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1. STRUCTURE

This service 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 service 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.

SECTION 1 GENERAL
This section explains the safety hints and gives the specification of the machine and major components.

SECTION 2 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.

SECTION 3 HYDRAULIC SYSTEM
This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM
This section explains the electrical circuit, monitoring system and each component. It serves not only to give an understanding electrical system, but also serves as reference material for trouble shooting.

SECTION 5 MECHATRONICS SYSTEM
This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING
This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD
This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBY 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.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI 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 shows how to read the page number.
   Example 1
   2 - 3
   Item number(2. Structure and Function)
   Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.
   10 - 4
   10 - 4 - 1
   10 - 4 - 2
   Added pages
   10 - 5

Revised edition mark(①②③…)

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

Revisions

Revised pages are shown at the list of revised pages on the between the contents page and section 1 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.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
※	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

1. **Method of using the Conversion Table to convert from millimeters to inches**

   Convert 55mm into inches.

   (1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.

   (2) Locate the number 5in the row across the top, take this as ⓑ, then draw a perpendicular line down from ⓑ.

   (3) Take the point where the two lines cross as ⓒ. This point ⓒ gives the value when converting from millimeters to inches. Therefore, 55mm = 2.165 inches.

2. Convert 550mm into inches.

   (1) The number 550 does not appear in the table, so divide by 10(Move the decimal point one place to the left) to convert it to 55mm.

   (2) Carry out the same procedure as above to convert 55mm to 2.165 inches.

   (3) The original value(550mm) was divided by 10, so multiply 2.165 inches by 10(Move the decimal point one place to the right) to return to the original value.
   This gives 550mm = 21.65 inches.

Millimeters to inches

ⓑ

1mm = 0.03937 in

	0	1	2	3	4	5	6	7	8	9
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

Millimeters to inches

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
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

1kg = 2.2046lb

	0	1	2	3	4	5	6	7	8	9
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	59.5.	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

1 l = 0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
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	6.6076	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	25.631	25.625	25.889	26.153

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
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	7.969	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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

	0	1	2	3	4	5	6	7	8	9
		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	396.6	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	10005.4
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

kgf/cm^2 to lbf/in^2

1kgf / cm^2 = 14.2233lbf / in^2

	0	1	2	3	4	5	6	7	8	9
		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	2863	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	5603	2617	2631	2646	2660	2674	2688
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 verse 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.

˚C		˚F	˚C		˚F	˚C		˚F	˚C		˚F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-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	35	95.0	21.1	70	158.0	51.7	125	257.0
-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	172	347.0

SECTION 1 GENERAL

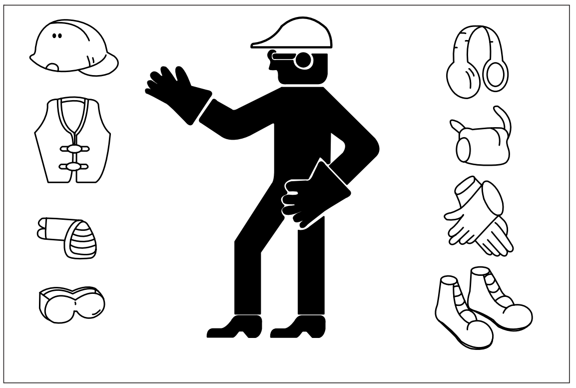
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

Unsafe work practices are dangerous. Understand service procedure before doing work; Do not attempt shortcuts.

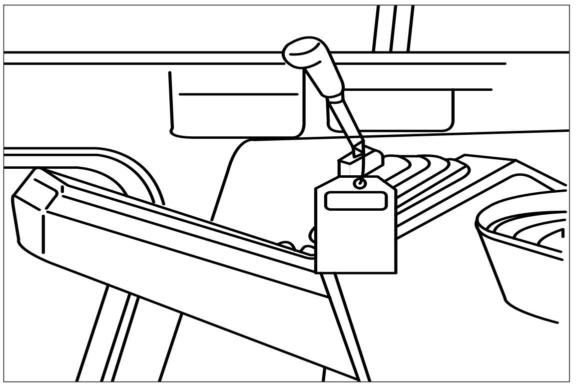
WEAR PROTECTIVE CLOTHING

Wear close fitting clothing and safety equipment appropriate to the job.



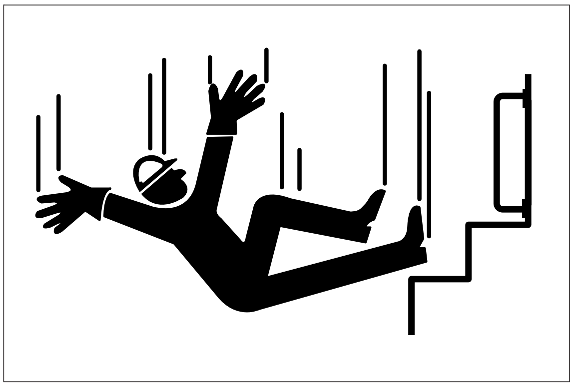
WARN OTHERS OF SERVICE WORK

Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「**Do Not Operate**」 tag on the right side control lever.



USE HANDHOLDS AND STEPS

Falling is one of the major causes of personal injury.
When you get on and off the machine, always maintain a three point contact with the steps and handrails and face the machine. Do not use any controls as handholds.
Never jump on or off the machine. Never mount or dismount a moving machine.
Be careful of slippery conditions on platforms, steps, and handrails when leaving the machine.

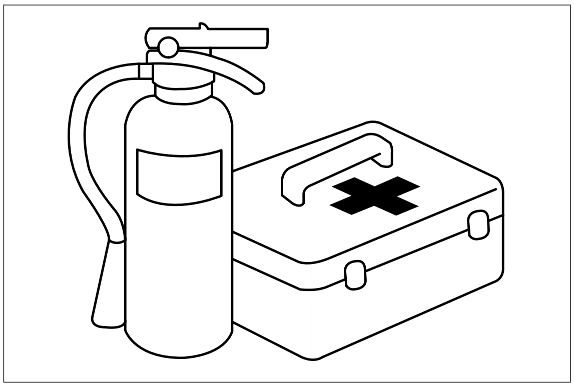


PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

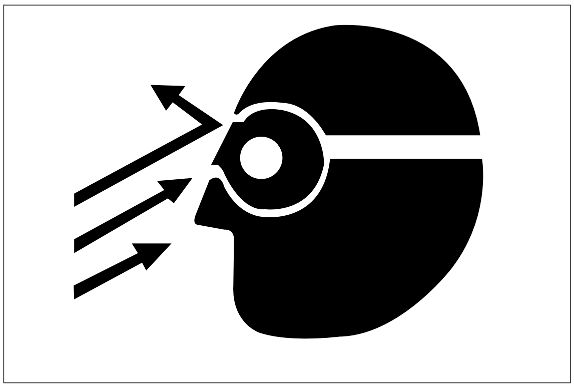
Keep a first aid kit and fire extinguisher handy.

Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



PROTECT AGAINST FLYING DEBRIS

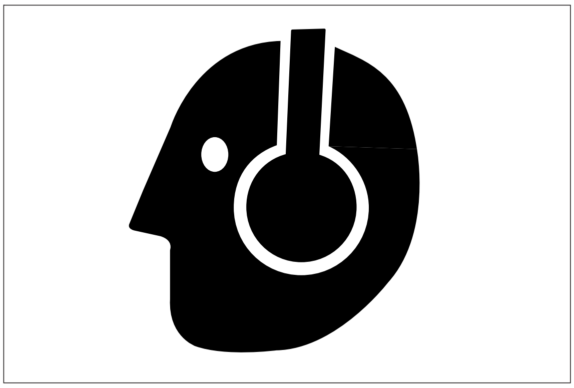
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

Prolonged exposure to loud noise can cause impairment or loss of hearing.

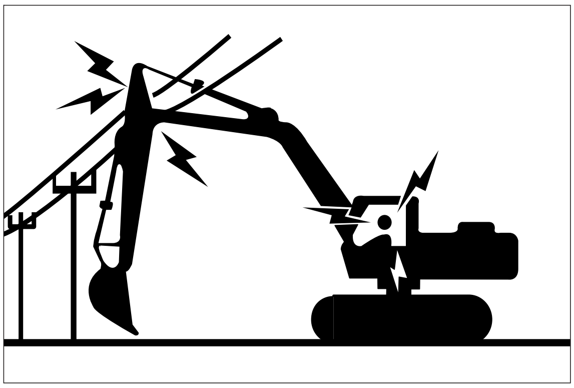
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

Serious injury or death can result from contact with electric lines.

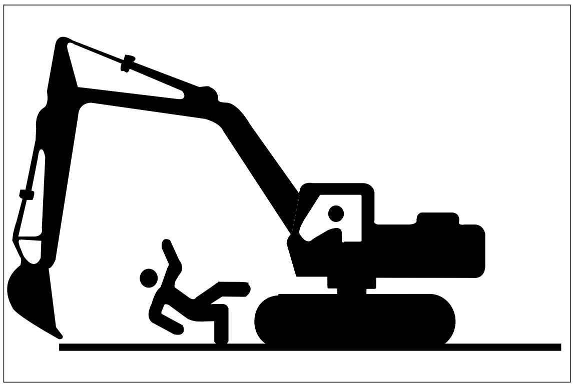
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

Only allow the operator on the excavator. Keep riders off.

Riders on excavator are subject to injury such as being struck by foreign objects and being thrown off the excavator. Riders also obstruct the operator's view resulting in the excavator being operated in an unsafe manner.

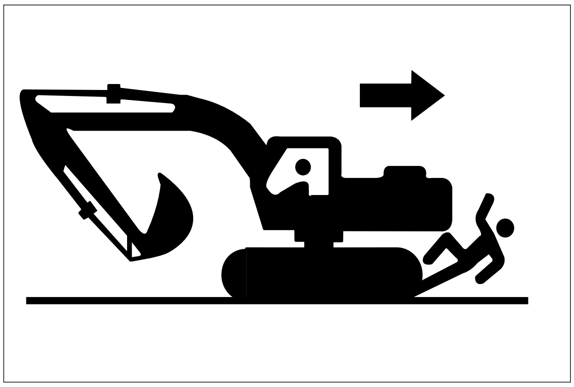


MOVE AND OPERATE MACHINE SAFELY

Bystanders can be run over. Know the location of bystanders before moving, swinging, or operating the machine.

Always keep the travel alarm in working condition. It warns people when the excavator starts to move.

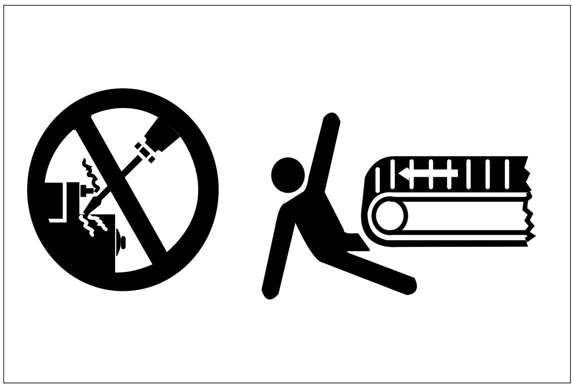
Use a signal person when moving, swinging, or operating the machine in congested areas. Coordinate hand signals before starting the excavator.



OPERATE ONLY FORM OPERATOR'S SEAT

Avoid possible injury machine damage. Do not start engine by shorting across starter terminals.

NEVER start engine while standing on ground. Start engine only from operator's seat.



PARK MACHINE SAFELY

Before working on the machine:

· Park machine on a level surface.
· Lower bucket to the ground.
· Turn auto idle switch off.
· Run engine at 1/2 speed without load for 2 minutes.
· Turn key switch to OFF to stop engine. Remove key from switch.
· Move pilot control shutoff lever to locked position.
· Allow engine to cool.

SUPPORT MACHINE PROPERLY

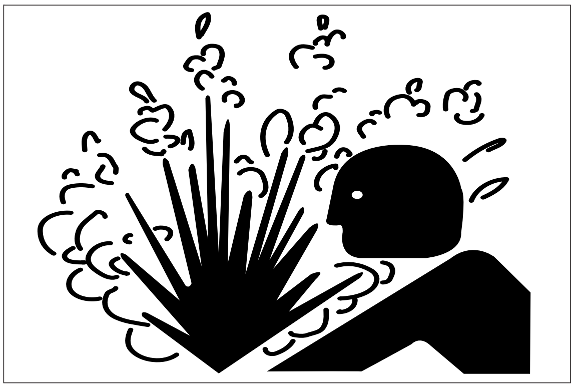
Always lower the attachment or implement to the ground before you work on the machine. If you must work on a lifted machine or attachment, securely support the machine or attachment.

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

SERVICE COOLING SYSTEM SAFELY

Explosive release of fluids from pressurized cooling system can cause serious burns.

Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



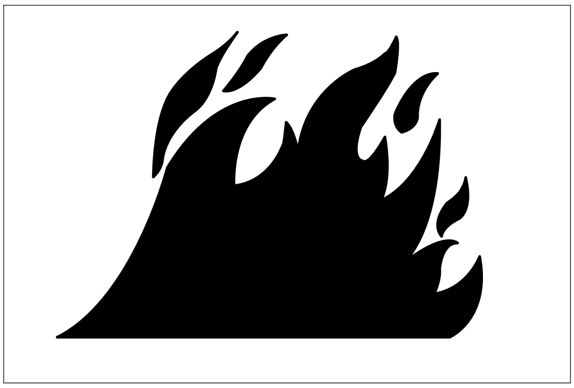
HANDLE FLUIDS SAFELY-AVOID FIRES

Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.

Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

Make sure machine is clean of trash, grease, and debris.

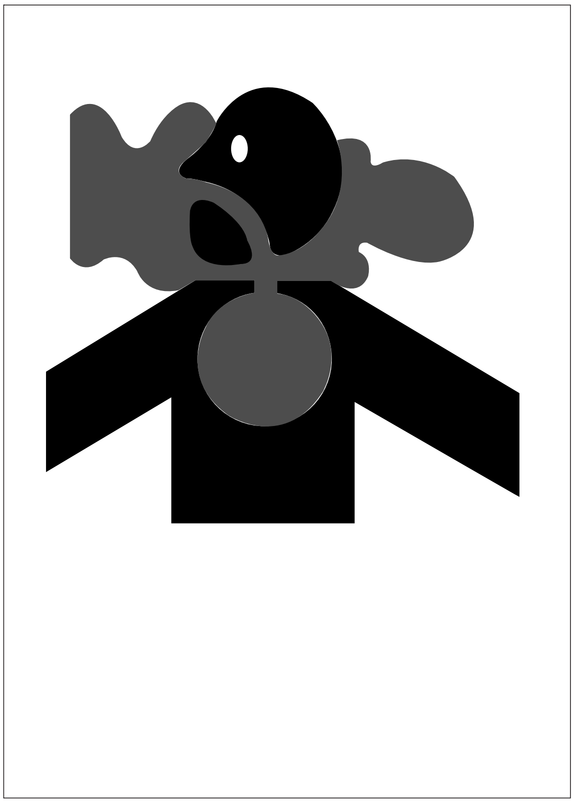
Do not store oily rags; They can ignite and burn spontaneously.



BEWARE OF EXHAUST FUMES

Prevent asphyxiation. Engine exhaust fumes can cause sickness or death.

If you must operate in a building, be positive there is adequate ventilation. Either use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring enough outside air into the area.



REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

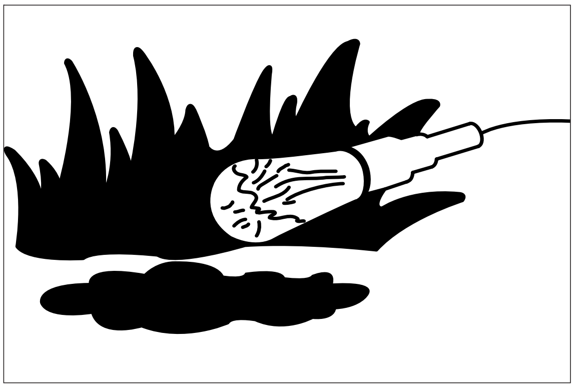
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

- If you sand or grind paint, avoid breathing the dust.
  Wear an approved respirator.
- If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

ILLUMINATE WORK AREA SAFELY

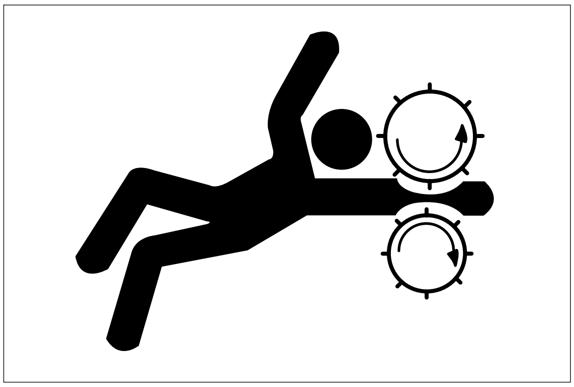
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.



SERVICE MACHINE SAFELY

Tie long hair behind your head. Do not wear a necktie, scarf, loose clothing or necklace when you work near machine tools or moving parts. If these items were to get caught, severe injury could result.

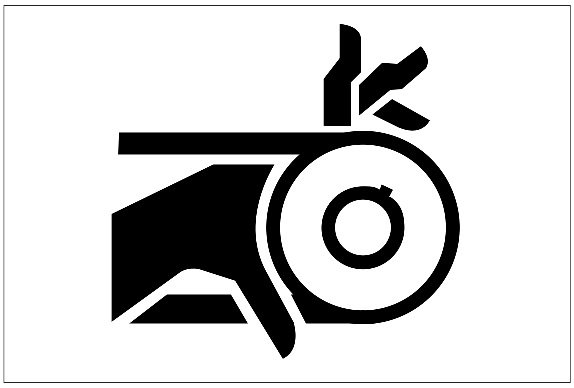
Remove rings and other jewelry to prevent electrical shorts and entanglement in moving parts.



STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

To prevent accidents, use care when working around rotating parts.



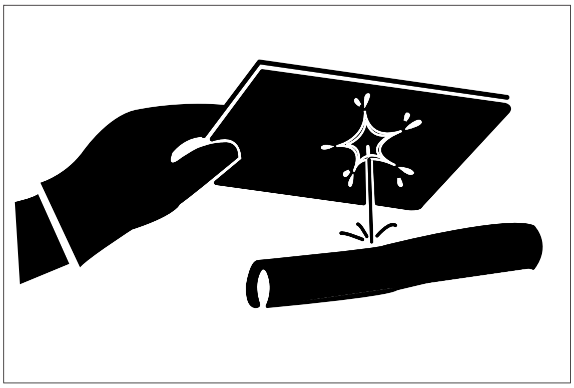
AVOID HIGH PRESSURE FLUIDS

Escaping fluid under pressure can penetrate the skin causing serious injury.

Avoid the hazard by relieving pressure before disconnecting hydraulic or other lines. Tighten all connections before applying pressure.

Search for leaks with a piece of cardboard. Protect hands and body from high pressure fluids.

If an accident occurs, see a doctor immediately. Any fluid injected into the skin must be surgically removed within a few hours or gangrene may result.



AVOID HEATING NEAR PRESSURIZED FLUID LINES

Flammable spray can be generated by heating near pressurized fluid lines, resulting in severe burns to yourself and bystanders. Do not heat by welding, soldering, or using a torch near pressurized fluid lines or other flammable materials.

Pressurized lines can be accidentally cut when heat goes beyond the immediate flame area. Install fire resisting guards to protect hoses or other materials.

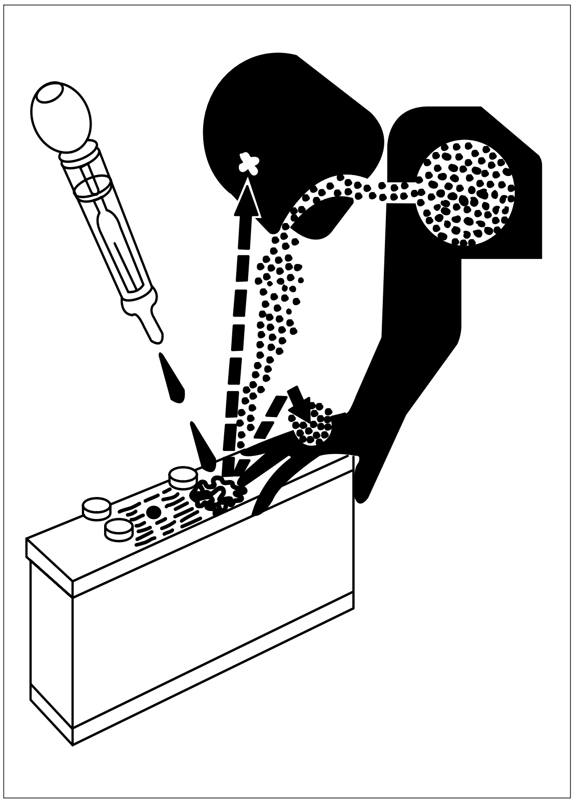
PREVENT BATTERY EXPLOSIONS

Keep sparks, lighted matches, and flame away from the top of battery. Battery gas can explode.

Never check battery charge by placing a metal object across the posts. Use a volt-meter or hydrometer.

Do not charge a frozen battery; It may explode. Warm battery to 16˚C (60˚F).

PREVENT ACID BURNS



Sulfuric acid in battery electrolyte is poisonous. It is strong enough to burn skin, eat holes in clothing, and cause blindness if splashed into eyes.

Avoid the hazard by:

1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

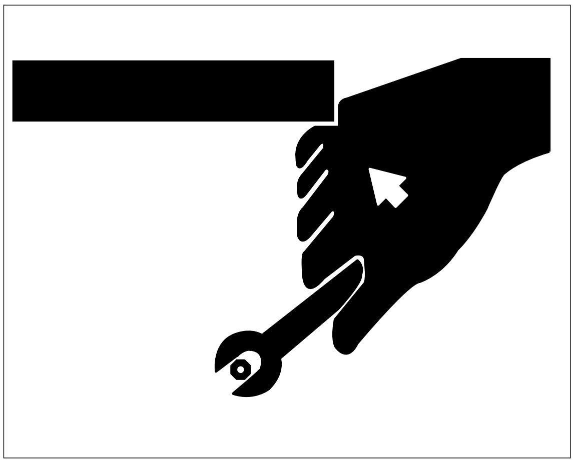
If you spill acid on yourself:

1. Flush your skin with water.
2. Apply baking soda or lime to help neutralize the acid.
3. Flush your eyes with water for 10-15 minutes. Get medical attention immediately.

If acid is swallowed:

1. Drink large amounts of water or milk.
2. Then drink milk of magnesia, beaten eggs, or vegetable oil.
3. Get medical attention immediately.

USE TOOLS PROPERLY



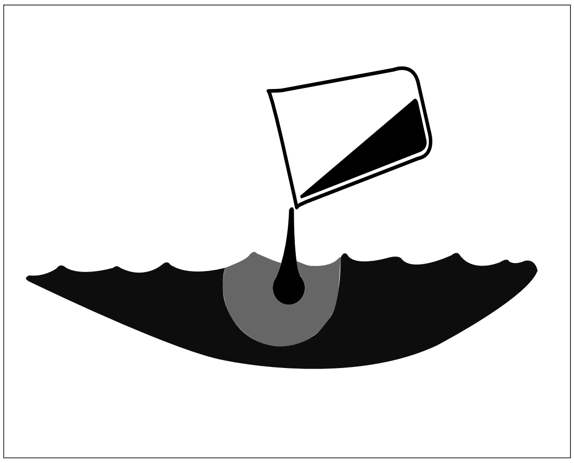
Use tools appropriate to the work. Makeshift tools, parts, and procedures can create safety hazards.

Use power tools only to loosen threaded tools and fasteners.

For loosening and tightening hardware, use the correct size tools. DO NOT use U.S. measurement tools on metric fasteners. Avoid bodily injury caused by slipping wrenches.

Use only recommended replacement parts. (See Parts catalogue.)

DISPOSE OF FLUIDS PROPERLY

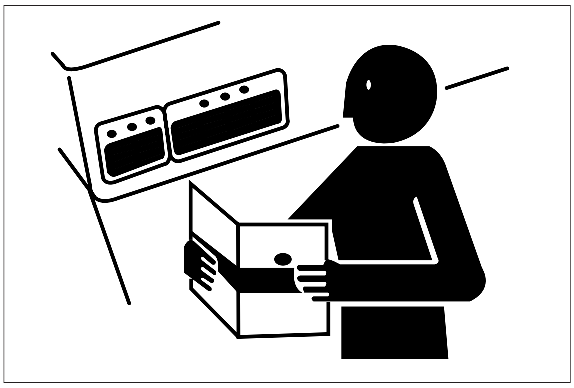


Improperly disposing of fluids can harm the environment and ecology. Before draining any fluids, find out the proper way to dispose of waste from your local environmental agency.

Use proper containers when draining fluids. Do not use food or beverage containers that may mislead someone into drinking from them.

DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.

REPLACE SAFETY SIGNS

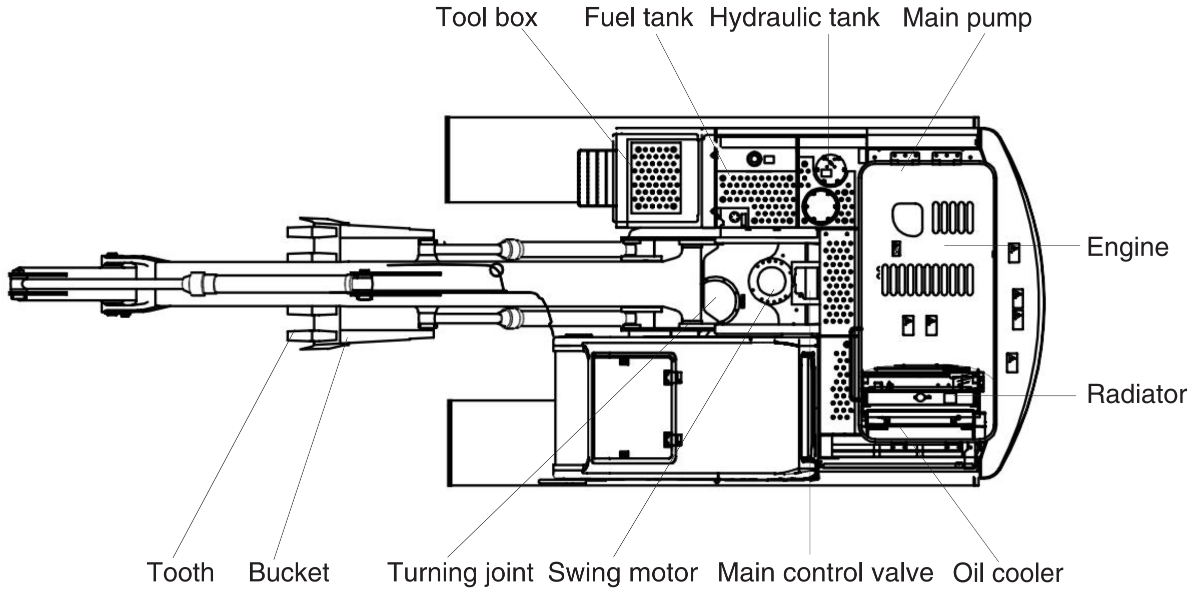


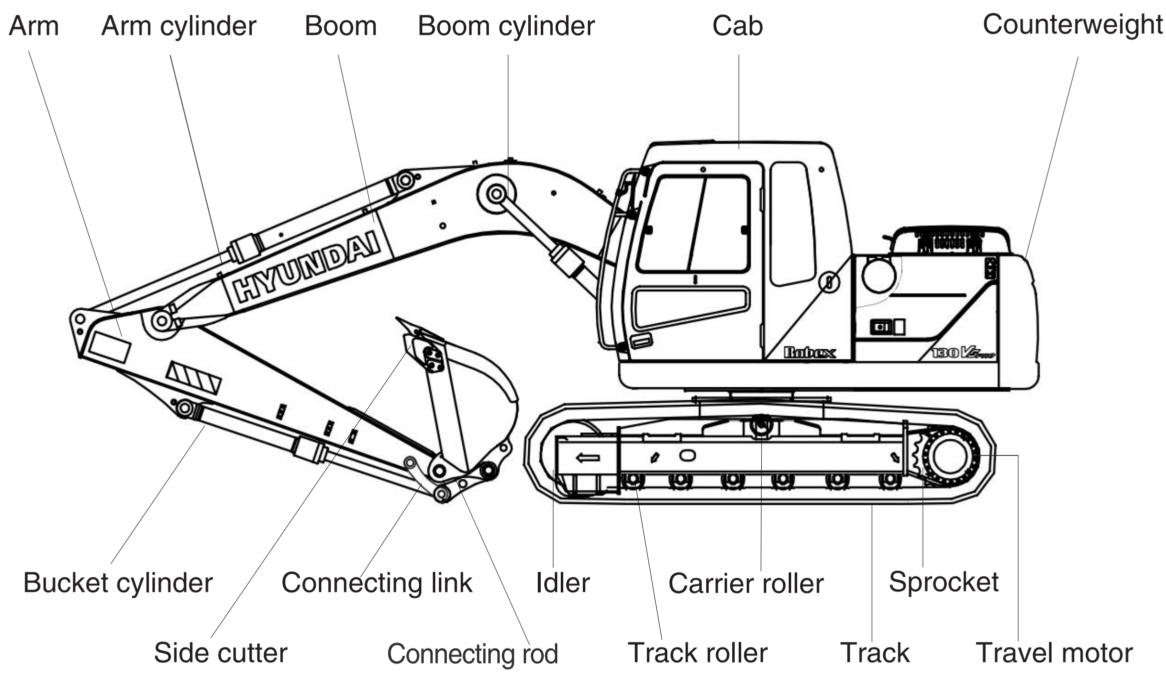
Replace missing or damaged safety signs. See the machine operator's manual for correct safety sign placement.

LIVE WITH SAFETY

Before returning machine to customer, make sure machine is functioning properly, especially the safety systems. Install all guards and shields.

GROUP 2 SPECIFICATIONS

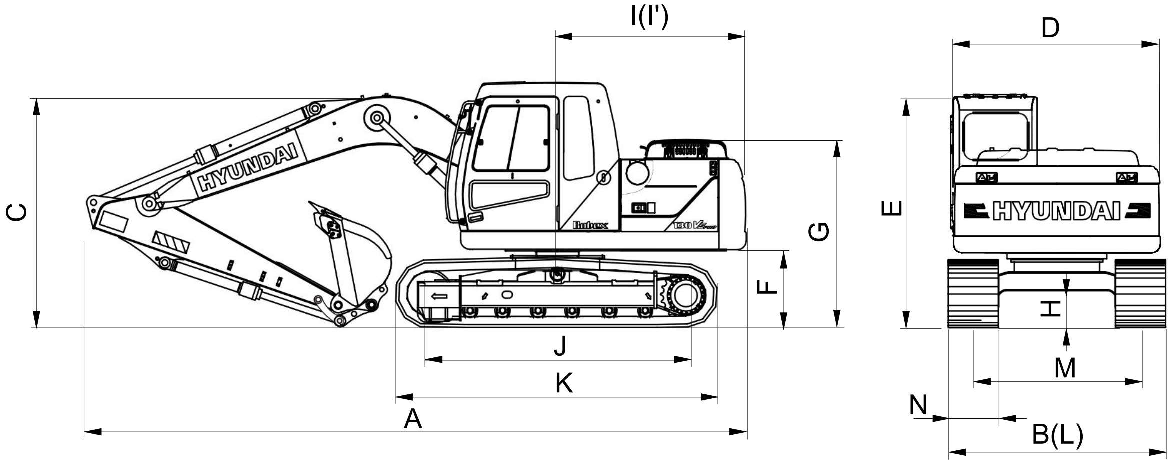




2. SPECIFICATIONS

1) R130VS PRO

· 4.60 m (15' 1") BOOM and 2.50 m (8' 2") ARM

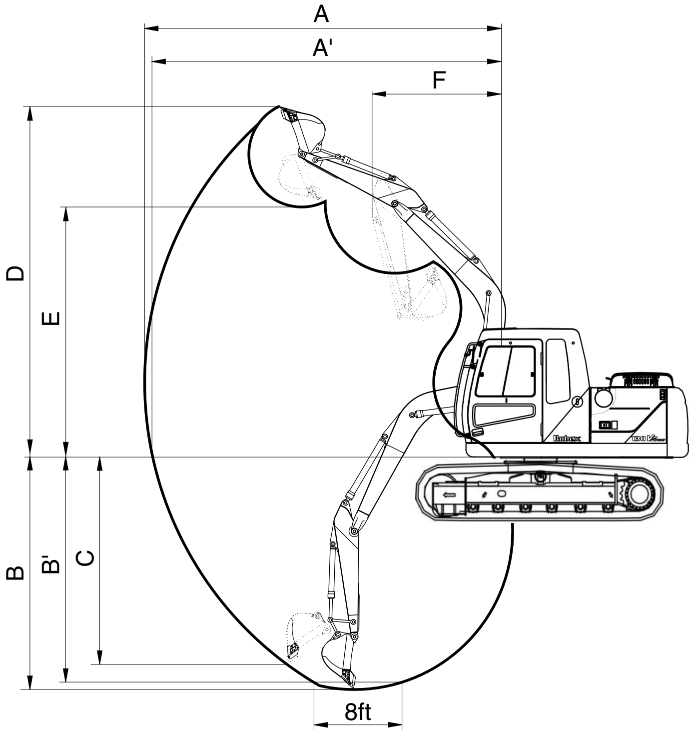


Description		Unit	Specification
Operating weight		kg	13400
Bucket capacity (SAE heaped)		m^3	0.52
Overall length	A	mm	7820
Overall width	B		2500
Overall height	C		2850
Superstructure width	D		2476
Overall height of cab	E		2860
Ground clearance of counterweight	F		935
Engine cover height	G		2215
Minimum ground clearance	H		440
Rear-end distance	I		2000
Rear-end swing radius	I'		2000
Distance between tumblers	J		2830
Undercarriage length	K		3580
Undercarriage width	L		2500
Track gauge	M		2000
Track shoe width, standard	N		500
Travel speed (low/high)		km/hr	3.2/5.5
Swing speed		rpm	12
Gradeability		Degree (%)	35 (70)
Ground pressure		kgf/cm^2	0.43
Max traction force		kg (lb)	13300

3. WORKING RANGE

1) R130VS PRO

· 4.60 m (15' 1") BOOM



Description		※2.50m Arm
Max digging reach	A	8330mm
Max digging reach on ground	A'	8180mm
Max digging depth	B	5550mm
Max digging depth (8 ft level)	B'	5340mm
Max vertical wall digging depth	C	5330mm
Max digging height	D	8500mm
Max dumping height	E	6060mm
Min swing radius	F	2650mm
Bucket digging force($0.52m^3$)	SAE	87.3 kN
Arm digging force	SAE	62.8 kN

※ : STD

4. WEIGHT

1) R130VS PRO

Item	R130VS PRO	
	kg	lb
Upperstructure assembly	5630	12420
Main frame weld assembly	1160	2560
Engine assembly	335	739
Main pump assembly	100	220
Main control valve assembly	140	310
Swing motor assembly	120	260
Hydraulic oil tank assembly	160	350
Fuel tank assembly	130	290
Counterweight	2000	4410
Cab assembly	500	1100
Lower chassis assembly	5340	11760
Track frame weld assembly	1590	3510
Swing bearing	190	410
Travel motor assembly	480	1060
Turning joint	50	110
Track recoil spring	210	460
Idler	250	550
Carrier roller	40	90
Track roller	490	1080
Track-chain assembly (500 mm standard triple grouser shoe)	1010	2230
Front attachment assembly (4.60 m boom, 2.50 m arm, 0.52 m^3 SAE heaped bucket)	2420	5330
4.60 m boom assembly	830	1830
2.50 m arm assembly	435	960
0.52 m^3 SAE heaped bucket	472	1041
Boom cylinder assembly	130	290
Arm cylinder assembly	160	350
Bucket cylinder assembly	100	220
Bucket control rod assembly	90	200

5. LIFTING CAPACITIES

1) R130VS PRO

(1) 4.60 m (15' 1") boom, 2.50 m (8' 2 ") arm equipped with 0.52 m³ (SAE heaped) bucket and 500 mm (24") triple grouser shoe and 2000 kg (4410 lb) counterweight.

- · : Rating over-front
- · : Rating over-side or 360 degree

Load point height		Load radius								At max. reach		
		1.5m (5.0ft)		3.0 m (10.0 ft)		4.5 m (15.0 ft)		6.0 m (20.0 ft)		Capacity		Reach
		Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	m(ft)
6.0m (20ft)	kg									*2810	1920	6.69
	lb									*6190	4230	(21.9)
4.5m (15.0ft)	kg							*2770	2270	2440	1500	7.53
	lb							*6110	5000	5380	3310	(24.7)
3.0m (10.0ft)	kg			*4930	*4930	*3830	3570	*3380	2190	2170	1310	7.95
	lb			*10870	*10870	*8440	7870	*7450	4830	4780	2890	(26.1)
1.5m (5.0ft)	kg			*8030	6240	*5010	3300	3380	2070	2100	1250	8.03
	lb			*17700	13760	*11050	7280	7450	4560	4630	2760	(26.3)
Ground Line	kg			*8780	5800	5200	3090	3270	1970	2180	1300	7.77
	lb			*19360	12790	11460	6810	7210	4340	4810	2870	(25.5)
-1.5m (-5.0ft)	kg	*5740	*5740	*9910	5700	5080	2990	3220	1920	2500	1500	7.15
	lb	*12650	*12650	*21850	12570	11200	6590	7100	4230	5510	3310	(23.5)
-3.0m (-10.0ft)	kg	*8760	*8760	*9040	5770	5100	3000			3340	2030	6.01
	lb	*19310	*19310	*19930	12720	11240	6610			7360	4480	(19.7)
-4.5m (-15.0ft)	kg			*6590	6030							
	lb			*14530	13290							

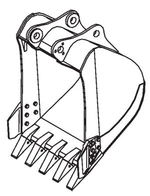
Note
1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook (standard equipment) located on the back of the bucket.
4. *indicates load limited by hydraulic capacity.

※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your Hyundai dealer regarding the lifting capacities for specific work tools and attachments.

⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET



※0.52m^{3}SAE heaped bucket

Type	Capacity		Width		Weight	Tooth	Recommendation
	SAE Heaped	CECE heaped	With side cutter	Without side cutter			4.60 m (15' 1") Boom
	m^3	m^3	mm	mm	kg	EA	
General bucket	0.52m^3	0.45 m^3	915mm	1015 mm	472kg	5	–

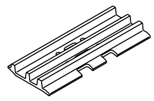
※ Applicable for materials with density of 1600 kg/m^3 (2700lb/yd^3) or less

7. UNDERCARRIAGE

1) TRACKS

X-leg type center frame is integrally welded with reinforced box-section track frames. The design includes dry tracks, lubricated rollers, idlers, sprockets, hydraulic track adjusters with shock absorbing springs and assembled track-type tractor shoes with triple grousers.

2) TYPES OF SHOES

Model	Shapes		Triple grouser
			
R130VS PRO	Shoe width	mm	500
	Operating weight	kg	13400
	Ground pressure	kgf/cm^2	0.43
	Overall width	mm	2500

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
	R130 VS PRO
Carrier rollers	1 EA
Track rollers	6 EA
Track shoes	44 EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes
Confirm the category from the list of applications in table 2, then use table 1 to select the shoe. Wide shoes(Categories B and C) have limitations on applications. Before using wide shoes, check the precautions, then investigate and study the operating conditions to confirm if these shoes are suitable.
Select the narrowest shoe possible to meet the required flotation and ground pressure. Application of wider shoes than recommendations will cause unexpected problem such as bending of shoes, crack of link, breakage of pin, loosening of shoe bolts and the other various problems.

※ Table 1

Track shoe	Specification	Category
500mm triple grouser	Option	A

※ Table 2

Category	Applications	Precautions
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins F3.8
Type	4-cycle turbocharged charger air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	4 cylinders, in-line
Firing order	1-3-4-2
Combustion chamber type	Direct injection type
Cylinder bore × stroke	102 ×115mm
Piston displacement	3760 c c
Compression ratio	17 : 1
Rated gross horse power (SAE J1995)	115Hp at 2200rpm (86kW at 2200 rpm)
Maximum torque	48kgf · m (3471lbf· ft) at 1100 -1700 rpm
Engine oil quantity	11ℓ (2.9 U.S. gal, CI - 4)
Dry weight	335kg (739lb)
High idling speed	2200 ± 50 rpm
Low idling speed	800 ± 50 rpm
Rated fuel consumption	185.9g/Hp · hr at 2200rpm
Starting motor	24V-4.8 KW
Alternator	28V-70 A
Battery	2 ×12V× 72 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 72.9 cc/rev
Maximum pressure	350 kgf/cm^2 [380 kgf/cm^2]
Rated oil flow	2 × 124 ℓ /min
Rated speed	1700rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm²
Rated oil flow	25.5 ℓ/min

4) MAIN CONTROL VALVE

Item	Specification
Type	11 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm² [380 kgf/cm²]
Overload relief valve pressure	400 kgf/cm²

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Axial piston motor
Capacity	72 cc/rev
Relief pressure	280 kgf/cm²
Braking system	Automatic, spring applied hydraulic released
Braking torque	640 kgf · m
Brake release pressure	24 kgf/cm²
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Axial piston motor
Relief pressure	400 kgf/cm²
Capacity (max / min)	77.1/ 45 cc/rev
Reduction gear type	Planetary differential
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	9.5 kgf/cm²
Braking torque	29.5 kgf · m

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 105 × ø 75 × 1075 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 115 × ø 80 × 1138 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 100 × ø 70 × 850 mm
	Cushion	Extend only

※ Discoloration of cylinder rod can occur when the friction reduction additive of lubrication oil spreads on the rod surface.

※ Discoloration does not cause any harmful effect on the cylinder performance.

8) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R130VSPRO	Standard	500 mm (20")	0.43 kgf/cm^2 (6.11 psi)	44	2500 mm (8' 2")

9) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
R130VSPRO	Standard	0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	5	915 mm (36.0")	1015 mm(40.0")

9. RECOMMENDED OILS

Use only oils listed below. Do not mix different brand oil.
Please use HYUNDAI genuine oil and grease.

Service point	Kind of fluid	Capacity ℓ	Ambient temperature °C(°F) -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	11	★ SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	3.5	★ SAE 80W-90 SAE 85W-140
Final drive	Gear oil	2.2×2	★ SAE 80W-90 SAE 85W-140
Hydraulic tank	Hydraulic oil	Tank 124 System 210	★ ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	270	★ ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★ NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★1	15.5	Ethylene glycol base permanent type (50 : 50) ★ Ethylene glycol base permanent type (60 :40)

SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material

★ : Cold region
Russia, CIS, Mongolia

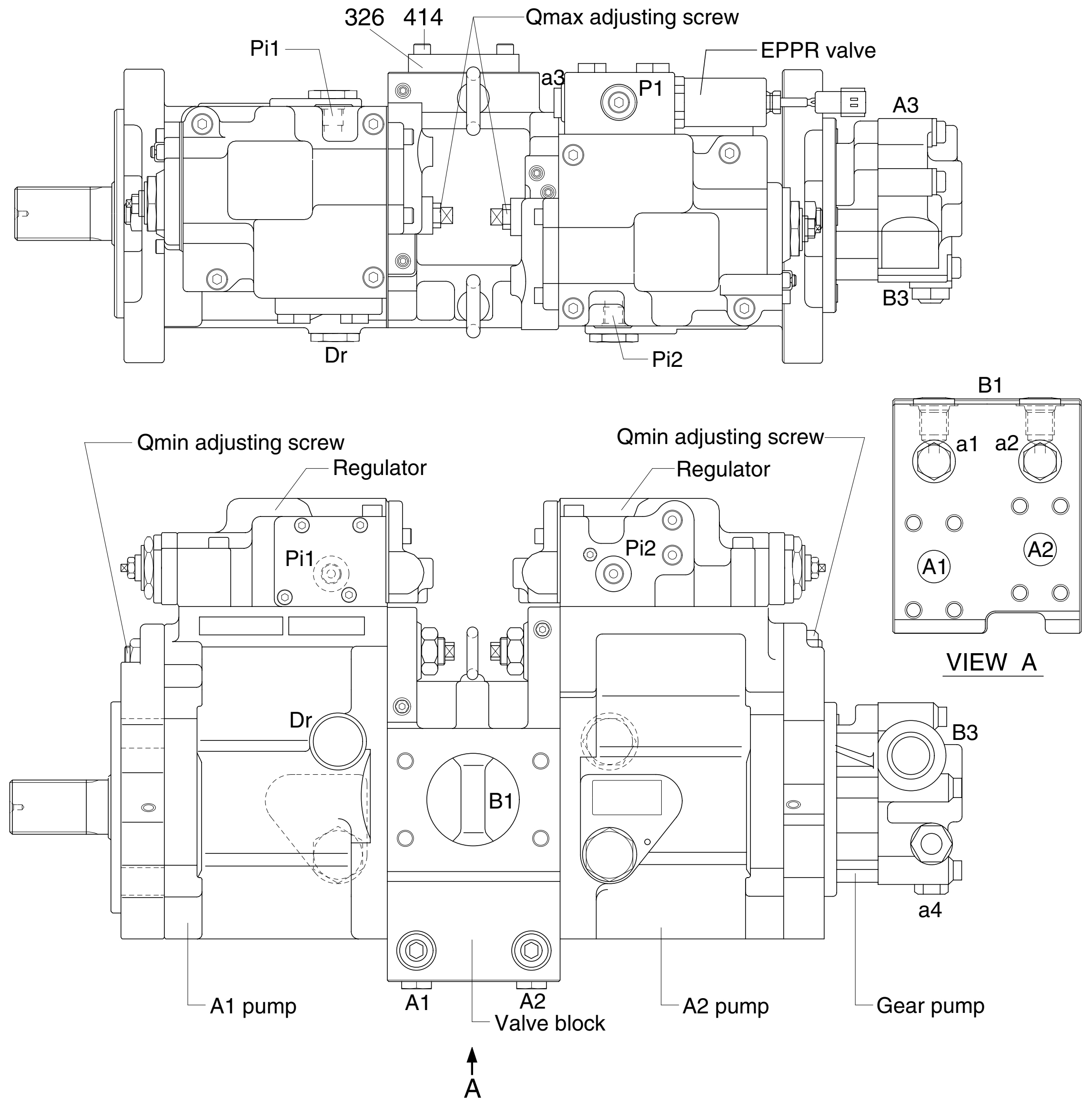
★1 : Soft water
City water or distilled water

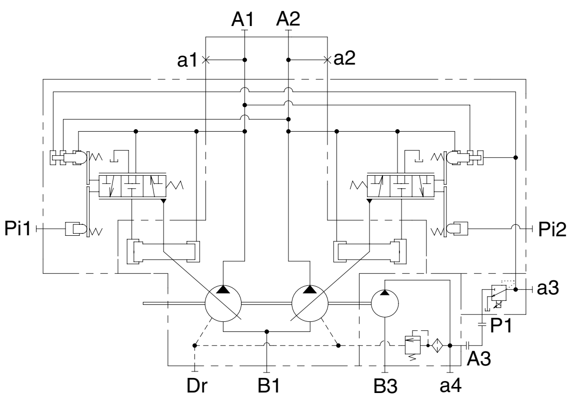
SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

The pump device consists of main pump, regulator and gear pump.

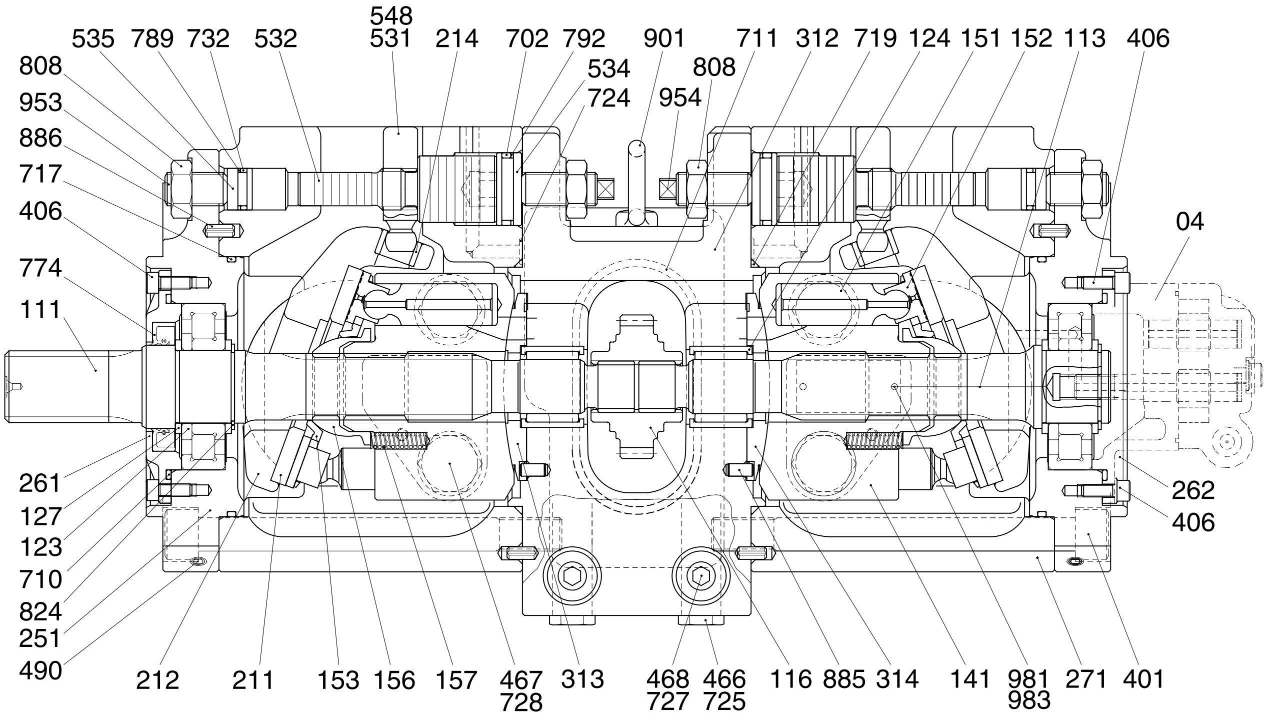




Port	Port name	Port size
A1, A2	Delivery port	SAE6000 psi 3/4"
B1	Suction port	SAE2500 psi 2 1/2"
Dr	Drain port	PF 1/2 - 19
Pi1, Pi2	Pilot port	PF 1/4 - 15
P1	EPPR port	PF 1/4 - 15
a1, a2, a3	Gauge port	PF 1/4 - 15
a4	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

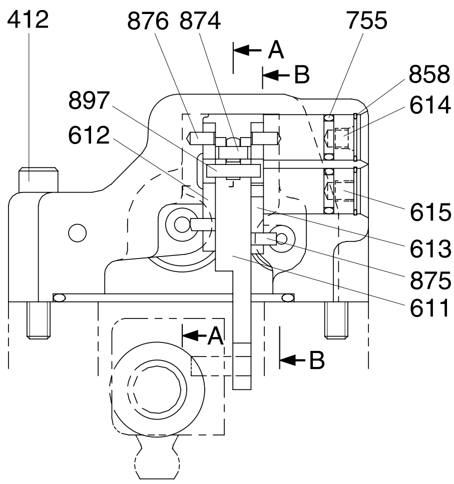
1) **MAIN PUMP** (1/2)

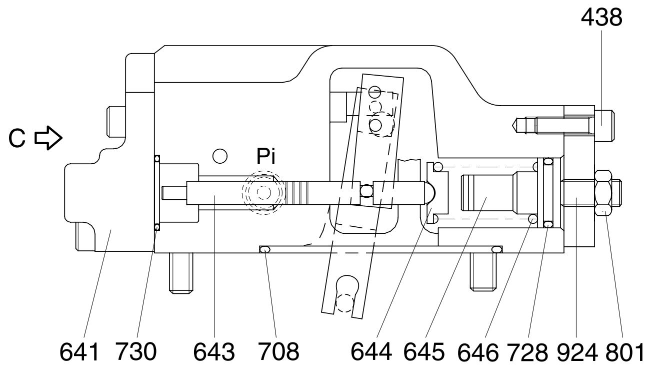
The main pump consists of two piston pumps (front & rear) and valve block.



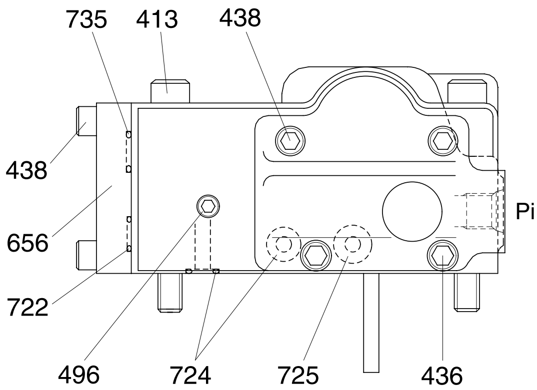
04	Gear pump	312	Valve block	717	O-ring
111	Drive shaft (F)	313	Valve plate (R)	719	O-ring
113	Drive shaft (R)	314	Valve plate (L)	724	O-ring
116	1st Gear	326	Cover	725	O-ring
123	Roller bearing	401	Hexagon socket bolt	727	O-ring
124	Needle bearing	406	Hexagon socket bolt	728	O-ring
127	Bearing spacer	414	Hexagon socket bolt	732	O-ring
141	Cylinder block	466	Plug	774	Oil seal
151	Piston	467	plug	789	Back up ring
152	Shoe	468	Plug	792	Back up ring
153	Set plate	490	Plug	808	Hexagon head nut
156	Bushing	531	Tilting pin	824	Snap ring
157	Cylinder spring	532	Servo piston	885	Pin
211	Shoe plate	534	Stopper (L)	886	Spring pin
212	Swash plate	535	Stopper (S)	901	Eye bolt
214	Bushing	548	Pin	953	Set screw
251	Support	702	O-ring	954	Set screw
261	Seal cover (F)	710	O-ring	981	Plate
271	Pump casing	711	O-ring	983	Pin

2) REGULATOR (1/2)

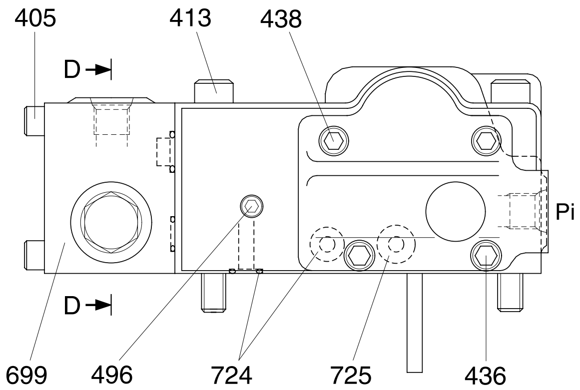




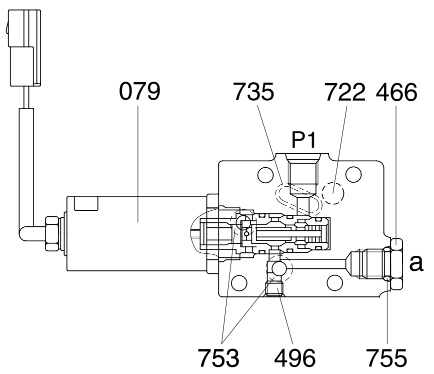
SECTION B-B



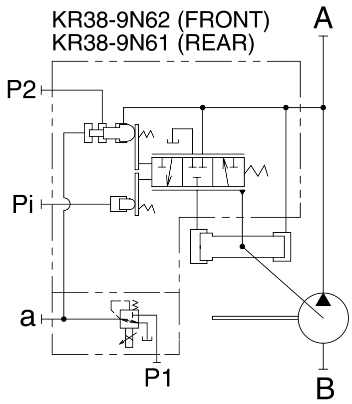
VIEW C (FRONT)



VIEW C (REAR)

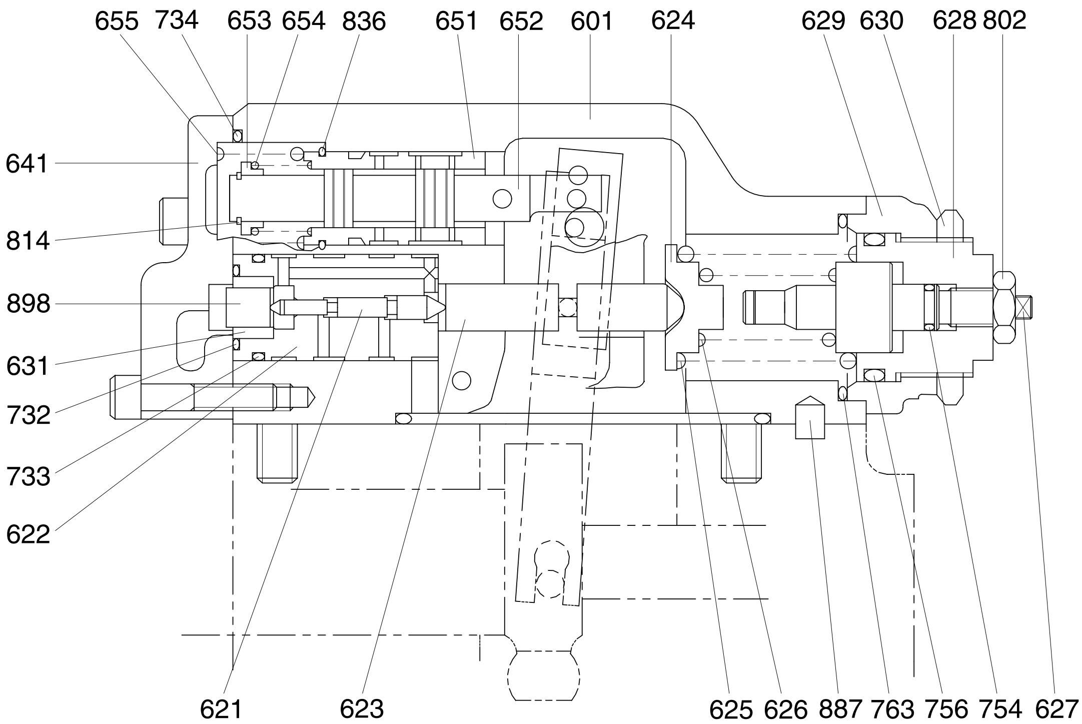


SECTION D-D(REAR)



Port	Port name	Port size
A	Delivery port	SAE6000 psi 3/4"
B	Suction port	SAE2500 psi 2 1/2"
Pi	Pilot port	PF 1/4-15

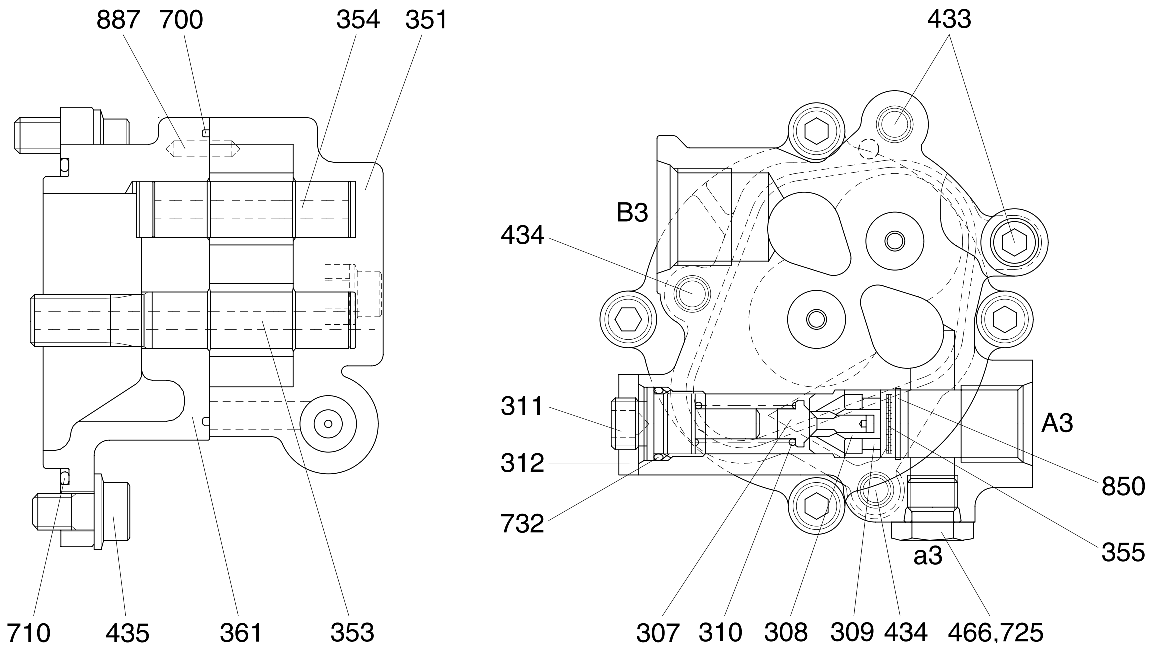
REGULATOR (2/2)



SECTION A-A

079	EPPR valve assembly	629	Cover (C)	733	O-ring
405	Hexagon socket screw	630	Lock nut	734	O-ring
412	Hexagon socket screw	631	Sleeve, Pf	735	O-ring
413	Hexagon socket screw	641	Pilot cover	753	O-ring
436	Hexagon socket screw	643	Pilot piston	754	O-ring
438	Hexagon socket screw	644	Spring seat (Q)	755	O-ring
466	Plug	645	Adjust stem (Q)	756	O-ring
496	Plug	646	Pilot spring	763	O-ring
601	Casing	651	Sleeve	801	Nut
611	Feed back lever	652	Spool	802	Nut
612	Lever (1)	653	Spring seat	814	Snap ring
613	Lever (2)	654	Return spring	836	Snap ring
614	Center plug	655	Set spring	858	Snap ring
615	Adjust plug	656	Block cover	874	Pin
621	Compensator piston	699	Valve casing	875	Pin
622	Piston case	708	O-ring	876	Pin
623	Compensator rod	722	O-ring	887	Pin
624	Spring seat (C)	724	O-ring	897	Pin
625	Outer spring	725	O-ring	898	Pin
626	Inner spring	728	O-ring	924	Set screw
627	Adjust stem (C)	730	O-ring		
628	Adjust screw (C)	732	O-ring		

3) GEAR PUMP



307	Poppet	353	Drive gear	466	Plug
308	Seat	354	Driven gear	700	Ring
309	Ring	355	Filter	710	O-ring
310	Spring	361	Front case	725	O-ring
311	Screw	433	Flange socket	732	O-ring
312	Nut	434	Flange socket	850	Snap ring
351	Gear case	435	Flange socket	887	Pin

2. FUNCTION

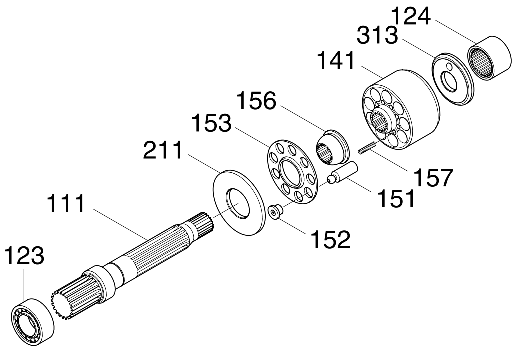
1) MAIN PUMP

The pumps may classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

(1) Rotary group

The rotary group consists of drive shaft (F) (111), cylinder block (141), piston shoes (151,152), set plate (153), spherical bushing (156) and cylinder spring (157). The drive shaft is supported by bearing (123,124) at its both ends.

The shoe is caulked to the piston to from a spherical coupling. It has a pocket to relieve thrust force generated by loading pressure and the take hydraulic balance so that it slides lightly over the shoe plate (211). The sub group composed by a piston and a shoe is pressed against the shoe plate by the action of the cylinder spring via a retainer and a spherical bush. Similarly, the cylinder block is pressed against valve plate (313) by the action of the cylinder spring.

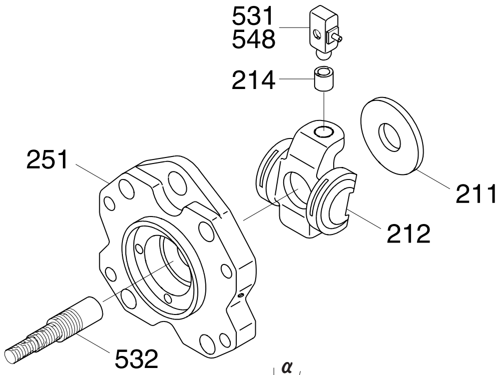


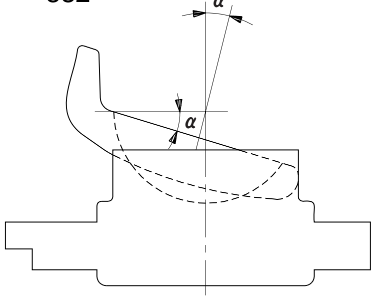
(2) Swash plate group

The swash plate group consists of swash plate (212), shoe plate (211), swash plate support (251), tilting bush (214), tilting pin (531) and servo piston (532).

The swash plate is a cylindrical part formed on the opposite side of the sliding surface of the shoe and is supported by the swash support.

If the servo piston moves to the right and left as hydraulic force controlled by the regulator is admitted to hydraulic chamber located on both sides of the servo piston, the swash plate slides over the swash plate support via the spherical part of the tilting pin to change the tilting angle (α)





(3) Valve block group

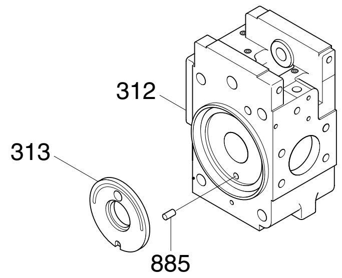
The valve block group consists of valve block (312), valve plate (313) and valve plate pin(885).

The valve plate having two melon-shaped ports is fixed to the valve block and feeds and collects oil to and from the cylinder block.

The oil changed over by the valve plate is connected to an external pipeline by way of the valve block.

Now, if the drive shaft is driven by a prime mover (electric motor, engine, etc), it rotates the cylinder block via a spline linkage at the same time. If the swash plate is tilted as in Fig (previous page) the pistons arranged in the cylinder block make a reciprocating motion with respect to the cylinder block, while they revolve with the cylinder block.

If you pay attention to a single piston, it performs a motion away from the valve plate (oil sucking process) within 180 degrees, and makes a motion towards the valve plate (or oil discharging process) in the rest of 180 degrees. When the swash plate has a tilting angle of zero, the piston makes no stroke and discharges no oil.



2) REGULATOR

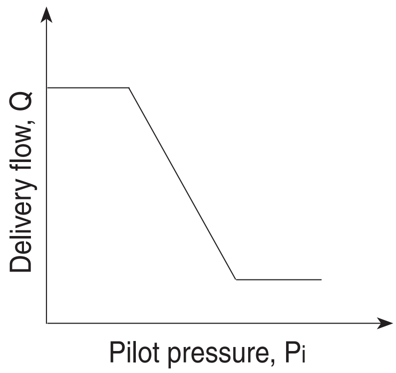
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

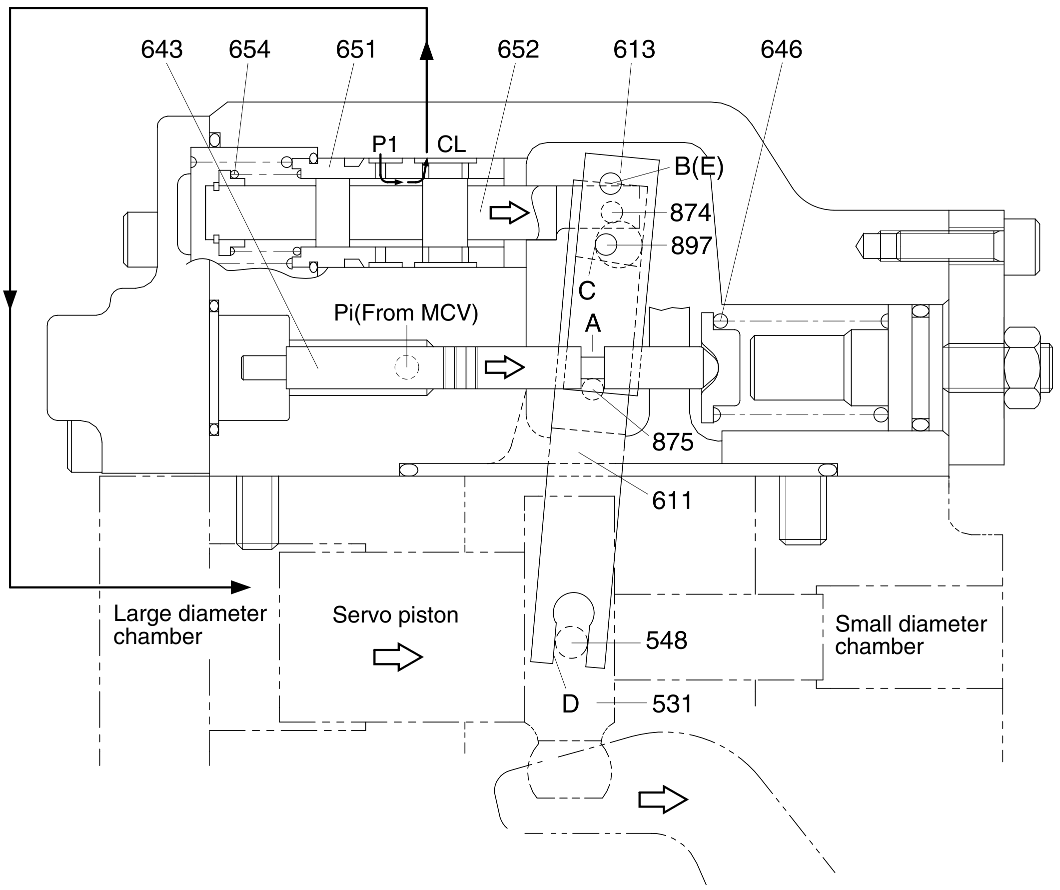
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

This regulator is of the negative flow control in which the delivery flow Q decreases as the pilot pressure Pi rises.

With this mechanism, when the pilot pressure corresponding to the flow required for the work is commanded, the pump discharges the required flow only, and so it does not consume the power uselessly.

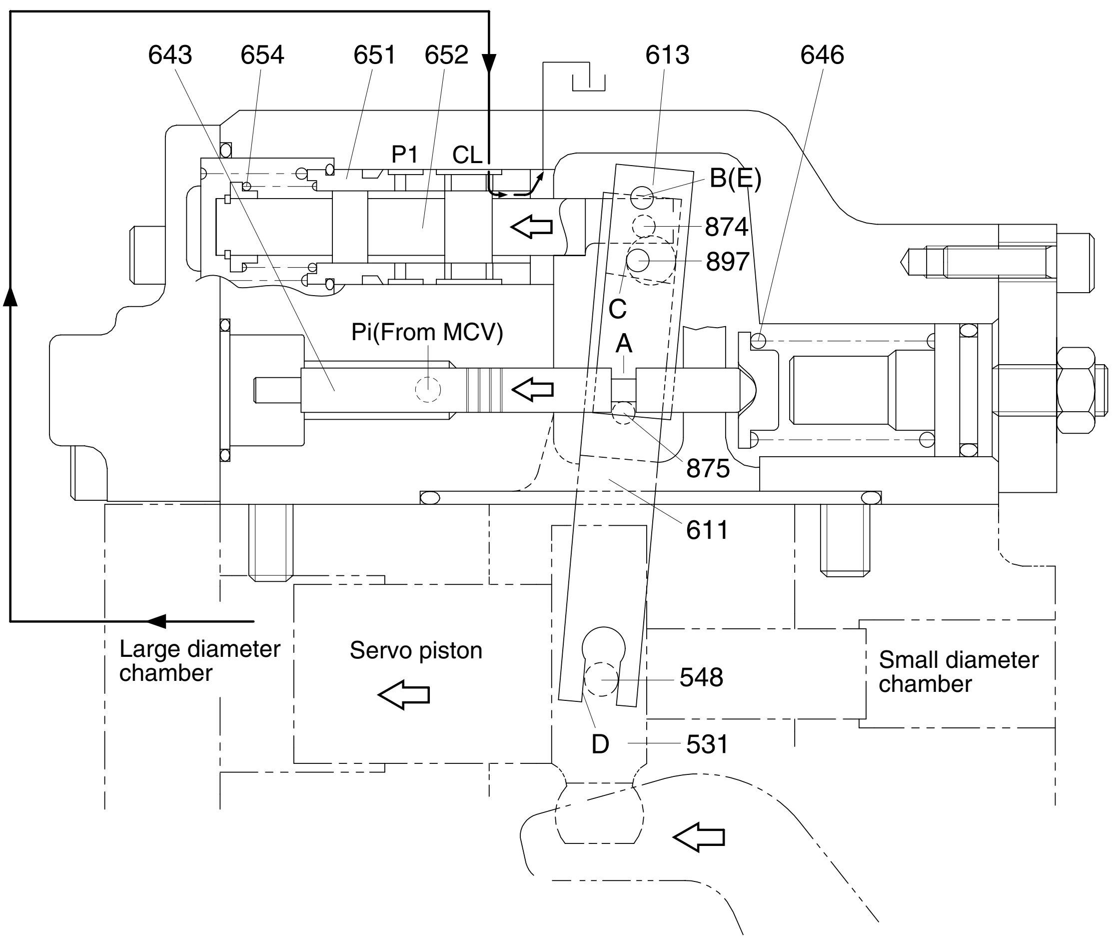


① Flow reducing function



As the pilot pressure Pi rises, the pilot piston (643) moves to the right to a position where the force of the pilot spring (646) balances with the hydraulic force.
The groove (A) in the pilot piston is fitted with the pin (875) that is fixed to lever 2 (613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [fixed by the fulcrum plug (614) and pin (875)]. Since the large hole section (C) of lever 2 contains a protruding pin (897) fixed to the feedback lever (611), the pin (897) moves to the right as lever 2 rotates. Since the opposing-flat section (D) of the feedback lever is fitted with the pin (548) fixed by the tilting pin (531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin (897) moves.
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.
The movement of the spool causes the delivery pressure P1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.
When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring (654) and is tensioned to the left at all times, and so the pin (897) is pressed against the large hole section (C) of lever 2.
Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve (651) and spool (652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

② Flow increasing function



As the pilot pressure Pi decreases, the pilot piston (643) moves to the left by the action of the pilot spring (646) and causes lever 2 (613) to rotate around the fulcrum of point B. Since the pin (897) is pressed against the large hole section (C) of lever 2 by the action of the return spring (654) via the spool (652), pin (874), and feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 2 rotates, and shifts the spool to the left. Port CL opens a way to the tank port as the spool moves. This deprives the large diameter section of the servo piston of pressure, and shifts the servo piston to the left by the discharge pressure P1 in the small diameter section, resulting in an increase in the flow rate.

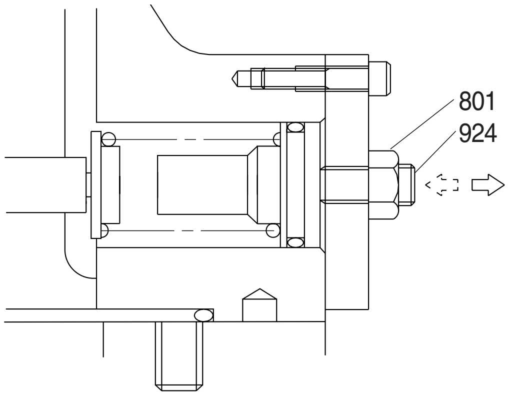
As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

③ Adjustment of flow control characteristic

The flow control characteristic can be adjusted with the adjusting screw.

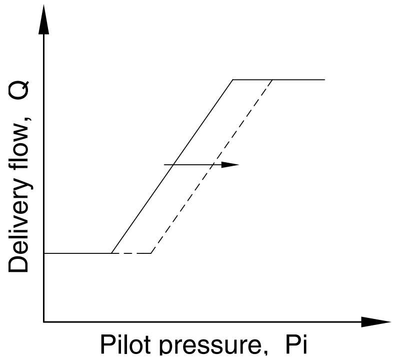
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

Tightening the screw shifts the control chart to the right as shown in the figure.



※ Adjusting value

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min -1)	(Turn)	(kgf/cm2)	(l/min)
1900	+1/4	+1.6	+9

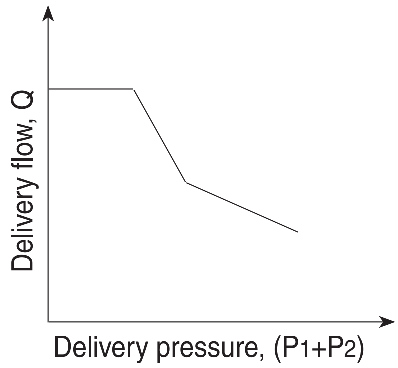


(2) Total horsepower control

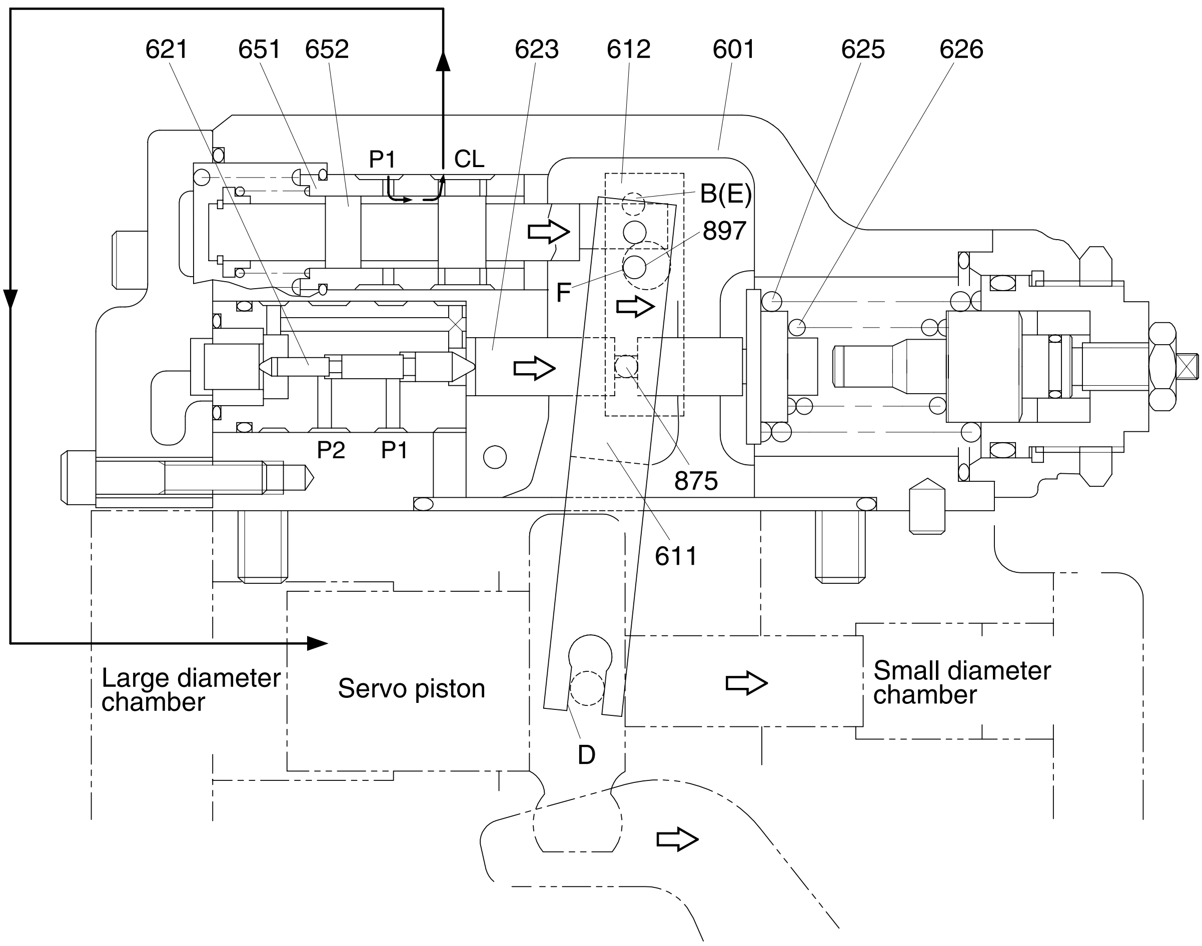
The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.
(The input horsepower is constant when the speed is constant.)
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control is under way.
Since this regulator is of the simultaneous total horsepower type, it controls the tilting angles (displacement volumes) of the two pumps to the same value as represented by the following equation :

$T_{in} = P1 \times q/2\pi + P2 \times q/2\pi$
$= (P1+P2) \times q/2\pi$

The horsepower control function is the same as the flow control function and is summarized in the following. (For detailed behaviors of respective parts, refer to the section of flow control).



① Overload preventive function

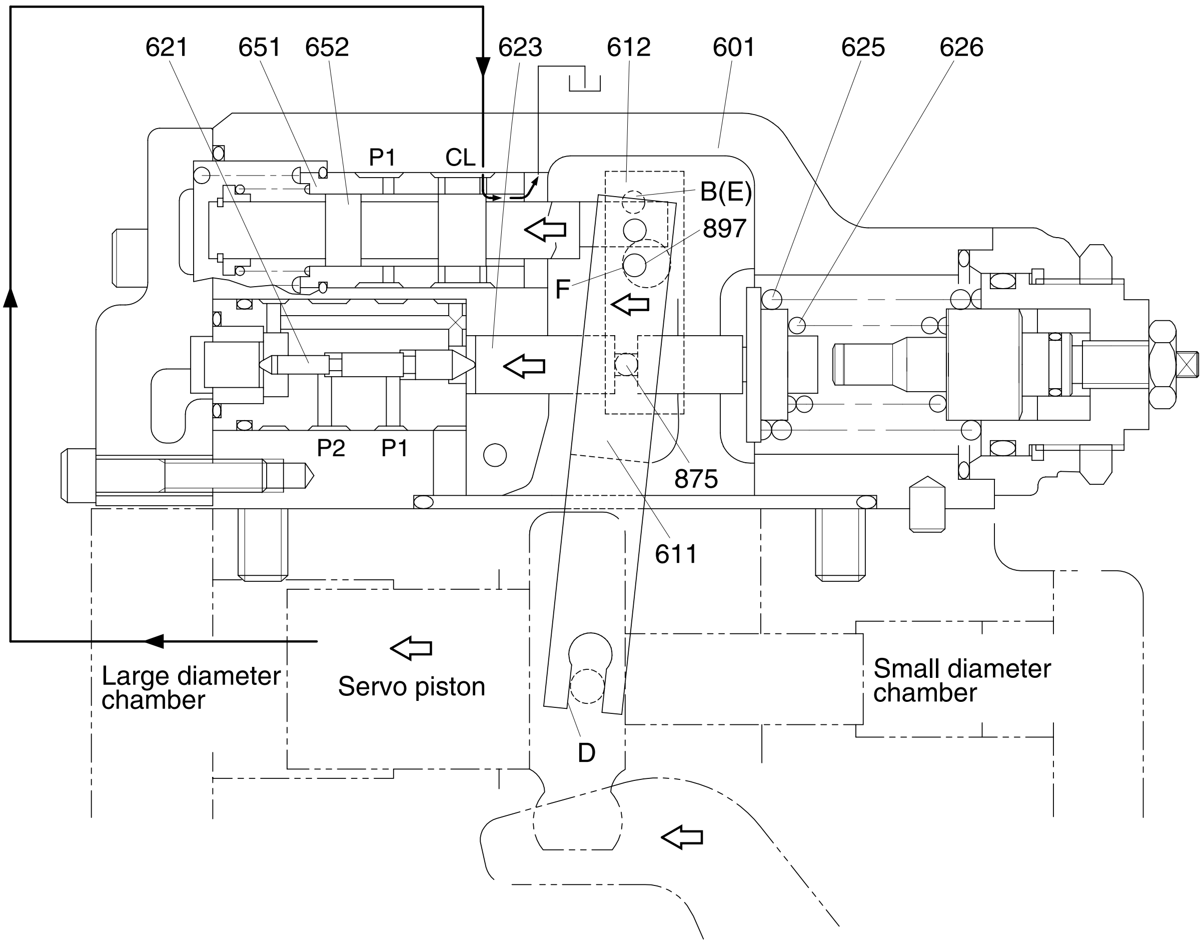


When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force. The movement of the compensating rod is transmitted to lever 1 (612) via pin (875).

Lever 1 rotates around the pin (875) (E) fixed to the casing (601).

Since the large hole section (F) of lever 1 contains a protruding pin (897) fixed to the feedback lever (611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool (652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery, flow rate, and prevents the prime mover from being overloaded. The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool (652) and sleeve (651) is closed.

② Flow reset function



As the self pump delivery pressure P1 or the companion pump delivery pressure P2 decreases, the compensating rod (623) is pushed back by the action of the springs (625 & 626) to rotate lever 1 (612) around point E. Rotating of lever 1 causes the feedback lever (611) to rotate around the fulcrum of point D and then the spool (652) to move to the left. As a result, port CL opens a way to the tank port.

This causes the servo piston to move to the left and the pump's delivery rate to increase.

The movement of the servo piston is transmitted to the spool by the action of the feedback mechanism to move it till the opening between the spool and sleeve is closed.

③ **Low tilting angle (low flow) command preferential function**

As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (ø4) protruding from the large hole (ø8), only the lever lessening the tilting angle contacts the pin (897) ; the hole (ø8) in the lever of a larger tilting angle command is freed without contacting the pin (897). Such a mechanical selection method permits preference of the lower tilting angle command of the flow control and horsepower control.

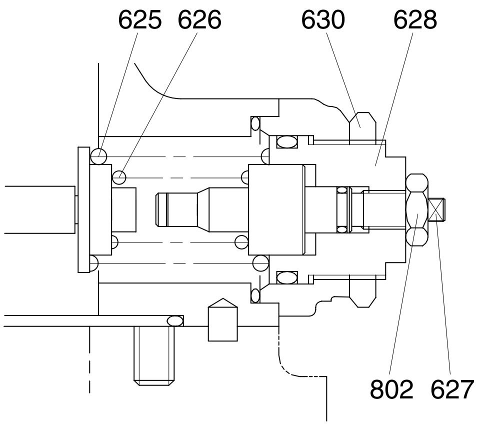
④ **Adjustment of input horsepower**

Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one pump is loaded.

a. **Adjustment of outer spring**

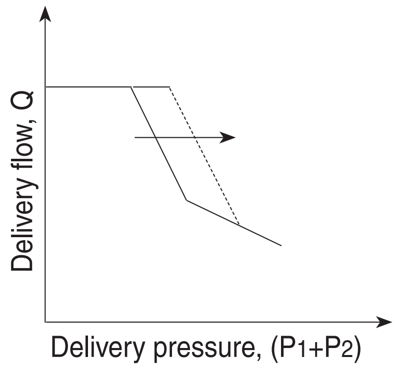
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628).

Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C (628) by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N×A turns at first. (A=1.73)



※ **Adjusting value**

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting screw (C) (628)	Compensa-ting control starting pressure change amount	Input torque change amount
(min⁻¹)	(Turn)	(kgf/cm²)	(kgf · m)
1900	+1/4	+19.2	+3.4



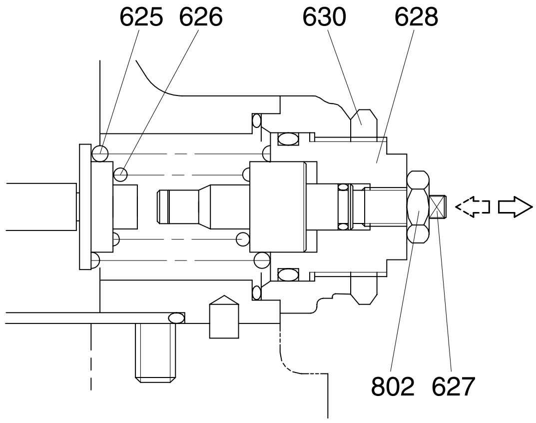
b. Adjustment of inner spring

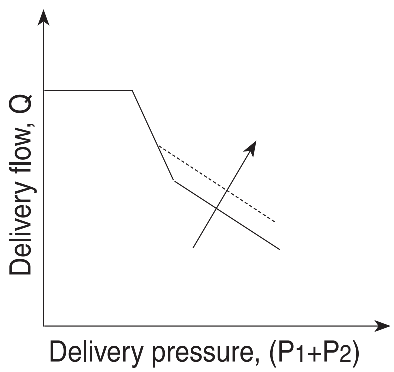
Adjust it by loosening the hexagon nut (802) and by tightening (or loosening) the adjusting stem C (627).

Tightening the screw increases the flow and then the input horsepower as shown in the figure.

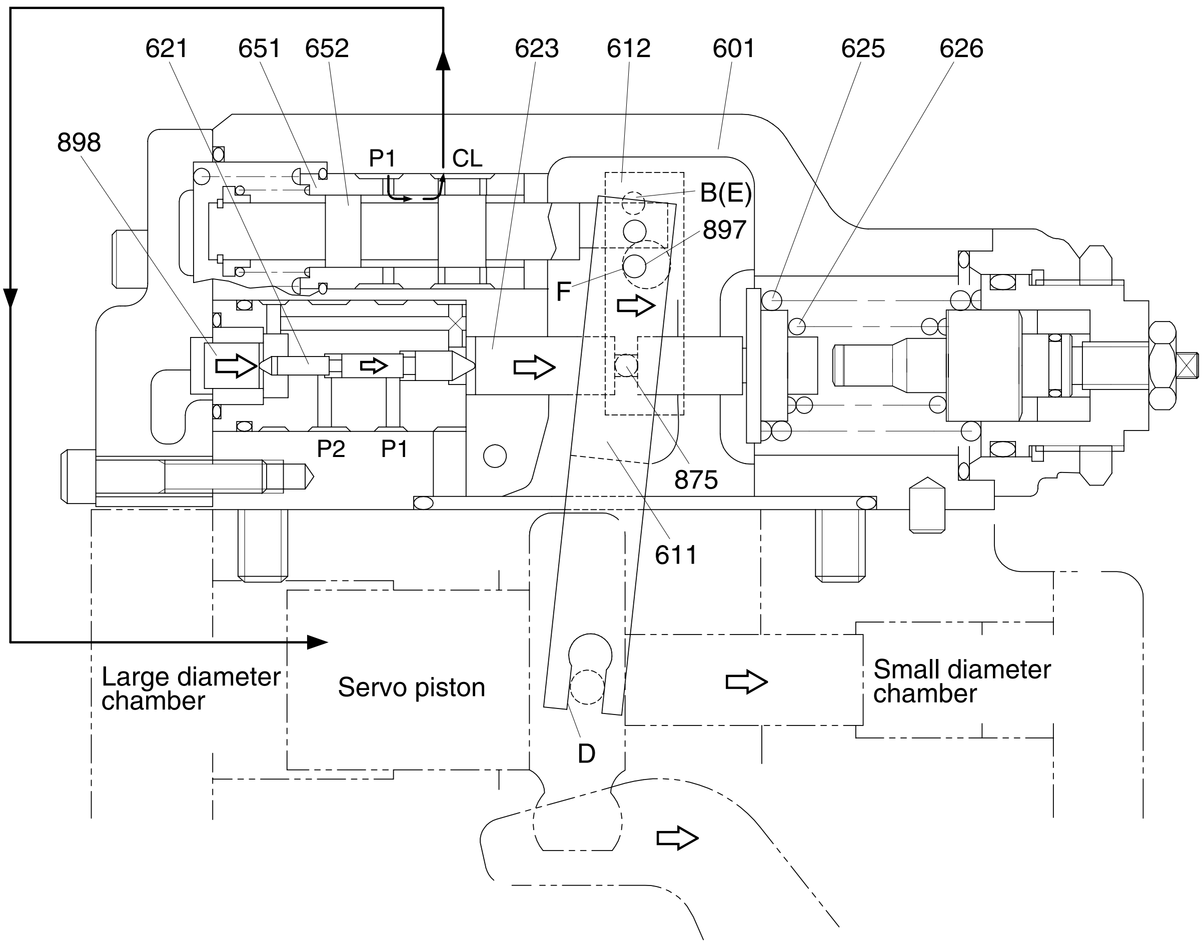
※ Adjusting value

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(l/min)	(kgf · m)
1900	+1/4	+8.6	+4.3





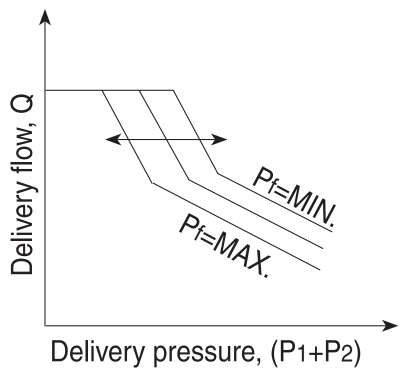
(3) Power shift control



The set horsepower valve is shifted by varying the command current level of the proportional pressure reducing valve attached to the pump.

Only one proportional pressure reducing valve is provided.

However, the secondary pressure Pf (power shift pressure) is admitted to the horsepower control section of each pump regulator through the pump's internal path to shift it to the same set horsepower level.



This function permits arbitrary setting of the pump output power, thereby providing the optimum power level according to the operating condition.

The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

As the power shift pressure Pf rises, the compensating rod (623) moves to the right via the pin (898) and compensating piston (621).

This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

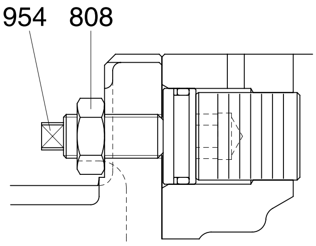
(4) Adjustment of maximum and minimum flows

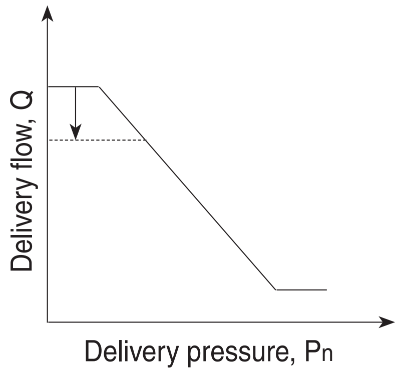
① Adjustment of maximum flow

Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

The maximum flow only is adjusted without changing other control characteristics.

Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(l/min)
1900	+1/4	-3.0



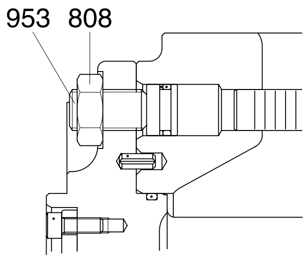


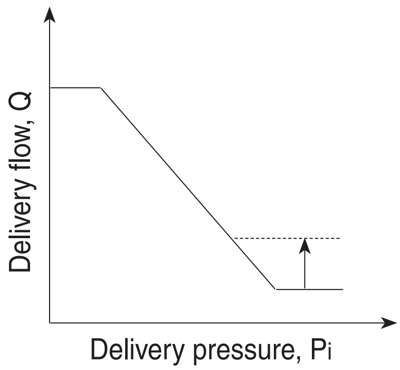
② Adjustment of minimum flow

Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

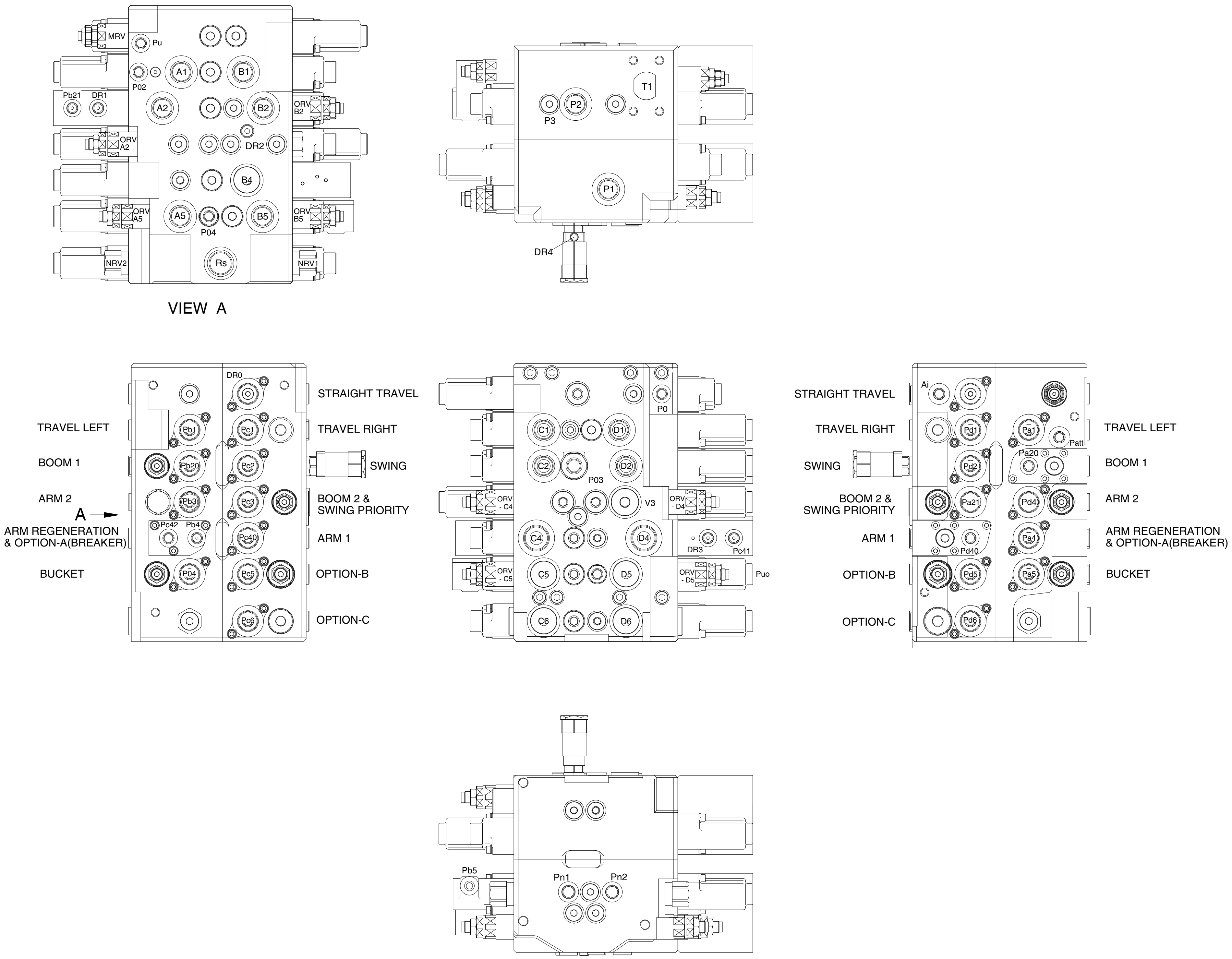
However, remember that, if tightened too much, the required horsepower during the maximum delivery pressure (or during relieving) may increase.

Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(l/min)
1900	+1/4	+3.0



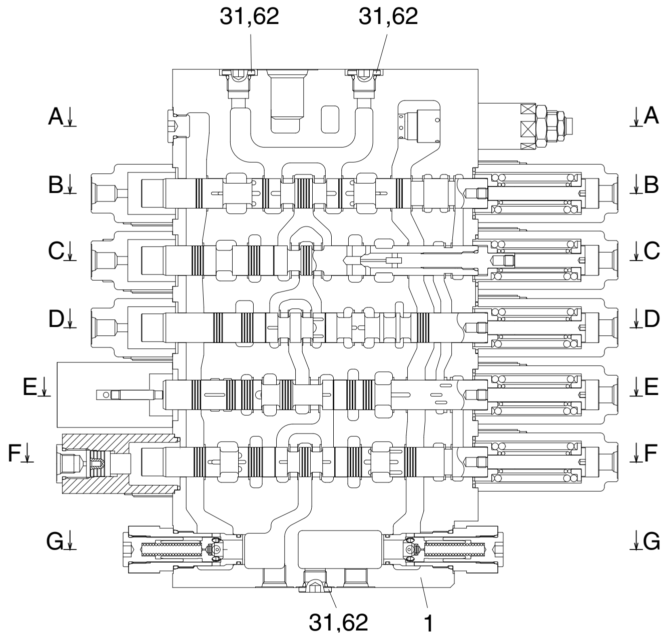


1. STRUCTURE



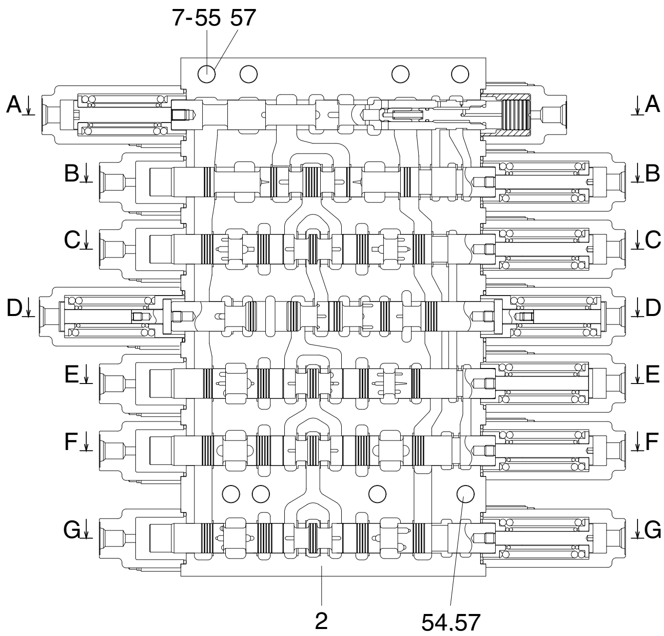
Mark	Port name	Port size	Tightening torque
(Rs)	-	UNF 1 3/16	18 kgf · m (130 lbf · ft)
Pd0 Pa1 Pb1 Pc1 Pd1 Pa20 Pa21 Pb20 Pb21 Pc2 Pd2 Pb3 Pc3 Pa4 Pb4 Pc40 Pc41 Pc42 Pd40 Pd4 Pa5 Pb5 Pc5 Pd5 Pc6 Pd6 (P0) Pu (Ai) Patt P02 P03 P04 DR0 DR1 DR2 DR3	Travel straight pilot port Travel left pilot port (BW) Travel left pilot port (FW) Travel right pilot port (FW) Travel right pilot port (BW) Boom up pilot port Boom up confluence pilot port Boom down pilot port Lock valve pilot port (boom) Swing pilot port (RH) Swing pilot port (LH) Arm in confluence pilot port Swing priority pilot port Option A pilot port (breaker) Arm in regeneration cut port Arm in pilot port Lock valve pilot port (arm) Arm in regen-cut signal selector port Arm out pilot port Arm out confluence pilot port Bucket in pilot port Bucket out pilot port Option B pilot port Option B pilot port Option C pilot port (dozer blade down) Option C pilot port (dozer blade up) - Main relief pressure up pilot port - Auto idle signal-attachment Pilot signal port Boom priority pilot port Boom parallel orifice pilot port Drain port (travel straight) Drain port (boom holding valve) Drain port (boom 2 & swing priority) Drain port (arm holding valve)	PF 1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Pn1 Pn2 (P3)	Negative control signal port (P1 port side) Negative control signal port (P2 port side) -	PF 3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
A1 B1 C1 D1 B2 C2 D2 B4 A5 B5 C5 D5 C6 D6 P1 P2	Travel motor left side port (BW) Travel motor left side port (FW) Travel motor right side port (FW) Travel motor right side port (BW) Boom rod side port Swing motor port (RH) Swing motor port (LH) Option A port (breaker) Bucket head side port Bucket rod side port Option B port Option B port Option C pilot port (dozer down port) Option C pilot port (dozer up port) Pump port (A2 pump) Pump port (A1 pump)	PF 3/4	15~18 kgf · m (109~130 lbf · ft)
A2 C4 D4	Boom head side port Arm head side port Arm rod side port	PF 1	20~25 kgf · m (115~180 lbf · ft)
DR4	Drain port (swing logic valve)	PF 1/8	1.5~1.9 kgf · m (10.8~13.7 lbf · ft)
T1	Return port	SAE 3000, 1 1/2 (M12×1.75)	8.5~11.5 kgf · m (61.5~83.1 lbf · ft)

1) P1 SPOOL SECTION



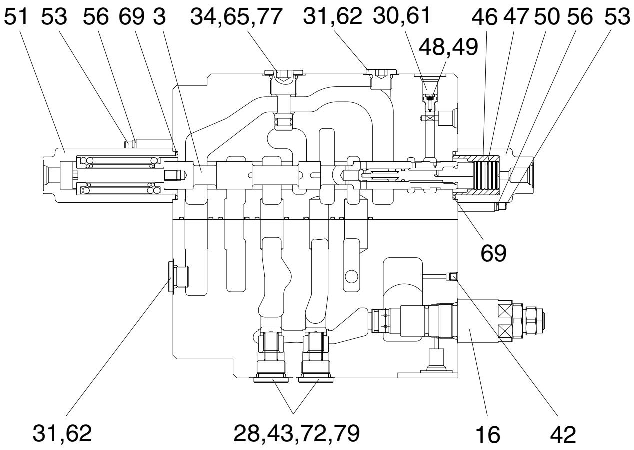
1	Housing P1
31	Plug
62	O-ring

2) P2 SPOOL SECTION



2	Housing P2
54	Socket bolt
55	Socket bolt
57	Spring washer

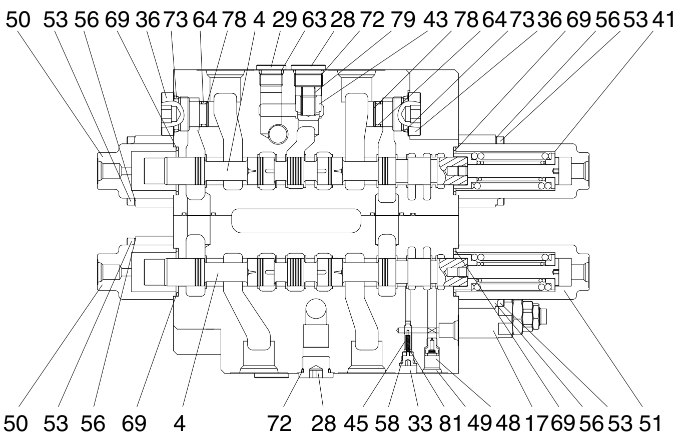
3) STRAIGHT TRAVEL AND SUPPLY SECTION



SECTION A-A

3	Straight travel spool assy
16	Main relief valve
28	Plug
30	Plug
31	Plug
34	Plug
42	Plug
43	Poppet
46	Sleeve
47	Piston
48	Signal orifice
49	Coin type filter
50	Pilot A cap
51	Pilot B1 cap
53	Socket bolt
56	Washer
61	O-ring
62	O-ring
65	O-ring
69	O-ring
72	O-ring
77	Back up ring
79	Spring

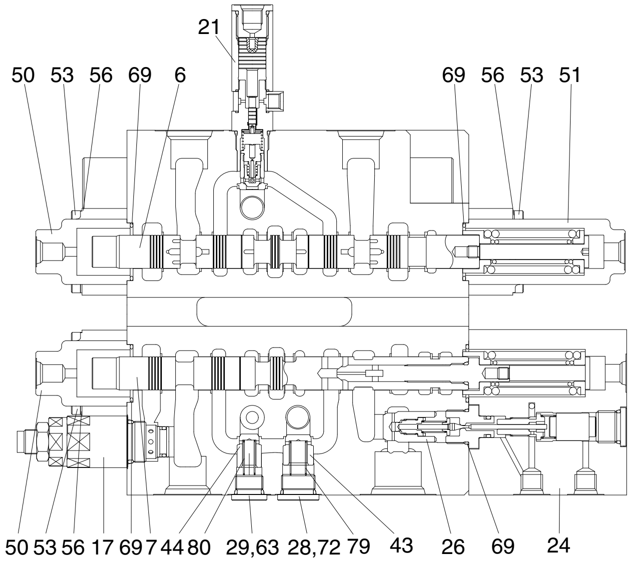
4) TRAVEL RIGHT AND LEFT SECTION



SECTION B-B

4	Travel spool assy
17	Overload relief valve
28	Plug
29	Plug
33	Plug
36	Plug
42	Plug
43	Poppet
45	Poppet
48	Signal orifice
49	Coin type filter
50	Pilot A cap
53	Socket bolt
56	Washer
58	O-ring
63	O-ring
64	O-ring
69	O-ring
72	O-ring
73	O-ring
78	Back up ring
79	Spring
81	Spring

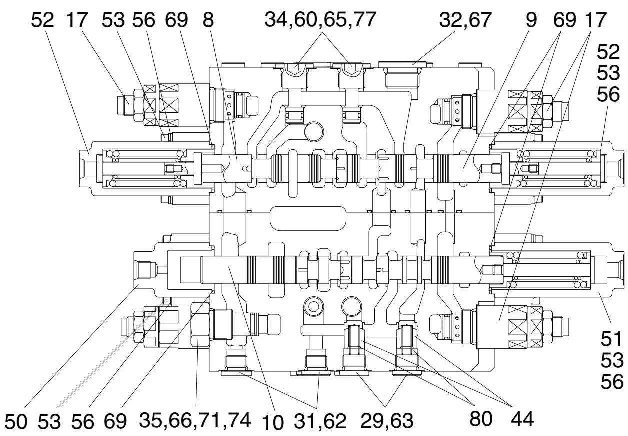
5) SWING AND BOOM 1 SECTION



SECTION C-C

6	Swing spool assy
7	Boom 1 spool assy
17	Overload relief valve
21	Swing logic valve
24	Holding valve kit A1
26	Holding valve kit B
28	Plug
29	Plug
43	Poppet
44	Poppet
50	Pilot A cap
53	Socket bolt
56	Washer
63	O-ring
69	O-ring
72	O-ring
79	Spring
80	Spring

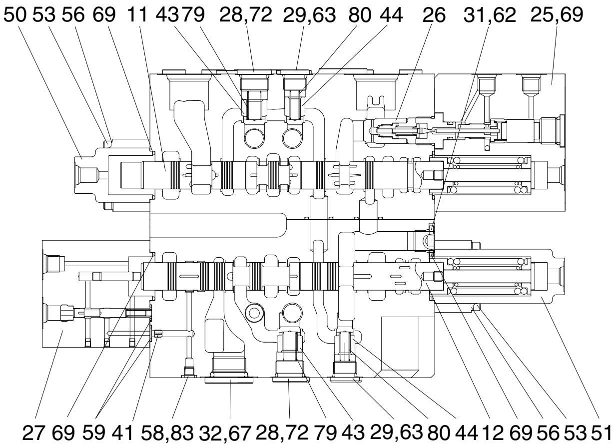
6) SWING PRIORITY AND BOOM 2 AND ARM 2 SECTION



SECTION D-D

8	Swing priority spool assy
9	Boom 2 spool assy
10	Arm 2 spool assy
17	Overload relief valve
29	Plug
31	Plug
32	Plug
34	Plug
35	Plug
44	Poppet
50	Pilot A cap
51	Pilot B1 cap
52	Pilot B2 cap
53	Socket bolt
56	Washer
60	O-ring
61	O-ring
63	O-ring
65	O-ring
66	O-ring
69	O-ring
71	O-ring
74	Back up ring
77	Back up ring
80	Spring

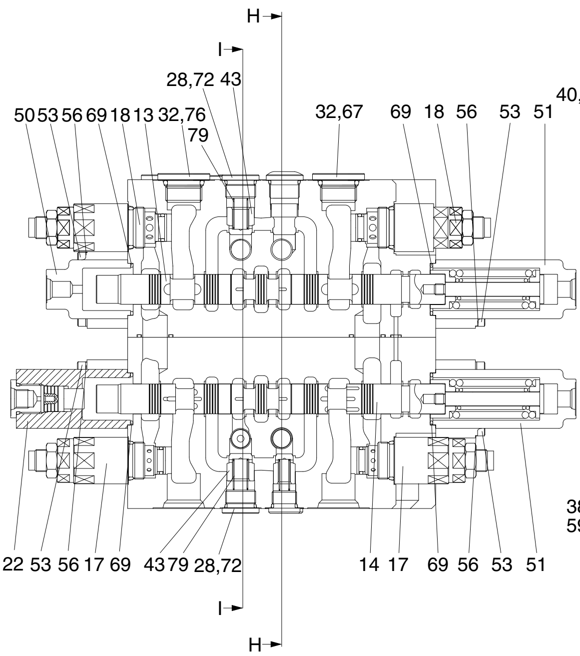
7) ARM 1 AND ARM REGEN/ BREAKER SECTION



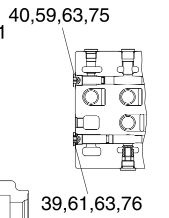
SECTION E-E

11 Arm 1 spool assy
12 Arm regen spool assy
25 Holding valve kit A2
26 Holding valve kit B
27 Regen block assy
28 Plug
29 Plug
31 Plug
32 Plug
41 Plug
43 Poppet
44 Poppet
50 Pilot A cap
53 Socket bolt
56 Washer
58 O-ring
59 O-ring
62 O-ring
63 O-ring
67 O-ring
69 O-ring
72 O-ring
80 Spring
81 Spring
83 Plug

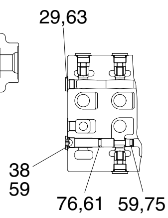
8) OPTION B AND BUCKET SECTION



SECTION F-F



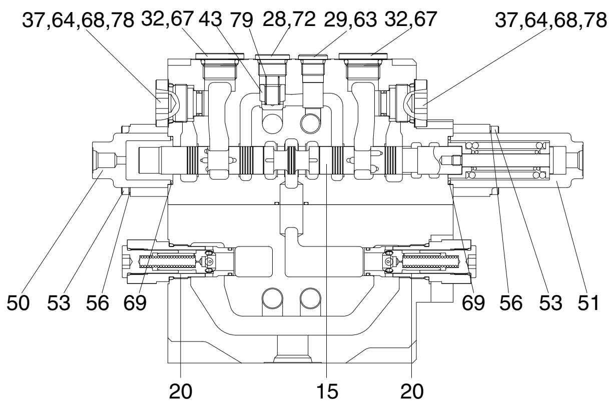
SEC H-H



SEC I-I

13 Option B spool assy
14 Bucket spool assy
17 Overload relief valve
18 Overload relief valve
22 Bucket stroke limiter
28 Plug
29 Plug
32 Plug
38 Plug
39 Plug
40 Plug
43 Poppet
50 Pilot A cap
51 Pilot B1 cap
53 Socket bolt
56 Washer
59 O-ring
61 O-ring
63 O-ring
67 O-ring
69 O-ring
72 O-ring
75 Back up ring
76 Back up ring
79 Spring

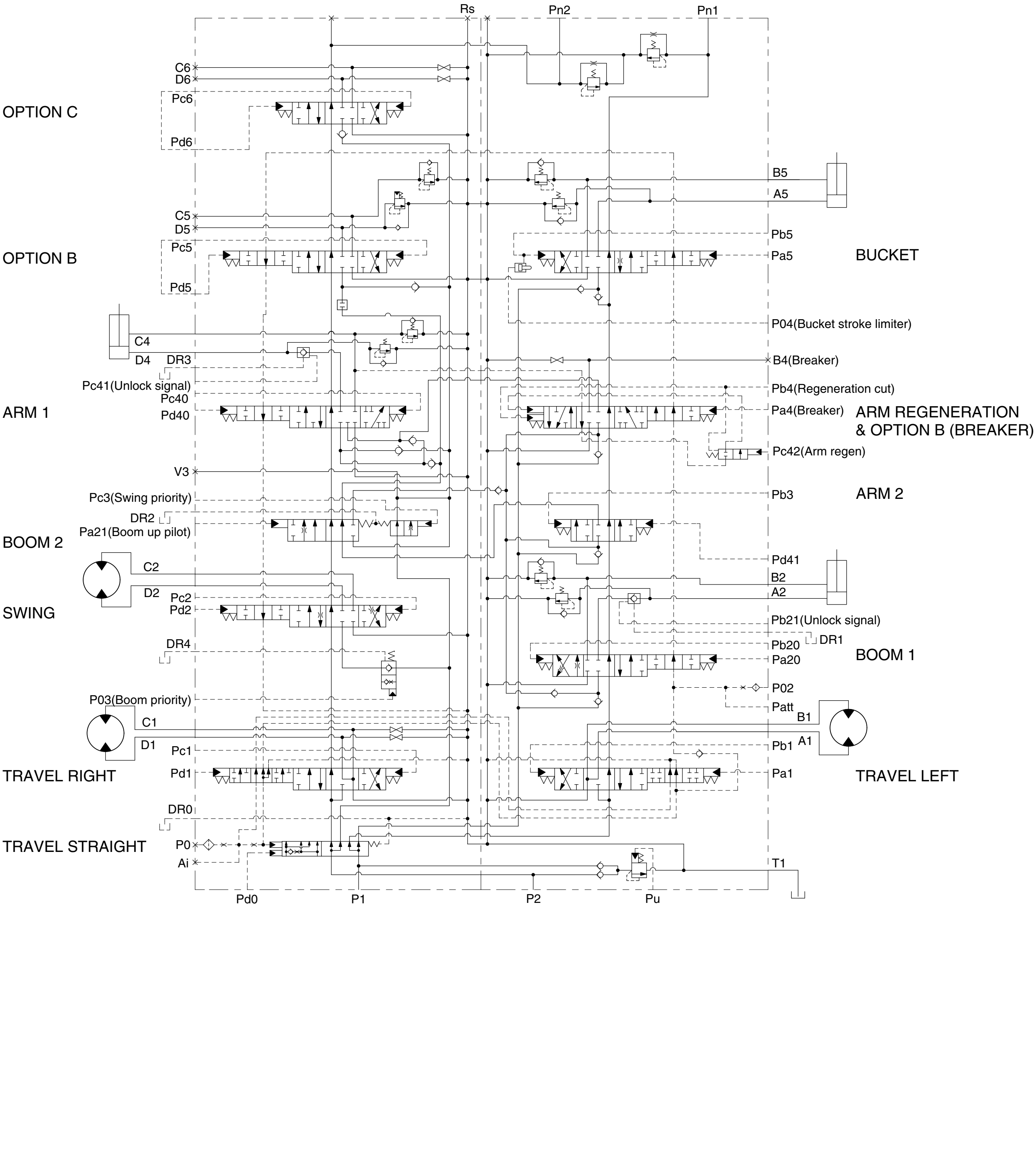
9) OPTION C AND NEGATIVE CONTROL SECTION



SECTION G-G

15	Option C1 spool assy
20	Negacon relief valve
28	Plug
29	Plug
32	Plug
37	Plug
43	Poppet
50	Pilot A cap
51	Pilot B1 cap
53	Socket bolt
56	Washer
63	O-ring
64	O-ring
67	O-ring
68	O-ring
69	O-ring
72	O-ring
78	Back up ring
79	Spring

2. HYDRAULIC CIRCUIT



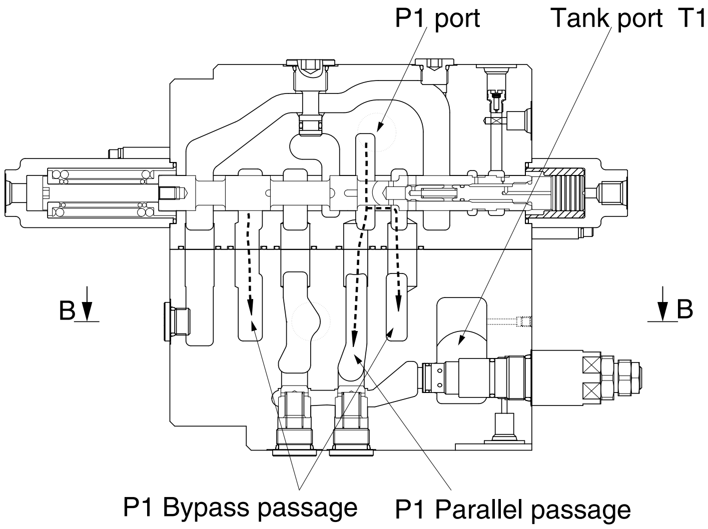
3. FUNCTION

1) CONTROL IN NEUTRAL

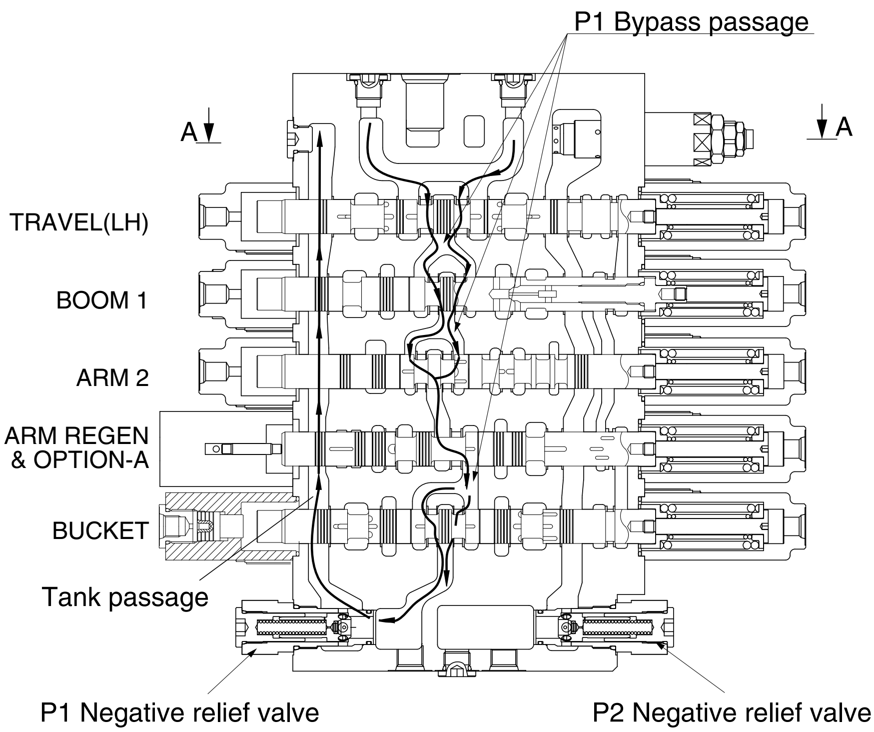
(1) P1 SIDE

The hydraulic fluid from pump A2 flows into the main control valve through the inlet port "P1", pass the straight travel spool into the P1 bypass passage and P1parallel passage.

The hydraulic fluid from the pump A2 is directed to the tank through the bypass passage of spools : travel left, boom 1, arm 2, arm regeneration & option A and bucket, the negative relief valve of P1, tank passage, and the tank port "T1"



SECTION A-A

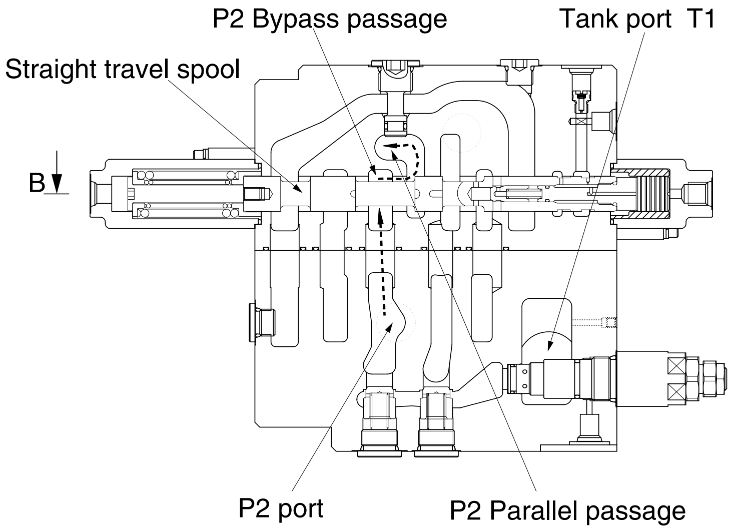


SECTION B-B

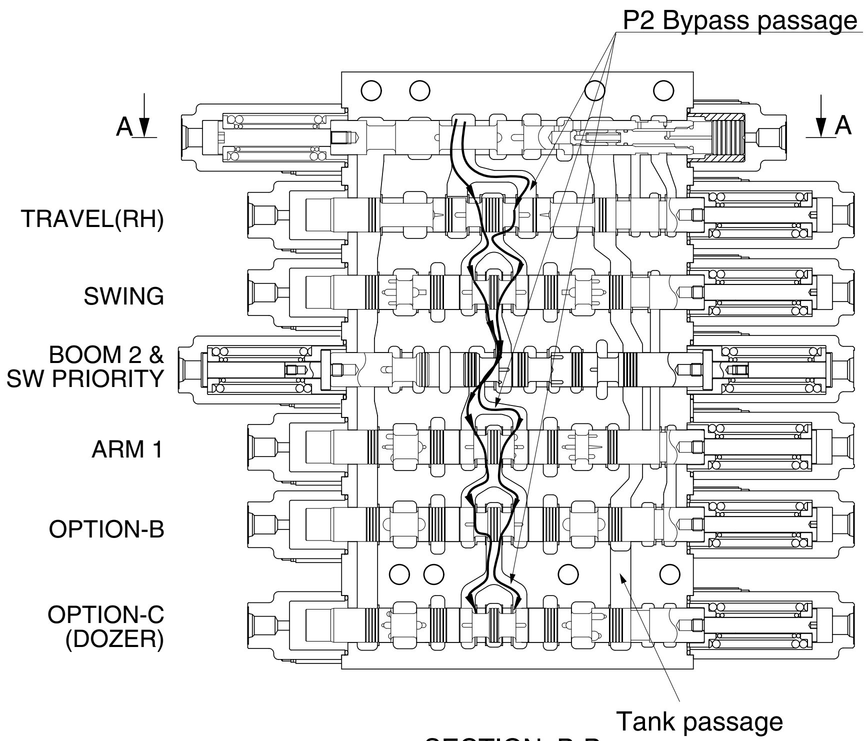
(2) P2 SIDE

The hydraulic fluid from pump A1 flows into the main control valve through the inlet port "P2", into the P2 bypass passage and P2 parallel passage.

The hydraulic fluid from the pump A1 is directed to the tank through the bypass passage of spools : travel right, swing, boom 2 & swing priority, arm 1, option "B" and option "C" (dozer), the negative relief valve of P2, tank passage and the tank port "T1".



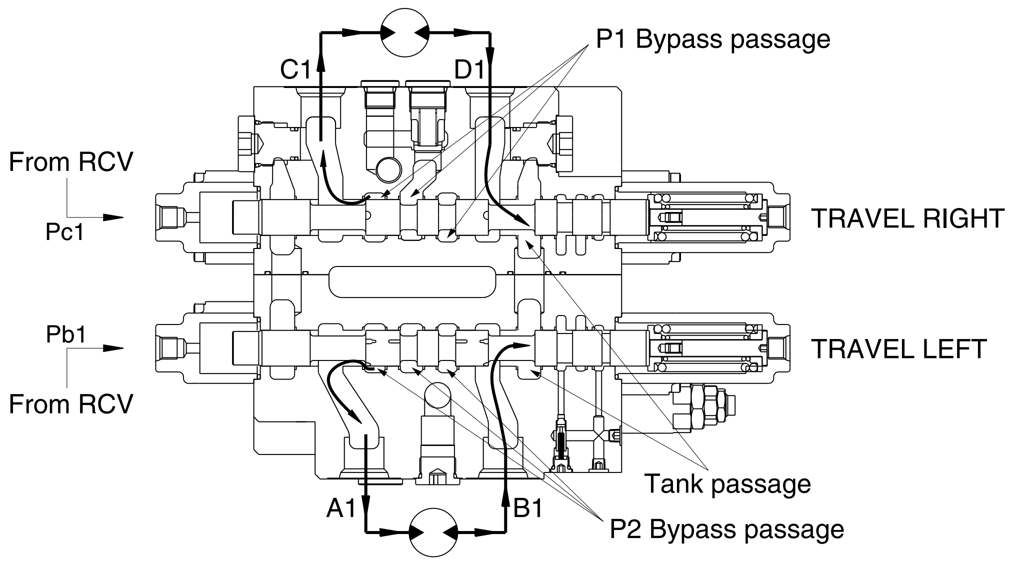
SECTION A-A



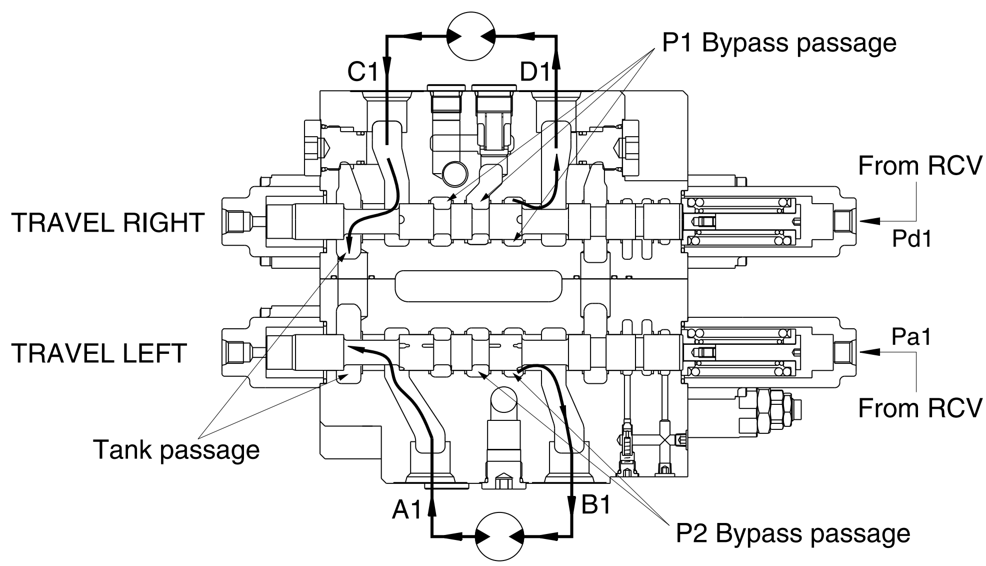
SECTION B-B

2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION

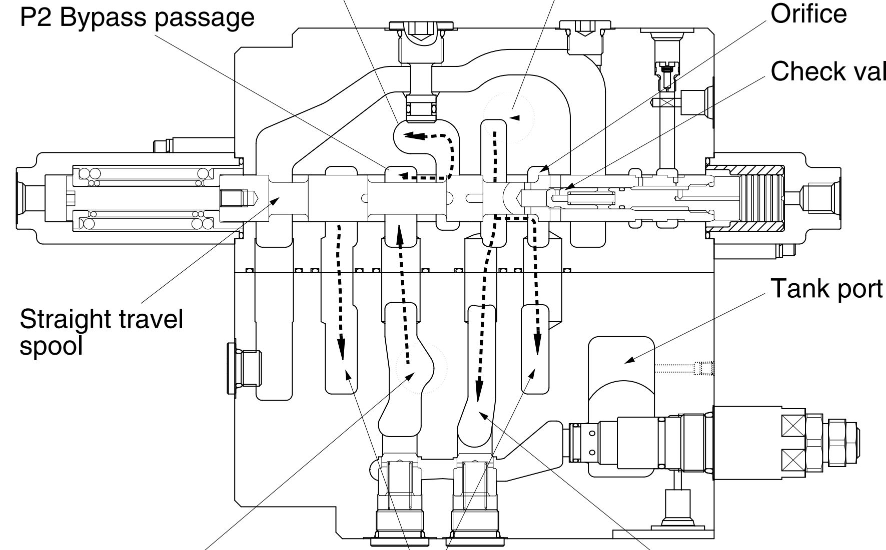


(2) TRAVEL BACKWARD OPERATION



During the travel forward operation, the hydraulic fluid of the pump A2 is supplied to the travel left motor and the hydraulic fluid of the pump A1 is supplied to the other travel right motor.
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pb1, pc1).
And it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump A1 flow into the travel right spool through the bypass passage and hydraulic fluid from the pump A2 flow into the travel left spool through the bypass passage.
Then they are directed to the each travel motor through port A1 and C1. As a result, the travel motors turn and hydraulic fluid returns to the tank passage through the travel spools.
In case of the reverse operation, the operation is similar.

(3) TRAVEL STRAIGHT FUNCTION



This function keeps straight travel in case of simultaneous operation of other actuators (boom, arm, bucket, swing) during a straight travel.

① **During travel only :**

The hydraulic fluid of the pump A1 is supplied to the travel right motor and the pump A2 is supplied to the travel left motor.

Thus, the machine keep travel straight.

② **The other actuator operation during straight travel operation :**

When the other actuator spool (s) is selected under straight travel operation, the straight travel spool is moved.

The hydraulic fluid from pump A2 is supplied actuator through P2 and P1 parallel pass and travel motors through orifice at side of straight travel spool.

The hydraulic oil fluid from pump A1 is supplied to travel motors (left/right).

Therefore, the other actuator operation with straight travel operation, hydraulic oil fluid from pump A2 is mainly supplied to actuator, and the hydraulic oil fluid form pump A1 is mainly supplied to travel motors (left/right).

Then the machine keeps straight travel.

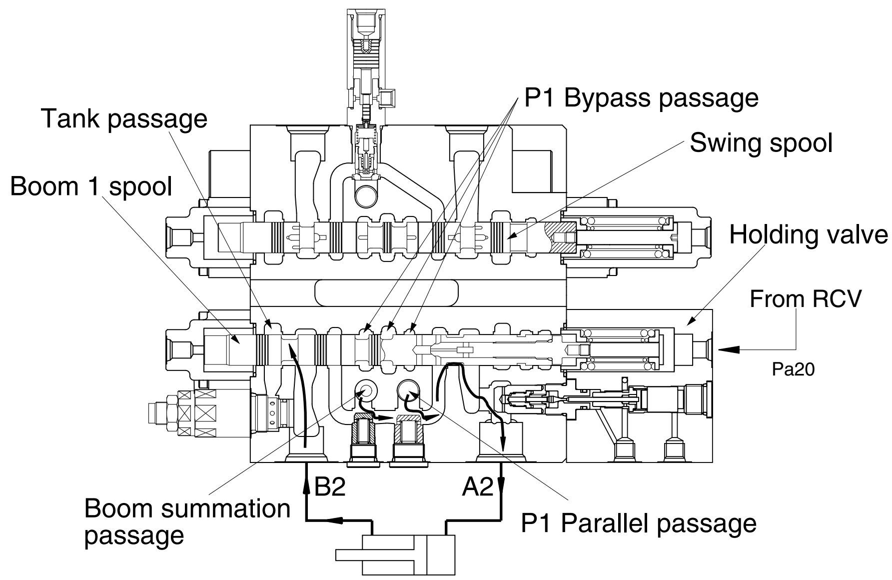
3) BOOM OPERATION

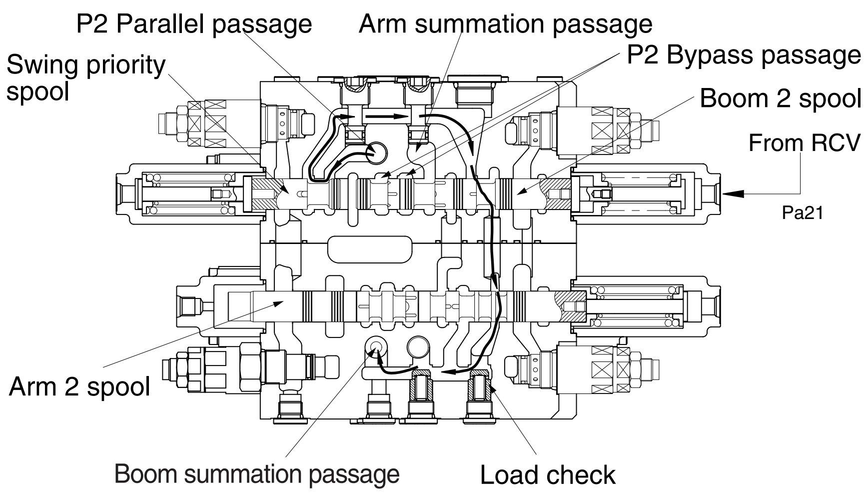
(1) BOOM UP OPERATION

During boom up operation, the pilot secondary pressure from RCV is supplied to the port Pa20 of the spring side and shifts the boom 1 spool in the left direction. The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic oil fluid from pump A2 is entered P1 parallel passage and then passes through the load check, bridge passage and boom holding valve then flows into the port A2. Following this it flows into the head side of the boom cylinder. (In this case, the boom holding valve is free flow condition)

At the same time, the pilot pressure from RCV is supplied to the port Pa21 of the spring side of boom 2 and shifts the boom 2 spool. The bypass passage is shut off by the movement of the boom 2 spool and the hydraulic oil fluid from pump A1 entered boom summation passage via the P2 parallel passage, the land of the swing priority spool, notch of the boom 2 spool, arm 2 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

At the same time, the flow from rod side of the boom cylinder return to the boom 1 spool through the port B2. Thereafter it is directed to the hydraulic oil tank through the tank passage.





(2) BOOM DOWN OPERATION

During the boom lowing operation, the pilot pressure from RCV is supplied to the port Pb20 of the spring opposite side and shifts the boom 1 spool in the right direction.

The bypass passage is shut off by the movement of the boom 1 spool and the hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check.

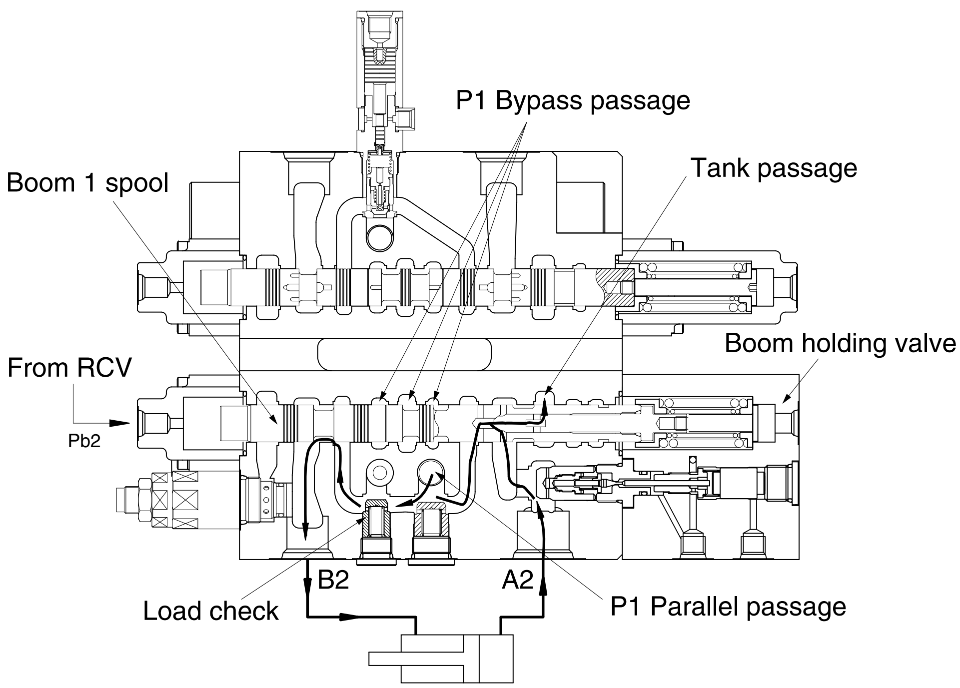
Following this, it flows into the rod side of the boom cylinder.

At the same time, the return flow from the head side of the boom cylinder returns to the port A2 and boom holding valve. And it is directed to the hydraulic oil tank through opened tank passage by movement of the boom 1 spool.

Meanwhile some of return flow is directed to P1 parallel passage through the internal passage of the boom 1 spool. (boom regeneration)

In this case, the holding valve is open condition, for details of the boom holding valve, see page following page.

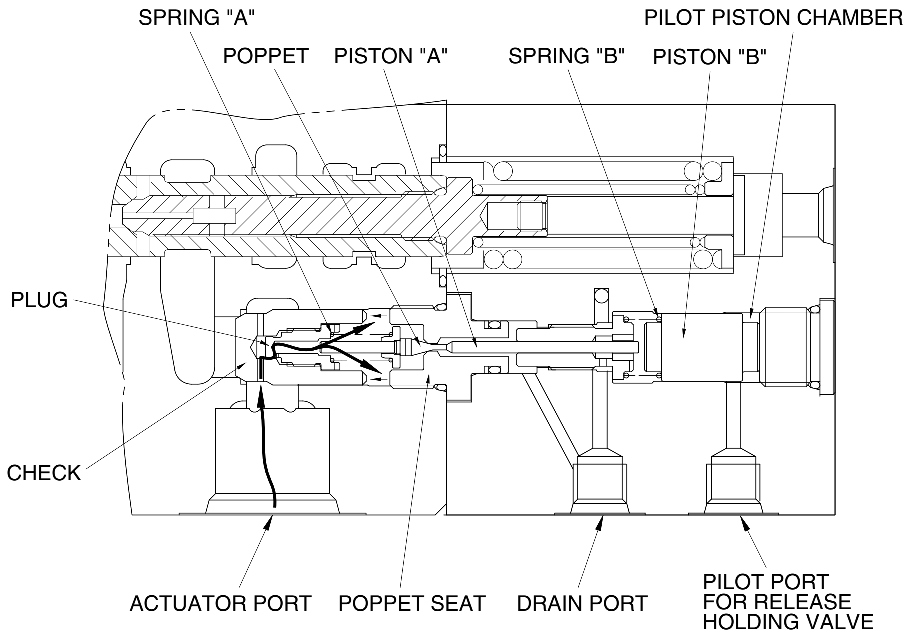
During the boom lowering operation, the fluid from A1 pump is not summation.



4) HOLDING VALVE OPERATION

(1) HOLDING OPERATION

At neutral condition, the pilot piston chamber is connected to drain port through the pilot port.
And the piston "B" is supported with spring "B".
Also, the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug.
Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body.
So the hydraulic fluid from actuator is not escaped and the actuator is not moved.

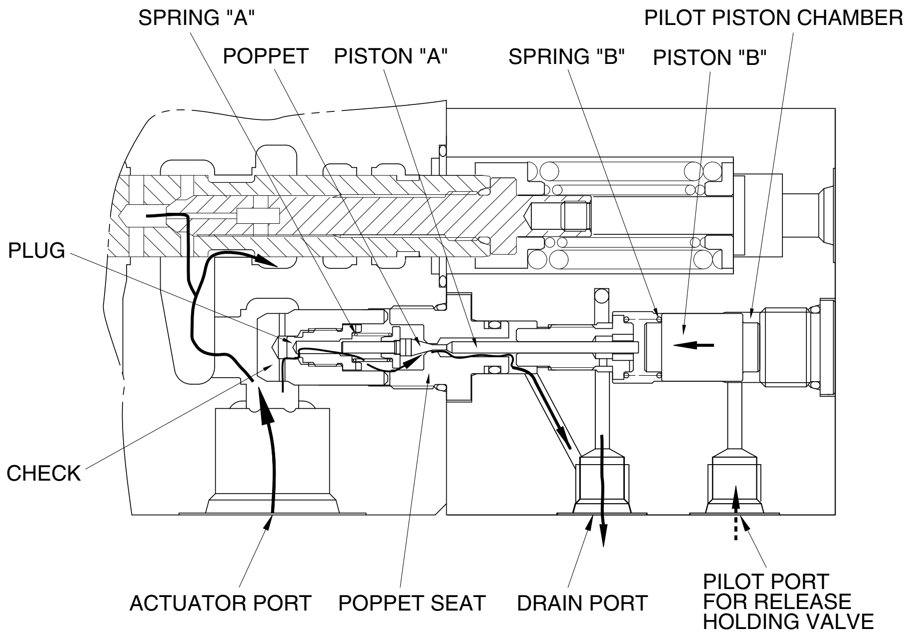


(2) RELEASE HOLDING OPERATION

The pilot pressure is supplied to the pilot port for release holding valve and shifts the piston "B" in the left direction against the spring "B", and shifts the poppet in the left direction through piston "B" and piston "A" against spring "B" and shifts the spool in the left side.

At same time, the return fluid from actuator returns to the drain port through the periphery hole of check, crevice of the check and the plug, the periphery hole of the plug, in side of holding valve, crevice of the poppet and the poppet seat, the periphery hole of the poppet seat, crevice of socket and spool and internal passage of spool.

When the poppet is opened, pressure of inside of holding valve is decreased and the return fluid from actuator returns to the tank passage through the notch of spool.



5) BUCKET OPERATION

(1) BUCKET IN OPERATION

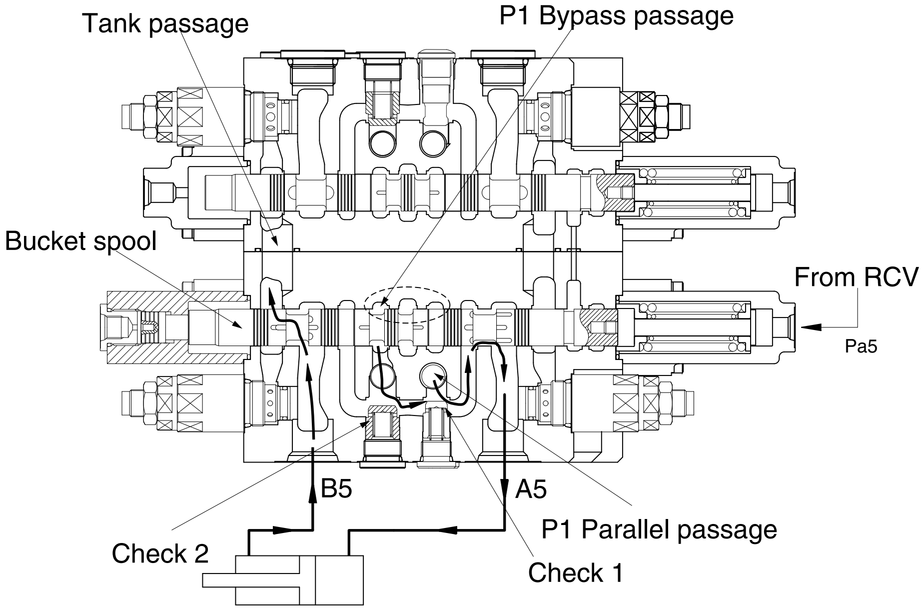
During the bucket in operation, the pilot secondary pressure from RCV is supplied to port Pa5 of the spring side and shifts the bucket spool in the left direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port A5 through the check 1.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port A5 through the check 2.

Following this it flows into the head side of the bucket cylinder.

The return flow from the rod side of the bucket cylinder returns to the bucket spool through the port B5. Thereafter it is directed to the hydraulic oil tank through the tank passage.



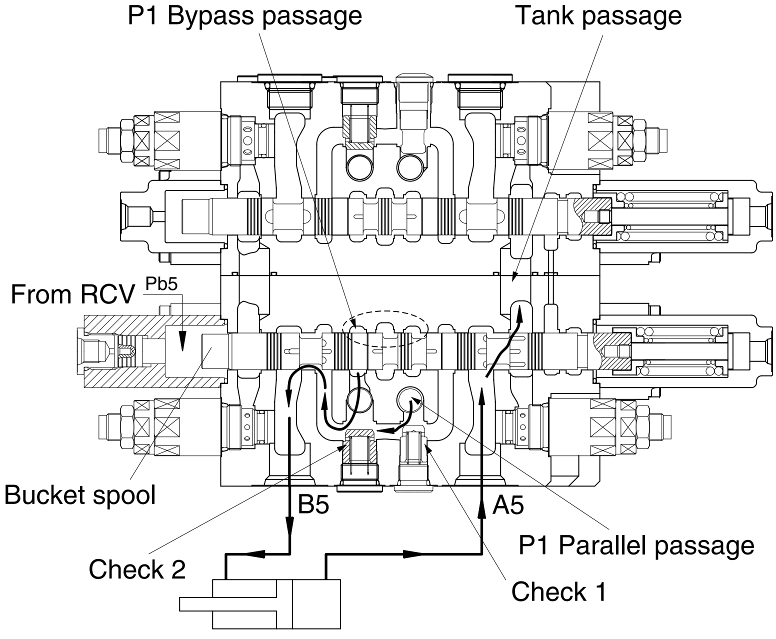
(2) BUCKET OUT OPERATION

During the bucket out operation, the pilot secondary pressure from RCV is supplied to port Pb5 of the spring opposite side and shifts the bucket spool in the right direction.

The bypass passage is shut off by the movement of the bucket spool and the hydraulic fluid from pump A2 entered P1 parallel passage and is directed to the port B5 through the check 1.

At the same time, the hydraulic fluid from P1 bypass passage is directed to the port B5 through the check 2.

The return flow from the head side of the bucket cylinder returns to the hydraulic oil tank through the port A5 and the tank passage

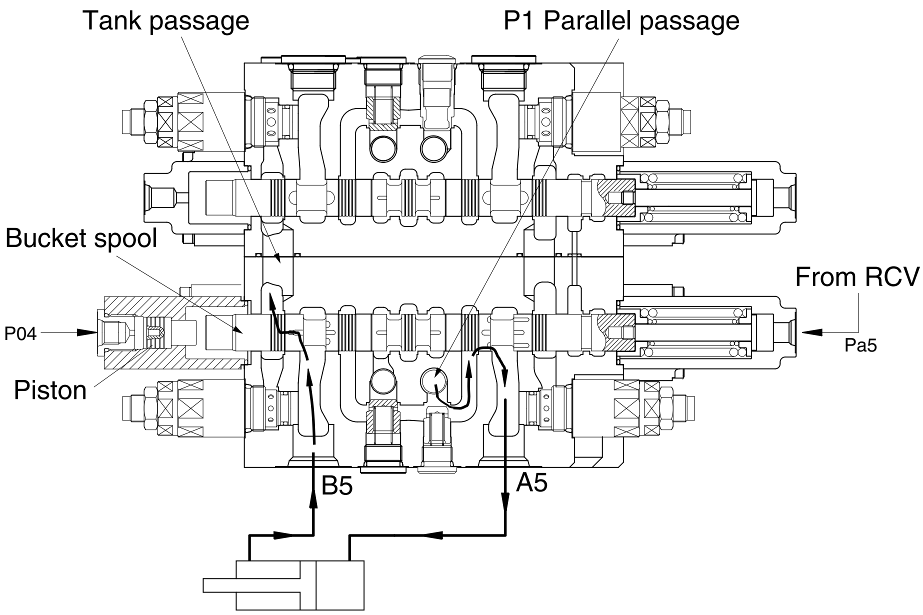


(3) BUCKET IN OPERATION WITH BOOM OPERATION

When combined operation, mostly same as previous page but the fluid from P1 bypass passage is empty.

When the boom up and bucket in combined operation, the boom up pilot pressure is supplied the pilot port (P04) of bucket spool stroke limit and the piston is shifted to the right and then the bucket in spool stroke is limited and the open of the bucket in spool is reduced.

Accordingly, the oil of the bucket in spool is reduced and the boom speed up



6) SWING OPERATION

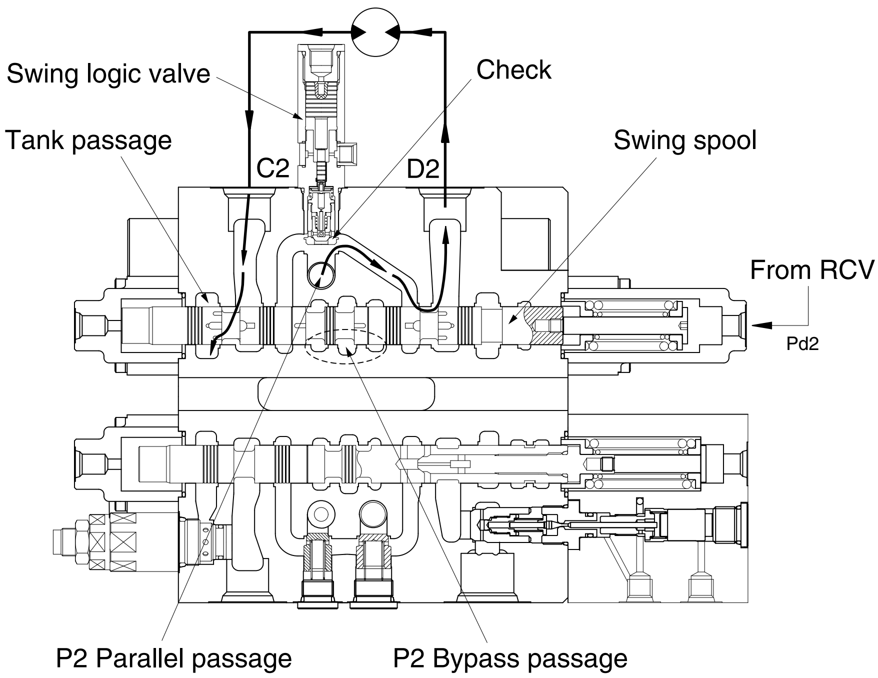
(1) SWING LEFT & RIGHT OPERATION

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port Pd2 of the spring side and shift the swing spool in left direction. The bypass passage is shut off by the movement of the swing spool and the hydraulic fluid from pump A1 flows into swing spool through the P2 parallel passage. Then it is directed to swing motor through the port D2.

As the result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port C2, swing spool and the tank passage.

In case of swing right operation, the operation is similar to swing left operation but the pilot secondary pressure from the RCV is supplied to the port Pc2 of the spring opposite side.

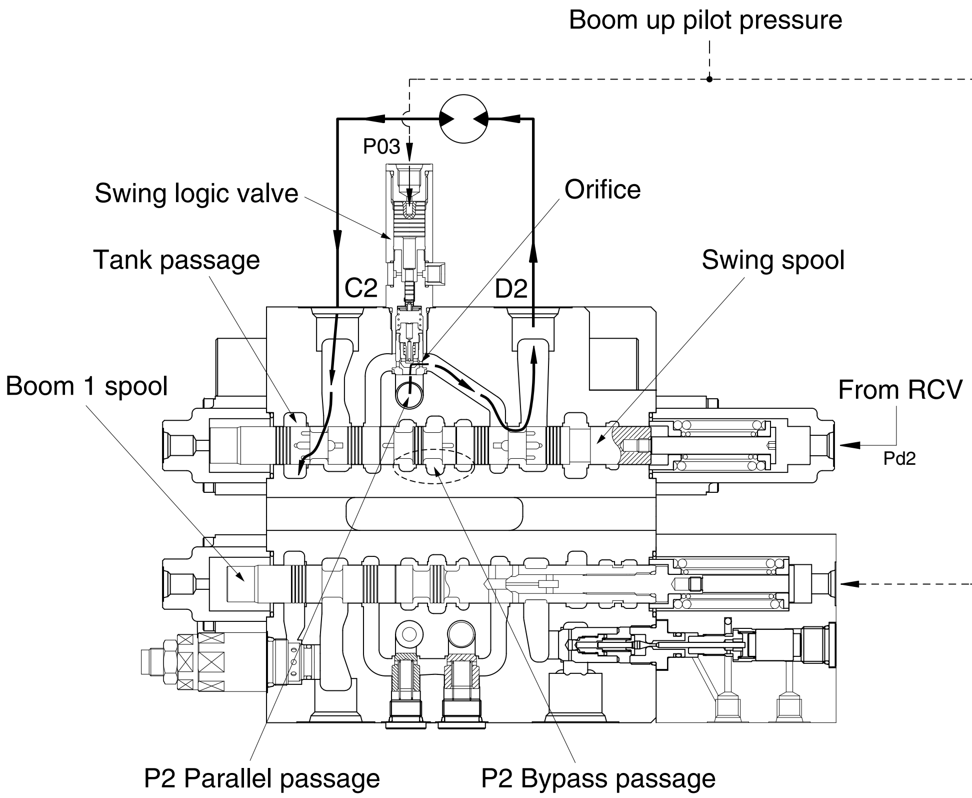
Accordingly, the hydraulic fluid from pump A1 flows into swing motor through the port C2 and returns to the hydraulic oil tank through the port D2 and the tank passage.



(2) SWING LEFT OPERATION WITH ARM OR BOOM OPERATION

When combined operation, mostly same as previous page but the fluid from P2 bypass passage is empty.

So only the fluid from parallel passage is supplied to the swing motor. Also, parallel passage is installed the orifice of swing logic valve for supplying the fluid from pump A1 to the boom or the arm operation prior to the swing operation. In case of the swing right operation with arm or boom operation, operation is similar.



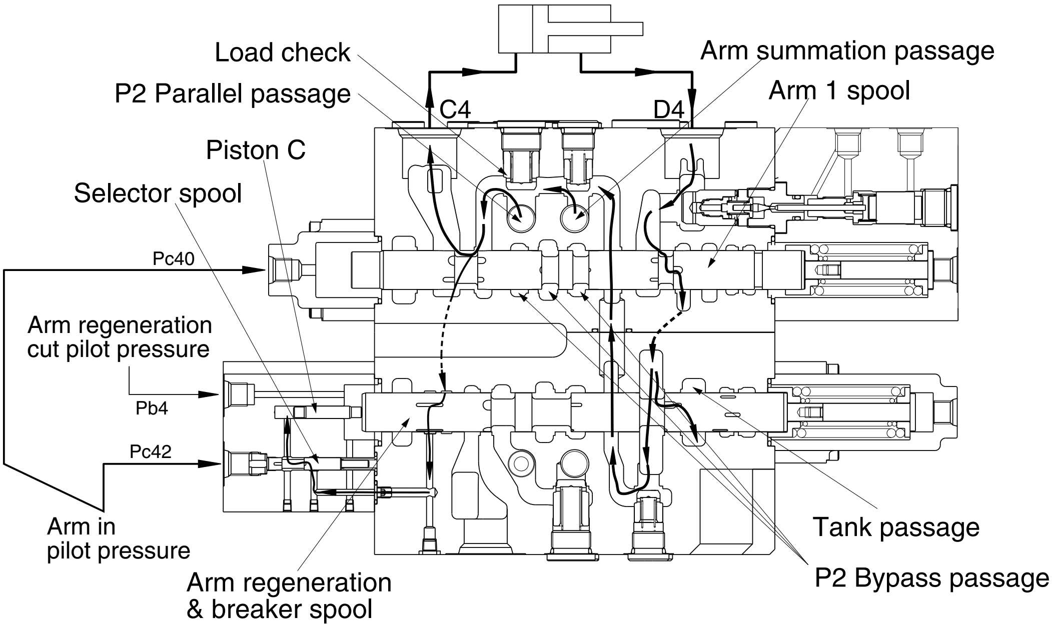
7) ARM OPERATION

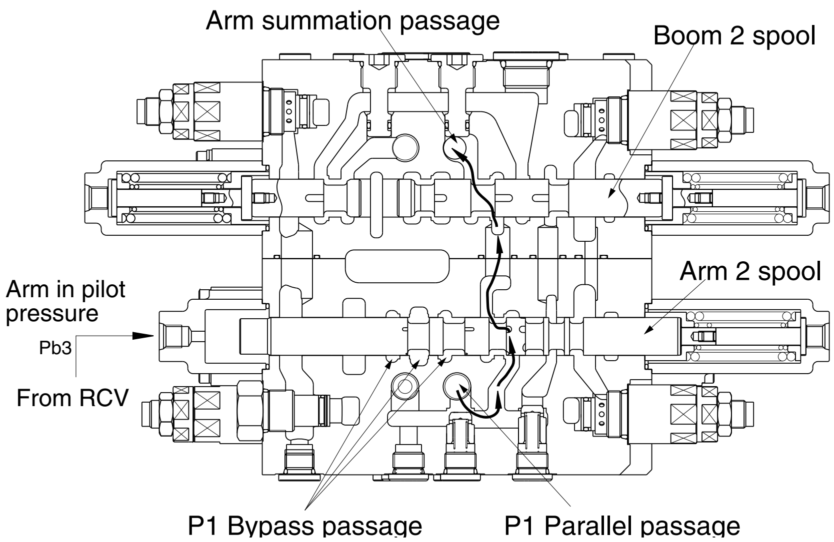
(1) ARM IN OPERATION

During arm in operation, the pilot secondary pressure from the RCV is supplied to the port Pc40 of spring opposite side and shifts arm 1 spool in the right direction.

The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic oil from the pump A1 flows into the arm cylinder head side through P2 parallel passage, the load check valve, bridge passage and the port C4.

At same time, the pilot secondary pressure from the RCV is supplied to the port Pb3 of spring opposite side and shifts arm 2 spool in the right direction. The bypass passage is shut off by the movement of the arm 2 spool and the hydraulic fluid from the pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, the arm 2 spool and the boom 2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm 1 spool.



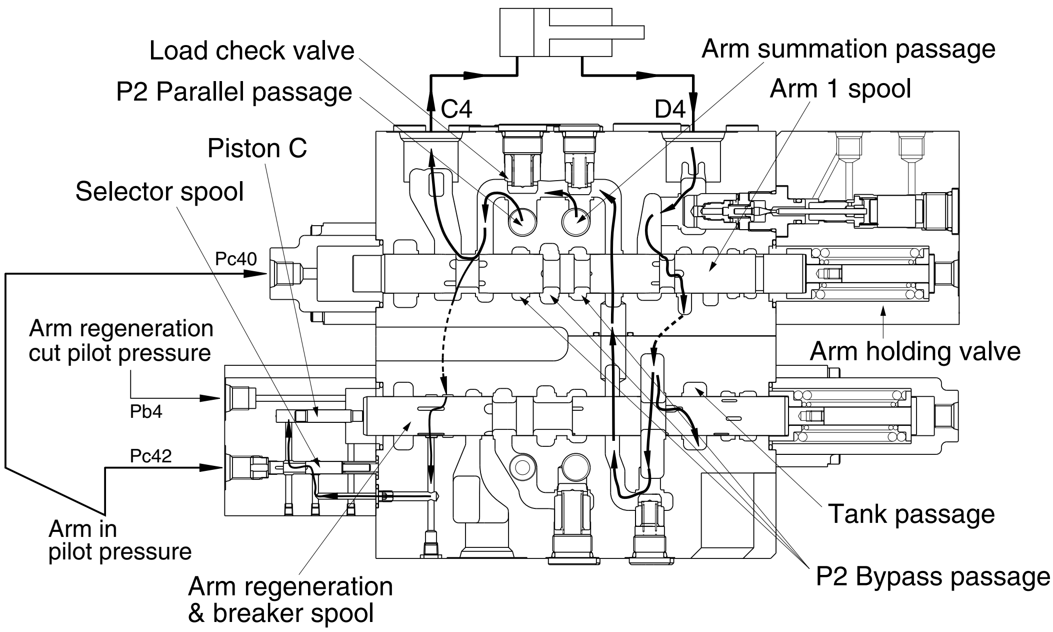


ARM REGENERATION

The return flow from the arm cylinder rod side is pressurized by self weight of arm and so, returns to port D4. The pressurized oil returning to port D4 enters the arm regeneration & breaker spool through the arm holding valve and the arm 1 spool. It is supplied the arm cylinder head through internal passage. This is called the arm regeneration function.

The amount of regeneration fluid is changed by movement of the arm regeneration spool. A few fluids after P2 parallel passage is push piston "C" through the notch of arm regeneration spool and selector spool. At this time, the selector spool is opened by pilot pressure from RCV.
Then, the arm regeneration spool shifts to right side and flow to tank pass increases and regeneration flow decreases. Therefore, pressure of arm cylinder head increases, then, arm regeneration flow decreases.

Furthermore, the arm regeneration cut pressure is supplied to the port Pb4 of spring opposite side and arm regeneration spool is move into the right direction fully. The flow from the arm cylinder rod is returned to the hydraulic oil tank and regeneration function is not activated. (The return fluid is maximum condition)



(2) ARM OUT OPERATION

During arm out operation, the pilot secondary pressure from RCV is supplied to the port Pd40 of spring side and shifts arm 1 spool in the left direction.

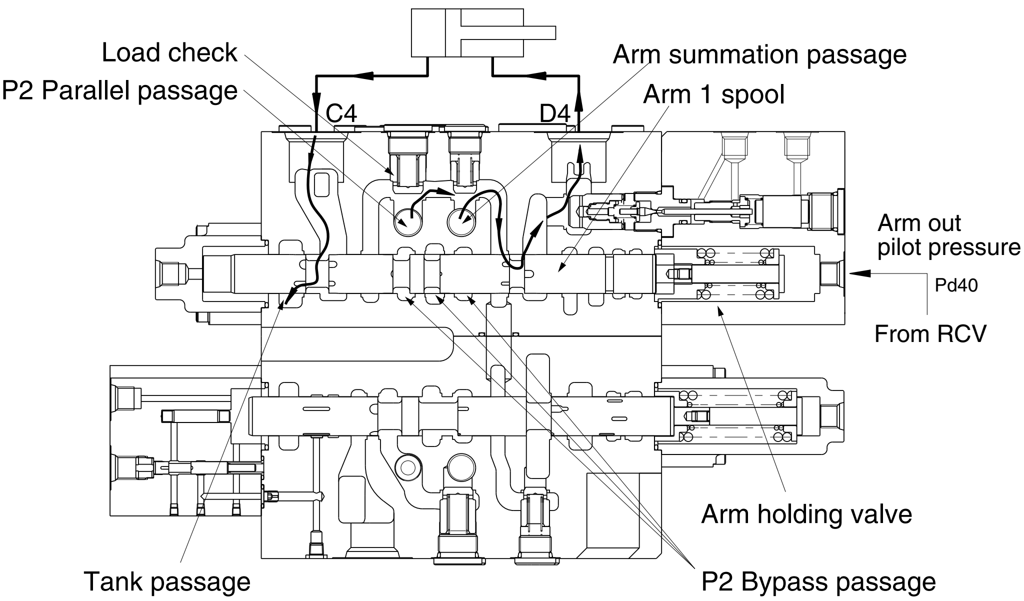
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic fluid from pump A1 flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve and the port D4.

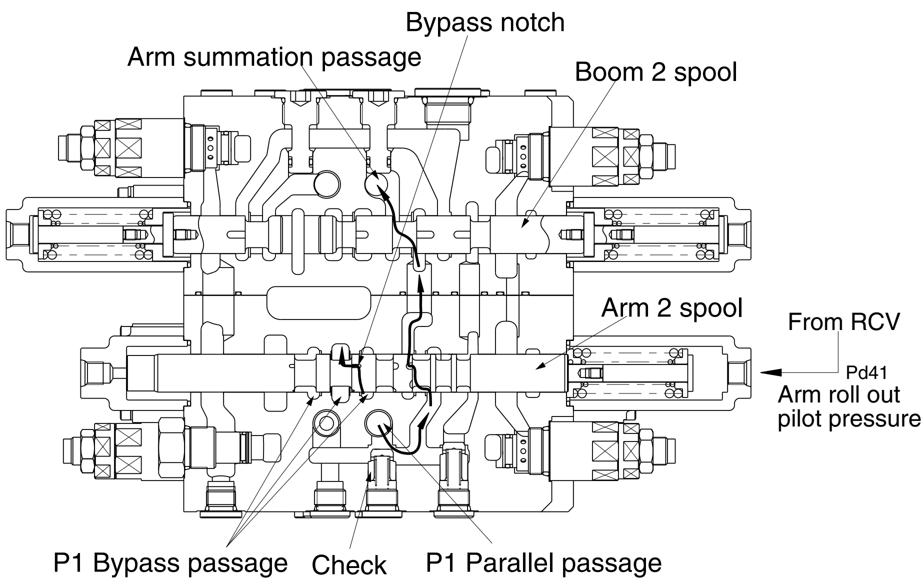
Also, the pilot secondary pressure from RCV is supplied to the port Pd41 of spring side and shifts arm 2 spool in the left direction.

The bypass passage is shut off by the movement of the arm 2 spool and some of the hydraulic fluid from pump A2 bypassed through bypass notch. The rest of hydraulic fluid from pump A2 flows into the arm summation passage through P1 parallel passage, the check valve, arm 2 spool and boom 2 spool.

Then it enters into the arm cylinder rod side with the fluid from the arm 1 spool.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port C4, the arm 1 spool and tank passage.



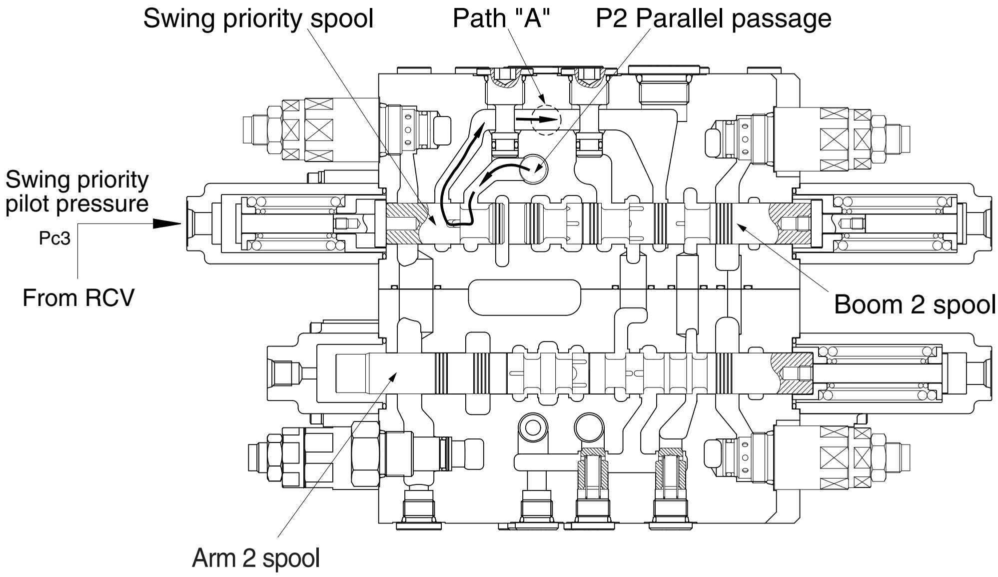


8) SWING PRIORITY FUNCTION

During swing priority operation, the pilot secondary pressure is supplied to the port Pc3 of the spring side of the swing priority spool and shift swing priority spool in the right direction.

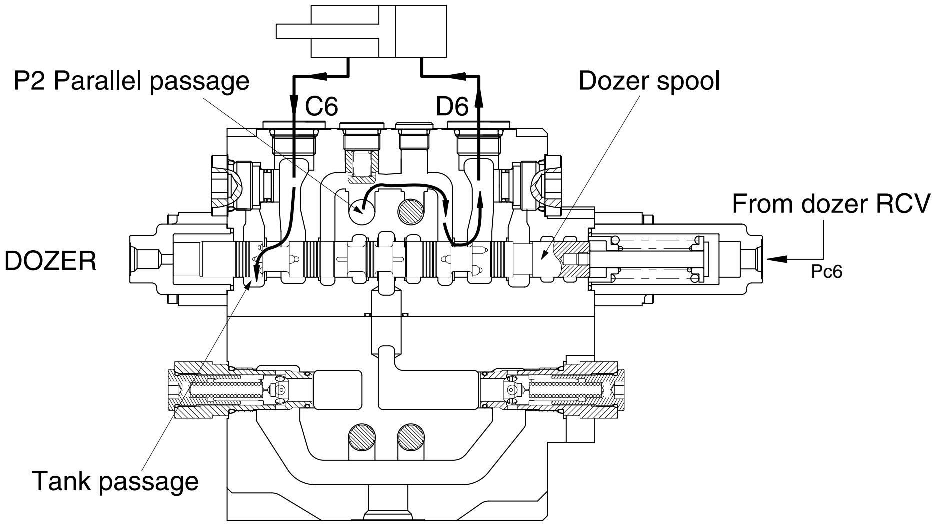
The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm 1 side through swing priority spool and the path "A" and also flows into the boom 2 spool.

When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump A1 flows to swing side more then the boom 2, arm 1, option B and dozer spools to make the swing operation most preferential.

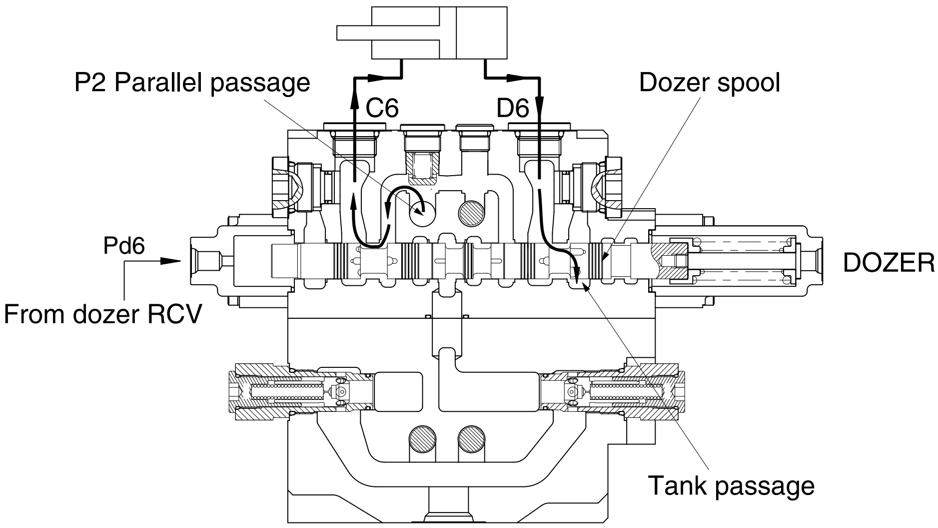


9) DOZER OPERATION

(1) Dozer down operation



(2) Dozer up operation



During the dozer down operation, the pilot pressure from the dozer control valve is supplied into the port Pc6 of the spring side and it shifts the dozer spool in the left direction.
The hydraulic fluid from the pump A1 enters the parallel passage and is direction to the head side of the dozer cylinder through port D6.
The return flow from the rod side of the dozer cylinder returns to the dozer spool through C6 port.
Thereafter it is directed to the hydraulic tank through tank passage.
In case of the dozer up operation, operation is similar.

10) NEGATIVE RELIEF VALVE OPERATION

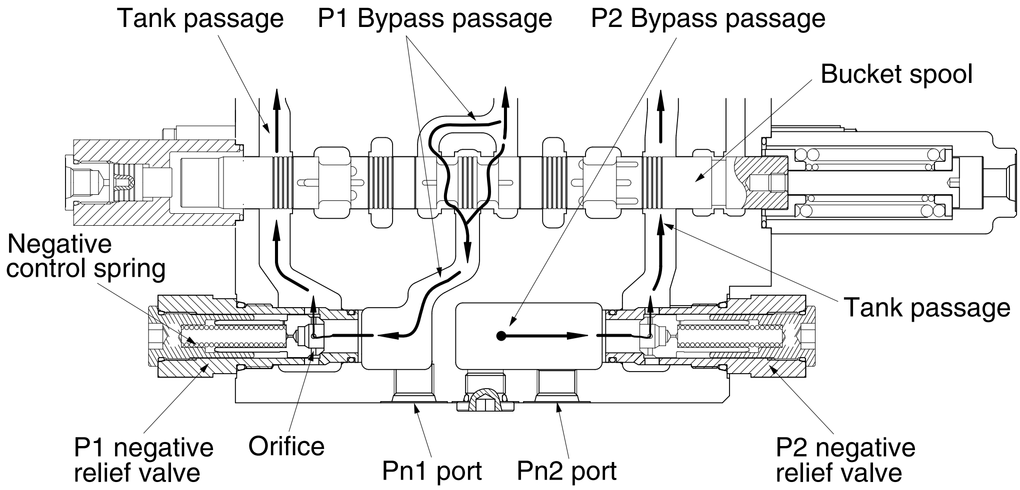
When no function is being actuated on P1 side, the hydraulic fluid from the pump A2, flows into the tank passage through the P1 bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump A2 regulator.

It controls the pump regulator so as to minimize the discharge of the pump A2.

The bypass passage is shut off when the shifting of one or more spools and the flow through bypass passage became zero. The pressure of negative control signal becomes zero and the discharge of the pump A2 becomes maximum.

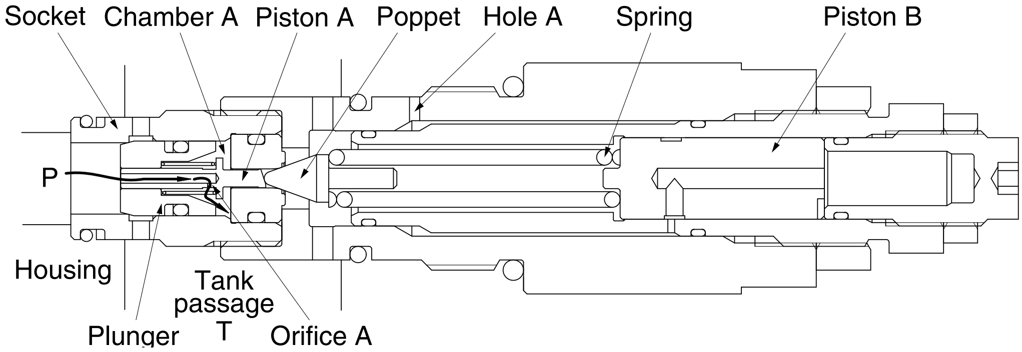
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump A1 the same negative control principle.

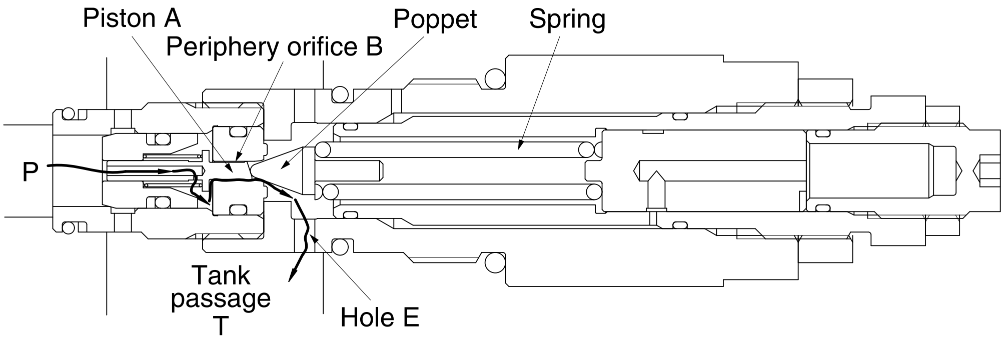


11) OPERATION OF MAIN RELIEF VALVE

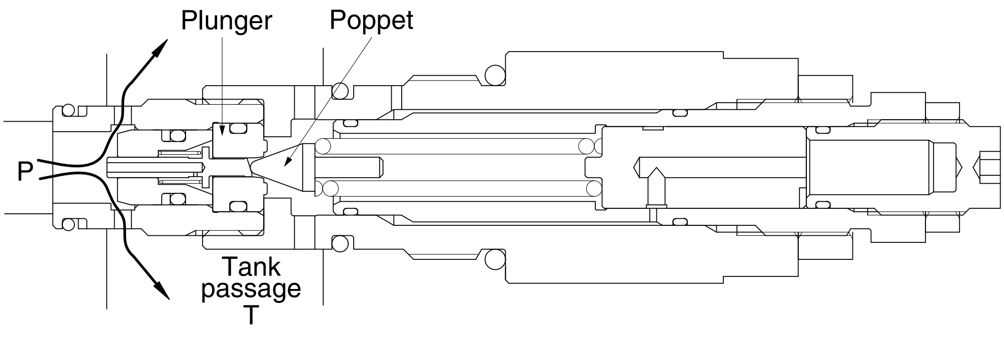
(1) The pressurized oil passes through the orifice (A) of the plunger is filled up in chamber A of the inside space, and seats the plunger against the housing securely.



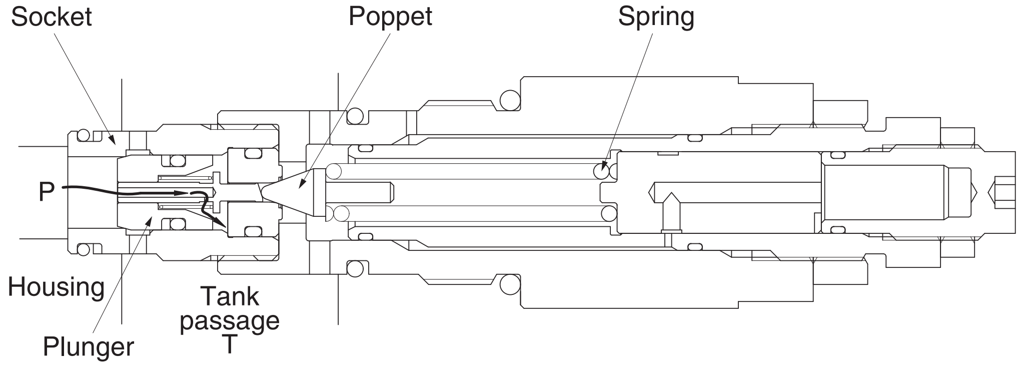
(2) When the pressure at (P) becomes equal to the set pressure of the spring the hydraulic oil passes through the piston (A) pushes open the poppet and flows to tank passage (T) through the plunger internal passage, periphery orifice A, chamber A, periphery orifice B and the hole (E).



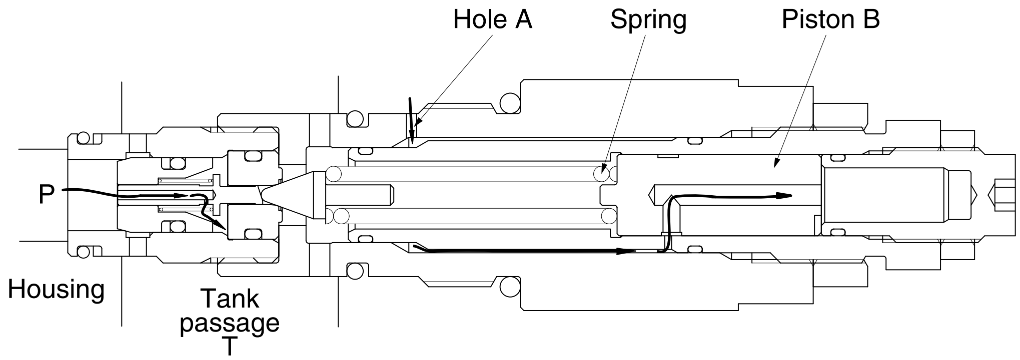
(3) Opening the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



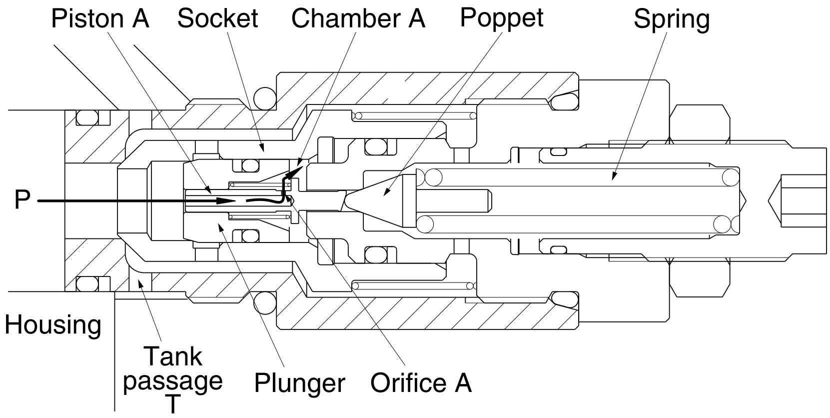
(5) When the power boost switch is ON, the pilot pressure enters through hole A.
It pushes the piston (B) in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.



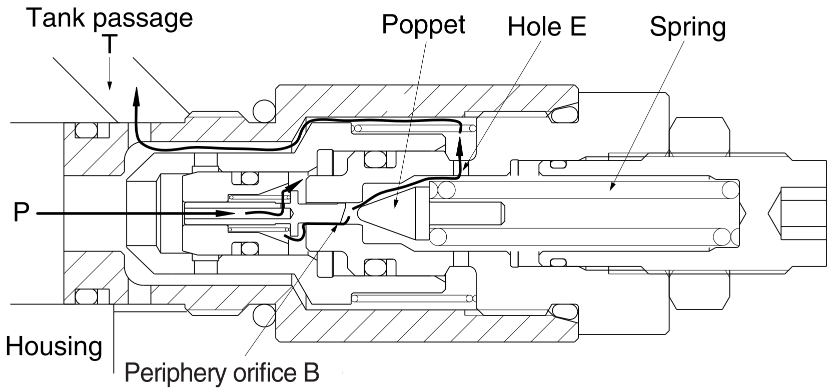
12) OPERATION OF OVERLOAD RELIEF VALVE

FUNCTION AS RELIEF VALVE

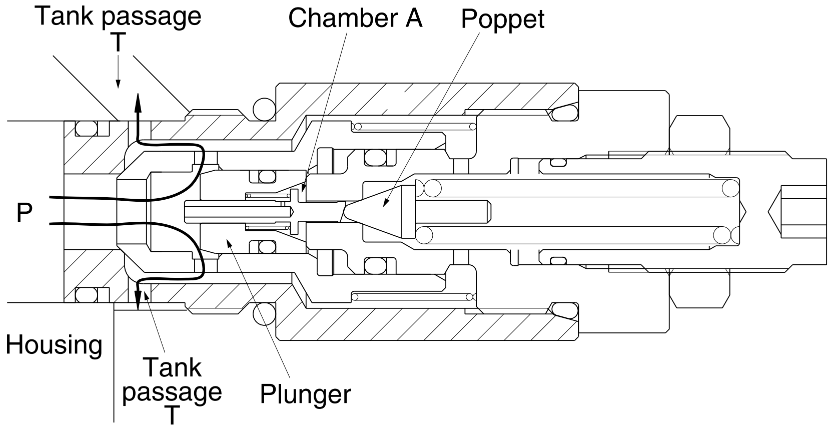
(1) The pressurized oil passes through the piston A and orifice A is filled up in chamber A of the inside space and seat the plunger against the socket and the socket against the housing securely.



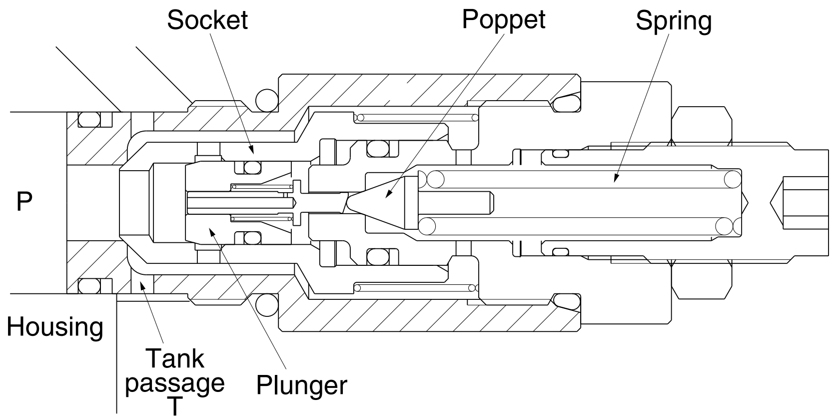
(2) When the pressure at port P becomes equal to the set pressure of the spring, the pressurized oil pushes open the poppet and flows to tank passage (T) through the plunger internal passage, orifice A, chamber A, periphery orifice B and hole E.



(3) Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).

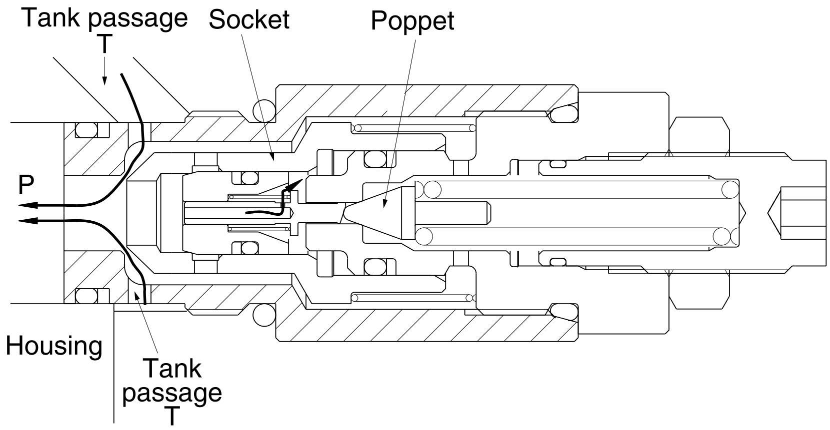


(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



MAKE-UP FUNCTION

(5) When negative pressure exists at port P, the oil is supplied through tank passage (T). When the pressure at tank passage (T) becomes higher than that of at port P, the socket moves in the right direction. Then, sufficient oil passes around the socket from tank passage (T) to port P and fills up the space.

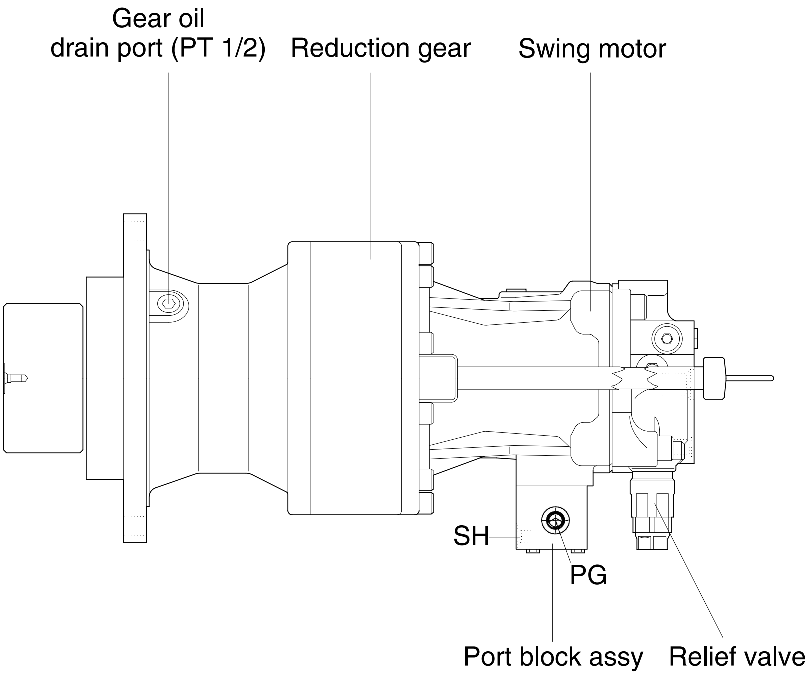


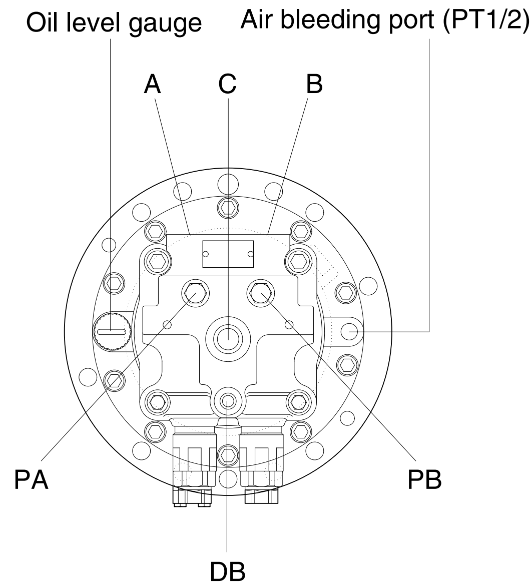
GROUP 3 SWING DEVICE

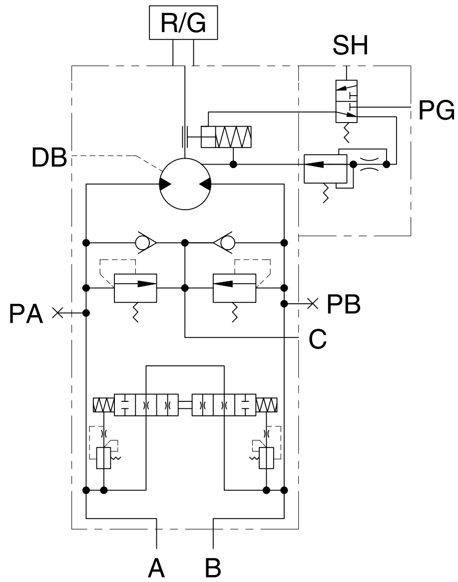
1. STRUCTURE

Swing device consists swing motor, and swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and port block assy.



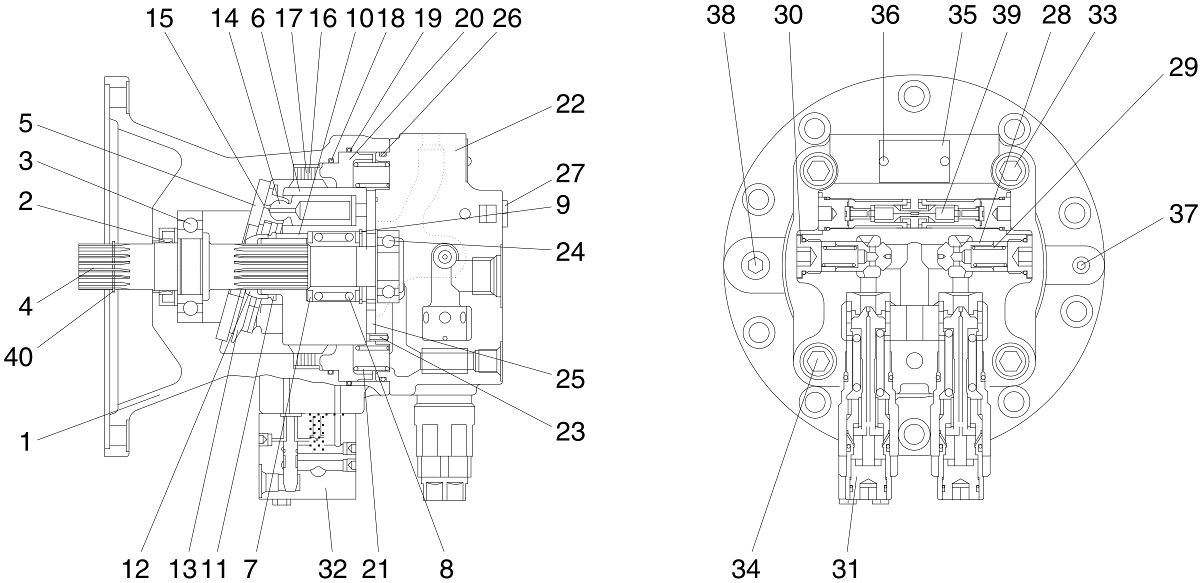




Hydraulic circuit

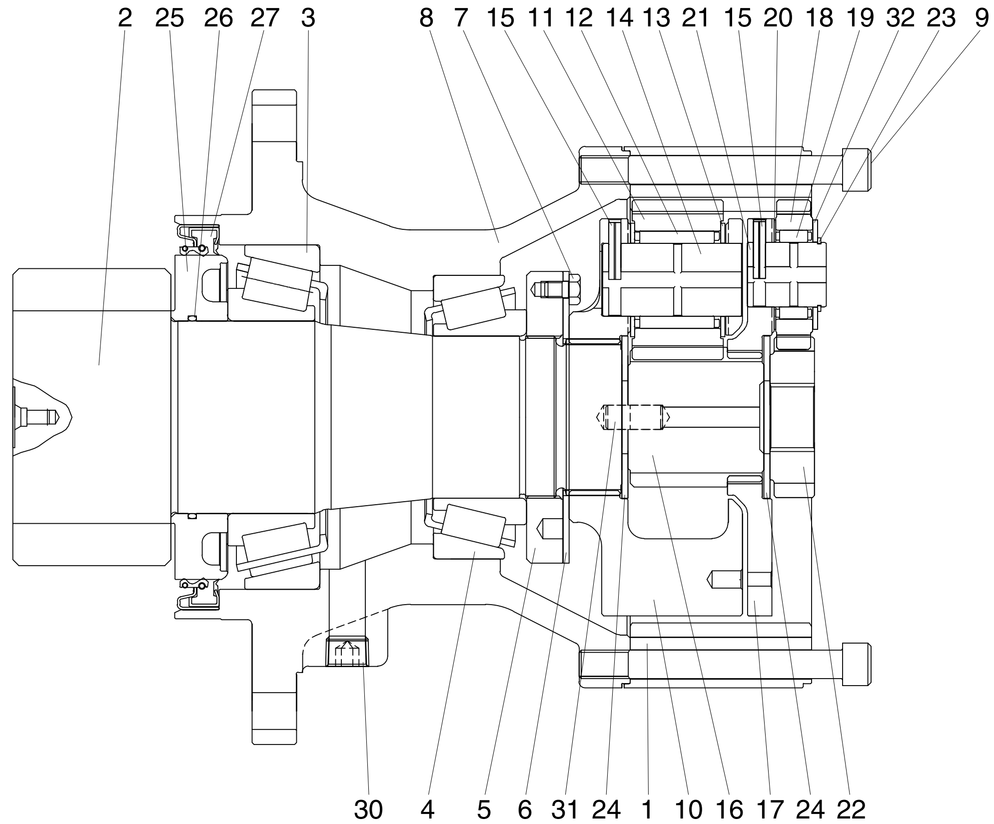
Port	Port name	Port size
A	Main port	Ø13
B	Main port	Ø13
DB	Drain port	PF 3/8
C	Make up port	PF 3/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4
PA, PB	Gauge port	PF 1/4

1) SWING MOTOR



No.	Part name
1	Casing
2	Oil seal
3	Ball bearing
4	Drive shaft
5	Shoe plate
6	Rotary block
7	Washer
8	Spring
9	Snap ring
10	Roller
11	Collar washer
12	Thrust ball
13	Retainer plate
14	Piston
15	Shoe
16	Separate plate
17	Friction plate
18	O-ring
19	O-ring
20	Brake piston
21	Spring
22	Valve casing
23	Spring pin
24	Ball bearing
25	Valve plate
26	O-ring
27	Plug assy
28	Plunger
29	Spring
30	Plug assy
31	Relief valve assy
32	Brake valve assy
33	Socket bolt
34	Socket bolt
35	Name plate
36	Screw
37	Plug
38	Plug
39	Reactionless valve assy
40	Snap ring

2) REDUCTION GEAR



1	Ring gear	11	Planetary gear No. 2	21	Carrier pin No. 1
2	Drive shaft	12	Needle bearing	22	Sun gear No. 1
3	Taper roller bearing	13	Thrust washer	23	Snap ring
4	Taper roller bearing	14	Carrier pin No. 2	24	Thrust plate
5	Ring nut	15	Spring pin	25	Sleeve
6	Lock plate	16	Sun gear No. 2	26	O-ring
7	Hexagon bolt	17	Carrier No. 1	27	Oil seal
8	Casing	18	Planetary gear No. 1	30	Socket plug
9	Socket bolt	19	Needle bearing	31	Parallel pin
10	Carrier No. 2	20	Thrust washer	32	Thrust washer

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a rotary block (6) through valve casing (22) of motor, and valve plate (25).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (14).

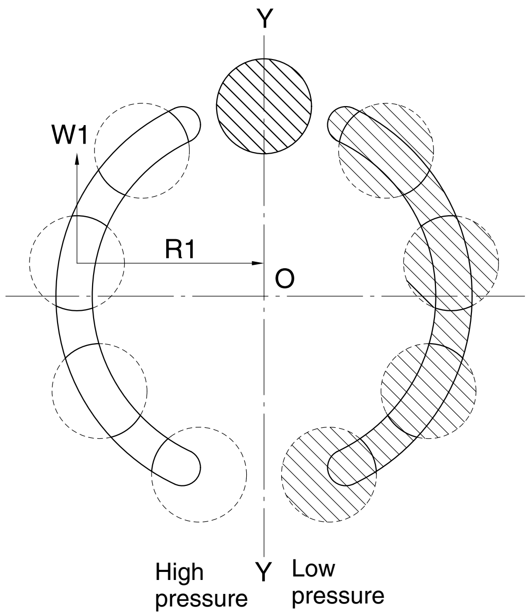
The high hydraulic can generate the force, $F1=P\times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

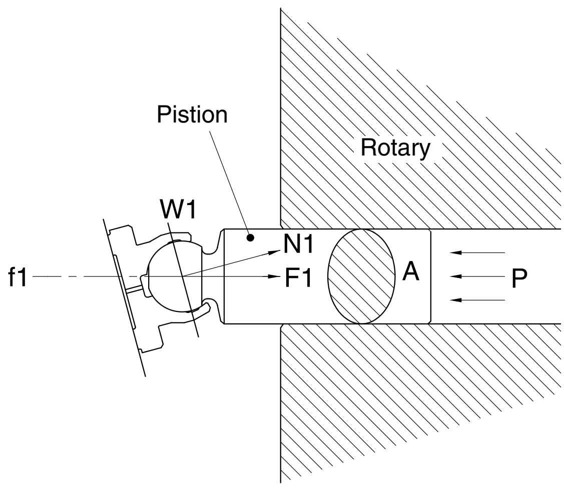
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α.

W1 generates torque, $T=W1+R1$, for Y-Y line connected by the upper and lower sides of the piston as following pictures.

The sum of torque ($\Sigma W1\times R1$), generated from each piston (4~5 pieces) on the side of a high hydraulic, generates the turning force.

This torque transfers the turning force to a rotary (6) through a piston; because a rotary is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.





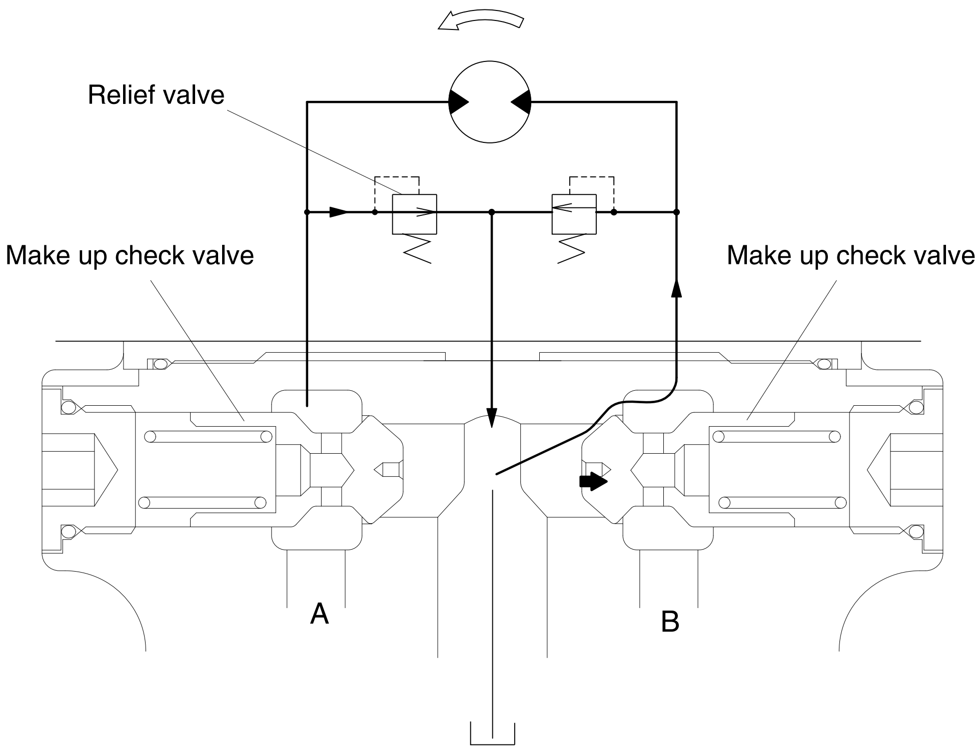
2) MAKE UP VALVE

In the system using this type of motor, there is no counterbalance functioning valve and there happens the case of revolution exceeding hydraulic supply of motor. To prevent the cavitation caused by insufficient oil flow there is a make up valve to fill up the oil insufficiency.

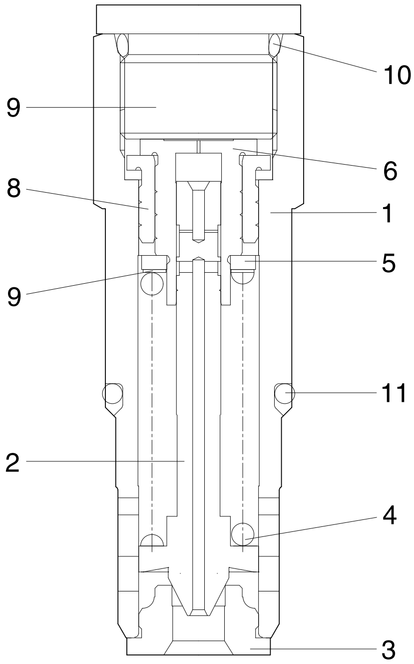
A make up valve is provided immediately before the port leading to the hydraulic oil tank to secure feed pressure required when the hydraulic motor makes a pumping action. The boost pressure acts on the hydraulic motor's feed port via the make up valve.

Pressurized oil into the port B, the motor rotate counterclockwise.

If the swing motion is stopped, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



3) RELIEF VALVE



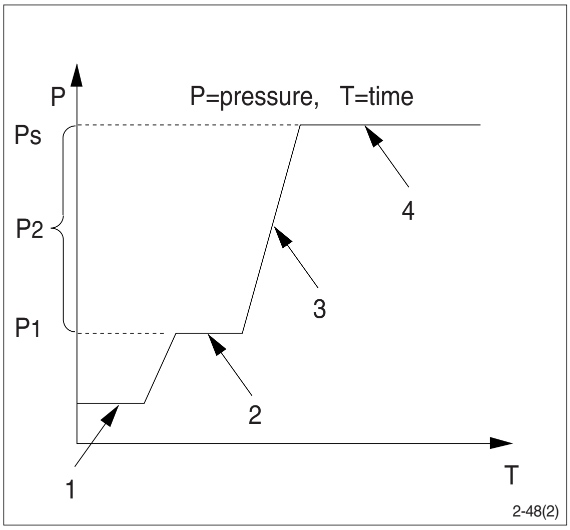
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

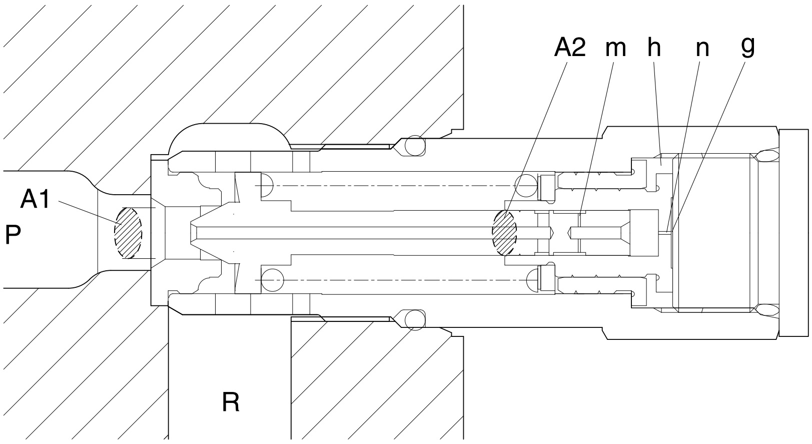
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

Figure illustrates how the pressure acting on the relief valve is related to its rising process. Here is given the function, referring to the figure following page.



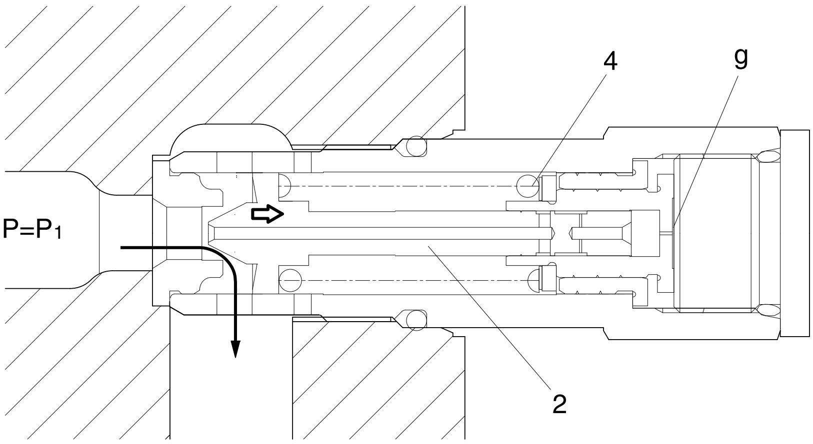
① Ports (P,R) at tank pressure.



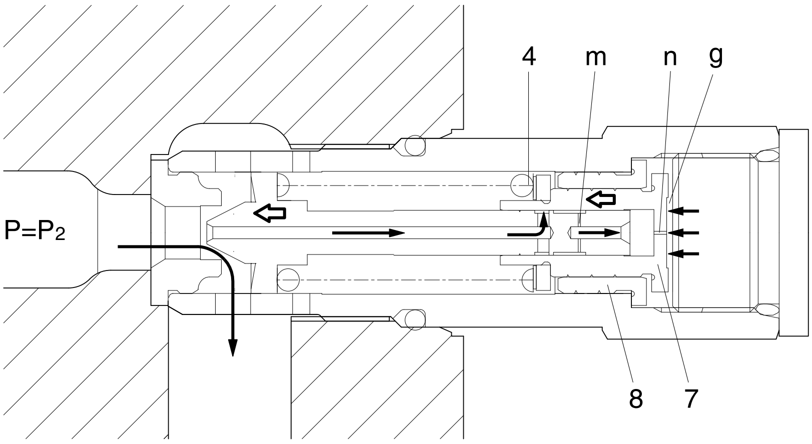
② When hydraulic oil pressure (P × A_1) reaches the preset force (F_{SP}) of spring (4), the poppet (2) moves to the right as shown.

$P_1 \times A_1 = Fsp + Pg \times A_2$

$$P_1 = \frac{Fsp + Pg \times A_2}{A_1}$$



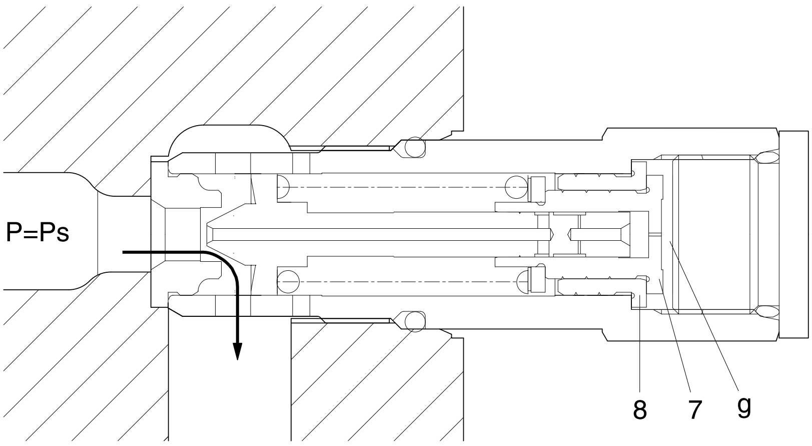
③ The oil flows into chamber (g) via orifice (m) and (n). When the pressure of chamber (g) reaches the preset force (F_{SP}) of spring (4), the piston (7) moves left and stop the piston (7) hits the bottom of stopper (8).



④ When piston (7) hits the bottom of stopper (8), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

$Ps \times A_1 = Fsp + Ps \times A_2$

$$Ps = \frac{Fsp}{A_1 - A_2}$$

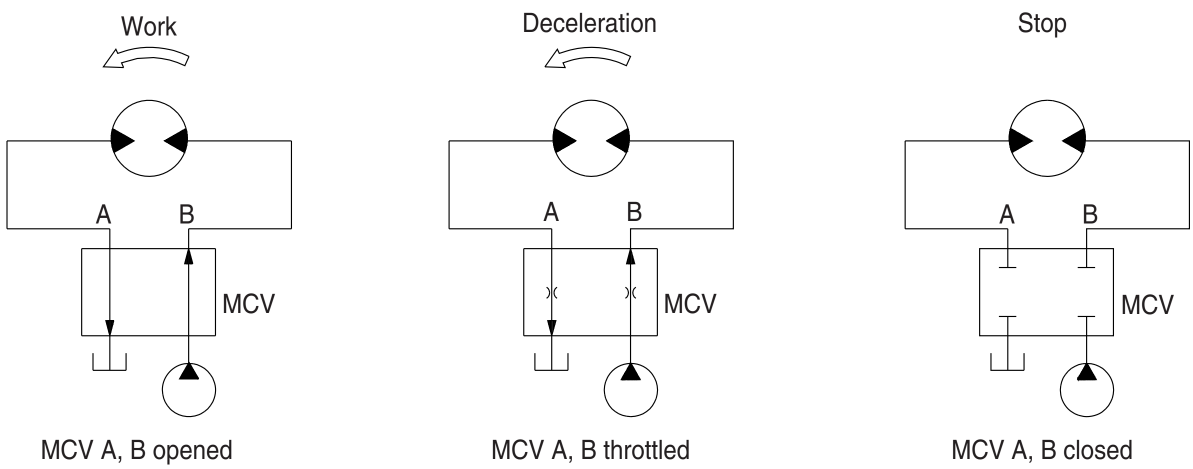


4) BRAKE SYSTEM

(1) Control valve swing brake system

This is the brake system to stop the swing motion of the excavator during operation.

In this system, the hydraulic circuit is throttled by the swing control valve, and the resistance created by this throttling works as a brake force to slow down the swing motion.



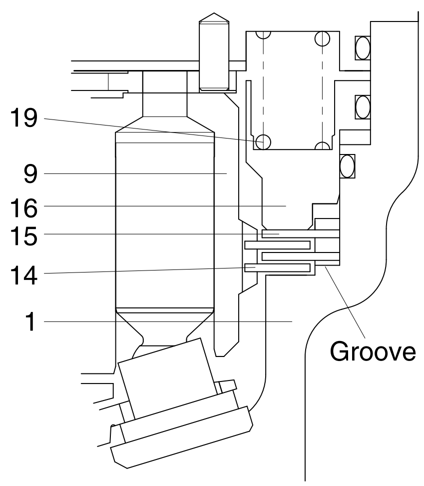
(2) Mechanical swing parking brake system

This is function as a parking brake only when any of the swing, arm in, travel and boom up function is not operated.

① Brake operation

Circumferential rotation of separate plate (15) is constrained by the groove located at body (1). When housing is pressed down by brake spring (19) through friction plate (14), separate plate (15) and parking piston (16), friction force occurs between friction plate and separate plate.

Friction force constrains motion of cylinder block (9). When hydraulic force exceeds spring force, brake is released.

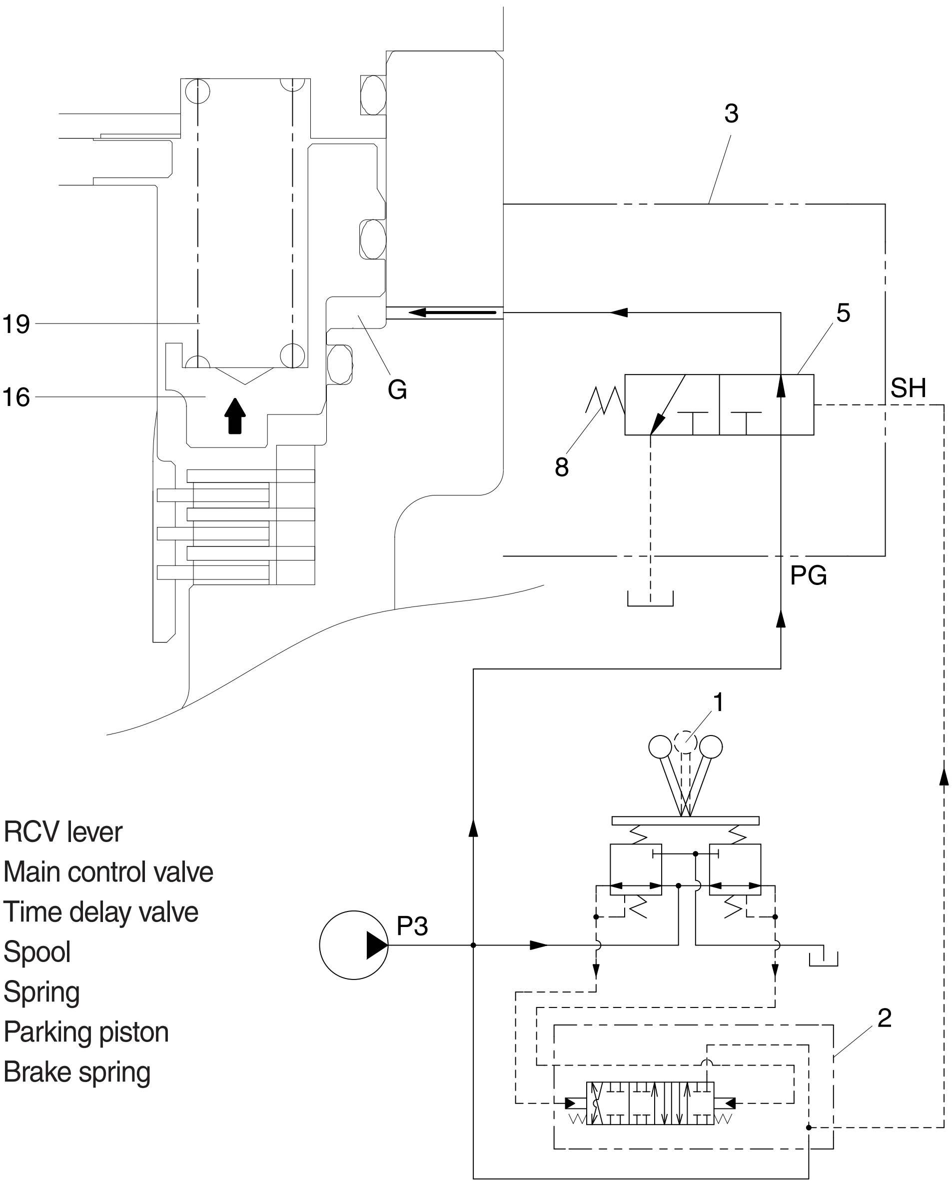


1	Body	15	Separate plate
9	Cylinder block	16	Parking piston
14	Friction plate	19	Brake spring

② Operating principle

a. When swing or arm in operation of the RCV lever (1) is tilted, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3).
This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the parking piston (16) to the upward against the force of the brake spring (19). Thus, it releases the brake force.

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the parking piston (16) is moved lower by spring (19) force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



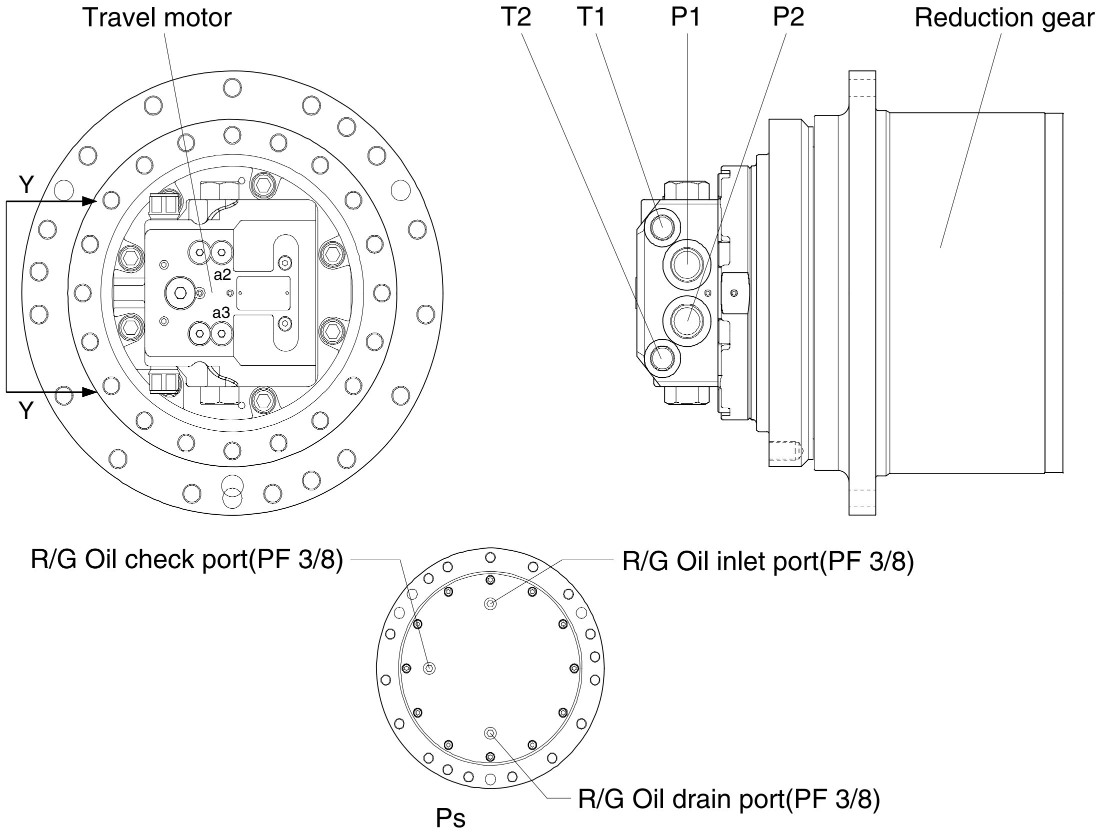
1	RCV lever
2	Main control valve
3	Time delay valve
5	Spool
8	Spring
16	Parking piston
19	Brake spring

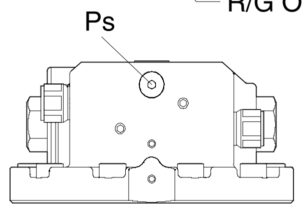
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

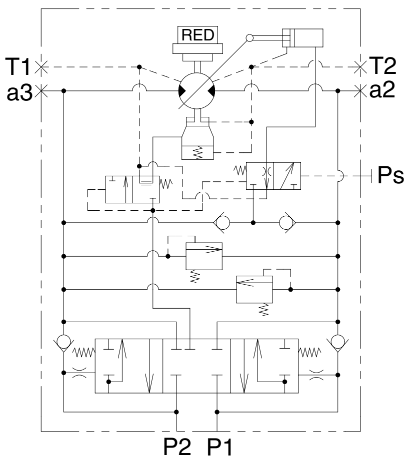
Travel device consists travel motor and gear box.

Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.





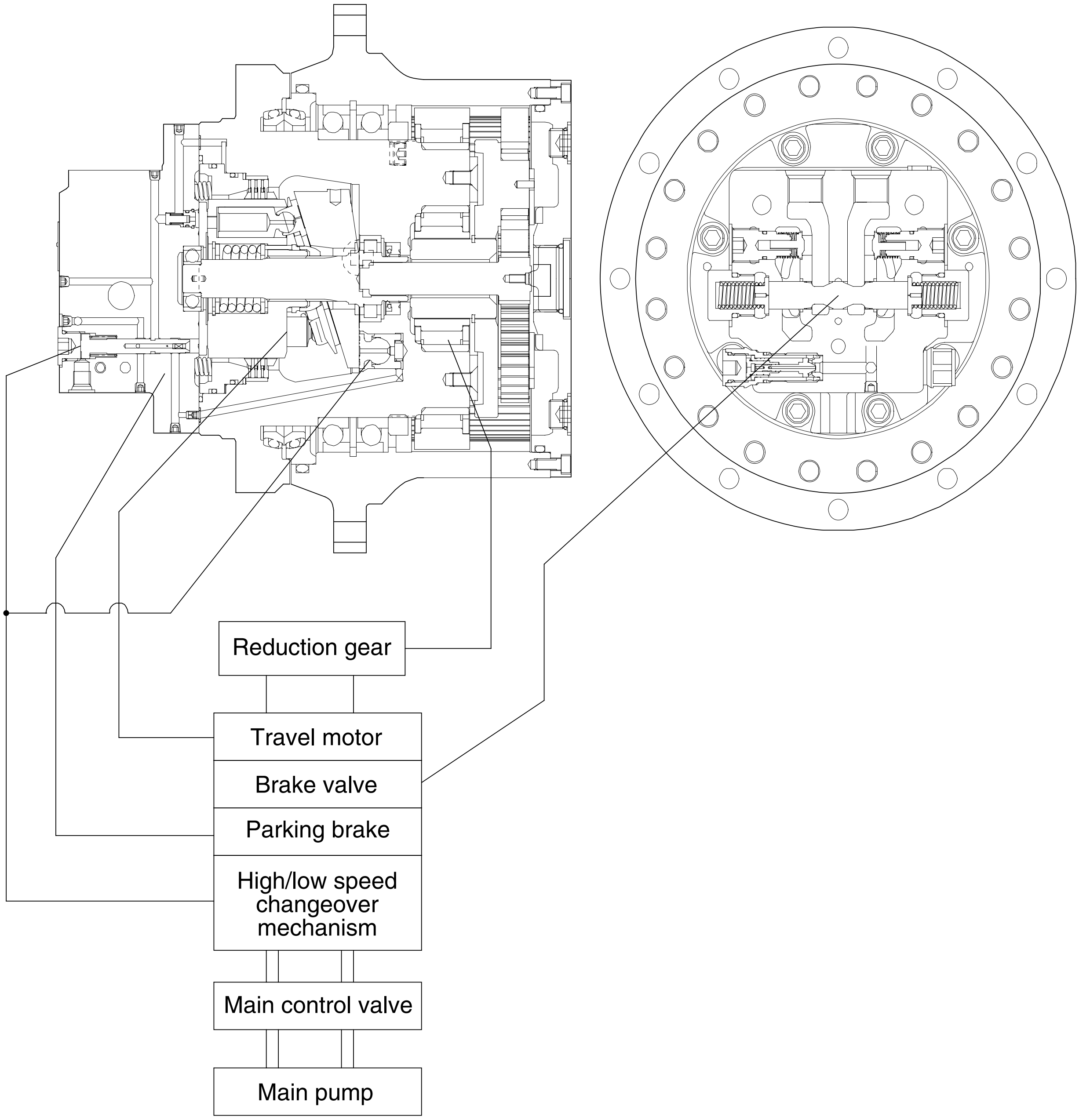
VIEW Y



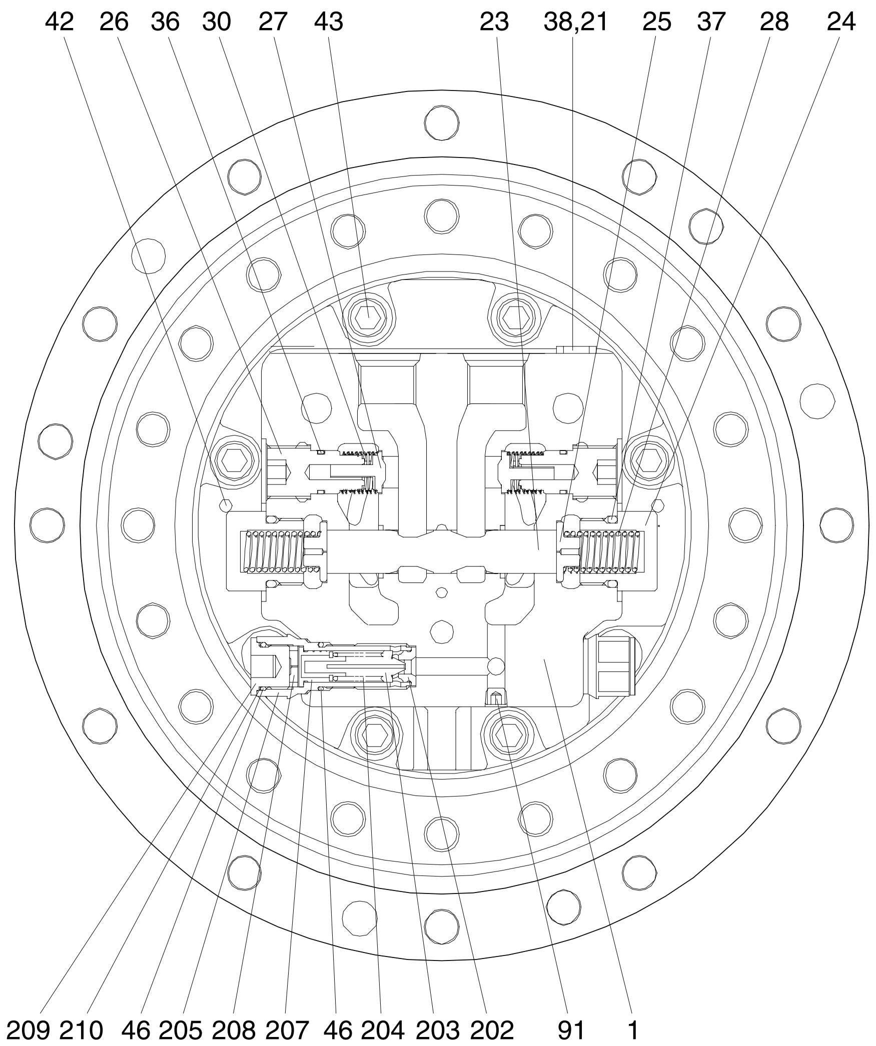
Hydraulic circuit

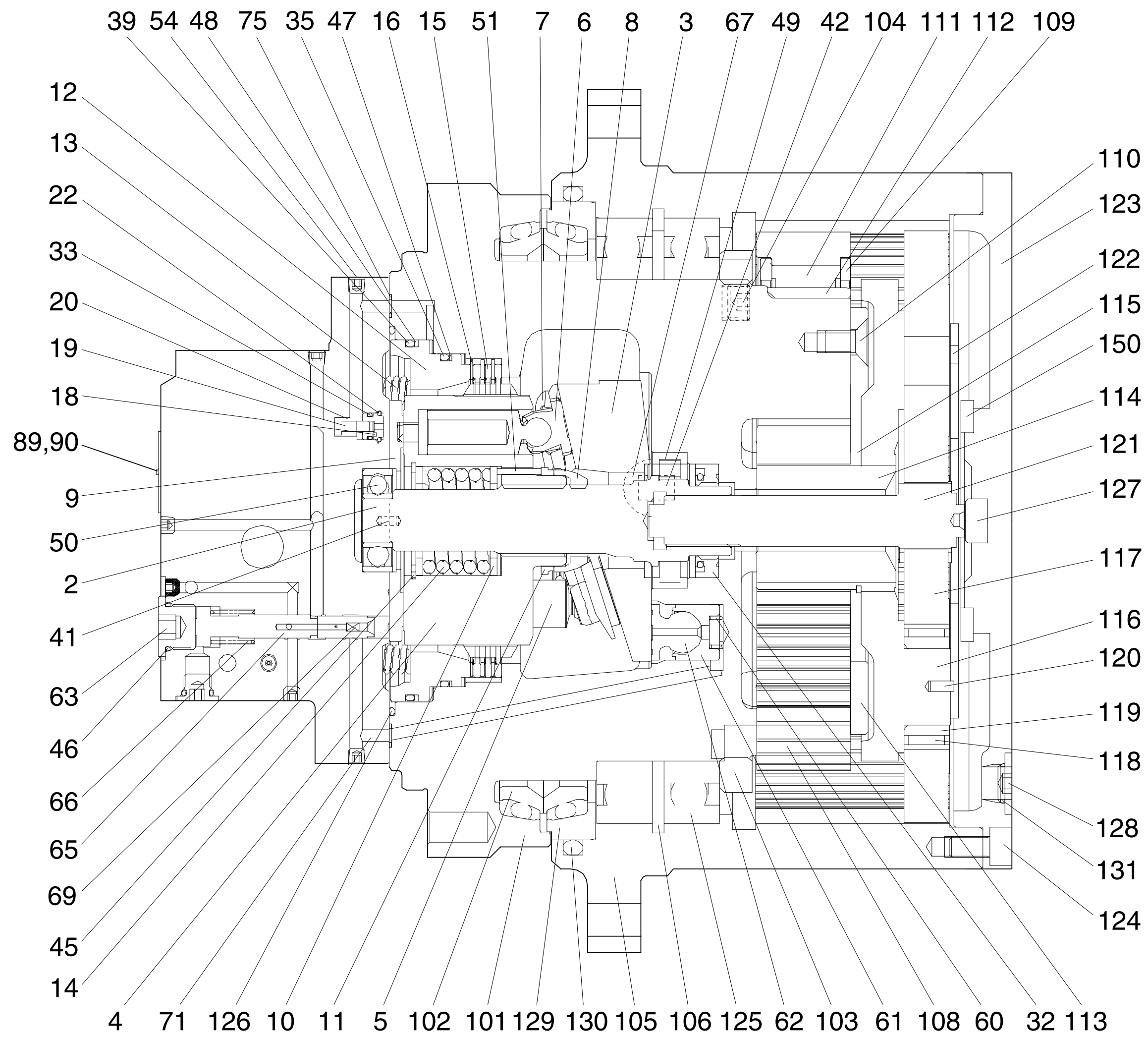
Port	Port name	Port size
P1	Main port	PF 3/4
P2	Main port	PF 3/4
a2, a3	Gauge port	PF 1/4
T1, T2	Drain port	PF 1/2
Ps	Parking brake release port	PF 1/4

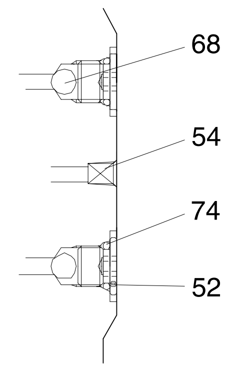
1) BASIC STRUCTURE



2) STRUCTURE







SECTION A - A

No.	Part name
1	Rear flange
2	Shaft
3	Swash plate
4	Cylinder block
5	Piston
6	Shoe
7	Retainer plate
8	Thrust ball
9	Timing plate
10	Washer
11	Washer-collar
12	Piston-parking
13	Spring
14	Spring
15	Friction plate
16	Mating plate
18	Seat valve
19	Valve
20	Spring
21	Plug
22	Ring
23	Main spool
24	Main plug
25	Retainer spring
26	Check plug
27	Check valve
28	Main spring
30	Check spring
32	Oil seal
33	O-ring
35	O-ring
36	O-ring
37	O-ring
38	O-ring
39	O-ring
41	Parallel pin
42	Parallel pin
43	Socket bolt
45	Snap ring
46	O-ring
47	Back up-ring
48	Back up-ring
49	Roller bearing
50	Ball bearing
51	Roller
52	Plug
54	Plug
60	Spring
61	Piston
62	Shoe
63	Plug
65	2 Speed spool
66	2 Speed spring
67	Pivot
68	Steel ball
69	Set screw
71	Orifice
74	O-ring
75	O-ring
89	Name plate
90	Set screw
91	Plug
101	Spindle
102	Floating seal
103	Nut ring
104	Plug
105	Hub
106	Snap ring
108	Planetary gear
109	Thrust washer
110	Screw
111	Needle bearing
112	Collar
113	Thrust plate
114	Sun gear
115	Snap ring
116	Holder
117	Planetary gear
118	Needle bearing
119	Inner race
120	Spring pin
121	Drive gear
122	Thrust plate
123	Cover
124	Socket bolt
125	Angular bearing
126	O-ring
127	Thrust washer
128	Plug
129	Seal ring
130	O-ring
131	O-ring
150	Thrust plate
205	Body
206	Shim
207	Piston
208	Rod
209	Plug
210	Back up-ring

2. HYDRAULIC MOTOR ASSEMBLY

With brake valve, parking brake and high/low speed changeover mechanism.

1) FUNCTION

(1) Hydraulic motor

This hydraulic motor is a swash plate type piston motor and converts the force of pressurized oil delivered from the pump into a rotational movement.

(2) Brake valve

This brake valve is incorporated in the hydraulic motor assembly and has the following four functions.

① Smoothly brakes and stops the motor by controlling inertial rotation of the motor due to inertia of the main body.

② Check valve function to prevent cavitation of the hydraulic motor.

③ Relief valve function to control the brake pressure of hydraulic motor and anti-cavitation valve function to prevent cavitation.

④ Opens a port which releases the parking brake force upon running of the motor and closes the upon stopping.

(3) Parking brake

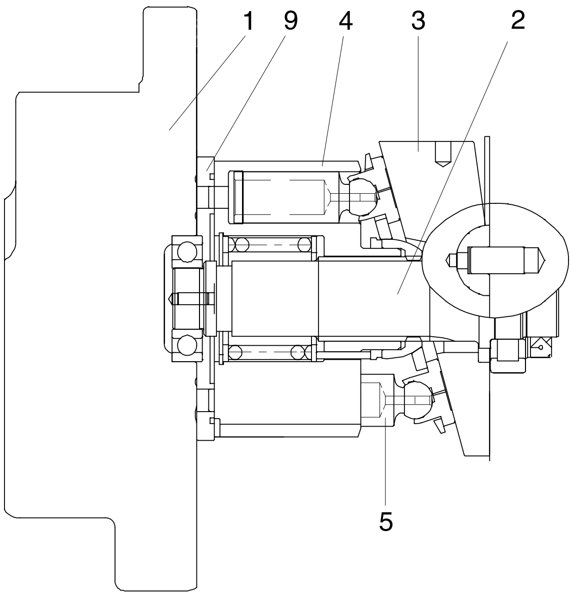
The parking brake prevents overrunning or slippage upon parking or stopping the machine on a slope with friction plate type brake mechanism, and combined with the hydraulic motor assembly into an integral structure.

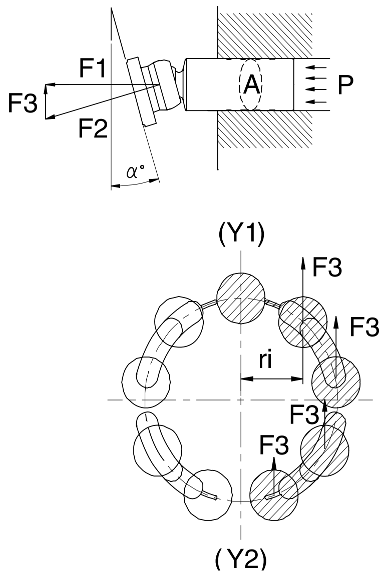
(4) High/low speed changeover mechanism

This mechanism changes over the tilt angle of swash plate between high-speed/low-torque rotation and low-speed/high-torque rotation with the changeover valve and control piston.

2) OPERATING PRINCIPLE

(1) Hydraulic motor





The pressurized oil delivered from the hydraulic pump flows to rear flange (1) of the motor, passes through the brake valve mechanism and is introduced into cylinder block (4) via timing plate (9). This oil constructively introduced only to one side of (Y1) - (Y2) connecting the upper and lower dead points of stroke of piston (5). The pressurized oil fed to one side in cylinder block (4) pushes each piston (5) (four or five) and generates a force (F kgf = P kgf/cm^2 × A cm^2). This force acts on swash plate (3) and is resolves into components (F2 and F3) because swash plate (3) is fixed at an angle (α ˚) with the axis of drive shaft (2). Radial component (F3) generates respective torques (T = F3 × ri) for (Y1) - (Y2). This residual of torque (T = S (F3 × ri)) rotates cylinder block (4) via piston (5). Cylinder block (4) is spline coupled with drive shaft (2). So the drive shaft (2) rotates and the torque is transmitted.

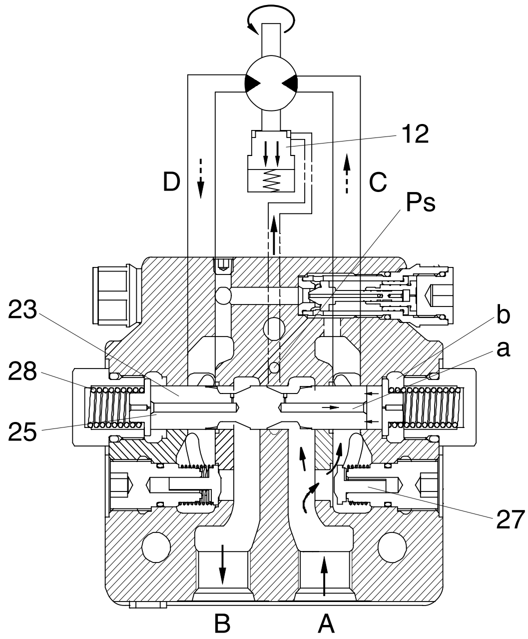
(2) Brake valve

① Brake released

When the pressurized oil supplied from port (A), the oil opens valve (27) and flows into port (C) at the suction side of hydraulic motor to rotate motor.

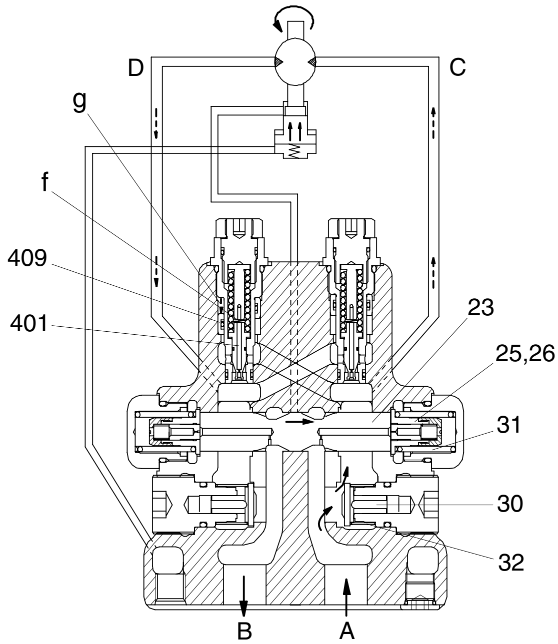
At the same time, the pressurized oil passes through pipe line (a) from a small hole in spool (23) and flow into chamber (b). The oil acts on the end face of spool (23) which is put in neutral position by the force of spring (28), thus causing spool (23) to slide to the left. When spool (23) slides, port (D) on the passage return side of hydraulic motor, which is closed by the spool groove during stoppage, communicates with port (B) at the tank side and the return oil from the hydraulic motor runs into the tank. In consequence, the hydraulic motor rotates.

Moreover, sliding of spool (23) causes the pressurized oil to flow into ports (P) and (S). The pressurized oil admitted into port (P) activates piston (12) of the parking brake to release the parking brake force. (For details, refer to description of the parking brake.) When the pressurized oil is supplied from port (B), spool (23) and valve (27) move reversely and the hydraulic motor also rotates reversely.



② **Stopping and stalling** (brake applied)

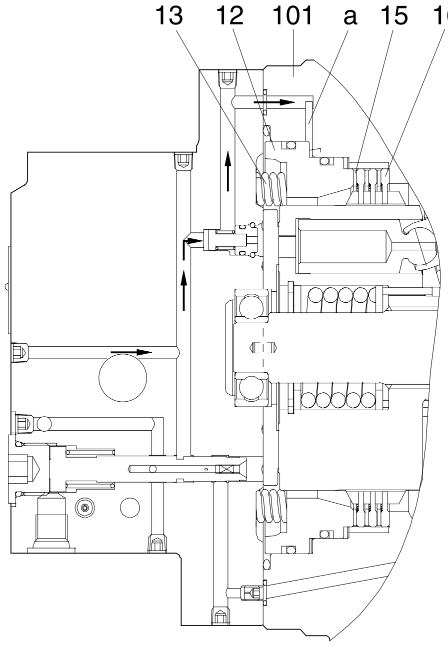
When the pressurized oil supplied from port (A) is stopped during traveling, no hydraulic pressure is applied and spool (23) which has slid to the left will return on the right (neutral) via stopper (25, 26) by the force of spring (31). At the same time, the hydraulic motor will rotate by the inertia even if the pressurized oil stopped, so the port (D) of the motor will become high pressure. This pressurized oil goes from chamber (f) to chamber (g) through the left-hand valve (401). When the oil enters chamber (g), the piston (409) slides to the right so as not to rise the pressure, as shown in the figure. Meanwhile, the left-hand valve (401) is pushed open by the pressurized oil in port (D). Therefore, the pressurized oil in port (D) flows to port (C) at a relatively low pressure, controlling the pressure in port (D) and preventing cavitation in port (C). When the piston (409) reaches the stroke end, the pressure in chamber (g) and (f) increase and the left-hand valve (401) closes again, allowing the oil pressure in port (D) to increase further. Then, the right-hand valve opens port (C) with pressure higher than that machine relief set pressure. In this way, by controlling the pressure in port (D) in two steps, the hydraulic motor is smoothly braked and to a stop.



(3) Parking brake

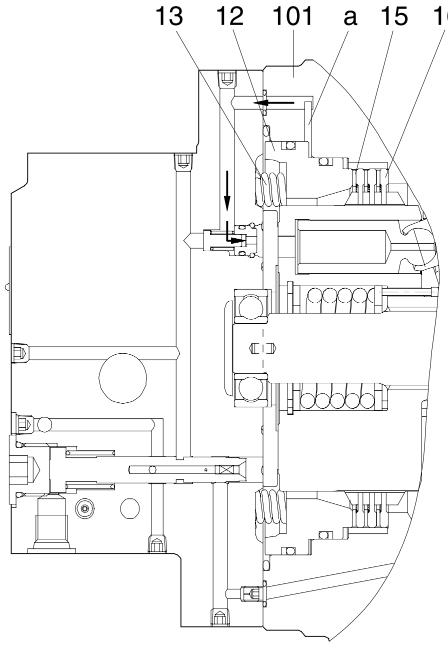
① Running

When the pressurized oil is supplied from the valve, the spool of brake valve in the hydraulic motor assembly actuates to open the passage to the parking brake and the pressurized oil is introduced into cylinder chamber (a) which is composed of the spindle of reduction gear assembly and piston (12). When the hydraulic pressure reaches 9.5 kgf/cm^2 or more, it overcomes the force of spring (13) and shifts piston (12). With shift of piston (12), no pressing force is applied to mating plate (16) and friction plate (15) and movement of friction plate (15) becomes free. Whereby the brake force to the cylinder in the hydraulic motor assembly is released.



② Stopping

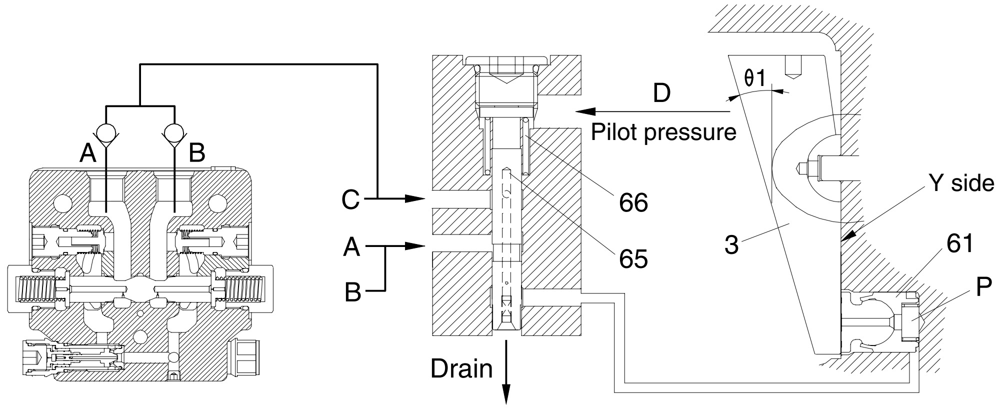
When the pressurized oil from the brake valve is shut off and the pressure in cylinder chamber (a) drops 9.5 kgf/cm^2 or less, piston (12) will return by the force of spring (13). Piston (12) is pushed by this force of spring (13), and mating plate (16) and friction plate (15) in free condition are pressed against the spindle of reduction gear assembly. The friction force produced by this pressing stops rotation of the cylinder and gives a braking torque 19.7 kgf · m to the hydraulic motor shaft. Note that oil control through a proper oil passage ensures smooth operation.



(4) High/low speed changeover mechanism

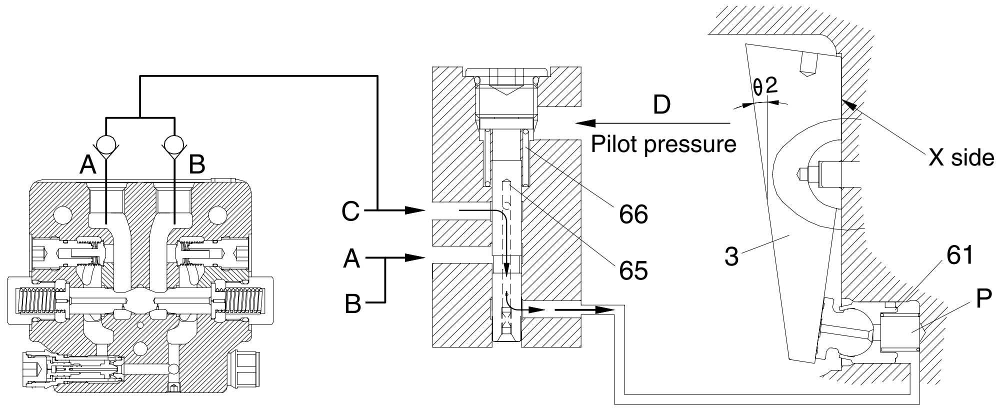
① **At low speed -** pilot pressure of less than 10 kgf/cm²

When no pilot pressure is supplied from (D) (at a pressure of 10 kgf/cm² or less), valve (65) is pressed toward the top by the force of spring (66) and (A) port or (B) port, the pressurized oil supply port (C) is shut off, and oil in chamber (P) is released into the motor case via valve(65). Consequently, swash plate (3) is tilted at a maximum angle (θ 1) and the piston displacement of hydraulic motor becomes maximum, thus leading to low-speed rotation.



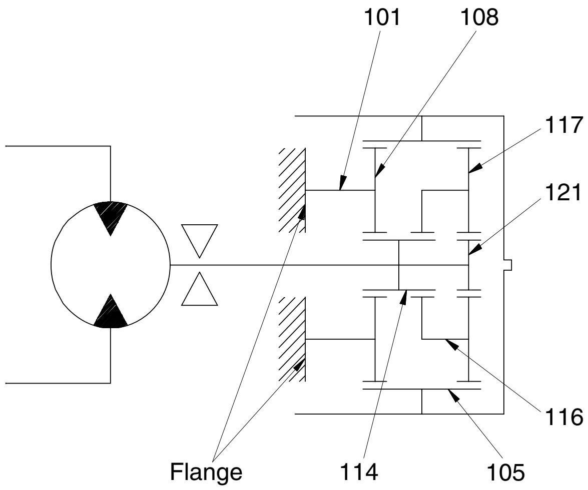
② **At high speed -** pilot pressure of 10 kgf/cm² or more

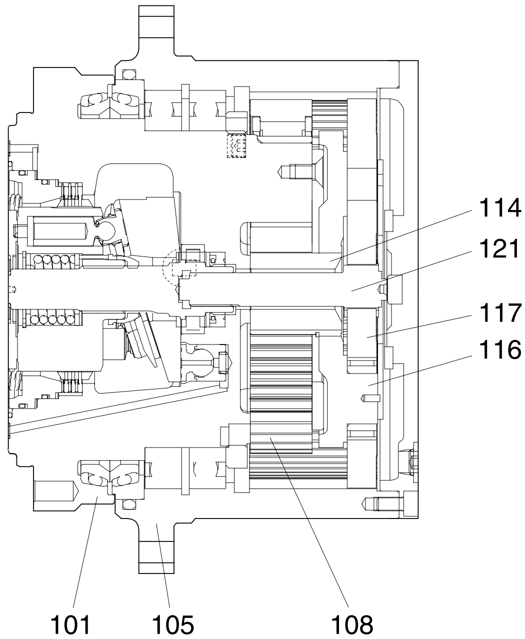
When a pilot pressure is supplied from port (D) (at a pressure of 20 kgf/cm² or more), the pressure overcomes the force of spring (66) and (A) port or (B) port of valve (65) is pressed toward the down. The pressurized oil at supply port (C) is then introduced into chamber (P) via valve (65). Piston (61) pushes up swash plate (3) until it touches side Y of the spindle. At this time, swash plate (3) is tilted at a minimum angle (θ 2) and the piston displacement of hydraulic motor becomes minimum, thus leading to high-speed rotation.



3. REDUCTION GEAR

1) The reduction gear is composed of a two-stage planetary gear mechanism shown in the following figure.





2) The rotating motion of the hydraulic motor is transmitted to drive gear (121) of 1st stage, and the drive gear rotate planetary gears (R, 117). Then planetary gears (R, 117) revolves inside fixed hub (105). This rotation becomes the output of 1st stage and is transmitted to carrier No.1 and sun gear (114). Similarly the revolution of planetary gears (F, 108) are transmitted to spindle (101). Then planetary gears (F, 108) do not revolve, but rotate to hub (105). Therefore, the rotating case is driven by the overall driving torque of hub (105).

This reduction ratio is expressed as shown below :

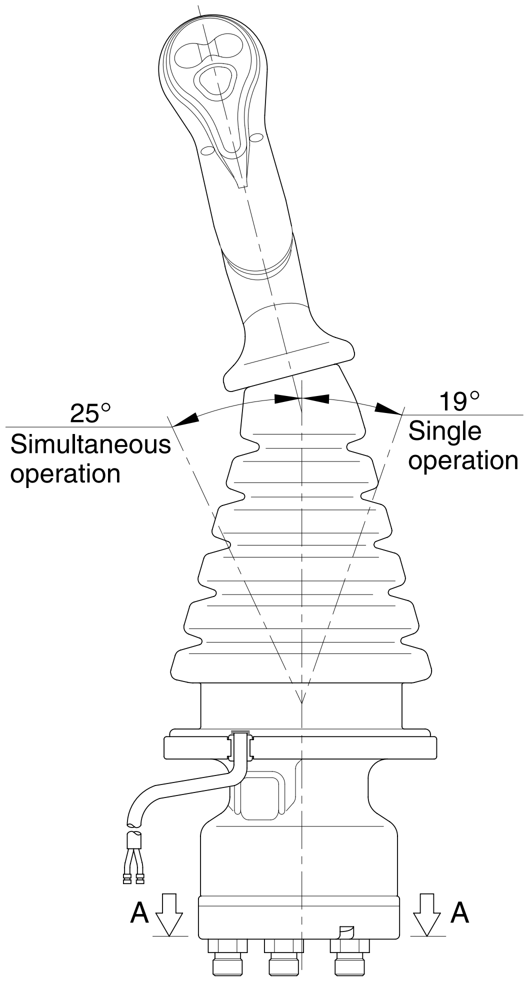
· Reduction ratio (I) = (Hub teeth / Drive gear teeth + 1) x (Hub teeth / Sun gear teeth + 1) - 1

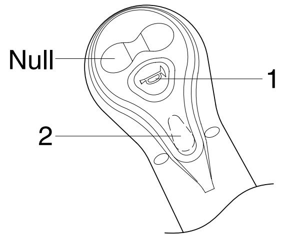
GROUP 5 RCV LEVER

1. STRUCTURE

The casing has the oil inlet port P (primary pressure) and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.

※ **Refer to the parts manual for the types of the RCV lever.**

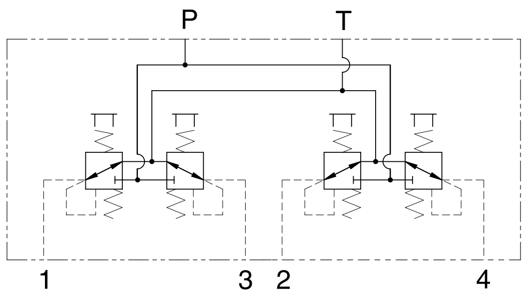




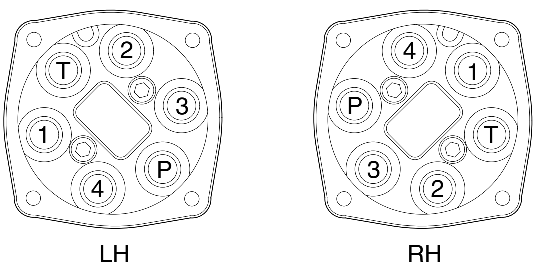
M2

Switches

Type	No.	LH	RH
M2	1	One touch decel	Horn
	2	Power boost	Breaker



Hydraulic circuit

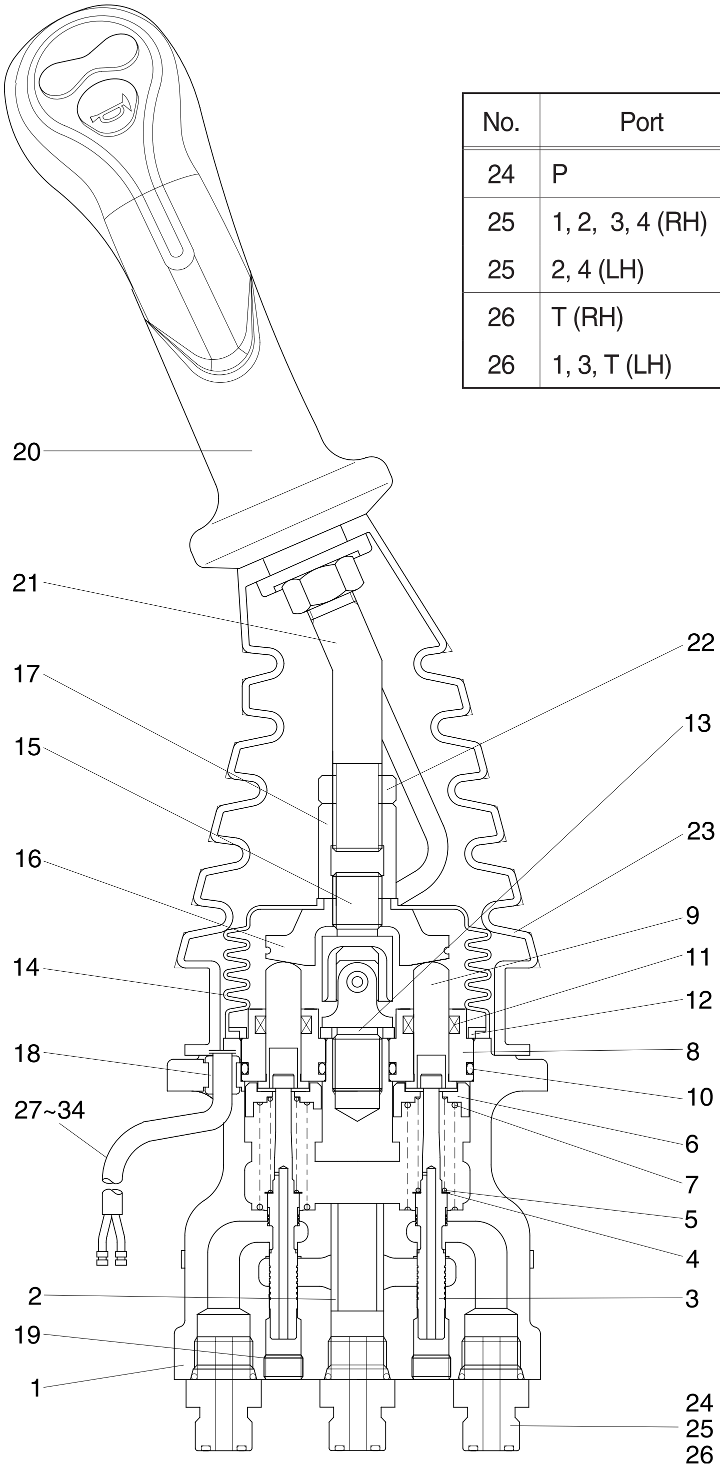


VIEW A-A

Pilot ports

Port	LH	RH	Port size
P	Pilot oil inlet port	Pilot oil inlet port	PF 3/8
T	Pilot oil return port	Pilot oil return port	
1	Left swing port	Bucket out port	
2	Arm out port	Boom up port	
3	Right swing port	Bucket in port	
4	Arm in port	Boom down port	

3) CROSS SECTION



No.	Port
24	P
25	1, 2, 3, 4 (RH)
25	2, 4 (LH)
26	T (RH)
26	1, 3, T (LH)

1 Case
2 Bushing
3 Spool
4 Shim
5 Spring
6 Spring seat
7 Spring
8 Plug
9 Push rod
10 O-ring
11 Rod seal
12 Plate
13 Spacer
14 Boot
15 Joint assembly
16 Swash plate
17 Adjusting nut
18 Bushing
19 Plug
20 Handle assembly
21 Handle bar
22 Nut
23 Boot
24 Last guard filter
25 Connector
26 Connector
27 Connector
28 Connector
29 Connector
30 Connector
31 Small guide
32 Connector
33 Big guide
34 Connector

Item numbers are based on the type M1.

The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (3), spring (5) for setting secondary pressure, return spring (7), spring seat (6) and shim (4). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (9) by the return spring.

When the push rod is pushed down by tilting the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve that controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure (secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

(1) Inlet port (P) where oil is supplied from hydraulic pump.

(2) Output ports (1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.

(3) Tank port (T) necessary to control the above output pressure.

(4) Spool to connect output port to inlet port or tank port.

(5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type M1.

The functions of the spool (3) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output port pressure oil to tank port T.

The spring (5) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (9) is inserted and can slide in the plug (8).

For the purpose of changing the displacement of the push rod through the swash plate (16) and adjusting nut (17) are provided the handle assy (20) that can be tilted in any direction around the fulcrum of the universal joint (15) center.

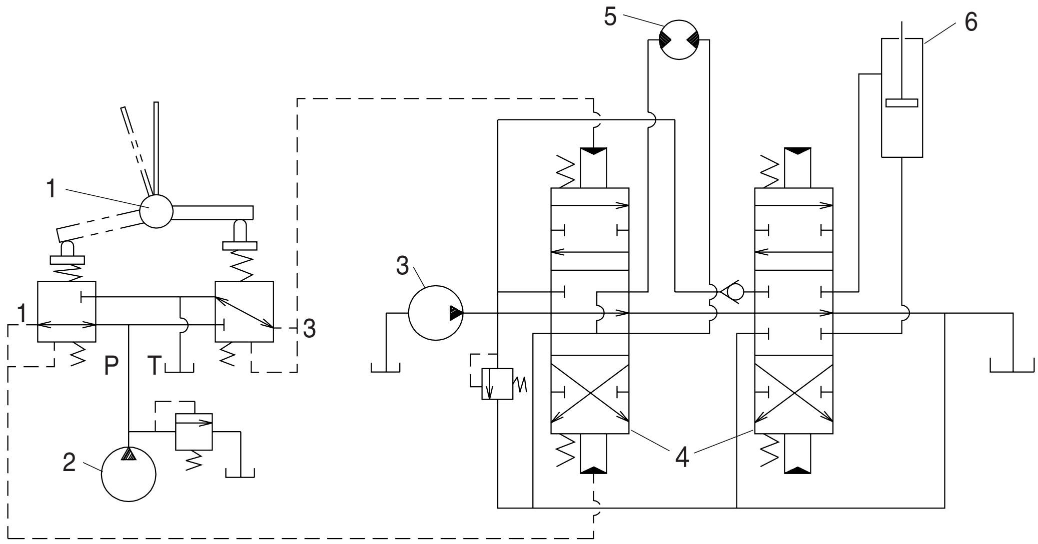
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

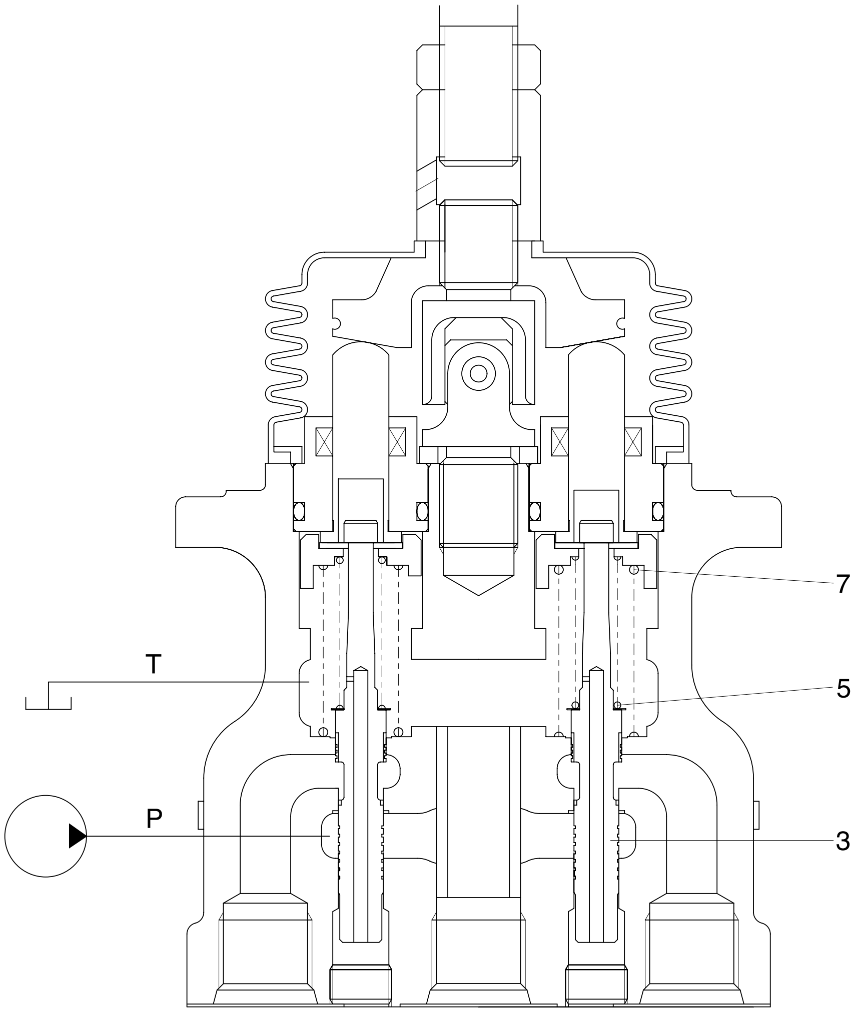
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

The diagram shown below is the typical application example of the pilot valve.



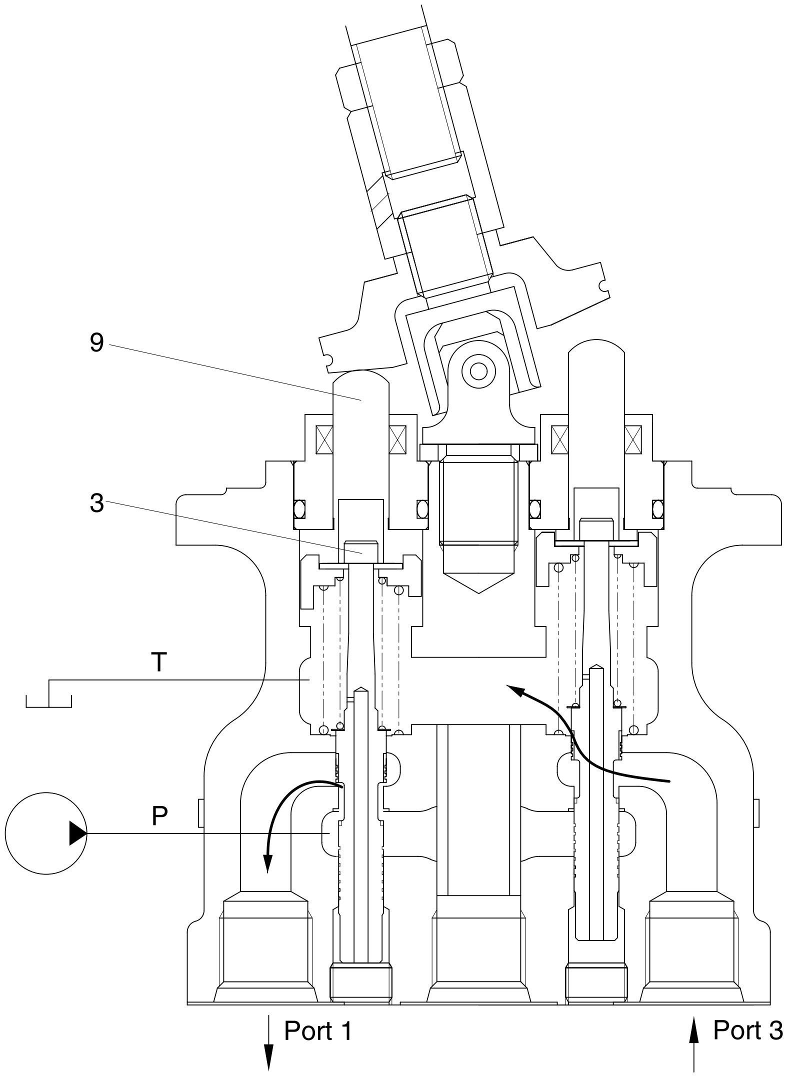
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle is in neutral position



The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (3). Therefore, the spool is pushed up by the spring (7) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where handle is tilted

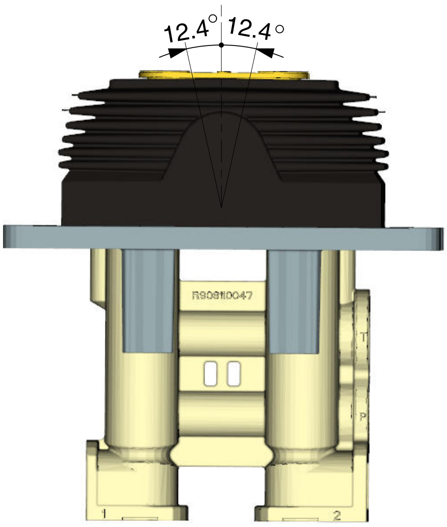


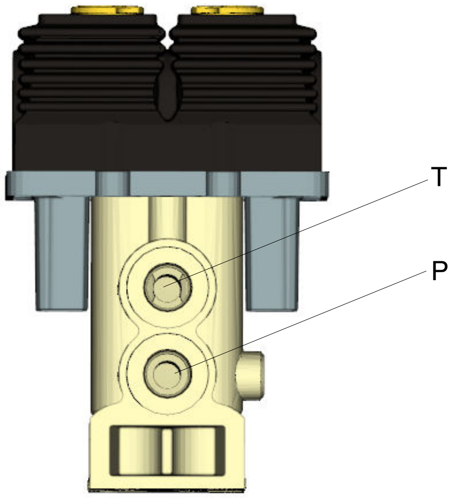
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port (1) increases higher than the set pressure, port P is disconnected from port (1) and port T is connected with port (1). If it decreases lower than the set pressure, port P is connected with port (1) and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with the inside bottom of the push rod and the output pressure is left to be connected with port P.

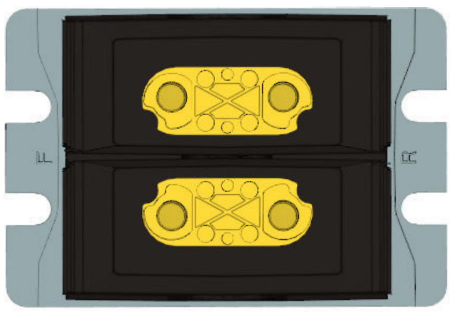
GROUP 6 RCV PEDAL

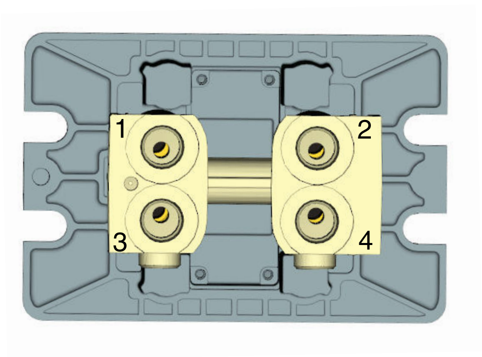
1. STRUCTURE

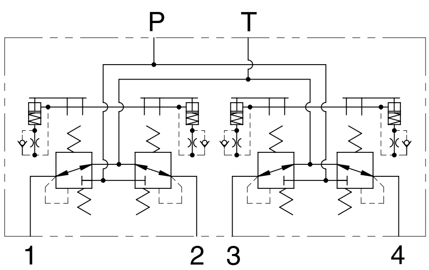
The casing (spacer) has the oil inlet port P (primary pressure), and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.











Hydraulic circuit

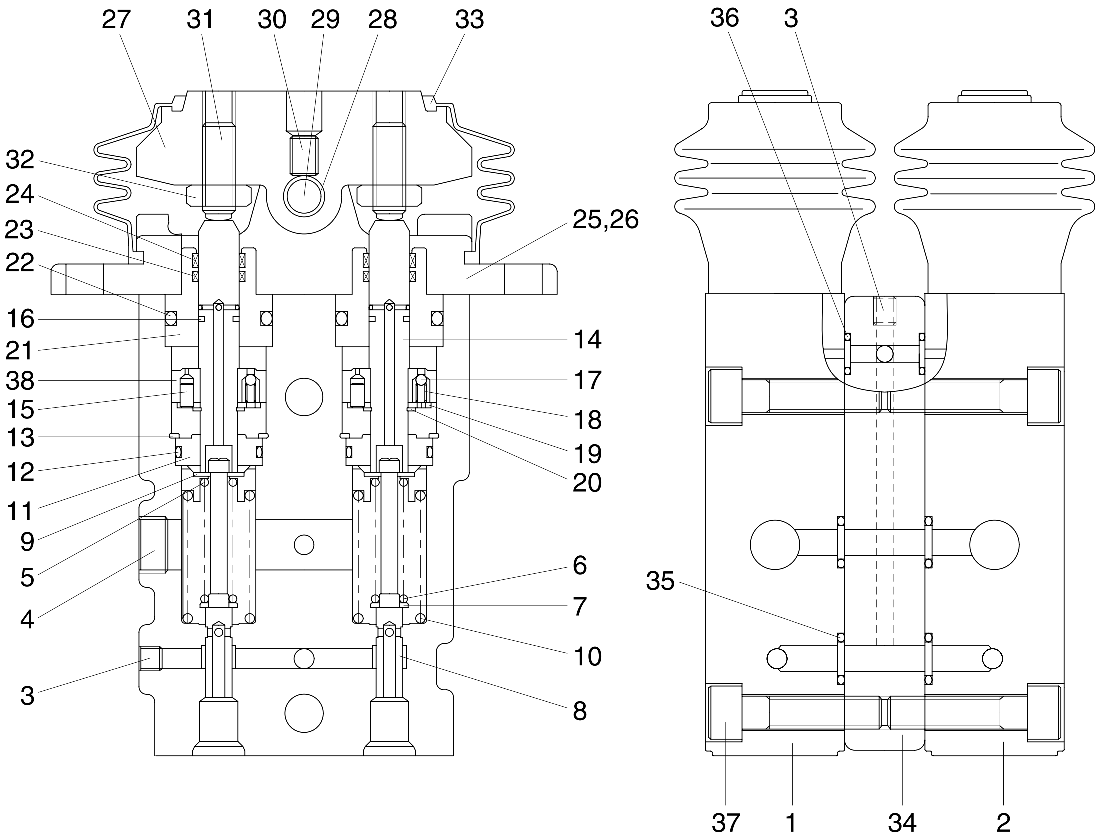
Port	Port	Port size
P	Pilot oil inlet port	G 1/4
T	Pilot oil return port	
1	Travel (LH, Forward)	
2	Travel (LH, Backward)	
3	Travel (RH, Forward)	
4	Travel (RH, Backward)	

CROSS SECTION

The construction of the RCV pedal is shown in the below drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool (8), spring (6) for setting secondary pressure, return spring (10), stopper (9), and spring seat (7). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 19 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (14) by the return spring.

When the push rod is pushed down by tilting pedal, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.



1	Body(1)	14	Push rod	27	Cam
2	Body(2)	15	Spring pin	28	Bushing
3	Plug	16	Seal	29	Cam shaft
4	Plug	17	Steel ball	30	Set screw
5	Spring seat	18	Spring	31	Set screw
6	Spring	19	Plate	32	Nut
7	Spring seat	20	Snap ring	33	Bellows
8	Spool	21	Plug	34	Space
9	Stopper	22	O-ring	35	O-ring
10	Spring	23	Rod seal	36	O-ring
11	Rod guide	24	Dust seal	37	Socket bolt
12	O-ring	25	Cover	38	Piston
13	Snap ring	26	Socket bolt		

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure (secondary pressure) of the pilot valve to the other end.

For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

(1) Inlet port (P) where oil is supplied from hydraulic pump.

(2) Output port (1, 2, 3 & 4) to apply pressure supplied from inlet port to ends of control valve spools.

(3) Tank port (T) necessary to control the above output pressure.

(4) Spool to connect output port to inlet port tank port.

(5) Mechanical means to control output pressure, including springs that work on the above spools.

2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool (8) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.

The spring (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (14) is inserted and can slide in the plug (21).

For the purpose of changing th displacement of the push rod through the cam (27) and adjusting nut (32) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

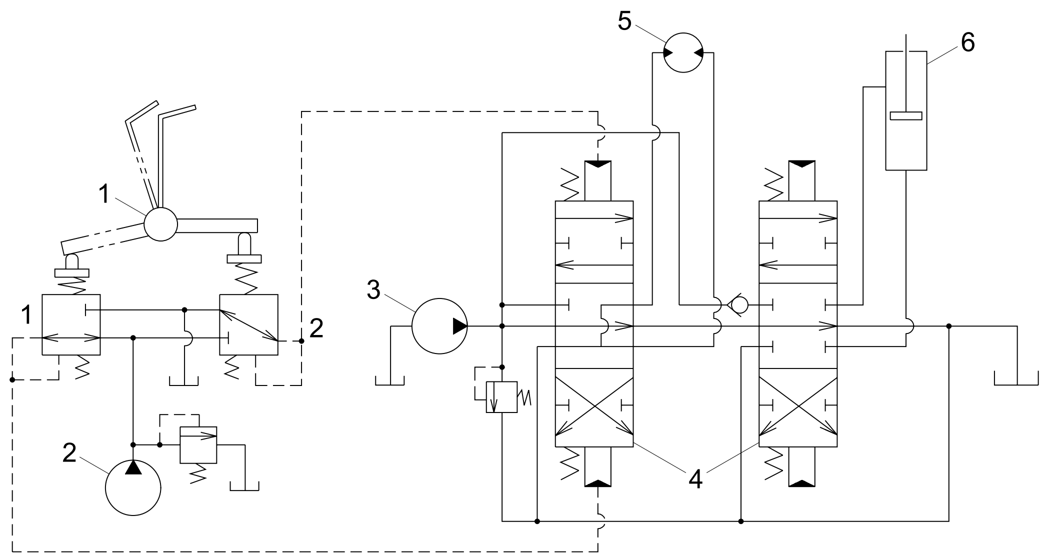
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

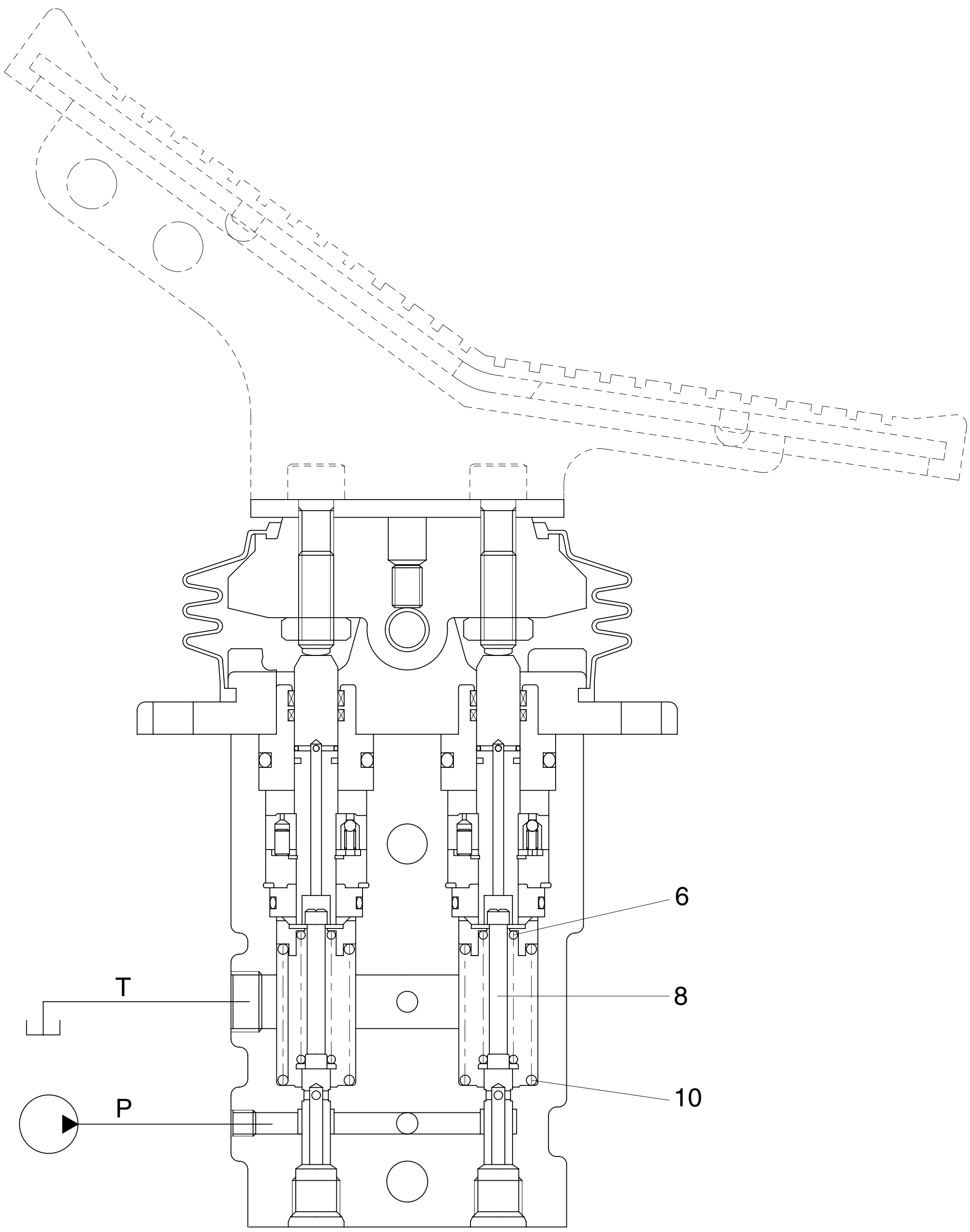
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

The diagram shown below is the typical application example of the pilot valve.



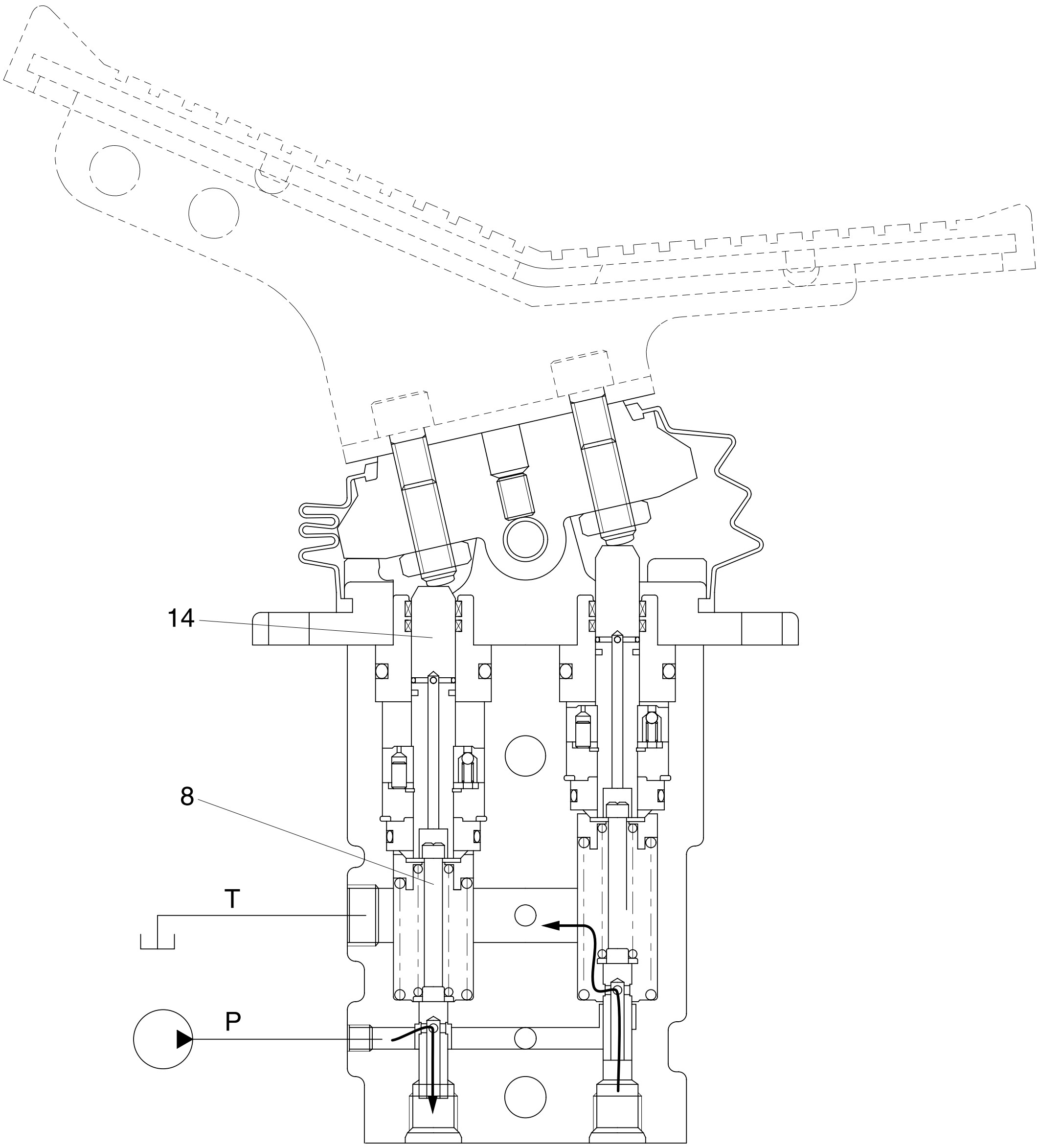
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (8). Therefore, the spool is pushed up by the spring (10) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted



When the push rod (14) is stroked, the spool (8) moves downwards.

Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.

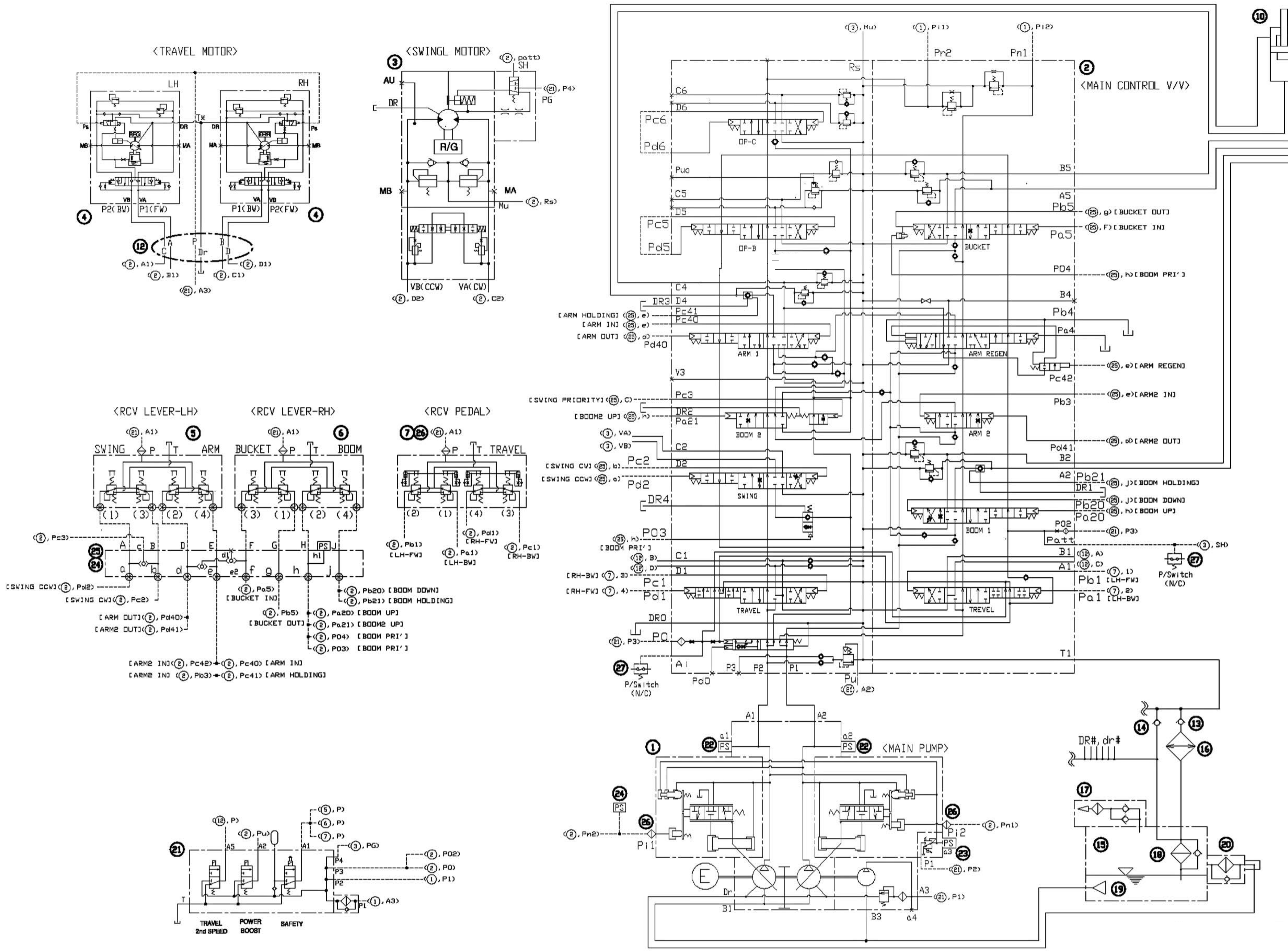
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.

In this manner the secondary pressure is kept at the constant value.

Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

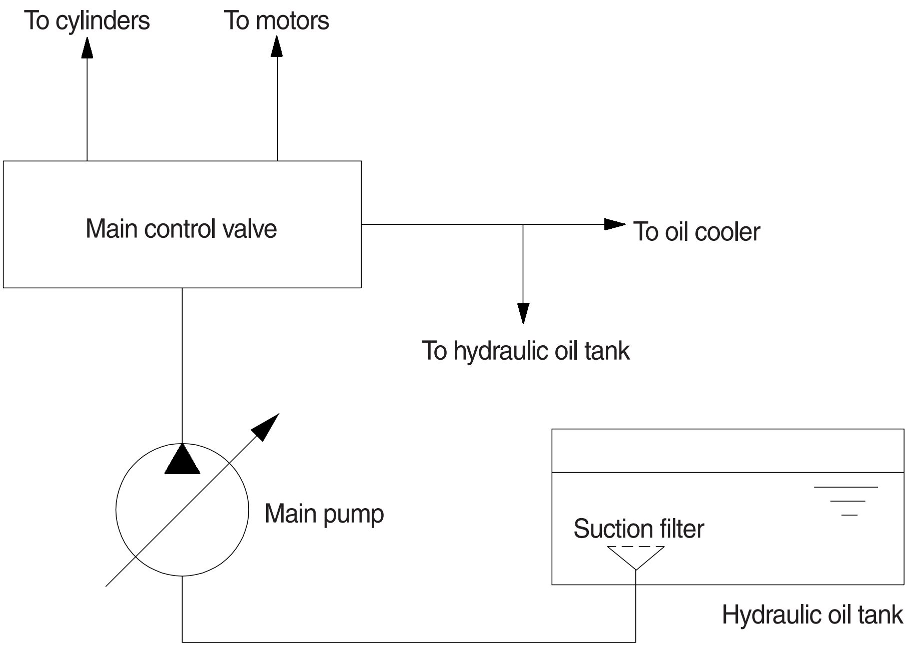


	NO	PARTS NO.	PART NAME	Q'TY	REMARK
STANDARD	27	31E5-40500	PRESS. SWITCH	2	N/Closed
	26	31N6-25060	LAST G. FILTER	3	
	25	31Q6-20600	BLOCK-SHUTTLE	1	
	24	31Q4-40830	PRESS. SENSOR	2	50K
	23	31Q4-40820	PRESS. SENSOR	1	100K
	22	31Q4-40800	PRESS. SENSOR	2	500K
	21	31Q4-20090	ACCUMULATOR	1	31Q6-25010
			3-CARTR' V/V	1	
			PILOT FILTER	1	31Q6-20340
	20	31K6-01310	DRAIN FILTER	1	
	19	31Q4-01090	STRAINER ASSY	1	
	18	31RF-10100	ELEMENT-RETURN	1	
		E131-0256	BYPASS V/V	1	
	17	31EE-02100	AIR BREATHER	1	
	16	1BQ4-43010	OIL COOLER	1	
	15	31Q4-01412	HYD. TANK ASSY	1	
	14	31E9-0142	CHECK V/V	1	3. 0K
	13	31ER-11111	CHECK V/V	1	1. 5K
	12	31Q4-40302	TURNING JOINT	1	
	11	31Q4-60114GG	BUCKET CYL.	1	
	10	31Q4-50132GG	ARM CYL.	1	
	9	31Q4-50121GG	BOOM CYL. -RH	1	
	8	31Q4-50111GG	BOOM CYL. -LH	1	
	7	3BN6-20010	RCV PEDAL	1	Rexroth
	6	3BQ4-20320	RCV LEVER(RH)	1	HENG LI
	5	3BQ4-20310	RCV LEVER(LH)	1	
	4	3TA4-40030	TRAVEL MOTOR ASS'Y	2	DOOSAN
	3	HSA4-01000	SWING MOTOR ASS'Y	1	DOOSAN
	2	31Q4-10310	MAIN CONTROL V/V	1	PARKER
	1	31Q4-10030	MAIN PUMP	1	FLUTEK

GROUP 2 MAIN CIRCUIT

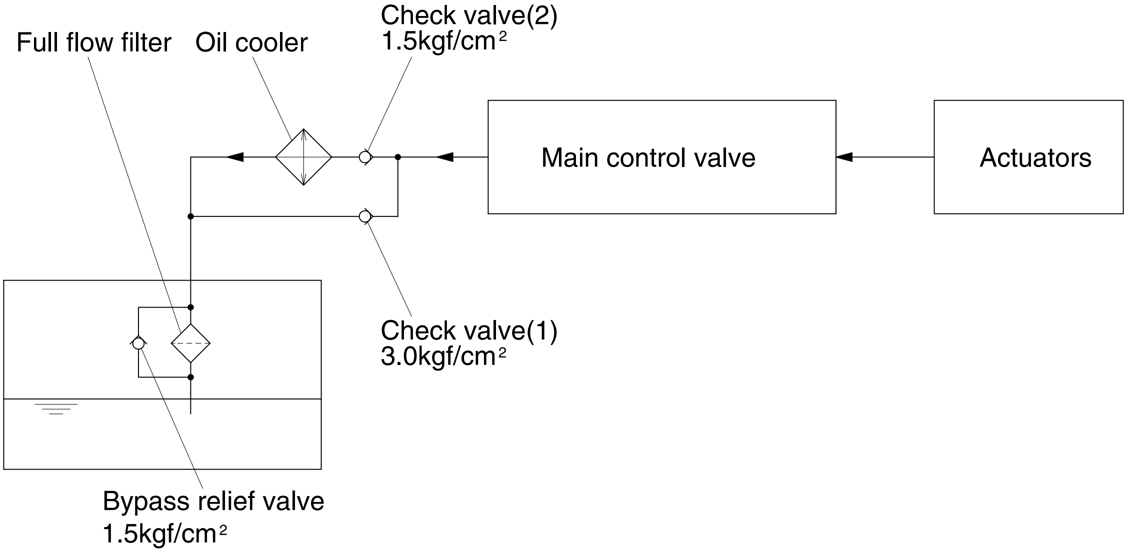
The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit.
The hydraulic system consists of one main pump, one control valve, one swing motor, four cylinders and two travel motors.
The swash plate type variable displacement tandem axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

1. SUCTION AND DELIVERY CIRCUIT



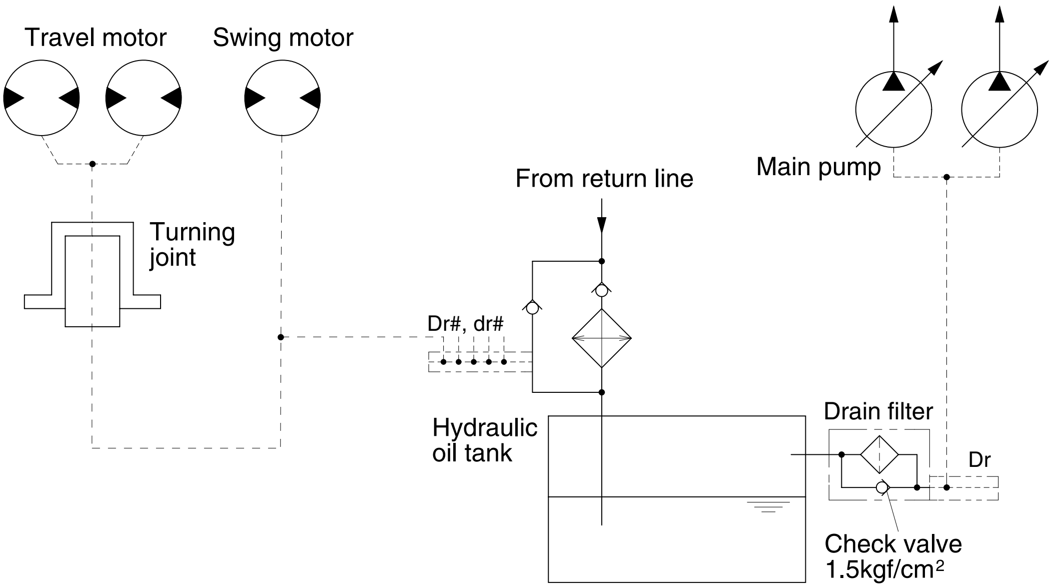
The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.
The oil discharged from the main pump flows to the actuators through the control valve.
The control valve controls the hydraulic functions.
The return oil from the actuators flows to the hydraulic tank through the control valve and the oil cooler.

2. RETURN CIRCUIT



All oil from each actuator returns to the hydraulic tank through the control valve.
The bypass check valves are provided in the return circuit.
The setting pressure of bypass check valves are 1.5 kgf/cm^2 (21psi) and 3.0 kgf/cm^2 (43psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. The oil pressure exceeds 3.0 kgf/cm^2 (43psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).
The full-flow filter and bypass relief valve are provided in the hydraulic tank.
The oil from right and left side of control valve is combined and filtered by the return filter. A bypass relief valve is provided in the full-flow filter.
When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm^2 (21psi) differential pressure.

3. DRAIN CIRCUIT



Besides internal leaks from the motors and main pump, the oil for lubrication circulates. These oil have to be fed to the hydraulic tank passing through drain filter.
When the drain oil pressure exceed 1.5 kgf/cm^2 (21psi), the oil returns to the hydraulic tank directly.

1) TRAVEL MOTOR DRAIN CIRCUIT

Oil leaking from the right and left travel motors comes out of the drain ports provided in the respective motor casing and join with each other. These oils pass through the turning joint and return to the hydraulic tank after being filtered by drain filter.

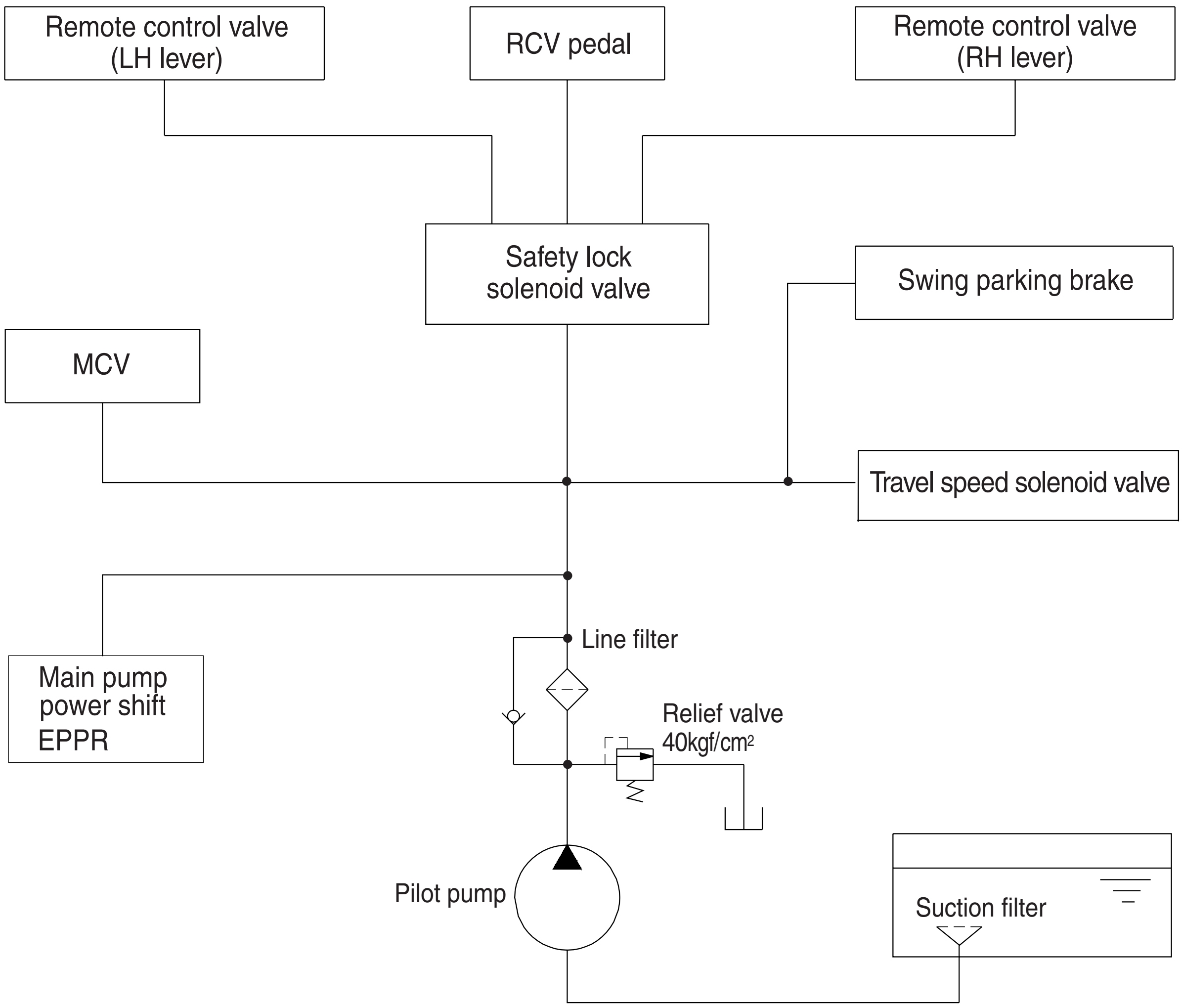
2) SWING MOTOR DRAIN CIRCUIT

Oil leaking from the swing motor come out and return to the hydraulic tank passing through a drain filter.

3) MAIN PUMP DRAIN CIRCUIT

Oil leaking from main pump come out and return to the hydraulic tank passing through drain filter.

GROUP 3 PILOT CIRCUIT



The pilot circuit consists of suction circuit, delivery circuit and return circuit.

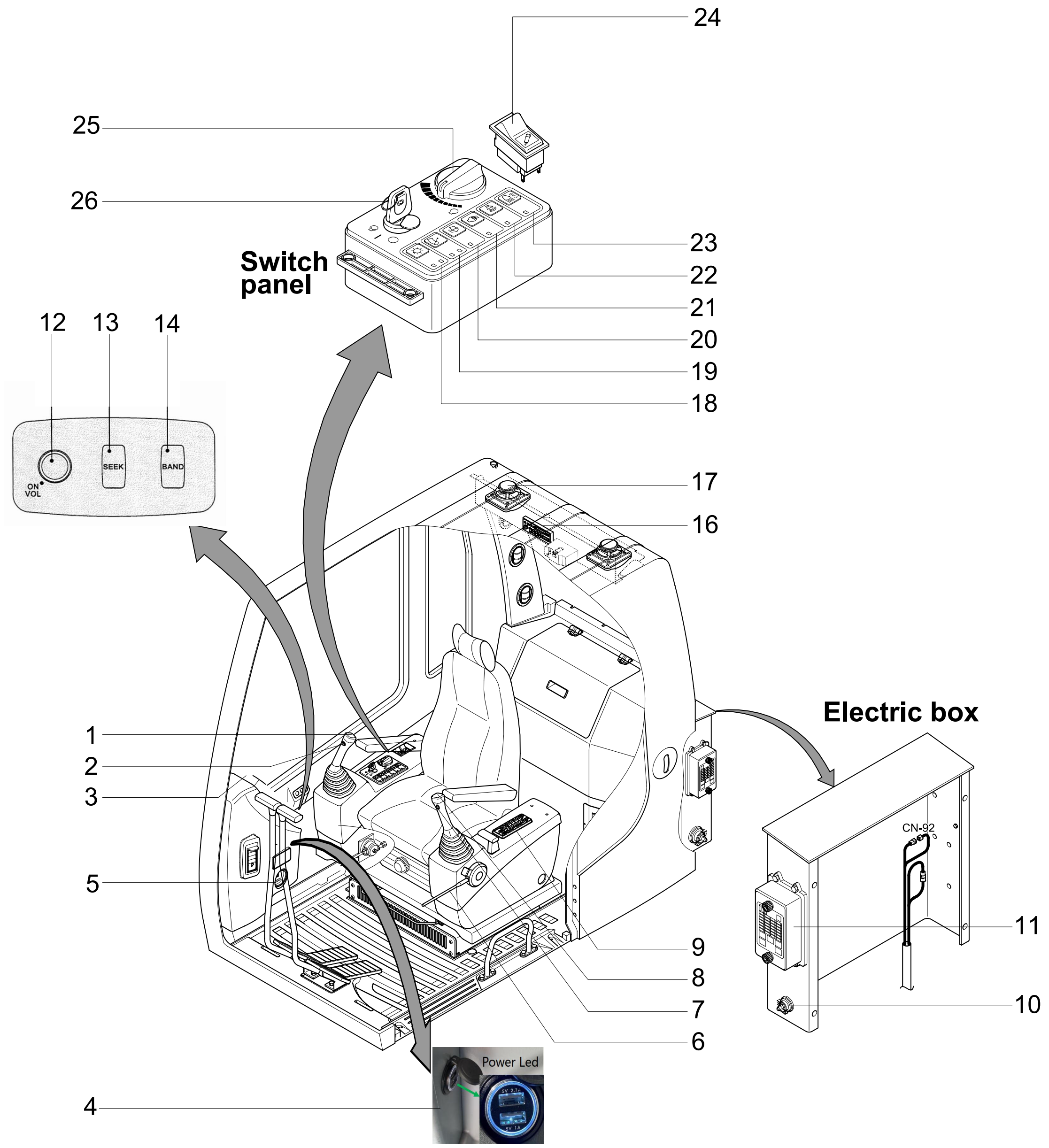
The pilot pump is provided with relief valve, receives the oil from the hydraulic tank through the suction filter.

The discharged oil from the pilot pump flows to the remote control valve through line filter, EPPR valve, solenoid valve assemblies, swing parking brake, main control valve and safety lock solenoid valve.

SECTION 4 ELECTRICAL SYSTEM

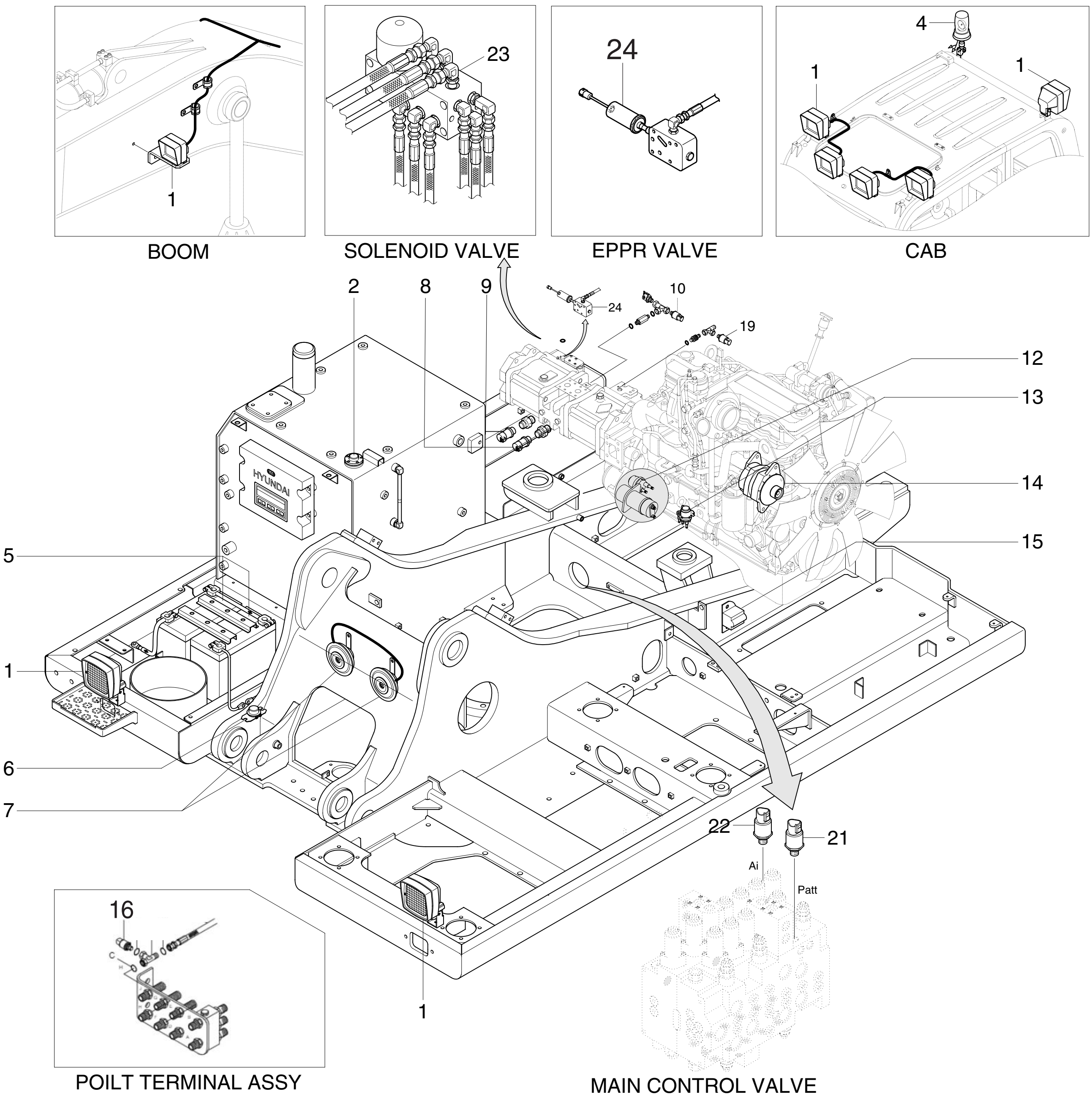
GROUP 1 COMPONENT LOCATION

1. LOCATION 1

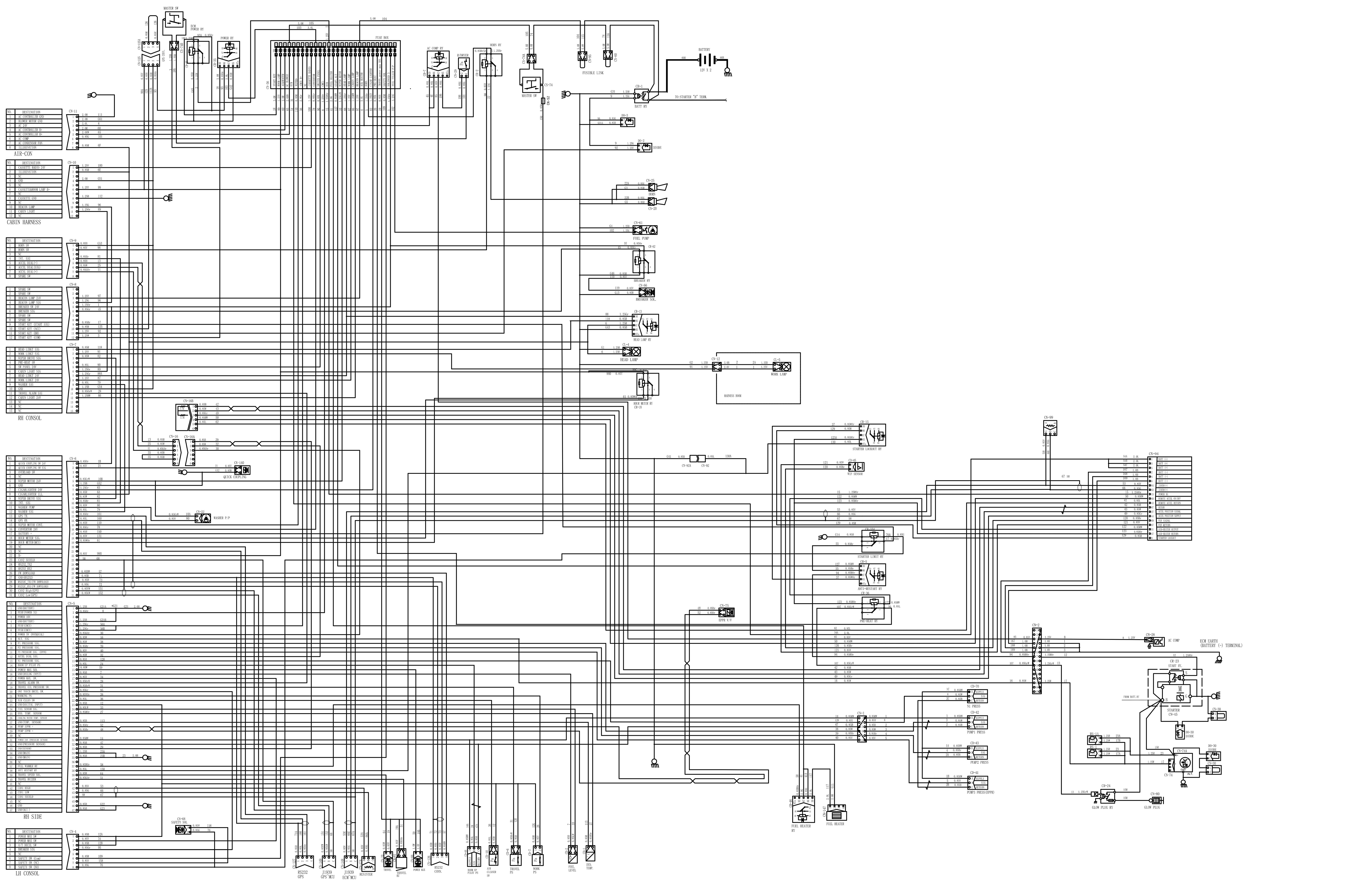


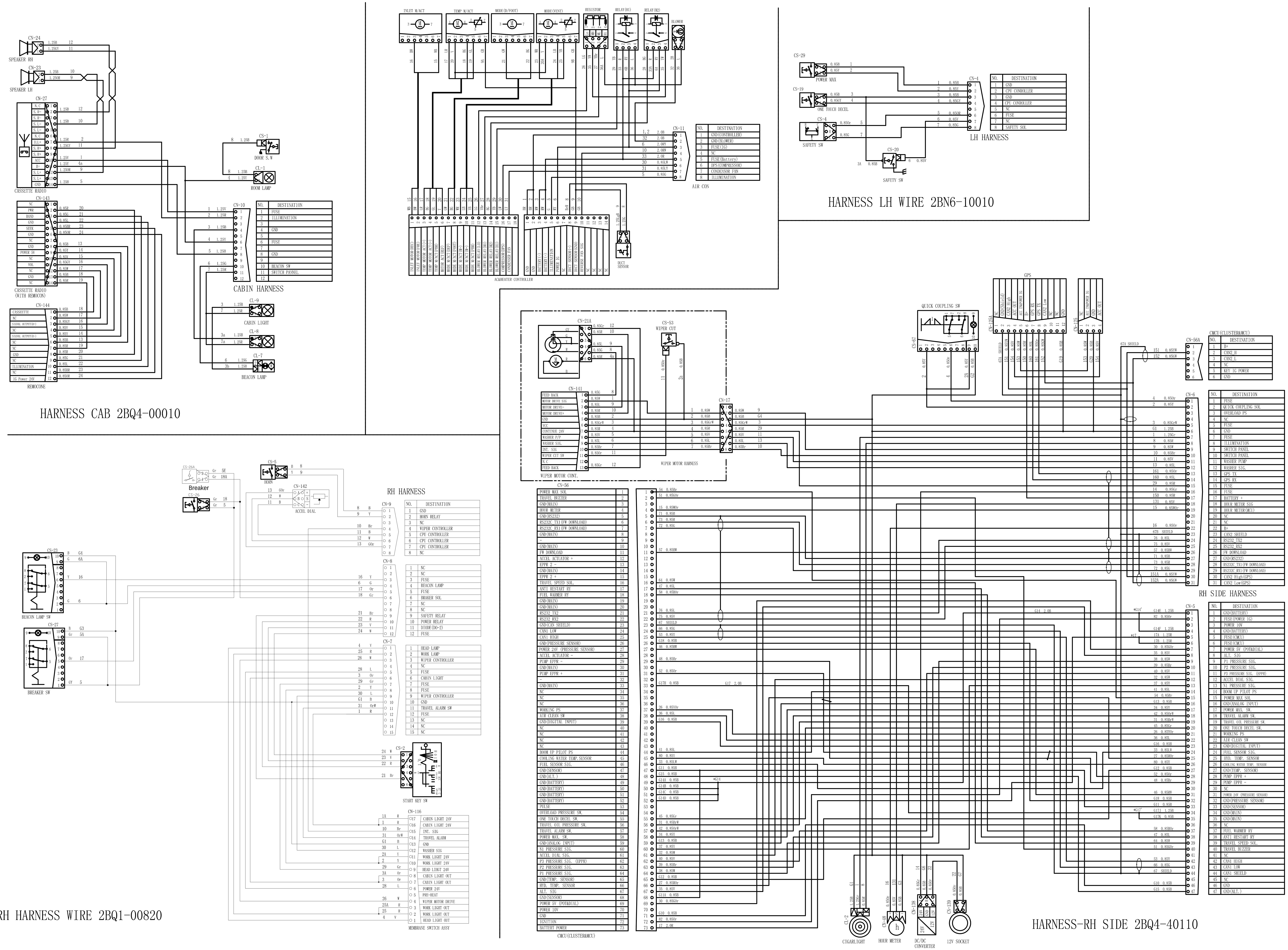
1	Horn switch	11	Fuse box	22	Travel alarm switch
2	Breaker operation switch	12	Radio power and volume button	23	Cab light switch
3	Cluster	13	Channel search button	24	Breaker selection switch(opt)
4	USB port	14	FM/AM band button	25	Accel dial
5	Hour meter	16	Cassette radio	26	Start switch
6	Safety lever	17	Speaker		
7	Power max switch	18	Main light switch		
8	One touch decel switch	19	Wiper switch		
9	Air conditioner switch	20	Washer switch		
10	Master switch	21	Preheat switch		

2. LOCATION 2



1 Lamp
2 Fuel sender
4 Beacon lamp
5 Battery
6 Battery relay
7 Horn
8 P1 pressure sensor
9 P2 pressure sensor
10 EPPR pressure sensor
12 Start relay
13 Heater relay
14 Alternator
15 Travel alarm buzzer
16 Boom up pressure sensor
19 Negative 1 pressure sensor
21 Work pressure switch
22 Travel pressure switch
23 Solenoid valve
24 Pump EPPR valve


AIR-CON
CABIN HARNESS
RH CONSOL
RH SIDE
LH CONSOL
BATTERY
FUSE BOX
ECM EARTH
(BATTERY (-) TERMINAL)


HARNESS CAB 2BQ4-00010
CABIN HARNESS
HARNESS LH WIRE 2BN6-10010
LH HARNESS
AIR CON
RH HARNESS
RH HARNESS WIRE 2BQ1-00820
RH SIDE HARNESS
HARNESS-RH SIDE 2BQ4-40110
WIPER MOTOR HARNESS
Breaker

1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis.

When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

Battery → Battery relay → Fusible link [CN-60] → Master switch [CS-74A]

- → Fuse box [No.1]
  - → Master switch [CS-74B(2)→(1)] → I/conn [CN-8 (12)] → Start switch [CS-2 (1)]
  - → Ecm power relay [CR-45 (3)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.2]
  - → I/conn [CN -10 (6)]
    - → Room lamp [CL-1 (2)]
    - → Radio [CN-27 (11)]
  - → I/conn [CN -6 (22)] → hour meter [CN-48 (+)]
  - → hour meter relay [CR-18 (2,3)]
- → Fuse box [No.3] → I/conn [CN - 11 (4)] → AC & heater controller
- → Fuse box [No.4] → I/conn [CN - 11 (5)]
  - → AC & Heater controller
  - → Blower relay (2)
- → Fuse box [No.5] → ECM [CN- 94(1,3,5)]
- → Fuse box [No.6] → I/conn [CN - 6 (15)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21A (6)]
- → Fuse box [No.7] → I/conn [CN - 5 (5,6)] → CMCU[CN -56 (73)]

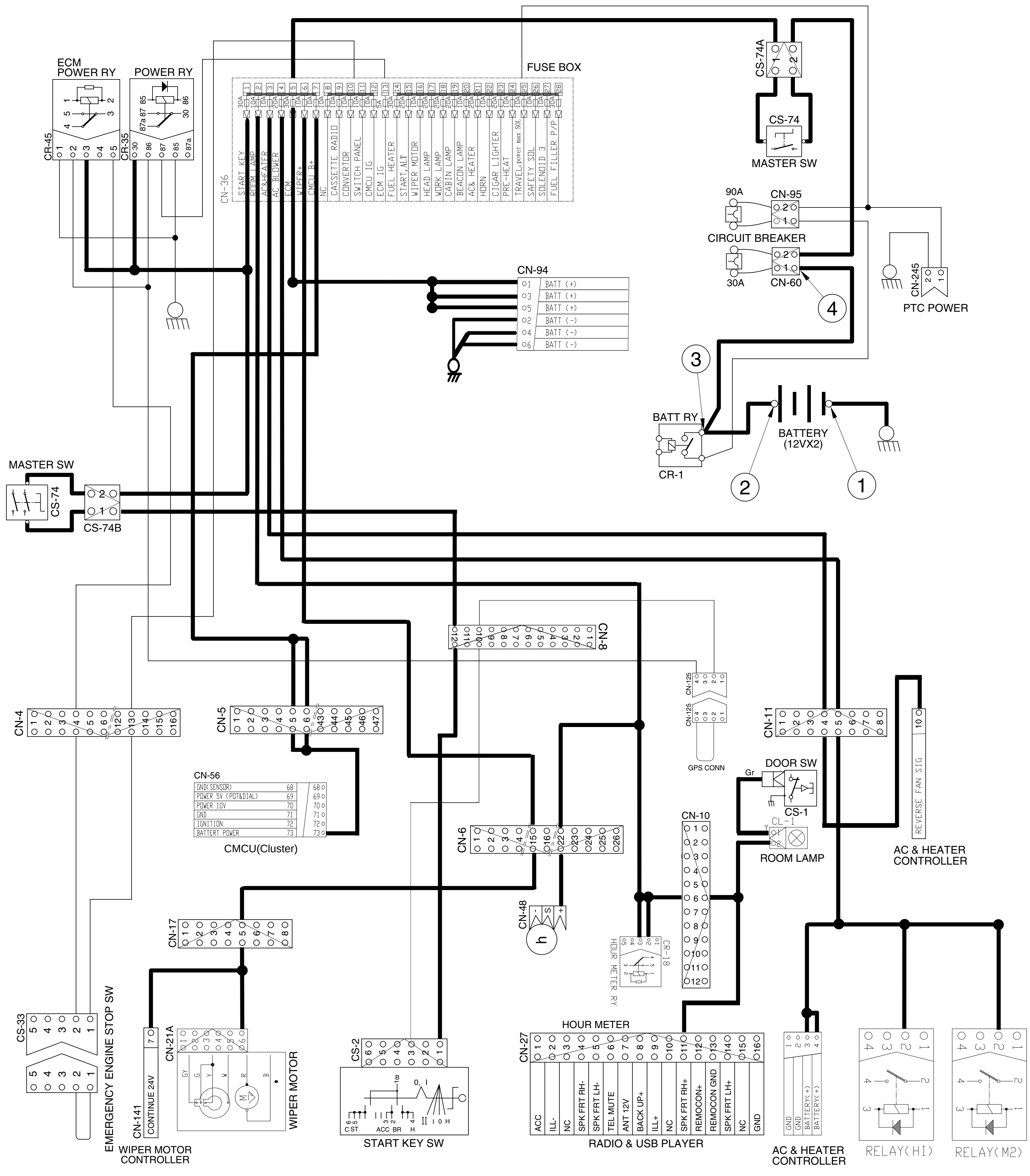
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	OFF	① - GND (battery 1EA) ② - GND (battery 2EA) ③ - GND (battery 2EA) ④ - GND (fusible link)	0 V 20~25V 20~25V 20~25V

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A] → Fuse box [No.1] → Master switch[CS-74B] → I/conn [CN-8(12)] → Start switch [CS-2(1)]

(1) When start key switch is in ON position

→ Start switch ON [CS-2 (2)] → I/conn [CN-8 (11)] → Battery relay [CR-1]
→ Battery relay operating (all power is supplied with the electric component)
→ Start switch ON [CS-2 (3)] → I/conn [CN-8(10)] → RMS conn [CN-125 (2)→(4)]
→ Power relay [CR-35 (86)→(87)] → Fuse box [No. 8,9,10,11,12]
→ ECM power relay [CR-45 (2)→(5)] → Fuse box [No. 13]

(2) When start key switch is in START position

Start switch START [CS-2 (5)] → I/conn [CN-8 (9)] → Stater limit relay[CR-104(3)→(4)]
→ Anti-restart relay [CR-5 (86)]

ECM [CN-94 (9)] → Starter lockout relay [CR-15(86)]

ECM [CN-94 (57)] → Starter lockout relay [CR-15(85)]

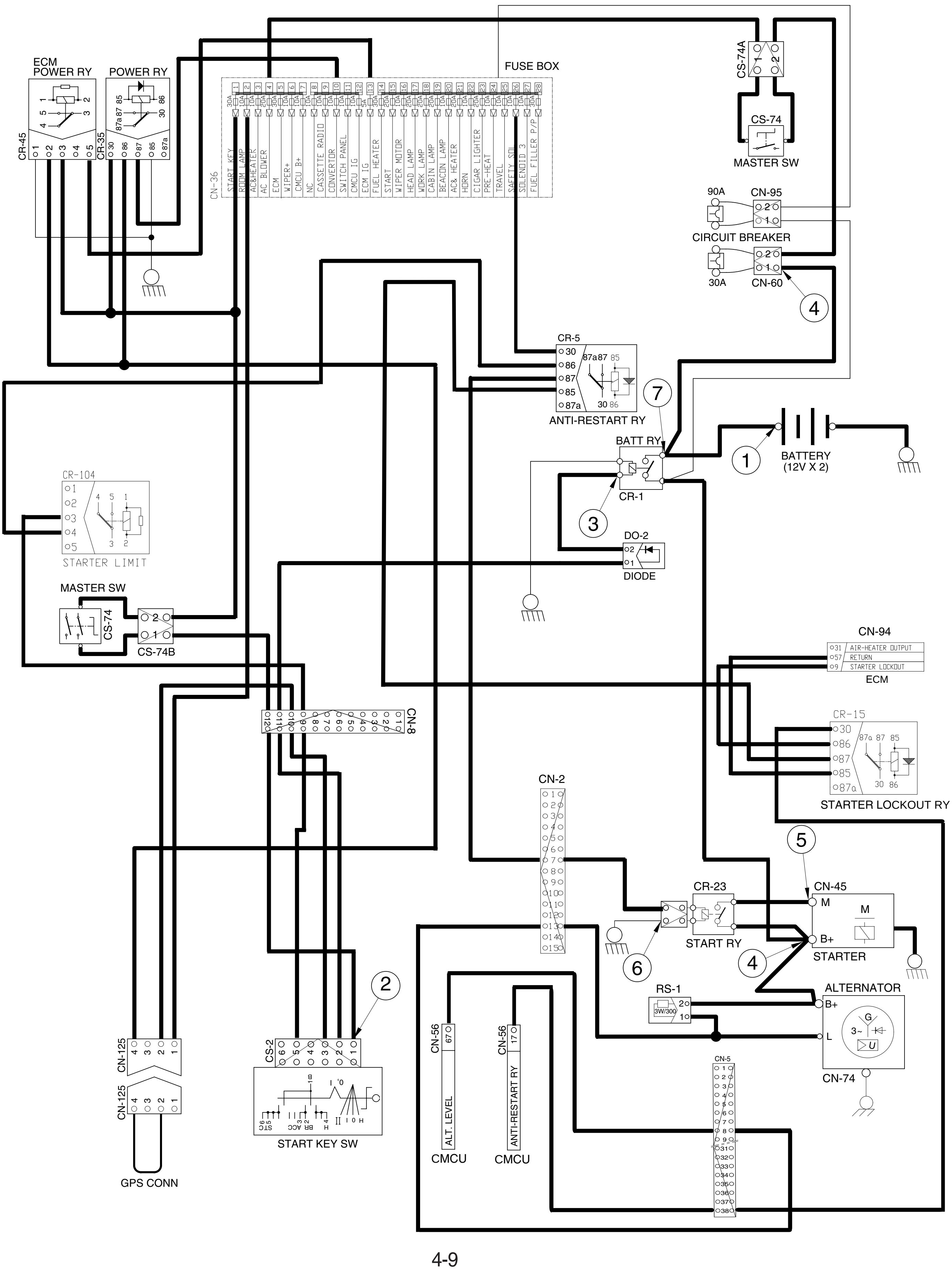
CMCU [CN-56 (17)] → I/conn [CN-5 (38)] → Starter lockout relay [CR-15(87a)→(30)]
→ Anti-restart relay [CR-5 (85)]

Anti-restart relay [CR-5 (30) →(87)] → I/conn [CN-2 (7)] → Start relay [CR-23(coil +)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OPERATING	START	① - GND (battery) ② - GND (start key) ③ - GND (battery relay M4) ④ - GND (starter B^{+}) ⑤ - GND (starter M) ⑥ - GND (start relay) ⑦ - GND (battery relay M8)	20~25V

STARTING CIRCUIT



3. CHARGING CIRCUIT

When the starter is activated and the engine is started, the operator releases the key switch to the ON position.

Charging current generated by operating alternator flows into the battery through the battery relay [CR-1].

The current also flows from alternator to each electrical component and controller through the fuse box.

1) OPERATING FLOW

(1) Warning flow

Alternator "L" terminal → I/conn [CN-2 (13)] → I/conn [CN-5 (8)] → CMCU [CN-56 (67)]
→ Cluster charging warning lamp(Via serial interface)

(2) Charging flow

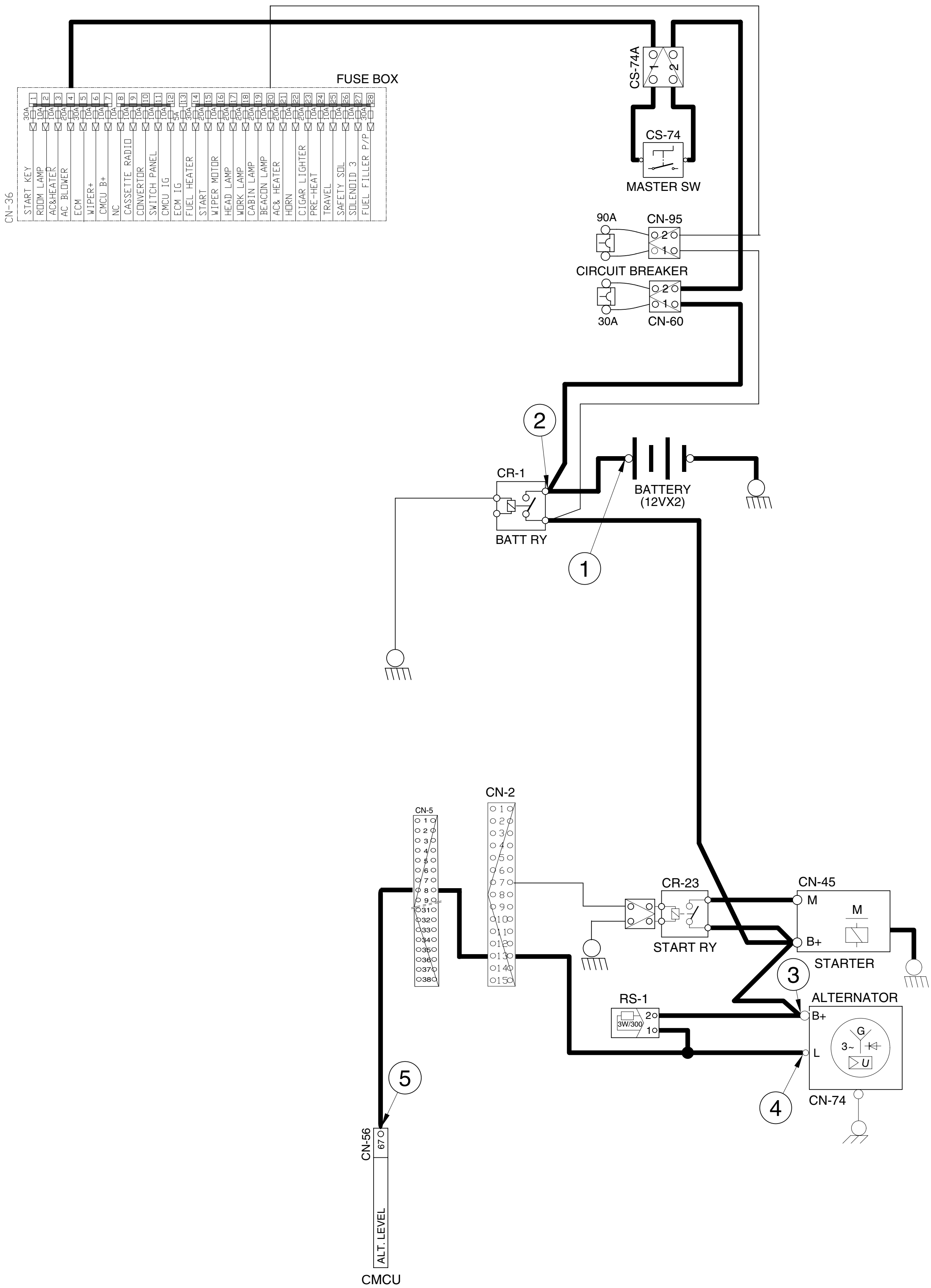
Alternator "B^+" terminal → Battery relay → Battery(+) terminal
→ Fusible link [CN-60] → Master switch [CS-74]
→ Fuse box

2) CHECK POINT

Engine	Start switch	Check point	Voltage
Run	ON	① - GND (battery voltage) ② - GND (battery relay) ③ - GND (alternator B^+ terminal) ④ - GND (alternator L terminal) ⑤ - GND (CMCU)	20~30V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.17) → Head light relay [CR-13 (30)]
→ I/conn [CN-7 (7)] → Switch panel [CN-116 (9)]

Fuse box (No.18) → I/conn [CN-7 (8)] → Switch panel [CN-116 (10,11)]

(1) Head light switch ON

Head light switch ON [CN-116 (1)] → I/conn [CN-7 (1)] → Head light relay [CR-13 (86)]
Head light relay [CR-13 (30)→(87)] → Head light ON [CL-4 (1)]

(2) Work light switch ON

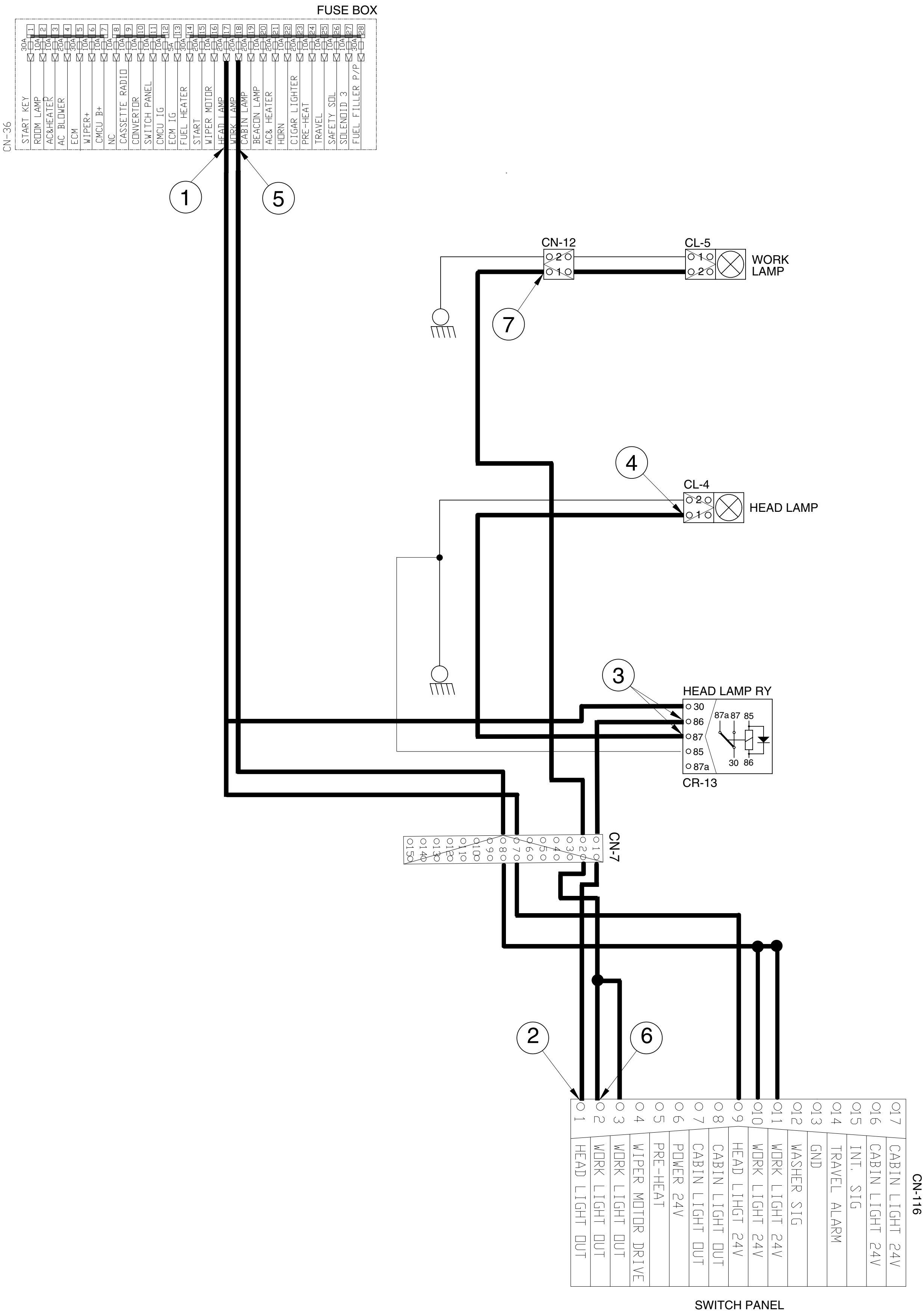
Work light switch ON [CN-116 (2,3)] → I/conn [CN-7 (2)]→ I/conn [CN-12 (1)]
→ Work light ON [CL-5 (2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (head light relay) ④ - GND (head light) ⑤ - GND (fuse box) ⑥- GND (switch power output) ⑦ - GND (work light)	20~25V

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.20) → I/conn [CN-8 (3)] → Beacon lamp switch [CN-23 (6)]
Fuse box (No.19) → I/conn [CN-7 (12)] → Switch panel [CN-116 (16,17)]

(1) Beacon lamp switch ON

Beacon lamp switch ON [CS-23 (2)] → Switch indicator lamp ON [CS-23 (9)]
→ I/conn [CN-8 (4)] → I/conn [CN-10 (10)]
→ Beacon lamp [CL-7(2)]

(2) Cab light switch ON

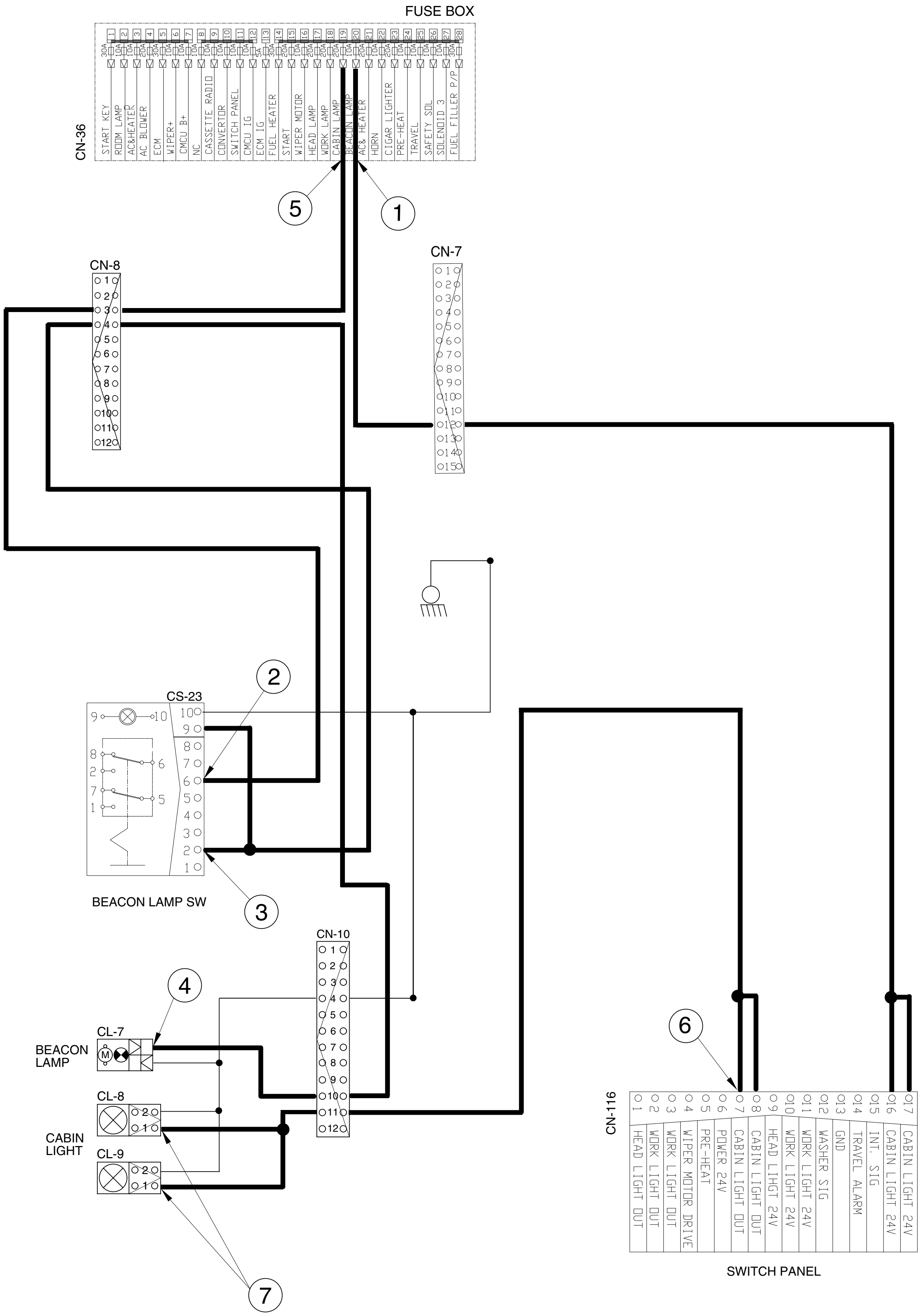
Cab light switch ON [CN-116 (7,8)] → I/conn [CN-7 (6)] → I/conn [CN-10 (11)]
→ Cab light [CL-8 (1),CL-9(1)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input) ③ - GND (switch power output) ④ - GND (beacon lamp) ⑤ - GND (fuse box) ⑥ - GND (switch power output) ⑦ - GND (cab light)	20~25V

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.11) → I/conn [CN-7 (5)] → Switch panel [CN-116 (6)]

Fuse box (No.6) → I/conn [CN-6 (15)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141(7)]
→ Wiper motor [CN-21A(6)]

Fuse box (No.16) → I/conn [CN-6 (5)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
→ Washer pump [CN-22 (2)]

(2) Wiper switch ON : 1st step (Intermittent)

Wiper switch ON [CN-116 (15)] → I/conn [CN-9 (4)] → I/conn [CN-6 (10)] → I/conn [CN-17 (8)]

Wiper motor controller [CN-141 (10) → (4)] → Wiper motor intermittently operating [CN-21A(2)]

(3) Wiper switch ON : 2nd step (continual)

Wiper switch ON [CN-116 (4)] → I/conn [CN-7 (3)] → I/conn [CN-6 (9) → I/conn [CN-17 (2)]

Wiper motor controller [CN-141 (2) → (4)] → Wiper motor continual operating [CN-21A(2)]

(4) Washer switch ON

Wiper switch ON [CN-116 (12)] → I/conn [CN-7 (9)] → I/conn [CN-6 (12)] → I/conn [CN-17 (7)]

Wiper motor controller [CN-141 (9) → (8)] → I/conn [CN-17 (6)] → I/conn [CN-6 (11)]

→ Washer pump[CN-22(1)]

(5) Wiper cut off switch ON

Wiper switch ON [CN-141 (11)] → Wiper cut off switch[CS-53] → I/conn [CN-17 (3)] → I/conn [CN-6 (6)]

Wiper motor controller don't supply power to the wiper motor

(6) Auto parking(when switch OFF)

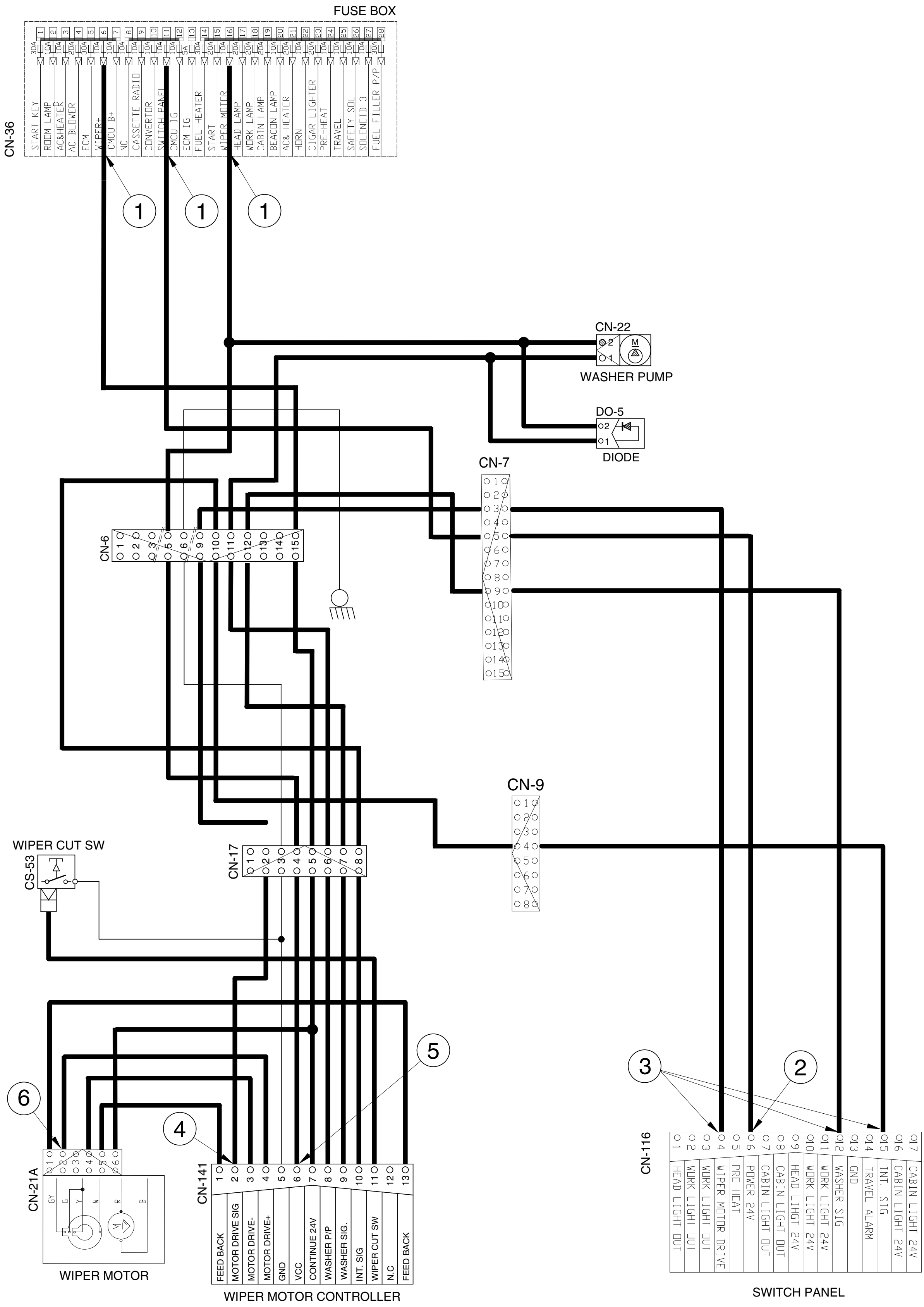
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

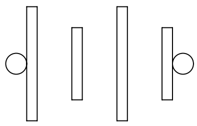
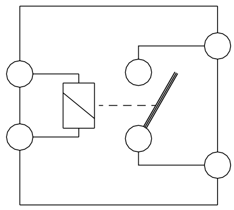
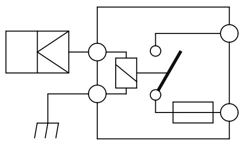
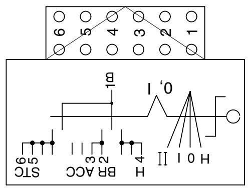
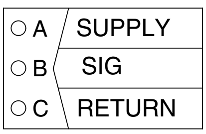
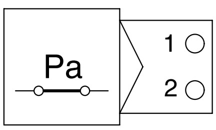
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	24V
		③ - GND (switch power output)	0 ~ 5V
		④ - GND (wiper power input) ⑤ - GND (wiper power output)	24V
		⑥ - GND (wiper motor)	0 or 24V

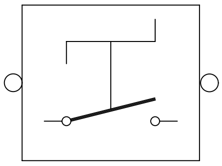
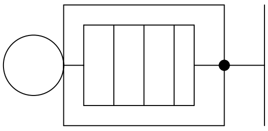
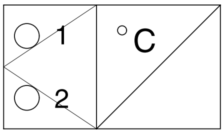
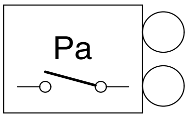
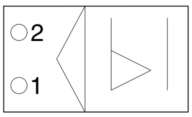
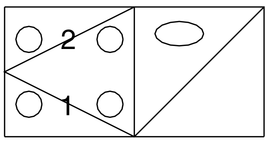
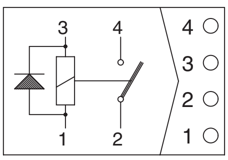
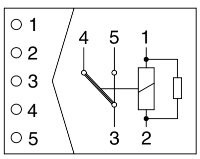
※ GND : Ground

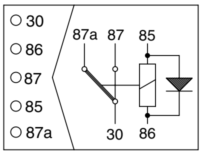
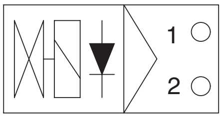
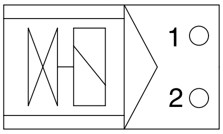
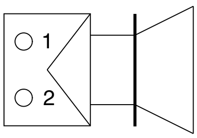
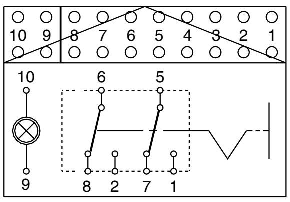
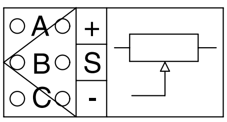
WIPER AND WASHER CIRCUIT

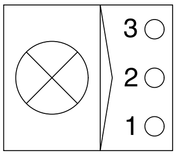
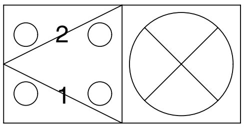
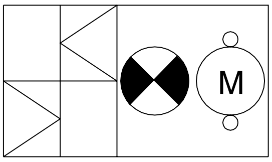
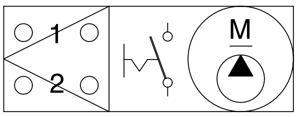
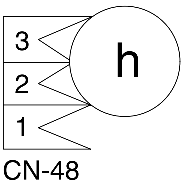
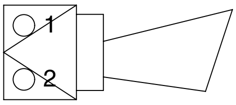


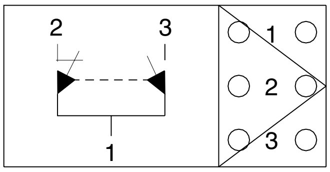
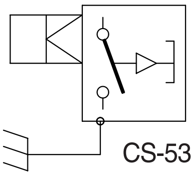
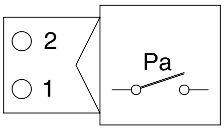
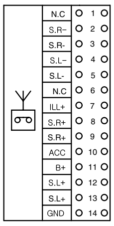
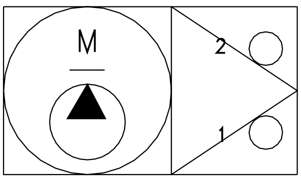
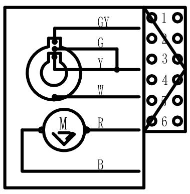
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

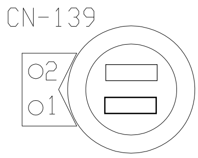
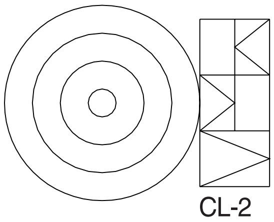
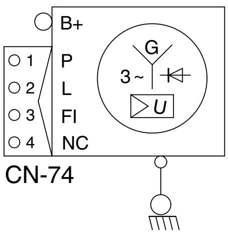
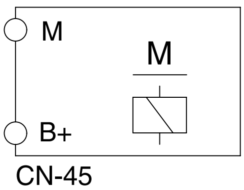
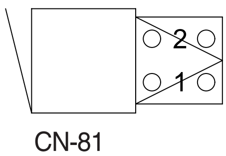
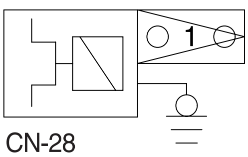
Part name	Symbol	Specifications	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	 CS-2	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-5)
Pressure sensor	 CD-42 CD-43 CD-44 CD-46 CD-70	8~30V	※ Check contact Normal : 0.1 Ω
Pressure switch (Travel, working)	 CD-6 CD-7	$10kgf/cm^2$ (N.C TYPE)	※ Check contact Normal : 0.1 Ω

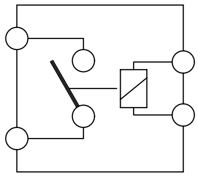
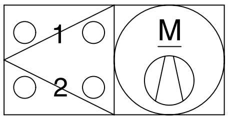
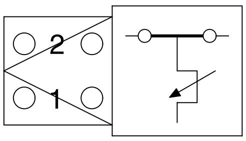
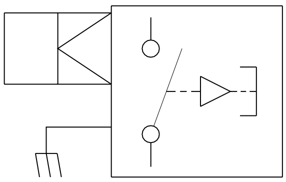
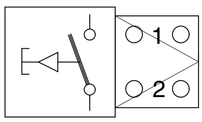
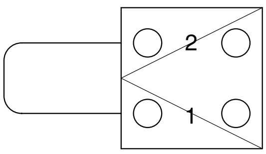
Part name	Symbol	Specifications	Check
Master switch	 CS-74A CS-74B	6-36V	※Check disconnection Normal : 0.1 Ω
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air cleaner pressure switch	 CD-10	-	※ Check contact High level : ∞ Ω Low level : 0 Ω
WIF sensor	 CD-45	-	-
Fuel sender	 CD-2	-	※ Check resistance Full : 50 Ω 6/12 : 350 Ω 11/12 : 100 Ω 5/12 : 400 Ω 10/12 : 150 Ω 4/12 : 450 Ω 9/12 : 200 Ω 3/12 : 500 Ω 8/12 : 250 Ω 2/12 : 550 Ω 7/12 : 300 Ω 1/12 : 600 Ω Empty warning : 700 Ω
Relay (air con blower)		24V 20A	※ Check resistance Normal : About 200 Ω (for terminal 1-3) 0 Ω (for terminal 2-4)
Relay	 CR-2 CR-18 CR-36 CR-45 CR-62 CR-104	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)

Part name	Symbol	Specifications	Check
Relay	 CR-5 CR-7 CR-13 CR-15 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-68 CN-66 CN-70 CN-88 CN-140	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-75	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-23 CS-27	24V 8A	※ Check contact Normal ON : 0 Ω (For terminal 1-5, 2-6) ∞ Ω (For terminal 5-7, 6-8) OFF : ∞ Ω (For terminal 1-5, 2-6) 0 Ω (For terminal 5-7, 6-8)
Accel dial	 CN-142	-	※ Check resist Normal : About 5k Ω (for terminal A-C) ※ Check voltage Normal : About 5V (for terminal A-C) : 2~4.5V (for terminal C-B)

Part name	Symbol	Specifications	Check
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Head lamp, Work lamp, Cab lamp	 CL-4 CL-5 CL-8 CL-9	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 l /min	※Check resistance Normal : 1.0 Ω
Service meter	 CN-48	16~32V	※Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※Check operation Supply power(24V) to each terminal and connect ground.

Part name	Symbol	Specifications	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 0 Ω (for terminal 1-2) ∞ Ω (for terminal 1-3) Operating : ∞ Ω (for terminal 1-2) 0 Ω (for terminal 1-3)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※Check contact Normal : ∞ Ω
Cassette radio	 CN-27	24V 2A	※Check voltage 20~25V (For terminal 10-14, 11-14)
Washer pump	 CN-22	24V 3.8A	※Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21A	24V 2A	※Check disconnection Normal : 7 Ω (for motor)

Part name	Symbol	Specifications	Check
USB socket		OUTPUT 5V 1A / 5V 2.1A	—
Cigar lighter		24V 5A 1.4W	※Check coil resistance Normal : About 1M Ω ※Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator		24V 50A	※Check contact Normal : 0 Ω (for terminal B$^+$-I) Normal : 24~27.5V
Starter		Denso 24V 4.5kW	※Check contact Normal : 0.1 Ω
Travel alarm		24V 0.5A	※Check contact Normal : 5.2 Ω
Aircon compressor		24V 79W	※Check contact Normal : 13.4 Ω

Part name	Symbol	Specifications	Check
Start relay	 CR-23	24V 300A	※Check contact Normal : 0.94 Ω (for terminal 1-2)
Blower motor		24V 9.5A	※Check resistance Normal : 2.5 Ω (for terminal 1-2)
Duct sensor (switch)		1˚C OFF 4˚C ON	※Check resistance Normal : 0 Ω (for terminal 1-2), the atmosphere temp : Over 4˚C
Door switch	 CS-1	24V 2W	※Check resistance Normal : About 5M Ω
Switch (power max, one touch decal, horn, breaker)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※Check resistance Normal : ∞ Ω
Fusible link (cluster type 2)	 CN-60 CN-95	60A	※Check disconnection normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

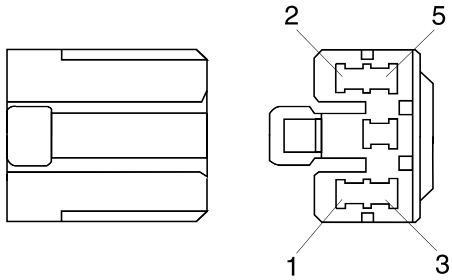
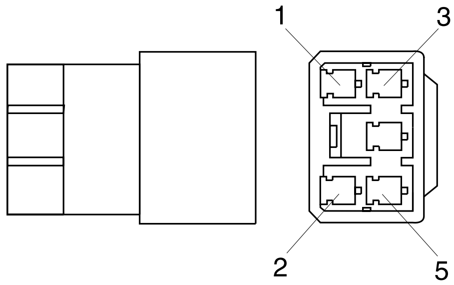
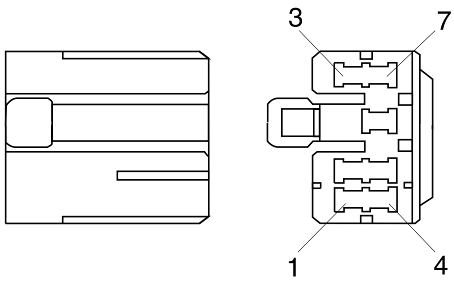
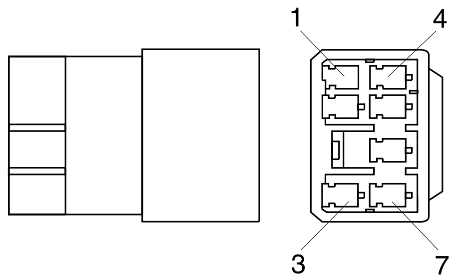
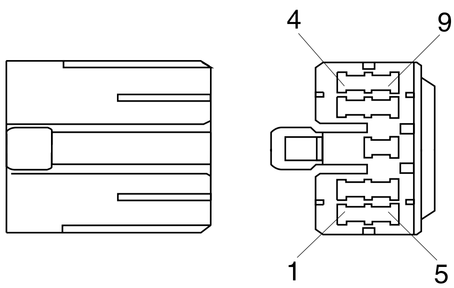
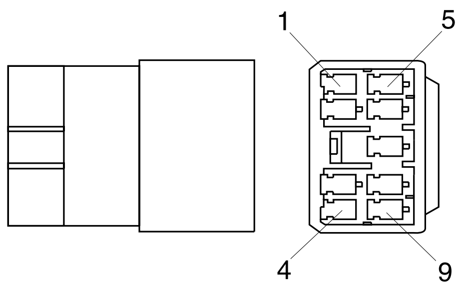
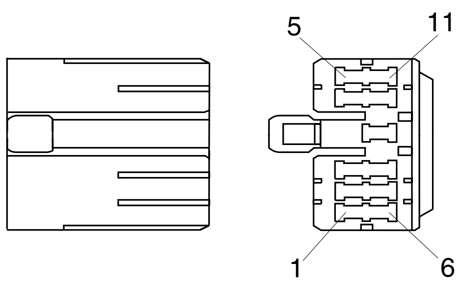
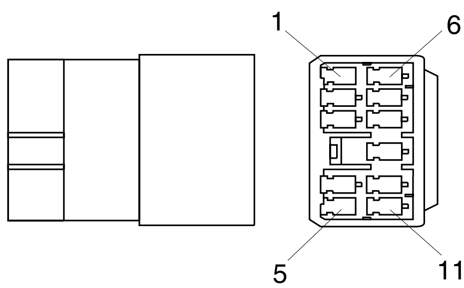
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	6	I/conn (Frame harness-Pump PS harness)	S816-006002	S816-106002
CN-2	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	368301-1
CN-3	AMP	8	I/conn (Frame harness-Engine harness)	S816-012002	S816-112002
CN-4	AMP	8	I/conn (Console harness LH-Frame harness)	368047-1	368050-1
CN-5	AMPHENOL	47	I/conn (Side harness RH-Frame harness)	AHDP06-24-47SR-WTA	AHDP06-24-47SR-WTA
CN-6	AMPHENOL	31	I/conn (Side harness RH-Frame harness)	AHDP06-24-31SR-WTA	AHDP06-24-31SR-WTA
CN-7	AMPHENOL	12	I/conn (Console harness RH-Frame harness)	AT06-12SA-EC01	AT06-12SA-EC01
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-9	AMP	8	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-16	AMP	6	I/conn (Accel dial harness)	S816-008002	S816-108002
CN-16B	AMP	6	I/conn (Remote Accel harness)	S816-008002	S816-108002
CN-17	AMP	8	I/conn (Wiper harness)	S816-008002	S816-108002
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer pump	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27	AMP	14	Cassette radio	173852	-
CN-28	KUM	1	Aircon compressor	MWP-01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	-	-
CN-45	RING-TERM	-	Starter motor B+	S820-308000	DT04-4P-E005
CN-48	KET	3	Service meter	2-520193-2	-
CN-52	MTA	-	Fuse(2A)	-	-
CN-56	PCB	73	CMCU	-	-
CN-56A	KET	6	CMCU	MG610335	-
CN-60	YAZAKI	2	Fusible link	21N4-01311	7122-4125-50
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	DT04-2P-EP005

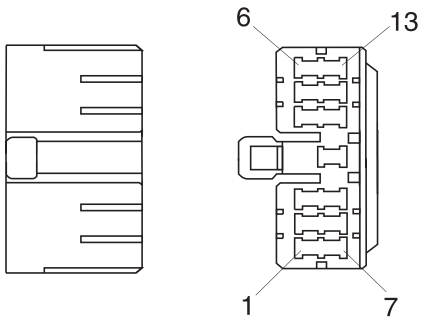
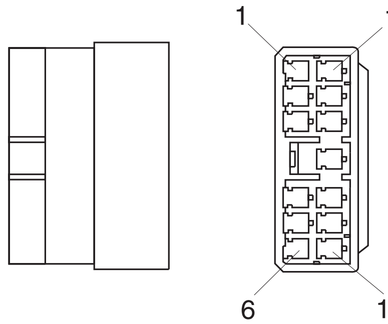
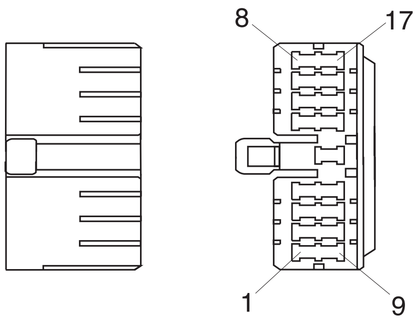
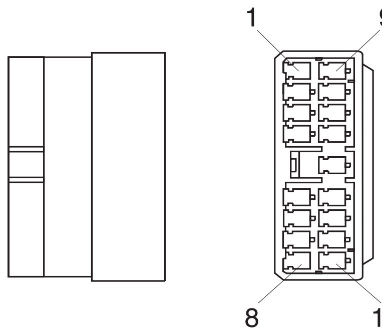
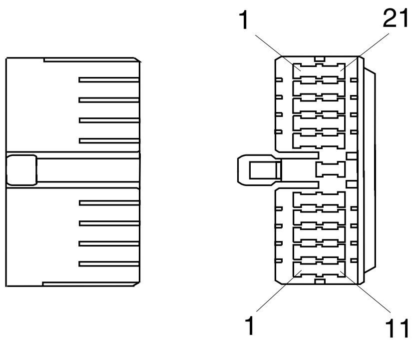
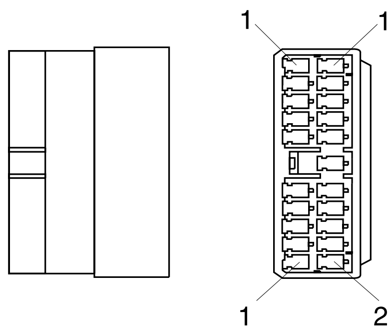
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S	-
CN-74	AMP	4	Alternator "L" terminal	12186568	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power Max solenoid	DT06-2S-EP06	-
CN-92	KET	1	I/conn(Starter Lockout RY)	MG610278	-
CN-94	-	2	ECM OEM Port	3-153490-4-2	-
CN-95	YAZAKI	2	Fusible link	21N4-01311	7122-4125-50
CN-99	DEUTSCH	2	RESISTER		DT04-2P-E005
CN-116	AMP	17	Switch panel	S811-017002	-
CN-125	DEUTSCH	4	GPS CONN	-	
CN-125A	-	4	RMS	174259-2	
CN-126	AMP	4	RS232 CONN	S816-010002	S816-110002
CN-139	AMP	2	USB socket	172434-2	-
CN-140	DEUTSCH	2	Quick clamp solenoid	DT06-2S-EP06	DT04-2P-E005
CN-141	AMP	13	Wiper motor controller	172498-1	DT04-3P-EP10
CN-142	DEUTSCH	3	Accel dial	DT06-3S-EP06	-
CN-147	Gray	4	Fuel warmer	2-967325-3	-
CN-148	-	3	ECM-MCU Comm Port	DT06-3S-P012	-
CN-149	-	3	GPS-MCU Comm Port	DT06-3S-P012	-
CN-156	DEUTSCH	2	Air seat	-	DT04-2P-E005
CN-174	KET	2	Comm Resister	-	DT04-3P-EP10
· Relay					
CR-1	RING-TERM	-	Battery relay	ST730135-2	-
CR-2	-	5	Horn relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-15	-	5	Starter lockout relay	-	-
CR-18	-	5	Hour meter relay	-	-
CR-23	AMP	4	Start relay	-	S814-102001
CR-24	AMP	4	Preheat relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-45	-	5	ECM power relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
CR-104	-	5	Starter limit relay	-	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	WP	6	Start key switch	S814-006100	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P-E005
CS-23	SWF	10	Beacon lamp switch	SWF593757	-
CS-26	AMP	2	Breaker switch	174198-2	-
CS-26A	AMP	2	Breaker foot pedal	S816-002002	S816-102002
CS-27	SWF	10	Breaker switch	SWF593757	-
CS-29	AMP	2	Power max switch	174661-2	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	SWF	10	Quick clamp switch	SWF 593757	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	3	Cigar light	S822-014002	S822-114002
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-5	AMP	2	Work lamp-LH	180923-0	-
CL-7	SHUR	2	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab light-LH	DT06-2S-EP06	DT-2P
CL-9	DEUTSCH	2	Cab light-RH	DT06-2S-EP06	DT04-2P
· Sensor, sender					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel level sender	DT06-2S-EP06	-
CD-6	KET	2	Travel pressure swtich	MG640795	-
CD-7	KET	2	Working pressure swtich	MG640795	-
CD-10	AMP	-	Air cleaner switch	85202-1	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Eppr pressure	DT06-3S-EP06	-
CD-45	DEUTSCH	2	Wif sensor	DT06-3S-EP06	-
CD-46	DEUTSCH	2	Boom up sensor	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure	DT06-3S-EP06	-

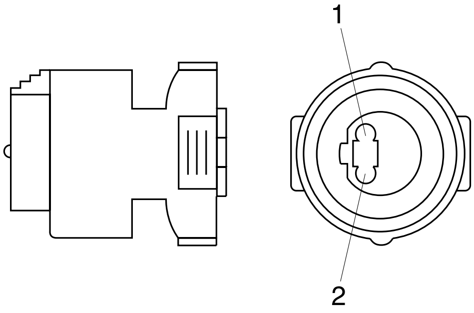
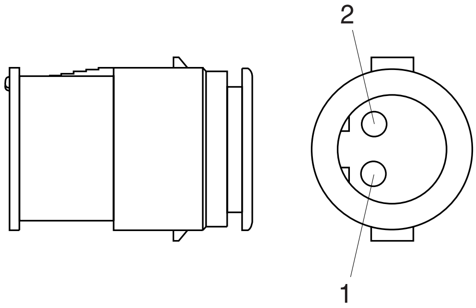
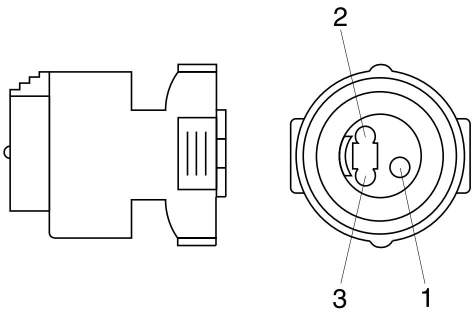
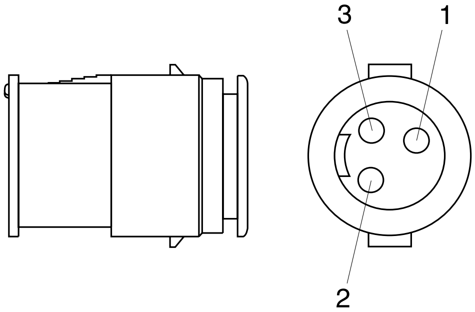
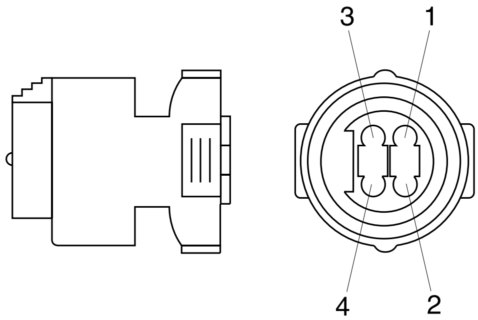
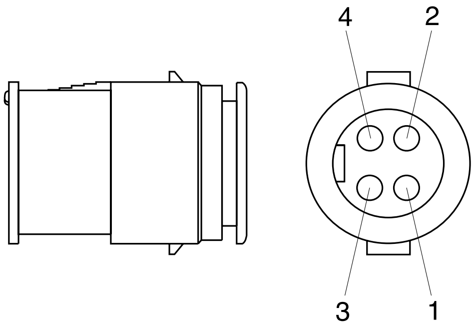
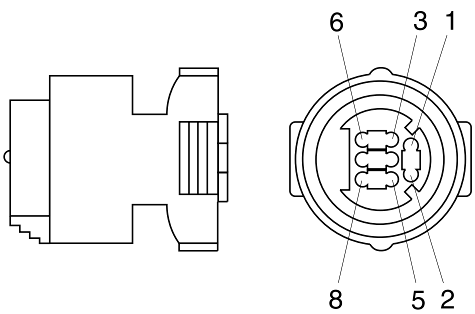
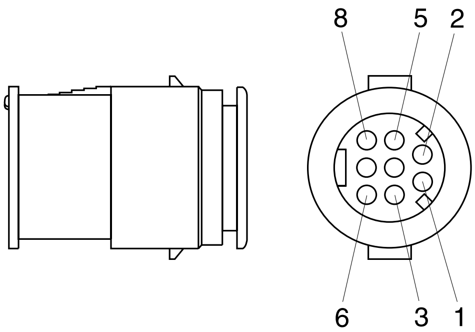
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

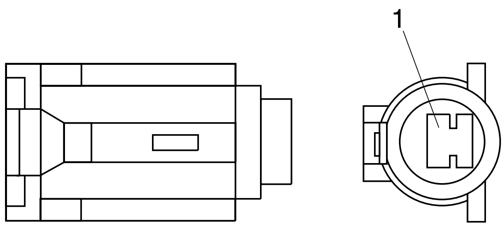
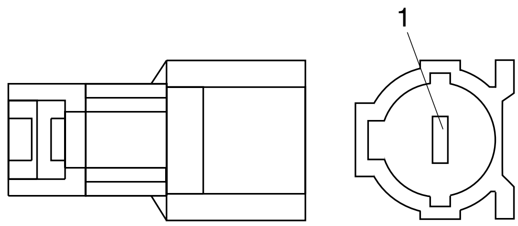
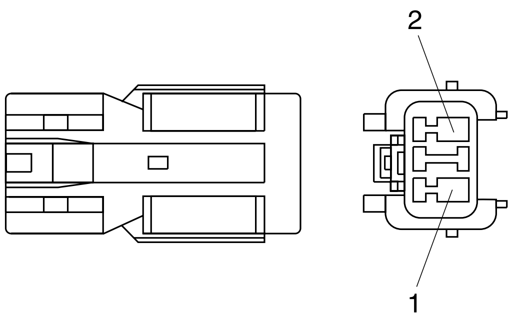
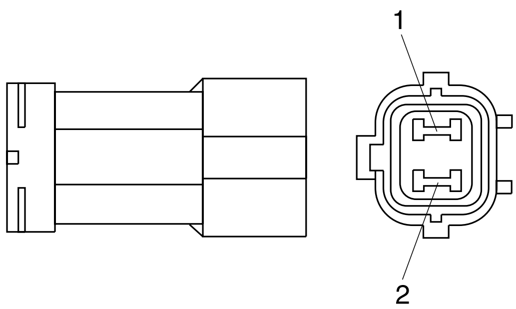
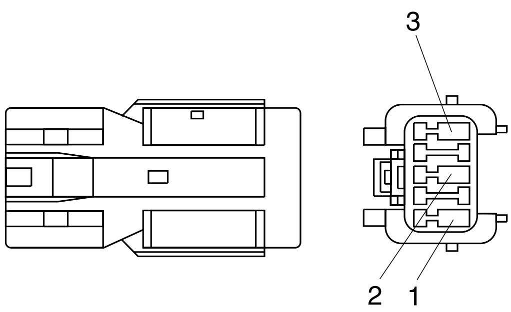
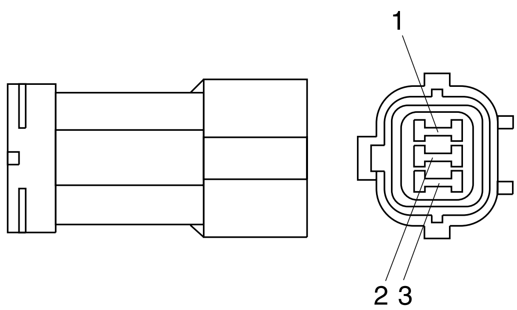
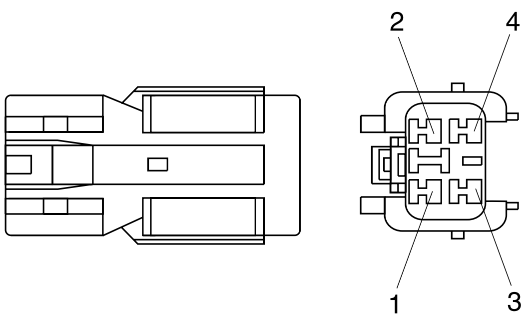
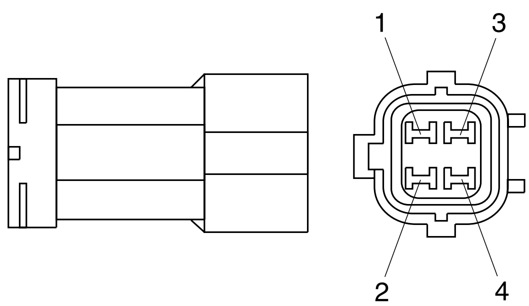
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

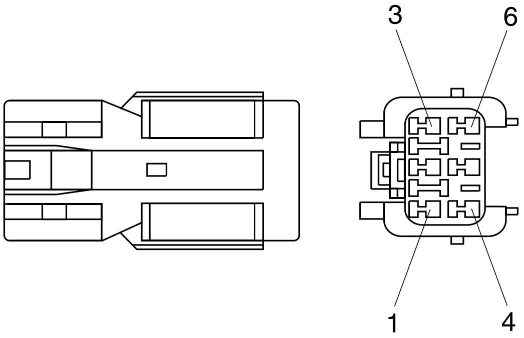
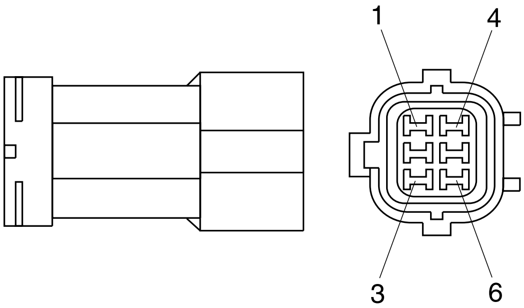
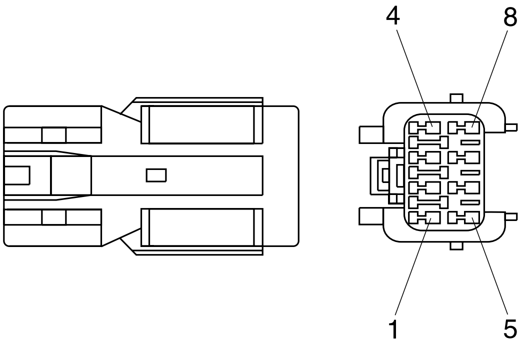
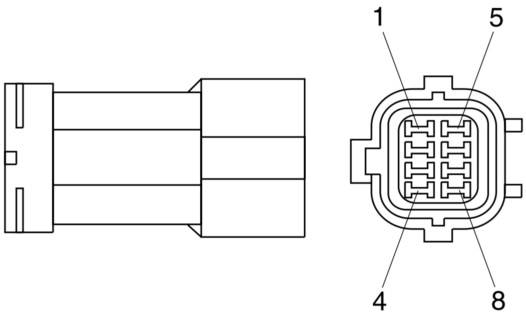
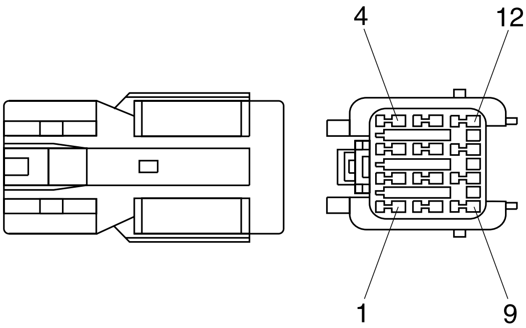
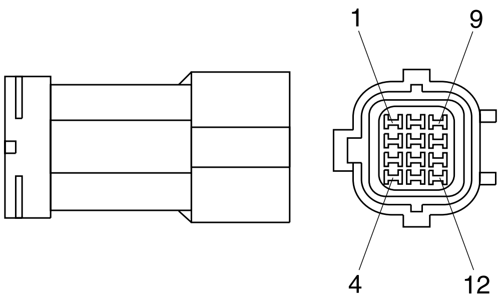
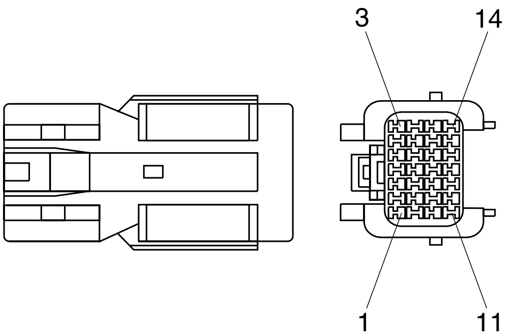
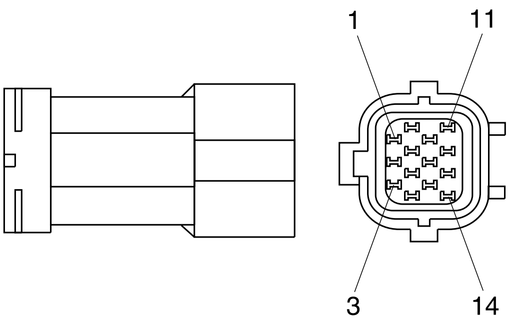
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

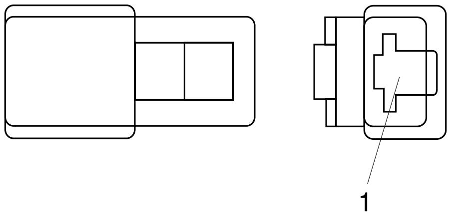
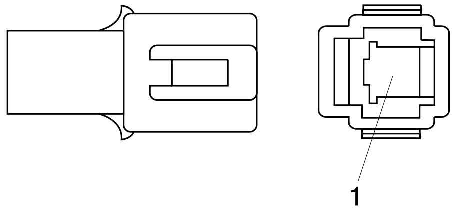
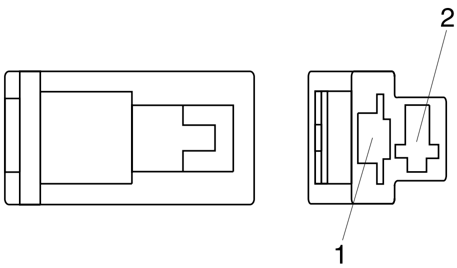
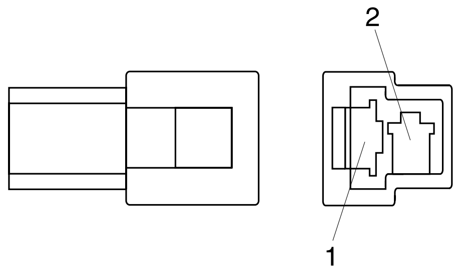
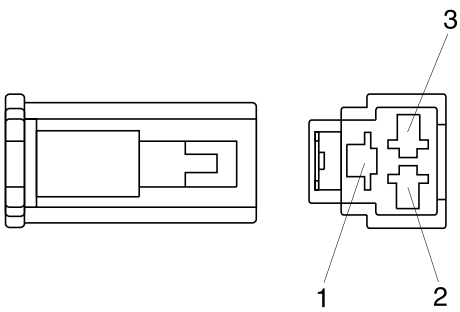
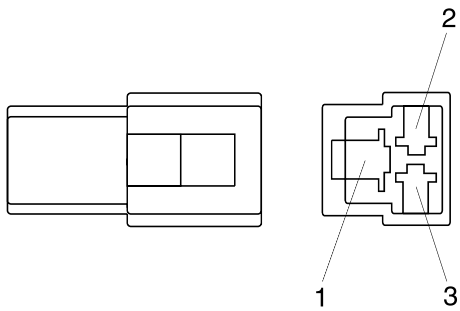
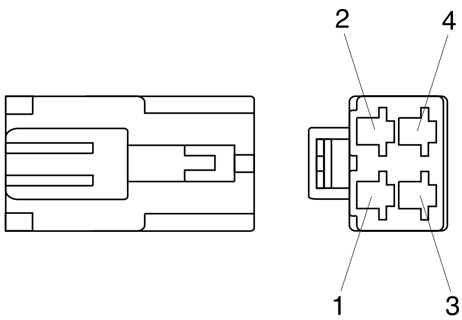
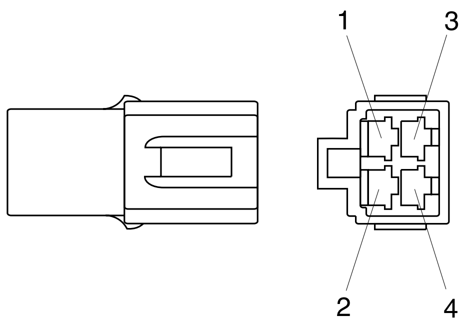
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

3) SWP TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S814-001000	 S814-101000
2	 S814-002000	 S814-102000
3	 S814-003000	 S814-103000
4	 S814-004000	 S814-104000

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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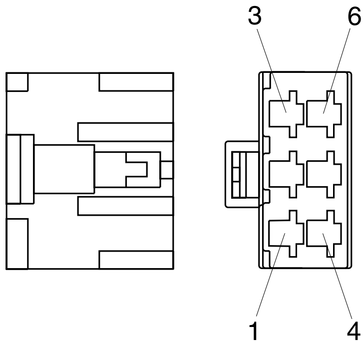
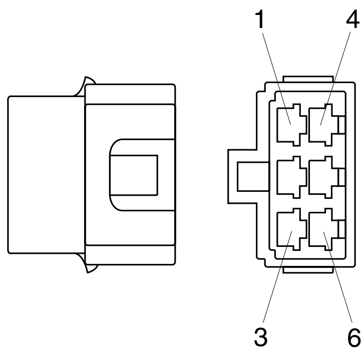
<tr><td>6</td><td>

S810-006202</td><td>

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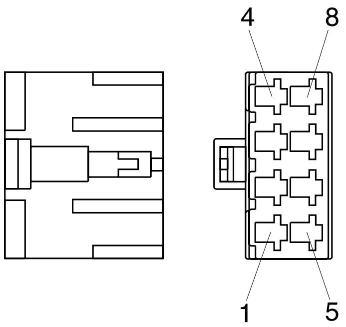
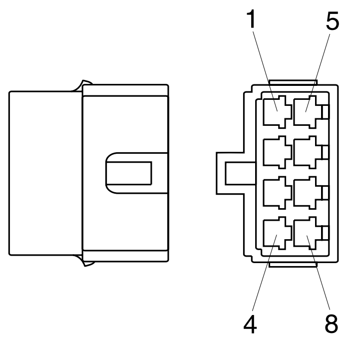
<tr><td>8</td><td>

S810-008202</td><td>

S810-108202</td></tr>
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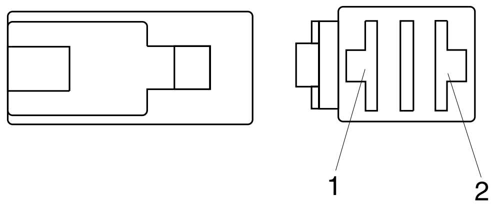
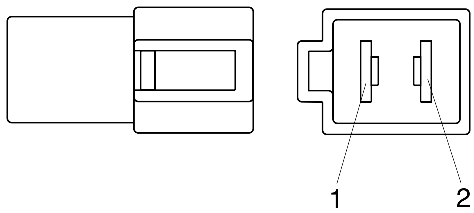
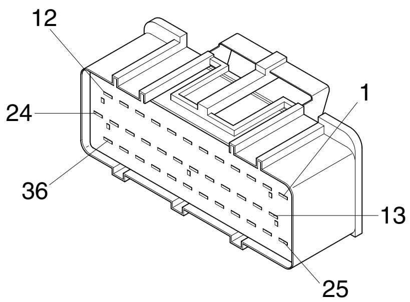
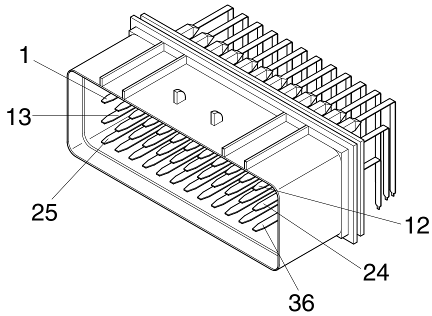
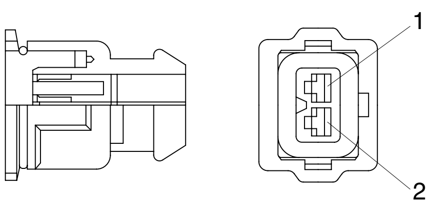
5) 375 FASTEN TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S810-002402	 S810-102402

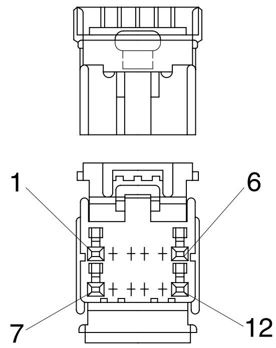
6) AMP ECONOSEAL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
36	 344111-1	 344108-1

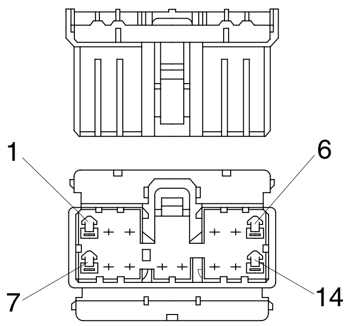
7) AMP TIMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 85202-1	

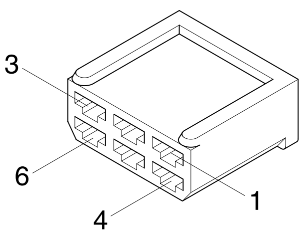
8) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
12	 174045-2	

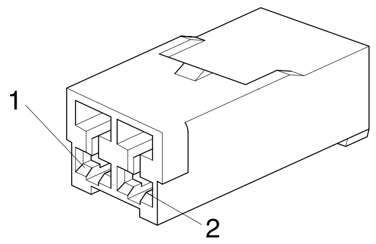
9) AMP 070 MULTILOCK CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
14	 173852	

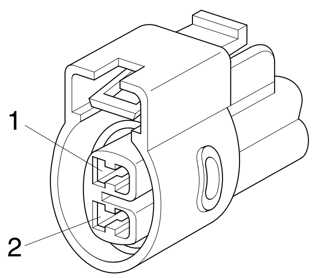
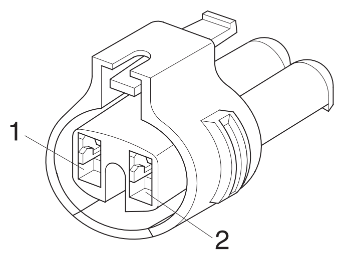
10) AMP FASTIN - FASTON CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 925276-0	

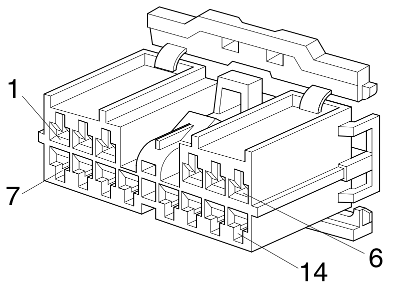
11) KET 090 CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 MG610070	

12) KET 090 WP CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 MG640605	
2	 MG640795	

13) KET SDL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
14	 MG610406	

14) DEUTSCH DT CONNECTORS

DT 06 - 3S - ★★★★

- ★★★★ : Modifications (see below)
- 3S : Number of contacts (P : Pin, S : Socket)
- 06 : 06 : Receptacle, 04 : Plug
- DT : Deutsch connectors

※ Modification

E003 : Standard end cap - gray

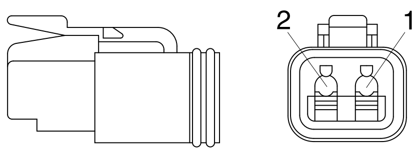
E004 : Color of connector to be black

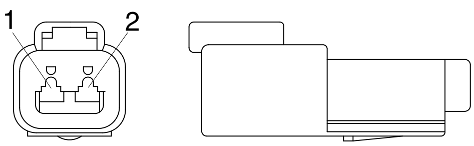
E005 : Combination - E004 & E003

EP04 : End cap

EP06 : Combination P012 & EP04

P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin

<table>
<tr><th>No. of pin</th><th>Receptacle connector (female)</th><th>Plug connector (male)</th></tr>
<tr><td>2</td><td>

DT06-2S</td><td>

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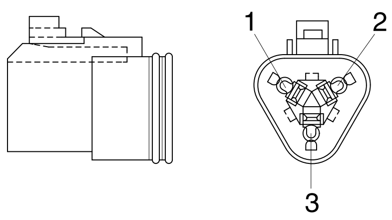
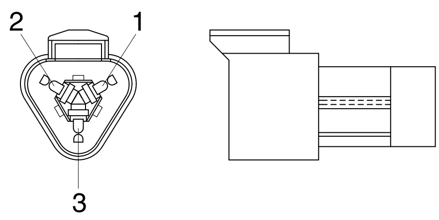
<tr><td>3</td><td>

DT06-3S</td><td>

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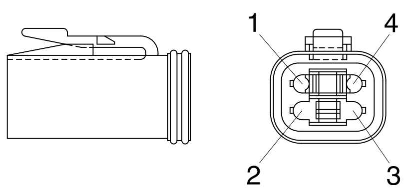
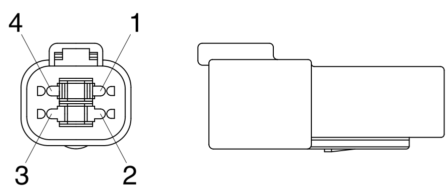
<tr><td>4</td><td>

DT06-4S</td><td>

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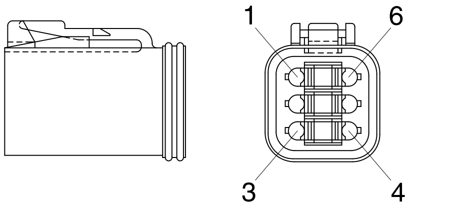
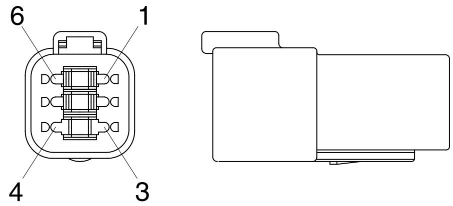
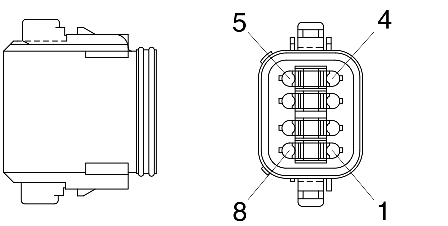
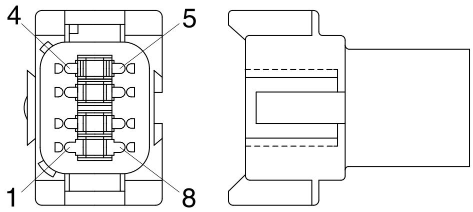
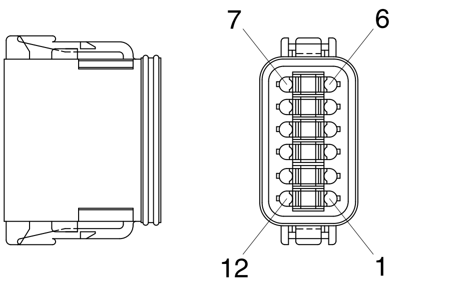
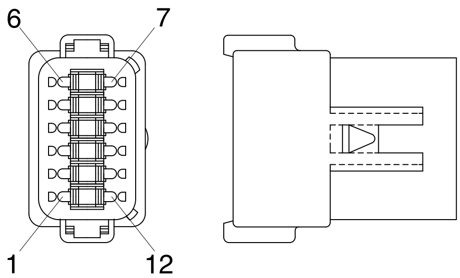
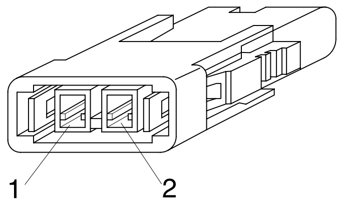
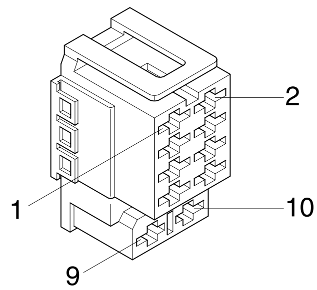
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 DT06-6S	 DT04-6P
8	 DT06-8S	 DT04-8P
12	 DT06-12S	 DT04-12P

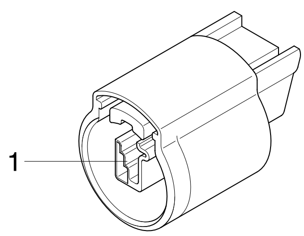
15) MOLEX 2CKTS CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 35215-0200	

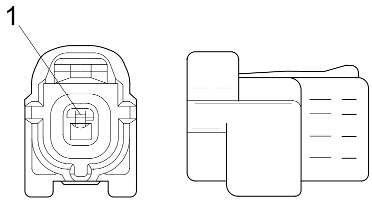
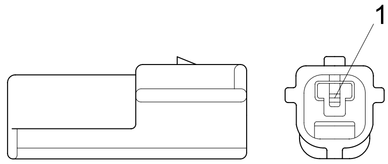
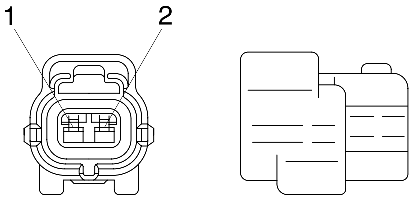
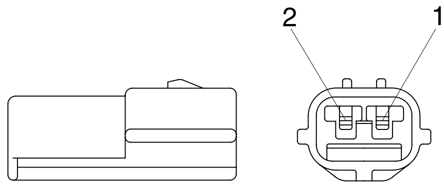
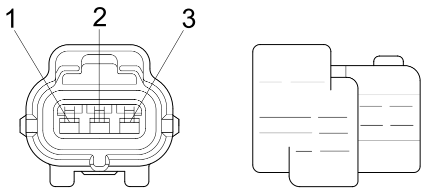
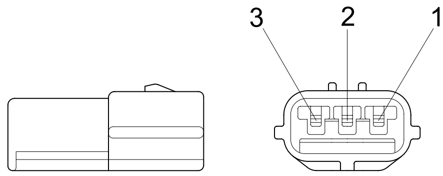
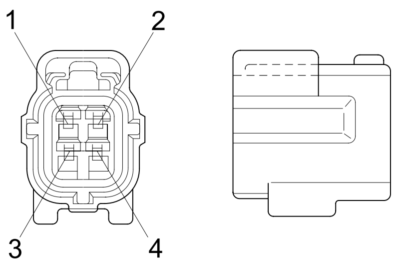
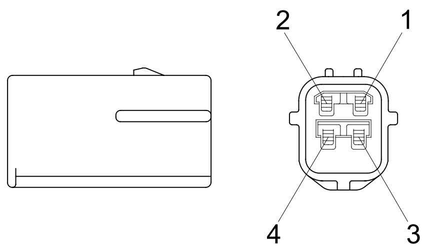
16) ITT SWF CONNECTOR

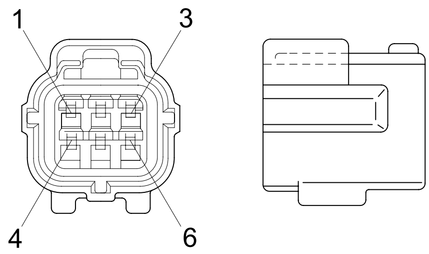
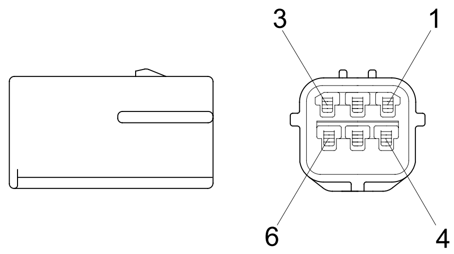
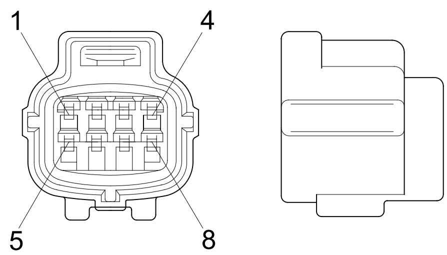
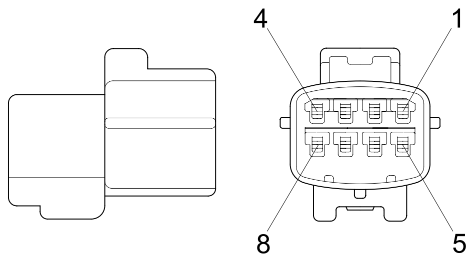
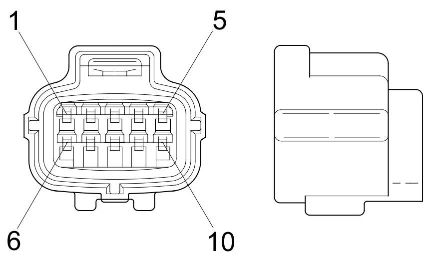
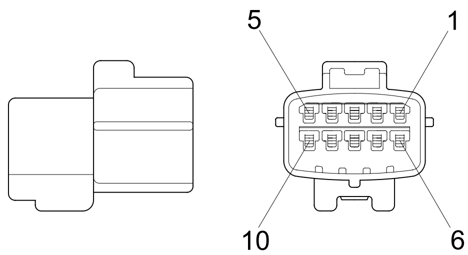
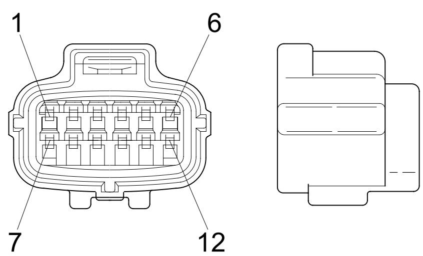
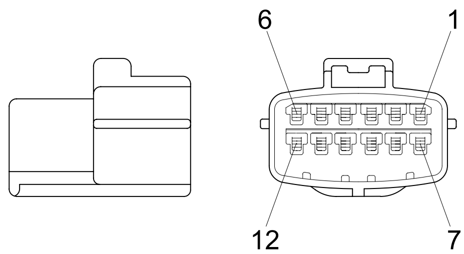
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

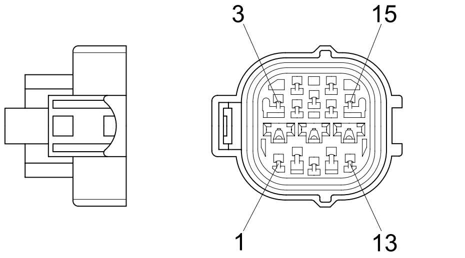
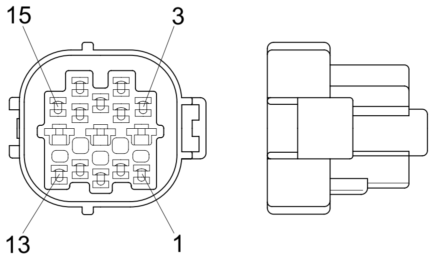
17) MWP NMWP CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 NMWP01F-B	

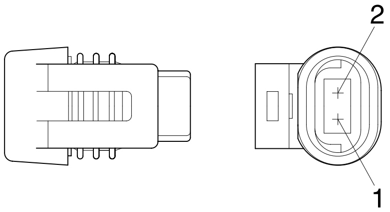
18) ECONOSEAL J TYPE CONNECTORS

No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S816-001002	 S816-101002
2	 S816-002002	 S816-102002
3	 S816-003002	 S816-103002
4	 S816-004002	 S816-104002

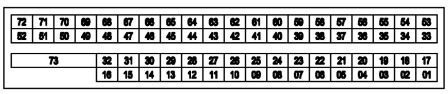
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

No. of pin	Receptacle connector (female)	Plug connector (male)
15	 368301-1	 2-85262-1

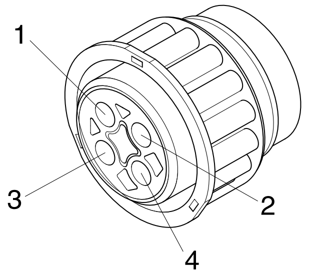
19) METRI-PACK TYPE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
2	 12040753	

20) PCB MOUNTING CMCU CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
73		

21) AMP FUEL WARMER CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
4	 2-967325-3	

SECTION 5 MECHATRONICS SYSTEM

SECTION 5 MECHATRONICS SYSTEM

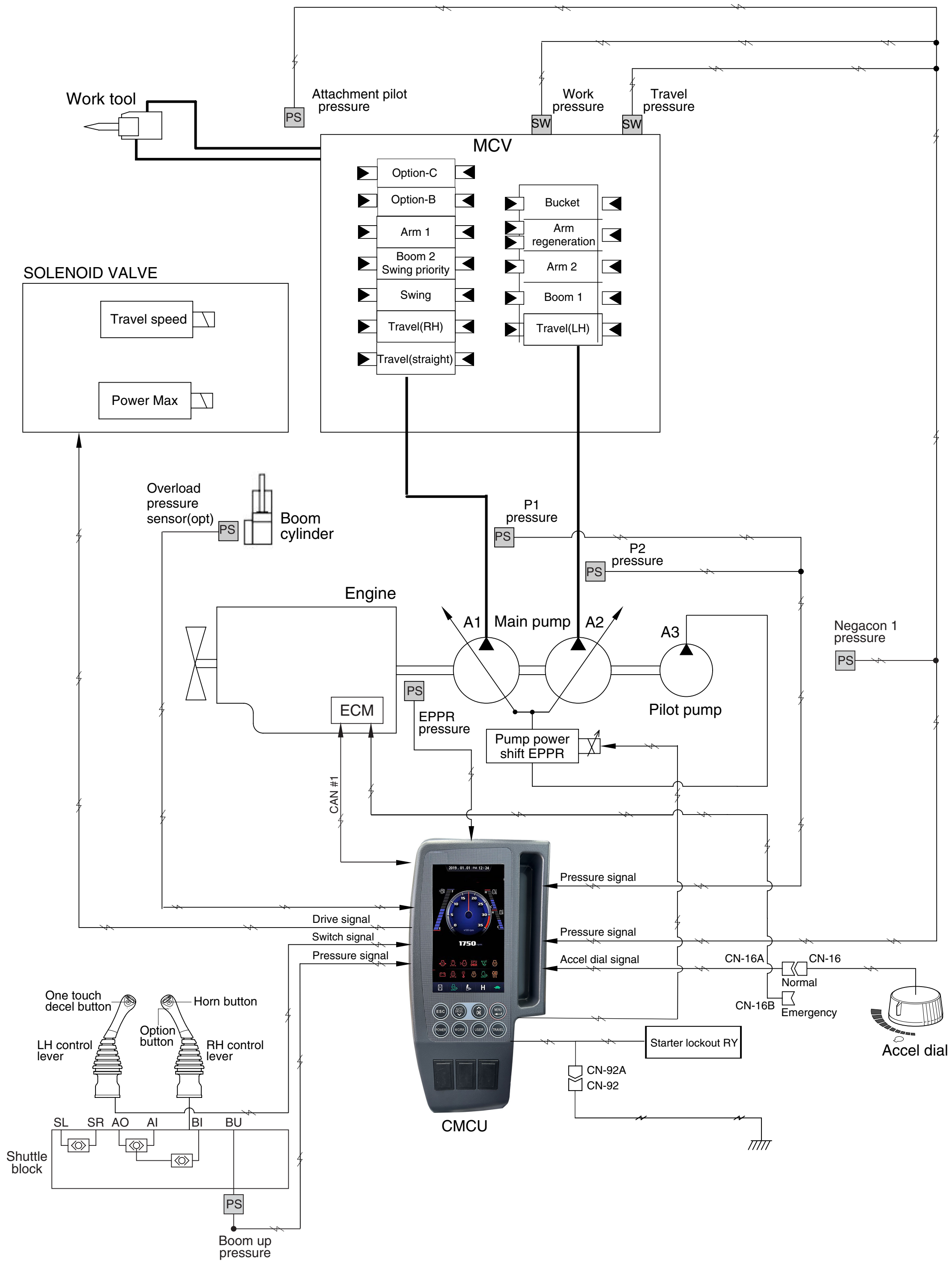
GROUP 1 OUTLINE

■ AD VANCED CAPO (Computer Aided Power Optimization) system

The CAPO (Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc. It consists of a CMCU(cluster& machine control unit integration), an accel actuator, and other components.
The CMCU protect itself from over-current and high voltage input, and diagnose malfunctions caused by short or open circuit in electric system, and display error codes on the cluster.

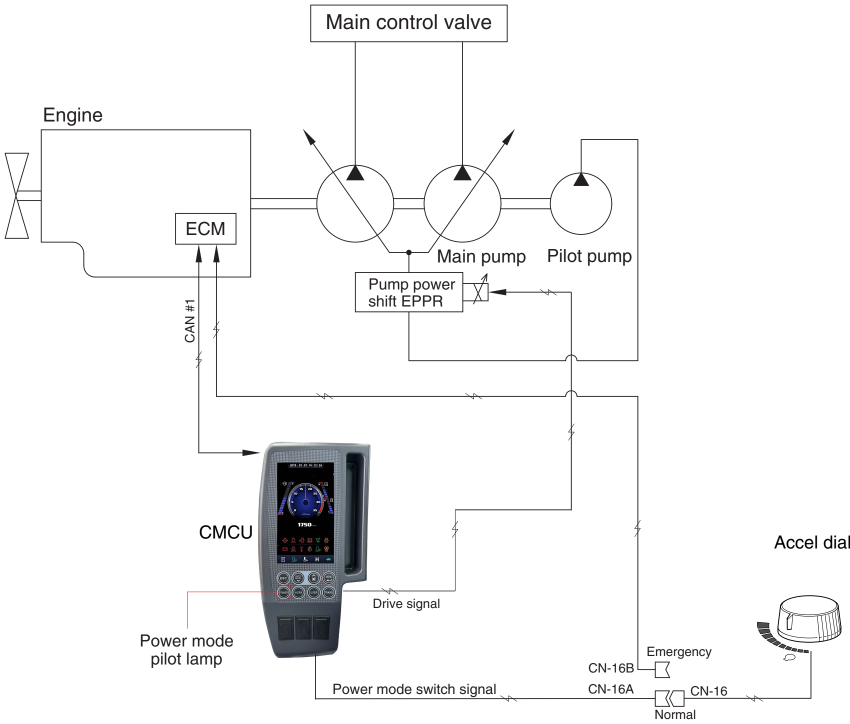
- ADVANCED CAPO SYSTEM
  - Mode selection system
    - M mode selection
    - H mode selection
    - S mode selection
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
  - Automatic warming up system
  - Engine overheat prevention system
  - Variable power control system
  - Anti-restart system
  - Self-diagnostic system
    - Warning lamps blink and buzzer beep
    - Machine error code display
  - Engine control system
  - Machine monitoring system
    - Equipment condition monitoring
    - Switch state monitoring
    - Output state monitoring
  - One touch deceleration system

SYSTEM DIAGRAM



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

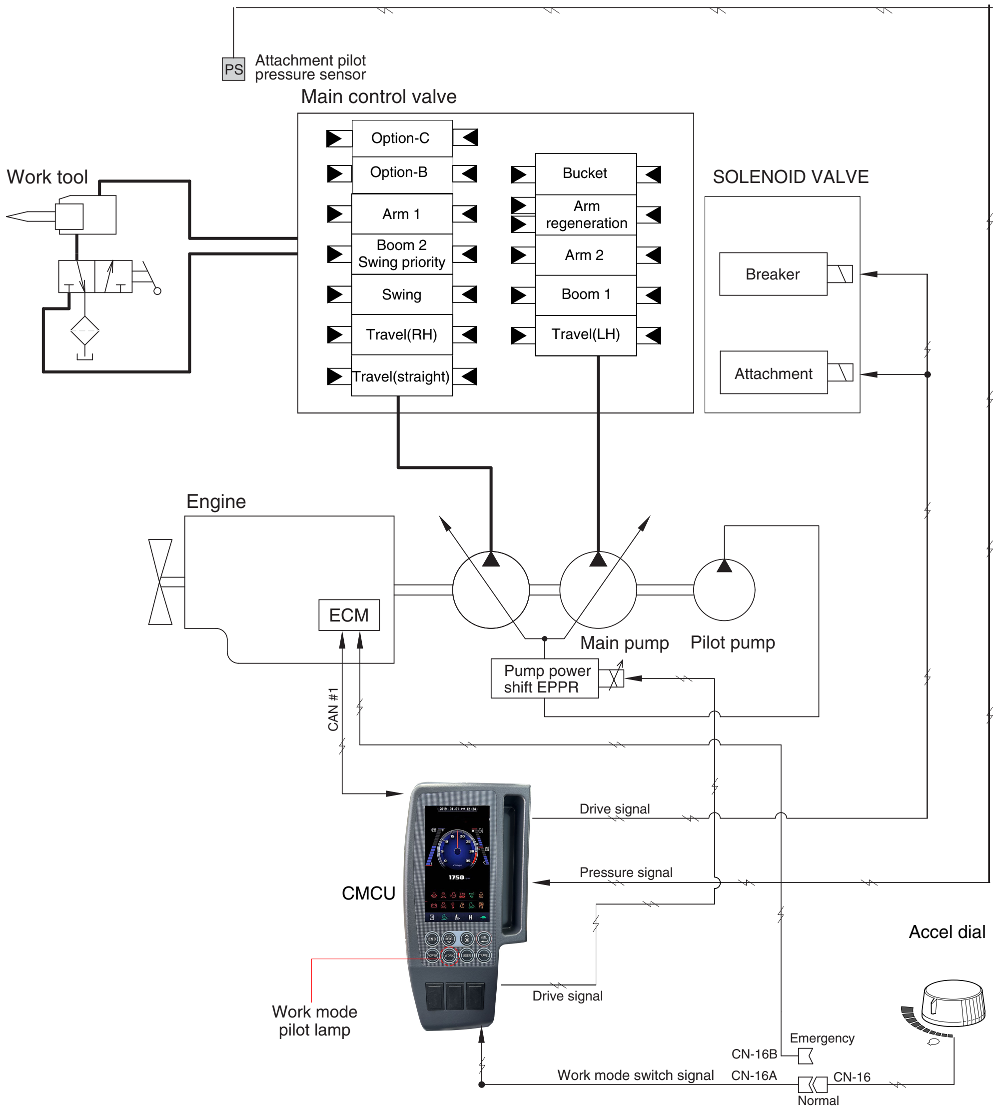
The combination of 3 power modes (M, H, S) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
M	Max mode	1800±50	-	1900±50	-	-	28(~21)	-	21
H	Heavy duty power	1600±50	-	1700±50	-	-	30(~23)	-	23
S	Standard power	1400±50	-	1500±50	-	-	32(~25)	-	25
Auto decel	Engine deceleration	1300±50	-	-	-	-	40±2	-	-
One touch decel	Engine quick deceleration	1200±50	-	-	-	-	40±2	-	-
Key start	Key switch start position	1200±50	-	-	-	-	40±2	-	-

※ Power shift (Standard/Option) can be changed by "Service menu" in "Management" on the cluster.

2. WORK MODE SELECTION SYSTEM

Work mode consists of the general operation (bucket) and the optional attachment (breaker, crusher).



1) GENERAL WORK MODE (bucket)

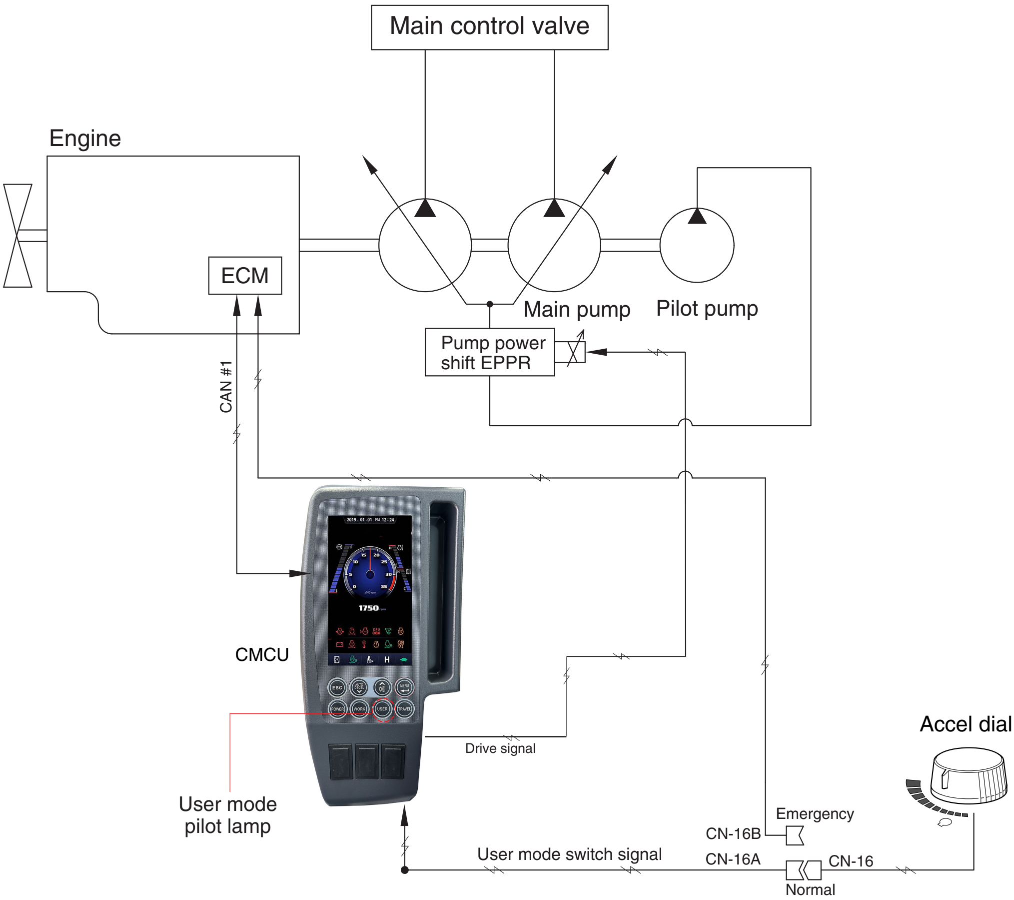
This mode is used to general digging work.

2) ATT WORK MODE (breaker, crusher)

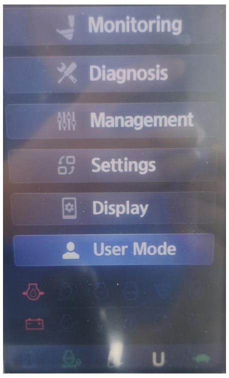
It controls the pump flow and system pressure according to the operation of breaker or crusher.

Description	General mode	Work tool	
	Bucket	Breaker	Crusher
Attachment safety solenoid	OFF	ON	ON

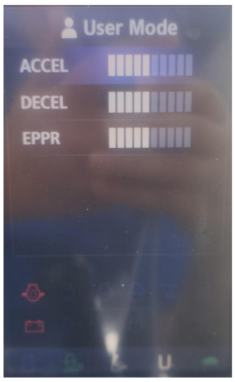
3. USER MODE SELECTION SYSTEM



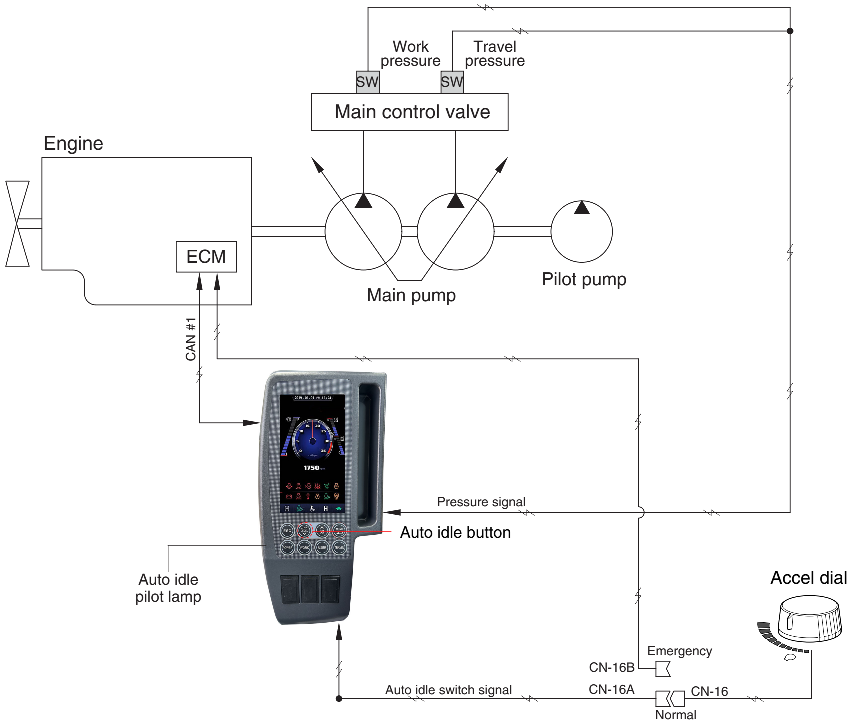
1) High idle rpm, low idle rpm and EPPR pressure can be adjusted and memorized in the U-mode.



⇨



GROUP 3 AUTOMATIC DECELERATION SYSTEM

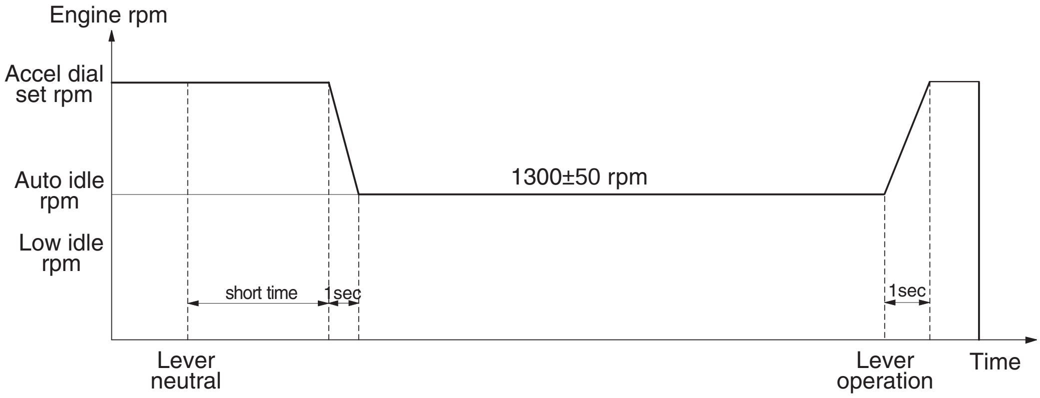


1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral within short time, CMCU drives the accel actuator to reduce the engine speed to 1300±50 rpm.

As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

When the Auto idle pilot lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed before deceleration in a second.

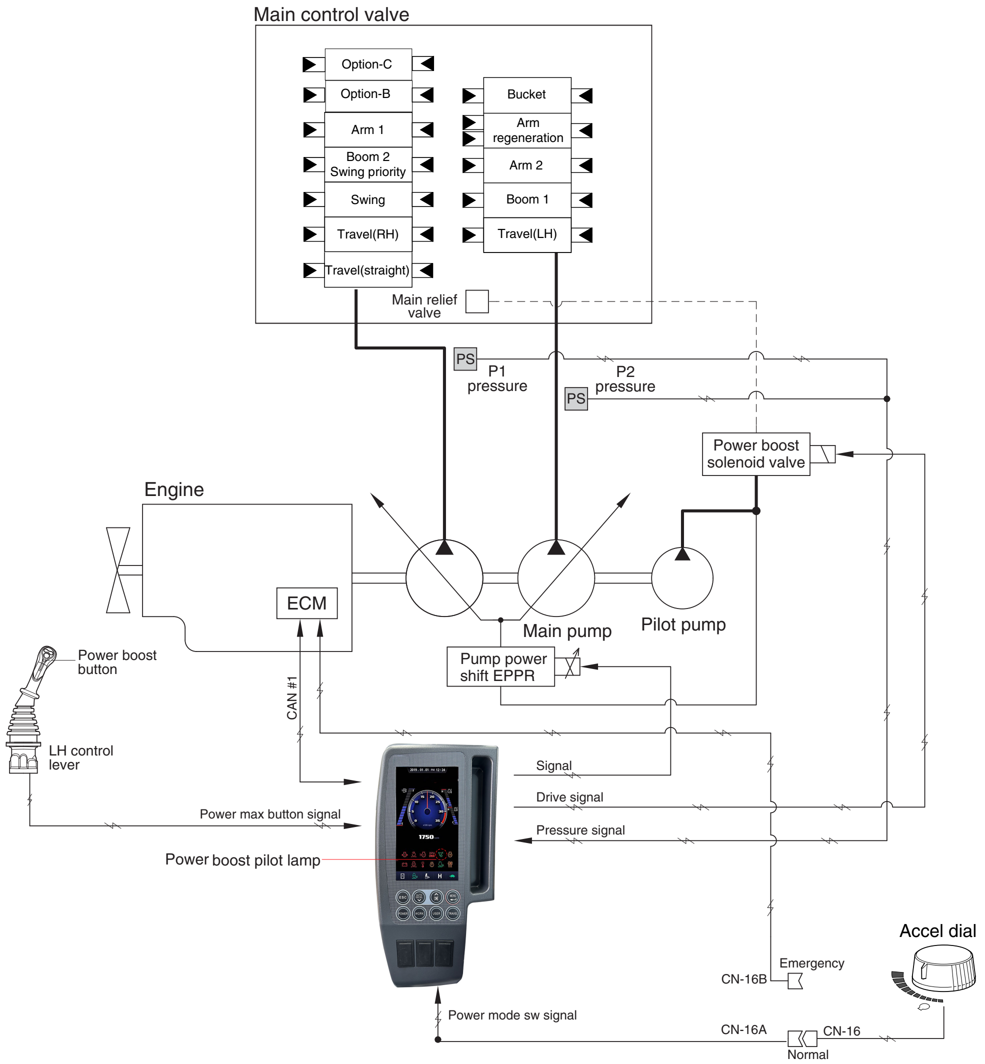


2. WHEN AUTO IDLE PILOT LAMP OFF

The engine speed can be set as desired using the accel dial switch, and even if the control levers are neutral, the engine speed is not reduced.

※ Auto idle function can be activated when accel dial position is over 4.

GROUP 4 POWER BOOST SYSTEM



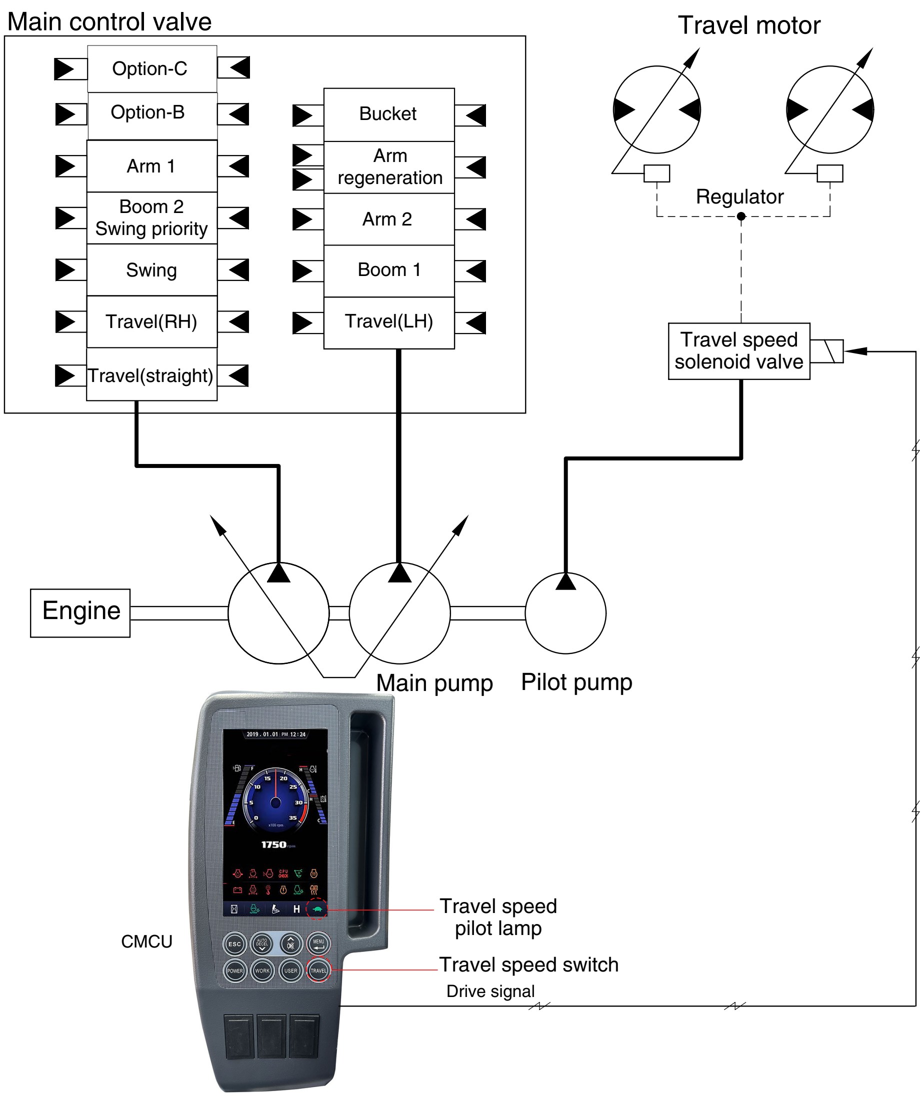
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set M mode and maximum digging power is increased by 10 %.

· When the power boost function is activated, the power boost solenoid valve pilot pressure raises the set pressure of the main relief valve to increase the digging power.

Description	Condition	Function
Activated	Power boost switch : ON Accel dial : over 8	- Power mode : M - Accel dial power : 9 - Power boost solenoid : ON - Power boost pilot lmap : ON - Operating time : max 8 seconds
Canceled	Power boost switch : OFF	- Pre-set power mode - Power boost solenoid : OFF - Power boost pilot lamp : OFF

※ When the auto power boost is set to Enable and power mode is set to M mode on the cluster, the digging power is automatically increased as working conditions by the CMCU. It is operated max 8 seconds.

GROUP 5 TRAVEL SPEED CONTROL SYSTEM

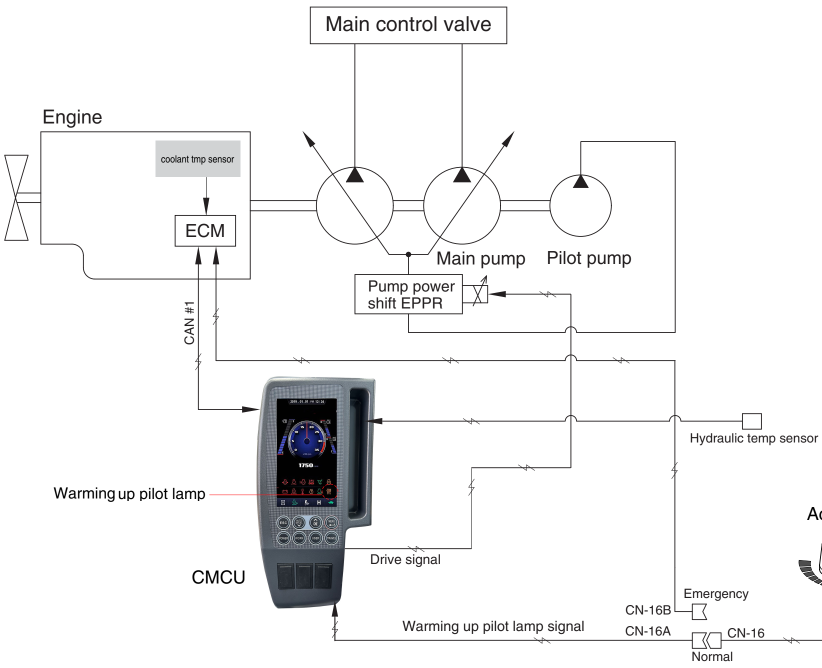


Travel speed can be switched manually by pressing the travel speed switch on the cluster.

Speed	Travel speed solenoid valve	Lamp on cluster	Operation
Low	OFF	Turtle	Low speed, high driving torque in the travel motor
High	ON	Rabbit	High speed, low driving torque in the travel motor

※ Default : Turtle (low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



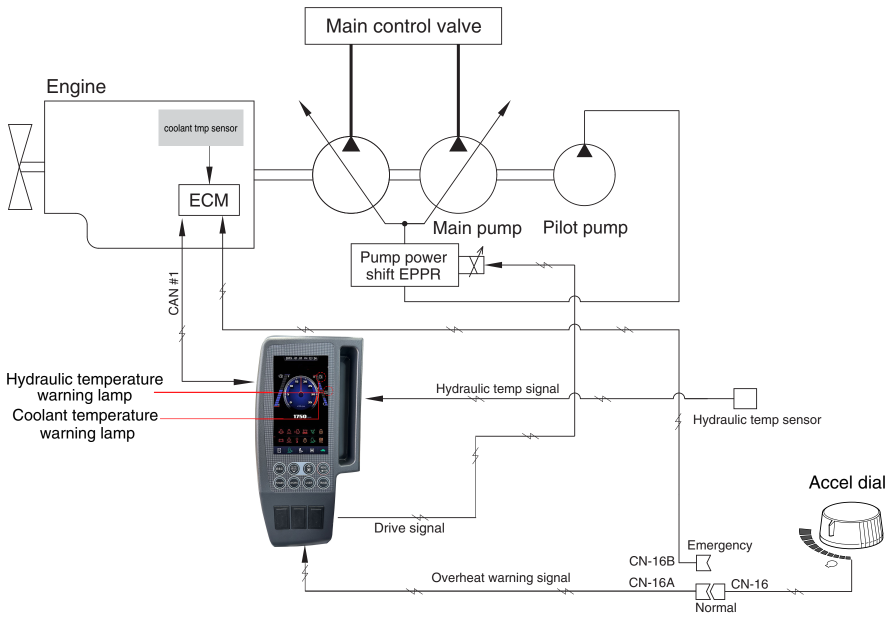
1. The CMCU reads engine coolant temperature through the temperature sensor and if the coolant temperature is below 30˚C, it increases the engine speed from key start. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

2. In case of the coolant temperature increases up to 30˚C, the engine speed is decreased to key start speed. And if an operator changes power mode set during the warming up function, the CMCU cancels the automatic warming up function.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : below 30˚C (after engine run)	- Power mode : Default (S mode) - Warming up time : 10 minutes (max) - Warming up pilot lamp : ON
Canceled	- Coolant temperature : Above 30˚C - Warming up time : Above 10 minutes - Changed power mode set by operator - RCV lever or pedal operating - Auto idle cancel ※ If any of the above conditions is applicable, the automatic warming up function is canceled	- Power mode : set mode - Warming up pilot lamp : OFF

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM

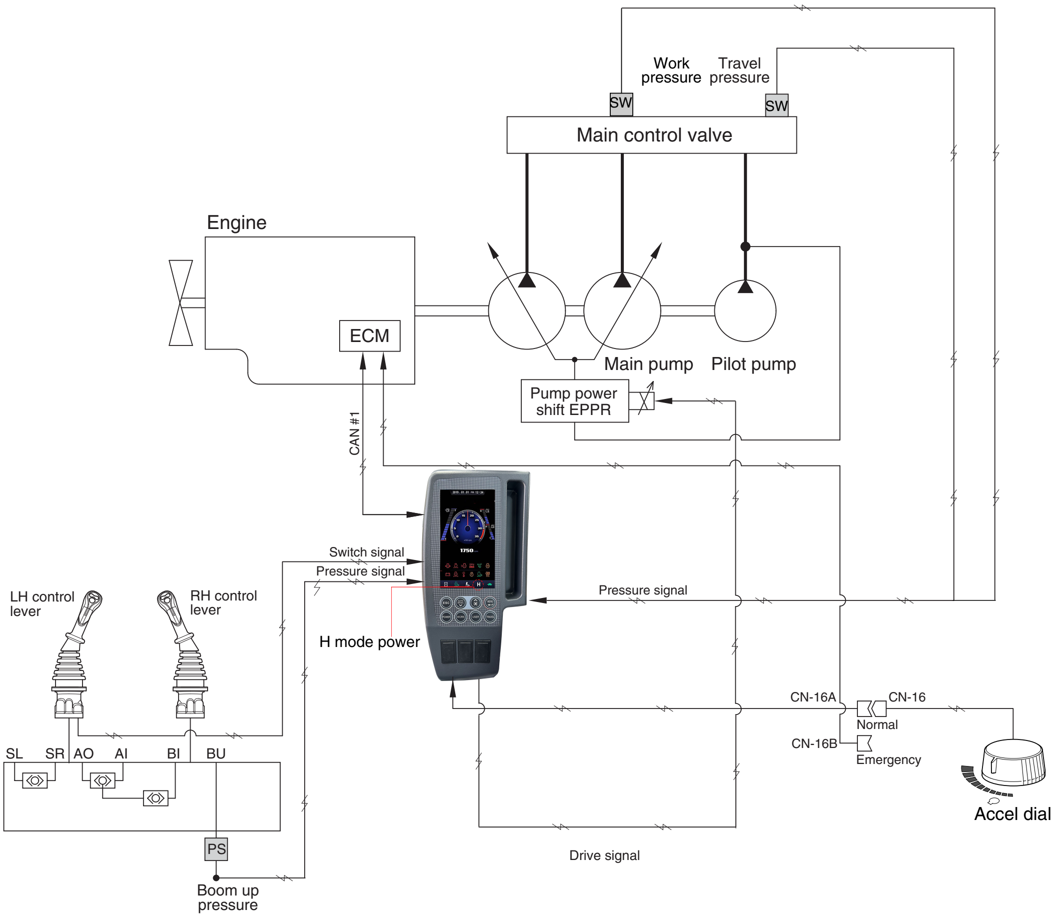


1. If the engine coolant temperature or the hydraulic oil temperature is overheated over 105˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant or hydraulic oil temperature : Above 100˚C	- Warning lamp buzzer : ON - Pump absorption torque is reduced.
	Canceled	- Coolant or hydraulic oil temperature : Less than 95˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant or hydraulic oil temperature : Above 105˚C	- Emergency warning lamp pops up on the center of LCD and the buzzer sounds. - Engine speed is reduced after 10 seconds.
	Canceled	- Coolant or hydraulic oil temperature : Less than 101˚C	- Return to pre-set the engine speed. - Hold pump absorption torque on the first step warning.

GROUP 8 VARIABLE POWER CONTROL SYSTEM

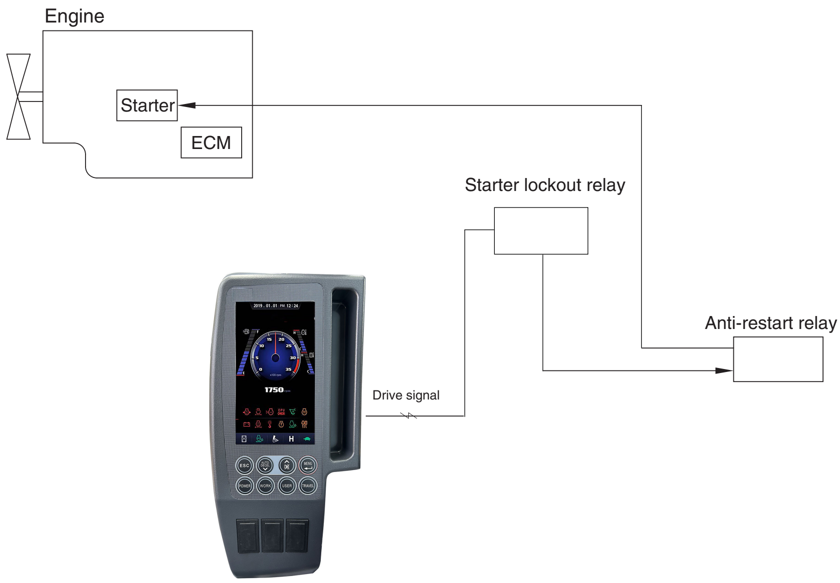


· The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.
It makes fuel saving and smooth control at precise work.

Description	Working condition
Power mode	M , H , S
Work mode	General (bucket)
Pressure sensor	Normal

※ The variable power control function can be activated when the power mode is set to S mode.

GROUP 9 ANTI-RESTART SYSTEM



1. ANTI-RESTART FUNCTION

After a few seconds from the engine starts to run, CMCU turns off the Anti-restart relay to protect the starter from inadvertent restarting.

1. OUTLINE

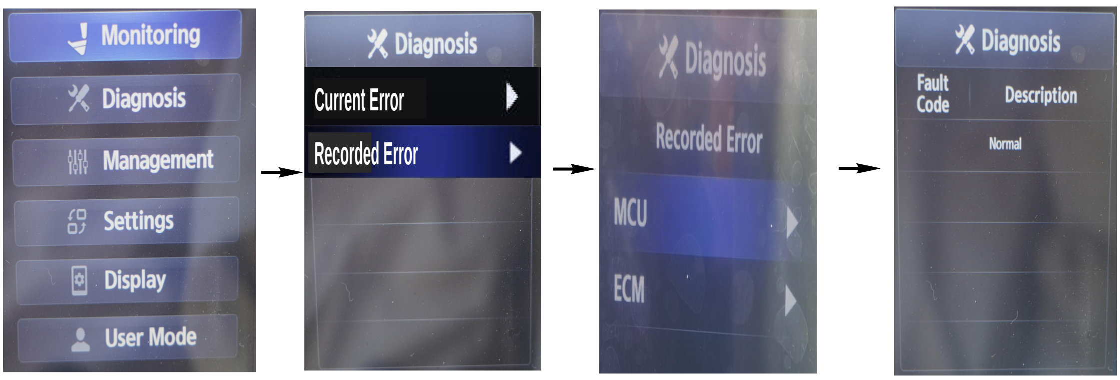
When any abnormality occurs in the Advanced CAPO system caused by electric parts malfunction and by open or short circuit, the CMCU diagnoses the problem, make warning lamp blink, the buzzer beep or sends the error codes to the cluster and also stores them in the memory.

2. MONITORING

1) Current Error

· The active faults of the CMCU can be checked by this menu.

2) Recorded Error



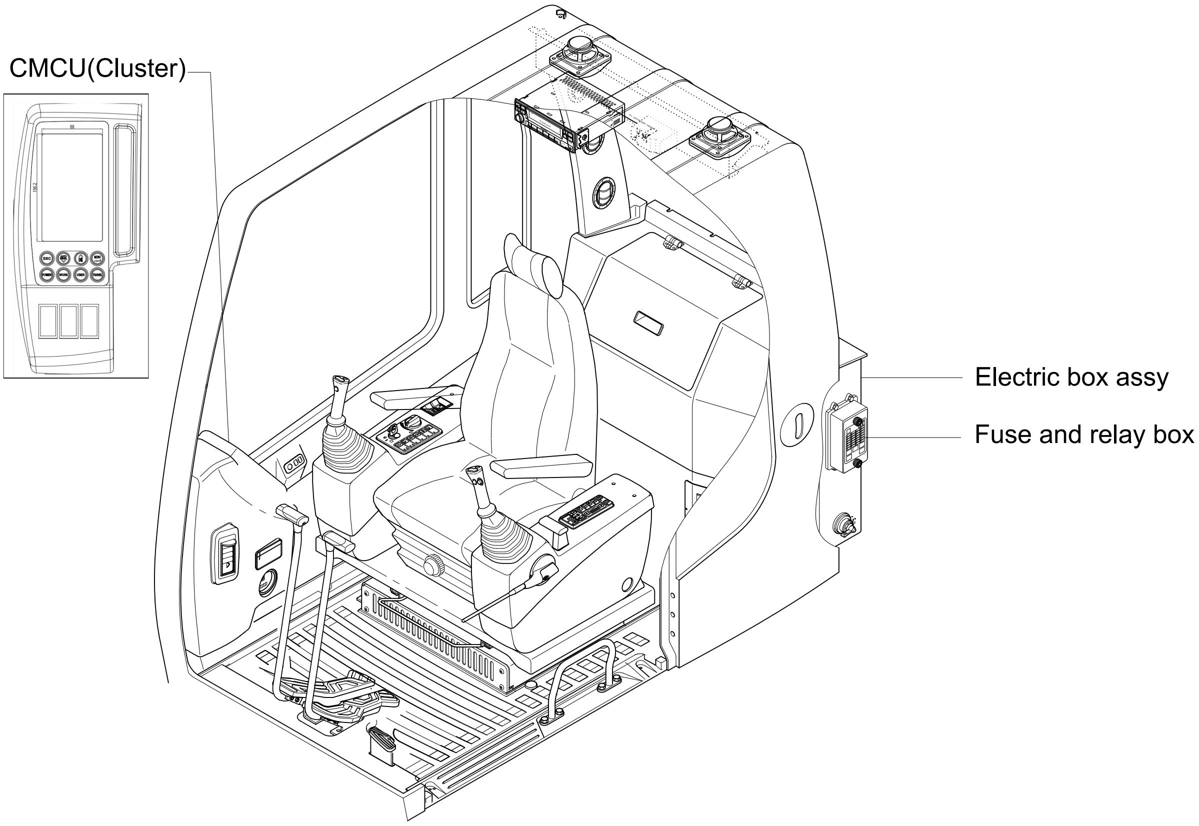
· The recorded error of the CMCU can be checked by this menu.

3. MACHINE ERROR CODES TABLE

FAULT CODE	SPN	FMI	SPN-FMI Description
1	341	6	Motor Driving Status for Engine Governor Actuator - Current Above Normal Or Grounded Circuit
2	340	3	Potentiometer Voltage for Engine Governor Actuator - Voltage Above Normal, Or Shorted To High Source
3	140	6	Main Pump EPPR Valve Current - Current Above Normal Or Grounded Circuit
5	167	6	Travel Speed Solenoid - Voltage Below Normal, Or Shorted To Low Source
10	701	3	Hour-Meter - Voltage Below Normal, Or Shorted To Low Source
11	714	3	Acceleration Dial Voltage - Voltage Above Normal, Or Shorted To High Source
12	120	0	Main Pump 1(P1) Pressure - Data Valid But Above Normal Operational Range
13	121	0	Main Pump 2(P2) Pressure - Data Valid But Above Normal Operational Range
14	200	0	P1_P2_EPPR_VALVE_PRESSURE_MEASUREMENT
16	341	5	Motor Driving Status for Engine Governor Actuator - Current Below Normal Or Open Circuit
18	140	5	Main Pump EPPR Valve Current - Current Below Normal Or Open Circuit
20	167	4	Travel Speed Solenoid - Voltage Below Normal, Or Shorted To Low Source
25	701	4	Hour-Meter - Voltage Below Normal, Or Shorted To Low Source
26	714	4	Acceleration Dial Voltage - Voltage Below Normal, Or Shorted To Low Source
27	120	4	Main Pump 1(P1) Pressure - Voltage Below Normal, Or Shorted To Low Source
28	121	4	Main Pump 2(P2) Pressure - Voltage Below Normal, Or Shorted To Low Source
29	200	4	P1 & P2 EPPR Valve Pressure (Measurement) - Voltage Below Normal, Or Shorted To Low Source
32	722	4	Travel Alarm Buzzer - Voltage Below Normal, Or Shorted To Low Source
33	707	1	Alternator Voltage - Data Valid But Below Normal Operational Range
34	705	1	(MCU Input)Battery Voltage - Data Valid But Below Normal Operational Range
35	705	0	(MCU Input)Battery Voltage - Data Valid But Above Normal Operational Range
36	840	2	Cluster Communication Status - Data Erratic, Intermittent Or Incorrect
38	327	6	Anti-Restart Relay - Current Above Normal Or Grounded Circuit
41	101	4	Hydraulic Oil Temperature - Voltage Below Normal, Or Shorted To Low Source
42	301	4	Fuel Level - Voltage Below Normal, Or Shorted To Low Source
44	127	0	Boom Up Pilot Pressure - Data Valid But Above Normal Operational Range
45	101	3	Hydraulic Oil Temperature - Voltage Above Normal, Or Shorted To High Source
46	301	3	Fuel Level - Voltage Above Normal, Or Shorted To High Source
48	127	4	Boom Up Pilot Pressure - Voltage Below Normal, Or Shorted To Low Sourc
56	722	6	Travel Alarm Buzzer Current Above Normal Or Grounded Circuit
72	841	2	ECM Communication Status - Data Erratic, Intermittent Or Incorrect

GROUP 11 ENGINE CONTROL SYSTEM

1.CMCU(cluster&machine control unit integration)



2. CMCU ASSEMBLY

1) To match the pump absorption torque with the engine torque, CMCU varies EPPR valve output pressure, which control pump discharge amount whenever feedbacked engine speed drops under the reference rpm of each mode set.

GROUP 12 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

EPPR (Electro Proportional Pressure Reducing) valve consists of electro magnet and spool valve installed at main pump.

(1) Electro magnet valve

Receive electric current from CMCU and move the spool proportionally according to the specific amount of electric current value.

(2) Spool valve

Is the two way direction control valve for pilot pressure to reduce main pump flow.
When the electro magnet valve is activated, pilot pressure enters into flow regulator of main pump.

(3) Pressure and electric current value for each mode

Mode		Pressure	Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm^2		
Standard (Stage : 1.0)	M	28(~21)	—	1800 ± 50
	H	30(~23)	—	1600 ± 50
	S	32(~25)	—	1400 ± 50
Option (Stage : 2.0)	M	21	—	1900 ± 50
	H	23	—	1700 ± 50
	S	25	—	1500 ± 50

2) HOW TO SWITCH THE STAGE (1.0↔2.0) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the stage (1.0↔2.0).

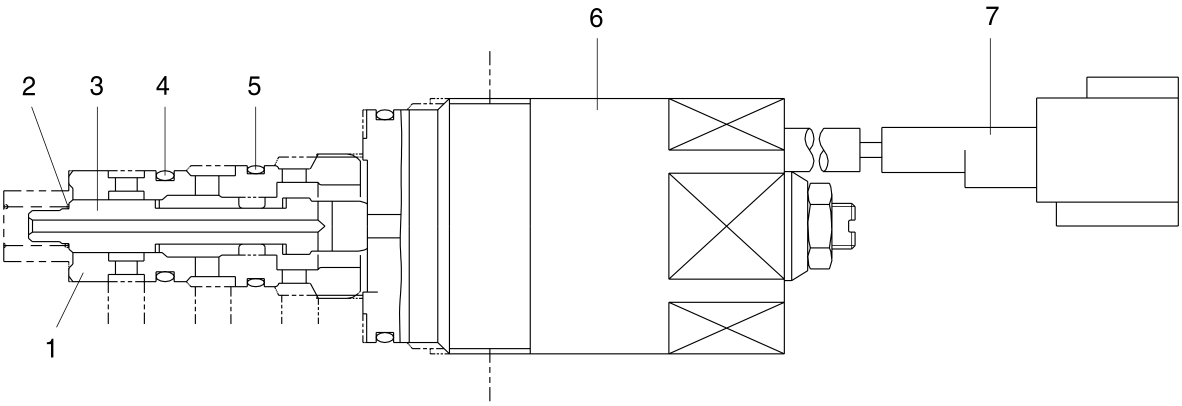
- Settings
  · Dual mode

→

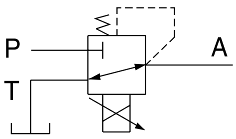
· You can change the mode of the device.

3) OPERATING PRINCIPLE

(1) Structure (pump EPPR valve)



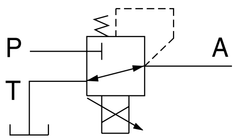
1 Sleeve
2 Spring
3 Spool
4 O-ring
5 O-ring
6 Solenoid valve
7 Connector

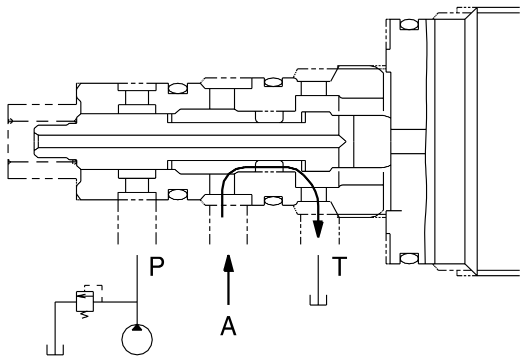


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

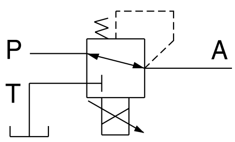
Pressure line is blocked and A oil returns to tank.

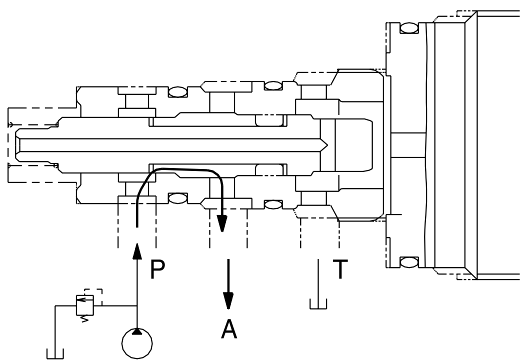




(3) Operating

Secondary pressure enters into A.

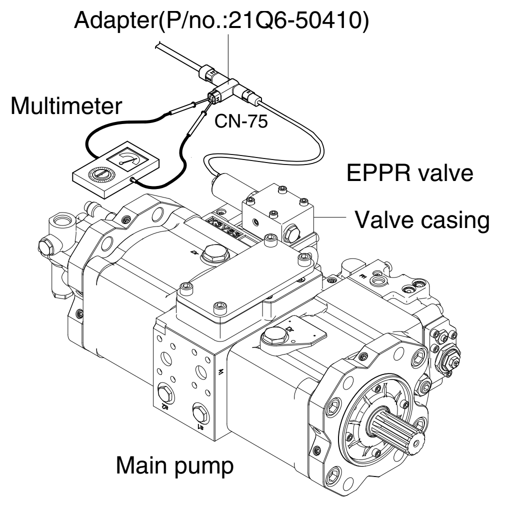




4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve

Spec : 100~700 mA



① Disconnect connector CN-75 from EPPR valve.

② Insert the adapter to CN-75 and install multimeter as figure.

③ Start engine.

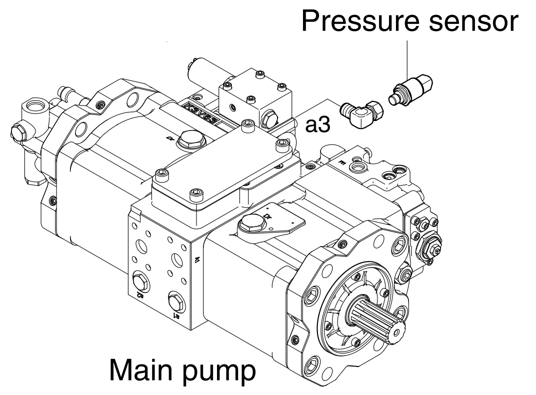
④ Set power mode and cancel auto decel mode.
  · Choise : H-mode

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1600±50 rpm check electric current at bucket circuit relief position.

(2) Check pressure at EPPR valve

Spec : 5~40 kgf/cm² (73~580 psi)



① Remove plug and connect pressure gauge as figure.
  · Gauge capacity : 0 to 50 kgf/cm² (0 to 725 psi)

② Start engine.

③ Set power mode and cancel auto decel mode.
  · Choise : H-mode

④ Position the accel dial at 10.

⑤ If rpm display approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

GROUP 13 MONITORING SYSTEM

1. OUTLINE

Monitoring system consists of the monitor part and switch part.

The monitor part gives warnings when any abnormality occurs in the machine and informs the condition of the machine.

Various select switches are built into the monitor panel, which act as the control portion of the machine control system.

2. CLUSTER(CMCU)

1) MONITOR PANEL

The monitor panel consists of LCD and lamps as shown below, to warn the operator in case of abnormal machine operation or conditions for the appropriate operation and inspection.

- · LCD : Indicate operating status of the machine.
- · Warning lamp : Indicate abnormality of the machine(Red).
- · Pilot lamp : Indicate operating status of the machine(Amber).

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor initial 5 seconds

a. All lamps light up.
b. Buzzer sound.

② Check monitor after 5 seconds : Indicate cluster version and machine condition

a. Cluster program version : 「1.00」 ◄— Indicates program version 「1.00」 for 5 seconds.
b. Tachometer : 0rpm
c. Fuel gauge : All light up below appropriate level
d. Hydraulic temperature : All light up below appropriate level
e. Engine coolant temperature gauge : All light up below appropriate level
f. Warning lamp
※ During start key **ON** the engine oil pressure lamp and battery charging lamp go on, but it is not abnormal.

③ Indicating lamp state

a. Work mode selection : General work
b. Power mode selection : H mode
c. User mode selection : No LED ON
d. Auto decel LED : ON
e. Travel speed pilot lamp : Low(Turttle)

(2) Start of engine

① Check machine condition

a. Tachometer indicates at present rpm
b. Gauge and warning lamp : Indicate at present condition.
※ When normal condition : All warning lamp OFF
c. Work mode selection : General work
d. Power mode selection : H mode
e. User mode selection : No LED ON
f. Auto decel LED : ON
g. Travel speed pilot lamp : Low(Turttle)

② When warming up operation

a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to1000 rpm(Auto decel LED : ON)
※ Others same as above ①.

③ When abnormal condition

a. The lamp lights up and the buzzer sounds.
b. If **BUZZER STOP** switch is pressed, buzzer sound is canceled but the lamp light up until normal condition.

3) CLUSTER CONNECTOR

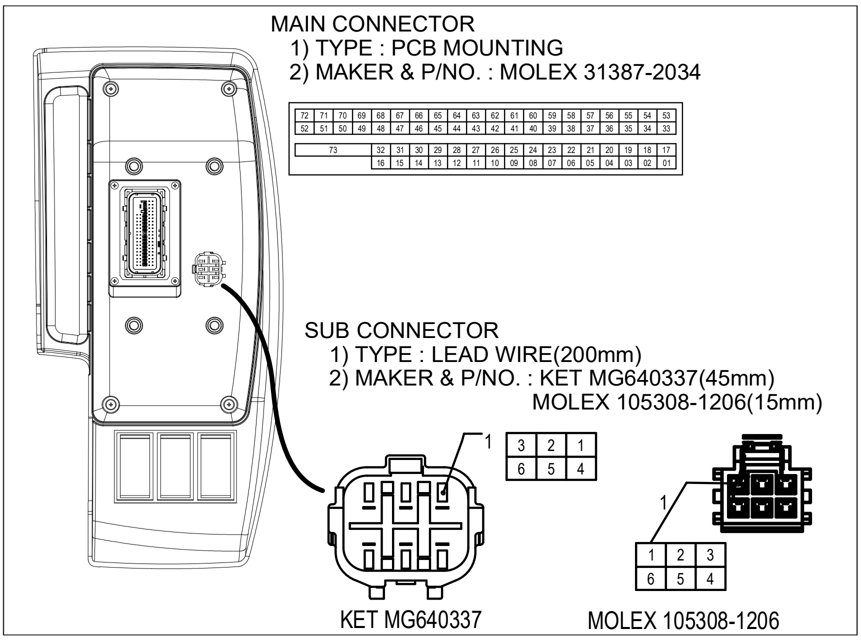
(1) MAIN CONNECTOR

NO	PIN NAME	APPLY	SPEC
1	DOUT_LOW5	X	
2	DOUT_LOW4	OK	Travel Buzzer, ON : 0~2V, OFF : 20~32V
3	GND	OK	MAIN GND
4	HOUR METER	OK	ON : 0V, OFF : 20~32V
5	GND	OK	RS232 GND
6	RS232C_TX1	OK	RS232 TX1(FW Download용)
7	RS232C_RX1	OK	RS232 RX1(FW Download용)
8	GND	OK	MAIN GND
9	NC	X	
10	GND	OK	MIAN GND
11	FW_DUMP	X	FW Download용
12	MOTOR_P	X	Accel Actuator+, 구동 : 20~24V, 정지 : 0V
13	EPPR_N02	X	BOOM DOWN EPPR-, 140~800mA
14	GND	OK	MAIN GND
15	V_EPPR2	X	EPPR POWER 20~32V
16	DOUT_LOW3	OK	Travel Speed SOL, ON : 0~2V, OFF : 20~32V
17	DOUT_LOW2	OK	ANTI Restart Relay, ON : 0~2V, OFF : 20~32V
18	DOUT_LOW1	OK	Fuel Warmer Relay, ON : 0~2V, OFF : 20~32V
19	GND	OK	MAIN GND
20	GND	OK	MAIN GND
21	NC	X	
22	NC	X	
23	GND	OK	CAN GND Shiled
24	CAN1_LOW	OK	CAN1 LOW
25	CAN1_HIGH	OK	CAN1 HIGH
26	GND	OK	Pressure Sensor GND
27	V_PRESS SENSOR	OK	Pressure Sensor Power(24V OUT)
28	MOTOR_N(not use)	X	Accel Actuator-, 구동 : 20~24V, 정지 : 0V
29	EPPR_N01	OK	Pump EPPR-, 140~800mA
30	GND	OK	MAIN GND
31	V_EPPR1	OK	EPPR POWER(Pump EPPR+) 20~32V
32	NC	X	
33	GND	OK	MAIN GND
34	DIN10	X	
35	DIN9	X	
36	DIN8	X	
37	DIN7	OK	Working PS, ON : 0~1V, OFF : 4~5V

NO	PIN NAME	APPLY	SPEC
38	DIN6	OK	Air Clean SW, ON : 0~1V, OFF : 4~5V
39	GND	OK	Digital input GND
40	AIN10	X	
41	AIN9	X	
42	AIN8	X	
43	AIN7	X	
44	AIN6	OK	Boom Up Pilot Press, 1~5V
45	AIN RES TEMP1	X	Cooling Water
46	AIN RES FUEL	OK	Fuel Sensor SIG, 50~700 ohm
47	GND	OK	Sensor GND
48	GND	OK	Altermator GND
49	GND	OK	BAT GND
50	GND	OK	BAT GND
51	GND	OK	BAT GND
52	GND	OK	BAT GND
53	DIN_PULSE(not use)	X	TACHO SIG
54	DIN5	OK	Overload PS SW, ON : 0~1V, OFF : 4~5V
55	DIN4	OK	One Touch Decel SW, ON : 0~1V, OFF : 4~5V
56	DIN3	OK	Travel OIL PS SW, ON : 0~1V, OFF : 4~5V
57	DIN2	OK	Travel alarm SW, ON : 0~1V, OFF : 4~5V
58	DIN1	X	Power MAX SW, ON : 0~1V, OFF : 4~5V
59	GND	OK	Analog input GND
60	AIN5	OK	Negative1 Press, 1~5V
61	AIN4	OK	Accel Dial SIG, 0.5V~4.5V
62	AIN3	OK	P3 Press SIG(Pump EEPR Press), 1~5V
63	AIN2	OK	P2 Press SIG, 1~5V
64	AIN1	OK	P1 Press SIG, 1~5V
65	GND	OK	Sensor Temp GND
66	AIN RES TEMP2	OK	Hydraulic Fluid, 50 ohm~30k ohm
67	AIN_ALT	OK	Alternator SIG(20~32V)
68	GND	OK	Sensor GND
69	5V OUT	OK	5V(POT&DIAL) (4.9~5.1V)
70	10V_OUT(not use)	X	
71	GND	OK	GND
72	IGN	OK	Ignition (ON : 20~32V, OFF : 0~2V)
73	E_VBAT	OK	Battery Power(20~32V)

(2) SUB CONNECTOR

NO	PIN NAME	APPLY	WIRE SPEC		
			COLOR	TYPE	SIZE[mm²]
1	RMCU BATTERY POWER	X	RED	FLRY-B	0.5
2	CAN 2 HIGH	◎	YELLOW / WHITE	FLRY-B	0.5
3	CAN 2 LOW	◎	GREEN / WHITE	FLRY-B	0.5
4	NC	-	-	-	-
5	RMCU IG POWER	X	RED / WHITE	FLRY-B	0.5
6	GROUND	X	BLACK	FLRY-B	0.5

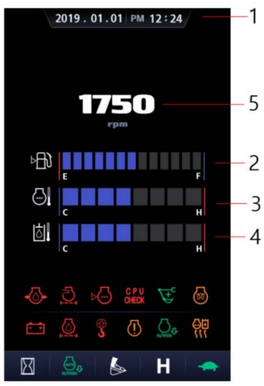


4) GAUGE

(1) Operation screen

Default screen (A Type)

Option screen(B Ttype)



1 Time display

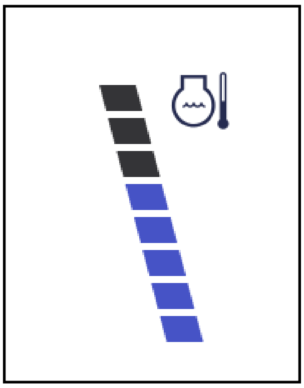
2 Fuel level guage

3 Engine coolant temperature gauge

4 Hydraulic temerature gauge

5 Engine speed(rpm)

(2) Engine coolant temperature gauge



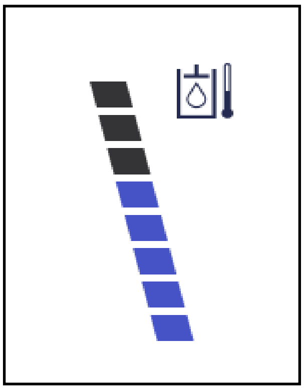
① This gauge indicates the temperature of coolant in 9 step guage

- 0 step: Below 30°C (86°F)
- 1 ~ 7step: 30–104°C (86–219°F)
- 8 step: Above 104°C (219°F)

② When the warning light flashes red, do not immediately extinguish the engine, keep running at intermediate speed,gradually cool and then turn off.

※ If the engine is shut down without sufficient cooling, the temperature of the engine will rise sharply, this can lead to problems with parts inside the engine.

(3) Hydraulic oil temperature gauge



① This gauge indicates the temperature of hydraulic oil in 9 step guage

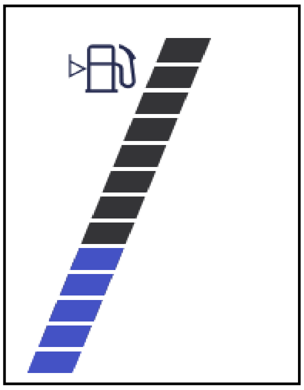
- 0 step: Below 30°C (86°F)
- 1 ~ 7step: 30–104°C (86–219°F)
- 8 step: Above 104°C (219°F)

② The gauge between 1st and 7th steps illuminates when operating.

③ Keep idling engine at low speed until the gauge between 1nd and 7th steps illuminates, before operation of machine.

④ When the gauge of 8th steps illuminates,reduce the load on the system. If the gauge stays in the8 steps, stop the machine and check the cause of the problem.

(4) Fuel level gauge

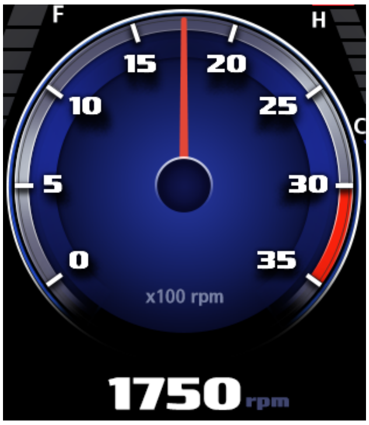


① This gauge indicates the amount of fuel in the fuel tank.

② Fill the fuel when the 1st step or fuel icon blinks in red.

(5) RPM

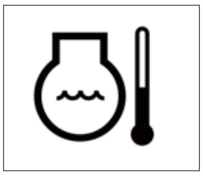
① This displays the round speed of engine



5) WARNING LAMPS

※ The warming lamp lights ON and the buzzer sounds when the machine has a problem.
In this case, press the buzzer stop switch and buzzer stop, but the warming lamp lights until the problem is cleared.

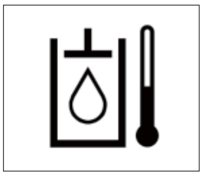
(1) Engine coolant temperature



① The lamp is ON and the buzzer sounds when the cooling water temperature is over the reference temperature (105°C)

② Check the cooling system when the lamp keeps ON.

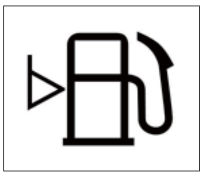
(2) Hydraulic oil temperature



① The lamp is ON and the buzzer sounds when the cooling water temperature is over the reference temperature (105°C)

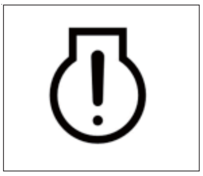
② Check the cooling water level if this warning lamp is ON.

(3) Fuel level



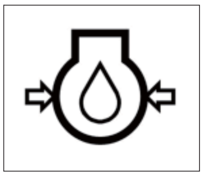
① This warning lamp pops up and the buzzer sounds when the level of fuel is below 31 ℓ (8.2 U.S. gal).
② Fill the fuel immediately when the lamp blinks.

(4) Check engine warning lamp



① This lamp blinks and the buzzer sounds when the communication between CPU controller and ECU on the engine is abnormal, or if any fault code received from ECU.
② Check the communication line between them.
If the communication line is OK, then check the fault code on the cluster

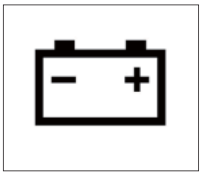
(5) Engine oil pressure warning lamp



① This warning lamp pops up and the buzzer sounds when the engine oil pressure is low.

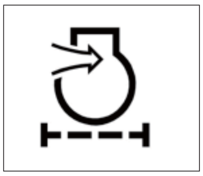
② If the lamp blinks, shut OFF the engine immediately. Check oil level.

(6) Battery charging warning lamp



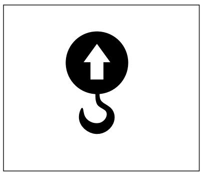
① This lamp blinks when the battery charging voltage is low.
② Check the battery charging circuit when this lamp blinks.

(7) Air cleaner warning lamp



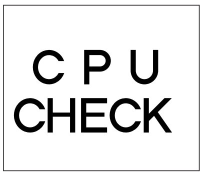
① This warning lamp pops up and the buzzer sounds when the filter of air cleaner is clogged.
② Check the filter and clean or replace it.

(8) Overload warning lamp (opt)



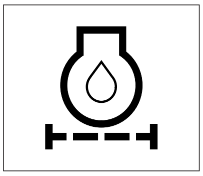
① When the machine is overload, the overload warning lamp blinks during the overload switch is ON. (if equipped)
② Reduce the machine load.

(9) **CPU check warning lamp**



① If any fault code is received from CPU controller, this lamp blinks and the buzzer sounds.
② Check the communication line between CPU controller and cluster.

(10) Engine oil filter clogged warning lamp



① This warning lamp pops up and the buzzer sounds when the engine oil filter is clogged.
② Check the filter and clean or replace it.

6) PILOT LAMPS

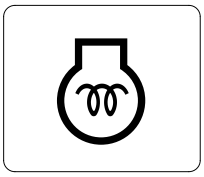
(1) Mode pilot lamps

No	Mode	Pilot lamp	Selected mode
1	Power mode	M H S	Max power mode High power mode Standard power mode
2	User mode	U	User preferable power mode
3	Work mode	 	General operation mode Heavy duty work mode
4	Travel mode	 	Low speed traveling High speed traveling
5	Auto idle mode		Auto idle

(2) Power boost pilot lamp

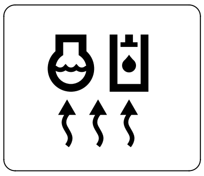
① The lamp will be ON when pushing power max switch on the LH RCV lever.
② The power max function operates for a max period of 8 seconds.

(3) Preheat pilot lamp



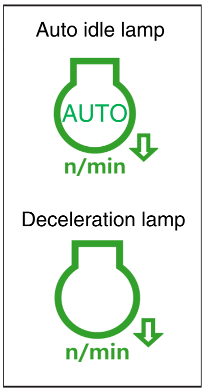
① Turning the start key switch ON position starts preheating in cold weather.
② Start the engine after this lamp is OFF.

(4) Warming up pilot lamp



① This lamp is turned ON when the coolant temperature is below 30˚C(86˚F).
② The automatic warming up is cancelled when the engine coolant temperature is above 30˚C, or when 10 minutes have passed since starting the engine.

(5) Auto idle status/ Deceleration lamp

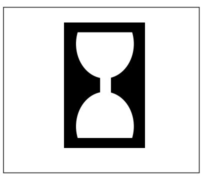


① The auto idle mode pilot lamp will light up when the Auto idle function is selected.
② a. Operating one touch decel switch on the RCV lever makes the Deceleration lamp ON.
b. When the Auto idle funciton is selected, and all levers and pedals are in the neutral position, the Auto idle lamp and Deceleration lamp will be ON.

③ One of the lever or pedal is operated, the Deceleration lamp will go OFF and the engine speed returns to the previous conditions.

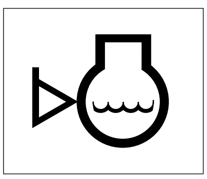
※ One touch decel is not available when the auto idle pilot lamp is turned ON.

(6) **Engine run status indicated lamp**



① This lamp indicated engine status.
When the engine and hour meter is running,this lamp is turn ON.

(7) Coolant level warning lamp

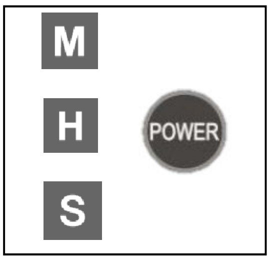


① This warning lamp indicates lack of coolant.
② Check and refill coolant.

7) SWITCHES

※ **When the switches are selected, the pilot lamps are displayed on the LCD.**

(1) Power mode switch



① This switch is to select the machine power mode,and select power mode pilot lamp is display on the position.

· M : Max power mode

· H : High power mode

· S : Standard power mode

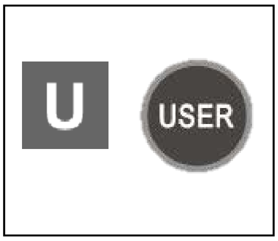
(2) Work mode switch

① This switch is to select the machine work mode, which shifts from general operation mode to optional attachment operation mode

 : General operation mode

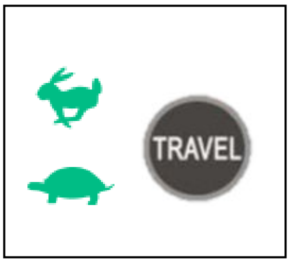
 : Heavy duty work mode

(3) User mode switch



① This Switch select User Mode

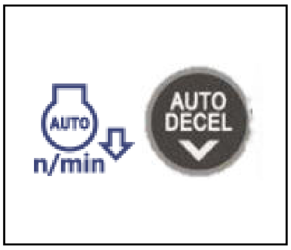
(4) Travel speed control switch



① This switch is used to select the travel speed alternatively.

-  : High speed
-  : Low speed

(5) Auto idle switch



① This switch is used to activate or cancel the auto idle function when all levers and pedals are in a nautral position,automatically reduces engine speed and saves fuel

- Pilot lamp ON : Auto idle function is activated.
- Pilot lamp OFF : Auto idle function is cancelled.

(6) Buzzer stop switch

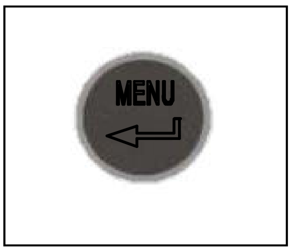
① This switch is used to turn off the buzzer. The buzzer buzzes 2 seconds after the start switch is first turned on,stopping is a normal phenomenon

② When something goes wrong with the equipment, the red light goes on and the buzzer goes off. It can be opened in this case the switch stops the buzze

(7) Escape switch

① This switch is used to return to the previous menu or parent menu.

(8) Menu switch



① This switch used to select the main menu and subordinate menu on the LCD

8) MAIN MENU

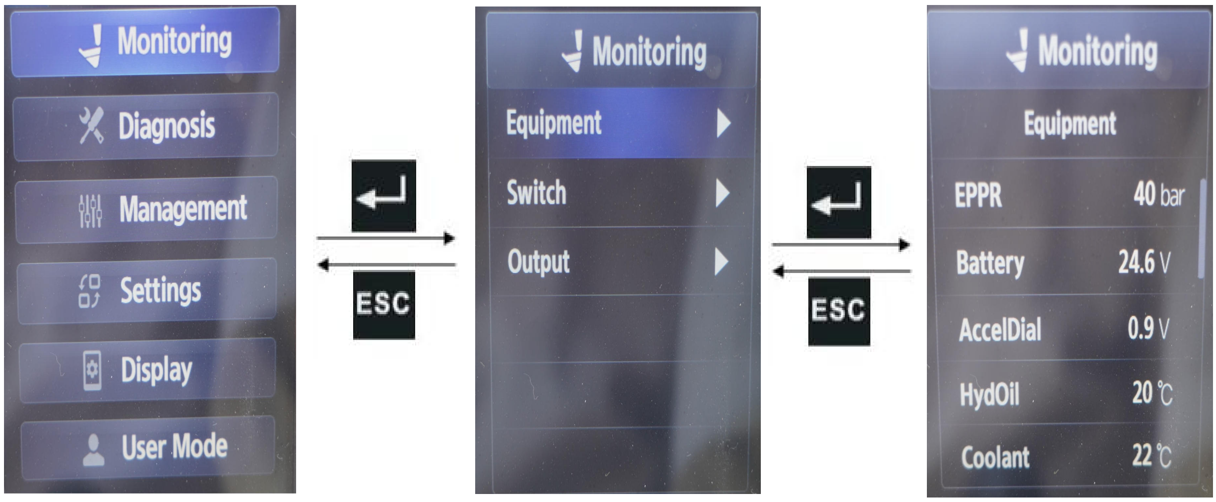
(1) Structure

NO	Main Menu	Sub Menu	Instructions
1	Monitoring	Equipment Switch Output	Device information and status Switch state output state
2	Diagnosis	Current Error Recorded Error	CMCU, engine ECM fault record confirmation and delete
3	Management	Equipment maintenance	Change the exchange cycle of oil and filter element Initialization of service time
4	Settings	Time Setting Machine Security Dual Mode Camera	Set time Set startup limits and change passwords Mode changes Camera Settings
5	Display	Operation Skin Brighteness Language	Select boot Mode Set screen brightness Language Settings
6	User Mode	User Mode Setting	Set engine high speed idling speed automatic decompression speed EPPR valve input current value

(2) Menu description

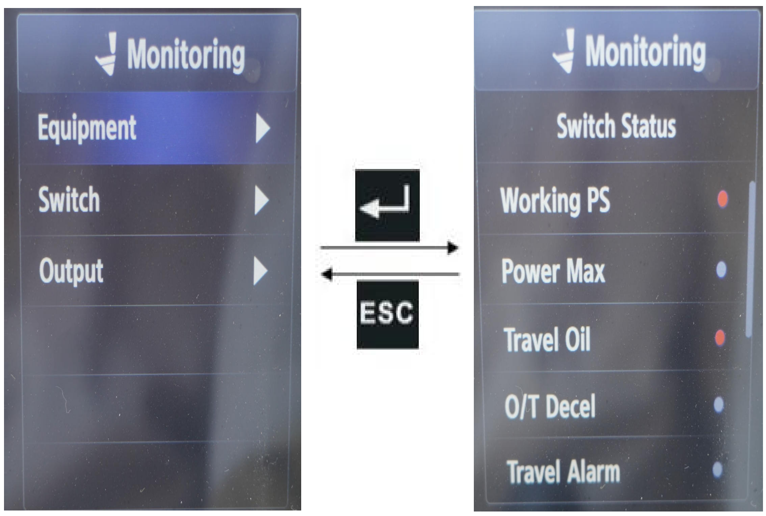
① **Monitoring**

a. Equipment



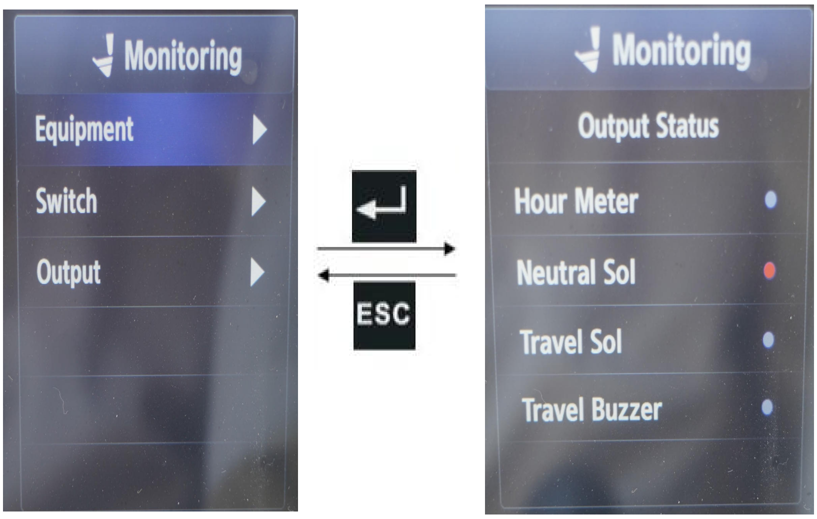
- Equipment status information.

b. Switch



- Switch status information.

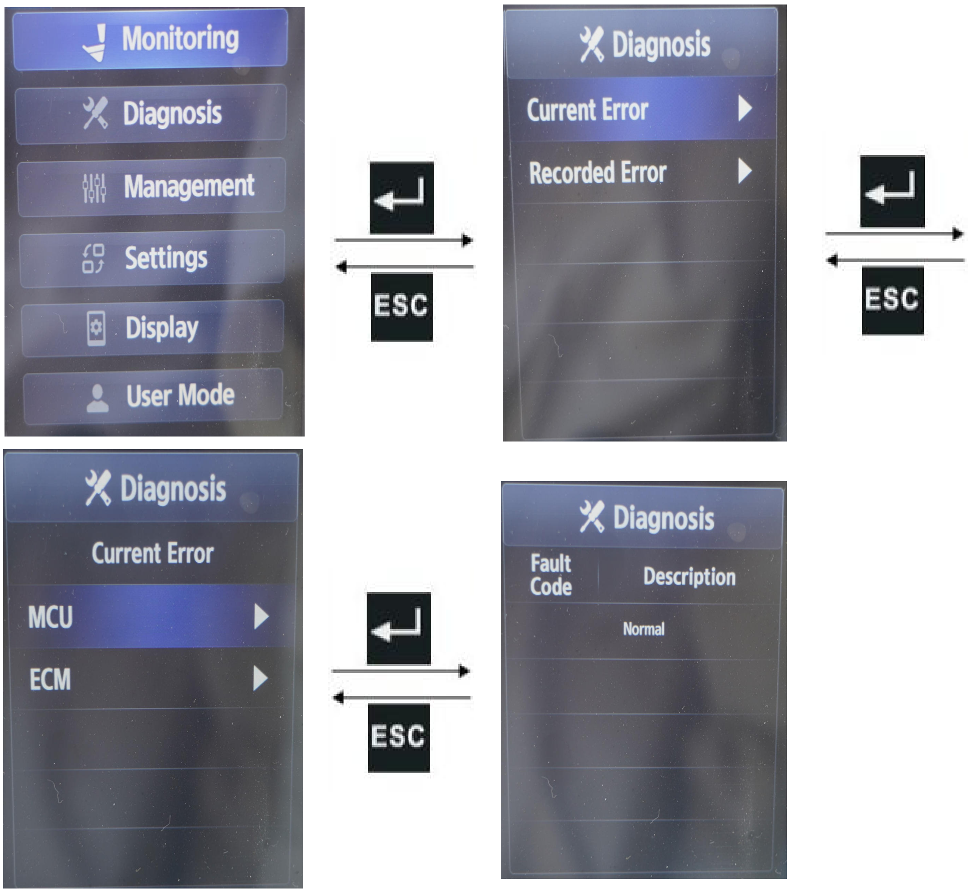
C.Output



- Output status information.

② **Diagnosis**

a. Current Error



- You can check for current CMCU or engine ECM failures.

b. Recorded Error

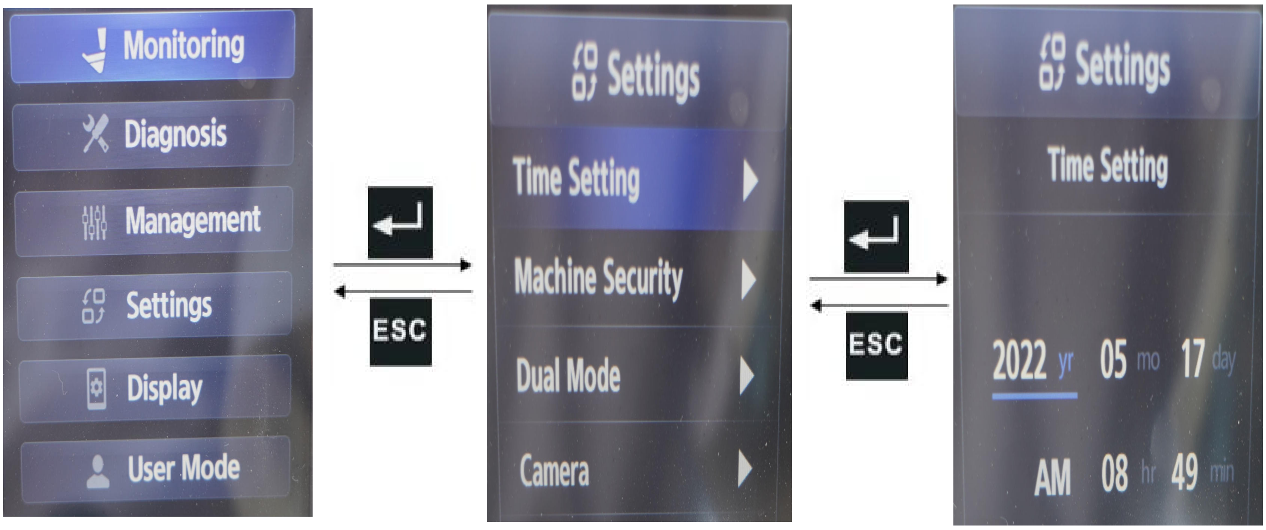
- You can check past CMCU or engine ECM failures.

(3). **Management**

- The exchange cycle and remaining time of consumables can be confirmed.
- Remaining time initialization: The remaining time can be initialized.
- Change the switching period: You can set the switching period.

(4).**Settings**

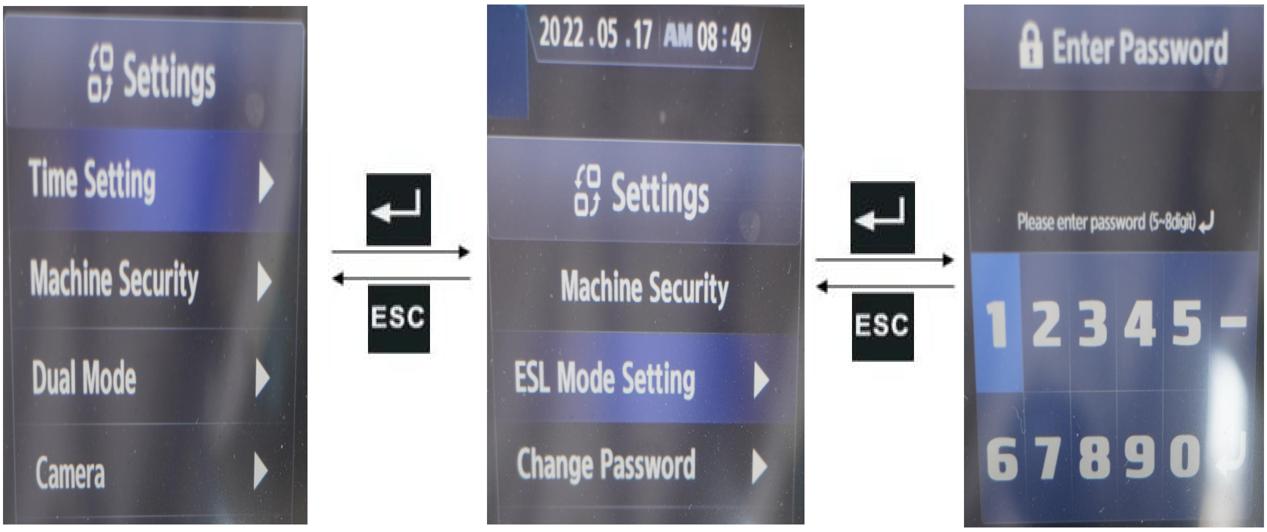
① Time Setting



- Year, month, day, hour, minute.

② Machine Security

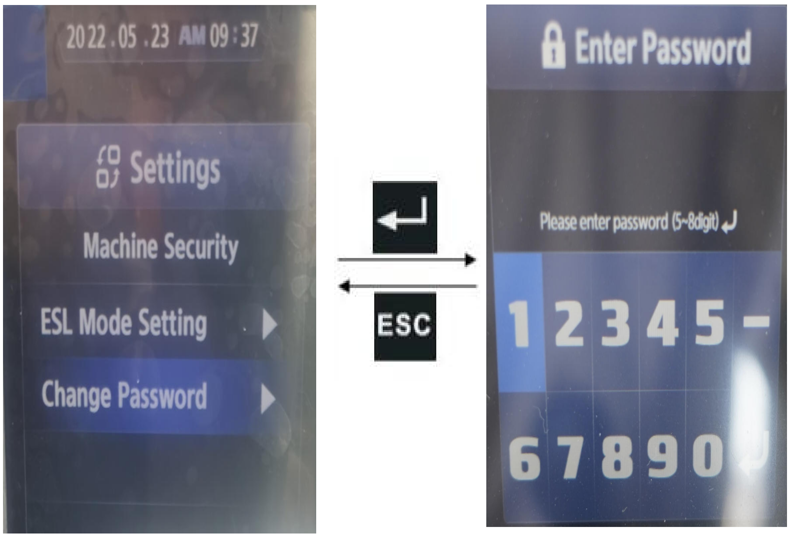
a. **Set startup limits**



- Features to prevent theft and unauthorized device startup.

If you continue to select the start limit setting, ask for a password when the start switch is ON. :
- Disable setting does not use the function.
- When setting 'continue operation', the driver will ask for a password when starting the engine.
- The password is required when the driver starts the engine for the first time when the action is set after the specified time. No password is required for a restart during a cycle time. The maximum period can be set to 7 days.

b. **Change password**



- The password is 5 to 8 digits. Enter the password and press
- The initial password is 00000.

③ Dual Mode

- You can change the mode of the device.

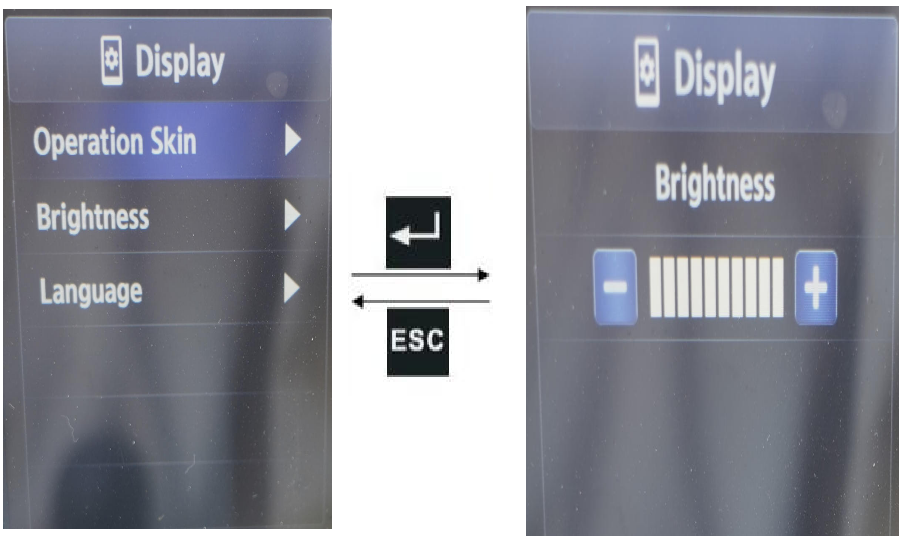
④ Camera

(5).**Display**

① Operation Skin

- You can set the screen type. (Analog/digital)

② Brighteness



- You can set the screen brightness.

③ Language

- You can select the language you want to use and all tags will be changed to the chosen language.

(6).**User Mode**

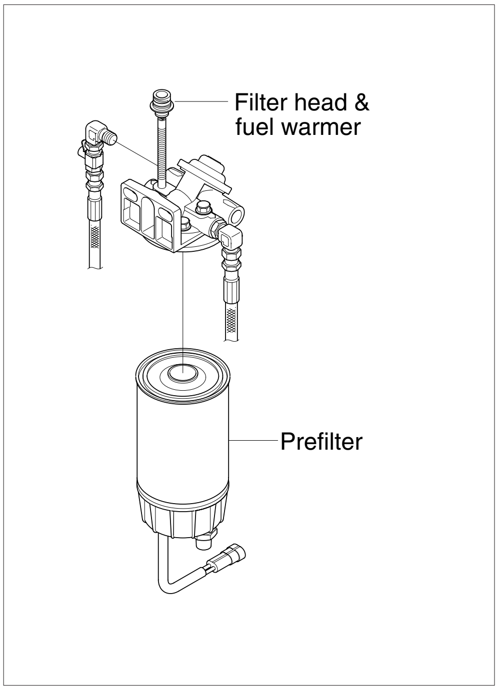
- You can set and store the values of engine high-speed idling RPM, autotorque reduction RPM and EPPR valve input current respectively in user mode (U).
- The menu is only accessible when user mode (U) is selected.

GROUP 14 FUEL WARMER SYSTEM

1. SPECIFICATION

1) Rated voltage : 24 V

2) Rated Power : 260 ±50 W



2. OPERATION

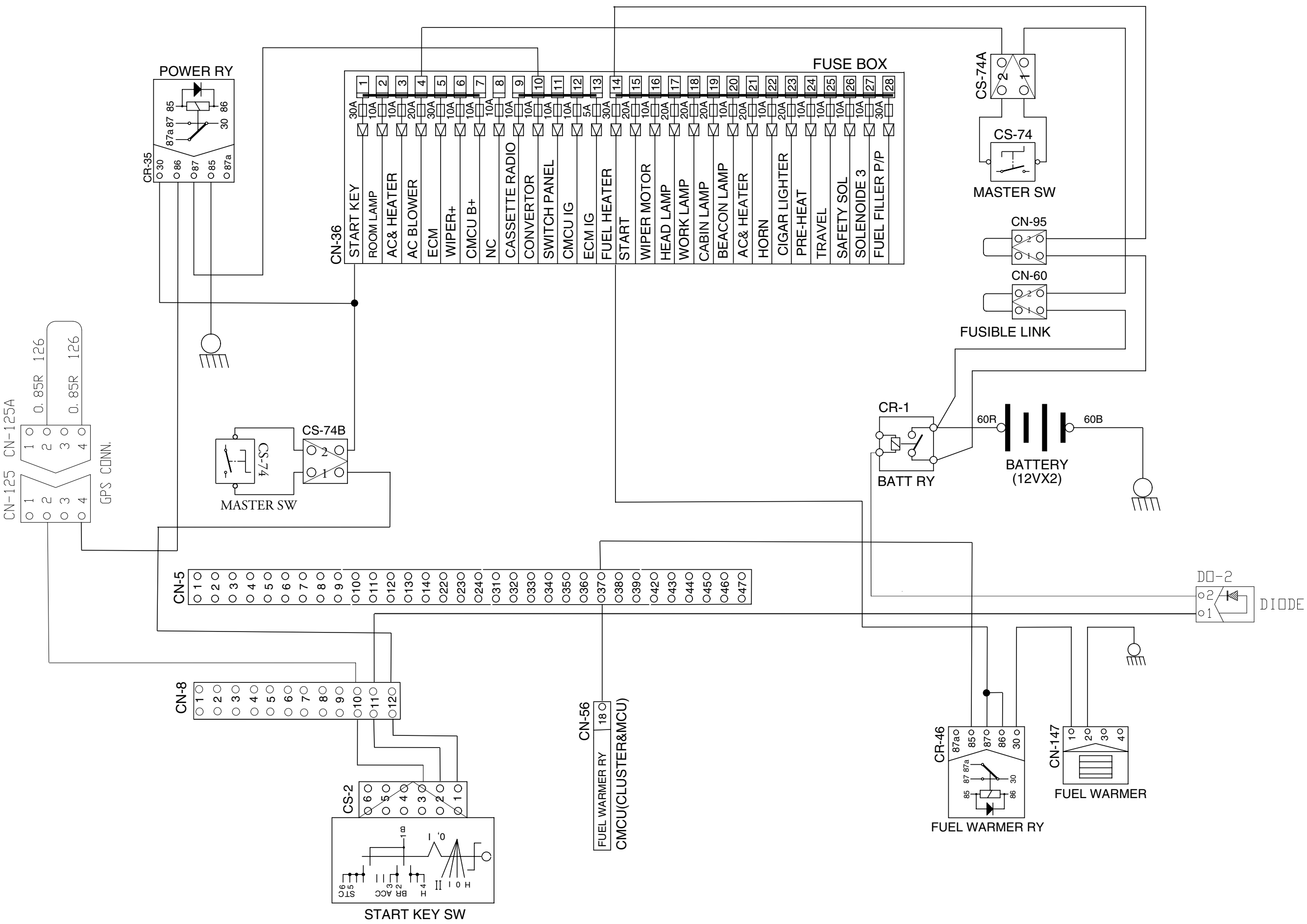
1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.

2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 1~2 minutes.

3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5 A.

So, fuel is protected from overheating by this mechanism.

3. ELECTRIC CIRCUIT



SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

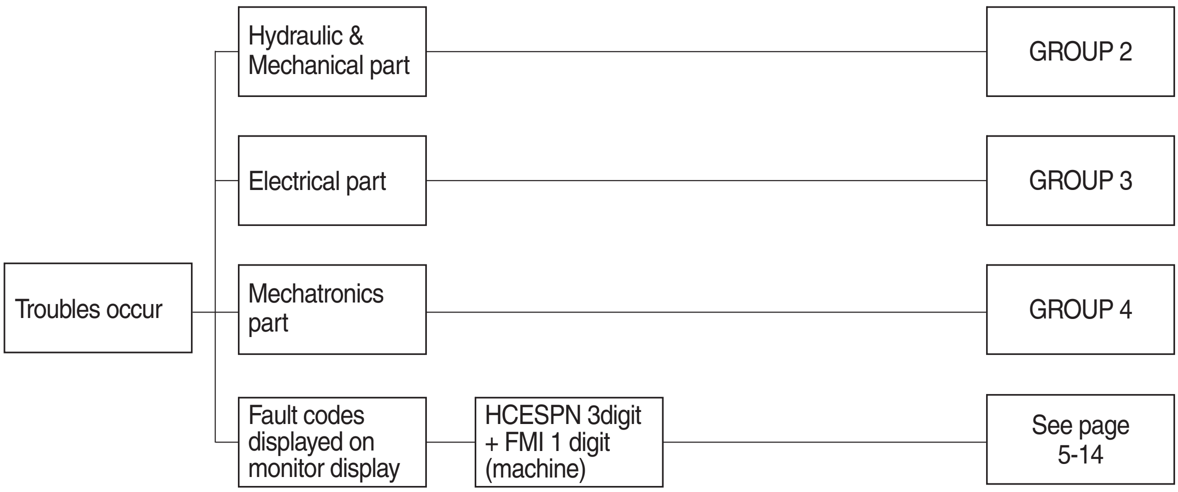
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

When a trouble is occurred in the machine, this section will help an operator to maintain the machine with easy.

The trouble of machine is parted Hydraulic & Mechanical system, Electrical system and Mechatronics system. At each system part, an operator can check the machine according to the troubleshooting process diagram.

※ **Before carring out troubleshooting procedure, check monitoring menu in the cluster.**

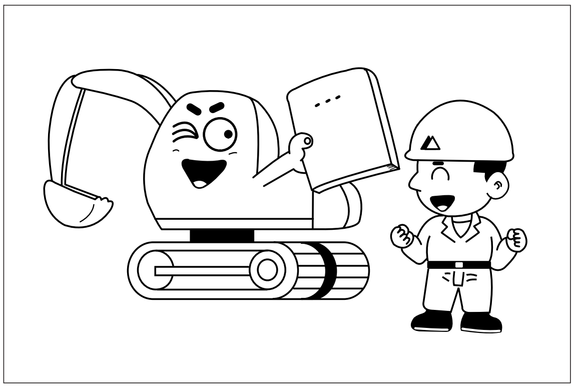


2. DIAGNOSING PROCEDURE

To carry out troubleshooting efficiently, the following steps must be observed.

STEP 1. Study the machine system

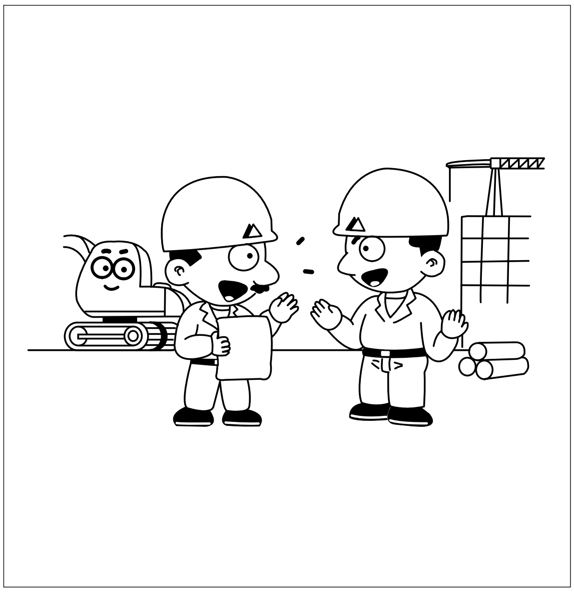
Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.



STEP 2. Ask the operator

Before inspecting, get the full story of malfunctions from a witness --- the operator.

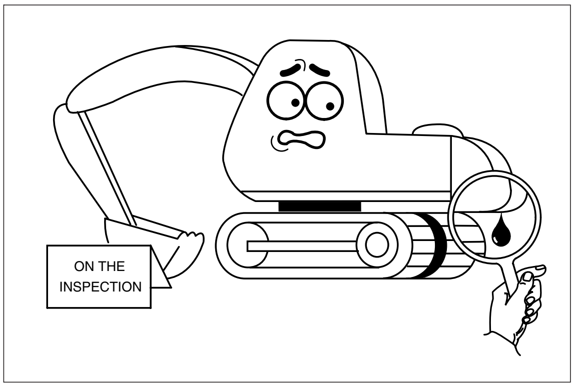
1) How the machine is used and when it is serviced?
2) When the trouble was noticed and what work the machine was doing at that time?
3) What is the phenomenon of the trouble?
   Was the trouble getting worse, or did it come out suddenly for the first time?
4) Did the machine have any troubles previously? If so, which parts were repaired before.



STEP 3. Inspect the machine

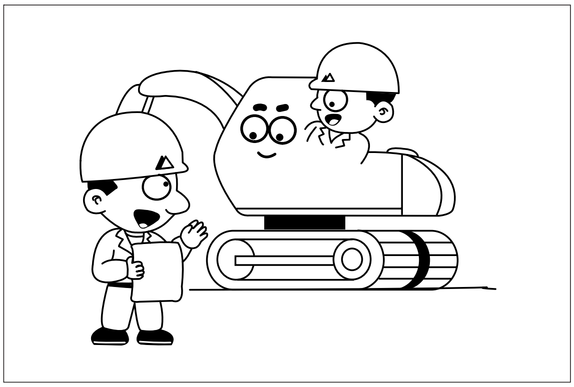
Before starting troubleshooting, check the machine for the daily maintenance points as shown in the operator's manual.

And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



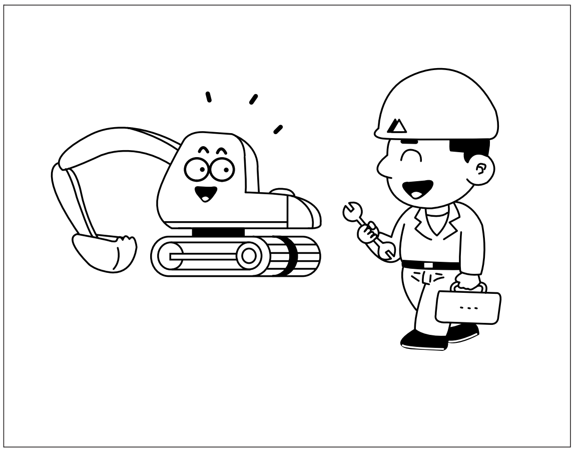
STEP 4. Inspect the trouble actually on the machine

In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



STEP 5. Perform troubleshooting

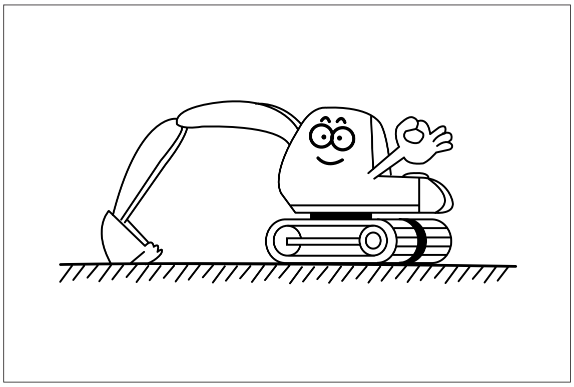
According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.



STEP 6. Trace a cause

Before reaching a conclusion, check the most suspectible causes again. Try to trace what the real cause of the trouble is.

Make a plan of the appropriate repairing procedure to avoid consequential malfunctions.



GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

(1) If even a minor fault is left intact and operation is continued, a fatal failure may be caused, entailing a large sum of expenses and long hours of restoration.
Therefore when even a small trouble occurs, do not rely on your intuition and experience, but look for the cause based on the troubleshooting principle and perform maintenance and adjustment to prevent major failure from occurring. Keep in mind that a fault results from a combination of different causes.

(2) The following lists up commonly occurring faults and possible causes with this machine. For the troubleshooting of the engine, refer to the coming troubleshooting and repair.

(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(4) Ask user or operator the following.
① Was there any strange thing about machine before failure occurred?
② Under what conditions did the failure occur?
③ Have any repairs been carried out before the failure?

(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2) MACHINE STATUS MONITORING ON THE CLUSTER

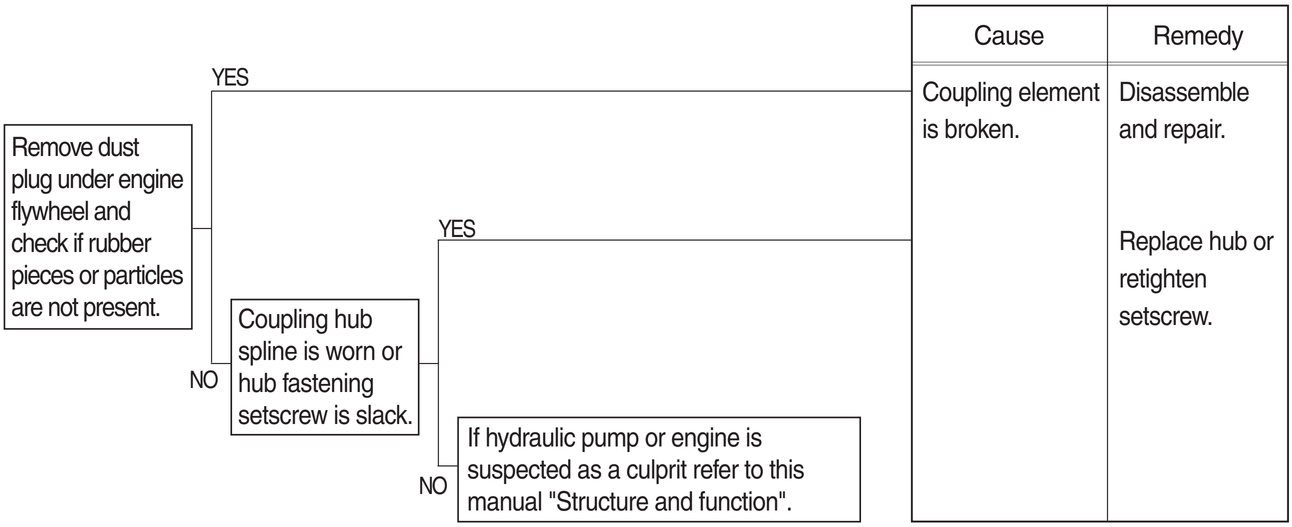
(1) The machine status such as the engine rpm, oil temperature, voltage and pressure etc. can be checked by this menu.

(2) Specification

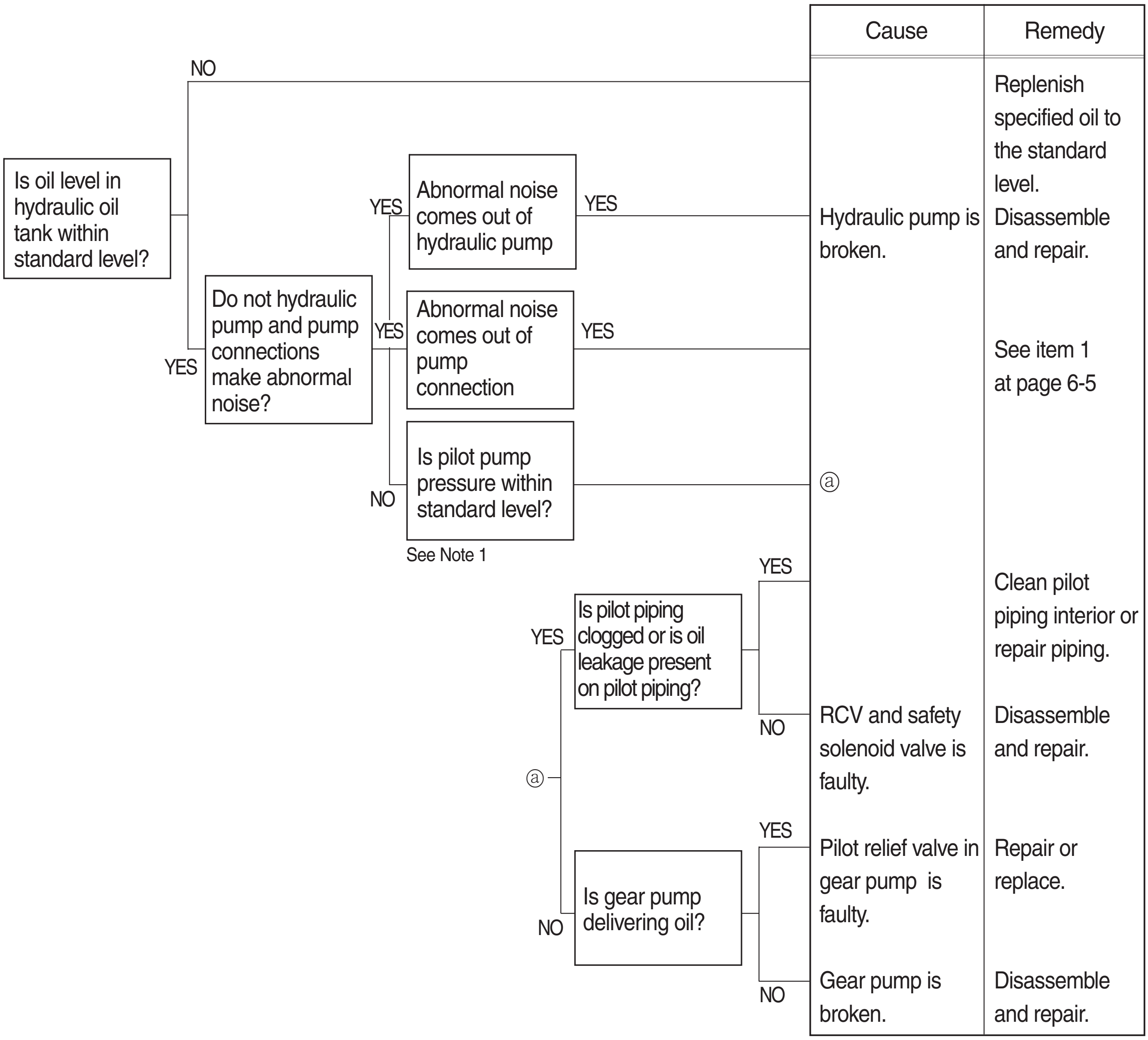
Description	Specification
Eppr pressure	0~40 bar
Boom up pilot pressure	0~40 bar
P1 pump negative pressure	0~38 bar
Pump 1 pressure	0~350 bar
Pump 2 pressure	0~350 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

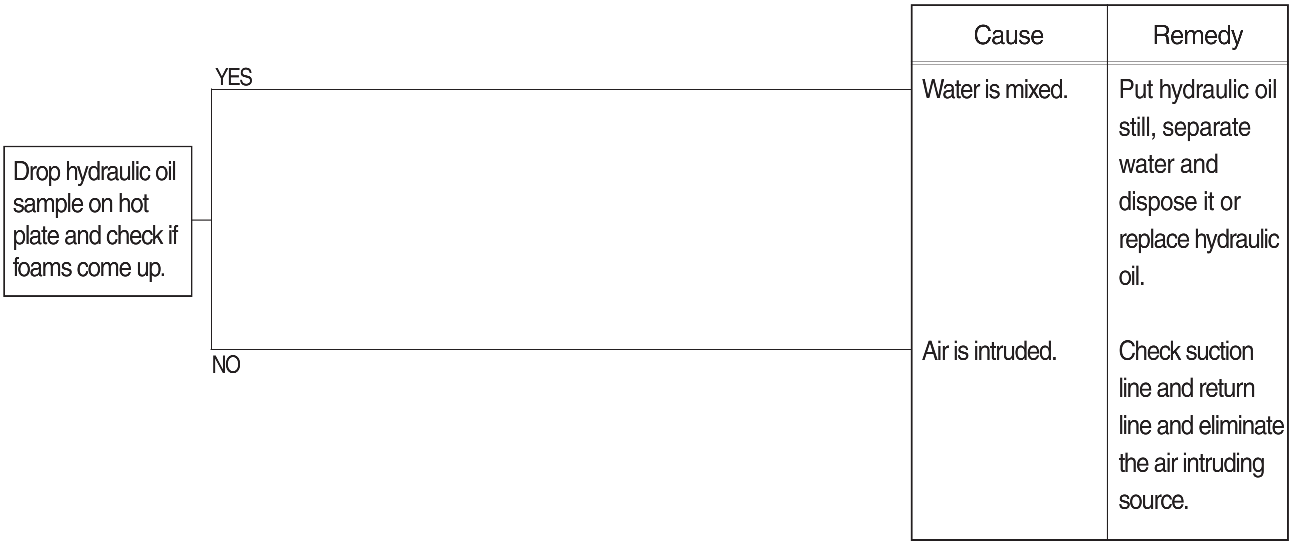


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

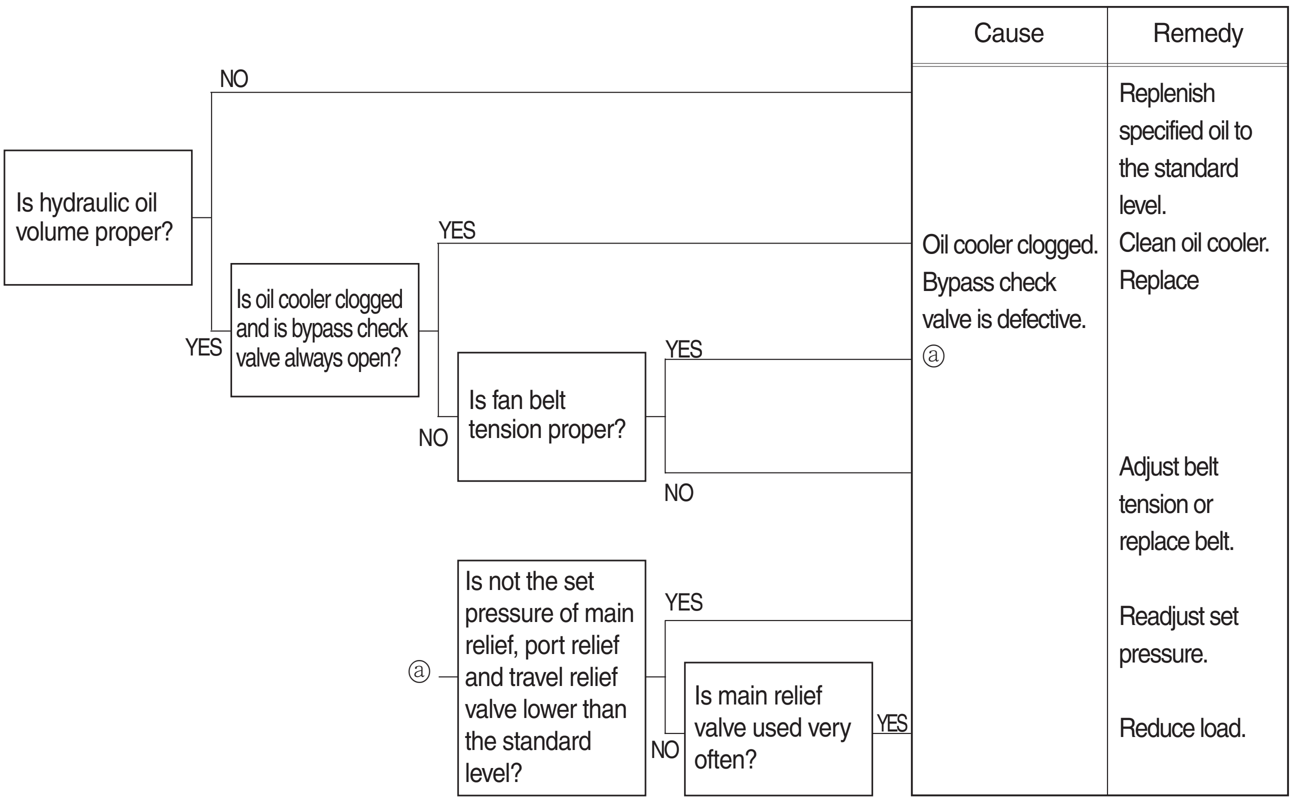


3. HYDRAULIC SYSTEM

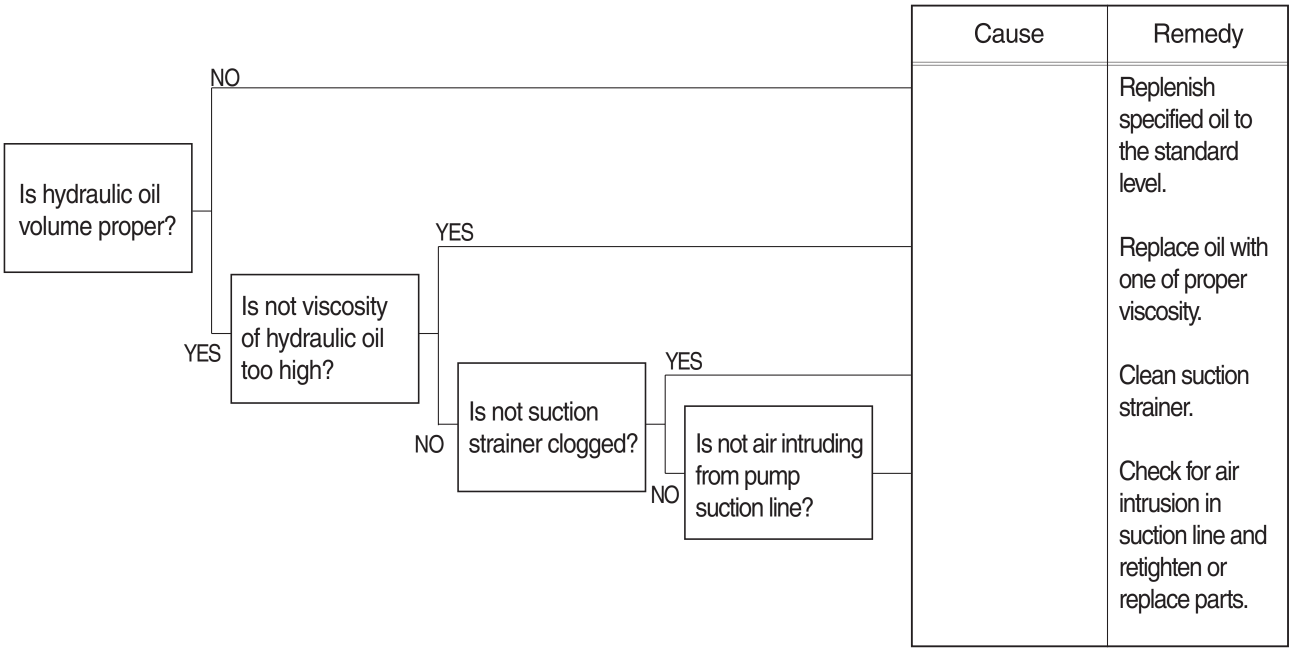
1) HYDRAULIC OIL IS CLOUDY



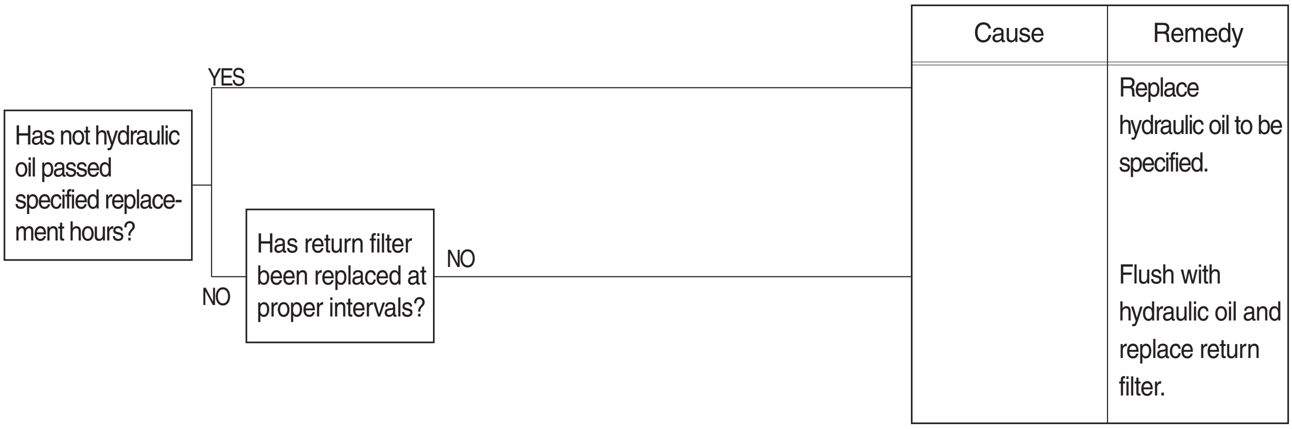
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

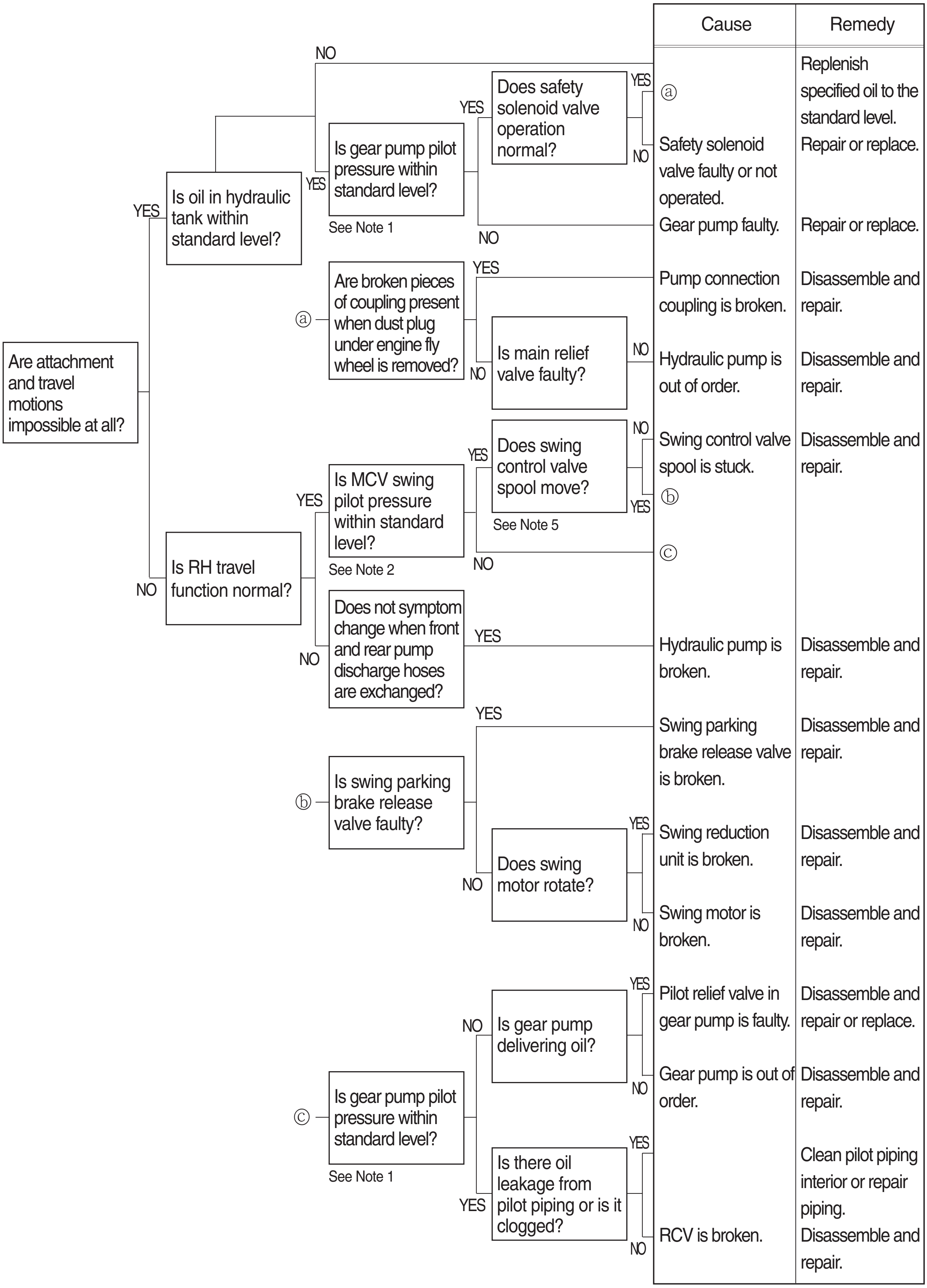


4) HYDRAULIC OIL IS CONTAMINATED

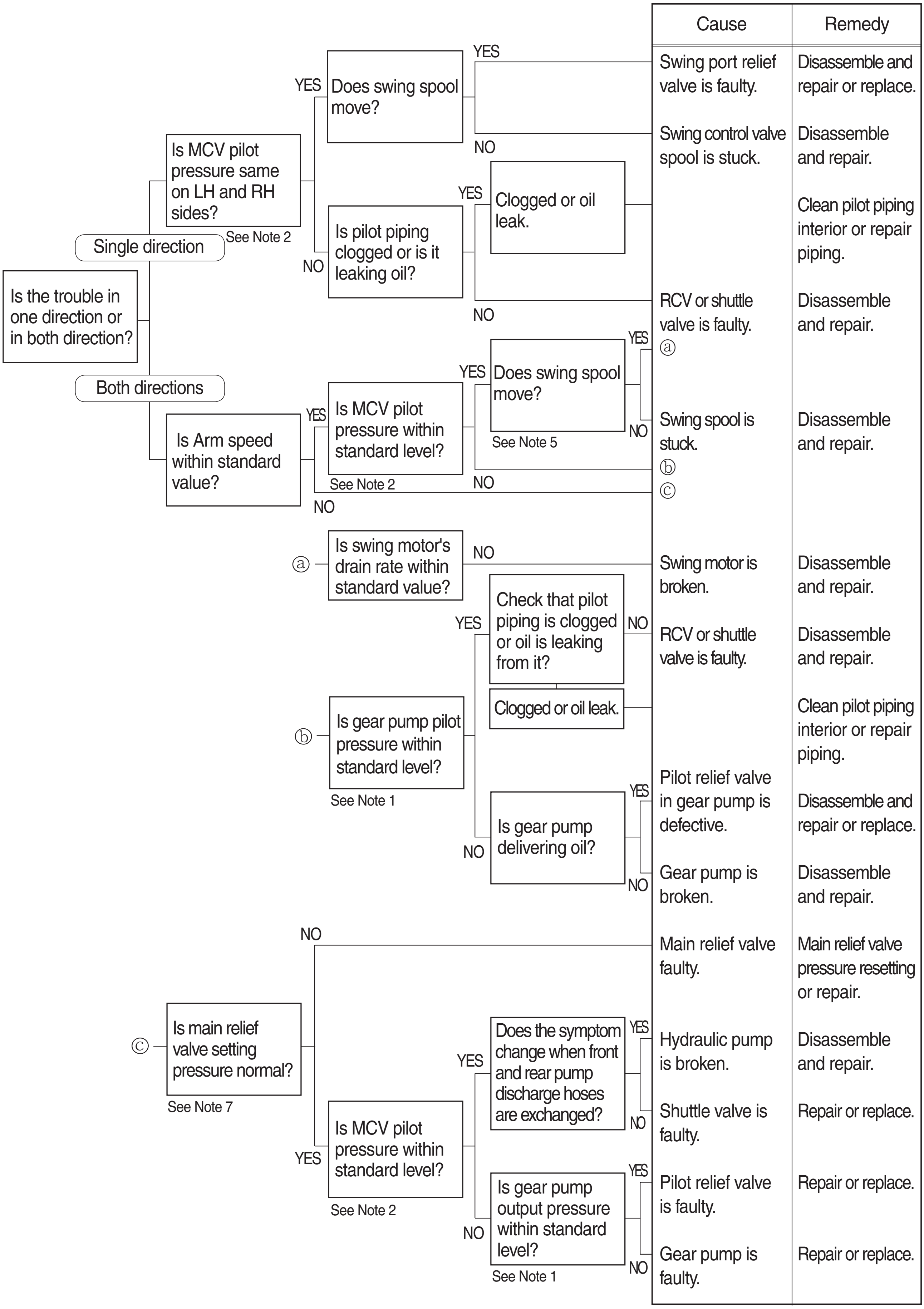


4. SWING SYSTEM

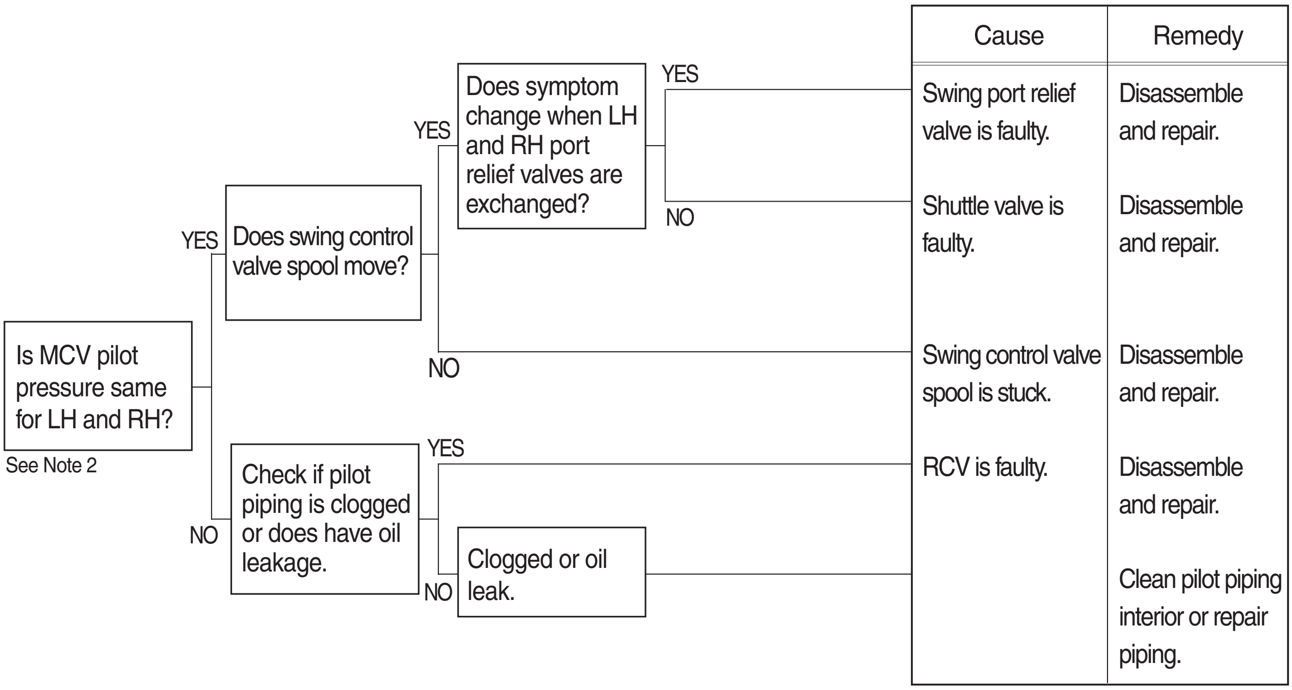
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



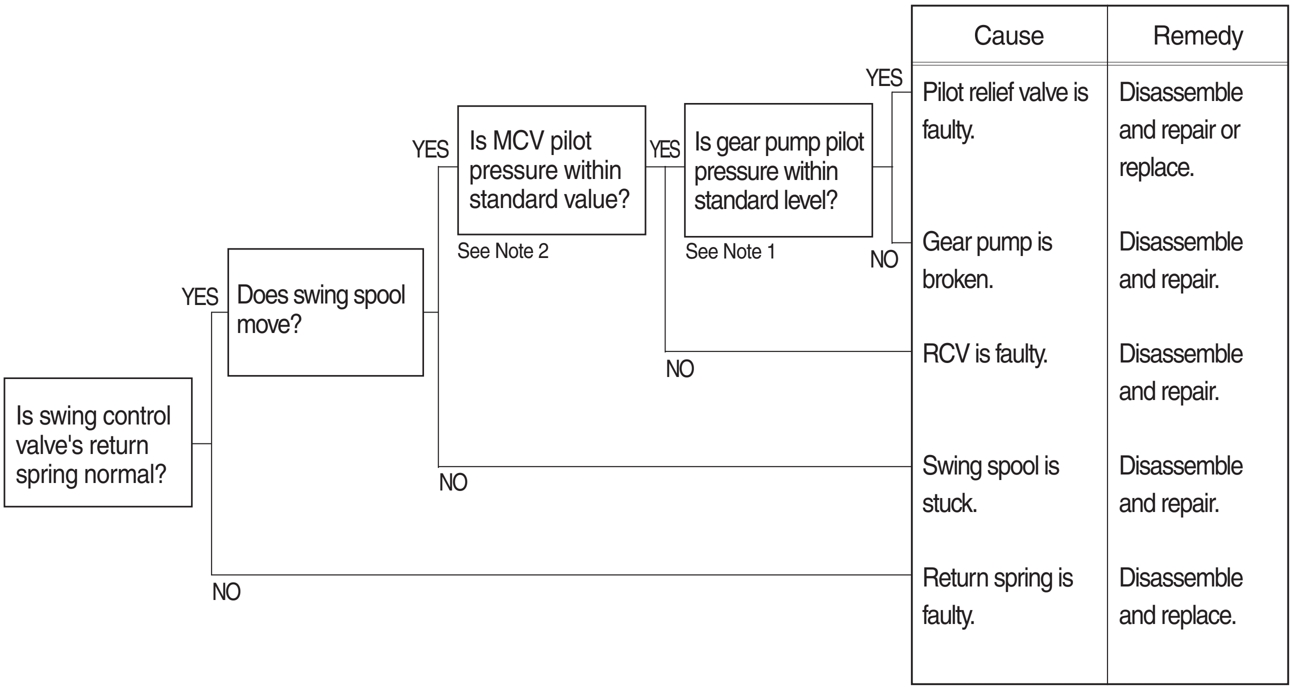
2) SWING SPEED IS LOW



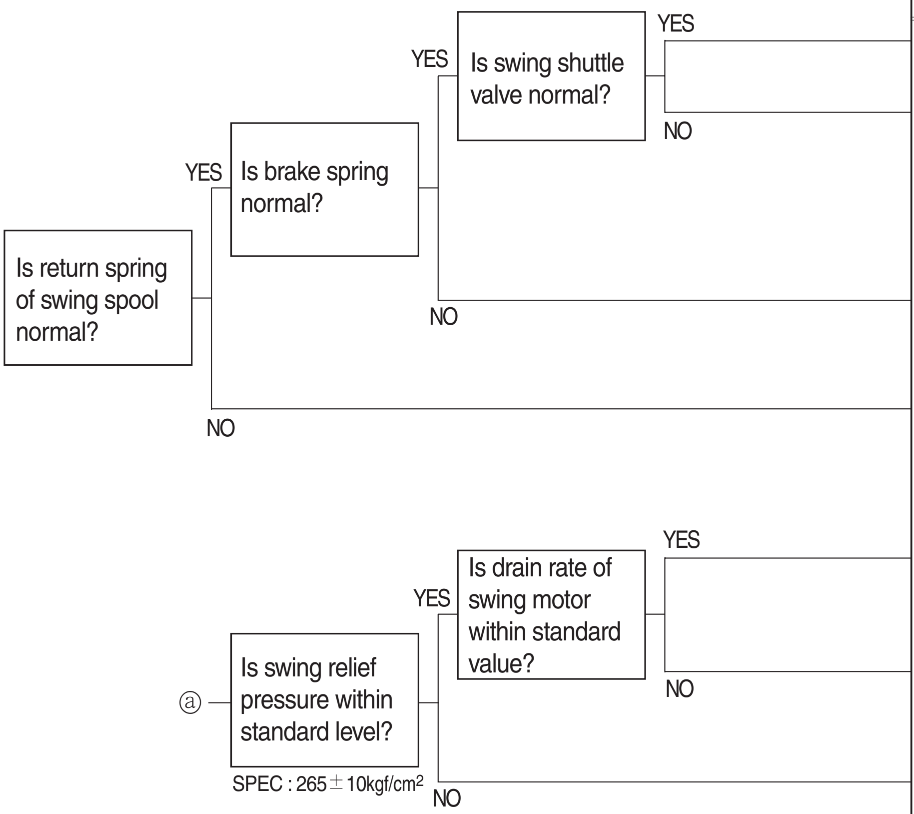
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP



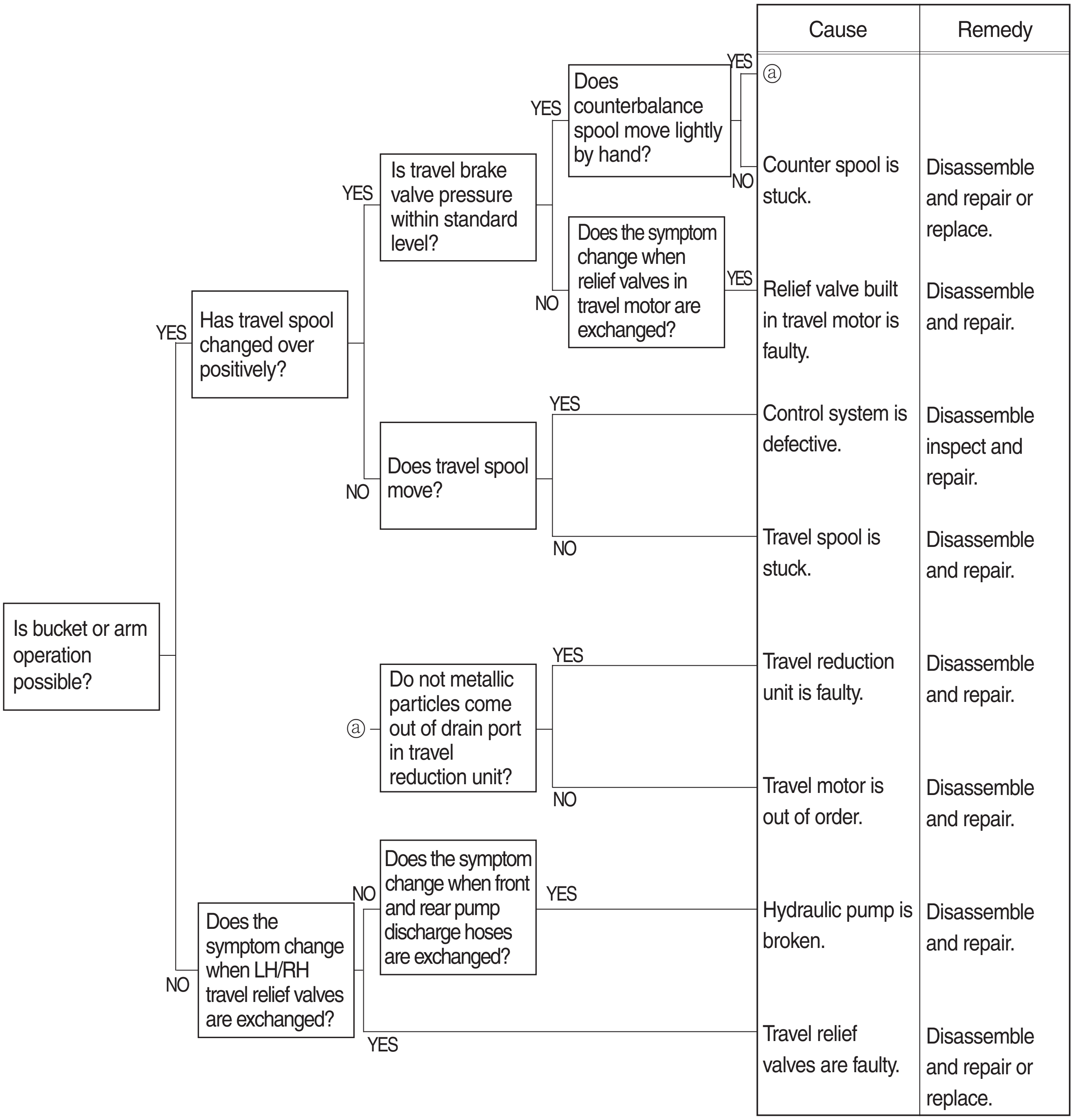
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



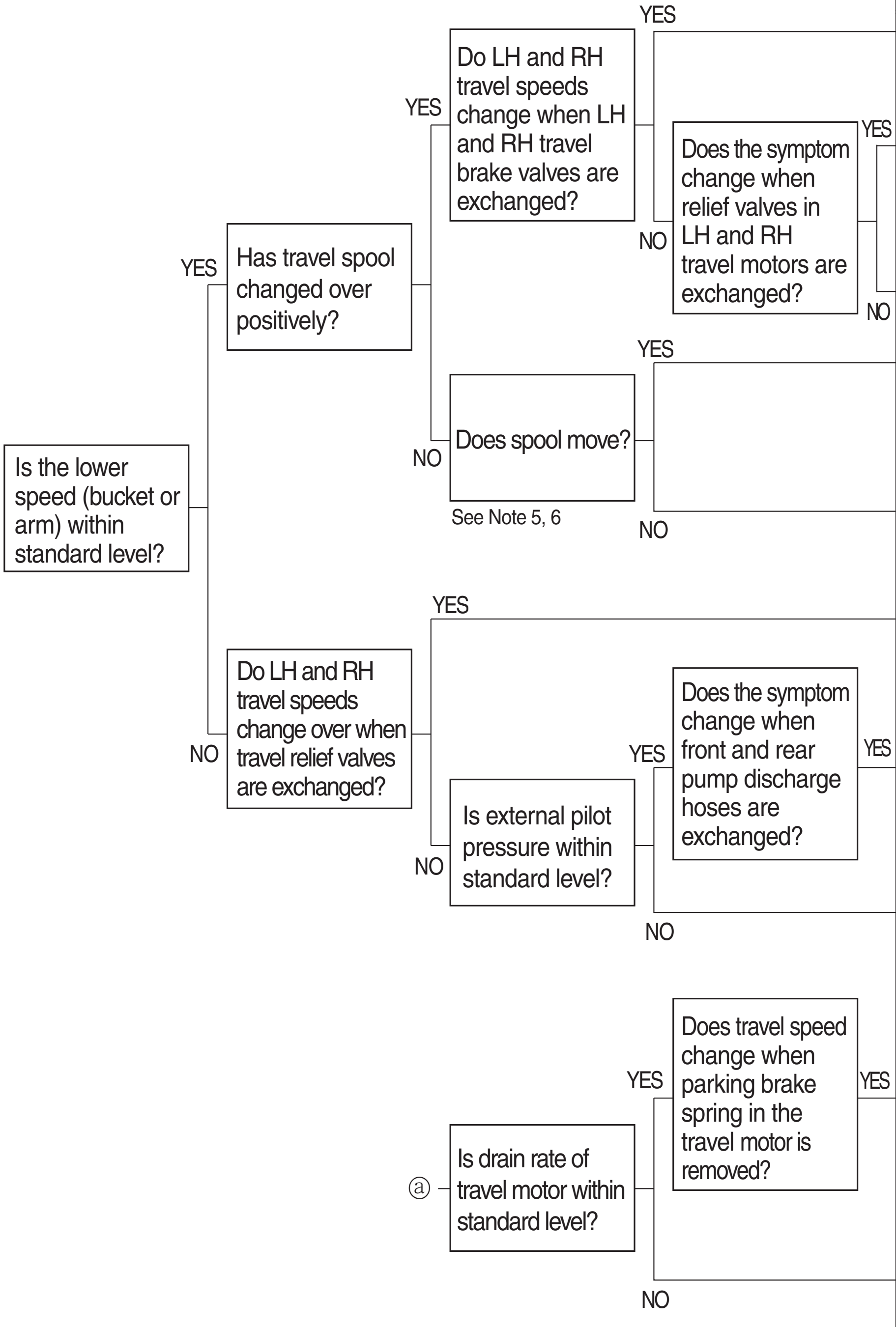
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing port relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.
	Adjust swing relief valve pressure or replace swing relief valve.

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



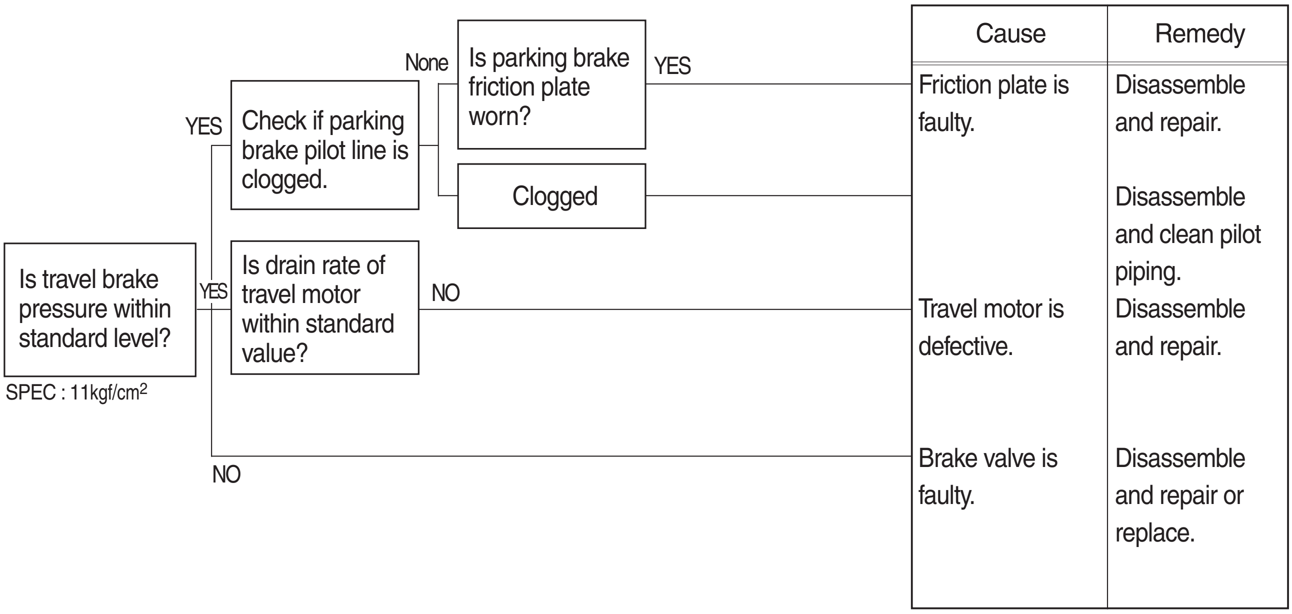
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



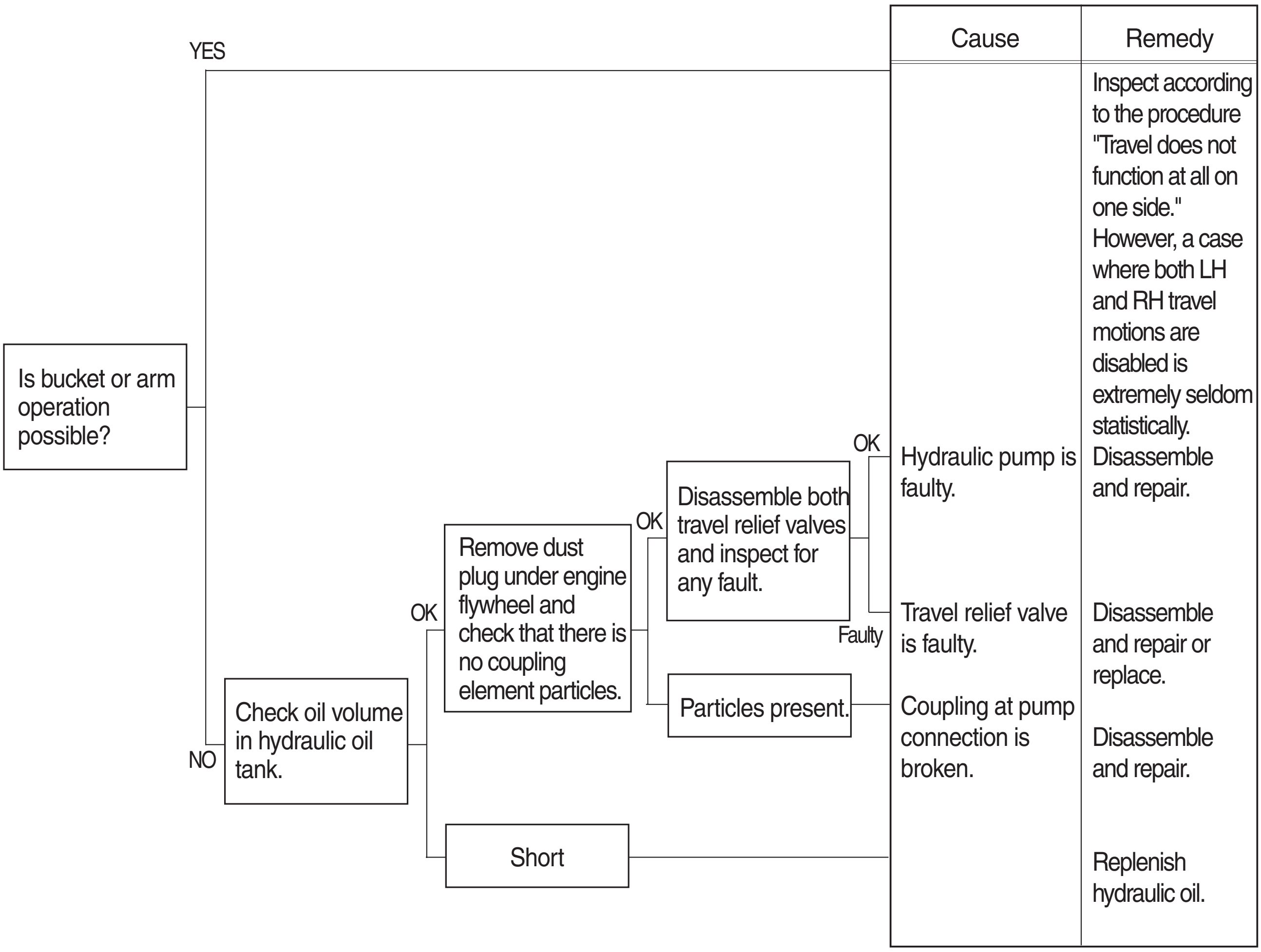
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
ⓐ	
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic pump is broken.	Disassemble and repair.
External pilot piping is clogged or oil is leaking from it.	Disassemble and clean.
Travel motor's parking brake is not released properly.	Disassemble and clean pilot piping.
Travel motor is faulty.	Disassemble and repair.

3) MACHINE DOES NOT STOP ON A SLOPE

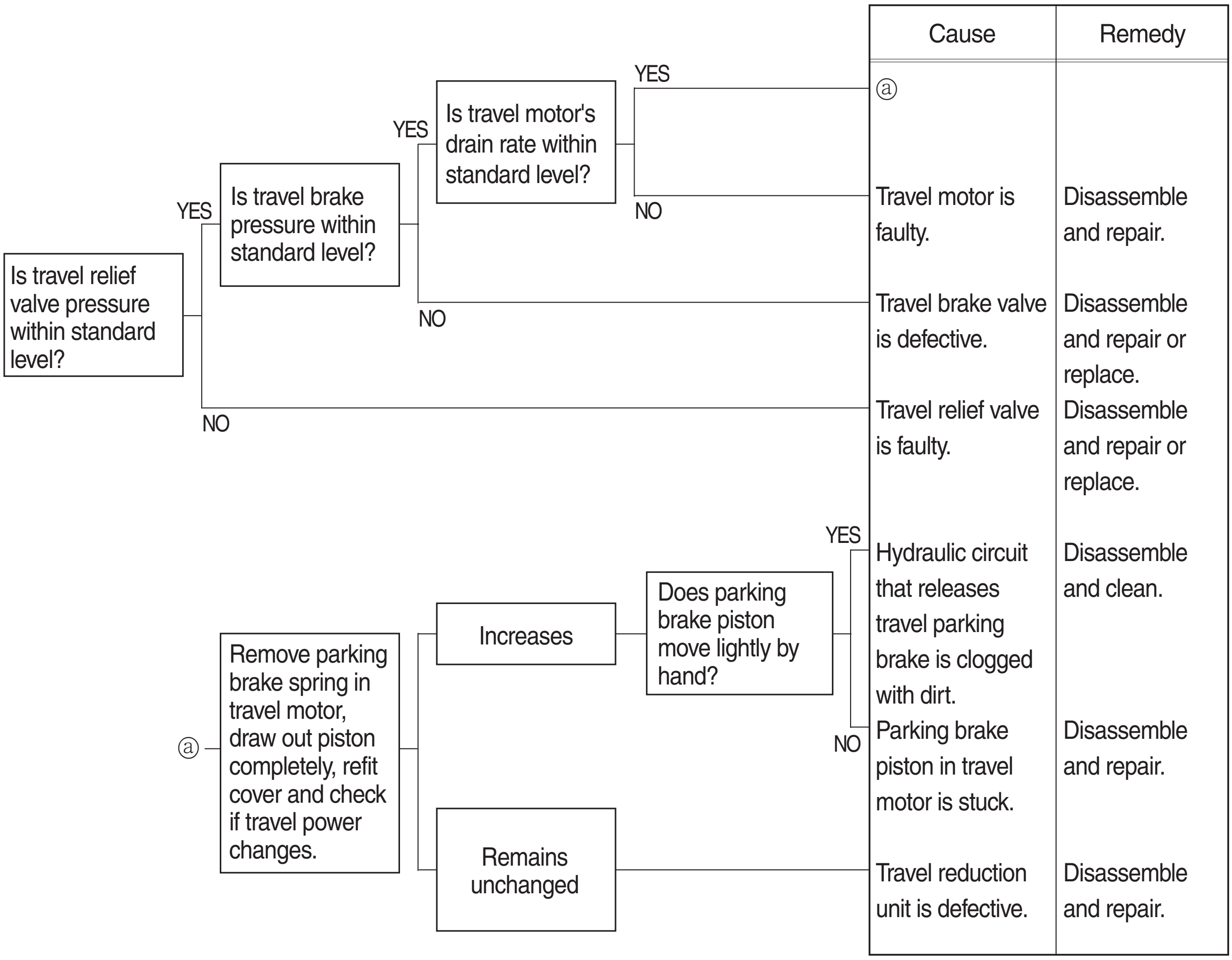
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

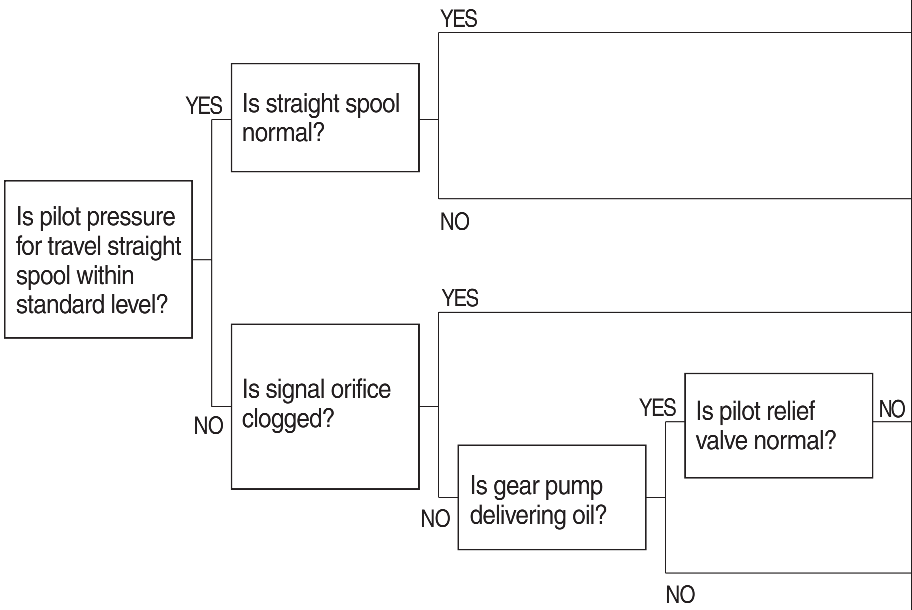


5) TRAVEL ACTION IS POWERLESS (travel only)



6) MACHINE RUNS RECKLESSLY ON A SLOPE

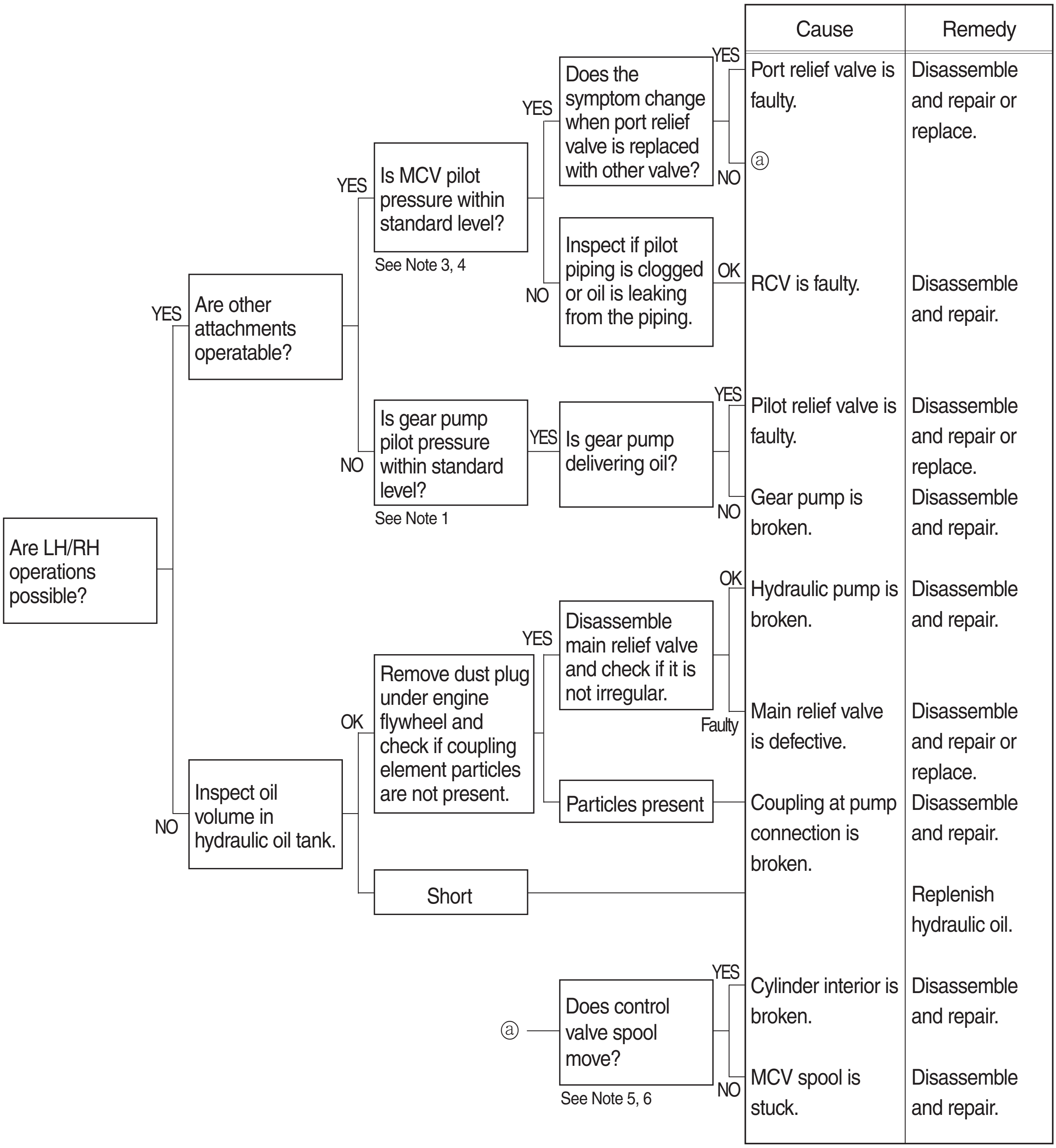
7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME



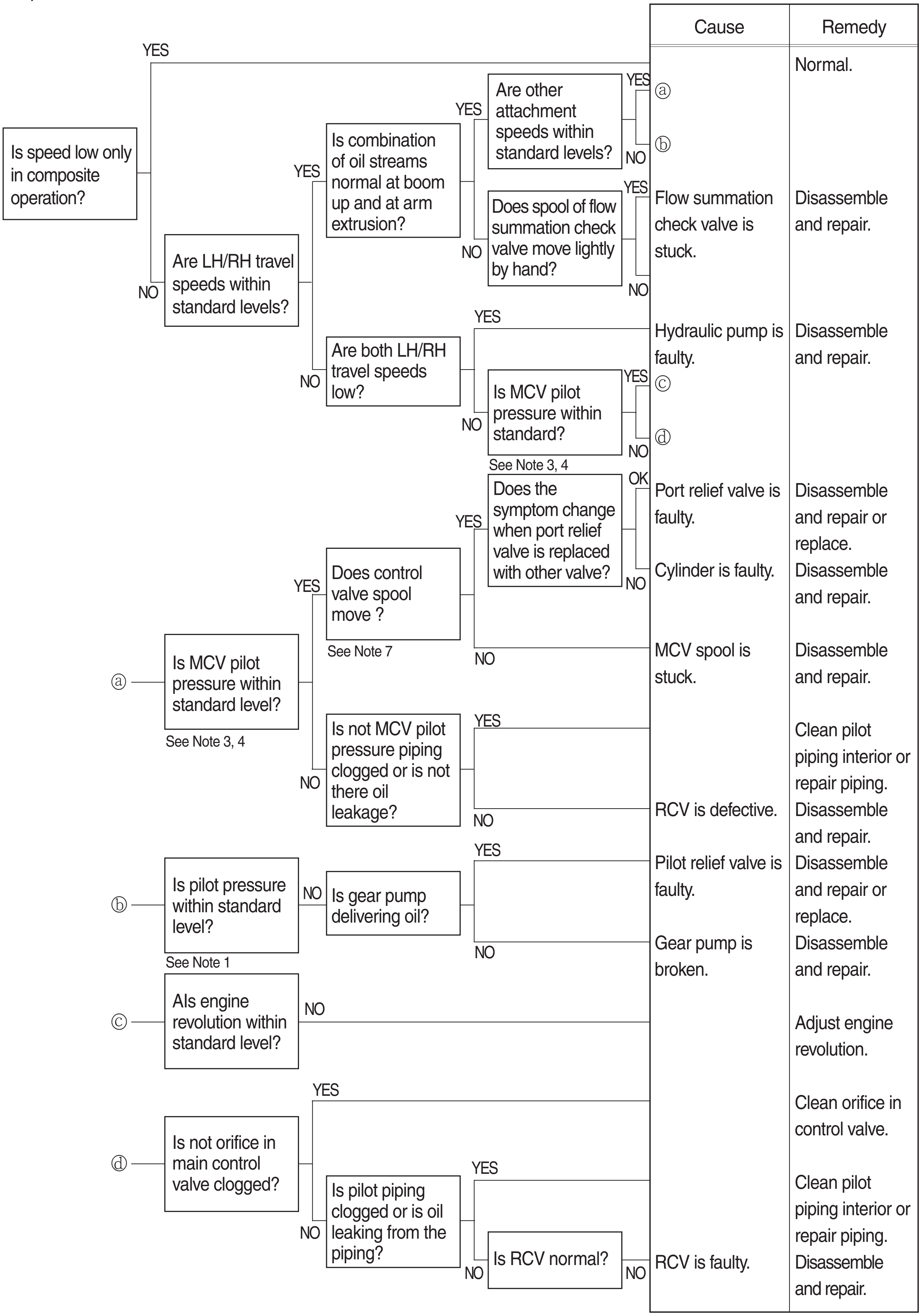
Cause	Remedy
	Normal.
Straight spool is faulty.	Repair or replace.
	Remove dirt on signal orifice.
Pilot relief valve is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.

6. ATTACHMENT SYSTEM

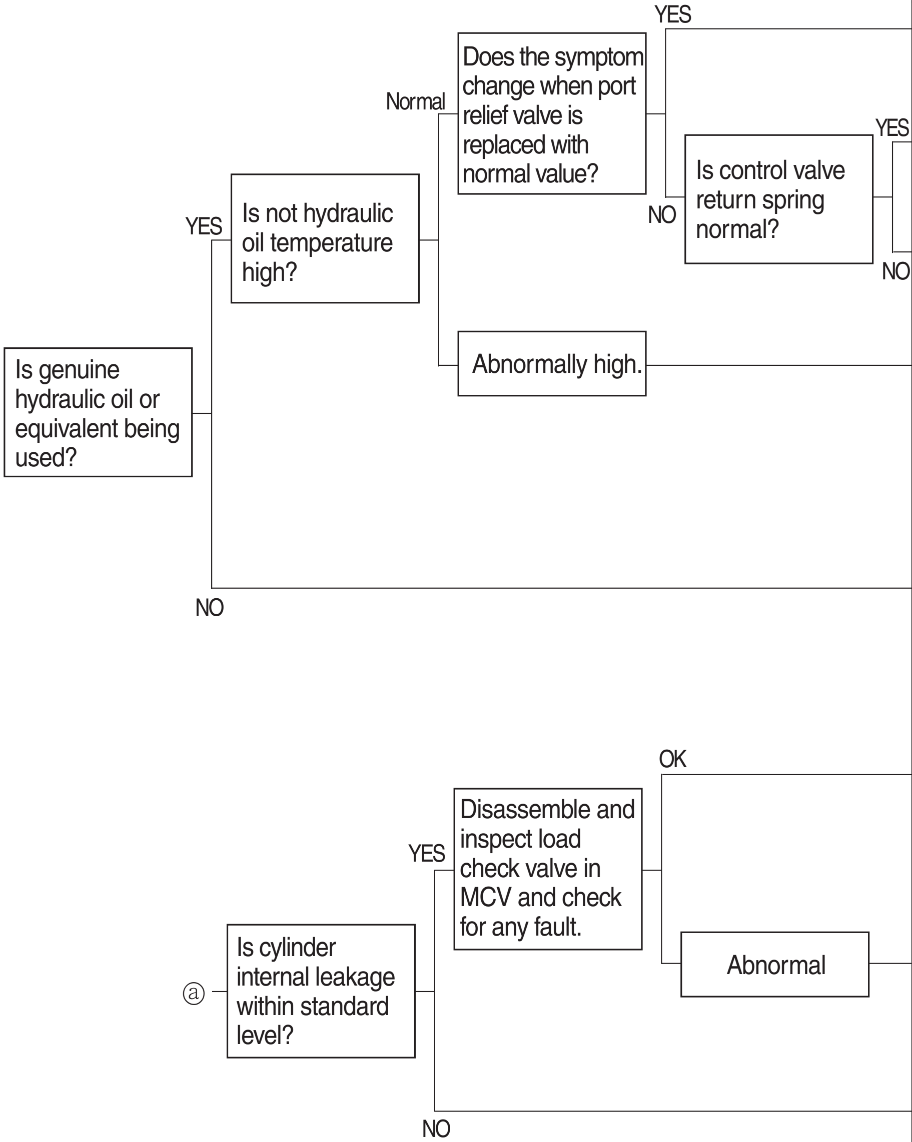
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

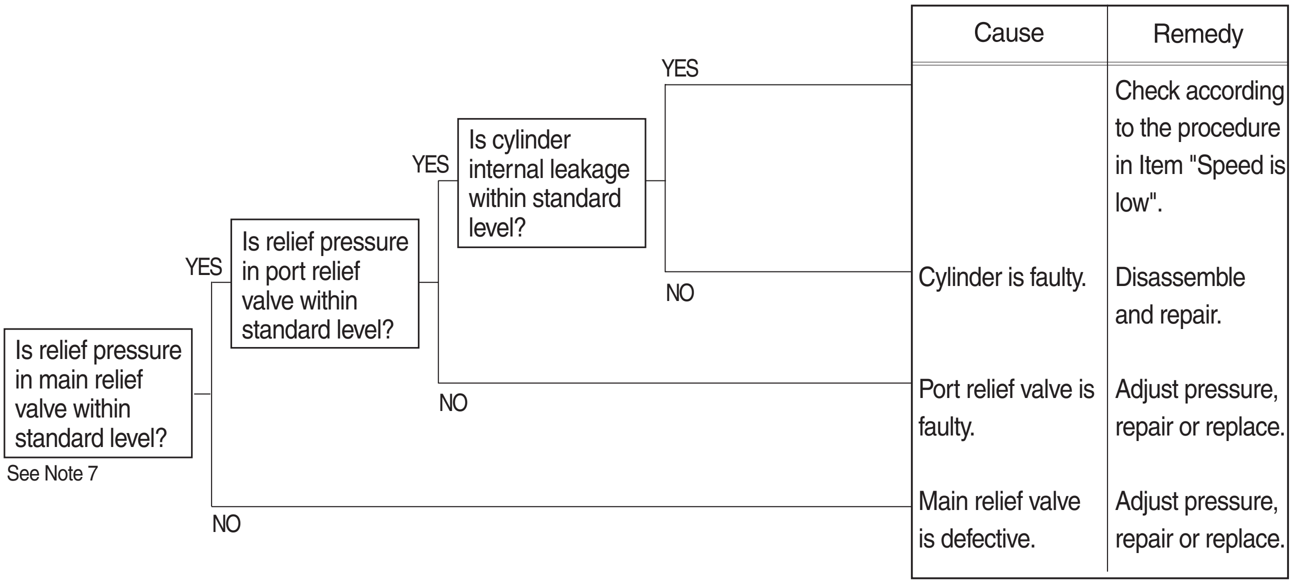


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

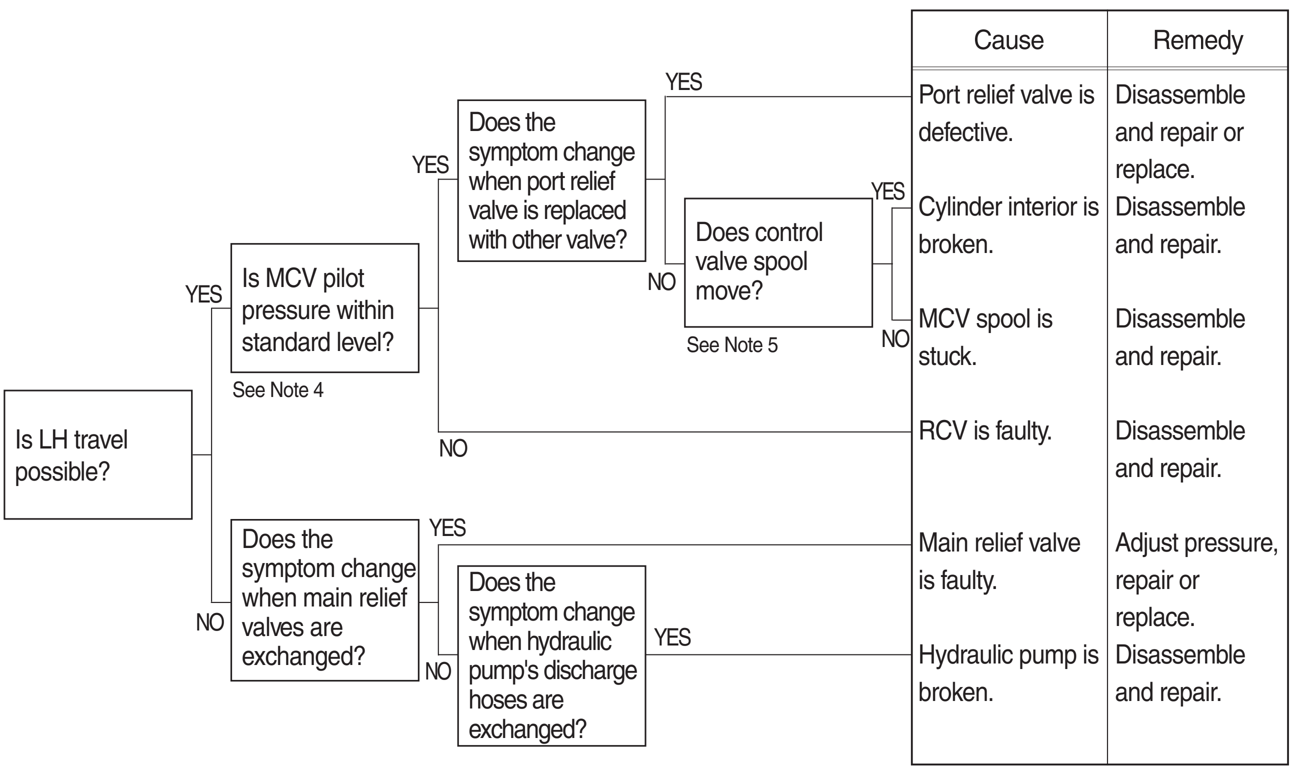


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between control valve casing and spool is poor.	Disassemble and repair.
Contact surface between poppet and seat is poor.	Disassemble and repair.
Cylinder is faulty.	Disassemble and repair.

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



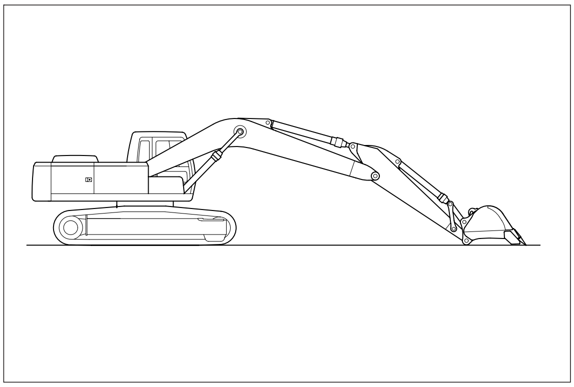
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

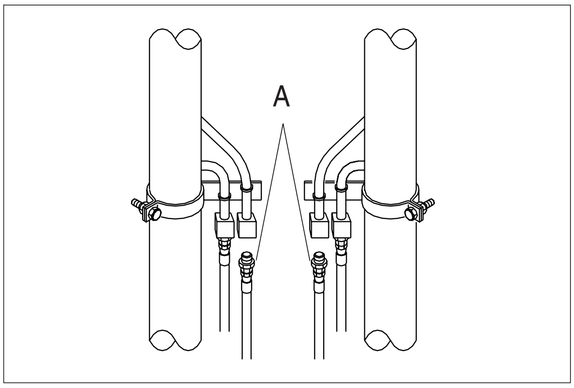
	Cause	Remedy
YES		Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
NO	Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in an initial stage, supply sufficient grease. If seizure is in a grown state, correct it by paper lapping or with an oil stone.

※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

1. Lower the bucket teeth to the ground with bucket cylinder fully retracted and arm cylinder rod retracted almost in full.

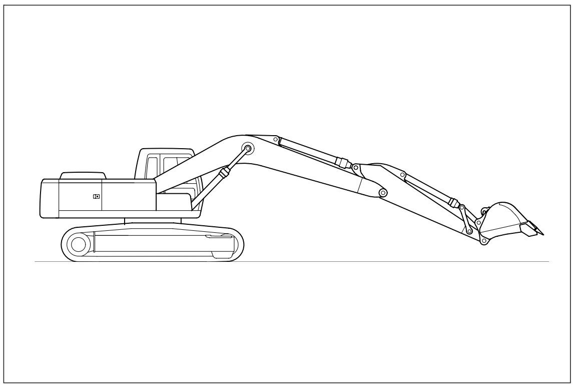


2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.

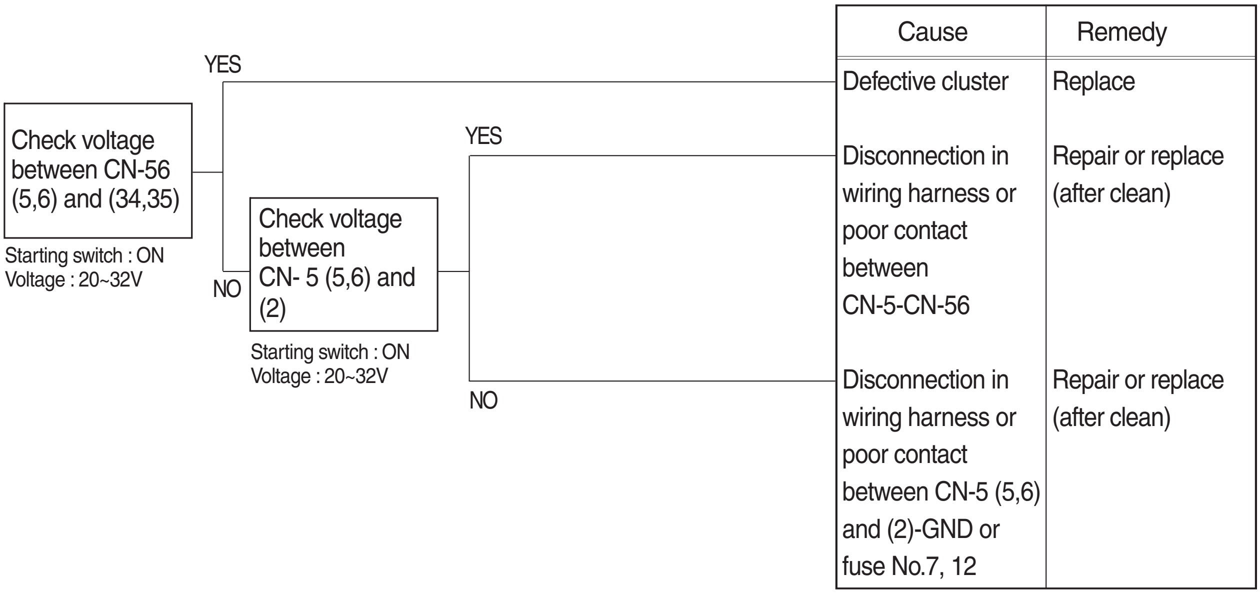


1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

· Before disconnecting the connector, always turn the starting switch OFF.

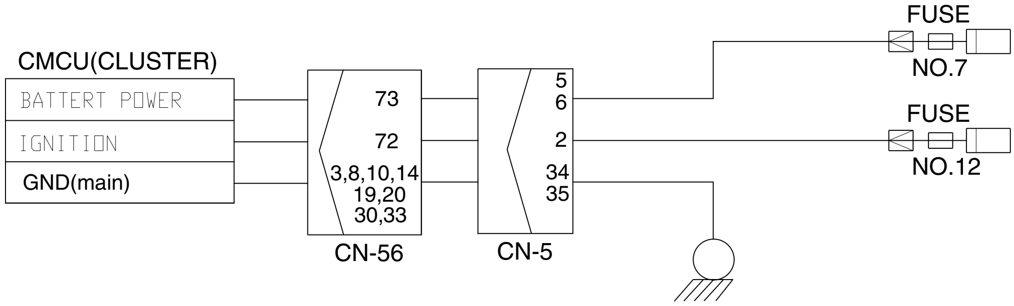
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.7 and 12 burnt out.

· After checking, insert the disconnected connectors again immediately unless otherwise specified.



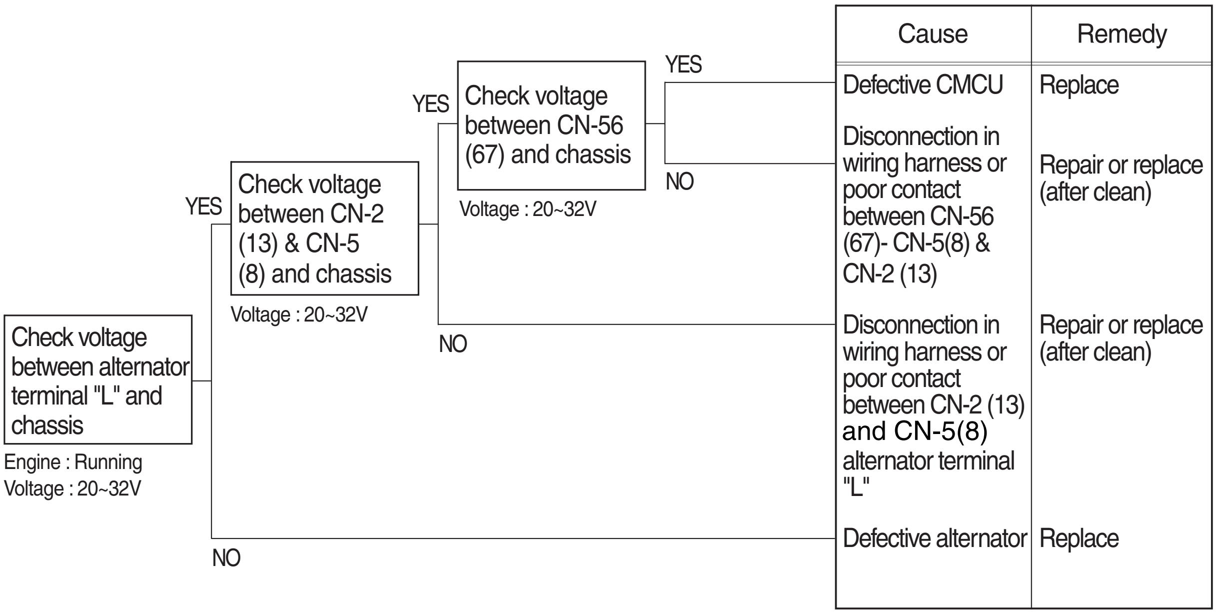
Check voltage

YES	20~32V
NO	0V



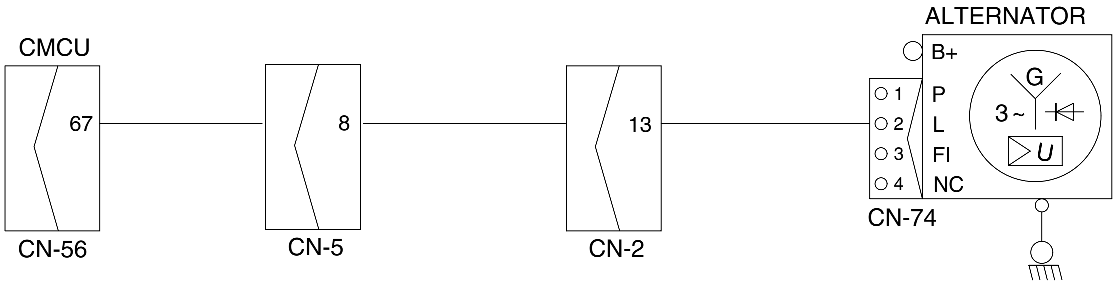
2. BATTERY CHARGING WARNING LAMP LIGHTS UP (Starting switch : ON)

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



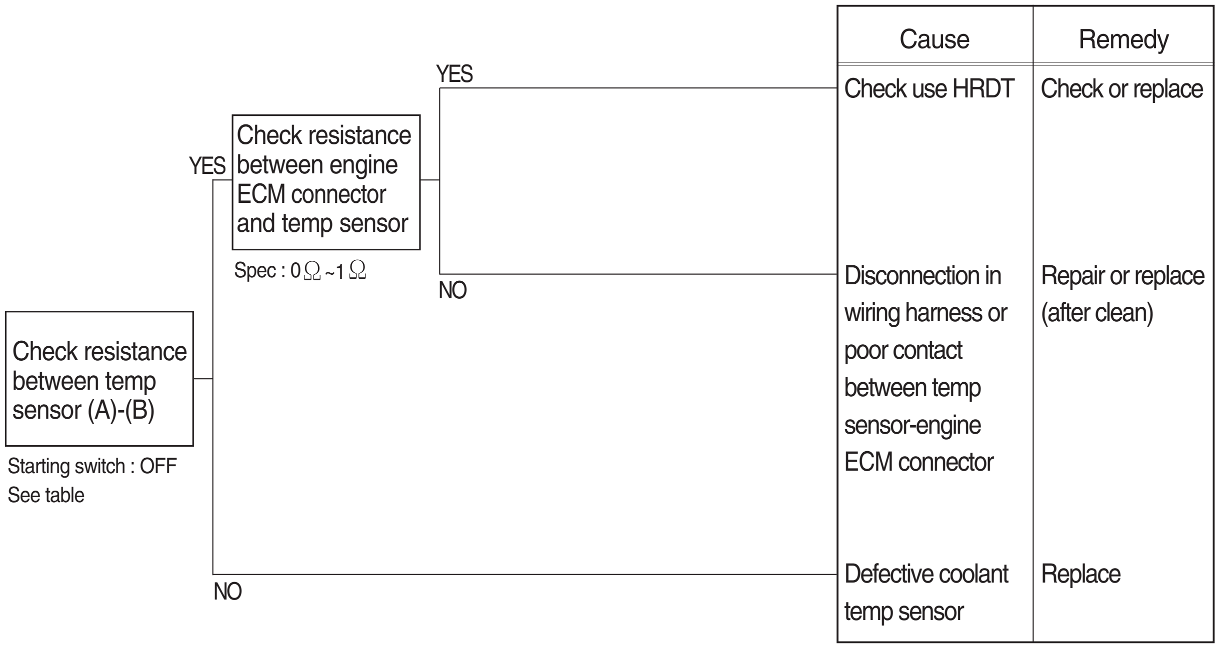
Check voltage

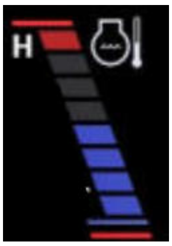
YES	20~32V
NO	0V



3. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP (engine is started)

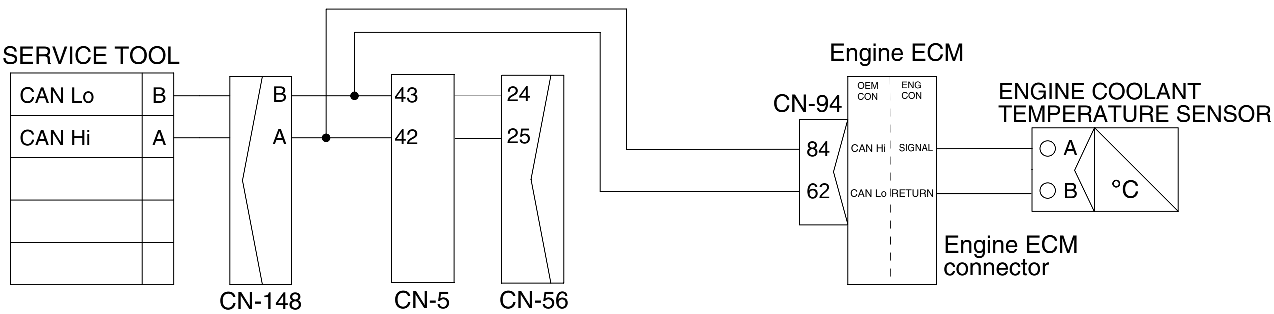
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





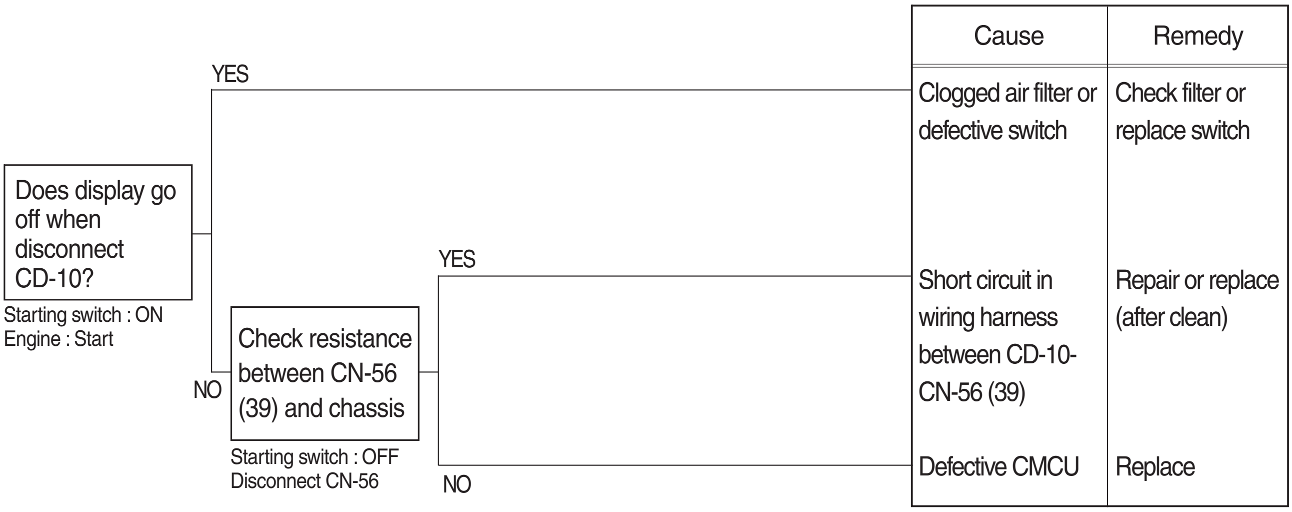
Check Table

Temperature (˚C)	0	25	50	80	95
Resistance (kΩ)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



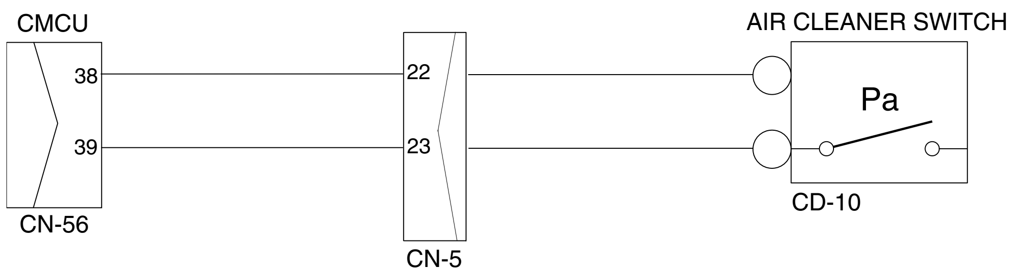
4. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



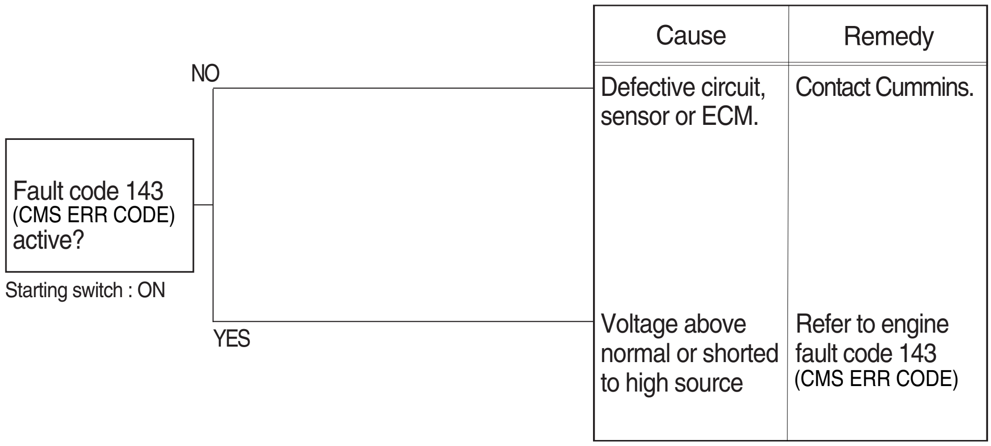
Check resistance

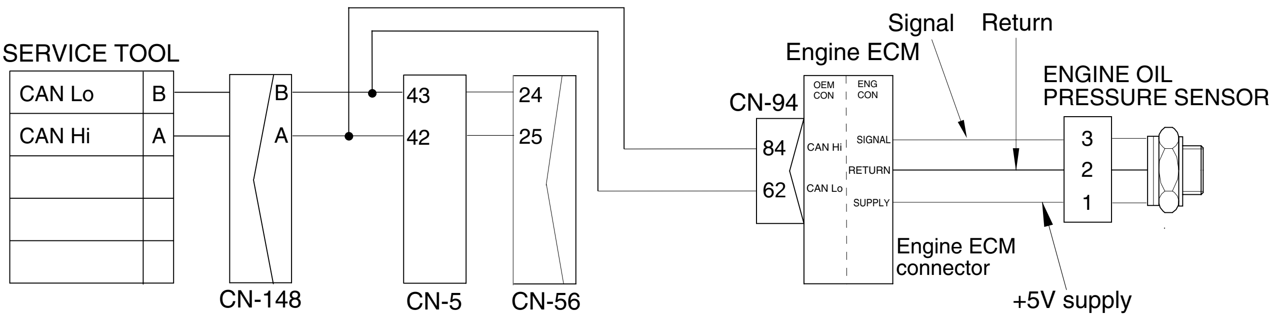
YES	MAX 1Ω
NO	MIN 1MΩ



5. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (engine is started)

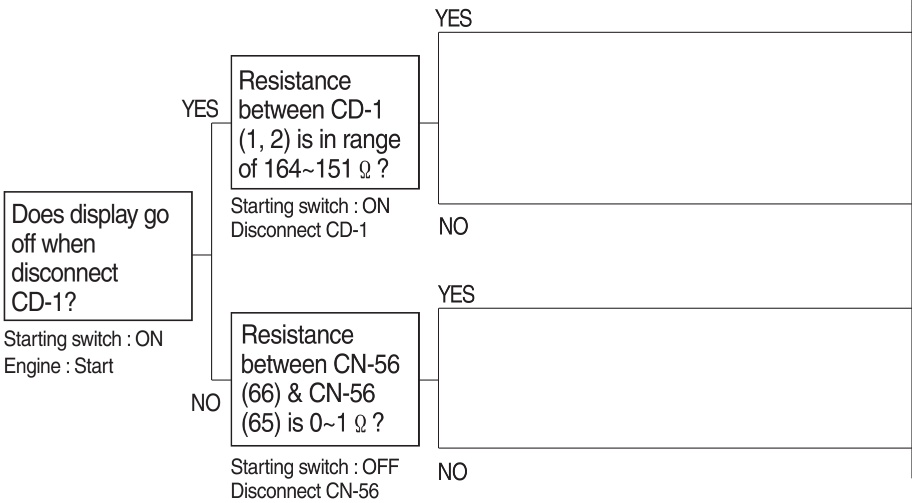
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



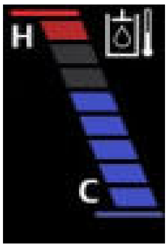


6. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP (engine is started)

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

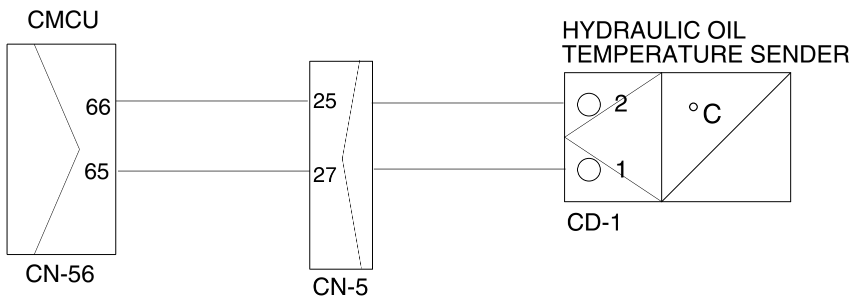


Cause	Remedy
High temperature	Check hydraulic oil temperature (105˚C±2˚C),
Defective temp sensor	Replace
Short circuit between temp sensor and CMCU	Repair or replace
Defective CMCU	Replace



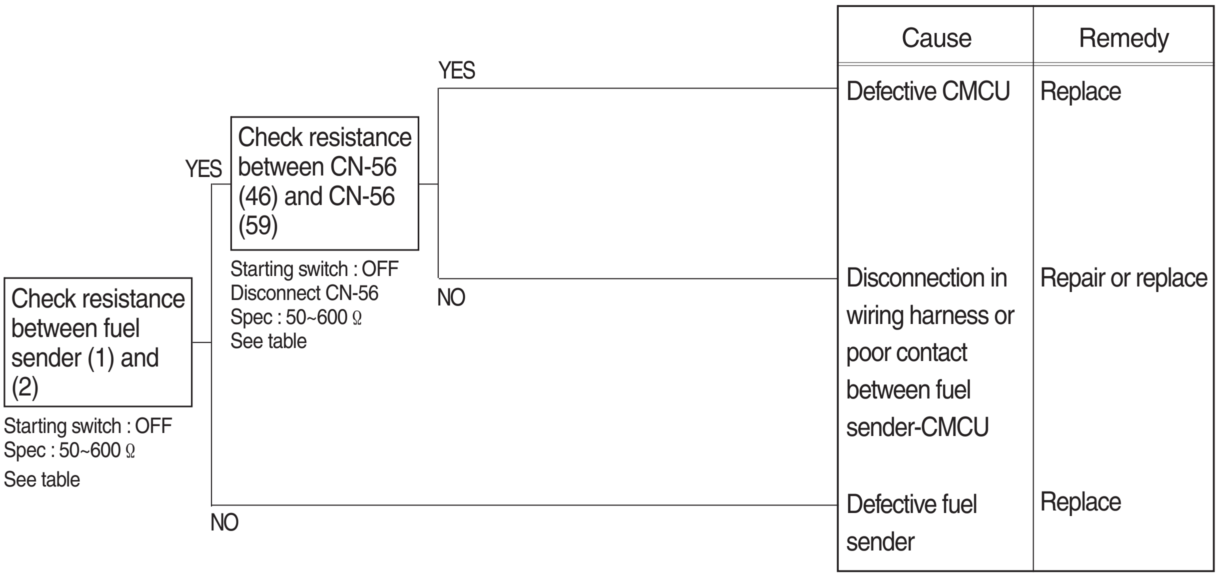
Check Table

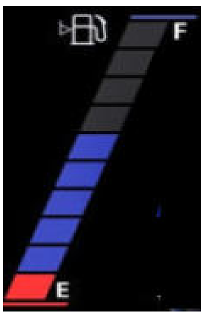
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151



7. WHEN FUEL GAUGE DOES NOT OPERATE

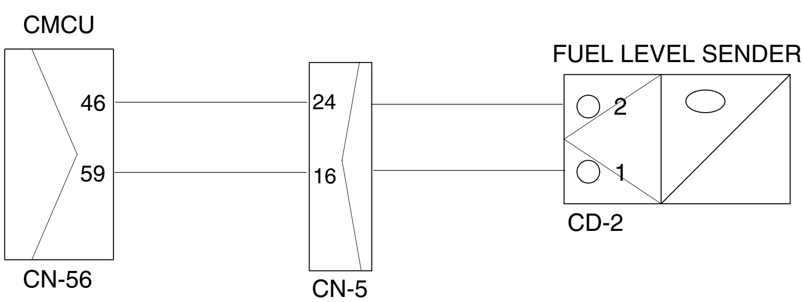
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





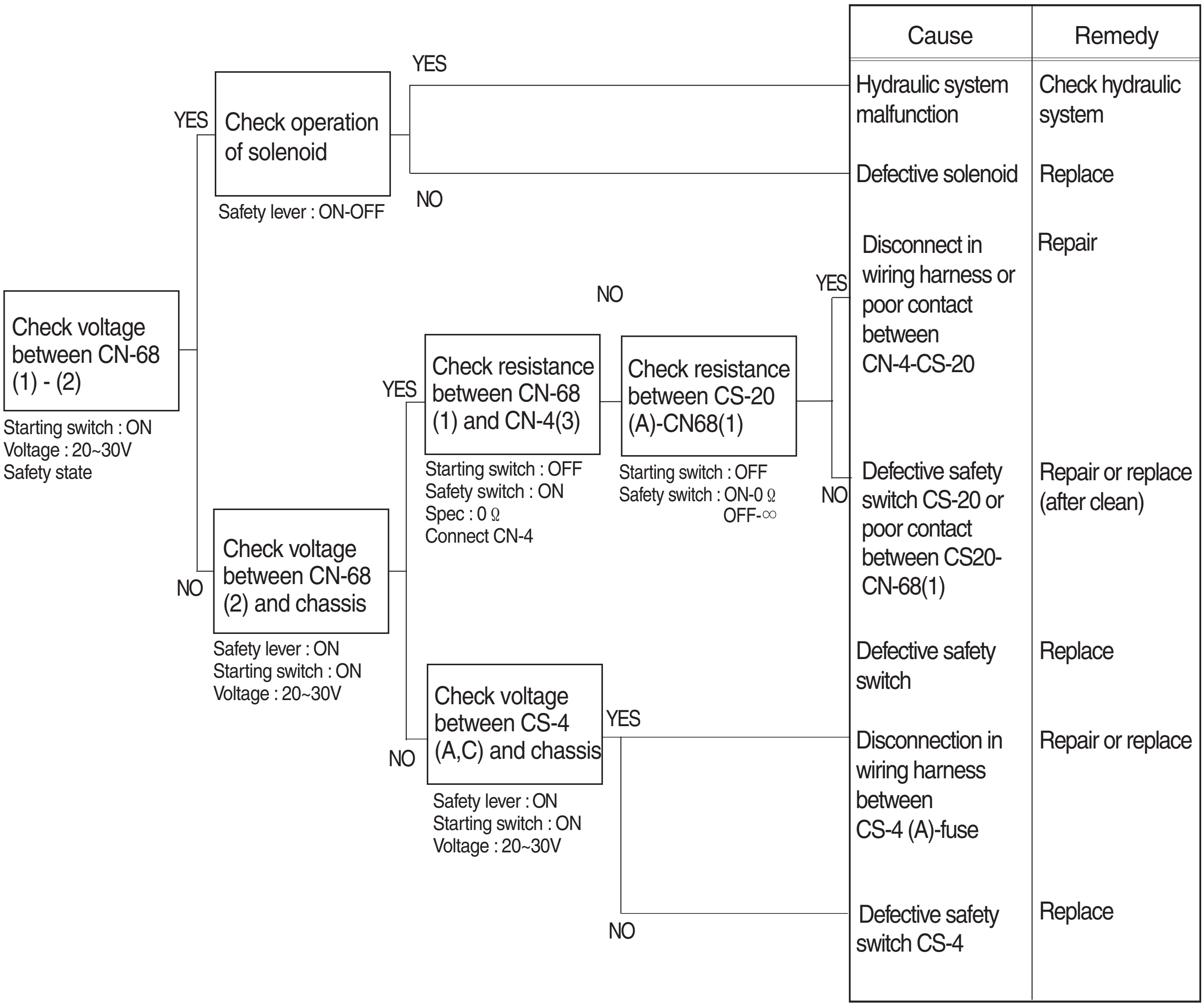
Check Table

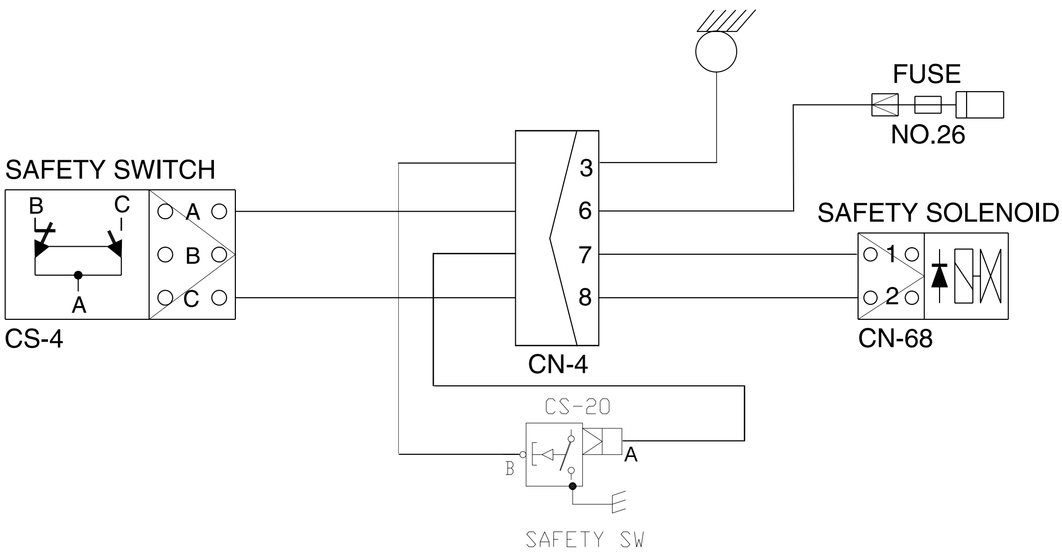
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-



8. WHEN SAFETY SOLENOID DOES NOT OPERATE

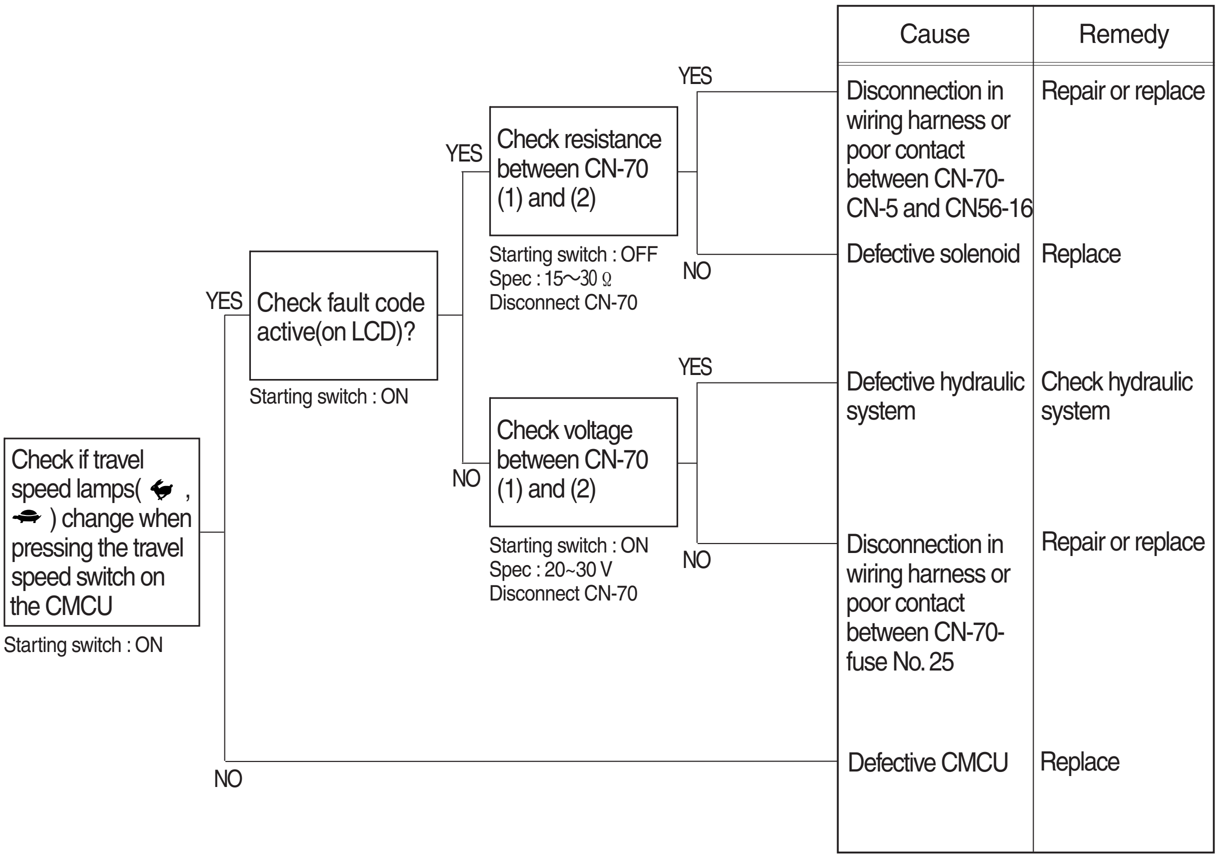
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.26 burnt out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

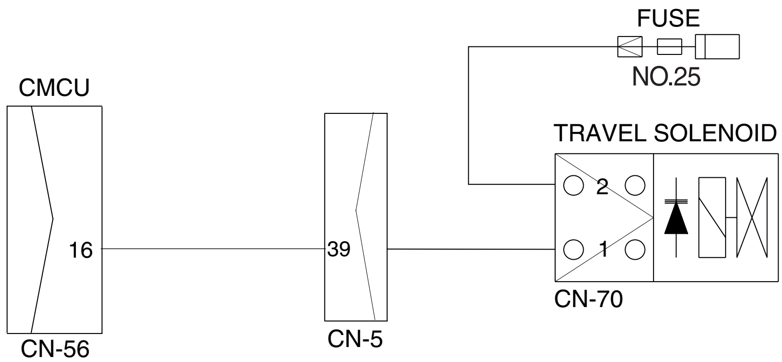




9. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 25 burnt out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



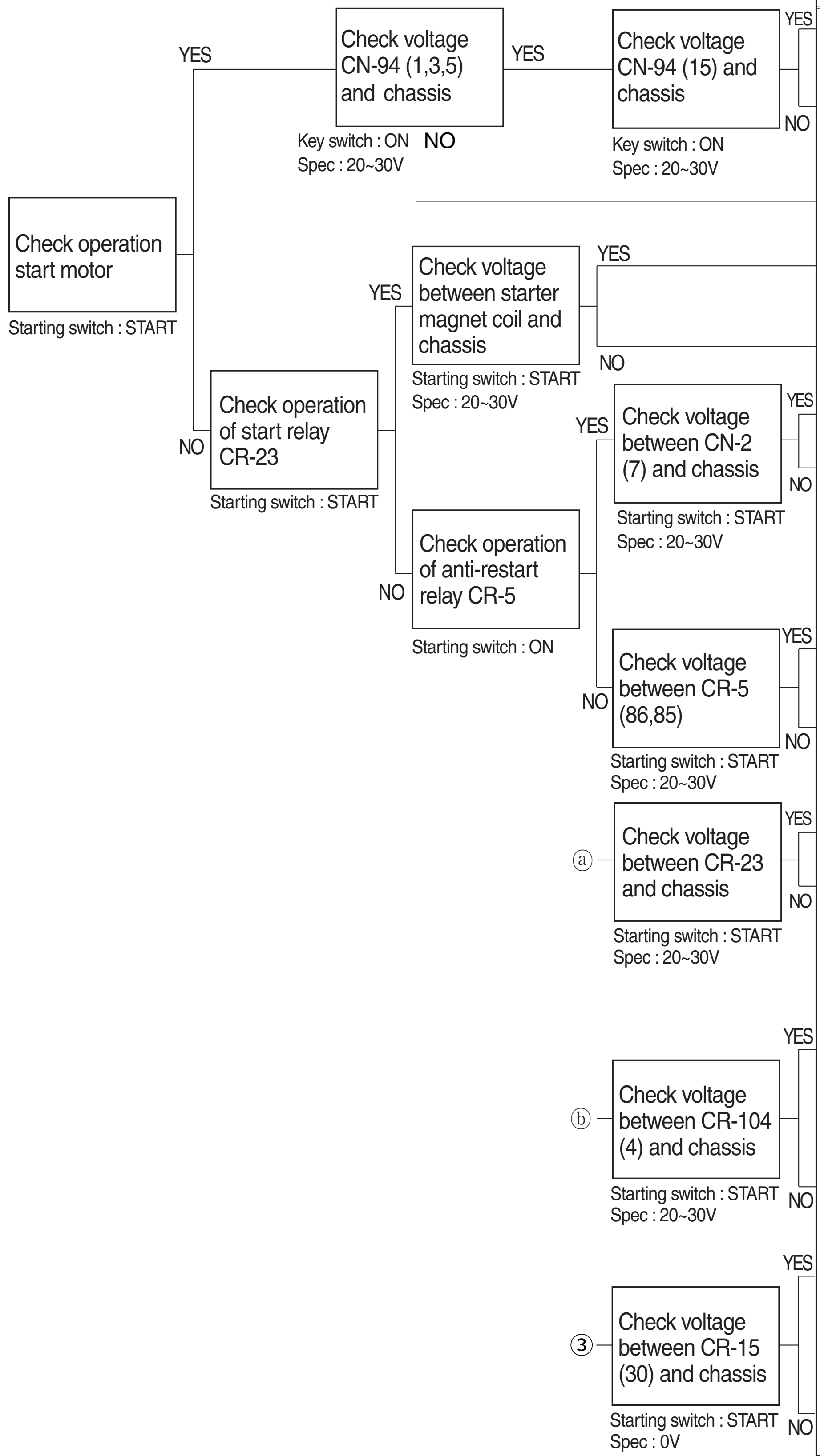


11. WHEN ENGINE DOES NOT START ([- +] lights up condition)

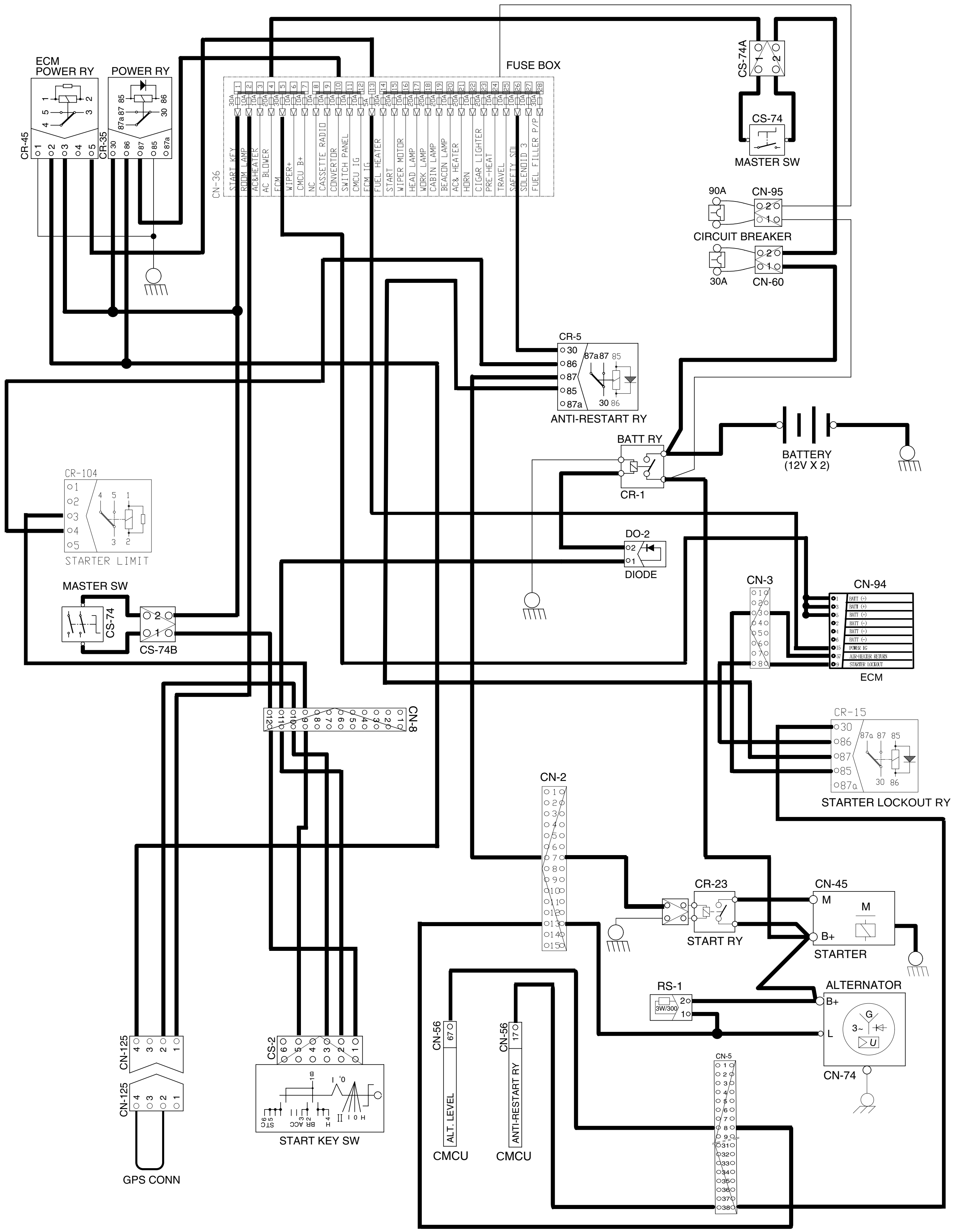
· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 1,2,5,7,12,13,15

· After checking, insert the disconnected connectors again immediately unless otherwise specified.

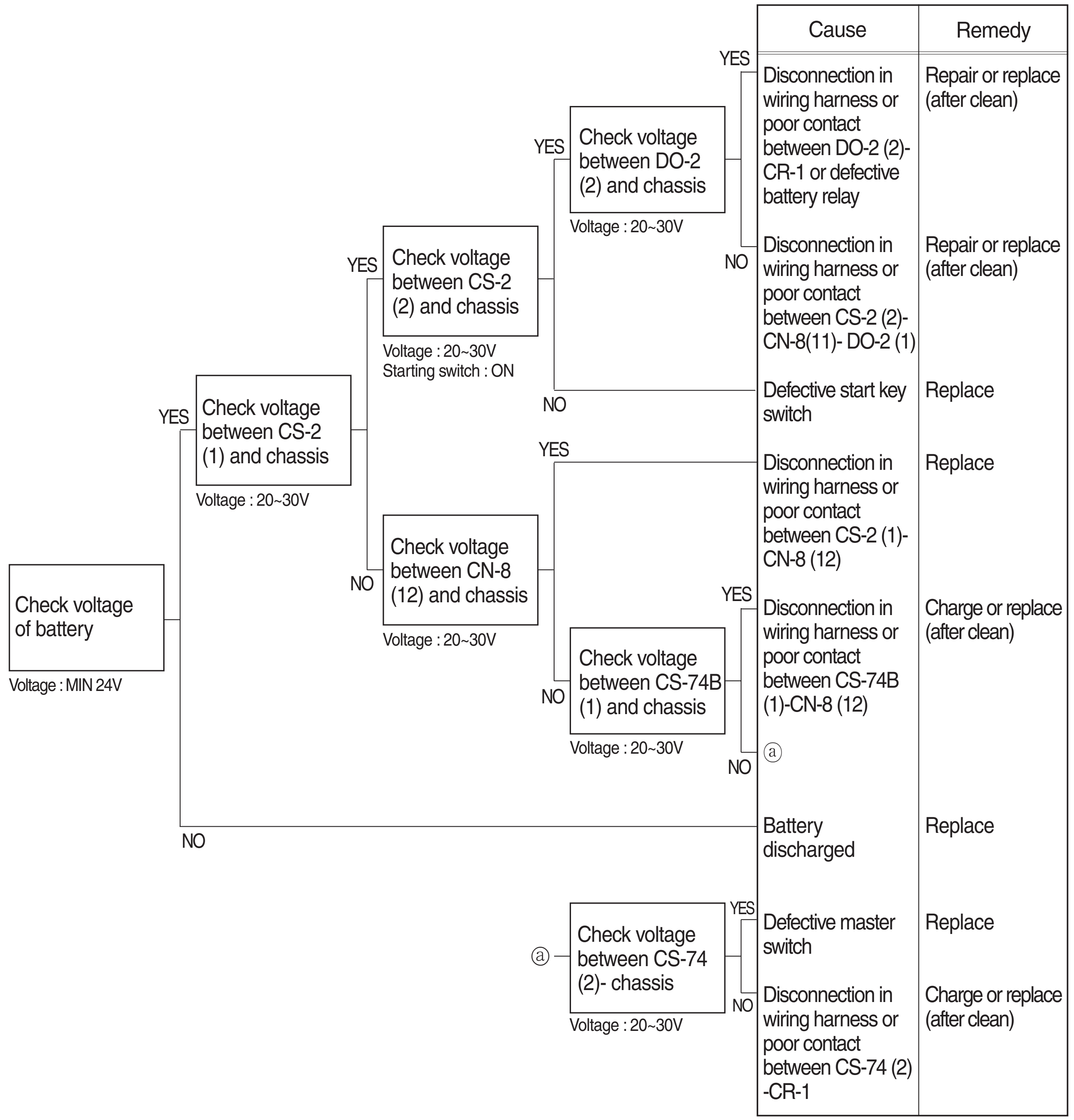


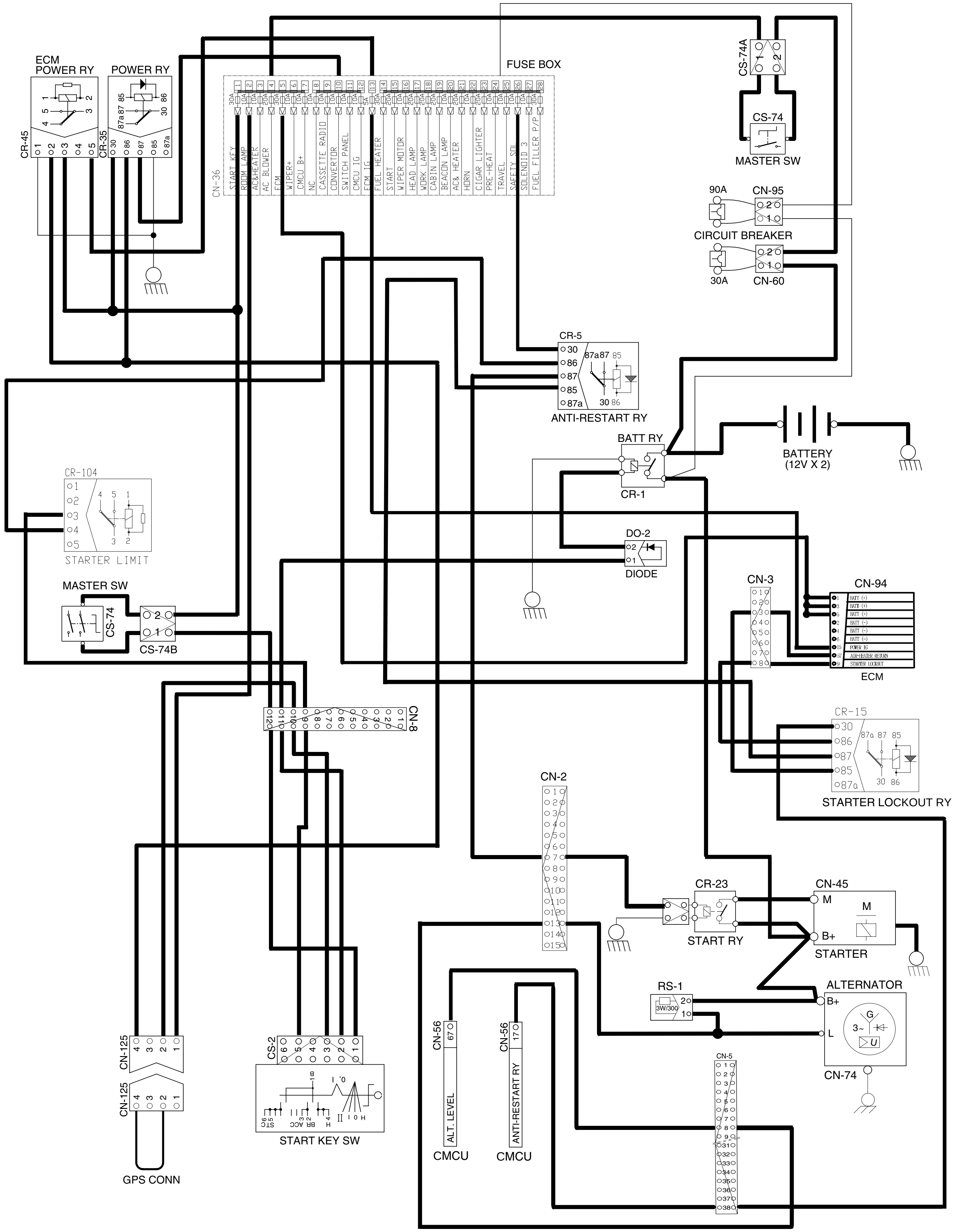
Cause	Remedy
Defective ECM or battery	Replace
Check fuse No.13 and ECM Power relay CR-45	Repair or replace
Check fuse No.1	Replace
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Disconnection in wiring harness or poor contact between CN-2 (7) -CR-5 (87)	Repair or replace
Defective anti-restart relay	Replace
ⓑ and ③	
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CN-2 (7) -CR-5 (87)	Repair or replace
Defective anti-restart relay	Repair or replace
Defective starter-limit relay	Repair or replace
ⓑ	
Check voltage between CR-15 (86,85) is 24V	Check ecm and wire



12. WHEN STARTING SWITCH ON DOES NOT OPERATE

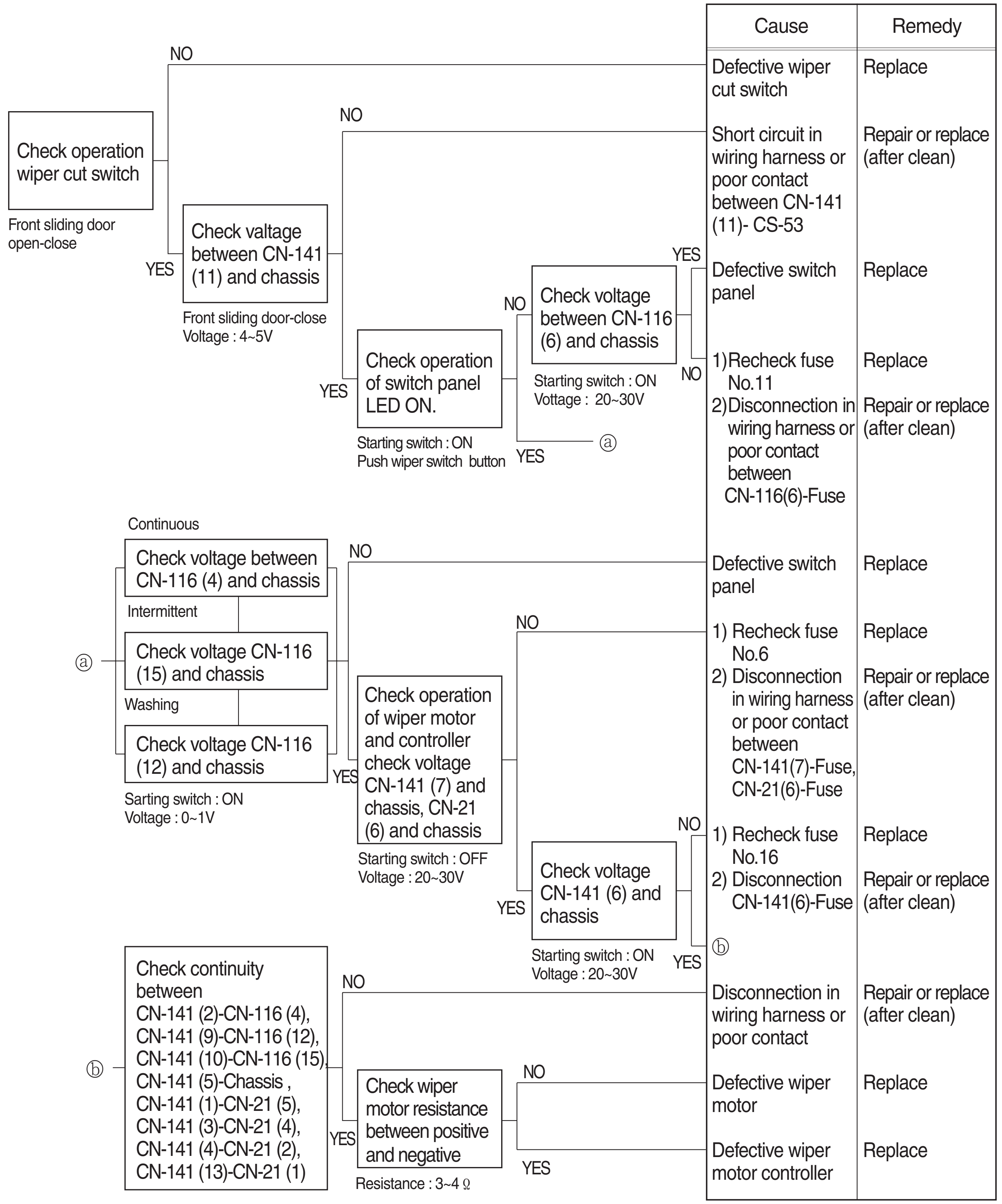
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted, master switch ON and check open circuit of fusible link (CN-60).
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

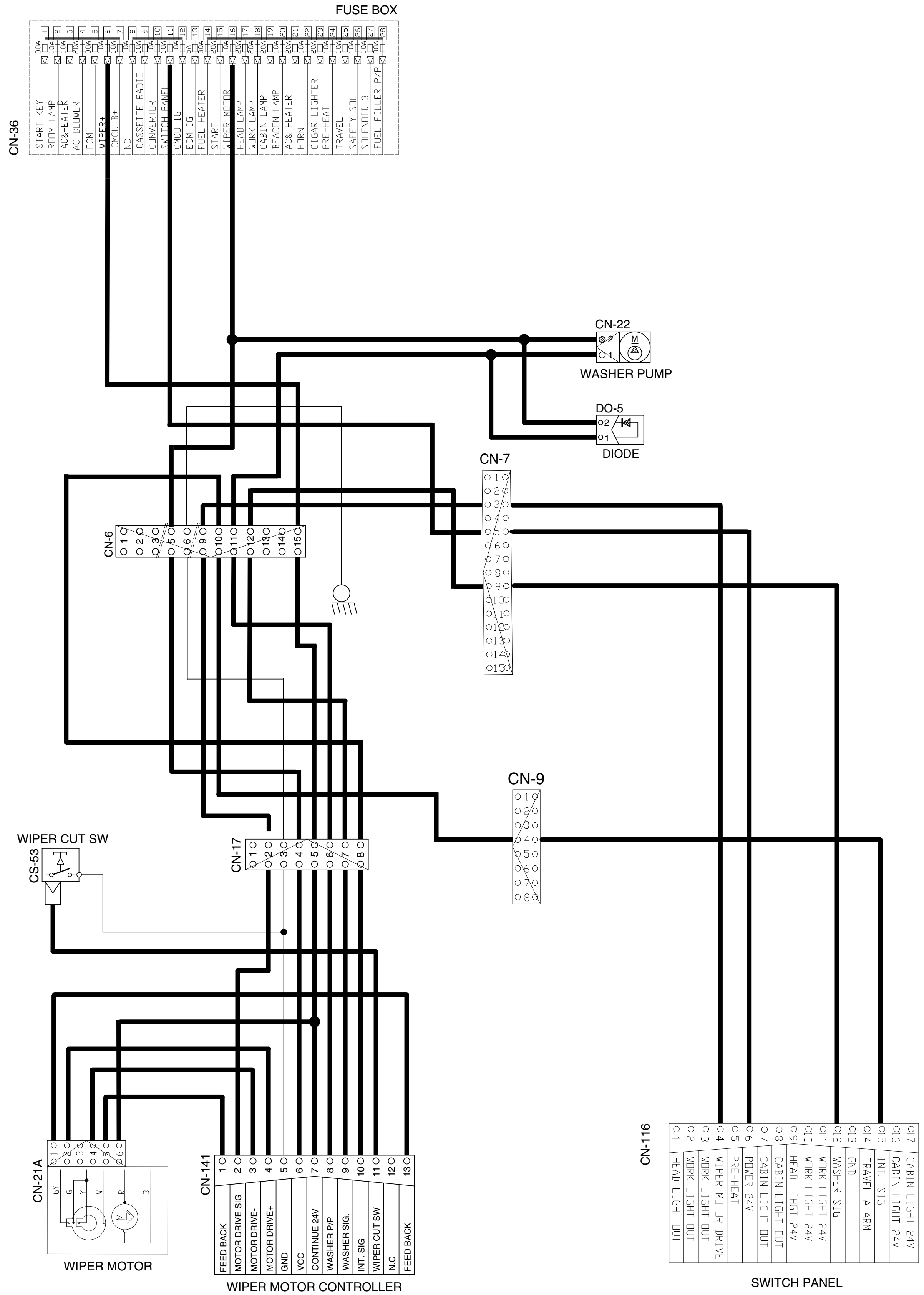




13. WHEN STARTING SWITCH IS TURNED ON, WIPER MOTOR DOES NOT OPERATE

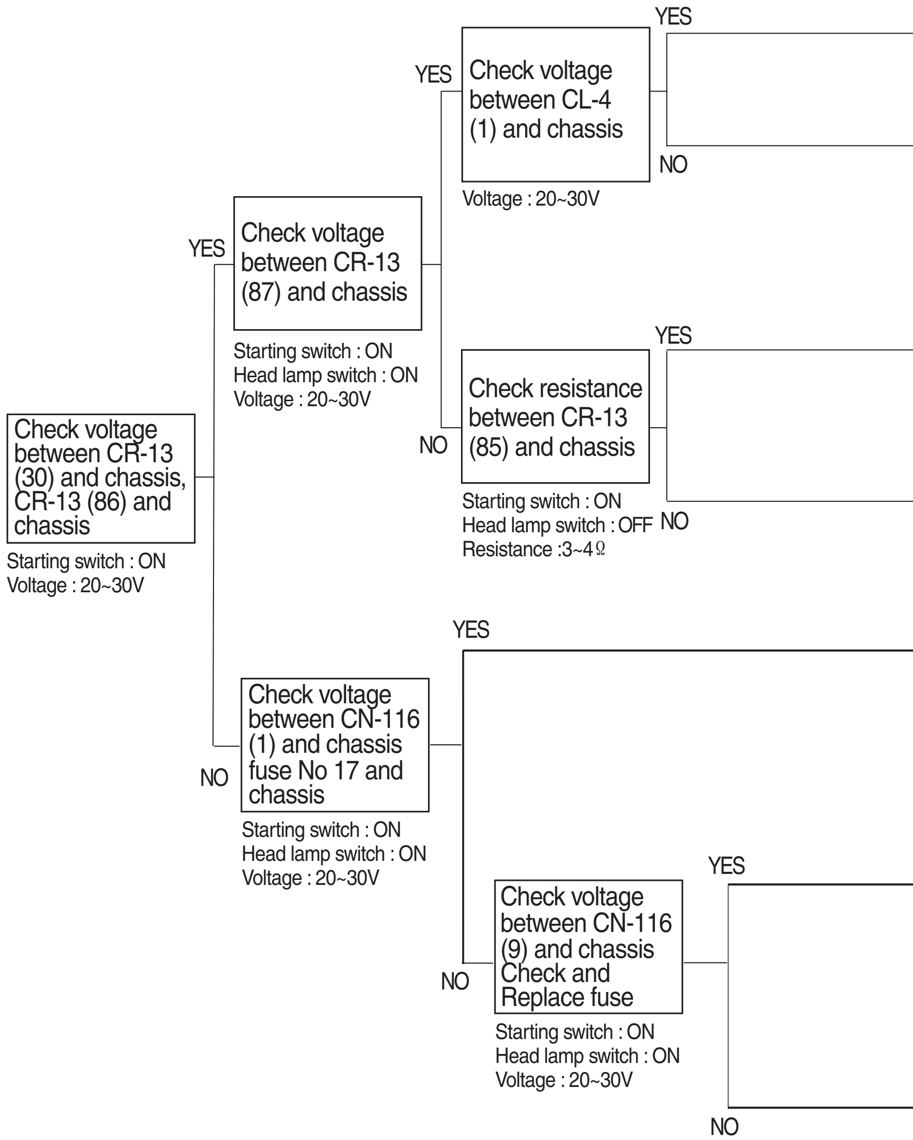
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No. 6, 11 and 16 burnt out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



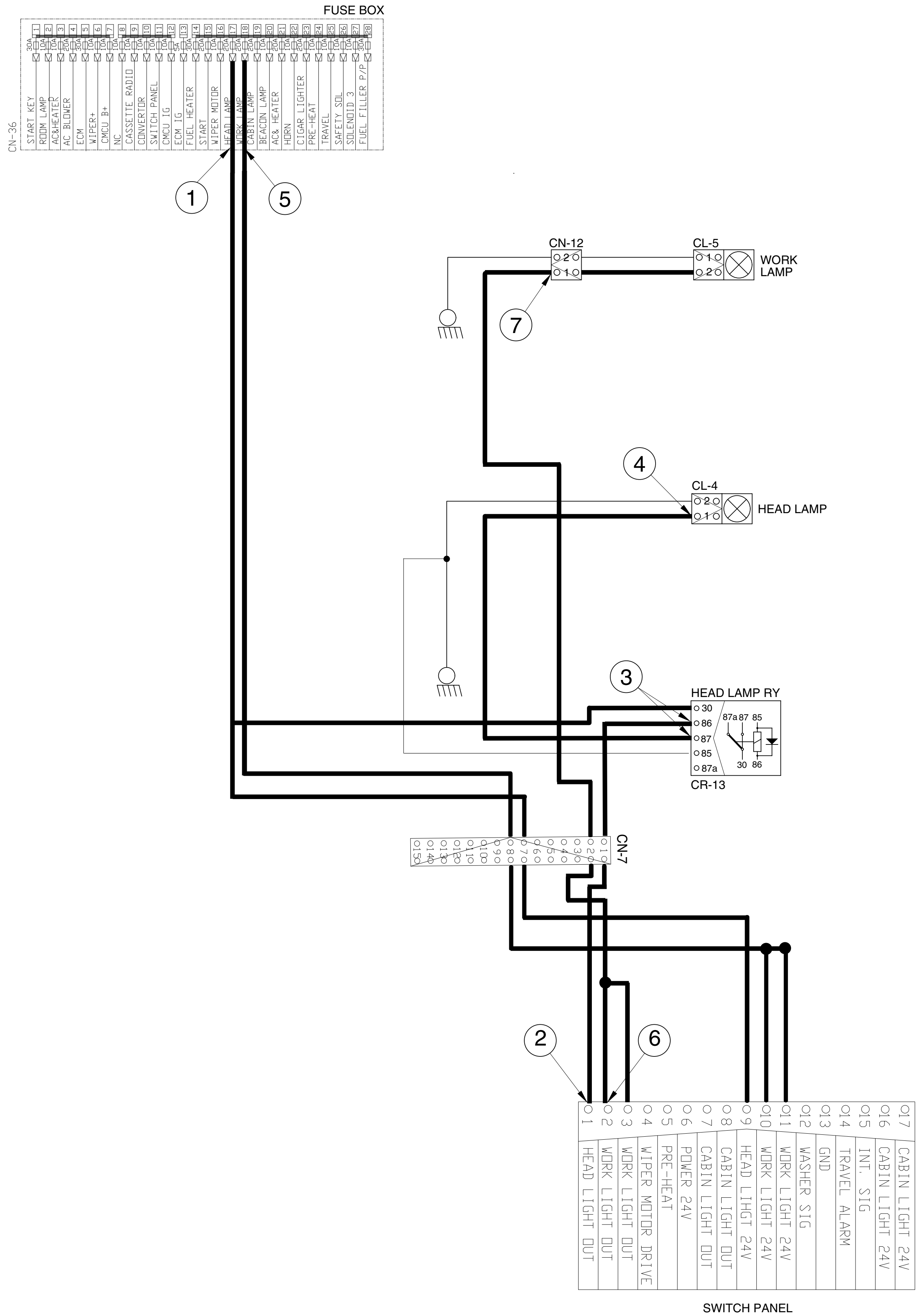


14. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.17 burnt out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (1)	Repair or replace (after clean)
Defective relay	Replace
Disconnection in wiring harness or poor contact between chassis -CR-13 (85)	Repair or replace
Disconnection in wiring harness or poor contact between CR-13 (30) and fuse or CR-13 (86) - CN-116(1)	Repair or replace
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between fuse - CN-116(9)	Repair or replace

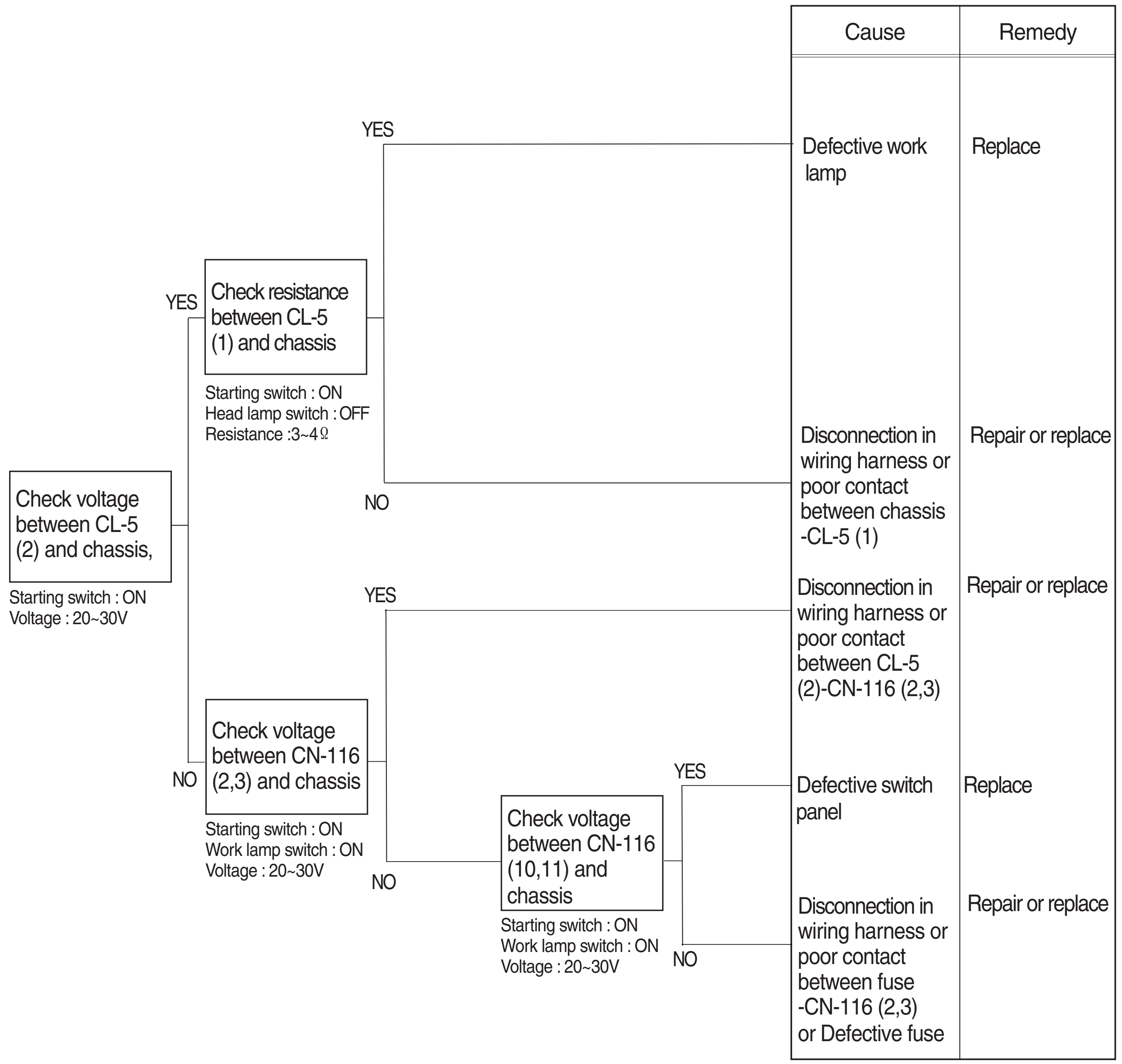


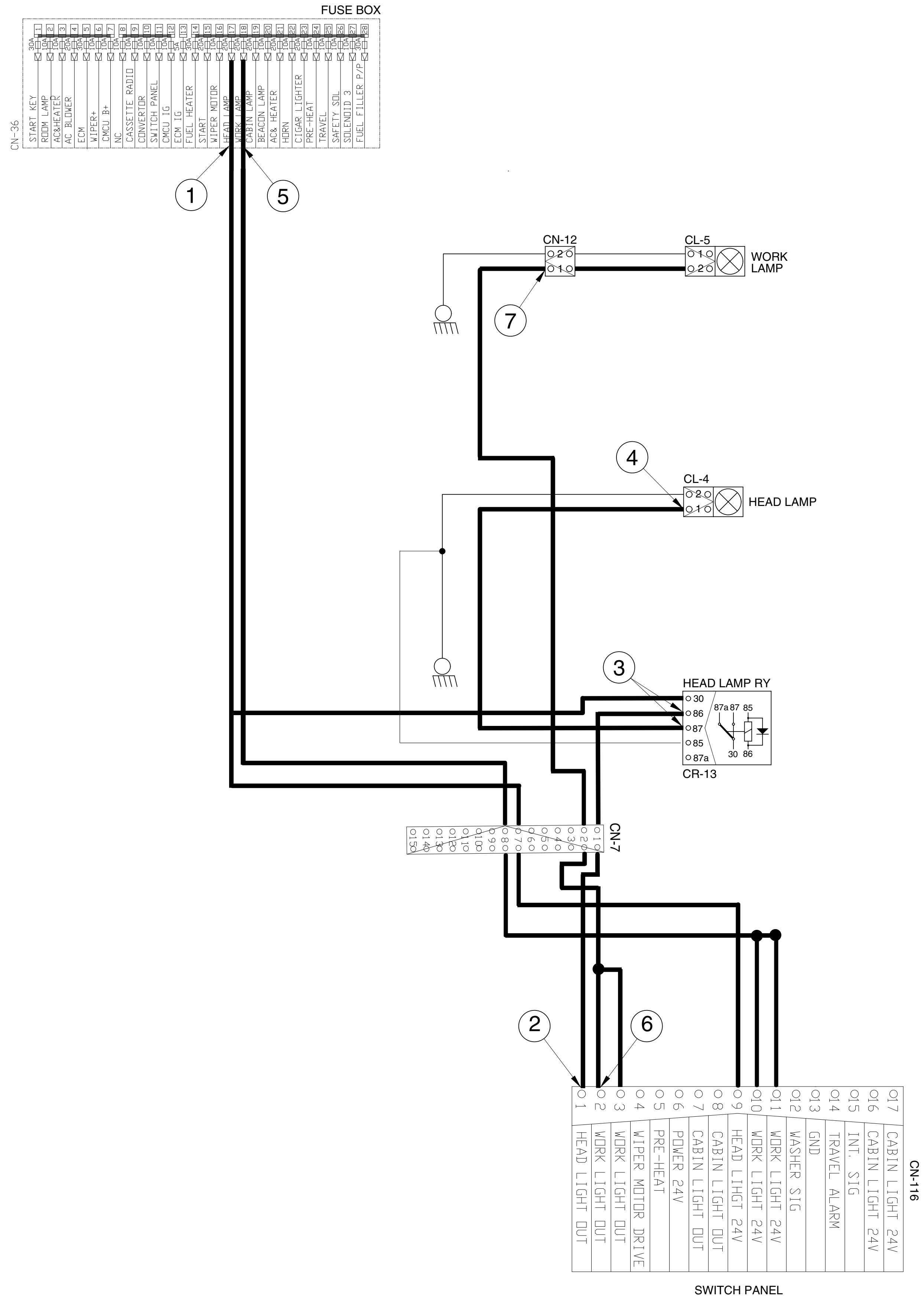
15. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.

· Before carrying out below procedure, check all the related connectors are properly inserted and fuse No.18 burnt out.

· After checking, insert the disconnected connectors again immediately unless otherwise specified.





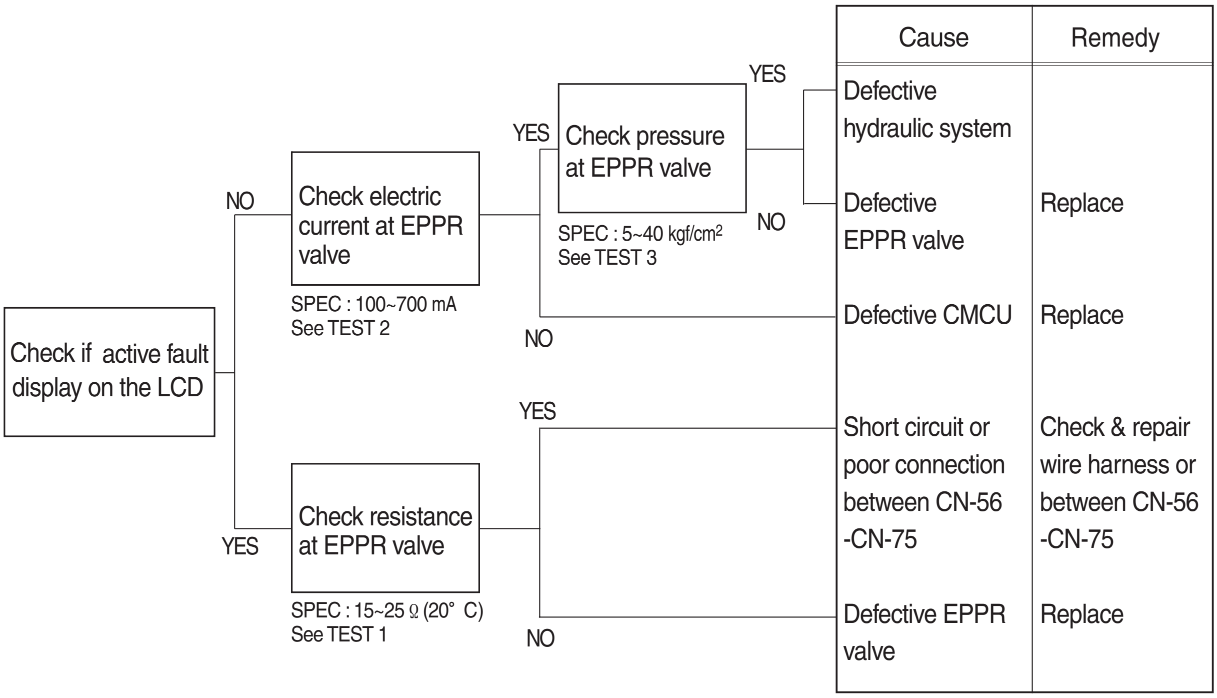
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.

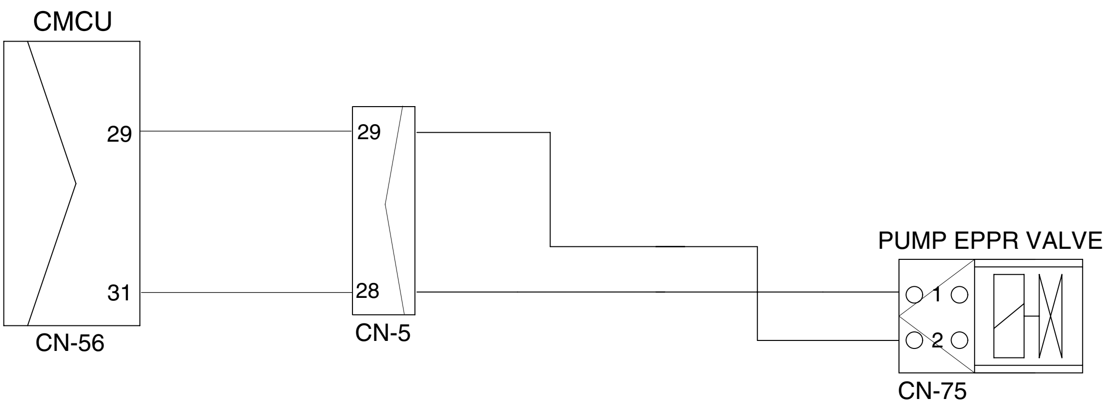
※ Spec : P-mode 1800 ± 50 rpm S -mode 1600 ± 50 rpm E-mode 1400 ± 50 rpm

※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

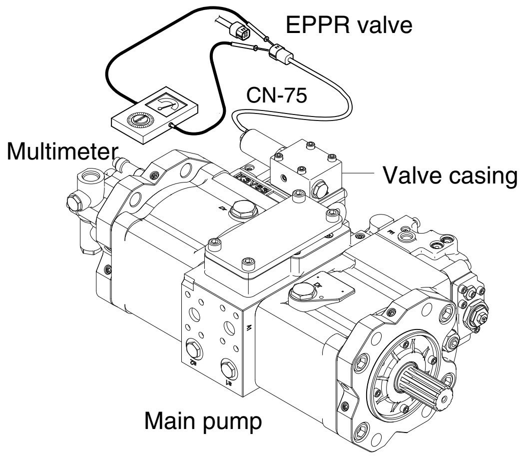
(1) Test 1 : Check resistance at connector CN-75.

① Starting key OFF.

② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.

SPEC : 15~25 Ω (20˚C)



(2) Test 2 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.

② Insert the adapter to CN-75 and install multimeter as figure.

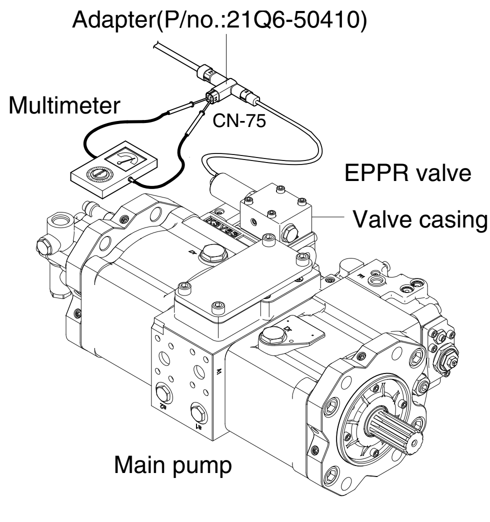
③ Start engine.

④ Set H-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display approx 1600 ±50 rpm check electric current at bucket circuit relief position.

Spec : 100~700 mA



(3) Test 3 : Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.

· Gauge capacity : 0 to 50 kgf/cm^2 (0 to 710 psi)

② Start engine.

③ Set H-mode and cancel auto decel mode.

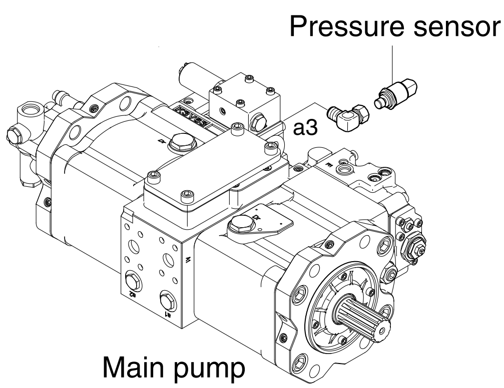
④ Position the accel dial at 10.

⑤ If rpm display approx 1600±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

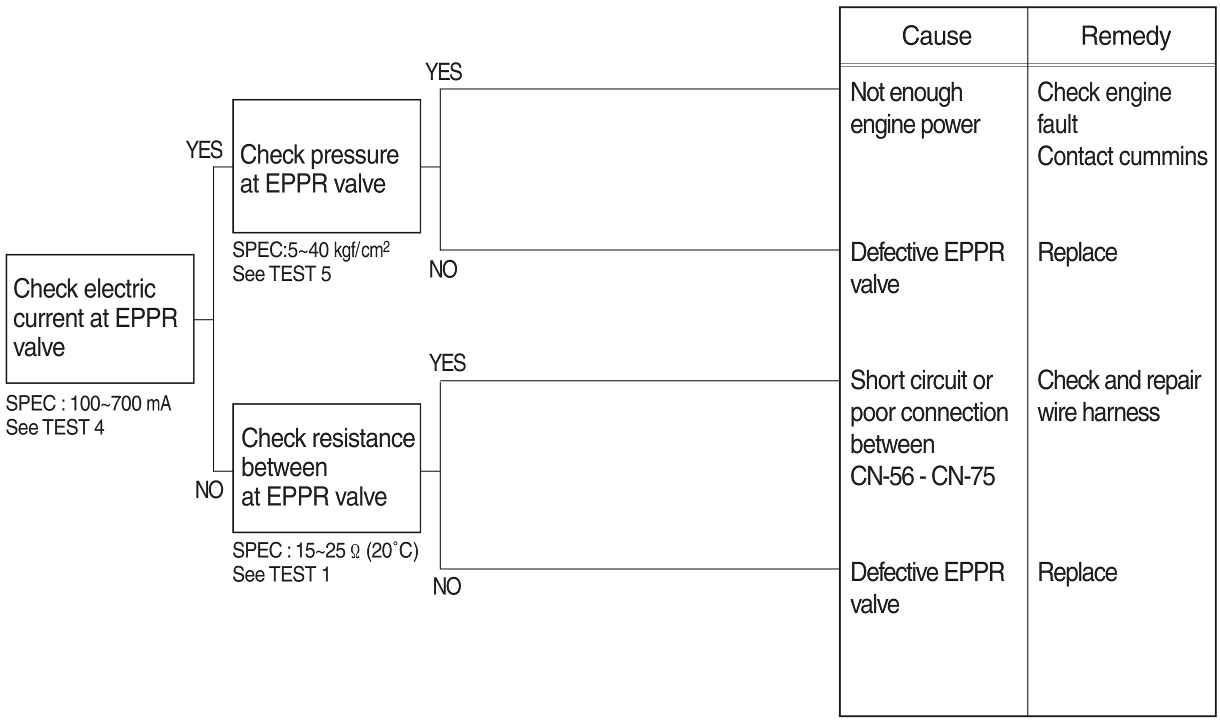
Spec : 5~40 kgf/cm^2 (73~580 psi)



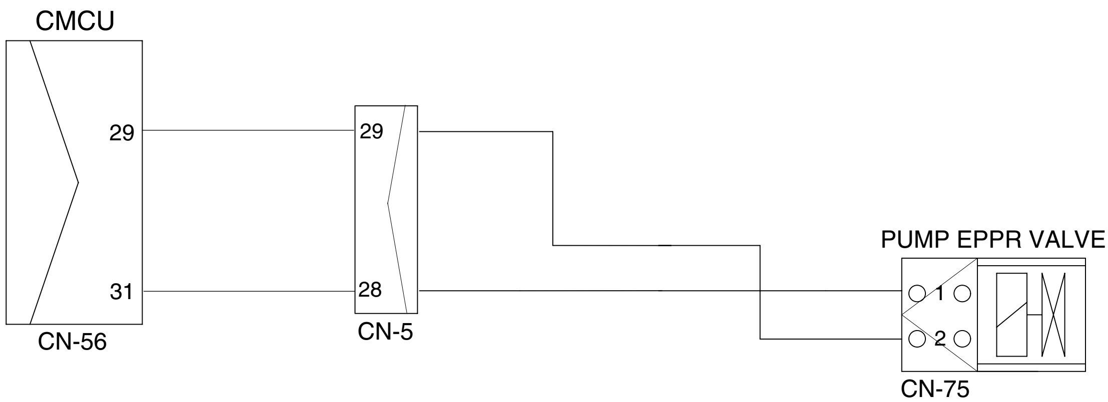
2. ENGINE STALL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram

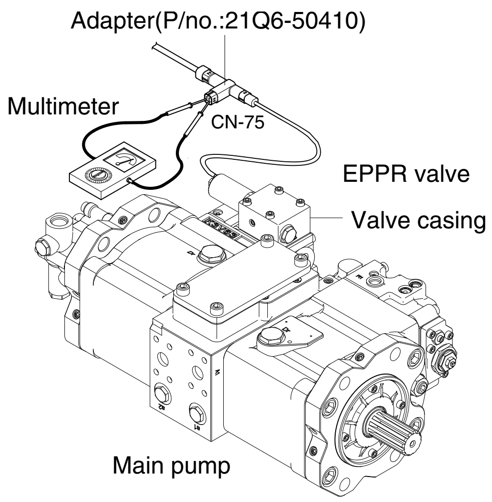


2) TEST PROCEDURE

(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set H-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If rpm display approx 1600 ±50 rpm check electric current at bucket circuit relief position.

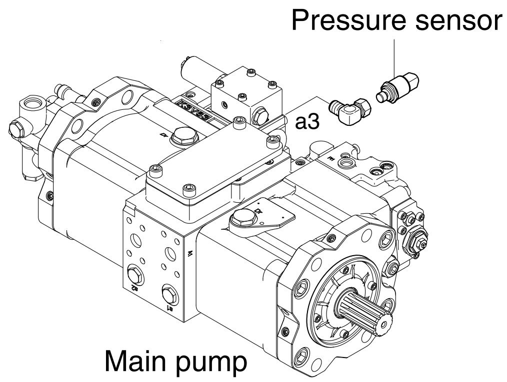
SPEC : 100~700 mA



(2) Test 5 : Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.
  · Gauge capacity : 0 to 50 kgf/cm^2 (0 to 710 psi)
② Start engine.
③ Set H-mode and cancel auto decel
④ mode.
⑤ Position the accel dial at 10.
If rpm display approx 1800±50 rpm check pressure at relief position of bucket circuit
⑥ by operating bucket control lever.
⑦ If pressure is not correct, adjust it.
After adjust, test the machine.

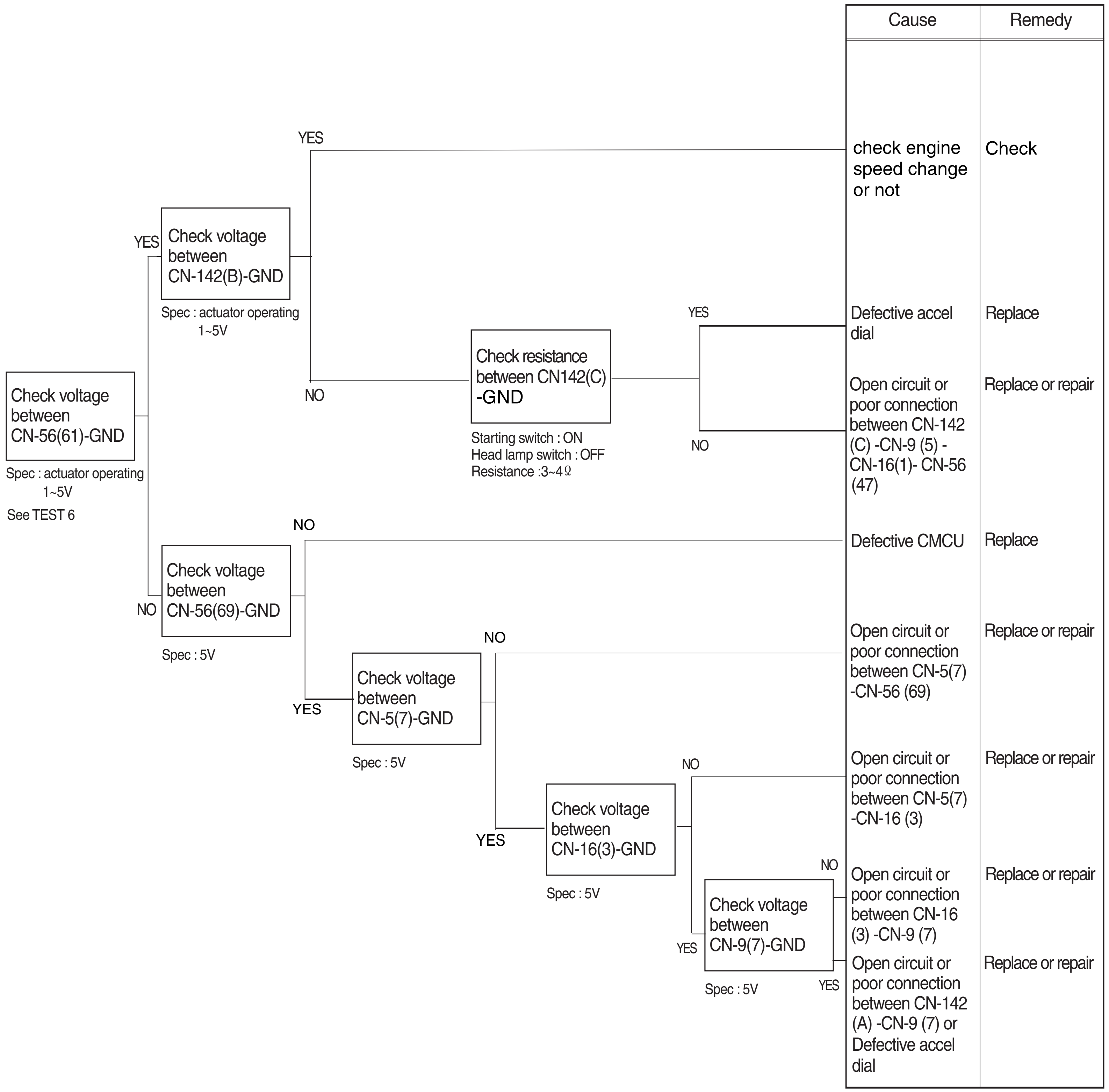
SPEC : 5~40 kgf/cm^2 (73~580 psi)

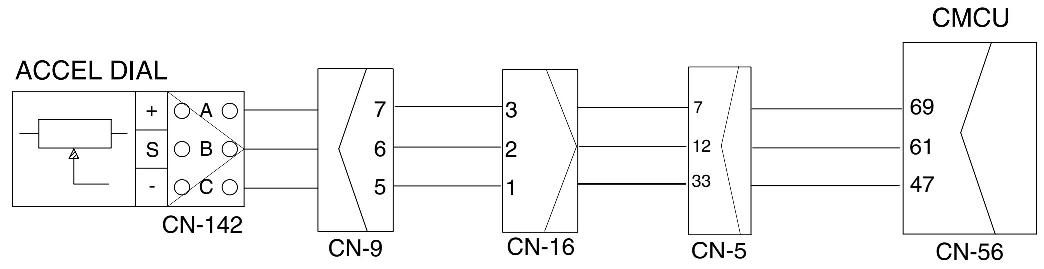


3. MALFUNCTION OF ACCEL DIAL

※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE





2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-56(61) and ground.

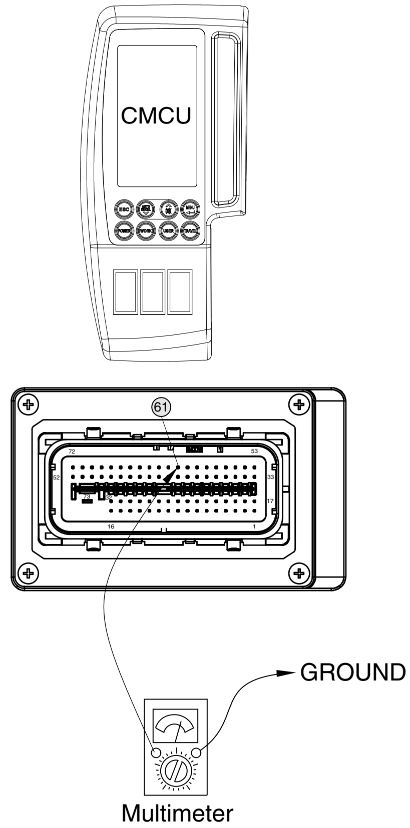
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (61) of CN-56.

③ Starting key ON.

④ Check voltage as figure.

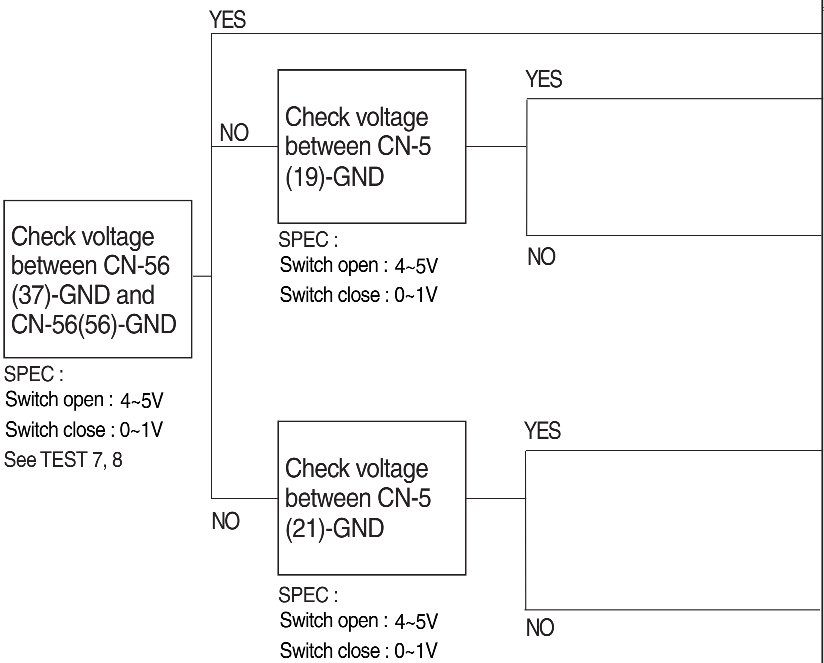
SPEC : Actuator operating : 1~5 V



5. AUTO DECEL SYSTEM DOES NOT WORK

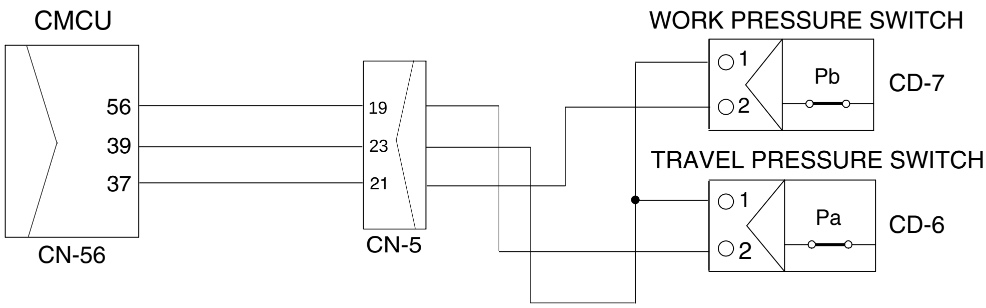
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective CMCU	Replace
Open circuit or poor connection between CN-56 (56) -CN-5 (19)	Replace or repair
Defective travel pressure switch or Open circuit or poor connection between CN-5(19) - CD-6(2)	Replace or repair
Open circuit or poor connection between CN-56 (37) -CN-5 (21)	Replace or repair
Defective travel pressure switch or Open circuit or poor connection between CN-5(21) - CD-7(2)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

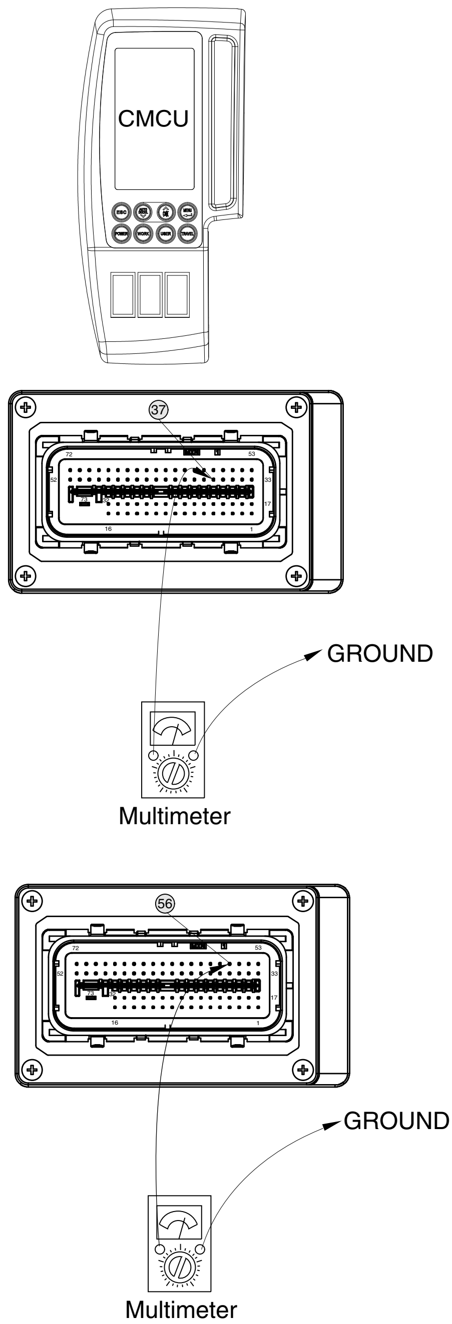
(1) Test 7 : Check voltage at CN-56(37) and GND.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (37) of CN-56.
③ Starting key ON.
④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-56(56)and GND.

① Prepare 1 piece of thin sharp pin, steel or copper
② Insert prepared pin to rear side of connectors : One pin to (56) of CN-56.
③ Starting key ON.
④ Check voltage as figure.

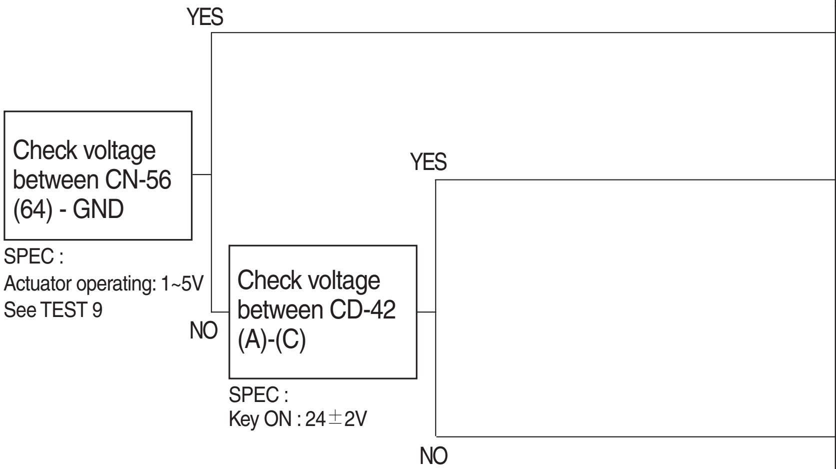
SPEC : Switch open : 4~5V Switch close : 0~1V



6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

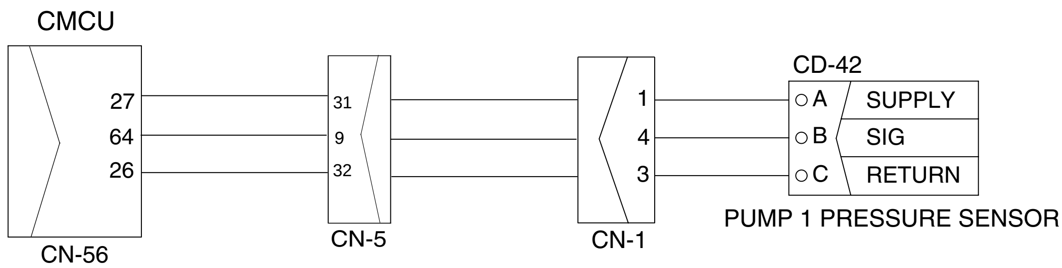
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective CMCU	Replace
Detective P1 pressure sensor Short circuit or poor connection between CN-56 (64)-CD-42 (B)	Replace or repair
Short circuit or poor connection between CD-42 (A)-CN-56(27) or CD-42(C)- CN-56 (26)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) **Test 9 :** Check voltage at CN-56(64) and ground.

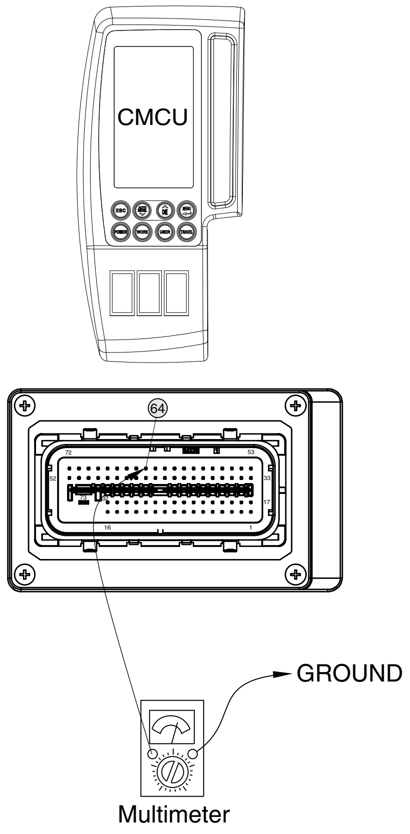
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (64) of CN-56.

③ Starting key ON.

④ Check voltage as figure.

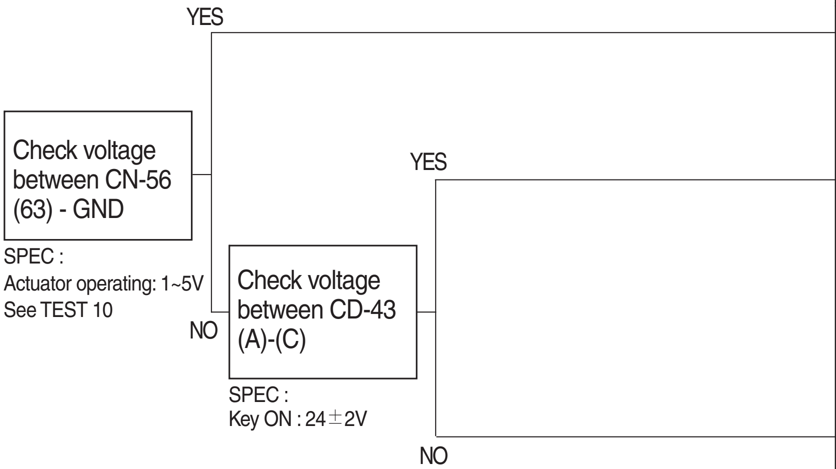
SPEC : Actuator operating : 1~5 V



7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

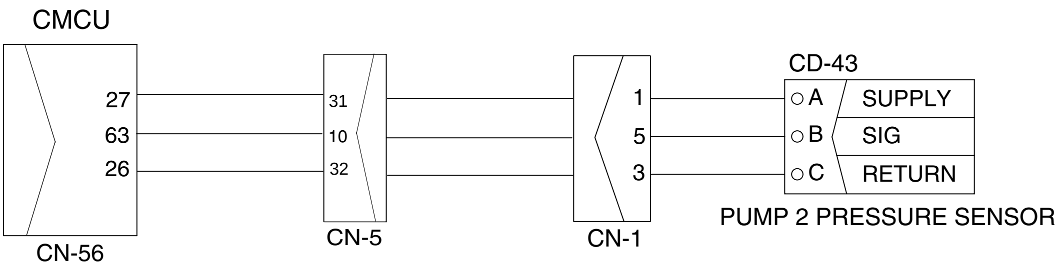
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective CMCU	Replace
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-56 (63)-CD-43 (B)	Replace or repair
Short circuit or poor connection between CD-43 (A)-CN-56(27) or CD-43(C)- CN-56 (26)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-56(63) and ground.

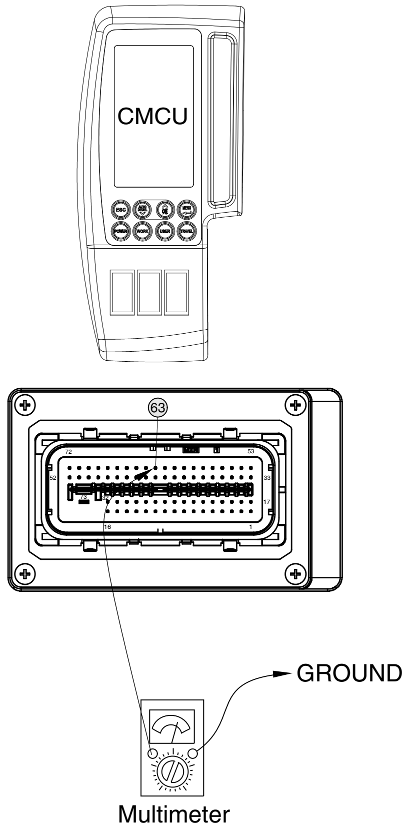
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (63) of CN-56.

③ Starting key ON.

④ Check voltage as figure.

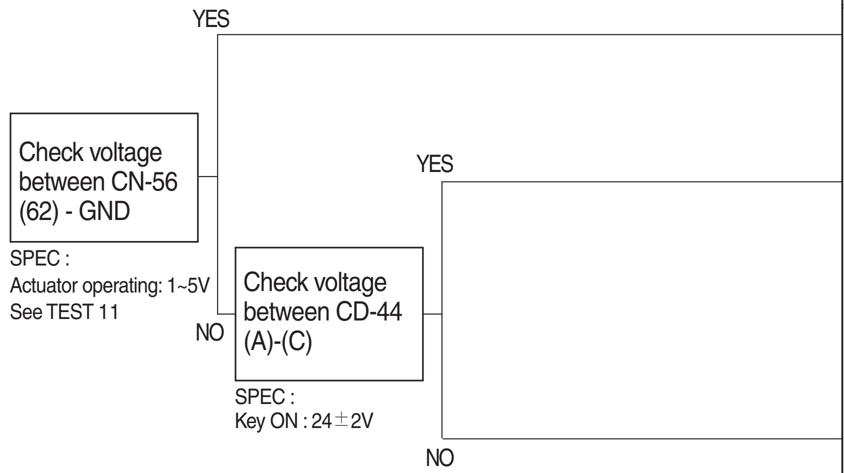
SPEC : Actuator operating : 1~5 V



8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR(EPPR PRESSURE)

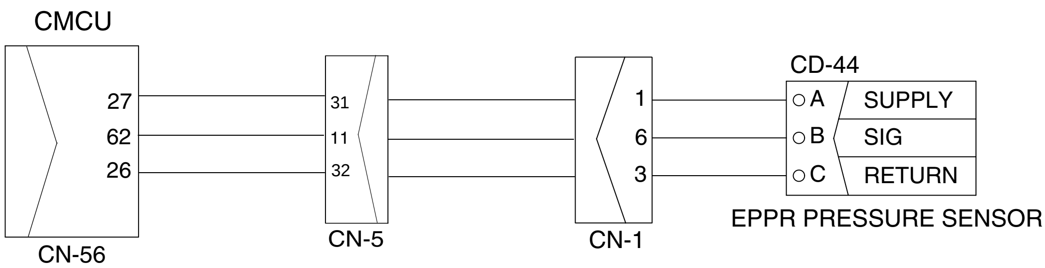
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective CMCU	Replace
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-56 (62)-CD-44 (B)	Replace or repair
Short circuit or poor connection between CD-44 (A)-CN-56(27) or CD-44(C)- CN-56 (26)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) **Test 11** : Check voltage at CN-56(62) and ground.

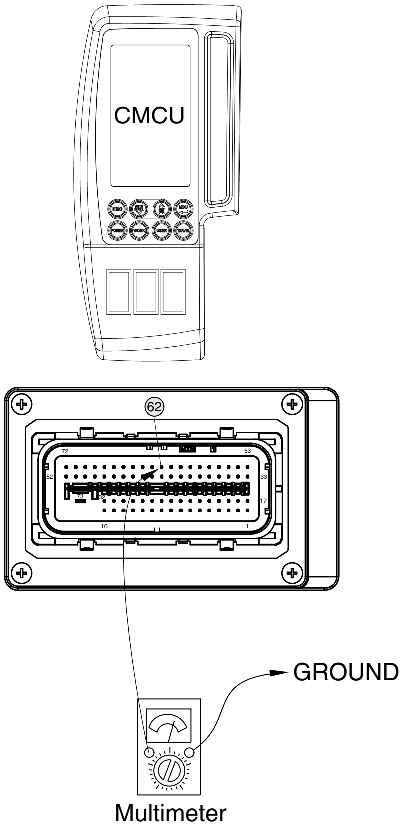
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (62) of CN-56.

③ Starting key ON.

④ Check voltage as figure.

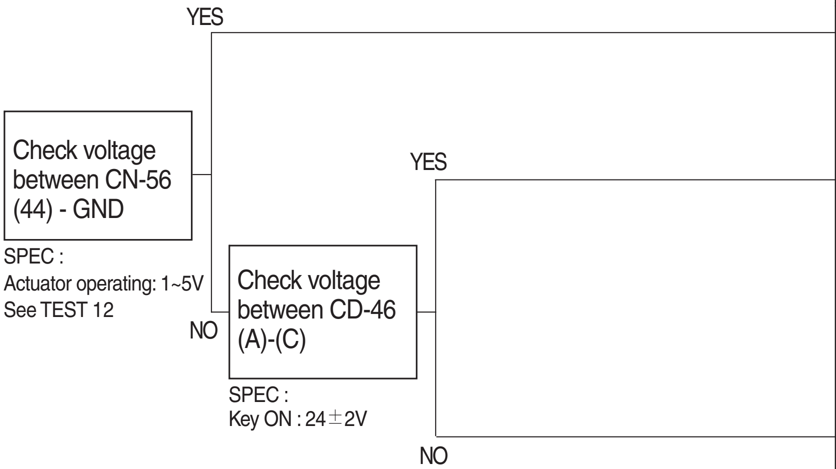
SPEC : Actuator operating : 1~5 V



9. MALFUNCTION OF BOOM UP PRESSURE SENSOR

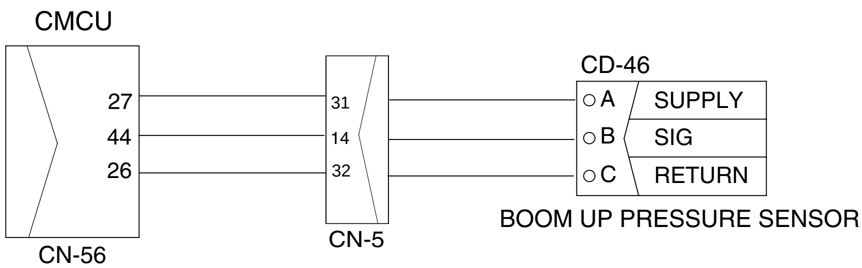
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective CMCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-56 (44)-CD-46 (B)	Replace or repair
Short circuit or poor connection between CD-46 (A)-CN-56(27) or CD-46(C)- CN-56 (26)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-56(44) and ground.

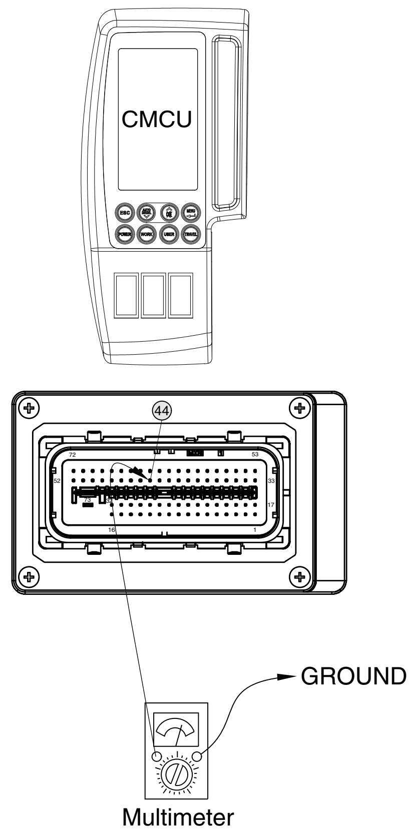
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (44) of CN-56.

③ Starting key ON.

④ Check voltage as figure.

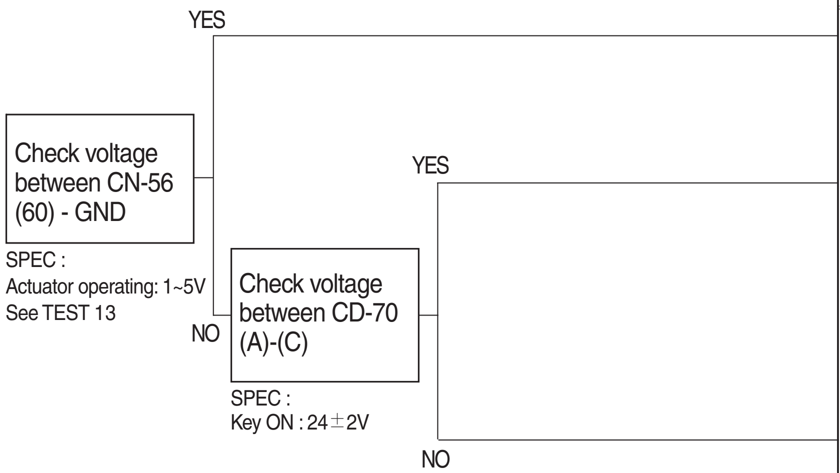
SPEC : Actuator operating : 1~5 V



10. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

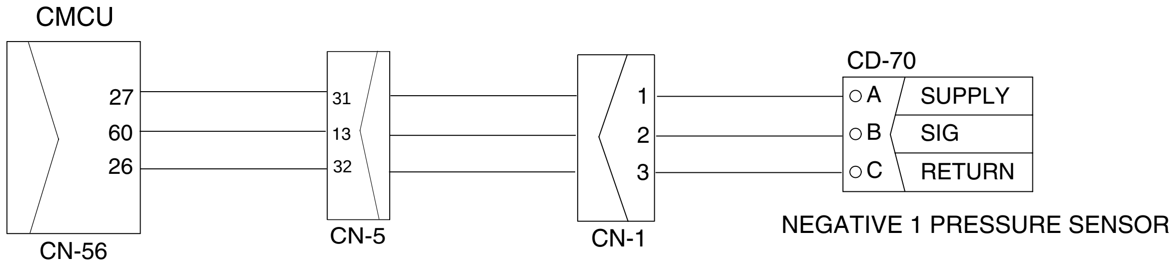
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective CMCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-56 (60)-CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-56(27) or CD-70(C)- CN-56 (26)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-56(60) and ground.

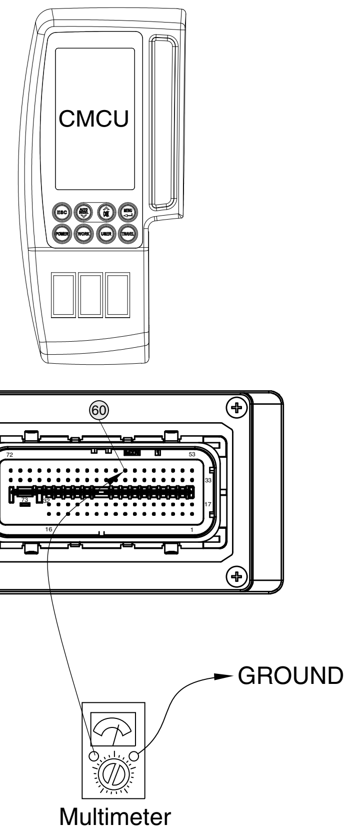
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (60) of CN-56.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

Whenever a new machine is delivered in parts and reassembled at a customer's site, it must be tested to confirm that the operational performance of the machine meets Hyundai spec.

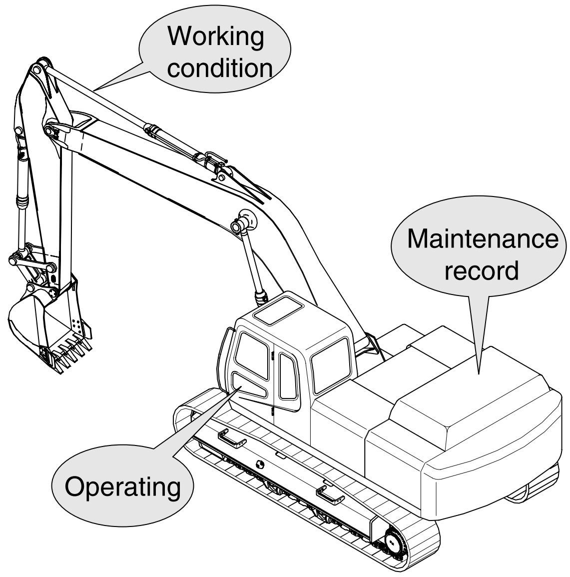
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

With the passage of time, the machine's operational performance deteriorates, so that the machine needs to be serviced periodically to restore it to its original performance level.

Before servicing the machine, conduct performance tests to check the extent of deterioration, and to decide what kind of service needs to be done(by referring to the "Service Limits" in this manual).

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

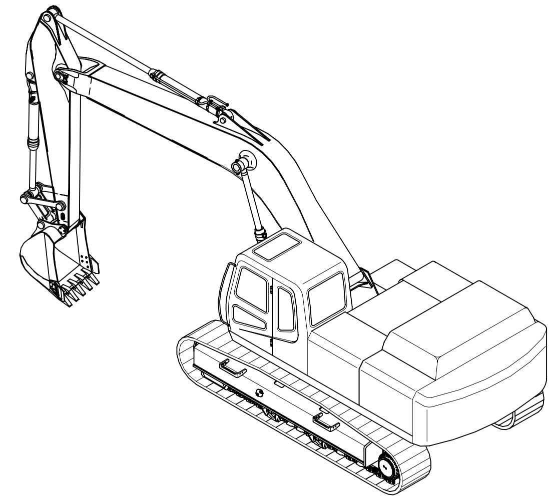
After the machine is repaired or serviced, it must be tested to confirm that its operational performance was restored by the repair and/or service work done.



2. TERMINOLOGY

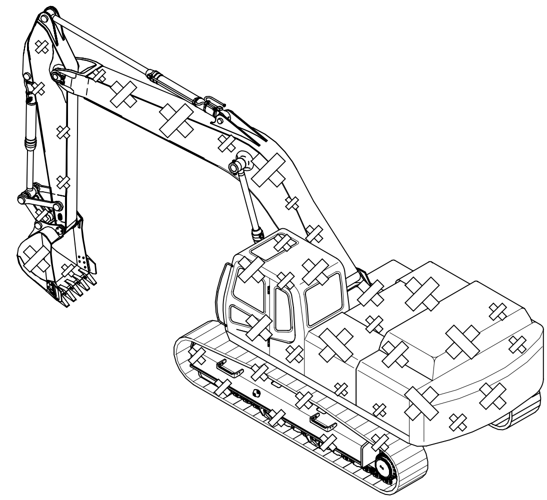
1) STANDARD

Specifications applied to the brand-new machine, components and parts.



2) SERVICE LIMIT

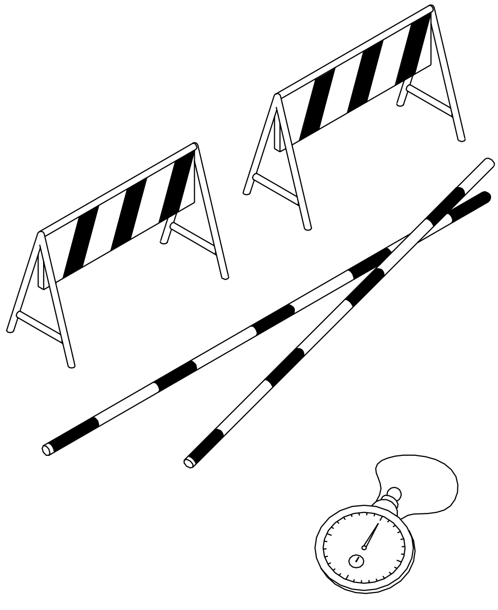
The lowest acceptable performance level. When the performance level of the machine falls below this level, the machine must be removed from work and repaired. Necessary parts and components must be replaced.



3. OPERATION FOR PERFORMANCE TESTS

1) Observe the following rules in order to carry out performance tests accurately and safely.

(1) The machine
Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.



(2) Test area
① Select a hard, flat surface.
② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.
③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions
① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.
② Operate the machine carefully and always give first priority to safety.
③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements
① Accurately calibrate test instruments in advance to obtain correct data.
② Carry out tests under the exact test conditions prescribed for each test item.
③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.

2) ENGINE SPEED

(1) Measure the engine speed at each power mode

※ The engine speed at each power mode must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation

① Warm up the machine, until the engine coolant temperature reaches 50˚C or more, and the hydraulic oil is 50±5˚C.

② Set the accel dial at 10 (Max) position.

③ Measure the engine RPM.

(3) Measurement

① Measure and record the engine speed at each mode (M, H, S)

② Select the M-mode .

③ Lightly operate the bucket control lever a few times, then return the control lever to neutral; The engine will automatically enter the auto-idle speed after 4 seconds.

④ Measure and record the auto deceleration speed.

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R130VSPRO	Start idle	1200 ±50	
	M mode	1800±50	
	H mode	1600±50	
	S mode	1400±50	
	Auto decel	1300±50	
	One touch decel	1200±50	

Condition : Set the accel dial at 10 (Max) position.

3) TRACK REVOLUTION SPEED

(1) Measure the track revolution cycle time with the track raised off ground.

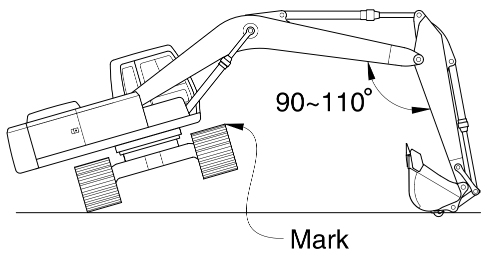
(2) Preparation

① Adjust the tension of both side tracks to be equal.

② On the track to be measured, mark one shoe with chalk.

③ Swing the upperstructure 90° and lower the bucket to raise the track off ground. Keep the boom-arm angle between 90 to 110° as shown. Place blocks under machine frame.

④ Keep the hydraulic oil temperature at 50±5˚C.



(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speedPower

· mode switch : M mode

· Auto idle switch : OFF

② Operate the travel control lever of the raised track in full forward and reverse.

③ Rotate 1 turn, then measure time taken for next 3 revolutions.

④ Raise the other side of machine and repeat the procedure.

⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard
R130VSPRO	1 Speed	23.4±2.0
	2 Speed	13.9±2.0

4) TRAVEL DEVIATION

(1) Measure the deviation by the tracks from a 20m straight line.

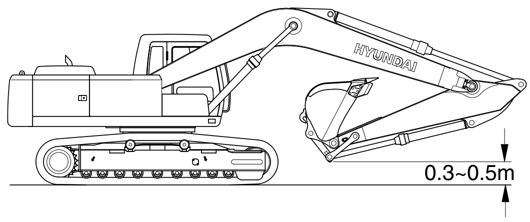
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Provide a flat, solid test yard 20 m in length, with extra length of 3 to 5 m on both ends for machine acceleration and deceleration.

③ Hold the bucket 0.3 to 0.5 m above the ground with the arm and bucket rolled in.

④ Keep the hydraulic oil temperature at 50±5˚C.



(3) Measurement

① Measure the amount of mistracking at high and low travel speeds.

② Before beginning each test, select the following switch positions.

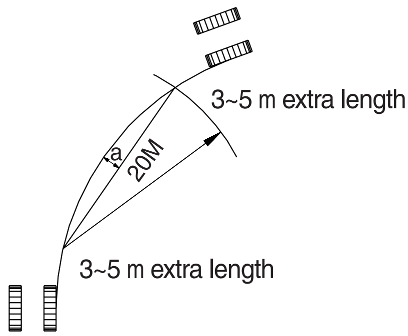
· Power mode switch : M mode

③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.

④ Measure the distance between a straight 20 m line and the track made by the machine. (Dimension a)

⑤ After measuring the tracking in forward travel, turn the upperstructure 180° and measure that in reverse travel.

⑥ Repeat steps ④ and ⑤ three times and calculate the average values.



(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
R130VSPRO	200 below	240	

5) SWING SPEED

(1) Measure the time required to swing three complete turns.

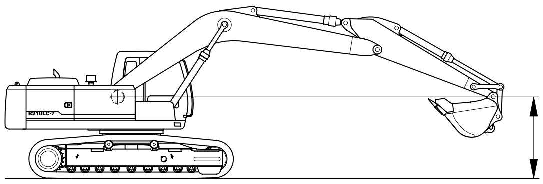
(2) Preparation

① Check the lubrication of the swing gear and swing bearing.

② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.

④ Keep the hydraulic oil temperature at 50±5˚C.



(3) Measurement

① Select the following switch positions.

· Power mode switch : M mode

② Operate swing control lever fully.

③ Swing 1 turn and measure time taken to swing next 3 revolutions.

④ Repeat steps ② and ③ three time and calculate the average values.

(4) Evaluation

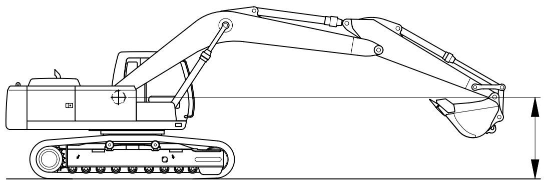
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard
R130VSPRO	M mode	14.9±1.5

6) SWING FUNCTION DRIFT CHECK

(1) Measure the swing drift on the bearing outer circumference when stopping after a 360° full speed swing.

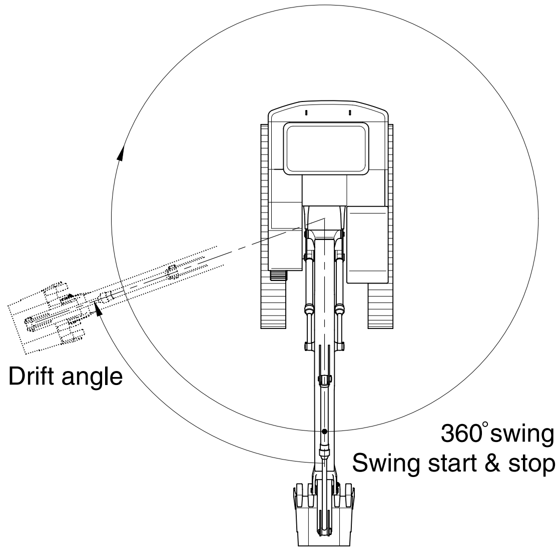


(2) Preparation

① Check the lubrication of the swing gear and swing bearing.
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.
③ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin. The bucket must be empty.
④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.
⑤ Swing the upperstructure 360˚.
⑥ Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Select the following switch positions.
② Power mode switch :M mode
· Operate the swing control lever fully and
③ return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360° Measure the distance between the two marks.
④ Align the marks again, swing 360° , then test the opposite direction.
⑤ Repeat steps ④ and ⑤ three times each and calculate the average values.



(4) Evaluation

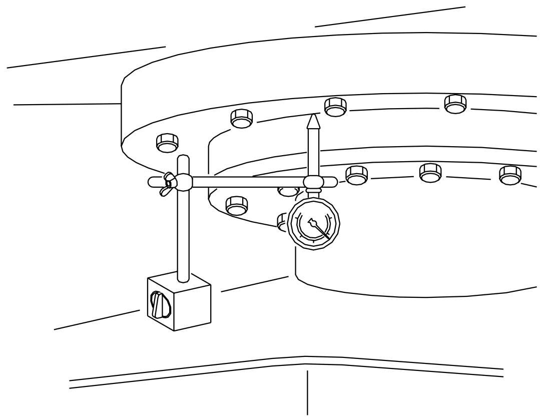
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R130VSPRO	M mode	90 below	126.7	

7) SWING BEARING PLAY

(1) Measure the swing bearing play using a dial gauge to check the wear of bearing races and balls.



(2) Preparation

① Check swing bearing mounting cap screws for loosening.

② Check the lubrication of the swing bearing. Confirm that bearing rotation is smooth and without noise.

③ Install a dial gauge on the track frame as shown, using a magnetic base.

④ Position the upperstructure so that the boom aligns with the tracks facing towards the front idlers.

⑤ Position the dial gauge so that its needle point comes into contact with the bottom face of the bearing outer race.

⑥ Bucket should be empty.

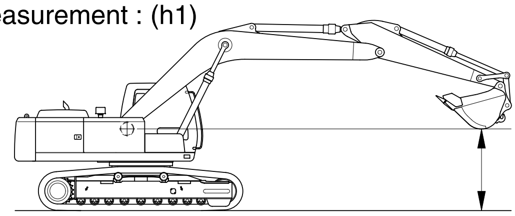
(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin. Record the dial gauge reading (h1).

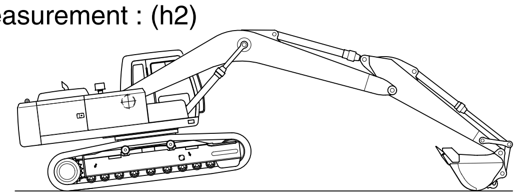
② Lower the bucket to the ground and use it to raise the front idler 50㎝. Record the dial gauge reading (h2).

③ Calculate bearing play (H) from this data (h1 and h2) as follows. H=h2-h1

Measurement : (h1)



Measurement : (h2)



(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R130VSPRO	0.5 ~ 1.5	3.0	

8) HYDRAULIC CYLINDER CYCLE TIME

(1) Measure the cycle time of the boom, standard arm, and standard bucket cylinders.

(2) Preparation

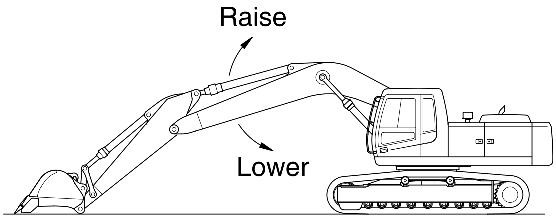
① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5 m above the ground.

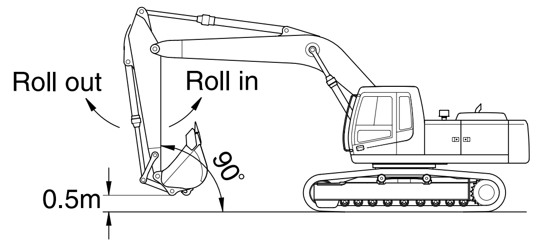
③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

④ Keep the hydraulic oil temperature at 50±5˚C.

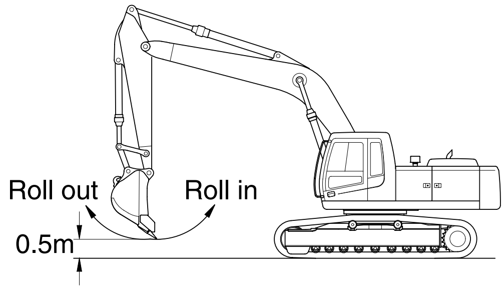
Boom cylinder



Arm cylinder



Bucket cylinder



(3) Measurement

① Select the following switch positions.
· Power mode switch : M modeTo
② measure cylinder cycle times.Boom
- cylinders.
Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.
- Arm cylinder.
Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

- Bucket cylinders
  Measure the time it takes to roll in the bucket, and the time it takes to roll out the bucket. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.
- Repeat each measurement 3 times and calculate the average values.

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Function	Standard	Remarks
R130VSPRO	Boom raise	3.3±0.4	
	Boom lower	2.3±0.4	
	Arm in	2.5±0.4	
	Arm out	2.7±0.3	
	Bucket in	3.4±0.4	
	Bucket out	2.3±0.3	

9) DIG FUNCTION DRIFT CHECK

(1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket. When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

① Load bucket fully. Instead of loading the bucket, weight(W) of the following specification can be used.

· $W = M^3 \times 1.5$

Where :

M^3 = Bucket heaped capacity (m^3)

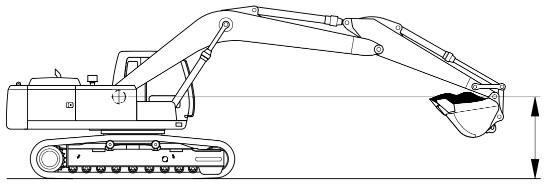
1.5 = Soil specific gravity

② Position the arm cylinder with the rod 20 to 30mm extended from the fully retracted position.

③ Position the bucket cylinder with the rod 20 to 30mm retracted from the fully extended position.

④ With the arm rolled out and bucket rolled in, hold the bucket so that the height of the bucket pin is the same as the boom foot pin.

⑤ Keep the hydraulic oil temperature at 50±5˚C.



(3) Measurement

① Stop the engine.

② Five minutes after the engine has been stopped, measure the changes in the positions of the boom, arm and bucket cylinders.

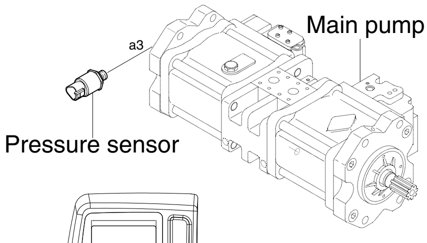
③ Repeat step ② three times and calculate the average values.

(4) The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Remarks
R130VSPRO	Boom cylinder	10 below	
	Arm cylinder	10 below	
	Bucket cylinder	40 below	

10) PILOT PRIMARY PRESSURE



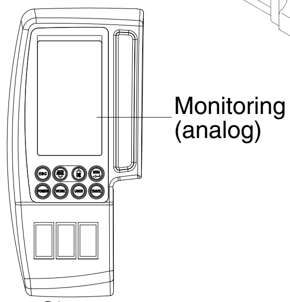
(1) Preparation

① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.
- Power mode switch : M mode
- Auto decel switch : OFF

② Measure the primary pilot pressure by the monitoring menu of the cluster.



Cluster

(3) Evaluation

The average measured pressure should meet the following specifications:

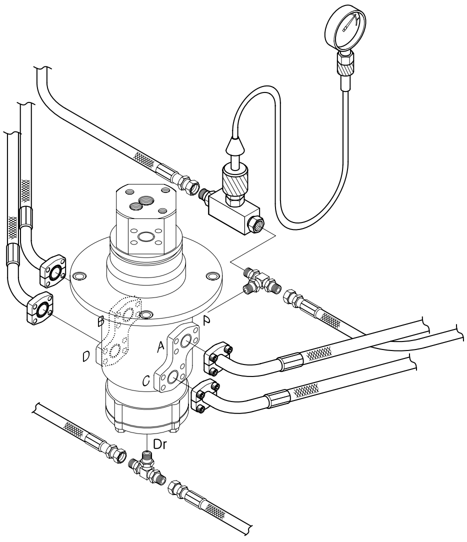
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R130VSPRO	M mode	40^{+2}	-	

11) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ To measure the speed selecting pressure: Install a connector and pressure gauge
④ assembly to turning joint P port as shown. Start the engine and check for on leakage from the adapter.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
· Power mode switch : M
② modeMeasure the travel speed selecting
③ pressure in the Hi or Lo mode.
Lower the bucket to the ground to raise the track off the ground. Operate the travel lever at full stroke and measure the
④ fast speed pressure.
Repeat steps ② and ③ three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

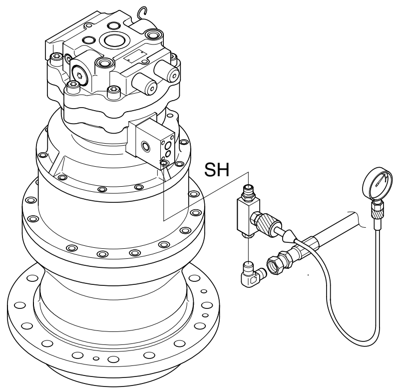
Unit : kgf / cm²

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R130VSPRO	1 Speed	0	-	
	2 Speed	40±2	-	

12) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

① Stop the engine.
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.
③ The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



(2) Measurement

① Select the following switch positions.
· Power mode switch : M mode

② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
Repeat step ② three times and calculate the average values.

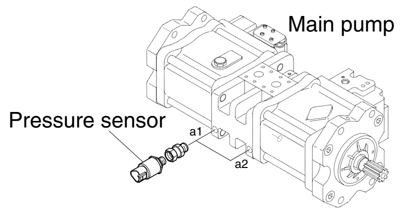
(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Description	Standard	Remarks
R130VSPRO	Cracking	24	

13) MAIN PUMP DELIVERY PRESSURE

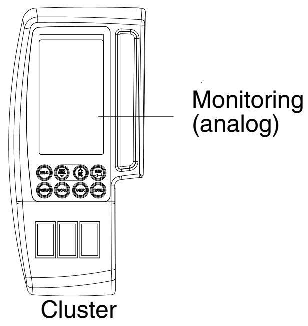


(1) Preparation

① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Select the following switch positions.
· Power mode switch : M mode
② Measure the main pump delivery pressure in the M mode (high idle).



(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R130VSPRO	High idle	40+2	-	

14) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

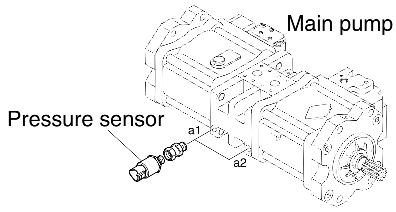
① Select the following switch positions.

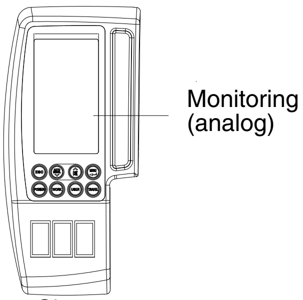
· Power mode switch : M mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.





Cluster

(3) Evaluation

The average measured pressure should be within the following specifications.

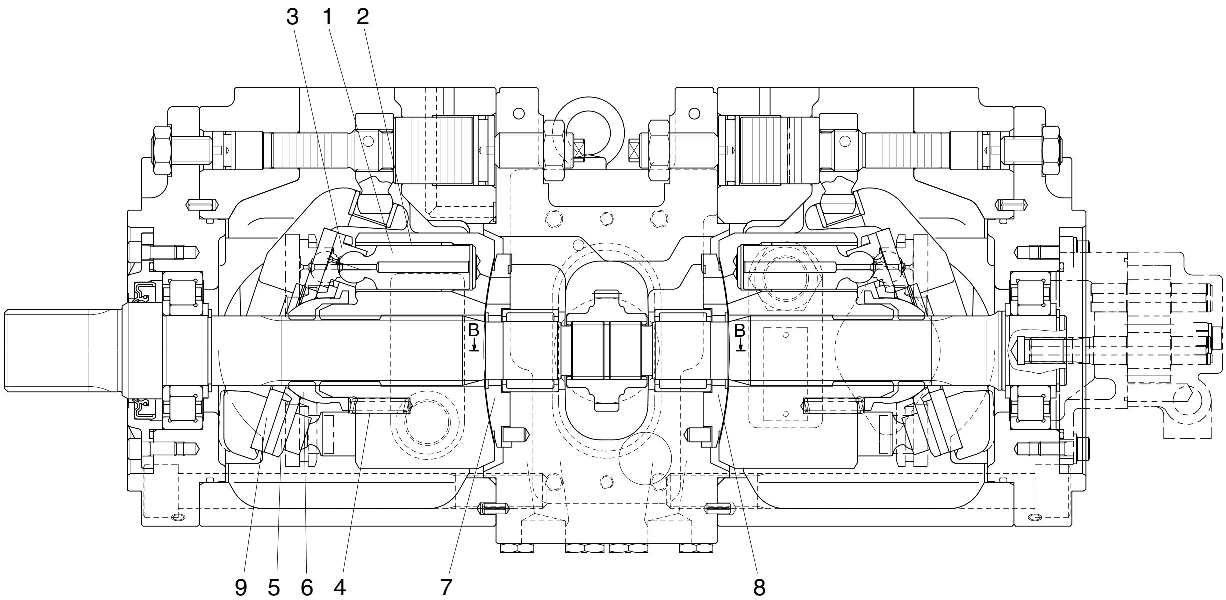
Unit : kgf / cm^2

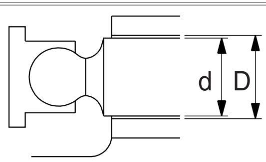
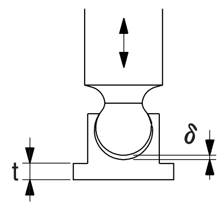
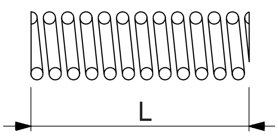
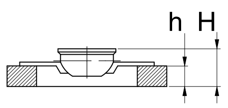
Model	Function to be tested	Standard
R130VSPRO	Boom, Arm, Bucket	350 (380)±10
	Travel	350±10
	Swing	280±10

( ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.032	0.056	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3) (δ)		0-0.1	0.3	Replace assembly of piston & shoe.
Thickness of shoe (t)		3.9	3.7	
Free height of cylinder spring (4) (L)		41.1	40.3	Replace cylinder spring.
Combined height of set plate (5) & spherical bushing (6) (H-h)		17.0	15.8	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder (2) (sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (corrected value)	0.4z or lower		

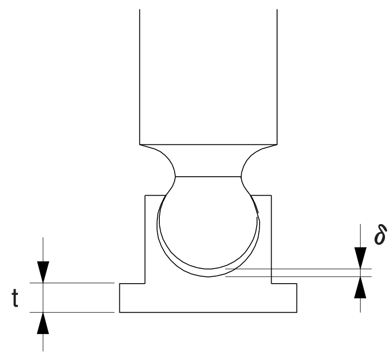
2. MAIN CONTROL VALVE

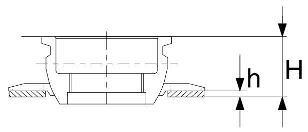
Part name	Inspection item	Criteria & measure
Casing	· Existence of scratches, rust or corrosion.	· In case of damage in following section, replace casing. - Sliding sections of casing hole and spool, especially land sections applied with held pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing section of each relief valve for main and port. - Sealing section of plug. - Other damages that may damage normal function.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool into casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of spring · Damage of poppet · Insert poppet into casing and function it.	· Replacement. · Correction or replacement when sealing is incomplete. · Normal when it can function lightly and smoothly without sticking.
Spring and related parts	· Rusting, corrosion, deformation or breakage of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & posi-nega conversion valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · O-rings and back up rings.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement in principle.

3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	6.5	6.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	4.0	3.6	Replace





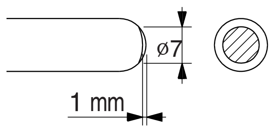
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z (Ra=0.2) (LAPPING)	3-Z (Ra=0.8)	
Shoe plate	0.4-Z (Ra=0.1) (LAPPING)	3-Z (Ra=0.8)	
Cylinder	1.6-Z (Ra=0.4) (LAPPING)	12.5-Z (Ra=3.2)	
Valve plate	0.8-Z (Ra=0.2) (LAPPING)	6.3-Z (Ra=1.6)	

4. TRAVEL MOTOR

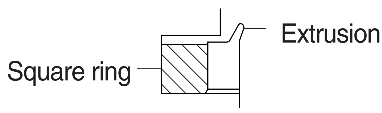
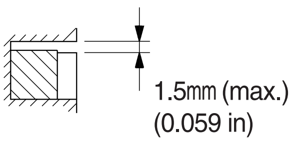
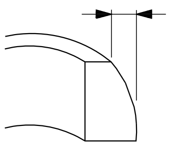
Problem		Cause	Remedy
Does not start	Pressure is not developed	· Pump failure · Control valve malfunction	· Check if action other than traveling is available. If faulty, repair. · Check if spool moves correctly. Repair if necessary.
	Pressure in developed	· Brake valve failure -Sleeve stick -Check valve stick · Motor failure -Valve seat seizure · Gear broken and fragment locked · Overloaded	· Replace brake valve · Replace -Check hydraulic oil for contamination · Replace reduction gear · Reduce load
Oil leakage	Leakage from engaging surfaces	· Scratch on engaging surfaces · Loosening by poor bolt tightening	· Correct surfaces by oilstone or sandpaper or replace · Check after retightening
	Leakage from casing	· Plug loosened · Crack formed by stone	· Retighten · Replace reduction gear
	Leakage from floating seal	· Sliding surfaces worn · Creep on O-ring	· Replace reduction gear · Replace floating seal
	Leakage from hydraulic motor	· Bolt loosened · O-ring damaged · Sealing surface scratched	· Tighten properly · Replace O-ring · Correct by oilstone or sandpaper
Coasts on slope excessively		· Poor volumetric efficiency of hydraulic motor · Increase of internal leakage of brake valve · Parking brake not actuated -Spring breakage -Wear of friction plate	· Replace hydraulic motor · Replace brake valve · Replace spring · Replace parking brake
Excessive temperature on reduction gear case		· Pitting on bearing · Lack of gear oil · Hydraulic oil introduced to gear case	· Replace reduction gear · Supply gear oil properly · Check motor and replace oil seal
Meanders	Meanders at low pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair pump · Replace motor
	Meanders at high pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair regulator or pump · Replace motor
	Meanders at high pressure	· Relief pressure dropped at right and left brake valve · Main relief pressure dropped at right or left of control valve	· Replace brake valve · Replace main relief valve
Pump delivery is poor		· Regulator operation poor · External leakage of pump is excessive	· Repair regulator · Repair pump
External leakage of motor is excessive		-	· Replace motor

5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions : Primary pressure : 40 kgf/cm^2 Oil viscosity : 23 cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. TURNING JOINT

Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring. 	Replace
	-	· Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring. 	Replace
	-	· Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in) 	Replace

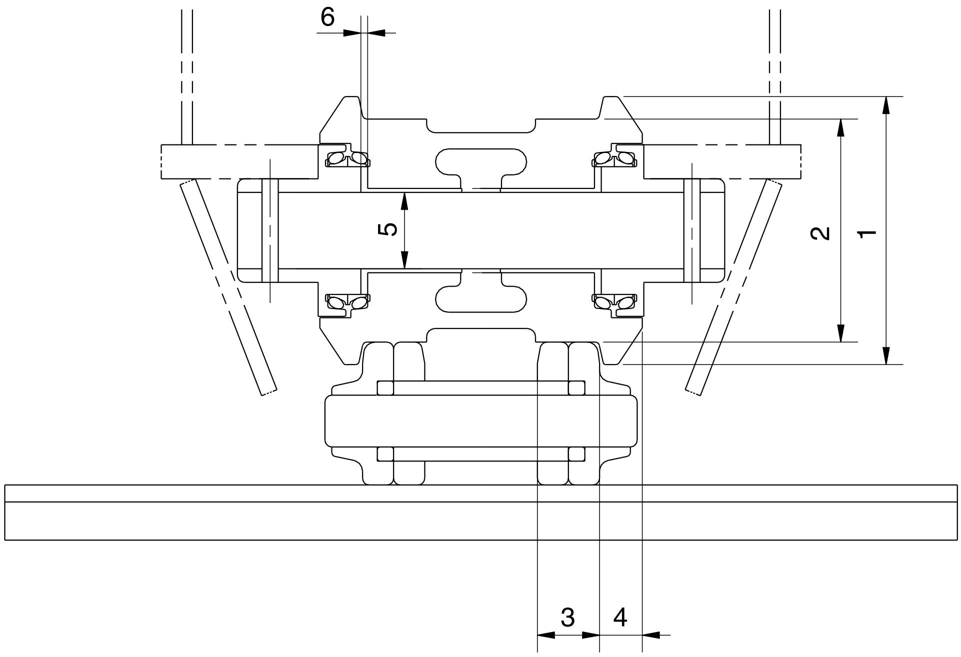
7. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal. · Rust is not present on plating. · Scratches are not present.	· Replace or replate · Replace or replate · Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
	· Bushing at mounting part	· Wear of I.D.	· Replace
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

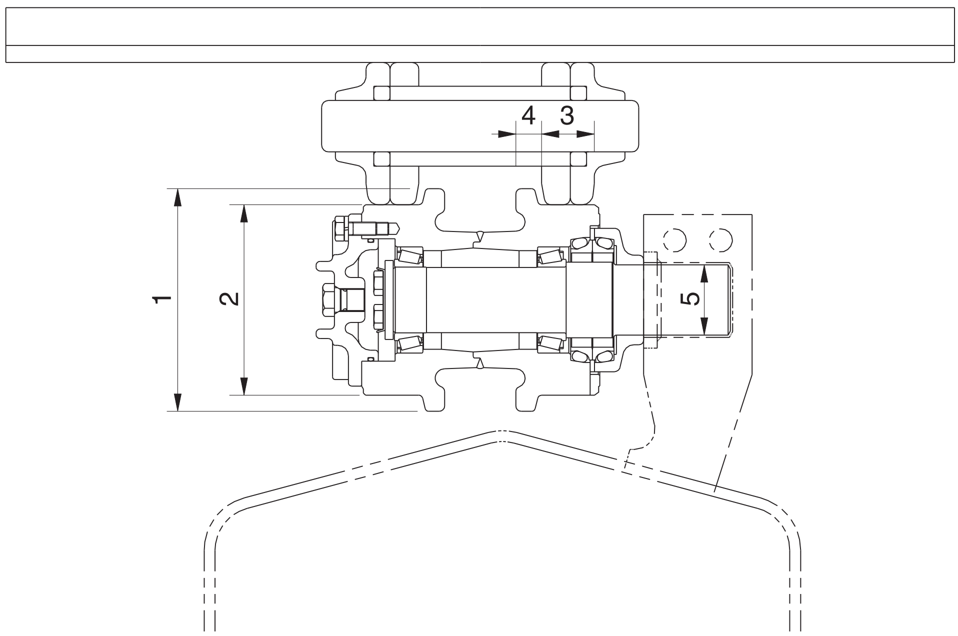
1) TRACK ROLLER



Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø190		–		
2	Outside diameter of tread	Ø150		Ø131		
3	Width of tread	38		45.5		
4	Width of flange	25		-		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø65 $^{0}_{-0.03}$	Ø65 $^{+0.37}_{+0.32}$	0.32 ~ 0.4	2.0	
6	Side clearance of roller (both side)	Standard clearance		Clearance limit		Replace
		0.23 ~ 1.32		2.0		

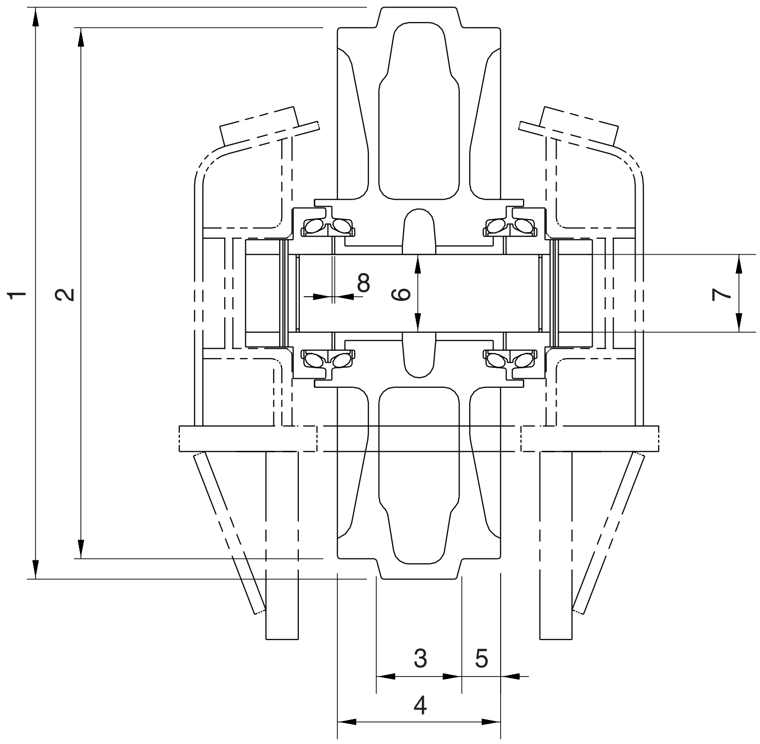
2) CARRIER ROLLER



Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="4">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="4">Ø175</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="4">Ø151</td><td colspan="2">Ø141</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="4">37.25</td><td colspan="2">42.25</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="4">18.25</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bracket</td><td colspan="4">Standard size & Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Dimension</td><td>Tolerance</td><td>Dimension</td><td>Tolerance</td></tr>
<tr><td>Ø41.27</td><td>0
-0.05</td><td>Ø41.5</td><td>+0.2
- 0.1</td><td>0.13~0.48</td><td>1.2</td></tr>
</table>

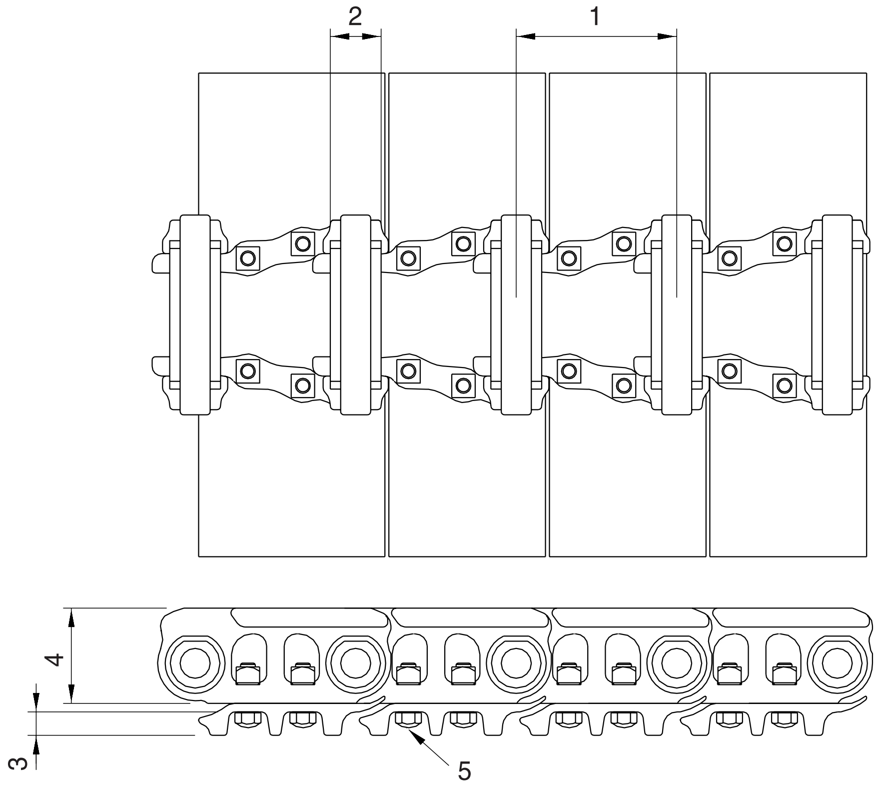
3) IDLER



Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="4">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="4">Ø552</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="4">Ø507</td><td colspan="2">Ø497</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="4">67</td><td colspan="2">-</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="4">135</td><td colspan="2">-</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="4">34</td><td colspan="2">39</td></tr>
<tr><td rowspan="3">6</td><td rowspan="3">Clearance between shaft and bushing</td><td colspan="4">Standard size & Tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Dimension</td><td>Tolerance</td><td>Dimension</td><td>Tolerance</td></tr>
<tr><td>Ø70</td><td>0
-0.03</td><td>Ø70.3</td><td>+0.35
+0.3</td><td>0.3 to 0.38</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>Ø70</td><td>0
-0.03</td><td>Ø70</td><td>+0.106
+0.06</td><td>0.03 to 0.1</td><td>1.2</td><td>Replace</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Side clearance of idler (both side)</td><td colspan="4">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace bushing</td></tr>
<tr><td colspan="4">0.31~1.29</td><td colspan="2">2.0</td></tr>
</table>

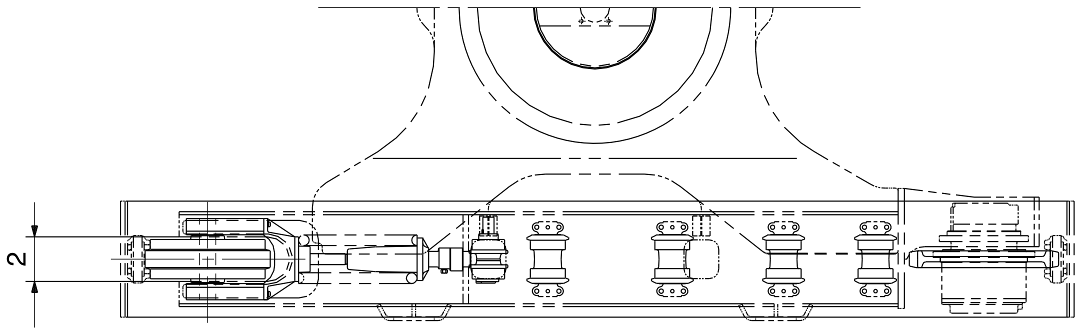
4) TRACK CHAIN

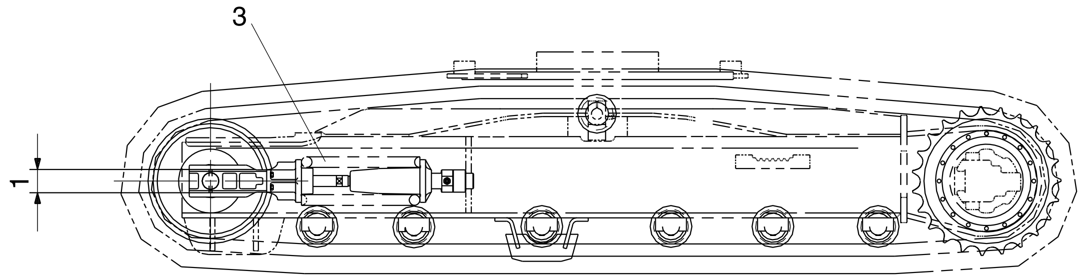


Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		171.45	175.65	
2	Outside diameter of bushing	Ø53.75	Ø43.95	Rebuild or replace
3	Height of grouser	25	16	
4	Height of link	94.5	86.5	
5	Tightening torque (Tightening angle method)	Initial tightening torque : 42±4 kgf · m Additional tightening angle : 32°		Retighten

5) TRACK FRAME AND RECOIL SPRING

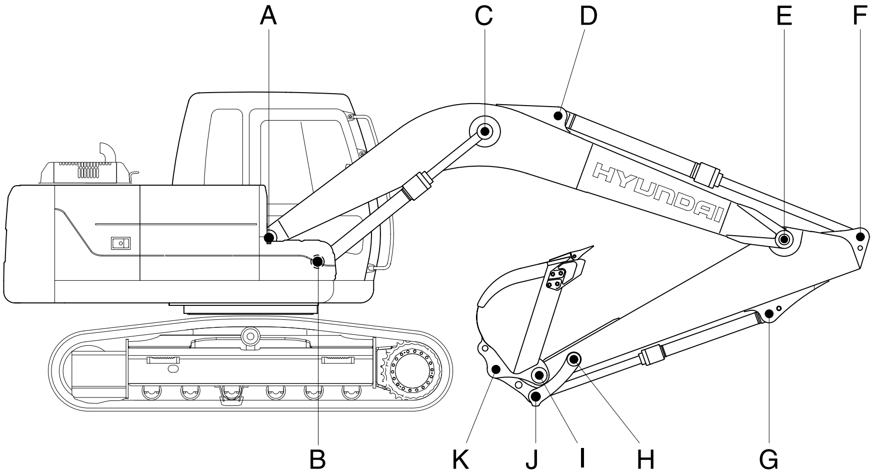




Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="6">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td></td><td>Standard size</td><td colspan="2">Tolerance</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td>103</td><td colspan="2">+2
0</td><td colspan="2">107</td></tr>
<tr><td>Idler support</td><td>100</td><td colspan="2">+0.3
- 0.3</td><td colspan="2">98</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td>192</td><td colspan="2">+2
0</td><td colspan="2">196</td></tr>
<tr><td>Idler support</td><td>190</td><td colspan="2">-</td><td colspan="2">188</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="3">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installation length</td><td>Installation load</td><td colspan="2">Free length</td><td>Installation load</td></tr>
<tr><td>470</td><td>405</td><td>8,497kg</td><td colspan="2">–</td><td>6,978kg</td></tr>
</table>

2. WORK EQUIPMENT



Unit : ㎜

Mark	Measuring point (Pin and Bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom Rear	90	89	88.5	90.5	91	Replace
B	Boom Cylinder Head	80	79	78.5	80.5	81	〃
C	Boom Cylinder Rod	80	79	78.5	80.5	81	〃
D	Arm Cylinder Head	80	79	78.5	80.5	81	〃
E	Boom Front	90	89	88.5	90.5	91	〃
F	Arm Cylinder Rod	80	79	78.5	80.5	81	〃
G	Bucket Cylinder Head	80	79	78.5	80.5	81	〃
H	Arm Link	79	69	68.5	70.5	71	〃
I	Bucket and Arm Link	80	79	78.5	80.5	81	〃
J	Bucket Cylinder Rod	80	79	78.5	80.5	81	〃
K	Bucket Link	80	79	78.5	80.5	81	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

1) Lower the work equipment completely to the ground.
   If the coolant contains antifreeze, dispose of it correctly.

2) After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.

3) When draining oil, prepare a container of adequate size to catch the oil.

4) Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.

5) To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.

6) Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.

7) Check the number and thickness of the shims, and keep in a safe place.

8) When raising components, be sure to use lifting equipment of ample strength.

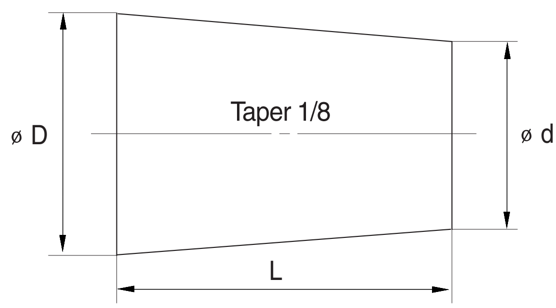
9) When using forcing screws to remove any components, tighten the forcing screws alternately.

10) Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

11) When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.

12) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Dimensions		
	D	d	L
06	6	5	8
08	8	6.5	11
10	10	8.5	12
12	12	10	15
14	14	11.5	18
16	16	13.5	20
18	18	15	22
20	20	17	25
22	22	18.5	28
24	24	20	30
27	27	22.5	34



2. INSTALL WORK

1) Tighten all bolts and nuts (sleeve nuts) to the specified torque.

2) Install the hoses without twisting or interference.

3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.

4) Bend the cotter pin or lock plate securely.

5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.

6) 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.

7) Clean all parts, and correct any damage, dents, burrs, or rust.

8) Coat rotating parts and sliding parts with engine oil.

9) When press fitting parts, coat the surface with antifriction compound (LM-P).

10) After installing snap rings, check that the snap ring is fitted securely in the ring groove (Check that the snap ring moves in the direction of rotation).

11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.

12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.

13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:

(1) Start the engine and run at low idling.

(2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100mm before the end of the stroke.

(3) Next, operate the piston rod to the end of its stroke to relieve the circuit. (The air bleed valve is actuated to bleed the air.)

(4) After completing this operation, raise the engine speed to the normal operating condition.

※ If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.

※ Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

1) 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.

2) 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.

3) 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.

4) Add the specified amount of grease (molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket, FR)	M12 × 1.75	11.5 ± 1.0	81.2 ± 7.2
2		Engine mounting bolt (engine-bracket, RR)	M12 × 1.75	11.5 ± 1.0	81.2 ± 7.2
3		Engine mounting bolt (bracket-frame, FR)	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
4		Engine mounting bolt (bracket-frame, RR)	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
5		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
6		Coupling mounting socket bolt	M16 × 2.0	32.0 ± 1.6	231 ± 11.6
7		Fuel tank mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
8	Hydraulic system	Main pump housing mounting bolt	M10 × 1.5	6.5 ± 0.7	47.0 ± 5.1
9		Main pump mounting socket bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
10		Main control valve mounting bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
11		Hydraulic oil tank mounting bolt	M20 × 2.5	57.8 ± 5.8	418 ± 42.0
12		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	89.0 ± 9.4
13	Power train system	Swing motor mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1
14		Swing bearing upper part mounting bolt	M18 × 2.5	41.3 ± 4.0	299 ± 28.9
15		Swing bearing lower part mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
16		Travel motor mounting bolt	M16 × 2.0	23.0 ± 2.5	166 ± 18.1
17		Sprocket mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18	Under carriage	Upper roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
19		Lower roller mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
20		Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
21		Track shoe mounting bolt, nut	M16 × 1.5	25.5 ± 2.5	184 ± 18.1
22		Track guard mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1
23	Others	Counterweight mounting bolt	M36 × 3.0	308 ± 46	1228 ± 333
24		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
25		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8
26		Under cover mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21

※ For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.73 ~ 4.12	19.7 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.5	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.17 ~ 3.37	15.7 ~ 24.3	3.04 ~ 4.44	22.0 ~ 32.0
M10 × 1.25	4.46 ~ 6.66	32.3 ~ 48.2	5.93 ~ 8.93	42.9 ~ 64.6
M12 × 1.25	7.78 ~ 11.58	76.3 ~ 83.7	10.6 ~ 16.0	76.6 ~ 115
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 130	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 194	26.6 ~ 36.0	193 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 390	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 515	70.7 ~ 95.7	512 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 664	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1338	182 ~ 248	1314 ~ 1795
M36 × 3.0	192 ~ 260	1389 ~ 1879	262 ~ 354	1893 ~ 2561

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

(4) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 120 ℓ (31.7 U.S. gal)

(5) Remove socket bolts (11) and disconnect hoses (1, 2).

(6) Disconnect pilot line hoses (5, 6, 7, 8, 9, 10).

(7) Remove socket bolts (12) and disconnect pump suction pipe (4).

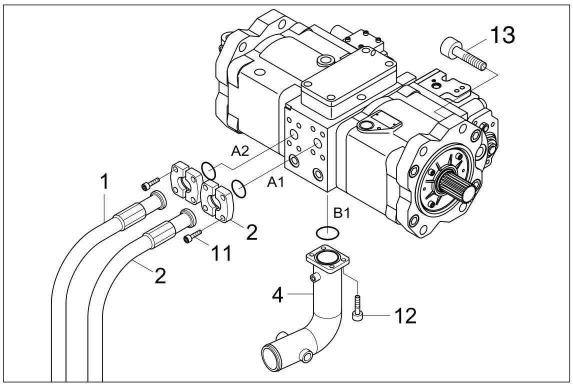
※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

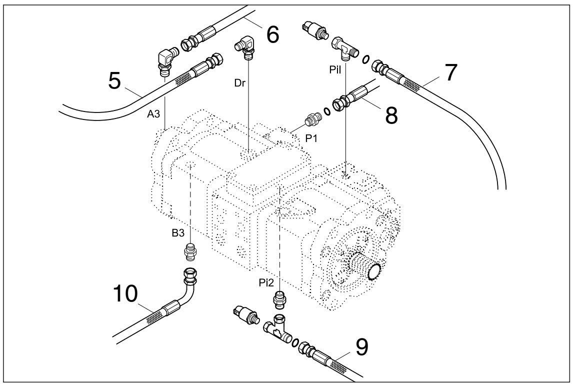
(8) Sling the pump assembly and remove the pump mounting bolts (13).

· Weight : 92 kg (203 lb)

· Tightening torque : 29.7±4.5 kgf · m (215±32.5 lbf · ft)

※ Pull out the pump assembly from housing.
When removing the pump assembly, check that all the hoses have been disconnected.





2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

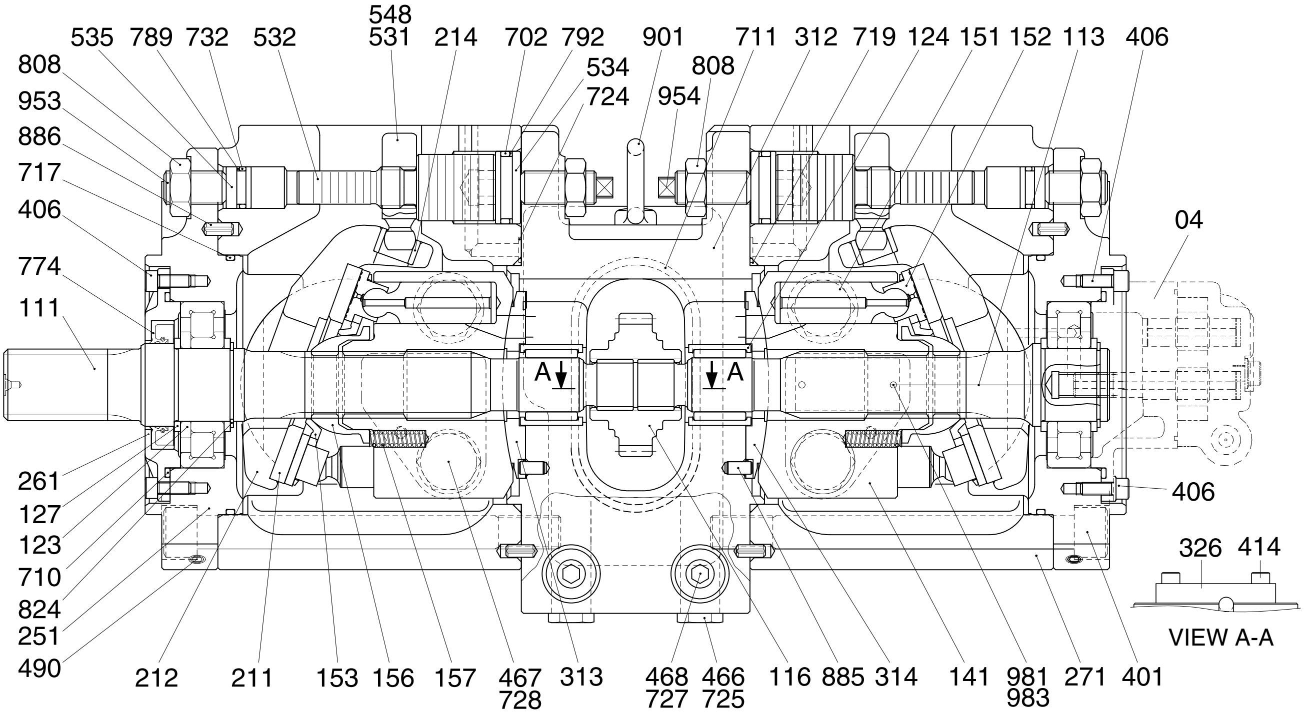
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

(8) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. MAIN PUMP (1/2)

1) STRUCTURE

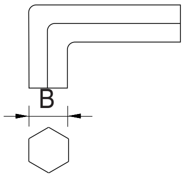


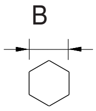
04	Gear pump	312	Valve block	717	O-ring
111	Drive shaft (F)	313	Valve plate (R)	719	O-ring
113	Drive shaft (R)	314	Valve plate (L)	724	Square ring
116	1st Gear	326	Cover	725	O-ring
123	Roller bearing	401	Hexagon socket bolt	727	O-ring
124	Needle bearing	406	Hexagon socket bolt	728	O-ring
127	Bearing spacer	414	Hexagon socket bolt	732	O-ring
141	Cylinder block	466	Plug	774	Oil seal
151	Piston	467	Plug	789	Back up ring
152	Shoe	468	Plug	792	Back up ring
153	Set plate	490	Plug	808	Hexagon head nut
156	Bushing	531	Tilting pin	824	Snap ring
157	Cylinder spring	532	Servo piston	885	Pin
211	Shoe plate	534	Stopper (L)	886	Spring pin
212	Swash plate	535	Stopper (S)	901	Eye bolt
214	Tilting bushing	548	Feed back pin	953	Set screw
251	Support	702	O-ring	954	Set screw
261	Seal cover (F)	710	O-ring	981	Name plate
271	Pump casing	711	O-ring	983	Pin

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="4">Part name</th></tr>
<tr><th>Name</th><th>B</th><th>Hexagon socket head bolt</th><th>PT plug (PT thread)</th><th>PO plug (PF thread)</th><th>Hexagon socket head setscrew</th></tr>
<tr><td rowspan="5">Allen wrench
</td><td>4</td><td>M 5</td><td>BP-1/16</td><td>-</td><td>M 8</td></tr>
<tr><td>5</td><td>M 6</td><td>BP-1/8</td><td>-</td><td>M10</td></tr>
<tr><td>6</td><td>M 8</td><td>BP-1/4</td><td>PO-1/4</td><td>M12, M14</td></tr>
<tr><td>8</td><td>M10</td><td>BP-3/8</td><td>PO-3/8</td><td>M16, M18</td></tr>
<tr><td>17</td><td>M20, M22</td><td>BP-1</td><td>PO-1, 1 1/4, 1 1/2</td><td>-</td></tr>
</table>

<table>
<tr><td rowspan="6">Double ring spanner, socket wrench, double (single) open end spanner
</td><td>-</td><td>Hexagon bolt</td><td>Hexagon nut</td><td>VP plug (PF thread)</td></tr>
<tr><td>19</td><td>M12</td><td>M12</td><td>VP-1/4</td></tr>
<tr><td>24</td><td>M16</td><td>M16</td><td>-</td></tr>
<tr><td>27</td><td>M18</td><td>M18</td><td>VP-1/2</td></tr>
<tr><td>30</td><td>M20</td><td>M20</td><td>-</td></tr>
<tr><td>36</td><td>-</td><td>-</td><td>VP-3/4</td></tr>
</table>

Adjustable angle wrench	Medium size, 1 set
Screw driver	Minus type screw driver, Medium size, 2 sets
Hammer	Plastic hammer, 1 set
Pliers	For snap ring, TSR-160
Steel bar	Steel bar of key material approx. 10×8×200
Torque wrench	Capable of tightening with the specified torques

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

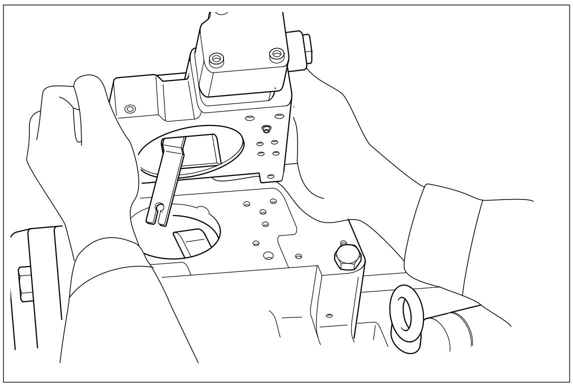
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug (468) and let oil out of pump casing (front and rear pump).

(4) Remove hexagon socket head bolts (412, 413) and remove regulator.

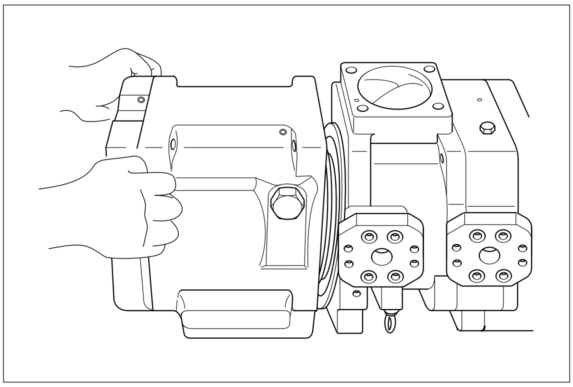


(5) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve block (312).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

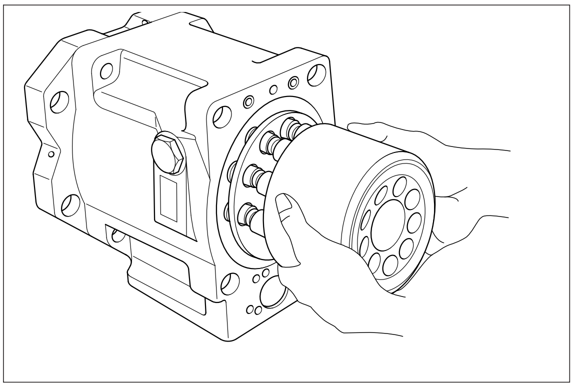
(6) Place pump horizontally on workbench with its regulator-fitting surface down and separate pump casing (271) from valve block (312).

※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



(7) Pull cylinder block (141) out of pump casing (271) straightly over drive shaft (111). Pull out also pistons (151), set plate (153), spherical bush (156) and cylinder springs (157) simultaneously.

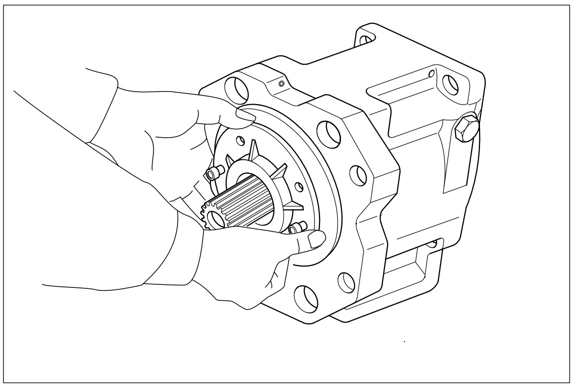
※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.



(8) Remove hexagon socket head bolts (406) and then seal cover (F, 261).

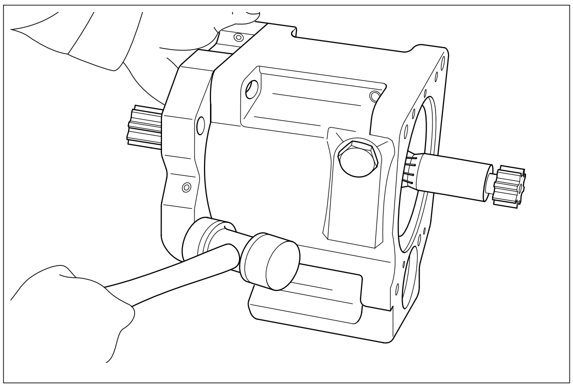
※ Fit bolt into pulling out tapped hole of seal cover (F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.

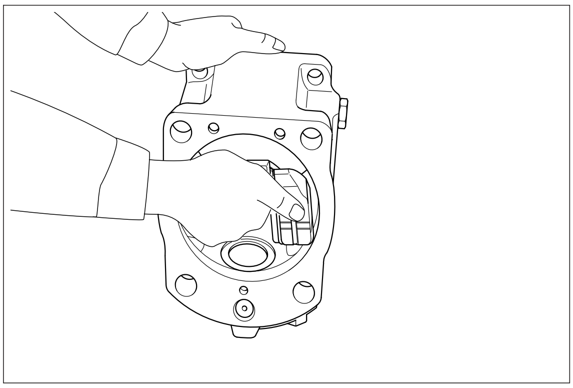


(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
In case fitting a gear pump, first, remove gear pump.

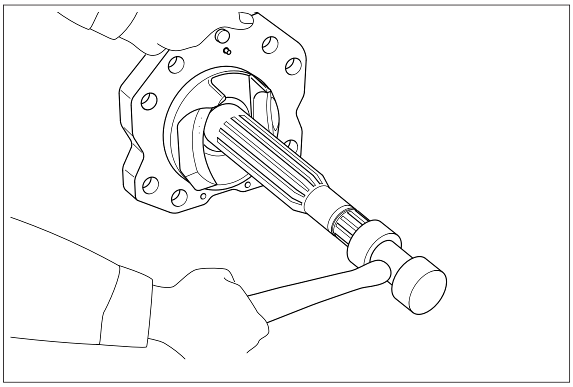
(10) Tapping lightly fitting flange section of swash plate support (251) on its pump casing side, separate swash plate support from pump casing.



(11) Remove shoe plate (211)and swash plate (212) from pump casing (271).

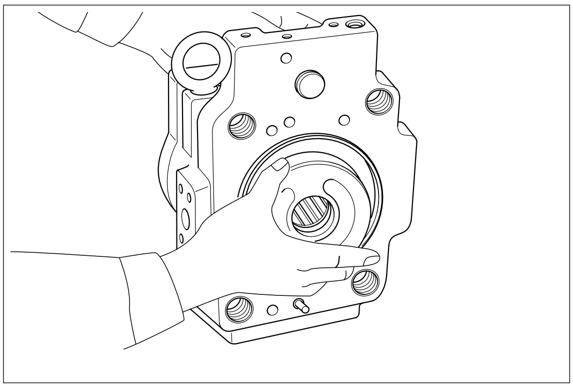


(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(13) Remove valve plates (313, 314) from valve block (312).

※ These may be removed in work (6).



(14) If necessary, remove stopper (L, 534), stopper (S, 535), servo piston (532) and tilting pin (531) from pump casing (271), and needle bearing (124) and splined coupling (114) from valve block (312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve block and swash plate support.
If loosened, flow setting will be changed.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

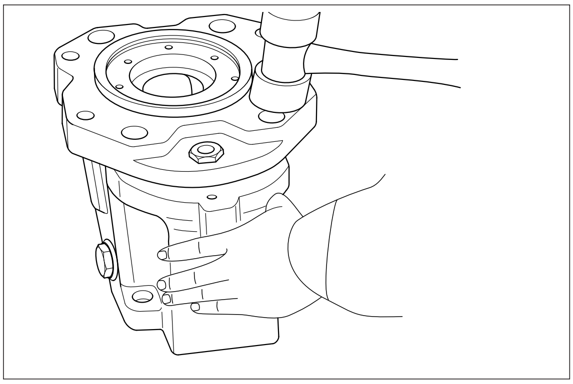
③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

⑤ For fitting bolts, plug, etc, prepare a torque wrench or so on, and tighten them with torques shown in page 8-10, 11.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

(2) Fit swash plate support (251) to pump casing (271), tapping the former lightly with a hammer.



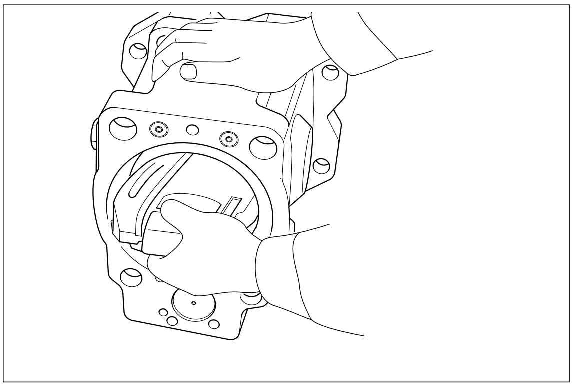
※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite (Medium strength) to their threaded sections.

(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.

※ Confirm with fingers of both hands that swash plate can be removed smoothly.

※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.

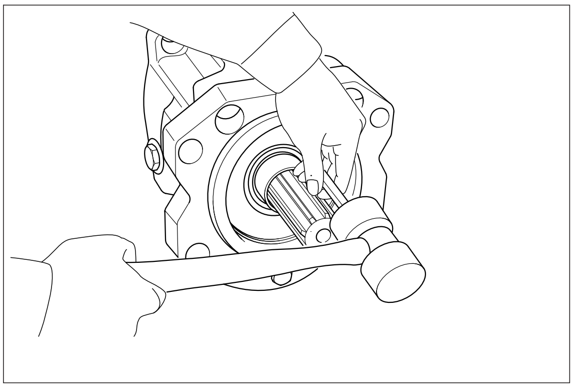


(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).

※ Do not tap drive shaft with hammer or so on.

※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.

Fit them fully, using steel bar or so on.

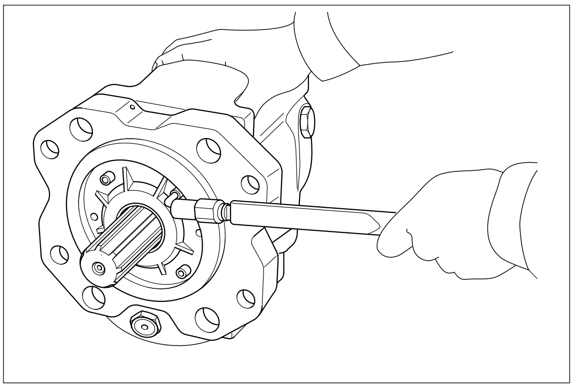


(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).

※ Apply grease lightly to oil seal in seal cover (F).

※ Assemble oil seal, taking full care not to damage it.

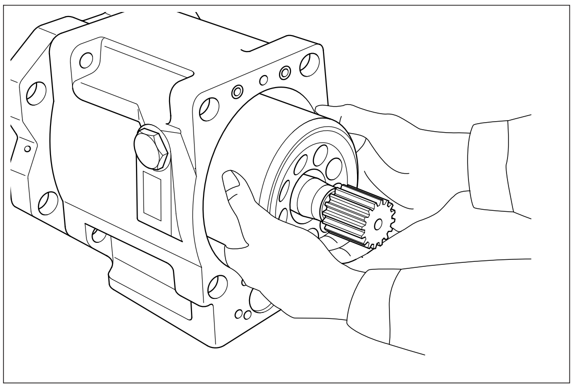
※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.



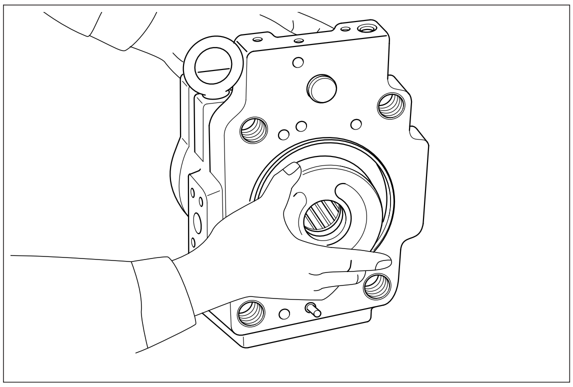
(6) Assemble piston cylinder subassembly 〔cylinder block (141), piston subassembly (151, 152), set plate (153), spherical bush (156), spacer (158) and cylinder spring (157)〕.

Fit spline phases of retainer and cylinder.

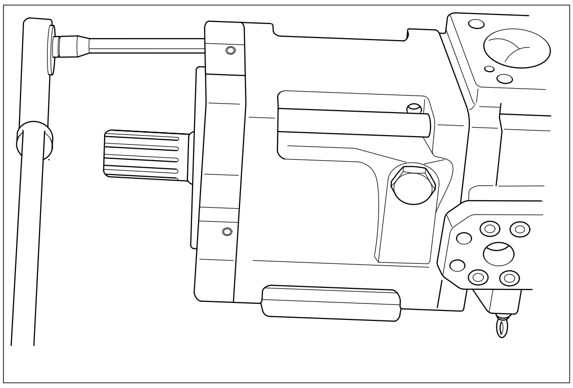
Then, insert piston cylinder subassembly into pump casing.



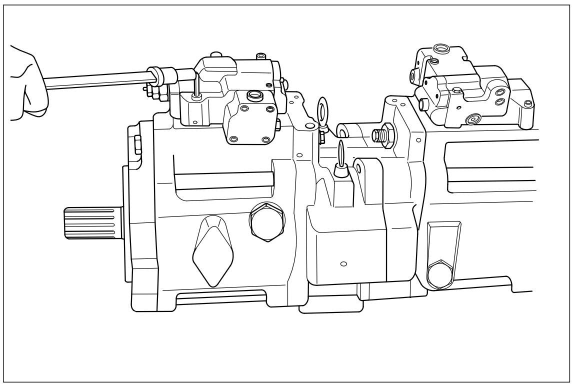
(7) Fit valve plate (313) to valve block (312), entering pin into pin hole.
※ Take care not to mistake suction / delivery directions of valve plate.



(8) Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).
※ At first assemble this at rear pump side, and this work will be easy.
※ Take care not to mistake direction of valve block.
※ Clockwise rotation (Viewed from input shaft side) - Fit block with regulator up and with delivery flange left, viewed from front side.
※ Counter clockwise rotation (Viewed from input shaft side) - Fit block with delivery flange right, viewed from front side.



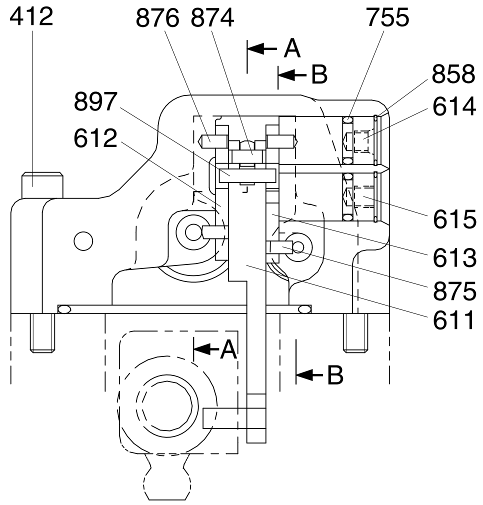
(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).
※ Take care not to mistake regulator of front pump for that of rear pump.

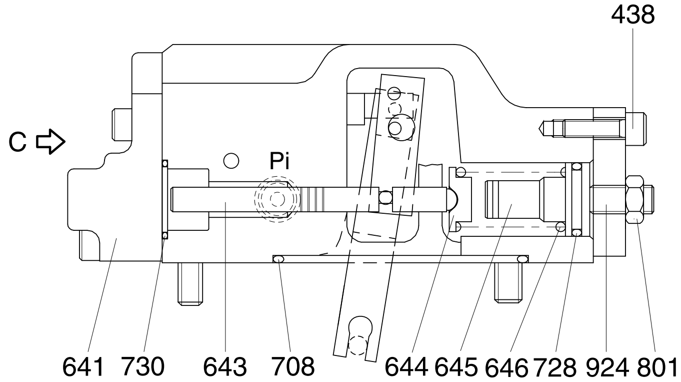


(10) Fit drain port plug (468).
This is the end of reassembling procedures.

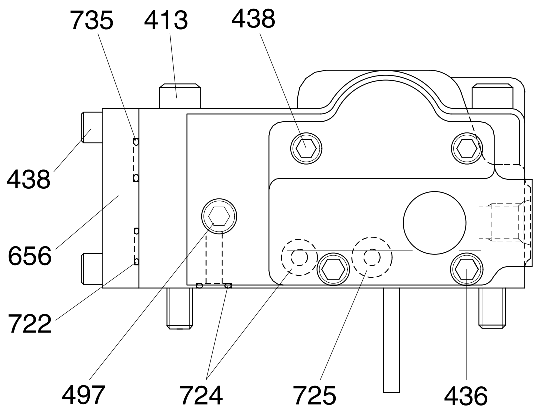
3. REGULATOR

1) STRUCTURE (1/2)

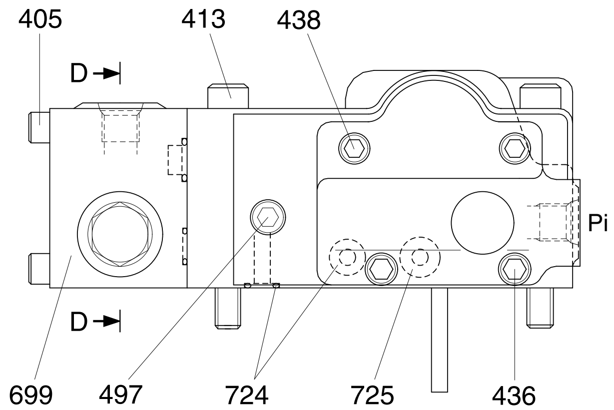




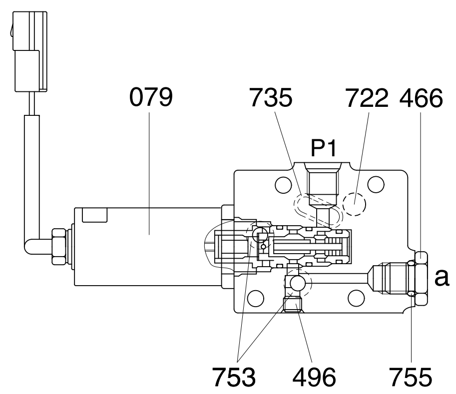
SECTION B-B



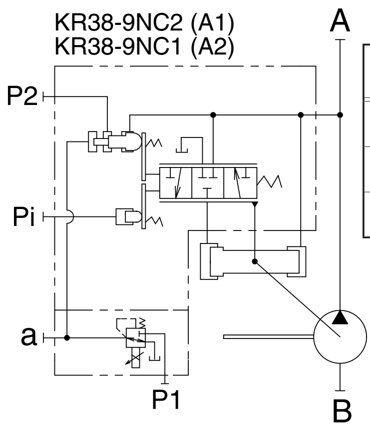
VIEW C (FRONT)



VIEW C (REAR)

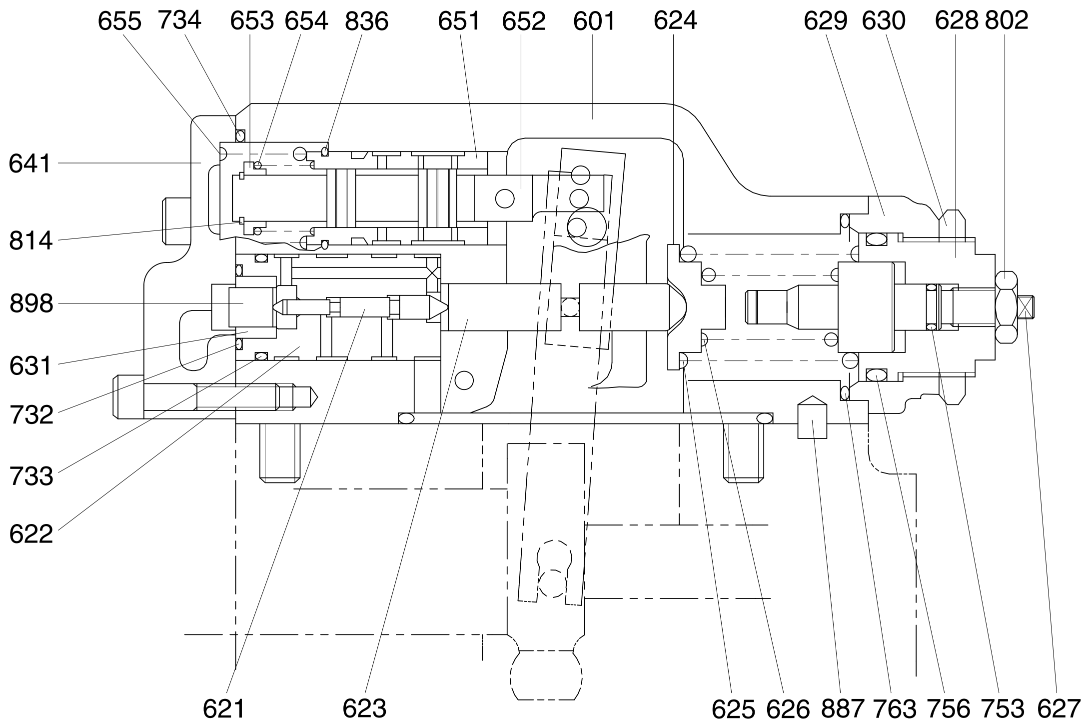


SECTION D-D(REAR)



Port	Port name	Port size
A	Delivery port	SAE 6000 psi 3/4"
B	Suction port	SAE 2500 psi 2 1/2"
Pi	Pilot port	PF 1/4-15

REGULATOR (2/2)



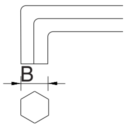
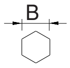
SECTION A-A

079	EPPR valve assembly	628	Adjust screw (C)	730	O-ring
405	Hexagon socket screw	629	Cover (C)	732	O-ring
412	Hexagon socket screw	630	Lock nut	733	O-ring
413	Hexagon socket screw	631	Sleeve, Pf	734	O-ring
436	Hexagon socket screw	641	Pilot cover	735	O-ring
438	Hexagon socket screw	643	Pilot piston	753	O-ring
466	Plug	644	Spring seat (Q)	755	O-ring
497	Plug	645	Adjust stem (Q)	756	O-ring
601	Casing	646	Pilot spring	763	O-ring
611	Feed back lever	651	Sleeve	801	Lock nut
612	Lever (1)	652	Spool	802	Lock nut
613	Lever (2)	653	Spring seat	814	Snap ring
614	Center plug	654	Return spring	836	Snap ring
615	Adjust plug	655	Set spring	858	Snap ring
621	Compensator piston	656	Block cover	874	Pin
622	Piston case	699	Valve casing	875	Pin
623	Compensator rod	708	O-ring	876	Pin
624	Spring seat (C)	722	O-ring	887	Pin
625	Outer spring	724	O-ring	897	Pin
626	Inner spring	725	O-ring	898	Pin
627	Adjust stem (C)	728	O-ring	924	Set screw

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

Tool name & size		Part name			
Name	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	4	M5	BP-1/16	-	M 8
	5	M6	BP-1/8	-	M10
	6	M8	BP-1/4	PO-1/4	M12, M14
Double ring spanner, socket wrench, double (single) open end spanner 	-	Hexagon head bolt	Hexagon nut	VP plug (PF thread)	
	6	M 8	M 8	-	
Adjustable angle wrench		Small size, Max 36 mm			
Screw driver		Minus type screw driver, Medium size, 2 sets			
Hammer		Plastic hammer, 1 set			
Pliers		For snap ring, TSR-160			
Steel bar		4×100 mm			
Torque wrench		Capable of tightening with the specified torques			
Pincers		-			
Bolt		M4, Length : 50 mm			

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

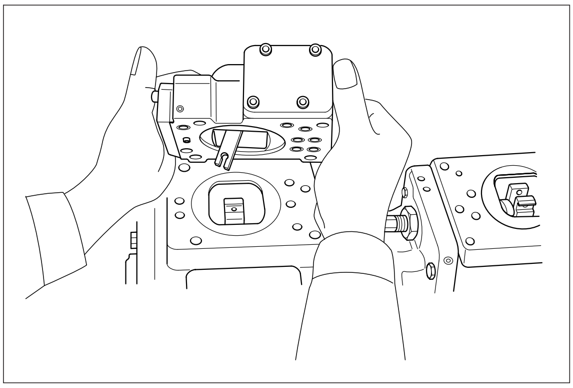
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.

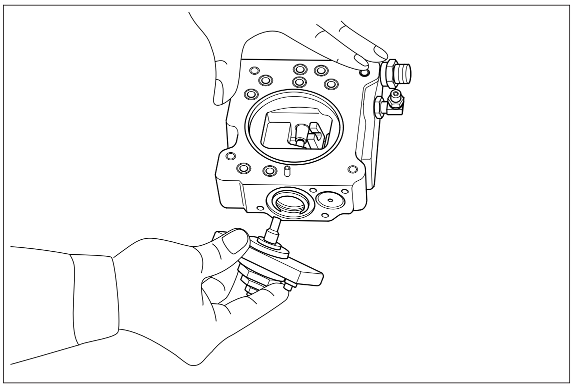


(4) Remove hexagon socket head screw (438) and remove cover (C,629)

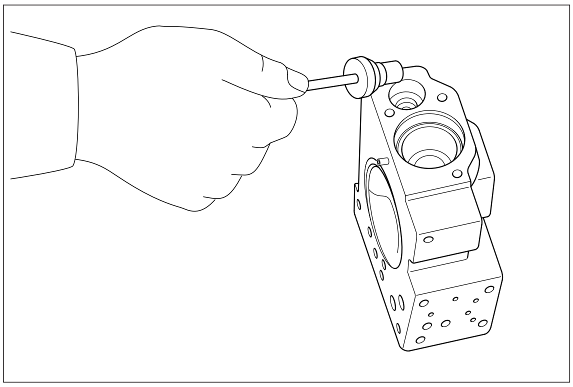
※ Cover (C) is fitted with adjusting screw (C, 628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).

※ Do not loosen these screws and nuts.

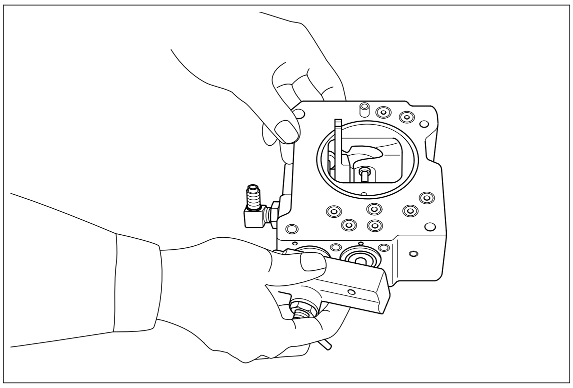
If they are loosened, adjusted pressure-flow setting will vary.



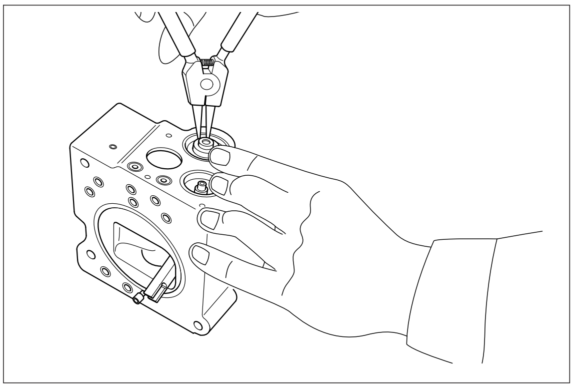
(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.
※ Adjusting ring (Q,645) can easily be drawn out with M4 bolt.



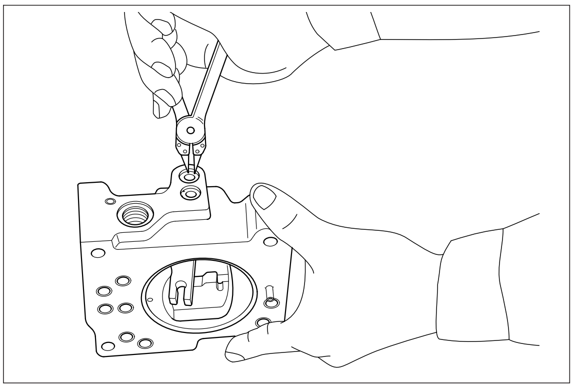
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover (641).
After removing pilot cover, take out set spring (655) from pilot section.

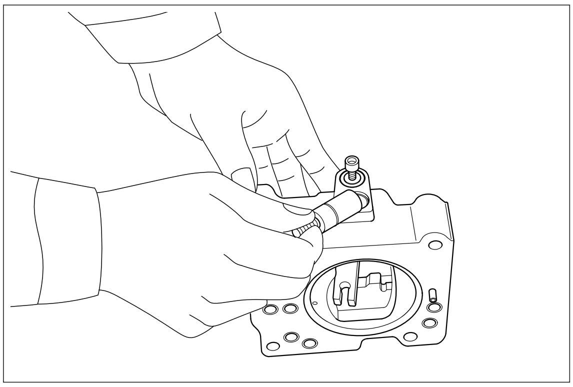


(7) Remove snap ring (814) and take out spring seat (653), return spring (654) and sleeve (651).
※ Sleeve (651) is fitted with snap ring (836).
※ When removing snap ring (814), return spring (654) may pop out.
Take care not to lose it.



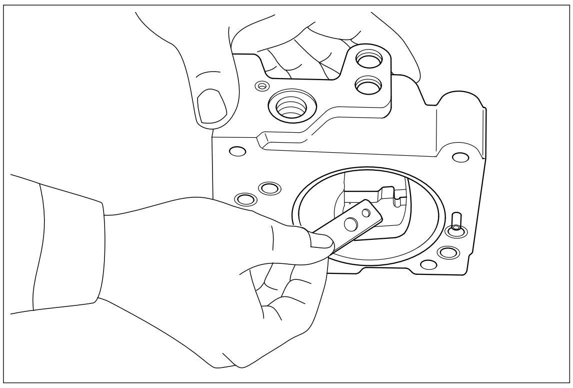
(8) Remove locking ring (858) and take out fulcrum plug (614) and adjusting plug (615).
※ Fulcrum plug (614) and adjusting plug (615) can easily be taken out with M6 bolt.





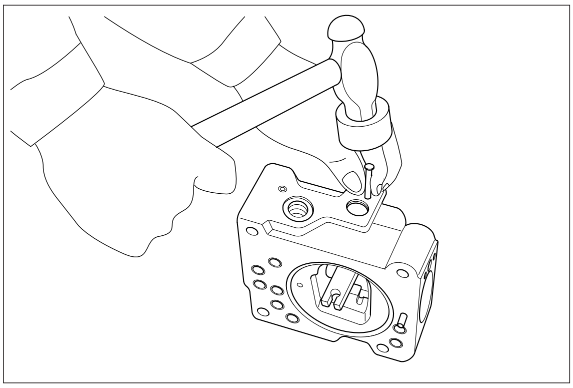
(9) Remove lever (2, 613). Do not draw out pin (875).

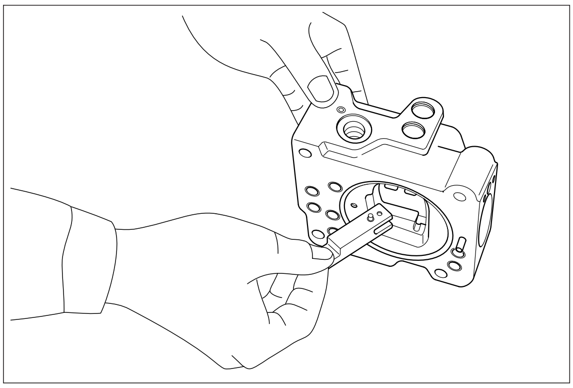
※ Work will be promoted by using pincers or so on.



(10) Draw out pin (874) and remove feedback lever (611).

Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).





(11) Remove lever 1 (612). Do not draw out pin (875).

(12) Draw out pilot piston (643) and spool (652).

(13) Draw out piston case (622), compensating piston (621) and compensating rod (623).

※ Piston case (622) can be taken out by pushing compensating rod (623) at opposite side of piston case.

This completes disassembly.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand. Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

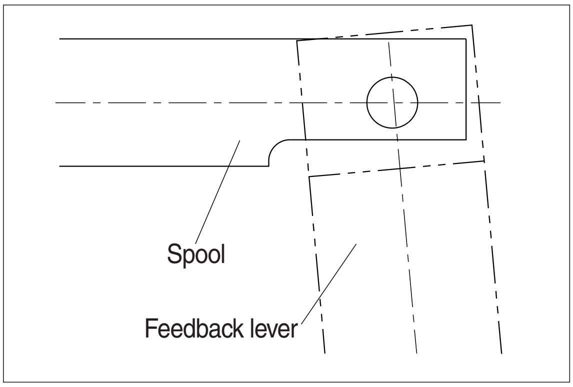
(2) Put compensating rod (623) into compensating hole of casing (601).

(3) Put pin force-fitted in lever 1 (612) into groove of compensating rod and fit lever 1 to pin force-fitted in casing.

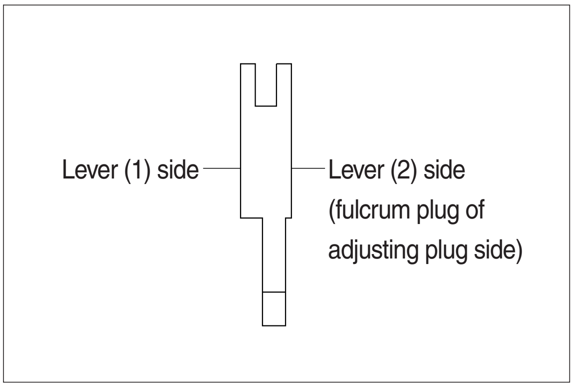
(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.

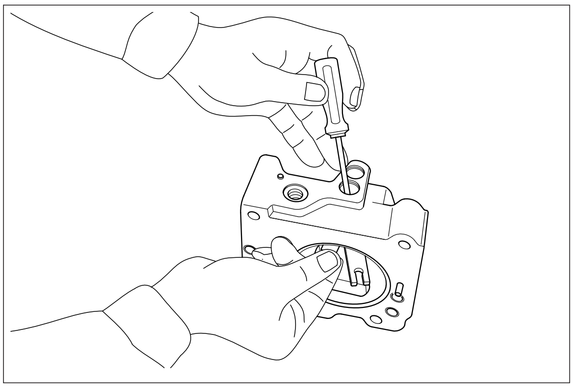


(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



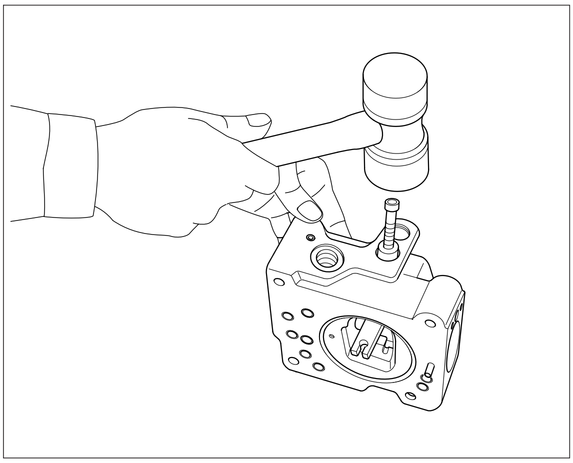
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever 2 (613) into groove of pilot piston.
Then fix lever 2.

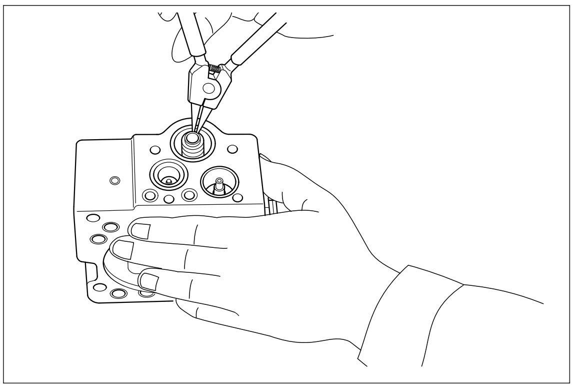


(8) Fit fulcrum plug (614) so that pin force-fitted in fulcrum plug (614) can be put into pin hole of lever 2.
Then fix locking ring (858).

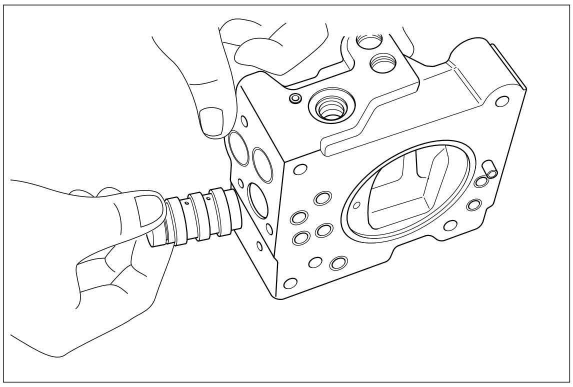
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.



(10) Fit return spring (654) and spring seat (653) into spool hole and attach snap ring (814).

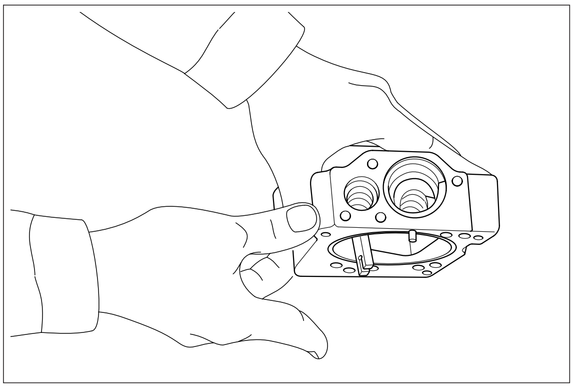


(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).

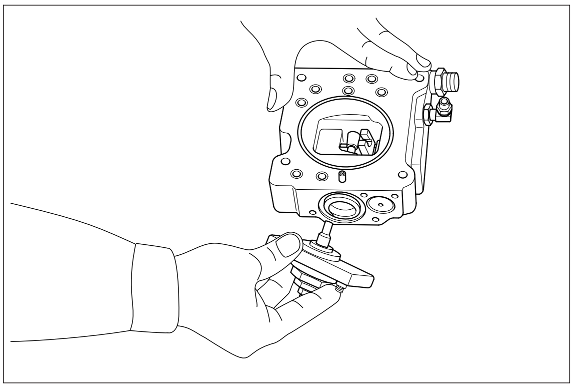


(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.

※ When fitting spring seat, take care not to mistake direction of spring seat.



(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).



This completes assembly.

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

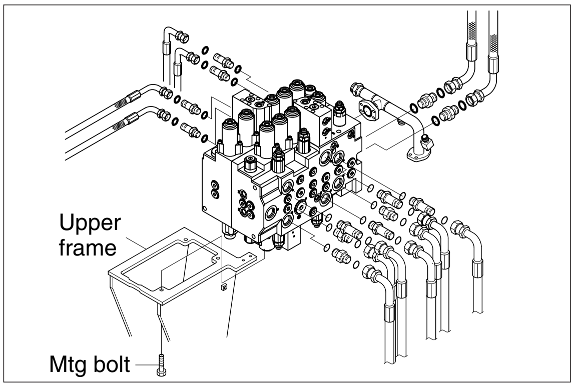
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



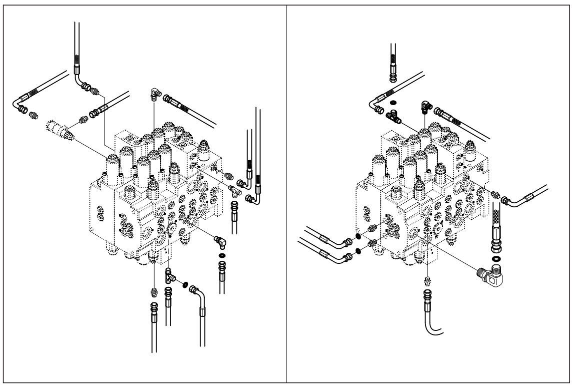
(4) Remove the wirings for the pressure sensor and so on.

(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.

(8) Sling the control valve assembly and remove the control valve mounting bolt.
  · Weight : 140 kg (310 lb)

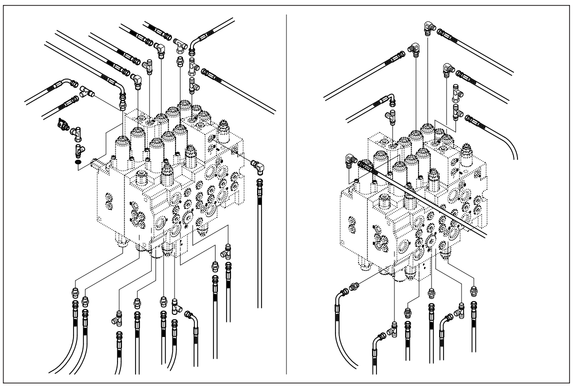


(9) Remove the control valve assembly. When removing the control valve assembly, check that all the piping have been disconnected.

2) INSTALL

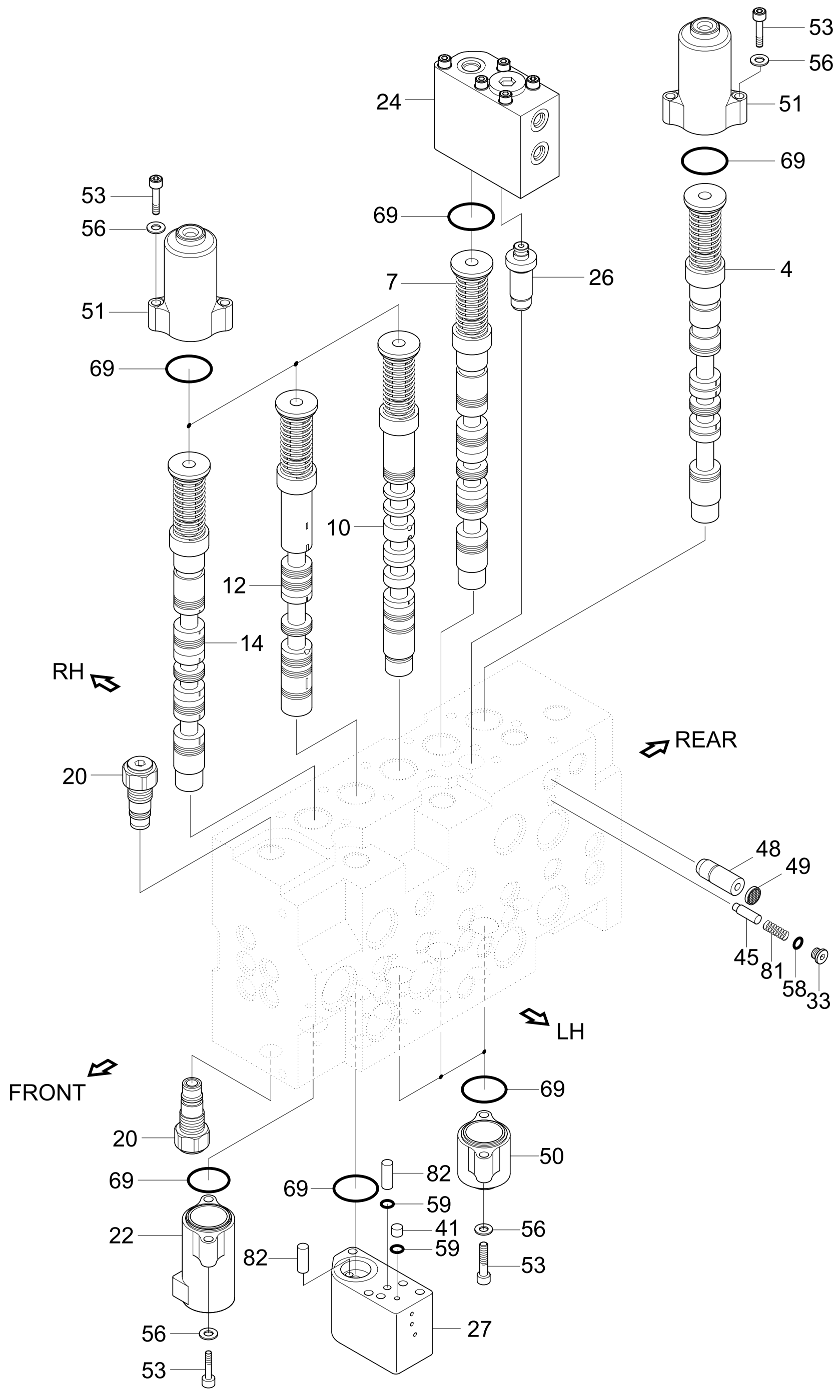
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.
① Cylinder (boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.



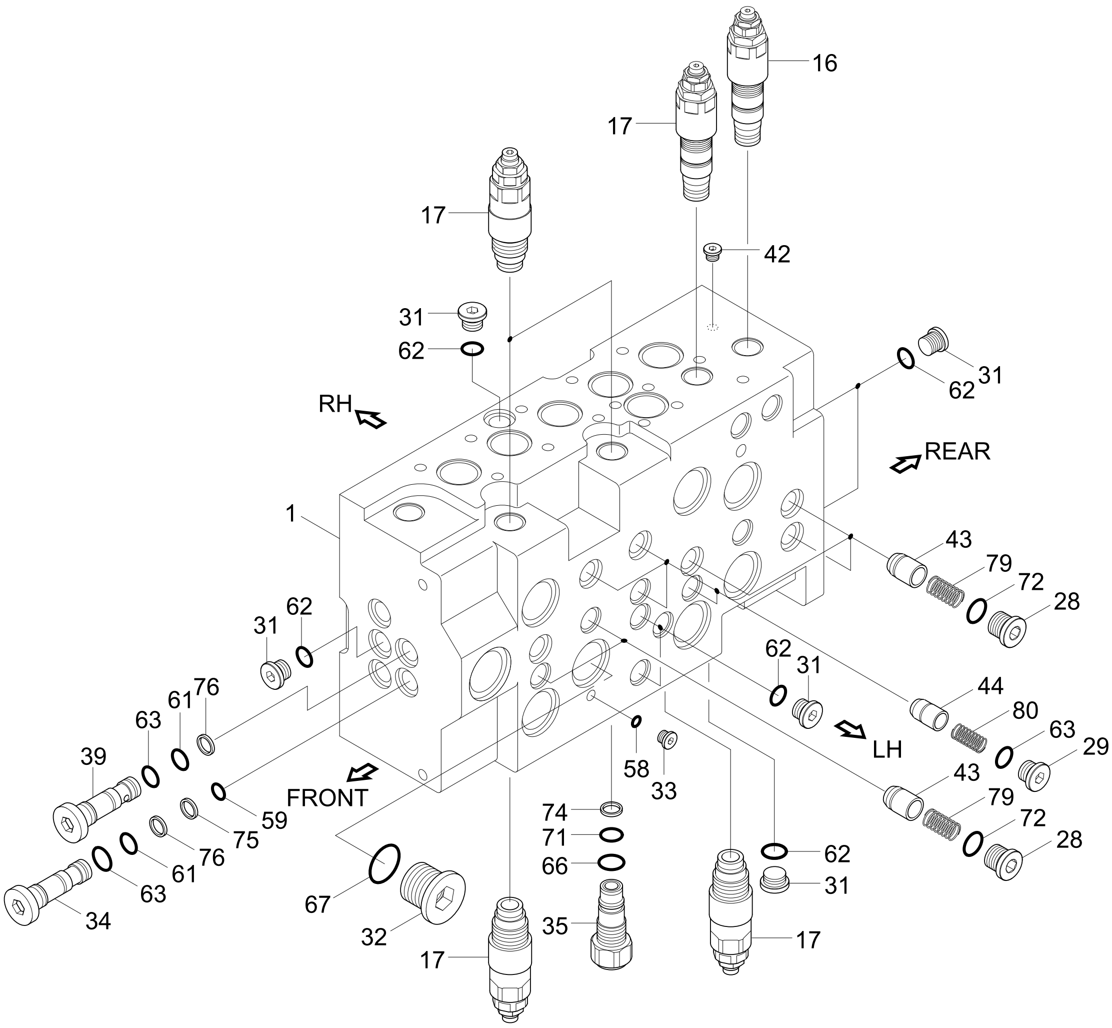
(3) Confirm the hydraulic oil level and recheck the hydraulic oil leak or not.

2. STRUCTURE (1/4)



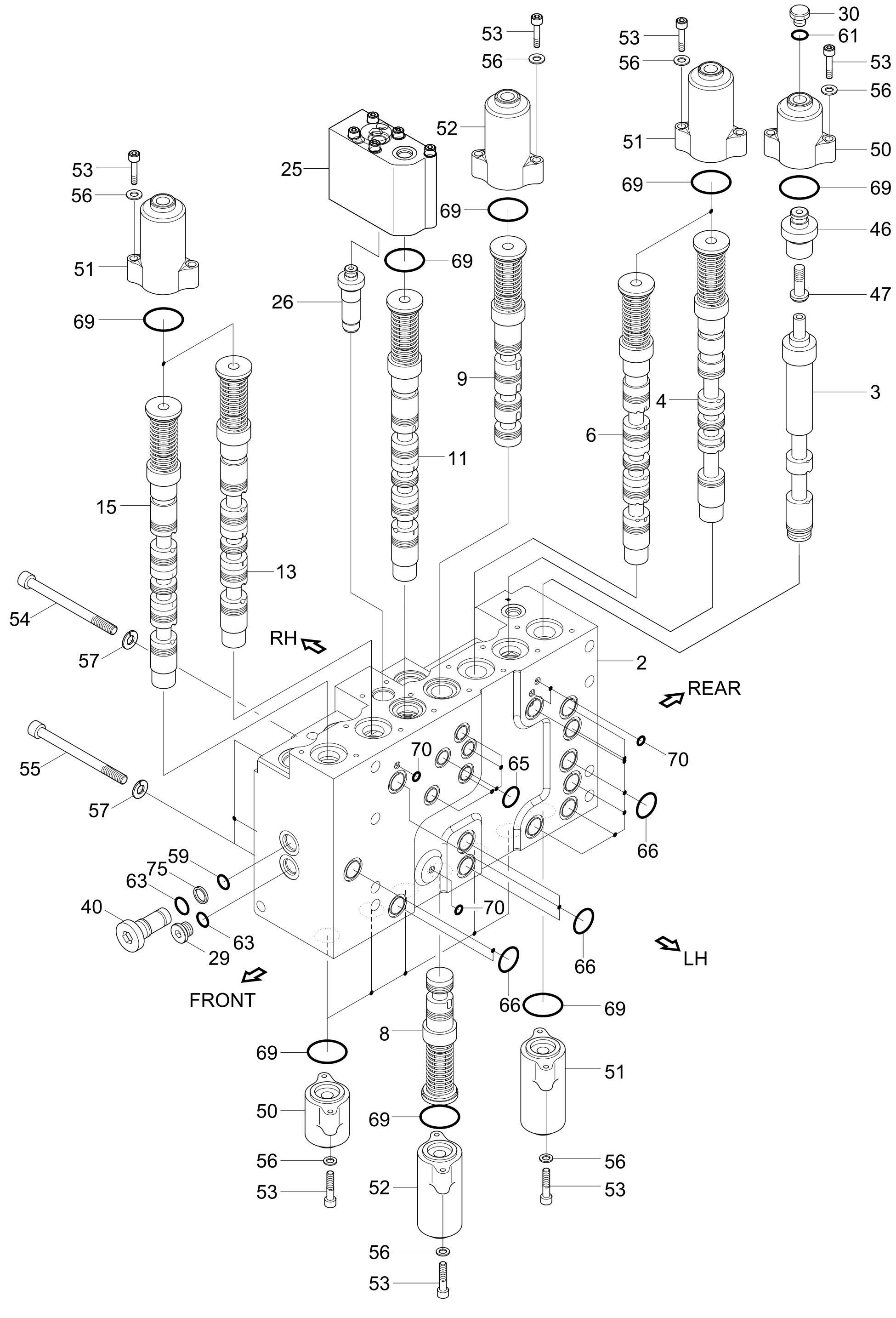
1	Housing-P1		26	Lock valve kit B		51	Pilot B1 cap
4	Spool assy-travel LH		27	Regeneration block		53	Socket head bolt
7	Spool assy-boom 1		28	Plug		56	Plain washer
10	Spool assy-arm 2		33	Plug		58	O-ring
12	Spool assy-arm regen		41	Plug		59	O-ring
14	Spool assy-bucket		45	Poppet		69	O-ring
20	Nega con relief valve		48	Orifice		81	Spring
22	Bucket stroke limiter		49	Coin type filter		82	Regeneration pin
24	Holding valve kit A1		50	Pilot A cap			

STRUCTURE (2/4)



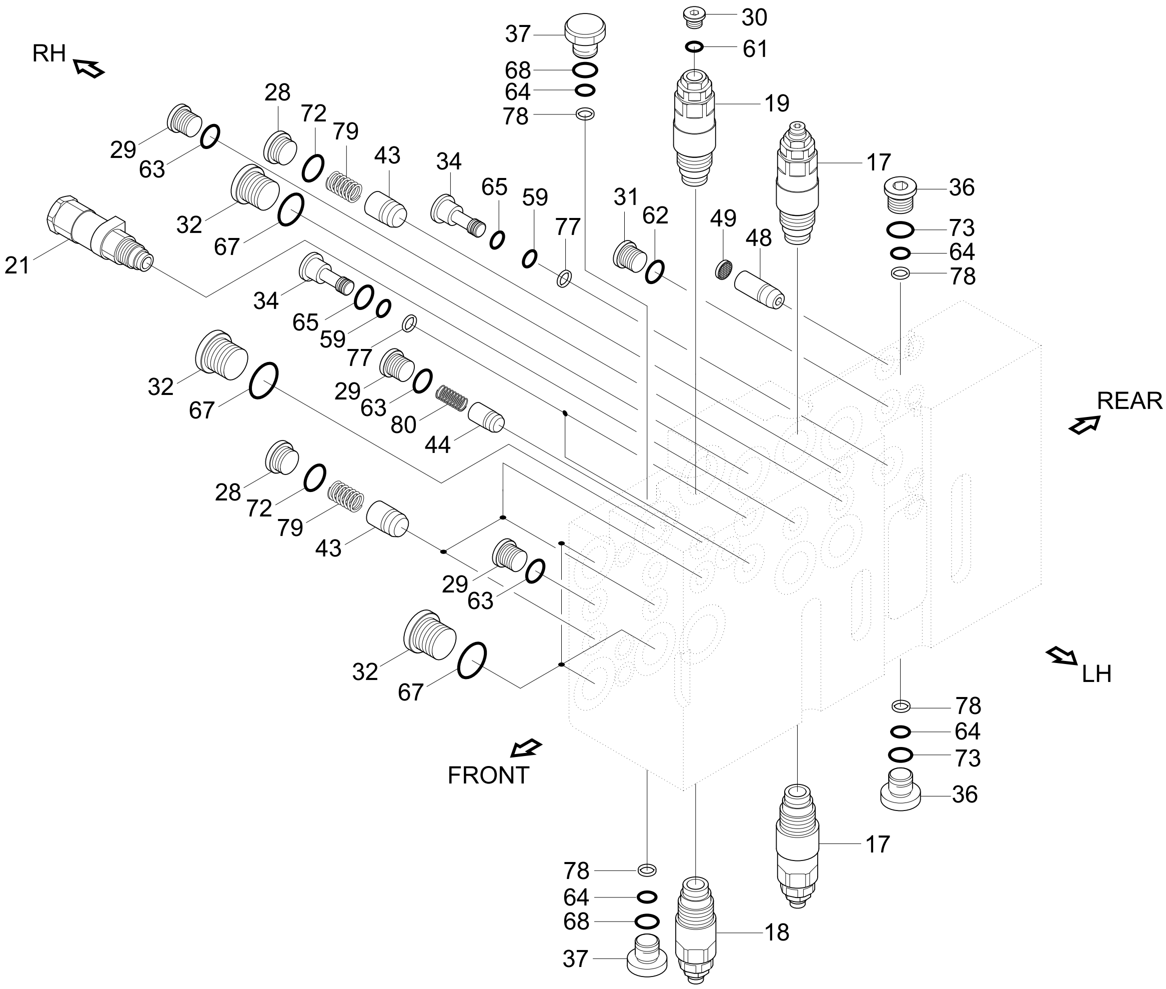
16	Main relief valve		43	Poppet		71	O-ring
17	Overload relief valve		44	Poppet		72	O-ring
28	Plug		58	O-ring		74	Back up ring
29	Plug		59	O-ring		75	Back up ring
31	Plug		61	O-ring		76	Back up ring
32	Plug		62	O-ring		79	Spring
34	Plug		63	O-ring		80	Spring
35	Plug		66	O-ring		83	Plug
39	Plug		67	O-ring			

STRUCTURE (3/4)



2	Housing-P2	29	Plug	56	Plain washer
3	Spool assy-straight travel	30	Plug	57	Spring washer
4	Spool assy-travel RH	40	Plug	59	O-ring
6	Spool assy-swing	46	Travel straight sleeve	61	O-ring
8	Spool assy-swing priority	47	Travel straight piston	63	O-ring
9	Spool assy-boom 2	50	Pilot A cap	65	O-ring
11	Spool assy-arm 1	51	Pilot B1 cap	66	O-ring
13	Spool assy-option B	52	Pilot B2 cap	69	O-ring
15	Spool assy-dozer	53	Socket head bolt	70	O-ring
25	Holding valve kit A2	54	Socket head bolt	75	Back up ring
26	Lock valve kit-B	55	Socket head bolt		

STRUCTURE (4/4)



17	Overload relief valve	37	Plug	67	O-ring
18	Overload relief valve	43	Poppet	68	O-ring
19	Overload relief valve	44	Poppet	72	O-ring
21	Swing logic valve	48	Orifice-signal	73	O-ring
28	Plug	49	Coin type filter	77	Back up ring
29	Plug	59	O-ring	78	Back up ring
30	Plug	61	O-ring	79	Spring
31	Plug	62	O-ring	80	Spring
32	Plug	63	O-ring		
34	Plug	64	O-ring		
36	Plug	65	O-ring		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests (for the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size (mm)
Vice mounted on bench (soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	27 and 32
Spanner	Each 1 piece	32 (main relief valve, overload relief valve, negative relief valve) 26 (holding valve)

3) DISASSEMBLY

(1) Disassembly of spools without holding valve

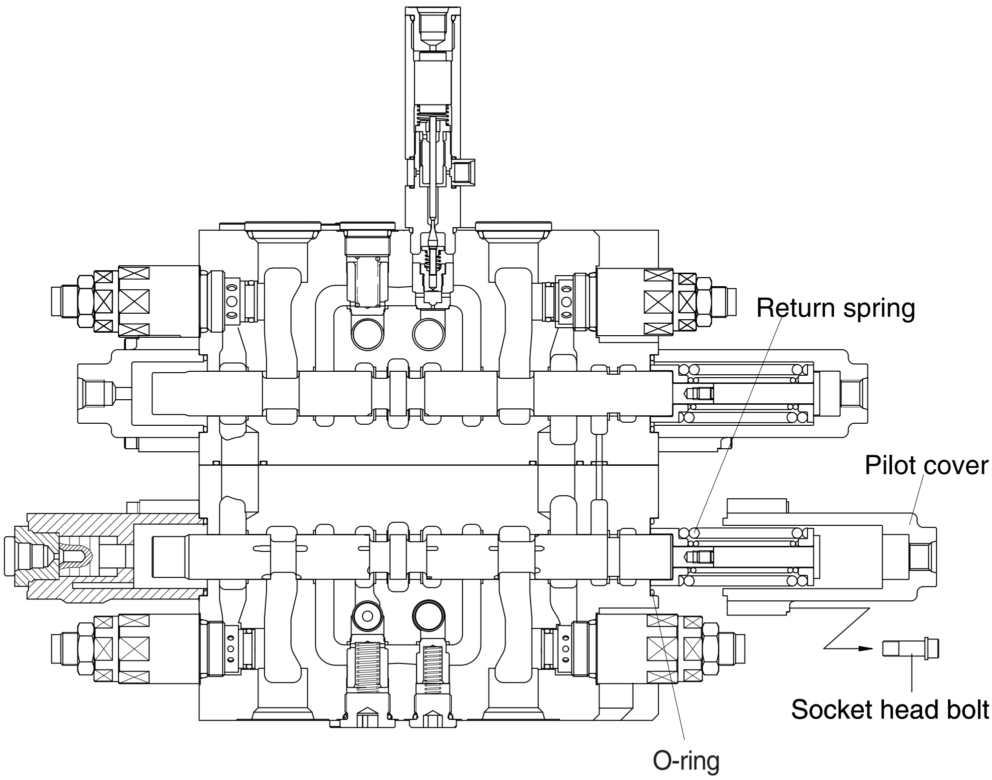
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

② Remove the pilot cover.

※ Pay attention not to lose the O-ring under the pilot cover.

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completely new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



(2) Disassembly of spools with holding valve (boom 1, Arm 1 spool)

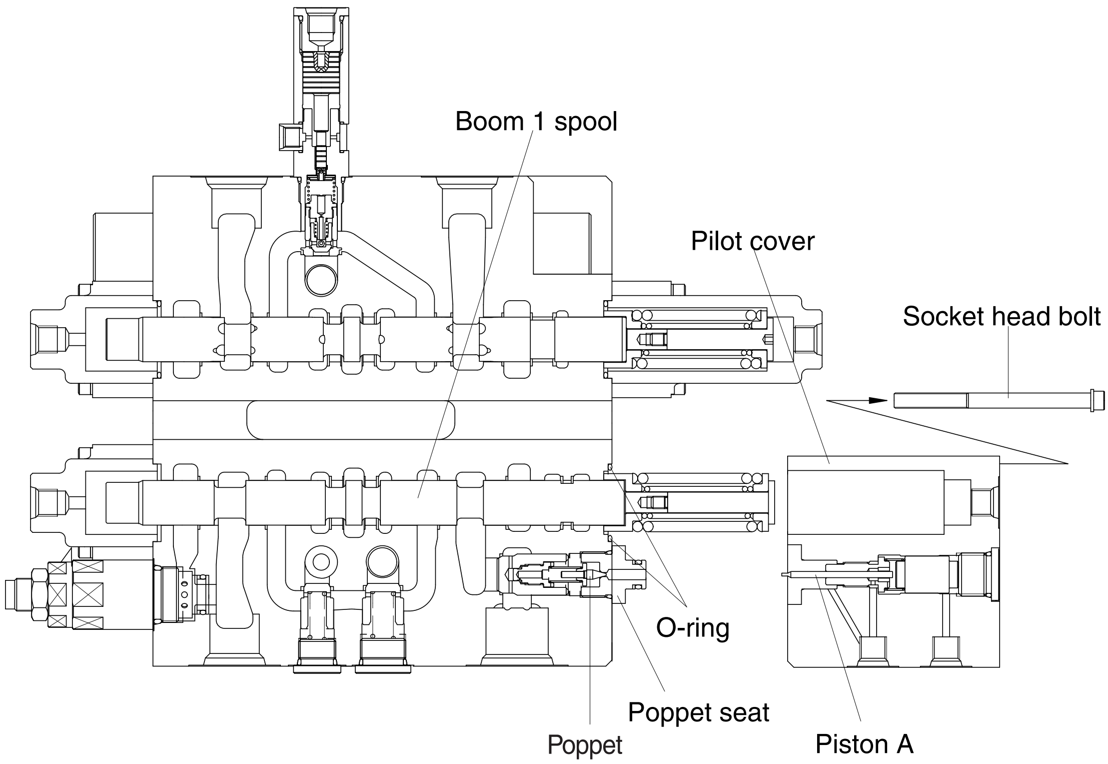
① Loosen hexagon socket head bolts with washer.
(hexagon wrench : 5 ㎜)

② Remove the pilot cover with internal parts.

※ Pay attention not to lose the O-ring and the poppet under the pilot cover.
※ Pay attention not to damage the "piston A" under pilot cover.

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completely new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



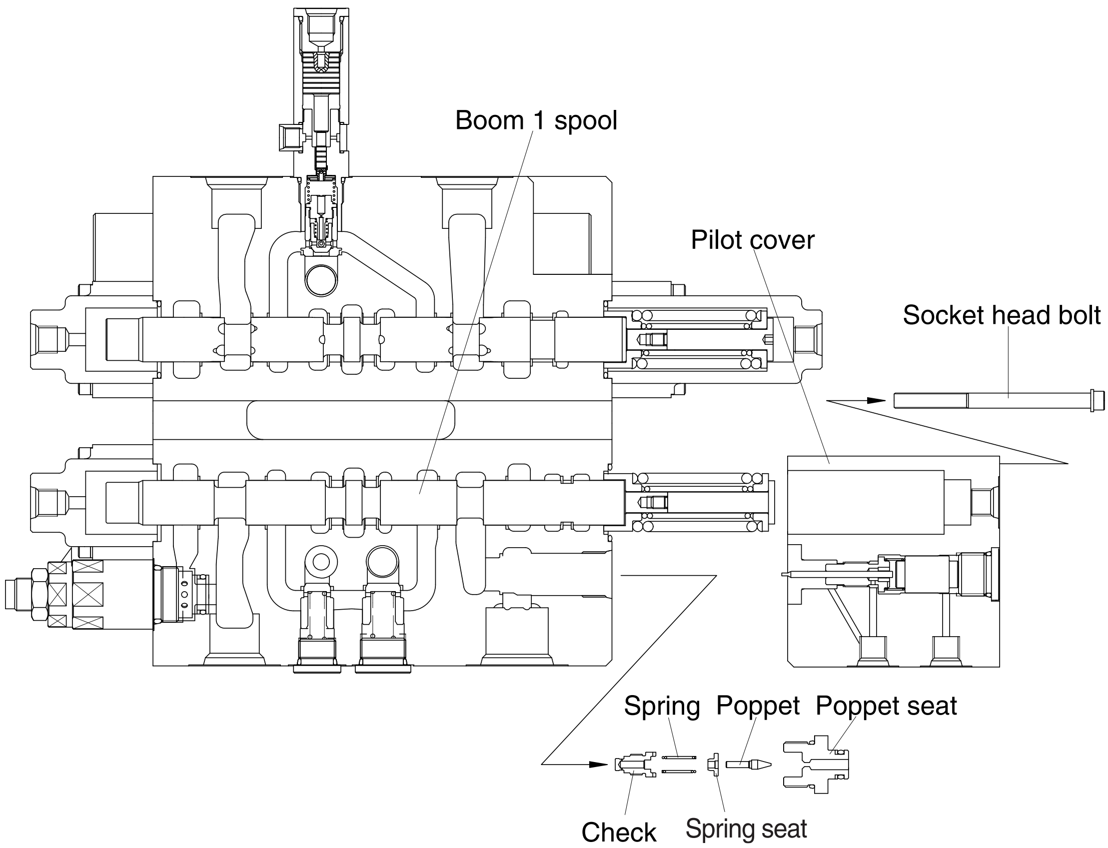
(3) Disassembly of the holding valve

① Remove the pilot cover with the holding valve as described on previous page.

※ Do not disassembled internal parts of the pilot cover.

② Loosen the poppet seat and remove the poppet, spring seat, spring and check. (spanner : 26 ㎜)

※ Pay attention not to lose the poppet.
※ Do not disassembled internal parts of the check.



(4) Disassembly of the load check valve and the negative relief valve

① The load check valve

a. Fix the body to suitable work bench.

※ Pay attention not to damage the body.

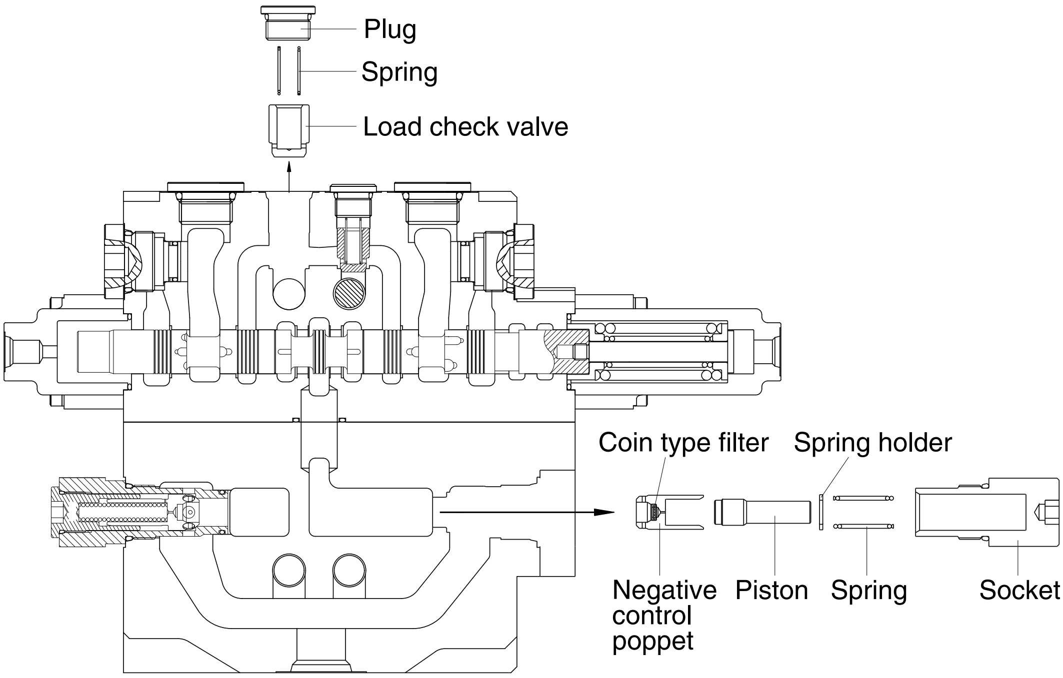
b. Loosen the plug (hexagon wrench : 10 ㎜).

c. Remove the spring and the load check valve with pincers or magnet.

② The negative relief valve

a. Loosen the socket (spanner : 32 ㎜).

b. Remove the spring, spring holder, piston and negative control poppet.



(5) Disassembly of the main and overload relief valve

① Fix the body to suitable work bench.

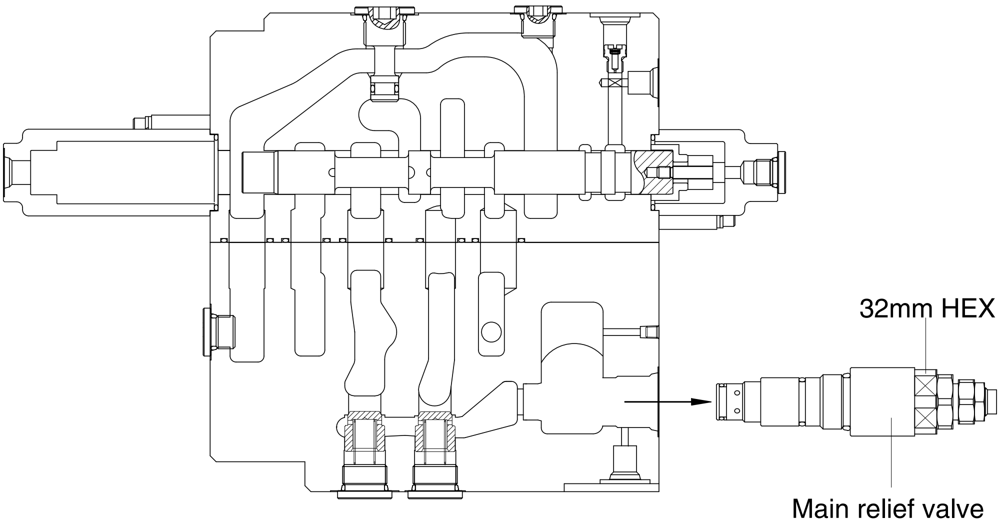
② Remove the main relief valve.
(spanner : 32 ㎜)

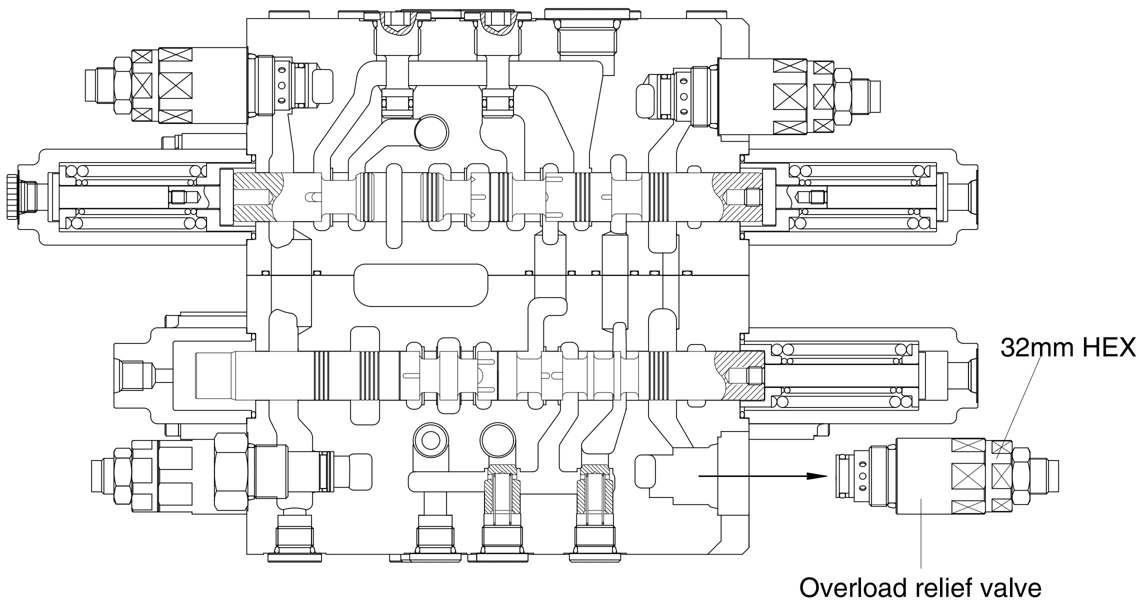
③ Remove the overload relief valve.
(spanner : 32 ㎜)

※ When disassembled, tag the relief valve for identification so that they can be reassembled correctly.

※ Pay attention not to damage seat face.

※ When any abnormal parts are found, replace it with completely new relief valve assembly.





(6) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that seal groove faces of body and block are smooth and free of dust, dent, rust etc.
c. Correct dents and damages and check seat faces within the body, if any, by lapping.
※ Pay careful attention not to leave any lapping agent within the body.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following it's the prescribed disassembly and assembly procedures.
g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that springs are free from breakage, deformation, and wear.
e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
f. Replace all O-rings with new ones.
g. When any light damage is found in above inspections, correct it by lapping.
h. When any abnormal part is found, replace it with a completely new relief valve assembly.

4) ASSEMBLY

(1) General precaution

① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures shown in the previous structure & disassembly section.
② Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.
③ Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly. Do not stretch seals so much as to deform them permanently.
④ In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted
⑤ O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.
⑥ Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.
⑦ Do not reuse removed O-rings and seals.

(2) Load check valve

① Assemble the load check valve and spring.
② Put O-rings on to plug.
③ Tighten plug to the specified torque.
· Hexagon wrench : 10 mm
· Tightening torque : 6~7 kgf · m (43.4~50.6 lbf · ft)

(3) Negative control relief valve

① Assemble the nega-con poppet, piston, spring holder and spring together into body.
② Put O-ring on to plug and tighten the latter to its specified torque.
· Hexagon wrench : 12 mm
· Tightening torque : 8~9 kgf · m (57.8~65.1 lbf · ft)

(4) Main relief, overload relief valves
Install main relief valve, overload relief valve into the body and tighten to the specified torque.

Component	Tools	Tightening torque	
		kgf · m	lbf · ft
Main relief valve	Spanner 32 mm	8~9	57.8~65.1
Overload relief valve	Spanner 32 mm	8~9	57.8~65.1

(5) Main spools

① Carefully insert the previously assembled spool assemblies into their respective bores within of body.
※ Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.

(6) Pilot covers

① Fit spool covers to the non-spring assembly end of the spool, and tighten the hexagonal socket head bolts to the specified torque.
- · Hexagon wrench : 5 mm
- · Tightening torque : 1.0~1.1 kgf · m (7.2~7.9 lbf · ft)

※ Confirm that O-rings have been fitted.

② Fit spring covers to the spring end for the spools, and tighten hexagon socket head bolts to the specified torque.
- · Hexagon wrench : 5mm
- · Tightening torque : 1.0~1.1 kgf·m (7.2~7.9 lbf·ft)

※ Confirm that O-rings have been fitted.

(7) Holding valves

① Assemble the check, spring seat and poppet together into body.

② Tighten the poppet seat to the specified torque.
- · Spanner : 26 mm
- · Tightening torque : 6~7 kgf · m (43.4~50.6 lbf · ft)

③ Fit the "piston A" under pilot cover with internal parts into hole on the poppet seat.

④ Tighten hexagon socket head bolt to specified torque.
- · Hexagon wrench : 5mm
- · Tightening torque : 1.0~1.1 kgf · m (7.2~7.9 lbf · ft)

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

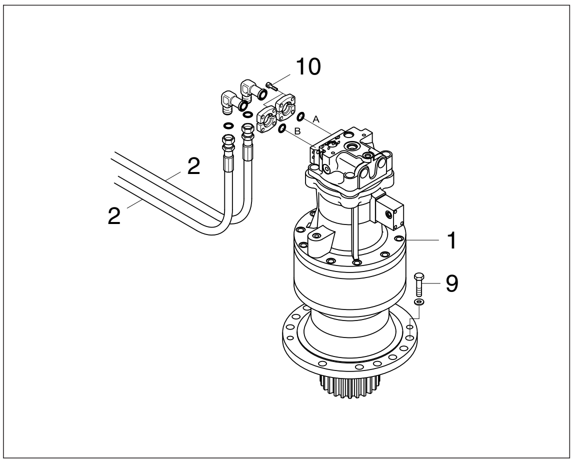
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



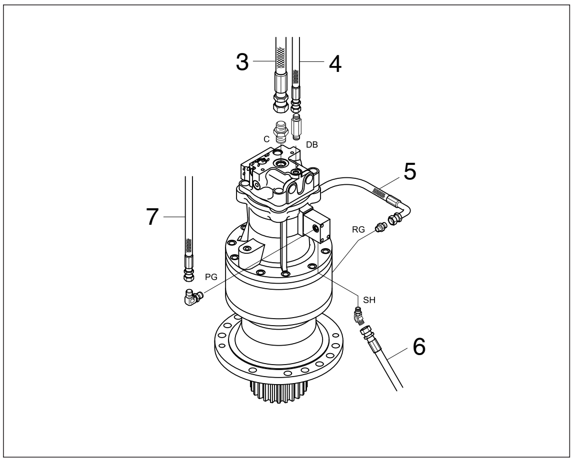
(4) Loosen the bolt (10) and disconnect hose assembly (2).

(5) Disconnect pilot line hoses (3, 4, 5, 6, 7).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).

· Weight : 130 ㎏ (287 ㏈)

· Tightening torque : 29.6±3.2 kgf · m (214±23.1 lbf · ft)



(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

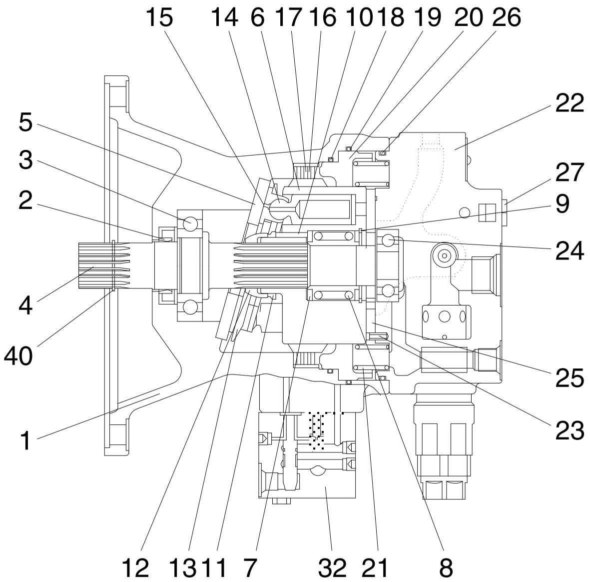
④ Start the engine, run at low idling and check oil come out from plug.

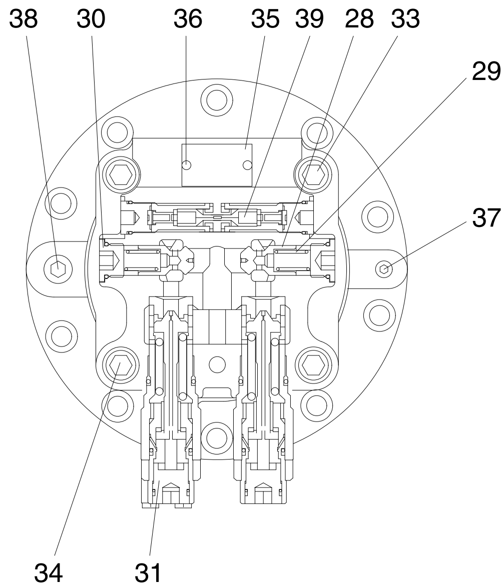
⑤ Tighten plug fully.

(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE





1	Casing	15	Shoe	29	Spring
2	Oil seal	16	Separate plate	30	Plug assy
3	Ball bearing	17	Friction plate	31	Relief valve assy
4	Drive shaft	18	O-ring	32	Brake valve assy
5	Shoe plate	19	O-ring	33	Socket bolt
6	Rotary block	20	Brake piston	34	Socket bolt
7	Washer	21	Spring	35	Name plate
8	Spring	22	Valve casing	36	Screw
9	Snap ring	23	Spring pin	37	Plug
10	Roller	24	Ball bearing	38	Plug
11	Collar washer	25	Valve plate	39	Reactionless valve assy
12	Thrust ball	26	O-ring	40	Snap ring
13	Retainer plate	27	Plug assy		
14	Piston	28	Plunger		

2) DISASSEMBLY

※ Some illustrations can be different from the machine.

(1) For easy assembly, put motor on worktable with the spline side of shaft (4) facing downwards.

※ Lay rubber plate on worktable and take care not to damage the components.

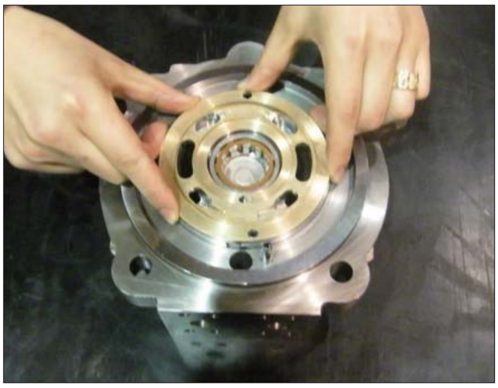
(2) Remove snap ring (40) using snap ring plier.

(3) Disassemble level gauge assembly (if equipped) using pipe wrench.

(4) Disassemble two sets of relief valve assembly (51) using socket wrench.

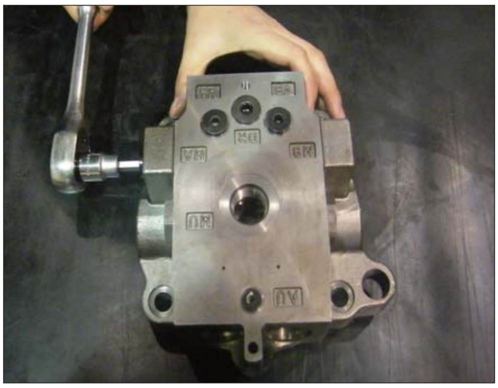
(5) Unscrew M16 socket bolt 33 (2EA), 34 (2EA) using 14 mm hexagon wrench.

(6) Remove valve plate (25) from valve casing.
※ Take care not to drop the valve plate (25).

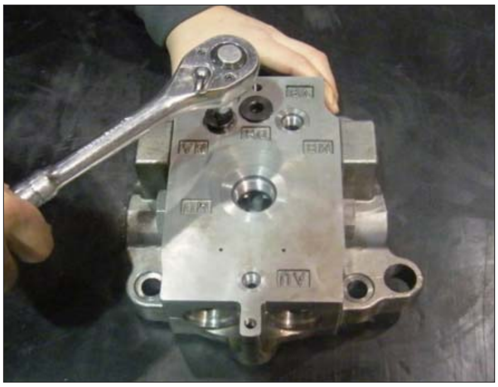


(7) Remove O-ring (19) from valve casing.

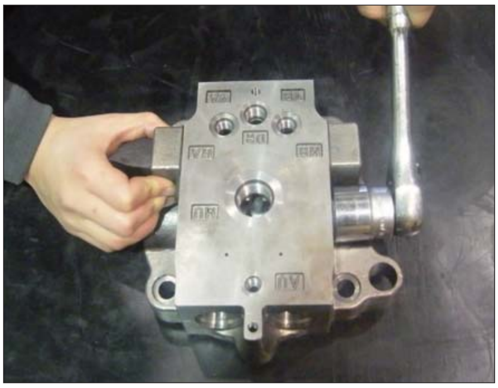
(8) Remove plug (39-1) using hexagon wrench and take out reactionless valve assembly (39). (same for the set on opposite side)



(9) Remove plug assy (27) (2ea) using 6 mm hexagon wrench.

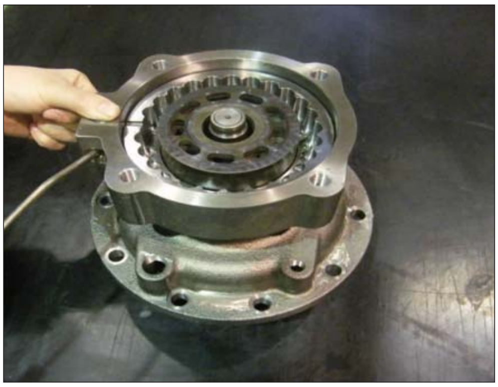


(10) Remove plug assy (30) using 17 mm socket wrench and separate spring ; spring (29) and plunger (28). (same for the set on opposite side)



(11) Remove spring (21) (22ea) from brake piston.

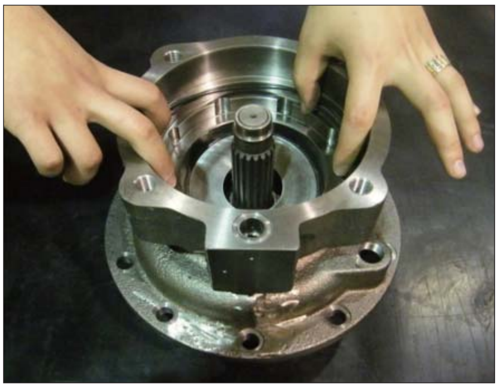
(12) Disassemble brake piston (20) from casing using air gun.



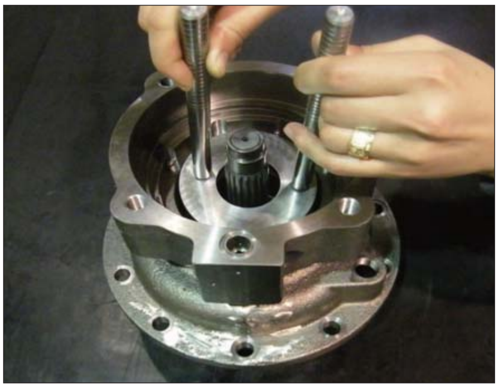
(13) Lay casing down horizontally and remove rotary block assembly from shaft.
And remove all friction plate (17) and separate plate (16).

(14) Separate piston assembly (14, 15), trust ball (12), retainer plate (13).

(15) Remove O-ring (18) from casing.



(16) Use a magnet to separate shoe plate (5) from casing.
※ Sliding surface should be carefully treated to avoid scratches and damage.



(17) Disassemble drive shaft (4) and ball bearing (3).

※ Do not remove ball bearing (5) unless malfunction is detected, since it is mounted by shrink fit.

(18) Turn casing (1) upside down and remove oil seal (2) using jig.

3) ASSEMBLY

※ Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring and oil seal with new parts is generally recommended.
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values.
⑥ When assembling bolt, spread loctite.

(1) Put casing (1) on worktable.
Press oil seal (2) using oil seal jig, until it reach the bottom.
※ Spread grease on external diameter of oil seal.

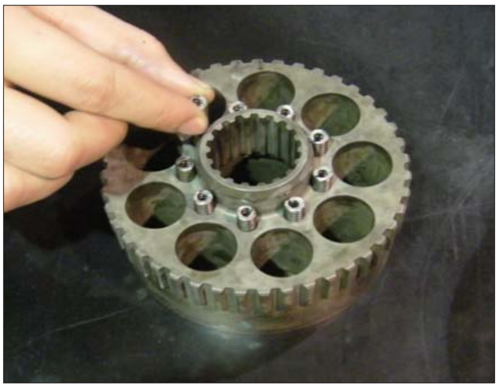
(2) Mount ball bearing (3, 24) on drive shaft (4) using shrink fitting method.

(3) Assemble shaft assembly in casing using urethane hammer.
※ Take care not to damage oil seal.

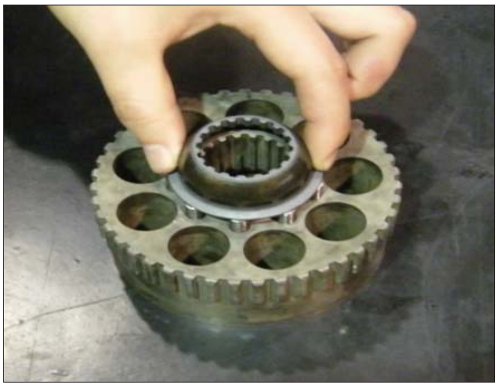
(4) Insert shoe plate (5).
※ Take care not to damage sliding surface.

(5) After applying grease on O-ring (18), insert O-ring in casing (1).

(6) Assemble cylinder spring (8) (9ea) in rotary block (6).



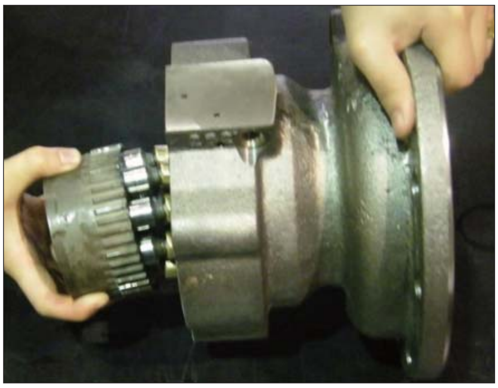
(7) Assemble thrust ball (12) in cylinder block.
※ Take care not to damage sliding surface of cylinder block.



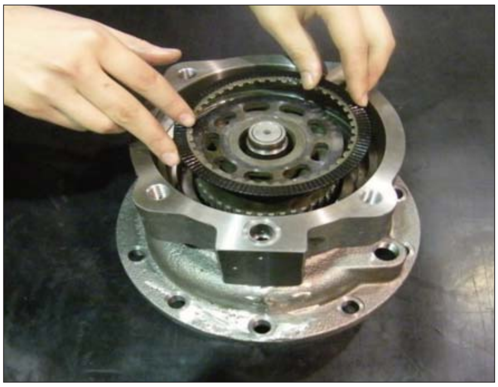
(8) Insert piston assembly (14, 15) in retainer plate (13).
※ Do not mix piston with other piston (9ea/1set).
※ Spread sufficient amount of hydraulic oil on piston assembly.

(9) Place all 9 pistons simultaneously into the holes of rotary block.
※ Take care not to damage sliding surface.

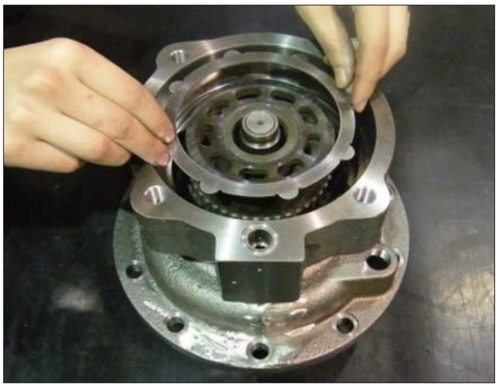
(10) Lay casing down horizontally and put rotary block assembly in casing.
※ Check whether rotary block assembly rotates smoothly.



(11) Put friction plate (17) in casing.



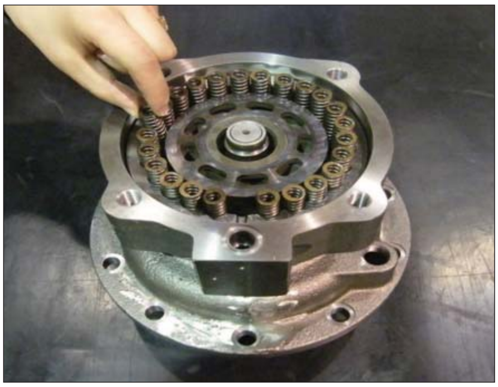
(12) Put separate plate (16) in casing.
※ Put friction plate and separate plate alternately.



(13) Assemble O-ring (19) in brake piston (20).
※ Apply grease on O-ring.

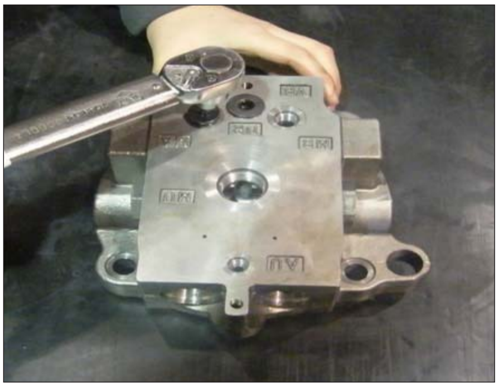
(14) Assemble parking piston (20) in casing using jig.
※ Pay attention to the hole location of parking piston.

(15) Put spring (21) (22ea) in each hole of brake piston.

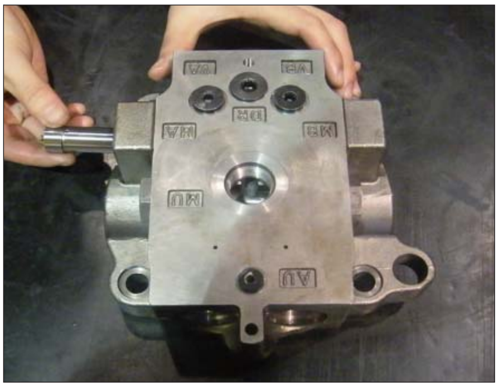


(16) Assemble plug (27) using 6 mm hexagon wrench.

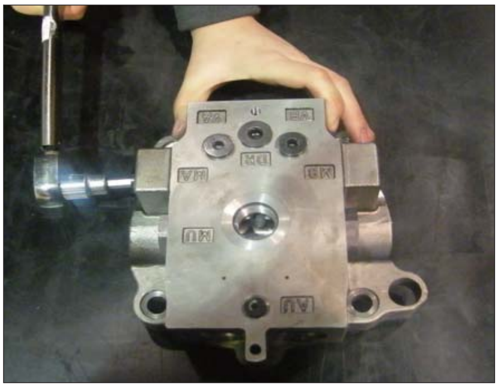
※ Tightening torque : 4.5±0.45 kgf · m (32.5±3.3 lbf · ft)



(17) Assemble reactonless valve assembly (39) in valve casing.



(18) Assemble plug (39-1) using hexagon wrench.



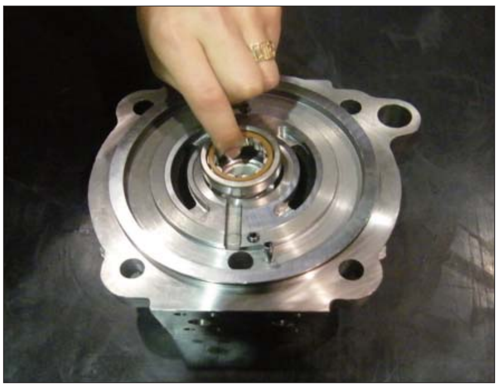
(19) Caulk plunger (28) using jig. (same for the set on opposite side)

(20) Assemble spring (29), plug (30). (in that order) (same for the set on opposite side)

(21) Assemble spring pin (23) in valve casing using jig.

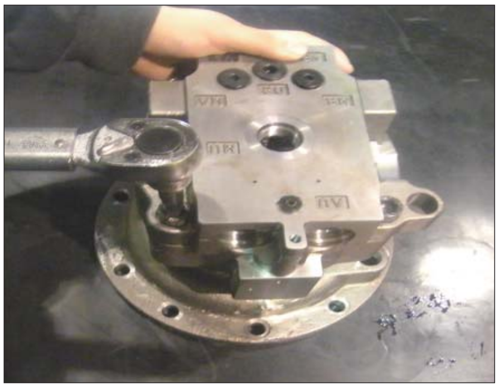
(22) Assemble O-ring (19) & ball bearing (24) in valve casing.

※ Use jig (press fit or cold shrink fit).



(23) Apply grease on steel side of valve plate (25) to prevent plate from sliding.
Assemble valve plate with the copper side facing upwards.
※ Pay attention to the assembly direction.
※ Take care not to damage sliding surface.

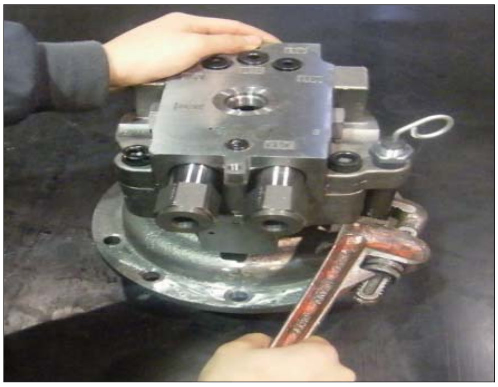
(24) Assemble valve casing by matching its holes and pins of casing and parking piston. And tighten M16 socket bolt 33 (2EA), 34 (2EA) using 14 mm hexagon wrench.
※ Make sure valve plate stays in place.
※ When tightening bolts, make sure mating surfaces between casing and valve casing maintain parallel to each other.



(25) Assemble relief valve assembly (31) using socket wrench in valve casing.
※ Spread grease on O-ring part of relief valve assembly.

(26) Assemble snap ring (40) in shaft by using snap ring plier.

(27) Wrap teflon tape 2 or 3 times around the tap part of level gauge assembly (if equipped).
And assemble it using pipe wrench.



3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

(2) Sling reduction gear assembly (1) and remove dowel pin (3) and mounting bolts (2).

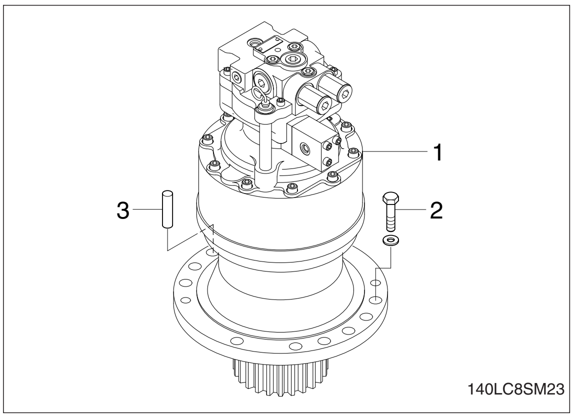
Remove the reduction gear assembly.

(3) · Reduction gear device weight : 75 kg (165 lb)

2) INSTALL

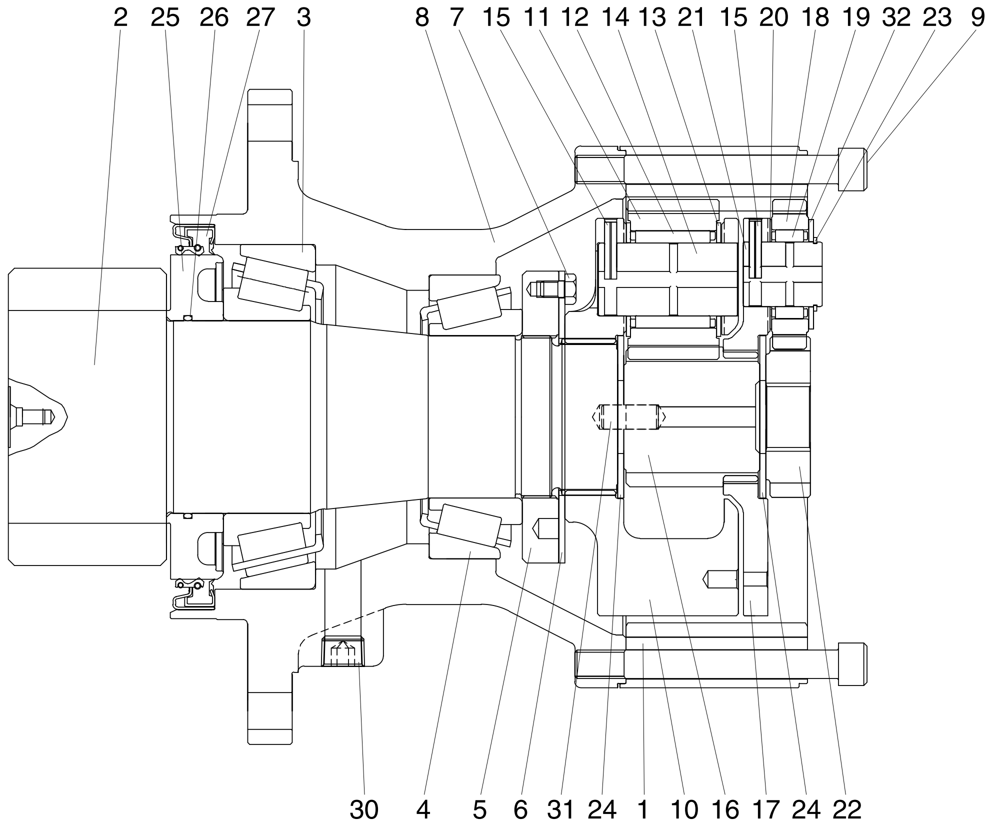
(1) Carry out installation in the reverse order to removal.

· Tightening torque : 29.6±3.2 kgf · m (214±23.1 lbf · ft)



4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



1	Ring gear	11	Planetary gear No. 2	21	Carrier pin No. 1
2	Drive shaft	12	Needle bearing	22	Sun gear No. 1
3	Taper roller bearing	13	Thrust washer	23	Snap ring
4	Taper roller bearing	14	Carrier pin No. 2	24	Thrust plate
5	Ring nut	15	Spring pin	25	Sleeve
6	Lock plate	16	Sun gear No. 2	26	O-ring
7	Hexagon bolt	17	Carrier No. 1	27	Oil seal
8	Casing	18	Planetary gear No. 1	30	Socket plug
9	Socket bolt	19	Needle bearing	31	Parallel pin
10	Carrier No. 2	20	Thrust washer	32	Thrust washer

2) DISASSEMBLY

(1) Remove the swing motor, and then place swing reduction gear on the bench.

(2) Disassemble sun gear No.1 (22).

(3) Disassemble carrier No.1 sub assembly.

Carrier No.1 sub assy disassembly

(4) Put carrier No.1 sub assembly on the bench, then remove the snap ring (23).

(5) Disassemble thrust washer No.1 (upper) (32).(3 pcs)

(6) Disassemble planetary gear No.1 (18). (3 pcs)

(7) Disassemble thrust plate (24).

(8) Disassemble needle bearing No.1 (19). (3 pcs)

(9) Disassemble thrust washer No.1 (lower) (20). (3 pcs)

(10) After placing spring pin (15) to center of carrier pin No.1 (21) with a jig, disassemble it. (3 pcs)

※ Do not reuse spring pin, carrier and carrier pin.

(11) Disassemble sun gear No.2 (16).

(12) Disassemble carrier No.2 sub assembly.

Carrier No.2 sub assy disassembly

(13) After placing spring pin (15) to center of carrier pin No.2 (14) with a press machine, disassemble it.(3 pcs)

※ Do not reuse spring pin.

(14) Disassemble planetary gear No.2.(3 pcs)

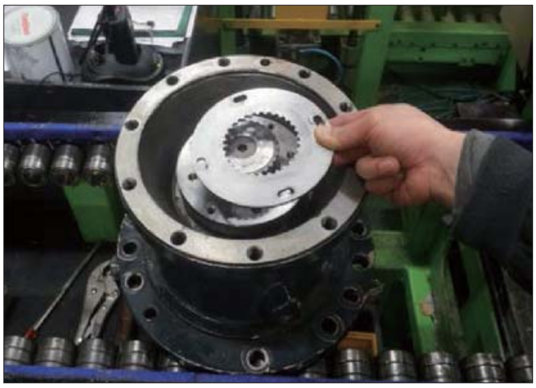
(15) Disassemble thrust plate (24).

(16) Disassemble thrust washer No.2 (13).(6 pcs)

(17) Disassemble needle bearing No.2 (12). (3 pcs)

(18) Separate ring gear (1) from casing (8).

(19) Loosen bolt (7) (4 pcs), and disassemble lock plate (6).



(20) Disassemble ring nut (5) by using the jig.

Drive shaft sub assy disassembly

(21) Separate drive shaft sub assembly from casing (8).

(22) Disassemble taper roller bearing (3) and oil seal (27) by using a press machine.

(23) Disassemble sleeve (25) and O-ring (26).

(24) Disassemble the outer ring of taper roller bearing (3) in casing (8) by using the jig.

3) ASSEMBLY

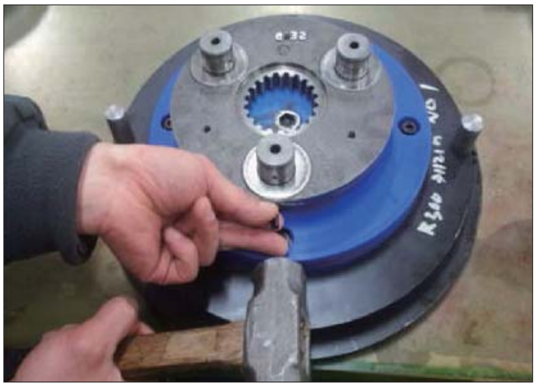
※ Even though assembly is accomplished by reversing disassembly steps, be careful of the following.

① Repair the damaged part when disassemblying and prepare parts for exchange in advance.
② All parts should be cleaned with cleaner, dried with compressed air.
③ Sliding surface, O-ring, bearing and oil seal should be lubricated with clean hydraulic oil, prior to final assembly.
④ Replacement of O-ring and oil seal with new parts is generally recommended.
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values.
⑥ When assembling bolt, spread loctite.

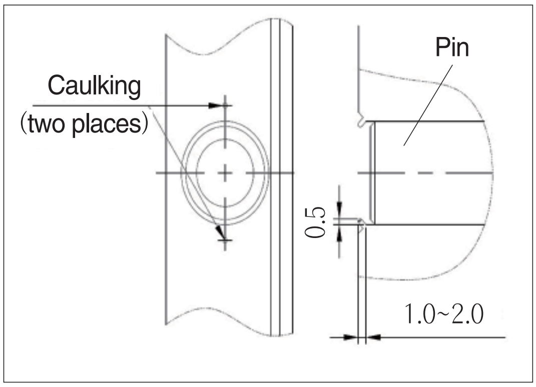
Carrier No.1 sub assembly

(1) After heating the carrier No.1 (17), assemble carrier pin No.1 (21) to the side without thehole.

(2) After drilling Ø6 hole, assemble spring pin (15).(3 pcs)



(3) Caulking is performed on the assembled spring pin unit.
※ To cover pins, implement the caulking in two places that are located direction of 180 degrees around assembled spring pin.



(4) Assemble thrust washer No.1 (lower) (20). (3 pcs)

(5) Assemble needle bearing No.1 (19).(3 pcs)

(6) Assemble thrust plate (24).

(7) Assemble planetary gear No.1 (18) of which groove is faced downward.(3 pcs)

(8) Assemble thrust washer No.1 (upper) (32). (3 pcs)

(9) Assemble snap ring (23) (3 pcs), complete carrier No.1 sub assembly.

※ Gear rotation state should be smooth.

Carrier No.2 sub assy assembly

(10) Assemble needle bearing No.2 (12) in the planetary gear No.2 (11).

(11) After spreading grease on thrust washer No.2 (13), assemble it on both upper side and lower side of planetary gear No.2.

(12) Assemble thrust plate (24).

(13) Assemble planetary gear No.2 in the carrier No.2 (10).(3 pcs)

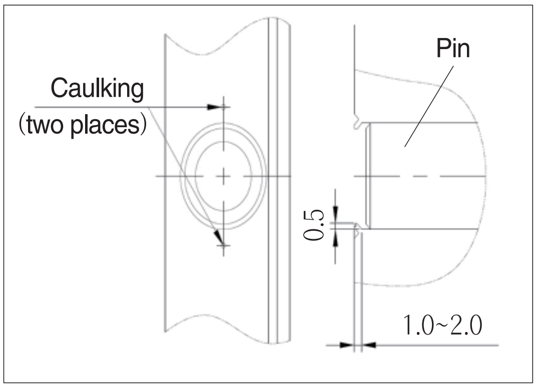
※ Thrust washer No.2 should notseparated.

(14) Assemble carrier pin No.2 (14) to match the pin hole of the carrier No.2.(3 pcs)

(15) Assemble spring pin (15).(3 pcs)

(16) Caulking is performed on the assembled spring pin unit.

※ To cover pins, implement the caulking in two places that are located direction of 180 degrees around assembled spring pin.



Drive shaft sub assy assembly

(17) After heating sleeve (25), assemble O-ring (26) to groove of inside diameter in it.

(18) Shrink fit the sleeve on drive shaft (2).

※ Be careful of fully seat at the bottom.

(19) Shrink fit taper roller bearing (3) on drive shaft, complete drive shaft sub assembly.

Casing assembly

(20) Press outer ring of the taper roller bearing in the casing (8) by using the jig.

(21) Press in oil seal (27) by using the jig.
※ Be careful of the direction of the assembly.

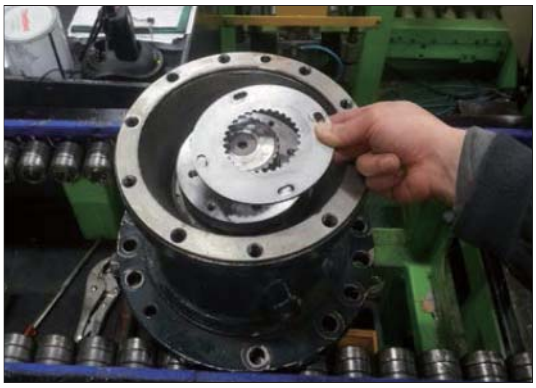
(22) Assemble drive shaft sub assembly.
※ Be careful of damage of oil seal.

(23) After fixing drive shaft so that it does not fall, and then turn it over, press taper bearing (4).

(24) Assemble nut ring (5) by using the jig.

※ Tightening torque : 3.5±0.4 kgf · m
(25.3±2.9 lbf · ft)

(25) Place lock plate (6) on the nut ring.

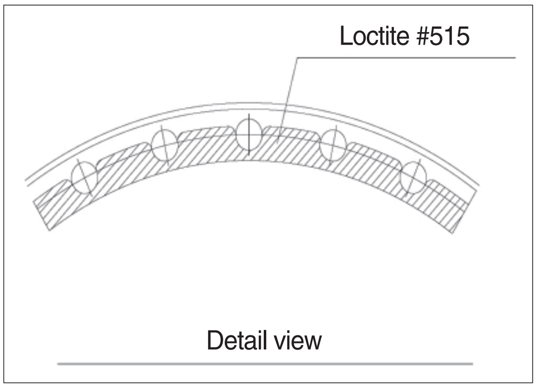


(26) After spreading loctite #242, assemble the bolt (7) (4 pcs).

※ Tightening torque : 2.5±0.25 kgf · m
(18.1±1.8 lbf · ft)

(27) Press parallel pin (31) by using press machine.

(28) Spread the loctite #515 on the casing with reference to the right detail view.
※ Loctite should not flow into casing.



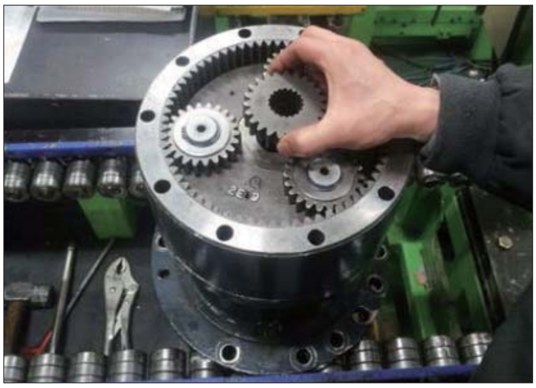
(29) Assemble ring gear (1) in accordance with a pin hole on casing.
※ Be careful of damage of the ring gear.

(30) Assemble carrier No.2 sub assembly.

(31) Assemble sun gear No.2 (16).

(32) Assemble carrier No.1 sub assembly.

(33) Assemble sun gear No.1 (22) of which grinding surface is faced downward.



(34) Fill with gear oil 3.5 liter.

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

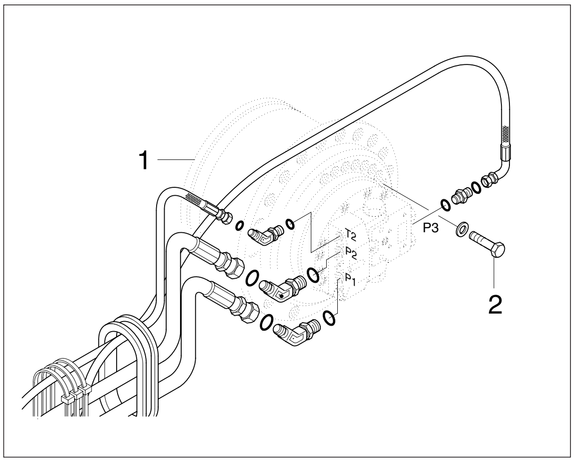
(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**



(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
· Weight : 240 kg (530 lb)

2) INSTALL

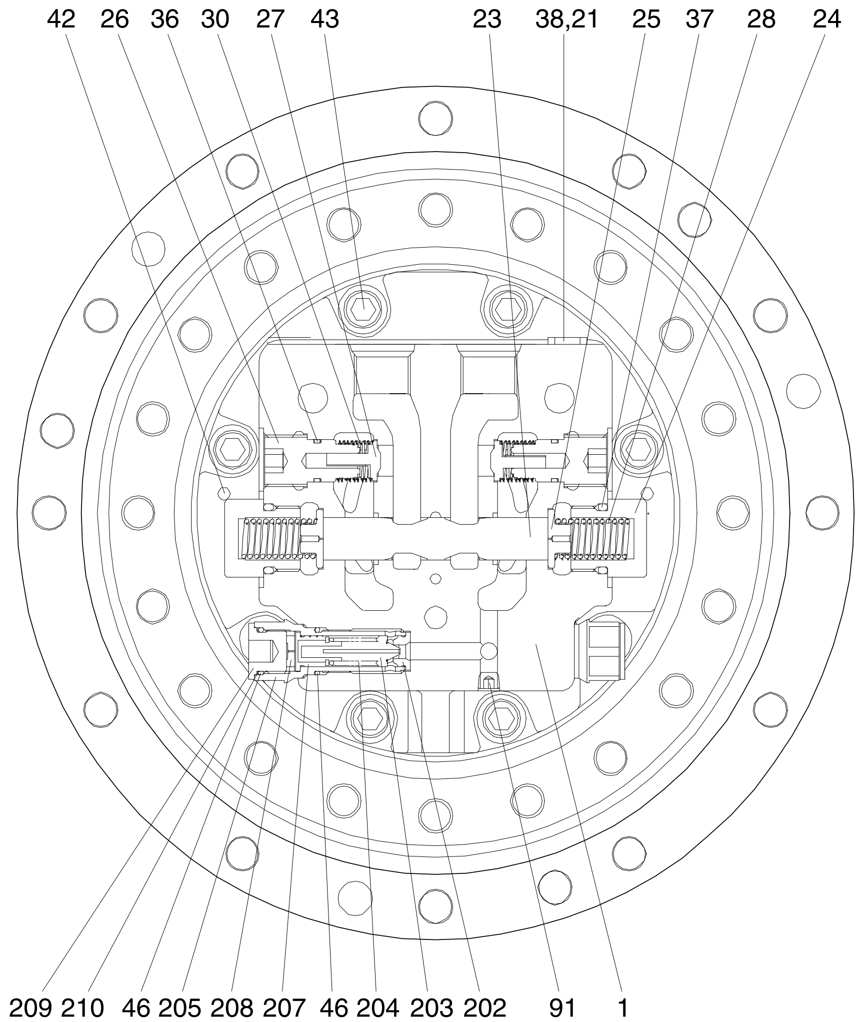
(1) Carry out installation in the reverse order to removal.

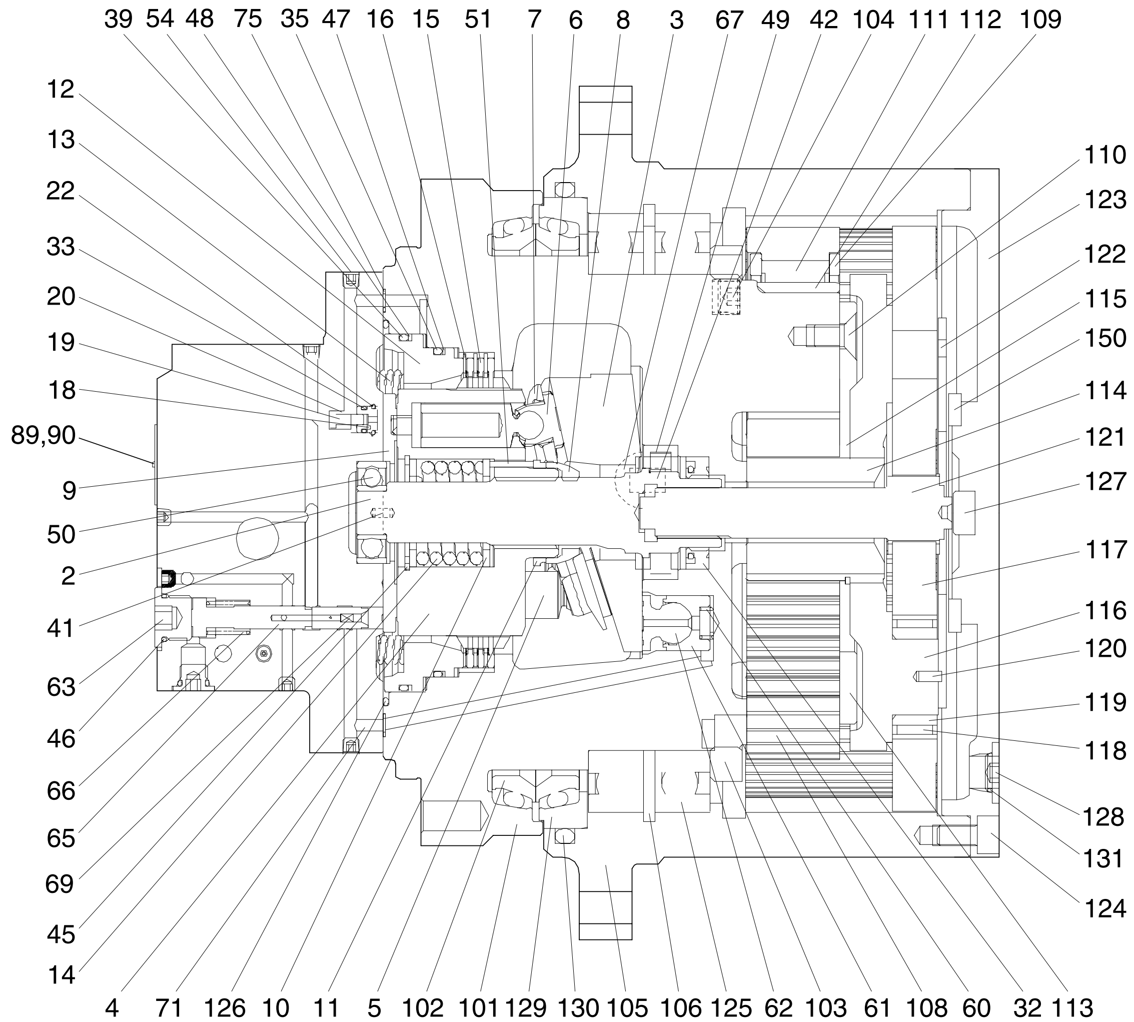
(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

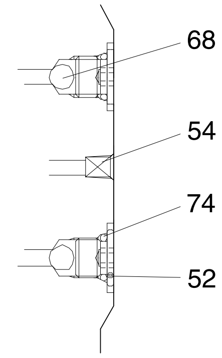
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. TRAVEL MOTOR

1) STRUCTURE







SECTION A - A

1	Rear flange	19	Valve	39	O-ring	65	2 Speed spool	108	Planetary gear	125	Angular bearing
2	Shaft	20	Spring	41	Parallel pin	66	2 Speed spring	109	Thrust washer	126	O-ring
3	Swash plate	21	Plug	42	Parallel pin	67	Pivot	110	Screw	127	Thrust washer
4	Cylinder block	22	Ring	43	Socket bolt	68	Steel ball	111	Needle bearing	128	Plug
5	Piston	23	Main spool	45	Snap ring	69	Set screw	112	Collar	129	Seal ring
6	Shoe	24	Main plug	46	O-ring	71	Orifice	113	Thrust plate	130	O-ring
7	Retainer plate	25	Retainer spring	47	Back up-ring	74	O-ring	114	Sun gear	131	O-ring
8	Thrust ball	26	Check plug	48	Back up-ring	75	O-ring	115	Snap ring	150	Thrust plate
9	Timing plate	27	Check valve	49	Roller bearing	89	Name plate	116	Holder	205	Body
10	Washer	28	Main spring	50	Ball bearing	90	Set screw	117	Planetary gear	206	Shim
11	Washer-collar	30	Check spring	51	Roller	91	Plug	118	Needle bearing	207	Piston
12	Piston-parking	32	Oil seal	52	Plug	101	Spindle	119	Inner race	208	Rod
13	Spring	33	O-ring	54	Plug	102	Floating seal	120	Spring pin	209	Plug
14	Spring	35	O-ring	60	Spring	103	Nut ring	121	Drive gear	210	Back up-ring
15	Friction plate	36	O-ring	61	Piston	104	Plug	122	Thrust plate		
16	Mating plate	37	O-ring	62	Shoe	105	Hub	123	Cover		
18	Seat valve	38	O-ring	63	Plug	106	Snap ring	124	Socket bolt		

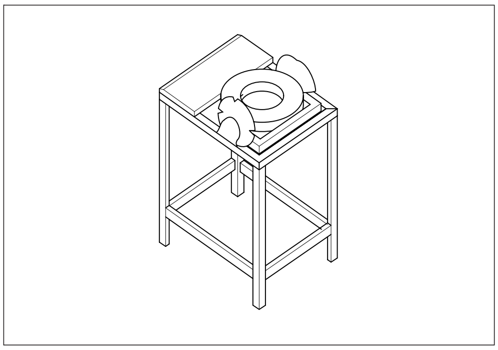
2) TOOLS

(1) Standard tools

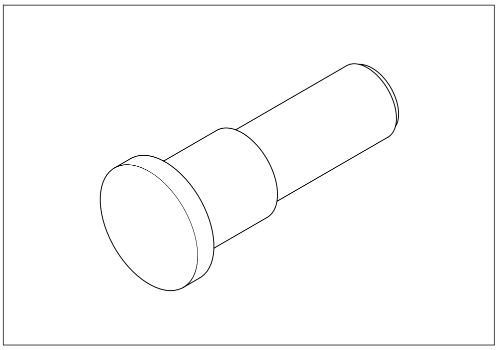
No.	Name	Description/Size	Qty
1	Hexagon wrench (JIS B 4650)	6 (M8) (PT1/4), 8 (M10)	each 1
		10 (M12) (PF1/2)	each 1
		4 (M6)	1
2	Socket wrench	-	1
3	Torque wrench	Nominal 30 kgf · m dial type	1
		Nominal 90 kgf · m dial type	1
4	Adapter for torque wrench	Socket 26, 27, 36	each 1
		Bar 4, 5, 6, 8, 10	each 1
5	Extension bar (JIS B 4637)	150 mm	1
6	Hammer (JIS B 4613)	12	1
7	Plastic hammer	L=300	1
8	(-) driver	150 mm	1
9	Snap ring plier	For shaft, For hole	1
10	Hanger	Weight : over 300 kgf	1
		Eye bolt (M16)	2
		Eye bolt (M10)	2
		Eye bolt (PF 1/2)	2
		Wire	1
11	Press	Press capacity above 200 kgf	1
12	Compressed air	3~5 kgf/cm^2, nozzle	1
13	Vessel	General vessel : W450 × D300 × H120	2
14	Heating vessel	Heating capacity : over 100 ˚C	1
		Volume : 500 × 500 × 500	
15	Depth micro-meter	Measuring range : 0.04 ~ 0.3 mm	1
16	Air hammer	BRH-8 (compressed air 5~6 kgf/cm^2)	1
17	Sealant	Silicone rubber (780-RTV)	1

(2) Special tools

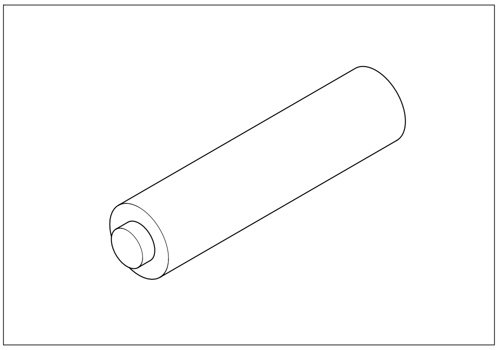
① Inversion working bench



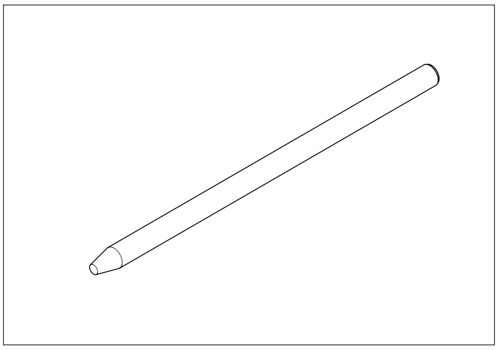
② Pressurize jig (Ⅰ)



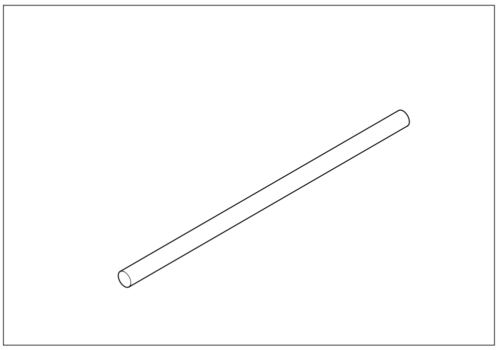
③ Pressurize jig (Ⅱ)



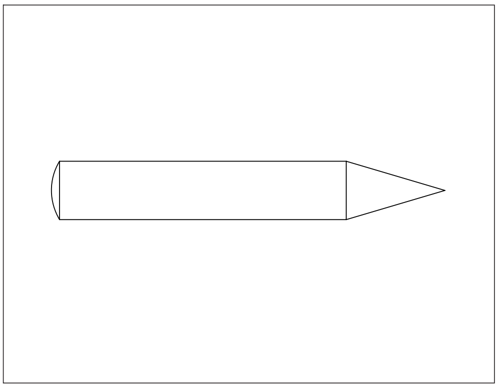
④ Aluminum bar



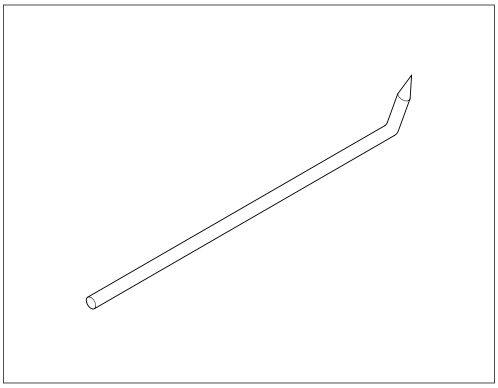
⑤ Steel bar



⑥ Sharp punch



⑦ Draw bar



3) TIGHTENING TORQUE

Item No.	Parts name	Size	Qty	Tightening torque	
				kgf · m	lbf · ft
21	Plug	PF 3/8	1	10 ± 2	72.3 ±14.5
24	Plug	M30×1.5	2	36 ± 7.2	260 ±52.1
26	Plug	M24×1.5	2	17 ± 3.4	123 ±24.6
43	Socket bolt	M10×1.5	8	5.9 ± 1.2	42.7 ±8.7
52	RO plug	PF 1/4	4	3.0 ± 0.5	21.7 ±3.6
54	Plug	NPTF 1/16	7	1.0 ± 0.25	7.2 ±1.8
63, 209	Plug	PF 1/2	1	3.0 ± 0.5	21.7 ±3.6
91	Plug	PT 1/8	4	1.25 ± 0.2	9 ±1.4
104	Plug	PT 3/8	3	6.0 ± 0.9	43 ±6.5
110	Screw	M6	4	0.83 ± 0.12	6 ±0.9
128	Plug	PF 3/8	3	6.0 ± 0.9	43 ±6.5
124	Socket bolt	M8	12	1.25 ± 0.2	9 ±1.4
205	Body	M20	1	12 ± 1.5	86.8 ±10.8
301	Plug	PF 1 1/2	1	26 ± 5.2	188 ±37.6

3. DISASSEMBLY

3.1 GENERAL PRECAUTIONS

1) Spread rubber or vinyl cover on the work bench.

2) When disassembling the travel motor, provide a match mark on the mating face or each part.

3) Arrange the detached parts to prevent them from being damaged or lost.

4) The disassembled seals must be replaced with new ones as a rule even if they are free from damage. For disassembly, therefore, prepare new seals in advance.

3.2 DISASSEMBLY PROCEDURE

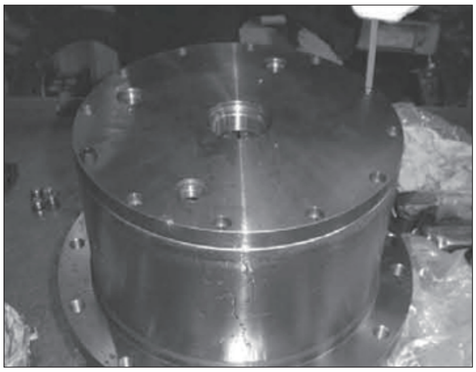
1) When inspecting or repairing the travel motors, use the disassembling procedures described below.

2) Numerals in brackets ( ) following the part name denote the item numbers used in the structure drawing at page 8-65.

3) Prior to disassembly, install the travel motor on a inversion working bench.

3.3 DISASSEMBLING ORDER

1) DISASSEMBLING THE REDUCTION GEAR PART



(1) Remove plugs (128, 3EA) and drain the reduction gear oil.

(2) Loosen socket bolts (124, 16EA) and remove the cover (123).

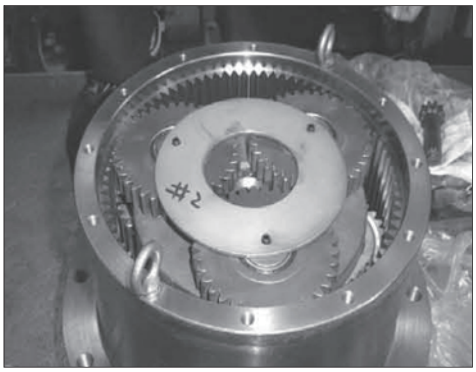
※ Remove the cover (123), after hook it, fit the eye bolt in a screw hole for use of the plug (128). If it's impossible, please remove the cover using the rod.

※ You can have difficulty removing it because loctite is spread in the socket bolt (124).

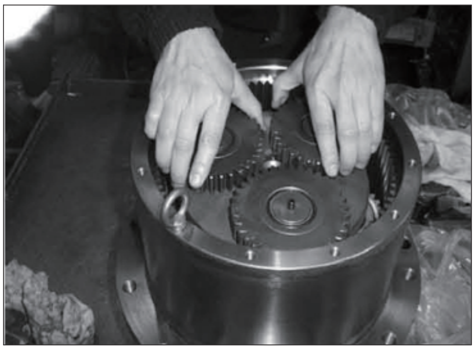
※ Tools

· Hexagon wrench 6, 8

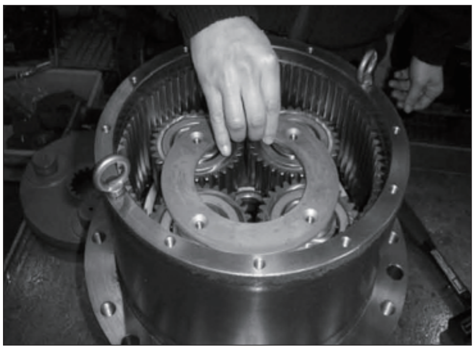
(3) Remove thrust plate R (122) and drive gear (121).



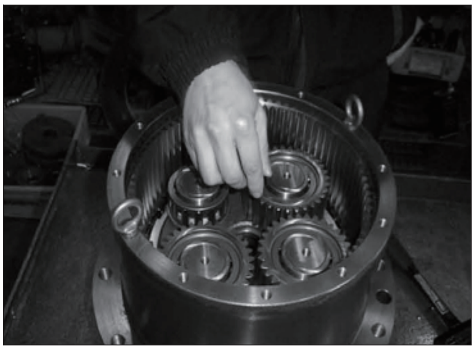
(4) Remove planetary gear R (117), needle bearing, inner race (119) and holder (116) from hub (105).



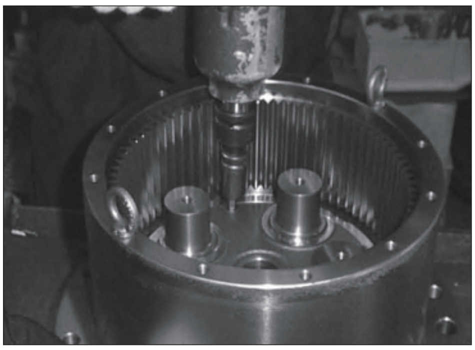
(5) Remove sun gear (114), screw (110) and thrust plate F (113).



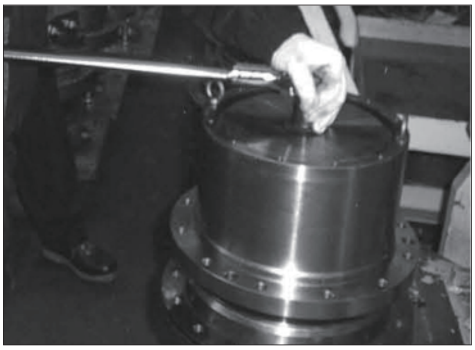
(6) Remove the thrust washer (109), planetary gears F (108), needle bearings (111) and collar (112) from hub (105).



(7) Remove the plugs (104, 3EA).

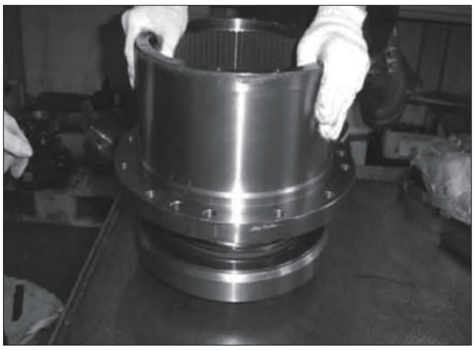


(8) Remove the nut ring (103) from hub (105).

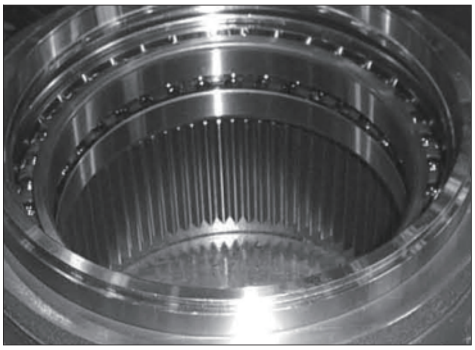


(9) Remove the spindle (101) from the hub (105).

※ Remove it using a crane after eye bolt is assembled at the hub (105).

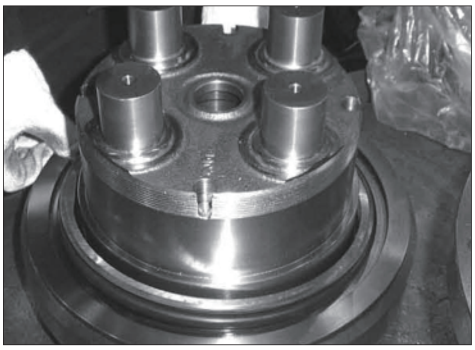


(10) Remove the floating seal (102), seal ring (129), angular bearings (125, 2EA), snap ring (106) and O-ring (130) from the hub (105).

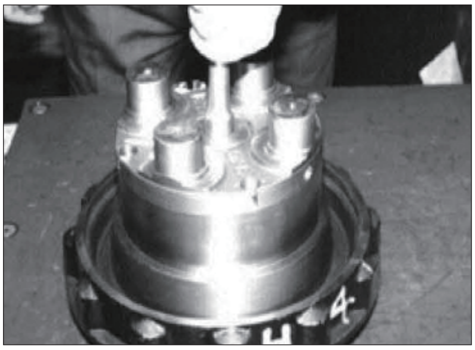


(11) Remove the floating seal (102) from the spindle (101).

※ User can remove easily if using (-) drivers.



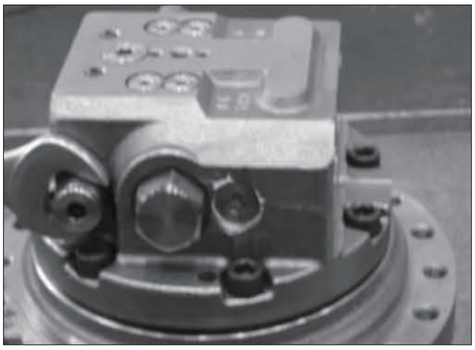
(12) Remove the oil seal (32) from spindle (101).



2) DISASSEMBLING THE HYDRAULIC MOTOR PART

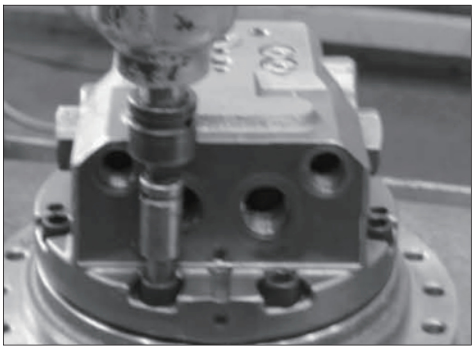
(1) Remove the relief valve (70, 2EA) from rear flange (1).

※ Tools
· Hexagon socket
· Torque wrench



(2) Remove hexagon socket head bolts (43, 8EA) from the rear flange (1).

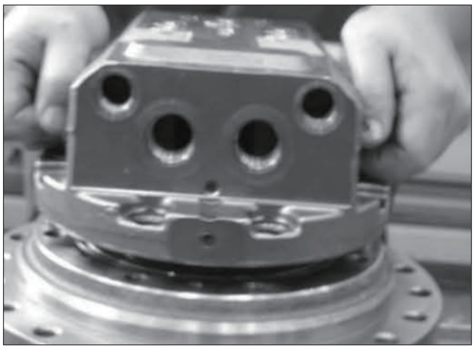
※ Tools
· Hexagon wrench 8



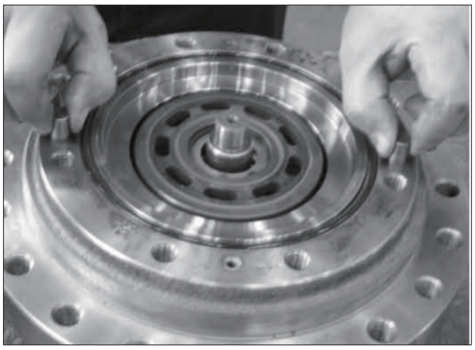
(3) Remove the rear flange (1) from the spindle (101).

(4) Remove the springs (13, 10EA) form the rear flange [1].

※ Remove the rear flange (1) carefully after taken using hands. Be careful not to detach the timing plate (9) and the spring (13) if twisted or beated by constraint.

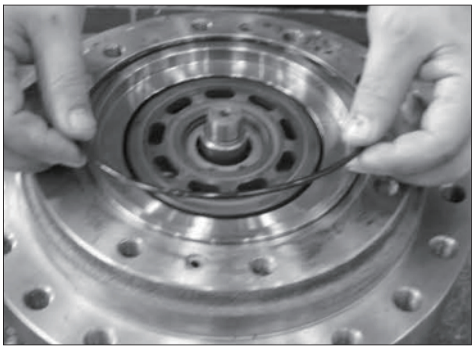


(5) Remove the parallel pin (42) from the spindle (101).



(6) Remove the O-ring (126) from the spindle (101).

※ Do not reuse the O-ring (126).



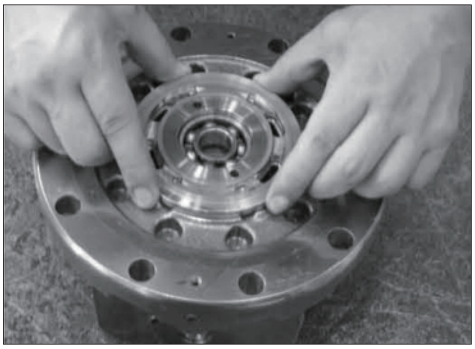
(7) Disassembling the rear flange (1) part

① Place the rear flange with the contact surface of the spindle upward.

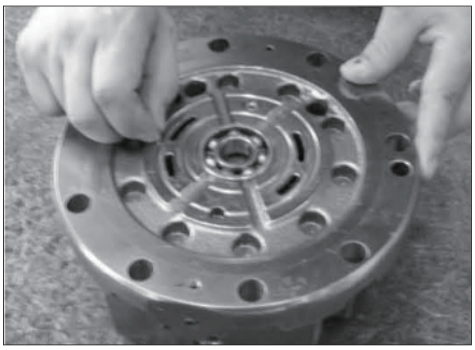
② Remove the timing plate (9) from the rear flange (1).

※ When removing the timing plate, user can have difficulty of the removal due to the close adhesion of rear flange (1) and oil. Remove it after fitting a rod through the hole which is used when a casting is detached.

※ Be careful of the leakage due to both surface scratch if using a sharp tool.



③ Remove the paralell pin (41) from the rear flange (1).



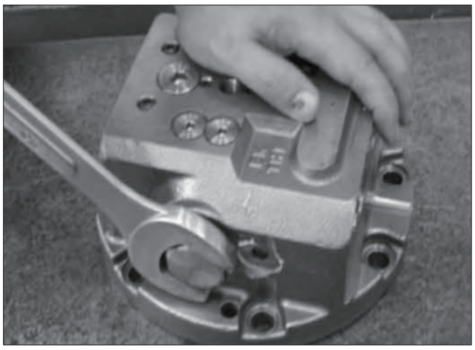
④ Remove the ball bearing (50) from the rear flange (1).

(8) Disassembling the brake valve part

① Remove two plugs (24) from the rear flange (1).

※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools
  · Hexagon wrench 36
  · Torque wrench

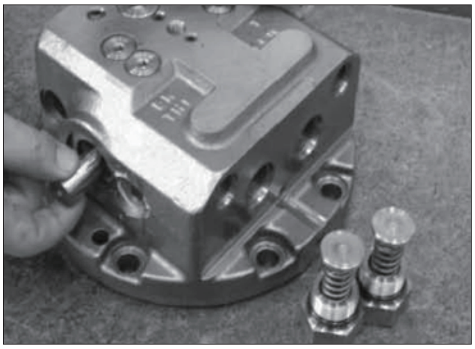


② Take out two spring retainers (25), two springs (28) from the rear flange (1).

③ Remove the spool (23) from the rear flange (1).

※ Be careful not to damage the outer surface of the spool (23) and the sliding surface of the rear flange (1).

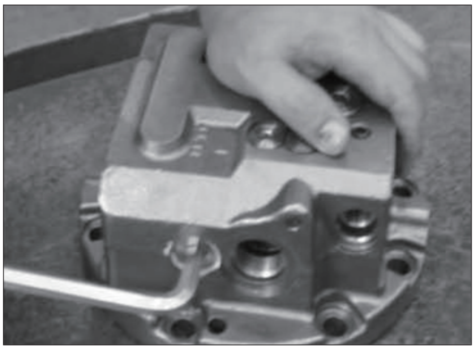
※ Since the rear flange (1) and the spool (23) are of the selective fitting type, replace them together as a kit even if only one of the two parts is damaged.



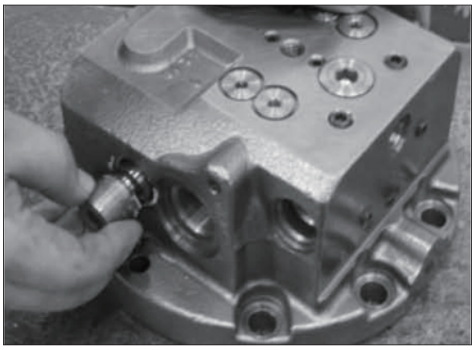
④ Remove two plugs (26) from the rear flange (1).

※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools
  · Hexagon wrench 10

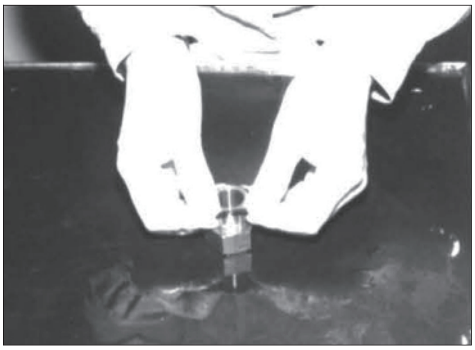


⑤ Remove the springs (30, 2EA), valves (27, 2EA) from rear flange (1).



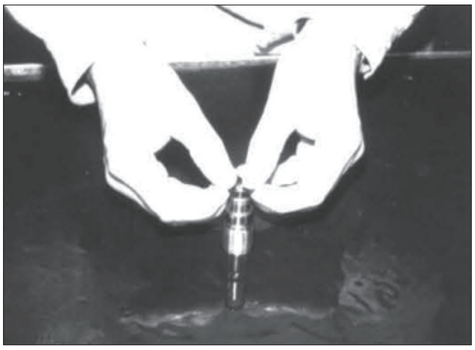
⑥ Remove the O-ring (37) from plug (24).

※ Do not reuse the O-ring (37).



⑦ Remove the O-ring (36) from plug (26).

※ Do not reuse the O-ring (36).



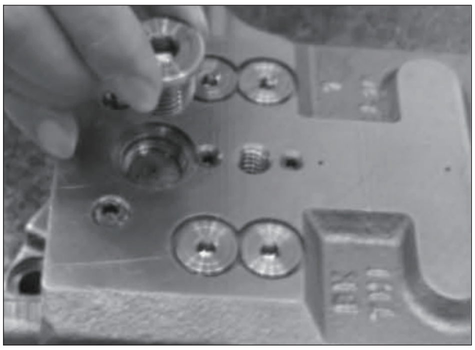
(9) Disassembling the two speed change valve

① Remove the plug (63) from the rear flange (1).

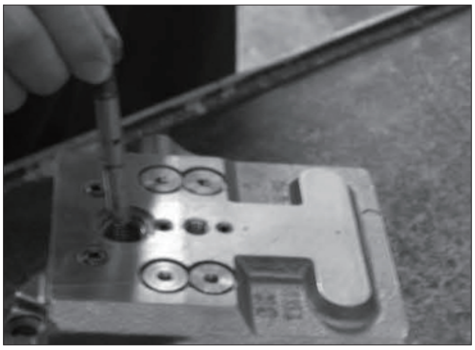
※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools

· Hexagon wrench 10



② Remove the spool (65) and spring (66) from rear flange (1).



(10) Disassembling the plug (52).

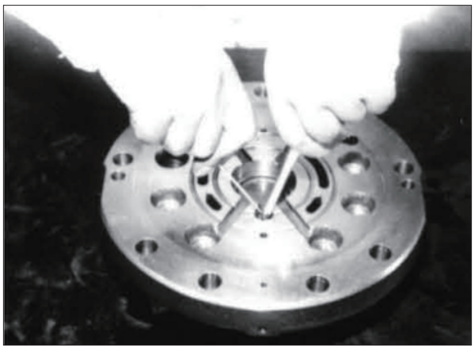
① Do not remove plug (52) if it not to be necessary. Disassembling the plug (52) if it was malfunction because of get mixed with dust. Clean the plug (52) after disassembled.

※ Be careful not to drop the steel ball (68).

(11) Disassembling the parking brake valve (19)

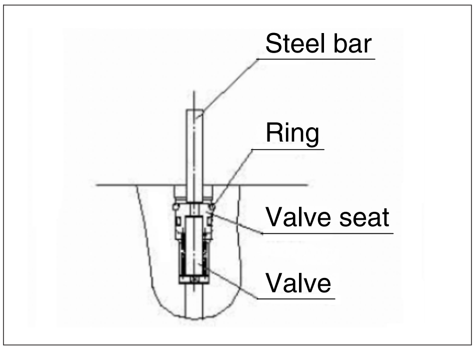
① Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.

② Pushing valve seat (18) by a steel bar, disassemble ring (22) from rear flange (1).

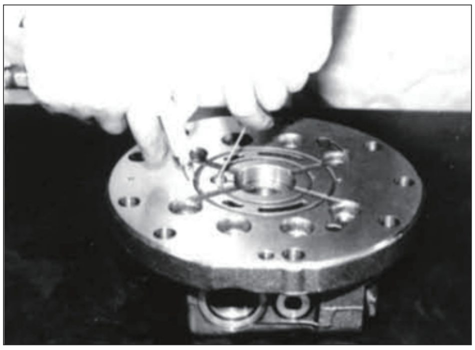


※ Do not remove ring (22) if it not to be replace.

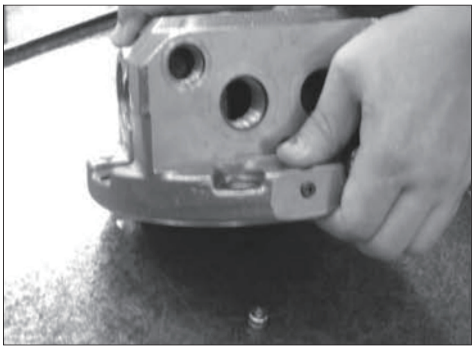
※ Do not reuse the ring (22), valve seat (18) and O-ring (33).



③ Remove the valve seat (18) by injecting compressed air from the access hole in the spindle (101) after caulking the hole of valve seat (18).



④ Remove the valve (19) and spring (20) from rear flange (1) downside hole with shaking lightly.

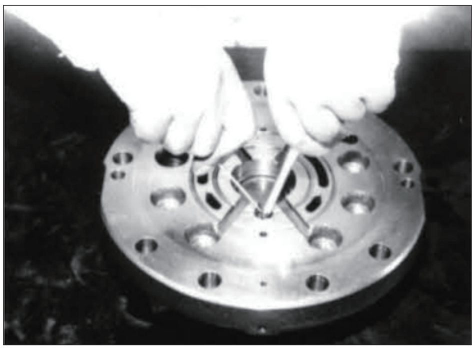


⑤ Remove the O-ring (33) and valve seat (18).
※ Do not reuse the O-ring (33).

(12) Disassembling the parking brake

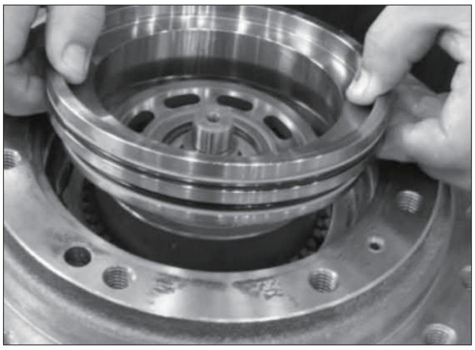
① Remove the piston (12) by injecting compressed air from the parking brake access hole in the spindle (101).

※ Use the protection cover on the upper part of spindle (101) when users put the pressed air into suddenly. Otherwise part damage and accident might go on because the piston (12) is rushed out of the spindle (101).



② Remove the O-rings (35, 39) and backup rings (47 , 48) from the piston (12).

※ Do not reuse O-rings (35, 39) and backup rings (47, 48) after removal.

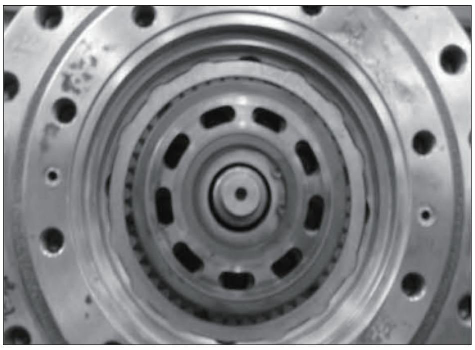


(13) Disassembling the hydraulic motor part

① Lay the travel motor body on the side.

② Drain out the oil from the travel motor.

※ Place an oil receptacle under the travel motor to receive the oil flowing out as the motor is being laid on the side.

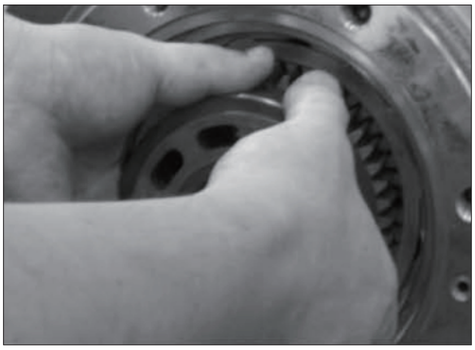


③ Hold the cylinder block (4) with both hands, and remove it from the shaft (2).

④ Remove the mating plates (16) and friction plates (15) from the cylinder block (4).

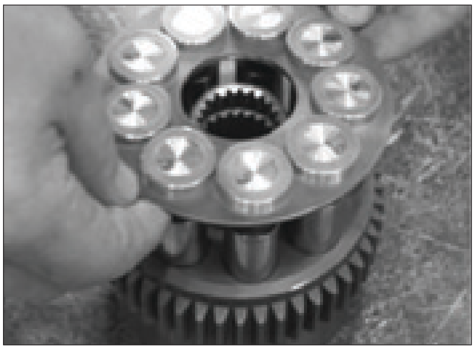
※ Before removal, hold the cylinder block (4) with both hands and turn it two to three times in a clockwise and a counterclockwise direction alternately to detach the shoe (6) from the swash plate (3).

※ Be careful that if an attempt is made to remove the cylinder block (4) without detaching the shoe (6) from the swash plate (3), then the piston, shoe and other parts that are connected to the cylinder block may come the cylinder loose and fall into the spindle (101).



(14) Disassembling the cylinder block kit

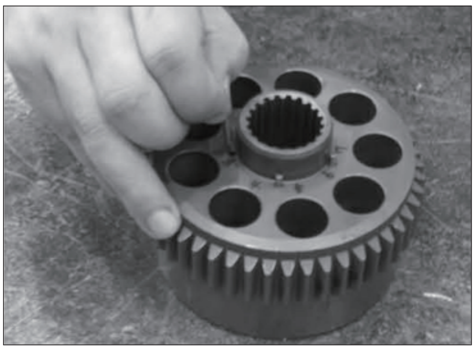
① Piston assembly [piston (5), shoe (6)] from the removed cylinder block (4).



② Piston (5) and shoe (6) from the removed retainer plate (7).

③ Thrust ball (8) from the removed cylinder block (4).

④ Roller (51, 5EA) from the removed cylinder block (204).

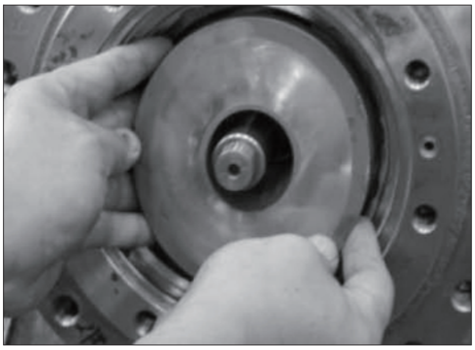


(15) Disassembling the spring of the cylinder block

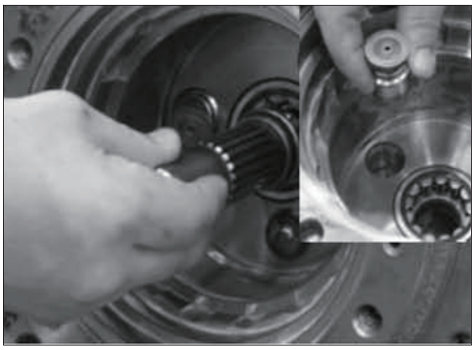
① Put the cylinder block (4) on the pressurize jig.
② Press the washer (10) with pressurize jig, and remove the spring (14) after snap ring (45) removed.
※ Put a vinyl cover on the sliding surface of cylinder block (4) for protection.
※ Do not remove spring (14) if it not to be replace.

③ Remove the snap ring (45), washer (10), spring (14) and washer (10) from cylinder block (4).

(16) Disassembling the shaft



① Remove swash plate (3) from the shaft (2).
② Remove shaft (2) from the spindle (101).
※ When separating the swash plate, separate and turn it by using hands to free from intervention of the stopper.



③ Remove speed selector piston assembly [piston (61) and shoe (62)] form the spindle [101] by feeding compressed air into the access hole in spindle (101).
④ Remove parallel pins (42, 2EA) and pivots (67, 2EA) from the spindle (101).
⑤ Remove roller bearing (49) from the spindle (101).
※ Piston assembly ; Piston (61), Shoe (62)
※ Compressed air ; 3~5 kgf/cm^2 (43~71 psi)
※ When piston (61) or shoe (62) is damaged, if exchange is necessary, they have to be exchanged together because the separation is impossible. Use the protection cover on the upper part spindle when users put the compressed air into suddenly. Otherwise part damage and accident might go on because the piston is rushed out of the spindle.

4. REASSEMBLY

4.1 GENERAL PRECAUTIONS

1) Reassemble in a work area that is clean and free from dust and dirt.

2) Handle parts with bare hands to keep them free of linty contaminants.

3) Repair or replace the damaged parts.
Each parts must be free of burrs its corners.

4) Do not reuse O-ring, oil seal and floating seal that were removed in disassembly. Provide the new parts.

5) Wash all parts thoroughly in a suitable solvent. Dry thoroughly with compressed air.
Do not use the cloths.

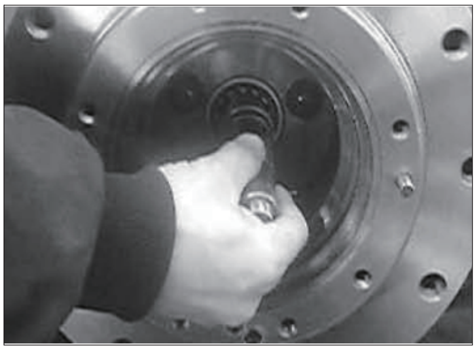
6) When reassembling oil motor components of travel motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)

7) Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

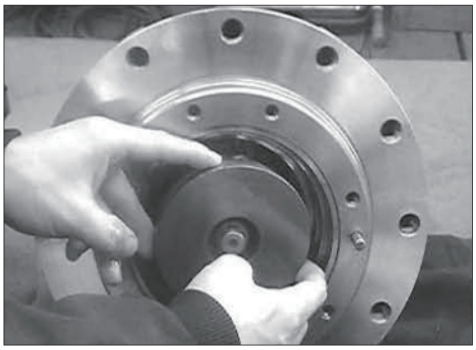
4.2 REASSEMBLY PROCEDURE

1) REASSEMBLE THE HYDRAULIC MOTOR PART

(1) Install roller bearing (49) into the spindle (101).
(2) Install pivots (67, 2EA), parallel pin (42, 2EA) and two speed piston assembly (61, 62) into the spindle (101).
(3) Install shaft (2) into the roller bearing (49) assembled spindle (101).
※ Be careful not to damage the seal (3) of assembling part.



(4) Lay the travel motor body on the side.
(5) Apply lithium grease to the shaft (2)'s spline part.
(6) Install swash plate (3) to the spindle (101).



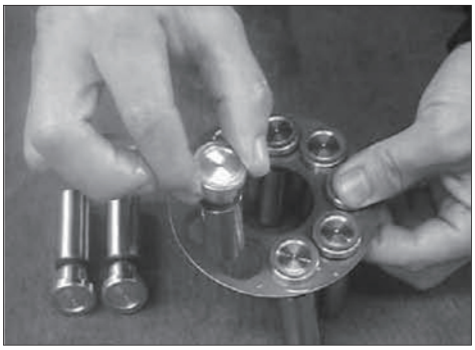
(7) Reassembe the cylinder block kit

① Install washer (10), spring (14, 9EA), washer (10) and snap ring (45) in that order, into the cylinder block (4) inner part.
② Put the cylinder block (4) on the pressurize jig.

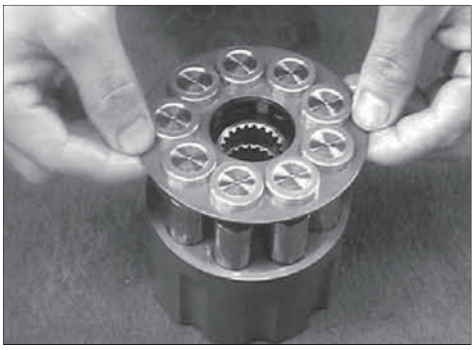
③ While pressing washer (10) by pressurize jig, install snap ring (45).
※ Put a vinyl cover on the sliding surface of the cylinder block (4) and timing plate (9) for protection.

(8) Reassembe the hydraulic motor

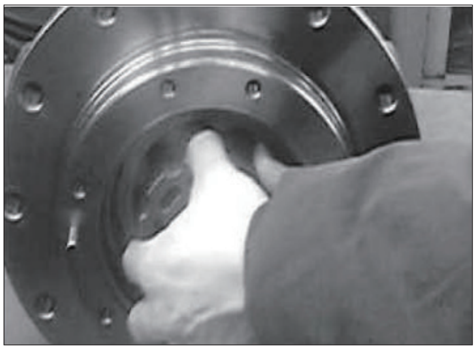
① Install roller (51, 5EA) to the pin hole of cylinder block (4).
② Install thrust ball (8) to the cylinder block (4).
③ Insert piston assembly [piston (61) and shoe (62), 9 set] into retainer plate (7).
※ After mounting, immerse the entire them in a working fluid.



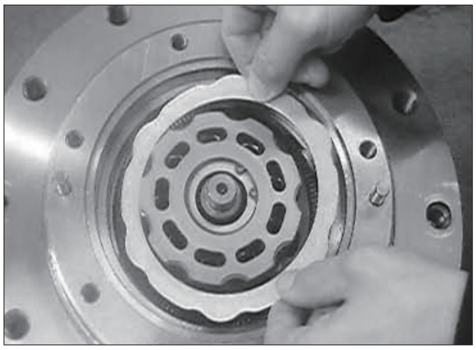
④ Mount the piston assembly (9 set) into the cylinder block (4).
※ The retainer plate (7) must be in contact with the round part of thrust ball (8).



⑤ Install cylinder block (4) assembly to the shaft (2).
※ After fitting splines of both cylinder block (4) and shaft (2), assemble them.
※ After installing the cylinder (4), confirm whether it revolves or not by turning using both hands.
※ Motor is malfunction when it isn't revolve.

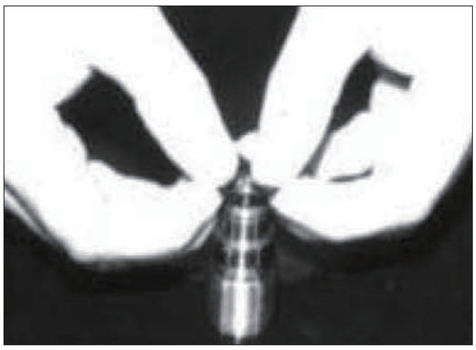


(9) Reassembe the parking brake
① Install mating plate (16) first and then a friction plate (15), one by one, into the grooves of the outer surface of the cylinder block (4).
※ Immerse the friction plates (15) in a working fluid before fitting them into the grooves.

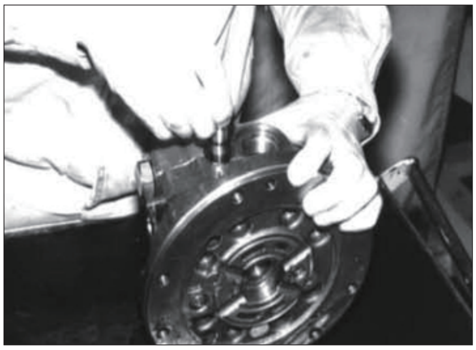


② Install two O-rings (35, 39) and two back up ring (47, 48) into O-ring grooves.
③ Mount a piston (12) in the spindle (101).
※ Apply a thin coat of grease to the O-rings (35, 39).
※ If the piston (12) does not fit into the spindle (101) because of the resistance of the O-ring, tap the edge of the piston (12) lightly and equally with a plastic hammer.
※ Be careful not to damage the O-ring and back up ring at this time.

2) REASSEMBLE THE REAR FLANGE (1) PART
(1) Reassemble the check valve
① Install O-ring (36, 2EA) on the plug (26, 2EA).
※ Apply grease to the O-ring (36).

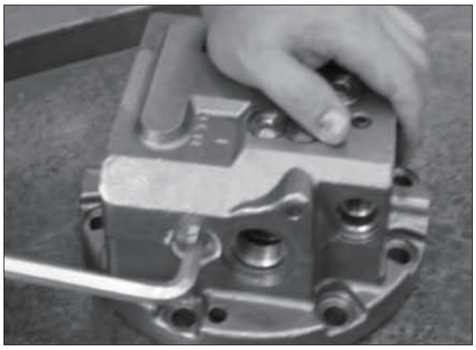


② Install spring (30) and valve (27) into the plug (26).
③ Install plug (26) into the rear flange (1).
※ Install spring (30) and valve (27) into the plug (26), and then grease the spring (30) and the valve (27) and hand-lock the former.



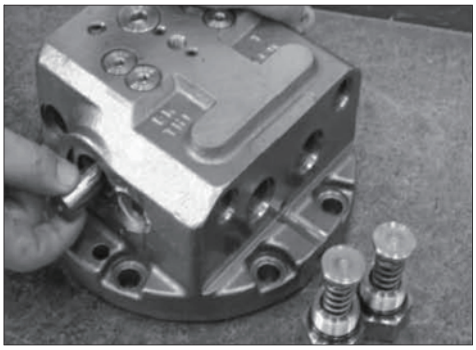
④ Install plug (26) in conjunction with the spring (30) and the valve (27) into the rear flange (1), and tighten the plug to the required torque.

※ Tightening torque : 17±2.6 kgf · m (123±18.8 lbf · ft)
※ Tools
  · Adapter for hexagon wrench 10
  · Torque wrench

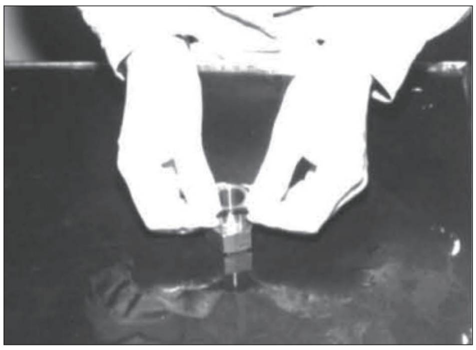


⑤ Install spool (23) into the rear flange (1).

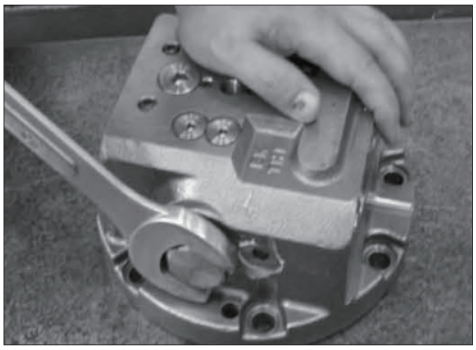
※ Before installing the spool (23), apply hydraulic oil to the spool. Be careful not to damage the spool's surface and the inner of rear flange (1).



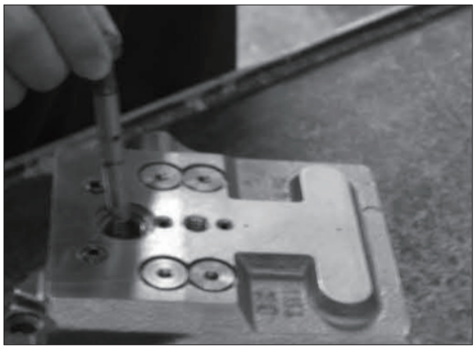
⑥ Install O-ring (37) on the plug (24).
Apply grease to the O-ring (37).



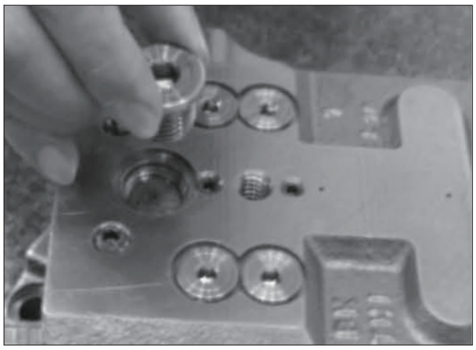
⑦ Install spring retainer (25) and spring (28) into the plug (24).
⑧ Install plug (24) into the rear flange (1).
⑨ Tighten the plug (24) to the required torque.
※ Tightening torque : 36±5.4 kgf · m (260±39 lbf · ft)
※ Socket (#36) / Torque for hexagon wrench.
※ Tools
· Hexagon socket 36
· Torque wrench



(2) Reassembe the two speed change valve
① Install spring (66) into the valve (65).
② Insert the valve (65) into the rear flange (1).



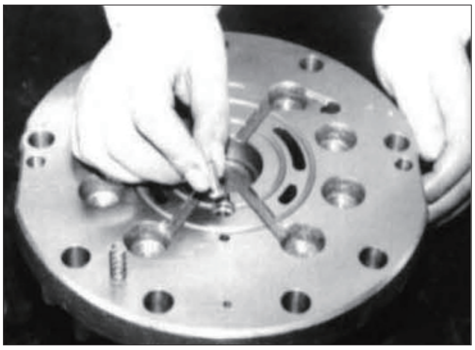
③ Insert a plug (63) into the rear flange (1).
※ Tightening torque : 13±2.6 kgf · m (94±18.8 lbf · ft)
※ Tools
· Adapter for hexagon wrench 10
· Torque wrench



(3) Reassembe the parking brake valve
① Install O-ring (33) on the valve seat (18).
※ Do not reuse the O-ring (33).

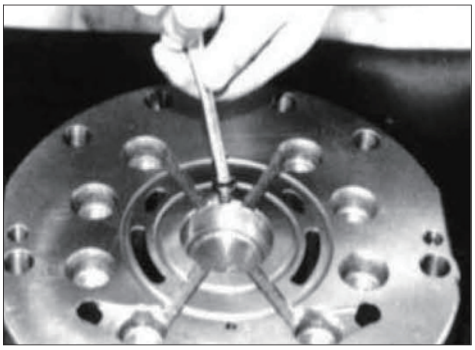
② Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.

③ Install valve (19), spring (20) and valve seat (18) in that order.



④ After new ring (22) bend somewhat and put the valve seat (18), then into the rear flange (1) ring's groove.

※ Do not reuse the ring (22).



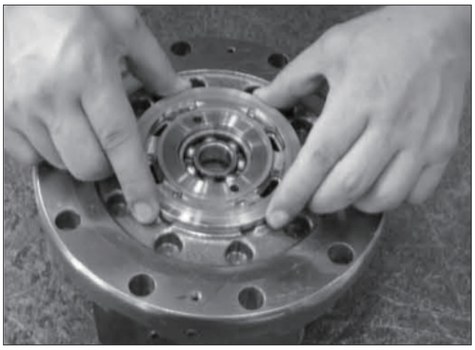
⑤ Install ball bearing (50) into the rear flange (1).

※ Apply hydraulic oil to the ball bearing (50).

⑥ Install parallel pin (41) into the pin hole of rear flange (1).

⑦ Install timing plate (9) into the rear flange (1).

※ Apply hydraulic oil to the contact surface of rear flange.



(4) Reassembe the rear flange (1) and spindle (101)

① Tilt the work bench 90˚ for travel motor reassembling.

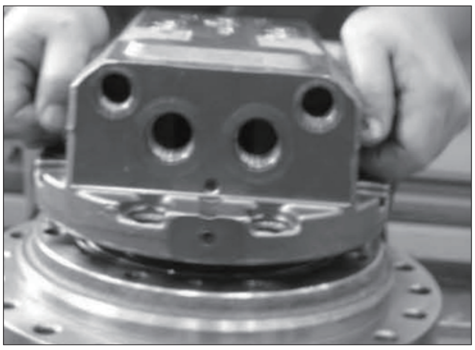
② Insert the O-ring (75, 126) on the spindle (101).

※ Apply grease to the O-rings (75, 126) thinly.

③ Install parallel pins (42, 2EA) into the spindle (101).

④ Mount the rear flange (1) on the spindle (101).

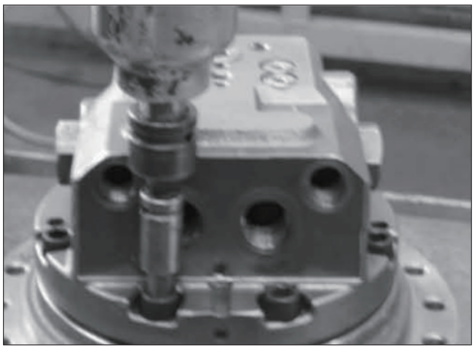
※ When the rear flange (1) is mounted on the spin-dle (101), fix the spring (13) applied grease to not drop.



⑤ Tighten the socket bolt (43) into the spindle (101) to the required torque.

※ Tightening torque : 5.9±1.0 kgf·m (42.7±7.2 lbf·ft)

※ Tools
- · Adapter for hexagon wrench 8
- · Torque wrench



⑥ Tighten the plug (24) into the rear flange (1) to the required torque.

※ Tightening torque : 13±4.0 kgf·m (94±28.9 lbf·ft)

※ Tools
- · Hexagon socket 36
- · Torque wrench

⑦ Tighten the plug (26) into the rear flange (1) to the required torque.

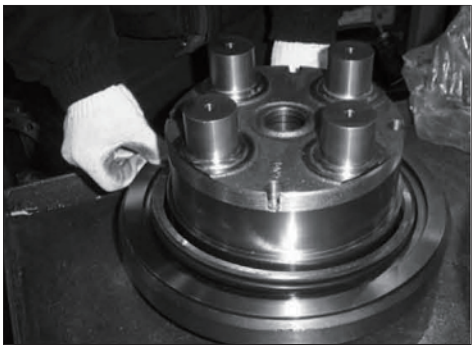
※ Tightening torque : 36±1.5 kgf·m (260±10.8 lbf·ft)

※ Tools
- · Hexagon socket 10
- · Torque wrench

3) REASSEMBLE THE REDUCTION GEAR ASSEMBLY

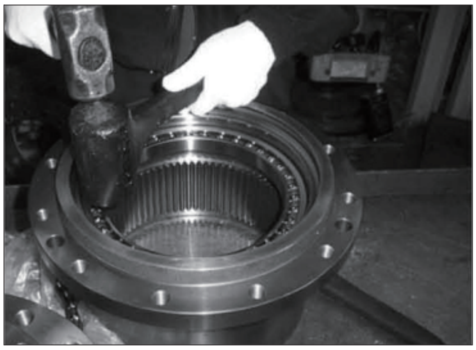
(1) Install floating seal (102) on the spindle (101).

※ Apply grease to the floating seal (102).



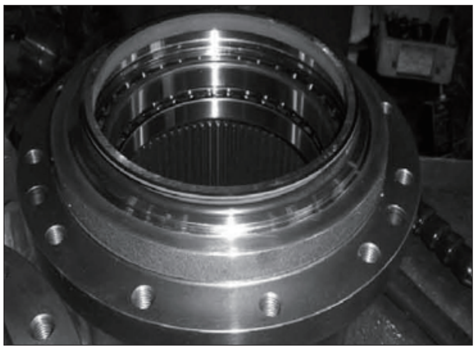
(2) Install angular bearing (125) and snap ring (106) into the hub (105).

※ Be careful for the insert direction.

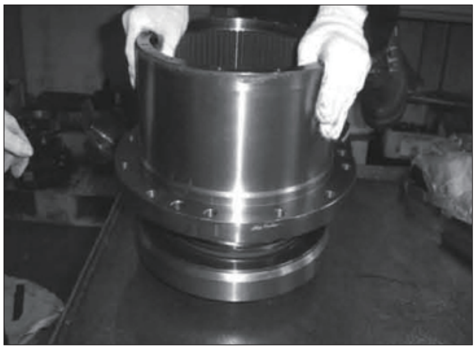


(3) Insert the O-ring (130), the sealing (129) and floating seal (102) in the hub (105).

※ Apply grease to the floating seal (102) thinly.



(4) Install the spindle (101) into the hub (105) assembly.



(5) Tighten the nut ring (103) and plug (104) into the hub (105) to the required torque.

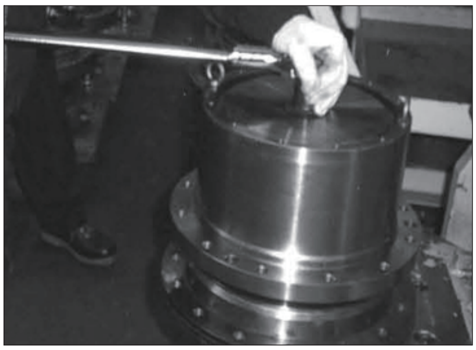
※ Do not wind the seal tape to the plug (104).

※ Punch two place for not to loosen the plug (104).

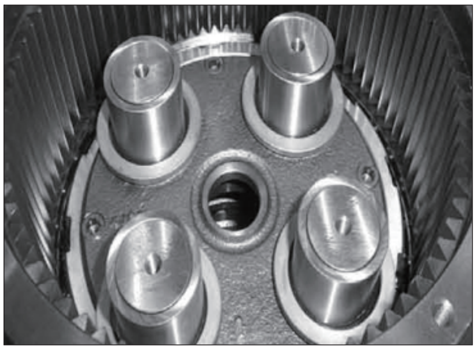
※ Tightening torque : 3.5±0.7 kgf · m (25.3±5.1 lbf · ft)

· Hexagon socket 8

· Torque wrench



(6) Install thrust washer (109) and collar (112) into the hub (105).

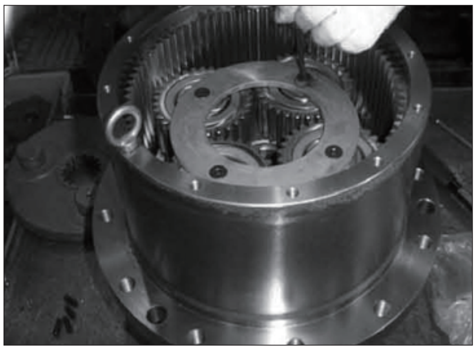


(7) Install needle bearing (111) planetary gear F (108), thrust washer (109), thrust plate F (113) and screw (110) into the hub (105).

※ Tightening torque : 0.83 kgf · m (6.0 lbf · ft)

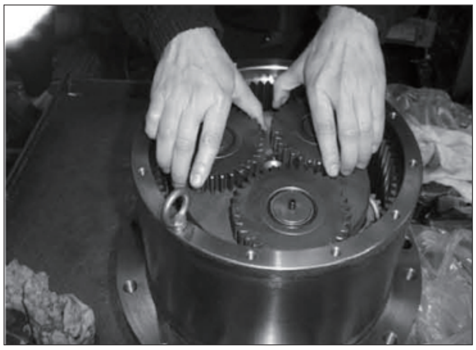
· Hexagon socket 5

· Torque wrench

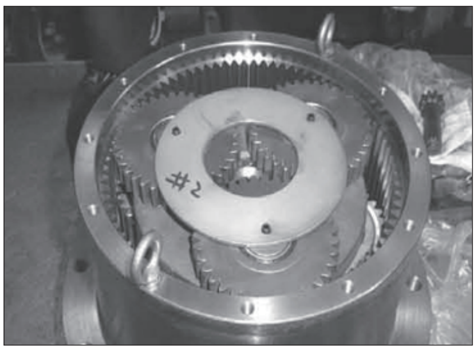


(8) Install sun gear (14) and holder assembly, then insert needle bearing (118) and planetary gear R (117) into the hub (105).

※ Holder assembly : holder (116) + spring pin (120) + inner race (119)

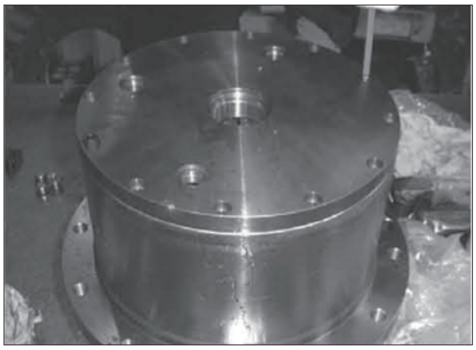


(9) Install drive gear (121) and thrust plate R (122) into the hub (105).



(10) Install cover (123), thrust plate (150), plug (301, 128) and socket bolt (124) into the hub (105).

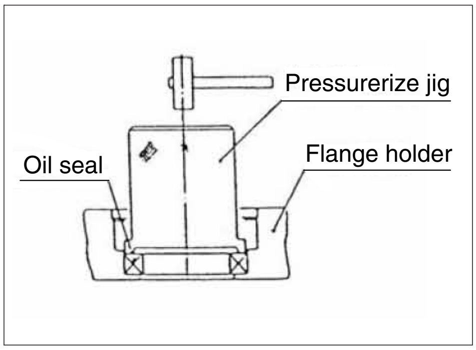
※ Apply grease to the cover (123) after installed O-ring (127).



(11) Pressing the oil seal

① Insert the oil seal (32) by hit the pressurize jig with plastic hammer.

※ Apply grease to the seat of oil seal (32).



3.3 CHECKING FACTS AFTER ASSEMBLY

1) AIR TEST OF REDUCTION GEAR

Disassemble plug (128) of reduction gear part. When compressed air (0.3 kgf/cm^2) is inserted that in water during the 2 minutes, it should be not happened air bubble.

Fill the gear oil.

· Oil amount : 3.0 liter (0.79 U.S.gallon)

2) AIR TEST OF HYDRAULIC MOTOR

One port should be opened, the others port should be closed. When compressed air (3 kgf/cm^2) is inserted opened port in water during the 2 minutes, it should be not happened air bubble.

Fill the hydraulic oil.

· Oil amount : 0.55 liter (0.15 U.S.gallon)

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

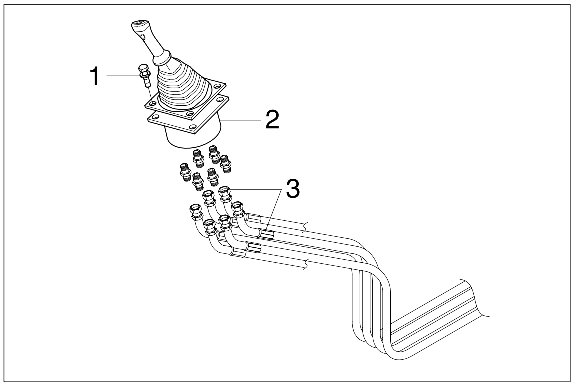
1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**



(4) Loosen the socket bolt (1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.

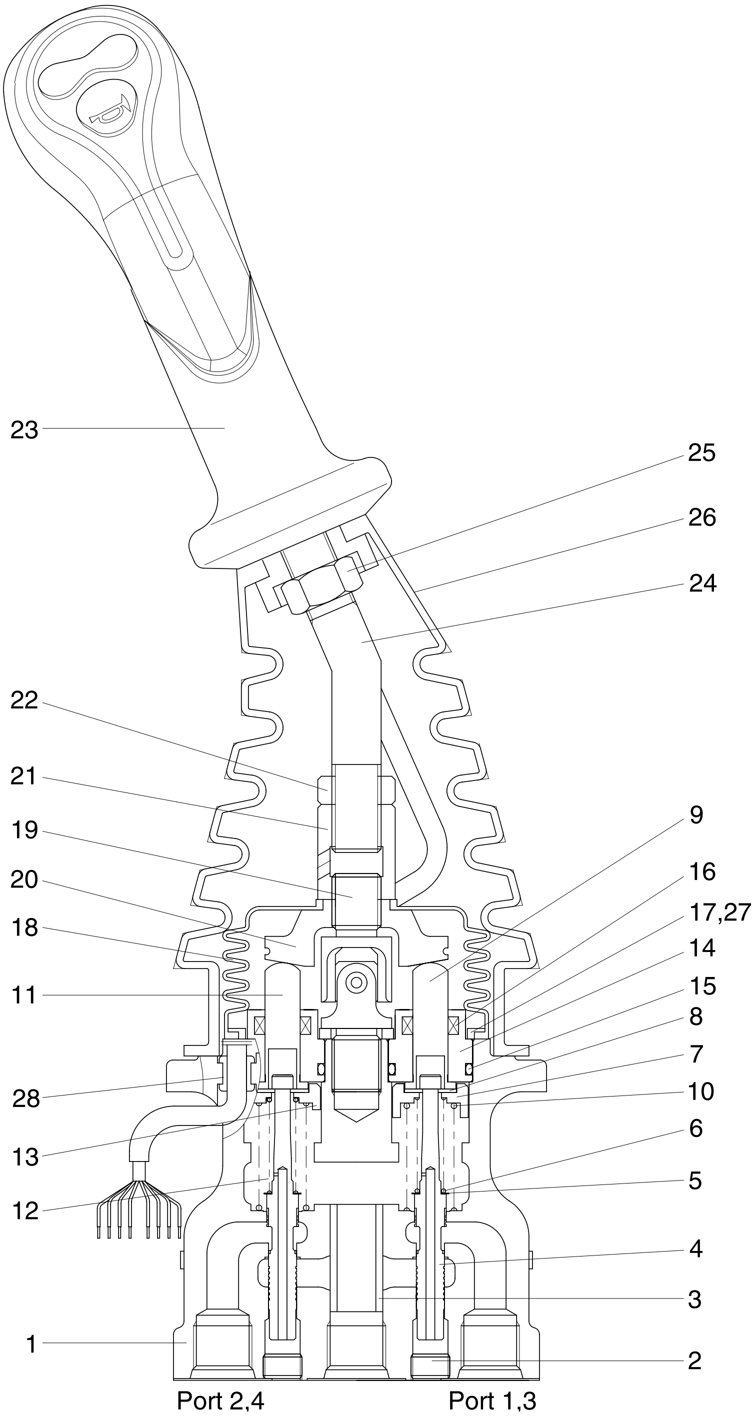
2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

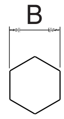
1) STRUCTURE



1	Case	8	Stopper	15	O-ring	22	Lock nut
2	Plug	9	Push rod	16	Rod seal	23	Handle assembly
3	Bushing	10	Spring	17	Plate	24	Handle bar
4	Spool	11	Push rod	18	Boot	25	Nut
5	Shim	12	Spring	19	Joint assembly	26	Boot
6	Spring	13	Spring seat	20	Swash plate	27	Spring pin
7	Spring seat	14	Plug	21	Adjusting nut	28	Bushing

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanner	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Plug	2	PT 1/8	3.0	21.7
Joint	19	M14	3.5	25.3
Swash plate	20	M14	5.0±0.35	36.2±2.5
Adjusting nut	21	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

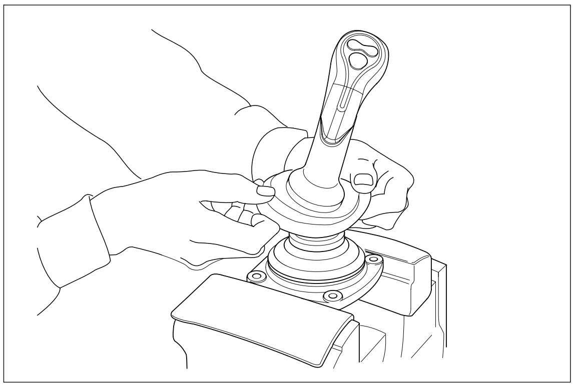
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

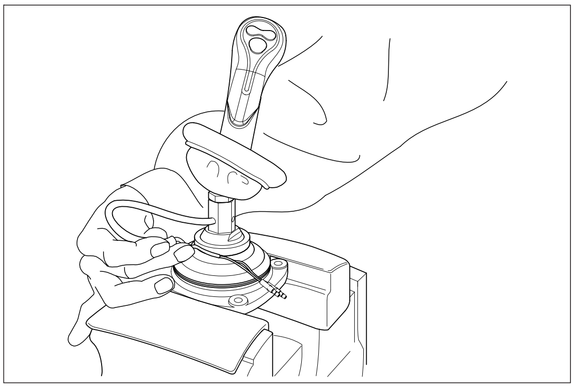
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper (or lead) sheets.

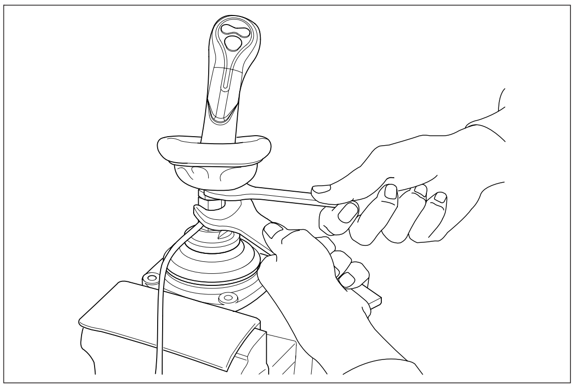
(3) Remove end of boot (26) from case (1) and take it out upwards.



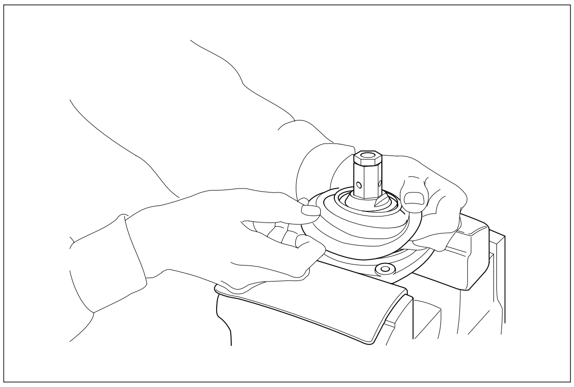
※ For valve with switch, remove cord also through hole of casing.



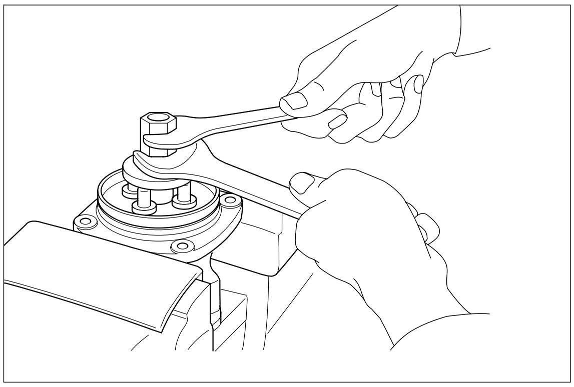
(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.

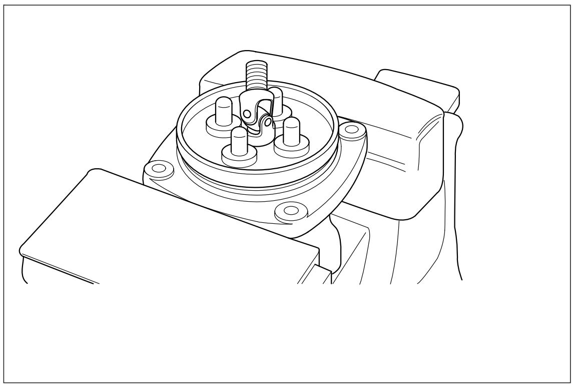


(5) Remove the boot (18).



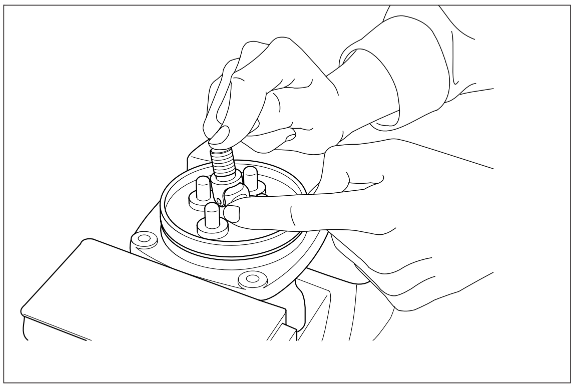
(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.

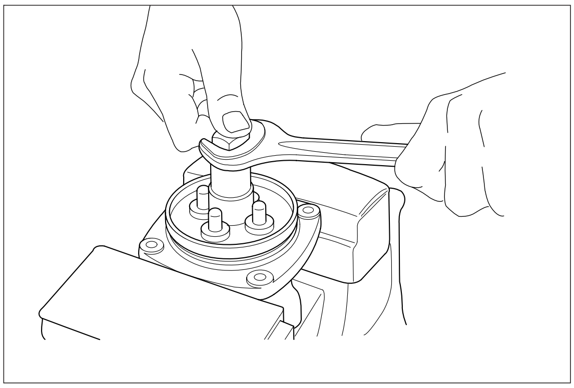




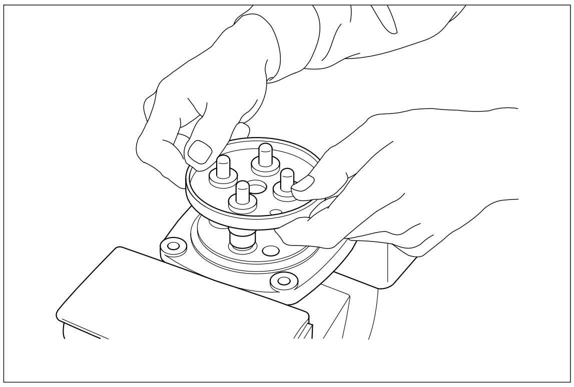
(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (10) is strong in force, plate (17), plug (14) and push rod (11) will come up on loosening joint.
Pay attention to this.





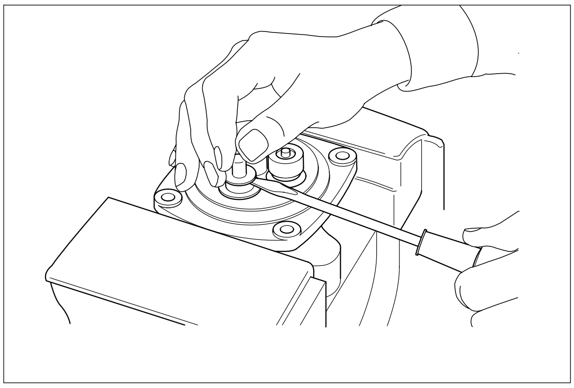
(8) Remove plate (17).



(9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.

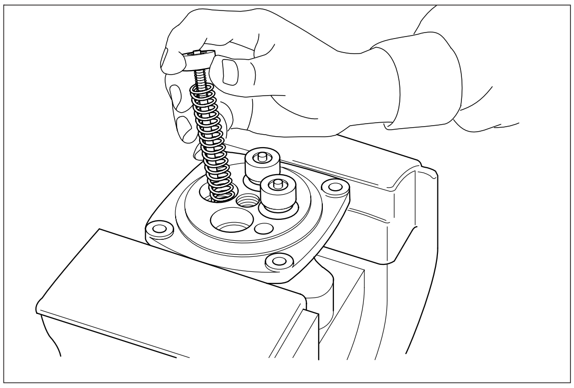
※ Take it out with minus screwdriver.
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring (10) force.
Pay attention to this.

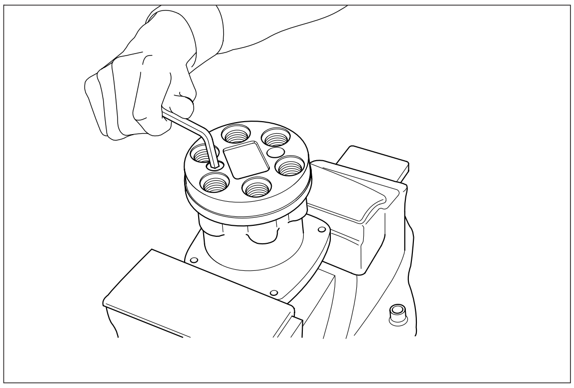


(10) Remove reducing valve subassembly and return spring (10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

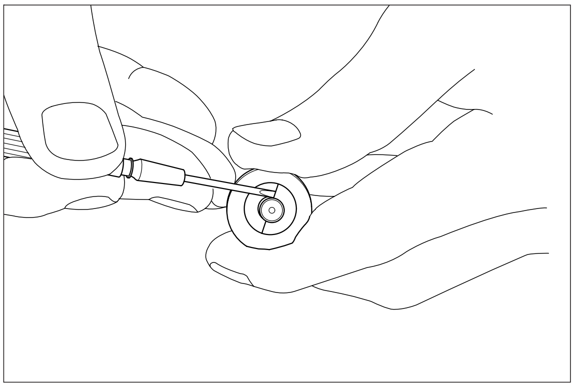


(12) For disassembling reducing valve section, stand it vertically with spool (4) bottom placed on flat workbench. Push down spring seat (7) and remove two pieces of semicircular stopper (8) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

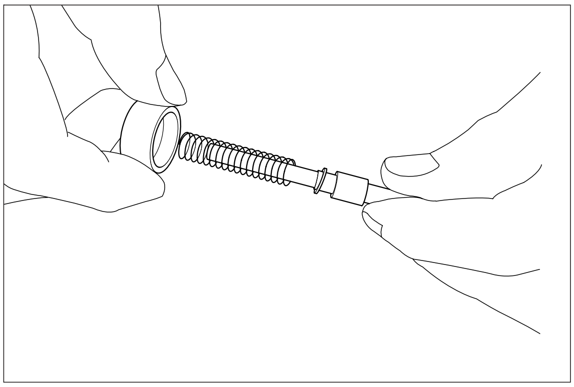
※ Record original position of spring seat (7).

※ Do not push down spring seat more than 6㎜.

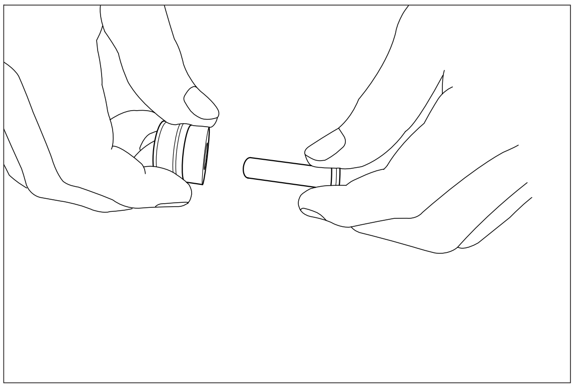


(13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.

※ Until being assembled, they should be handled as one subassembly group.

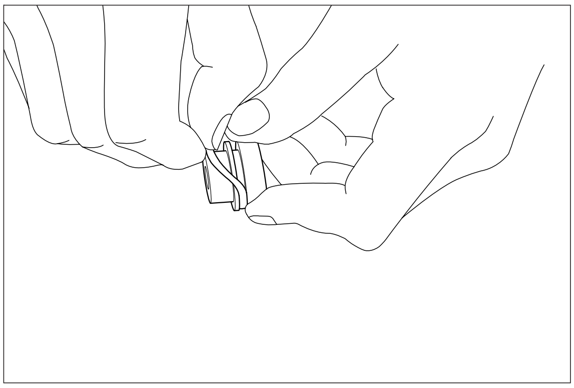


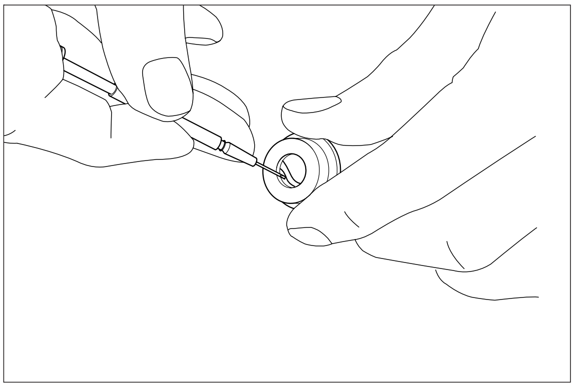
(14) Take push rod (11) out of plug (14).



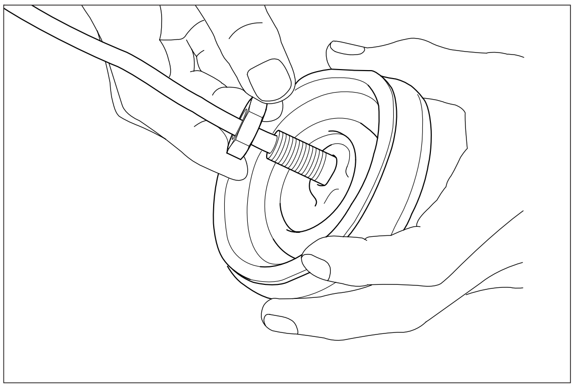
(15) Remove O-ring (15) and seal (16) from plug (14).

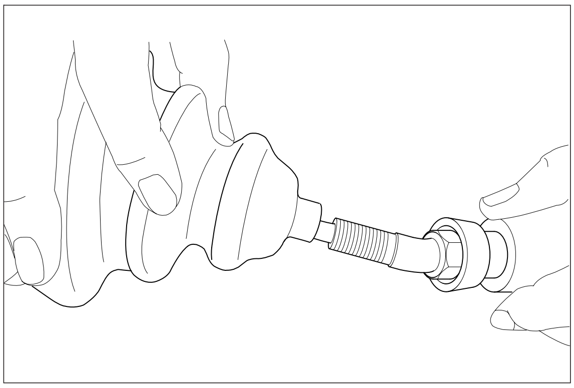
Use small minus screwdriver or so on to remove this seal.





(16) Remove lock nut (22) and then boot (26).





(16) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides (finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

(17) Rust prevention of parts

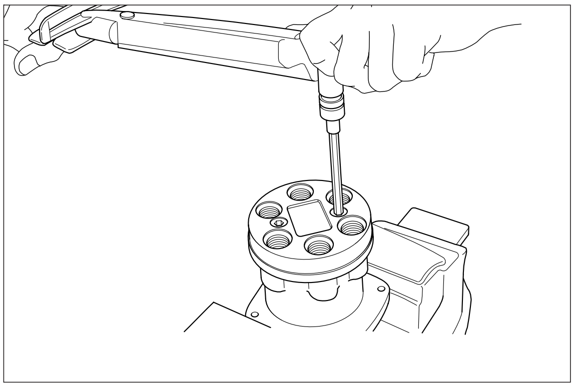
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

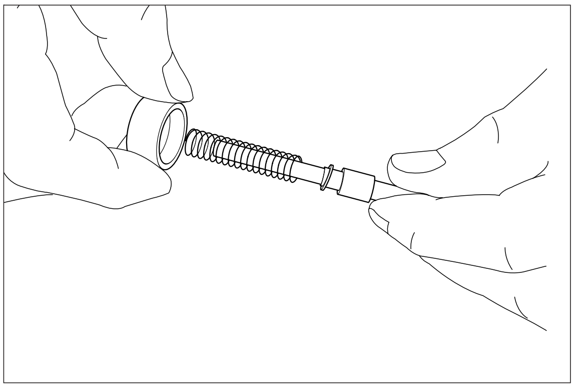
4) ASSEMBLY

(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.

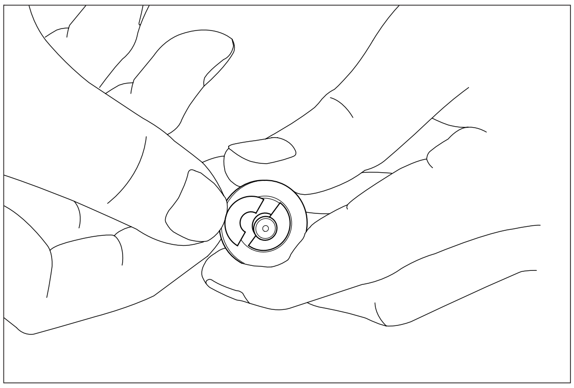


(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



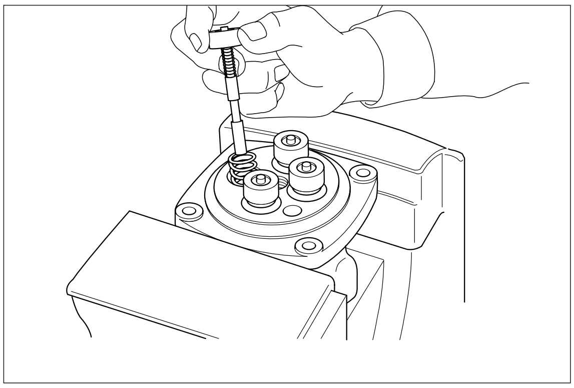
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.

※ Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.

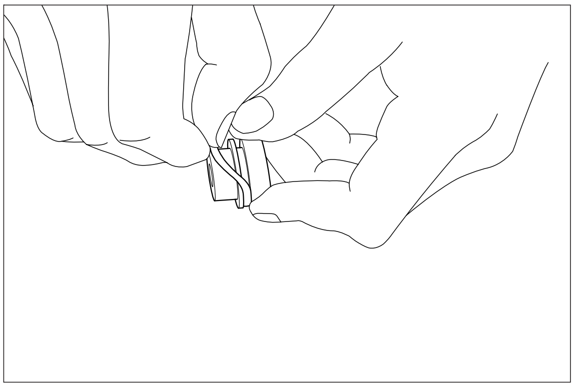


(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

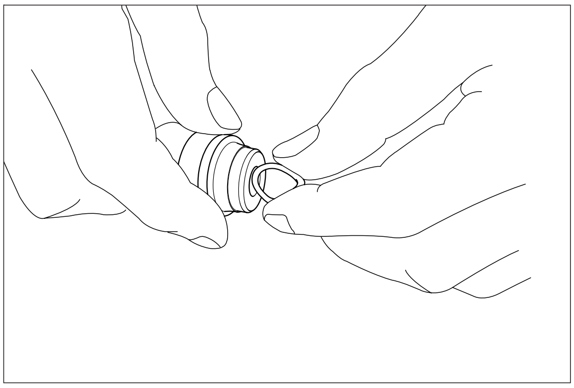


(5) Assemble O-ring (15) onto plug (14).



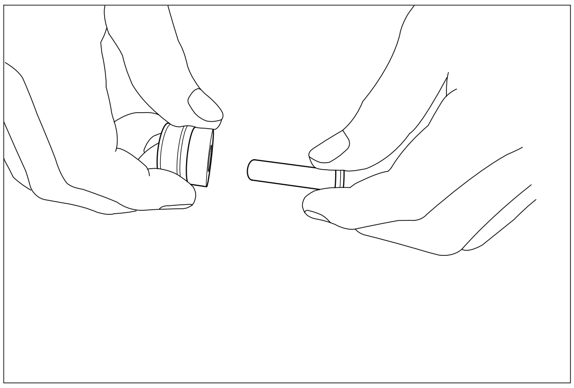
(6) Assemble seal (16) to plug (14).

※ Assemble seal in such lip direction as shown below.



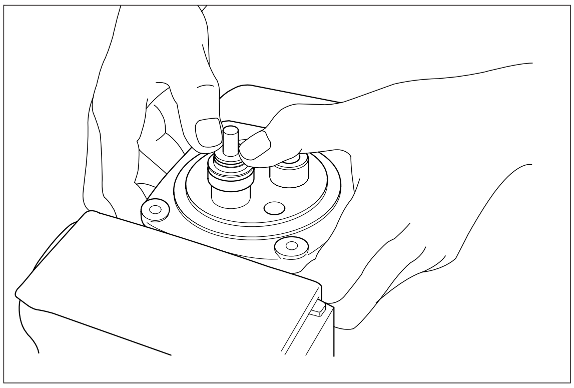
(7) Assemble push rod (11) to plug (14).

※ Apply working oil on push-rod surface.

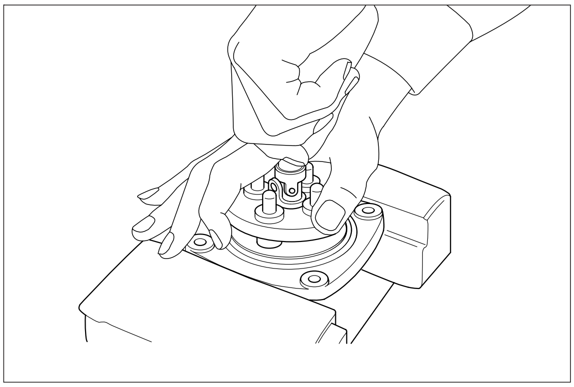


(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

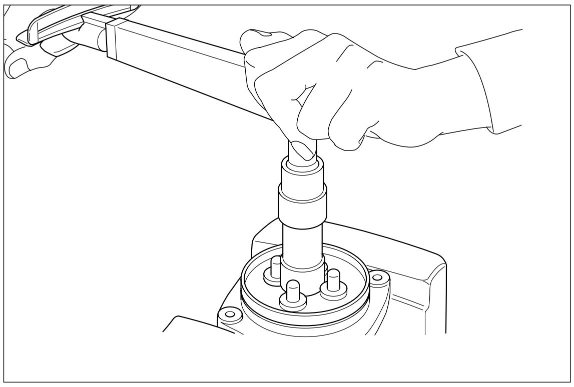


(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



(10) Fit plate (17).

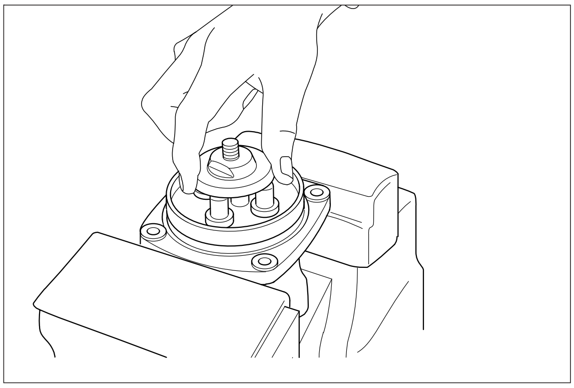
(11) Tighten joint (19) with the specified torque to casing, utilizing jig.



(12) Assemble swash plate (20) to joint (19).

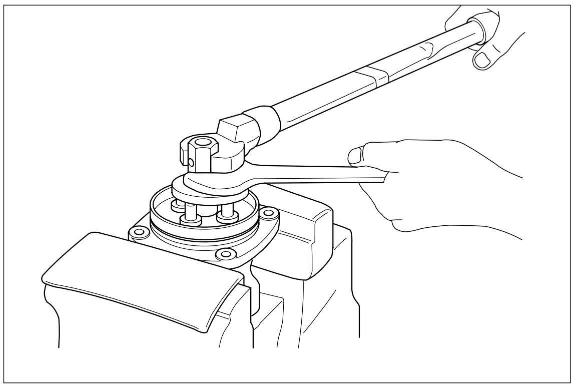
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

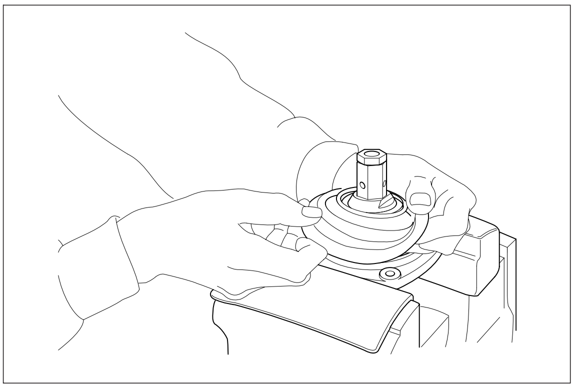


(13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.

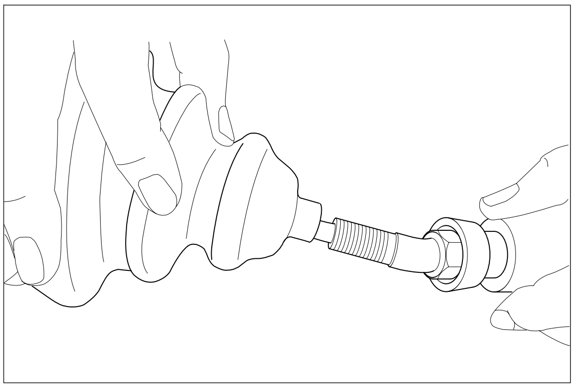
※ During tightening, do not change position of disk.

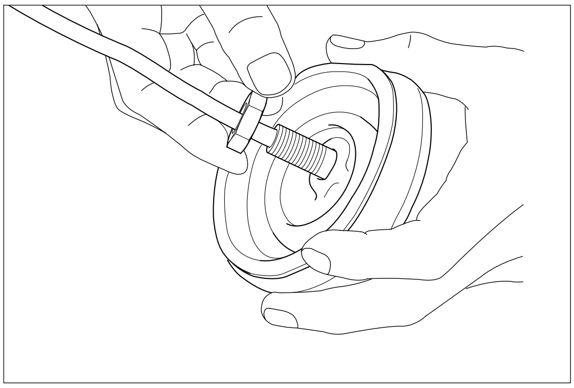


(14) Fit boot (18) to plate.

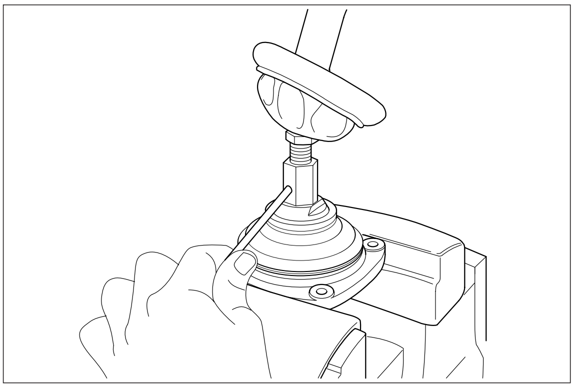


(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.



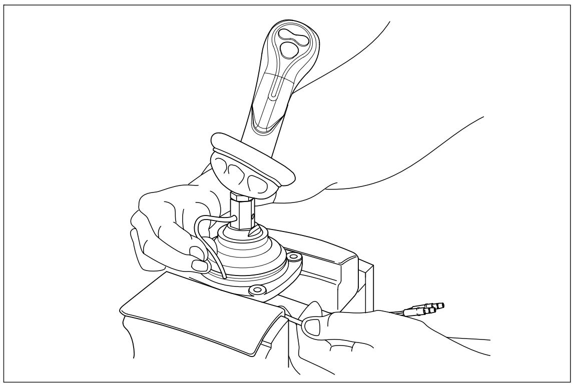


(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.

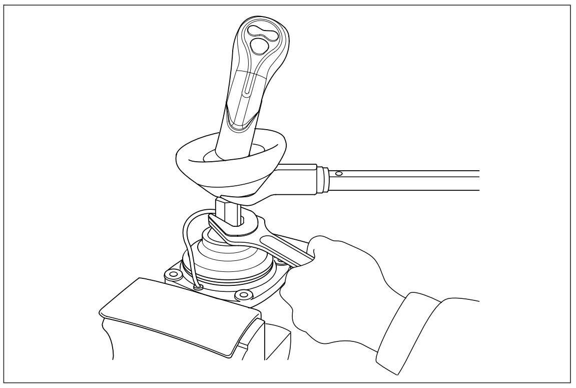


(17) Assemble bushing (28) to plate and pass cord and tube through it.

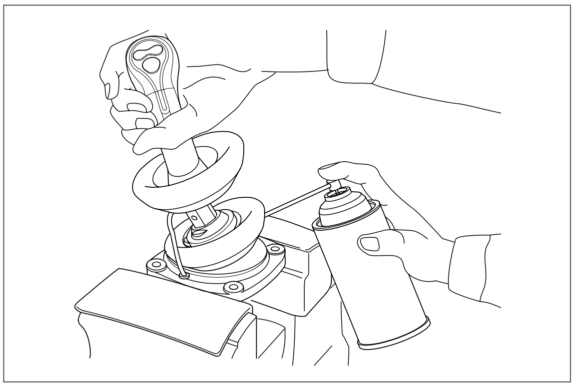
※ Provide margin necessary to operation.



(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

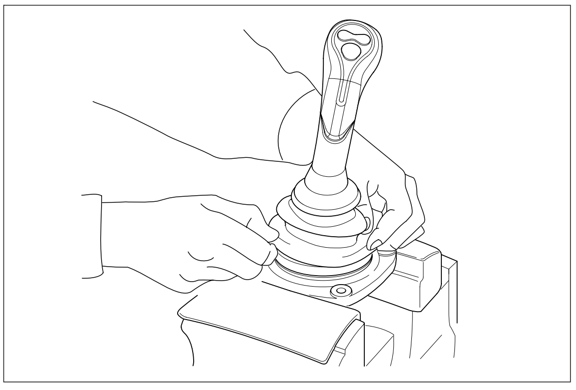


(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

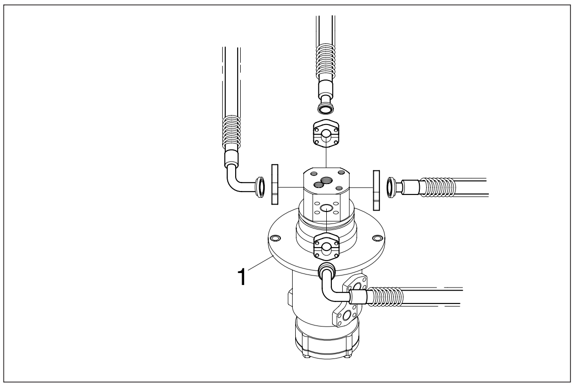
(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

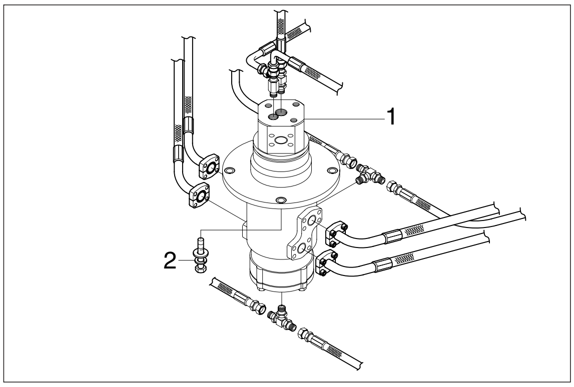
· Weight : 55 kg (120 lb)

· Tightening torque : 12.3± 1.3 kgf · m (88.9± 9.4 lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

2) INSTALL



(1) Carry out installation in the reverse order to removal.

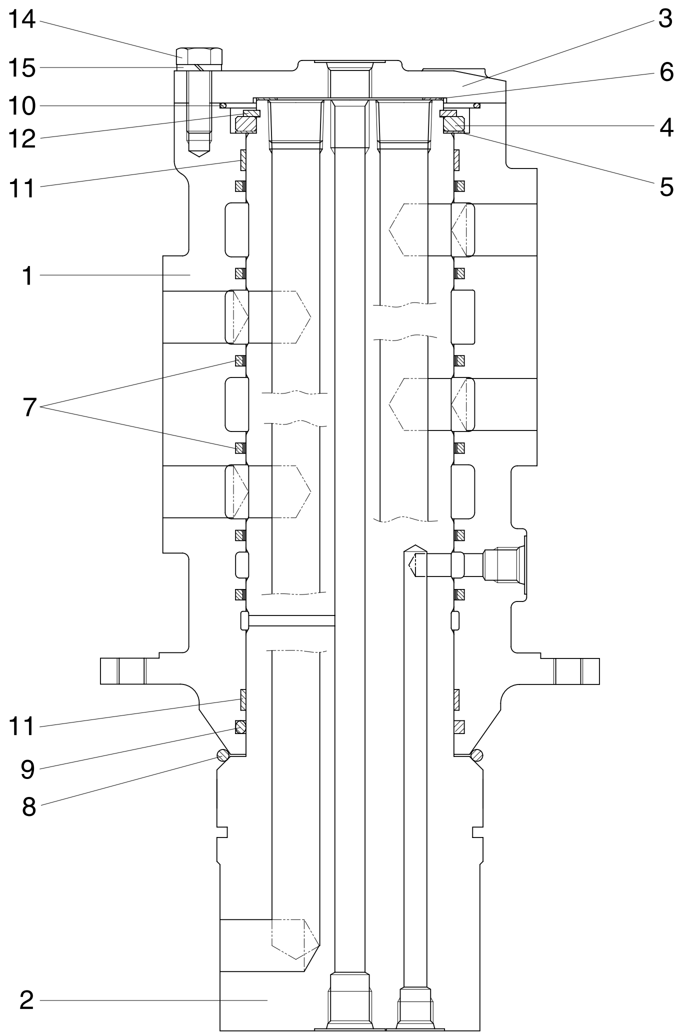
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

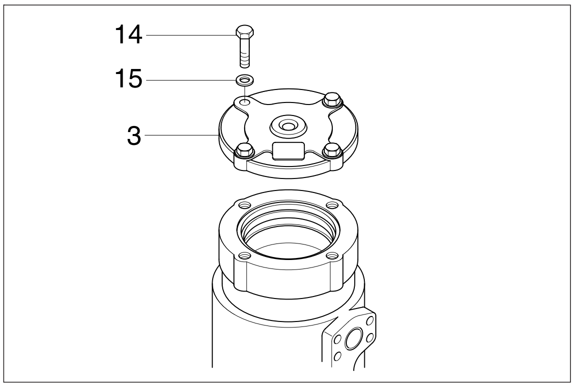


1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

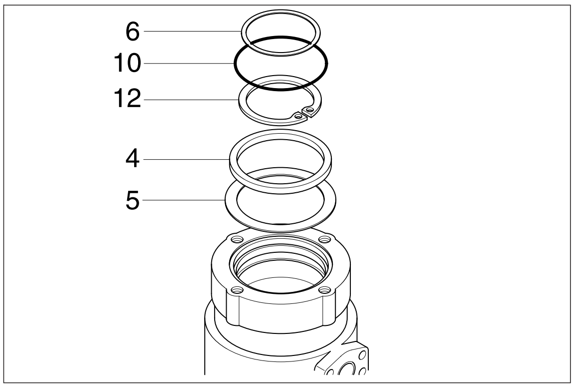
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

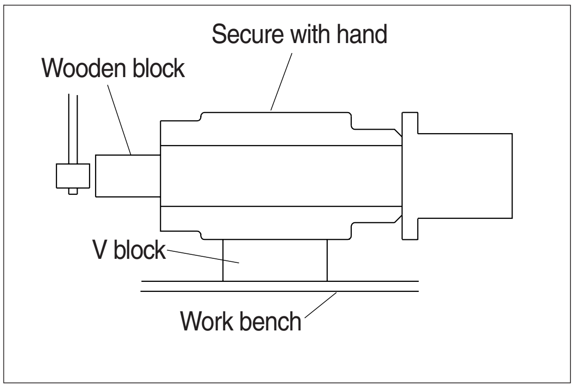
(3) Remove retainer ring (12), spacer (4) and shim (5).



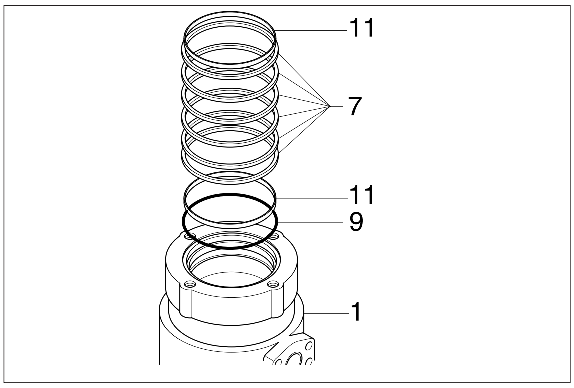
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).



3) ASSEMBLY

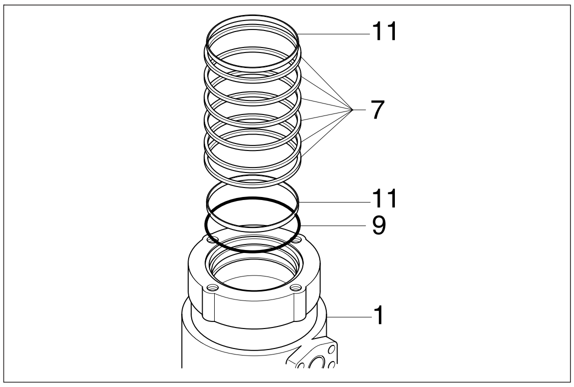
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

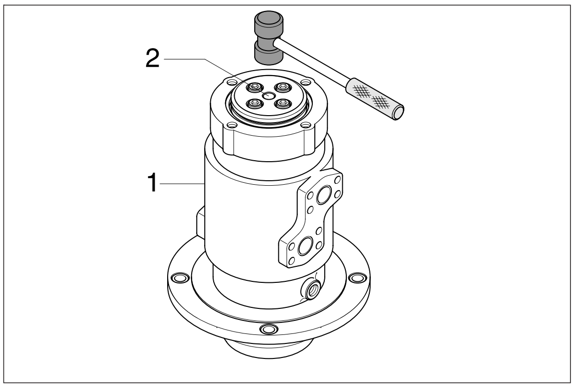
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



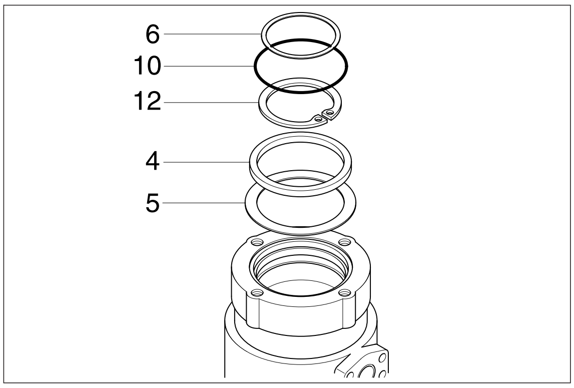
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

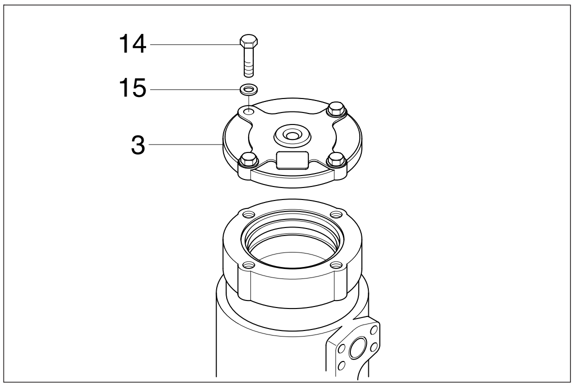
(5) Fit O-ring (10) to hub (1).

(6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

· Torque : 10~12.5 kgf · m
(72.3~90.4 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

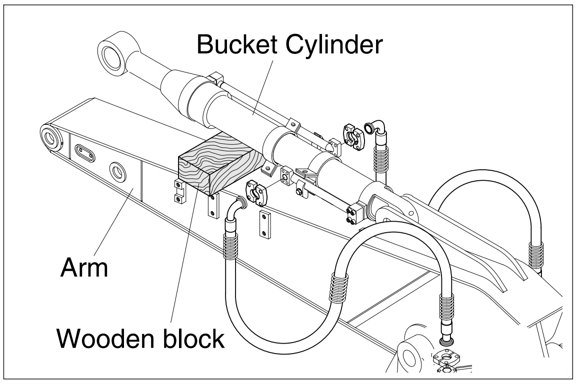
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

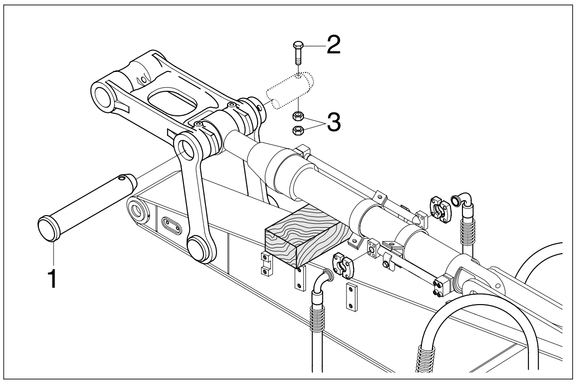
※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.

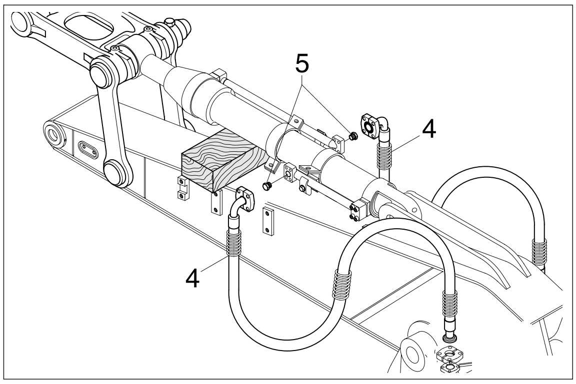


② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.

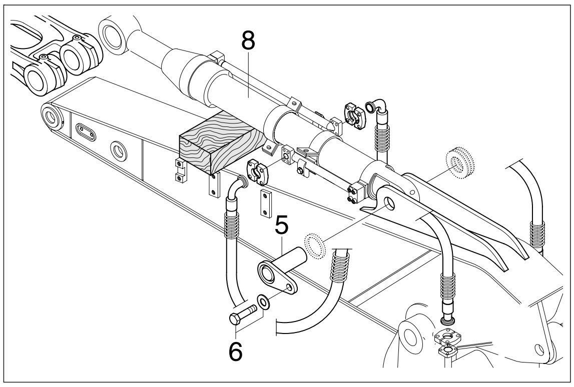


③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.



④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).
  · Weight : 175 ㎏ (390 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

▲ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

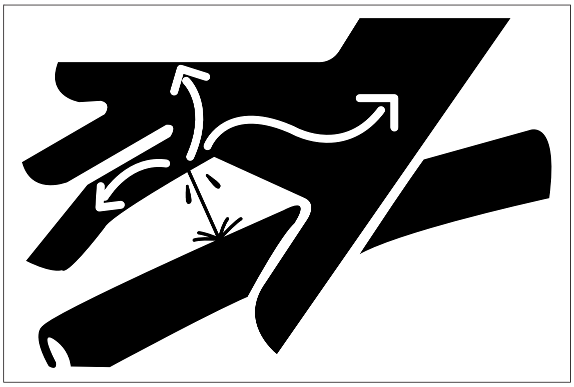
2) ARM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

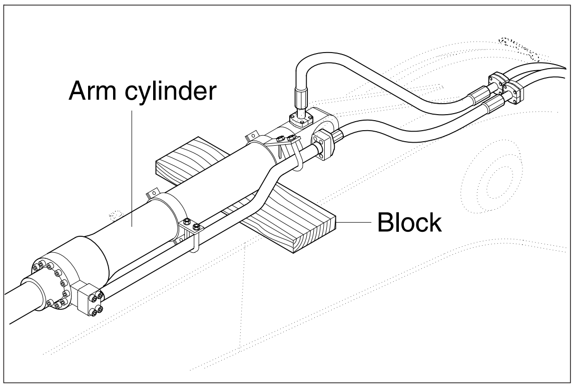
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.



⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

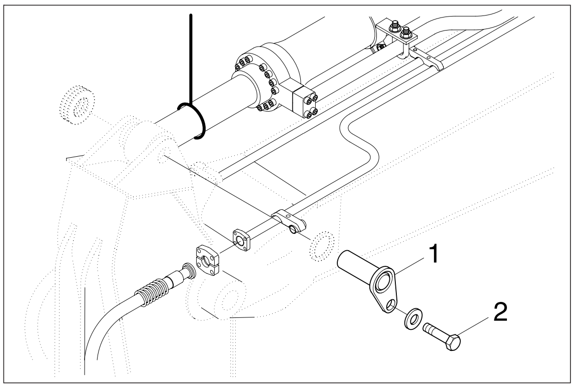
※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



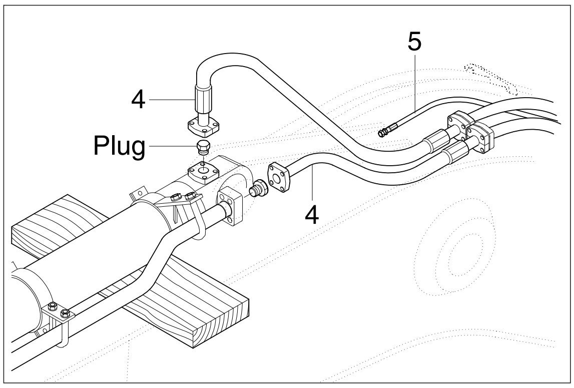
② Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

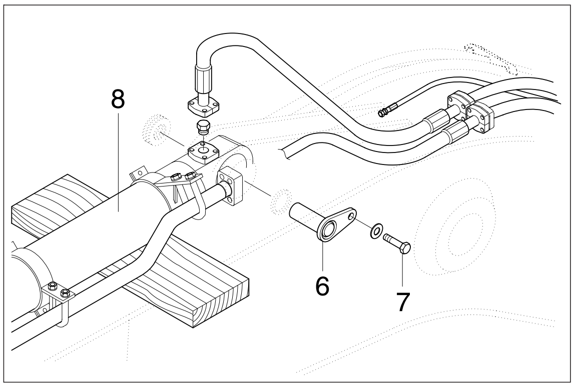
④ Disconnect greasing pipings (5).



⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 290 ㎏ (640 ㏖)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the arm cylinder.

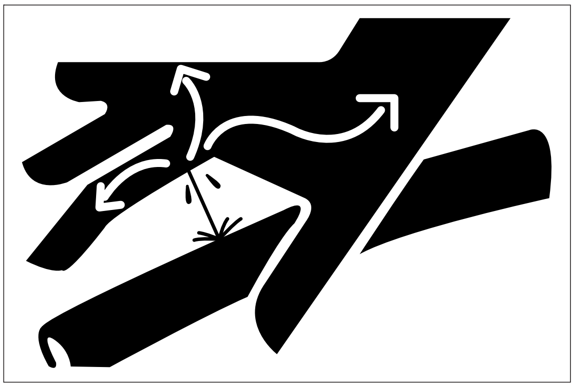
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.



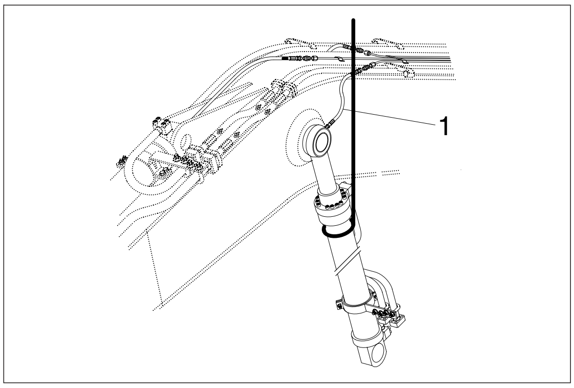
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrate the skin causing serious injury.**

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

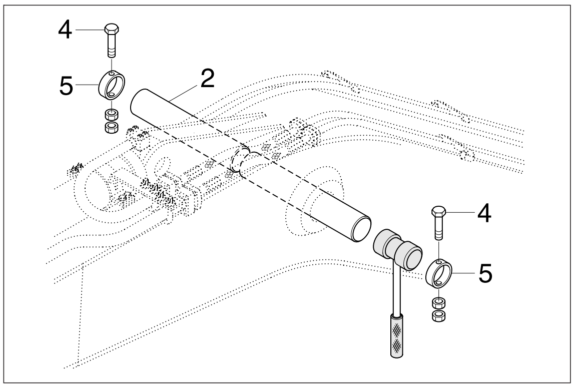
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

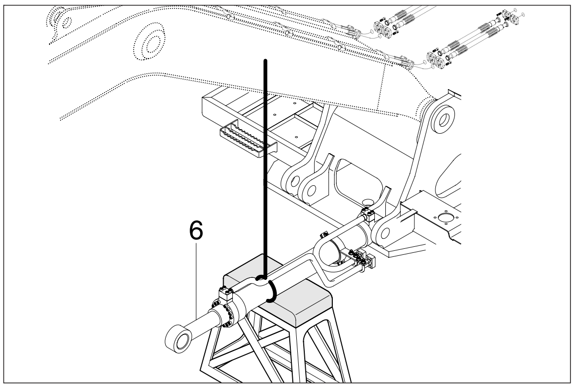


③ Remove bolt (4), stopper (5) and pull out pin (2).

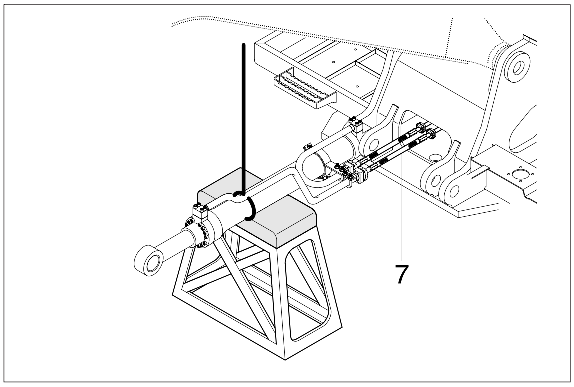
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly (6) on a stand.



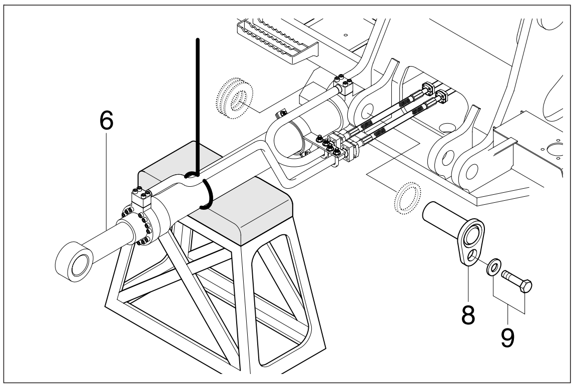
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 180 ㎏ (400 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

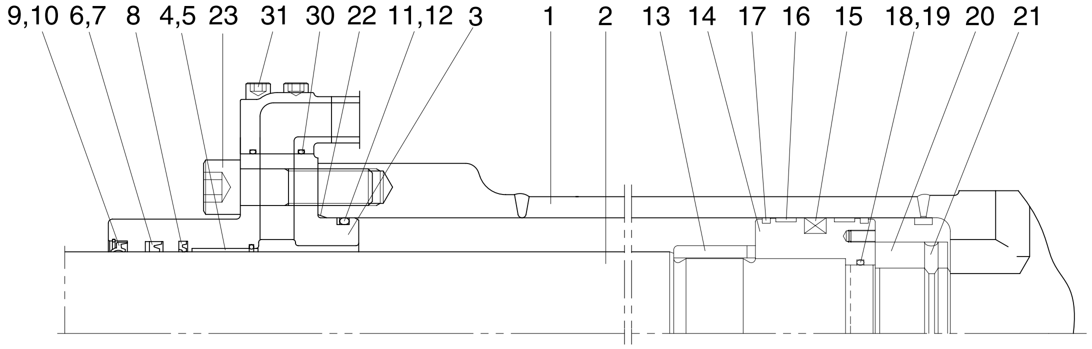
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

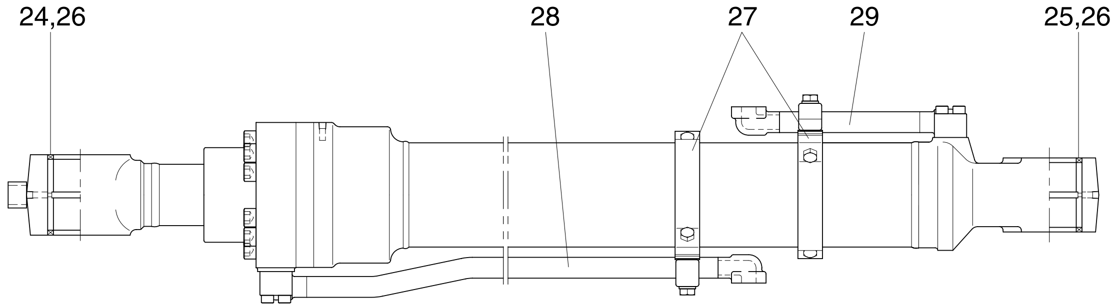
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

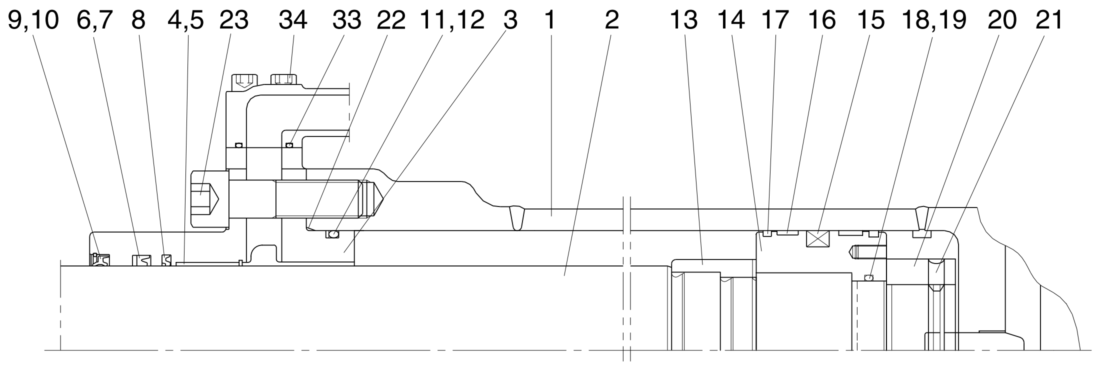


Internal detail

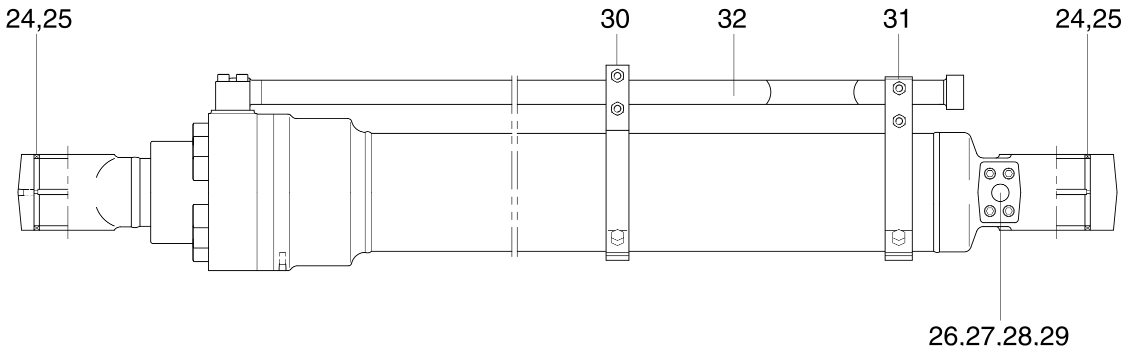


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

(2) Arm cylinder

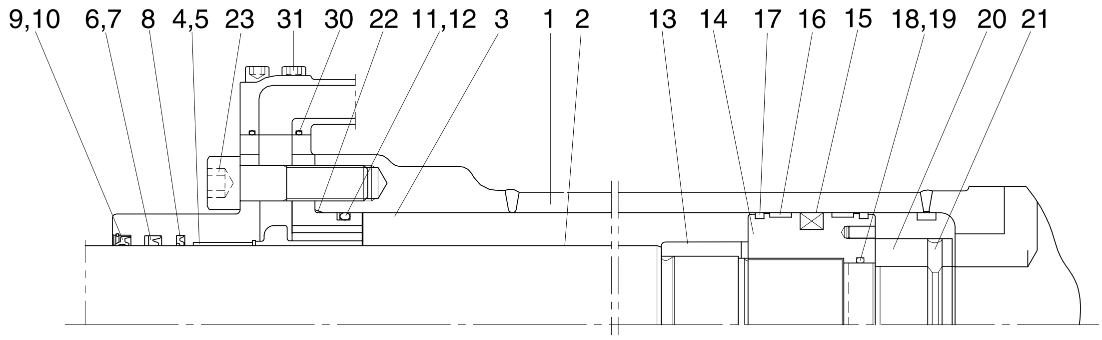


Internal detail

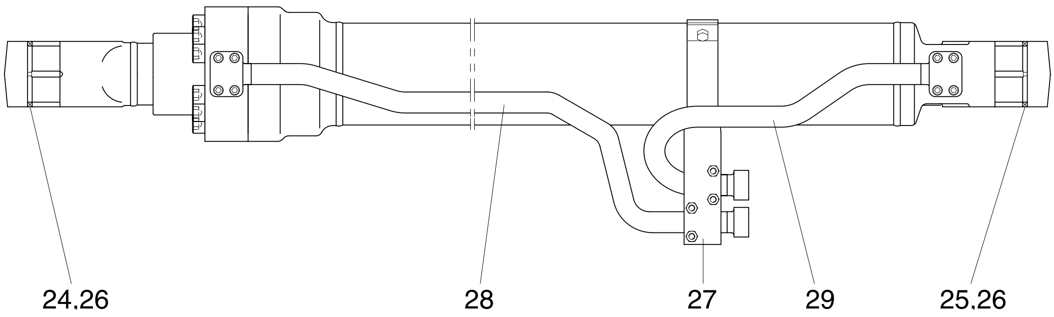


1 Tube assembly
2 Rod assembly
3 Gland
4 DD2 bushing
5 Snap ring
6 Rod seal
7 Back up ring
8 Buffer ring
9 Dust wiper
10 Snap ring
11 O-ring
12 Back up ring
13 Cushion ring
14 Piston
15 Piston seal
16 Wear ring
17 Dust ring
18 O-ring
19 Back up ring
20 Lock nut
21 Hexagon socket set screw
22 O-ring
23 Hexagon socket head bolt
24 Pin bushing
25 Dust seal
26 Check valve
27 Coil spring
28 O-ring
29 Plug
30 Band assembly-R
31 Band assembly-B
32 Pipe assembly-R
33 O-ring
34 Hexagon socket head bolt

(3) Boom cylinder



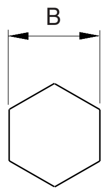
Internal detail



1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools	Remark	
Allen wrench	6	
	8	
	14	
	17	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder	23	M16	23±2.0	166±14.5
		31	M10	5.4±0.5	39.1±3.6
	Boom cylinder	23	M16	23±2.0	166±14.5
		31	M10	5.4±0.5	39.1±3.6
	Arm cylinder	23	M18	32±3.0	232±21.7
		34	M12	9.4±1.0	68±7.2
Lock nut	Bucket cylinder	20	-	100±10	723±72.3
	Boom cylinder	20	-	100±10	723±72.3
	Arm cylinder	20	-	150±15	1085±108
Piston	Bucket cylinder	14	-	150±15	1085±108
	Boom cylinder	14	-	150±15	1085±108
	Arm cylinder	14	-	200±20	1447±145

3) DISASSEMBLY

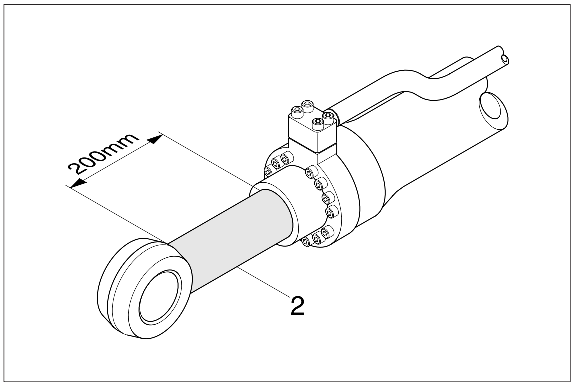
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

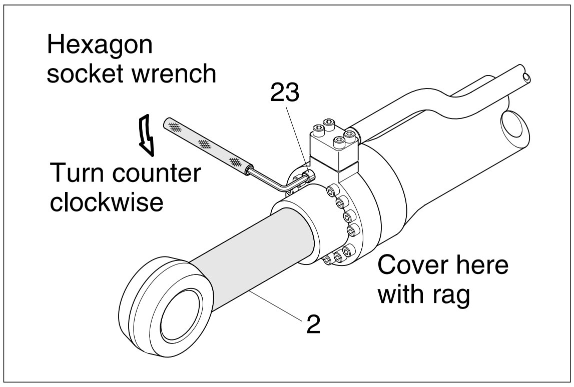
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



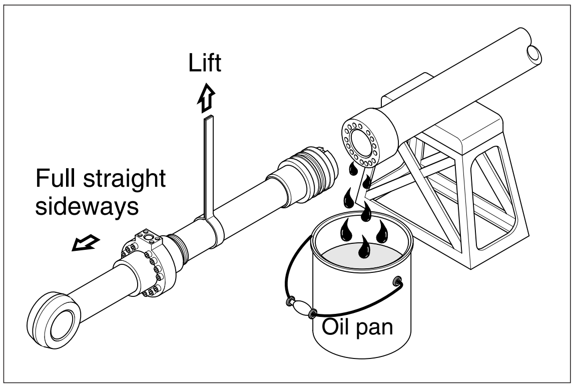
③ Loosen and remove socket bolts (23) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



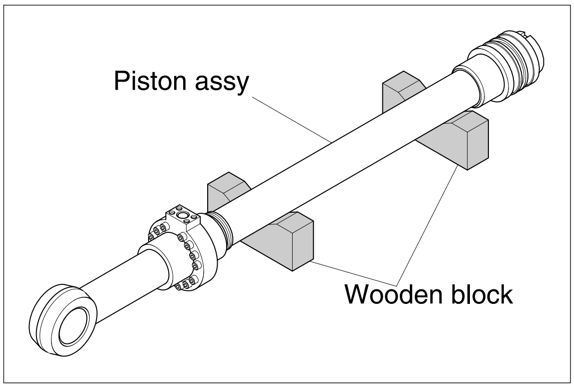
④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



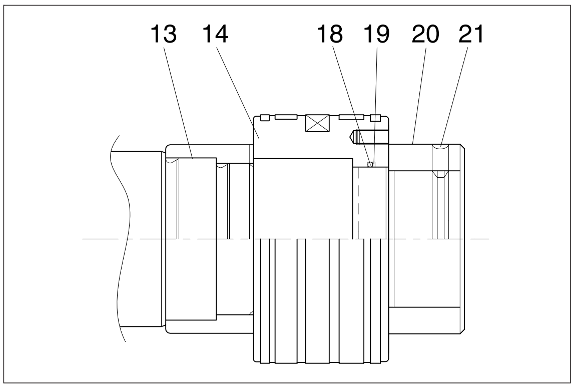
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.

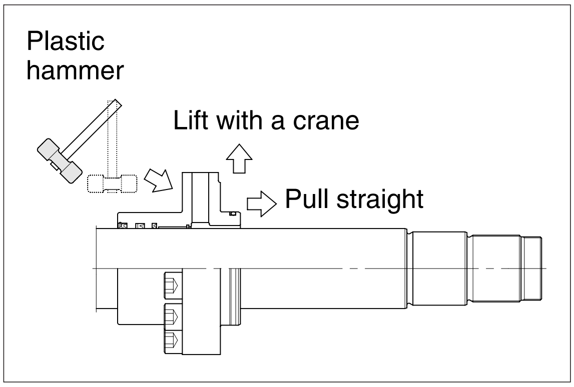


(2) Remove piston and cylinder head

① Remove set screw (21).
※ Since set screw (21) and lock nut (20) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock set screw (21) and lock nut (20).
② Remove piston assembly (14), back up ring (19), and O-ring (18).



③ Remove the cylinder head assembly from rod assembly (2).
※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.
※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

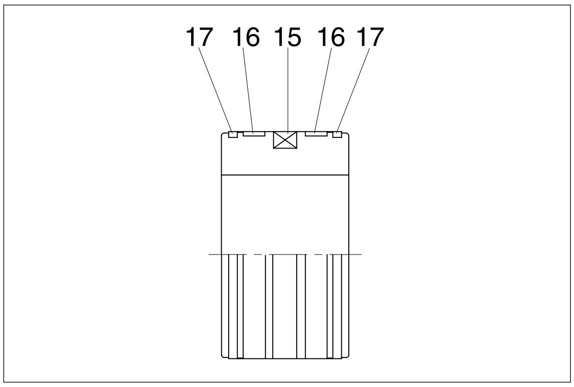


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

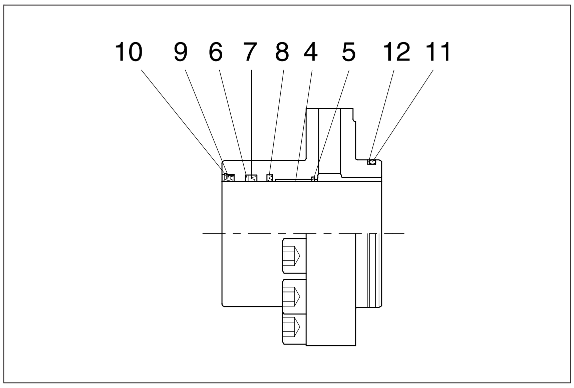
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

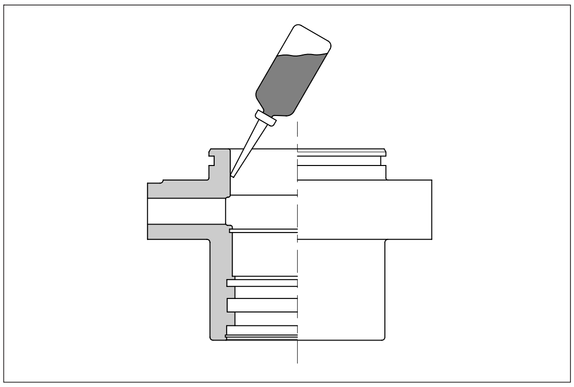


3) ASSEMBLY

(1) Assemble cylinder head assembly

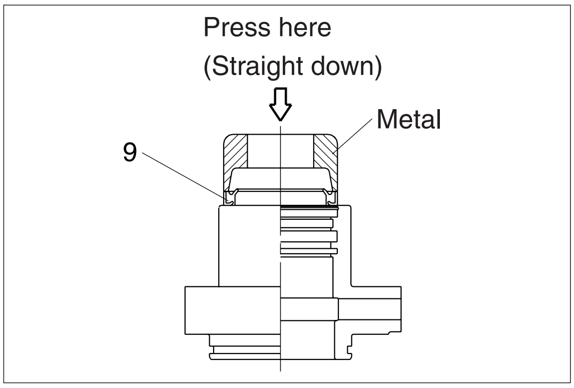
※ Check for scratches or rough surfaces if found smooth with an oil stone.

① Coat the inner face of gland (3) with hydraulic oil.



② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

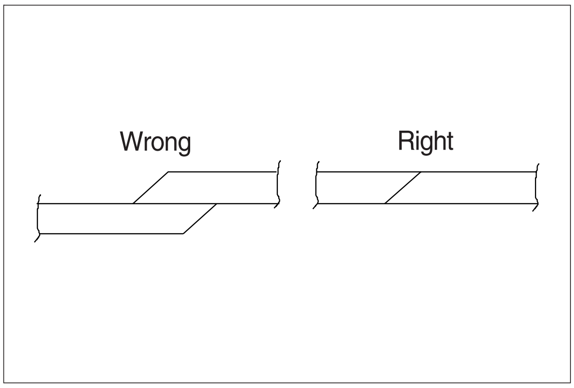
③ Fit snap ring (10) to the stop face.



④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

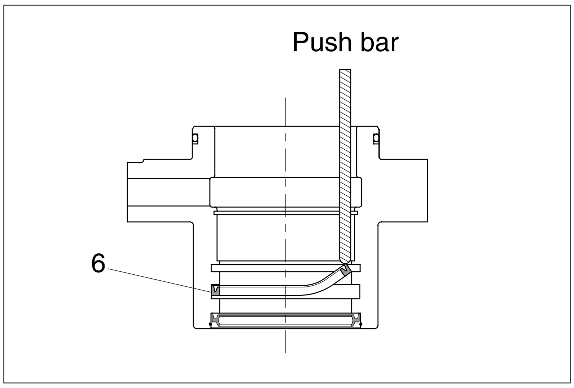
※ Coat each packing with hydraulic oil before fitting it.

※ Insert the backup ring until one side of it is inserted into groove.



※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

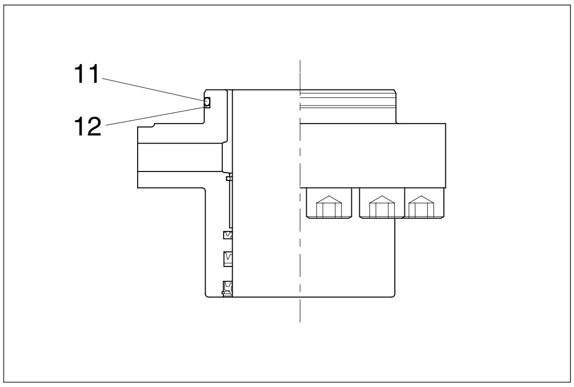
※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.



⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

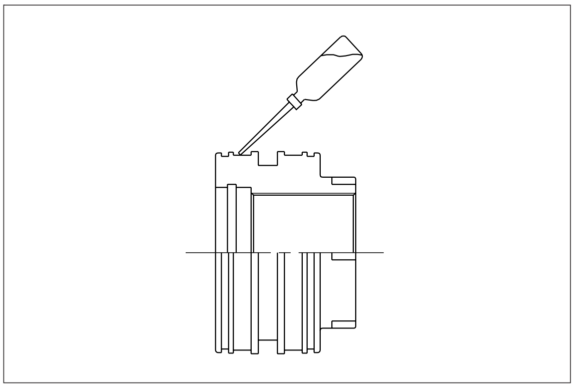
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

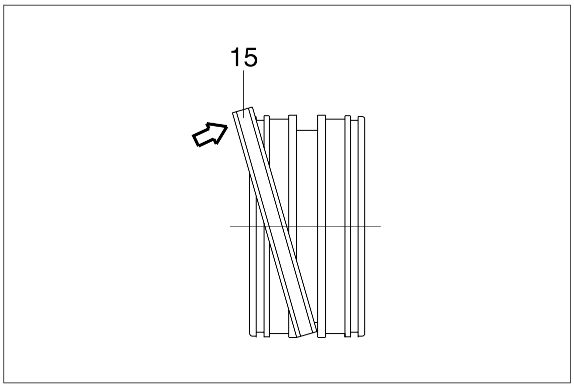
① Coat the outer face of piston (14) with hydraulic oil.



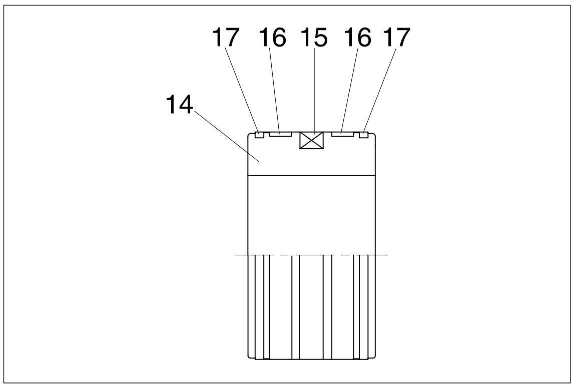
② Fit piston seal (15) to piston.

※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.

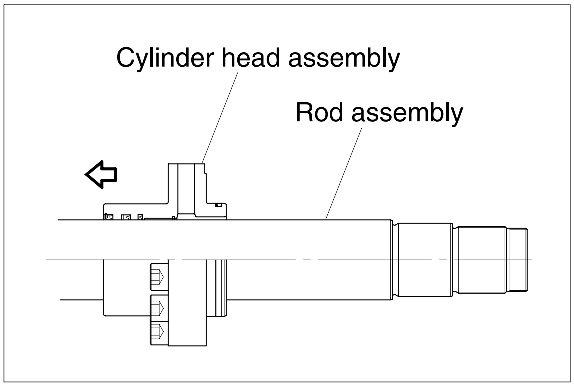


③ Fit wear ring (16) and dust ring (17) to piston (14).

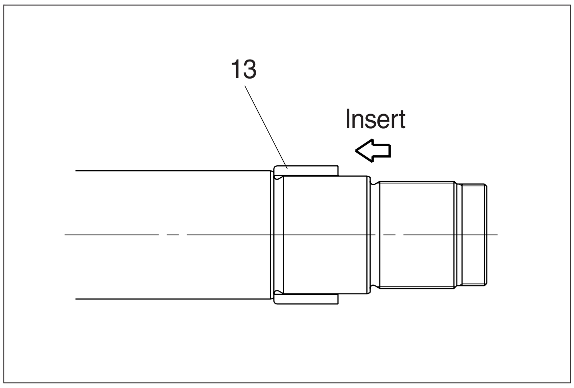


(3) Install piston and cylinder head

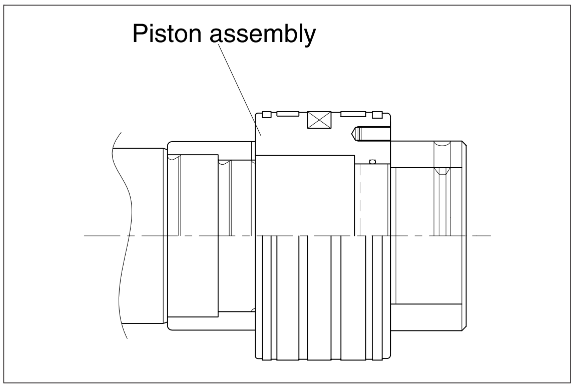
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (13) to rod assembly.
※ Note that cushion ring (13) has a direction in which it should be fitted.

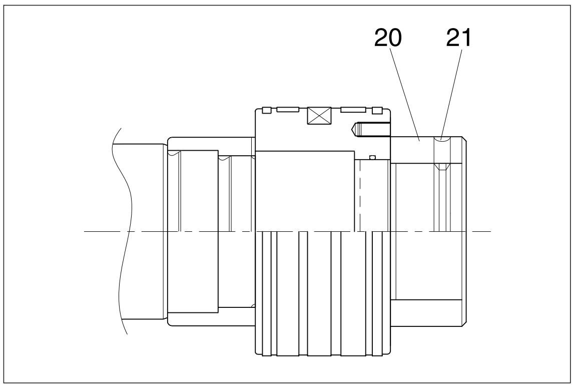


⑤ Fit piston assembly to rod assembly.
· Tightening torque : 150±15 kgf · m (1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the screw (21).
· Tightening torque :

Item		kgf · m	lbf · ft
20	Bucket	100±10	723±72.3
	Boom	100±10	723±72.3
	Arm	150±15	1085±108
21		2.7±0.3	19.6±2.2



(3) Overall assemble

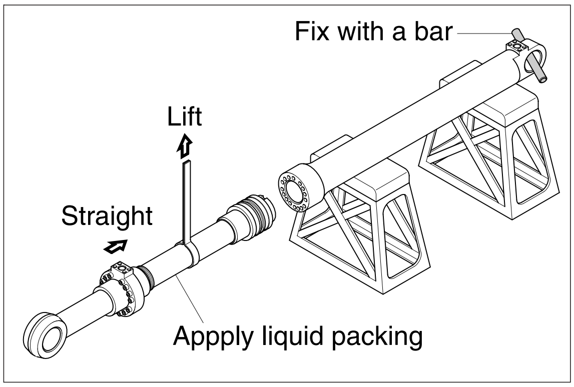
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

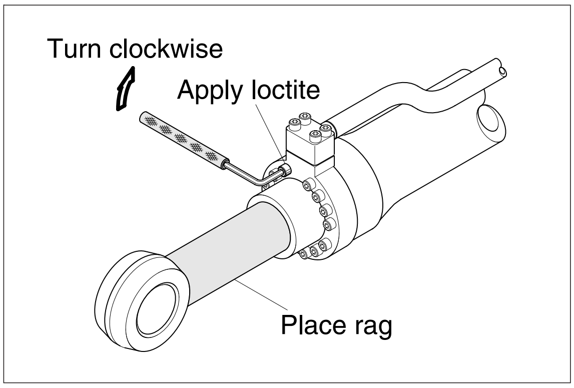
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.



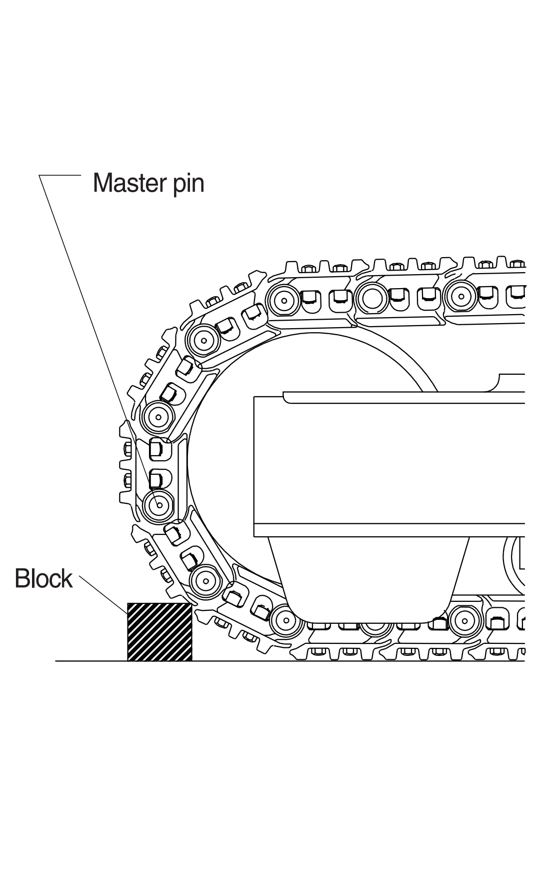


GROUP 10 UNDERCARRIAGE

1. TRACK LINK

1) REMOVAL

(1) Move track link until master pin is over front idler in the position put wooden block as shown.



(2) Loosen tension of the track link.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

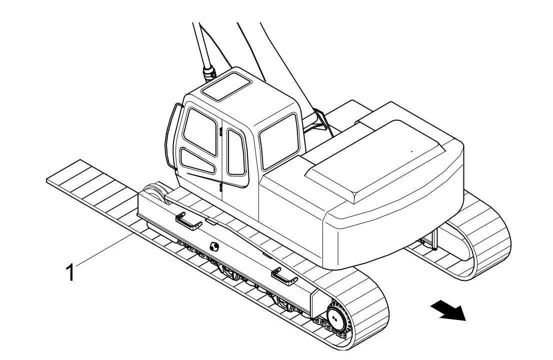
※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by pressurized grease.

(3) Push out master pin by using a suitable tool.

(4) Move the machine slowly in reverse, and lay out track link assembly (1).

※ Jack up the machine and put wooden block under the machine.

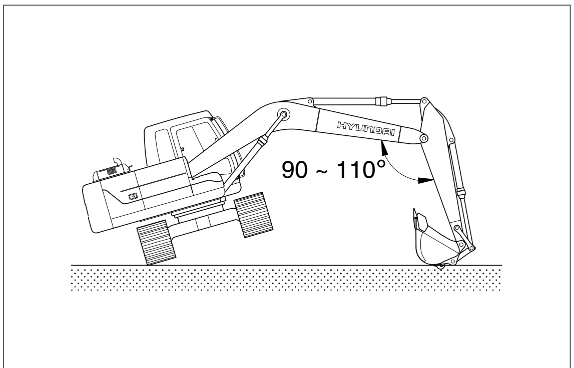
※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.



2) INSTALL

(1) Carry out installation in the reverse order to removal.

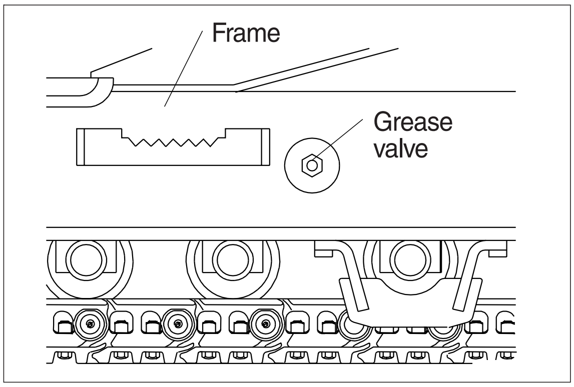
※ Adjust the tension of the track link.



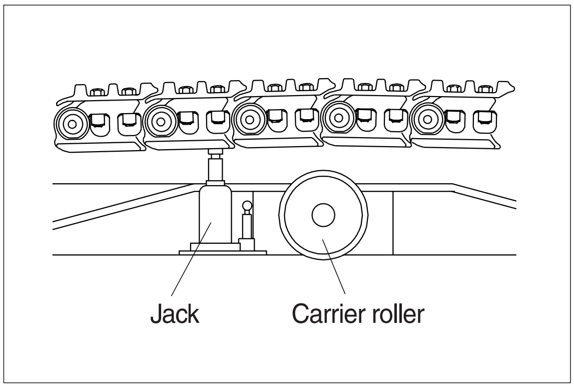
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

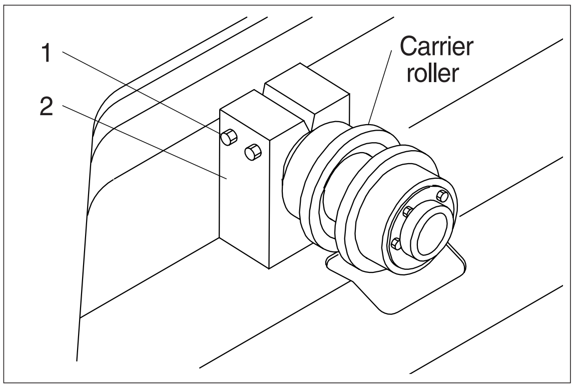


(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
- · Weight : 20 kg (45 lb)



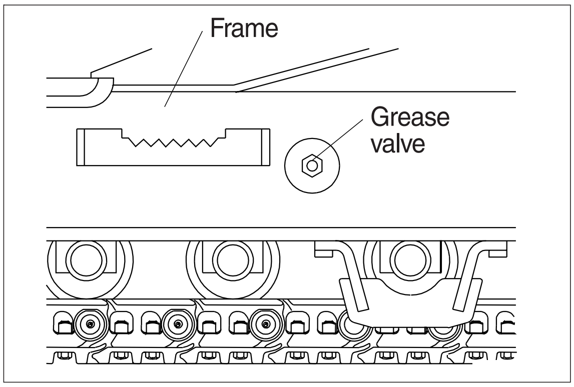
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

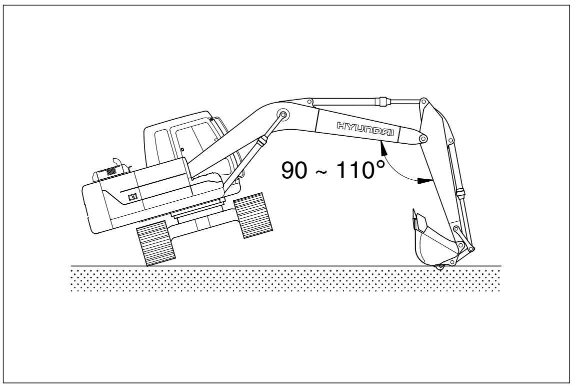
1) REMOVAL

(1) Loosen tension of the track link.



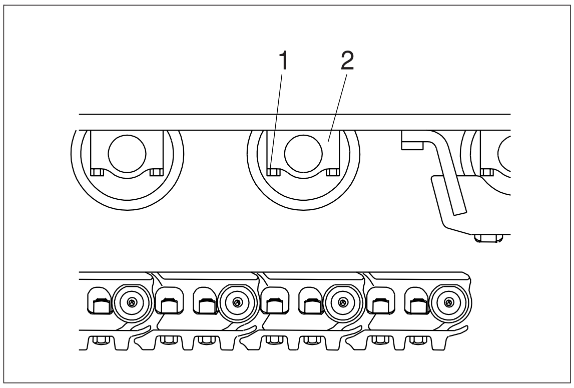
(2) Using the work equipment, push up track frame on side which is to be removed.

※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 40 kg (90 lb)



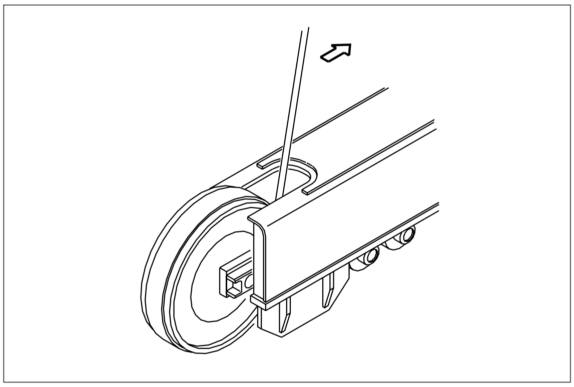
2) INSTALL

(1) Carry out installation in the reverse order to removal.

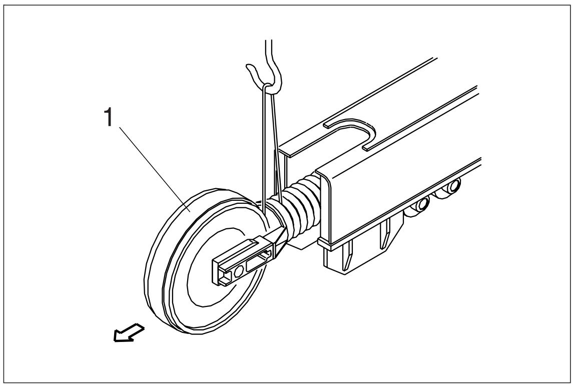
4. IDLER AND RECOIL SPRING

1) REMOVAL

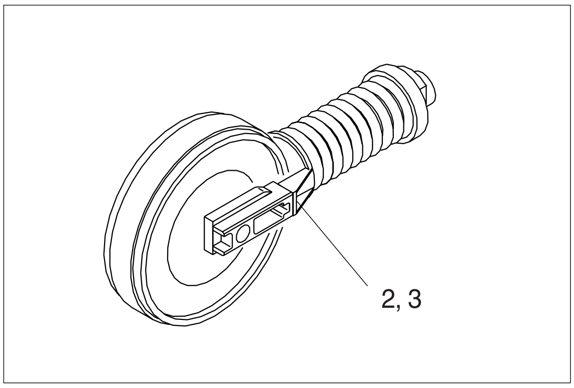
(1) Remove the track link.
For detail, see removal of track link.



(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 310 ㎏ (680 ℔)



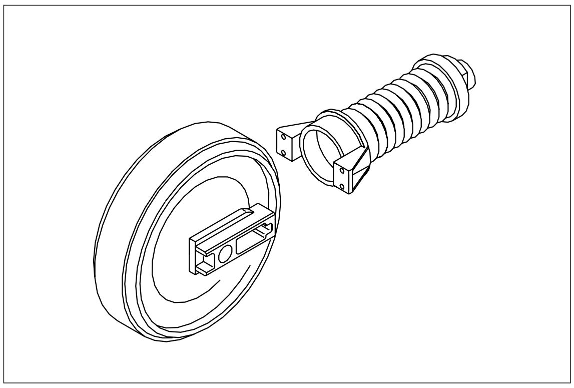
(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.



2) INSTALL

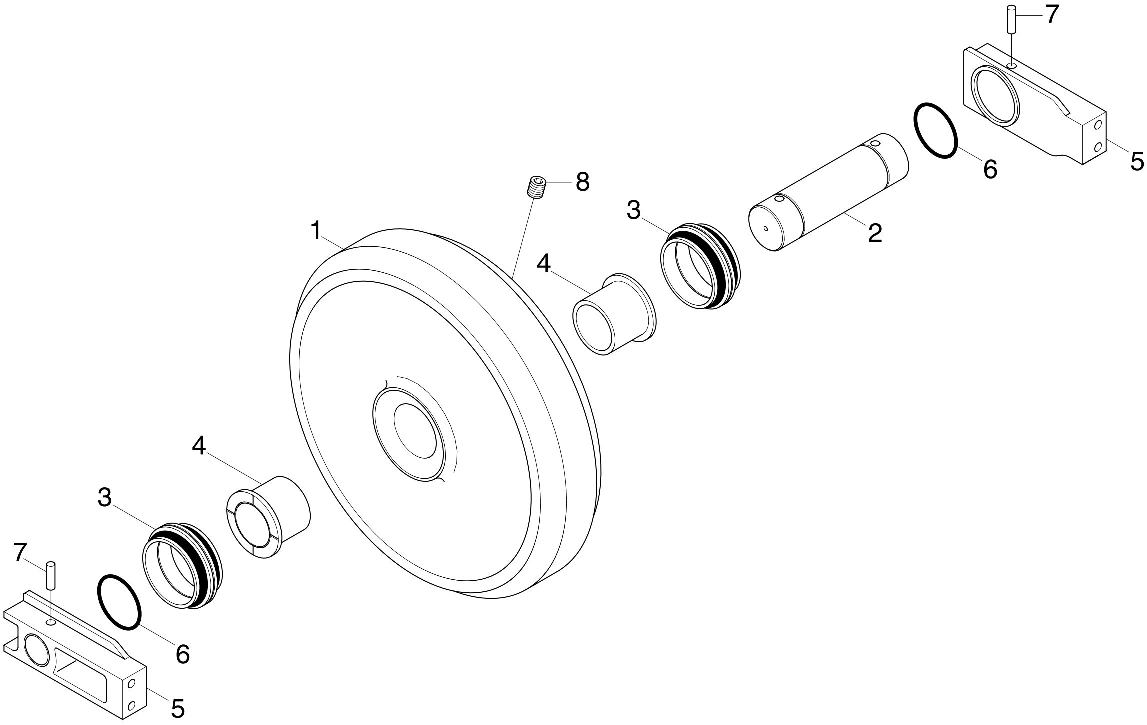
(1) Carry out installation in the reverse order to removal.

※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure

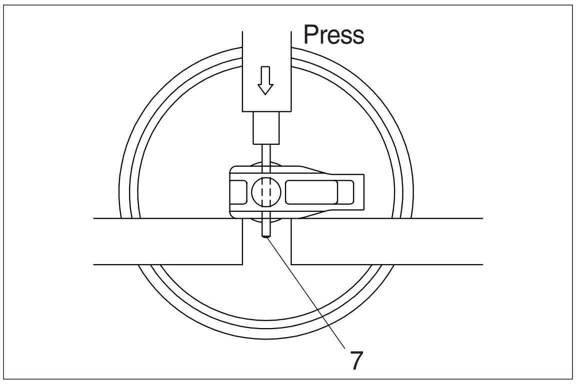


1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

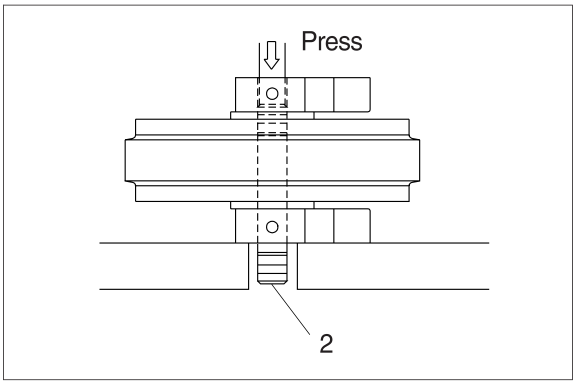
② Draw out the spring pin (7), using a press.



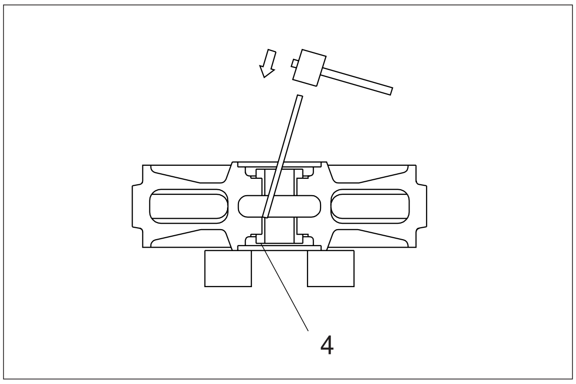
③ Pull out the shaft (2) with a press.

④ Remove seal (3) from idler (1) and bracket (5).

⑤ Remove O-ring (6) from shaft.



⑥ Remove the bushing (4) from idler, using a special tool.
Only remove bushing if replacement is necessity.

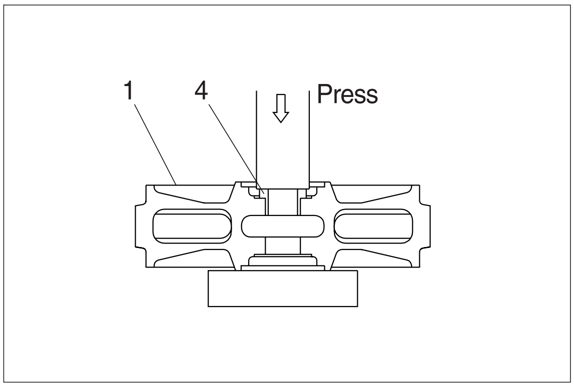


(3) Assembly

※ Before assembly, clean the parts.

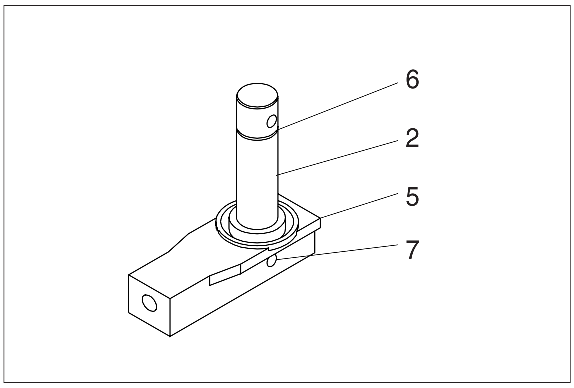
※ Coat the sliding surfaces of all parts with oil.

① Cool up bushing (4) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.

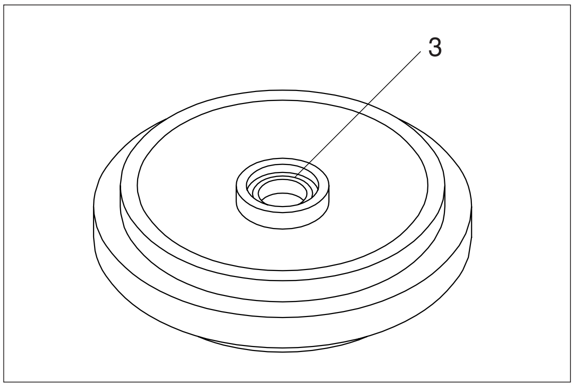


② Coat O-ring (6) with grease thinly, and install it to shaft (2).

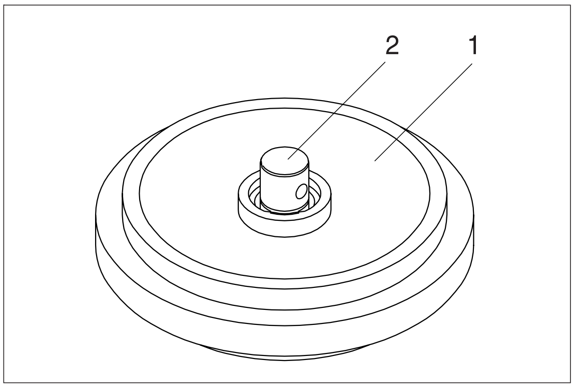
③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



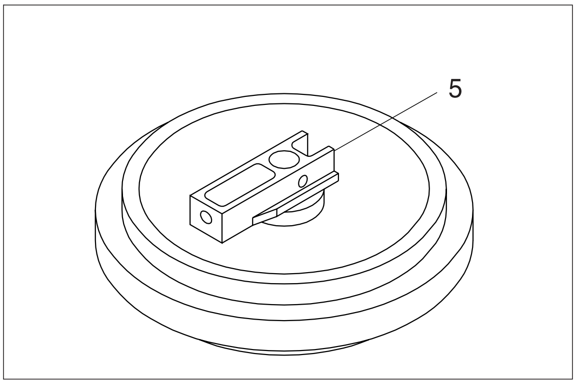
④ Install seal (3) to shell (1) and bracket (5).



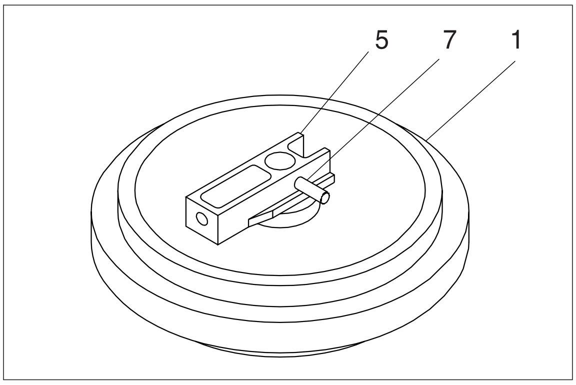
⑤ Install shaft (2) to shell (1).



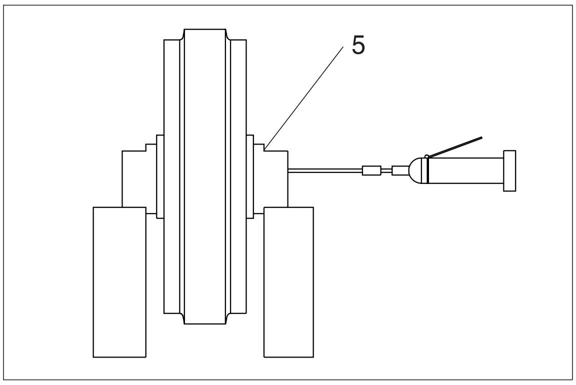
⑥ Install bracket (5) attached with seal (3).



⑦ Knock in the spring pin (7) with a hammer.

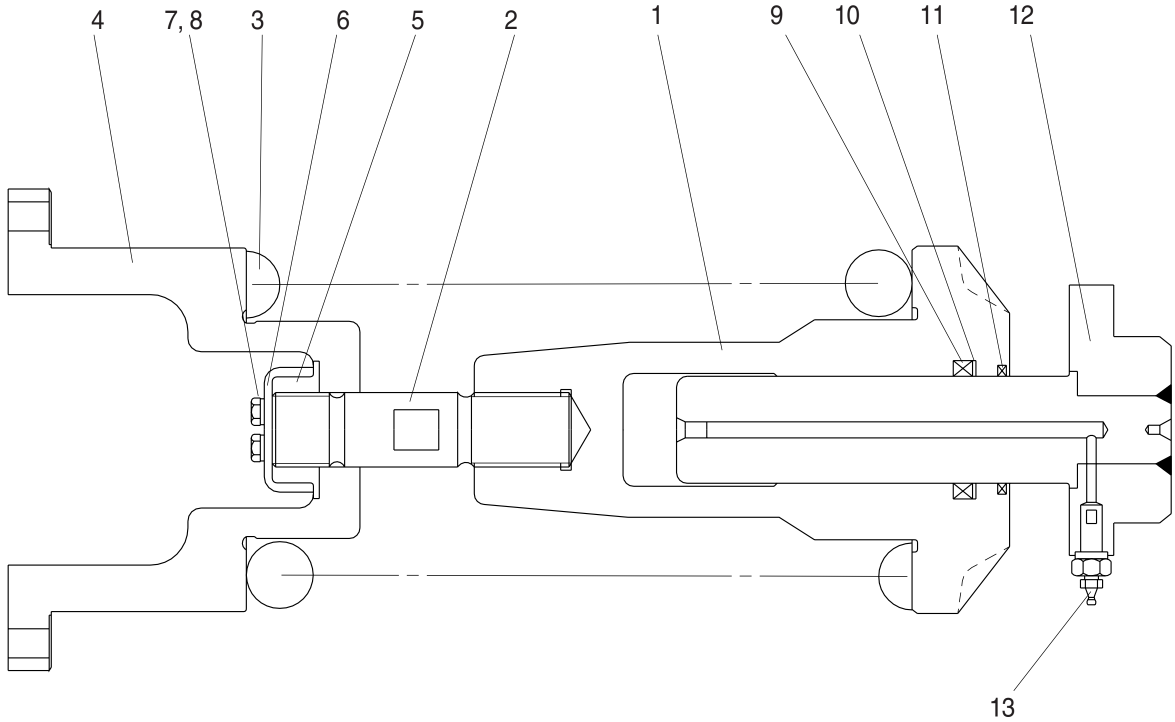


⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod assembly
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal		
5	Lock nut	10	Back up ring		

(2) Disassembly

① Apply pressure on spring (3) with a press.

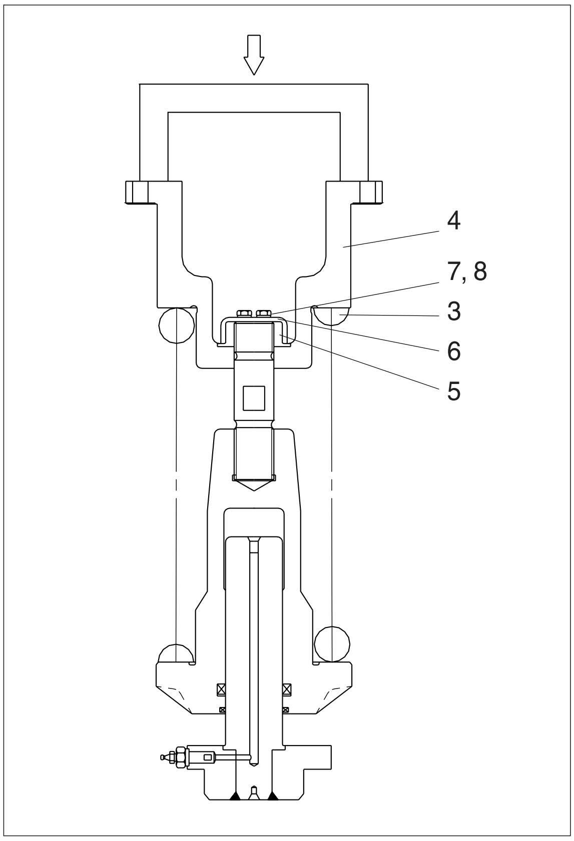
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

 · Spring set load : 13716 ㎏ (30238 ℔)

② Remove bolt (7), spring washer (8) and lock plate (6).

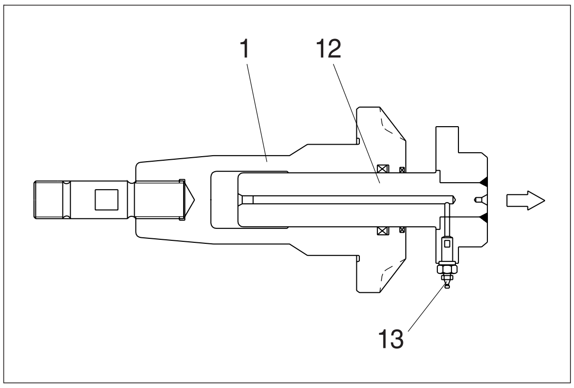
③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (4) and spring (3).

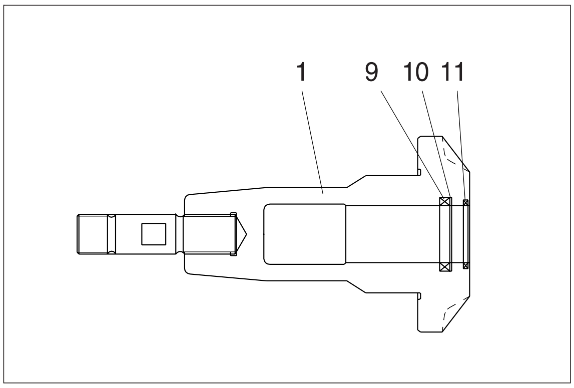


⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



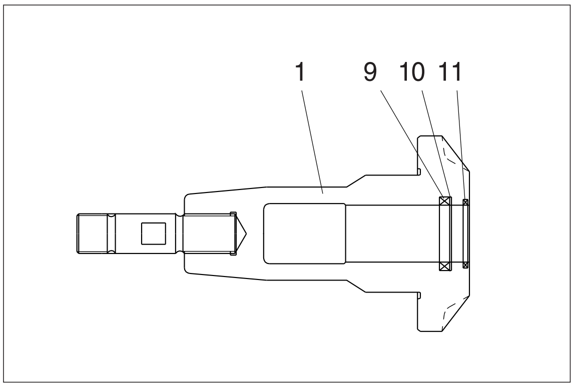
⑦ Remove rod seal (9), back up ring (10) and dust seal (11).



(3) Assembly

Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

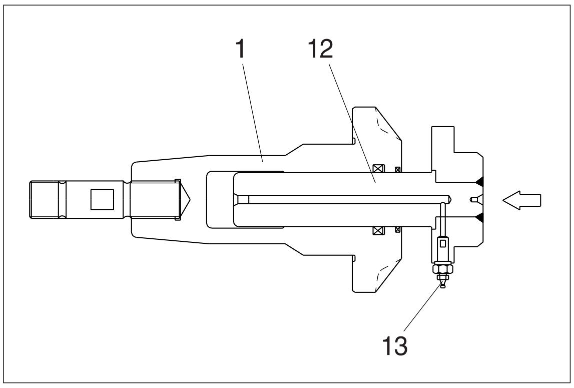
※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



② Pour grease into body (1), then push in rod (12) by hand.
After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to rod (12).
·Tightening torque : 13±1.0 kgf·m
(94±7.2 lbf·ft)

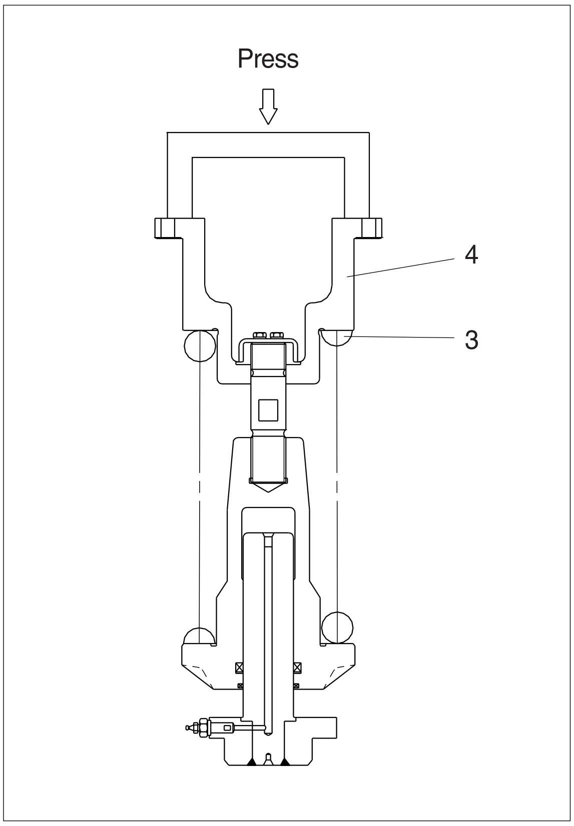


④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

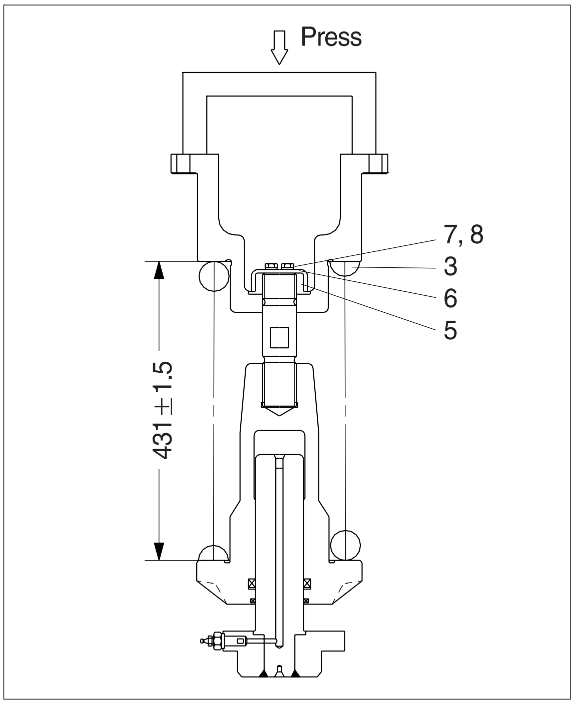
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.



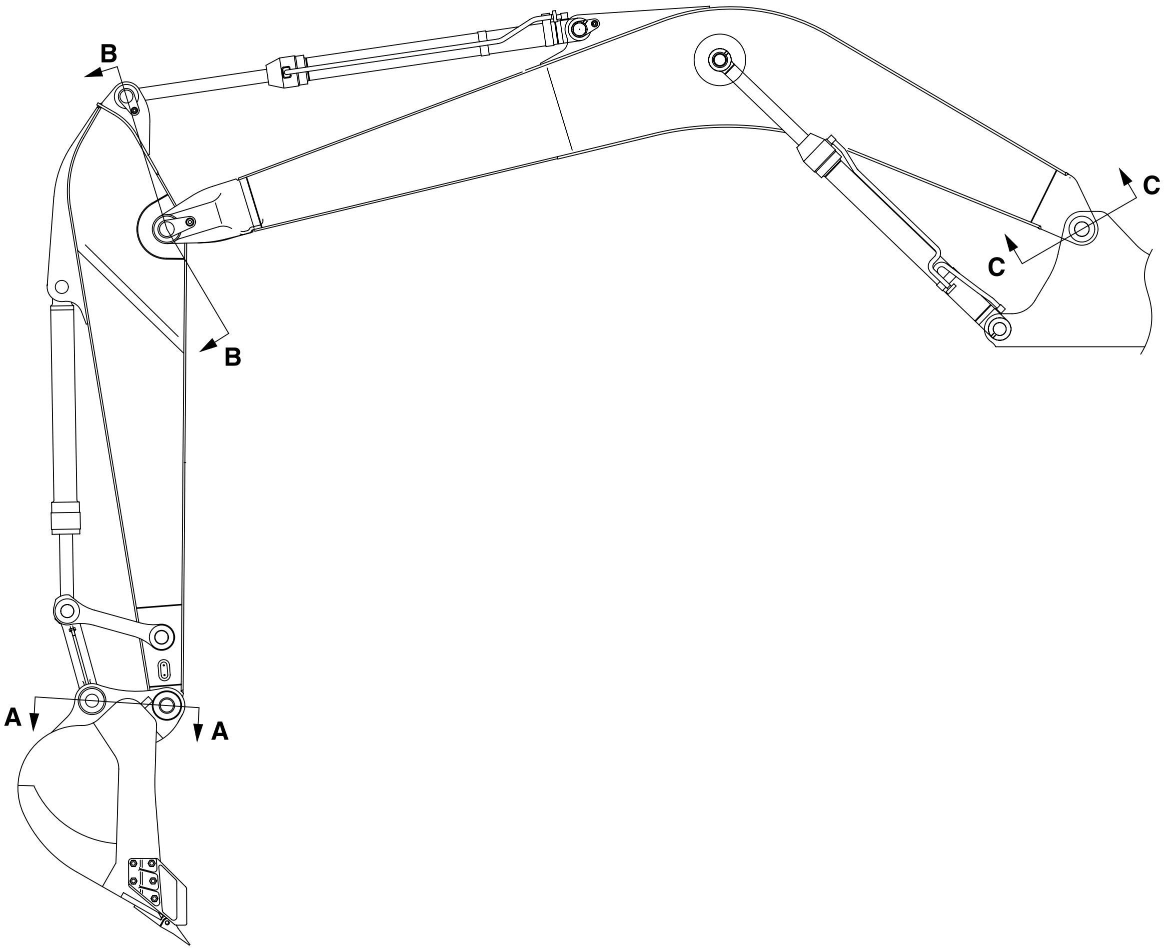
⑥ Lighten the press load and confirm the set length of spring (3).

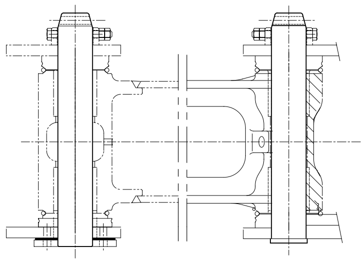
⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).



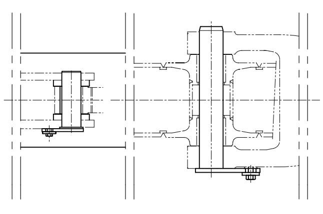
GROUP 11 WORK EQUIPMENT

1. STRUCTURE

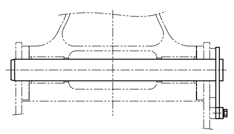




SECTION A



SECTION B



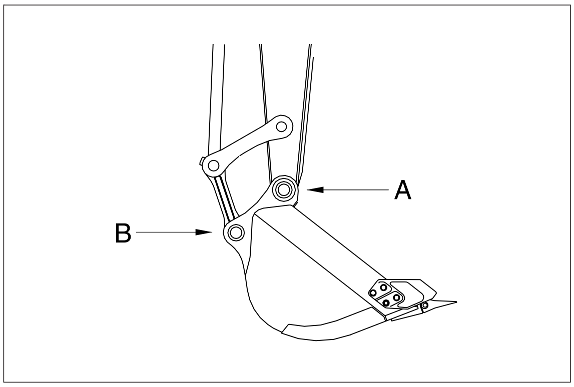
SECTION C

2. REMOVAL AND INSTALL

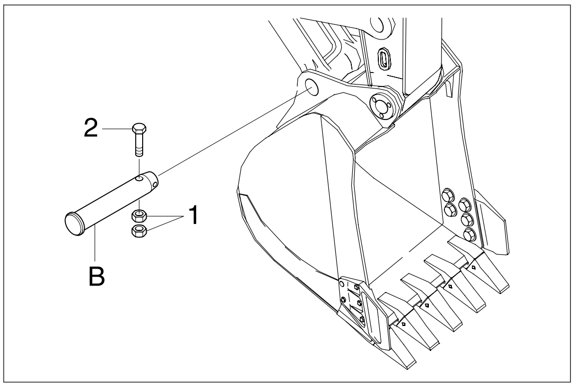
1) BUCKET ASSEMBLY

(1) Removal

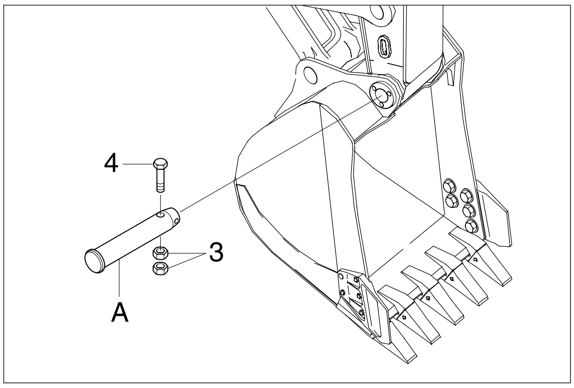
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut (1), bolt (2) and draw out the pin (A).



③ Remove nut (3), bolt (4) and draw out the pin (B).

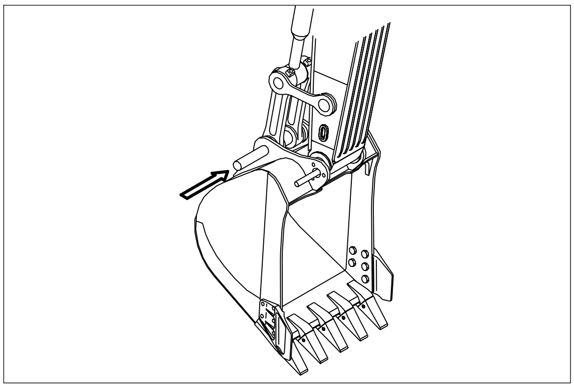


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance.
For detail, see operation manual.



2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **Escaping fluid under pressure can penetrated the skin causing serious injury.**

① Remove bucket assembly.
For details, see removal of bucket assembly.

② Disconnect bucket cylinder hose (1).

⚠ **Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

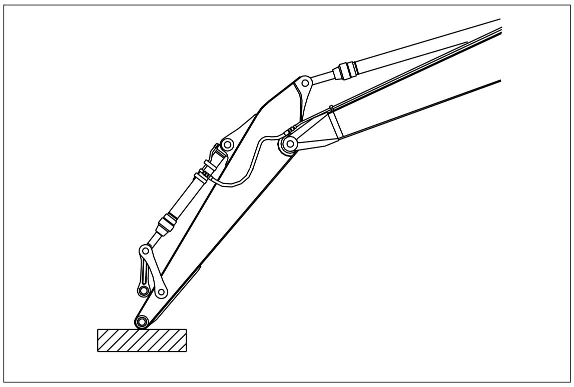
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

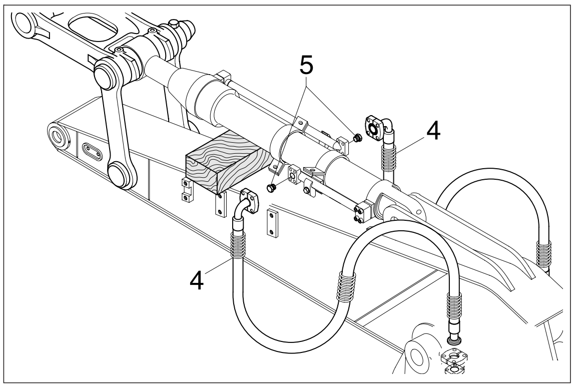
※ Tie the rod with wire to prevent it from coming out.

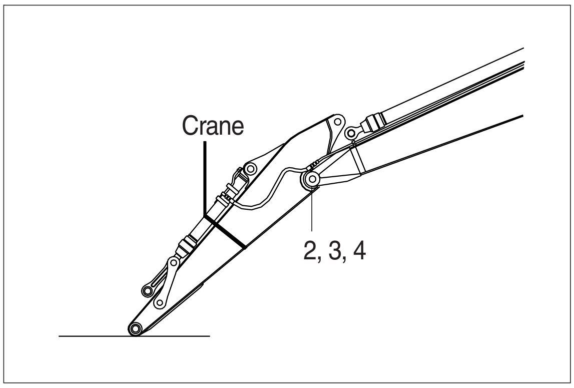
④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

※ · Weight : 1050 kg (2310 lb)
When lifting the arm assembly, always lift the center of gravity.







(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

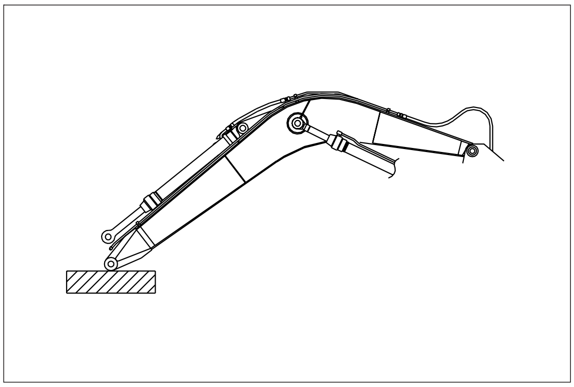
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.
For details, see removal of arm and bucket assembly.

② Remove boom cylinder assembly from boom.
For details, see removal of arm cylinder assembly.

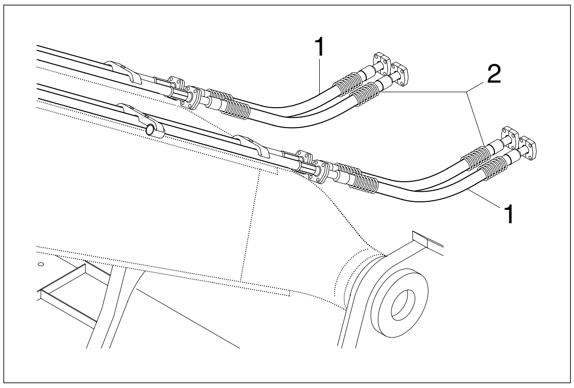


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

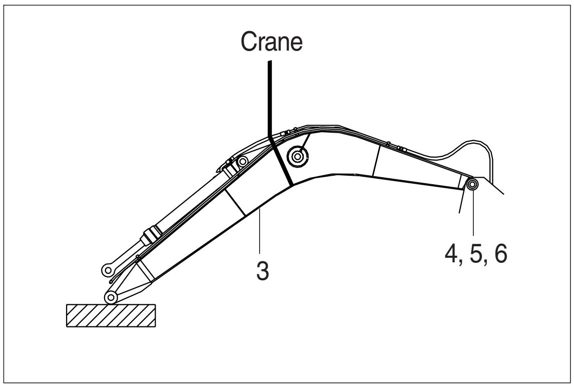
※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight :1950 kg (4300 lb)

※ When lifting the boom assembly always lift the center of gravity.



(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the arm assembly, always lift the center of gravity.

※ Bleed the air from the cylinder.