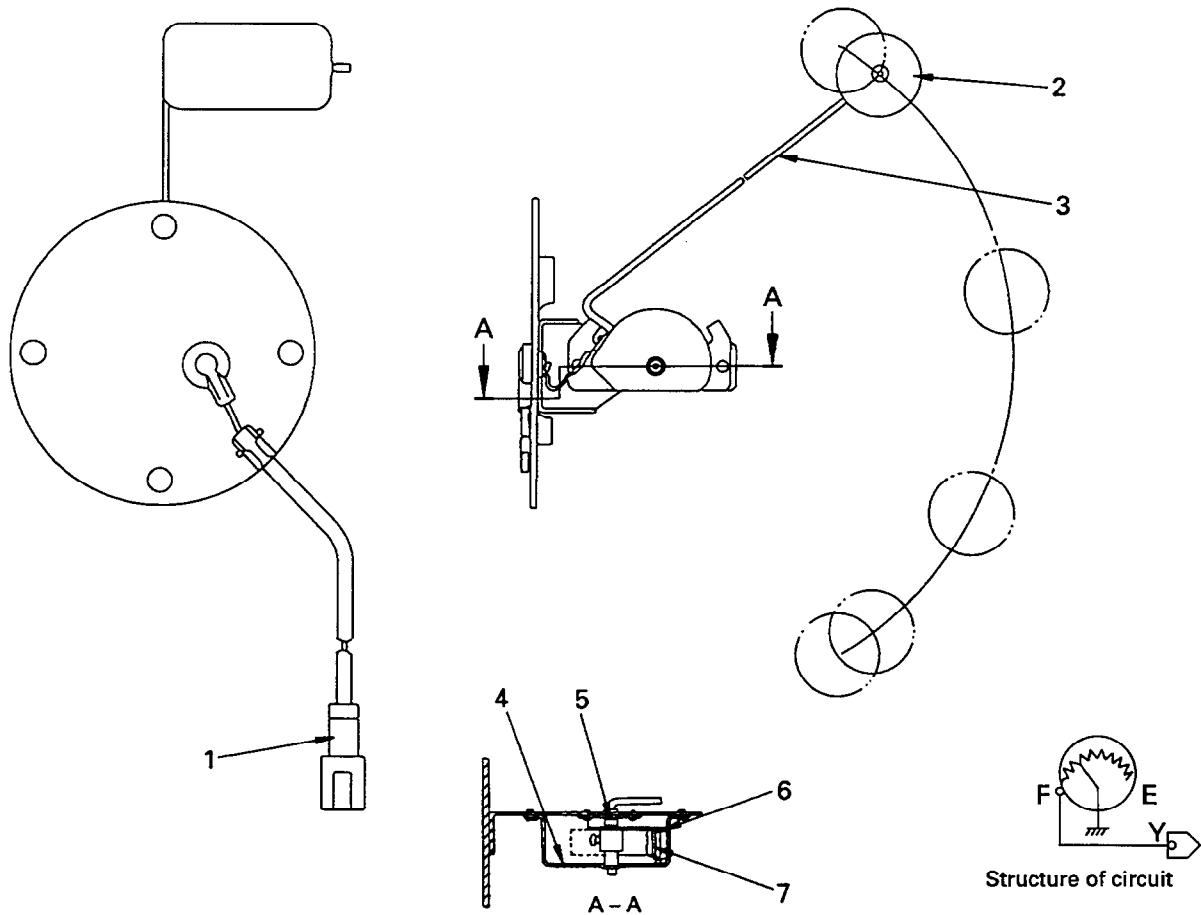
L08CD248

1. Thermistor
2. Plug
3. Tube
(Black: torque converter oil temperature)
4. Wire
5. Connector

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 maintenance monitor reaches the specified position, the lamp flashes and the buzzer sounds to warn of the abnormality.

FUEL LEVEL SENSOR



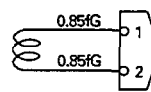
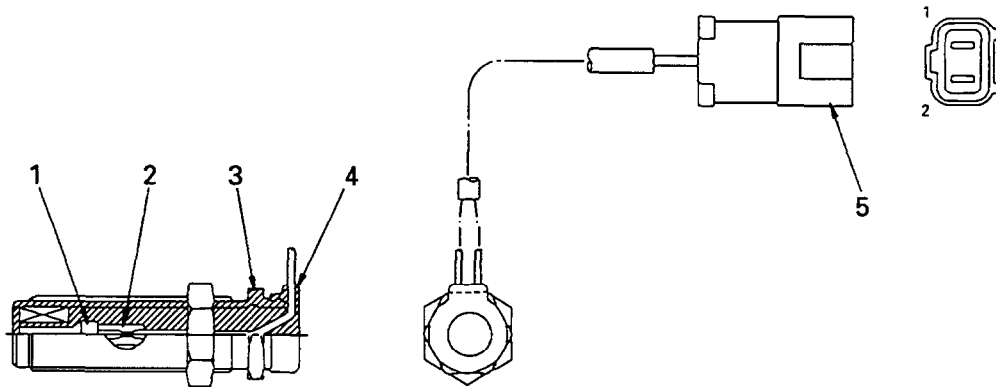
SEW00293

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 maintenance monitor to display the fuel level. When the display on the maintenance monitor reaches the specified level, the warning lamp flashes.

ENGINE SPEED SENSOR



Structure of circuit

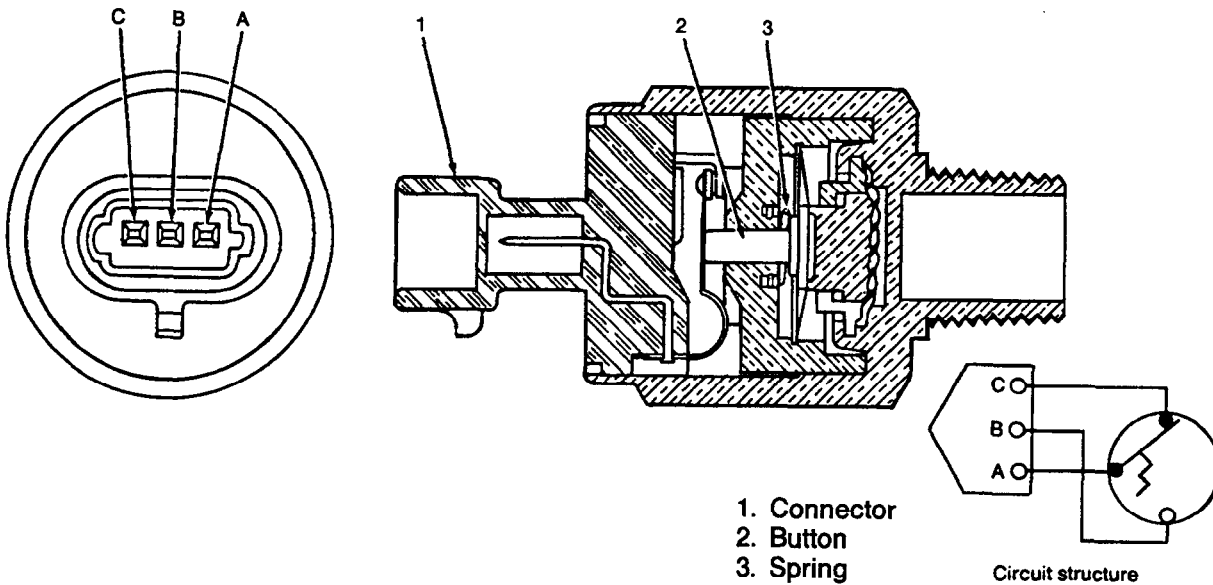
SBW00606

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 monitor panel.

ENGINE OIL PRESSURE SENSOR



1. Connector
2. Button
3. Spring

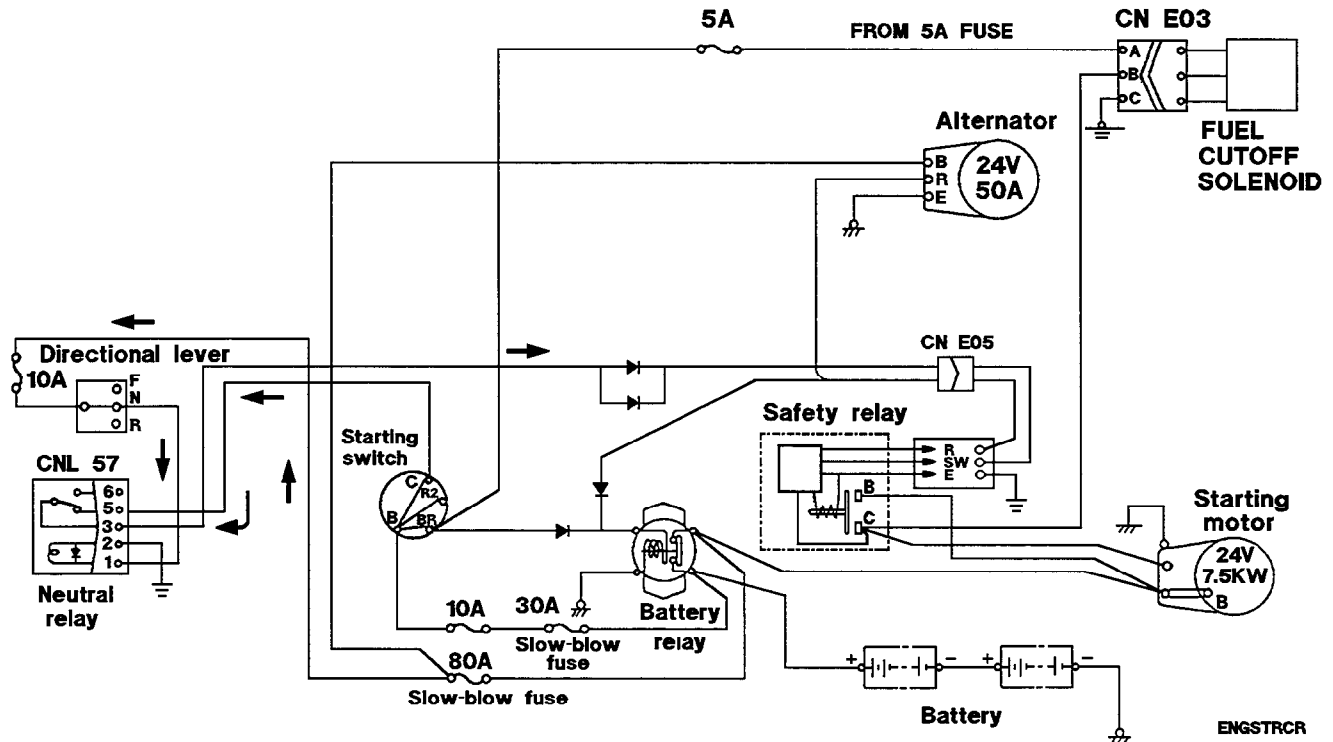
Circuit structure

L08CD013

Function

- This sensor is installed to the engine block. The button detects the oil pressure, and when it drop below the set pressure, the switch turns OFF and the machine monitor lamp flashes to warn of the abnormality.

ENGINE STARTING CIRCUIT



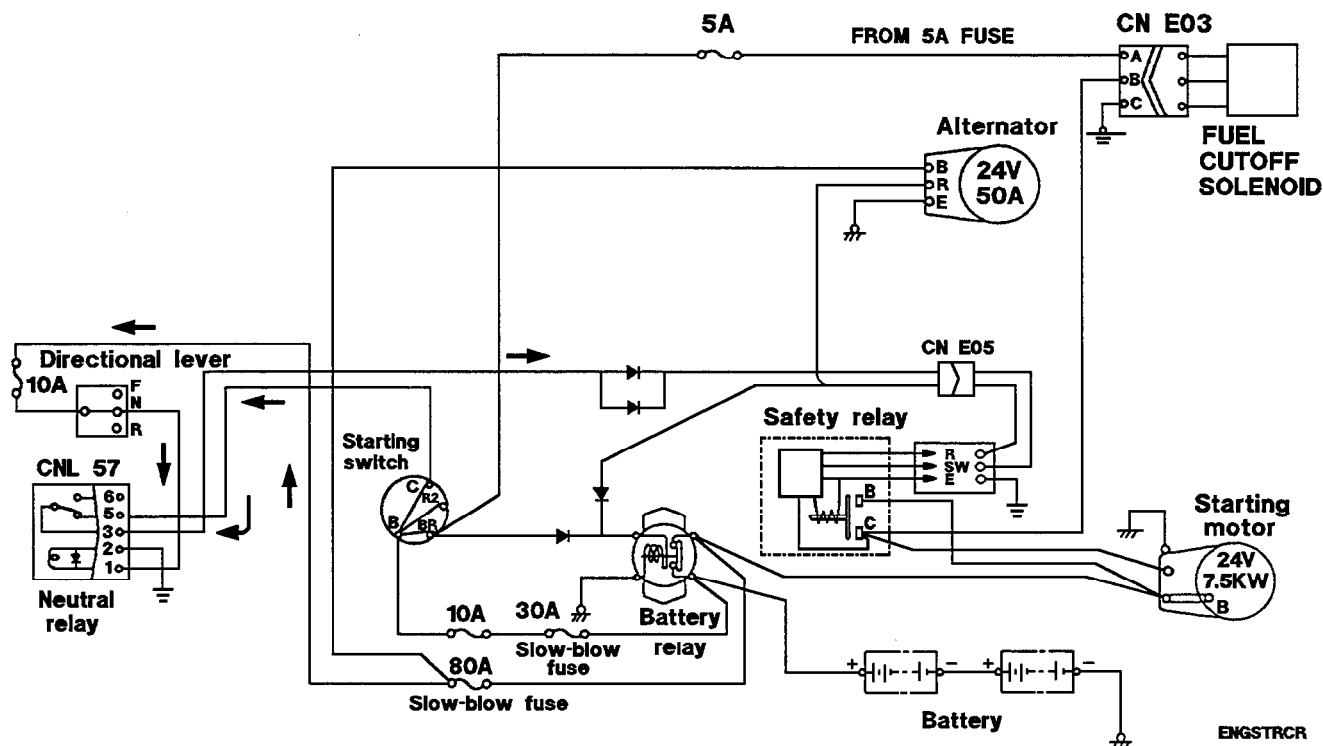
Function

- To ensure safety when starting the engine, the system is equipped with a neutral safety circuit. This makes it impossible for the engine to start if the directional lever is not at the N (Neutral) position.
- To protect the starting motor, the system is equipped with a safety relay. This makes it impossible for the starting motor to start if "R" terminal of alternator voltage is over $12 \pm 1v$. And also when the starting motor "R" terminal voltage reaches $12 \pm 1v$, the starter will cut-out automatically.
- When lever is set to N (neutral) position, the lever's neutral contact is closed. At this time current flows to neutral relay terminals 1 and 2 and the coil is excited.
- This causes current to flow in the following circuit:
(1) Starting switch terminal C → neutral relay terminals 5 and 3 → starter terminal C, and → fuel cutoff solenoid terminal B (pull in coil). This actuates fuel cutoff solenoid, allowing fuel to flow.
- The following circuit is formed:
 battery → battery relay → starter terminal B. The engine then starts. When the directional lever is at a position other than N (neutral), circuit **(1)** is not formed, so the engine does not start.

Operation

- When the starting switch is set to the start position, voltage flows in the following circuit:
 Starting switch terminal BR → battery relay coil → ground connection.
 This closes battery relay switch.
 Current also flows in the following circuit:
 Starting switch terminal BR → fuel cut off solenoid terminal A (holding coil).

ENGINE STOP CIRCUIT



STARTER SWITCH

	B	BR	R1	R2	C	ACC
ACC	O	O	O			O
OFF	O					
ON	O	O				O
START	O	O		O	O	O

Function

- The system is equipped with an electrical fuel cut device (fuel cutoff solenoid). 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

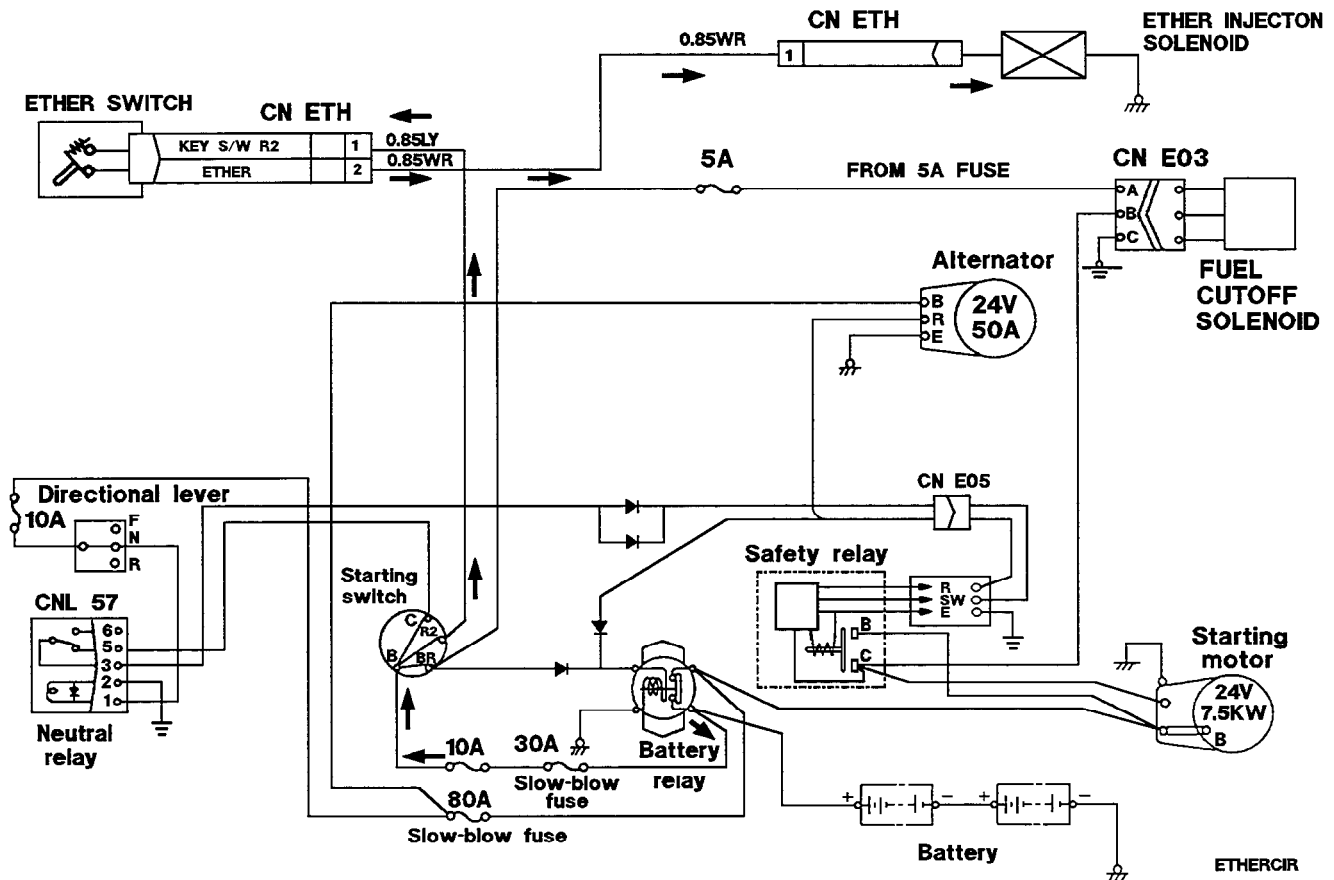
- When the starting is turned ON, electric current flows in the following circuit.
(1) Battery (+) → starting switch terminal B → starting switch terminal BR → fuel cut solenoid → ground connection.

When electric current flows to the fuel cut solenoid, the fuel governor is put in the FREE position by the fuel control linkage.

Fuel flows to the fuel injection pump and the engine starts.

- When the starting switch is turned OFF, circuit (1) is shut off, but the engine is rotating, so there is still voltage at terminal R → of the alternator. For this reason the following circuit is formed.
(2) Alternator terminal R → starting switch BR → fuel cut solenoid → ground.
But because of the diode inserted into the circuit, no electric current flows to the fuel cut solenoid, so the engine stops.

ETHER START CIRCUIT

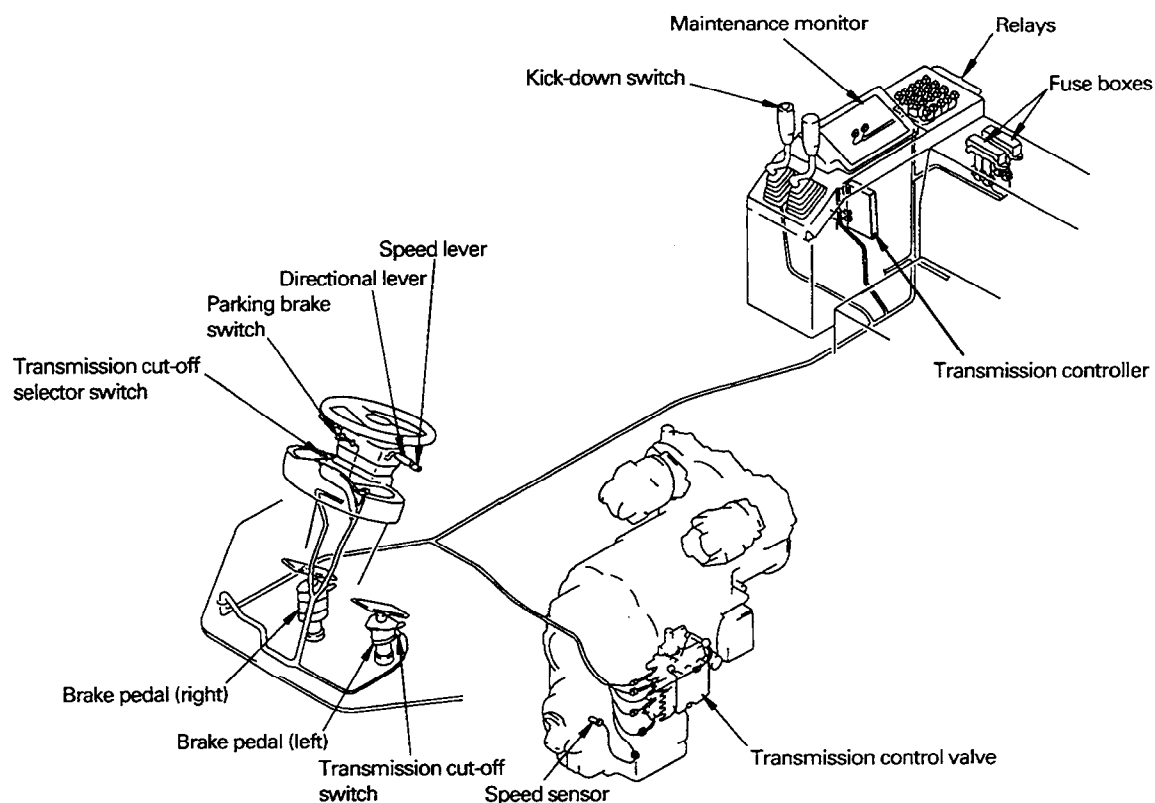
**Function**

- The ether injection system delivers a 3cc shot of ether to the engine to aid in cold weather starting.

Operation

- With the lever in N (neutral) turn key to start position. This completes cranking circuit as described in engine starting section, and engine begins cranking. This also completes circuit from start switch "B" to start switch "R2" applying power to ether start switch.
- Move ether start switch to ON position then release immediately (Do not hold it at ON position for more than 5 seconds. This will cause failure of ether start solenoid) This allows current to flow in the following circuit. Start switch terminal "R2" to ether start switch terminal "1" to ether start switch terminal "2" to ether solenoid "1" to ground. This actuates ether start solenoid, injecting ether.

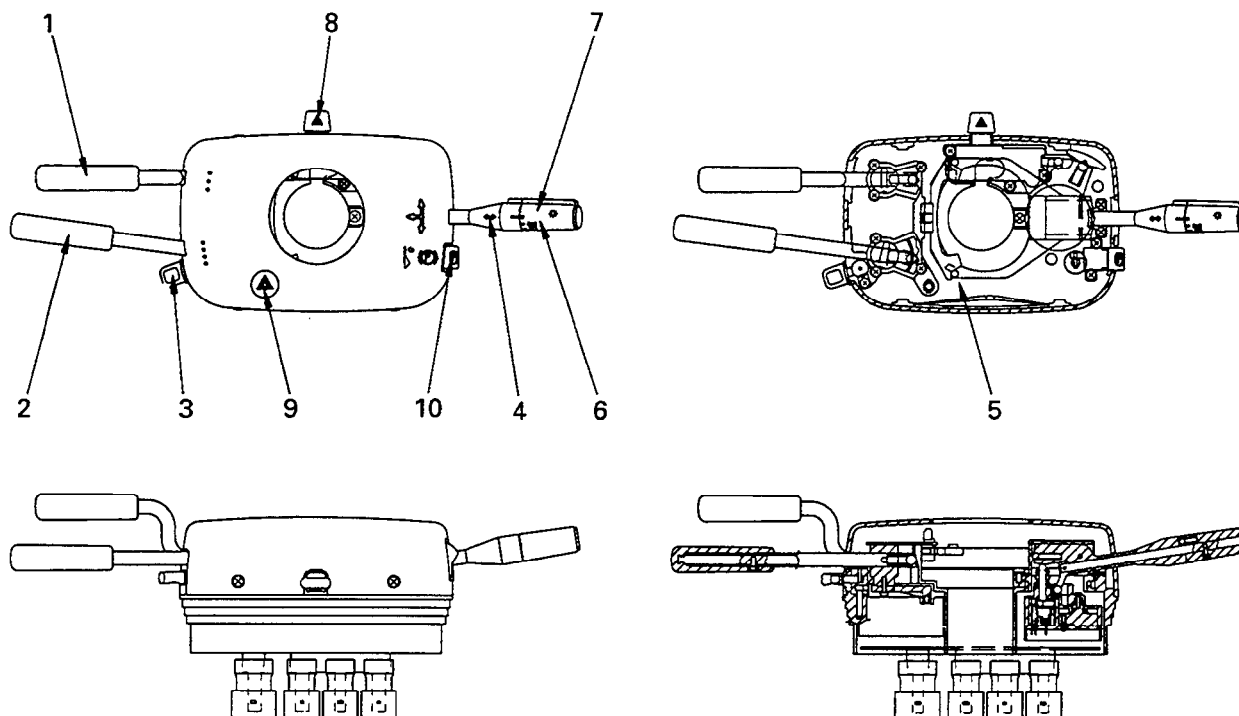
ELECTRIC TRANSMISSION CONTROL



SBW00752

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

Outline

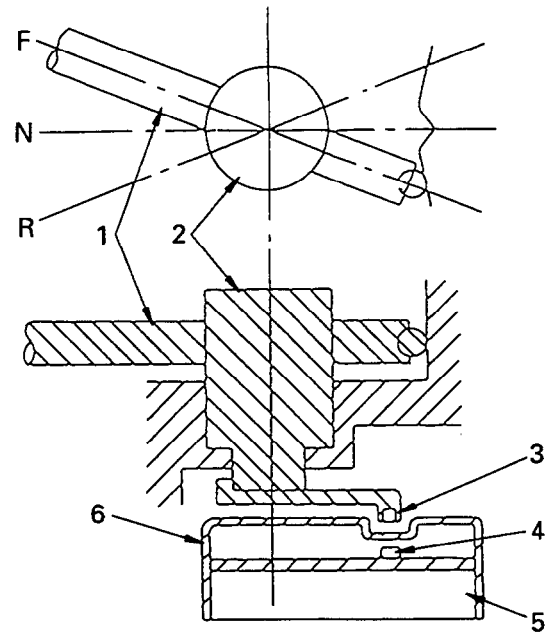
- The directional lever has three positions and the speed lever switch has four positions. As an individual part, the switch does not have a detent mechanism; the detent mechanism is in the combination switch. Each switch is positioned by two pins, and is secured to the body by three screws. When each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

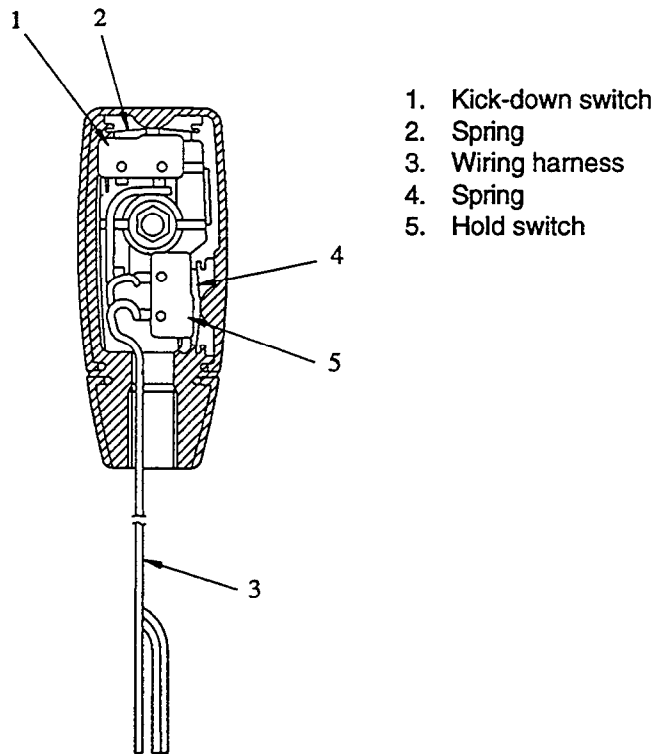
Operation

- 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.



SLW00613

KICK-DOWN, HOLD SWITCH



SEW00304

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

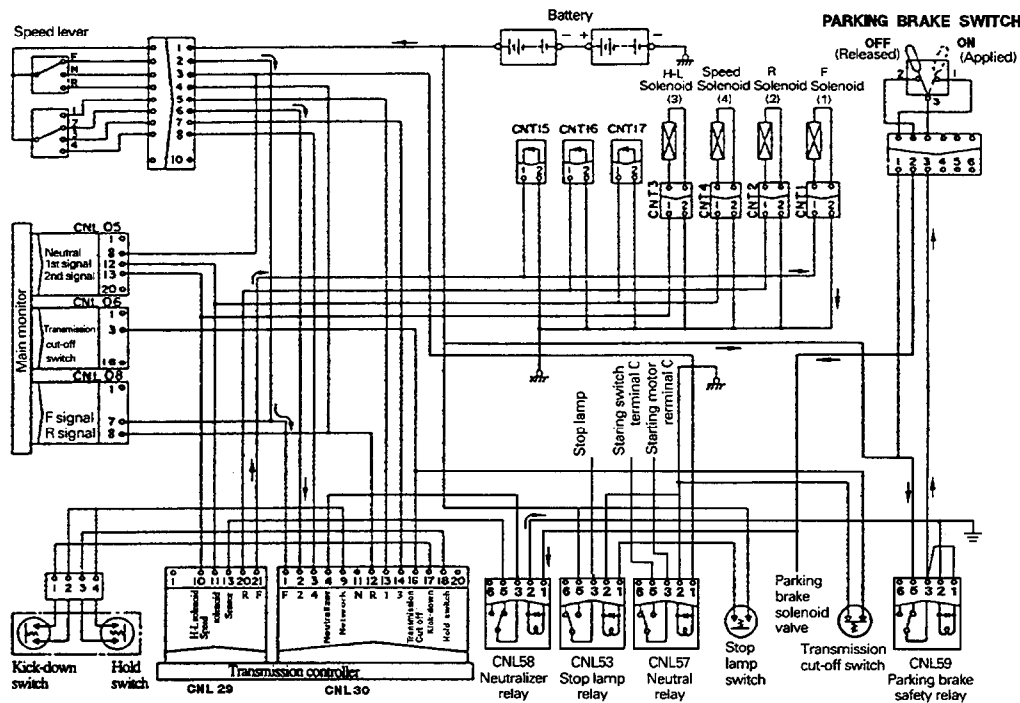
HOLD SWITCH

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

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM

Normal operation

(directional lever at F, speed lever at 2nd)



Solenoid actuation table

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

23F03102

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 released, the 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 neutralizer relay terminal 3 - 5 are connected.

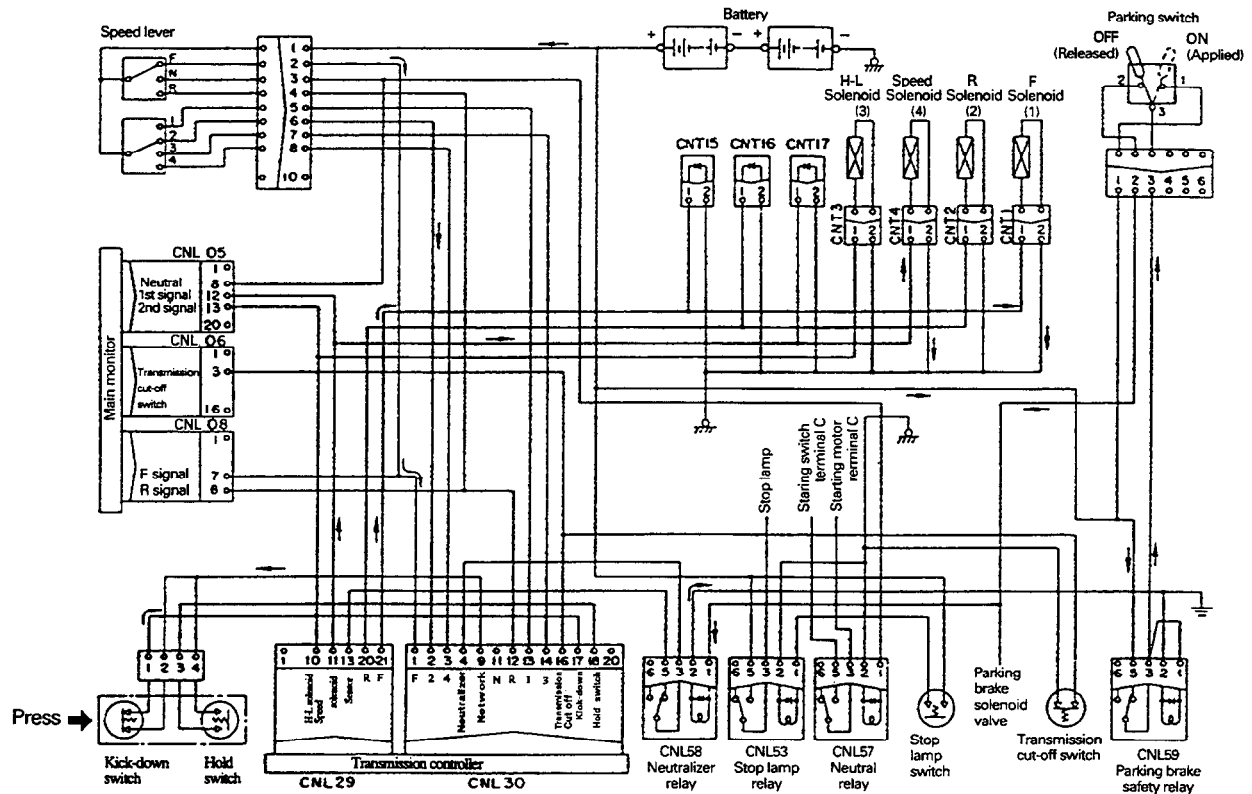
Speed lever set to 2nd

- When the speed lever is at position 2nd, 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, if the kick-down is not pressed. Therefore, the kick-down relay is not actuated, and the transmission is held in F2.

Kick-down switch operated

(When operating or traveling in F2)

(When kick-down switch is pressed ON)

**Solenoid actuation table**

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

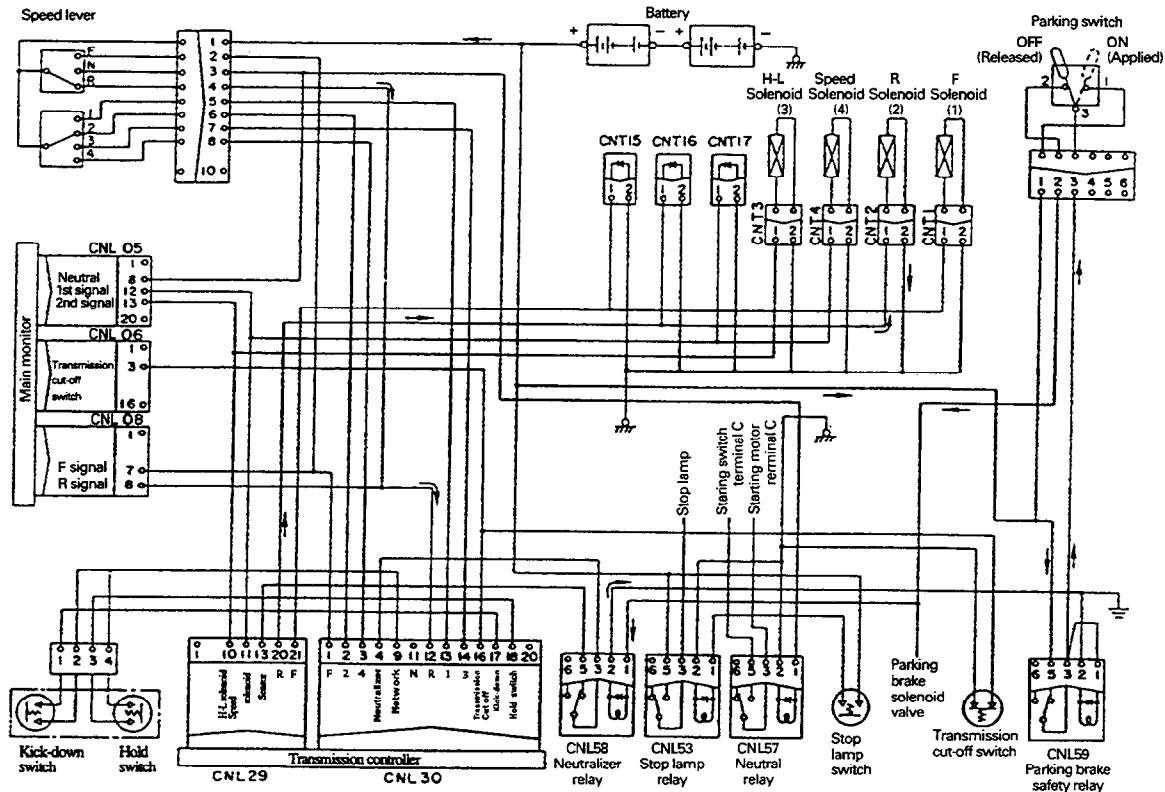
23F03103

- When pressing the kickdown switch, electricity flows from the kickdown terminal no. 17 on the transmission controller back to the controller where the kickdown circuit is composed within. Then the solenoid output signal flows from terminal 21 and 11 to the forward solenoid (1) and the speed solenoid (4) which operate the solenoid valve to change the speed shift back to "F1".
- the kick-down circuit continues to be actuated even if the kick-down switch is returned. (Self-hold circuit of kick-down)

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 circuit even when the kick-down switch is released. However many times the kick-down switch is pressed, the transmission will stay in **F1**.

STRUCTURE AND FUNCTION**KICK-DOWN ELECTRIC CIRCUIT DIAGRAM****Canceling actuation of kick-down switch (case I)**

(Directional lever moved to N or R)

**Solenoid actuation table**

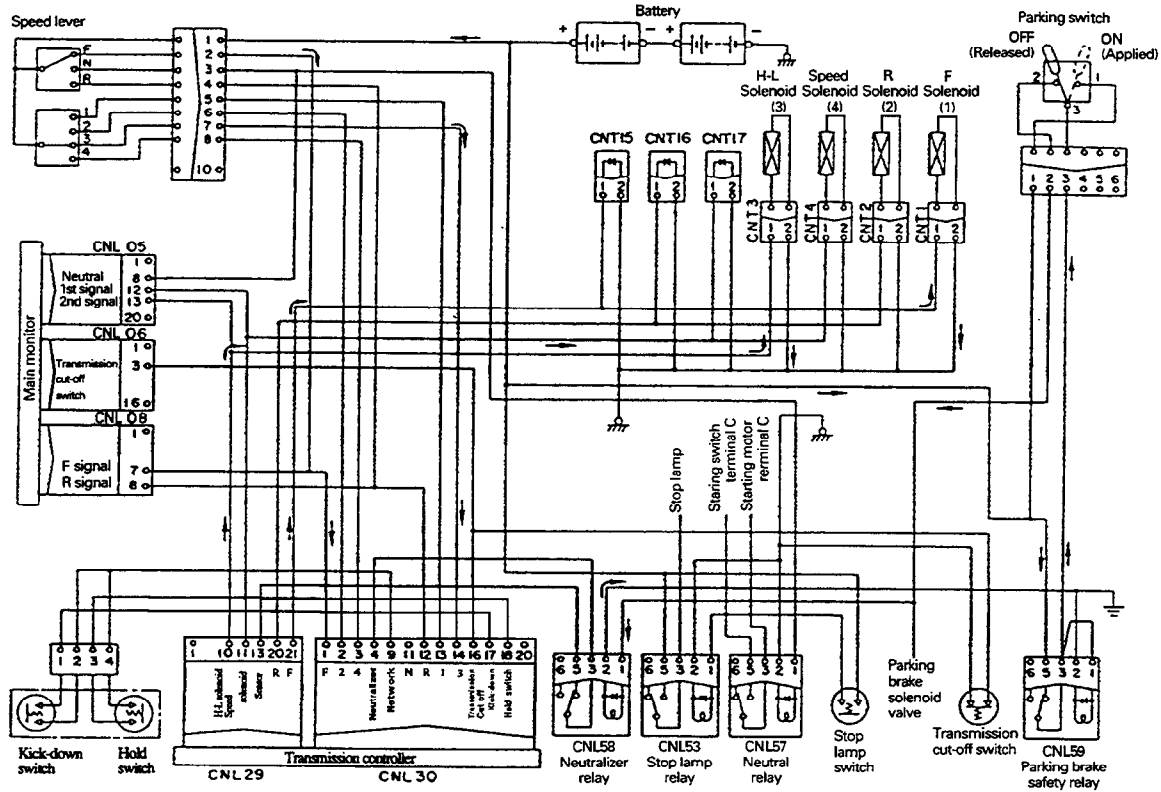
Solenoid	F1	F2	F3	F4	N	R1	R2	R3	R4
FORWARD	(1)	○	○	○					
REVERSE	(2)					○	●	○	○
H-L select	(3)			○				○	○
Speed select	(4)	○				○			○

23F03104

- 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 switch terminal 1-2 → transmission controller.
- When the forward circuit in the transmission controller is turned to the "open" position then the electric current is unable to flow to the kickdown circuit.
- In this way, the self-hold circuit of the kickdown is canceled, 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 circuit 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 switch terminal 1-4 → transmission controller reverse terminal 12, and flows as the reverse output signal from terminal 20 → reverse solenoid (2) → ground, and the solenoid valve is actuated. Therefore, only solenoid (2) is actuated, and the transmission is set to the **R2** position.

Canceling actuation of kick-down switch (Case II)

(Speed lever moved to position other than 2nd)

**Solenoid actuation table**

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

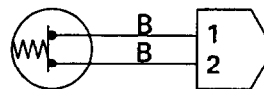
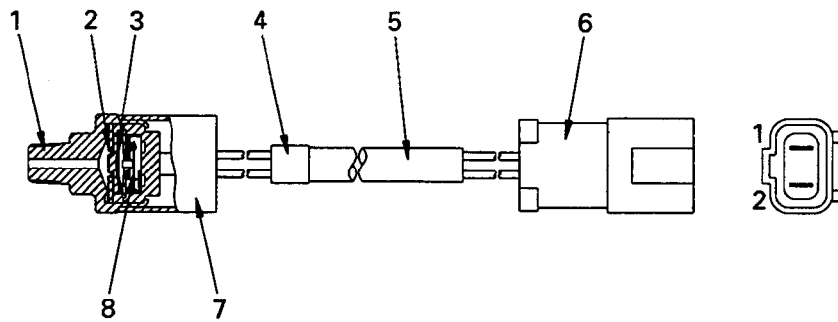
23F03105

- When the speed lever is moved to any position other than 2nd, the level terminal 2 contacts are turned OFF, so the electric current stops flowing from the battery (+) → speed lever switch terminal 1-6 → transmission controller
- Therefore, the kick-down circuit connected with F2 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.

STRUCTURE AND FUNCTION

KICK-DOWN ELECTRIC CIRCUIT DIAGRAM

TRANSMISSION CUT-OFF SWITCH



SDW00313

1. Case
2. Seal film
3. Disc
4. Vinyl tape

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

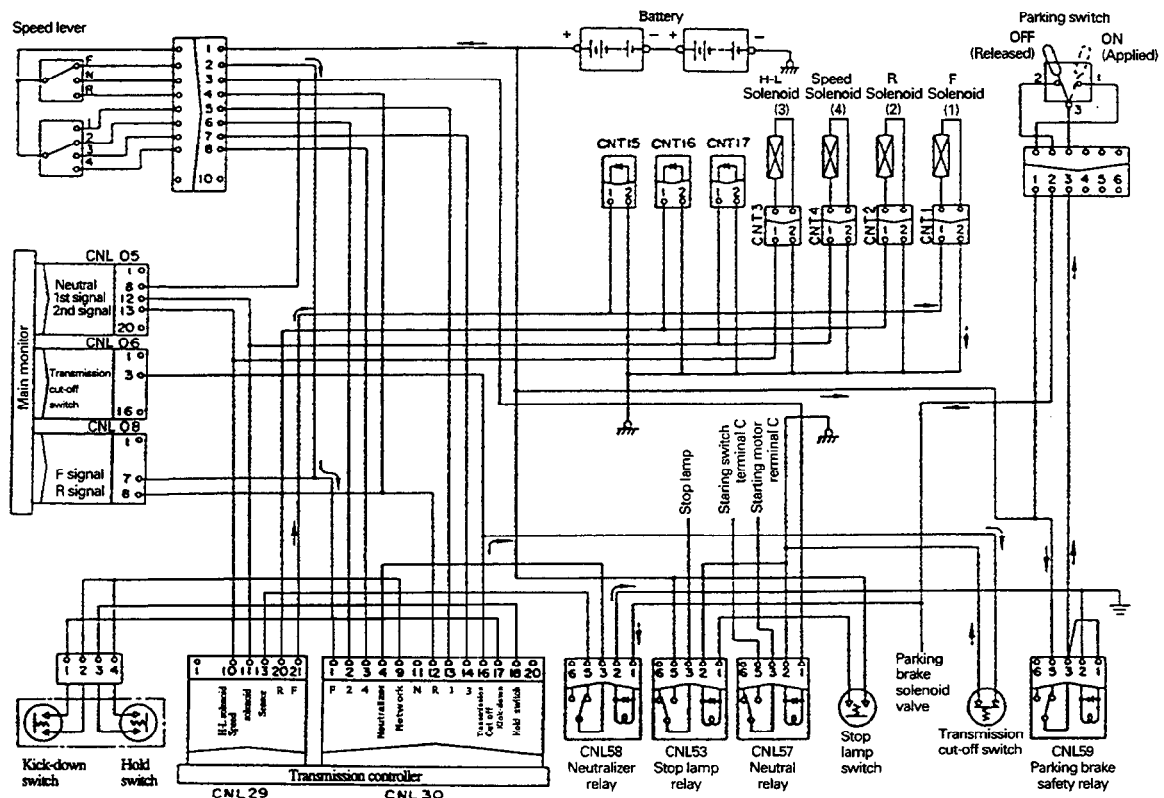
Outline

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

Voltage value	Min.	18v
	Max.	30v
Current value	Min.	5mA
	Max.	0.1A

TRANSMISSION CUT-OFF FUNCTION



23F03108

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.
- When the output flow of transmission controller terminal 16 to the ground is interrupted, it is judged that the transmission has been cut off.

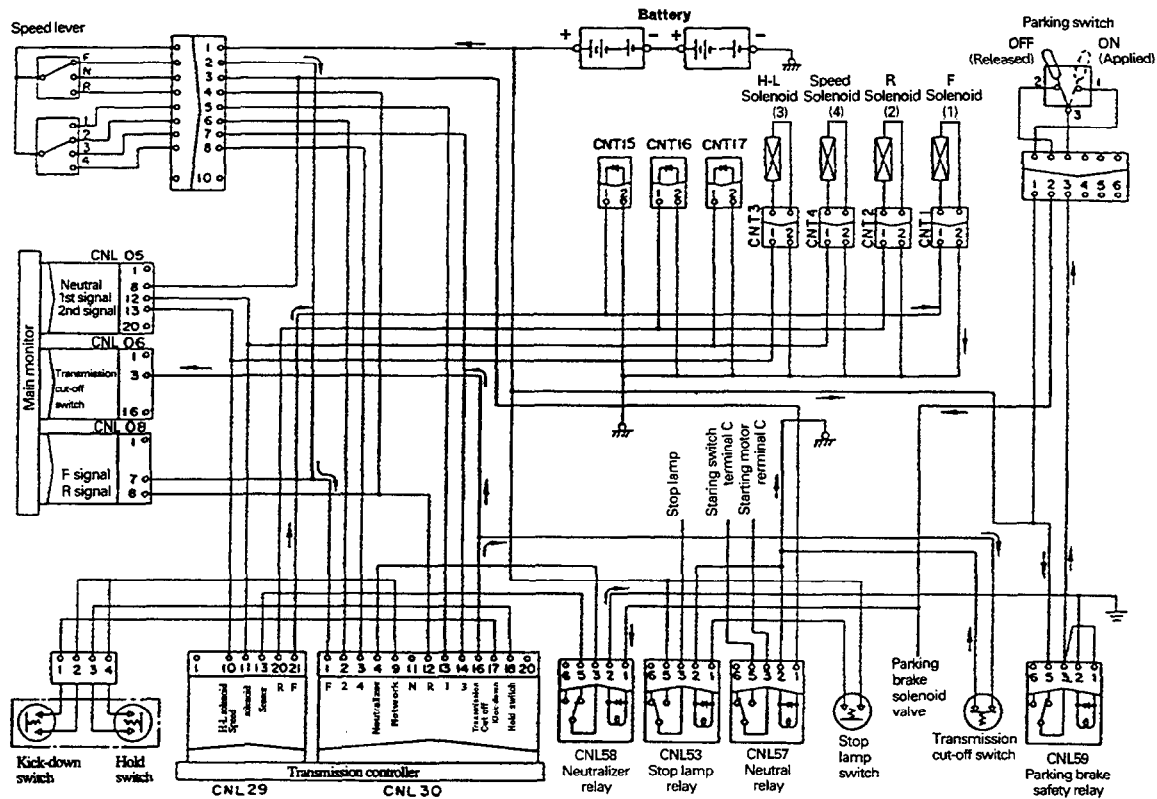
Operation

1. When transmission cut-off selector switch is turned ON

- When the main monitor's transmission cut-off selector switch is turned ON, the transmission cut-off selector switch is opened, the output from transmission controller terminal 16 passes only through the transmission cut-off switch to the ground, and voltage is applied to transmission solenoid F (FORWARD) or R (REVERSE).
- When the left brake pedal is depressed, the transmission cut-off switch is opened and the output flow of transmission controller terminal 16 to the ground is interrupted. At the same time, the voltage of transmission controller terminals 20 (R) and 21 (F) is interrupted, the transmission is set to neutral (N), and the brakes work normally.

STRUCTURE AND FUNCTION

TRANSMISSION CUT-OFF FUNCTION

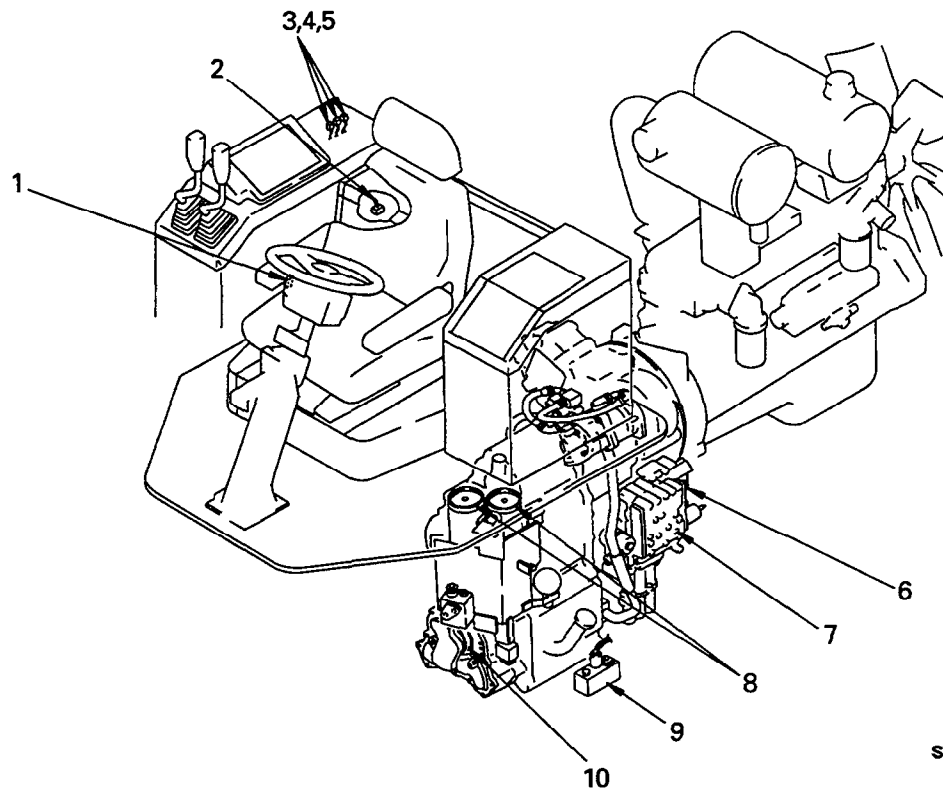


23F03109

2. When transmission cut-off selector switch is turned OFF

- When the transmission cut-off selector switch is turned OFF, the transmission cut-off selector switch closes, and the output from transmission controller terminal 16 flows from the transmission cut-off selector switch and the transmission cut-off switch to the ground. Because of this, voltage is applied to transmission solenoid F (FORWARD) or R (REVERSE) regardless of the position of the transmission cut-off switch, and transmission is not set to neutral even when the left brake pedal is pressed.

ELECTRIC PARKING BRAKE CONTROL



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 relay
 4. Parking brake emergency release relay
 5. Neutralizer relay
 6. Parking brake solenoid valve
 7. Transmission control valve
 8. Accumulator
 9. Parking brake emergency release valve
 10. Transmission (built-in parking brake)

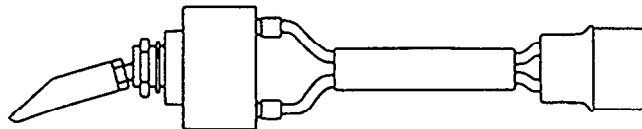
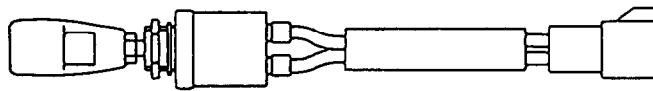
Function

- 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.
- 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.

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.

PARKING BRAKE EMERGENCY RELEASE SWITCH

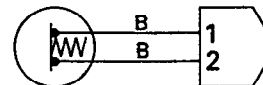
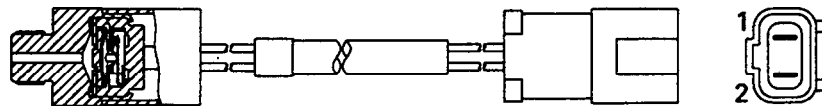


Connection table

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

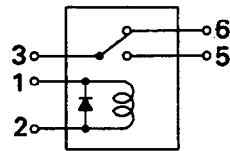
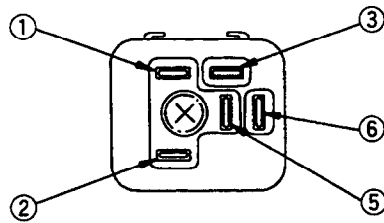
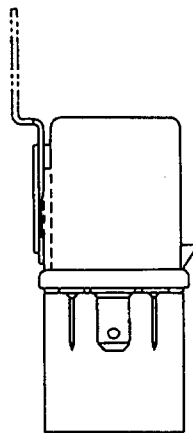
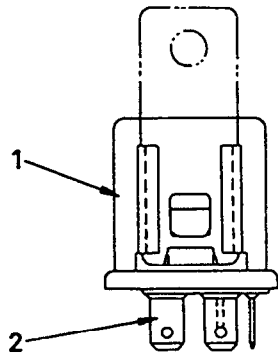
SLW00628

EMERGENCY BRAKE SWITCH



SAW00629

**PARKING SAFETY RELAY
NEUTRALIZER RELAY**



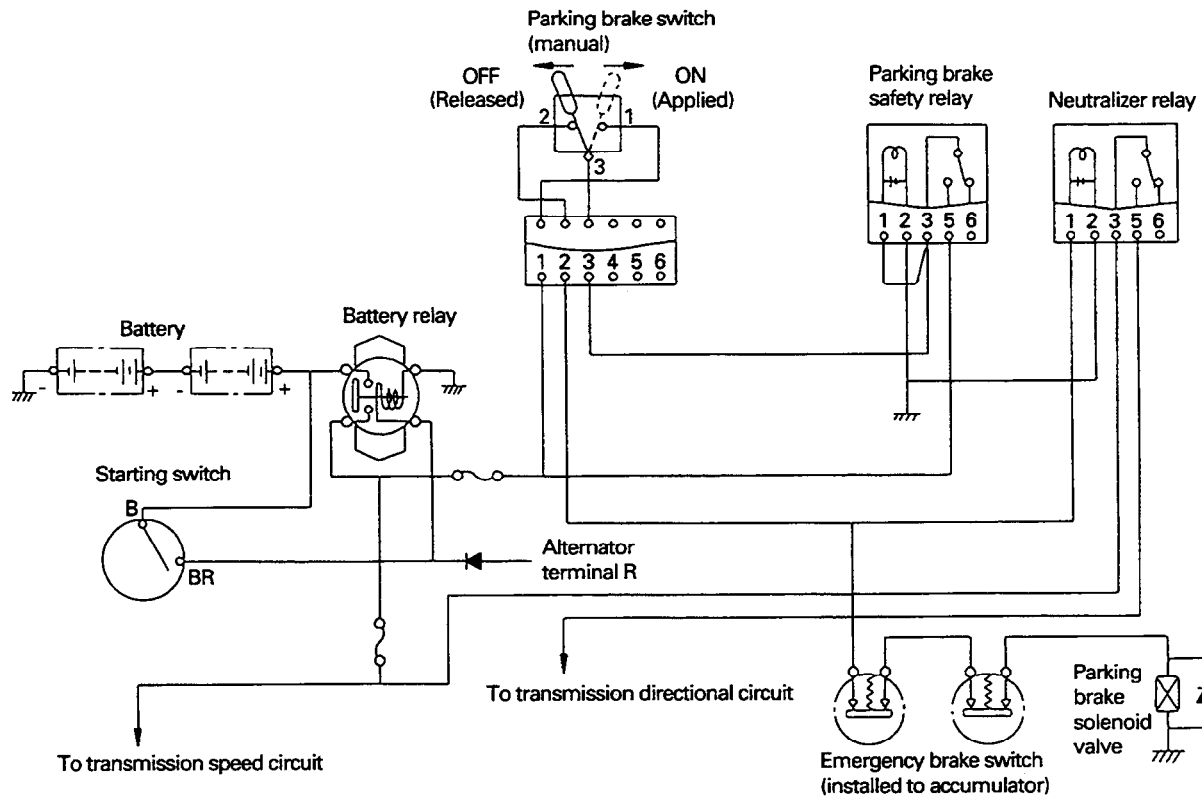
Internal connection diagram

Relay actuation table

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

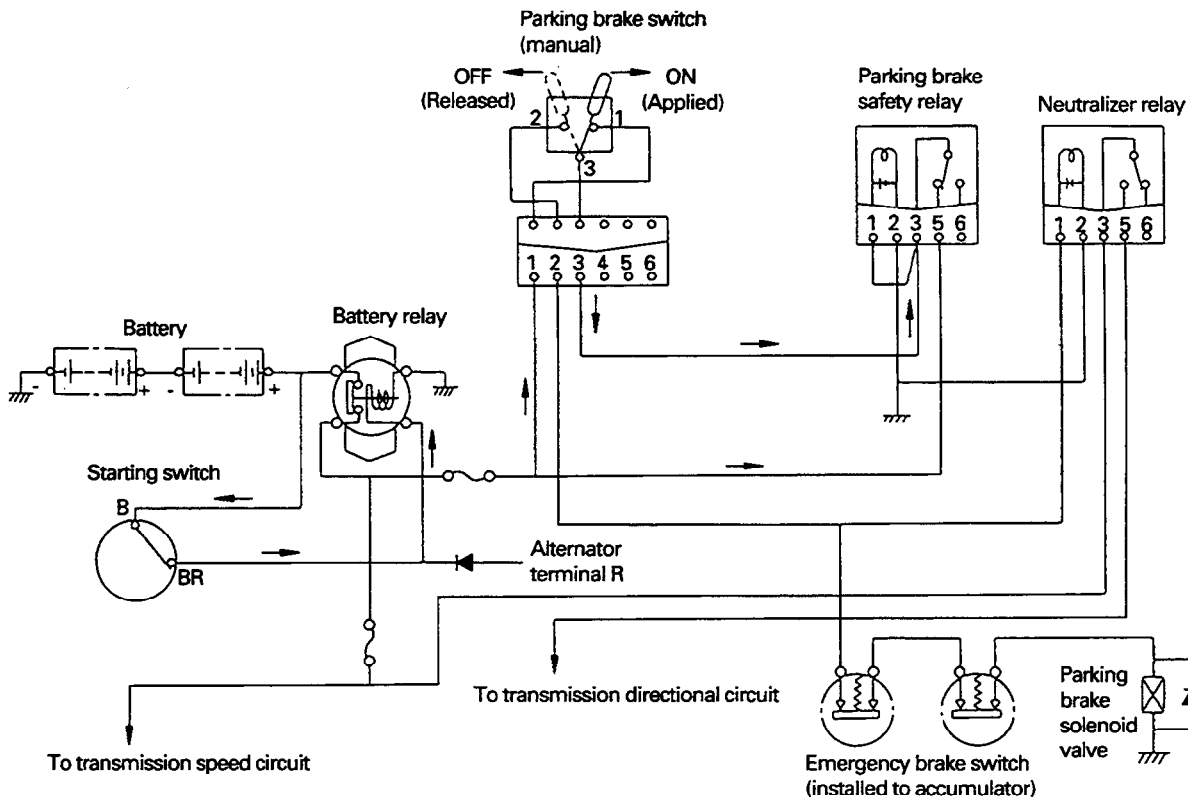
- 1. Case
- 2. Base

SEW00321

OPERATION**1. Starting switch OFF**

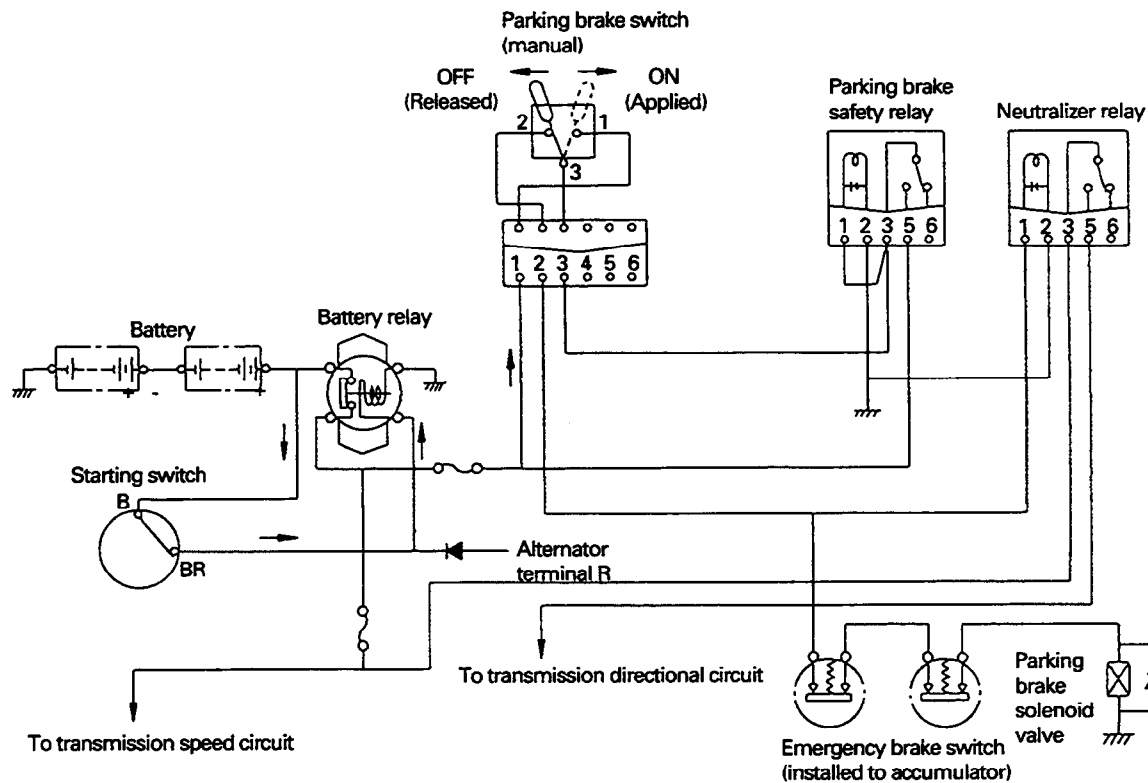
TBW00630

- 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)

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

TBW00631

- The electric current flows in circuit (1) from the battery (+) → starting switch → battery relay coil → ground, so the battery relay is closed. When this happens, electric current flows in circuit (2) from the battery(+) → battery relay → parking brake switch terminal 1 - 3 → parking brake safety relay terminal 1 - 2 → 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 (+) → battery relay → parking safety relay terminal 5 - 3 → parking safety relay terminal 1 - 2 → 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.

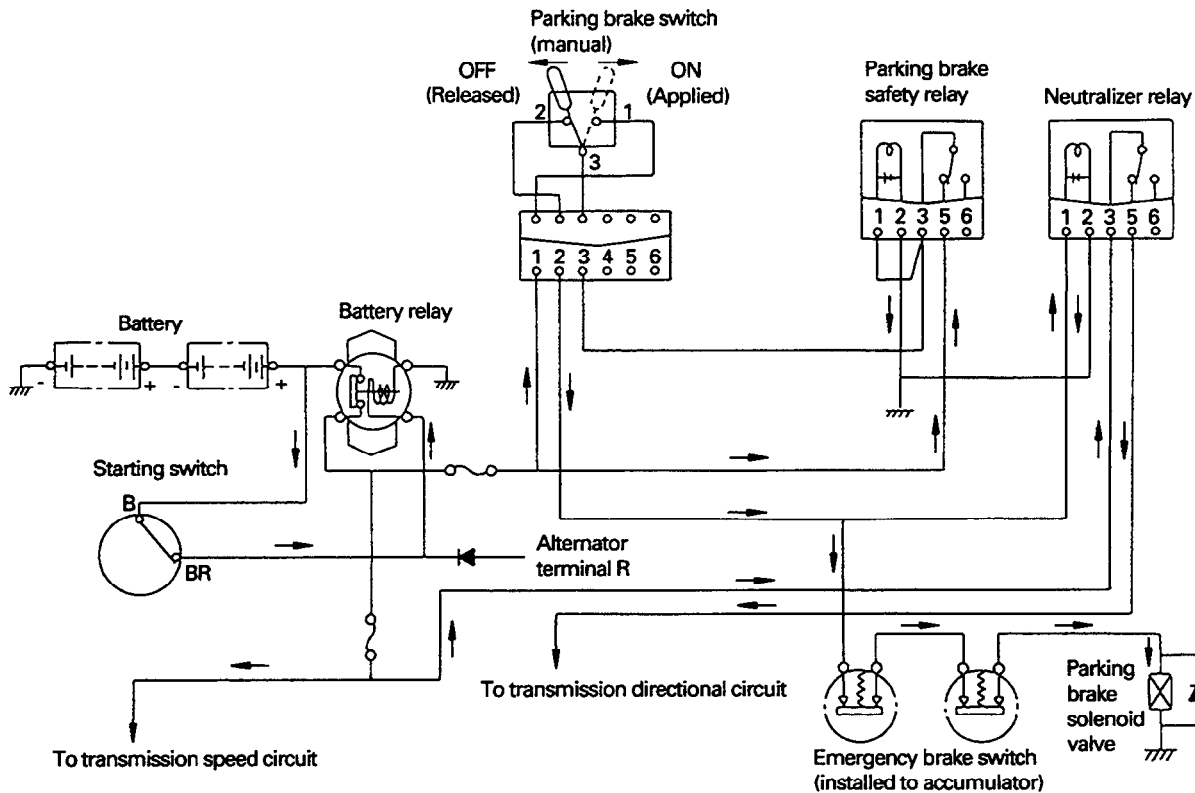
2-2 When parking brake switch is OFF(actuated) before starting switch is turned ON

TBW00632

- Electric current flows in circuit 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



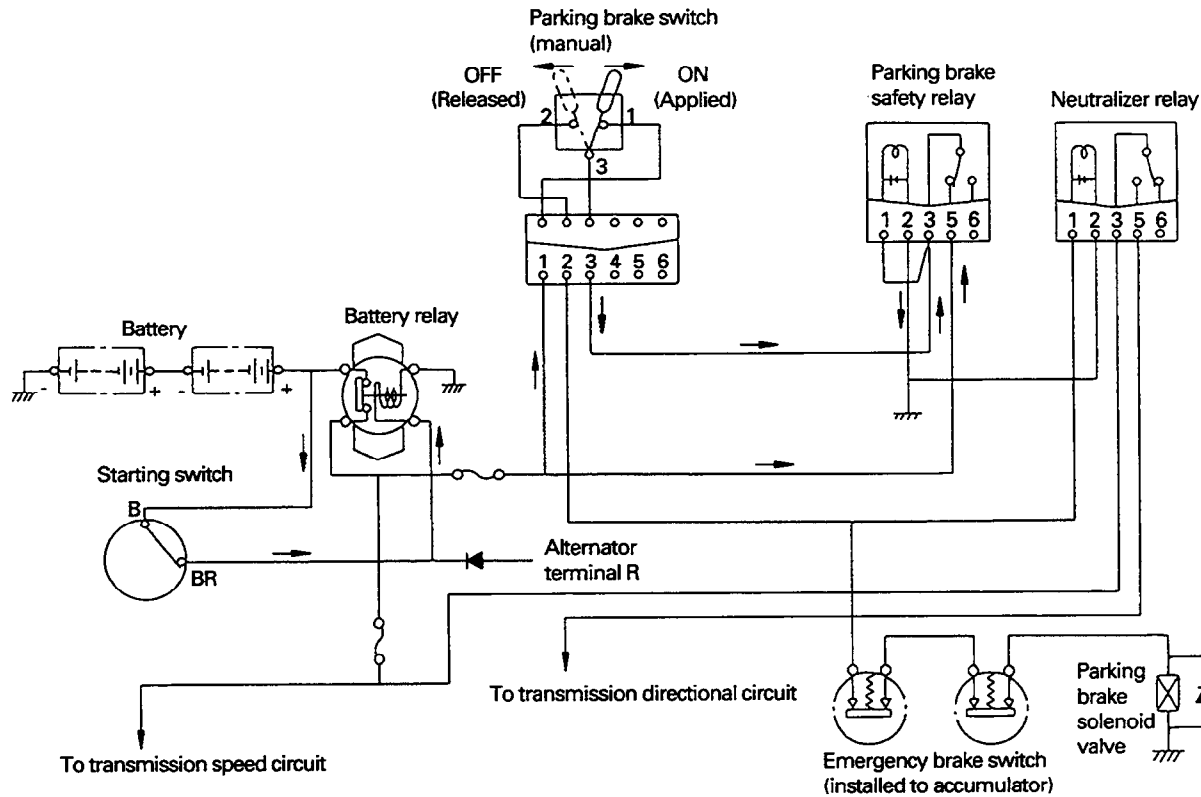
TBW00633

- 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 (+) → battery relay → parking brake safety relay → parking brake switch, and then flows to circuits (2) and (3) given below.

(2) This circuit is formed from the emergency brake switch → parking brake solenoid valve → ground, and the parking brake is released.

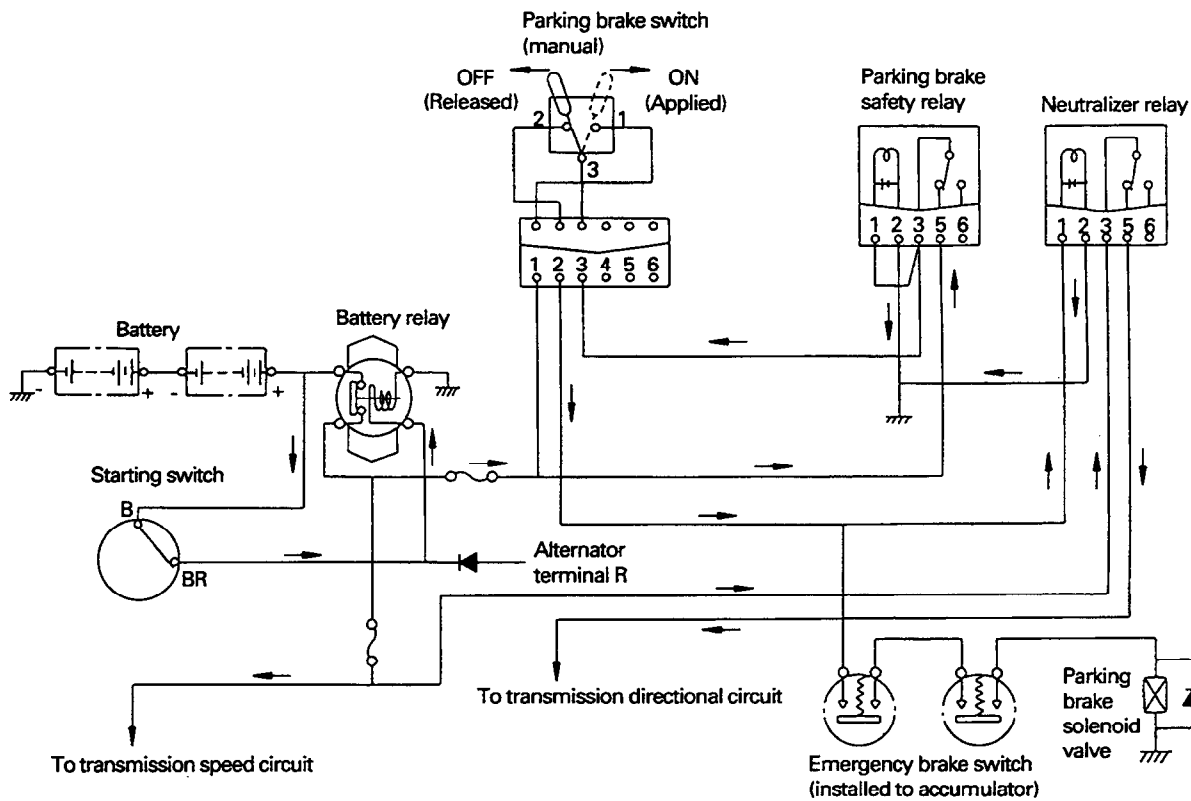
(3) This circuit is formed from the battery(+) → battery relay → neutralizer relay terminal 3 - 5 → transmission directional circuit, so when the directional lever is operated, the machine will move.

4. Parking brake switch ON (actuated)



TBW00634

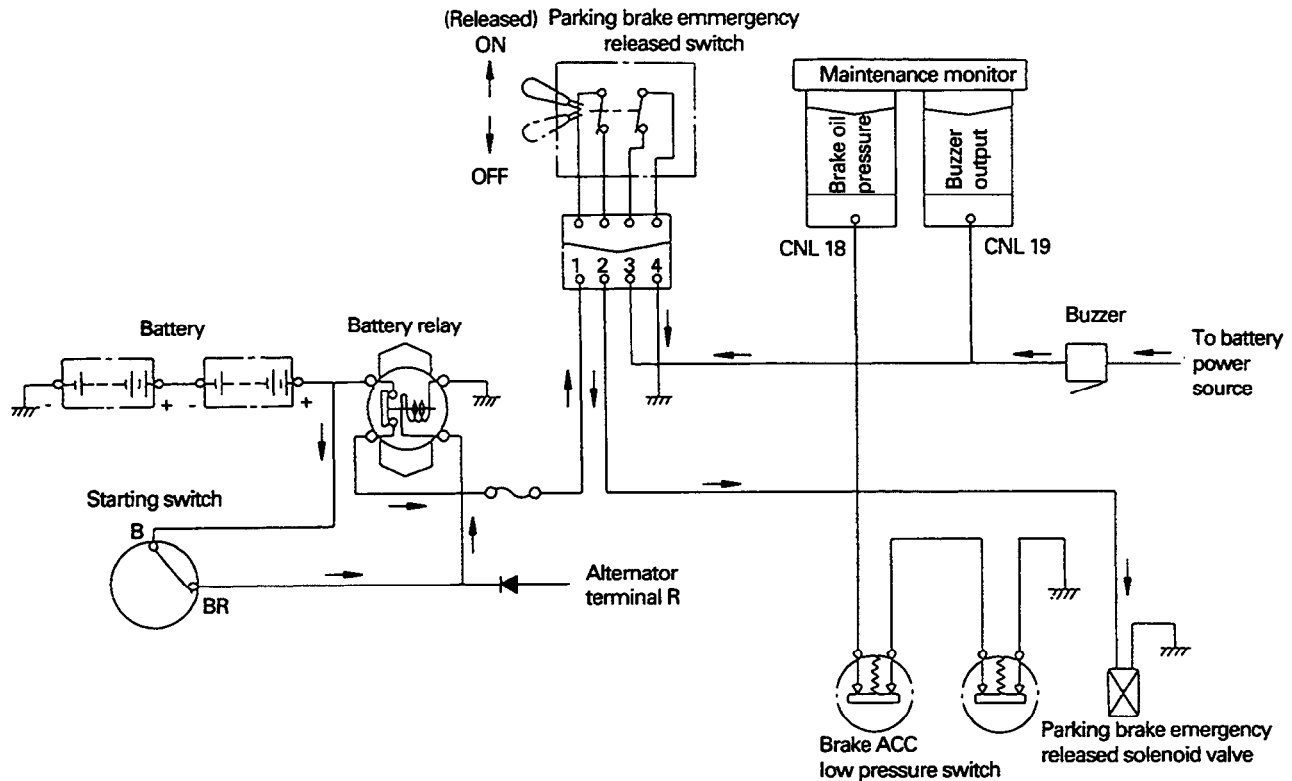
- If the parking brake switch is turned **ON** (applied) after carrying out operations with the parking brake switch **OFF** (released), the circuit in the diagram above is formed.
- Electric current does not flow to the parking brake solenoid valve, so the oil pressure from the transmission pump to 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)

TBW00635

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

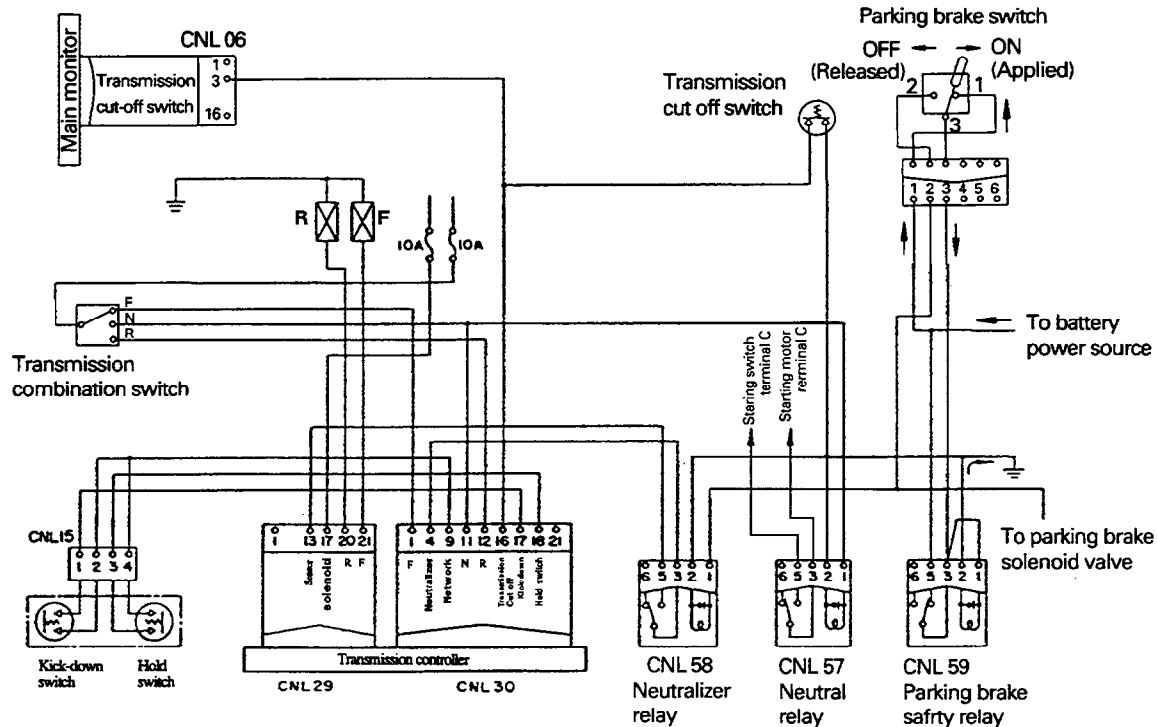
SLW00636

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.



23F03120

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.

20 STRUCTURE AND FUNCTION

Standard value table for engine	20- 2	Measuring clearance between tire and wheel	20-26
Standard value table for chassis	20- 3	Testing and adjusting steering wheel	20-27
Standard value table for electrical system	20- 7	Testing and adjusting steering control	20-30
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Measuring engine speed	20-12	Measuring operating force and travel of brake pedal	20-33
Measuring intake manifold pressure	20-12	Measuring brake performance	20-34
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Measuring stall speeds	20-17	Measuring work equipment	20-47
Measuring accelerator pedal	20-19	Testing and adjusting bucket positioner	20-49
Measuring operating force & travel of directional speed levers	20-21	Testing and adjusting boom kick-out	20-50
Measuring torque converter, transmission, & parking brake oil pressure	20-22	Adjusting main monitor (speedometer module)	20-52
Method of operating emergency manual spool	20-24		

★ When using the standard value tables to make judgement for testing and adjusting or troubleshooting, the following precautions are necessary.

1. The standard value for a new machine given in the table is the value used when shipping the machine from the factory and is given for reference. It is used as a guideline for judging the progress of wear after the machine has been operated, and as a reference value when carrying out repairs.
2. The service limit value given in the tables is the estimated value for the shipped machine based on the results of various tests. It is used for reference together with the state of repair and the history of operation to judge if there is a failure.
3. These standard values are not the standards used in dealing with claims.



When carrying out testing, adjusting, or troubleshooting, park the machine on level ground and use 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 coolant level, always wait for the coolant to cool down. If the radiator cap is removed when the coolant is still hot, the coolant will spurt out and cause burns.



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

TESTING AND ADJUSTING**STANDARD VALUE TABLE FOR ENGINE****STANDARD VALUE TABLE FOR ENGINE - In Chassis**

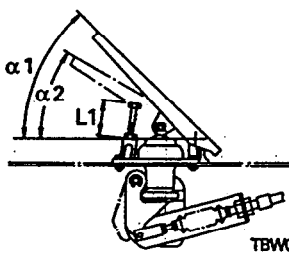
Machine model			WA380-3LE	
Engine model			S6D114E-1	
Item	Measurement condition	Unit	Standard value for new machine	Service limit value
Engine speeds	High idle	rpm	2450±50	2450±50
	Low idle		800±25	800±25
	Rated speed		2200	2200
Intake manifold pressure	At T.C. stall and W.O.T (Wide Open Throttle)	mm Hg	850-1100	850-1100
Intake air restriction	At T.C. stall and W.O.T. at restriction indicator port	mm H ₂ O	New element: 380 Used element: 635	635 max.
Lubricating oil pressure with SAE 15W-40 oil & coolant temperature in operating range	Minimum at low idle	kPa (kg/cm ²)	70 (0.70)	70 (0.70)
	Minimum at high idle	kPa (kg/cm ²)	210 (2.10)	210 (2.10)
Fuel filter inlet restriction	Maximum restriction at high idle	mm Hg	90	100
Blow-by pressure	Coolant temperature in operating range: • Service Tool orifice size: 7.67 mm • At T.C. stall and W.O.T.	mm H ₂ O	100	460
Exhaust back pressure	Maximum at T.C. stall & W.O.T.	mm Hg	76	76
Exhaust gas color	Maximum at sudden acceleration	Bosch index	0.70	
Coolant temperature	Maximum operating temperature	°C	100	100
Valve clearance	Engine cold:	mm		
	Intake valves Exhaust valves		0.30 0.61	0.30 0.61
Turbocharger wastegate actuator calibration	Apply air pressure	kPa (kg/cm ²)	80-90 (0.80-0.90)	80-90 (0.80-0.90)

★ For further detailed information, refer to Engine Shop Manual.

TESTING AND ADJUSTING

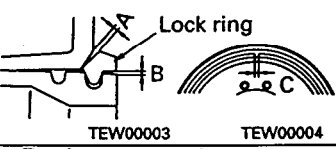
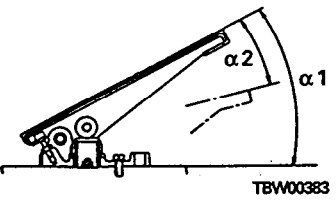
STANDARD VALUE TABLE FOR CHASSIS

STANDARD VALUE TABLE FOR CHASSIS

Machine model				WA380-3LE		
Engine model				S6D114E-1		
Item	Measurement condition	Unit	Standard value for new machine	Service limit value		
Engine stall speeds:	• Coolant temperature in operating range • Torque converter oil temperature in operating range • Hydraulic oil at normal operating temperature	rpm				
Torque converter			2290±100	2290±100		
Hydraulic			2300±100	2300±100		
Full			1880±200	1880±200		
Accelerator pedal	Operating force		N (kg)	58.8 – 73.5 (6 – 7.5)	108 (11)	
	Operating angle		deg.	48	—	
				31 ± 3	—	
	Stopper height		L1	mm	51 ± 5	—
Directional lever	Operating force	• Engine stopped • Torque converter oil temperature: 60 – 80°C	N (kg)	5.9 ^{+4.9} _{-2.9} (0.6 ^{+0.5} _{-0.3})	13.7 (1.4)	
				5.9 ^{+4.9} _{-2.9} (0.6 ^{+0.5} _{-0.3})	13.7 (1.4)	
	Travel		mm	40 ± 10	40 ± 20	
				40 ± 10	40 ± 20	
Speed lever	Operating force	• Engine stopped • Torque converter oil temperature: 60 – 80°C	N (kg)	5.9 ^{+4.9} _{-2.9} (0.6 ^{+0.5} _{-0.3})	13.7 (1.4)	
				5.9 ^{+4.9} _{-2.9} (0.6 ^{+0.5} _{-0.3})	13.7 (1.4)	
				5.9 ^{+4.9} _{-2.9} (0.6 ^{+0.5} _{-0.3})	13.7 (1.4)	
	Travel		mm	40 ± 10	40 ± 20	
		40 ± 10		40 ± 20		
		40 ± 10		40 ± 20		
	Transmission valve	Priority pressure	• Engine water temperature gauge: Green range • Torque converter oil temperature: 60 – 80°C	MPa (kg/cm²)	2.9 ± 0.15 (30 ± 1.5)	2.9 ^{+0.15} _{-0.29} (30 ^{+1.5} _{-3.0})
					2.7 ± 0.15 (28 ± 1.5)	2.7 ^{+0.15} _{-0.25} (28 ^{+1.5} _{-2.5})
Torque converter outlet port pressure		0.44 ± 0.05 (4.5 ± 0.5)			0.44 ^{+0.05} _{-0.1} (4.5 ^{+0.5} _{-1.0})	
		0.34 ± 0.08 (3.5 ± 0.8)			0.34 ^{+0.08} _{-0.12} (3.5 ^{+0.8} _{-1.2})	
Pilot pressure		0.98 ± 0.1 (10 ± 1)			0.98 ^{+0.1} _{-0.2} (10 ⁺¹ ₋₂)	
Clutch pressure		2.3 ± 0.2 (23 ± 2)			2.3 ^{+0.2} _{-0.39} (23 ⁺² ₋₄)	
	2.1 ± 0.34 (21.5 ± 3.5)	2.1 ^{+0.34} _{-0.69} (21.5 ^{+3.5} _{-7.0})				
Parking brake pressure	2.7 ± 0.15 (28 ± 1.5)	2.7 ^{+0.15} _{-0.25} (28 ^{+1.5} _{-2.5})				

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

Category	Item	Measurement conditions	Unit	Standard value	Permissible value
Tire	Fitting of wheel lock ring	• Tire inflation pressure: Specified pressure 	mm	Max. 2.5	—
				Max. 4.5	—
	Clearance of wheel lock ring			2 – 12	—
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)	34.3 (3.5)
	Operating time	• Hydraulic oil temperature: 45 – 55°C	Sec.	Max. 4.7	6.0
	Low idling			2.7 ± 0.5	5.0
Frame	Clearance between front frame and rear frame	• Engine speed: 1,200rpm • Hydraulic oil temperature: 45 – 55°C	mm	40 ± 5	—
Steering valve	Relief pressure	• Engine speed: High idling • Hydraulic oil temperature: 45 – 55°C	MPa (kg/cm ²)	20.6 ^{+0.49} _{-0.39} (210 ⁺⁵ ₋₄)	20.6 ^{+0.98} _{-0.59} (210 ⁺¹⁰ ₋₆)
Brakes	Operating force	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C	N (kg)	294 ± 29.4 (30 ± 3)	472 (43)
	Play		deg.	5 ± 0.5	—
	Operating angle			45	—
				15 ± 1	—
	Performance	• Flat, horizontal, straight, dry paved road surface • Speed when applying brake: 20 km/h, braking delay: 0.1 sec. • Brake pedal operating force: 265N(27kg) • Tire inflation pressure: Specified pressure	m	Max. 5	Max. 5
	Drop in hydraulic pressure	• 4.9 MPa (50 kg/cm²) in 5 minutes	MPa (kg/cm ²)	Max. 0.34 (Max. 3.5)	Max. 0.34 (Max. 3.5)
	Wear of disc	• Thickness of disc	mm	8.0 ± 0.15	7.2

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

Category	Item		Measurement conditions	Unit	Standard value	Permissible value			
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	—			
	Wear of disc		• Thickness of disc	mm	3.2 ± 0.08	2.83			
Work equipment control lever	Operating force	Boom	• Engine speed: Low idling • Hydraulic oil temperature: 45 – 55°C	N (kg)	Max. 23.5 (Max. 2.4)	35.3 (3.6)			
					Max. 15.7 (Max. 1.6)	23.5 (2.4)			
					Max. 24.5 (Max. 2.5)	37.3 (3.8)			
					—	37.3 (3.8)			
					Max. 34.3 (Max. 3.5)	52 (5.3)			
					Max. 14.7 (Max. 1.5)	22.6 (2.3)			
		Bucket			Max. 23.5 (Max. 2.4)	35.3 (3.6)			
					Max. 23.5 (Max. 2.4)	35.3 (3.6)			
					Max. 14.7 (Max. 1.5)	22.6 (2.3)			
					Travel	Boom	mm	67 ± 15	67 ± 30
								53 ± 15	53 ± 30
								67 ± 15	67 ± 30
	Bucket	60 ± 15		60 ± 30					
		60 ± 15		60 ± 30					
		60 ± 15		60 ± 30					
	Main control valve	Relief pressure		• Hydraulic oil temperature: 45 – 55°C • Engine speed: High idling	MPa (kg/cm ²)	20.6 ^{+0.98} _{-0.29} (210 ⁺¹⁰ ₋₃)	20.6 ± 1.96(210 ± 20)		
		Relief pressure				2.94 ^{+0.39} ₀ (30 ⁺⁴ ₀)	2.94 ± 0.98(30 ± 10)		
	Work equipment	Work equipment speed		Boom lifting time	• Hydraulic oil temperature: 45 – 55°C • Engine speed: High idling • Steering valve: Neutral • No load	Sec.	5.3 ± 0.3	8.7	
Boom lowering time			2.7 ± 0.5	5.0					
Bucket dumping time			1.4 ± 0.3	2.1					
Bucket tilting time			At full stroke	1.8 ± 0.3			2.7		
			Bucket horizontal	1.2 ± 0.3			1.8		

TESTING AND ADJUSTING

STANDARD VALUE TABLE FOR CHASSIS

Category	Item	Measurement conditions	Unit	Standard value	Permissible value
Work equipment	Hydraulic drift	- Hydraulic oil temperature: 45 – 55°C - Leave for 5 minutes after stopping engine then measure for next 15 minutes - Bucket empty, boom horizontal	mm	Max. 15.0	20
	Retraction of boom cylinder rod			Max. 15.0	20
Proximity switch	Retraction of bucket cylinder rod	Hydraulic oil temperature: 45 – 55°C	mm	3 – 7	—
	Clearance of bucket positioner switch			3 – 7	—

STANDARD VALUE TABLE FOR ELECTRICAL SYSTEM

System	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions					
Maintenance monitor	Fuel level sensor	CNR07 (male)	Resistance measurement	Normal if as follows: <table><tr><td>Full stopper</td><td rowspan="2">Between ① and ②</td><td>Approx. 4 Ω</td></tr><tr><td>Empty</td><td>85 Ω</td></tr></table>	Full stopper	Between ① and ②	Approx. 4 Ω	Empty	85 Ω	1) Starting switch OFF 2) CNR07 disconnected
	Full stopper	Between ① and ②	Approx. 4 Ω							
	Empty		85 Ω							
	Engine water temperature sensor	CNE06 (male)	Resistance measurement	Normal if as follows: <table><tr><td>25°C</td><td rowspan="2">Between ① and ②</td><td>Approx. 40 Ω</td></tr><tr><td>130°C</td><td>Approx. 1.7 Ω</td></tr></table>	25°C	Between ① and ②	Approx. 40 Ω	130°C	Approx. 1.7 Ω	1) Starting switch OFF 2) CNE06 disconnected
	25°C	Between ① and ②	Approx. 40 Ω							
	130°C		Approx. 1.7 Ω							
	Torque converter oil temperature sensor	CNT07 (male)	Resistance measurement	Normal if as follows: <table><tr><td>25°C</td><td rowspan="2">Between ① and ②</td><td>Approx. 40 Ω</td></tr><tr><td>130°C</td><td>Approx. 1.7 Ω</td></tr></table>	25°C	Between ① and ②	Approx. 40 Ω	130°C	Approx. 1.7 Ω	1) Starting switch OFF 2) CNT07 disconnected
	25°C	Between ① and ②	Approx. 40 Ω							
	130°C		Approx. 1.7 Ω							
Radiator water lever sensor	CNR06 (male)	Continuity	Normal if as follows: <table><tr><td>Radiator water level normal</td><td rowspan="2">Between ② and ①</td><td>Continuous</td></tr><tr><td>Radiator water level abnormal</td><td>Non-continuous</td></tr></table>	Radiator water level normal	Between ② and ①	Continuous	Radiator water level abnormal	Non-continuous	1) Starting switch OFF 2) CNR06 disconnected	
Radiator water level normal	Between ② and ①	Continuous								
Radiator water level abnormal		Non-continuous								
Engine oil level sensor	CNE10 (male)	Continuity	Normal if as follows: <table><tr><td>Engine oil level normal</td><td rowspan="2">Between ① and chassis</td><td>Continuous</td></tr><tr><td>Engine oil level abnormal</td><td>Non-continuous</td></tr></table>	Engine oil level normal	Between ① and chassis	Continuous	Engine oil level abnormal	Non-continuous	1) Starting switch OFF 2) CNE10 disconnected	
Engine oil level normal	Between ① and chassis	Continuous								
Engine oil level abnormal		Non-continuous								
Brake oil pressure sensor	CNB13 (male) CNB08 (male)	Continuity	Normal if as follows: <table><tr><td>Brake oil pressure normal</td><td rowspan="2">Between ① and ②</td><td>Continuous</td></tr><tr><td>Brake oil pressure abnormal</td><td>Non-continuous</td></tr></table>	Brake oil pressure normal	Between ① and ②	Continuous	Brake oil pressure abnormal	Non-continuous	1) Starting switch OFF 2) CNB13 disconnected LNB08 disconnected	
Brake oil pressure normal	Between ① and ②	Continuous								
Brake oil pressure abnormal		Non-continuous								
Dust indicator	CNE19 (male) CNE20 (female)	Continuity	Normal if as follows: <table><tr><td>Dust indicator normal</td><td rowspan="2">Between CNE19 (male) and CNE20 (female)</td><td>Continuous</td></tr><tr><td>Dust indicator abnormal</td><td>Non-continuous</td></tr></table>	Dust indicator normal	Between CNE19 (male) and CNE20 (female)	Continuous	Dust indicator abnormal	Non-continuous	1) Starting switch OFF 2) CNE19 disconnected CNE20 disconnected	
Dust indicator normal	Between CNE19 (male) and CNE20 (female)	Continuous								
Dust indicator abnormal		Non-continuous								
Engine oil pressure sensor	Ring terminal	Continuity	Normal if as follows: <table><tr><td>Engine oil pressure normal</td><td rowspan="2">Between ring terminal and chassis</td><td>Continuous</td></tr><tr><td>Engine oil pressure abnormal</td><td>Non-continuous</td></tr></table>	Engine oil pressure normal	Between ring terminal and chassis	Continuous	Engine oil pressure abnormal	Non-continuous	1) Starting switch OFF 2) Ring terminal disconnected	
Engine oil pressure normal	Between ring terminal and chassis	Continuous								
Engine oil pressure abnormal		Non-continuous								
Alternator	Between alternator terminal R and chassis	Voltage measurement	When engine is running (1/2 throttle or greater) → 27.5 to 29.5V * In cold regions or if the battery is weak, the voltage may not rise directly after the engine is started.	1) Engine started						

System	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions					
Main monitor	Alternator	Between alternator terminal R and chassis	Voltage measurement	When engine is running (1/2 throttle or greater) → 27.5 to 29.5V * In cold regions or if the battery is weak, the voltage may not rise directly after the engine is started.	1) Engine started					
	Engine water temperature sensor	CNE05 (male)	Resistance measurement	Normal if as follows: <table><tr><td>25°C</td><td rowspan="2">Between CNE05 (male) and GND</td><td>Approx. 2 kΩ</td></tr><tr><td>5°C</td><td>Approx. 4 kΩ</td></tr></table>	25°C	Between CNE05 (male) and GND	Approx. 2 kΩ	5°C	Approx. 4 kΩ	1) Starting switch OFF 2) CNE05 disconnected
	25°C	Between CNE05 (male) and GND	Approx. 2 kΩ							
5°C	Approx. 4 kΩ									
Speed sensor	CNT06 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>500 to 1000 Ω</td></tr></table>	Between ① and ②	500 to 1000 Ω	1) Starting switch OFF 2) CNT06 disconnected				
Between ① and ②	500 to 1000 Ω									
Transmission controller	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	47 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									

System	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions						
Work equipment controller	Bucket dump solenoid	CNF25 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>7.5 to 9.5 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	7.5 to 9.5 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF 2) Connector disconnected		
	Between ① and ②	7.5 to 9.5 Ω									
	Between ① and chassis	1 MΩ or greater									
	Bucket tilt solenoid	CNF24 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>7.5 to 9.5 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	7.5 to 9.5 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF 2) Connector disconnected		
	Between ① and ②	7.5 to 9.5 Ω									
	Between ① and chassis	1 MΩ or greater									
	Dumping solenoid	CNF26 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>18.8 to 20.8 Ω</td></tr><tr><td>Between ① and chassis</td><td>1 MΩ or greater</td></tr></table>	Between ① and ②	18.8 to 20.8 Ω	Between ① and chassis	1 MΩ or greater	1) Starting switch OFF 2) Connector disconnected		
Between ① and ②	18.8 to 20.8 Ω										
Between ① and chassis	1 MΩ or greater										
Boom angle potentiometer	CNF28 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>0 to 5 Ω</td></tr><tr><td>Between ② and ③</td><td>4 to 5 Ω</td></tr><tr><td>Between ③ and ①</td><td>0 to 5 Ω</td></tr></table>	Between ① and ②	0 to 5 Ω	Between ② and ③	4 to 5 Ω	Between ③ and ①	0 to 5 Ω	1) Starting switch OFF 2) Connector disconnected	
Between ① and ②	0 to 5 Ω										
Between ② and ③	4 to 5 Ω										
Between ③ and ①	0 to 5 Ω										
Bucket angle potentiometer	CNL29 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>0 to 5 Ω</td></tr><tr><td>Between ② and ③</td><td>4 to 5 Ω</td></tr><tr><td>Between ③ and ①</td><td>0 to 5 Ω</td></tr></table>	Between ① and ②	0 to 5 Ω	Between ② and ③	4 to 5 Ω	Between ③ and ①	0 to 5 Ω	1) Starting switch OFF 2) Connector disconnected	
Between ① and ②	0 to 5 Ω										
Between ② and ③	4 to 5 Ω										
Between ③ and ①	0 to 5 Ω										
Boom lever raise pressure switch	CNF21	Resistance measurement	Normal if within the following range: <table><tr><td colspan="2">Between ① and ②, boom lever operated</td></tr><tr><td>Other than raised</td><td>1 Ω or less</td></tr><tr><td>Raised</td><td rowspan="2">1 MΩ or greater</td></tr><tr><td>Between ① and chassis</td></tr></table>	Between ① and ②, boom lever operated		Other than raised	1 Ω or less	Raised	1 MΩ or greater	Between ① and chassis	1) Starting switch OFF 2) Connector disconnected
Between ① and ②, boom lever operated											
Other than raised	1 Ω or less										
Raised	1 MΩ or greater										
Between ① and chassis											
Boom lever lower pressure switch	CNF22	Resistance measurement	Normal if within the following range: <table><tr><td colspan="2">Between ① and ②, boom lever operated</td></tr><tr><td>Other than lowered</td><td>1 Ω or less</td></tr><tr><td>Lowered</td><td rowspan="2">1 MΩ or greater</td></tr><tr><td>Between ① and chassis</td></tr></table>	Between ① and ②, boom lever operated		Other than lowered	1 Ω or less	Lowered	1 MΩ or greater	Between ① and chassis	1) Starting switch OFF 2) Connector disconnected
Between ① and ②, boom lever operated											
Other than lowered	1 Ω or less										
Lowered	1 MΩ or greater										
Between ① and chassis											

System	Name of component	Connector No.	Inspection method	Judgment table	Measurement conditions				
E.C.S.S. controller	Relief solenoid	CNAF4 (male)	Resistance measurement	<table><tr><td>Between ① and ②</td><td>20 to 40 Ω</td></tr></table>	Between ① and ②	20 to 40 Ω	1) Starting switch OFF 2) CNAF4 disconnected		
	Between ① and ②	20 to 40 Ω							
	High pressure solenoid	CNAF5 (male)	Resistance measurement	<table><tr><td>Between ① and ②</td><td>20 to 40 Ω</td></tr></table>	Between ① and ②	20 to 40 Ω	1) Starting switch OFF 2) CNAF5 disconnected		
	Between ① and ②	20 to 40 Ω							
	Low pressure solenoid	CNAF6 (male)	Resistance measurement	Normal if as follows: <table><tr><td>Between ① and ②</td><td>20 to 40 Ω</td></tr></table>	Between ① and ②	20 to 40 Ω	1) Starting switch OFF 2) CNAF6 disconnected		
Between ① and ②	20 to 40 Ω								
Pressure switch	CNAF7 (male)	Resistance measurement	Normal if as follows: <table><tr><td>Oil pressure 5.4 MPa (55kg/cm²) or greater</td><td rowspan="2">Between ① and ②</td><td>Continuous</td></tr><tr><td>Oil pressure 4.4 MPa (45kg/cm²) or less</td><td>Non-continuous</td></tr></table>	Oil pressure 5.4 MPa (55kg/cm ²) or greater	Between ① and ②	Continuous	Oil pressure 4.4 MPa (45kg/cm ²) or less	Non-continuous	1) Starting switch OFF 2) CNAF7 disconnected
Oil pressure 5.4 MPa (55kg/cm ²) or greater	Between ① and ②	Continuous							
Oil pressure 4.4 MPa (45kg/cm ²) or less		Non-continuous							
Speed sensor	CNT06 (male)	Resistance measurement	Normal if within the following range: <table><tr><td>Between ① and ②</td><td>500 to 1000 Ω</td></tr></table>	Between ① and ②	500 to 1000 Ω	1) Starting switch OFF 2) CNT06 disconnected			
Between ① and ②	500 to 1000 Ω								

TESTING AND ADJUSTING
TOOLS FOR TESTING, ADJUSTING AND TROUBLE SHOOTING
SERVICE TOOLS FOR TESTING, ADJUSTING & TROUBLESHOOTING

Check or measurement item	Symbol	Tool Number	Tool Description	Remarks
Engine speeds	A		Digital optical tachometer	Digital display L : 60-2000 rpm R : 60-19999 rpm
Intake manifold pressure	-		Pressure gauge	See Engine Shop Manual
Intake air restriction	-		Water manometer	See Engine Shop Manual
Lubricating oil pressure	C		Pressure gauge	See Engine Shop Manual
Fuel filter inlet restriction	-		Vacuum gauge	See Engine Shop Manual
Blow-by pressure	E		Tool, adapter & manometer	See Engine Shop Manual
Exhaust back pressure	-		Mercury manometer	See Engine Shop Manual
Exhaust gas color	G	1 799-201-9000	Handy smoke detector	Discoloration 0-70% with standard color % x 1/10 = Bosch index
		2 Commercially available	Smoke meter	
Coolant temperature	B		Digital temperature gauge	See Engine Shop Manual
Valve clearance	F	Commercially available	Feeler gauge	
Turbocharger wastegate actuator calibration	-		Pressure gauge	See Engine Shop Manual
Troubleshooting of wiring harnesses and sensors	I	799-601-7400	T-adapter	—
Measuring voltage and resistance values	J	Commercially available	Tester	—
Operating force	K	79A-264-0020	Push-pull scale	0 - 294N (0 - 30kg)
Clearance measurement	L	Commercially available	Thickness gauge	—
Pushing angle	M	Commercially available	Angle gauge	—
Pushing force	N	Commercially available	Push gauge	—
Stroke	O	Commercially available	Scale	—
Brake oil pressure	P	793-605-1001	Brake test kit	—
Length measurement	Q	Commercially available	Slide calipers	—
Speed	R	Commercially available	Stop watch	—

MEASURING ENGINE SPEEDS

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

★ Measure the engine speed under the following conditions.

- Coolant temperature: Within operating range
- Torque converter oil temperature: 60 to 80°C
- Hydraulic oil temperature: 45 to 55°C

1. Install the digital optical tachometer using the instructions supplied with it.

⚠ When measuring engine speeds, be careful not to touch any high temperature parts or rotating parts.

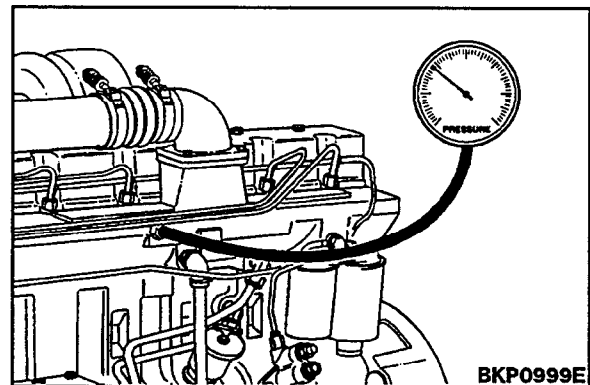
2. Start the engine, and measure the engine speed when it is set to the conditions for measuring.

- 1) Measuring low idle and high idle speeds.
- 2) Measure the speed at near the rated speed.

★ When measuring speeds for items other than the above, such as torque converter stall, see the procedure for the item as described in this section.

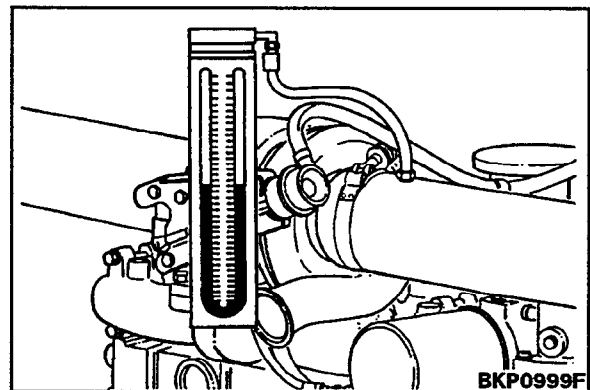
MEASURING INTAKE MANIFOLD PRESSURE

★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



MEASURING INTAKE AIR RESTRICTION

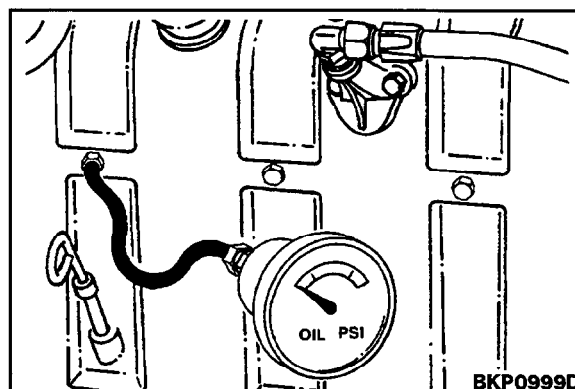
★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



TESTING AND ADJUSTING MEASURING ENG. OIL PRESS., FUEL FILTER RESTRICTION & BLOW BY PRESS.

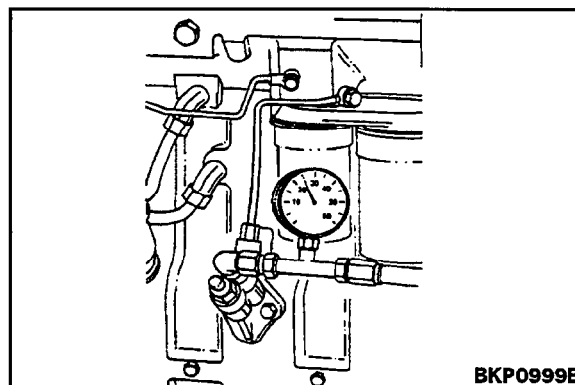
MEASURING ENGINE LUBRICATING OIL PRESSURE

- ★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



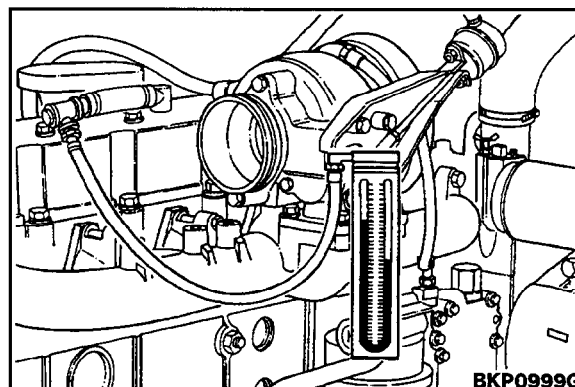
MEASURING FUEL FILTER INLET RESTRICTION

- ★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



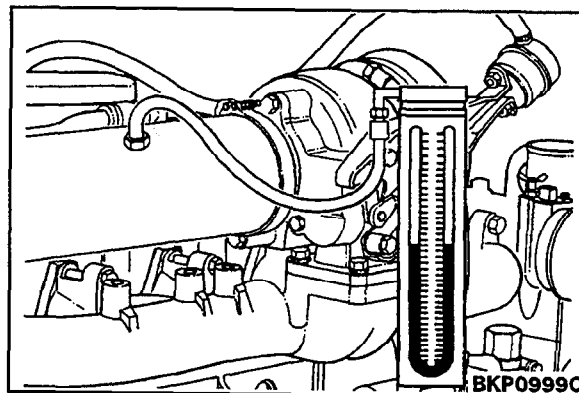
MEASURING BLOW-BY PRESSURE

- ★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



MEASURING EXHAUST BACK PRESSURE

- ★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.

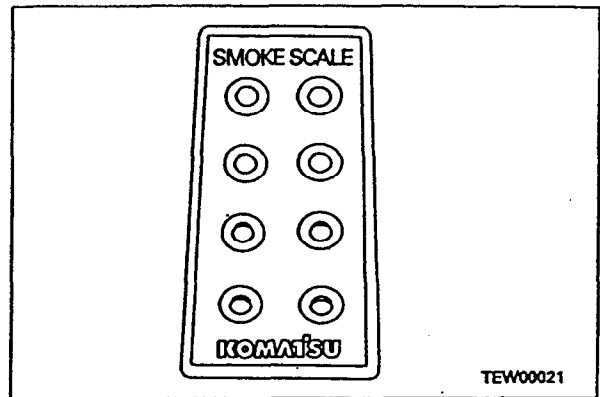
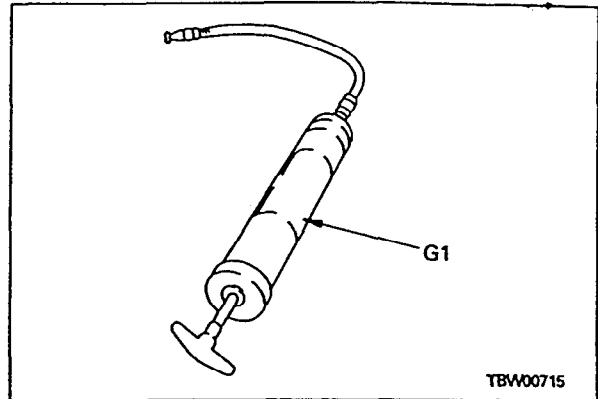


MEASURING EXHAUST GAS COLOR

- ★ 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.

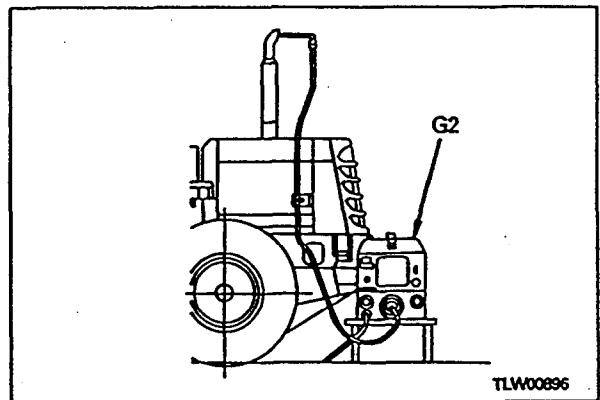
Measuring with handy smoke checker G1

- ⚠ 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 G1.
 - 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.



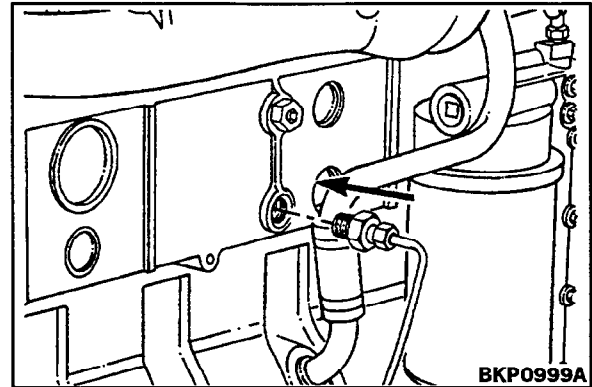
Measuring with smoke meter G2

- ⚠ 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 G2.
 - ★ 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.



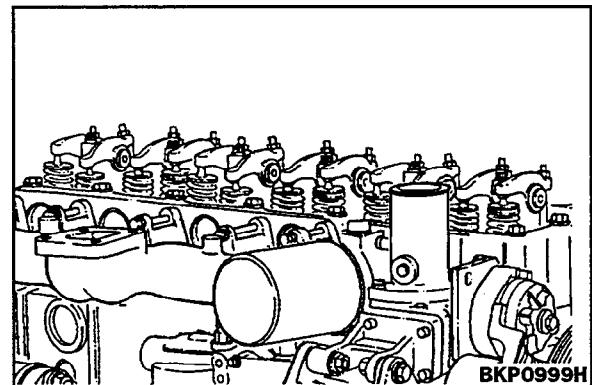
MEASURING COOLANT TEMPERATURE

- ★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



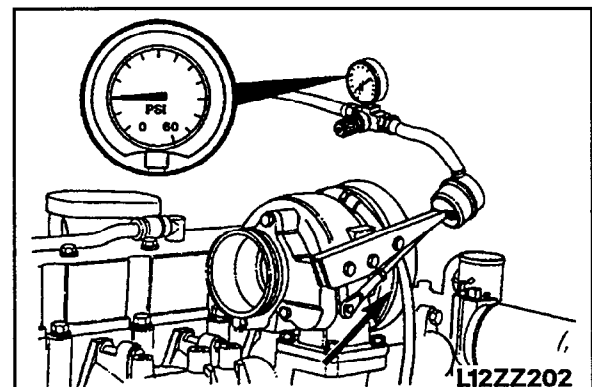
MEASURING AND ADJUSTING VALVE CLEARANCE

- ★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.



MEASURING WASTEGATE ACTUATOR CALIBRATION

- ★ Refer to **ENGINE SHOP MANUAL** for tools and proper procedure.

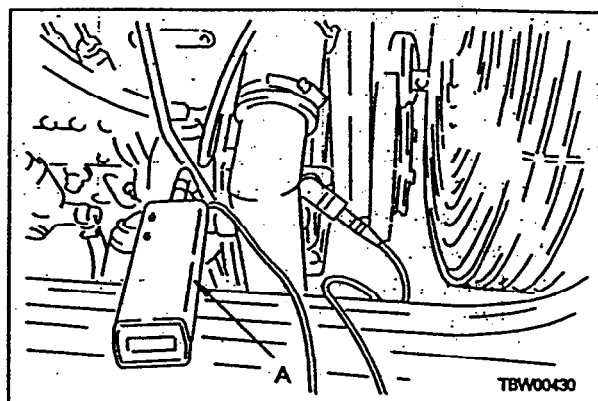


MEASURING STALL SPEEDS

★ 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 the digital optical tachometer A using the instructions supplied with it.
 - ★ 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.



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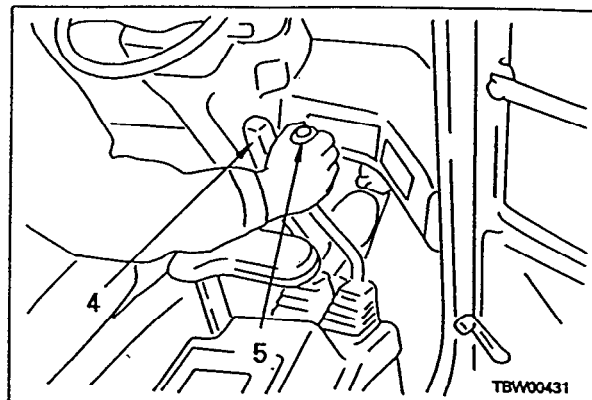
TORQUE CONVERTER STALL SPEED

Check that the tires are chocked and release the parking brake.

1. Start the engine and run at low idling.
2. Place the speed lever at the highest position for FORWARD or REVERSE.
3. 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 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.

HYDRAULIC STALL SPEED

1. Start the engine and run at high idling.
2. Operate the bucket (4) or boom lever (5), set the cylinder to the stroke end, and activate the work equipment valve relief valve.
3. Use multi-tachometer 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.

MEASURING ACCELERATOR PEDAL

★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge

OPERATING FORCE OF ACCELERATOR PEDAL

1. Measuring

- 1) Set push-pull scale K at a position 150 mm from pedal fulcrum a.
★ Put the center of push-pull scale K 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).

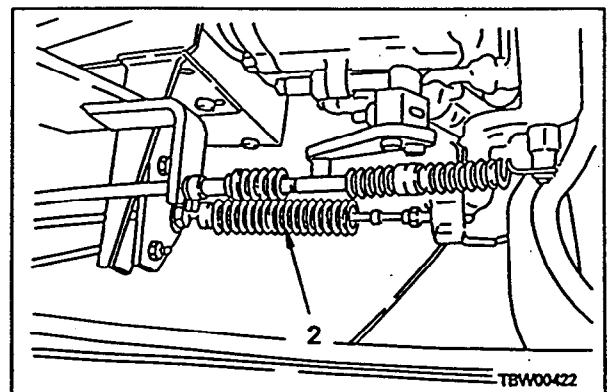
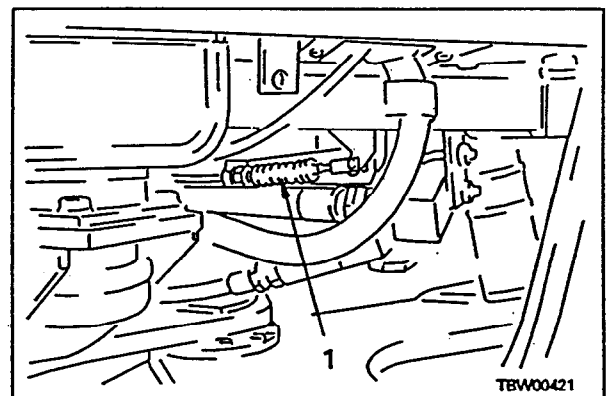
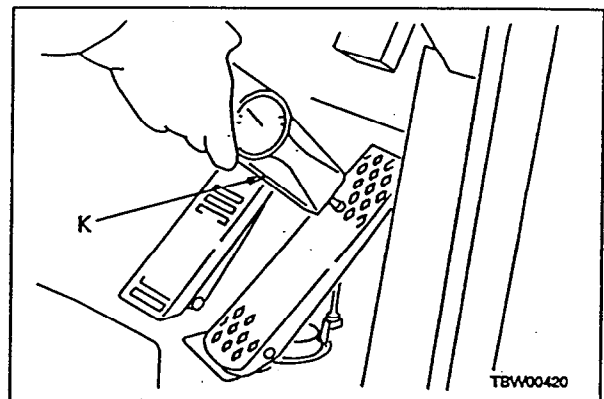
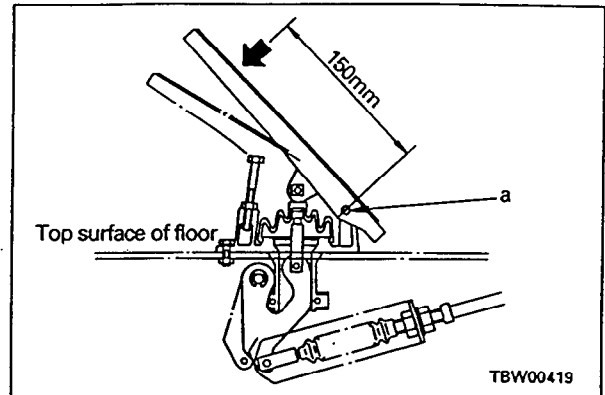
2. Testing

- 1) Stop the engine.
- 2) Disconnect cable (1) at the bottom of the accelerator pedal and check that there is no heaviness in the accelerator pedal linkage.
- 3) Connect cable (1) at the bottom of the pedal, detach cable (2) at the injection pump connection, and check that there is no heaviness in the cable.

⌘ Cable joint nut:

$13.7 \pm 0.98\text{Nm} (1.4 \pm 0.1\text{kgm})$

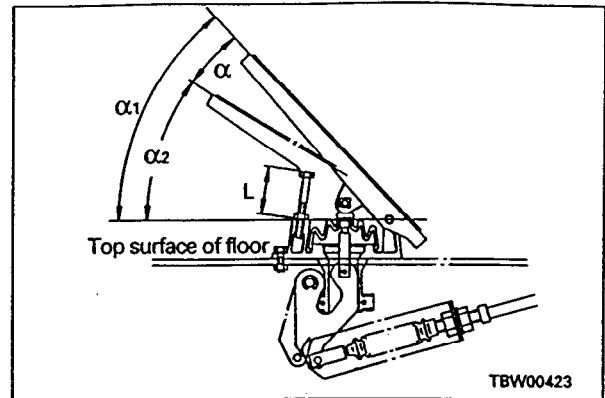
- ★ Carry out the above inspection, and adjust or replace parts if necessary. Then carry out the measurement of the operating force again to check that it is within the standard value.



OPERATING ANGLE OF ACCELERATOR PEDAL

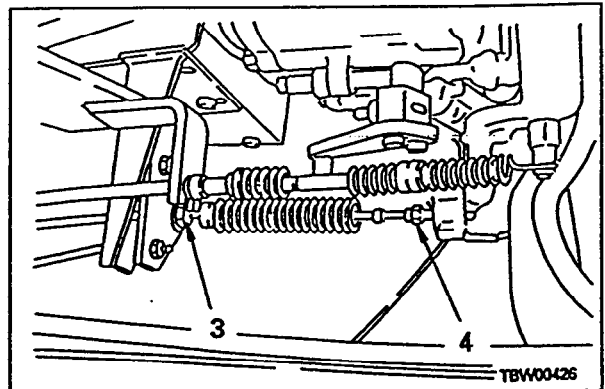
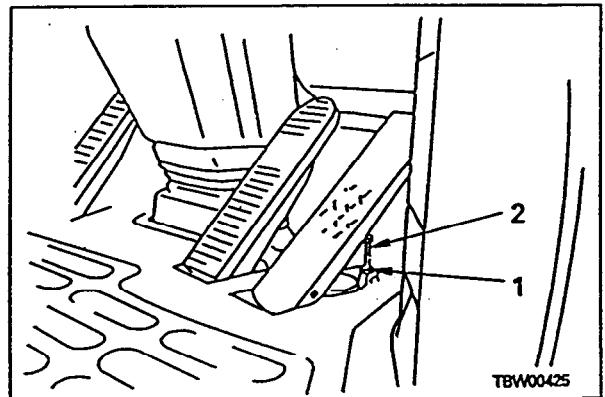
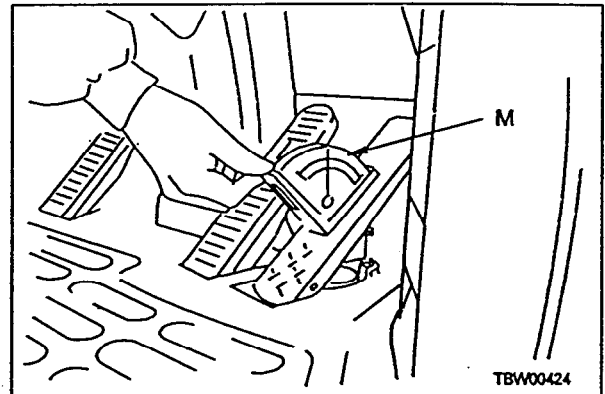
1. Measuring

- 1) Stop the engine.
- 2) Put angle gauge **M** 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 51 ± 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 ± 0.98 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.

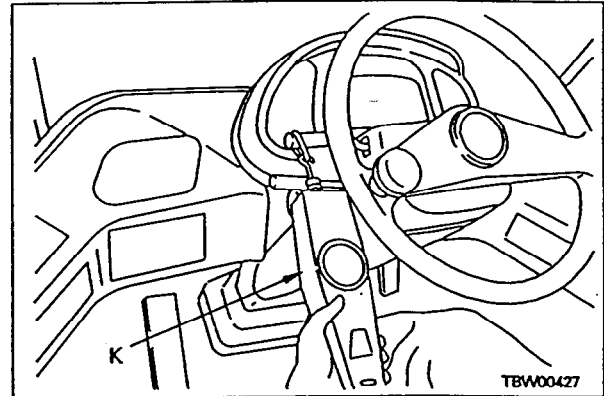


MEASURING OPERATING FORCE & TRAVEL OF DIRECTIONAL & SPEED LEVERS

★ Measurement conditions

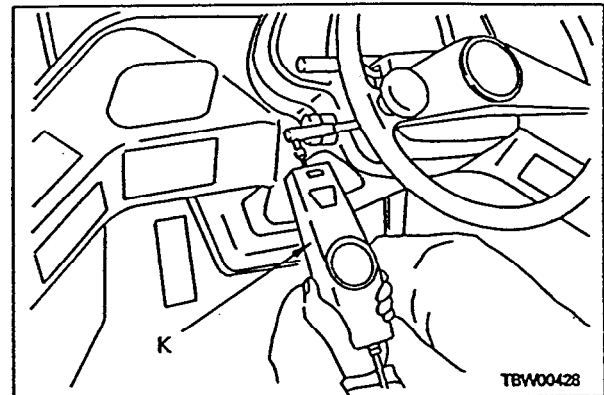
- Engine stopped
- Torque converter oil temperature: 60 – 80°C

⚠ Block the tires securely.



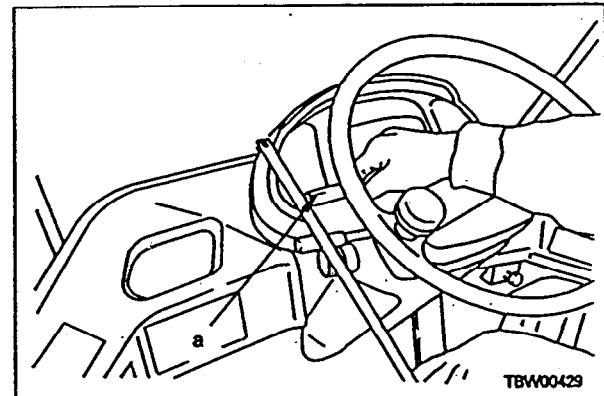
OPERATING FORCE OF SPEED LEVER

1. Stop the engine.
2. Install push-pull scale K 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

1. Stop the engine.
2. Make mark a at the center of the control lever knob, and measure the travel when the lever is operated in the direction of operation.



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

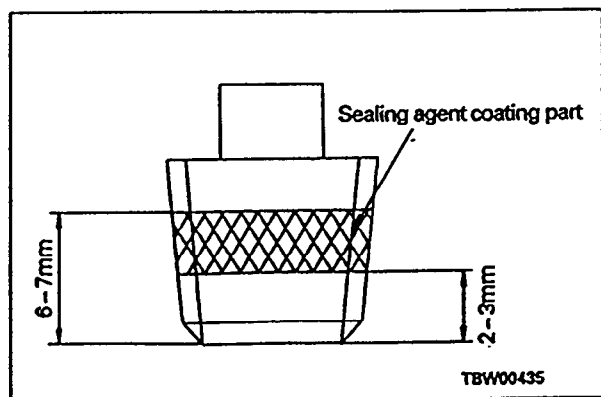
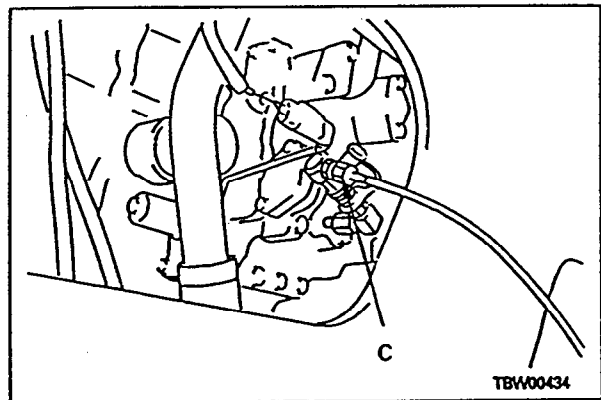
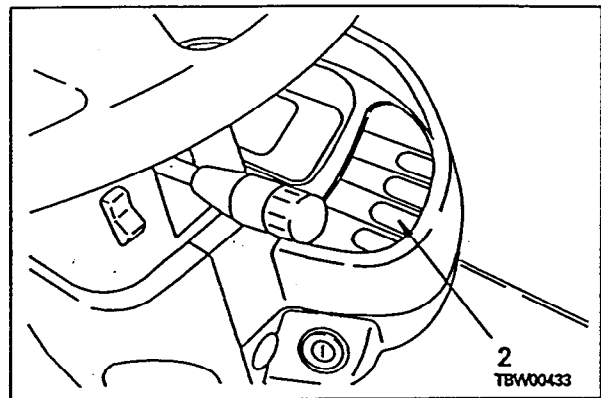
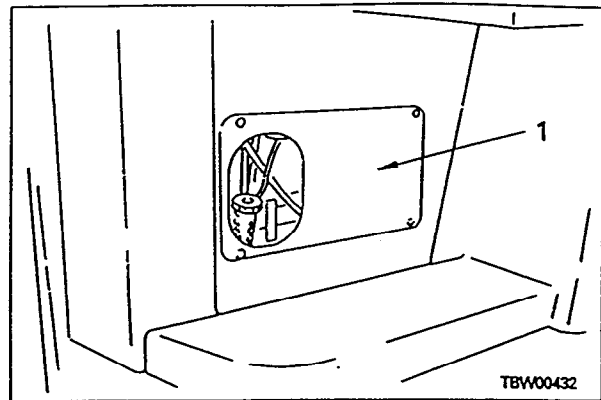
★ The following preparatory work is necessary when measuring all oil pressures.

- 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 C 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.

★ After removing the measurement plug, always coat the plug with adhesive.

🔧 plug: Sealing agent (LG-1)

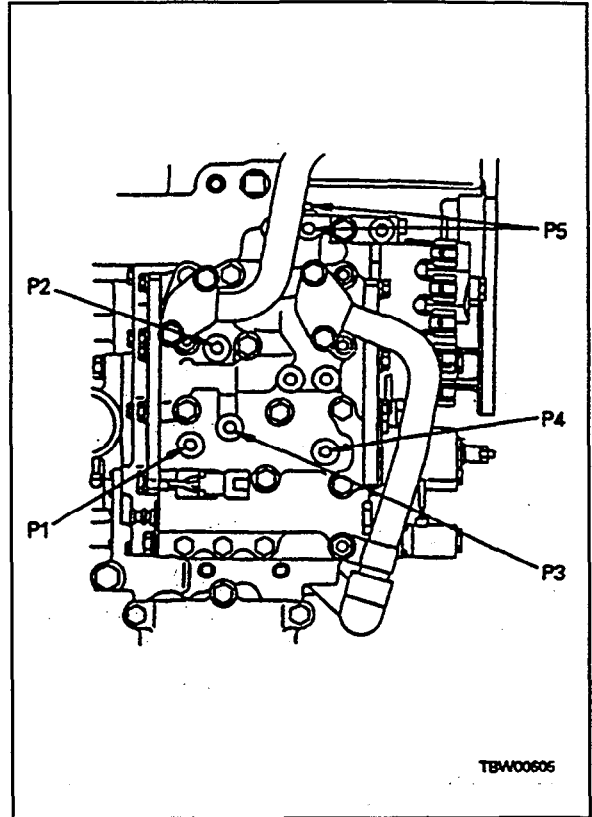


TESTING AND ADJUSTING

MEASURING T/C, TRANS., & PARKING BRAKE OIL PRESSURE

Measuring procedure

1. Priority pressure
 - 1) Measuring port (P1) - PR on valve housing
 - 2) Start the engine and measure the pressure at low and high idle.
2. Torque converter outlet pressure
 - 1) Measuring port (P2) - T/C OUT on valve housing
 - 2) Start the engine and measure the pressure at low and high idle.
3. Pilot pressure
 - 1) Measuring port (P3) - P1 on valve housing
 - 2) Start the engine and measure the pressure.
4. Clutch pressure
 - 1) Measuring port (P4) - PC on valve housing
 - 2) Start the engine, set the forward/reverse lever to neutral and measure the pressure when the gear shift lever is operated.
5. Parking brake release pressure
 - 1) Measuring port (P5) - No marking on valve housing
 - 2) Start the engine and measure the pressure when the parking brake is released.



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.

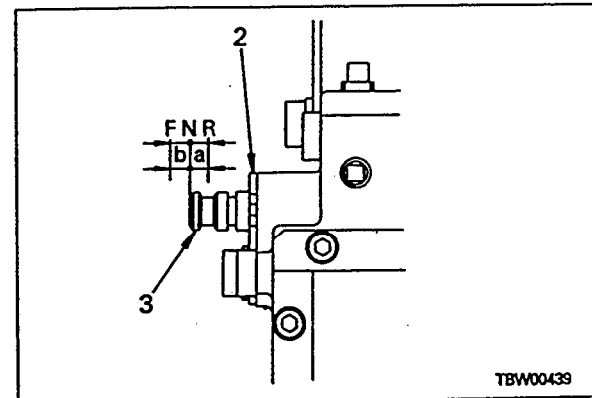
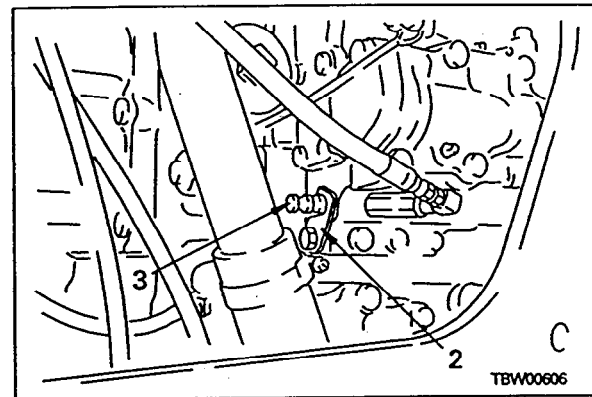
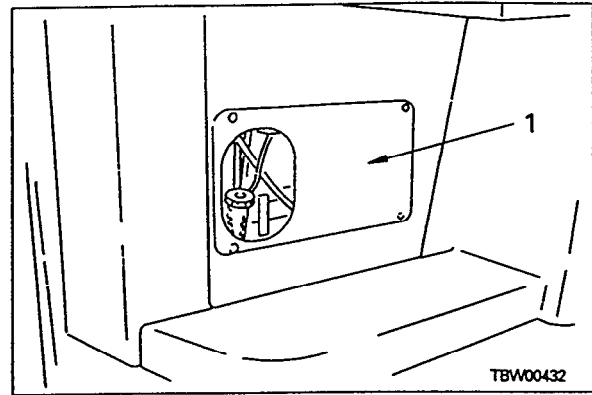
This spool must not be operated except when there has been a failure.

! 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 (2) from emergency manual spool (3) of the transmission valve.
 - ★ The lock plate can be removed simply by loosening the mounting bolts.
3. Operate emergency spool (3) 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.
a = Approx. 8 mm
 - FORWARD: Pull the spool until it enters the detent.
b = Approx. 8 mm



TESTING AND ADJUSTING METHOD OF OPERATING EMERGENCY MANUAL SPOOL

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

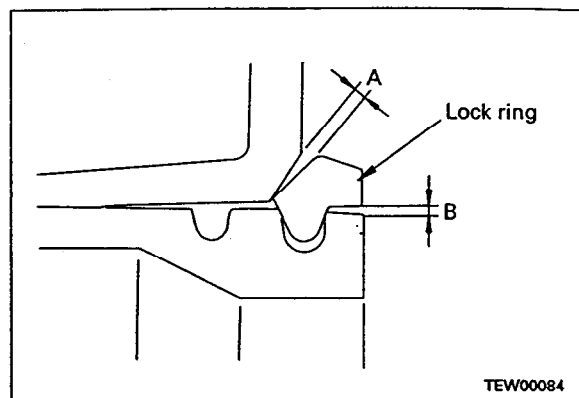
★ Measurement conditions

- Tire inflation pressure: Specified pressure

Method of measuring

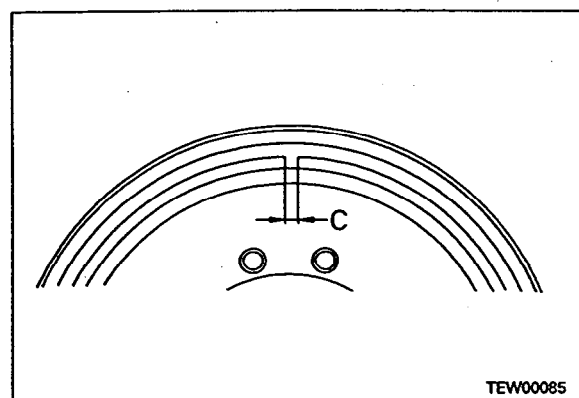
1. Fitting of wheel lock ring

Using feeler gauge, measure dimensions **A** and **B** at four places around the circumference.



2. Clearance of wheel lock ring

Measure dimension **C**.



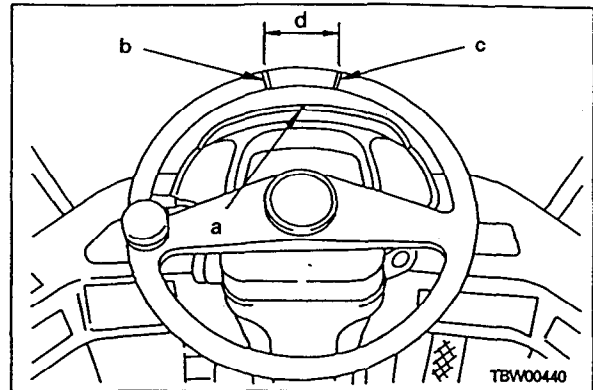
TESTING AND ADJUSTING STEERING WHEEL

Measuring steering wheel play

- ★ Measurement conditions
- Engine: Stopped.
- Vehicle posture: Facing straight

Measuring procedure

1. Turn the steering wheel lightly clockwise and counterclockwise two or three times to check that the steering mechanism is in neutral, then put a mark "a" on the outer frame of the vehicle monitor.
2. Turn the steering wheel lightly clockwise, align the position where it stops with mark "a", and place mark "b" on the steering wheel.
3. Turn the steering wheel lightly counterclockwise, align the position where it stops with mark "a", and place mark "c" on the steering wheel. Measure the straight distance "d" between mark "c" and the position marked in step 2.



TESTING AND ADJUSTING MEASURING OPERATING FORCE OF STEERING WHEEL

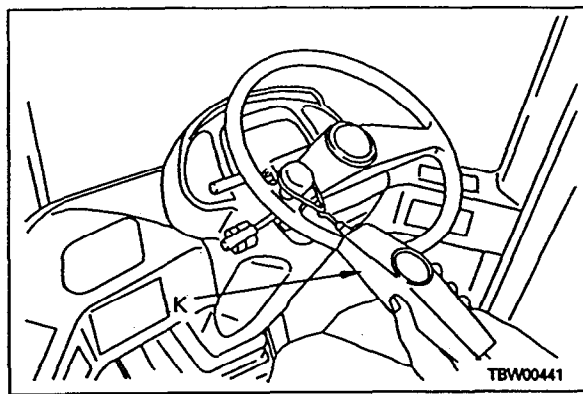
MEASURING OPERATING FORCE OF STEERING WHEEL

★ 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 K 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 K in the tangential direction and measure the value when the steering wheel moves smoothly.
 - ★ Avoid measuring when the steering wheel starts to move.



TESTING AND ADJUSTING

MEASURING OPERATING TIME FOR STEERING WHEEL

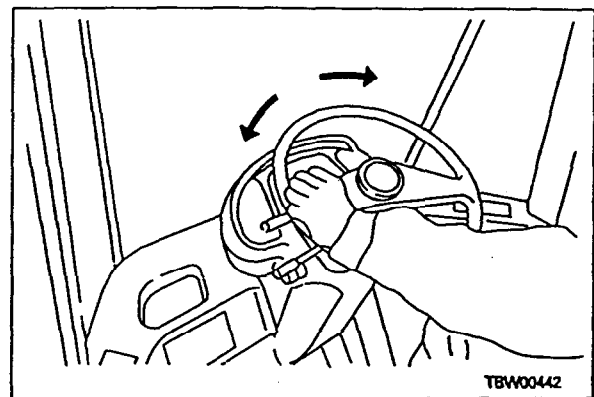
MEASURING OPERATING TIME FOR STEERING WHEEL

★ 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.



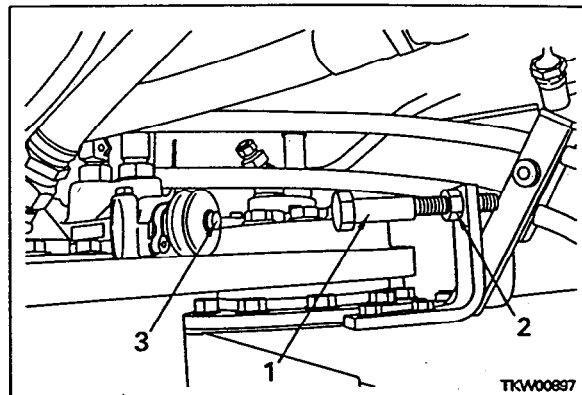
TESTING AND ADJUSTING STEERING CONTROL

★ 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

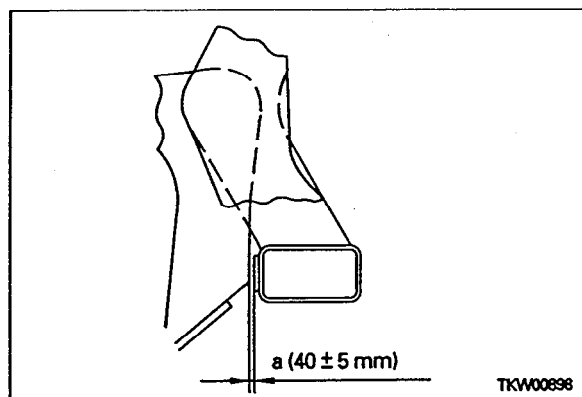
Testing

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.



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.



MEASURING STEERING OIL PRESSURE

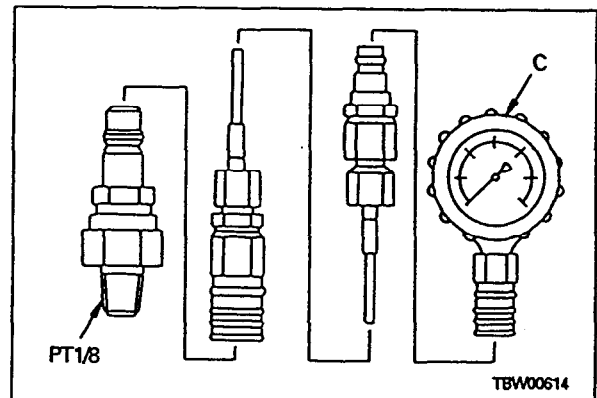
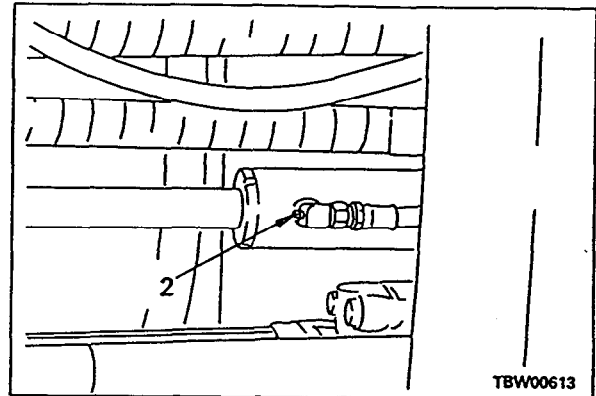
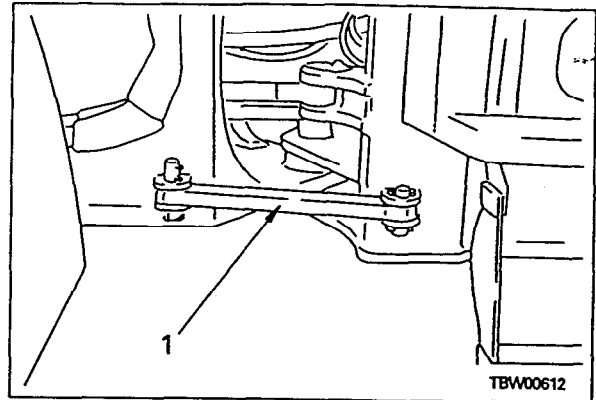
★ Measurement conditions

- 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 C 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.



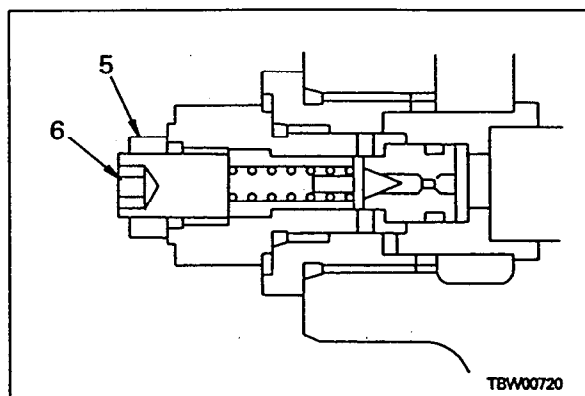
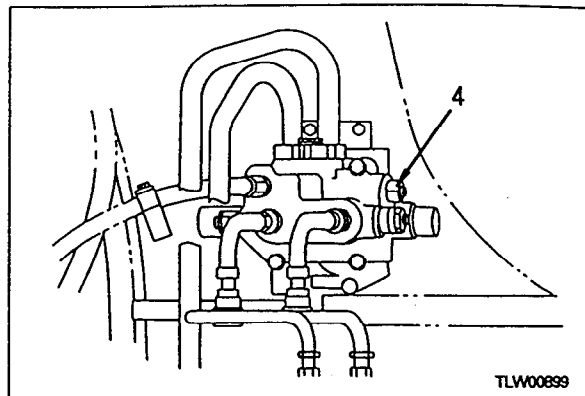
TESTING AND ADJUSTING

MEASURING STEERING OIL PRESSURE

Adjusting

⚠ Always stop the engine before adjusting the pressure.

1. Stop the engine.
2. Loosen lock nut (5) and turn adjustment screw (6) to adjust relief valve (4).
 - ★ 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

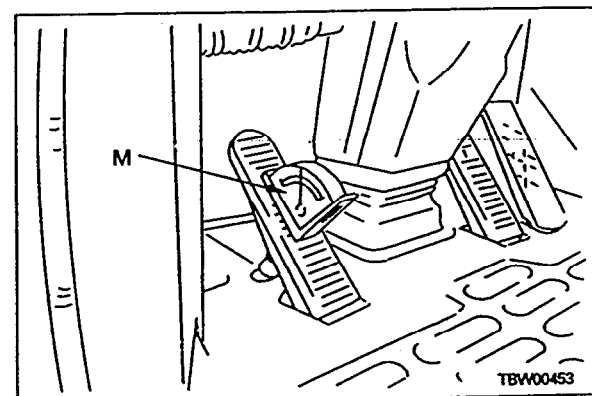
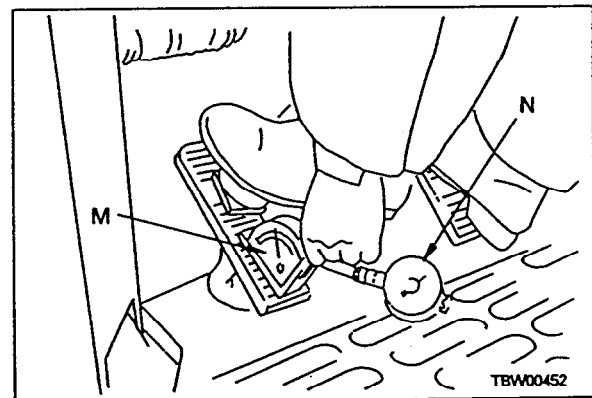
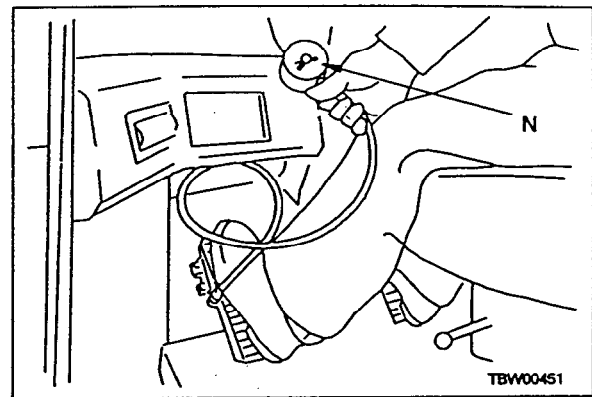
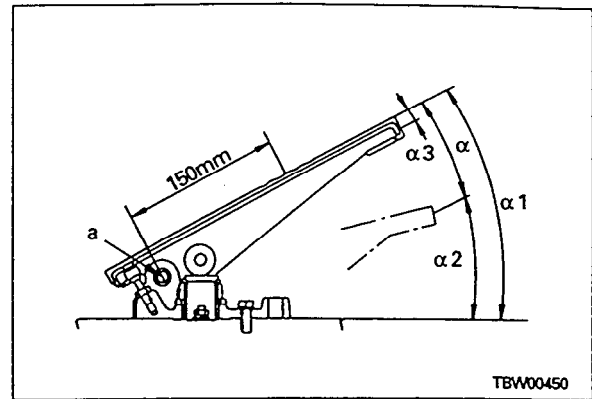
1. Fit push gauge **N** to your foot.
 - ★ Set the push gauge at a position 150 mm from the pedal fulcrum.
2. Start the engine and measure the pedal pushing force at low idle.

Travel of pedal

1. Fit push gauge **N** to your foot.
 - ★ Set the push gauge at a position 150 mm from the pedal fulcrum.
2. Start the engine and measure the pedal pushing angle at low idle with a pedal pushing force of 294N (30 kg).
3. Install angle gauge **M** on the brake pedal and measuring pushing angle α with a pushing force of 294N (30 kg). It is also possible to measure α_1 and α_2 and calculate $\alpha = \alpha_1 - \alpha_2$.

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.



MEASURING BRAKE PERFORMANCE

★ Measurement conditions

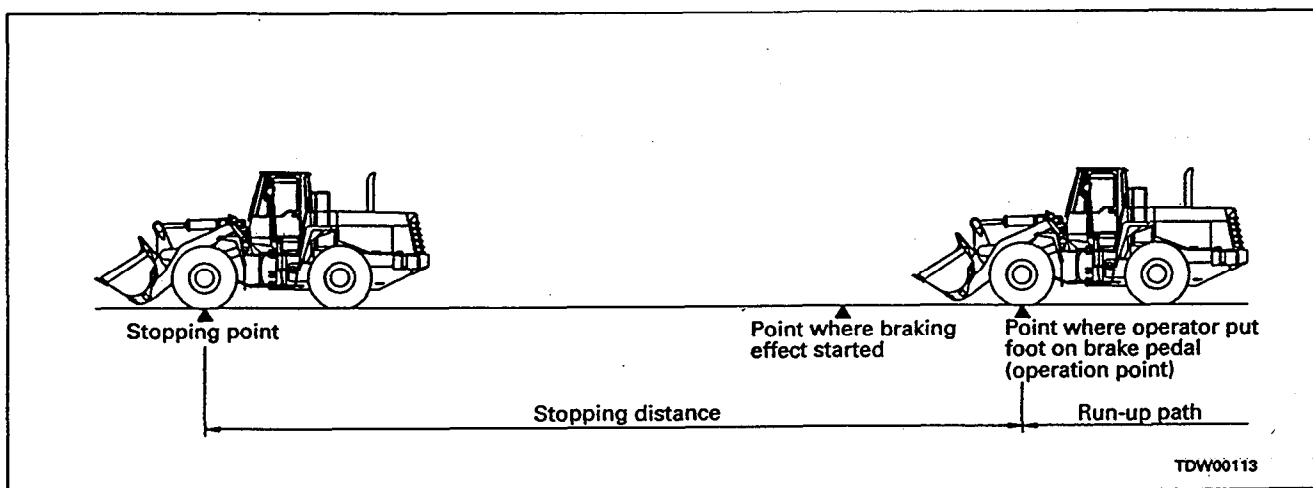
- Road surface: Flat, horizontal, dry paved surface
- Travel speed: 20 km/h when brakes are applied
- Delay in applying brakes: 0.1 sec
- Tire inflation pressure: Specified pressure

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.

Specified operating force: 265N (27 kg)

- ★ 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.



TESTING AND ADJUSTING

TESTING BRAKE OIL PESSURE

TESTING BRAKE OIL PRESSURE

★ Measurement conditions

- Engine water temperature: Within engine water temperature gauge green range
- Testing pressure: 4.9 MPa (50 kg/cm²)

⚠ Apply the parking brake and chocks the tires.

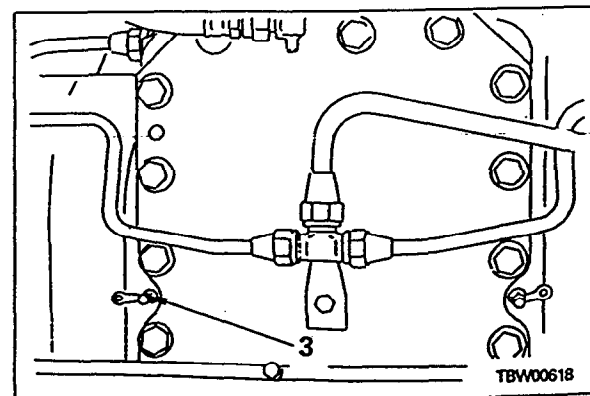
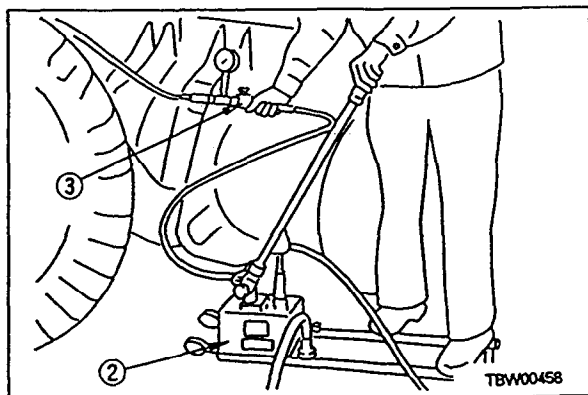
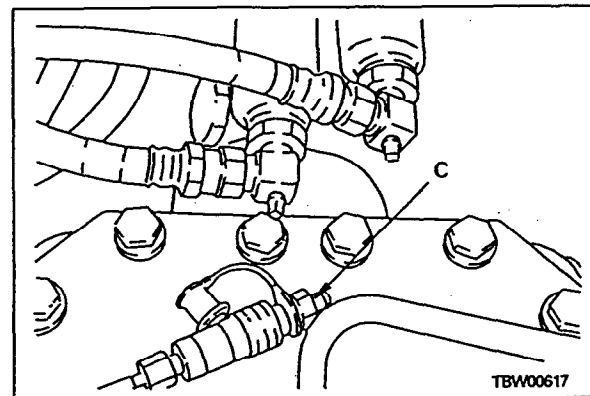
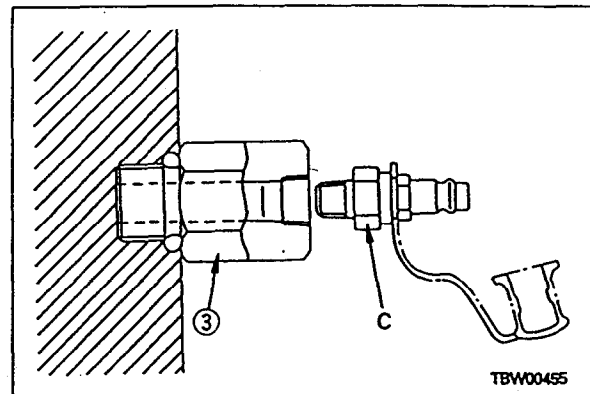
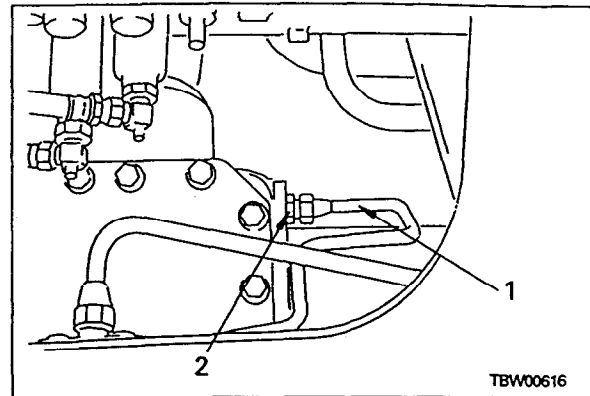
Measuring procedure

1. Stop the engine.
2. Disconnect brake tube (1) on the side to be measured.
3. Disconnect union (2), install joint (3) and attach hydraulic test kit C

★ Use the O-ring installed on the union. (O-ring: 07002-02034)

★ Connect the hydraulic test kit quick coupler.

4. Loosen bleeder screw (3) and bleed the air.
 - ★ Bleed the air by activating pump (2).
5. Tighten bleeder screw (3), activate pump (2), increase the pressure to 4.9 MPa (50 kg/cm²), then tighten stop valve (3).
6. Let sit for five minutes with pressure applied and check the pressure decrease.
 - ★ Do not move the hose while the pressure is being measured, as this will cause pressure fluctuations.
 - ★ After testing, activate pump (2) and lower the pressure of hydraulic test kit C before removing the test kit.
 - ★ When testing is completed, install the brake tube and bleed the air from the brake circuit.



TESTING FOR BRAKE DISC WEAR

★ Measurement conditions

- Engine water temperature: Within engine water temperature gauge green range
- ⚠ Apply the parking brake and chocks the tires.

Measuring

1. Loosen drain plug (1) and drain the axle oil.



Axle oil: 32 ℓ

2. Install measuring plug (2).

3. Lightly press the brake pedal.

- ★ Check that the piston is pressed against the disc.

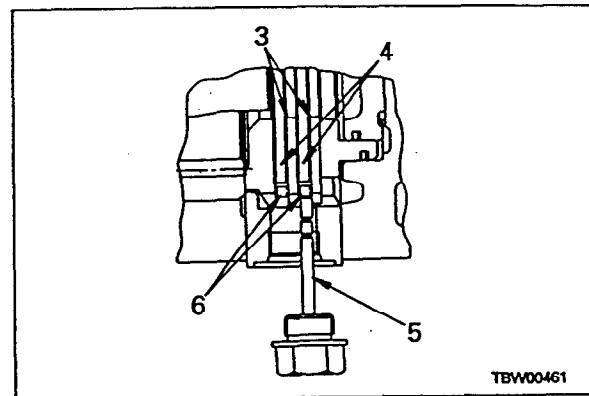
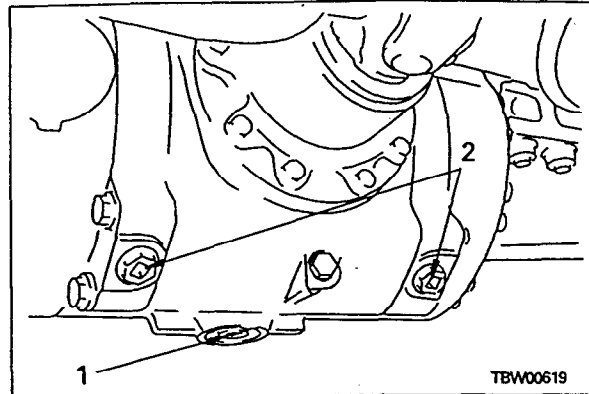
4. Insert gauge plug (5) between the plates (3) and check the wear of disc (4).

- ★ For gauge plug (5), use the oil level plug attached to the axle housing.
- ★ Note that forcing in the gauge plug may damage the springs (6).
- The disc has not reached its usage limit if there is a clearance when the gauge plug is inserted.
- If there is no clearance in the gauge plug or if it cannot be inserted, the disc has reached its usage limits.

5. Fasten the drain plug and supply axle oil to the specified level through the oil supply port.



Axle oil: 32 ℓ



BLEEDING AIR FROM BRAKE SYSTEM

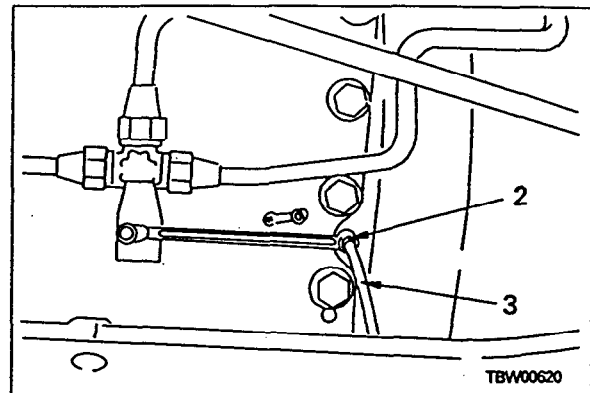
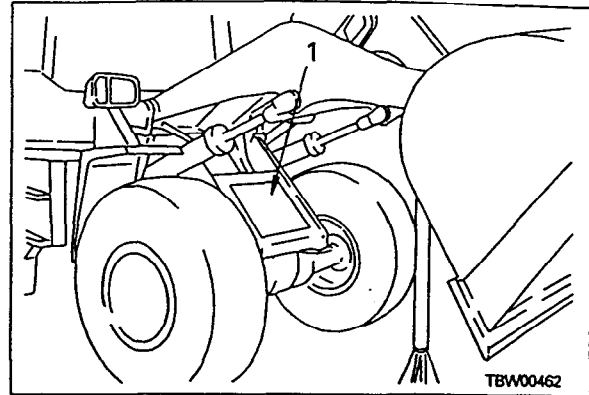
⚠ Apply the parking brake and securely chocks the tires.

⚠ Securely apply the boom drop prevention prop.

- Remove the front frame front cover (1).

1. Bleeding air from front axle brake circuit

- 1) Once pressure has accumulated in the accumulator, stop the engine, insert vinyl hose (3) into the front axle bleeder screw (2) and place the other end in a container.
- 2) Press the brake pedal, loosen the bleeder screw and bleed the air. Slowly release the brake pedal after tightening the bleeder screw.
- 3) Repeat this operation until there are no air bubbles in the fluid coming from the vinyl hose, then press the pedal in fully and tighten the bleeder screw while oil is flowing out.
- 4) Use the same procedure to bleed the air from the other side.
 - ★ If the accumulator pressure drops, start the engine to increase it.



2. Bleeding air from rear axle brake circuit

Bleed the air from rear axle brake circuit in the same way as for the front.

- ★ When air bleeding is completed, set the engine to low idle, check the hydraulic oil level, and add oil if necessary.

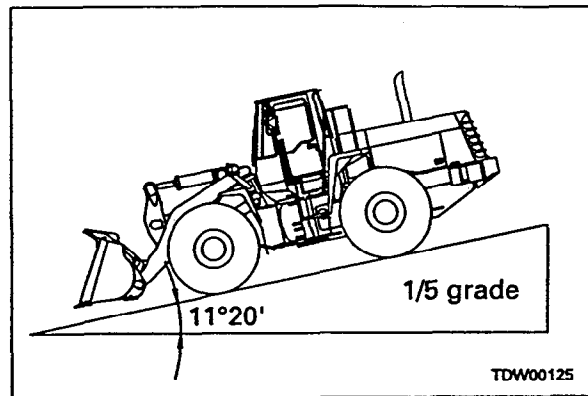
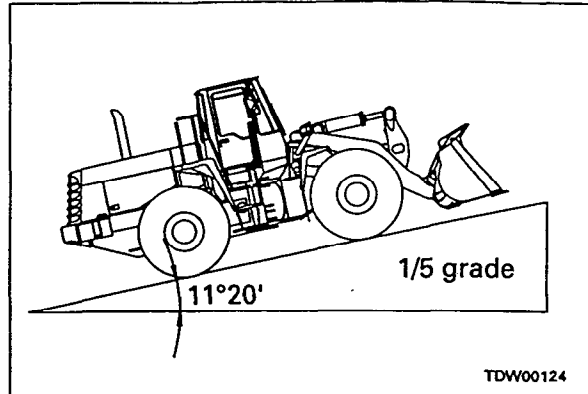
MEASURING PARKING BRAKE PERFORMANCE

★ 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

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

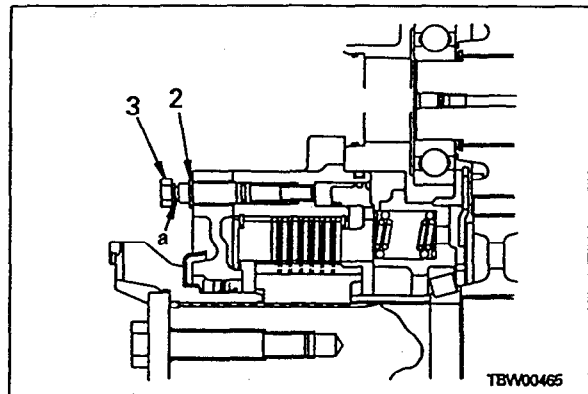
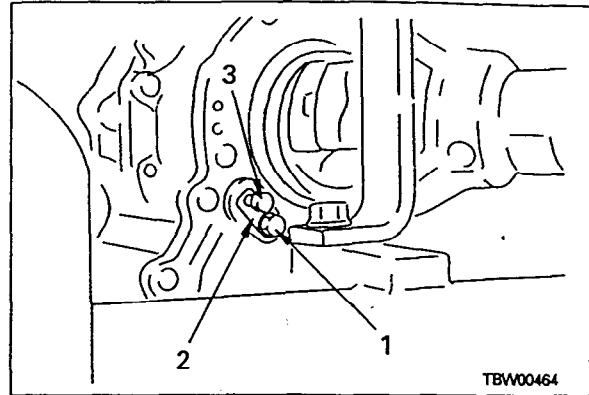
★ The parking brake is controlled by hydraulic pressure, so if there should be any failure in the solenoid valve and it becomes impossible to release the parking brake, it is possible to release it manually to move the machine.

⚠ 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 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.

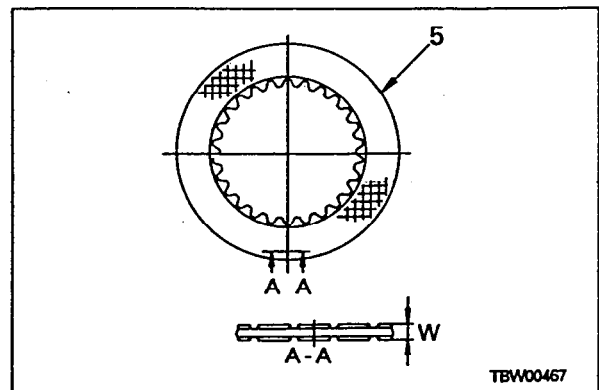
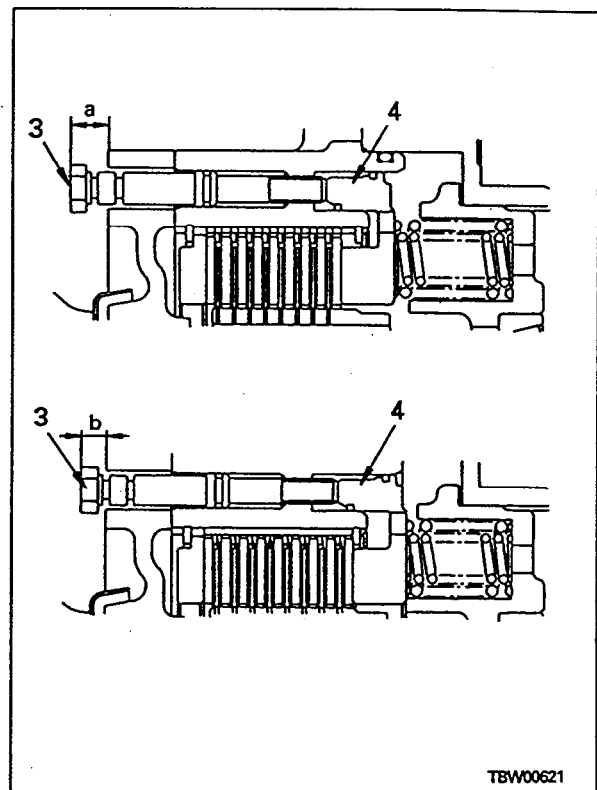
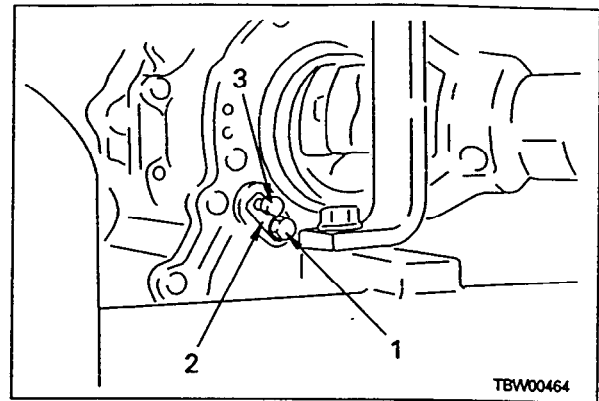
⚠ To prevent the machine from moving, lower the bucket to the ground and put blocks under the tires.

⚠ 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).
3. Tighten the three manual release bolts (3) in turn and measure dimension "b" when brake piston (4) is pushed in fully.
 - ★ Piston stroke (L) = a - b
 - L = Max. 7.4

★ If the piston stroke is greater than 7.4 mm, check thickness W of brake disc (5). 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

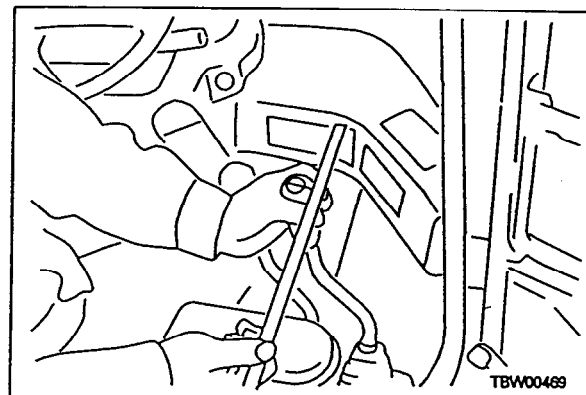
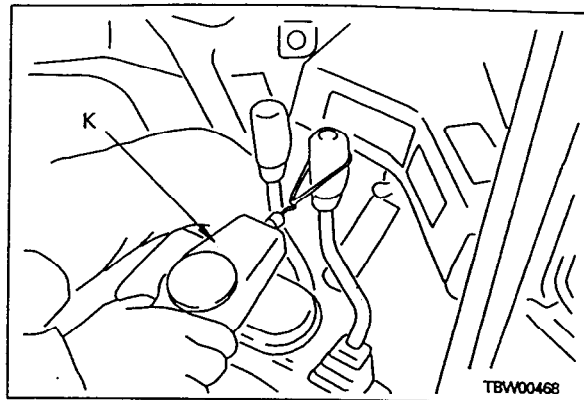
Install push-pull scale K to the work equipment control lever and measure the operating force.

- ★ 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 at each position when operating the work equipment control lever.

- ★ Mark the lever knob and use scale to measure.

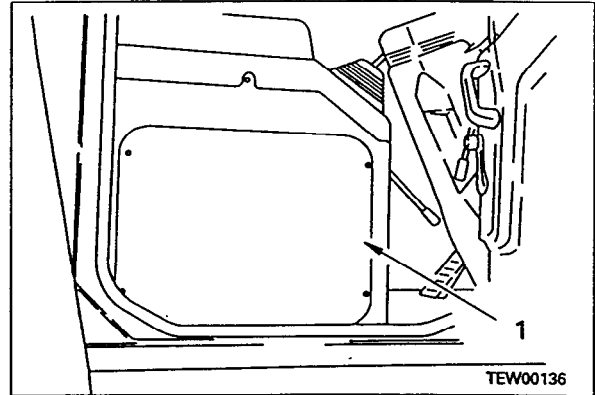


TESTING AND ADJUSTING

MEASURING WORK EQUIPMENT CONTROL LEVER

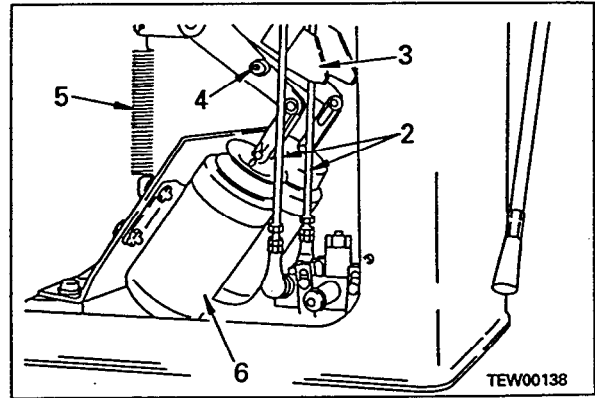
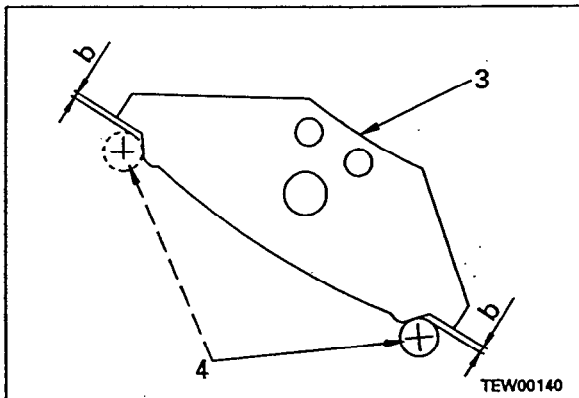
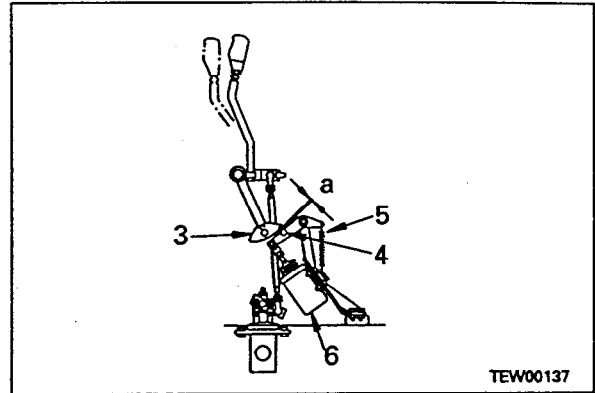
Adjusting

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 boom lever at the HOLD position.
 - ★ If cam (3), roller (4), or spring (5) are broken, replace them before adjusting.



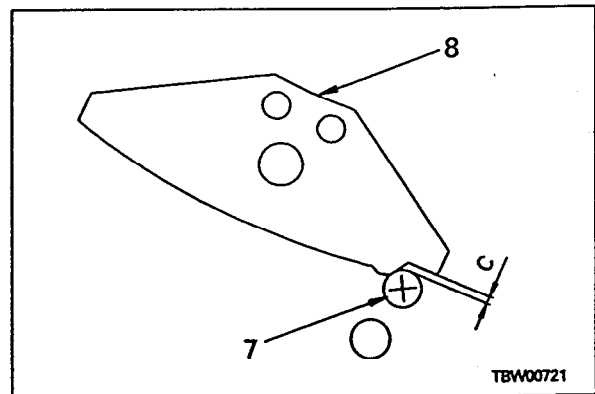
3. Boom lever

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 (7) is dimension C at the notch at both ends of cam (8).
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

Work equipment relief valve pressure measuring procedure

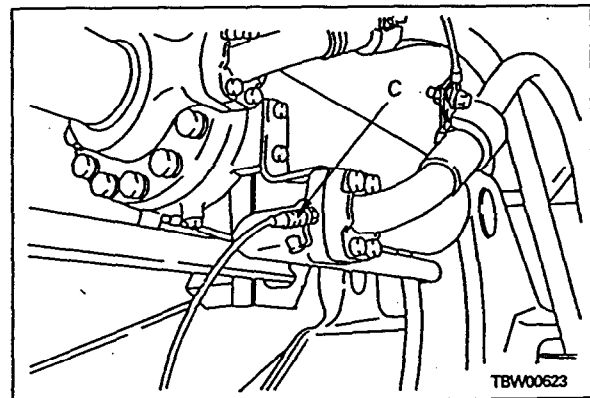
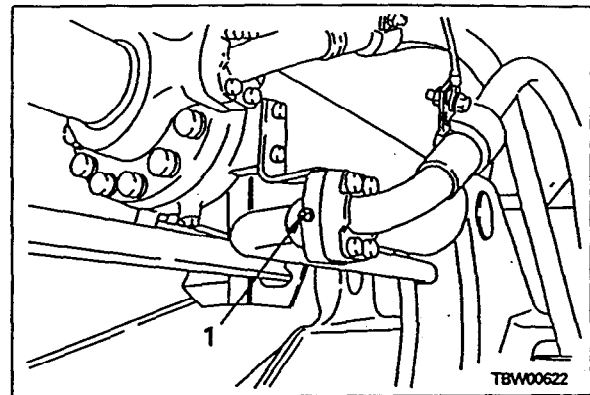
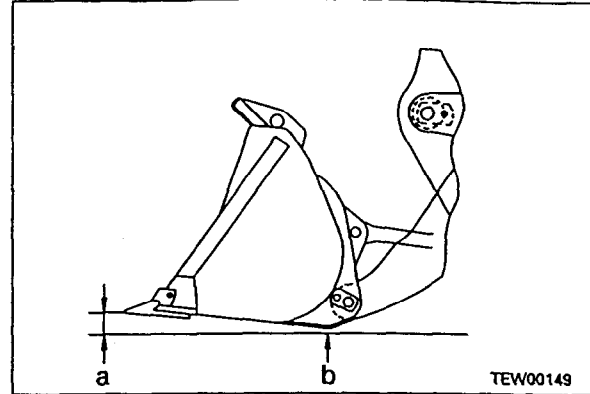
- ★ Raise bucket tip "a" 30 to 50 mm and ground the bucket at point "b", then stop the engine.
- ★ After operating the levers, check that both points "a" and "b" on the bottom of the bucket are touching the ground.

⚠ Loosen the oil supply cap to release the pressure inside the hydraulic oil tank, then operate the control levers two or three times to release any pressure remaining in the piping.

1. Remove bucket cylinder circuit oil pressure measuring plug (1).
2. Install hydraulic test kit C to the measuring port.
 - ★ Check that there is no oil leakage from any joints.
 - ★ Use a hose which is long enough to reach the operator's seat.
3. Start the engine, raise the boom about 400 mm, tilt back the bucket using the control lever, and measure the pressure when the relief valve is activated.

- ★ Be careful not to apply any sudden pressure to the pressure gauge.

⚠ When removing the hydraulic pressure gauge, release the pressure inside the circuit in the same way as when it was installed.



Adjusting work equipment relief valve pressure

⚠ Be sure to stop the engine when adjusting the pressure.

1. Raise the boom, set the boom prop, and remove front frame inspection cover (1).

⚠ Set the prop securely.

2. Remove the relief valve cap nut (2).

3. Loosen lock nut (3), and turn adjust screw (4) to adjust.

★ Pressure adjustment for one turn of adjustment screw:

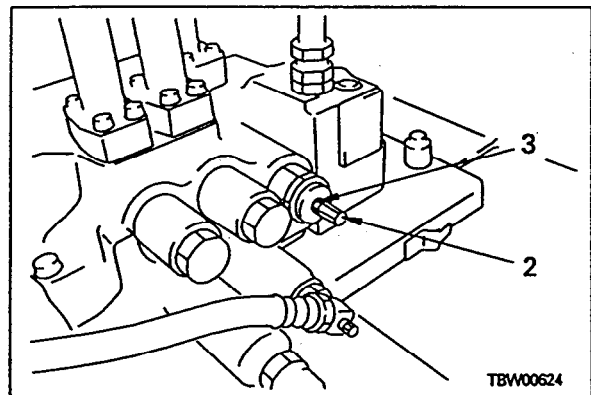
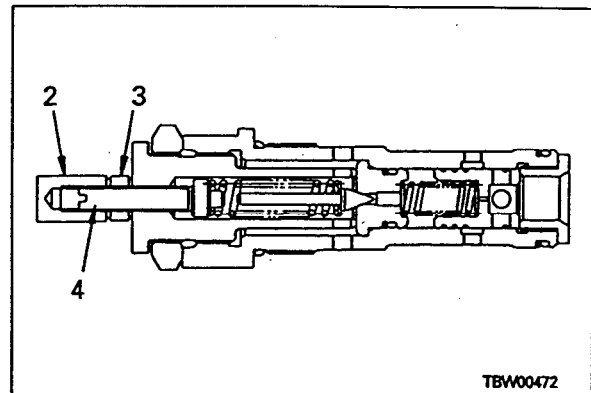
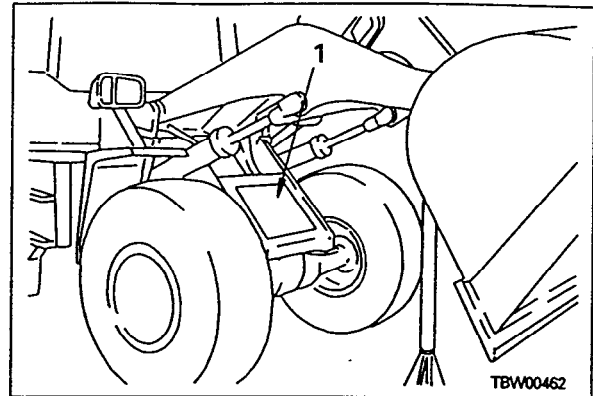
Approx. 3.5 MPa (35.7 kg/cm²)

★ 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 PPC VALVE PRESSURE

★ Measurement conditions

- Engine water temperature: Within engine water temperature gauge green range
- Hydraulic oil temperature : 45 to 55°C
- Engine speed : High idle

⚠ Apply the parking brake and blocks the tires.

Measuring

1. Raise boom (1), set boom prop (2), set the bucket to an angle of approximately 45° (not to the maximum dump position) and remove front cover (3).

⚠ Set the prop securely.

2. Stop the engine, loosen the oil supply cap, release the pressure inside the hydraulic oil tank, then stroke the bucket control lever between the tilt and neutral positions at least 40 times to completely release the accumulator pressure.

★ Be sure to stop the engine before operating the lever.

★ After the accumulator pressure is completely released, set the bucket lever to the dump position and check that the bucket does not dump.

3. Remove the work equipment dump cylinder circuit pressure measurement plug (4).

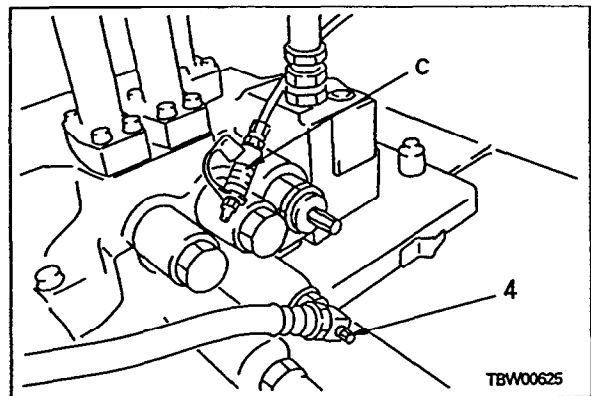
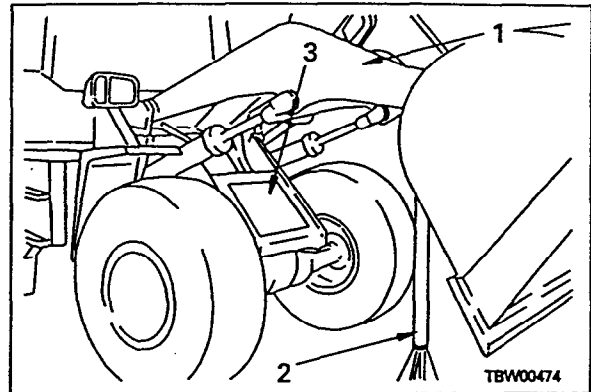
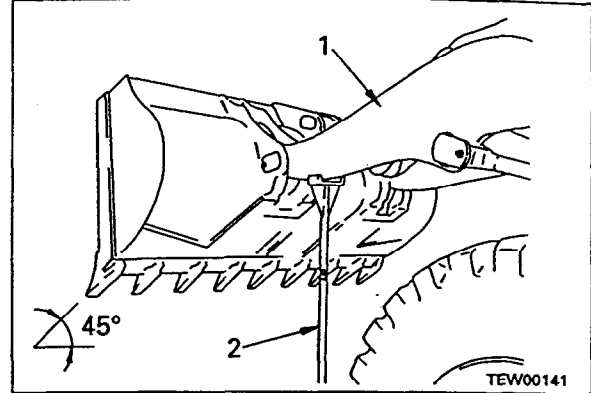
4. Install hydraulic test kit C to the measuring port.

- Connect the hose after installing the hydraulic test kit 90° elbow to the measuring port.
- Check that there is no oil leakage from any joints.
- Use a hose which is long enough to reach the operator's seat.

5. Start the engine, raise the boom about 400 mm, tilt back the bucket using the control lever, and measure the pressure when the relief valve is activated.

- Be careful not to apply any sudden pressure to the pressure gauge.

⚠ When removing the hydraulic pressure gauge, release the pressure inside the circuit in the same way as when it was installed.



TESTING AND ADJUSTING

MEASURING PPC VALVE PRESSURE

Adjusting

⚠ Always stop the engine when adjusting the oil pressure.

★ The PPC relief valve is installed on the left front of the rear frame.

1. Loosen locknut (2), then turn adjustment screw (3) to adjust.

★ Pressure adjustment for one turn of adjustment screw:

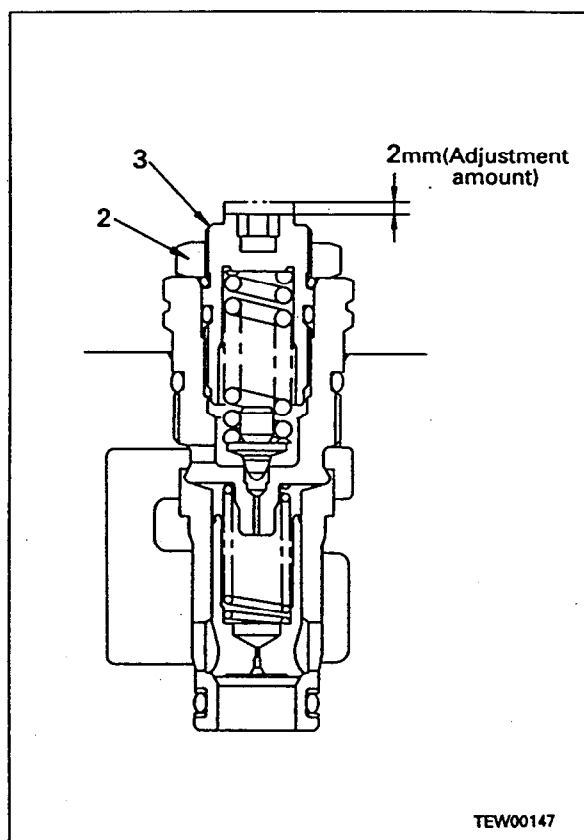
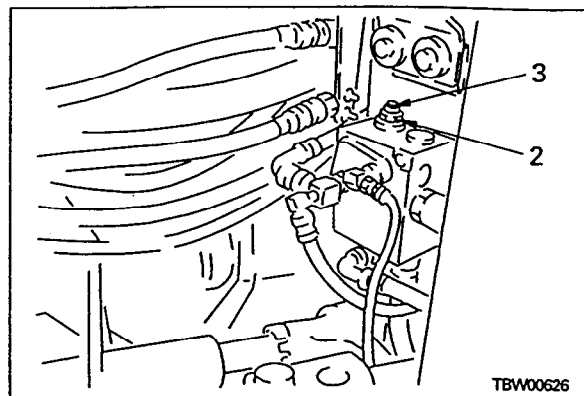
Approx. 1.79 MPa (18.3 kg/cm²)

★ 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.



MEASURING WORK EQUIPMENT

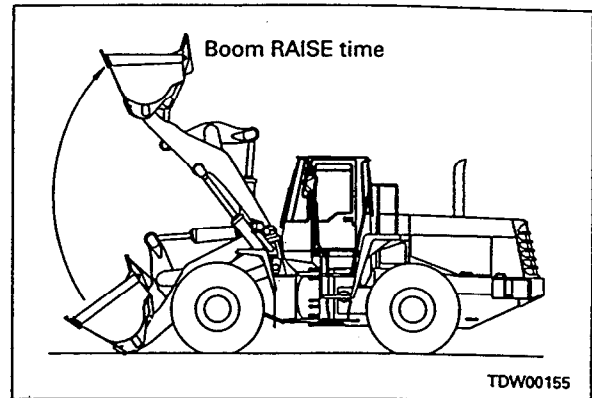
★ Measurement conditions

- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Engine speed: High idling
- Steering position: Neutral
- No load

Measurement method

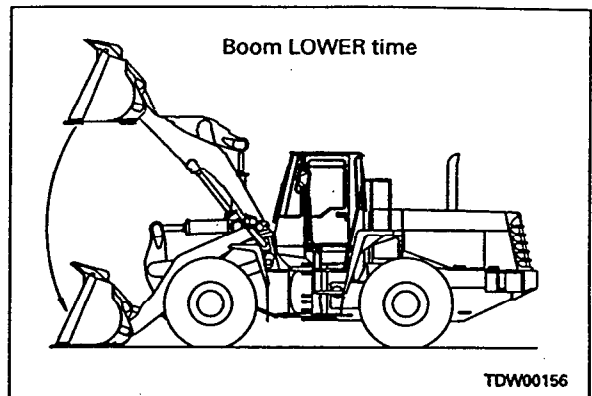
1. Boom RAISE time

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.



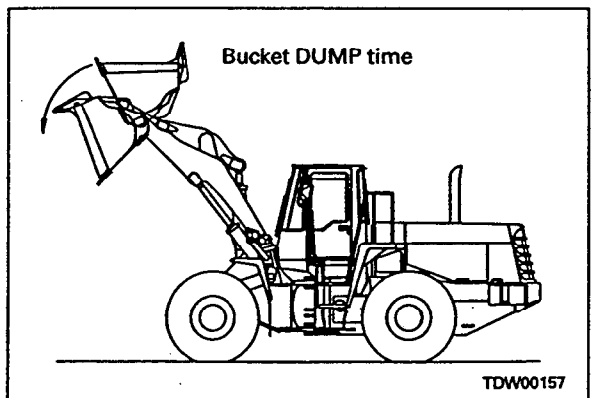
2. Boom LOWER time

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.



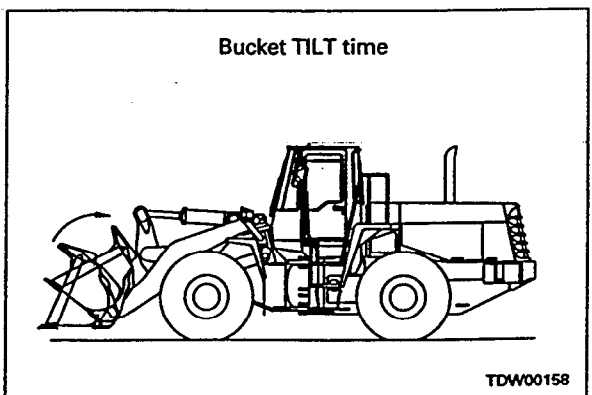
3. Bucket DUMP time

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**

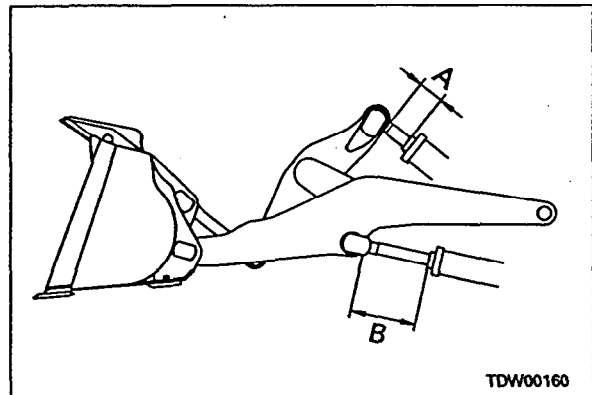
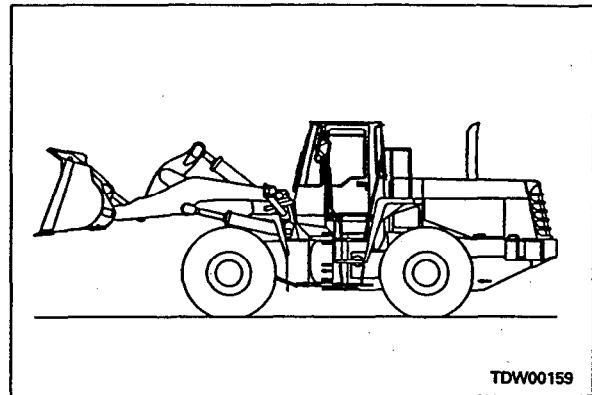
- Engine water temperature: Within green range on engine water temperature gauge
- Hydraulic oil temperature: 45 – 55°C
- Stop the engine, leave for 5 minutes, then measure for 15 minutes.
- Boom: Horizontal
- Bucket: Horizontal
- No load

⚠ 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.



A: Retraction amount of bucket cylinder rod
B: Retraction amount of boom cylinder rod

TESTING AND ADJUSTING BUCKET POSITIONER

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 (4) 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

kgm Switch mounting nut: $17.7 \pm 2 \text{ Nm}$
($1.8 \pm 0.2 \text{ kgm}$)

3. Using shims, adjust the switch protector so that the clearance b between the switch (1) sensing surface and angle (2) is the standard value, then secure the switch in that position.

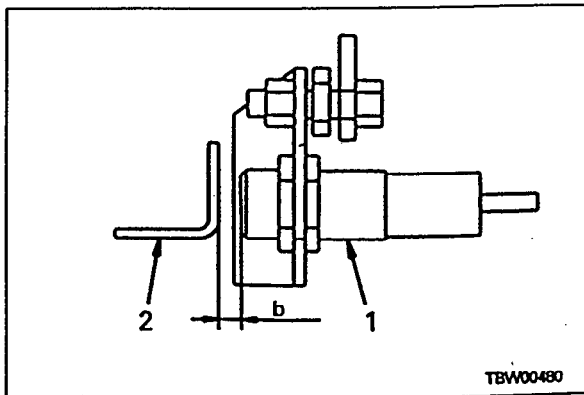
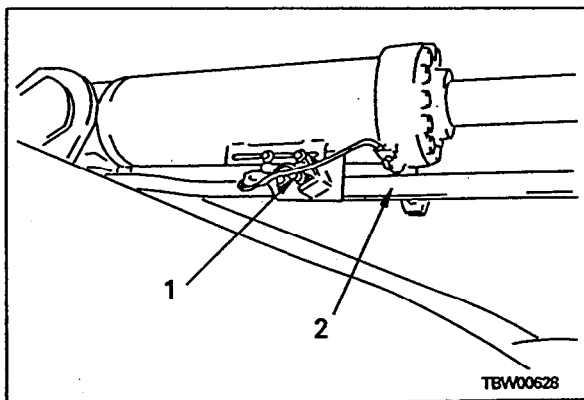
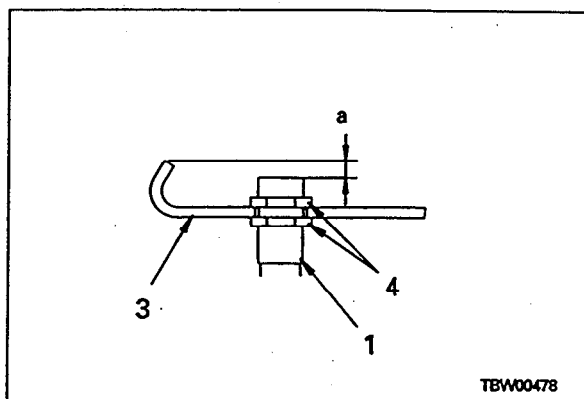
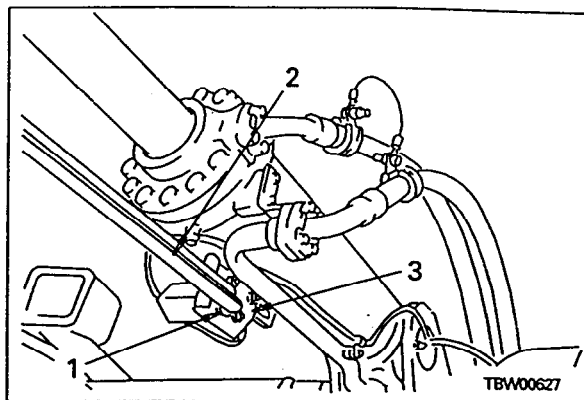
★ Check that the switch sensing surface and the angle are not in contact.

★ Adjust with shims so that the clearance between the switch sensing surface and the angle is the standard value at the full stroke of the angle, then lock in position.

★ After adjusting, operate the bucket lever and check that the bucket positioner is actuated at the desired position.

★ Check that the switch sensing surface and angle do not slip from the center, then lock them in position.

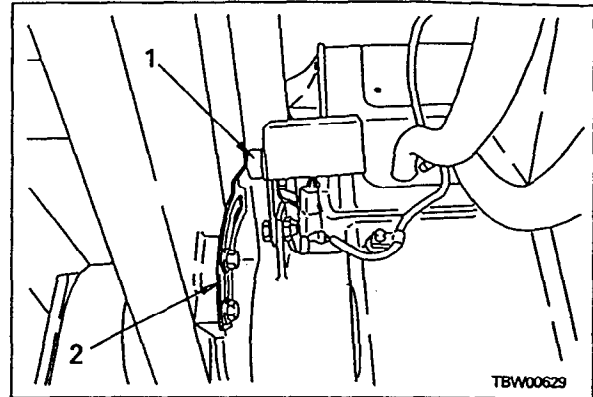
★ Clearance b: 3 – 7 mm



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

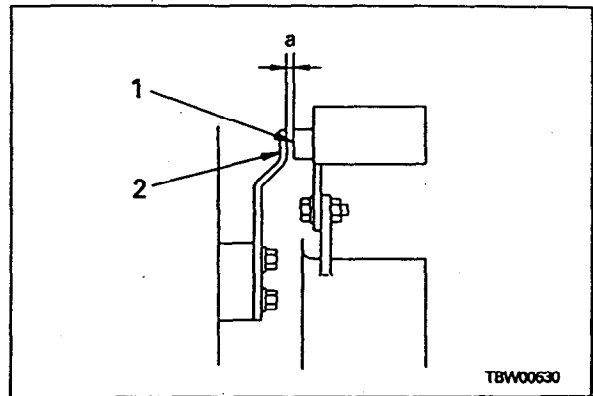
1. Raise the boom to the desired position and mark it at the position where the center of the switch is at the lower end of the plate.

⚠ Be sure to apply the safety lock to the control lever.

2. Lower the boom and stop the engine.
3. Adjust the plate position so that the center of switch (1) is aligned with the lower end of plate (2) as marked, then lock in position.

 Switch installation bolt:
 $17.7 \pm 2.0 \text{ Nm}$ ($1.8 \pm 0.2 \text{ kgm}$)

4. Adjust the switch so that the clearance **a** between the switch (1) sensing surface and plate (2) is the standard value, then secure the switch in that position.
 - ★ Clearance **a**: 3 to 7 mm
 - ★ After adjusting, operate the boom lever and check that the kick-out is actuated at the desired position.

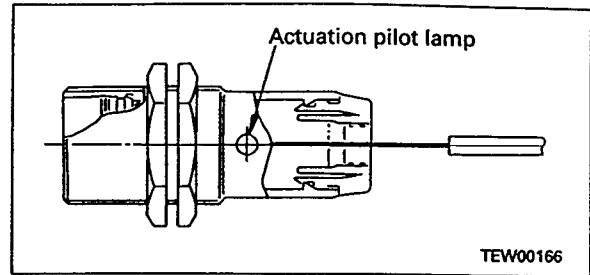


TESTING AND ADJUSTING

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		
Boom kick-out (machines equipped with MDC monitor)		

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

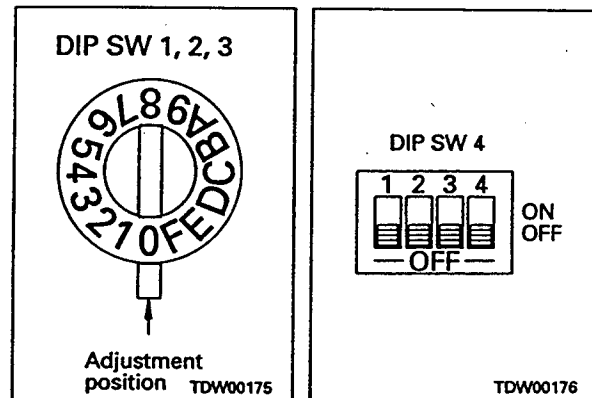
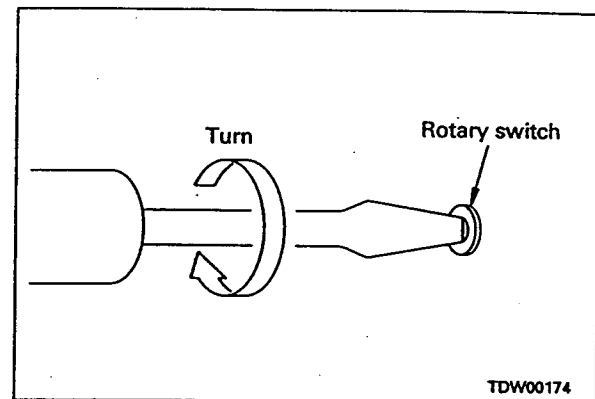
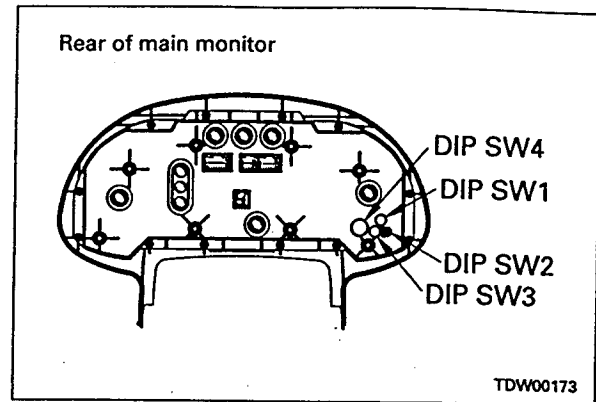
- Turn off the power, then remove the main monitor and adjust the switches at the back of the speedometer.
- Setting machine model**
 - Remove the rubber caps from dipswitches (1), (2), (3), and (4) at the back of the speedometer.
 - When the rubber cap is removed, a rotary switch can be seen inside. 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 (speedometer correction)	Switch 3 (tachometer input selection)
20.5x25-16 PR(L-3)	2	C	0
23.5x25-16 PR(L-3)	2	7	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.



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

TROUBLESHOOTING

Points to remember when troubleshooting	20-102
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Troubleshooting of main monitor system (M mode)	20-251
Troubleshooting of maintenance monitor system (K mode)	20-301
Troubleshooting of electrical system (E mode)	20-351
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Troubleshooting of Eagle Air Conditioner	20-701

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.

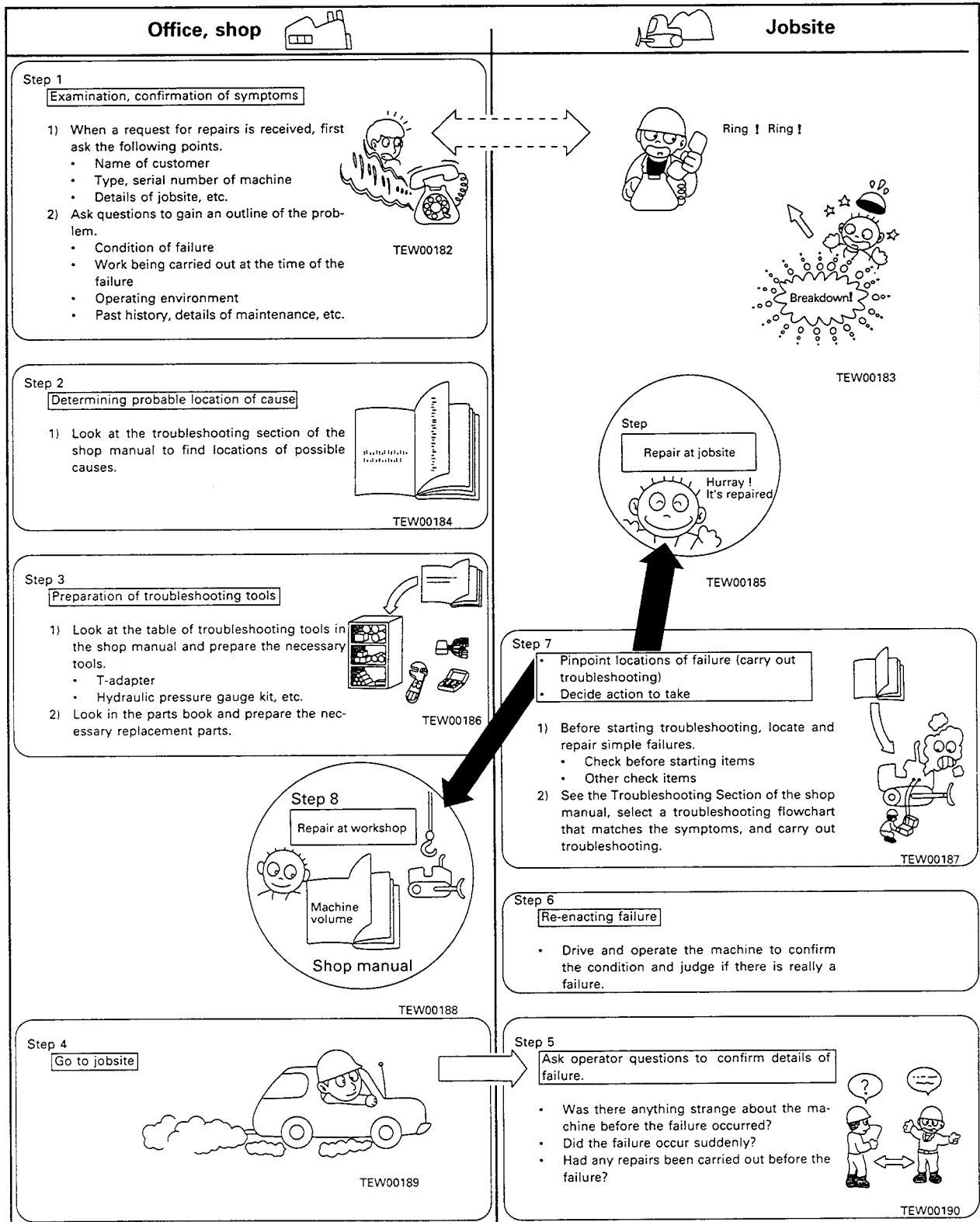
When carrying out troubleshooting, an important point is of course to understand the structure and function. However, a short cut to effective troubleshooting is to ask the operator various questions to form some idea of possible causes of the failure that would produce the reported symptoms.

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.

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SEQUENCE OF EVENTS IN TROUBLESHOOTING



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PRECAUTIONS WHEN CARRYING OUT MAINTENANCE

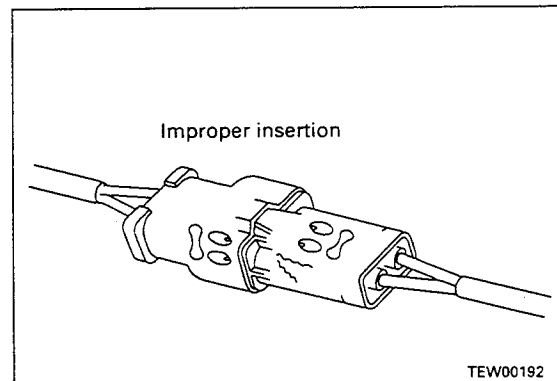
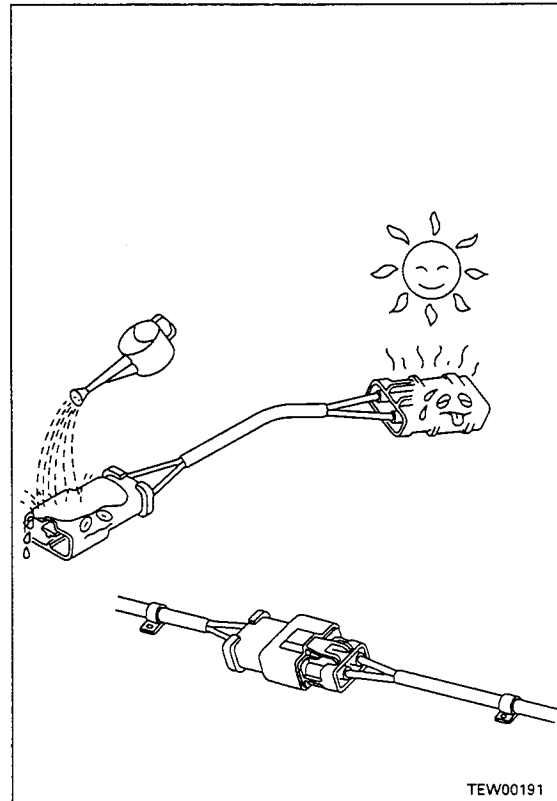
To maintain the performance of the machine over a long period, and to prevent failures or other troubles before they occur, correct operation, maintenance and inspection, troubleshooting, and repairs must be carried out. This section deals particularly with correct repair procedures for mechatronics 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

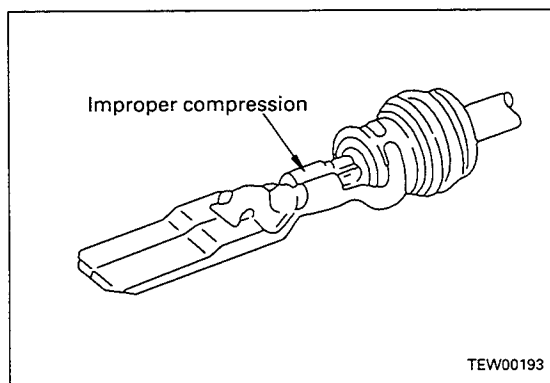
- (1) Defective contact of connectors (defective contact between male and female)
Problems with defective contact are likely to occur because the male connector is not properly inserted into the female connector, or because one or both of the connectors is deformed or the position is not correctly aligned, or because there is corrosion or oxidization of the contact surfaces.



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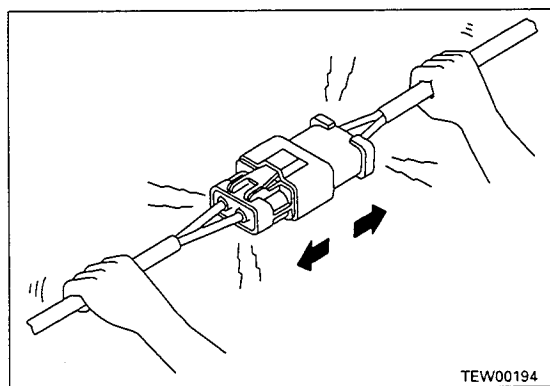
- (2) Defective compression or soldering of connectors

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

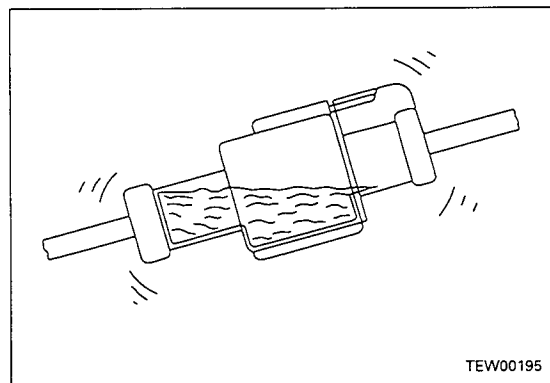
If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the compression of the connector may be lost, or the soldering may be damaged, or the wiring may be broken.



- (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.

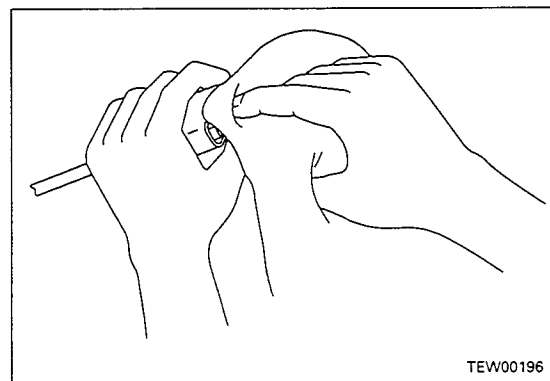


- (5) Oil or dirt stuck to connector

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.



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.

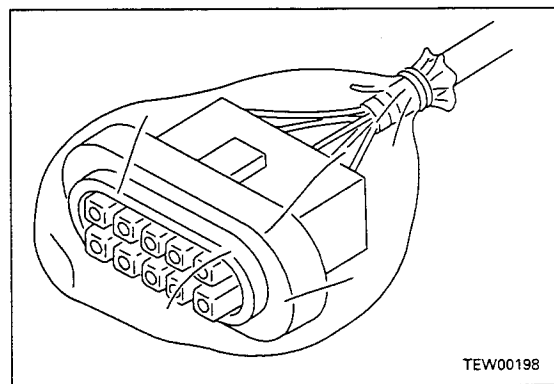
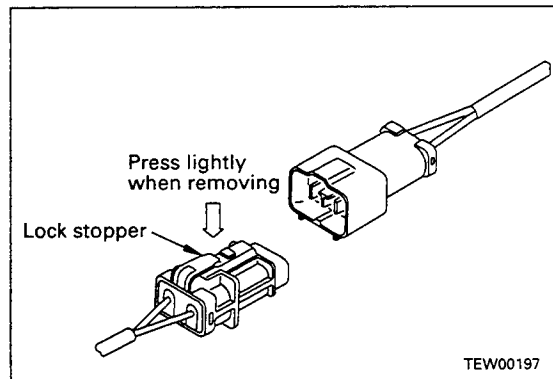
For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.

- (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.

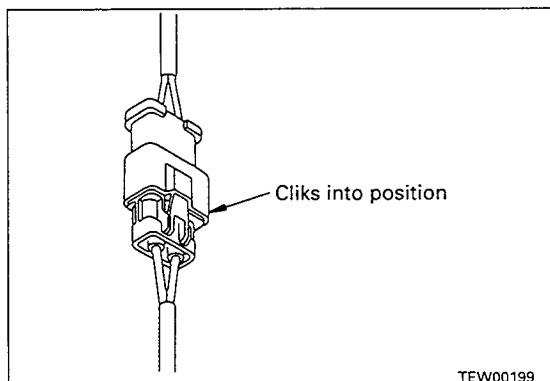
Connecting connectors

- (1) Check the connector visually.
- Check that there is no oil, dirt, or water stuck to the connector pins (mating portion).
 - Check that there is no deformation, defective contact, corrosion, or damage to the connector pins.
 - 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.



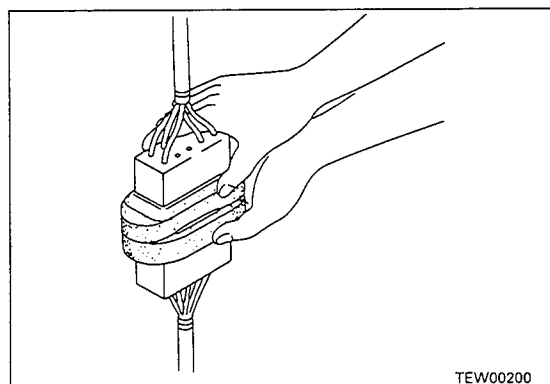
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- (2) Fix the connector securely.
Align the position of the connector correctly, then insert it securely.
For connectors with lock stopper
Push in the connector until the stopper clicks into position.



- (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.

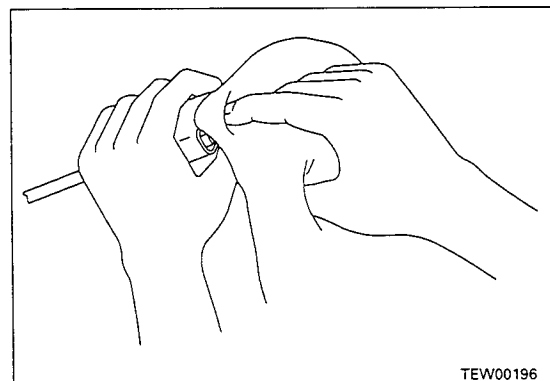
- ★ When blowing with dry air, there is danger that the oil in the air may cause improper contact, so clean with air from which all the water and oil has been removed.



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.

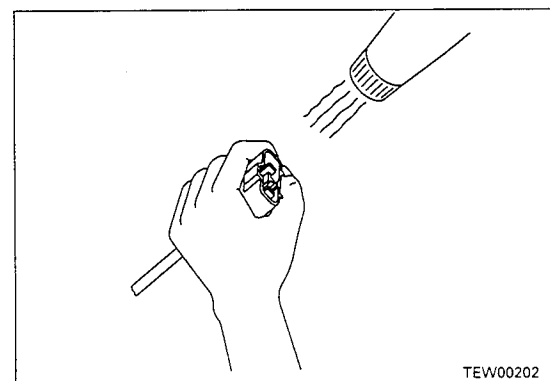
- (1) Disconnect the connector and wipe off the water with a dry cloth.
- ★ If the connector is blown dry with air, there is the risk that oil in the air may cause defective contact, so avoid blowing with air.



- (2) Dry the inside of the connector with a dryer.

If water gets inside the connector, use a dryer to dry the connector.

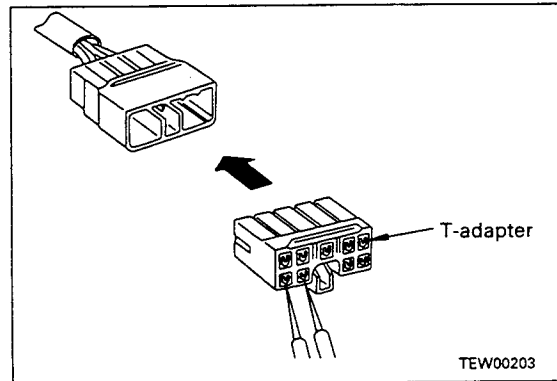
- ★ Hot air from the dryer can be used, but be careful not to make the connector or related parts too hot, as this will cause deformation or damage to the connector.



- (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.



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.

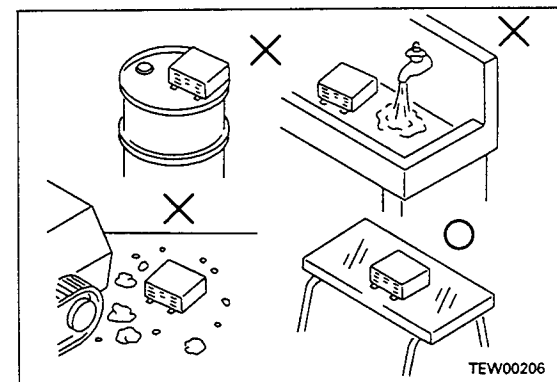
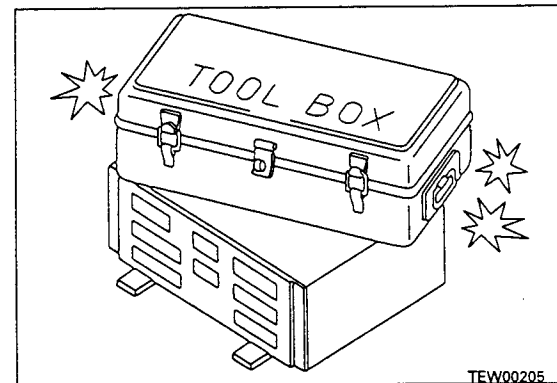
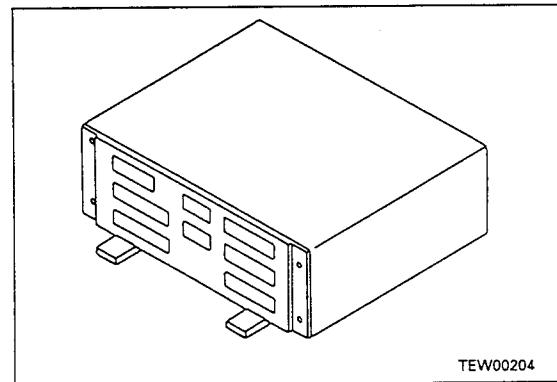
- (4) Cover the control connectors with tape or a vinyl bag.

- (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.



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2. POINTS TO REMEMBER WHEN HANDLING HYDRAULIC EQUIPMENT

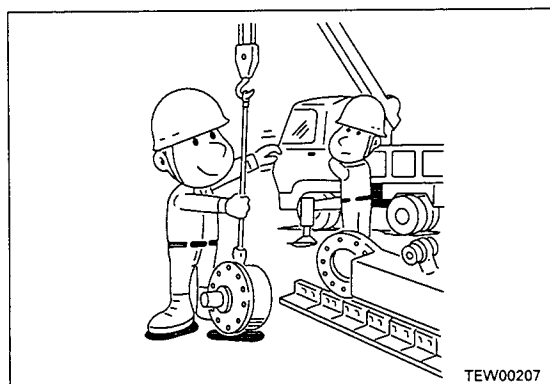
With the increase in pressure and precision of hydraulic equipment, the most common cause of failure is dirt (foreign material) in the hydraulic circuit. When adding hydraulic oil, or when disassembling or assembling hydraulic equipment, it is necessary to be particularly careful.

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

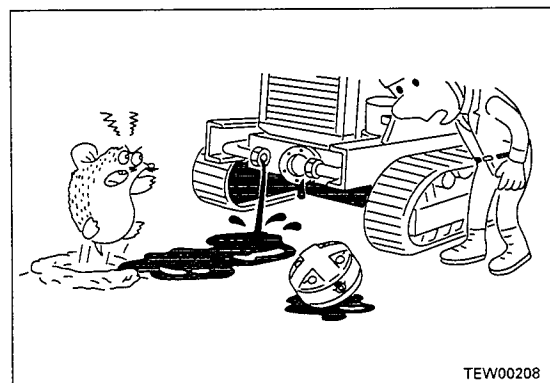
If disassembly or maintenance work is carried out on hydraulic equipment in the field, there is danger of dust entering the equipment. It is also difficult to confirm the performance after repairs, so it is desirable to use unit exchange. Disassembly and maintenance of hydraulic equipment should be carried out in a specially prepared dustproof workshop, and the performance should be confirmed with special test equipment.



3) Sealing openings

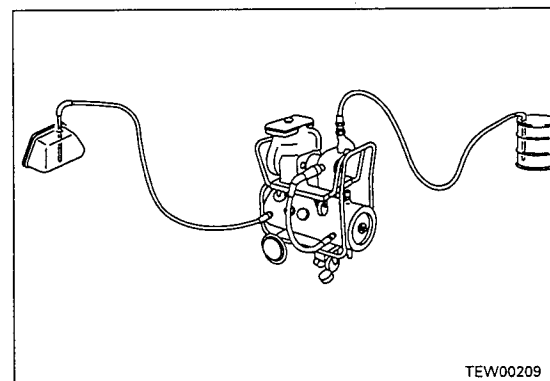
After any piping or equipment is removed, the openings should be sealed with caps, tapes, or vinyl bags to prevent any dirt or dust from entering. If the opening is left open or is blocked with a rag, there is danger of dirt entering or of the surrounding area being made dirty by leaking oil so never 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.



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.



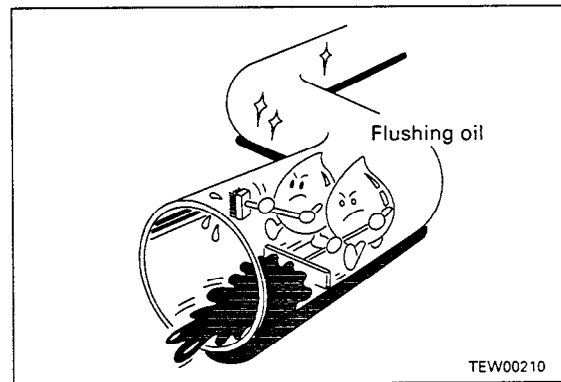
5) Change hydraulic oil when the temperature is high.

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. (Do not 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.

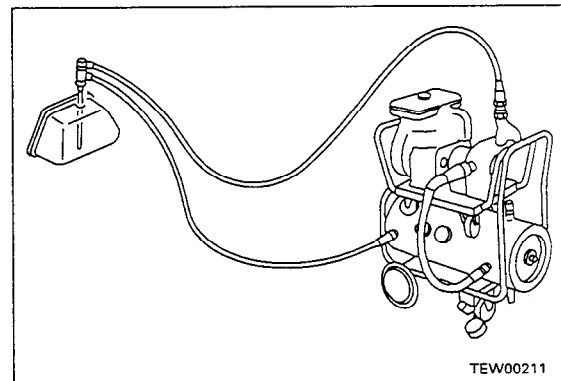


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7) Cleaning operations

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.

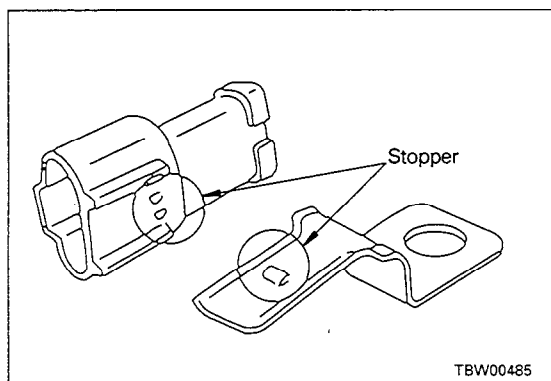
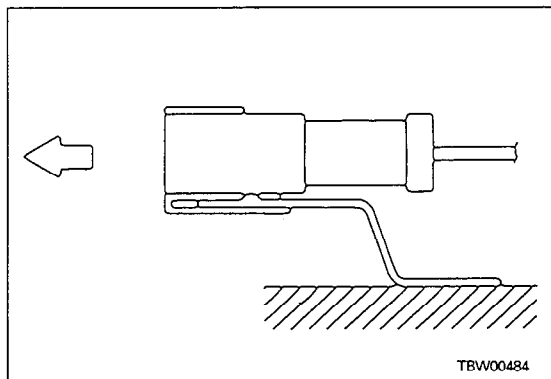
The oil cleaning equipment is used to remove the ultrafine (about 3μ) particles that the filter built into the hydraulic equipment cannot remove, so it is an extremely effective device.



HANDLING CONNECTORS

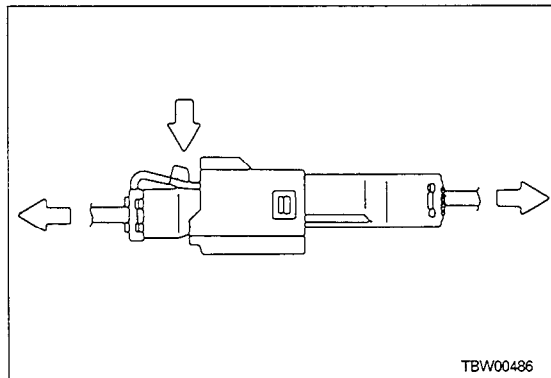
1. When removing the connectors from the clips, pull the connector in a parallel direction to the clip.

★ If the connector is twisted to the left and right or up and down, the housing may break.

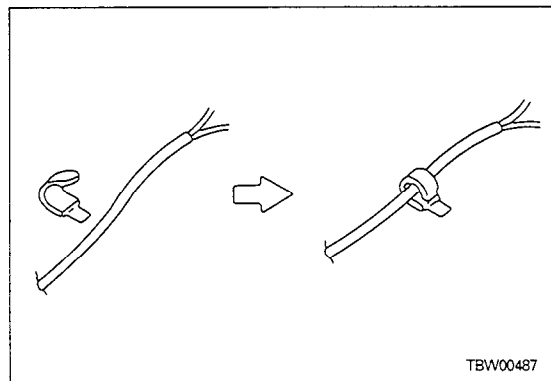


2. When disconnecting male and female connectors, release the lock and pull in parallel with both hands.

★ 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.



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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	Replace 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).

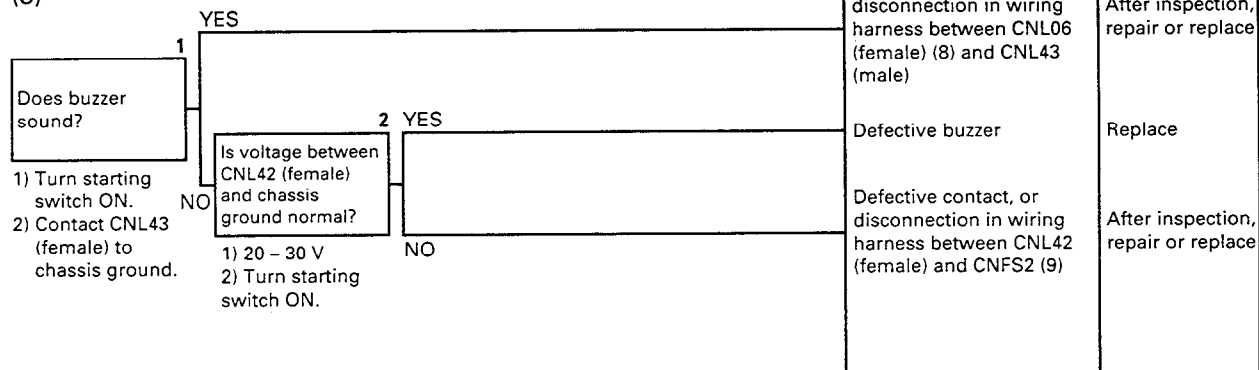
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< Example >

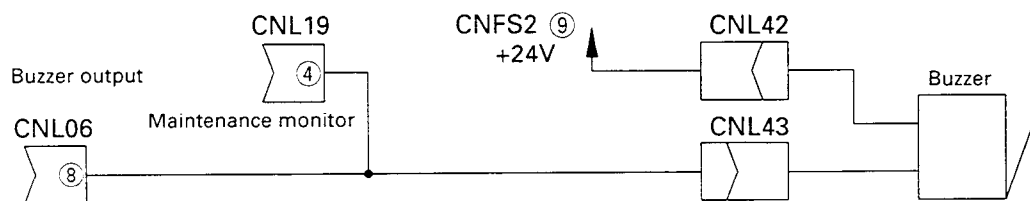
(1) **M-15 Abnormality in buzzer**

(2) (a) Buzzer does not sound when starting switch is turned ON (during self-check)

(3)



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TAW00722

(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.

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 ① + ② in the chart on the right corresponds to the items where answers can be obtained from the user. The items in ② 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 ③ in the chart on the right correspond to this.

The serviceman narrows down the causes from information ① that he has obtained from the user and the results of ③ 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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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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- **Example of troubleshooting when exhaust gas is black**

Let us assume that [Clogged air cleaner] is taken to be the cause of black exhaust gas. Three symptoms have causal relationship with this problem: [Exhaust gas slowly became black], [Power slowly became weaker], and [Dust indicator is red].

If we look from these three symptoms to find the causes, we find that there is a relationship with five causes. Let us explain here the method of using this causal relationship to pinpoint the most probable cause.

S-7 Exhaust gas is black (incomplete combustion)

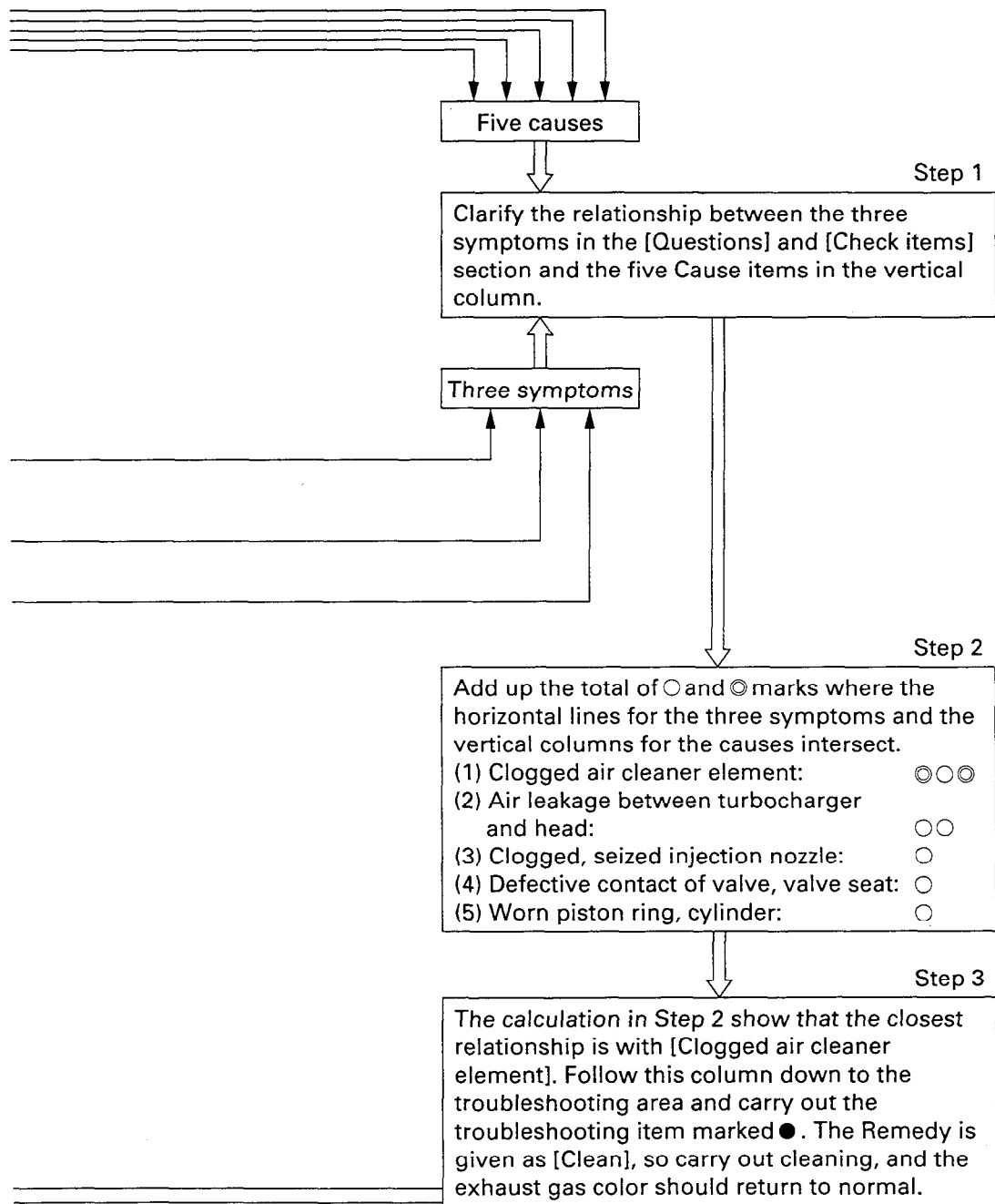
General causes why exhaust gas is black

- Insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

[illegible]

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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.

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.

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.

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

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?

[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
	Remedy	×	C	△	A	×
1		○	○	○	○	○
2		---	---	●	---	●
3			○		○	
4		○			○	
5			○			○

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- 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 ○ 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.)

- 5) Narrow down the possible causes.

There is one common cause among the causes located in Steps 2) and 4). (One cause marked ○ 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 ○ 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.)

- 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, △: Repair, A: Adjust, C: Clean

Problems	Causes				
	a	b	c	d	e
Remedy	X	C	△	A	X
1	○	○	○	○	
2			○		●
3		○		○	
4	○			○	
5		●			●

Applicable troubleshooting item located in Step 3).

Applicable troubleshooting item located in Step 1).

Problems	Causes				
	a	b	c	d	e
Remedy	X	C	△	A	X
1	○	○	○	○	
2			○		●
3		○		○	
4	○			○	
5		●			●

Ignore these causes

Common causes

Problems	Causes				
	a	b	c	d	e
Remedy	X	C	△	A	X
1	○	○	○	○	
2			○		●
3		○		○	
4	○			○	
5		○			●

Action to take

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 water 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.

Ambient temperature	Charging rate				
	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 glow plug	Defective regulator	Defective alternator	Defective or deteriorated battery	Defective injection nozzle
		Leakage, clogging, air in fuel system	Clogged fuel pump (rack, plunger, stick)	Leakage, clogging, air in fuel system	Clogged fuel tank air breather hole						
Questions	Confirm recent repair history										
	Degree of use	Operated for long period	△	△	△						
	Ease of starting	Gradually became worse	○	○	○						
	Indicator lamp does not light up	Starts when warm			○			○			
	Engine oil must be added more frequently				○						
	Replacement of filters has not been carried out according to operation manual			○	○				○	○	
	Dust indicator is red			○	○						
	Non-specified fuel has been used			○	○				○	○	
	Battery charge lamp is ON					○	○				
	Starting motor cranks engine slowly							○			
Check items	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									○	
	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)			○	○						○
Troubleshooting	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					●					
	Glow plug 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								●		
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working									●	
	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)										●
Remedy		Replace	Repair	Clean	Clean	Replace	Replace	Replace	Adjust	Replace	Clean

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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 strainer	Defective glow plug	Leakage or deteriorated battery	Clogged, clogging, air in fuel system	Clogged injection nozzle, defective spray	Improper fuel tank air breather hole
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						●					
	Glow plug 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									●		
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working										●	
	When fuel cap is inspected directly, it is found to be clogged											●
Remedy		Replace	Replace	Replace	Clean	Clean	Clean	Repair	Replace	Repair	Clean	Clean

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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

		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	Defective contact of valve, valve seat			
Questions	Confirm recent repair history												
	Degree of use	△	△	△		△				△			
	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					○							
Check items	Blue under light load					○							
	Black	○		○		○							○
	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		●										
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working			●									
	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		

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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										
		Broken, seized feed pump strainer										
		Clogged, leaking fuel pump piston										
		Clogged fuel tank air breather piping										
		Defective injection pump (rack, plunger stuck)										
		Failure in chassis power train										
Questions	Confirm recent repair history											
	Degree of use	Operated for long period							△	△		
	Condition when engine stopped	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							○	○	○		○
	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											◎
Check items	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							◎	◎			
Troubleshooting	Metal particles are found when oil is drained	◎	◎					○	○			
	Remove oil pan and check directly	●	●									
	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									●		
Remedy	When control rack is pushed, it is found to be heavy or does not return										●	
		Replace	Replace	Replace	Replace	Replace	Add	Clean	Clean	Replace	Repair	Replace

Carry out troubleshooting in chassis volume

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S-5 Engine does not rotate smoothly (hunting)

General causes why engine does not rotate smoothly

- Air in fuel system
- Defective governor mechanism
- Defective engine throttle controller mechanism (engine throttle controller type)

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					△	△				
	Condition of hunting	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					○	○				
	Leakage from fuel piping							⊙	⊙		
Check items	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		⊙		⊙						
Troubleshooting	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			●							
	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 valve plunger	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	△	△	△	△					△			
	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	◎	◎										
Check items	Black	◎	◎										
	Blue under light load		◎										
	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					○				◎			
Troubleshooting	Leakage from fuel piping									◎			
	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				●								
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working					●							
	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									●			
Remedy	When feed pump is operated, operation is too light or too heavy										●		
	When fuel cap is inspected directly, it is found to be clogged											●	
		Clean	Replace	Replace	Clean	Clean	Repair	Replace	Adjust	Replace	Adjust	Repair	Clean

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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)
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		○	○					○	○	
	Non-specified fuel has been used			○							○
	Noise of interference is heard from around turbocharger	○									
	Dust indicator is red		○								
Check items	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	○		○			○				
	Muffler is crushed						○				
	Leakage of air between turbocharger and head, loose clamp							○			
Troubleshooting	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			●						●	
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working				●						
	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								●		
	When control rack is pushed, it is found to be heavy, or does not return										●
Remedy		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

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		Causes											
		Broken piston ring	Worn piston ring	Clogged breather or cylinder liner	Leakage from oil filter, oil cooler	Leakage from oil piping	Leakage from oil drain plug	Broken oil cooler	Worn oil pan, cylinder head, etc.	Worn seal at turbine end	Worn seal at blower end	Turbocharger	
												Dust sucked in from intake system	Worn valve (stem, guide), broken seal
Questions	Confirm recent repair history												
	Degree of use												
	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												
	Area around engine is dirty with oil												
Check items	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

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

		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	Defective adjustment of fuel lever linkage
Questions	Confirm recent repair history								
	Degree of use		△	△				△	
	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	○							○
Troubleshooting	Injection pump test shows that injection amount is excessive	●							
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working		●						
	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				●				
	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

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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	
Questions	Confirm recent repair history								
	Degree of use	Operated for long period	△				△		
	Oil level	Suddenly increased	○	○		○			
		Gradually increased					○	○	
Check items	Hard water is being used as cooling water		○				○		
	Engine oil level has risen, oil is cloudy white		◎				○	○	
	Excessive air bubbles inside radiator, spurts back			◎	◎				
	Hydraulic oil, torque converter, transmission oil is cloudy white					◎			
	When hydraulic oil, torque converter, transmission oil is drained, water is found						◎		
Troubleshooting	Pressure-tightness test of oil cooler shows there is leakage		●			●			
	Pressure-tightness test of cylinder head shows there is leakage			●					
	Remove cylinder head and check directly				●				
	Remove oil pan and check directly						●	●	
			Remedy	Replace	Replace	Replace	Replace	Replace	Replace

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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 torque converter, transmission, or damper chamber				○						
Check items	Oil level goes down in hydraulic tank					⊙					
	Engine oil smells of diesel fuel						⊙	⊙	⊙		
	Fuel is added more frequently						⊙	⊙	⊙		
	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							●			
Troubleshooting	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
		Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace
		Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace
		Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace
		Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace
		Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace
		Replace	Replace	Replace	Replace	Repair	Replace	Repair	Replace	Repair	Replace
		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.

		Causes									
		Broken water pump	Clogged, crushed radiator fin	Clogged radiator core	Defective thermostat (does not open)	Insufficient cooling water	Fan belt slipping, worn fan pulley	Clogged, broken oil cooler	Defective pressure valve	Broken head, head gasket	Damaged liner O-ring, holes made by pitting
Questions	Confirm recent repair history										
	Degree of use		△	△						△	△
	Condition of overheating					○	○				
		⊙									
	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						○			○	
Check items	There is play when fan pulley is rotated	○									
	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

Carry out troubleshooting for chassis

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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	Deformed fan, interference of fan belt	Improper adjustment of fan belt	Broken valve system (valve, rocker lever, etc.)	Improper gear train backlash	Defect inside muffler (dividing board out of position)
Questions	Confirm recent repair history										
	Degree of use										
	Condition of abnormal noise										
	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	◎									
	Black	◎	◎					○		○	
Check items	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									◎	
	Vibrating noise is heard from around muffler										◎
Troubleshooting	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			●					●		
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working				●						
	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								●		
	When muffler is removed, abnormal noise disappears										●
Remedy		Replace	Replace	Replace	Replace	Adjust	Repair	Adjust	Replace	Repair	Replace

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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

		Causes									
		Worn connecting rod, main bearing	Worn balancer, cam bushing	Worn support pilot	Loose engine mounting bolts, broken cushion	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		○	○							
	Vibration occurs at mid-range speed					○	○				
	Vibration follows engine speed					○	○	○			
Check items	Exhaust gas is black								◎	○	
	Seal on injection pump has come off									◎	
Troubleshooting	Remove oil pan and check directly		●								
	Remove side cover and check directly			●							
	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	

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TROUBLESHOOTING OF MAIN MONITOR SYSTEM (M MODE)

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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.)

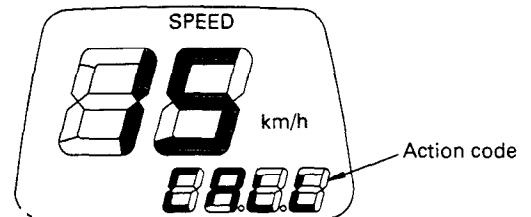
2. Abnormality in failure action code

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.

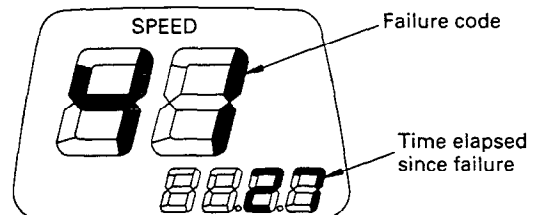
The failure codes for failures that are now occurring flash, and the codes for failures that are not occurring light up.

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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4. Action code table

Action code: "E□□+ CALL" means that E□□ and CALL are displayde alternatty

Action code	Transmission control system		Alarm Buzzer	Action by operator
	Problem system	Action of maschine		
E00	Speed sensor system (disconnection)	Does not shift gear automatically (gear must be shifted manually)	No	Normal operation possible using manual gear shifting
E01 + CALL	H-L solenoid, speed solenoid system	Transmission range fixed (1st - 3rd, depending on case)	Yes	Travel under own power possible, call for service after moving to a safe place
	-	-		
E03 + CALL	Shift lever system	Neutral (F,R solenoids output OFF)	Yes	Actuate emergency manual spool, open modulation solenoid manually. This action makes it possible to travel under own power. Call for service
	Directional solenoid system	Neutral (F,R solenoids, modulation solenoids output OFF)		
	Moulation solenoid system	Neutral (F,R solenoids, modulation solenoids output OFF)		
CALL	Wiring harness on return side of modulation solenoid short circuit with power source	Neutral (F,R solenoids, modulation solenoids output OFF), possible that controller is burnt out	Yes	Stop machine immediately, turn starting switch OFF, then call for service

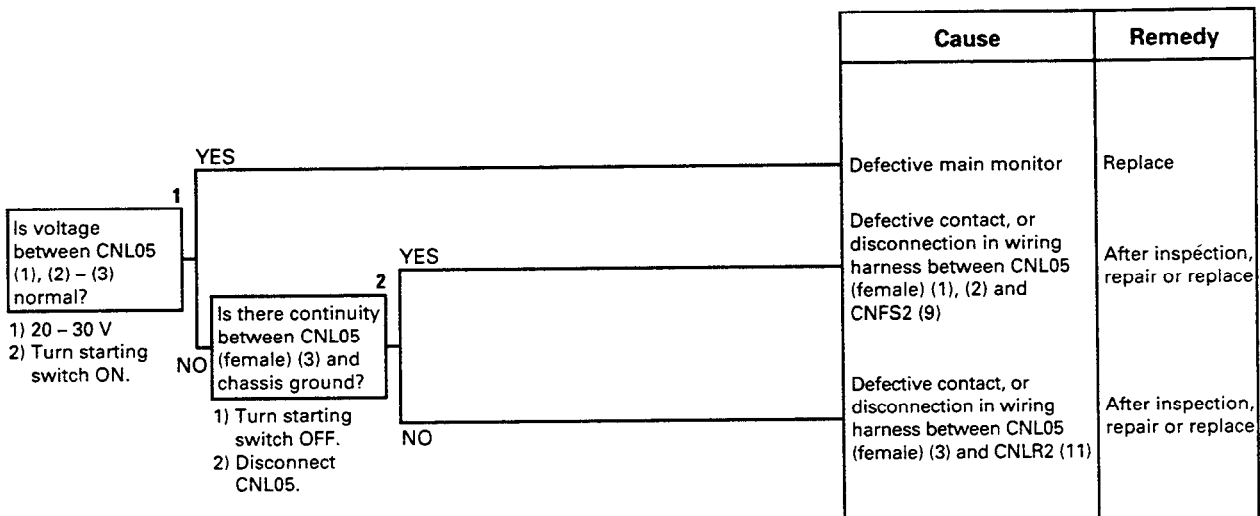
5. Failure code chart

Transmission control system	
10	Modulation solenoid system
11	Modulation solenoid system
12	F solenoid valve system
13	R solenoid valve system
14	H-L solenoid valve system
16	Speed solenoid system
17	Parking brake system
20	Directional lever input system
21	Speed lever input system
22	Speed sensor input system
23	Engine speed input system

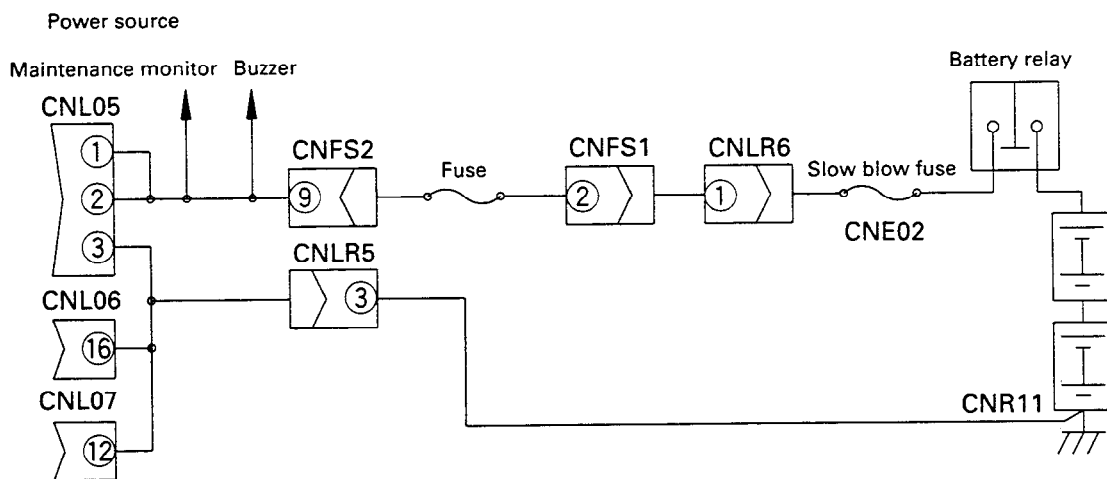
ECSS control system	
d0	Relief solenoid system
d1	High pressure solenoid system
d2	Low pressure solenoid system
d3	Speed sensor system
d4	Abnormality in model selection

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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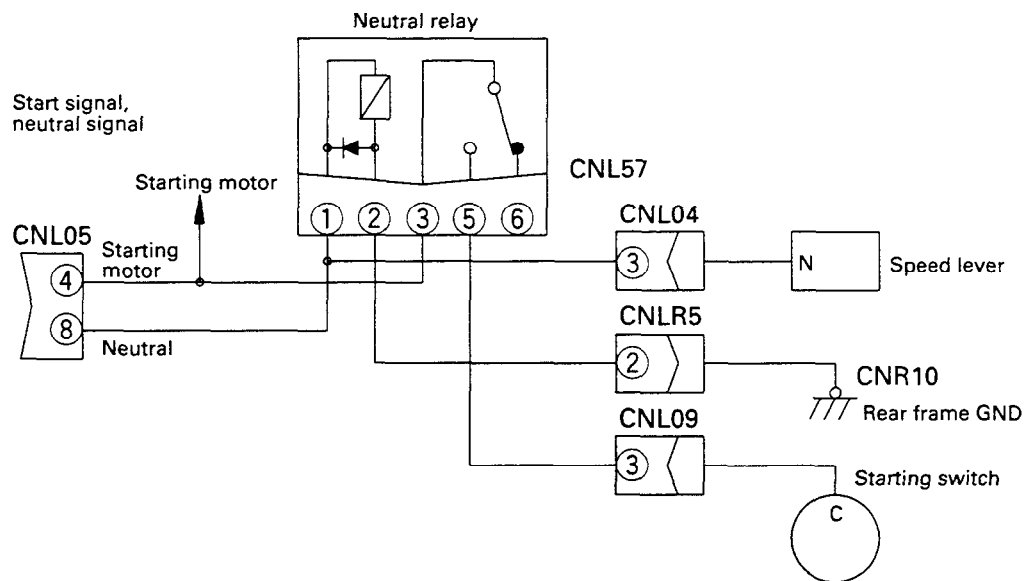


TDW00285

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



TDW00286

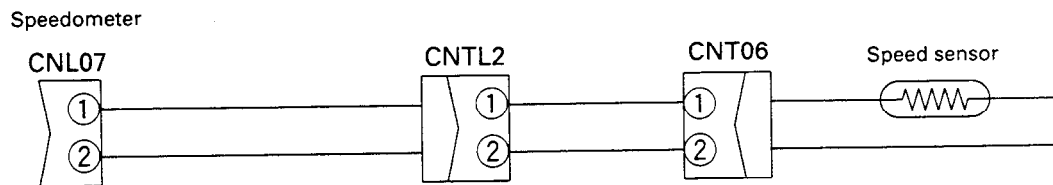
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M-3 Speedometer display does not work properly

- ★ 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 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

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TDW00287

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?

1) 20 – 30 V

2) Turn starting
switch ON.

3) Directional
lever: F

NO

Cause	Remedy
Defective main monitor	Replace
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?

1) 20 – 30 V

2) Turn starting
switch ON.

3) Directional
lever: R

NO

Defective main monitor	Replace
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?

1) 0 – 5 V

2) Turn starting
switch ON.

3) Directional
lever: N

NO

Defective main monitor	Replace
Contact of power source with wiring harness between CNL08 (female) (8) and CNL04 (4), or defective control lever	After inspection, repair or replace

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(g) Does not display 2nd, 3rd

1 YES
Is voltage between CNL05 (12) and chassis ground normal?

- 1) 0 – 5 V
2) Turn starting switch ON.
3) Speed lever: 2

NO

Cause	Remedy
Defective main monitor	Replace
Contact of power source with wiring harness between CNL05 (female) (12) and CNL04 (5), or defective control lever	After inspection, repair or replace

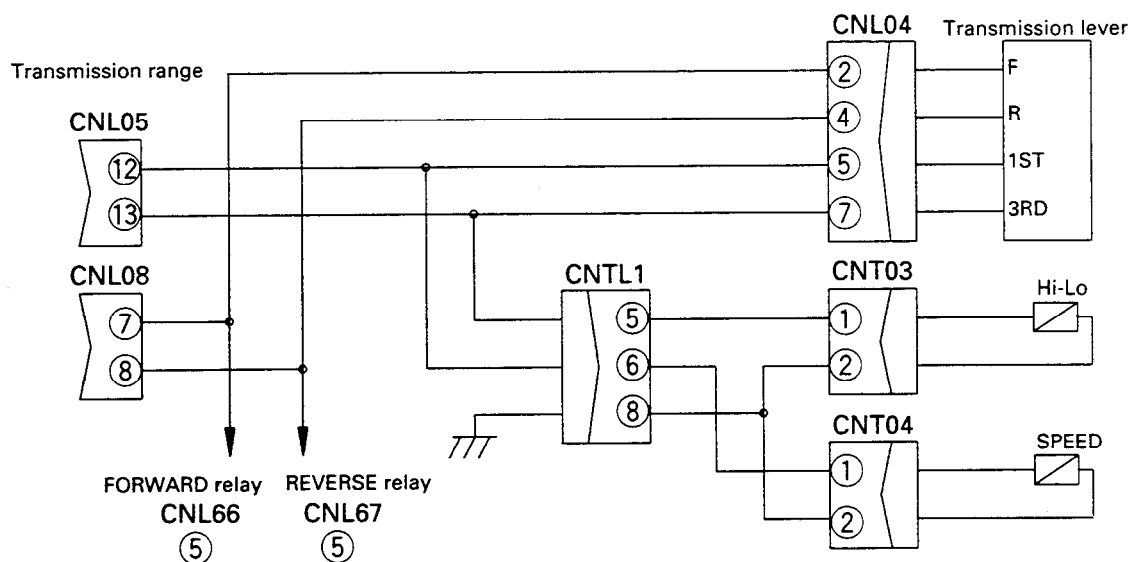
(h) Does not display 1st, 2nd

1 YES
Is voltage between CNL05 (13) and chassis ground normal?

- 1) 0 – 5 V
2) Turn starting switch ON.
3) Speed lever: 2

NO

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

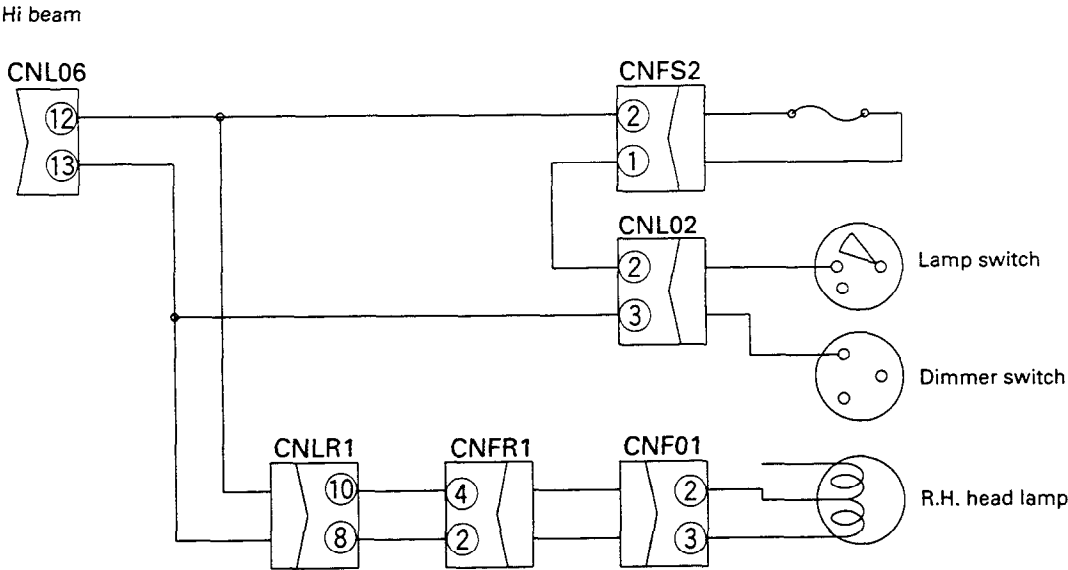
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M-5 High beam does not light up

- ★ 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. 2 Is there continuity between CNL06 (female) (13) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNL06. 3) Dimmer switch: Hi beam	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

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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?

- NO
1) Repeat 0V and 20 – 30 V.
2) Turn starting switch ON.

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

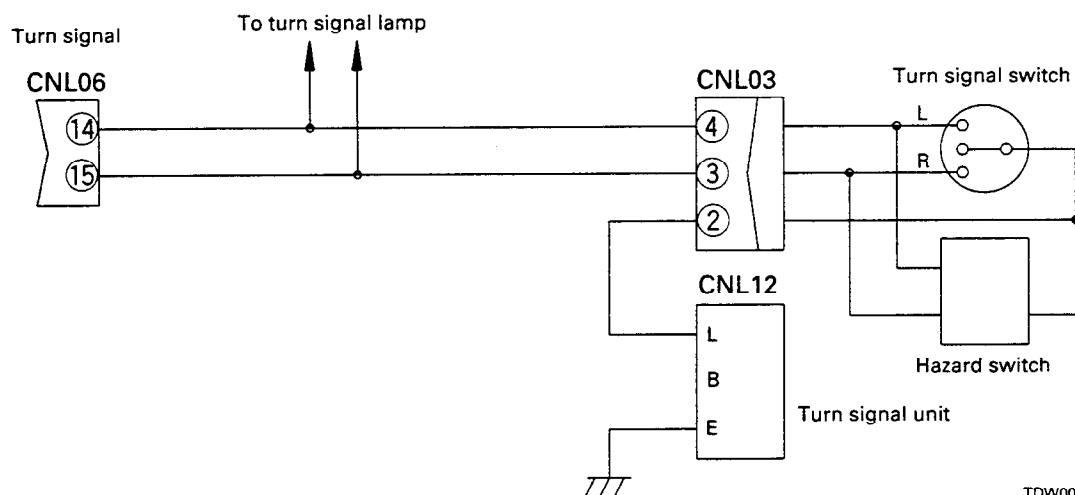
(b) R.H. turn signal does not light up

1 YES
Is voltage between CNL06 (15) and chassis ground normal?

- NO
1) Repeat 0 V and 20 – 30 V.
2) Turn starting switch ON.

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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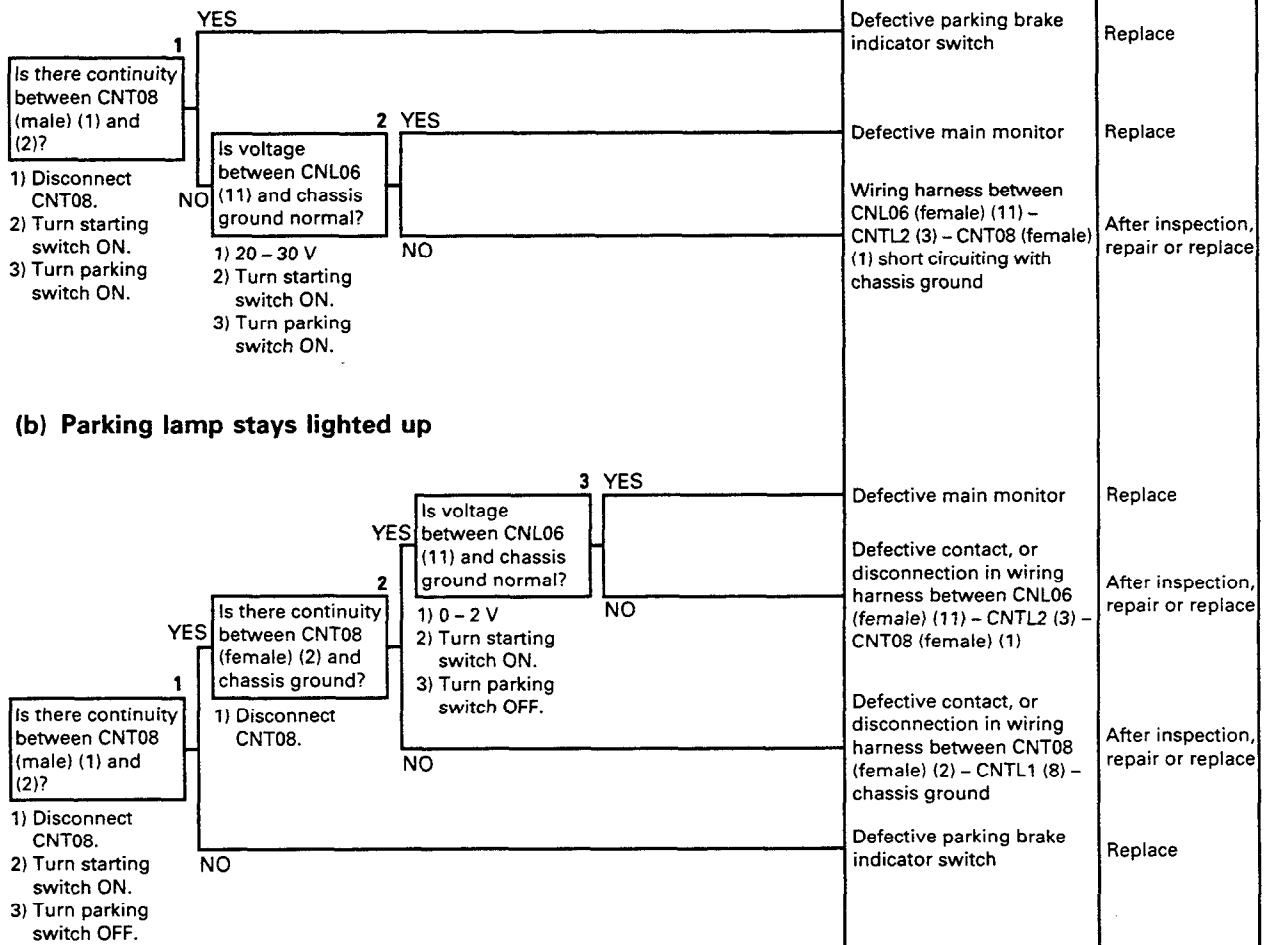
TDW00291

M-7 Abnormality in parking 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.

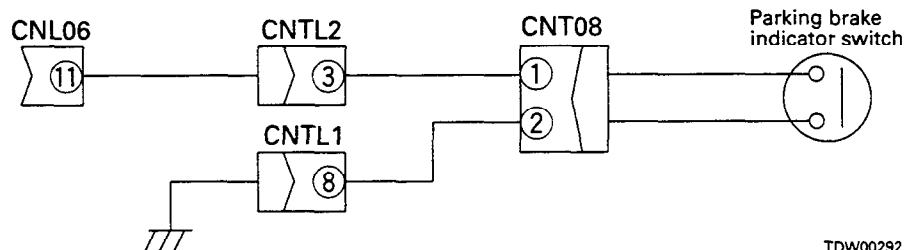
(a) Parking lamp does not light up

- ★ Before starting troubleshooting, check that the lamp bulb is not blown.



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Parking signal



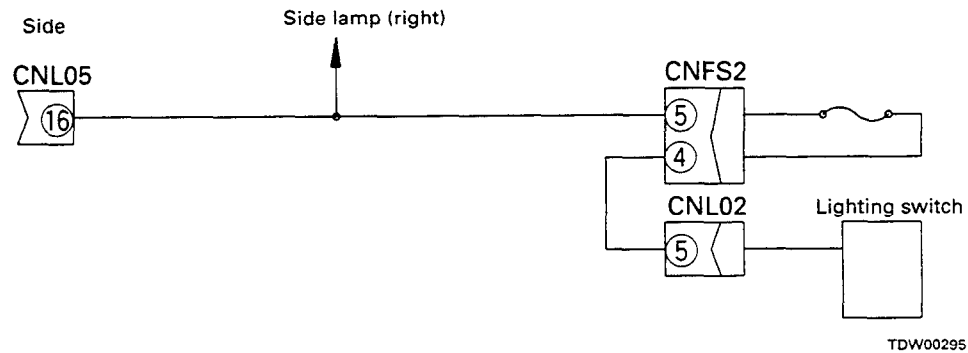
TDW00292

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
1 YES Is voltage between CNL05 (16) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON. 3) Turn side lamp switch ON.	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

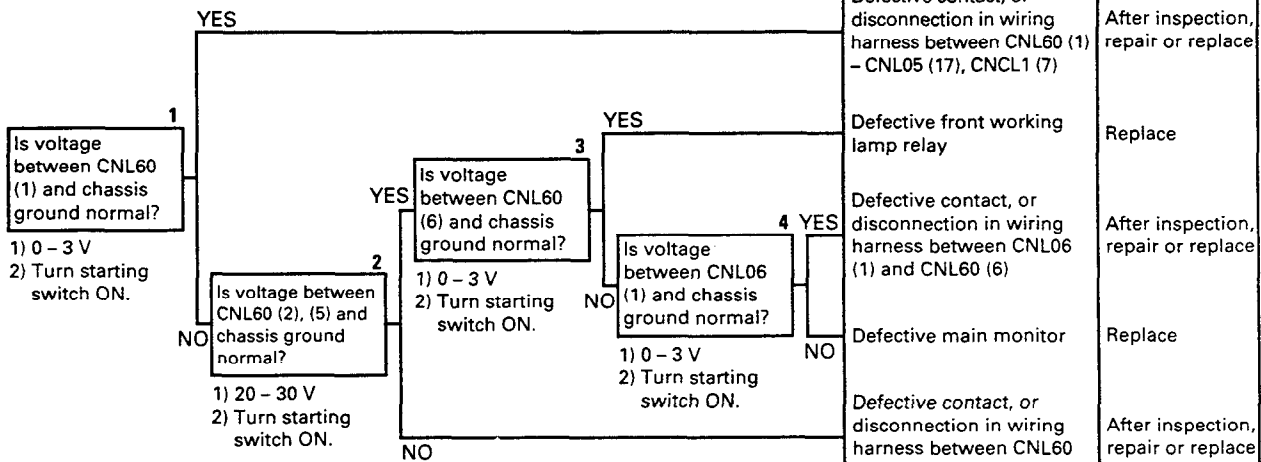
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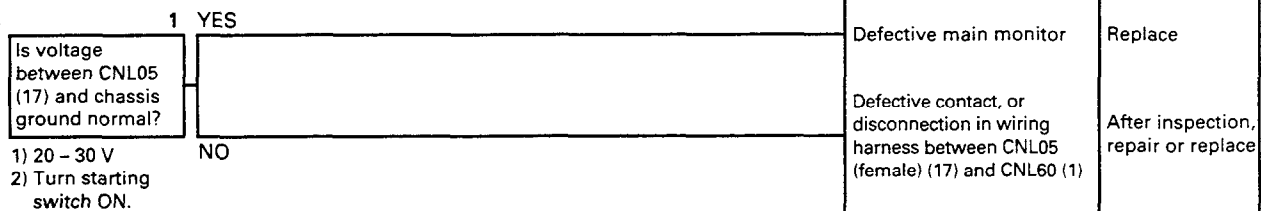
M-10 Abnormality in front working lamp

- ★ 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.

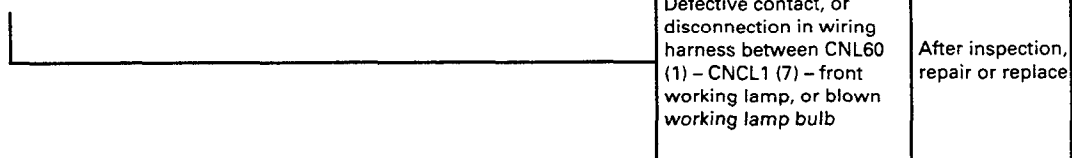
(a) Neither monitor display nor front working lamp light up



(b) Working lamp lights up but monitor display does not light up



(c) Monitor lights up but working lamp does not light up

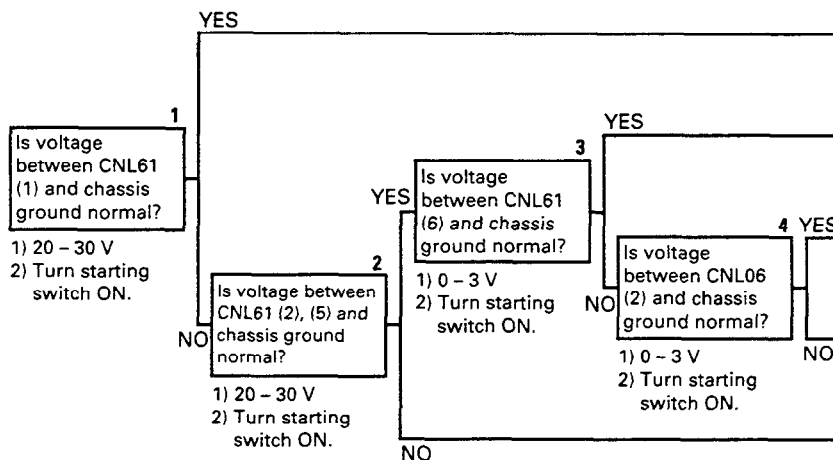


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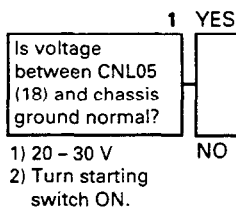
M-11 Abnormality in rear working lamp

- ★ 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

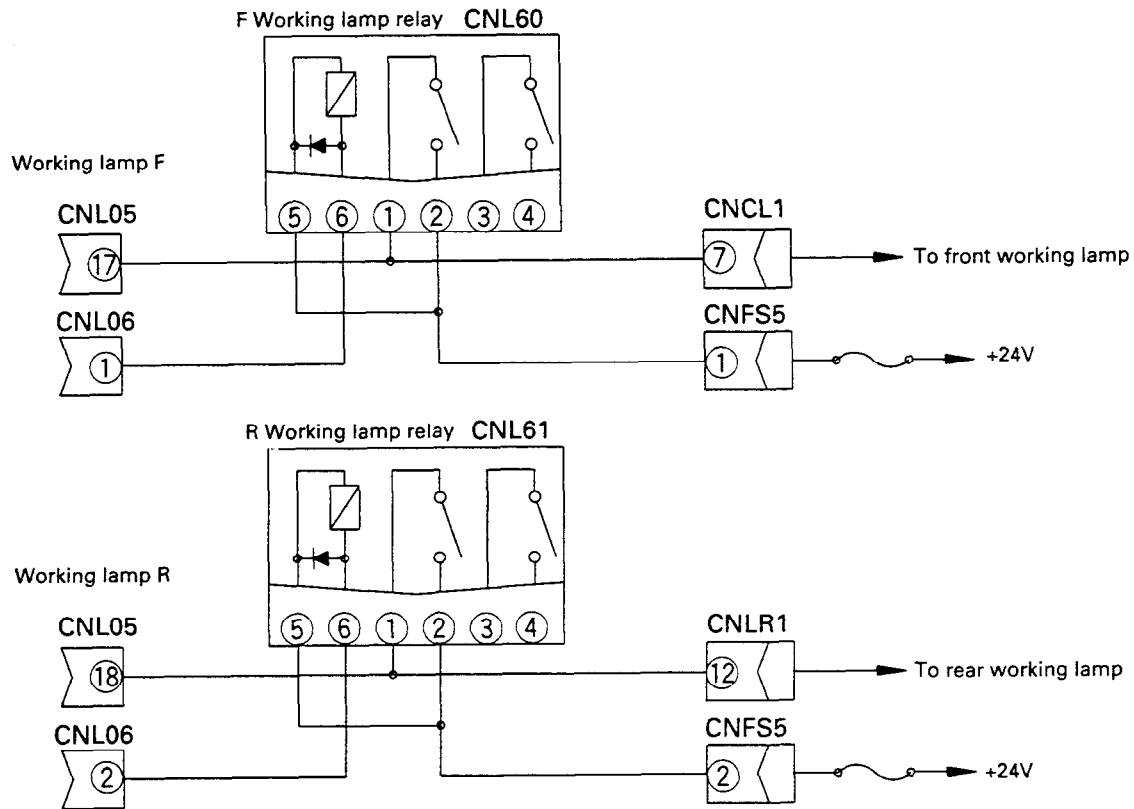


(c) Monitor lights up but working lamp does not light up



Cause	Remedy
Defective contact, or disconnection in wiring harness between CNL61 (1) – CNL05 (18), CNLR1 (12)	After inspection, repair or replace
Defective rear working lamp relay	Replace
Defective contact, or disconnection in wiring harness between CNL06 (2) and CNL61 (6)	After inspection, repair or replace
Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL61 (2), (5) – CNFS5 (2)	After inspection, repair or replace
Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL05 (female) (18) and CNL61 (1)	After inspection, repair or replace
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

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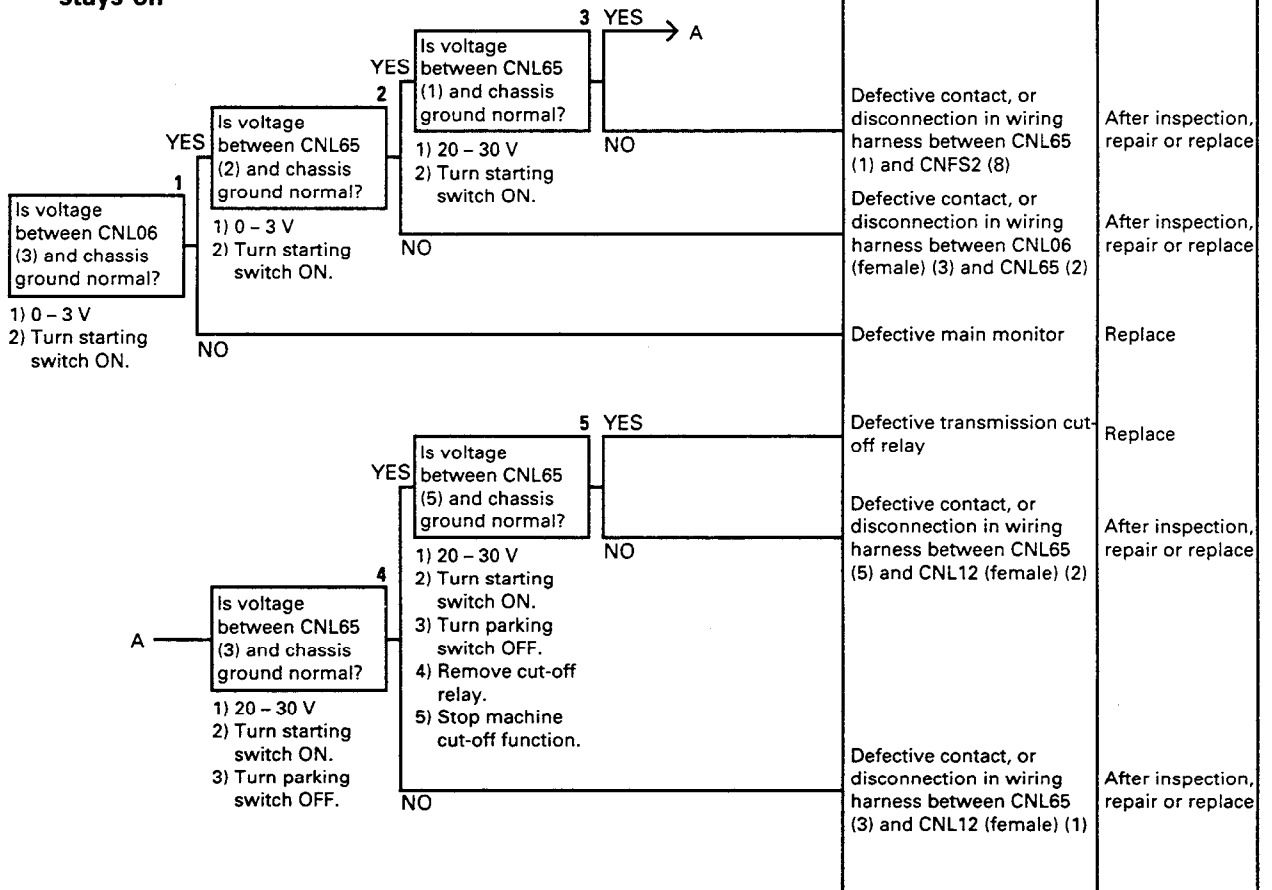
M-12 Abnormality in transmission cut-off

- ★ 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

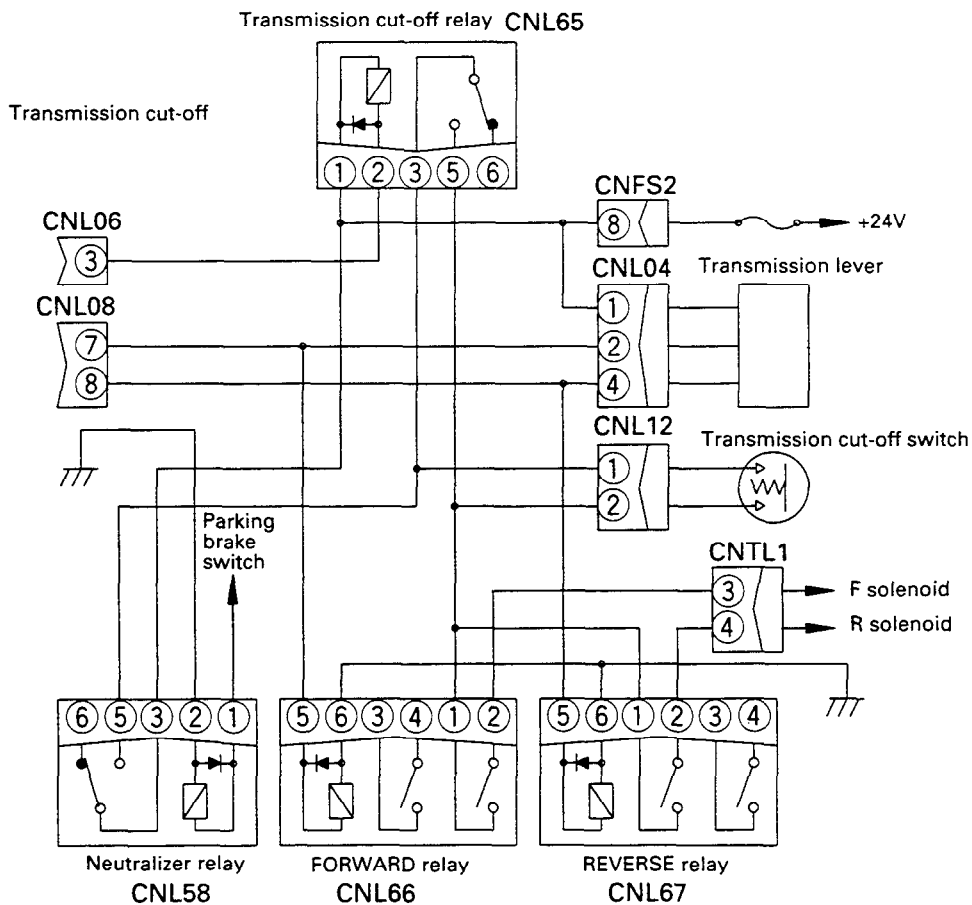
Cause	Remedy
Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL65 (1) and CNFS2 (8)	After inspection, repair or replace
Defective contact, or disconnection in wiring harness between CNL06 (female) (3) and CNL65 (2)	After inspection, repair or replace
Defective main monitor	Replace
Defective transmission cut-off relay	Replace
Defective contact, or disconnection in wiring harness between CNL65 (5) and CNL12 (female) (2)	After inspection, repair or replace
Defective contact, or disconnection in wiring harness between CNL65 (3) and CNL12 (female) (1)	After inspection, repair or replace

(b) Monitor display goes out but cut-off function stays on



(c) Monitor display lights up but cut-off function is not actuated

	Cause	Remedy
1) Turn starting switch ON. 2) Remove cut-off relay. Does cut-off function work?		
YES Is voltage between CNL65 (2) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	Defective cut-off relay	Replace
NO Does cut-off function work? 1) Turn starting switch ON. 2) Disconnect CNL06.	Defective main monitor	Replace
YES	Wiring harness between CNL06 (female) (3) and CNL65 (2) short circuiting with chassis ground	After inspection, repair or replace
NO	Contact of wiring harness between CNL65 (3) and (5), or defective cut-off switch	After inspection, repair or replace



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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

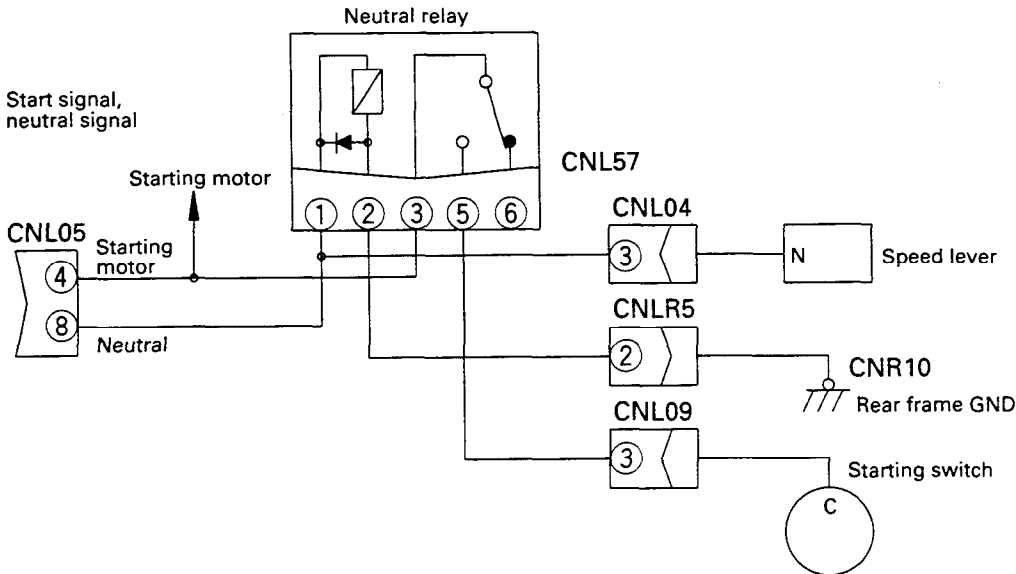
		Cause	Remedy
1 YES Is voltage between CNL05 (8) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	YES	Defective main monitor	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL05 (female) (8) and CNL04 (3)	After inspection, repair or replace

(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.

		Cause	Remedy
1 YES Is voltage between CNL05 (8) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON.	YES	Defective main monitor	Replace
	2 YES Is resistance between CNL05 (male) (8) and (3) normal? 1) 3 kΩ – 4 kΩ 2) Turn starting switch OFF. 3) Disconnect CNL05.	Contact of power source with wiring harness between CNL05 (female) (8) and CNL04 (female) (3)	After inspection, repair or replace
		Defective main monitor	Replace

U42303

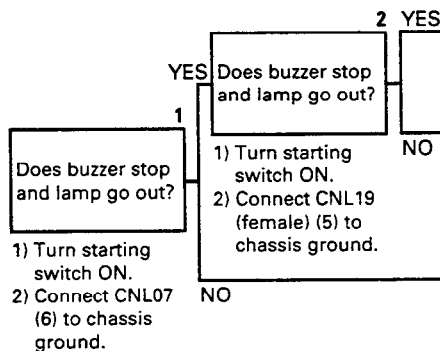


TDW00286

M-14 When parking brake dragging warning is given, buzzer and caution lamp are actuated continuously, or they are not actuated

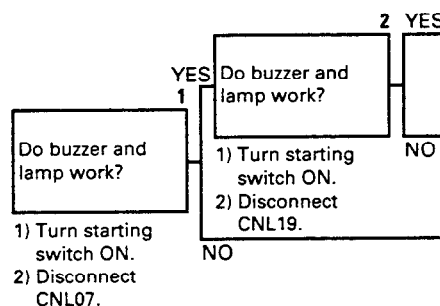
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Actuated continuously



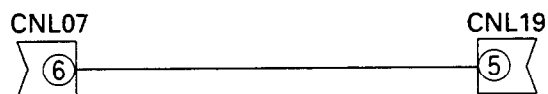
Cause	Remedy
Defective maintenance monitor	Replace
Defective contact, or disconnection in wiring harness between CNL07 (female) (6) and CNL19 (female) (5)	After inspection, repair or replace
Defective main monitor	Replace

(b) Not actuated



Defective maintenance monitor	Replace
Wiring harness between CNL07 (female) (6) and CNL19 (female) (5) short circuiting with chassis ground	After inspection, repair or replace
Defective main monitor	Replace

Synchronous flashing signal



TDW00300

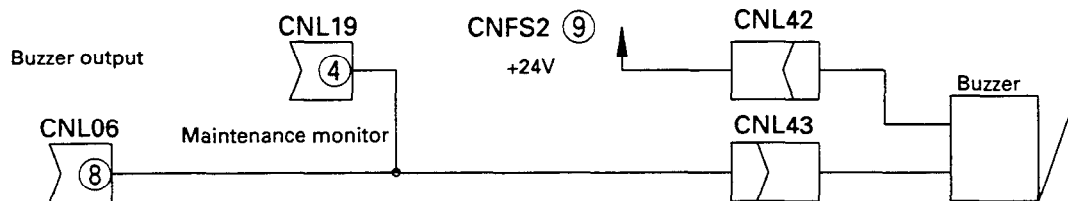
U42303

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.

		Cause	Remedy
(a) Buzzer does not sound when starting switch is turned ON (during self-check)			
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	Is voltage between CNL42 (female) and chassis ground normal? 1) 20 – 30 V 2) Turn starting switch ON.	
	2 YES	Defective buzzer	Replace
	2 NO	Defective contact, or disconnection in wiring harness between CNL42 (female) and CNFS2 (9)	After inspection, repair or replace
(b) Buzzer always sounds			
1 Does buzzer stop? 1) Turn starting switch ON. 2) Disconnect CNL06.	YES	Defective main monitor.	Replace
	NO	2 YES Does buzzer stop? 1) Turn starting switch ON. 2) Disconnect CNL19.	Go to Troubleshooting for maintenance monitor
	2 NO	3 YES Does buzzer stop? 1) Turn starting switch ON. 2) Disconnect CNL43.	Wiring harness between CNL06 (female) (8) and CNL43 (male) short circuiting with chassis ground
	3 NO	Defective buzzer	Replace

U42303



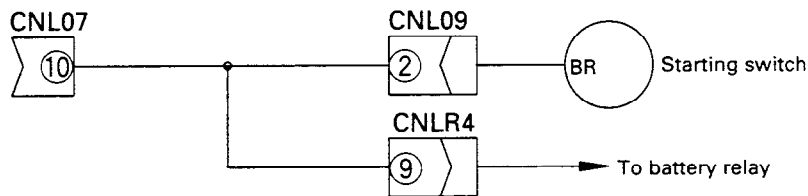
TDW00301

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

U42303

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.

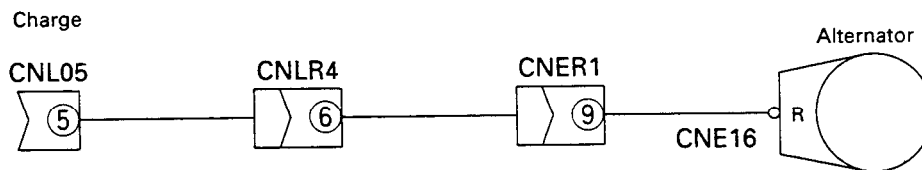
(a) Does not enter failure display mode

Is voltage between CNL05 (5) and chassis ground normal? 1) 0 – 5 V 2) Turn starting switch ON.	1 YES	Defective main monitor	Replace
	NO	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

(b) Time for time elapsed since failure on failure display mode does not advance

Is voltage between CNL05 (5) and chassis ground normal? 1) 20 – 30 V 2) Start engine.	1 YES	Defective main monitor	Replace
	NO	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

U42303

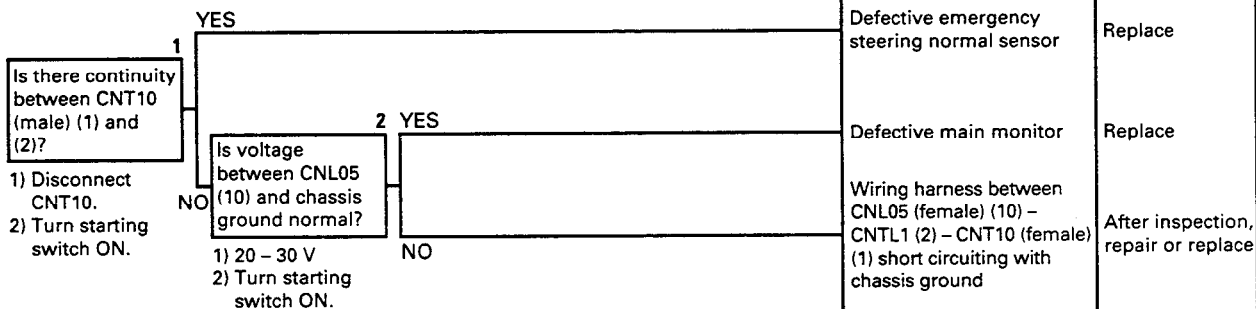


TDW00303

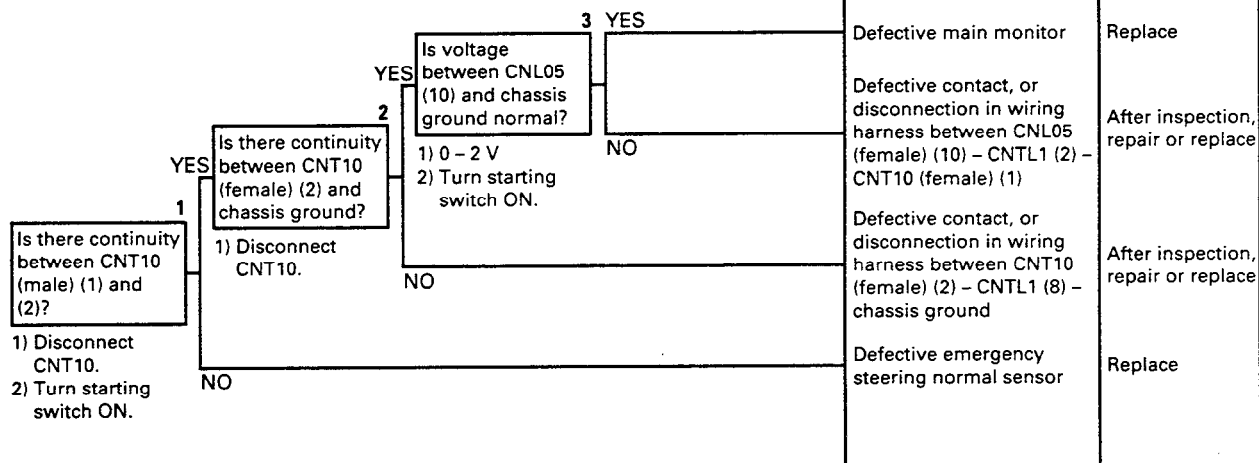
M-18 Abnormality in emergency steering normal display

- ★ 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

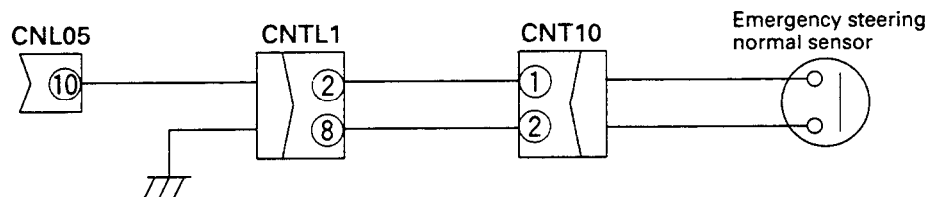


(b) Emergency steering normal display stays lighted up



U42303

Emergency steering normal

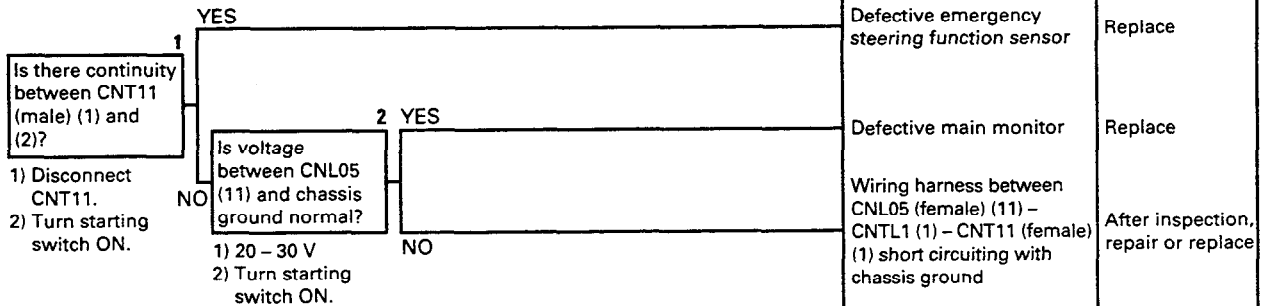


TDW00307

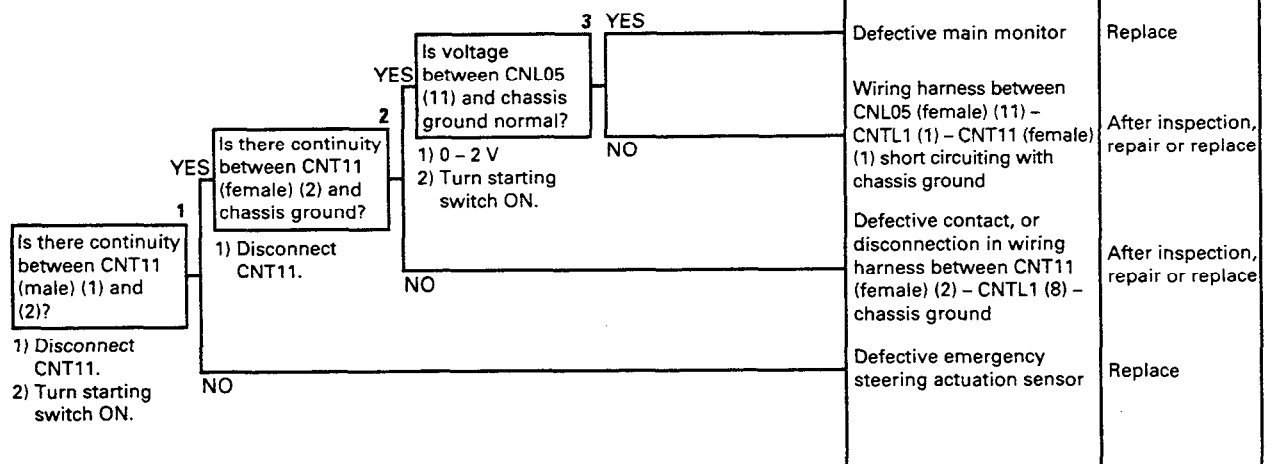
M-19 Abnormality in emergency steering actuation display

- ★ 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

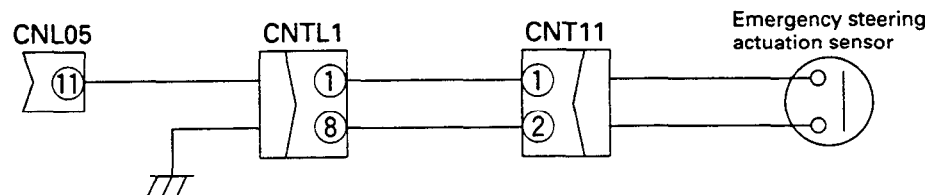


(b) Emergency steering actuation display stays lighted up



U42303

Emergency steering actuation

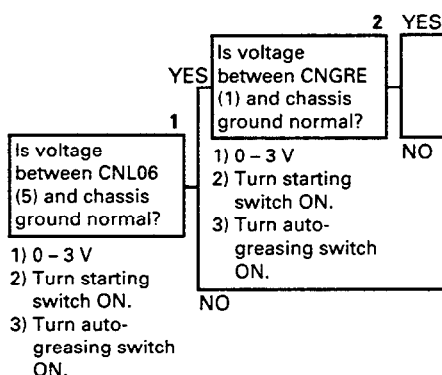


TDW00308

M-20 Abnormality in auto-greasing system

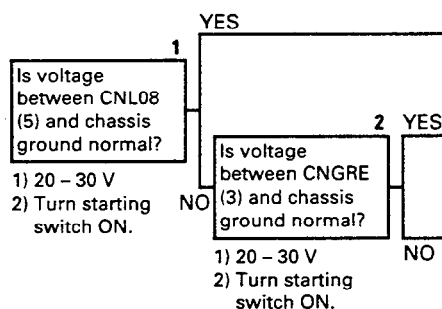
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Forced greasing cannot be carried out



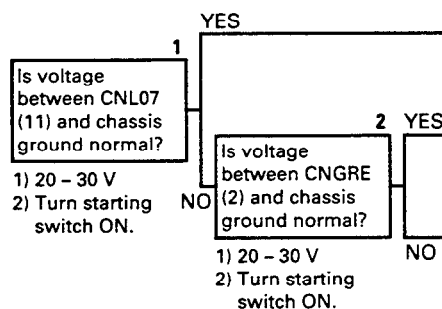
Cause	Remedy
Go to operation maintenance manual for handling auto-greasing system	—
Defective contact, or disconnection in wiring harness between CNL06 (female) (5) and CNGRE (1)	After inspection, repair or replace
Defective main monitor	Replace

(b) Monitor display flashes rapidly (2 times/sec)



Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL08 (female) (5) and CNGRE (3)	After inspection, repair or replace
Go to operation maintenance manual for handling auto-greasing system	—

(c) When no more grease remains, monitor display flashes rapidly (2 times/sec)

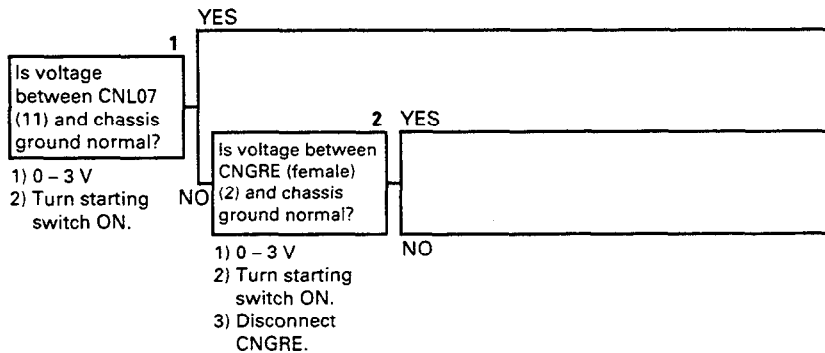


Defective main monitor	Replace
Defective contact, or disconnection in wiring harness between CNL07 (female) (11) and CNGRE (2)	After inspection, repair or replace
Go to operation maintenance manual for handling auto-greasing system	—

U42303

(d) Monitor display flashes slowly (1 time/sec)

Cause	Remedy
Go to operation 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
Go to operation maintenance manual for handling auto-greasing system	—

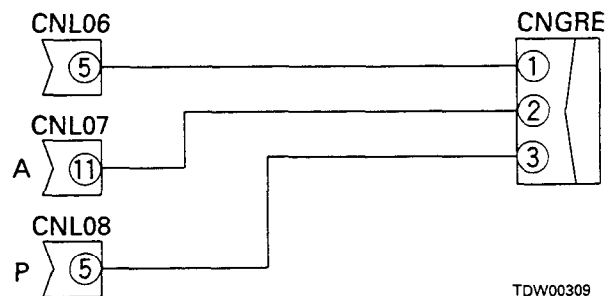
(e) Monitor display goes out

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

U42303

Auto-greasing



TDW00309

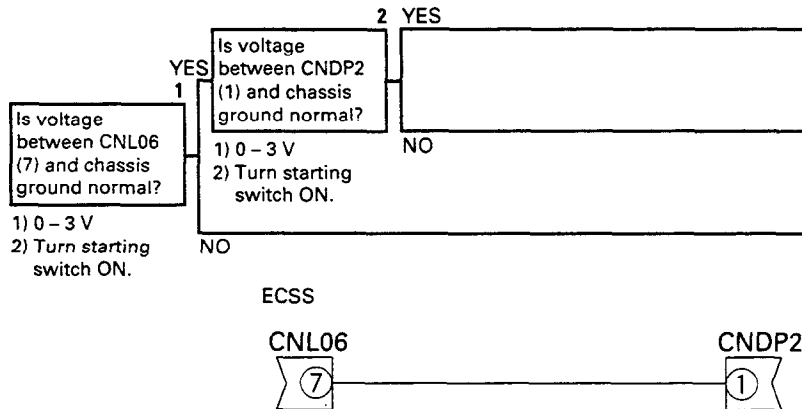
M-21 Abnormality in ECSS system

- ★ 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



(b) Monitor display lights up but ECSS function does not work

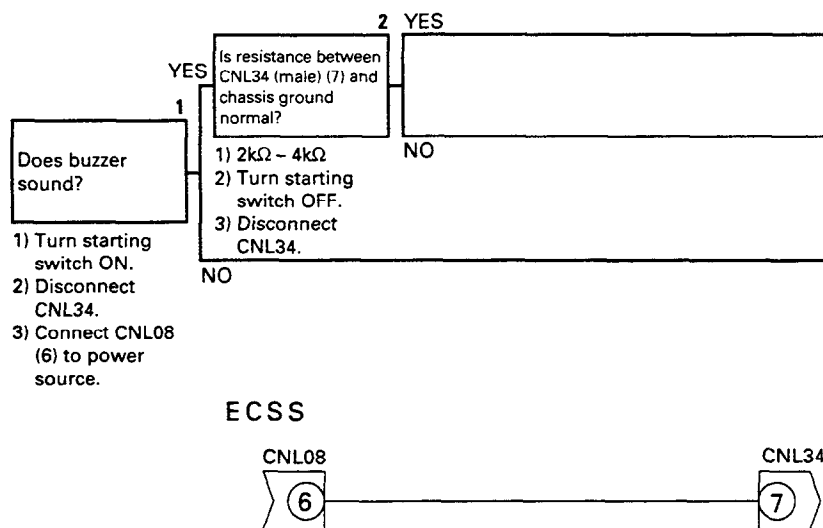


Cause	Remedy
Defective main monitor	Replace
Defective ECSS controller	Go to Troubleshooting for ECSS controller
Defective contact, or disconnection in wiring harness between CNL06 (7) and CNDP2 (1)	After inspection, repair or replace
Defective main monitor	Replace

TDW00310

U42303

M-22 Buzzer does not sound when auto-leveling switch is actuated



Cause	Remedy
Defective auto-leveling controller	Go to Troubleshooting for auto-leveling controller
Defective contact, or disconnection in wiring harness between CNL08 (female) (6) and CNL34 (male) (7)	After inspection, repair or replace
Defective main monitor	Replace

TAW00493

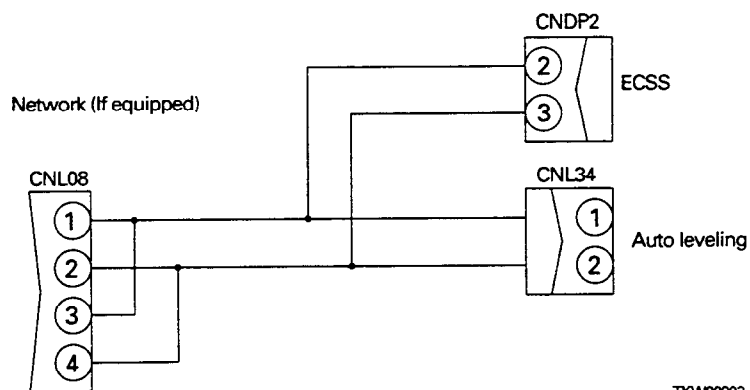
M-23 Failure code is not sent to main monitor (abnormality in network)

- ★ 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	2 Is voltage normal between pins of connectors in table below? 1) Repeat 0V and 12V. 2) Turn starting switch ON. 3) Disconnect connector to be measured.	YES Applicable controller is defective Replace
	NO 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	
		Defective main monitor	Replace

Table

Connector	Pin No.
CNL34(female)	Between (1) – (2)
CNDP2(female)	Between (2) – (3)



U42303

TROUBLESHOOTING OF MAINTENANCE MONITOR SYSTEM (K MODE)

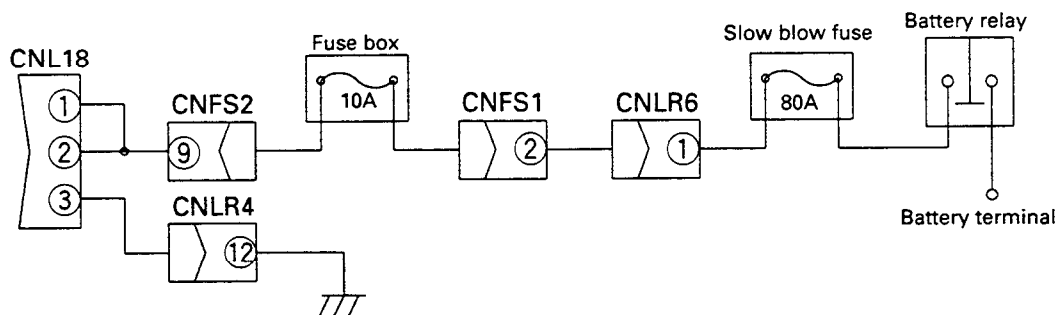
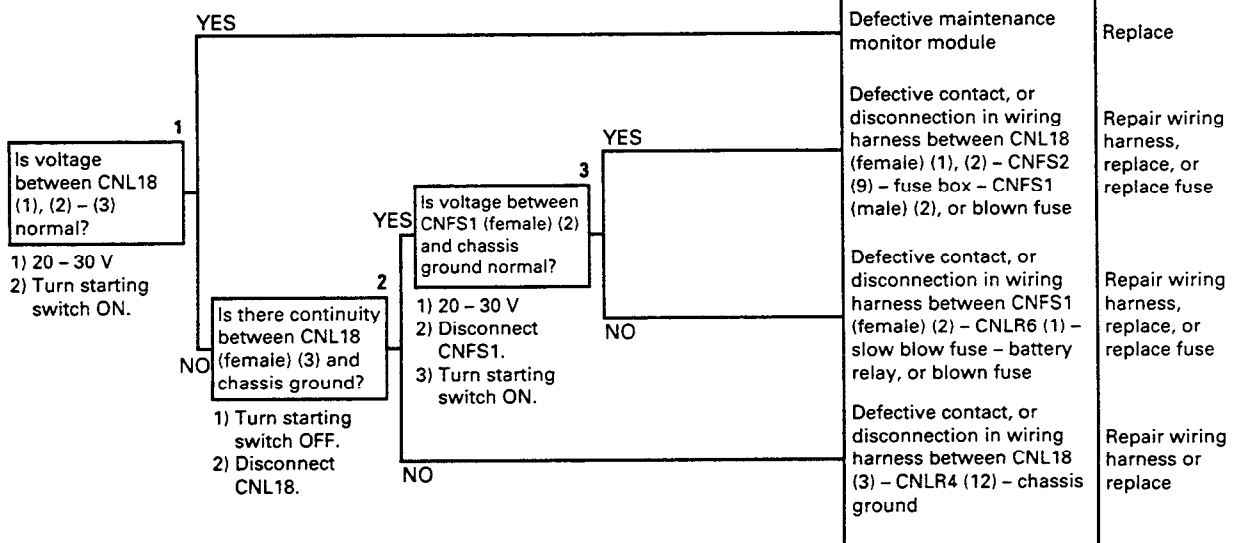
U42303

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	20-302
	(a) All lamps on maintenance monitor do not light up for 3 seconds	20-302
	(b) Some lamps do not light up	20-303
K- 2	When starting switch is turned ON, all lamps on maintenance monitor light up but do not go out	20-303
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	20-304
K- 4	When starting switch is turned ON (engine stopped), CHECK items flash	20-305
	(a) Engine oil level display flashes	20-305
	(b) Engine water level display flashes	20-306
K- 5	When starting switch is turned ON (engine started), CAUTION items flash	20-307
	(a) Engine oil pressure display flashes	20-307
	(b) Battery charge level display flashes	20-308
	(c) Brake oil pressure display flashes	20-309
	(d) Air cleaner display flashes	20-310
K- 6	CAUTION items are flashing but alarm buzzer does not sound	20-311
K- 7	There is no abnormality in monitor display but alarm buzzer sounds	20-312
K- 8	CAUTION items are flashing but warning lamp (CHECK lamp, CAUTION lamp) does not light up	20-313
	(a) CHECK lamp	20-313
	(b) CAUTION lamp	20-313
K- 9	There is no abnormality in maintenance monitor display but warning lamp (CHECK lamp, CAUTION lamp) lights up	20-314
	(a) CHECK lamp	20-314
	(b) CAUTION lamp	20-314
K-10	Night lighting does not light up when lamp switch is turned ON (only lighting of maintenance monitor does not light up)	20-315
K-11	Night lighting lights up even when lamp switch is OFF, night lighting stays lighted up	20-316
K-12	Service meter does not work	20-317
K-13	Service meter is running even when engine is stopped	20-317
K-14	Abnormality in gauge items	20-318
	(a) Abnormality in fuel gauge	20-318
	(b) Abnormality in engine water temperature gauge	20-319
	(c) Abnormality in torque converter oil temperature gauge	20-320

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

U42303

(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.

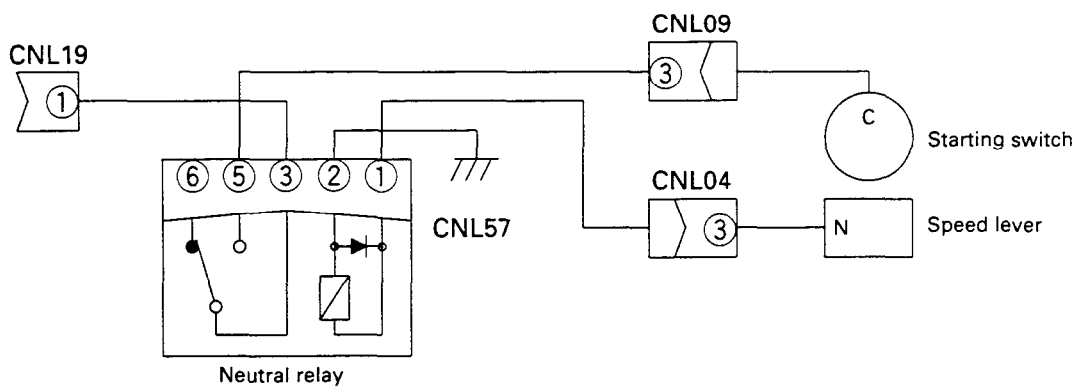
U42303

Cause	Remedy
Defective maintenance monitor module	Replace

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

U42303

K-4 When starting switch is turned ON (engine stopped), CHECK items flash

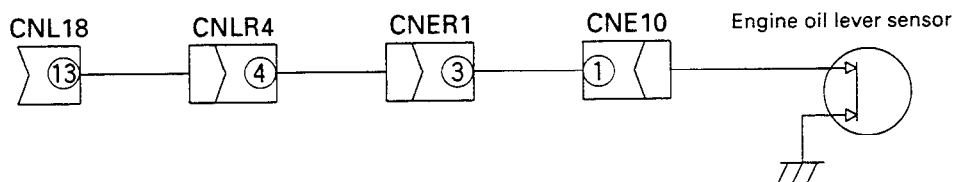
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

(a) Engine oil level display flashes

- ★ Before starting troubleshooting, check the engine oil level again.

		Cause	Remedy
Is there continuity between CNE10 (male) (1) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNE10.	YES		
	2 YES	Defective maintenance monitor module	Replace
	NO	Defective contact, or disconnection in wiring harness between CNL18 (female) (13) – CNLR4 (4) – CNER1 (3) – CNE10 (female) (1)	Repair wiring harness or replace
	NO	Defective engine oil level sensor	Replace

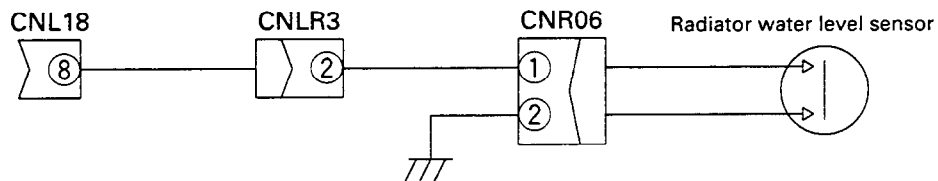
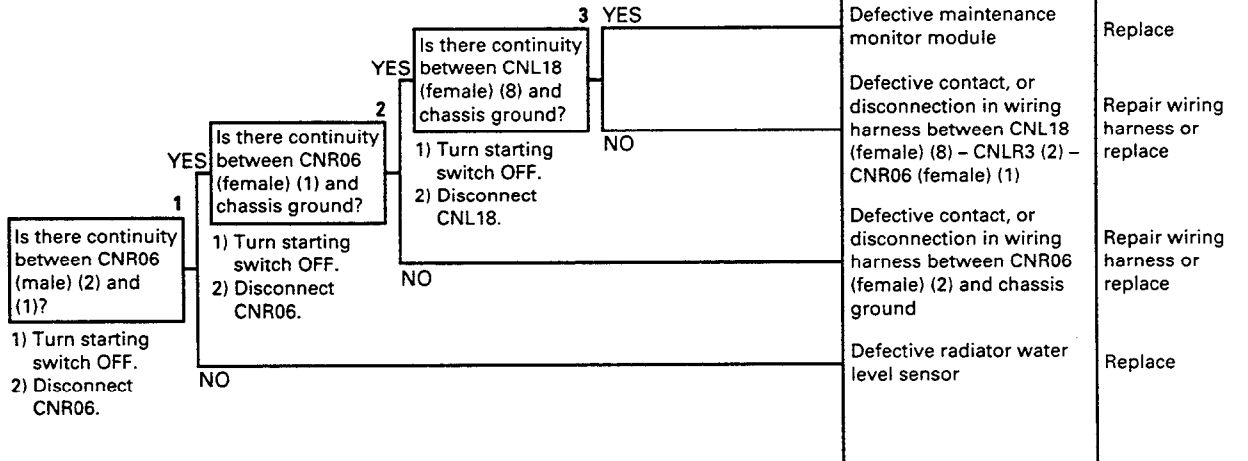
U42303



TDW00316

(b) Engine water level display flashes

- ★ Before starting troubleshooting, check the engine water level again.



TDW00317

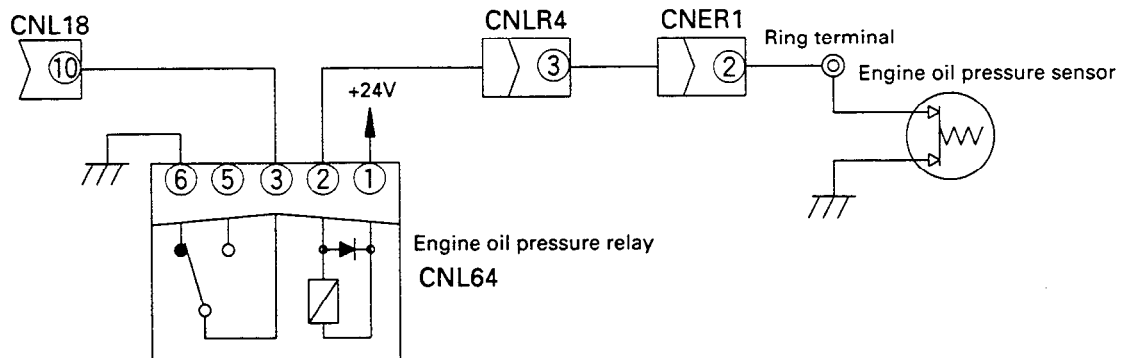
U42303

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 YES 2 NO Is voltage between ring terminal and chassis ground normal? 1) 20 – 30 V 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
	NO	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

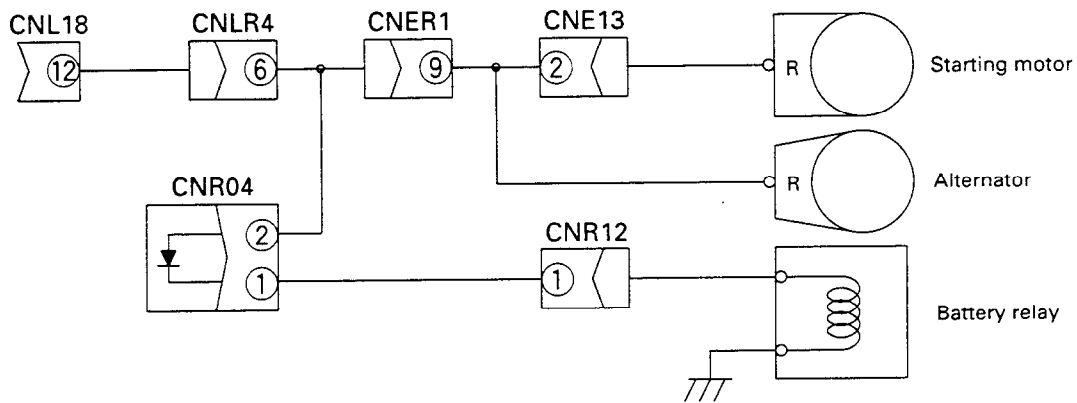


TDW00318

U42303

(b) Battery charge level display flashes

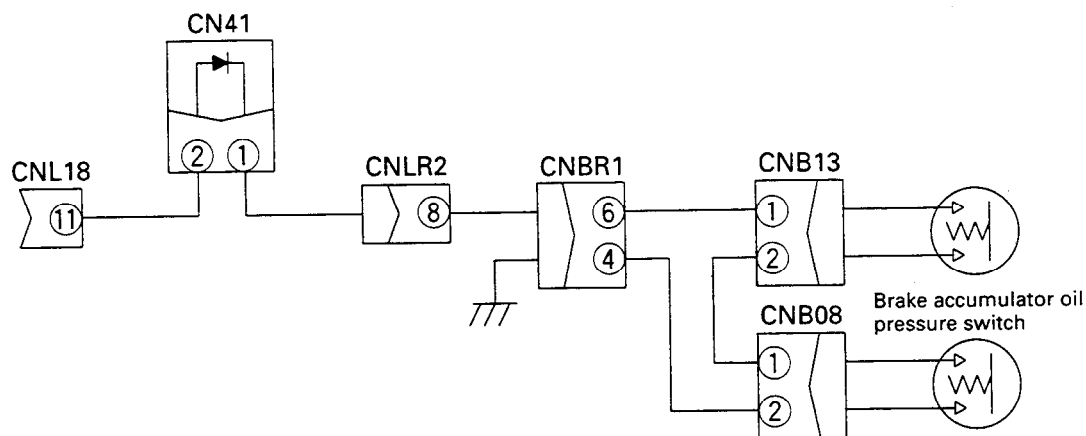
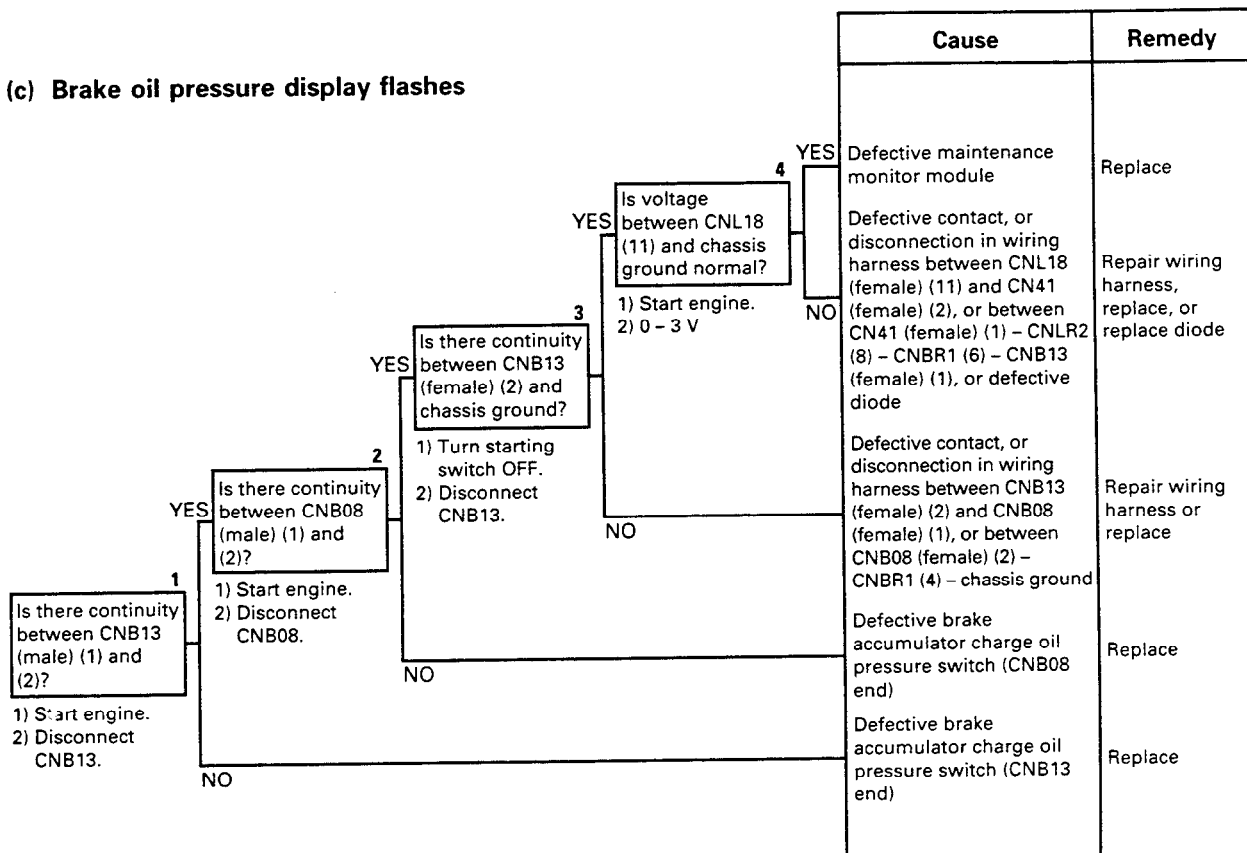
		Cause	Remedy
1 YES Is voltage between alternator terminal R and chassis ground normal? 1) 20 – 30 V 2) Start engine. NO	2 YES Is voltage between CNL18 (female) (12) and chassis ground normal? 1) 20 – 30 V 2) Start engine. NO	Defective maintenance monitor module	Replace
	NO	Disconnection in wiring harness between CNL18 (female) (12) – CNLR4 (6) – CNER1 (9) – alternator terminal R	Repair wiring harness or replace
	NO	Defective alternator	Replace



TDW00319

U42303

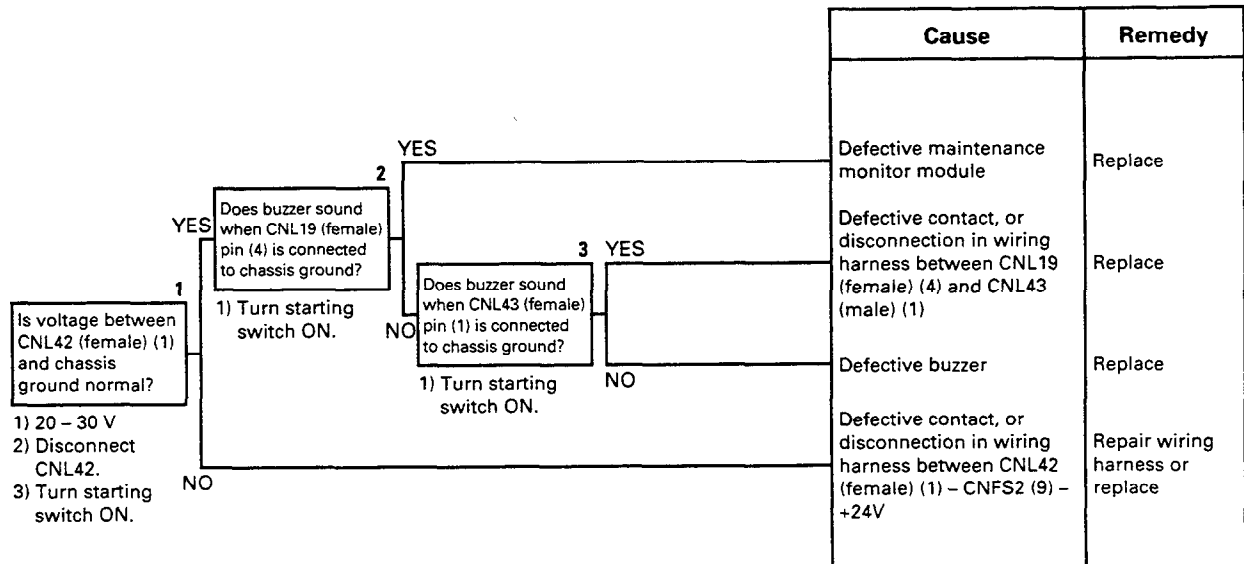
(c) Brake oil pressure display flashes



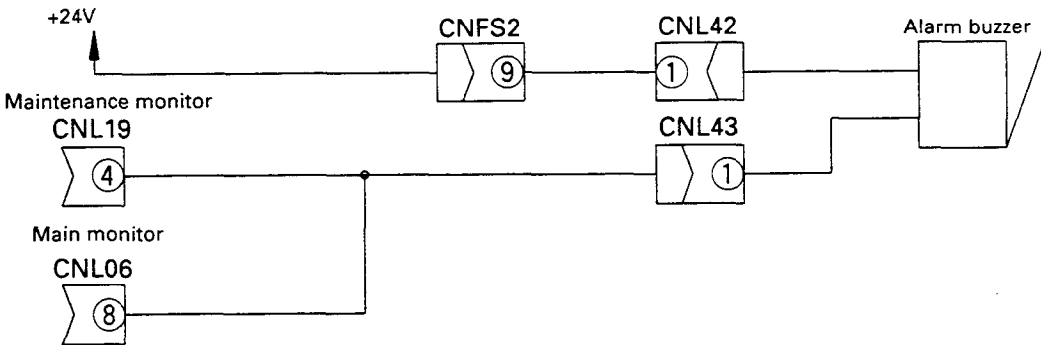
TDW00320

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.



U42303

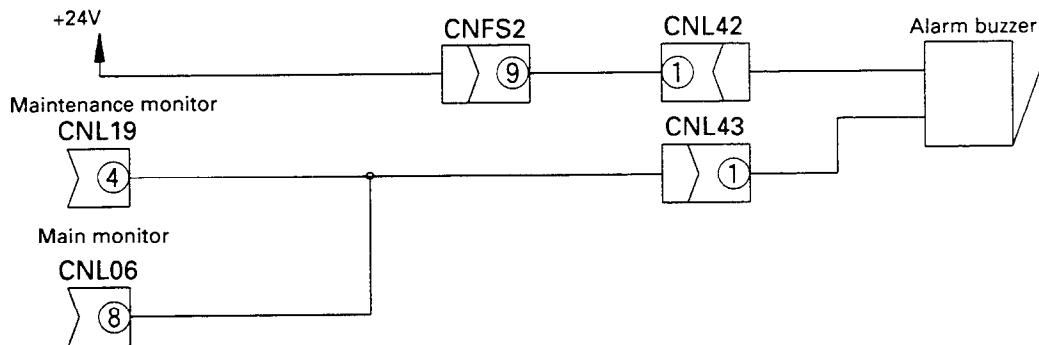


TDW00322

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
1 Is there continuity between CNL43 (female) (1) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNL43. YES NO 2 Is there continuity between CNL19 (female) (4) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNL19. YES NO		Defective buzzer	Replace
		Contact of chassis ground with wiring harness between CNL19 (female) (4) and CNL43 (male) (1)	Repair wiring harness or replace
		Defective maintenance monitor module	Replace



TDW00322

U42303

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

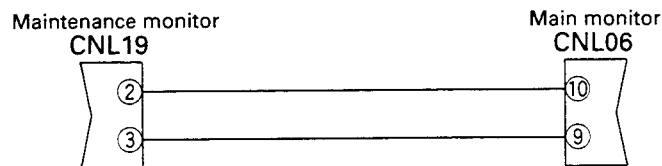
1		YES	Defective maintenance monitor module	Replace
Does check lamp light up when CNL19 (female) pin (2) is connected to chassis ground?		NO		
1) Disconnect CNL19. 2) Turn starting switch ON.		2		
Does check lamp light up when CNL06 (male) pin (10) is connected to chassis ground?		YES	Defective contact, or disconnection in wiring harness between CNL19 (female) (2) and CNL06 (female) (10)	Repair wiring harness or replace
1) Disconnect CNL06. 2) Turn starting switch ON.		NO	Defective main monitor	Replace

(b) CAUTION lamp

1		YES	Defective maintenance monitor module	Replace
Does caution lamp light up when CNL19 (female) pin (3) is connected to chassis ground?		NO		
1) Disconnect CNL19. 2) Turn starting switch ON.		2		
Does caution lamp light up when CNL06 (male) pin (9) is connected to chassis ground?		YES	Defective contact, or disconnection in wiring harness between CNL19 (female) (3) and CNL06 (female) (9)	Repair wiring harness or replace
1) Disconnect CNL06. 2) Turn starting switch ON.		NO	Defective main monitor	Replace

(b) CAUTION lamp

		Cause	Remedy		
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 maintenance monitor module	Replace		
	NO	2 Does caution lamp light up when CNL06 (male) pin (9) is connected to chassis ground? 1) Disconnect CNL06. 2) Turn starting switch ON.	YES	Defective contact, or disconnection in wiring harness between CNL19 (female) (3) and CNL06 (female) (9)	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

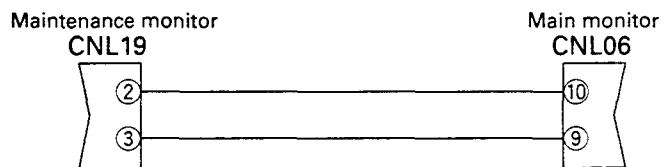
(b) CAUTION lamp

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



TDW00324

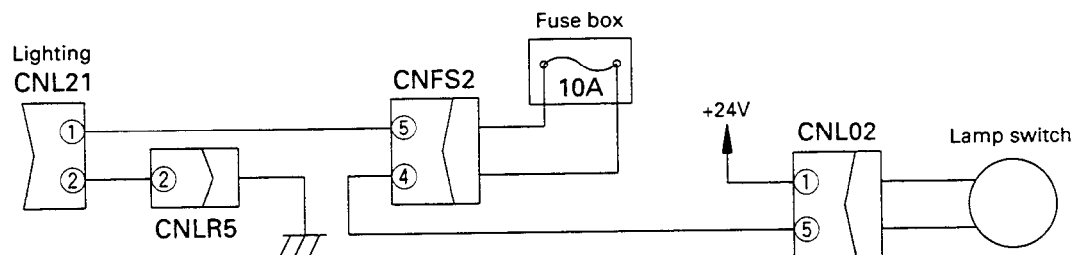
U42303

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

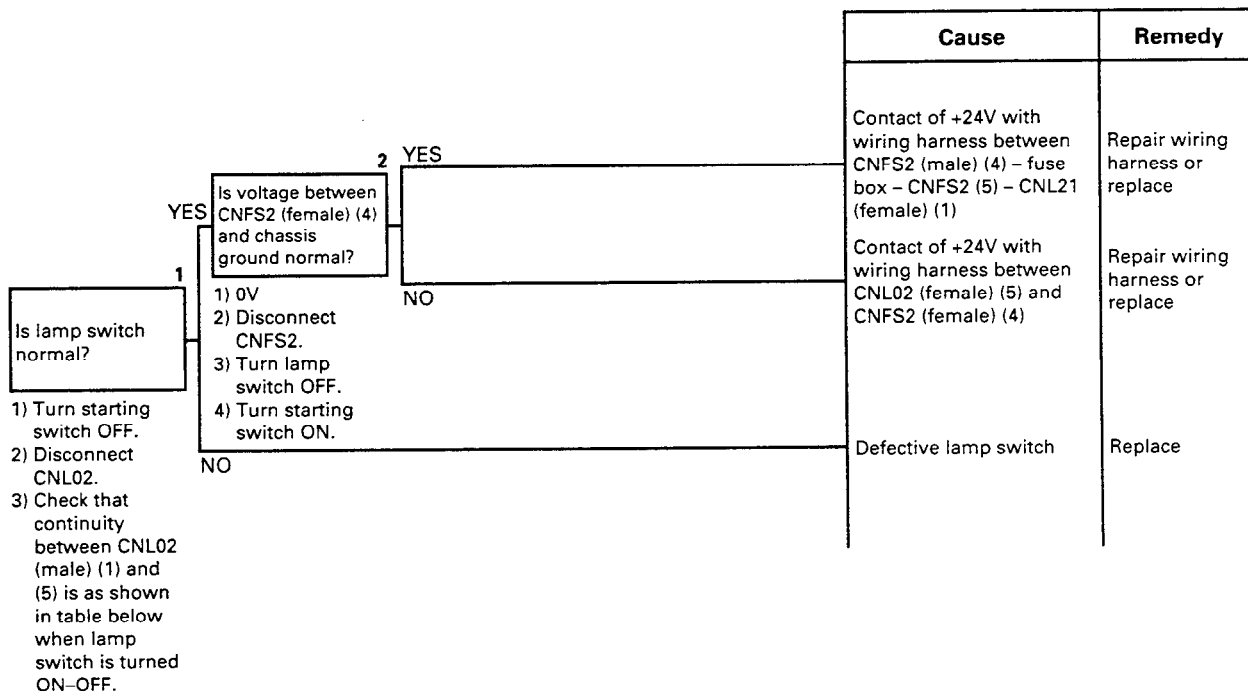
U42303



TDW00326

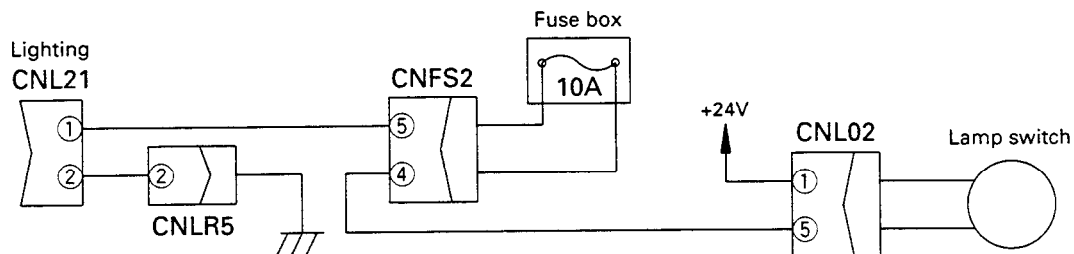
K-11 Night lighting lights up even when lamp switch is OFF, night lighting stays lighted up

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the the next step.



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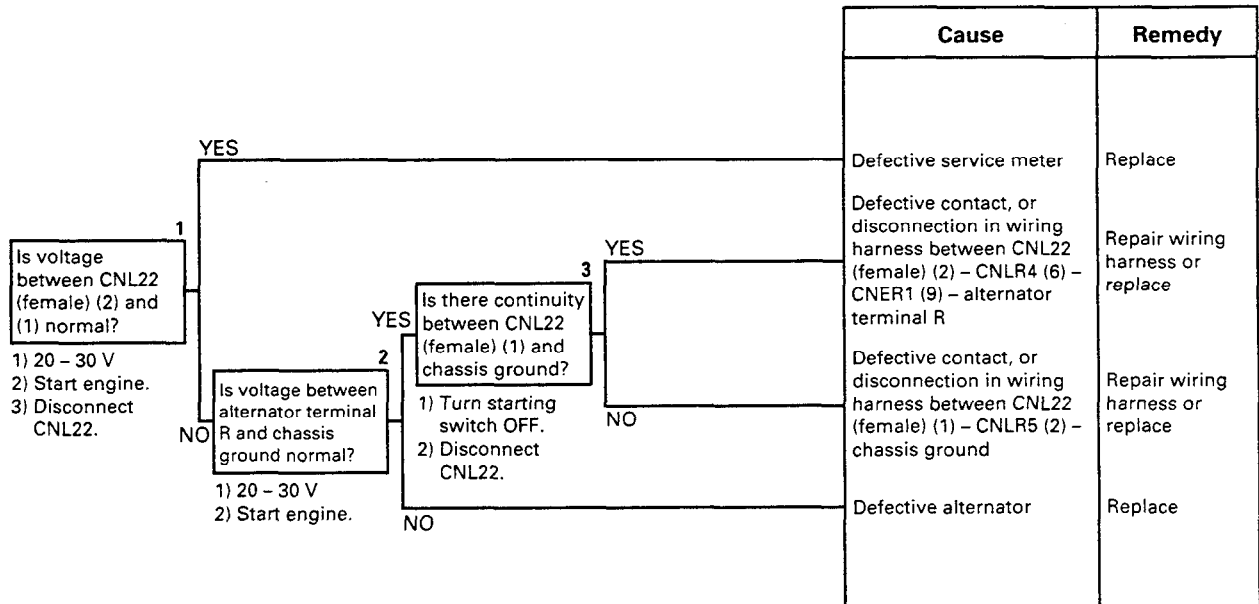
Switch	Continuity
ON	Continuity
OFF	NO continuity



TDW00326

K-12 Service meter does not work

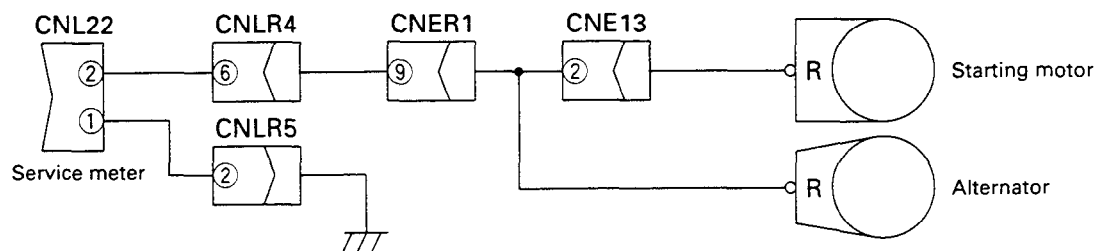
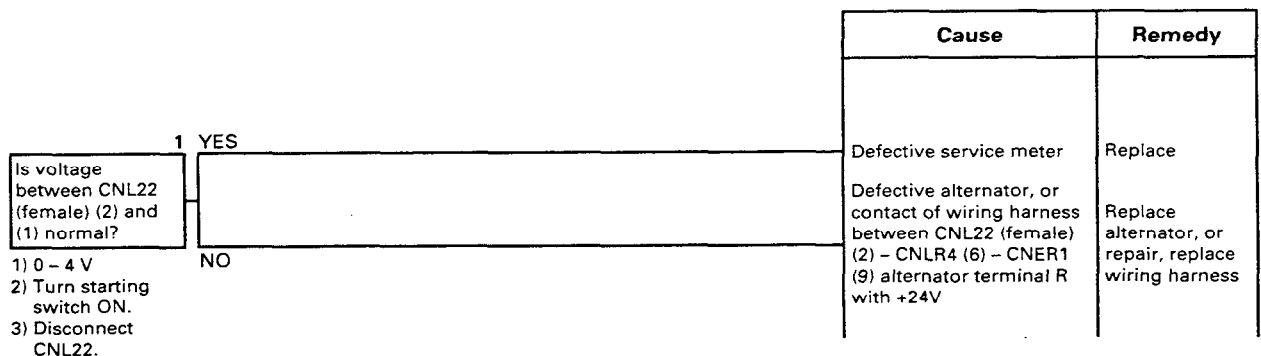
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.



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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

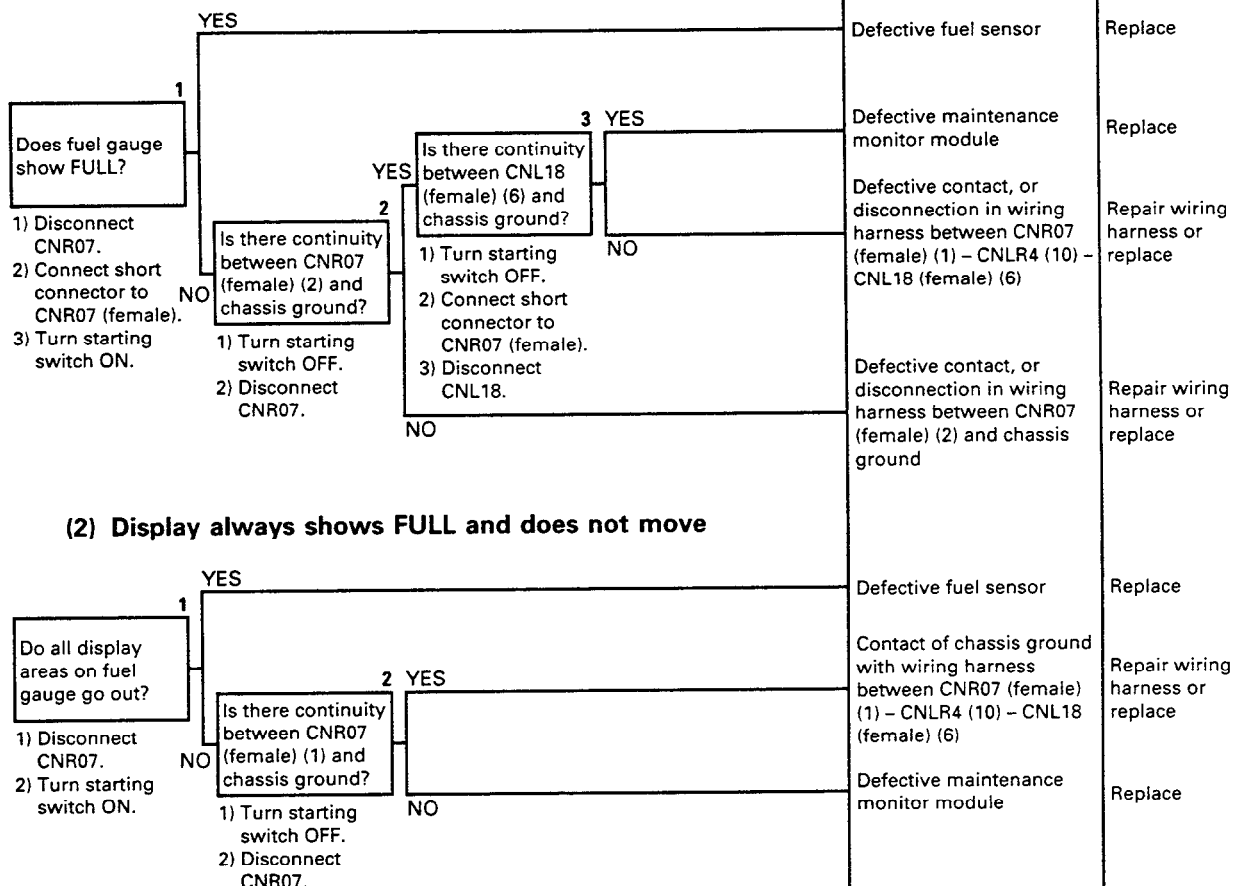
K-14 Abnormality in gauge items

- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.

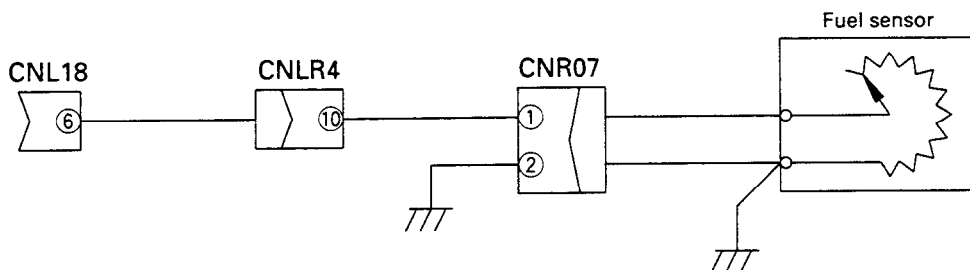
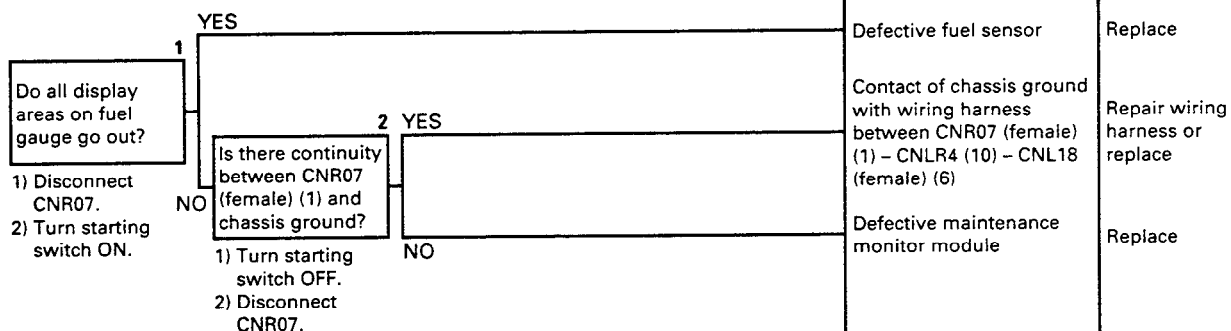
(a) Abnormality in fuel gauge

- ★ Before carrying out troubleshooting, check the fuel level again.

(1) Little or nothing is displayed in the display area



(2) Display always shows FULL and does not move



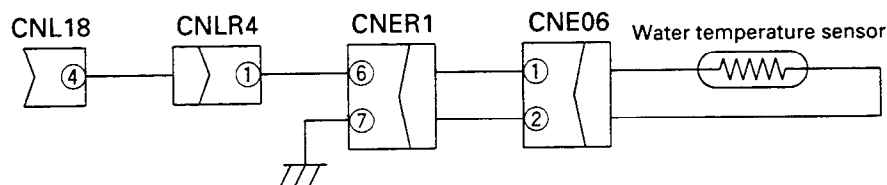
TDW00329

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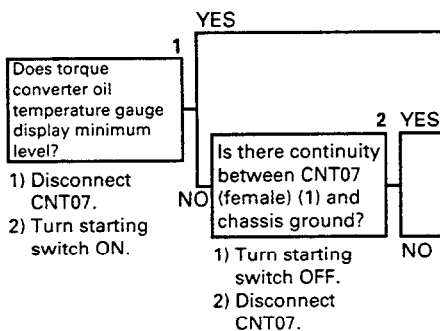
(b) Abnormality in engine water temperature gauge**(1) Nothing is displayed in the display area**

		Cause	Remedy		
1 Does engine water temperature gauge display minimum level? 1) Disconnect CNE06. 2) Turn starting switch ON.	YES	Defective engine water temperature sensor	Replace		
	2 YES Is there continuity between CNE06 (female) (1) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNE06.	YES	Contact of chassis ground with wiring harness between CNE06 (female) (1) – CNER1 (6) – CNLR4 (1) – CNL18 (female) (4)	Repair wiring harness or replace	
		NO	Defective maintenance monitor module	Replace	
	(2) Display shows lowest level and does not move				
1 Do all display areas on engine water temperature gauge go out? 1) Disconnect CNE06. 2) Connect short connector to CNE06 (female). 3) Turn starting switch ON.	YES	Defective engine water temperature sensor	Replace		
	2 Is there continuity between CNE06 (female) (2) and chassis ground? 1) Turn starting switch OFF. 2) Disconnect CNE06.	YES	Defective maintenance monitor module	Replace	
		3 YES Is there continuity between CNL18 (female) (4) and chassis ground? 1) Turn starting switch OFF. 2) Connect short connector to CNE06 (female). 3) Disconnect CNL18.	YES	Defective contact, or disconnection in wiring harness between CNE06 (female) (1) – CNER1 (6) – CNLR4 (1) – CNL18 (female) (4)	Repair wiring harness or replace
			NO	Defective contact, or disconnection in wiring harness between CNE06 (female) (2) – CNER1 (7) – chassis ground	Repair wiring harness or replace
	NO				

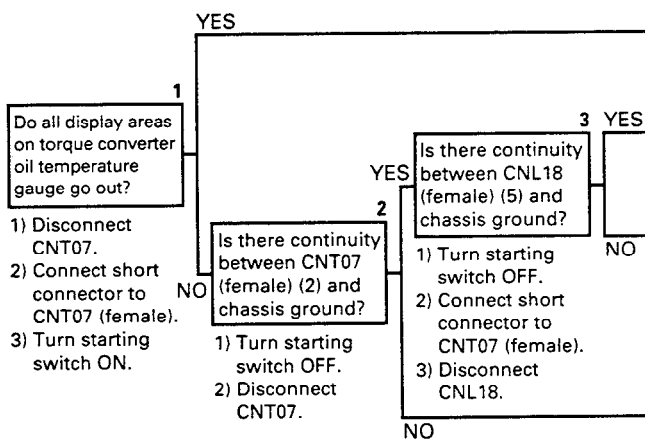
U42303



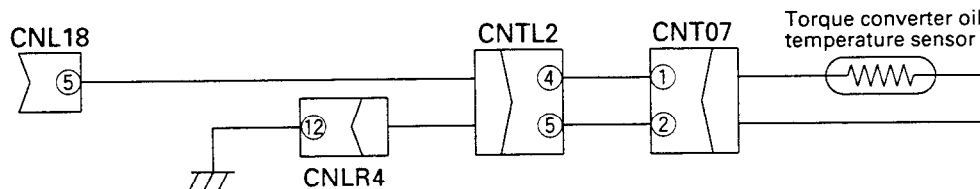
TDW00330

(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



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TROUBLESHOOTING OF ELECTRICAL SYSTEM (E MODE)

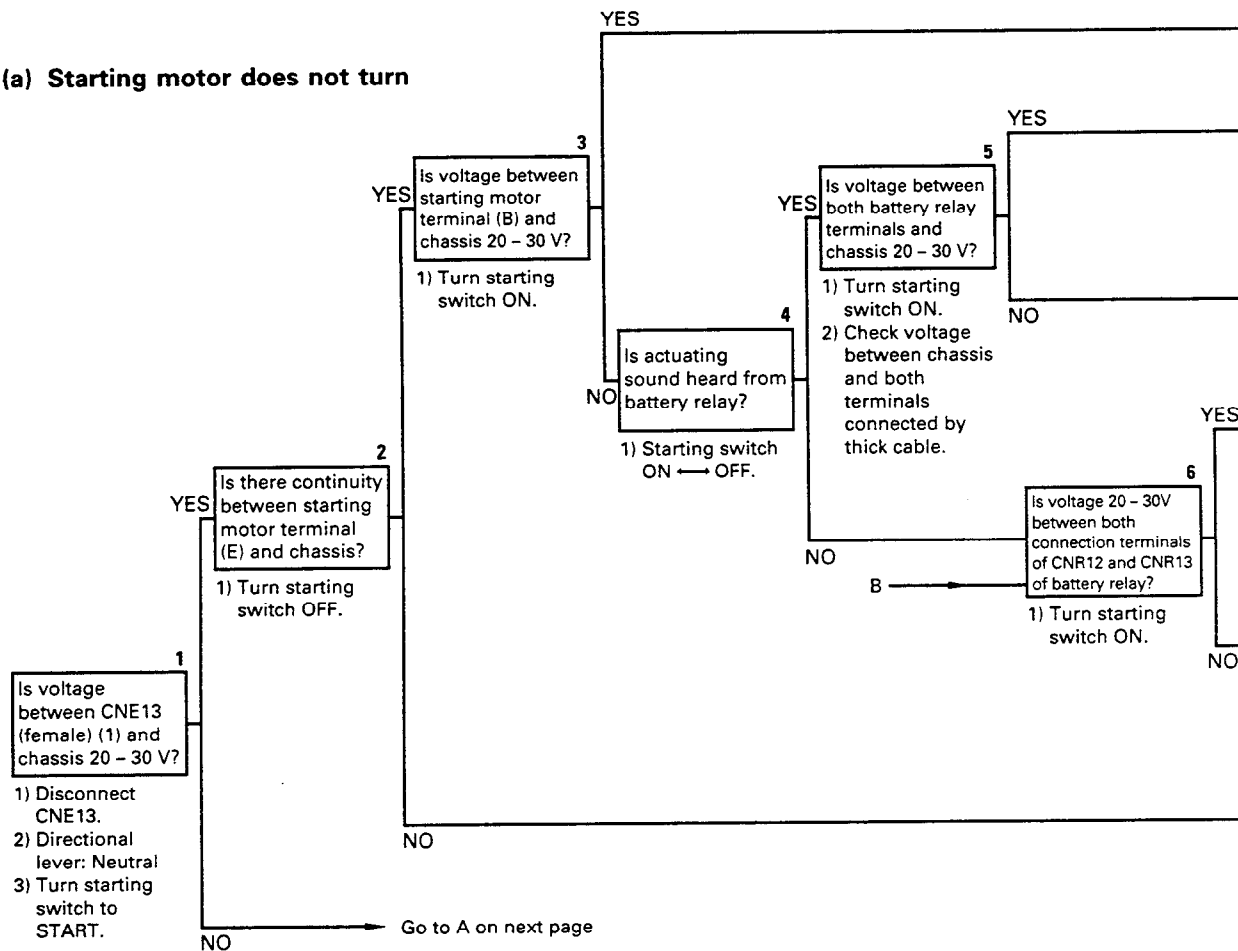
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E- 1	Engine does not start	20-352
	(a) Starting motor does not turn	20-352
	(b) Starting motor turns	20-356
E- 2	Engine does not stop	20-358
E- 3	Engine stops when machine is traveling	20-358
E- 4	Parking brake does not work	20-359
	(a) Parking brake has no effect when parking brake switch is turned on	20-359
	(b) Parking brake has no effect when brake pressure drops	20-359
E- 5	Parking brake is applied when machine is traveling	20-360
E- 6	Parking brake is released when starting switch is turned ON	20-362
E- 7	Transmission does not change to neutral when parking brake is applied	20-362
E- 8	Transmission does not work normally	20-364
	(a) Problem in common circuit for transmission (always stays in 2nd)	20-366
	(b) Problem in H-L circuit	20-366
	(c) Problem in speed circuit	20-367
	(d) Problem in 4th circuit (does not enter 4th)	20-367
	(e) Contact in H-L circuit	20-368
	(f) Contact in speed circuit	20-370
	(g) Contact in 4th circuit (always stays in 4th)	20-372
	(h) Problem in FORWARD circuit (REVERSE is normal)	20-374
	(i) Problem in REVERSE circuit (FORWARD is normal)	20-376
	(j) Problem in common circuit for FORWARD and REVERSE (does not travel forward, parking brake is normal)	20-378
	(k) Contact in FORWARD circuit	20-380
	(l) Contact in REVERSE circuit	20-382
	(m) Problem in common circuit for FORWARD and REVERSE	20-384
E- 9	Kick-down switch does not work	20-386
E-10	Kick-down works only when kick-down switch is ON (Kick-down switch relay does not hold in position)(self-holding function))	20-388
E-11	Kick-down operation cannot be canceled	20-388
	(a) Not canceled even when directional lever is moved from F to N or R	20-388
	(b) Not canceled even when speed lever is moved from 2nd to other position (becomes 4th)	20-390
E-12	Kick-down switch is actuated by mistake when traveling in 2nd	20-392

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 $\bigcirc$ Δ ().
- ★ 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.

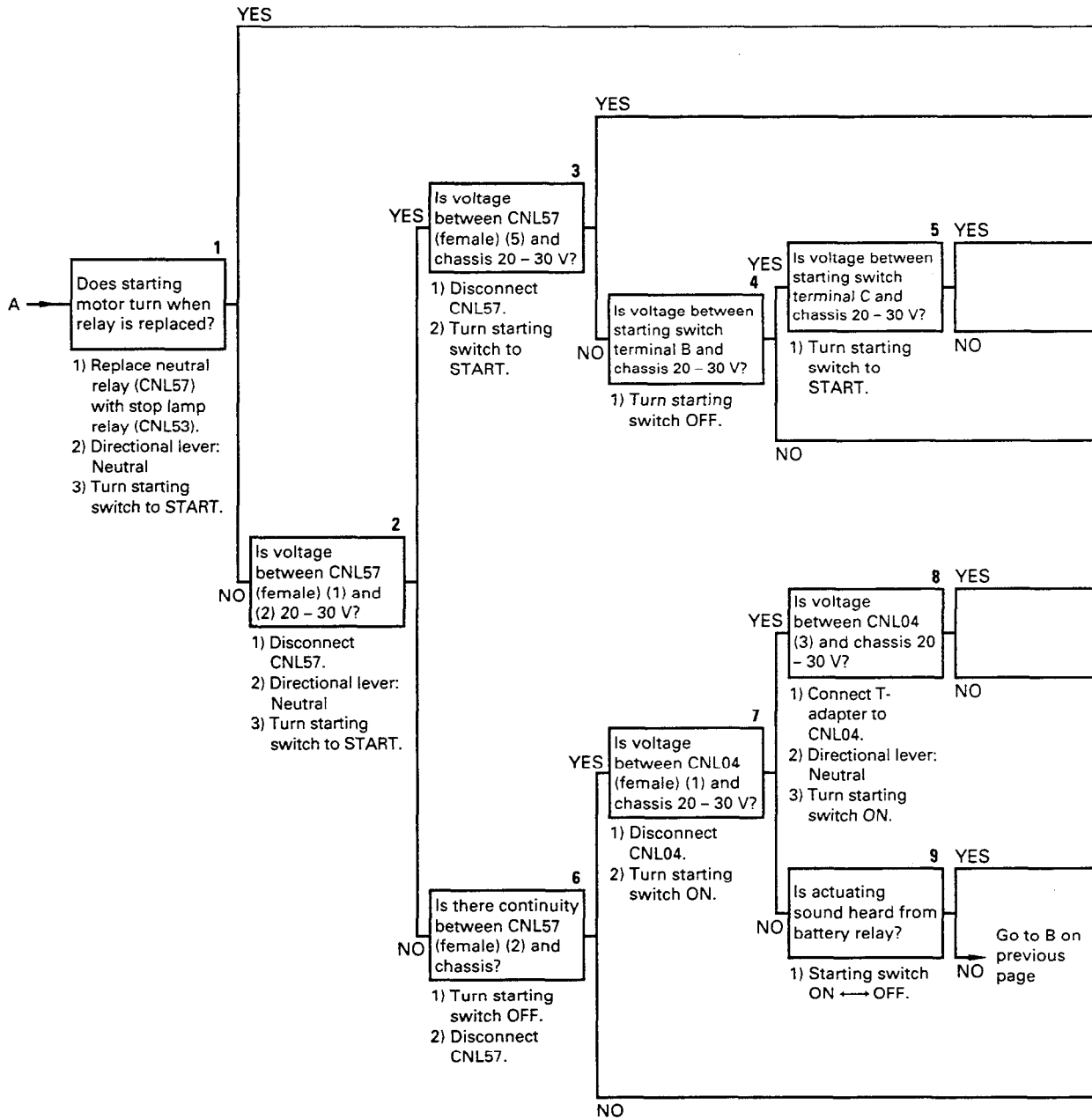
(a) Starting motor does not turn



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		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
	7	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 disconnection in wiring harness between CNR13 and chassis ground	After inspection, repair or replace
	NO	Defective starting switch	Replace
		Defective contact, or disconnection in starting motor ground cable	After inspection, repair or replace

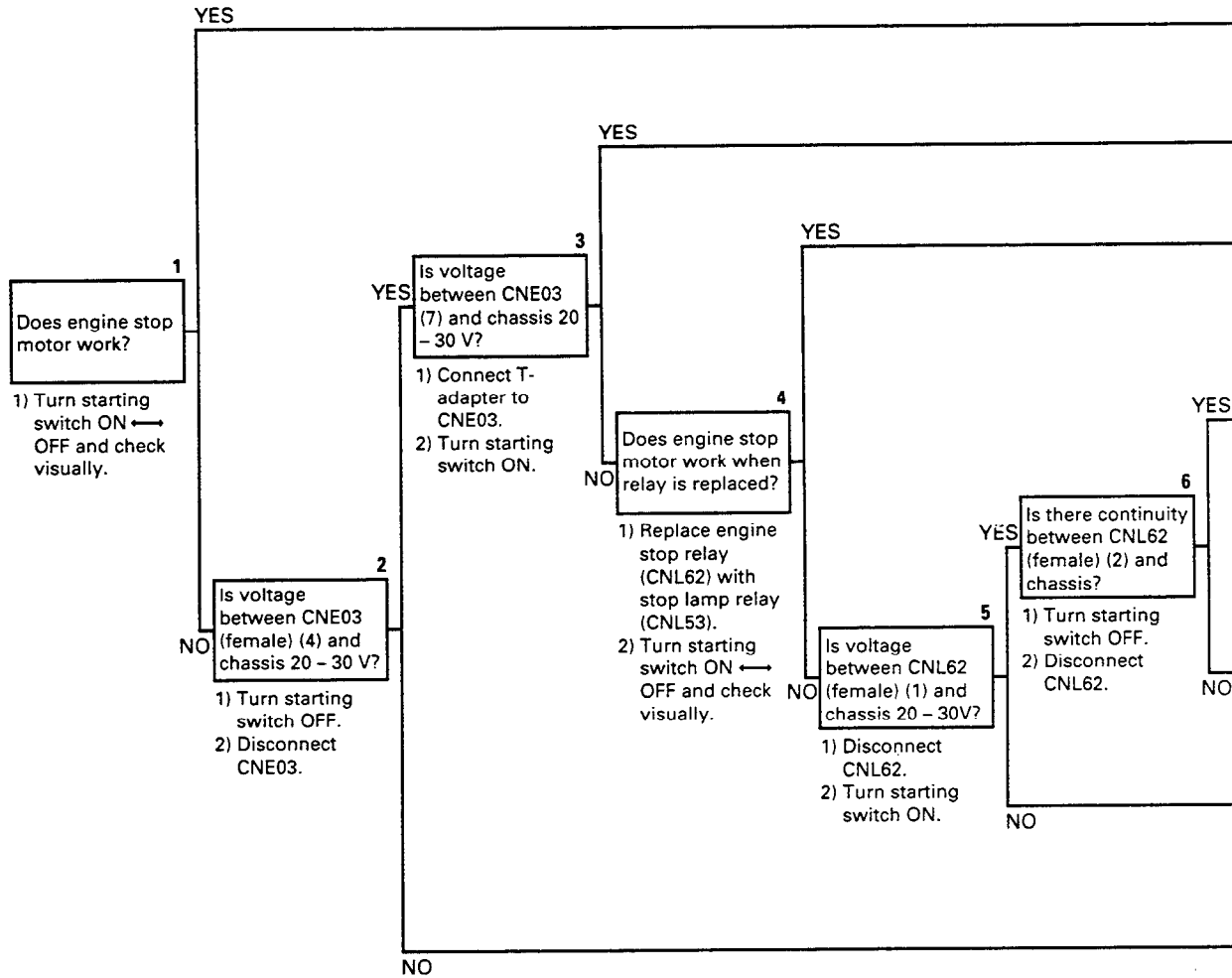


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		Cause	Remedy
		Defective neutral relay	Replace
		Defective contact, or disconnection in wiring harness between CNL57 (female) (3) – CNLR4 (8) – CNR01, 02 (diode) – CNER1 (10) – CNE13 (female) (1)	After inspection, repair or replace
		Defective contact, 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

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	

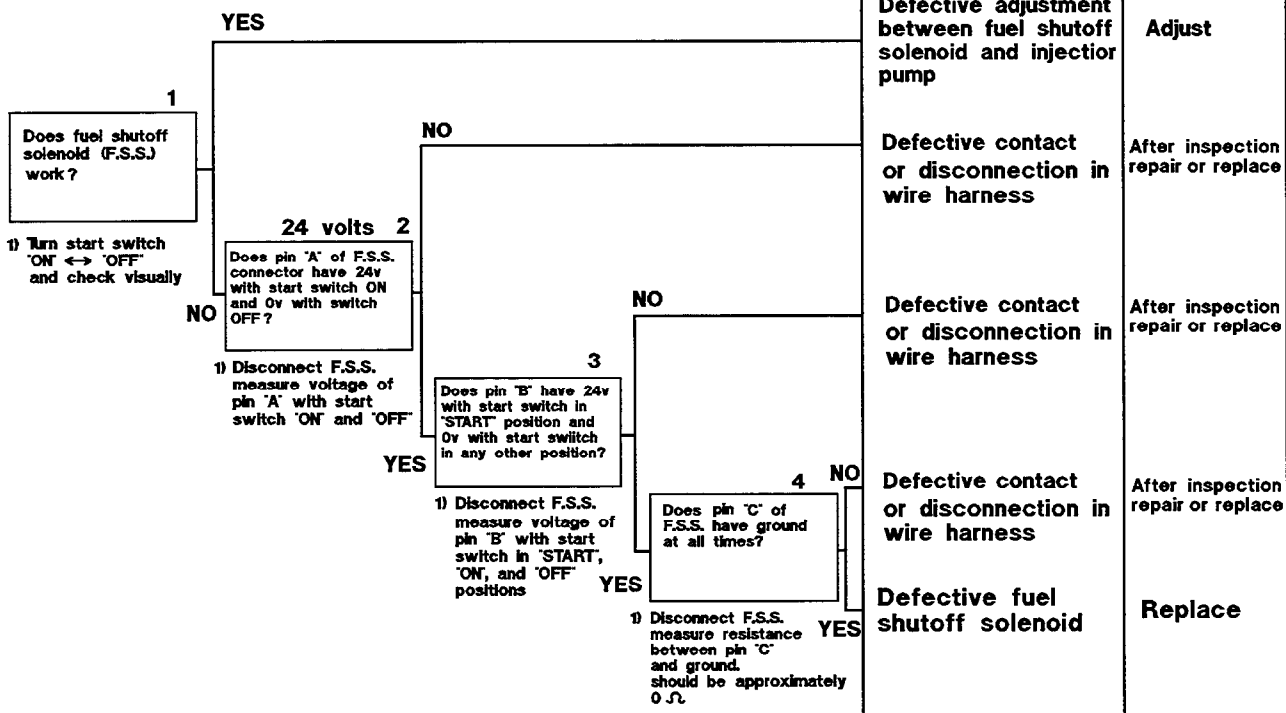
(b) Starting motor turns



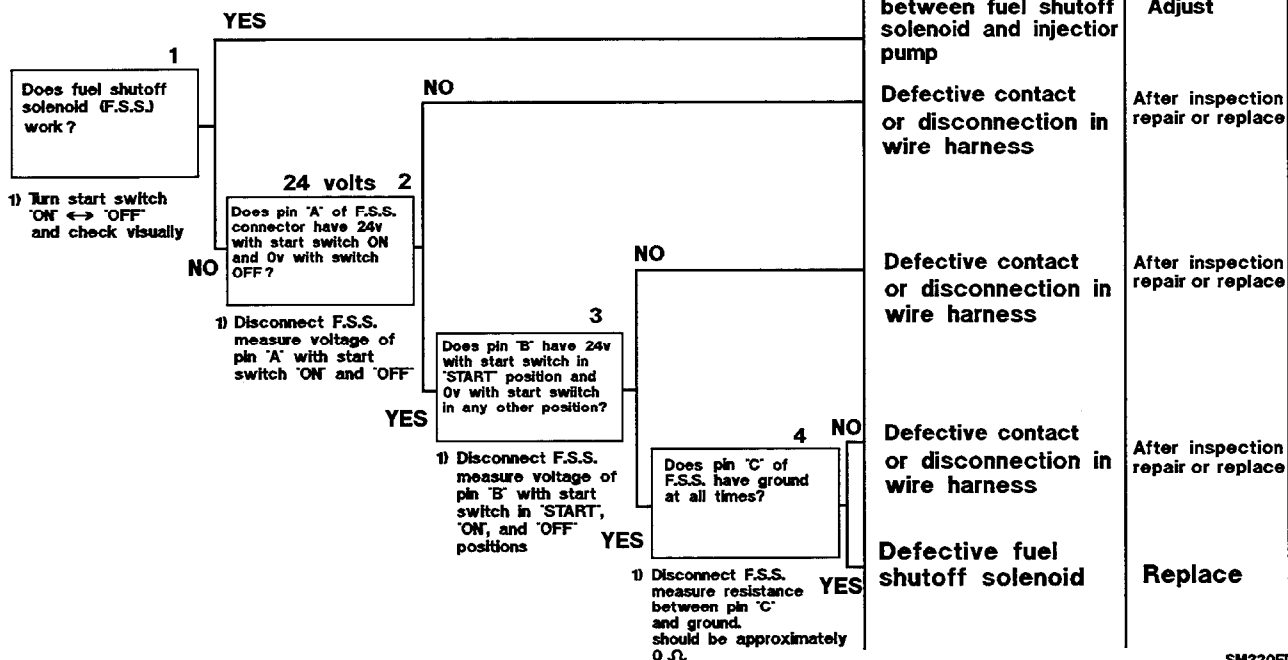
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		Cause	Remedy
		Defective adjustment of wire between engine stop motor and lever	Adjust
		Defective engine stop motor, or defective contact, or disconnection in wiring harness between CNE03 (female) (8) – CNER2 (5) – chassis ground	After inspection, repair or replace
		Defective engine stop relay	Replace
		Defective engine stop motor	Replace
Is there continuity between CNE03 (female) (5) and (7)? 7 YES NO 1) Disconnect CNE03. 2) Turn starting switch ON.		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
		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**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).

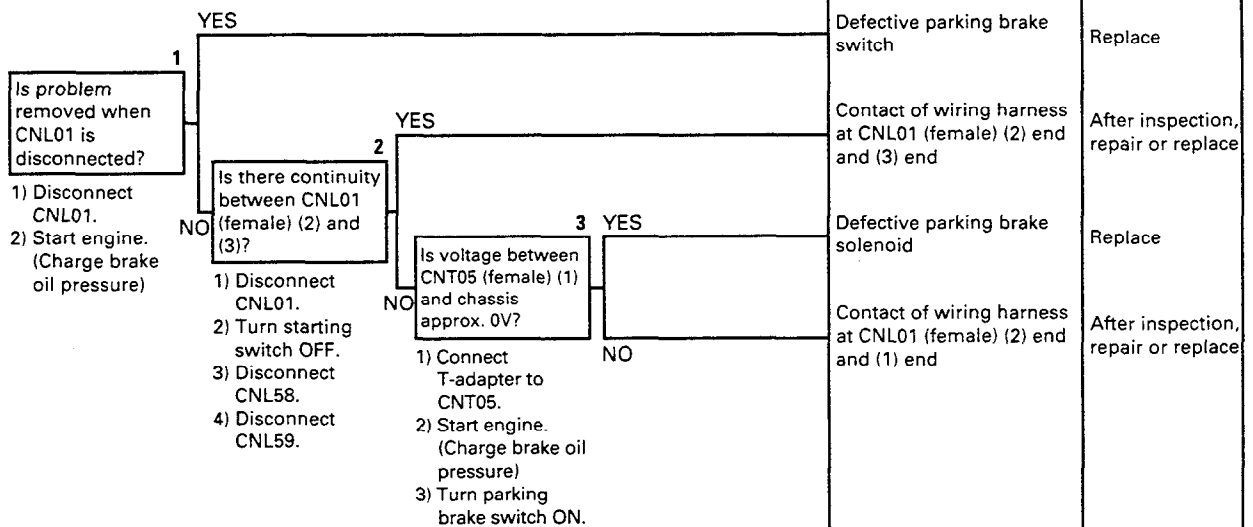


SM320EDN

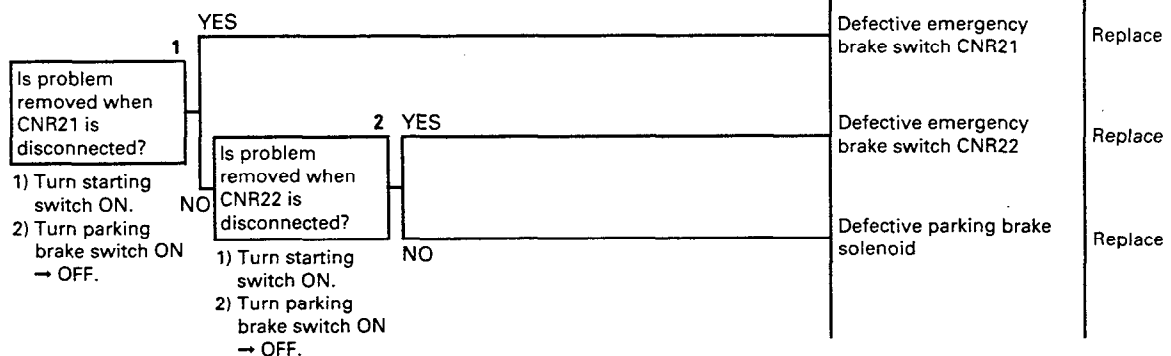
E-4 Parking brake does not work

- ★ 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)

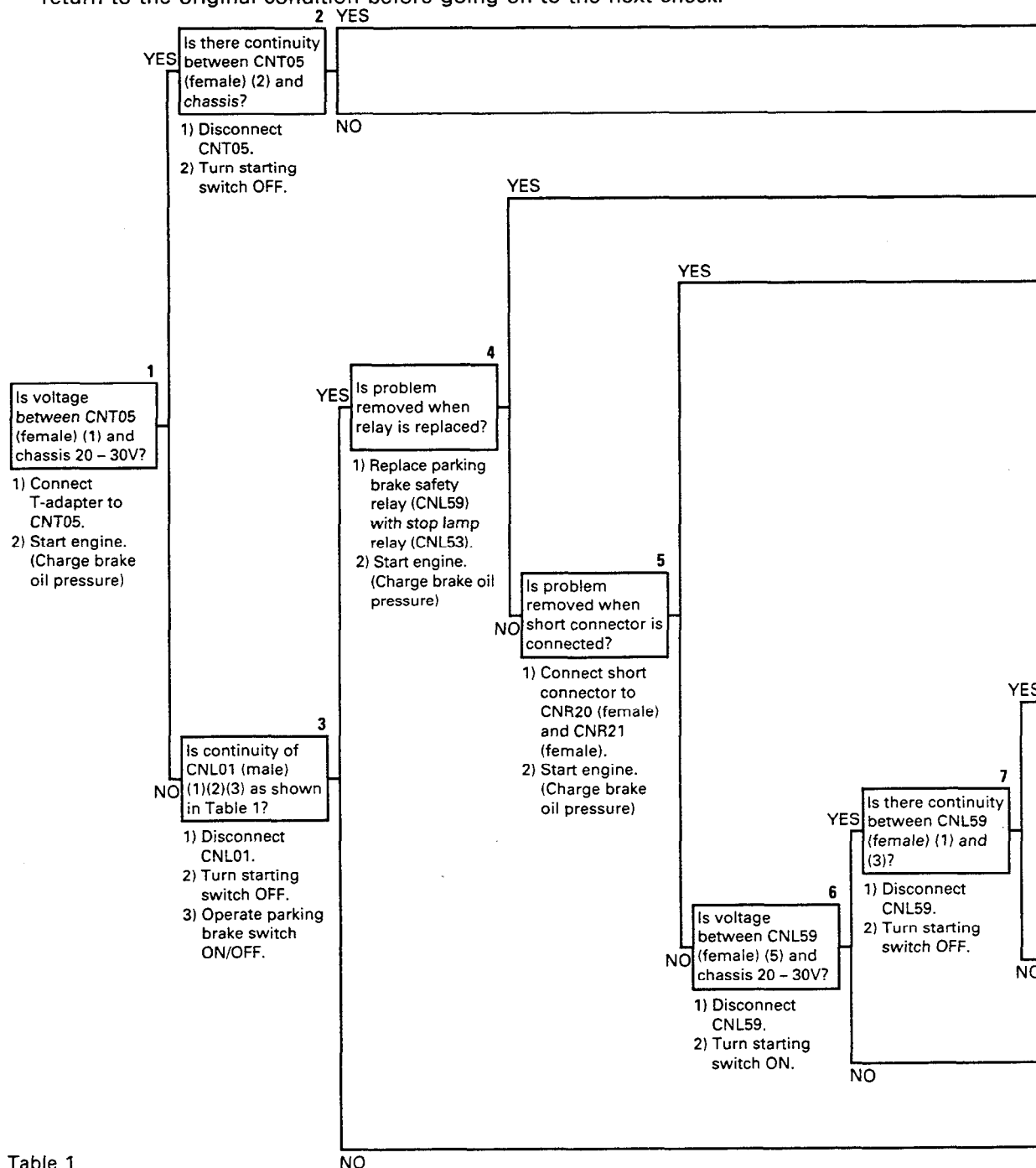


(b) Parking brake has no effect when brake pressure drops (Does not work as emergency brake)



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.



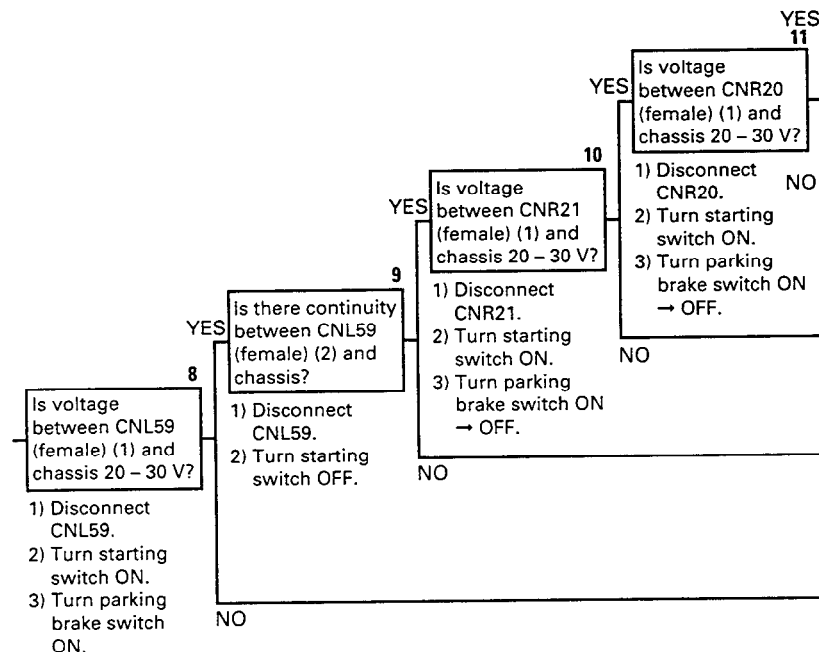
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Table 1

Operation	Between terminal (2) - (3)	Between terminal (1) - (3)
ON (parking)	No continuity	Continuity
OFF (travel)	Continuity	No continuity

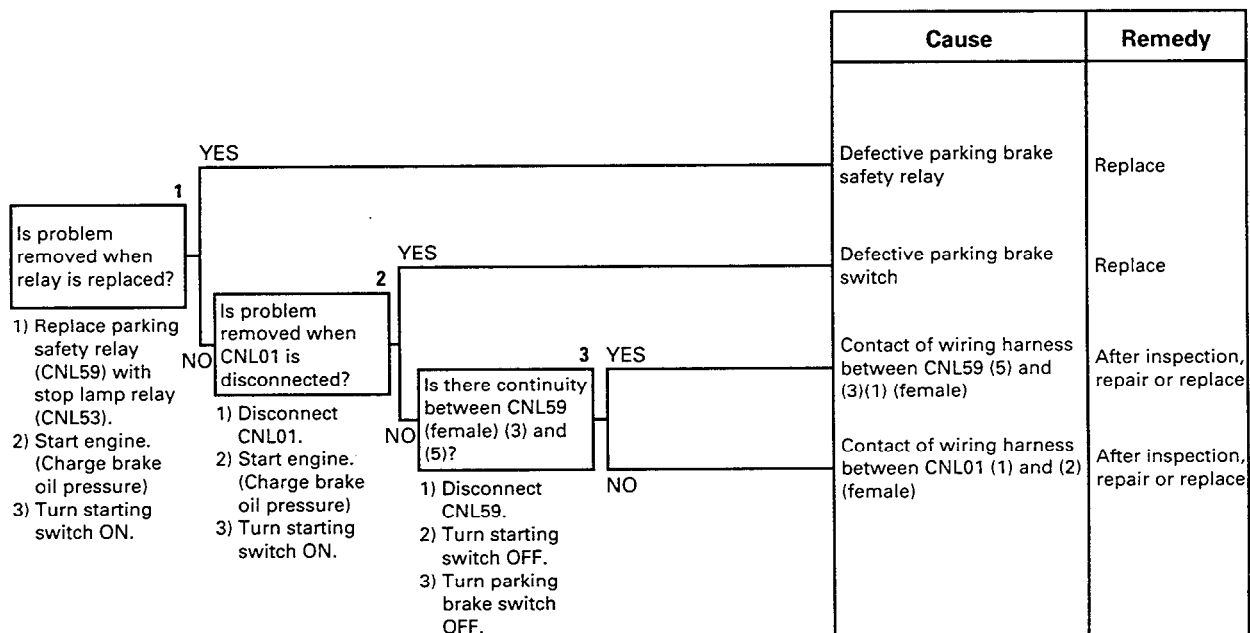
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		Cause	Remedy
		Defective parking brake solenoid	Replace
		Defective contact, or disconnection in wiring harness between CNT05 (female) (2) and chassis	After inspection, repair or replace
		Defective parking brake safety relay	Replace
		Defective emergency brake switch	Replace
		Defective contact, or disconnection in wiring harness between CNR20 (female) (2) and CNT05 (female) (1)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNR21 (female) (2) and CNR20 (female) (1)	After inspection, repair or replace
		Defective contact, or disconnection in wiring harness between CNR21 (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



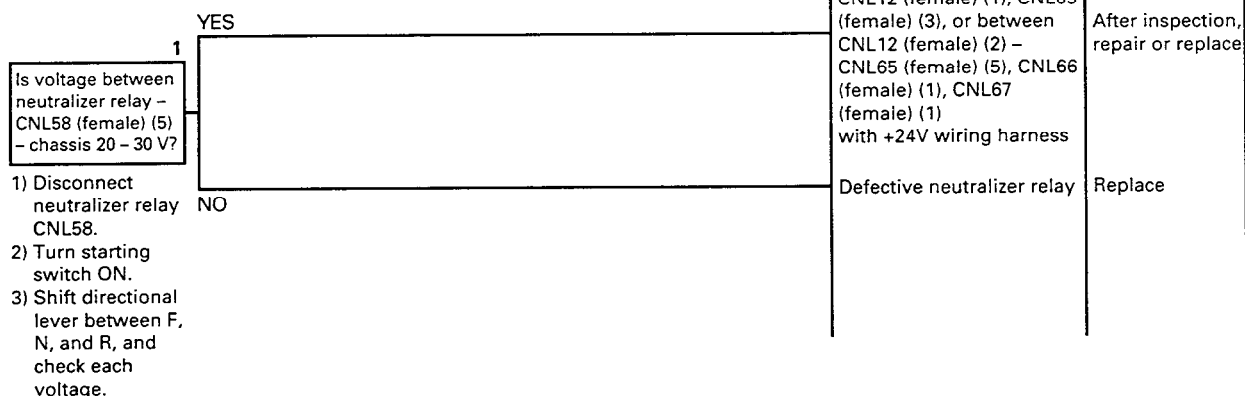
E-6 Parking brake is released when starting switch is turned ON

- ★ 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.



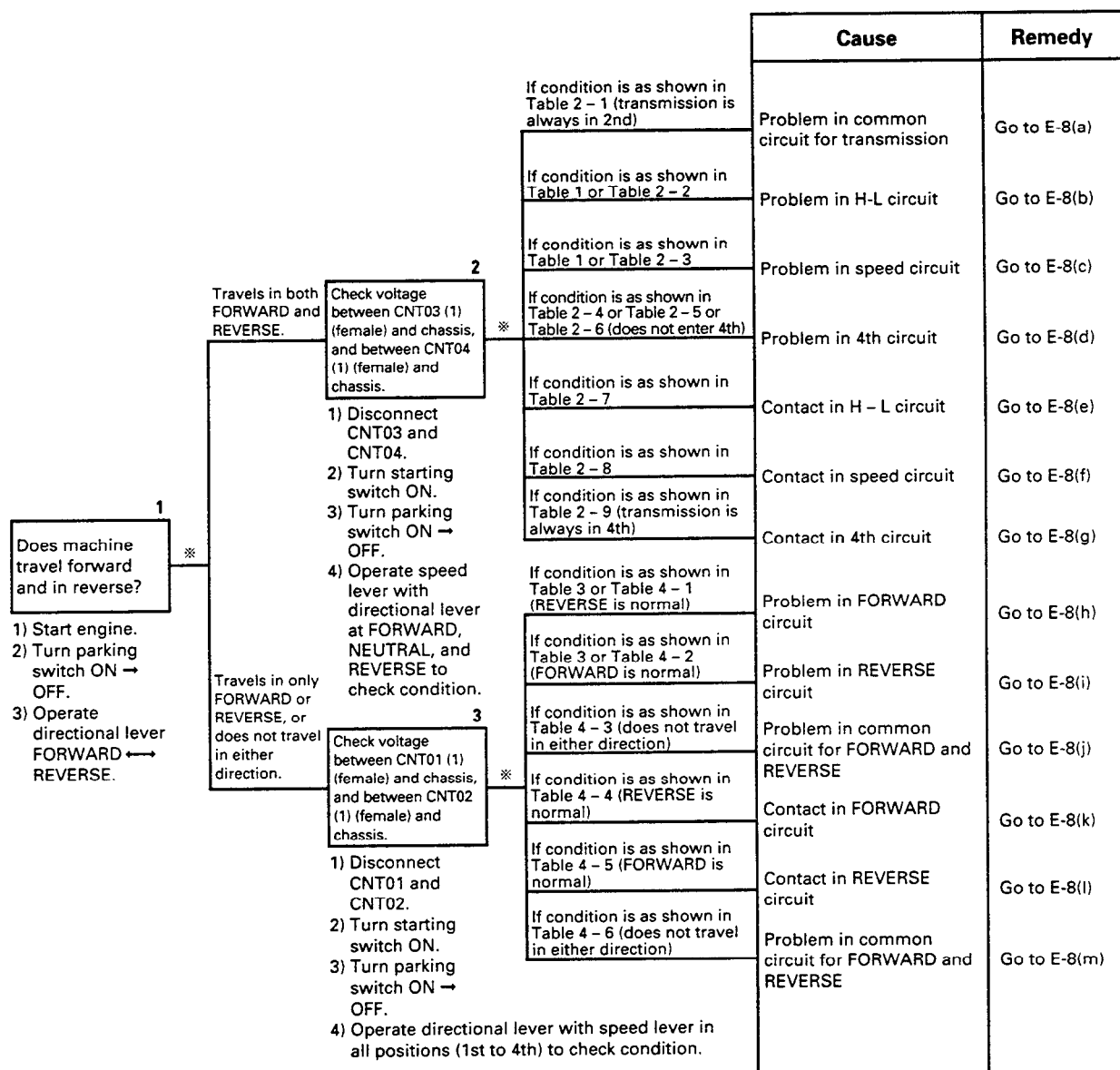
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E-7 Transmission does not change to neutral when parking brake is applied (but parking brake works normally)



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)

Directional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	○
REVERSE	○	●

Table 3 (normal)

Directional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	○	○
REVERSE	○	●

Table 4-1 (abnormal)

Directional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	○
REVERSE	○	○

Table 4-2 (abnormal)

Directional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	○	○
REVERSE	○	○

Table 4-3 (abnormal)

Directional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	●
REVERSE	○	●

Table 4-4 (abnormal)

Directional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	○
REVERSE	●	●

Table 4-5 (abnormal)

Directional lever	Between CNT01 (female) (1) chassis ground	Between CNT02 (female) (1) chassis ground
FORWARD	●	●
REVERSE	●	●

Table 4-6 (abnormal)

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(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 2 YES Is voltage between CNT03 (female) (1) and chassis 20 – 30V? 1) Disconnect CNT03. 2) Turn starting switch ON. 3) Speed lever: 3rd	Defective H – L solenoid	Replace
	NO 3 YES Is voltage between CNL04 (7) and chassis 20 – 30V? 1) Connect T-adapter to CNL04. 2) Turn starting switch ON. 3) Speed lever: 3rd	Defective contact, or disconnection in wiring harness between CNL04 (female) (7) – CNTL1 (5) – CNT03 (female) (1)	After inspection, repair or replace
	NO	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

Cause	Remedy
Defective speed solenoid	Replace
Defective contact, or disconnection in wiring harness between CNL04 (female) (5) – CNTL1 (6) – CNT04 (female) (1)	After inspection, repair or replace
Defective speed lever switch	Replace
Defective contact, or disconnection in wiring harness between CNT04 (female) (2) and chassis ground	After inspection, repair or replace

1) Disconnect CNT04. 2) Turn starting switch OFF.	1) Disconnect CNT04. 2) Turn starting switch ON. 3) Speed lever: 1st	1) Connect T-adaptor to CNL04. 2) Turn starting switch ON. 3) Speed lever: 1st	
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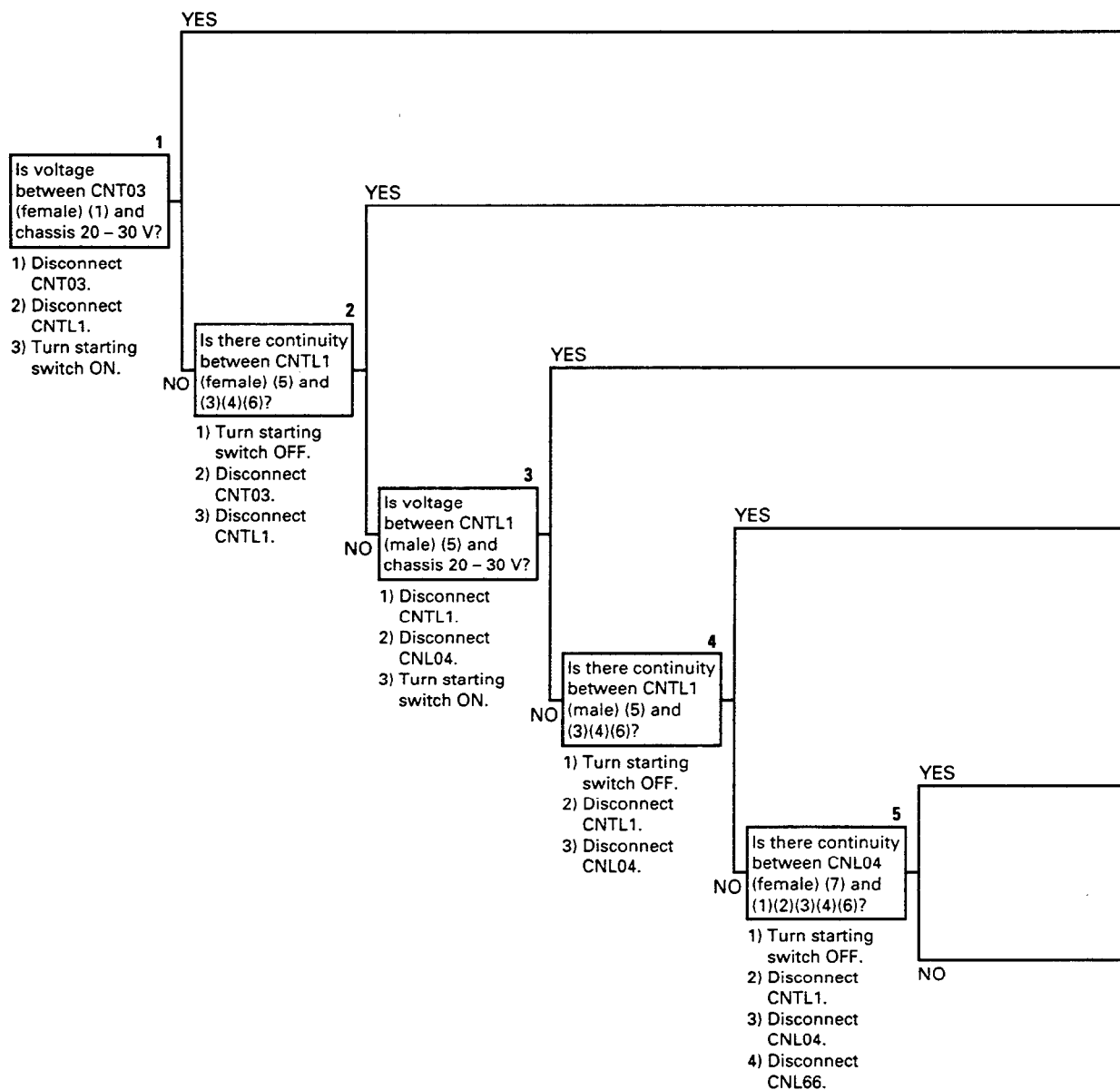
1) Connect T-adaptor to CNL04. 2) Turn starting switch ON. 3) Speed lever: 4th	
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(d) Problem in 4th circuit (does not enter 4th)

1) Connect T-adaptor to CNL04. 2) Turn starting switch ON. 3) Speed lever: 4th		Defective contact, or disconnection in wiring harness between CNL04 (female) (8) – CN37 – CNTL1 (male) (6) or CNL04 (female) (8) – CN38 – CNTL1 (male) (5)	After inspection, repair or replace
		Defective speed lever switch	Replace

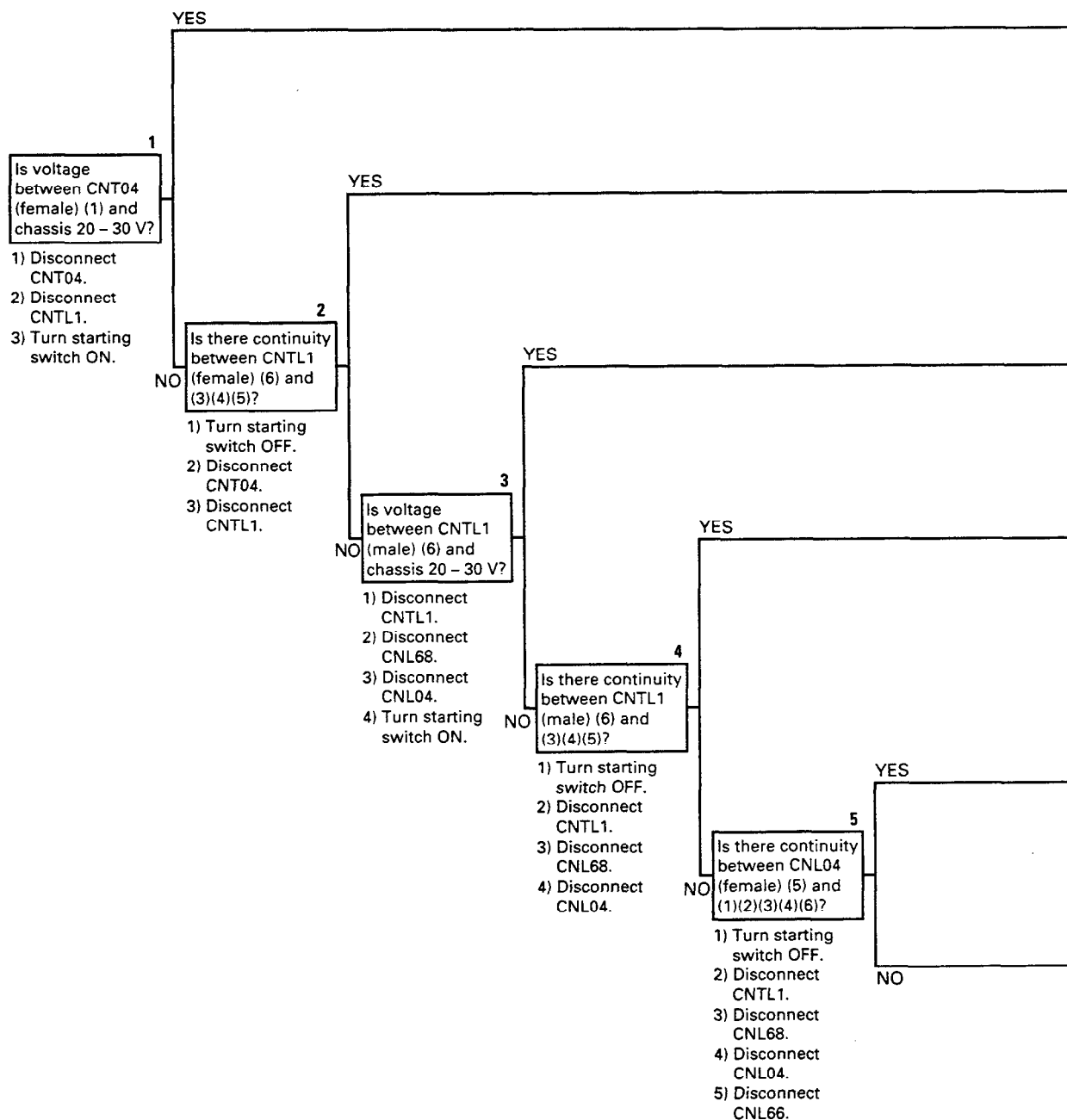
(e) Contact in H-L circuit



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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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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

(g) Contact in 4th circuit (always stays in 4th)

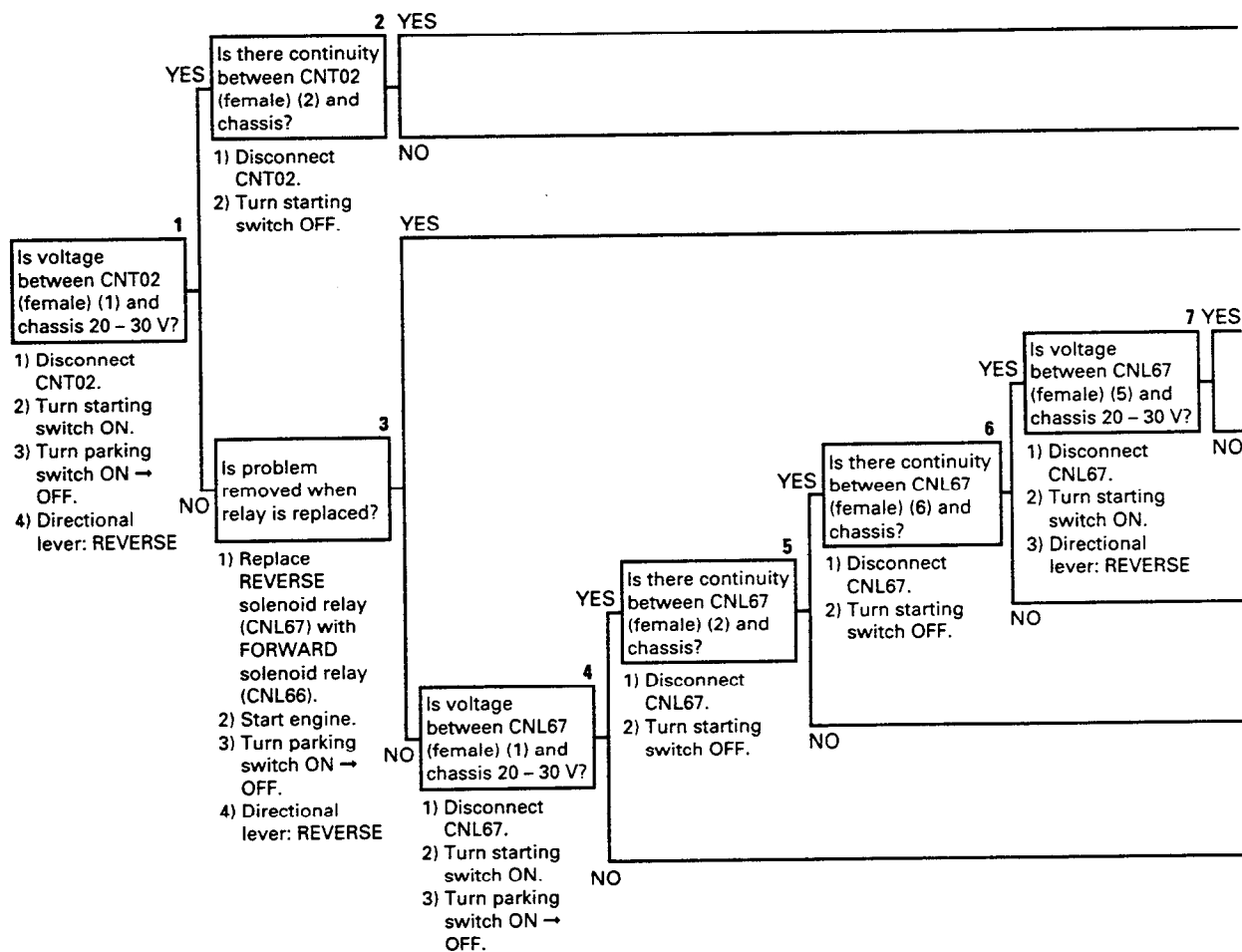
		Cause	Remedy
Is voltage between CNL04 (female) (8) and chassis 20 – 30V? 1) Disconnect CNL04. 2) Turn starting switch ON.	1 YES	Abnormal contact of CNL04 (female) (8) – CN37 (female) (2), CN38 (female) (2) with +24V wiring harness	After inspection, repair or replace
	NO	Defective speed lever switch	Replace

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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)

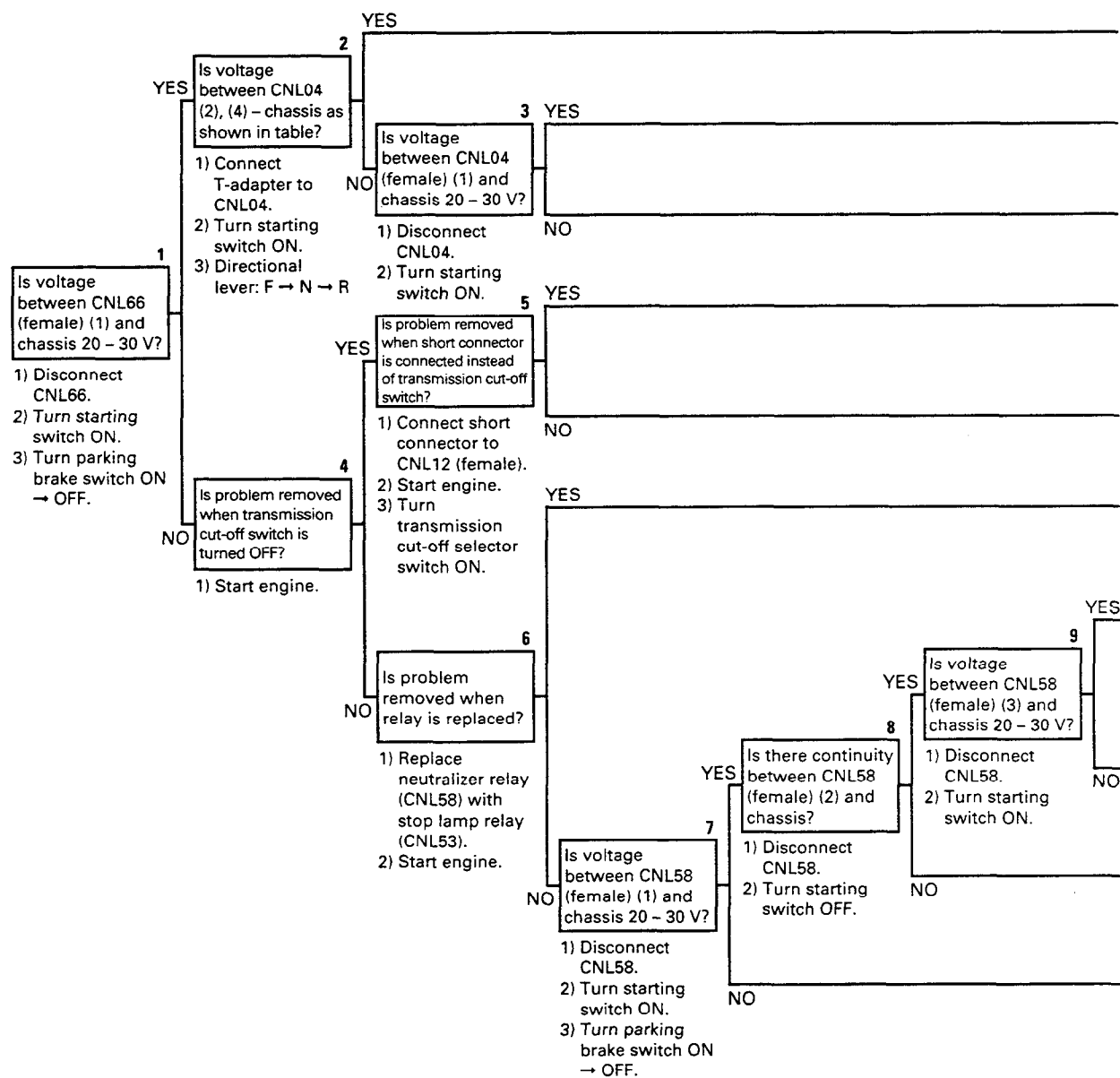


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	Cause	Remedy
	Defective contact, or disconnection in wiring harness between CNT02 (female) (2) and chassis	After inspection, repair or replace
	Defective REVERSE solenoid	Replace
	Defective REVERSE relay	Replace
	Defective contact, or disconnection 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

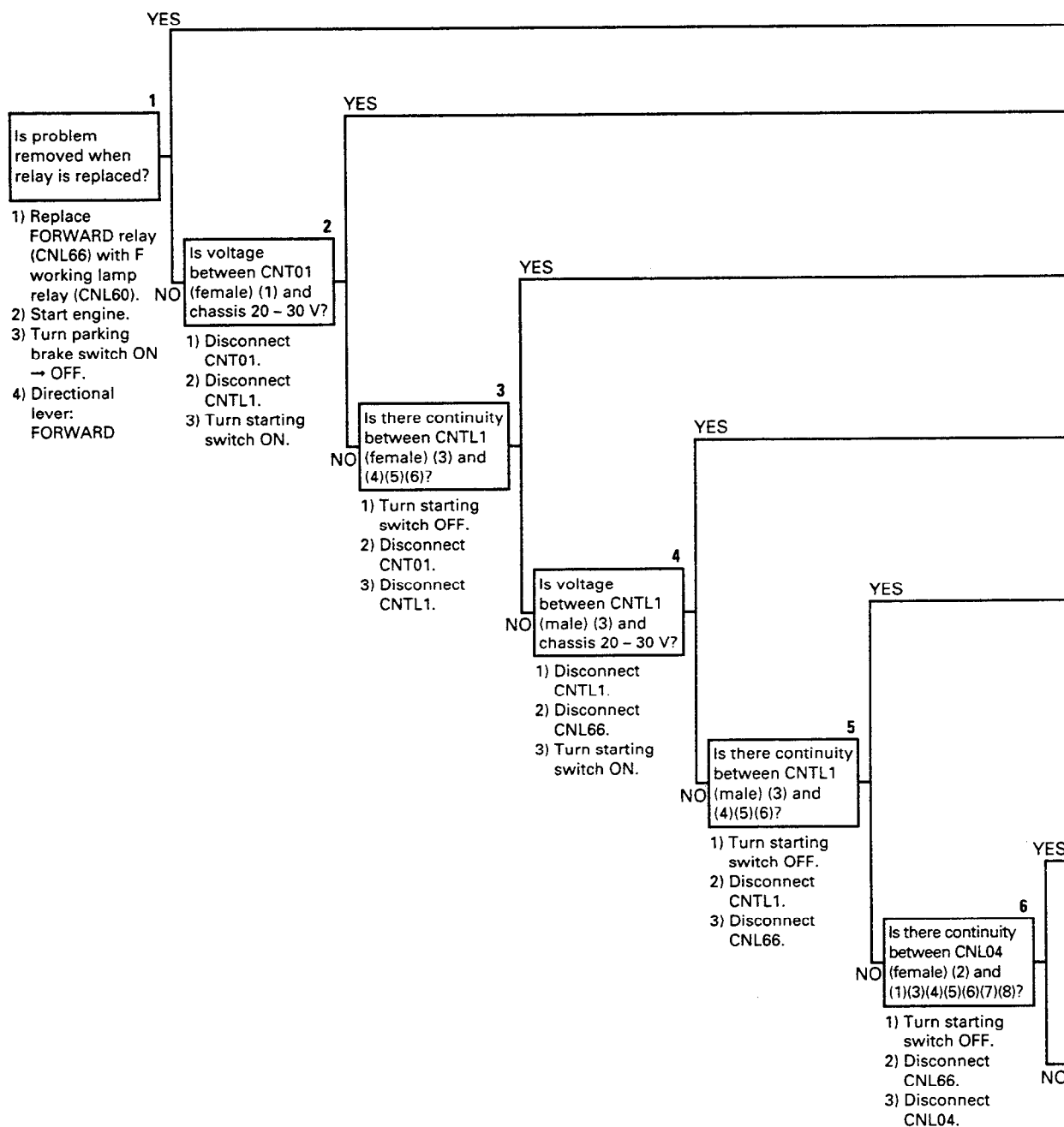
Directional lever	Between CN04(2) – chassis	Between CN04(4) – chassis
F	●	○
N	○	○
R	○	●

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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) (2) 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

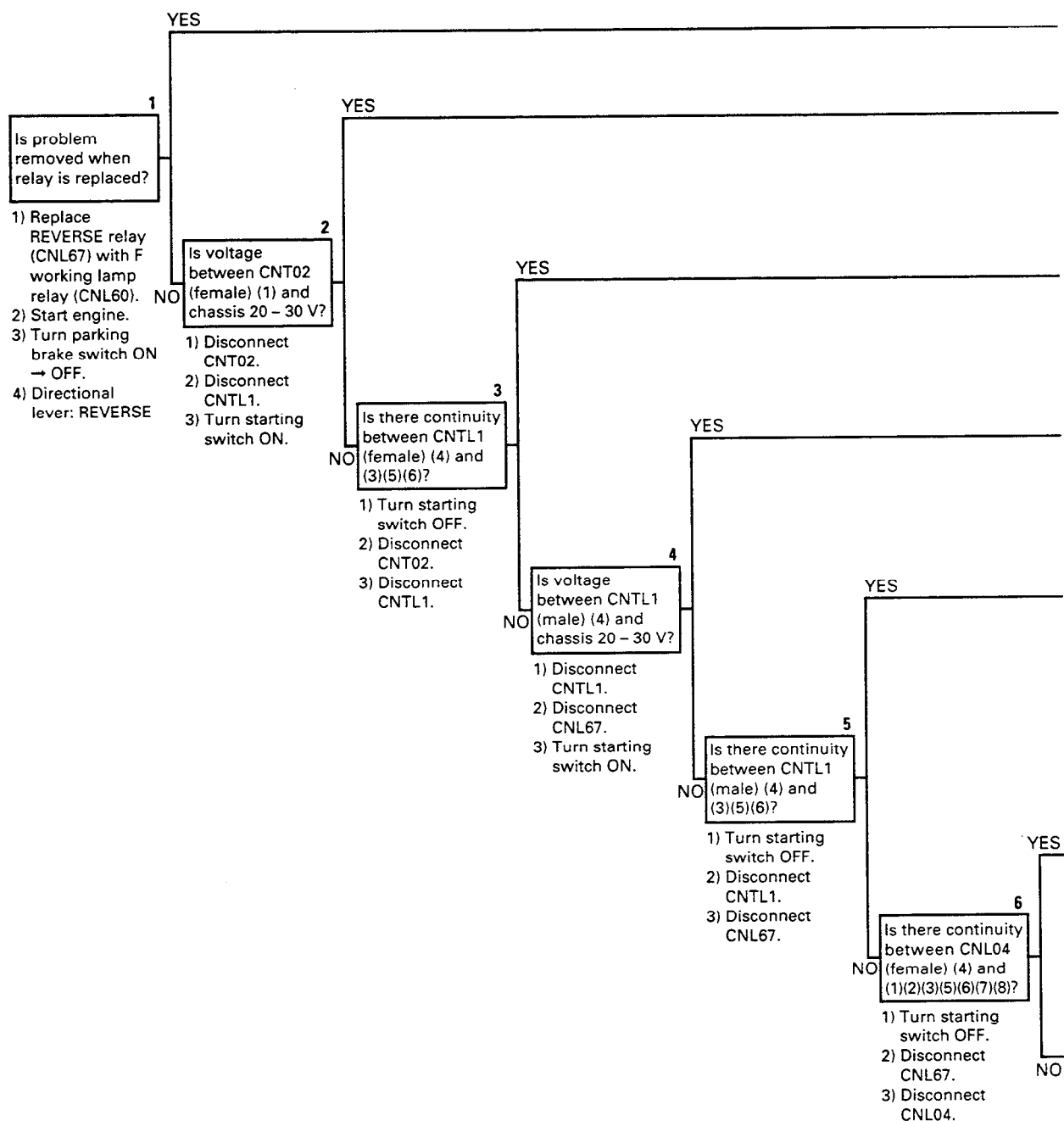


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	Cause	Remedy
	Defective FORWARD relay	Replace
	Abnormal contact of wiring harness between CNT01 (female) (1) and CNTL1 (female) (3) with +24V wiring harness	After inspection, repair or replace
	Abnormal contact of wiring harness between CNTL1 (female) (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

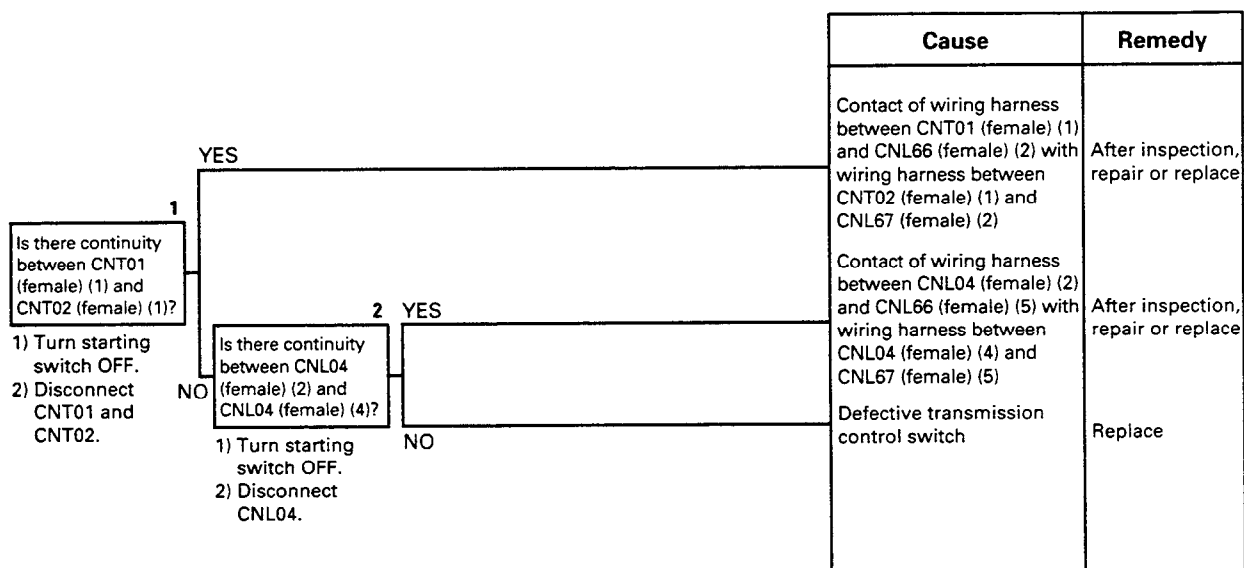
(I) Contact in REVERSE circuit



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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

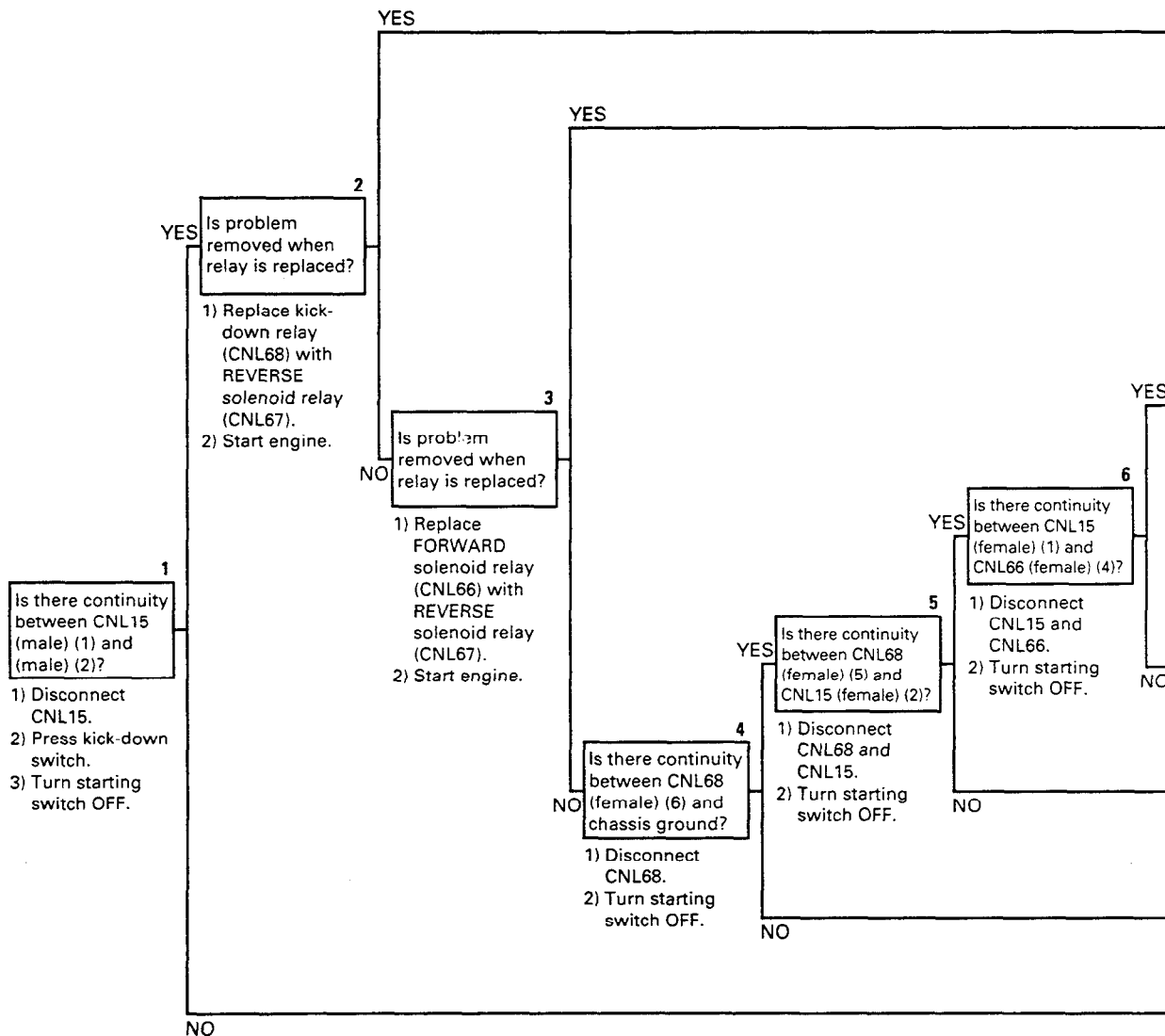
(m) Problem in common circuit for FORWARD and REVERSE



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E-9 Kick-down switch does not work (the regular F1 to F4 shifts normally)

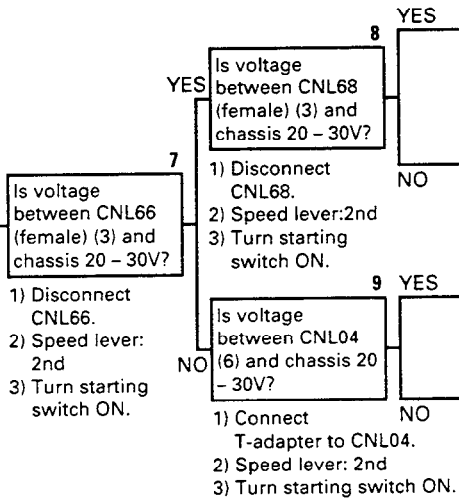
- ★ When connecting or disconnecting the T-adapter (or socket adapter) or short connector to carry out checks, always turn the starting switch OFF before starting.
- ★ When connecting the T-adapter (or socket adapter), connect to the connector specified as CN○△().
- ★ After checking, connect the disconnected 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

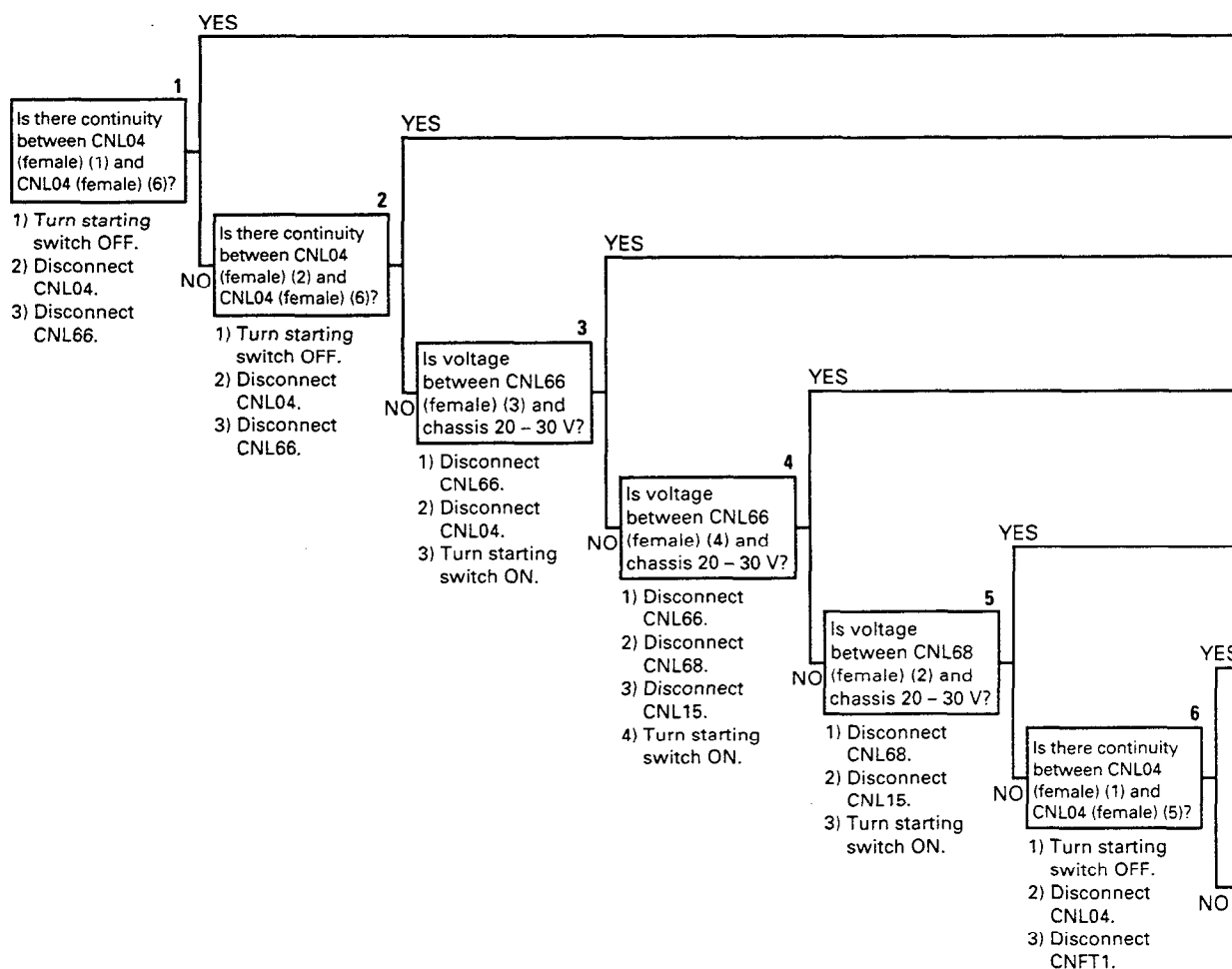
U42303

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)



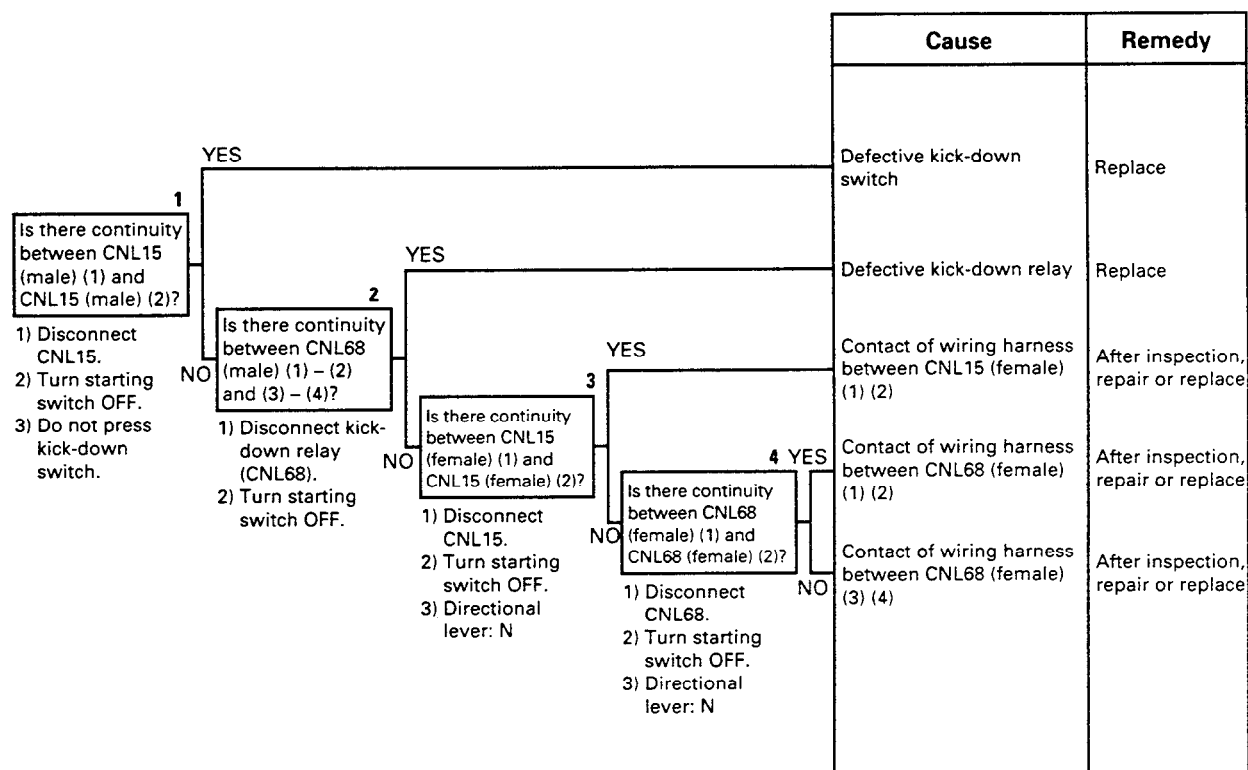
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U42303

		Cause	Remedy
Is voltage between CNL68 (female) (4) and chassis 20 – 30V? 1) Disconnect CNL68. 2) Disconnect CNTL1. 3) Disconnect CNL04. 4) Starting switch ON.	YES	Abnormal contact of wiring harness between CNL04 (female) (1) (6)	After inspection, repair or replace
	NO	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
		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	20-402
T- 2	Travel speed is slow, thrusting power is weak, lacks power on slopes	20-404
T- 3	Excessive shock when starting machine or shifting gear	20-406
T- 4	Excessive time lag when starting machine or shifting gear	20-407
T- 5	Torque converter oil temperature is high	20-408

STEERING SYSTEM

T- 6	Steering does not turn	20-409
T- 7	Steering wheel is heavy	20-410
T- 8	Steering wheel wobbles or there is excessive shock	20-411
T- 9	Machine steers to one side when traveling	20-411
T-10	Turning radius to left and right is different	20-411

BRAKE SYSTEM

T-11	Brakes do not work or braking effect is poor	20-412
T-12	Brakes are not released or brakes drag	20-413
T-13	Parking brake is not released or brake drags	20-414

WORK EQUIPMENT

T-14	Boom does not rise	20-415
T-15	Boom movement is slow or boom lacks lifting power	20-416
T-16	When boom is raised, it moves slowly at a certain height	20-417
T-17	Bucket cannot be pushed with boom cylinder (bucket floats)	20-417
T-18	Excessive hydraulic drift of boom	20-417
T-19	Boom shakes during operation	20-417
T-20	Boom drops momentarily when control lever is operated from HOLD to RAISE	20-418
T-21	Bucket does not tilt back	20-419
T-22	Bucket movement is slow or tilt-back lacks power	20-420
T-23	Bucket movement becomes slow during tilt-back operation	20-421
T-24	Bucket cannot be pushed with bucket cylinder	20-421
T-25	Excessive hydraulic drift of bucket	20-421
T-26	Bucket shakes during loading operation	20-422
T-27	Bucket dumps momentarily when control lever is operated from HOLD to TILT	20-422
T-28	Boom, bucket control levers are heavy or do not move smoothly	20-423

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

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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
Air sucked in at charging pump suction end									
Defective charging pump									
No drive for charging pump									
Breakage inside torque pump (defective PTO)									
Defective operation of torque converter (bearing, turbine, pump, stator, seal, etc.)									
Breakage inside torque converter relief valve									
Defective operation of transmission control valve									
Defective operation of clutch pressure regulator valve									
Defective operation of control valve (dirt caught, scuffing, etc.)									
Clogged orifice of solenoid valve									
Clogged orifice of control valve									

No.	Problems	Remedy									
		a	b	c	d	e	f	g	h	i	j
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							
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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	Low in every transmission range		○	○			○
9		Low in certain transmission ranges					○	
10		Indicator is unstable and fluctuates violently		○				
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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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	X	X		X		
○		○	○	○	○		○					
	○	○					○		○			
				○	○			○	○			
		○	○						○			
○		○			○							
	○	○				○			○			
			○	○	○		○					
		○										
										○		

Clogged orifice of control valve

Leakage of oil from seal ring of transmission clutch pack shaft

Leakage of oil from seal ring of transmission clutch pack shaft

Breakage inside transmission clutch piston seal

Clogged transmission breather

Clogged torque converter cooler circuit

Excessive leakage of oil from parking brake seal (worn, broken)

Breakage inside accumulator valve (abnormal wear of spool portion)

Leakage of oil from seal of shaft in work equipment and steering circuit pump

Defect in engine related part

Defective cut-off valve

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						
		△ X	△ X	△ X	△ X	△ X	C △	△ X
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?

No.	Problems	Remedy	Causes							
			Transmission control valve				Transmission		Accumulator valve	
			a	b	c	d	e	f	g	h
			△	△	△	△	△	△	△	△
			×	×	×	×	×	×	×	×
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				○		○			○

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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

Causes										
Air sucked in at charging pump suction end										
Defective charging pump										
Defective torque converter										
Leakage of oil inside torque converter relief valve										
Breakage inside torque converter (seal ring, bushing, snap ring, bearing, etc.)										
Defective transmission clutch pressure regulator valve										
Breakage inside transmission										
Clogged transmission breather										
Defective bleeding of air from torque converter cooler or clogged circuit										
Leakage of oil from seal of shaft in work equipment circuit and steering circuit pump										
Defect in engine related part										
Charging pump	Torque converter			Trans- mission			Torque converter, transmission circuit			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	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	Low in every transmission range										
8		Low in certain transmission ranges										
9		Indicator is unstable and fluctuates violently										
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?

No.	Problems	Causes										
		Oil divided at steering valve										
		Steering switch, PPC pump broken										
		Steering relief valve										
Remedy		Safety valve										
		Demand spool										
		Pilot pressure load portion										
		Internal defect										
		Defect inside steering valve										
		Defect inside steering cylinder (leakage of oil from piston seal)										
		Internal defect										
		Internal defect										
		Hydraulic pump, PTO or pump broken										
		Valves										
		Others										
		Others										
		a	b	c	d	e	f	g	h	i		
		△	△	△	△	△	△	△	△	△		
		×	×	×	×	×	×	×	×	×		
		×	×	×	×	×	×	×	×	×		
1	Steering does not turn to in either direction	○							○			
2	Same as Item 1, but there is abnormality in movement of work equipment	○										
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										
		Tank - pump			Valves					Others		
		Hydraulic pump defective			Defect inside steering valve					Stop valve		
		a	b	c	d	e	f	g	h	i	j	k
No.	Problems	△	△	△	△	△	△	△	△	△	△	△
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										○	○

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- ★ 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 "T-7 Steering wheel is heavy."

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 "T-7 Steering wheel is heavy."

		Causes	Safety valve	Steering valve selector spool out of position	Internal defect in orbitrol (relief valve)	Defect inside steering cylinder (inside surface of cylinder, piston seal, nut, bolt)		
	Remedy	Valves			Cylinder			
		a	b	c	d			
		△ A	△	△	△			
No.	Problems	×	×	×	×			
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		○					

- ★ Excessive shock when steering is turned to left or right lock.
Cause: Improper adjustment of stop valve stopper.

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 abnormality of brake lining inside axle Air in brake circuit Defect inside brake valve Defective accumulator piston seal, insufficient gas pressure Defective operation of charge valve Defective pilot pump (for charge), scuffing										
		a	b	c	d	e	f	g	h	i	j	
Remedy		△	△	△	△	△	△	△	△	△	△	
No.	Problems	x	x	x	x	x	x	x	x	x	x	
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
		△	△	△
		×	×	×
No.	Problems	Remedy		
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 disc lining Defective operation of parking brake switch line Defective operation of emergency parking brake cancel valve					
		a	b	c	d	e	f
Remedy		△	△	△	△	△	△
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?

No.	Problems	Causes									
		Tank - pump									
		a	b	c	d	e	f	g	h	i	j
		C	△	△	△	△	△	△	△	△	△
		△	x	x	x	x	x	x	x	x	x
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-15 Boom movement is slow or boom lacks lifting power

Checks before troubleshooting

- Is the travel of the boom 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

- There is a strong connection between lifting power and speed, so this problem first appears as a lack of lifting speed. Measure the boom lifting speed when the bucket is loaded and use the Standard Value Table to judge if there is any abnormality.

		Causes Clogged suction port of pump or excessive air in oil Defective hydraulic pump and switch pump Defective operation of demand spool Defective operation of relief valve Defective operation of spool Breakage or wear inside valve body (boom spool) Damaged boom cylinder piston seal Defective operation of cut-off valve or defective adjustment								
		Tank - pump			Steering valve			PPC valve		
		Main control valve			Cylinder			Cut-off valve		
		a	b	c	d	e	f	g	h	i
No.	Problems	△	×	△	×	△	×	△	×	△
1	Bucket tilting power and speed are abnormal and boom lifting speed is slow	○	○	○			○			○
2	Bucket tilting power and speed are normal but boom lifting speed is slow					○	○	○		
3	As in Item 1, but lifting speed is particularly slow 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 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-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?

- 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 Defective operation of main relief valve 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
Remedy		C	△	△	△	△	△	△	A	×	×
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	○									

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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	Cut-off valve
		a	b	c	d	e	f	g	h	i	j
		△	△	△	△	△	△	△	△	△	△
No.	Problems	△	△	△	△	△	△	△	△	△	△
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

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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

U42303

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.

U42303

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		○										

TROUBLESHOOTING OF ECSS (ELECTRONICALLY CONTROLLED SUSPENSION SYSTEM) (D MODE)

Judgement Table for controller electrical system	20-452
D- 1 ECSS does not work	20-453
(a) Error code [d0] is displayed	20-454
(b) Error code [d1] is displayed	20-454
(c) Error code [d2] is displayed	20-455
(d) Error code [d3] is displayed	20-455
(e) Error code [d4] is displayed	20-456
(f) No abnormality display is given	20-456
D- 2 ECSS cannot be canceled	20-460
D- 3 Output is turned ON (travel speed does not become 5 km/h) (deviates around 5 km/h)	20-461
D- 4 Output is turned ON when transmission is in 1st	20-461
D- 5 Output is turned ON when transmission is in 4th	20-462
D- 6 Controller LED code is not displayed	20-463
D- 7 ECSS is abnormal but main monitor does not give abnormality display	20-463

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JUDGEMENT TABLE FOR CONTROLLER ELECTRICAL SYSTEM

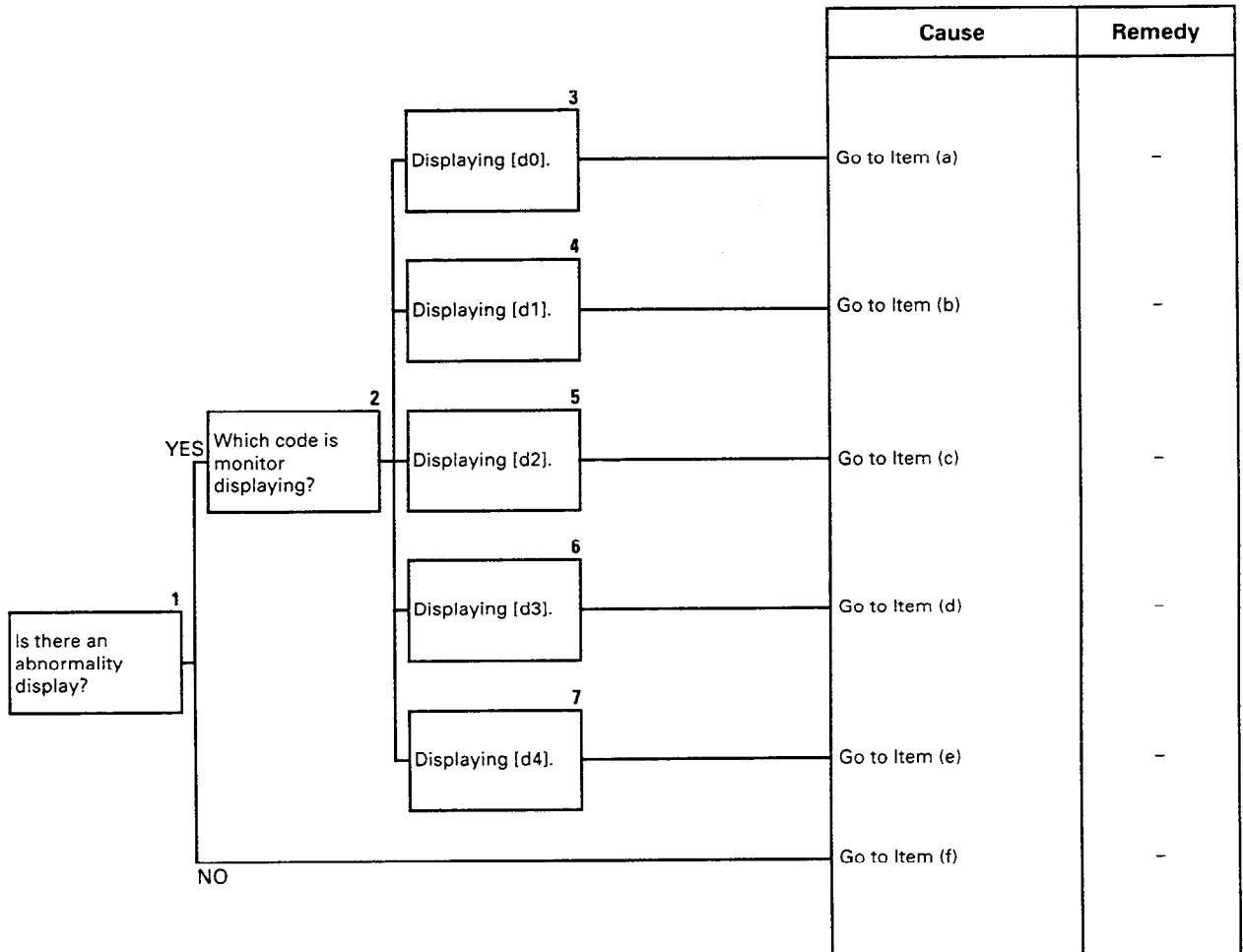
Error code Failure mode	Self-diagnosis table (abnormality display)					
	Solenoid (relief) system	Solenoid (high pressure) system	Solenoid (low pressure) system	Travel speed sensor system	Model selection abnormality	Troubleshooting code when no abnormality display is given
	d0	d1	d2	d3	d4	
ECSS does 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

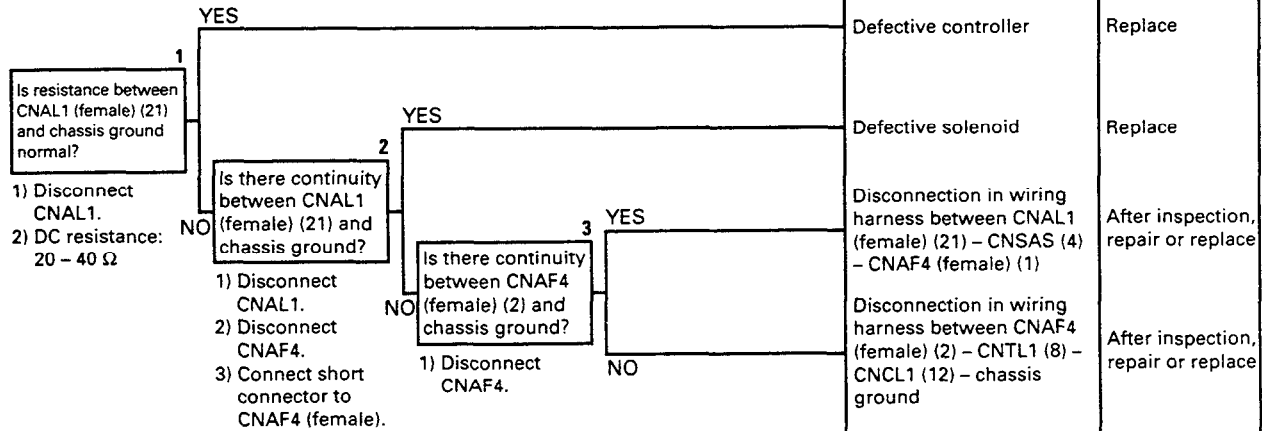
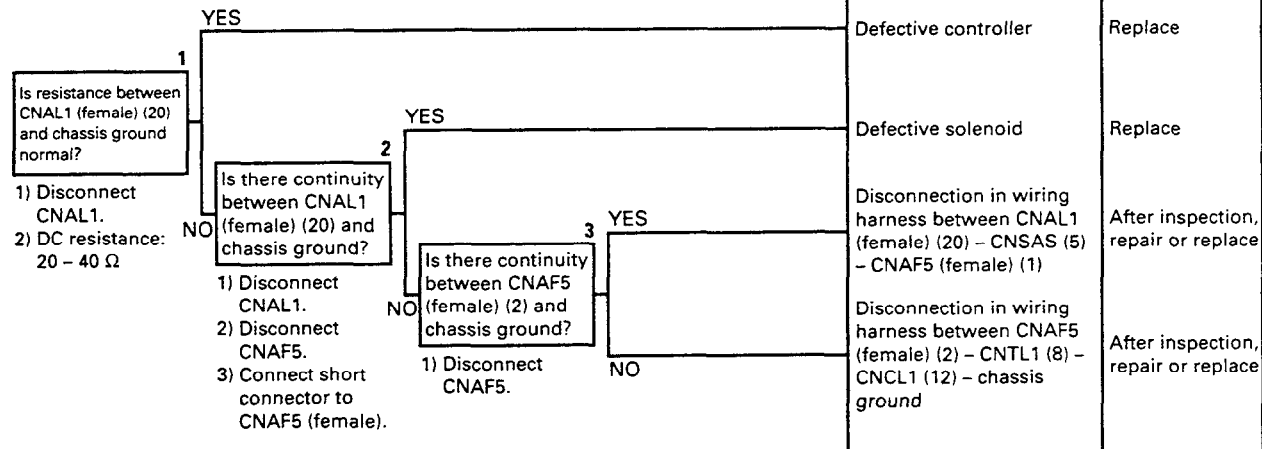
U42303

D-1 ECSS does not work

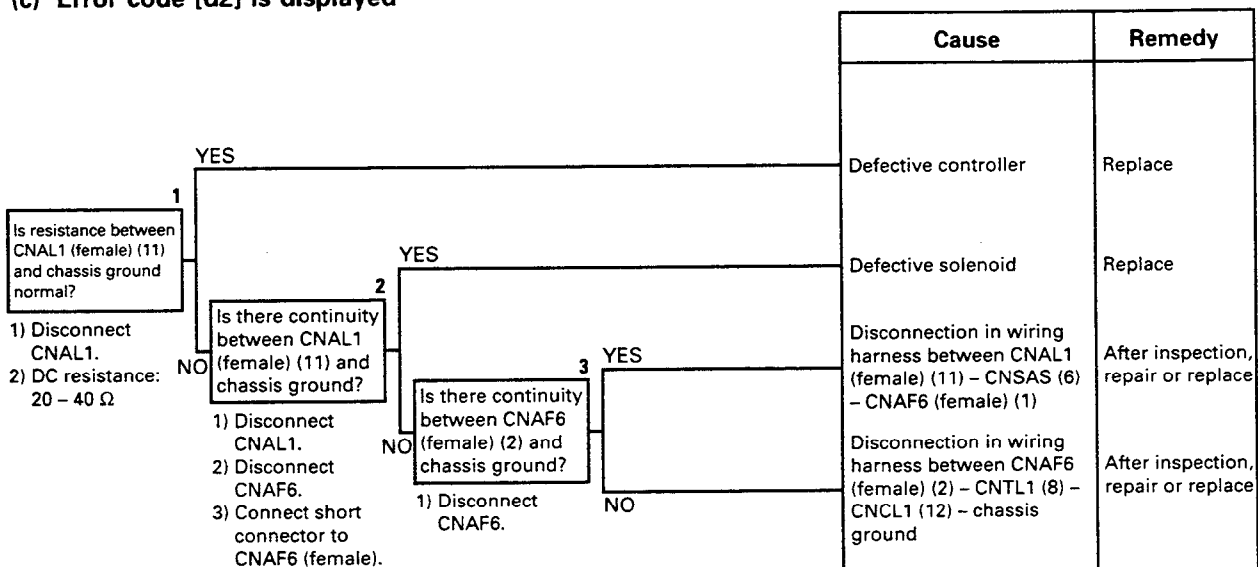
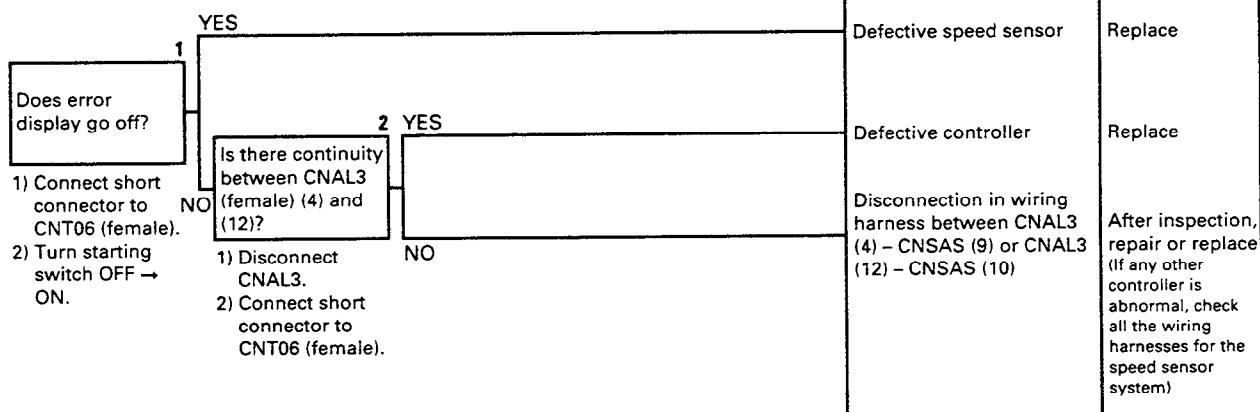
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ Carry out troubleshooting with the starting switch ON.
- ★ Check that the ECSS switch on the main monitor is ON.

U42303

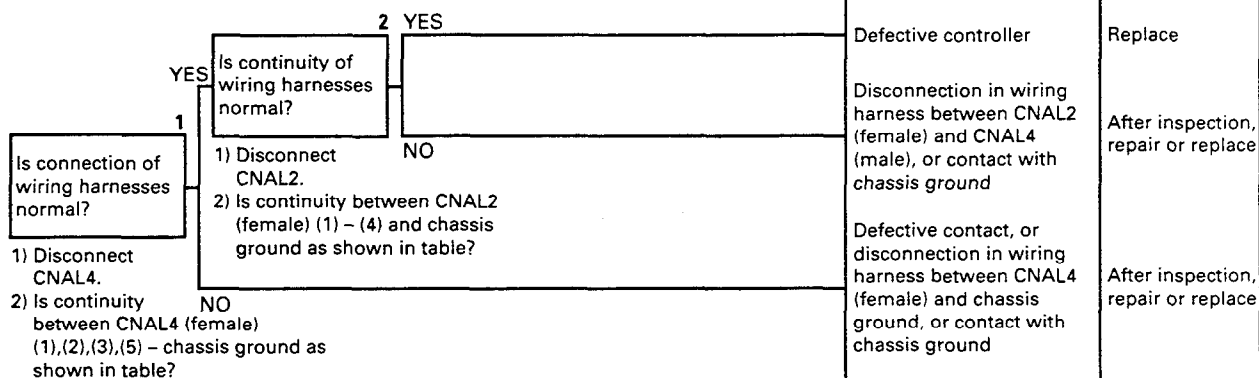


(a) Error code [d0] is displayed**(b) Error code [d1] is displayed**

U42303

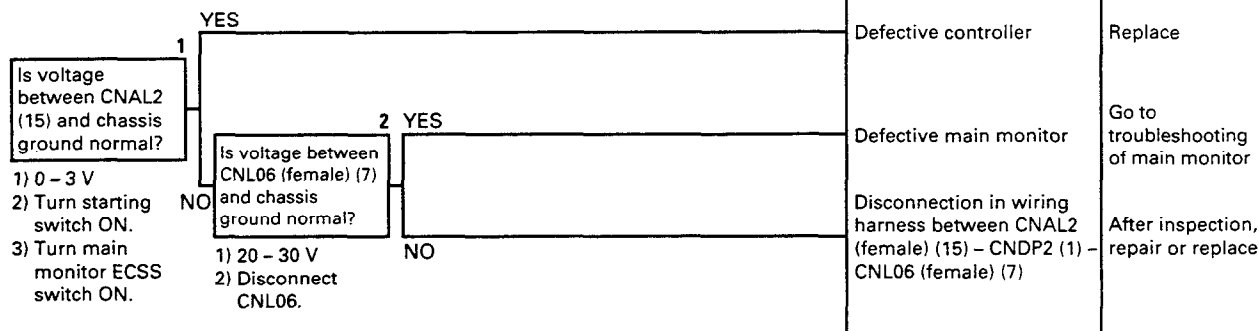
(c) Error code [d2] is displayed**(d) Error code [d3] is displayed**

U42303

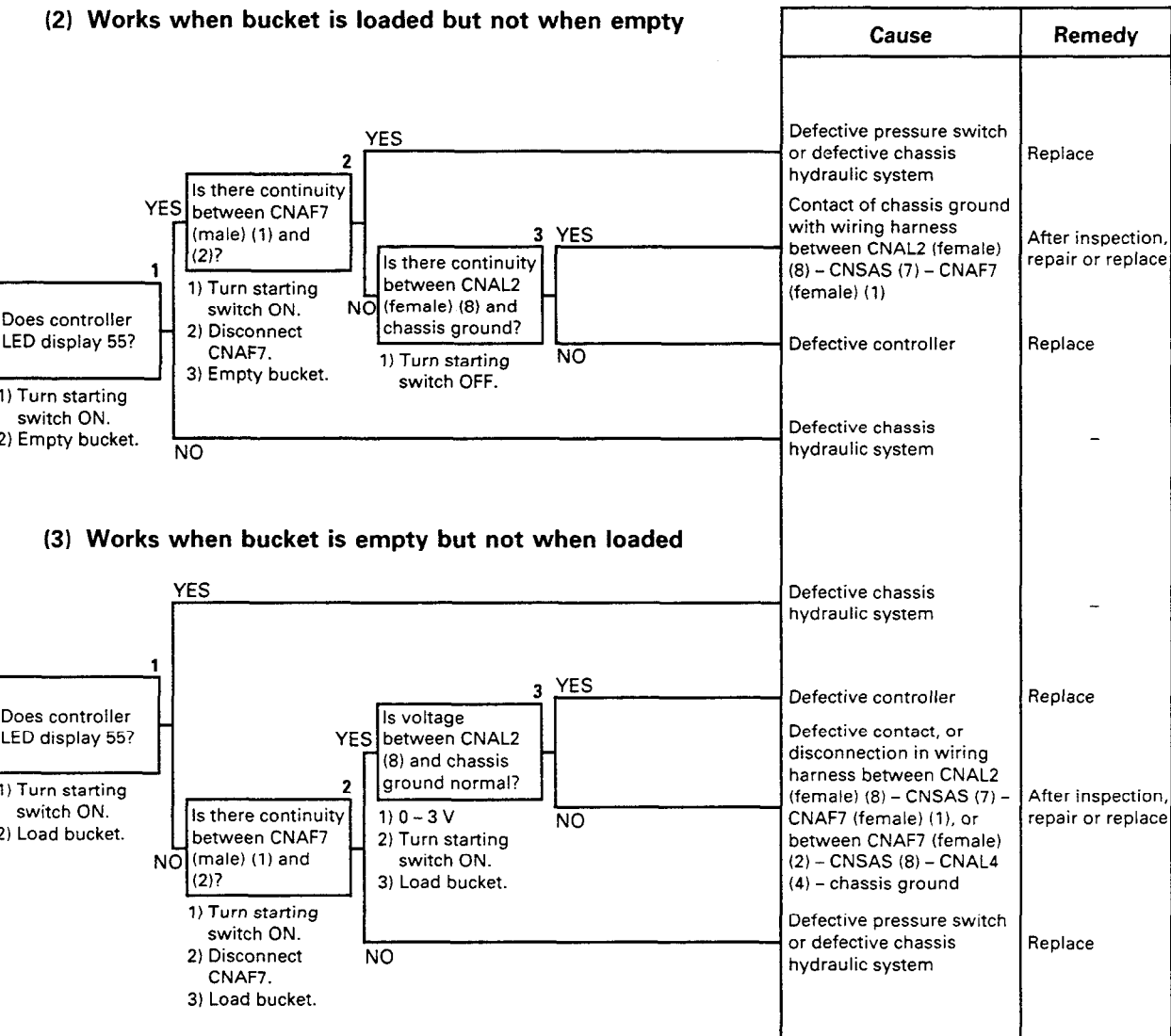
(e) Error code [d4] is displayed

Table

Model \ Connector	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

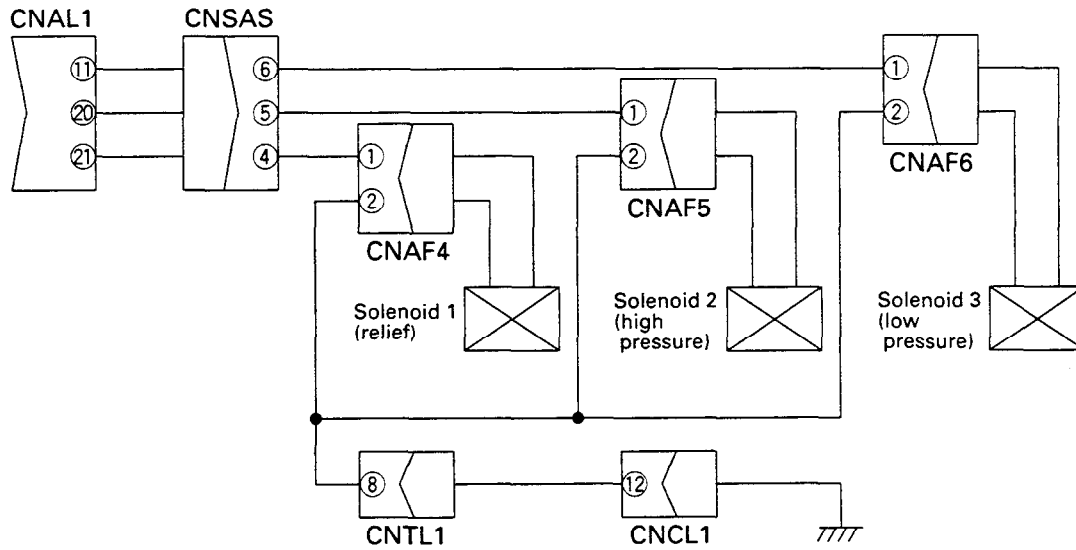
**(f) No abnormality display is given
(1) Does not work at all**

U42303



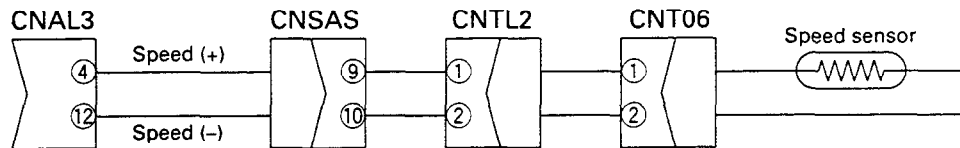
U42303

D-1 (a), (b), (c) Related electric circuit diagram
Solenoid system



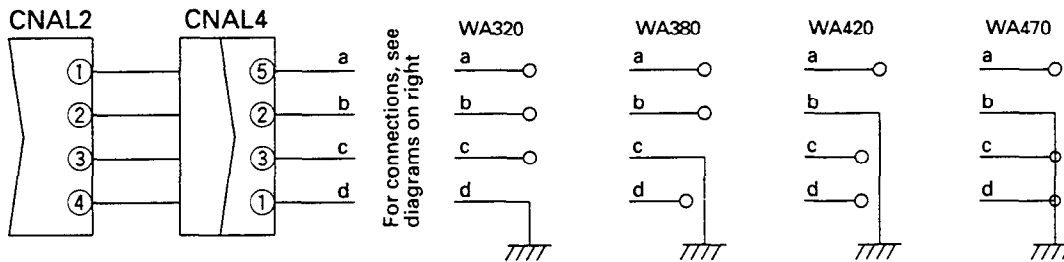
TDW00349

D-1 (d) Related electric circuit diagram
Speed sensor system



TDW00350

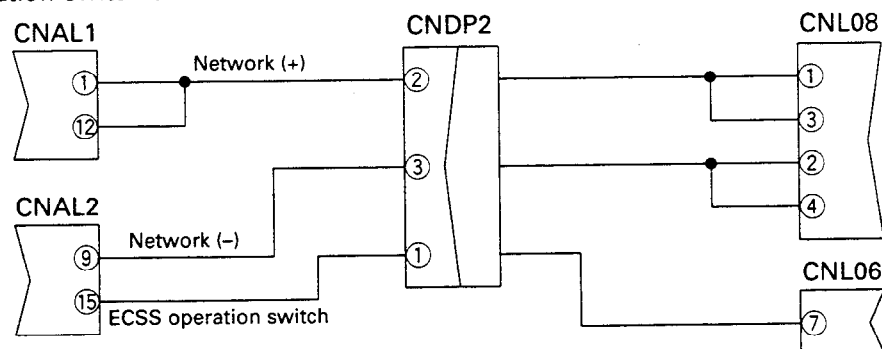
D-1 (e) Related electric circuit diagram
Model selection system



TDW00904

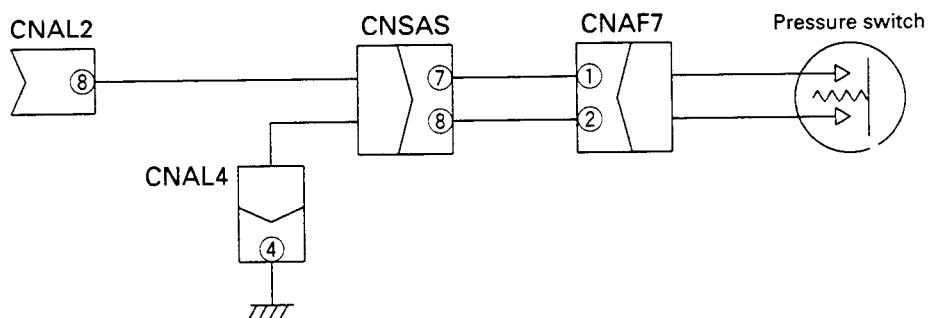
U42303

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

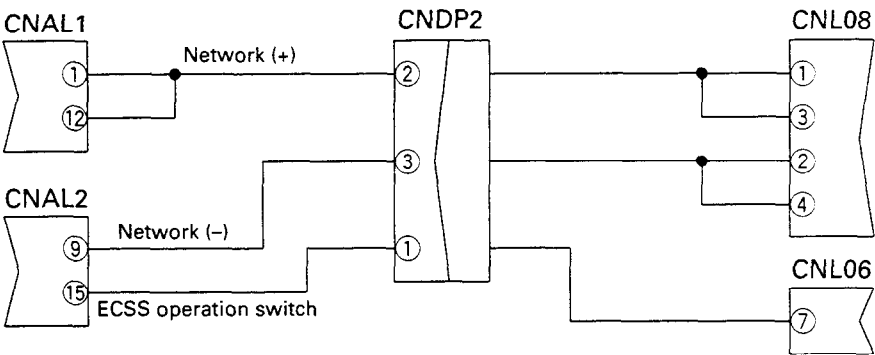
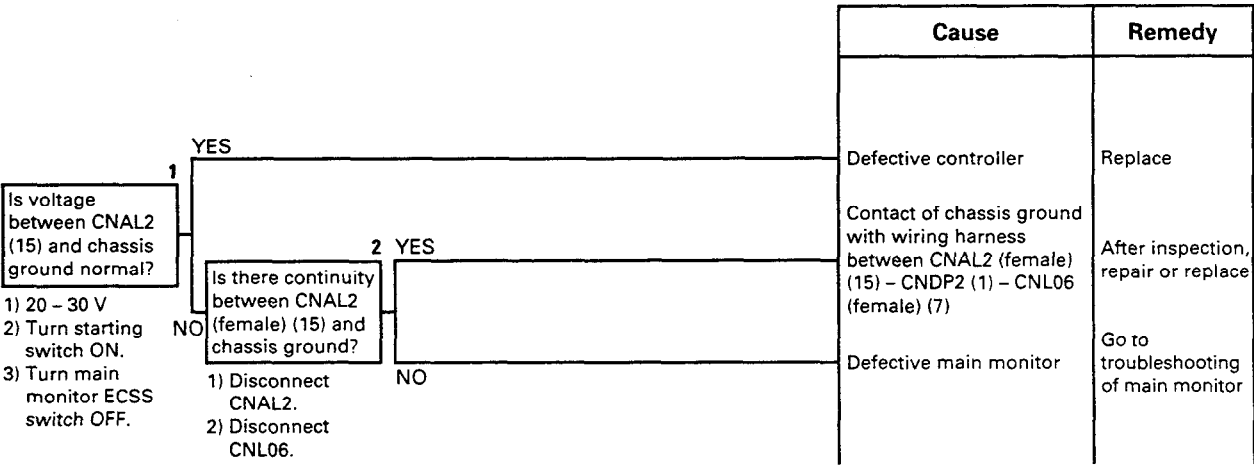


TDW00353

U42303

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.

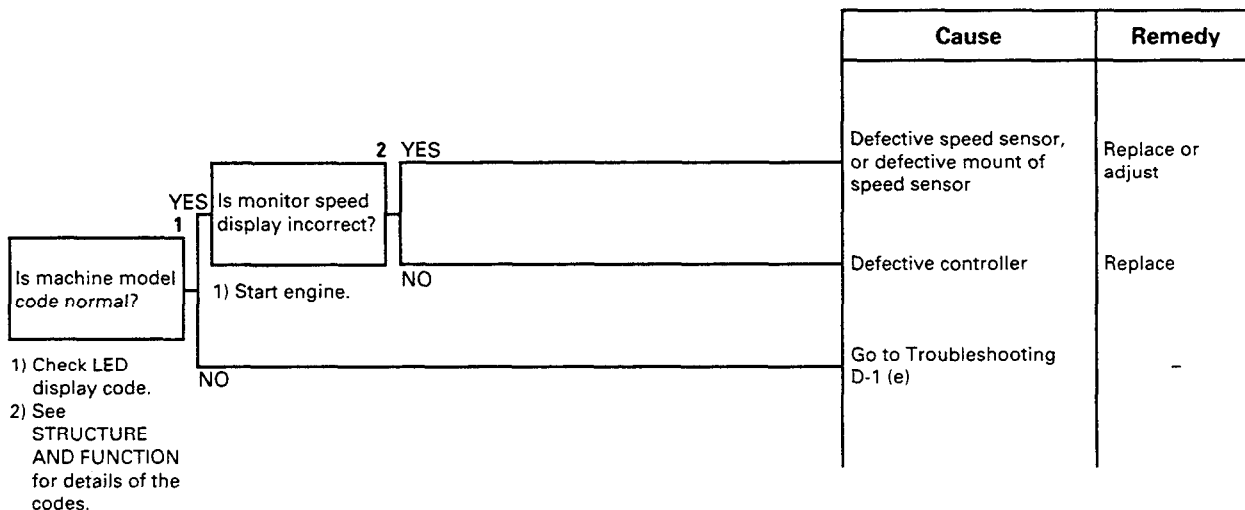


TDW00352

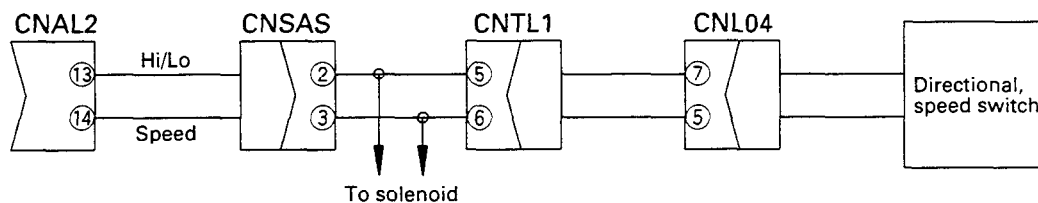
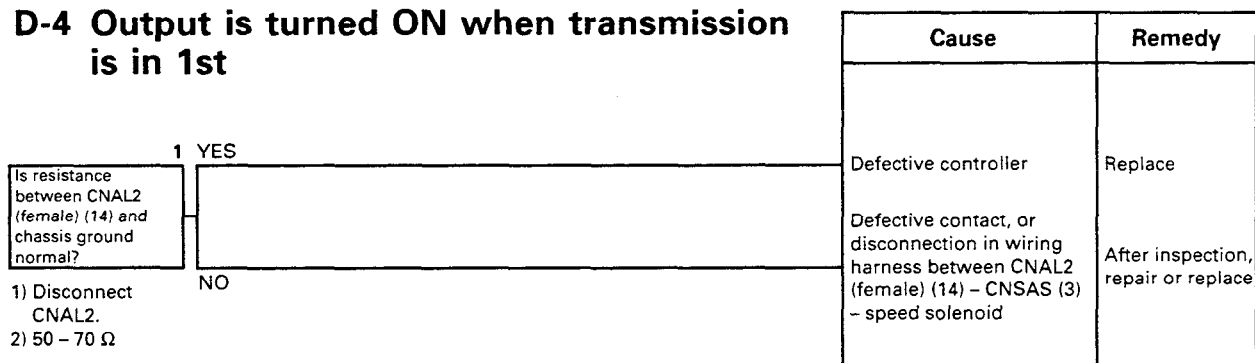
U42303

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.

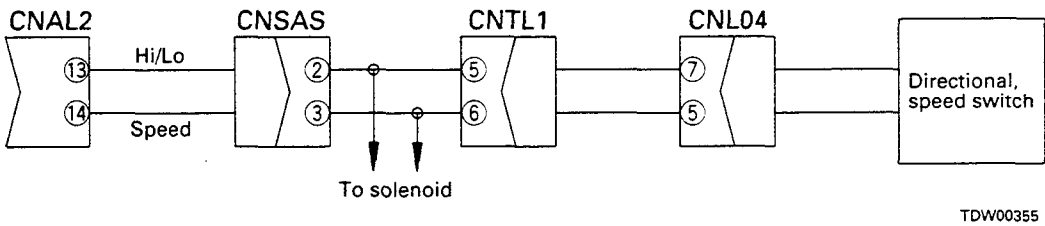
1
YES

Is resistance between CNAL2 (female) (13) and chassis ground normal?

NO

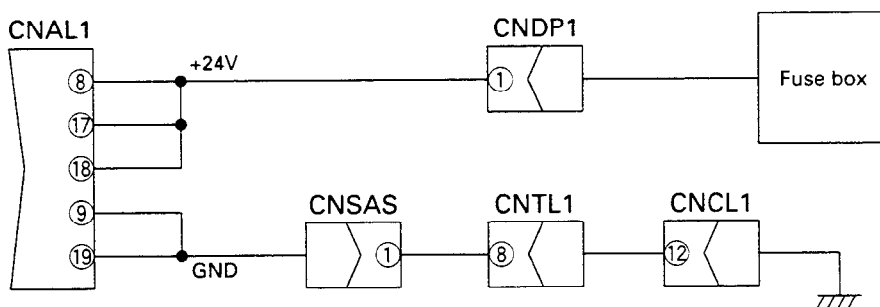
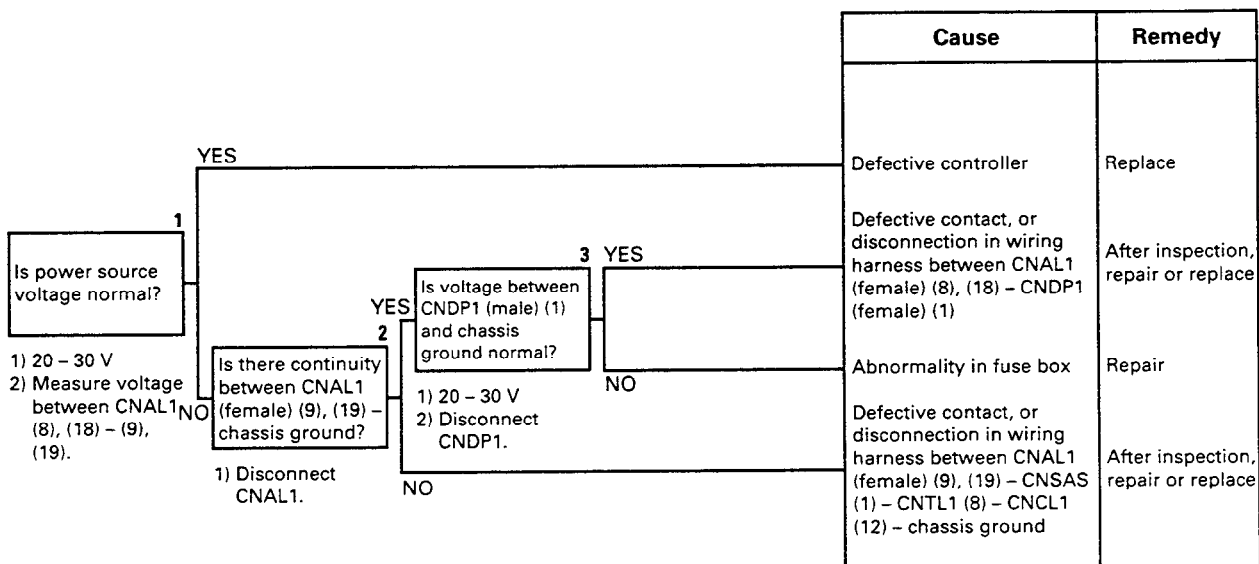
1) Disconnect CNAL2.
2) 50 – 70 Ω

Cause	Remedy
Defective controller	Replace
Defective contact, or disconnection in wiring harness between CNAL2 (female) (13) – CNSAS (2) – Hi/Lo solenoid	After inspection, repair or replace



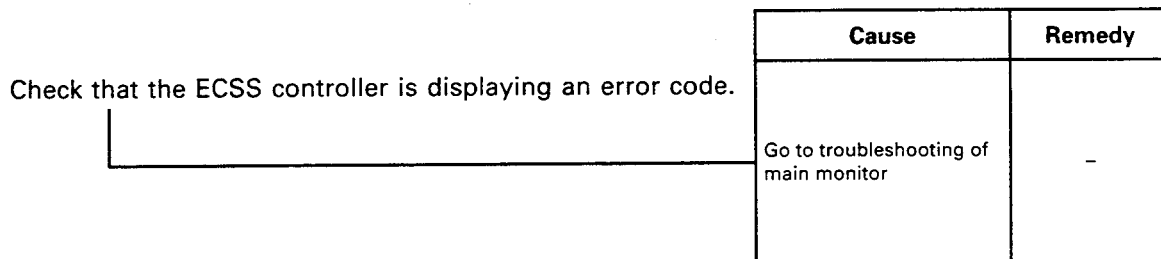
D-6 Controller LED code is not displayed

- ★ 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



TROUBLESHOOTING OF TRANSMISSION CONTROLLER SYSTEM

(A MODE)

OUTLINE	20-502
1 Function	20-502
2 When carrying out troubleshooting	20-502
3 Failure code table	20-502
4 Table of troubleshooting modes and causes	20-503
A- 1 Troubleshooting code [10] Modulation valve solenoid system (disconnection, short circuit)	20-504
A- 2 Troubleshooting code [11] Short circuit in power source for modulation valve solenoid system	20-505
A- 3 Troubleshooting code [12] F solenoid signal system	20-506
A- 4 Troubleshooting code [13] R solenoid signal system	20-506
A- 5 Troubleshooting code [14] Abnormality in H-L solenoid signal system	20-507
A- 6 Troubleshooting code [16] Abnormality in speed solenoid signal system	20-508
A- 7 Troubleshooting code [17] Brake output signal	20-509
A- 8 Troubleshooting code [20] Abnormality in directional lever signal system	20-510
A- 9 Troubleshooting code [21] Abnormality in speed lever signal system	20-511
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A-11 Troubleshooting code [23] Abnormality in engine speed signal	20-513
A-12 Hold switch system	20-514
A-13 Kick-down switch system	20-514
A-14 Kick-down output signal system	20-515
A-15 Transmission cut-off signal system	20-516
A-16 Neutralizer signal system	20-517
A-17 Buzzer signal system	20-518
A-18 Network signal system	20-519
A-19 Controller power source system	20-520
A-20 Abnormality in model selection wiring harness	20-521

042303

OUTLINE

1. Function

The control mechanism of the transmission controller consists of the controller, sensors, input switch, solenoid output, and buzzer output. The controller receives the input signal, processes it, and carries out the auto-shift control by controlling the solenoid to a transmission range that matches the travel speed.

2. When carrying out troubleshooting

The controller has a troubleshooting function, and when a failure is detected, the alarm buzzer sounds to warn the operator that there has been a failure, and the display also shows the failure code on the main monitor. However, failure codes number A-12 to A-20 are no function to display in the display area but are abnormality in the control.

3. Failure code table

No.	Failure code	Failure	No.	Failure code	Failure
A-1	10	Abnormality in modulation solenoid signal system	A-11	23	Abnormality in engine speed sensor signal system
A-2	11	Abnormality in modulation solenoid signal system	A-12	–	Hold switch signal system
A-3	12	Abnormality in F solenoid signal system	A-13	–	Kick-down switch signal system
A-4	13	Abnormality in R solenoid signal system	A-14	–	Kick-down output signal system
A-5	14	Abnormality in H-L solenoid signal system	A-15	–	Transmission cut-off signal system
A-6	16	Abnormality in speed solenoid signal system	A-16	–	Neutralizer signal system
A-7	17	Abnormality in brake signal system	A-17	–	Alarm buzzer signal system
A-8	20	Abnormality in directional lever signal system	A-18	–	Network signal system
A-9	21	Abnormality in speed lever signal system	A-19	–	Abnormality in controller power source voltage
A-10	22	Abnormality in travel speed sensor signal system	A-20	–	Abnormality in model selection wiring harness

042303

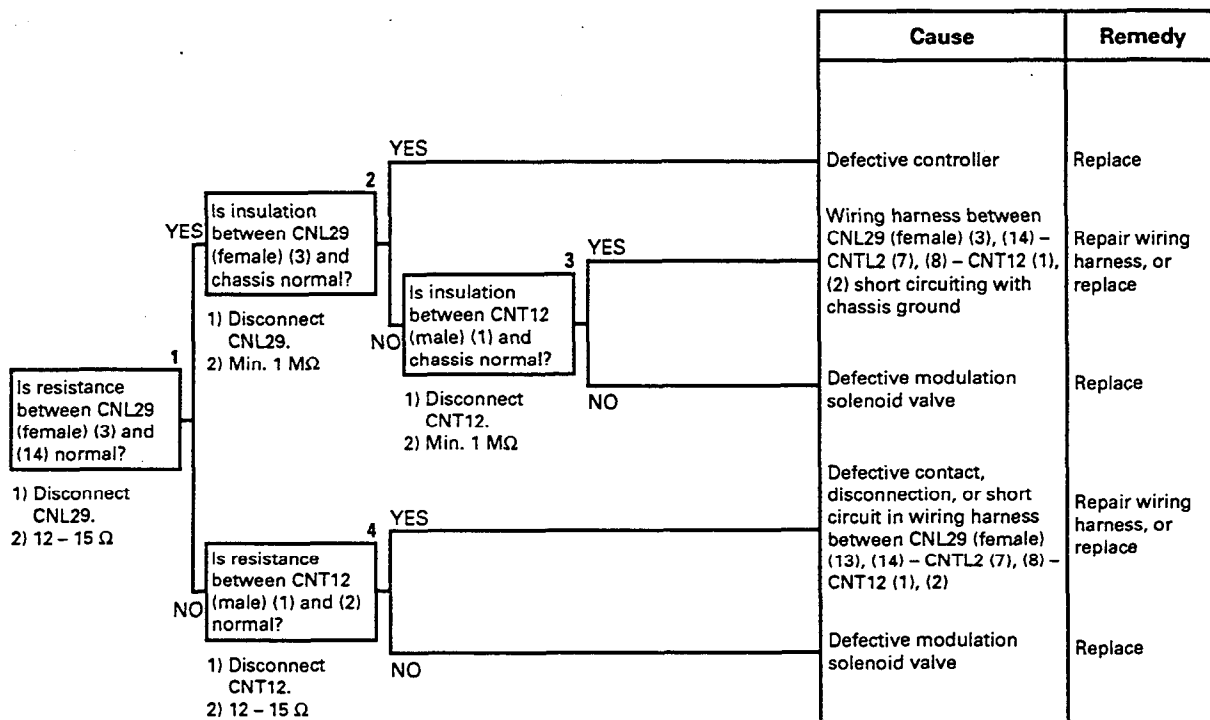
4. Table of troubleshooting modes and causes

Cause of failure Failure mode	Related equipment															
	F solenoid system	R solenoid system	H-L solenoid system	Speed solenoid system	Modulation valve solenoid system	Directional lever signal system	Speed lever signal system	Travel speed sensor signal system	Engine speed sensor signal system	Hold switch signal system	Kick-down signal system	Transmission cut-off signal system	Neutralizer signal system	Alarm buzzer signal system	Network signal system	Controller power source voltage system
Main monitor display failure code	12	13	14	16	10 11	20	21	22	23	-	-	-	-	-	-	-
Impossible to travel	○	○			○	○						○	○			○
Auto-shift does not work			○	○			○	○								
Position of directional lever and direction of travel do not match						○										
Machine travels forward when directional lever is not at F position	○															
Machine travels in reverse when directional lever is not at R position		○														
Transmission does not shift down in accordance with travel speed			○	○				○								
Transmission does not shift up in accordance with travel speed			○	○												
Transmission stays in same range as speed lever regardless of travel speed								○								
There is excessive shock when shifting gear					○			○								○
There is shift hunting when traveling							○									
There is shift hunting when shifting gear								○								○
Transmission range cannot be controlled with speed lever							○									
Shift cannot be held										○						12
Transmission does not shift to 1st with kick-down switch											○					13
No power for scooping operations when kick-down switch is ON											○					14
Transmission is not cut off when left brake is operated												○				15
Machine can travel when parking brake is applied													○			16
Alarm buzzer does not sound when travel direction is switched between forward and reverse when traveling at high speed														○		17
Alarm buzzer does not stop														○		17
Main monitor does not display transmission controller information (alarm buzzer, failure code, etc.)															○	18
Model selection cannot be carried out																○
																20

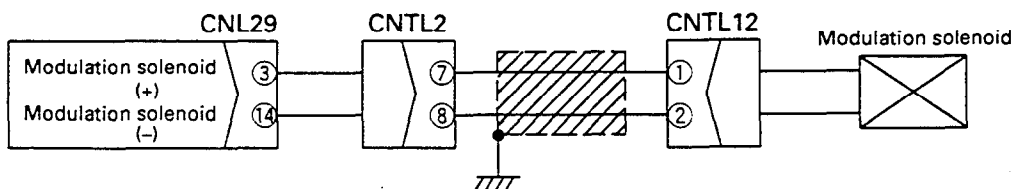
042303

A-1 Troubleshooting code [10] Modulation valve solenoid system (disconnection, short circuit)

- ★ 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.



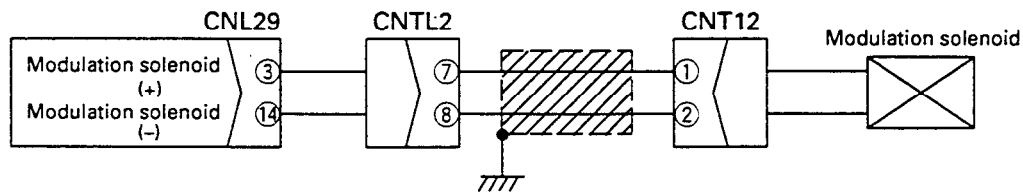
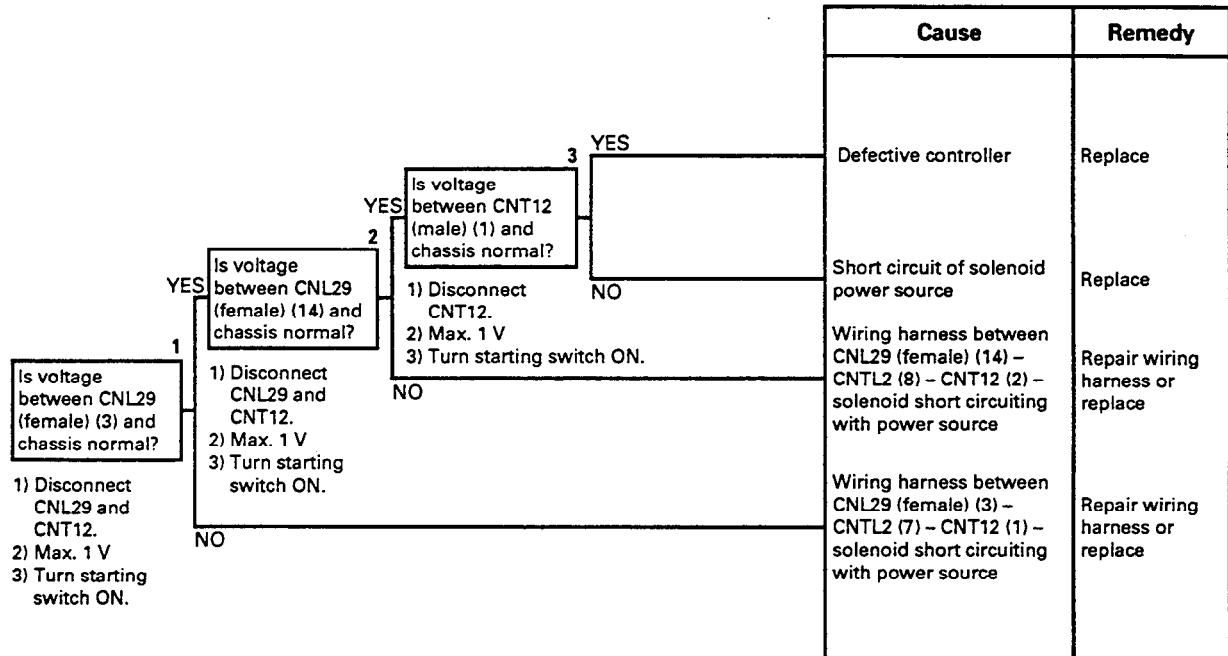
042303



TDW00332

A-2 Troubleshooting code [11] Short circuit in power source for modulation valve solenoid system

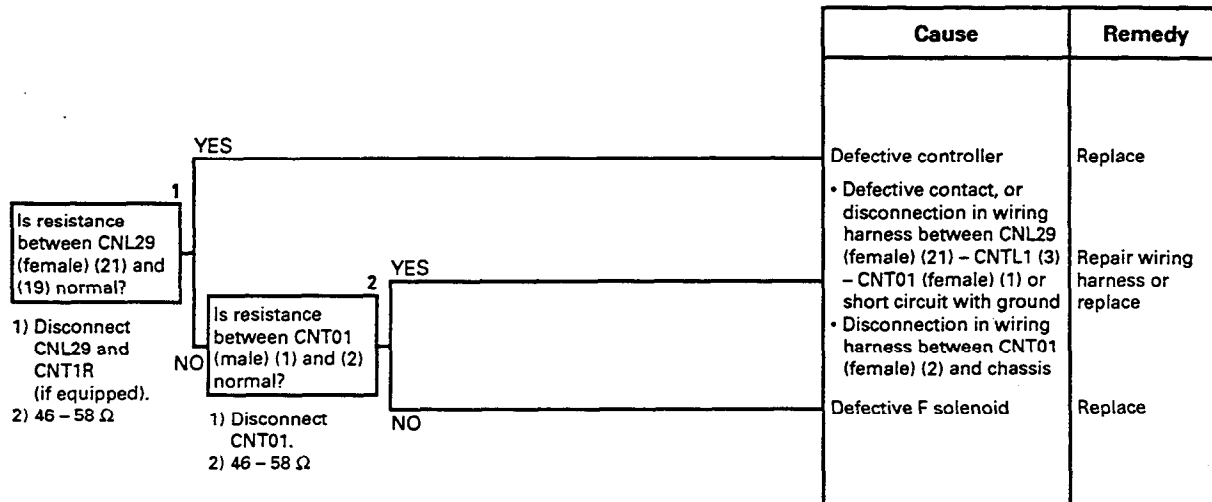
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.



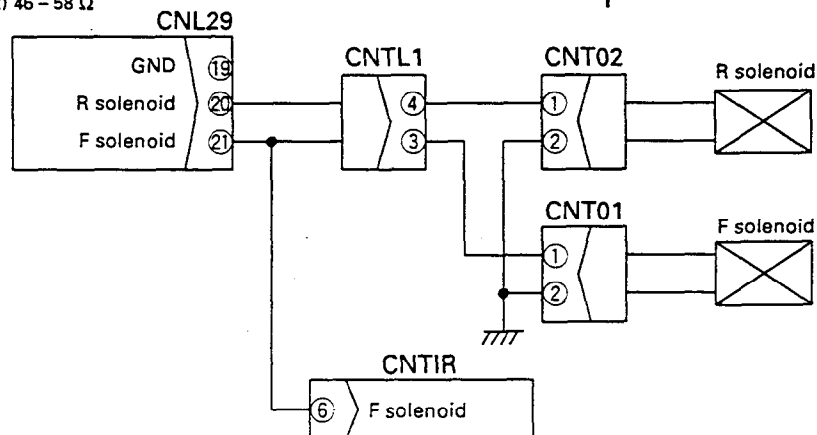
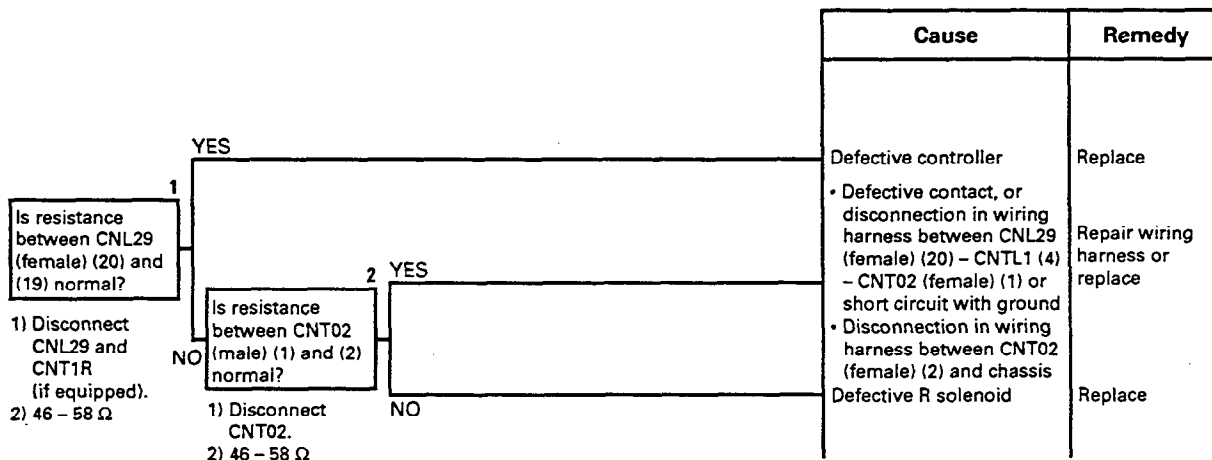
TDW00332

A-3 Troubleshooting code [12] F solenoid signal 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.



A-4 Troubleshooting code [13] R solenoid signal system

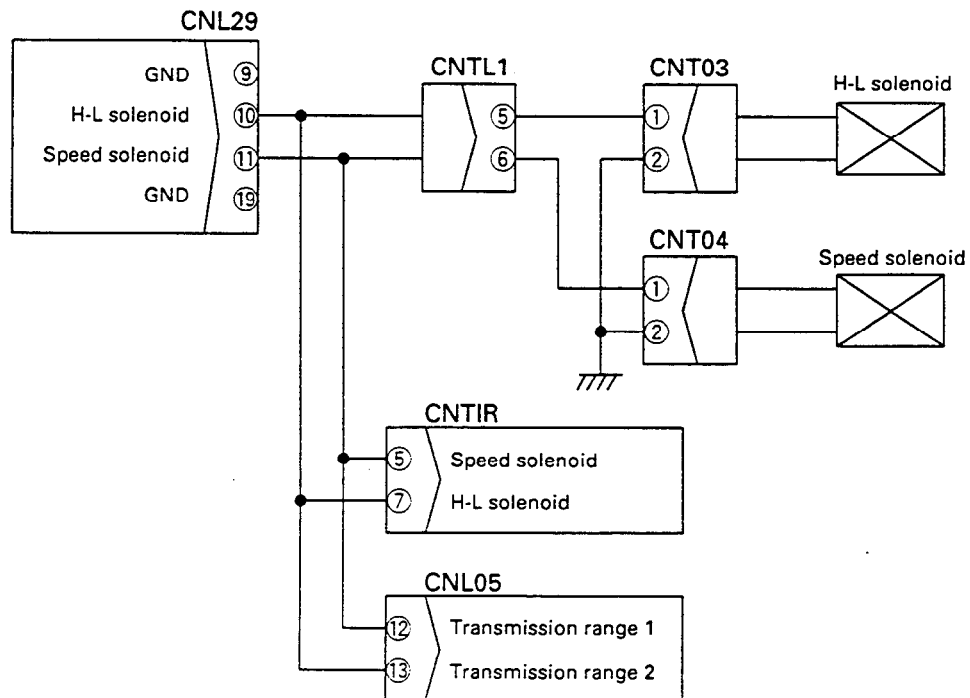
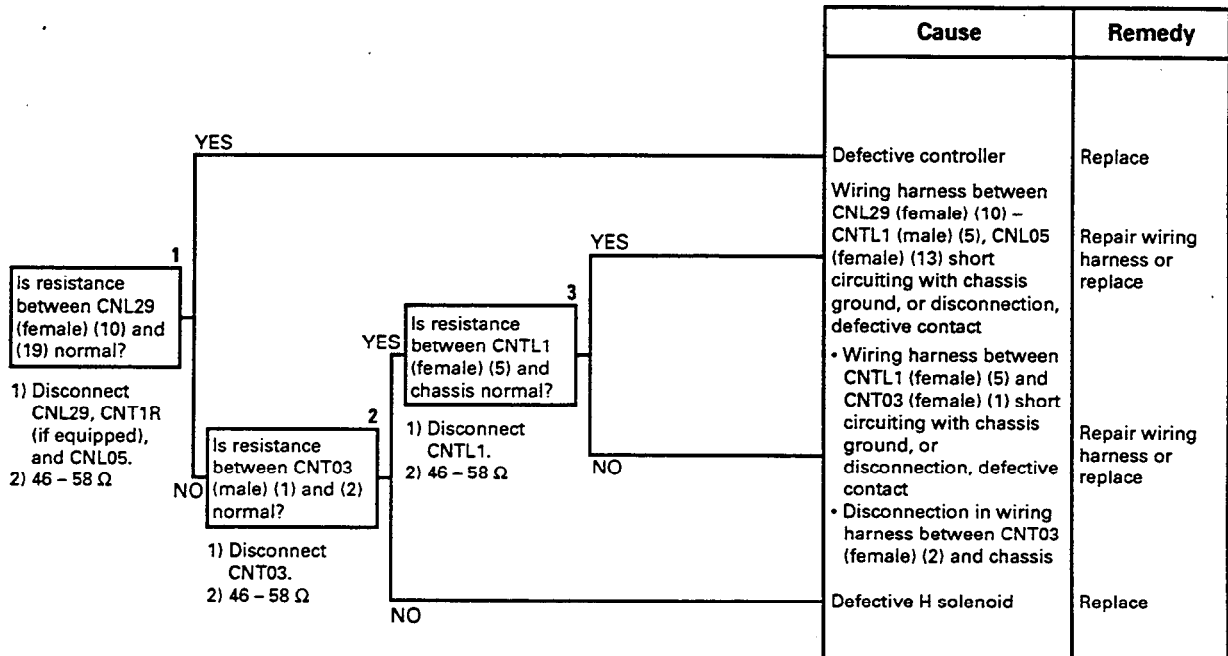


TDW00334

042303

A-5 Troubleshooting code [14] Abnormality in H-L solenoid signal system

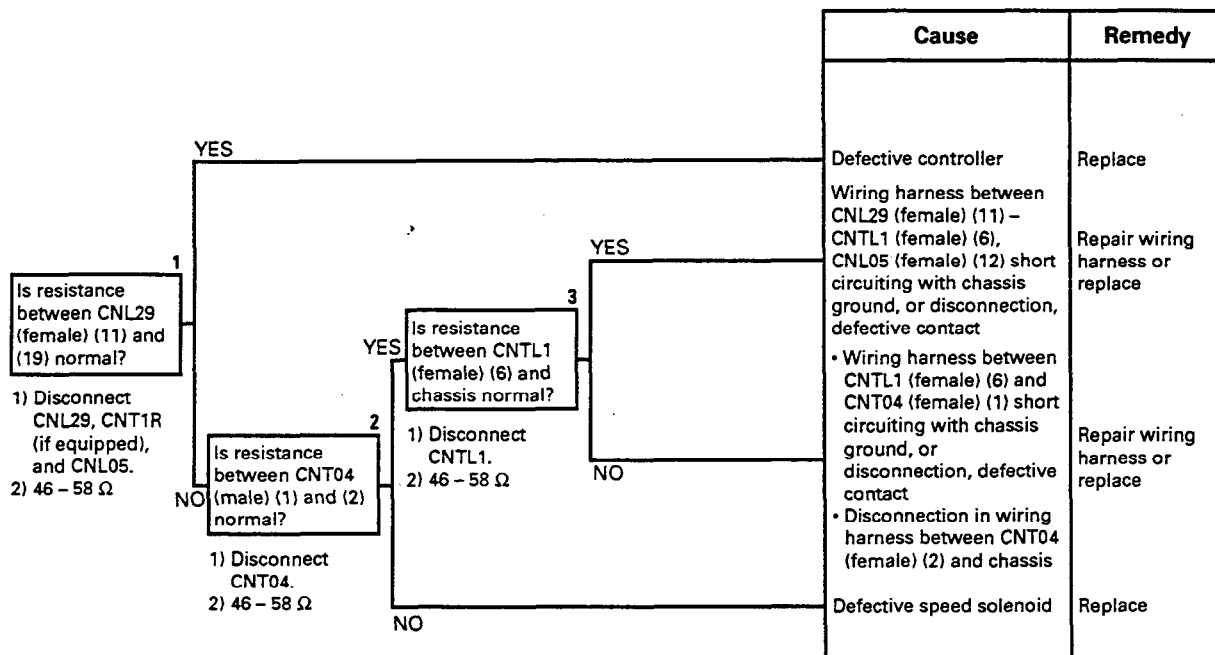
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.



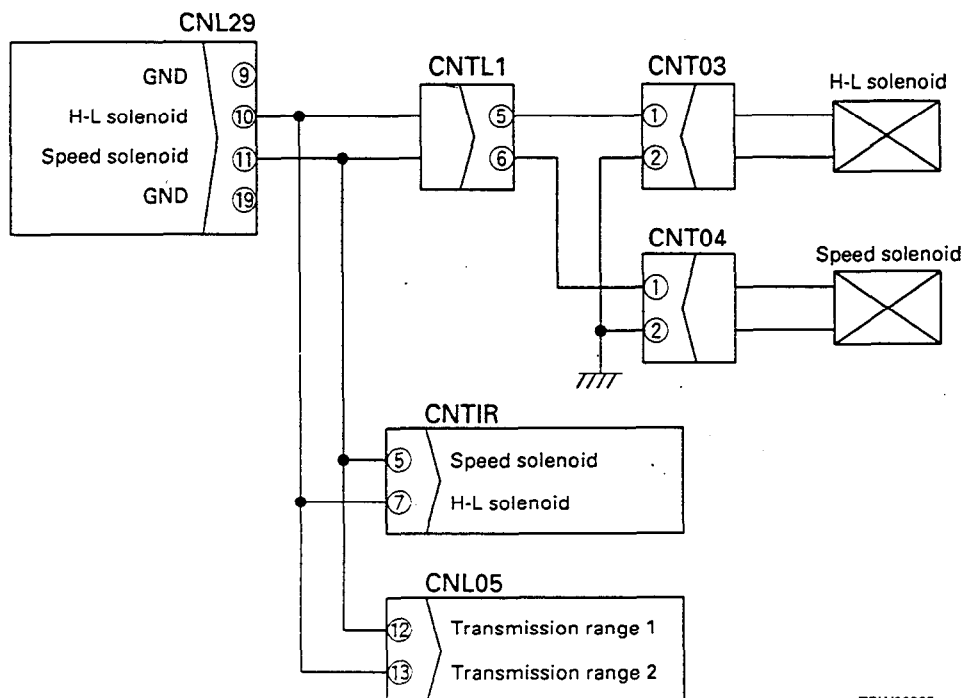
TDW00335

A-6 Troubleshooting code [16] Abnormality in speed solenoid signal 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 adaptor), always turn the starting switch OFF.



042303

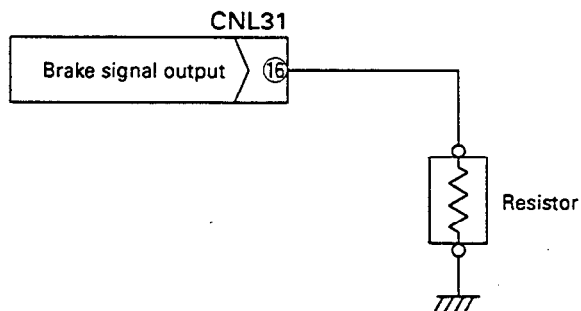


TDW00335

A-7 Troubleshooting code [17] Brake output signal

- ★ 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.

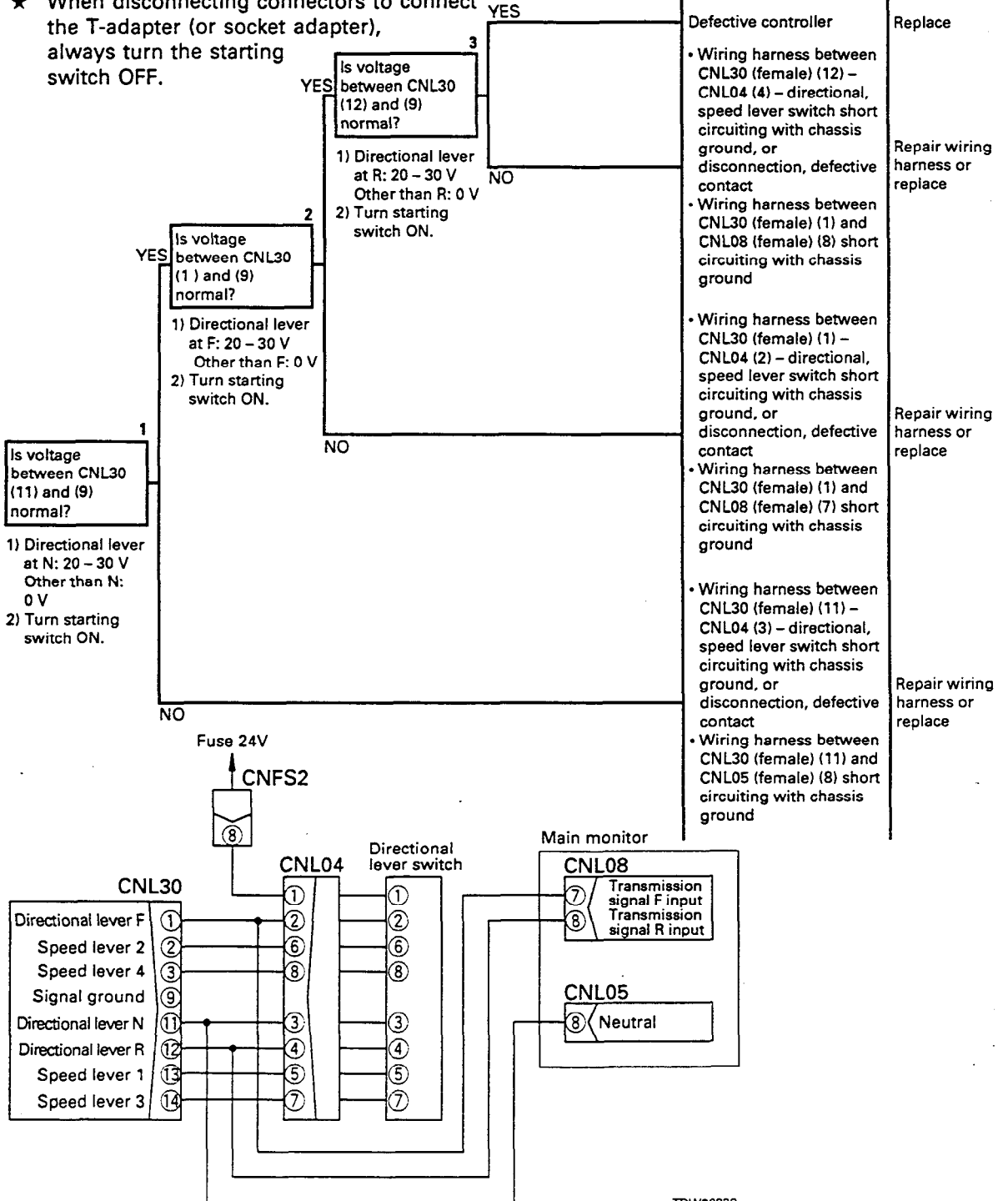
		Cause	Remedy
Is resistance between CNL31 (female) (16) and chassis normal? 1) Disconnect CNL31. 2) 4 kΩ – 7 kΩ	YES	Defective controller	Replace
	NO	Resistance value • If over 1 M Ω : Disconnection between CNL31 (female) (16) and chassis • If less than 10 Ω : Wiring harness between CNL31 (female) (16) and resistance short circuiting with chassis ground	Repair wiring harness or replace



TDW00337

A-8 Troubleshooting code [20] Abnormality in directional lever signal system

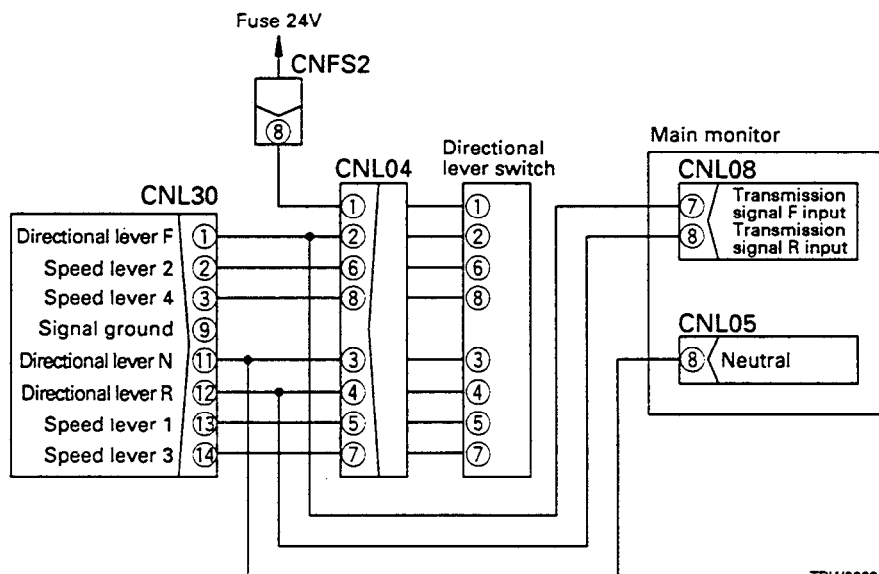
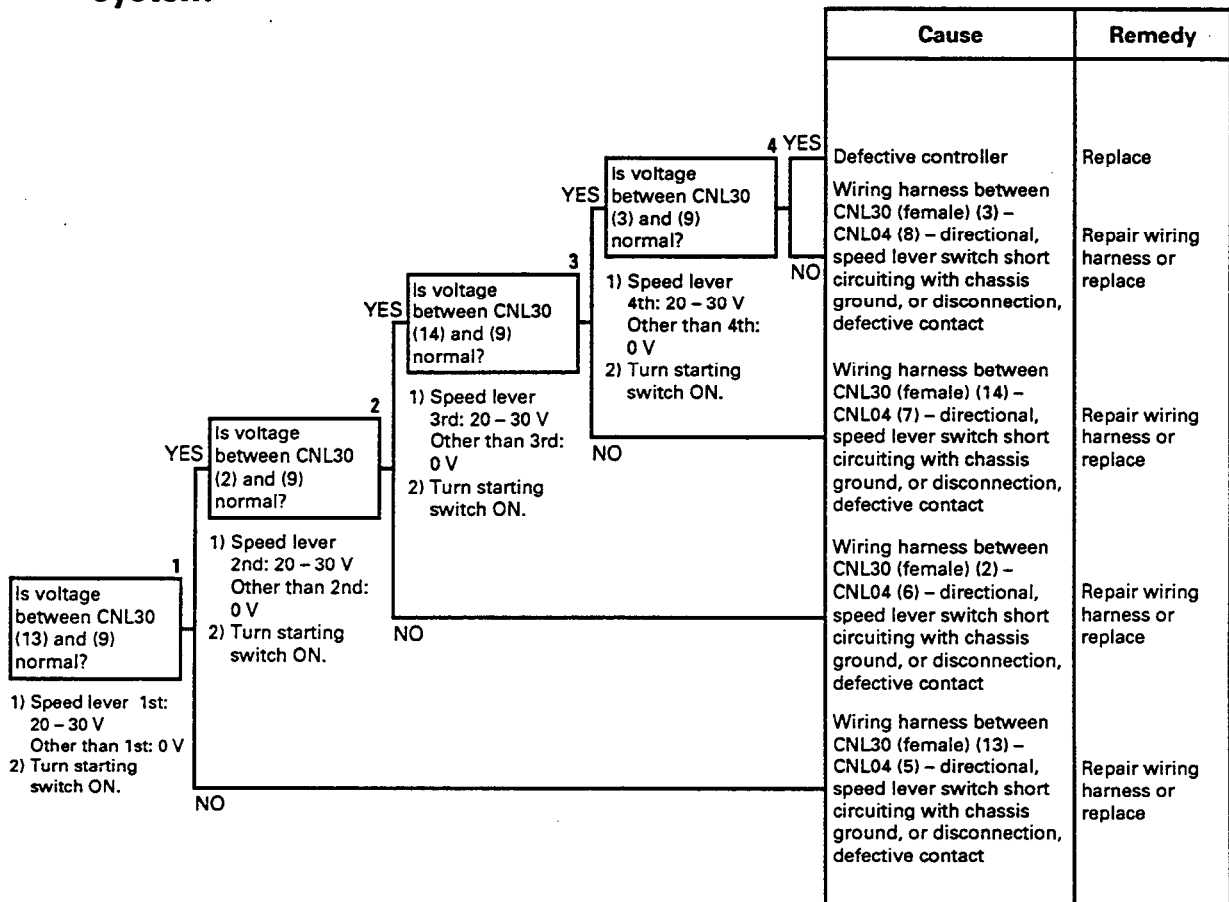
- ★ Check that there is no abnormality in the combination switch for the directional and speed levers.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adapter), always turn the starting switch OFF.



042303

TDW00338

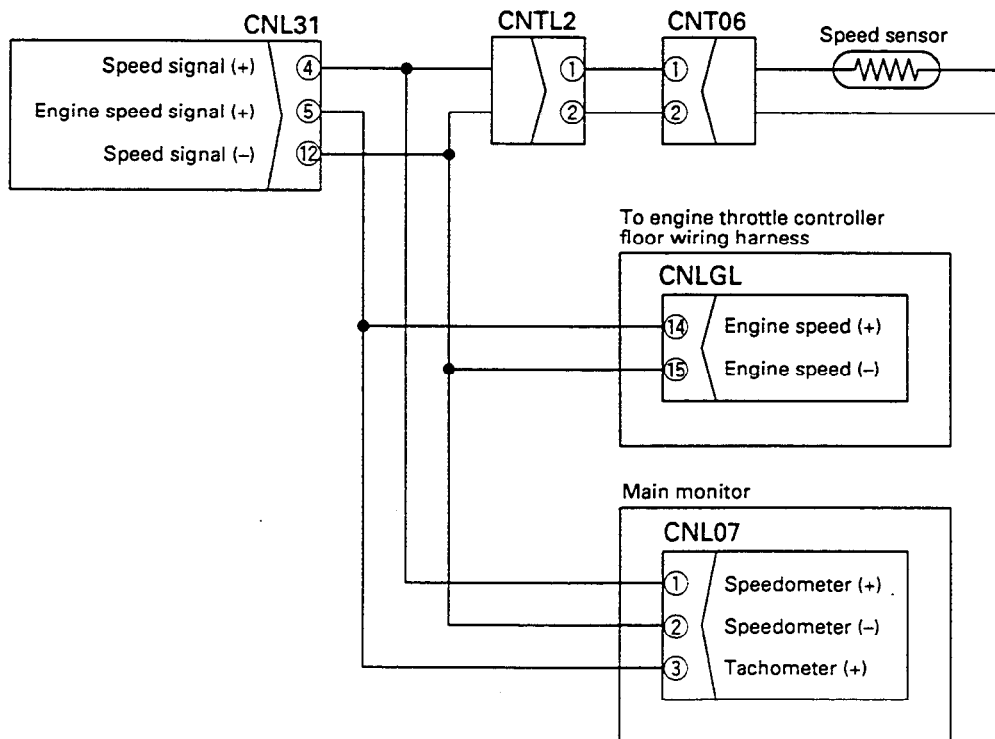
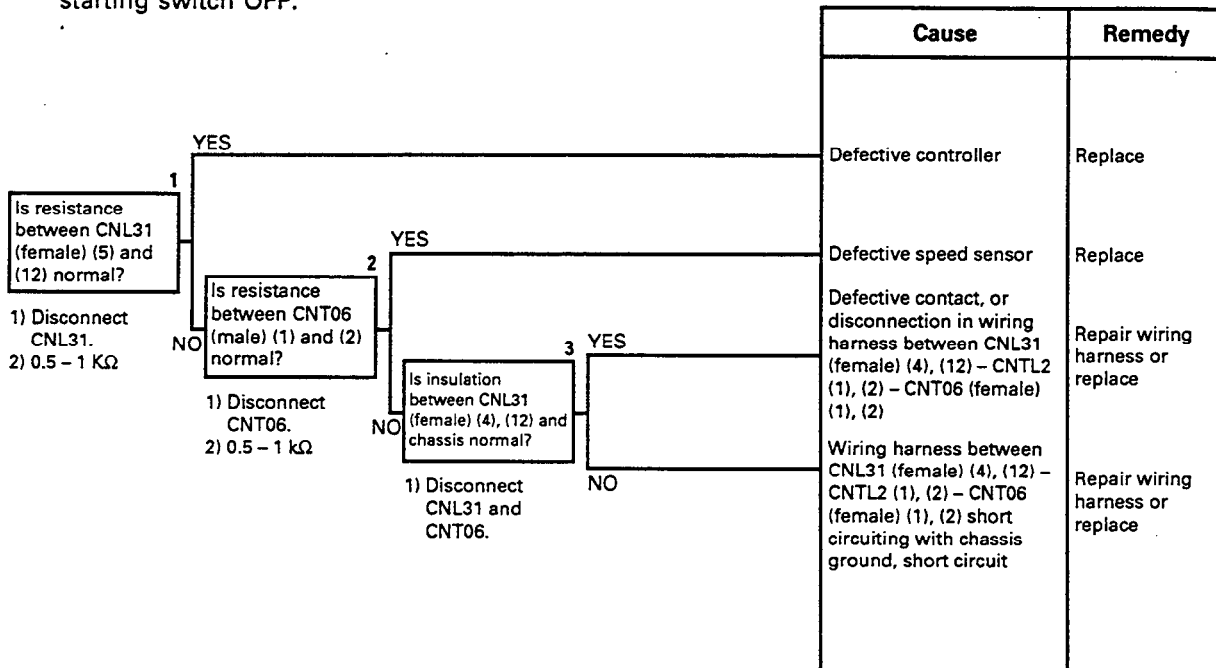
A-9 Troubleshooting code [21] Abnormality in speed lever signal system



A-10 Troubleshooting code [22] Abnormality in travel speed signal

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.

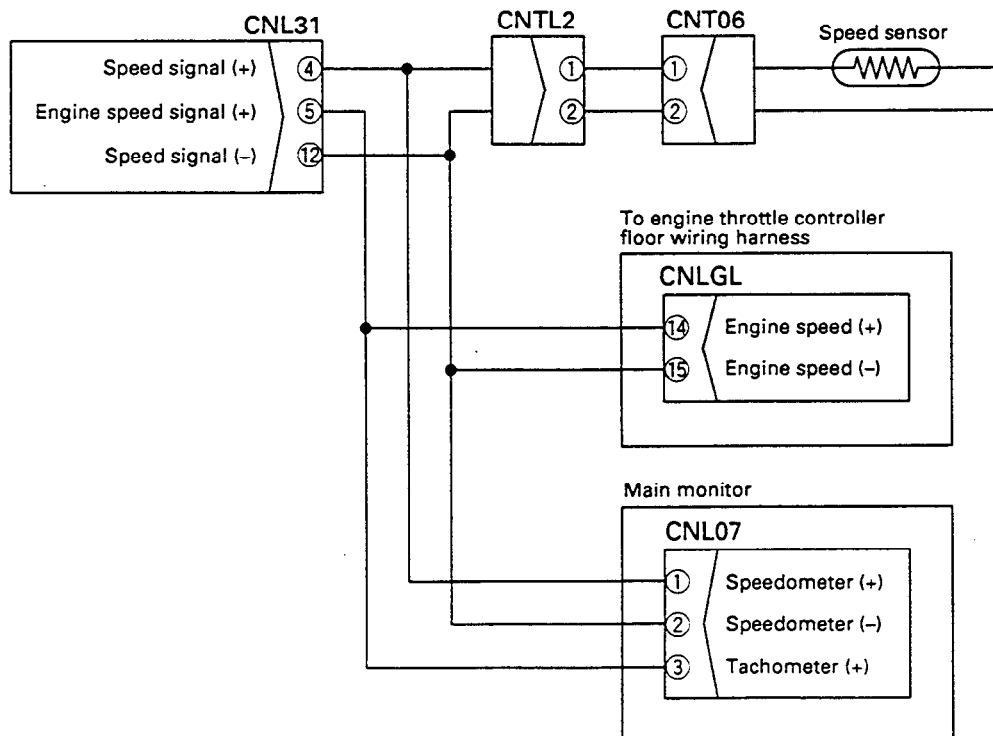
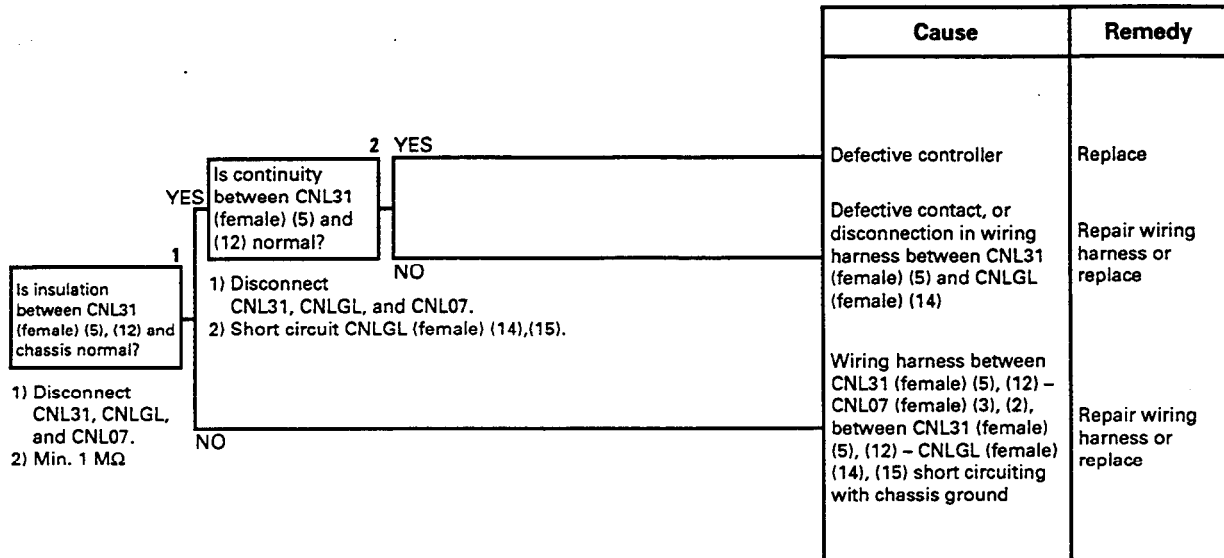


TDW00340

042303

A-11 Troubleshooting code [23] Abnormality in engine speed signal

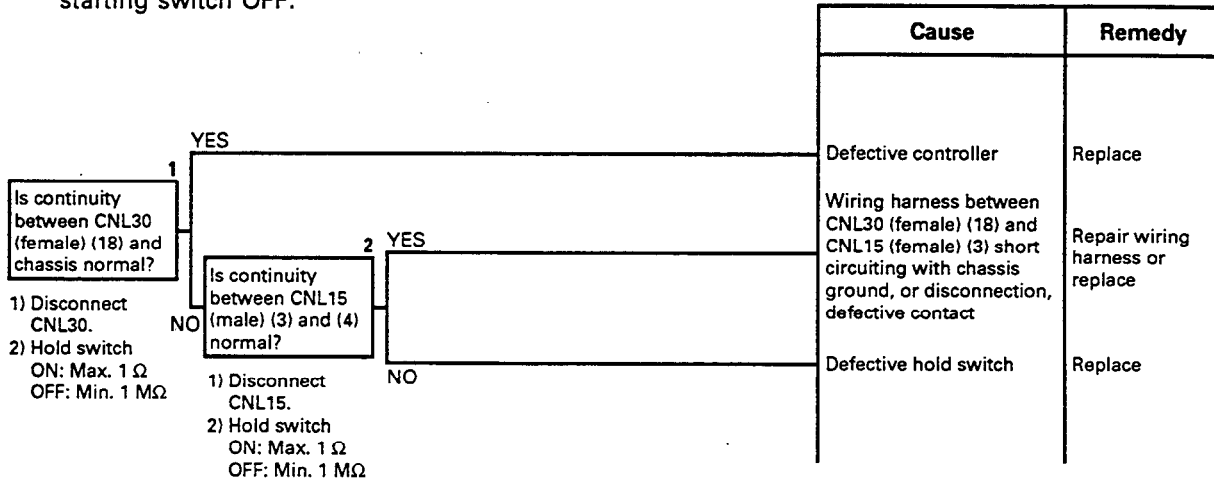
- ★ Check that there is no error message for the engine speed signal for the engine throttle controller.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adaptor (or socket adaptor), always turn the starting switch OFF.



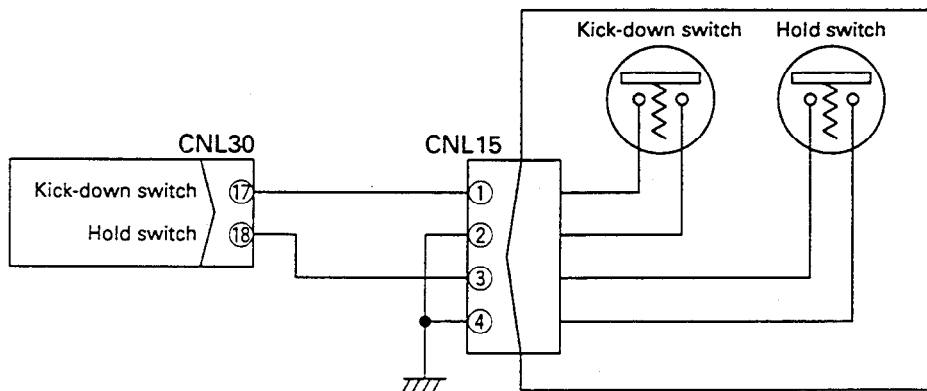
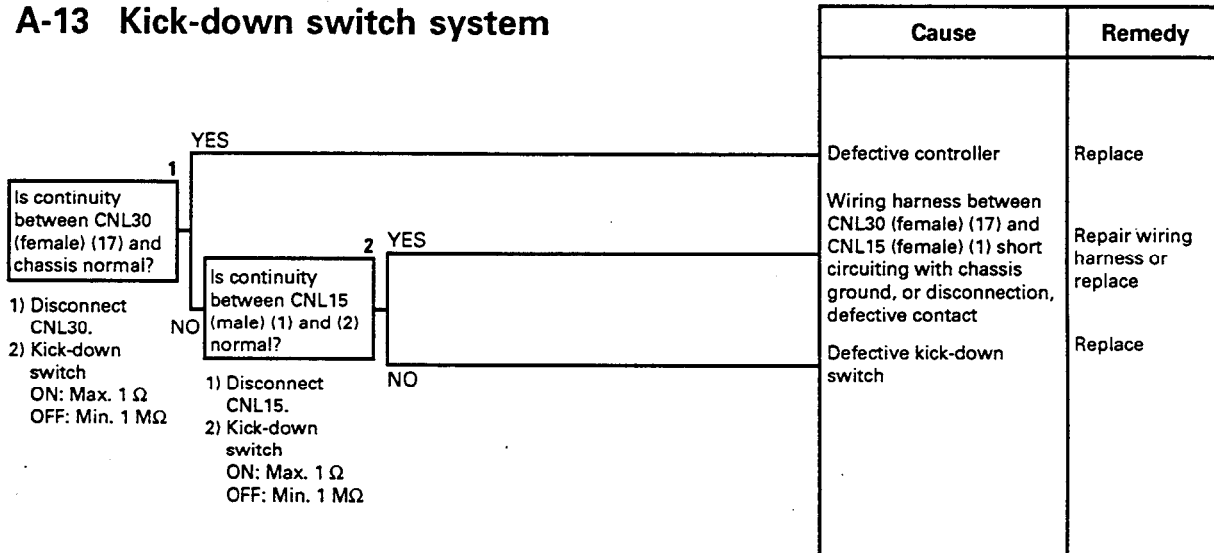
TDW00340

A-12 Hold switch 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.



A-13 Kick-down switch system



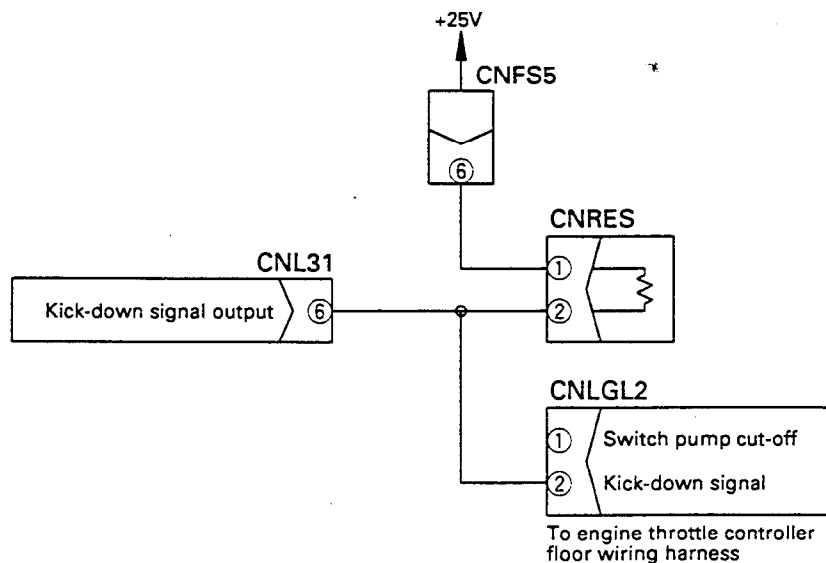
TDW00342

042303

A-14 Kick-down output signal system

- ★ Check that the fuses of CNFS2 (10), CNFS5 (6) are not blown.
- ★ 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.

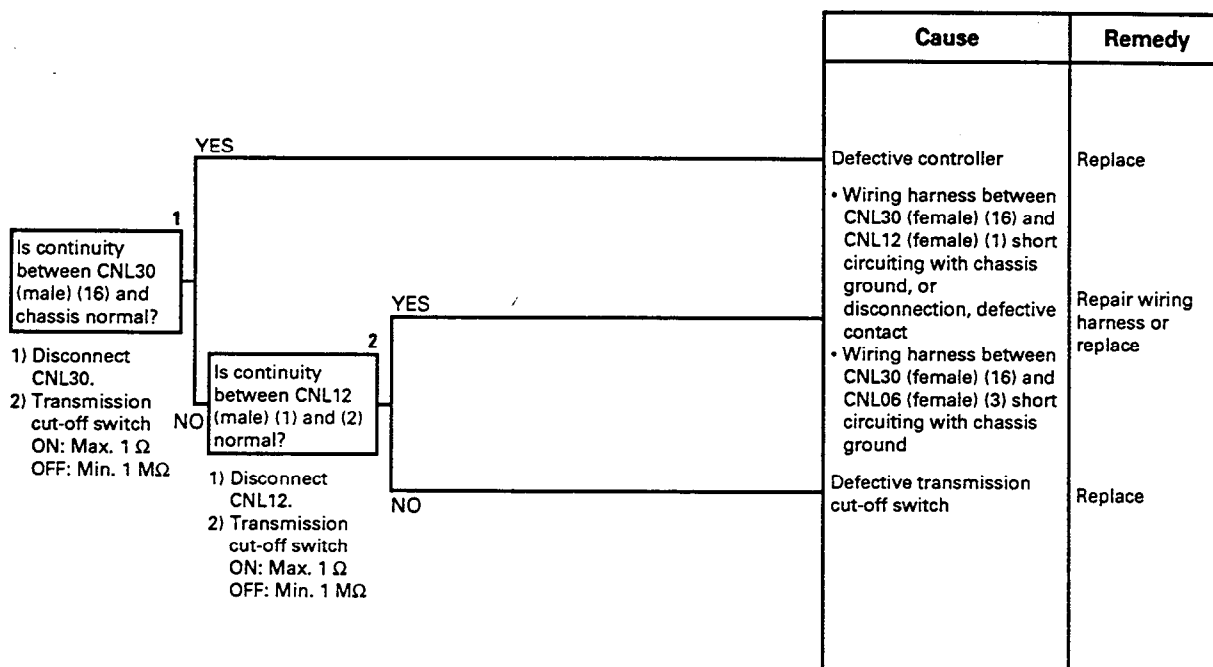
			Cause	Remedy
Is voltage between CNL31 (6) and chassis normal? 1) Insert T-adaptor. 2) Starting switch ON: Max. 1 V 3) Kick-down switch ON: 10 – 15 V	YES	Is voltage between CNLGL2 (female) (2) and chassis normal?	Go to Troubleshooting of engine throttle controller	–
		2 YES		
		NO	Defective contact, or disconnection in wiring harness between CNRES (female) (2) and CNLGL2 (female) (2), or short circuit with ground	Repair wiring harness or replace
	NO	Is voltage between CNL31 (female) (6) and chassis normal? 1) Disconnect CNL31. 2) 20 – 30 V	Defective controller	Replace
		3 YES	Defective contact, or disconnection in wiring harness between CNL31 (female) (6) and CNFS5 (female) (6), or short circuit with ground	Repair wiring harness or replace
		NO		



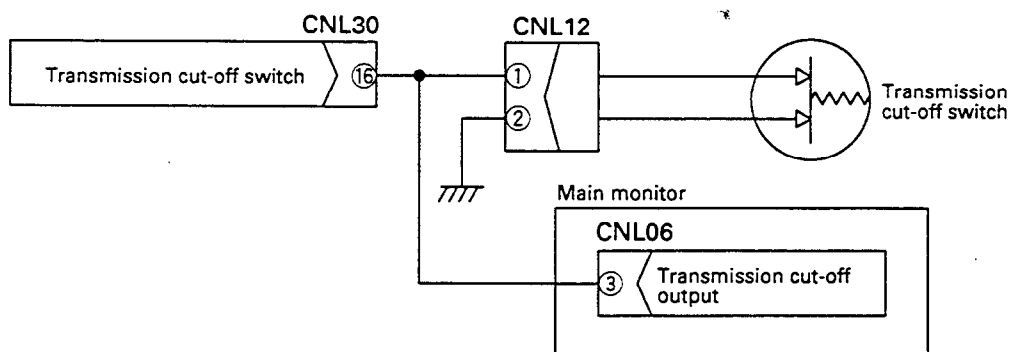
TDW00343

A-15 Transmission cut-off signal 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 adaptor), always turn the starting switch OFF.



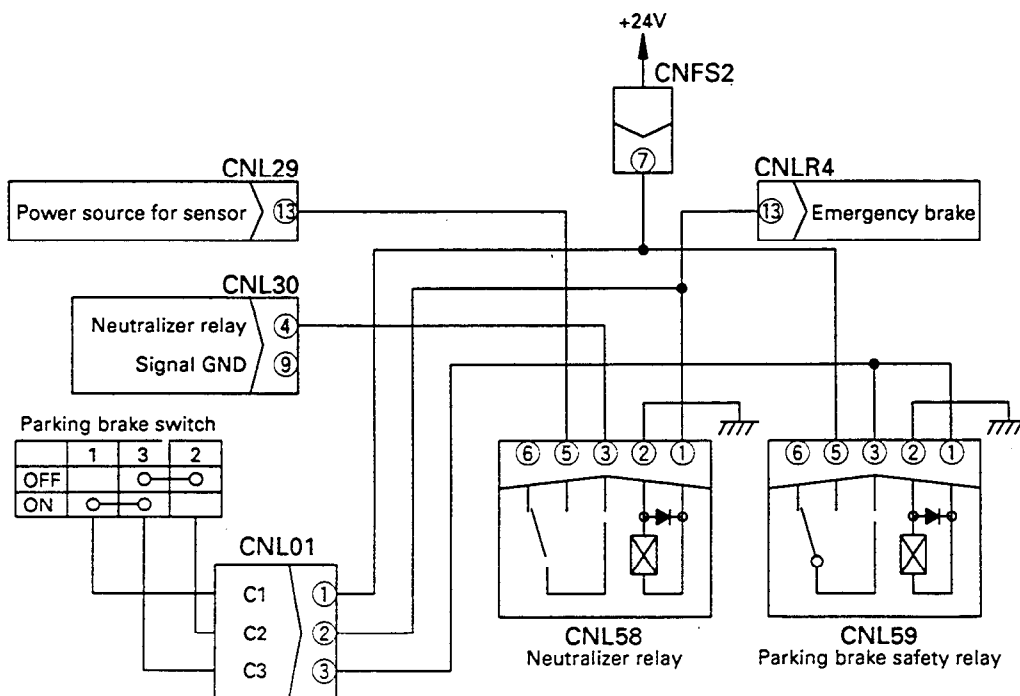
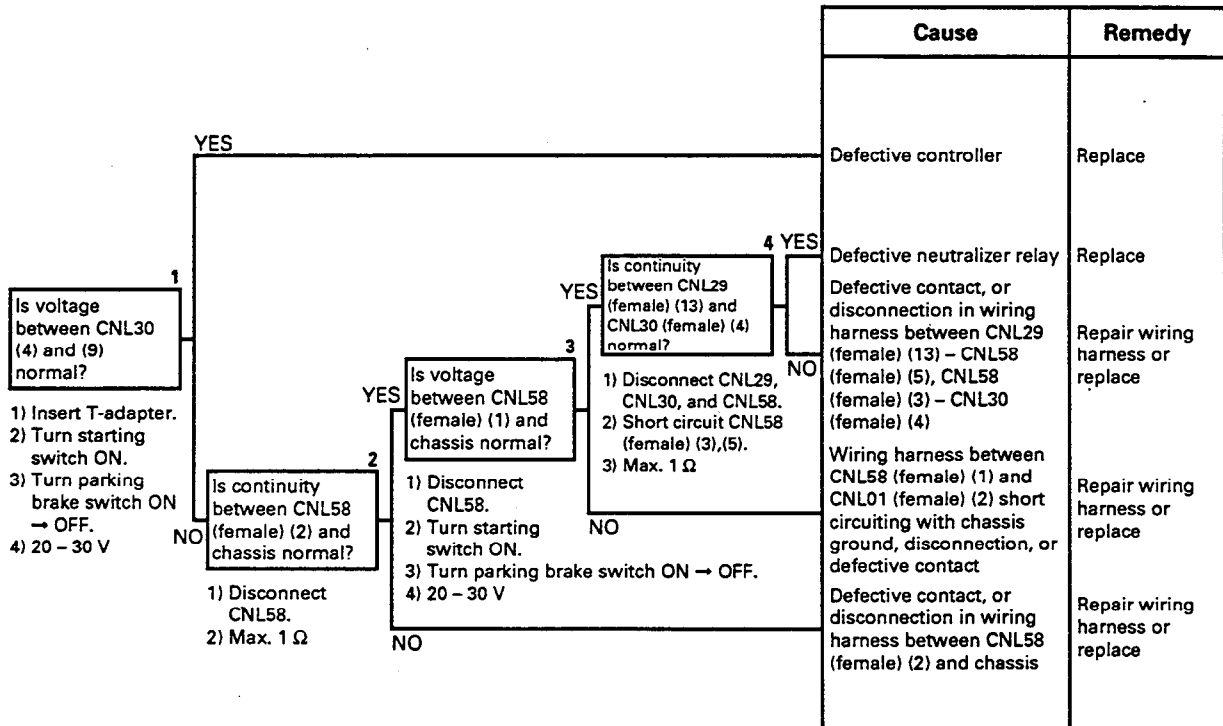
042303



TDW00344

A-16 Neutralizer signal system

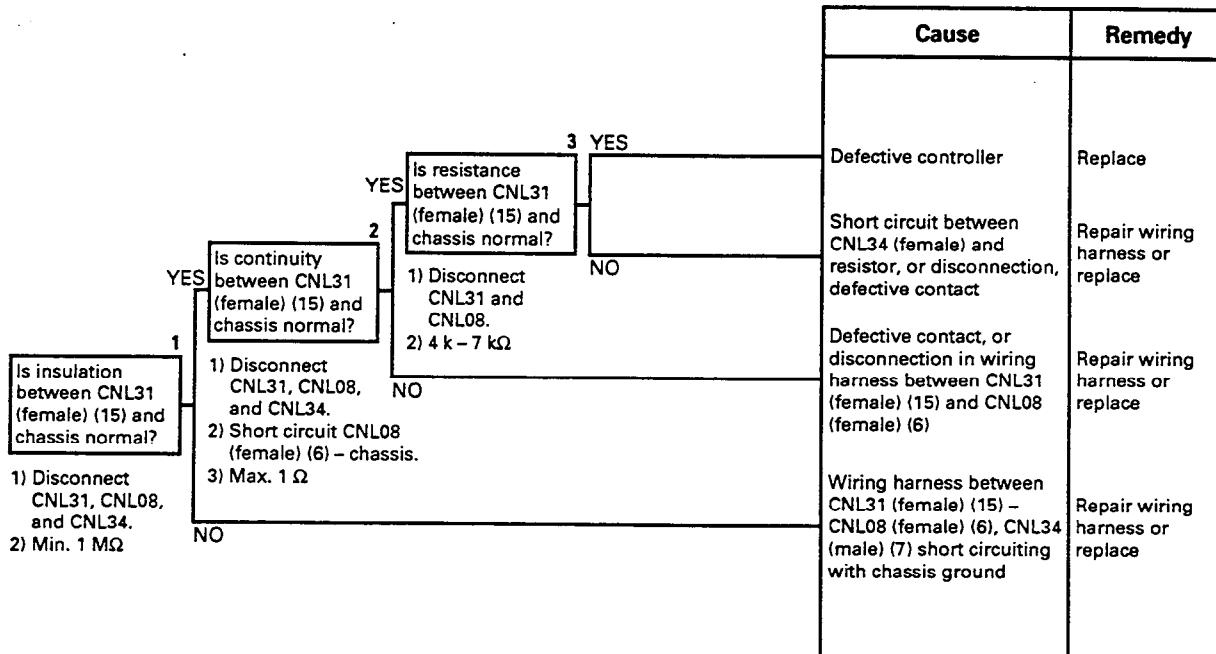
- ★ Check that the parking brake works properly.
- ★ Before carrying out troubleshooting, check that all the related connectors are properly inserted.
- ★ Always connect any disconnected connectors before going on the next step.
- ★ When disconnecting connectors to connect the T-adapter (or socket adapter), always turn the starting switch OFF.



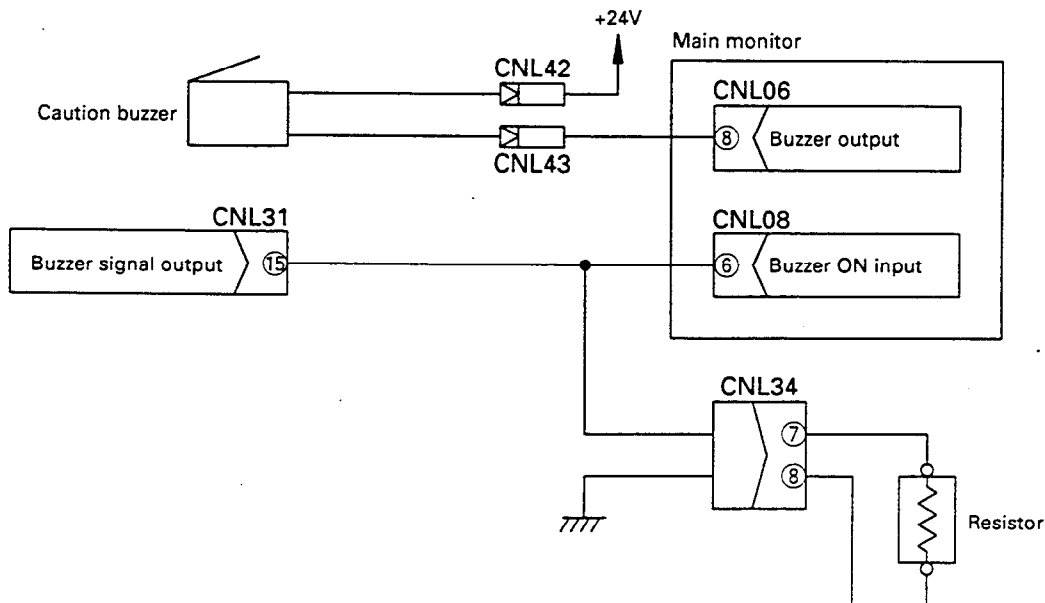
TDW00345

A-17 Buzzer signal system

- ★ 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 adaptor), always turn the starting switch OFF.



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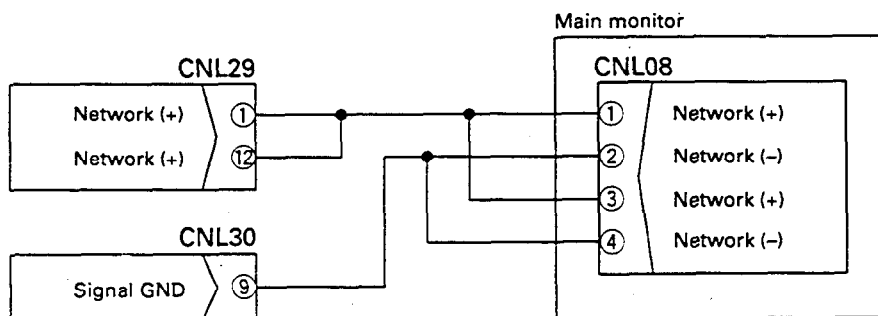
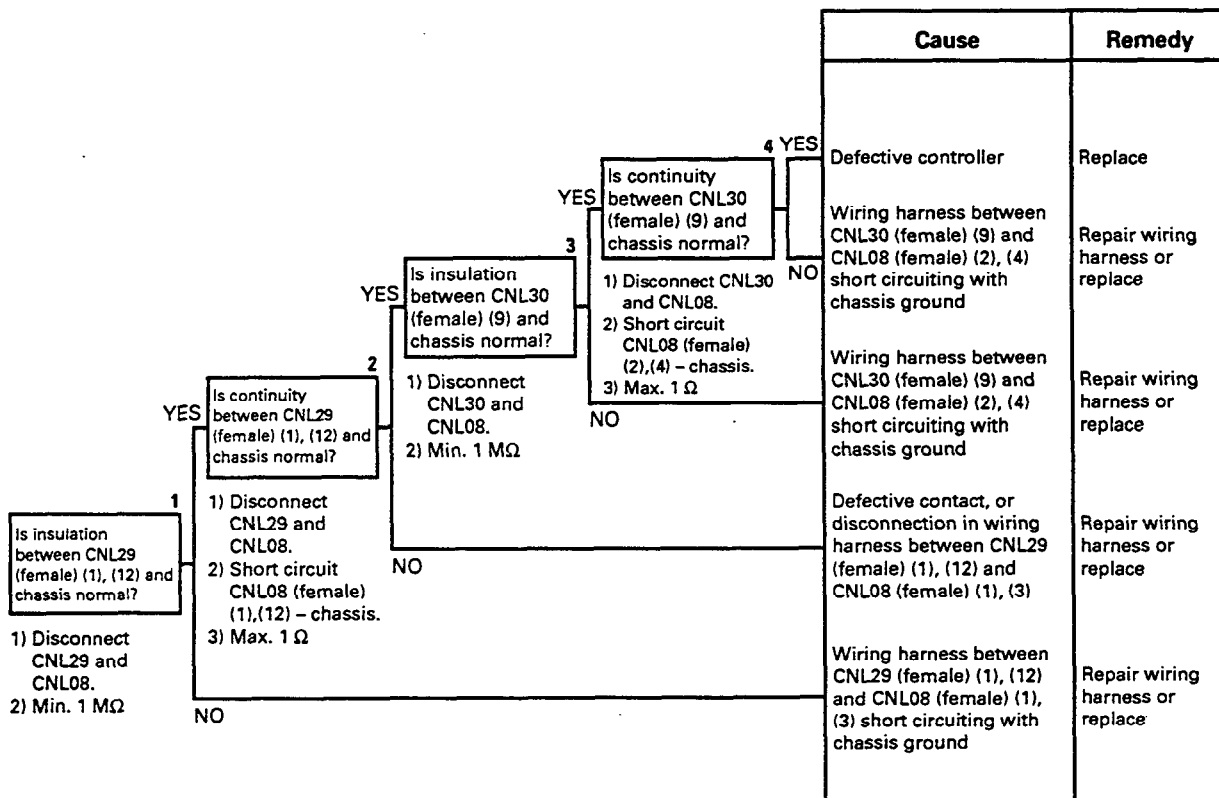


TDW00346

A-18 Network signal 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 adaptor), always turn the starting switch OFF.

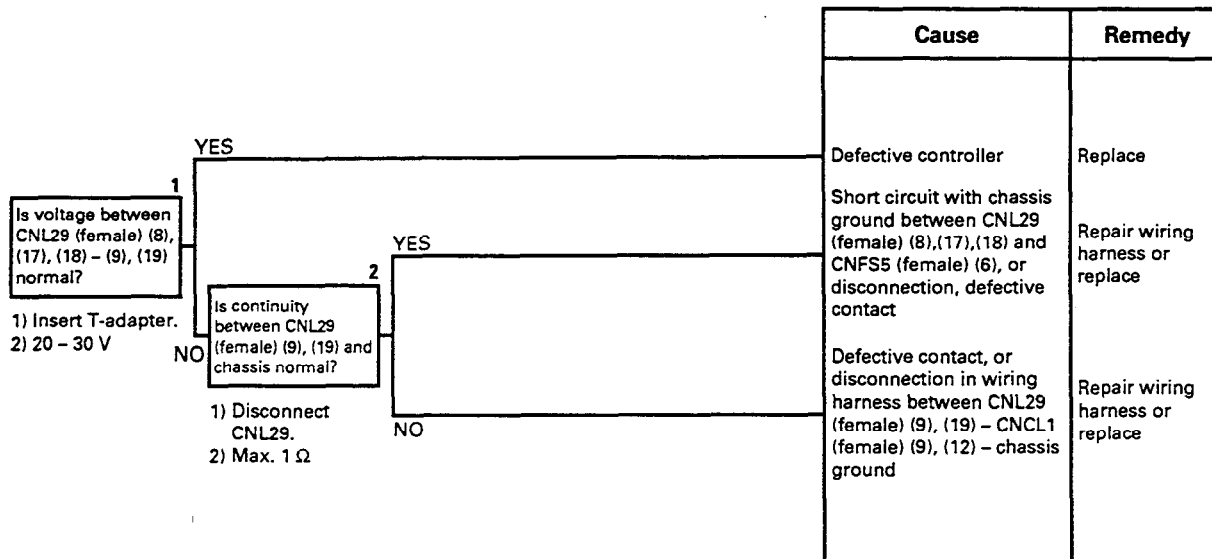
042303



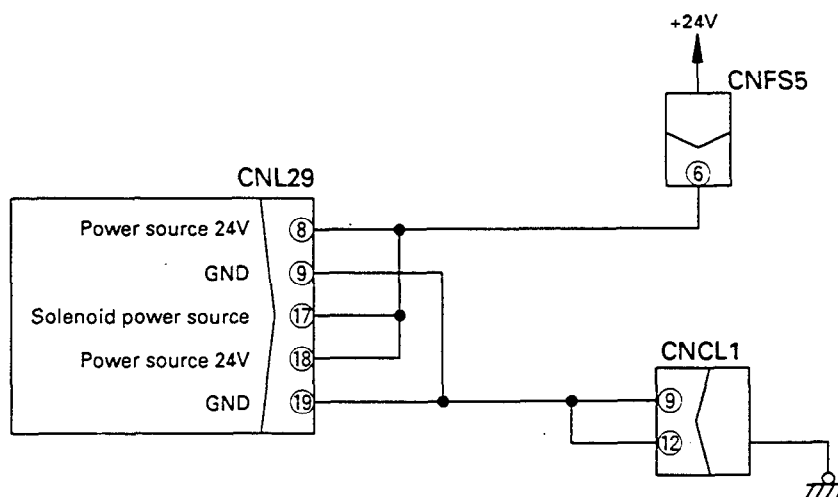
TDW00347

A-19 Controller power source system

- ★ Check that fuse for the transmission controller power source is not blown.
- ★ 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.



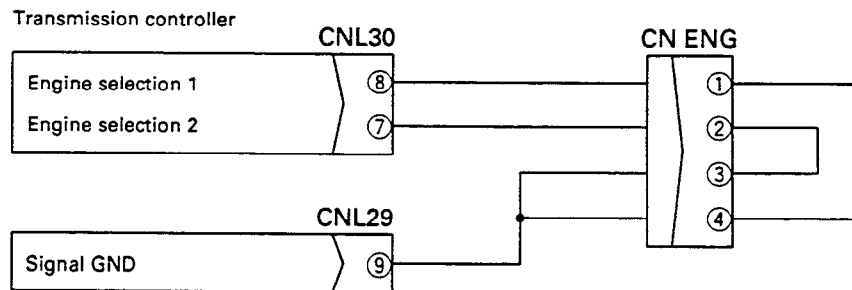
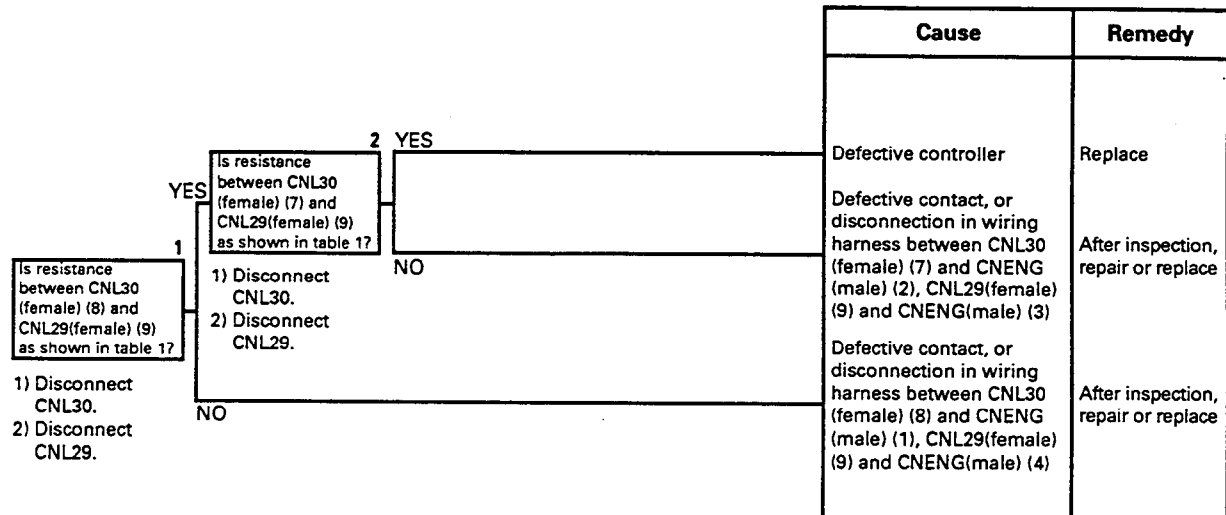
042303



TDW00348

A-20 Abnormality in model selection wiring harness

- ★ Check that the model selection connector has been properly selected.



TAW00001

Table 1

Model	WA350	WA380	WA400	WA420	WA450	WA470
Connector						
Between CNL30(female)(8)-CNL29(female)(9)	Min.1MΩ	Max.1Ω	Min.1MΩ	Max.1Ω	Min.1MΩ	Max.1Ω
Between CNL30(female)(7)-CNL29(female)(9)	Min.1MΩ	Max.1Ω	Min.1MΩ	Max.1Ω	Min.1MΩ	Max.1Ω

TROUBLESHOOTING

(Eagle air conditioner/Heater)

Troubleshooting		
Setup: Controller on Temp. 60° F Defrost "off", Fan on high Abbreviations: EC - Electric Condenser		
(A) Problem - EO error message display on the controller:		
Possible Cause	Inspection	Remedy
1. Open EC power circuit	Check the EC circuit breaker for power, voltage, and continuity	a) Repair the wiring b) Replace open circuit breaker
2. Defective EC relay (circuit)	Check for output voltage on the yellow wire, at the relay coil. Check the voltage and continuity across the relay contacts.	a) Repair the connections / wiring b) Replace the defective relay
3. Open EC voltage detection circuit	Check for input voltage on the brown wire, at the controller.	a) Repair the wiring or connector
4. Improper wiring installation	Applicable to systems without an EC	a) See note #3
5. Defective controller	Check for output voltage on the yellow wire, at the controller.	a) Replace the controller
(B) Problem - E1 error message display on the controller:		
Possible Cause	Inspection	Remedy
1. Abnormal A/C refrigerant pressure(s). * Cool weather operation may cause low pressure short cycling	Check the refrigerant pressures with gauges. High side greater than: 320 psig (R12), or 350 psig (R134a). Low side less than: 3 - 6 psig.*	a) Check the condenser operation for air and refrigerant blockage b) Leak check system, repair the leaks and recharge the system c) Relocate the low pressure switch to the evaporator outlet
2. Opened compressor clutch circuit	Check for output voltage on the green wire at the compressor. Check the wire connections. Check for continuity across the pressure switch(es) and thermostat. Check the continuity of the clutch solenoid to ground.	a) Repair the connections/wiring b) Replace the defective switch(es) or the thermostat c) Replace the defective compressor clutch
3. Opened pressure switch detection circuit	Check for an input voltage on the tan wire, at the controller.	a) Repair the connections/ wiring
4. Defective controller	Check for output voltage on the green wire, at the controller.	a) Replace the controller

(B) Problem continued**False E1 error message / cold weather charging problems:**

(Occurs particularly when vapor charging in cold weather)

1. E1 error message may occur during charging when the low pressure switch (LPS) opens at 3 psig. The suction side pressure must rise above 45 psig to reset the E1 error message.
2. When the system is fully charged, the E1 error message should not appear under normal operating conditions.
3. In order to continue charging, by-pass the LPS, turn the controller "off" then "on", and set the controller to 60° F. This will reset the controller and force into the air conditioning mode.
4. If the LPS can't be easily reached, disconnect the clutch wire at the compressor, and run a hot wire directly to the compressor clutch solenoid. Take care not to short out the controller clutch circuit.
5. E1 error message may occur while charging, when the compressor is wired hot.

(C) Problem - No Heat

Possible Cause	Inspection	Remedy
1. Opened heat solenoid circuit. Poor connection, loss of voltage.	Check for an output voltage on the white wire, at the heat solenoid valve. Check the solenoid continuity to ground.	a) Repair connections/wiring
2. Defective heat solenoid or improper installation.	Check for coolant blockages in the heat solenoid valve and hoses. Check the direction of coolant flow (feel the hoses).	a) Repair or replace the valve. b) Reverse the coolant hoses to the valve.
3. Defective controller	Check for output voltage on the white wire, at the controller.	a) Replace the controller

(D) Problem - No display, the blower fan will not turn off, when the power is turned on.

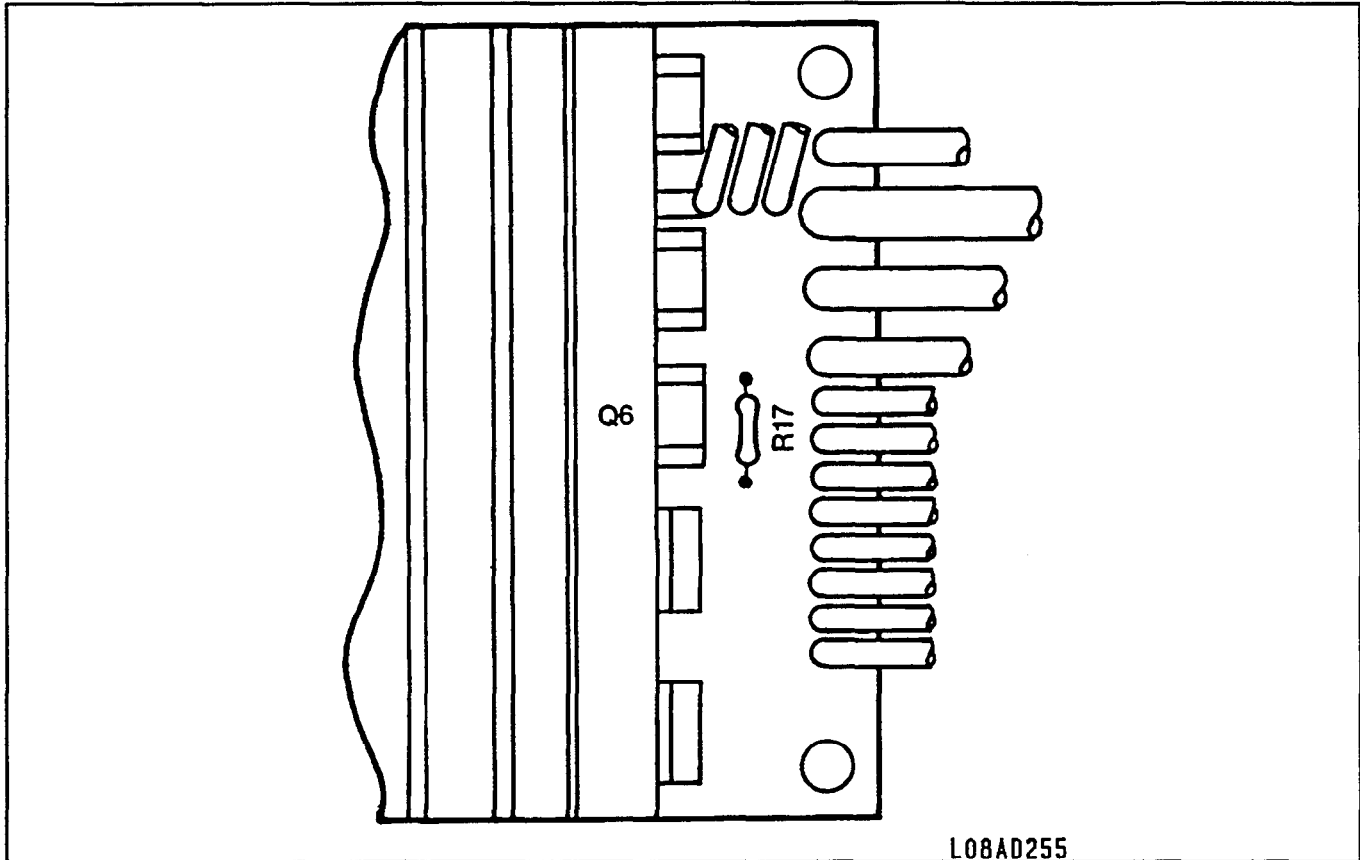
Possible Cause	Inspection	Remedy
1. Fan wires shorted to ground or vehicle chassis	Disconnect the controller from the external harness, Individually check the continuity of the orange and black fan wires to ground, in the external harness.	a) Unground and repair the shorted wiring.

(E) Problem - Compressor clutch will not engage, unless defrost button is pushed.

Possible Cause	Inspection	Remedy
1. Defective preset thermostat inside evaporator. Opened preset thermostat circuit. Broken thermostat wiring. Evaporator coil temperature too cold for a/c operation.	Push, hold defrost / temperature decrease buttons simultaneously. Check display for "OP" or "CL" readout. Disconnect red leads, and check for continuity across thermostat terminals.	a) If "CL", go to step 2. b) If "OP", repair connections or wiring to preset thermostat. c) Replace preset thermostat.
2. Ambient cab temperature too cool (below 60° F).	Set controller at 68-70° F, in a/c mode. Warm-up ambient temperature probe with fingers or heat gun.	a) Verify if compressor clutch will pull in or not. b) If not go to step 3.
3. Opened ambient cab temperature probe (thermistor)	Push, hold temp. Decrease/increase buttons simultaneously. Display will read 40F if probe is defective. Disconnect the controller, check for continuity across black probe leads. Check resistance of thermistor.	a) If display reads 49F, at room temperature, replace thermistor. b) Repair connections/wiring. c) If 10K ohms +/- 20%, thermistor is good. If 100K-1M ohms, replace thermistor.

Notes:

1. Wire colors may vary with installation. Refer to the wiring schematic.
2. For 24V controllers, resistor (R17) must be clipped and removed from the circuit board. (Refer to figure below) If the resistor is not clipped on the 24V system, the controller display will light up, but the blower fan will not turn on.



3. For air conditioning systems that do not use an electric condenser, the blue and brown wires must be connected together, on the external harness. The brown wire must be connected to the battery voltage, or the EO error message will result.
4. Care must be taken during installation, not to pinch or cut wiring from the controller. Shorted wiring may result in damage to the controller.
5. Improper probe location of the evaporator coil thermostat sensor, or ambient cab temperature sensor, may cause short cycling of the compressor.
6. Eagle climate controllers are designed to use normally closed heat solenoid valves.
7. Disconnect the vehicle battery leads, if a machine is to be inactive, or put into storage, for a period of a week or more. The current drain from the controller's memory may result in a dead vehicle battery. An optional ignition relay may be installed to disable the controller's memory function, when the key switch is turned off.

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 ※ 1, 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): ※ 1 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.

※ 1

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

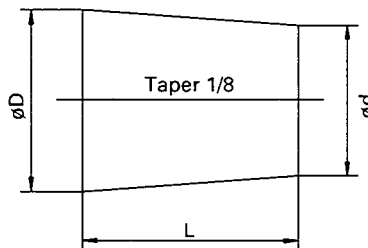
Nominal number	Plug (nut end)	Sleeve nut (elbow end) Use the two items below as a set
02	07376-50210	07221-20210 (Nut), 07222-00210 (Plug)
03	07376-50315	07221-20315 (Nut), 07222-00312 (Plug)
04	07376-50422	07221-20422 (Nut), 07222-00414 (Plug)
05	07376-50522	07221-20522 (Nut), 07222-00515 (Plug)
06	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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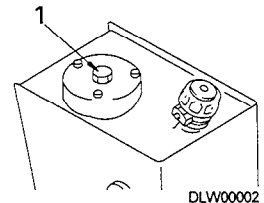
U42303

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 steering, bucket, and boom cylinders 3 - 4 times to the end of their strokes, then stop the engine and loosen air bleed plug (1) to bleed the air from the hydraulic tank. After bleeding the air, tighten plug (1).
 - 4) Following this, raise the engine speed, repeat the procedure in Step 3) to bleed the air. Repeat this operation until no more air comes out from the plug hole.

 Plug : $11.3 \pm 1.5 \text{ Nm}$ ($1.15 \pm 0.15 \text{ kgm}$)

 - 5) 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.



DLW00002

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.

SPECIAL TOOL LIST

Nature of work	Symbol	Part No.	Part Name	Q'ty	Remarks
Disassembly, assembly of transmission assembly	A	1	793-305-1600	2	Rear housing lifting tool
		2	793-415-1210	1	For F – R clutch
		3	793-415-1220	1	For 1st, 2nd, 3rd 4th clutch
		4	793-415-1150	1	Removal, installation of parking brake disc
		01010-51075	Bolt	4	
		01580-11008	Nut	4	
Disassembly, assembly of transmission clutch pack assembly	B	1	793-310-1300	1	Removal, installation of end plate
		2	793-310-1370	5	
		3	793-310-1330	1	
		4	01541-01260	2	
		5	793-310-1360	2	
		6	793-415-1250	1	F – R Jig for settling piston seal
		7	793-415-1130	1	1st – 4th
Disassembly, assembly of differential assembly	C	1	793-422-1120	1	Positioning bearing of differential pinion
		2	793-422-1100	1	Insertion of brake piston
		793-422-1130	• Plate	5	
		3	01016-30880	5	
		01011-01010	• Bolt	5	
		01643-32060	• Washer	5	
		5	790-301-1720	1	Checking for oil leakage
		6	799-101-5002	1	
		7	793-605-1001	1	
		8	790-101-1102	1	
Disassembly, assembly of axle housing assembly	D	1	790-101-2910	1 set	Puller assembly: 790-101-2900
		2	790-101-2920	2	Removal of axle shaft bearing
		3	790-101-2930	2	
		4	793-422-1140	2	Holder for oil seal when press fitting oil seal
		4-1	01016-30840	6	
		5	793-422-1110	1	For adjusting shim

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DISASSEMBLY AND ASSEMBLY

SPECIAL TOOL LIST

Nature of work	Symbol	Part No.	Part Name	Q'ty	Remarks
Installation of center hinge pin	E	1 793-840-1310	Push tool	1	Press fitting of bearing
		2 792-103-0400	Grip	1	
		3 790-101-1002	Pump	1	
		4 790-101-2102	Puller	1	
		5 790-101-2300	Push-puller	1	
		6 793-520-2370	Push tool	1	
		7 793-520-2350	Push tool	1	
		8 793-520-2540	Guide	1	
		9 793-520-2360	Bar	2	
Disassembly, assembly of hydraulic cylinder	F	790-502-1003 or 790-502-2000	Cylinder repair stand	1	
		790-101-1102	Pump	1	
	G	790-330-1100	Wrench ass'y	1	Steering Cylinder Removal, installation of round head
	H	Commercially available	Socket (width across flats: 46)	1	Steering Cylinder Removal, installation of nylon nut
	I	790-101-5021	Grip	1	Press fitting of coil bushing Kit Part No.: 790-201-1702
		01010-50816	Bolt	1	
		790-201-1841	Push tool	1	
		790-201-1751	Push tool	1	
	J	1 790-720-1000	Expander	1	Installation of piston ring
		796-720-1680	Ring	1	
		07281-01589	Clamp	1	
		796-720-1690	Ring	1	
		07281-01919	Clamp	1	
		796-720-1640	Ring	1	
		07281-00909	Clamp	1	
	K	790-101-5021	Grip	1	Insertion of dust seal Kit Part No.: 790-201-1500
		01010-50816	Bolt	1	
		790-201-1650	Plate	1	
		790-201-1560	Plate	1	

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INSTRUCTIONS FOR
REMOVAL AND INSTALLATION OF STARTING MOTOR
WERE NOT AVAILABLE FOR THIS PRINTING

INSTRUCTIONS FOR
REMOVAL AND INSTALLATION OF ALTERNATOR
WERE NOT AVAILABLE FOR THIS PRINTING

INSTRUCTIONS FOR
REMOVAL AND INSTALLATION OF ENGINE OIL COOLER
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL).

INSTRUCTIONS FOR
REMOVAL OF FUEL INJECTION PUMP
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

INSTRUCTIONS FOR
INSTALLATION OF FUEL INJECTION PUMP
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

INSTRUCTIONS FOR
REMOVAL AND INSTALLATION OF WATER PUMP
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

INSTRUCTIONS FOR
REMOVAL AND INSTALLATION OF TURBOCHARGER
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

INSTRUCTIONS FOR
REMOVAL AND INSTALLATION OF NOZZEL HOLDER ASSEMBLY
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

INSTRUCTIONS FOR
REMOVAL AND INSTALLATION OF THERMOSTAT
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

INSTRUCTIONS FOR
REMOVAL OF CYLINDER HEAD ASSEMBLY
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

INSTRUCTIONS FOR
INSTALLATION OF CYLINDER HEAD ASSEMBLY
WERE NOT AVAILABLE FOR THIS PRINTING
(REFER TO ENGINE SHOP MANUAL)

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.

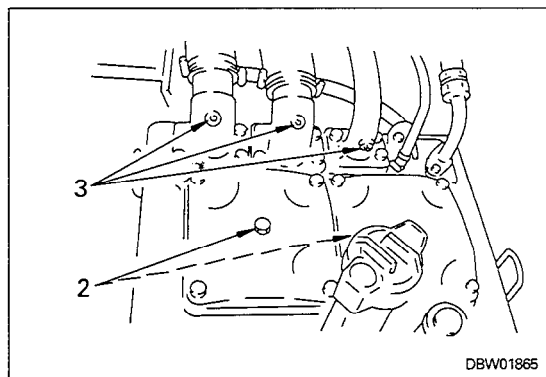
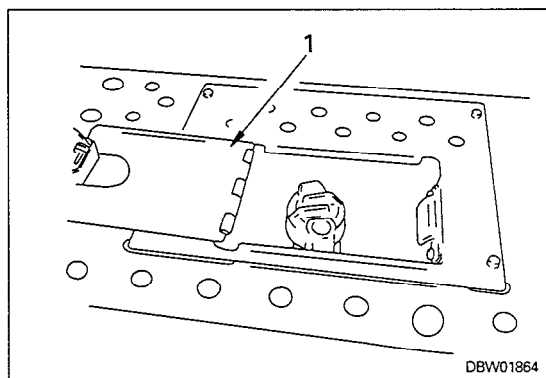
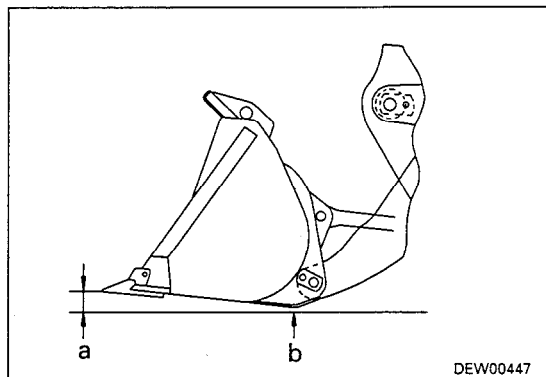
⚠ Release the remaining pressure in the piping.

- ★ 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.

⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Cover

- 1) Remove mounting bolts, then remove inspection cover (1).
- 2) Loosen plugs (2) at top of hydraulic tank filter and plugs (3) of pump piping to prevent oil inside tank from flowing out.

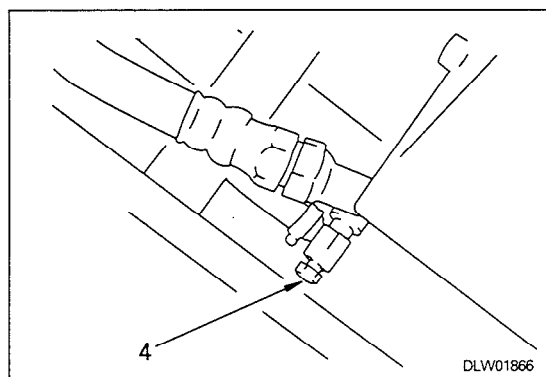


2. Draining water

Loosen drain valve (4) and drain coolant.

- ★ If the coolant contains antifreeze, dispose of it correctly.

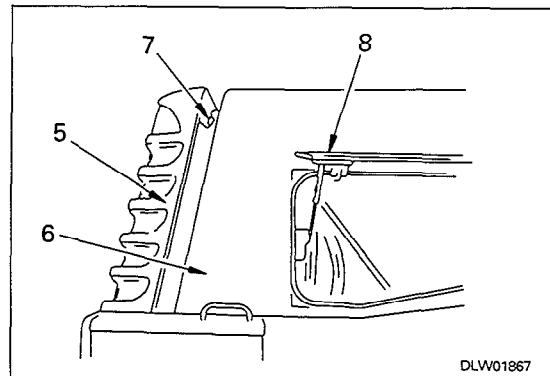
 Coolant : 53 ℓ



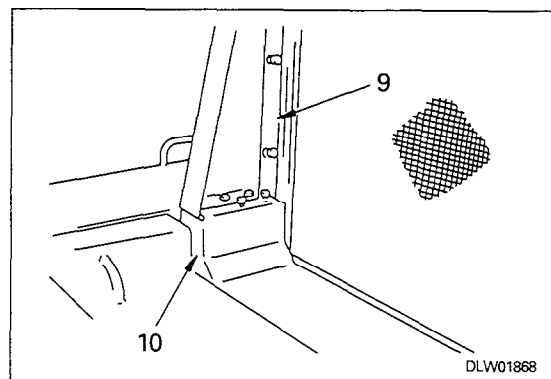
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3. Grill

- 1) Loosen mounting bolts of grill (5), then fit grill to engine hood (6) temporarily, and remove light wiring from clip portion of engine hood (6).
- 2) Disconnect wiring connector (7), and remove grill (5).
 - ★ Open left and right side panels (8) to make it possible to fit the lifting tool.

**4. Engine hood**

- 1) Remove radiator left and right plates (9) and bottom cover (10).
- 2) Pass nylon rope ① through left and right hinge portions of side panel (8), then connect to lifting chain and lift at 4 points.
 - ★ Be careful that the lifting tool does not come off.
 - ★ Fit the lifting tool with the exhaust pipe still installed.



- 3) Remove the front, rear, left, and right mounting bolts and top front mounting bolts of engine hood (6).

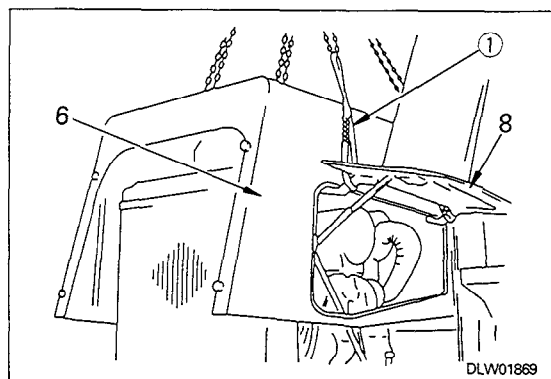


Hood assembly :
200 kg (without rear fender)

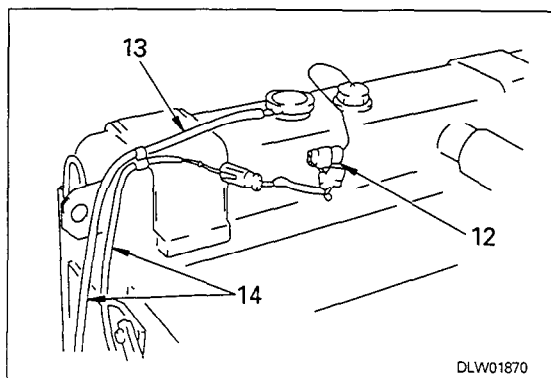


Hood assembly :
260 kg (with rear fender)

- ★ Thread size when using eyebolts for removal : **12 mm**

**5. Wiring**

- 1) Disconnect wiring connector (12) for radiator water level sensor.
- 2) Disconnect hose (13) between radiator and sub-tank at radiator end.
 - ★ To prevent the water from leaking out of the sub-tank, bend the tip of the hose and fix it with a band.
 - ★ Remove the sub-tank hose and wirings (14) from the radiator clip.

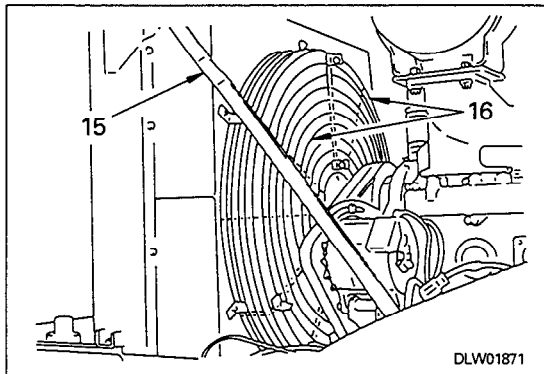


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6. Fan guard, stay

※ 2

- 1) Remove mounting bolts of radiator stay (15) at radiator end.
- 2) Remove fan guard (16).
- ★ Be careful not to damage the radiator fins when removing.

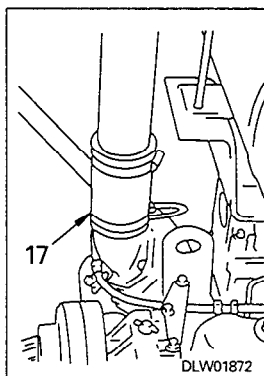


DLW01871

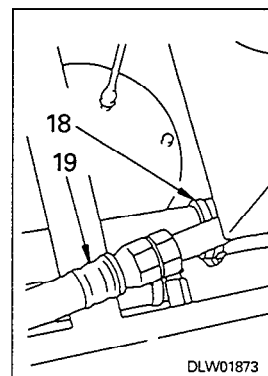
7. Radiator hoses

※ 3

- 1) Disconnect radiator upper hose (17) at engine end.
- 2) Disconnect radiator lower hose (18) at radiator end.
- ★ Loosen the hose clamp of the connection portion at the radiator end.



DLW01872



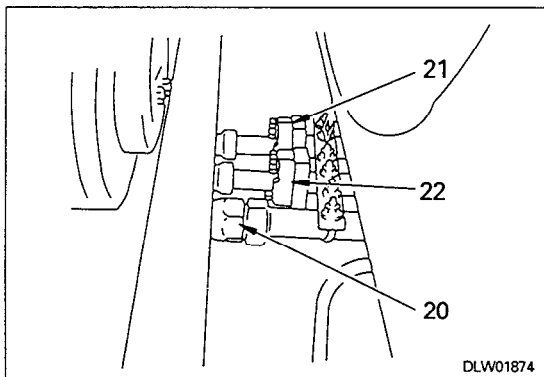
DLW01873

8. Hydraulic piping

※ 4

Disconnect oil cooler hoses (19), (20), (21), and (22) at connection portion of tube at bottom of radiator.

- ★ Mask the openings to prevent water or dust from entering.



DLW01874

9. Radiator

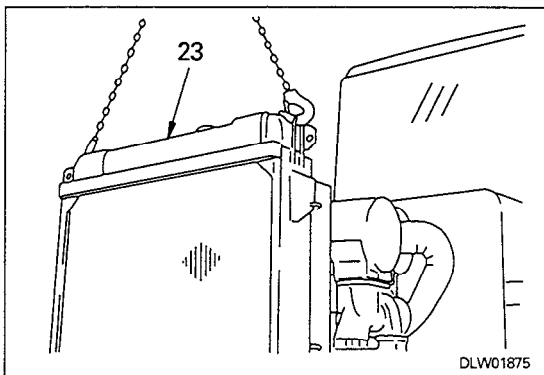
※ 5

Remove mounting bolts of radiator (23) and lift off.



Radiator : **165 kg**

- ★ Be careful not to damage the radiator fins when removing.



DLW01875

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INSTALLATION OF RADIATOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Run the engine to circulate the water through the system. Then check the water level again.

※ 2

- ★ Temporarily install the radiator stays.

 **kgm** Mounting bolt :

$110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)

- ★ Install the fan guard so that the clearance between the fan and fan guard is uniform.

※ 3

 **kgm** Hose clamp : **$5.9 \pm 0.5 \text{ Nm}$ ($0.6 \pm 0.05 \text{ kgm}$)**

※ 4

- ★ Fit the O-ring securely into the groove and be careful that it does not get caught when assembling.
- ★ Install the hoses without twisting or interference.

 **kgm** Joint nut : **$196 \pm 49 \text{ Nm}$ ($20.0 \pm 5.0 \text{ kgm}$)**
(width across flats: 41 mm)

※ 5

- ★ Be careful not to damage the radiator fins.
- ★ Install the radiator from the counterweight slowly.
- ★ Install so that the clearance from the fan is uniform.

 **kgm** Radiator mounting bolt :
 $176 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2.0 \text{ kgm}$)

- ★ Tighten the mounting bolts of the radiator stay fully.

- **Refilling with oil**

- 1) Tighten drain valve and add transmission oil through oil filler to the specified level.
 - ★ Run the engine to circulate the oil through the system. Then check the oil level again.



Transmission : **35 ℓ**

- 2) Tighten plug at top of hydraulic tank filter and plug of pump piping, then add hydraulic oil through oil filler to specified level.

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INSTRUCTIONS FOR
REMOVAL OF ENGINE
WERE NOT AVAILABLE FOR THIS PRINTING

INSTRUCTIONS FOR
INSTALLATION OF ENGINE ASSEMBLY
WERE NOT AVAILABLE FOR THIS PRINTING

REMOVAL OF TORQUE CONVERTER CHARGING PUMP ASSEMBLY

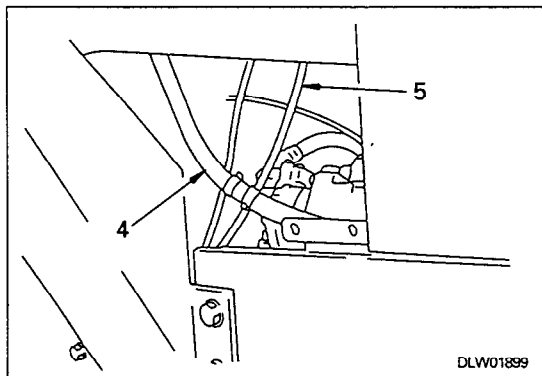
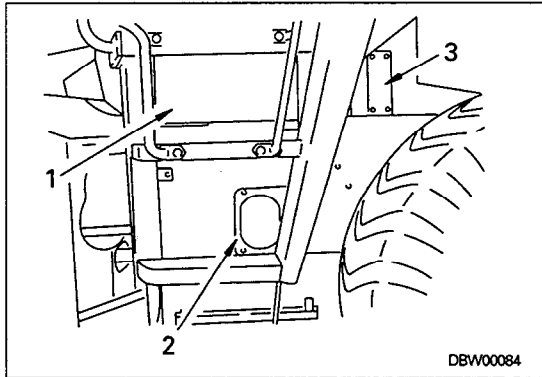
- ⚠** Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.
- ★ Open the left inspection cover and apply the lock.

1. Cover

Remove cover (1) at bottom of cab, transmission inspection cover (2), and side inspection cover (3).

2. Air conditioner hose, fuel control cable

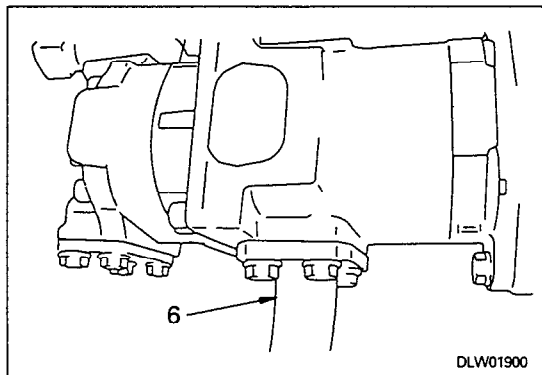
Remove clamp of air conditioner hose (4), and raise air conditioner hose and fuel control cable (5) with wire.



3. Hydraulic piping

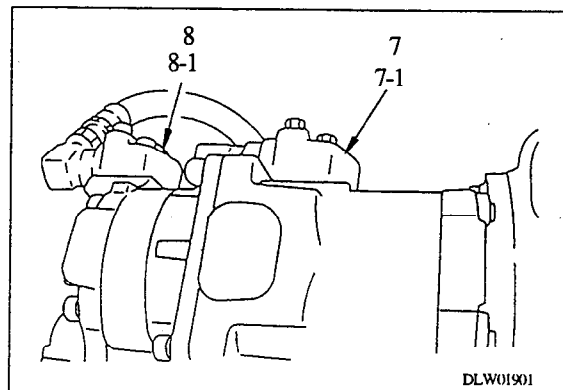
Disconnect the following hydraulic piping.

- Tube (6) between transmission strainer and charging pump
- Hose (7) between charging pump and torque converter oil filter
- Hose (8) between charging pump and top of transmission
 - ★ Disconnect the tubes and hoses from the pump end.



Disconnect the following hydraulic piping. (WA350-3H)

- Tube (6) between transmission strainer and charging pump
- Hose (7-1) between charging pump and flange at top of flow control valve
- Hose (8-1) between charging pump and flange at top of flow control valve
 - ★ Disconnect the tubes and hoses from the pump end.



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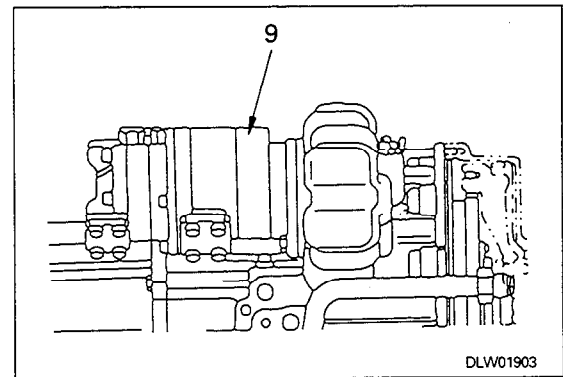
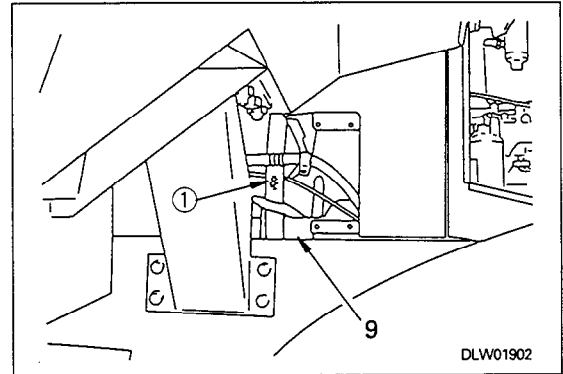
4. Torque converter charging pump ※ 1

Remove mounting bolts, and pull out torque converter charging pump (9) from cover removal portion.

- ★ The working space is confined, so be careful not to crush your hands or fingers.
- ★ Carry out the removal operation with two workers, and fit lifting tool ① to prevent the pump from falling.



Torque converter charging pump :
10 kg



INSTALLATION OF TORQUE CONVERTER CHARGING PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Check that there is an O-ring at the mating surface with the housing.
- ★ Fit the O-ring securely in the groove and be careful not to get it caught when assembling.

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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.

- Drain transmission oil.

⚠ 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.

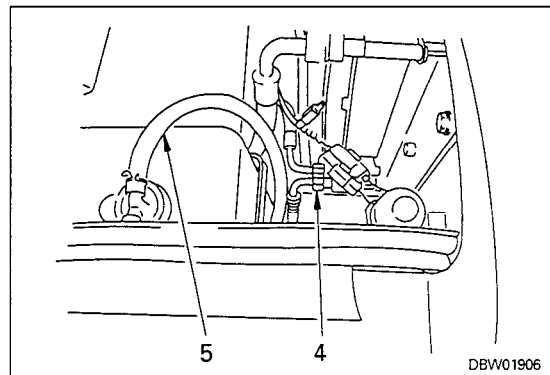
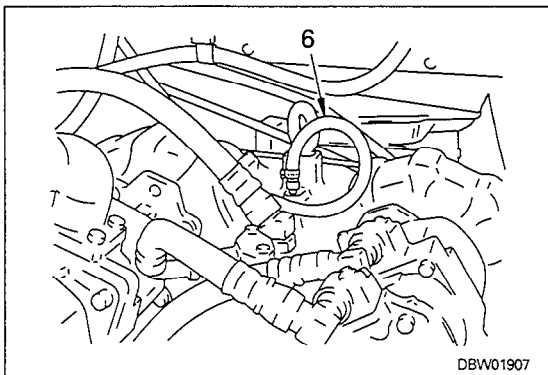
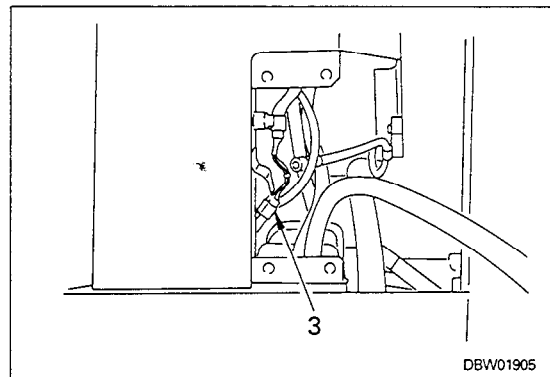
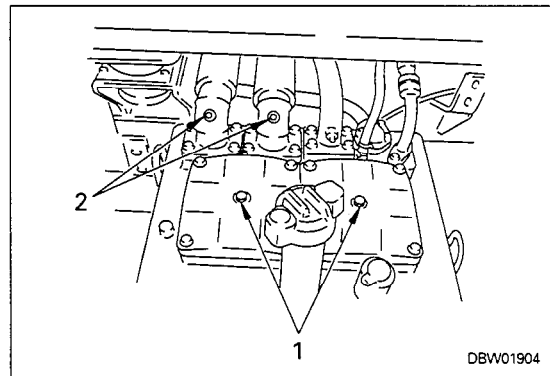
⚠ Disconnect the cable from the negative (–) terminal of the battery.

1. Loosen plugs (1) at top of hydraulic tank filter and plugs (2) of pump piping to prevent oil inside tank from flowing out.

2. Remove cab and floor frame assembly.
For details, see REMOVAL OF CAB, FLOOR FRAME ASSEMBLY.

3. Remove bulkhead assembly as follows. ※ 1

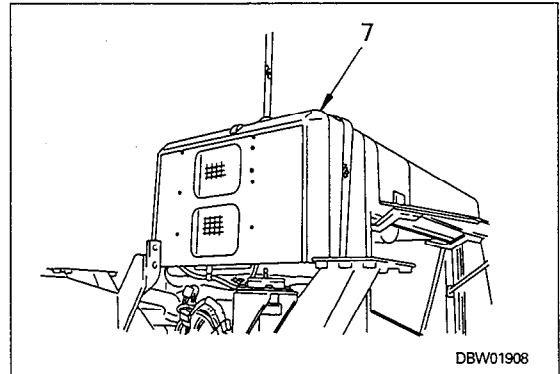
- 1) Disconnect air conditioner connector (3).
- 2) Disconnect air conditioner hose (4).
- 3) Disconnect 2 reservoir tank hoses (5).
- 4) Disconnect breather hose (6).



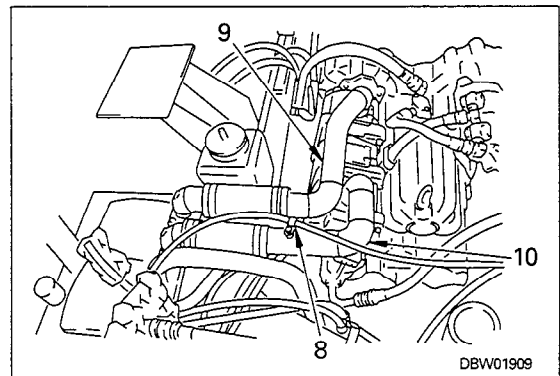
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- 5) Sling bulkhead (7), remove mounting bolt, then remove bulkhead.



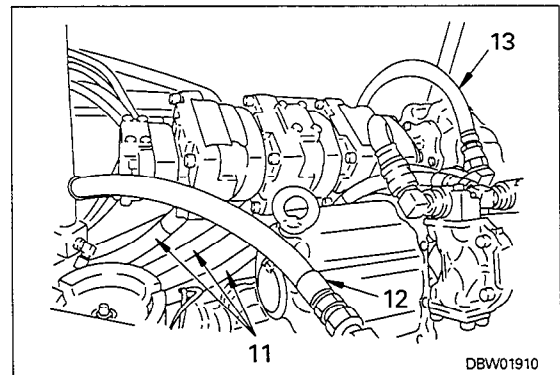
4. Remove hose clamp (8), then remove pipes (9) and (10) at top of hydraulic and steering pump.



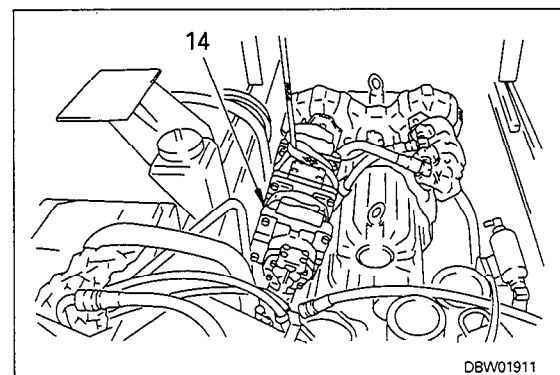
5. Disconnect hoses (11) and (12) mounted at bottom of hydraulic and steering pump. ※ 2

★ The hose flange and spacer are tightened together, so be careful not to lose them when disconnecting hoses (11).

6. Disconnect transmission cooler hose (13).

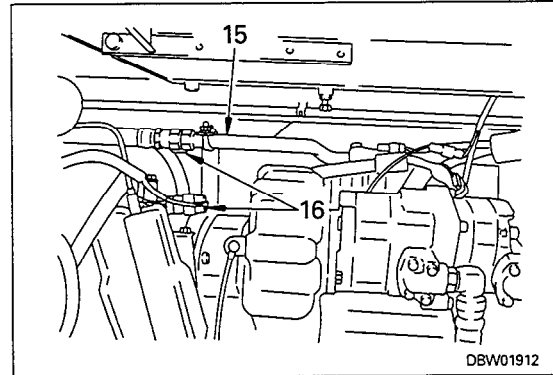


7. Sling hydraulic and steering pump assembly (14), remove mounting bolts, then lift off.



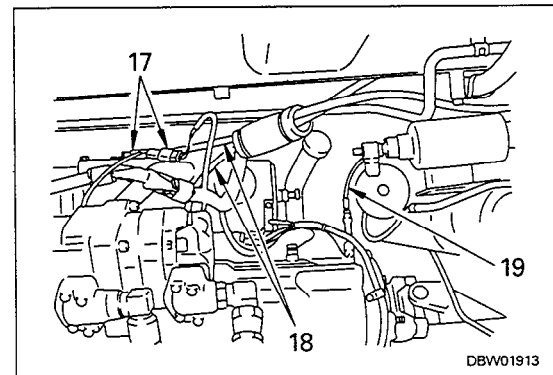
8. Disconnect tube (15) between valve and cooler at transmission valve end.

9. Remove 3 connectors (16) from clip and disconnect.



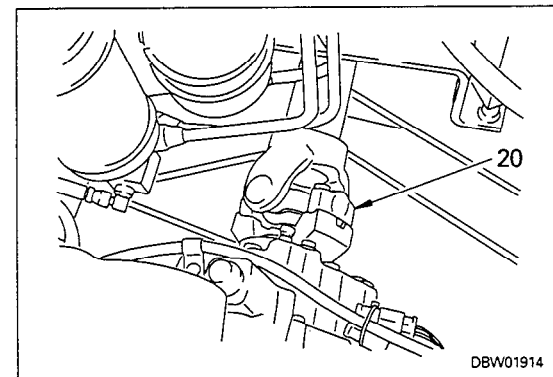
10. Remove connector (17) from clip and disconnect.

11. Disconnect hoses (18) and (19).



12. Disconnect front drive shaft (20).

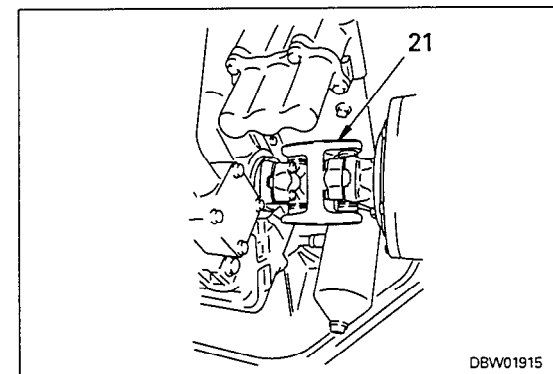
※ 3



13. Remove rear drive shaft (21).

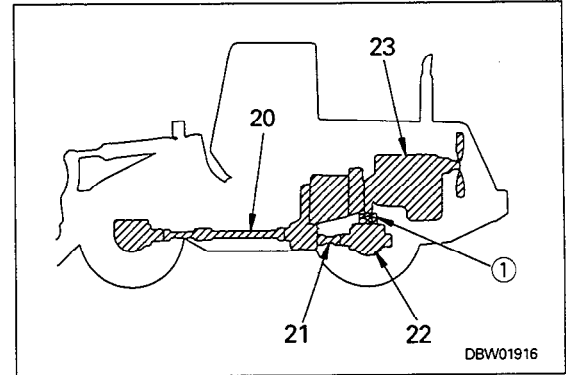
※ 4

★ Be careful not to let the coupling fall out.

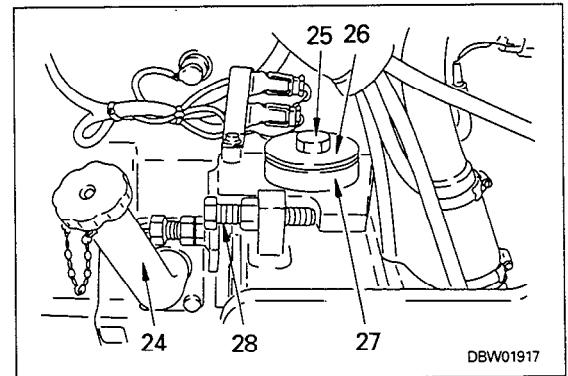


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14. Set block ① between rear axle (22) and engine flywheel, and support engine (23).

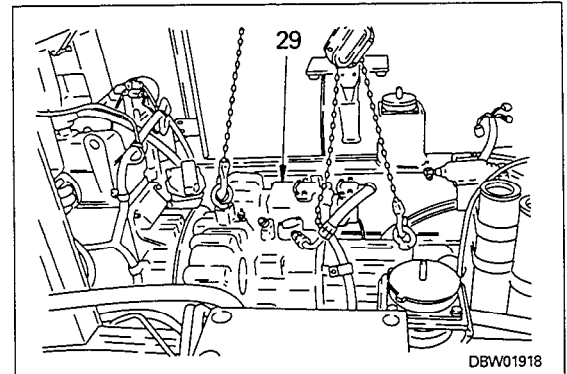


15. Remove oil filler tube (24).
16. Sling torque converter and transmission assembly, remove left and right mounting bolts (25), then remove spacer (26) and cushion (27).
- ★ Measure the clearances of clearance adjustment bolt (28).
 - ★ Make match marks on the mount bracket and rear frame mount, then measure the protrusion of the positioning bolt, and use it as a guide when assembling.



17. Lift off torque converter and transmission assembly (29), taking care not to hit rear frame.
- ★ When raising, be extremely careful of the meshing of the engine and torque converter gear.

 Torque converter, transmission assembly:
700 kg



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INSTALLATION OF TORQUE CONVERTER, TRANSMISSION ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

 **kgm** Air conditioner hose sleeve nut :
22.1 ± 2.5 Nm (2.25 ± 0.25 kgm)

※ 2

- ★ When connecting the 3 hoses at the bottom of the hydraulic and steering pump, check the hose and spacer mount O-rings for damage and deterioration before installing.

※ 3

※ 4

 **kgm** Drive shaft mounting bolt :
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

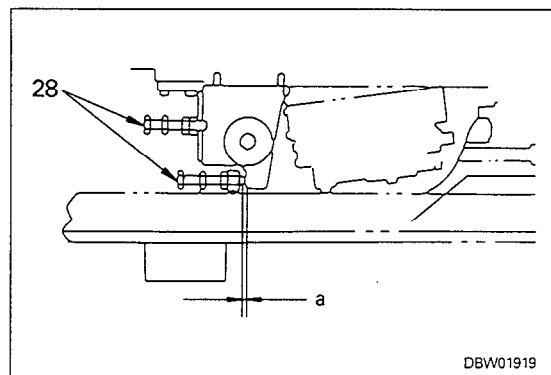
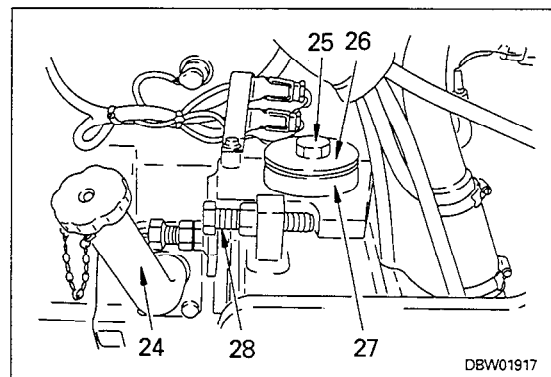
※ 5

- Position torque converter and transmission assembly as follows.
 - Replace the O-ring at the mating surface of the engine and transmission with a new part, fit securely in the groove, then align the tooth groove of the ring gear and connect to the engine.
 - Assemble cushion (27) and spacer (26).
 - ★ Assemble the cushion so that the chamfered surface is on the spacer side.
 - ★ When assembling the cushion, do not use oil or soapy water under any circumstances.
 - Tighten mounting bolt (25) temporarily.
 - Adjust clearance of clearance adjustment bolt (28). (4 places)
 - ★ Standard value for clearance **a** of clearance adjustment bolt : 1 – 2 mm
-  **kgm** Clearance adjustment nut :
549 ± 59 Nm (56.0 ± 6.0 kgm)

※ 6

 **kgm** Mounting bolt (25) :
549 ± 59 Nm (56.0 ± 6.0 kgm)

- Refilling with oil**
Add transmission oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

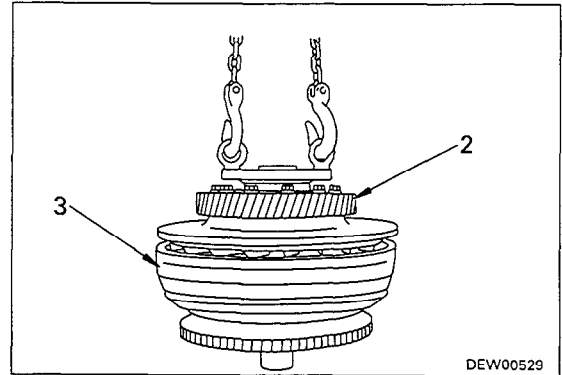


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DISASSEMBLY OF TORQUE CONVERTER ASSEMBLY

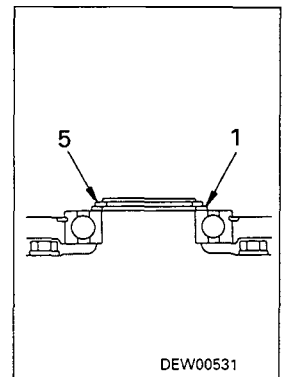
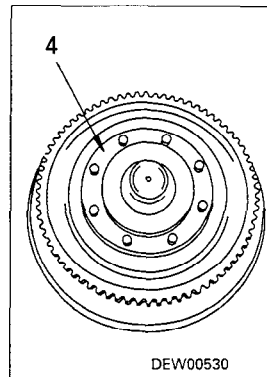
1. Turbine, case assembly

- 1) Remove stator shaft and pump assembly (2) from turbine and case assembly (3).

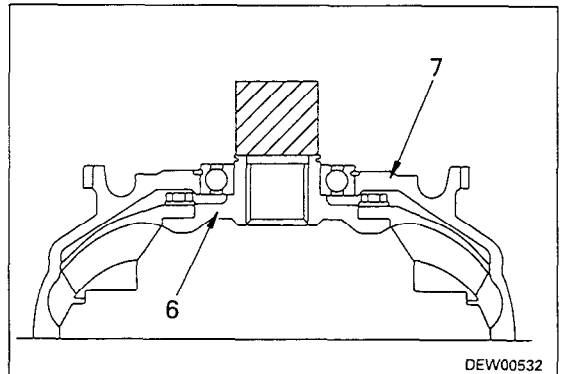


- 2) Disassemble turbine and case assembly as follows.

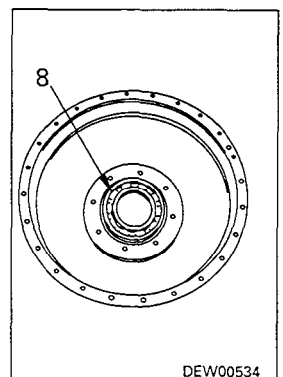
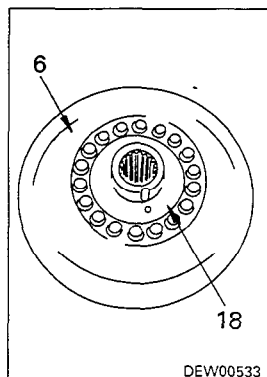
- i) Remove pilot (4).
- ii) Remove snap ring (5), then remove plate (1).



- iii) Push boss portion of turbine (6) and remove from case (7).



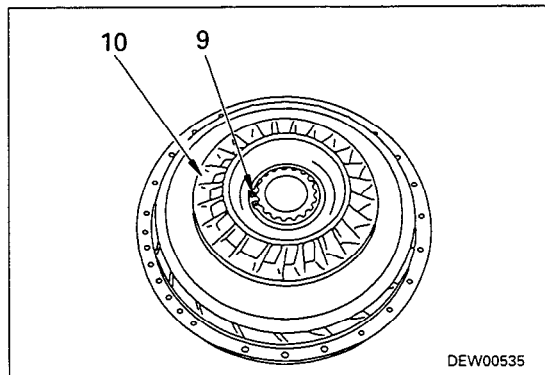
- iv) Remove mounting bolts and disconnect turbine (6) and boss (18).
- v) Remove bearing (8) from case.



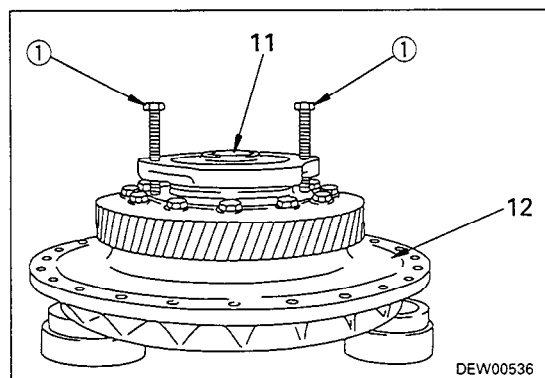
U42303

2. Stator

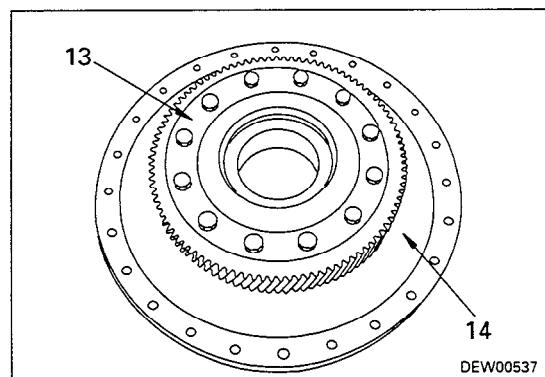
- 1) Remove snap ring (9).
- 2) Remove stator (10).

**3. Stator shaft**

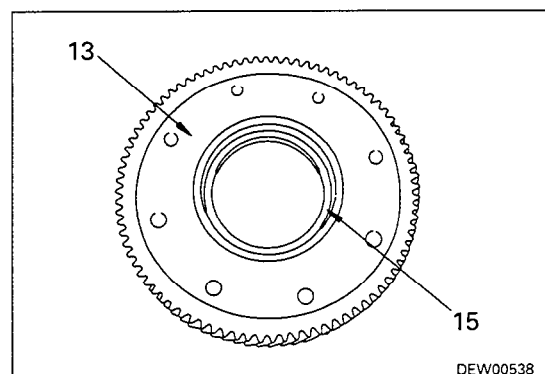
Using forcing screws ①, push from stator shaft (11) end and disconnect from pump assembly (12).

**4. Gear**

Remove gear (13) from pump (14).

**5. Bearing**

Remove bearing (15) from gear (13).

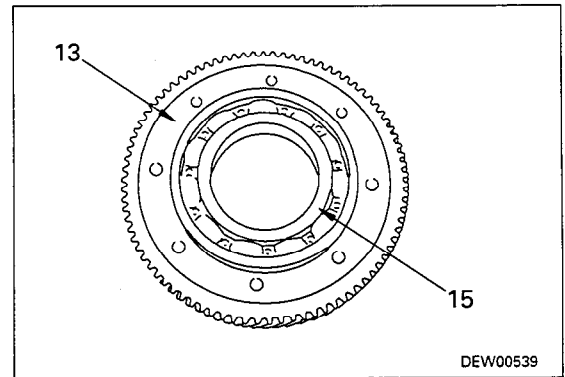


U42303

ASSEMBLY OF TORQUE CONVERTER ASSEMBLY

1. Bearing

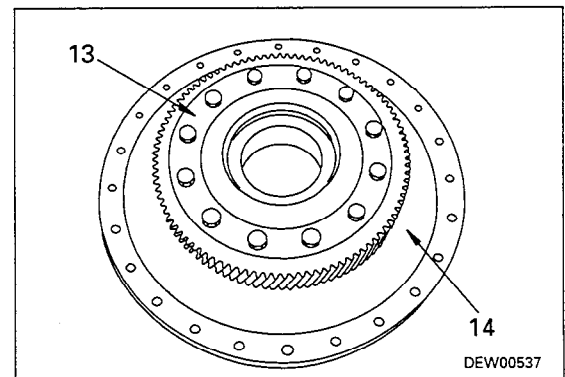
Install bearing (15) to gear (13).



2. Gear

Install gear (13) to pump (14).

 Mounting bolt:
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)

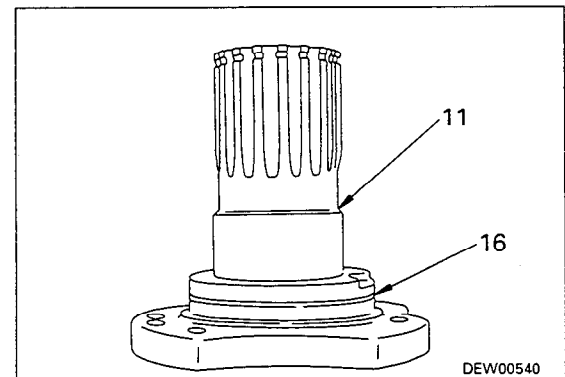


3. Stator shaft

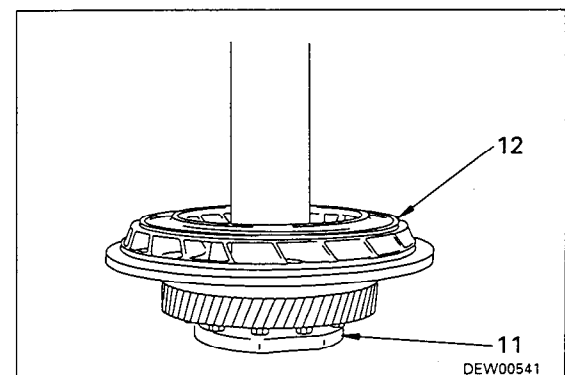
1) Install seal ring (16) to stator shaft (11).

 Seal ring: **Grease (G2-LI)**

★ Make the protrusion of the seal ring uniform.



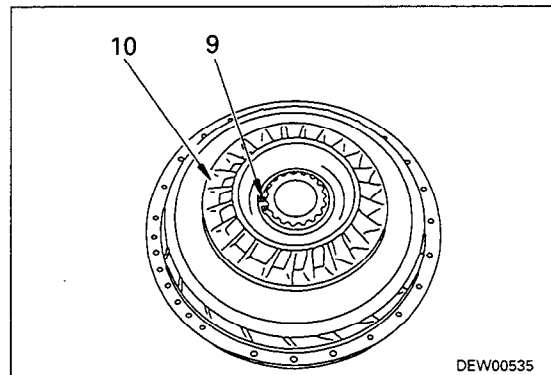
2) Push inner race of bearing and install pump assembly (12) to shaft (11).



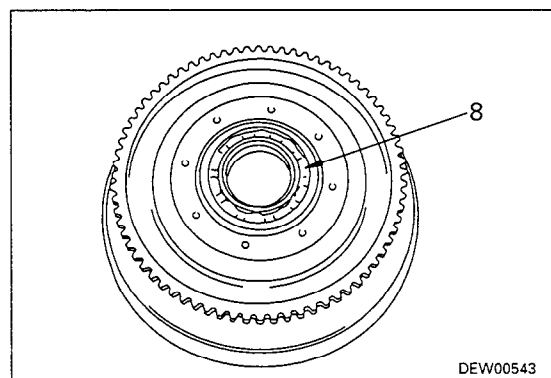
U42303

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).



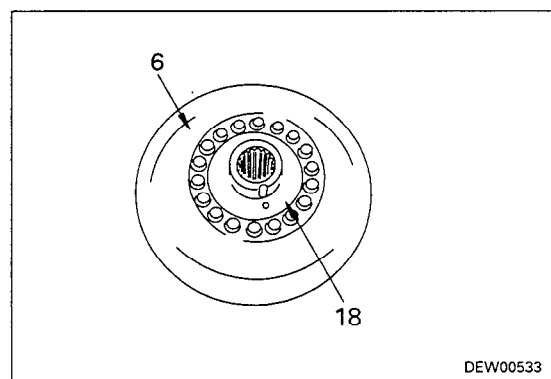
Mounting bolt:

Thread tightener (LT-2)

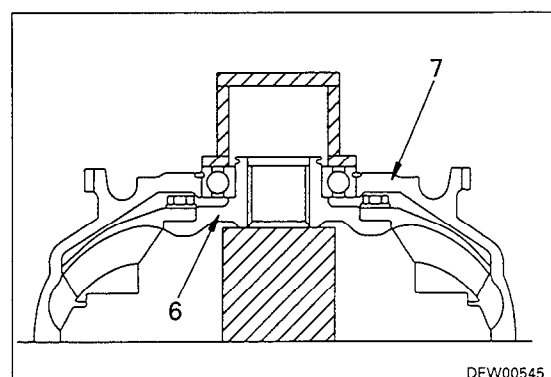


Mounting bolt:

$66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)



- iii) Push inner race of bearing and install turbine (6) to case (7).



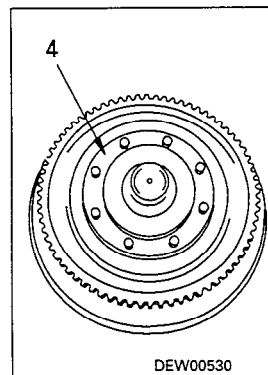
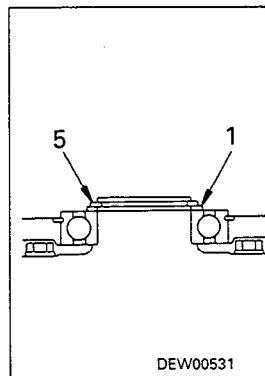
U42303

iv) Fit plate (1) and install snap ring (5).

v) Install pilot (4).

 Mounting bolt:
Thread tightener (LT-2)

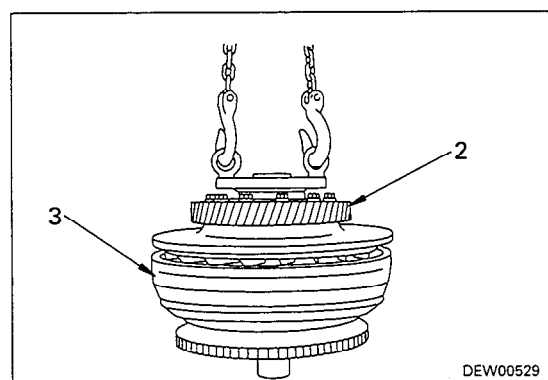
 Mounting bolt:
 $30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)



2) Install turbine and case assembly (3) to stator shaft and pump assembly (2).

 Mounting bolt:
Thread tightener (LT-2)

 Mounting bolt:
 $30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)



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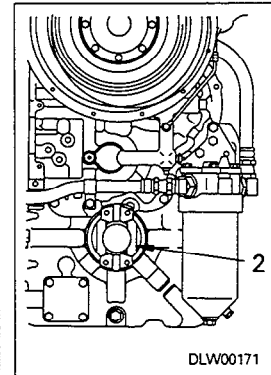
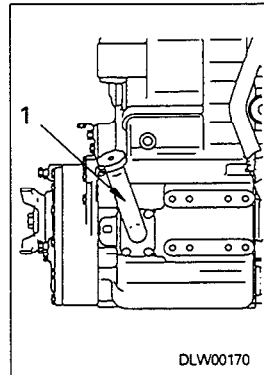
DISASSEMBLY OF TRANSMISSION ASSEMBLY

- Remove the left and right mount brackets from the transmission assembly first.

1. Oil filler, rear coupling

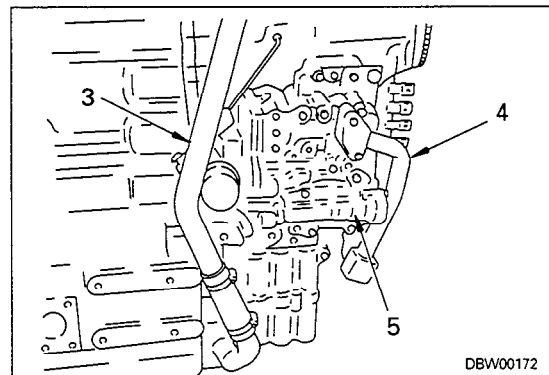
Remove oil filler (1) and rear coupling (2).

- ★ Lower the transmission assembly and install it to the assembly stand.



2. Hydraulic piping

- Remove tube hose (3) between strainer and charging pump.
 - Remove tube hose (4) between torque converter filter and transmission valve from transmission valve.
- ★ Remove the tube clamps.

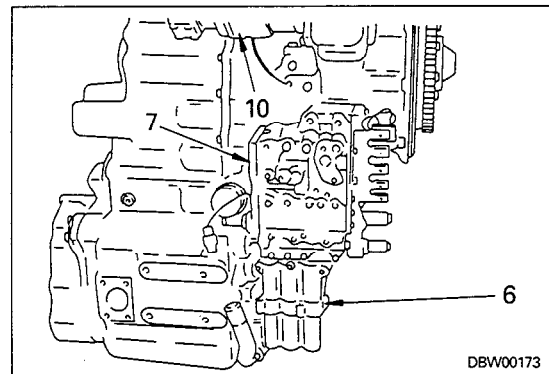


3. Transmission control valve

- Remove modulation valve (5).
 - Remove accumulator valve (6).
 - Lift off transmission control valve (7).
- ★ Leave the upper valve and lower valve assembly set bolts installed.

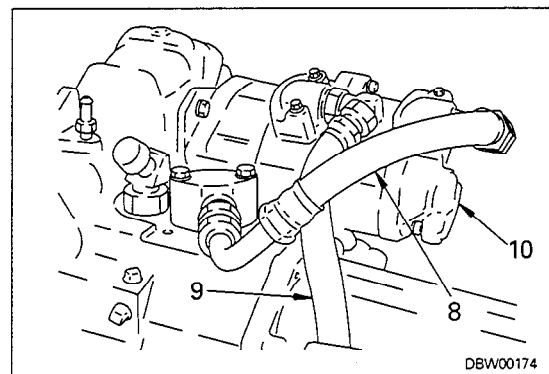


Transmission control valve assembly:
45 kg



4. Charging pump

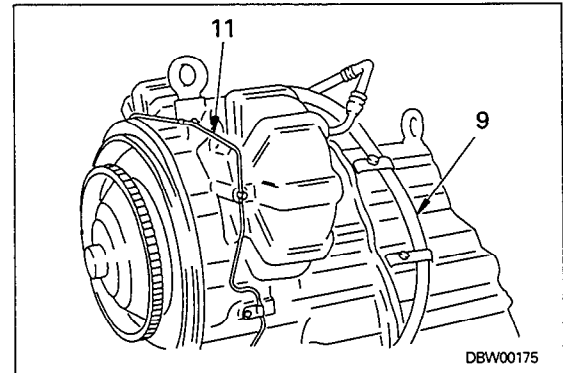
- Remove hoses and flanges (8) and (9) from charging pump (10) and housing.
- Remove charging pump (10).



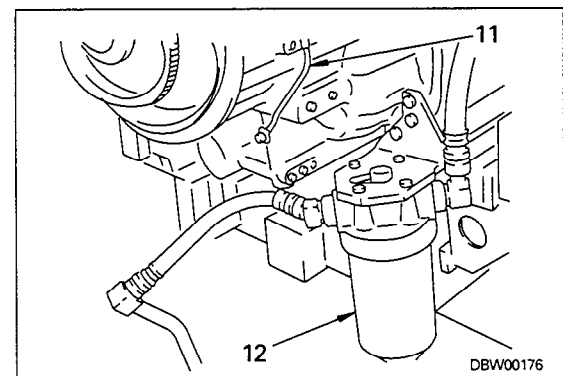
U42303

5. Hydraulic piping

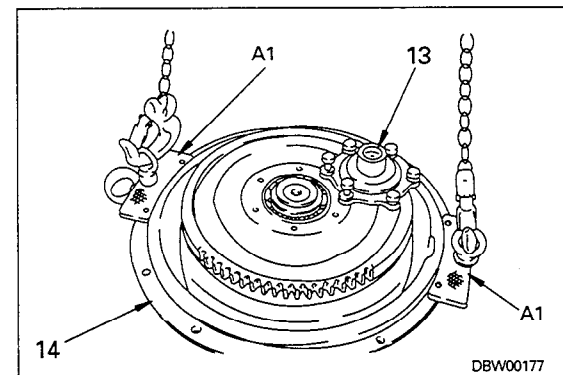
- 1) Remove PTO lubrication tube (11).
 - ★ Be careful not to crush the tube during the operation.
 - ★ After removing the tube, fit a cover to protect the thread.
- 2) Remove clamp of hose (9).

**6. Oil filter**

- 1) Remove mounting bracket of oil filter (12), then remove together with bracket, filter, and hose.

**7. Rear housing**

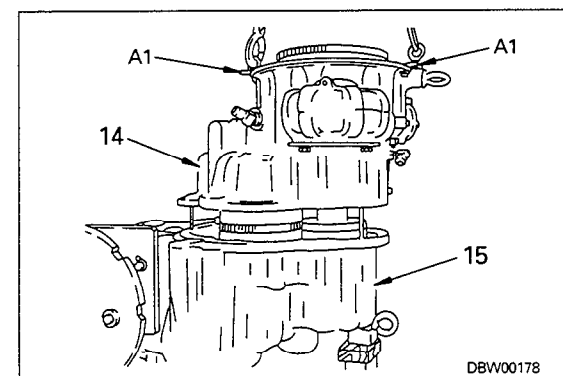
- 1) Remove torque converter pilot cap (13).
- 2) Install tool **A1** to rear housing (14) and sling.
 - ★ Install tool **A1** securely so that it does not come off.



- 3) Using forcing screws, raise rear housing (14), then use tool **A1** to lift it off.
 - ★ Remove slowly and be careful not to damage the seal ring.
 - ★ When removing, install a guide bolt to front housing (15), then lift off horizontally.



Rear housing, torque converter assembly : **190 kg**



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8. Torque converter

Lift off torque converter (16) from rear housing (14).

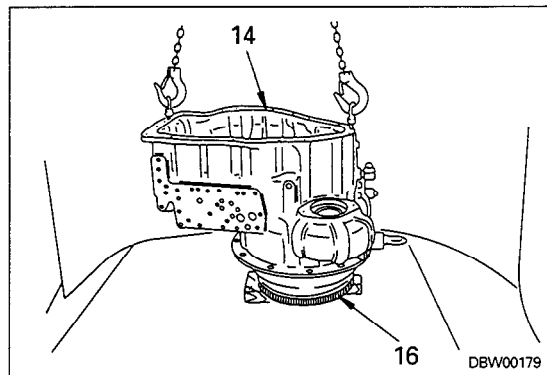
- ★ Before removing, use a felt pen to make match marks on the mating surface of the housing and torque converter.



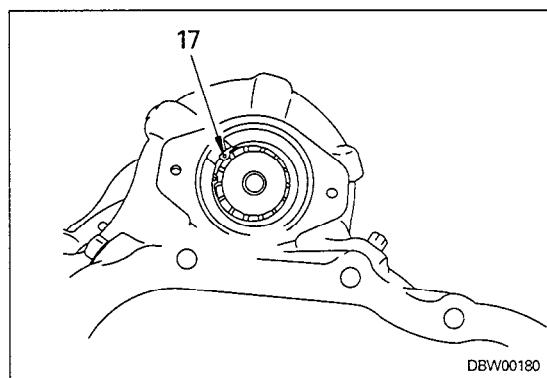
Torque converter assembly : **55 kg**



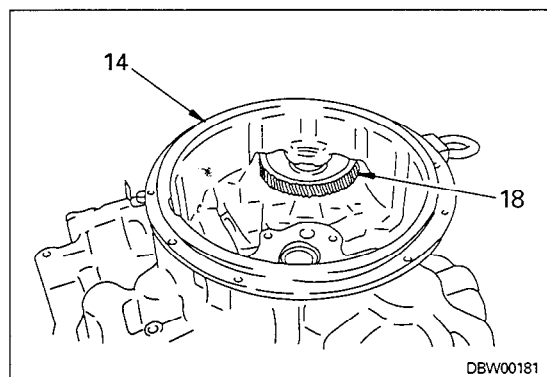
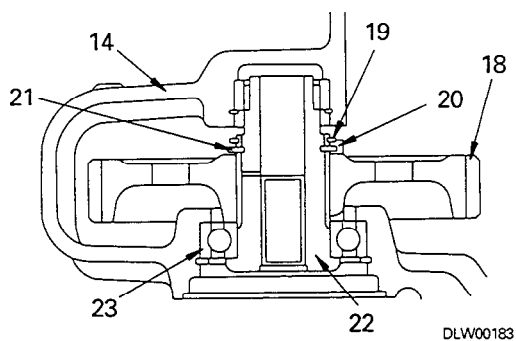
Rear housing : **135 kg**

**9. Pump (torque converter, loader)**

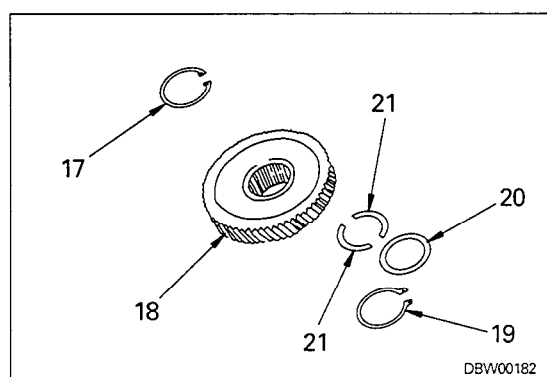
- 1) Remove snap ring (17) at torque converter pump mount.



- 2) Turn over rear housing (14), remove snap ring (19) of pump gear (18), then remove ring washer (20) and split spacer (21).

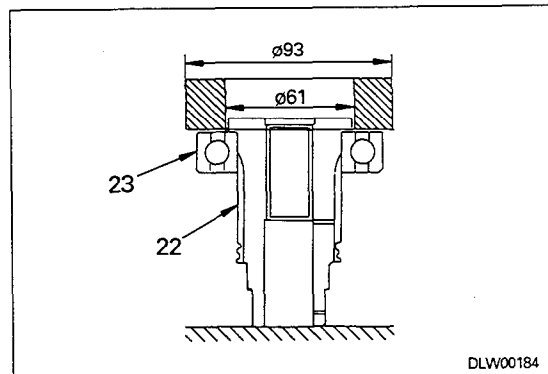


- 3) Insert screwdriver between rear housing (14) and shaft (22), then lever shaft and push down to remove.



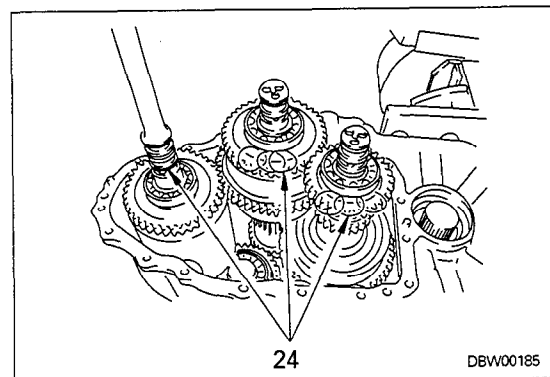
U42303

- 4) Remove bearing (23) from shaft (22).
 ★ Carry out the same procedure at the loader pump end.



10. Seal ring

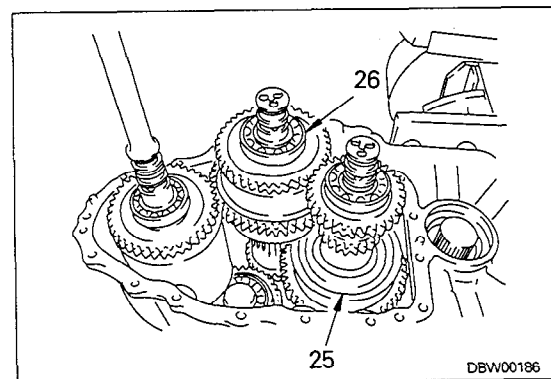
Remove seal rings (24) from each clutch shaft.



U42303

11. 2nd, 4th, and 1st, 3rd clutch

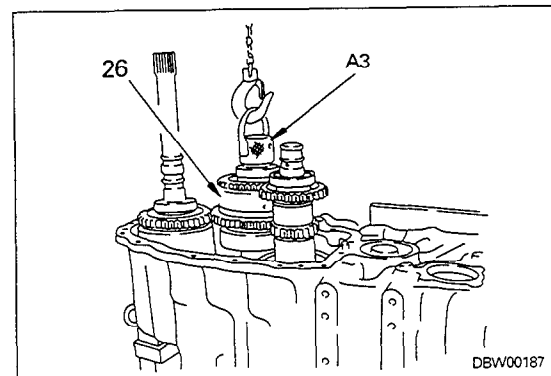
- 1) Remove 2nd, 4th clutch (25) and 1st, 3rd clutch (26) together from housing bearing, then move towards 2nd, 4th clutch output shaft.
 ★ Remove 1st, 3rd clutch from bearing, then move towards FORWARD, REVERSE side.



- 2) Using tool **A3**, lift off 1st, 3rd clutch (26).
 ★ Remove slowly and take care not to hit any other gear.



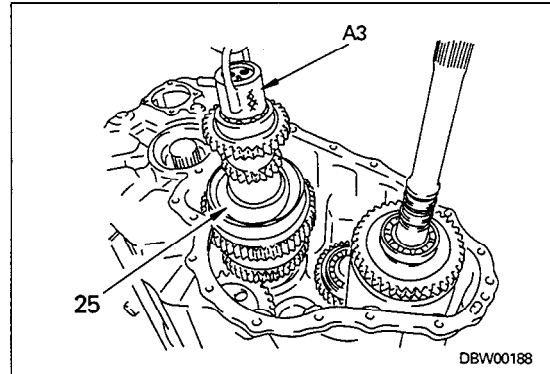
1st, 3rd clutch : 47 kg



- 3) Using tool **A3**, lift off 2nd, 4th clutch (25).



2nd, 4th clutch : **54 kg**



12. FORWARD, REVERSE clutch

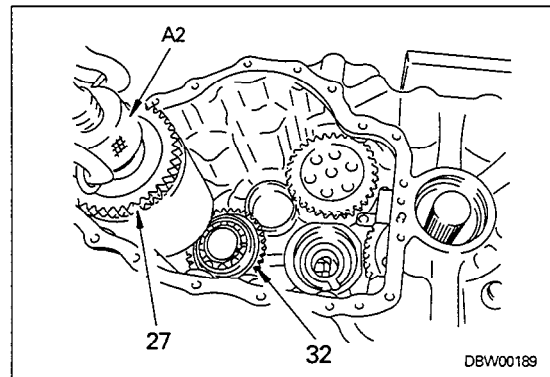
- 1) Using tool **A2**, pull out FORWARD, REVERSE clutch (27).



Be careful not to get your fingers caught between gear (32) and the housing.



FORWARD, REVERSE clutch : **44.1 kg**

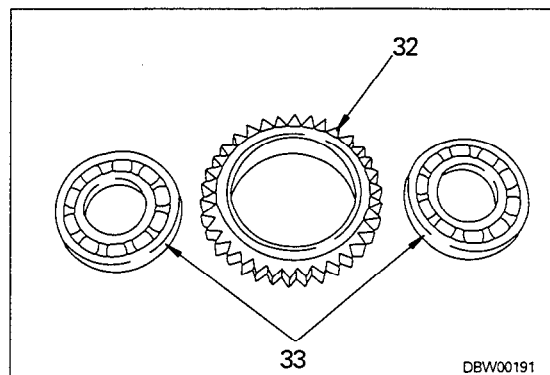
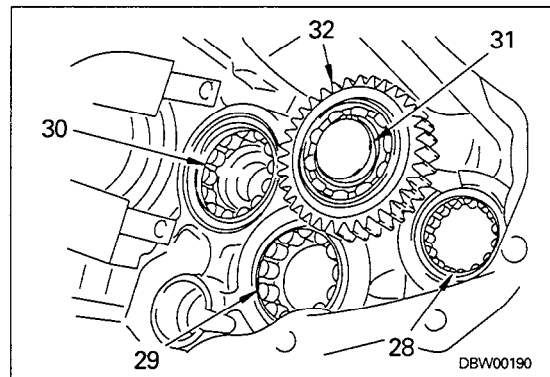


13. Bearing

- 1) Remove FORWARD, REVERSE outer bearing (28), 1st, 3rd outer bearing (29), and 2nd, 4th outer bearing (30) from housing.

14. Idler gear

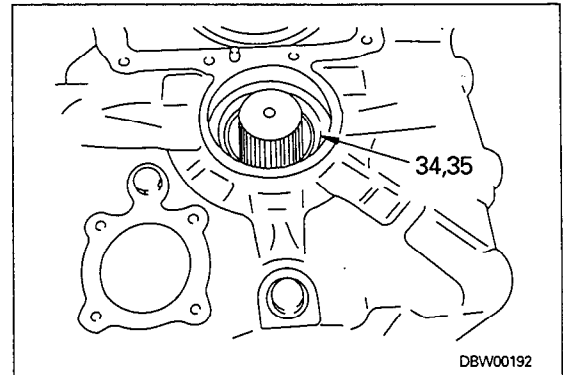
- 1) Remove snap ring (31), then remove idler gear (32) from housing.
- 2) Remove snap ring from idler gear (32), then remove bearings (33).



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15. Rear dust seal, oil seal

Remove dust seal (34) and oil seal (35).



16. Parking brake assembly

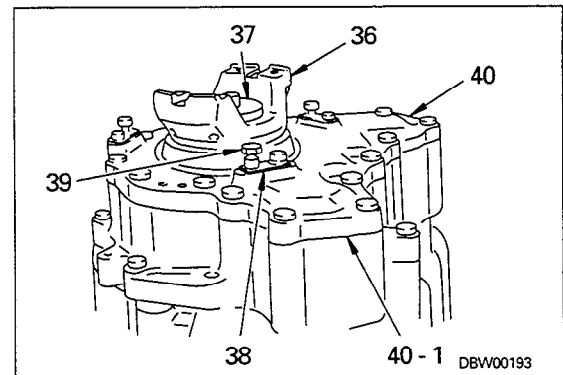
★ Turn over the front housing.

1) Remove mounting bolts, then remove front coupling (36), holder (37), and O-ring.

2) Remove mounting bolts, then remove lock plate (38) and manual cancel bolt (39).

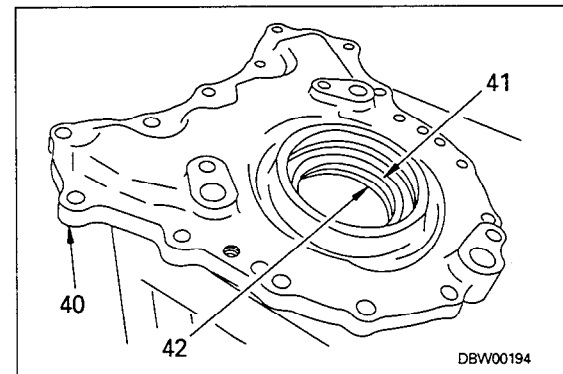
3) Remove mounting bolts, then remove cover (40) and gasket (40-1).

★ There is a dowel pin, so use forcing screws to remove.



4) Remove dust seal (41) and oil seal (42) from cover (40).

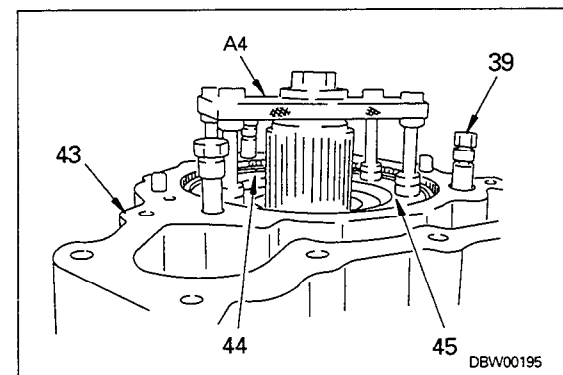
5) Install manual cancel bolt (39) to parking brake housing (43), and set piston in FREE condition.



6) Tighten tool **A4** with coupling mounting bolts.

★ Bolt length of tool **A4**: 64 mm

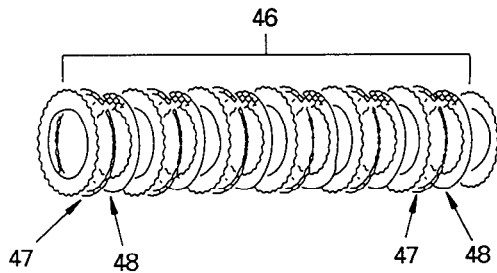
7) Remove snap ring (44), remove tool **A4**, then remove end plate (45).



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- 8) Remove separate plates (46), wave springs (47), and discs (48), then remove hub (49) and spacer (50).

★ Remove the manual cancel bolt.



DLW00200

- 9) Set guide bolts (43-1) to parking brake housing (43), then remove mounting bolts, and lift off.

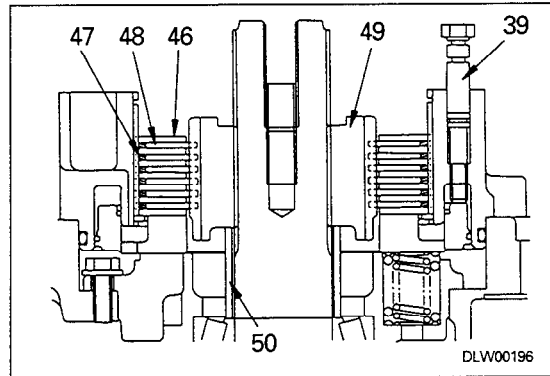
★ Loosen the mounting bolts uniformly a little at a time.

★ Guide bolt : (12 mm, pitch 1.75 mm, length: 130 mm)

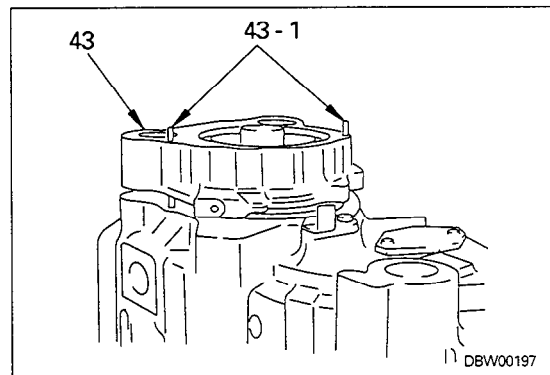
★ Install the lifting tool. (12 mm, pitch: 1.75 mm)



Parking brake housing : **21 kg**

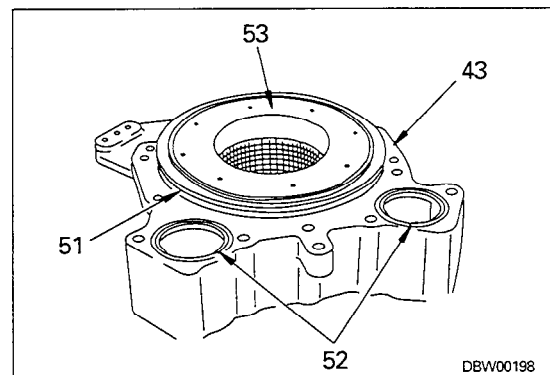


DLW00196



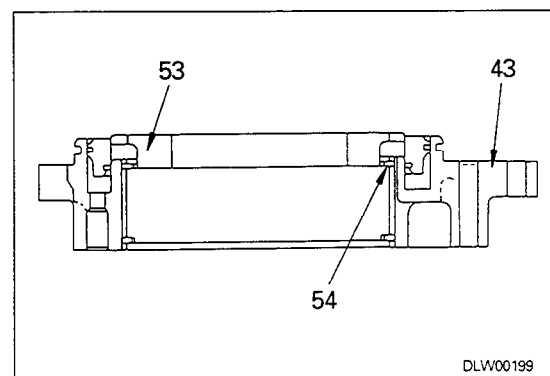
DBW00197

- 10) Turn over parking brake housing (43) and remove O-rings (51) and (52).



DBW00198

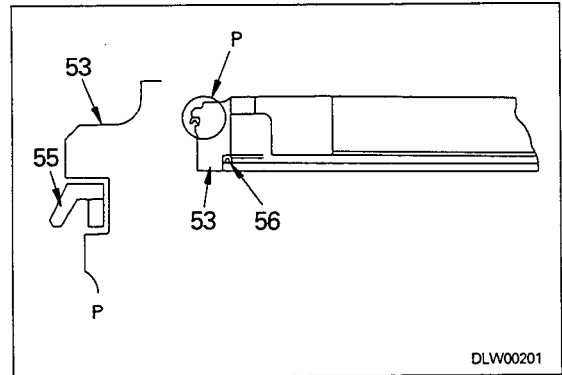
- 11) Remove piston (53) and snap ring (54) from parking brake housing (43).



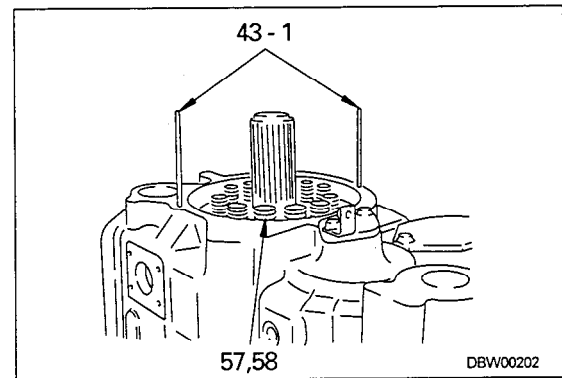
DLW00199

U42303

- 12) Remove piston seal rings (55) and (56) from piston (53).

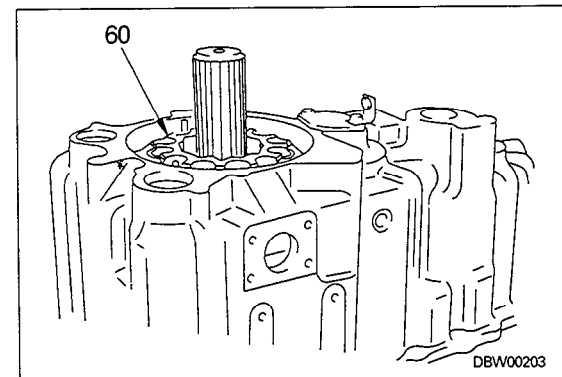
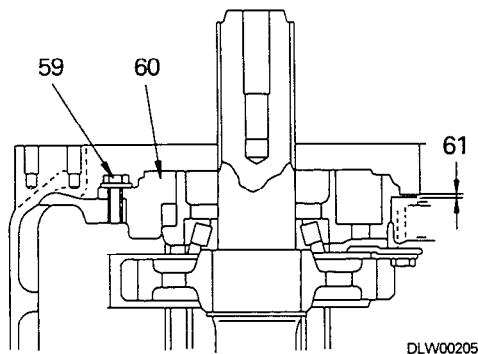


- 13) Remove springs (57) and (58) from parking brake retainer.
★ Remove guide bolts (43-1).

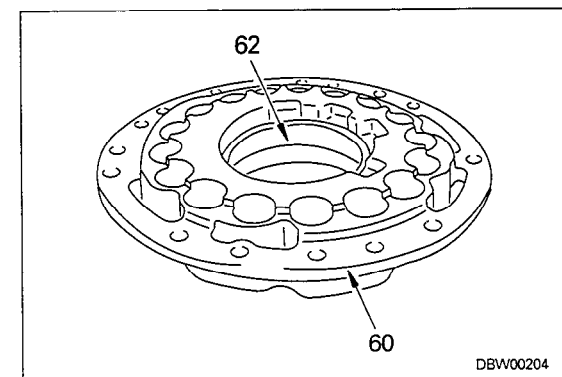


17. Parking brake retainer

- 1) Remove mounting bolts (59) from front housing, then remove parking brake retainer (60).
★ Check the number and thickness of the shims (61) and use for reference when assembling.



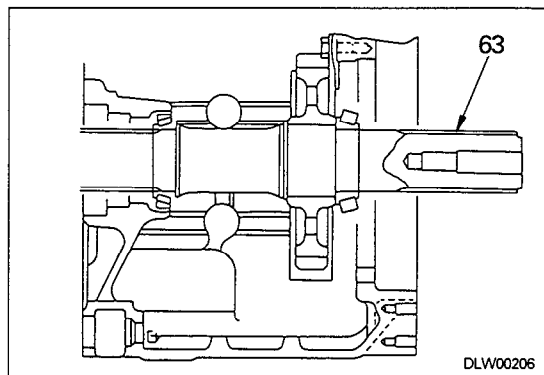
- 2) Remove bearing cup (62) from parking brake retainer (60).



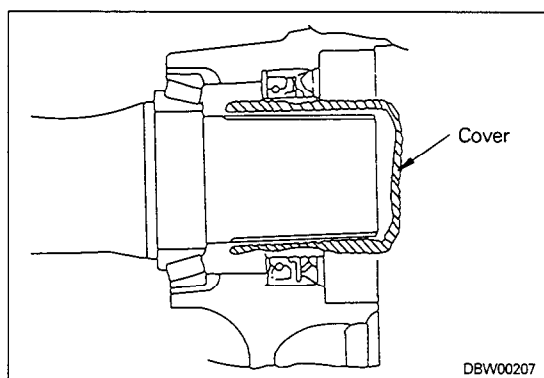
U42303

18. Output shaft gear

- 1) Support output shaft (63) from outside, and remove shroud (64).

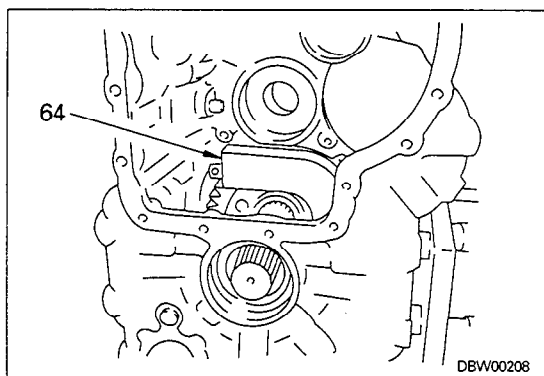


- ★ Fit a cover to the shaft spline to prevent damage to the oil seal.

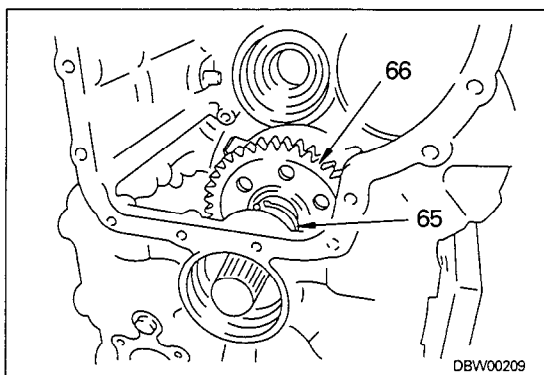


- 2) Remove shroud (64).

- ★ Be careful not to cut your hand on the edge of the shroud.



- 3) Remove snap ring (65) from groove, move towards center, then move gear (66) to same position as snap ring.



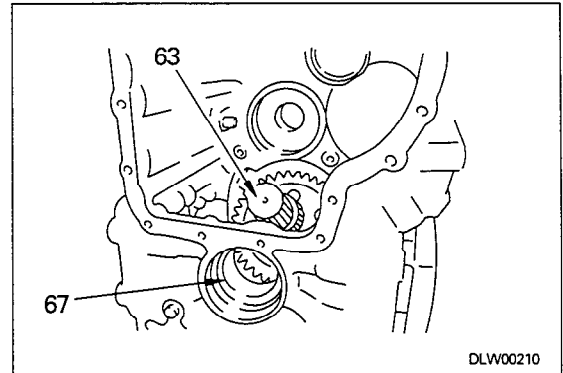
U42303

- 4) Push in shaft (63) towards rear, then pass shaft through front housing and remove.

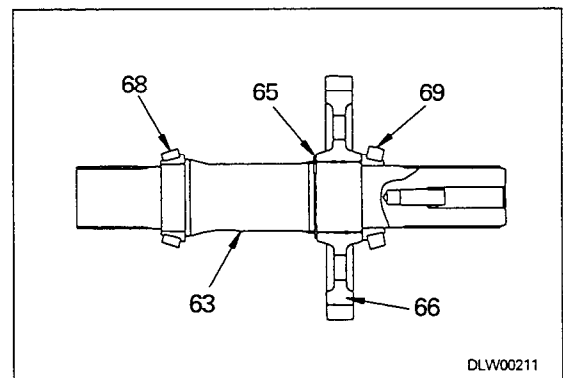
⚠ Be careful not to get your fingers caught between gear and the housing.

★ Be careful not to damage the spline groove of the shaft.

- 5) Remove bearing cup (67).



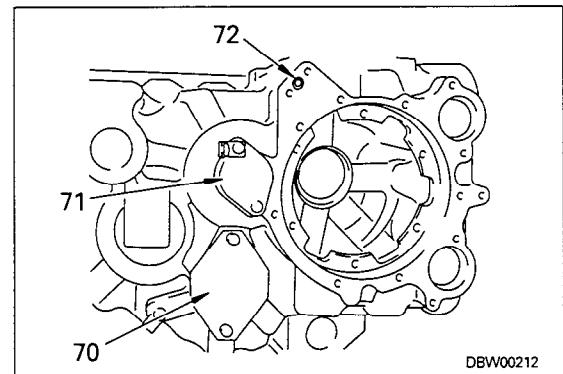
- 6) Remove bearing cone (68), snap ring (65), gear (66), and bearing cone (69) from shaft (63).



19. Covers

- 1) Remove covers (70) and (71).
 - ★ Remove both the O-rings.

- 2) Remove O-ring (72).



U42303

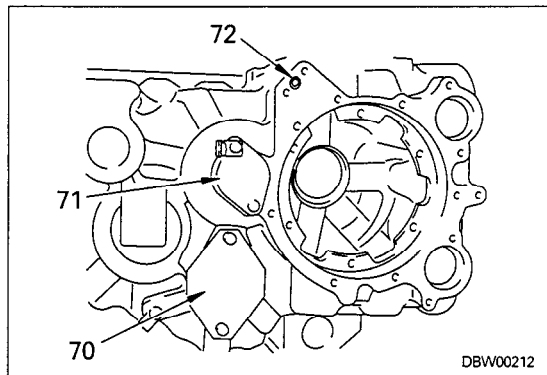
ASSEMBLY OF TRANSMISSION ASSEMBLY

1. Covers

Assemble O-rings and assemble covers (70) and (71) to front housing.

- ★ Be careful not to the O-rings fall out.
- ★ Install O-ring (72) to the mating surface of the parking brake housing.

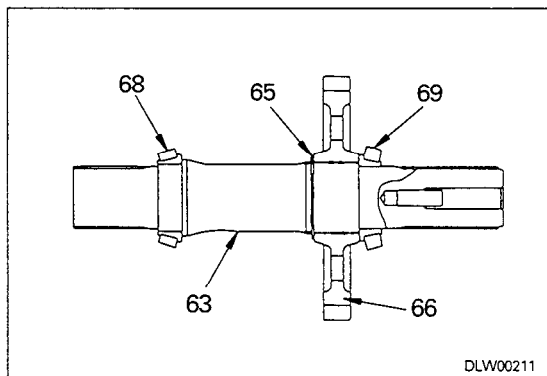
 Outside circumference of O-ring :
Grease (G2-LI)



2. Output shaft gear

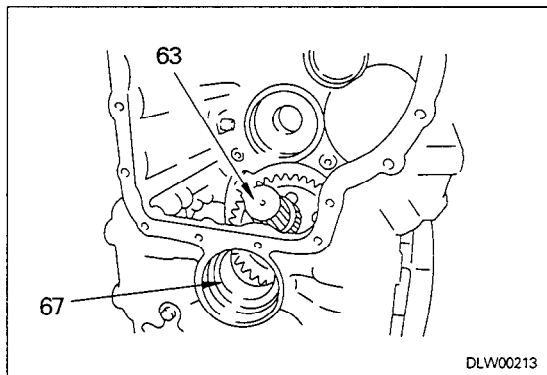
1) Press fit bearing cone (69) to output shaft (63), assemble gear (66) and snap ring (65), then press fit bearing cone (68).

- ★ To prevent defective adjustment of the end play, press fit the cone as far as the shoulder of the shaft.
- ★ Do not insert snap ring (65) into the groove. Move it to the center, then remove gear (66) from the spline groove, and put it in the same position as the snap ring.

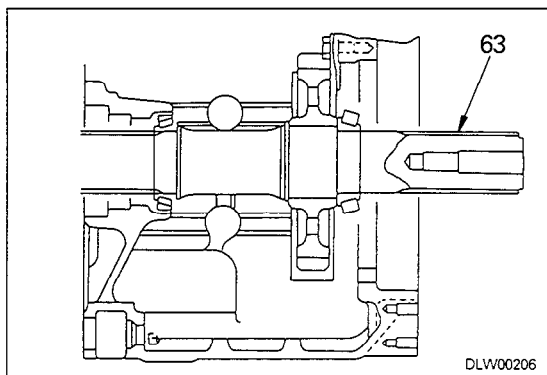


2) Press fit bearing cup (67) to front housing.
★ Press fit the bearing cup fully to the stepped portion of the housing, and check that there is no clearance.

3) Assemble shaft (63) to front housing.
★ Set the shaft at an angle and insert it.



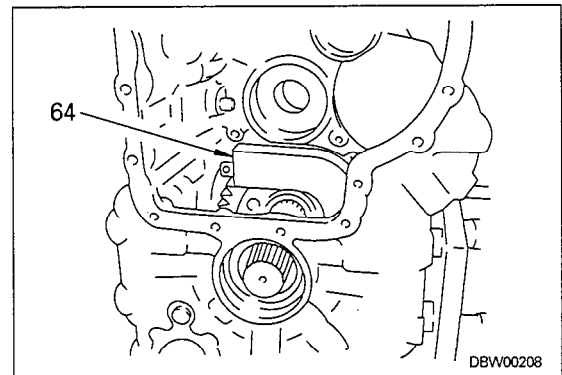
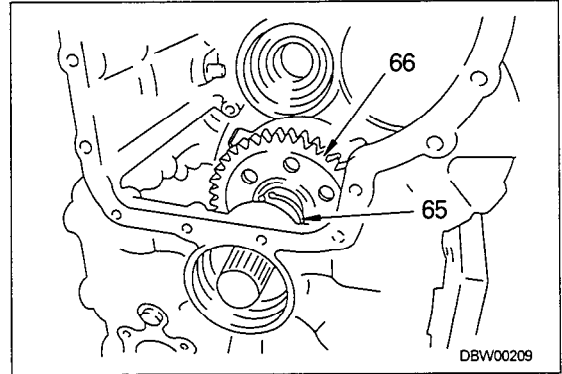
4) Support output shaft (63) from outside.
★ Temporarily assemble the bolt and secure with wire. Or carry out the work with two workers and support it by hand.



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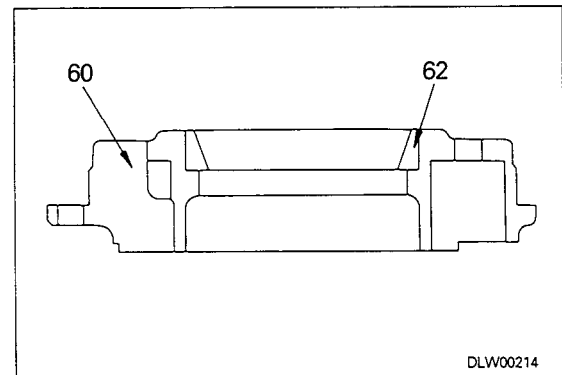
- 5) Insert gear (66) in shaft spline portion, and secure with snap ring (65).
- 6) Coat mounting bolts with thread tightener, and install shroud (64).
 - ★ Wash and remove all oil and grease from the mounting bolt hole and mounting bolt.
 - ★ Insert the shroud from immediately above the gear, then turn over and assemble.
 - ★ Check that the gear does not interfere with the shroud.

 **Mounting bolt :**
 $110.3 \pm 12.3 \text{ Nm } (11.25 \pm 1.25 \text{ kgm})$
 **Mounting bolt :**
Thread tightener (LT-2)

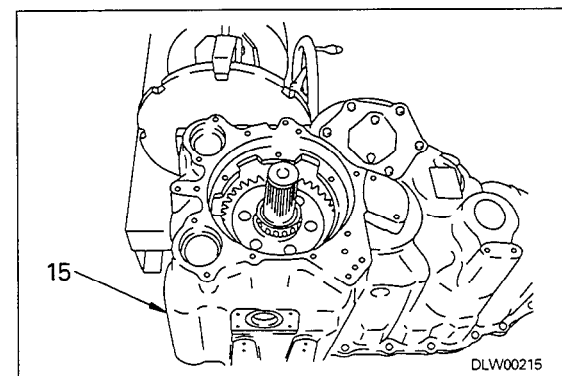


3. Parking brake retainer

- 1) Press fit bearing cup (62) to parking brake retainer (60).
 - ★ Press fit the bearing cup fully to the stepped portion of the retainer, and check that there is no clearance.



- 2) Turn over front housing (15).
 - ★ When turning over, be careful that the output shaft does not become at an angle.
 - ★ Set a stand under the top of the front housing.
 - ★ After turning over, hold the output shaft bearing cone in the bottom bearing cup.



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- 3) Assemble desired shims (61) to parking brake retainer assembly (60), then tighten 3 mounting bolts (59) to specified torque.

 Mounting bolt :

$110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)

- ★ To settle the bearing, rotate the shaft while tightening. After tightening, tap the end face of the shaft several times with a plastic hammer to settle the bearing again.

- ★ Coat the bearing well with oil.

- ★ Standard shim thickness: 0.95 mm

 Bearing: **Transmission oil**

 Mounting bolt :

$110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)

- 4) Tighten coupling mounting bolts to shaft (63) and measure rotating torque.

- ★ Rotating torque : 0.1 – 1 Nm (0.01 – 0.1 kgm)

- ★ If a small torque wrench is not available, it is possible to measure as follows.

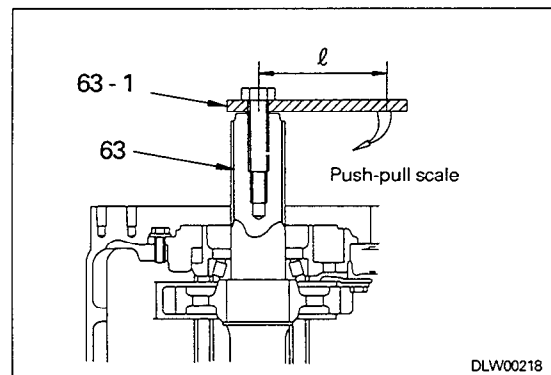
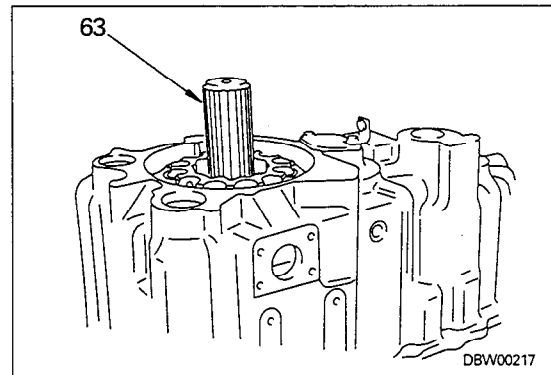
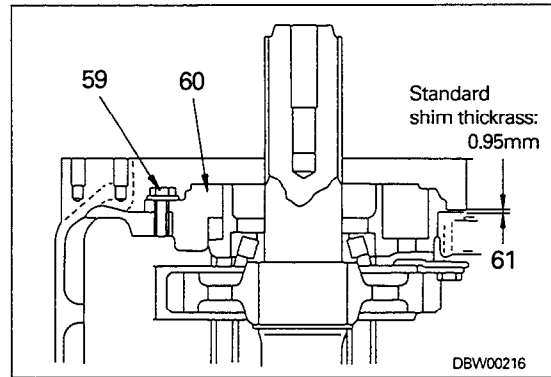
- ★ Install measurement plate (63-1) and retainer plate to shaft (63), tighten coupling mounting bolts, then install push-pull scale to tip of plate (63-1) and measure.

- Plate length ℓ : 100 mm
- Reading of push-pull scale : 1.0 – 9.8 Nm (0.1 – 1.0 kgm)

- ★ When measuring the rotating torque, do not measure at the point where movement begins. Measure while it is rotating.

- ★ If the rotating torque is not within the standard value, change the shim thickness to adjust again.

- ★ If the rotating torque is within the standard value, check that the end play is "0".



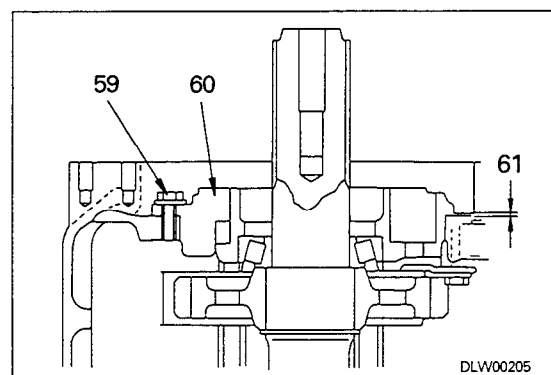
- 5) Assemble selected shims (61) to parking brake retainer (60), then assemble to front housing.

- ★ Assemble the thinnest shim on the inside and the thickest shim on the outside.

- ★ Assemble so that the casting holes (3 places) are at the bottom.

 Mounting bolt (59):

$110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)

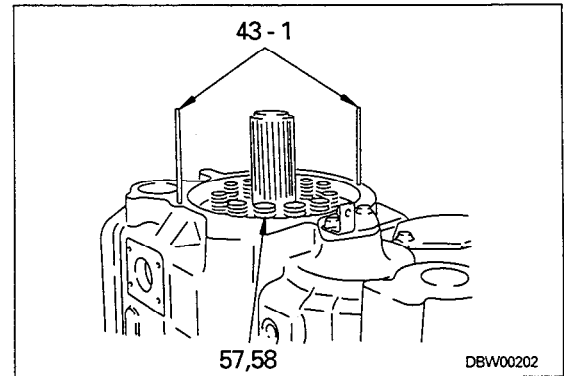


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4. Parking brake assembly

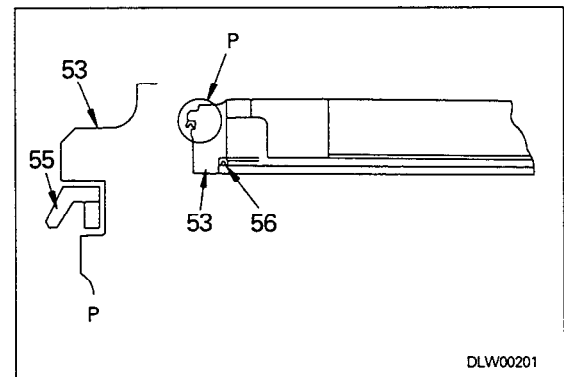
- 1) Assemble springs (57) and (58) to parking brake retainer.

- ★ Keep the inner and outer springs in sets.
- ★ Set guide bolts (43-1) in position.
Guide bolt : (12 mm, pitch: 1.75 mm, length: 130 mm)



- 2) Install seal rings (55) and (56) to piston (53).

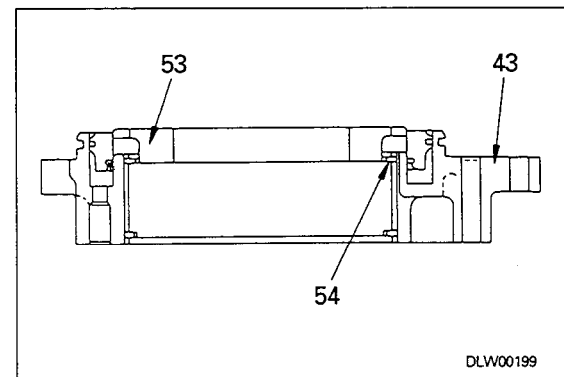
- ★ Be sure to assemble the piston seal facing in the correct direction and without twisting.



- 3) Assemble snap ring (54) to parking brake housing (43), and install piston (53).

- ★ Check that the snap ring is fitted securely in the groove.
- ★ Knock in the piston uniformly a little at a time with a plastic hammer.

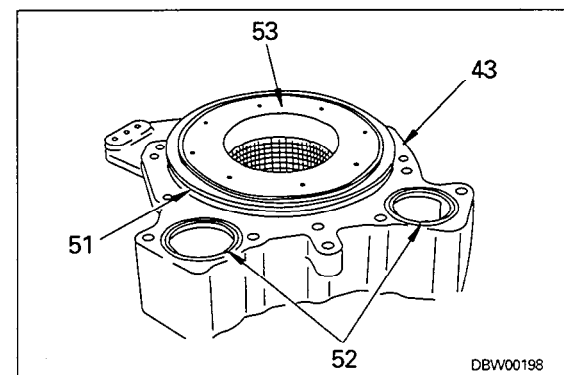
 Outside circumference of seal ring, sliding surface : **Transmission oil**



- 4) Assemble O-rings (51) and (52) to parking brake housing (43).

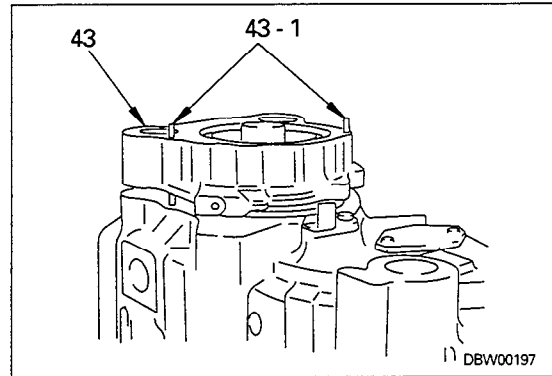
- ★ Fit the O-rings securely in the grooves.
- ★ Coat the O-rings thinly with grease and stick them on to prevent them from falling out.

 Outside circumference of O-ring : **Grease (G2-LI)**

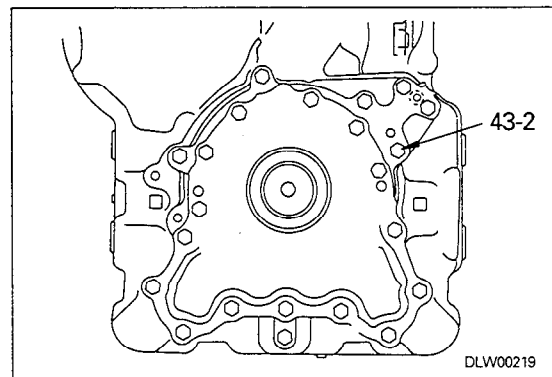


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- 5) Turn over parking brake housing (43), align with guide bolts (43-1), and set in position.
★ Lifting bolt : 12 mm, pitch: 1.75



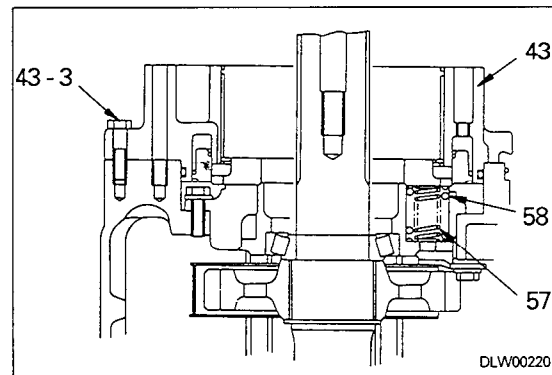
- 6) Tighten parking brake housing (43) with 3 temporary tightening bolts (43-2) uniformly and screw in approx. 30 mm. Then replace one at a time with standard bolts (43-3) and tighten uniformly.
★ Temporary tightening bolt : 12 mm, pitch: 1.75, length: 60 mm



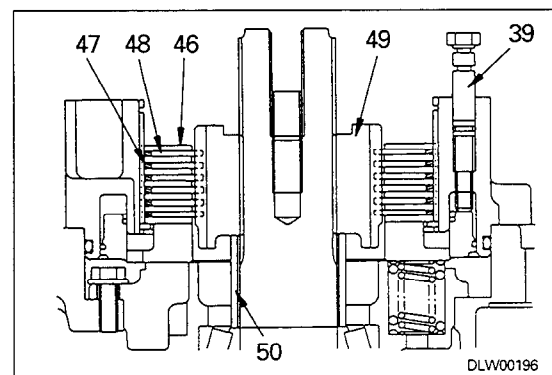
- ★ Springs (57) and (58) are strong, so be careful to tighten uniformly.
★ Be careful not to let the O-ring fall out or get caught.

 Mounting bolt (43-3) :
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

- 7) Install manual cancel bolt (39) to parking brake housing (43), and set piston to FREE position.



- 8) Align spacer (50) and hub (49) with output shaft spline, then assemble.
9) Assemble separate plates (46), wave springs (47), and discs (48).
★ Align the separate plate with the parking brake housing spline when assembling.
★ Be careful not to let the plate or spring get caught in the housing ring groove.
★ Align the disc with the hub spline, then assemble.
★ Be careful not to let the spring and plate rest on top of each other.



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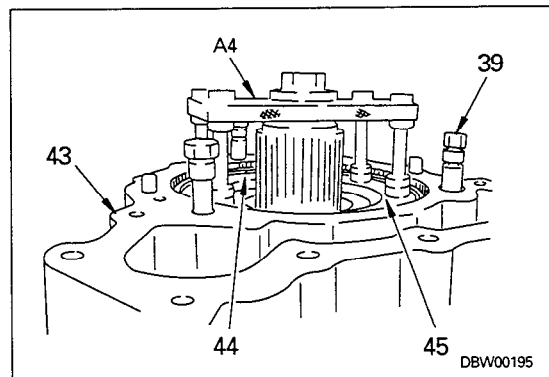
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- 10) Assemble end plate (45), then install tool **A4**, and tighten with coupling mounting bolts.

★ Bolt length of tool **A4** : 64 mm

- 11) Install snap ring (44), and remove tool **A4**.

- ★ Check that the snap ring is fitted securely in the groove.
- ★ Check that the shaft turns, then remove manual cancel bolt (39).

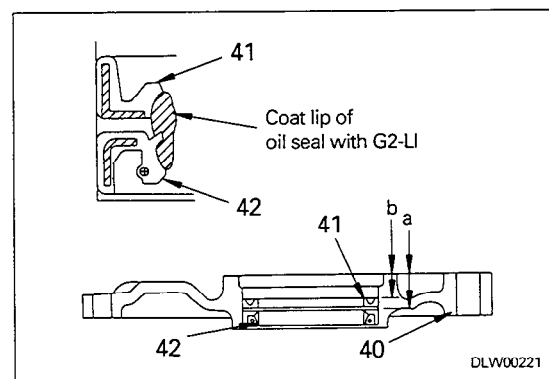


- 12) Press fit oil seal (42) and dust seal (41) to cover (40).

Press-fitting dimension **a** : 28.5 ± 1 mm

Press-fitting dimension **b** : 17.5 ± 1 mm

 Lip of oil seal : **Grease (G2-LI)**



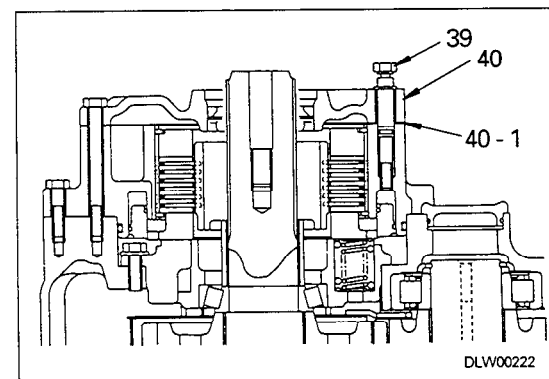
- 13) Install gasket (40-1) to parking brake housing (43), align with dowel pin, then install cover (40).

- ★ Knock the cover in uniformly with a plastic hammer.
- ★ Be careful not to let the oil seal contact the shaft.

 Mounting bolt :
 110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

- 14) Tighten manual cancel bolt (39) by hand, lock at position of lock plate (38), then tighten lock plate (38) with mounting bolts.

 Mounting bolt :
 66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

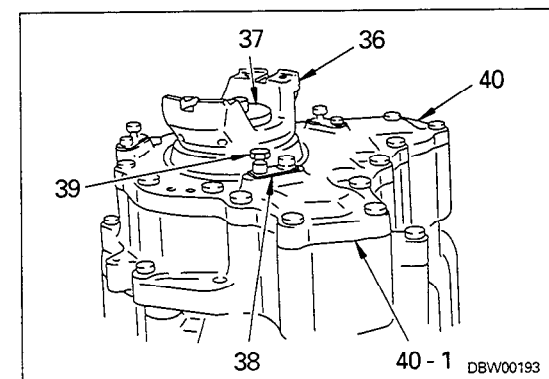


- 15) Tighten coupling (36), O-ring and holder (37) with mounting bolts.

- ★ Push the O-ring into the shaft groove.
- ★ Be careful not to damage the oil seal.

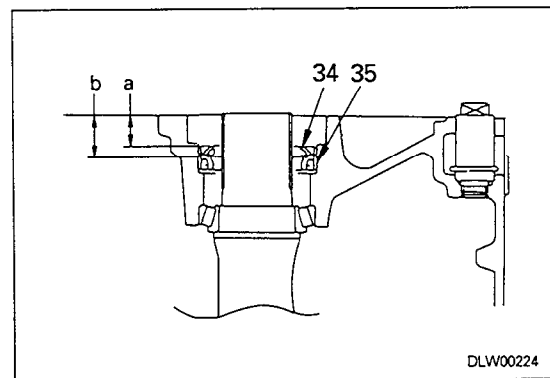
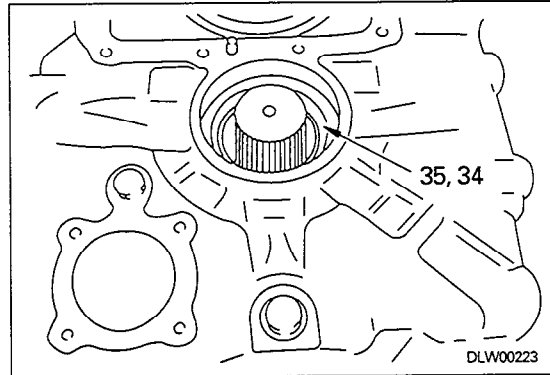
 Outside circumference of coupling :
Transmission oil

 Coupling mounting bolt :
 549 ± 59 Nm (56.0 ± 6.0 kgm)

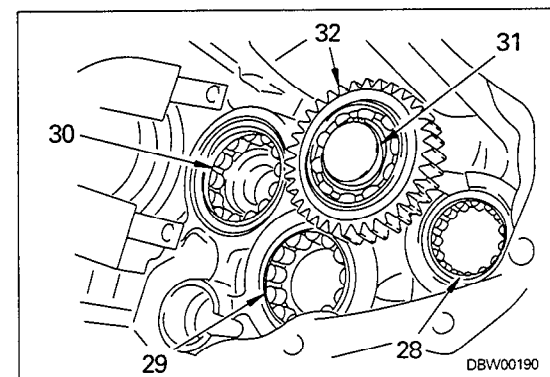
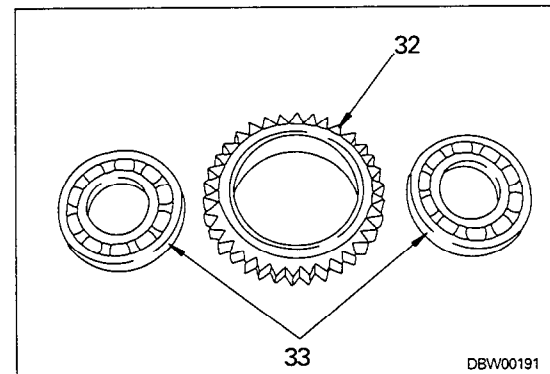
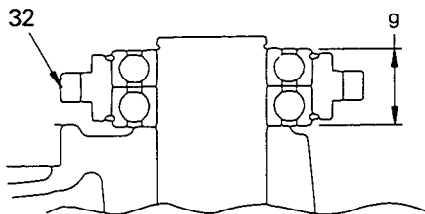


5. Rear oil seal, dust seal

- 1) Turn over front housing, and press fit oil seal (35) and dust seal (34).
 - ★ Press fitting dimension **a** : 28.0 ± 1.0 mm
 -  Lip of oil seal : **Grease (G2-LI)**
 - ★ Press fitting dimension **b** : 36.0 ± 1.0 mm
 -  Lip of oil seal : **Grease (G2-LI)**

**6. Idler gear**

- 1) Press fit bearings (33) to idler gear (32).
- 2) Press fit idler gear (32) to shaft, and install snap ring (31).
- ★ If the shaft has been removed, cool the shaft to -70°C , then press fit it to dimension **g**.
- ★ Shaft dimension **g** : 46.5 ± 0.5 mm

**7. Bearing**

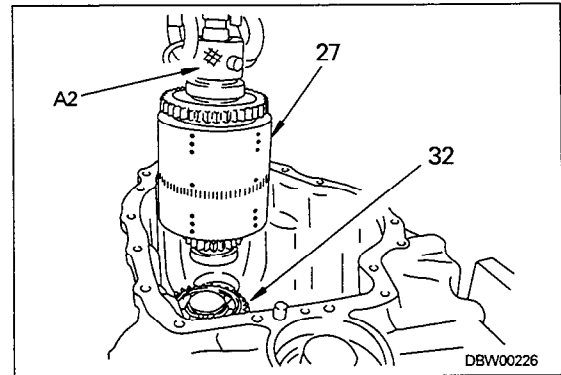
- 1) Assemble FORWARD, REVERSE outer bearing (28), 1st, 3rd outer bearing (29), and 2nd, 4th outer bearing (30) to housing.

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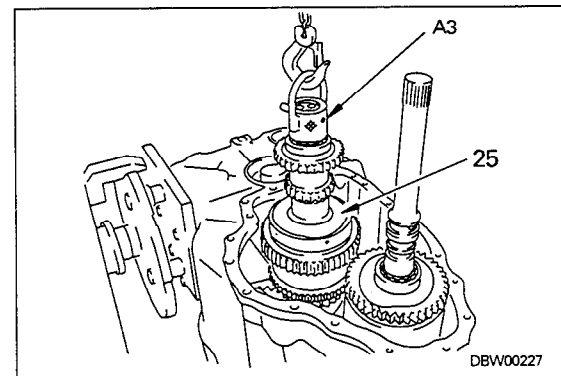
8. FORWARD, REVERSE clutch

- 1) Using tool **A2**, insert FORWARD, REVERSE clutch (27) in housing, then align REVERSE gear and idler gear (32) and assemble.

⚠ Be careful not to get your fingers caught in the gears.

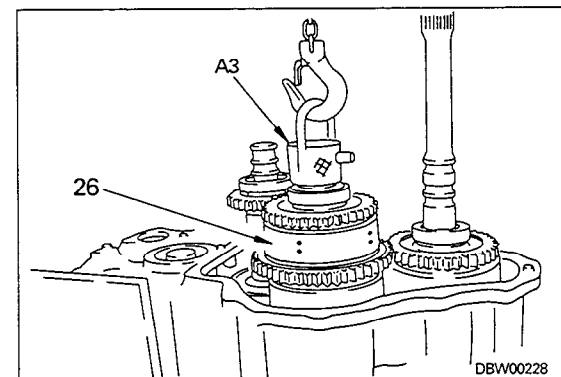
**9. 2nd, 4th, and 1st, 3rd clutch**

- 1) Using tool **A3**, insert 2nd, 4th clutch (25) in housing, and move it towards output shaft end.

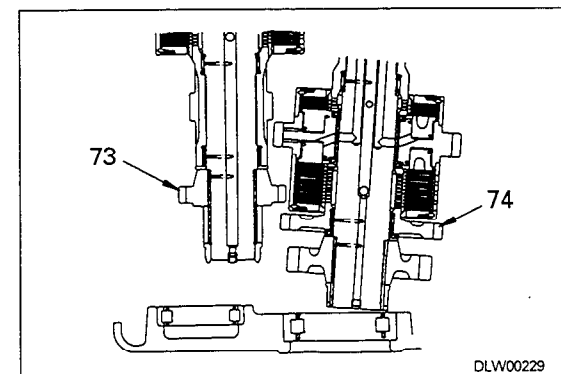


- 2) Using tool **A3**, assemble 1st, 3rd clutch (26) to housing.

★ Do not fit the bearing at the bottom of the clutch completely.



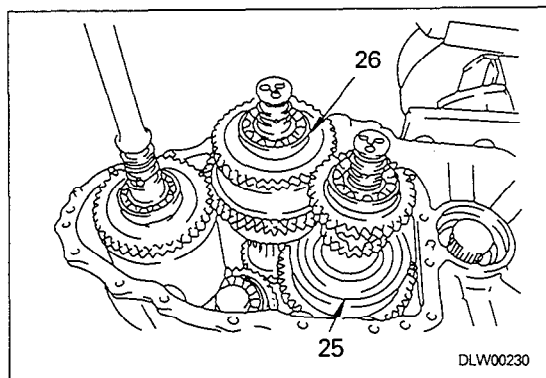
- 3) When 1st gear (73) passes 2nd, 4th clutch gear (74), insert bearing of 2nd, 4th clutch into housing.



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- 4) Insert 1st, 3rd clutch (26) into bearing assembly portion.

- ★ Check that each gear is correctly meshed when inserting into the bearing.
- ★ If the gears are not properly meshed, do not use force. Rotate slightly to assemble.

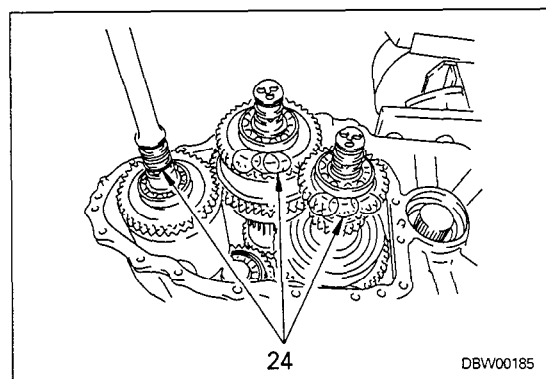


10. Seal rings

Install seal rings (24) to each clutch shaft.

- ★ Coat the seal rings well with oil, then assemble and check that the rotation is smooth.

 Seal ring : **Transmission oil**

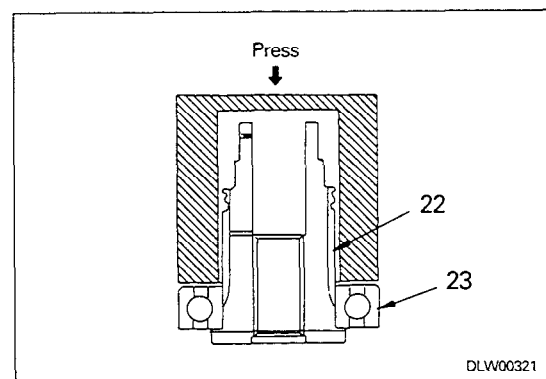


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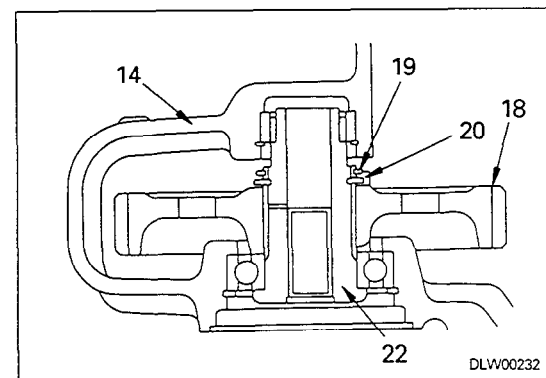
11. Pump (torque converter, loader)

- 1) Press fit bearing (23) to shaft (22).

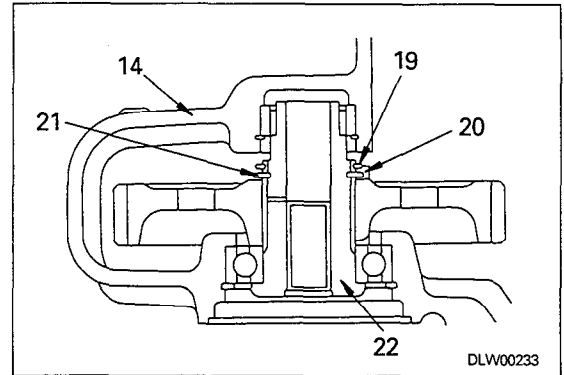
- ★ Press fit so that there is no clearance at the rear of the shaft.



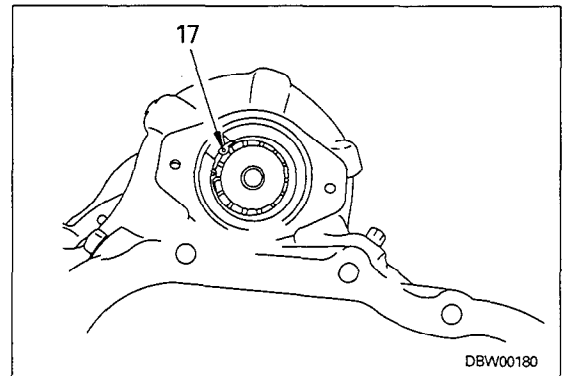
- 2) Assemble gear (18), ring washer (20), and snap ring (19) to inside of rear housing (14), then insert shaft (22) from pump mount end.



- 3) Assemble split spacer (21) to stepped portion of shaft, then assemble ring washer (20) to split spacer, and install snap ring (19).



- 4) Turn over rear housing, and install snap ring (17) at pump mount.
★ Carry out the same procedure at the loader pump end.



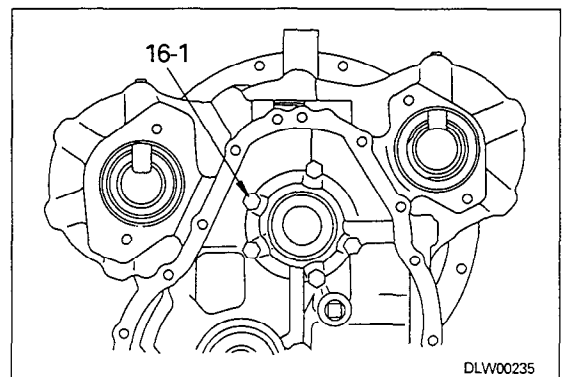
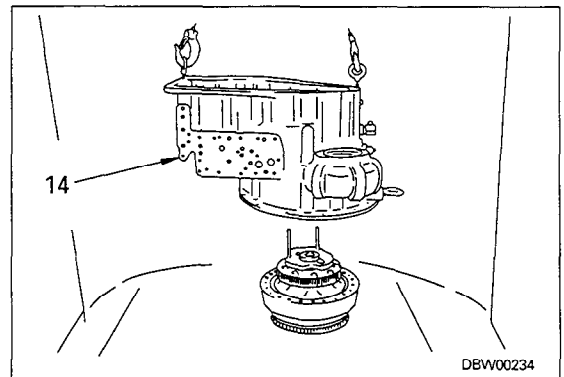
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12. Torque converter

Using eyebolts, raise rear housing (14), then set to mounting position of torque converter, and tighten mounting bolts (16-1).

- ★ Align the mounting bolt holes properly, be careful of the meshing with the pump accessory gear, and install.
- ★ Blow in air to check if the oil holes are correctly aligned.

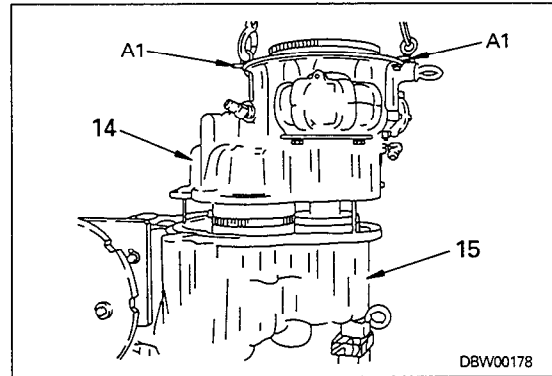
 Mounting bolt : $112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)



13. Rear housing

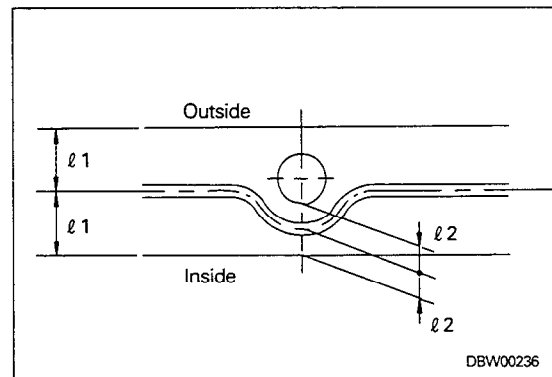
1) Using tool **A1**, raise rear housing (14), and assemble to front housing (15).

- ★ Screw guide pins into the front housing. (12 mm, pitch: 1.75 mm, length: 55 mm)
- ★ Make sure that the gasket sealant is not squeezed out inside the case. Be careful also not to coat with too much gasket sealant.



- ★ See the right for details of the procedure for coating with gasket sealant.
- ★ Mesh the input shaft spline correctly.
- ★ Be careful not to damage the seal ring of each shaft.

 Mating surface of housing :
Gasket sealant (Three Bond 1207B)
 Housing mounting bolt :
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

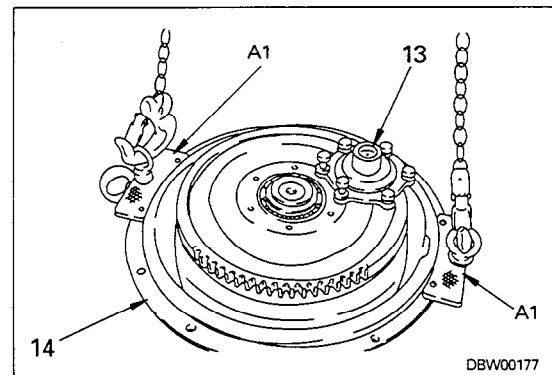


2) Assemble pilot cap (13).

- ★ Remove all oil and grease from the bolt hole before installing the mounting bolt.

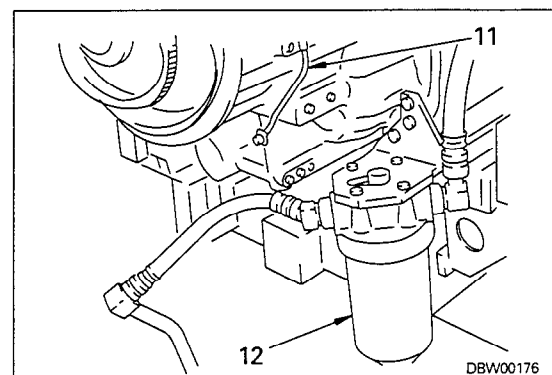
 Cap mounting bolt :
Thread tightener (LT-2)
 Cap mounting bolt :
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

- ★ Remove tool **A1** from rear housing (14).

**14. Oil filter**

Assemble oil filter (12) with bracket assembly.

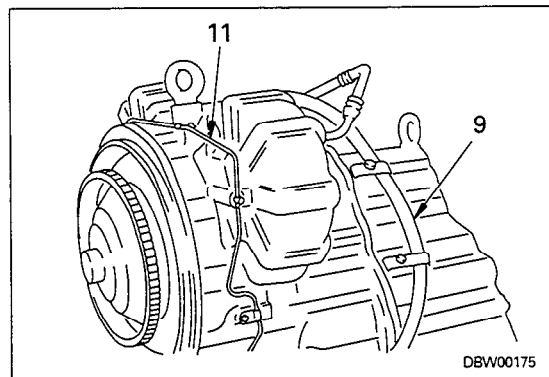
 Mounting bolt :
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)



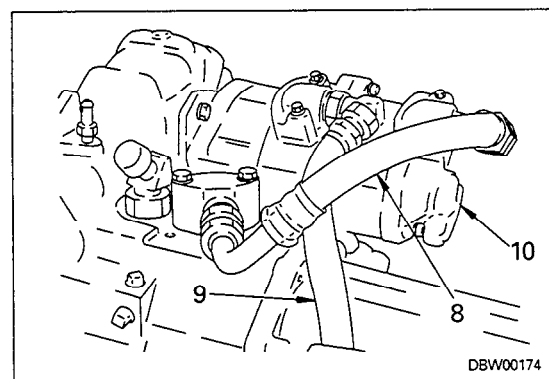
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15. Hydraulic piping

- 1) Install PTO lubrication tube (11).
 - ★ Be careful not to crush the tube during the operation.
- 2) Assemble clamp to hose (9) between torque converter oil filter and torque converter charging pump.

**16. Charging pump**

- 1) Assemble O-ring to charging pump (10), and install to transmission.
 - ★ Be careful not to get the O-ring caught.
-  **kgm** Mounting bolt :
 $110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)
- 2) Install hose and flange (8) and (9) to charging pump (10) and rear housing.
 - ★ Be careful not to get the O-ring caught.
-  **kgm** Hose, flange (pump end) :
 $30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)
-  **kgm** Hose, flange (housing end) :
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)
-  **kgm** Hose joint :
 $177 \pm 29 \text{ Nm}$ ($18.0 \pm 3.0 \text{ kgm}$)

**17. Transmission control valve**

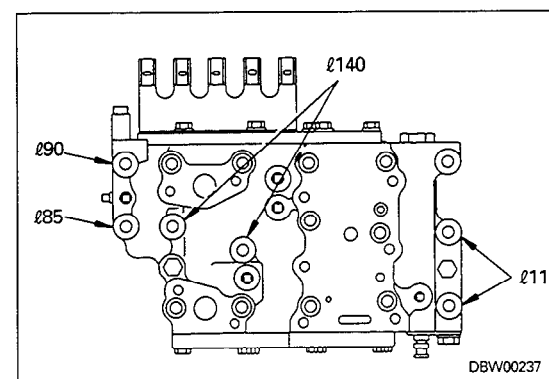
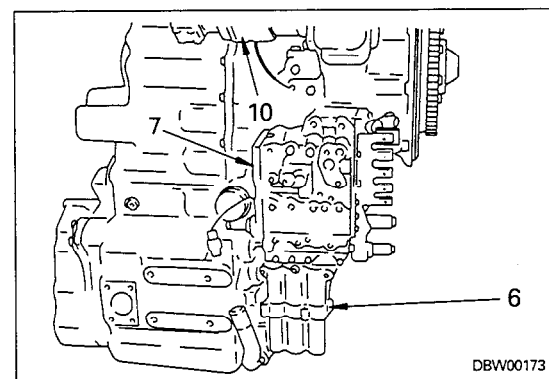
- 1) Install guide bolt to mount portion of transmission control valve (7).
 - ★ Wash and remove all oil and grease from the control valve mounting bolt hole and mounting bolt thread.
- 2) Align with guide bolt and assemble gasket, then fit control valve (7) temporarily.
- 3) Coat mounting bolts of control valve (7) with thread tightener and tighten.
 - ★ Tighten the mounting bolts in turn on diametrically opposite sides and be careful not to tighten too much.
 - ★ The length of the mounting bolts is different, so be careful when using them.



Mounting bolt :

Thread tightener (LT-2)

Mounting bolt :

 $34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

- 4) Assemble O-ring to accumulator valve (6), and install to transmission.

★ Wash and remove all oil and grease from the mounting bolt hole and mounting bolt.

 Mounting bolt :

Thread tightener (LT-2)

 Mounting bolt :

$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

- 5) Align gasket with modulation valve (5) and assemble to transmission valve.

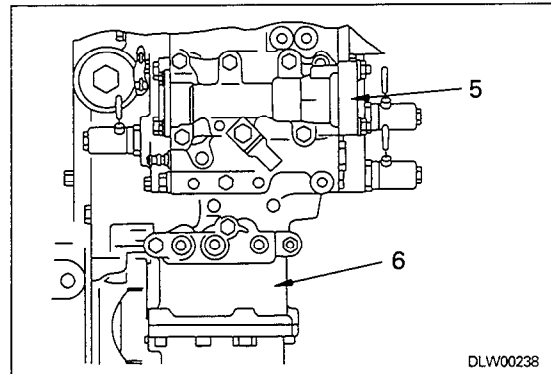
★ Wash and remove all oil and grease from the mounting bolt hole and mounting bolt.

 Mounting bolt :

Thread tightener (LT-2)

 Mounting bolt :

$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)



DLW00238

18. Hydraulic piping

- 1) Install tube and hose (4) between torque converter filter and transmission valve to transmission valve.

★ Install the tube clamps.

★ Wash and remove all oil and grease from the mounting bolt hole and mounting bolt.

 Mounting bolt :

Thread tightener (LT-2)

 Mounting bolt :

$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

- 2) Install tube hose (3) between strainer and charging pump.

 Mounting bolt (pump end) :

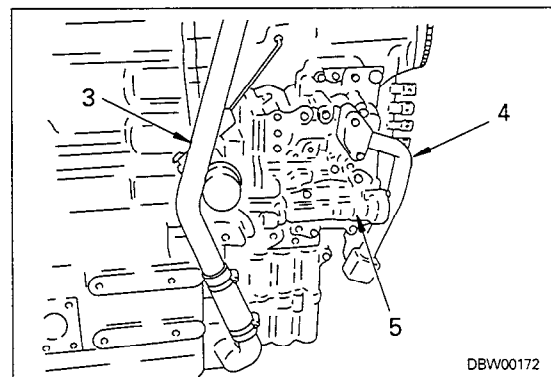
$110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)

 Mounting bolt (strainer end) :

$66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)

 Hose clamp :

$4.4 \pm 0.5 \text{ Nm}$ ($0.45 \pm 0.05 \text{ kgm}$)



DBW00172

19. Oil filler, rear coupling

- 1) Sling transmission assembly and lift off from assembly stand.

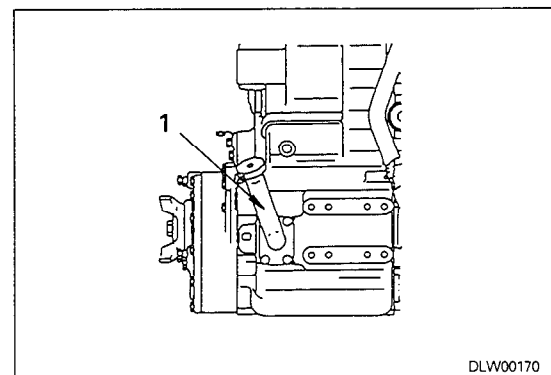
★ When standing the transmission assembly up, be careful of the center of gravity, and lift off slowly.

- 2) Assemble O-ring and install oil filler (1).

★ Be careful not to get the O-ring caught.

 Mounting bolt :

$66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)



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- 3) Assemble so that rear coupling (2) and front coupling face in same direction.

20. Adjusting speedometer sensor

- 1) Screw in sensor (75) until it contacts outermost surface of gear (76).
 - ★ Before installing the sensor, check that the gear is at the outermost circumference in relation to the mounting surface.
 - ★ When screwing in the sensor with a wrench, stop before it contacts the gear, and finally tighten by hand until it is lightly in contact.
- 2) After sensor (75) contacts gear (76), turn it back 1/2 – 1 turn, and secure it in position with locknut (77).
 - ★ When securing with the locknut, hold the nut with a wrench when tightening.



Sensor thread portion :

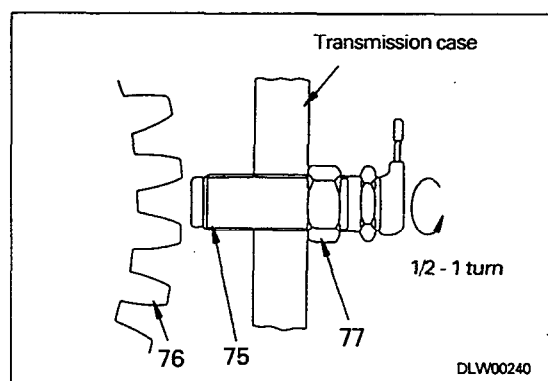
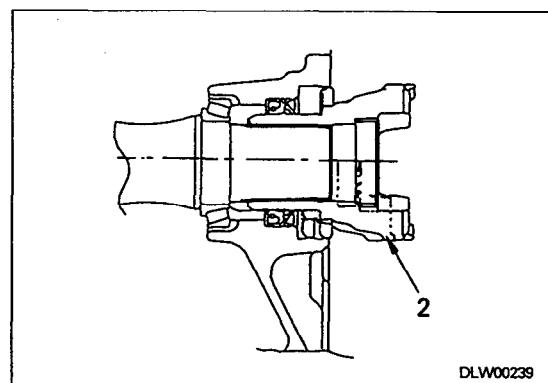
Gasket sealant (LG-5)



Sensor locknut :

$58.8 \pm 9.8 \text{ Nm}$ ($6.0 \pm 1.0 \text{ kgm}$)

- ★ Install the transmission bracket.



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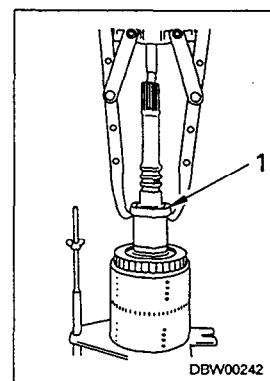
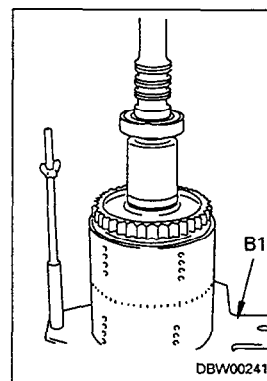
DISASSEMBLY OF TRANSMISSION CLUTCH PACK ASSEMBLY

Disassembly of FORWARD, REVERSE clutch pack

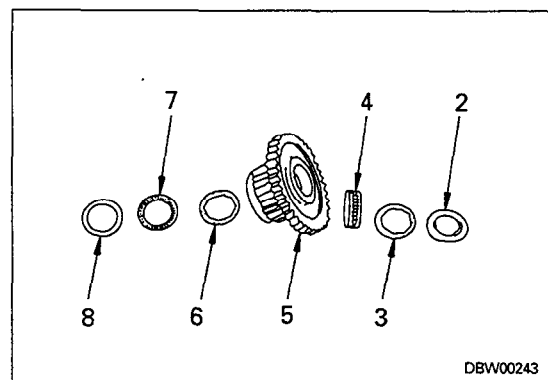


The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand. Be careful also not to get your fingers caught between the stand and the clutch pack.

- ★ Set on tool B1 with the FORWARD clutch side at the top.

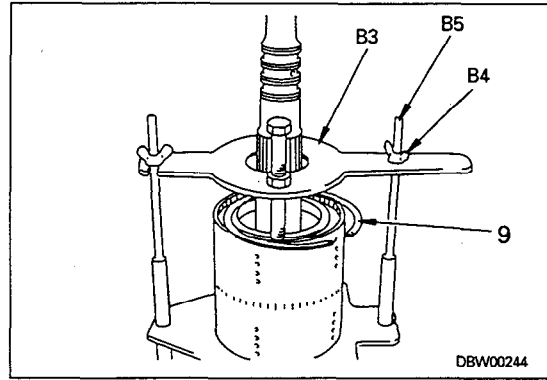


1. **Bearing**
Using puller and remove bearing (1).
2. **Spacer, FORWARD gear**
Remove spacer (2), thrust washer (3), needle bearing (4), FORWARD gear (5), thrust washer (6), thrust bearing (7), and washer (8).

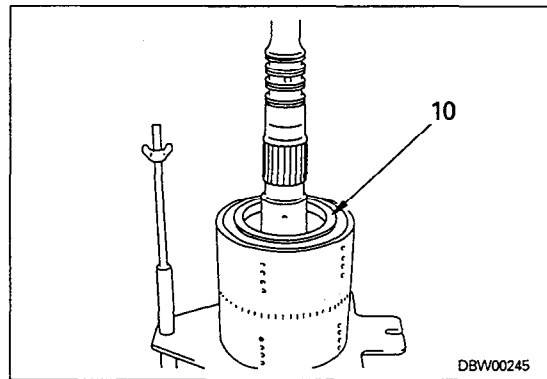


3. End plate

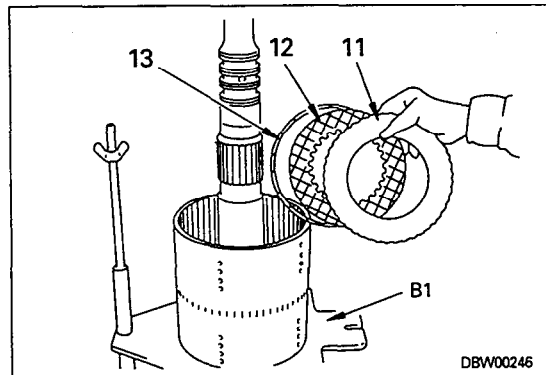
- 1) Install tools **B3** and **B5**, then tighten tool **B4**, and remove ring (9).
★ After removing the ring, remove tool **B3**.



- 2) Remove end plate (10).

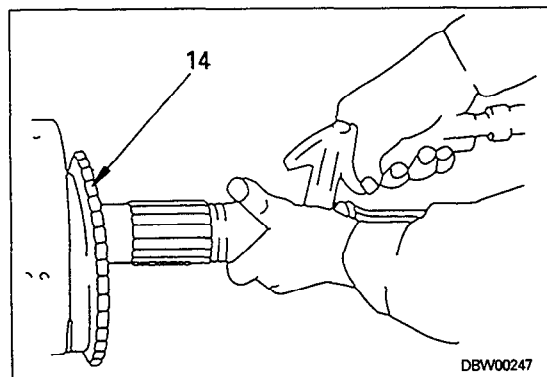
**4. Clutch plate**

Remove plate (11), disc (12), and spring (13) from housing.

**5. Piston**

Blow air in FORWARD oil hole of shaft and remove piston (14).

- ★ If the piston is at an angle and cannot be removed, push the piston in and try to remove it again.
- ★ Do not use force to remove it. The inside circumference of the cylinder will be damaged.



6. Return spring, plate

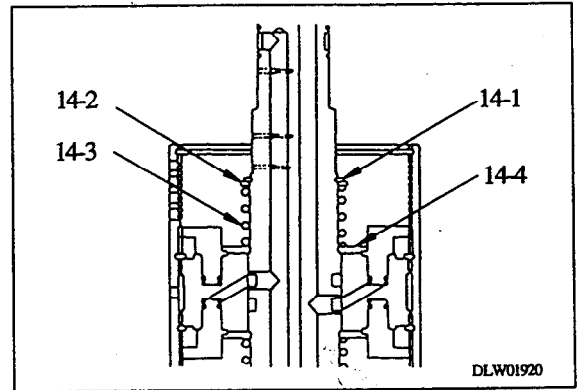
Remove snap ring (14-1), then remove plate (14-2), return spring (14-3), and plate (14-4).

★ Return spring (reference value)

- Free length : 100 mm
- Installed length : 45 mm
- Installed load :

$612 \pm 25 \text{ Nm } (62.4 \pm 2.6 \text{ kgm})$

⚠ When removing snap ring (14-1), there is danger that the snap ring and washer will fly off under the force of the spring, so use ample force to push the spring down, then remove the snap ring slowly from the groove in the shaft.



7. Snap ring

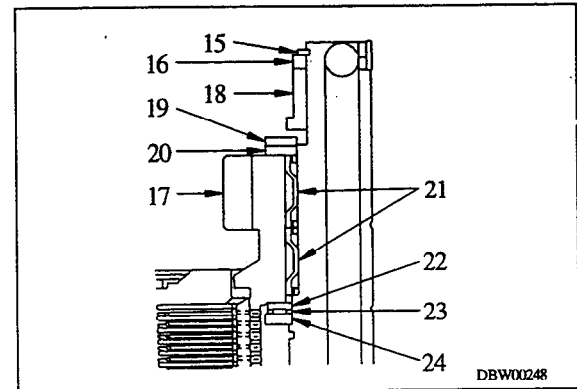
★ Set on tool B1 with the REVERSE clutch side at the top.

Remove snap ring (15).

8. Bearing, REVERSE gear

Using puller, remove spacer (16), gear (17), inner bearing (18), spacer (19), thrust washer (20), needle bearing (21), thrust washer (22), thrust bearing (23), and washer (24).

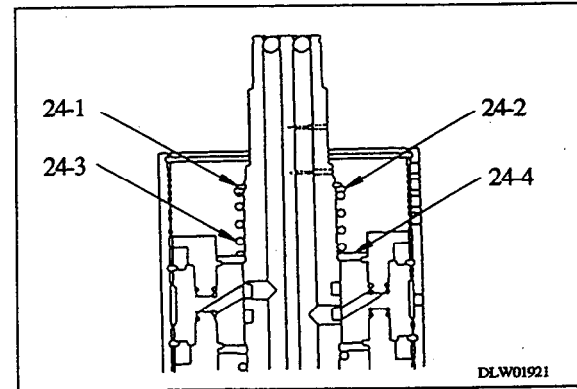
Use the same procedure as in Steps 3 – 5 for the FORWARD gear to continue disassembly.



9. Return spring, plate

Remove snap ring (24-1), then remove plate (24-2), return spring (24-3), and plate (24-4).

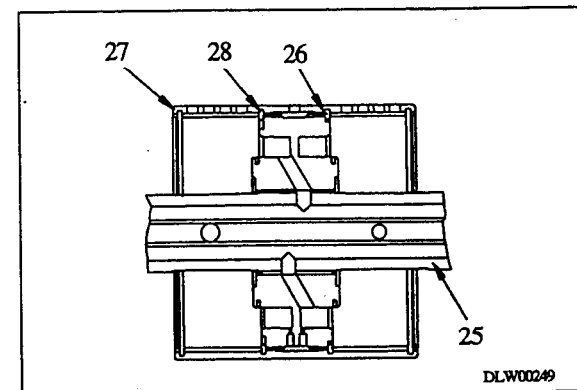
★ The free length and other dimensions for the return spring are the same as in Step 6.



10. Shaft, cylinder

1) Remove snap ring (26) from shaft and housing (25), then remove housing (27).

2) Remove snap ring (28), then remove housing (27).

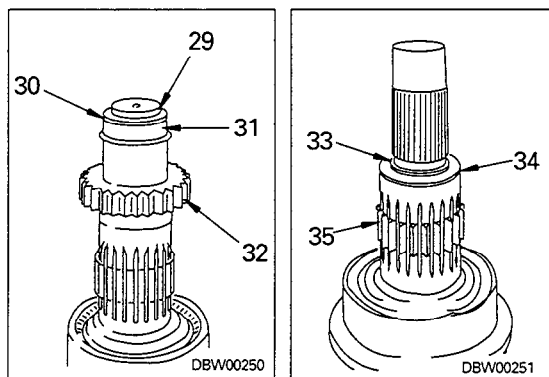


Disassembly of 1st, 3rd clutch

★ Set on tool **B1** with the 1st clutch side at the top.

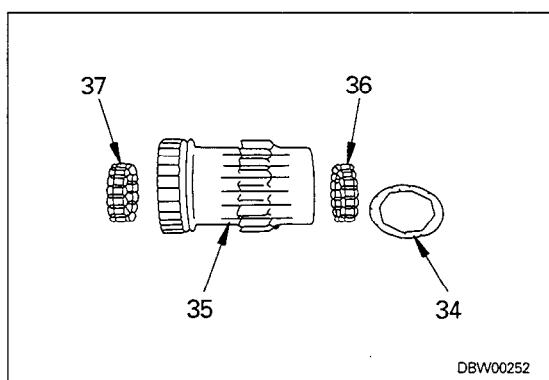
1. Idler gear

- 1) Remove snap ring (29), then using puller, remove spacer (30), inner bearing (31), and idler gear (32).



2. 1st gear

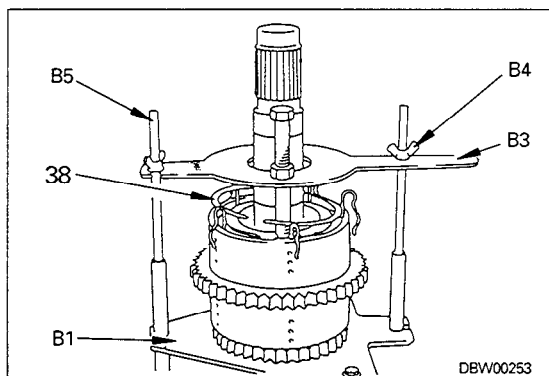
- 1) Remove snap ring (33), then remove thrust washer (34).
- 2) Remove 1st gear (35), and needle bearings (36) and (37).



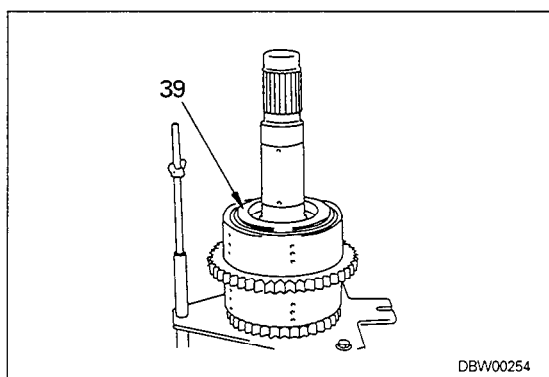
3. End plate

- 1) Install tool **B3** and **B5**, then tighten tool **B4**, and remove ring (38).

★ After removing the ring, remove tool **B3**.



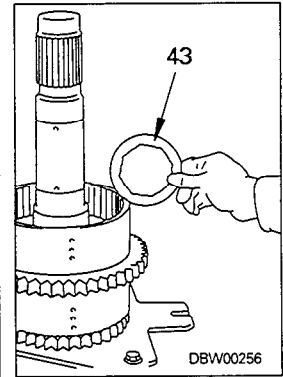
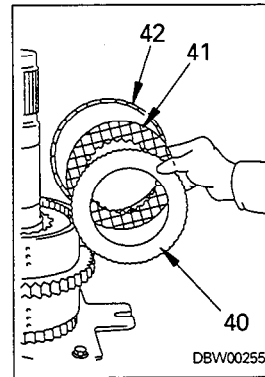
- 2) Remove end plate (39).



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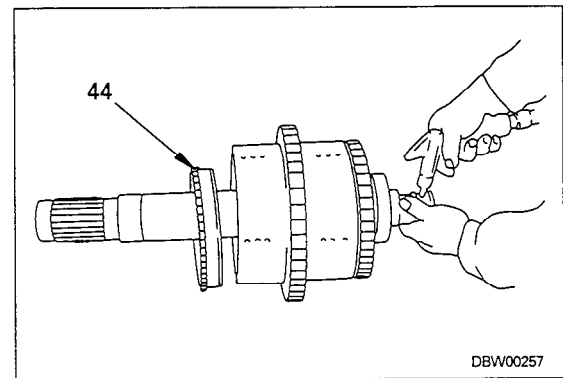
4. Clutch plate

- 1) Remove plate (40), disc (41), and spring (42) from housing.
- 2) Remove thrust washer (43).

**5. Piston**

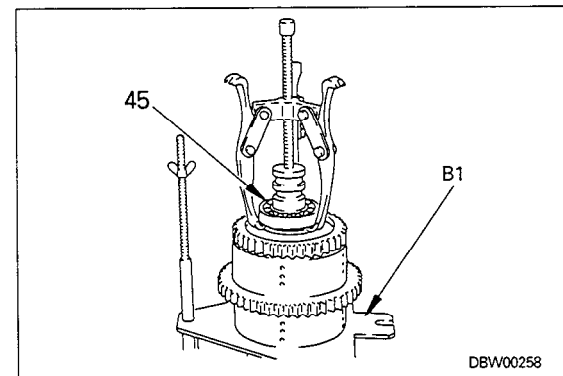
Blow air in REVERSE oil hole of shaft, and remove piston (44).

- ★ If the piston is at an angle and cannot be removed, push the piston in and try to remove it again.
- ★ Do not use force to remove it. The inside circumference of the cylinder will be damaged.

**6. Bearing**

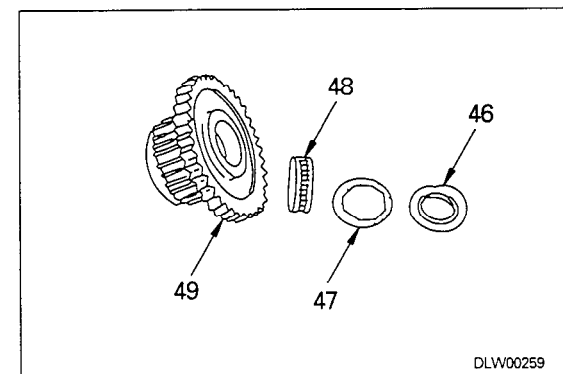
Set on tool **B1** with the 3rd clutch side at the top.

Using puller, remove bearing (45).

**7. 3rd gear**

Remove spacer (46), thrust washer (47), needle bearing (48), and 3rd gear (49).

- ★ Use the same procedure as in Steps 3 – 5 for the 1st gear to continue disassembly.



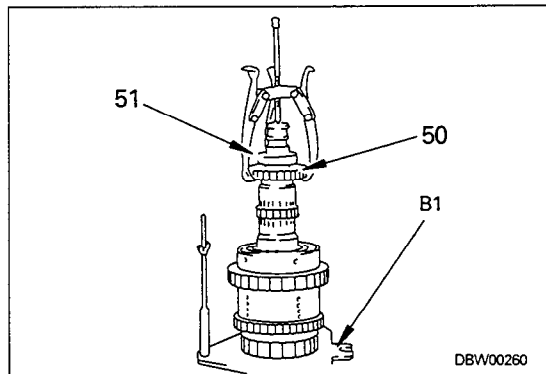
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Disassembly of 2nd, 4th clutch pack

★ Set on tool **B1** with the 4th clutch side at the top.

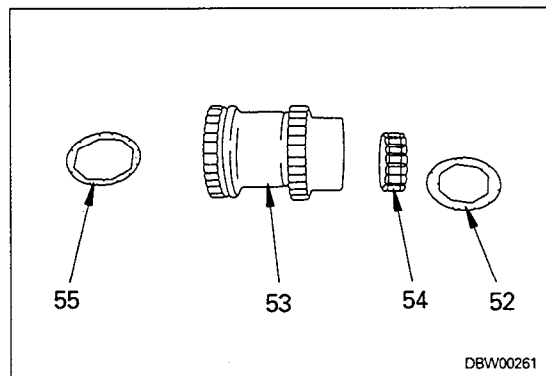
1. Idler gear

Fit puller to idler gear (50), then remove bearing (51) together with idler gear.



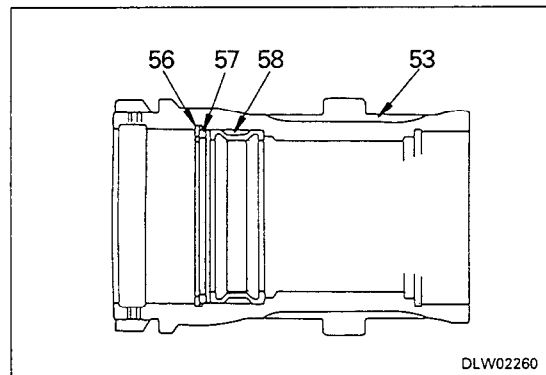
2. 4th gear

- 1) Remove thrust washer (52), 4th gear (53), needle bearing (54), and thrust washer (55).
- 2) Remove snap ring (56), spacer (57), and needle bearing (58) from 4th gear (53).

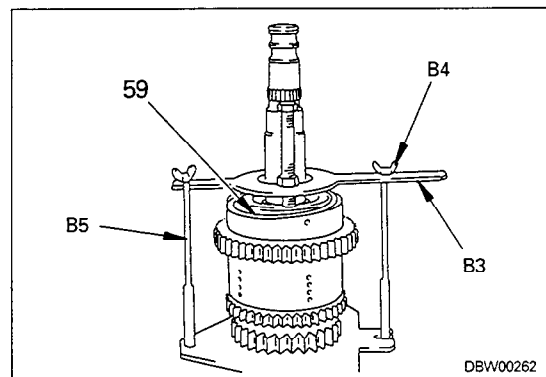
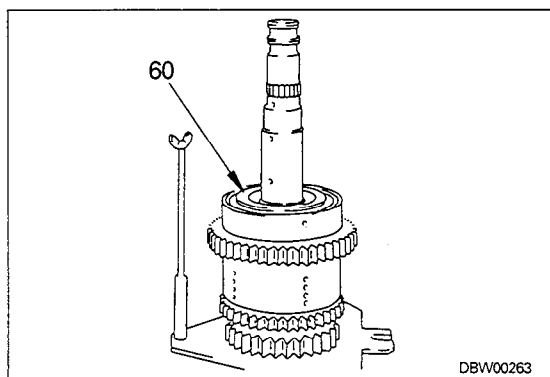


3. End plate

- 1) Install tools **B3** and **B5**, then tighten tool **B4**, and remove ring (59).
- ★ After removing the ring, remove tool **B3**.



- 2) Remove end plate (60).

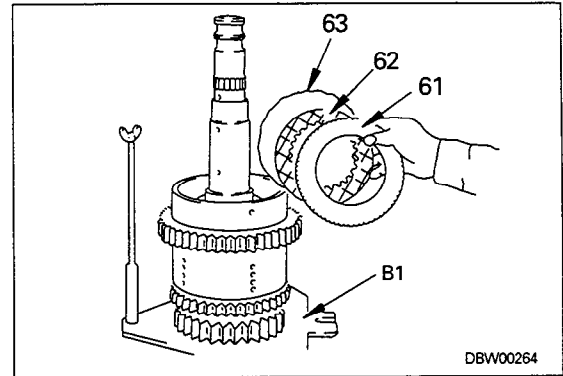


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4. Clutch plate

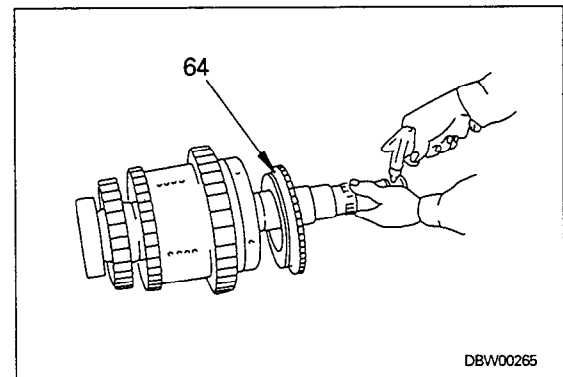
Remove plate (61), disc (62), and spring (63) from housing.



5. Piston

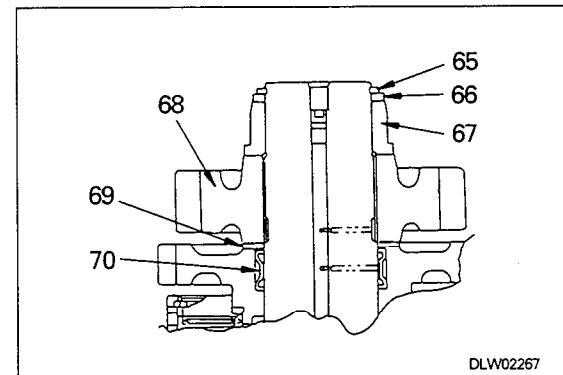
Blow air in 4th oil hole of shaft, and remove piston (64).

- ★ If the piston is at an angle and cannot be removed, push the piston in and try to remove it again.
- ★ Do not use force to remove it. The inside circumference of the cylinder will be damaged.



6. Idler gear

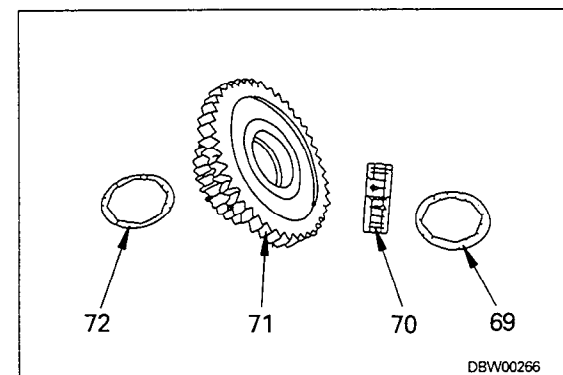
- ★ Set on tool B1 with the 2nd clutch side at the top.
- 1) Remove snap ring (65).
- 2) Using puller, remove spacer (66), inner bearing (67), and idler gear (68).
- ★ When fitting the puller, put the plate in contact with the center first.



7. 2nd gear

Remove thrust washer (69), needle bearing (70), 2nd gear (71), and thrust washer (72).

- ★ Use the same procedure as in Steps 3 – 5 for the 2nd gear to continue disassembly.



ASSEMBLY OF TRANSMISSION CLUTCH PACK ASSEMBLY

Assembly of FORWARD, REVERSE clutch pack

▲ The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand. Be careful also not to get your fingers caught between the stand and the clutch pack.

- Set on the assembly stand with the REVERSE clutch side at the top.

1. Housing

Assemble snap ring (28) to one side of housing (27).

2. Shaft, housing

- 1) Put housing (27) and snap ring (27) on tool B1.
- 2) Assemble shaft and housing to housing (27), and install snap ring (26).

3. Piston seal

Assemble piston seal (73-1) to piston (73).

- ★ When assembling a new piston seal, use tool B6 to make the seal fit well (time: approx. 2 – 3 minutes), then assemble the seal.
- ★ If the seal is assembled to the cylinder without making it fit first, the seal will be damaged.



Inside surface of tool B6 :

Transmission oil

4. REVERSE piston

Install REVERSE piston (73).

- ★ Be careful not to damage the piston seal.
- ★ Check that the spring pin does not extend from the circumference of the shaft.



Sliding surface of piston seal :

Transmission oil

5. Return spring, plate

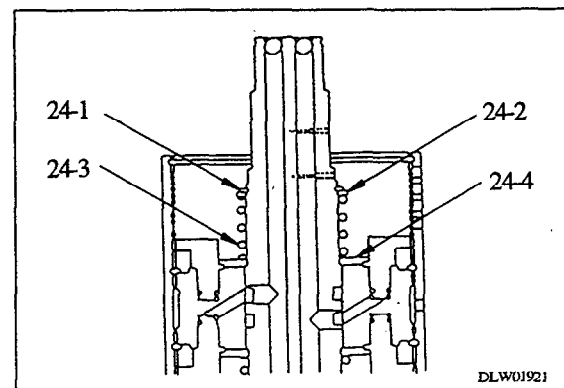
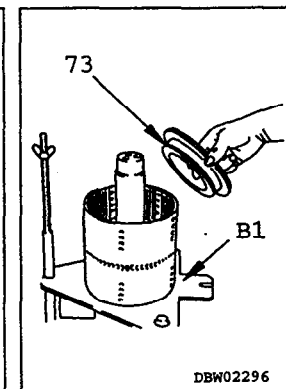
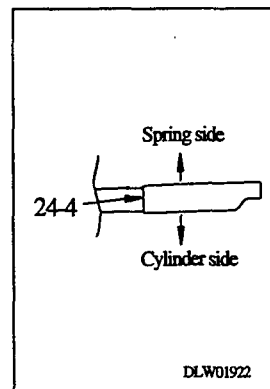
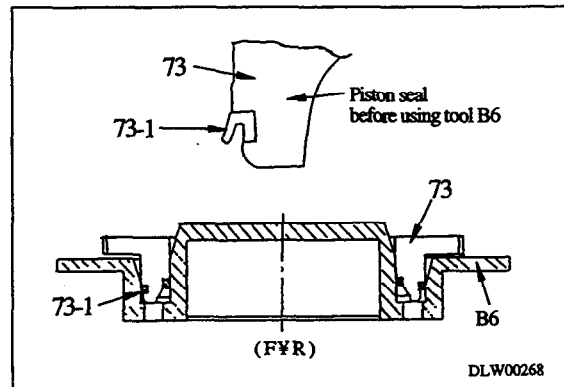
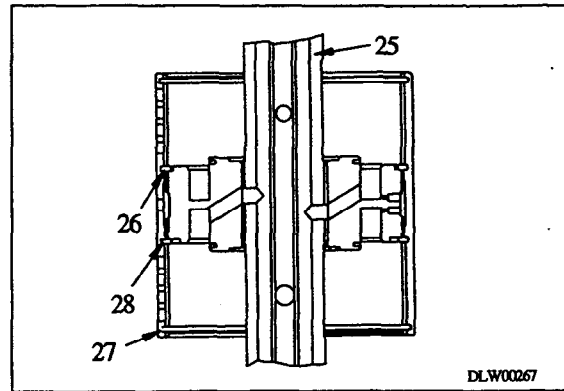
- 1) Assemble plate (24-4), return spring (24-3), and plate (24-2) to shaft.

- ★ Check that plate (24-4) is facing in the correct direction for assembly, then insert it on the shaft.

- 2) Assemble snap ring (24-1) to shaft, then use a ring clamp to push in so that snap ring fits in shaft groove.

- ★ Check that the snap ring is fitted in the shaft groove.
- ★ Be extremely careful that the ring clamp does not come off.
- ★ Installed load of spring :

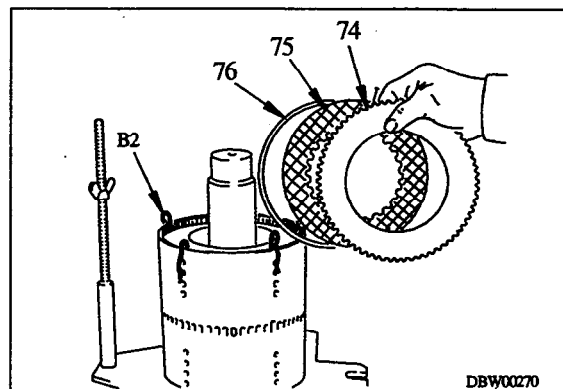
612 Nm (62.4 kg)



6. Clutch plate

Insert tool B2 into housing, then assemble plate (74), disc (75), and spring (76) in turn.

- ★ Soak disc (75) in clean transmission oil for at least 2 minutes before assembling.
- ★ Be careful to assemble so that disc (75) and spring (76) are not resting on each other.
- ★ Be careful that the plate or spring are not caught in the clutch housing ring groove when assembling.

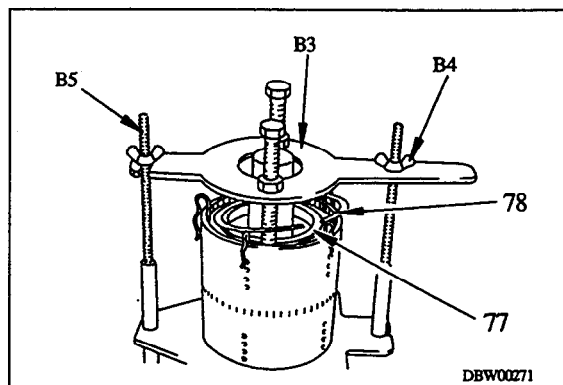


7. End plate

1) Install tools B3 and B5, then tighten tool B4 to push in end plate (77).

2) Assemble ring (78), and remove tool B3.

- ★ Check that the disc rotates smoothly by hand.



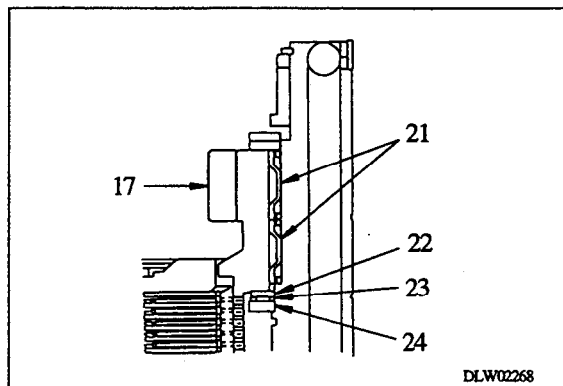
8. Thrust washer

Assemble washer (24), thrust bearing (23), thrust washer (22).

9. REVERSE gear

Align spline groove on inside of plate with a screwdriver to assemble gear (17).

- ★ If the gear spline does not match, turn lightly when assembling. Never use force to push it in.



10. Needle bearing

Assemble needle bearing (21) and thrust washer (20).

- ★ Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.

11. Bearing

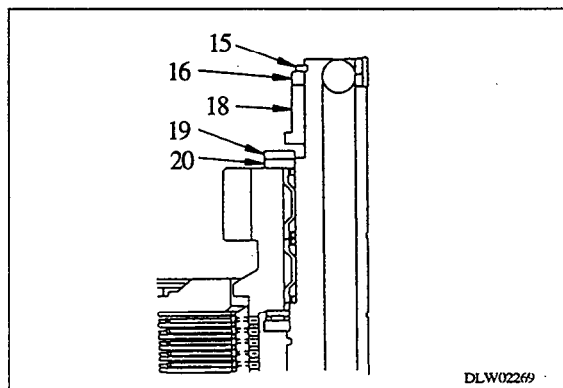
1) Assemble spacer (19), then press fit inner bearing (18) and spacer (16).

- ★ Press fit completely so that there is no clearance.



Thrust washer : Transmission oil

2) Assemble snap ring (15).



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- 3) After press fitting bearing, check that clearance "a" between thrust washer and spacer is within standard value.

★ $a = 0.106 - 0.991 \text{ mm}$

12. FORWARD piston

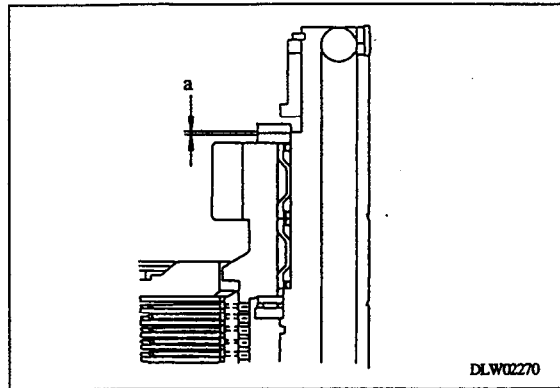
- 1) Turn over clutch pack.

⚠ When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

- 2) In the same way as with REVERSE piston, make sure that piston seal fits well before assembling it to piston (14).

- 3) Assemble piston (14) in the same way as REVERSE piston.

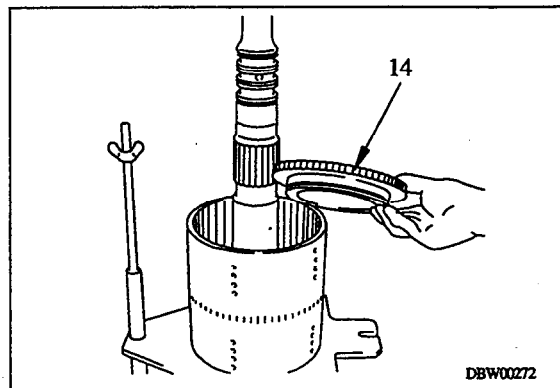
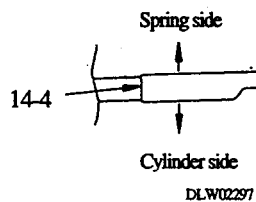
 Sliding surface of piston seal :
Transmission oil



13. Return spring, plate

- 1) Assemble plate (14-4), return spring (14-3), and plate (14-2) to shaft.

★ Check that plate (14-4) is facing in the correct direction for assembly, then insert it on the shaft.



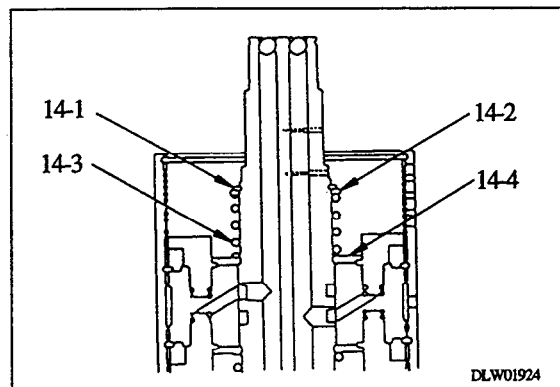
- 2) Assemble snap ring (14-1) to shaft, then use a ring clamp to push in so that snap ring fits in shaft groove.

★ Check that the snap ring is fitted in the shaft groove.

★ Be extremely careful that the ring clamp does not come off.

★ Installed load of spring :

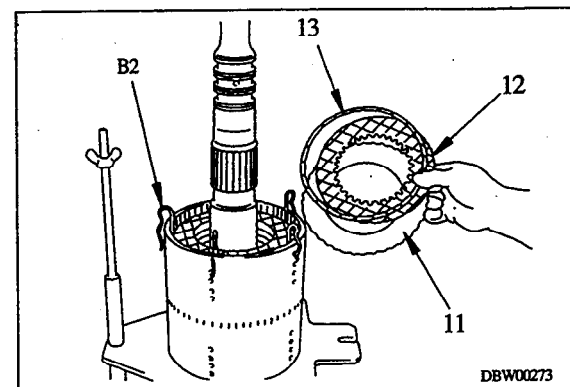
612 Nm (62.4 kg)



14. Clutch plate

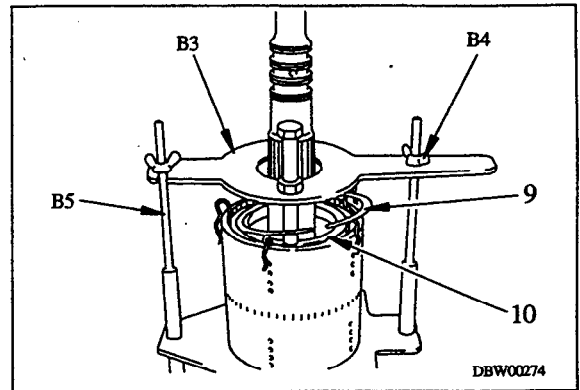
Insert tool B2 in housing, and assemble plate (11), disc (12), and spring (13) in turn.

★ Assemble in the same way as for the REVERSE clutch plate.



15. End plate

- 1) Install tools B3 and B5, then tighten tool B4 to push in end plate (10).
- 2) Assemble ring (9), and remove tool B3.
- ★ Assemble in the same way as for the REVERSE end plate.



16. Thrust washer

Assemble washer (8), thrust bearing (7), and thrust washer (6).

 Thrust washer : Transmission oil

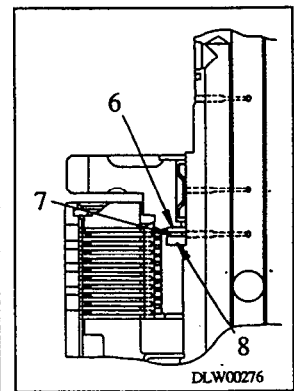
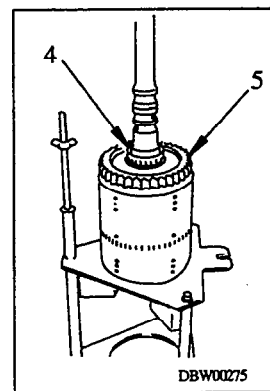
17. FORWARD gear

Assemble FORWARD gear (5).

- ★ Assemble in the same way as for the REVERSE gear.

18. Needle bearing

Assemble needle bearing (4).

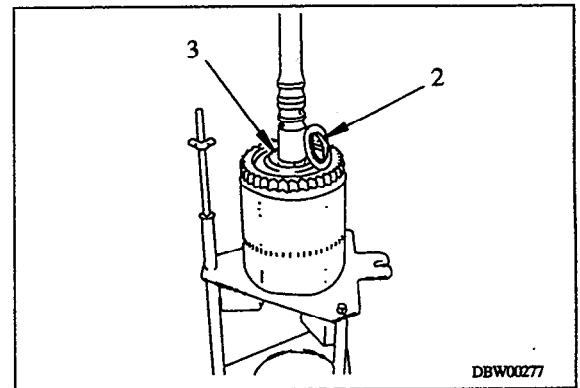


19. Spacer

Assemble thrust washer (3), then assemble spacer (2).

- ★ Check that the end face of the thrust race of the thrust washer is below the surface of the stepped portion of the shaft.

 Thrust washer : Transmission oil



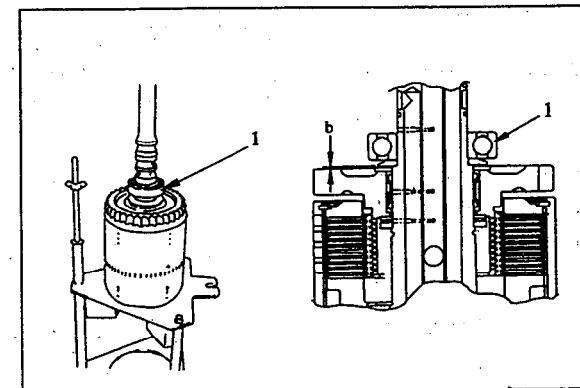
20. Bearing

Press fit bearing (1).

- ★ Press fit completely so that the spacer is in tight contact with bearing (1) at the stepped portion of the shaft.

- ★ After press fitting bearing (1), check that clearance "b" between the thrust washer and the spacer is within the standard value.

- ★ $b = 0.106 - 0.991 \text{ mm}$



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21. Clutch pack operation test

Blow in compressed air through oil hole in shaft and check that each clutch works properly.

- ★ If the gear where the air is blown in is held in position, the clutch is working properly.

Assembly of 1st, 3rd clutch pack

⚠ The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand. Be careful also not to get your fingers caught between the stand and the clutch pack.

- ★ Set the shaft housing on tool B1 with the 3rd clutch side at the top.

1. Piston seal

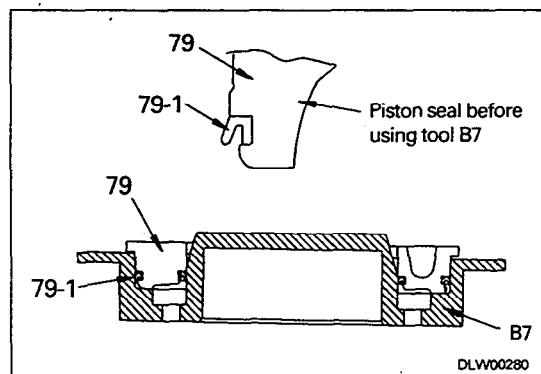
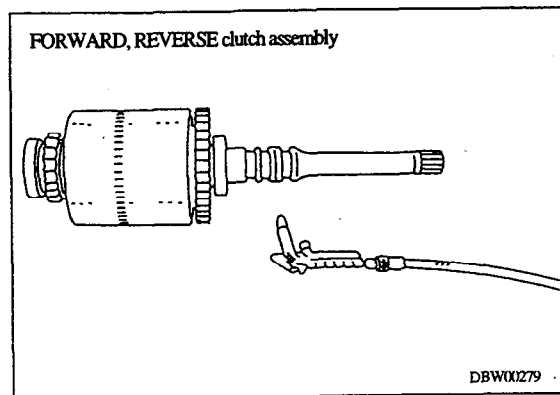
Assemble piston seal (79-1) to piston (79).

- ★ When assembling a new piston seal, use tool B7 to make the seal fit well (time: approx. 2 – 3 minutes), then assemble the seal.
- ★ If the seal is assembled to the cylinder without making it fit first, the seal will be damaged.



Inside surface of tool B7

Transmission oil

**2. 3rd piston**

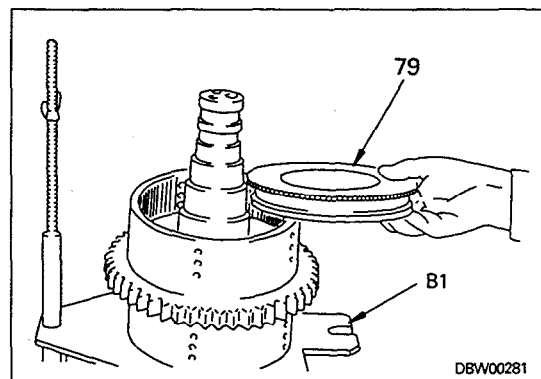
Install 3rd piston (79).

- ★ Be careful not to damage the piston seal.
- ★ Check that the spring pin does not extend from the circumference of the shaft.



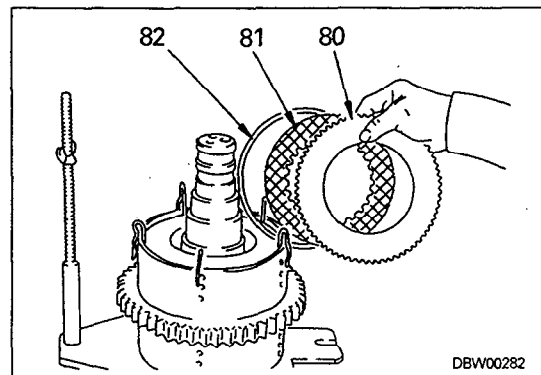
Sliding surface of piston seal :

Transmission oil

**3. Clutch plate**

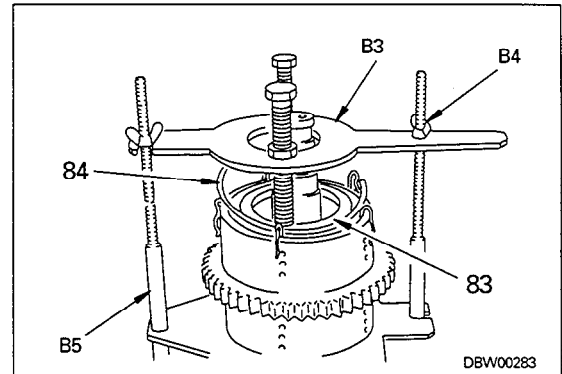
Assemble plate (80), disc (81), and spring (82) in turn to housing.

- ★ Soak disc (81) in clean transmission oil for at least 2 minutes before assembling.
- ★ Be careful to assemble so that disc (81) and spring (82) are not resting on each other.
- ★ Be careful that plate (80) or spring (82) are not caught in the clutch housing ring groove when assembling.



4. End plate

- 1) Install tools **B3** and **B5**, then tighten tool **B4** to push in end plate (83).
- 2) Assemble ring (84), and remove tool **B3**.
 - ★ Check that ring (84) is fitted securely in the groove.
 - ★ Check that the disc rotates smoothly by hand.

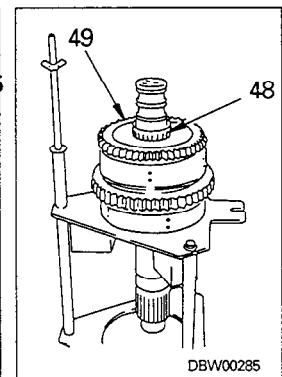
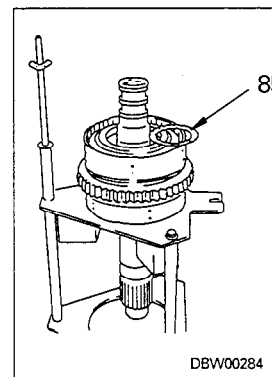


- 3) Assemble thrust washer (85).

5. 3rd gear

Assemble 3rd gear (49), then assemble needle bearing (48).

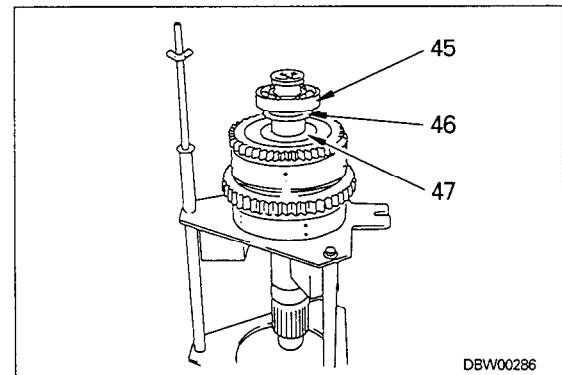
- ★ If the gear spline does not match, turn lightly when assembling. Never use force to push it in.
- ★ Assemble the needle bearing at the bottom first.



6. Bearing

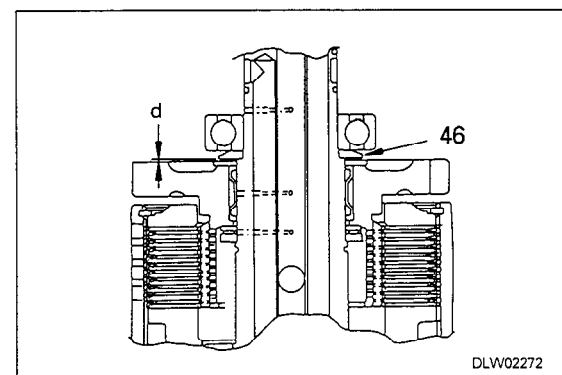
Assemble thrust washer (47) and spacer (46), then press fit bearing (45).

- ★ Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.
- ★ Press fit completely so that the spacer is in tight contact with bearing (45) at the stepped portion of the shaft.



- ★ After press fitting bearing, check that clearance "d" between thrust washer (47) and spacer (46) is within standard value.

- ★ $d = 0.1 - 0.9 \text{ mm}$



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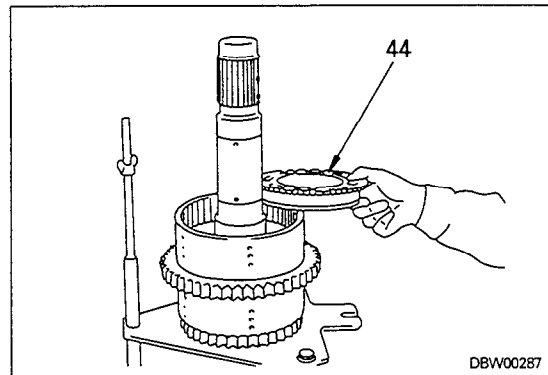
7. 1st piston

- 1) Turn over clutch pack.

⚠ When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

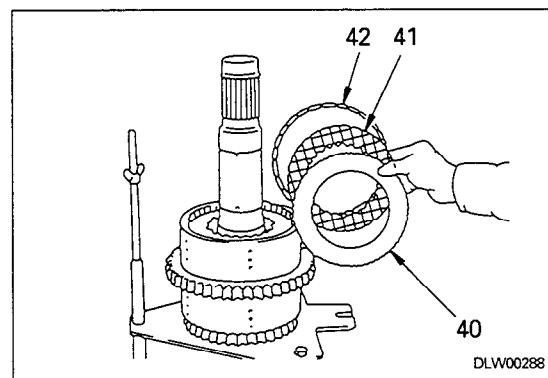
- 2) In the same way as with 3rd piston, make sure that piston seal fits well before assembling it to piston (44).
- 3) Assemble piston (44) in the same way as 3rd piston.

 Sliding surface of piston seal :
Transmission oil

**8. Clutch plate**

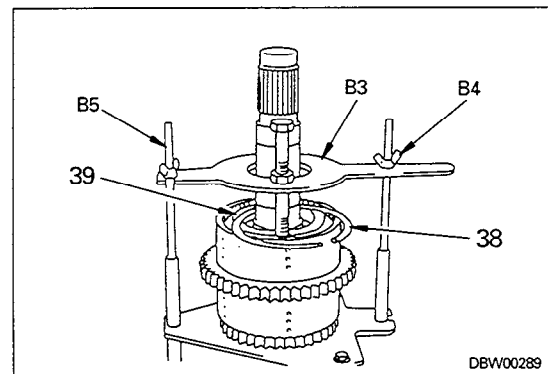
Assemble plate (40), disc (41), and spring (42) in turn to housing.

- ★ Assemble in the same way as for the 3rd clutch plate.

**9. End plate**

- 1) Install tools **B3** and **B5**, then tighten tool **B4** to push in end plate (39).
- 2) Assemble ring (38), and remove tools **B3** and **B4**.

★ Assemble in the same way as for the 3rd end plate.

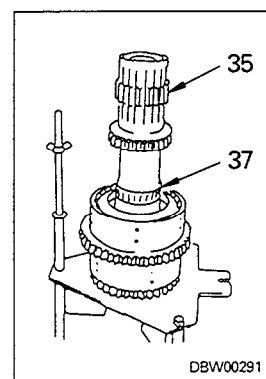
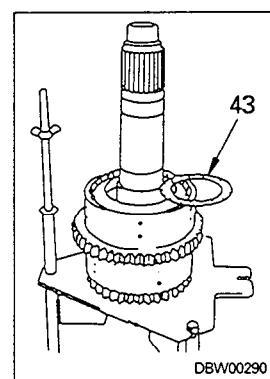


- 3) Assemble thrust washer (43).

10. 1st gear

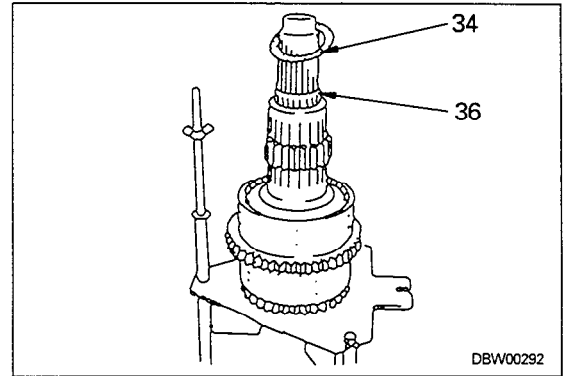
- 1) Assemble 1st gear (35) and needle bearing (37).

★ Assemble in the same way as for the 3rd gear.



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- 2) Assemble needle bearing (36) and thrust washer (34).
- ✎ Thrust washer : **Transmission oil**
- 3) Assemble snap ring (33).
- ★ Fit the snap ring securely in the groove of the shaft.

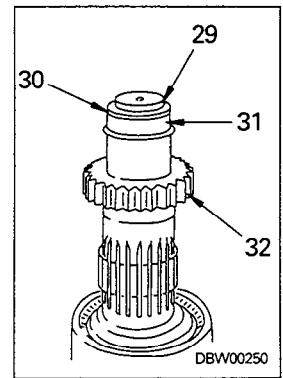
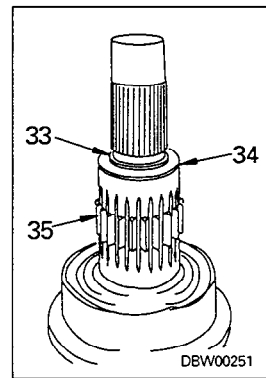


11. Idler gear

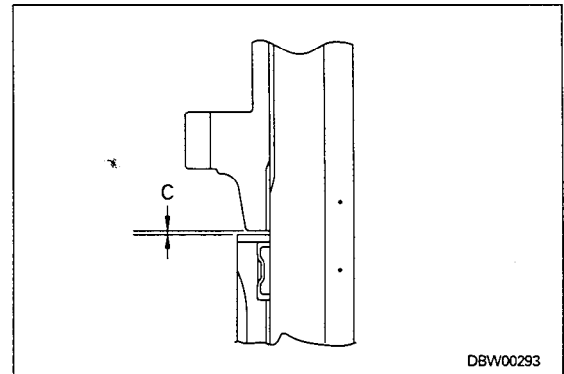
- 1) Assemble idler gear (32).

12. Bearing

- 1) Press fit inner bearing (31) and spacer (30).
- 2) Assemble snap ring (29).
- ★ Fit the snap ring securely in the shaft groove.



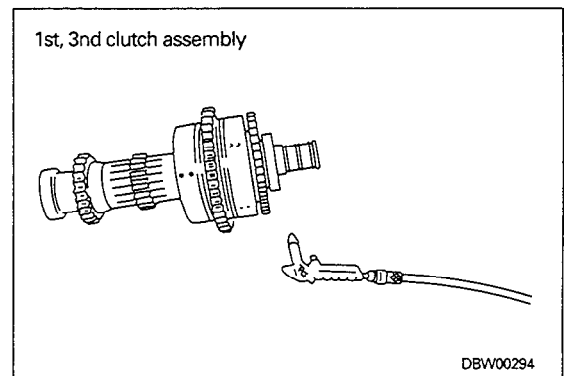
- ★ After press fitting the bearing, check that clearance "c" between the thrust washer and the gear is within the standard value.
- ★ $c = 0.02 - 1.58 \text{ mm}$



13. Clutch pack operation test

Blow in compressed air through oil hole in shaft and check that each clutch works properly.

- ★ If the gear where the air is blown in is held in position, the clutch is working properly.



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Assembly of 2nd, 4th clutch pack

⚠ The clutch pack is oily, so be careful not to let it slip when setting the clutch pack on the stand. Be careful also not to get your fingers caught between the stand and the clutch pack.

- ★ Set the shaft housing on tool **B1** with the 2nd clutch side at the top.

1. Piston seal

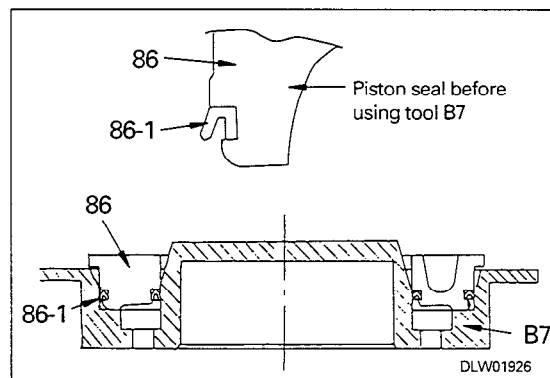
Assemble piston seal (86-1) to piston (86).

- ★ When assembling a new piston seal, use tool **B7** to make the seal fit well (time: approx. 2 – 3 minutes), then assemble the seal.
- ★ If the seal is assembled to the cylinder without making it fit first, the seal will be damaged.



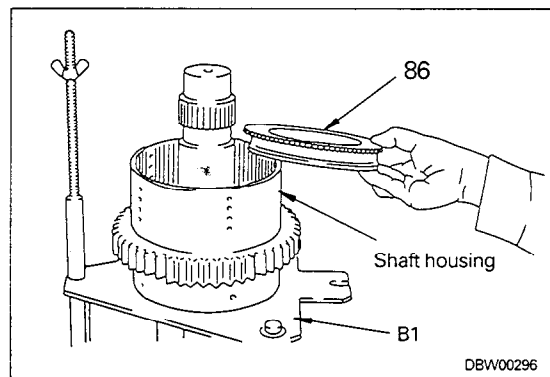
Inside surface of tool **B7** :

Transmission oil

**2. 2nd piston**

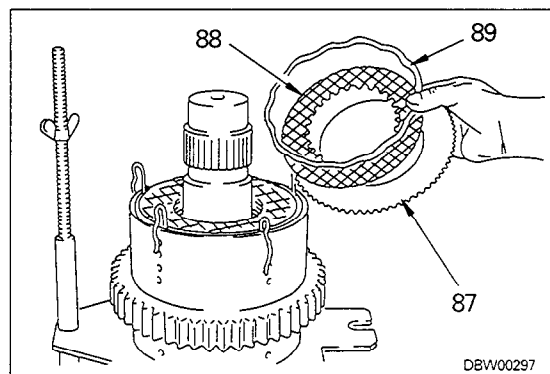
Install 2nd piston (86).

- ★ Be careful not to damage the piston seal.
- ★ Check that the spring pin does not extend from the circumference of the shaft.

**3. Clutch plate**

Assemble plate (87), disc (88), and spring (89) in turn to housing.

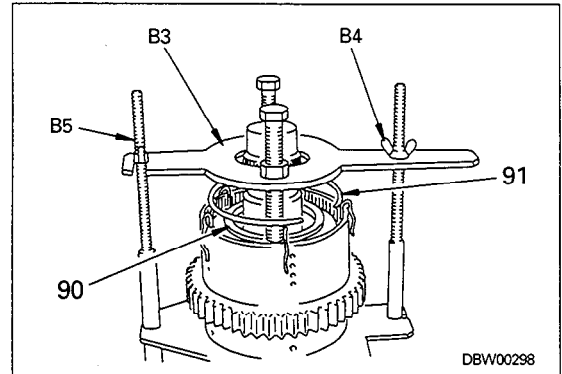
- ★ Soak disc (88) in clean transmission oil for at least 2 minutes before assembling.
- ★ Be careful to assemble so that disc (88) and spring (89) are not resting on each other.
- ★ Be careful that the plate or spring are not caught in the clutch housing ring groove when assembling.



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4. End plate

- 1) Install tools **B3** and **B5**, then tighten tool **B4** to push in end plate (90).
- 2) Assemble ring (91), and remove tool **B3**.
 - ★ Check that the disc rotates smoothly by hand.

**5. Thrust washer**

Assemble thrust washer (72).

6. 2nd gear

Assemble 2nd gear (71), then assemble needle bearing (70).

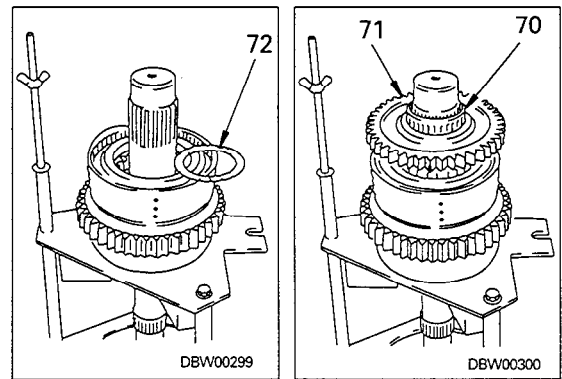
- ★ If the gear spline does not match, turn lightly when assembling. Never use force to push it in.

7. Idler gear

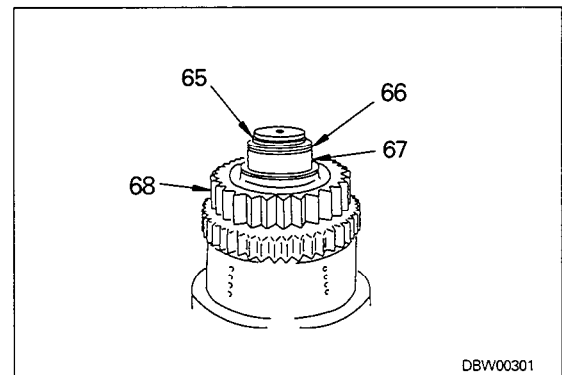
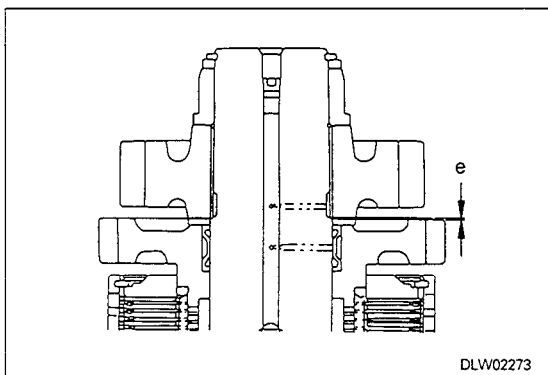
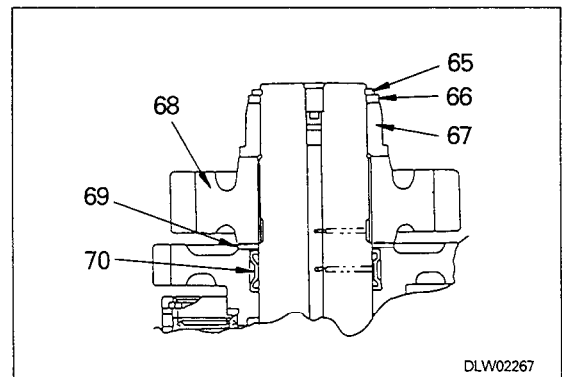
Assemble thrust washer (69) and idler gear (68).

- ★ Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.

 Thrust washer : **Transmission oil**

**8. Bearing**

- 1) Press fit inner bearing (67) and spacer (66).
- 2) Assemble snap ring (65).
 - ★ Fit the snap ring securely in the shaft groove.
 - ★ After press fitting the bearing, check that clearance "e" between the thrust washer and the idler gear is within the standard value.
 - ★ $e = 0.34 - 1.66 \text{ mm}$



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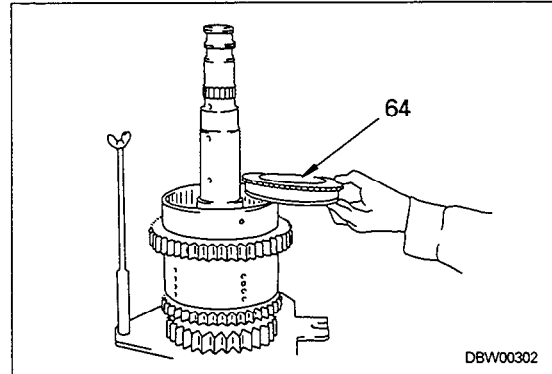
9. 4th piston

- 1) Turn over clutch pack.

⚠ When turning over the clutch pack, be careful not to get your fingers caught between the stand and clutch pack.

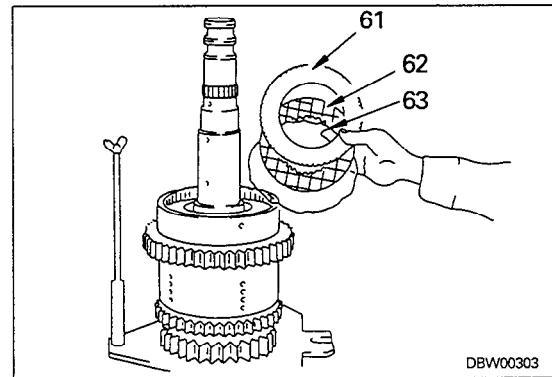
- 2) In the same way as with 1st piston, make sure that piston seal fits well before assembling it to piston (64).
- 3) Assemble piston (64) in the same way as 2nd piston.

 Sliding surface of piston seal :

**10. Clutch plate**

Assemble plate (61), disc (62), and spring (63) in turn to housing.

- ★ Assemble in the same way as for the 2nd clutch plate.



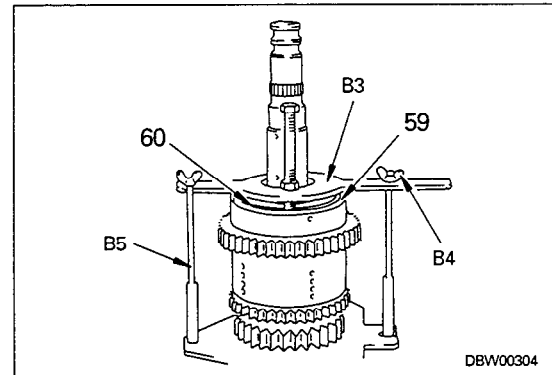
U42303

11. End plate

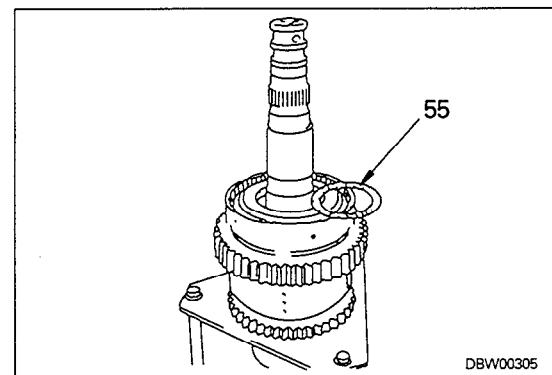
- 1) Install tools **B3** and **B5**, then tighten tool **B4** to push in end plate (60).

- 2) Assemble ring (59), and remove tool **B3**.

★ Assemble in the same way as for the 2nd end plate.



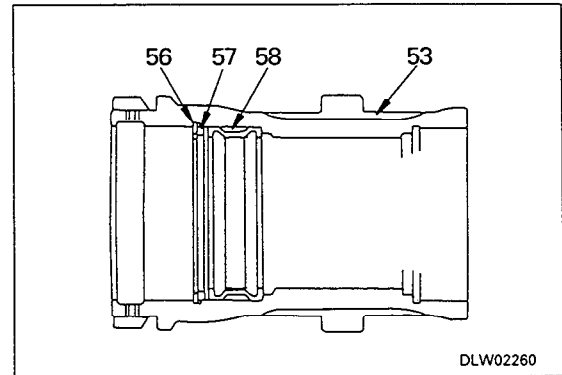
- 3) Assemble thrust washer (55).



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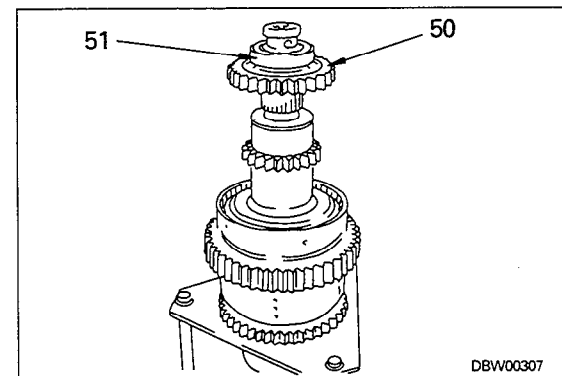
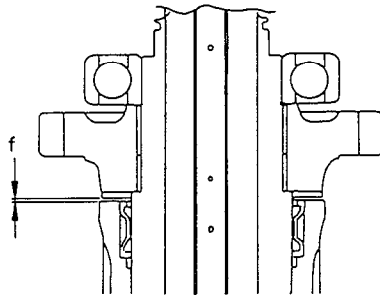
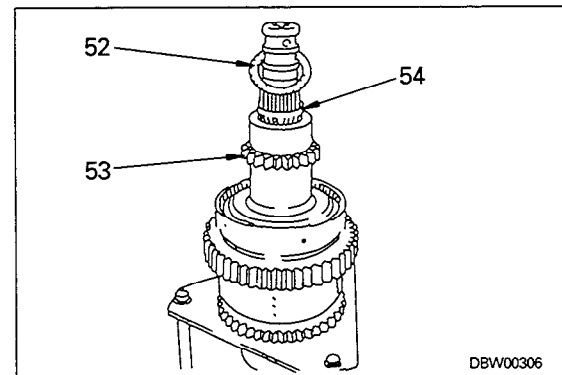
12. 4th gear

- 1) Assemble in same way as for 2nd gear.
 - 2) Assemble needle bearing (58), spacer (57), and snap ring (56) to 4th gear (53), then assemble 4th gear (53).
 - 3) Assemble top needle bearing (54).
 - 4) Assemble thrust washer (52).
- ★ Check that the end face of the thrust washer is below the surface of the stepped portion of the shaft.

**13. Bearing**

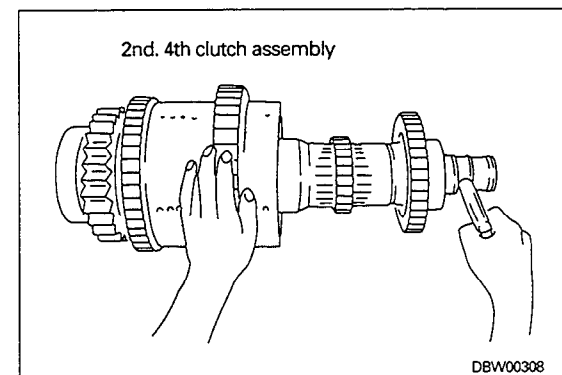
Assemble idler gear (50), then press fit bearing (51).

- ★ Press fit completely so that the idler gear is in tight contact with bearing (51) at the stepped portion of the shaft.
- ★ After press fitting the bearing, check that clearance "f" between the thrust washer and the idler gear is within the standard value.
- ★ $f = 0.17 - 1.43 \text{ mm}$

**14. Clutch pack operation test**

Blow in compressed air through oil hole in shaft and check that each clutch works properly.

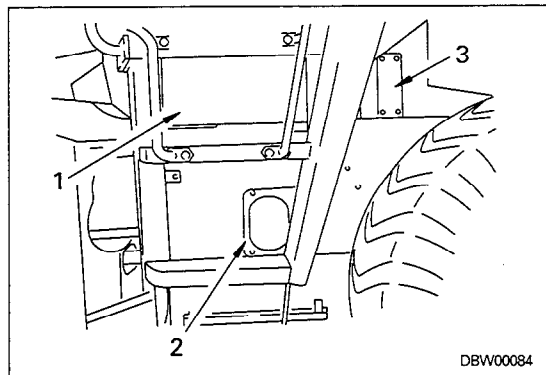
- ★ If the gear where the air is blown in is held in position, the clutch is working properly.



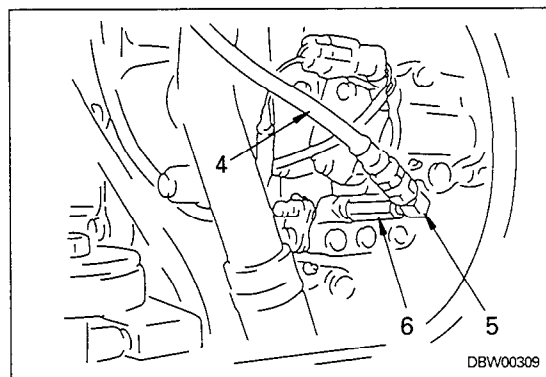
REMOVAL OF TRANSMISSION CONTROL VALVE ASSEMBLY

! 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.

1. Remove covers (1), (2), and (3).



2. Remove parking brake hose (4), elbow (5), and nipple (6).



3. Remove accumulator valve (7).

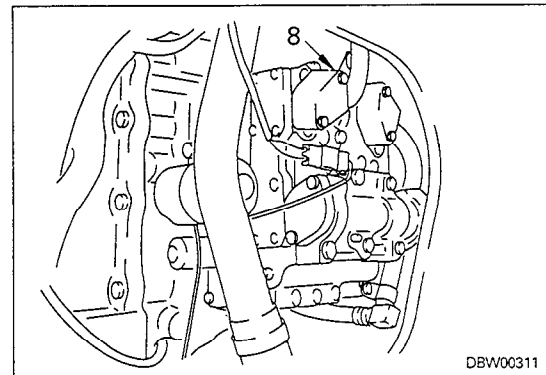
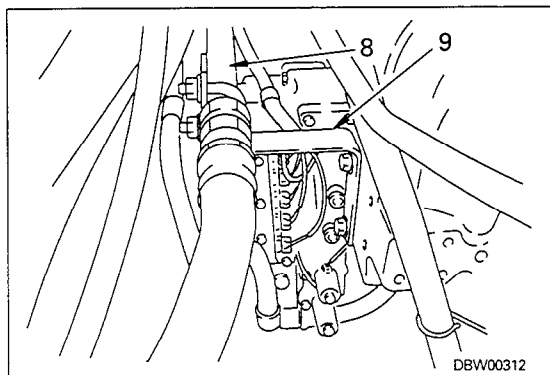
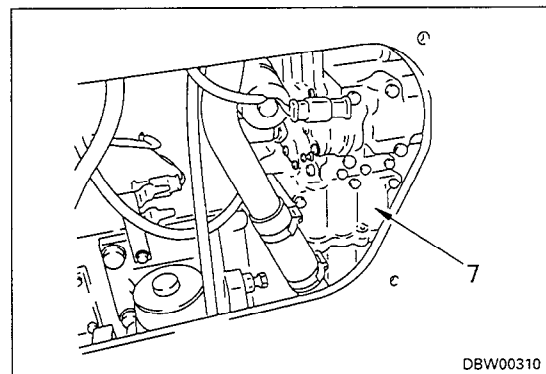


Accumulator valve : 8.5 kg



4. **Torque converter cooler tube**

- 1) Remove mounting bolts, and disconnect torque converter cooler tube (8).
 - 2) Remove lock bracket (9) of torque converter cooler tube (8) from engine.
- ★ Move the tube up.



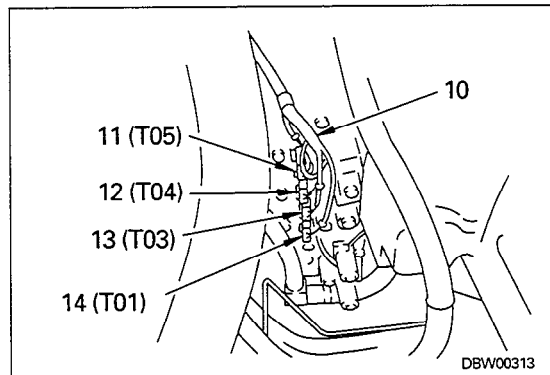
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5. Electric wiring

- 1) Disconnect clamp of transmission wiring (10) from transmission valve.
- 2) Disconnect transmission wirings (11), (12), (13), (14), and (15) from transmission valve.

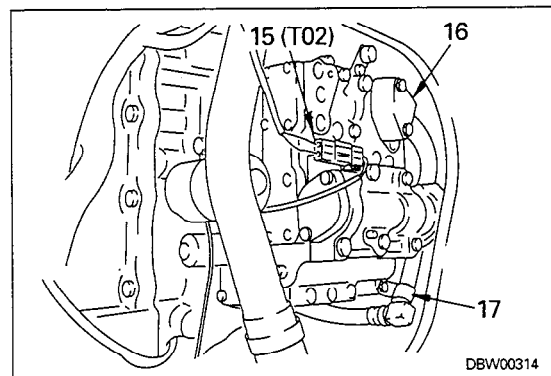
※ 3

★ Fit tags to distinguish the wiring.

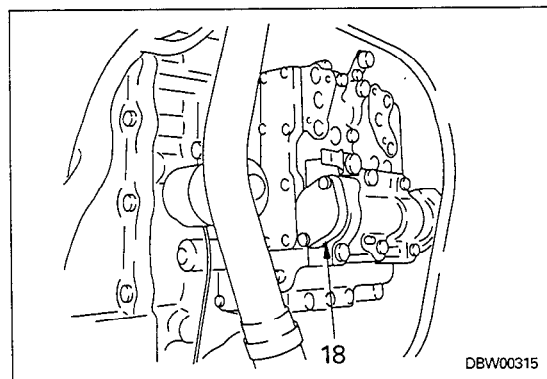


6. Disconnect tube (16) between transmission filters from transmission valve. ※ 4

★ Remove the valve mounting bolts, then remove clamp (17).



7. Remove modulating valve (18). ※ 5



8. Sling transmission valve assembly (19), then remove mounting bolts, and lower assembly under chassis. ※ 6

★ Leave upper and lower valve mounting bolts (20) installed.

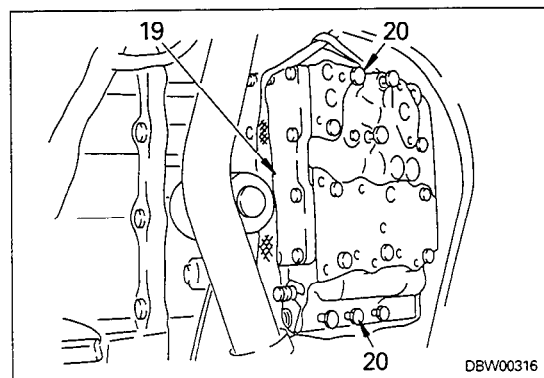
★ Remove together with the wiring bracket.

⚠ The working space is confined, so be extremely careful when carrying out this operation.

★ When fitting the lifting tool, avoid the connectors, fit securely to the valve body, and be careful to maintain the balance.



Transmission valve : 46 kg



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INSTALLATION OF TRANSMISSION CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1 ※ 2 ※ 4

- ★ Use a new part for the O-ring.
- ★ Wash and remove all oil and grease from the mounting bolts and bolt holes.

 Mounting bolt : **Thread tightener (LT-2)**

 Mounting bolt : **$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)**

※ 3

Connect the wiring connector securely.

※ 5

- ★ Use a new part for the gasket.
- ★ Wash and remove all oil and grease from the mounting bolts and bolt holes.

 Mounting bolt: **Thread tightener (LT-2)**

 Mounting bolt : **$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)**

※ 6

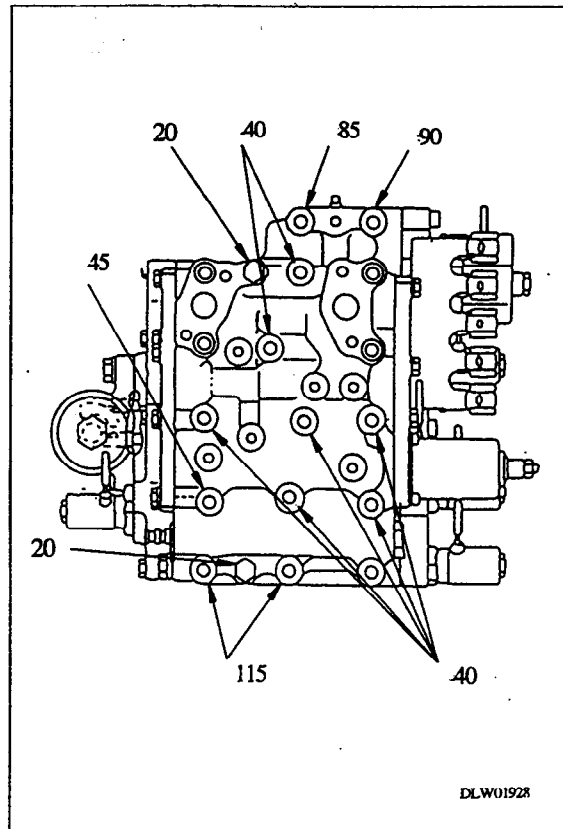
 The working space is confined, so be extremely careful when carrying out this operation.

- ★ Use a new part for the gasket.
- ★ Use guide bolts to prevent the part from falling out during installation.
- ★ Lock with upper and lower valve set bolts (20).
- ★ Wash and remove all oil and grease from the valve mounting bolts and bolt holes.

 Mounting bolt : **Thread tightener (LT-2)**

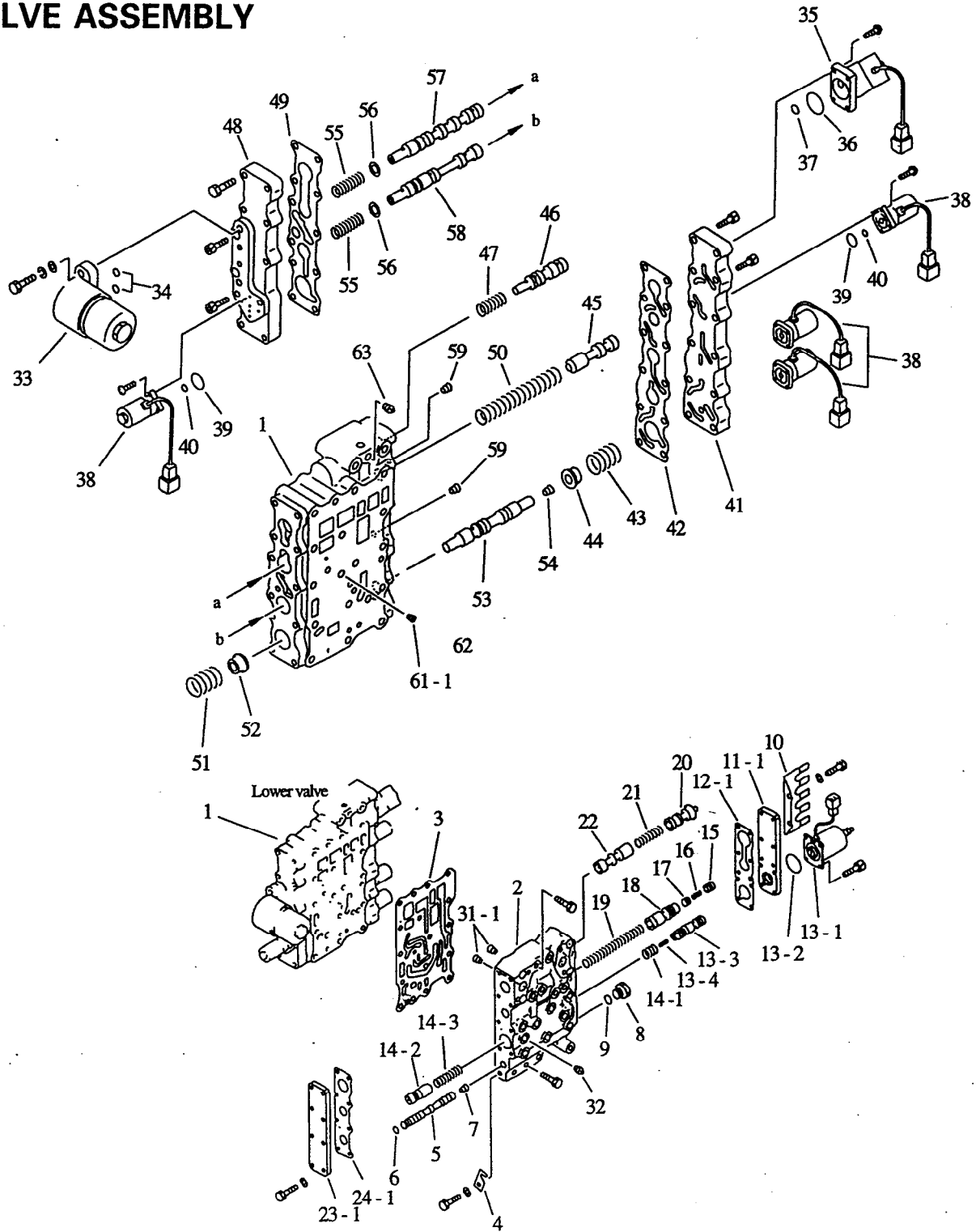
 Mounting bolt : **$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)**

 Set bolt : **$49 \pm 4.9 \text{ Nm}$ ($5.0 \pm 0.5 \text{ kgm}$)**



DLW01928

DISASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY

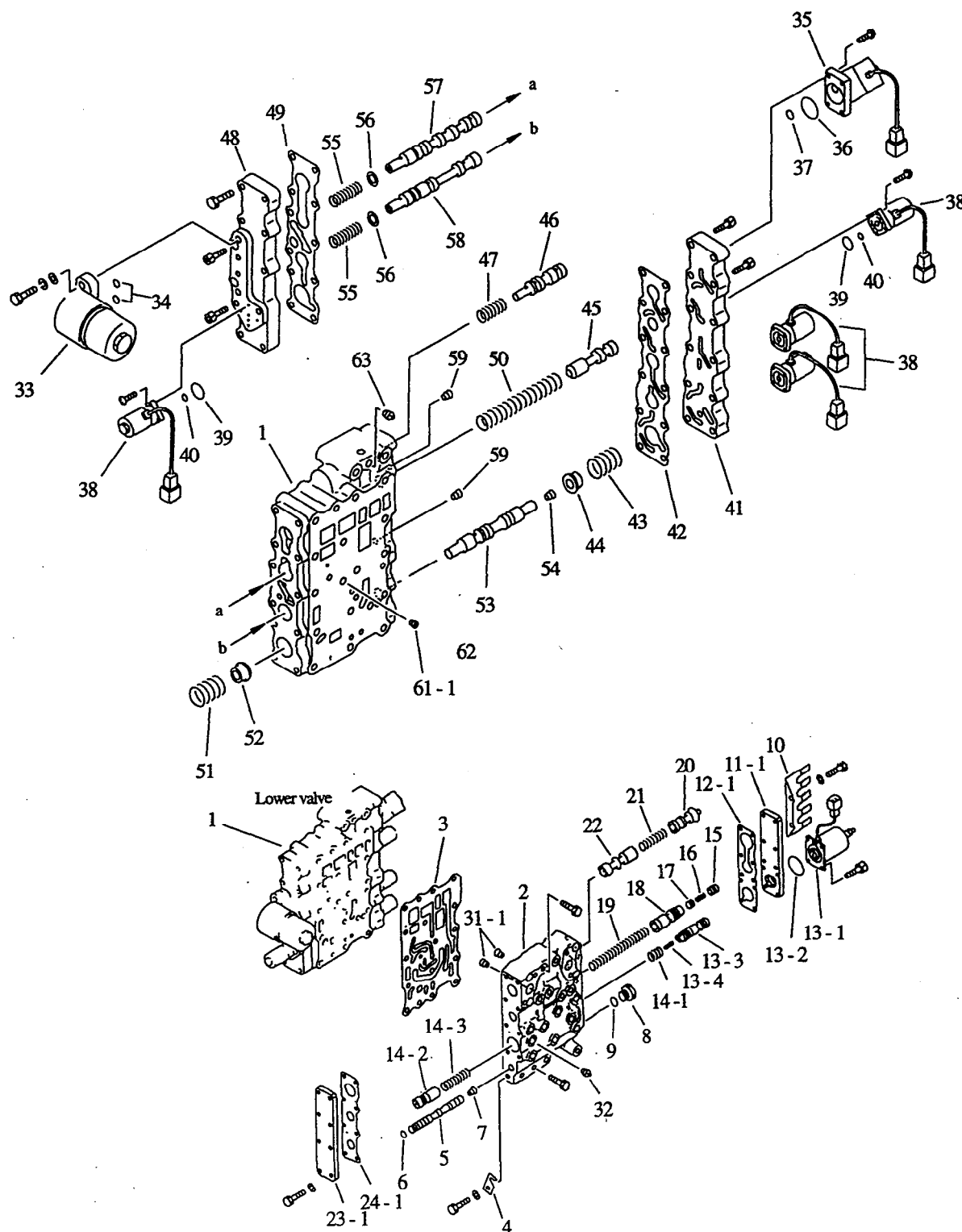


DBW01930

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1. Disconnection
Remove mounting bolts, then disconnect upper valve (2) from lower valve (1), and remove gasket (3).
2. Disassembly of upper valve
 - 1) Remove mounting bolts, remove lock plate (4), then remove manual valve (5).
 - 2) Remove O-ring (6) and orifice (7) from manual valve (5).
 - 3) Remove plug (8) and O-ring (9).
 - 4) Remove mounting bolts, then remove solenoid valve (13-1) and O-ring (13-2).
 - 5) Remove mounting bolts, then remove bracket (10), cover (11-1), gasket (12-1), modulating valve (13-3), modulating piston (13-4), and modulating spring (14-1).
 - 6) Remove valve (15), spring (16), valve (17), main relief valve (18), and mode spring (19).
★ Record the shim thickness.
 - 7) Remove dummy spool (20), torque converter out spring (21), and torque converter out valve (22).
 - 8) Remove mounting bolts, then remove cover (23-1), gasket (24-1), pilot valve (14-2), and spring (14-3).
 - 9) Remove orifice (31-1) and plug (32) from upper valve (2).
3. Disassembly of lower valve
 - 1) Remove mounting bolts, then remove pilot filter (33) and O-ring (34).
 - 2) Remove mounting bolts, then remove parking brake solenoid (35), and O-rings (36) and (37).
 - 3) Remove mounting bolts, then remove solenoid valve (38), and O-rings (39) and (40).
 - 4) Remove mounting bolts, then remove cover (41), gasket (42), F return spring (43), and sleeve (44).
 - 5) Remove priority valve (45).
 - 6) Remove brake valve (46) and return spring (47).
 - 7) Remove mounting bolts, then remove cover (48), gasket (49), and priority spring (50).
 - 8) Remove F return spring (51) and sleeve (52), then remove F-R valve (53).
 - 9) Remove plug (54) from F-R valve (53).
 - 10) Remove return spring (55) and spring spacer (56), then remove speed valve (57) and H-L valve (58).
 - 11) Remove orifice (59) and plugs (61-1) and (63) from lower valve (1).
★ When removing the orifice, check the assembly position and use for reference when assembling.

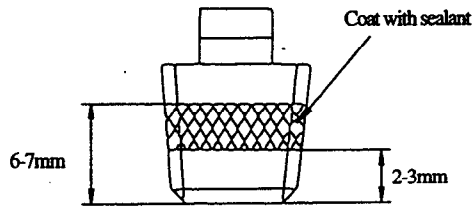
ASSEMBLY OF TRANSMISSION CONTROL VALVE ASSEMBLY



DBW01930

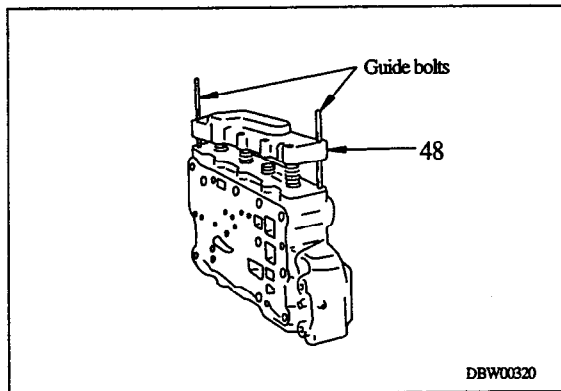
1. Assembly of lower valve

- 1) Install plug (63) to lower valve (1).

 Plug : Sealant (LG-1 or LG-5)


DLW00319

- 2) Install plug (61-1) and orifice (59) ($\phi 1.1$) to lower valve (1).
- 3) Install H-L valve (58), speed valve (57), spring spacer (56), and return spring (55) (L=48).
- 4) Install plug (54) to F-R valve (53), then assemble F-R valve, and install sleeve (52) and F return spring (51) (L=42).
- 5) Install priority spring (50) (L=150), set gasket (49) in position, then install cover (48).



DBW00320

 **kgm** Mounting bolt :
 $30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)

- ★ Install guide bolts.
- ★ Replace the gasket with a new part.

- 6) Install return spring (47) (L=46) and brake valve (46).
- 7) Install priority valve (45).
- 8) Install sleeve (44) and F return spring (43) (L=42), set gasket (42) in position, then install cover (41).

 **kgm** Mounting bolt :
 $30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)

- ★ Install guide bolts.
- ★ Replace the gasket with a new part.

- 9) Assemble O-rings (40) and (39) to solenoid valve (38), then install solenoid valve (38).

- ★ Check that there are no scratches, cracks, deformation, or any other deterioration in the O-rings.

- ★ Set the mounting angle of reverse solenoid valve (38) to 45° , then tighten the nut.

 **kgm** Mounting bolt :
 $1.62 \pm 0.15 \text{ Nm}$ ($0.165 \pm 0.015 \text{ kgm}$)

 **kgm** Solenoid nut :
 $12.5 \pm 4.7 \text{ Nm}$ ($1.275 \pm 0.475 \text{ kgm}$)

- 10) Fit O-rings (37) and (36) to parking brake solenoid (35), and install parking brake solenoid (35).

- ★ Check that there are no scratches, cracks, deformation, or any other deterioration in the O-rings.

 **kgm** Mounting bolt :
 $1.62 \pm 0.15 \text{ Nm}$ ($0.165 \pm 0.015 \text{ kgm}$)

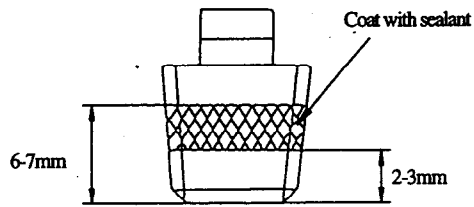
- 11) Assemble O-ring (34) to pilot filter (33), then install pilot filter (33).

- ★ Check that there are no scratches, cracks, deformation, or any other deterioration in the O-rings.

 **kgm** Mounting bolt :
 $66.2 \pm 7.4 \text{ Nm}$ ($6.75 \pm 0.75 \text{ kgm}$)

2. Assembly of upper valve

- 1) Install plug (32) to upper valve (2).

 Plug : Sealant (LG-1 or LG-5)


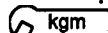
DLW00319

- 2) Install orifice (31-1) (ø4.0) to upper valve (2).

- 3) Assemble spring (14-3) and pilot valve (14-2), set gasket (24-1) in position, then install cover (23-1).

★ Install guide bolts.

★ Replace the gasket with a new part.

 kgm Mounting bolt :
 $30.9 \pm 3.4 \text{ Nm}$ ($3.15 \pm 0.35 \text{ kgm}$)

- 4) Install torque converter out valve (22), torque converter out spring (21) (L=65), and dummy spool (20).

- 5) Install mode spring (19) (L=163.5), main relief valve (18), valve (17), spring (16) (L=26) and valve (15).

★ Install the recorded shim thickness to the main relief valve, and set with the mode spring.

- 6) Assemble modulating spring (14-1), modulating piston (13-4), and modulating valve (13-3), then install gasket (12-1), cover (11-1), and bracket (10).

★ Coat the modulating piston with oil, then insert it in the modulating valve, and assemble the valve assembly.

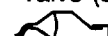
 Outside diameter of modulating piston : Transmission oil

- 7) Fit O-ring (13-2) in groove of solenoid valve (13-1), then set solenoid valve to upper cover (11-1), and tighten mounting bolts.

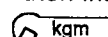
★ Be careful not to get the O-ring caught.

- 8) Fit O-ring (9) to plug (8), then install plug.

- 9) Install orifice (7) and O-ring (6) to manual valve (5).

 O-ring : Grease (G2-LI)

- 10) Install manual valve (5) to upper valve (2), then install lock plate (4).

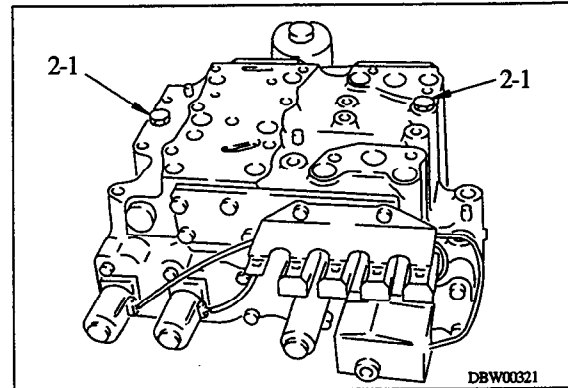
 kgm Mounting bolt :
 $53.9 \pm 19.6 \text{ Nm}$ ($5.5 \pm 2.0 \text{ kgm}$)

3. Connection

Set gasket (3) to lower valve (1), and assemble upper valve (2) with set bolts (2-1).

★ Install guide bolts.

★ Replace the gasket with a new part.

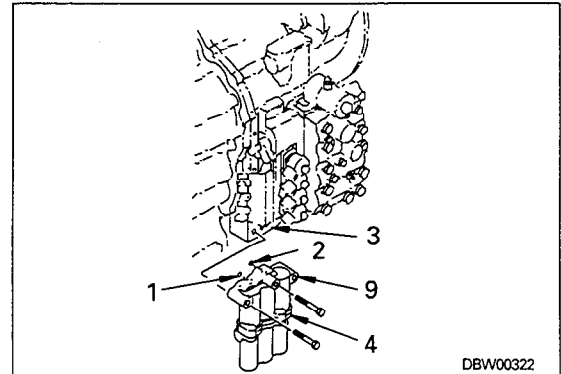
 kgm Set bolt : $49 \pm 4.9 \text{ Nm}$ ($5.0 \pm 0.5 \text{ kgm}$)


DBW00321

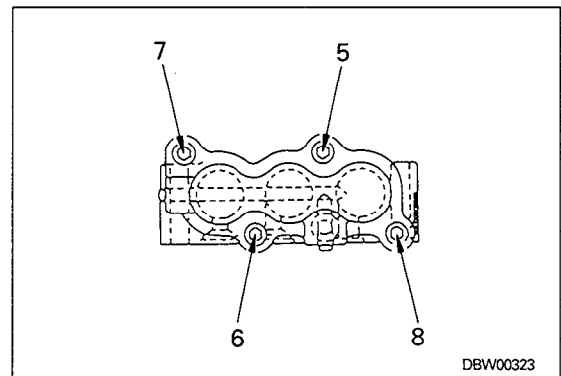
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DISASSEMBLY OF TRANSMISSION ACCUMULATOR VALVE ASSEMBLY

1. Remove accumulator valve (4) from transmission assembly (3).
2. Remove O-rings (1) and (2) from accumulator valve (4).
3. Using pads, set accumulator valve body (9) in vice.



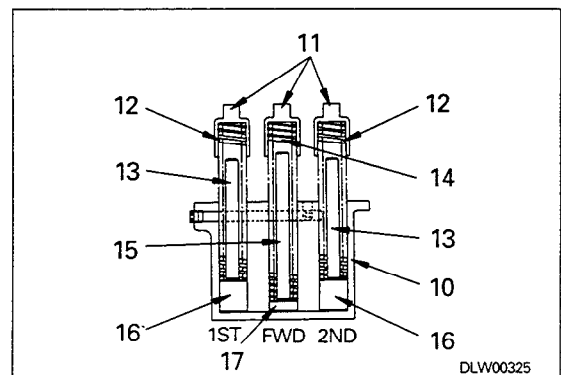
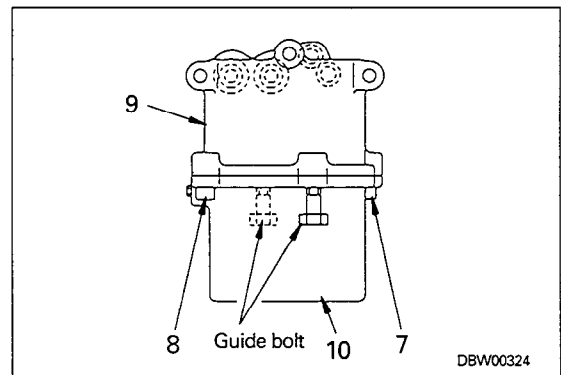
4. Remove mounting bolts (5) and (6), and assemble guide bolts.
 - M = 10, P = 1.5, L = Approx. 40 mm
5. Remove bolts (7) and (8), then remove cover (10) together with guide bolts.
 - ★ The internal parts will come off together with the cover, so be extremely careful not to damage them when removing.



6. Pull out valves (11), springs (12) and (14), stoppers (13) and (15), and spacers (16) and (17) from cover (10).
 - ★ Fit tags to each spring, stopper, spacer, and use for reference when assembling.

★ Reference

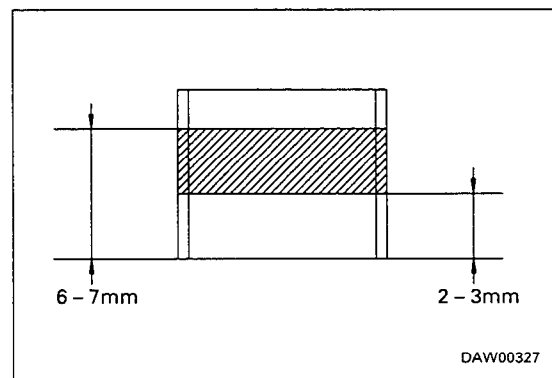
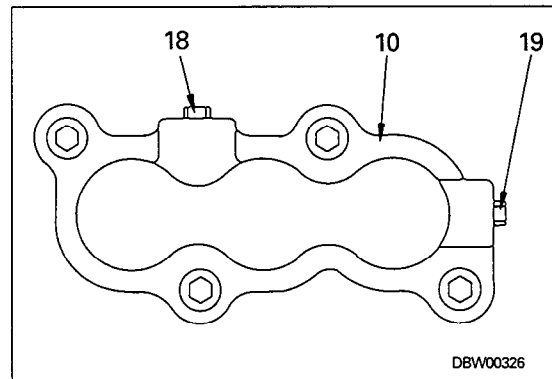
	Spring	Stopper	Spacer
FWD	$\ell = 184.8$	$\ell = 135.8$	$\ell = 10$
1ST	$\ell = 157.5$	$\ell = 110$	$\ell = 50$
2ND	$\ell = 157.5$	$\ell = 110$	$\ell = 50$



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7. Remove plugs (18) and (19) from cover (10).
 - Plug : 5 mm (width across flats)
 - ★ Do not remove the plugs unless necessary.
 - ★ If plugs (18) and (19) have been removed, coat the thread with thread tightener as shown in the diagram below, then tighten the plugs.
 - ★ Be careful not to let the thread tightener drip on to the hatched portion when coating with thread tightener.

 Plug : Thread tightener (LG-1)



ASSEMBLY OF TRANSMISSION ACCUMULATOR VALVE ASSEMBLY

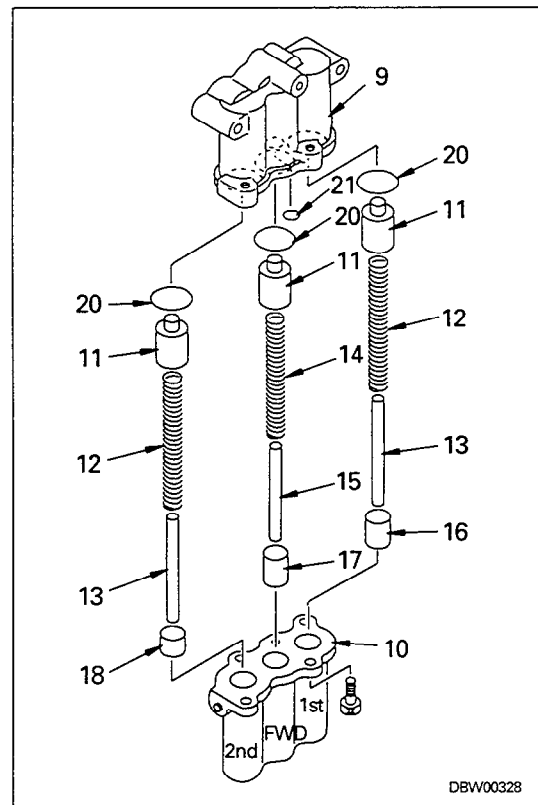
1. Using pads, set accumulator valve cover (10) in vice.
 - ★ Be careful not to tighten the vice on the cover with excessive force.
2. Assemble spacers (18), (17), and (16), stoppers (13), (15), and (13), and springs (12), (14), and (12) to accumulator valve cover (10), then insert valves (11) from top of each spring.
3. Fit O-rings (20) and (21) in each groove of accumulator valve body (9).
 - ★ Assemble the O-ring securely in the body groove.
4. Assemble accumulator valve body (9) perpendicularly from above cover (10), then temporarily install with guide bolts.
 - ★ Assemble the body carefully and be sure that the O-ring does not fall out.
5. Push in accumulator valve body (9), and remove guide bolts, then secure with standard bolt.



Mounting bolt :

$54 \pm 19.6 \text{ Nm}$ ($5.5 \pm 2.0 \text{ kgm}$)

- Mounting bolt : 8 mm (width across flats)

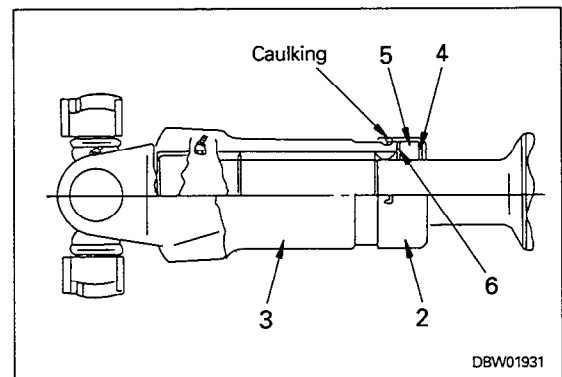
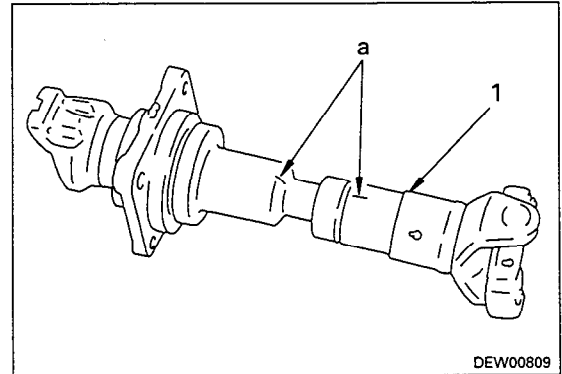


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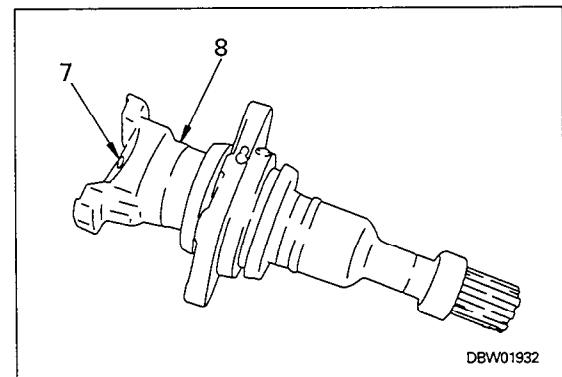
DISASSEMBLY OF DRIVE SHAFT ASSEMBLY

1. Front drive shaft

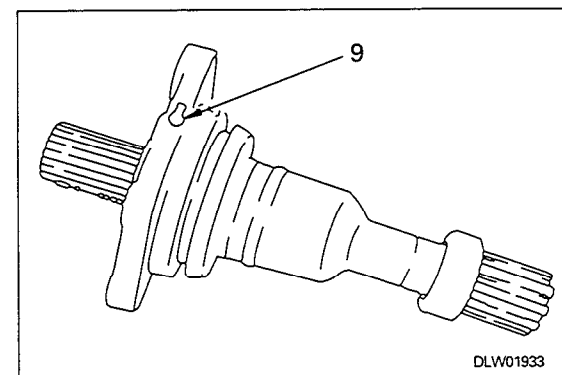
- 1) Remove coupling and tube (1).
 - ★ Make match marks **a** to prevent the coupling from being installed in the opposite direction.
 - ★ Cover (2) is caulked at 2 places with a punch, so do not remove it unless necessary.
 - If cover (2) was removed and the oil seal was replaced.
 - i) Remove cover (2).
 - ★ When removing cover (2), be careful not to damage cover (2) or tube (3).
 - ★ When removing the caulking, use a screwdriver to raise the caulked portion.
 - ii) Remove washer (4), oil seal (5) and washer (6).



- 2) Loosen bolt (7), and remove coupling (8) and retainer.
 - ★ Make match marks to prevent the coupling from being installed in the opposite direction.

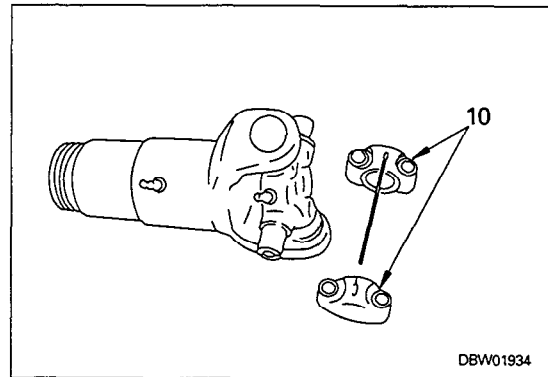


- 3) Using press, pull out flange bearing (9).

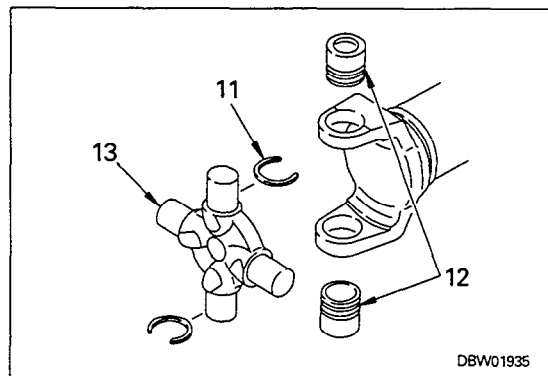


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- 4) Remove bearing cap (10) from spider.
★ Be careful not to lose the bearing inside bearing cap (10).



- 5) Remove ring (11) and bearing (12), then remove spider (13).

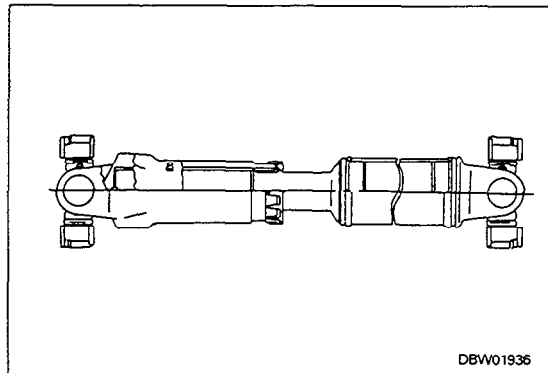


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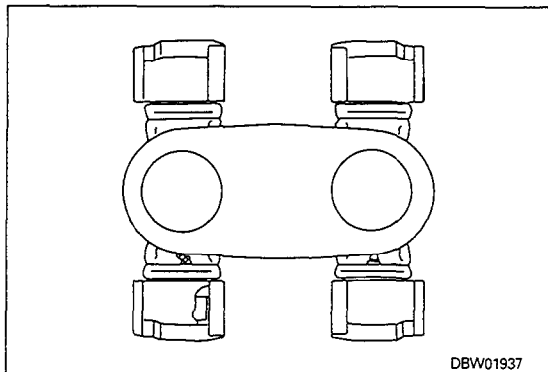
2. Center drive shaft, rear drive shaft

- 1) Carry out the same operation as in Step 1) for the front drive shaft.

Center drive shaft

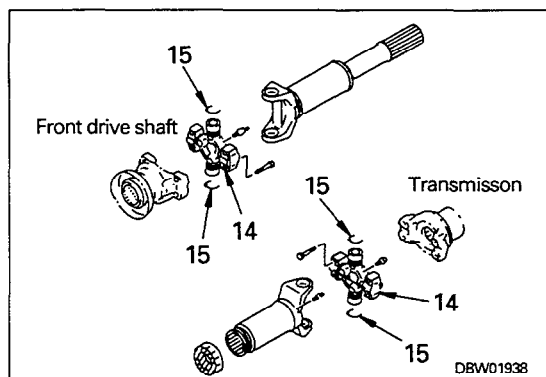


Rear drive shaft

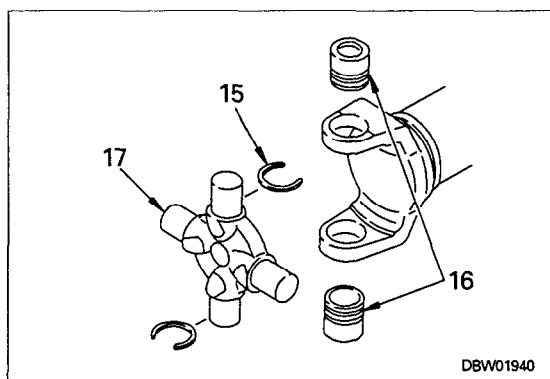
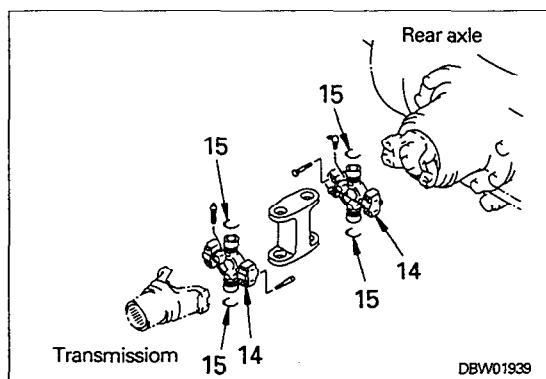


- 2) Remove bearing cap (14).
★ Be careful not to lose the bearing inside seal bearing cap (14).
- 3) Remove ring (15) and bearing (16), then remove spider (17).

Center drive shaft



Rear drive shaft

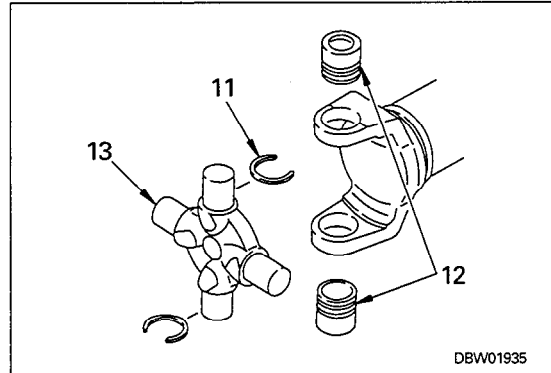


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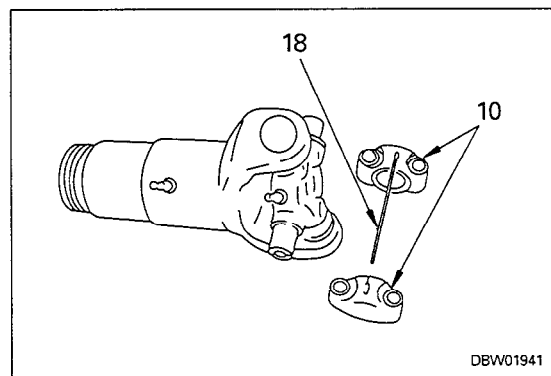
ASSEMBLY OF DRIVE SHAFT

1. Spider, bearing

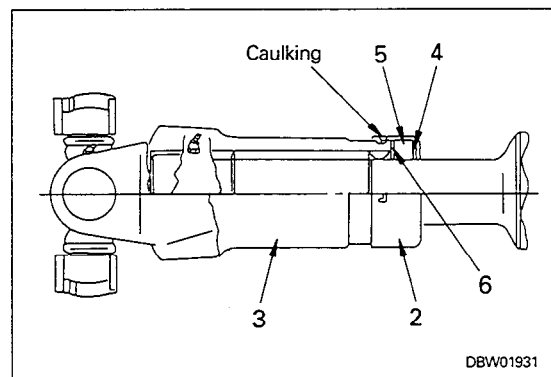
- 1) Set bearing (12) of spider (13) in mounting position, and after assembling spider (13), assemble ring (11), then install.
 - ★ Assemble so that the grease nipples are facing in the same direction.
 - ★ Use the same procedure for the front, center, and rear drive shafts.



- 2) Assemble seal bearing cap (10).
 - ★ Check that the bearing and washer are inside the bearing cap.
 -  **Bearing cap: Grease (G2-LI)**
 - ★ If the spider and bearing cap is worn, replace the spider and bearing as a set.
 - ★ When welding strap (18) of the cap, be careful not to damage the bearing with the heat.
 - ★ If cover (2) has been removed, do as follows.

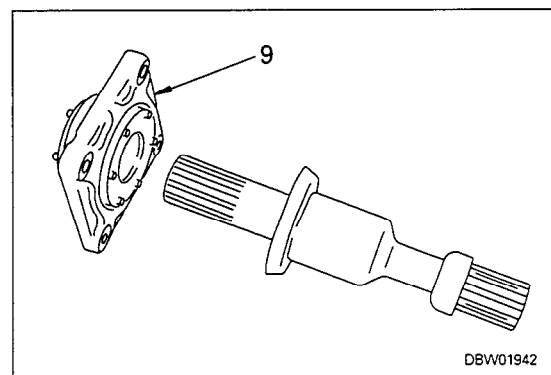


- 1) Insert seal (5) and washers (4) and (6) in cover (2) and tube (3), then assemble cover (2) and caulk with a punch at points on diametrically opposite sides.



2. Front drive shaft

- 1) Press fit flange bearing (9).
 - ★ Do not knock the flange bearing in directly with a hammer.



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- 2) Align match marks, and tighten coupling (8) and retainer (19) with mounting bolt (7).

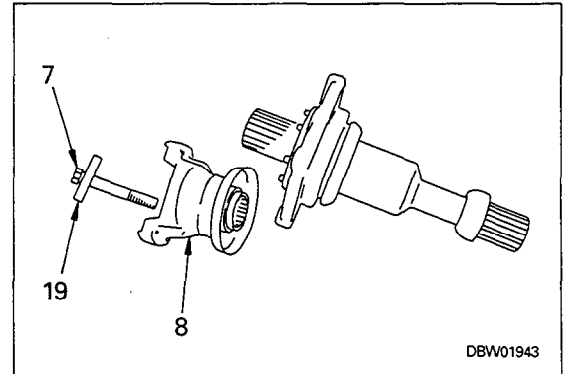
★ Tighten the bolt to the specified tightening torque after installing to the machine.



Spline portion: **Grease (G2-LI)**

Mounting bolt:

$276 \pm 29 \text{ Nm}$ ($28.2 \pm 3.0 \text{ kgm}$)



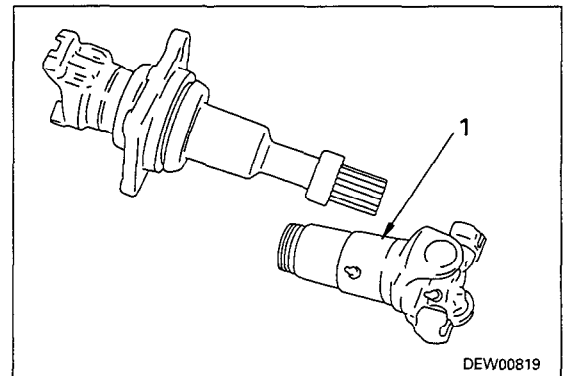
- 3) Align match marks, and install coupling and tube (1).

★ 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)**

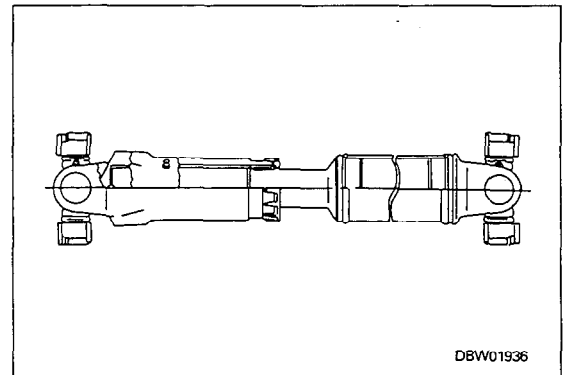


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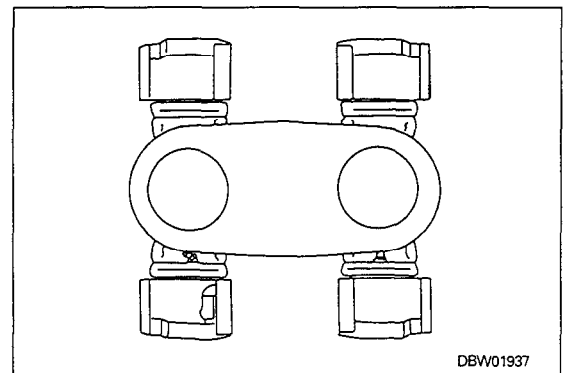
3. Center, rear drive shaft

- ★ Carry out the same operation as in Step 3) for the front drive shaft.

Center drive shaft



Rear drive shaft



REMOVAL OF FRONT AXLE ASSEMBLY

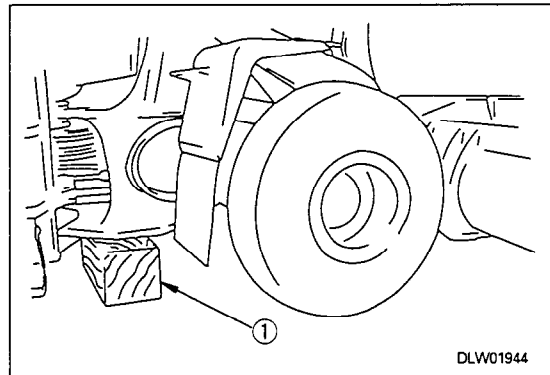
! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

1. Jacking up chassis

Jack up chassis and insert block ① under front frame.

※ 1

★ Jack up the front frame with the bucket, and set block ① in position when the tires are slightly off the ground.



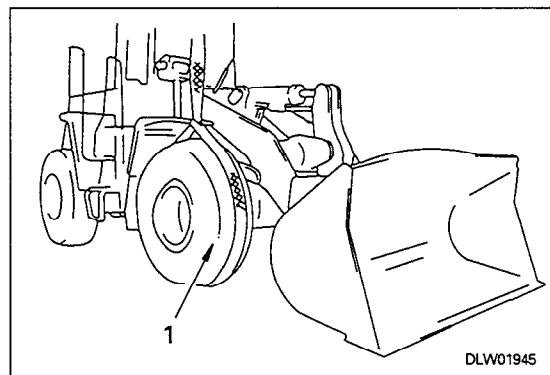
2. Tire, wheel

Put sling around tire (1), then remove mounting bolts and lift off.

※ 2



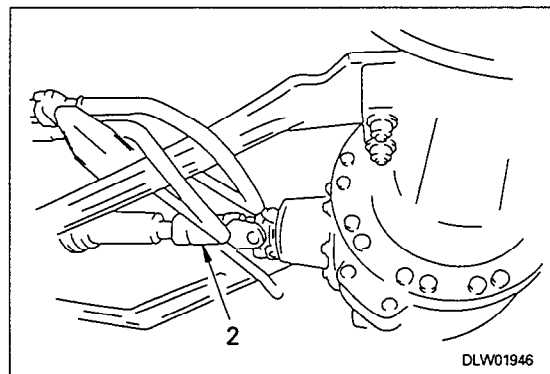
kg Tire, wheel : 317 kg



3. Drive shaft

Disconnect front drive shaft (2).

※ 3

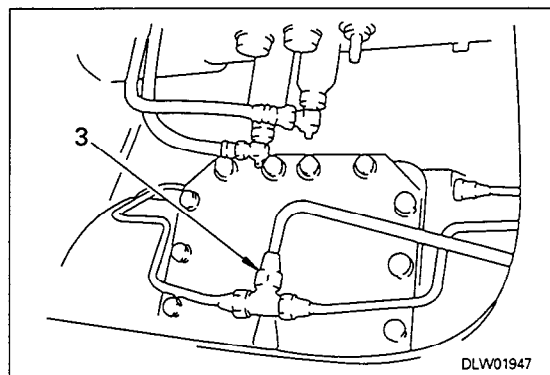
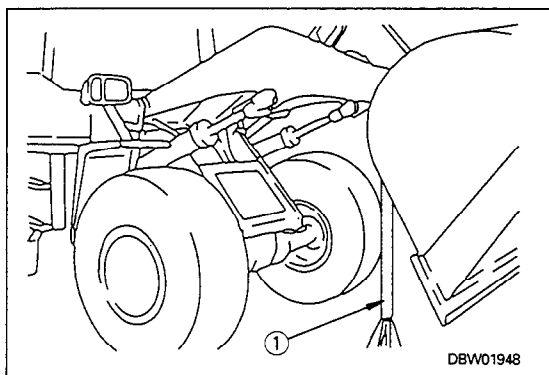


4. Axle

1) Disconnect brake tube (3).

※ 4

! When removing the front frame inspection cover and disconnecting the brake tube to carry out the operation, set support ① under the lift arm.



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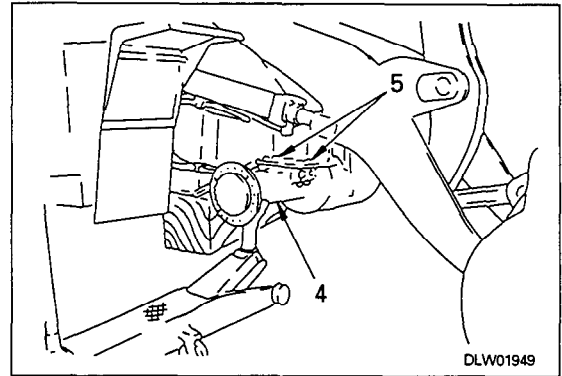
- 2) Using jack and hoist, sling axle (4), and remove mounting bolts (5), then lift off. ※ 5

⚠ When installing the nylon lifting tool, tighten the nylon rope fully. After removing the axle assembly, make sure that it does not fall.

- ★ Adjust the height of the jack, then remove the mounting bolts.

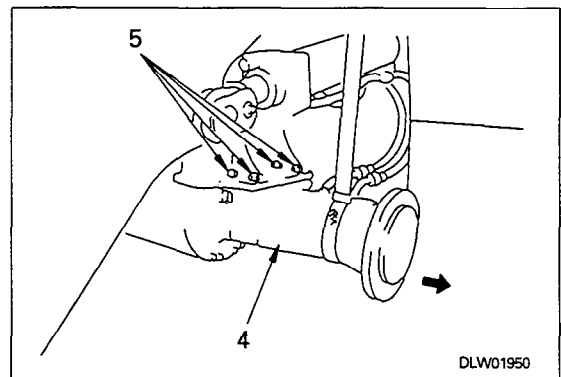


Axle : 1,060 kg (including oil 37ℓ)



- 3) Pull out axle from chassis in direction of arrow.

- ★ Use a hoist and jack for the operation.



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INSTALLATION OF FRONT AXLE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Raise the front frame with the bucket, and remove block ① when the frame is slightly raised.

※ 2

- ⌘ kgm Mounting bolt :
 $927 \pm 103 \text{ Nm}$ ($94.5 \pm 10.5 \text{ kgm}$)
(Width across flats : 36 mm)

※ 3

- ⌘ kgm Drive shaft mounting bolt :
 $110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)

※ 4

- ★ Be careful not to tighten the tube nut too far.

⌘ kgm Tube nut : **$80.9 \pm 12.3 \text{ Nm}$ ($8.25 \pm 1.25 \text{ kgm}$)**

※ 5

- ★ Use the bolt as a guide to align the mounting position.

⌘ kgm Mounting bolt :
 $132.4 \pm 14.7 \text{ Nm}$ ($13.5 \pm 1.5 \text{ kgm}$)
(Width across flats : 41 mm)

- Bleed the air from the brake system and carry out an actuation check.
 - ★ For details, see TESTING AND ADJUSTING, Bleeding air.

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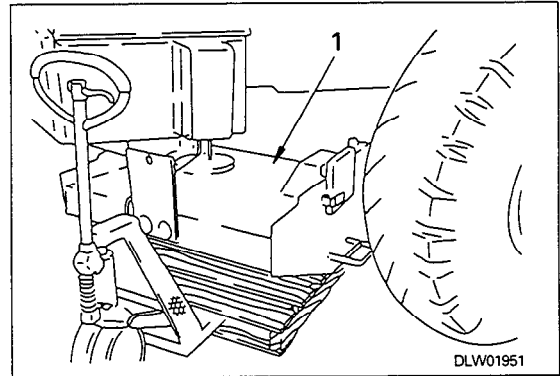
REMOVAL OF REAR AXLE ASSEMBLY

⚠ 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.

1. Fuel tank

Remove fuel tank (1).

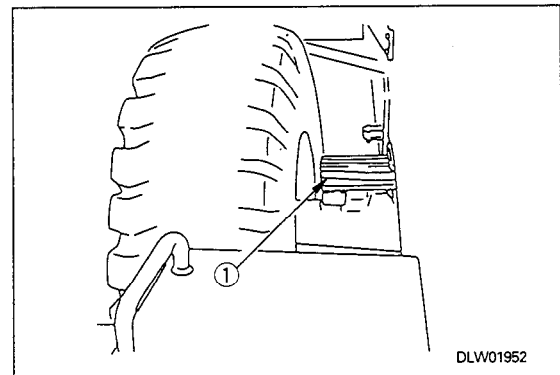
For details, see REMOVAL OF FUEL TANK ASSEMBLY.



2. Jacking up chassis

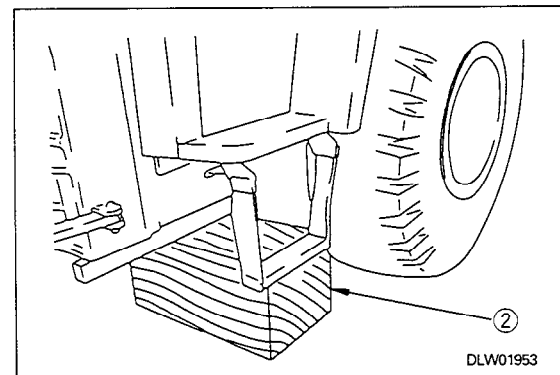
1) Set blocks ① between left and right rear axles and rear frame.

★ Set the blocks so that the angle of the tire angle on the opposite side does not change when the tire assembly is removed.



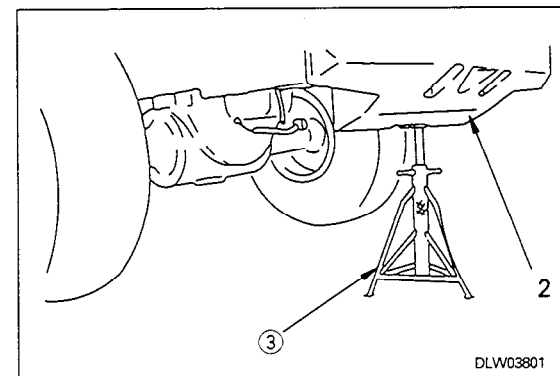
2) Jack up chassis and insert block ② under rear frame.

★ Jack up the rear frame with a garage jack, and set block ② in position when the tires are slightly off the ground.



3) Set support ③ under counterweight (2).

★ Set the support securely so that it does not come out when the tire assembly is removed.



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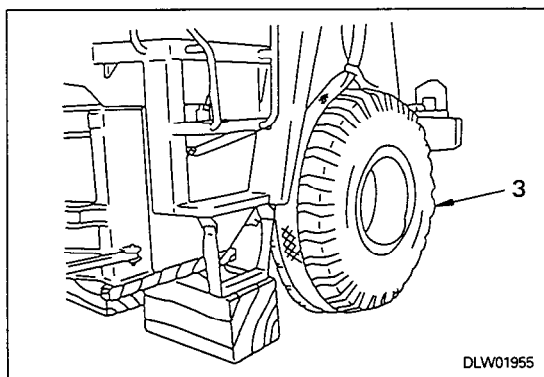
3. Tire, wheel

Put sling around tire (3), then remove mounting bolts and lift off.

※ 1



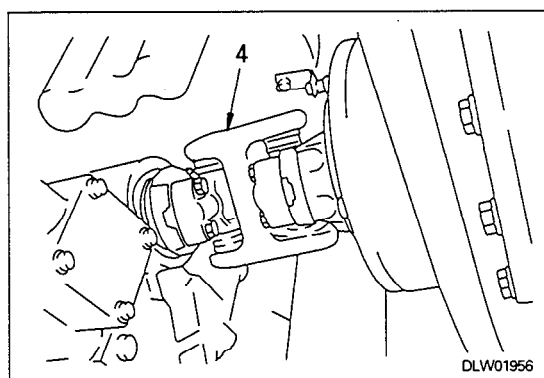
Tire, wheel : 317 kg

**4. Drive shaft**

Remove rear drive shaft (4).

※ 2

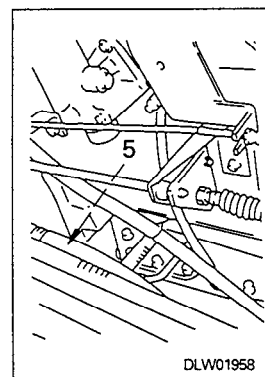
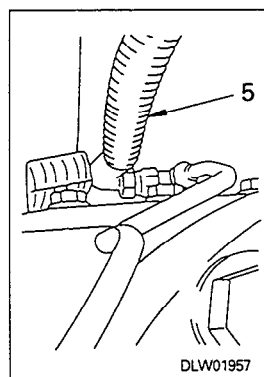
★ Make match marks to show the mounting position.

**5. Brake, grease tubes**

1) Disconnect brake hose (5).

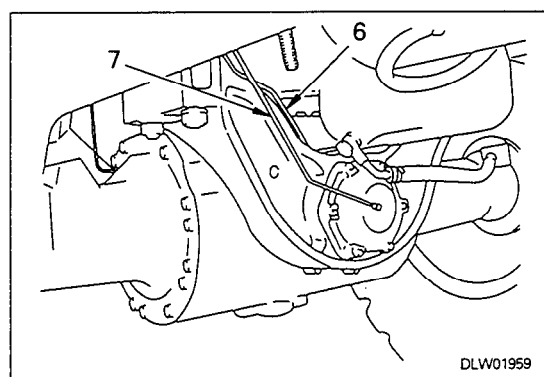
※ 3

★ Disconnect this brake hose from the connection with the tube at the left side of the engine compartment.



2) Remove grease tubes (6) and (7).

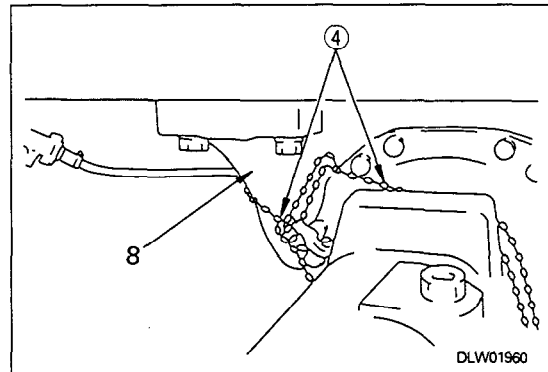
★ Remove the clamps of the grease tubes from the inside right of the engine compartment at the rear frame.



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6. Axle

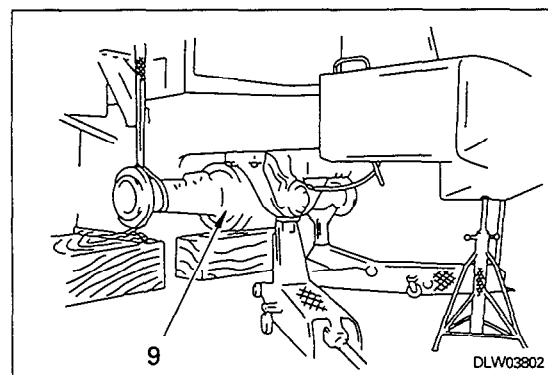
- 1) Secure rear pivot (8) to axle with chain ④ or wire.
 - ★ Fix the pivot securely so that it does not move.
 - ★ When removing the axle assembly, fit a cover to the coupling to prevent damage to the dust seal and bushing at the front pivot.



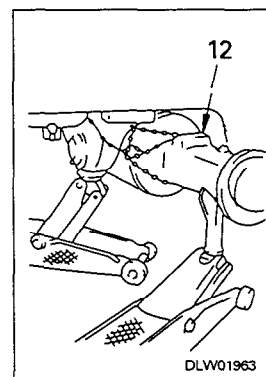
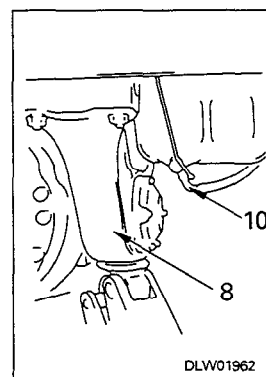
- 2) Sling one side of axle (9) and set a garage jack under axle housing on opposite side, then remove mounting bolts. ※ 4
 - ★ Adjust the height of the garage jack and remove the axle.
 - ★ When removing the axle, the pivot will go down, so support it with a garage jack.



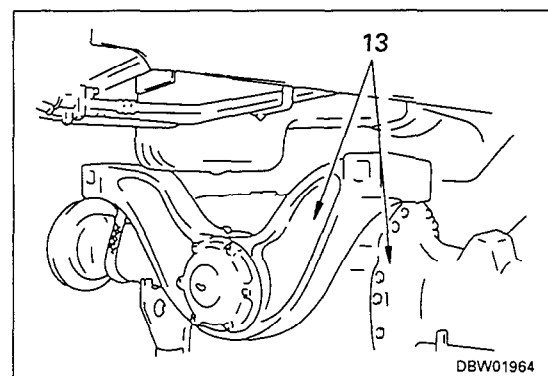
Rear axle, pivot : 1,100 kg



- 3) Lower rear pivot (8) a little at a time, taking care not to let it hit engine oil drain tube (10), move to the rear, then remove from front pivot (12).
 - ★ Be careful not to lower the rear pivot too far. It is lowered too far, there is danger that it will damage the dust seal and bushing at the front pivot.



- 4) Pull out axle and pivot assembly (13) from under chassis.
 - ★ Use a hoist and jack for the operation.
 - ★ After pulling the assembly out from the chassis, remove chain ④ or the wire used to hold it.



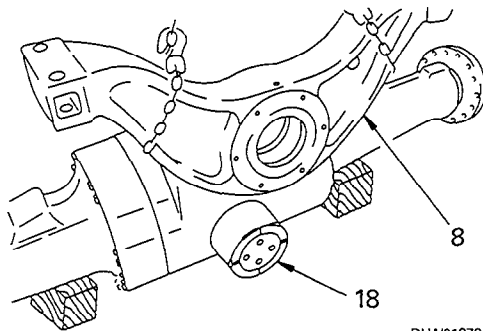
U42303

7. Rear pivot

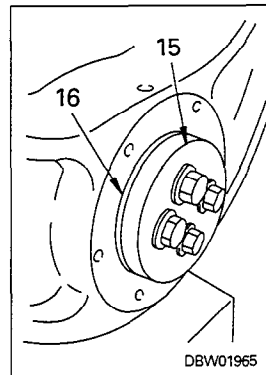
- 1) Remove trunnion cap (14). ※ 5
- ★ Sling the rear pivot.
- 2) Remove mounting bolts, then remove thrust plate (15) and thrust washer (16). ※ 6
- 3) Remove plate (17).
- 4) Lift off rear pivot (8), and remove thrust washer (18).
★ Be careful to fit the lifting tool so that it will not come off, then lift off carefully.



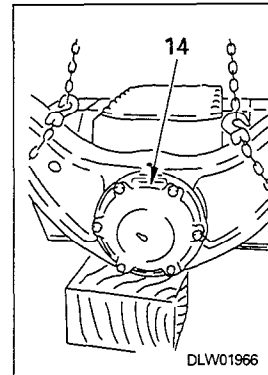
Rear pivot : 120 kg



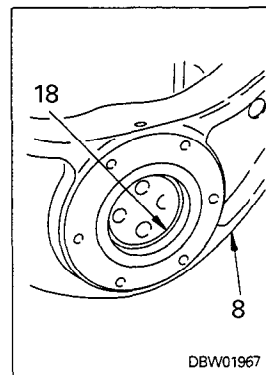
DLW01970



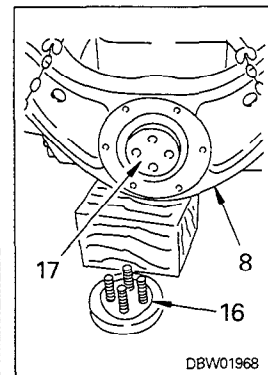
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DLW01966



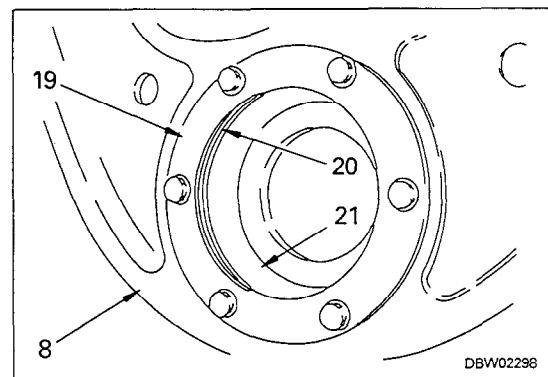
DBW01967



DBW01968

- 5) Remove retainer (19) from rear pivot, then remove packing (20) from retainer. ※ 7

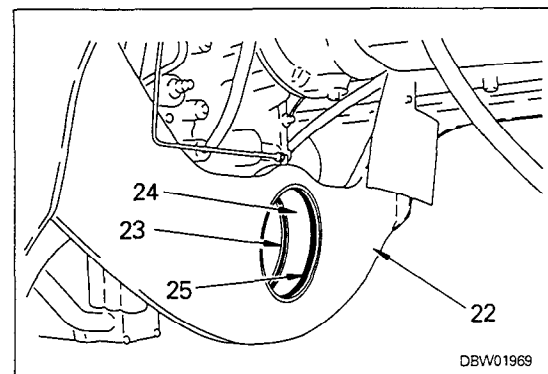
- 6) Remove bushing (21) from rear pivot (8). ※ 8



DBW02298

8. Front pivot

- 1) Remove retainer from front pivot (22), then remove packing (23) from retainer. ※ 9
- 2) Remove bushing (24) from front pivot, then remove dust seal (25). ※ 10



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INSTALLATION OF REAR AXLE ASSEMBLY

Carry out installation in the reverse order to removal.

※ 1

Mounting bolt :
 $927 \pm 103 \text{ Nm}$ ($94.5 \pm 10.5 \text{ kgm}$)
 (Width across flats: 36 mm)

※ 2

- ★ Align the match marks, and take care to assemble the coupling facing in the correct direction.
- ★ Align the pilot portion securely and take care to assemble with the yoke facing in the correct direction.

 **kgm** Mounting bolt :
 $110.3 \pm 12.3 \text{ Nm}$ ($11.25 \pm 1.25 \text{ kgm}$)

※ 3

- ★ Be careful not to tighten the tube nut too far.

 **kgm** Tube nut : $80.9 \pm 12.3 \text{ Nm}$ ($8.25 \pm 1.25 \text{ kgm}$)

※ 4

- ★ Use the bolt as a guide to set to the mounting position.
- ★ When tightening the mounting bolts, do not tighten in one step. Divide the torque and tighten in three steps.
- ★ After installing the axle assembly, remove the chain or wire.

 **kgm** Mounting bolt :
 $1,324 \pm 147 \text{ Nm}$ ($135.0 \pm 15.0 \text{ kgm}$)
 (Width across flats : 41 mm)

※ 5

 **kgm** Mounting bolt :
 $108 \pm 14.7 \text{ Nm}$ ($11.0 \pm 1.5 \text{ kgm}$)

※ 6

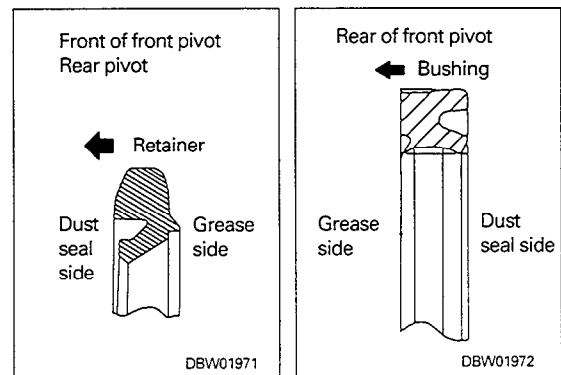
- ★ Wash and remove all oil and grease from the mounting bolts and bolt hole.
- ★ Coat the mounting bolts with thread tightener.

 Mounting bolt : **Thread tightener (LT-2)**

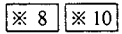
※ 7 ※ 9 ※ 10

- ★ Check the assembly direction of the packing and dust seal.

 Packing, dust seal : **Grease (G2-LI)**



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Bushing : **Grease (G2-LI)**

- **Bleeding air from brake system**
For details, see TESTING AND ADJUSTING.
- **Greasing**
Grease each pivot well.
★ Wipe off any grease that is squeezed out.

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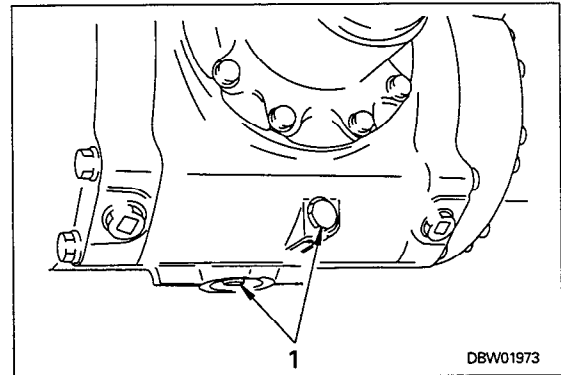
DISASSEMBLY OF DIFFERENTIAL ASSEMBLY

1. Draining oil

Remove drain plugs (1), and drain oil.



Axle oil : 37 ℓ



2. Axle assembly

1) Set axle assembly (2) on pallet.

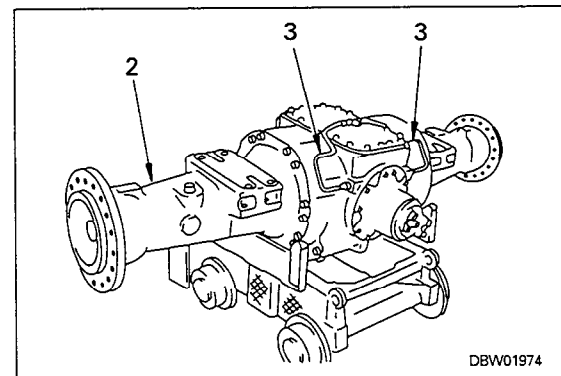


Axle assembly : 1,021 kg (front)



Axle assembly : 971 kg (rear)

2) Remove brake tubes (3).



3. Differential cover

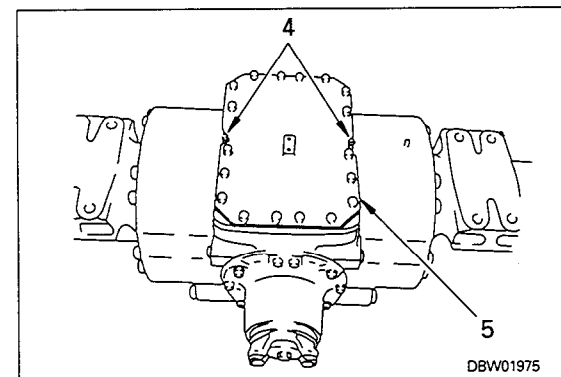
Remove bleeder screws (4), then remove differential cover (5).

4. Axle housing

1) Sling axle housing assembly (6), and remove housing mounting bolts.

★ Make match marks on the housings to prevent mistakes between the left and right axle housings.

★ Set blocks to prevent the assembly from tilting when the housing assembly on one side is removed.



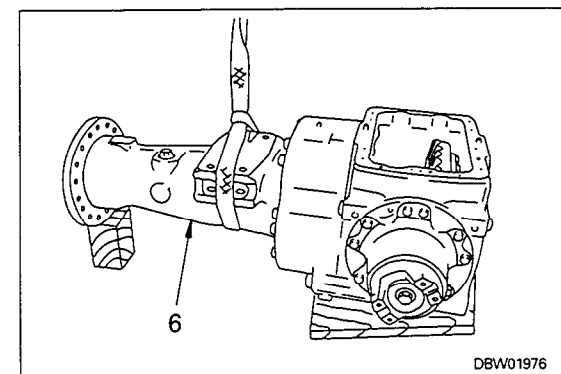
2) Lift off axle housing assembly (6).



Axle housing assembly : 280 kg (front)



Axle housing assembly : 270 kg (rear)



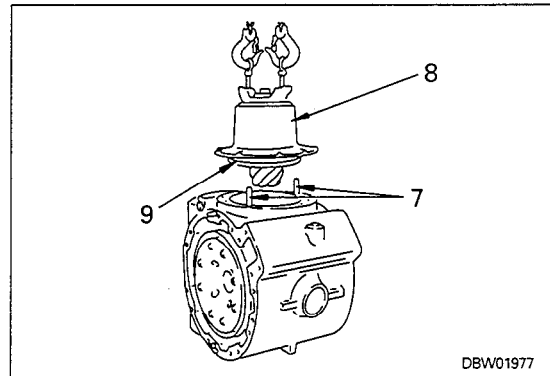
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5. Cage

- 1) Screw in forcing screws, and using guide bolts (7) (16 mm, P=2, L=50mm), remove cage assembly (8).
 - ★ Check the number of shims and use as reference when assembling.
 - ★ Loosen the mounting bolts of the coupling, and fit temporarily.

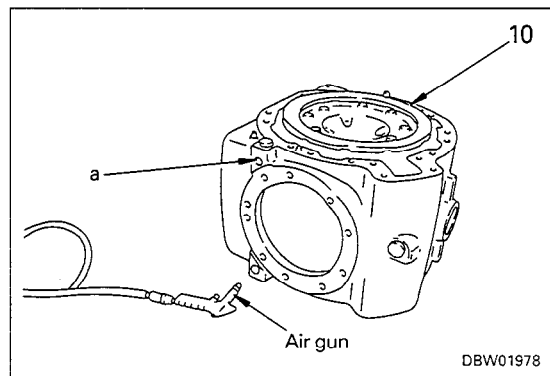
Cage assembly : **46 kg**

- 2) Remove O-ring (9) from cage.

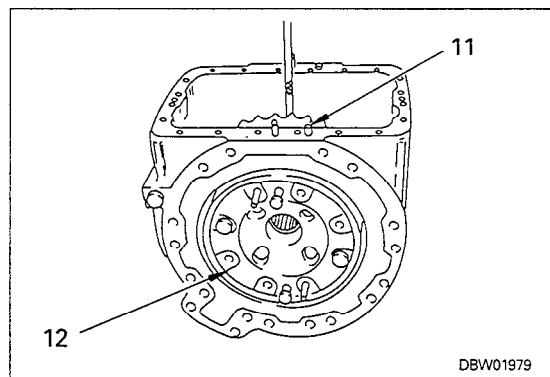
**6. Brake piston**

Install bleeder screw, blow in compressed air from portion **a**, raise housing and piston (10), and remove.

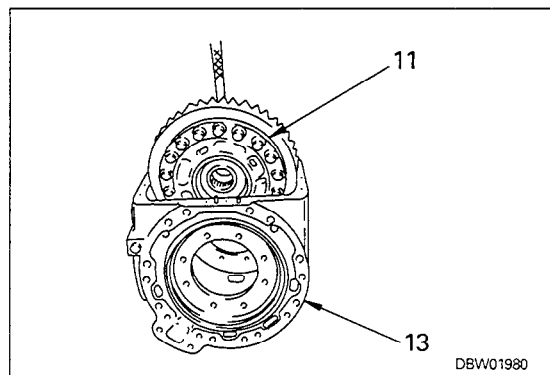
- ★ If the D-ring is damaged, blow in air suddenly to make a gap between the housing and piston, then use a screwdriver to lever it out and remove it.
- ★ When removing the piston, be careful not to damage the housing and piston surface.

**7. Bearing carrier assembly**

- 1) Sling differential carrier assembly (11), and screw in forcing screws, raise evenly, and remove bearing carrier (12).
- 2) Remove square ring and D-ring.
 - ★ Check the number of shims and use as reference when assembling.
 - ★ Make marks to distinguish between the left and right bearing carriers.
 - ★ Fit the sling around the flange half, then raise.
 - ★ Use a puller to remove the bearing cone from the bearing carrier.
 - ★ Use a puller to remove the bearing cone from the bearing carrier.

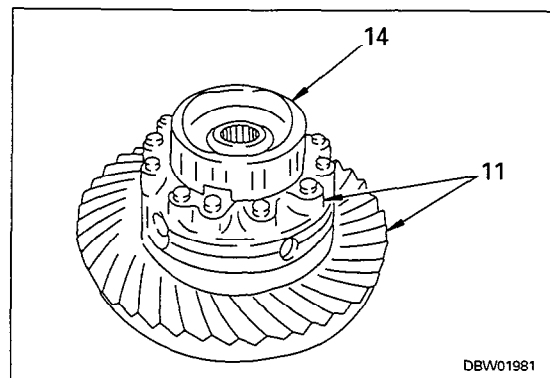
**8. Differential carrier assembly**

- 1) Lift off differential carrier assembly (11) from differential housing (13).
 - ★ Be extremely careful not to let the lifting tool come off when removing.

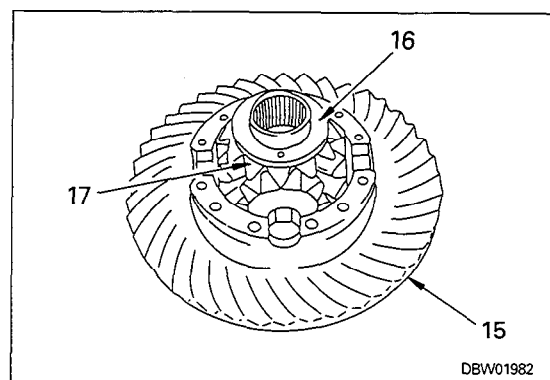
Differential carrier assembly : **120 kg**

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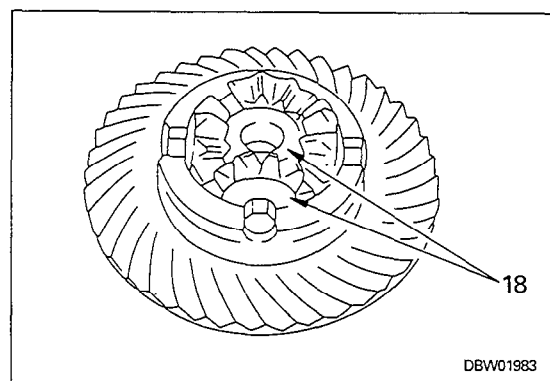
- 2) Remove plain half (14) from differential carrier assembly (11).
★ Check the match marks on the carrier assembly and flange half.



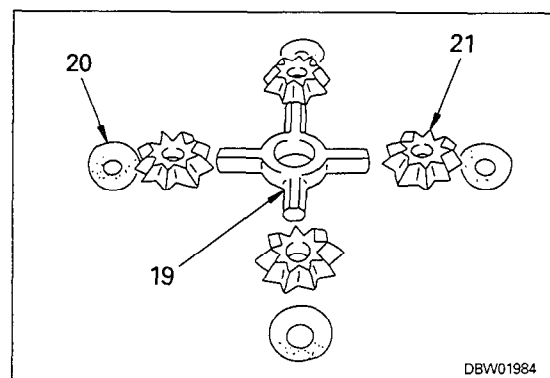
- 3) Remove thrust washer (16) from bevel gear and flange half assembly (15), then remove side gear (17).



- 4) Remove spider shaft, pinion shaft, and spherical washers (18).

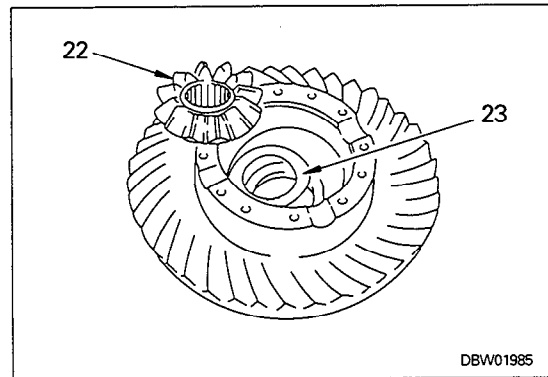


- 5) Remove spherical washers (20) and pinion gears (21) from spider shaft (19).



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- 6) Remove side gear (22) and thrust washer (23).



- 7) Turn over bevel gear and flange half assembly (15), then remove mounting bolts (24), and remove flange half (25).



Bevel gear, flange half assembly : **50 kg**

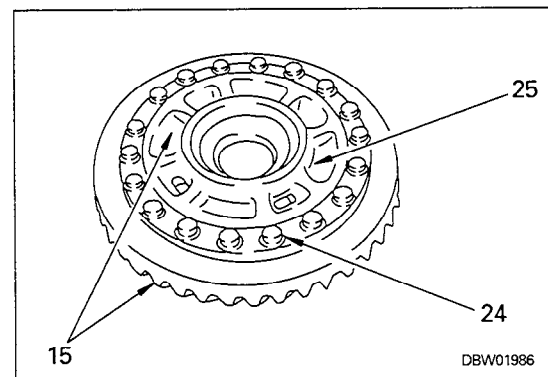


Bevel gear : **24 kg**



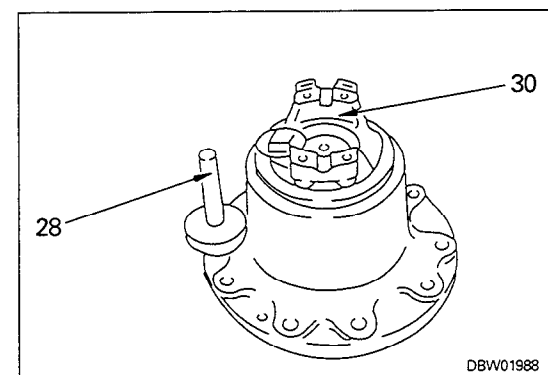
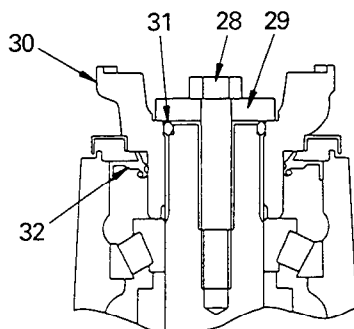
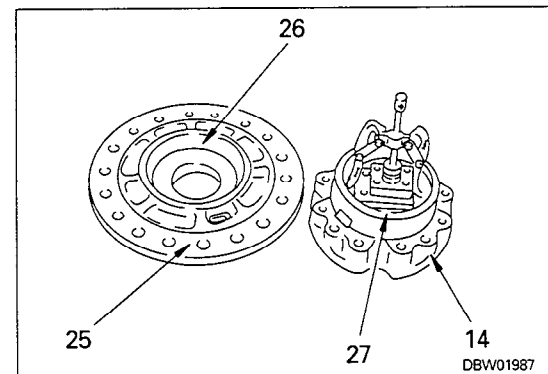
Flange half : **25 kg**

- 8) Use a puller to pull out bearing cups (26) and (27) from plain half (14) and flange half (25).



9. Coupling

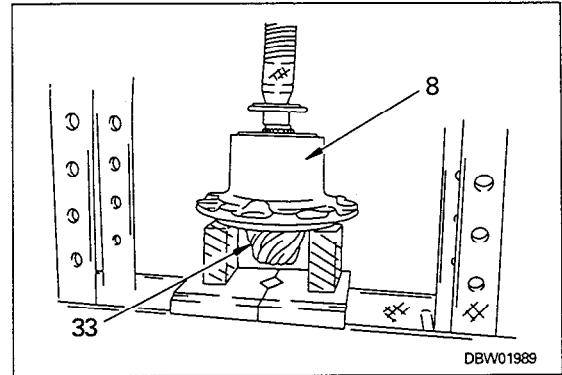
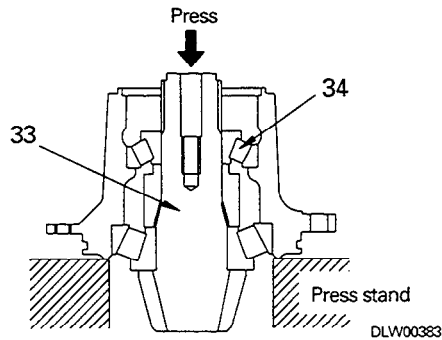
- 1) Remove mounting bolt (28), then remove holder (29), coupling (30), and O-ring (31).
 - ★ Do not remove the protector press fitted to the coupling unless necessary.
- 2) Remove oil seal (32).



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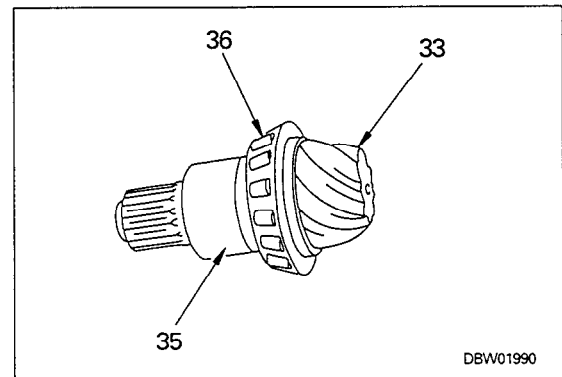
10. Pinion gear

- 1) Using press, pull out pinion gear (33) from cage assembly (8), then remove bearing cone (34).



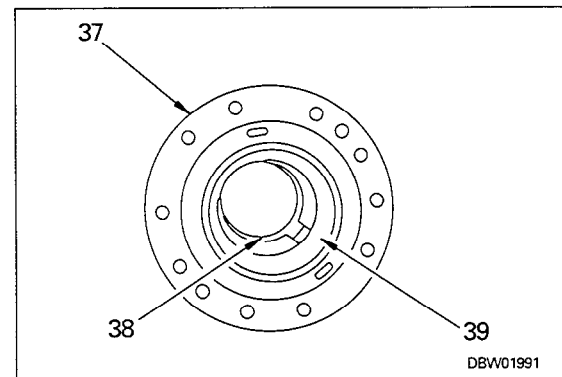
- ★ Be careful not to let the bearing catch on the press stand when removing.

- 2) Remove spacer (35) and bearing cone (36) from pinion gear (33).



11. Cage

- Remove bearing cups (38) and (39) from cage (37).



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ASSEMBLY OF DIFFERENTIAL ASSEMBLY

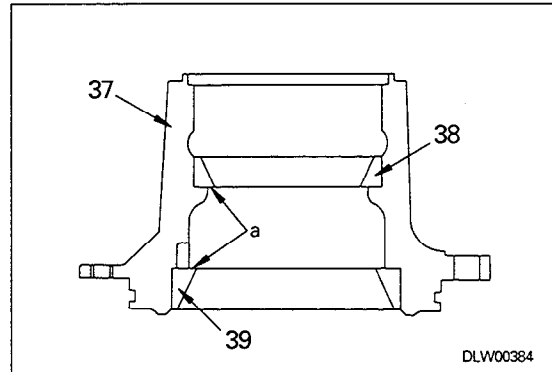
1. Cage

Press fit bearing cups (39) and (38) to cage (37).

★ After press fitting the cup, check that there is no clearance at portion a.

★ Coat the cup press-fitting portion with oil.

 Cup press-fitting portion : **Oil (axle oil)**



2. Pinion gear

1) Press fit bearing cone (36) to pinion gear (33), and assemble spacer (35).

★ Check that there is no clearance at the mating surface of each part.

2) Assemble pinion gear (33) to cage (37), and press fit bearing cone (34).

★ Use a press to apply pressure at the specified load to the bearing, and rotate the case to settle the bearing.

★ Press load : 145 kN (14.8 ton)

 Bearing : **Oil (axle oil)**

★ Reference

- Starting turning force (A): Max. 62 N (6.3 kg)

- End play : 0 – 0.187 mm

★ When the case has been rotated at the specified load, check that it can be rotated smoothly by hand.

★ If the rotation is heavy, replace the bearing and spacer, then check again.

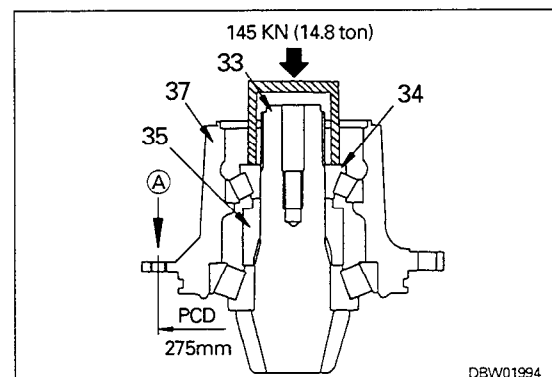
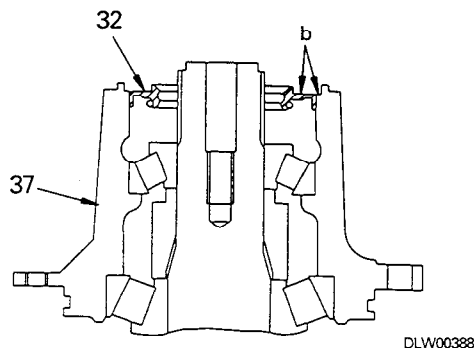
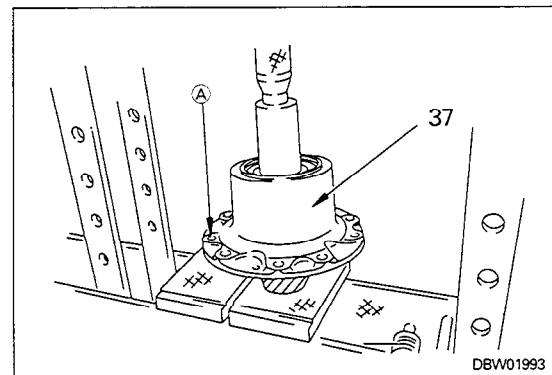
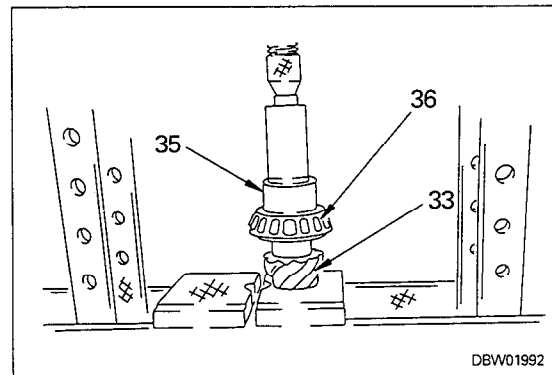
3) Coat seal press-fitting portion of cage (37) with gasket sealant, then press fit oil seal (32).

★ Press fit so that the oil seal is level with the surface of portion b.

 Oil press-fitting portion :

Gasket sealant (Seal end 242)

 Lip of oil seal : **Grease (G2-LI)**



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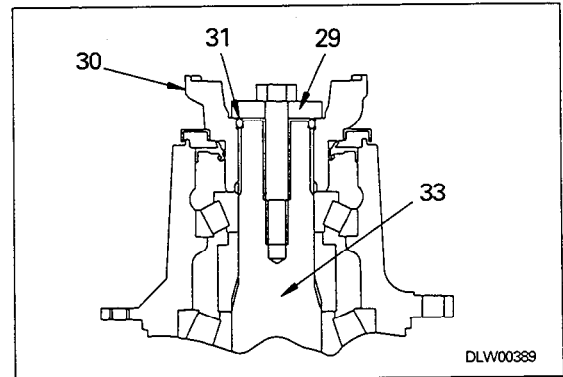
3. Coupling

Install coupling (30), O-ring (31), and holder (29) to pinion gear (33), and tighten mounting bolts.

- ★ Tighten the mounting bolts temporarily, and tighten fully after assembling.
- ★ When inserting the coupling, be extremely careful not to damage the seal.

 Mounting bolt : **Thread tightener (LT-2)**
(When tightening fully)

 Mounting bolt : **549 ± 59 Nm (56.0 ± 6.0 kgm)**

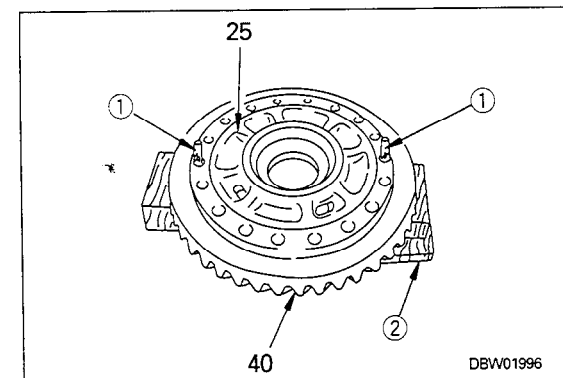
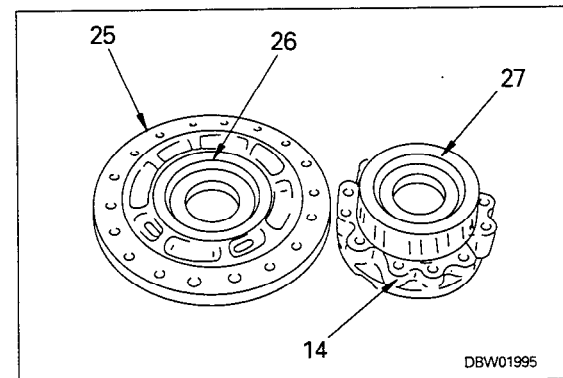
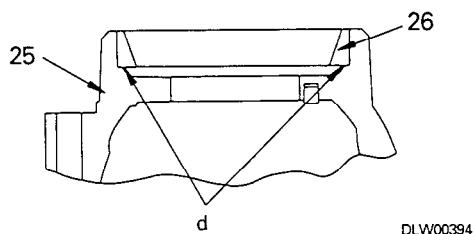
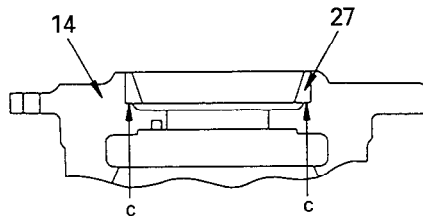


4. Differential carrier assembly

- 1) Press fit bearing cups (27) and (26) to plain half (14) and flange half (25).

- ★ After press fitting the cups, check that there is no clearance at portions **c** and **d**.

 Bearing cup press-fitting portion : **Oil (axle oil)**

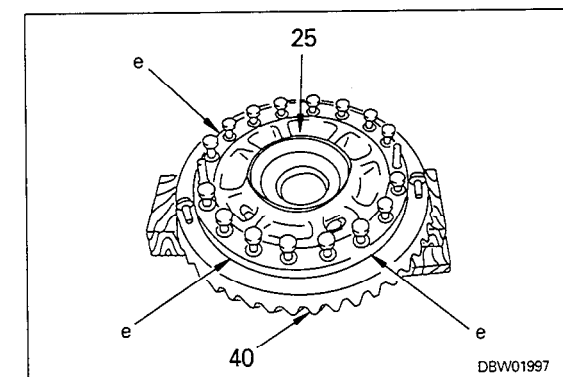


- 2) Set bevel gear (40) on block ② with gear side at bottom, then install guide bolts ① (Thread dia. = 14mm, Pitch = 2mm, Length = 55mm).

- ★ Check that there is no clearance at mating portion **e** of flange half (25) and bevel gear (40).
- ★ Wash and remove all oil and grease from the threaded hole of the bevel gear.
- ★ Tighten the mounting bolts on diametrically opposite sides.

 Mounting bolt : **Thread tightener (LT-2)**

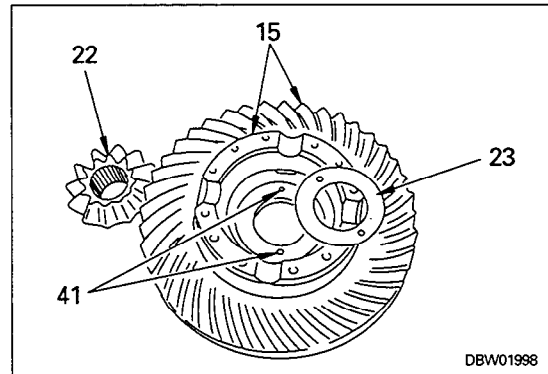
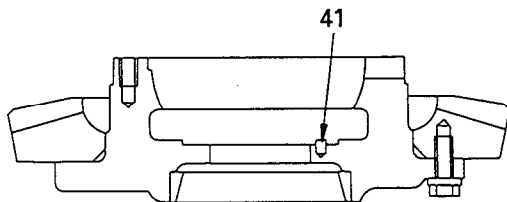
 Mounting bolt : **176.5 ± 19.6 Nm (18.0 ± 2.0 kgm)**



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- 3) Turn over bevel gear and flange half assembly (15), align with dowel pins (41), install thrust washer (23), coat with thrust washer oil, then assemble side gear (22).

★ When assembling the thrust washer, be careful not to assemble it upside down.



DLW00398

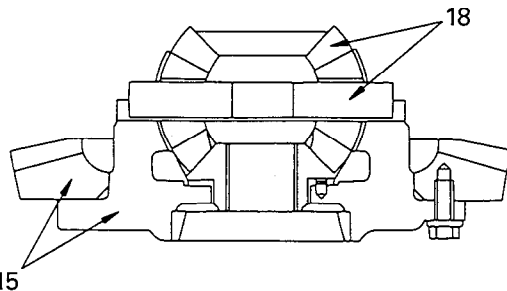
 Thrust washer sliding surface :
Oil (axle oil)

- 4) Coat spider shaft (19) with oil, assemble pinion gears (21), then assemble spherical washers (20).

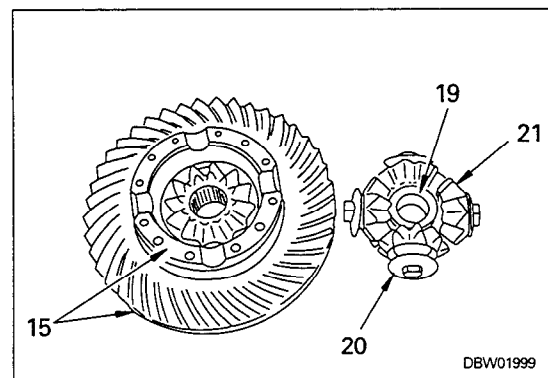
 Spider shaft : **Oil (axle oil)**

 Spherical washer : **Oil (axle oil)**

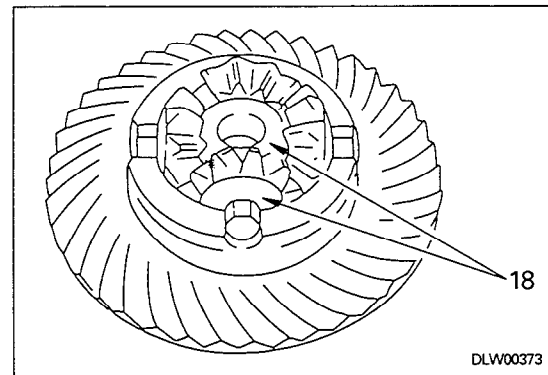
- 5) Assemble spider shaft, pinion gear, and spherical washer (18), then assemble to bevel gear and flange half assembly (15).



DLW00399



DBW01999



DLW00373

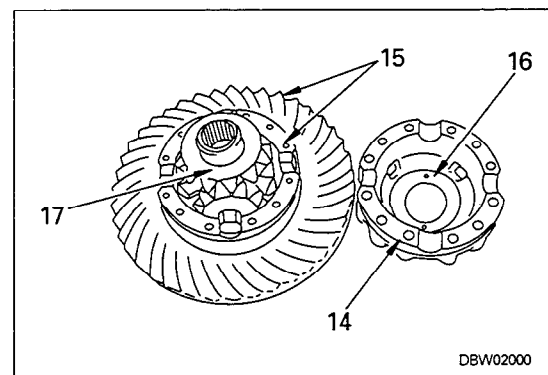
- 6) Assemble side gear (17) to bevel gear and flange half assembly (15).

- 7) Coat thrust washer (16) with grease, align with dowel pin of plain half (14), then stick thrust washer (16) in position, and be careful that it does not fall out when assembling.

★ When assembling the thrust washer, be careful not to assemble it upside down.

 Thrust washer : **Grease (G2-LI)**

★ Be careful not to coat with too much grease.



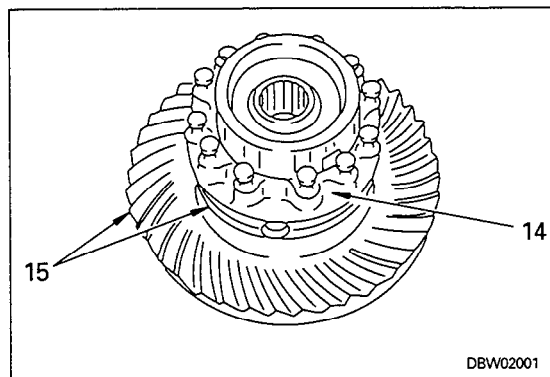
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- 8) Align match mark on plain half (14) with bevel gear and flange half assemble (15), and install.

- ★ Align the match marks securely.
- ★ Tighten the mounting bolts on diagonally opposite sides.

 Mounting bolt :
 $176.5 \pm 19.6 \text{ Nm } (18.0 \pm 2.0 \text{ kgm})$



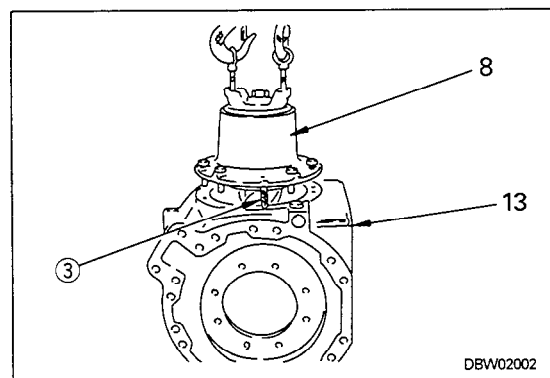
5. Adjusting shim of cage

- 1) Assemble guide bolt ③ (16 mm, P = 2, L = 55mm), then assemble cage assembly (8) to differential housing (13) without shims.

 Mounting bolt :
 $277 \pm 32 \text{ Nm } (28.25 \pm 3.25 \text{ kgm})$

- 2) Insert measurement tool C1 to differential housing (13), then measure distance L between bevel pinion gear end face and tool C1 with inside micrometer or cylinder gauge.

- ★ When inserting tool C1 in the differential housing, coat with oil thinly, and insert uniformly so that it is not twisted.



- 3) Selection of shims

$$t = C - (L + D/2)$$

t : Shim thickness

$$C : (A + a) - (B + b)$$

L : Actual measured value

D : Diameter of tool C1

A : 212 ± 0.3

B : 64 ± 0.3

a : Deviation from dimension A

b : Deviation from dimension B

- ★ Use the actual measured value for dimension D.

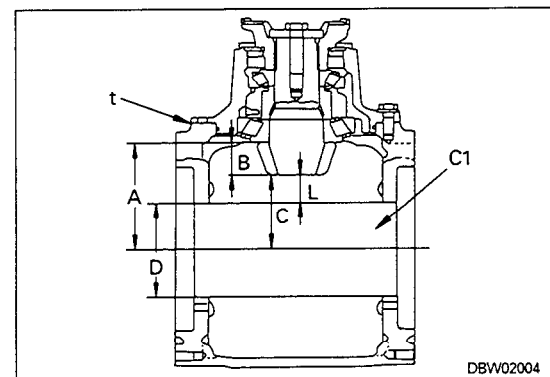
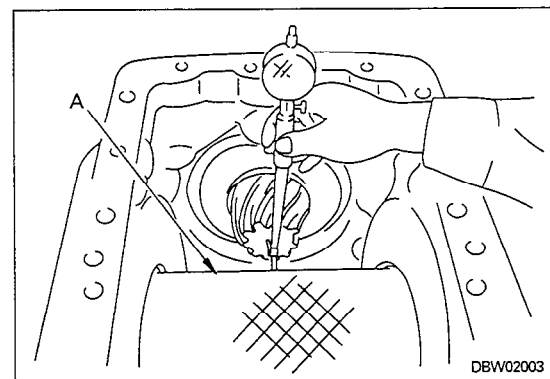
- ★ Adjust so that shim thickness "t" is within a range of 0.91 – 1.61 mm.

- ★ Mark the end face of the pinion gear with an electric pen as follows.

MD + 0.10 (– 0.01)

└─ Dimension b (unit: mm)

└─ Dimension a (unit: mm)



- ★ Always use the bevel pinion gear and bevel gear in pairs with the same number.

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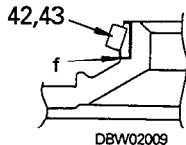
6. Bearing carrier

Press fit bearing cones (42) and (43) to bearing carrier assemblies (12) and (12-1).

 Bearing cup press-fitting portion :

Oil (axle oil)

- ★ After press fitting the bearing, check that there is no clearance at portion f.



DBW02009

7. Adjusting shim of bearing carrier

- 1) Raise differential carrier assembly (11), then set to mounting position on differential housing.

- 2) Using guide bolt ④ (14 mm, P=2, L=55mm), assemble a shim to bearing carrier assembly (12-1) at plain half end and a shim to bearing carrier assembly (12) at bevel gear end, and assemble the differential carrier assembly to differential housing.

★ Reference value

- Shim thickness (plain half side):
0.75 mm
- Shim thickness (bevel gear side):
0.95 mm

★ Assemble the differential carrier assembly so that the bevel gear is on the right side as seen from the cage mount end.

★ Assemble the bearing carrier assembly without the square ring and D-ring, and adjust.

★ Rotate the bevel gear and coat the bearing with oil.

 Bearing oil : **Oil (axle oil)**

- ★ To settle all the parts, rotate the bevel gear when tightening.

- 3) Tighten mounting bolts of bearing carrier assemblies (12) and (12-1).

 **Mounting bolt :**

176.5 ± 19.6 Nm (18.0 ± 2.0 kgm)

- 4) Measure preload of bevel gear with a spring balance and check that it is within standard range.

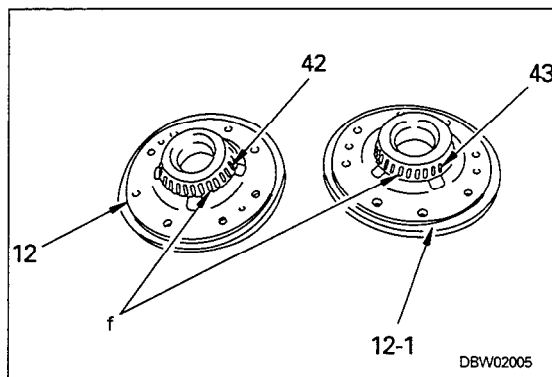
★ Starting turning force:

13 – 36 N (1.3 – 3.7 kg)

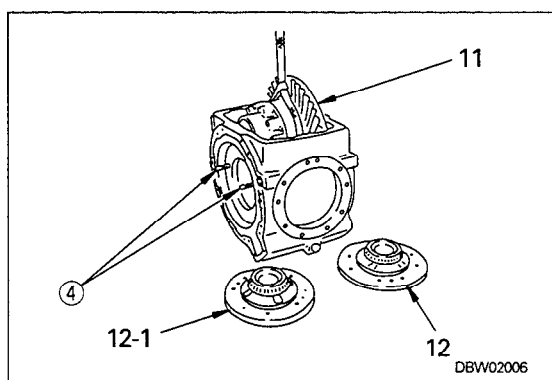
- ★ If the starting turning force is not within the standard value, adjust the shim thickness.

★ Reference value

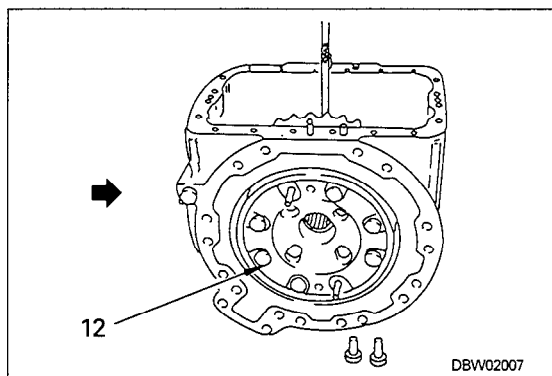
- Standard shim thickness on one side:
0.3 – 1.25 mm



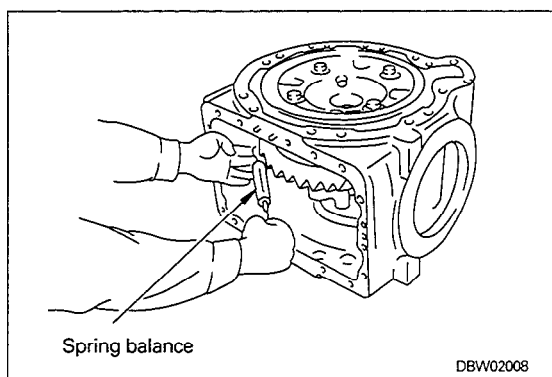
DBW02005



DBW02006



DBW02007



Spring balance

DBW02008

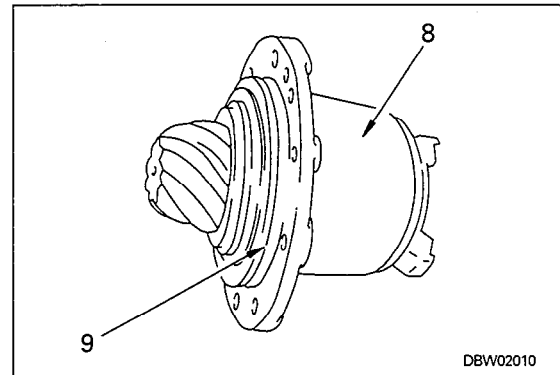
U42303

8. Cage

- 1) Fit O-ring (9) in groove of cage assembly (8).

 O-ring : **Oil (axle oil)**

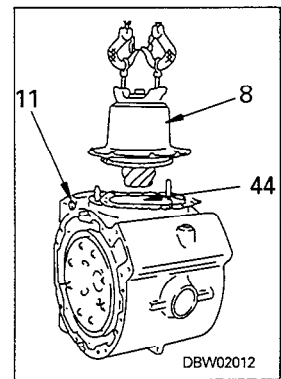
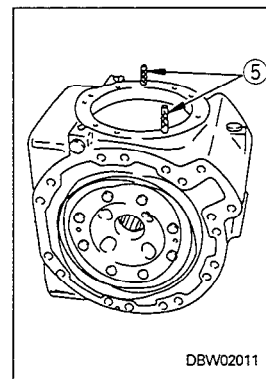
★ Coat thinly with oil.



- 2) Install guide bolts (5) to differential carrier assembly (11), assemble shim (44) selected in Step 5, then install cage assembly (8).

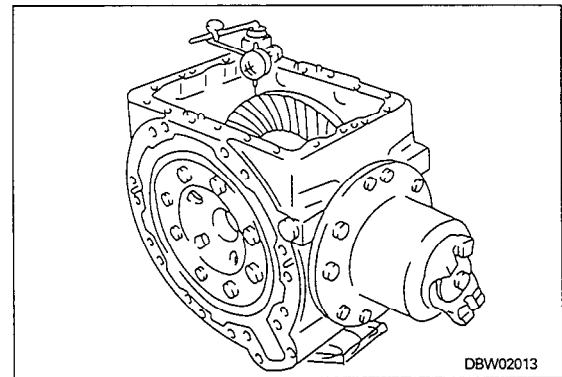
★ Assemble the shims with the thinner shim on the inside and the thicker shim on the outside.

 Mounting bolt :
 $277 \pm 31.9 \text{ Nm}$ ($28.25 \pm 3.25 \text{ kgm}$)

**9. Adjusting backlash**

- 1) Measure backlash of bevel gear with dial gauge.

★ Backlash standard value: 0.30 – 0.46 mm
★ Measure the backlash at three places around the circumference of the bevel gear, and check that the variation between each measurement is less than 0.1 mm.

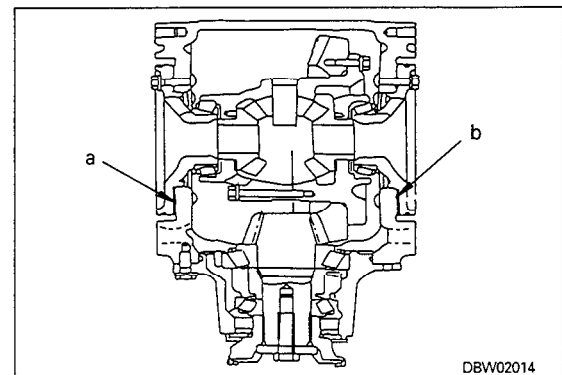


- 2) To get backlash within standard value, move part of shim on bevel gear side to opposite side.

★ When moving the shim, do not change the total for the left and right shim thickness.

★ If the backlash is too large:
Move part of shim **b** to shim **a**.

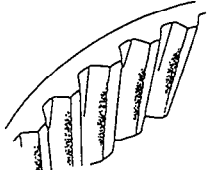
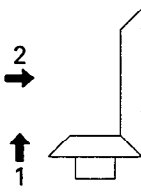
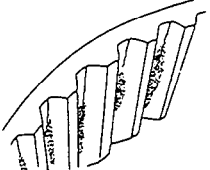
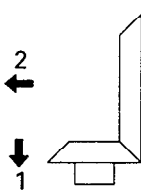
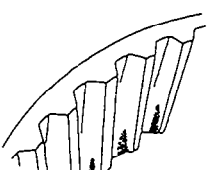
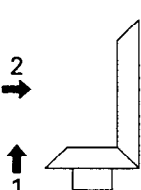
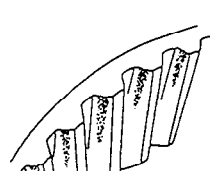
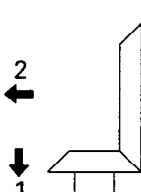
★ If the backlash is too small:
Move part of shim **a** to shim **b**.



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10. 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

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★ 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.

11. Bearing carrier assembly

Remove bearing carrier assembly (12-1), assemble square ring (45) and D-ring (46), then assemble again using adjusted shims.

- ★ Coat the square ring with grease and be careful not to let it drop out when assembling.
- ★ When assembling bearing carrier assembly (12-1), there is danger that the square ring may fall out, so do not hit with a hammer when assembling.

 Square ring, D-ring : **Grease (G2-LI)**

 Mounting bolt :

$176.5 \pm 19.6 \text{ kgm}$ ($18.0 \pm 2.0 \text{ kgm}$)

12. Brake piston

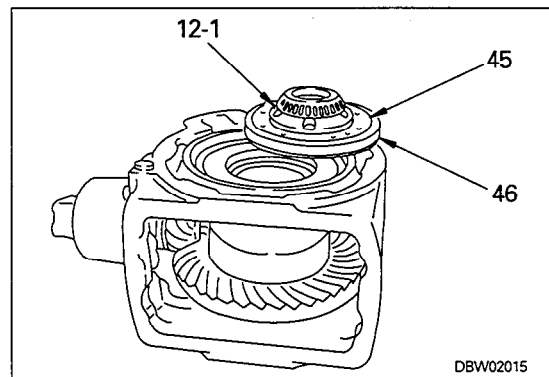
- 1) Assemble D-ring (46-1) in groove of brake piston (10).

- ★ Coat the brake piston and piston mount thinly with grease to prevent the O-ring from being twisted or cut.

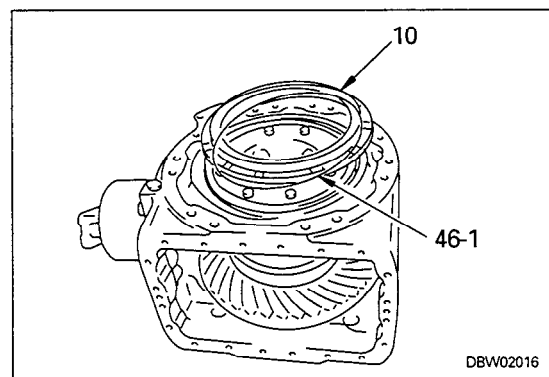
 Piston and piston mounting surface :
Grease (G2-LI)

- 2) Install piston press-fitting tool **C2** to differential housing, and tighten tool **C3** uniformly to press fit.

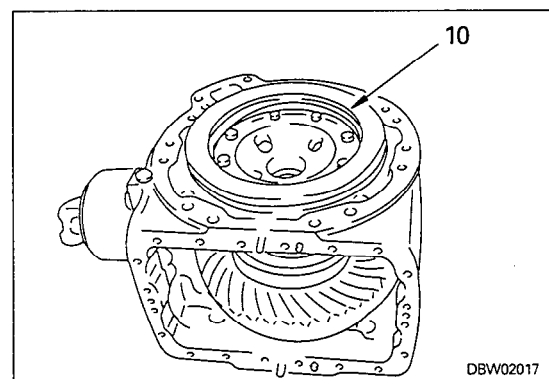
- ★ Press fit completely until the piston contacts the housing.
- ★ Do not hit with a plastic hammer to insert. If a hammer is used, the D-ring and piston will be damaged.
- ★ Put a pad under tool **C3** to prevent damage to the piston surface.
- ★ When pushing the piston with the end face of tool **C3**, install tool **C2** to make sure that the center of the piston is pushed.



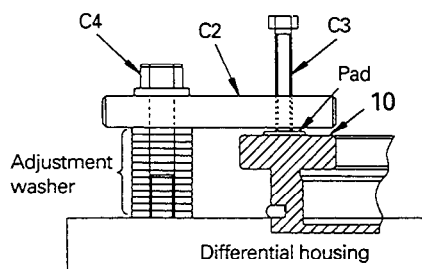
DBW02015



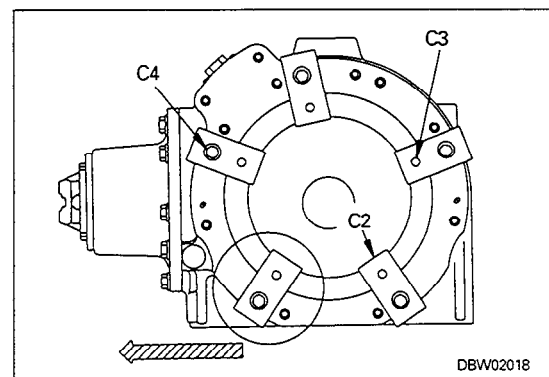
DBW02016



DBW02017



DBW02019

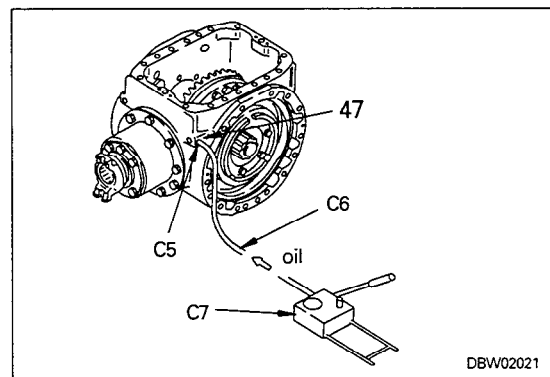
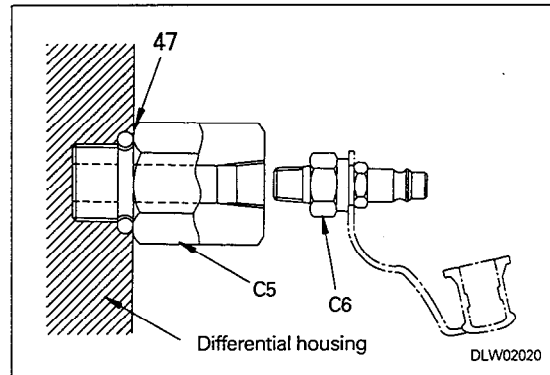


DBW02018

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13. Checking for brake oil leakage

- 1) Install bleeder screw.
- 2) After screwing in tool **C3** of each piston press-fitting tool **C2** fully, turn back one turn.
- 3) Install tools **C5** and **C6** to brake tube mount (47), then bleed air inside cylinder.
- 4) Operate tool **C7**, and raise pressure to 1.4 MPa (14 kg/cm²).
 - ★ After raising pressure to 1.4 MPa (14 kg/cm²), leave for 5 minutes and check that the drop in pressure is less than 0.35 MPa (3.5 kg/cm²).
- 5) If the result of the inspection shows that there is no oil leakage, raise the pressure further to 4.9 MPa (50 kg/cm²).
 - ★ After raising pressure to 4.9 MPa (50 kg/cm²), leave for 5 minutes and check that the drop in pressure is less than 0.1 MPa (1.0 kg/cm²).
 - ★ If there is oil leakage, remove the brake piston, check the O-ring and other parts for damage, then assemble again.
 - ★ After checking for brake oil leakage, insert the piston fully.

**14. Coupling**

Tighten mounting bolts of coupling (30) fully.



Mounting bolt : Thread tightener (LT-2)

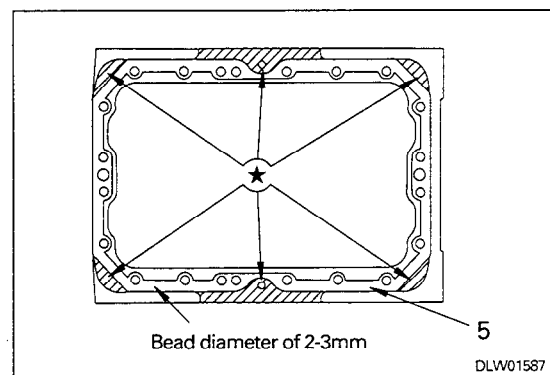
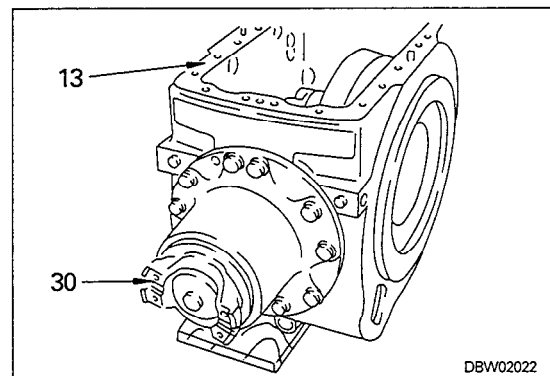


Mounting bolt :

549 ± 59 Nm (56.0 ± 6.0 kgm)

15. Differential cover

- 1) Wash and remove all oil and grease from mounting surface of differential cover (5) and differential housing (13), then coat with gasket sealant.
 - ★ Guide bolt : 14 mm, P = 2, L = 40 mm
 - ★ When installing the differential cover, screw the mounting bolts into the forcing screw holes, and raise.
 - ★ Temporarily assemble the bleeder screw so that gasket sealant does not get into the mounting hole of the bleeder screw.
 - ★ See the diagram on the right for details of coating.
 - Coat continuously with a bead diameter of 2 – 3 mm.
 - The shape of the differential cover at portion ★ is different, so coat and take care that the bead does not come off.



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- 2) Install differential cover (5) to differential housing.

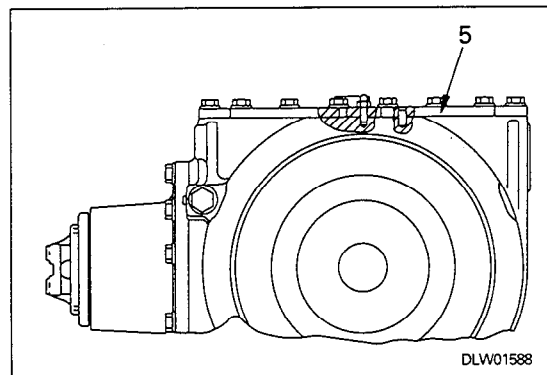
★ Coat carefully with gasket sealant so that there is no break in the gasket sealant.

 Cover mating surface :

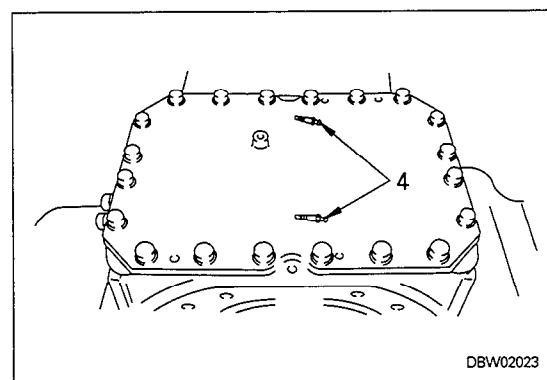
Gasket sealant (Loctite 515)

 **Cover mating surface :**

$176.5 \pm 19.6 \text{ Nm}$ ($18.0 \pm 2.0 \text{ kgm}$)



- 3) Check that there is no gasket sealant stuck to the bolt hole, then tighten bleeder screw (4) fully.



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16. Axle housing assembly

17. Refilling with oil

- ★ For details, see Step 13 in ASSEMBLY OF AXLE HOUSING ASSEMBLY.

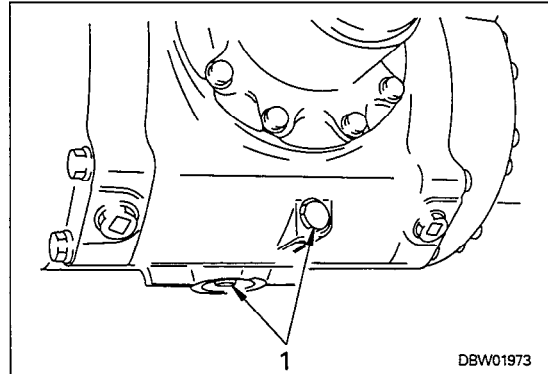
DISASSEMBLY OF AXLE HOUSING ASSEMBLY

1. Draining oil

Remove drain plugs (1) and drain oil.



Axle oil : 37 ℓ



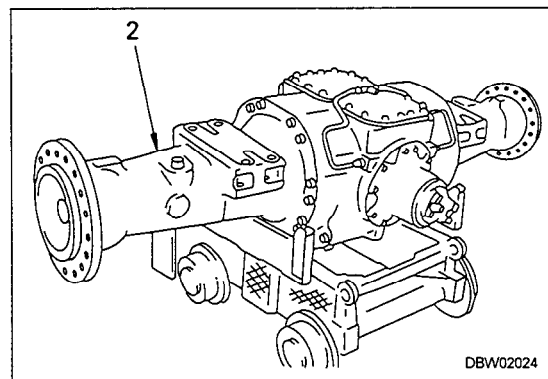
★ Set axle assembly (2) on pallet.



Axle assembly : 1,021 kg (front)



Axle assembly : 971 kg (rear)



2. Differential cover

Using forcing screws, remove differential cover (3).

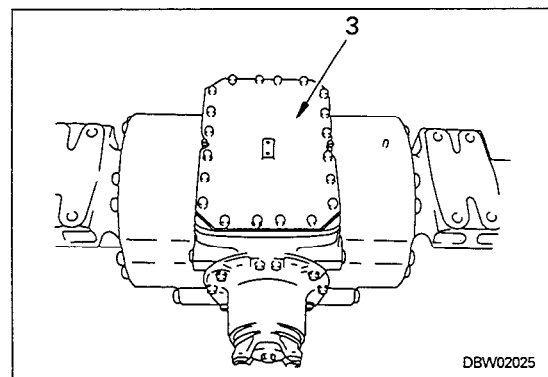
- ★ Do not remove the differential cover unless necessary.
- ★ When removing the differential cover, be careful not to damage the bleeder screw.
- ★ When moving the differential assembly, remove the 4 cover mounting bolts, and use eyebolts to lift at 4 points and move.



(F) Differential assembly : 300 kg



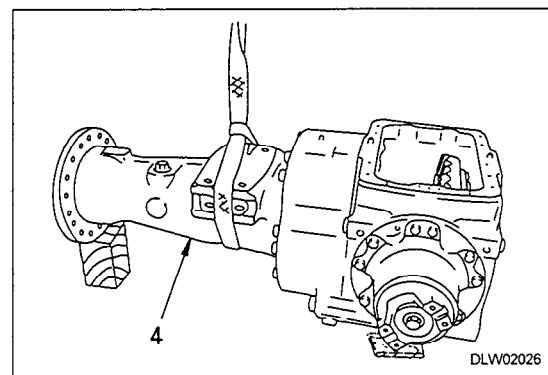
(R) Differential assembly : 320 kg



3. Axle housing

1) Sling axle housing assembly (4), and remove housing mounting bolts.

- ★ Make match marks on the housings to prevent mistakes between the left and right axle housings.
- ★ Set blocks to prevent the assembly from tilting when the housing assembly on one side is removed.



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- 2) Lift off axle housing assembly (4).



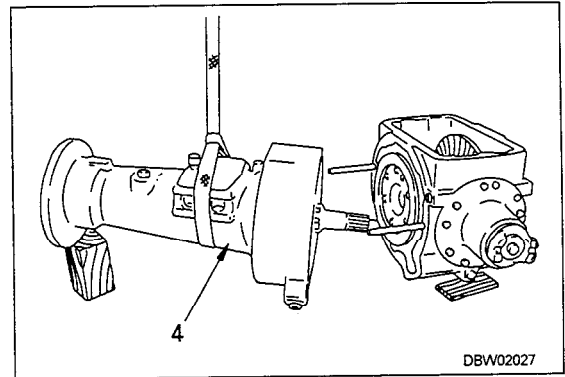
Axle housing assembly :

280 kg (front)



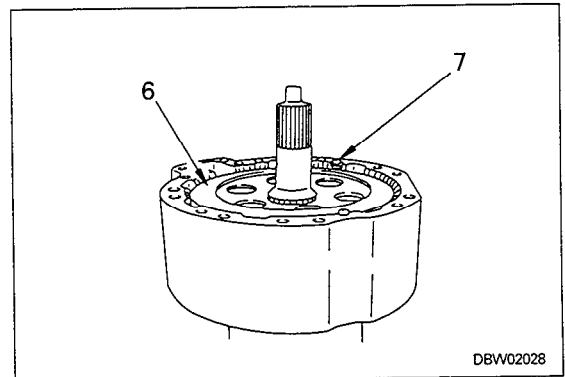
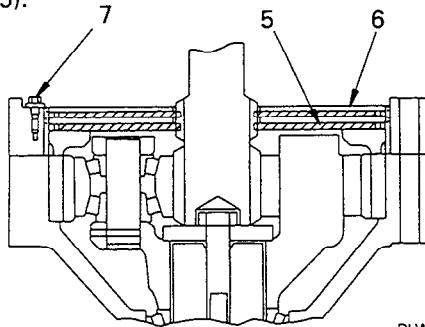
Axle housing assembly : **270 kg (rear)**

- ★ Change the place for the axle housing lifting tool, and stand the axle housing assembly upright.



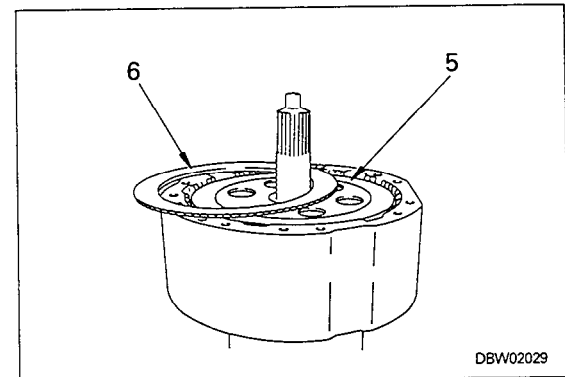
4. Brake disc, plate

- 1) Remove lock bolts (7) of plate (6) and brake disc (5).



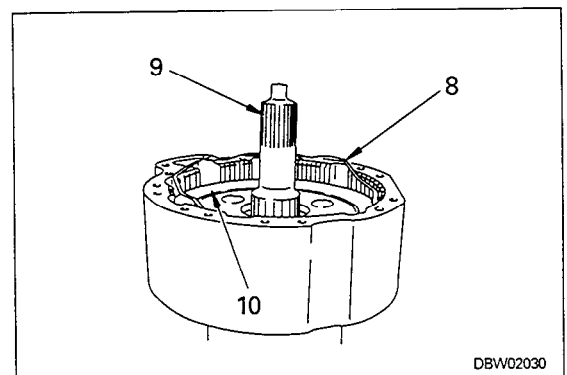
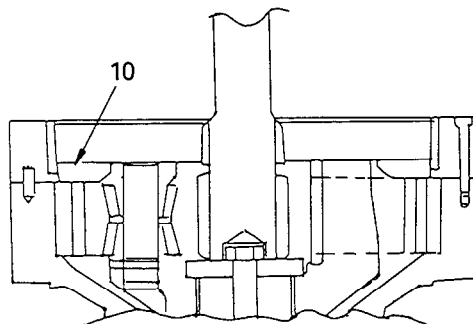
- 2) Remove plate (6) and brake disc (5).
★ Be careful not to damage the front face of the disc.

- 3) Remove wave spring (8).



5. Sun gear shaft, outer ring

- 1) Remove shaft (9).
2) Remove outer ring (10).
★ Be careful not to damage face in contact with the brake disc.

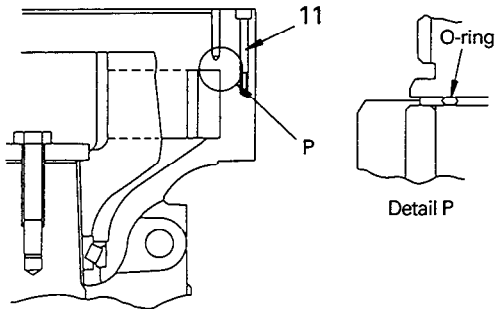


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6. Brake housing

Remove mounting bolts (11), then remove brake housing (12).

★ Remove the O-ring.



DLW01604



Brake housing : 25 kg

7. Planetary carrier assembly

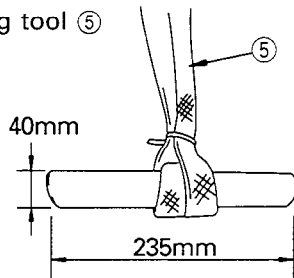
1) Remove axle shaft mounting bolts, then lift off planetary carrier assembly (13) with lifting tool (5).

★ The planetary carrier assembly is heavy, so be extremely careful when removing it.



Planetary carrier assembly : 48 kg

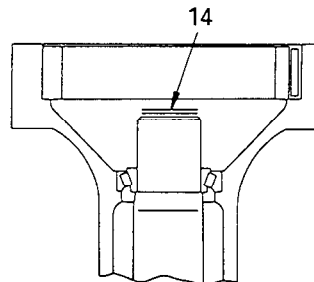
★ Lifting tool (5)



DBW02035

2) Remove shims (14).

★ Record the shim thickness and use for reference when assembling.



DLW01602

8. Ring gear

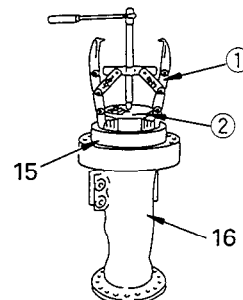
Use puller (1) and pull up uniformly to remove ring gear (15) from axle housing (16).

★ Assemble spacer (2) to the end face of the puller bolt to adjust the height.

★ When pulling up with the puller, be extremely careful that the teeth of the puller do not come off the ring gear.



Ring gear : 15 kg

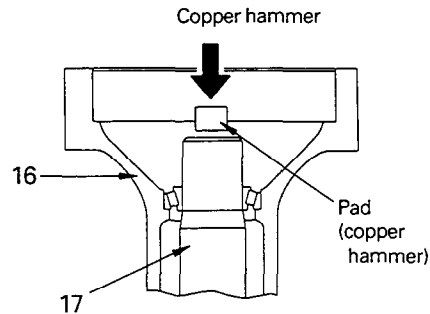


DBW02034

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9. Axle shaft

- 1) Stand housing and shaft assembly, then raise housing (16).
- 2) Put a copper hammer in contact with end face of axle shaft (17), then knock in shaft and rotate housing (16) to remove shaft.



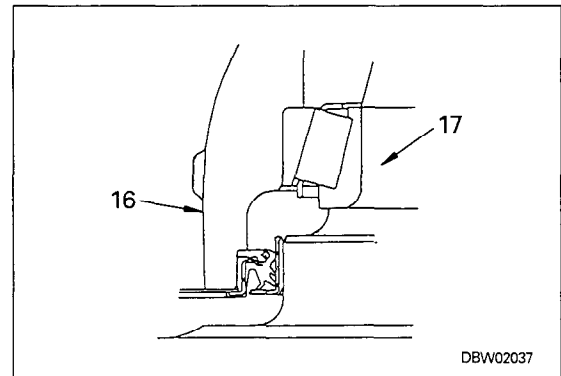
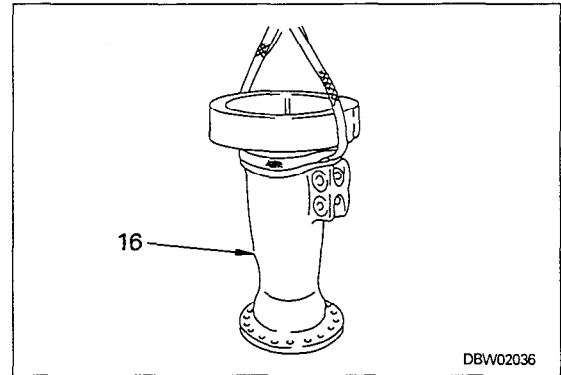
DLW01609



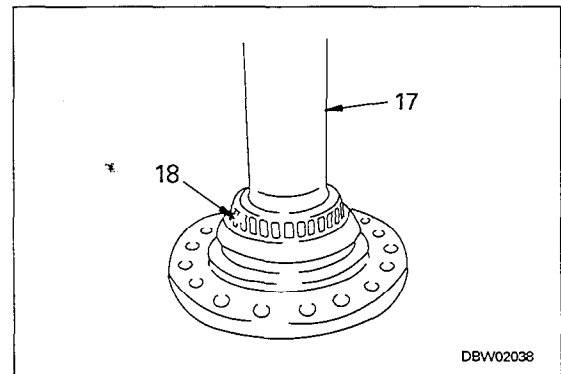
Axle shaft assembly : 90 kg



Axle housing : 85 kg

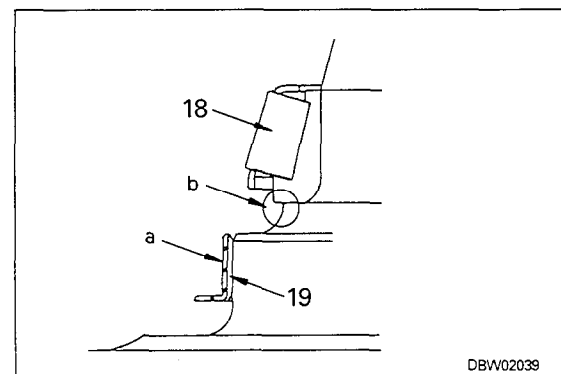


- 3) Pull out bearing (18) from axle shaft (17).
 - ★ Do not use a gas cutter or heat to remove the bearing under any circumstances.
 - If the shaft is heated, the hardening of the shaft will be reduced and the strength will drop.



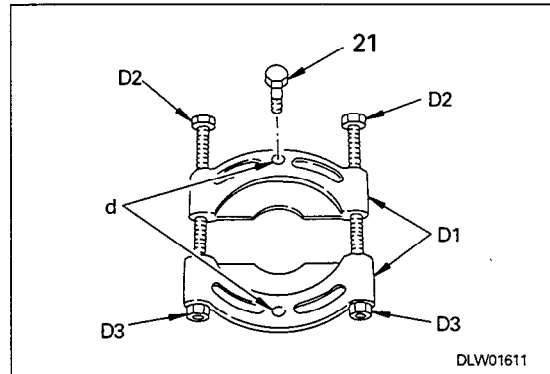
★ Remove the bearing as follows.

- 4) When removing bearing (18) of axle shaft (17), be careful not to let adjustment bolt of puller contact outside circumference **a** of oil seal and sleeve (19).
- ★ Install the puller so that the teeth grip the whole circumference of portion **b** of bearing (18).

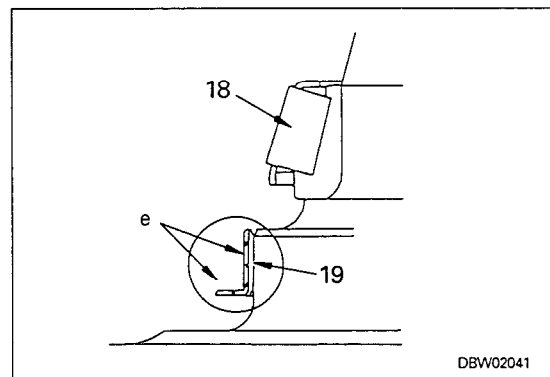


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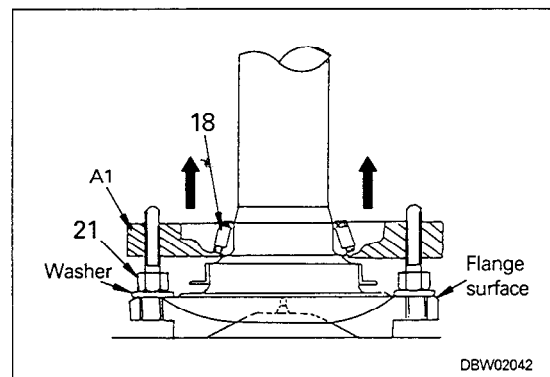
- 5) Install bolt (21) in portion **d** of tool **D1**.
 ★ Screw the bolt fully into the thread.
 • Bolt (21) : 1-14UNF



- 6) Insert tool **D1** under bearing (18), and assemble tools **D2** and **D3**.
 ★ When installing tool **D1**, be careful not to deform portion **e** of oil seal sleeve (19).
 ★ When doing this, fix the bearing puller securely in place so that there is no play.



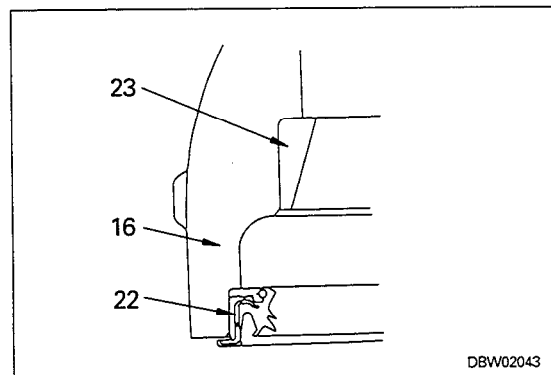
- 7) Insert washer between bolt (21) and flange surface, turn bolt (21) to loosen it, and remove bearing (18).
 ★ The puller has little grip on the bearing, so be extremely careful that the puller does not come off from the bearing.
 ★ If the thread of bolt (21) is too short, add a washer to the flange surface to adjust the height of bolt (21) when removing bearing (18).
 ★ Replace the oil seal and sleeve assembly with a new part.



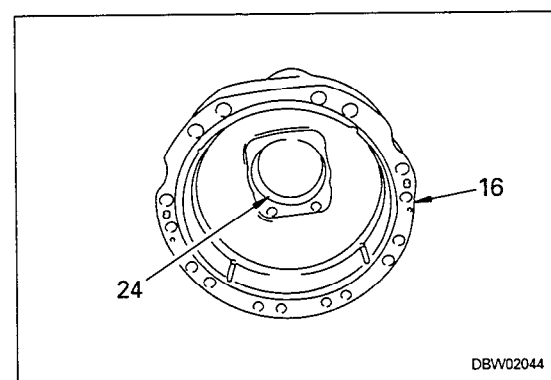
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10. Axle housing

- 1) Remove oil seal (22) from axle housing (16).



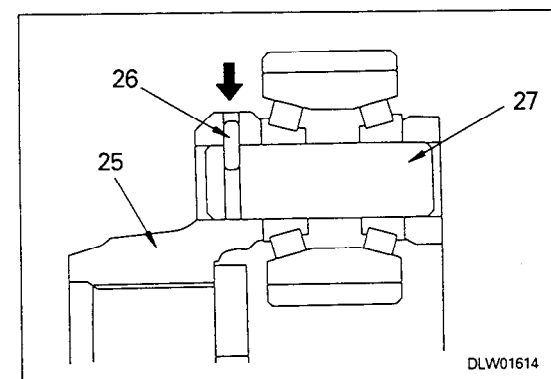
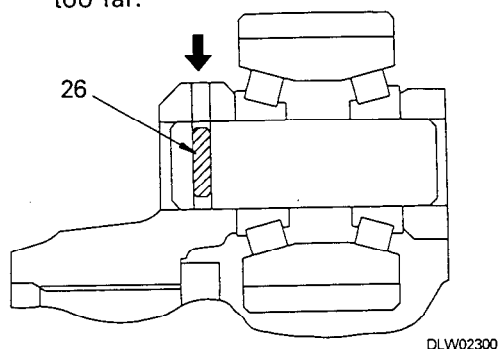
- 2) Remove bearing cups (23) and (24) from axle housing (16).



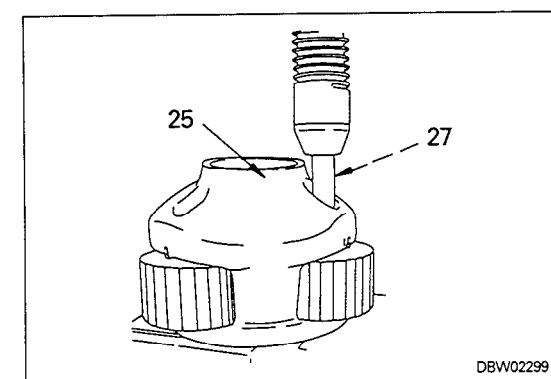
11. Planetary carrier

- 1) Knock in spring pin (26) of planetary carrier (25).

★ Be careful not to knock the spring pin in too far.

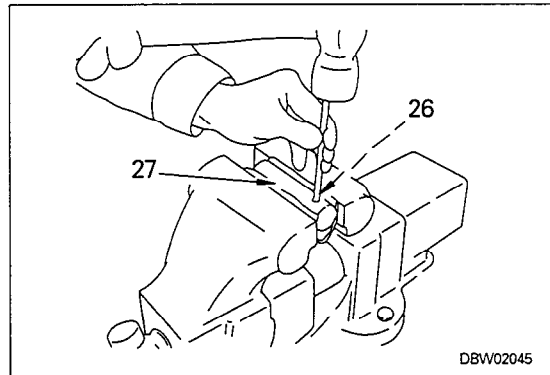


- 2) Using press, remove shaft (27).
- ★ When removing the shaft, use a block at the end face of the shaft.



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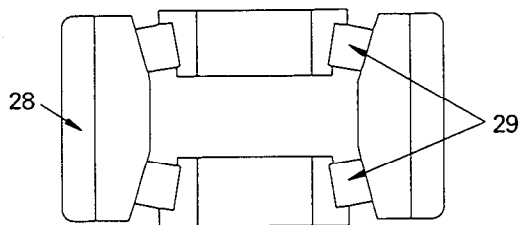
- 3) Remove spring pin (26) from shaft (27).



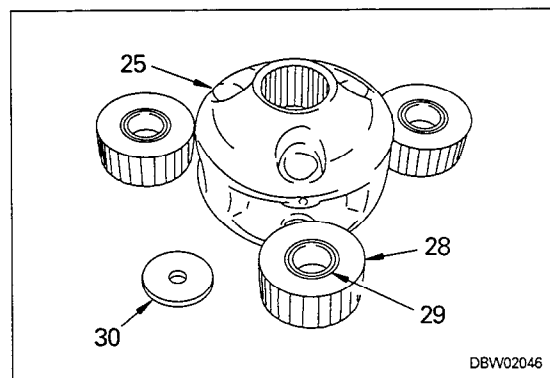
- 4) Remove pinion gear (28) from planetary carrier (25), then remove bearing cone (29) and spacer (30).



Planetary carrier : 30 kg



DLW01619



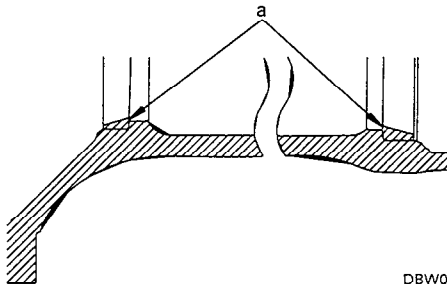
U42303

ASSEMBLY OF AXLE HOUSING ASSEMBLY

1. Axle housing

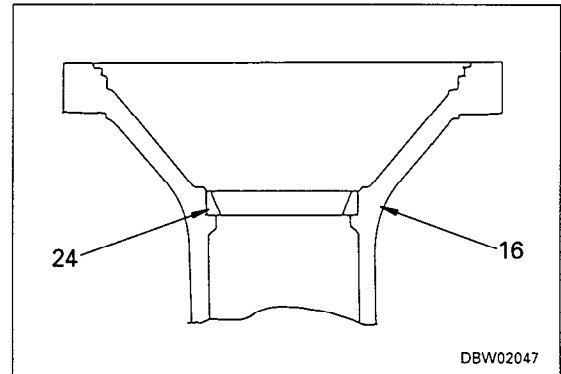
Press fit bearing cups (24) and (23) to axle housing (16).

- ★ Coat the bearing cup press-fitting portion of the axle housing with oil.
- ★ After press fitting the cup, check that there is no clearance at portion a.

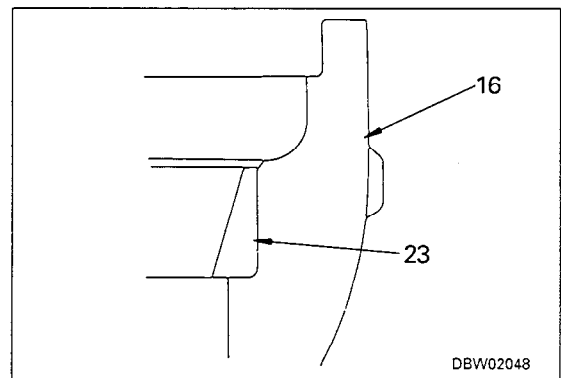


DBW02051

 Bearing cup press-fitting portion :
Oil (axle oil)



DBW02047



DBW02048

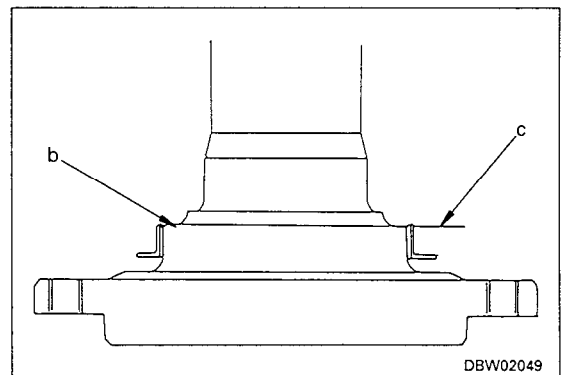
2. Axle shaft

1) Press fit axle shaft (17) and oil seal sleeve (19).

- ★ Be careful not to deform the parts when hitting with a hammer.
- ★ Coat the sleeve contact surface portion b of the oil seal thinly with axle oil.

 Sleeve contact surface of shaft :
Oil (axle oil)

- ★ After press fitting the oil seal sleeve, check that surface c is level with the surrounding surface.



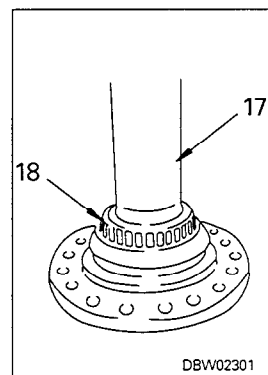
DBW02049

2) Press fit bearing (18) to axle shaft (17).

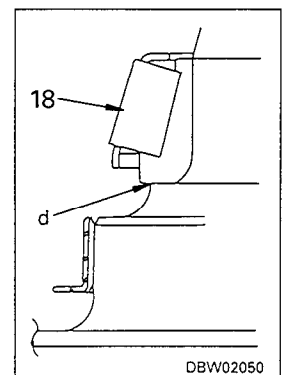
- ★ Be careful not to fit the bearing at an angle.

 Bearing press-fitting portion :
Oil (axle oil)

- ★ After press fitting the bearing, check that there is no clearance at portion d.



DBW02301



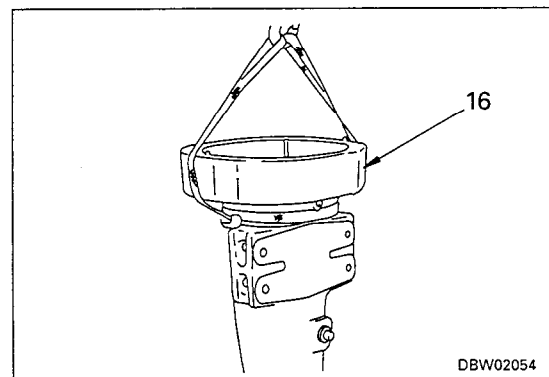
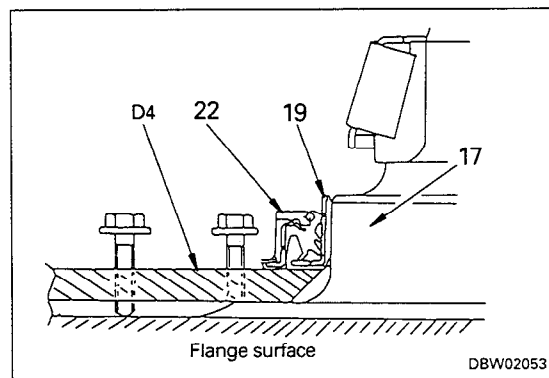
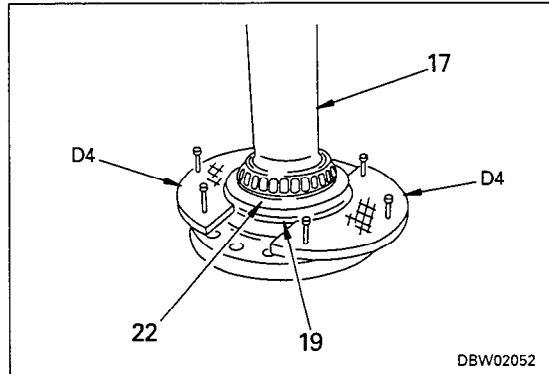
DBW02050

U42303

3. Housing, shaft

- 1) Stand shaft (17) upright and install tool **D4**.
 - ★ Adjust the height of the seal support with the adjustment bolts, put the top surface of tool **D4** in light contact with seal (22), then set so that the clearance is uniform.
 - ★ Set tool **D4** securely so that it does not come off.
- 2) Assemble oil seal (22) to oil seal sleeve (19).
 - ★ When assembling the oil seal, be extremely careful not to damage the lip surface.

 Lip of oil seal : **Grease (G2-LI)**

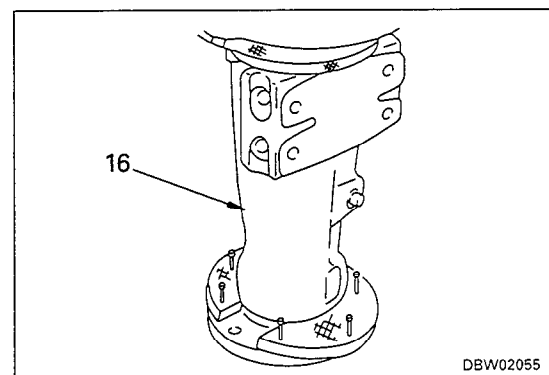


- ★ When raising axle housing (16), coat the oil seal press-fitting portion of the housing with oil.

 Oil seal press-fitting portion :

Oil (axle oil)

- 3) Raise axle housing (16) to a horizontal position, then insert to shaft carefully.
 - ★ Stop axle housing (16) before press fitting the oil seal.
- 4) Align axle housing (16) with oil seal press-fitting portion, then lower housing slowly.
 - ★ Use the weight of the axle housing to insert it.



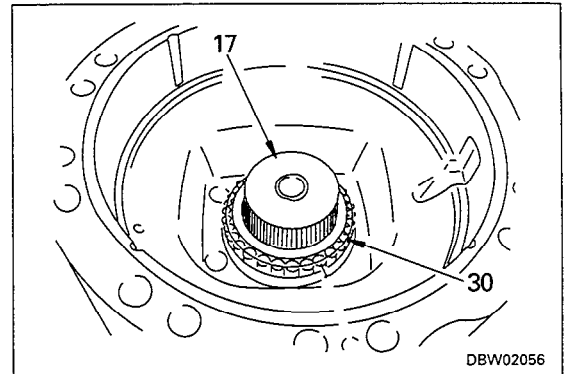
U42303

- 5) Press fit bearing (30) to shaft (17), then rotate axle housing by hand, and press fit until end play is 0.1 mm.

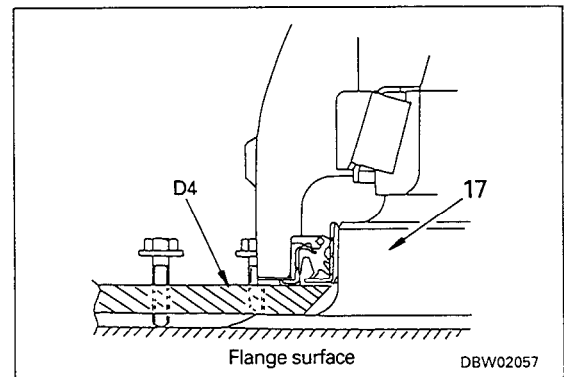
★ Do not press fit so that there is no end play.

 Bearing cone press-fitting portion :
Oil (axle oil)

★ Press-fitting force :
Approx. 19.6 KN (2 ton)



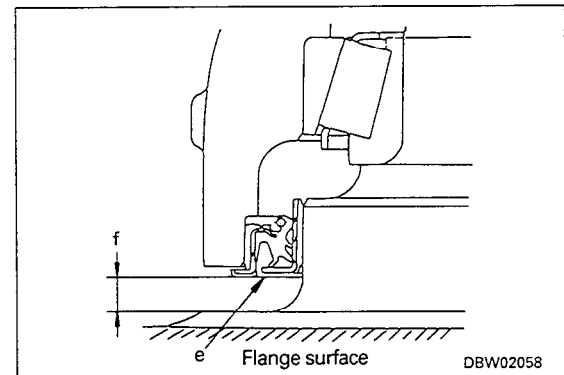
- 6) Pull out tool **D4** horizontally.



★ After press fitting the bearing to the shaft, check that there is no stepped portion between the seal and the sleeve and that surface **e** is level with the surrounding surface.

★ Reference
Clearance (**f**) : 10.5 ± 0.2 mm

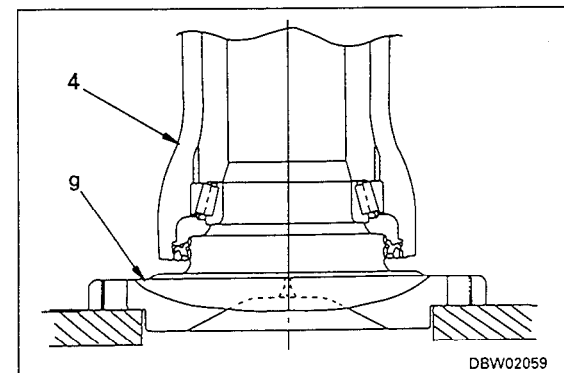
★ Be careful not to install the seal at an angle.



4. Adjusting end play

- 1) Stand axle shaft and housing assembly (4) upright.

★ Secure flange **g** so that the axle shaft and housing assembly does not fall over.



U42303

- 2) Install planetary carrier (25) to spline of axle shaft (17), then assemble shim adjustment tool **D5** to portion **j** of planetary carrier, and install mounting bolts.

★ Install planetary carrier (25) without the gears.

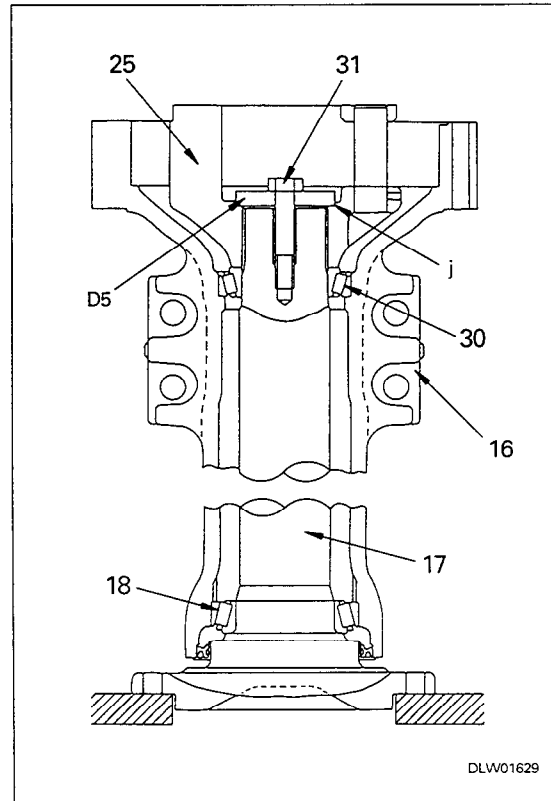
★ Remove all adhesive from the mounting bolts and mounting bolt holes of the axle shaft before using.

- 3) Rotate axle housing (16) and tighten retainer mounting bolt (31).

 Bolt : **43 Nm (4.4 kgm)**

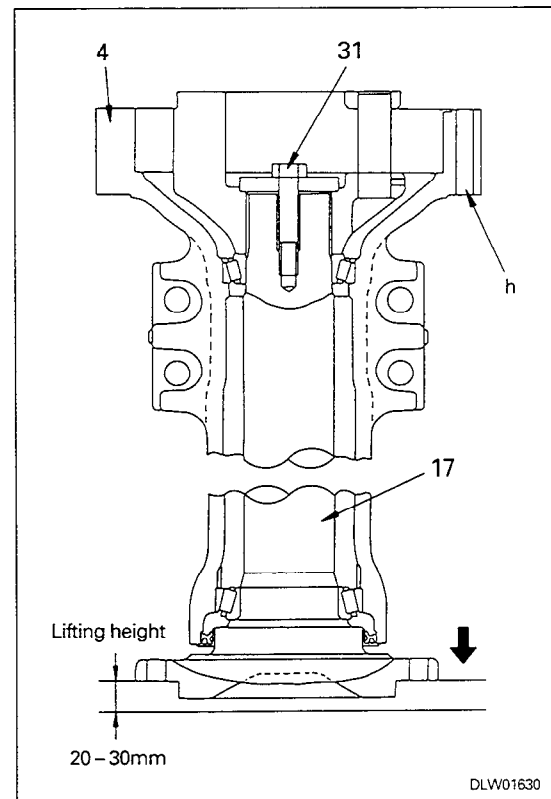
- 4) Make sure that bearings (18) and (30) are fully settled, then measure starting turning force "X" at drill hole **h** of axle housing (16).

- Starting turning force **X** :
44.1 – 70.6 N (4.5 – 7.2 kg)



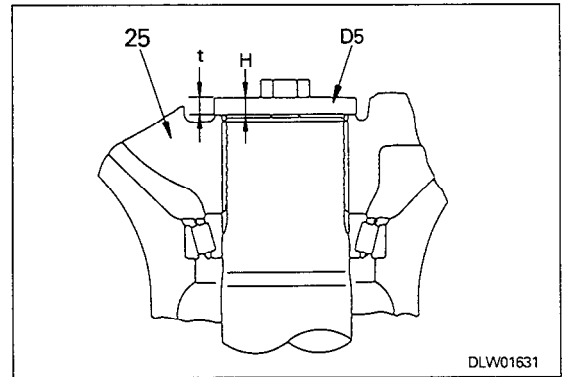
- ★ If the starting turning force is not within the standard value, adjust again as follows.

- If the starting turning force is less than 44.1 N (4.5 kg), press fit the bearing again and repeat the operation from Step 3).
- If the starting turning force is more than 70.6 N (7.2 kg), loosen mounting bolt (31) of the shim adjustment tool 1 – 2 turns.
- At the same time as assembling axle shaft and housing assembly (4) to the axle housing, sling at two points and raise 20 – 30 mm.
- Rotate axle shaft (17) and hit the flange portion with a copper hammer several times in the direction of the arrow to remove axle shaft (17).
- Repeat Steps 3) and 4) to bring the starting turning force within the standard value.



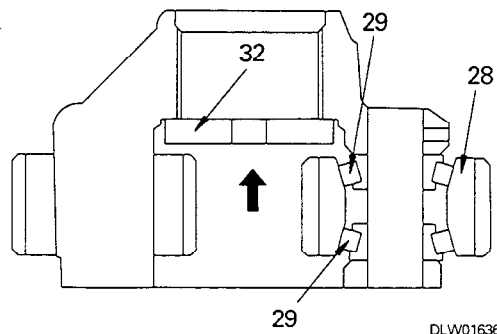
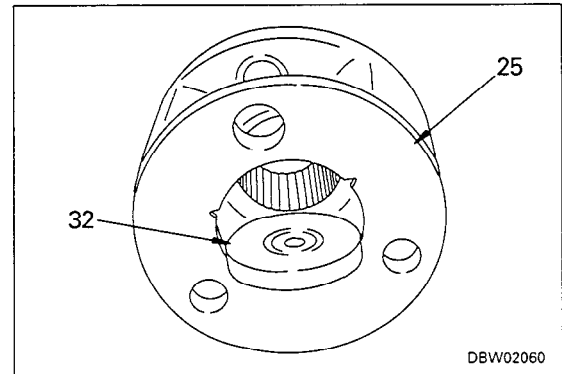
U42303

- 5) Using depth micrometer, measure distance **H** from tool **D5** to axle shaft end face. Subtract thickness **t** of the jig from **H** to give the value **(H - t)**.
 - Shim thickness = $(H - t)_{+0.05}^{+0}$
- 6) After deciding shim, loosen bolt and remove planetary carrier (25).

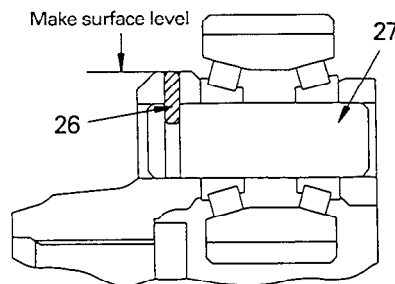
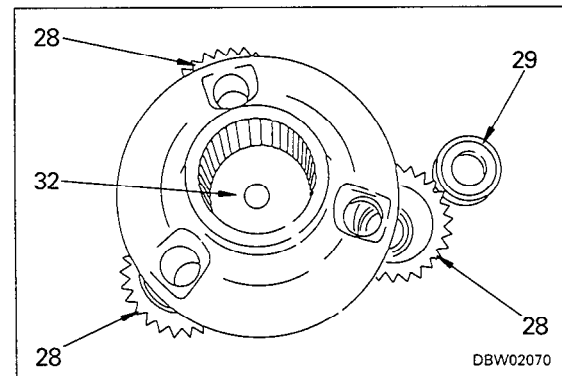


5. Planetary carrier

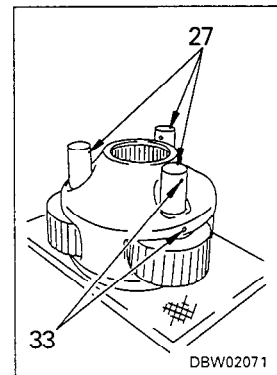
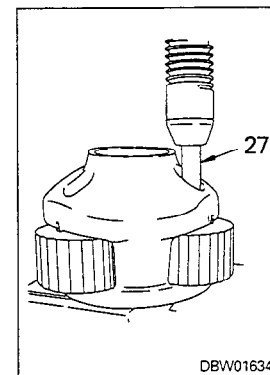
- 1) Assemble spacer (32) inside planetary carrier (25).
 - ★ Assemble the spacer from the brake housing side.
- 2) Assemble bearing cone (29) to gear (28), lift up spacer (32), and set gear (28) in position.



- 3) Align shaft (27) and spring pin hole (33), and press fit shaft.
 - 🔧 Shaft : Oil (axle oil)

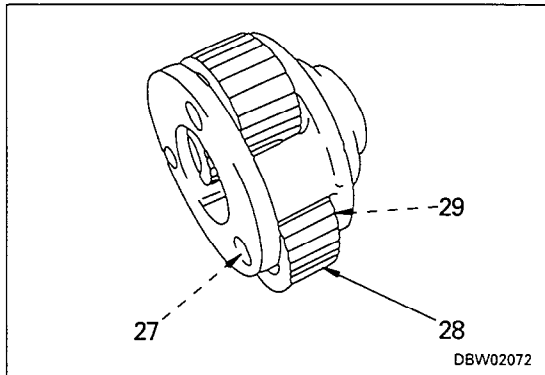


- ★ Align the holes of shaft (27) and spring pin (26), and knock in the spring pin so that it is level with the surface of the carrier.



U42303

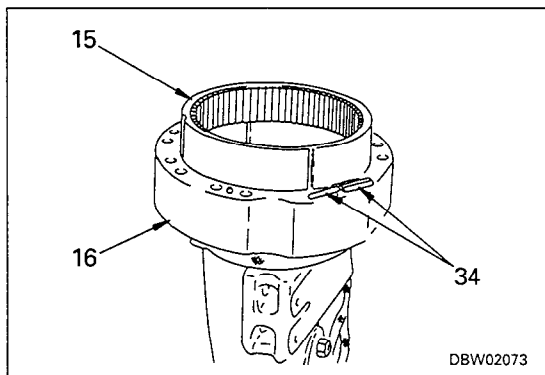
- 4) Tap differential side of gear (28) and end face of shaft (27), and push back bearing (29) so that the gear can rotate smoothly.
★ Check that the gear rotates smoothly.



6. Ring gear

Press fit ring gear (15) to axle housing (16), then insert pins (34).

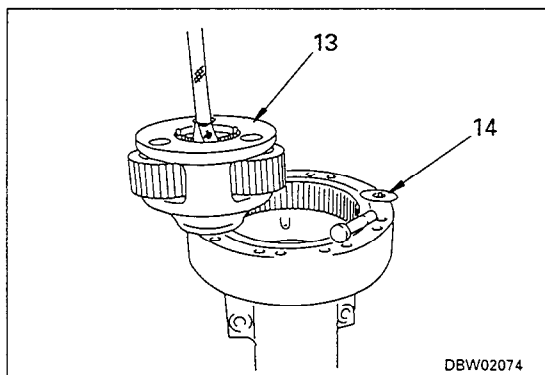
- ★ Align the pin holes of the ring gear and the housing, then assemble.
- ★ Press fit horizontally and make sure that the ring gear is not at an angle.



7. Planetary carrier assembly

- 1) Assemble shim (14) selected in Step 5) to end face of axle shaft, then install planetary carrier assembly (13) and install mounting bolts.

- ★ Wash and remove all oil and grease from mounting bolts and mounting bolt holes of axle shaft.



Mounting bolt :

Thread tightener (LT-2)



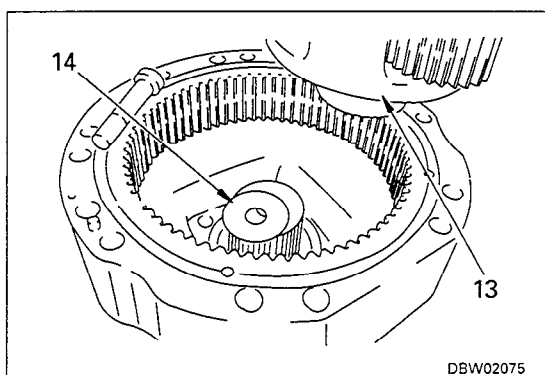
Mounting bolt :

927 ± 98 Nm (94.5 ± 10.0 kgm)

- ★ Clean the end face of the shaft and the planetary carrier spline before assembling.



When assembling the planetary carrier, be extremely careful not to get your fingers caught in the gear.



U42303

- 2) Make sure that bearing is fully settled, then check turning force "X" at axle housing assembly (4) and drill hole (h).

★ Reference value

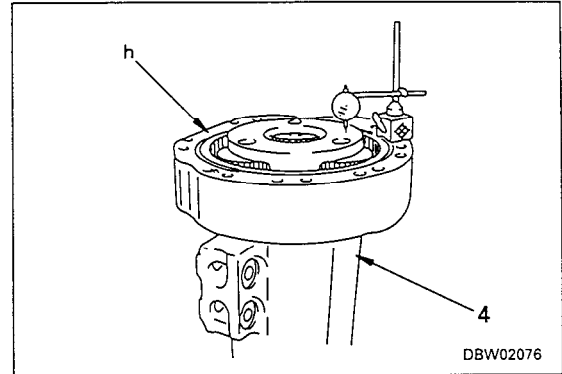
- Starting turning force X:

44 – 71 N (4.5 – 7.2 kg)

- 3) Install stand of dial gauge to axle housing (4), and measure end play of planetary carrier at end face of planetary carrier.

★ Reference value

- End play of planetary carrier :
0 – 0.1 mm

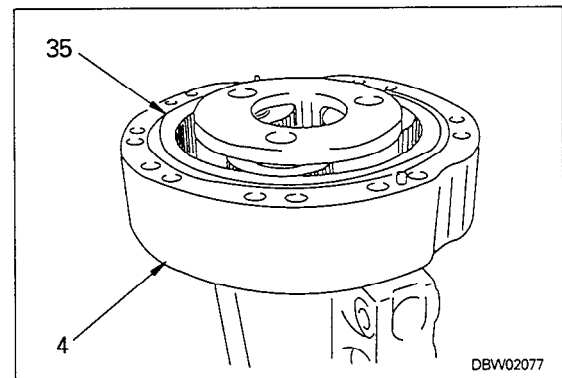


8. Brake housing

- 1) Assemble O-ring (35) in groove of axle housing (4).

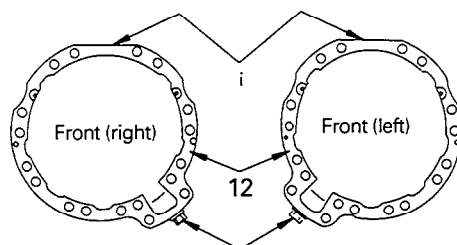
★ Coat the O-ring thinly with grease.

 O-ring : **Grease (G2-LI)**

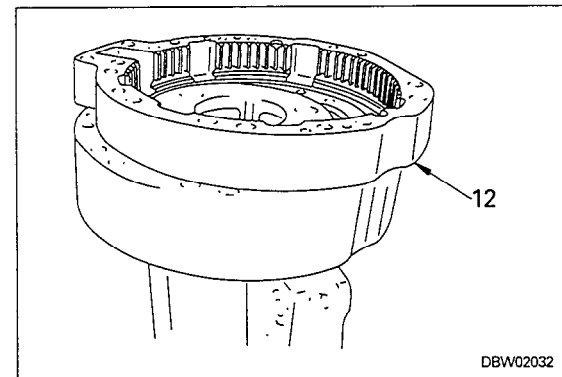


- 2) Align axle housing (4) and portion i, and install brake housing (12).

★ Be careful that the O-ring is not twisted or caught when installing.



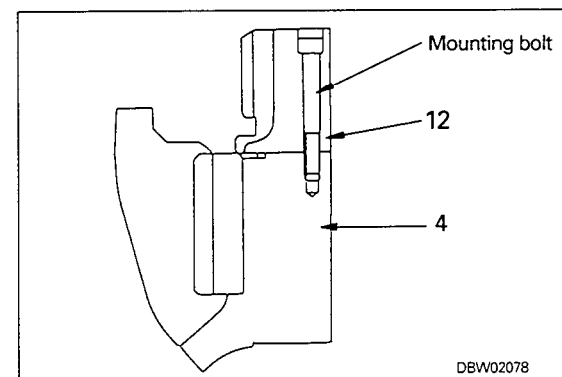
Plug for measuring the brake disc wear DBW02079



★ Assemble the axle housing so that the plug for measuring the brake disc wear is facing the rear.

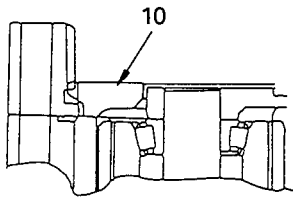
★ Axle housing

- | | |
|-----------------|-----------------|
| • Front (left) | } Oil filler |
| • Rear (right) | |
| • Front (right) | } No oil filler |
| • Rear (left) | |

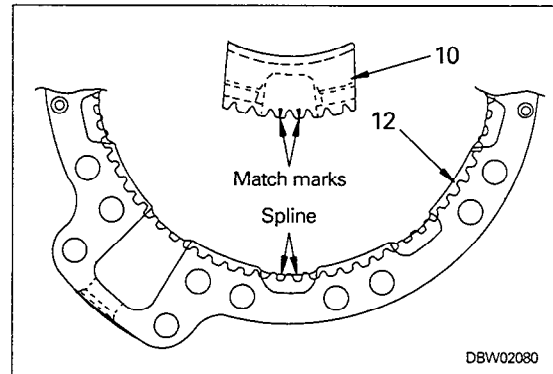


9. Sun gear shaft, outer ring

- 1) Align match mark of outer ring (10) with spline portion at bottom of brake housing (12), then assemble.
 - ★ Always align the match mark with the spline portion when assembling.
 - ★ Be careful not to damage the surface in contact with the brake disc.



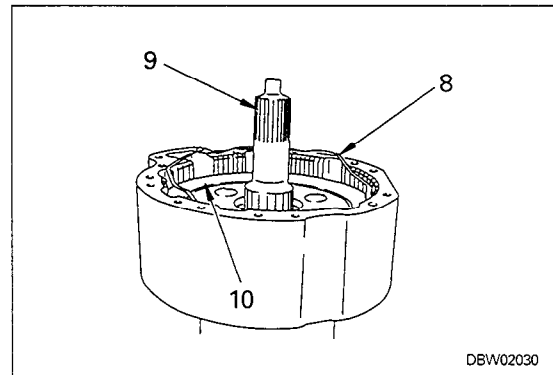
DBW02082



DBW02080

- 2) Assemble shaft (9).

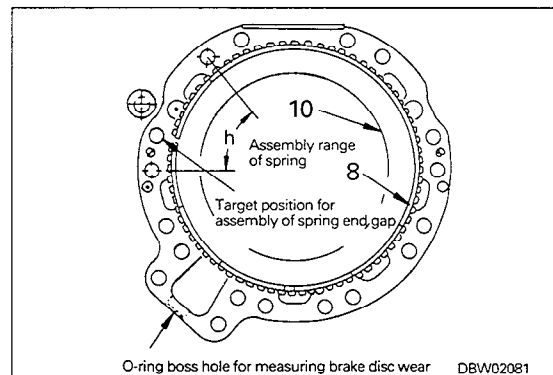
- ★ Always install the shaft before assembling the brake disc, wave spring (8), and plate.



DBW02030

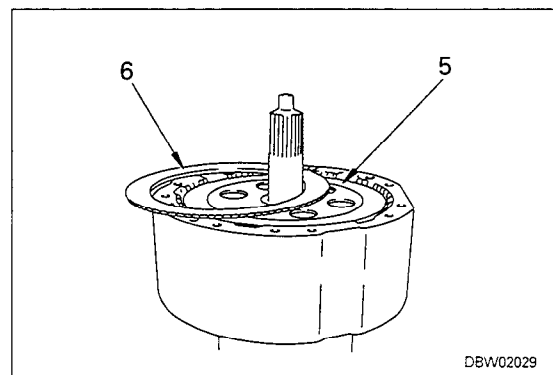
10. Brake disc, plate

- 1) Align end gap of wave spring (8), then assemble both to range (h).
 - ★ Assemble so that the end gap of the wave spring is on the O-ring boss hole side for measuring the disc wear, and is also within range (h).
 - ★ Always use 2 wave springs together.



O-ring boss hole for measuring brake disc wear DBW02081

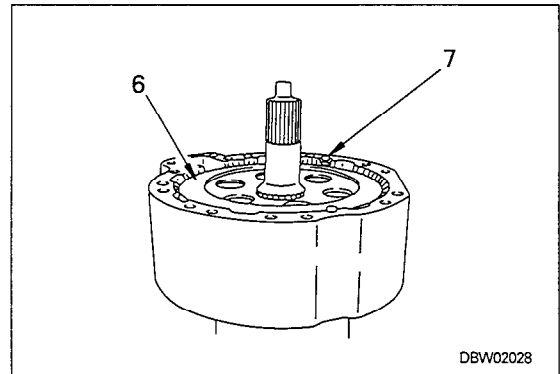
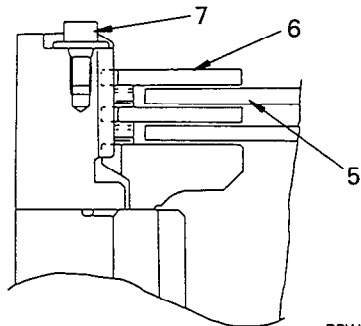
- 2) Assemble brake disc (5), plate (6), wave spring (8), brake disc (5), and plate (6) in order.
 - ★ Be careful not to damage the front face of the brake disc.
 - ★ Check that there is no damage to the front face of the plate when assembling.



DBW02029

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- 3) Assemble brake disc (5) and plate (6), then install lock bolt (7).



11. Axle housing assembly

- 1) Wash and remove all oil and grease from mounting surface of axle housing (4) and differential housing (36), then coat with gasket sealant.

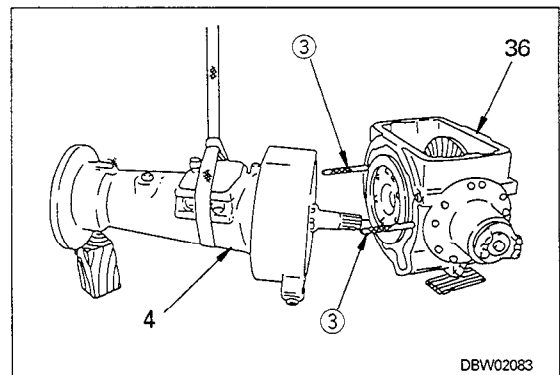
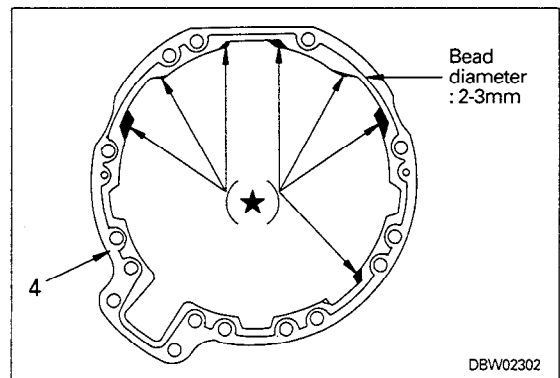
- ★ See the diagram on the right for the coating procedure.
 - Coat with a continuous bead diameter of 2 – 3 mm.
 - The shape at portion ★ is different at the differential housing end. Coat so that the bead does not come off.
- ★ Wash and remove all oil and grease from the axle housing and differential housing mounting surface, then coat with a continuous line of gasket sealant so that there is no break.

 Mating surface of housing :

Gasket sealant (Loctite 515)

- 2) Raise axle housing (4) horizontally, then align spline groove and guide bolts ③ (20 mm, P=2.5, L=230mm), and assemble carefully.

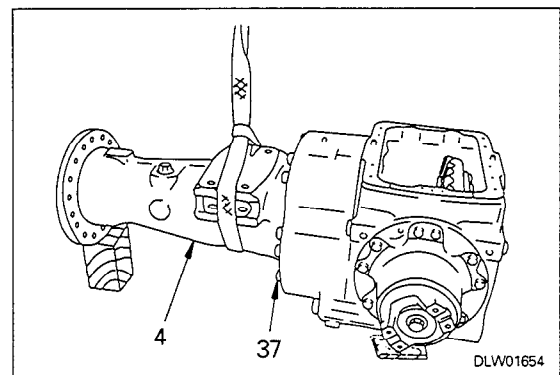
- ★ When assembling the axle housing, be careful not to cut the gasket bead.
- ★ When assembling, be careful not to damage the plate surface.



- 3) Install mounting bolts (37) on diagonally opposite sides, and tighten.

 Housing mounting bolt :

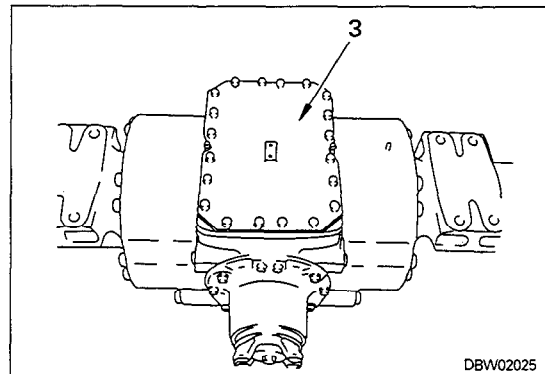
549 ± 59 Nm (56.0 ± 6.0 kgm)



U42303

12. Differential cover

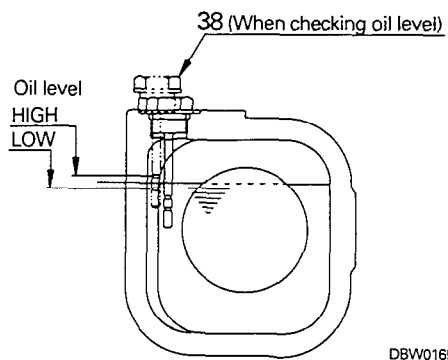
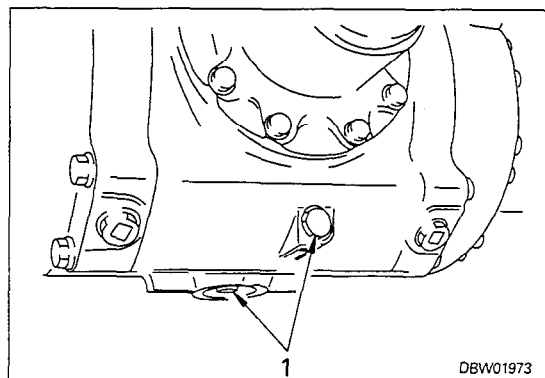
If differential cover (3) was removed, see DIS-
ASSEMBLY AND ASSEMBLY OF DIFFERENTIAL
ASSEMBLY.



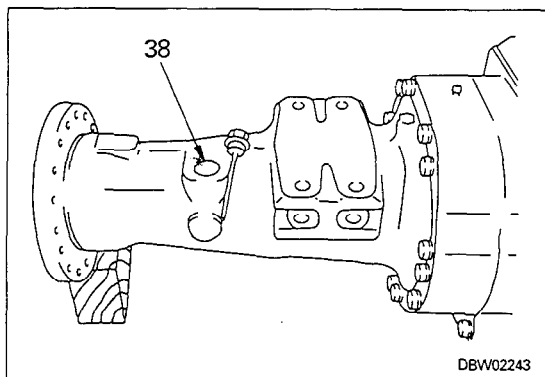
13. Refilling with oil

Tighten drain plugs (1) and add oil through oil
filler (38) to specified level.

- ★ Set the axle horizontal and add a small
amount of oil. (Before installing to chassis)
- ★ After installing to the chassis, add oil and
check the oil level again.



- ★ Set to a horizontal position when checking
the oil level.



U42303

REMOVAL OF CENTER HINGE PIN

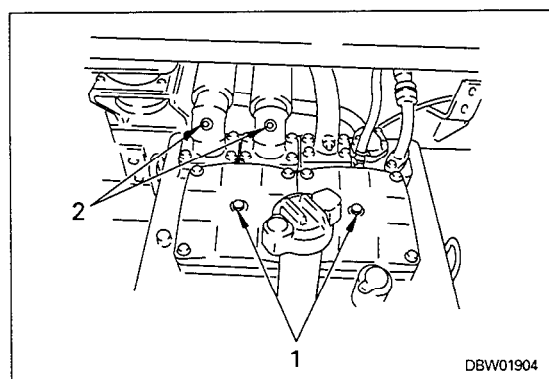
! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

! 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.

! Disconnect the cable from the negative (-) terminal of the battery.

1. Loosen plugs (1) at top of hydraulic tank filter and plugs (2) of pump piping to prevent oil inside tank from flowing out.

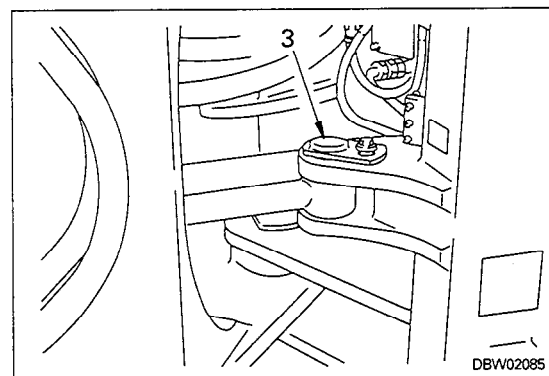
2. Remove cab and floor frame assembly.
For details, see REMOVAL OF CAB AND FLOOR FRAME ASSEMBLY. ※ 1



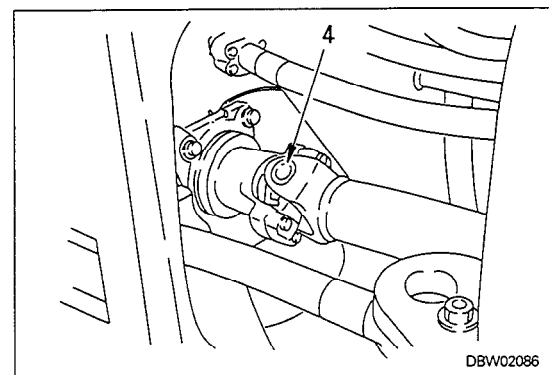
3. Remove lock bolt at rod end of steering cylinder, then remove pin (3). ※ 2

- Do the same for both left and right steering cylinders.

- ★ If there are shims, check the number and thickness of the shims, and keep in a safe place.



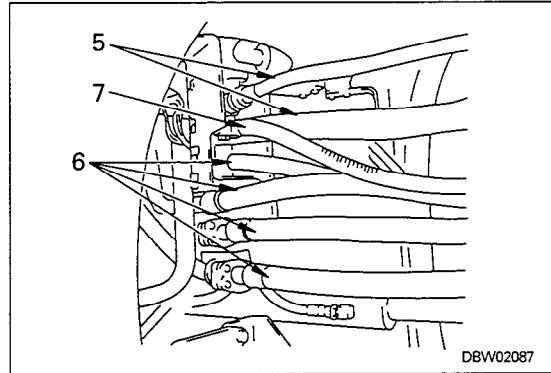
4. Disconnect center drive shaft (4).



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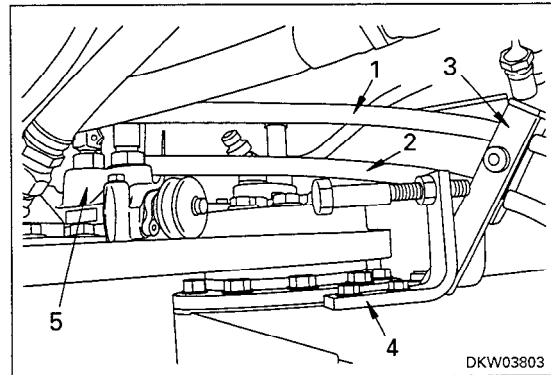
5. Disconnect hoses (5) and (6), and cable (7).

- ★ Disconnect hose (5) at the connecting portion at the rear frame end, then disconnect hose (6) at the valve end.



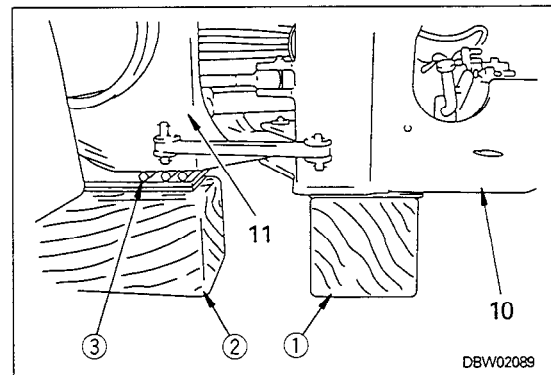
6. Disconnect stop valves as follows.

- 1) Disconnect hoses (1) and (2) from the steering valve.
- 2) Remove blocks (3) on the front and rear frame sides.
- 3) Remove adjustment brackets (4) for stop valves on the left and right sides. ※ 3
- 4) Remove left and right stop valves (5).
 - ★ Remove the left side stop valve (5) and under spacer. Then put them aside on the right side of the frame.

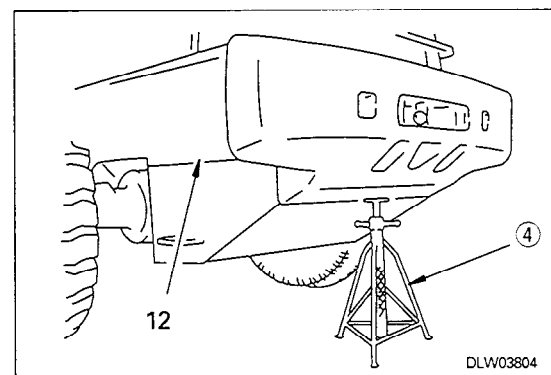


7. Disconnect frame as follows. ※ 4

- 1) Adjust height of rear frame (10) and set block ① in position.
 - ★ Set block ① under the frame on the left and right sides.
- 2) Adjust height of front frame (11), then set block ② in position, and assemble rollers ③ between frame (11) and block ②.
 - ★ Set block ② and rollers ③ under the frame on the left and right sides.
 - ★ Adjust the height of the frame carefully.

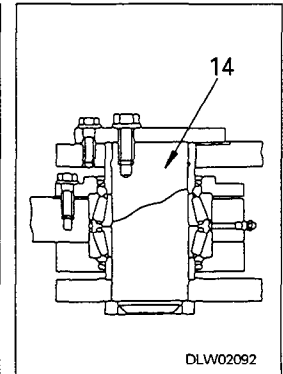
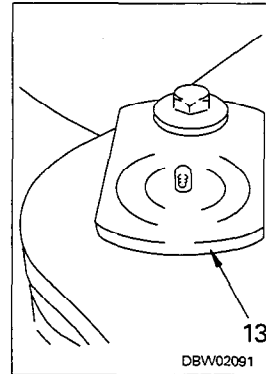


- 3) Set support ④ under counterweight (12).
 - ★ Block the left and right rear tires securely to prevent them from moving.
 - ★ Choose a support with adjustable height for support ④.
- 4) Remove safety bar.

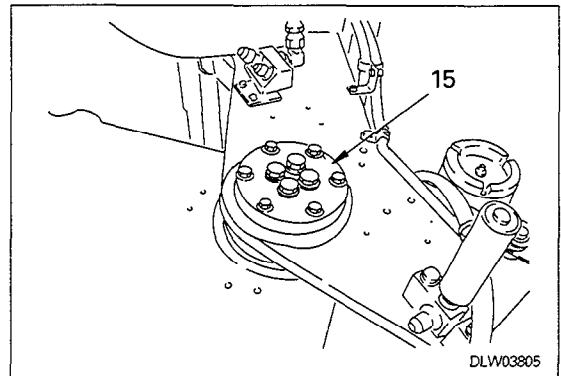


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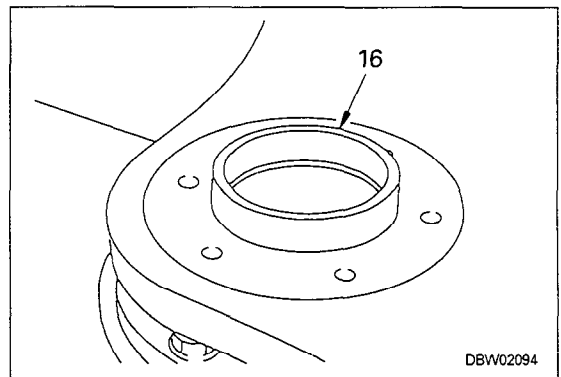
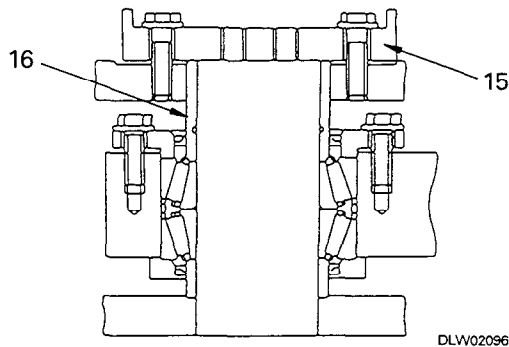
- 5) Remove lower hinge pin mounting bolts, and remove pin (13) from top.
★ Adjust the height of the front frame and rear frame carefully and set so that the pin can be removed without using force.
- 6) Remove upper hinge pin mounting bolts, and remove pin (14) from bottom.
★ Be careful not to let the pin fall.



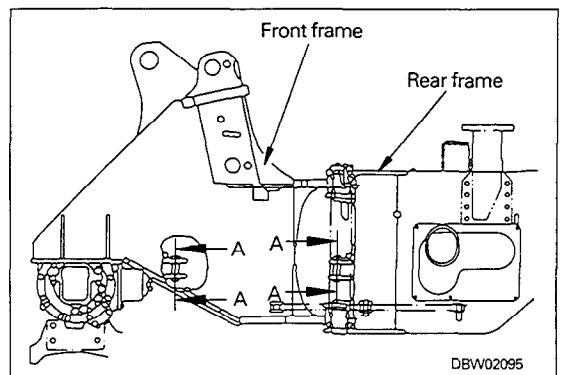
- 7) Remove mounting bolts, then remove re-tilt (15) at rear frame end.
★ There are shims, so check the number and thickness of the shims, and keep in a safe place.



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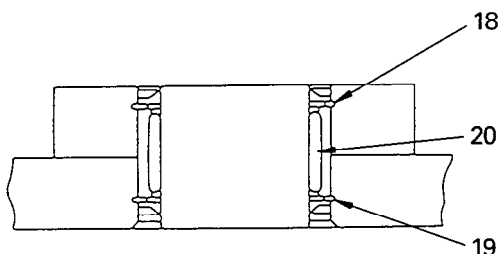
- 8) Pull out spacer (16).
- 9) Jack up front differential, and pull out front frame towards front.
★ Be careful not to get the spacer at the bottom of the upper hinge caught in the rear frame. After disconnecting, remove the spacer.
★ Be extremely careful to maintain the balance during the operation.



8. Lower hinge bearing

※ 5

- 1) Remove both top and bottom dust seals (17).
- 2) Remove snap rings (18) and (19), and pull out bearing (20).

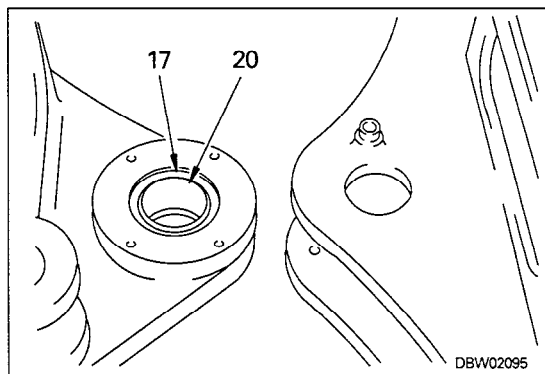


DLW02101

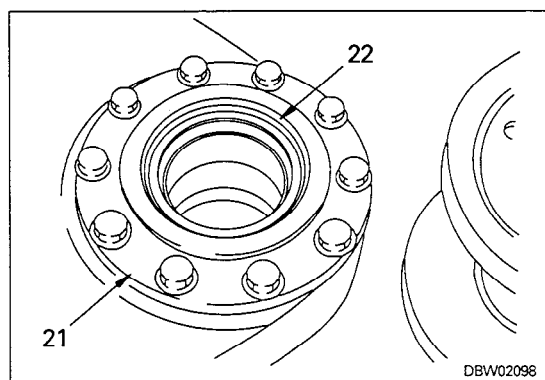
9. Upper hinge bearing

※ 6

- 1) Remove mounting bolts, remove retainer (21), then remove dust seal (22) from retainer.
- ★ There are shims between the retainer and the front frame, so check the number and thickness of the shims and keep in a safe place.

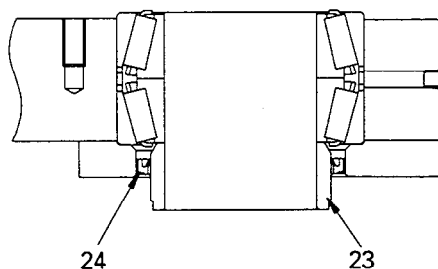


DBW02095

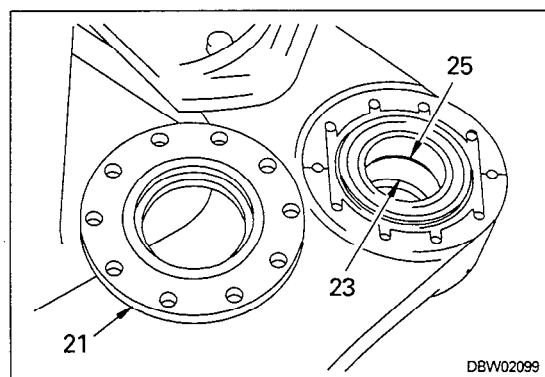


DBW02098

- 2) Remove bottom spacer (23) and seal (24) from front frame.

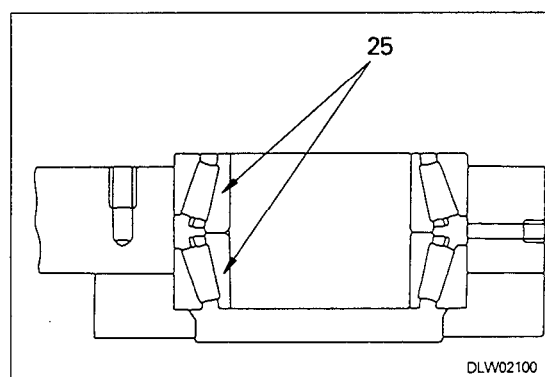


DAW02102



DBW02099

- 3) Remove bearing (25).



DLW02100

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INSTALLATION OF CENTER HINGE PIN

- Carry out installation in the reverse order to removal.

※ 1

Install cab and floor assembly.

For details, see INSTALLATION OF CAB, FLOOR FRAME ASSEMBLY.

※ 2

- ★ Be careful not to forget to assemble the shim.
- ★ Adjust the shims so that the clearance between the cylinder and frame is 0 – 0.5 mm.

※ 3

Adjust the clearance between the front and rear frames.

For details, see TESTING AND ADJUSTING STEERING CONTROL.

※ 4

Connect the frame as follows.

- 1) Jack up front differential, then move front frame towards rear frame end, and align pin holes.

- ★ Be careful that the spacer at the bottom of the upper hinge does not interfere with the rear frame.

- ★ Align the pin holes securely.

- ⚠ When aligning the position of the pin hole, always use a bar. Never insert your fingers in the pin hole.

- 2) Assemble spacer (16) to upper hinge.

- ★ Assemble spacer (16) from the top so that the large chamfered side is on the bearing side.

- ★ Be careful not to damage the dust seal lip.

 Outside circumference of hinge :

Grease (G2-LI)

 Inside circumference of spacer :

Grease (G2-LI)

- 3) Assemble upper hinge pin (14) from bottom.

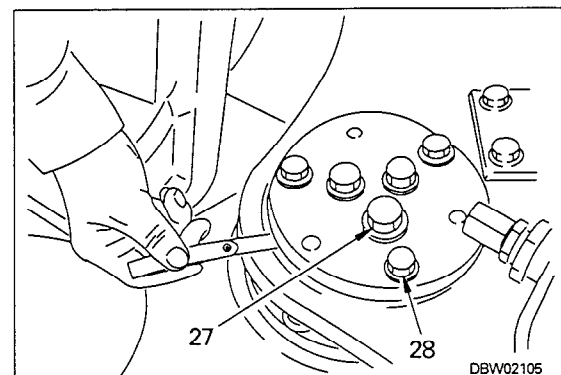
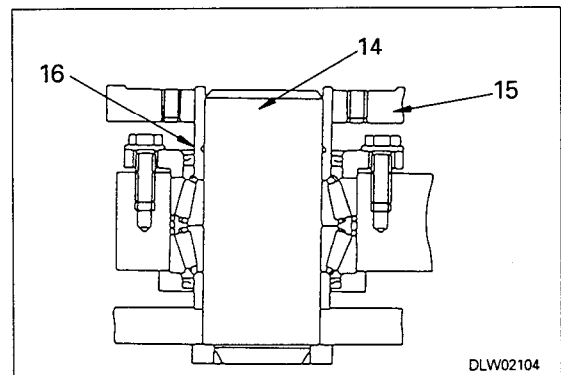
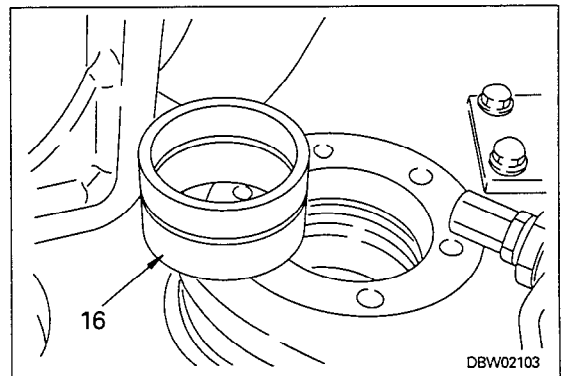
- 4) Tighten retainer (15) to upper hinge pin with 3 mounting bolts (27), then select shims so that clearance **b** between hinge and retainer is below 0.2 mm, and assemble.

 Pin mounting bolt :

19.6 ± 2 Nm (2.0 ± 0.2 kgm)

(When adjusting shims)

- ★ Temporarily tighten mounting bolts (28), leaving a clearance of approx. 5 mm from the surface of retainer (15).



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- 5) After adjusting shims, tighten retainer mounting bolt (28) to specified torque, then tighten pin mounting bolt (27) fully.

 Retainer mounting bolt :

Thread tightener (LT-2)

 Retainer mounting bolt :

$206 \pm 19.6 \text{ Nm}$ ($21.0 \pm 2.0 \text{ kgm}$)

 Pin mounting bolt :

Thread tightener (LT-2)

 Pin mounting bolt :

$206 \pm 9.8 \text{ Nm}$ ($21.0 \pm 1.0 \text{ kgm}$)

 Retainer mounting bolt :

$112.8 \pm 9.8 \text{ Nm}$ ($11.5 \pm 1.0 \text{ kgm}$)

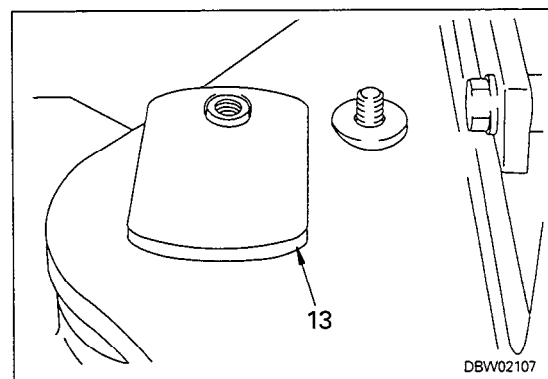
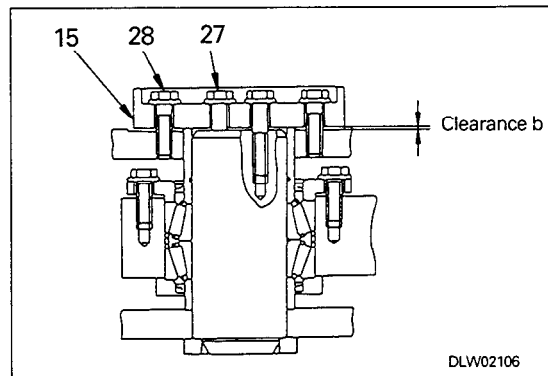
- 6) Insert lower hinge pin (13) and secure with lock bolt.

 Outside circumference of hinge pin :

Grease (G2-LI)

- 7) Remove support from counterweight, and front and rear frames.

- 8) Install safety bar.

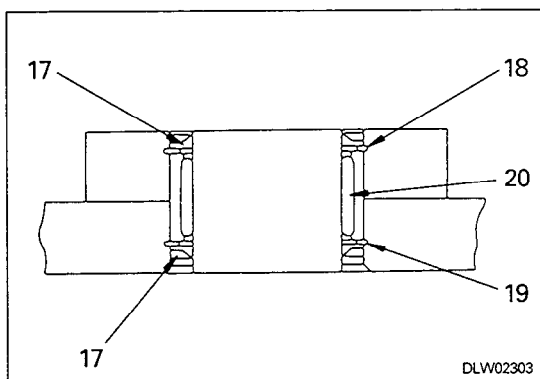


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※ 5

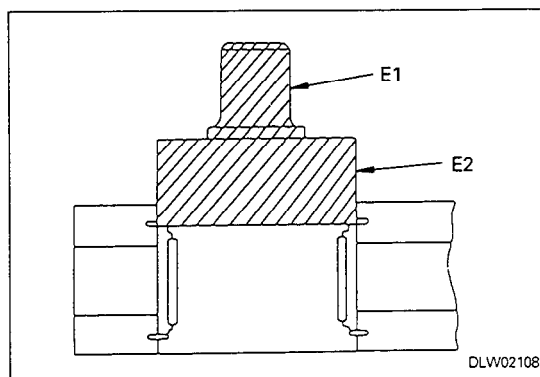
1. Lower hinge bearing

- 1) Assemble snap ring (19) to front frame lower hinge, then use tools E1 and E2 to press fit bearing (20), and secure with snap ring (18).
★ Press fit so that the bearing is level with the surface of snap ring (19).



- 2) After assembling snap ring (18), press fit dust seals (17) to top and bottom of pin portion.
★ Replace the dust seal with a new part, and press fit so that the lip surface is facing the outside.

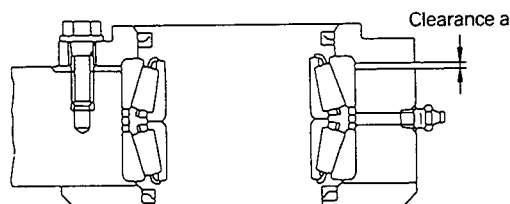
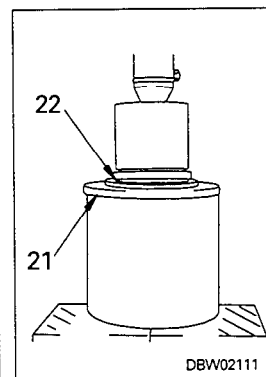
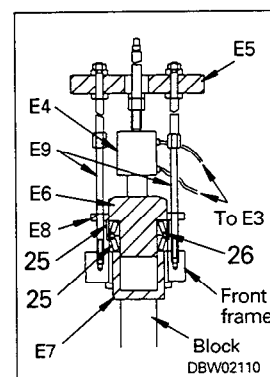
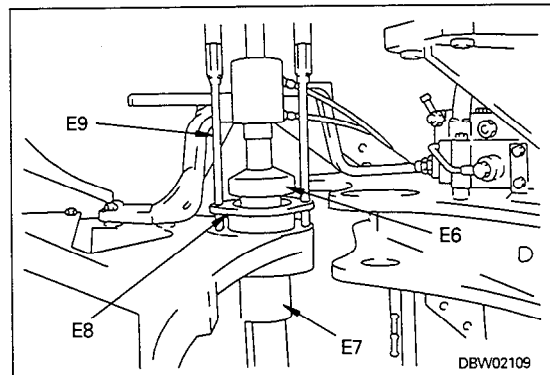
 Lip of dust seal : **Grease (G2-LI)**



※ 6

2. Upper hinge bearing

- 1) Assemble tools **E3, E4, E5, E7, E8, and E9** to top of front frame upper hinge, set bearing (25) in tool **E6**, then set to press-fitting portion from above and press fit.
 - ★ When press fitting, use tool **E8** as a guide.
 - ★ Be careful that the bearing is not at an angle.
 - ★ Fill the inside of bearing (25) with an ample amount of grease.
 - ★ When assembling the bearing, do not forget to assemble spacer (26).
 - ★ The clearance of bearing (25) is adjusted, so do not change the combination with spacer (26).
When replacing, always replace the parts as a set.
- 2) Press fit dust seal (22) to retainer (21).
 - ★ Replace the dust seal with a new part, and press fit so that the lip surface is facing the outside.
- 3) Tighten retainer (21) with 3 mounting bolts, and select shims so that maximum clearance **a** between retainer and hinge is below 0.1 mm, then assemble.

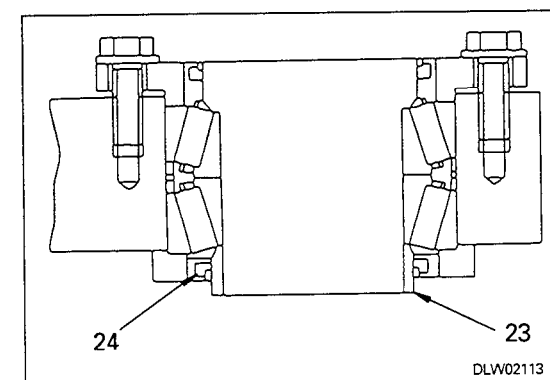
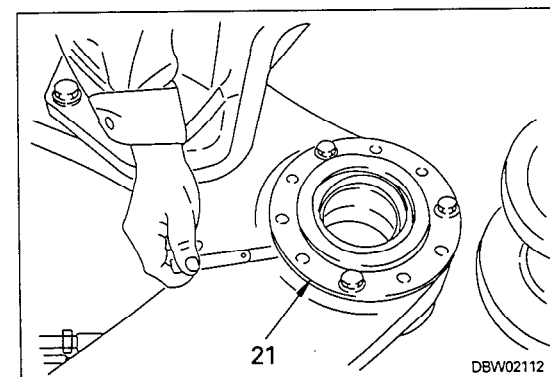


DLW02114

 **Mounting bolt :**
 $19.6 \pm 2.0 \text{ Nm } (2.0 \pm 0.2 \text{ kgm})$
 (When adjusting shims)

 **Mounting bolt :**
 $112.8 \pm 9.8 \text{ Nm } (11.5 \pm 1.0 \text{ kgm})$

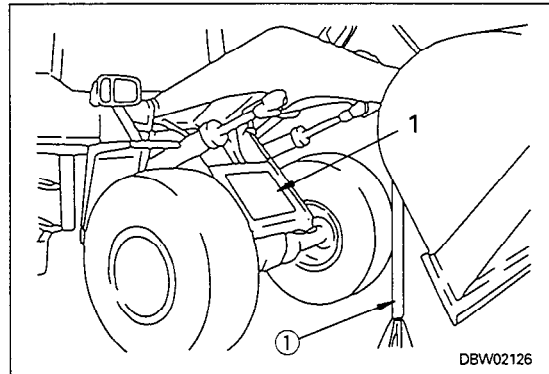
- 4) Install dust seal (24) and spacer (23) from under front frame.
 -  Lip of dust seal : **Grease (G2-LI)**
 -  Inside circumference of spacer : **Grease (G2-LI)**
 - ★ Replace the dust seal with a new part, and press fit so that the lip surface is facing the outside.
 - ★ Assemble spacer (23) from the bottom so that the large chamfered side is on the bearing side.



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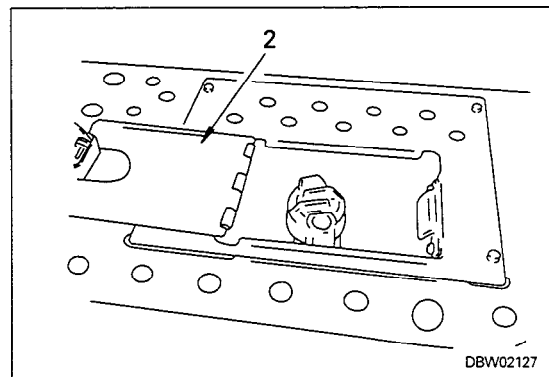
REMOVAL OF STEERING VALVE ASSEMBLY

- ⚠ 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.
- ★ Raise the boom, set a support under the boom, then remove front frame inspection cover (1).
- ⚠ Set support ① in position securely.
- ★ 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.

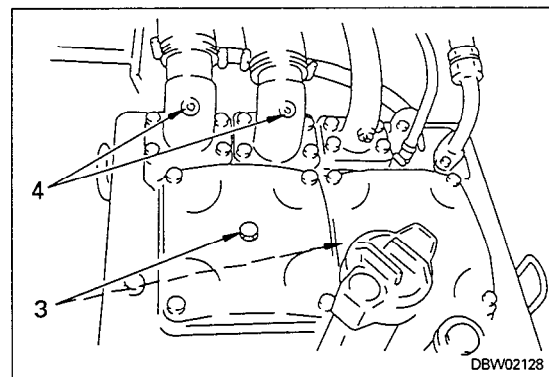


1. Cover

- 1) Remove mounting bolts, then remove inspection cover (2).
- ★ Remove the covers on the front and right side at the bottom of the cab.

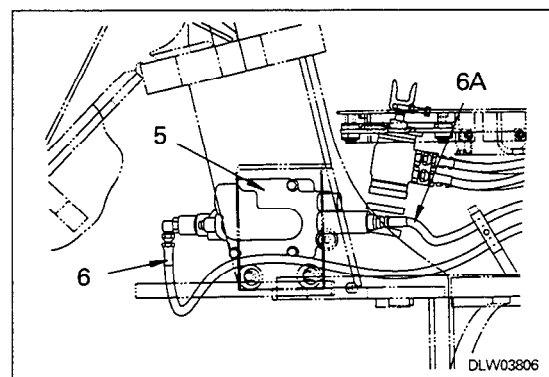


- 2) Loosen plugs (3) at top of hydraulic tank filter and plugs (4) of pump piping to prevent oil inside tank from flowing out.



2. Hydraulic piping

- Disconnect hoses (6) and (6A) between stop valves from steering valve (5).
- ★ Remove clamps and brackets.



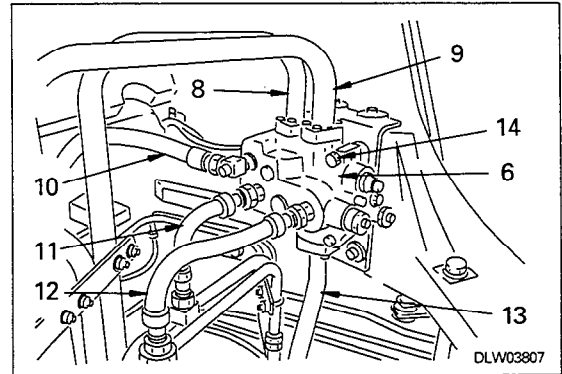
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3. Hydraulic piping

※ 1

Disconnect following hydraulic piping from steering valve.

- Tube (8) between switch pump and steering valve
- Tube (9) between steering pump and steering valve
- Tube (10) between steering valve and main control valve
- Tubes (11) and (12) between steering valve and steering cylinder
- Tube (13) between steering valve and hydraulic tank

**4. Steering valve**

※ 1

Sling steering valve (6), and remove mounting bolts (14), then lift off steering valve.



Steering valve : **24 kg**

- ★ Carry out the removal operation with two workers.

⚠ The steering valve is oily, so be careful not to let it slip.

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INSTALLATION OF STEERING VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Replace the O-ring with a new part.
- ★ Remove the clamp to avoid applying force when installing the tube.

- **Refilling with oil**

Tighten the plug at the top of the hydraulic tank filter and add hydraulic oil through oil filler to the specified level.

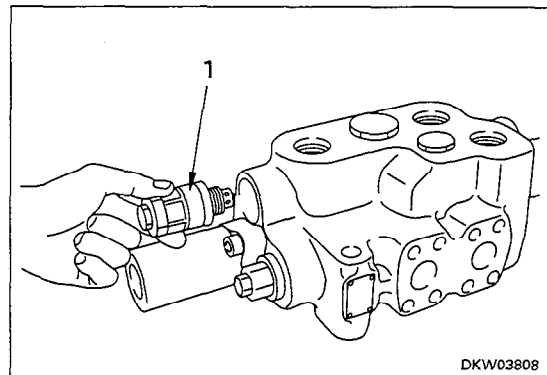
 kgm Plug at top of filter :

11.8 ± 1.0 Nm (1.2 ± 0.1 kgm)

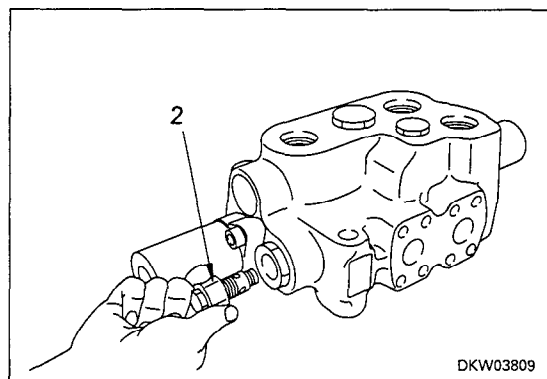
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DISASSEMBLY OF STEERING VALVE

1. Remove safety valve assembly (1).
 - ★ The set pressure of the safety valve is fixed, so do not disassemble it.

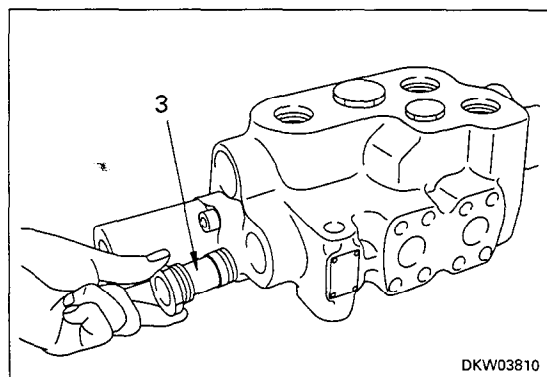


2. Remove main relief valve assembly (2).
 - ★ The set pressure of the main relief valve is fixed, so do not disassemble it.

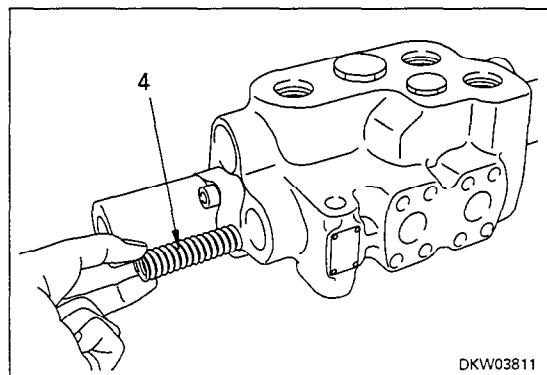


3. Removal of demand spool

- 1) Remove plug (3).

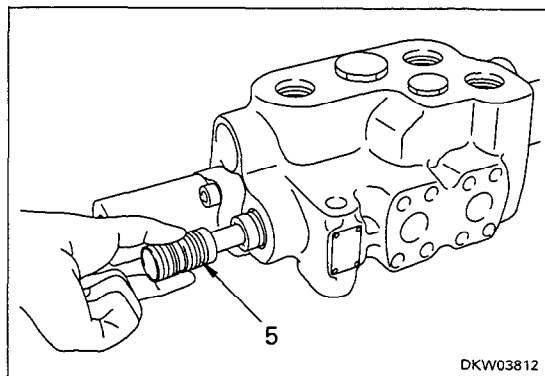


- 2) Remove spring (4).

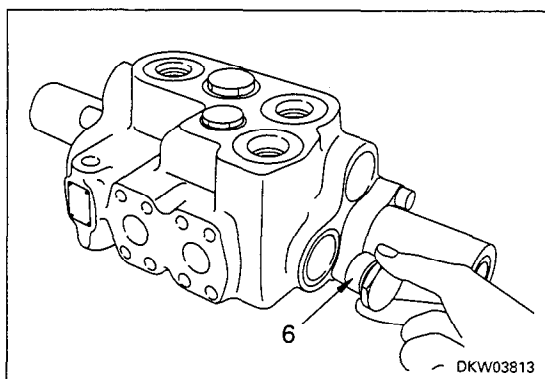


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- 3) Remove demand spool (5).
- ★ Remove slowly, taking care not to damage the spool.
 - ★ If shims are fitted, check the number and thickness of the shims, and keep in a safe place.



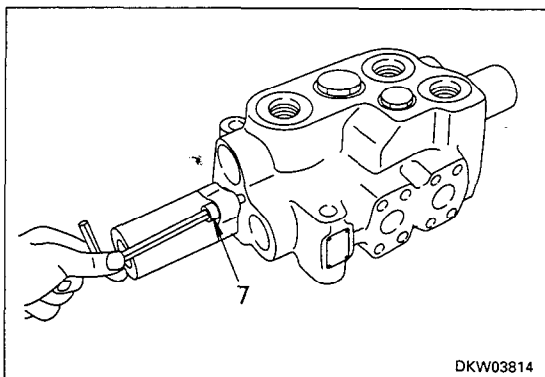
- 4) Remove plug (6).



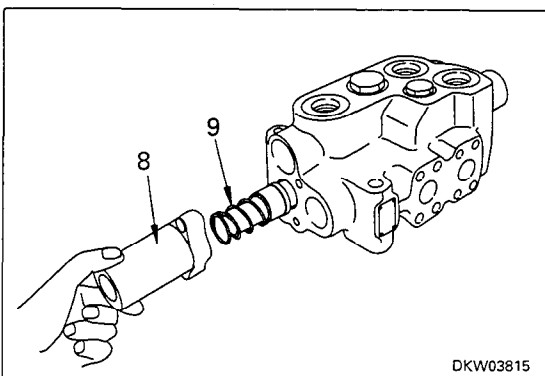
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4. Removal of steering spool

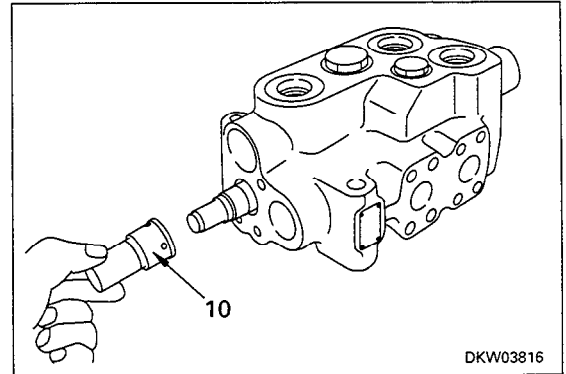
- 1) Remove 2 bolts (7).
- ★ Remove on the opposite side in the same way.



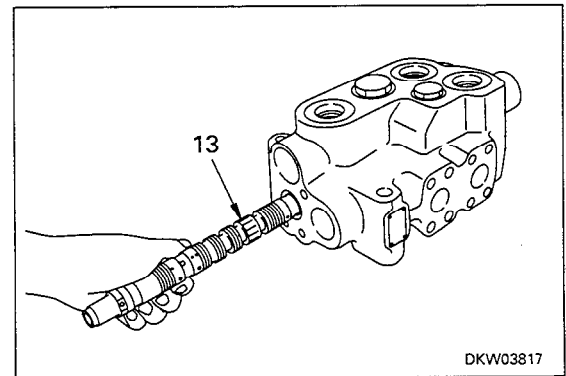
- 2) Remove case (8) and spring (9).
- ★ Remove on the opposite side in the same way.



- 3) Remove spring seat (10).
 - ★ Remove slowly, taking care not to damage the spool.
 - ★ Remove on the opposite side in the same way.

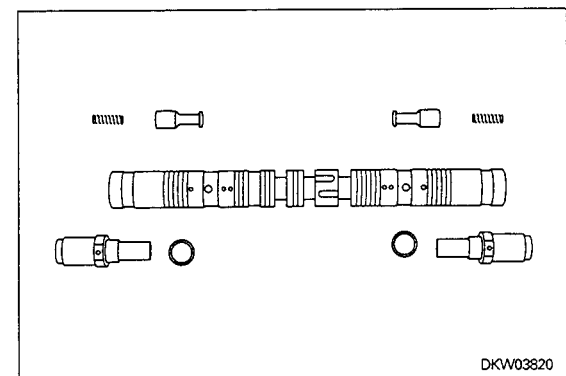
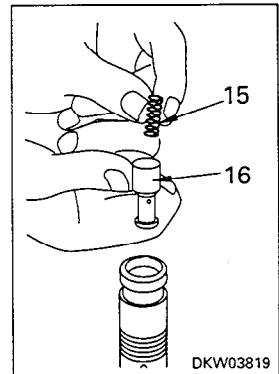
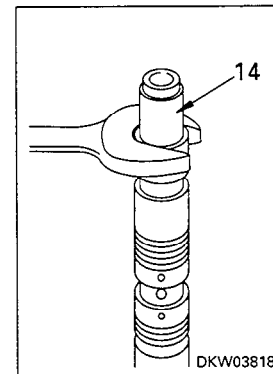


- 4) Remove steering spool assembly (13).
 - ★ Remove slowly, and be careful not to bend or damage the spool assembly.
 - ★ To prevent it from falling into the valve body, remove the poppets at both ends.



5. Disassembly of steering spool assembly

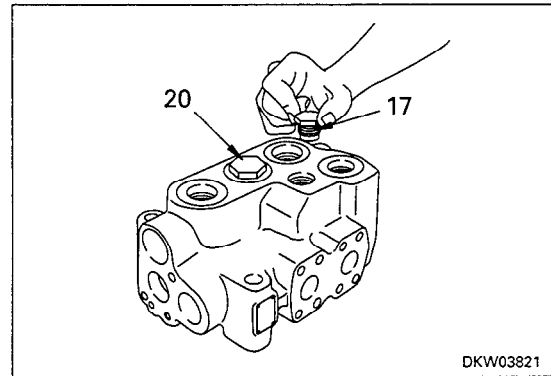
- 1) Remove cap screw (14).
 - ★ The cap screw is coated with adhesive (Loctite #271), so use an industrial dryer, and heat (200 – 250°C) before removing.
- 2) Remove spring (15) and poppet (16).
 - ★ Remove on the opposite side in the same way.



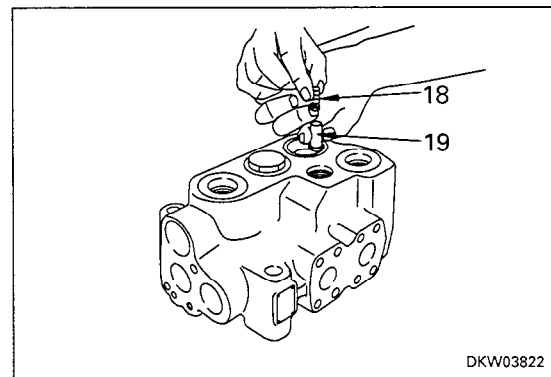
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6. Disassembly of check valve

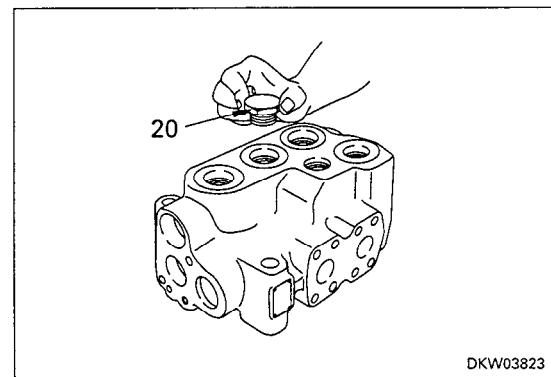
1) Remove plug (17).



2) Remove spring (18) and poppet (19).



7. Remove plug (20).

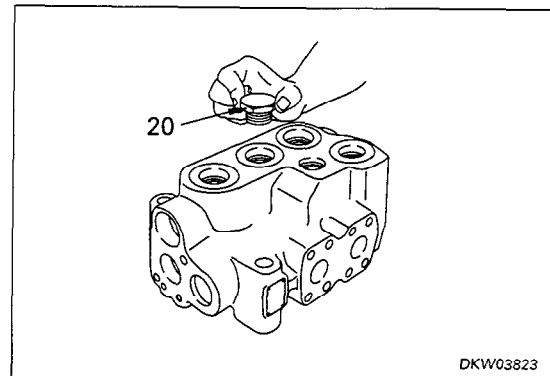


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ASSEMBLY OF STEERING VALVE

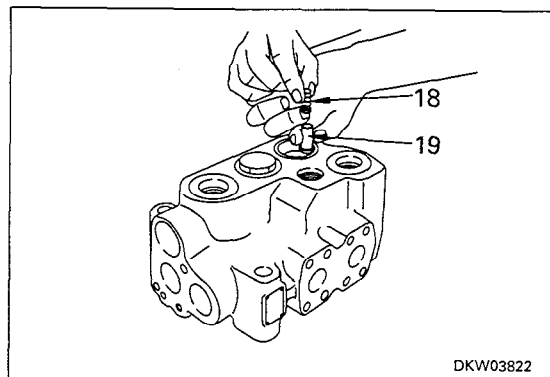
1. Fit O-ring to plug (20) and install to valve body.

 plug: $93.2 \pm 4.9 \text{ Nm}$ ($9.5 \pm 0.5 \text{ kgm}$)



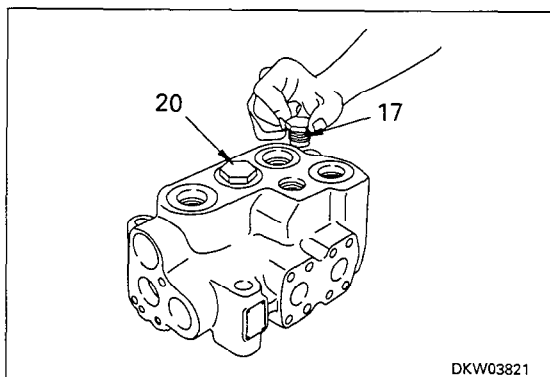
2. Assembly of check valve

- 1) Install poppet (19) and spring (18).



- 2) Fit O-ring (17) and install to valve body.

 plug: $63.7 \pm 4.9 \text{ Nm}$ ($6.5 \pm 0.5 \text{ kgm}$)



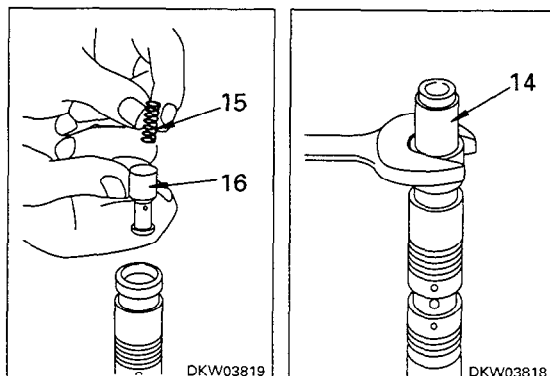
3. Assembly of steering spool

- 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: $8.8 \pm 1.0 \text{ Nm}$ ($0.9 \pm 0.1 \text{ kgm}$)

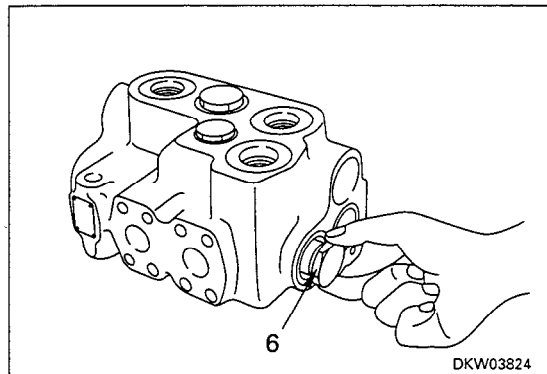


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4. Installation of demand spool

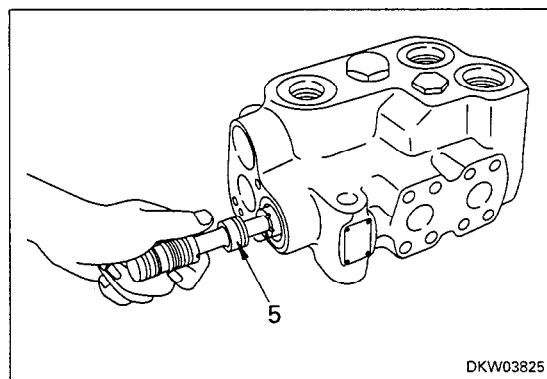
- 1) Fit O-ring to plug (6) and install to valve body.

 Plug: $137.3 \pm 2.0 \text{ Nm}$ ($14.0 \pm 0.2 \text{ kgm}$)

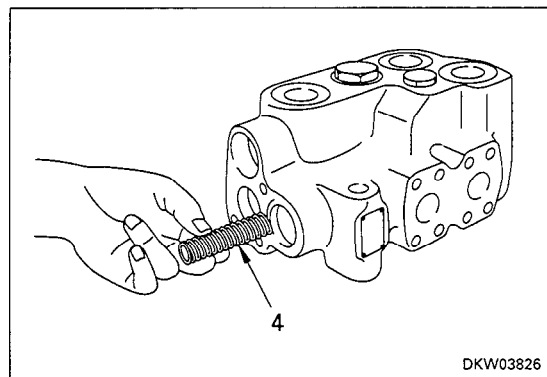


- 2) Install demand spool (5) to valve body.

- ★ If shims were fitted, assemble shims.
- ★ Install slowly, taking care not to damage the spool.

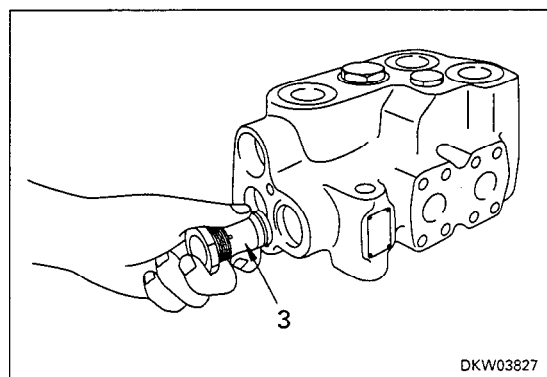


- 3) Install spring (4).



- 4) Fit O-ring and backup ring to plug (3), and install to valve body.

 Plug: $137.3 \pm 2.0 \text{ Nm}$ ($14.0 \pm 0.2 \text{ kgm}$)

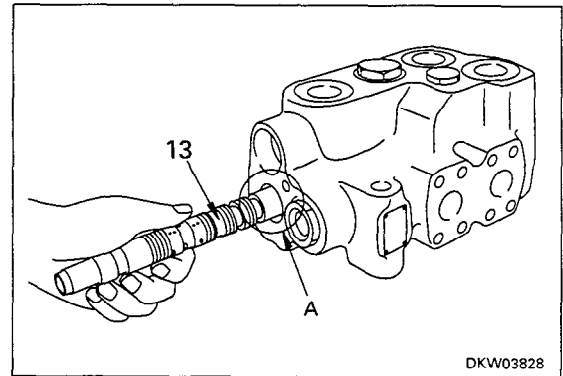


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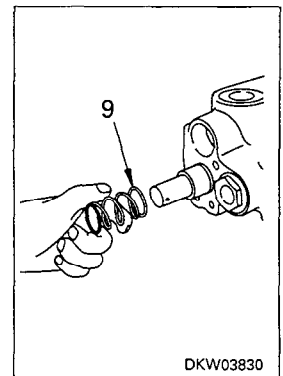
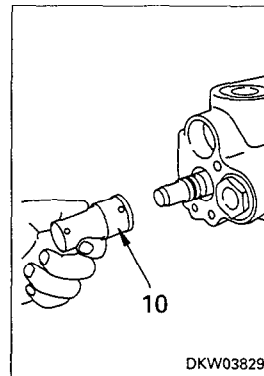
5. Installation of steering spool assembly

- 1) Install steering spool assembly (13) to valve body.

★ Be careful to install portion A of the spool facing in to the correct direction.



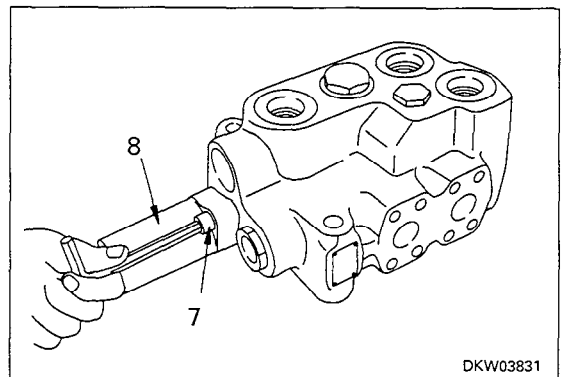
- 2) Install spring seat (10).
 - 3) Install spring (9).
- ★ Install on the opposite side in the same way.



- 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.

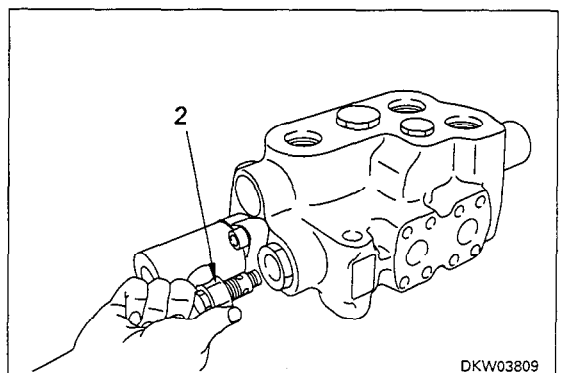
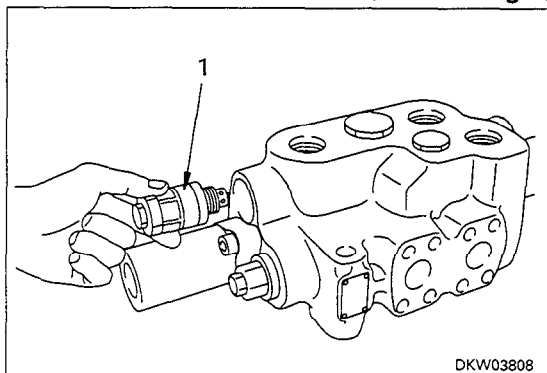


6. Install main relief valve assembly (2) to valve body.

 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:
 $73.5 \pm 4.9 \text{ Nm}$ ($7.5 \pm 0.5 \text{ kgm}$)



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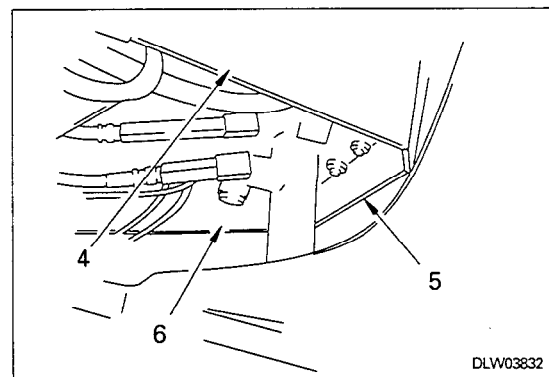
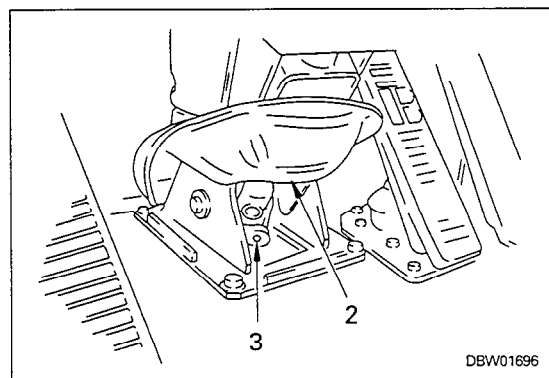
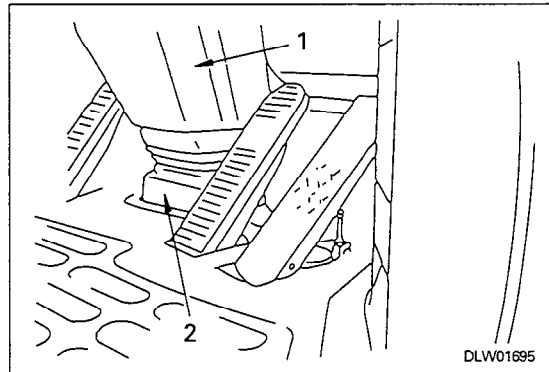
REMOVAL OF ORBIT-ROLL VALVE ASSEMBLY

⚠ 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.

- Loosen the plug at the top of the hydraulic tank filter to prevent the oil inside the tank from flowing out.

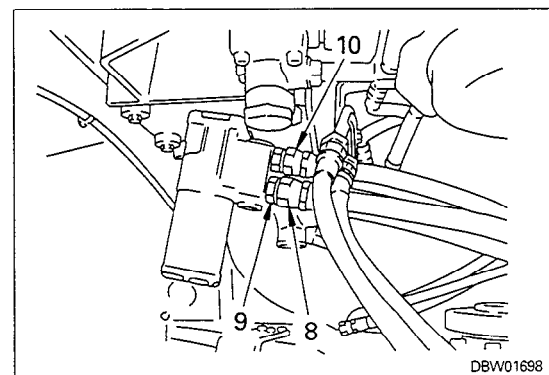
1. Remove steering post cover (1).
2. Remove plug, and lift boot (2) up.
★ Remove the floor mat.
3. Remove column connecting bolt (3).  1
4. Remove covers (4), (5), and (6) under floor.



5. Piping

Disconnect the following piping from orbit-roll valve.

- 1) Disconnect hose (8) between orbit-roll valve and accumulator, then remove nipple (9).
- 2) Disconnect hose (10) between orbit-roll valve and hydraulic tank.



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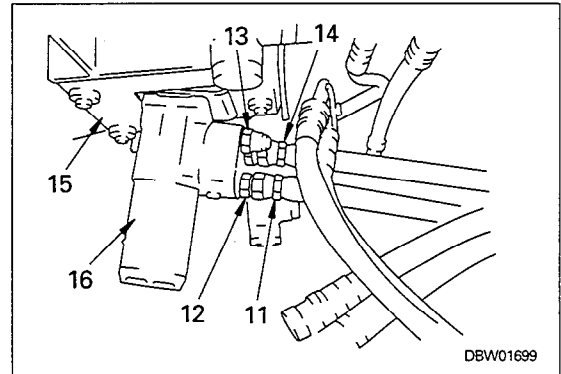
- 3) Disconnect hose (11) between orbit-roll valve and stop valve (R.H.), then remove nipples (12) and (13).
- 4) Disconnect hose (14) between orbit-roll valve and stop valve (L.H.), then remove nipple.

6. Steering valve

Remove bracket (15) mounting bolts, then remove together with orbit-roll valve (16). ※ 2



Orbit-roll valve : 8 kg



INSTALLATION OF ORBIT-ROLL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

kgm Column connecting bolt:
55.9 ± 7.8 Nm (5.7 ± 0.8 kgm)

※ 2

kgm Orbit-roll valve bolt:
52 ± 6.8 Nm (5.3 ± 0.7 kgm)

kgm Bracket bolt:
88.3 ± 34.3 Nm (9.0 ± 3.5 kgm)

- ★ Align the spline at the steering column end and the spline at the orbit-roll valve end.

- **Refilling with oil (hydraulic tank)**

Add oil through the oil filler to the specified level.

- ★ Run the engine to circulate the oil through the system. Then check the oil level again.

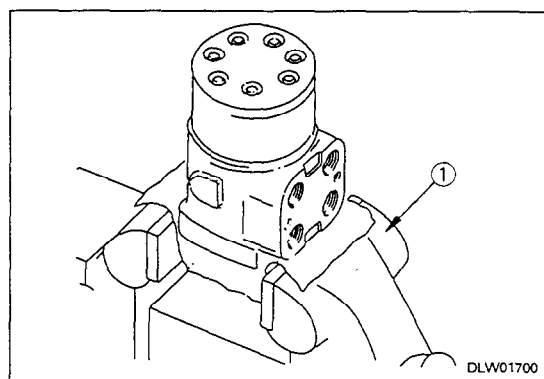
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DISASSEMBLY OF ORBIT-ROLL VALVE

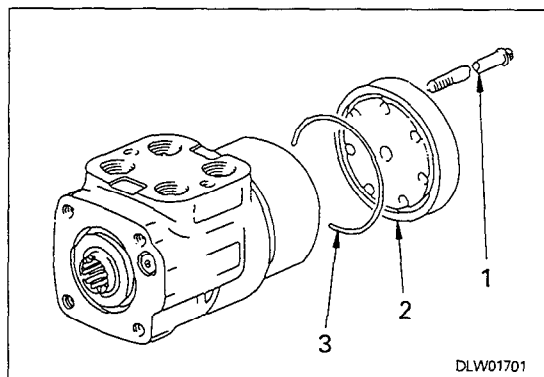
- ★ Use a wire brush to remove all the dirt and dust stuck to the joint around the outside circumference of the unit.
- ★ Carry out the operation in a clean place to prevent dirt or dust from sticking to the valve.
- ★ As far as possible, hold the valve in a vice when disassembling.

DISASSEMBLY OF ROTOR

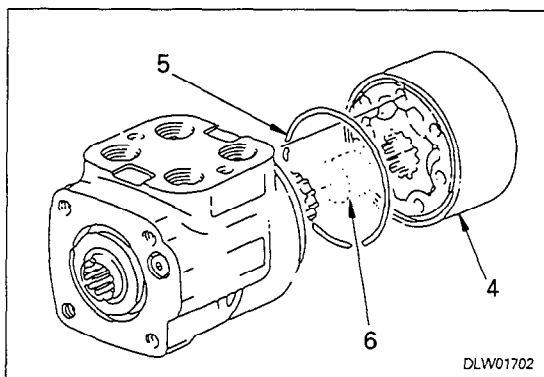
1. Set rotor side facing up, and hold mounting flange lightly in vice ①.
- ★ Put a copper plate in contact with the vice and be careful not to tighten the vice too hard.



2. Remove screw (1), then remove end cap (2).
3. Remove O-ring (3) from end cap (2).

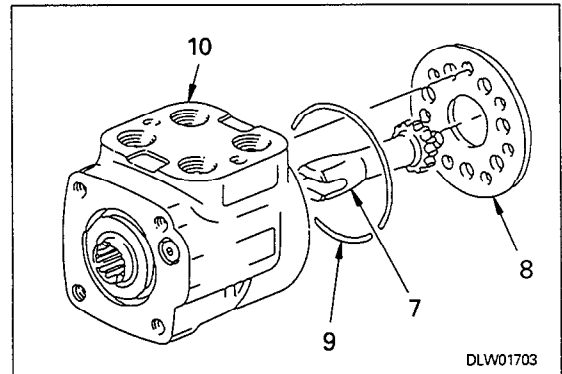


4. Pull out rotor set (4), then remove O-ring (5).
- ★ Be careful not to drop the star inside the rotor set.
5. Remove spacer (6).



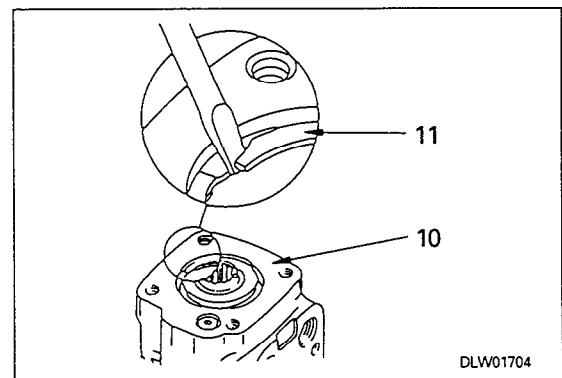
U42303

6. Remove drive shaft (7).
7. Remove spacer plate (8).
8. Remove O-ring (9) from housing (10).

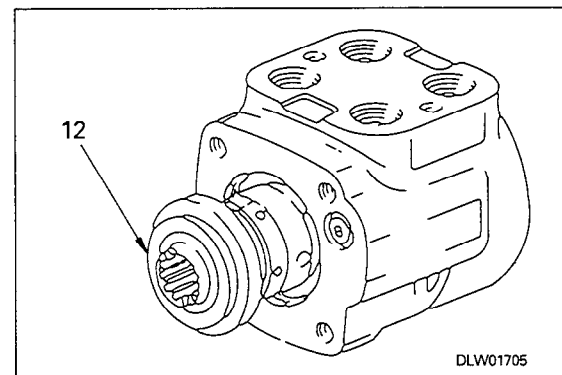


DISASSEMBLY OF CONTROL SIDE

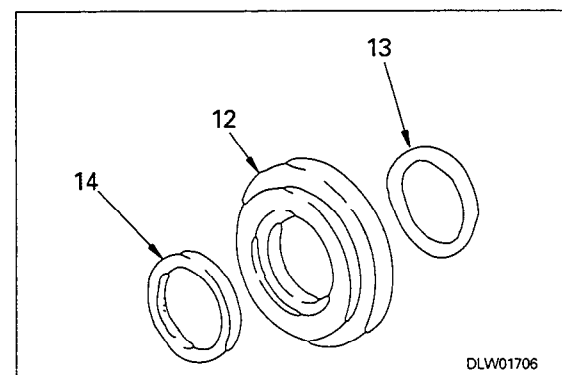
9. Remove housing (10) from vice, and place on a clean cloth. Be careful not to damage the finished surface.
10. Raise tip of snap ring (11) with screwdriver, and remove from housing.



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.

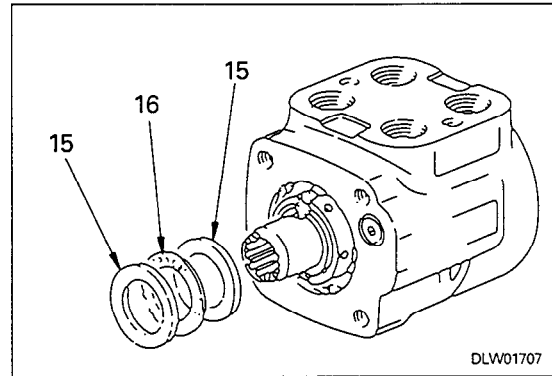


12. Remove X-ring seal (13) from bushing (12).
13. Remove dust seal (14) from bushing (12) with screwdriver.
 - ★ Be careful not to damage the bushing.



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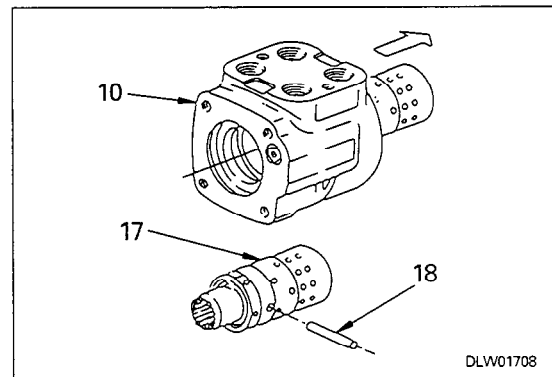
14. Remove 2 bearing races (15) and thrust needle (16) from spool and sleeve.



15. Pull out spool and sleeve assembly (17) from housing (10) in the direction of the arrow.

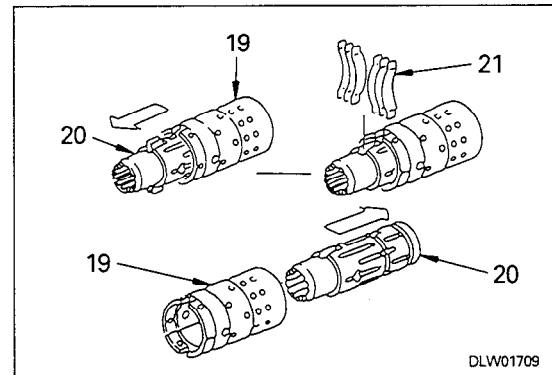
★ To prevent the spool and sleeve assembly from catching in the housing, rotate the spool and sleeve assembly slowly to the left and right when pulling out from the housing.

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).



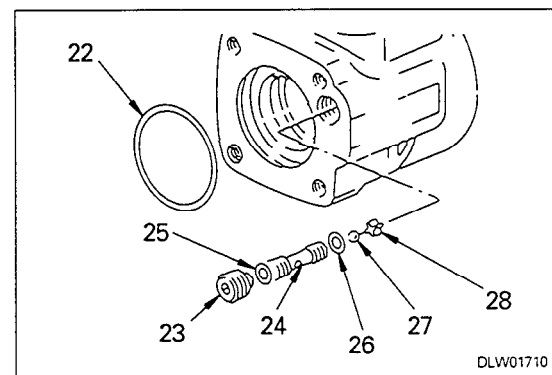
19. Remove O-ring (22) from housing.

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).



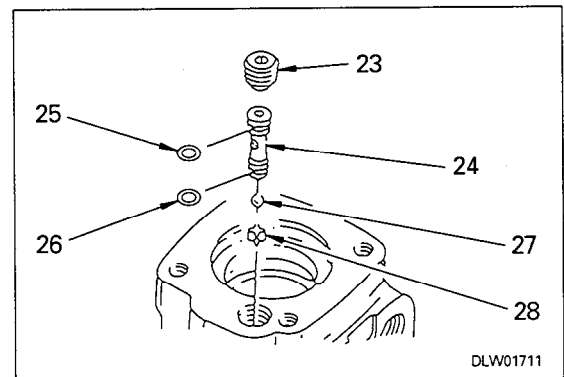
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ASSEMBLY OF ORBIT-ROLL VALVE

- ★ 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.

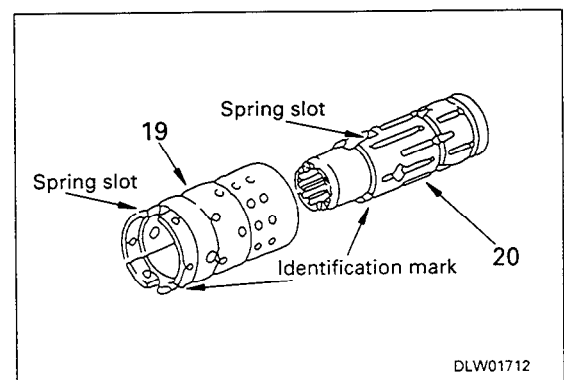
ASSEMBLY OF CONTROL SIDE

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 : **Loctite**

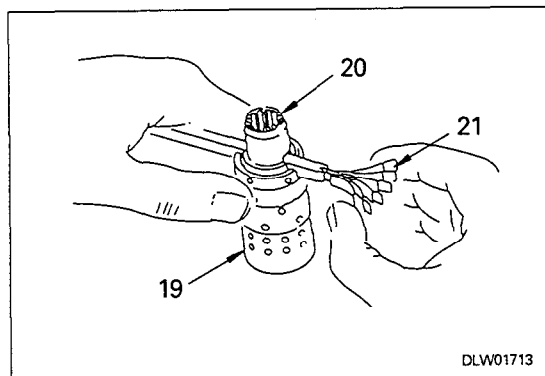
5. Assemble spool (20) and sleeve (19) so that spring groove is on same side.
 - ★ Rotate the spool and slide it in.
 - ★ Grip the splined portion of the spool lightly and check that the spool rotates smoothly inside the sleeve.
 - ★ If there are match marks, check that the match marks are aligned.



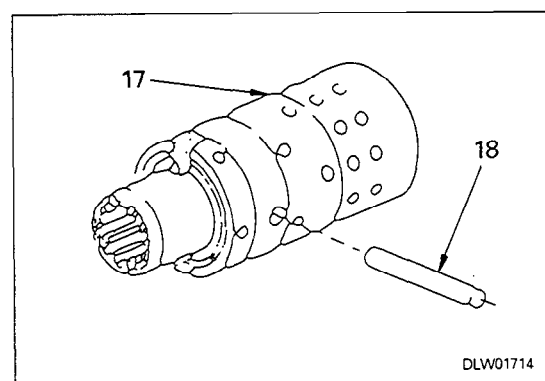
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6. Align spring groove positions of spool (20) and sleeve (19), and set on flat plate, then insert spring (21) in spring groove.

★ 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.

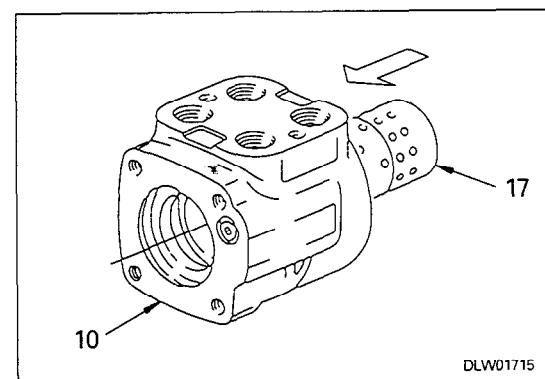
1) Keep pin horizontal and rotate to left and right a little at a time to insert.

★ Be extremely careful not to get it caught.

2) Make the spool and sleeve assembly flush with the rear end face of the housing.

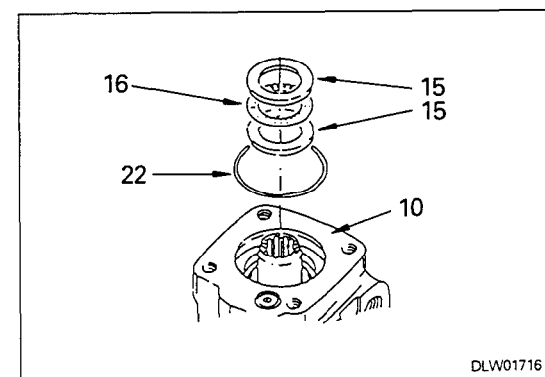
★ If it is inserted beyond the end face, the pin will fall out.

3) Check that spool and sleeve rotate smoothly inside housing.



9. Install O-ring (22) to housing (10).

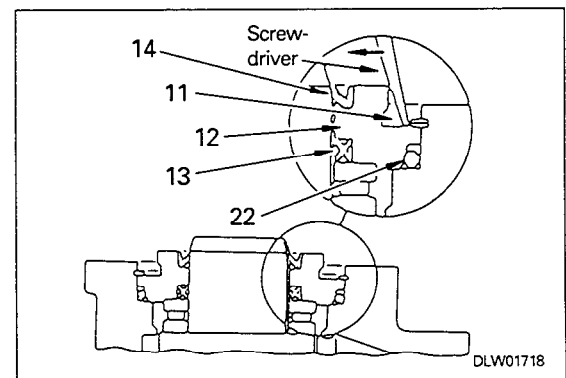
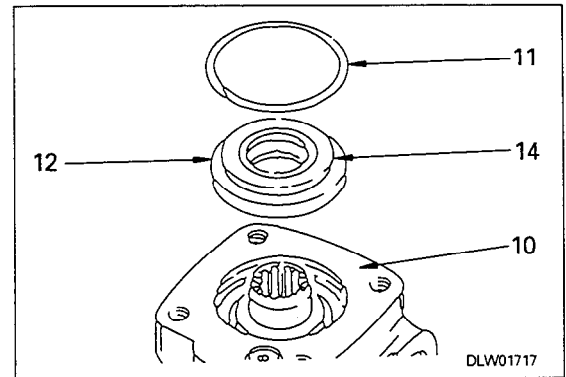
10. Fit 2 bearing races (15) and thrust needle (16) in case (10).



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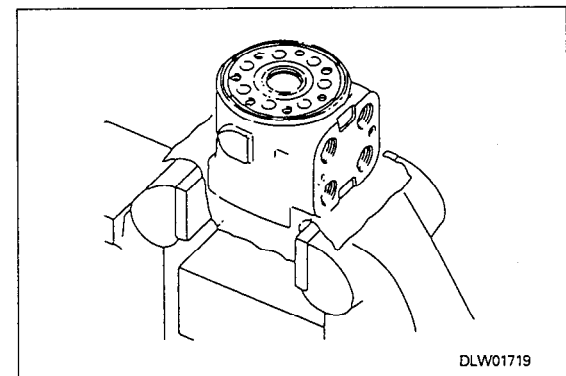
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11. Insert dust seal (14) in bushing (12).
12. Insert X-ring seal (13) in bushing (12).
13. Insert bushing (12) in spool, and rotate to install.
 - Tap with a plastic hammer to assemble to the specified position.
 - It must be in contact horizontally with the bearing race.
14. Fit snap ring (11) in housing.

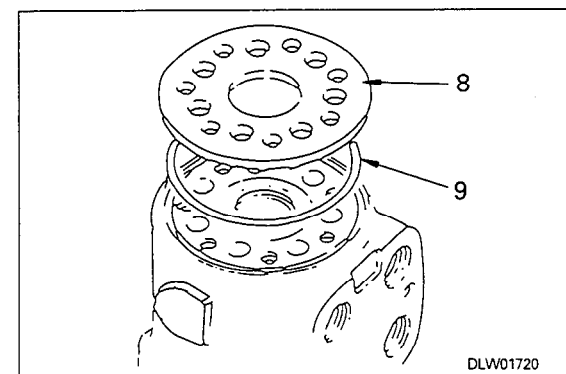


ASSEMBLY OF ROTOR

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.

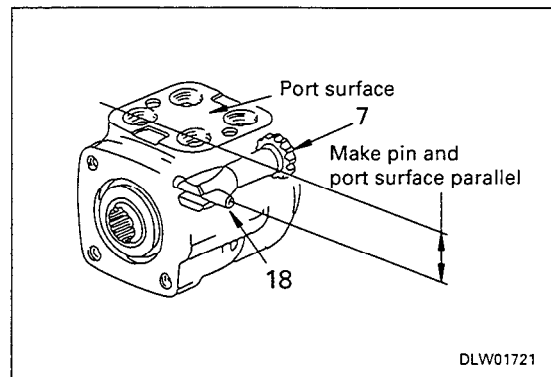


16. Insert O-ring (9) in housing.
17. Put on spacer plate (8), and align positions of bolt hole and tap hole of housing.

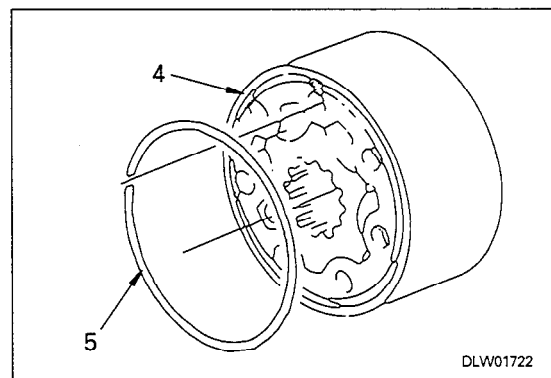


18. Turn spool and sleeve assembly to make pin (18) and port surface of housing parallel, then mesh pin and yoke of drive shaft (7).

★ To position accurately, draw a line on the end face of the drive shaft spline.



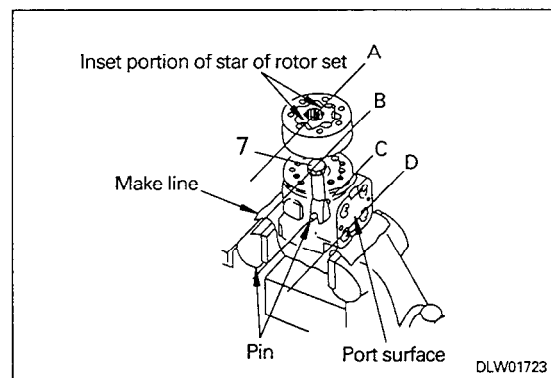
19. Insert O-ring (5) in rotor set (4).



20. Make O-ring (5) end of rotor set to spacer plate end, then align insert portion of star of rotor (4) with drive.

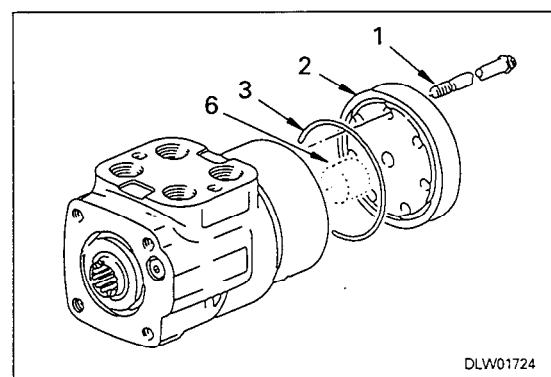
- 1) Check that lines **A**, **B**, **C**, and **D** are all parallel.
- 2) Without removing joint of drive shaft (7), position bolt holes of rotor set.

★ 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.



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23. Coat thread of screw with grease, and tighten end cap.

- ★ Install the handle to the spool, and check that the spool rotates.

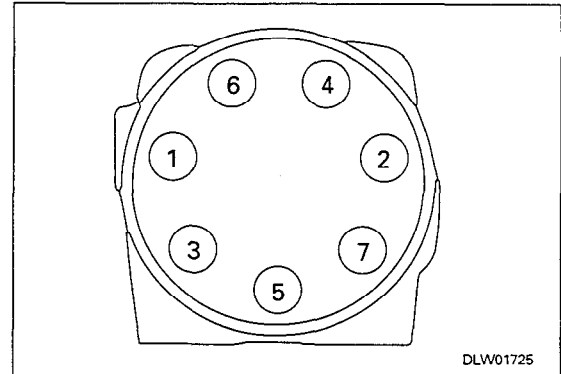


End cap mounting screw

First step : **14.7 Nm (1.5 kgm)**

Second step :

27.0 ± 1.5 Nm (2.75 ± 0.15 kgm)



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REMOVAL OF STEERING CYLINDER ASSEMBLY

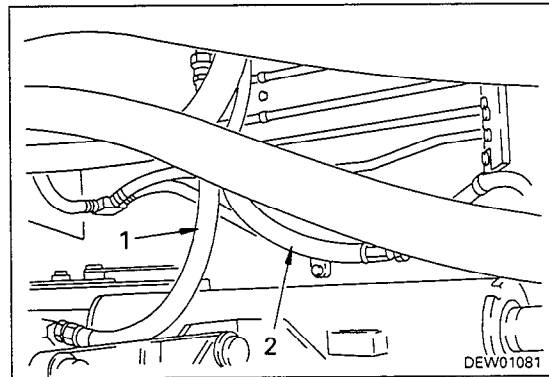
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Release the remaining pressure in the piping. For details, see REMOVAL OF RADIATOR ASSEMBLY.

1. Hydraulic piping

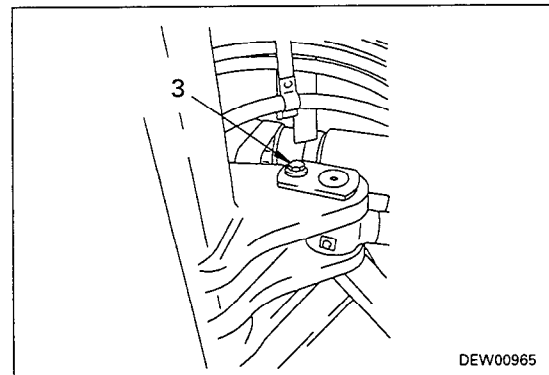
Disconnect steering cylinder rod and bottom hoses (1) and (2) at cylinder end.

★ 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).



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.

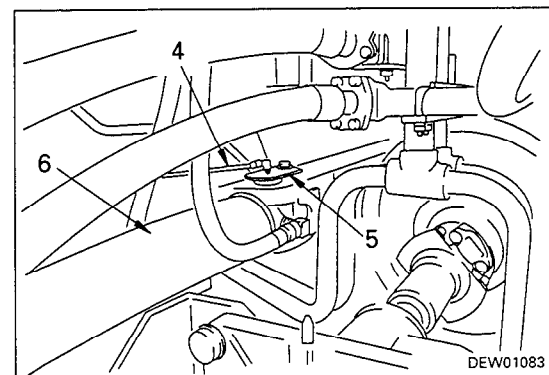
4) Remove steering cylinder (6).

★ Carry out the removal operation with two people.

★ Be careful not to scratch the cylinder rod.



Steering cylinder: 25 kg



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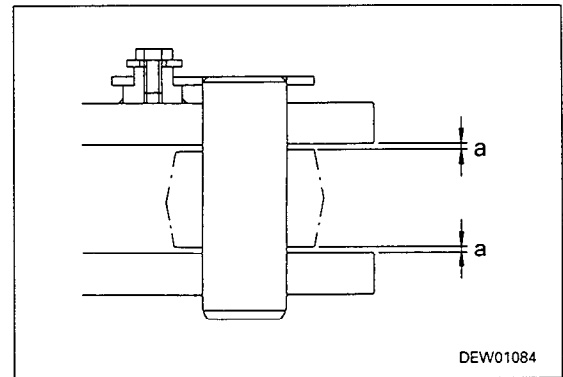
INSTALLATION OF STEERING CYLINDER ASSEMBLY

- 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.



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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)

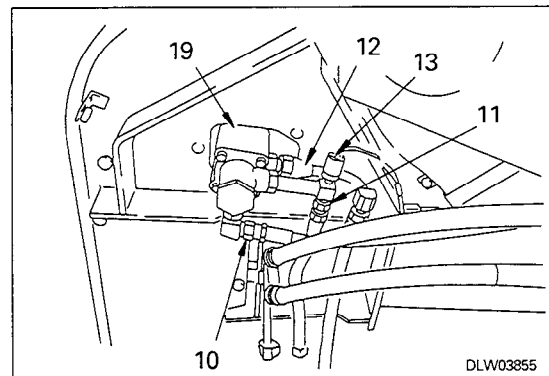
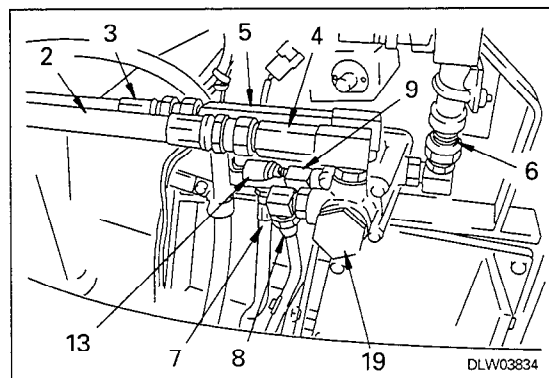
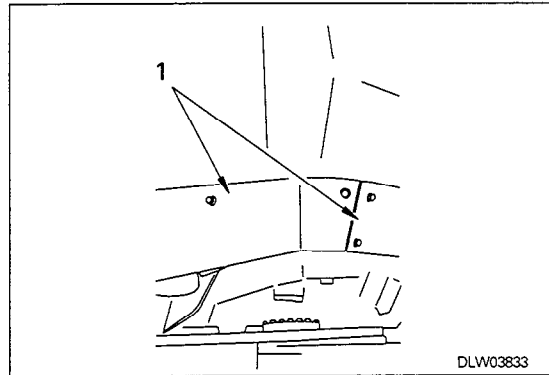
- 1) Disconnect hoses (2) and (3) between accumulator and brake valve, and adapters (4) and (5) at valve end. ※ 1
- 2) Disconnect brake valve drain hose and tube (6) at valve end.
- 3) Disconnect hose (7) going to left brake valve at valve end.
- 4) Disconnect tube (8) which goes to front brake and tube (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).



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5. Pedal

Pull out cotter pin (16) of pin (15) of brake pedal (14), then pull out pin, and remove pedal.

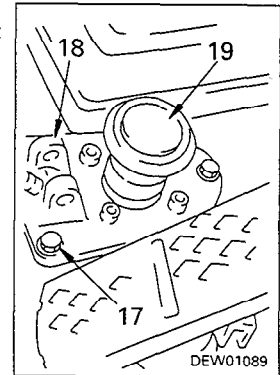
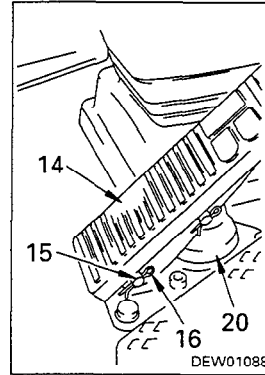
★ Carry out the same procedure for both the left and right brake pedals.

6. Brake valve

※ 5

1) Remove brake valve mounting bolts (17), and disconnect mount flange (18) and body (19), then pull out cap (20).

2) Remove mount flange mounting bolts, then remove mount flange from floor portion.



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INSTALLATION OF BRAKE VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1 ※ 2 ※ 3 ※ 4

★ Replace the O-ring with a new part.

※ 5

⌚ **kgm** Mounting bolt :
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

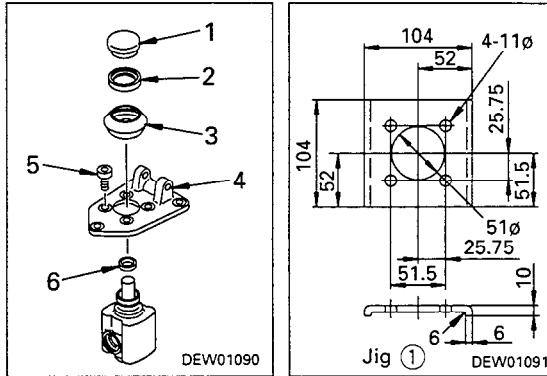
⌚ **kgm** Mounting bolt :
66.2 ± 7.4 Nm (6.75 ± 0.75 kgm)

★ After completion of assembly, bleed the air.
For details, see TESTING AND ADJUSTING,
Bleeding air from brake system.

DISASSEMBLY OF RIGHT BRAKE VALVE ASSEMBLY (TANDEM)

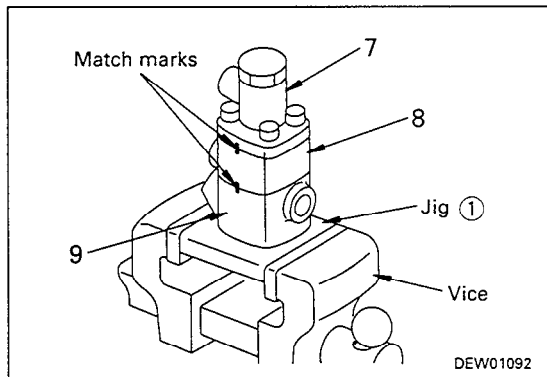
1. Bracket assembly

- 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.

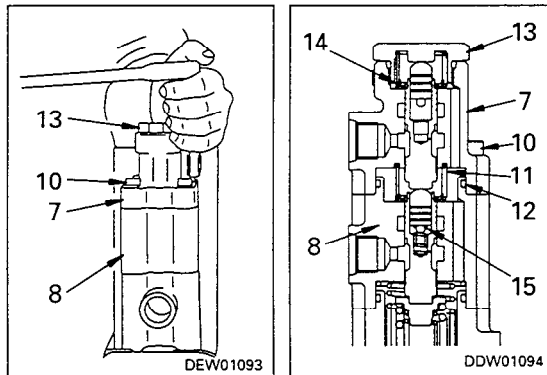


2. Valve

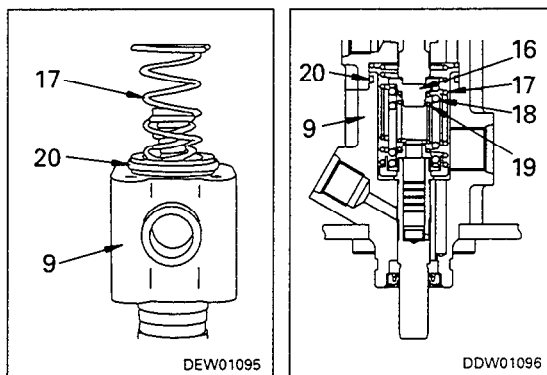
- 1) Install valve to jig ① with bolts (5), and secure jig in vice.
 - ★ Make match marks before disassembling the valve.
- 2) Remove valve mounting bolts (10), then remove S cylinder assembly (7).



- 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.



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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.

 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)

 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.

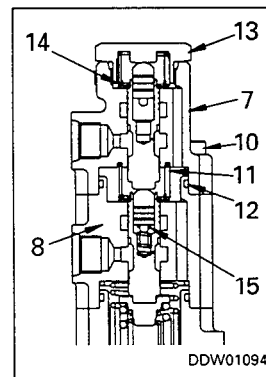
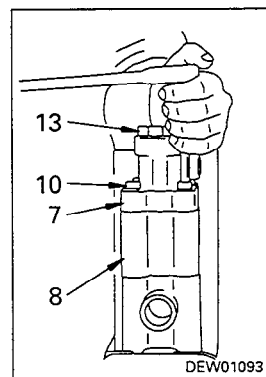
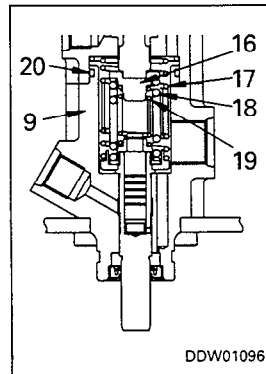
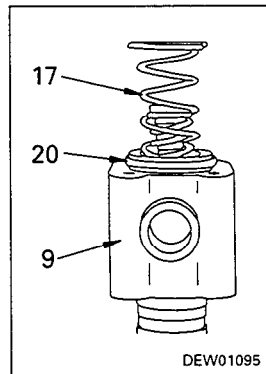
 Lip of oil seal: **Lithium grease**

- 2) Install bracket assembly (4), and tighten with mounting bolts (5).

 Mounting bolt:

58.8 – 73.6 Nm (6.0 – 7.5 kgm)

- 3) Install seat (1), pedal stopper (2), and boot (3) to valve.

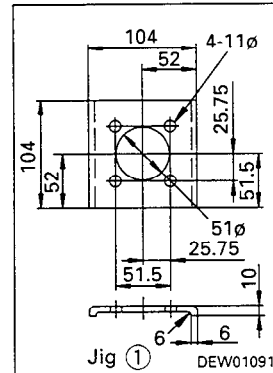
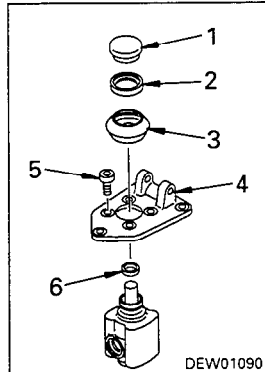


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DISASSEMBLY OF LEFT BRAKE VALVE ASSEMBLY (SINGLE)

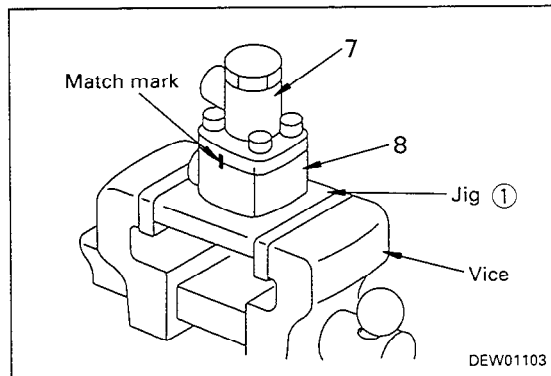
1. Bracket assembly

- 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.

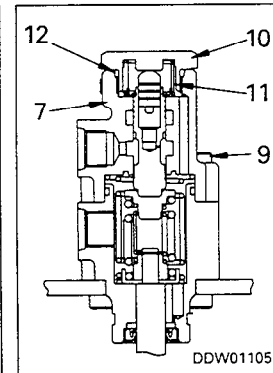
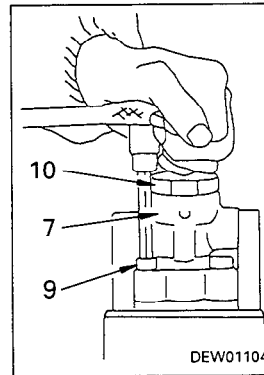


2. Valve

- 1) Install valve to jig ① with bolts (5), and secure jig in vice.
 - ★ Make match marks before disassembling the valve.

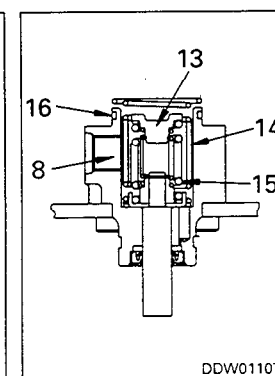
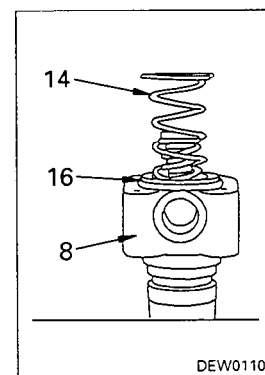


- 2) Remove valve mounting bolts (9), then remove S cylinder assembly (7).
- 3) Remove plug (10) of S cylinder assembly, then remove spring (11) and O-ring (12).



- 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.



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ASSEMBLY OF LEFT BRAKE VALVE VALVE ASSEMBLY (SINGLE)

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.

 **kgm** 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)**

 **kgm** 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.

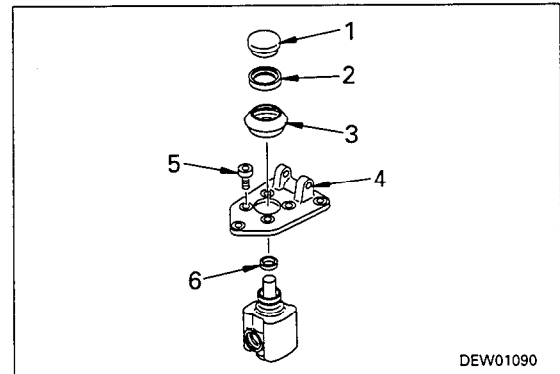
 Lip of oil seal: **Lithium grease**

- 2) Install bracket assembly (4), and tighten with mounting bolts (5).

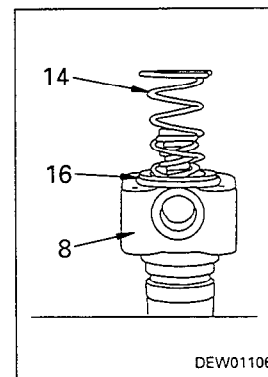
 **kgm** Mounting bolt:

58.8 – 73.6 Nm (6.0 – 7.5 kgm)

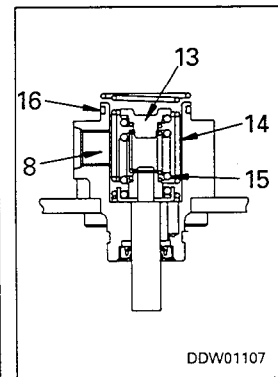
- 3) Install seat (1), pedal stopper (2), and boot (3) to valve.



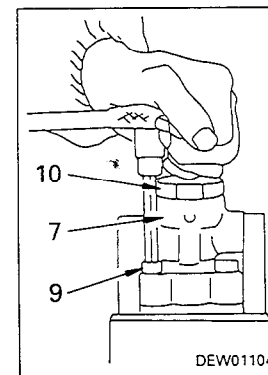
DEW01090



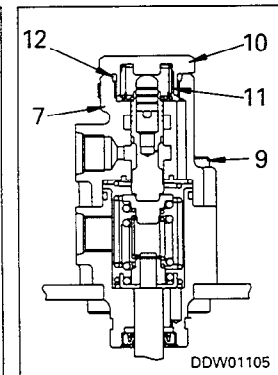
DEW01106



DDW01107



DEW01104



DDW01105

U42303

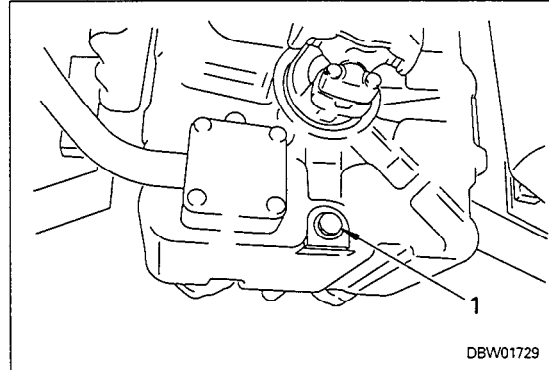
REMOVAL OF PARKING BRAKE DISC

- ⚠ Stop the machine on level ground, lower the work equipment to the ground, apply the parking brake, and put blocks under the wheels to prevent the machine from moving.
★ Release the parking brake.

1. Loosen drain plug (1) and drain transmission oil.



Transmission oil : 40 ℓ

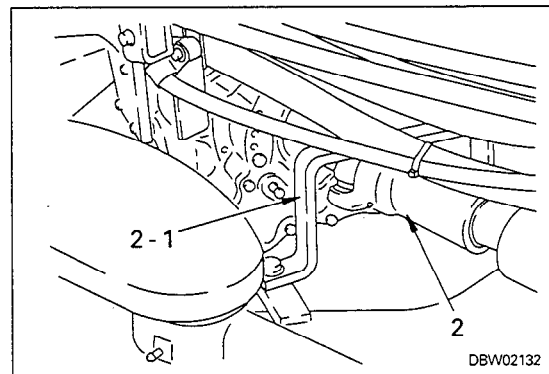


2. Drive shaft

Remove protector (2-1) of drive shaft, and disconnect center drive shaft (2) at transmission end.

※ 1

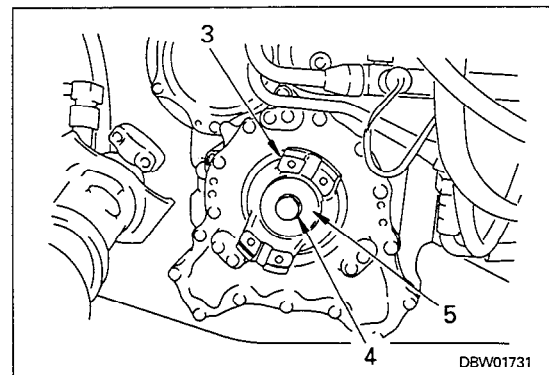
★ After disconnecting the drive shaft, move it to the right end.



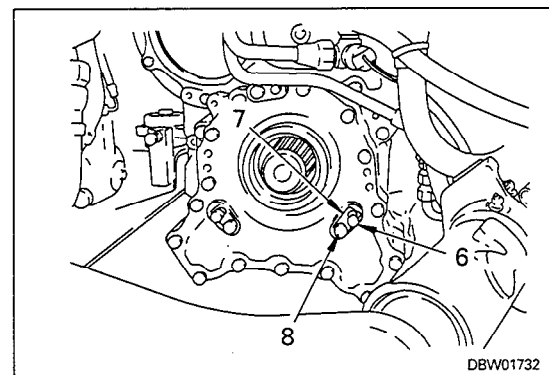
3. Remove mounting bolt (4) and washer (5) of coupling (3) at front end of transmission from coupling.

※ 2

★ Remove together with the O-ring.



4. Remove lock plate (7) and 3 mounting bolts (8) of parking brake manual cancel bolt (6).



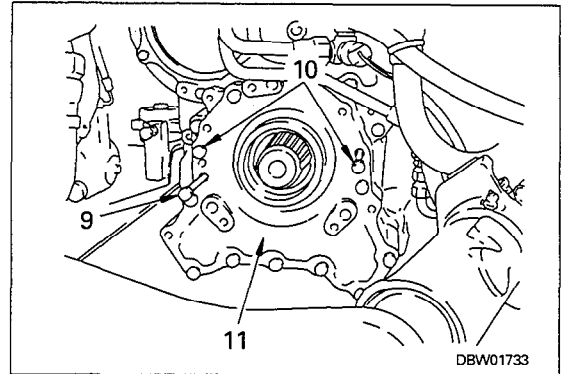
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5. Remove cover mounting bolts, then using guide bolt (9) and forcing screws (10), remove cover (11).

★ Be careful not to damage or get dirt on the oil seal lip surface.

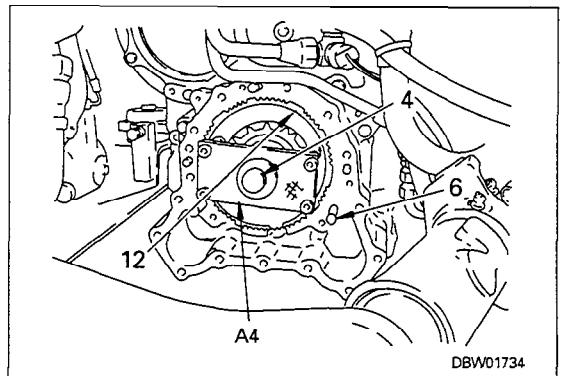


Cover assembly : 6.2 kg



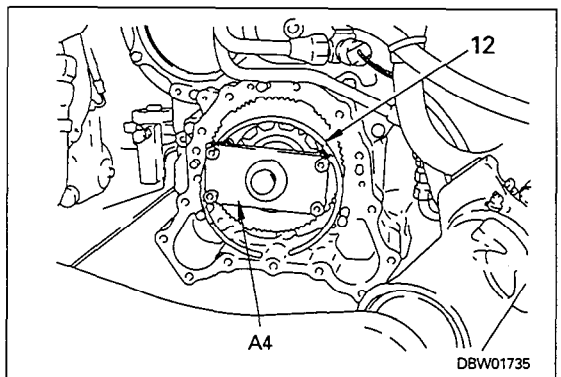
6. Install 3 parking brake manual cancel bolts (6), then tighten, and release parking brake.

7. Tighten tool **A4** with coupling mounting bolt (4).
★ Bolt length of tool : 56 mm



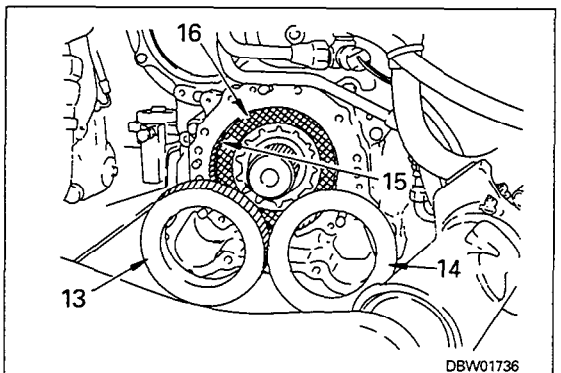
8. Remove snap ring (12), then remove tool **A4**.

※ 4



9. Remove end plate (13), then remove separator plate (14), wave spring (15), and disc (16) in turn.

★ Be careful not to damage or get dirt on the discs and plates.



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INSTALLATION OF PARKING BRAKE DISC

- Carry out installation in the reverse order to removal.

※ 1

- ★ Be careful to connect the coupling facing in the correct direction.

 Mounting bolt :
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

※ 2

- ★ Be careful to assemble the coupling facing in the correct direction.
- ★ Fit the O-ring securely in the groove.

 Mounting bolt :
549 ± 59 Nm (56.0 ± 6.0 kgm)

※ 3

- ★ Be careful not to damage or get dirt on the oil seal lip surface.

 Mounting bolt :
110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)

 Lip of oil seal : **Grease (G2-LI)**

※ 4

- ★ Assemble the ring securely in the ring groove of the housing.

- Refilling with oil
Tighten the drain plug and add transmission oil through oil filler to the specified level.

 Transmission oil : **40 ℓ**

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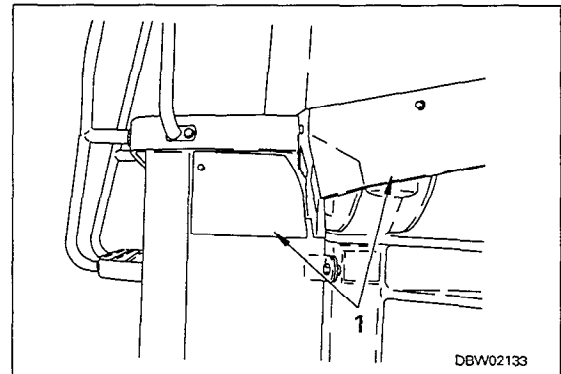
REMOVAL OF HYDRAULIC TANK ASSEMBLY

⚠ 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.

⚠ Operate the steering wheel and control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Cover

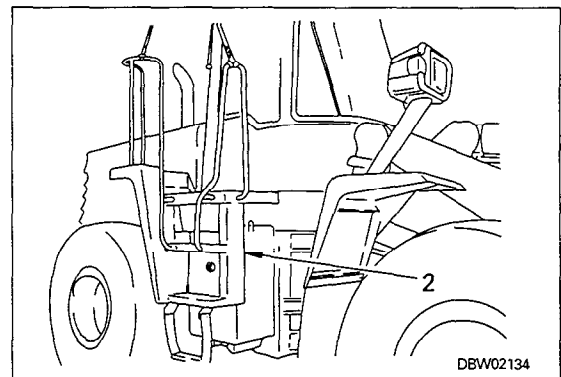
Remove covers (1) on right side of floor.



2. Ladder

Sling ladder (2), then remove mounting bolts, and lift off.

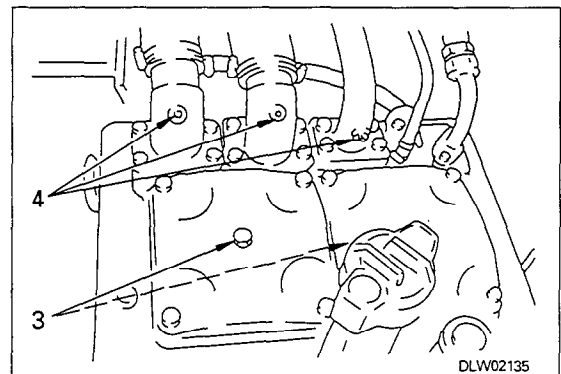
★ Use the lifting tool to lift at two places.



3. Hydraulic piping

※ 1

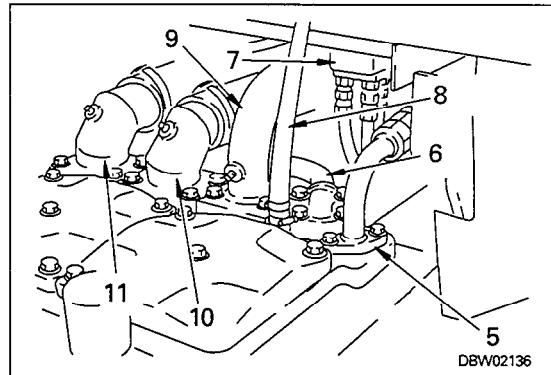
1) Loosen plugs (3) at top of hydraulic tank filter and plugs (4) of pump piping to prevent oil inside tank from flowing out.



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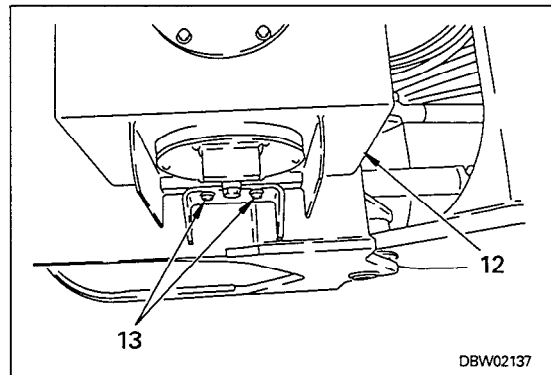
2) Disconnect following hoses and remove each tube.

- Brake oil return tube (5)
- Oil cooler tube (6)
- Disconnect PPC valve (7) and hose (8) from valve end.
- Tube (9) between main control valves
- Tubes (10) and (11) between hydraulic pump.
- ★ After removing the tubes, tie them with wire and move them to the side.



4. Hydraulic tank

1) Sling hydraulic tank (12), and remove front, rear, and bottom mounting bolts (13).

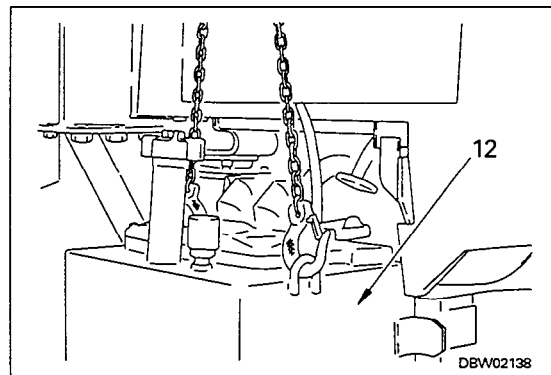


2) Lift off hydraulic tank (12).



Hydraulic tank :

365 kg (including oil 190 ℓ)



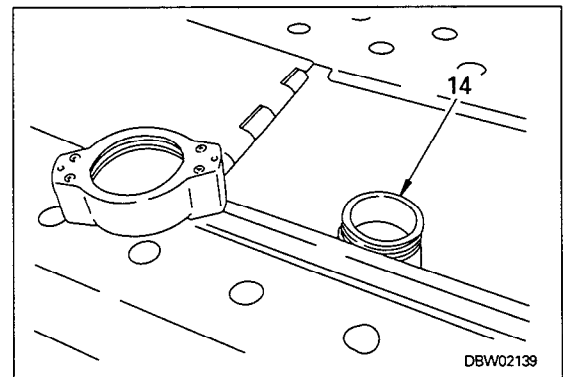
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INSTALLATION OF HYDRAULIC TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Fit the O-ring securely in the groove and be careful not to get it caught when assembling.
 - ★ Install the hoses without twisting or interference.
-
- **Refilling with oil**
Tighten the plugs at the top of the hydraulic tank filter and the plugs of the pump piping, and add hydraulic oil through oil filler (14) to the specified level.
 - ★ Run the engine to circulate the oil through the system. Then check the oil level again.
 - ★ After installing the piping, bleed the air. For details, see the precautions given for the installation procedure.



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REMOVAL OF HYDRAULIC FILTER ASSEMBLY

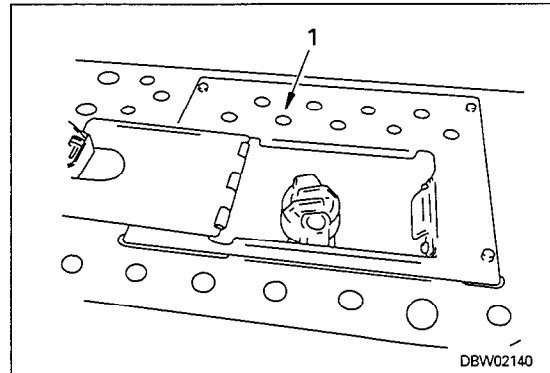
⚠ Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Cover

Remove mounting bolts, then remove covers (1) and (1-1). ※ 1

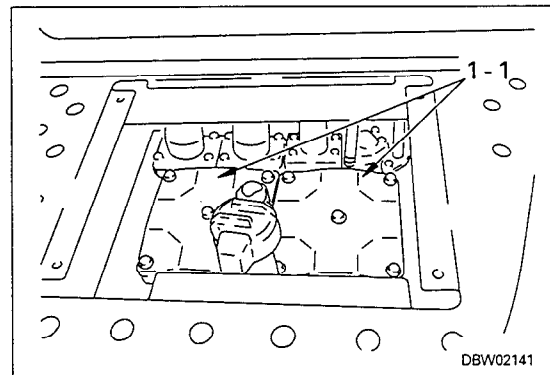
⚠ The tension of the spring is applied to cover (1-1), so be careful when removing.

★ Be careful not to damage the O-ring at the mating surface of cover (1-1) and the tank.



2. Filter

Remove spring (2) and bypass valve (3), then remove filter (4).



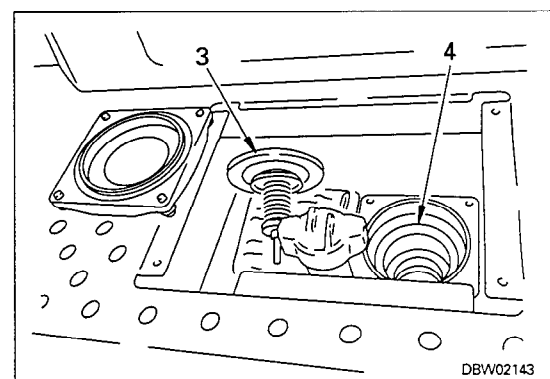
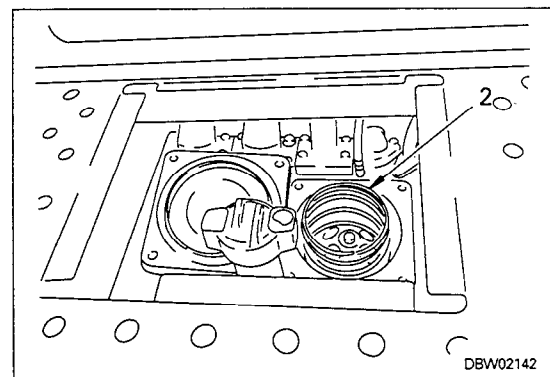
INSTALLATION OF HYDRAULIC FILTER ASSEMBLY

• Carry out installation in the reverse order to removal.

※ 1

★ Replace the O-ring with a new part.

★ Fit the O-ring securely in the groove and be careful not to get it caught when assembling.



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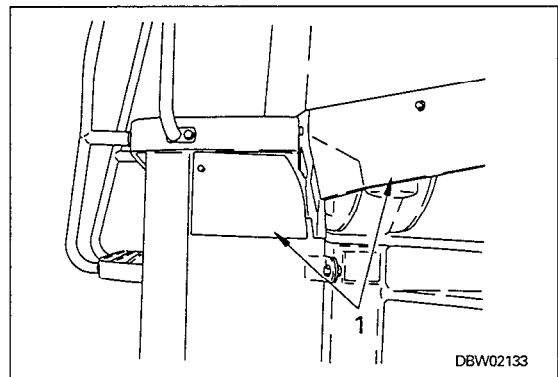
REMOVAL OF HYDRAULIC, STEERING, SWITCH, PPC PUMP ASSEMBLY

⚠ 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.

⚠ Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Cover

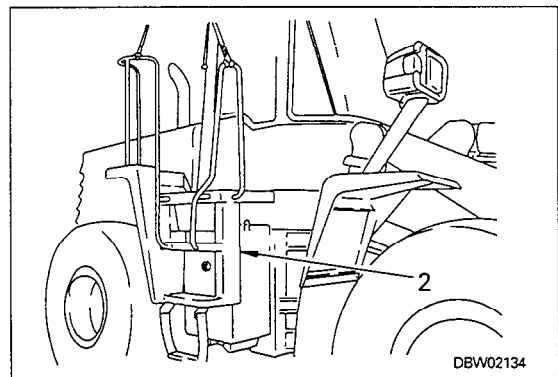
Remove covers (1) on right side of floor.



2. Ladder

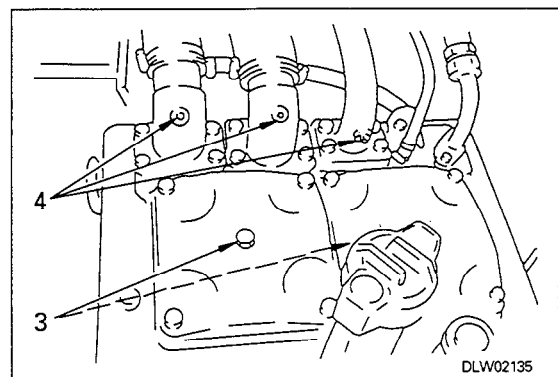
Sling ladder (2), then remove mounting bolts, and lift off.

★ Use the lifting tool to lift at two places.



3. Loosen plugs (3) at top of hydraulic tank filter and plugs (4) of pump piping to prevent oil inside tank from flowing out.

※ 1

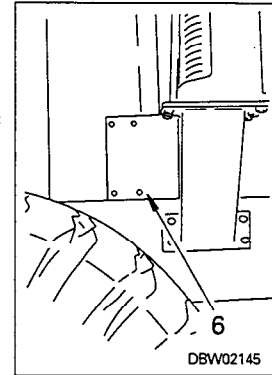
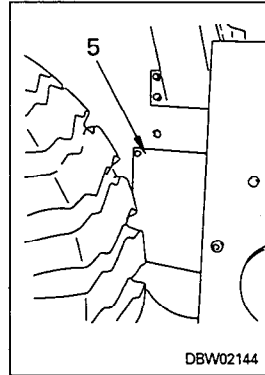


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4. Floor support

※ 2

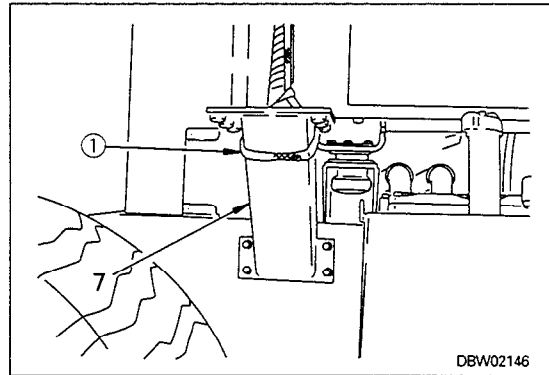
- 1) Remove inspection covers (5) and (6) on right side.



- 2) Sling right floor support (7) with nylon lifting tool ①, then remove mounting bolts and lift off.

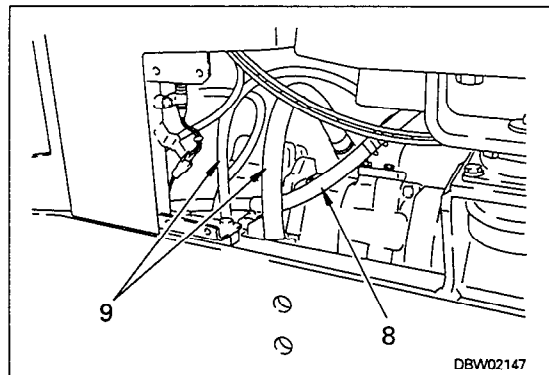


Support : 19 kg



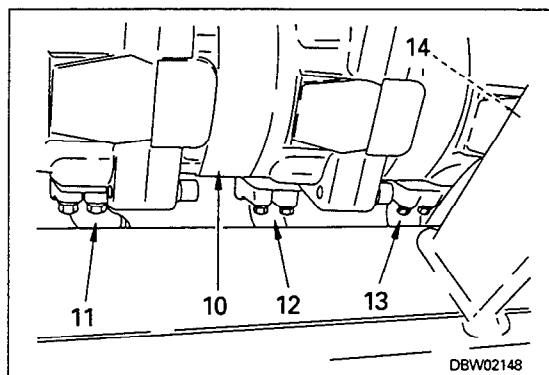
5. Hydraulic piping

- 1) Remove clamps of air conditioner hose (8) and hydraulic hoses (9), then move to rear.



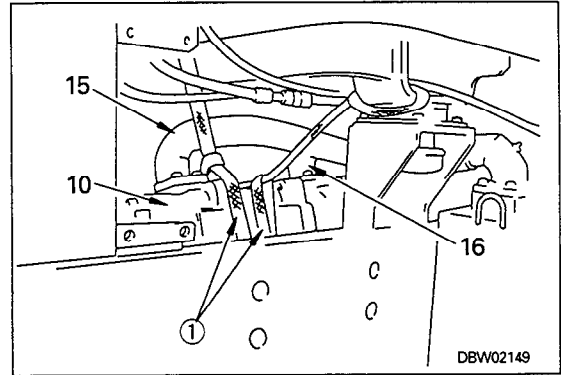
- 2) Remove hydraulic hoses (11), (12), (13), and (14) at bottom of hydraulic pump (10). ※ 3

- ★ After disconnecting the hoses, fit plugs to prevent dirt or dust from entering.
- ★ After disconnecting the hoses, mark them with tags to distinguish them.



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- 3) Remove hydraulic tubes (15) and (16) from hydraulic pump (10).
- 4) Sling hydraulic pump with nylon lifting tool ①.
 - ★ After disconnecting the tubes, fit plugs to prevent dirt or dust from entering.
 - ★ After disconnecting the tubes, mark them with tags to distinguish them.



6. Hydraulic pump

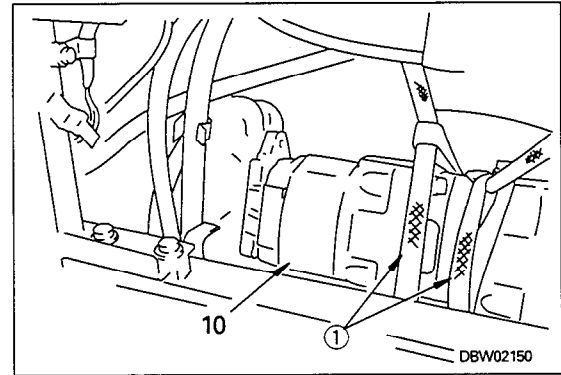
Remove mounting bolts, and take care to maintain balance when lifting off hydraulic pump (10).

※ 4

- ★ The working space is confined, so be extremely careful when carrying out this operation.
- ★ Carry out the removal operation with two workers.



Hydraulic pump : 46 kg



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INSTALLATION OF HYDRAULIC, STEERING, SWITCH, PPC PUMP ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Wash and remove all oil and grease from the plug thread and piping thread.

Thread of plug : **Gasket sealant (LG-4)**

※ 2

- ★ Tighten the floor support mounting bolts fully after installing the floor.



Mounting bolt :

277 ± 31.9 Nm (28.25 ± 3.25 kgm)

※ 3

- ★ Fit the O-ring securely in the groove and be careful not to get it caught when assembling.
- ★ Install the hoses without twisting or interference.

※ 4

- ★ Fit the O-ring securely in the groove and be careful not to get it caught when assembling.

- **Refilling with oil**

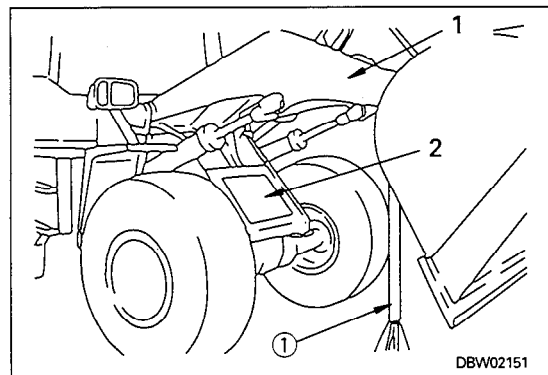
Tighten the plugs at the top of the hydraulic tank filter and the plugs of the pump piping, and add hydraulic oil through the oil filler to the specified level.

- ★ Run the engine to circulate the oil through the system. Then check the oil level again.
- ★ After installing the piping, bleed the air. For details, see the precautions given for the installation procedure.

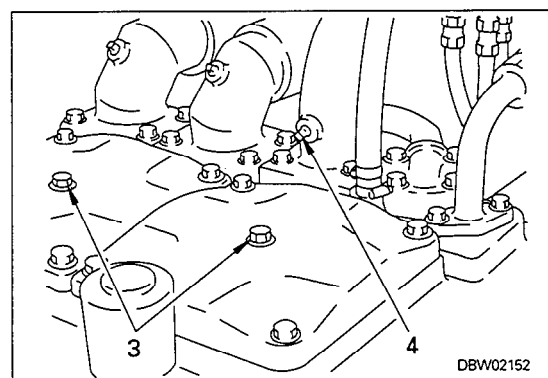
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REMOVAL OF MAIN CONTROL VALVE ASSEMBLY

- ⚠ 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.
- Raise the boom, and set support ① under boom (1), then remove front cover (2).
 - ⚠ Set the support securely.



- ⚠ Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.
- ★ Remove the cover at the front of the hydraulic tank.
 - Loosen plugs (3) at top of hydraulic tank filter and plugs (4) of pump piping to prevent oil inside tank from flowing out.



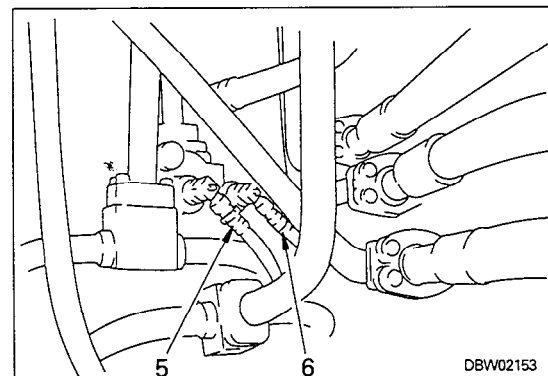
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1. PPC hoses

※ 1

Disconnect following hoses from main control valve.

- Hose (5) for bucket spool between PPC valve (P4) and main control valve (J)
- Hose (6) for boom spool between PPC valve (P2) and main control valve (K)
- Hose (7) for bucket spool between PPC valve (P1) and main control valve (H)
- Hose (8) for boom spool between PPC valve (P3) and main control valve (I)
- ★ After disconnecting the hoses, move them towards the rear of the machine.
- ★ After disconnecting the hoses, mark them with tags to distinguish them.

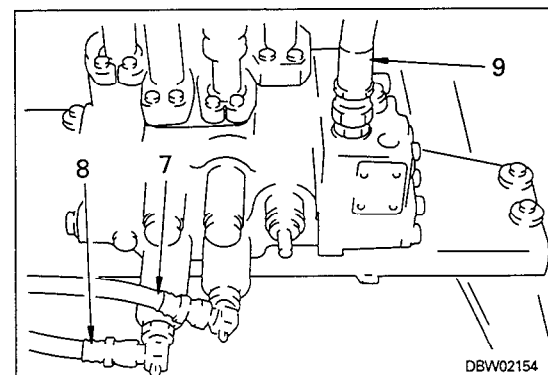


2. Hydraulic hoses

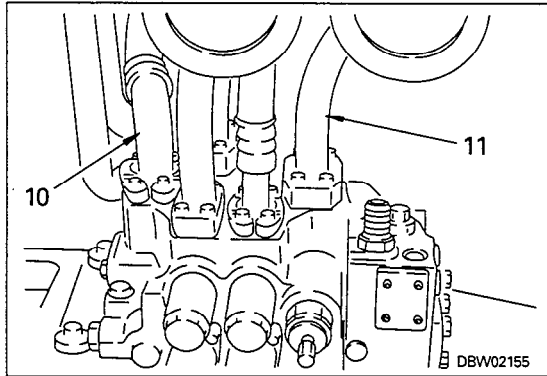
※ 2

Disconnect following hydraulic piping.

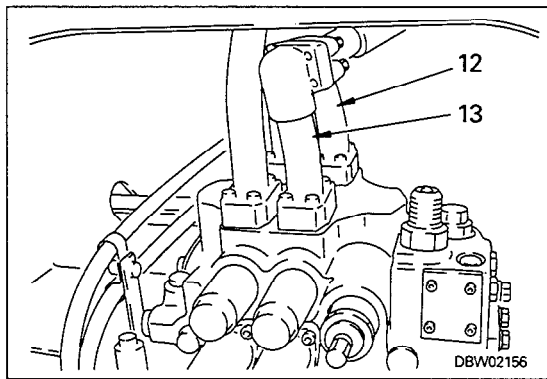
- ★ After removing each hose and tube, move them to the side.
- Hose (9) between steering valve and main control valve



- Hose (10) between hydraulic pump and hydraulic tank
- Tube (11) between hydraulic pump and main control valve



- Tubes (12) and (13) between main control valve and bucket cylinder
 - Tubes (14) and (15) between main control valve and boom cylinder
- ★ Remove the tube clamps.
 ★ After disconnecting the tubes, move them towards the rear of the machine.



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3. Main control valve

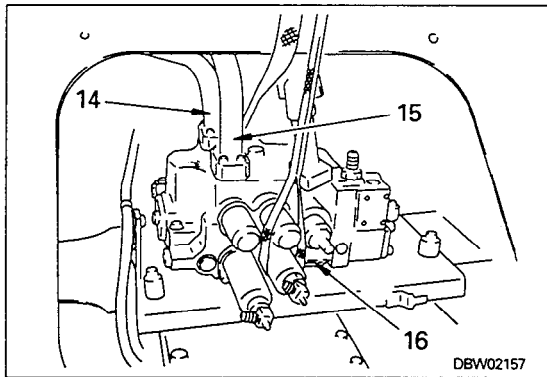
※ 3

Sling main control valve (16), then remove mounting bolts and lift off main control valve.



Main control valve : **75 kg**

- ★ When raising the main control valve, be careful to fit the lifting equipment securely.
- ★ When lifting off the main control valve, be careful not to let it hit the horn.



INSTALLATION OF MAIN CONTROL VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Check the tags on the hoses, then connect the hoses.
- ★ Install the hoses without twisting or interference.

※ 2

- ★ Fit the O-ring securely in the groove and be careful not to get it caught when assembling.
- ★ Install the hoses without twisting or interference.

※ 3

- ★ Tighten the mounting bolts on diametrically opposite sides, and be careful not to deform the valve when tightening.
- ★ Be careful of the angle of the tube when tightening the clamp.
- ★ Be careful that the tube does not interfere with any other part.

- **Refilling with oil**

Tighten the plugs at the top of the hydraulic tank filter and the plugs of the pump piping, and add hydraulic oil through the oil filler to the specified level.



kgm

Plug at top of filter :

$11.8 \pm 1.0 \text{ Nm}$ ($1.2 \pm 0.1 \text{ kgm}$)

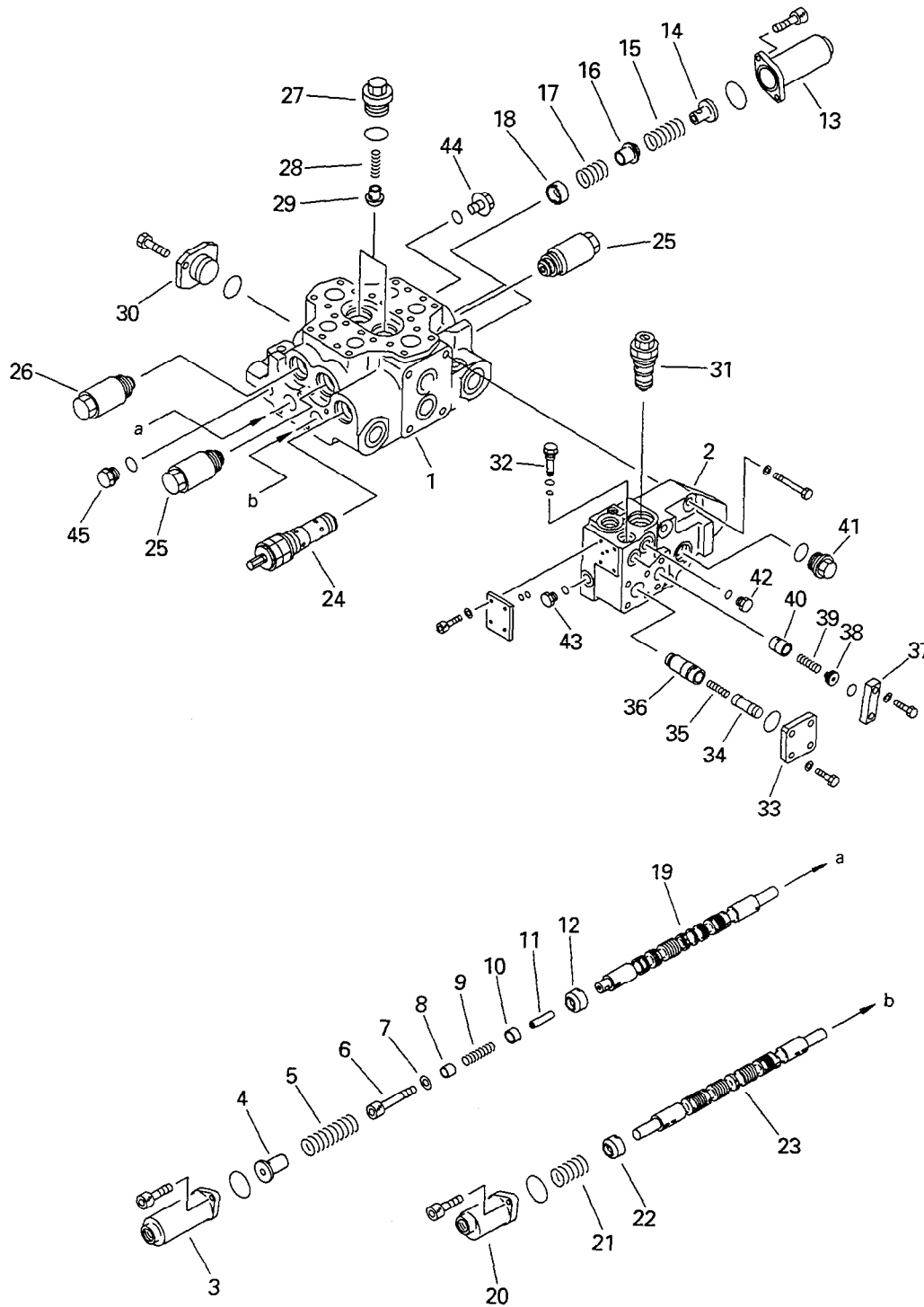


Hydraulic oil : **138 ℓ**

(Replacement amount)

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DISASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY

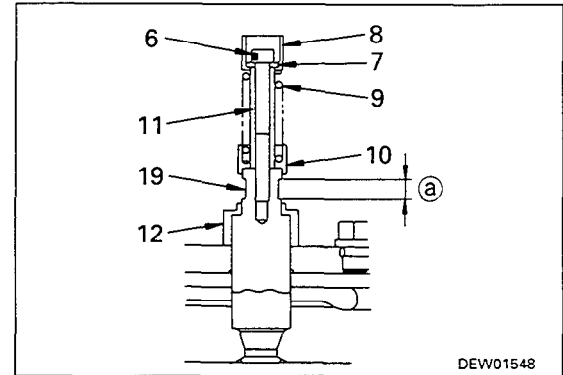


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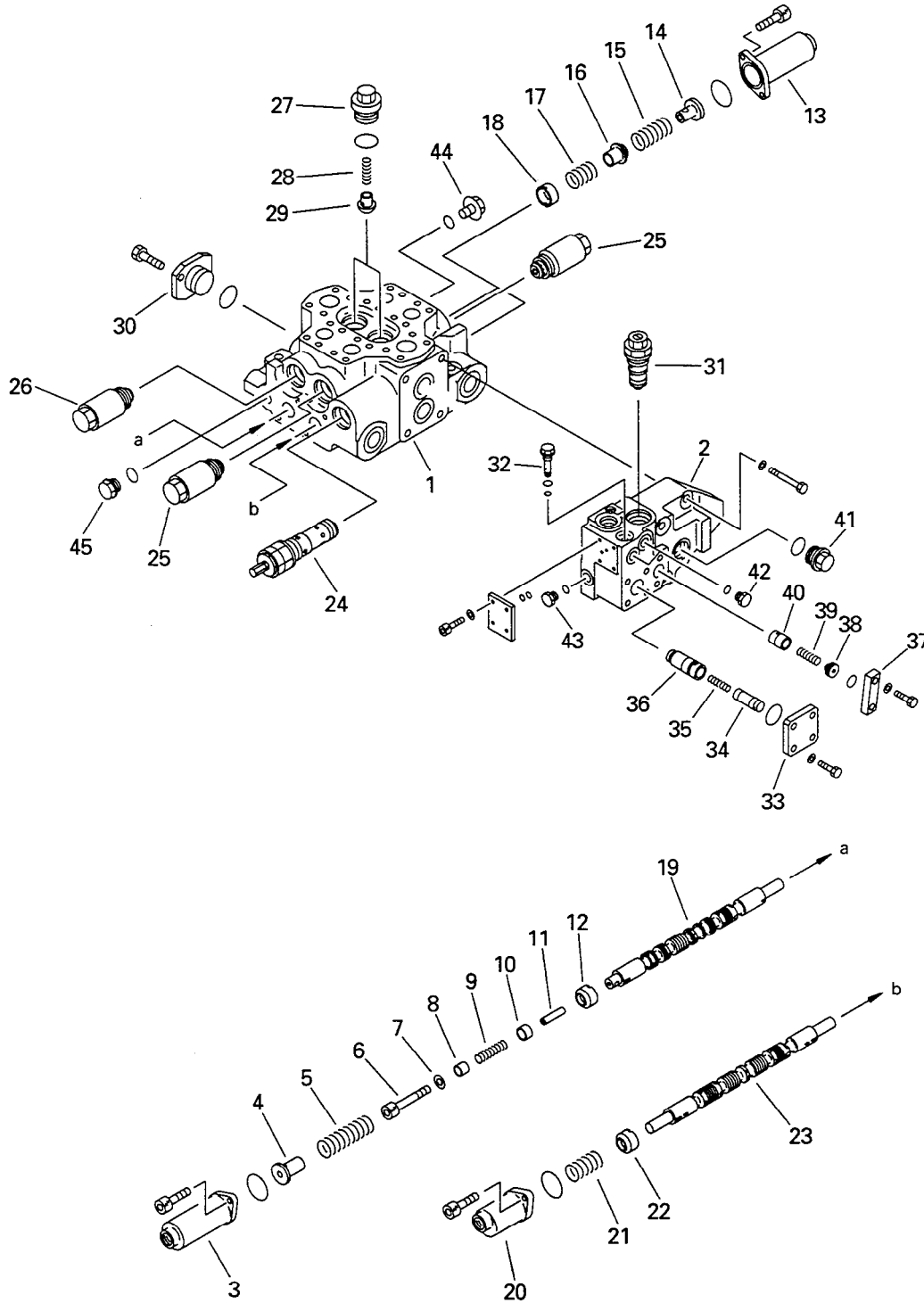
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1. Remove cut-off valve (2) from valve body (1).
2. **Spool assembly (boom)**
 - 1) Remove case (3), then remove retainer (4) and spring (5).
 - 2) Hold spool (19) in position with a wrench (width across flats: 14 mm) at position **a** shown in diagram on right and loosen bolt (6).
 - ★ Loosen bolt (6) with spool (19) assembled to body (1). (To prevent damage to the spool)
 - 3) Remove bolt (6), then remove washer (7), retainer (8), spring (9), retainer (10), collar (11), and retainer (12).
 - 4) Remove case (13), then remove retainer (14), spring (15), retainer (16), spring (17), and retainer (18).
 - 5) Remove spool (19) from body (1).
 - ★ Check the correct direction for assembling spool (19) to the body.
3. **Spool assembly (bucket)**
 - 1) Remove case (20), then remove spring (21) and retainer (22).
 - 2) Remove case (13), then remove retainer (14), spring (15), retainer (16), spring (17), and retainer (18).
 - 3) Remove spool (23) from body (1).
4. **Main relief valve assembly**
Remove main relief valve assembly (24).
5. **Safety valve assembly with suction**
Remove safety valve (25).
 - ★ The safety valve cannot be adjusted when it is installed to the machine, so do not disassemble it.
6. **Suction valve assembly**
Remove suction valve assembly (26).
7. **Check valve assembly, flange, plugs**
 - 1) Remove plug (27), then remove spring (28) and valve (29).
 - 2) Remove flange (30).
 - 3) Remove plugs (44) and (45).
8. **Cut-off valve assembly**
 - 1) Remove pilot valve (31).
 - 2) Remove screen (32).
 - 3) Remove flange (33), then remove piston (34), spring (35), and valve (36).
 - 4) Remove bar (37), then remove seat (38), spring (39), and valve (40).
 - 5) Remove plugs (41), (42), and (43).



ASSEMBLY OF MAIN CONTROL VALVE ASSEMBLY



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1. Cut-off valve assembly

- 1) Fit O-rings to plugs (43), (42), and (41) and install.

 Plug (41) :
275 ± 29.4 Nm (28.0 ± 3.0 kgm)

- 2) Assemble valve (40), spring (39), and seat (38) to valve body (2), then install O-ring to bar (37) and install.

 Mounting bolt :
66.7 ± 7.8 Nm (6.8 ± 0.8 kgm)

- 3) Assemble valve (36), spring (35), and piston (34) to valve body (2), then fit O-ring to flange (33) and install.

 Mounting bolt :
66.7 ± 7.8 Nm (6.8 ± 0.8 kgm)

- 4) Install screen (32) and pilot valve (31).

 Screen :
34.3 ± 4.9 Nm (3.5 ± 0.5 kgm)

 Pilot valve :
147 ± 9.8 Nm (15.0 ± 1.0 kgm)

2. Check valve assembly, flange, plugs

- 1) Install plugs (45) and (44) and install to body (1).

 Plug (44) :
152 ± 24.5 Nm (15.5 ± 2.5 kgm)

- 2) Install flange (30).

 Mounting bolt :
66.7 ± 7.8 Nm (6.8 ± 0.8 kgm)

- 3) Assemble valve (29) and spring (28) to body (1), then fit O-ring to plug (27) and install.

 Plug : **466 ± 24.5 Nm (47.5 ± 2.5 kgm)**

3. Suction valve assembly

Install suction valve (26).

 Suction valve assembly :
226 ± 9.8 Nm (23.0 ± 1.0 kgm)

4. Safety valve assembly with suction

Install safety valve assembly (25).

 Safety valve assembly :
226 ± 9.8 Nm (23.0 ± 1.0 kgm)

5. Main relief valve assembly

Install main relief valve assembly (24).

 Main relief valve assembly :
152 ± 24.5 m (15.5 ± 2.5 kgm)

6. Spool assembly (bucket)

- 1) Assemble spool (23) to body (1).
- 2) Assemble retainer (18), spring (17), retainer (16), spring (15), and retainer (14), then fit O-ring to case (13) and install.
- 3) Assemble retainer (22) and spring (21) to spool (23), then fit O-ring to case (20) and install.

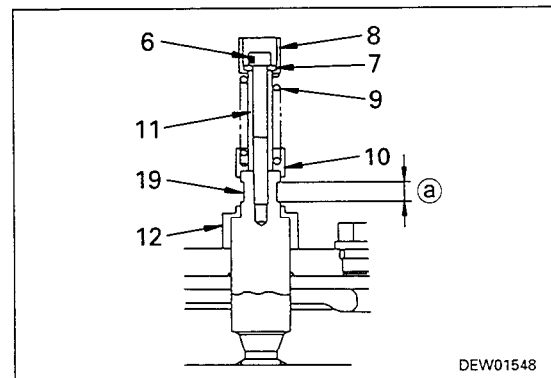
7. Spool assembly (boom)

- 1) Assemble spool (19) to body (1).
 - ★ Check that spool (19) is facing the correct direction when assembling it to the body.
- 2) Assemble retainer (12) to spool (19).
- 3) Assemble washer (7), retainer (8), spring (9), retainer (10), and collar (11) to bolt (6), then hold spool in position with a wrench (width across flats: 14 mm) at position ① shown in diagram on right, and tighten bolt (6).

 Bolt (6) :

$13.7 \pm 1.5 \text{ Nm}$ ($1.4 \pm 0.15 \text{ kgm}$)

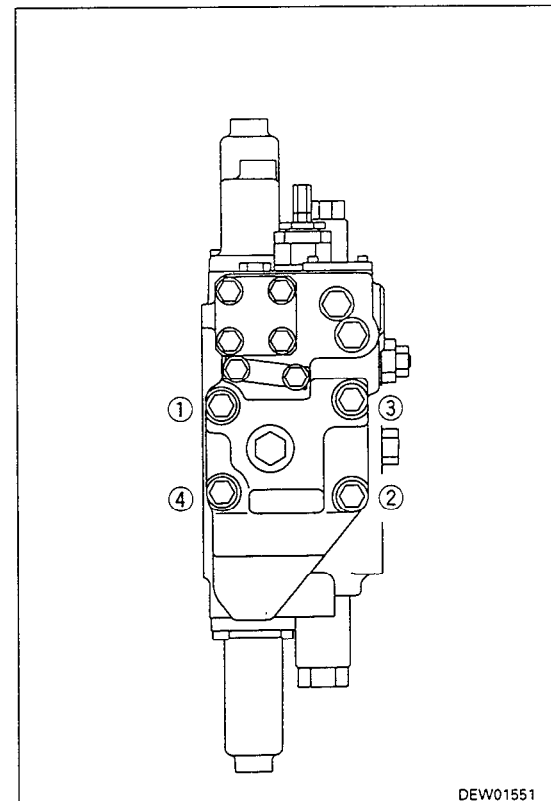
- 4) Assemble spring (5) and retainer (4), then fit O-ring to case (3) and install.
- 5) Assemble retainer (18), spring (17), retainer (16), spring (15), and retainer (14), then fit O-ring to case (13) and install.

**8. Install cut-off valve (2) to valve body (1).**

 Mounting bolt :

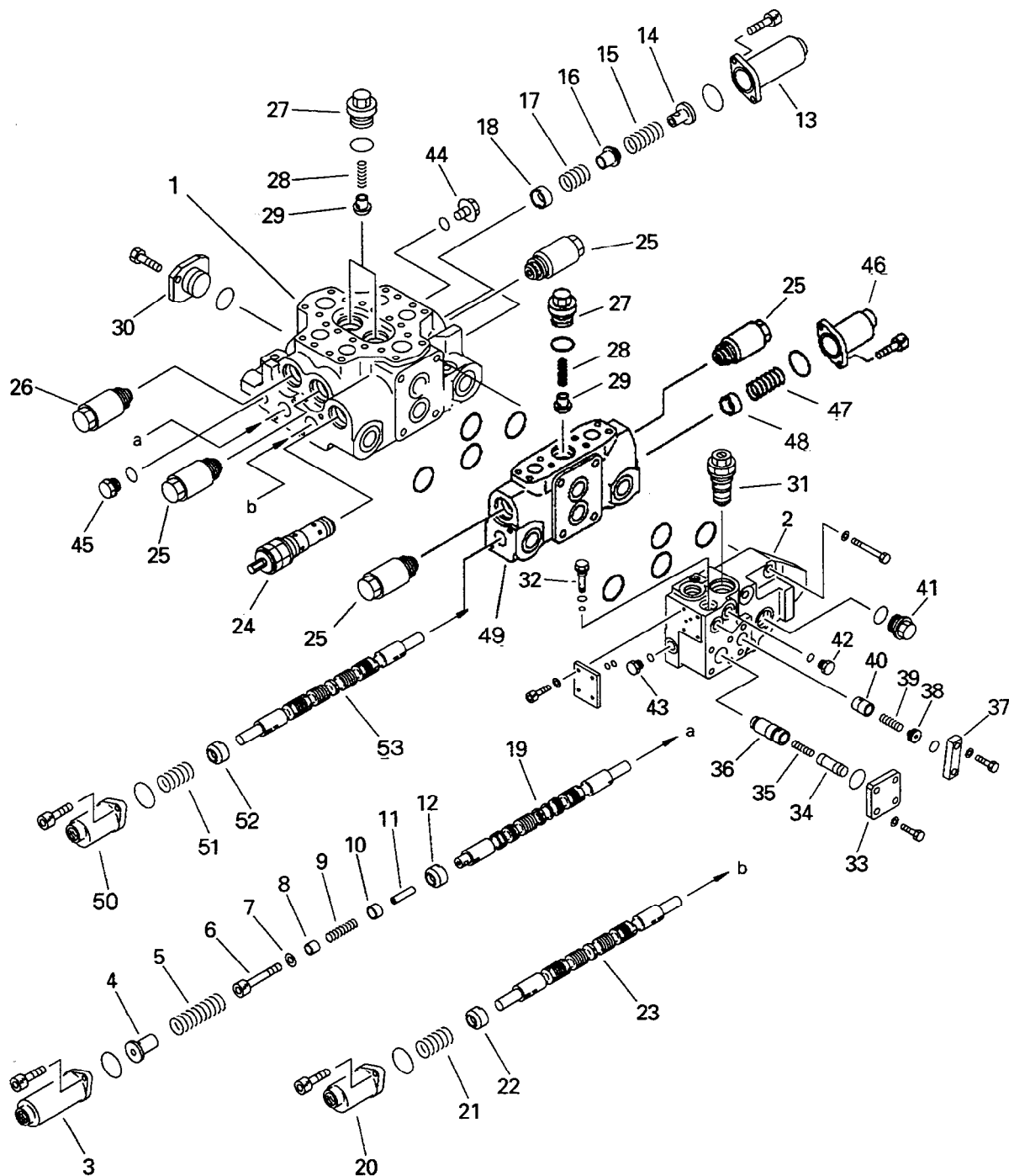
$108 \pm 9.8 \text{ Nm}$ ($11.0 \pm 1.0 \text{ kgm}$)

- ★ Tighten the bolts in the order shown in the diagram on the right.



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DISASSEMBLY OF 3-SPOOL CONTROL VALVE ASSEMBLY



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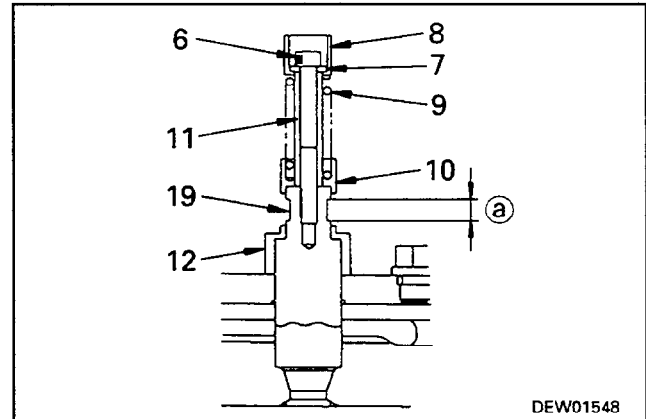
1. Remove cut-off valve (2) from valve body (1).

2. Spool assembly (boom)

- 1) Remove case (3), then remove retainer (4) and spring (5).
 - 2) Hold spool (19) in position with a wrench (width across flats: 14 mm) at position **a** shown in diagram on right and loosen bolt (6). Loosen bolt (6) with spool (19) assembled to body (1). (To prevent damage to the spool)
 - 3) Remove bolt (6), then remove washer (7), retainer (8), spring (9), retainer (10), collar (11), and retainer (12).
 - 4) Remove case (13), then remove retainer (14), spring (15), retainer (16), spring (17), and retainer (18).
 - 5) Remove spool (19) from body (1)
- ★ Check the correct direction for assembling spool (19) to the body.

(34), spring (35), and valve (36).

- 4) Remove bar (37), then remove seat (38), spring (39), and valve (40).
- 5) Remove plugs (41), (42), and (43).



3. Spool assembly (bucket)

- 1) Remove case (20), then remove spring (21) and retainer (22).
- 2) Remove case (13), then remove retainer (14), spring (15), retainer (16), spring (17), and retainer (18).
- 3) Remove spool (23) from body (1).

4. Spool assembly (3 spool)

- 1) Remove case (50), then remove spring (51) and retainer (52).
- 2) Remove case (46), then remove spring (47), retainer (48),.
- 3) Remove spool (53) from body (1).

5. Main relief valve assembly

Remove main relief valve assembly (24).

6. Safety valve assembly with suction

Remove safety valve (25).

- ★ The safety valve cannot be adjusted when it is installed to the machine, so do not disassemble it.

7. Suction valve assembly

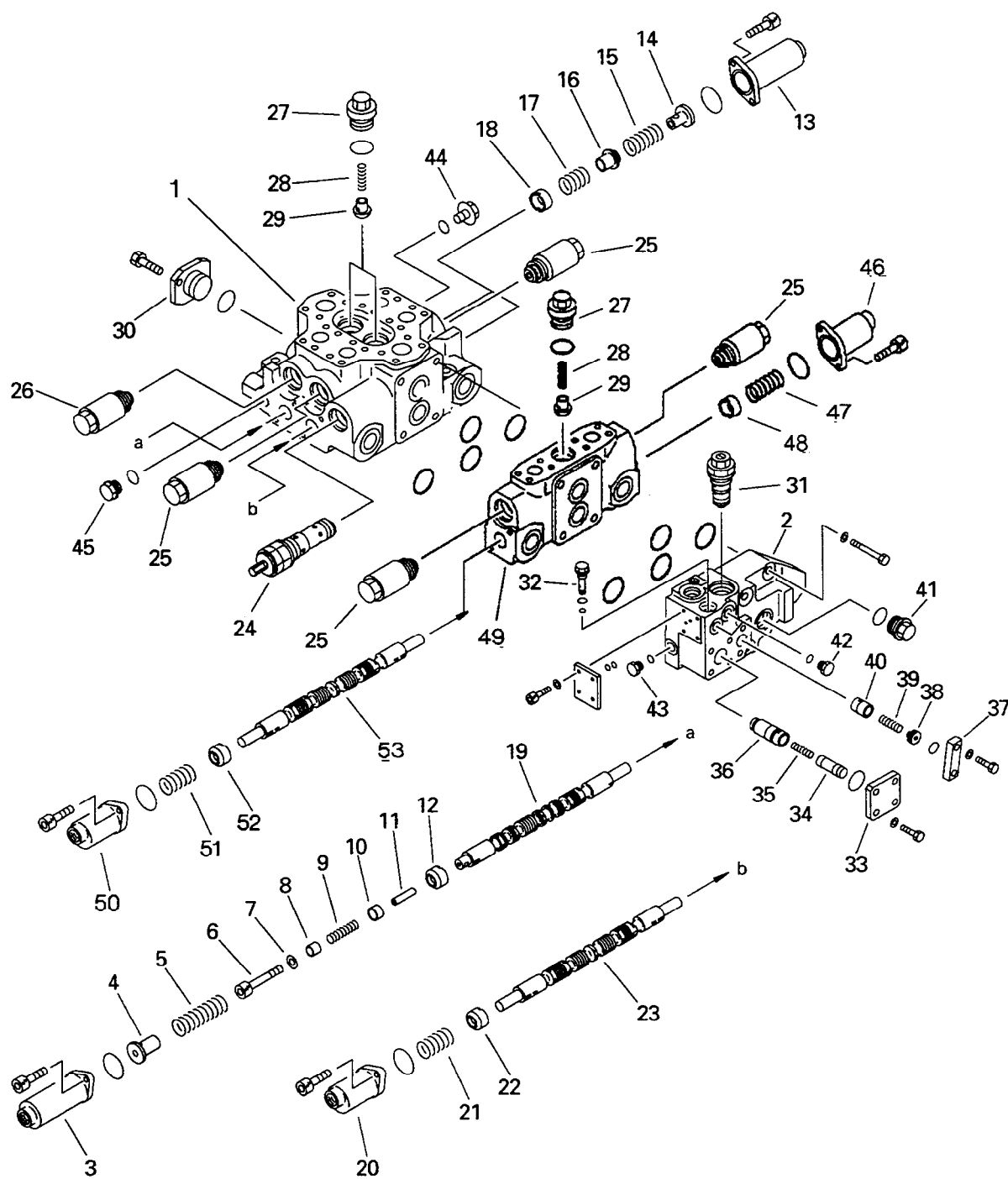
Remove suction valve assembly (26).

8. Check valve assembly, flange, plugs

- 1) Remove plug (27), then remove spring (28) and valve (29).
- 2) Remove flange (30).
- 3) Remove plugs (44) and (45).

9. Cut-off valve assembly

- 1) Remove pilot valve (31).
- 2) Remove screen (32).
- 3) Remove flange (33), then remove piston

**ASSEMBLY OF 3 SPOOL
CONTROL VALVE ASSEMBLY**

DDW01547

1. Cut-off valve assembly

- 1) Fit O-rings to plugs (43), (42), and (41) and install.

 **kgm** Plug (41) :

$275 \pm 29.4 \text{ Nm}$ ($28.0 \pm 3.0 \text{ kgm}$)

- 2) Assemble valve (40), spring (39), and seat (38) to valve body (2), then install O-ring to bar (37) and install.

 **kgm** Mounting bolt :

$66.7 \pm 7.8 \text{ Nm}$ ($6.8 \pm 0.8 \text{ kgm}$)

- 3) Assemble valve (36), spring (35), and piston (34) to valve body (2), then fit O-ring to flange (33) and install.

 **kgm** Mounting bolt :

$66.7 \pm 7.8 \text{ Nm}$ ($6.8 \pm 0.8 \text{ kgm}$)

- 4) Install screen (32) and pilot valve (31).

 **kgm** Screen :

$34.3 \pm 4.9 \text{ Nm}$ ($3.5 \pm 0.5 \text{ kgm}$)

 **kgm** Pilot valve :

$147 \pm 9.8 \text{ Nm}$ ($15.0 \pm 1.0 \text{ kgm}$)

2. Check valve assembly, flange, plugs

- 1) Install plugs (45) and (44) and install to body (1).

 **kgm** Plug (44) :

$152 \pm 24.5 \text{ Nm}$ ($15.5 \pm 2.5 \text{ kgm}$)

- 2) Install flange (30).

 **kgm** Mounting bolt :

$66.7 \pm 7.8 \text{ Nm}$ ($6.8 \pm 0.8 \text{ kgm}$)

- 3) Assemble valve (29) and spring (28) to body (1), then fit O-ring to plug (27) and install.

 **kgm** Plug : **$466 \pm 24.5 \text{ Nm}$ ($47.5 \pm 2.5 \text{ kgm}$)**

3. Suction valve assembly

Install suction valve (26).

 **kgm** Suction valve assembly :

$226 \pm 9.8 \text{ Nm}$ ($23.0 \pm 1.0 \text{ kgm}$)

4. Safety valve assembly with suction

Install safety valve assembly (25).

 **kgm** Safety valve assembly :

$226 \pm 9.8 \text{ Nm}$ ($23.0 \pm 1.0 \text{ kgm}$)

5. Main relief valve assembly

Install main relief valve assembly (24).

 **kgm** Main relief valve assembly :

$152 \pm 24.5 \text{ m}$ ($15.5 \pm 2.5 \text{ kgm}$)

6. Spool assembly (bucket)

- 1) Assemble spool (23) to body (1).
- 2) Assemble retainer (18), spring (17), retainer(16), spring (15), and retainer (14), then fit 0-ring to case (13) and install.
- 3) Assemble retainer (22) and spring (21) to spool (23), then fit 0-ring to case (20) and install.

7. Spool assembly (3 spool)

- 1) Assemble spool (53) to body (49).
- 2) Assemble retainer (48), spring (47), then fit 0-ring to case (46) and install.
- 3) Assemble retainer (52) and spring (51) to spool (53), then fit 0-ring to case (50) and install.

8. Spool assembly (boom)

- 1) Assemble spool (19) to body (1)
 - ★ Check that spool (19) is facing the correct direction when assembling it to the body.
- 2) Assemble retainer (12) to spool (19).
- 3) Assemble washer (7), retainer (8), spring (9),retainer (10), and collar (11) to bolt (6), then hold spool in position with a wrench (width across flats: 14 mm) at position shown in diagram on right, and tighten bolt (6).

Bolt (6) :

$13.7 \pm 1.5 \text{ Nm}$ ($1.4 \pm 0.15 \text{ kgm}$)

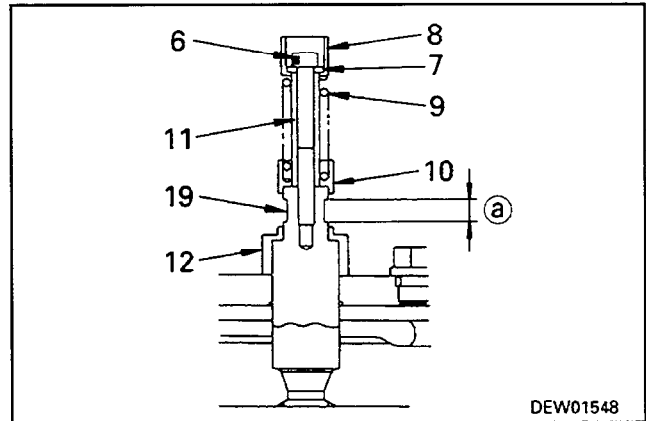
- 4) Assemble spring (5) and retainer (4), then fit 0-ring to case (3) and install.
- 5) Assemble retainer (18), spring (17), retainer (16), spring (15), and retainer (14), then fit 0-ring to case (13) and install.

9. Install cut-off valve (2) to valve body (1).

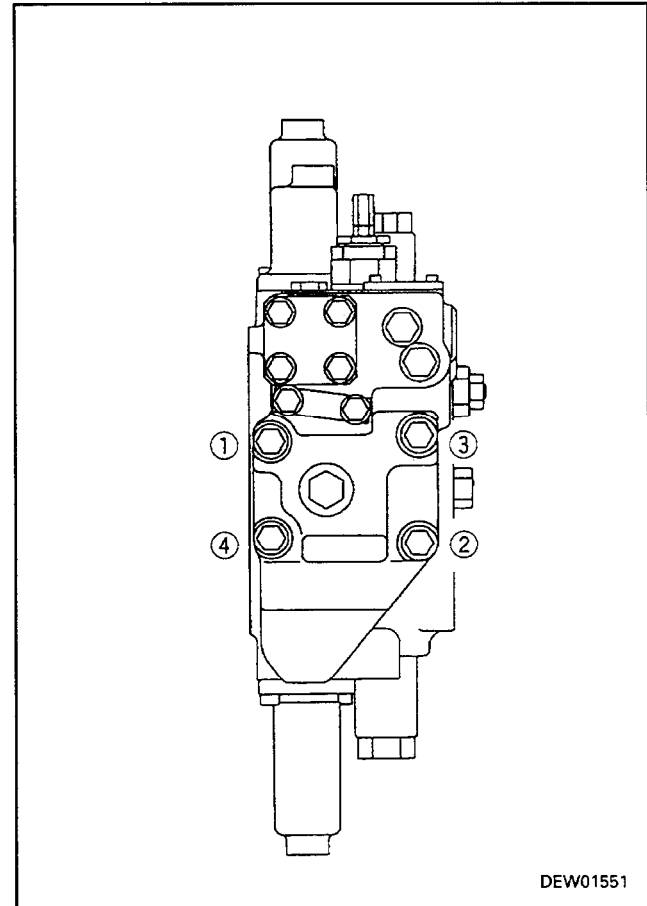
Mounting bolt :

$108 \pm 9.8 \text{ Nm}$ ($11.0 \pm 1.0 \text{ kgm}$)

- ★ Tighten the bolts in the order shown in the diagram on the right.



DEW01548



DEW01551

REMOVAL OF PPC VALVE ASSEMBLY

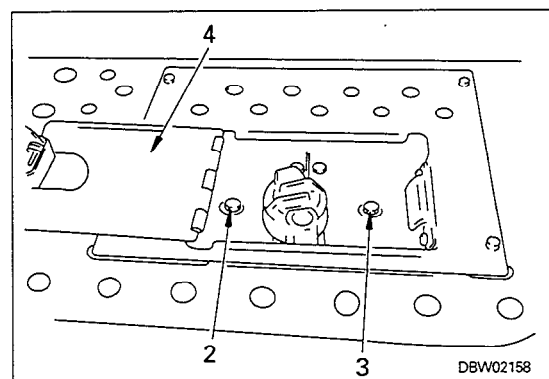
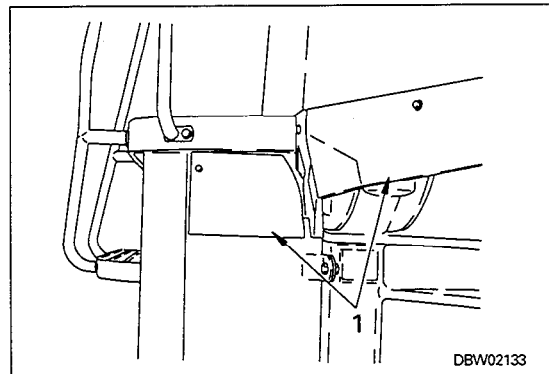
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- Remove covers (1).
- Loosen plugs (2) and (3) at top of hydraulic tank filter to prevent oil inside tank from flowing out.

1. Cover

- 1) Remove floor inspection cover (4).



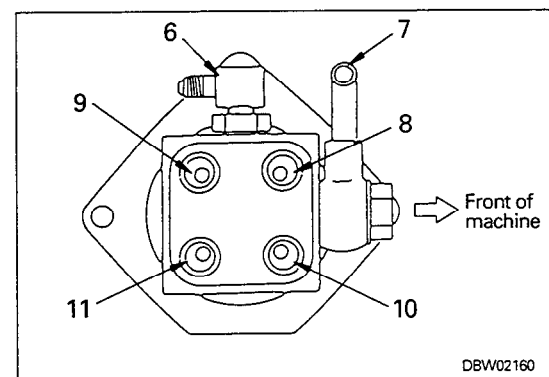
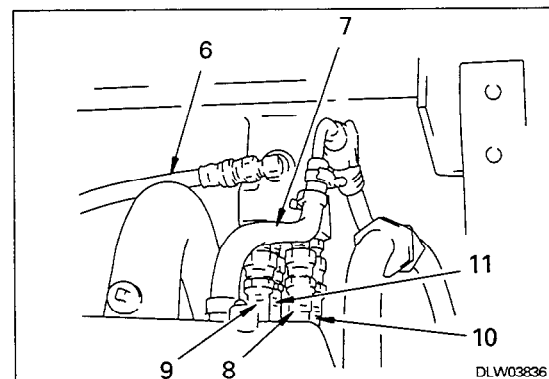
2. Hydraulic piping

Disconnect following hydraulic piping from PPC valve.

- Hose (6) between PPC valve and PPC valve
- Hose (7) between PPC valve and hydraulic tank
- Hoses **P2** (8) and **P3** (9) for boom spool
- Hoses **P4** (10) and **P1** (11) for bucket spool

★ When removing the 4 hoses at the bottom of the PPC valve, remove the hoses from the outside, then remove the nipple and disconnect the hoses.

★ After disconnecting the hoses, mark them with tags to distinguish them.

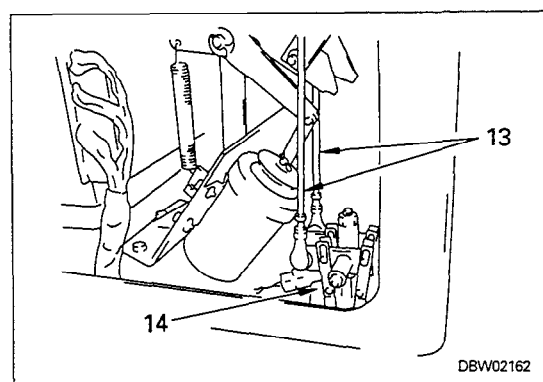
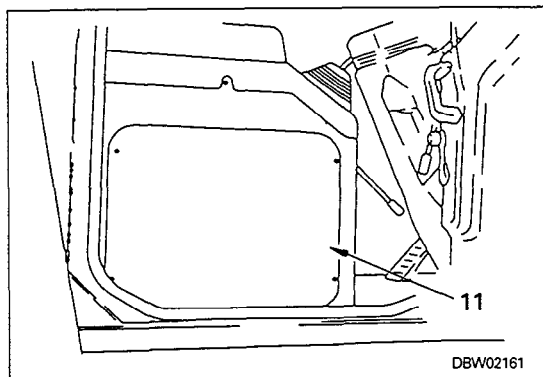
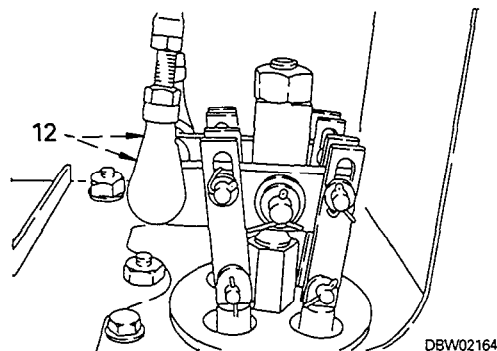


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3. Linkage

※ 1

- 1) Remove console box side face cover (11).
- 2) Loosen locknut (12), and disconnect linkage (13) from PPC valve.

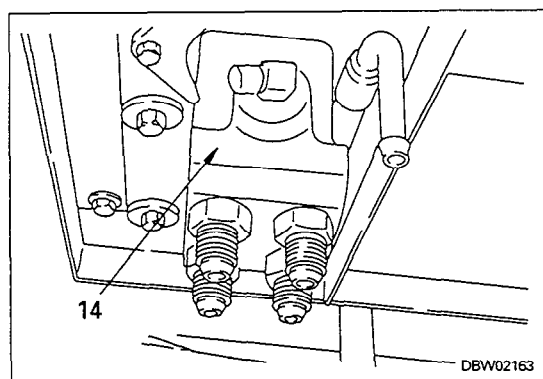


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4. PPC valve

Remove mounting bolts, then remove PPC valve (14) from under floor.

- ★ The working space is confined, so be extremely careful when carrying out this operation.



INSTALLATION OF PPC VALVE ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Adjust the linkage.
For details, see TESTING AND ADJUSTING.

- **Refilling with oil**

Tighten the plugs at the top of the hydraulic tank filter, and add hydraulic oil through oil filler to the specified level.

 **kgm** Plug at top of filter :

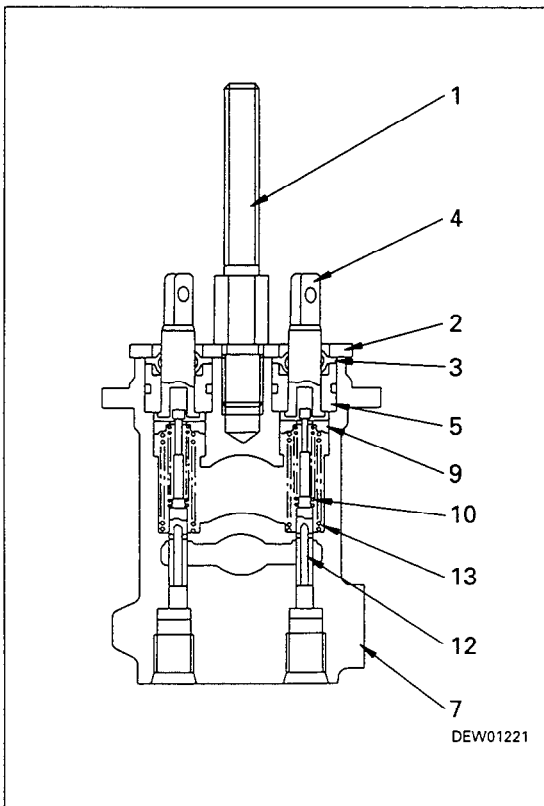
11.8 ± 1.0 Nm (1.2 ± 0.1 kgm)

- ★ Run the engine to circulate the oil through the system. Then check the oil level again.

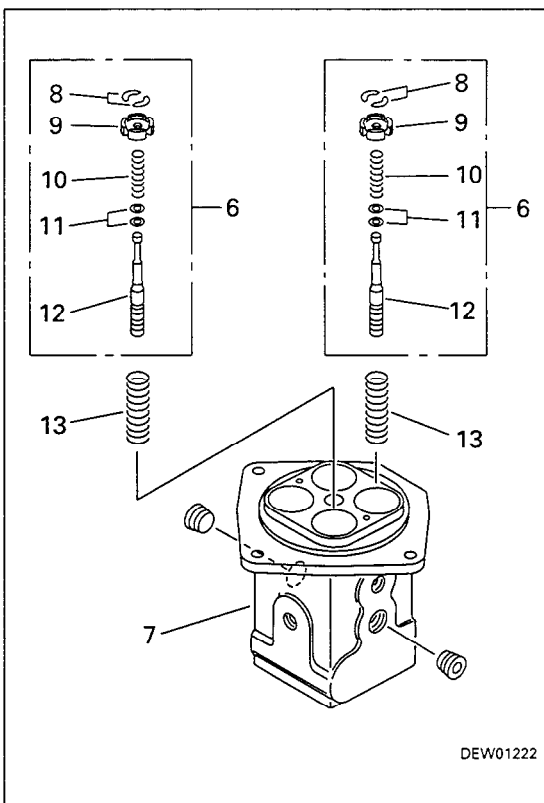
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DISASSEMBLY OF PPC VALVE ASSEMBLY

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.



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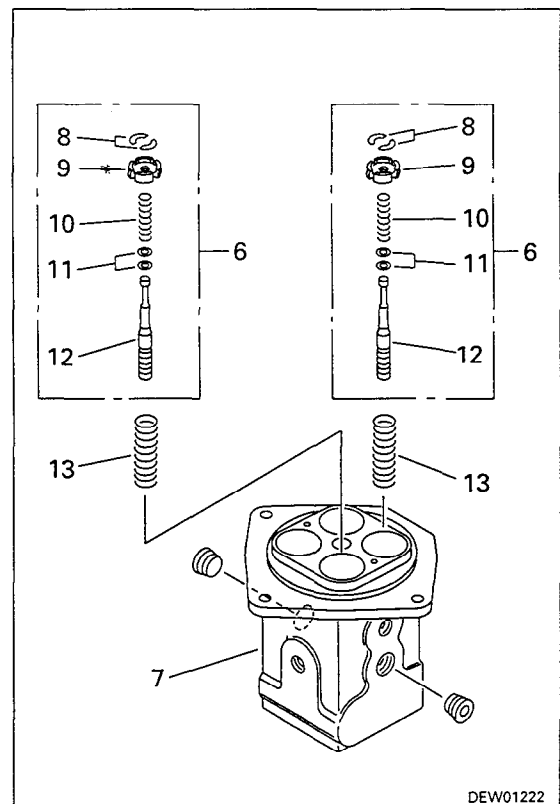
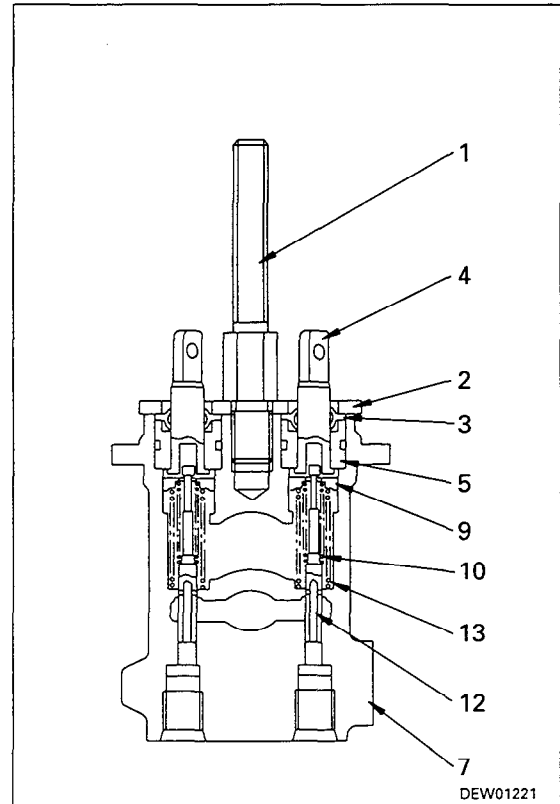


ASSEMBLY OF PPC VALVE ASSEMBLY

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	14
P4 Bucket DUMP	

- ★ 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: $44.1 \pm 4.9 \text{ Nm}$ ($4.5 \pm 0.5 \text{ kgm}$)



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REMOVAL OF BUCKET CYLINDER ASSEMBLY

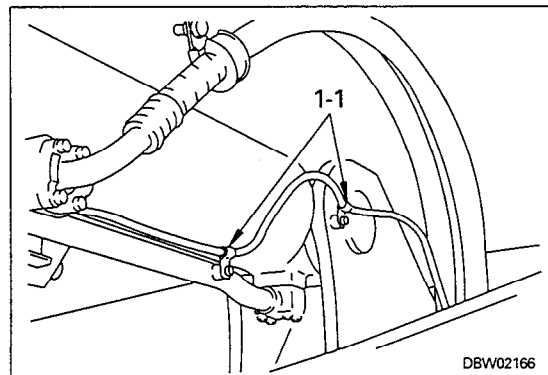
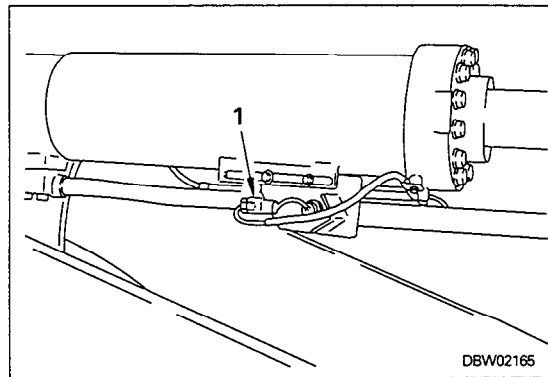
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

1. Bucket positioner

※ 1

- 1) Disconnect connector (1).
- 2) Remove wiring clamps (1-1) for bucket positioner.

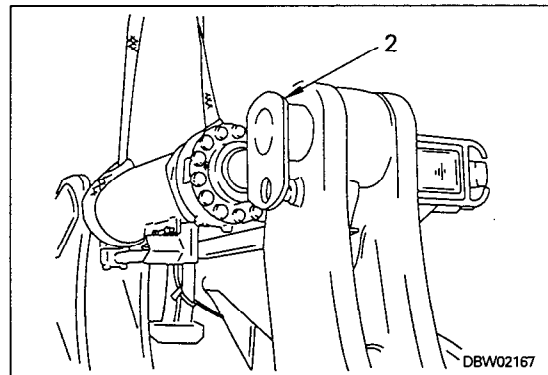


2. Rod pin

※ 2

Sling cylinder, and remove lock bolt, then remove pin (2).

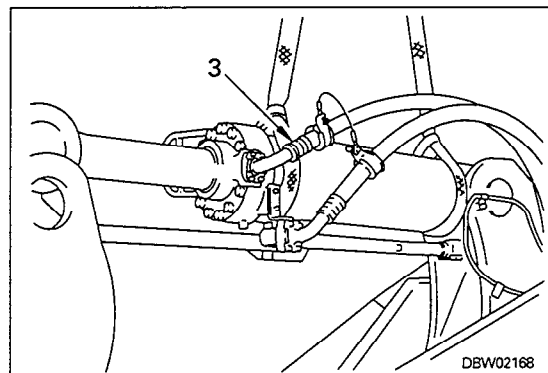
- ★ Be careful of the center of gravity when slinging, and lift at two places.
- ★ Check the number and thickness of the shims, and keep in a safe place.



3. Hydraulic piping

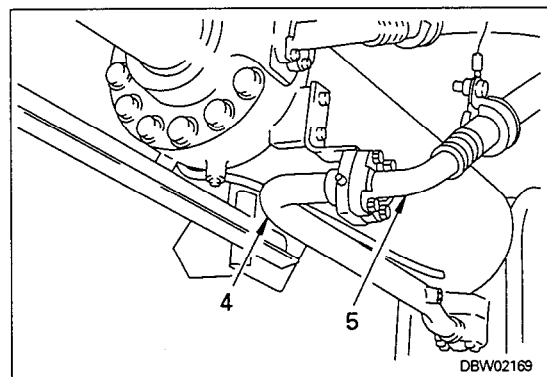
※ 3

- 1) Disconnect hose (3) at rod end from cylinder.



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- 2) Disconnect tube (4) and hose (5) at bottom end from connecting portion.



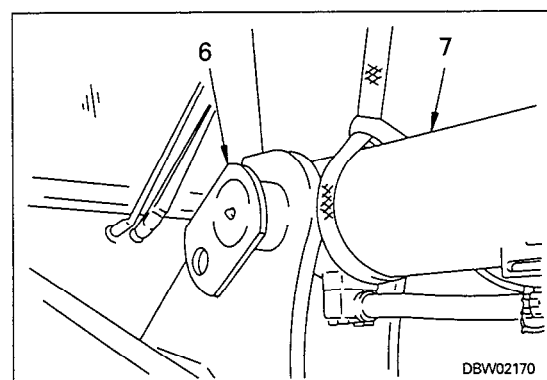
4. Bucket cylinder

※ 4

- 1) Remove lock bolt, then remove bottom pin (6).
 - ★ If there are shims, check the number and thickness of the shims, and keep in a safe place.
- 2) Lift off bucket cylinder (7).
 - ★ Be careful not to damage the cylinder rod portion.



Bucket cylinder : 170 kg (with tube)



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INSTALLATION OF BUCKET CYLINDER

- Carry out installation in the reverse order to removal.

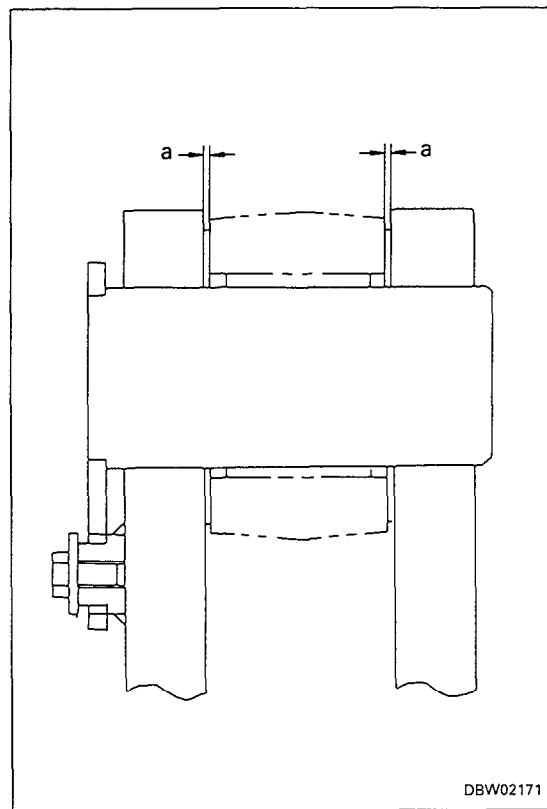
! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

※ 1

- ★ Adjust the bucket positioner.
For details, see TESTING AND ADJUSTING.

※ 2

- ★ Clearance **a** : Max. 1.5 mm



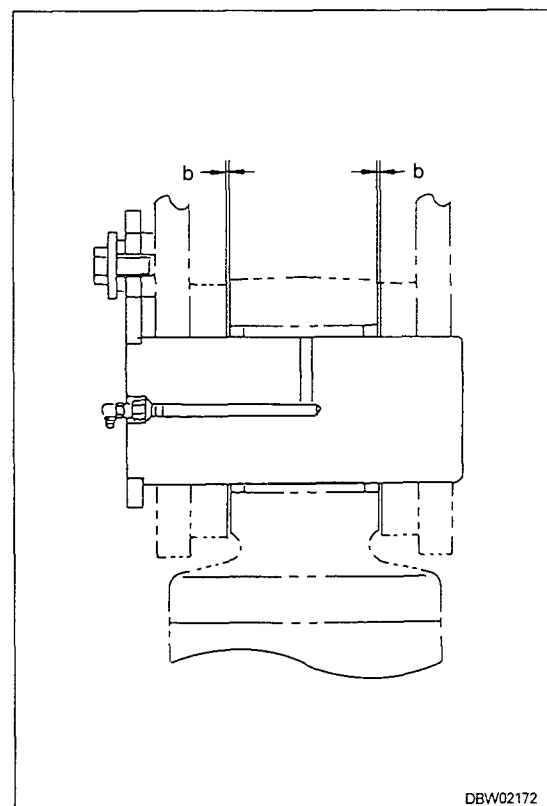
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※ 3

- ★ Fit the O-ring securely in the groove.
- ★ Install the hoses without twisting or interference.

※ 4

- ★ Clearance **b** : Max. 1.5 mm
- ★ Coat each pin with grease.



REMOVAL OF BOOM CYLINDER

⚠ 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.

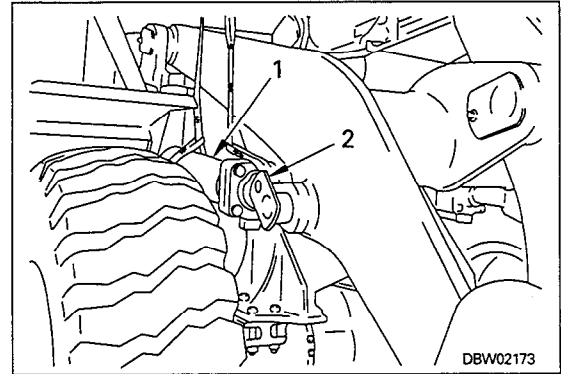
⚠ Operate the control levers several times to release the remaining pressure in the hydraulic piping. Then loosen the oil filler cap slowly to release the pressure inside the hydraulic tank.

- ★ Set the pin at a higher position than the top face of the tire.
- ★ Set a support under the boom.

1. Rod pin

※ 1

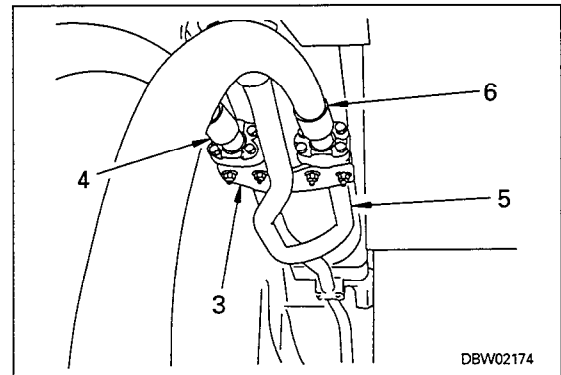
- 1) Sling boom cylinder (1), and remove lock bolt, then remove pin (2).
 - ★ If there are shims, check the number and thickness of the shims, and keep in a safe place.
- 2) Start engine, and operate control lever to retract cylinder rod of cylinder which has been removed.



2. Hydraulic piping

※ 2

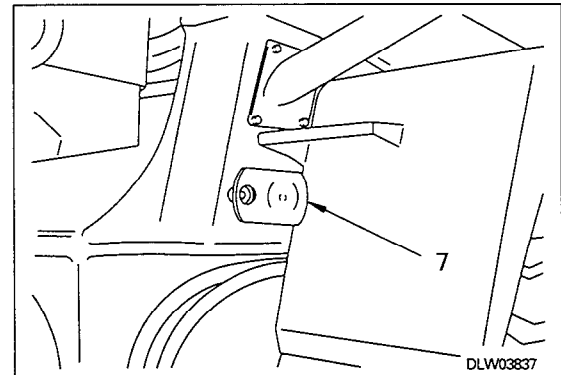
- 1) Disconnect tube (3) and hose (4) at rod end from disconnection.
- 2) Disconnect tube (5) and hose (6) at bottom end from connection.



3. Boom cylinder

※ 3

- 1) Remove lock bolt, then remove bottom pin (7).
 - ★ If there are shims, check the number and thickness of the shims, and keep in a safe place.

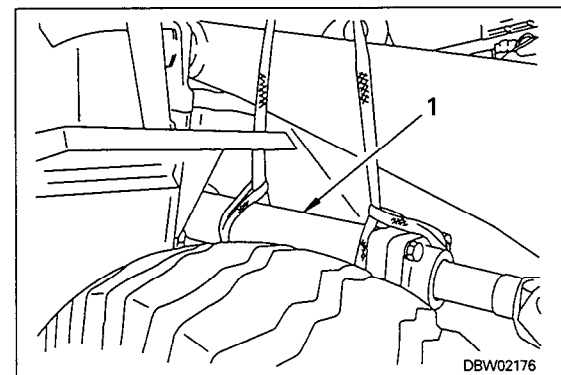


- 2) Remove boom cylinder (1).
 - ★ Be careful of the center of gravity, and remove slowly.
 - ★ Be careful not to damage the cylinder rod portion.



Boom cylinder assembly :

170 kg (with tube)



U42303

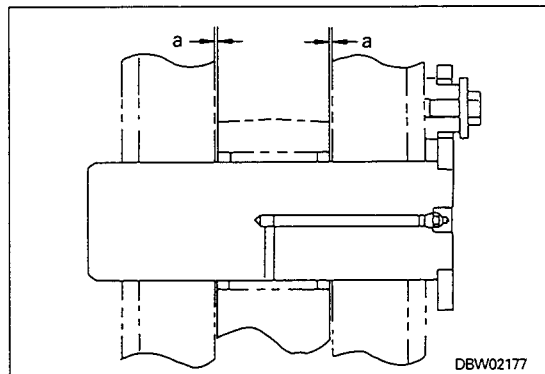
INSTALLATION OF BOOM CYLINDER ASSEMBLY

- Carry out installation in the reverse order to removal.

! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

※ 1

- ★ Clearance (a) : Max. 1.5 mm

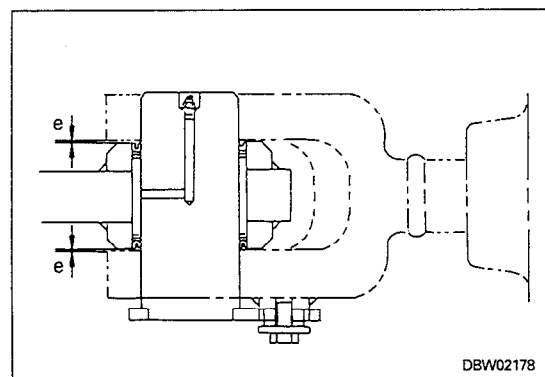


※ 2

- ★ Fit the O-ring securely in the groove.
- ★ Install the hoses without twisting or interference.

※ 3

- ★ Clearance (e) : Max. 2.0 mm
- ★ Remove the support.
- ★ Coat each pin with grease.

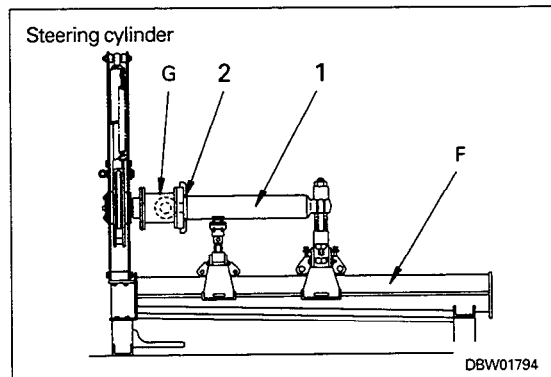


U42303

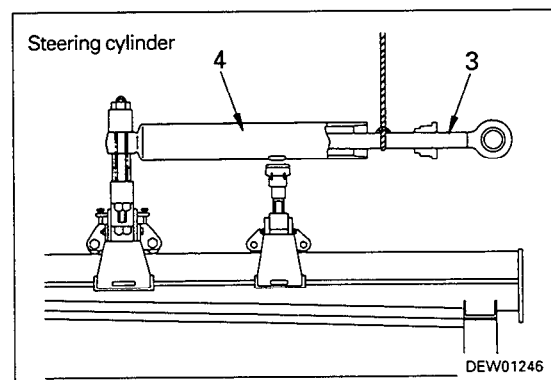
DISASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

(STEERING, BOOM, BUCKET CYLINDER ASSEMBLY)

1. Set cylinder assembly (1) to tool F.
2. **Cylinder head, piston rod assembly**
 - **Steering cylinder assembly**
 - 1) Using tool G, remove cylinder head (2) from cylinder.



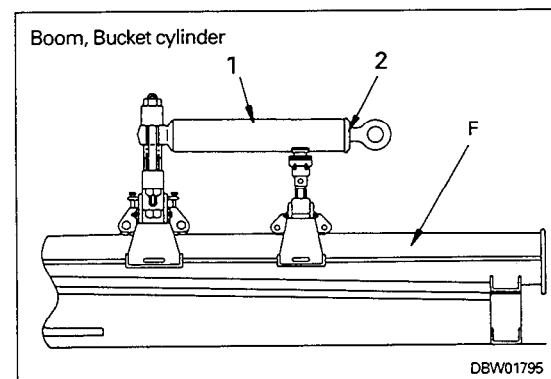
- 2) Pull out cylinder head and piston rod assembly (3) from cylinder (4), and lift off.
 - ★ Oil will flow out when the piston rod assembly is removed from the cylinder, so place a container under the cylinder to catch the oil.



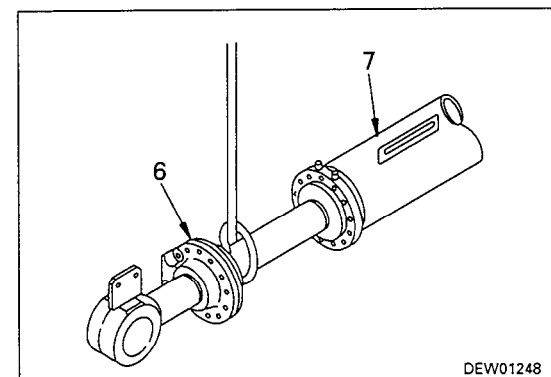
- **Boom, bucket cylinder assembly**

- 1) Remove mounting bolts of cylinder head (2).

Cylinder	Width across flats of bolt (mm)
Boom cylinder	41
Bucket cylinder	27



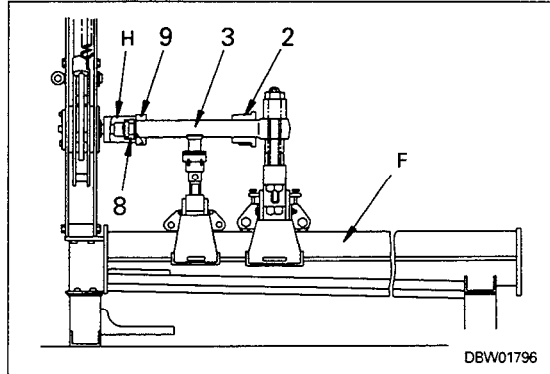
- 2) Pull out cylinder head and piston rod assembly (6) from cylinder (7), and lift off.
 - ★ Oil will flow out when the piston rod assembly is removed from the cylinder, so place a container under the cylinder to catch the oil.



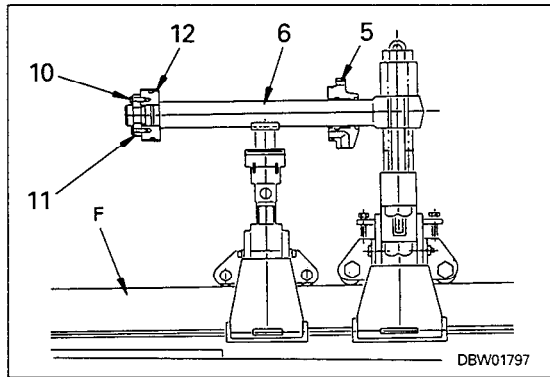
U42303

3. Cylinder head• **Steering cylinder assembly**

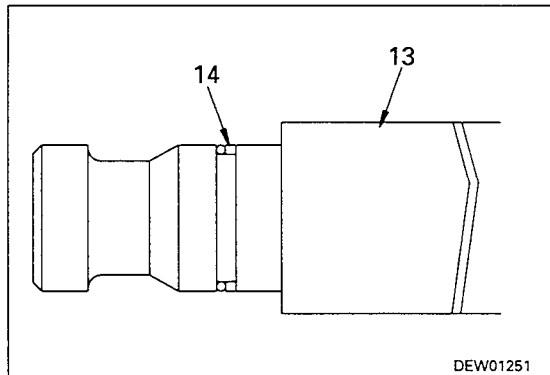
- 1) Set cylinder head and piston rod assembly (3) to tool F.
- 2) Using tool H, remove nut (8).
★ Width across flats of nut: 46 mm
- 3) Remove piston (9), then remove cylinder head (2).

• **Boom, bucket cylinder assembly**

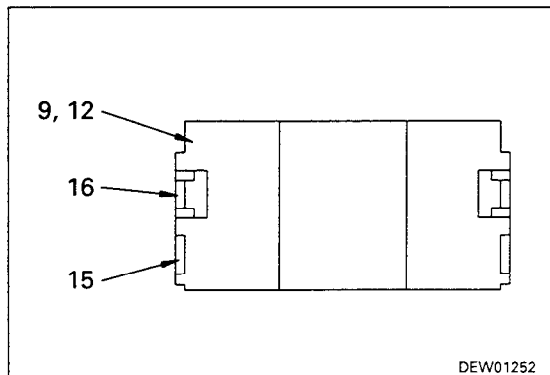
- 1) Set cylinder head and piston rod assembly (6) to tool F.
- 2) Remove piston mounting bolt (10), then remove spacer (11), piston (12), and cylinder head (5).



4. Remove O-ring and backup ring (14) from piston rod (13).
★ Rod of boom, bucket cylinder only.

**5. Disassembly of piston assembly**

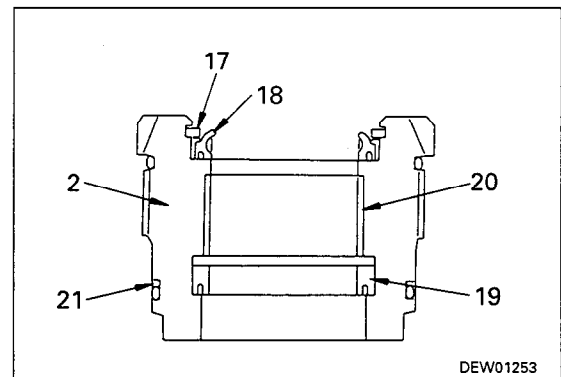
Remove wear ring (15) and piston ring (16) from pistons (9) and (12).



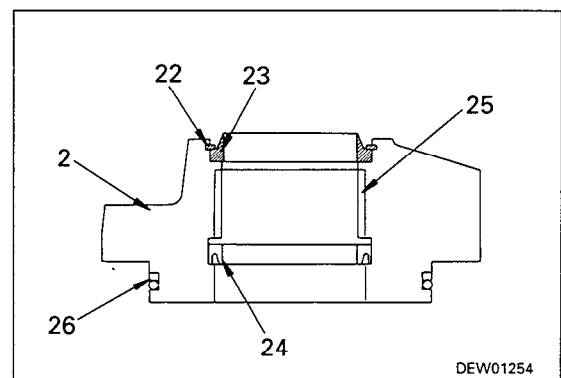
U42303

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).



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ASSEMBLY OF HYDRAULIC CYLINDER ASSEMBLY

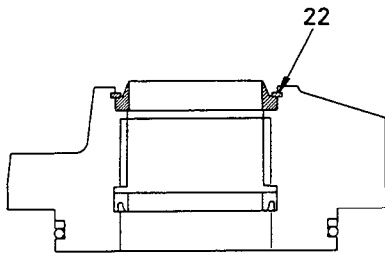
(STEERING, BOOM, BUCKET CYLINDER ASSEMBLY)

- ★ 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 I, press fit bushing (25) to cylinder head (2).
- 2) Install rod packing (24).
- 3) Using tool K, fit dust seal (23), then install snap ring (22).

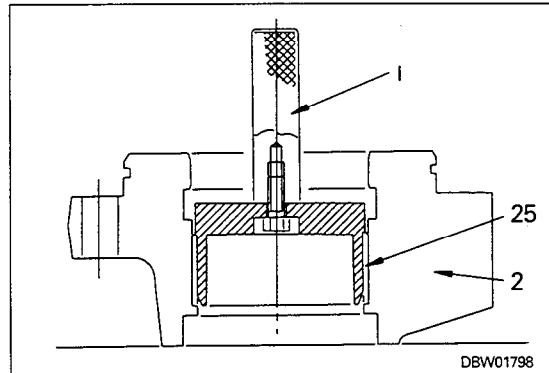


DEW01257

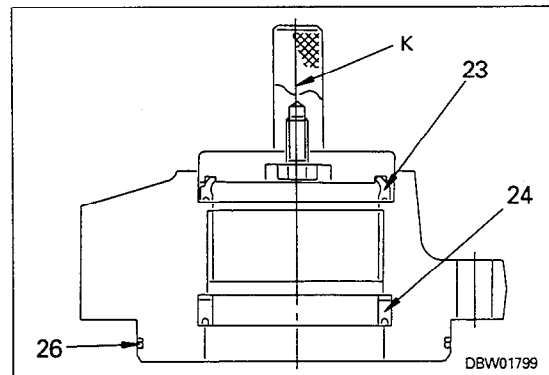
- 4) Install O-ring and backup ring (26).
- ★ Do not try to force the backup ring into position. Warm it in warm water (50 – 60°C) before fitting it.

• Steering assembly

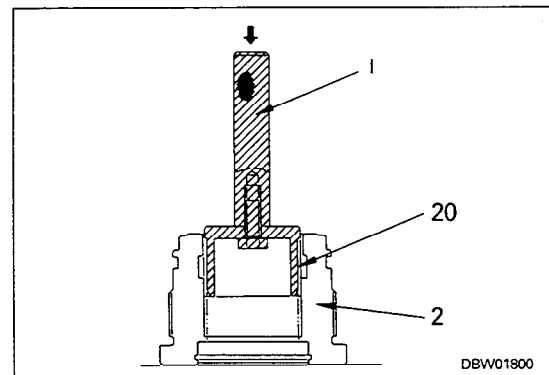
- 1) Using tool I, press fit bushing (20) to cylinder head (2).
- 2) Install rod packing (19).
- 3) Using tool K, install dust seal (18) to cylinder head.



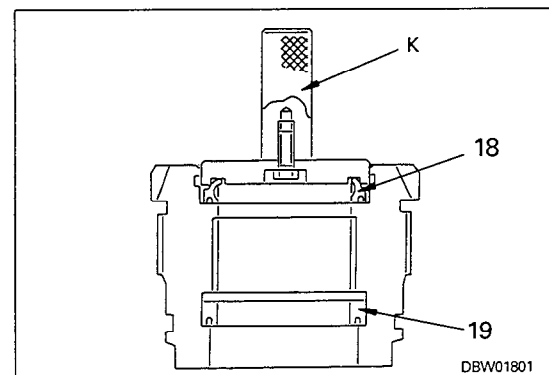
DBW01798



DBW01799



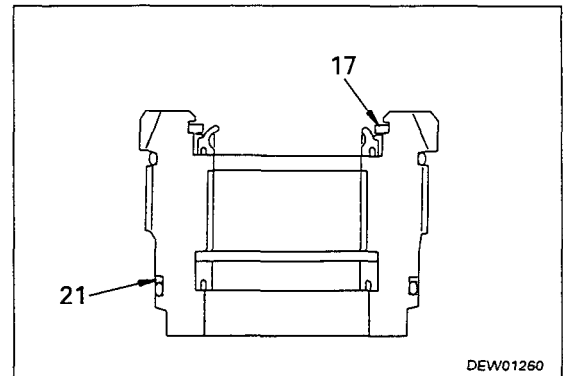
DBW01800



DBW01801

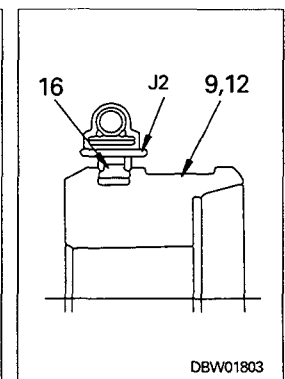
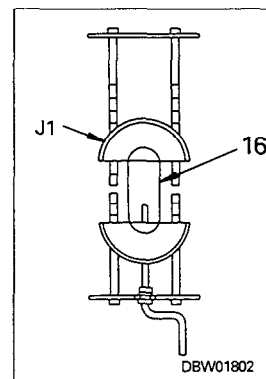
U42303

- 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.



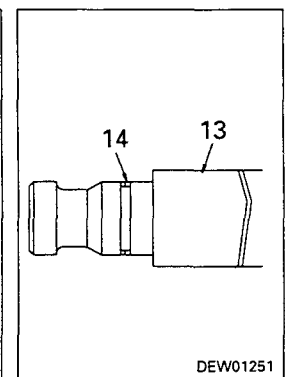
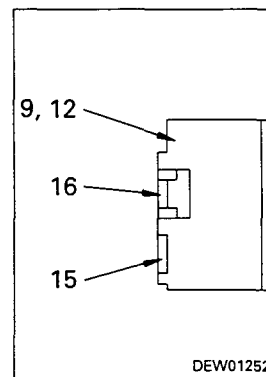
2. Assembly of piston assembly

- 1) Using tool **J1**, 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 **J1**, then assemble to pistons (12) and (9).
- 3) Using tool **J2**, 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

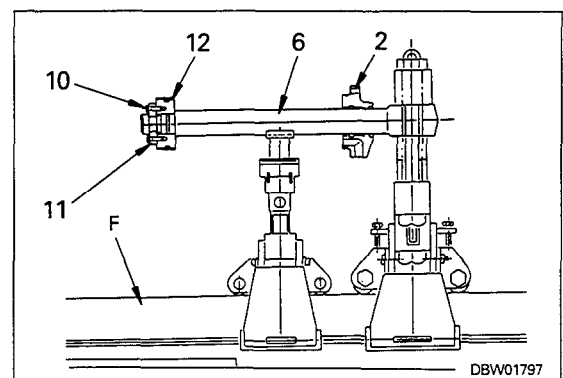
- **Boom, bucket cylinder assembly**
- 1) Set piston rod assembly (6) to tool **F**.
- 2) Assemble cylinder head (2), piston (12), and spacer (11) to piston rod, then tighten mounting bolt (10).

Mounting bolt:

Thread tightener (LT-2)

Mounting bolt:

Cylinder	Nm(kgm)
Boom cylinder	110.8 ± 12.8(11.3 ± 1.3)
Bucket cylinder	



U42303

- Steering cylinder assembly**

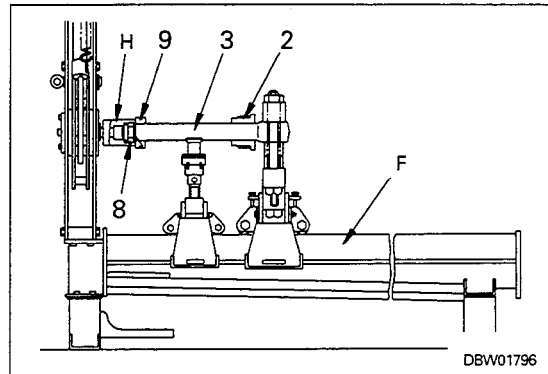
- 1) Set piston rod assembly (3) to tool F.
- 2) Assemble cylinder head (2) and piston (9) to piston rod.
- 3) Assemble nut (8), and using tool H, tighten nut (8).

 Thread of piston rod:

Thread tightener (LT-2)

 Nut:

Width across flats	Nm(kgm)
46	785 ± 78 (80 ± 8)



DBW01796

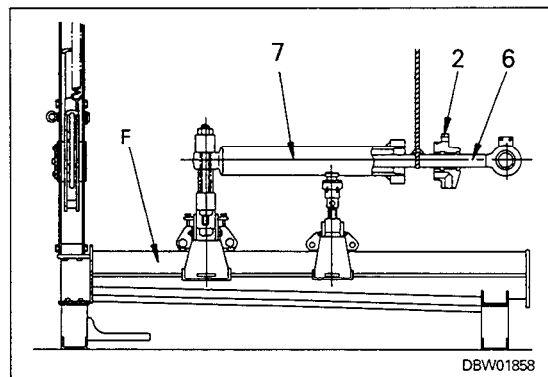
5. Cylinder head

- Boom, bucket cylinder**

- 1) Set cylinder (7) to tool F.
- 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	$1,324 \pm 147$ (135 ± 15)
Bucket cylinder	343 ± 34 (35 ± 3.5)



DBW01858

- 4) Remove cylinder assembly from tool F.

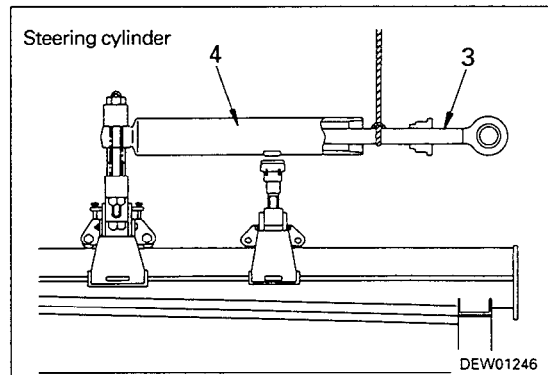
- Steering cylinder assembly**

- 1) Set cylinder (4) to tool F.
- 2) Raise cylinder head and piston rod assembly (3) and assemble to cylinder (4).
- 3) Using tool G, install cylinder head (2) to cylinder (4).

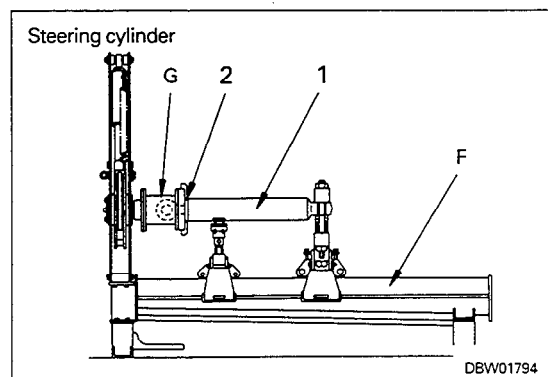
 Cylinder head:

588 ± 59 Nm (60 ± 6 kgm)

- 4) Bend lock of cylinder head (2) into notch at cylinder end.
- 5) Remove cylinder assembly (1) from tool F.



DEW01246



DBW01794

U42303

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.

1. Bucket link

1) Remove bucket link mounting pin (1). ※ 1

★ Secure the bucket link to the bellcrank with wire.

2) Remove left and right bucket hinge mounting pins (2). ※ 2

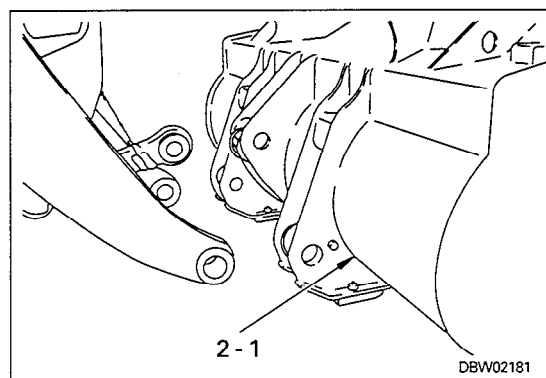
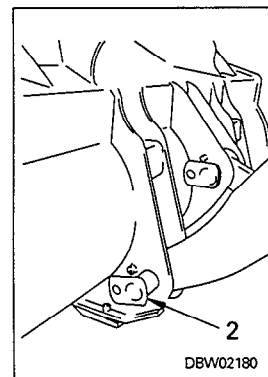
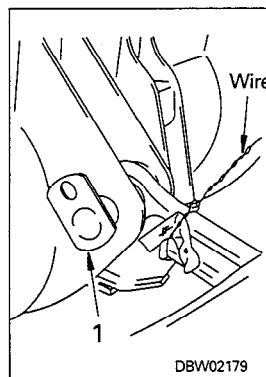
⚠ When aligning the position of the pin hole, never insert your fingers in the pin hole.

3) Bucket

Move machine towards rear, then disconnect bucket (2-1).



Bucket : 1,583 kg (with edge)



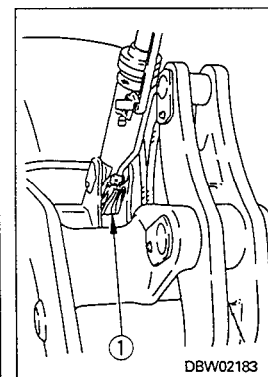
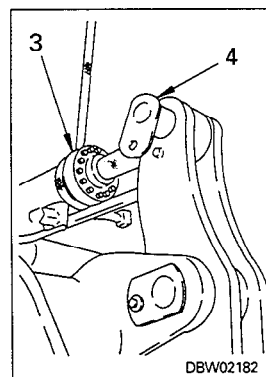
2. Bucket cylinder mounting pin

Sling bucket cylinder (3) and pull out pin (4), then disconnect cylinder rod and bellcrank.

★ Set block ① between the cylinder bottom and the frame.



Bucket cylinder : 166 kg



3. Boom cylinder pin

Sling boom cylinder (5), and remove mounting pin (6).

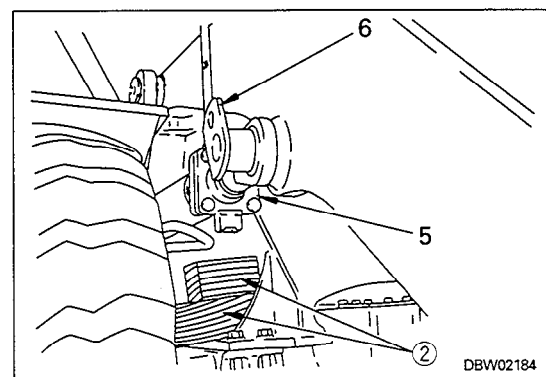
★ If there are shims, check the number and thickness of the shims, and keep in a safe place.

★ Set a support under the end of the boom.

★ Set blocks ② on the top of the axle and lower the cylinder.



Boom cylinder : 164 kg (each)



U42303

4. Boom, bellcrank, bucket link

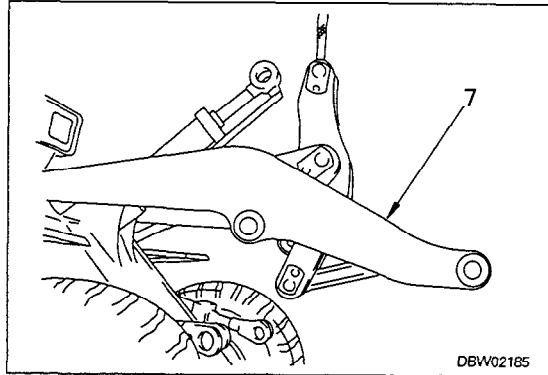
Sling boom, bellcrank, and bucket link assembly (7), then pull out boom mounting pin (8), and lift off boom.

※ 5



Boom, bellcrank, bucket link assembly :
1,380 kg

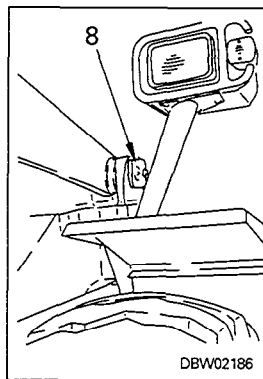
- ★ If there are shims, check the number and thickness of the shims, and keep in a safe place.



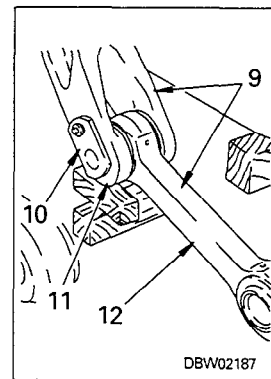
DBW02185

5. Bellcrank, bucket link

- 1) Remove pin (10) from bellcrank and bucket link assembly (9), and disconnect bellcrank (11) and bucket link (12).



DBW02186

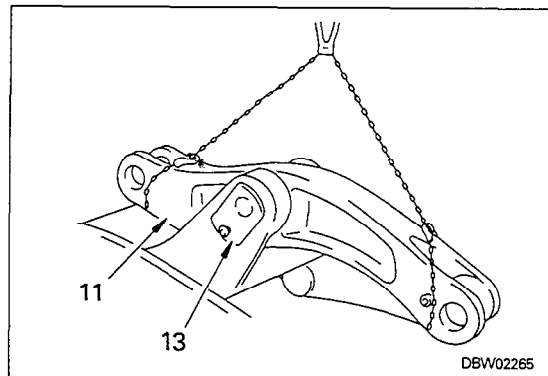


DBW02187

- 2) Sling bellcrank (11), then pull out mounting pin (13), and lift off.



Bellcrank : **310 kg**

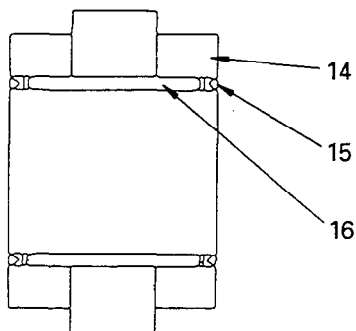


DBW02265

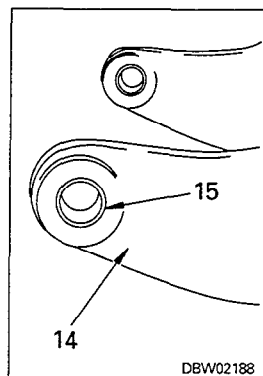
6. Dust seal, bushing

※ 6

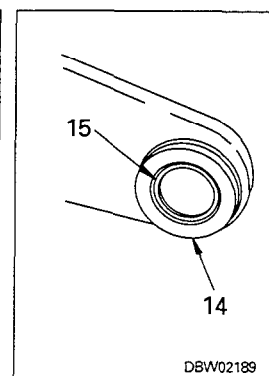
- 1) Pull out dust seal (15) and bushing (16) from boom (14).



DLW02190



DBW02188

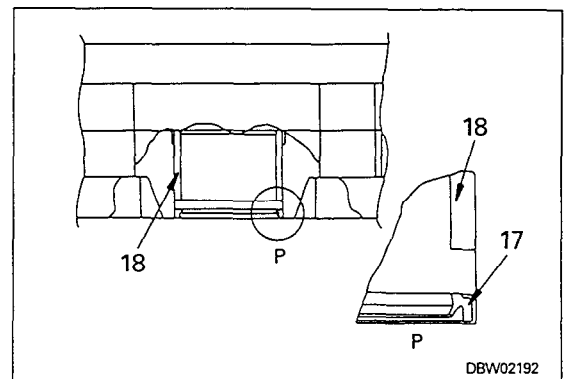
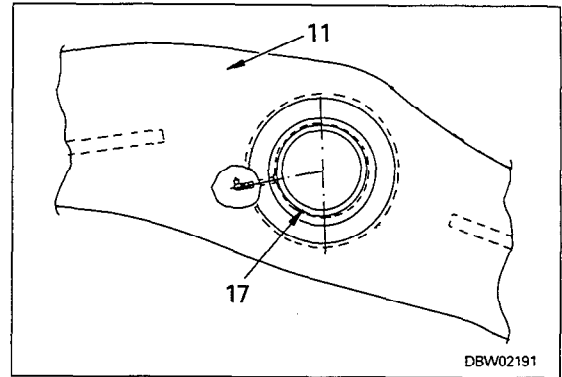


DBW02189

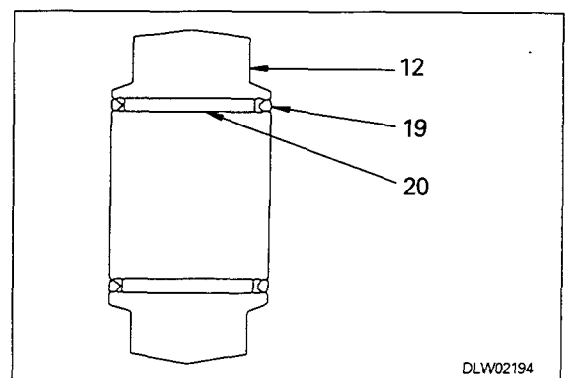
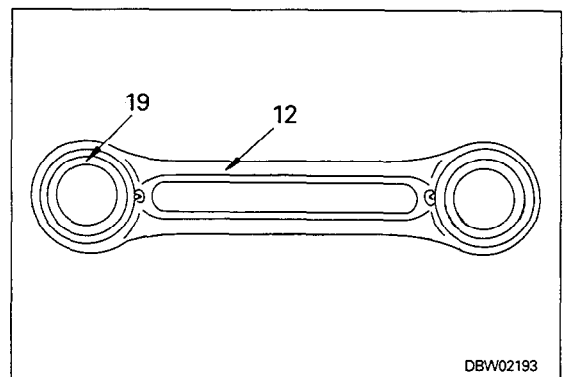
U42303

U42303

- 2) Pull out dust seal (17) and bushing (18) from bellcrank (11).



- 3) Pull out dust seal (19) and bushing (20) from bucket link (12).



INSTALLATION OF WORK EQUIPMENT ASSEMBLY

- Carry out installation in the reverse order to removal.

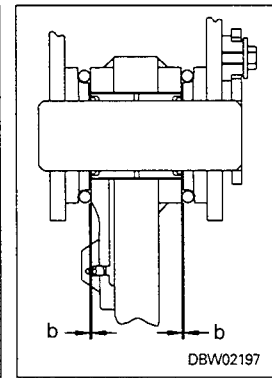
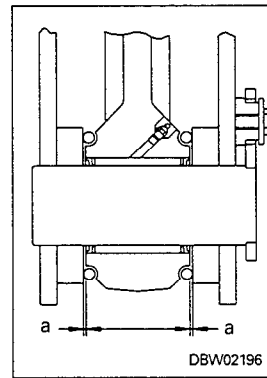
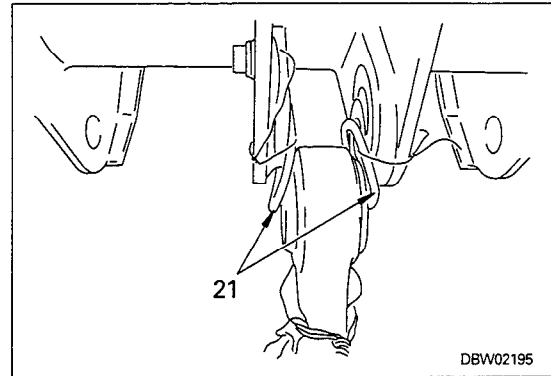
! When aligning the position of the pin hole, use a bar. Never insert your fingers in the pin hole.

※ 1

- ★ Operate the control levers, align the mounting pin holes for the bucket and bucket link, install cord rings (21), insert shims so that clearances **a** and **b** on the left and right are uniform, then assemble the mounting pin and lock with the bolt.
- ★ Be careful not to get the cord ring caught.
- ★ Clearance **a** : Max. 1.5 mm (bucket link portion)

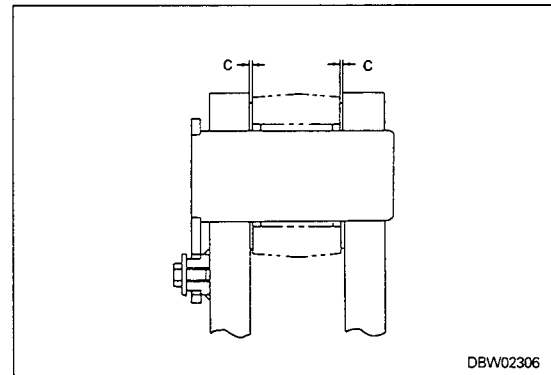
※ 2

- ★ Clearance **b** : Max. 1.5 mm (bucket hinge portion)



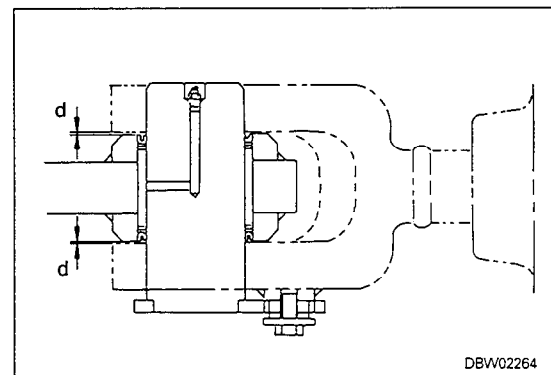
※ 3

- ★ After assembling the mounting pin, remove block ①.
- ★ Clearance **c** : Max. 1.5 mm



※ 4

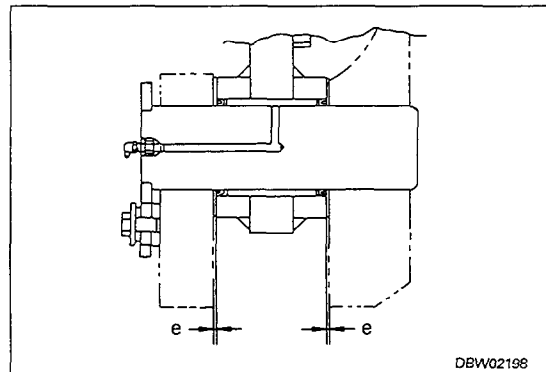
- ★ Clearance **d** : Max. 2.0 mm



U42303

※ 5

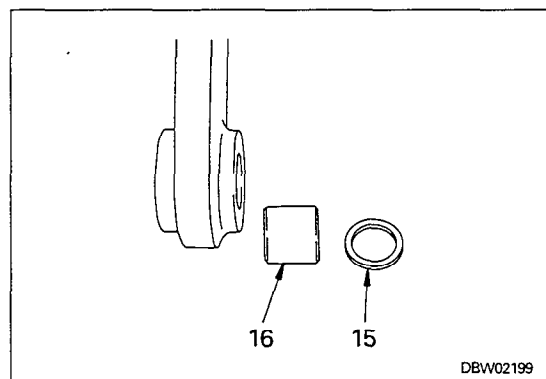
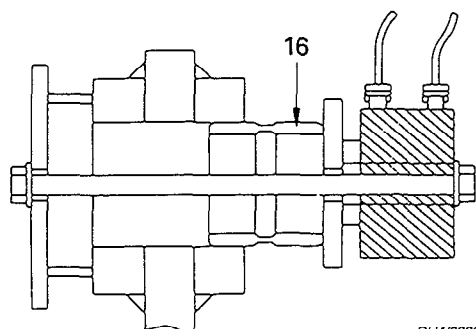
- ★ After installing the boom, install boom kickout switch.
- ★ Clearance e : Max. 1.5 mm
- ★ After assembling the pin, set the support to the tip of the boom.



※ 6

- ★ Press fit bushing (16) to each of bucket link, bellcrank, and boom with press, then assemble dust seal (15).

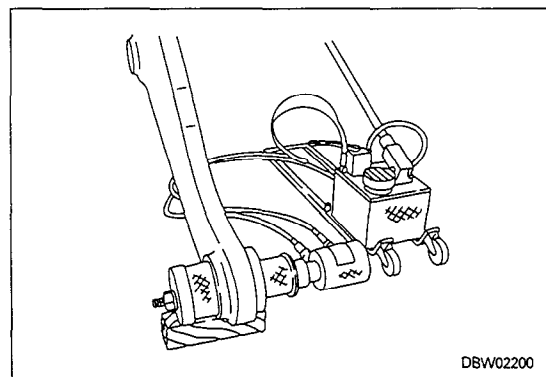
 Bushing : Grease (G2-LI)



U42303

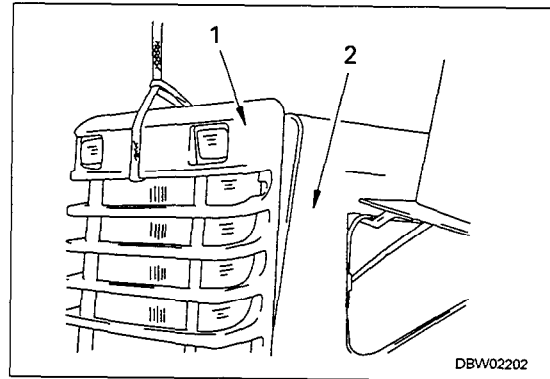
★ **Greasing**

Coat each pin with grease.



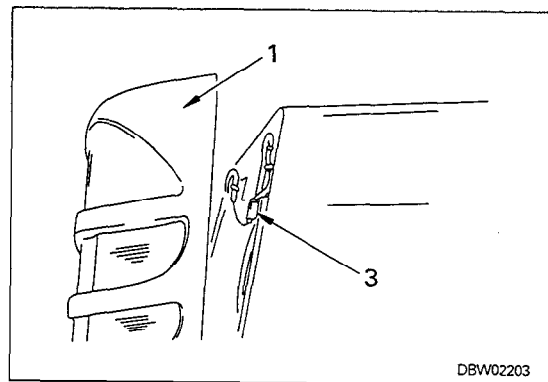
REMOVAL OF COUNTERWEIGHT

- ⚠** 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. Grill

- 1) Sling grill (1), and remove from engine hood (2), then make a clearance.
- 2) Disconnect wiring connector (3), then lift off grill (1).



2. Counterweight

Sling counterweight (5), then remove mounting bolts (4) and lift off.

- ★ Be careful to maintain the balance when lifting off.



Counterweight: 1,170 kg

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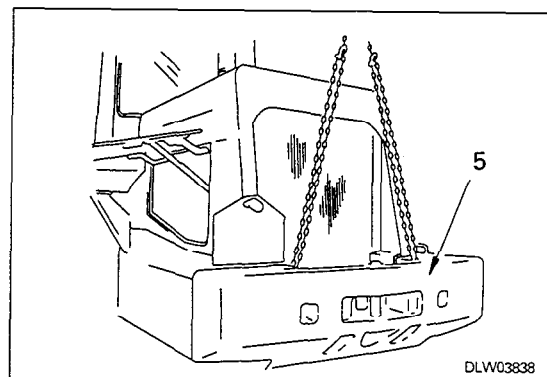
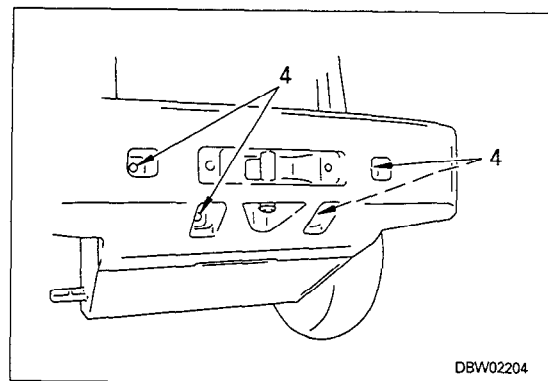
INSTALLATION OF COUNTERWEIGHT

- Carry out installation in the reverse order to removal.



Mounting bolt :

927 ± 103 Nm (94.5 ± 10.5 kgm)
(Width across flats: 36 mm)

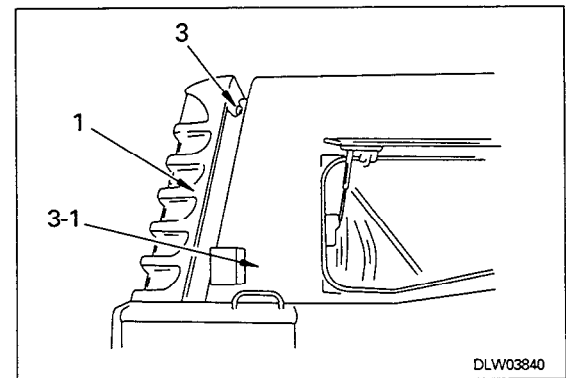
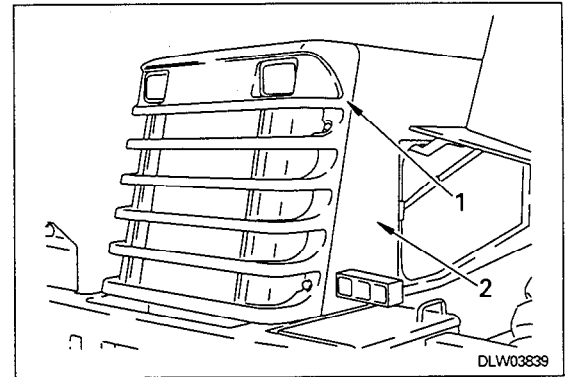


REMOVAL OF FUEL TANK ASSEMBLY

- ⚠ 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.
- ⚠ Open the inspection cover and apply the lock.

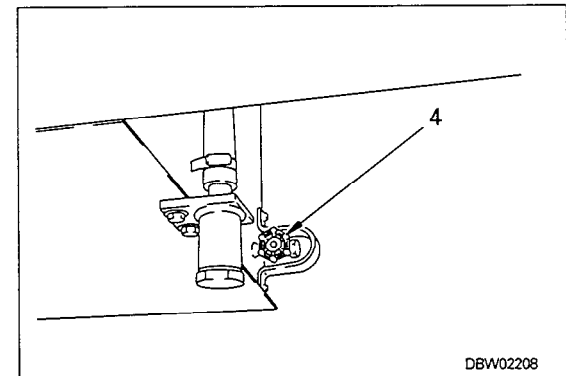
1. Grill

- 1) Loosen mounting bolts of grill (1), then fit grill to engine hood (2) temporarily, and remove light wiring from engine hood (3-1) clip portion.
- 2) Disconnect wiring connector (3), and remove grill (1).



2. Draining fuel

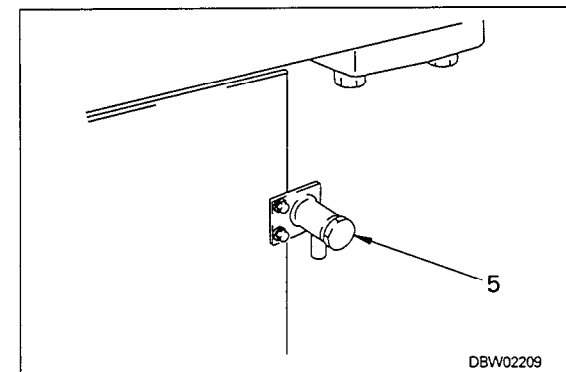
Loosen drain valve (4) and drain fuel.



3. Drain valve

Remove engine oil drain valve (5) from fuel tank.

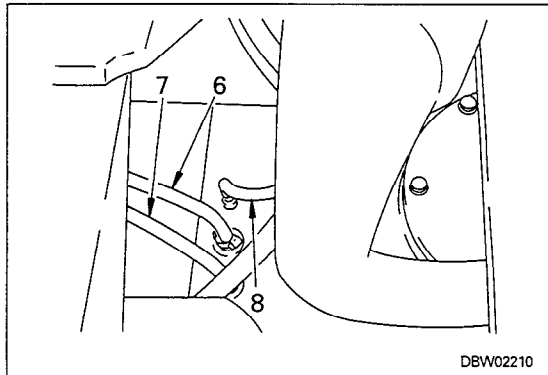
- ★ Remove the drain valve, then tie with wire and move to the side.



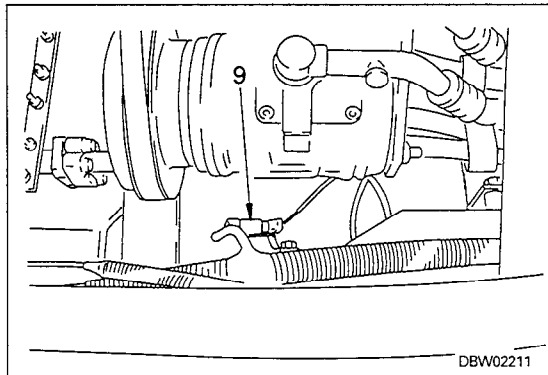
U42303

4. Fuel tubes, wiring

- 1) Disconnect fuel hoses (6) and (7) from fuel tank.
- 2) Disconnect spill hose (8) from fuel tank.



- 3) Disconnect wiring connector (9) for fuel unit.

**5. Fuel tank**

※ 1

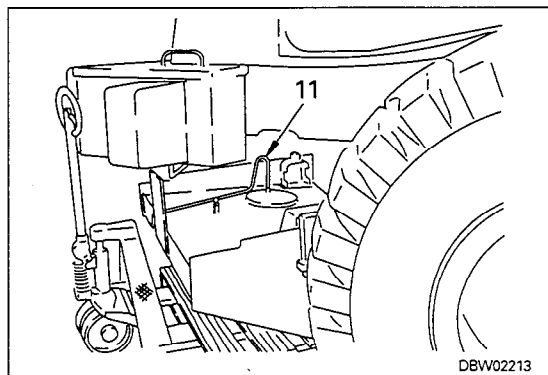
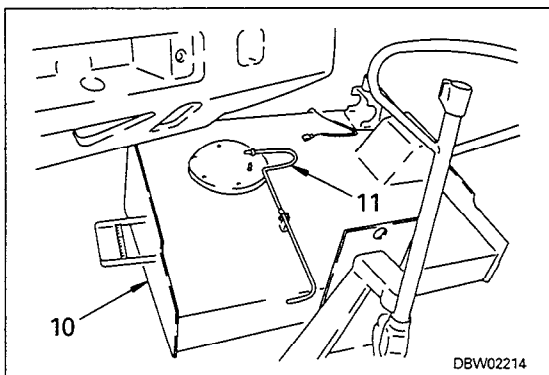
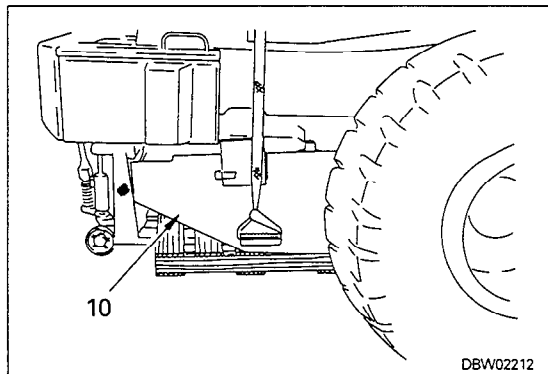
- 1) Sling fuel tank (10), then remove mounting bolts and lift off.
 - ★ Use two nylon ropes of a length of approx. 5 m to sling the tank.
 - ★ Set a pallet under the tank, then slowly lower the fuel tank on to the pallet, taking care to maintain the balance.

Fuel tank : **179 kg (empty)**

- 2) Pull out fuel tank (10) from under machine.

※ 2

- ★ Tilt breather tube (11) to the side to prevent it from hitting the chassis.
- ★ When pulling the fuel tank out from under the chassis, remove it from the right side.



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INSTALLATION OF FUEL TANK ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ When tightening the bolts, tighten in the following order: left, rear, right



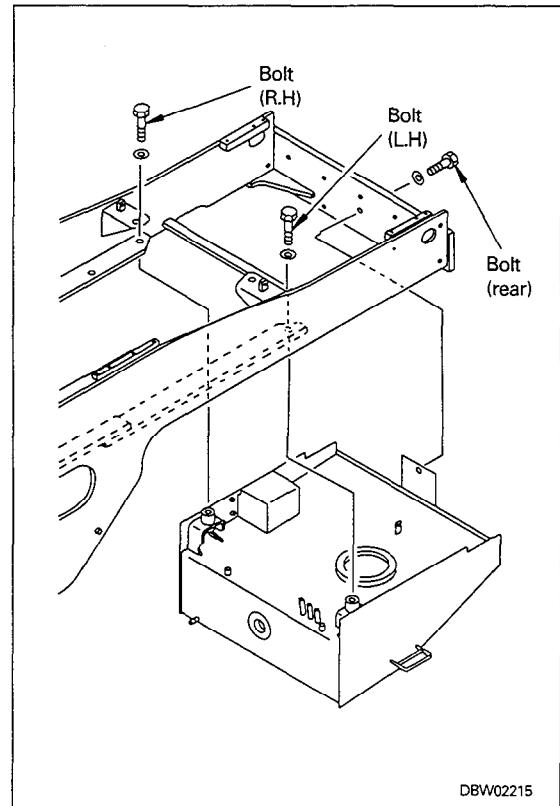
kgm Mounting bolt :

927 ± 103 Nm (94.5 ± 10.5 kgm)
(Width across flats: 36 mm)

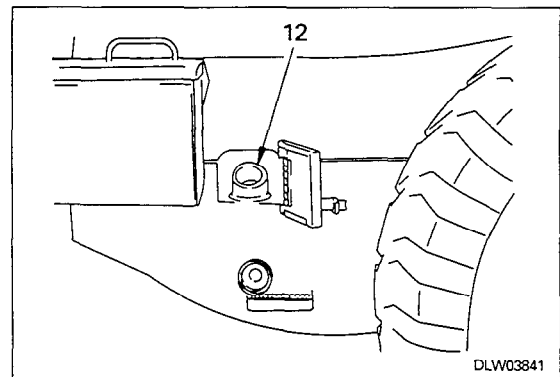
- ★ When raising the tank, keep it horizontal and set it in the mounting position.
- ★ Raise the pallete fully, then lift the fuel tank.

※ 2

- ★ Pull the breather tube under the chassis before connecting.



- **Refilling with oil**
Tighten drain valve and add fuel through oil filler (12).



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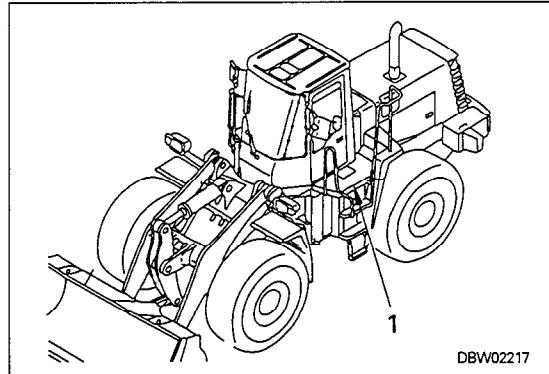
REMOVAL OF CAB, FLOOR FRAME ASSEMBLY

! Disconnect the cable from the negative (-) terminal of the battery.

1. Lift off left and right ladders (1).



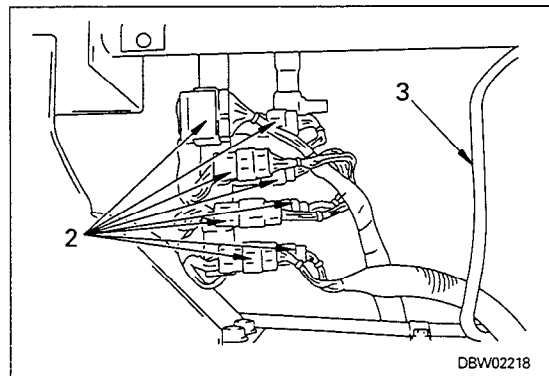
Ladder : 60 kg



2. Remove 8 connectors (2) from clip and disconnect.

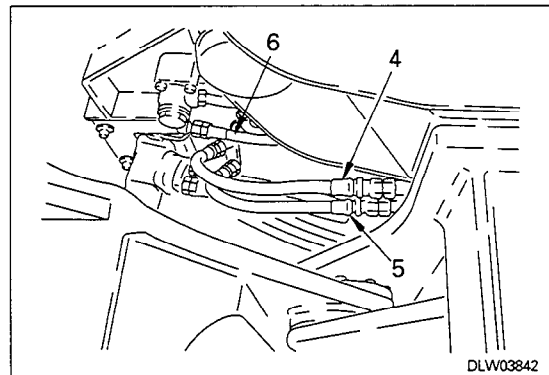
- ★ To distinguish the connectors, mark them with tags.
- ★ After disconnecting, fit the connectors at the cab end to the clip, and take steps to prevent oil or mud from getting on the connectors at the chassis end.

3. Disconnect ground connection (3) between cab and chassis.



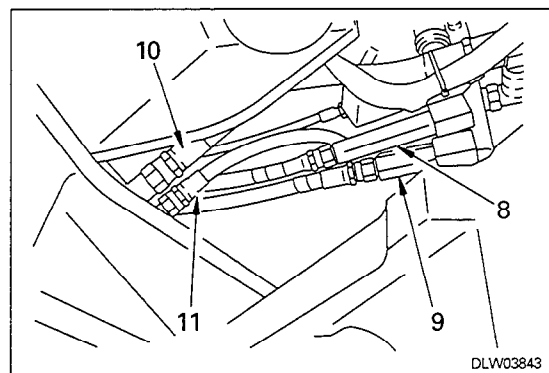
4. Disconnect hoses (4), (5), and (6).

- ★ Disconnect the intermediate hose clamp of hose (6).
- ★ After disconnecting the hoses, tie them securely with wire to the bottom of the cab.
- ★ To distinguish the hoses, mark them with tags.



5. Disconnect brake hoses (8), (9), (10), and (11).

- ★ To distinguish the hoses, mark them with tags.

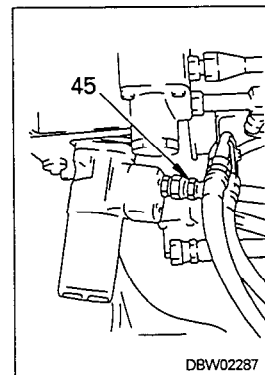
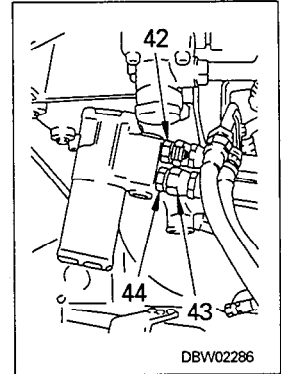
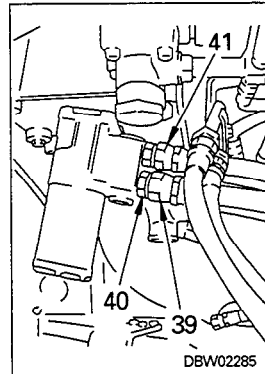


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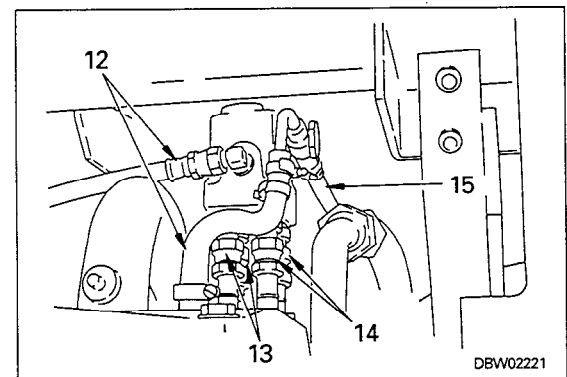
U42303

6. Orbit-roll valve piping

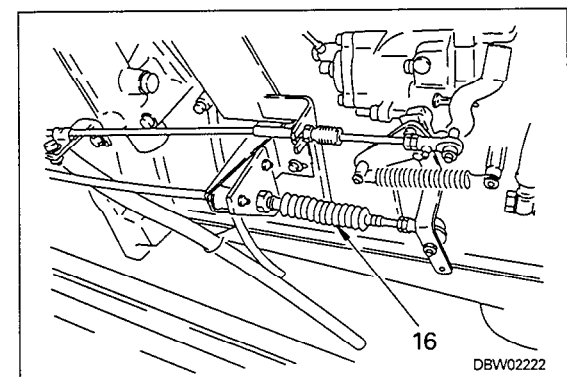
- Disconnect hose (39) between orbit-roll valve and accumulator from orbit-roll valve end, then remove nipple (40).
- Disconnect hose (41) between orbit-roll valve and hydraulic tank from orbit-roll valve end, then remove nipple (42).
- Disconnect hose (43) between orbit-roll valve and stop valve (R.H.) then remove nipple (44).
- Disconnect hose (45) between orbit-roll valve and stop valve (L.H.) from orbit-roll valve end.

**7. Disconnect work equipment PPC valve hoses (12), (13), (14), and (15).**

- ★ When removing the 4 hoses at the bottom of the PPC valve, remove the hoses from the outside, then remove the nipple and disconnect the hoses.
- ★ To distinguish the hoses, mark them with tags.

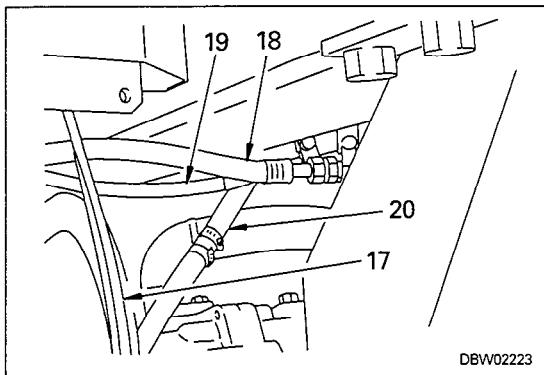
**8. Disconnect accelerator cable (16) at fuel injection pump end.**

※ 1



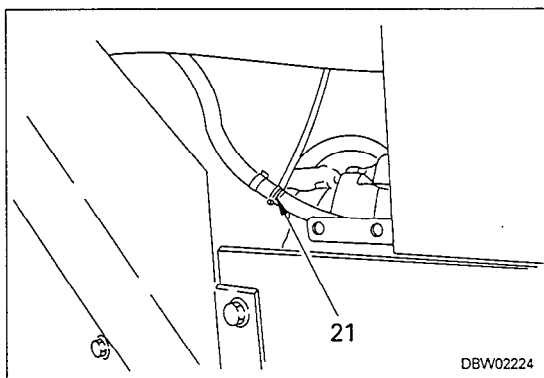
9. Disconnect 2 window washer tubes (17) at washer tank end.

- ★ Fit blind plugs to prevent the water inside the washer tank from leaking out.
- ★ After disconnecting the tubes, check the position for inserting them into the tank, then coil the tubes and secure them to the cab.

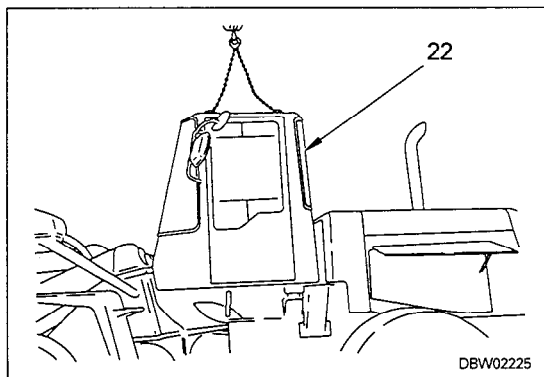


10. Disconnect air conditioner hoses (18) and (19), and heater hoses (20) and (21). ※ 2

- ★ Loosen the sleeve nut of the air conditioner hose and gradually drain the refrigerant (R-134a).
- ★ To prevent coolant from leaking out from the heater hose, bend the tip of the hose and tie it with wire.
- ★ Put the air conditioner hoses in a vinyl bag to prevent oil, mud, or dirt from entering.



11. Sling cab and floor frame assembly (22), then remove mount bolts, and lift off cab and floor frame assembly (22). ※ 3



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INSTALLATION OF CAB, FLOOR FRAME ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

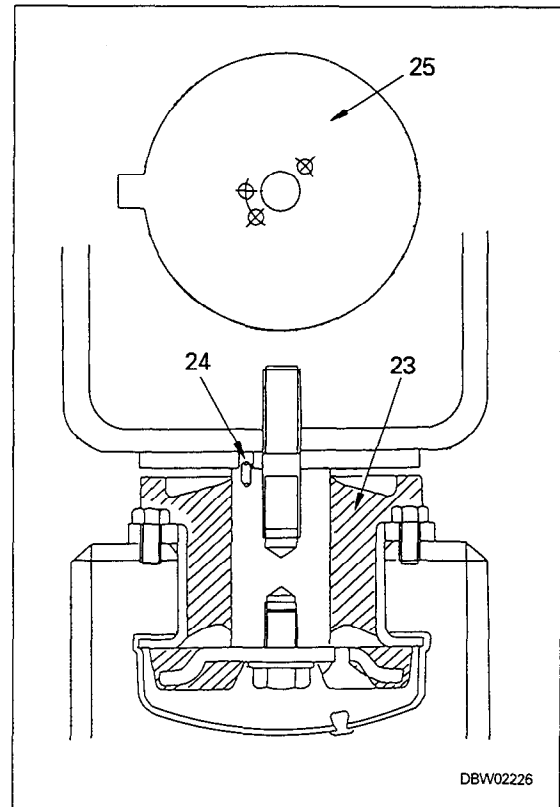
- Adjust the accelerator cable.
For details, see TESTING AND ADJUSTING,
Measuring accelerator pedal.

※ 2

- ★ Check that there is no damage to the air conditioner hose, sleeve nut, or O-ring, then connect.

 Sleeve nut:

Thread size	Tightening torque Nm (kgm)
M16 x 1.5	11.8 – 14.7 (1.2 – 1.5)
M22 x 1.5	19.6 – 24.5 (2.0 – 2.5)
M24 x 1.5	29.4 – 34.3 (3.0 – 3.5)
M6 bolt at receiver portion	3.9 – 6.9 (0.4 – 0.7)
Other M6 bolts	7.8 – 11.8 (0.8 – 1.2)

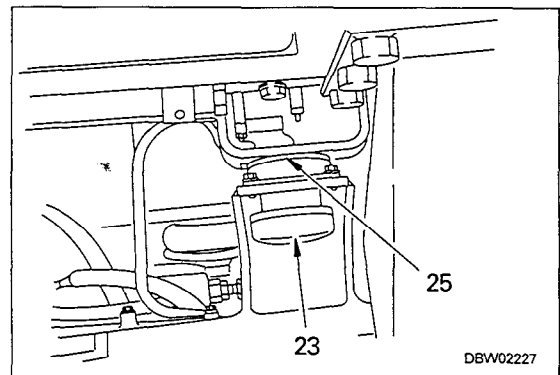


※ 3

 Cab, floor frame assembly : **700 kg**

- ★ Align the hole of plate (25) with dowel pin (24) of viscous mount (23) and assemble.
Align the position of the flange of plate (25) so that it is easy to prevent rotation during the tightening operation.

- ★ Charge with refrigerant (R-134a).



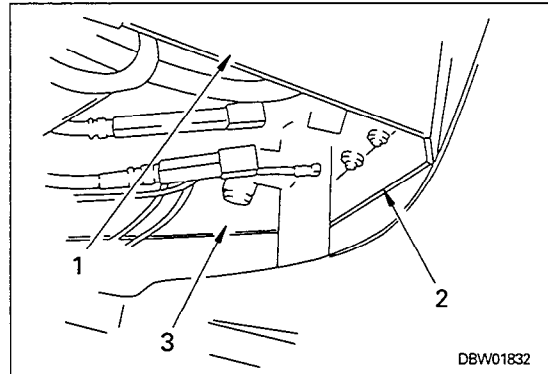
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REMOVAL OF CAB ASSEMBLY

⚠ 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. Cover

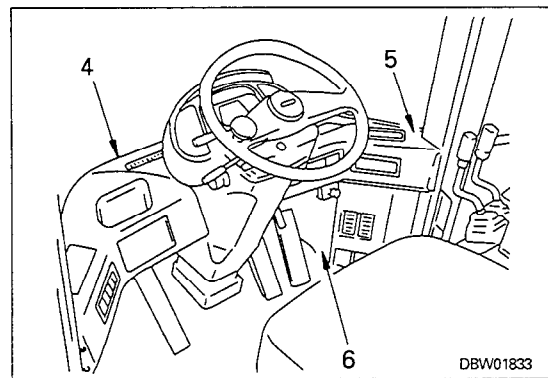
1) Remove covers (1), (2), and (3) from under floor.



2) Remove cover mounting bolts, then remove covers (4) and (5).

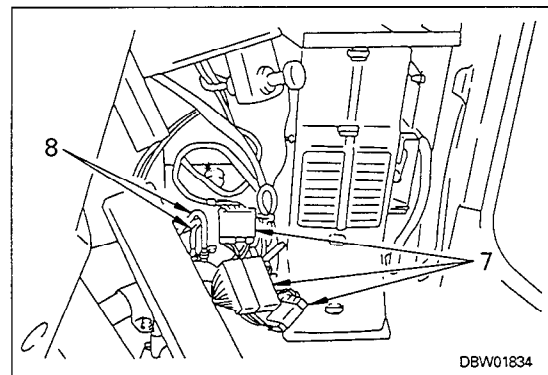
★ Remove the ashtray from cover (5).

3) Remove cover (6).



2. Electric wiring

1) Disconnect cab wiring connectors (7).  1
★ Fit tags to distinguish the connectors.
(Connectors CL1, CL2, CL3)

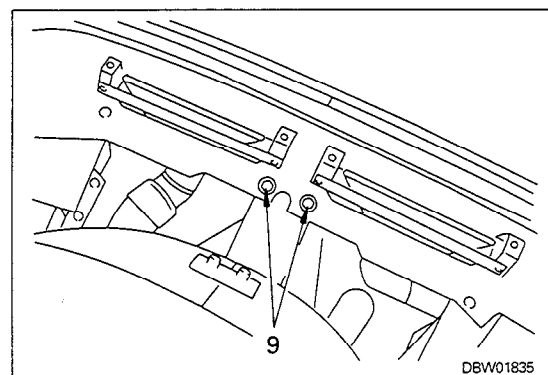


3. Hoses

1) Disconnect 2 window washer hoses (8).
★ Make marks to distinguish the hoses.
★ Drain the washer fluid.

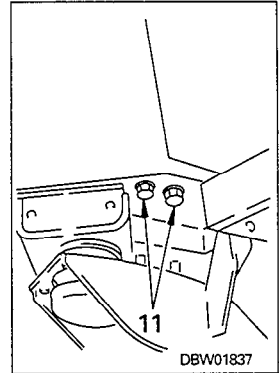
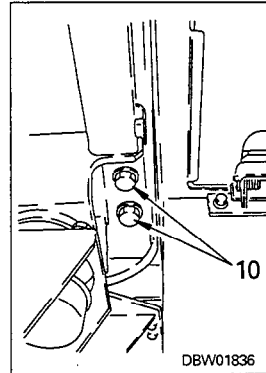
4. Cab

1) Remove steering post and cab mounting bolts (9).
★ Pull the steering post to tip it down.



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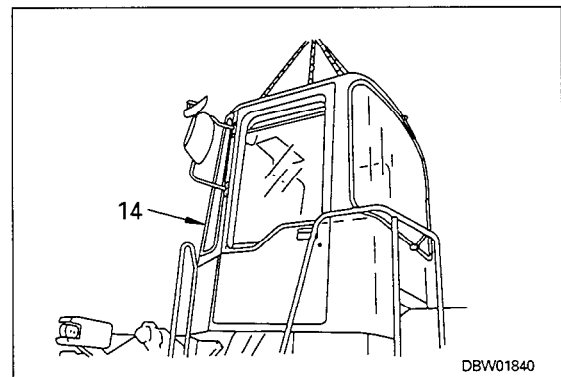
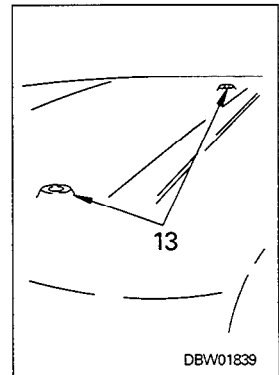
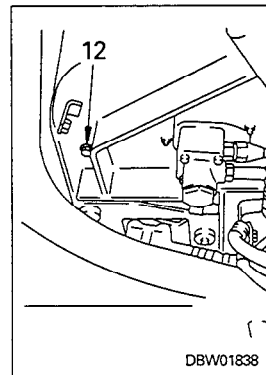
- 2) Remove floor and cab mounting bolts (10), (11), and (12) on left and right.



- 3) Lift off cab (14).
 ★ Remove 4 plugs (13) from the cab roof, then install eyebolts.
 ★ Raise horizontally and lift off slowly.



Cab : 295 kg



INSTALLATION OF CAB ASSEMBLY

- Carry out installation in the reverse order to removal.



- ★ Connect the wiring connectors securely.

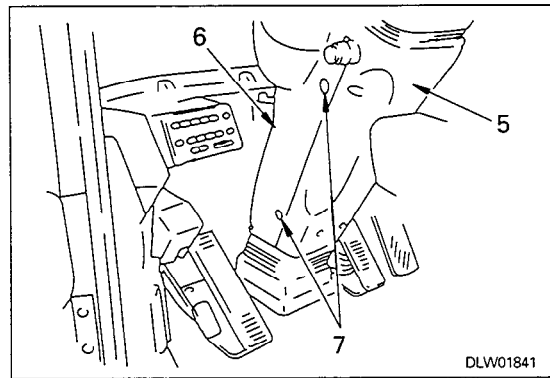
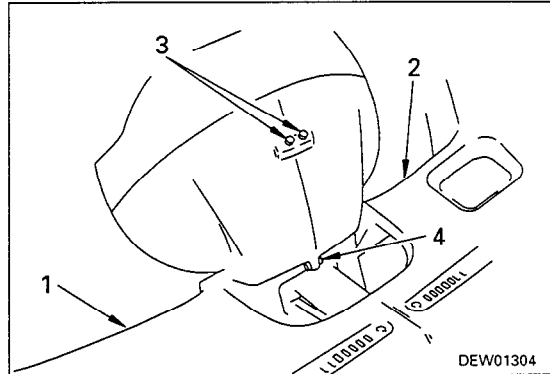
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REMOVAL OF MAIN MONITOR ASSEMBLY

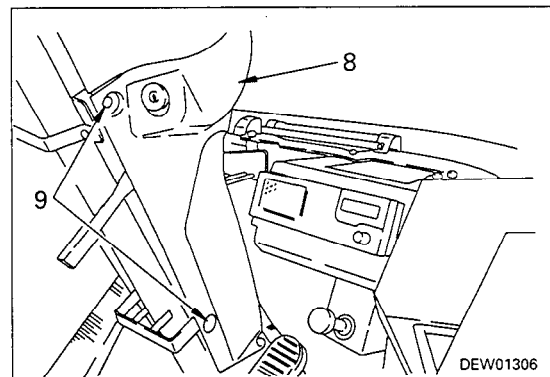
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Disconnect the cable from the negative (-) terminal of the battery.

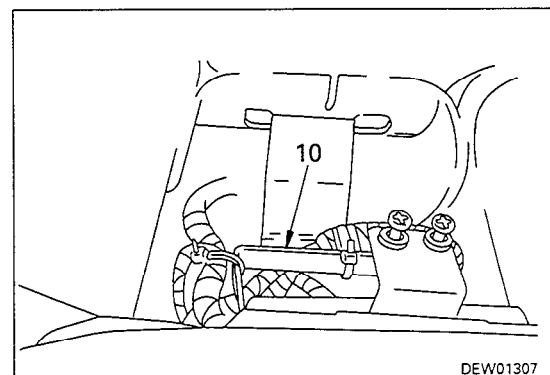
1. Remove dashboards (1) and (2).
2. Remove steering post cover mounting bolts (3) and (4).
3. Remove steering post cover (5).
4. Remove mounting bolt caps (7) of steering post cover (6), then remove bolts.



5. Remove mounting bolt caps from steering post cover (8), then remove mounting bolts (9).
★ Tip the steering post cover to the front.



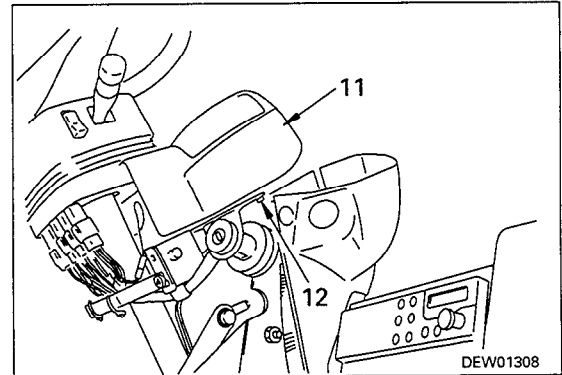
6. Remove bracket (10) at back of main monitor.



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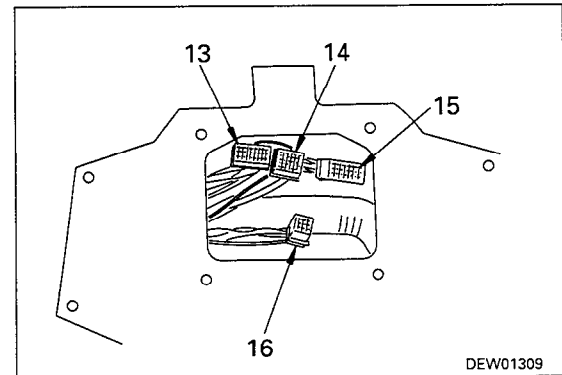
7. Remove 8 mounting bolts (12) of main monitor (11).

★ 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, and remove main monitor (11).

※ 1

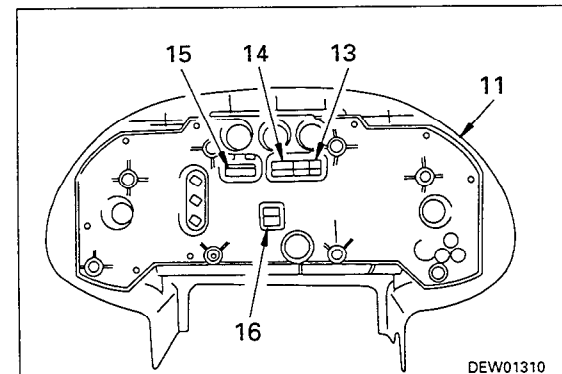


INSTALLATION OF MAIN MONITOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

★ Fit the connector lock securely.



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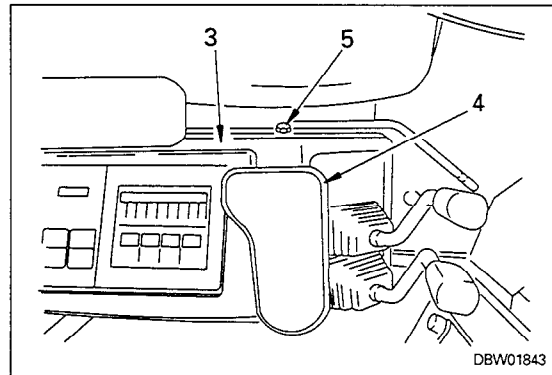
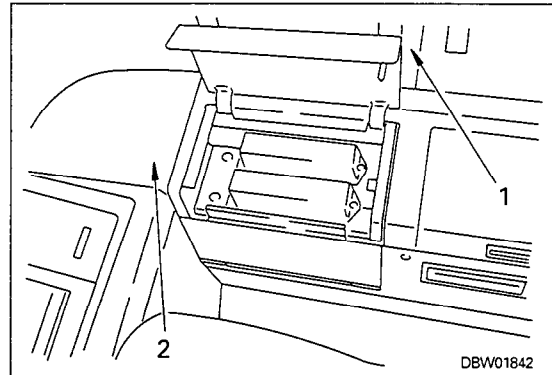
REMOVAL OF MAINTENANCE MONITOR ASSEMBLY

⚠ 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.

⚠ Disconnect the cable from the negative $\ominus$ terminal of the battery.

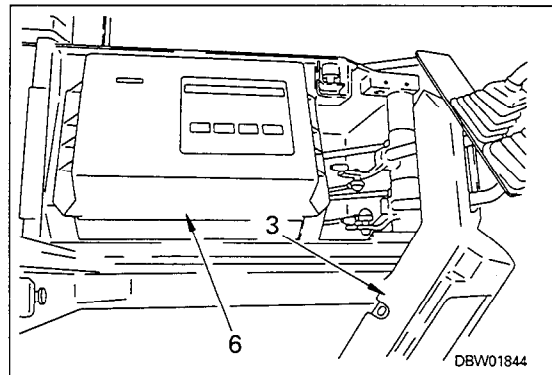
1. Cover

- 1) Remove cover (1) from cab.
★ Remove the cover and leave the bolts loosened.
- 2) Remove cover (2).
★ Open the fuse box cover and leave the bolts loosened.
- 3) Remove monitor cover (3).
★ Remove pad assembly (4) and mounting bolt cap (5).
★ Remove the boot.
★ Turn the cover to the outside.



2. Maintenance monitor

- 1) Remove mounting bolts, then remove maintenance monitor (6).
★ Move the maintenance monitor to the side.



3. Disconnect electrical wiring (7) from connector.

- ★ Electrical wiring (7): L18, L19, L22, L20
- ★ Fit tags to distinguish the wiring.

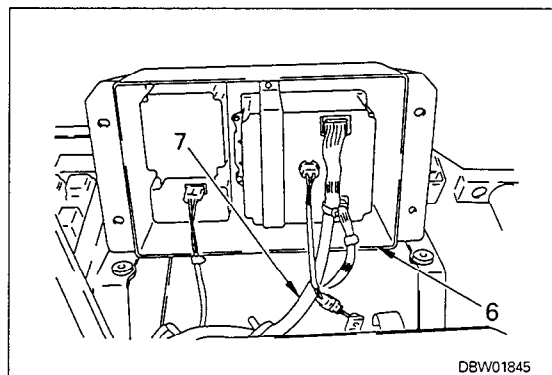
※ 1

INSTALLATION OF MAINTENANCE MONITOR ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1

- ★ Connect the connectors securely.



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REMOVAL OF AIR CONDITIONER UNIT ASSEMBLY

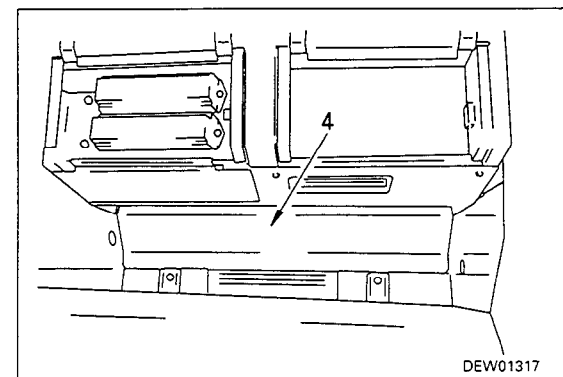
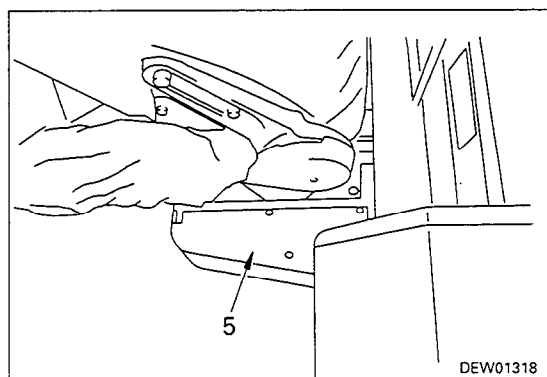
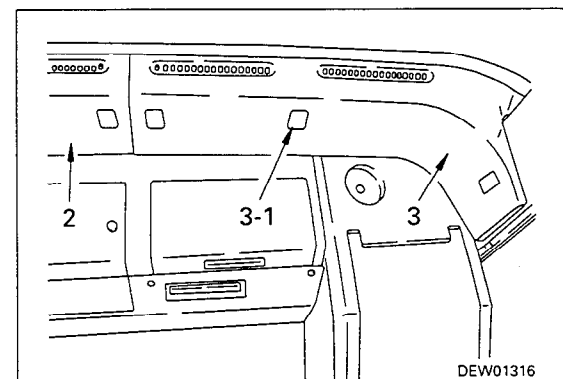
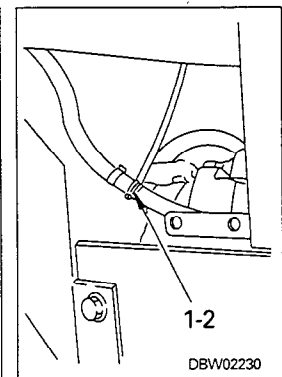
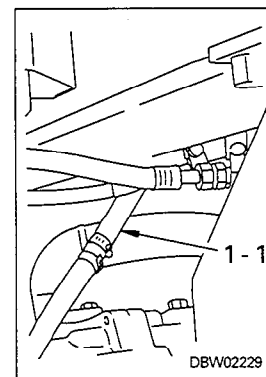
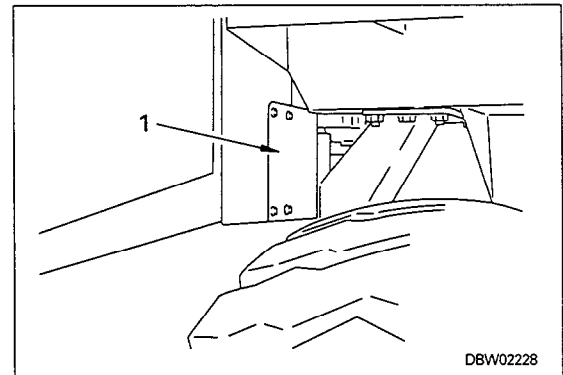
⚠ Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

⚠ Disconnect the cable from the negative $\ominus$ terminal of the battery.

- Remove the cover under the cab.
- Carry out the oil return operation for the compressor, then use a gauge manifold and release the refrigerant slowly from the core of the compressor high-pressure and low-pressure valves.
- When carrying out the oil return operation, set the fan switch to the maximum position, run the engine at low idling, and operate the air conditioner for 5 minutes.

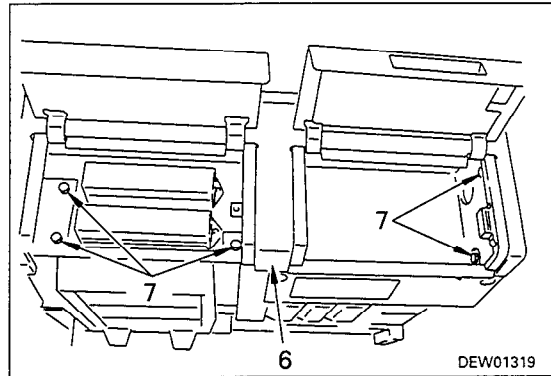
⚠ If the refrigerant gets in your eyes, there is danger of losing your sight, so always wear protective goggles.

1. Remove inspection cover (1) under floor.
2. Remove clamps of heater hoses (1-1) and (1-2).
3. Remove covers (2) and (3) at rear of cab.
 - ★ Slide the operator's seat to the front, then tip it over.
 - ★ Remove blind cap (3-1).
 - ★ Remove 2 bolts and loosen 6 bolts.
4. Remove 5 mounting bolts of cover (4), remove cover, then remove seat support cover (5).

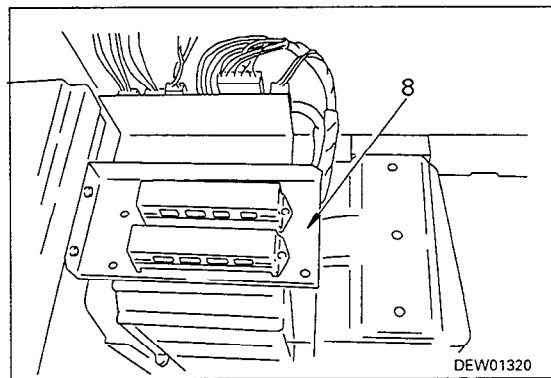


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5. Remove cool and hot box assembly (6) and mounting bolts (7), then remove cool and hot box assembly.

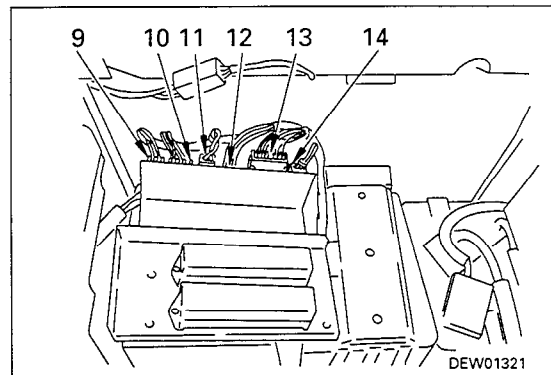


6. Remove fuse box assembly bracket (8) from right console box.

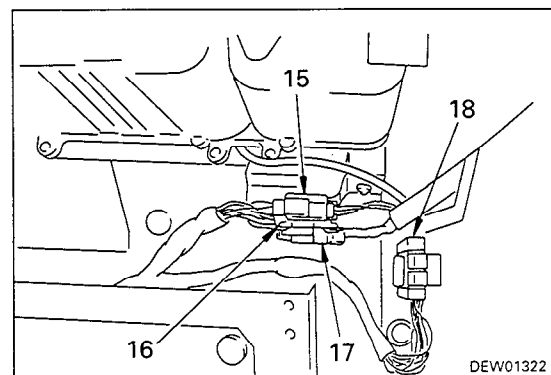


7. Remove connectors (9), (10), (11), (12), (13), and (14) from fuse box assembly bracket, and put fuse box assembly on right console box temporarily.

★ Mark the connectors with a tag to distinguish when installing.



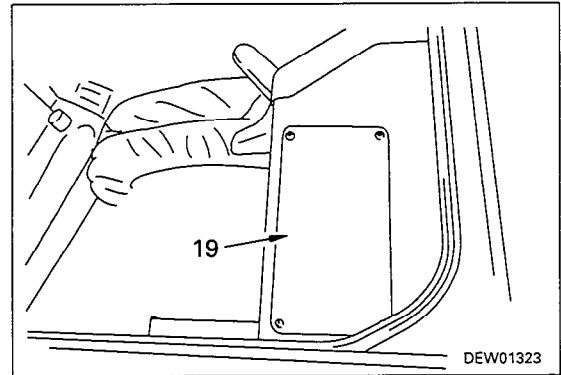
8. Disconnect floor wiring connectors (15), (16), and (17) from air conditioner unit wiring, then disconnect air conditioner relay wiring connector (18).



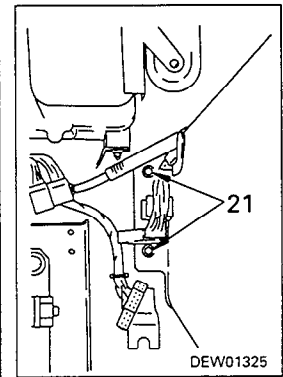
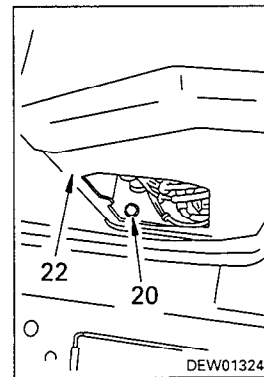
U42303

U42303

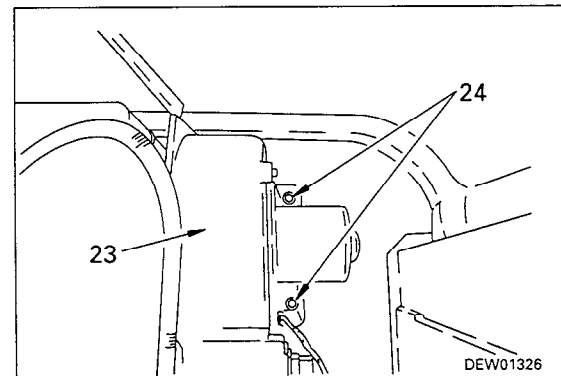
9. Remove left console box cover (19).



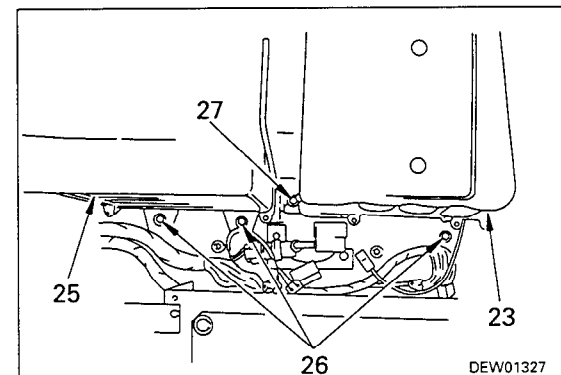
10. Remove left console box mounting bolts (20) and (21), then remove left console box (22).



11. Remove mounting bolts (24) of air conditioner unit (23).



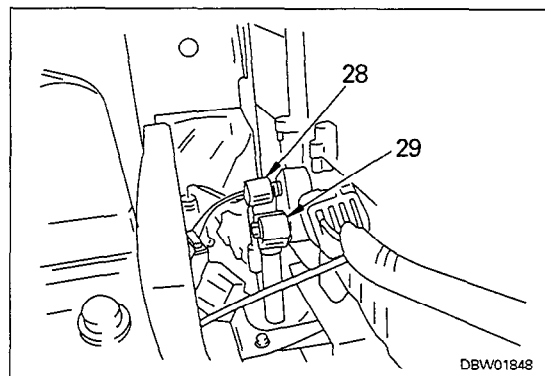
12. Remove mounting bolts (26) of air conditioner unit (23) and air conditioner damper (25).
 ★ Loosen mounting bolt (27).
 ★ Loosen the 4 mounting bolts at the cab end.



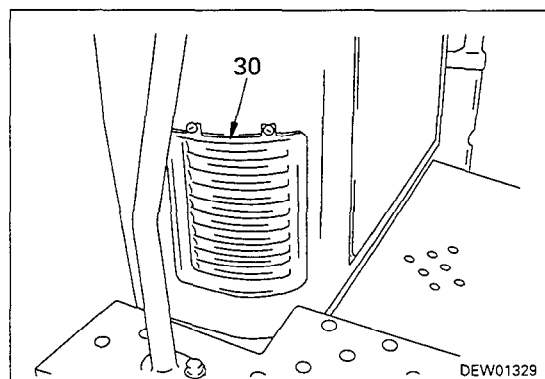
13. Disconnect air conditioner tubes (28) and (29) from air conditioner unit.

※ 1

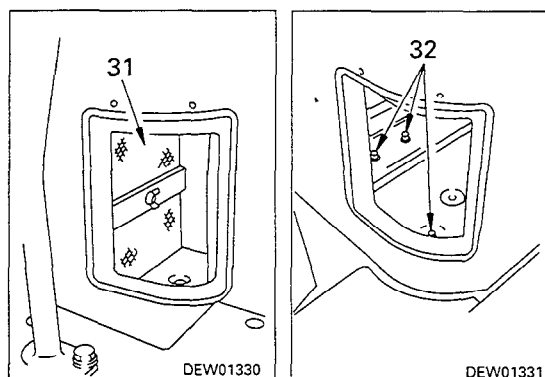
★ Check that the pressure has been reduced.



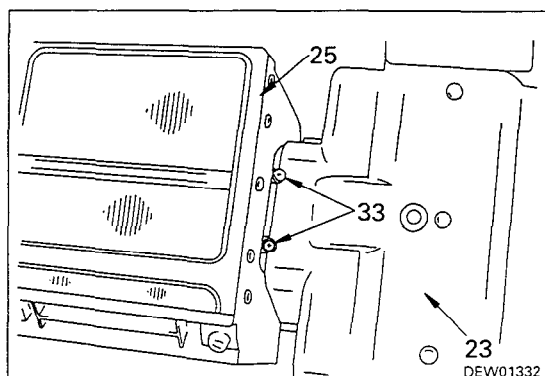
14. Remove cover (30) at rear right of cab.



15. Remove air conditioner filter (31), then remove duct mounting bolts (32).

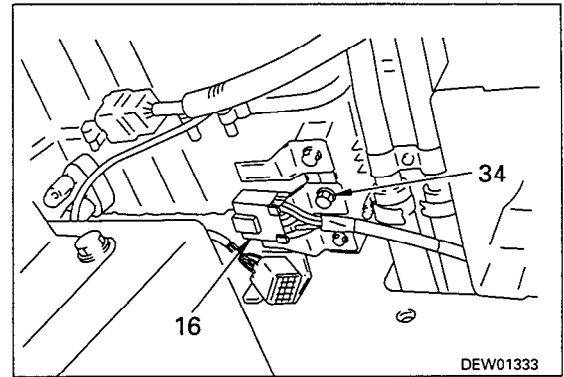


16. Remove connecting bolts (33) of air conditioner unit (23) and air conditioner damper (25).



U42303

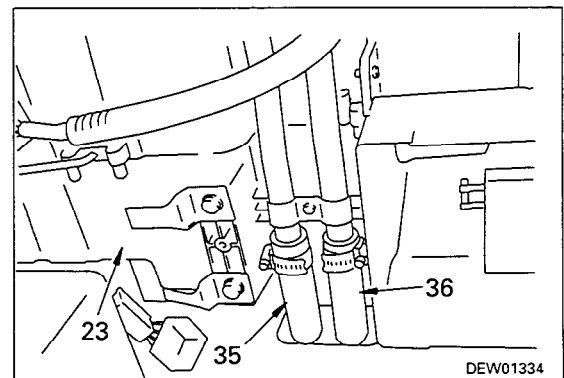
17. Remove clamp bolt (34) of air conditioner wiring connector (16).



18. Disconnect heater hoses (35) and (36) from air conditioner unit (23). ※ 2

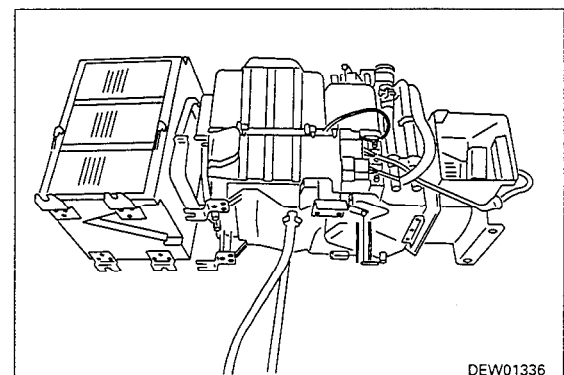
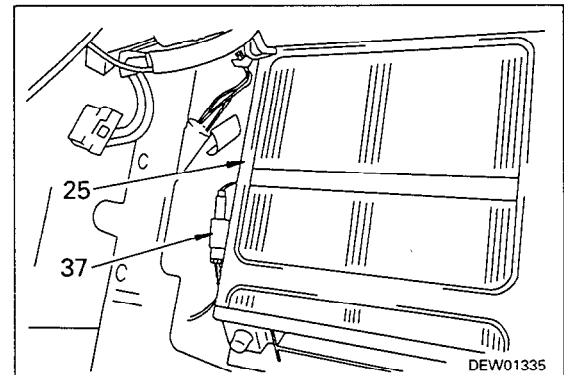


Air conditioner unit assembly: **38 kg**



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



Tube mounting bolt:

 $9.8 \pm 2 \text{ Nm}$ ($1.0 \pm 0.2 \text{ kgm}$)

- ★ Coat the O-ring with compressor oil ND-OIL8.

※ 2

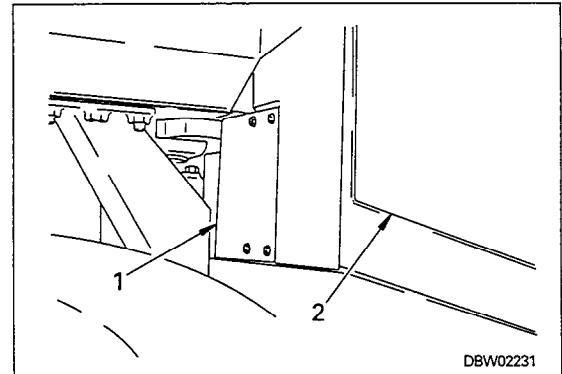
- ★ Pass the air conditioner drain hose through the floor support grommet.
- Fill the air conditioner with new refrigerant.
 - ★ **Precautions when filling air conditioner line with new refrigerant**
 - 1) Keep the temperature inside the room at above 3°C.
(If the temperature is below 3°C, the system 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^{+14}_0 cc ND-OIL8)

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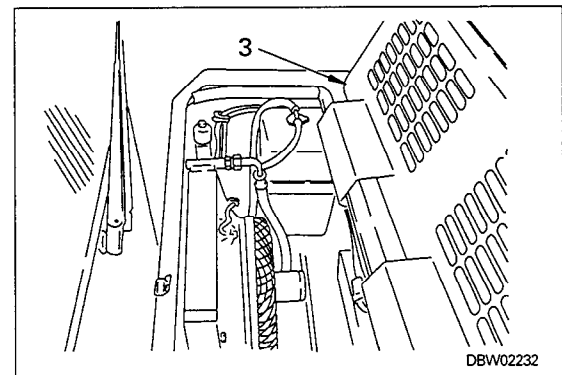
REMOVAL OF AIR CONDITIONER CONDENSER ASSEMBLY

⚠ 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.

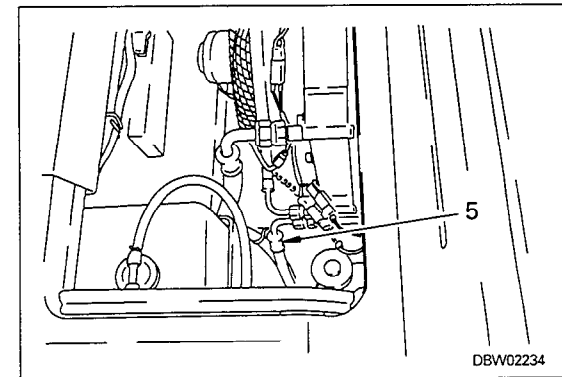
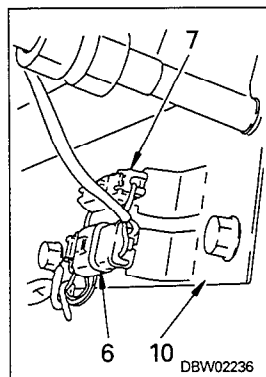
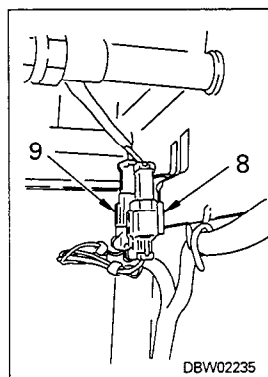
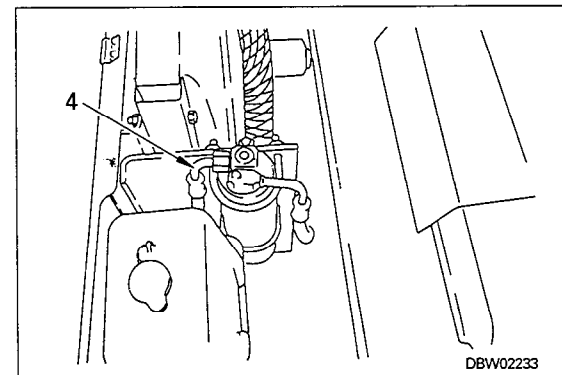
1. Remove left and right covers (1) under bulk-head, and open left and right engine hood inspection covers (2), then apply lock.



- ★ Open inspection cover (3) on top of the bulk-head.
- ★ Carry out the air return operation for the compressor, then use a gauge manifold and release the refrigerant slowly from the compressor high-pressure valve.



2. Disconnect hoses (4) and (5). ※ 1
 - ★ After disconnecting the hoses and tubes, fit covers to prevent dirt, dust, or water from entering the joint.
3. Disconnect electric wiring connectors (6), (7), (8), and (9).
4. Sling condenser and bracket assembly (10), and remove mounting bolts of condenser and bracket assembly.
 - ★ Leave 1 mounting bolt each installed temporarily on the left and right sides at the top.



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5. Remove mounting bolts of condenser and bracket assembly, then remove condenser (12) together with bracket assembly from inside of bulkhead (11).

★ Leave dry receiver (13) installed to the bracket when removing.



Condenser, bracket assembly : 20 kg
(including dry receiver)

6. Remove condenser piping, then remove condenser (12) from brackets (14) and (15). ※ 2

★ After disconnecting the hoses and tubes, fit covers to prevent dirt, dust, or water from entering the joint.



Condenser (each) : 5.4 kg

INSTALLATION OF AIR CONDITIONER CONDENSER ASSEMBLY

- Carry out installation in the reverse order to removal.

※ 1 ※ 2

★ Do not remove the covers from the hoses until immediately before installing.

★ To prevent the hoses from twisting, use two wrenches to hold the hoses securely in position when tightening.

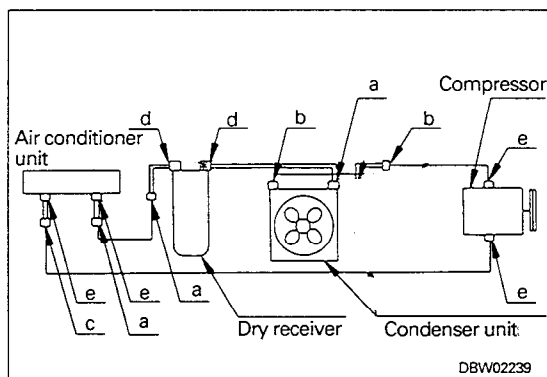
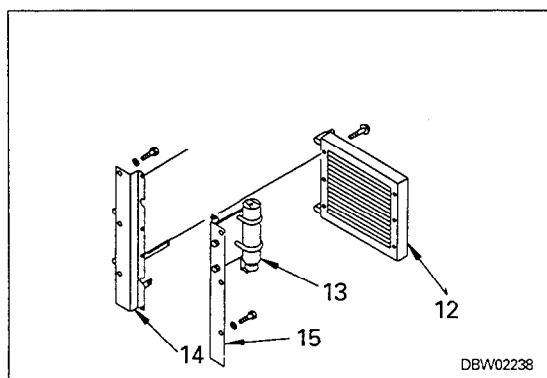
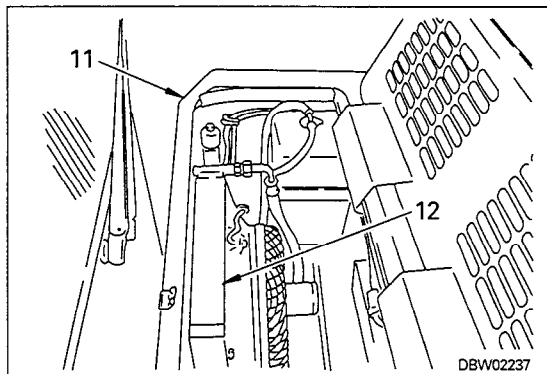
Hose joint, thread : **Compressor oil**

★ The tightening torques for the air conditioner piping are as follows.

	Thread size	Tightening torque Nm (kgm)
a	M16 x 1.5	11.8 – 14.7 (1.2 – 1.5)
b	M22 x 1.5	19.6 – 24.5 (2.0 – 2.5)
c	M24 x 1.5	29.4 – 34.3 (3.0 – 3.5)
d	M6 bolt at receiver portion	3.9 – 6.9 (0.4 – 0.7)
e	Other M6 bolts	7.8 – 11.8 (0.8 – 1.2)

• Filling with gas

- ★ Fill the air conditioner with gas. (R134a)
- ★ Before filling with refrigerant, always use the repeat vacuum method to completely evacuate.
- ★ 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.
- ★ Check that the refrigerant level is correct.
- ★ Check the oil level in the compressor.
(Specified oil level: 150 ⁺¹⁴₀ cc ND-OIL8)



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★ Checks after assembly

	Amount of bubbles in receiver sight glass	Remedy
Correct	Almost completely transparent; even if there are bubbles, becomes transparent when engine speed is raised or lowered	—
Low	Continuous stream of bubbles passes	Connect charging hose to compressor, then add refrigerant until condition becomes normal

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.

★ Open inspection cover (1-1) on top of the bulk-head.

1. Carry out oil return operation for compressor, then use a gauge manifold and release refrigerant slowly from compressor high-pressure and low-pressure valves.

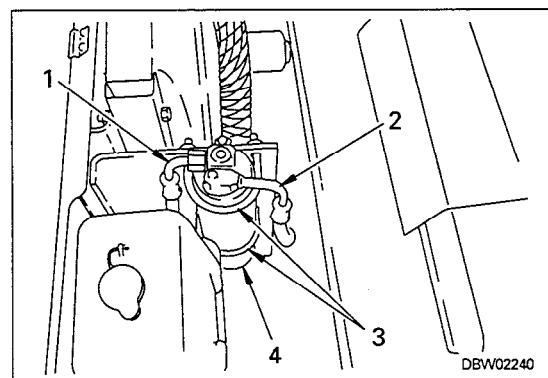
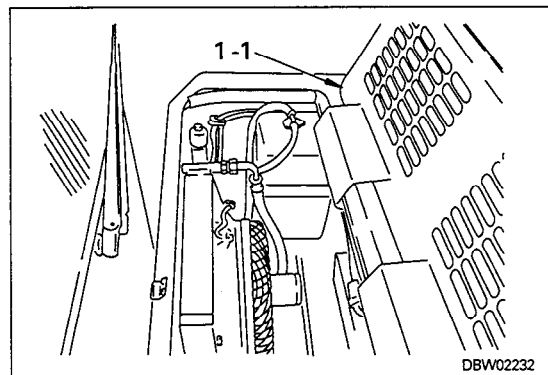
• **Procedure for oil return operation**

Set fan switch to maximum position, run engine at low idling, and operate air conditioner for 5 minutes.

2. Disconnect hoses (1) and (2). ※ 1

★ After disconnecting the hoses, fit covers to the joint.

3. Remove mounting U-bolts (3), then remove dry receiver (4) from bracket. ※ 2



INSTALLATION OF DRY RECEIVER ASSEMBLY

• Carry out installation in the reverse order to removal.

※ 1

Hose mounting bolt :

$5.4 \pm 1.5 \text{ Nm}$ ($0.55 \pm 0.15 \text{ kgm}$)

★ To prevent dirt, dust, or water from entering, do not remove the covers from the air conditioner hoses until immediately before installing.

Hose joint : Compressor oil

※ 2

U-bolt : $18.6 \pm 7.8 \text{ Nm}$ ($1.9 \pm 0.8 \text{ kgm}$)

★ Be careful not to tighten the U-bolts too far.

• **Filling with gas**

★ Fill the air conditioner with gas. (R134a)

★ Before filling with refrigerant, always use the repeat vacuum method to completely evacuate.

★ 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.

★ Check that the refrigerant level is correct.

★ Check the oil level in the compressor.

(Specified oil level: $150^{+14}_{-0} \text{ cc ND-OIL8}$)

	Amount of bubbles in receiver sight glass	Remedy
Correct	Almost completely transparent; even if there are bubbles, becomes transparent when engine speed is raised or lowered	—
Low	Continuous stream of bubbles passes	Connect charging hose to compressor, then add refrigerant until condition becomes normal

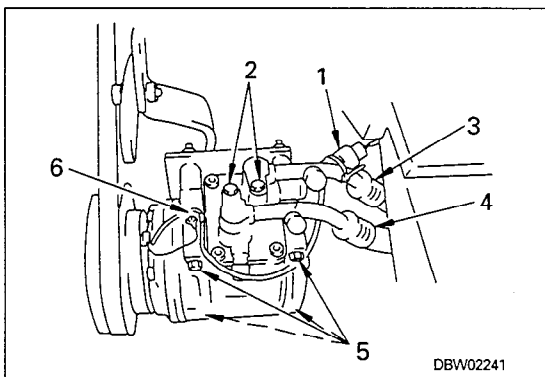
U42303

REMOVAL OF AIR CONDITIONER CONDENSER COMPRESSOR ASSEMBLY

⚠ Open the hood and apply the lock.

⚠ Disconnect the cable from the negative (-) terminal of the battery.

1. Carry out oil return operation for compressor, then use a gauge manifold and release refrigerant slowly from compressor high-pressure valve.
2. Disconnect electric wiring from connector (1).
3. Remove hose mounting bolts (2), and disconnect hoses (3) and (4). ※ 1
★ After disconnecting the hoses, fit covers to prevent dirt, dust, or water from entering the joint.
4. Remove bolts (5), remove V-belt, then remove compressor (6). ※ 2



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INSTALLATION OF AIR CONDITIONER CONDENSER COMPRESSOR ASSEMBLY

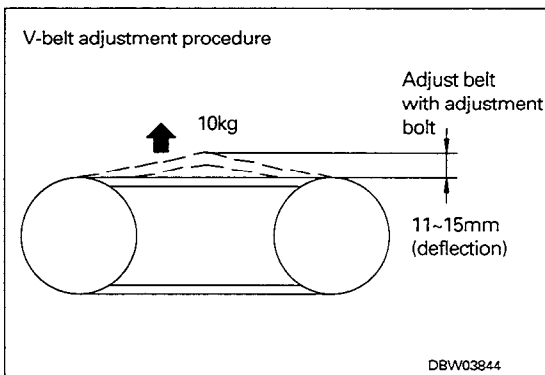
- Carry out installation in the reverse order to removal.

※ 1 kgm Hose mounting bolt :
7.8 – 11.8 Nm (0.8 – 1.2 kgm)

※ 2
★ Adjust the V-belt as follows.
★ V-belt deflection at approx. 98 N (10 kg):
11– 15 mm

• Filling with gas

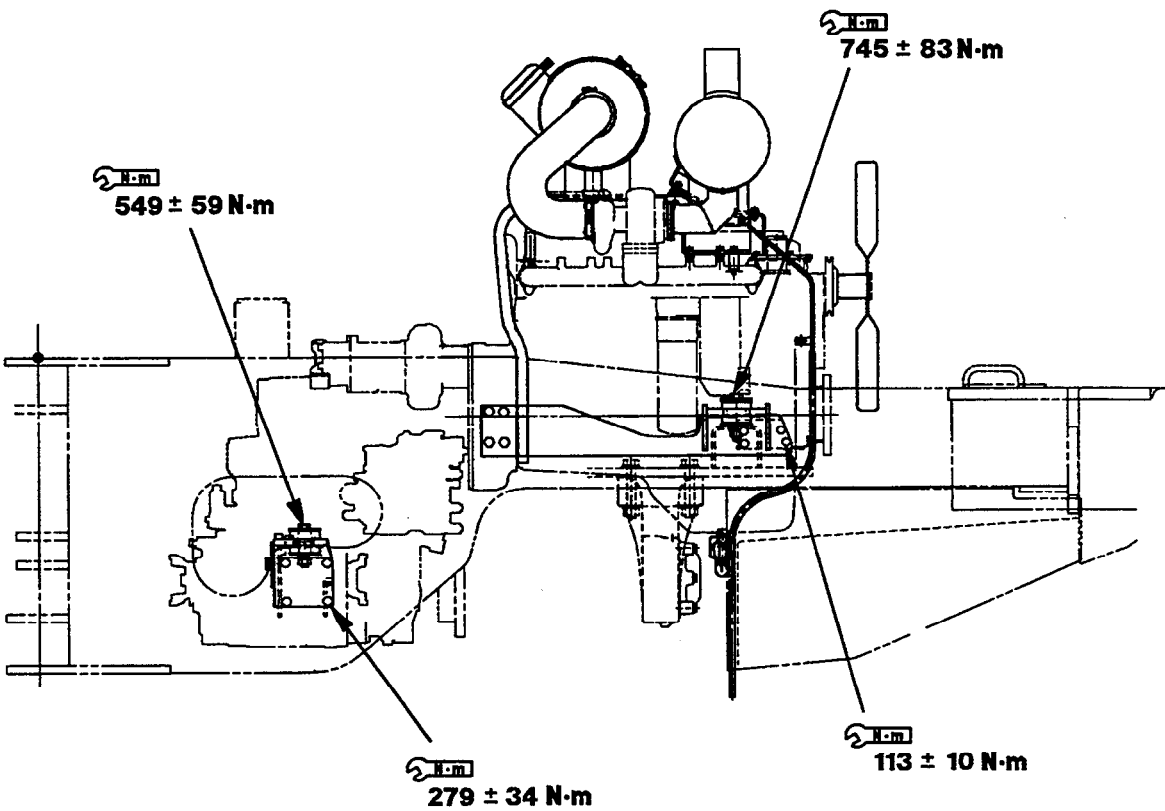
- ★ Fill the air conditioner with gas. (R134a)
- ★ Before filling with refrigerant, always use the repeat vacuum method to completely evacuate.
- ★ Do not use the can of refrigerant upside-down or use any other mistaken method. Be careful not to let liquid freon get into the refrigerating system.
- ★ Do not operate the compressor before charging with refrigerant.
- ★ Check that the refrigerant level is correct.
- ★ Check the oil level in the compressor.
(Specified oil level: 150^{+14}_0 cc ND-OIL8)



40 MAINTENANCE STANDARD

Engine mount, transmission mount.....	40- 2
Torque converter charging pump	40- 3
Torque converter	40- 4
Transmission	40- 5
Transmission control valve	40-14
Flow control valve	40-18
Accumulator valve	40-19
Drive shaft	40-20
Differential	40-21
Final drive	40-24
Axle mount	40-26
Center hinge pin	40-28
Steering column	40-30
Steering valve	40-31
Steering cylinder mount	40-32
Brake	40-33
Brake valve	40-35
Parking brake	40-38
Main control valve	40-40
PPC valve	40-44
Hydraulic cylinder	40-45
Work equipment linkage	40-46
Bucket	40-48
Bucket positioner and boom kick-out	40-49

ENGINE MOUNT, TRANSMISSION MOUNT

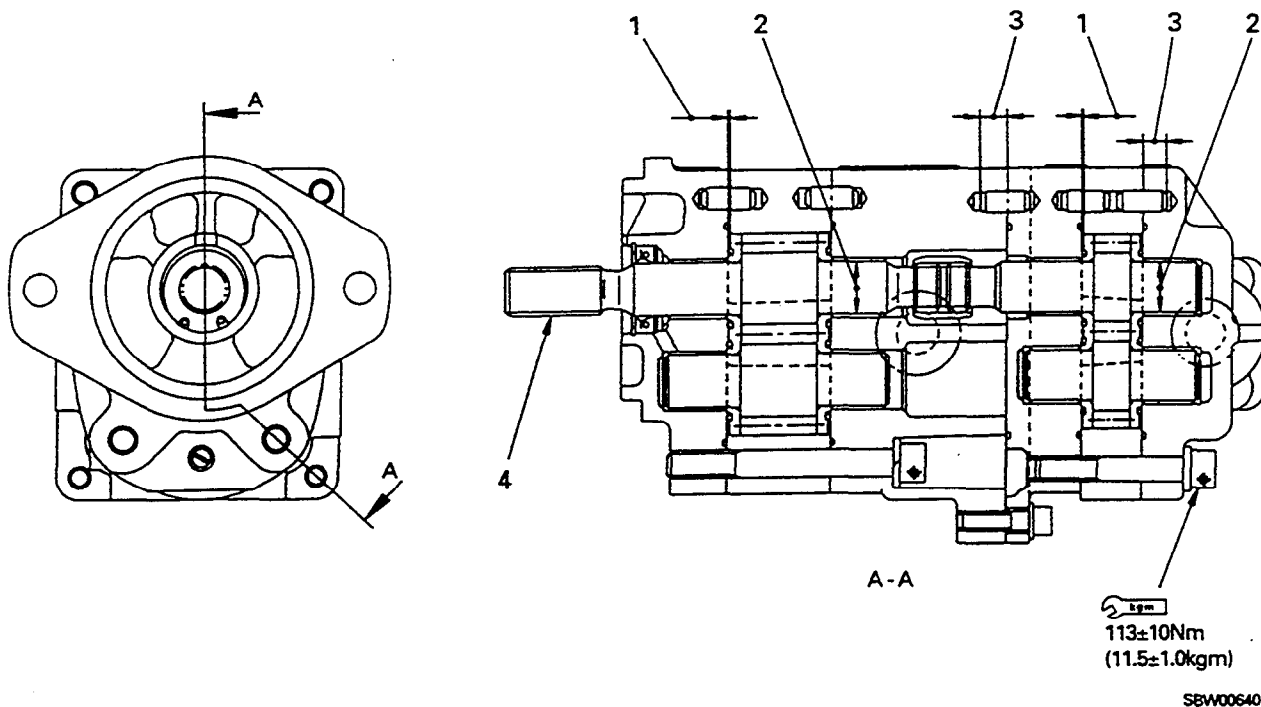


380EMTM

Unit: mm			
No.	Check item	Criteria	Remedy
1	Crearance between trans- mission bracket and adjustment bolt	1 - 2	Adjust

TORQUE CONVERTER CHARGING PUMP

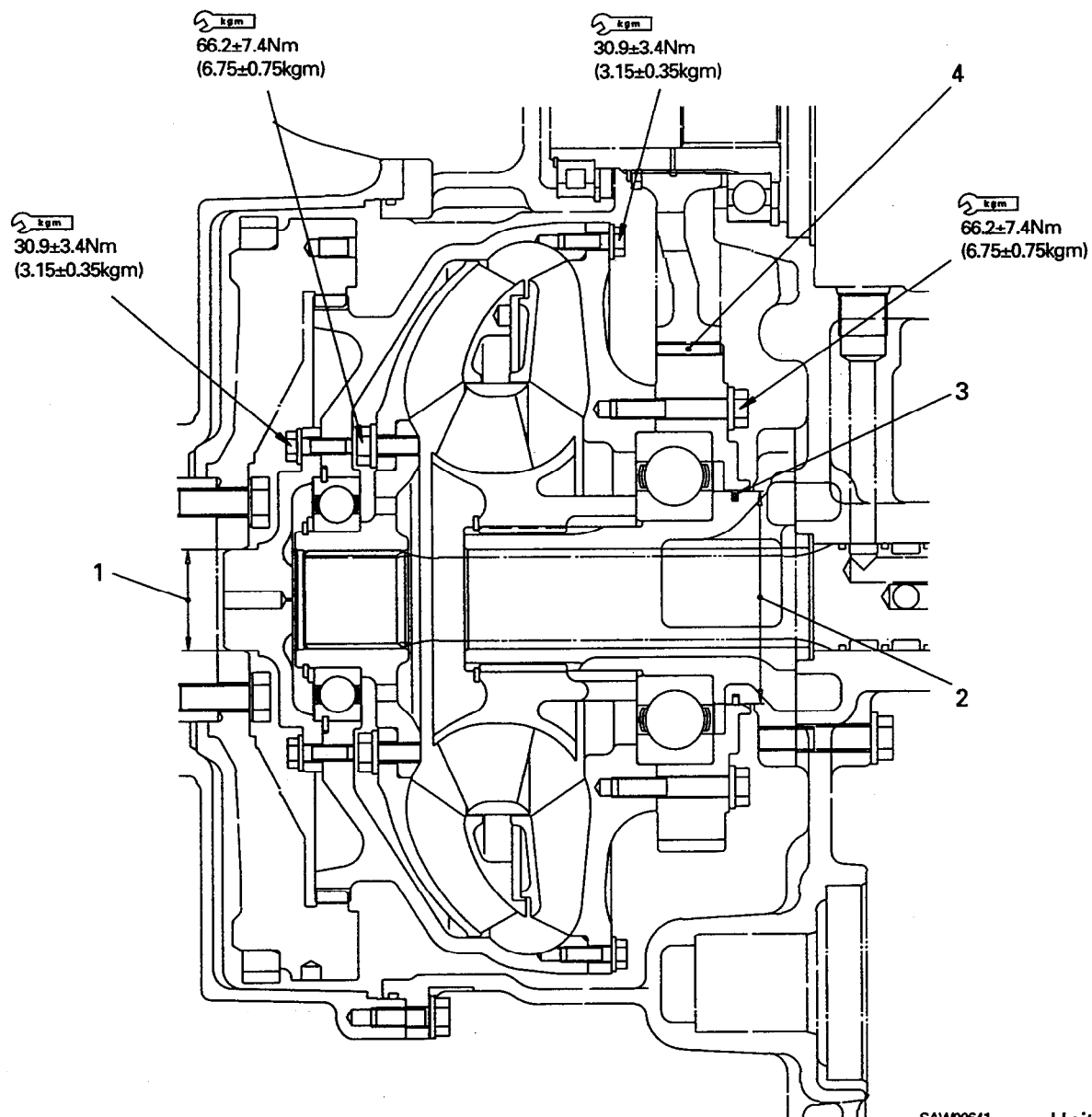
(SAL(2)40+20)



Unit: mm

No.	Check item	Criteria					Remedy
1	Side clearance	Model	Standard clearance		Clearance limit		Replace
		SAL(2)40	0.10 – 0.15		0.19		
		SAL(2)20					
2	Clearance between inside diameter of plain bearing and outside of diameter of gear shaft	SAL(2)40	0.060 – 0.125		0.20		
		SAL(2)20					
3	Depth for knocking in pin	Model	Standard size		Tolerance		
		SAL(2)40	12		0 – 0.5		
		SAL(2)20					
4	Rotating torque of spline shaft	5.9 – 13.7Nm (0.6 – 1.4kgm)					
—	Discharge amount Oil: EO10-CD Oil temperature: 45 – 55°C	Model	Rotating speed	Delivery pressure	Standard delivery amount	Delivery amount limit	—
		SAL(2)40	3,000rpm	2.9MPa (30kg/cm ²)	115ℓ/min	106ℓ/min	
		SAL(2)20	3,000rpm	2.9MPa (30kg/cm ²)	59ℓ/min	53ℓ/min	

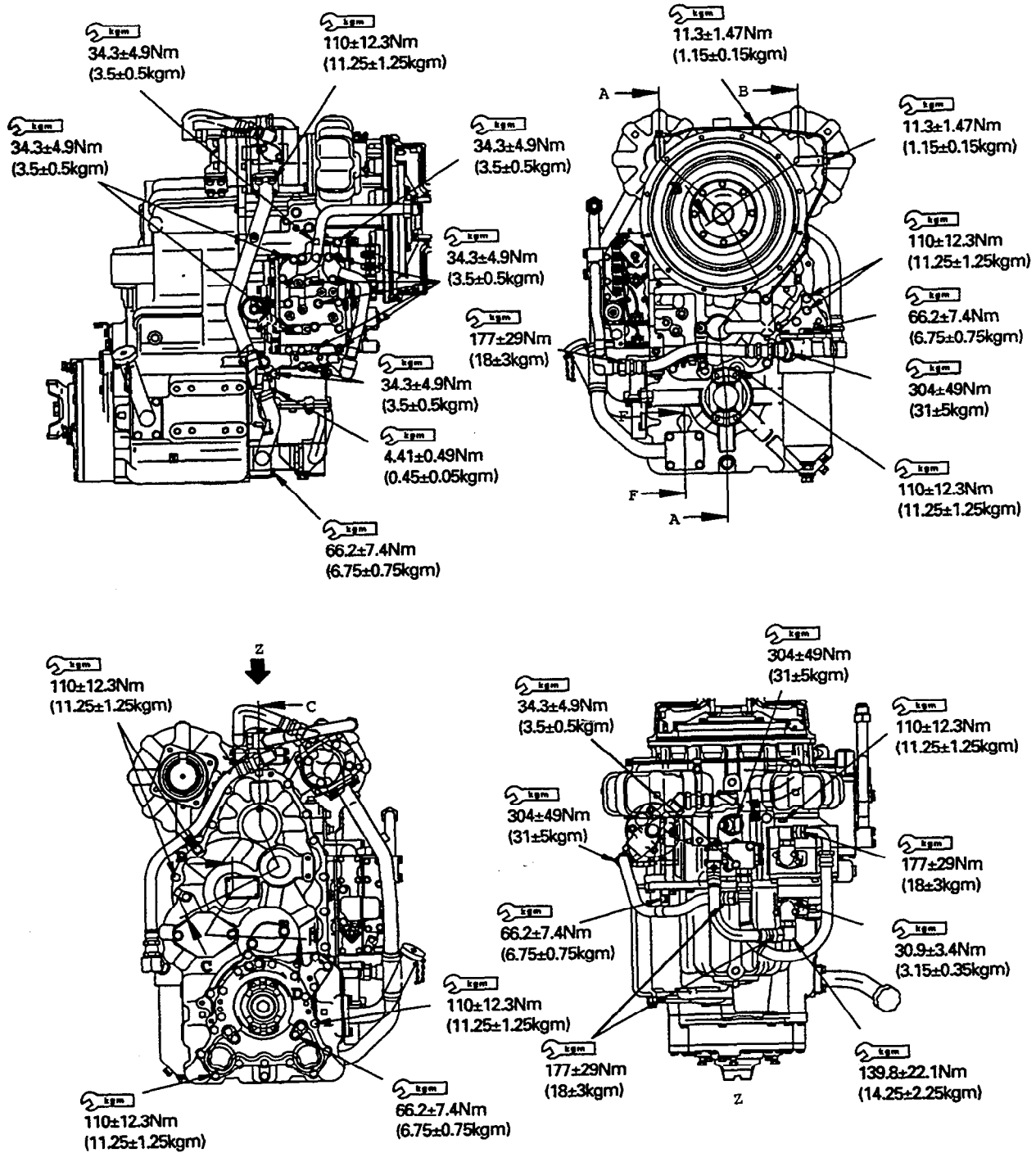
TORQUE CONVERTER



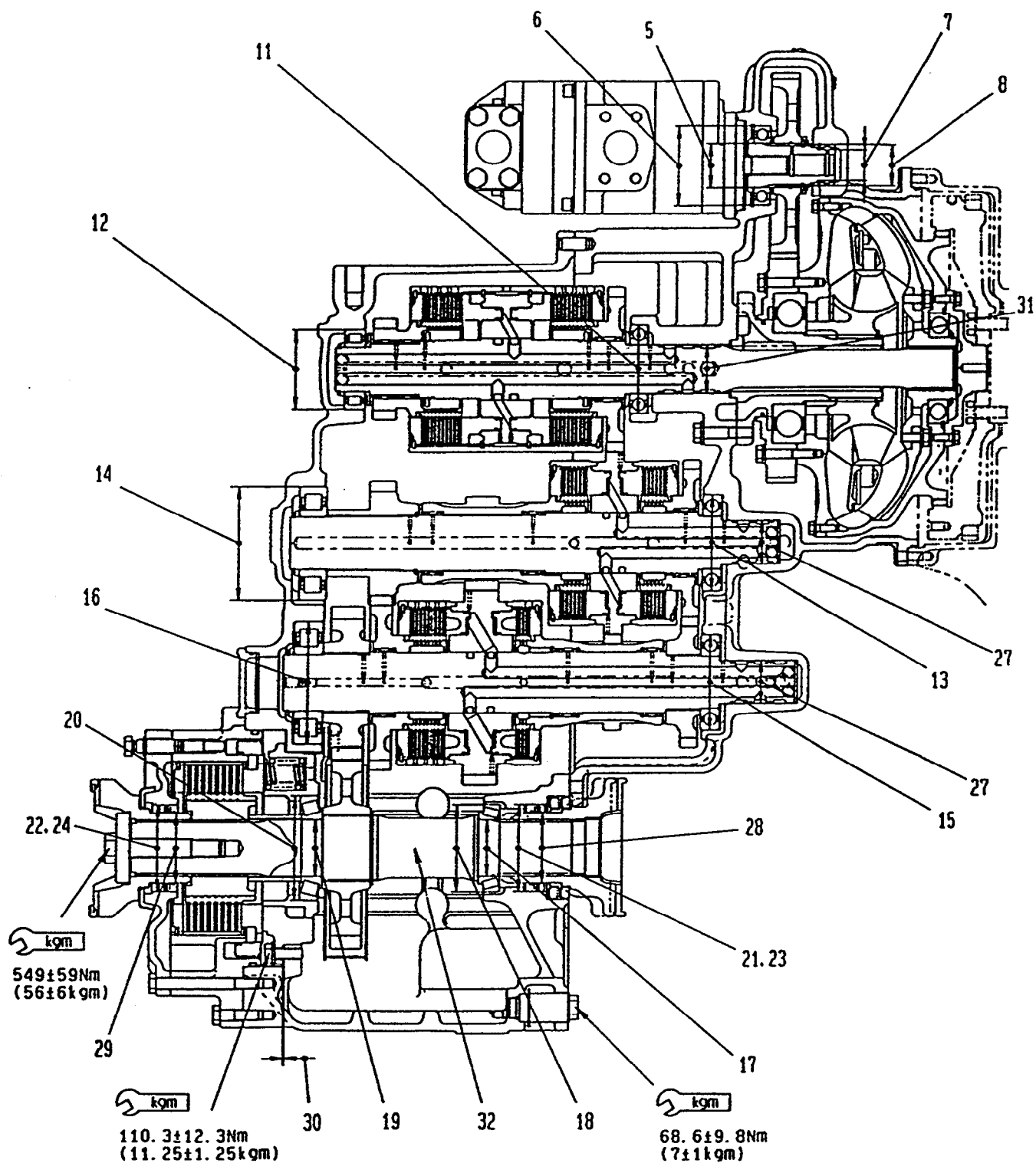
SAW00641

Unit: mm

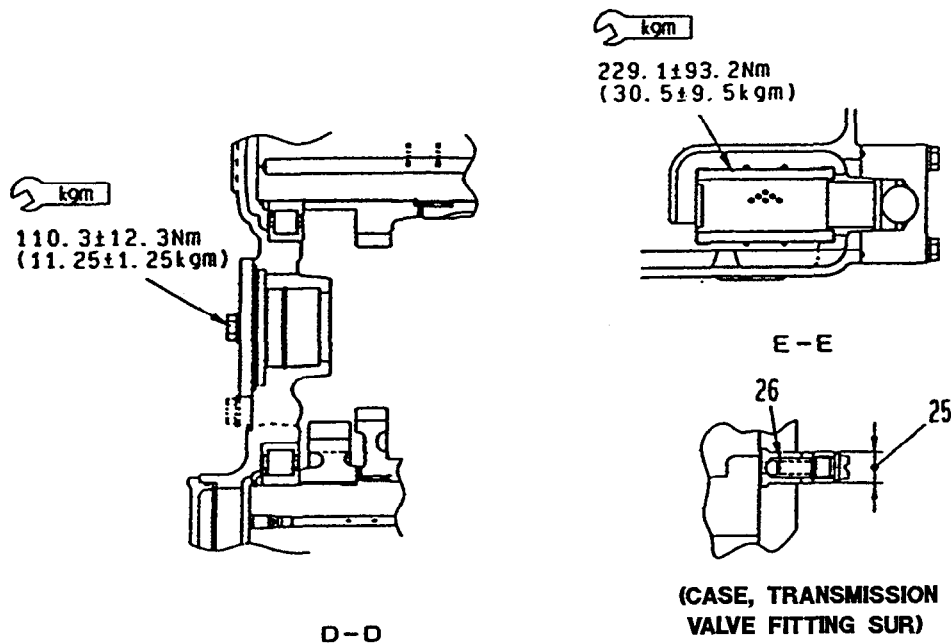
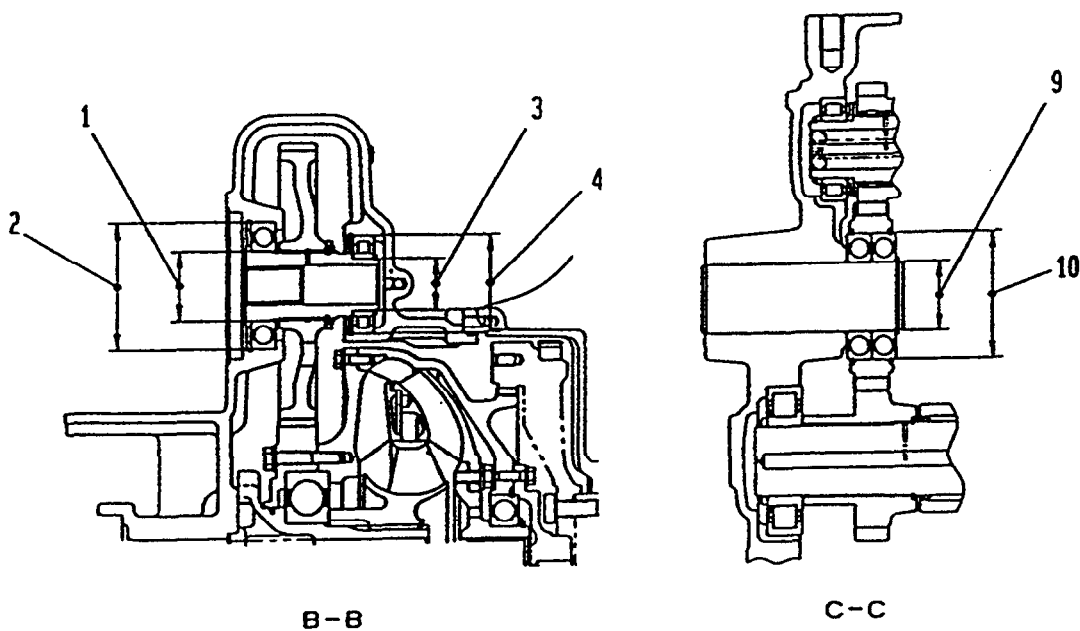
No.	Check item		Criteria			Remedy
			Standard size	Tolerance	Repair limit	
1	Outside diameter of pilot		52	-0.010 -0.040	51.75	Repair chrome plating or replace
2	Inside diameter of retainer seal ring contact surface		110	$+0.035$ 0	110.5	
3	Wear of stator shaft seal ring	Width	3	-0.01 -0.03	2.7	Replace
		Thickness	4.3	± 0.1	3.9	
4	Backlash between PTO drive gear and drive gear		0.18 – 0.49			



SAW00643



3CA03406



CA03407R

Unit: mm

Unit: mm

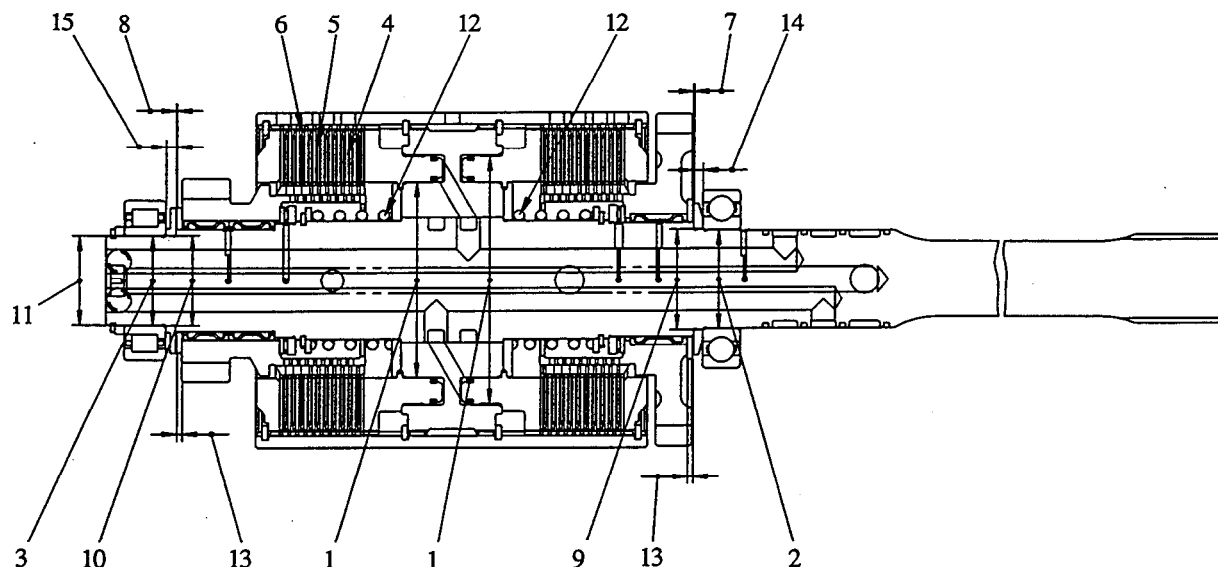
No.	Check item	Criteria					Remedy
1	Clearance between pump drive shaft and bearing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		60	+0.030 +0.011	0 -0.015	-0.011 - -0.045	—	
2	Clearance between pump drive shaft bearing and housing	110	0 -0.015	+0.022 -0.013	-0.013 - 0.037	—	
3	Clearance between pump drive shaft and bearing	45	+0.025 +0.009	0 -0.012	-0.009 - -0.037	—	
4	Clearance between pump drive shaft bearing and housing	85	0 -0.015	+0.022 -0.013	-0.013 - 0.037	—	
5	Clearance between pump drive shaft and bearing	50	+0.025 +0.009	0 -0.012	-0.009 - -0.037	—	
6	Clearance between pump drive shaft bearing and housing	90	0 -0.015	+0.022 -0.013	-0.013 - 0.037	—	
7	Clearance between pump drive shaft and bearing	35	-0.009 -0.025	+0.041 +0.025	0.034 - 0.066	—	
8	Clearance between pump drive shaft bearing and housing	47	0 -0.011	+0.014 -0.011	-0.011 - 0.025	—	
9	Clearance between idler shaft and bearing	60	+0.023 +0.011	0 -0.015	-0.011 - -0.038	—	
10	Clearance between idler gear and bearing	110	0 -0.015	-0.020 -0.042	-0.005 - -0.042	—	
11	Clearance between forward/reverse clutch bearing and housing (R)	100	0 -0.015	+0.030 0	0 - 0.045	—	
12	Clearance between forward/reverse clutch bearing and housing (F)	90	0 -0.015	+0.030 0	0 - 0.045	—	
13	Clearance between 1st and 3rd clutch bearing and housing (R)	110	0 -0.015	+0.030 0	0 - 0.045	—	
14	Clearance between 1st and 3rd clutch bearing and housing (F)	130	0 -0.018	+0.030 0	0 - 0.048	—	
15	Clearance between 2nd and 4th clutch bearing and housing (R)	110	0 -0.015	+0.030 0	0 - 0.045	—	
16	Clearance between 2nd and 4th clutch bearing and housing (F)	140	0 -0.018	+0.030 0	0 - 0.048	—	
17	Clearance between output shaft and bearing (R)	65	+0.030 +0.011	0 -0.015	-0.011 - -0.045	—	
18	Clearance between output shaft bearing and housing (R)	100	0 -0.015	-0.015 -0.040	0 - 0.040	—	
19	Clearance between output shaft and bearing (F)	65	+0.030 +0.011	0 -0.015	-0.011 - -0.045	—	
20	Clearance between output shaft bearing and housing (F)	120	0 -0.015	-0.015 -0.040	0 - 0.040	—	
21	Clearance between output shaft oil seal and housing (R)	100	+0.35 +0.15	+0.054 0	-0.096 - -0.35	—	

MAINTENANCE STANDARD

TRANSMISSION

Unit: mm

No.	Check item	Criteria					Remedy
22	Clearance between output shaft oil seal and housing (F)	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
23	Clearance between output shaft dust seal and housing (R)	100	+0.35 +0.15	+0.054 0	-0.096 - -0.35	—	
24	Clearance between output shaft dust seal and housing (F)	100	+0.35 +0.10	+0.054 0	-0.046 - -0.35	—	
25	Clearance between check valve and case	13	-0.016 -0.027	+0.515 +0.500	0.516 - -0.542	—	
26	Check valve spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		23.5	16.2	0.39±0.02N (0.04±0.002kg)	22.6	0.35N (0.036kg)	
27	Inner diameter of housing seal ring contact surface	Standard size		Tolerance		Repair limit	
		50		+0.05 0		0.05(wear)	
	Width of shaft seal ring groove	3.2		+0.076 0		3.5	
	Width of seal ring	3.0		0 -0.13		2.6	
	Thickness of seal ring	2.29		0 -0.1		2.1	
28	Outer diameter of coupling oil seal slide part (R)	80		0 -0.074		0.05(wear)	
29	Outer diameter of coupling oil seal slide part (F)	80		0 -0.074		0.05(wear)	
30	Clearance between output retainer and case	Standard size		Standard clearance		Clearance limit	
		0.95		0.25 - 1.65		—	
31	Inner diameter of housing seal ring contact surface	55		+0.05 0		0.05(wear)	
	Width of shaft seal ring groove	3.2		+0.076 0		3.5	
	Width of seal ring	3.0		0 -0.13		2.6	
	Thickness of seal ring	2.29		0 -0.1		2.1	
32	Free rotation torque of output shaft	0.1 - 1.0Nm(0.01 - 0.10kgm)					Adjust shim.

FORWARD/REVERSE Clutch

SAW00647

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between piston and cylinder (forward/reverse)	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		(inner)	110	-0.27 -0.32	+0.06 -0.07	0.20 – 0.38	
(outer)	140	-0.20 -0.25	+0.13 0	0.20 – 0.38	0.43		
2	Clearance at forward/reverse clutch shaft bearing press-fitted section (R)	55	+0.030 +0.011	0 -0.015	-0.011 – -0.045	—	
3	Clearance at forward/reverse clutch shaft bearing press-fitted section (F)	50	+0.034 +0.021	0 -0.012	-0.021 – -0.046	—	
4	Separator plate thickness	Standard size		Tolerance		Repair limit	
		1.7		±0.05		1.6	
	Separator plate distortion	—		0.1		0.15	
5	Friction plate thickness	2.2		±0.08		1.95	
	Friction plate distortion	—		0.1		0.25	
6	Wave spring load at height of 2.2 mm	1,010N (103kg)		±101N (±10.3kg)		804N (82kg)	

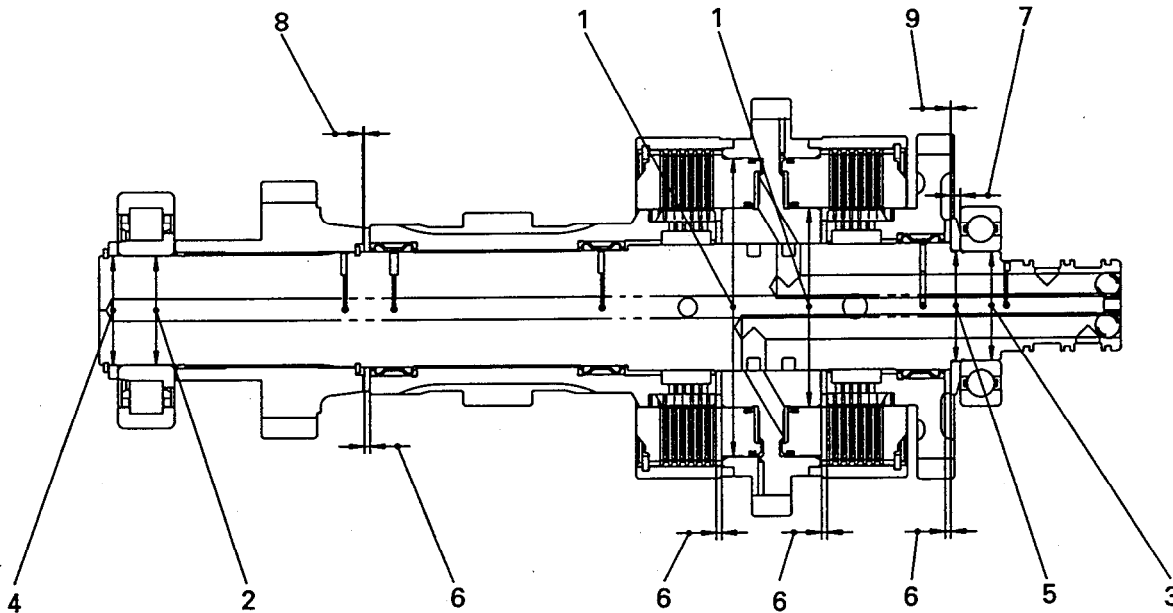
042303

Unit: mm

042303

No.	Check item	Criteria					Remedy
7	End play of forward gear	0.106 – 0.991					Replace
8	End play of reverse gear	0.106 – 0.991					
9	Clearance at forward/reverse clutch shaft spacer press-fitted section (R)	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		56	+0.030 +0.011	0 –0.030	–0.011 – –0.060	—	
10	Clearance at forward/reverse clutch shaft spacer press-fitted section (F)	50.5	+0.025 +0.009	0 –0.030	–0.009 – –0.055	—	
11	Clearance at forward/reverse clutch shaft bearing end spacer press-fitted section	50	+0.034 +0.021	–0.020 –0.040	–0.041 – –0.074	—	
12	Forward/reverse clutch piston return spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		100	45	612±25N (62.4±2.6kg)	96	551N (56.2kg)	
13	Thickness of forward/reverse clutch thrust washer	Standard size		Tolerance		Repair limit	
		3.0		±0.1		2.7	
14	Thickness of forward clutch spacer	5.0		±0.05		—	
15	Thickness of reverse clutch spacer	5.5		±0.05		—	

1st and 3rd Clutch



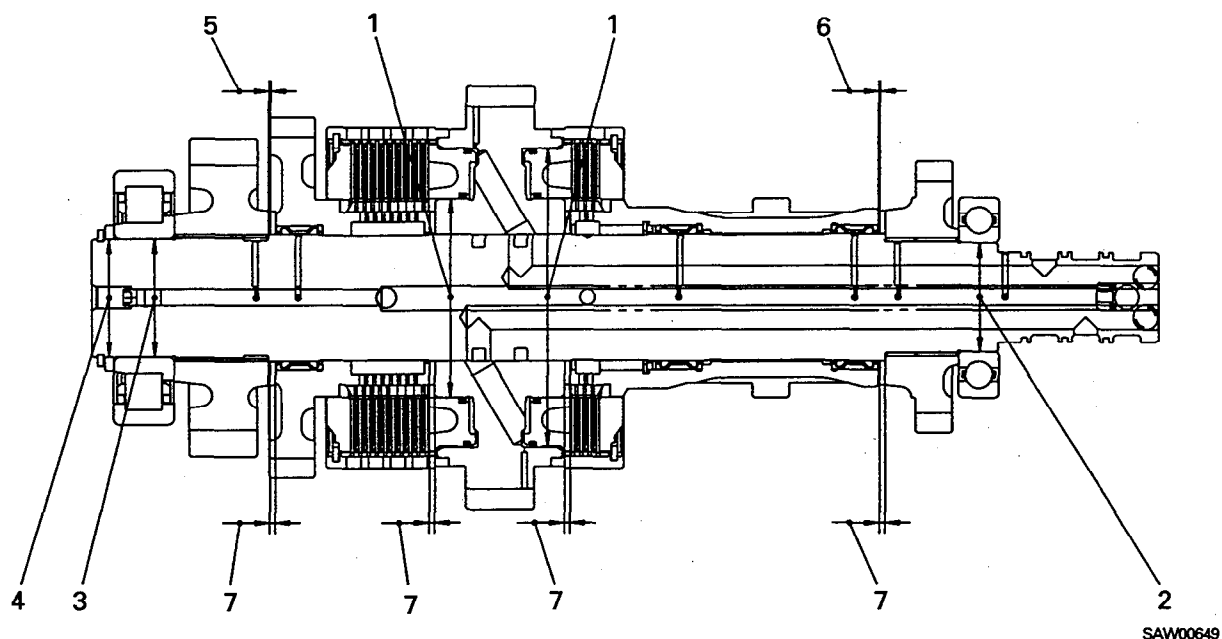
SAW00648

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between piston and cylinder	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		(inner)	110	-0.27 -0.32	+0.06 -0.07	0.20 – 0.38	
(outer)	165	-0.27 -0.32	+0.06 -0.07	0.20 – 0.38	0.43		
2	Clearance at 1st and 3rd clutch shaft bearing press-fitted section (F)	60	+0.054 +0.044	0 -0.015	-0.044 – -0.069	—	
3	Clearance at 1st and 3rd clutch shaft bearing press-fitted section (R)	60	+0.030 +0.011	0 -0.015	-0.011 – -0.045	—	
4	Clearance at 1st and 3rd clutch shaft spacer press-fitted section (F)	60	+0.054 +0.044	-0.02 -0.04	-0.064 – -0.094	—	
5	Clearance at 1st and 3rd clutch shaft spacer press-fitted section (R)	61	+0.030 +0.011	0 -0.03	-0.011 – -0.06	—	
6	Thickness of gear end thrust washer	Standard size		Tolerance		Repair limit	
		3.0		±0.1		2.7	
7	Thickness of 3rd clutch side spacer	5.0		±0.05		—	
8	End play of 1st gear	0.02 – 1.58					
9	End play of 3rd gear	0.1 – 0.9					

U42303

2nd and 4th Clutch



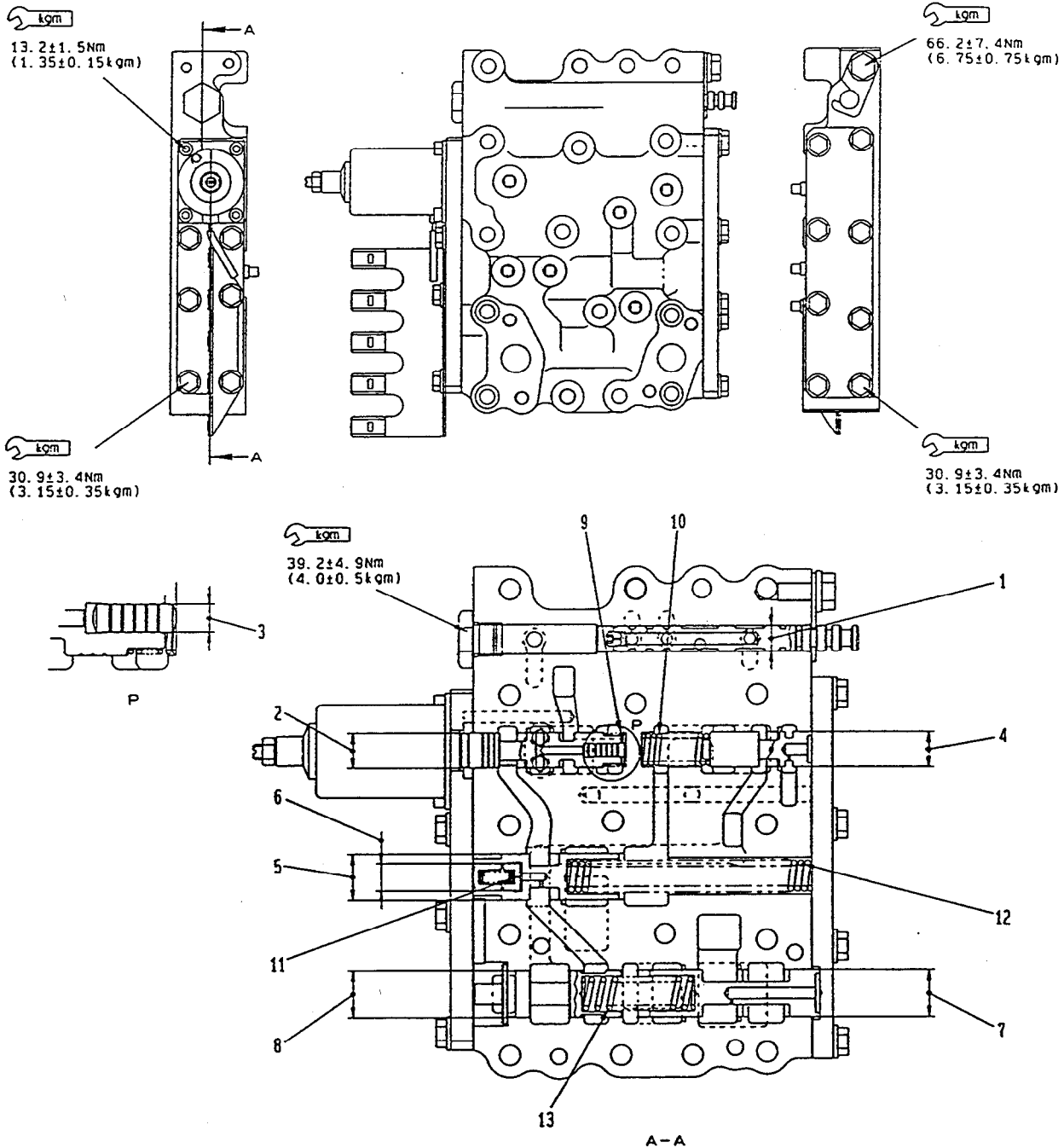
U42303

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between piston and cylinder (inner)	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
	110	-0.27 -0.32	+0.06 -0.07	0.20 – 0.38	0.43		
	(outer)	165	-0.27 -0.32	+0.06 -0.07	0.20 – 0.38	0.43	
2	Clearance at 2nd and 4th clutch shaft bearing press-fitted section outer diameter (R)	60	+0.033 +0.017	0 -0.015	-0.017 – -0.048	—	
3	Clearance at 2nd and 4th clutch shaft bearing press-fitted section outer diameter (F)	65	+0.059 +0.049	0 -0.015	-0.049 – -0.074	—	
4	Clearance at 2nd and 4th clutch shaft spacer press-fitted section (F)	65	+0.059 +0.049	-0.021 -0.041	-0.070 – -0.100	—	
5	End play of 2nd gear	0.34 – 1.66					
6	End play of 4th gear	0.17 – 1.43					
7	Thickness of thrust washer	Standard size		Tolerance		Repair limit	
		3.0		±0.1		2.7	

TRANSMISSION CONTROL VALVE

UPPER VALVE



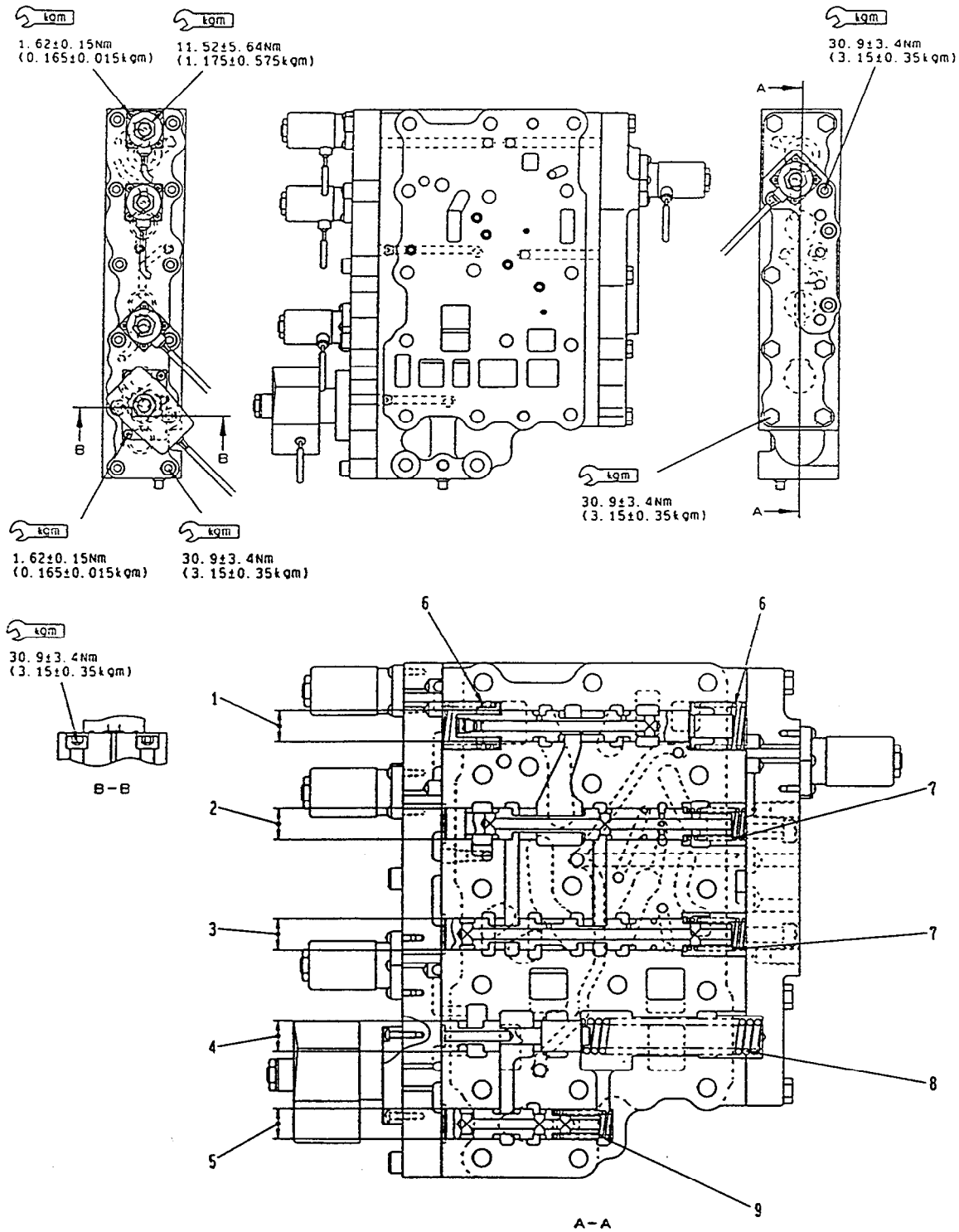
423CA03414

Unit: mm

042303

No.	Check item	Criteria					Remedy
1	Clearance between emergency manual valve spool and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between modulation valve spool and body	14	-0.02 -0.03	+0.011 0	+0.020 - +0.044	0.050	
3	Clearance at modulation valve load piston	19	-0.035 -0.045	+0.013 0	+0.035 - +0.058	0.065	
4	Clearance between pilot valve spool and body	7	-0.035 -0.045	+0.012 0	+0.035 - +0.057	0.065	
5	Clearance between pilot valve spool and body	19	-0.035 -0.045	+0.013 0	+0.035 - +0.058	0.065	
6	Clearance between main relief valve spool and body	25	-0.035 -0.045	+0.013 0	+0.035 - +0.058	0.065	
7	Clearance at main relief valve load piston	15	-0.02 -0.03	+0.018 0	+0.020 - +0.048	0.055	
8	Clearance between torque converter regulator valve spool and body	25	-0.035 -0.045	+0.013 0	+0.035 - +0.058	0.065	
9	Clearance between dummy spool and body	25	-0.02 -0.03	+0.013 0	+0.020 - +0.048	0.055	
9	Modulation valve spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		23.8	13	8.9±0.5N (0.91±0.05kg)	22.8	8.0N (0.82kg)	
10	Pilot valve spring	59.8	37	266.7±13.7N (27.2±1.4kg)	57.4	240N (24.5kg)	
11	Main relief valve load piston spring	26	19	5.7±0.3N (0.58±0.03kg)	25.0	5.1N (0.52kg)	
12	Main relief valve spring	170.5	132	411.9±20.6N (42±2.1kg)	163.7	370.7N (37.8kg)	
13	Torque converter regulator valve spring	65	61	93.7±4.7N (9.55±0.48kg)	62.4	84.3N (8.6kg)	

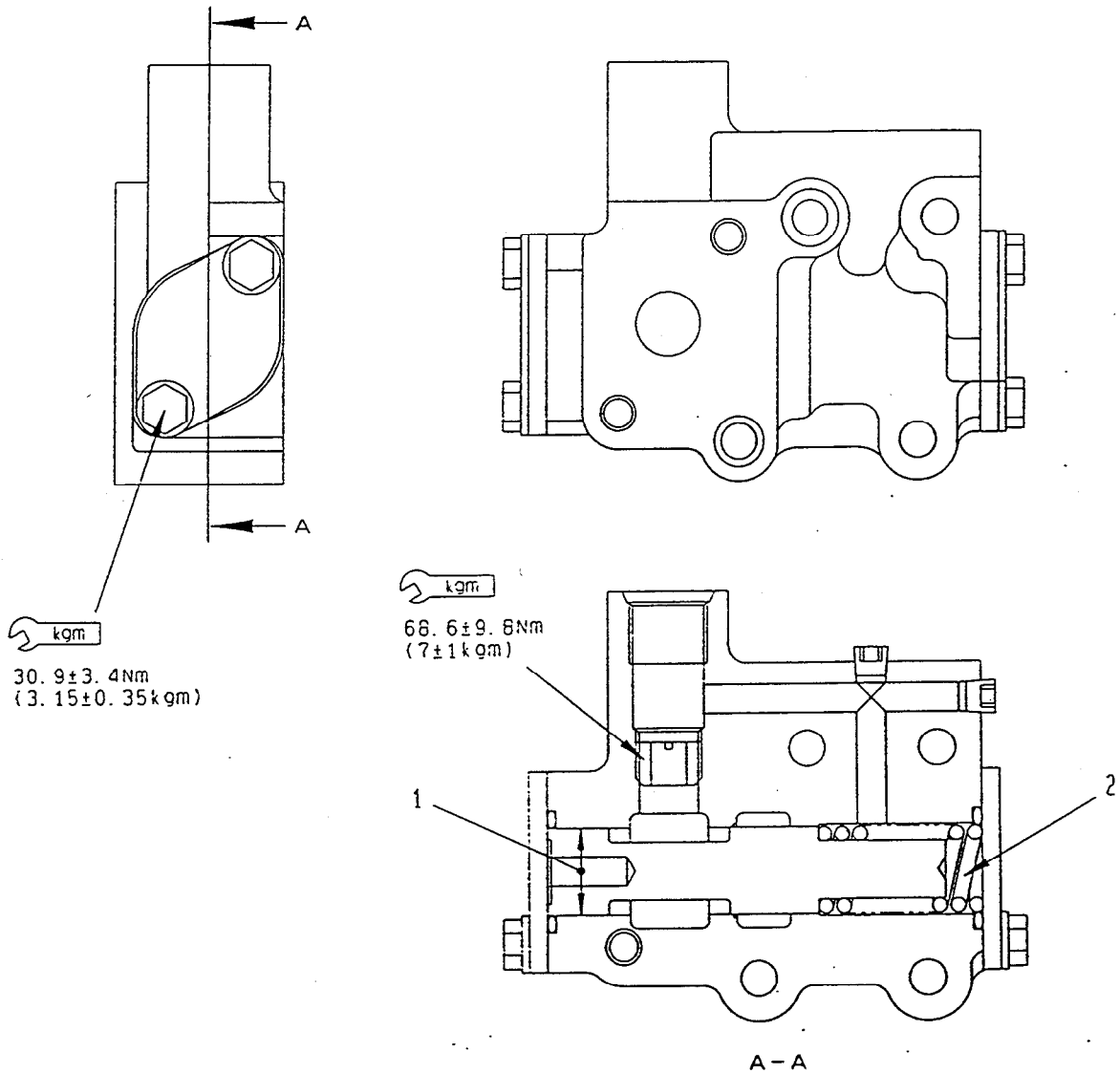
LOWER VALVE



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	-0.02 -0.03	+0.013 0	+0.02 - +0.043	0.050	
3	Clearance between range selector spool and body	19	-0.02 -0.03	+0.013 0	+0.02 - +0.043	0.050	
4	Clearance between priority valve spool and body	19	-0.035 -0.045	+0.013 0	+0.035 - +0.058	0.065	
5	Clearance between parking brake valve spool and body	19	-0.02 -0.03	+0.013 0	+0.02 - +0.043	0.050	
6	Directional selector spool spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		42	32	78.9±3.9N (8.05±0.4kg)	40.3	70.6 N (7.2 kg)	
7	H-L selector spool return spring	48	36.7	69.8±3.5N (7.12±0.36kg)	46.1	62.8 N (6.4 kg)	
8	Priority valve spring	150	111	841.4±42.2N (85.8±4.3kg)	144	757N (77.2kg)	
9	Parking brake valve spring	46	37	81.4±3.9N (8.3±0.4kg)	44.2	73.5N (7.5kg)	

FLOW CONTROL VALVE

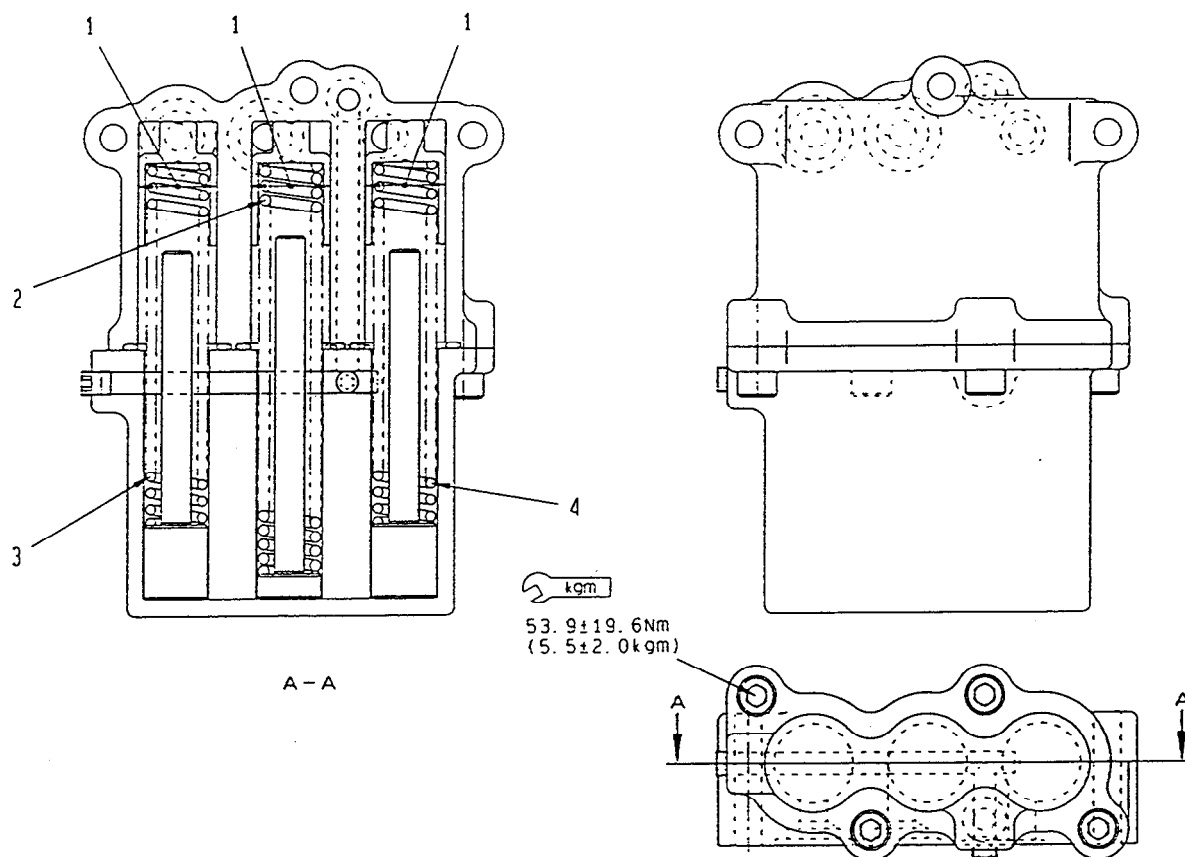


423CA03415A

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Clearance between flow control valve spool and body Flow control valve spring	25	-0.020 -0.030	+0.013 0	0.020 - 0.043	0.050	
2	Replace	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		63.8	47.0	79.5 ± 3.9 N (8.11 ± 0.4 kg)	61.2	71.6 N (7.3 kg)	

ACCUMULATOR VALVE

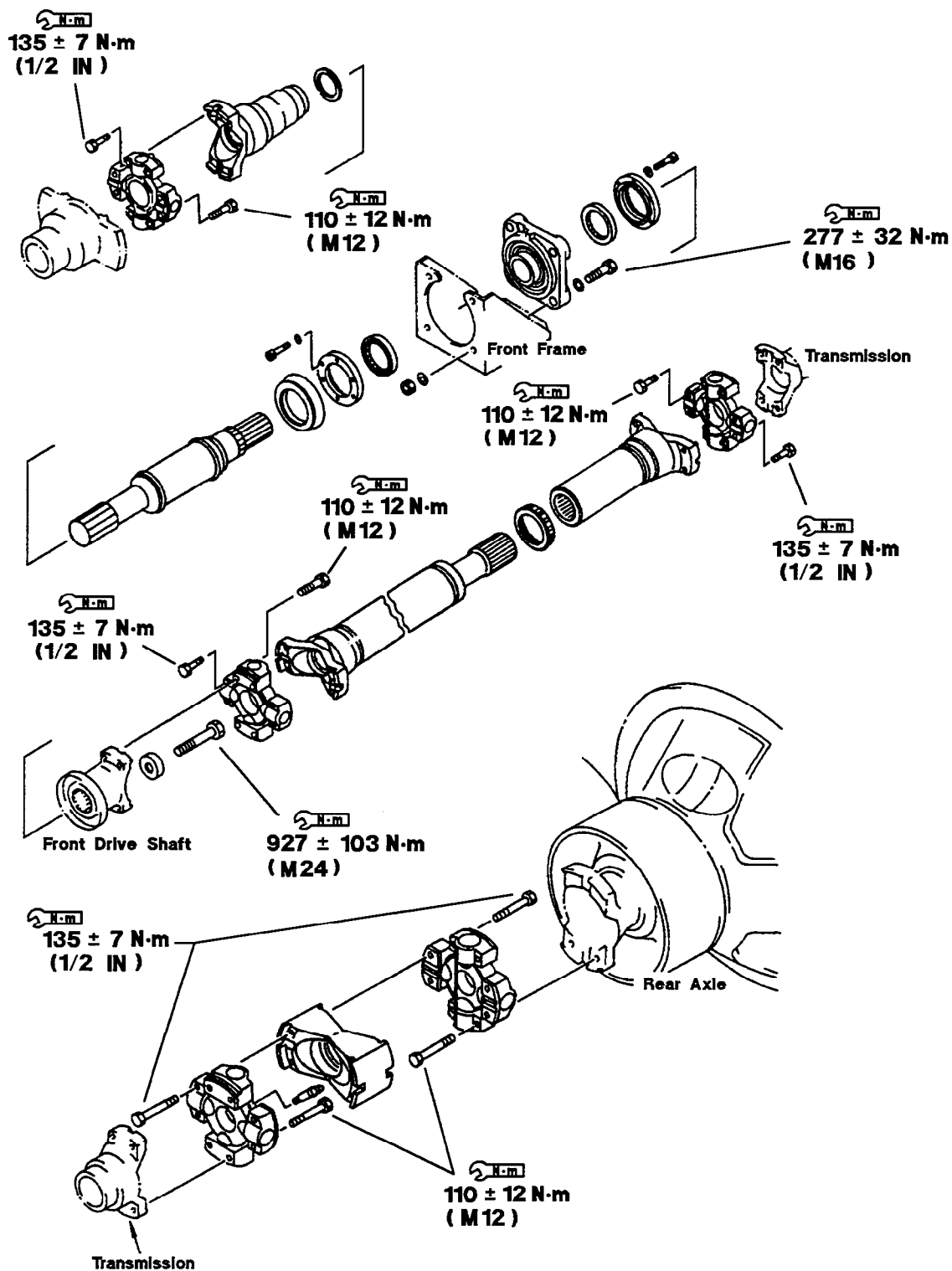


423CA03417

Unit: mm

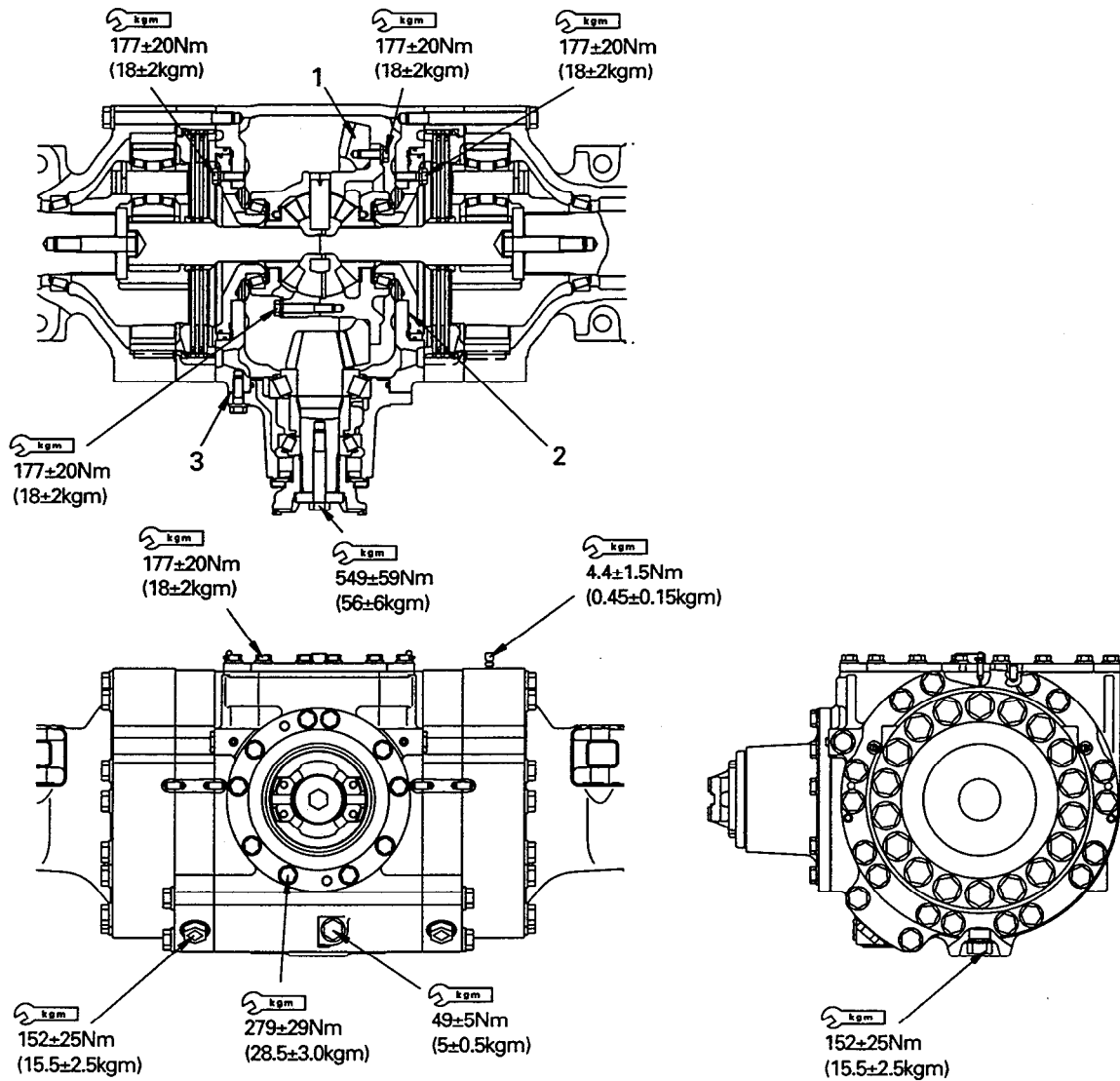
No.	Check item	Criteria					Remedy	
1	Clearance between piston and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
		32	-0.035 -0.045	+0.025 0	0.035 – 0.070	0.08		
2	Forward clutch accumulator spring	Standard size			Repair limit			Replace
		Free length	Installed length	Installed load	Free length	Installed load		
		184.8	165	319N (32.5kg)	177.4	—		
3	1st clutch accumulator spring 2nd clutch accumulator	157.7	145	158N (16.1kg)	151.4	—	Replace	
4	spring	157.7	145	158N (16.1kg)	151.4	—		

DRIVE SHAFT



380DS

DIFFERENTIAL (1/2)



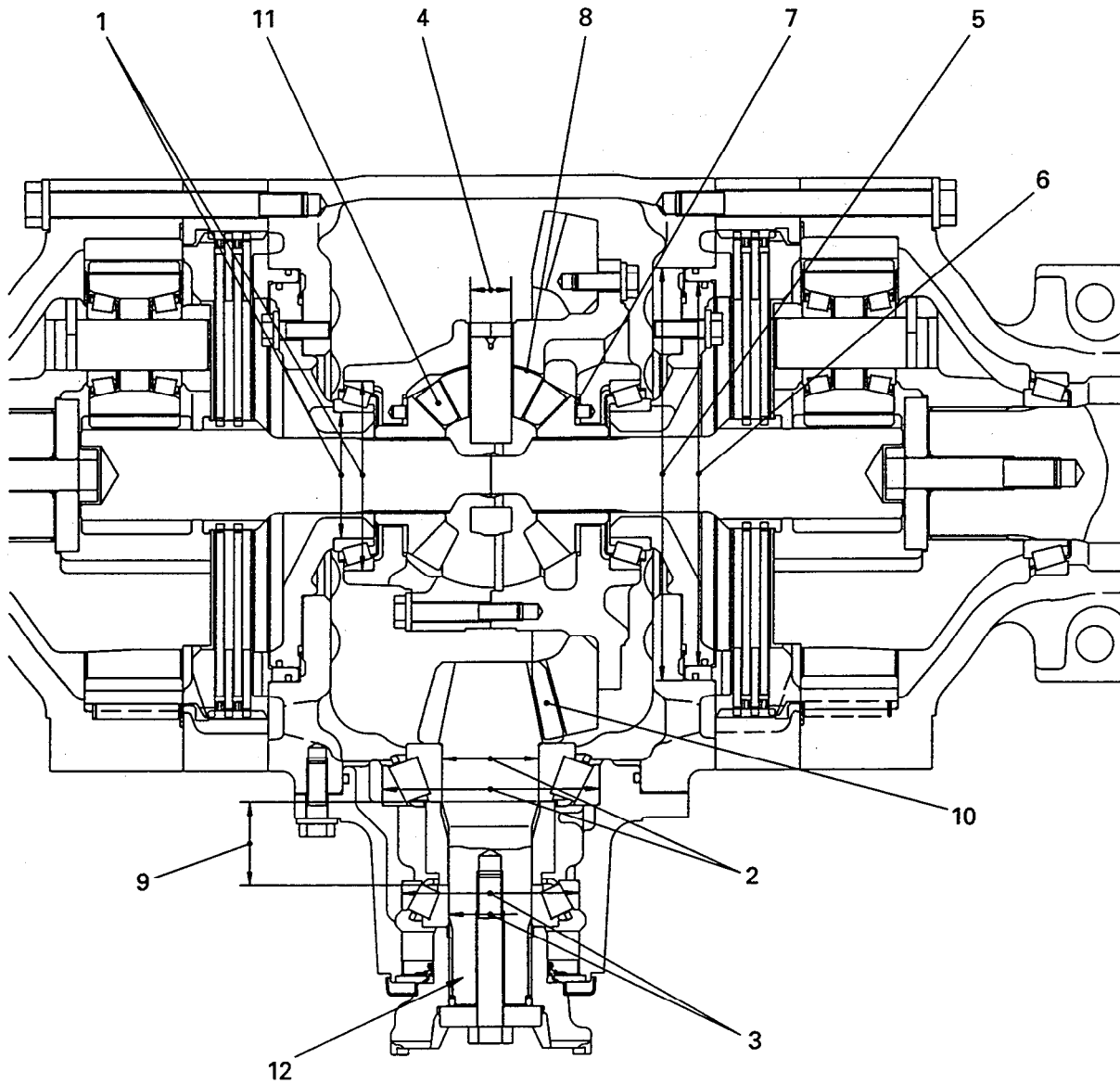
U42303

SAW00659

Unit: mm

No.	Check item	Criteria	Remedy
1	Bevel gear starting rotational force	12.7 – 36.3 N (1.3 – 3.7 kg) (outer diameter of bevel gear)	Adjust
2	Differential side bearing carrier shim thickness (one side)	0.4 – 1.0	
3	Differential housing and gauge assembly shim thickness	0.66 – 1.86	

DIFFERENTIAL (2/2)



U42303

SAW00660

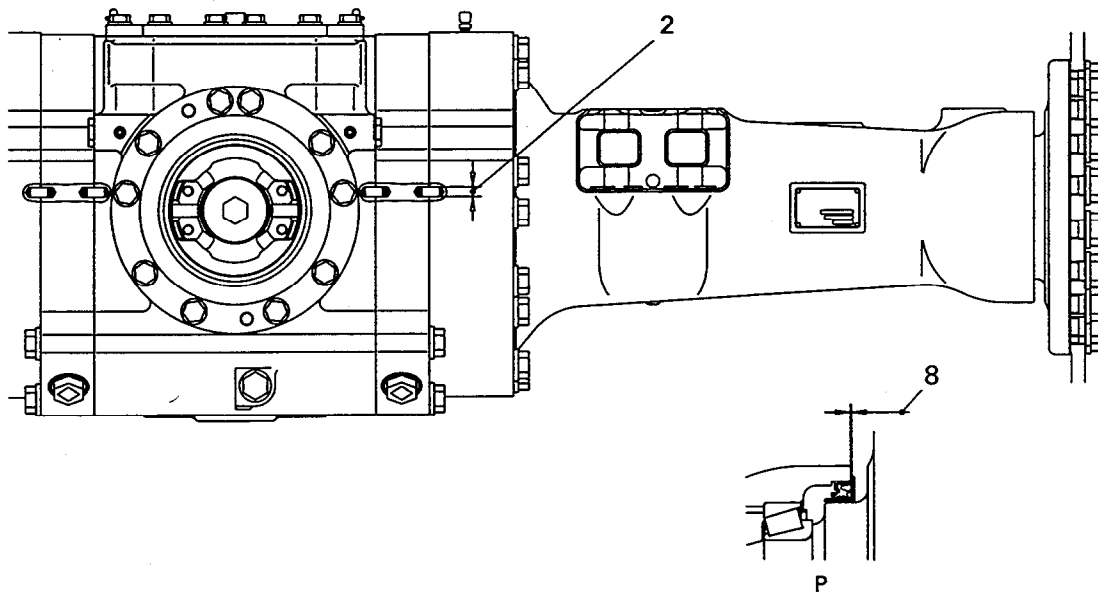
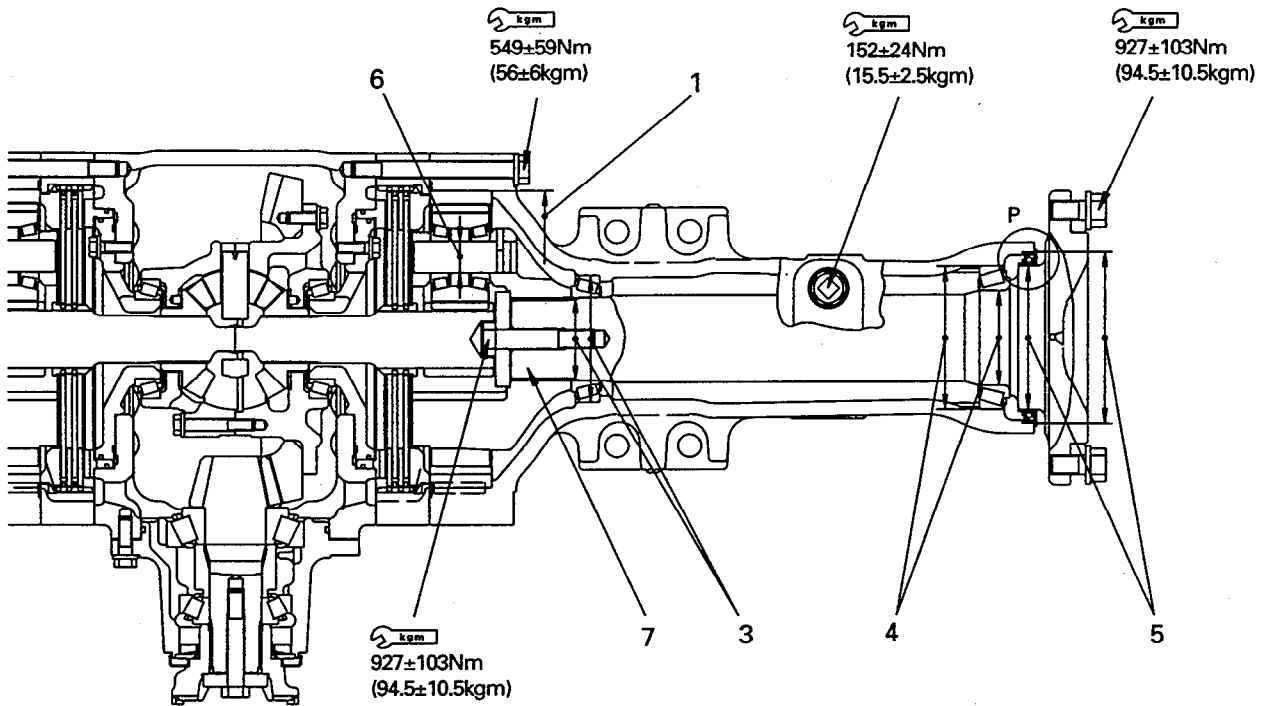
Unit: mm

Unit: mm

No.	Check item	Criteria						Remedy
1	Clearance at differential side bearing	Outer lace	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
				Shaft	Hole			
		150	0 -0.018	-0.045 -0.085	-0.085 - -0.027	—		
Inner lace	100	+0.059 +0.037	0 -0.020	-0.079 - -0.037	—			
2	Clearance at pinion shaft gear side bearing	Outer lace	171.45	+0.025 0	-0.028 -0.068	-0.093 - -0.028	—	
		Inner lace	76.2	+0.062 +0.043	+0.013 0	-0.062 - -0.030	—	
3	Clearance at pinion shaft coupling side bearing	Outer lace	140	0 -0.018	-0.048 -0.088	-0.088 - -0.030	—	
		Inner lace	65	+0.039 +0.020	0 -0.015	-0.054 - -0.020	—	
4	Clearance between pinion gear and spider		34.93	-0.06 -0.11	+0.10 +0.05	0.11 - 0.21	0.3	
5	Differential housing piston mount (housing piston)		326.5	-0.125 -0.214	+0.089 0	0.125 - 0.303	—	
6	Bearing carrier piston mount (piston carrier)		304	-0.110 -0.191	+0.081 0	0.110 - 0.272	—	
7	Thickness of side gear washer	Standard size		Tolerance		Repair limit		
		4		±0.05		3.8		
8	Thickness of pinion gear washer	1.5		+0.09 -0.01		1.35		
9	Height of spacer between pinion shaft bearings	66.61		±0.025		—		
10	Bevel gear backlash	0.30 - 0.46						Adjust
11	Differential gear backlash	0.10 - 0.25						
12	End play of pinion gear	less than 0.18						

U42303

FINAL DRIVE



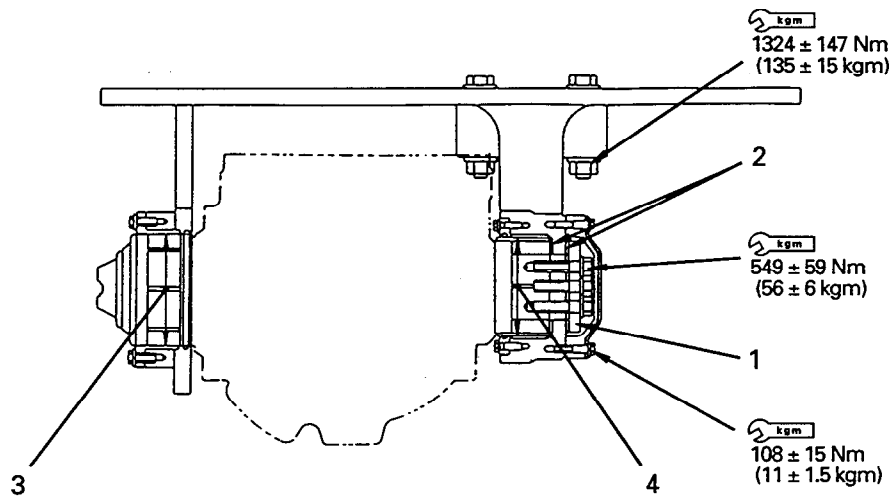
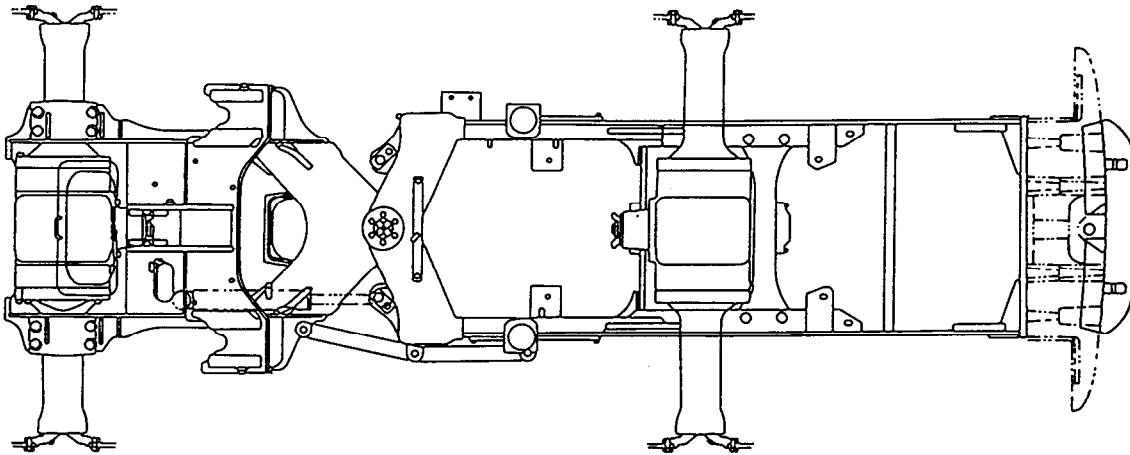
U42303

MAINTENANCE STANDARD
FINAL DRIVE

Unit: mm

No.	Check item		Criteria				Remedy	
1	Clearance between axle housing and ring gear		Standard size	Tolerance		Standard clearance	Clearance limit	Replace
				Shaft	Hole			
2	Clearance at guide pin		374	+0.10 +0.03	+0.10 0	-0.10 – 0.07	—	
3	Clearance at axle housing bearing press-fitted section	Outer lace	160	0 -0.025	-0.045 -0.085	-0.085 – -0.020	—	
		Inner lace	105	+0.035 +0.013	0 -0.020	-0.055 – -0.013	—	
4	Clearance at axle housing bearing press-fitted section	Outer lace	180	0 -0.025	-0.045 -0.085	-0.085 – -0.020	—	
		Inner lace	120	+0.045 +0.023	0 -0.020	-0.065 – -0.023	—	
5	Axle shaft seal press-fitted section	Housing	215	—	+0.072 0	—	—	
		Shaft	180	0 -0.063	—	—	—	
6	Clearance between pinion gear bearing and shaft		40	+0.013 +0.002	0 -0.012	-0.025 – -0.002	—	
7	End play of axle shaft		0 – 0.1				Adjust	
8	Clearance between oil seal and housing		0.1 – 1.9					

AXLE MOUNT

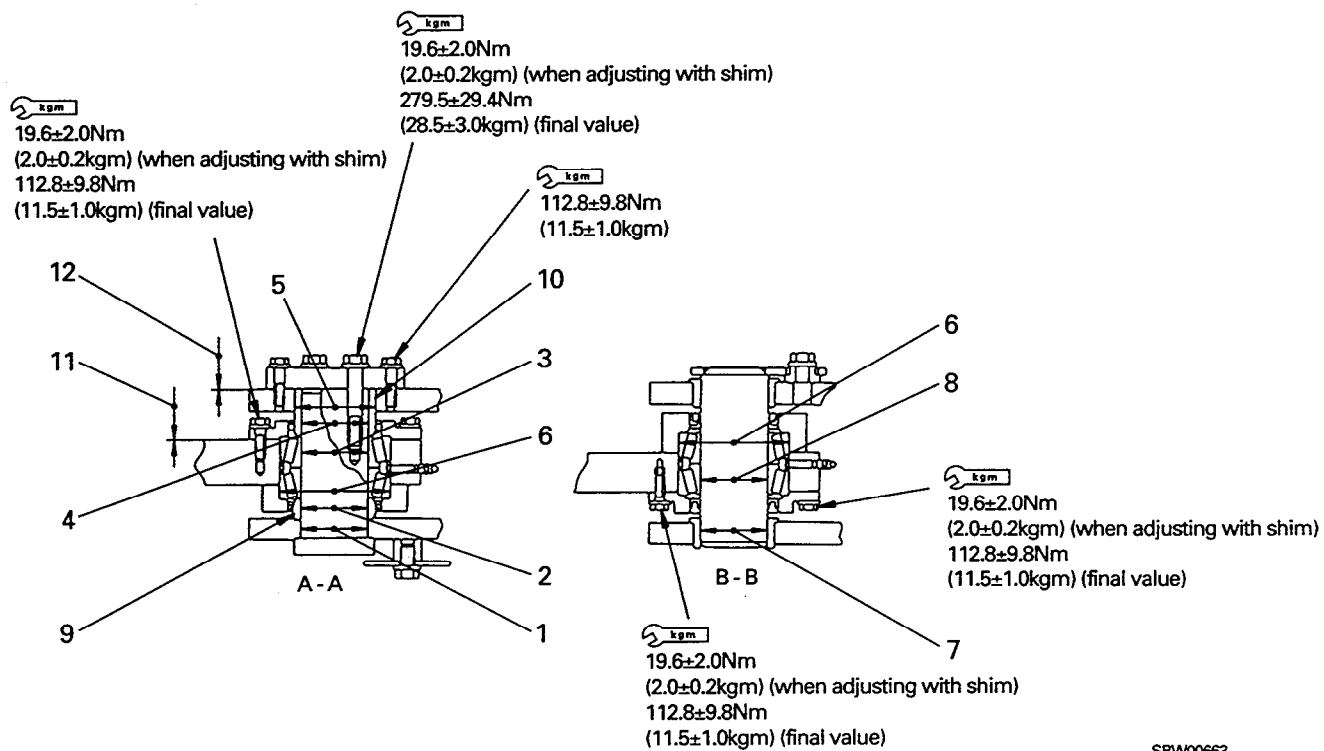
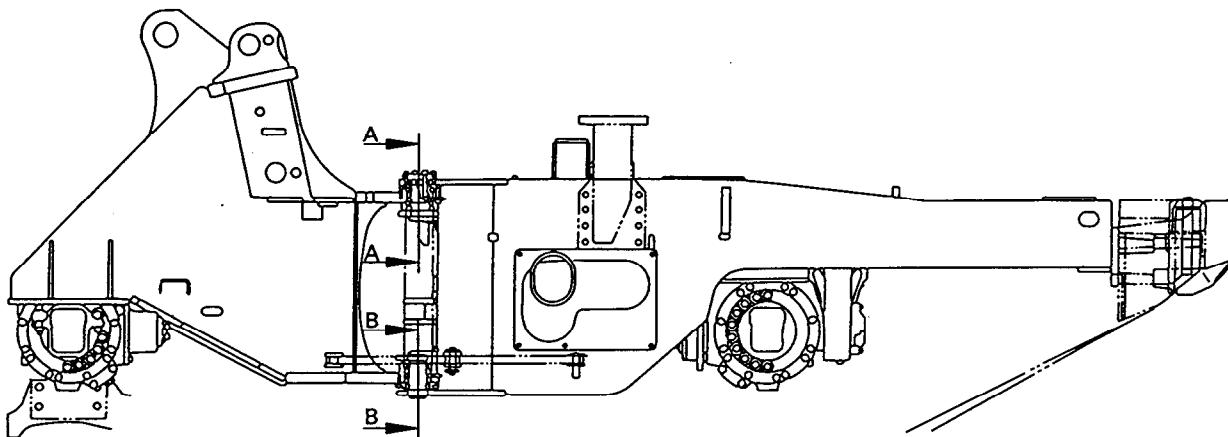


SBW00662

Unit: mm

No.	Check item	Criteria				Remedy
		Standard size	Tolerance		Repair limit	
1	Thickness of thrust plate	22	± 0.5		—	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	
			Shaft	Hole	Clearance limit	
		190	-0.050 -0.122	$+0.472$ 0	$0.050 - 0.594$	—
4	Clearance between hole and shaft at rear support end	170	-0.005 -0.124	$+0.522$ $+0.050$	$0.055 - 0.646$	—

CENTER HINGE PIN



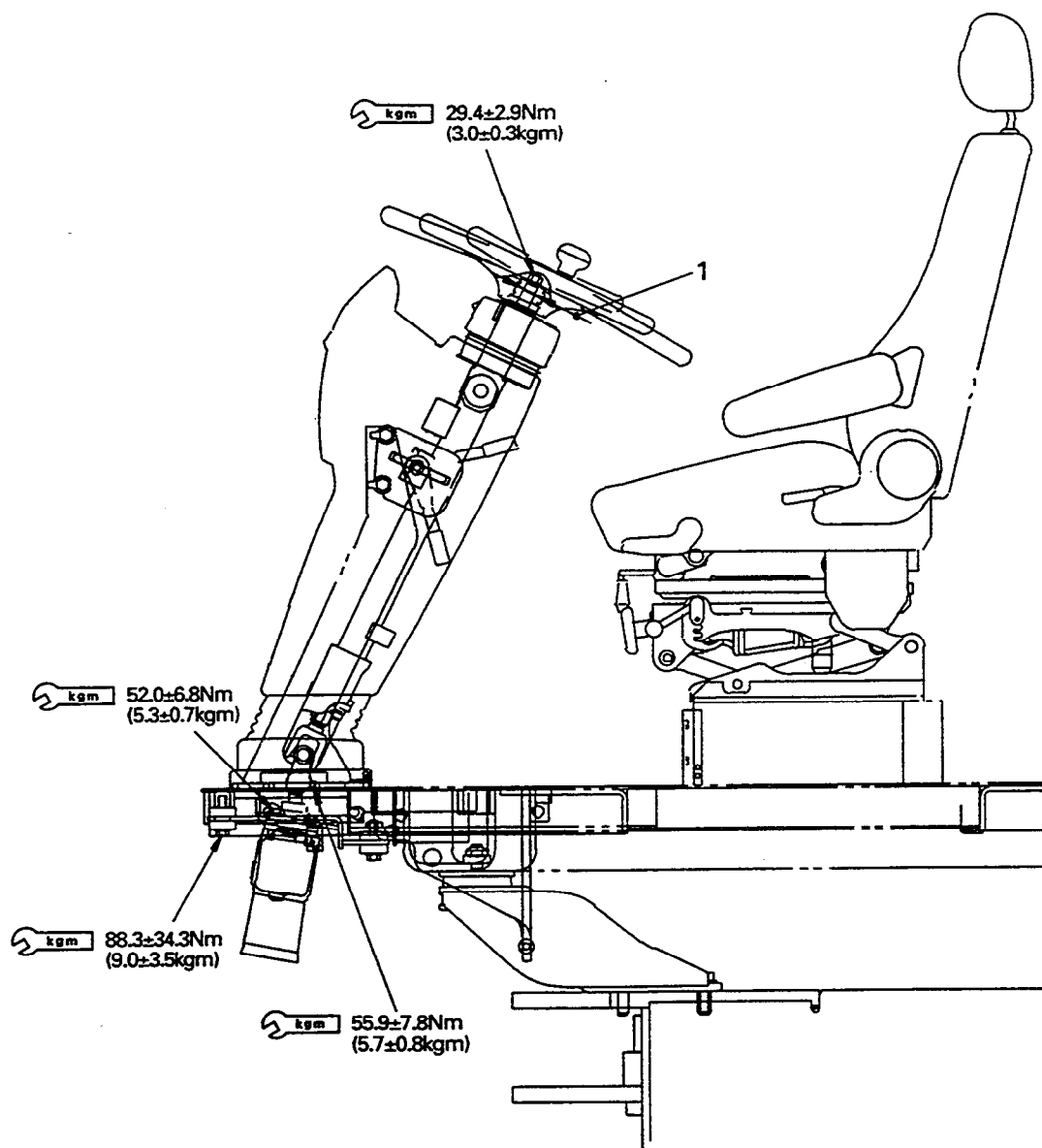
SBW00663

MAINTENANCE STANDARD
CENTER HINGE PIN

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			
1	Clearance between upper hinge pin and rear frame	80	-0.030 -0.049	+0.071 +0.036	0.066 – 0.130	—	
2	Clearance between upper hinge pin and spacer (small)	80	-0.030 -0.049	+0.060 +0.030	0.060 – 0.109	—	
3	Clearance between upper hinge pin and bearing	80	-0.030 -0.049	0 -0.015	0.015 – 0.049	—	
4	Clearance between upper hinge pin and spacer (large)	80	-0.030 -0.049	+0.030 0	0.030 – 0.079	—	
5	Clearance between rear frame and spacer (large)	95	-0.036 -0.071	+0.071 +0.036	0.072 – 0.142	—	
6	Clearance between frame and bearing	130	0 -0.025	-0.048 -0.088	-0.088 – -0.023	—	
7	Clearance between lower hinge pin and rear frame	80	-0.030 -0.076	+0.054 0	0.030 – 0.130	—	
8	Clearance between lower hinge pin and bearing	80	-0.030 -0.076	0 -0.015	0.015 – 0.076	—	
9	Height of upper hinge spacer (small)	Standard size		Tolerance		Repair limit	
		25.5		±0.1		—	
10	Height of upper hinge spacer (large)	56		±0.1		—	
11	Value for shim between upper hinge and retainer	Standard size		Standard clearance		Clearance limit	Adjust
		2.5		0.05		0.1	
12	Value for shim between upper hinge and retainer	2.5		0.1		0.2	

STEERING COLUMN

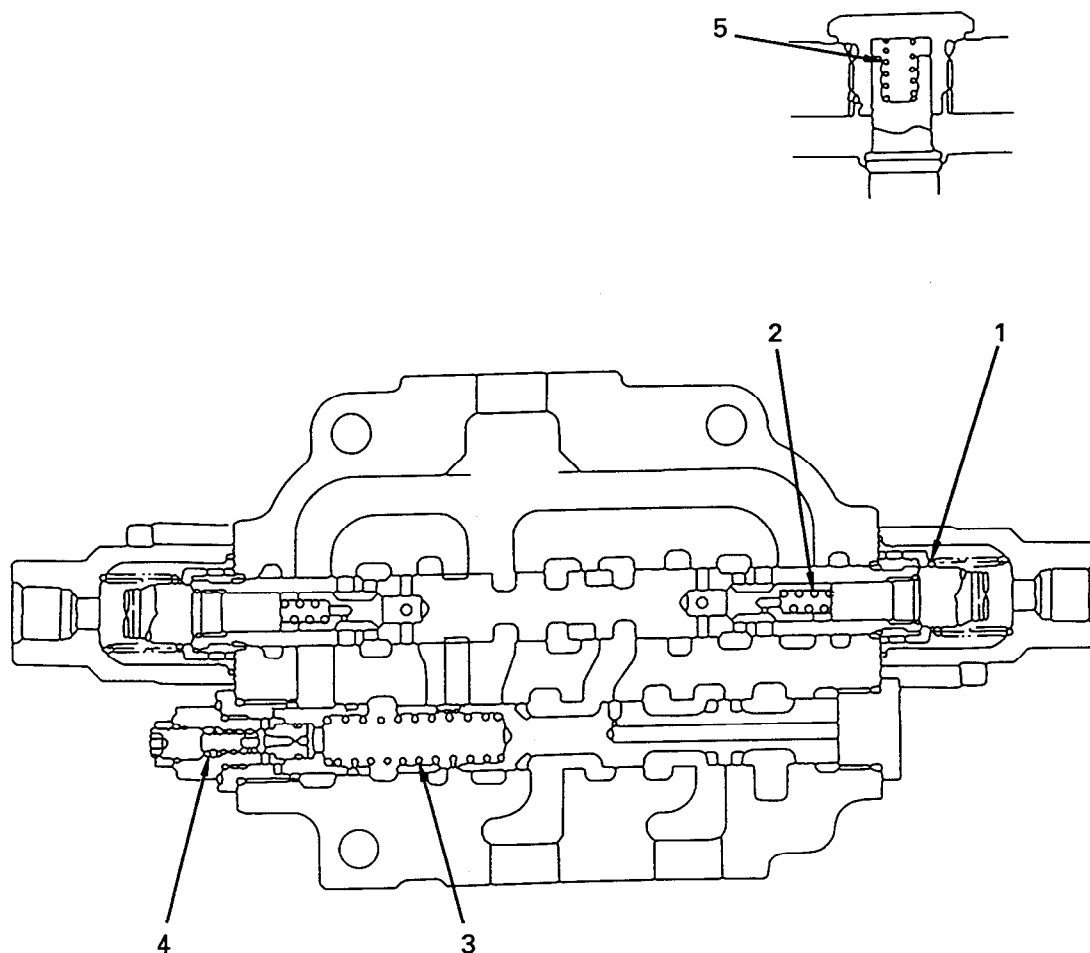


SAW00768

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

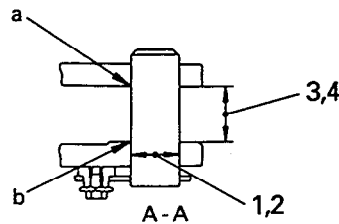
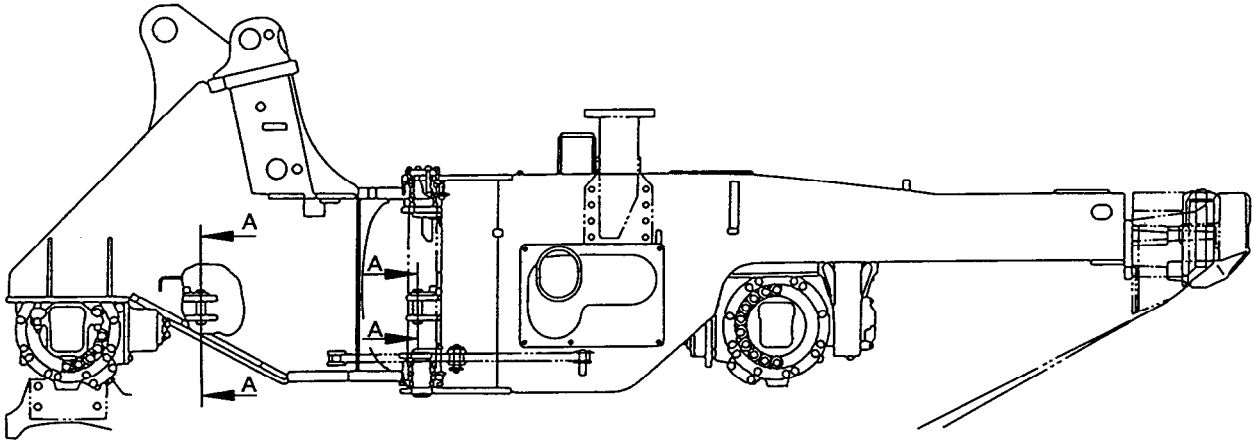


SLW01253

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

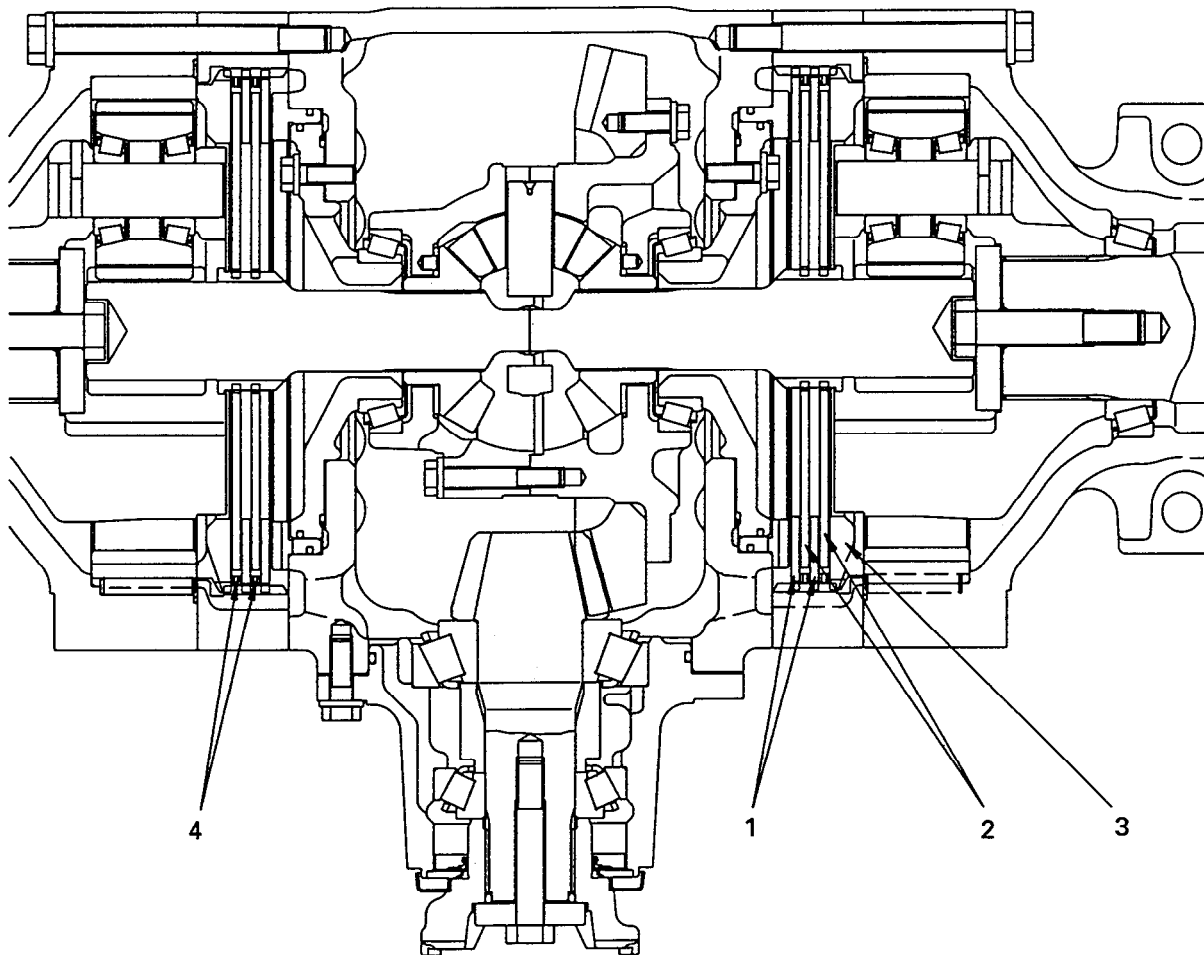


SBW00667

Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between mounting pin and bushing at connection of steering cylinder rod and frame	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
2	Clearance between mounting pin and bushing at connection of steering cylinder bottom and frame	50	0 -0.025	+0.20 +0.10	0.10 – 0.225	—	
3	Clearance between mounting pin and bushing at connection of steering cylinder bottom and frame	50	0 -0.025	+0.150 +0.050	0.050 – 0.175	—	
4	Connection between steering cylinder and front frame	Width of boss		Width of hinge		Standard clearance (clearance a + b)	
		60 ^{+0.8} ₀		63±1		—	
5	Connection between steering cylinder and rear frame	60 ^{+0.8} ₀		66±1		Max. 0.5 (after adjusting with shim)	

BRAKE



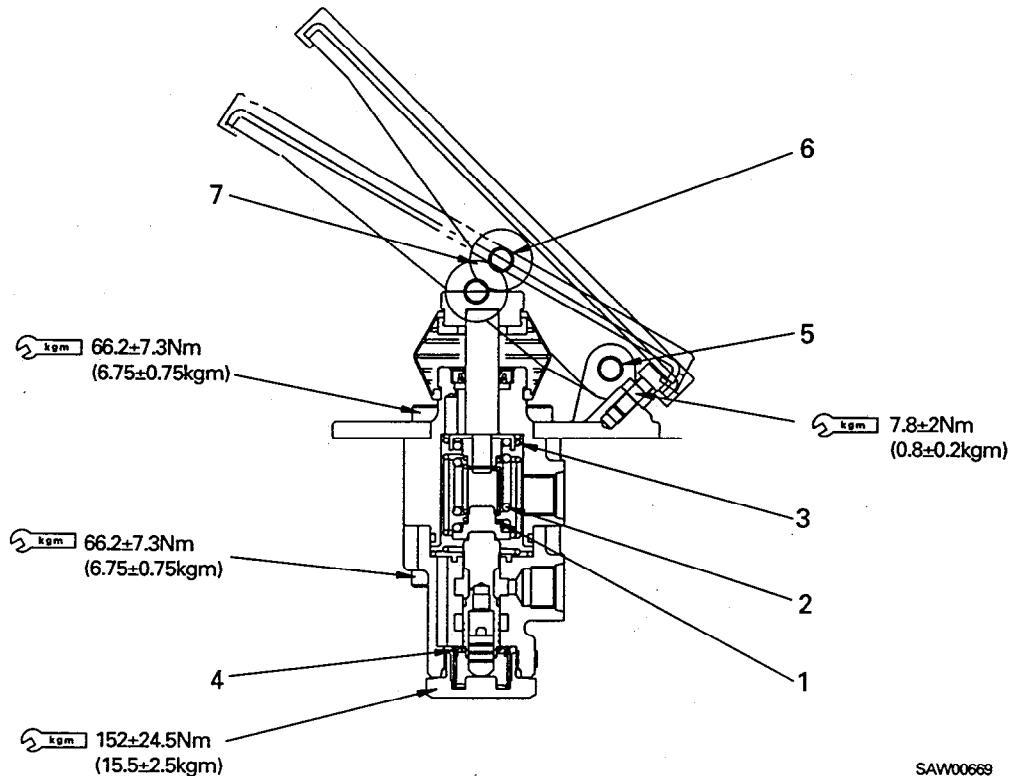
SAW00668

Unit: mm

No.	Check item	Criteria			Remedy
		Standard size	Tolerance	Repair limit	
1	Inner ring thickness	6	± 0.1	5.5	Replace
	Brake disc thickness	8	± 0.15	7.2	
2	Depth of lining grooves	0.9	0.8 (min.)	0.4	
	Lining thickness	1.0	0.9 (min.)	—	
3	Wear of brake outer ring disc contact surface	25	± 0.1	0.3	
4	Spring load	Standard size		Repair limit	
		Installed length	Installed load	Installed load	
		7.8	682 N (69.5 kg)	549 N (56 kg)	

BRAKE VALVE

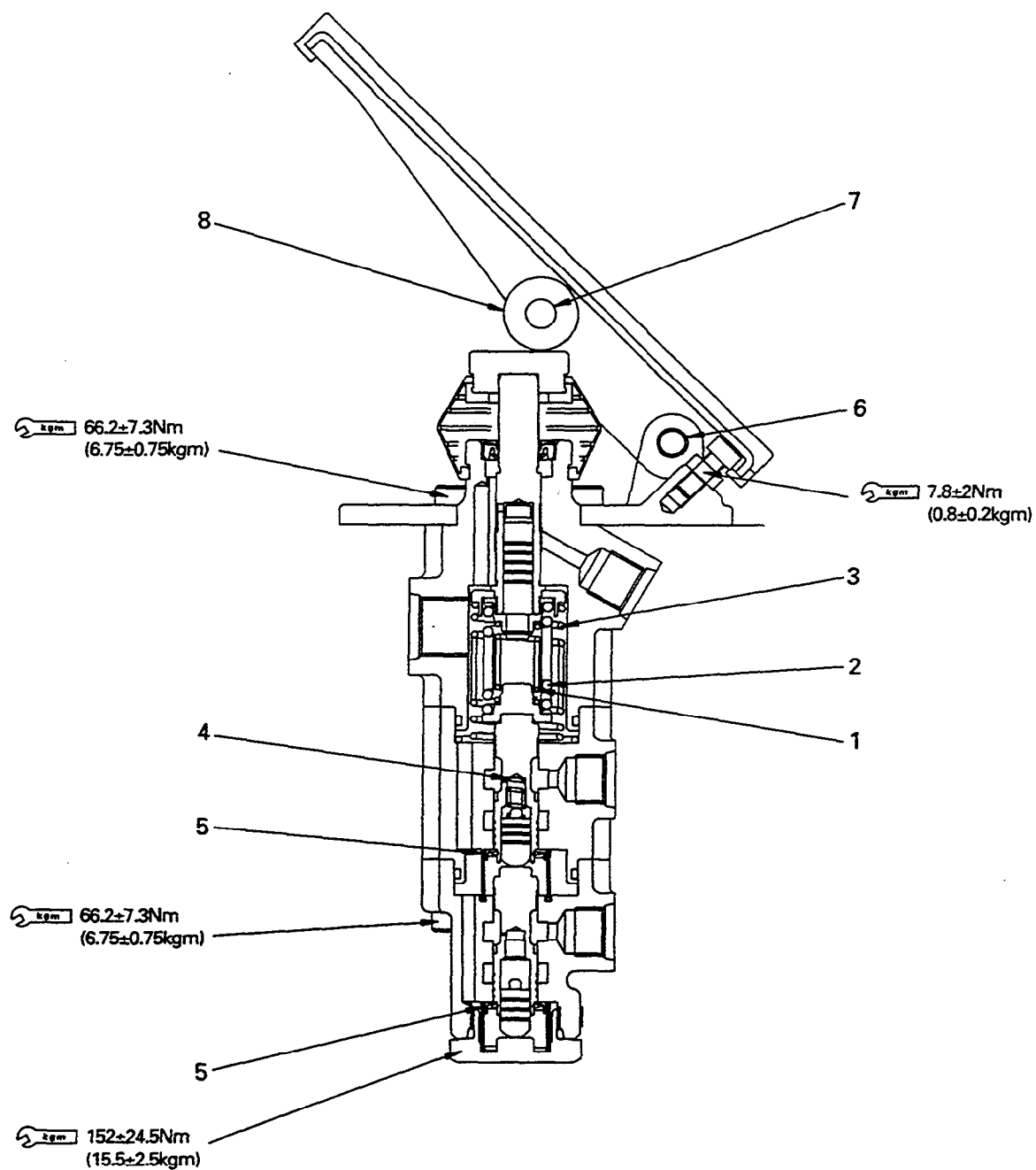
BRAKE VALVE (LEFT)



Unit: mm

No.	Check item	Criteria					Remedy
1	Control spring	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		34	21.8	93.2 N (9.5 kg)	33	—	
2	Control spring	46.3	34.3	459 N (46.8 kg)	45.3	—	
3	Return spring	86.2	58	60.8 N (6.2 kg)	78	—	
4	Return spring	31.5	19.5	16.7 N (1.7 kg)	28	—	
5	Clearance between pedal mount hole and bracket hole	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		10	-0.025 -0.075	+0.1 0	0.175 – 0.025	0.25	
6	Clearance between roller and pin	10	-0.025 -0.075	+0.1 0	0.175 – 0.025	29.2	
7	Outside diameter of roller	Standard size		Tolerance		Repair limit	
		30		0 -0.5		29.2	

BRAKE VALVE (RIGHT)

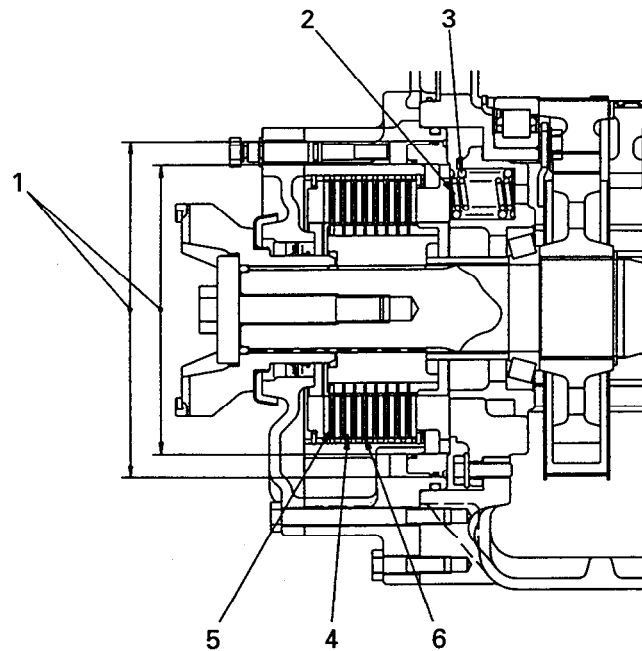


SAW00670

Unit: mm

No.	Check item	Criteria					Remedy
1	Control spring	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		34	21.8	93.2N (9.5kg)	33	—	
2	Control spring	46.3	34.3	459N (46.8kg)	45.3	—	
3	Return spring	86.2	58	60.8N (6.2kg)	78	—	
4	Spring	17	15	69.6N (7.1kg)	16.2	—	
5	Return spring	31.5	19.5	16.7N (1.7kg)	28	—	
6	Clearance between pedal mount hole and bracket hole	Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
		10	-0.025 -0.075	+0.1 0	0.175 – 0.025	0.25	
7	Clearance between roller and pin	10	-0.025 -0.075	+0.1 0	0.175 – 0.025	29.2	
8	Outside diameter of roller	Standard size		Tolerance		Repair limit	
		30		0 -0.5		29.2	

PARKING BRAKE



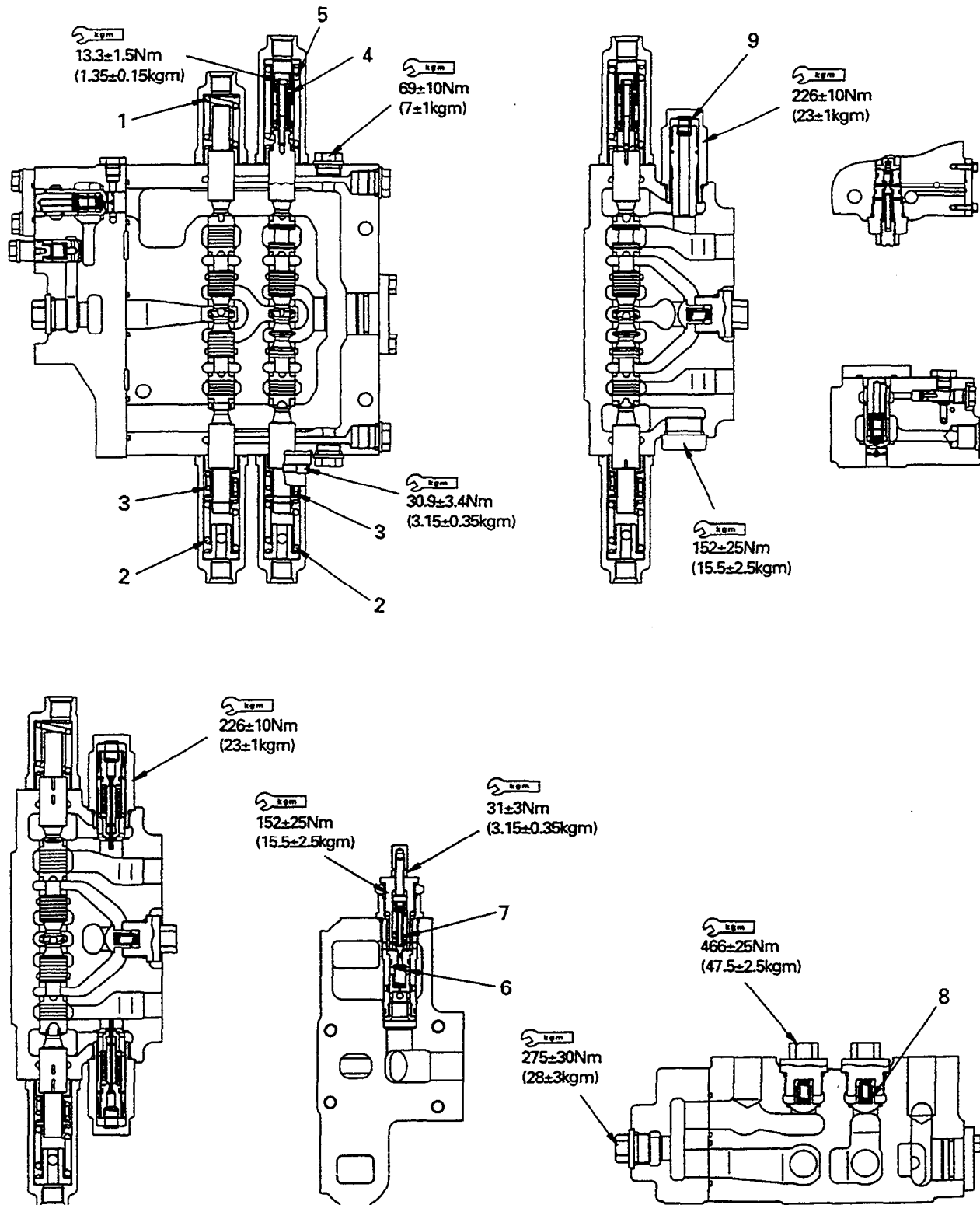
SAW00671

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
1	Clearance between piston and cylinder	Inner side	215	0 -0.05	+0.13 0	0 - 0.18	0.23
		Outer side	250	-0.10 -0.15	+0.13 0	0.10 - 0.28	0.33
2	Parking brake spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		68.7	53.7	438±21.6 N (44.7±2.2 kg)	66.0	944 N (96.3 kg)	
3	Parking brake spring	76.5	53.7	1,049±52.9 N (107±5.4 kg)	68.9	394 N (40.2 kg)	
4	Separator plate	Standard size		Tolerance		Repair limit	
		Thickness		4.0		±0.05	
		Distortion		—		0.05	
5	Brake disc	Thickness		3.2		±0.08	
		Depth of lining groove		0.45		+0.175 0	
		Lining thickness		0.7		±0.075	
						—	
6	Wave spring load	1,106 N (112.8 kg) (Height: 3.2 mm)		±56.9 N (±5.8 kg)		892 N (91 kg) (Height: 3.2 mm)	

MAIN CONTROL VALVE

2-SPOOL VALVE

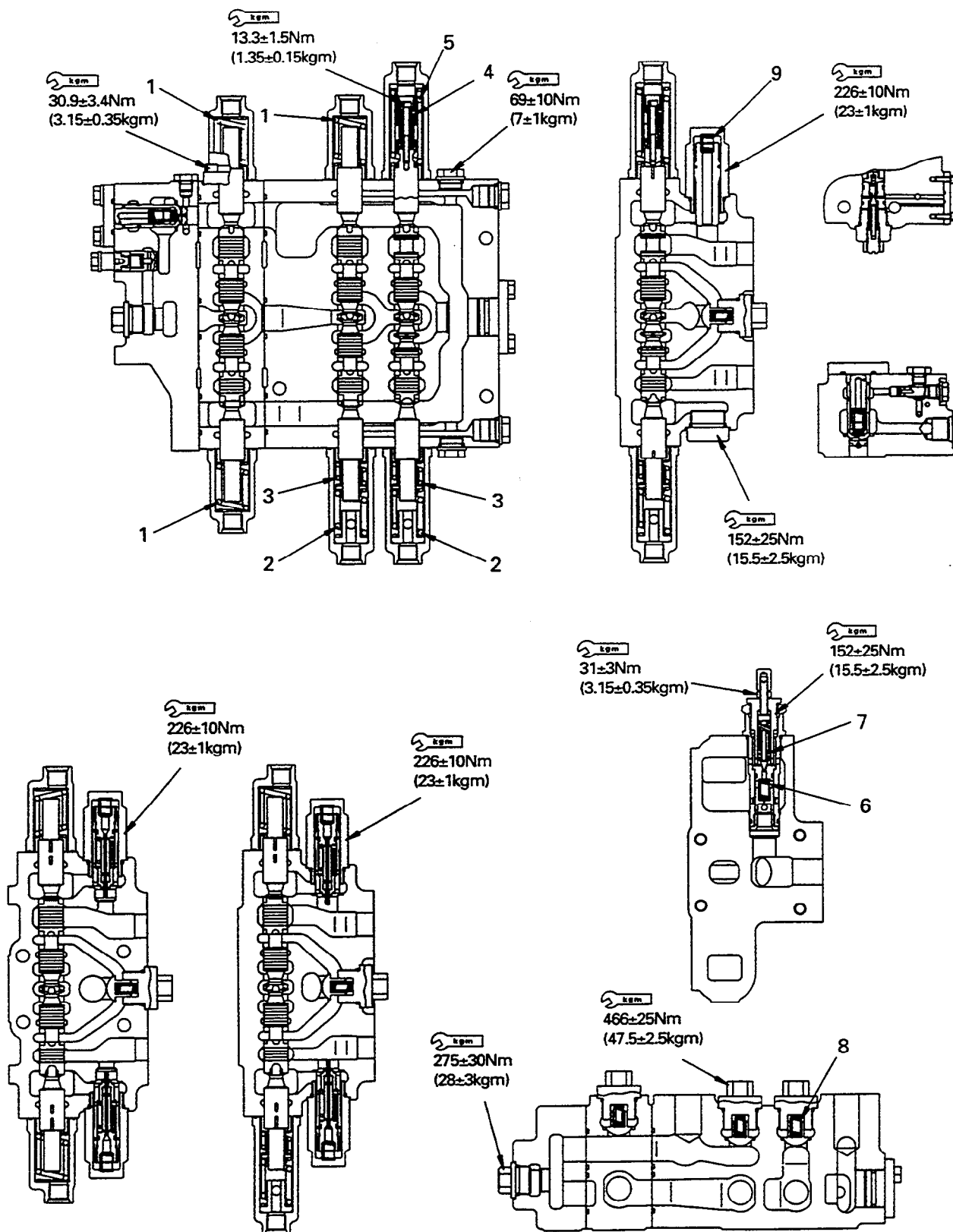


SAW00673

Unit: mm

No.	Check item	Criteria					Remedy
1	Spool return spring (for bucket)	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		54.8	53.5	125N (12.7kg)	—	—	
2	Spool return spring (for bucket and boom)	54.8	52.2	235N (24kg)	—	—	
3	Spool return spring (for bucket and boom)	30.7	26.8	235N (24kg)	—	—	
4	Spool return spring (for boom)	55.3	40	233N (23.8kg)	—	—	
5	Spool return spring (for boom)	86.8	83.5	208N (21.2kg)	—	—	
6	Main relief valve main valve spring	39.5	23.2	33.3N (3.4kg)	—	—	
7	Relief valve poppet spring	49.3	41.9	259N (26.4kg)	47.8	208N (21.2kg)	
8	Check valve spring	32.6	24.5	44.1N (4.5kg)	—	—	
9	Suction valve spring	27.9	19	6.9N (0.7kg)	—	—	

3-SPOOL VALVE

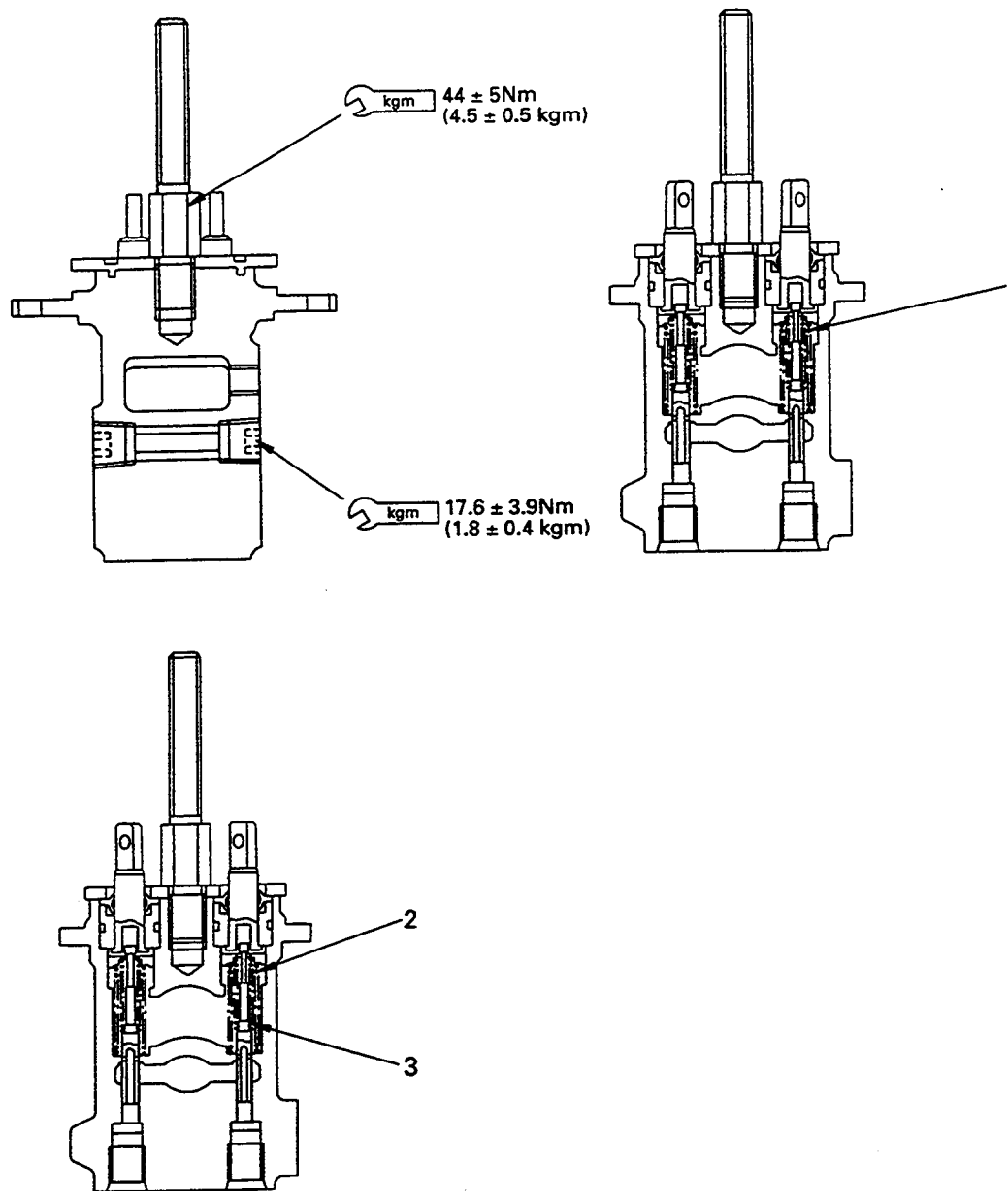


SAW00674

Unit: mm

No.	Check item	Criteria					Remedy
1	Spool return spring (for bucket and attachment)	Standard size			Repair limit		Replace
		Free length	Installed length	Installed load	Free length	Installed load	
		54.8	53.5	125N (12.7kg)	—	—	
2	Spool return spring (for bucket and boom)	54.8	52.2	235N (24kg)	—	—	
3	Spool return spring (for bucket and boom)	30.7	26.8	235N (24kg)	—	—	
4	Spool return spring (for boom)	55.3	40	233N (23.8kg)	—	—	
5	Spool return spring (for boom)	86.8	83.5	208N (21.2kg)	—	—	
6	Main relief valve main valve spring	39.5	23.2	33.3N (3.4kg)	—	—	
7	Relief valve poppet spring	49.3	41.9	259N (26.4kg)	47.8	208N (21.2kg)	
8	Check valve spring	32.6	24.5	44.1N (4.5kg)	—	—	
9	Suction valve spring	27.9	19	6.9N (0.7kg)	—	—	

PPC VALVE

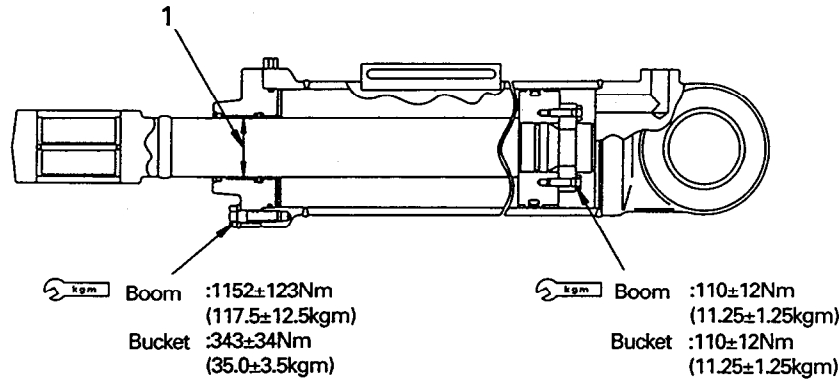


SEW00357

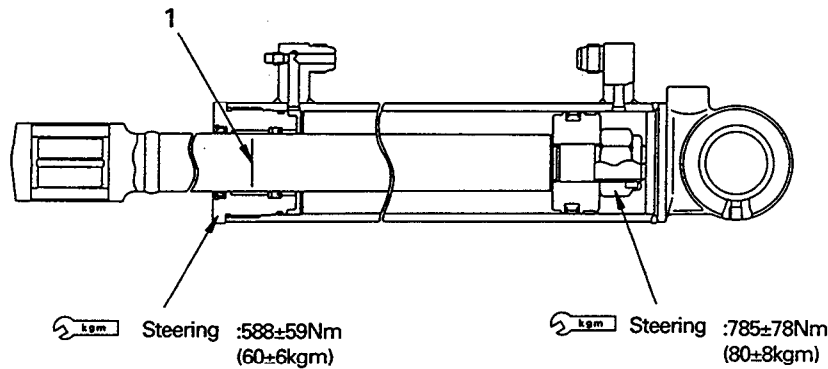
Unit: mm

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	
		52.78 x 1.3	36.0	29.4 N (3.0 kg)	—	23.5 N (2.4 kg)	
2	Centering spring (bucket TILT, boom RAISE)	52.78 x 1.3	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)	

HYDRAULIC CYLINDER



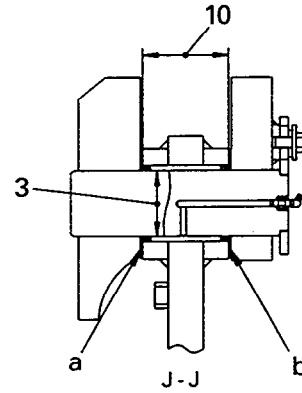
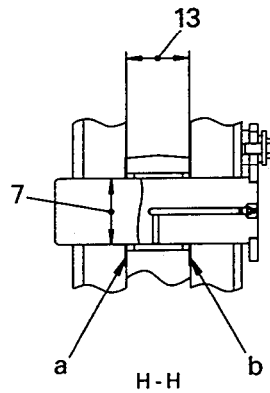
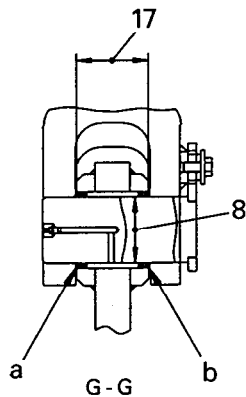
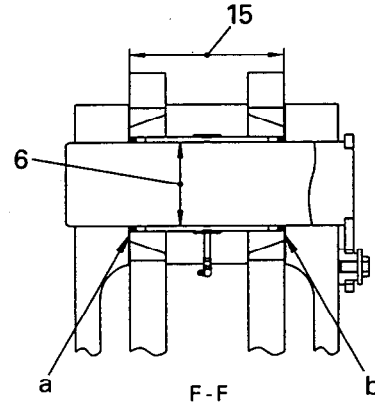
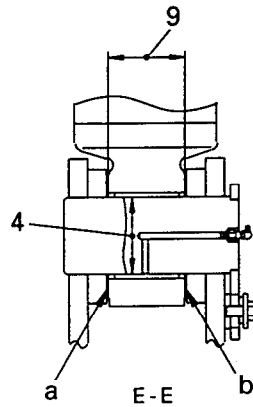
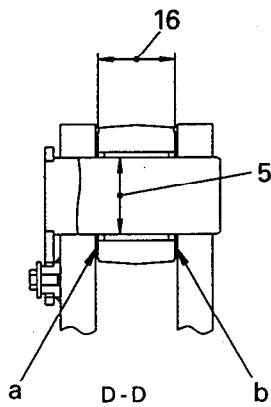
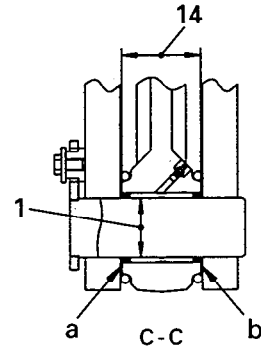
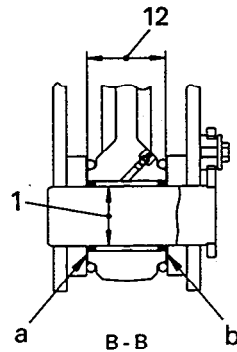
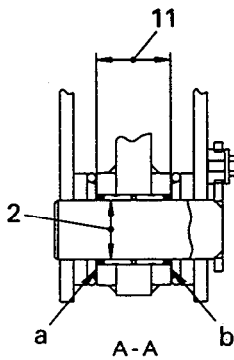
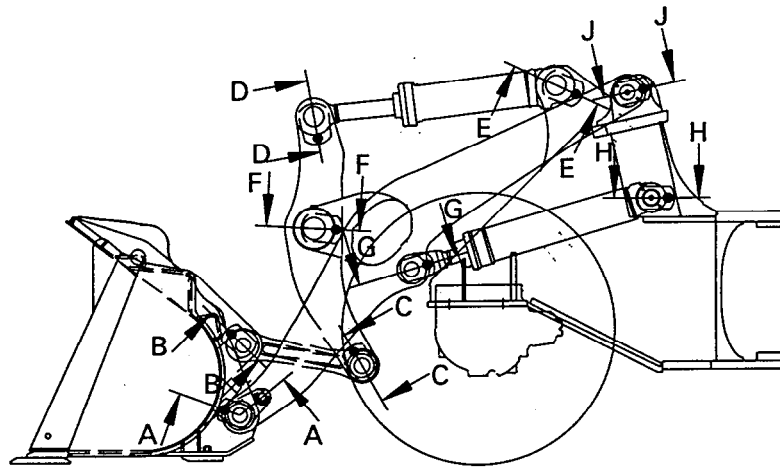
SBW00675



SBW00676

Unit: mm								
No.	Check item	Criteria					Remedy	
1	Clearance between piston rod and bushing	Standard size	Tolerance		Standard clearance	Clearance limit	Replace	
			Shaft	Hole				
		Boom	90	-0.036 -0.123	+0.270 +0.061	0.097 – 0.393		0.693
		Bucket	90	-0.036 -0.123	+0.270 +0.061	0.097 – 0.393		0.693
		Steering	45	-0.025 -0.087	+0.152 +0.007	0.032 – 0.239		0.539

WORK EQUIPMENT LINKAGE



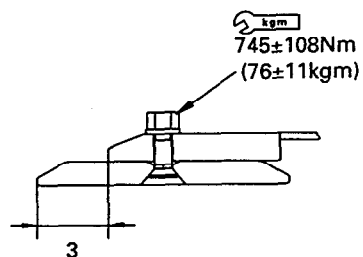
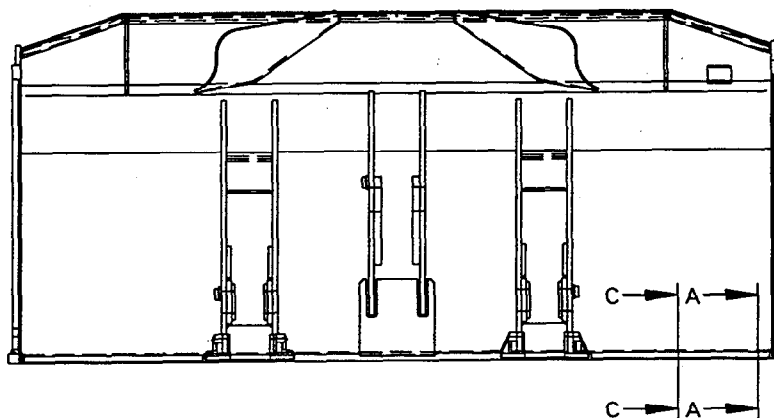
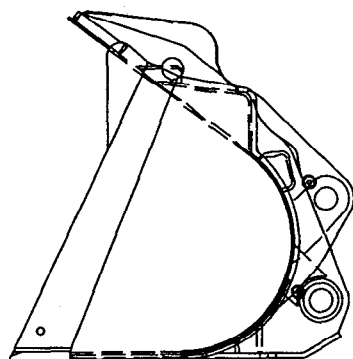
SAW00677

MAINTENANCE STANDARD
WORK EQUIPMENT LINKAGE

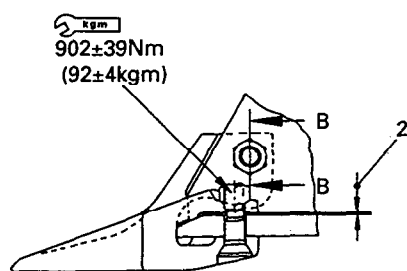
Unit: mm

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			
		85	-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	85	-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	95	-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	110	-0.036 -0.090	+0.207 +0.120	0.156 – 0.297	1.0	
5	Clearance between pin and bushing at connection of bucket cylinder rod and bellcrank	110	-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	120	-0.036 -0.090	+0.245 +0.145	0.181 – 0.335	1.0	
7	Clearance between pin and bushing at connection of boom cylinder bottom and frame	95	-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 rod and boom	95	-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
		110 ^{+0.8} ₀		114±1.5	1.7 – 5.5		
10	Connection of boom and frame	122±1.5		129 ⁺³ ₀	5.5 – 11.5		
11	Connection of boom and bucket	106±1.5		108 ^{+1.5} ₀	0.5 – 5		
12	Connection of bucket link and bucket	112.5 ^{+2.8} _{-0.5}		116 ^{+1.5} ₀	0.7 – 5		
13	Connection of boom cylinder and frame	90 ^{+0.8} ₀		93.5 ⁺³ ₀	2.7 – 6.5		
14	Connection of bellcrank and bucket link	112.5 ^{+2.8} _{-0.5}		117±1.5	0.2 – 6.5		
15	Connection of bellcrank and boom	220 ⁺² ₀		223±0.5	0.5 – 5.5		
16	Connection of bucket cylinder and bellcrank	110 ^{+0.8} ₀		117±1.5	4.7 – 8.5		
17	Connection of boom and boom cylinder	103±1.5		106±1.5	0 – 6		

BUCKET



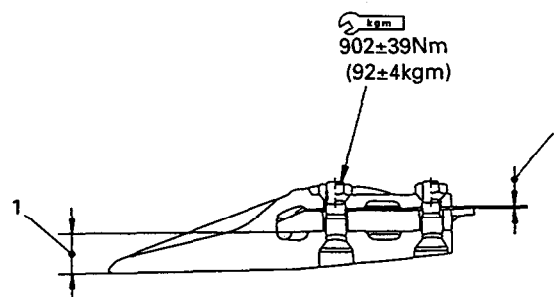
A - A



A - A



B - B



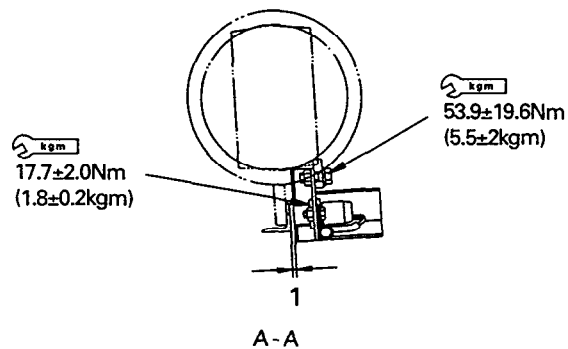
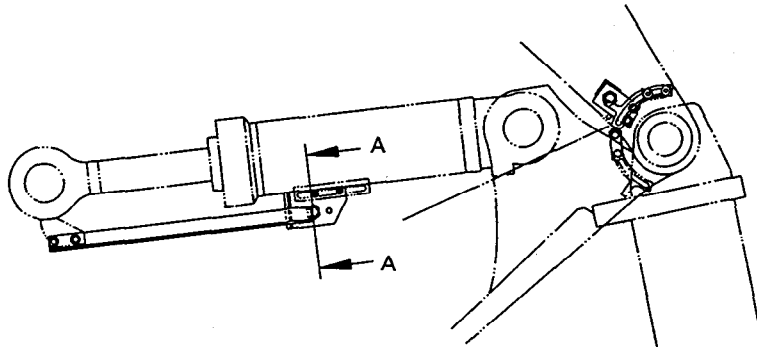
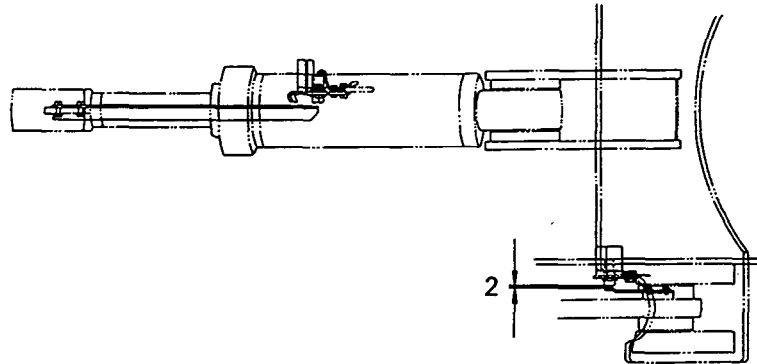
C - C

SAW00678

Unit: mm

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Bucket tooth wear	50	18.5	Replace
2	Clearance of bucket tooth mounting base	Max. 0.5	—	Adjust or replace
3	Cutting edge wear	93	—	Reverse or replace

BUCKET POSITIONER AND BOOM KICK-OUT



SBW00679

Unit: mm

No.	Check item	Criteria	Remedy
1	Clearance at bucket positioner switch	3 - 7	Adjust
2	Clearance at boom kickout switch	3 - 7	

P R O P O S E R	NAME OF COMPANY:		LOCATION:			
			PHONE NO:			
	DEPARTMENT:		DATE:			
	NAME:					
MANUAL NAME:						
MANUAL NO:						
MACHINE MODEL: S/N IF APPLICABLE:						
PAGE NO:						
PROBLEM:						
Attach photo or sketch. If more space is needed, use another sheet.						
FOR INTERNAL USE ONLY						
CORRECTIVE ACTION:						
