HYDRAULIC EXCAVATOR

SERVICE MANUAL

Robex

140LS

SMART

HYUNDAI

HYUNDAI
CONSTRUCTION EQUIPMENT
INDIA

SERVICE BOOK NO:
INDIA COPY:

CONTENTS

SECTION 1 GENERAL

SECTION 2 STRUCTURE AND FUNCTION

SECTION 3 HYDRAULIC SYSTEM

SECTION 4 ELECTRICAL SYSTEM

SECTION 5 MECHATRONICS SYSTEM

SECTION 6 TROUBLESHOOTING

SECTION 7 MAINTENANCE STANDARD

SECTION 8 DISASSEMBLY AND ASSEMBLY

SECTION 9 COMPONENT MOUNTING TORQUE

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

SECTION 9 COMPONENT MOUNTING TORQUE
This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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 ┐ Added pages
   10 - 4 - 2 ┘
   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
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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/cm² to lbf/in²

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

	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

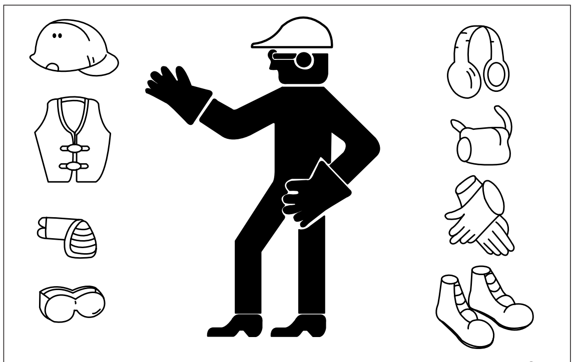
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

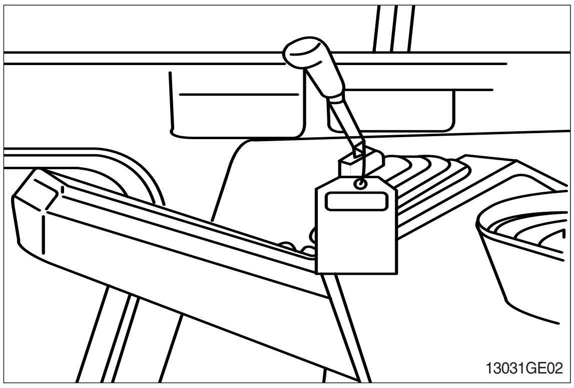
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

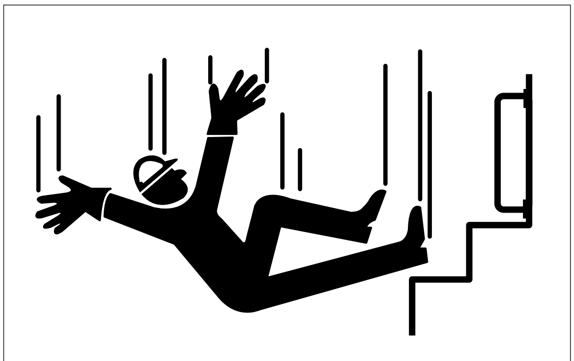
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「**Do Not Operate**」 tag on the right side control lever.



13031GE02

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.



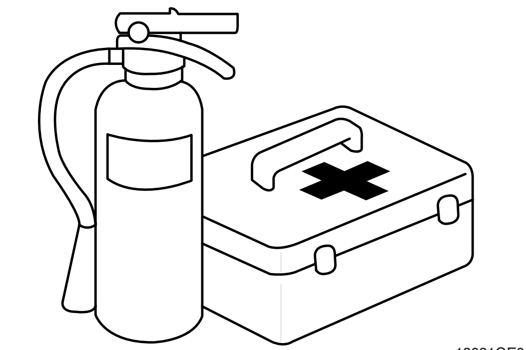
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

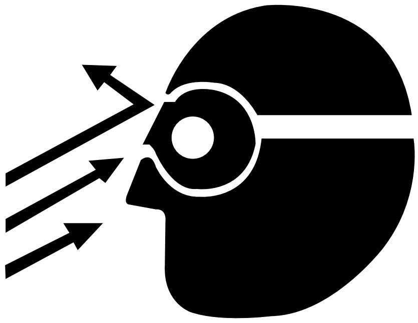
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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



13031GE05

PROTECT AGAINST NOISE

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

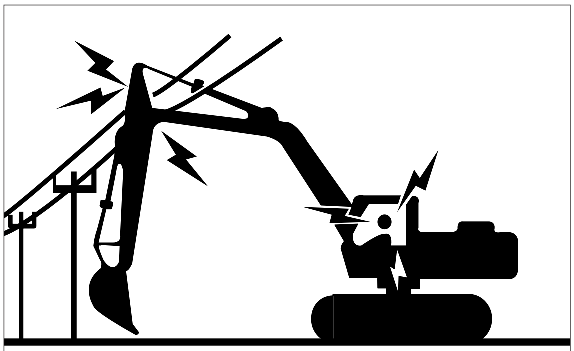
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

13031GE06

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.

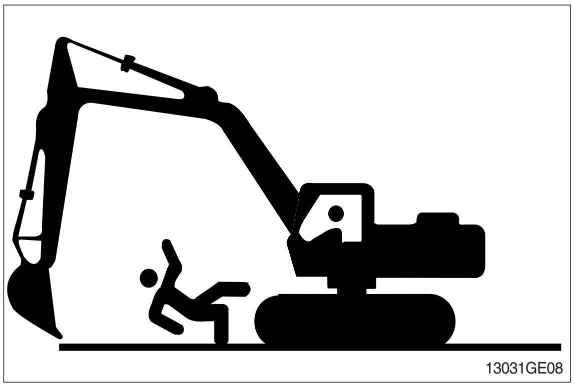


13031GE07

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.



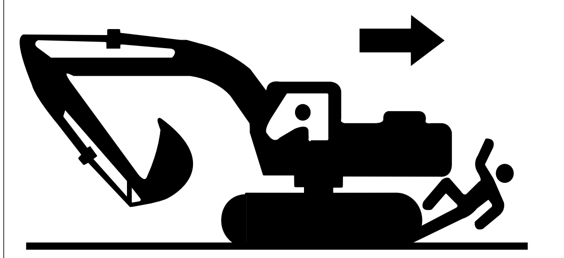
13031GE08

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.

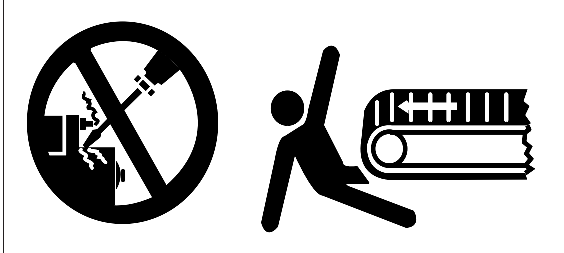


13031GE09

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.



13031GE26

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.

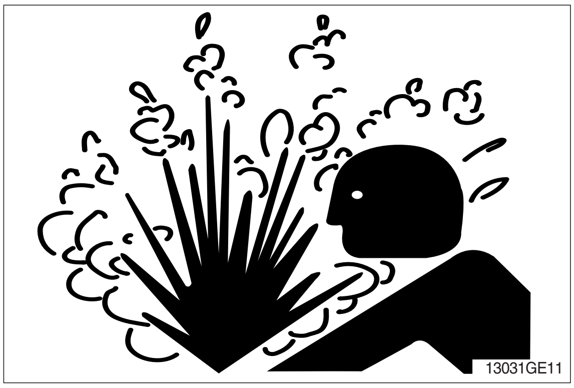
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.


13031GE10

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.


13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

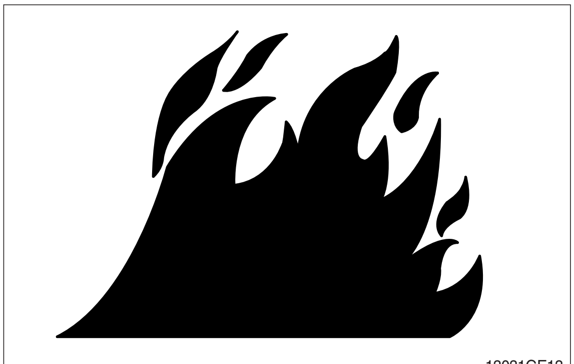
Handle fuel with care; It is highly flammable. Do not refuel the machine while smoking or when near open flame or sparks. Always stop engine before refueling machine.
Fill fuel tank outdoors.


13031GE12

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

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

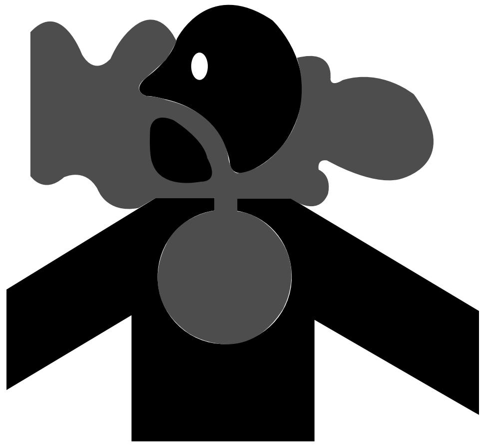
Do not store oily rags; They can ignite and burn spontaneously.


13031GE13

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.



13031GE14

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

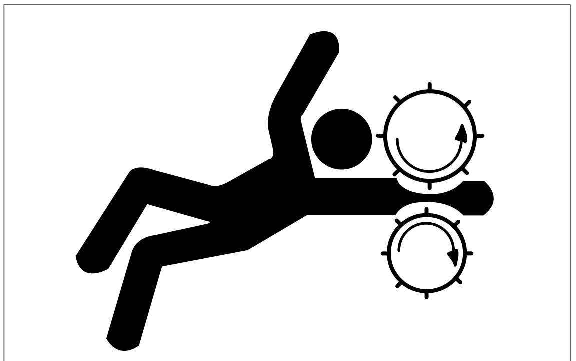
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

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.

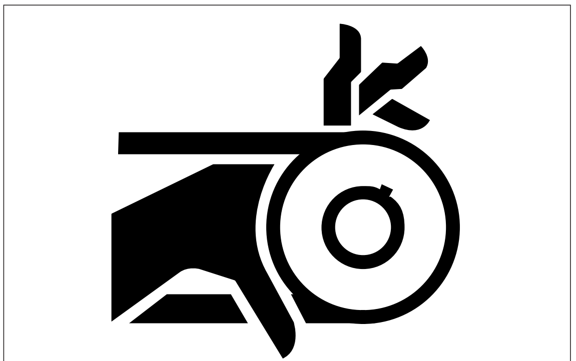


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

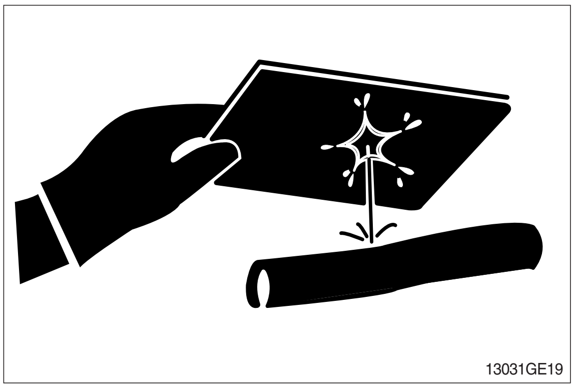
Escaping fluid under pressure can penetrate the skin causing serious injury.

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.

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

13031GE20

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

13031GE21

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:

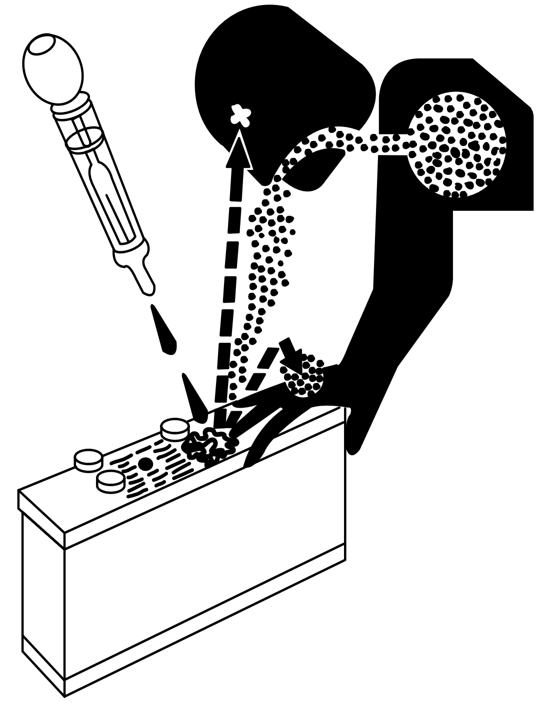
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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.



13031GE22

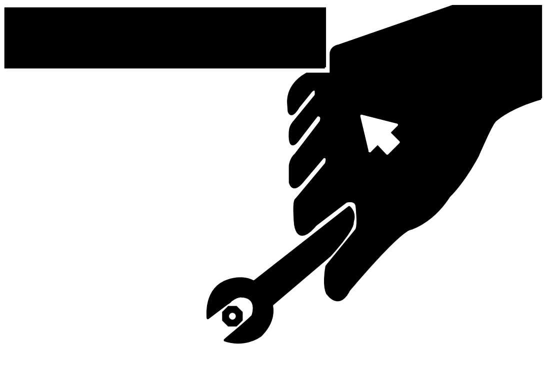
USE TOOLS PROPERLY

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.)



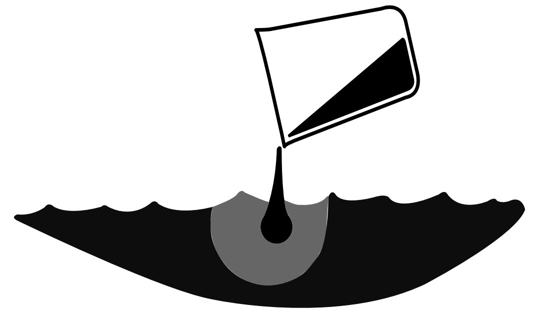
13031GE23

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.

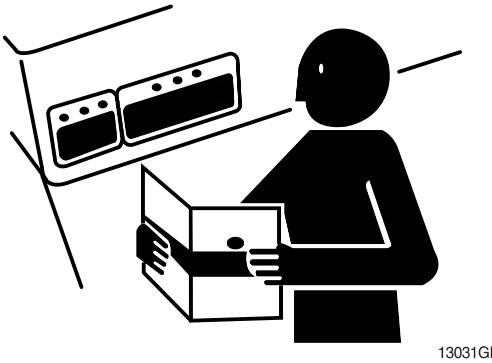
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



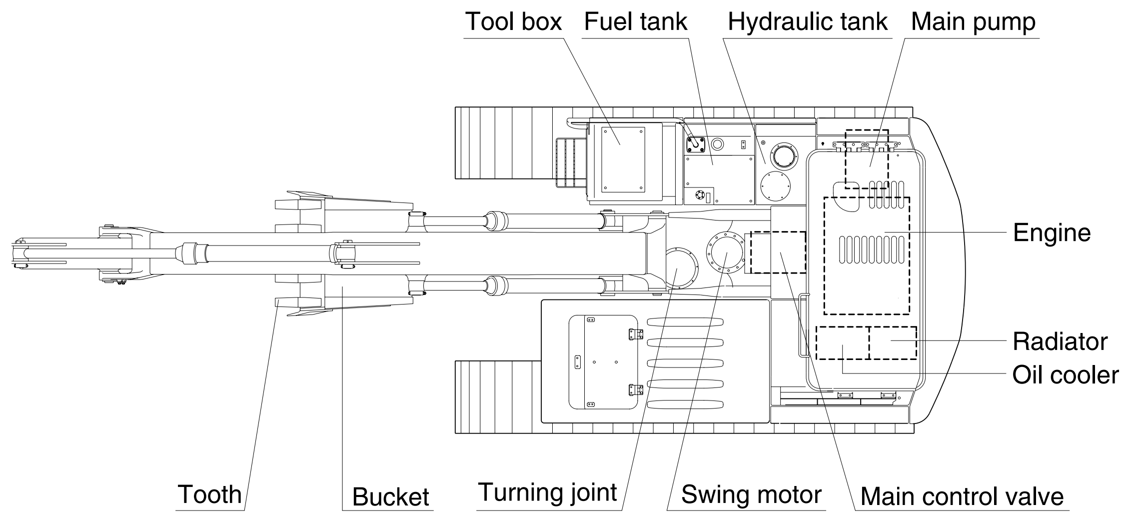
13031GE25

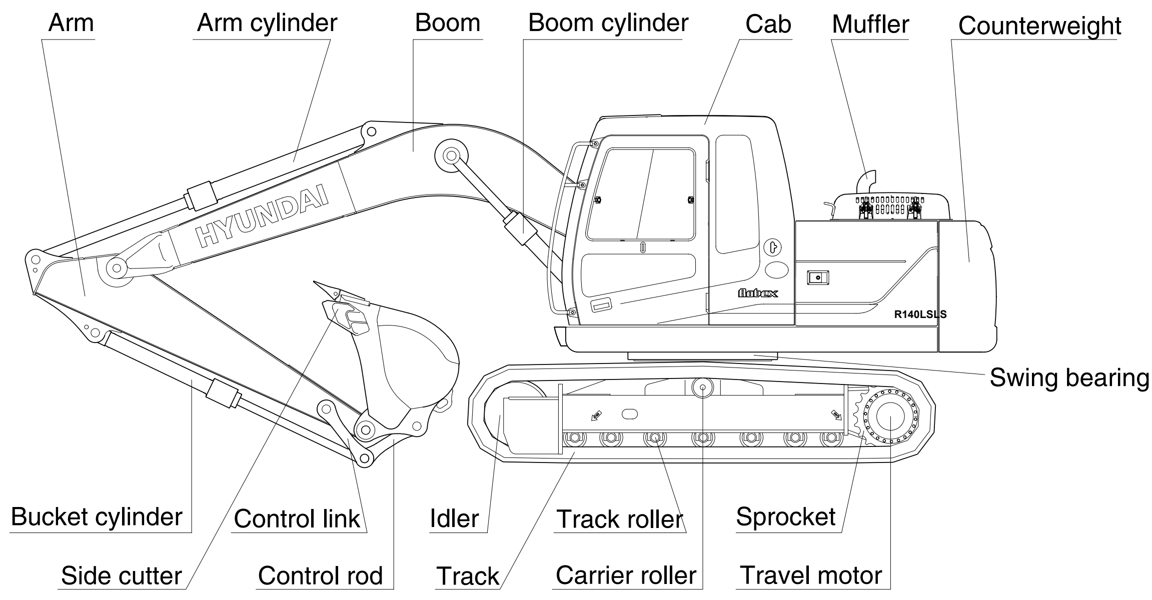
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT



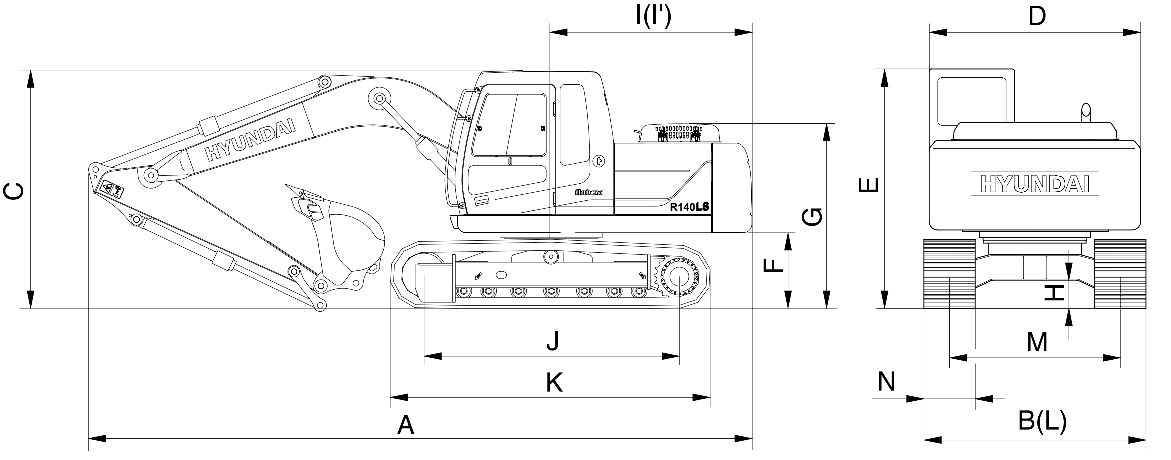


140D92SP01

2. SPECIFICATIONS

1) R140LS

· 4.60 m (15' 1") BOOM and 2.10 m (6' 11") ARM



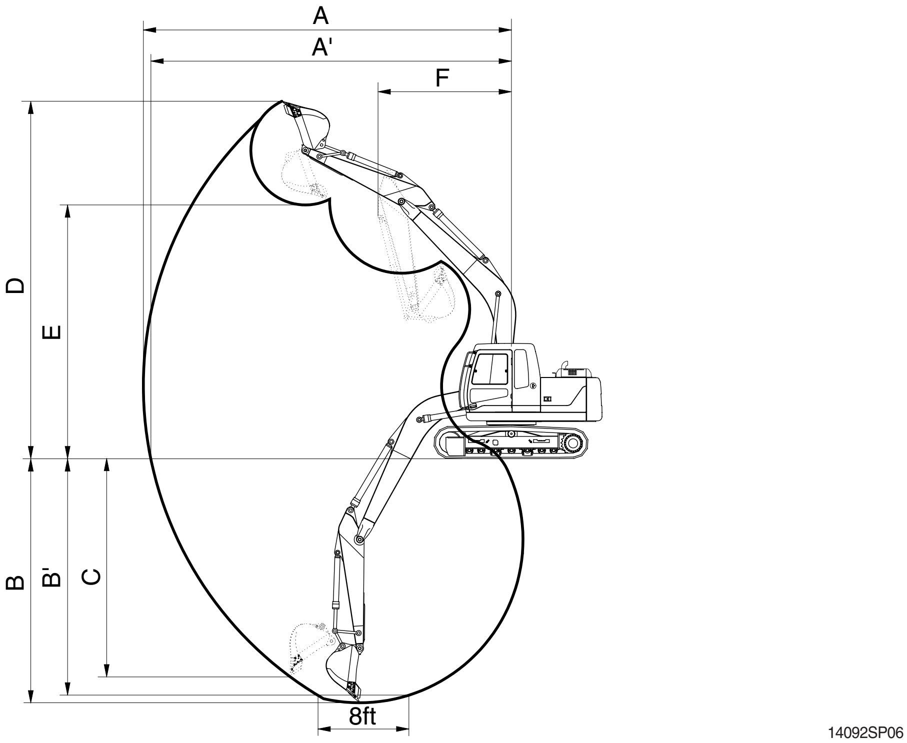
140D92SP02

Description		Unit	Specification
Operating weight		kg (lb)	13980 (30820)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.65 (0.85)
Overall length	A		7850 (25' 8")
Overall width, with 600 mm shoe	B		2600 (8' 6")
Overall height	C		2760 (9' 1")
Superstructure width	D		2600 (8' 6")
Overall height of cab	E		2860 (9' 5")
Ground clearance of counterweight	F		940 (3' 1")
Engine cover height	G		2210 (7' 3")
Minimum ground clearance	H	mm (ft-in)	440 (1' 5")
Rear-end distance	I		2330 (7' 8")
Rear-end swing radius	I'		2330 (7' 8")
Distance between tumblers	J		3000 (9' 10")
Undercarriage length	K		3750 (12' 4")
Undercarriage width	L		2600 (8' 6")
Track gauge	M		2000 (6' 7")
Track shoe width, standard	N		600 (24")
Travel speed (low/high)		km/hr (mph)	3.2/5.5 (2.0/3.4)
Swing speed		rpm	12.0
Gradeability		Degree (%)	35 (70)
Ground pressure (600 mm shoe)		kgf/cm^2 (psi)	0.36 (5.12)
Max traction force		kgf (lbf)	13300 (29320)

3. WORKING RANGE

1) R140LSLS

(1) 4.60 m (15' 1") MONO BOOM



Description		※2.10 m (6' 11") Arm
Max digging reach	A	7920 mm (25'11")
Max digging reach on ground	A'	7780 mm (25' 6")
Max digging depth	B	5200 mm (17' 1")
Max digging depth (8ft level)	B'	4950 mm (16' 3")
Max vertical wall digging depth	C	4590 mm (15' 1")
Max digging height	D	8140 mm (26' 8")
Max dumping height	E	5710 mm (18' 9")
Min swing radius	F	2680 mm (8'10")
Bucket digging force	SAE	87.3 [94.8] kN
		8900 [9660] kgf
		19620 [21300] lbf
	ISO	102 [110.8] kN
		10400 [11290] kgf
		22930 [24890] lbf
Arm crowd force	SAE	73.6 [79.9] kN
		7500 [8140] kgf
		16530 [17950] lbf
	ISO	77.5 [84.1] kN
		7900 [8580] kgf
		17420 [18910] lbf

※ : STD   [ ] : Power boost

4. WEIGHT

1) R140LSLS

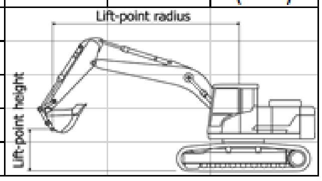
Item	R140LS	
	kg	lb
Upper structure assembly	5630	12420
Main frame weld assembly	1120	2470
Engine assembly	550	1210
Main pump assembly	100	220
Main control valve assembly	140	310
Swing motor assembly	120	260
Hydraulic oil tank assembly	160	350
Fuel tank assembly	130	290
Counterweight	1900	4190
Cab assembly	310	680
Lower chassis assembly	5340	11760
Track frame weld assembly	1590	3510
Swing bearing	215	475
Travel motor assembly	480	1060
Turning joint	50	110
Track recoil spring	210	460
Sprocket	80	180
Idler	250	550
Carrier roller	40	90
Track roller	490	1080
Track-chain assembly (600 mm standard triple grouser shoe)	2050	4520
Front attachment assembly (4.6 m boom, 2.1 m arm, 0.65 m^3 SAE heaped bucket)	2380	5250
4.6 m boom assembly	830	1830
2.1 m arm assembly	370	820
0.65 m^3 SAE heaped bucket	560	1235
Boom cylinder assembly	130	290
Arm cylinder assembly	160	350
Bucket cylinder assembly	100	220
Bucket control rod assembly	90	200

5. LIFTING CAPACITIES

Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	[illegible]	Outtriger[F]	Outtriger[R]	Cabin type
GP	4600	GP	2100	GP	0.65	NO	NO	1900	500	NONE	NONE	CABIN

Lift-point height (m/ft)		Lift-point radius								At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		Capacity		Reach
												m(ft)
6.0m	kg					*3170	*3170			*2570	*2570	5.05
19.7ft	lb					*6990	*6990			*5670	*5670	(16.6)
4.5m	kg					*3400	*3400	*2760	2110	*2430	2050	6.09
14.8ft	lb					*7500	*7500	*6080	4650	*5360	4520	(20.0)
3.0m	kg			*5980	*5980	*4270	3350	3330	2050	*2500	1690	6.64
9.8ft	lb			*13180	*13180	*9410	7390	7340	4520	*5510	3730	(21.8)
1.5m	kg			*8270	5780	5170	3090	3220	1940	2600	1550	6.81
4.9ft	lb			*18230	12740	11400	6810	7100	4280	5730	3420	(22.3)
0.0m	kg			*7270	5470	4960	2910	3120	1860	2660	1570	6.64
0.0ft	lb			*16030	12060	10930	6420	6880	4100	5860	3460	(21.8)
-1.5m	kg	*5390	*5390	*9650	5460	4890	2840	3100	1830	3030	1790	6.09
-4.9ft	lb	*11880	*11880	*21270	12040	10780	6260	6830	4030	6680	3950	(20.0)
-3.0m	kg	*9570	*9570	*8390	5590	4960	2900			4120	2450	5.05
-9.8ft	lb	*21100	*21100	*18500	12320	10930	6390			9080	5400	(16.6)

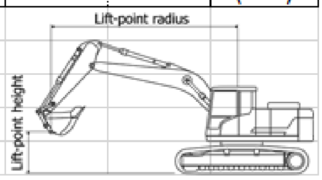
Notes: 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the Robex Series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is a hook (standard equipment) located on the back of the bucket.
4. (*) indicates load limited by hydraulic capacity.



Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	[illegible]	Outtriger[F]	Outtriger[R]	Cabin type
GP	4600	GP	2100	GP	0.65	NO	NO	1900	600	NONE	NONE	CABIN

Lift-point height (m/ft)		Lift-point radius								At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		Capacity		Reach
												m(ft)
6.0m	kg					*3170	*3170			*2570	*2570	5.05
19.7ft	lb					*6990	*6990			*5670	*5670	(16.6)
4.5m	kg					*3400	*3400	*2760	2140	*2430	2080	6.09
14.8ft	lb					*7500	*7500	*6080	4720	*5360	4590	(20.0)
3.0m	kg			*5980	*5980	*4270	3400	3380	2080	*2500	1720	6.64
9.8ft	lb			*13180	*13180	*9410	7500	7450	4590	*5510	3790	(21.8)
1.5m	kg			*8270	5860	5250	3140	3270	1970	2650	1580	6.81
4.9ft	lb			*18230	12920	11570	6920	7210	4340	5840	3480	(22.3)
0.0m	kg			*7270	5560	5040	2950	3180	1890	2710	1600	6.64
0.0ft	lb			*16030	12260	11110	6500	7010	4170	5970	3530	(21.8)
-1.5m	kg	*5390	*5390	*9650	5540	4970	2890	3150	1870	3080	1820	6.09
-4.9ft	lb	*11880	*11880	*21270	12210	10960	6370	6940	4120	6790	4010	(20.0)
-3.0m	kg	*9570	*9570	*8390	5680	5040	2950			4190	2490	5.05
-9.8ft	lb	*21100	*21100	*18500	12520	11110	6500			9240	5490	(16.6)

Notes: 1. Lifting capacity are based on 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 Lift-point is a hook (standard equipment) located on the back of the bucket.
4. (*) indicates load limited by hydraulic capacity.



Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	[illegible]	Outtriger[F]	Outtriger[R]	Cabin type
GP	4600	GP	2500	GP	0.65	NO	NO	1900	500	NONE	NONE	CABIN

Lift-point height (m/ft)		Lift-point radius								At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		Capacity		Reach
												m(ft)
6.0m	kg									*1700	*1700	5.61
19.7ft	lb									*3750	*3750	(18.4)
4.5m	kg							*2760	2140	*1590	*1590	6.56
14.8ft	lb							*6080	4720	*3510	*3510	(21.5)
3.0m	kg			*5090	*5090	*3870	3400	3340	2060	*1620	1490	7.07
9.8ft	lb			*11220	*11220	*8530	7500	7360	4540	*3570	3280	(23.2)
1.5m	kg			*8130	5910	*5030	3110	3210	1940	*1750	1370	7.23
4.9ft	lb			*17920	13030	*11090	6860	7080	4280	*3860	3020	(23.7)
0.0m	kg			*7490	5480	4950	2900	3100	1830	*2040	1390	7.07
0.0ft	lb			*16510	12080	10910	6390	6830	4030	*4500	3060	(23.2)
-1.5m	kg	*4640	*4640	*9680	5390	4840	2800	3050	1790	*2610	1550	6.56
-4.9ft	lb	*10230	*10230	*21340	11880	10670	6170	6720	3950	*5750	3420	(21.5)
-3.0m	kg	*7840	*7840	*8850	5480	4870	2830			3430	2030	5.61
-9.8ft	lb	*17280	*17280	*19510	12080	10740	6240			7560	4480	(18.4)
-4.5m	kg			*6280	5770					*4610	3770	3.90
-14.8ft	lb			*13850	12720					*10160	8310	(12.8)

Notes:
1. Lifting capacity are based on ISO 10567.
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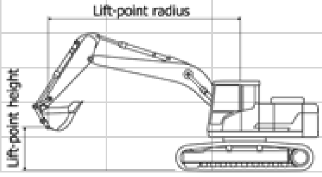
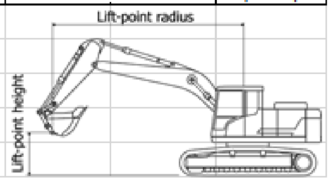


Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	[illegible]	Outtriger[F]	Outtriger[R]	Cabin type
GP	4600	GP	2500	GP	0.65	NO	NO	1900	600	NONE	NONE	CABIN

Lift-point height (m/ft)		Lift-point radius								At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		Capacity		Reach
												m(ft)
6.0m	kg									*1700	*1700	5.61
19.7ft	lb									*3750	*3750	(18.4)
4.5m	kg							*2760	2170	*1590	*1590	6.56
14.8ft	lb							*6080	4780	*3510	*3510	(21.5)
3.0m	kg			*5090	*5090	*3870	3440	*3390	2090	*1620	1520	7.07
9.8ft	lb			*11220	*11220	*8530	7580	*7470	4610	*3570	3350	(23.2)
1.5m	kg			*8130	6000	*5030	3160	3270	1970	*1750	1400	7.23
4.9ft	lb			*17920	13230	*11090	6970	7210	4340	*3860	3090	(23.7)
0.0m	kg			*7490	5560	5030	2940	3160	1870	*2040	1410	7.07
0.0ft	lb			*16510	12260	11090	6480	6970	4120	*4500	3110	(23.2)
-1.5m	kg	*4640	*4640	*9680	5480	4920	2850	3100	1820	*2610	1580	6.56
-4.9ft	lb	*10230	*10230	*21340	12080	10850	6280	6830	4010	*5750	3480	(21.5)
-3.0m	kg	*7840	*7840	*8850	5570	4950	2880			3490	2060	5.61
-9.8ft	lb	*17280	*17280	*19510	12280	10910	6350			7690	4540	(18.4)
-4.5m	kg			*6280	5860					*4610	3830	3.90
-14.8ft	lb			*13850	12920					*10160	8440	(12.8)

Notes:
1. Lifting capacity are based on 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 Lift-point is a hook (standard equipment) located on the back of the bucket.
4. (*) indicates load limited by hydraulic capacity.



Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[㎥]	QC	Swing Post	CWT[kg]	[illegible]	Outrigger[F]	Outrigger[R]	Cabin type
GP	4600	GP	2100	GP	0.65	NO	NO	1900	500	NONE	NONE	CABIN

Lift-point height (m/ft)		Lift-point radius								At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		Capacity		Reach
												m(ft)
6.0m	kg					*3940	3880			*3520	3400	4.86
19.7ft	lb					*8690	8550			*7760	7500	(15.9)
4.5m	kg					*4070	3830			*3230	2440	5.94
14.8ft	lb					*8970	8440			*7120	5380	(19.5)
3.0m	kg			*7060	6770	*4940	3640	3630	2350	3200	2070	6.49
9.8ft	lb			*15560	14930	*10890	8020	8000	5180	7050	4560	(21.3)
1.5m	kg					5480	3410	3540	2270	3010	1940	6.67
4.9ft	lb					12080	7520	7800	5000	6640	4280	(21.9)
0.0m	kg			*5900	*5900	5310	3270	3460	2200	3090	1970	6.49
0.0ft	lb			*13010	*13010	11710	7210	7630	4850	6810	4340	(21.3)
-1.5m	kg	*5140	*5140	*9930	5940	5270	3230			3510	2230	5.94
-4.9ft	lb	*11330	*11330	*21890	13100	11620	7120			7740	4920	(19.5)
-3.0m	kg			*8390	6070	5360	3300			4780	2990	4.86
-9.8ft	lb			*18500	13380	11820	7280			10540	6590	(15.9)

Notes:
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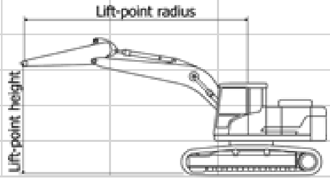
4. (*) indicates load limited by hydraulic capacity.



Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[㎥]	QC	Swing Post	CWT[kg]	[illegible]	Outrigger[F]	Outrigger[R]	Cabin type
GP	4600	GP	2100	GP	0.65	NO	NO	1900	600	NONE	NONE	CABIN

Lift-point height (m/ft)		Lift-point radius								At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		Capacity		Reach
												m(ft)
6.0m	kg					*3940	3930			*3520	3440	4.86
19.7ft	lb					*8690	8660			*7760	7580	(15.9)
4.5m	kg					*4070	3880			*3230	2470	5.94
14.8ft	lb					*8970	8550			*7120	5450	(19.5)
3.0m	kg			*7060	6850	*4940	3680	3680	2390	*3220	2100	6.49
9.8ft	lb			*15560	15100	*10890	8110	8110	5270	*7100	4630	(21.3)
1.5m	kg					5560	3460	3590	2300	3060	1970	6.67
4.9ft	lb					12260	7630	7910	5070	6750	4340	(21.9)
0.0m	kg			*5900	*5900	5390	3310	3520	2230	3140	2000	6.49
0.0ft	lb			*13010	*13010	11880	7300	7760	4920	6920	4410	(21.3)
-1.5m	kg	*5140	*5140	*9930	6020	5350	3280			3560	2260	5.94
-4.9ft	lb	*11330	*11330	*21890	13270	11790	7230			7850	4980	(19.5)
-3.0m	kg			*8390	6150	5440	3350			4850	3030	4.86
-9.8ft	lb			*18500	13560	11990	7390			10690	6680	(15.9)

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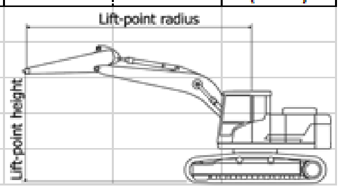

Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	[illegible]	Outtriger[F]	Outtriger[R]	Cabin type
GP	4600	GP	2500	GP	0.65	NO	NO	1900	500	NONE	NONE	CABIN

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												m(ft)
6.0m	kg					*3410	*3410			*2420	*2420	5.41
19.7ft	lb					*7520	*7520			*5340	*5340	(17.7)
4.5m	kg					*3660	*3660	*3400	2430	*2220	2170	6.39
14.8ft	lb					*8070	*8070	*7500	5360	*4890	4780	(21.0)
3.0m	kg			*6150	*6150	*4550	3680	3640	2360	*2200	1870	6.91
9.8ft	lb			*13560	*13560	*10030	8110	8020	5200	*4850	4120	(22.7)
1.5m	kg			*7530	6200	5510	3430	3530	2260	*2310	1760	7.07
4.9ft	lb			*16600	13670	12150	7560	7780	4980	*5090	3880	(23.2)
0.0m	kg			*6400	5900	5300	3250	3440	2180	*2570	1790	6.91
0.0ft	lb			*14110	13010	11680	7170	7580	4810	*5670	3950	(22.7)
-1.5m	kg	*4630	*4630	*9720	5860	5230	3190	3410	2150	*3110	1980	6.39
-4.9ft	lb	*10210	*10210	*21430	12920	11530	7030	7520	4740	*6860	4370	(21.0)
-3.0m	kg	*8650	*8650	*8960	5960	5270	3230			4020	2530	5.41
-9.8ft	lb	*19070	*19070	*19750	13140	11620	7120			8860	5580	(17.7)
-4.5m	kg											
-14.8ft	lb											

Notes:
1. Lifting capacity are based on ISO 10567.
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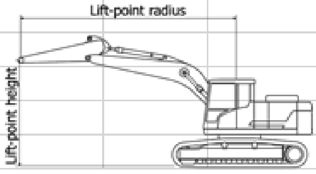

Boom type	Length[mm]	Arm type	Length[mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	[illegible]	Outtriger[F]	Outtriger[R]	Cabin type
GP	4600	GP	2500	GP	0.65	NO	NO	1900	600	NONE	NONE	CABIN

Lift-point height (m/ft)		Lift-point radius								At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		Capacity		Reach
												m(ft)
6.0m	kg					*3410	*3410			*2420	*2420	5.41
19.7ft	lb					*7520	*7520			*5340	*5340	(17.7)
4.5m	kg					*3660	*3660	*3400	2460	*2220	2200	6.39
14.8ft	lb					*8070	*8070	*7500	5420	*4890	4850	(21.0)
3.0m	kg			*6150	*6150	*4550	3720	3700	2400	*2200	1900	6.91
9.8ft	lb			*13560	*13560	*10030	8200	8160	5290	*4850	4190	(22.7)
1.5m	kg			*7530	6290	5590	3480	3590	2290	*2310	1790	7.07
4.9ft	lb			*16600	13870	12320	7670	7910	5050	*5090	3950	(23.2)
0.0m	kg			*6400	5980	5380	3300	3500	2210	*2570	1810	6.91
0.0ft	lb			*14110	13180	11860	7280	7720	4870	*5670	3990	(22.7)
-1.5m	kg	*4630	*4630	*9720	5940	5310	3230	3460	2180	*3110	2010	6.39
-4.9ft	lb	*10210	*10210	*21430	13100	11710	7120	7630	4810	*6860	4430	(21.0)
-3.0m	kg	*8650	*8650	*8960	6040	5350	3280			4080	2570	5.41
-9.8ft	lb	*19070	*19070	*19750	13320	11790	7230			8990	5670	(17.7)
-4.5m	kg											
-14.8ft	lb											

Notes:
1. Lifting capacity are based on 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.
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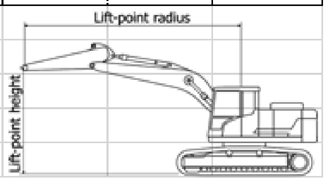
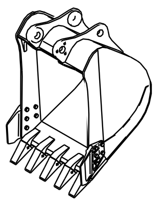
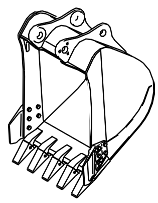
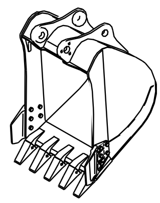


6. BUCKET SELECTION GUIDE

1) R140LSLS

7. General bucket

		
0.52 m³ SAE heaped bucket	※0.65 m³ SAE heaped bucket	0.72 m³ SAE heaped bucket

MODEL		R140LS		500mm	보기	Grade		1900	1900
Capacity m3 (yd3)				Width mm (in)		Weight kg (lb)		Recommendation mm(ft-in)	
SAE heaped		CECE heaped						4,600 (15′ 1″) Boom	4,600 (15′ 1″) Boom
								2,100 (6′ 11″) Arm	2,500 (8′ 2″) Arm
0.52	(0.68)	0.45	(0.59)	935	(36.8″)	510	(1,120)	●	●
0.65	(0.85)	0.55	(0.72)	1,110	(43.7″)	555	(1,220)	●	◐
0.72	(0.94)	0.60	(0.78)	1,205	(47.4″)	551	(1,210)	◐	■

● : Applicable for materials with density of 2,100 kg/m³ (3,500 lb/yd³) or less

◐ : Applicable for materials with density of 1,800 kg/m³ (3,000 lb/yd³) or less

■ : Applicable for materials with density of 1,500 kg/m³ (2,500 lb/yd³) or less

▲ : Applicable for materials with density of 1,200 kg/m³ (2,000 lb/yd³) or less

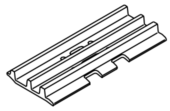
x : Not Recommended

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		
					
R140LS	Shoe width	mm (in)	500 (20)	※600 (24)	
	Operating weight	kg (lb)	13790 (30400)	13980 (30820)	
	Ground pressure	kgf/cm^2 (psi)	0.43 (6.11)	0.36 (5.12)	
	Overall width	mm (ft-in)	2500 (8' 2")	2600 (8' 6")	

※ : Standard

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	1 EA
Track rollers	7 EA
Track shoes	46 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
600 mm triple grouser	Standard	A
500 mm triple grouser	Option	A

※ Table 2

Category	Applications	Applications
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	HM4.2
Type	4-cycle turbocharged 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	105 × 120 mm
Piston displacement	4160 cc (254 cu in)
Compression ratio	17 : 1
Rated gross horse power (SAE J1995)	105 Hp (77.2 kW) at 2200 rpm
Maximum torque	38.2 kgf · m (276 lbf · ft) at 1400 rpm
Engine oil quantity	17.5 ℓ (4.6 U.S. gal)
Dry weight	550 kg (1210 lb)
High idling speed	2400 ± 50 rpm
Low idling speed	850 ± 50 rpm
Rated fuel consumption	162.8 g/Hp · hr at 1400 rpm
Starting motor	24 V-4.5 kW
Alternator	24 V-55 A
Battery	2 × 12 V × 80 Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 62 cc/rev
Maximum pressure	350 kgf/cm^2 (4980 psi) [380 kgf/cm^2 (5400 psi)]
Rated oil flow	2 × 114.7 ℓ /min (30.3 U.S. gpm / 25.2 U.K. gpm)
Rated speed	2200 rpm

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15cc/rev
Maximum pressure	35 kgf/cm² (500 psi)
Rated oil flow	27.75 l/min (7.3 U.S. gpm / 6.1 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	11 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm² (4980 psi) [360 kgf/cm² (5120 psi)]
Overload relief valve pressure	380 kgf/cm² (5400 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	72 cc/rev
Relief pressure	285 kgf/cm² (4054 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	Minimum 30 kgf · m (217 lbf · ft)
Brake release pressure	15~50 kgf/cm² (213~711 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification	
	Type 1	Type 2
Type	Two kinds of displacement axial piston motor	
Relief pressure	350 kgf/cm² (4980 psi)	365 kgf/cm² (5192 psi)
Capacity (max / min)	77/45 cc/rev	
Reduction gear type	2-stage planetary	
Braking system	Automatic, spring applied hydraulic released	
Brake release pressure	9.5 kgf/cm² (135 psi)	8.75 kgf/cm² (125 psi)
Braking torque	Min 19.7 kgf · m (143 lbf · ft)	

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 × 840 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
R140LS	Standard	600 mm (24")	0.36 kgf/cm^2 (5.12 psi)	46	2600 mm (8' 6")
	Option	500 mm (20")	0.43 kgf/cm^2 (6.11 psi)	46	2500 mm (8' 2")

9) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
R140LS	Standard	0.65 m^3 (0.85 yd^3)	0.55 m^3 (0.72 yd^3)	5	1110 mm (43.7")	1210 mm (47.6")
	Option	0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	5	935 mm (36.8")	1035 mm (40.8")
		0.72 m^3 (0.93 yd^3)	0.60 m^3 (0.78 yd^3)	5	1205 mm (47.4")	1305 mm (51.4")

9. RECOMMENDED OILS

Use only oils listed below or equivalent.
Do not mix different brand oil.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature °C (°F) -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	17.5 (4.6)	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Grease	0.35 (0.09)	NLGI NO.1 NLGI NO.2
Swing drive	Gear oil	2.5 (0.7)	SAE 85W-140
Final drive	Gear oil	2.2×2 (0.6×2)	SAE 85W-140
Hydraulic tank	Hydraulic oil	Tank : 124 (32.8) System : 210 (55.5)	ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	270 (71.0)	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 water 50 : 50	15.5 (4.1)	Ethylene glycol base permanent type

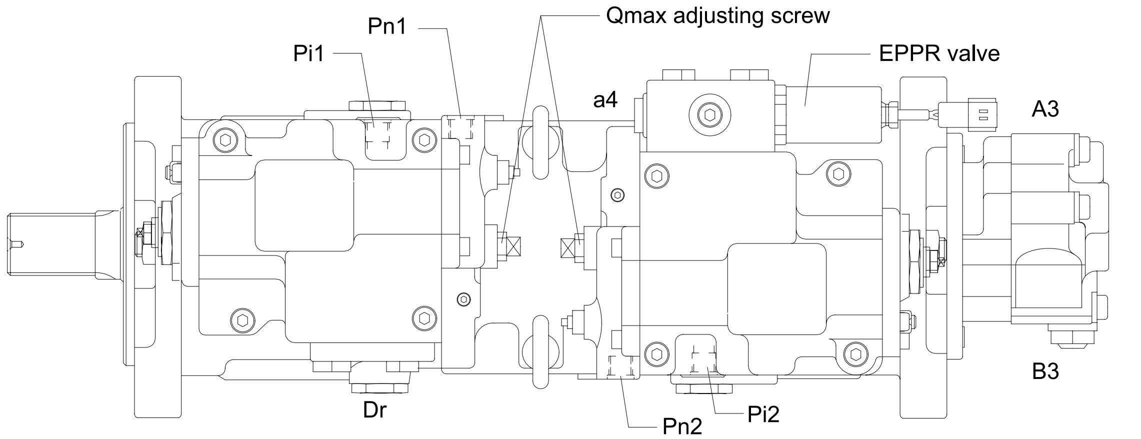
SAE : Society of Automotive Engineers
API : American Petroleum Institute
ISO : International Organization for Standardization
NLGI : National Lubricating Grease Institute
ASTM : American Society of Testing and Material

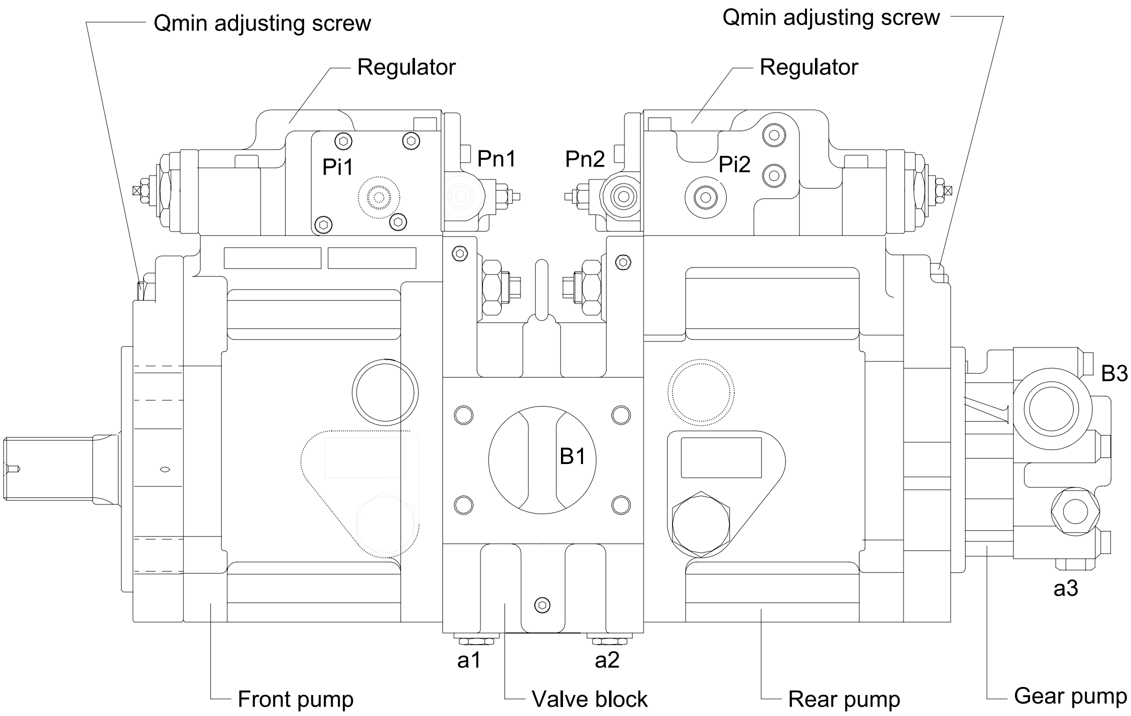
SECTION 2 STRUCTURE AND FUNCTION

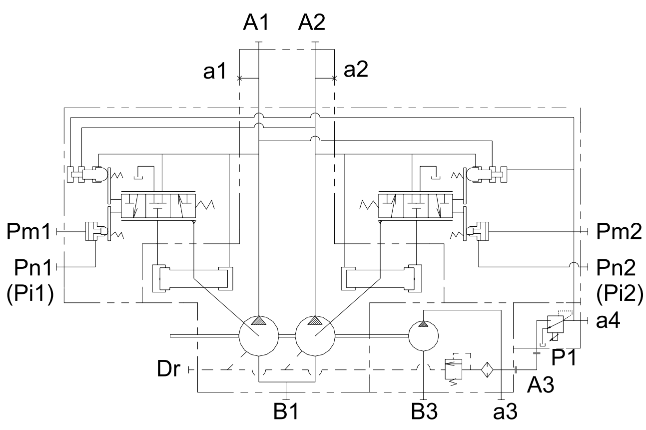
GROUP 1 PUMP DEVICE

1. STRUCTURE

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



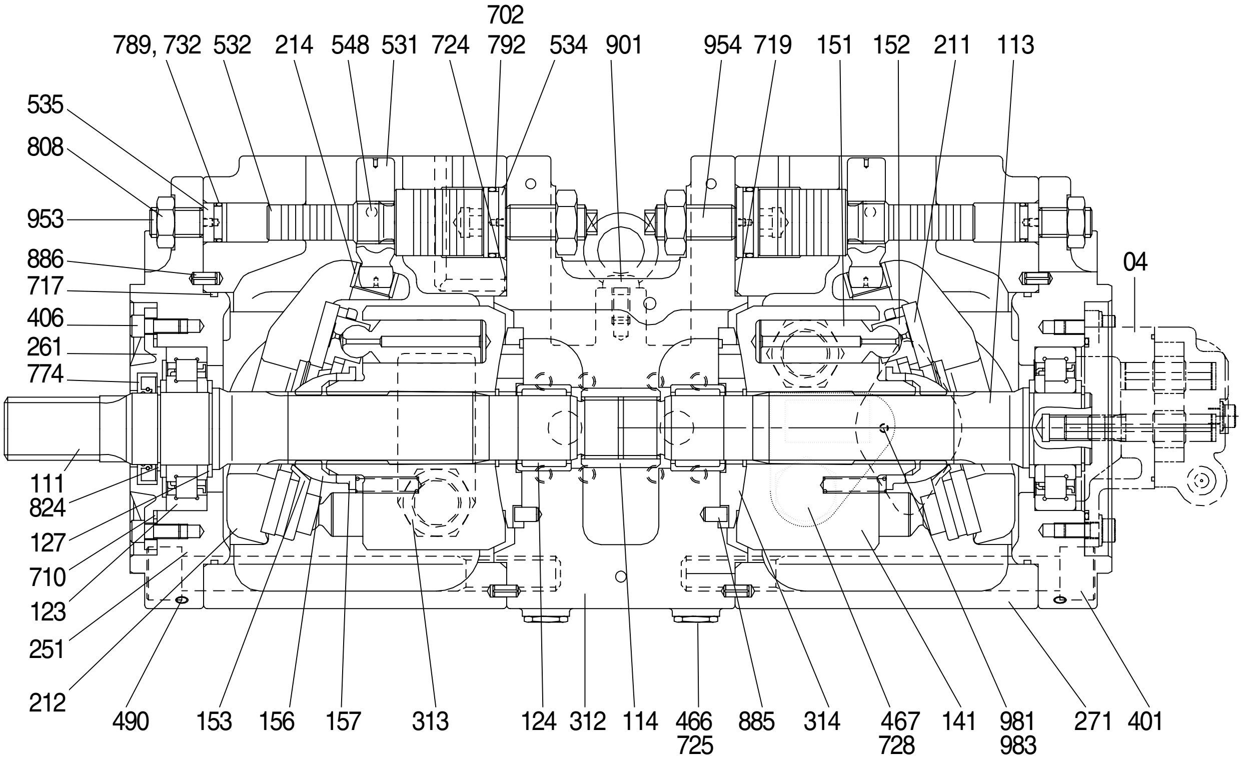




Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 3/4"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 1/2 - 19
Pn1,n2	Pilot port	PF 1/4 - 15
Pm1,Pm2	Qmax cut port	PF 1/4 - 15
P1	EPPR port	PF 1/4 - 13
a1,2	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4 - 14
a4	Gauge port	PF 1/4 - 13
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20

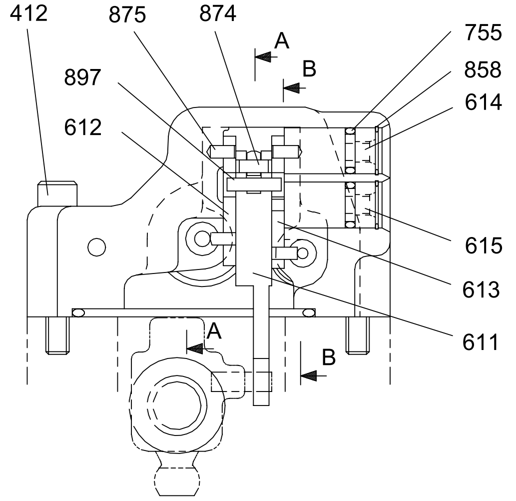
1) MAIN PUMP(1/2)

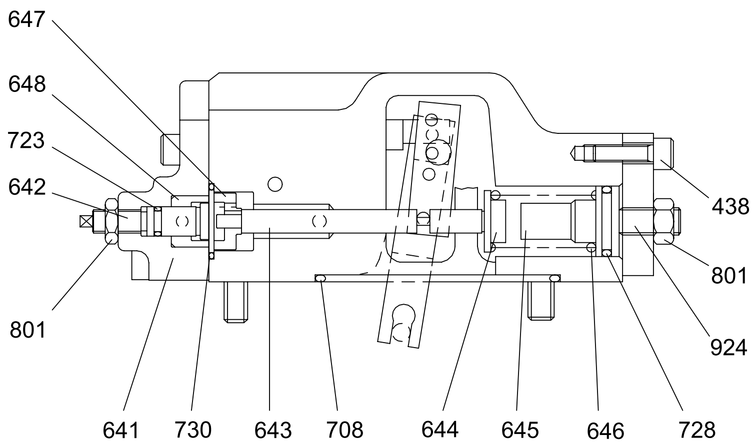
The main pump consists of two piston pumps(front & rear) and valve block.



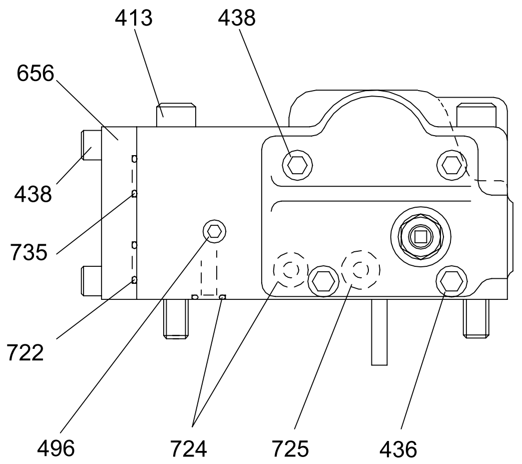
04	Gear pump	261	Seal cover(F)	717	O-ring
111	Drive shaft(F)	271	Pump casing	719	O-ring
113	Drive shaft(R)	312	Valve block	724	O-ring
114	Spline couping	313	Valve plate(R)	725	O-ring
123	Roller bearing	314	Valve plate(L)	728	O-ring
124	Needle bearing	401	Hexagon socket bolt	732	O-ring
127	Bearing spacer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

2) REGULATOR(1/2)

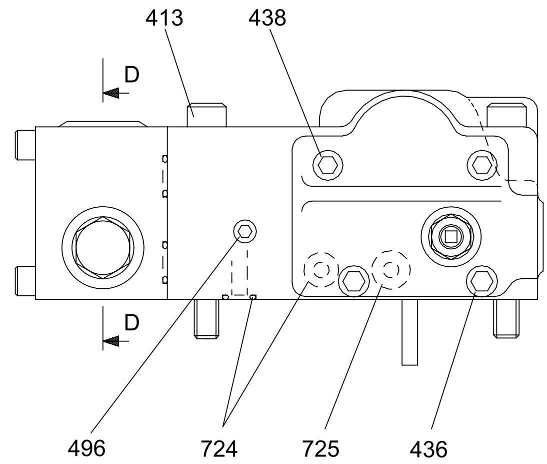




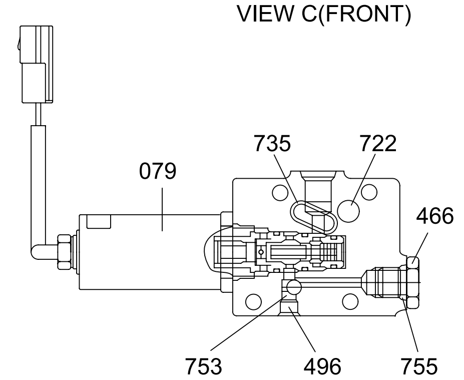
SECTION B-B



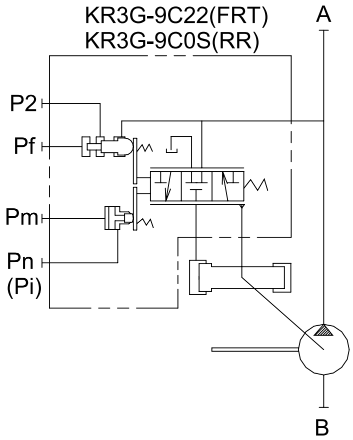
VIEW C(FRONT)



VIEW C(REAR)

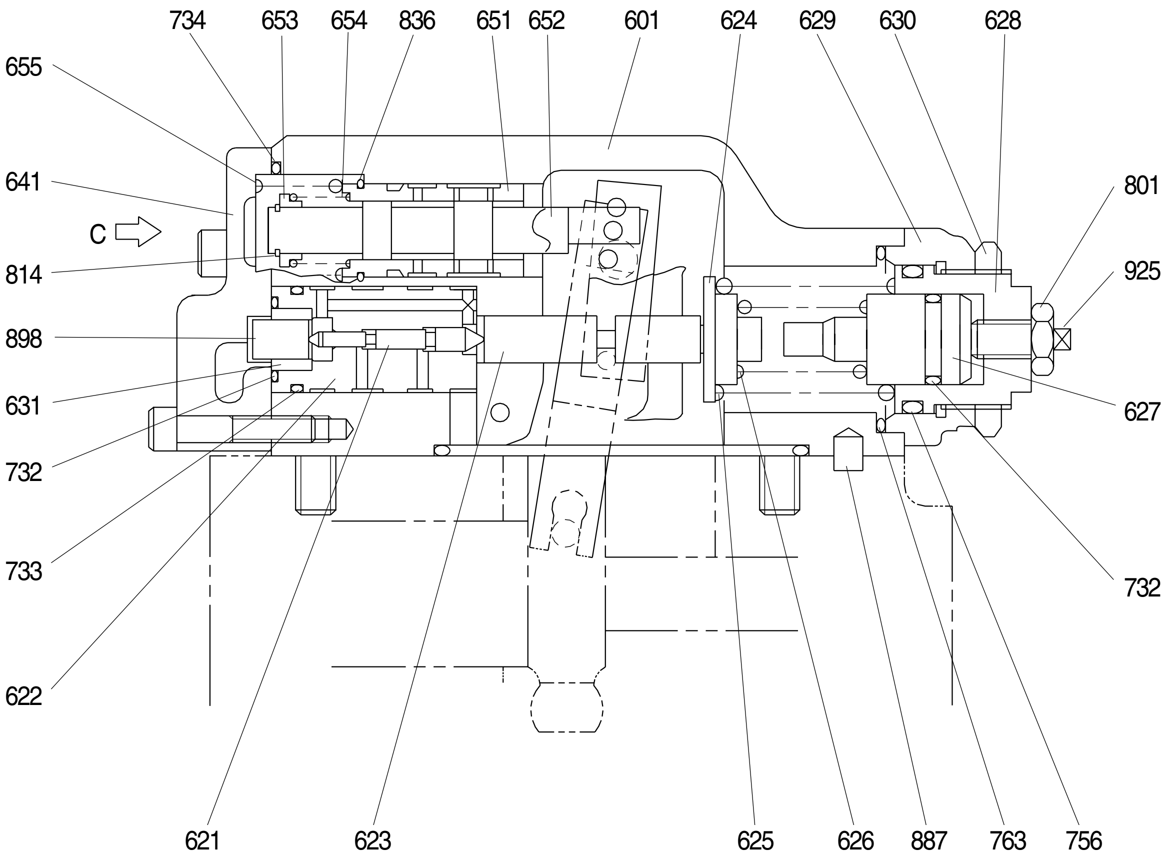


SECTION D-D



Port	Port name	port size
A	Delivery port	3/4"
B	Suction port	2 1/2"
Pn	Pilot port	PF 1/4-15
Pm	Qmax cut port	PF 1/4-15

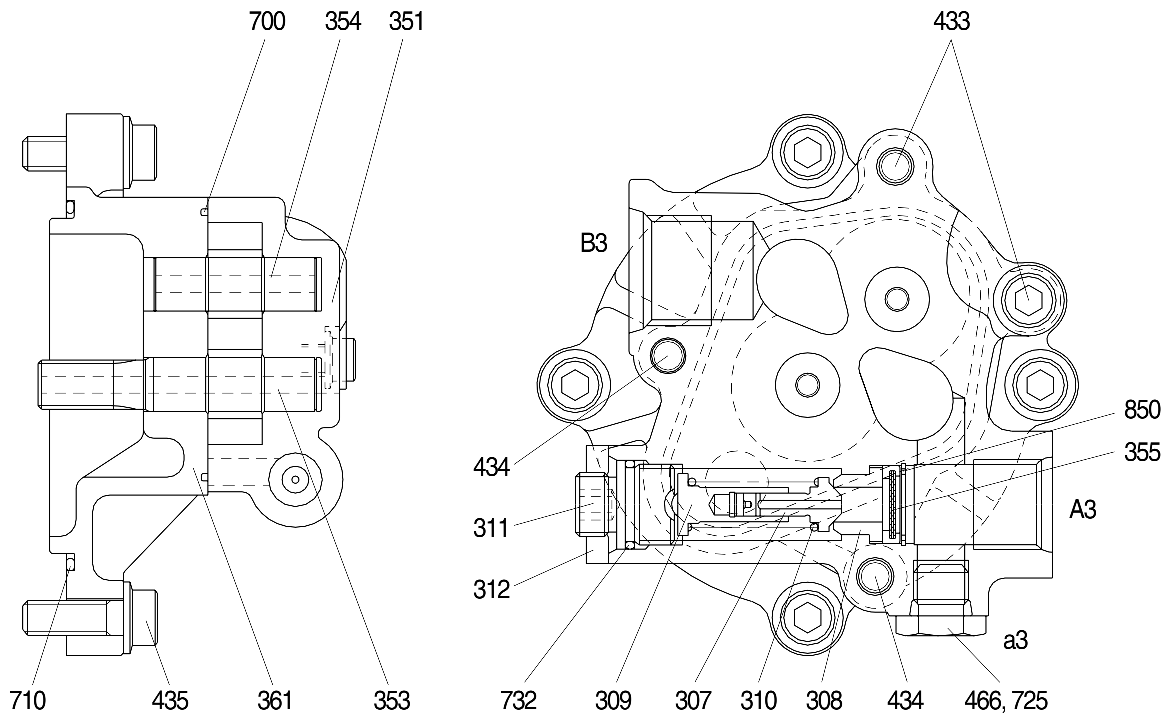
REGULATOR(2/2)



SECTION A-A

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

3) GEAR PUMP



307	Poppet	353	Drive gear	466	Plug
308	Seat	354	Driven gear	700	Ring
309	Spring seat	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		

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.

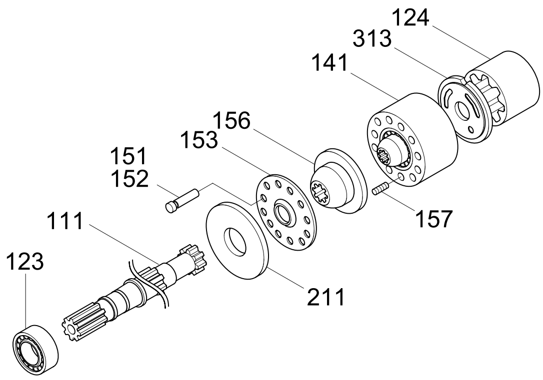
(1) Rotary group

The rotary group consists of drive shaft (F)(111), cylinder block(141), piston shoes(151,152), set plate(153), spherical bush(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.

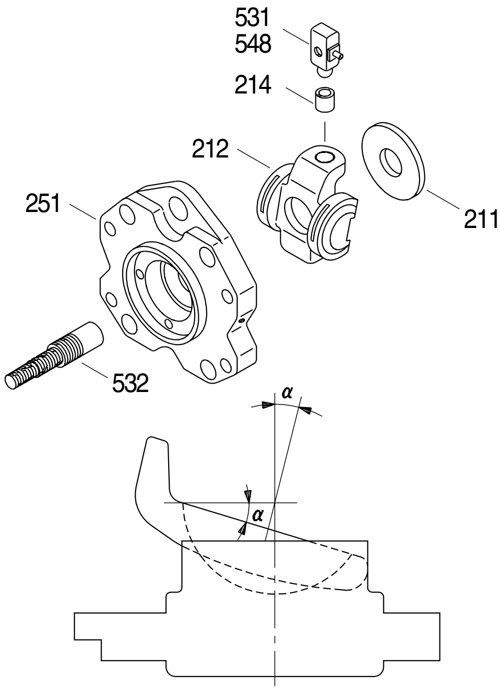


(2) Swash plate group

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

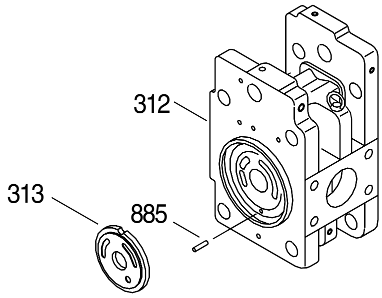
The valve block group consists of valve block(312), valve plate(313) and valve plate pin(885).

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

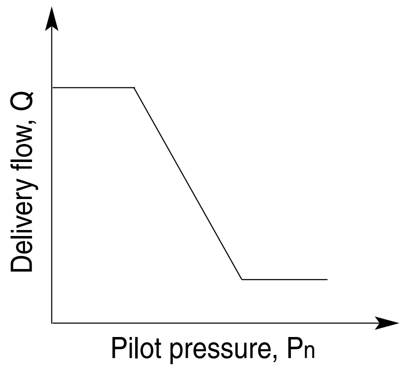
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

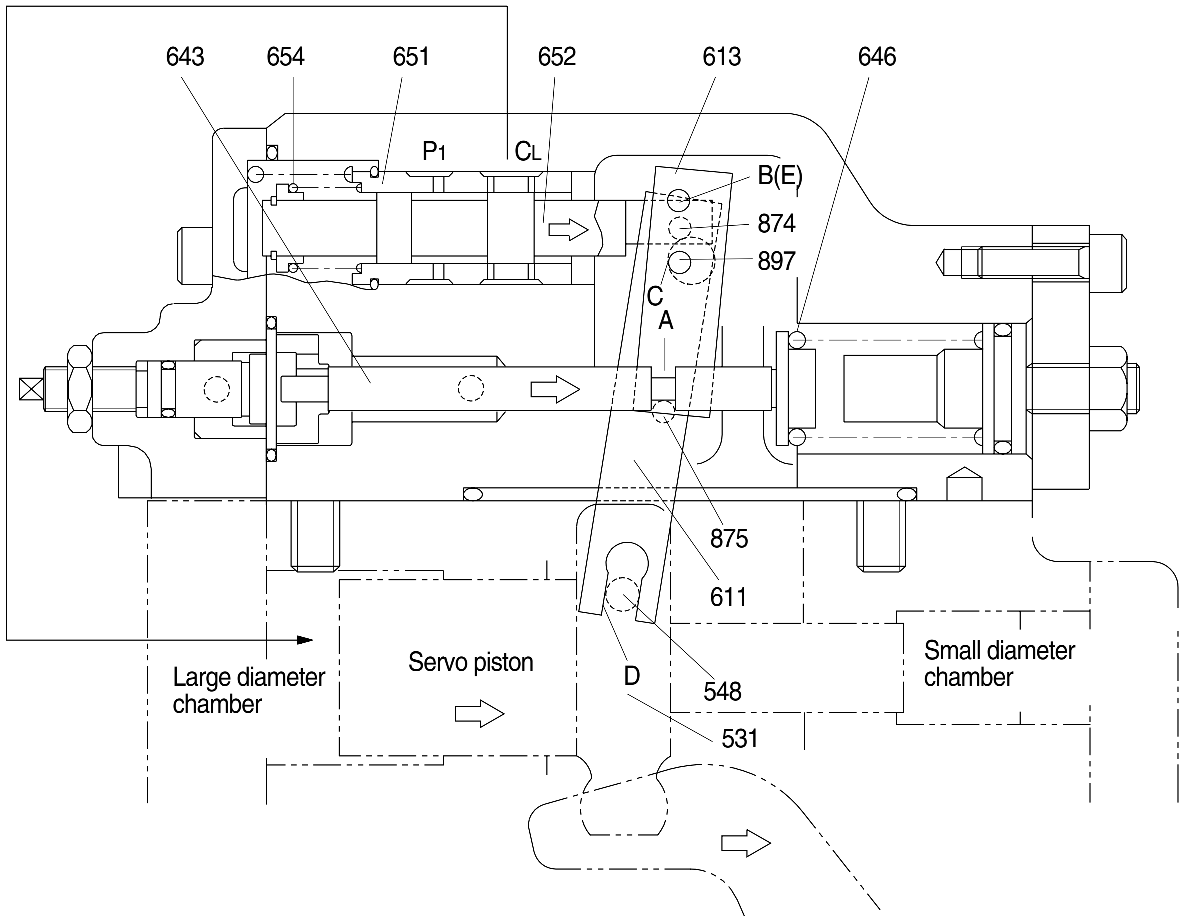
By changing the pilot pressure Pn, the pump tilting angle(delivery flow) is regulated arbitrarily, as shown in the figure.

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

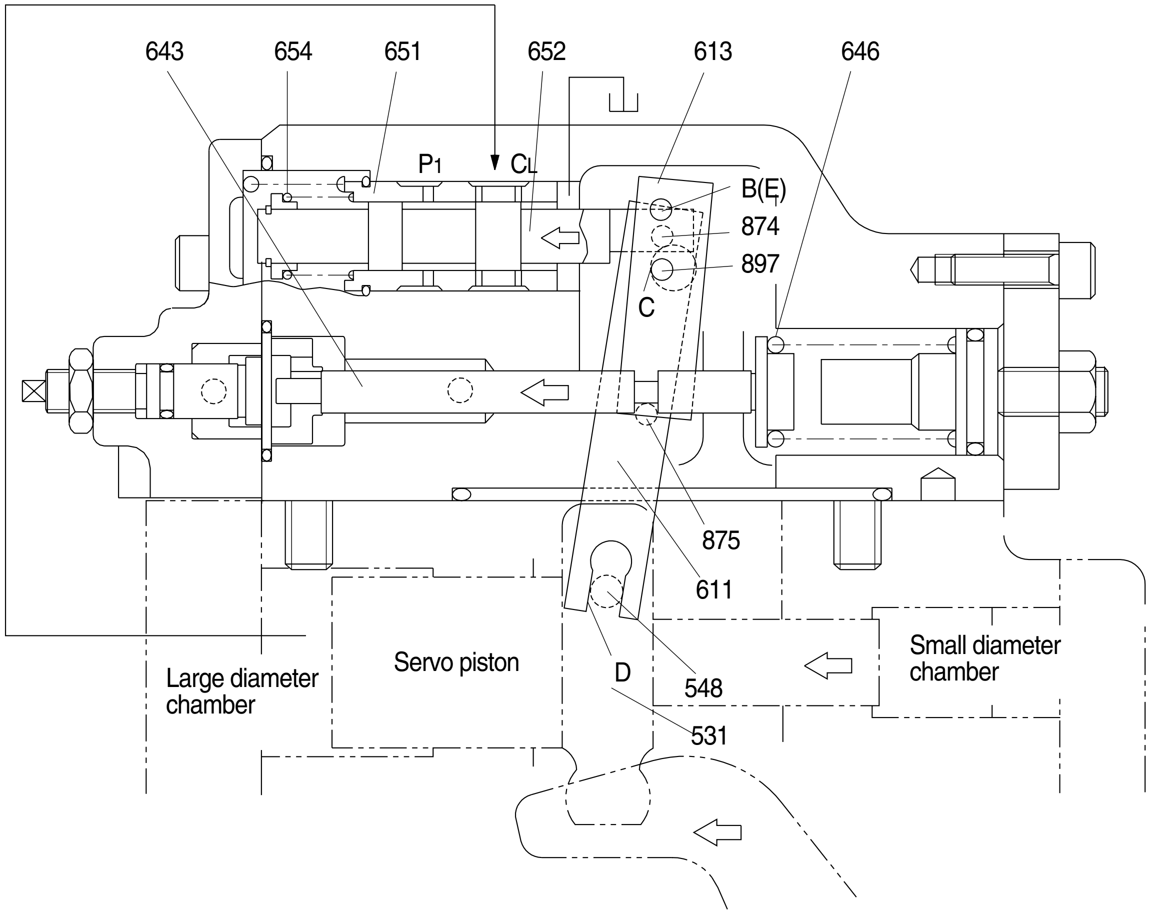
Since the feedback lever is connected with the spool(652) via the pin(874), the spool moves to the right.

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 Pn 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.

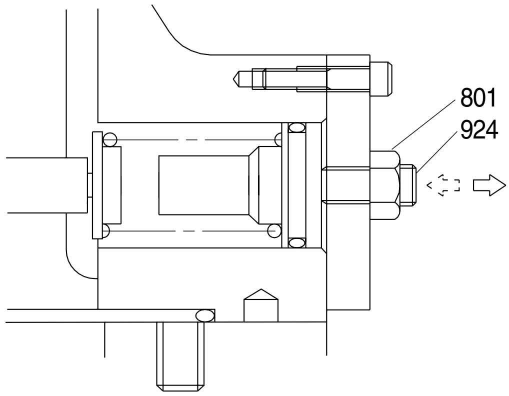
As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

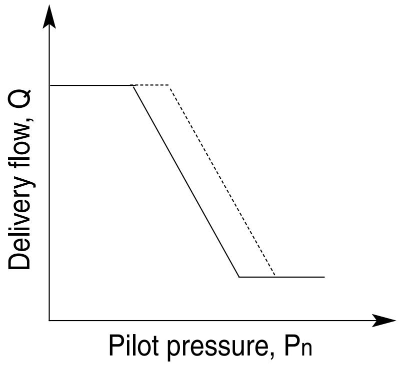
③ **Adjustment of flow control characteristic**

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 values are shown in table.**

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/cm^2)	(ℓ /min)
2100	+1/4	+1.5	+7.9



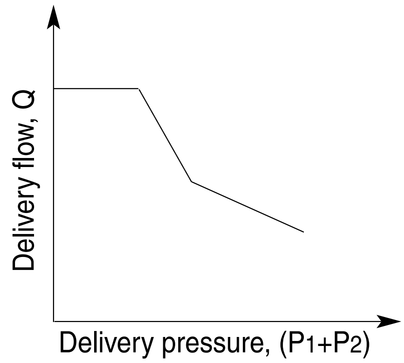


(2) Total horsepower control

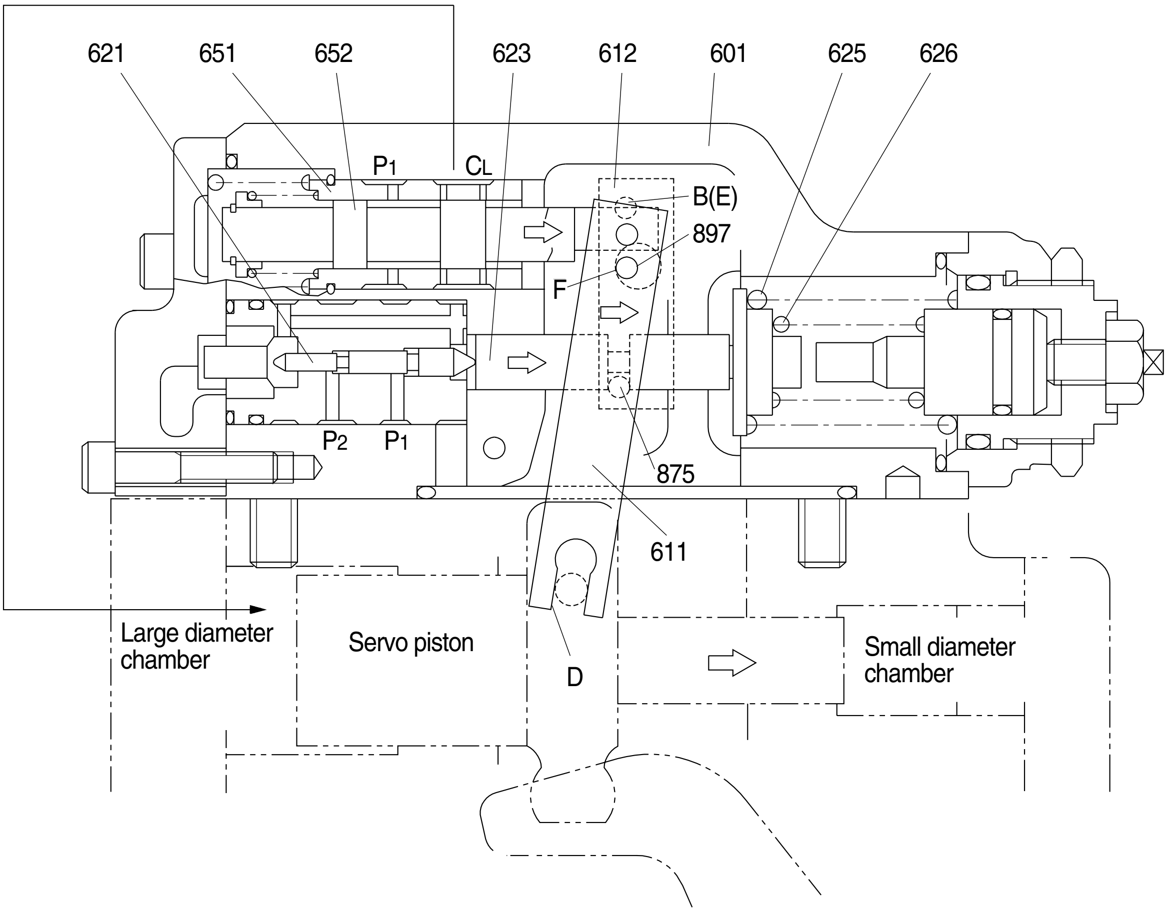
The regulator decreases the pump tilting angle(delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.
(The input horsepower is constant when the speed is constant.)
Since 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 :

$$Tin = P1 \times q/2\pi + P2 \times q/2\pi$$
$$= (P1+P2) \times q/2\pi$$

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).

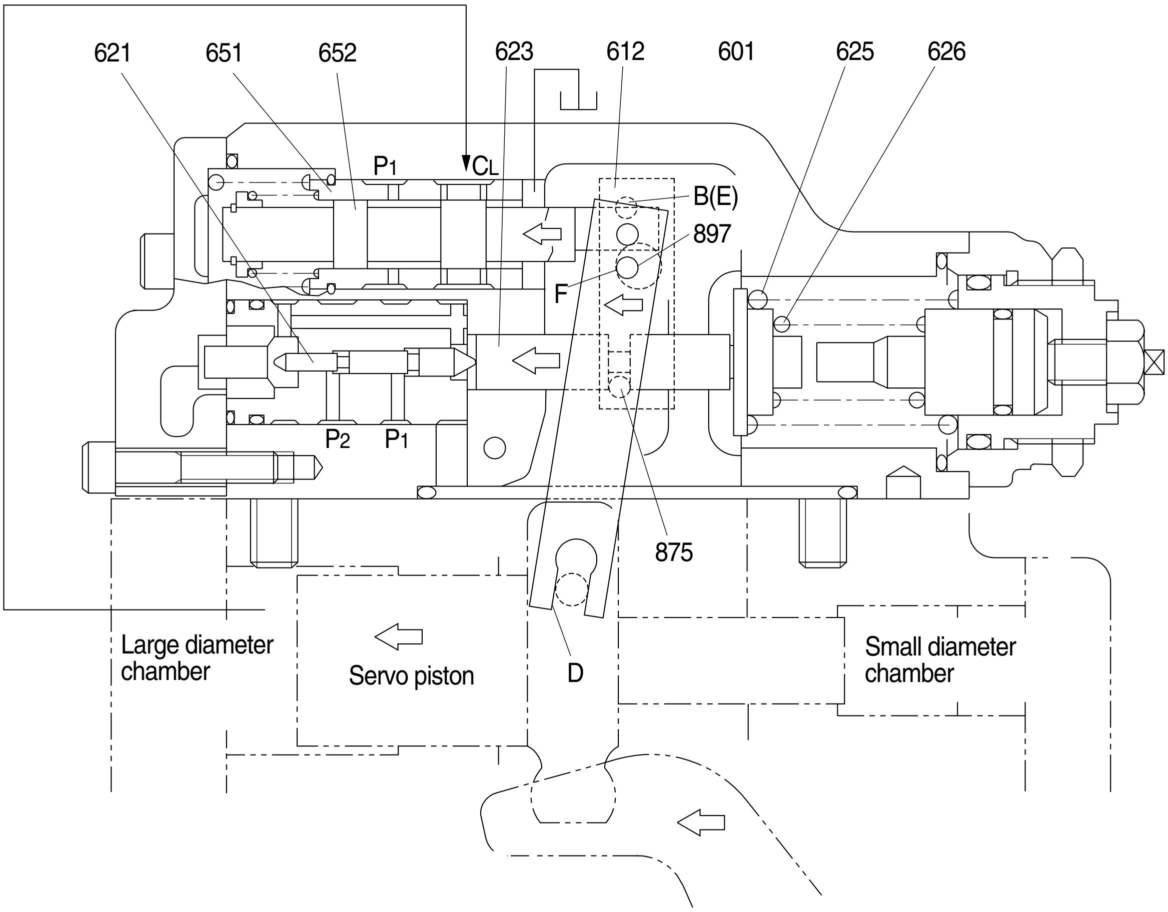


① **Overload preventive function**



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**

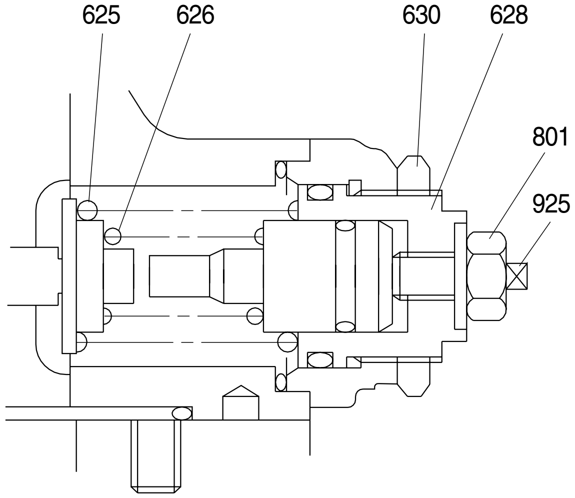
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections(C & F) of levers 1 and 2. However, since sections C and F have the pins(ø 4) protruding from the large hole(ø 8), only the lever lessening the tilting angle contacts the pin(897) ; the hole(ø 8) 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.

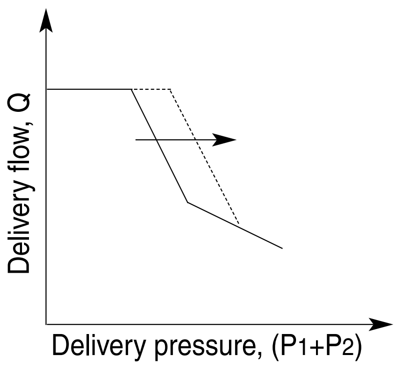
a. Adjustment of outer spring

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 by N turns changes the setting of the inner spring(626), return the adjusting screw QI(925) by N×A turns at first.(A=1.9)



※ **Adjusting values are shown in table**

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw(C) (924)	Compens-ating control starting pressure change amount	Input torque change amount
(min⁻¹)	(Turn)	(kgf/cm²)	(kgf · m)
2100	+1/4	+19.2	+2.9



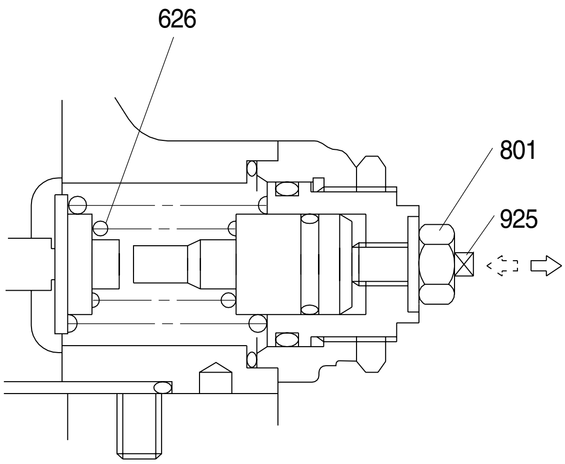
b. Adjustment of inner spring

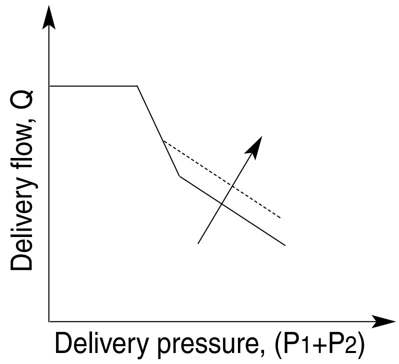
Adjust it by loosening the hexagon nut (801) and by tightening(or loosening) the adjusting screw QI(925).

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

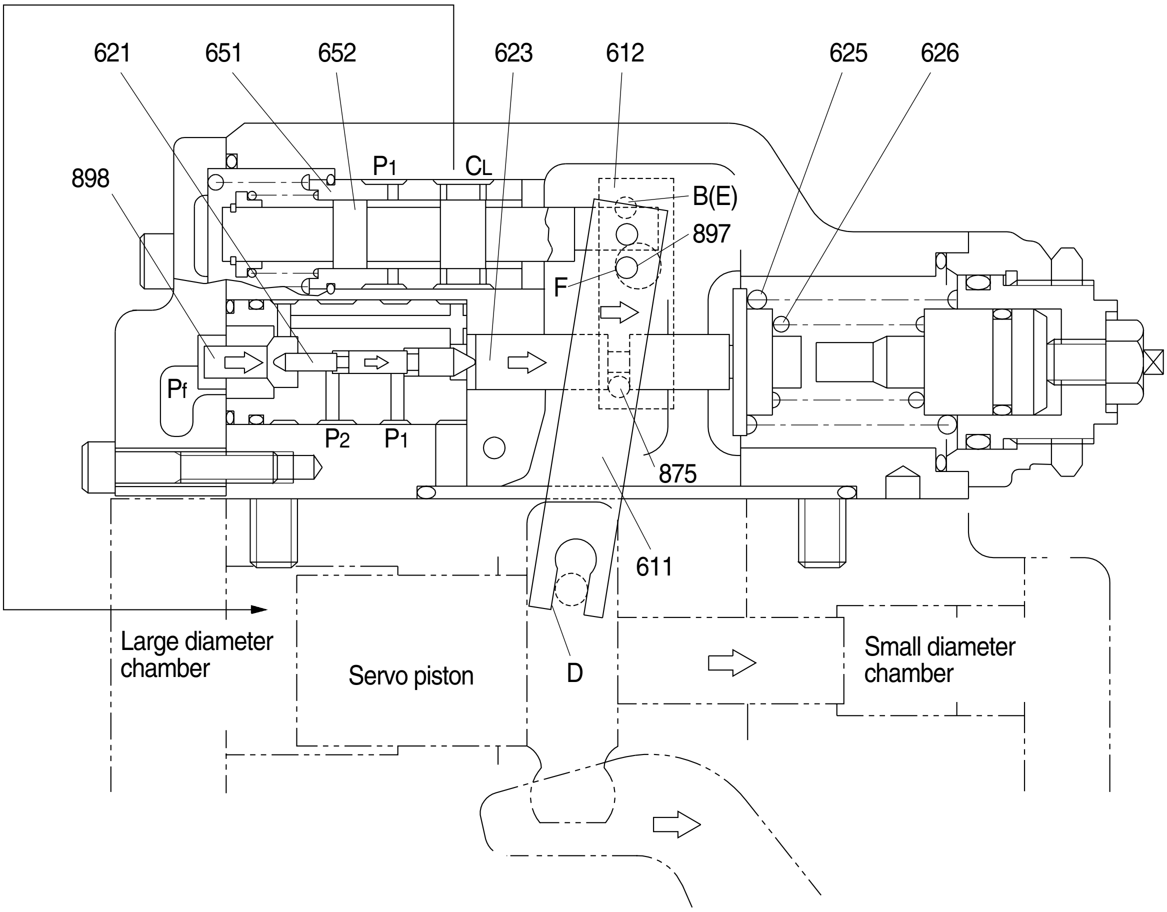
※ **Adjusting valves are shown in table**

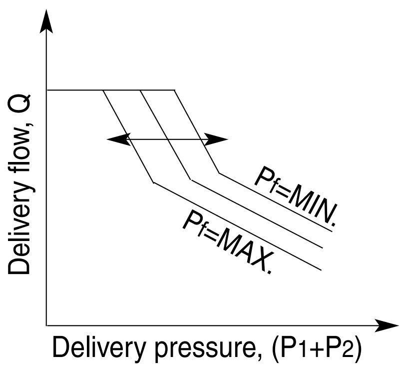
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw(QI) (925)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(l/min)	(kgf · m)
2100	+1/4	+5.6	+2.4





(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.

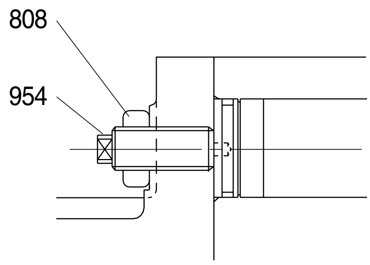
The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

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

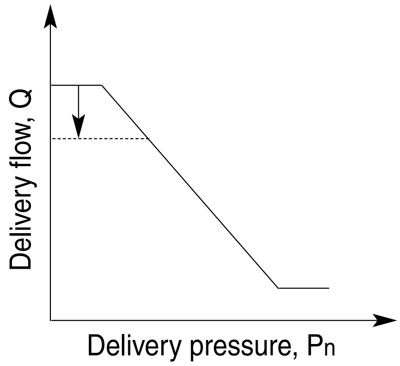
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum

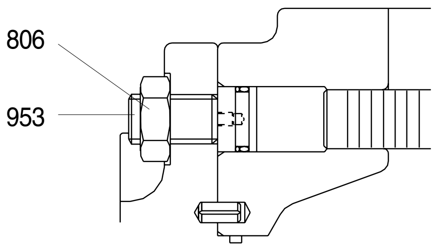
① Adjust it by loosening the hexagon nut(808) and by tightening(or loosening) the set screw(954).
The maximum flow only is adjusted without changing other control characteristics.



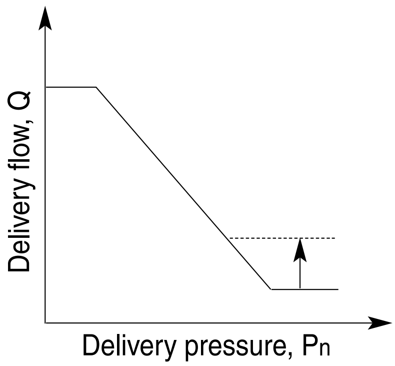
Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min $^{-1}$)	(Turn)	(l /min)
2100	+1/4	-3.4



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.

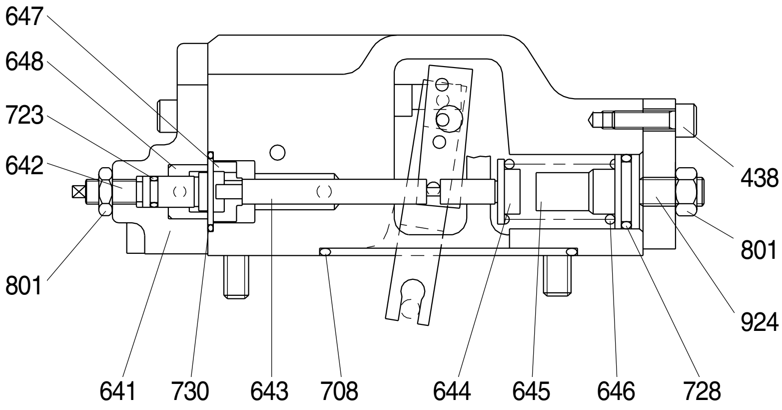


Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min $^{-1}$)	(Turn)	(l /min)
2100	+1/4	+3.4



(5) Qmax cut control

The regulator regulates the maximum delivery flow by inputting the pilot pressure Pm. Since this is a 2-position control method, the maximum delivery flow may be switched in two steps by turning on/off the pilot pressure Pm.(The maximum control flow cannot be controlled in intermediate level.)

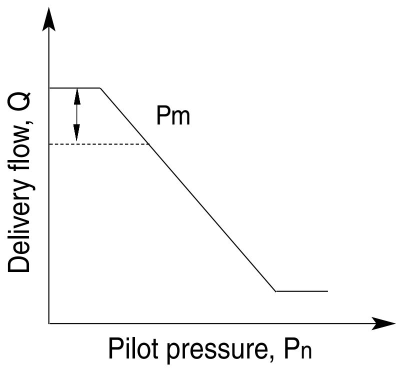


① Functional explanation

As shown in the figure, the pilot pressure Pm switches the maximum flow in two steps.

When the pilot pressure Pm is given, it is admitted to the lefthand side of the piston QMC(648). The piston QMC moves the stopper(647) and pilot piston(643) to the right, overcoming the force of the pilot spring(646), thereby reducing the delivery flow of the pump.

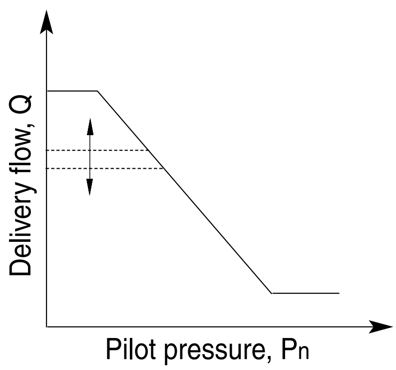
Since the adjusting screw QMC(642) is provided with a flange, the piston QMC stops upon contact with the flange, and the position of the pilot piston at this time determines the maximum flow of the pump.



② Adjustment of Qmax cut flow

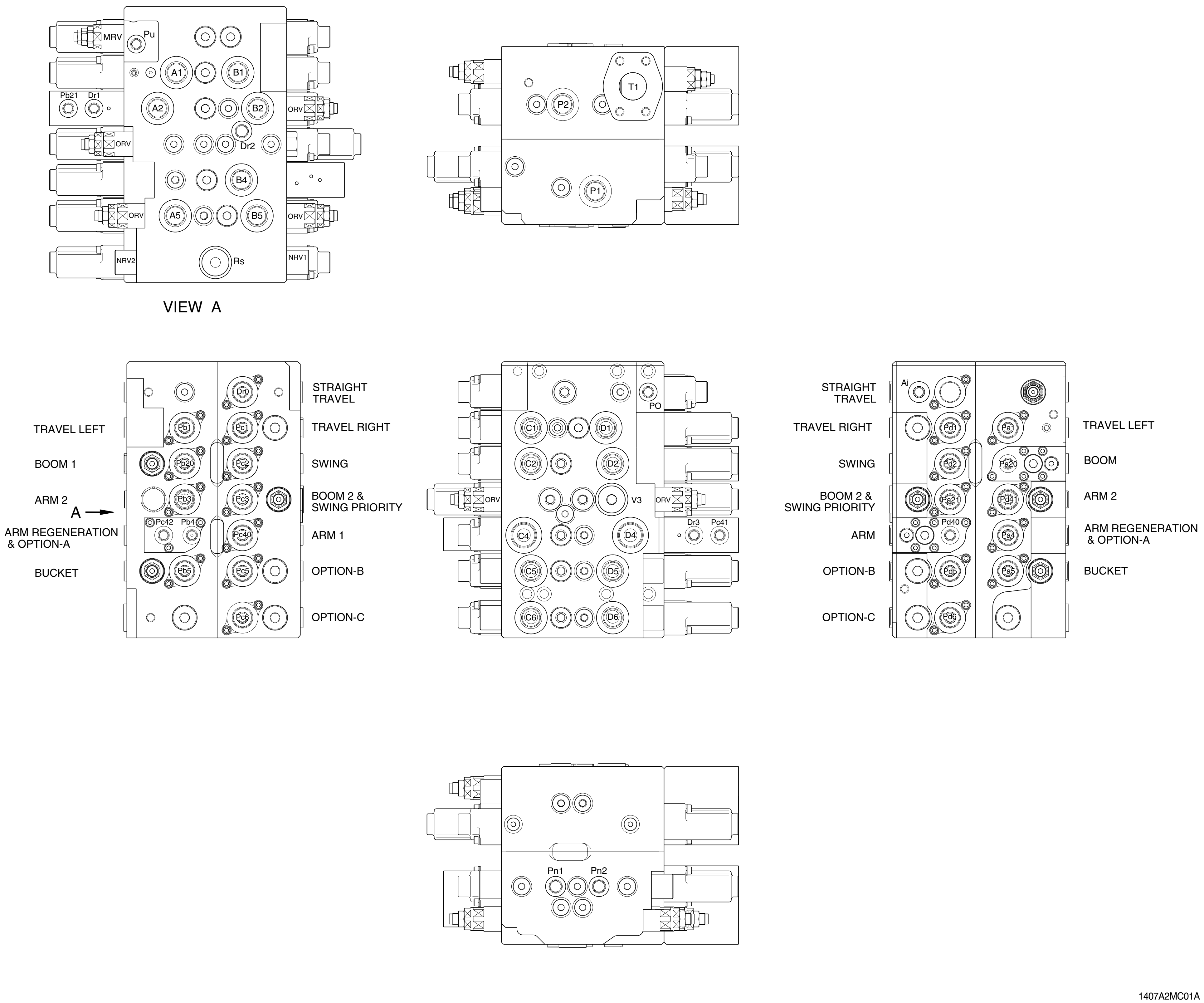
Adjust it by loosening the hexagon nut(801) and by tightening(or loosening) the adjusting screw QMC(642).

Tightening the screw decreases the Qmax cut flow as shown in the figure.

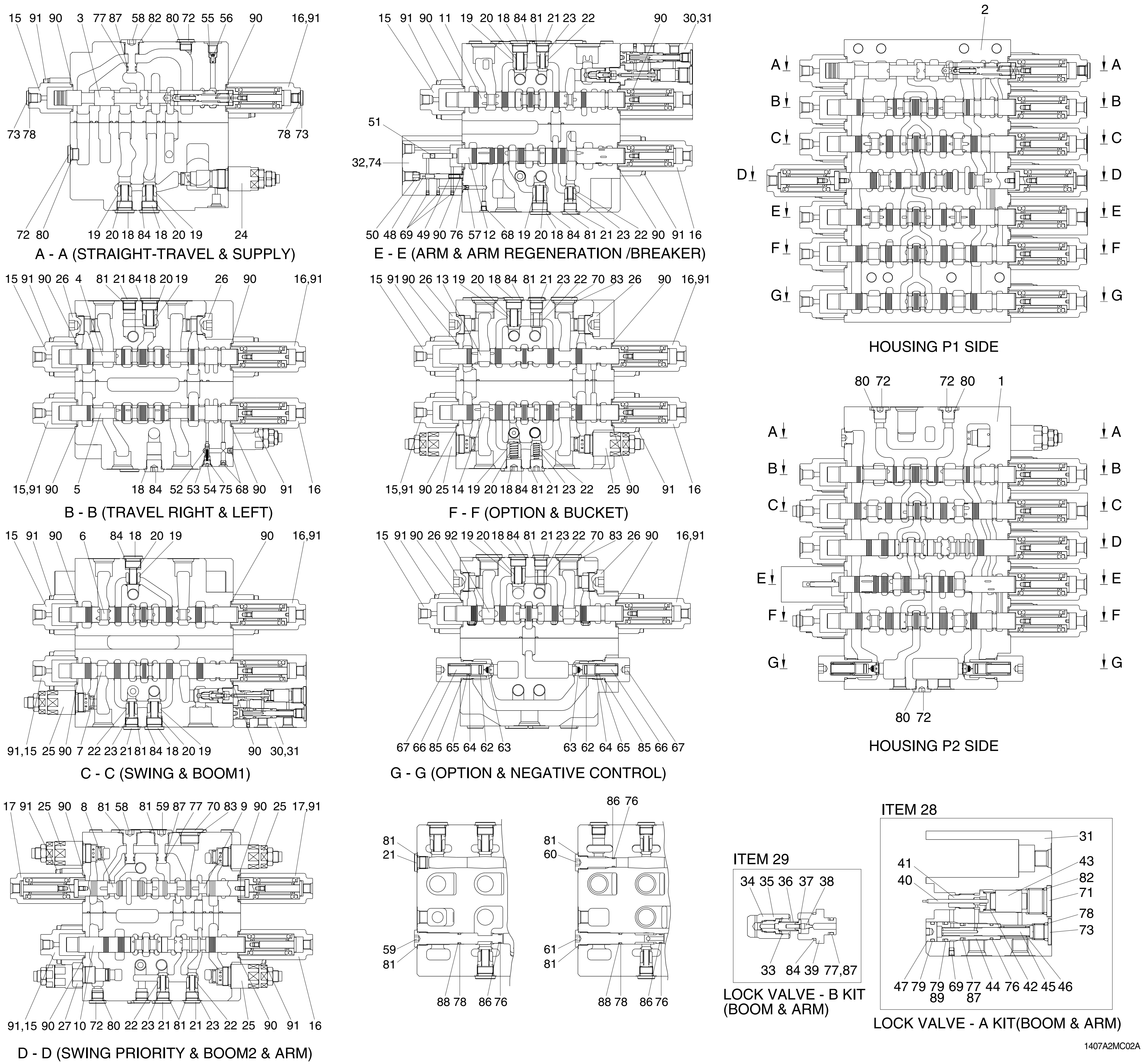


GROUP 2 MAIN CONTROL VALVE

1. STRUCTURE

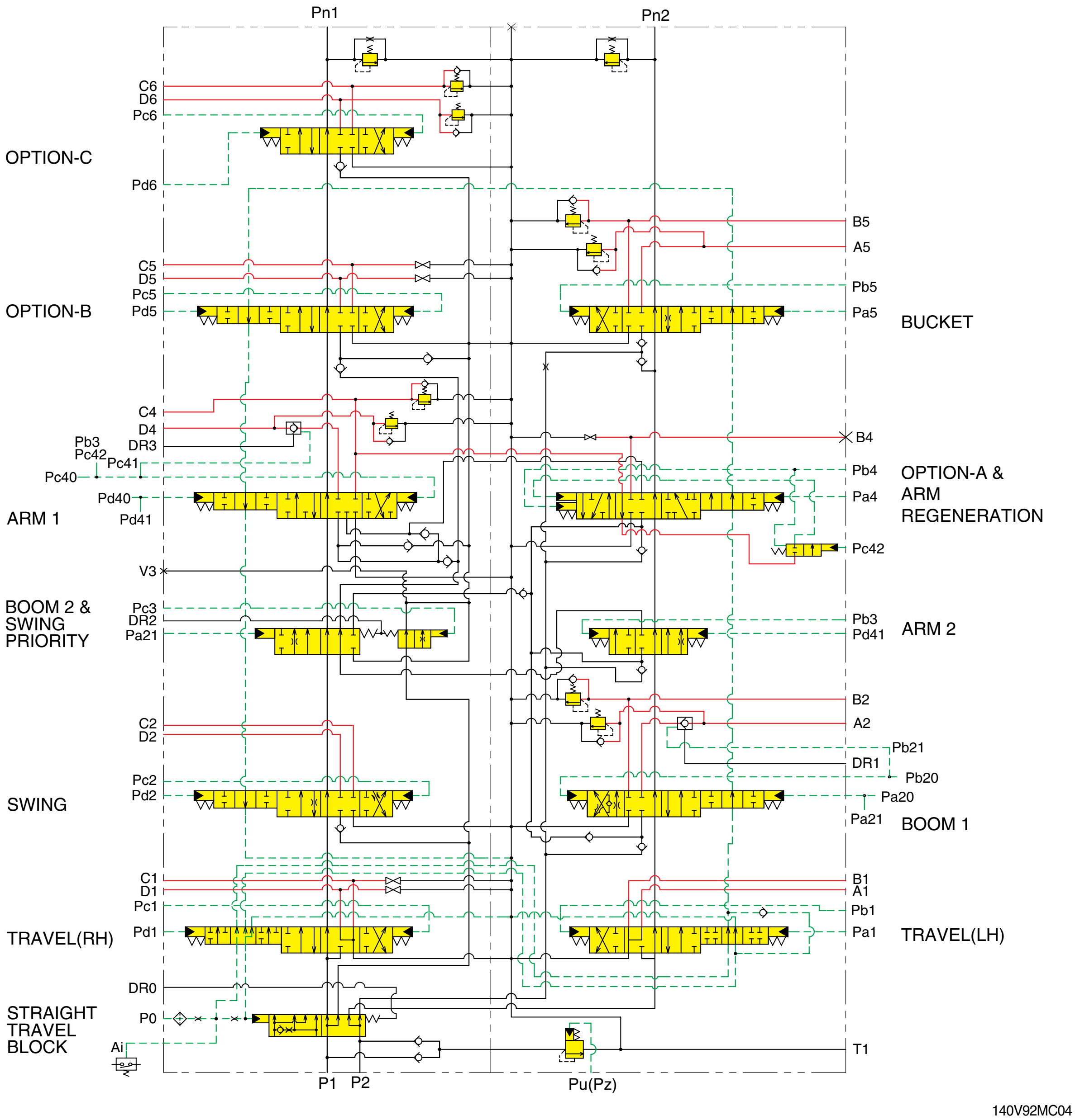


Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	PF1/4	3.5~3.9kgf · m (25.3~28.2lbf · ft)
Pa1	Travel left pilot port(FW)		
Pb1	Travel left pilot port(BW)		
Pc1	Travel right pilot port(BW)		
Pd1	Travel right pilot port(FW)		
Pa20	Boom up pilot port		
Pa21	Boom up confluence pilot port		
Pb20	Boom down pilot port		
Pb21	Lock valve pilot port(Boom)		
Pc2	Swing pilot port(RH)		
Pd2	Swing pilot port(LH)		
Pb3	Arm in confluence pilot port		
Pc3	Swing priority pilot port		
Pa4	Option A pilot port(Breaker)		
Pb4	Arm in regeneration cut port		
Pc40	Arm in pilot port		
Pc41	Lock valve pilot port(Arm)		
Pc42	Arm in regen-cut signal selector port		
Pd40	Arm out pilot port		
Pd41	Arm out confluence pilot port		
Pa5	Bucket in pilot port		
Pb5	Bucket out pilot port		
Pc5	Option B pilot port		
Pd5	Option B pilot port		
Pc6	Option C pilot port		
Pd6	Option C pilot port		
PO	Pilot pressure port		
Pu	Main relief pressure up pilot port		
Ai	Auto idle signal port		
Dr0	Drain port(Travel straight)		
Dr1	Drain port(Boom holding valve)		
Dr2	Drain port(Boom2 & swing priority)		
Dr3	Drain port(Arm holding valve)		
Pn1	Negative control signal port(P1 port side)	PF3/8	
Pn2	Negative control signal port(P2 port side)		
A1	Travel motor left side port(FW)	PF3/4	15~18kgf · m (109~130lbf · ft)
B1	Travel motor left side port(BW)		
C1	Travel motor right side port(BW)		
D1	Travel motor right side port(FW)		
B2	Boom rod side port		
C2	Swing motor port(LH)		
D2	Swing motor port(RH)		
B4	Option A port(Breaker)		
A5	Bucket head side port		
B5	Bucket rod side port		
C5	Option B port		
D5	Option B port		
C6	Option C port		
D6	Option C port		
P1	Pump port(P1 side)		
P2	Pump port(P2 side)		
A2	Boom head side port	PF1	20~25kgf · m (115~180lbf · ft)
C4	Arm head side port		
D4	Arm rod side port		
T1	Return port	SAE3000, 1 1/2 (M12)	8.5~11.5kgf · m (61.5~83.1lbf · ft)



1	Housing-P2	47	Stopper-lock valve
2	Housing-P1	48	Spool-regen selector
3	Spool-straight travel	49	Spring-regeneration
4	Spool-travel 1-RH	50	Stopper-regeneration
5	Spool-travel 2-LH	51	Piston-cut off
6	Spool-swing	52	Poppet-signal
7	Spool-boom1	53	Spring-signal
8	Spool-swing priority	54	Plug
9	Spool-boom2	55	Orifice-signal
10	Spool-arm 2	56	Coin type filter
11	Spool-arm 1	57	Orifice-plug
12	Spool-arm regeneration & breaker	58	Plug
		59	Plug
13	Spool-option	60	Plug
14	Spool-bucket	61	Plug-orifice
15	Cover-pilot A	62	Poppet-negative control
16	Cover-pilot B1	63	Coin type filter
17	Cover-Pilot B2	64	Spring seat
18	Plug	65	Spring-negative control
19	Poppet1-check valve	66	Piston-negative control
20	Spring-check valve	67	Socket-negative control
21	Plug	68	Plug
22	Poppet2-check valve	69	Plug
23	Spring-check valve	70	Plug
24	Main relief valve	71	Plug
25	Over load relief valve	72	Plug
26	Plug	73	Plug
27	Plug	74	Socket head bolt
28	Lock valve kit A	75	O-ring
29	Lock valve kit B	76	O-ring
30	Socket-head bolt	77	O-ring
31	Block-holding	78	O-ring
32	Block-regeneration	79	O-ring
33	O-ring	80	O-ring
34	Poppet-lock valve	81	O-ring
35	Restrictor-lock valve	82	O-ring
36	Spring-lock valve pilot	83	O-ring
37	Guide-poppet	84	O-ring
38	Poppet pilot	85	O-ring
39	Seat poppet	86	Back-up ring
40	Piston 1	87	Back-up ring
41	Guide-piston	88	Back-up ring
42	Spring 1-lock valve	89	Back-up ring
43	Piston 2	90	O-ring
44	Sleeve	91	Bolt with washer
45	Spool-lock valve	92	Socket head bolt
46	Spring-lock valve		

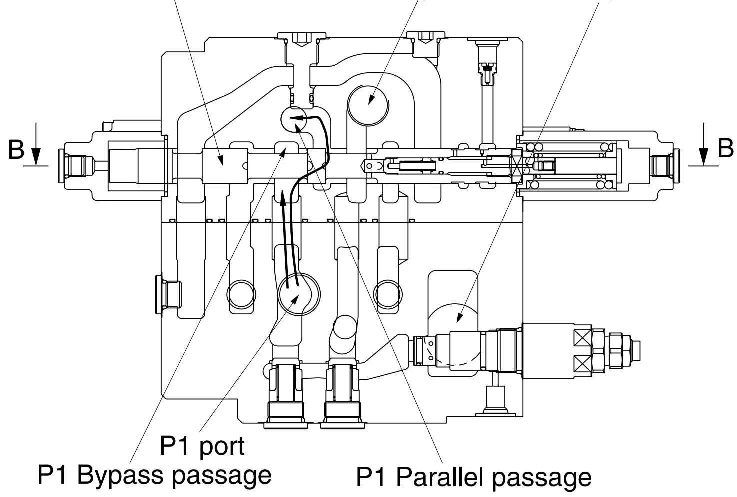
2. HYDRAULIC CIRCUIT



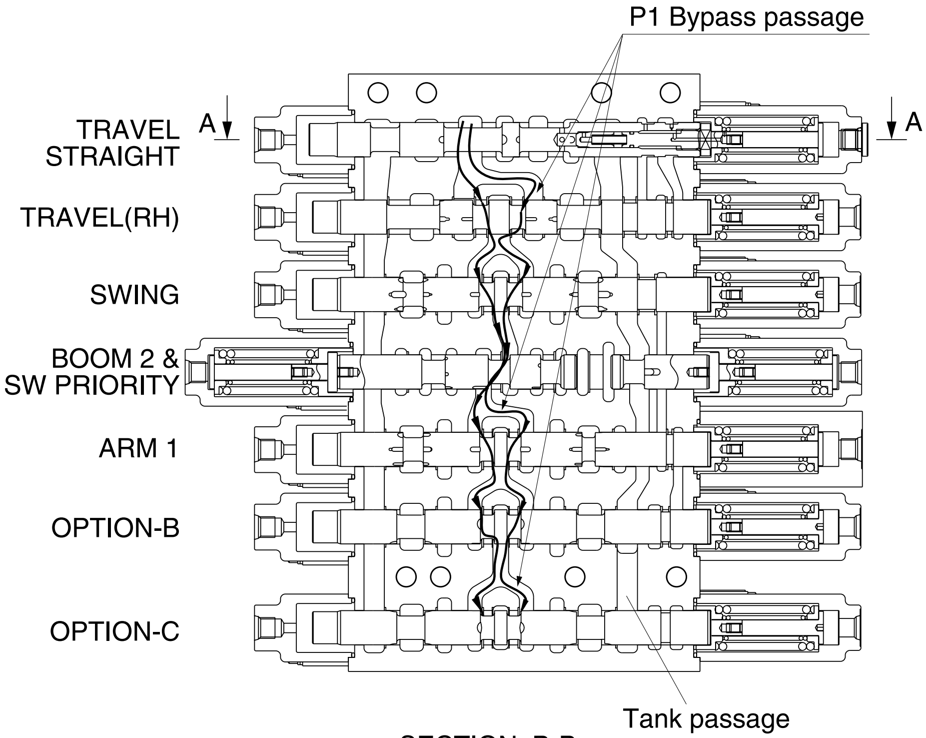
3. FUNCTION

1) CONTROL IN NEUTRAL FUNCTION

(1) P1 SIDE



SECTION A-A



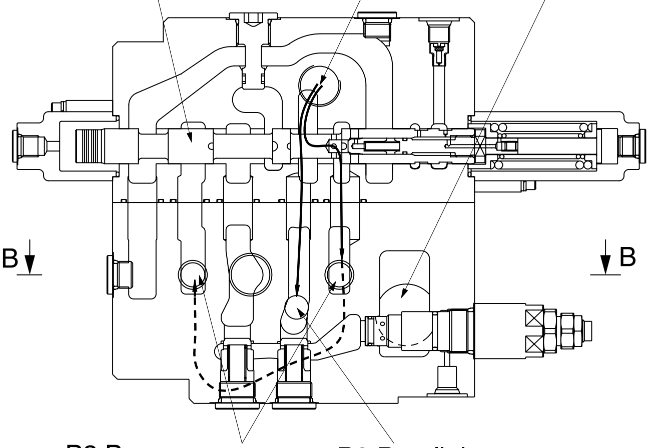
SECTION B-B

1607A2MC12A

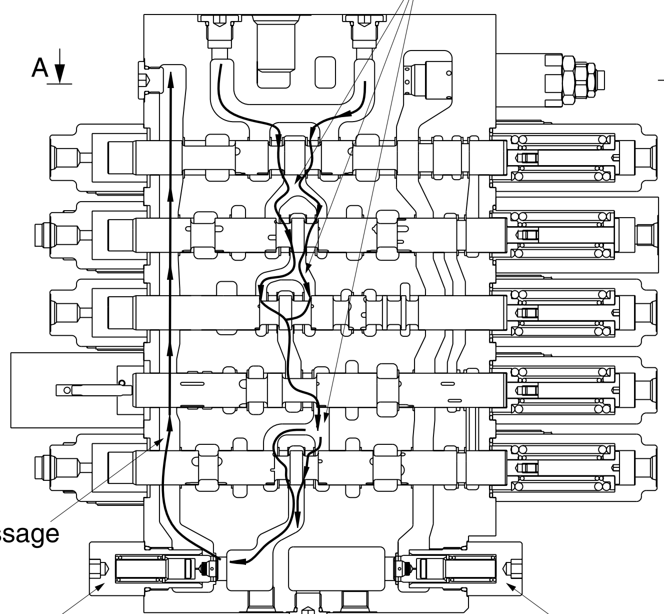
The hydraulic fluid from pump A1 flows into the main control valve through the inlet port "P1", pass the straight travel spool, into the P1 bypass passage and P1 parallel passage.

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", and the negative relief valve with the tank passage.

(2) P2 SIDE



SECTION A-A



SECTION B-B

1607A2MC11

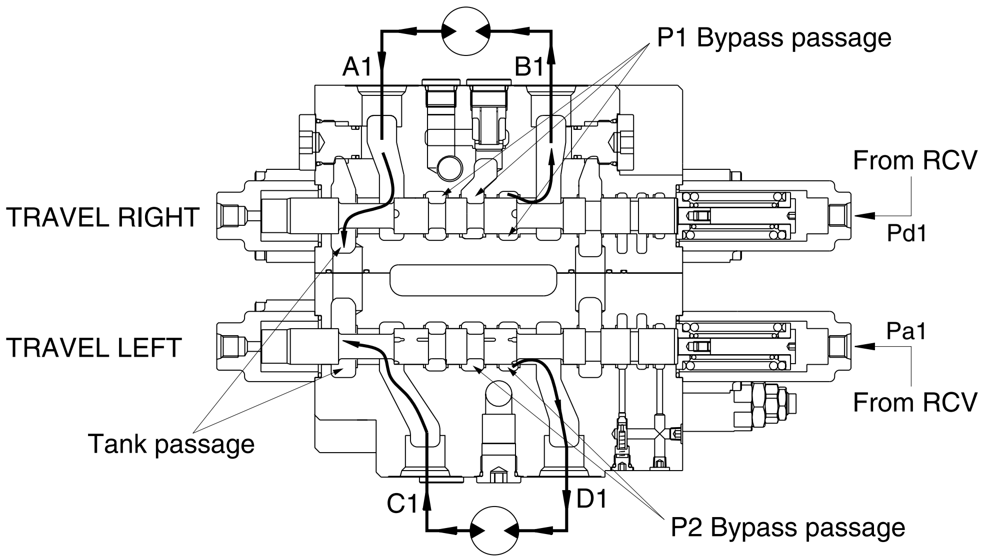
The hydraulic fluid from pump A2 flows into the main control valve through the inlet port "P2", pass the travel straight spool, into the P2 bypass passage and P2 parallel passage.

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, tank passage, and the tank port "T1"

2) EACH SPOOL OPERATION

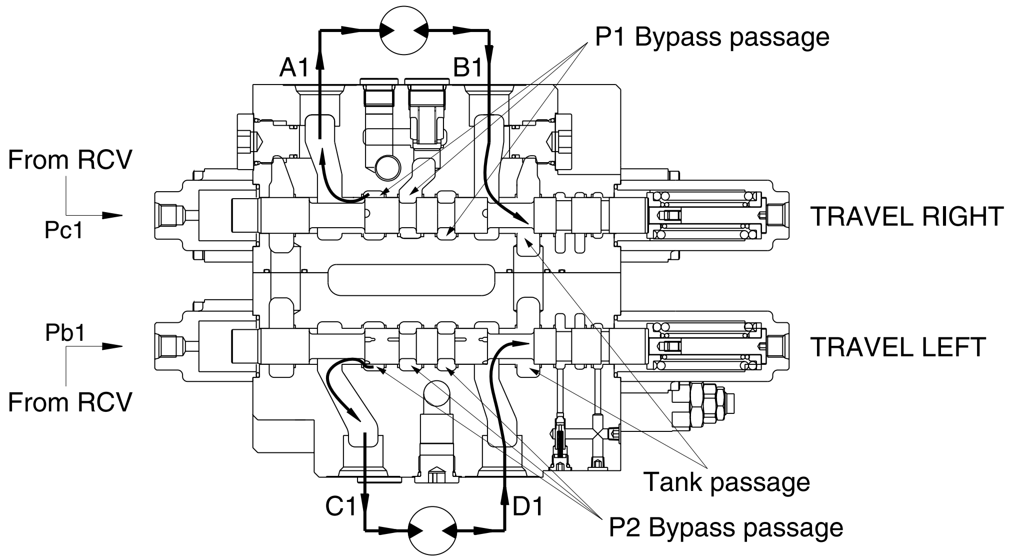
(1) TRAVEL OPERATION

① Travel forward operation



1607A2MC17A

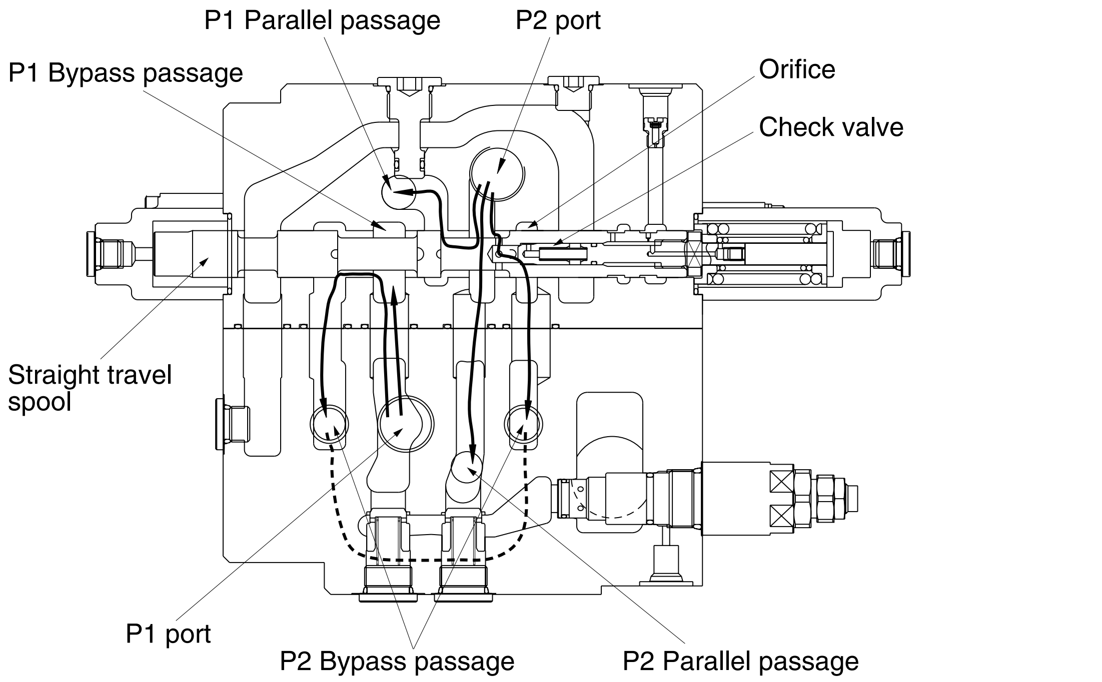
② Travel backward operation



1607A2MC18A

During the travel operation, the hydraulic fluid of the pump A2 is supplied to the travel motor and the hydraulic fluid of the pump A1 is supplied to the other travel motor.
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pa1, pd1).
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 D1. As a result, the travel motors turn and hydraulic fluid returns to the tank passage through the travel spools.
In case of the opposite operation, the operation is similar.

(2) 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 A2 is supplied to the travel motor and the pump A1 is supplied to the other 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.

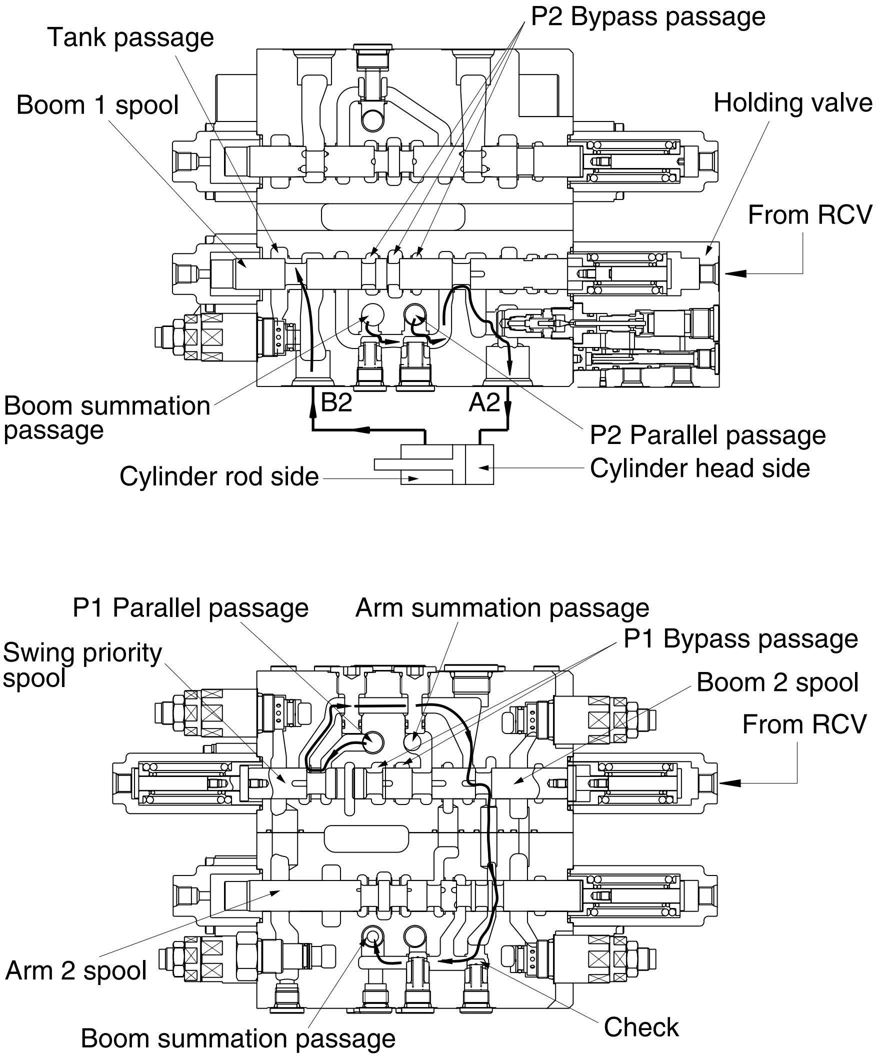
The hydraulic oil fluid from pump A1 is supplied to travel motors (left/right).

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



1607A2MC24A

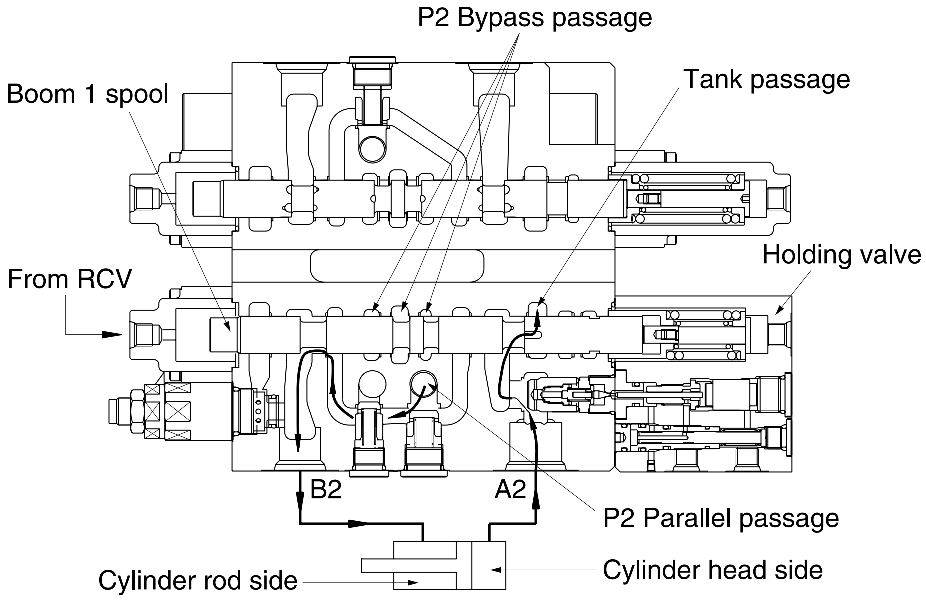
During boom up operation, the pilot pressure from RCV is supplied into the port Pa20 and shift the boom1 spool in the left direction. The hydraulic oil fluid from pump A2 is entered P2 parallel passage and then passes through the load check valve and boom holding valve then flows into the port A2. Following 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 through the port Pa21 shifts the boom 2 spool. The hydraulic oil fluid from pump A1 entered boom summation passage via the P1 parallel passage, the swing priority spool, the boom 2 spool, arm1 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

The flow from rod side of the boom cylinder return to the boom 1 spool through the port B2. There after it is directed to the hydraulic oil tank through the tank passage.

② **Boom down operation**

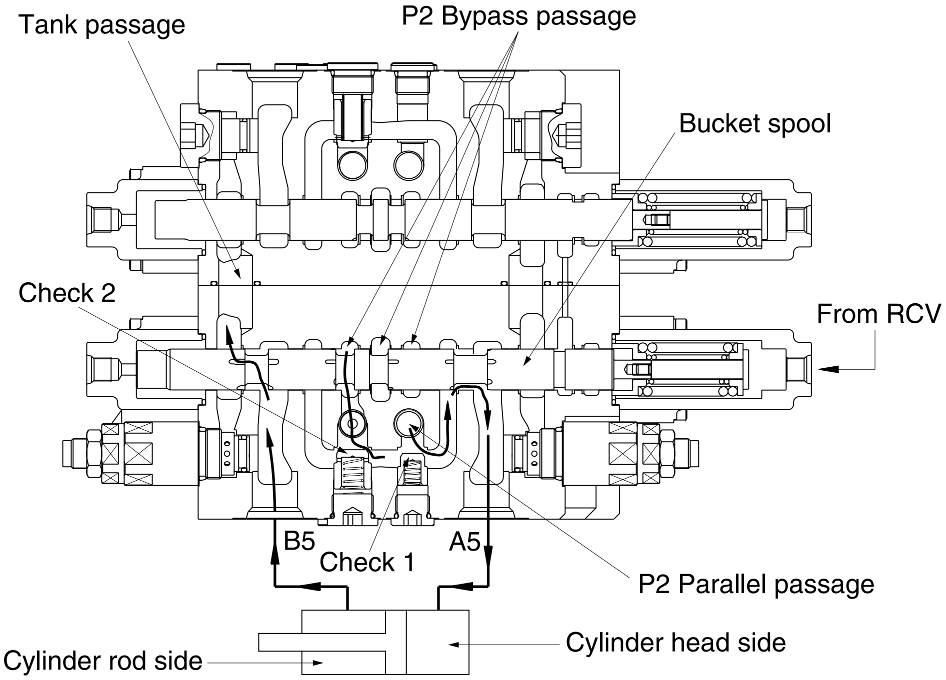


1607A2MC26

During the boom lowing operation, the pilot pressure from RCV is supplied to the port Pb20 and shift the boom 1 spool in the right direction.
The hydraulic fluid from the pump A2 enters the parallel passage and is directed to the port B2 through the load check valve. Following this, it flows into the rod side of the boom cylinder.
The return flow from the head side of the boom cylinder returns to the boom 1 spool through the port A2 and boom holding valve. Thereafter it is directed to the hydraulic oil tank through tank passage.
For details of the boom holding valve, see page 2-36.

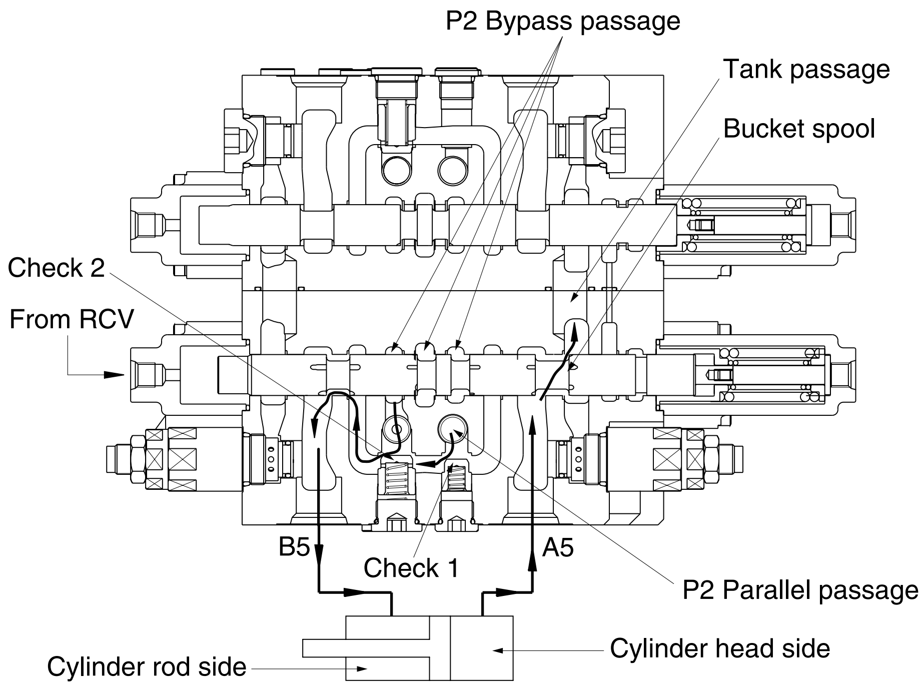
(4) BUCKET OPERATION

① Bucket roll in operation



1607A2MC34A

② Bucket roll out operation



1607A2MC35

① **Bucket roll in operation**

During the bucket roll in operation, the pilot pressure from RCV is supplied to port Pa5 and shift the bucket spool in the left direction.

The hydraulic fluid from pump A2 entered P2 parallel passage and is directed to the port A5 through the check 1.

At the same time, the hydraulic fluid from P2 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 roll out operation**

In case of the bucket roll out operation, the operation is similar

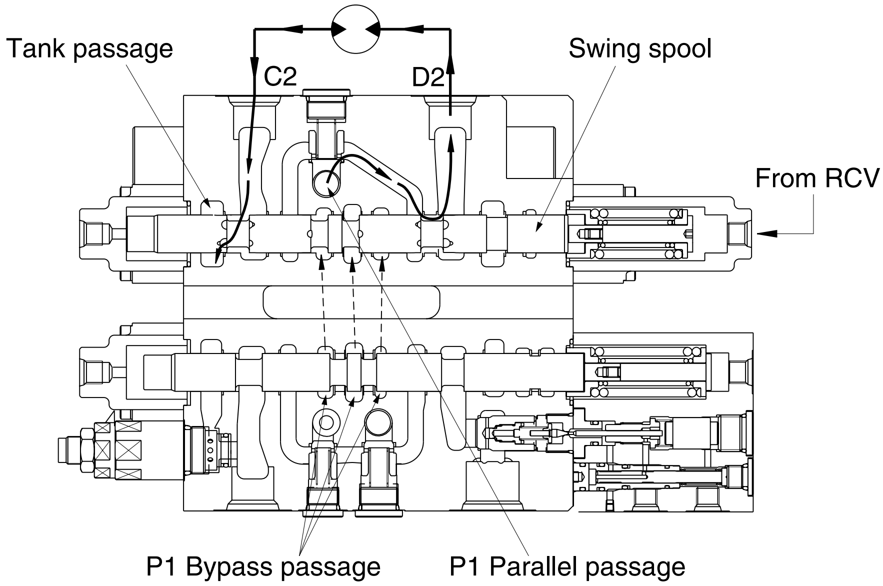
③ **Bucket operation with arm or boom operation**

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

So only the fluid from parallel passage is supplied to the bucket cylinder. Also, parallel passage is installed the orifice for supplying the fluid from pump to the boom or the arm operation prior to the bucket operation.

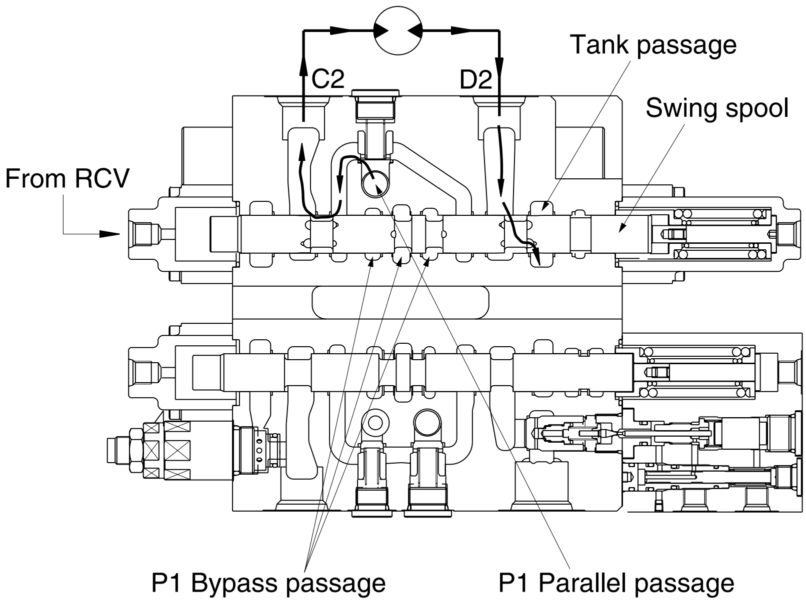
(5) SWING OPERATION

① Swing left operation



1607A2MC32

② Swing right operation



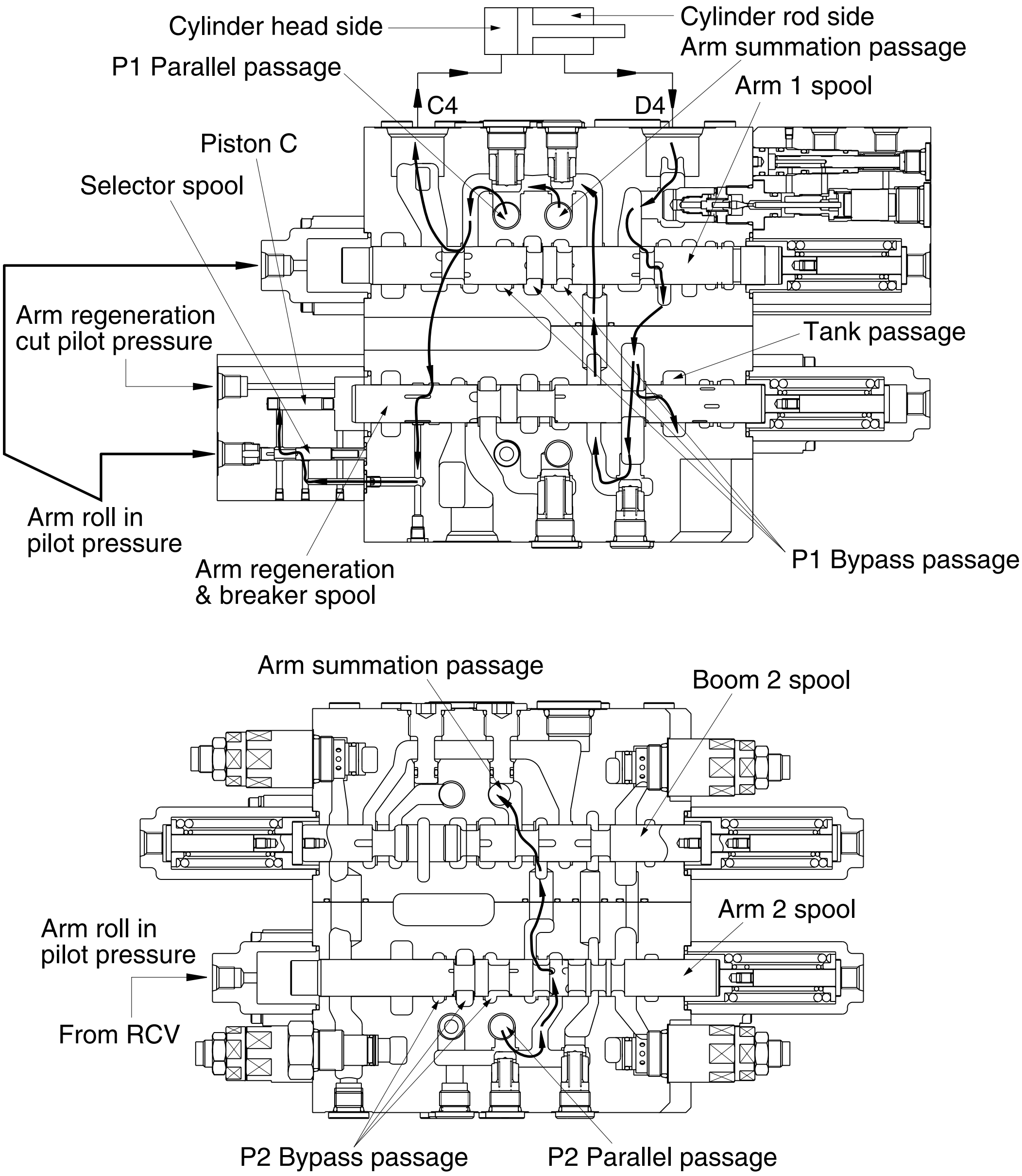
1607A2MC33

The pilot pressure from the RCV is supplied to the Pd2 and shift the swing spool in left direction. The hydraulic fluid from pump A1 flows into swing spool through the 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.

(6) ARM OPERATION

① Arm roll in operation



1607A2MC21

· **Arm roll in operation :**

During arm roll in operation the pilot pressure from the RCV is supplied to the port Pc4o and Pb3 and shifts arm 1 spool and arm 2 spool in the right direction.

The hydraulic oil from the pump A1 flows into the arm cylinder head side through P1 parallel passage, the load check valve and the port C4.

At same time, the hydraulic fluid from the pump A2 flows into the arm summation passage through 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 suppled the arm cylinder head through internal passage. This is called the arm regeneration function.

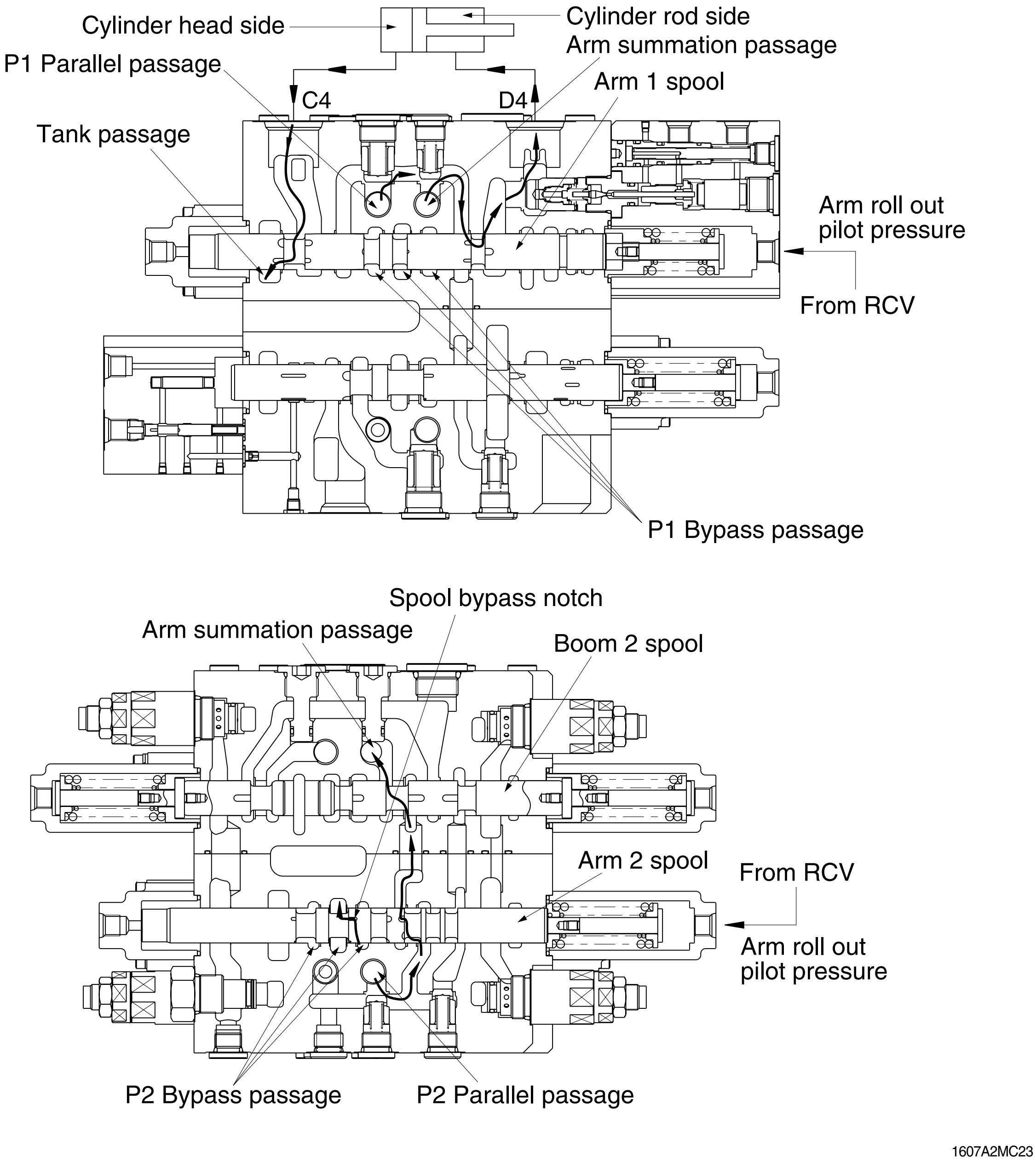
The amount of regeneration fluid are changed by movement of the arm regeneration & breaker spool.

A few fluid after P1 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 shift 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 port 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.

② **Arm roll out operation**



During arm roll out operation the pilot pressure from RCV is supplied to the port Pd40 and the Pd41 and shifts arm 1 spool and arm 2 spool in the right direction.

The hydraulic fluid from pump A1 flows into arm1 spool through the parallel passage. Then it enters into the arm cylinder rod side through the load check valve, bridge passage, arm holding valve and the port D4.

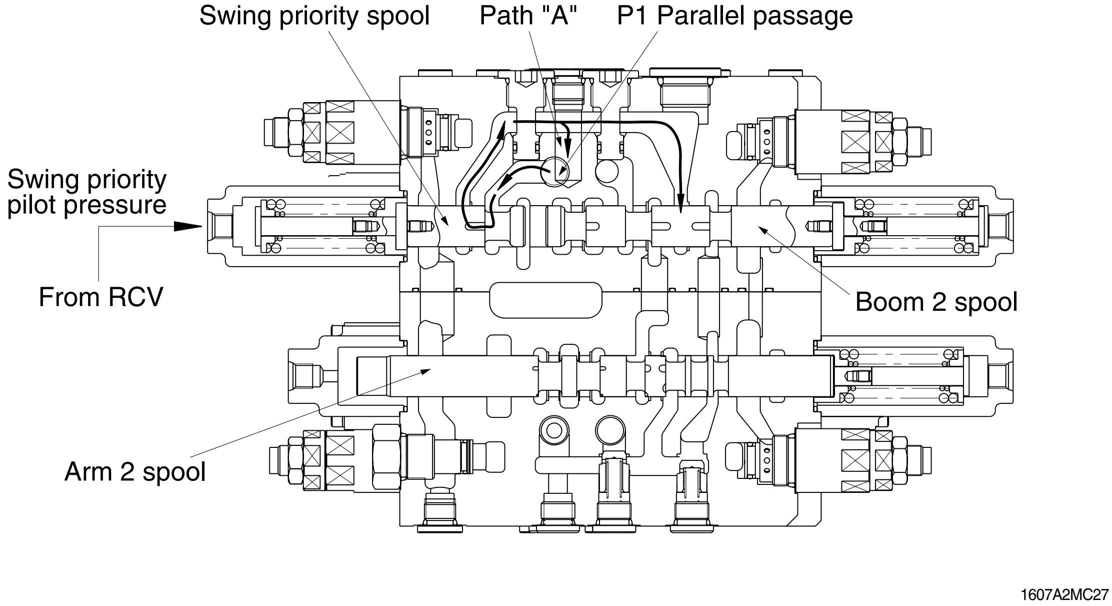
Some of the hydraulic fluid from pump A1 bypassed through bypass notch.

The rest of hydraulic fluid from pump A2 flows into the arm summation passage through P2 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.

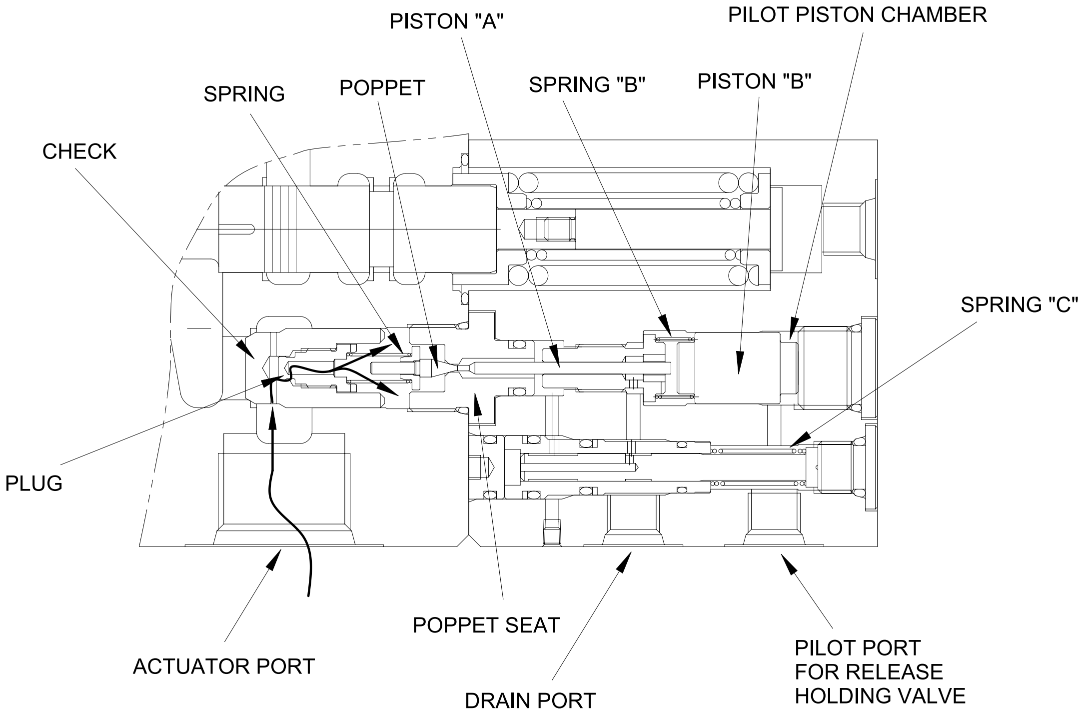
(7) SWING PRIORITY FUNCTION



During swing priority operation, the pilot pressure is supplied to the port Pc3 and shift swing priority spool in the right direction.
The hydraulic fluid from P1 parallel passage flows into the parallel passage of arm 1 side through swing priority spool and the passage "A" and also flows into the boom 2 spool.
Due to shifting of the swing priority spool, the fluid from pump A1 flows to swing side more then next spools to make the swing operation most preferential.

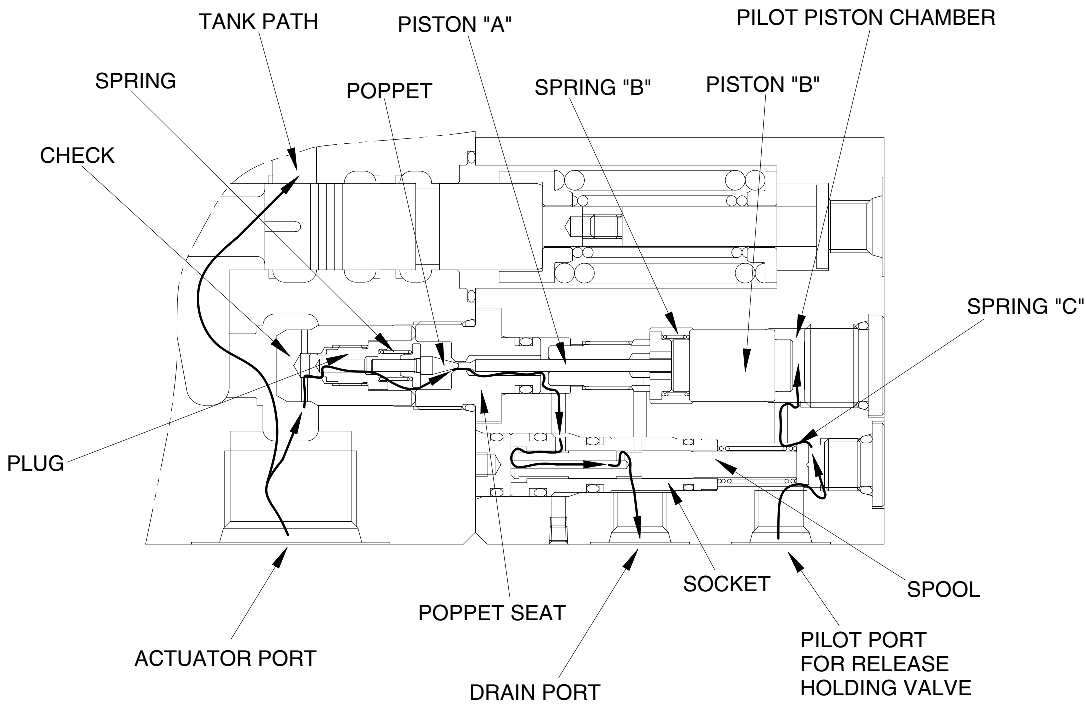
(8) HOLDING VALVE OPERATION

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" and 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**



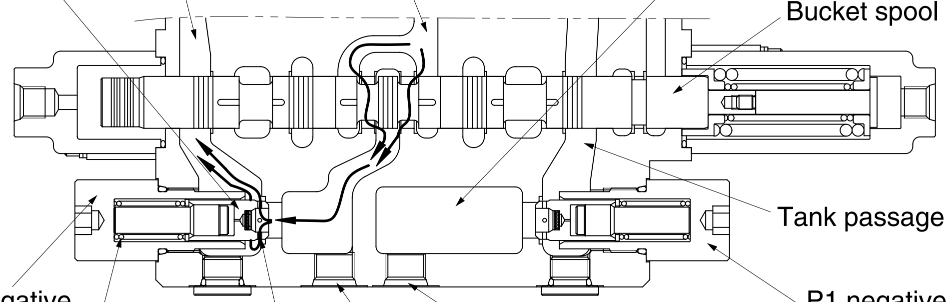
14072SF31

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 the socket and spool and inside 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.

(9) NEGATIVE RELIEF VALVE CONTROL



When no function is being actuated on P2 side, the hydraulic fluid from the pump A2, flows into the tank passage through the bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn2 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 become zero and the discharge of the pump A2 become maximum.

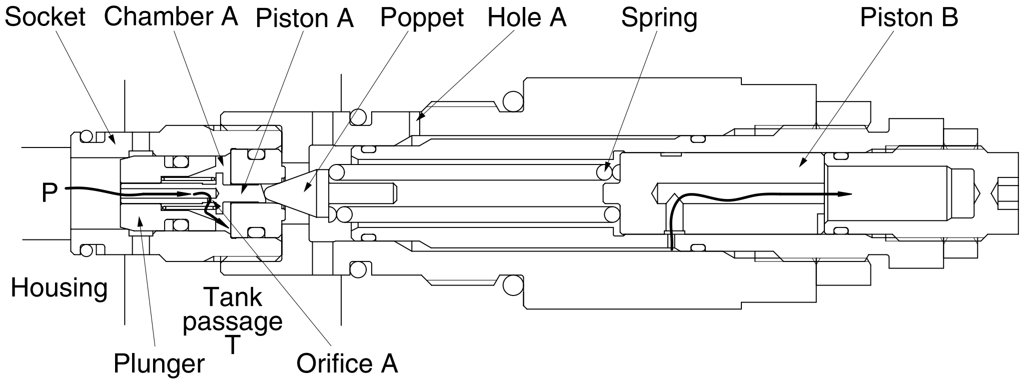
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump A1 the same negative control principle.

(10) OPERATION OF MAIN RELIEF VALVE

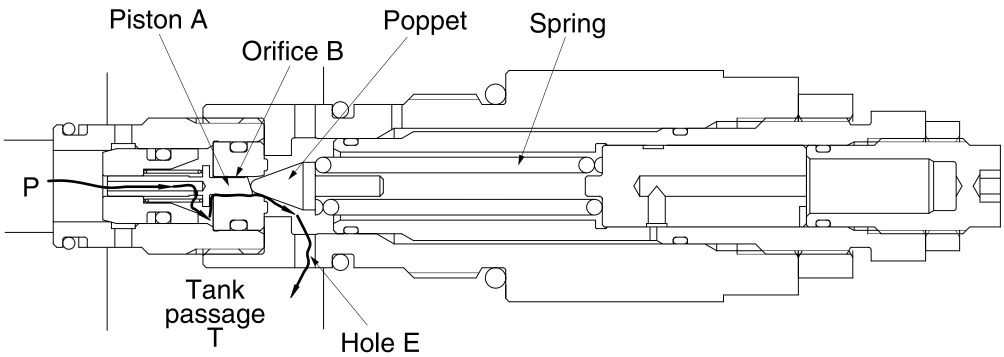
The main relief valve is fitted to the straight travel valve block and functions as follows :

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.



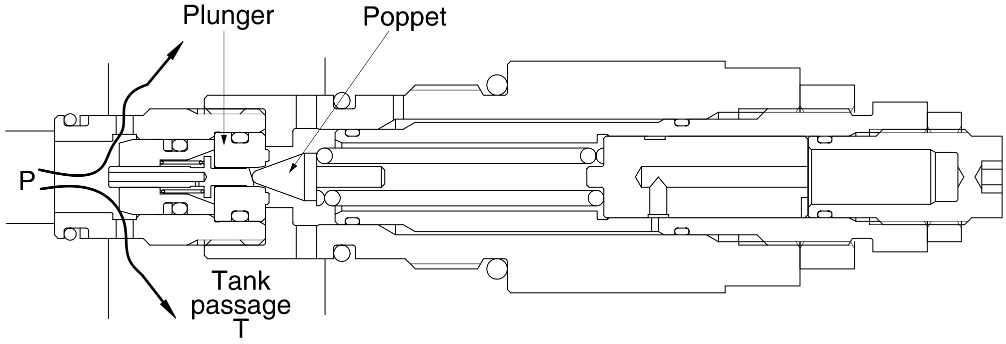
1607A2MC36

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 hole (E).



1607A2MC37

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).

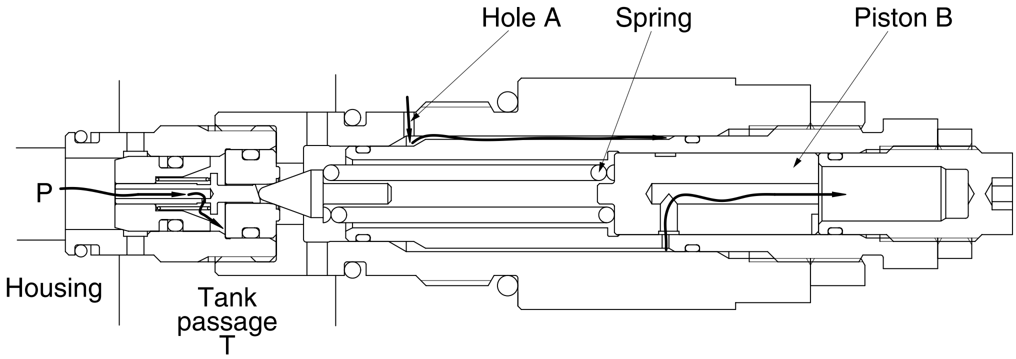


1607A2MC38

④ **High pressure setting pilot signal (Pu) : ON**

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.

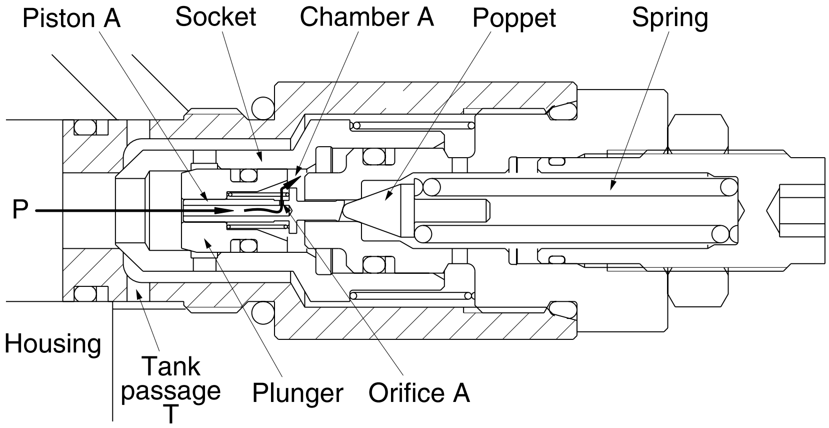


1607A2MC36A

(11) OPERATION OF PORT RELIEF VALVE

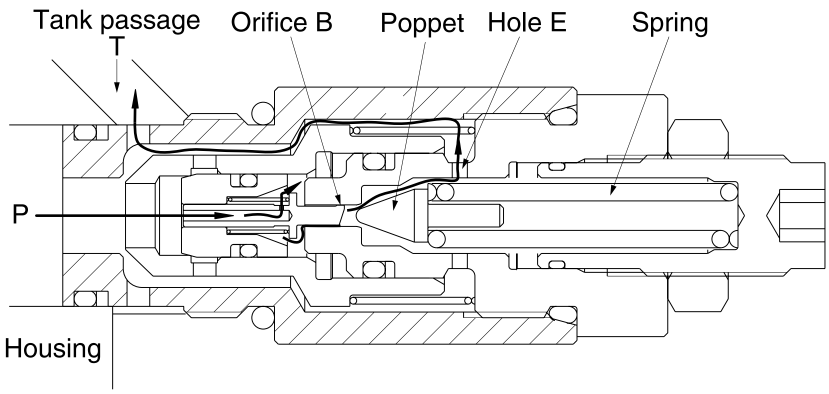
① **Function as relief valve**

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



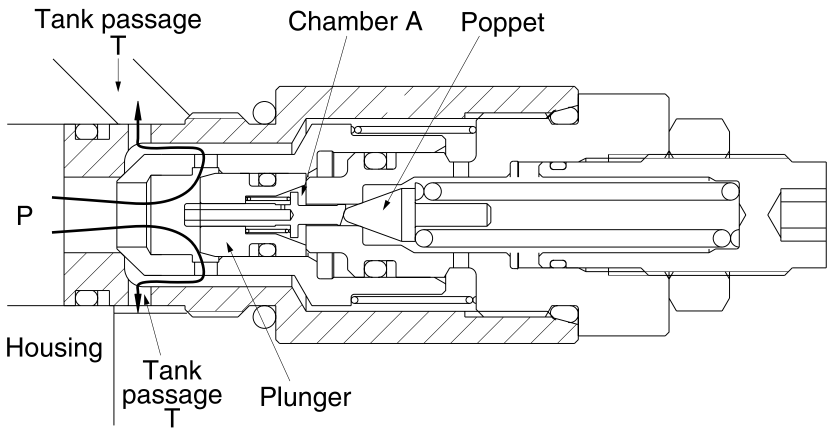
1607A2MC39

ⓑ When the pressure at port P becomes equal to the set pressure of the spring, the pressurized oil pushes open the poppet flows to tank passage (T) through hole E.



1607A2MC40

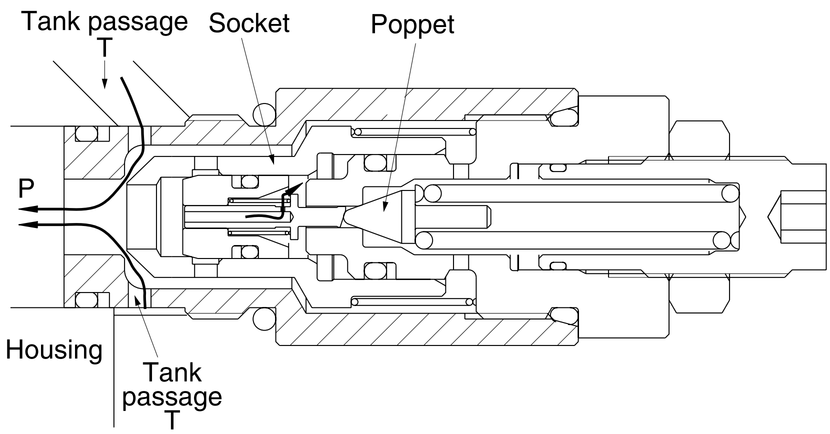
ⓒ Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



1607A2MC41

② **Make-up function**

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 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.



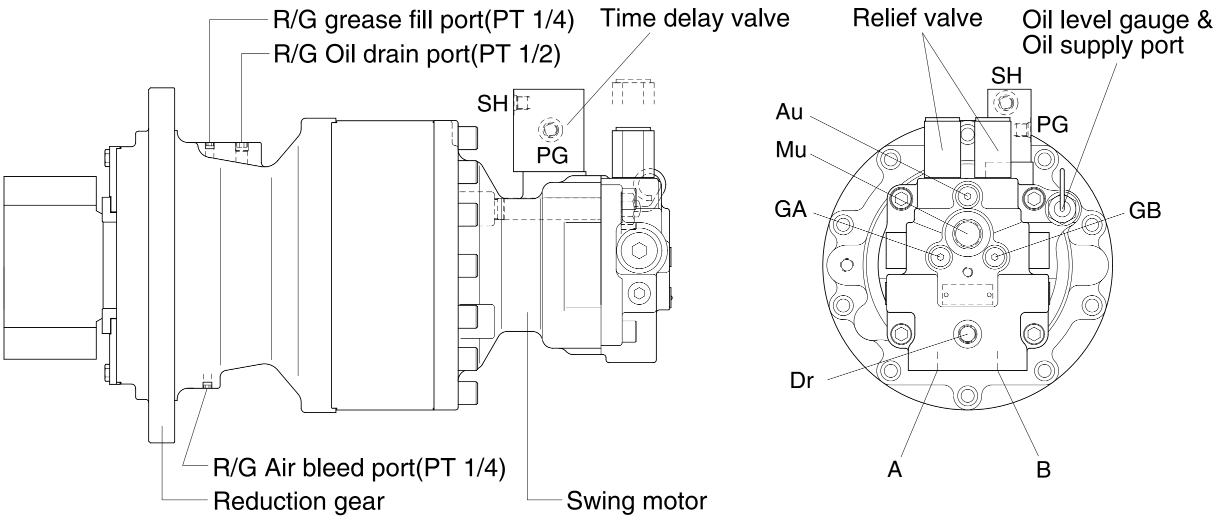
1607A2MC42

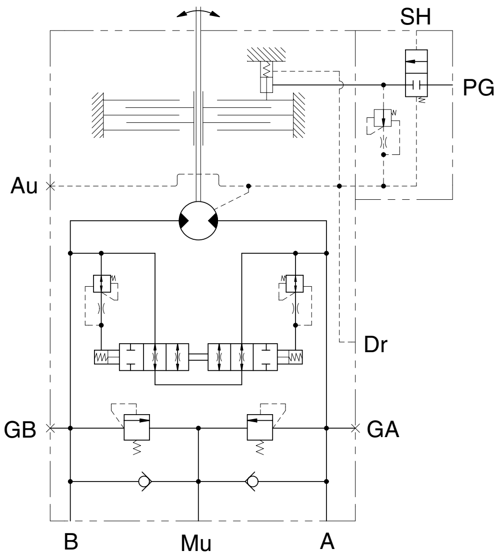
GROUP 3 SWING DEVICE

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

Swing motor include mechanical parking valve, relief valve, make up valve and time delay valve.



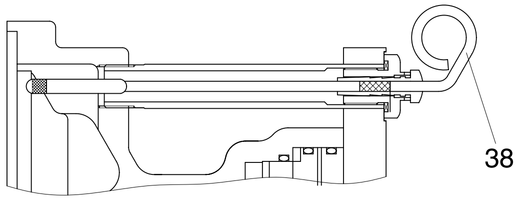


Hydraulic circuit

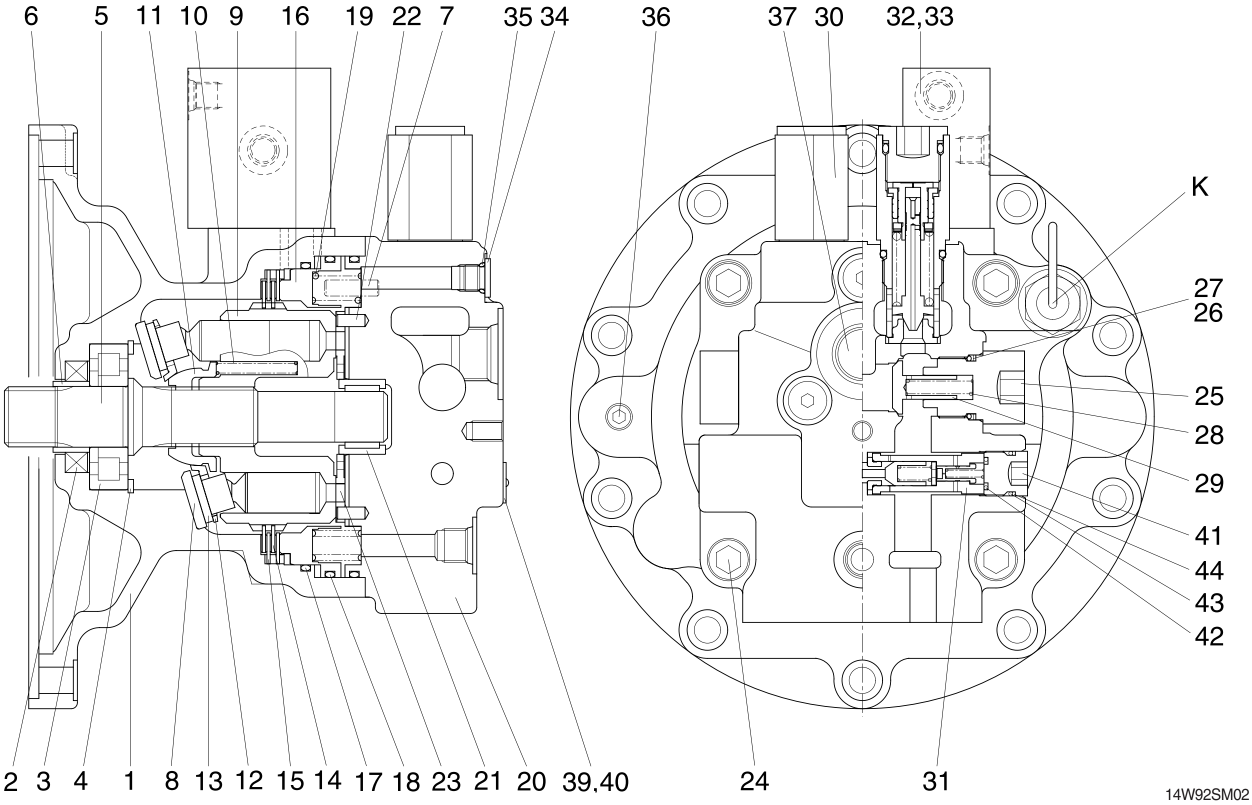
14W92SM01

Port	Port name	Port size
A	Main port	ø 13
B	Main port	ø 13
Dr	Drain port	PF 3/8
Mu	Make up port	PF 3/4
SH	Brake release port	PF 1/4
PG	Stand by port	PF 1/4
GA, GB	Gage port	PF 1/4
Au	Air vent port	PF 1/4

1) SWING MOTOR

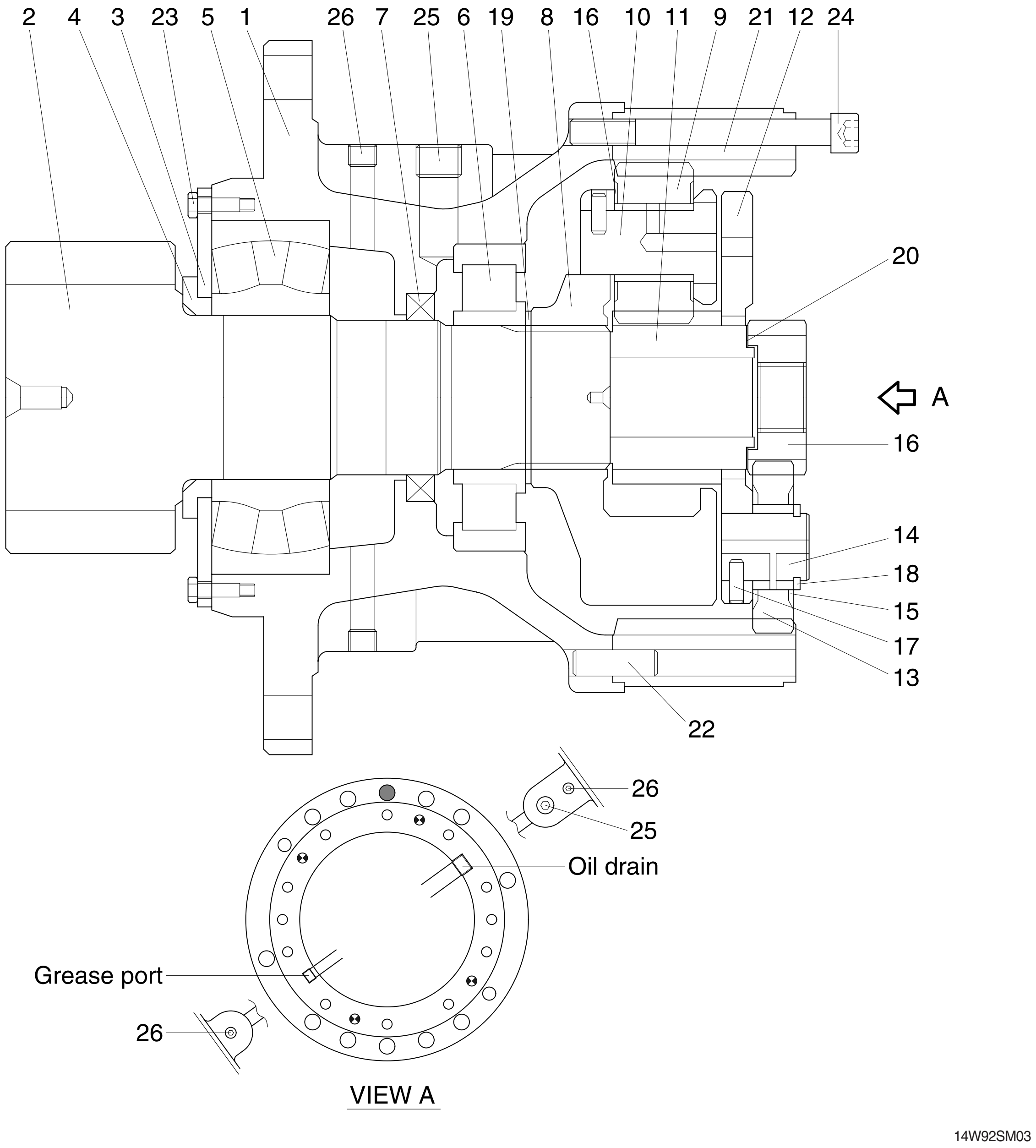


DETAIL K



1	Body
2	Oil seal
3	Roller bearing
4	Snap ring
5	Drive shaft
6	Bushing
7	Pin
8	Shoe plate
9	Cylinder block
10	Spring
11	Ball guide
12	Set plate
13	Piston assembly
14	Friction plate
15	Separate plate
16	Brake piston
17	O-ring
18	O-ring
19	Brake spring
20	Rear cover
21	Needle bearing
22	Pin
23	Valve plate
24	Wrench bolt
25	Plug
26	Back up ring
27	O-ring
28	Spring
29	Check
30	Relief valve
31	Anti-rotating valve
32	Time delay valve
33	Wrench bolt
34	Plug
35	O-ring
36	Plug
37	Plug
38	Level gauge
40	Rivet
41	Plug
42	O-ring
43	O-ring
44	Back up ring

2) REDUCTION GEAR



1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16	Sun gear No. 1	25	Plug
8	Carrier No. 2	17	Spring pin	26	Plug
9	Planet gear No. 2	18	Stop ring		

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a cylinder (9) through valve cover of motor (20), and valve plate (23).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (13).

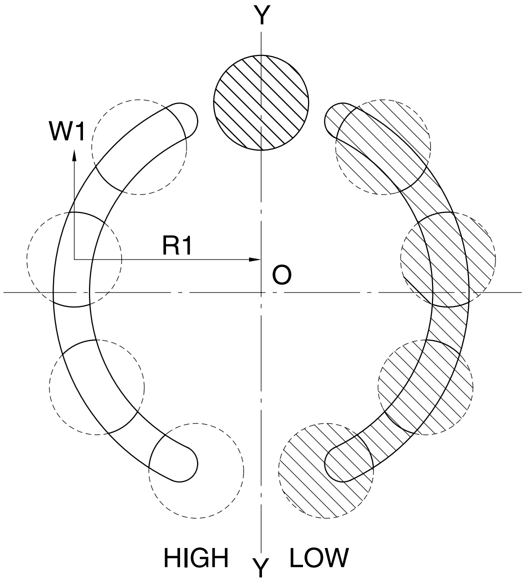
The high hydraulic can generate the force, $F1=P \times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

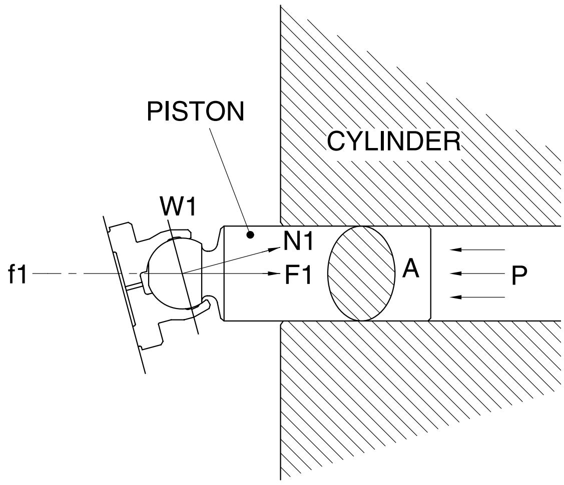
This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate of a tilt angle, α .

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 cylinder (9) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.





14072NEWSM03

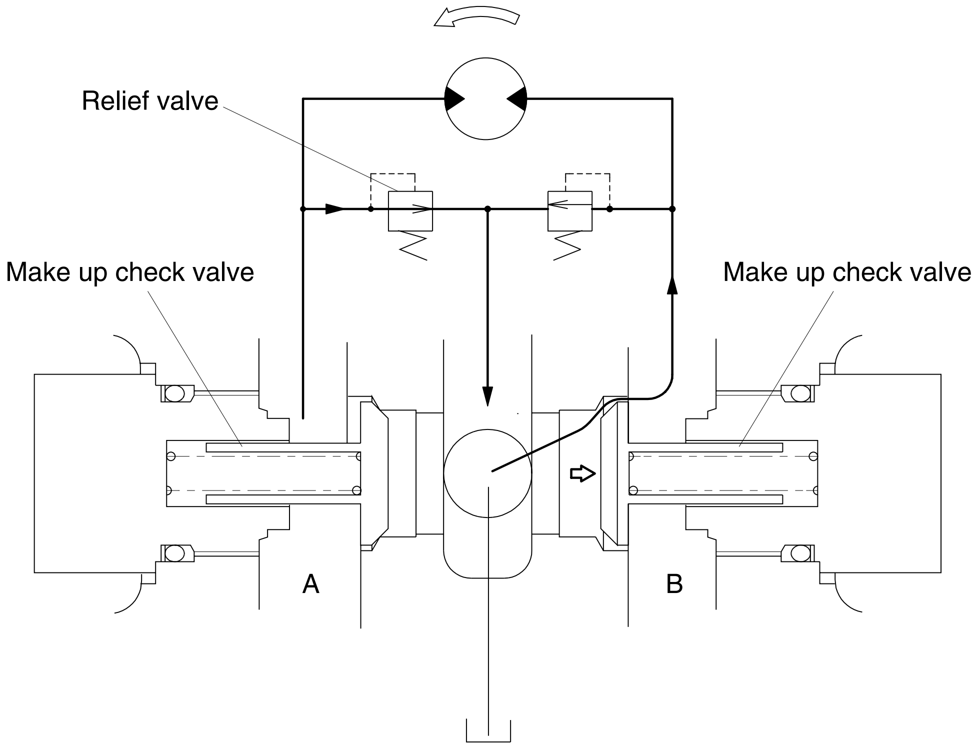
2) MAKE UP VALVE

In the system using this type of motor, there is no counter balance 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.

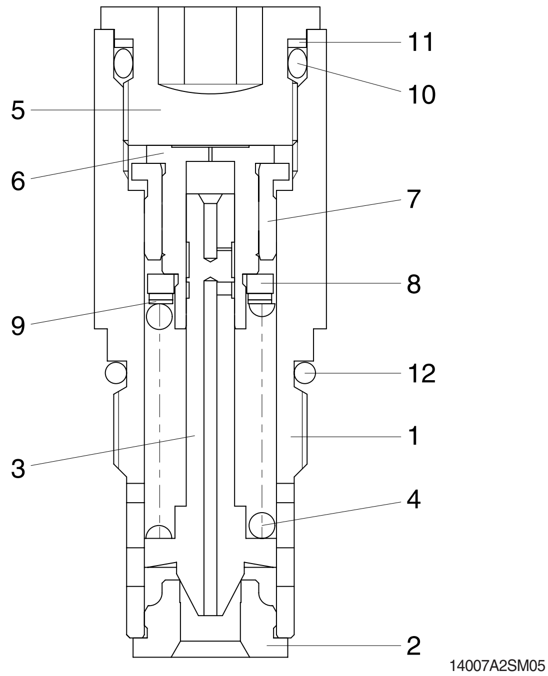
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, 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.



21092SM04

3) RELIEF VALVE



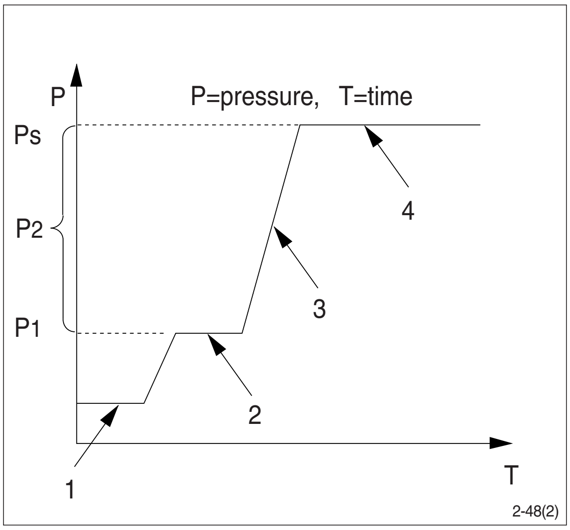
1	Body
2	Seat
3	Plunger
4	Spring
5	Adjusting screw
6	Piston
7	Bushing
8	Spring seat
9	Shim
10	O-ring
11	Back up ring
12	O-ring

(1) Construction of relief valve

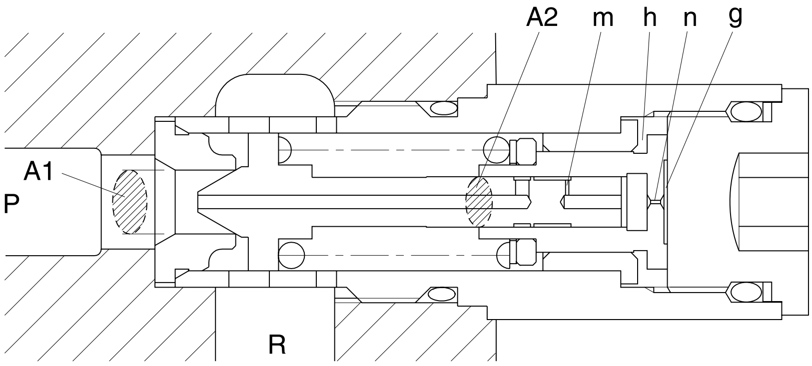
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(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.

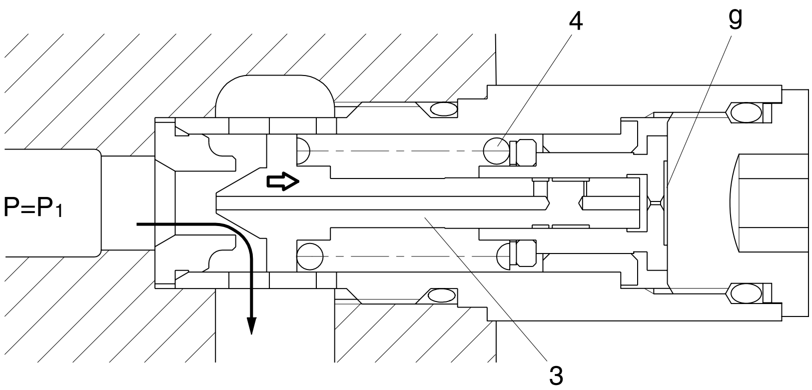


14007A2SM06

② When hydraulic oil pressure ($P \times A_1$) reaches the preset force (F_{SP}) of spring (4), the plunger (3) moves to the right as shown.

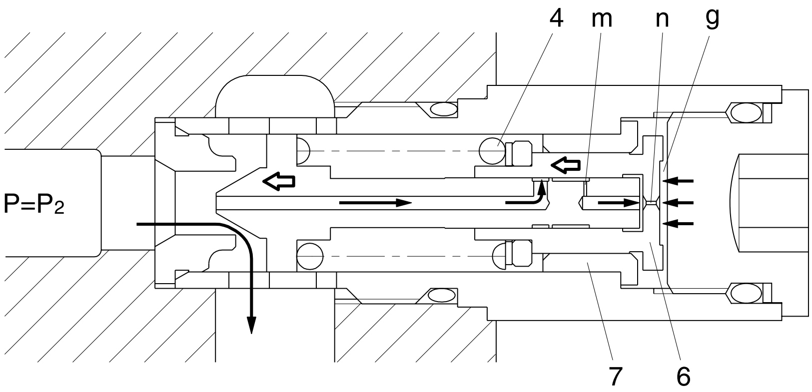
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



14007A2SM07

③ The oil flow chamber g via orifice m and n. When the pressure of chamber g reaches the preset force (FSP) of spring (4), the piston (6) moves left and stop the piston (6) hits the bottom of bushing (7).

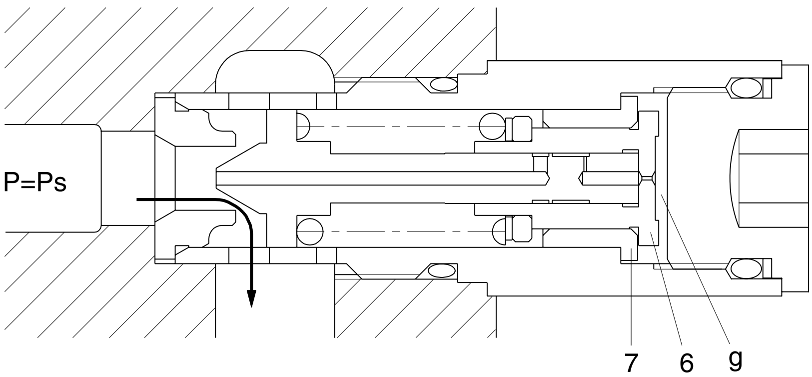


14007A2SM08

④ When piston (6) hits the bottom of bushing (7), it stops moving to the left any further. As the result, the pressure in chamber (g) equals (Ps).

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

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



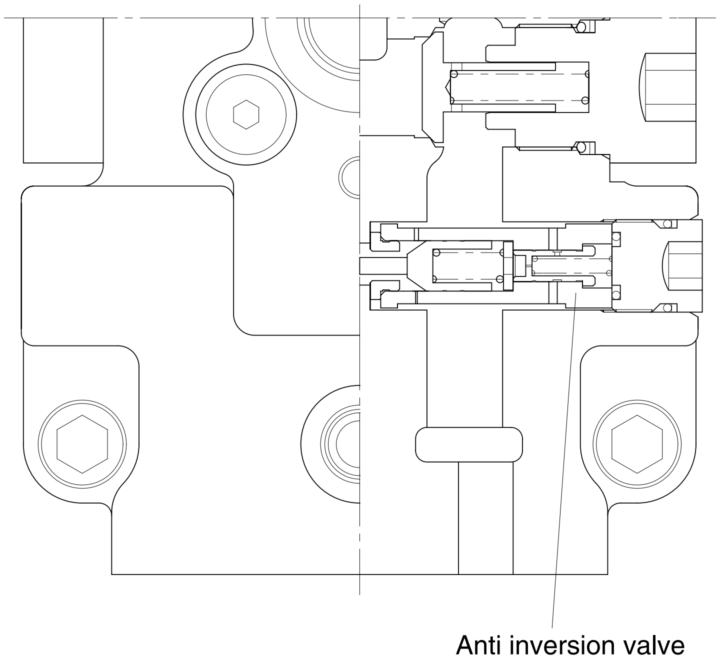
14007A2SM09

4) ANTI-INVERSION VALVE

In the event of swing motor operates switch part to drive and stop the swing part. By the action of pump on motor, there is brake on both-side of port because of the block on both sides.

Swing part is stopped by pressure of brake (in order words, 4-5 times of inversion)

Under the operating condition, the side of anti-inversion blocks off both ports but bypassing compressed oil which is blocked in processing of anti-inversion fixed time and amount to inverse port, prevent increasing pressure of motor and decrease inversing action.



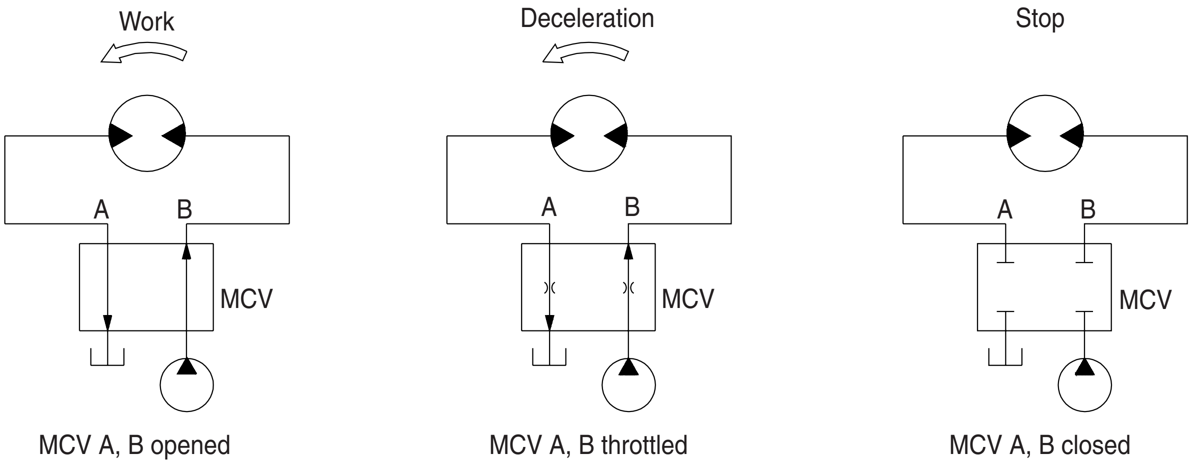
14W92SM10

5) 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.



2-48(1)

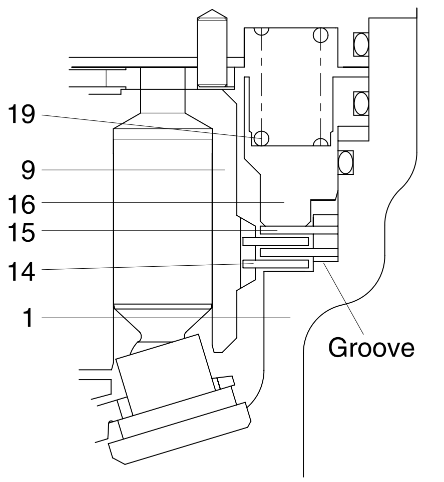
(2) Mechanical swing parking brake system

This is function as a parking brake only when all of the RCV lever (except travel pedal) are not operated.

① Brake assembly

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

Cylinder block (9) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.

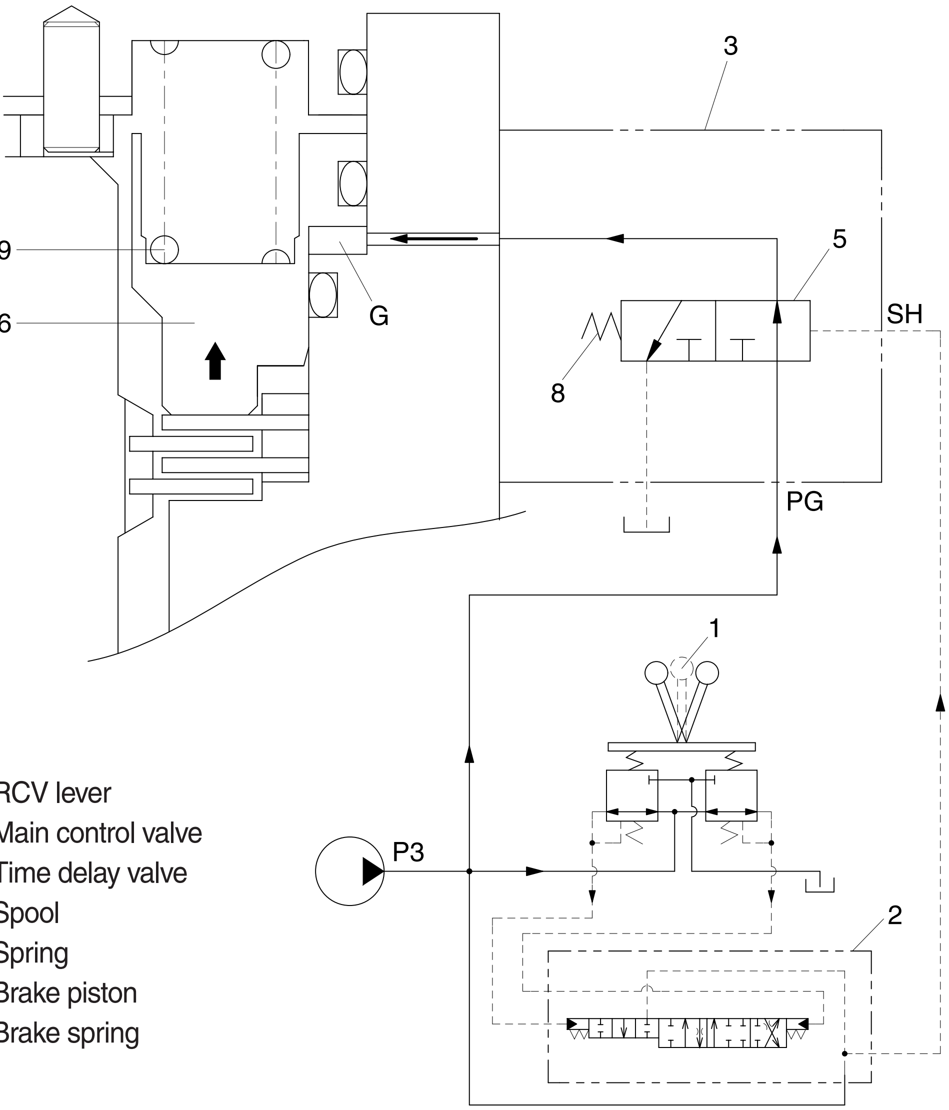


14W92SM15

1	Housing	15	Separate plate
9	Cylinder block	16	Brake piston
14	Friction plate	19	Spring

② Operating principle

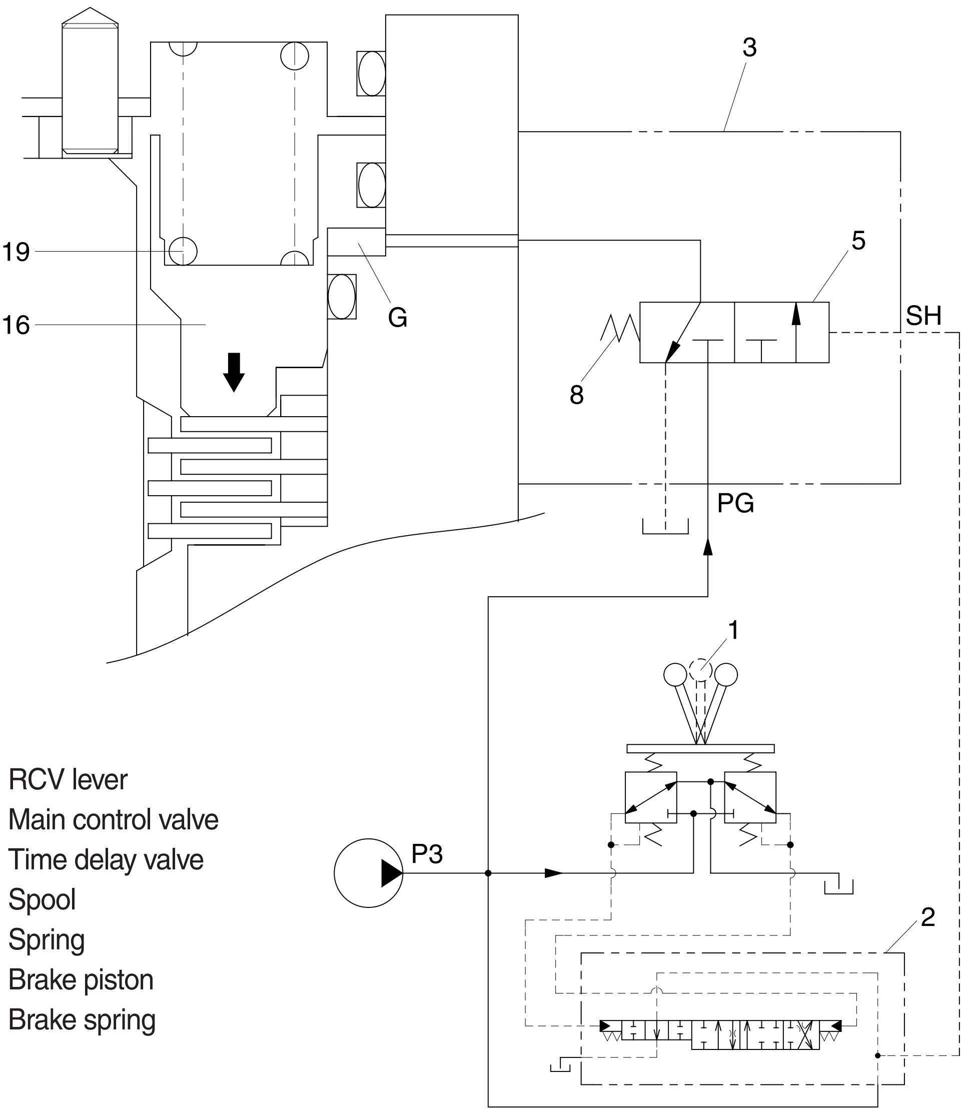
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (3).
   This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump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



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

14W92SM16

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the piston (16) is moved lower by spring 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	Brake piston
19	Brake spring

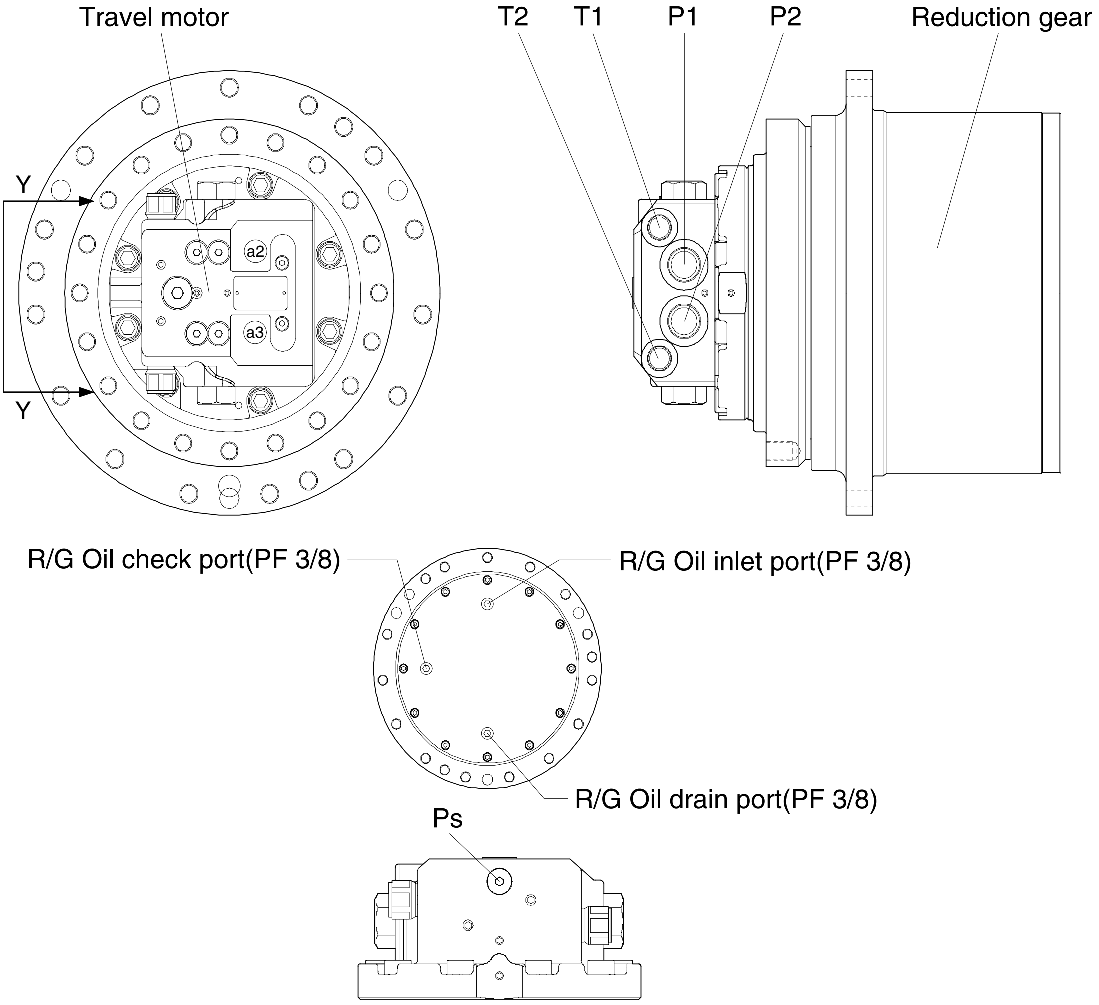
14W92SM17

GROUP 4 TRAVEL DEVICE (TYPE1)

1. CONSTRUCTION

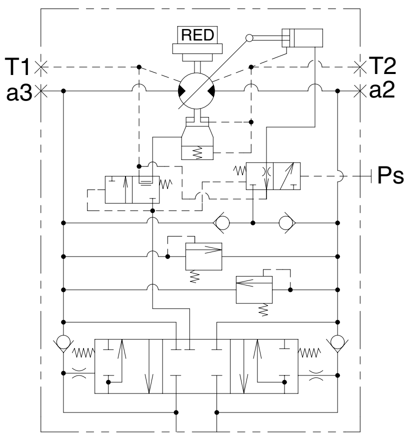
Travel device consists travel motor and gear box.

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



VIEW Y

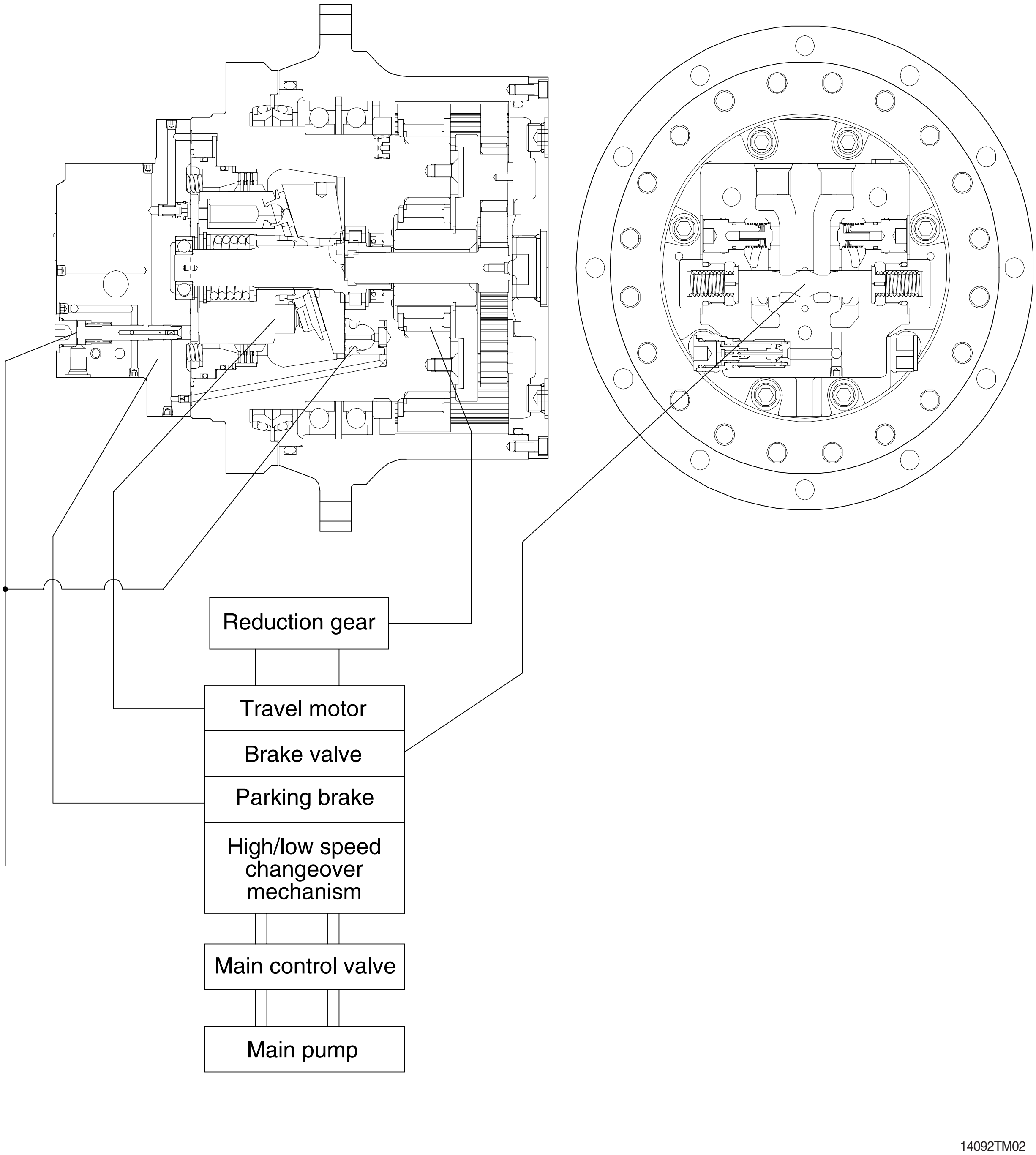
14092TM01A



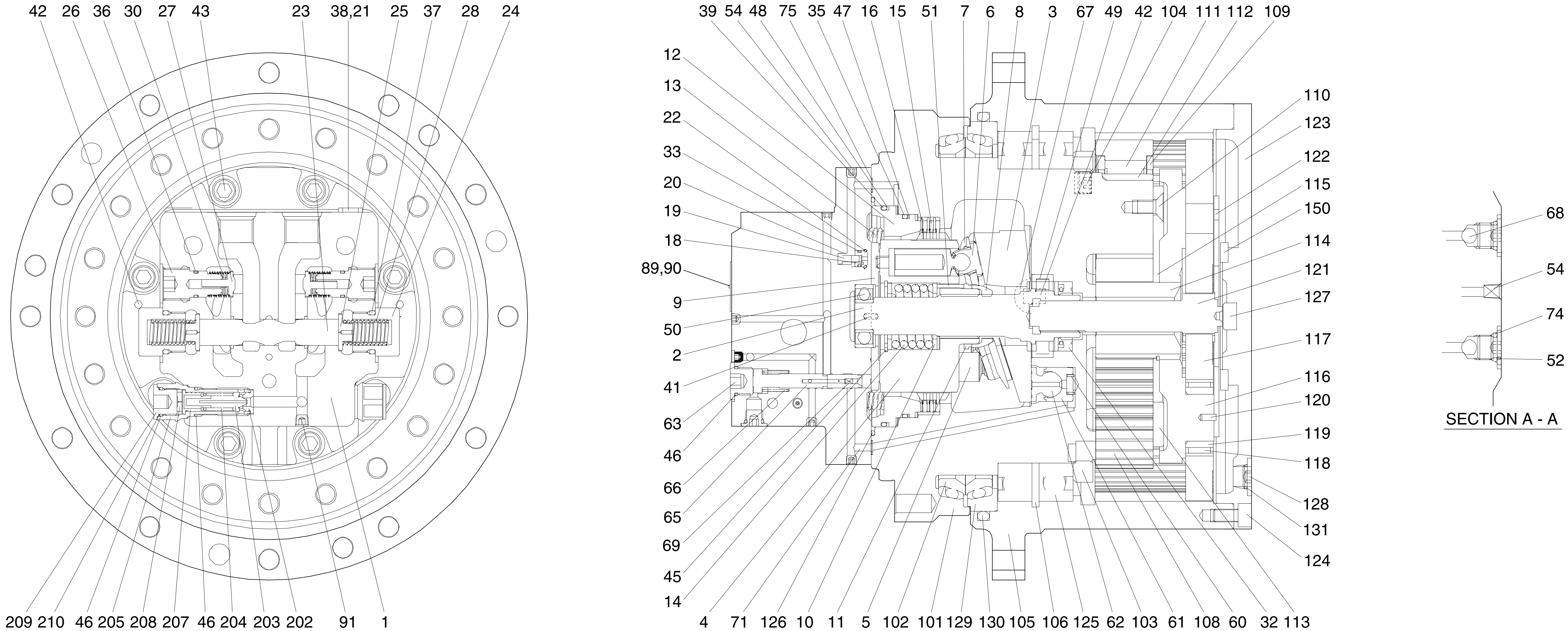
Hydraulic circuit

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



14092TM03

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. 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

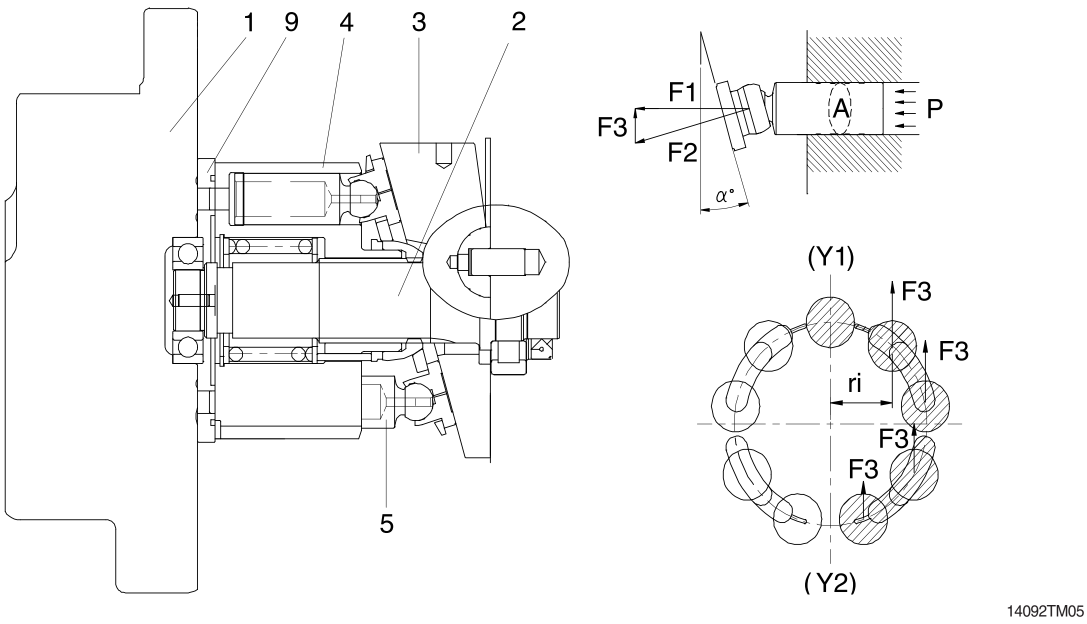
The parking brake prevents overrunning or slippage upon parking or stopping the machine on a slope with friction plate type brake mechanism, and combined with the hydraulic motor assembly into an integral structure.

(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.

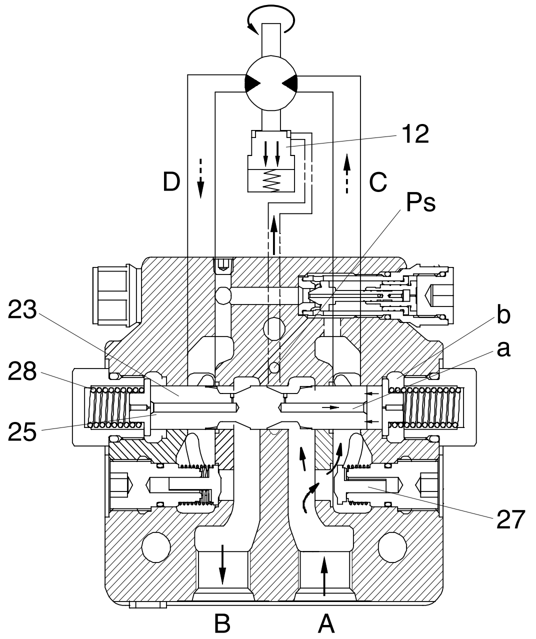
(2) Brake valve

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.

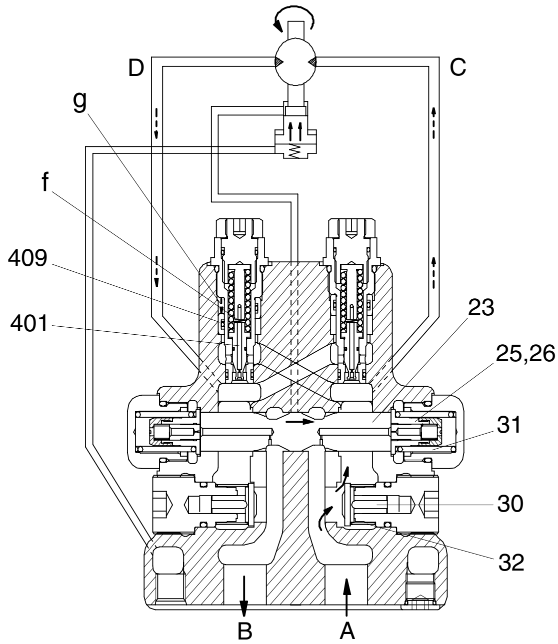
Moreover, sliding of spool (23) causes the pressurized oil to flow into ports (P) and (S). The pressurized oil admitted into port (P) activates piston (12) of the parking brake to release the parking brake force. (For details, refer to description of the parking brake.) When the pressurized oil is supplied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



14092TM06

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.



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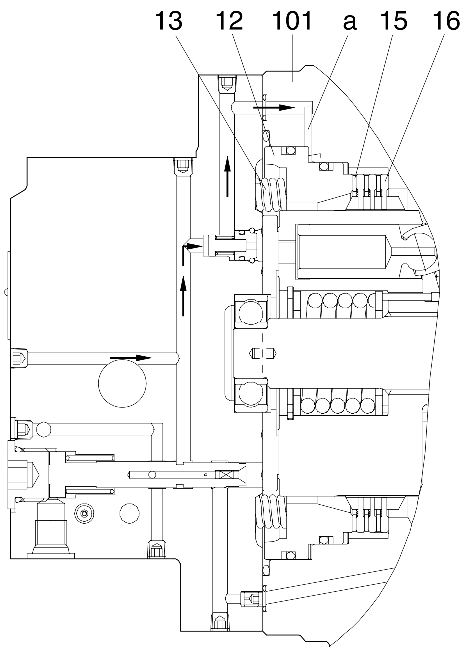
(3) Parking brake

① Running

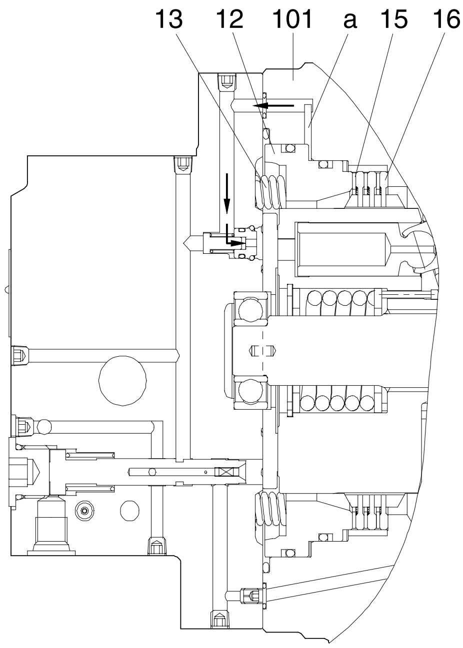
When the pressurized oil is supplied from the valve, the spool of brake valve in the hydraulic motor assembly actuates to open the passage to the parking brake and the pressurized oil is introduced into cylinder chamber (a) which is composed of the spindle of reduction gear assembly and piston (12). 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.



14092TM08

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.

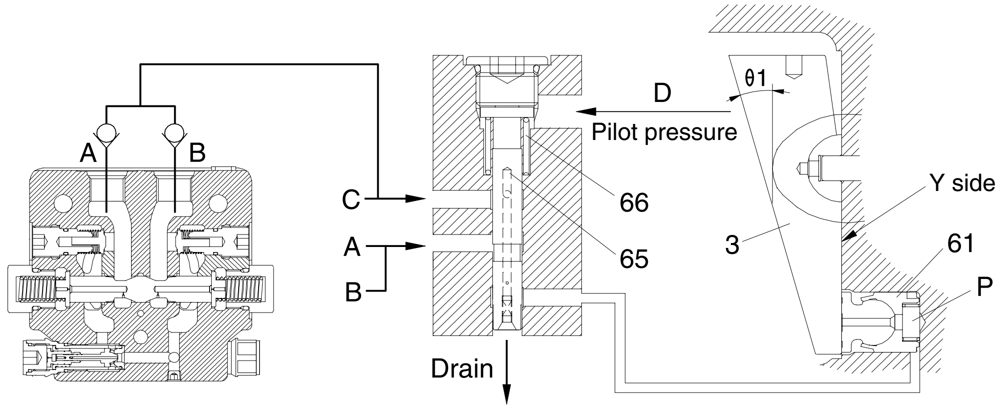


14092TM09

(4) High/low speed changeover mechanism

① **At low speed -** pilot pressure of less than 10 kgf/cm^2

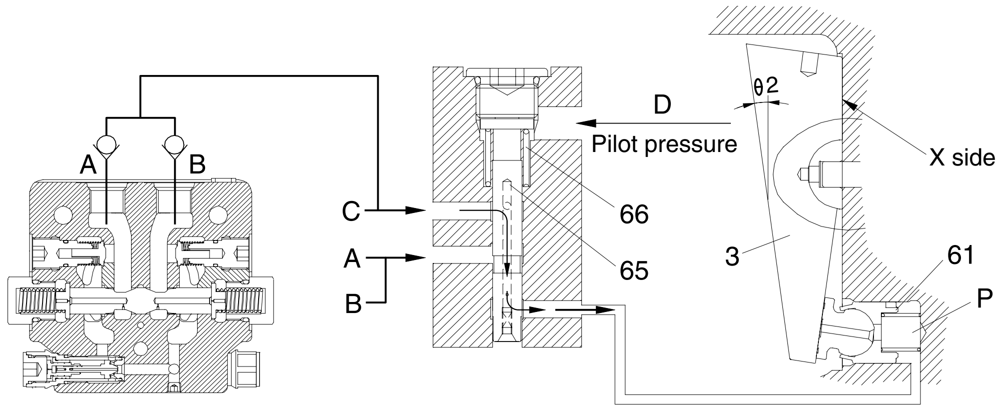
When no pilot pressure is supplied from (D) (at a pressure of 10 kgf/cm^2 or less), valve (65) is pressed toward the top by the force of spring (66) and (A) port or (B) port, the pressurized oil supply port (C) is shut off, and oil in chamber (P) is released into the motor case via valve(65). Consequently, 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.



14092TM10

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

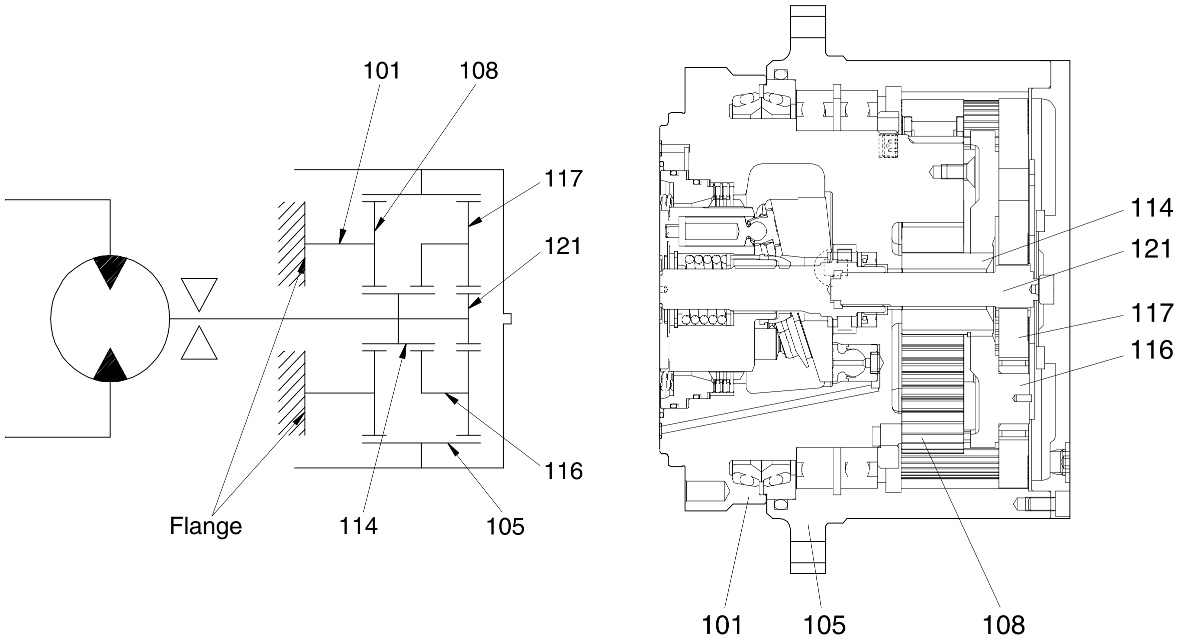
When a pilot pressure is supplied from port (D) (at a pressure of 20 kgf/cm^2 or more), the pressure overcomes the force of spring (66) and (A) port or (B) port of valve (65) is pressed toward the down. The pressurized oil at supply port (C) is then introduced into chamber (P) via valve (65). Piston (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.



14092TM11

3. REDUCTION GEAR

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



14092TM12

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 :

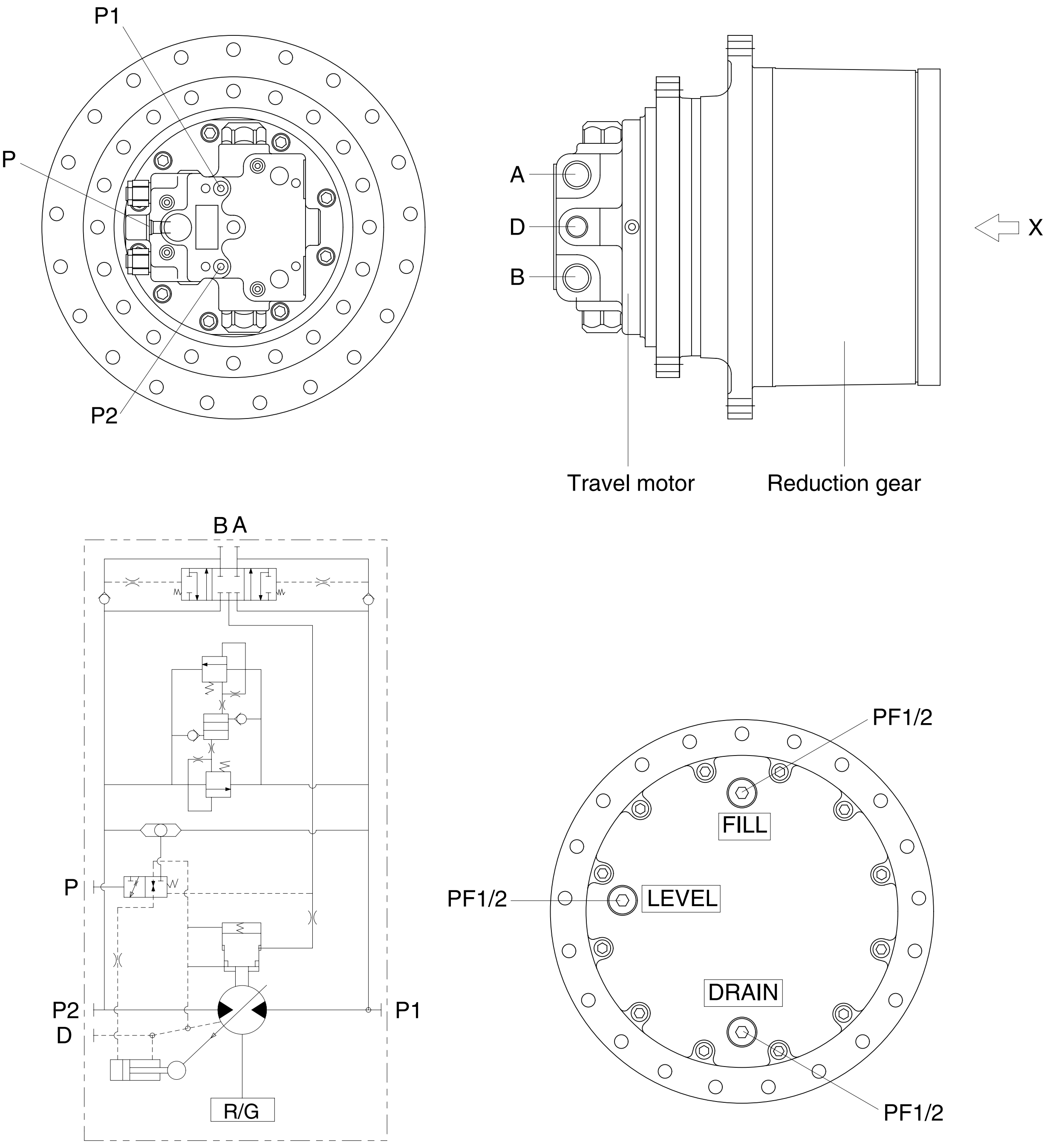
· Reduction ratio (I) = (Hub teeth / Drive gear teeth + 1) x (Hub teeth / Sun gear teeth + 1) - 1

■ TRAVEL MOTOR (TYPE 2)

1. CONSTRUCTION

Travel device consists travel motor and gear box.

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



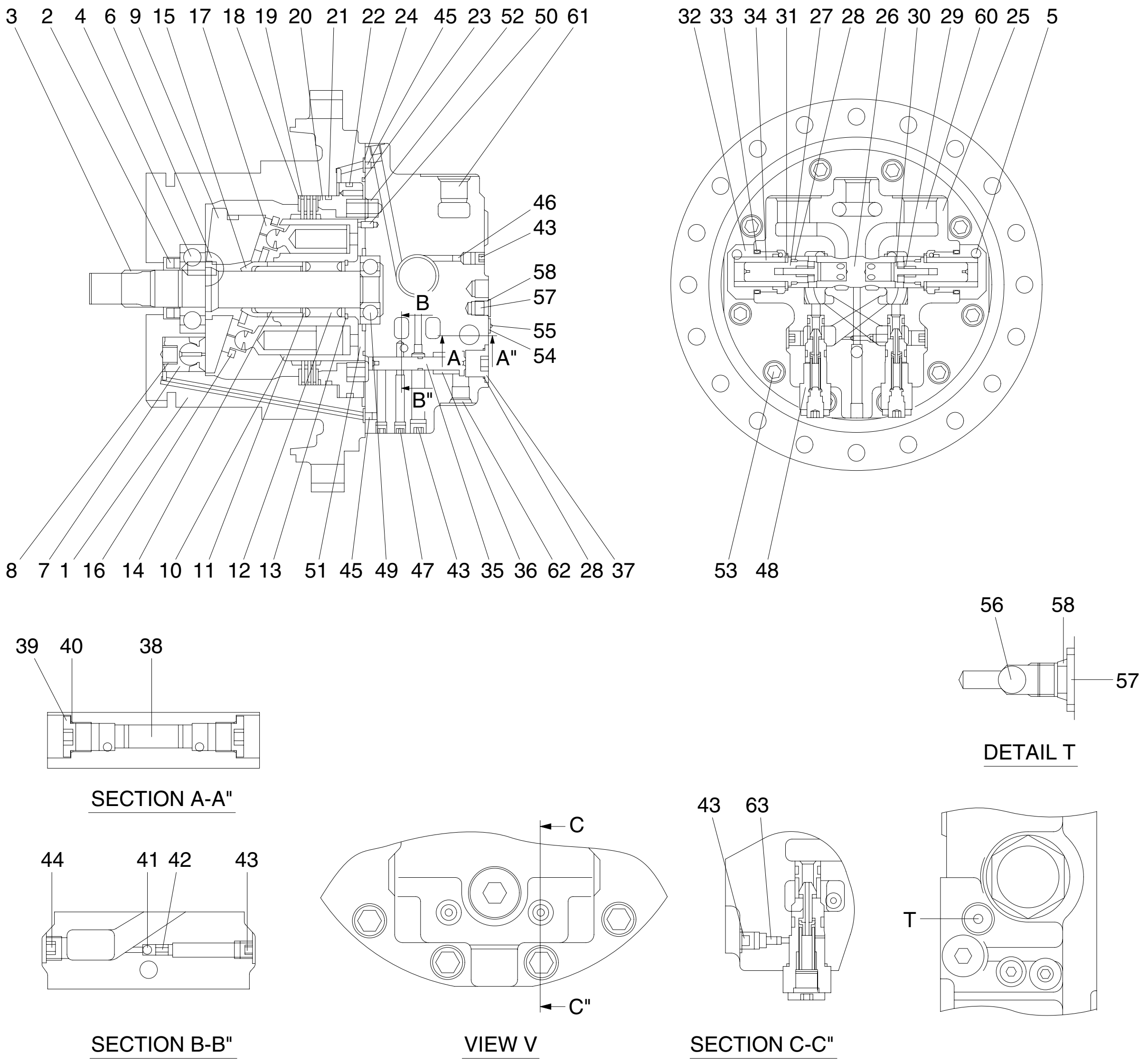
Hydraulic circuit

VIEW X

145Z9A2TM01

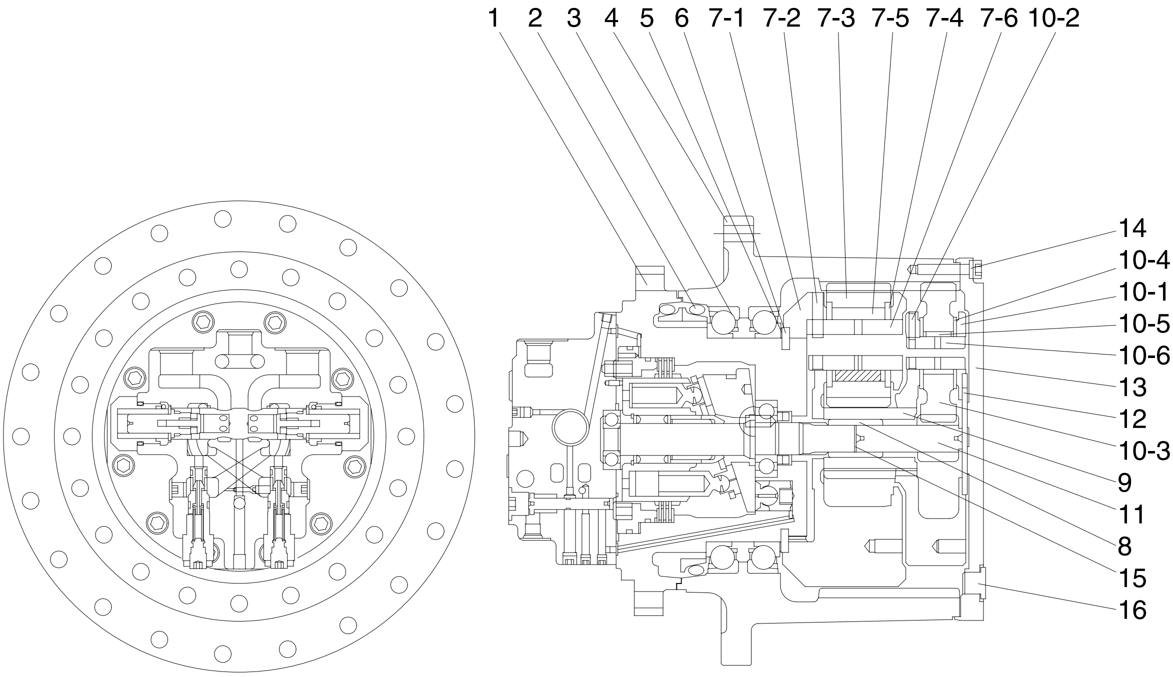
Port	Port name	Port size
A, B	Main port	PF 3/4
P	Two speed control port	PF 1/4
D	Drain port	PF 1/2
P_1, P_2	Gage port	PF 1/8

1) STRUCTURE



145Z9A2TM02

1	Shaft casing	17	Piston assy	33	O-ring	49	Bearing
2	Oil seal	18	Steel plate	34	Spring	50	Pin
3	Shaft	19	Friction plate	35	Spool	51	Valve plate
4	Bearing	20	Brake piston	36	Spring	52	Spring
5	Pin	21	Ring	37	Plug	53	Wrench bolt
6	Swash ball	22	Ring	38	Piston	54	Name plate
7	Swash piston	23	O-ring	39	Plug	55	Rivet
8	Spring	24	O-ring	40	O-ring	56	Steel ball
9	Swash plate	25	Valve casing	41	Steel ball	57	Plug
10	Cylinder block	26	Main spool	42	Orifice	58	O-ring
11	Spring seat	27	Plug	43	Plug	60	Plastic plug
12	Spring	28	O-ring	44	Plug	61	Plastic plug
13	Snap ring	29	Spring	45	Orifice	62	Plastic plug
14	Pin	30	Check	46	Orifice	63	Orifice
15	Ball guide	31	Plate	47	Plug		
16	Set plate	32	Plug	48	Relief valve assy		



145Z9A2TM02A

1	Spindle	7-4	Washer 2	10-5	Bearing 1
2	Floating sesal	7-5	Bearing 2	10-6	Pin 1
3	Ball bearing	7-6	Pin 2	11	Sun gear 1
4	Housing	8	Coupling	12	Plate 1
5	Shim	9	Sun gear 2	13	Cover
6	Shim	10	Carrier assy 1	14	Bolt
7	Carrier assy 2	10-1	Carrier 1	15	Snap ring
7-1	Carrier 2	10-2	Spring pin 1	16	Plug
7-2	Spring pin 2	10-3	Planetary gear 1		
7-3	Planetary gear 2	10-4	Washer 1		

3. PRINCIPLE OF DRIVING

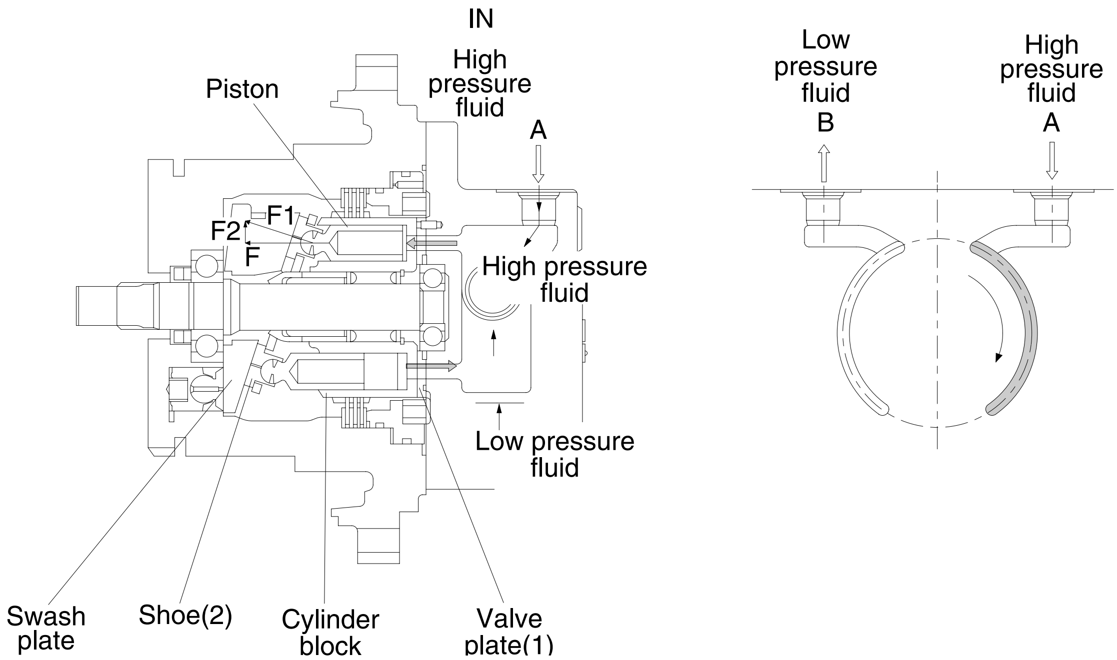
Travel motor comprises with rotary, relief valve, parking brake, counterbalance valve and 2-speed control.

1) WORKING OF ROTARY PART

In the figure below, axis directional force F1 occurs when the high pressure oil flows into the cylinder block through to the valve plate (1) port, and the piston moves to the left hand side.

This force F1, which takes shoe (3) as a medium, split into axial force F which is parallel with a shaft, and radial force F2 which is perpendicular to the shaft. By the reaction force F2, cylinder block rotate with piston and shoe, while shoe (2) moves on the shoe plate with piston.

There are 9 pistons inserted into the cylinder block and they rotate with the cylinder block by taking high pressure oil in order at the entrance. When the oil flow is reversed, piston and cylinder block rotate in the opposite direction.



145Z9A2TM03

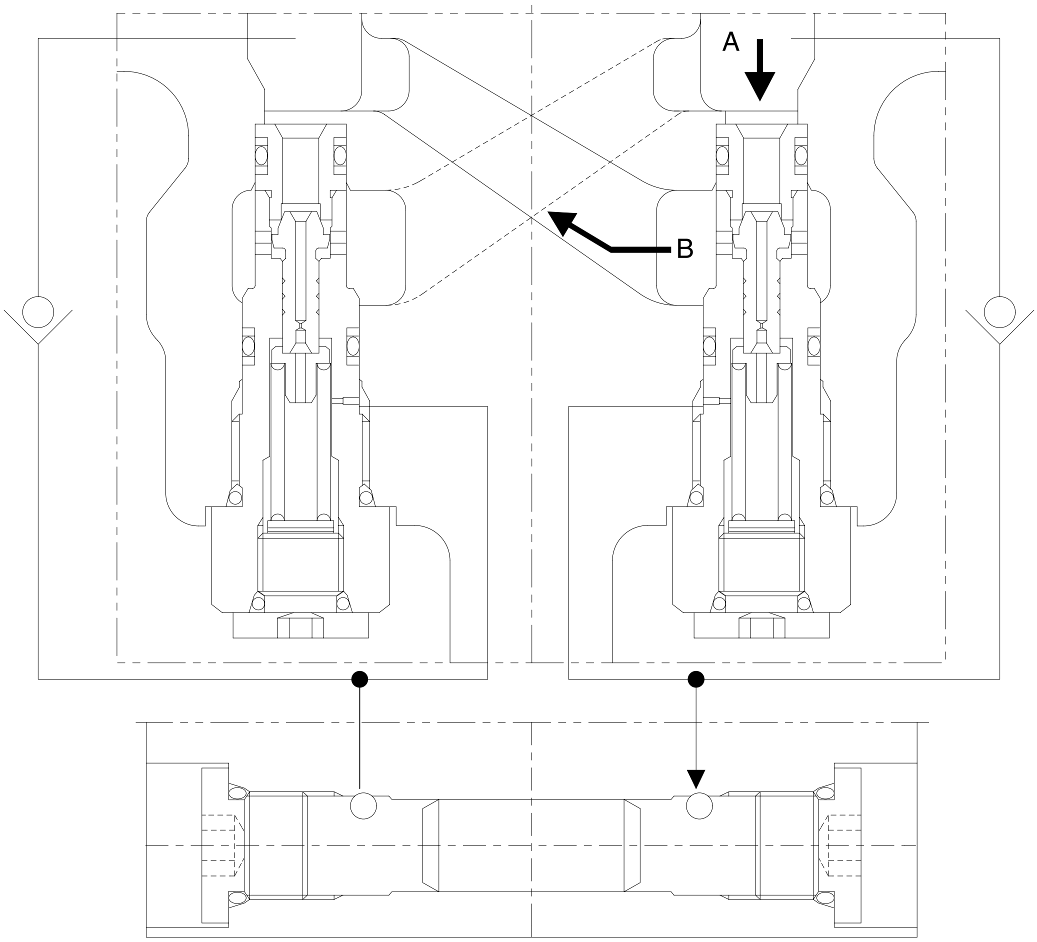
2) WORKING OF RELIEF VALVE

When the control valve spool is returned to neutral, the circuit between control valve and motor is blocked, and traveling movement stops.

However, motor continues rotating because of the traveling inertia of the excavator's heavy weight.

Then the motor will act as a pump, and oil blocked between control valve and motor will be pressured sharply and the increased oil pressure will damage internal parts.

To prevent this damage, relief valve discharge the high pressure oil from A to B which has lower pressure.



145Z9A2TM04

- Setting pressure : 350 kgf/cm^2
- Back pressure : 5 kgf/cm^2
- Cracking pressure : 315 kgf/cm^2 over

- AT THE BEGINNING OF TRAVELING

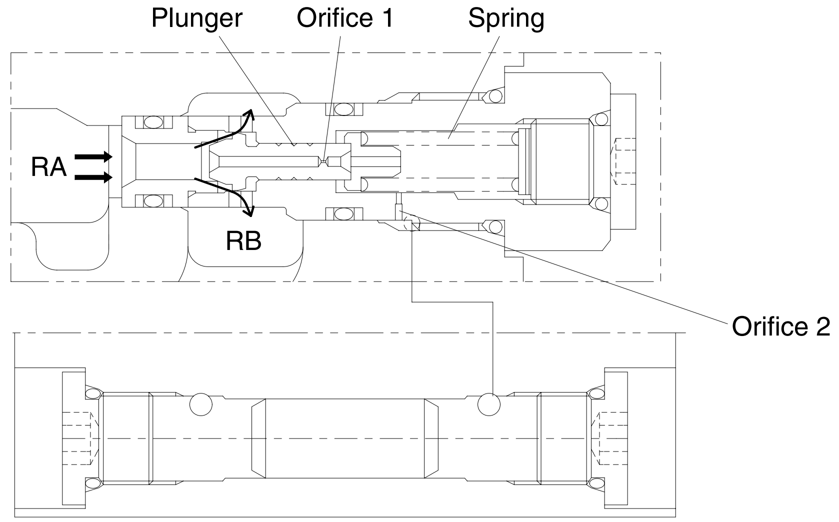
RELIEF VALVE A

When travel control lever moves, high pressure oil works to rise the pressure of RA port up. This pressurized oil press plunger to the right, and then sustain the power of the spring, the plunger moves to the right and release the pressure oil of RA port to RB port (Stage 1)

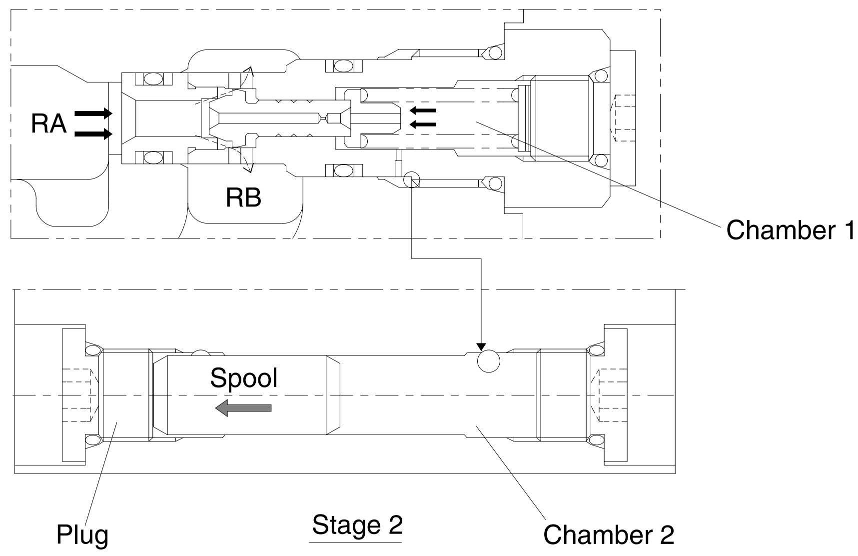
The plunger moves slowly by the pressure oil which flows into chamber 1 through orifice 1. The pressure oil flowed into chamber 1 flows into chamber 2 through orifice 2, and at this point, the plunger moves to the left again, when the spring is compressed by the flowed pressure oil which press the spool to the left. (Stage 2)

When the RA port pressure goes up much more and the set pressure overcome the power of the compressed spring again, the plunger moves to the right and the pressure has of RA port is released to RB port.

Thus, at the early stage of the relief valve operation, it works primarily at lower pressure, after then, shock is reduced during rotating at the set pressure as the secondary operation.



Stage 1



Stage 2

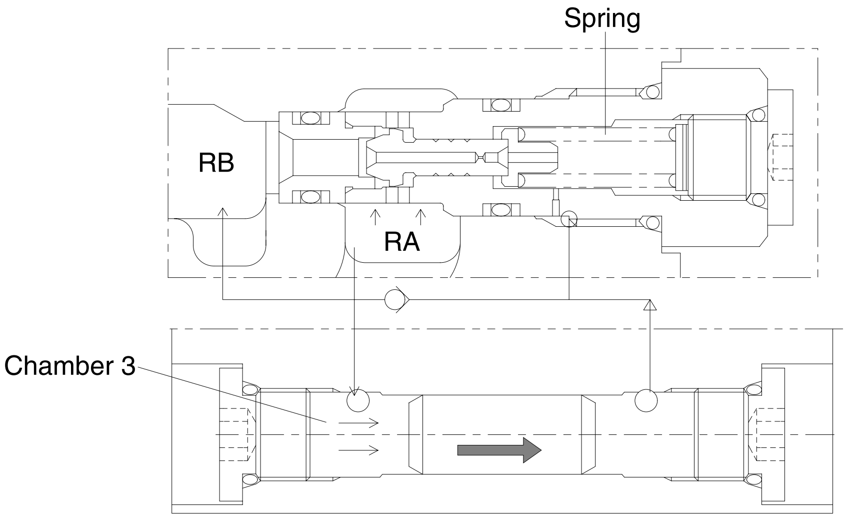
RELIEF VALVE A

145Z9A2TM05

- DURING TRAVELING OPERATION

RELIEF VALVE B

During traveling operation, RA port pressure goes up and RB port pressure goes down.
Thus RA port pressure oil flows into chamber 3, and pushes plunger to the left with a high pressure and the power of the spring.



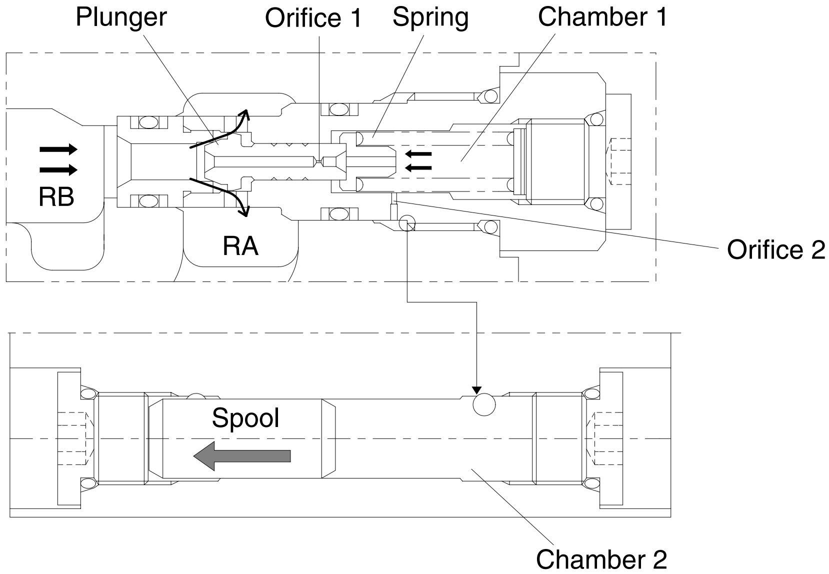
RELIEF VALVE B

145Z9A2TM06

- WHEN IT STOP

RELIEF VALVE B

When it stops or operates reversely, RA port pressure is decreased and RB port pressure suddenly goes up by the inertia of the machine heavy structure.
Relief valve B operates as the same order as relief valve A, and maintains the set pressure by releasing the high pressure of RB port to RA port.



RELIEF VALVE B

145Z9A2TM07

3) WORKING OF PARKING BRAKE

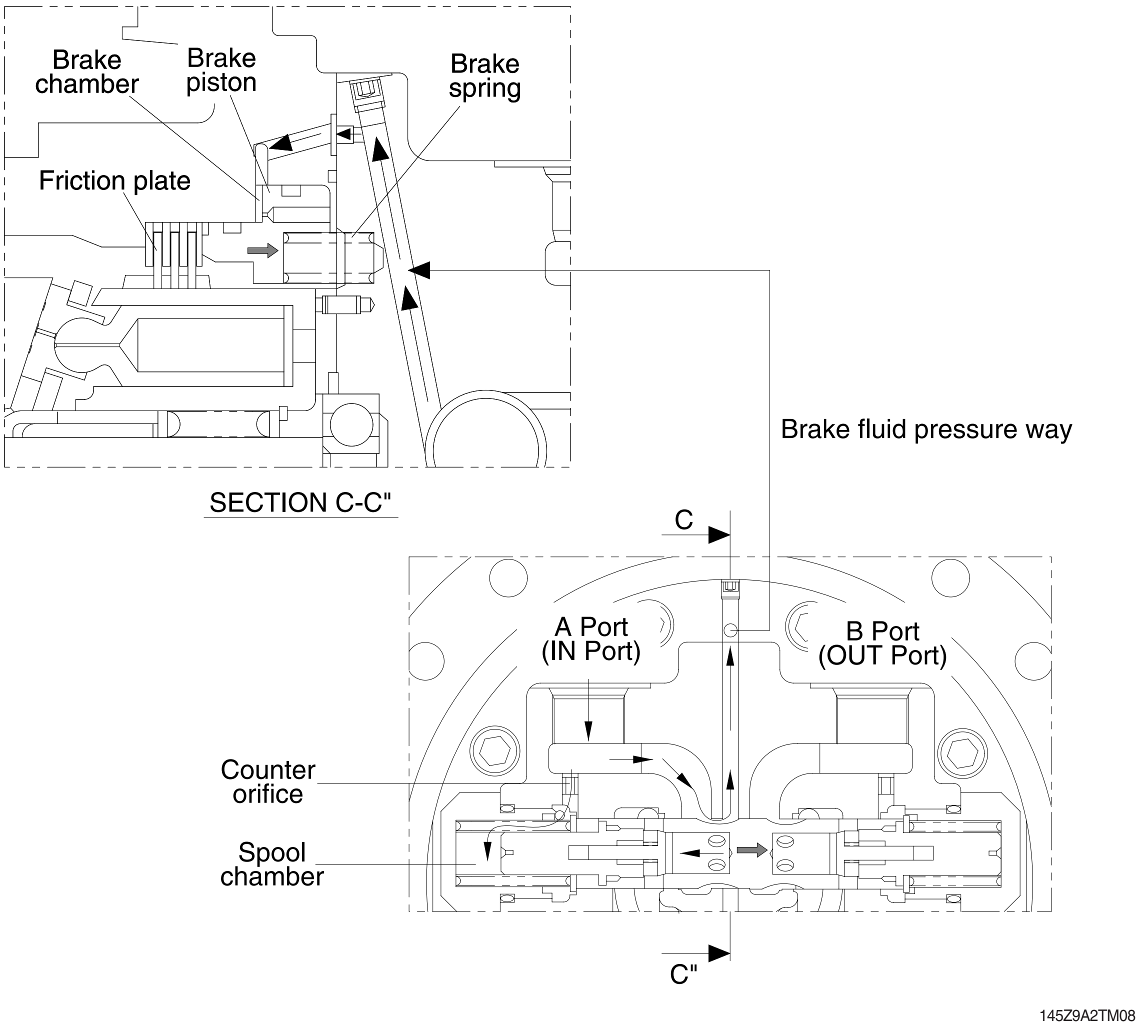
Parking brake system consists of a brake piston, springs, friction plates and separating plates, and some orifices to control responsibility of the brake piston. The brake is usually held with the force of compressed spring, and it is released automatically by traveling oil pressure coming from inlet A, or B when the motor starts to run.

- Parking brake OFF

  When operator moves the traveling control lever, traveling working pressurized oil into IN PORT flows from spool chamber through counter orifice.

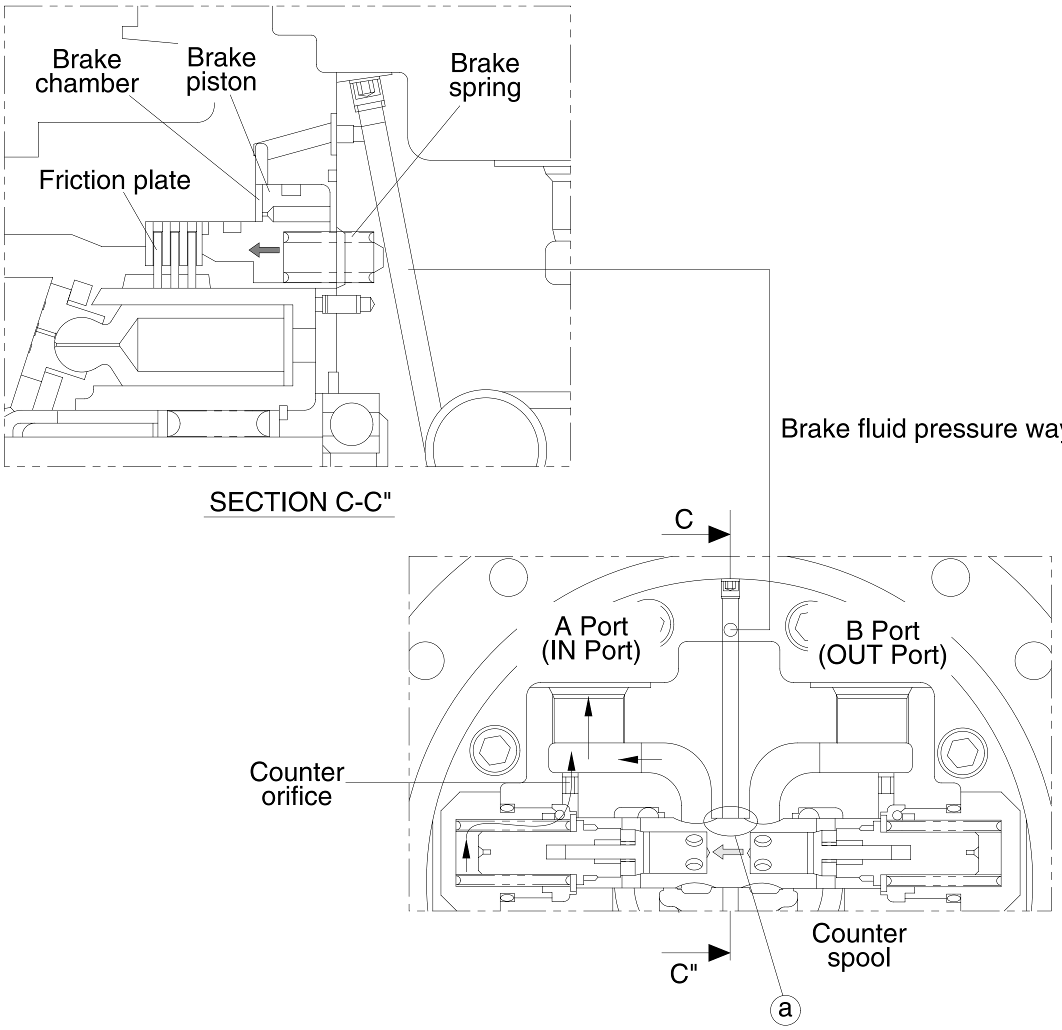
  Pressurized oil pushes counter balance spool to right.

  Then notch of spool opens the brake line. At the same time, pressurized oil flows to the brake chamber of motor through a brake passage, and makes brake piston move against brake spring force to allow clearance between fiction plates and separate plates thereby releasing the brake.



- **Parking brake ON**

  When the control lever is returned to neutral position, the circuit between control valve and motor is blocked. As oil pressure in spool chamber drops to zero and the counter balance spool returns to neutral position. At the spool neutral position, notch ⓐ is disconnected from oil supply port A, instead, brake chamber oil is drained to tank through brake orifice which is center opened.



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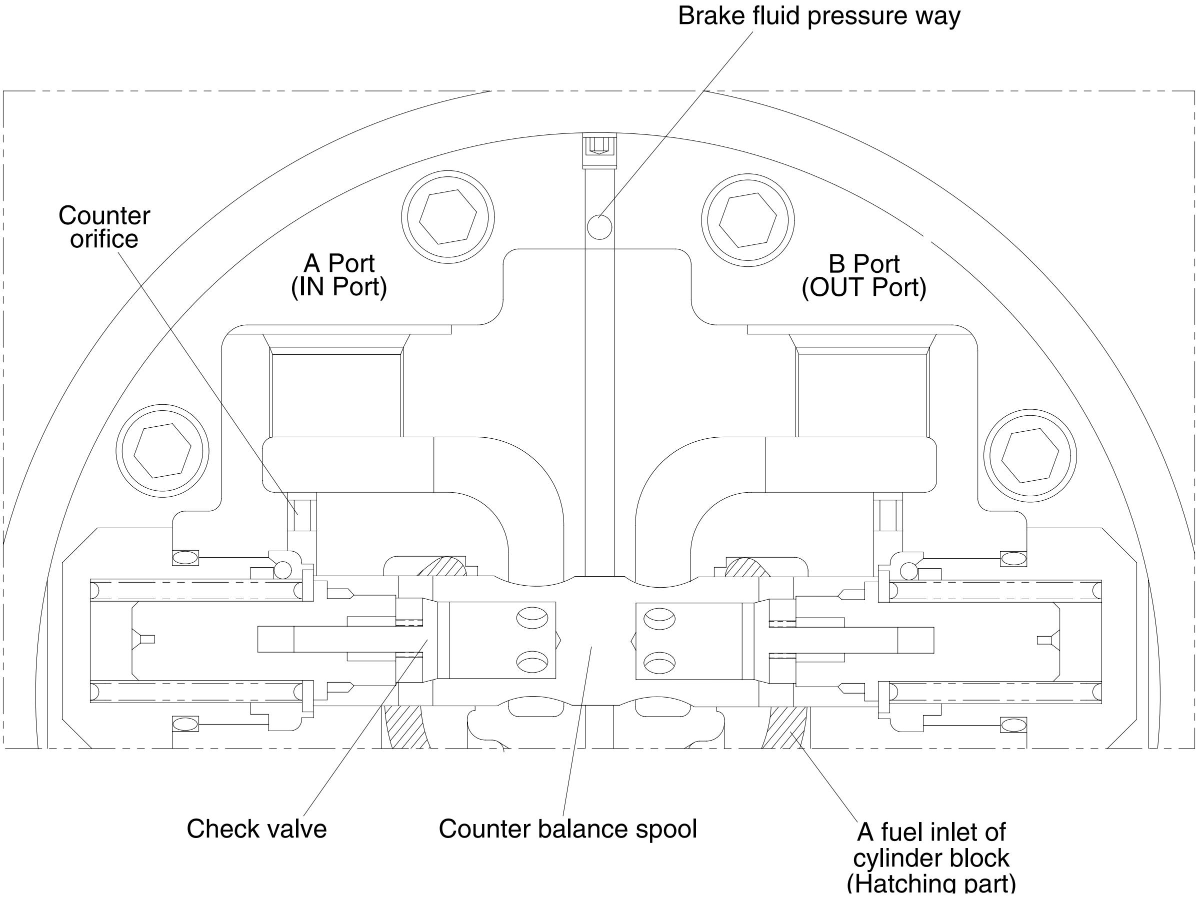
4) COUNTERBALANCE VALVE

(1) Function

① Control oil flow in the action of mechanical parking brake operation.
② Prevent overrun while traveling on down slope.
③ Work as a hydraulic brake when motor stops, and prevent motor not to slip on slope.

(2) NEUTRAL

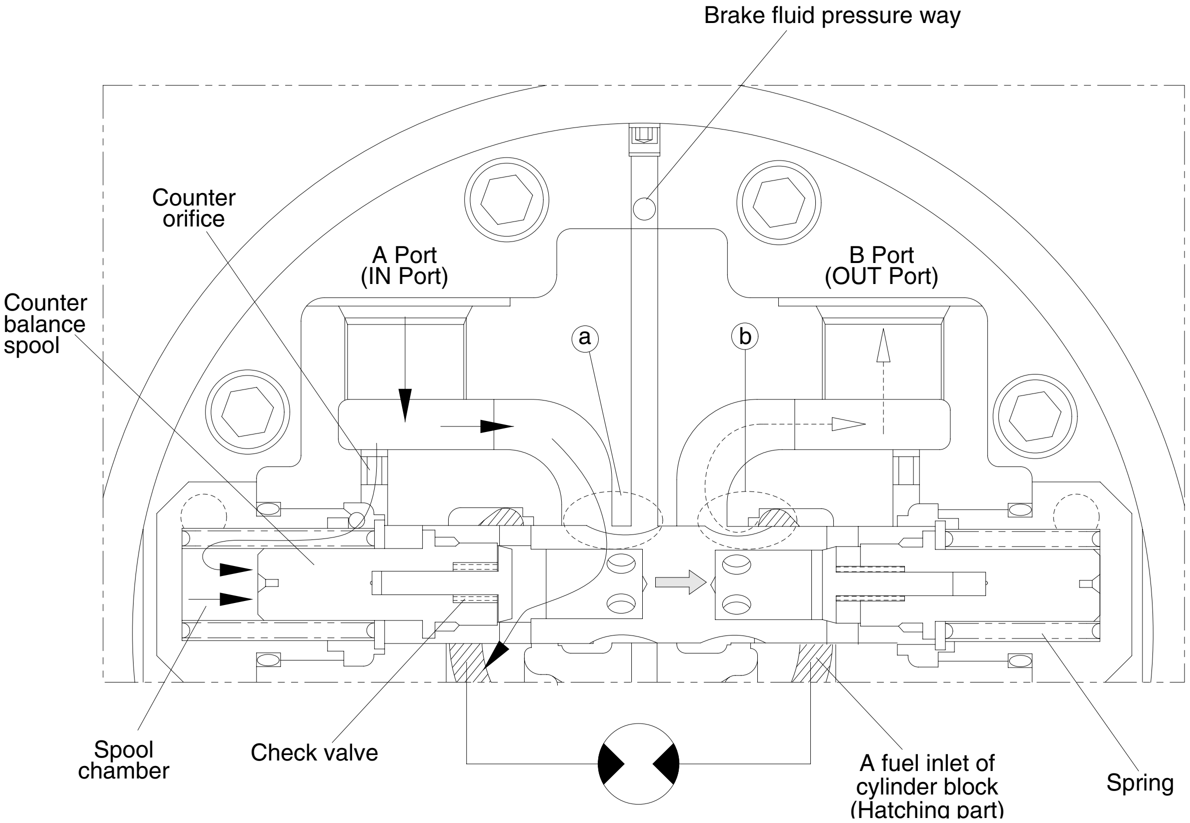


145Z9A2TM10

(3) How to work

① When motor travel

When operator moves a traveling control lever, pressurized oil flows from pump to motor inlet A, and passes into spool chamber through counter orifice, and hydraulic force moves counter balance spool to the right, it makes pump oil flow into cylinder block through check poppet and kidney port. At that time spool notch is opened and pump oil also go through line ⓐ and passes into parking brake chamber, and it releases parking brake. At the same time, return oil from cylinder block flows to outlet B through the line ⓑ.



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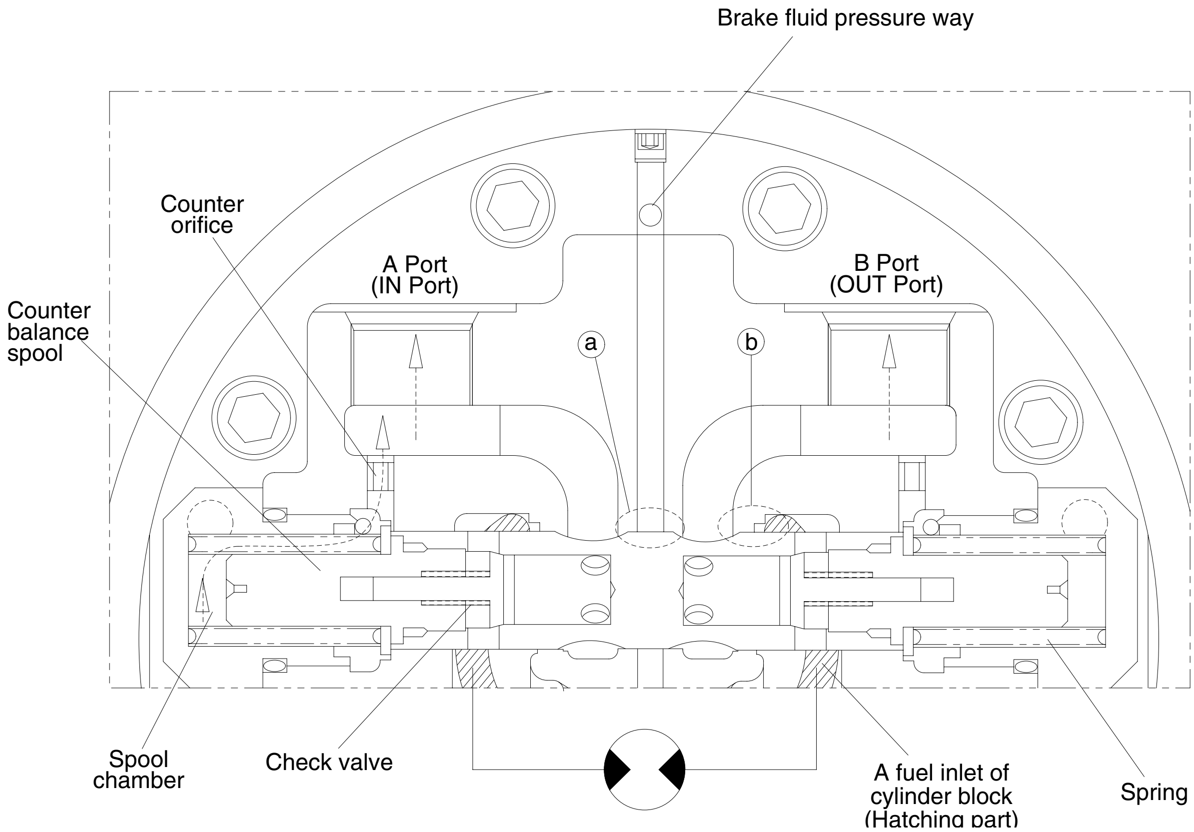
② When motor stop

When operator moves a travel control lever to neutral position, pump oil flow is blocked. It reduce oil pressure of supply line down to zero, and oil in the spool chamber moves back to oil tank through counter orifice by the return force of spring in opposite side, and then counter balance spool returns to neutral position.

As the counter balance spool moves to left, line ⓐ is blocked, parking brake line is connected to drain passage designed in the center of counter balance spool, and oil in the parking brake chamber return to tank, finally brake piston return to parking ON position.



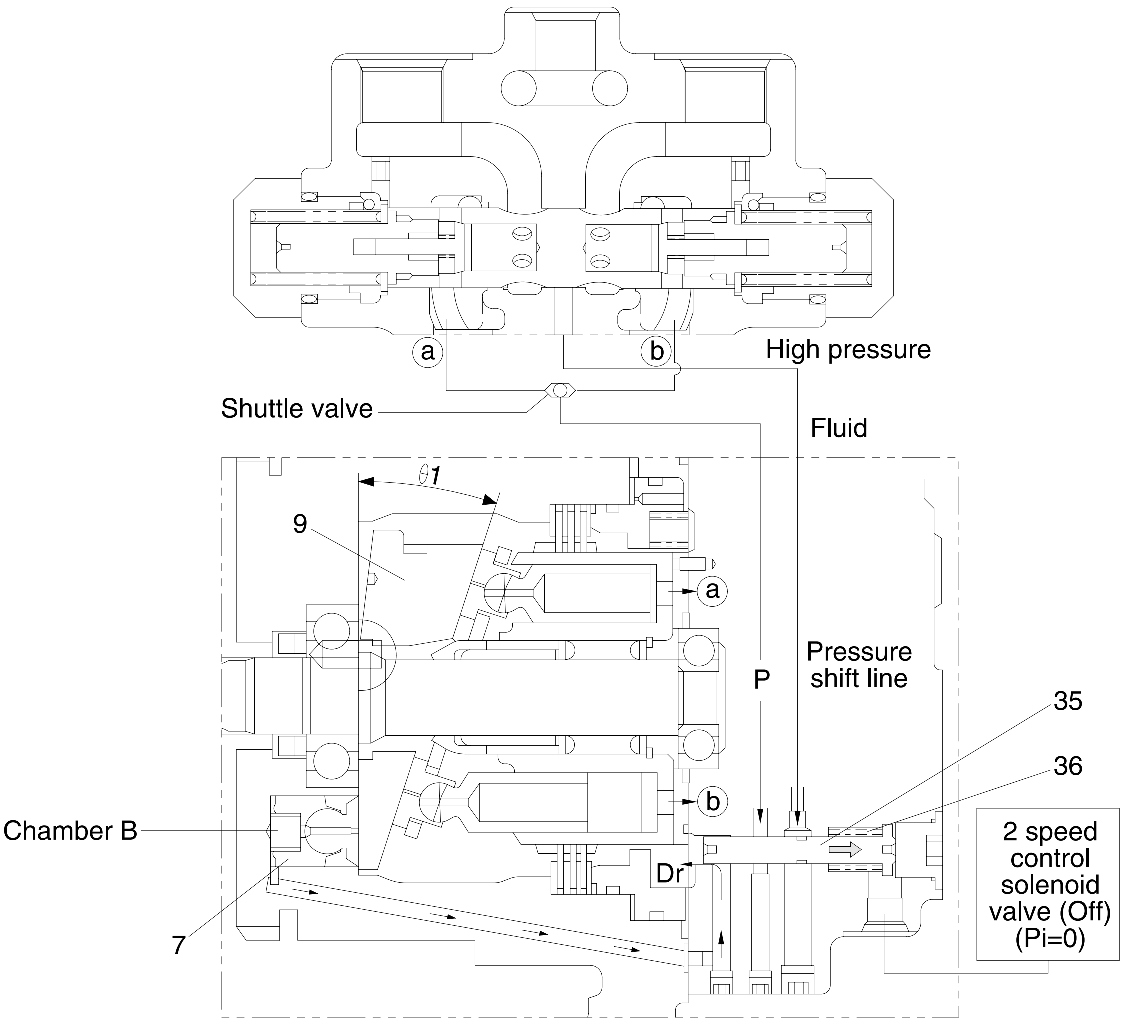
145Z9A2TM12

5) TWO SPEED (LOW SPEED - HIGH SPEED) CHANGEOVER EQUIPMENT

Rotating speed of the motor depends on slope angle of swash plate (9). Motor rotates slow when the angle is large, and rotates fast when the angle is small.

- Low speed

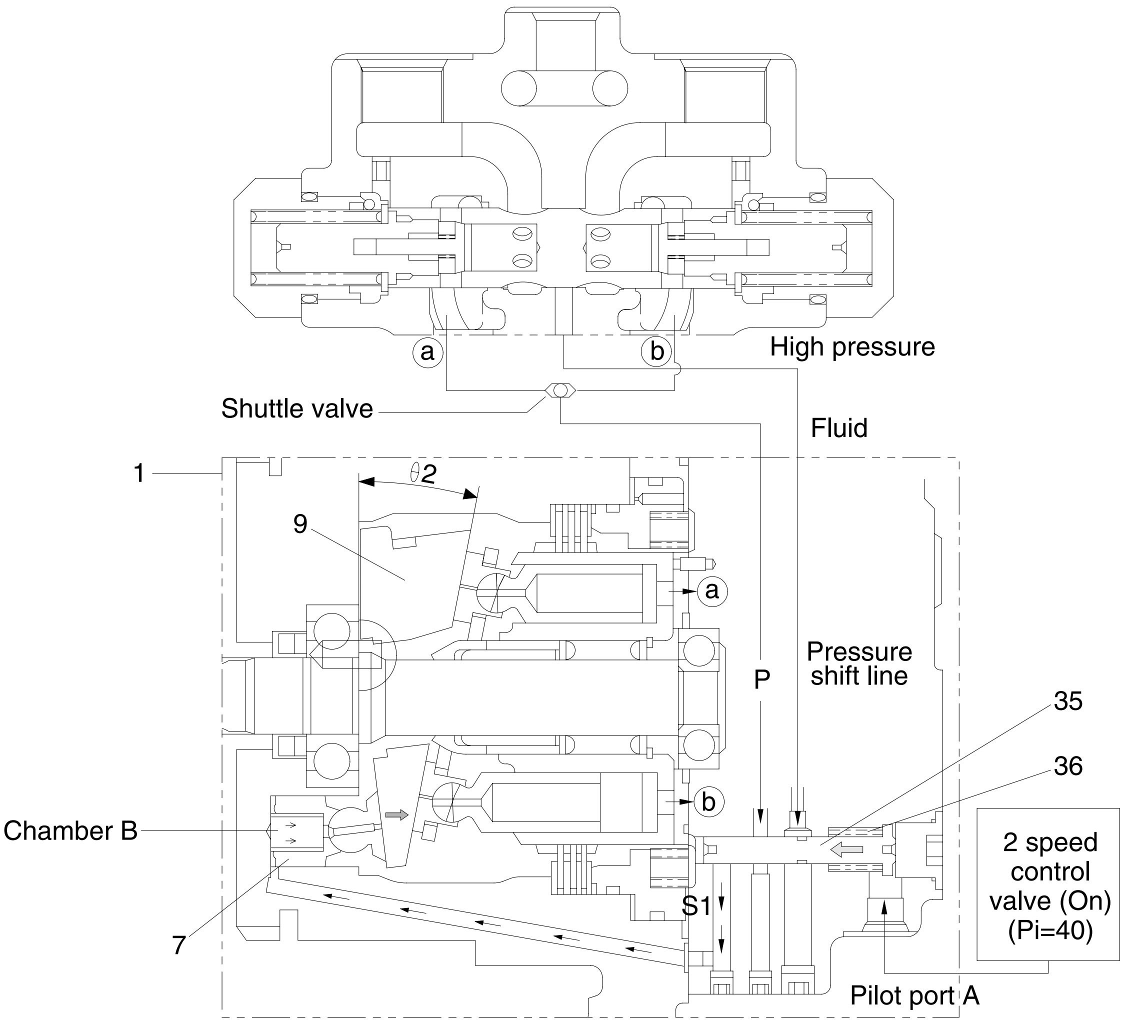
When pilot pressure signal Pi=0, spool (35) is located at right side by the spring (36) force and chamber A is connected to casing drain through hole S1. At this spool position, swash plate (9) sustain large angle, and motor rotate at low speed.



145Z9A2TM13

- **High speed**

  When pilot pressure signal Pi is activated on spool (31), the spool moves to left hand end, and high pressure oil from Port ⓐ or ⓑ is transferred to S1 which is connected to chamber A. The high pressure transferred to chamber A lift the piston (5) up, then the swash plate (12) tilts to smaller angle, and the motor rotates higher speed.



145Z9A2TM14

4. REDUCTION GEAR

1) PLANETARY GEAR MECHANISM

Reduction unit slows down the rotating speed of motor and converts motor torque to strong rotating force.

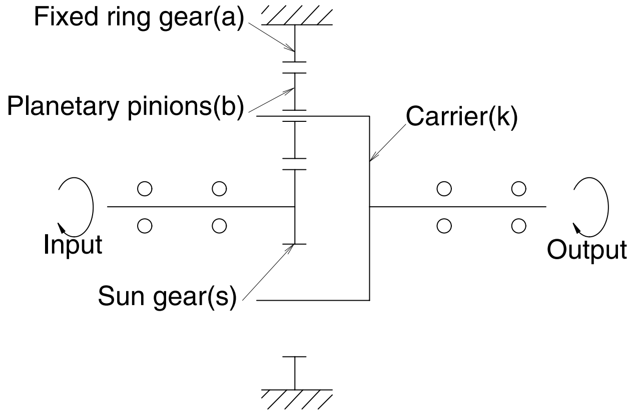
This reduction unit utilizes two stages, planetary reduction system.

Planetary reduction system consists of sun gear, planetary gears, carriers and ring gear.

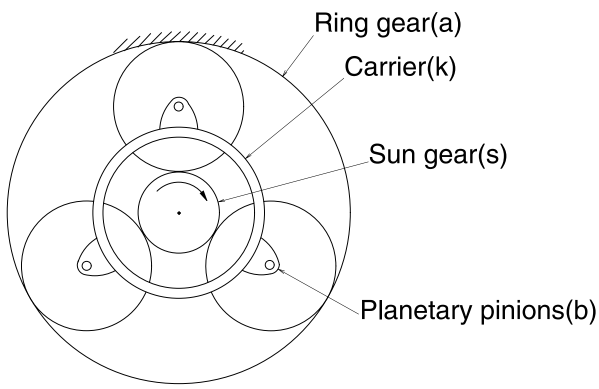
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gears (s).

This movement is transferred to carrier (k) and deliver the torque.

This mechanism is called planetary gear mechanism.



29072TM10

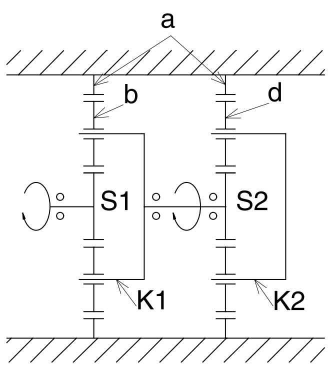


29072TM11

2) TWO STAGES REDUCTION GEAR

When the sun gear S1 is driven by input shaft, planetary action occurs among gears S1, a and b and revolution of gear b transfers the rotation of carrier K1 to second sun gear S2, and also evokes planetary action between gear S2, a and d.

This time, because carrier K2 is fixed to frame, gear d drives ring gear a and then ring gear a rotates to drive sprocket.



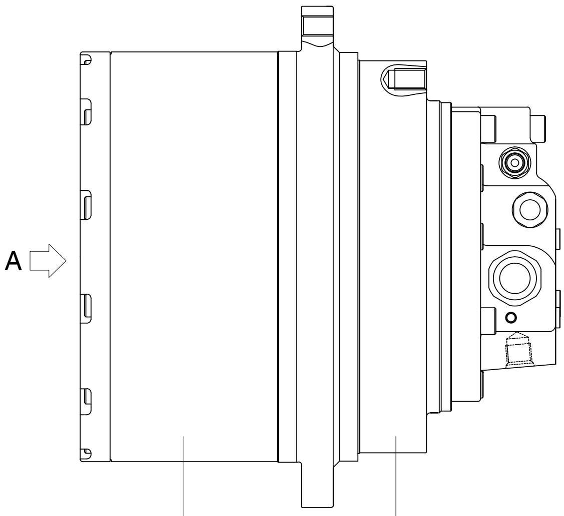
29072TM12

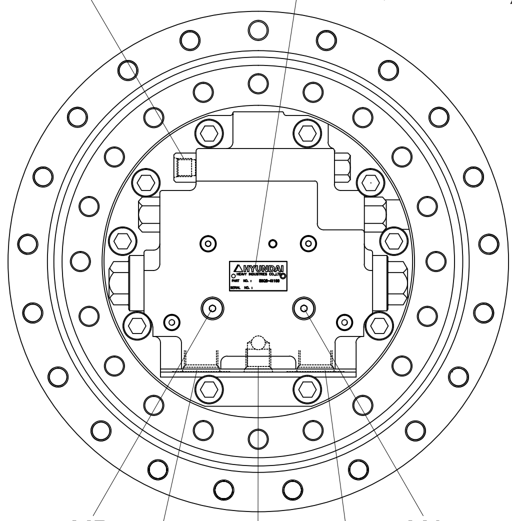
■ TRAVEL MOTOR (TYPE 3, 4)

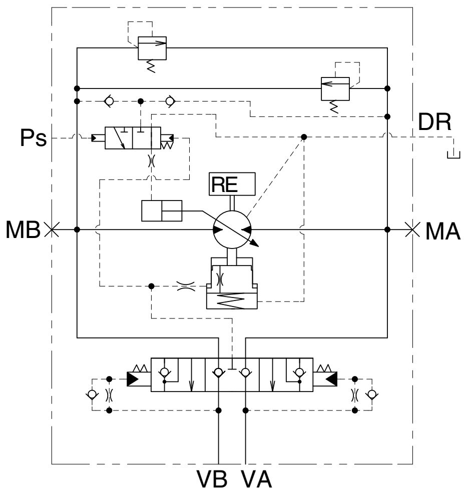
1. CONSTRUCTION

Travel device consists travel motor and gear box.

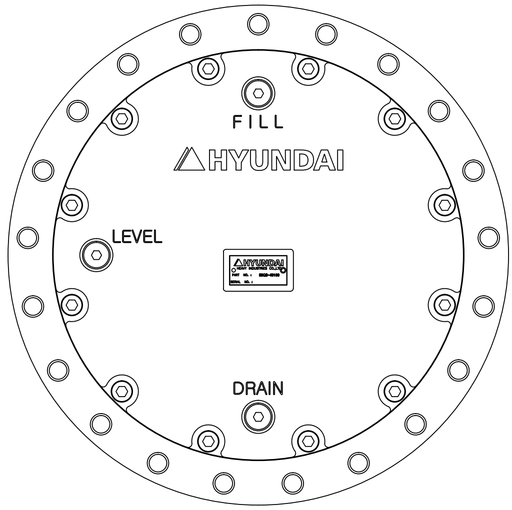
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







Hydraulic circuit

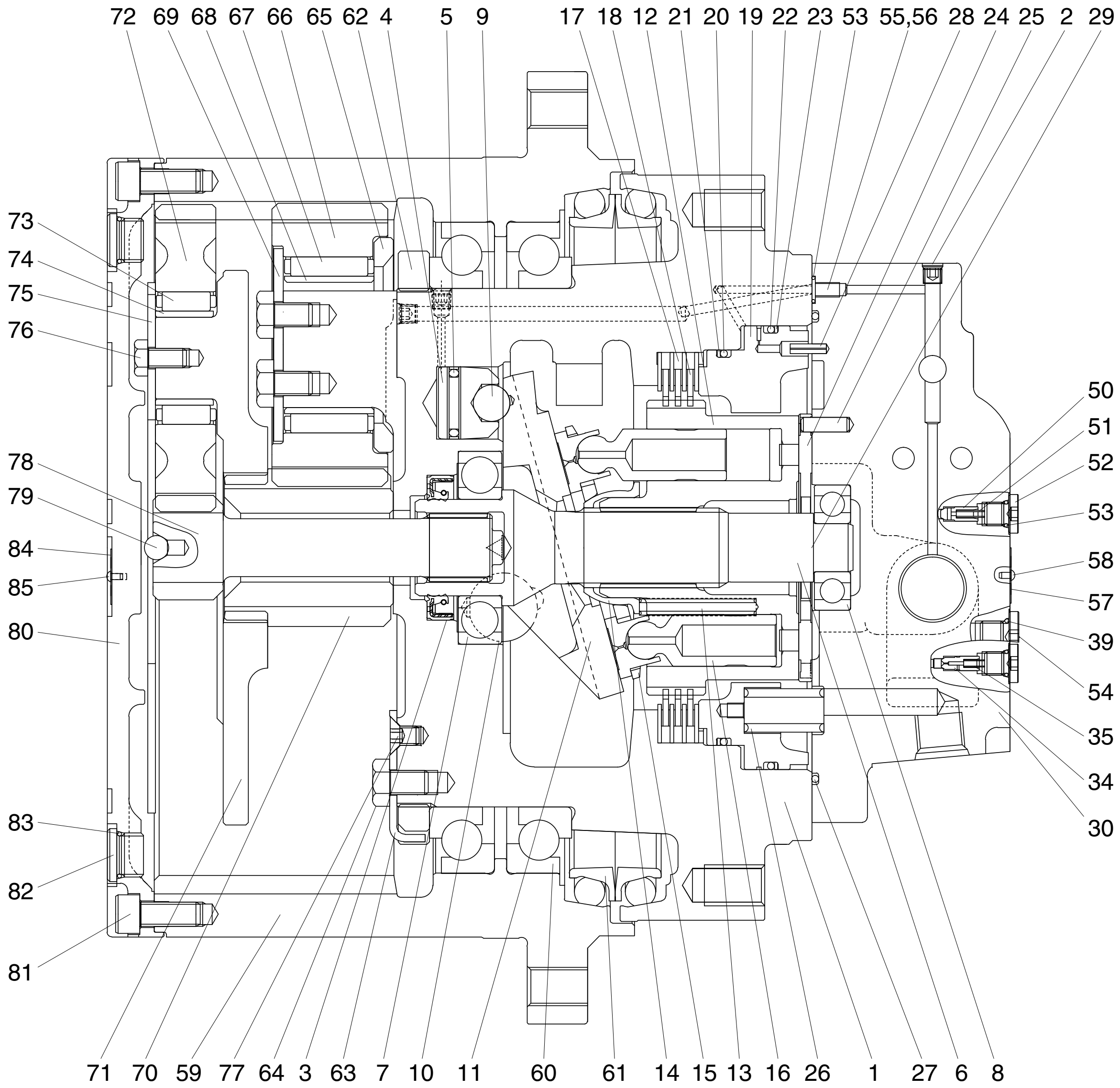


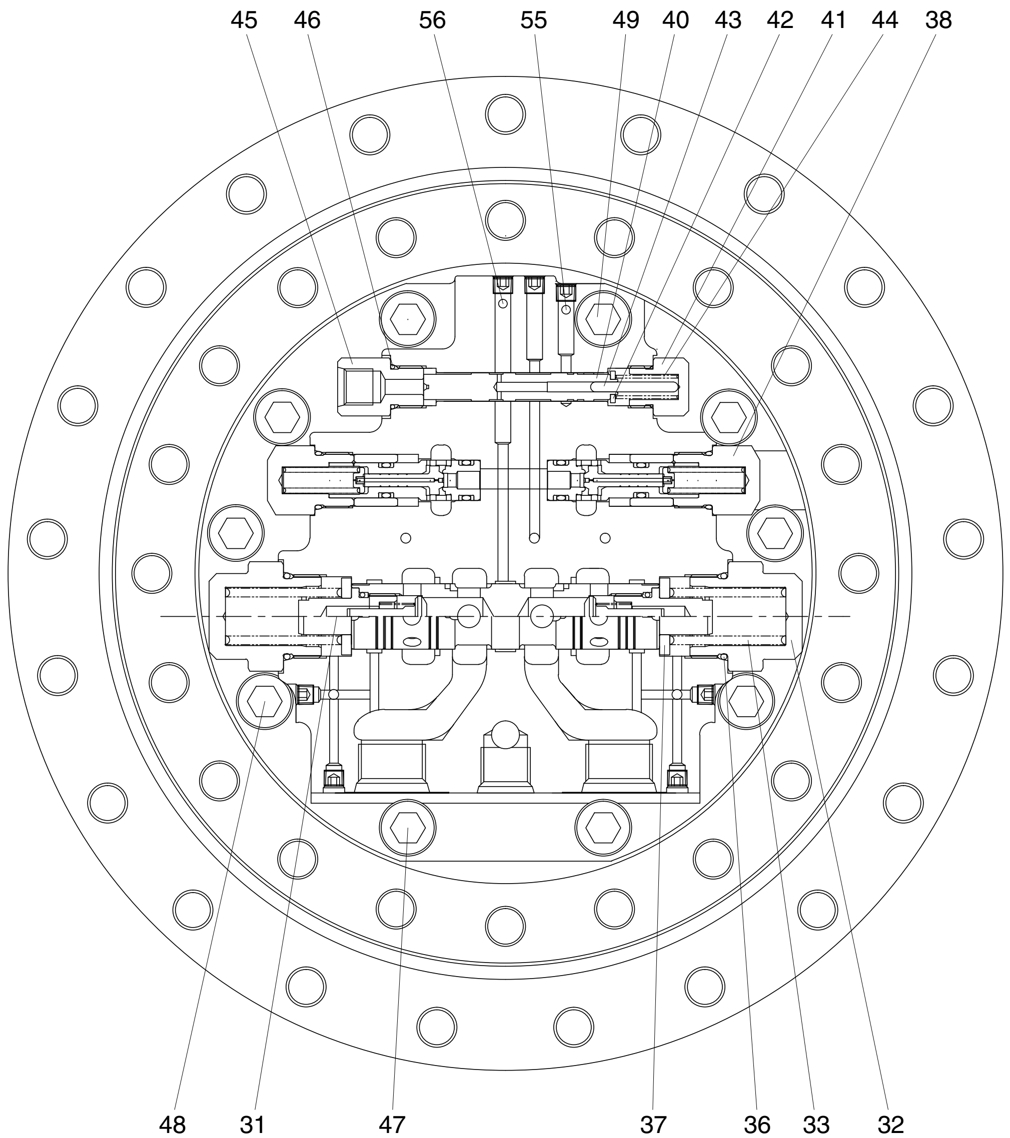
VIEW A

145LCR2TM20

Port	Port name	Port size
VA, VB	Valve port	PF 3/4
Ps	Pilot port	PF 1/4
DR	Drain port	PF 1/2
MA, MB	Gauge port	PF 1/4

2. STRUCTURE





125LCR2TM21

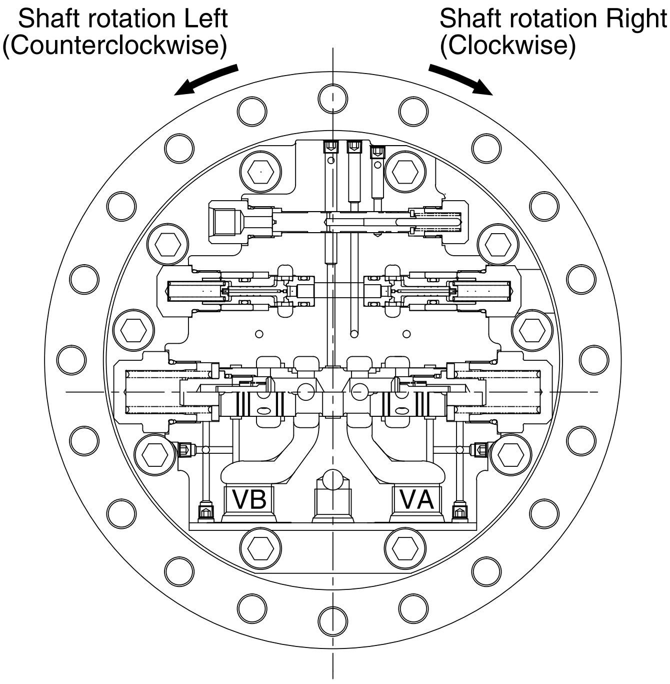
1	Casing	18	Separated plate	35	Spring	52	Plug	69	Thrust washer No. 2
2	Plug	19	Parking piston	36	O-ring	53	O-ring	70	Sun gear No.2
3	Oil seal	20	O-ring	37	Spring seat	54	Plug	71	Carrier No.1
4	Piston	21	Back up ring	38	Relief valve assy	55	Restrictor	72	Planetary gear No.1
5	Piston seal	22	O-ring	39	O-ring	56	Restrictor	73	Needle bearing No.1
6	Shaft	23	Back up ring	40	Spool	57	Name plate	74	Inner race No. 1
7	Front ball bearing	24	Valve plate	41	Plug	58	Rivet	75	Thrust plate No. 1
8	Rear ball bearing	25	Spring pin	42	Spring seat	59	Ring gear	76	Hexagon head bolt
9	Steel ball	26	Spring	43	Parallel pin	60	Bearing	77	Countersunk head screw
10	Steel ball	27	O-ring	44	Spring	61	Floating seal assy	78	Sun gear No.1
11	Swash plate	28	Spring pin	45	Connector	62	Nut ring	79	Steel ball
12	Cylinder block	29	Parallel pin	46	O-ring	63	Lock plate	80	Cover
13	Spring	30	Rear cover	47	Hexagon socket head bolt	64	Hexagon head bolt	81	Hex socket head bolt
14	Ball guide	31	Main spool assy	48	Hexagon socket head bolt	65	Thrust plate No. 2	82	Plug
15	Retainer plate	32	Cover	49	Hexagon socket head bolt	66	Planetary gear No.2	83	O-ring
16	Piston assy	33	Spring	50	Check valve	67	Needle bearing No.2	84	Name plate
17	Friction plate	34	Restrictor	51	Spring	68	Inner race No. 2	85	Rivet

3. OPERATION

1) MOTOR

High pressure oil delivered form hydraulic pump is led to inlet port that is provided in the brake valve portion and, through the rear cover (30) and valve plate (24), led to cylinder block (12).

The oil flow and direction of shaft rotation are indicated in table.



Inlet port	Outlet port	Direction of shaft rotation (viewing from rear cover)
VB	VA	Right (clockwise)
VA	VB	Left (counterclock wise)

125LCR2TM23

As shown in below figure, high pressure oil is supplied to the pistons which are on one side of the line Y-Y that connects upper and lower dead points and produces force F1.

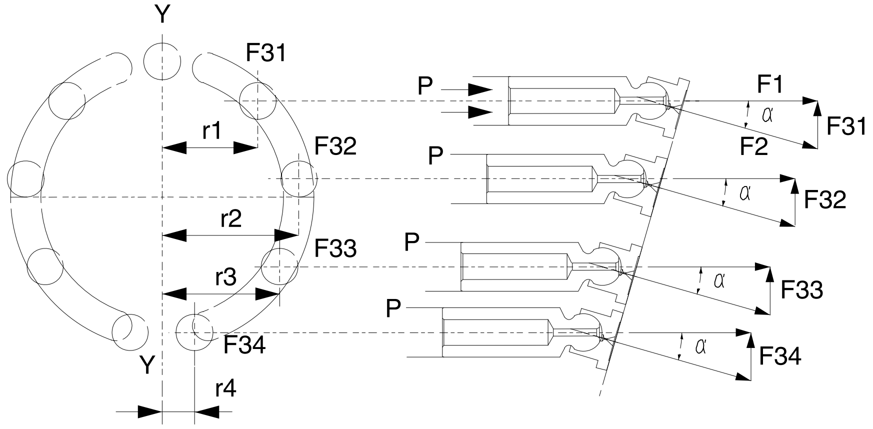
F1 = P × A (P : pressure, A : area of piston section)

The swash plate (11) with inclined angle of α divides this force F1 into thrust force F2 and radial force F31-34.

This radial force is applied to axis Y-Y as turning force and generate drive torque of T.

$T = r_1 \cdot F31 + r_2 \cdot F32 + r_3 \cdot F33 + r_4 \cdot F34$

This drive torque is transmitted via cylinder block (12) to driving shaft (6).

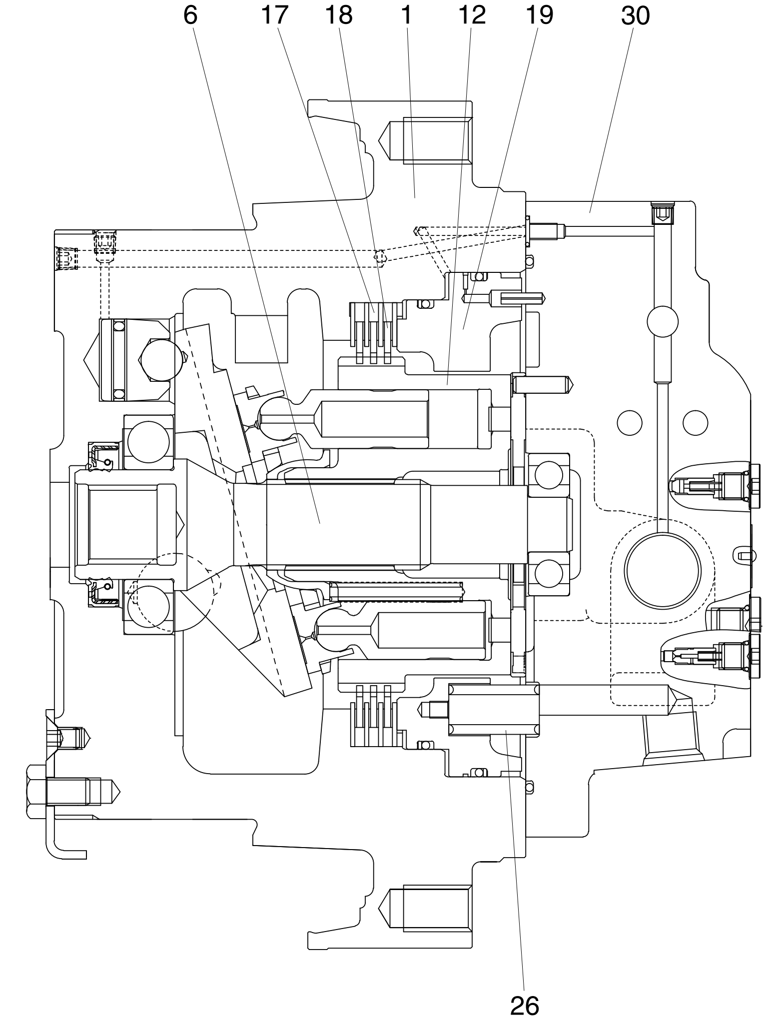


29092TM07

2) PARKING BRAKE

Parking brake is released when high pressure oil selected by the brake valve portion that is connected directly to the rear cover (30), is applied to the parking piston (19).
Otherwise the braking torque is always applied.

This braking torque is generated by the friction between the separated plates (18), inserted into the casing (1), and friction plates (17), coupled to cylinder block (12) by the outer splines.
When no pressure is activated on the parking piston (19), it is pushed by the brake springs (26) and it pushes friction plates (17) and separated plates (18) towards casing (1) and generates the friction force which brakes the rotation of cylinder block (12) and hence the shaft (6).



125LCR2TM24

3) CAPACITY CONTROL MECHANISM

Figure typically shows the capacity control mechanism.

When high speed pilot line is charged with the pressure P_A that overcome the spring (44), the spring (44) is compressed and spool (40) shifts to the right to connect the port P and port C.

Then, the highest pressure is selected by the check valve (50) from inlet and outlet pressure of the motor and high speed pilot line pressure and pushes shifter piston (4). As a result, swash plate (11) turns around the line L which connect the two steel balls (10) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (11) keeps the position.

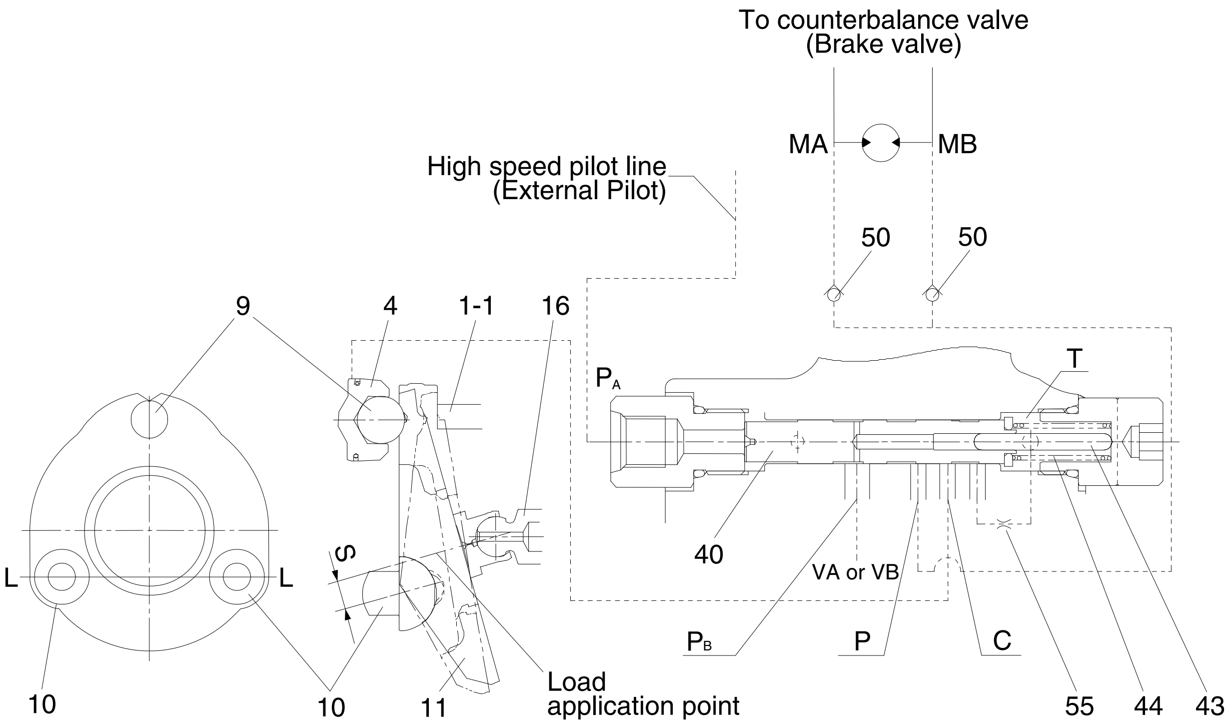
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A, spool (40) is pushed back by the spring (44) and pressure that pressed the shifter piston (4) is released to the hydraulic tank through restrictor (55).

Here, nine pistons are there and they equally spaced on the swash plate (11). The force that summed up those of pistons comes to almost the center of the swash plate (11) as shown. Since the steel balls (10) are off-set by S from the center, the rotating force of product S and the force moves swash plate (11) to the former position and the speed returns to low.

When the power demand exceeds the engine power, such as in steep slope climbing or turning at high speed mode, the system step down to the low speed automatically. The mechanism is that: pump pressure is led to the port P_B and this pressure activate on pin (43). When the pressure at P_B exceeds predetermined value, spool (40) returns to the left by the counter-pressure against pin (43) and the pressure on the shifter piston (4) through port C is released to the tank and the motor comes to low speed.

When P_B goes down, the spool (40) moves to the right and the speed become high.

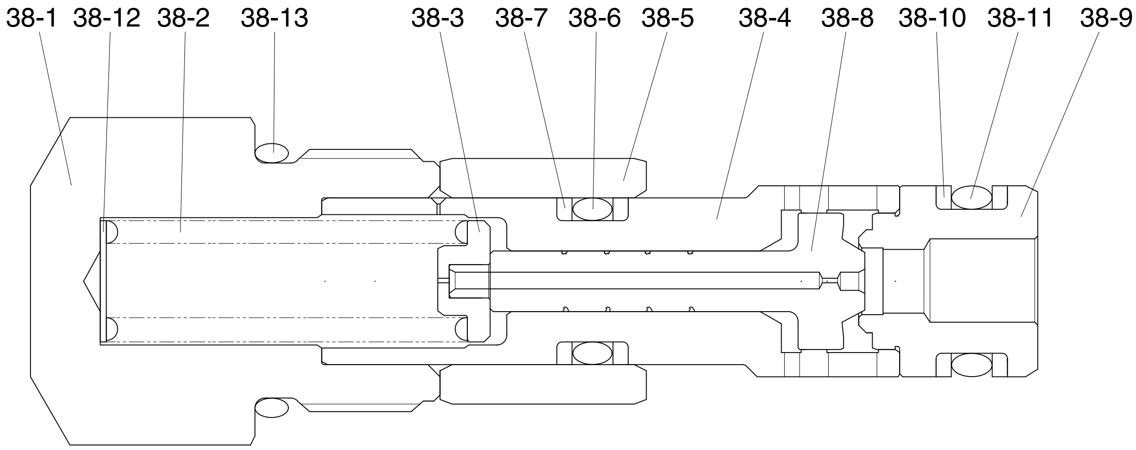


125LCR2TM19

4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (30) and consists of : plug (38-1) that is screwed and fixed in the rear cover (30), poppet (38-8) and supports the poppet seat (38-9), spring (38-2) that is operating relief valve setting pressure and supports the spring seat (38-3), that is inserted in the sleeve (38-4), piston (38-5) that reduce the shock.



125LCR2TM25

38-1	Plug	38-6	O-ring	38-11	O-ring
38-2	Spring	38-7	Back-up ring	38-12	Ring
38-3	Spring seat	38-8	Poppet	38-13	O-ring
38-4	Sleeve	38-9	Poppet seat		
38-5	Piston	38-10	Back-up ring		

(2) Operation

Two pieces of overload valves are located at cross-over position in the counterbalance circuit of brake valve and have the following functions :

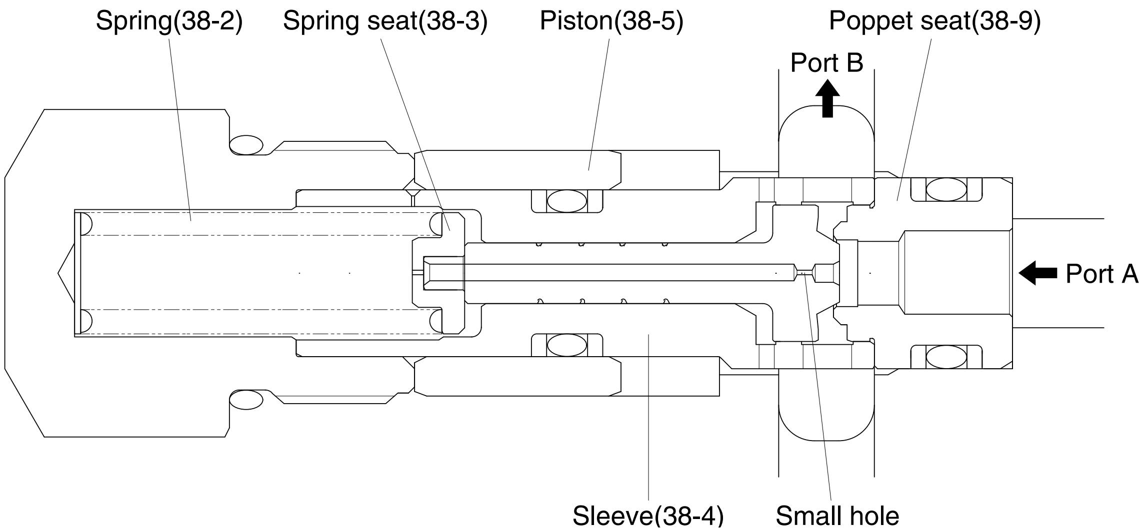
① When hydraulic motor starts, keep the driving pressure below predetermined value and while accelerating, bypasses surplus oil to return line.

② When stopping the motor, keep the brake pressure, that develops on the outlet side of motor, under the predetermined value to stop the inertial force.

③ To accelerate sharply while starting, and to mitigate the braking shock while stopping. For these purposes, the developed pressure is kept comparatively low for a short period, then keep the line pressure as normal value. While the pressure is low, meshing of reduction gears, crawler and sprocket etc. can be smoothly done and the shock are absorbed.

When starting, "A" port pressure of overload valve increases, this pressure is applied to the effective diameter of poppet (38-8) which seats on the poppet seat (38-9) and, at the same time, is delivered, via small hole, to the spring seat (38-3) located inside the sleeve (38-4) and the seat bore pressure increases up to "A" port pressure. The poppet (38-8) opposes to spring (38-2) by the force of the pressure exerted on the area difference between poppet seat's effective diameter and spring seat bore and keep the predetermined pressure.

When hydraulically braking, the piston (38-5) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (38-5) through the small hole in the poppet (38-8), sleeve (38-4) and piston (38-5) moves rightward until it touches the stopper in rear cover. In this while, the poppet (38-8) maintains "A" port pressure at comparatively low against the spring (38-2) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



125LCR2TM27

5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

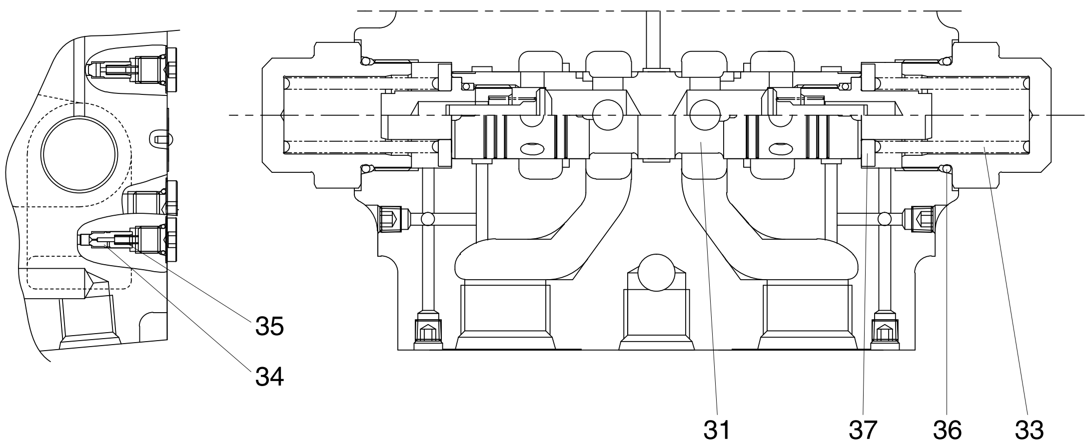
① Spool

By shifting the spool (31), the discharged oil from hydraulic motor is automatically shut off or restricted according to the condition and give the effect of holding, accelerating, stopping and counterbalance operations.

(See page 2-66, (2) Operation)

② Check valve (built in the spool)

This valve is located in the oil supplying passage to hydraulic motor, and at the same time functions to lock oil displacement. Therefore, this valve serves as not only a suction valve but also a holding valve for hydraulic motor.



31	Main spool	34	Restrictor	36	O-ring
33	Spring	35	Restrictor spring	37	Spring seat

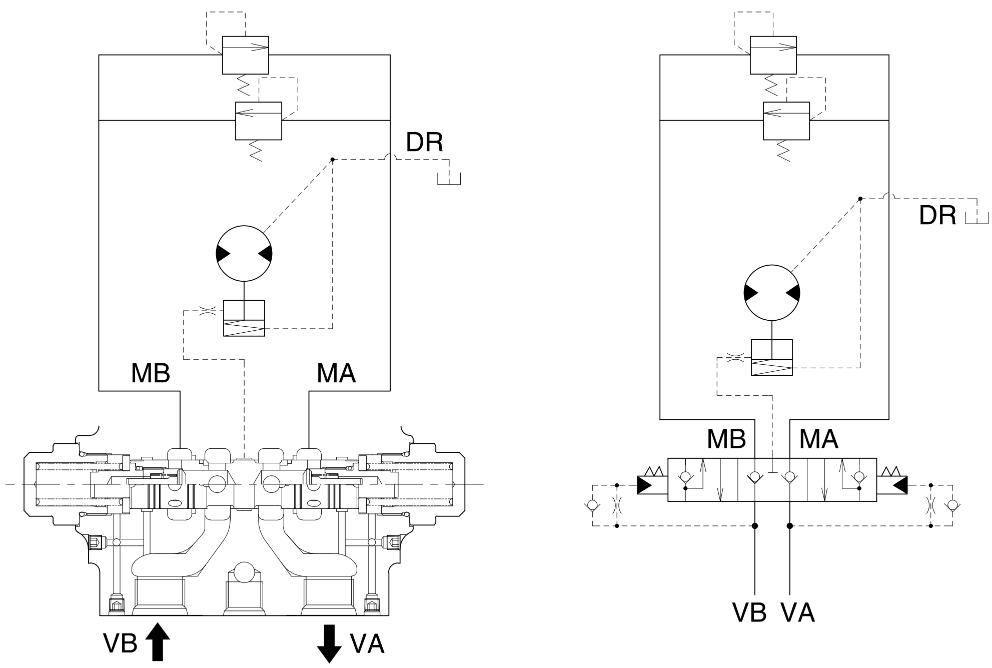
(2) Operation

① Holding operation

When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (33) located on both spool ends holds the spool (31) at central position.
Therefore, the passages from VA to MA and VB to MB are closed, which result in closing MA and MB ports connected to hydraulic motor.

Since the passage to parking brake is connected to the tank line, the brake cylinder pressure is equal to the tank pressure and the brake is applied by the springs. Thus, the rotation of the motor is mechanically prevented.
If external torque is exerted on the motor shaft, the motor would not rotate as usual by this negative parking brake.

In case the brake should be released for some reason, pressure is built on MA or MB port. But, due to oil leakage inside hydraulic motor or so, high-pressure oil escapes from the closed circuit and motor rotates a bit. So, the cavitation tends to occur in the lower pressure side of the closed circuit. Then, the check valve, built in the spool (31), operates to avoid the cavitation and opens the passage from VA to MA or from VB to MB. Then the oil equivalent to the leakage is sucked from the tank line to the closed circuit.



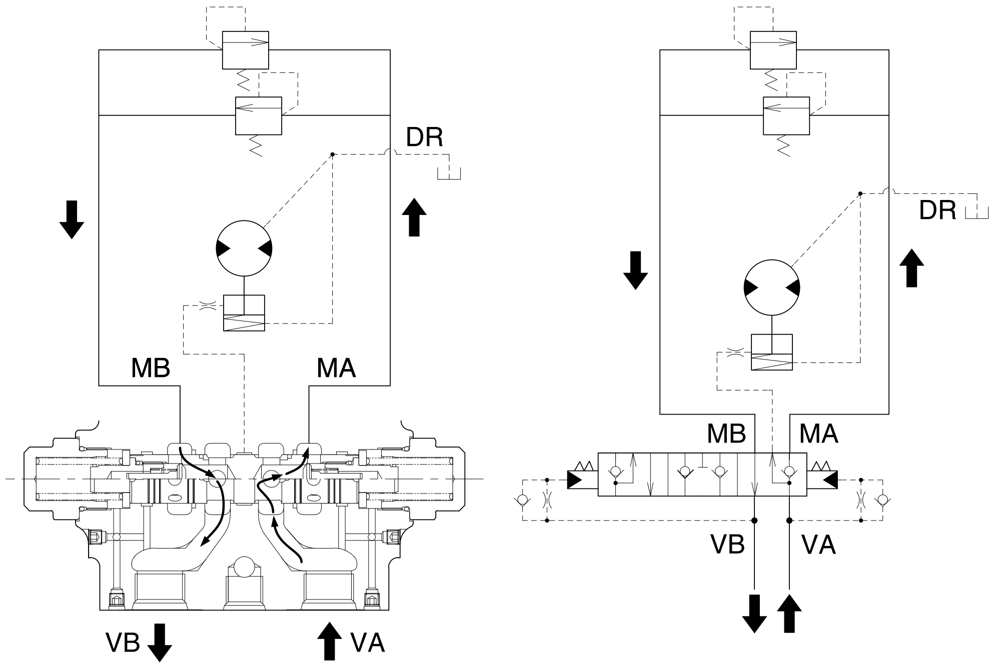
125LCR2TM29

② Accelerating operation

When VA and VB ports are connected respectively to pump and tank by operating the control valve, hydraulic oil from pump is forwarded through VA port to push open the check valve provided inside spool (31), and oil flows to motor via MA port to rotate the motor.

Therefore, the pressure increases and negative brake is released by the pressure supplied from pump. At the same time, the pressure of pilot chamber increases to push and move the spool (31) leftwards, overcoming the spring (33) force. Thus, the return line from MB to VB opens to rotate the motor.

In case inertia load is too big to start rotation, accelerating pressure reaches the set pressure of relief valve and high pressure oil is being relieved while the motor gains the rotational speed.
As the rotational speed goes up, the relieved volume decreases, and finally the motor rotates at a fixed speed.



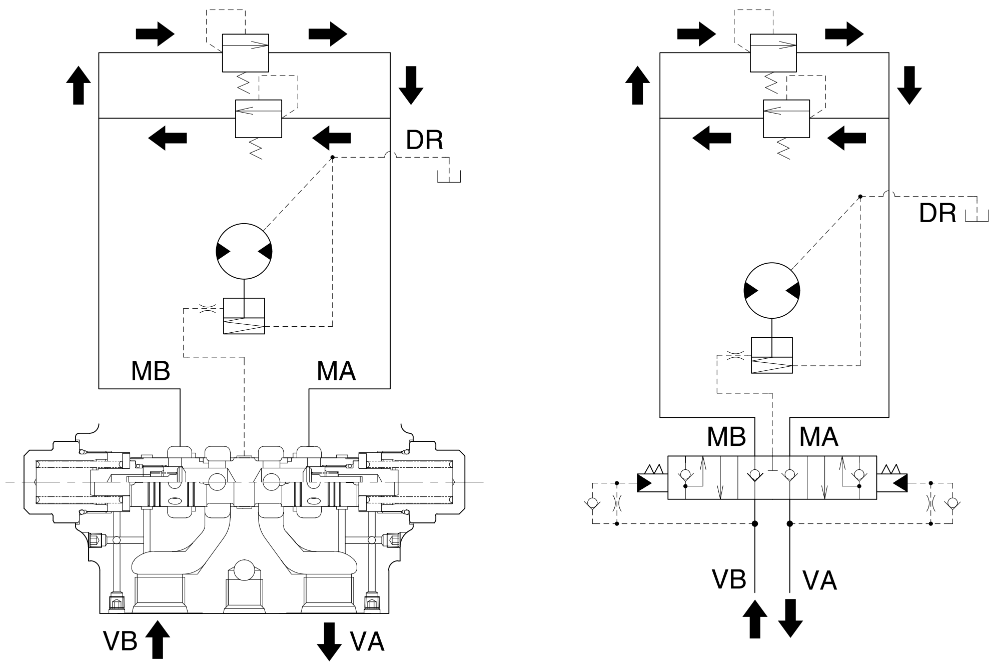
125LCR2TM30

③ Stopping operation

Returning the control valve to neutral position while running the motor, the oil supply is cut off and VA and VB ports are connected to the tank line. Then the pressure of the pilot chamber located on both spool ends become equal, and the spool (31) returns to the neutral position by spring (33) force. Thus, the passage from MA to VA is closed.

Owing to the inertia force of the load, the hydraulic motor tends to continue the rotation. Here, the motor functions as a pump and forwards the oil to MB port but the passage is blocked and MB port pressure increases. Then the relief valve opens to relieve the pressure and rotational speed decelerates and at last the motor stops.

Negative brake release pressure is gradually lowered due to the restrictor and finally the brake works and the motor is mechanically stopped.



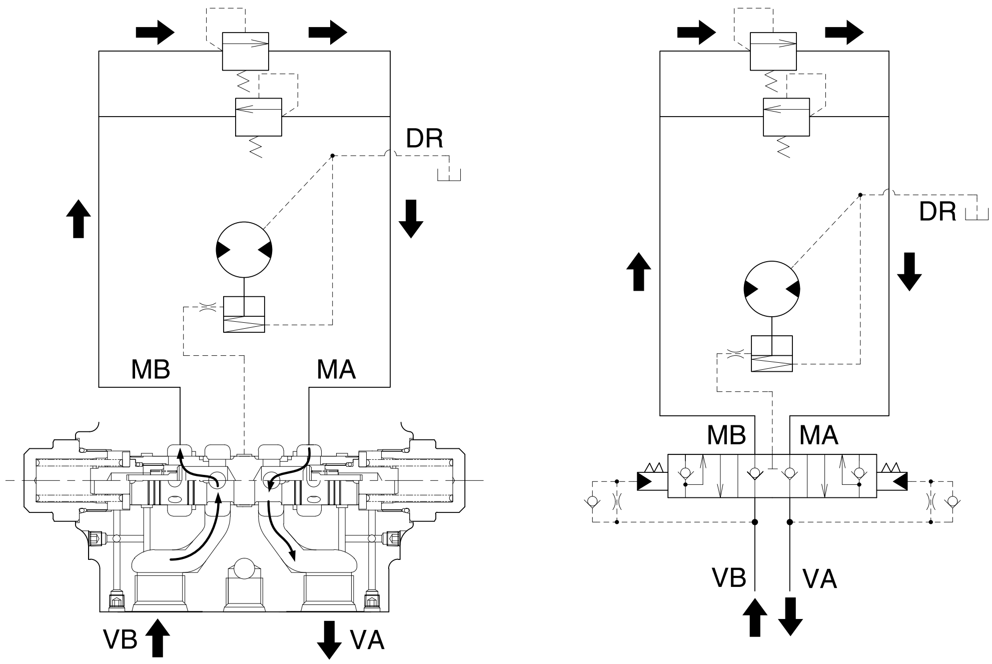
125LCR2TM31

④ Counterbalance operation

Counterbalance operation is required to decelerate slowly the hydraulic motor while absorbing inertia force.

In case the hydraulic oil is gradually decreased from pump to VB port, the drive shaft of hydraulic motor tends to rotate faster than that matched to the volume of oil supply.
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (33) force moves the spool (31) leftwards towards neutral position.
Therefore, the area of passage from MA to VA becomes smaller and the pressure on MA side rises due to increased resistance in the passage and the motor receives hydraulic braking effect.

If the motor rotates slower than that matched to the volume of supplied oil, the pilot chamber pressure on VB port increases, and spool (31) moves rightwards to enlarge the area of passage from MA to VA. Therefore the braking effect becomes smaller and the rotational speed of motor is controlled to correspond to the volume of supplied oil.
In order to give stable counterbalance operation, the restrictors (34) are set in the pilot chamber to damp the spool (31) movement.
The parking brake is released during pressure adjusting action of the spool (31).



125LCR2TM32

6) REDUCTION GEAR

Reduction unit slows down the rotating speed of motor and converts motor torque to strong rotating force.

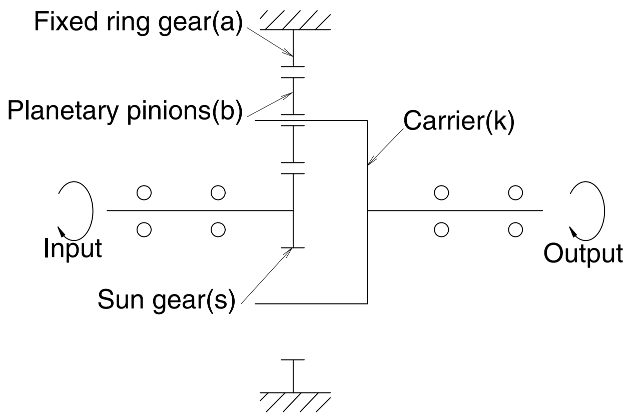
This reduction unit utilizes two stages, planetary reduction system.

Planetary reduction system consists of sun gear, planetary gears, (planetary) carriers, and ring gear.

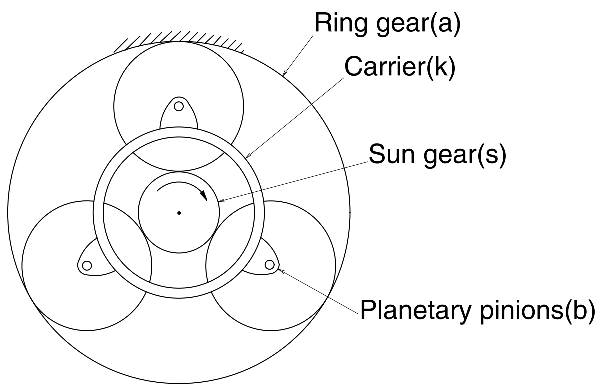
When the sun gear (s) is driven through input shaft, planetary pinions (b), rotating on their center, also move, meshing with fixed ring gear (a), around sun gear (s).

This movement is transferred to carrier (k) and deliver the torque.

This mechanism is called planetary gear mechanism.



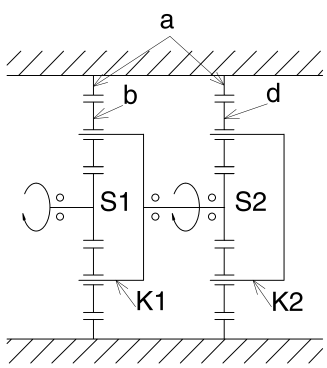
29072TM10



29072TM11

When the sun gear S1 is driven by input shaft, planetary action occurs among gears S1, a and b and revolution of gear b transfers the rotation of carrier K1 to second sun gear S2, and also evokes planetary action between gear S2, a and d.

This time, because carrier K2 is fixed to frame, gear d drives ring gear a and then ring gear a rotates to drive sprocket.

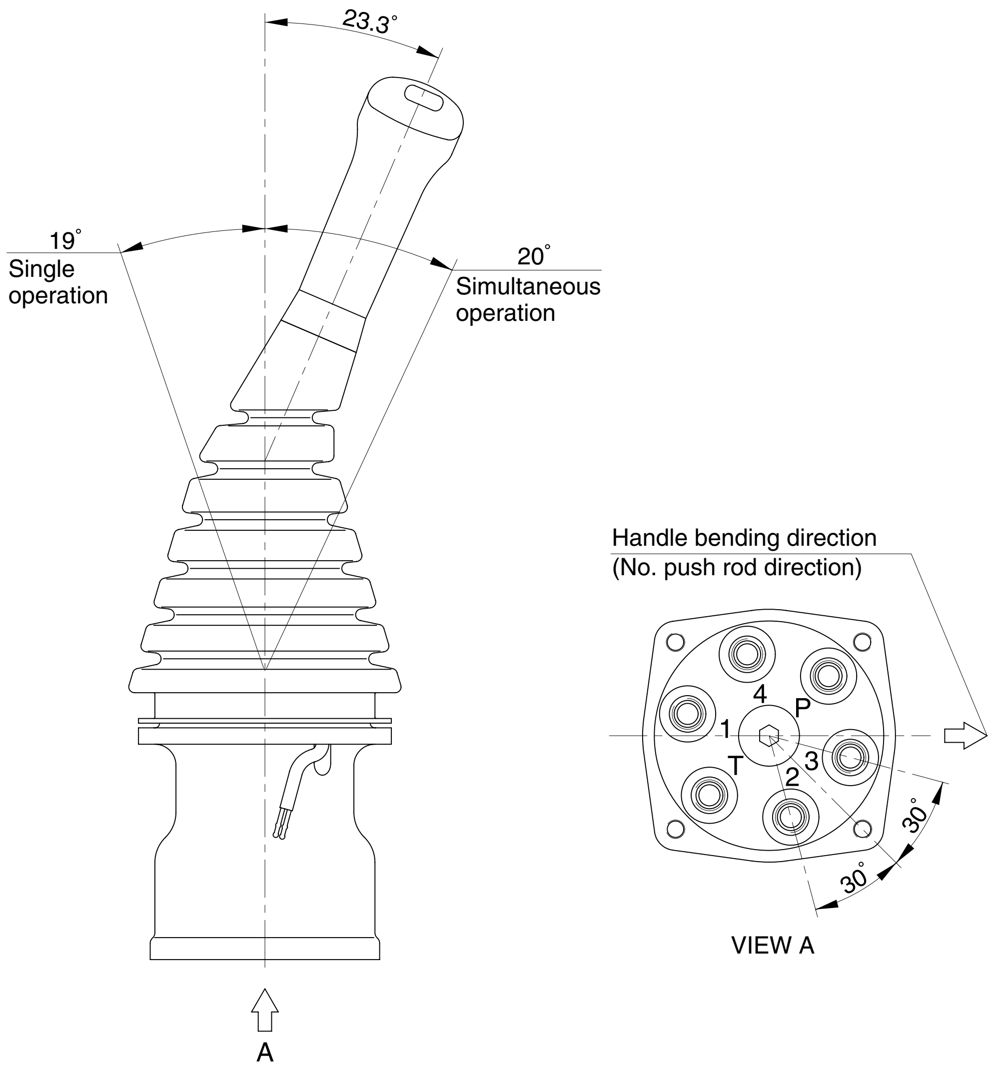


29072TM12

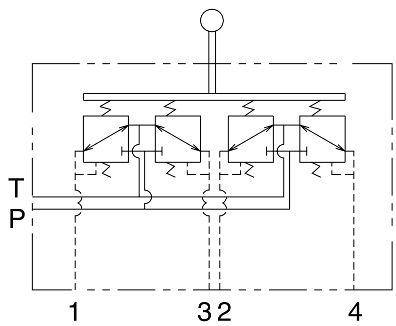
GROUP 5 RCV LEVER

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.



VIEW A



Hydraulic circuit

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

CROSS SECTION

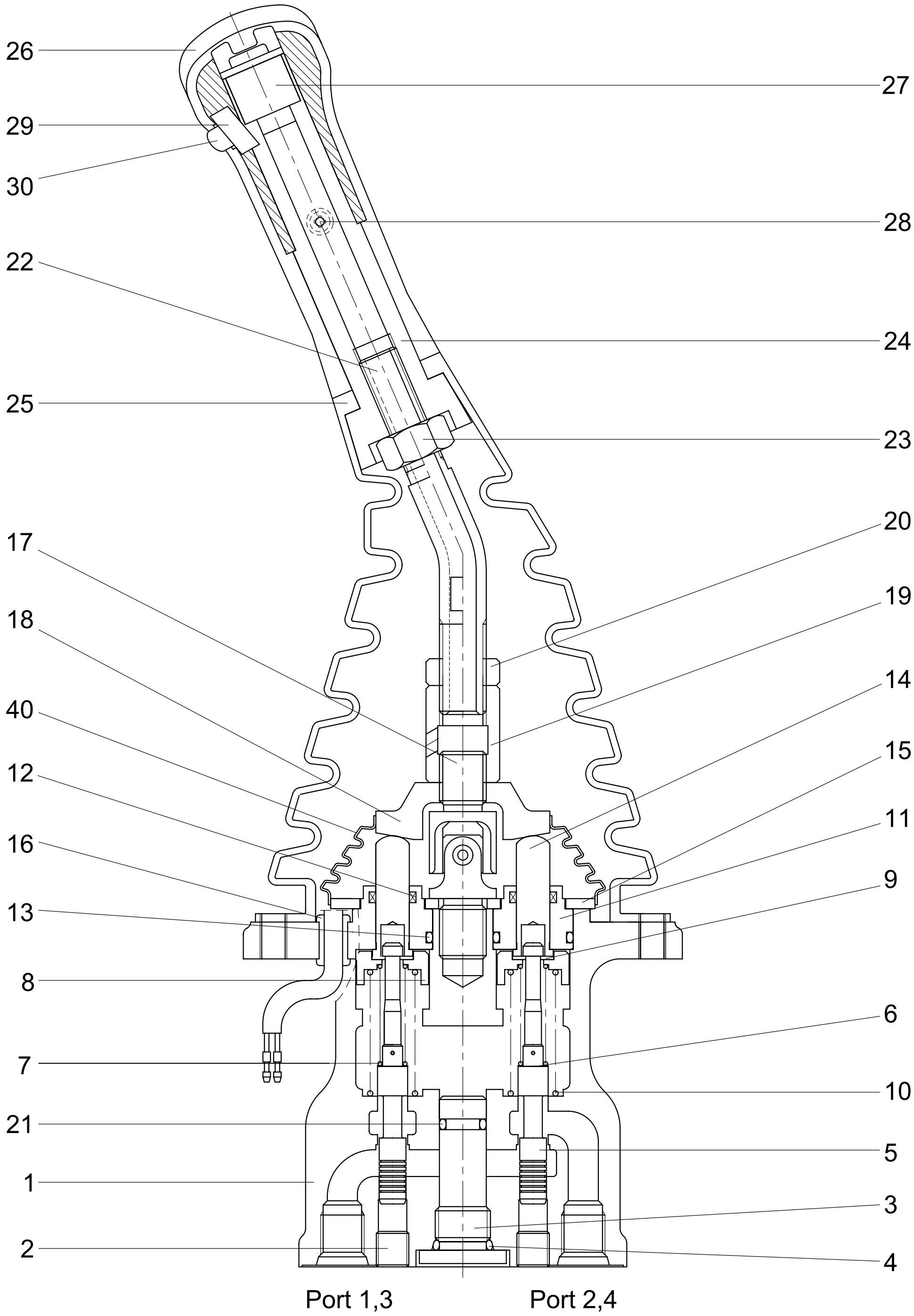
The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool(5), spring(7) for setting secondary pressure, return spring(10), stopper(9), spring seat(8) and shim(6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5kgf/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 the handle, the spring seat comes down simultaneously and changes setting of the secondary pressure spring.

1	Case	11	Plug	21	O-ring
2	Plug	12	Rod seal	22	Handle connector
3	Plug	13	O-ring	23	Nut
4	O-ring	14	Push rod	24	Insert
5	Spool	15	Plate	25	Boot
6	Shim	16	Bushing	26	Handle
7	Spring	17	Joint assembly	27	Switch assembly
8	Spring seat	18	Swash plate	28	Screw
9	Stopper	19	Adjusting nut	29	Switch assembly
10	Spring	20	Lock nut	30	Switch cover
				40	Boot

CROSS SECTION



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

The functions of the spool(5) 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(7) 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(11).

For the purpose of changing the displacement of the push rod through the switch plate(19) and adjusting nut(20) are provided the handle(27) that can be tilted in any direction around the fulcrum of the universal joint(18) center.

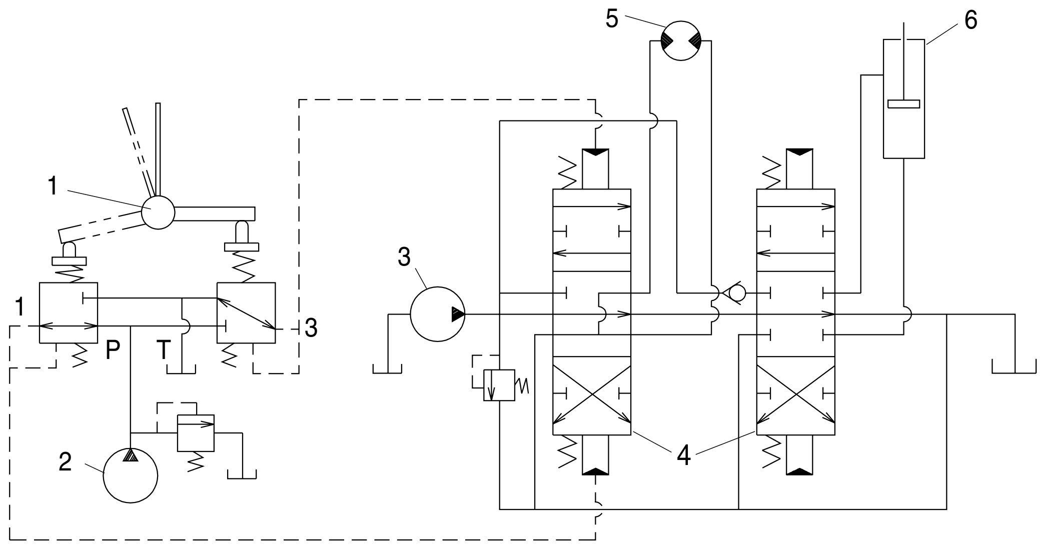
The spring(10) works on the case(1) and spring seat(8) and tries to return the push rod(14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

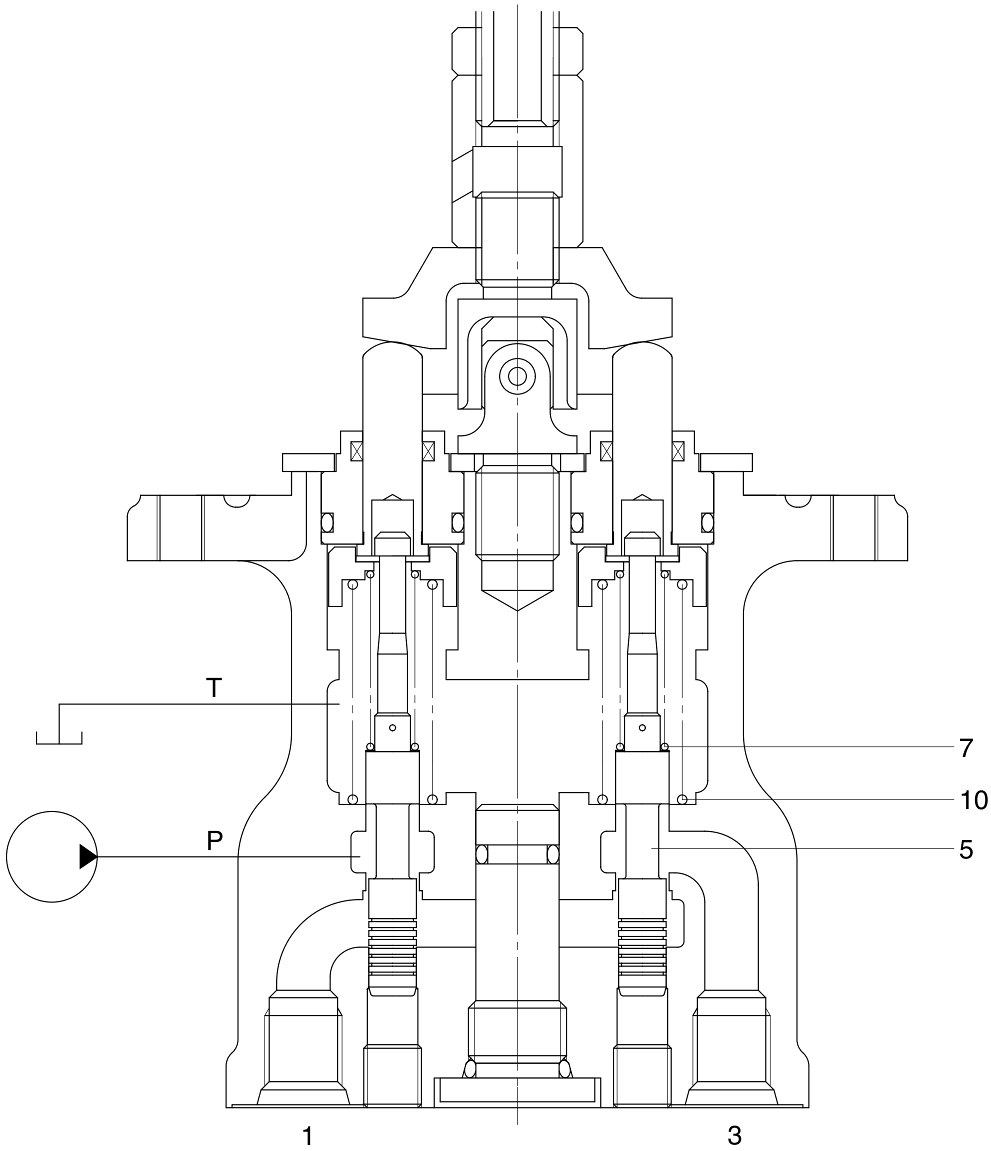
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



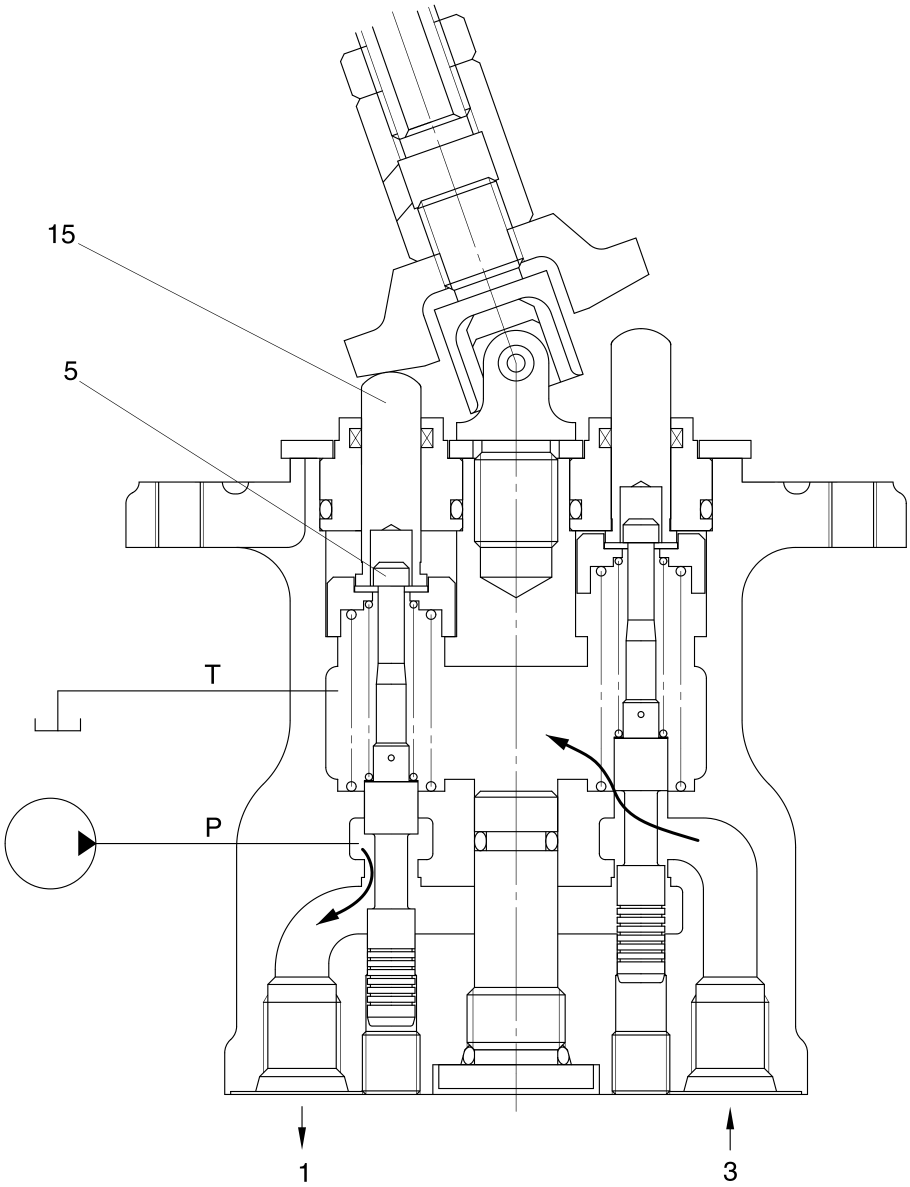
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle is in neutral position



The force of the spring(7) that determines the output pressure of the pilot valve is not applied to the spool(5). Therefore, the spool is pushed up by the spring(10) 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

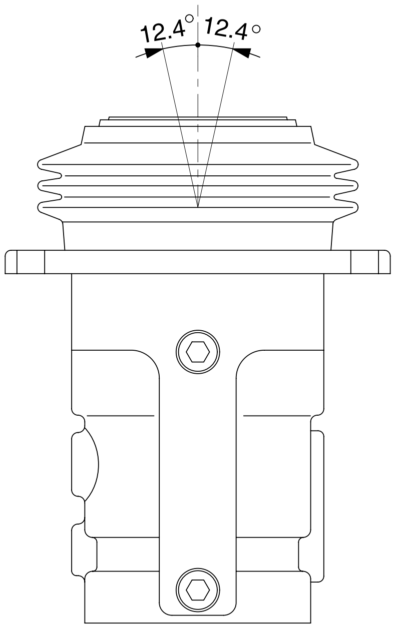


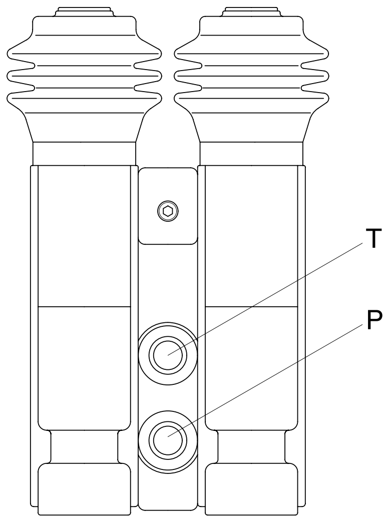
When the push rod(14) is stroked, the spool(5) moves downwards.
Then port P is connected with port(1) and the oil supplied from the pilot pump flows through port(1) to generate the pressure.
When the pressure at port(1) increases to the value corresponding to the spring force set by tilting the handle, 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.

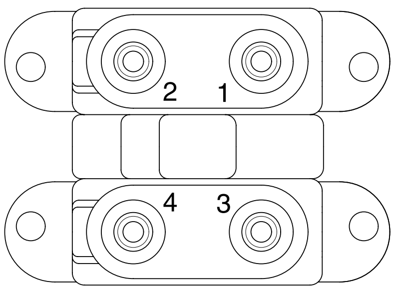
GROUP 6 RCV PEDAL

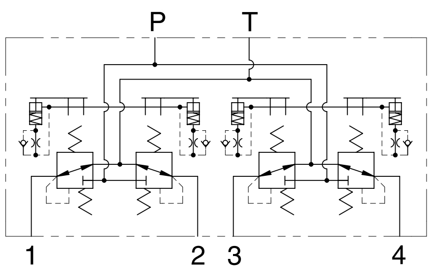
1. STRUCTURE

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	PF 1/4
T	Pilot oil return port	
1	Travel (LH, Forward)	
2	Travel (LH, Backward)	
3	Travel (RH, Forward)	
4	Travel (RH, Backward)	

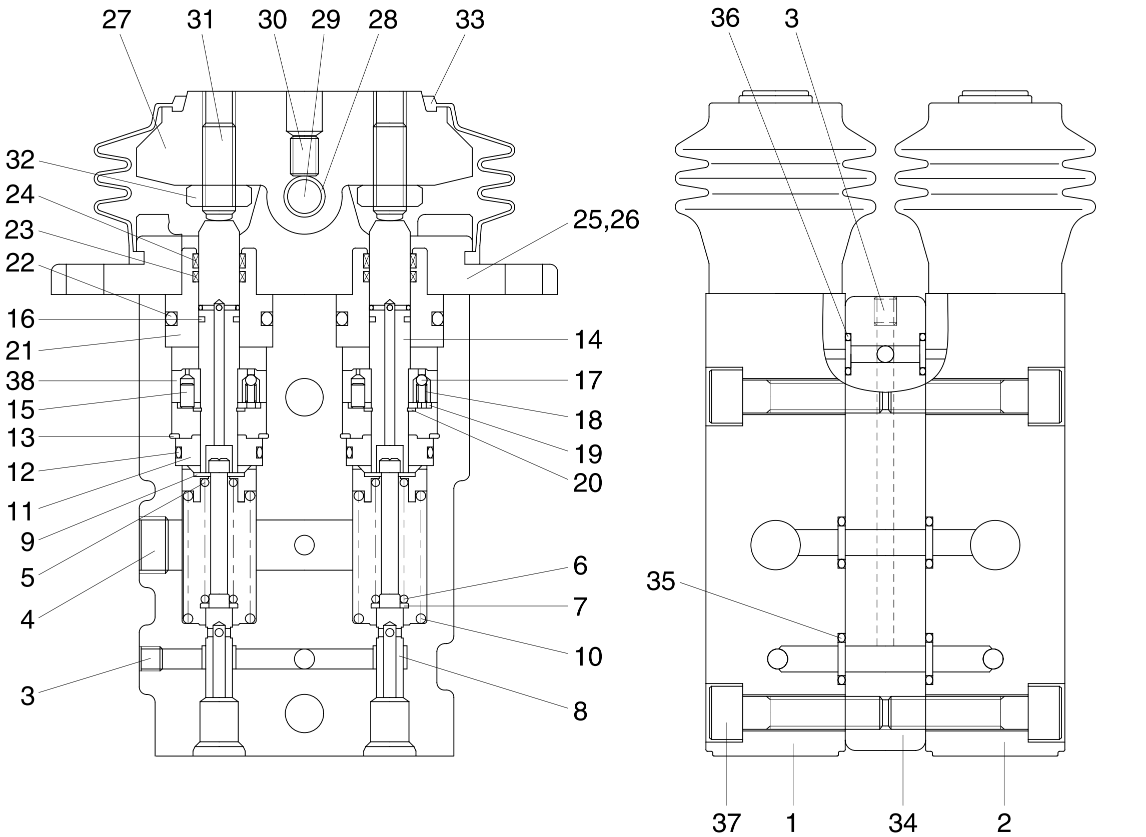
21092RP01

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.



21092RP02

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.

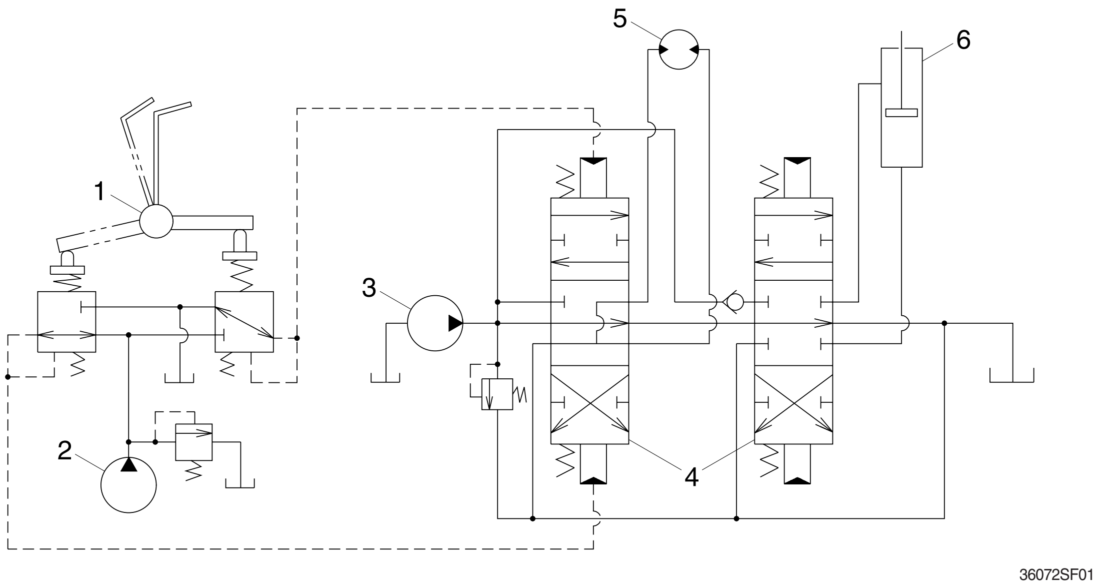
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

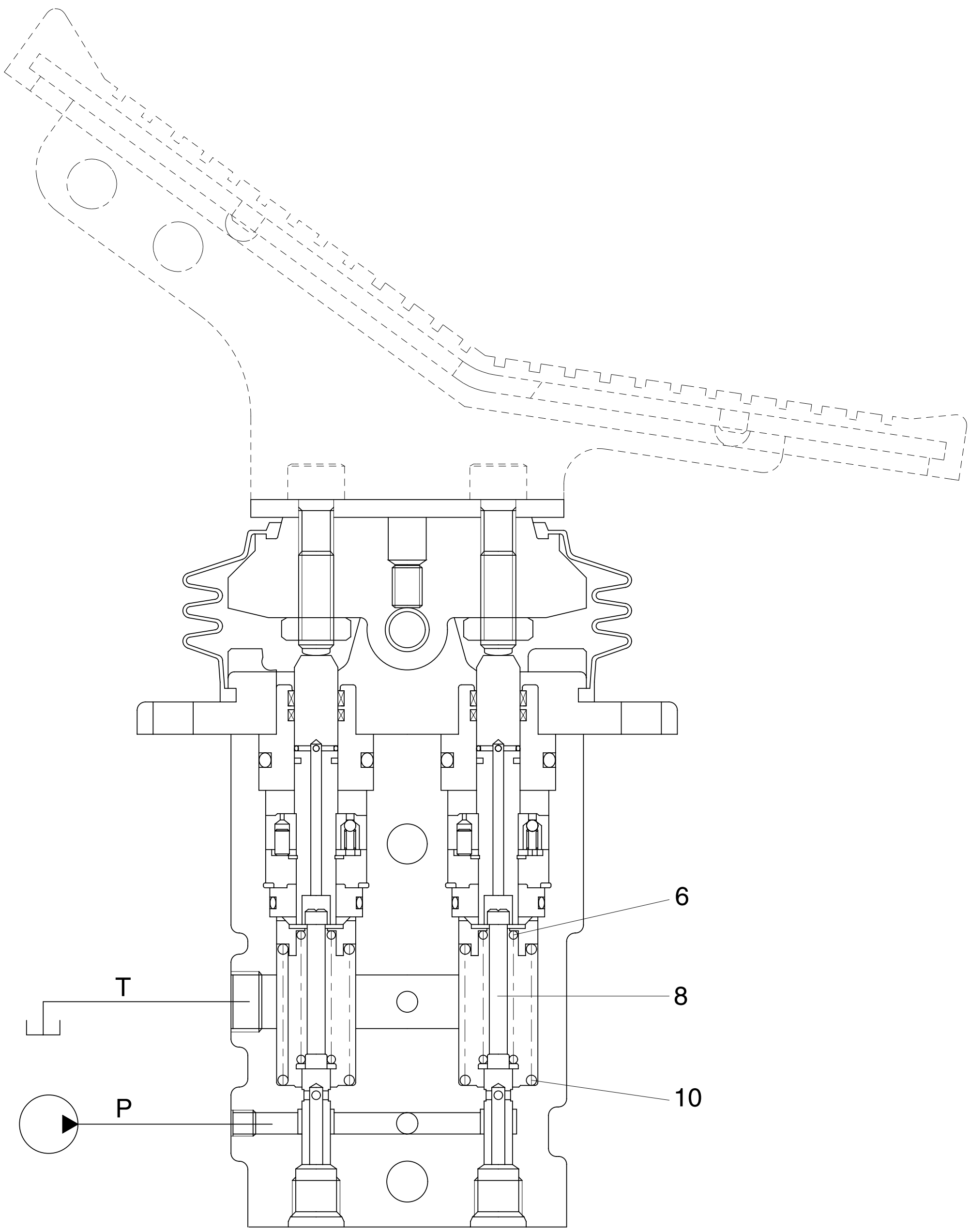
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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

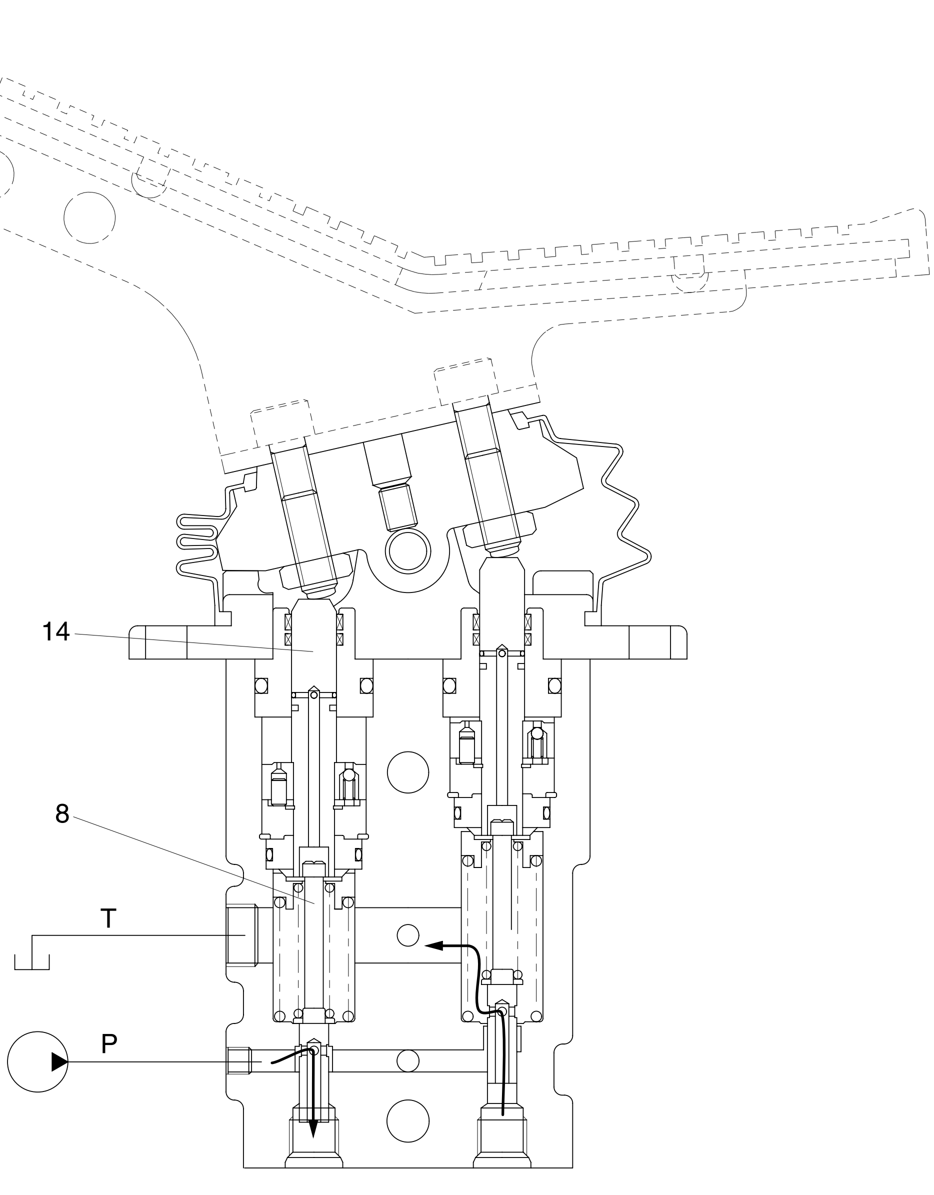
(1) Case where pedal is in neutral position



21092RP03

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

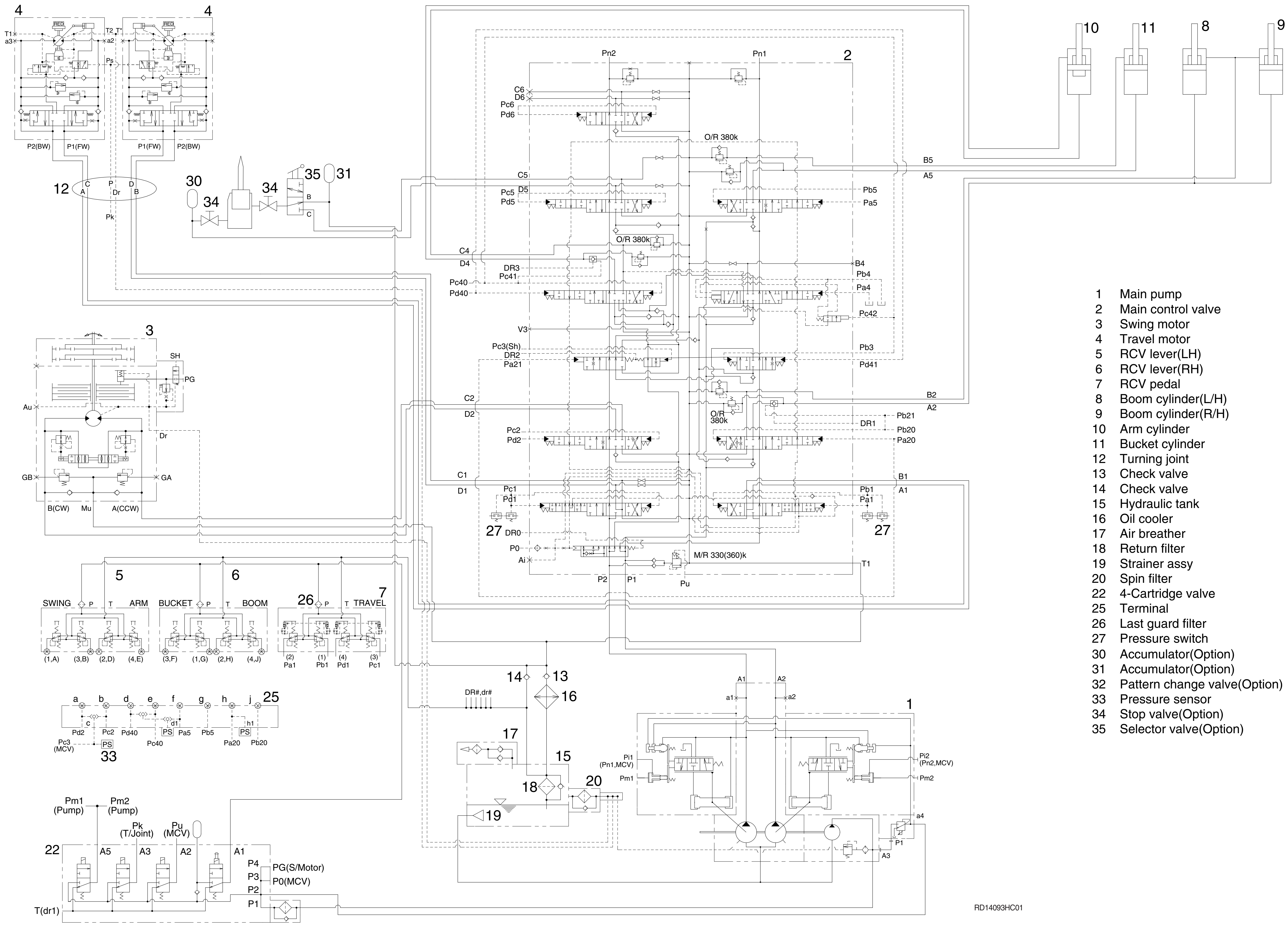


21092RP04

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

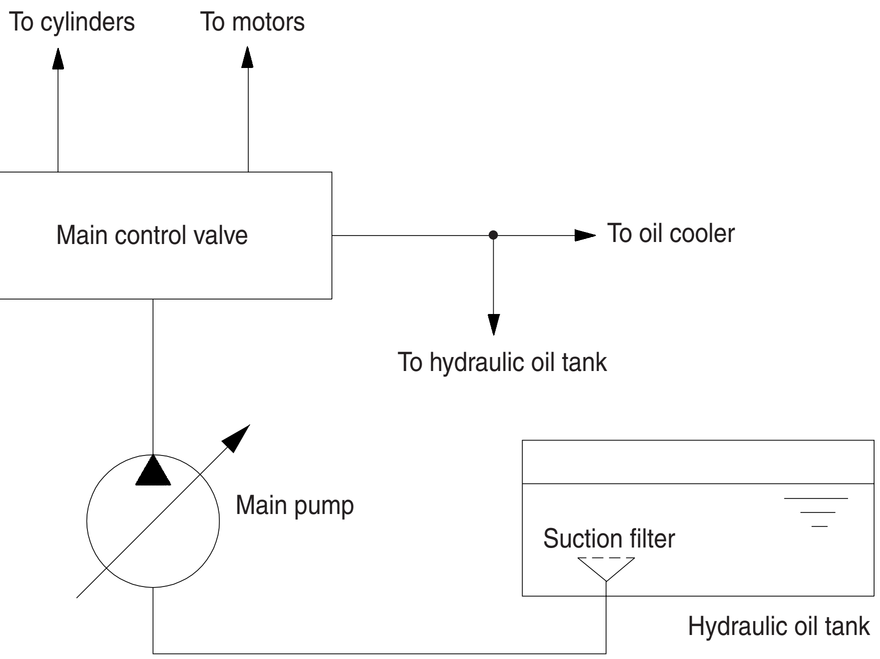


1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(L/H)
9 Boom cylinder(R/H)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Return filter
19 Strainer assy
20 Spin filter
22 4-Cartridge valve
25 Terminal
26 Last guard filter
27 Pressure switch
30 Accumulator(Option)
31 Accumulator(Option)
32 Pattern change valve(Option)
33 Pressure sensor
34 Stop valve(Option)
35 Selector valve(Option)

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 axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

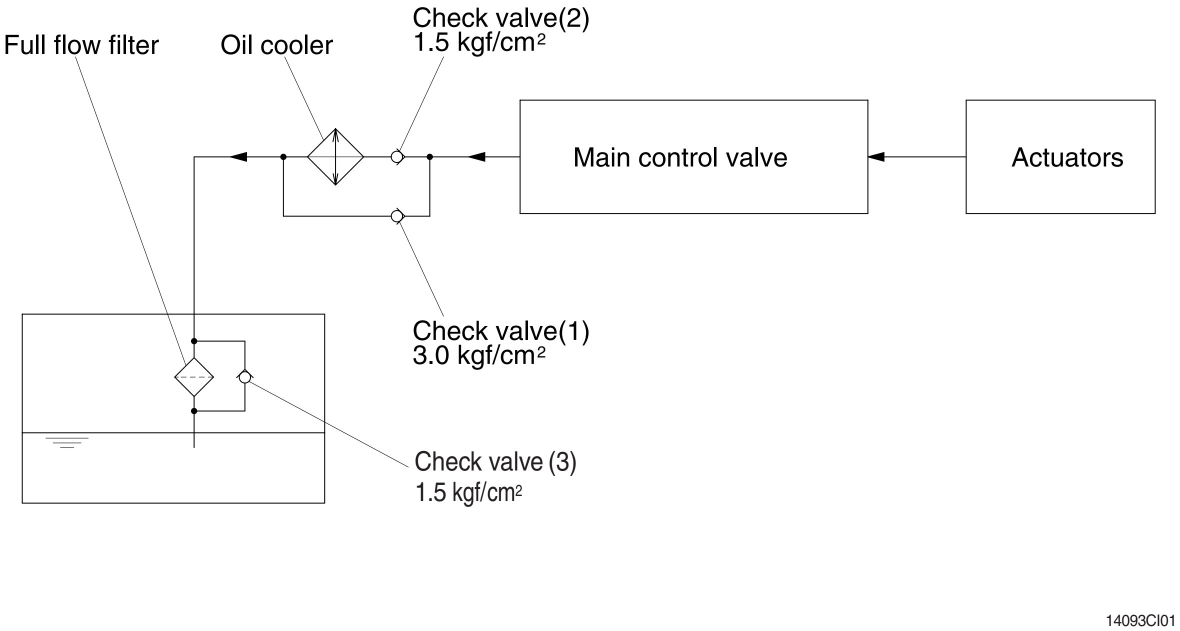
1. SUCTION AND DELIVERY CIRCUIT



(210-7) 3-03

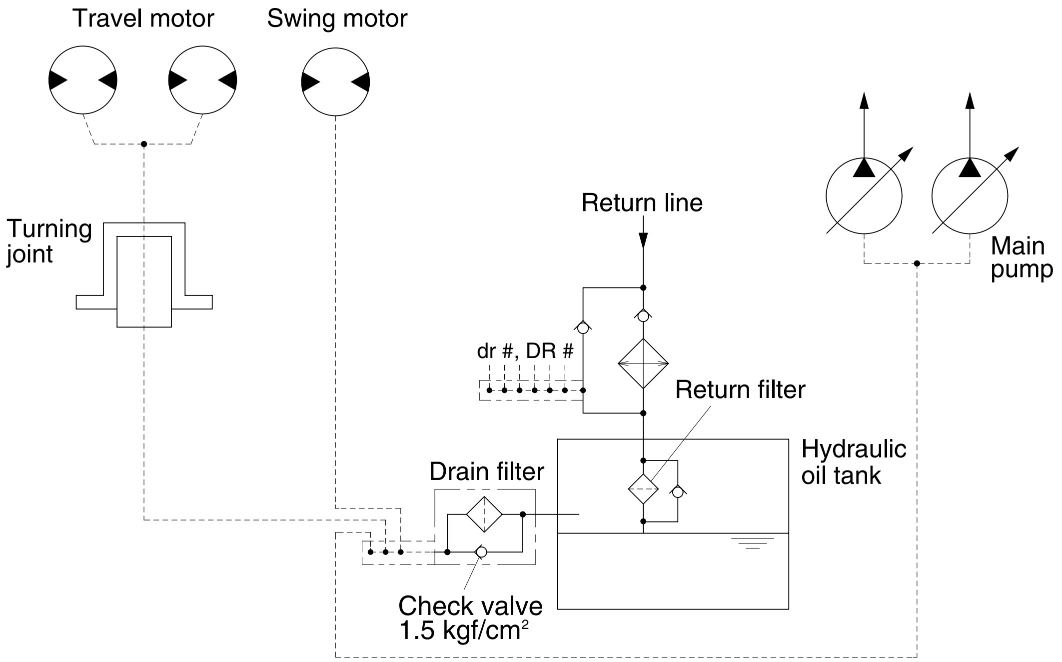
The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.
The oil discharged from the main pump flows to the actuators through the main control valve.
The main control valve controls the hydraulic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

2. RETURN CIRCUIT



All oil returned from each actuator returns to the hydraulic tank through the main 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 (21 psi) and 3.0 kgf/cm^2 (43 psi). 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. When the oil pressure exceeds 3.0 kgf/cm^2 (43 psi), 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 returned from right and left side of control valve is combined and filtered by the full-flow 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 (21 psi) differential pressure.

3. DRAIN CIRCUIT



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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 (21 psi), the oil returns to the hydraulic tank directly.

1) TRAVEL MOTOR DRAIN CIRCUIT

Oil leaked 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.

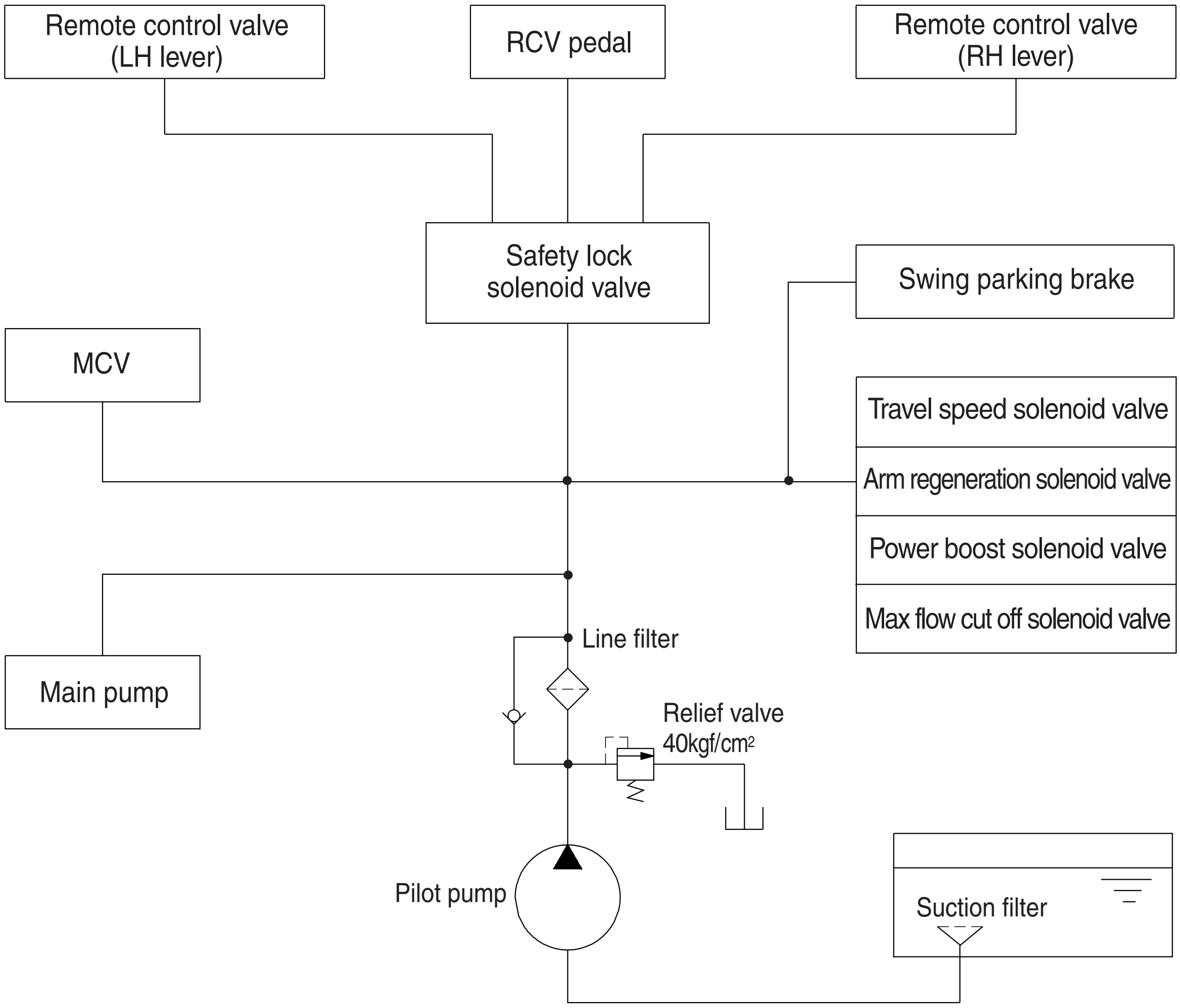
2) SWING MOTOR DRAIN CIRCUIT

Oil leaked from the swing motor returns to the hydraulic tank passing through a drain filter.

3) MAIN PUMP DRAIN CIRCUIT

Oil leaked from main pump returns to the hydraulic tank passing through drain filter.

GROUP 3 PILOT CIRCUIT



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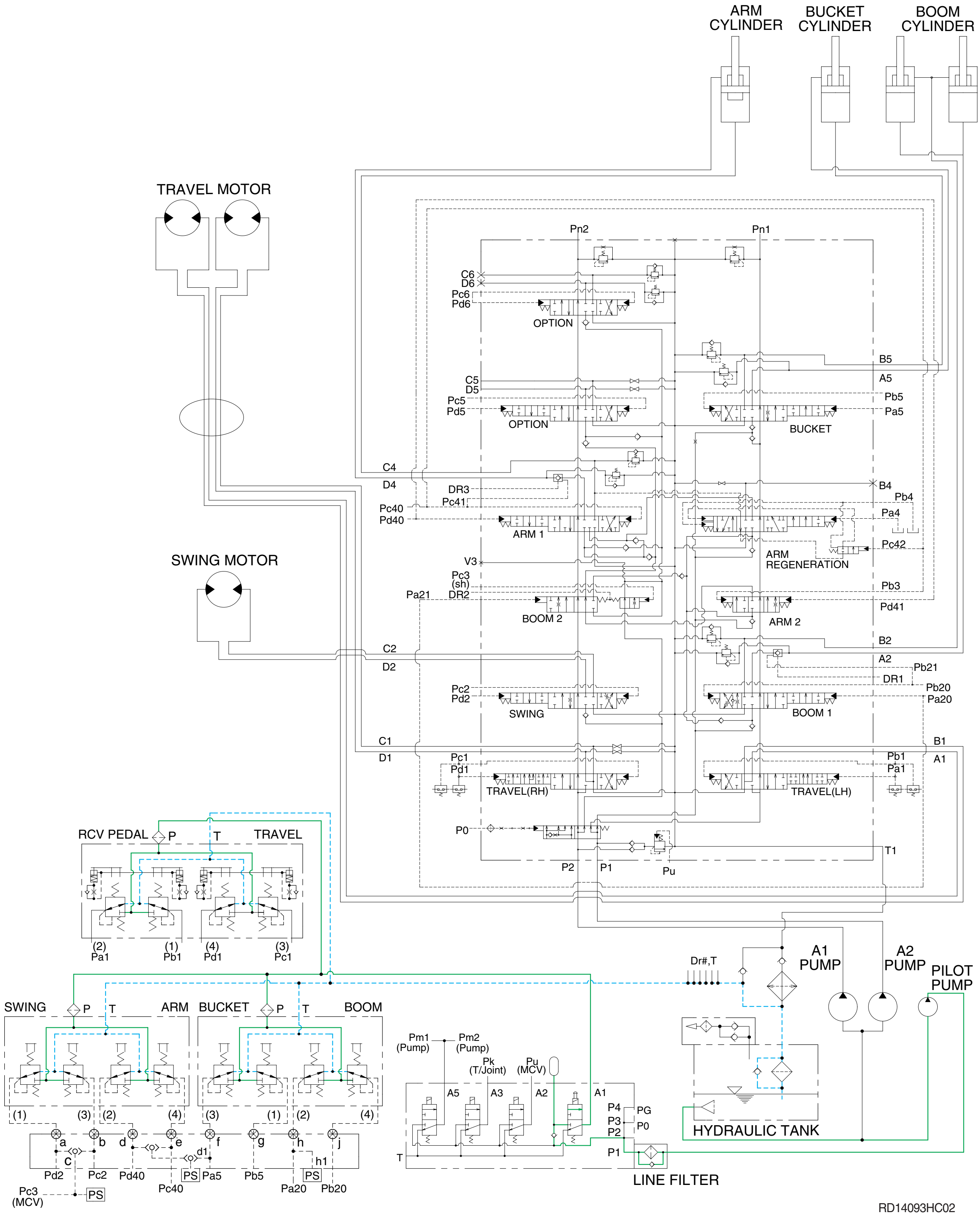
The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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.

1. SUCTION, DELIVERY AND RETURN CIRCUIT

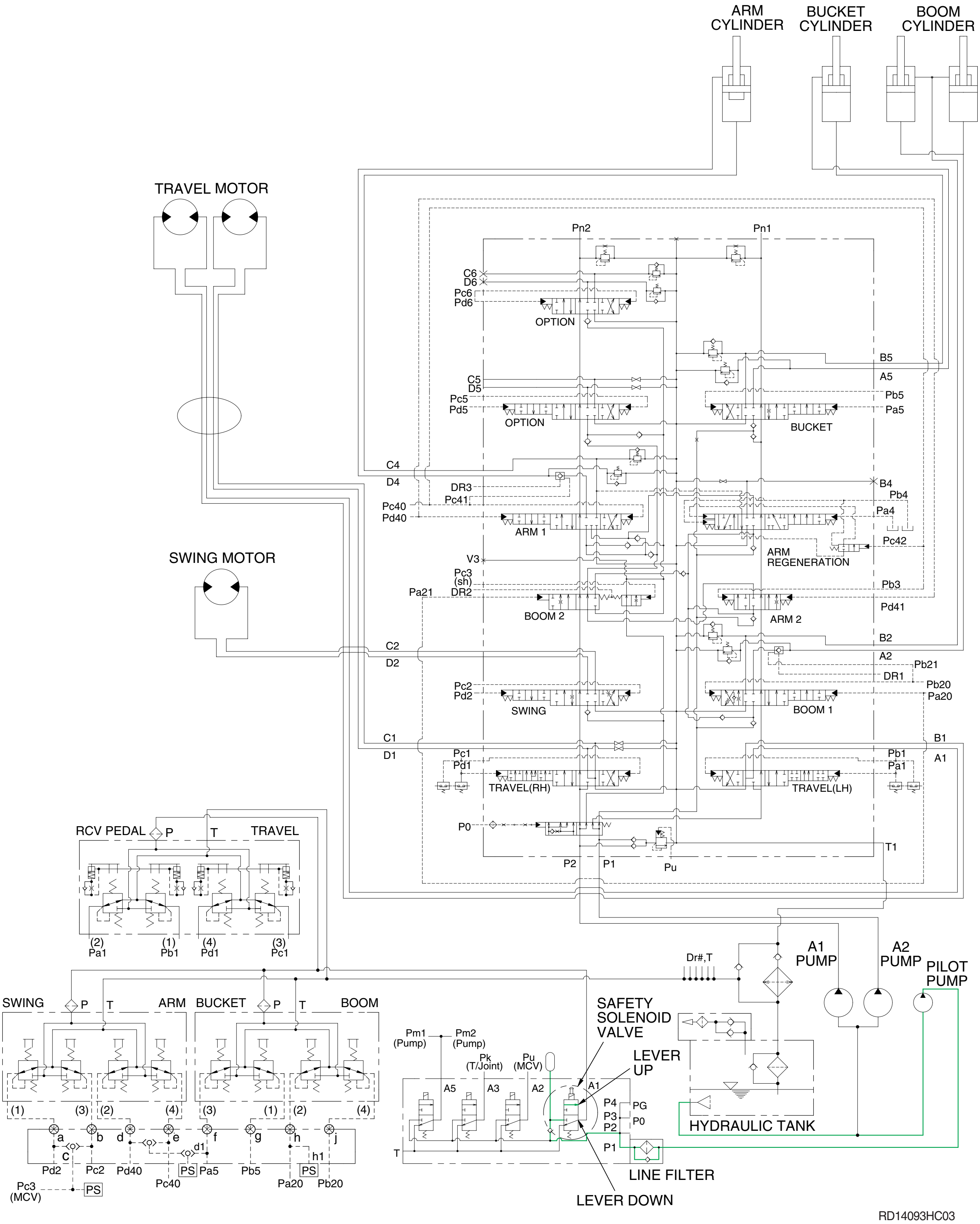


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

The oil filtered by line filter flows remote control valve through safety solenoid valve.

The return oil flow from remote control valve is returned to the hydraulic tank.

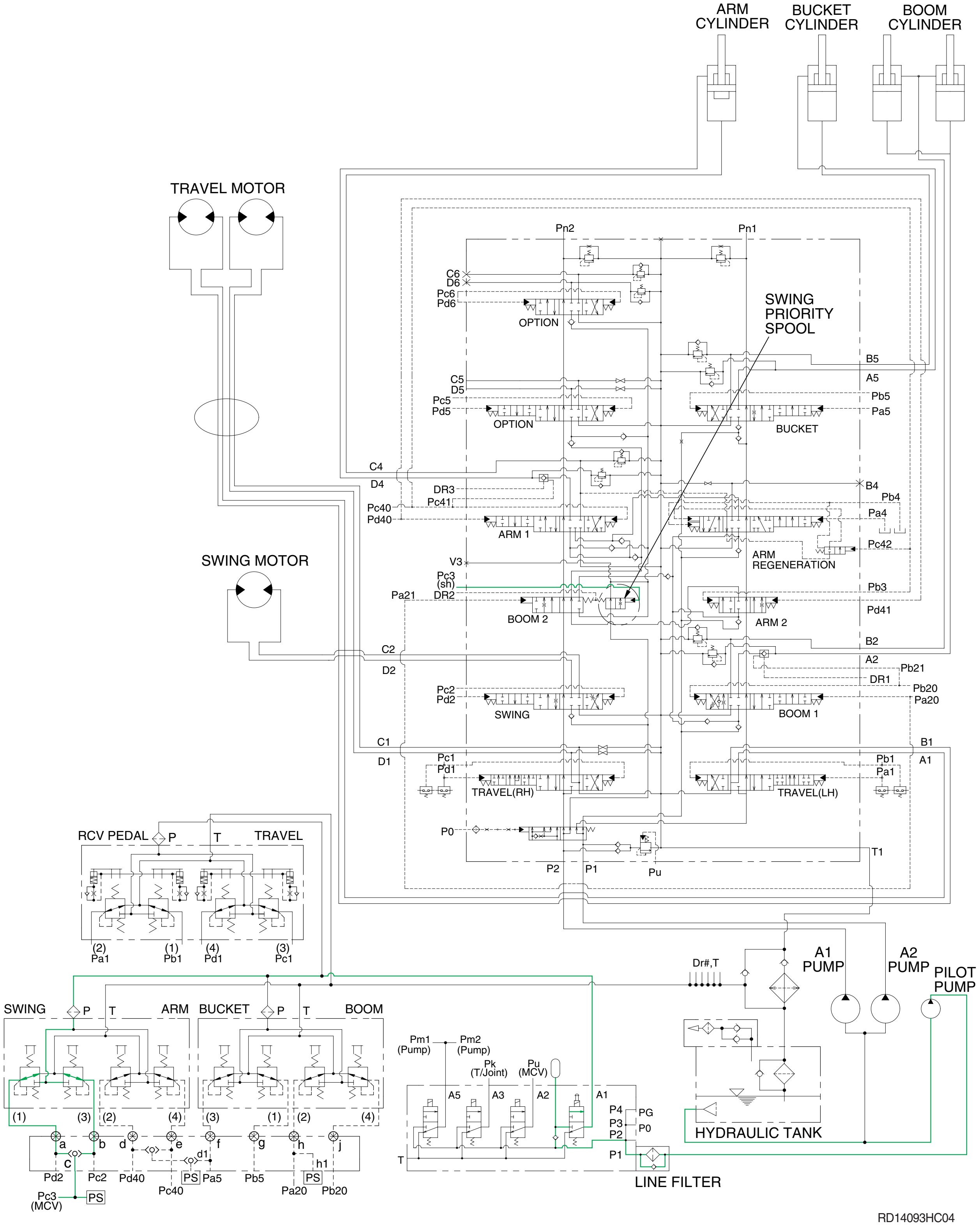
2. SAFETY SOLENOID VALVE (SAFETY LEVER)



When the lever of the safety solenoid valve is moved upward, oil flows into the remote control valve through solenoid valve and line filter.

When the lever of the safety solenoid valve is moved downward, oil does not flows into the remote control valve, because of the blocked port.

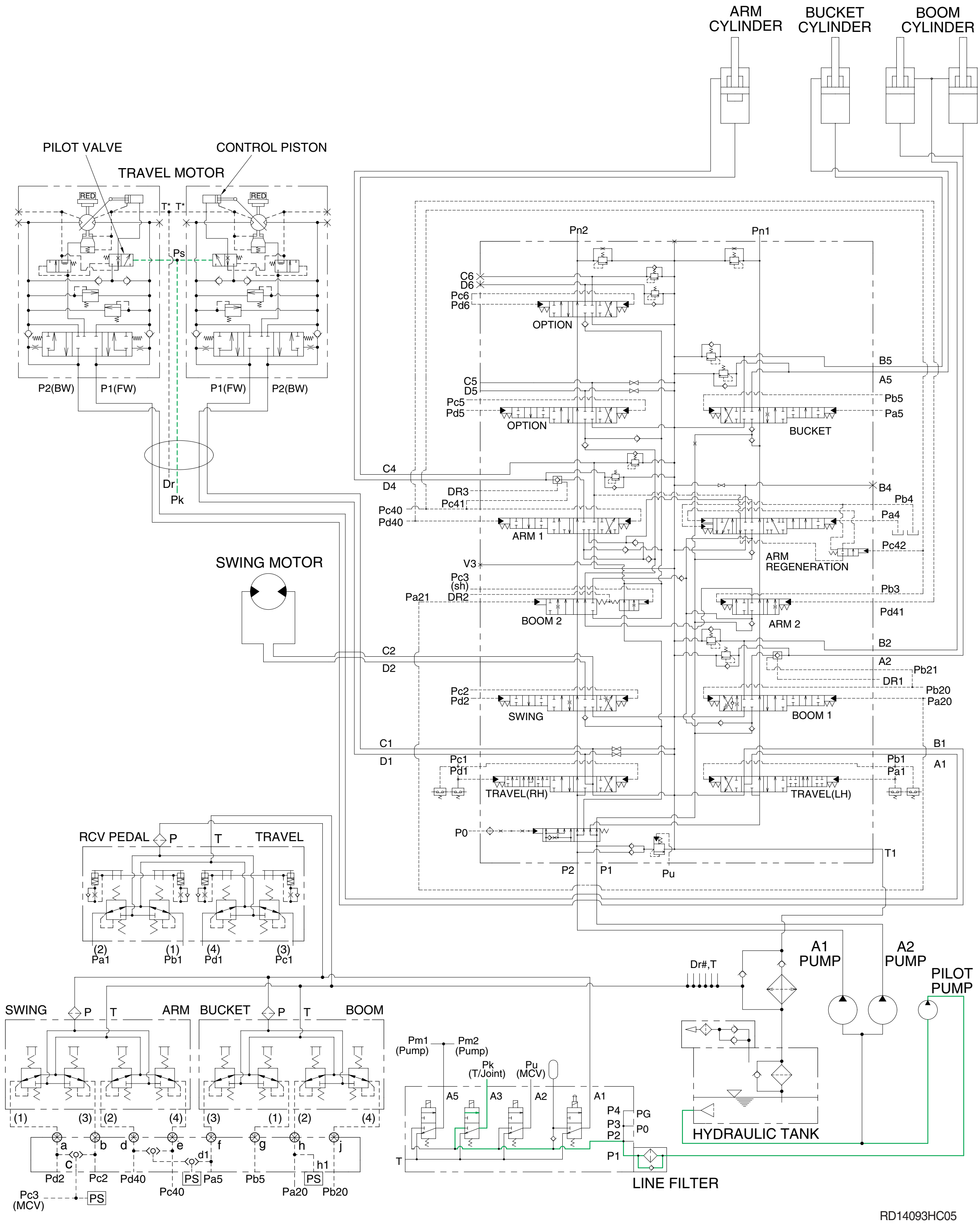
3. SWING PRIORITY SYSTEM



When carrying out the combined operation of swing and boom or arm of the left control valve, the swing speed can be lowered than operating speed of boom or arm. To prevent it, swing priority spool is used. Pc3 pressure from shuttle valve(sh) shifts the swing priority spool to the left and decreases the oil flow rate to the boom or arm section by orifice.

This is called the swing priority system.

4. TRAVEL SPEED CONTROL SYSTEM



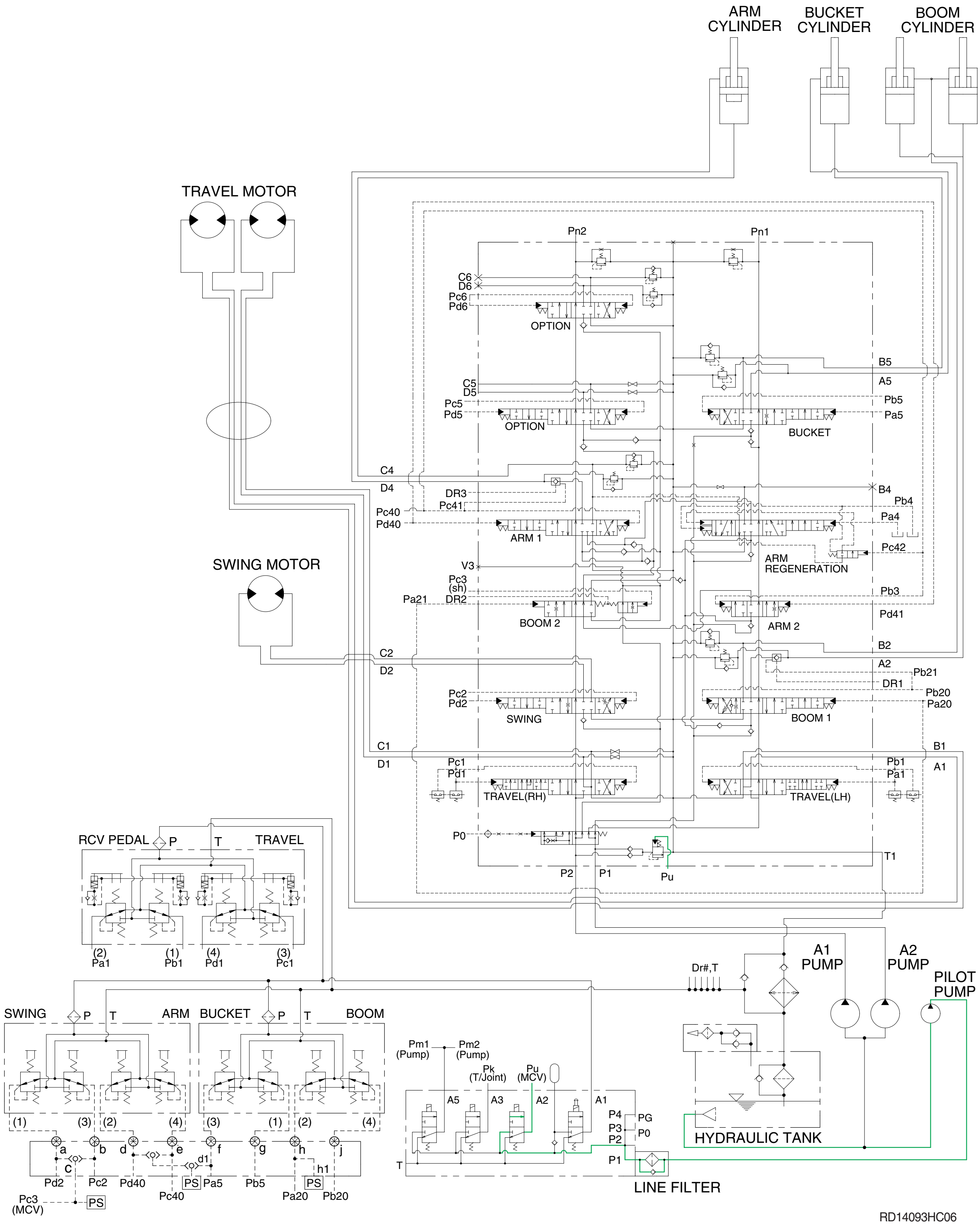
When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the **Ps** port of pilot valve in the travel motors.

As a result, the control piston is pushed by the main oil flow, thus the displacement is minimized.

When the travel speed switch is pushed once more, the travel speed solenoid valve is return to original position by the force of spring, the hydraulic oil of **Ps** port returns to the hydraulic tank.

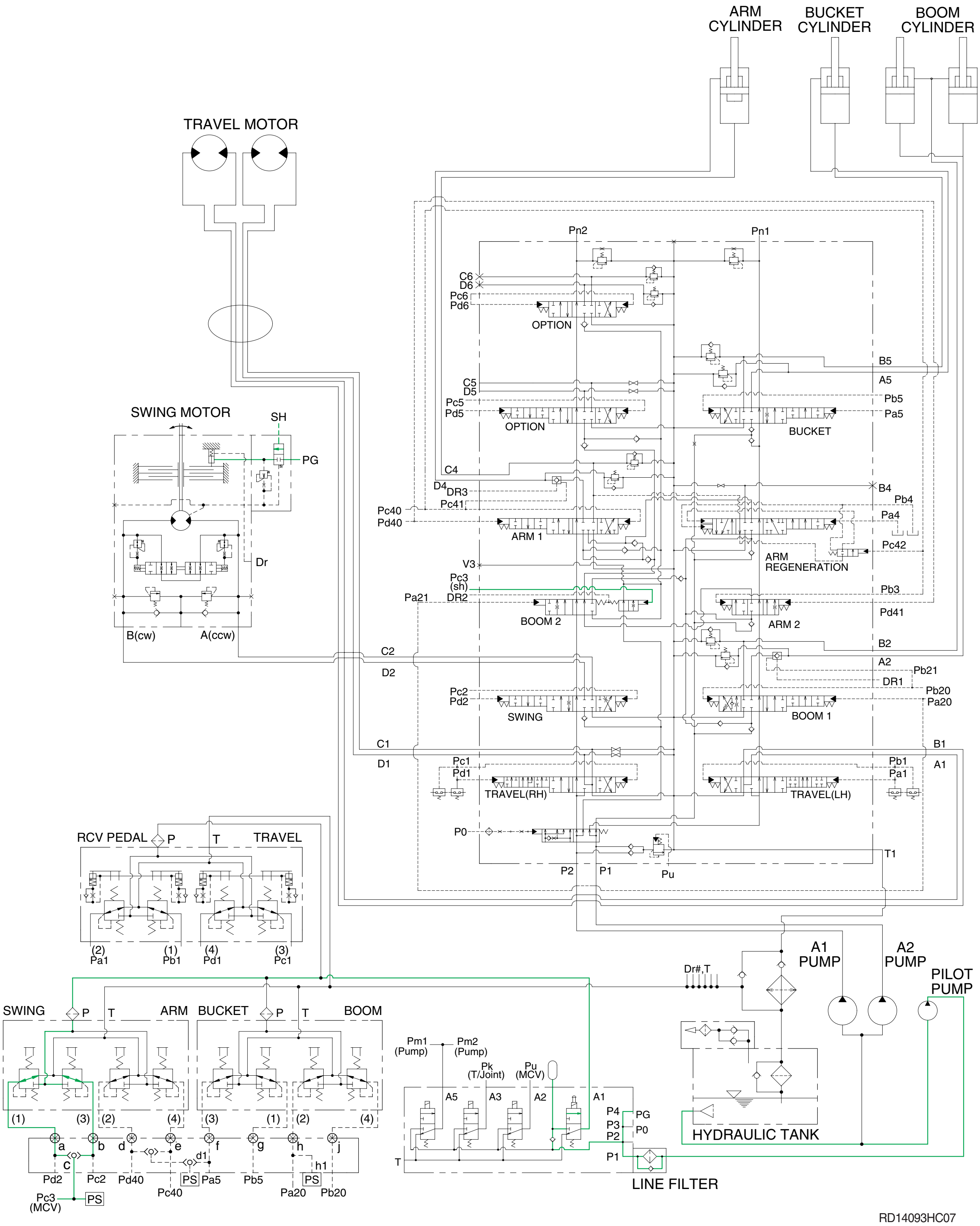
As a result, the control piston is returned by the main oil flow, thus the displacement is maximized.

5. MAIN RELIEF PRESSURE CHANGE SYSTEM



When the power boost switch on the left control lever is pushed ON, the power boost solenoid valve is actuated, the discharged oil from the pilot pump flows into Pu port of the main relief valve of main control valve; then the setting pressure of the main relief valve is raised from 330kgf/cm2 to 360kgf/cm2 for increasing the digging power. And even when pressed continuously, it is canceled after 8 seconds.

6. SWING PARKING BRAKE RELEASE



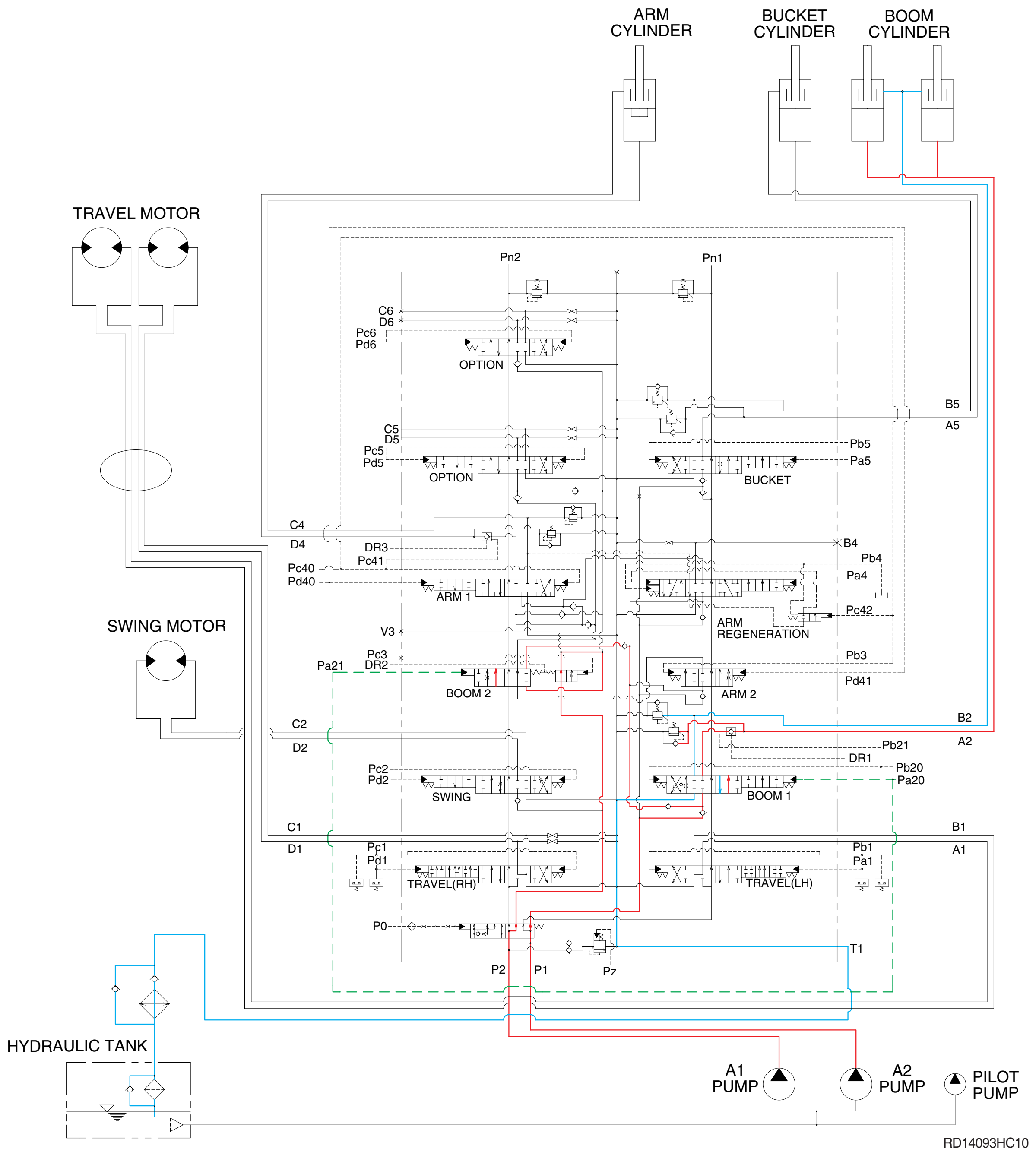
When the swing control lever is tilted, the pilot oil flow into SH port of shuttle valve, this pressure move spool so, discharged oil from pilot valve flow into PG port.

This pressure is applied to swing motor disc, thus the brake is released.

When the swing control lever is set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



RD14093HC10

When the right control lever is pulled back, the boom spools in the main control valve are moved to the up position by the pilot oil pressure from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of boom cylinders.

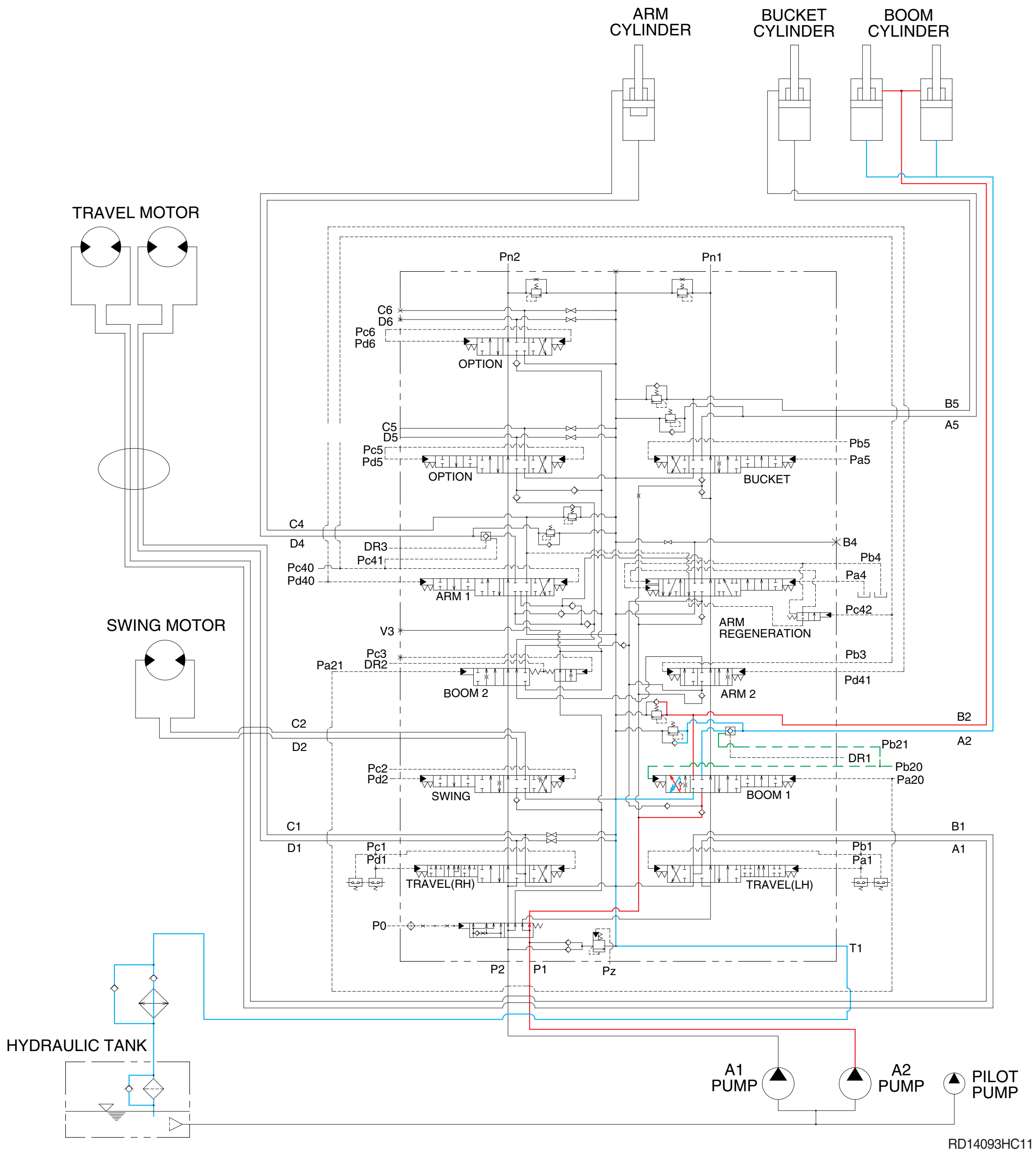
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.

The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve.

When the boom is up and the control lever is returned to neutral position, the circuit for the holding pressure at the bottom end of the boom cylinder is closed by the boom holding valve.

This prevents the hydraulic drift of boom cylinder.

2. BOOM DOWN OPERATION



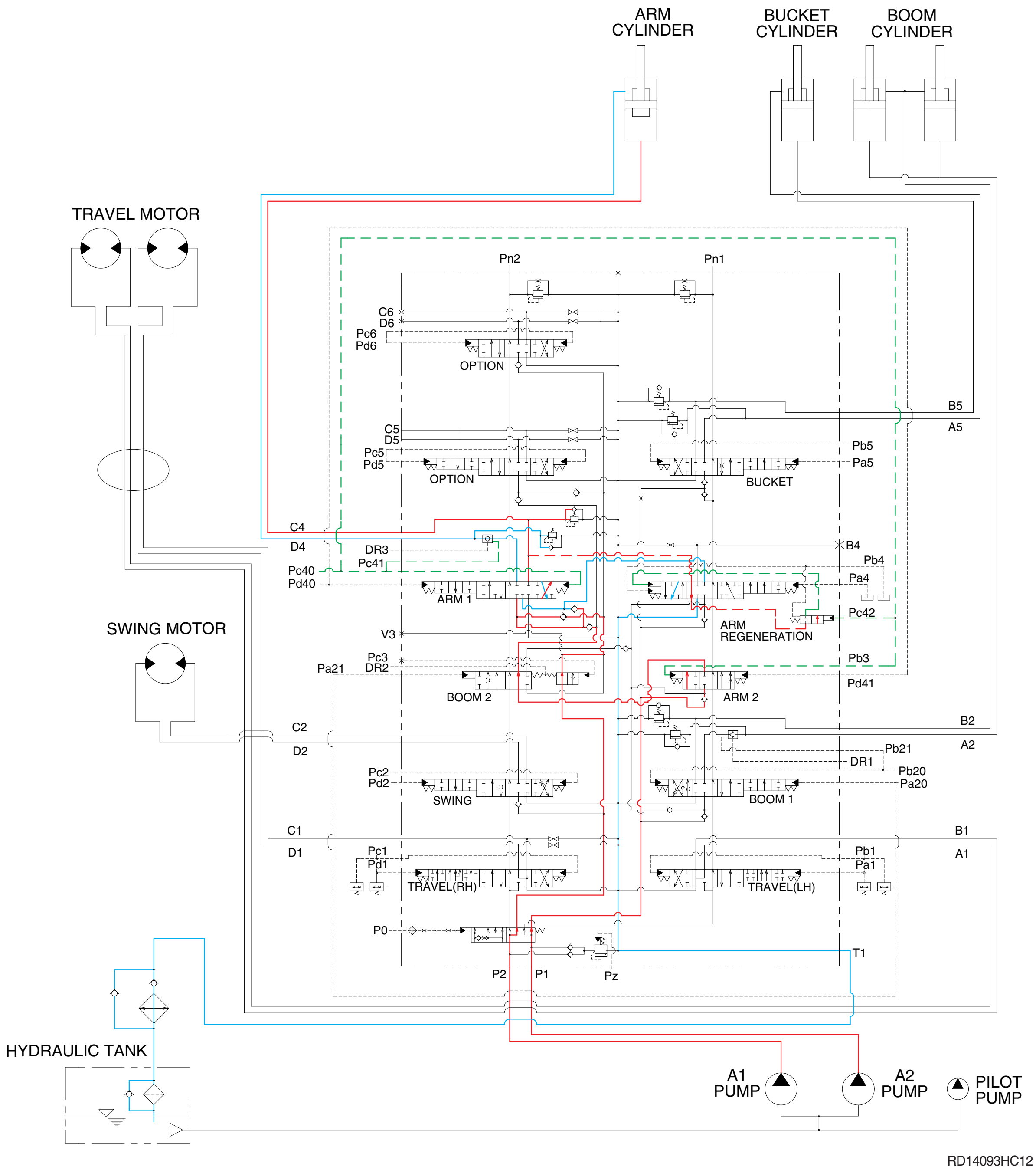
When the right control lever is pushed forward, the boom spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1, spool in the main control valve.

When the down speed of boom is faster, the oil returned from the large chamber of boom cylinder combines with the oil from the A2 pump, and flows into the small chamber of the cylinder.

This prevents cylinder cavitation by the negative pressure when the A2 pump flow can not match the boom down speed. And the excessive pressure in the boom cylinder rod end circuit is prevented by the relief valve.

3. ARM ROLL IN OPERATION



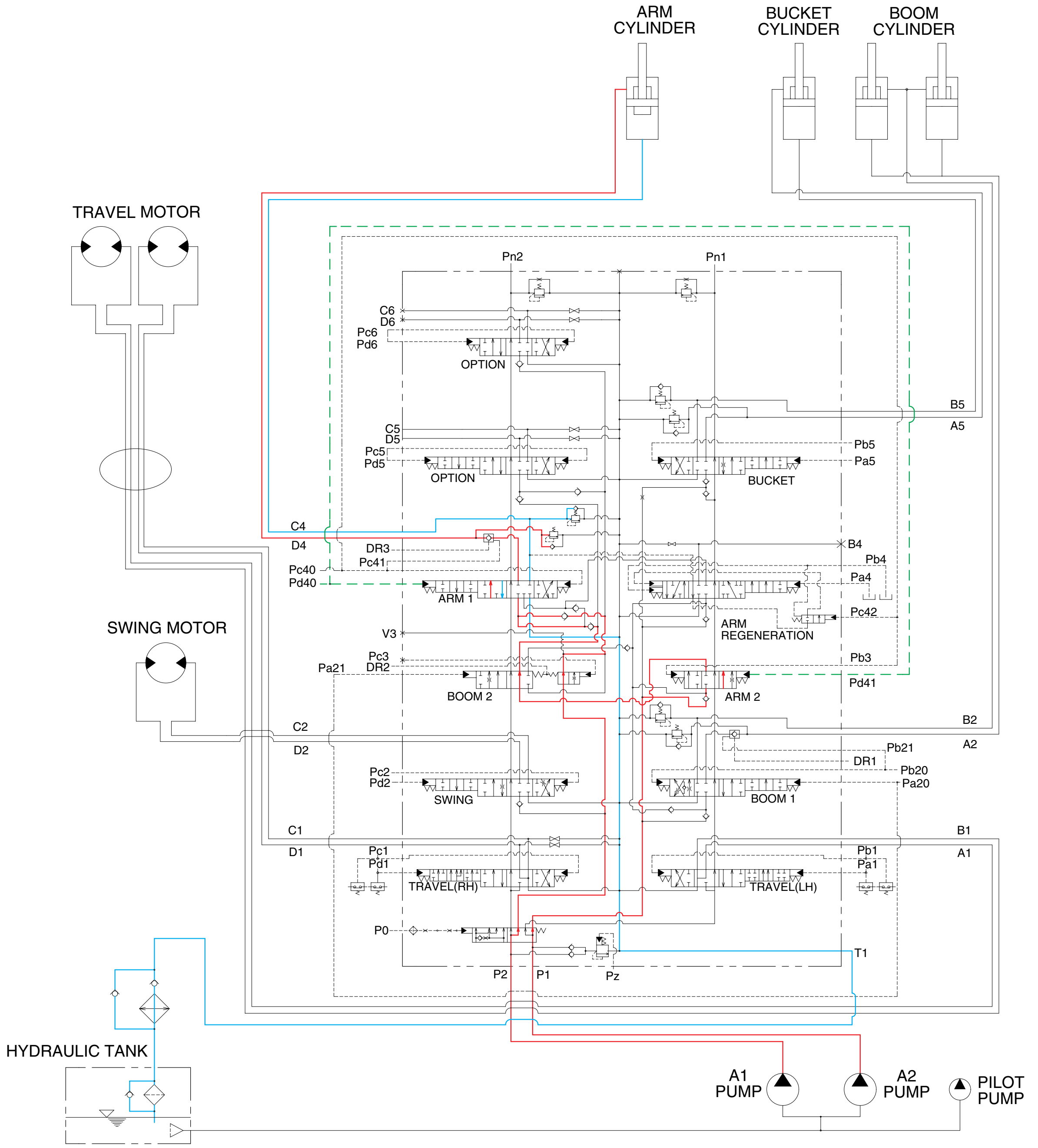
When the left control lever is pulled back, the arm spools in the main control valve are moved the to roll in position by the pilot oil pressure from the remote control valve.

The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls in.

The cavitation which will happen to the bottom of the arm cylinder is also prevented by the make-up valve in the main control valve.

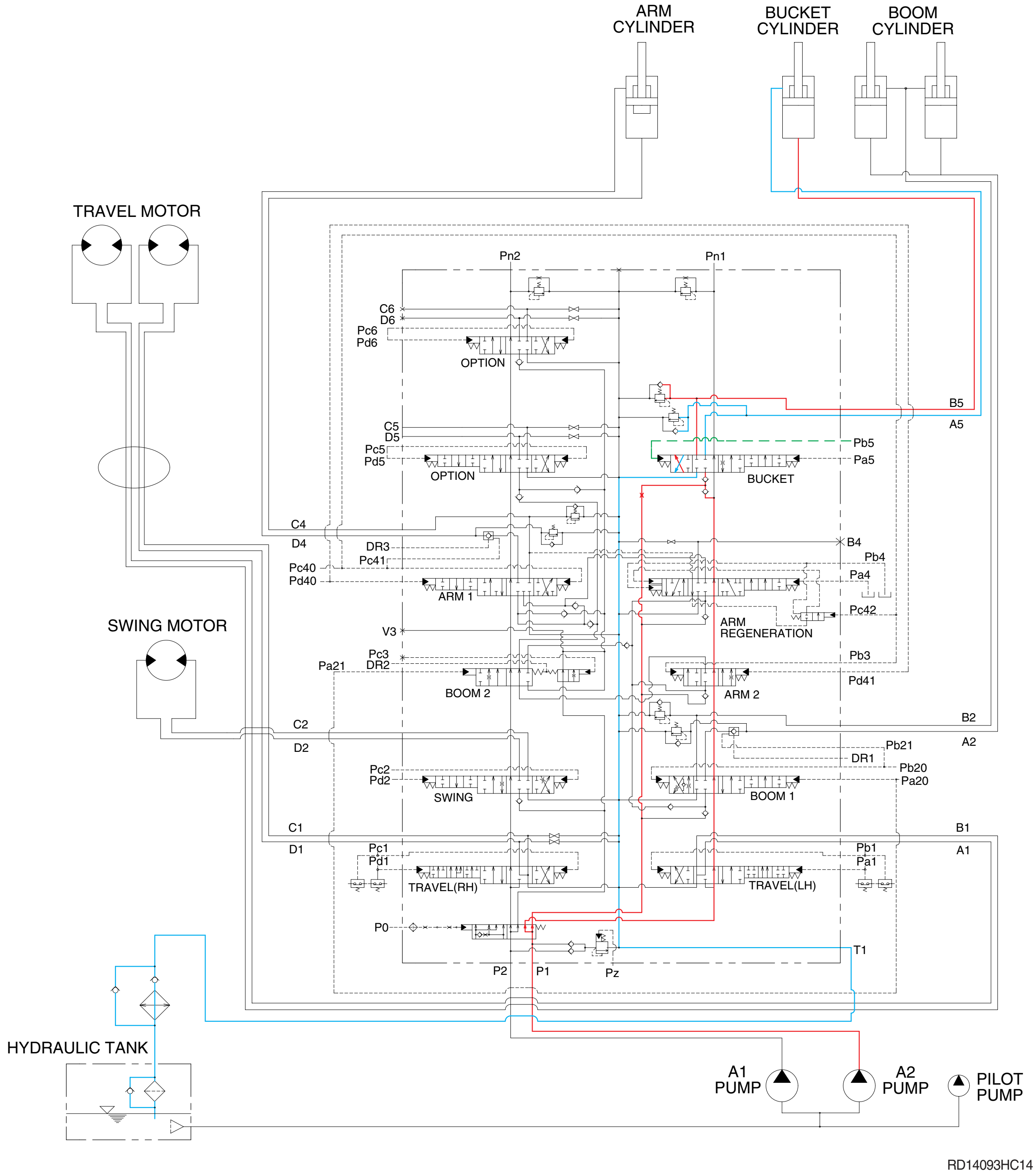
4. ARM ROLL OUT OPERATION



RD14093HC13

When the left control lever is pushed forward, the arm spool in the main control valve are moved to the roll out position by the pilot oil pressure from the remote control valve.
The oil from the A1 and A2 pump flows into the main control valve and then goes to the small chamber of arm cylinder.
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls out.
The cavitation which will happen to the rod of the arm cylinder is also prevented by the make-up valve in the main control valve.

5. BUCKET ROLL IN OPERATION



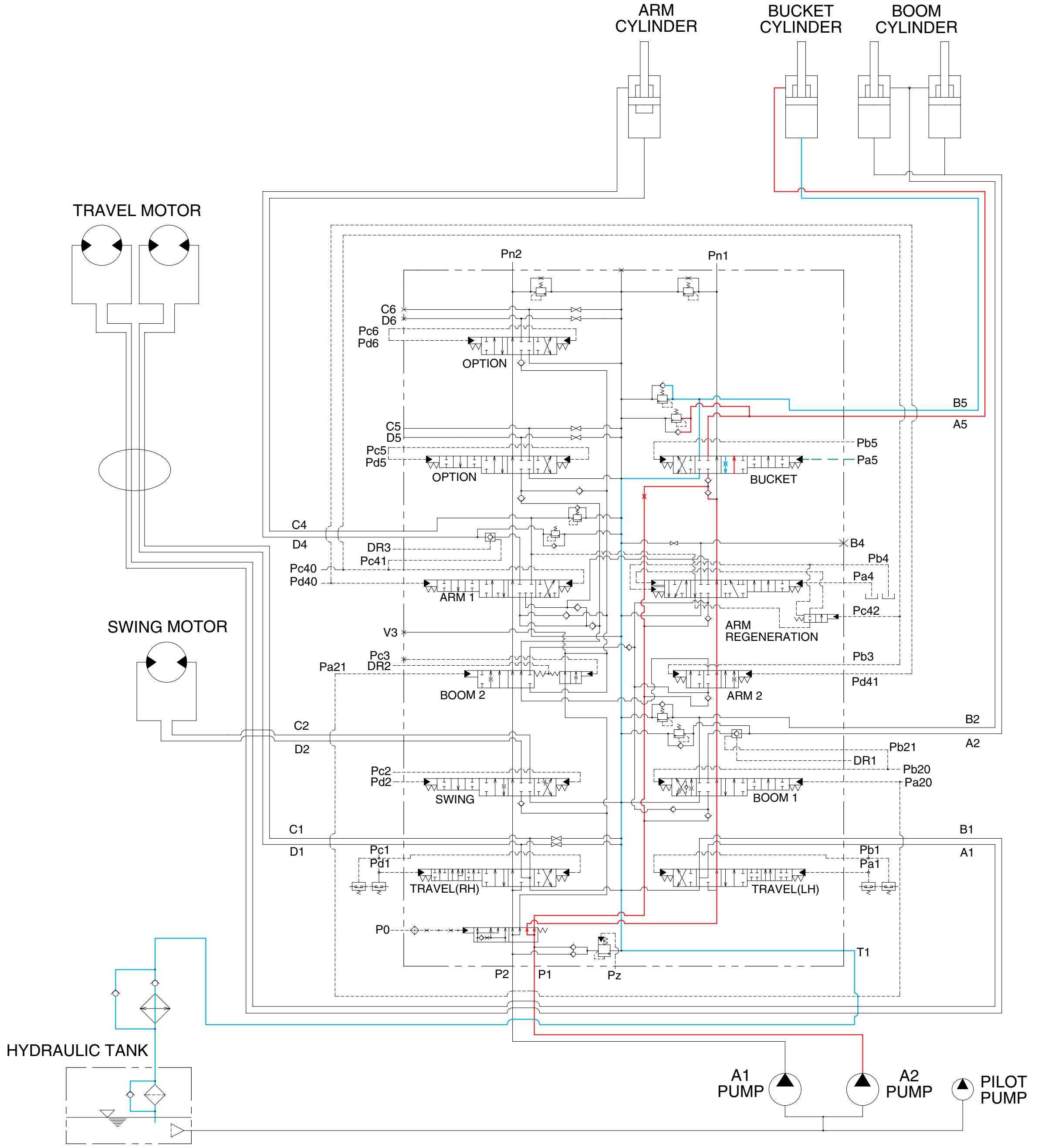
When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure from the remote control valve.

The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the bucket rolls in.

The cavitation which will happen to the bottom of the bucket cylinder is also prevented by the make-up valve in the main control valve.

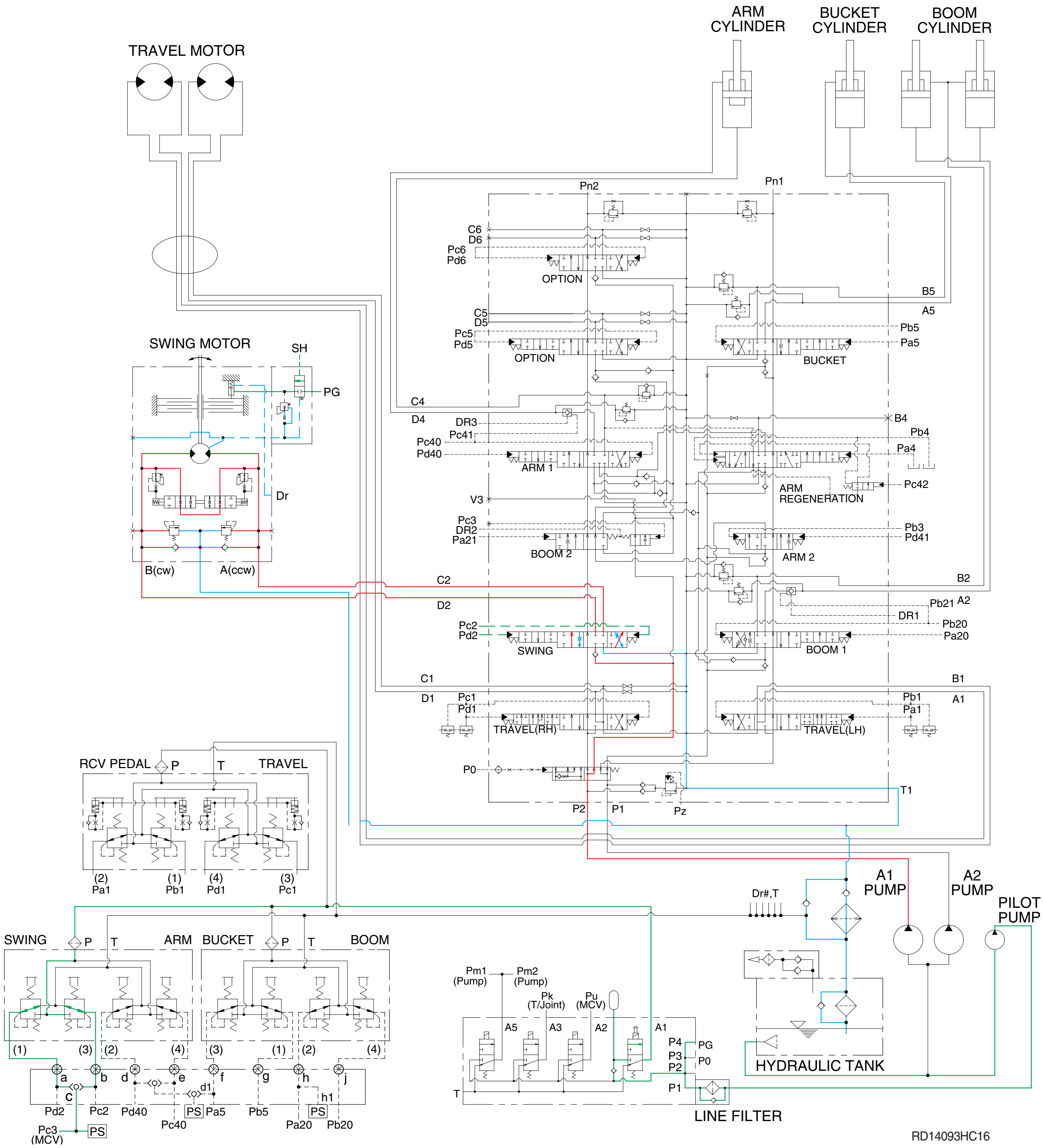
6. BUCKET ROLL OUT OPERATION



RD14093HC15

When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure from the remote control valve.
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spool in the main control valve. When this happens, the bucket rolls out.
The cavitation which will happen to the rod of the bucket cylinder is also prevented by the make-up valve in the main control valve.

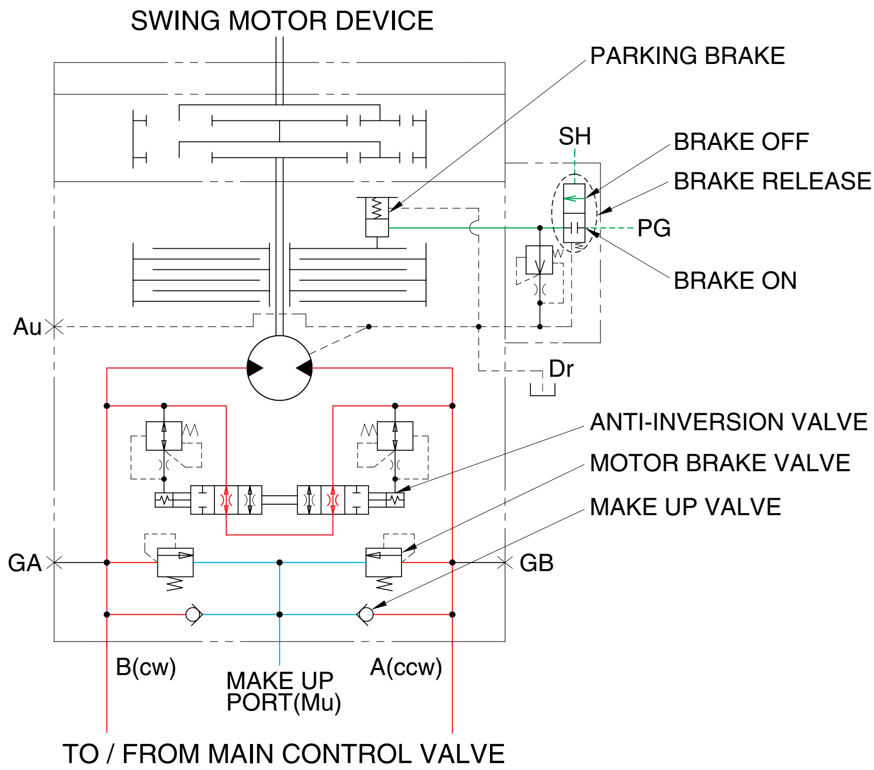
7. SWING OPERATION



RD14093HC16

When the left control lever is pushed left or right, the swing spool in the main control valve is moved to the left or right swing position by the pilot oil pressure from the remote control valve.
The oil from the A1 pump flows into the main control valve and then goes to the swing motor.
At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.
When this happens, the superstructure swings to the left or right.
The swing parking brake, make up valve and the overload relief valve are provided in the swing motors. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



14W93HC18A

1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation and controls the swing motor operating pressure.

2) MAKE UP VALVE

The make up valves prevent cavitation by supplying return oil to the vacuum side of the motor.

3) PARKING BRAKE

This is function as a parking brake only when all of the RCV lever (except travel pedal) are not operated.

PARKING BRAKE "OFF" OPERATION

The parking brake is released by the pilot pressure oil from the pilot pump.

When the RCV lever placed in the operating position, the pilot oil flows into SH port through the MCV. This pressure transferred to the brake release valve and the brake release valve is change over. Then the pilot oil pressure PG lift the brake piston and release the parking brake.

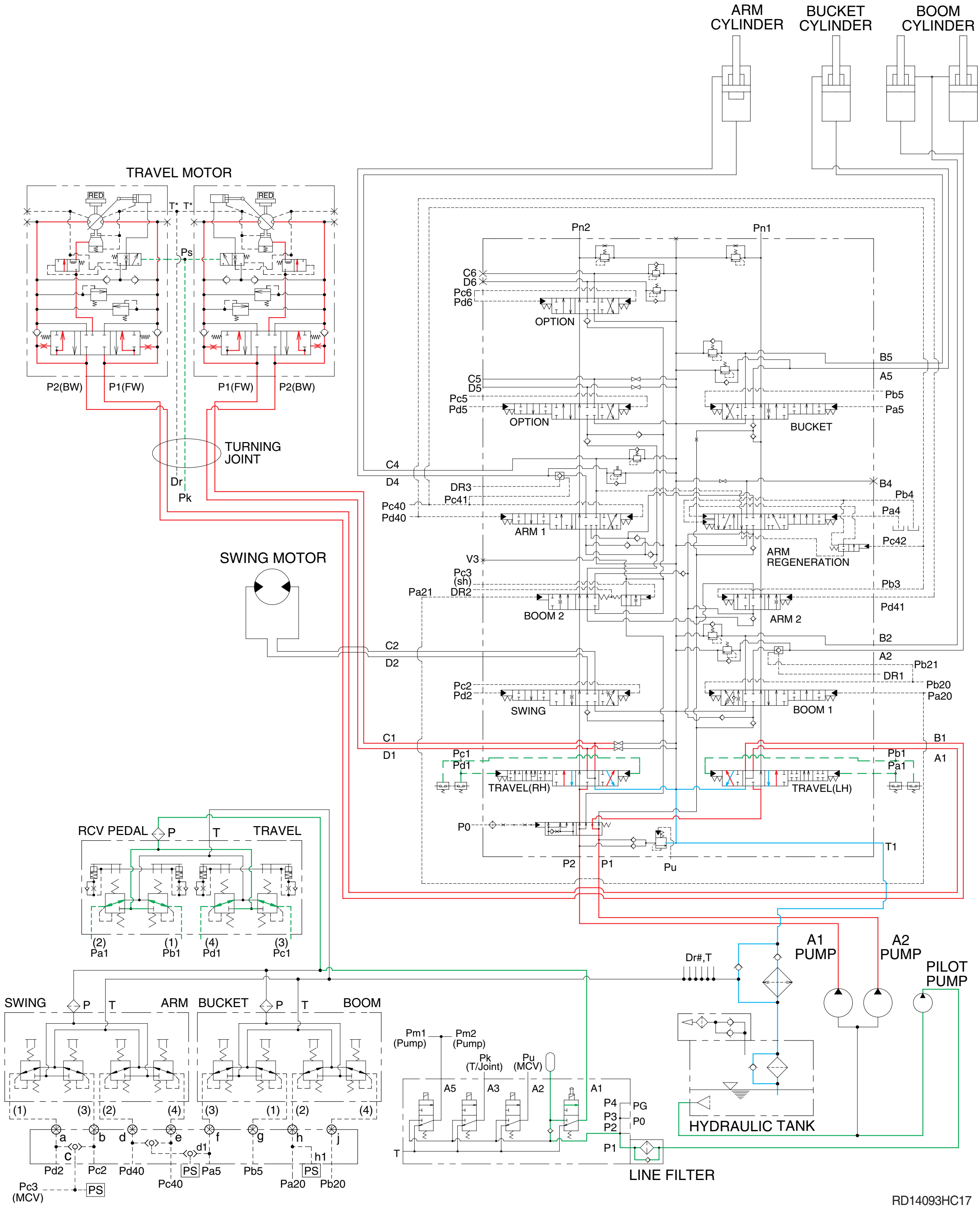
PARKING BRAKE "ON" OPERATION

When all of the RCV lever placed in the neutral position, the pressure of the pilot oil passage down. Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to 'ON".

4) ANTI-INVERSION VALVE

This anti-inversion valve absorbs shocks produced as swing motion stops and reduced oscillation cause by swing motion.

8. TRAVEL FORWARD AND REVERSE OPERATION



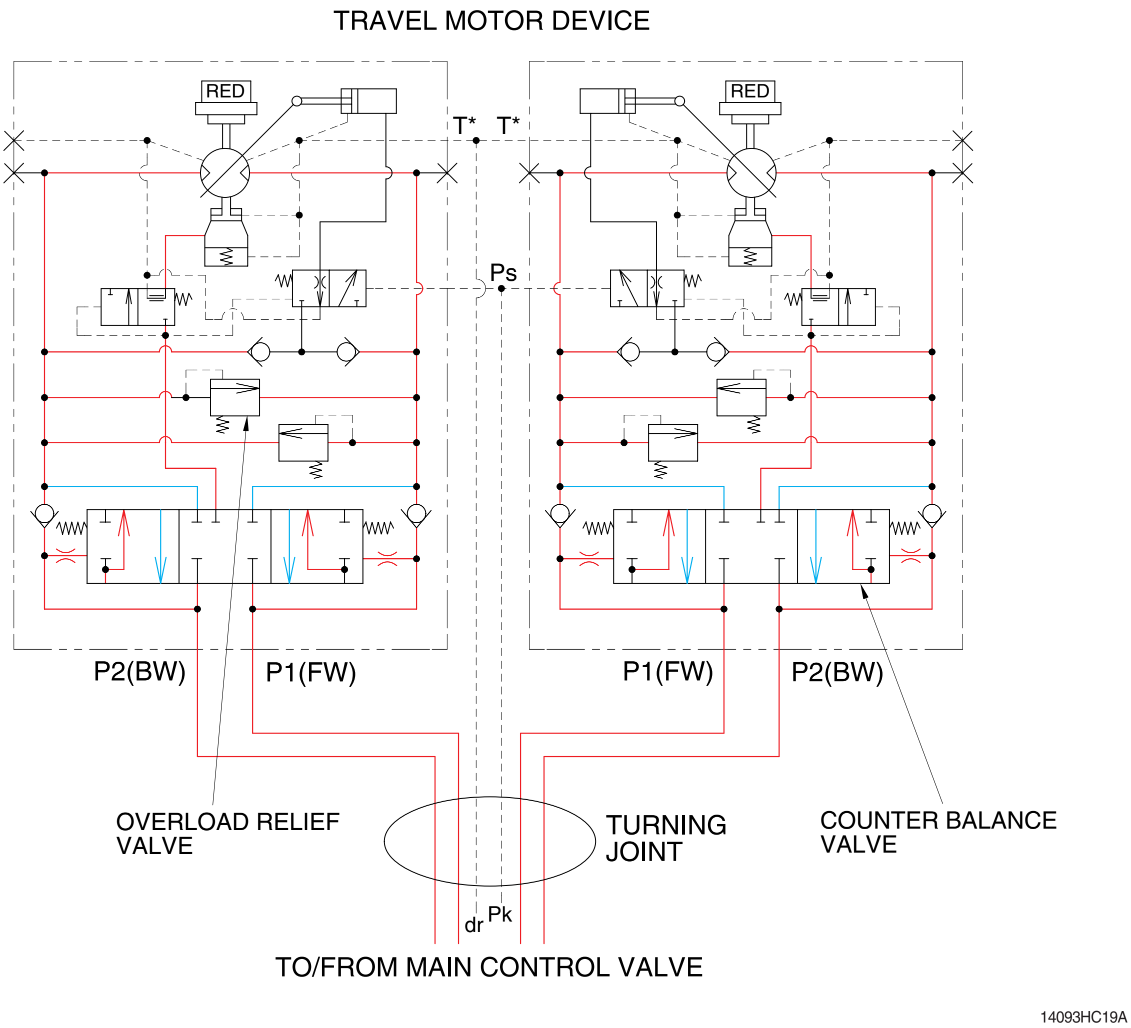
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

The oil from the both pumps flows into the main control valve and then goes to the both travel motors through the turning joint.

The return oil from both travel motors returns to the hydraulic oil tank through the turning joint and the travel spools in the main control valve.

When this happens, the machine moves to the forward or reverse.

TRAVEL CIRCUIT OPERATION



Valves are provided on travel motors to offer the following functions.

1) COUNTER BALANCE VALVE

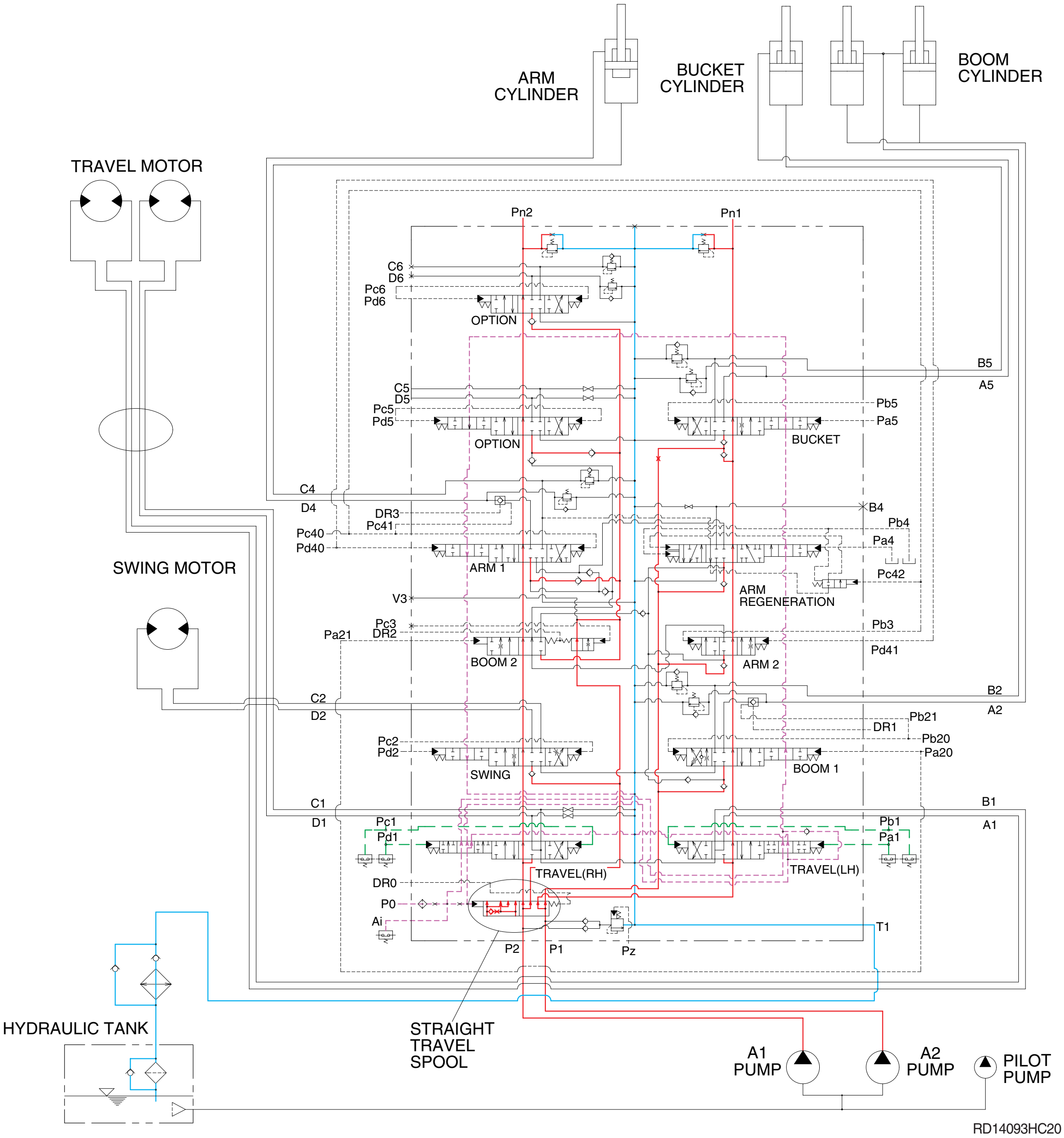
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 365 kgf/cm^2 to prevent high pressure generated at a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

GROUP 5 COMBINED OPERATION

1. OUTLINE



The oil from the A1 and A2 pump flows through the neutral oil passage, bypass oil passage and confluence oil passage in the main control valve. Then the oil goes to each actuator and operates them. Check valves and orifices are located on these oil passage in the main control valve. These control the oil from the main pumps so as to correspond to the operation of each actuator and smooth the combined operation.

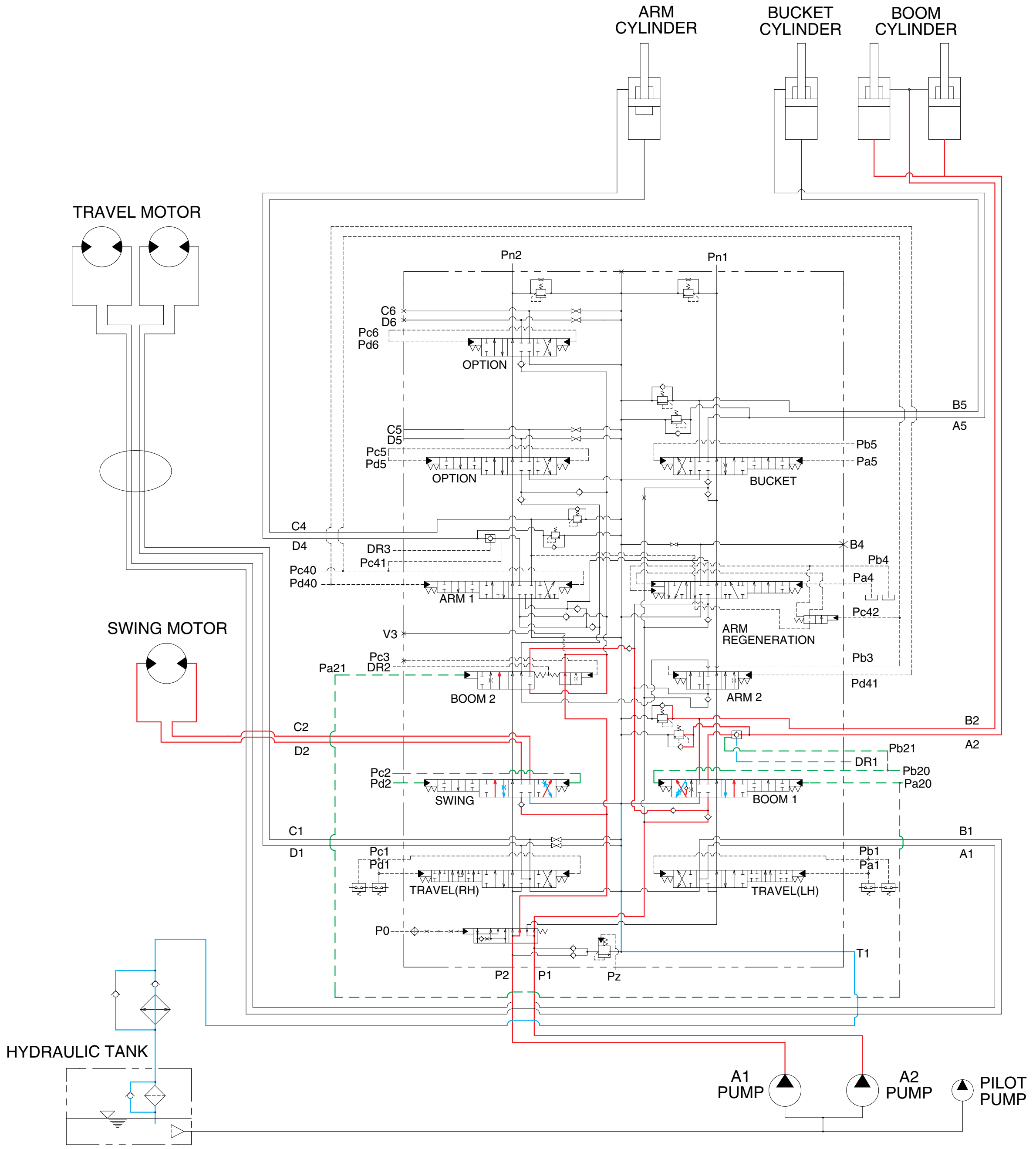
STRAIGHT TRAVEL SPOOL

This straight travel spool for straight travel is provided in the main control valve.

If any actuator is operated when traveling, the straight travel spool is pushed to the left by the pilot oil pressure.

Consequently, the left and right travel oil supply passage are connected, and equivalent amount of oil flows into the left and right travel motors. This keeps the straight travel.

2. COMBINED SWING AND BOOM UP OPERATION



RD14093HC21

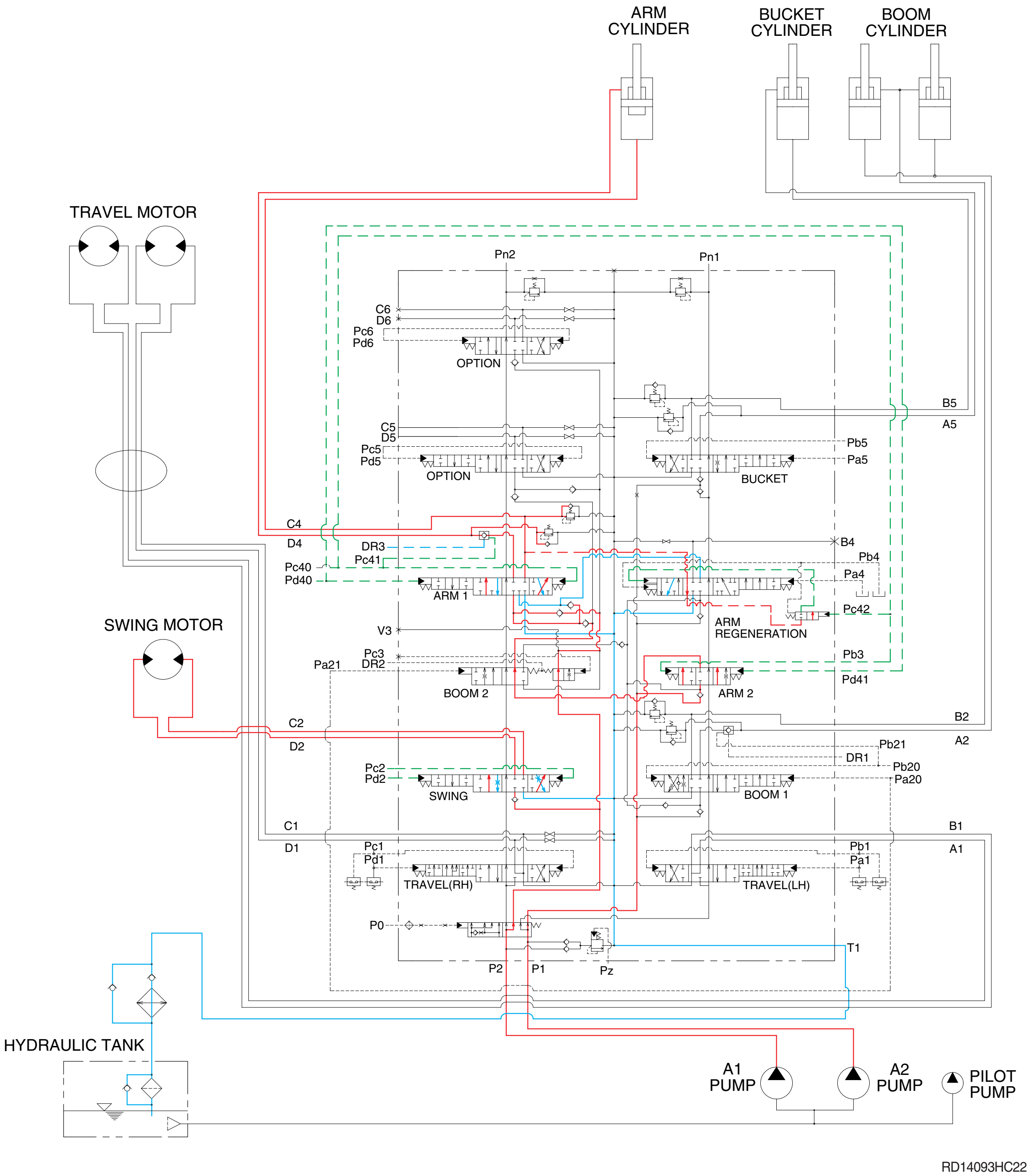
When the swing and boom functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor through swing spool and the boom cylinder through boom 2 spool.

The oil from the A2 pump flows into the boom cylinders through the boom 1 spool.

The superstructure swings and the boom is operated.

3. COMBINED SWING AND ARM OPERATION



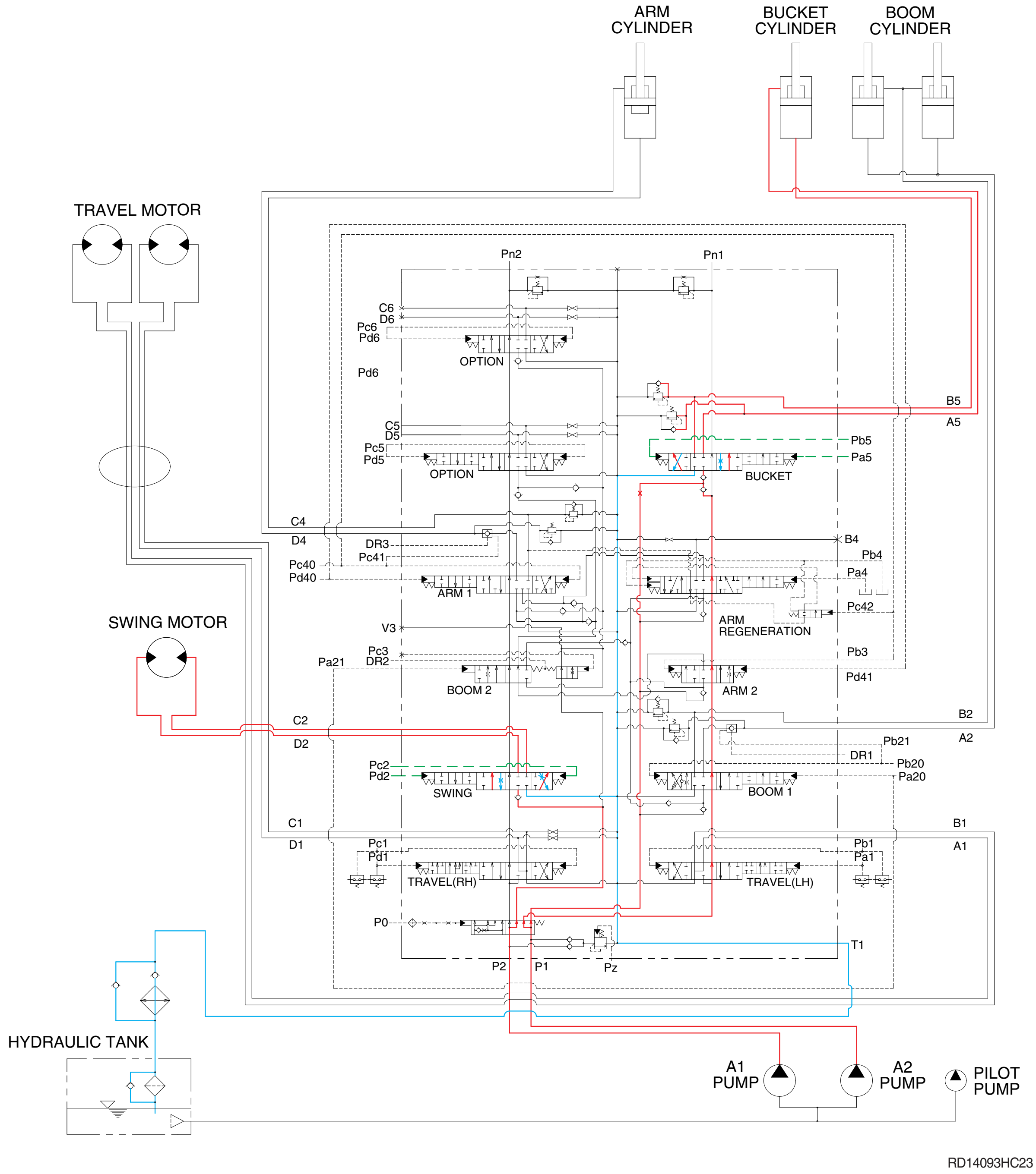
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor through swing spool and the arm cylinder through arm 1 spool.

The oil from the A2 pump flows into the arm cylinder through the arm 2 spool.

The superstructure swings and the arm is operated.

4. COMBINED SWING AND BUCKET OPERATION

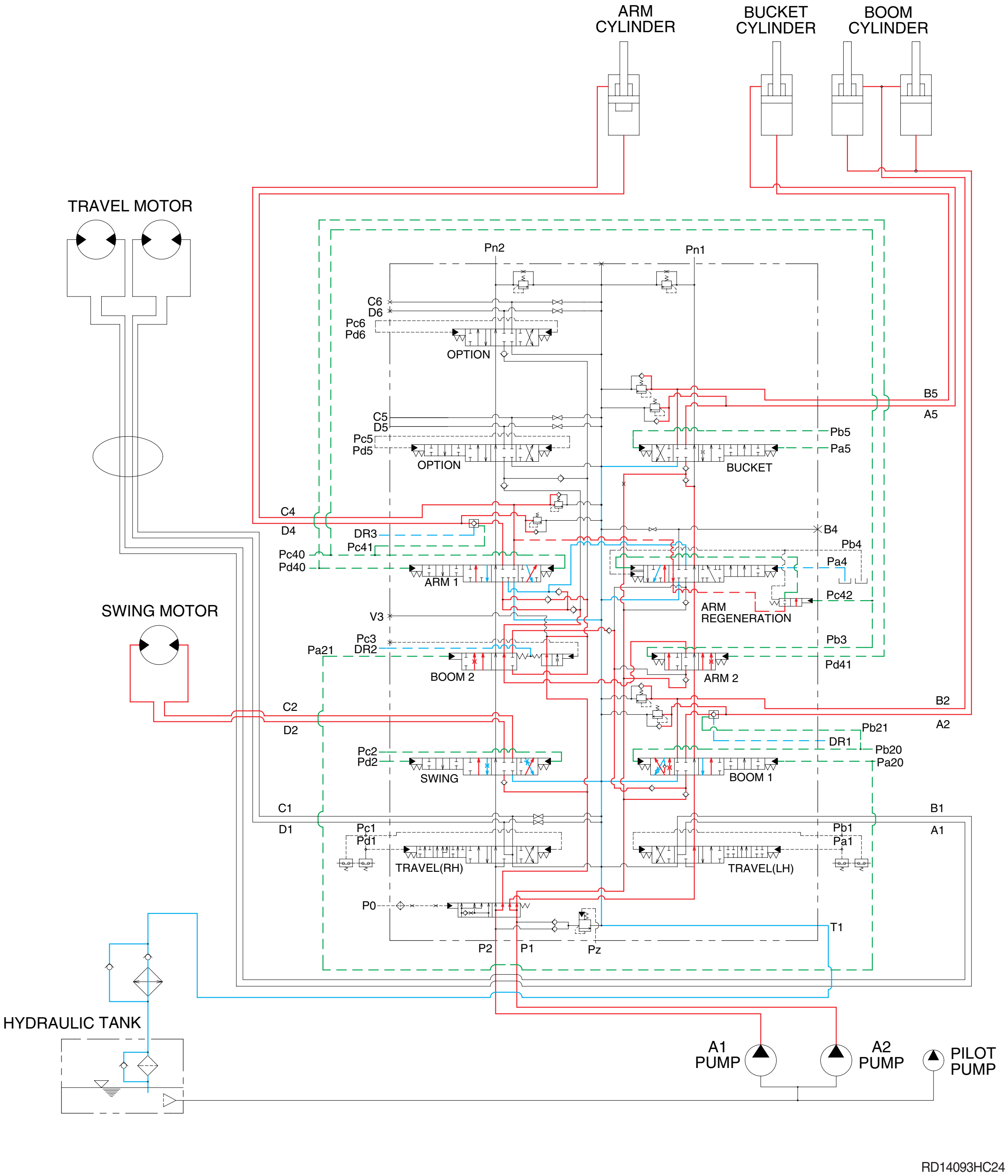


When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor through the swing spool.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool.

5. COMBINED SWING AND TRAVEL OPERATION



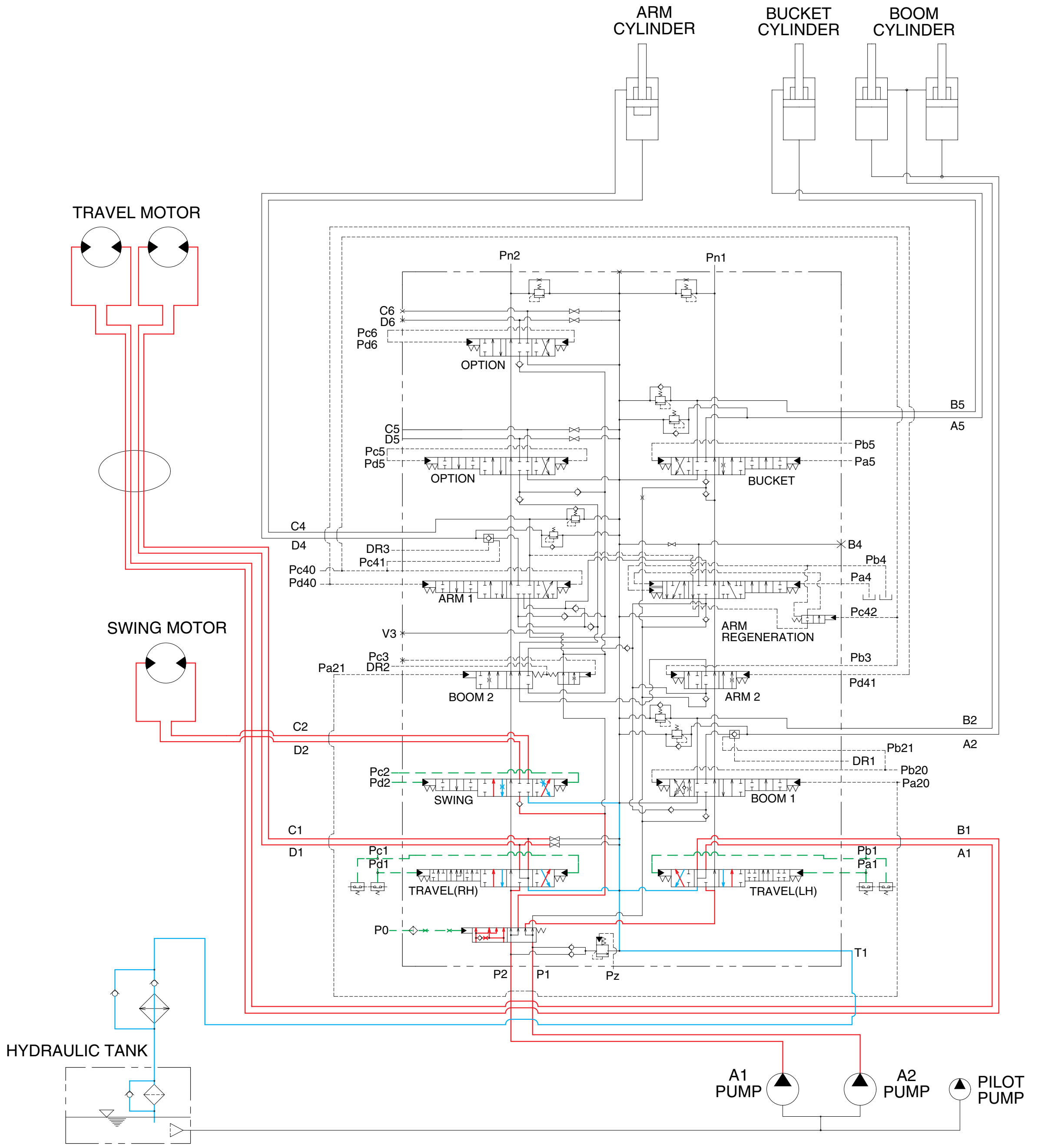
When the swing, boom, arm and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor, boom cylinders and arm cylinder through the swing spool, boom 2 spool, arm 1 spool, and the parallel and confluence oil passage.

The oil from the A2 pump flows into the boom cylinders, arm cylinder and bucket cylinder through the boom 1 spool, arm 2 spool, bucket spool and the parallel and confluence oil passage.

The superstructure swings and the boom, arm and bucket are operated.

6. COMBINED BOOM AND TRAVEL OPERATION



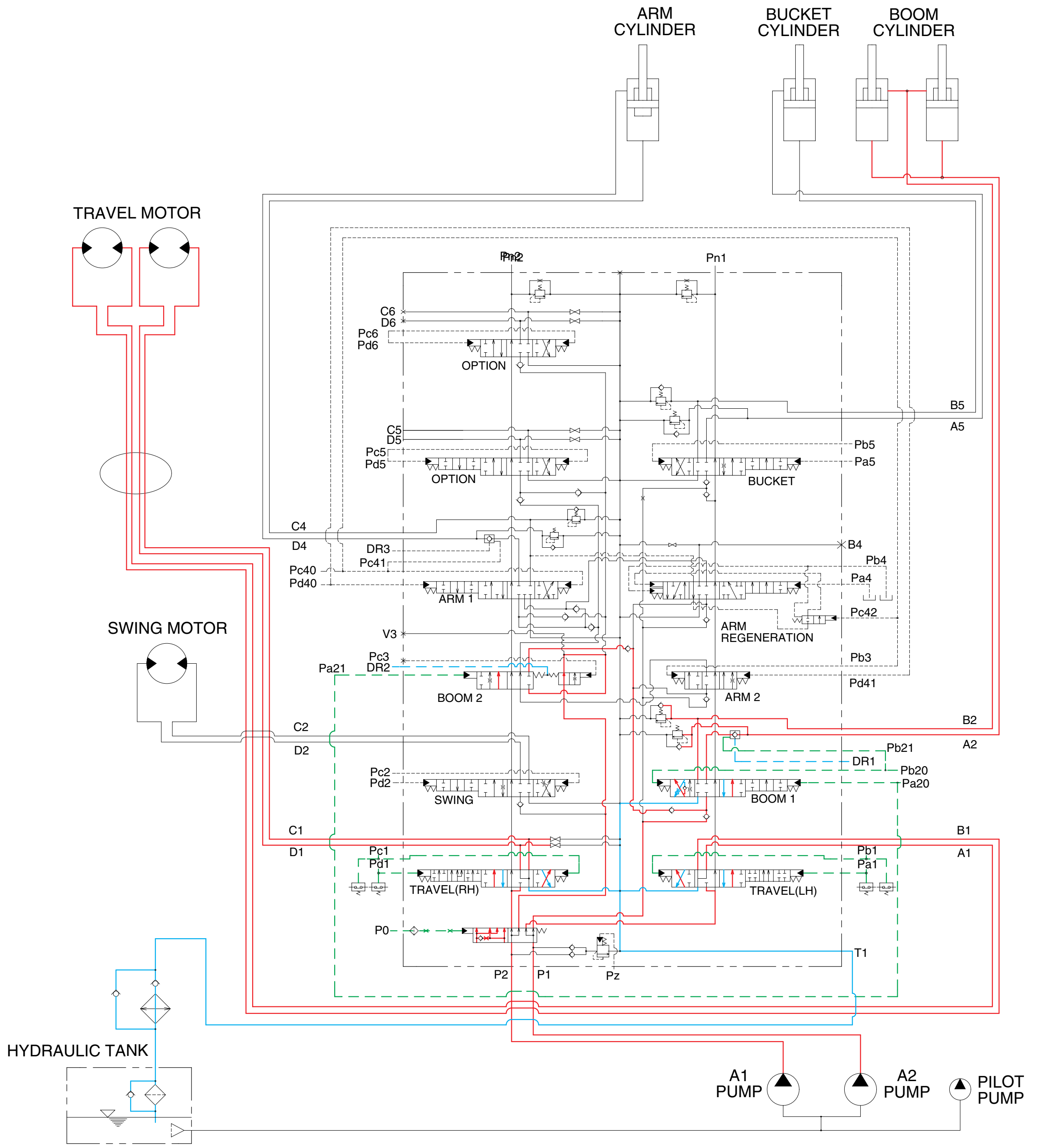
RD14093HC25

When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool is pushed to the left by the pilot oil pressure from the pilot pump.

The oil from the A2 pump flows into the swing motor through the swing spool. The oil from the A1 pump flows into the travel motor through the RH travel spool and the LH travel spool via the straight travel spool.

The superstructure swings and the machine travels straight.

7. COMBINED ARM AND TRAVEL OPERATION

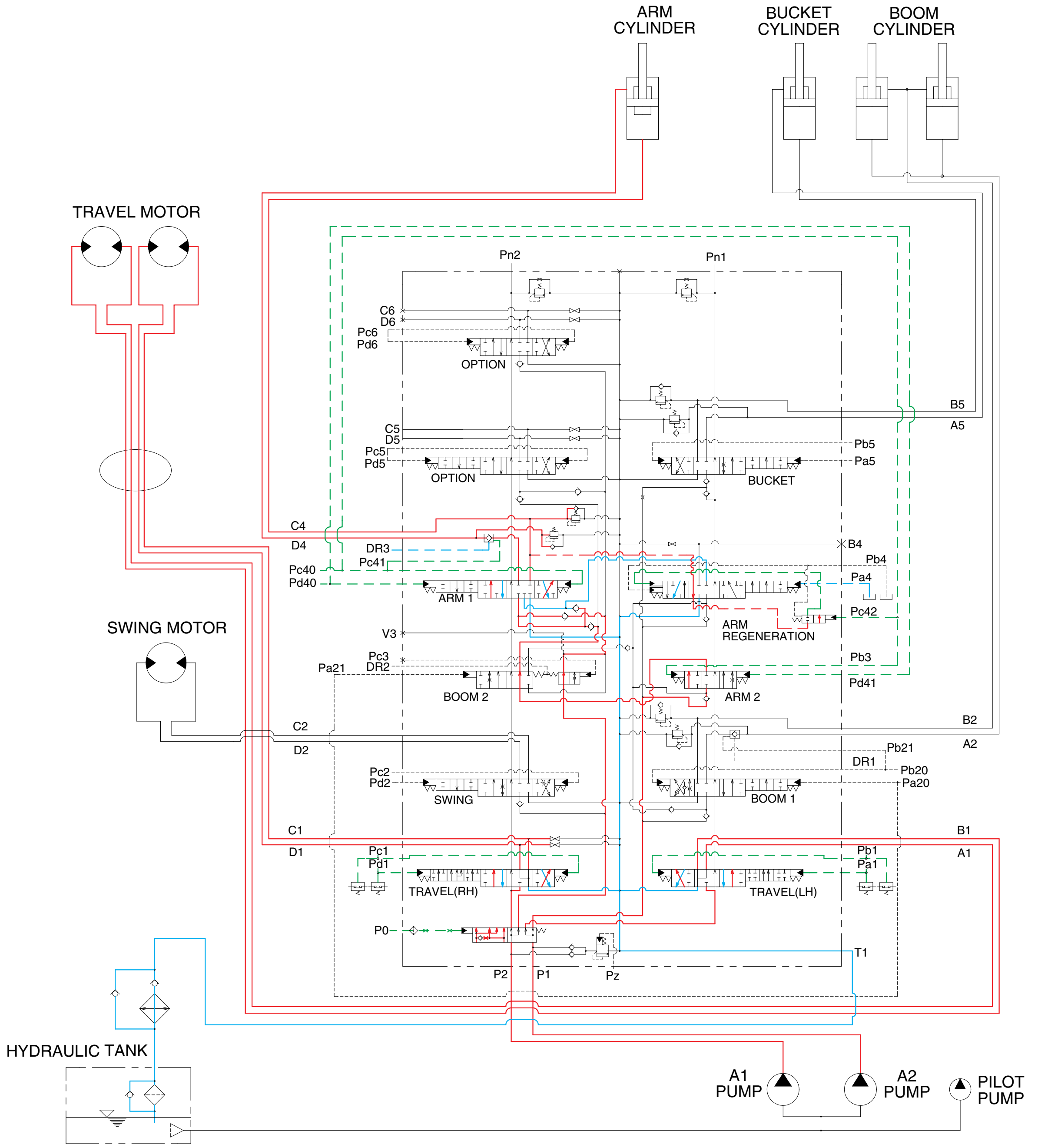


RD14093HC26

When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the left by the oil pressure from pilot pump.

The oil from the A2 pump flows into the boom cylinders through the boom 2 spool and boom 1 spool via the parallel and confluence oil passage in case boom up operation. The oil from the A1 pump flows into the travel motors through the RH travel spool and the LH travel spool via the straight travel spool.

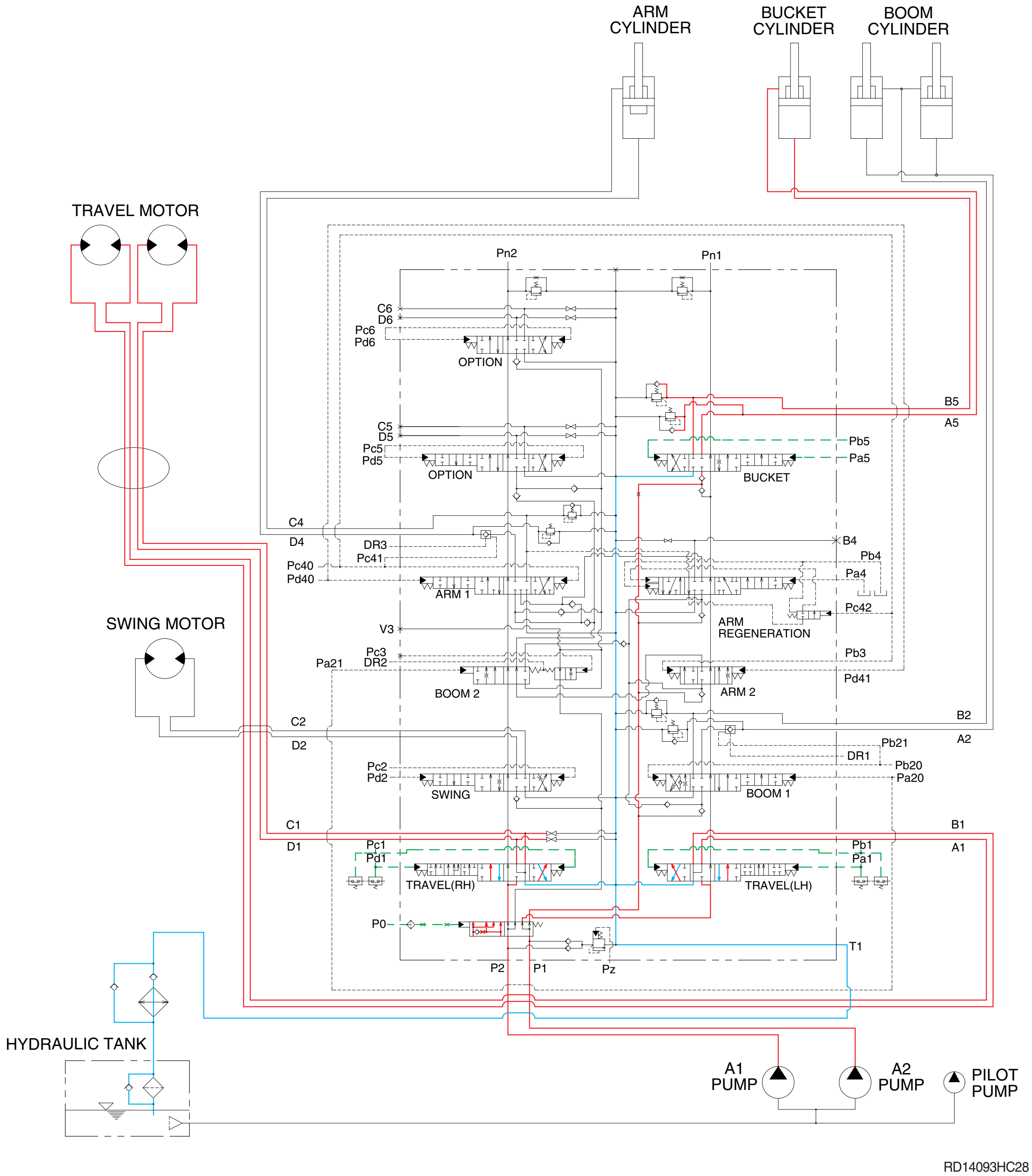
8. COMBINED BUCKET AND TRAVEL OPERATION



RD14093HC27

When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the left by the oil pressure from pilot pump.
The oil from the A2 pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage. The oil from the A1 pump flows into the travel motors through the RH travel spool and the LH travel spool via the straight travel spool.
The arm is operated and the machine travels straight.

9. COMBINED BUCKET AND TRAVEL OPERATION

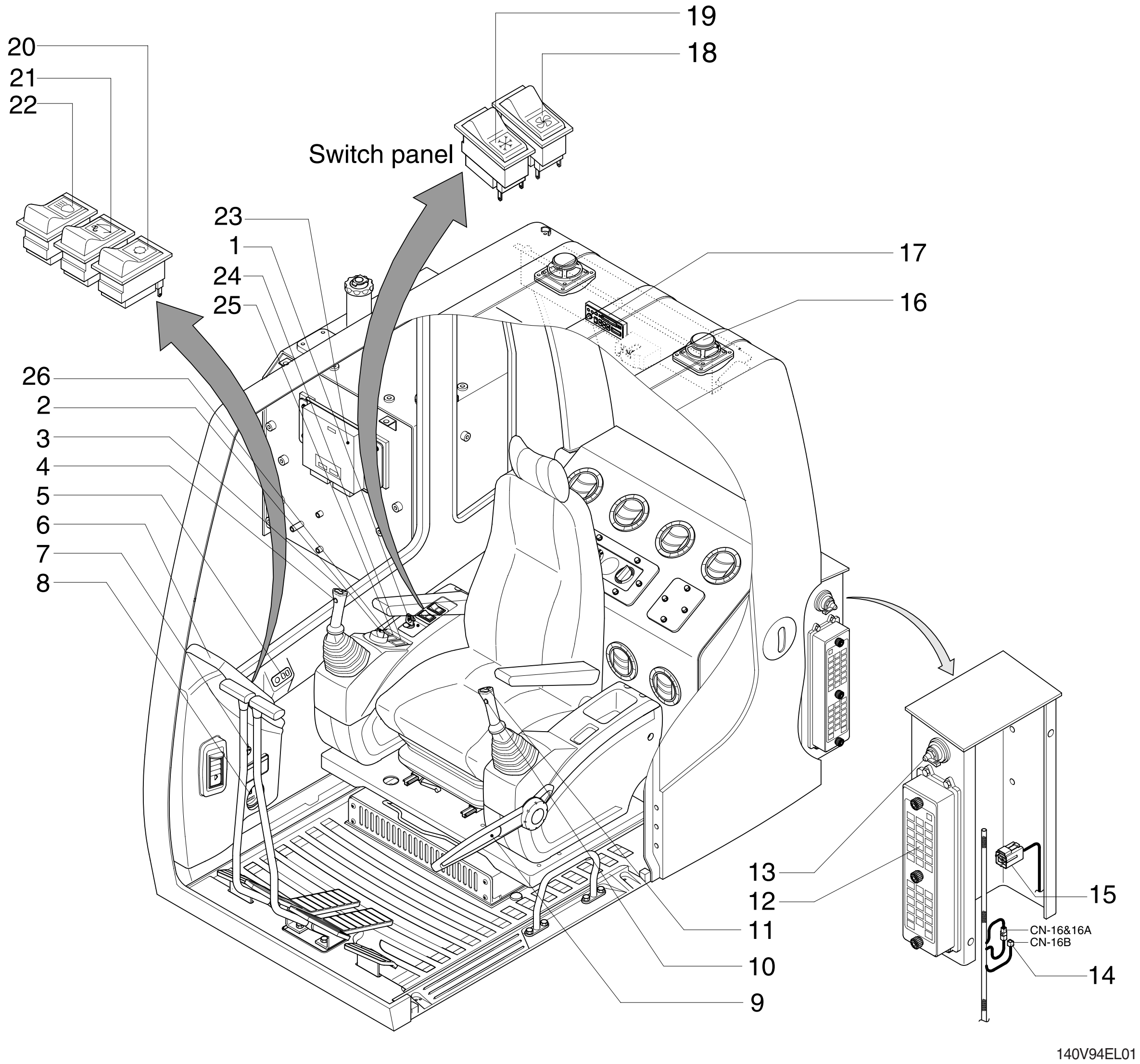


When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve, and the straight travel spool is pushed to the left by the oil pressure from pilot pump. The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage. The oil from the A1 pump flows into the travel motors through the RH travel spool and the LH travel spool via the straight travel spool of the control valve.
The bucket is operated and the machine travels straight.

SECTION 4 ELECTRICAL SYSTEM

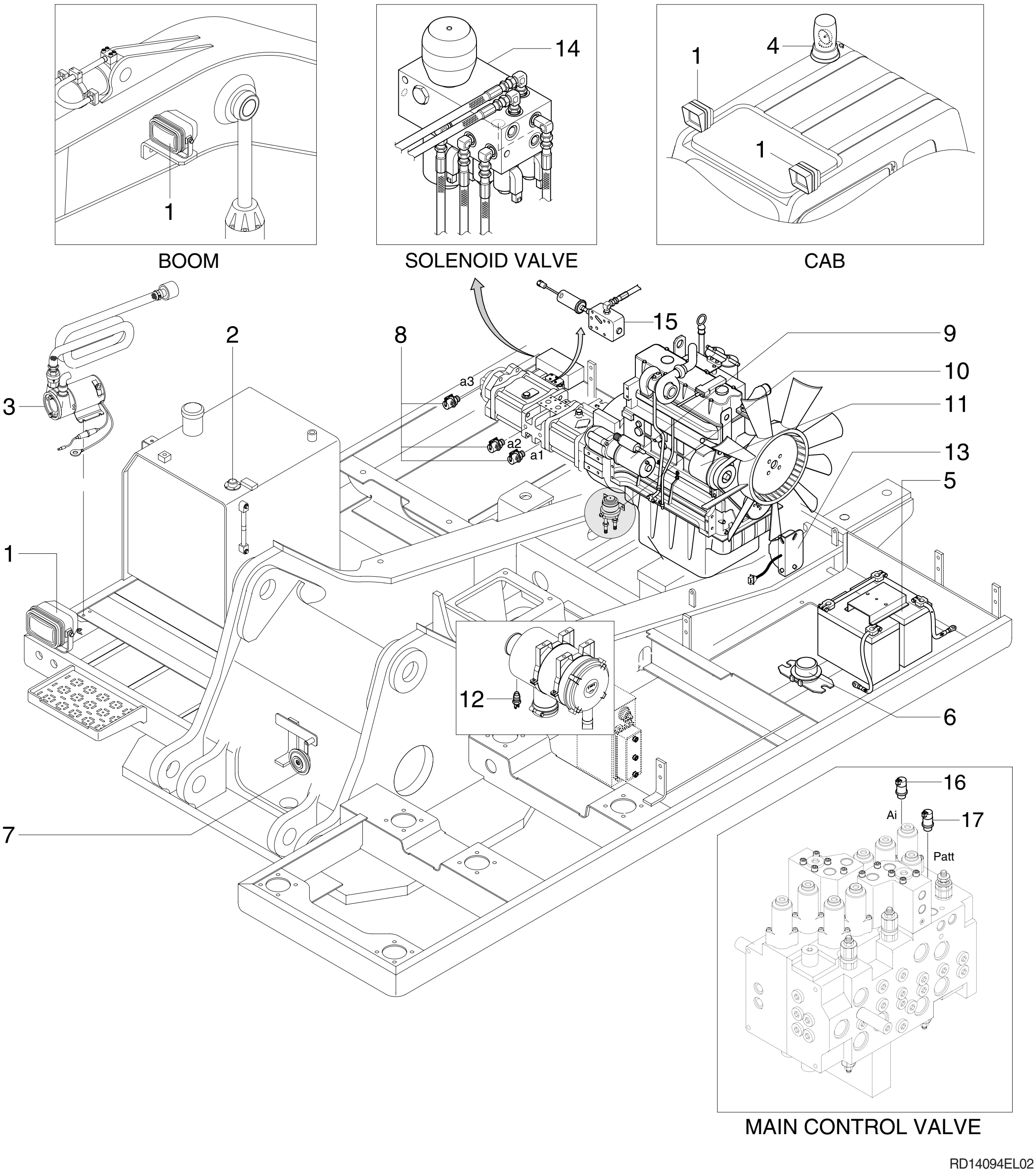
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



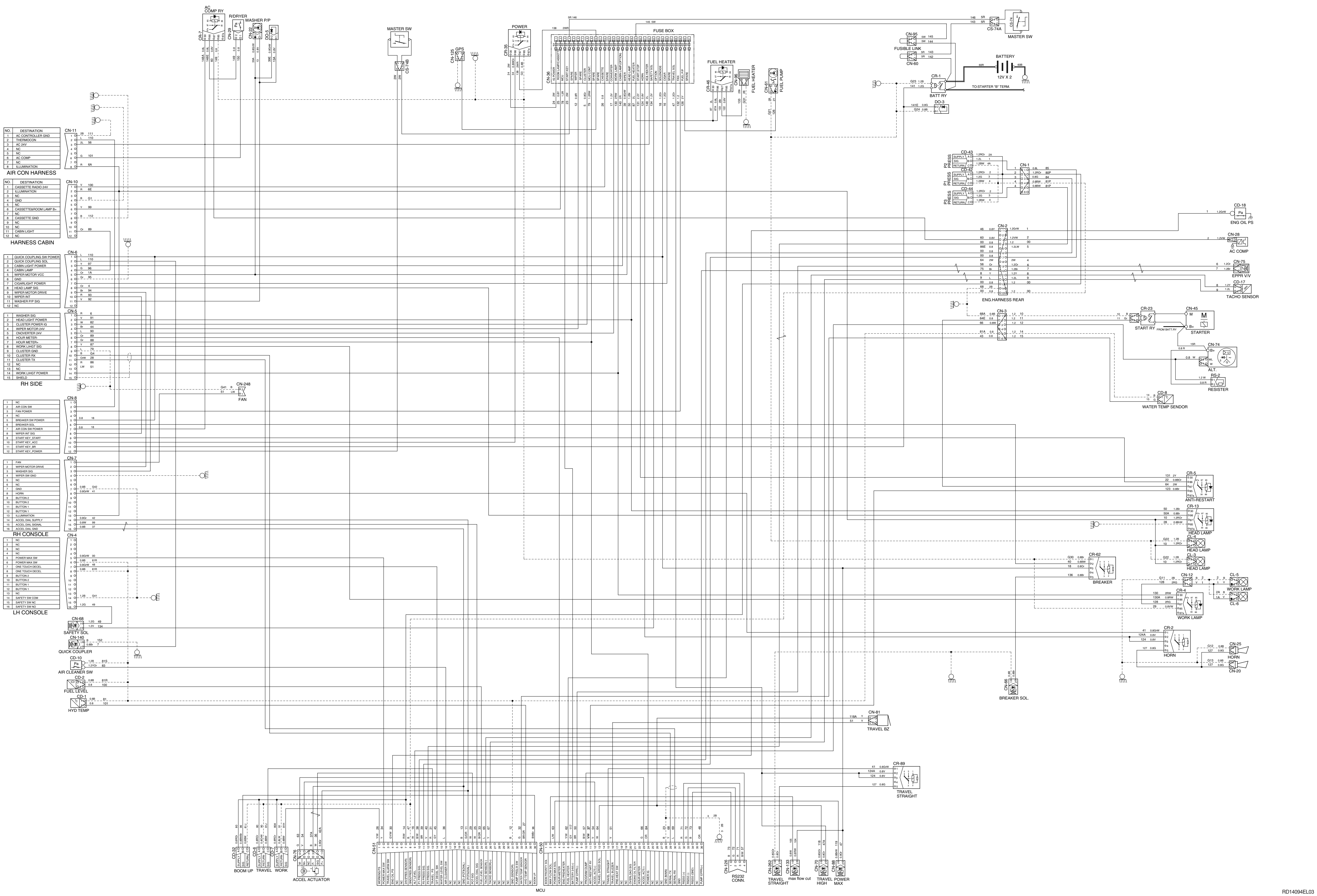
1	Start switch	10	Power max switch	19	Aircon switch
2	Accel dial switch	11	One touch decel switch	20	Main light switch
3	Horn switch	12	Fuse & relay box	21	Quick clamp switch
4	Breaker operation switch	13	Master switch	22	Cab light switch
5	Cassette & radio remote controller	14	Emergency engine connector	23	Machine control unit
6	Cluster	15	RS232 service socket	24	Wiper switch
7	Power socket	16	Speaker	25	Washer switch
8	Hour meter	17	Cassette & Radio	26	Breaker selection switch
9	Safety lever	18	Fan switch		

2. LOCATION 2

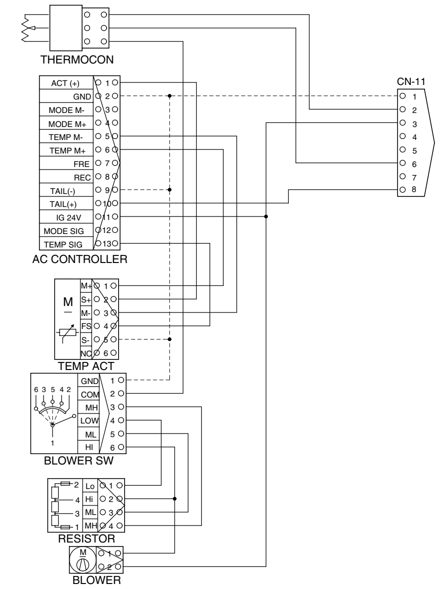


1	Lamp	7	Horn	13	Travel alarm buzzer
2	Fuel sender	8	Screw coupling	14	Solenoid valve
3	Fuel filler pump	9	Heater relay	15	Pump EPPR valve
4	Beacon lamp	10	Start relay	16	Travel pressure sensor
5	Battery	11	Alternator	17	Attach pressure sensor
6	Battery relay	12	Air cleaner switch		

GROUP 2 ELECTRICAL CIRCUIT(1/2)

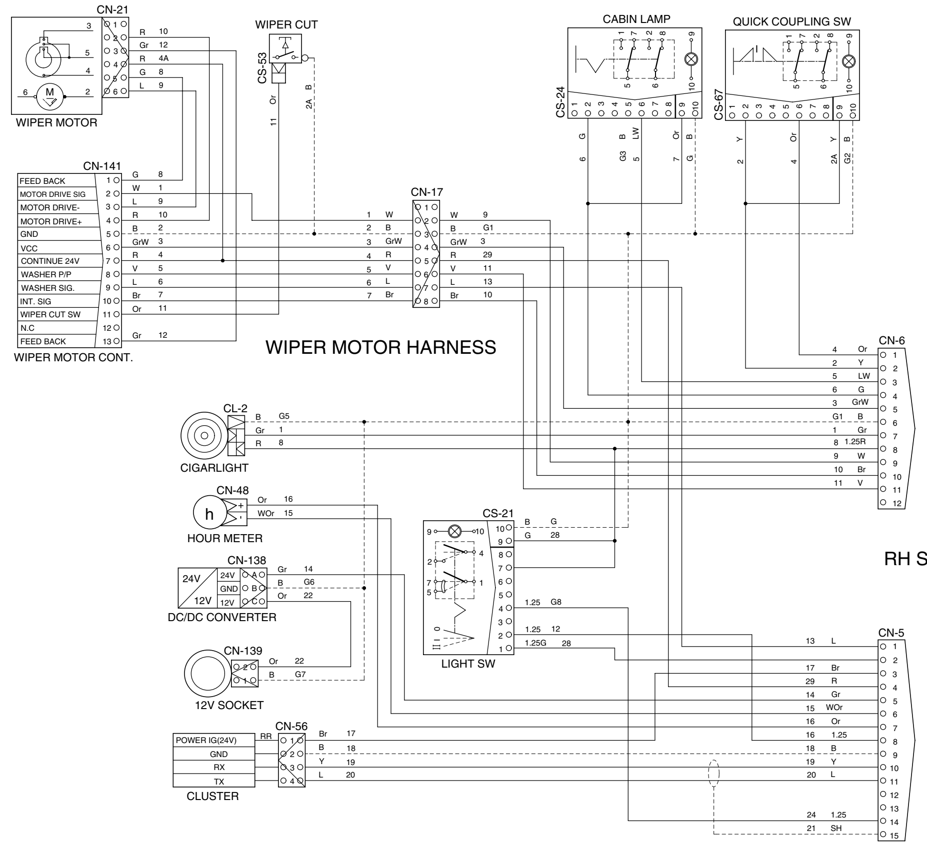


· ELECTRICAL CIRCUIT(2/2)



NO.	DESTINATION
1	GND
2	A/CON SW
3	FUSE(IG)
4	NC
5	NC
6	DPS(COMPRESSOR)
7	NC
8	ILLUMINATION

AIR CON



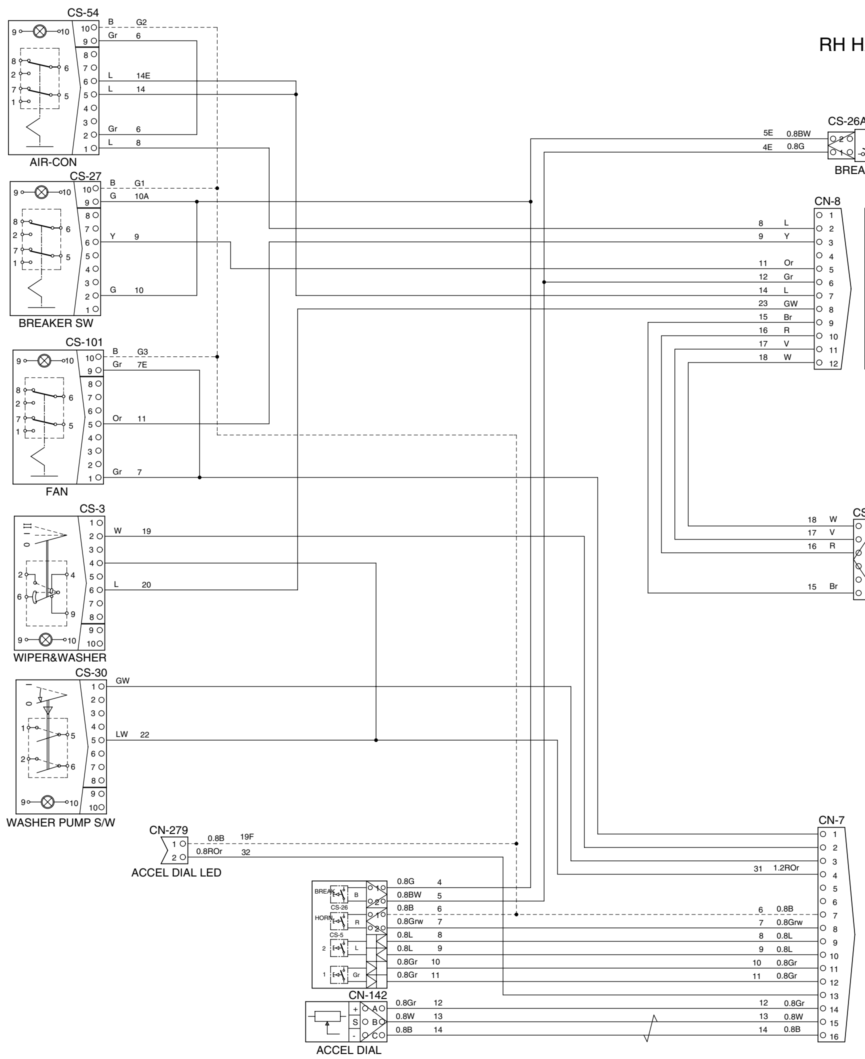
WIPER MOTOR HARNESS

NO.	DESTINATION
1	FUSE
2	QUICK COUPLING SOL
3	OVERLOAD PS
4	CABIN LAMP
5	FUSE
6	GND
7	FUSE
8	HEAD LAMP
9	SWITCH PANEL
10	SWITCH PANEL
11	WASHER PUMP
12	MCU

RH SIDE HARNESS

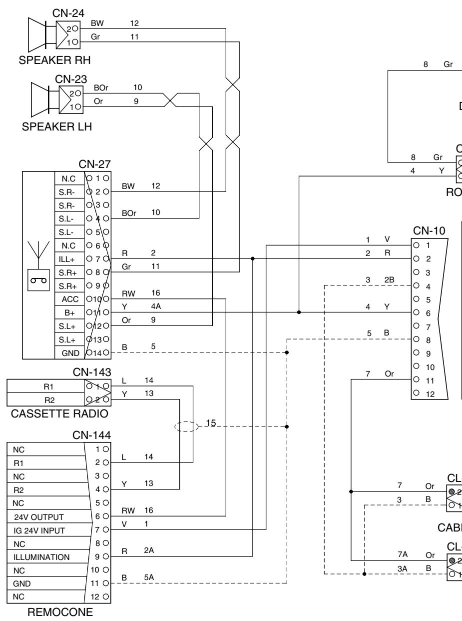
1	SWITCH PANEL
2	NC
3	FUSE
4	FUSE
5	FUSE
6	CPU CONTROLLER
7	FUSE
8	WORK LAMP
9	GND
10	MCU
11	MCU
12	MCU
13	GND
14	WORL LAMP FUSE
15	NC

RH HARNESS



1	NC
2	AIR-CON THERMOCON
3	FAN POWER
4	BEACON LAMP
5	FUSE
6	BRAKER SOL
7	FUSE
8	WIPER INT
9	ANTI-RESTART RY
10	POWER RELAY
11	DIODE(DO-2)
12	FUSE

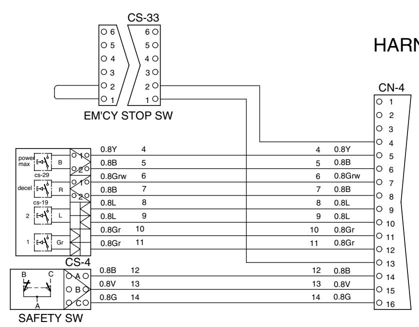
NO.	DESTINATION
1	FAN
2	WIPER DRIVE
3	WASHER SIG
4	WIPER SW GND
5	BREAKER SW
6	BREAKER RY
7	GND
8	HORN RY
9	NC
10	NC
11	NC
12	NC
13	ILLUMINATION
14	MCU_5V
15	MCU_ACCEL SIG.
16	MCU_SUPPLY GND



NO.	DESTINATION
1	FUSE
2	ILLUMINATION
3	
4	GND
5	
6	FUSE
7	
8	GND
9	
10	BEACON LAMP
11	SWITCH PANNEL
12	

CABIN HARNESS

HARNESS LH,CONSOLE



NO.	DESTINATION
1	NC
2	NC
3	NC
4	NC
5	MCU_POWER MAX
6	MCU_SIG.GND
7	MCU_DECEL
8	MCU_SIG.GND
9	NC
10	NC
11	NC
12	NC
13	NC
14	GND
15	NC
16	SAFETY SOL

140V94EC13

MEMORANDUM

HYUNDAI HEAVY INDUSTRIES CO., LTD
CONSTRUCTION EQUIPMENT DIV.

1. POWER CIRCUIT

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

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-74]

- → Fuse box [No.1] → Power relay [CR -35 (30)]
- → Fuse box [No.2] → I/conn [CN -10 (6)] → Cassette & radio [CN-27 (11)]
  → Room lamp [CL-1 (2)] → Door switch [CS-1]
- → Fuse box [No.3] → MCU [CN-50 (7)]
- → Fuse box [No.4] → Master switch [CS-74B] → I/conn [CN-8 (12)] → Start switch [CS-2 (1)]
- → Fuse box [No.6] → I/conn [CN - 5 (4)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]

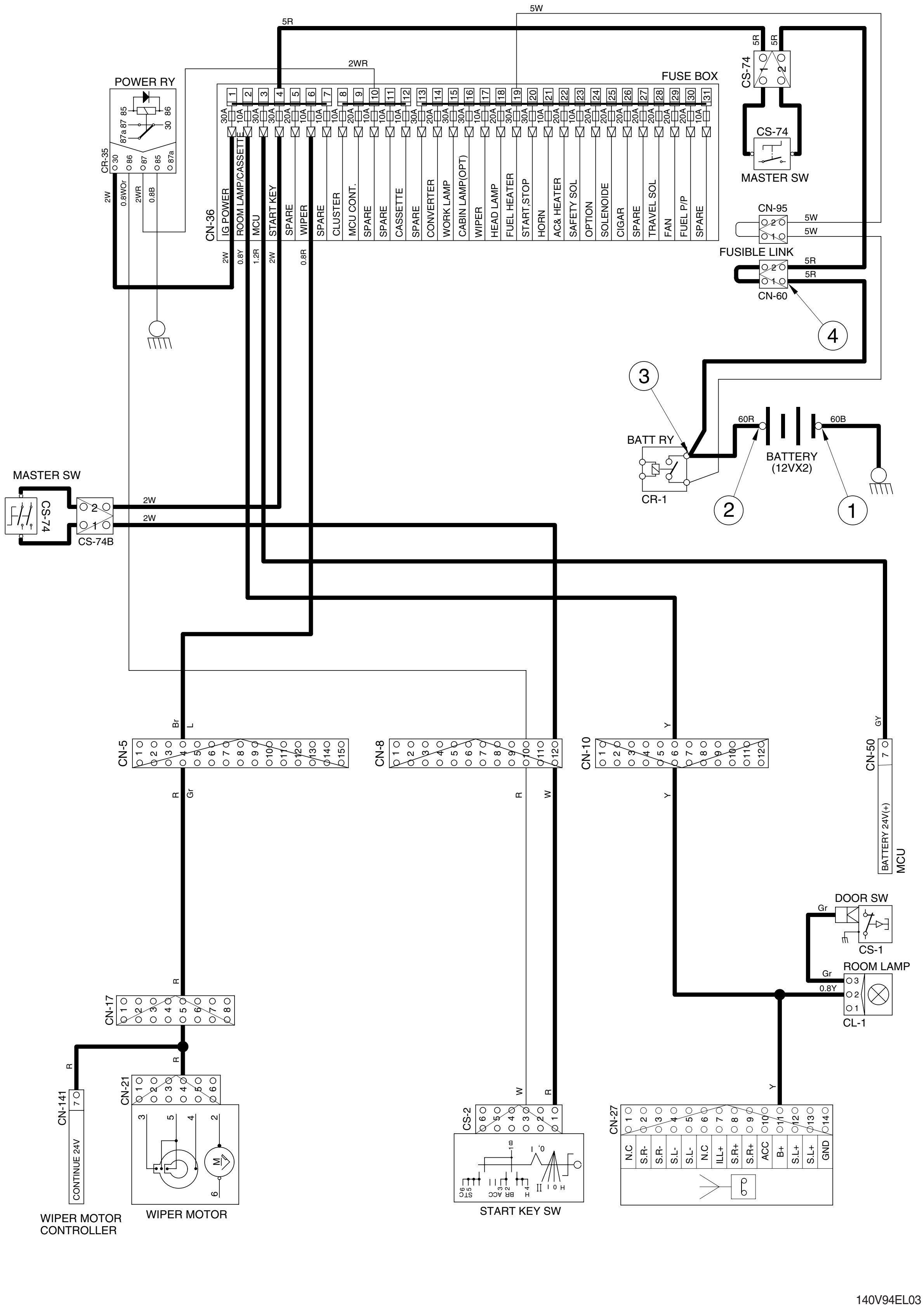
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	OFF	① - GND (battery 1EA)	10~12.5V
		② - GND (battery 2EA)	20~25V
		③ - GND (battery 2EA)	20~25V
		④ - GND (fusible link)	20~25V

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Fusible link [CN-60] → Master switch [CS-74] → Fuse box [No.4] → 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)]
→ Power relay [CR-35 (86) → (87)] → Fuse box [No.10]

(2) When start key switch is in START position

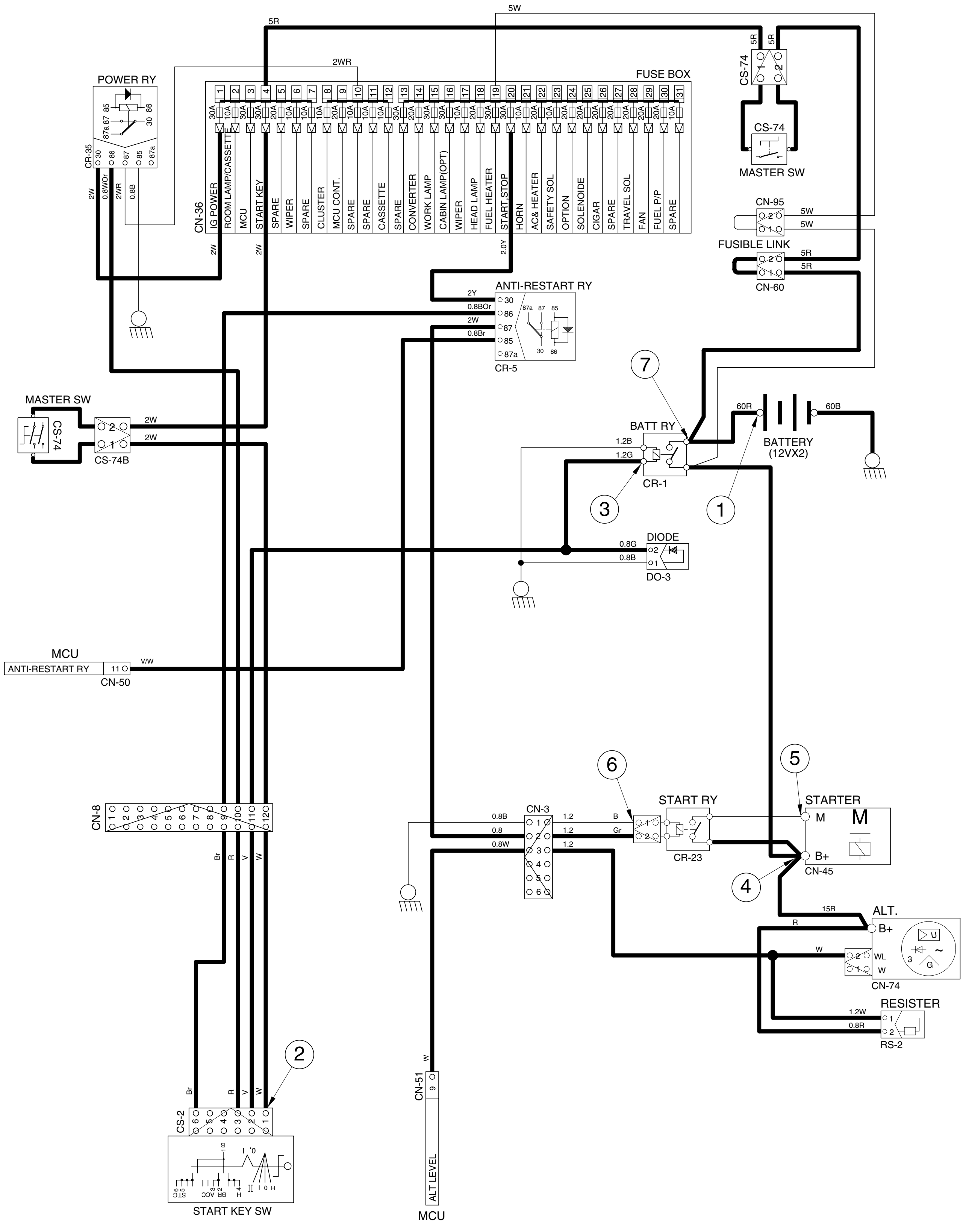
Start switch START [CS-2 (6)] → I/conn [CN-8 (9)] → Anti-restart relay [CR-5 (86) → (87)] → I/conn [CN-3 (2)] → Start relay [CR-23]

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

※ GND : Ground

STARTING CIRCUIT



140V94EL04

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 "I" terminal [CN-74 (2)] → I/conn [CN-3 (3)] → MCU alternator level [CN-51 (9)]
Cluster charging warning lamp (Via serial interface)

(2) Charging flow

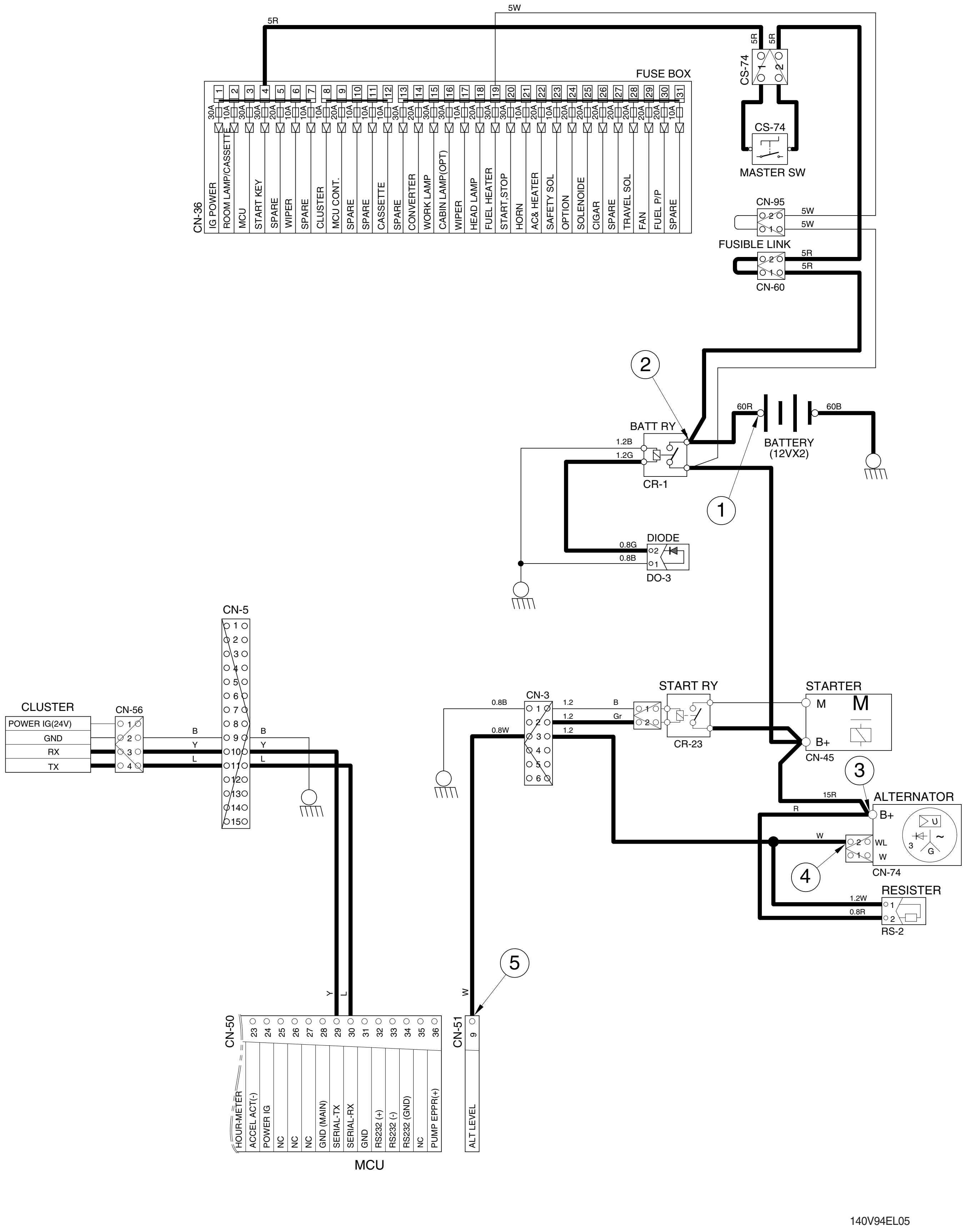
Alternator "B^+" terminal → Battery relay(M8) → Battery(+) terminal
→ Fusible link [CN-60] → Master switch [CS-74]
→ Fuse box

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 I terminal) ⑤ - GND (MCU)	20~30V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.18) → Head light relay [CR-13 (30,86)]
Fuse box (No.15) → Work light relay [CR-4 (30,86)]

(1) Head light switch ON

Head light switch ON [CS-21 (7)] ┬→ I/conn [CN-6 (8)] → Head light relay [CR-13 (86) → (87)]
└→ Cigar light [CL-2]

┬→ Head light ON [CL-3 (1)] , [CL-4 (1)]
├→ I/conn [CN-11 (8)] → AC & Heater controller illumination ON [10]
└→ I/conn [CN-10 (2)] ┬→ Remote controller illumination ON [CN-144 (9)]
└→ Cassette & radio illumination ON [CN-27 (7)]

(2) Work light switch ON

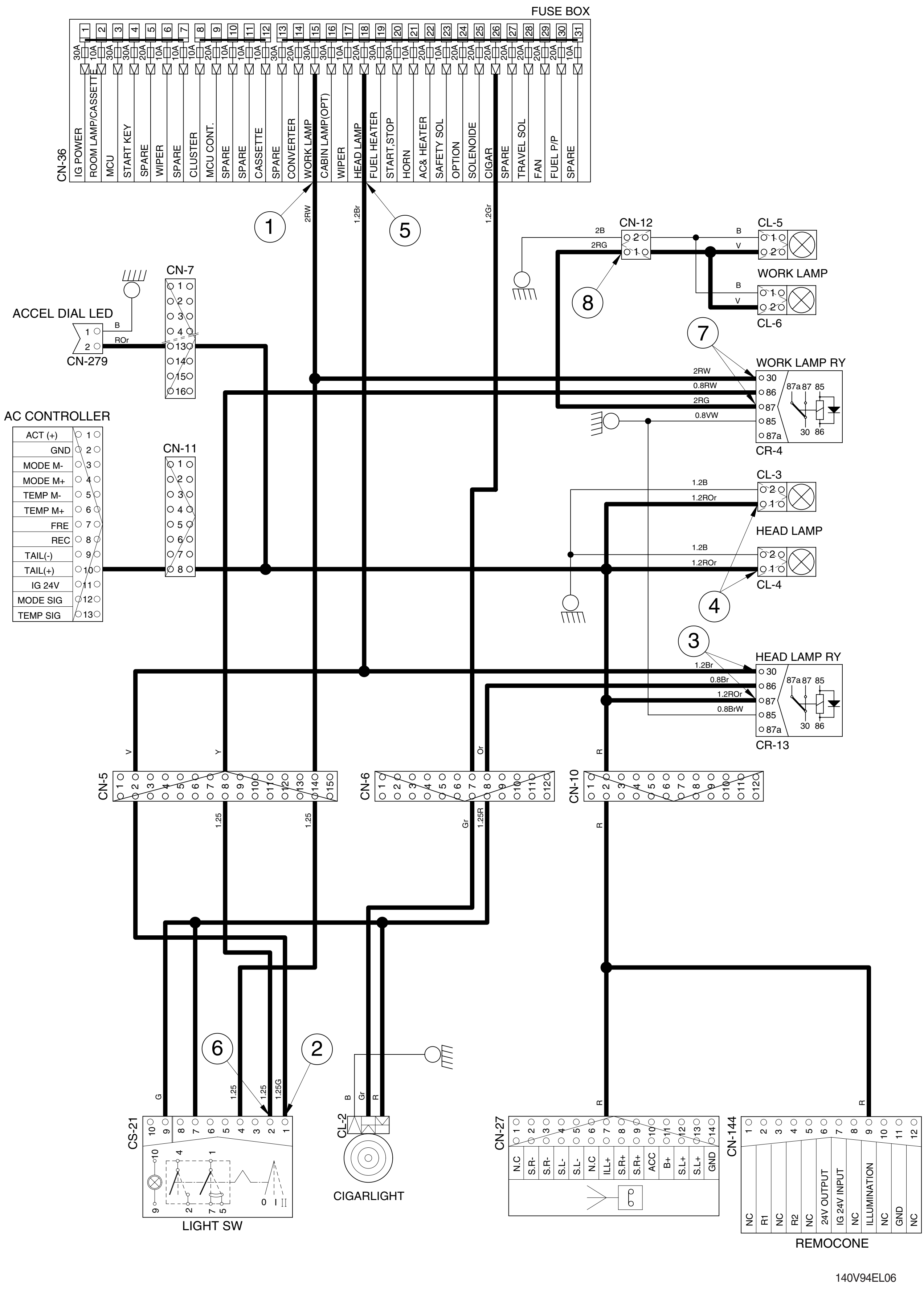
Work light switch ON [CN-21 (2)] → I/conn [CN-5 (8)] → Work light relay [CR-4 (86) → (87)]
→ I/conn [CN-12 (1)] → Work light ON [CL-5 (2), CL-6 (2)]

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 relay) ⑧ - GND (work light)	20~25V

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



5. CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.16) → Cab light relay [CR-9 (30, 86)]

(1) Cab light switch ON

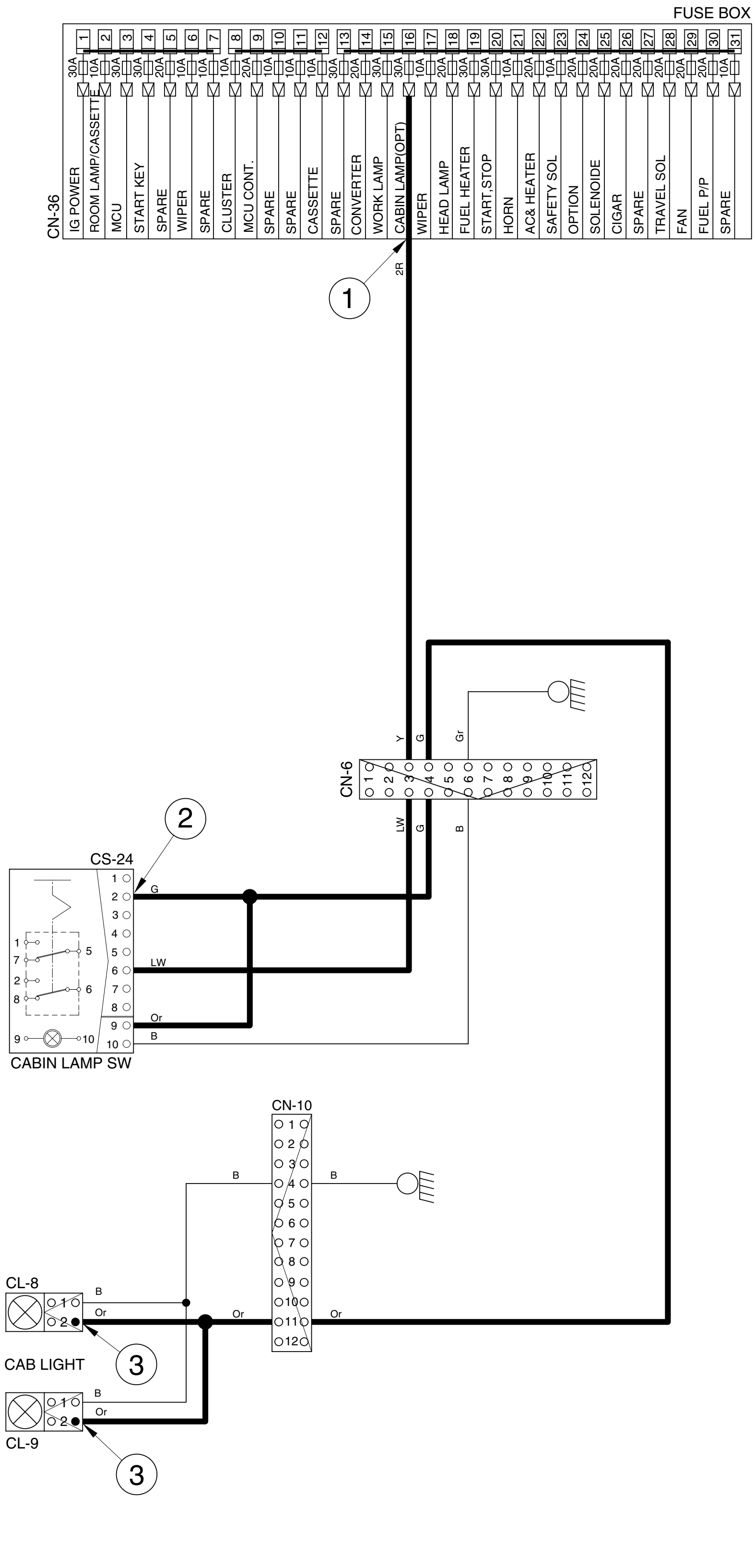
Cab light switch ON [CS-24 (2)] → I/conn [CN-6 (4)] → I/conn [CN-10 (11)]
→ Cab light ON [CL-8 (2)]
→ Cab light ON [CL-9 (2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (cabin light relay) ③ - GND (cab light)	20~25V

※ GND : Ground

CAB LIGHT CIRCUIT



140V94EL07

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.6) → I/conn [CN-5 (4)] → I/conn [CN-17 (5)] ┬→ Wiper motor controller [CN-141(7)]
└→ Wiper motor [CN-21(4)]

Fuse box (No.17) ┬→ 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 [CS-3 (6)] → I/conn [CN-8 (8)] → I/conn [CN-6 (10)] → I/conn [CN-17 (8)]
→ Wiper motor controller [CN-141 (10) → (3)] → Wiper motor intermittently operating [CN-21 (6)]

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

Wiper switch ON [CS-3(2)] → I/conn [CN-7 (2)] → I/conn [CN-6 (9)] → I/conn[CN-17(2)]
→ Wiper motor controller [CN-141(2) → (4)] → Wiper motor operating [CN-21(2)]

(4) Washer switch ON

Washer switch ON [CS-30(1)] → I/conn [CN-7 (3)] → I/conn [CN-5 (1)] → 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)] → Washer operating
→ Wiper switch ON [CS-3 (2)] → I/conn [CN-7 (2)] → I/conn [CN-6 (9)] → I/conn[CN-17 (2)]
→ Wiper motor controller [CN-141 (2) → (4)] → Wiper motor operating [CN-21 (2)]

(5) Auto parking(when switch OFF)

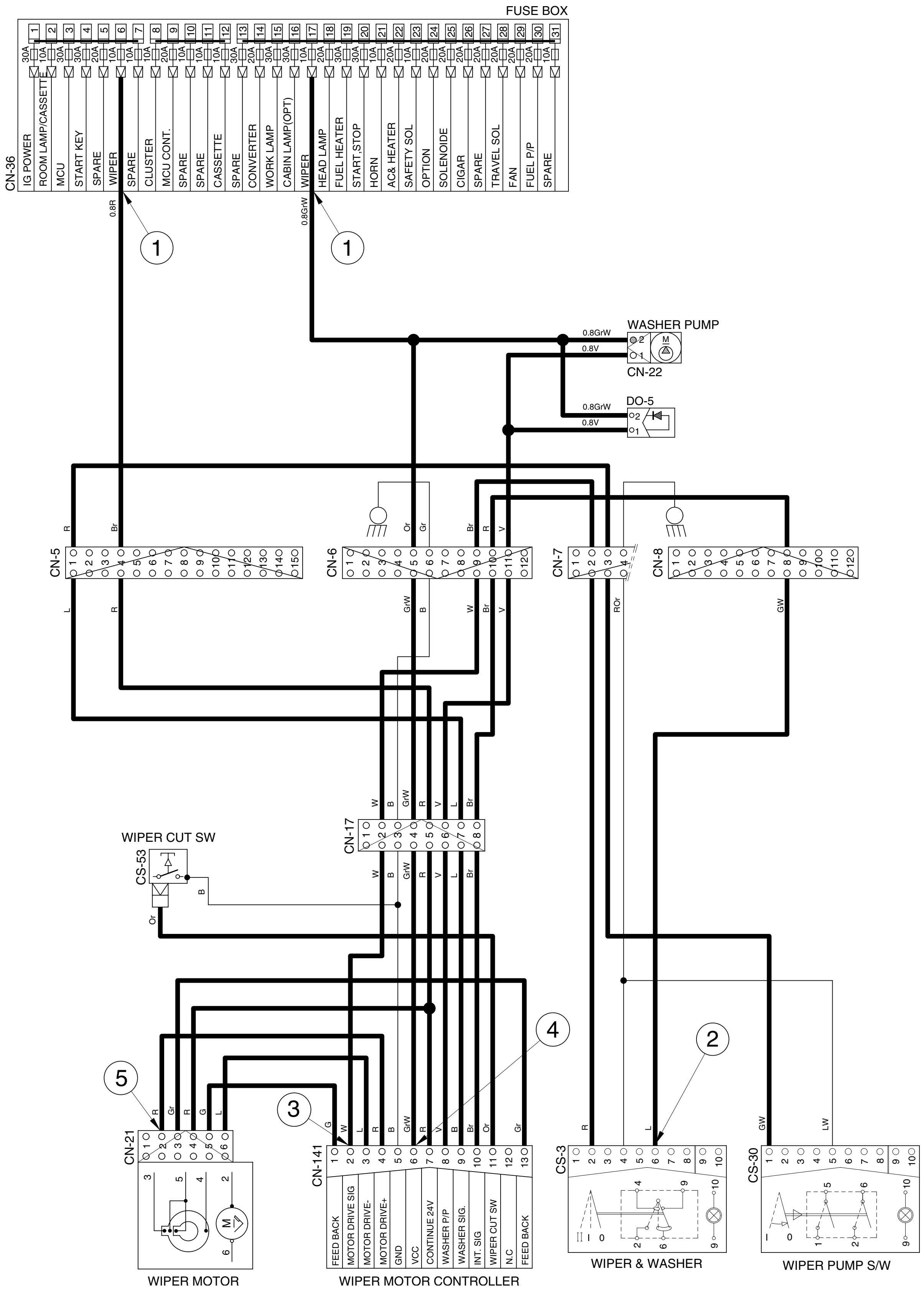
Switch OFF [CS-3 (2)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

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

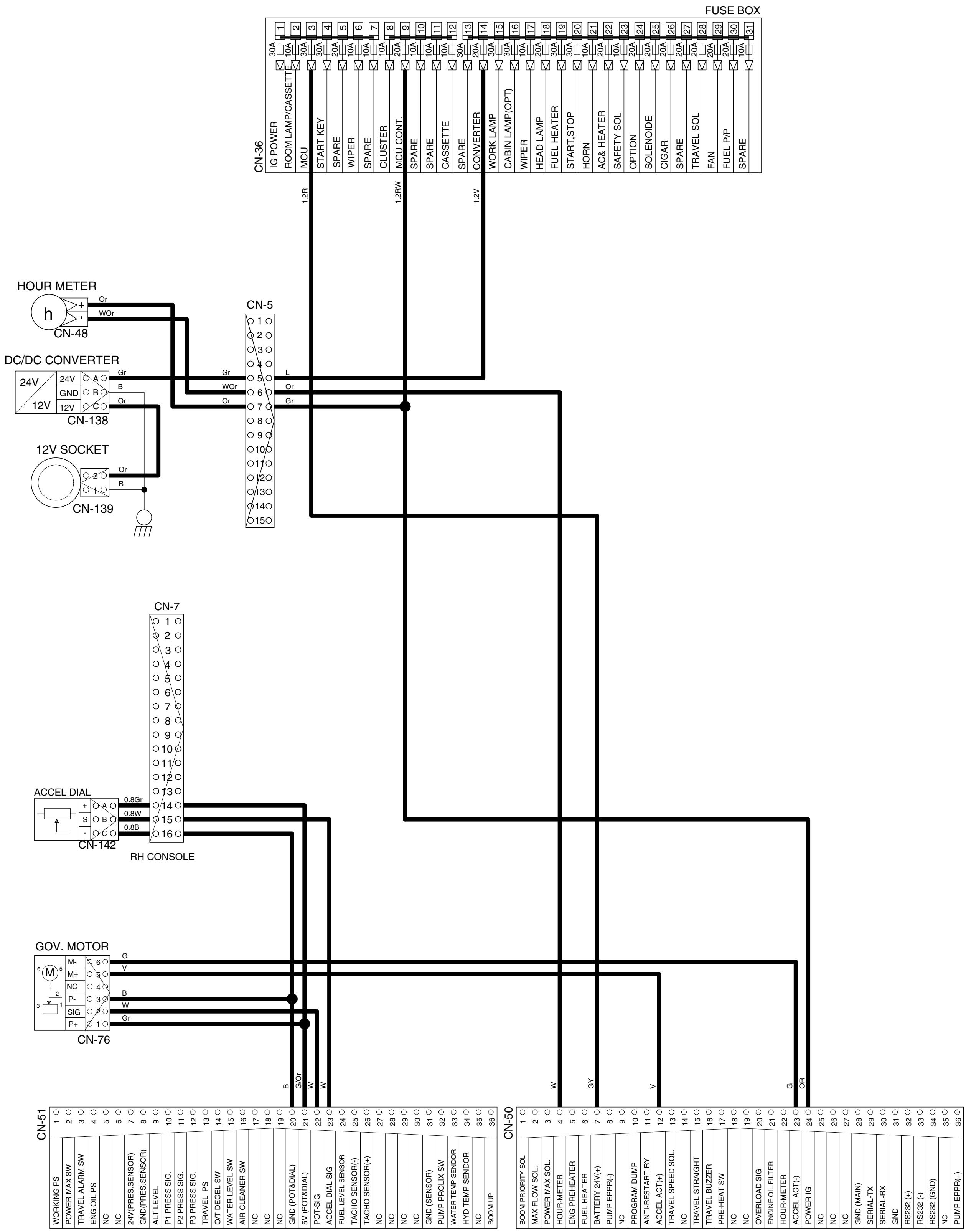
※ GND : Ground

WIPER AND WASHER CIRCUIT



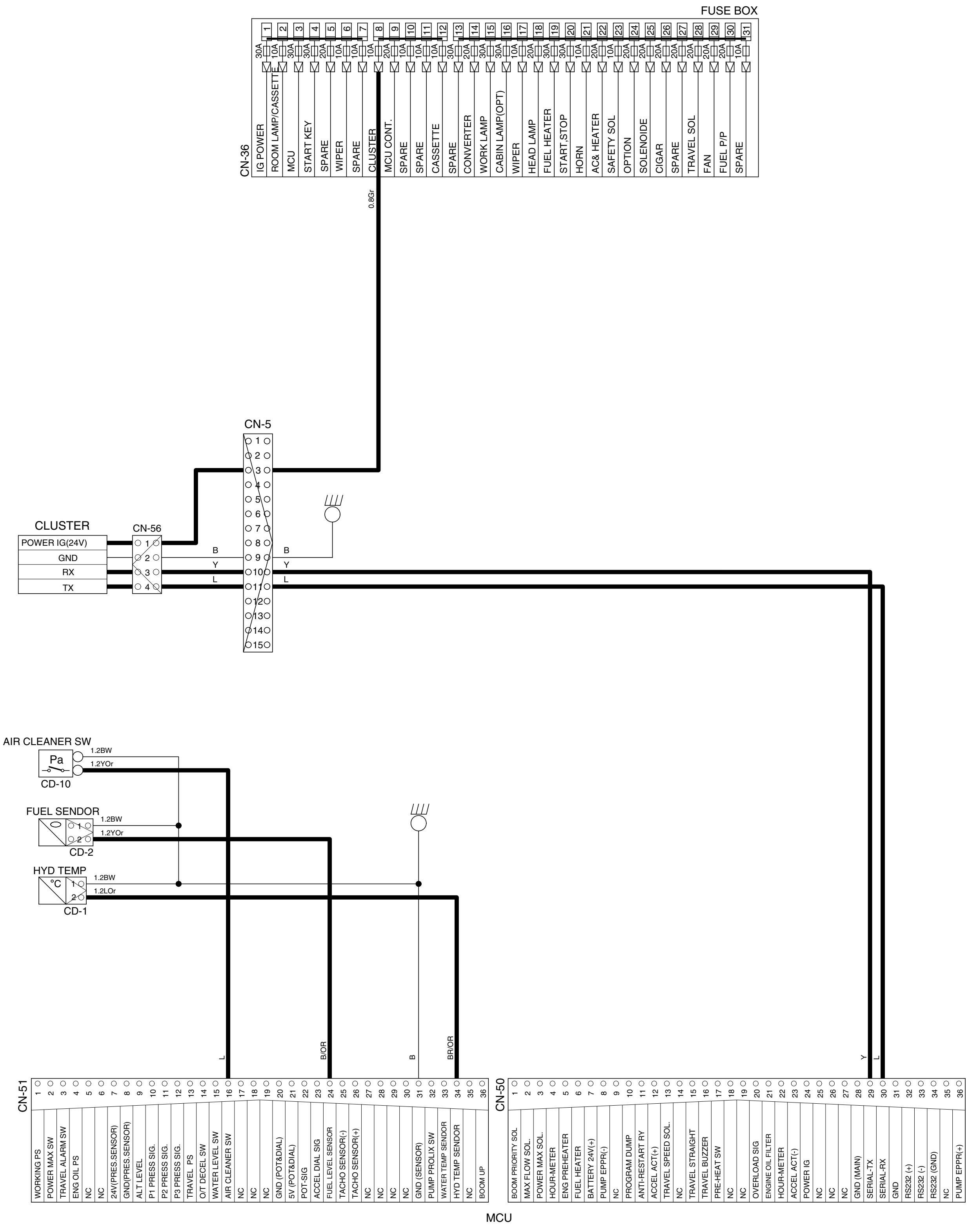
140V94EL08

CONTROLLER CIRCUIT



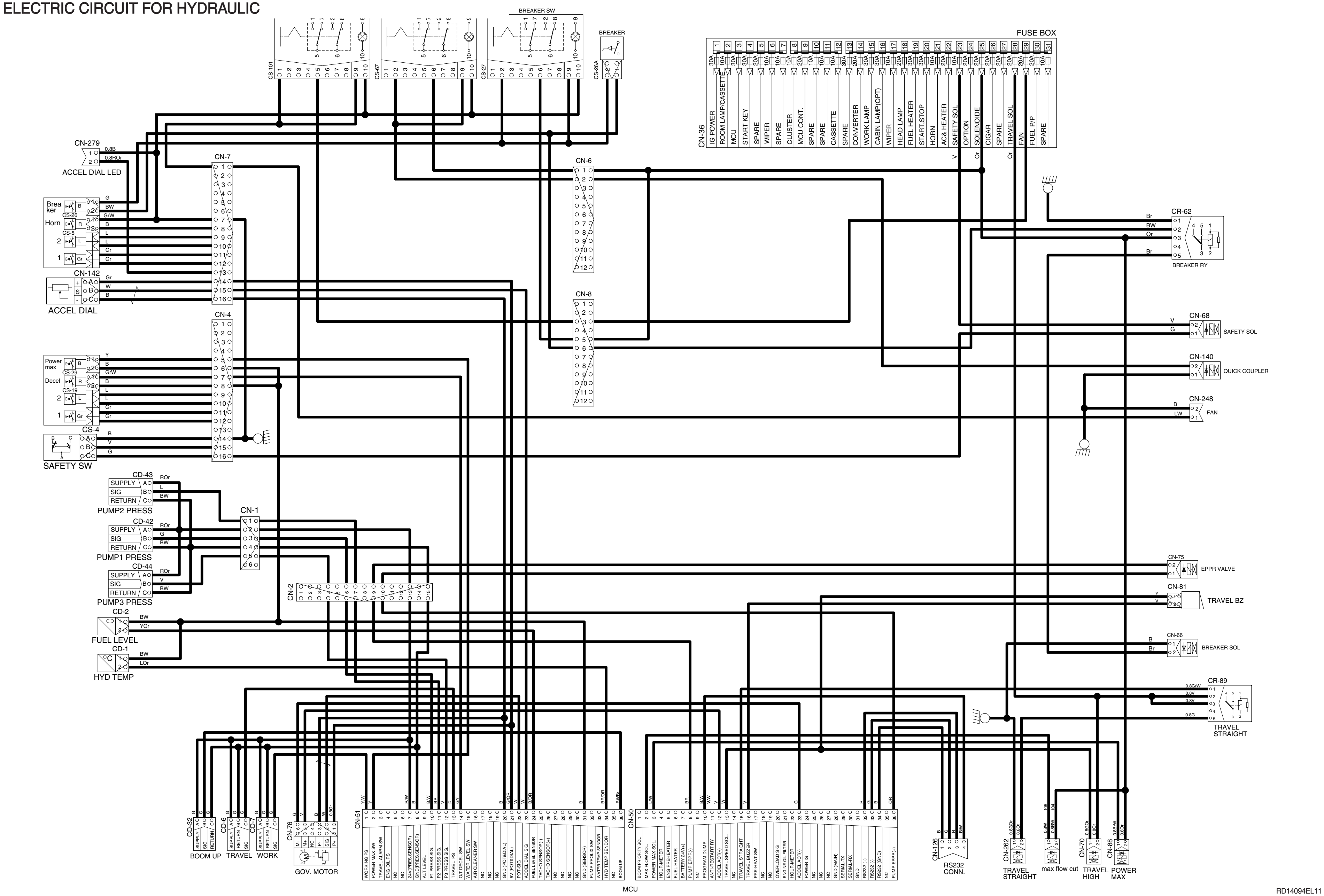
140V94EL09

MONITORING CIRCUIT

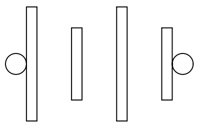
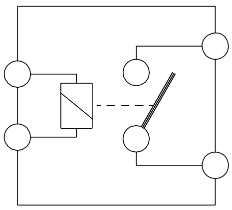
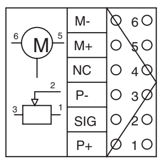
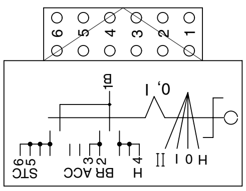
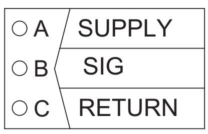
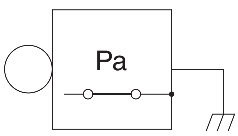


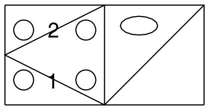
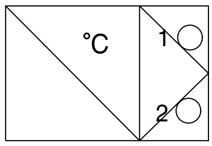
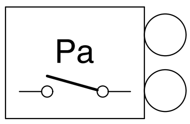
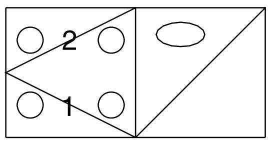
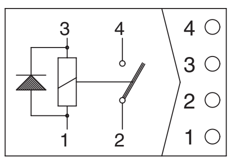
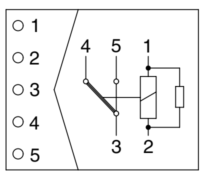
140V94EL10

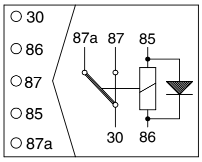
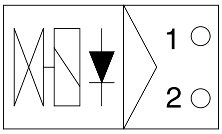
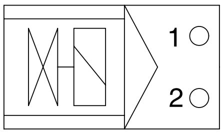
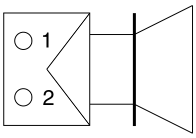
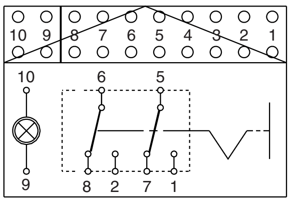
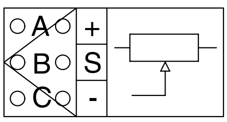
ELECTRIC CIRCUIT FOR HYDRAULIC

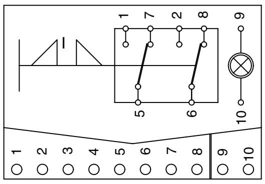
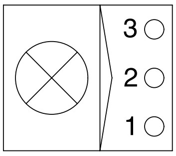
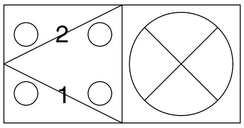
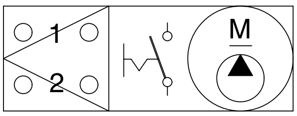
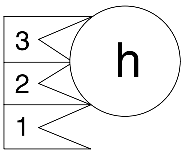


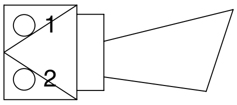
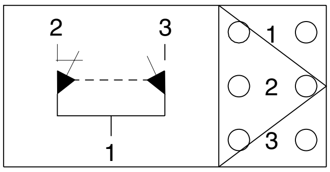
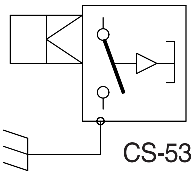
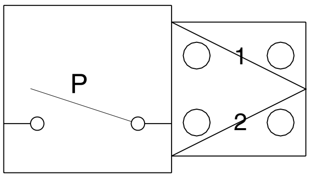
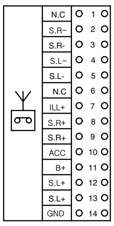
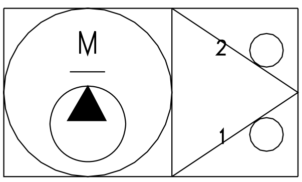
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

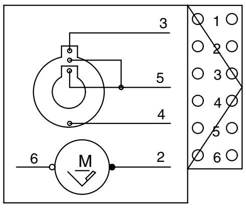
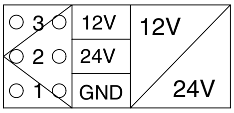
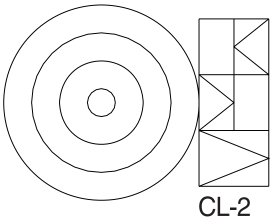
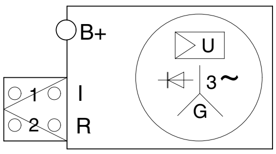
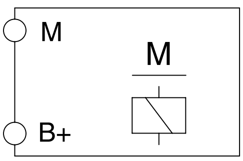
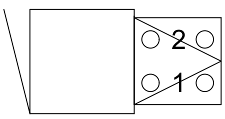
Part name	Symbol	Specifications	Check
Battery		12V × 80Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Accel actuator	 CN-76	-	※ Check resistance Normal : 1-2 Ω (For terminal 5-6) 0.8-1.2k Ω (For terminal 1-3)
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-6 CD-7 CD-32 CD-42 CD-43 CD-44	8~30V	※ Check contact Normal : 0.1 Ω
Pressure switch (For engine oil)	 CD-18	0.5 kgf/cm^2 (N.C TYPE)	※ Check resistance Normal : 0 Ω (CLOSE)

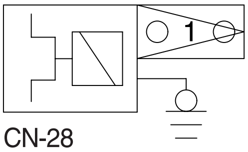
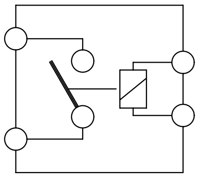
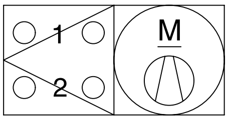
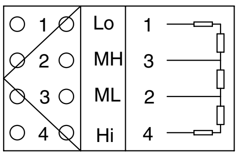
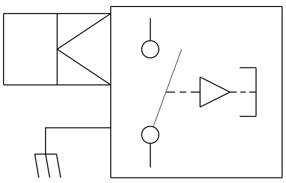
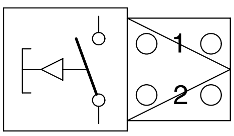
Part name	Symbol	Specifications	Check
Tacho sensor	 CD-17	24V 20A	※ Check resistance Normal : 300 Ω (For terminal 1, 2)
Temperature sensor (hydraulic, coolant)	 CD-1 CD-8	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞ Ω Low level : 0 Ω
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-62 CR-89	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 1-2) 0 Ω (for terminal 3-4) ∞ Ω (for terminal 3-5)

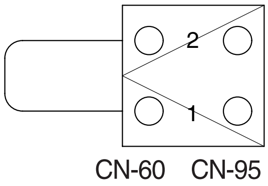
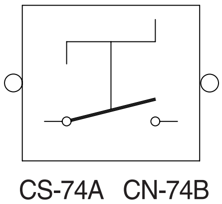
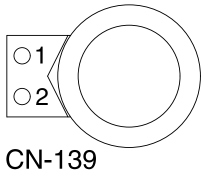
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-5 CR-7 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-133 CN-140 CN-262	24V 1A	※ Check resistance Normal : 15~25 Ω (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-24 CS-27 CS-54 CS-67 CS-101	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
Switch	 CS-67	24V 8A	※ Check disconnection Normal : 1.0Ω ON : 0 Ω (For terminal 1-5, 2-6) ∞ Ω (For terminal 5-7, 6-8) OFF : ∞ Ω (For terminal 1-5, 6-8) 0 Ω (For terminal 5-7, 6-8)
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-3 CL-4 CL-5 CL-6 CL-8 CL-9	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Fuel filler pump	 CN-61	24V 10A 35 l /min	※ Check resistance Normal : 1.0 Ω
Hour meter	 CN-48	16~32V	※ Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground

Part name	Symbol	Specifications	Check
Horn	 CN-20 CN-25	DC22~28V 2A	※Check operation Supply power(24V) to each terminal and connect ground.
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)

Part name	Symbol	Specifications	Check
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7 Ω (for terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	24V (1-2) 12V (1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※Check coil resistance Normal : About 1M Ω ※Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	24V 55A	※Check contact Normal : 0 Ω (for terminal B+-I) Normal : 24~27.5V
Starter	 CN-45	Denso 24V 4.5kW	※Check contact Normal : 0.1 Ω
Travel alarm	 CN-81	24V 0.5A	※Check contact Normal : 5.2 Ω

Part name	Symbol	Specifications	Check
Aircon compressor	 CN-28	24V 79W	※Check contact Normal : 13.4 Ω
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)
Resistor		-	※Check resistance 1.12 Ω (For terminal 4-2) 2.07 Ω (For terminal 2-3) 3.17 Ω (For terminal 3-1)
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-26A CS-29	24V 6A	※Check resistance Normal : ∞ Ω

Part name	Symbol	Specifications	Check
Fusible link		60A	※Check disconnection Normal : 0 Ω (connect ring terminal and check resist between terminal 1 and 2)
Master switch		6-36V	※Check disconnection Normal : 0.1 Ω
Socket		12V 10A	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

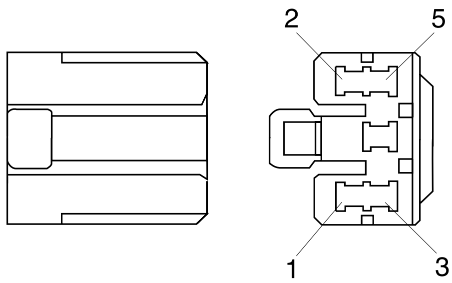
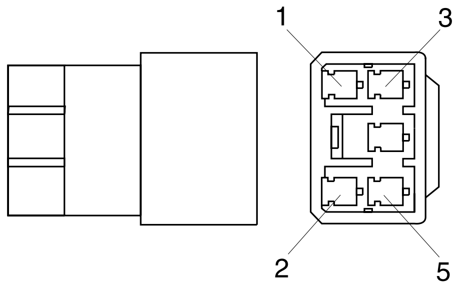
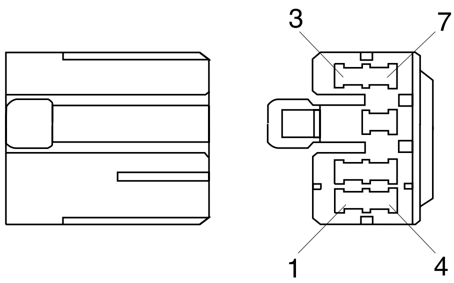
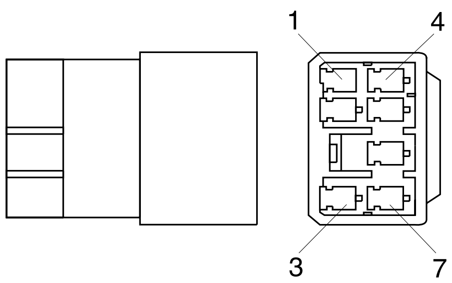
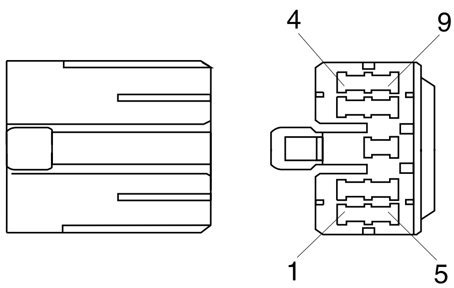
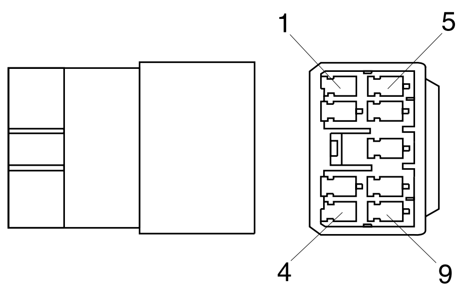
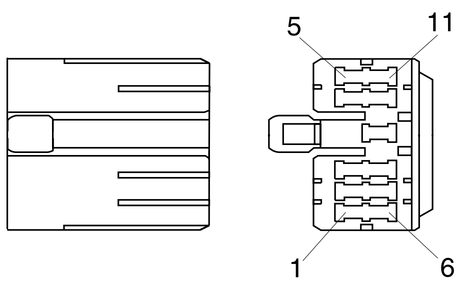
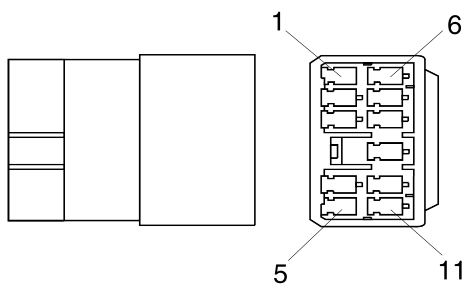
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	6	I/conn (Frame harness-Pump PS harness)	S816-006002	S816-106002
CN-2	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	S816-112002
CN-3	AMP	6	I/conn (Frame harness-Engine harness)	S816-006002	S816-106002
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	S816-116002
CN-5	DEUTSCH	15	I/conn (Side harness RH-Frame harness)	2-85262-1	368301-1
CN-6	AMP	12	I/conn (Side harness RH-Frame harness)	S816-012002	S816-112002
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	S816-016002	S816-116002
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Frame harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E005
CN-17	DEUTSCH	8	I/conn (Side harness RH-Wiper harness)	DT06-8S-EP06	DT04-8P
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-21A	AMP	6	Wiper motor	S816-006202	-
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	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse & relay box	21Q7-10901	-
CN-45	RING-TERM	-	Starter motor B+	R8-10	-
CN-48	KET	1	Hour meter	GP890469	-
CN-51	DEUTSCH	36	MCU	341111-1	-
CN-52	DEUTSCH	36	MCU	341111-1	-
CN-56	DEUTSCH	4	Cluster	-	DT04-4P-E004
CN-60	AMP	2	Fusible link	21N4-01320	S813-130201
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	-
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-

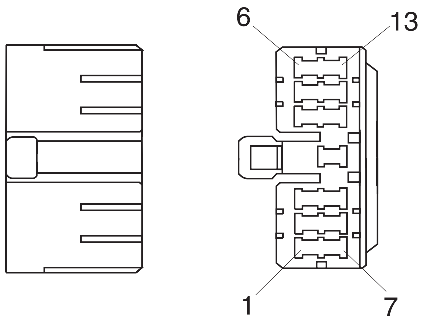
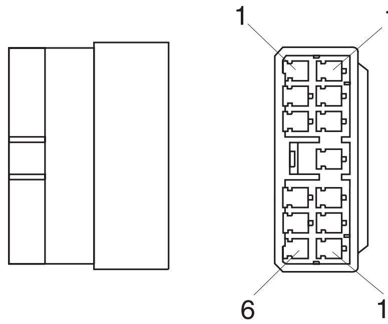
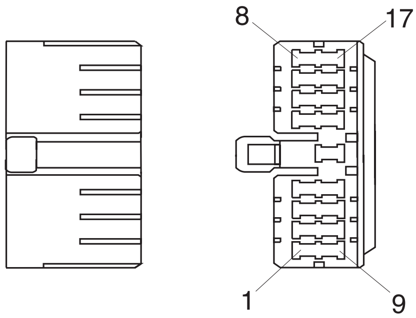
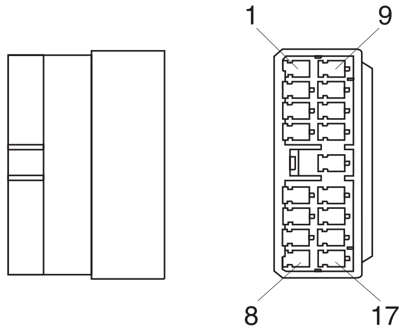
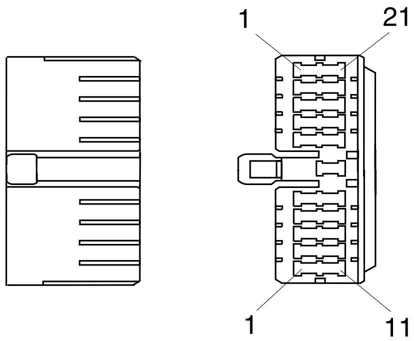
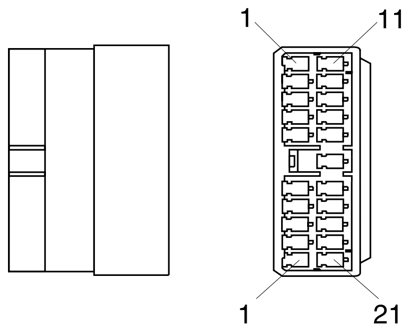
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-74	KET	2	Alternator "I" terminal	S810-002200	-
CN-75	AMP	2	Pump EPPR	S816-002002	-
CN-76	DEUTSCH	-	Accel actuator	DT06-6S-EP06	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-95	YAZAKI	2	Fusible link	-	S813-130201
CN-125	Econoseal J	2	GPS connector	S816-002002	S816-102002
CN-126	DEUTSCH	4	RS 232 connector	DT06-4S	-
CN-133	DEUTSCH	2	Max flow cut off solenoid	DT06-2S-EP06	-
CN-138	DEUTSCH	3	DC/DC Converter	DT06-3S-P012	-
CN-139	DEUTSCH	2	12V socket	DT04-2P-E004	-
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-144	AMP	12	Remocon	174045-2	-
CN-147	AMP	2	Fuel heater	1530-0027	-
CN-248	AMP	2	Fan	S816-002002	S816-102002
CN-262	DEUTSCH	2	Straight travel solenoid	DT06-2S-EP06	-
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710289-1	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Work lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-13	-	5	Head lamp relay	-	-
CR-23	RING TERM	-	Start relay	-	S814-102001
CR-35	-	5	Power relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014004	S822-114004
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-20	AMP	1	Safety switch	S822-014002	-
CS-21	SWF	12	Light switch	SWF 593757	-
CS-23	SWF	12	Beacon lamp switch	SWF 589790	-
CS-24	SWF	12	Cab light switch	SWF 593757	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-27	SWF	10	Breaker switch	SWF 593757	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-54	SWF	12	Aircon switch	SWF 593757	-
CS-67	SWF	12	Quick clamp switch	SWF 593757	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	
CS-83	SWF	12	Spare switch	SWF 593757	-
CS-99	SWF	12	Air compressor switch	SWF 593757	-
CS-100	SWF	12	Spare switch	SWF 593757	-
CS-101	SWF	12	Fan switch	SWF 593757	-
CS-142	DEUTSCH	3	Accel dial switch	DT06-3S	-
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar light	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2P-EP06	DT04-2P-E005
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2P-EP06	DT04-2P-E005
CL-5	AMP	2	Work lamp-LH	-	180923-0
CL-6	AMP	2	Work lamp-RH	-	180923-0
CL-8	DEUTSCH	2	Cab light-LH	DT04-2S	DT04-2P-E005
CL-9	DEUTSCH	2	Cab light-RH	DT04-2S	DT04-2P-E005
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel level sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure sensor	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure sensor	DT06-3S-EP06	-
CD-8	AMP	2	Water temp sender	85202-1	-
CD-10	RING TERM	-	Air cleaner switch	ST730135-2	-
CD-17	AMP	2	Tacho sensor	S816-002002	-
CD-18	RING TERM	-	Engine oil pressure sensor	S820-104000	-
CD-32	DEUTSCH	3	Boom up sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure 3	DT06-3S-EP06	-
CD-50	DEUTSCH	2	Dozer pressure switch	DT06-2S-EP06	DT04-2P-E005

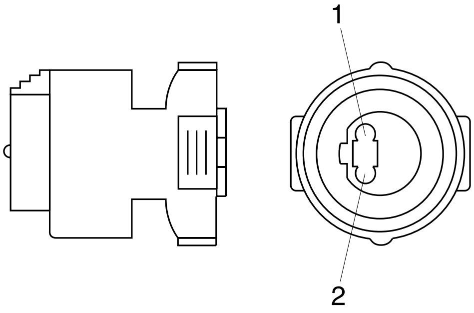
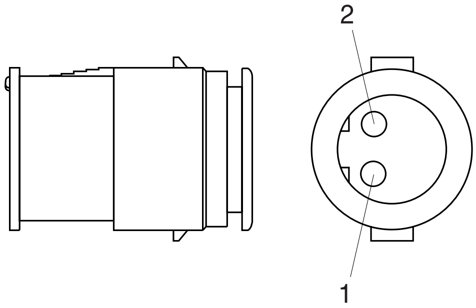
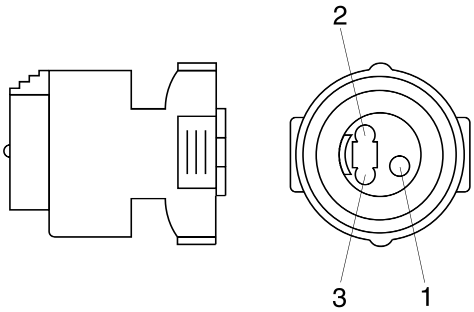
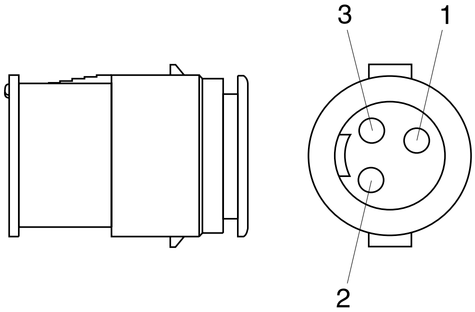
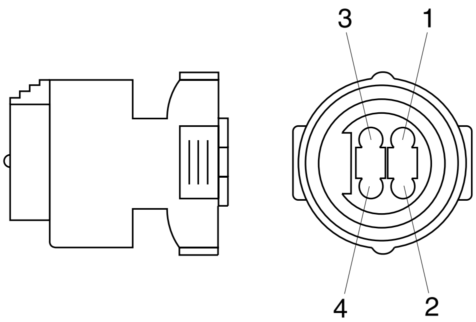
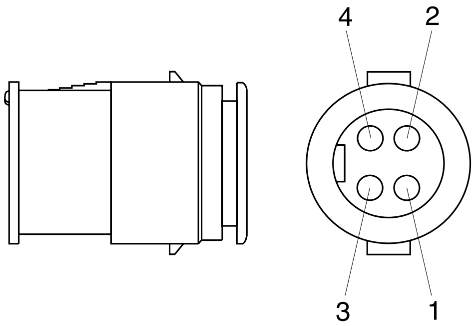
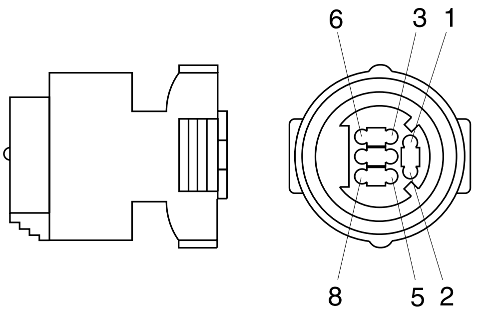
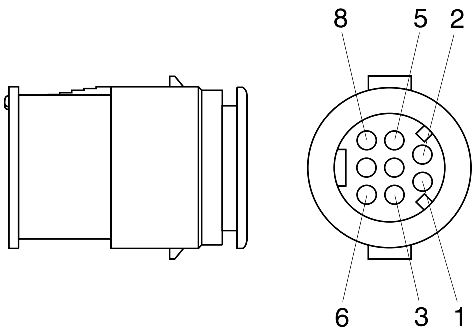
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

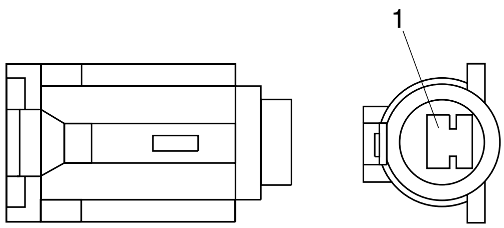
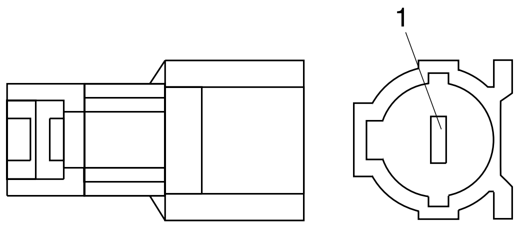
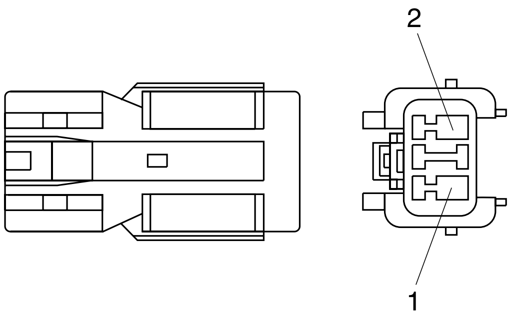
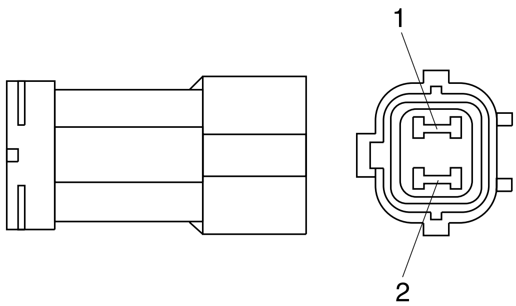
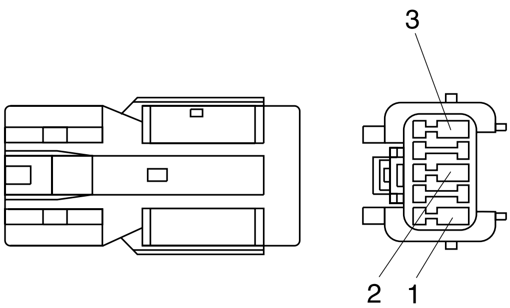
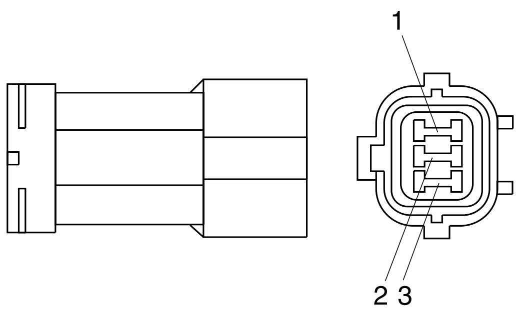
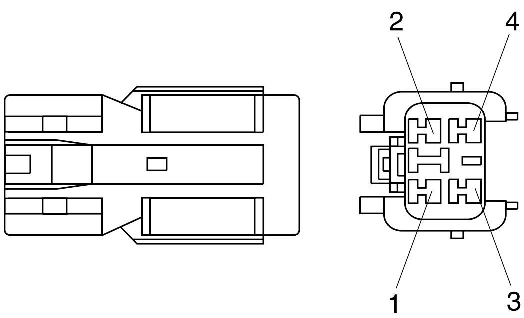
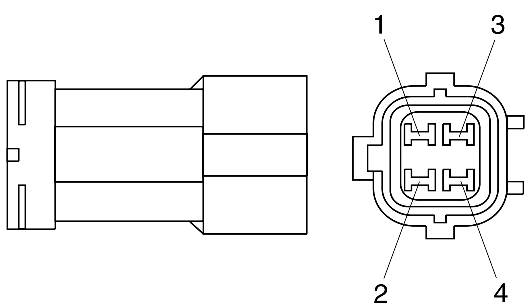
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

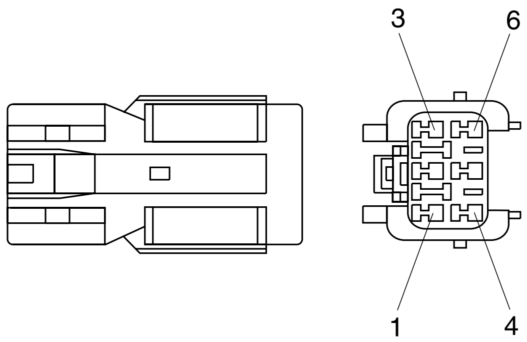
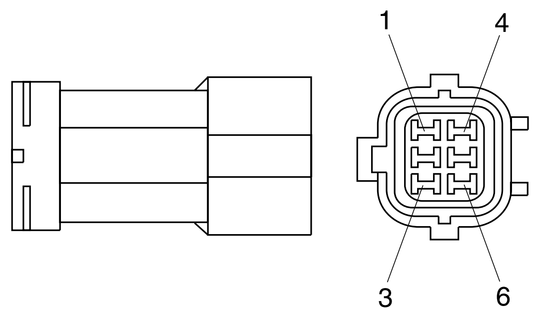
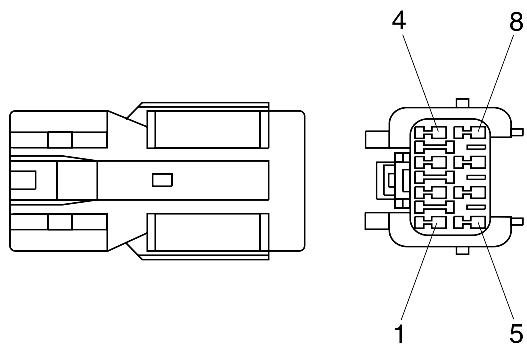
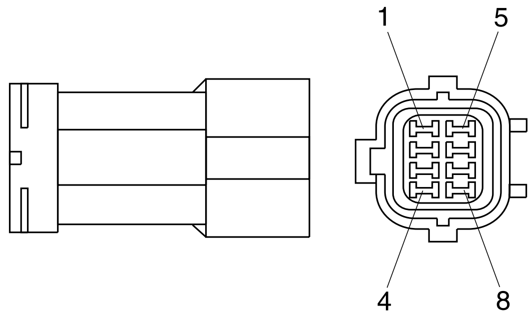
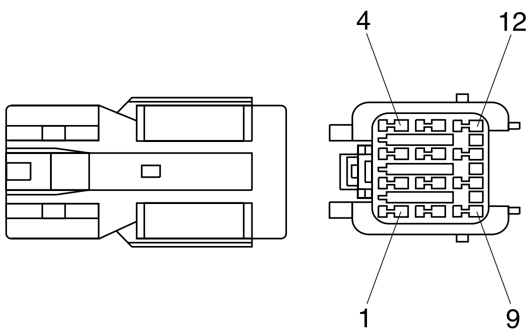
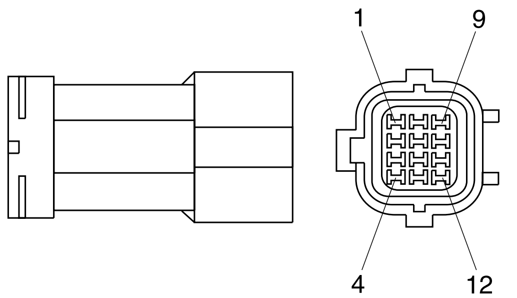
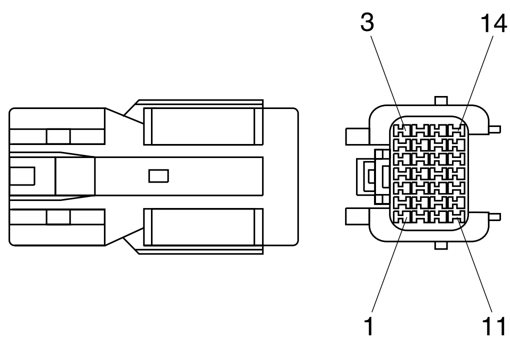
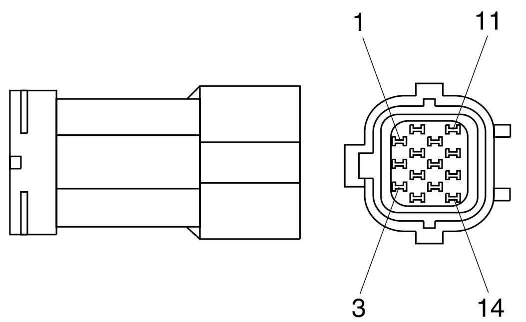
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

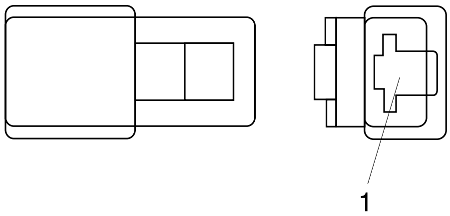
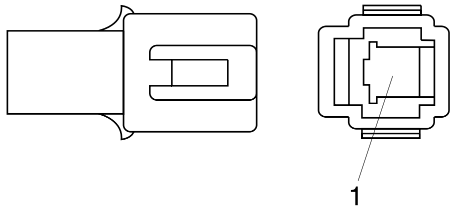
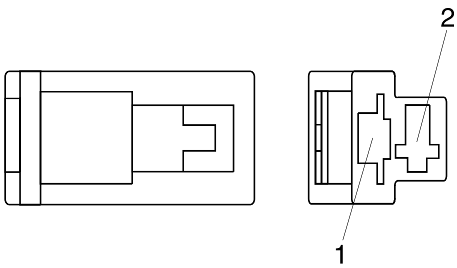
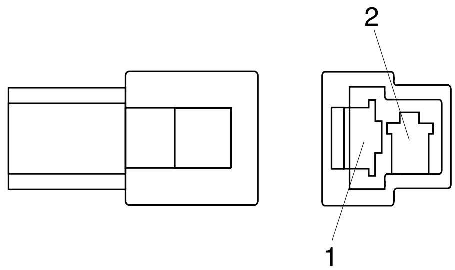
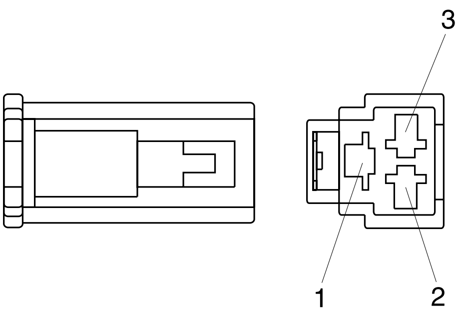
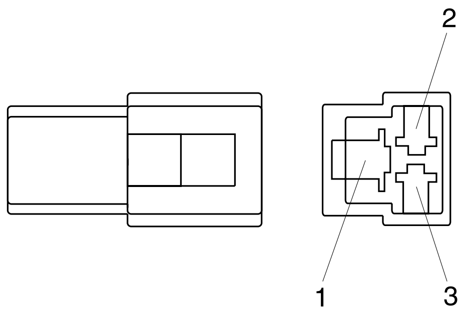
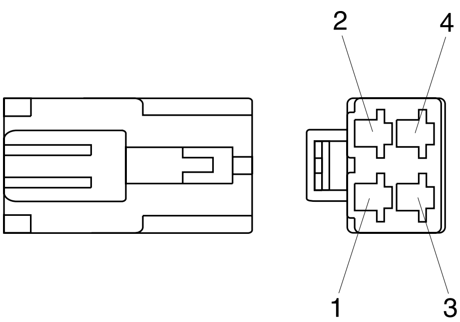
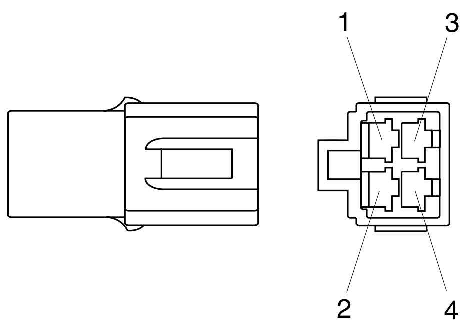
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

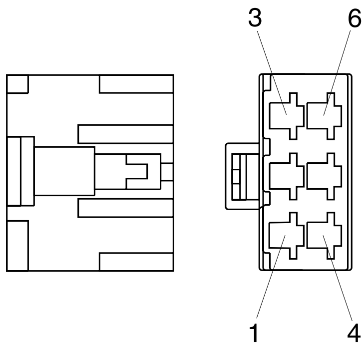
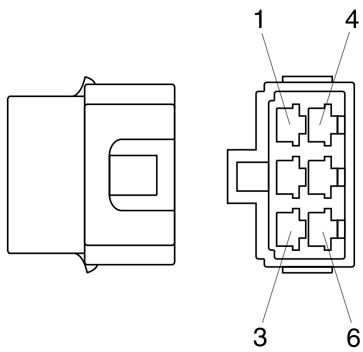
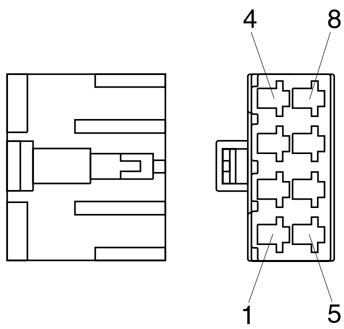
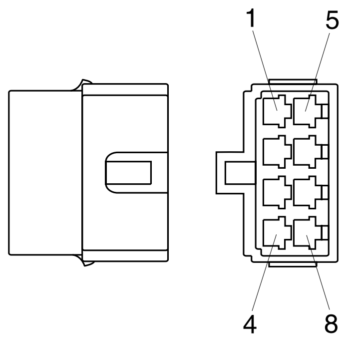
3) SWP TYPE CONNECTOR

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

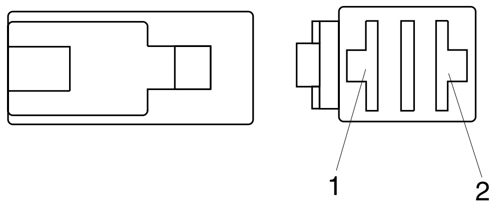
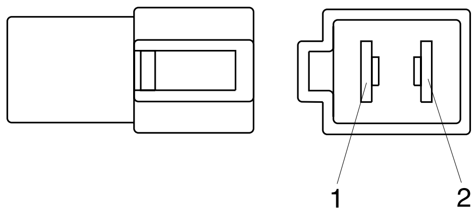
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

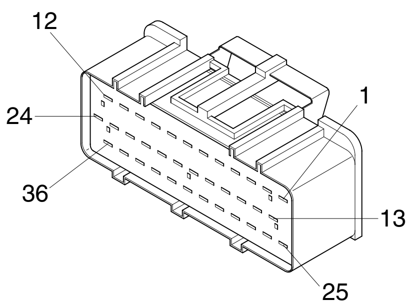
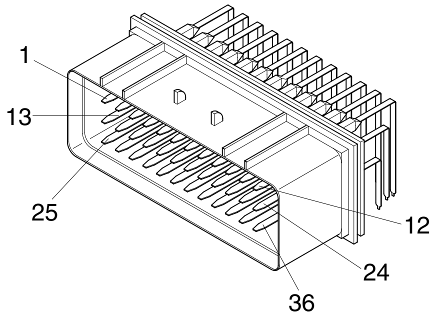
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S810-006202	 S810-106202
8	 S810-008202	 S810-108202

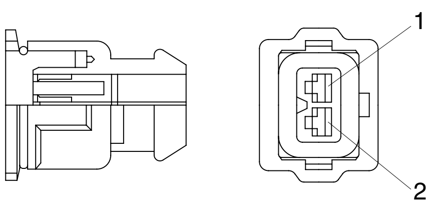
5) 375 FASTEN TYPE CONNECTOR

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

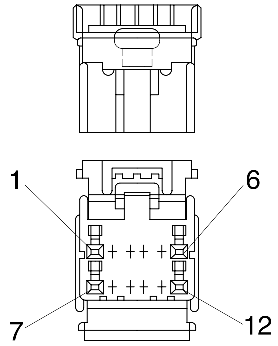
6) AMP ECONOSEAL CONNECTOR

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

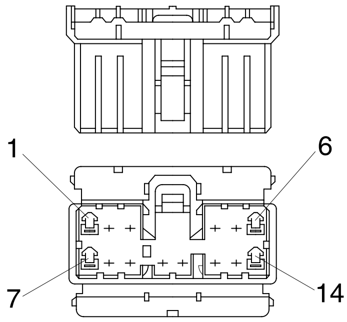
7) AMP TIMER CONNECTOR

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

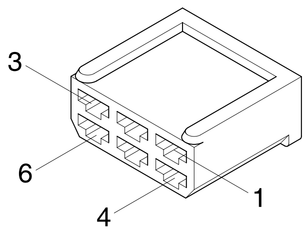
8) AMP 040 MULTILOCK CONNECTOR

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

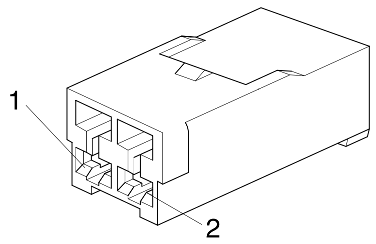
9) AMP 070 MULTILOCK CONNECTOR

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

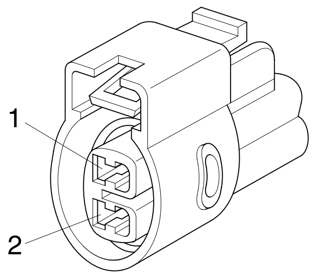
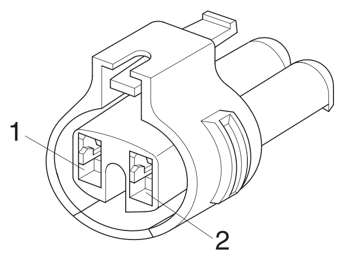
10) AMP FASTIN - FASTON CONNECTOR

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

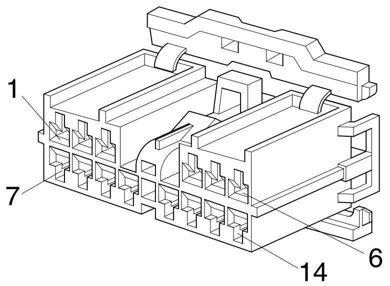
11) KET 090 CONNECTOR

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	

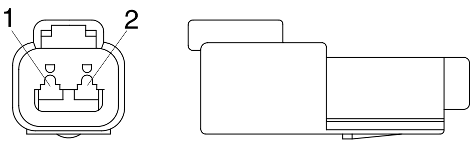
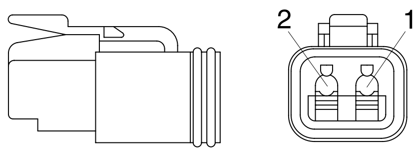
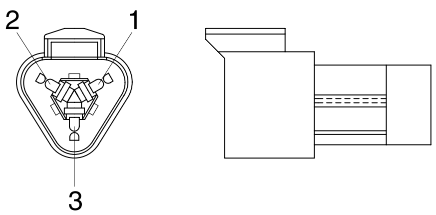
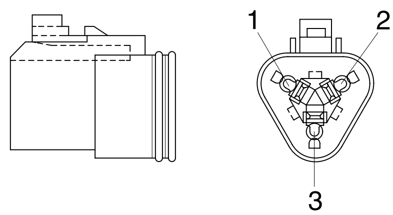
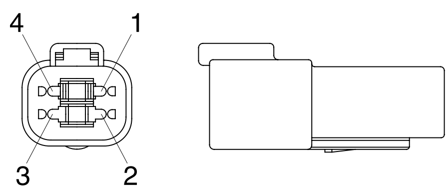
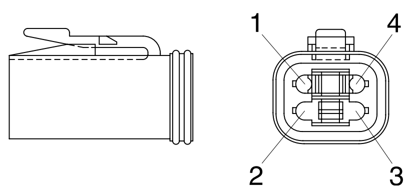
14) DEUTSCH DT CONNECTORS

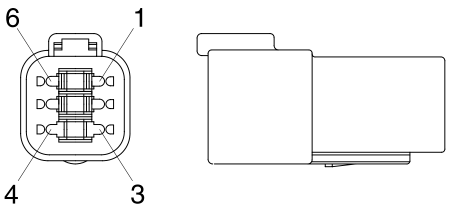
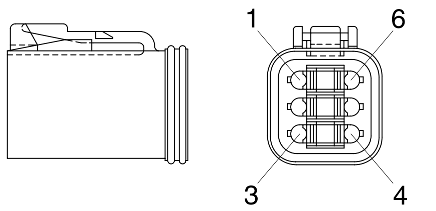
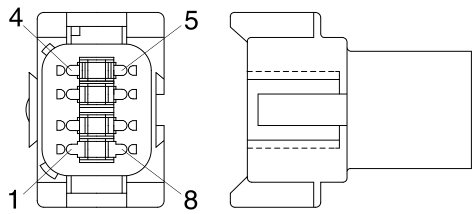
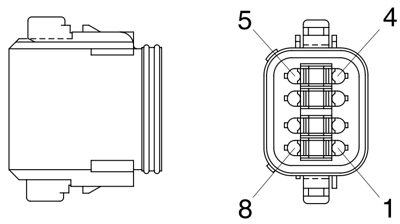
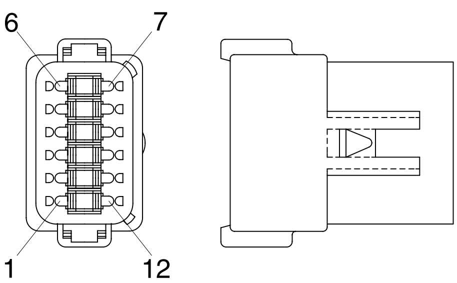
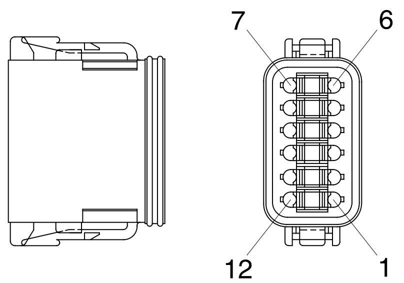
DT 06 - 3S - ★★★★

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

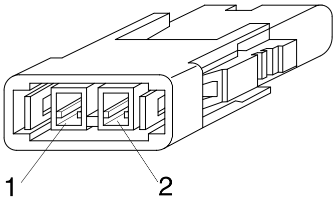
※ Modification

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

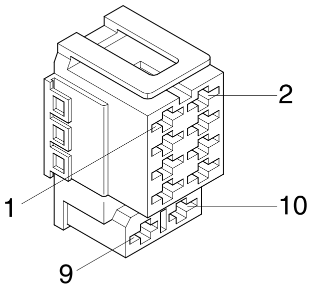
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

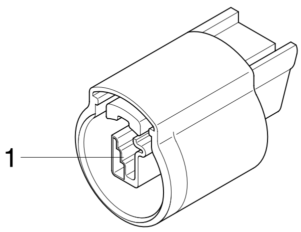
15) MOLEX 2CKTS CONNECTOR

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

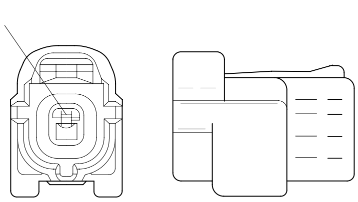
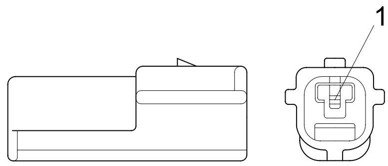
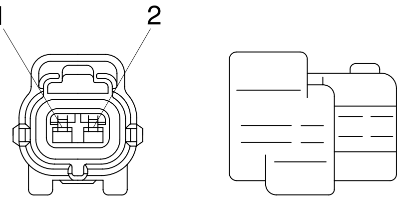
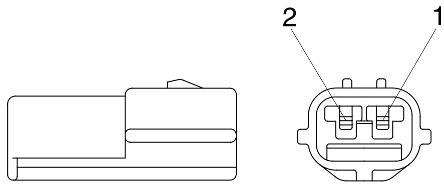
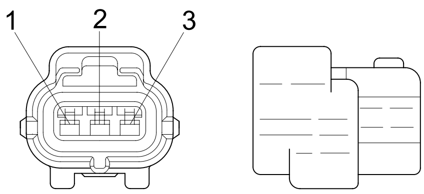
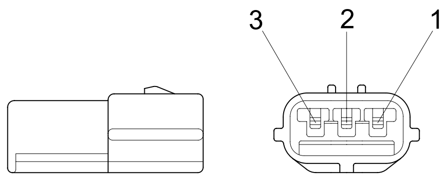
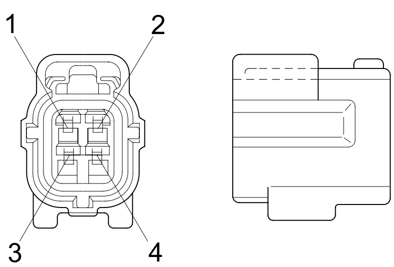
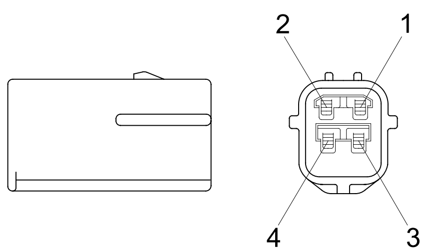
16) ITT SWF CONNECTOR

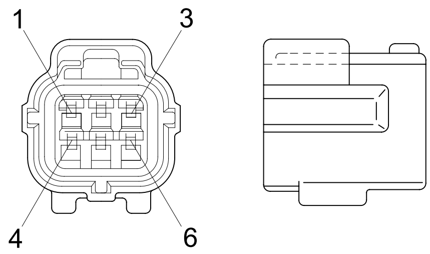
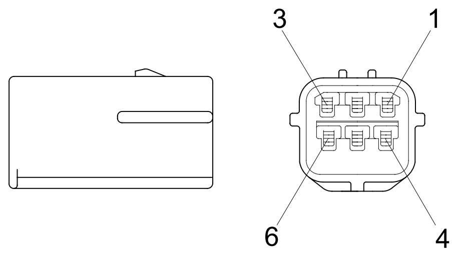
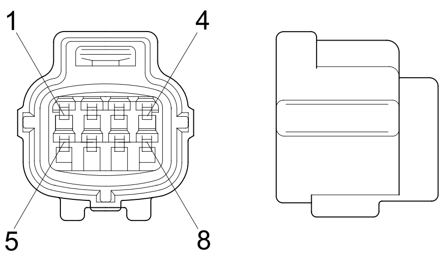
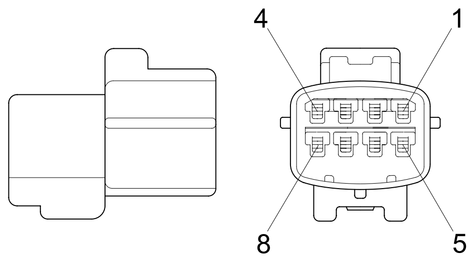
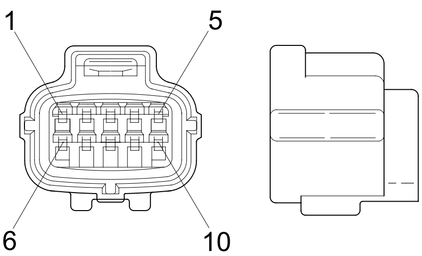
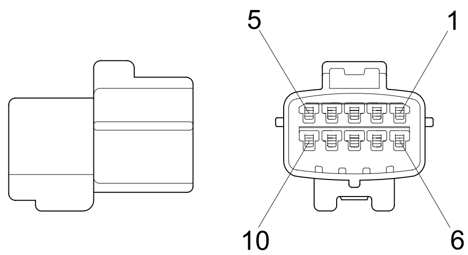
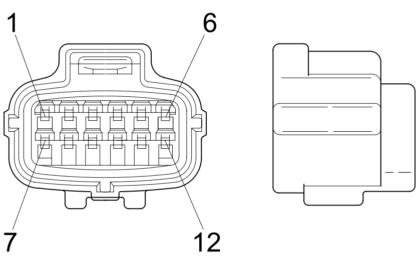
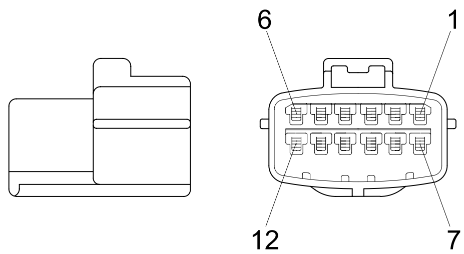
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

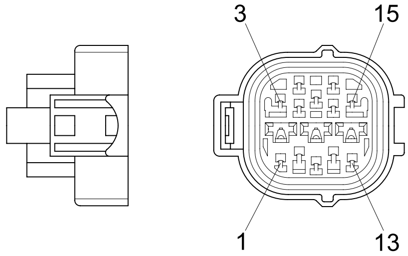
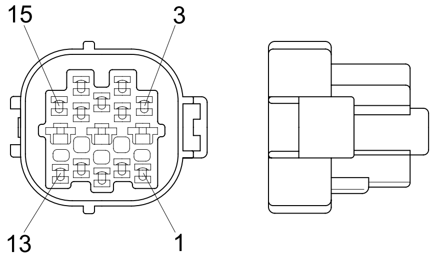
17) MWP NMWP CONNECTOR

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

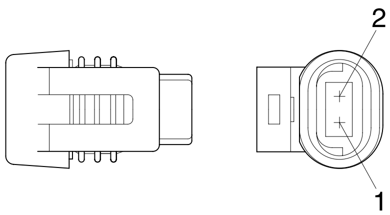
18) ECONOSEAL J TYPE CONNECTORS

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

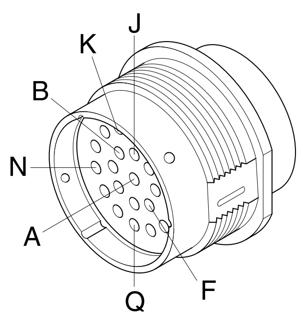
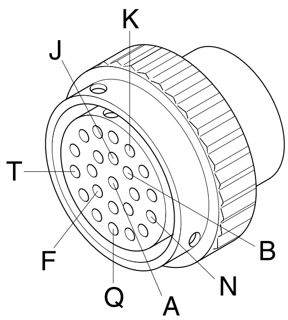
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

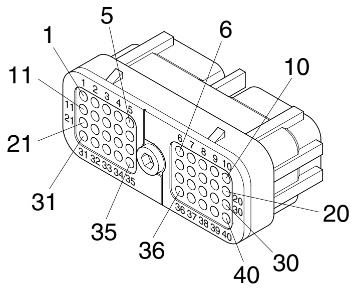
19) METRI-PACK TYPE CONNECTOR

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

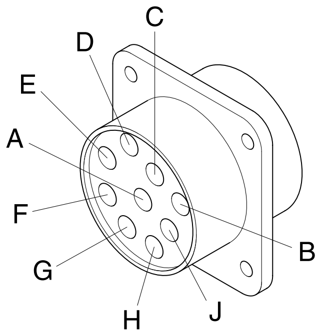
20) DEUTSCH HD30 CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
23	 HD36-24-23SN	 HD34-24-23PN

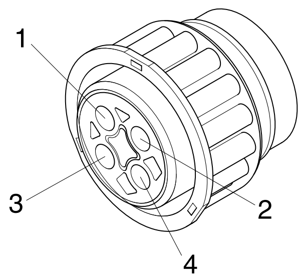
21) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
40	 DRC26-40SA/B	

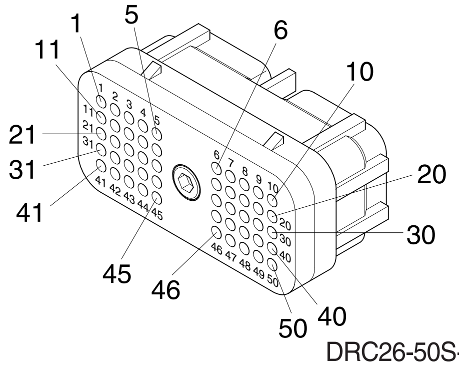
22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
9	 HD10-9-96P	

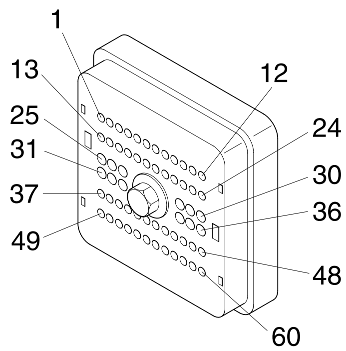
23) AMP FUEL WARMER CONNECTOR

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

24) DEUTSCH ENGINE ECM CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
50	DRC26-50S-04	

25) DEUTSCH INTERMEDIATE CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
60	DRB16-60SAE-L018	

SECTION 5 MECHATRONICS SYSTEM

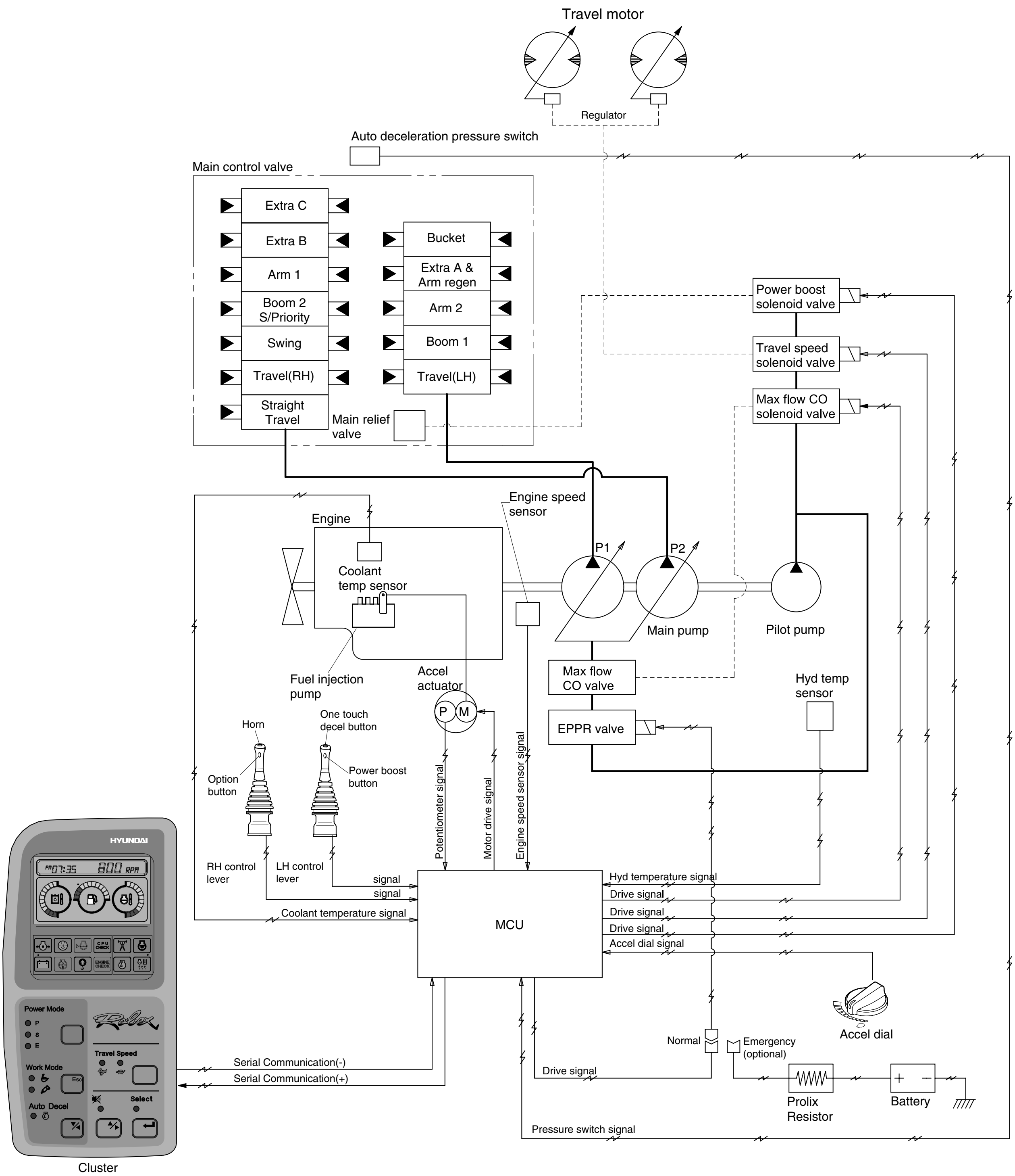
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

The ADVANCED 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 MCU, a cluster, an ECM, EPPR valves, and other components. The MCU and the cluster protect themselves 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
    - Engine control system
    - Pump control system
    - Work mode selection
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
  - Automatic warming up system
  - Overheat prevention system
  - Max flow control system
  - Attachment flow control system
  - Anti-restart system
  - Self-diagnostic system
    - MCU & cluster protection
    - Open-short diagnosis & error code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system

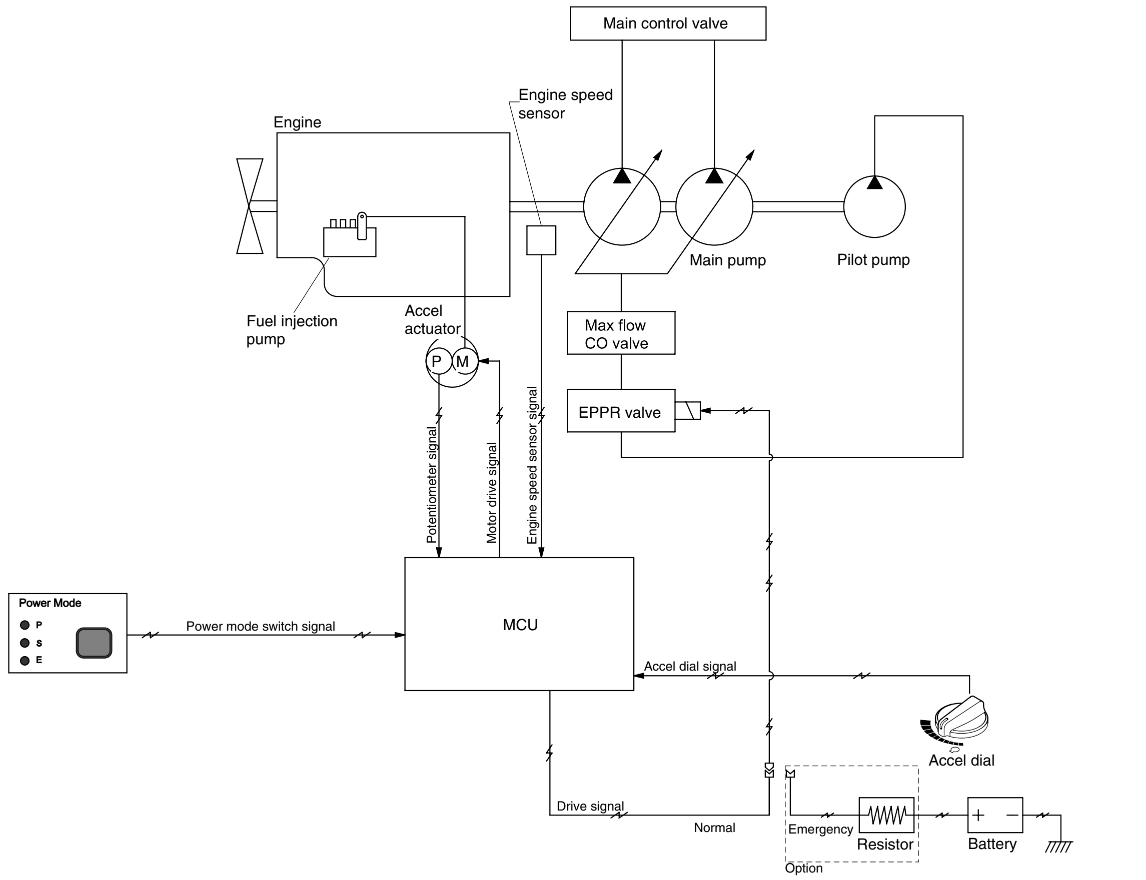
SYSTEM DIAGRAM



RD14095MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



RD14095MS07

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

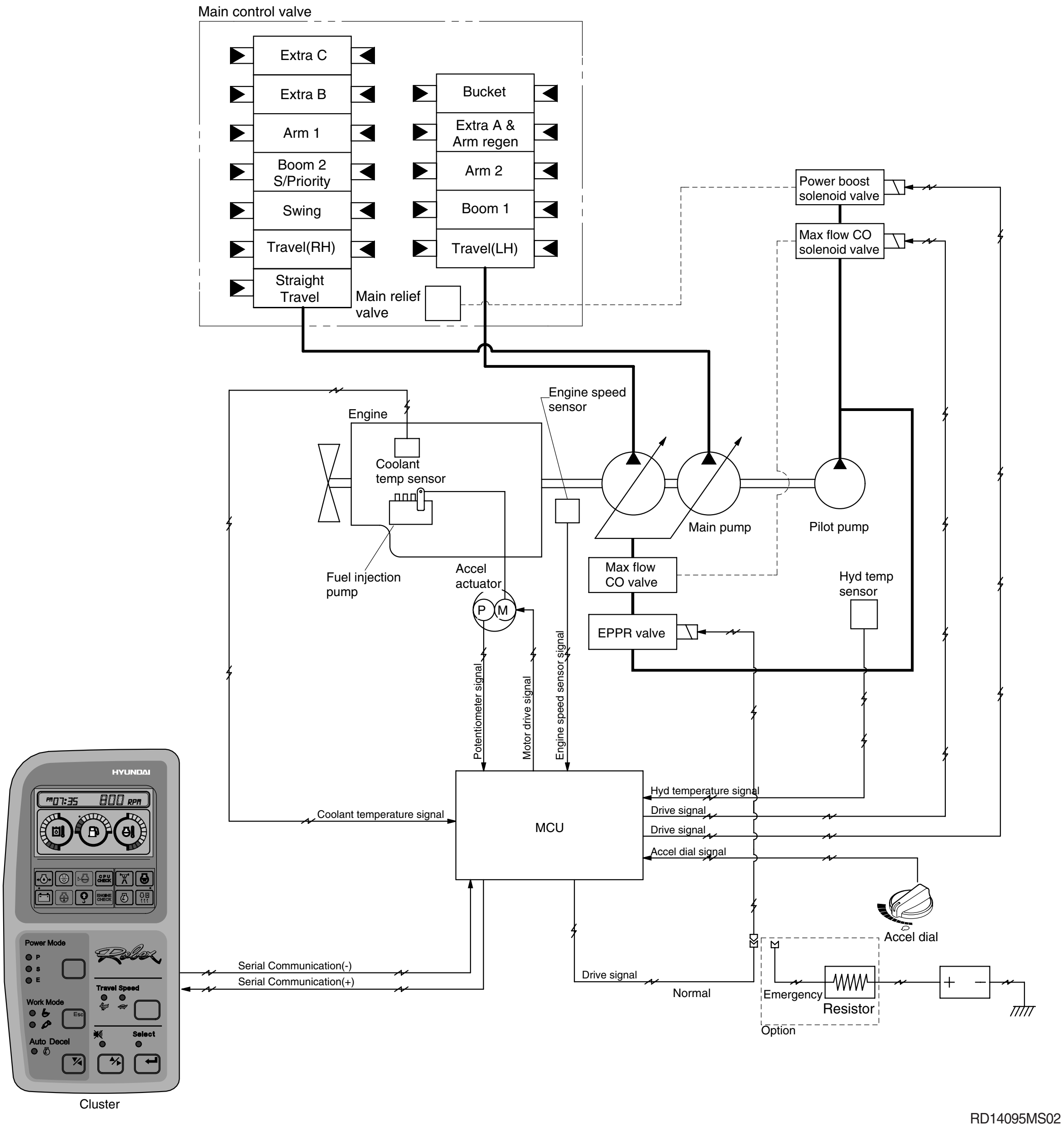
The combination of 3 power modes(P, S, E) and accel dial position(10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Mode	Application	Engine rpm				Power shift by EPPR valve			
		Default		Other case		Default		Other case	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Maximum power	2150±50	1950	2250	2050	330±30	10	290±30	8
S	High power	2000±50	1800	2100	1900	400±30	15	360±30	12
E	Standard power	1850±50	1650	1950	1750	460±30	18	400±30	15
AUTO DECEL	Engine deceleration	1200±100	-	1200±100	-	700±30	38	700±30	38
One touch decel	Engine quick deceleration	950±100	-	950±100	-	700±30	38	700±30	38
KEY START	Key switch start position	950±100	-	950±100	-	700±30	38	700±30	38

※ Other case can be set by pressing the "travel speed" switch and "buzzer stop switch" for 2 seconds at the same time in "model & version" display on the cluster(for detail, see 5-21)

2. WORK MODE SELECTION SYSTEM

2 work modes can be selected for the optional work speed of the machine operation.



1) GENERAL WORK MODE

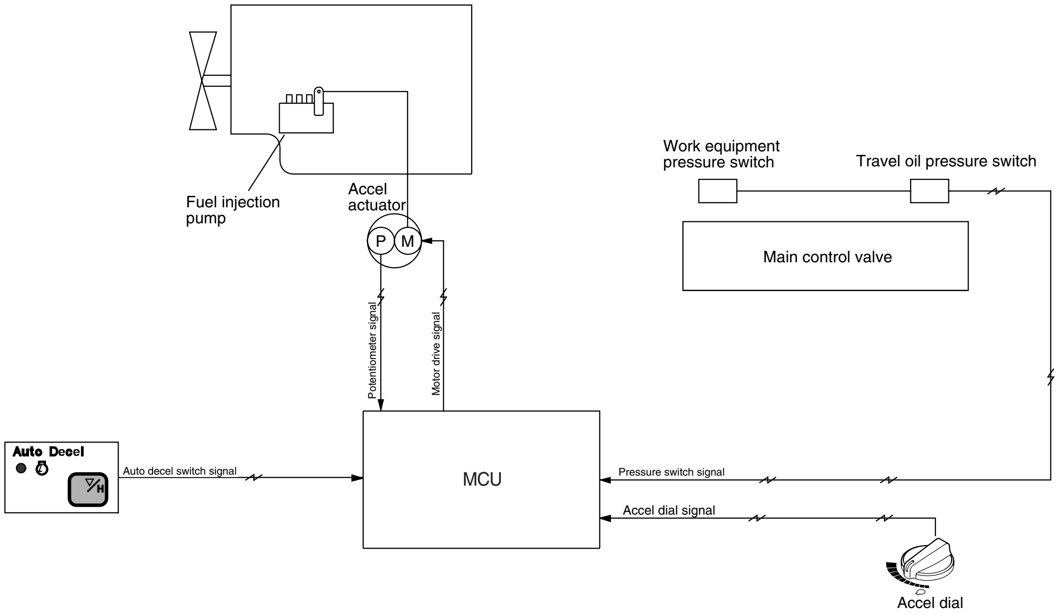
When key switch is turned ON, this mode is selected and swing operation speed is faster than heavy duty work mode.

2) BREAKER OPERATION MODE

It sets the pump flow to the optimal operation of breaker by activating the max flow cut-off solenoid.

Work mode	Swing priority solenoid	Max flow cut-off solenoid
General	ON	OFF
Breaker	OFF	ON

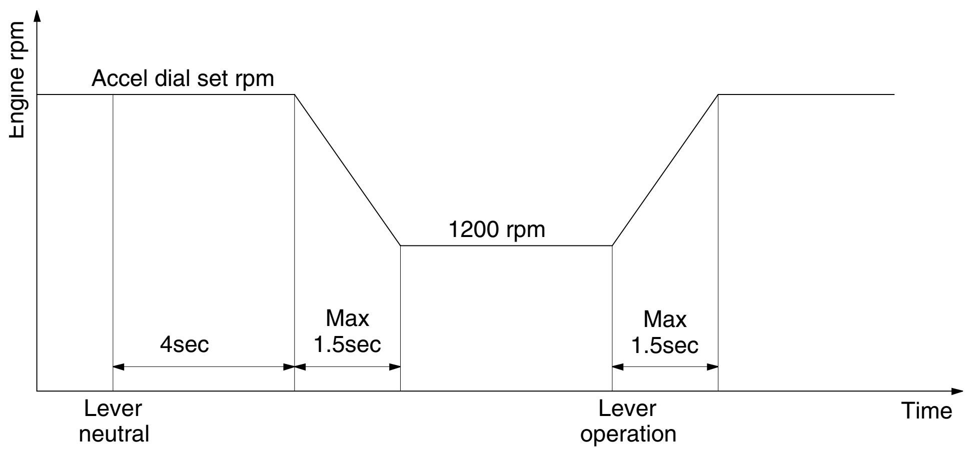
GROUP 3 AUTOMATIC DECELERATION SYSTEM



1. WHEN AUTO DECEL LAMP ON

If all the work equipment control levers including swing and travel levers are at neutral for at least 4 seconds, MCU drives the governor motor to reduce the engine speed to 1200rpm. 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 decel lamp is turned off by pressing the switch or any control lever is operated, the reduced engine speed rises upto the speed set before deceleration in a second.

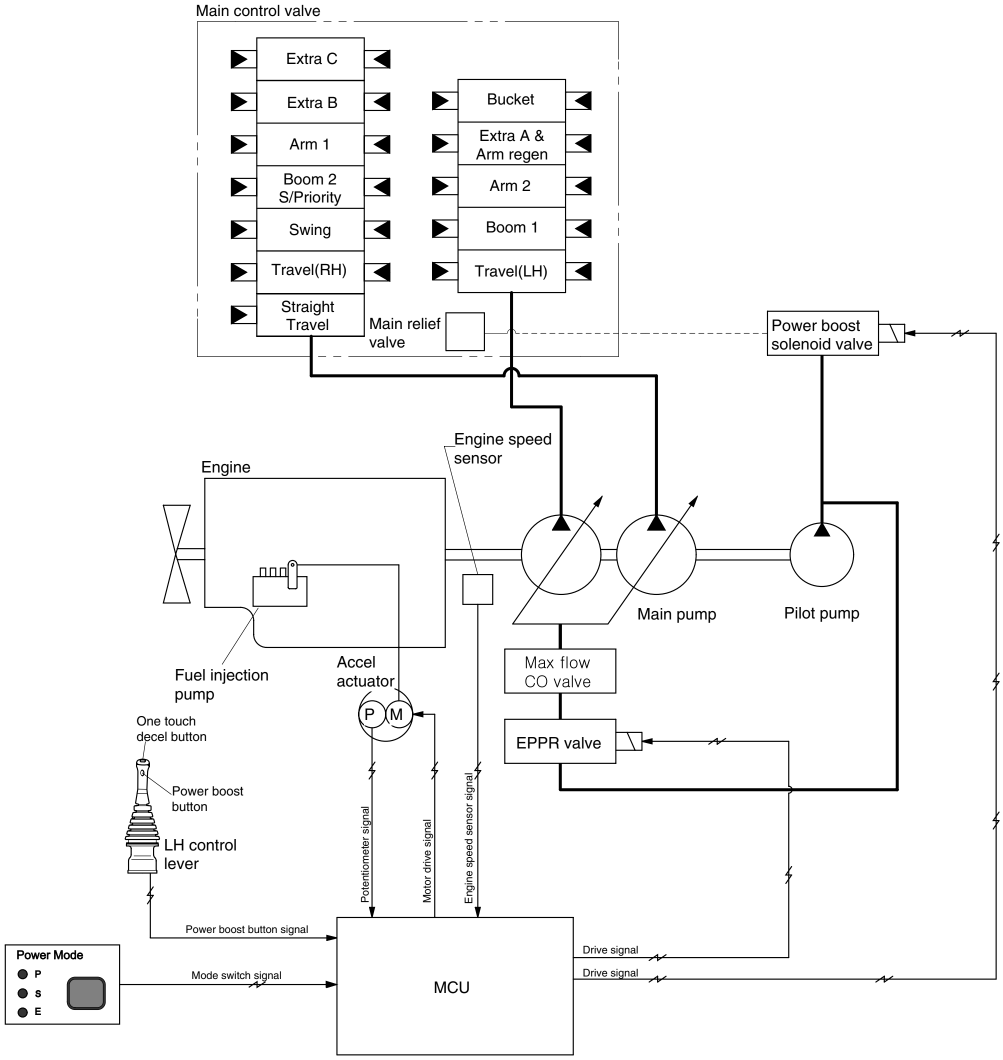


2. WHEN AUTO DECEL LAMP OFF

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

Note : Auto decel function can be activated when accel dial position is over 4.

GROUP 4 POWER BOOST SYSTEM



RD14095MS03

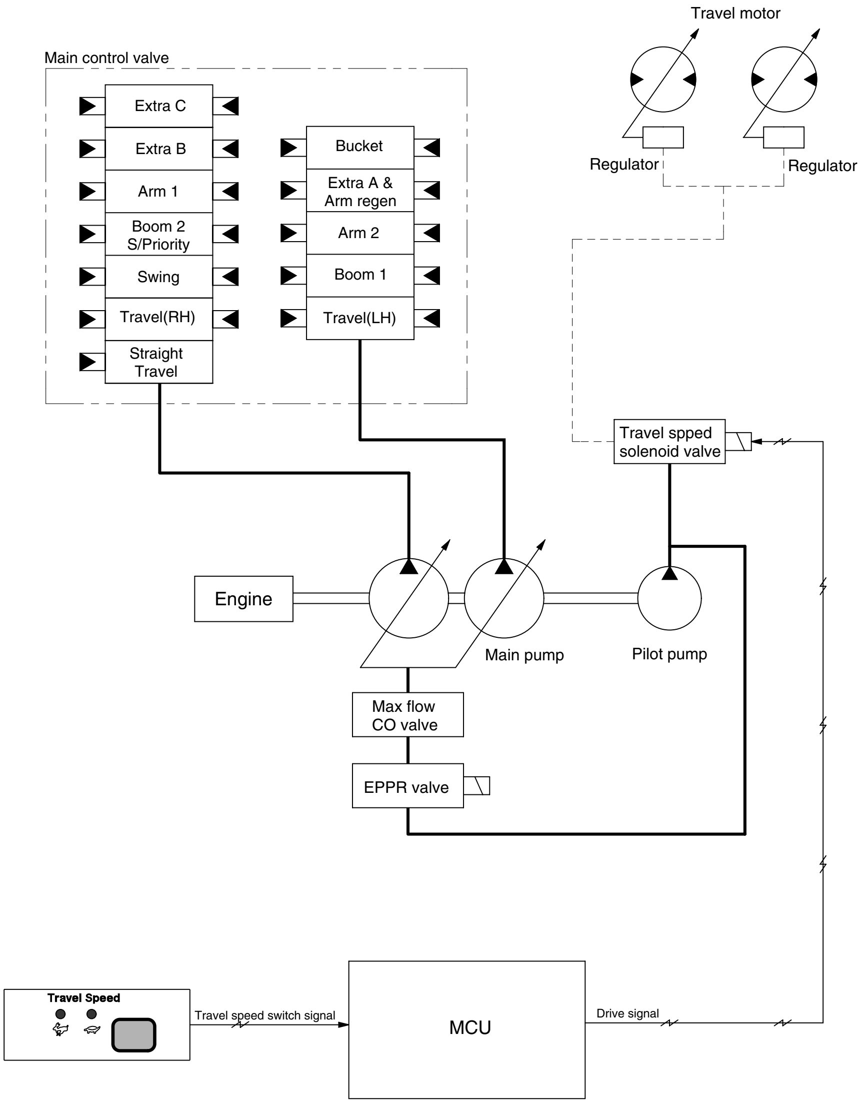
· When the power boost switch on the left control lever knob is pushed ON, the maximum digging power is increased by 10%.

· When the power set is at H or S and 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	Power boost switch	
	OFF	ON
Power set	P, S or E	P or S
Main relief valve set pressure	330kgf/cm^2	360kgf/cm^2
Time of operation	-	Even when pressed continuously, it is canceled after 8 sec.

※ Default - Power boost solenoid valve : OFF

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



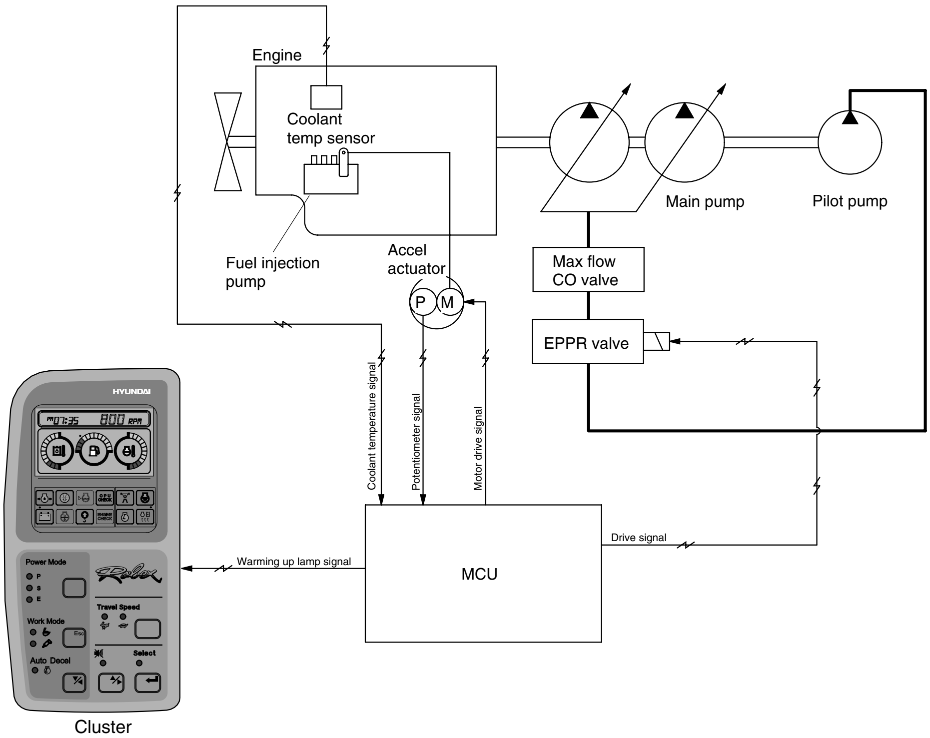
RD14095MS08

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

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

※ Default : Turtle (Lo)

GROUP 6 AUTOMATIC WARMING UP FUNCTION



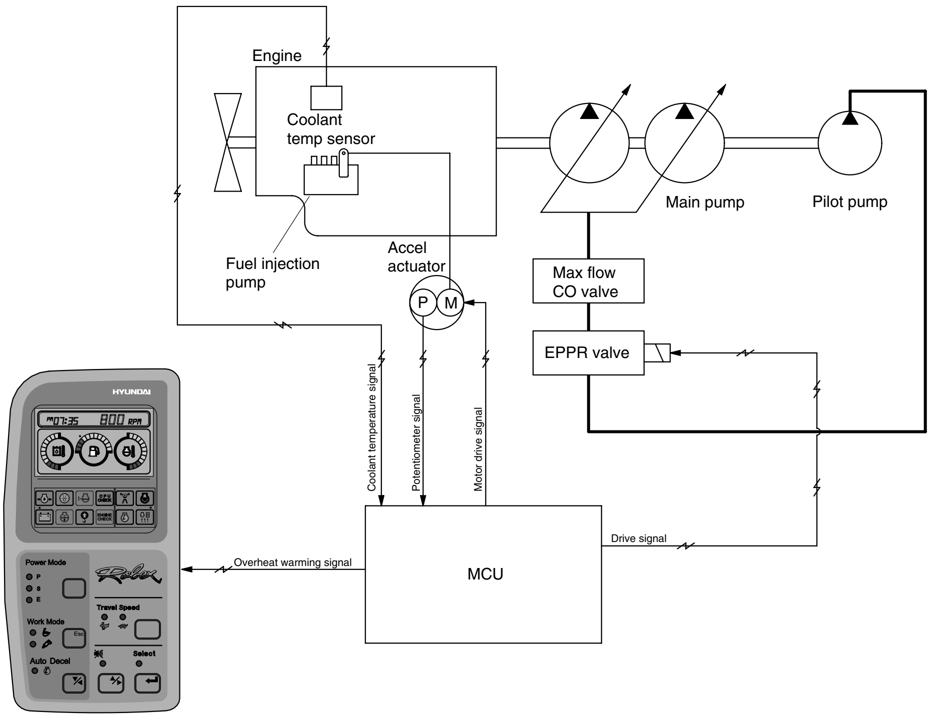
RD14095MS04

1. The MCU reads engine coolant temperature through the temperature sensor, and if the coolant temperature is less than 30˚C, it increases the engine speed from key start rpm to 1200rpm. At this time the mode does not change.
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 mode set during the warming up function, the MCU cancels the automatic warming up function.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Less than 30˚C(After engine run) - Accel dial position is under 3	- Mode : Default(S mode) - Warming up time : 10 minutes(Max) - Warming up lamp : ON
Canceled	- Coolant temperature : Above 30˚C - Warming up time : Above 10 minutes - Changed mode set by operator - Increase engine speed by rotating accel dial clockwise ※ If any of the above conditions is applicable, the automatic warming up function is canceled	- Default mode - Default mode - Changed mode
Warming up lamp	- Coolant temperature : Above 30˚C	- Warming up lamp : OFF

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM



RD14095MS05

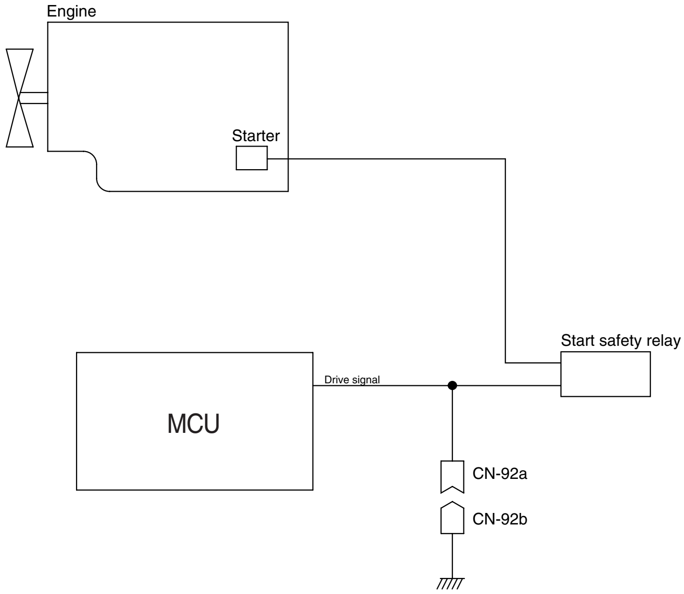
1. MCU reads engine coolant temperature through the temperature sensor and when the engine coolant boils up to 110˚C, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial **7** position.

2. If the coolant temperature drops less than 100˚C, the MCU returns the mode to the mode set before. And if mode set is changed during the function, the MCU cancels the function.
   Even if the overheat prevention function is canceled by mode change, the overheat warning lamp turns OFF only when the coolant temperature is less than 100˚C.

3. LOGIC TABLE

Description	Condition	Function
Actuated	- Coolant temperature : Above 110˚C - Accel dial set : Above **8**	- Engine rpm drop to accel dial 7 position - Overheat warning lamp & buzzer : ON
Canceled	- Coolant temperature : Less than 100˚C - Changed mode set by operator ※ If any of the above conditions is applicable, engine overheat prevention function is canceled	- Return to the mode and accel dial set before - Hold on the changed set
Overheat warning lamp	- Coolant temperature : Less than 100˚C	- Overheat warning lamp : OFF

GROUP 8 ANTI-RESTART SYSTEM



1. ANTI-RESTART FUNCTION

After 10 seconds from the engine starts to run, MCU turns off the start safety relay to protect the starter from inadvertent restarting.

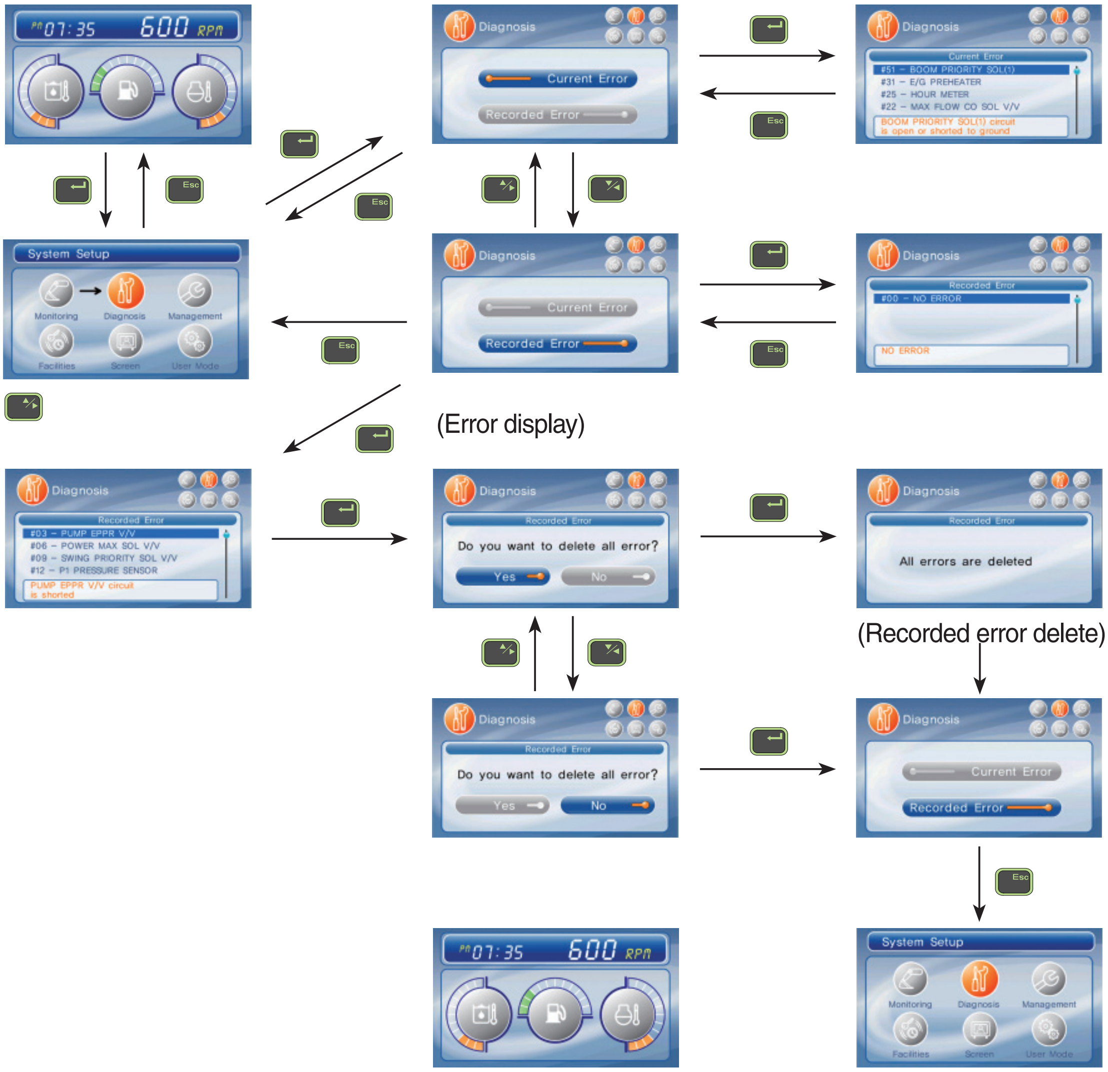
2. When a replacement or taking-off of the MCU is needed, connect CN-92a and CN-92b to ensure the engine start without the MCU.

GROUP 9 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

When any abnormality occurs in the NEW CAPO system caused by electric parts malfunction and by open or short circuit, the MCU diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

2. CURRENT ERROR DISPLAY



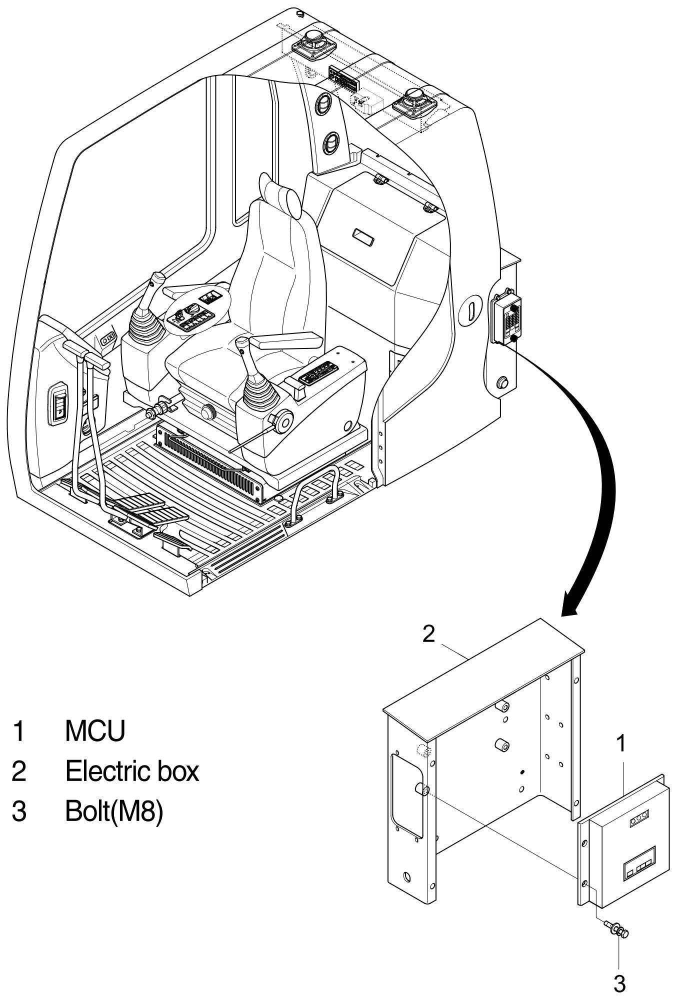
5. ERROR CODES TABLE

Fault code No.	Description
1	Short circuit in governor motor system
2	Potentiometer circuit is shorted to Vcc(5V) or battery +
3	Short circuit in pump EPPR valve system
4	Short circuit in boom down EPPR valve system
5	Short circuit in travel speed solenoid system
6	Short circuit in power boost solenoid system
7	Short circuit in max flow solenoid system
10	Short circuit in hour-meter system
11	Accel dial circuit is shorted to Vcc(5V) or battery +
12	P1 pressure sensor circuit is shorted to power supply(24V) line
13	P2 pressure sensor circuit is shorted to power supply(24V) line
14	P3 pressure sensor circuit is shorted to power supply(24) line
15	Boom down pressure circuit is shorted to power supply(24V) line
16	Governor motor circuit is open or shorted to ground
17	Potentiometer circuit is open or shorted to ground
18	Pump EPPR valve circuit is open or shorted to ground
19	Boom down EPPR valve circuit is open or shorted to ground
20	Travel speed solenoid circuit is open or shorted to ground
21	Power boost solenoid circuit is open or shorted to ground
22	Max flow solenoid circuit is open or shorted to ground
25	Hour-meter circuit is open or shorted to ground
26	Accel dial circuit is open or shorted to ground
27	P1 pressure sensor circuit is open or shorted to ground
28	P2 pressure sensor circuit is open or shorted to ground
29	P3 pressure sensor circuit is open or shorted to ground
30	Boom down pressure sensor circuit is open or shorted to ground
31	Engine preheater circuit is open or shorted to ground
32	Travel alarm buzzer circuit is open or shorted to ground
33	Alternator circuit is open or shorted to ground
34	Controller input voltage is below 18V
35	Controller input voltage is over 38V
36	Communication error with cluster
37	Engine speed sensor circuit is open or shorted to ground
38	Anti-restart relay circuit is open or shorted to ground
39	Accel actuator does not stop at a target position
40	There is more than 500rpm difference between target speed and actual speed

Fault code No.	Description
41	Hydraulic oil temperature sensor circuit is shorted to ground
42	Fuel level sensor circuit is shorted to ground
43	Coolant temperature sensor circuit is shorted to ground
44	Boom up pressure sensor circuit is shorted to power supply(24V) line
45	Hydraulic oil temperature sensor circuit is open or shorted to battery +
46	Fuel level sensor circuit is open or shorted to battery +
47	Coolant temperature sensor circuit is open or shorted to battery +
48	Boom up pressure sensor circuit is open or shorted to ground
49	Engine preheater circuit is shorted to battery +
51	Boom priority solenoid circuit is open or shorted to ground
56	Travel alarm buzzer circuit is shorted to battery +
58	Boom priority solenoid circuit is shorted to battery +

GROUP 10 ENGINE CONTROL SYSTEM

1. MCU MOUNTING



1 MCU
2 Electric box
3 Bolt(M8)

2. MCU ASSEMBLY

1) Remove four pieces of bolt(3) of electric box(2).

2) Disconnect 2 connectors from MCU.

3) Remove 6 pieces of screw and open the cover of MCU.

4) Inspection : Check PCB(Printed Circuit Board)

(1) If any damage is found, replace MCU assembly.

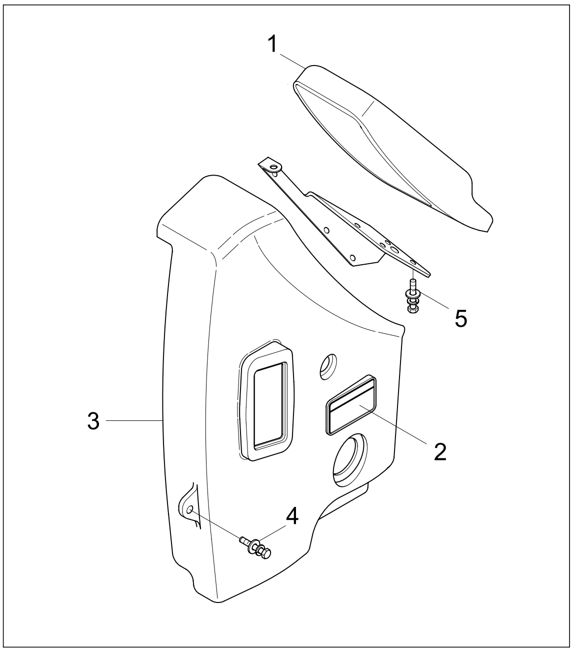
(2) If not, but CAPO system does not work please report it to HHI dealer or A/S department.

3. EXCHANGE METHOD OF THE ROM

1) Disassemble the ash tray(2).

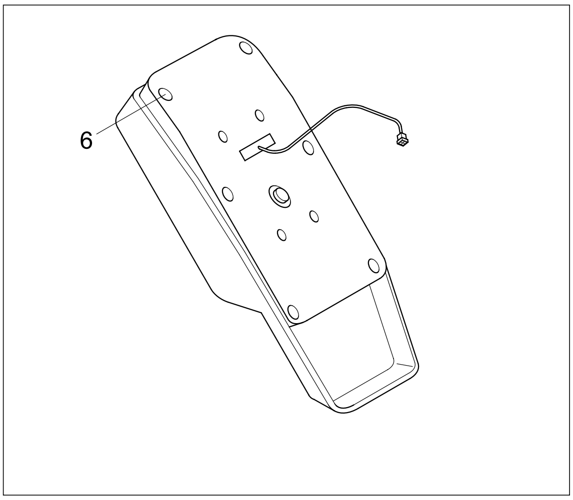
2) Disassemble the wiper motor cover(3).

3) Disassemble the cluster(1).

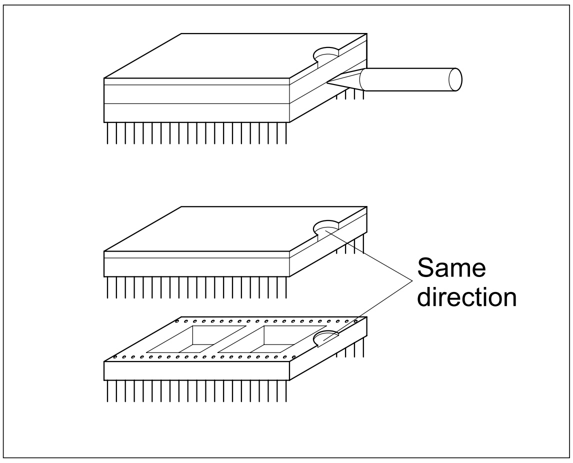


4) Loosen the screws(6EA) located back of the cluster.

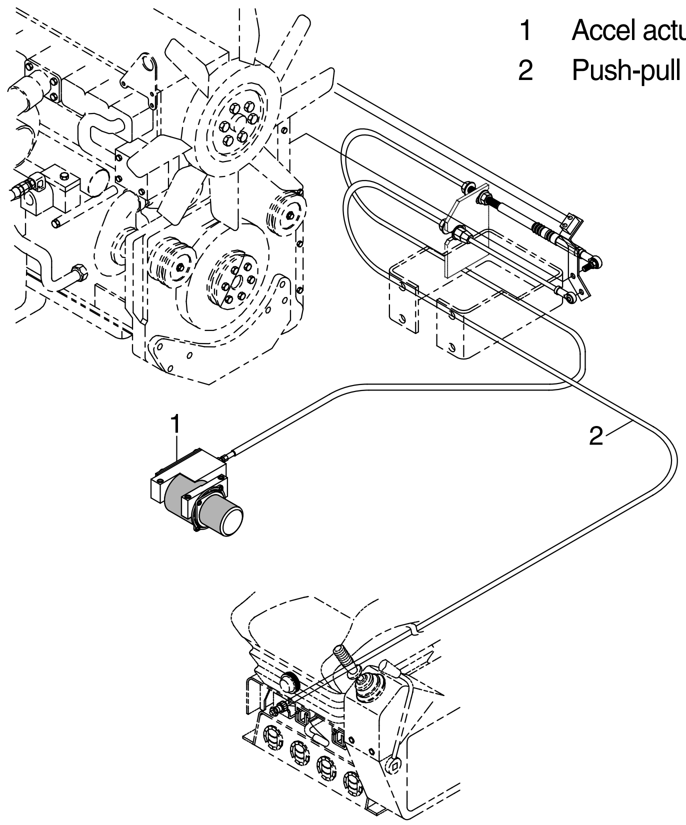
5) Then you can open the upper case of the cluster easily.



6) Install the new ROM.(Be careful of direction and assmelbe the cluster in the reverse order to removal).

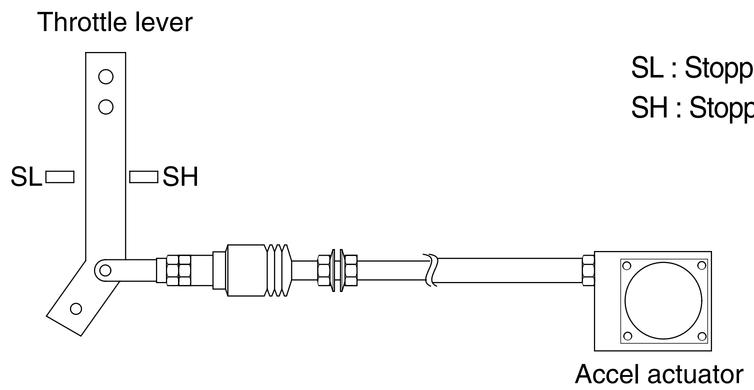


4. ENGINE ACCEL ACTUATOR



1 Accel actuator
2 Push-pull cable for manual control

1) ENGINE THROTTLE LEVER

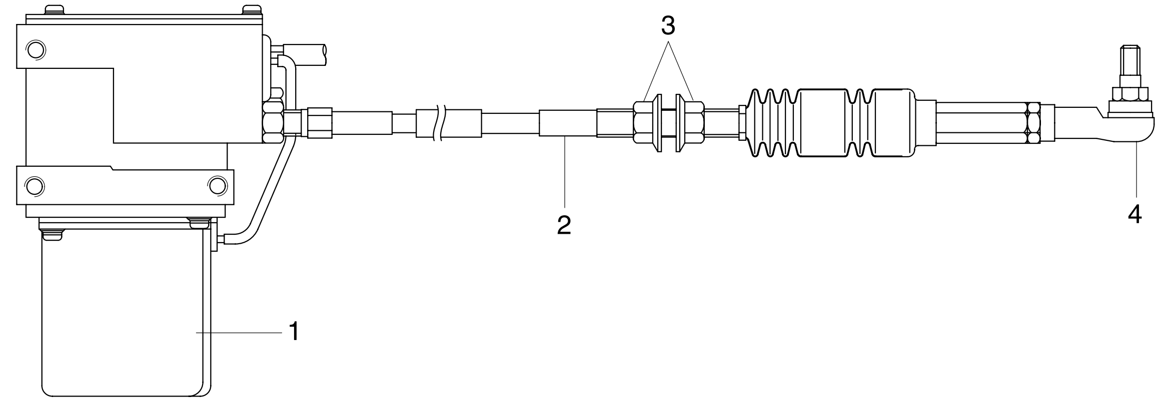


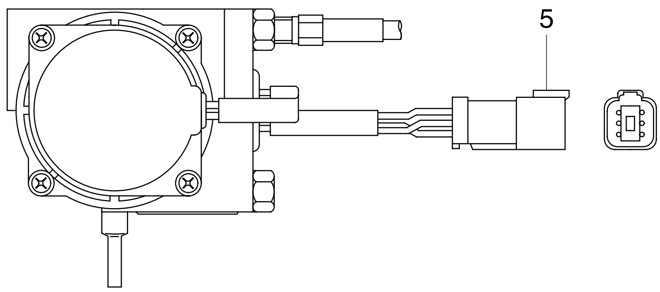
SL : Stopper, low idle
SH : Stopper, high idle

2) EMERGENCY CABLE (Push-pull cable)

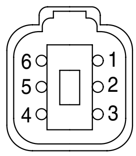
It controls engine speed by connecting onto the lever of the injection pump when the malfunction of the MCU or the accel actuator happen.

3) ACCEL ACTUATOR





1 DC motor
2 Cable
3 Nut
4 Ball joint
5 Connector

Connector		
Type		6P, female
Line color & description	1	White(Potentiometer 5V)
	2	Blue(Potentiometer SIG)
	3	Black(Potentiometer GND)
	4	-
	5	Green(Motor+)
	6	Yellow(Motor -)
Inspection		Check resistance Spec : 1~2 Ω (Between No.5-6) 0.8~1.2kΩ (Between No.1-3)

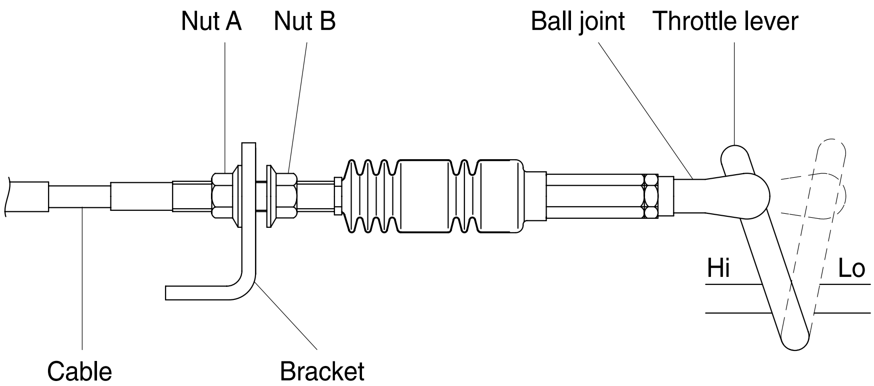
4) ACCEL ACTUATOR CABLE SETTING PROCEDURE

(1) **Key OFF**

① Connect the ball joint of cable to engine throttle lever.
② Pull the cable to high stopper and put nut **A** edge to yoke of the bracket.
※ Make throttle lever not contact to the edge of high stopper.
③ Turn nut **A** to clockwise until touching to the edge of high stopper.
④ Make 1 turn more to clockwise in condition of the nut **A** contact to the edge of high stopper.

(2) **Key START**

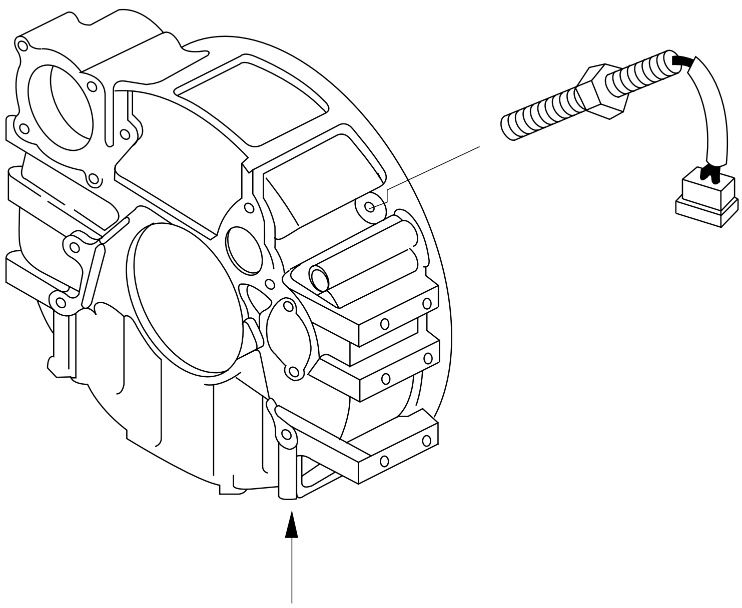
⑤ Confirm if the engine speed on cluster is same as each mode specification.
⑥ If the engine speed displayed on cluster is highter than each mode specification, then turn the nut **A** to counter clockwise and make the engine speed same to each mode specification.
⑦ If the engine speed displayed on cluster is lower than each mode specification, then turn the nut **A** to clockwise and make the engine speed same to each mode specification.
⑧ Turn nut **B** to clockwise and fix the cable to bracket.



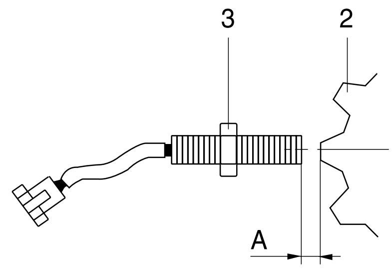
Mode	RPM
P	2150±50
S	2000±50
E	1850±50
Auto decel	1200±100
Key start	950±100

5. ENGINE SPEED SENSOR

1) DETECT ACTUAL ENGINE RPM AND SEND SIGNAL TO TACHOMETER



Flywheel housing



2 Gear teeth, flywheel

3 Lock nut, speed sensor

A Clearance

2) INSTALLATION

(1) Clean contacting point of sensor.

(2) Loosen lock nut.

(3) Screw speed sensor into flywheel housing.

(4) Turn it back 135° when it contacts with gear teeth.

(5) Tight lock nut and connect wiring.

3) INSPECTION

(1) Check resistance

· SPEC : 300 Ω

(2) Check voltage while engine run.

· SPEC : 2~28Vac, dependent on the engine speed(rpm)

GROUP 11 EPPR VALVE

1. COMPOSITION OF EPPR VALVE

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

1) ELECTRO MAGNET VALVE

Receive electric current from MCU 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 hydraulic pump flow.
When the electro magnet valve is activated, pilot pressure enters into flow regulator of hydraulic pump.
So, pump flow decreases to prevent engine stall.

3) PRESSURE AND ELECTRIC CURRENT VALUE FOR EACH MODE

Mode		Pressure		Electric current (mA)	Engine rpm (At accel dial 10)
		kgf/cm²	psi		
Standard (Ver : 3.1)	P	10 ± 3	142 ± 40	330 ± 30	2150 ± 50
	S	15 ± 3	213 ± 40	400 ± 30	2000 ± 50
	E	18 ± 3	256 ± 40	460 ± 30	1850 ± 50
Option (Ver : 4.1)	P	8 ± 3	114 ± 40	290 ± 30	2050 ± 50
	S	12 ± 3	171 ± 40	360 ± 30	1900 ± 50
	E	15 ± 3	213 ± 40	400 ± 30	1750 ± 50

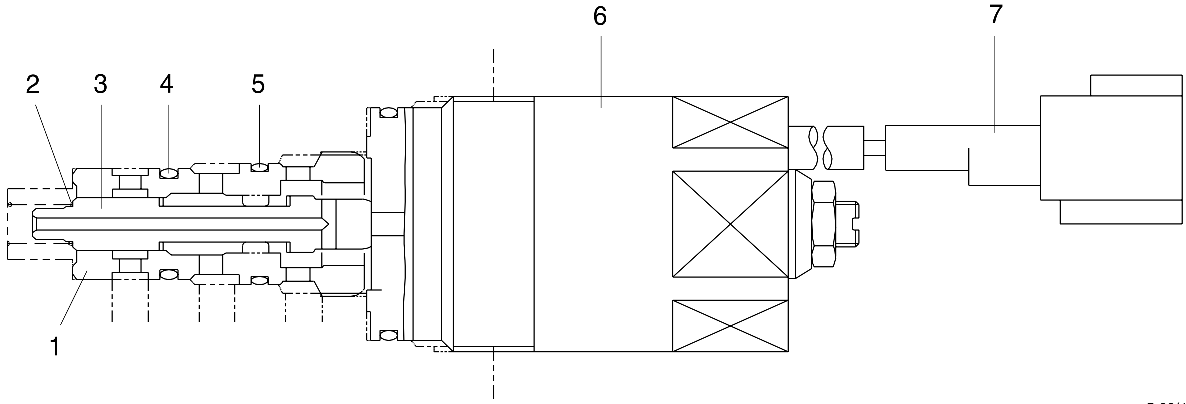
2. HOW TO SWITCH THE VERSION(3.1↔ 4.1) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the version(3.1↔4.1).

- Dual mode
  · Changing the MCU mode

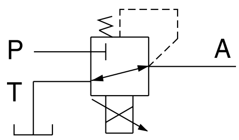
2. OPERATING PRINCIPLE

1) STRUCTURE



5-22(1)

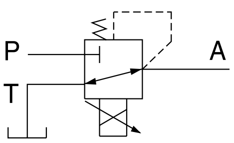
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

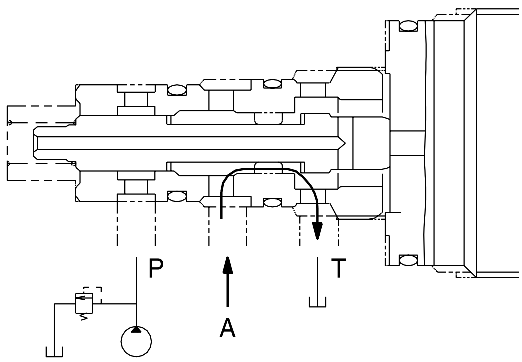


P Pilot oil supply line(Pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at hydraulic pump

2) AT H MODE

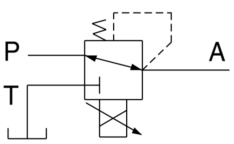
Pressure line is blocked and A oil returns to tank.

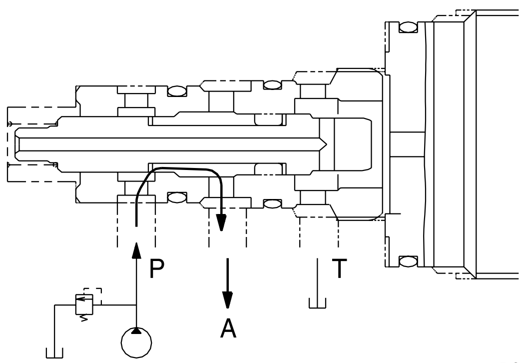




3) AT S MODE

Secondary pressure enters into A.





5-22(2)

3. EPPR VALVE CHECK PROCEDURE

1) CHECK ELECTRIC VALUE AT EPPR VALVE

(1) Start engine.

(2) Set S-mode and cancel auto decel mode.

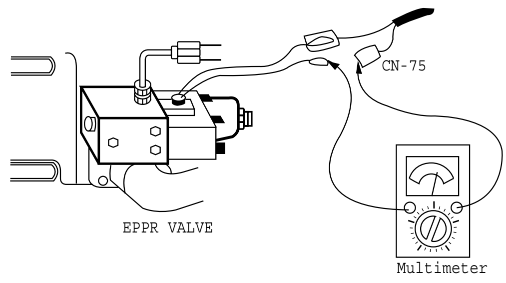
(3) Position the accel dial at 10.

(4) If tachometer show approx 2000±50rpm, disconnect one wire harness from EPPR valve.

(5) Install multimeter as figure.

(6) Check electric current at bucket circuit relief position.

Spec : 200~500mA



2) CHECK PRESSURE AT EPPR VALVE

(1) Remove plug and connect pressure gauge as figure.

· Gauge capacity : 0 to 40-50kgf/cm^2 (0 to 580-725psi)

(2) Start engine.

(3) Set S-mode and cancel auto decel mode.

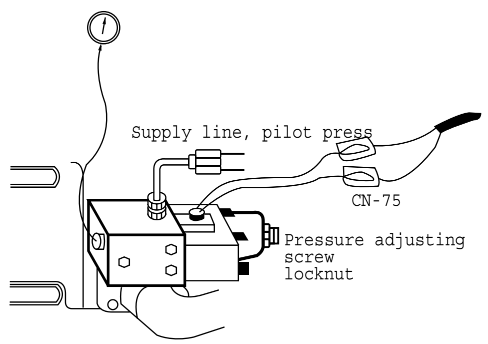
(4) Position the accel dial at 10.

(5) If tachometer show approx 2000±50rpm, 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 : 2~25kgf/cm^2(30~350psi)



GROUP 12 MONITORING SYSTEM

1. OUTLINE

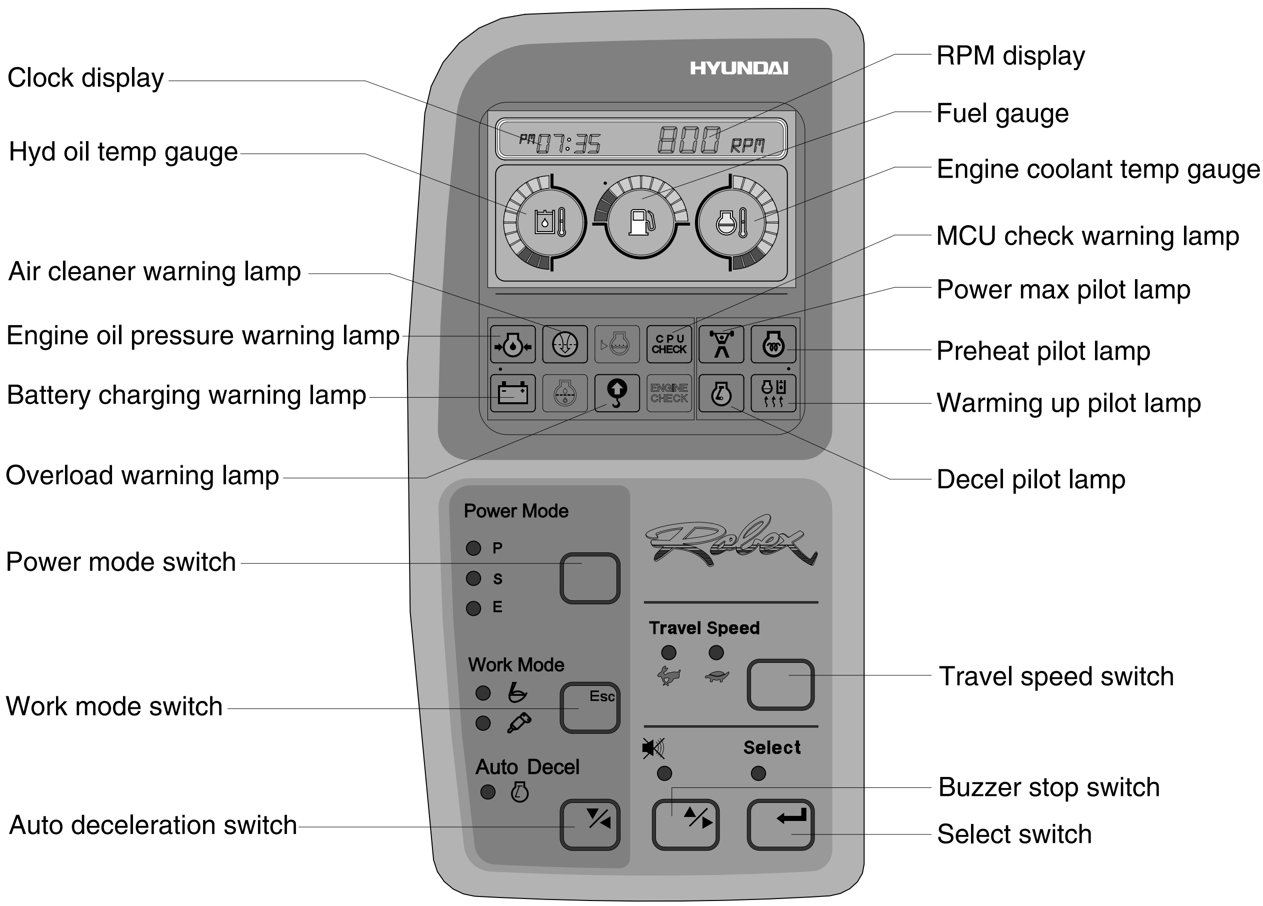
Monitoring system consists of the monitor part and switch part.

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

1) MONITOR PANEL



140V95MS06

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.
※ When engine coolant temperature below 30°C, the warming up lamp lights up.

③ Indicating lamp state

a. Work mode selection : General work
b. Power mode selection : S 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 : S 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

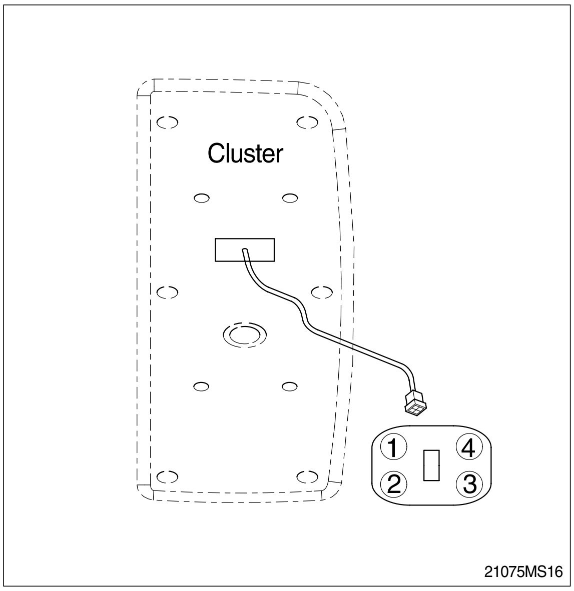
a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to1200 rpm(Auto decel LED : ON)
※ Others same as above ①.

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

No.	Signal	Input / Output
1	Power IG(24V)	Input(20~32V)
2	GND	Input(0V)
3	Serial-(RX)	Input(Vpp=12V)
4	Serial+(TX)	Output(Vpp=4V)



2) LCD main operation display

Default screen

1607A3CD02A

Option screen

1607A3CD02B

1 Time display
2 RPM display
3 Hydraulic oil temperature gauge
4 Fuel level gauge
5 Engine coolant temperature gauge

(1) Time display

1607A3CD02C

① This displays the current time.

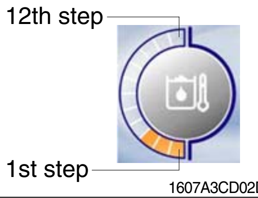
※ **Refer to the page 5-36 to set time for details.**

(2) RPM display

1607A3CD02C

① This displays the engine rpm.

(3) Hydraulic oil temperature gauge



1607A3CD02D

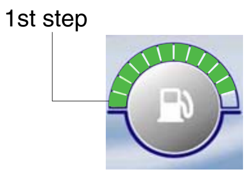
① This gauge indicates the temperature of hydraulic oil in 12 step gauge.
 · 1st step : Below 30℃(86°F)
 · 2nd~10th step : 30-105 °C(86-221°F)
 · 11th~12th step : Above 105℃(221°F)

② The gauge between 2nd and 10th steps illuminates when operating.

③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.

④ When the gauge of 11th and 12th steps illuminates, reduce the load on the system. If the gauge stays in the 11th~12th steps, stop the machine and check the cause of the problem.

(4) Fuel level gauge



1607A3CD02E

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.

※ **If the gauge illuminates the 1st step or fuel icon blinks in red even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.**

(5) Engine coolant temperature gauge

1607A3CD02F

① This gauge indicates the temperature of coolant in 12 step gauge.
 · 1st step : Below 30℃(86°F)
 · 2nd~10th step : 30-105 °C(86-221°F)
 · 11th~12th step : Above 105℃(221°F)

② The gauge between 2nd and 10th steps illuminates when operating.

③ Keep idling engine at low speed until the gauge between 2nd and 10th steps illuminates, before operation of machine.

④ When the gauge of 11th and 12th steps illuminates, turn OFF the engine, check the radiator and engine.

3) Warning of main operation screen

(1) Warning display

① Engine coolant temperature

- This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 105℃ (221°F) .
- Check the cooling system when the lamp blinks.

② Fuel level

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

③ Hydraulic oil temperature

- This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105 °C (221 °F) .
- Check the hydraulic oil level when the lamp blinks.
- Check for debris between oil cooler and radiator.

④ All gauge

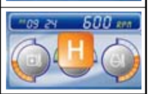
 

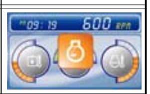
- This lamp blinks and the buzzer sounds when the all gauge is abnormal.
- Check the each system when the lamp blinks.

⑤ Communication error

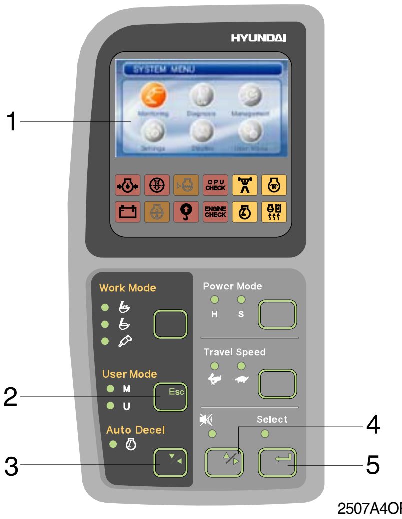
- Communication problem between MCU and cluster makes the lamp blinks and the buzzer sounds.
- Check if any fuse for MCU burnt off.
  If not check the communication line between them.

(2) Pop-up icon display

No	Switch	Selected mode	Display
1	Work mode switch	General work mode	
		Heavy duty work mode	
		Breaker operation mode	
2	Power mode switch	High power work mode	
		Standard power work mode	

No	Switch	Selected mode	Display
3	Auto deceleration switch	Light ON	
		Light OFF	
4	Travel speed control switch	Low speed	
		High speed	

4) LCD



2507A4OP95B

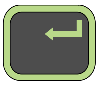
1  : LCD

2 

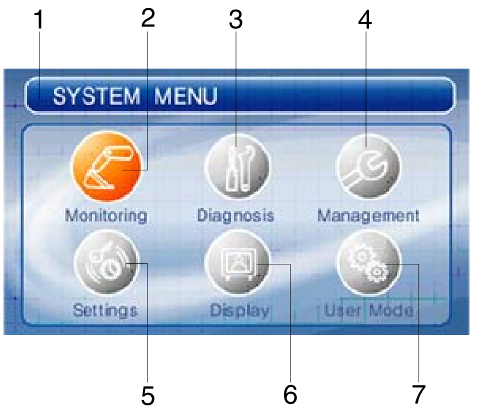
: Escape,
Return to the previous menu

3  : Down/Left Direction

4  : Up/Right Direction

5  : Select(Enter)
Activate the currently chosen item

(1) Main menu



2507A4OP94

1  : Menu information

2  : Monitoring
- Equipment, Switch, Output

3  : Diagnosis
- Current error, Recorded error

4  : Maintenance

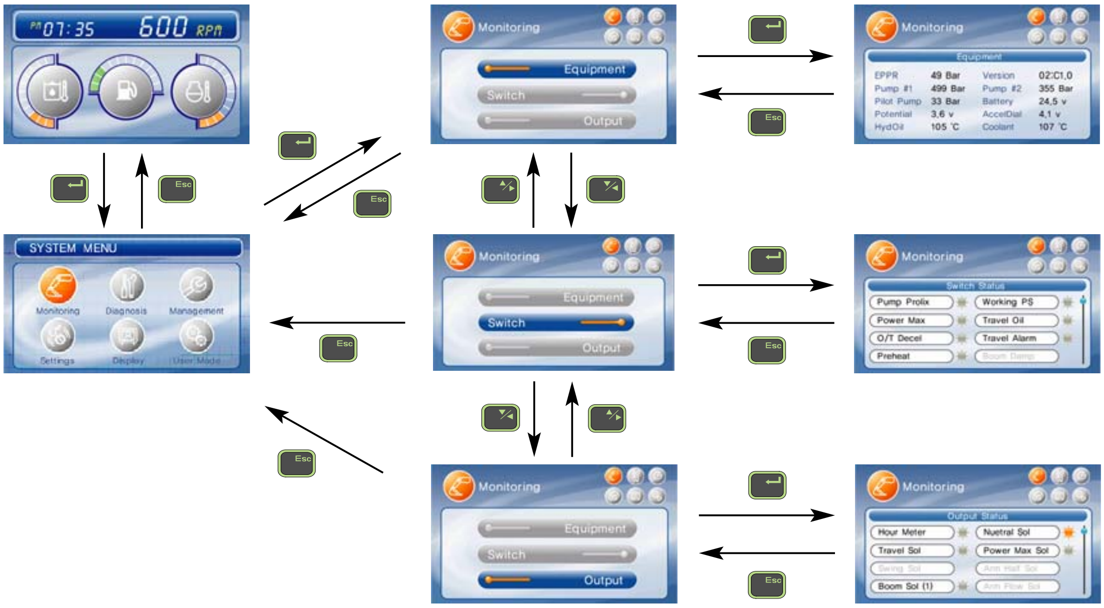
5  : Settings
- Time set, Dual mode
- System lock(Reserved)

6  : Display
- Operation skin, Brightness, Language

7  : User mode

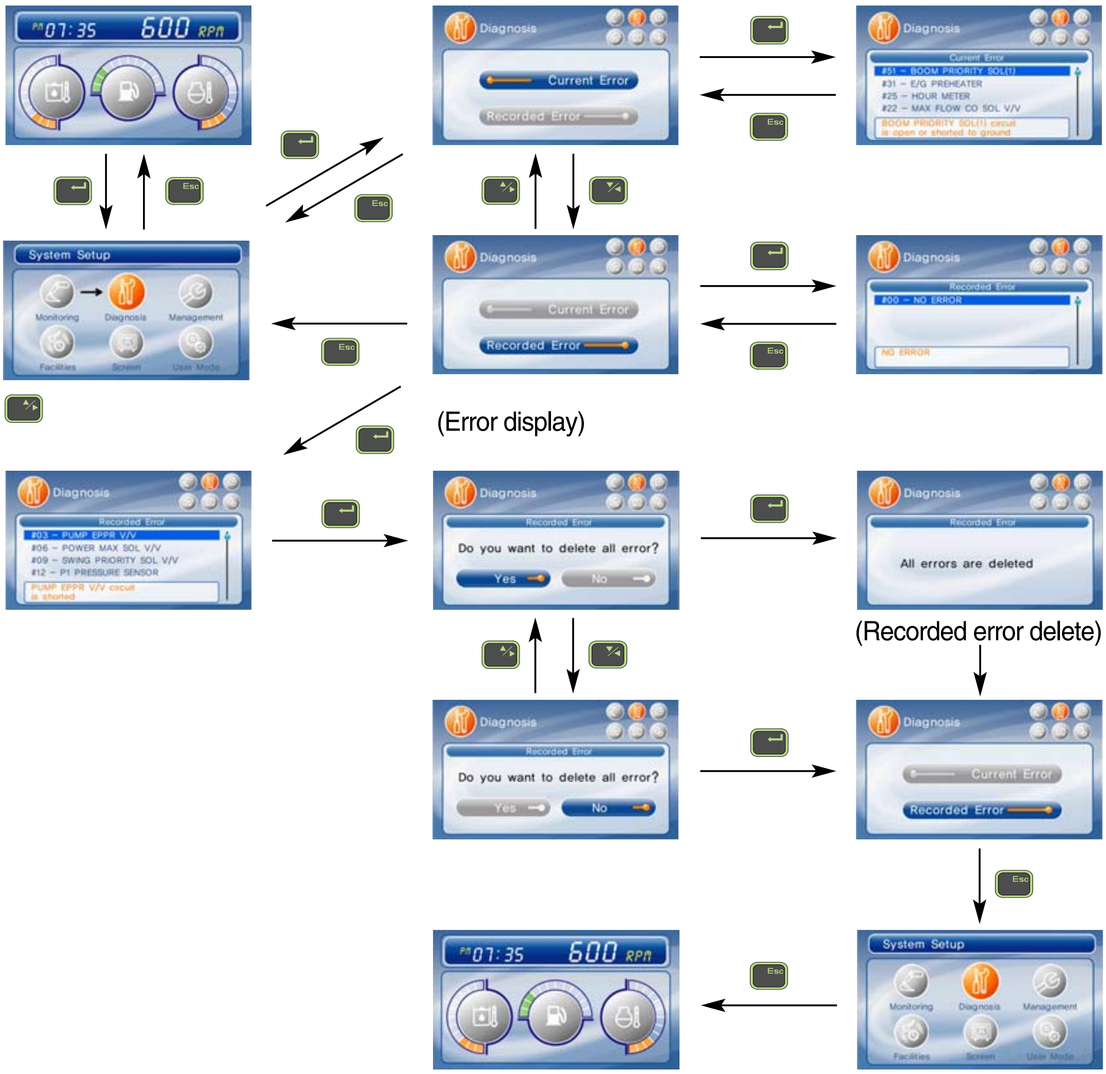
(2) Display map

① Monitoring



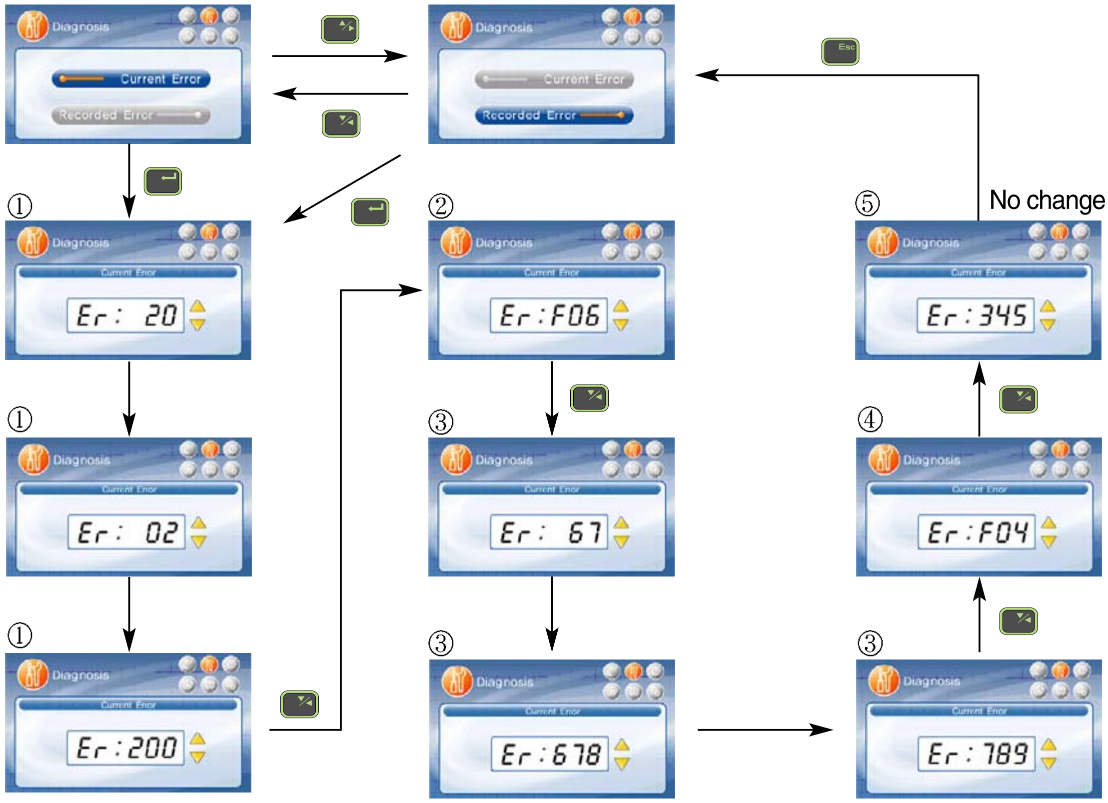
② Diagnosis

a. Protocol type 1

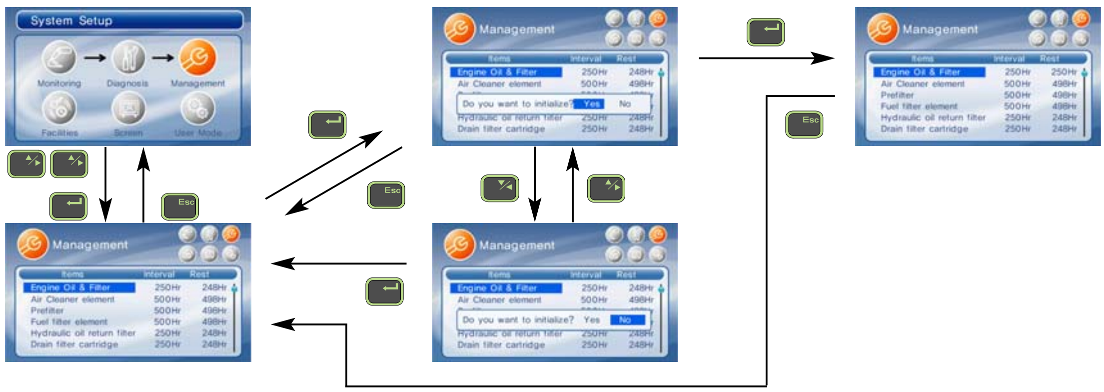


b. Protocol type 2

- If there are more than 2 error codes, each one can be displayed by pressing or switch respectively.
- 3 error codes (①SPN200200, ②FMI06, ③SPN6789, ④FMI04, ⑤345) display.



③ Maintenance



④ Setting

a. Time set

: Adjusting

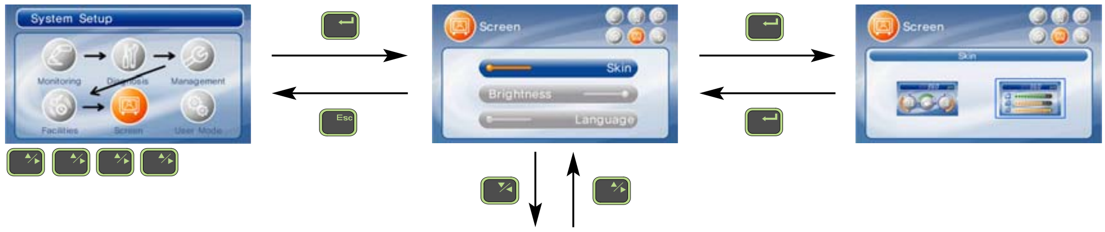
: Setting

b. System lock - Reserved

c. Dual mode
- Changing the MCU mode

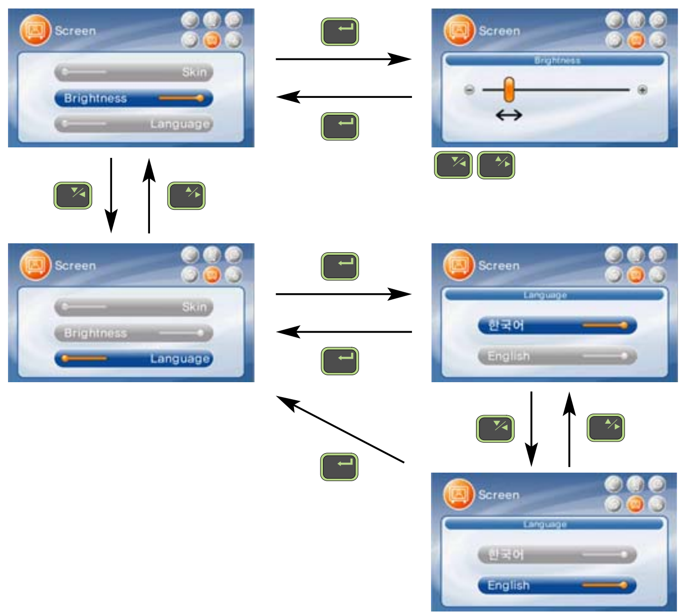
⑤ Display

a. Operation skin

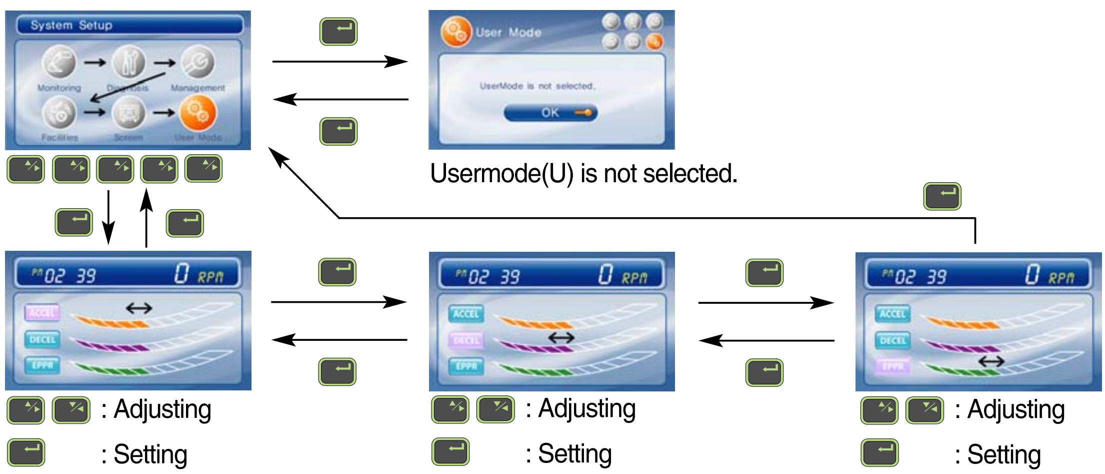


b. Brightness

c. Language

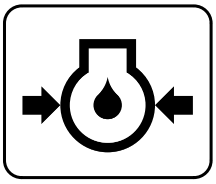


⑥ User mode



5) Warning and pilot lamp

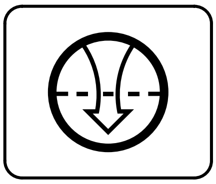
(1) Engine oil pressure warning lamp



21073CD07

① This lamp blinks and the buzzer sounds after starting the engine because of the low oil pressure.
② If the lamp blinks during engine operation, shut OFF engine immediately. Check oil level.

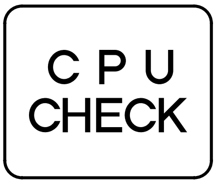
(2) Air cleaner warning lamp



21073CD08

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

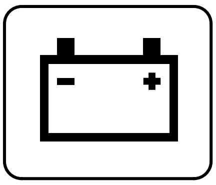
(3) MCU check warning lamp



21073CD10

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

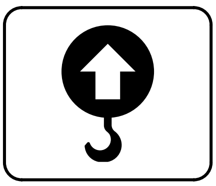
(4) Battery charging warning lamp



21073CD13

① This lamp blinks and the buzzer sounds when the starting switch is ON, it is turned OFF after starting the engine.
② Check the battery charging circuit when this lamp blinks during engine operation.

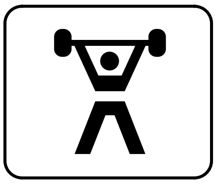
(5) Overload warning lamp



21073CD15

① When the machine is overload, the overload warning lamp blinks during the overload switch is ON.

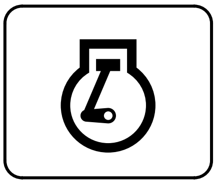
(6) Power max pilot lamp



21073CD11

① The lamp will be ON when pushing power max switch on the LH RCV lever.

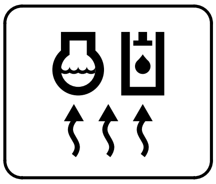
(7) Decel pilot lamp



21073CD17

① Operating auto decel or one touch decel makes the lamp ON.
② The lamp will be ON when pushing one touch decel switch on the LH RCV lever.

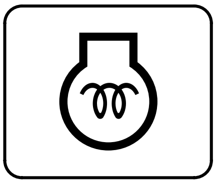
(8) Warming up pilot lamp



21073CD18

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 ℃, or when 10 minutes have passed since starting.

(9) Preheat pilot lamp



21073CD12

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

SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

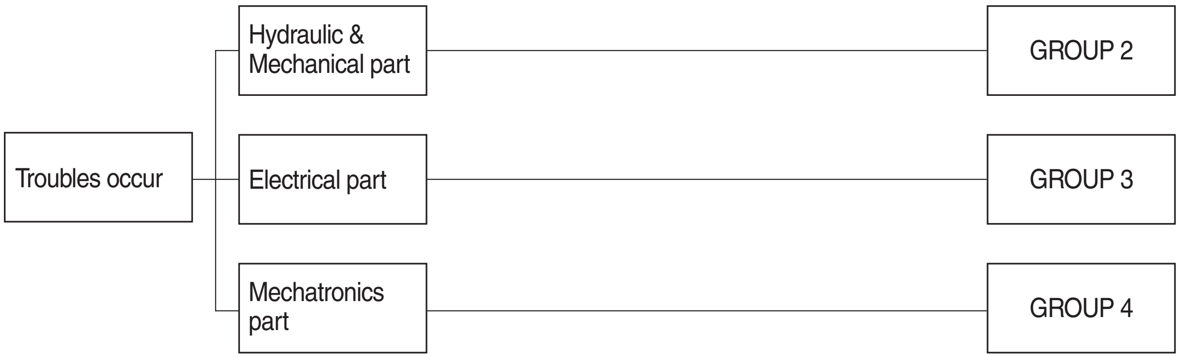
GROUP 1 BEFORE TROUBLESHOOTING

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.**

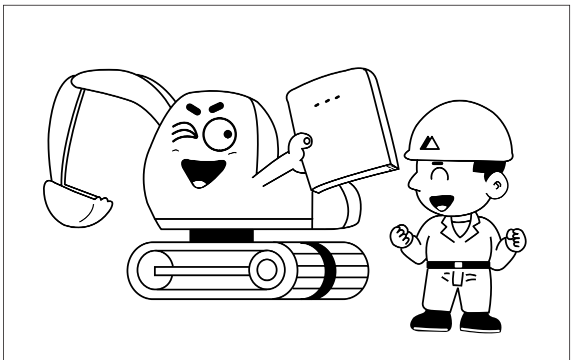


2. DIAGNOSING PROCEDURE

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.

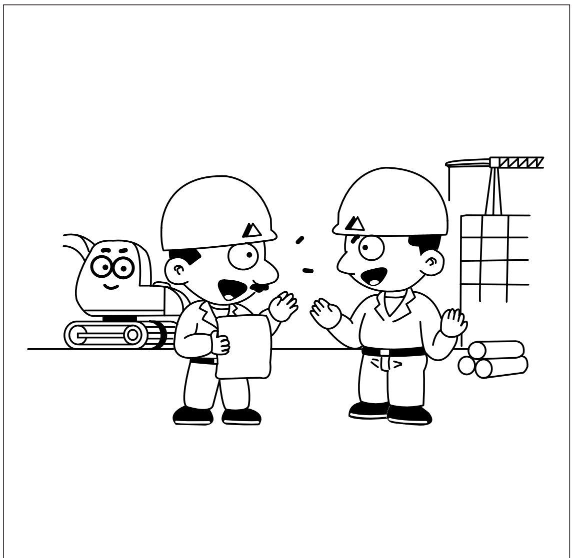


13031SH02

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.

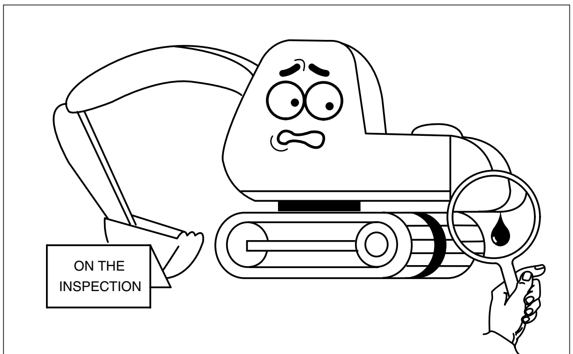


13031SH03

STEP 3. Inspect the machine

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

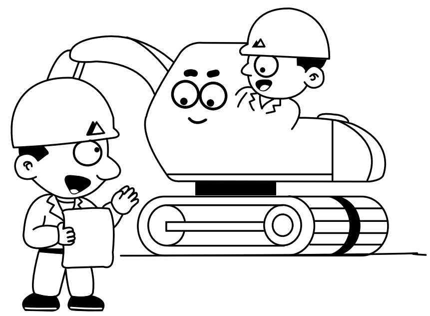
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

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.



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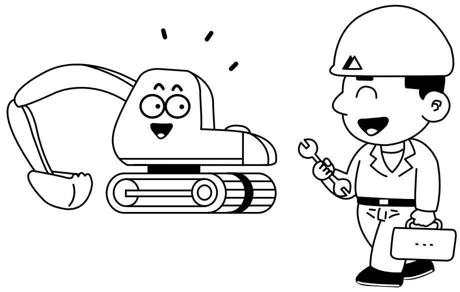
STEP 5. Perform troubleshooting

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.

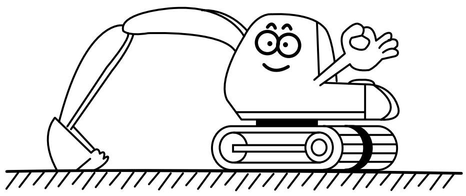


13031SH05

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.



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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.

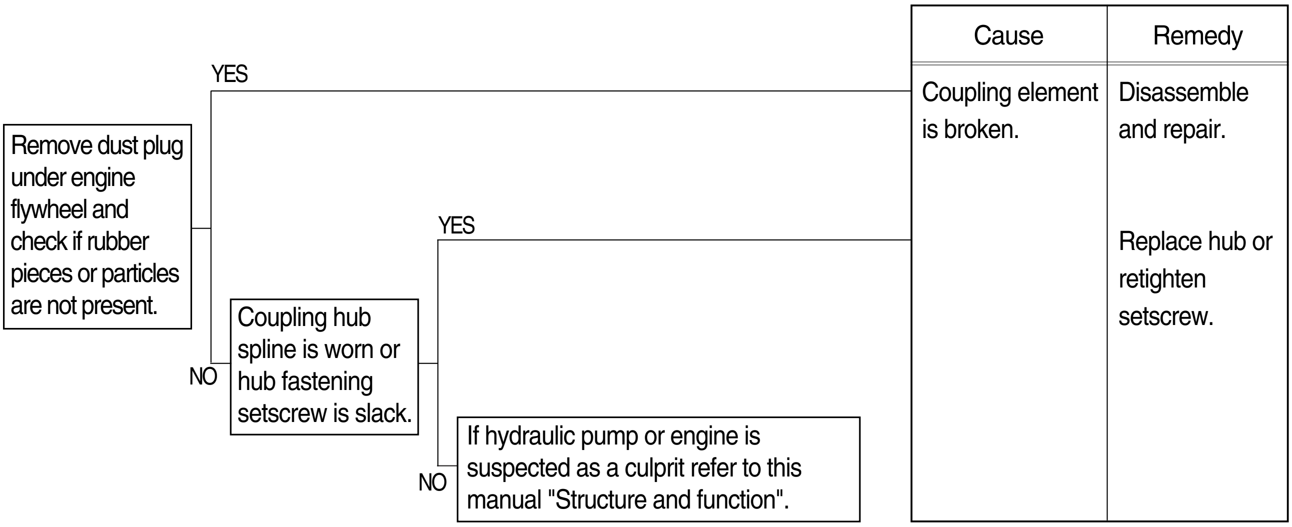
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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?

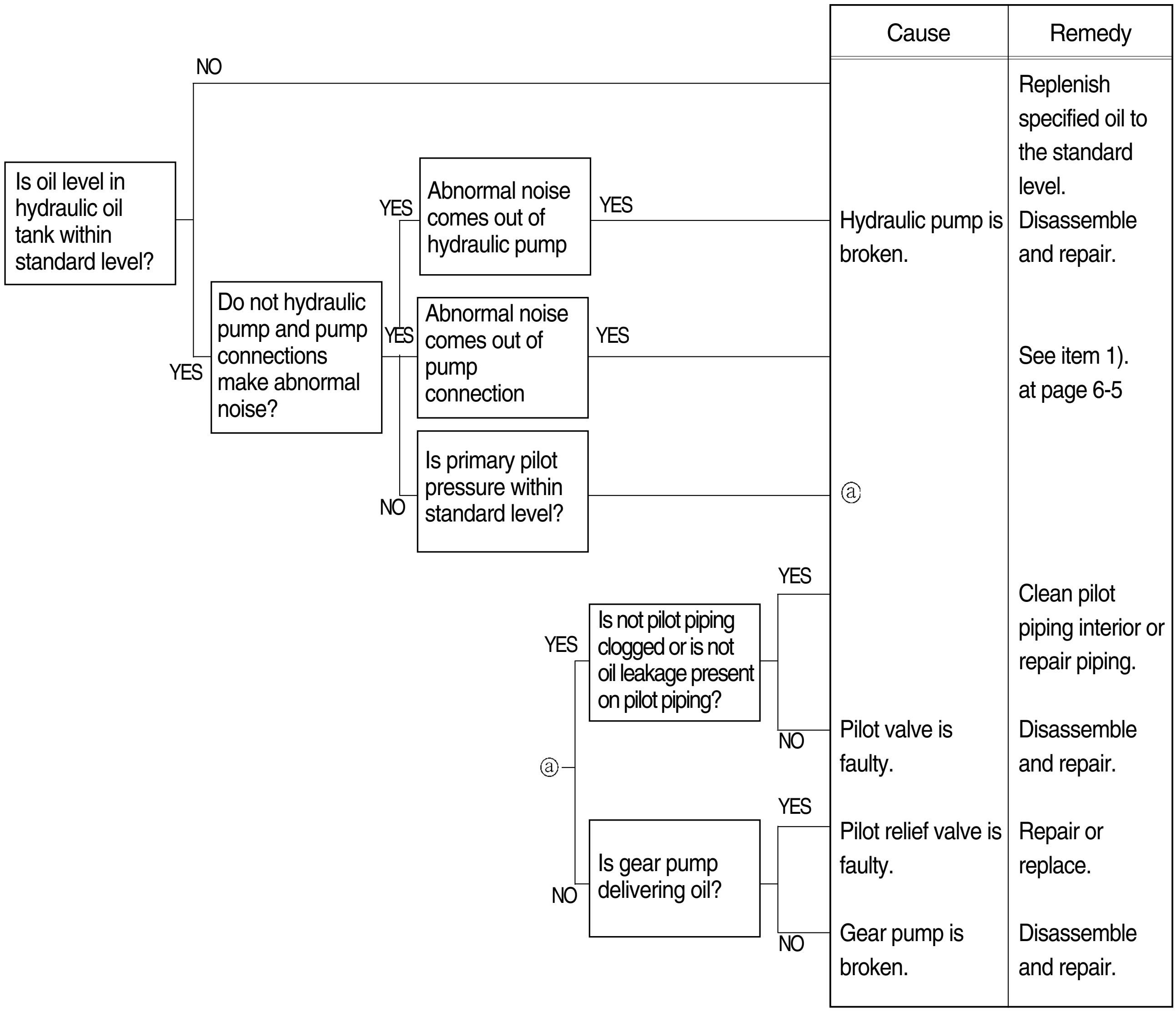
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

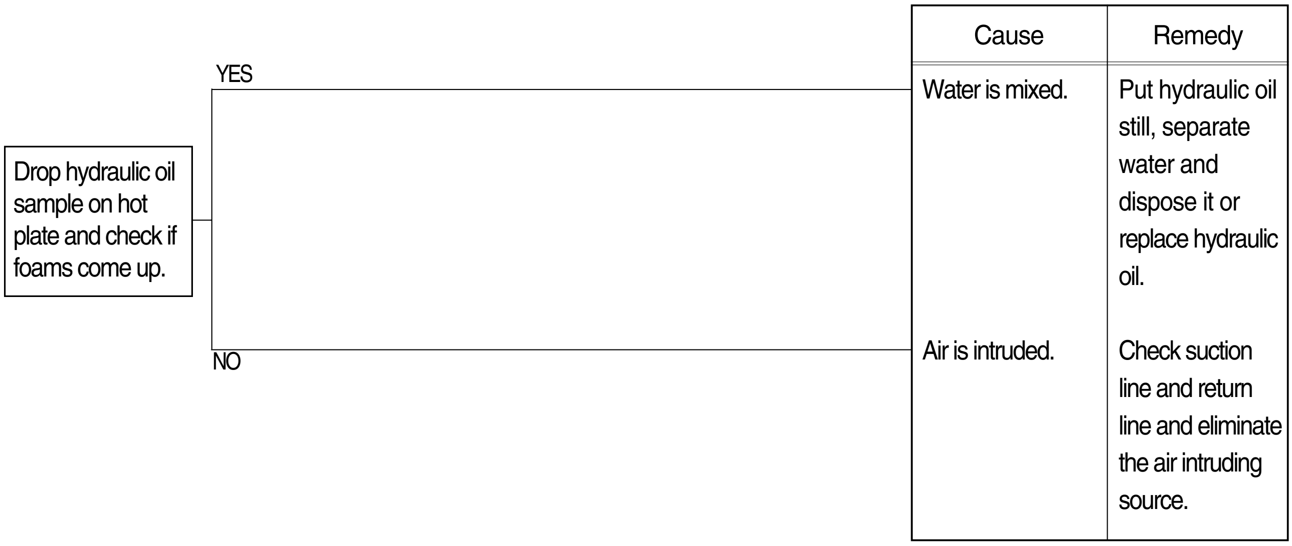


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

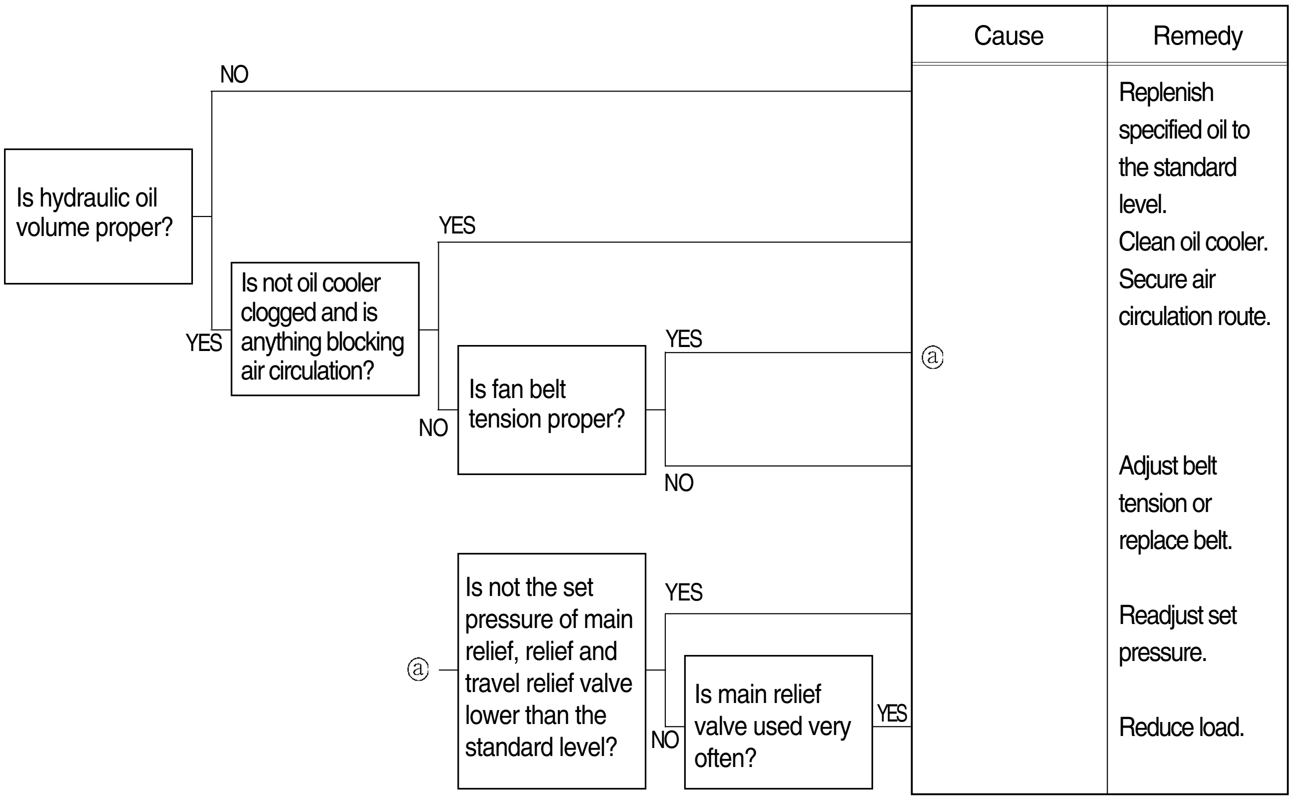


3. HYDRAULIC SYSTEM

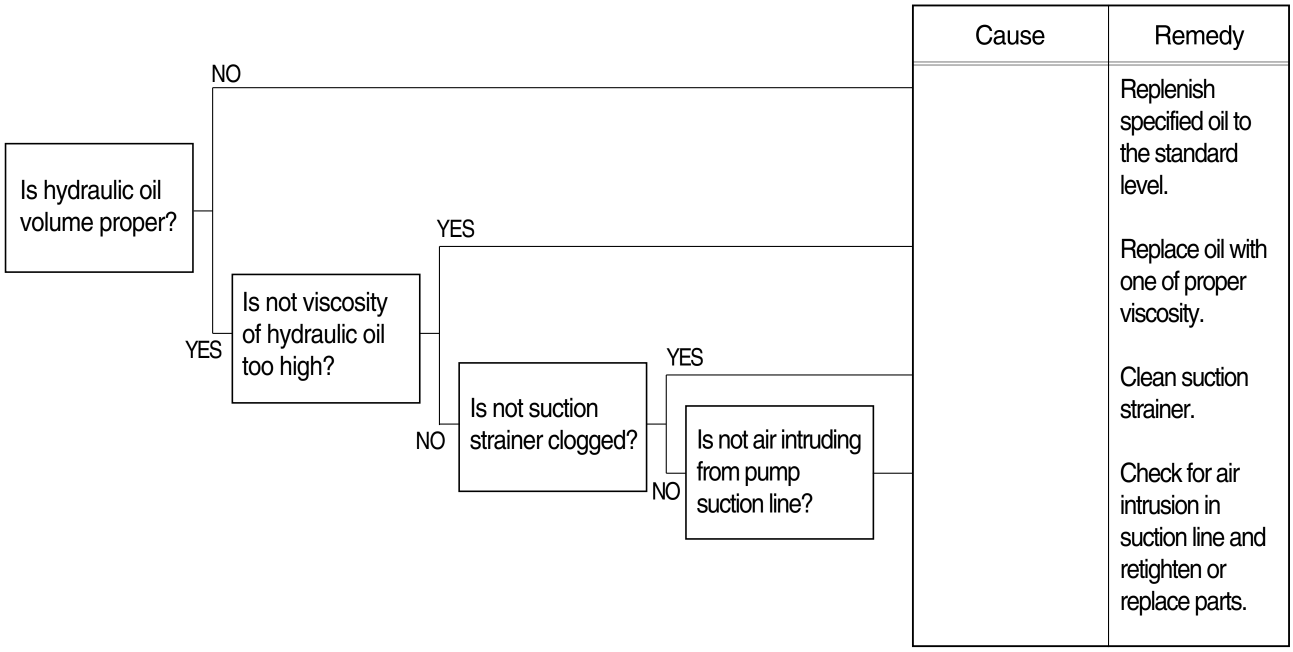
1) HYDRAULIC OIL IS CLOUDY



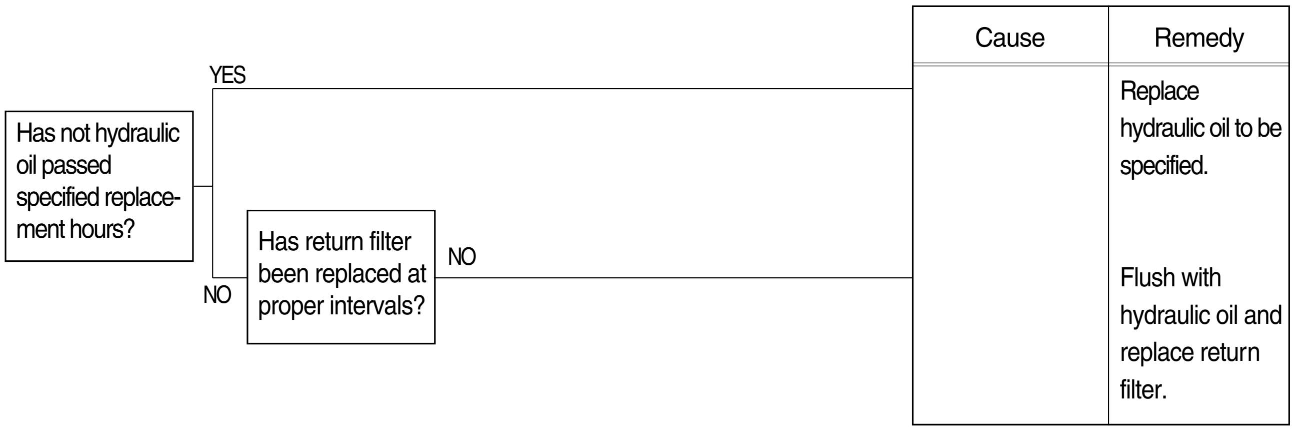
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

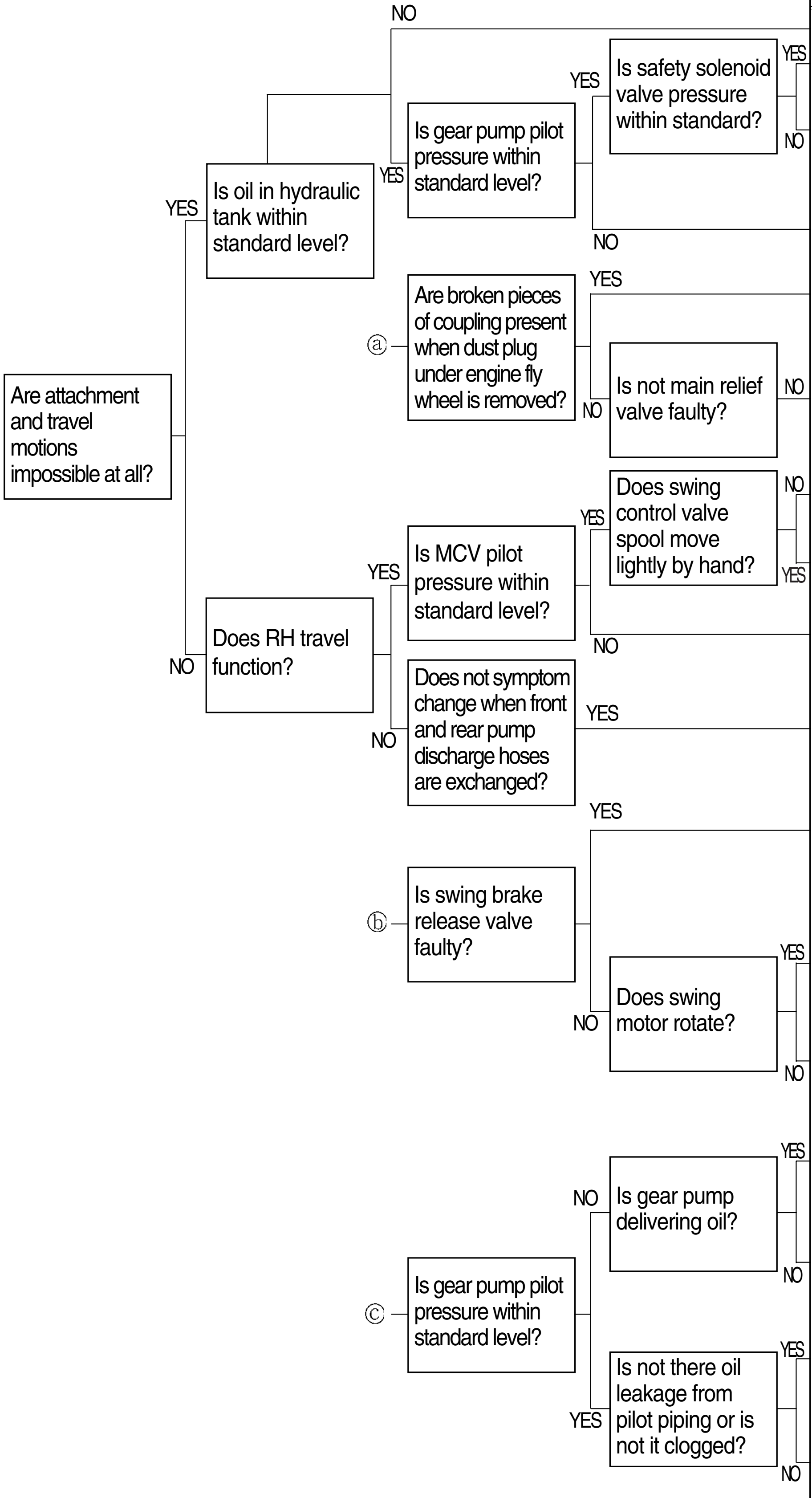


4) HYDRAULIC OIL IS CONTAMINATED



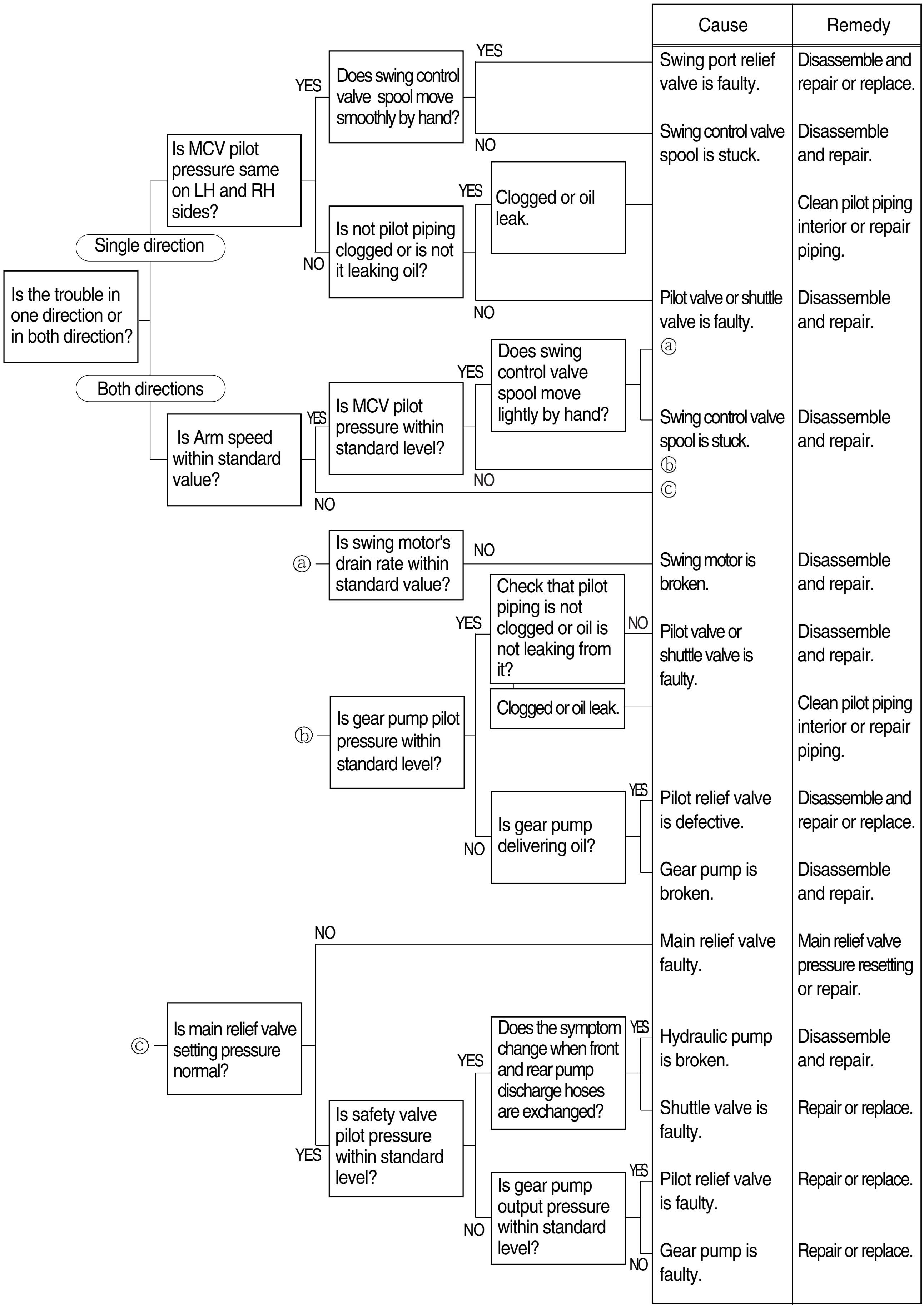
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

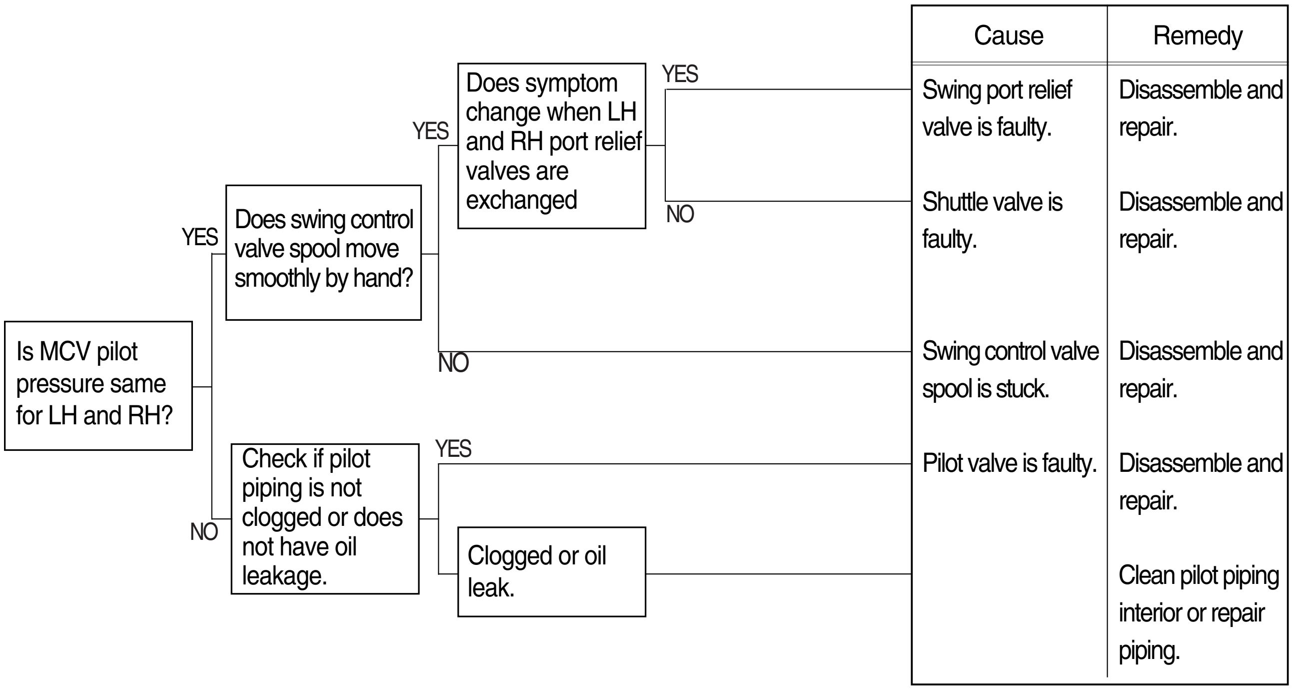


Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
ⓑ	
ⓒ	
Hydraulic pump is broken.	Disassemble and repair.
Swing brake release valve is broken.	Disassemble and repair.
Swing reduction unit is broken.	Disassemble and repair.
Swing motor is broken.	Disassemble and repair.
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is out of order.	Disassemble and repair.
	Clean pilot piping interior or repair piping.
Pilot valve is broken.	Disassemble and repair.

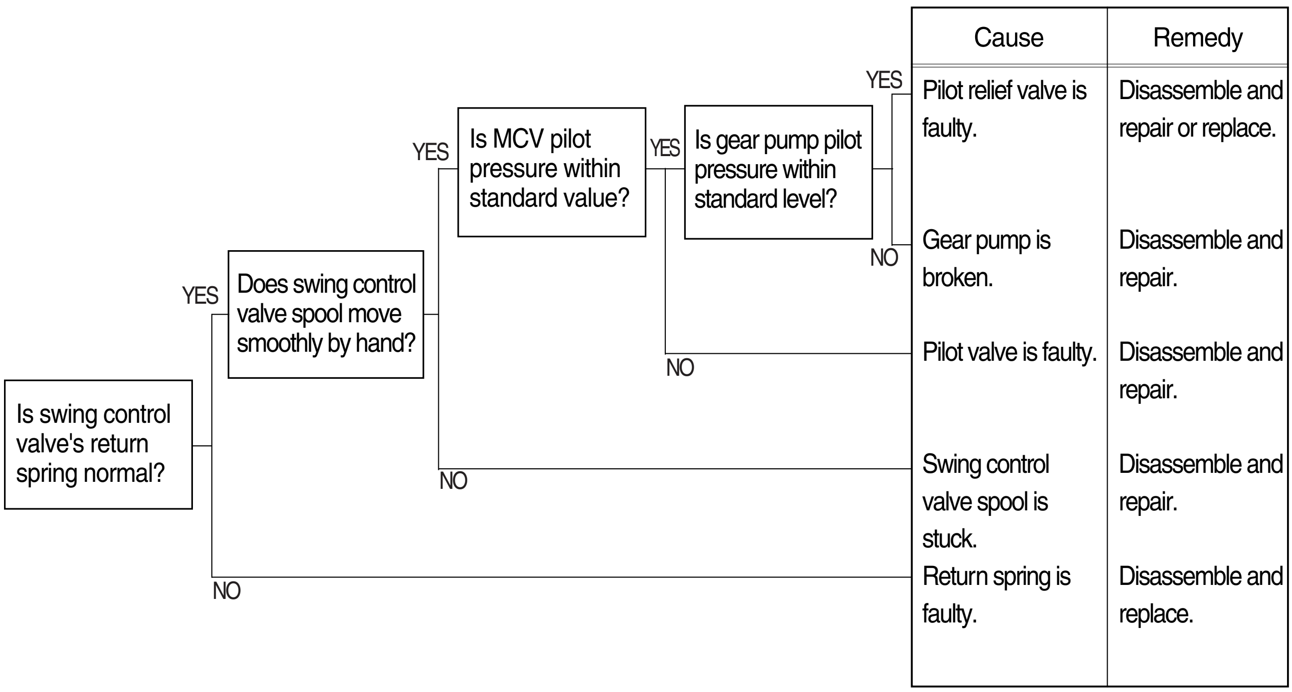
2) SWING SPEED IS LOW



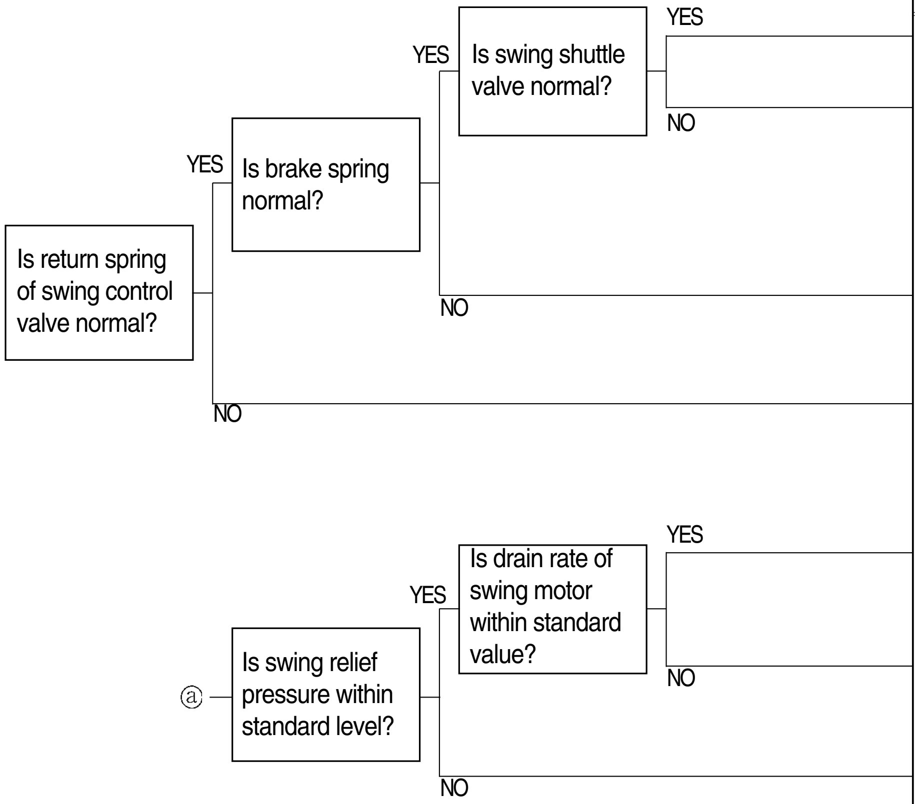
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP



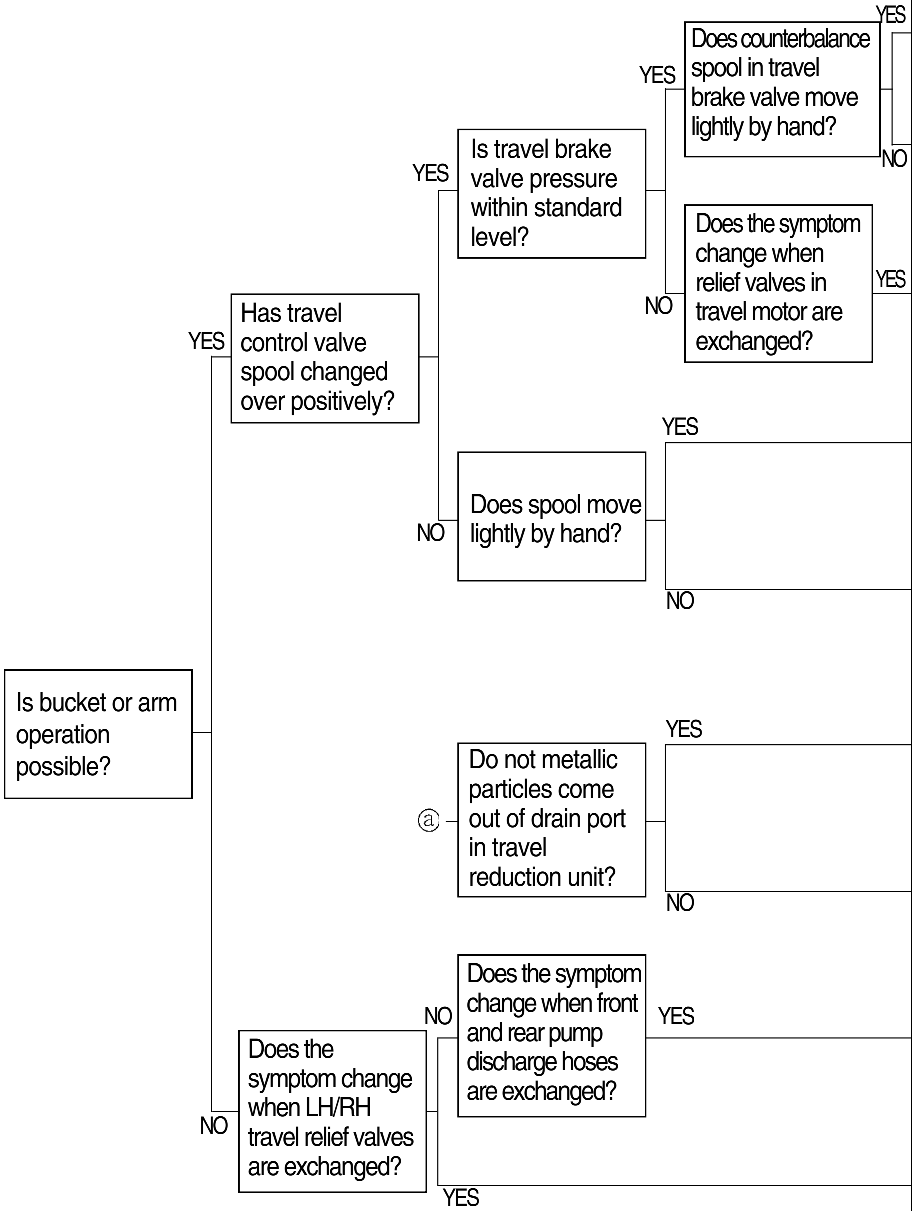
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



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 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.

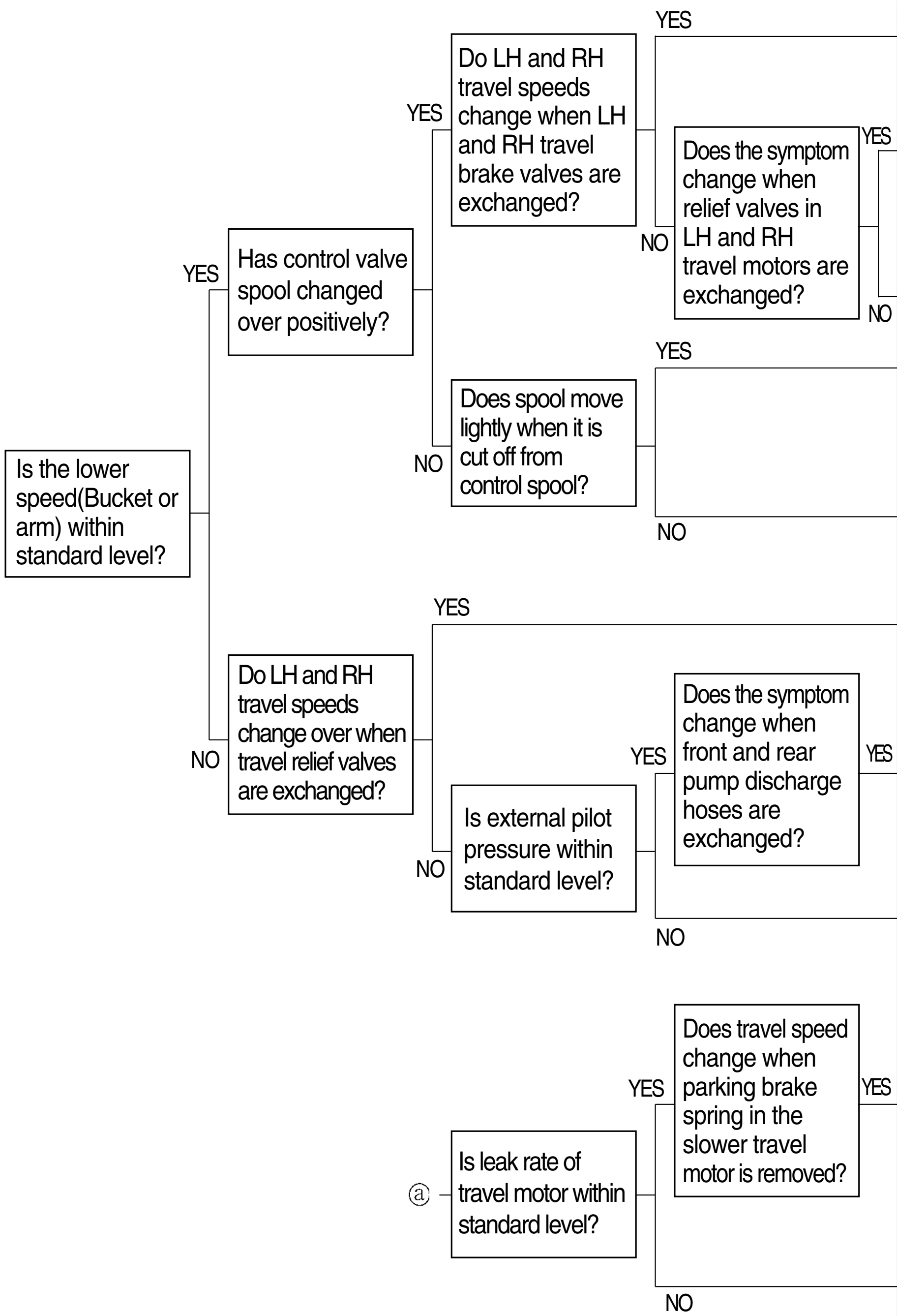
5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



Cause	Remedy
ⓐ	
Counter spool in travel brake valve is stuck.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is defective.	Disassemble inspect and repair.
Travel control valve spool is stuck.	Disassemble and repair.
Travel reduction unit is faulty.	Disassemble and repair.
Travel motor is out of order.	Disassemble and repair.
Hydraulic pump is broken.	Disassemble and repair.
Travel relief valves are faulty.	Disassemble and repair or replace.

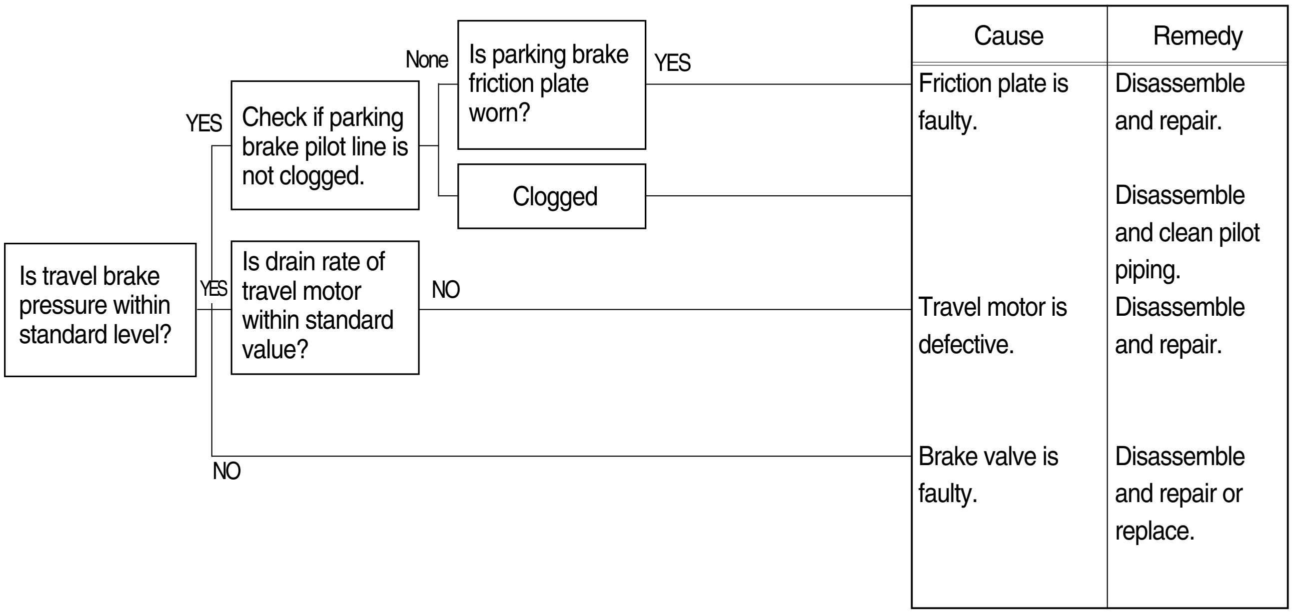
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



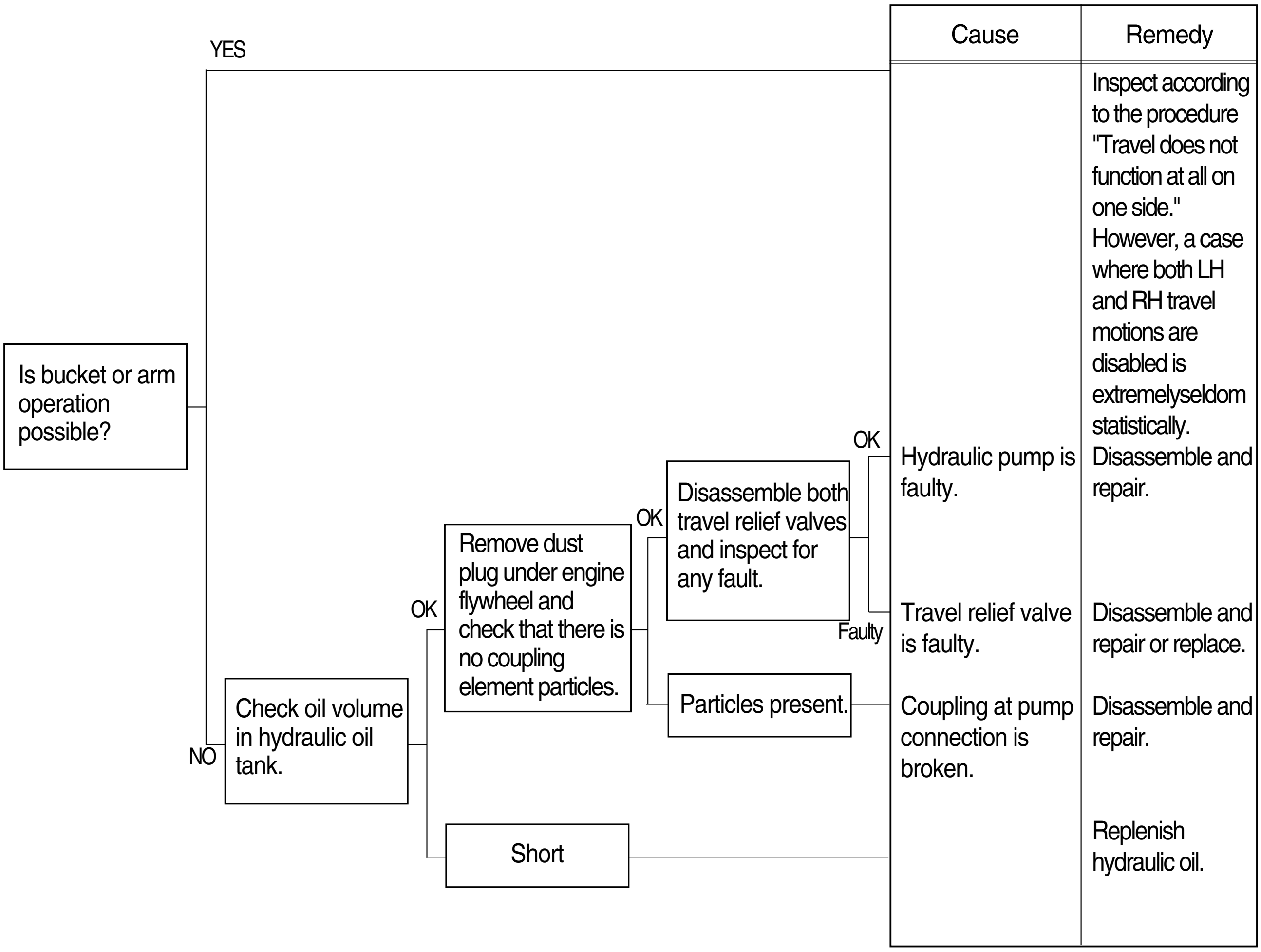
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
ⓐ	
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble 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

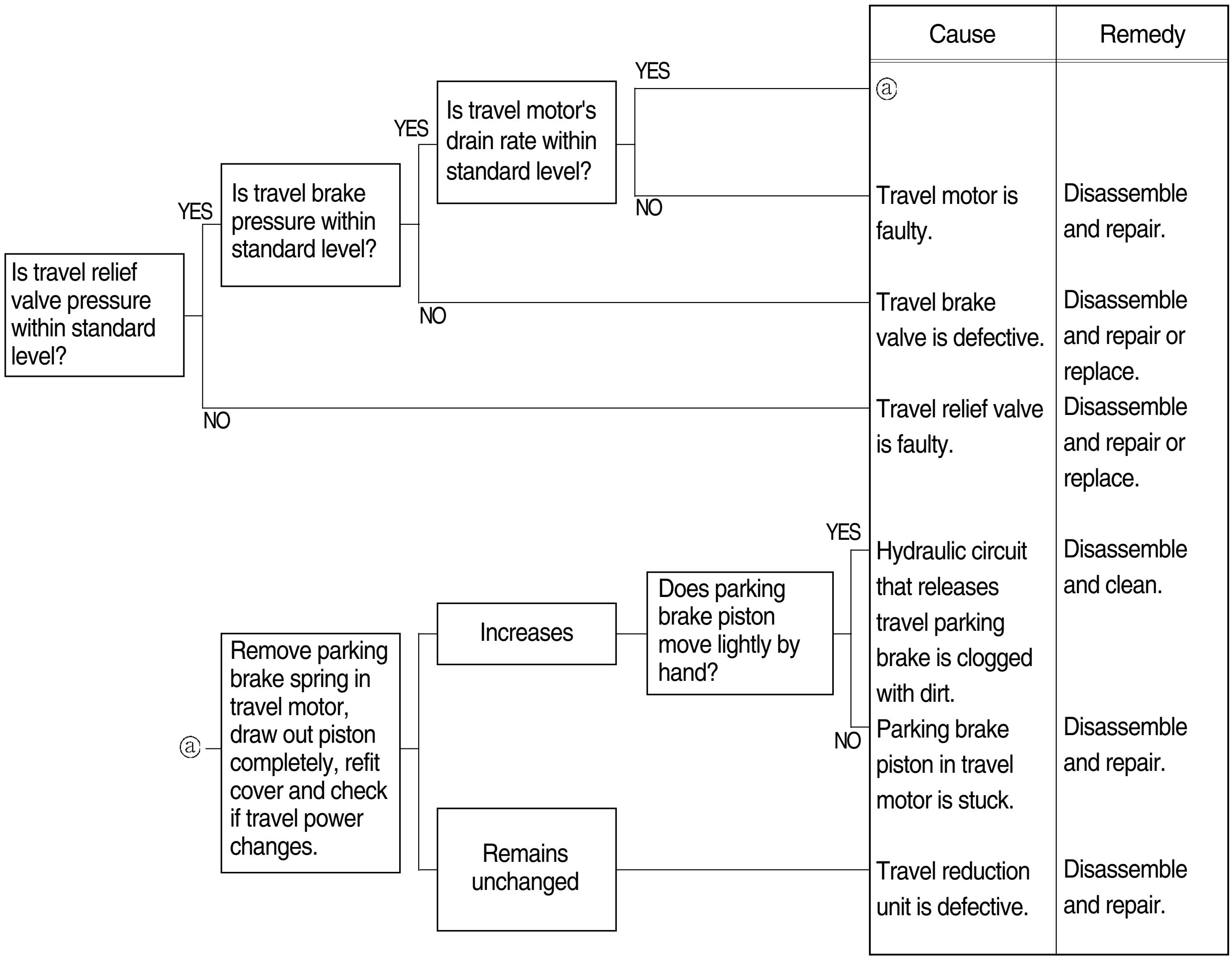
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

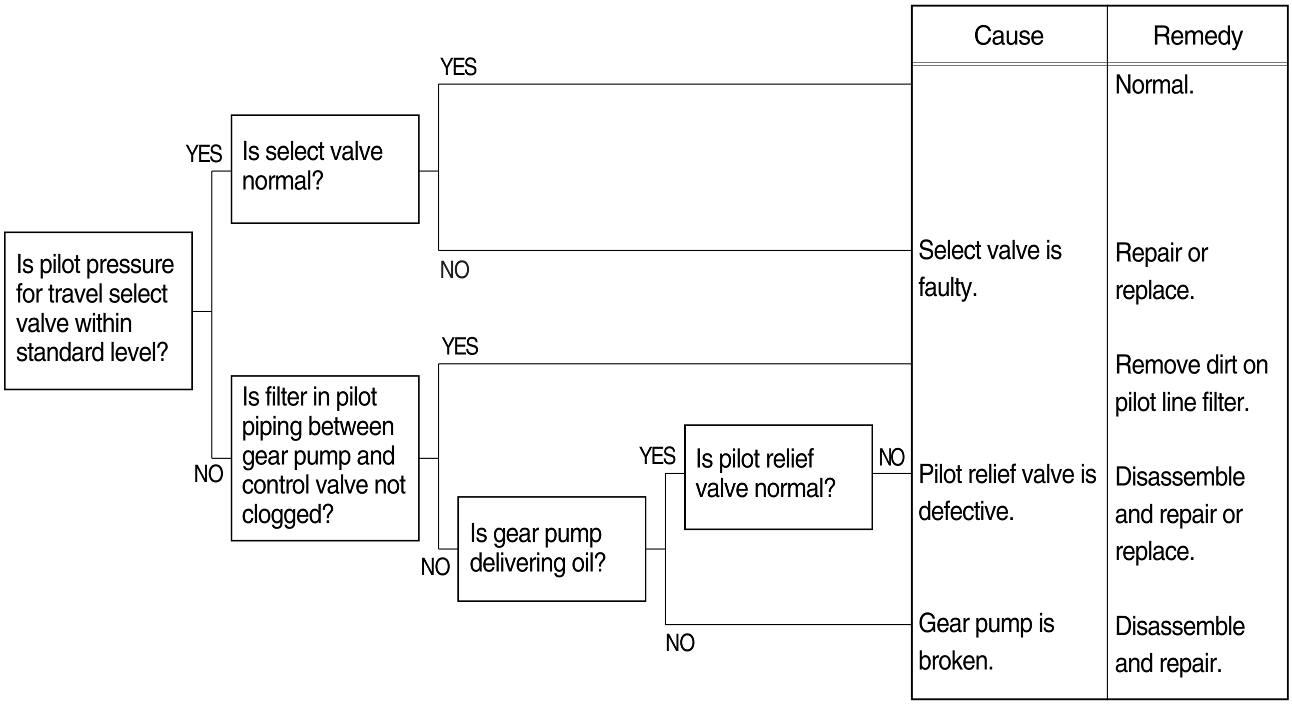


5) TRAVEL ACTION IS POWERLESS(Travel only)



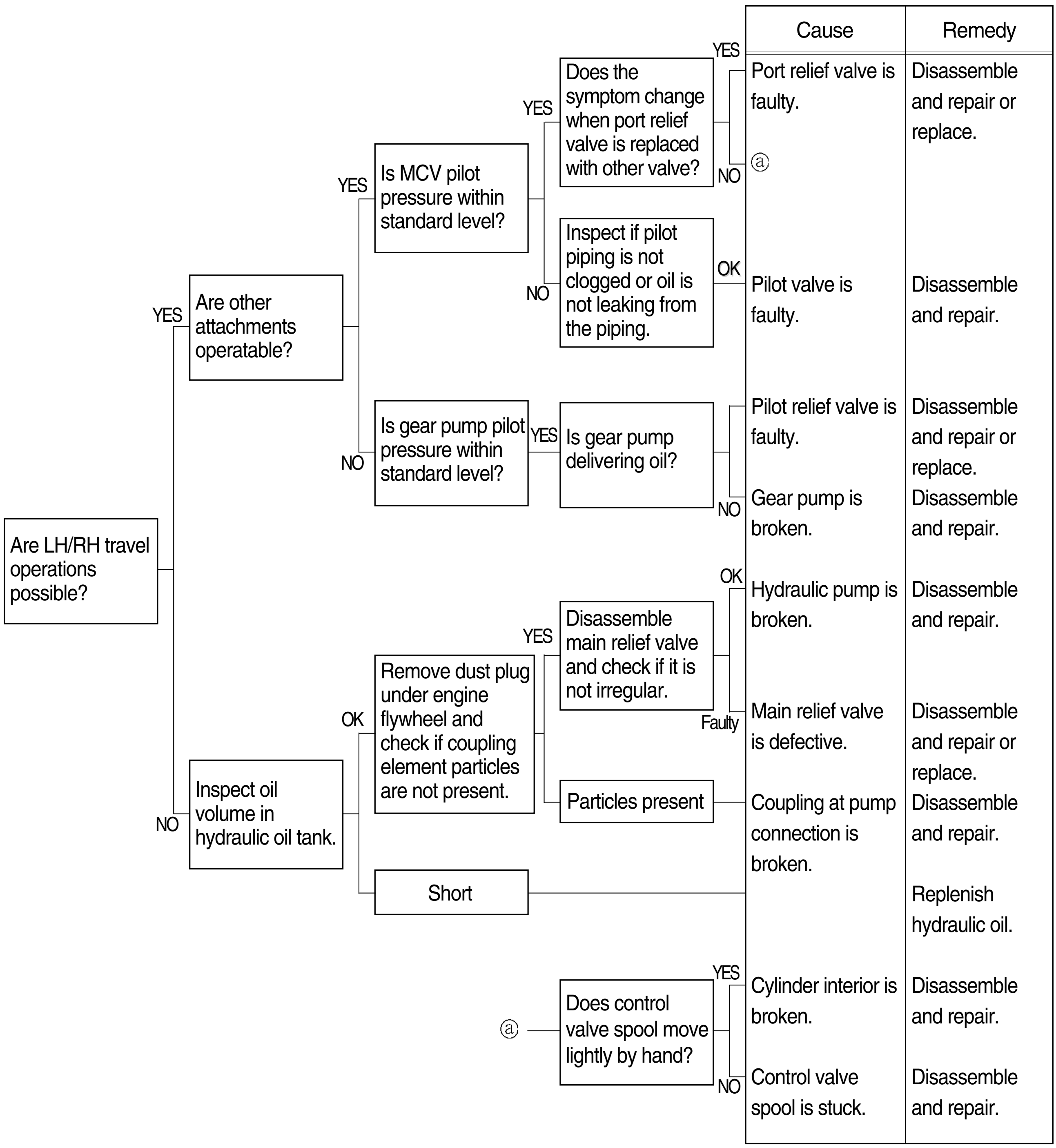
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

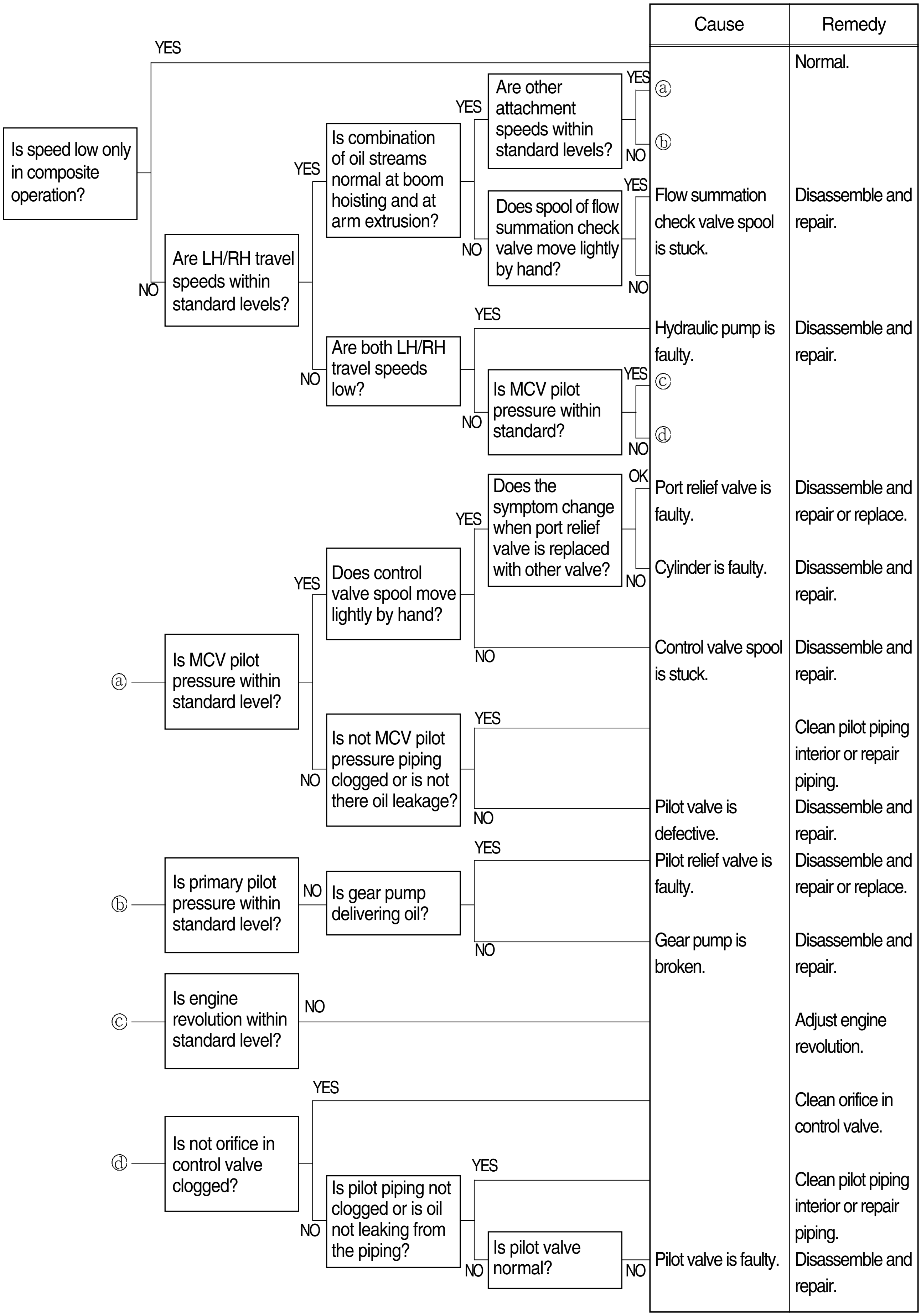


6. ATTACHMENT SYSTEM

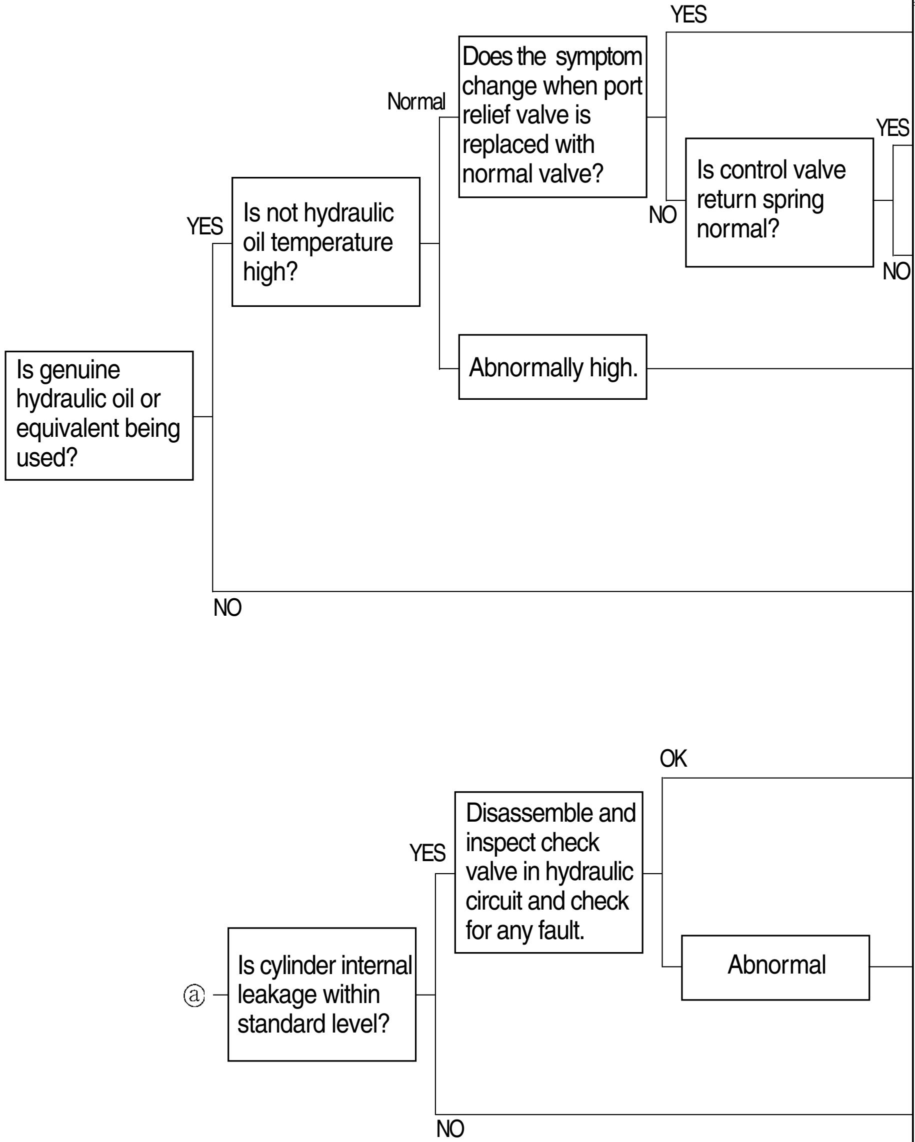
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

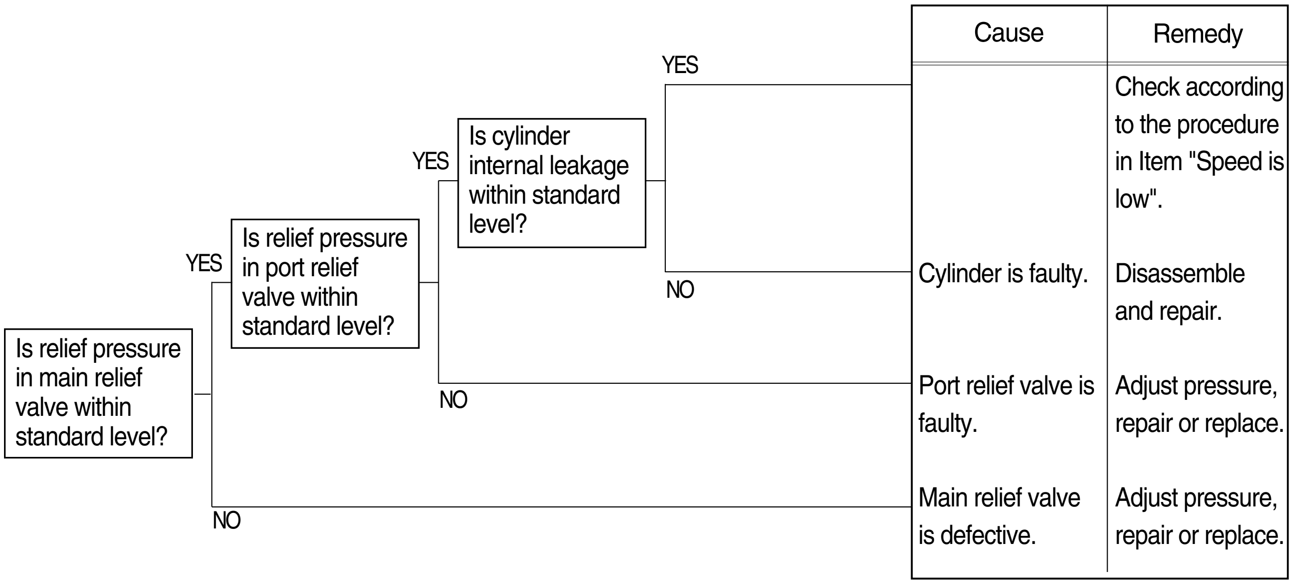


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

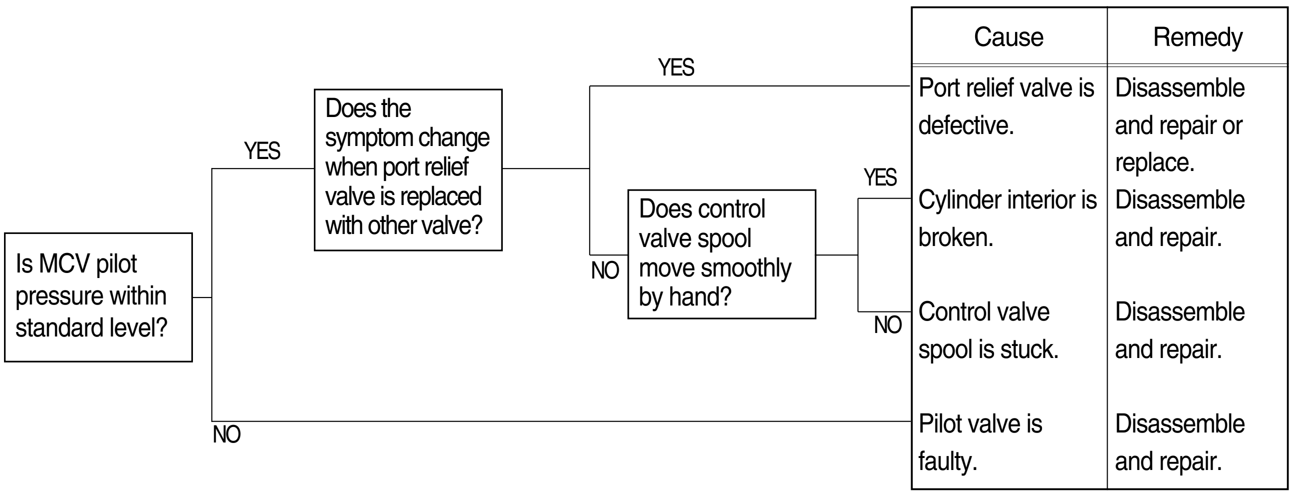


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE

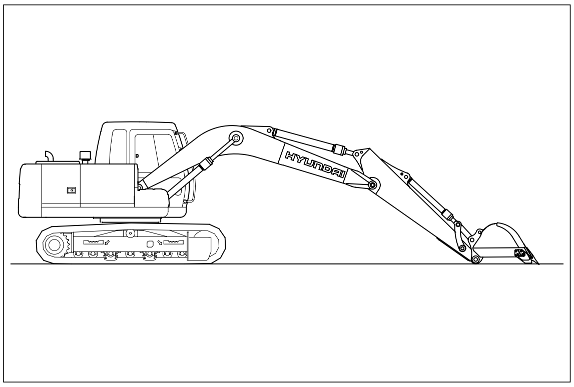


6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

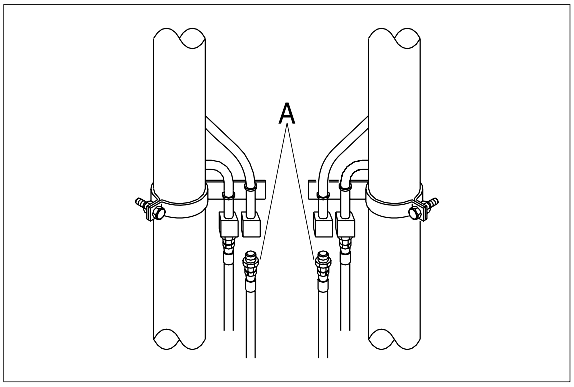
Check	Answer	Cause	Remedy
Is boom foot pin greased sufficiently?	YES		Frictional noise occurs between the sliding faces of boom cylinder's oil seal and boom proper. ※ Frictional noise will disappear if they are kept used.
	NO	Boom foot pin has run out of grease.	Supply grease to it. ※ If seizure is in 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.

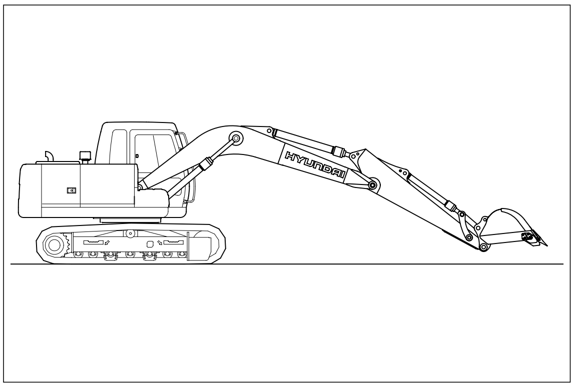


2. Disconnect hose(A) from rod side of boom cylinder and drain oil from cylinders and hose.(Put cups on piping and hose ends)



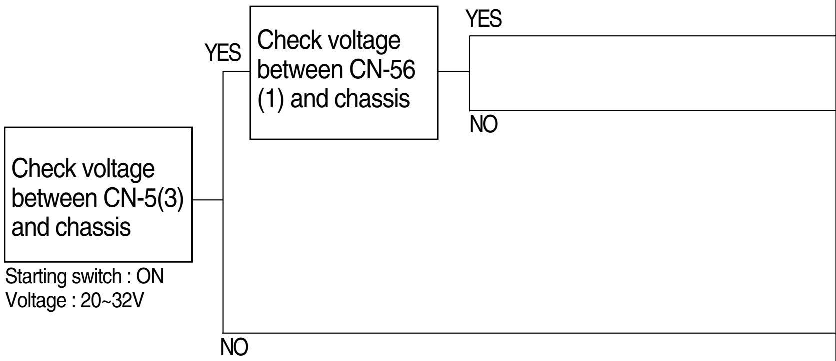
3. Raise bucket OFF the ground by retracting the arm cylinder rod.

   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.

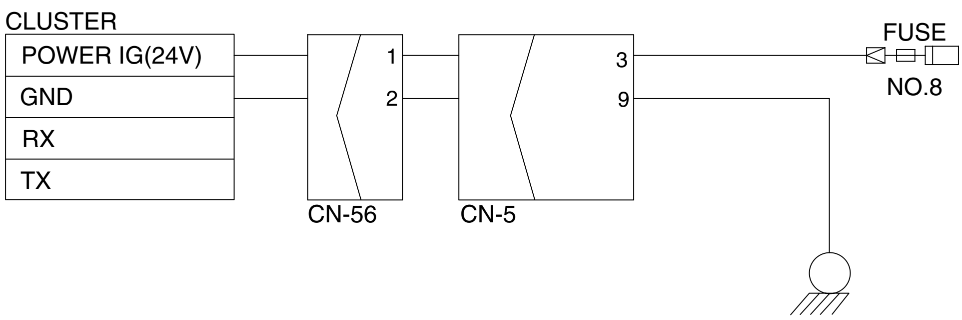


1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.8.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective clucter	Replace
Disconnection in wiring harness or poor contact between CN-5(3)-CN-56(1)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-5(3)- and fuse No.8	Repair or replace (After clean)



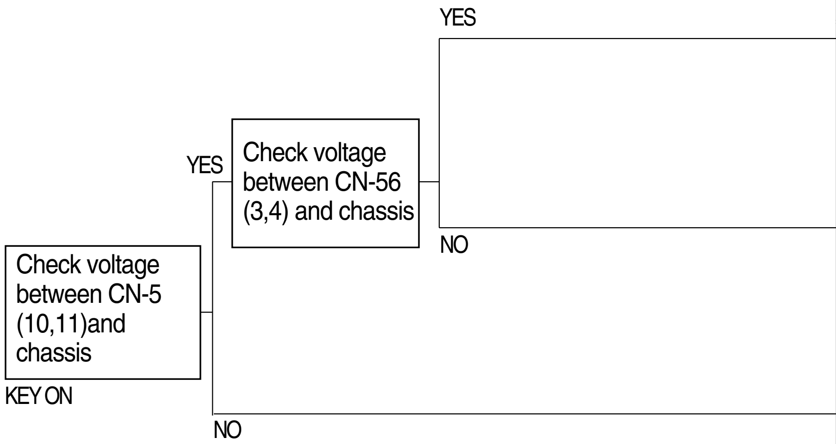
140V95ES01

Check voltage

YES	20 ~ 30V
NO	0V

2. COMMUNICATION ERROR "Co : Err" FLASHES ON THE CLUSTER

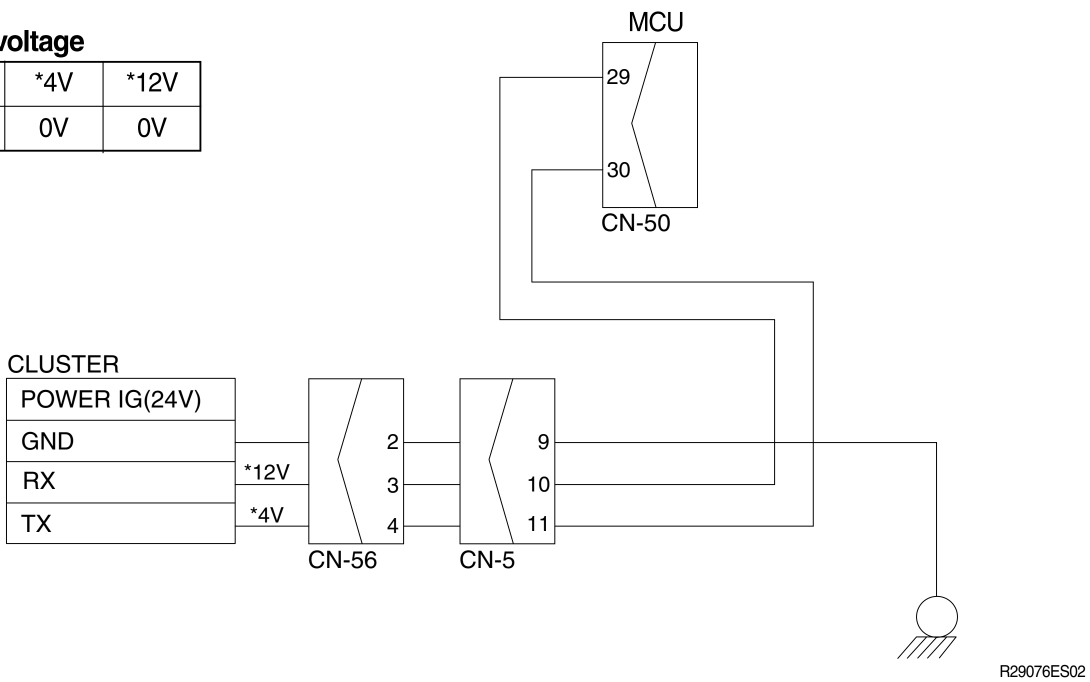
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective MCU	Replace
Disconnection in wiring harness or poor contact between CN-56 (3,4) CN-5(10,11)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-5 (10,11)-CN-50 (29,30)	Repair or replace (After clean)

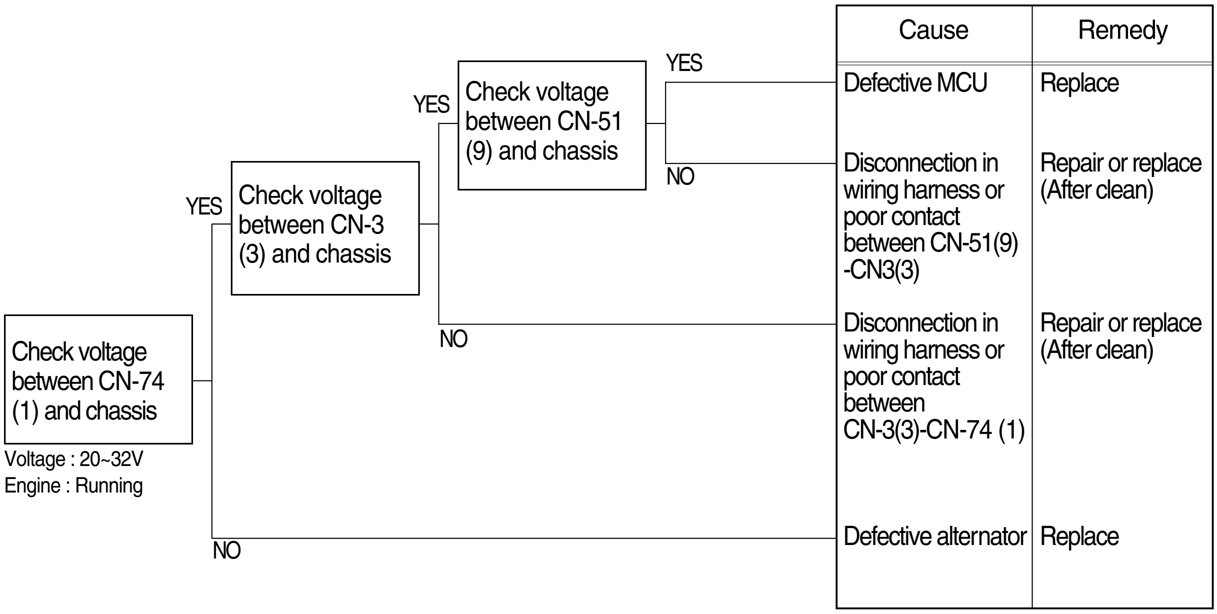
Check voltage

YES	*4V	*12V
NO	0V	0V



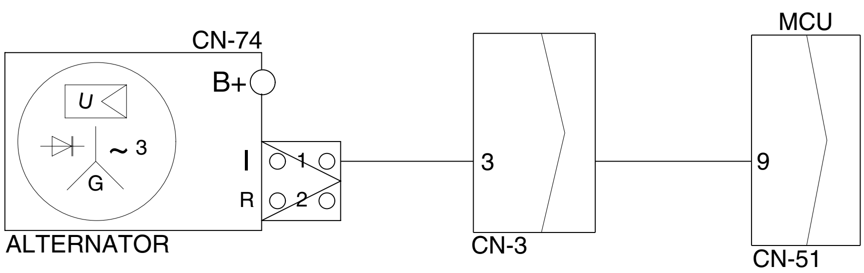
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

· 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

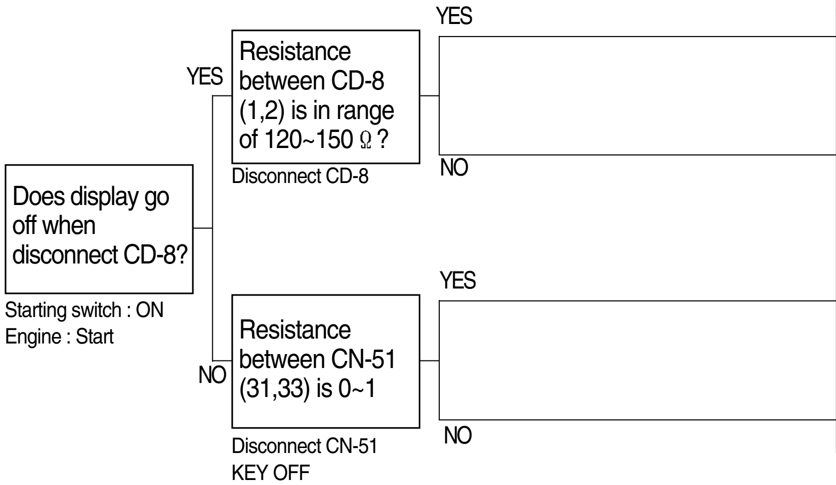
YES	20 ~ 32V
NO	0V



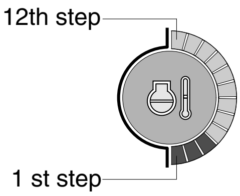
140V96ES09

4. 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.

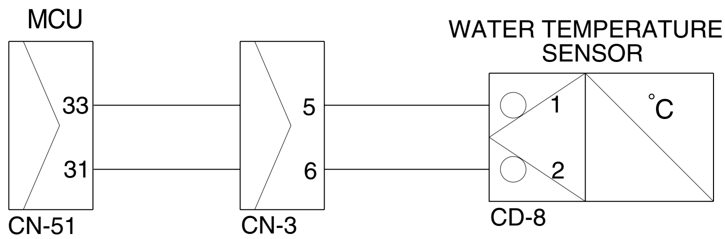


Cause	Remedy
Coolant overheat (110˚C ±2˚C)	Check engine cooling system
Defective temp sensor	Replace
Short circuit in wiring harness	Repair or replace (After clean)
Defective MCU	Replace



Check Table

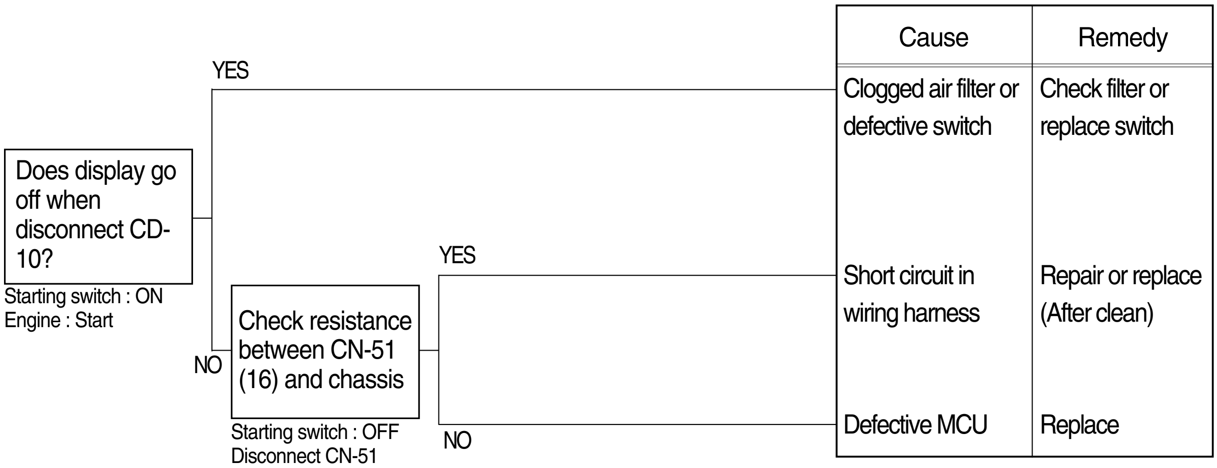
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29℃	30~105℃	105℃ ~



14076TS22

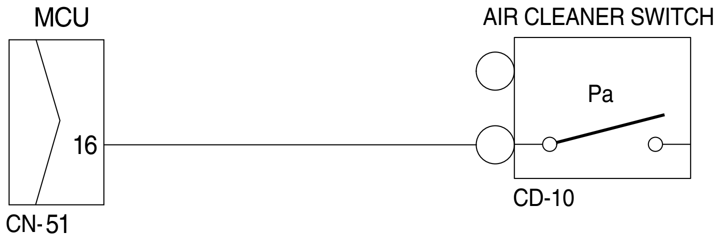
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP(Engine is started)

· 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

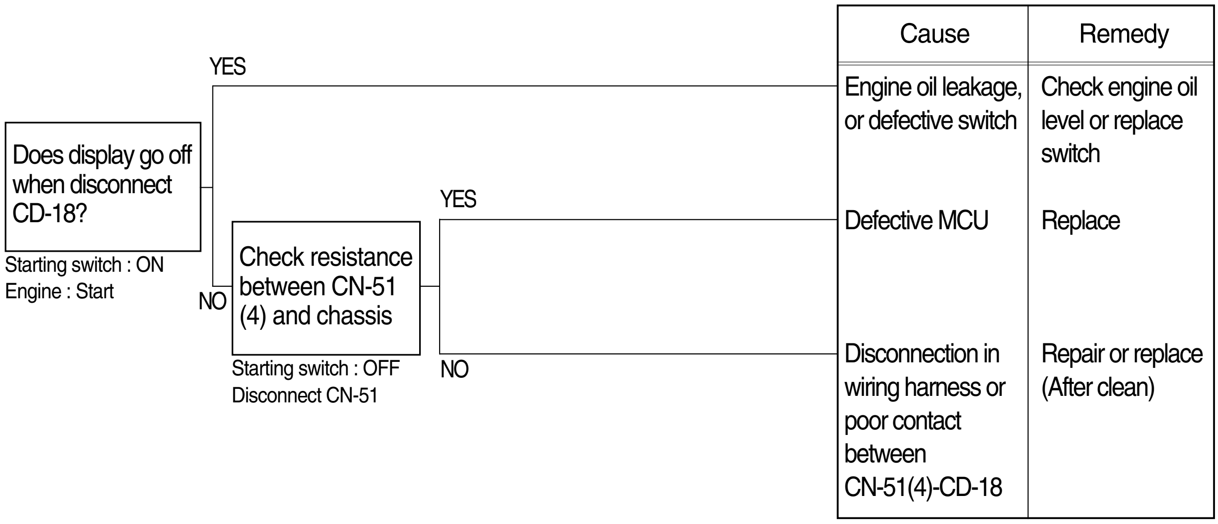
YES	MAX 1Ω
NO	MIN 1M Ω



14076TS22

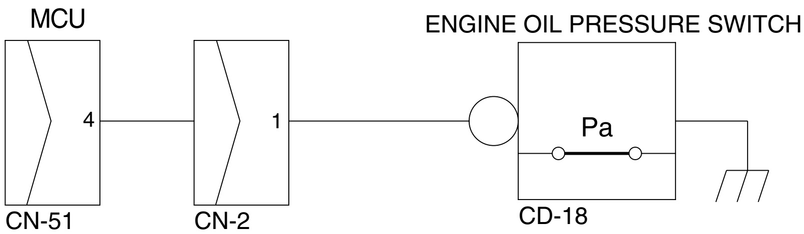
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP(Engine is started)

· 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.



Check resistance

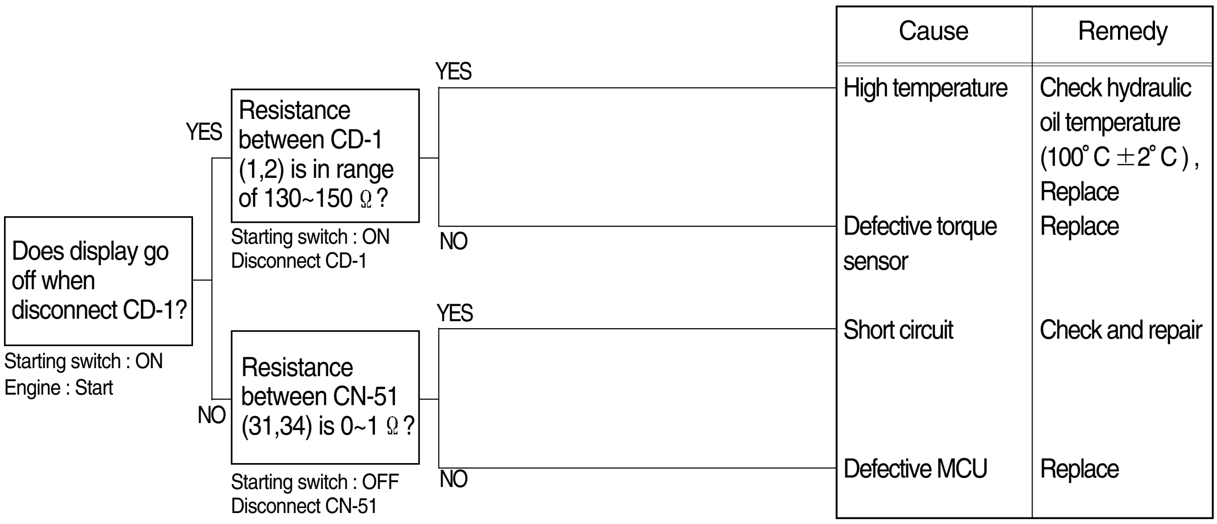
YES	MAX 1Ω
NO	MIN 1MΩ

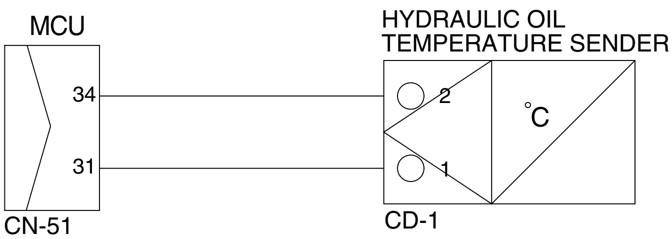


R29076ES03

7. 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.

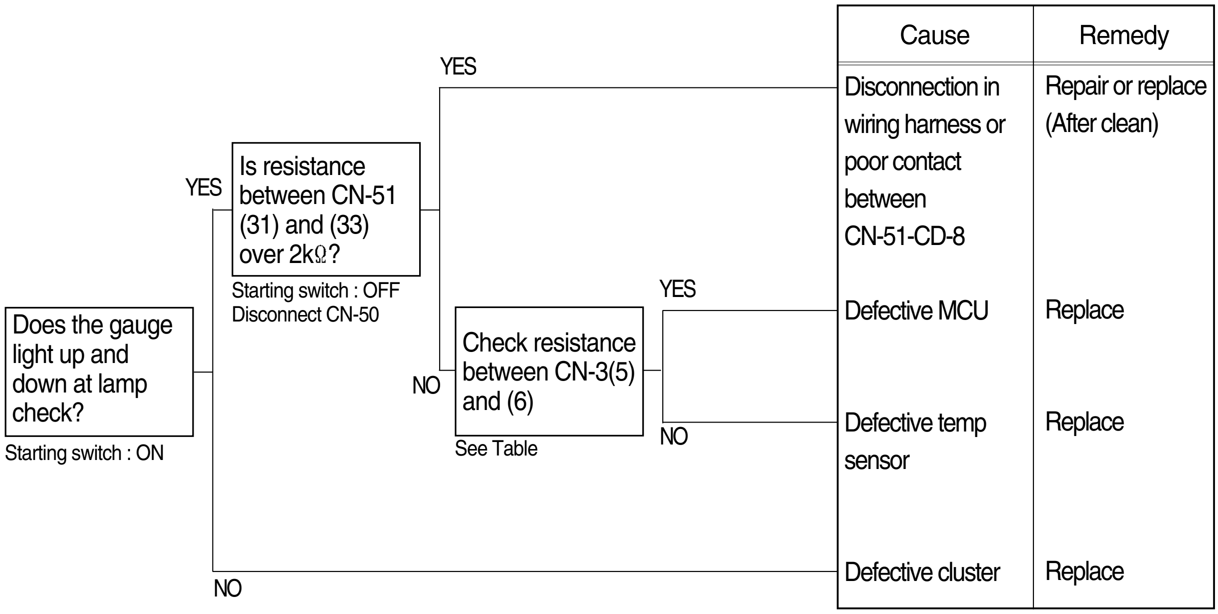


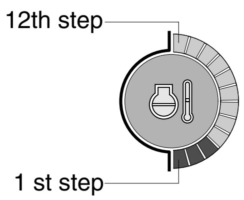


R29076ES04

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

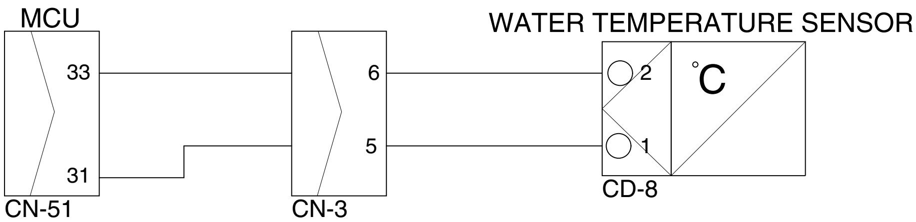
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

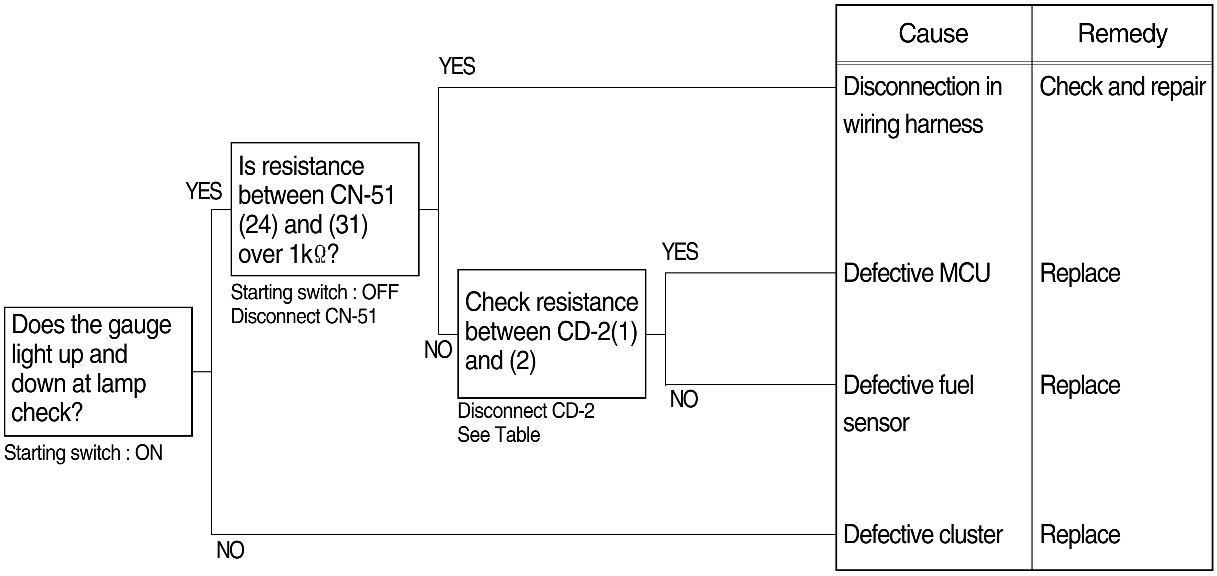
Range	1st step	2nd~10th step	11th~12th step
Temperature	~29˚ C	30~105˚C	105˚C ~

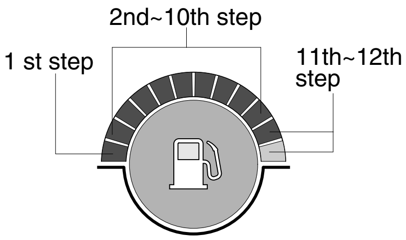


140V96ES01

9. WHEN FUEL GAUGE DOES NOT OPERATE(Check warning lamp ON/OFF)

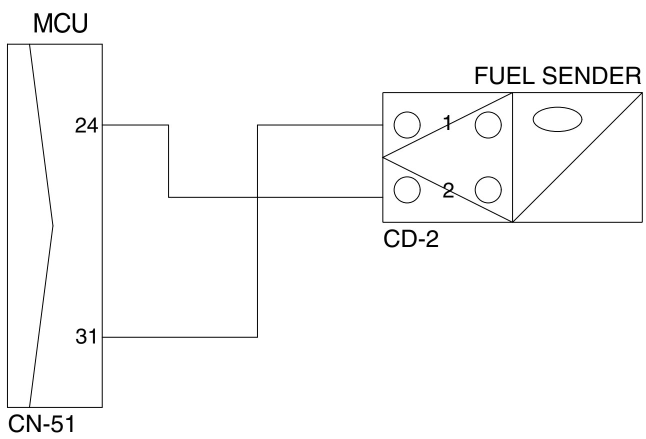
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

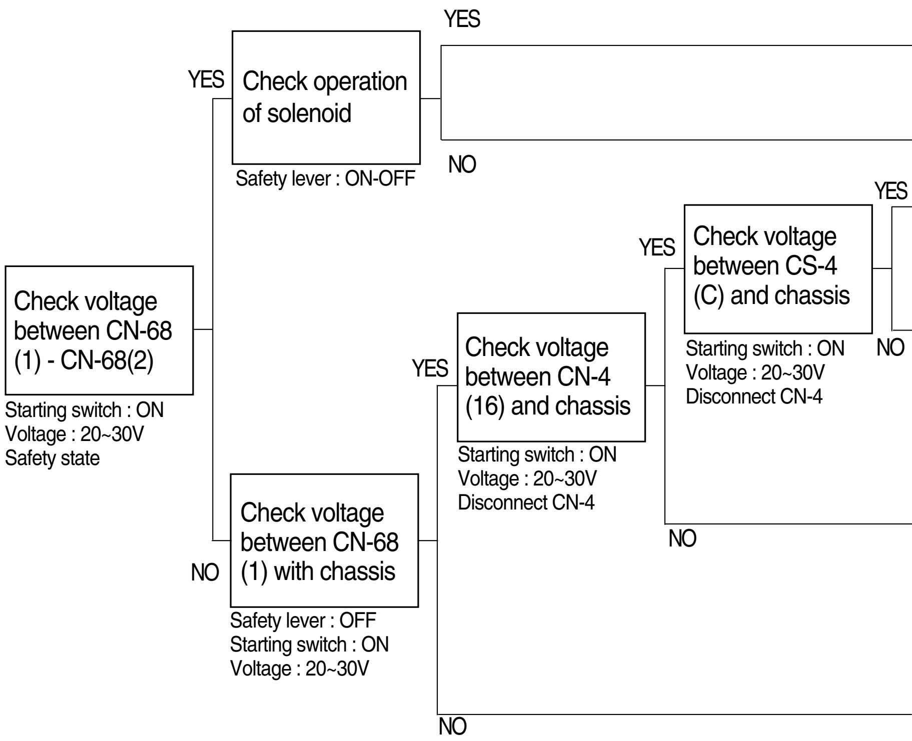
Item \ Level	White range	Green	Red range
Unit Resistance(Ω)	700~601	600~101	~100
Tolerance(%)	±5	±5	±5



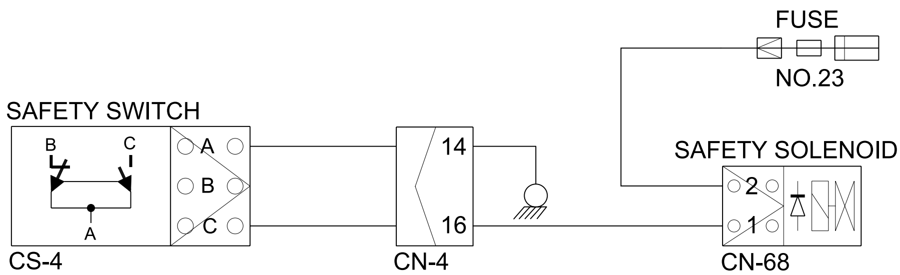
R29076ES06

10. 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 short of fuse No. 23.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



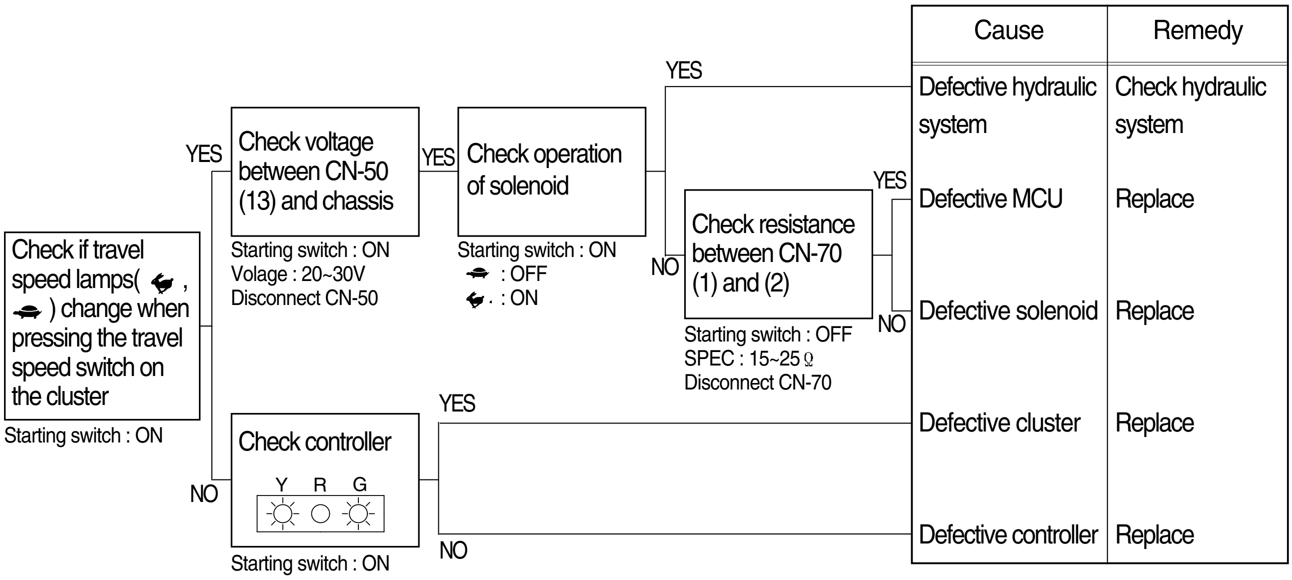
Cause	Remedy
Hydraulic malfunction	Check hydraulic system
Defective solenoid	Replace
Defective switch CS-4	
Disconnect in wiring harness or poor contact between CN-4(16)-CS-4(C)	Repair or replace (After clean)
Disconnect in wiring harness or poor contact between CN-4(16)-CN-68 (1)	Repair or replace (After clean)
Disconnection in fuse	Replace

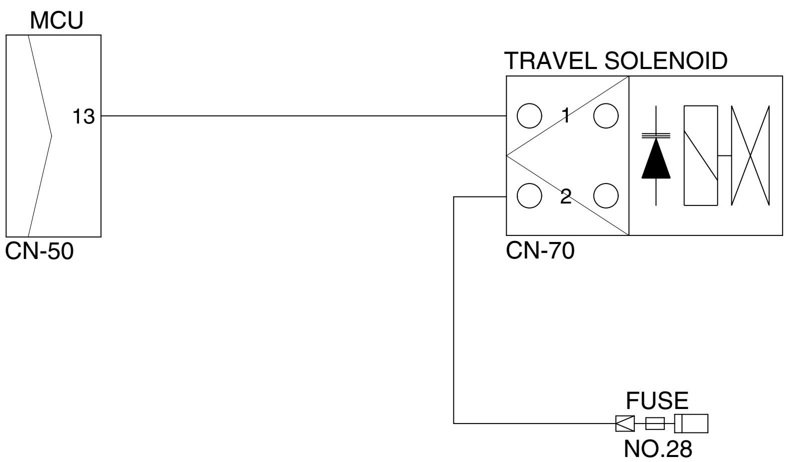


140V96ES02

11. 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 short of fuse No. 8.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

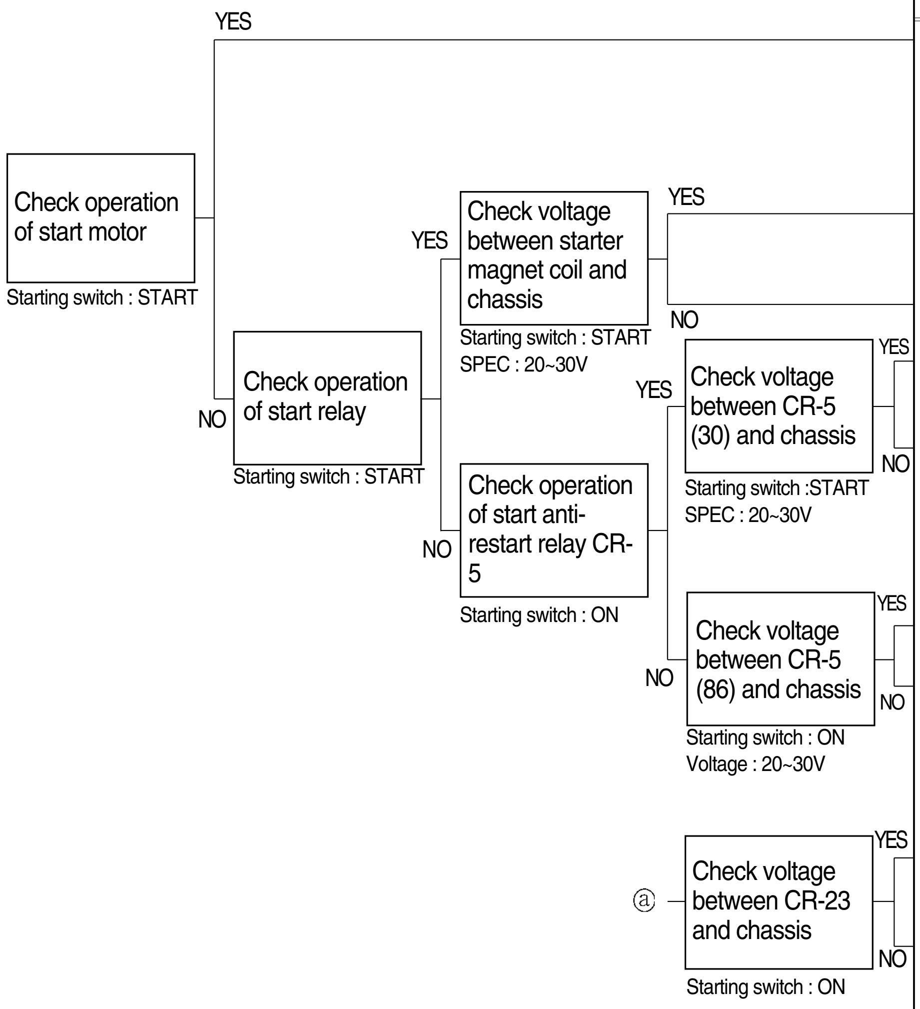




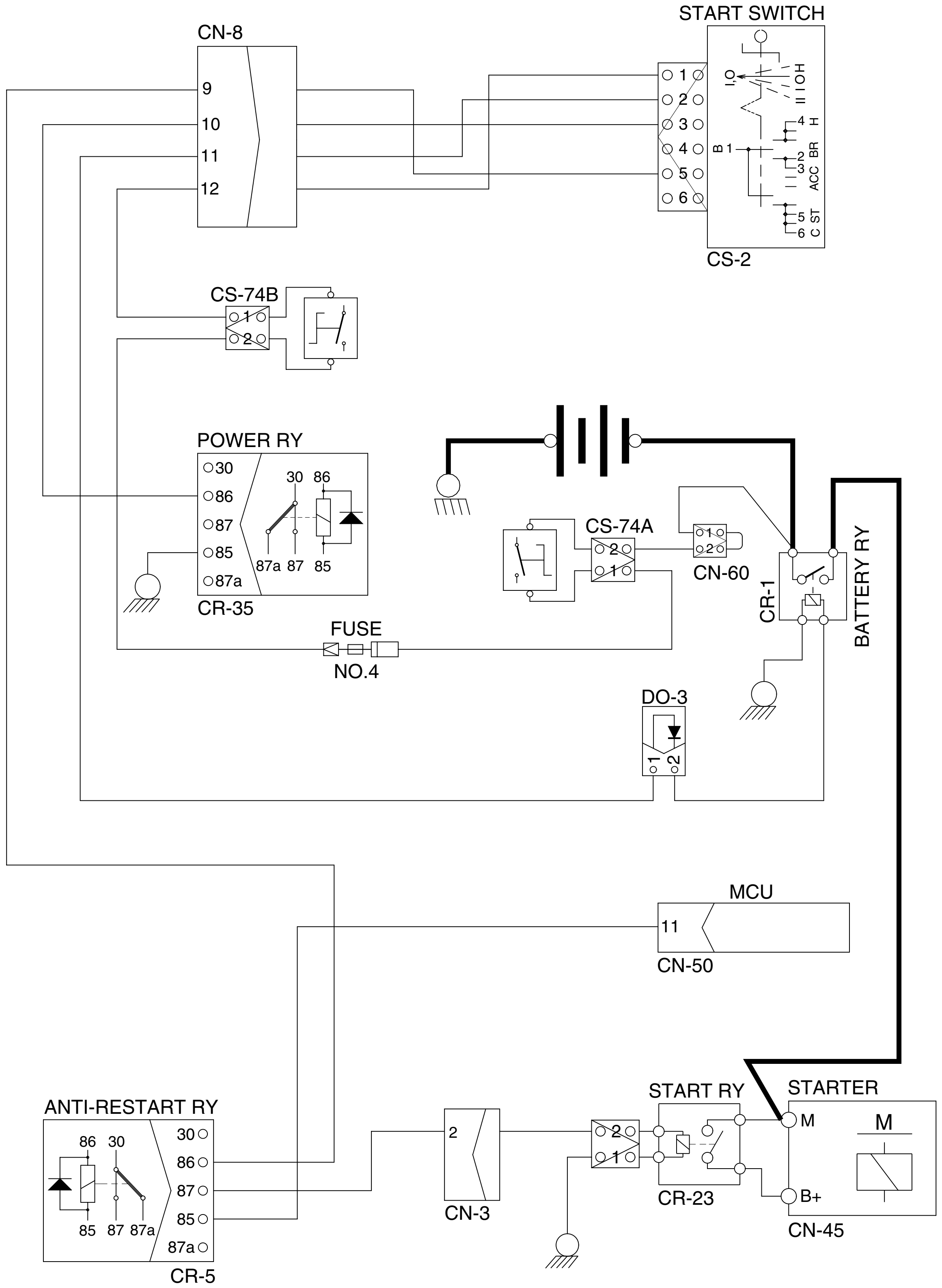
140V96ES03

12. WHEN ENGINE DOES NOT START

- 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
Defective battery	Check engine system charge or replace(After checking specific gravity of battery)
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Defective start anti-restart relay	Repair or replace (After clean)
Defective relay	Replace
Disconnection in wiring harness or poor contact between CR-5 (86)-CS-2(5)	Repair or replace (After clean)
Defective start relay	Replace
Disconnection in wiring harness or poor contact between CR-5(87)-CR-23	Repair or replace (After clean)



140V96ES04

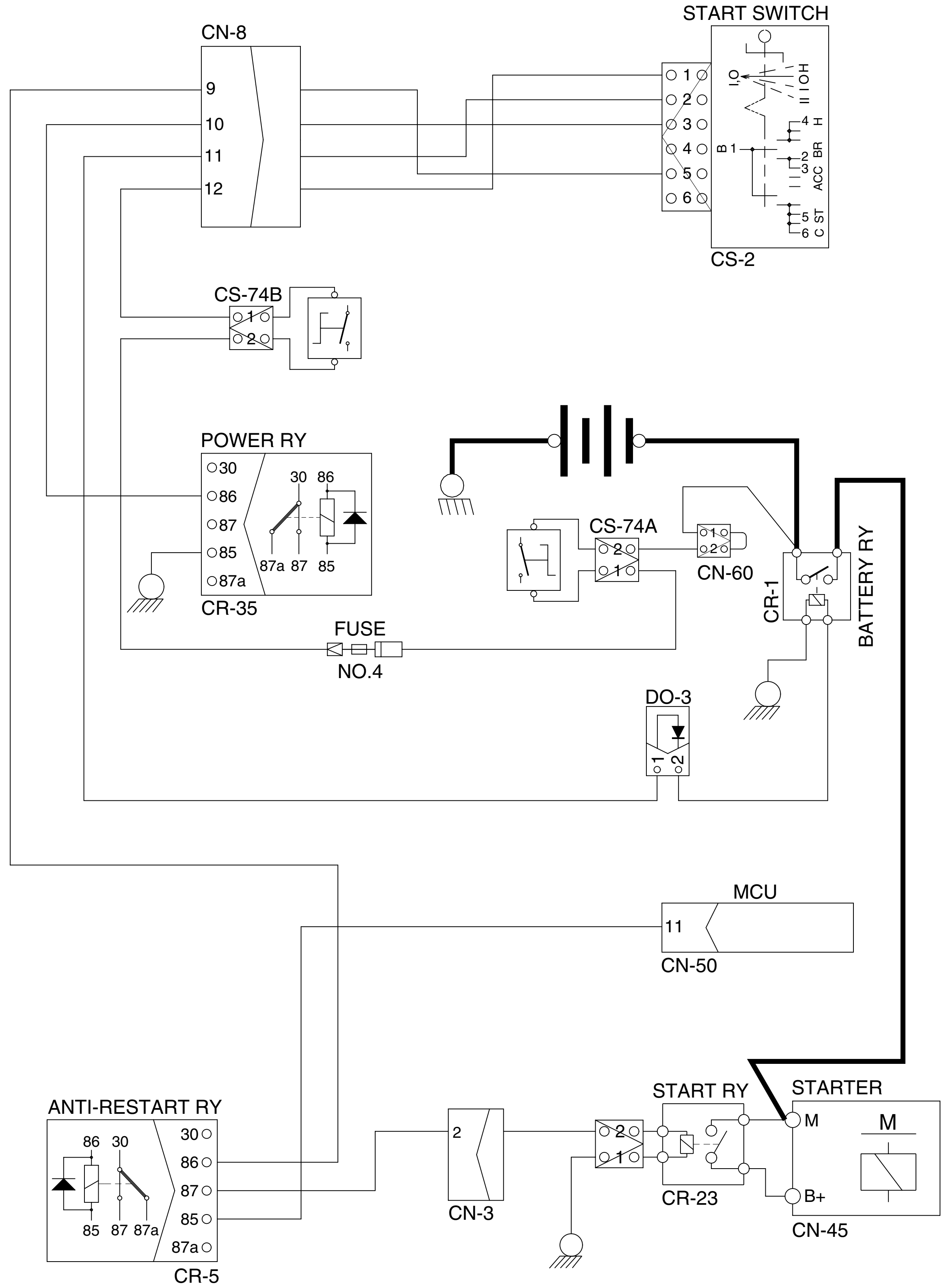
13. WHEN STARTING SWITCH ON DOES NOT OPERATE

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

Check voltage and specific gravity of battery
Specific gravity : MIN 1.28
Voltage : MIN 24V

- YES → Check voltage between CS-2(1) and chassis (Voltage : 20~30V)
  - YES → Check voltage between CS-2 (2) and chassis (Voltage : 20~30V)
    - YES → Check voltage between DO-3 (1) and chassis (Voltage : 20~30V)
      - YES → Disconnection in wiring harness or poor contact between DO-3(2)-CR-1 or defective battery relay
      - NO → Disconnection in wiring harness or poor contact between CS-2(2)-CN-8(11)- DO-3(1)
    - NO → Defective start switch
  - NO → Disconnection in wiring harness or poor contact between CS-2(1)-CN-8(12)-CN-60-CR-1-Battery
- NO → Battery capacity too low

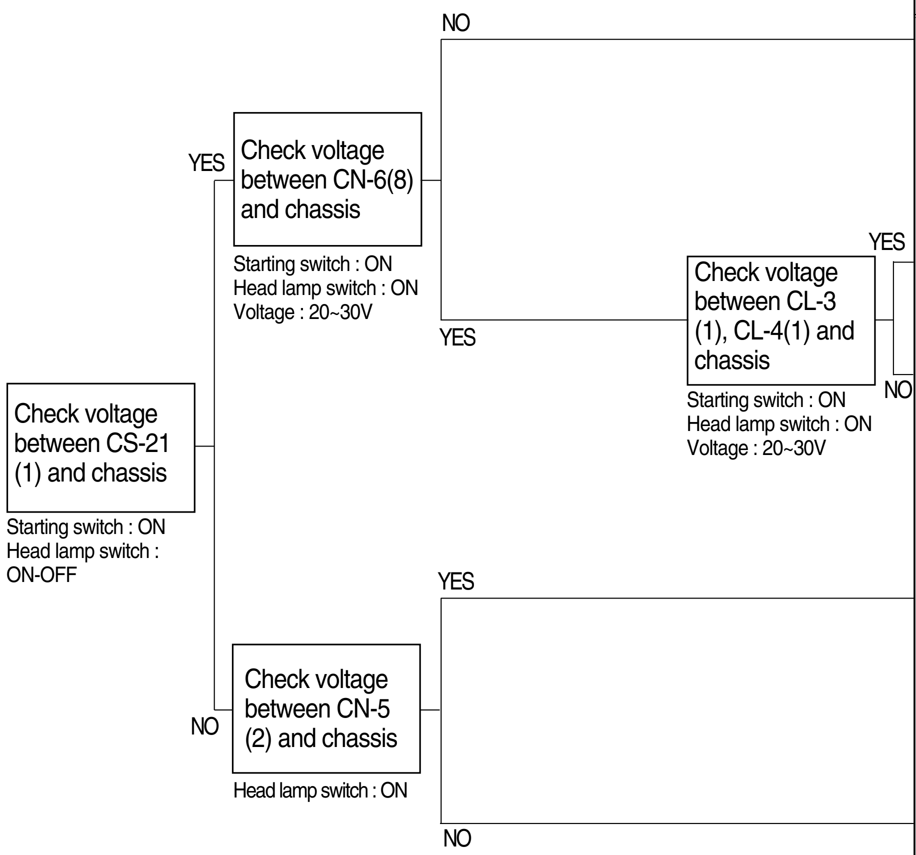
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-3(2)-CR-1 or defective battery relay	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-2(2)-CN-8(11)- DO-3(1)	Replace
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2(1)-CN-8(12)-CN-60-CR-1-Battery	Replace
Battery capacity too low	Charge or replace (After clean)



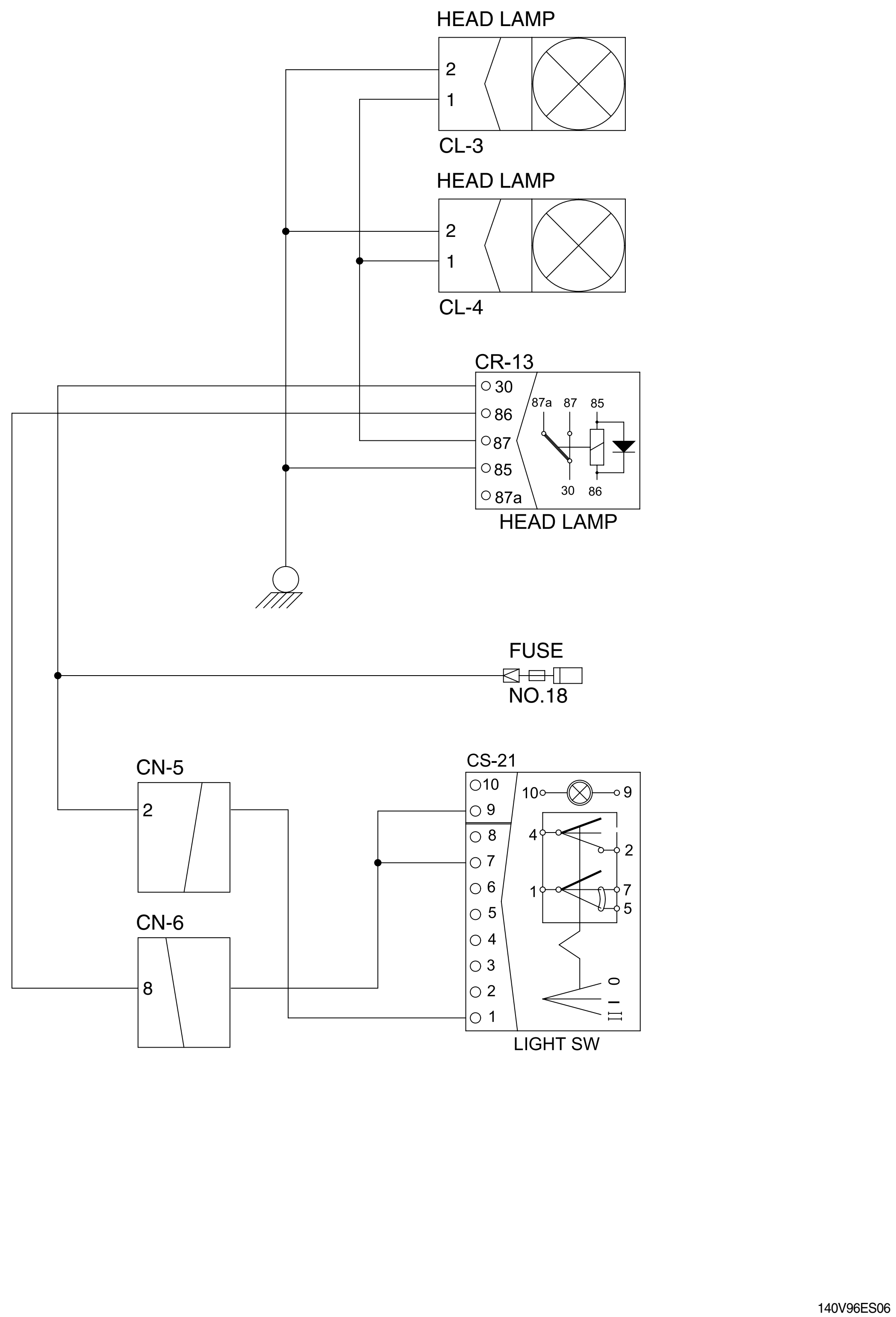
140V96ES04

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 short of fuse No.16.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

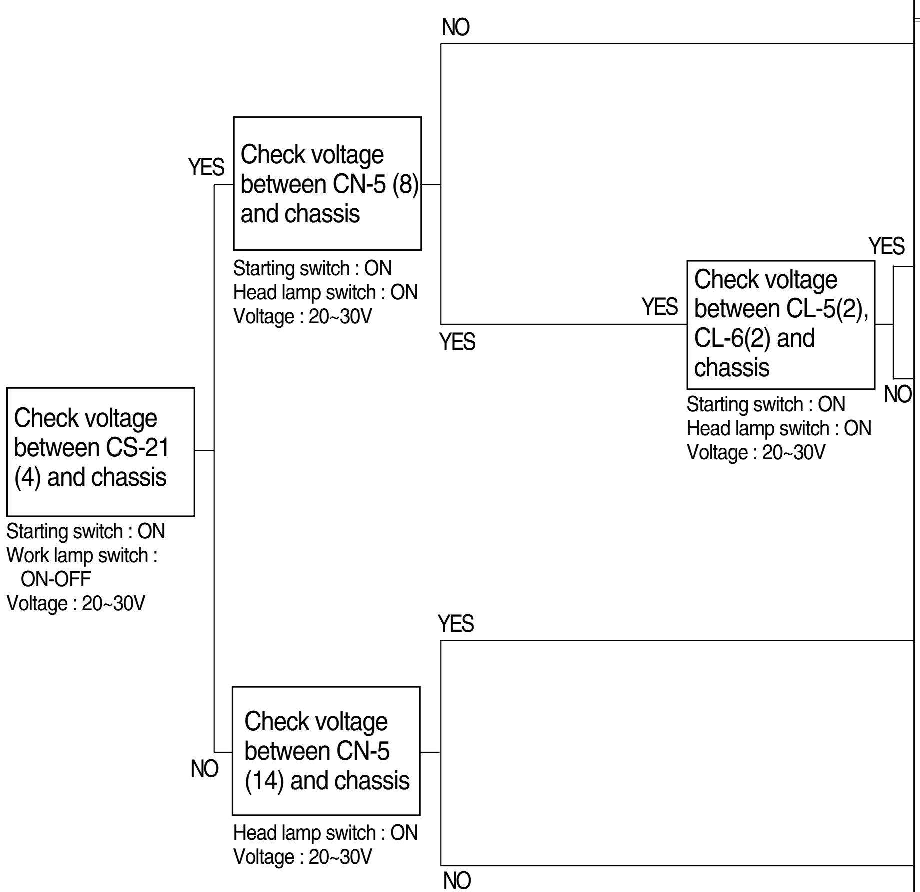


Cause	Remedy
Defective light switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-6(8)-CL-3(1), CL-4(1)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-21(1)-CN-5(2)	Repair or replace (After clean)
Recheck fuse	Replace

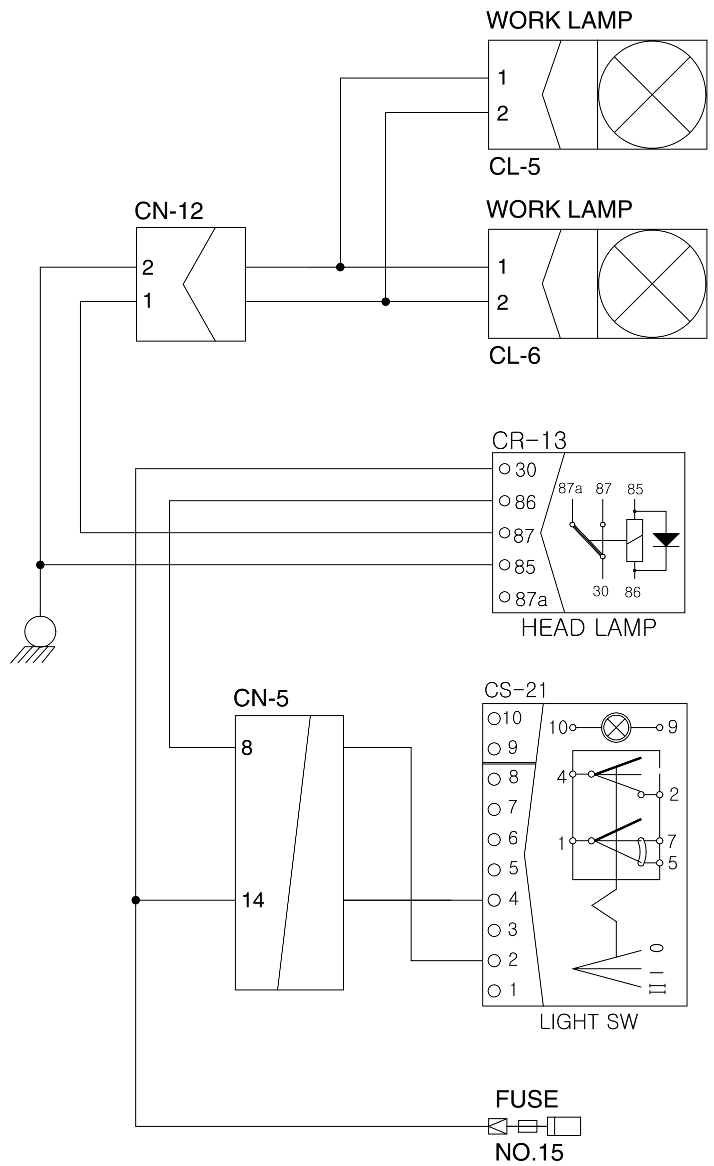


15. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.15.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective light switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-5(8) -CL-5(2) and CL-6 (2)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-21(4)-CN-5(14)	Repair or replace (After clean)
Recheck fuse No. 15	Replace



140V96ES07

GROUP 4 MECHATRONICS SYSTEM

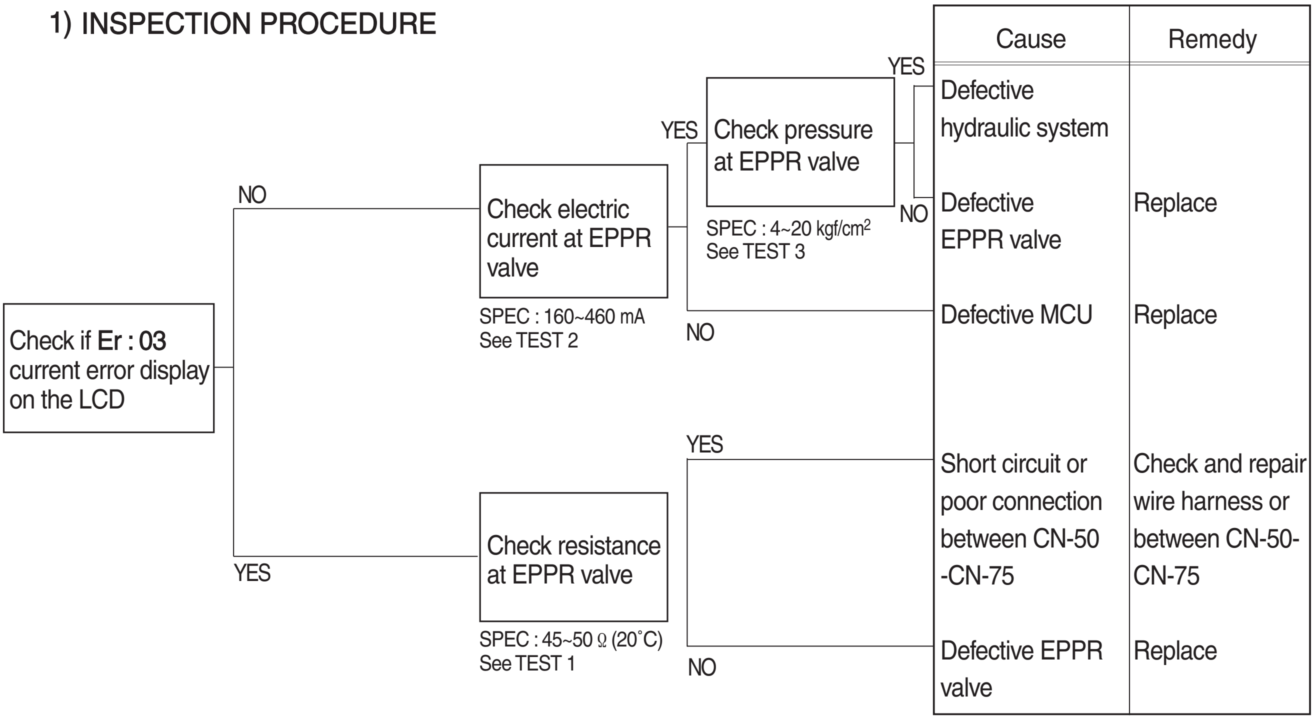
1. ALL ACTUATORS SPEED ARE SLOW

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

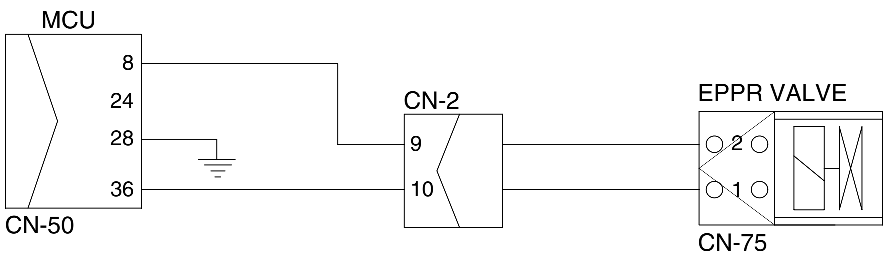
※ Spec : P-mode 2100 ± 50 rpm S-mode 1950 ± 50 rpm E-mode 1800 ± 50 rpm

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

1) INSPECTION PROCEDURE



Wiring diagram



140V96MS01

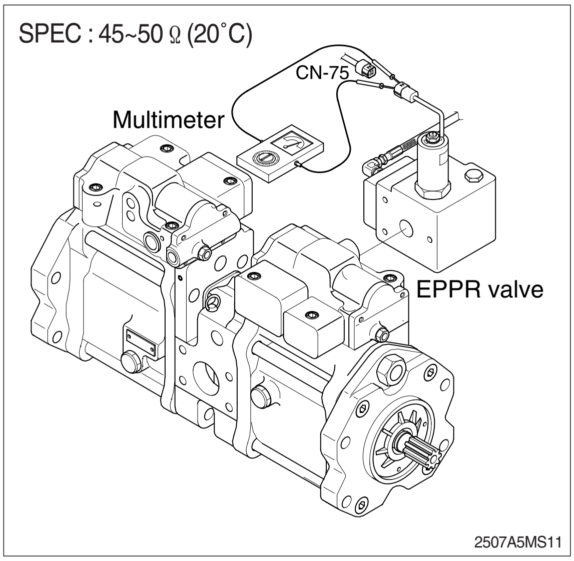
2) TEST PROCEDURE

(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.



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

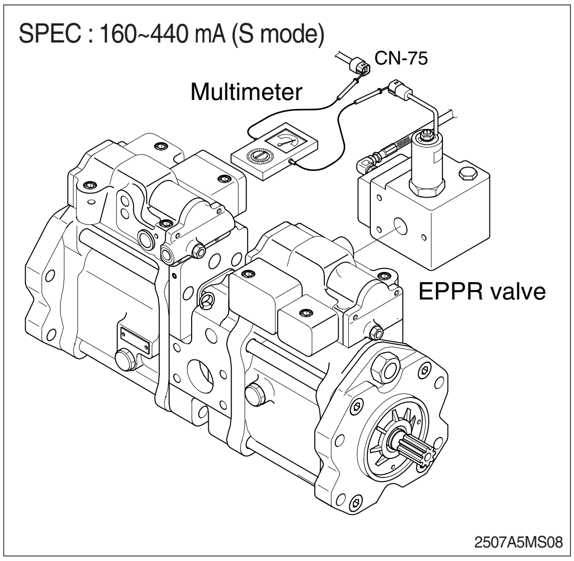
① Install multimeter as figure.

② Start engine.

③ Set the accel dial at "10" (MAX)

④ Set S-mode and cancel auto decel mode.

⑤ If tachometer show approx 2000±50rpm, check electric current.



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

① Remove plug and connect pressure gauge as figure.

· Gauge capacity : 0 to 40~50 kgf/cm² (0 to 570~710psi)

Start engine.

② Set the accel dial at "10" (Max).

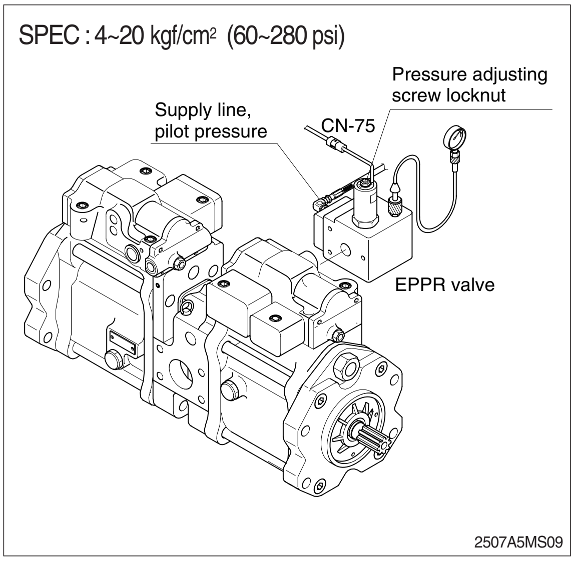
③ Set S-mode and cancel auto decel

④ mode.

⑤ If tachometer show approx 2000±50rpm, check pressure.

⑥ If pressure is not correct, adjust it.

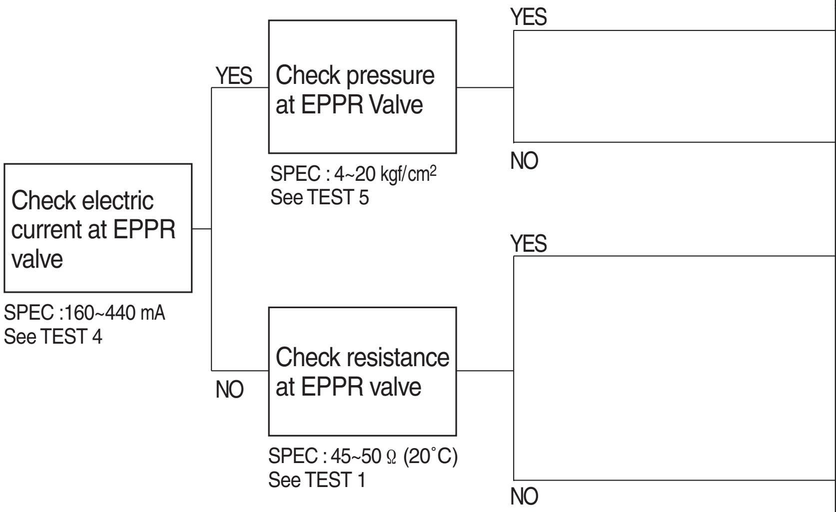
⑦ After adjust, test the machine.



2. ENGINE STALL

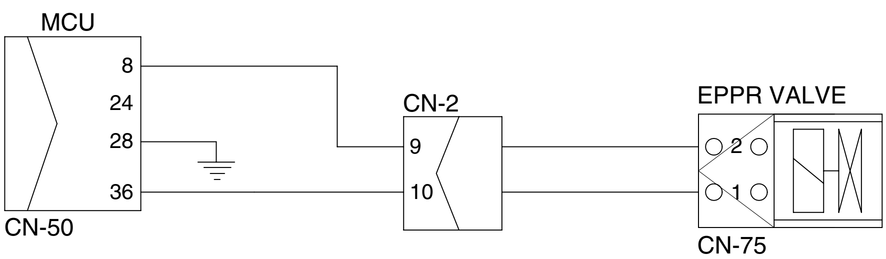
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Not enough engine power	Contact cummins engine dealer
Defective EPPR valve	Replace
Short circuit or poor connection between CN-50 - CN-75	Check and repair wire harness
Defective EPPR valve	Replace

Wiring diagram

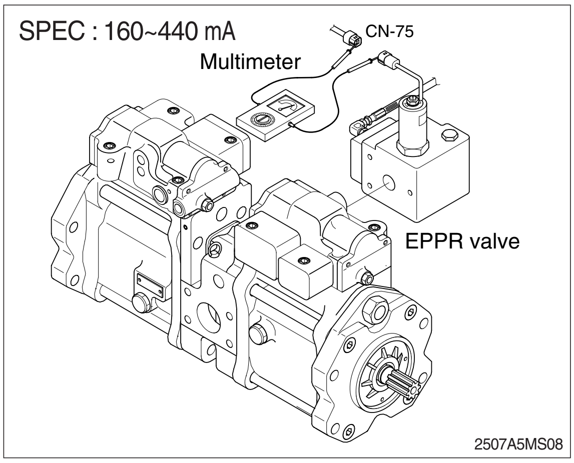


140V96MS01

2) TEST PROCEDURE

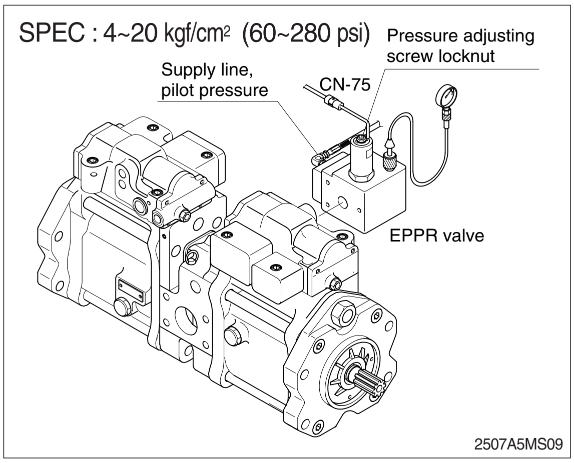
(1) Test 4 : Check electric current at EPPR valve at S-mode

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set S-mode with 2000±50 rpm.
⑤ Check electric current.



(2) Test 5 : Check pressure at EPPR valve at S-mode

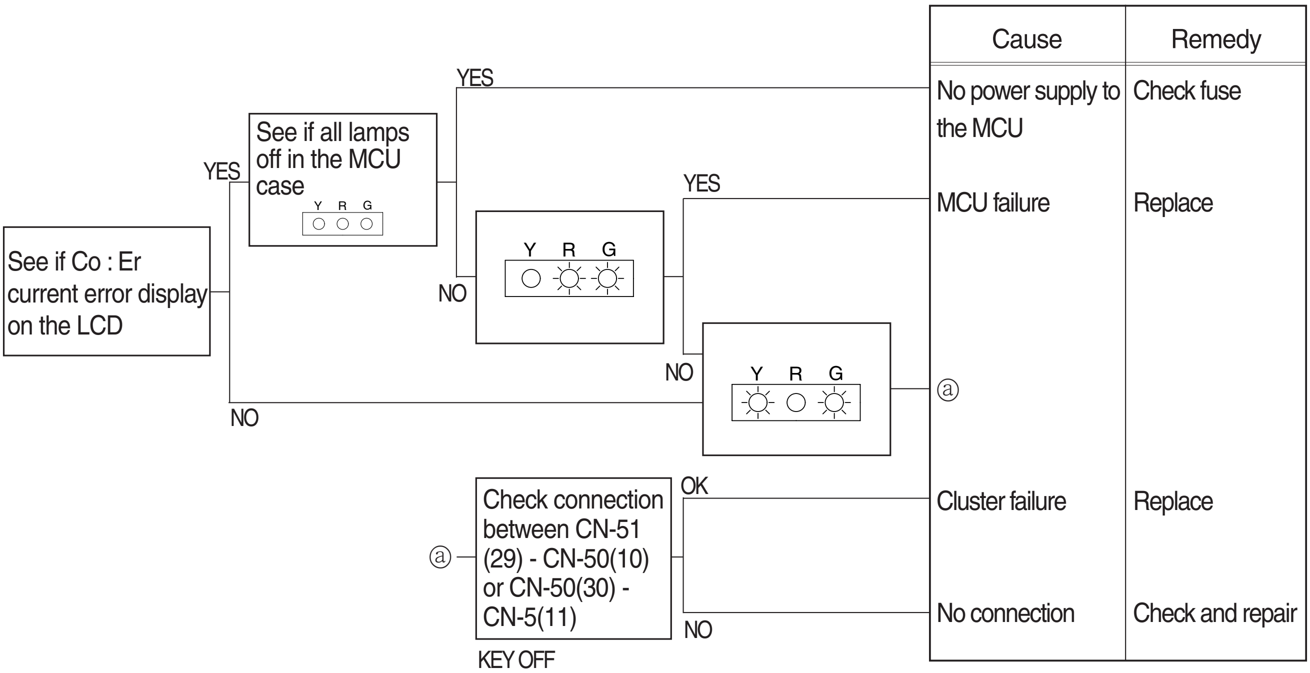
① Connect pressure gauge at EPPR valve.
② Start engine.
③ Set the accel dial at "10" (max)
④ Set S-mode with 2000±50 rpm.
⑤ Operate bucket lever completely push or pull.
⑥ Hold arm lever at the end of stroke.
⑦ Check pressure at relief position.



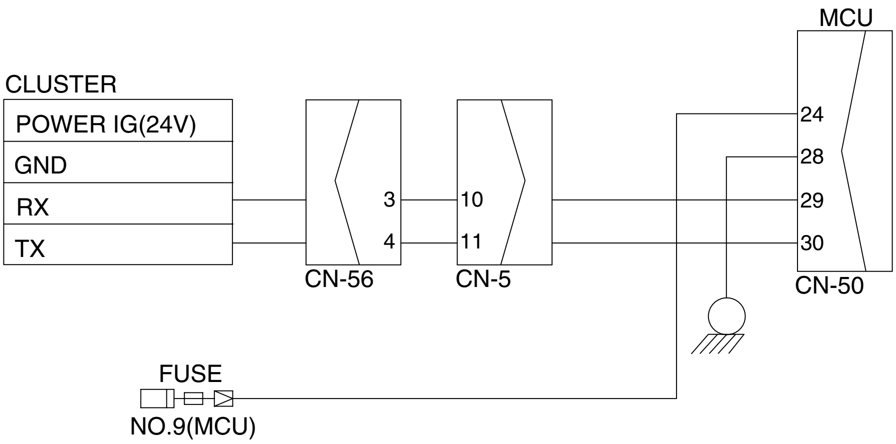
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

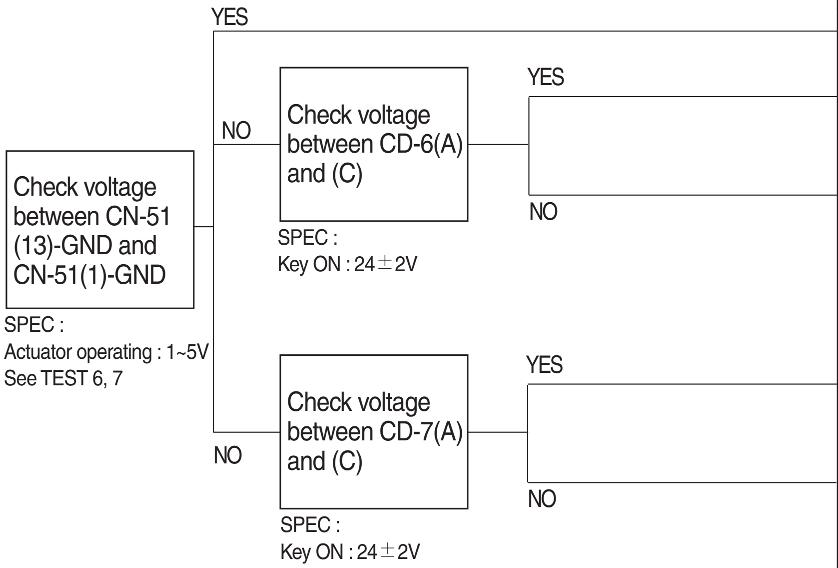


140V96MS02

4. AUTO DECEL SYSTEM DOES NOT WORK

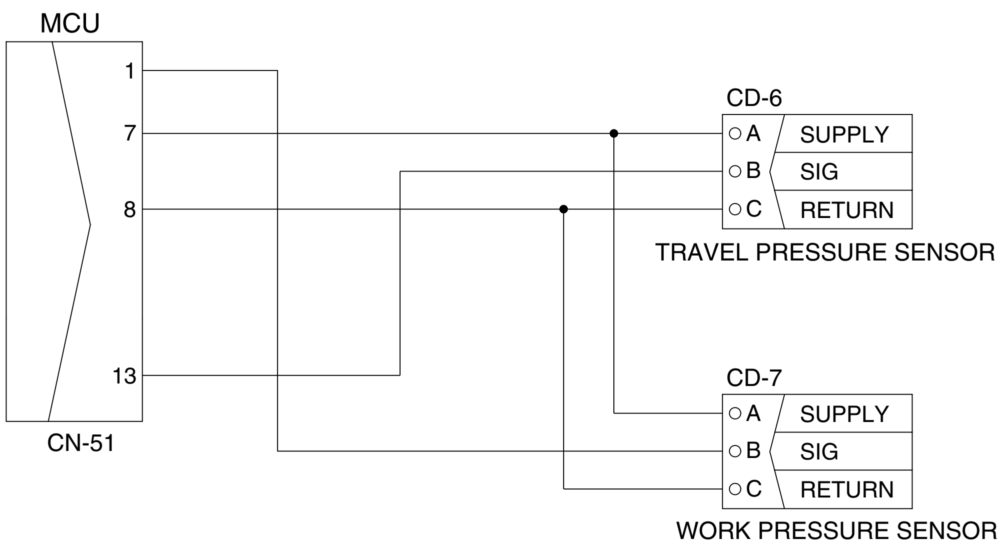
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(7)-CD-6(A) and / or CN-51(8)-CD-6(C)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(7)-CD-7(A) and / or CN-51(8)-CD-7(C)	Replace or repair

Wiring diagram



140V96MS03

2) TEST PROCEDURE

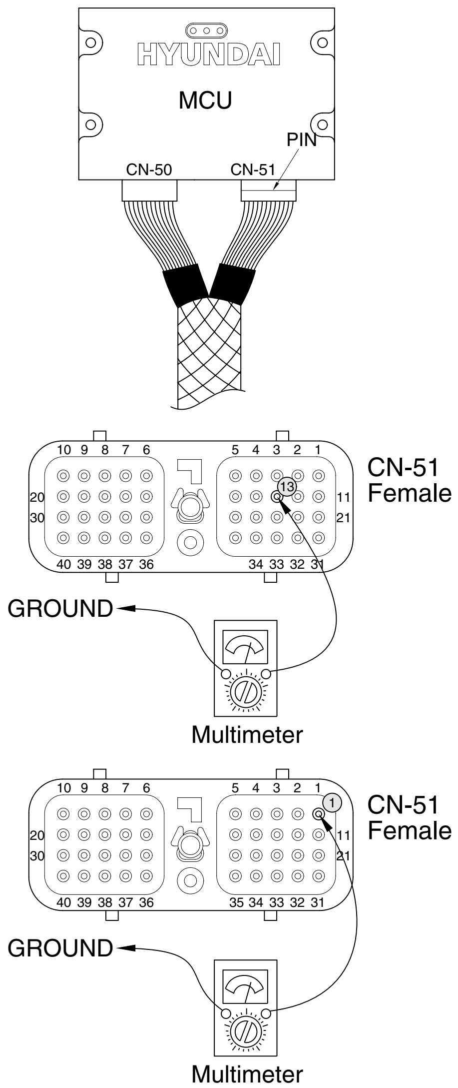
(1) Test 6 : Check voltage at CN-51(13) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of connectors : One pin to (13) of CN-51.
③ Starting key ON.
④ Check voltage as figure.

(2) Test 7 : Check voltage at CN-51(1)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 (1) of CN-51.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

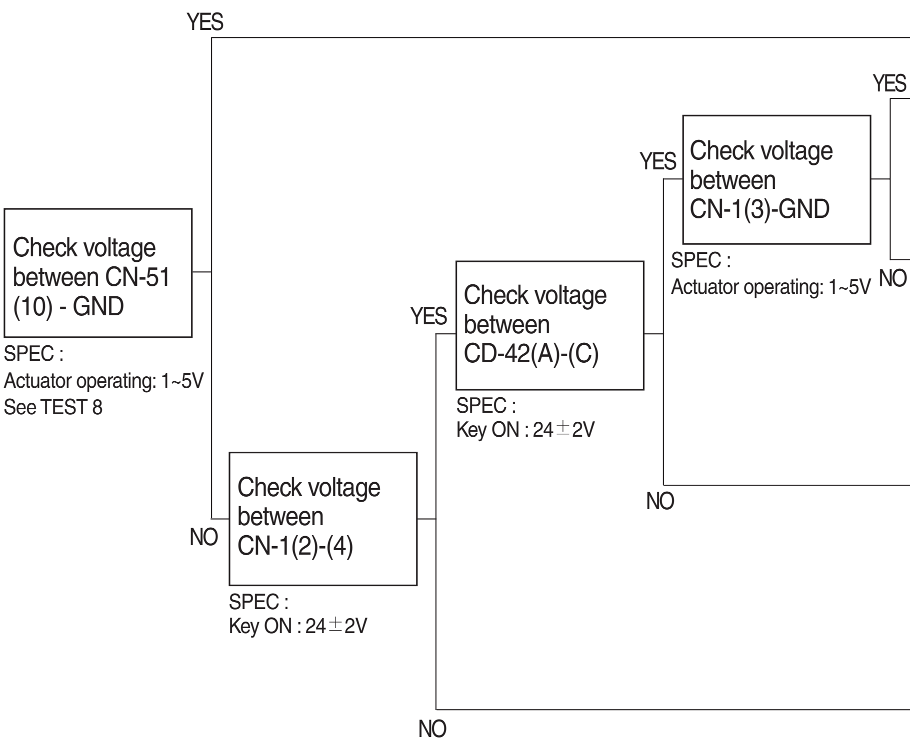


140V96MS04

5. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

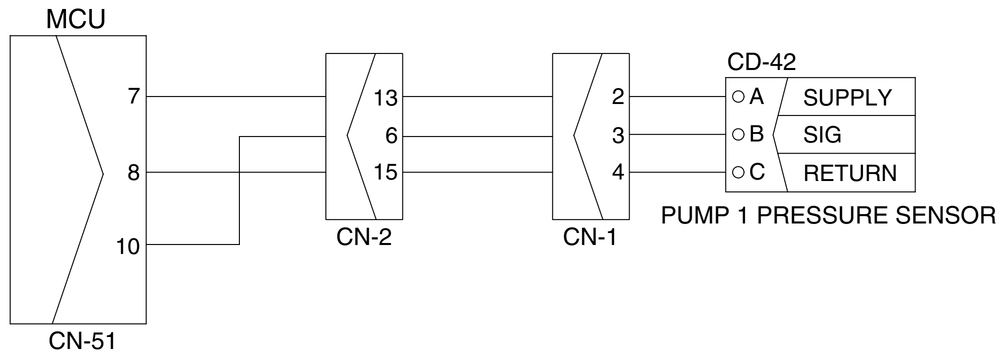
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(10)-CN-1(3)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(3)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-1(2) or CD-42(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(7) or CN-1 (4) - CN-51(8)	Replace or repair

Wiring diagram



140V96MS05

2) TEST PROCEDURE

(1) Test 8 : Check voltage at CN-51(10) and ground.

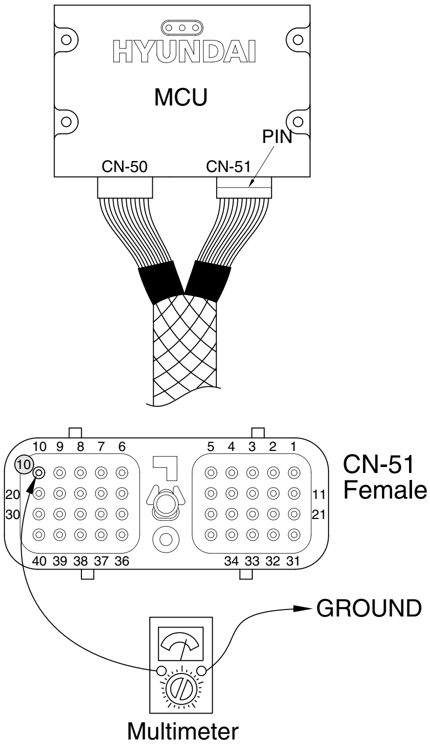
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (10) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

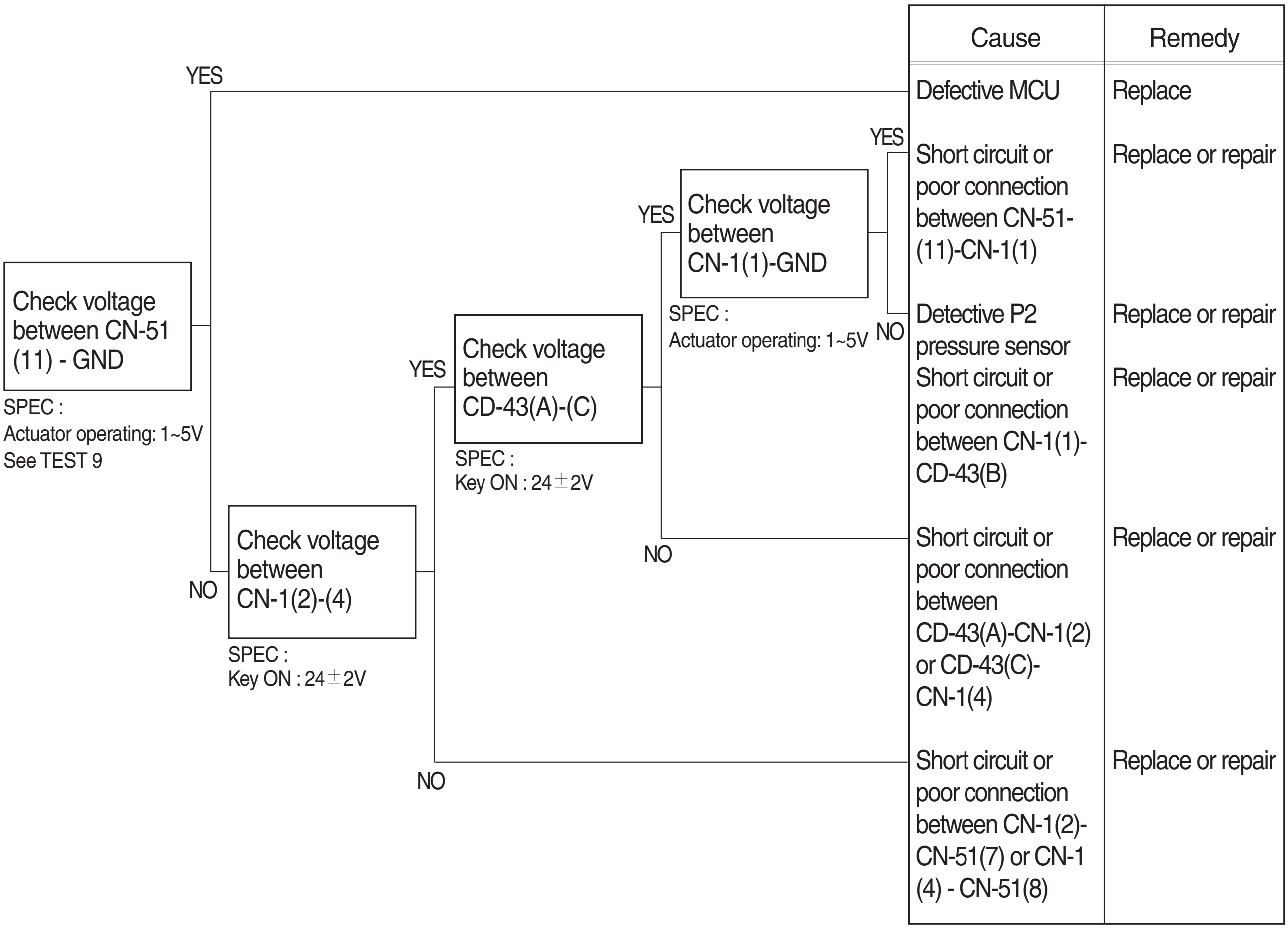


140V96MS06

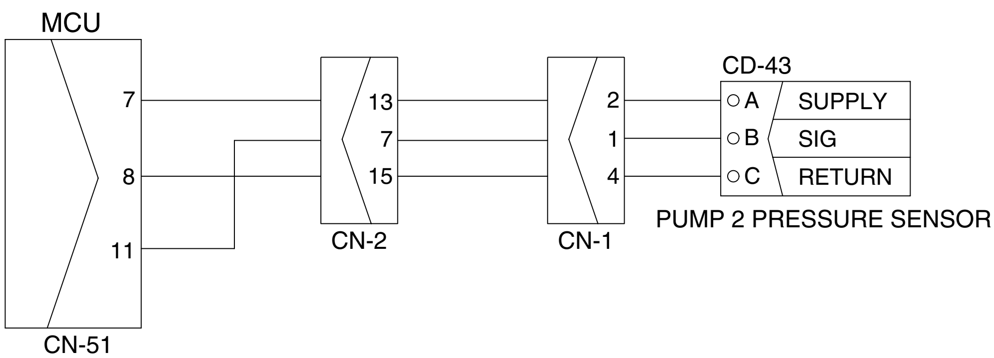
6. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

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

1) INSPECTION PROCEDURE



Wiring diagram



140V96MS07

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-51(11) and ground.

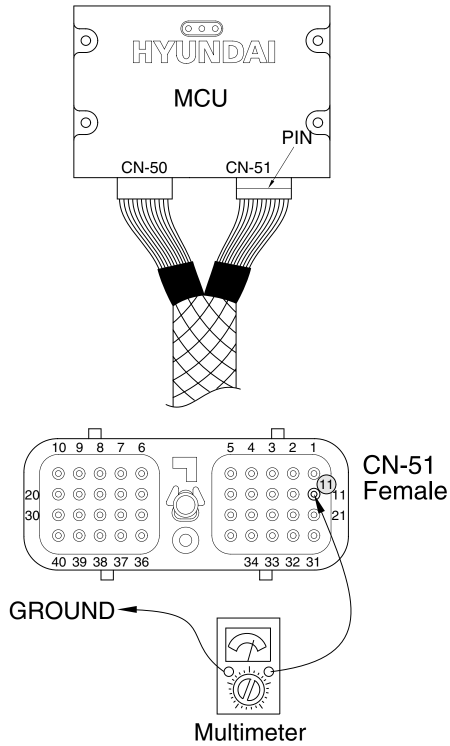
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (11) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

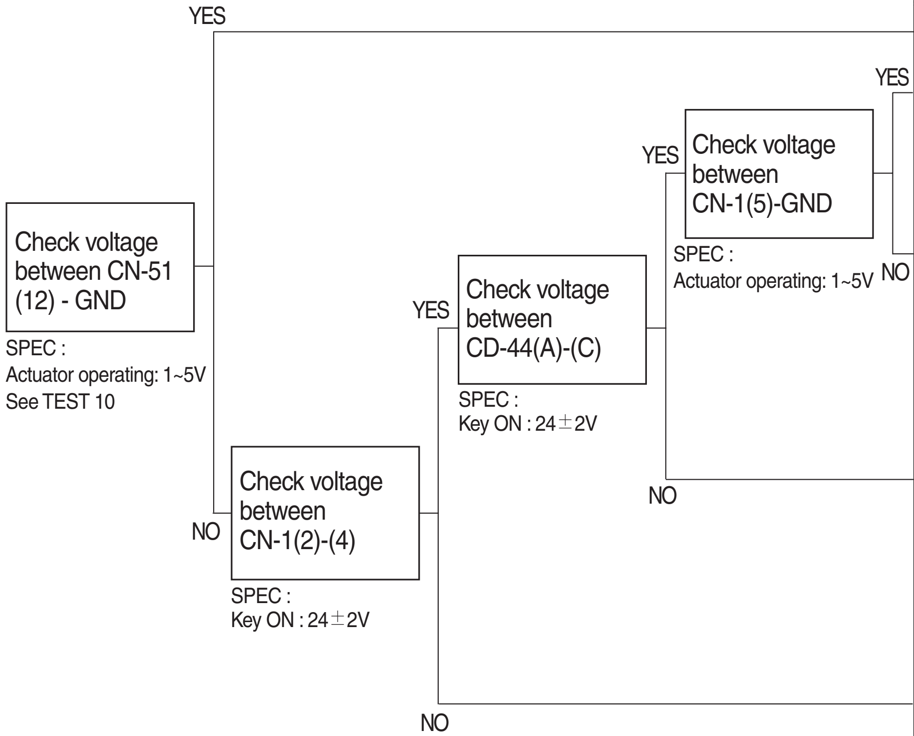


140V96MS08

7. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

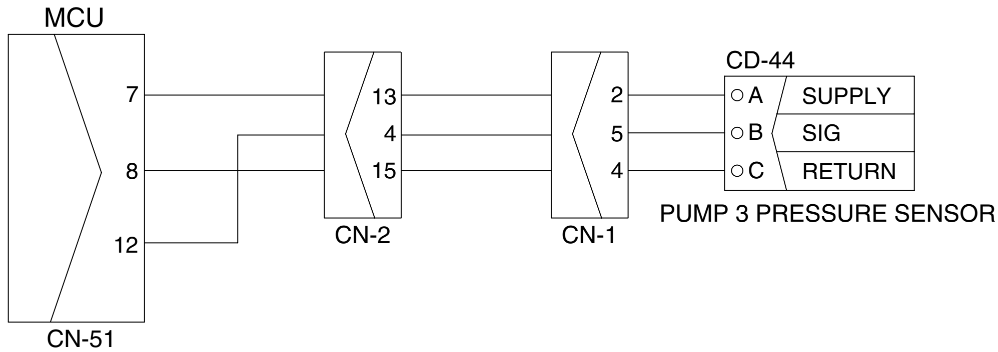
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-51-(12)-CN-1(5)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(5)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(2) or CD-44(C)-CN-1(4)	Replace or repair
Short circuit or poor connection between CN-1(2)-CN-51(7) or CN-1 (4) - CN-51(8)	Replace or repair

Wiring diagram



140V96MS09

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-51(12) and ground.

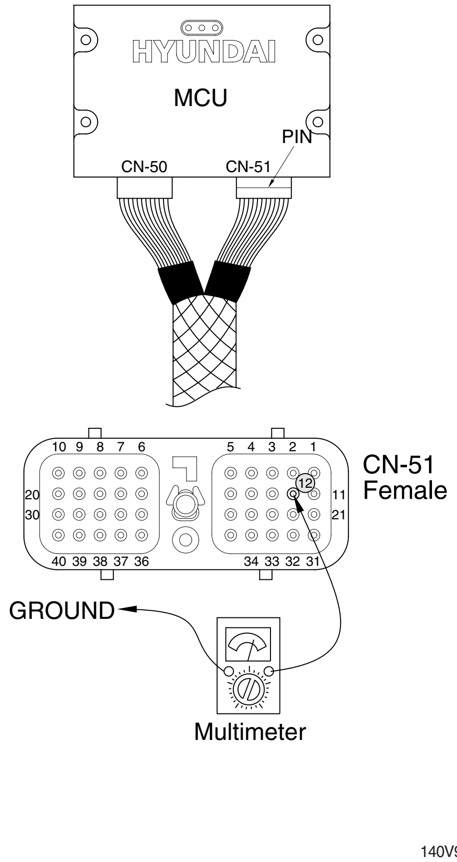
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (12) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

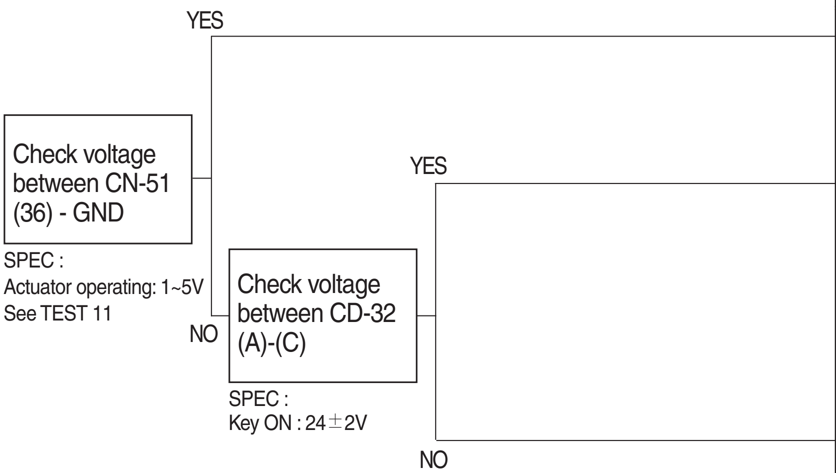
SPEC : Actuator operating : 1~5 V



8. MALFUNCTION OF BOOM UP PRESSURE SENSOR

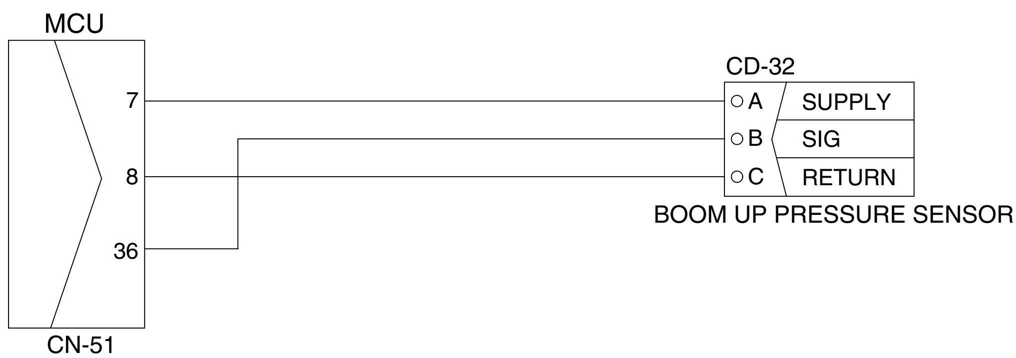
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective boom up pressure sensor	Replace or repair
Short circuit or poor connection between CN-51 (36)-CD-32 (B)	Replace or repair
Short circuit or poor connection between CD-32 (A)-CN-51(7) or CD-32(C)- CN-51 (8)	Replace or repair

Wiring diagram



140V96MS11

2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-51(36) and ground.

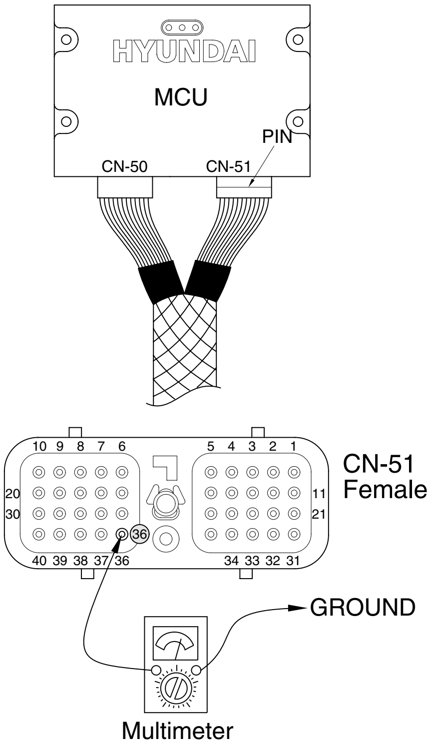
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (36) of CN-51.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

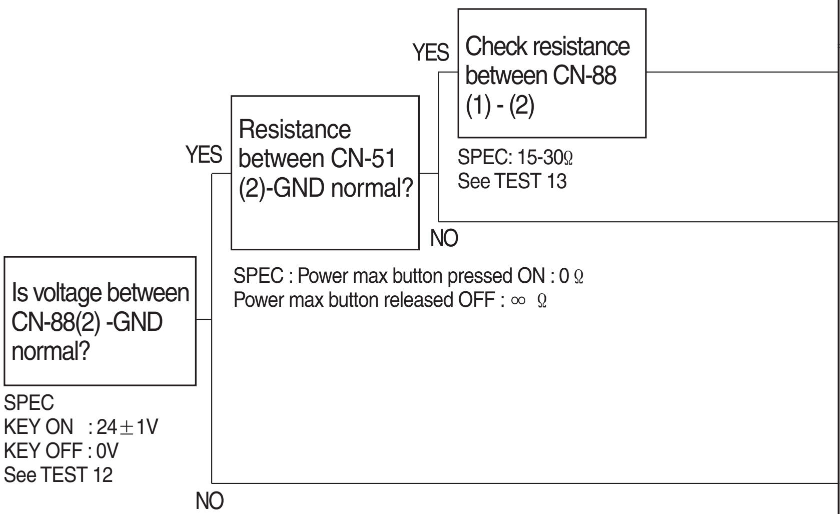


140V96MS12

9. MALFUNCTION OF POWER MAX

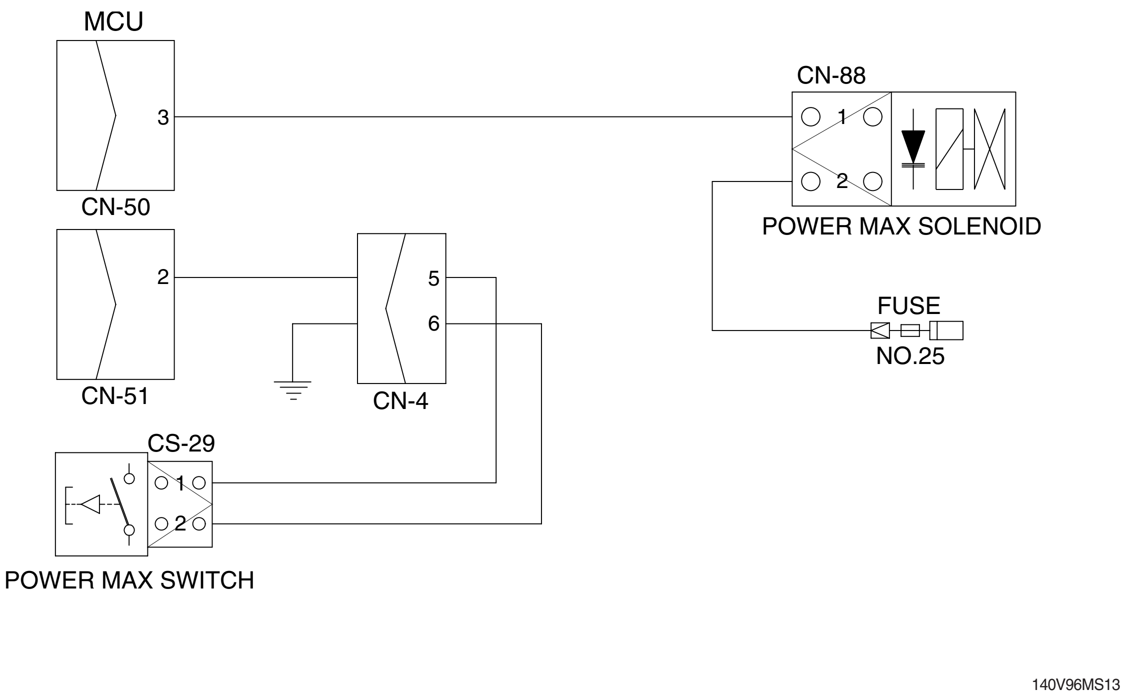
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective power max. solenoid valve	Repair or replace
Short circuit or poor connection between CN-51(2) - CS-29 and CN-50 (3) -CN-88(1)	Repair or replace
Short circuit or poor connection between CN-88(2)-battery relay(+)	Repair or replace

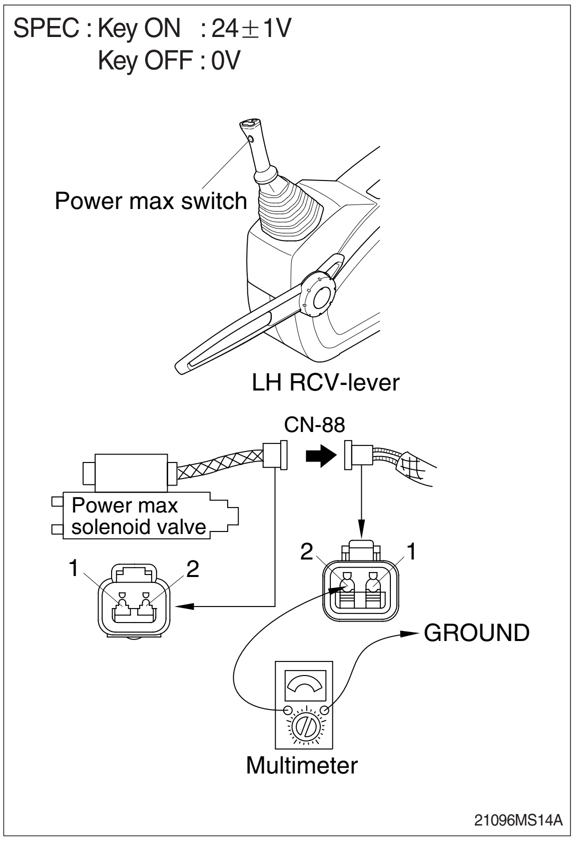
Wiring diagram



2) TEST PROCEDURE

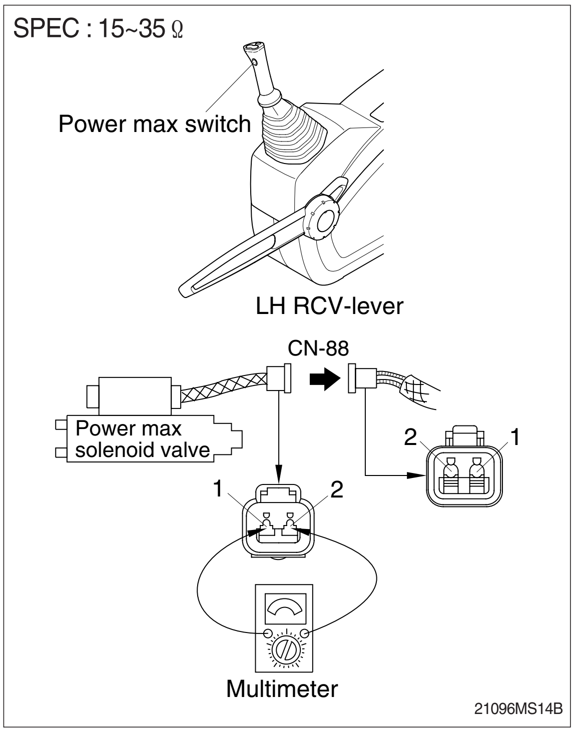
(1) Test 12: Check voltage between connector CN-88(2) - GND.

① Disconnect connector CN-88 from power max solenoid valve.
② Start key ON.
③ Check voltage as figure.



(2) Test 13: Check resistance of the solenoid valve between CN-88(1)-(2).

① Starting key OFF.
② Disconnect connector CN-88 from power max solenoid valve.
③ Check resistance as figure.



SECTION 7 MAINTENANCE STANDARD

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.

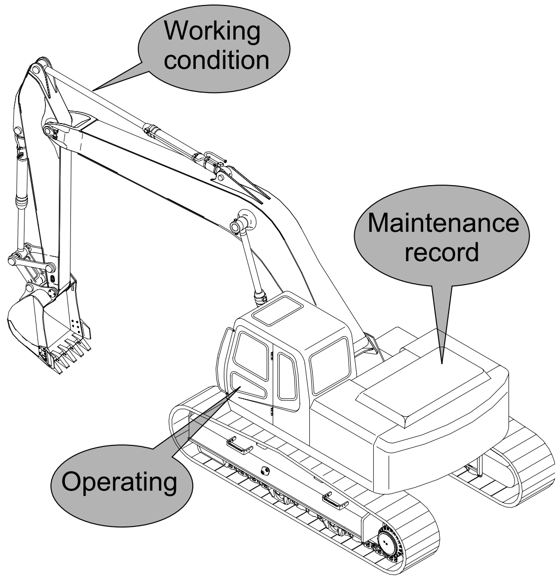
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

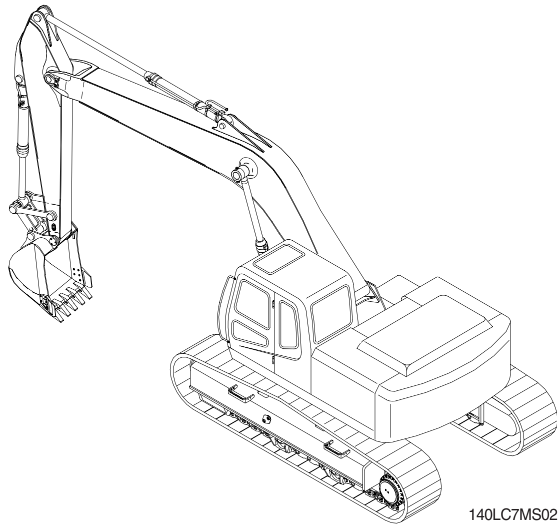


140LC7MS01

2. TERMINOLOGY

1) STANDARD

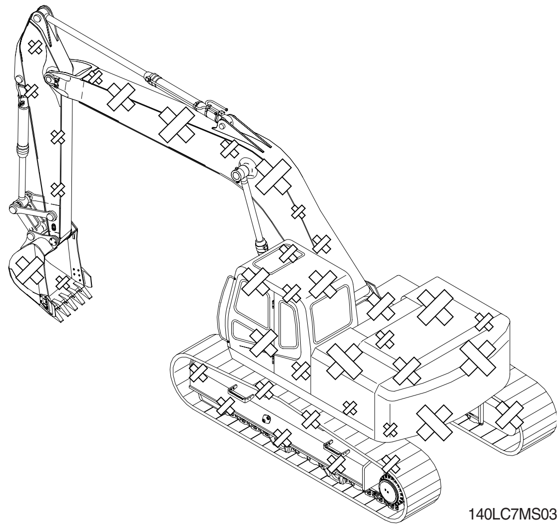
Specifications applied to the brand-new machine, components and parts.



140LC7MS02

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.



140LC7MS03

3. OPERATION FOR PERFORMANCE TESTS

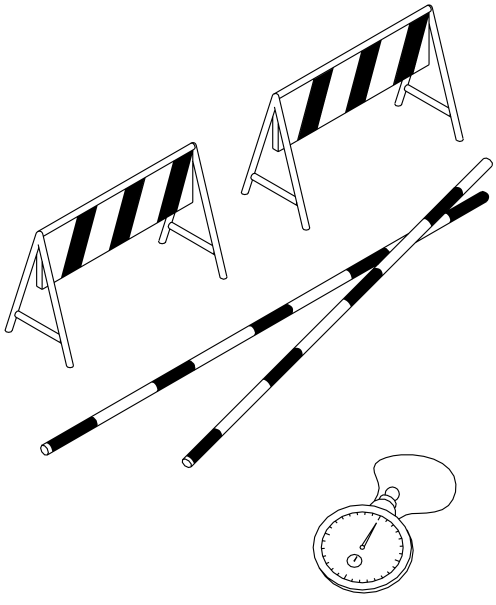
1) Observe the following rules in order to carry out performance tests accurately and safely.

(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.



(290-7TIER) 7-3

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 Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

② Measure and record the engine speed at each mode (P, S, E).

③ Select the P-mode.

④ 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.

⑤ Measure and record the auto deceleration speed.

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R140LS	Start idle	950±100	
	P mode	2150±50	
	S mode	2000±50	
	E mode	1850±50	
	Auto decel	1200±100	
	One touch decel	950±100	

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

3) TRAVEL SPEED

(1) Measure the time required for the excavator to travel a 20 m test track.

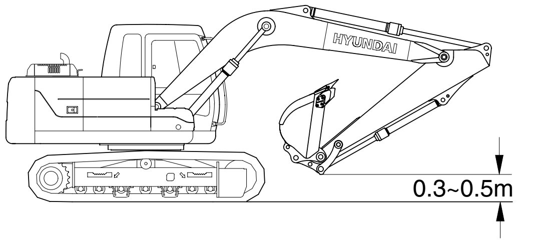
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Prepare a flat and solid test track 20m 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.



14097MS04

(3) Measurement

① Measure both the low and high speeds of the machine.

② Before starting either the low or high speed tests, adjust the travel mode switch to the speed to be tested, then select the following switch positions.

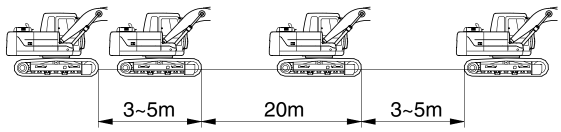
· Power mode switch : P mode

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

④ Measure the time required to travel 20 m.

⑤ After measuring the forward travel speed, turn the upperstructure 180° and measure the reverse travel speed.

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



14097MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
R140LS	1 Speed	22.5±2.0	27.7	
	2 Speed	13.1±1.0	16.1	

4) TRACK REVOLUTION SPEED

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

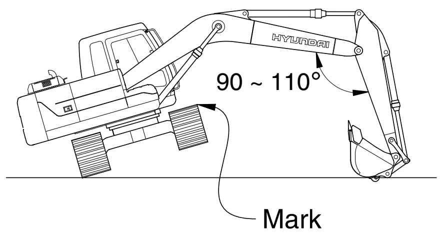
(2) Preparation

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.



14097MS06

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed

· Power mode switch : P 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	Maximum allowable
R140LS	1 Speed	26.6±2.0	33.3
	2 Speed	15.5±2.0	19.9

5) TRAVEL DEVIATION

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

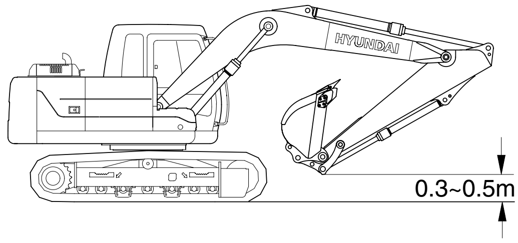
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



14097MS04

(3) Measurement

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

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

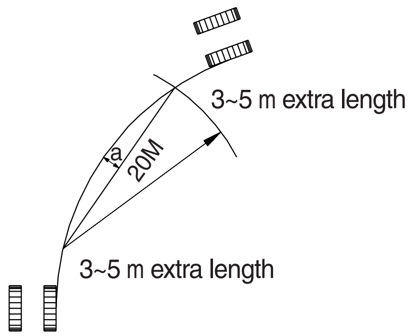
· Power mode switch : P mode

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

④ Measure the distance between a straight 20 ㎧ 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.



(210-7) 7-7(2)

(4) Evaluation

Mistrack should be within the following specifications.

Unit : ㎜ / 20 ㎧

Model	Standard	Maximum allowable	Remarks
R140LS	200 below	240	

6) SWING SPEED

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

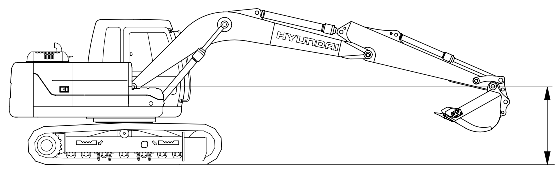
(2) Preparation

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.



14097MS07

(3) Measurement

① Select the following switch positions.

· Power mode switch : P 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

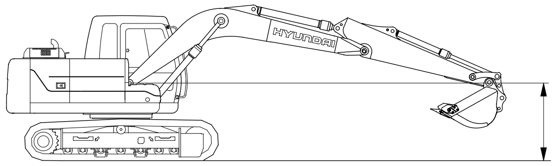
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
R140LS	P mode	15±1.5	19.2

7) SWING FUNCTION DRIFT CHECK

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



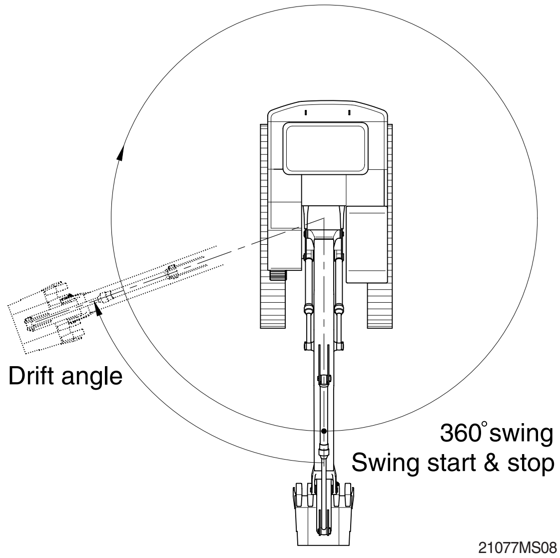
14097MS07

(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 Conduct this test in the M mode.
② Select the following switch positions.
· Power mode switch : P mode
③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°
④ Measure the distance between the two marks.
⑤ Align the marks again, swing 360° , then test the opposite direction.
⑥ Repeat steps ④ and ⑤ three times each and calculate the average values.



21077MS08

(4) Evaluation

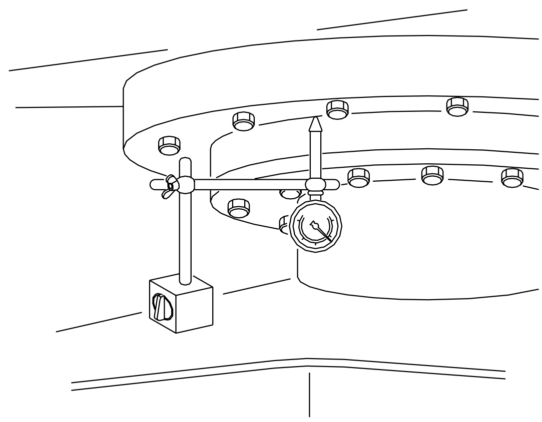
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R140LS	P mode	90 below	157.5	

8) SWING BEARING PLAY

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



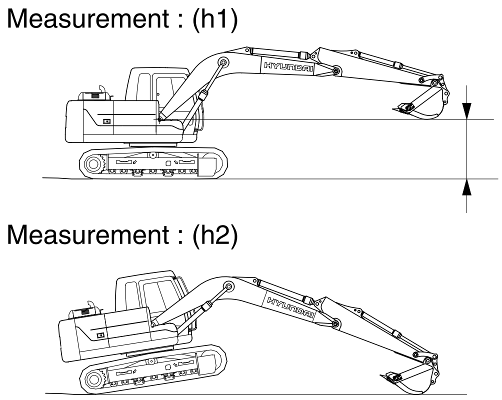
(210-7) 7-10(1)

(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



14097MS09

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R140LS	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

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

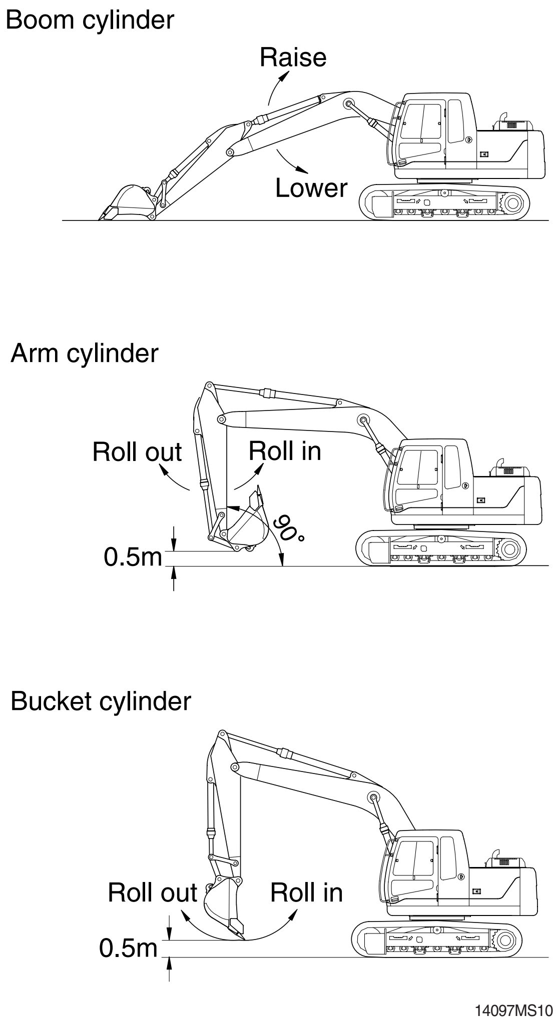
(2) Preparation

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.



(3) Measurement

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

② To 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	Maximum allowable	Remarks
R140LS	Boom raise	3.6±0.4	4.7	
	Boom lower	2.5±0.4	4.1	
	Arm in	2.6±0.4	3.6	
	Arm out	2.6±0.3	3.3	
	Bucket in	3.5±0.4	5.4	
	Bucket out	2.1±0.3	3.6	

10) 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.

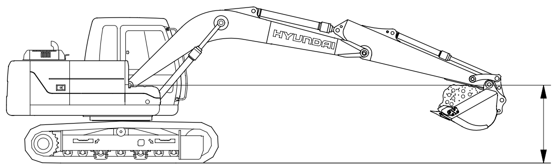
· $W=M^3\times1.5$
Where :
M^3 = Bucket heaped capacity (m^3)
1.5 = Soil specific gravity

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.



14097MS11

(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	Maximum allowable	Remarks
R140LS	Boom cylinder	10 below	20	
	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

(1) Use a spring scale to measure the maximum resistance of each control lever at the middle of the grip.

(2) Preparation

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

(3) Measurement

① Start the engine.

② Select the following switch positions.

· Power mode switch: P mode

③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.

④ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required. When finished, lower the track and then jack-up the other track.

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

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
R140LS	Boom lever	1.6 or below	2.0	
	Arm lever	1.6 or below	2.0	
	Bucket lever	1.6 or below	2.0	
	Swing lever	1.6 or below	2.0	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

(1) Measure each lever stroke at the lever top using a ruler.

※ When the lever has play, take a half of this value and add it to the measured stroke.

(2) Preparation

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

(3) Measurement

① Stop the engine.

② Measure each lever stroke at the lever top from neutral to the stroke end using a ruler.

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
R140LS	Boom lever	87±10	109	
	Arm lever	87±10	109	
	Bucket lever	87±10	109	
	Swing lever	87±10	109	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

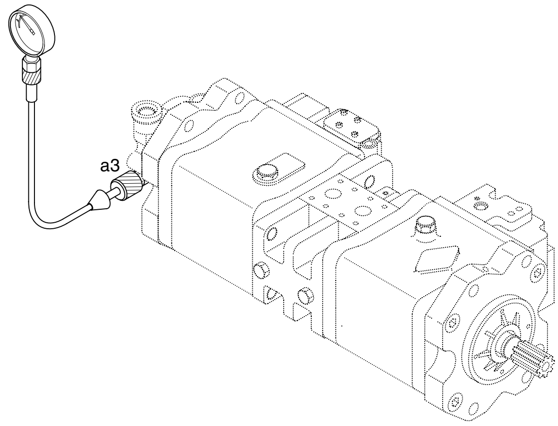
① Stop the engine.

② Push the pressure release button to bleed air.

③ Loosen and remove plug on the pilot pump delivery port and connect pressure gauge.

④ Start the engine and check for oil leakage from the port.

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



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(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

· Auto decel switch : OFF

② Measure the primary pilot pressure in the P mode.

(3) Evaluation

The average measured pressure should meet the following specifications:

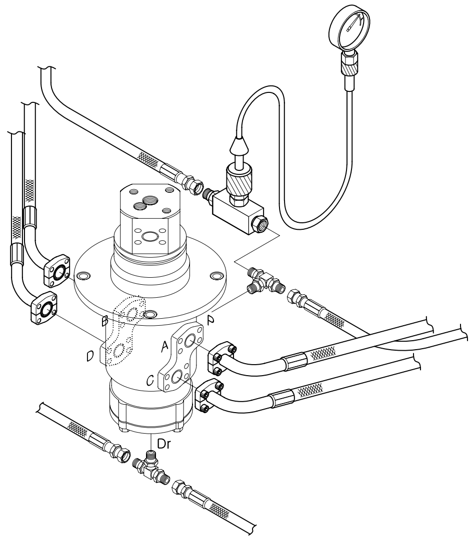
Unit : kgf / cm²

Model	Engine speed	Standard	Allowable limits	Remarks
R140LS	M mode	35^{+2}_{0}	-	

14) 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 assembly to turning joint P port as shown.
④ Start the engine and check for on leakage from the adapter.
⑤ Keep the hydraulic oil temperature at $50\pm5^{\circ}C$.



21077MS13

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
· Mode selector : P mode
② Measure the travel speed selecting pressure in the Hi or Lo mode.
③ Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

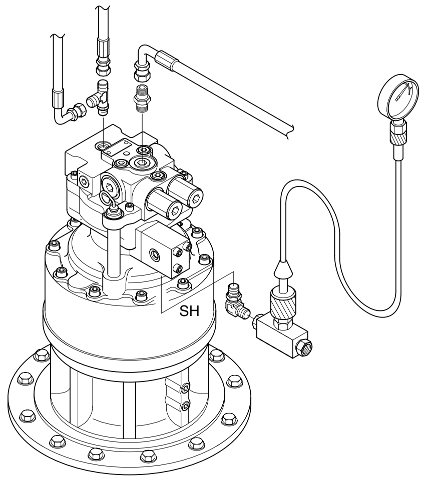
Unit : kgf/cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R140LS	1 Speed	0	-	
	2 Speed	35 ± 5	-	

15) SWING PARKING BRAKE RELEASING PILOT 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.



14W97MS14

(2) Measurement

① Select the following switch positions.
· Power mode switch : P 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.
③ Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

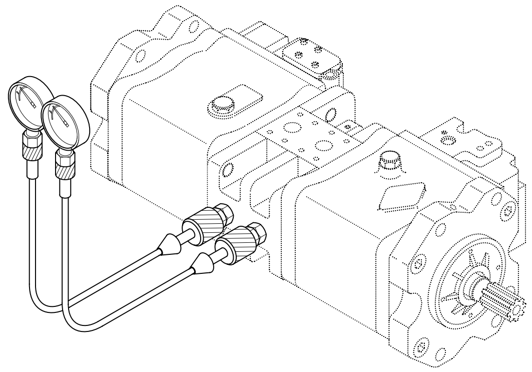
Unit : kgf / cm^2

Model	Description	Standard	Allowable limits	Remarks
R140LS	Brake disengaged	35	15~44	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

① Stop the engine.
② Push the pressure release button to bleed air.
③ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.
④ Start the engine and check for oil leakage from the port.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



2507A7MS03A

(2) Measurement

① Select the following switch positions.
  · Power mode switch : P mode
② Measure the main pump delivery pressure in the P mode (High idle).

(3) Evaluation

The average measured pressure should meet the following specifications.

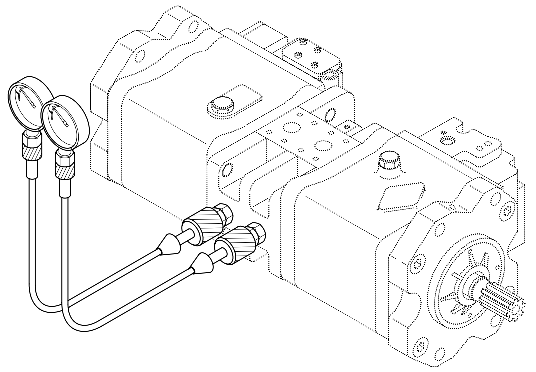
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R140LS	High ilde	40±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Stop the engine.
② Push the pressure release button to bleed air.
③ To measure the system relief pressure. Install a connector and pressure gauge assembly main pump gauge port, as shown.
④ Start the engine and check for oil leakage from the port.
⑤ Keep the hydraulic oil temperature at 50±5˚C.



2507A7MS03A

(2) Measurement

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

(3) Evaluation

The average measured pressure should meet the following specifications.

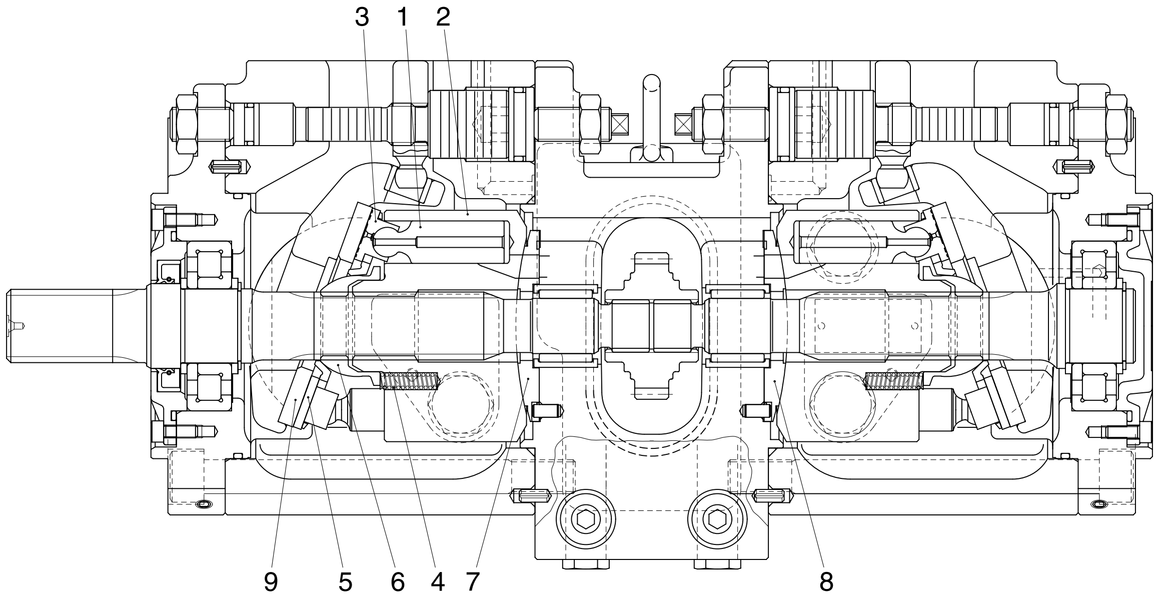
Unit : kgf / cm^2

Model	Function to be tested	Standard	Port relief setting at 20 lpm
R140LS	Boom, Arm, Bucket	350 (380)±10	-
	Travel	350±10	-
	Swing	285±10	-

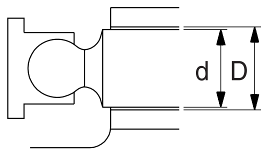
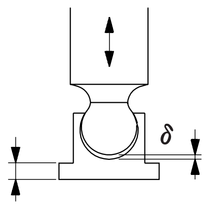
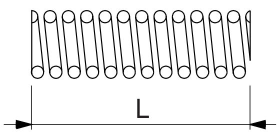
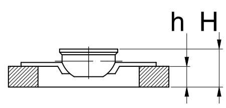
(   ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



14097MP01

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.028	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)		31.3	30.5	Replace cylinder spring.
Combined height of set plate(5)(H) & spherical bushing(6)(h) (H-h)		19.0	18.3	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		

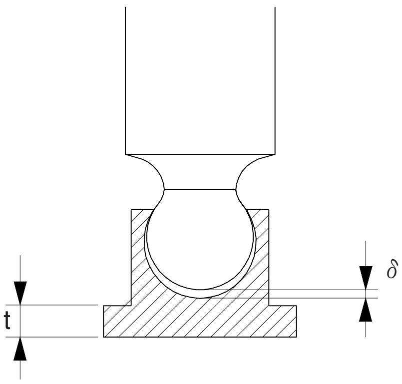
2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool in 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 poppet or spring · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking 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 & negative control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Standard dimension	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 assembly 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	6.0	Replace set of retainer plate and spherical bushing
Thickness of friction plate	4.0	3.6	Replace



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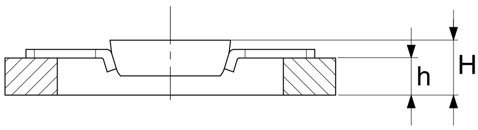


2507A7MS05

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

1) TYPE 1

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 is 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

2) TYPE 2

(1) Troubleshooting

① The motor does not rotate

Problem	Cause	Remedy
The pressure of a motor does not increase	· The oil is bypassed at relief valve	- Fix or exchange relief valve
	· Malfunction of relief valve - Stick of plunger - Malfunction of plunger seat part - Cut of Spring	- Modify of stick part - Disassembly, clean - Exchange a parts - Exchange the relief valve
	· The cracks happens at the inner path of valve casing	- Exchange the check valve
	· Abrasion and abnormality on the adhered surface of check	- Fix or exchange the abnormal parts
Although the pressure increases, a hydraulic motor does not rotate	· Unmeasured external resistance	- Exchange friction plate and separated Plate
	· Stick of counter balance spool	- Check of counter balance spool
	· Do not become break off	- Check and exchange the orifice (4) - Check of brake piston ring
	· Stick of brake piston	- Disassembly and check
	· Stick of friction plate	- Fix or exchange the abnormal parts
	· Damage of traveling reduction gear	- Exchange the traveling reduction gear

② Rotate very slow

Problem	Cause	Remedy
Lack of the number of rotation	· Shortage of supplied oil	- Check the oil circuit up to a motor
	· Oil Temperature is too higher	- Make the temperature down of the oil
	· Abnormal oil leakage	- Fix or exchange the abnormal parts
	· Two speed is late - Stick of swash piston	- Fix or exchange the abnormal parts

③ To control or adjust a brake is hard

Problem	Cause	Remedy
Brake torque is low	· Abrasion of friction and separated plate	- Fix or exchange the abnormal parts
	· Damage of brake spring	
	· Damage of brake piston	

④ Shortage of rotating force at the standard value

Problem	Cause	Remedy
Brake is released, but the turning force is low	· Excavator main relief valve is not set correctly	- Resetting the main relief valve
	· Pressure down of motor relief valve	- Resetting the relief valve pressure - Exchange the relief valve
	· Malfunction of check valve	- Exchange the check valve
	· Scratch of valve plate	- Fix or exchange the abnormal parts

⑤ Many slip

Problem	Cause	Remedy
Brake is released, but the turning force is week	· Malfunction of relief valve	- Fix or exchange the abnormal parts
	· Check valve error	
	· Stick of counter balance spool	
	· Valve plate scratch / copper peeling phenomena	

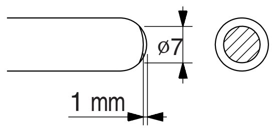
⑥ It is not two speed changeover

Problem	Cause	Remedy
It is not variable speed (low/high 2- stage speed) changeover	· Pilot Line error	- Fix or exchange the abnormal parts
	· Two speed changeover spool stick	
	· Swash piston stick	

⑦ Oil leakage

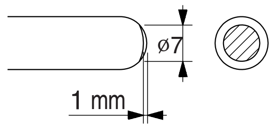
Problem	Cause	Remedy
Leakage at oil seal	· Drain pressure is high	- Remove the abnormal substances after exchanging the damaged part
	· Seal error	- Check a drain line of an equip
Leakage on a assembled surface	· Damage of a O-ring	- Exchange O-ring
	· Bolt or plug is released	- Tighten the parts with fixed torque

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 1mm.	
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.	

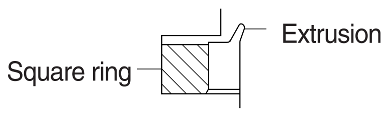
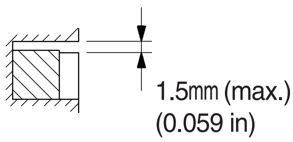
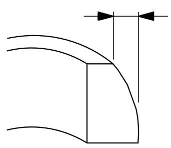
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	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 10μ 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.

7. 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

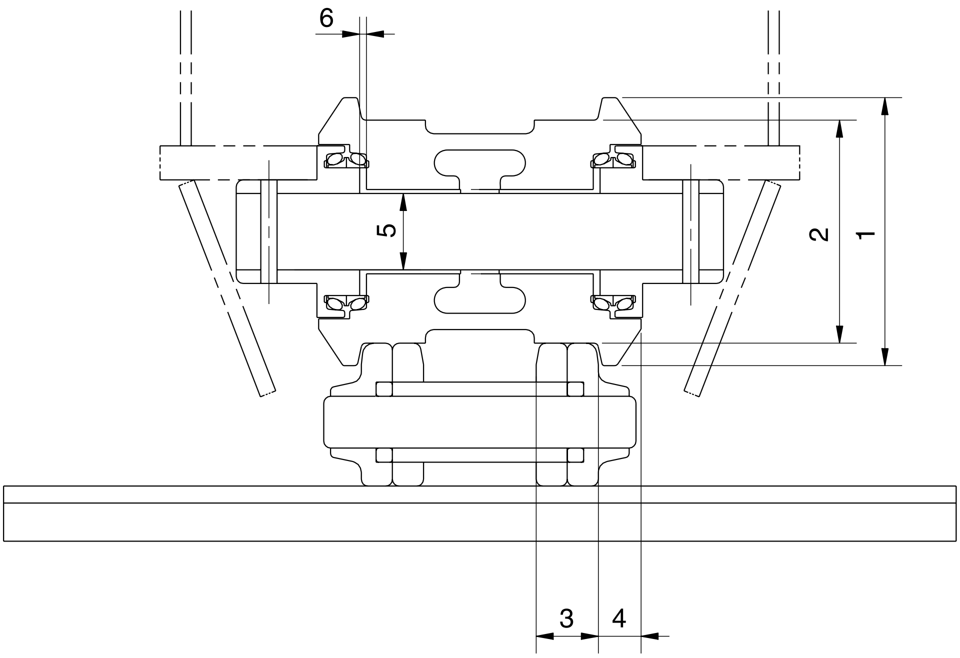
8. CYLINDER

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.	· Replace or replate
		· Rust is not present on plating.	· Replace or replate
		· Scratches are not present.	· 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

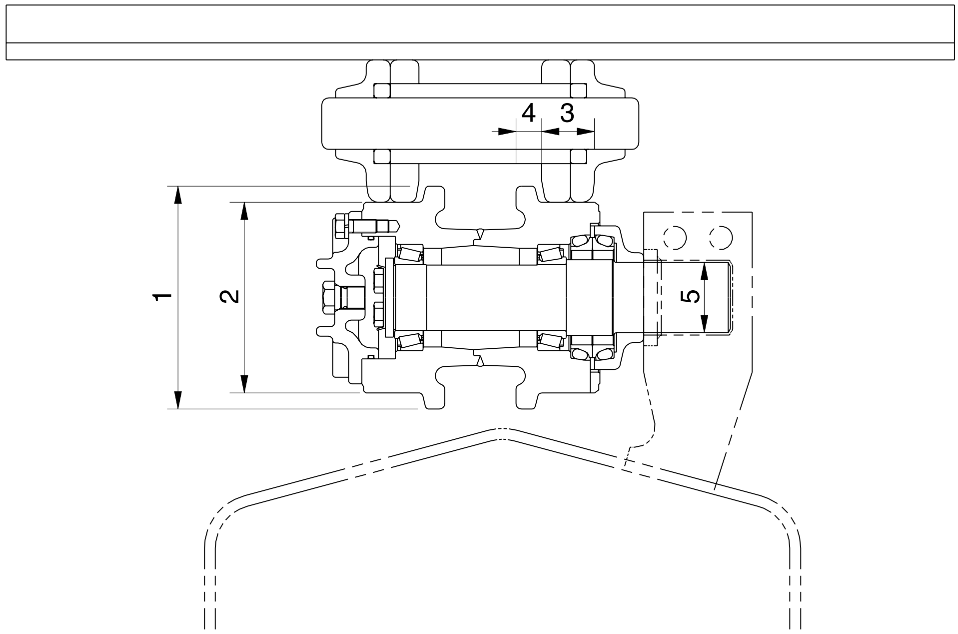


21037MS01

Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="3">ø 190</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="3">ø 150</td><td colspan="2">ø 138</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="3">36.5</td><td colspan="2">42.5</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="3">26.5</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and bushing</td><td rowspan="2">Standard size</td><td colspan="2">tolerance</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft</td><td>Hole</td></tr>
<tr><td>ø 65</td><td>-0.25
-0.35</td><td>+0.12
+0.075</td><td>0.325
to 0.47</td><td>2.0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Side clearance of roller (both side)</td><td colspan="3">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="3">0.1 to 1.3</td><td colspan="2">2.0</td></tr>
</table>

2) CARRIER ROLLER



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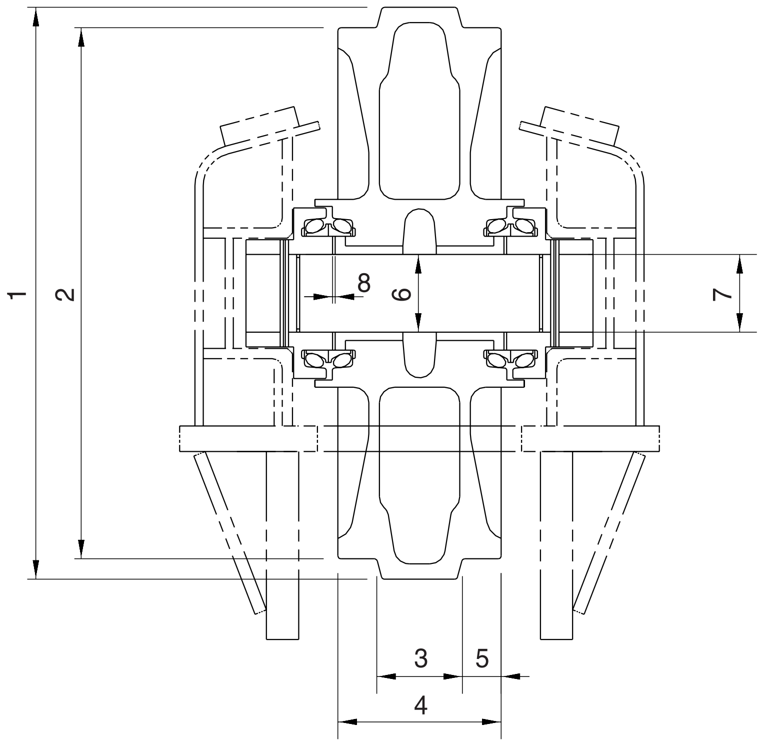
Unit : ㎜

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø 175		-		
2	Outside diameter of tread	ø 151		ø 141		
3	Width of tread	37.25		42.25		
4	Width of flange	18.25		-		
5	Clearance between shaft and bushing	Standard size & Tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 41.27 $^{0}_{+0.05}$	ø 41.5 $^{+0.2}_{-0.1}$	0.13 to 0.48	1.2	

3) IDLER



21037MS03

Unit : mm

<table>
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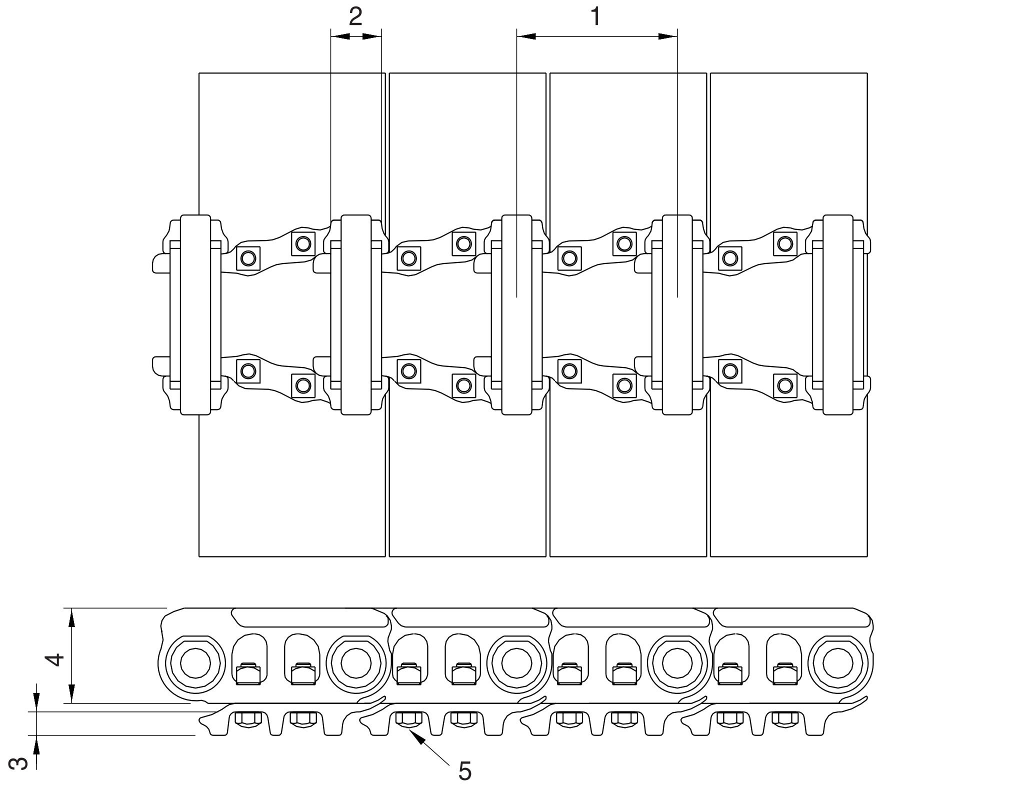
<tr><td colspan="2">ø 552</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 507</td><td colspan="2">ø 497</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">67</td><td colspan="2">-</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">135</td><td colspan="2">-</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">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="2">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>Shaft</td><td>Hole</td></tr>
<tr><td>ø 70 $^{0}_{-0.03}$</td><td>ø 70.3 $^{+0.05}_{0}$</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>ø 70 $^{0}_{-0.03}$</td><td>ø 70 $^{+0.07}_{+0.03}$</td><td>0.3 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="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace bushing</td></tr>
<tr><td colspan="2">0.25 to 1.15</td><td colspan="2">2.0</td></tr>
</table>

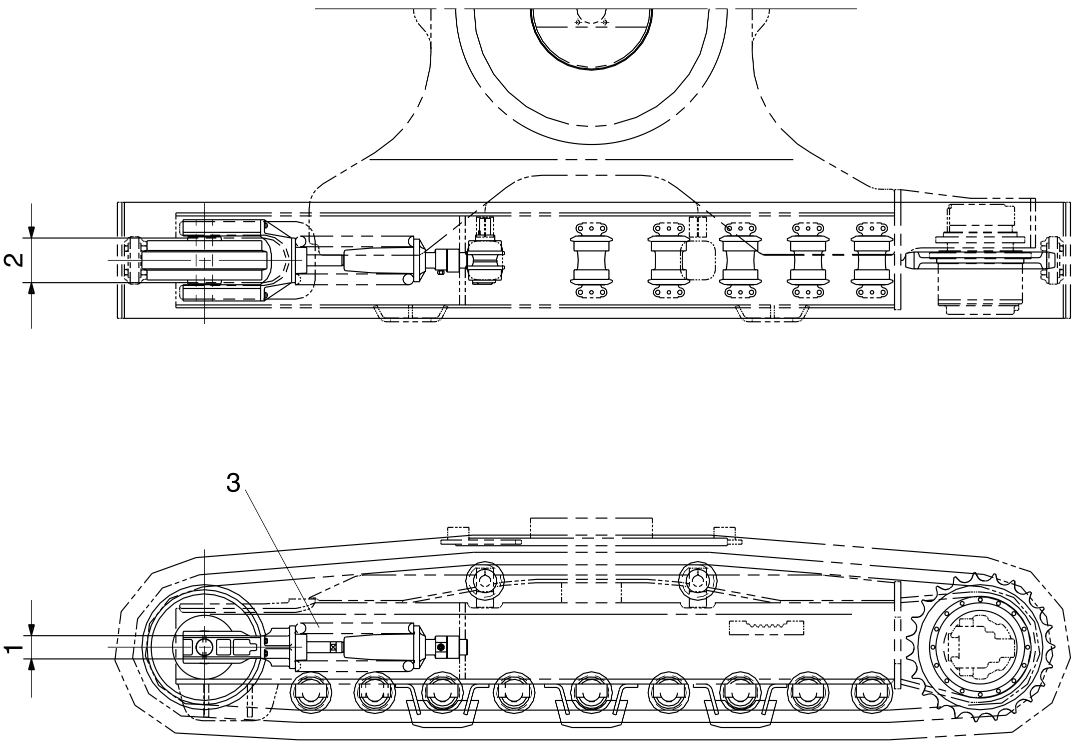
4) TRACK



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	ø 53.75	ø 43.95	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



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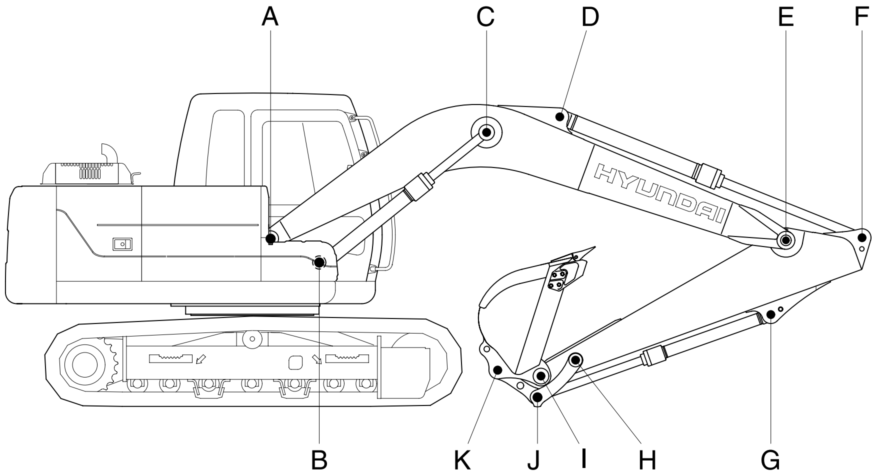
Unit : ㎜

<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 colspan="2">Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td colspan="2">103</td><td colspan="2">+2
0</td><td>107</td></tr>
<tr><td>Idler support</td><td colspan="2">100</td><td colspan="2">0
- 0.5</td><td>98</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td colspan="2">192</td><td colspan="2">+2
0</td><td>196</td></tr>
<tr><td>Idler support</td><td colspan="2">190</td><td colspan="2">-</td><td>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>ø 192 × 470</td><td>405</td><td>8,497kg</td><td colspan="2">-</td><td>6,978kg</td></tr>
</table>

2. WORK EQUIPMENT



14097MS01

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	70	69	68.5	70.5	71	Replace
B	Boom Cylinder Head	70	69	68.5	70.5	71	〃
C	Boom Cylinder Rod	70	69	68.5	70.5	71	〃
D	Arm Cylinder Head	70	69	68.5	70.5	71	〃
E	Boom Front	70	69	68.5	70.5	71	〃
F	Arm Cylinder Rod	70	69	68.5	70.5	71	〃
G	Bucket Cylinder Head	70	69	68.5	70.5	71	〃
H	Arm Link	65	64	63.5	65.5	66	〃
I	Bucket and Arm Link	65	64	63.5	65.5	66	〃
J	Bucket Cylinder Rod	70	69	68.5	70.5	71	〃
K	Bucket Link	65	64	63.5	65.5	66	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

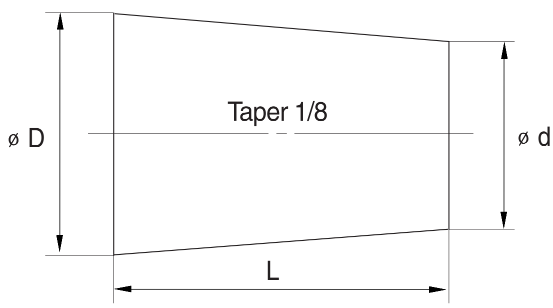
SECTION 8 DISASSEMBLY AND ASSEMBLY

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 100㎜ 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)	M14 × 2.0	18 ± 0.5	130 ± 3.6
2		Engine mounting bolt (engine-bracket, RR)	M12 × 1.75	10 ± 0.5	72.3 ± 3.6
3		Engine mounting bolt (bracket-frame, FR)	M16 × 2.0	30 ± 3.5	217 ± 25.3
4		Engine mounting bolt (bracket-frame, RR)	M20 × 2.5	55 ± 3.5	398 ± 25.3
5		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
6		Coupling mounting socket bolt	M16 × 2.0	22 ± 1.0	159 ± 7.2
7		Main pump housing mounting bolt	M10 × 1.5	6.0 ± 0.3	43.4 ± 2.2
8	Hydraulic system	Main pump mounting socket bolt	M16 × 2.0	22 ± 1.0	159 ± 7.2
9		Main control valve mounting bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
10		Fuel tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 36.9
11		Hydraulic oil tank mounting bolt	M20 × 2.5	46 ± 5.1	333 ± 36.9
12		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	88.9 ± 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 × 1.5	29.7 ± 3.0	215 ± 21.7
16		Travel motor mounting bolt	M16 × 2.0	25.7 ± 4.0	186 ± 28.9
17		Sprocket mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
18	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
19		Track roller mounting bolt	M16 × 2.0	29.7 ± 3.0	215 ± 21.7
20		Track tension cylinder mounting bolt	M16 × 2.0	21.9 ± 3.3	158 ± 23.9
21		Track shoe mounting bolt, nut	5/8 - 18UNF	42 ± 4	304 ± 28.9
22		Track guard mounting bolt	M16 × 2.0	29.6 ± 3.2	214 ± 23.1
23	Others	Counterweight mounting bolt	M27 × 3.0	140 ± 15	1013 ± 108
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

※ 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

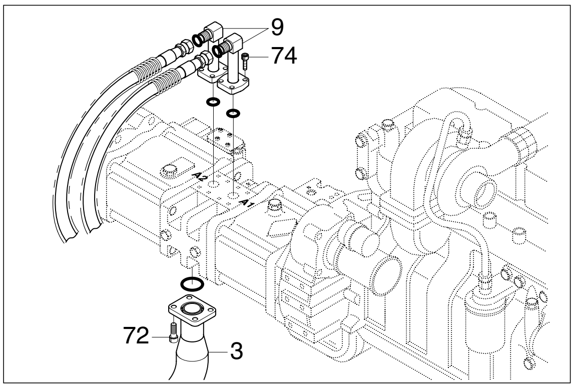
1) REMOVAL

(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.

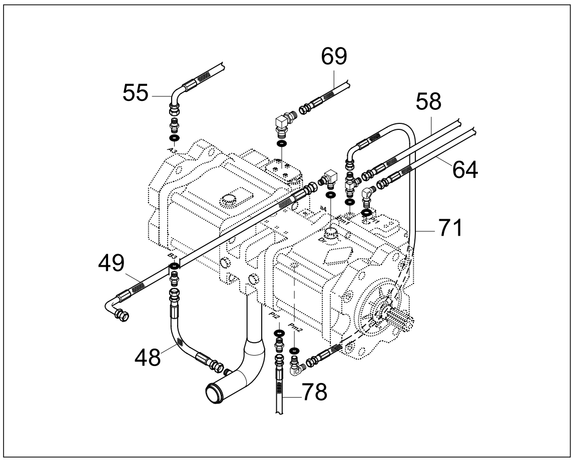
· Hydraulic tank quantity : 124 l

(5) Remove socket bolts(74) and disconnect pipe(9).

(6) Disconnect pilot line hoses(48, 49, 55, 58, 64, 69, 71, 78).

(7) Remove socket bolts(72) and disconnect pump suction tube(3).

※ 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.

· Weight : 85㎏(188lb)

※ 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.

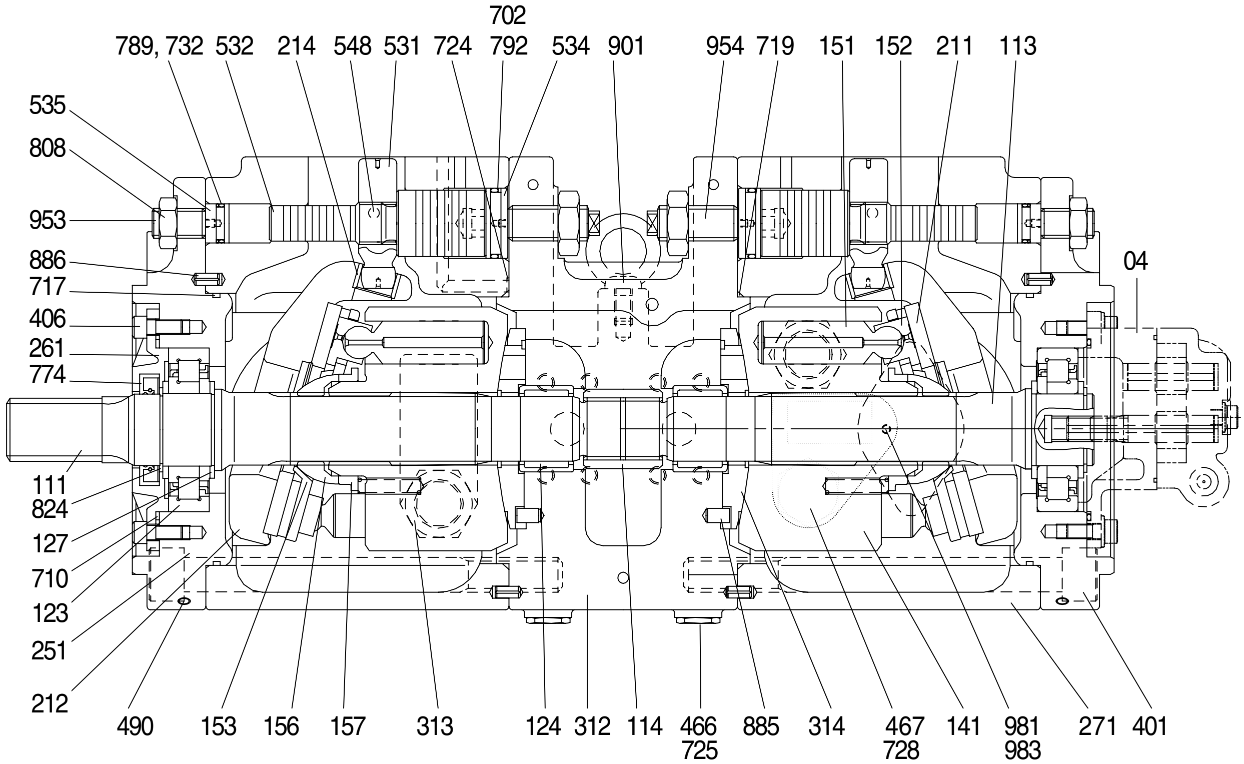
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug(2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

(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

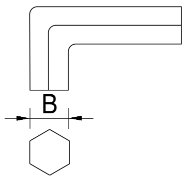


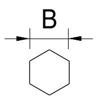
04	Gear pump	261	Seal cover(F)	717	O-ring
111	Drive shaft(F)	271	Pump casing	719	O-ring
113	Drive shaft(R)	312	Valve block	724	O-ring
114	Spline couping	313	Valve plate(R)	725	O-ring
123	Roller bearing	314	Valve plate(L)	728	O-ring
124	Needle bearing	401	Hexagon socket bolt	732	O-ring
127	Bearing spacer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

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	M 5	BP-1/16	-	M 8
	5	M 6	BP-1/8	-	M10
	6	M 8	BP-1/4	PO-1/4	M12, M14
	8	M10	BP-3/8	PO-3/8	M16, M18
	17	M20, M22	BP-1	PO-1, 1 1/4, 1 1/2	-

Name	B	Hexagon socket head bolt	Henagon nut	VP plug (PF thread)
Double ring spanner, socket wrench, double(Single) open end spanner 	-			
	19	M12	M12	VP-1/4
	24	M16	M16	-
	27	M18	M18	VP-1/2
	30	M20	M20	-
	36	-	-	VP-3/4

Tool name	Part name
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(Materal : 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(Materal : 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.

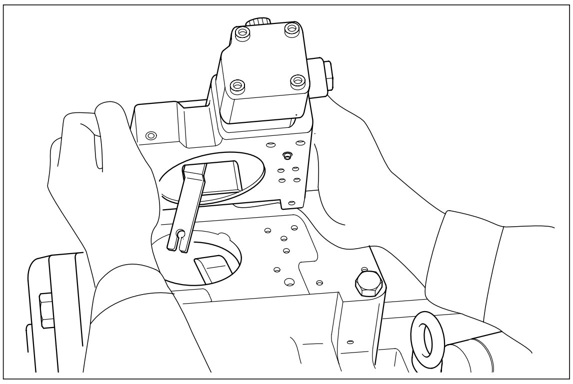
※ Select clean place.

※ 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.

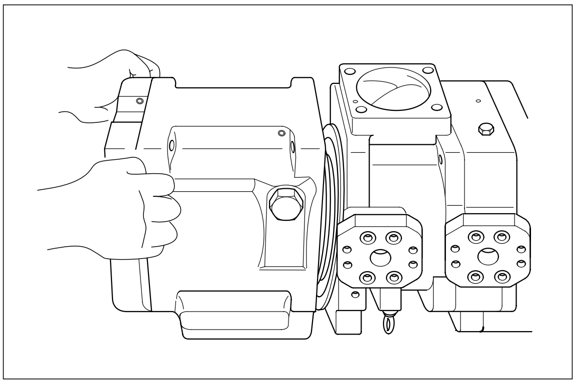


(5) Loosen hexagon socket head bolts(401) which tighten swash plate support(251), pump casing(271) and valve block(312).

※ If gear pump and so on are fitted to rear face of pump, remove them before starting this work.

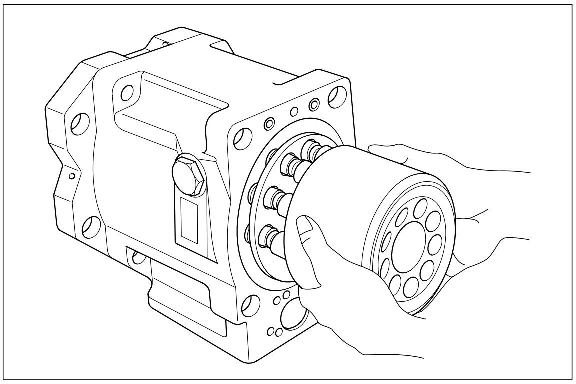
(6) Place pump horizontally on workbench with its regulator-fitting surface down and separate pump casing(271) from valve block(312).

※ 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.

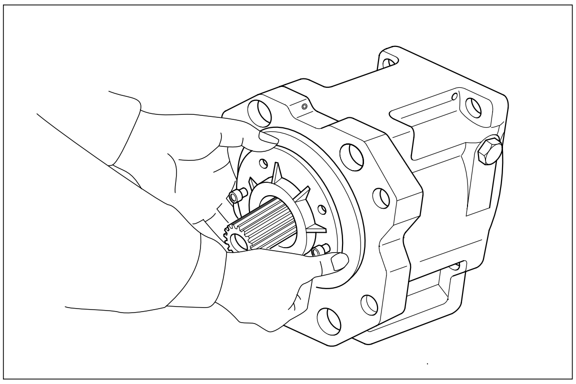
※ Take care not to damage sliding surfaces of cylinder, spherical bushing, shoes, swash plate, etc.



(8) Remove hexagon socket head bolts(406) and then seal cover(F, 261).

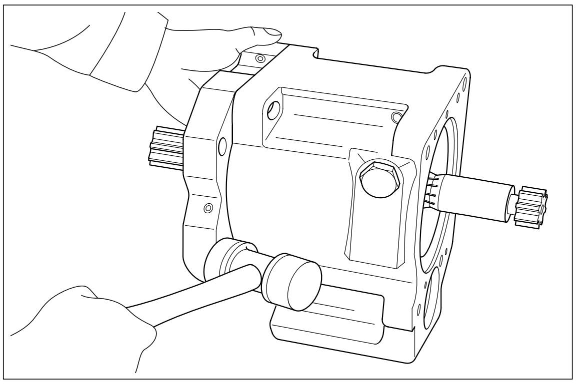
※ Fit bolt into pulling out tapped hole of seal cover(F), and cover can be removed easily.

※ Since oil seal is fitted on seal cover(F), take care not to damage it in removing cover.

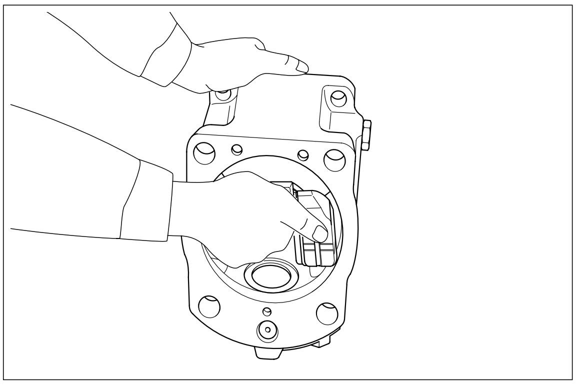


(9) Remove hexagon socket head bolts(408) and then seal cover(R, 262).
In case fitting a gear pump, first, remove gear pump.

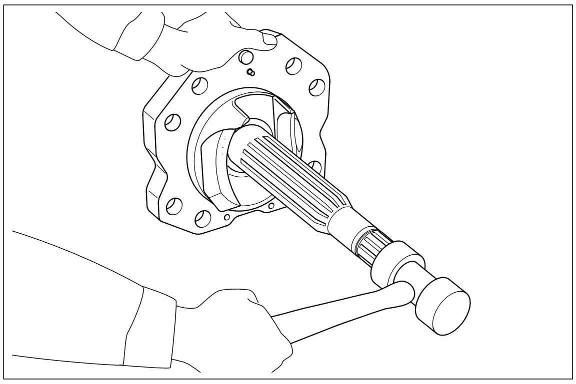
(10) Tapping lightly fitting flange section of swash plate support(251) on its pump casing side, separate swash plate support from pump casing.



(11) Remove shoe plate(211)and swash plate(212) from pump casing(271).

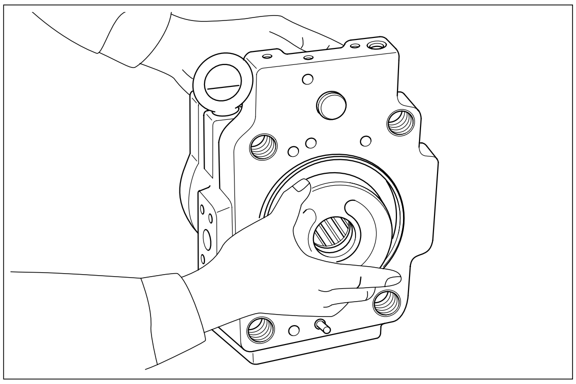


(12) Tapping lightly shaft ends of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



(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.

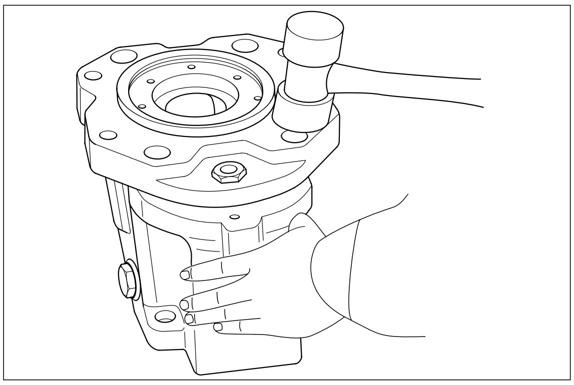
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

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.

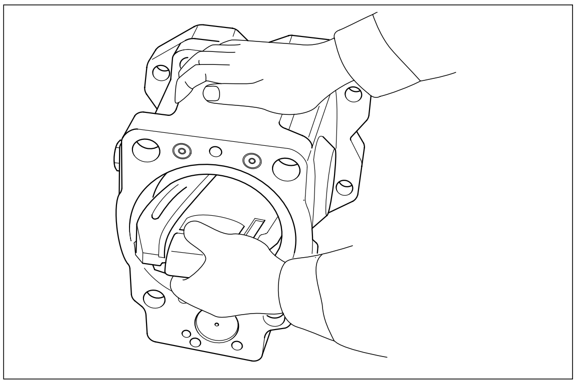
※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply loctite(Medium strength) to their threaded sections.



(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.

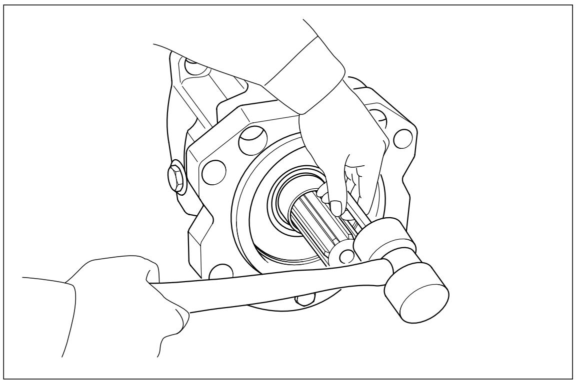


(4) To swash plate support(251), fit drive shaft(111) set with bearing(123), bearing spacer(127) and snap ring(824).

※ 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.

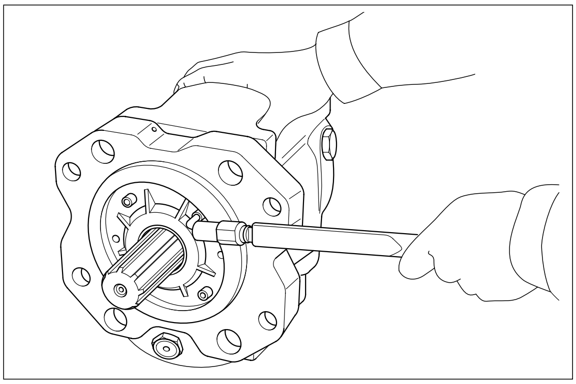


(5) Assemble seal cover(F, 261) to pump casing(271) and fix it with hexagon socket head bolts(406).

※ Apply grease lightly to oil seal in seal cover(F).

※ Assemble oil seal, taking full care not to damage it.

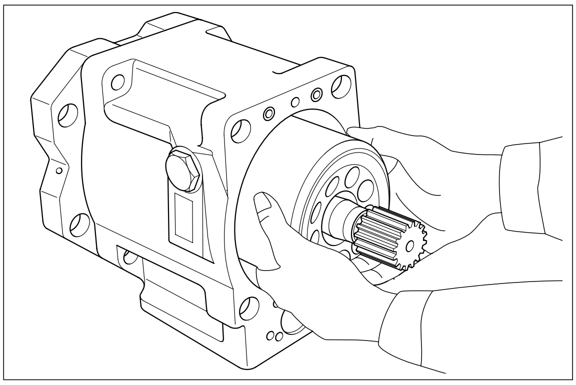
※ For tandem type pump, fit rear cover(263) and seal cover(262) similarly.



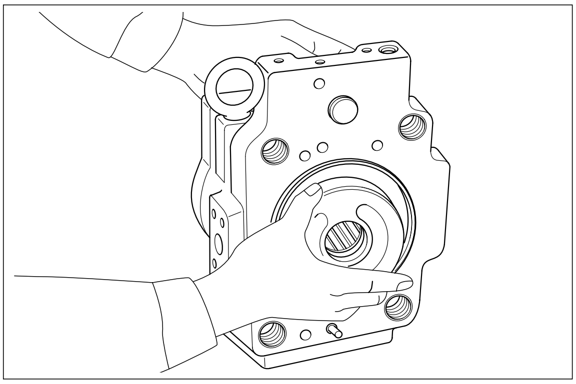
(6) Assemble piston cylinder subassembly 〔cylinder block(141), piston subassembly (151, 152), set plate(153), spherical bush (156), spacer(158) and cylinder spring (157)〕.

Fit spline phases of retainer and cylinder.

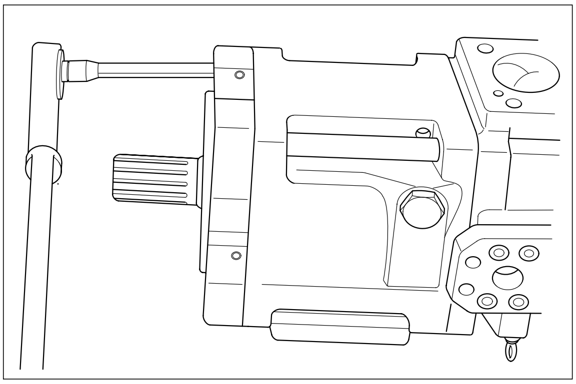
Then, insert piston cylinder subassembly into pump casing.



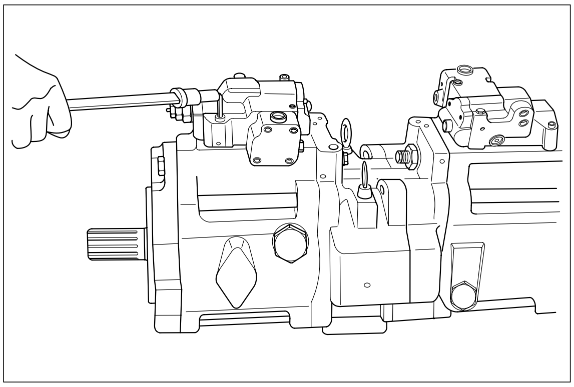
(7) Fit valve plate(313) to valve block(312), entering pin into pin hole.
※ Take care not to mistake suction / delivery directions of valve plate.



(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.



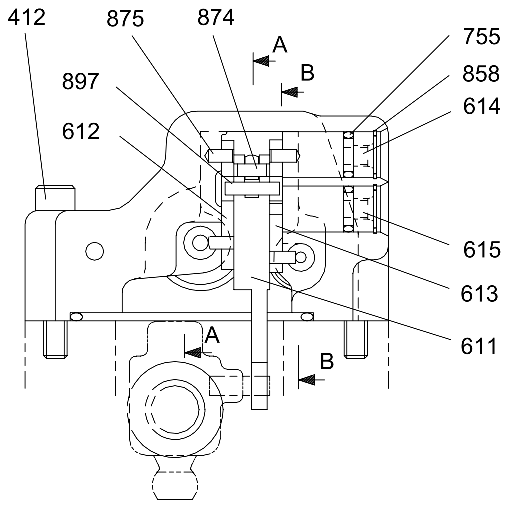
(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).
※ Take care not to mistake regulator of front pump for that of rear pump.

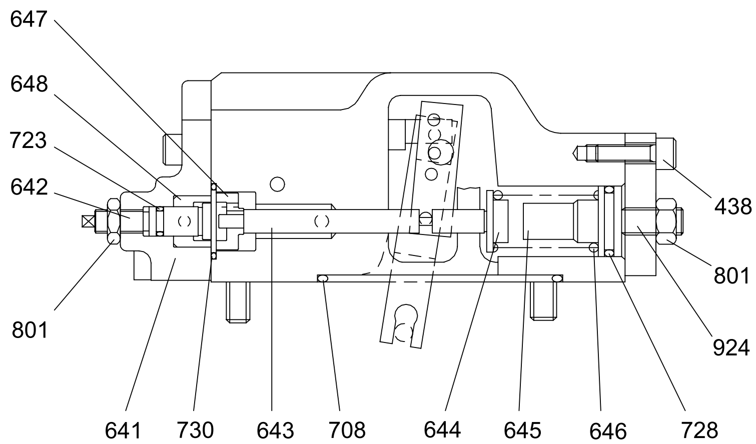


(10) Fit drain port plug(468).
This is the end of reassembling procedures.

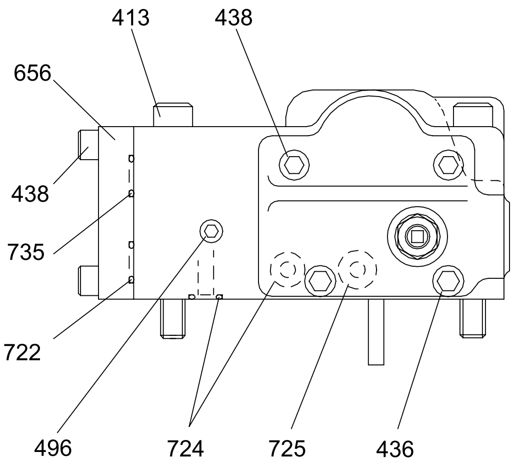
3. REGULATOR

1) STRUCTURE(1/2)

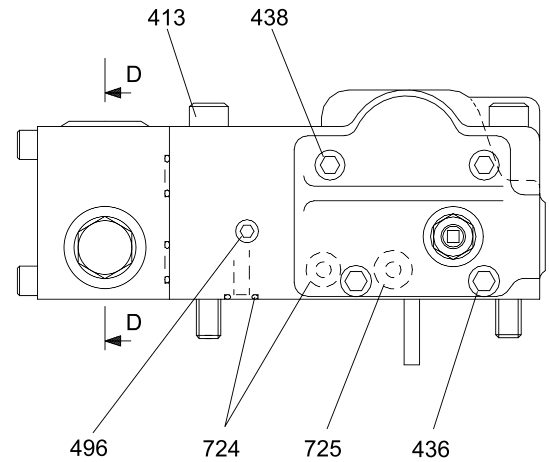




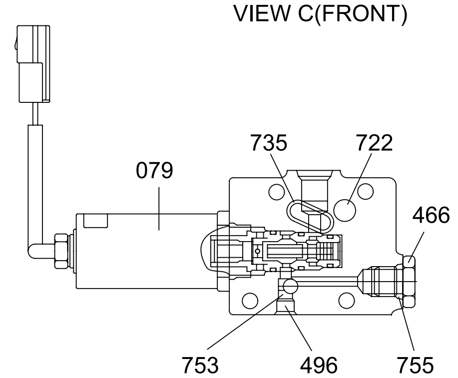
SECTION B-B



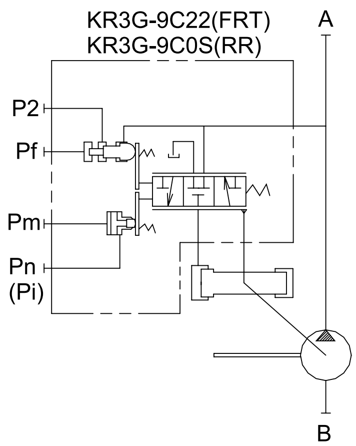
VIEW C(FRONT)



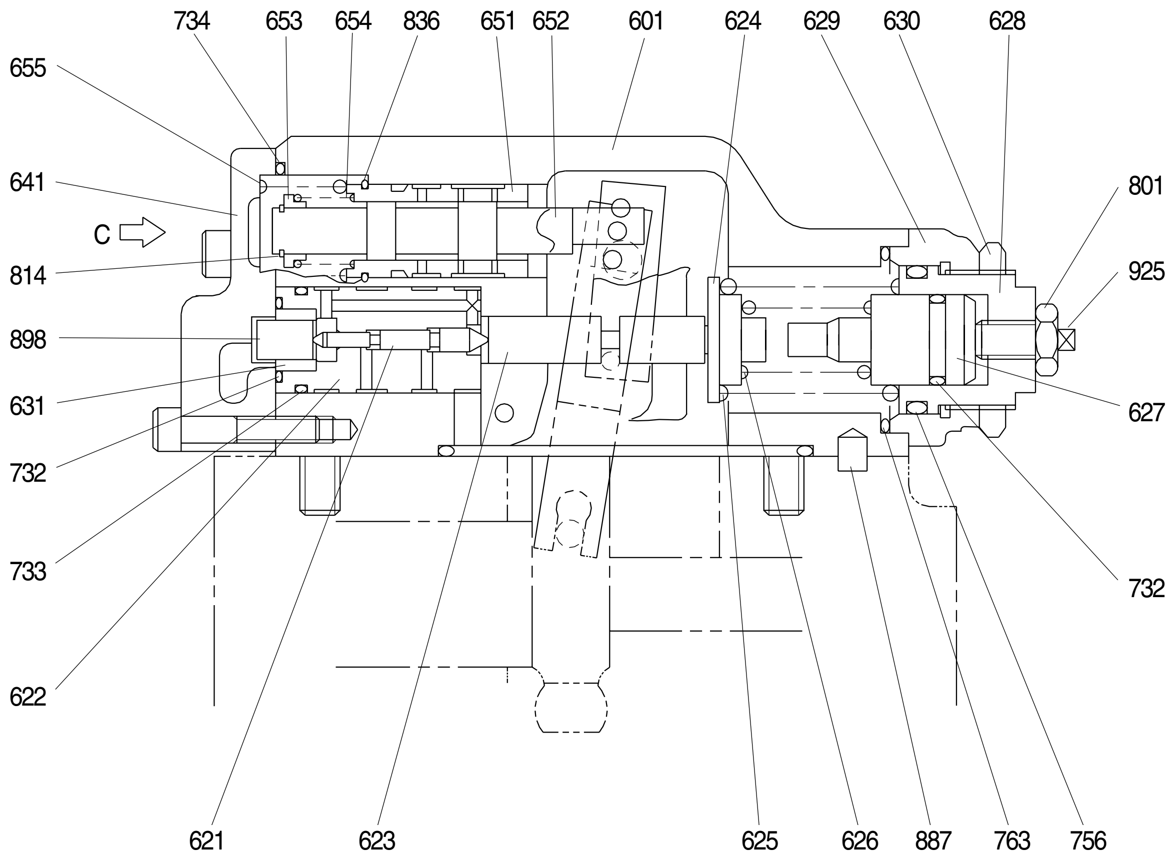
VIEW C(REAR)



SECTION D-D



REGULATOR(2/2)



SECTION A-A

412	Hexagon socket screw	631	Sleeve, pf	730	O-ring
413	Hexagon socket screw	641	Pilot cover	732	O-ring
436	Hexagon socket screw	642	Pilot cover(QMC)	733	O-ring
438	Hexagon socket screw	643	Pilot piston	734	O-ring
496	Plug	644	Spring seat(Q)	735	O-ring
601	Casing	645	Adjust stem(Q)	755	O-ring
611	Feed back lever	646	Pilot spring	756	O-ring
612	Lever(1)	647	Stopper	763	O-ring
613	Lever(2)	648	Piston(QMC)	801	Nut
614	Fulcrum plug	651	Sleeve	814	Snap ring
615	Adjust plug	652	Spool	836	Snap ring
621	Compensator piston	653	Spring seat	858	Snap ring
622	Piston case	654	Return spring	874	Pin
623	Compensator rod	655	Set spring	875	Pin
624	Spring seat(C)	656	Block cover	887	Pin
625	Outer spring	708	O-ring	897	Pin
626	Inner spring	722	O-ring	898	Pin
627	Adjust stem(C)	723	O-ring	924	Set screw
628	Adjust screw(C)	724	O-ring	925	Adjust screw(QI)
629	Cover(C)	725	O-ring		
630	Lock nut	728	O-ring		

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="12">Part name</th></tr>
<tr><td>Name</td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td rowspan="3">Allen wrench</td><td>4</td><td colspan="3">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP-1/8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double(Single) open end spanner</td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon nut</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="4">M 8</td><td colspan="4">M 8</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Small size, Max 36mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">4 × 100mm</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</td></tr>
<tr><td colspan="2">Pincers</td><td colspan="12">-</td></tr>
<tr><td colspan="2">Bolt</td><td colspan="12">M4, Length : 50mm</td></tr>
</table>

(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 Plut(Materal : 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 Plut(Materal : 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.

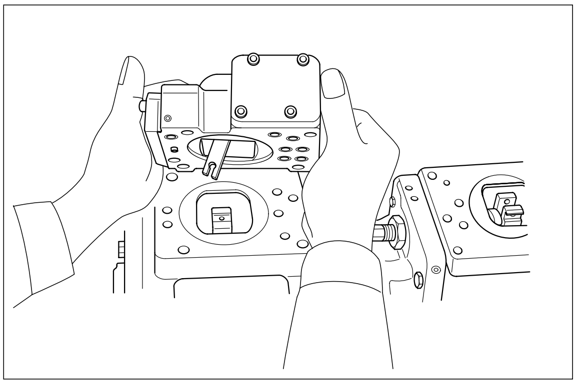
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on 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.

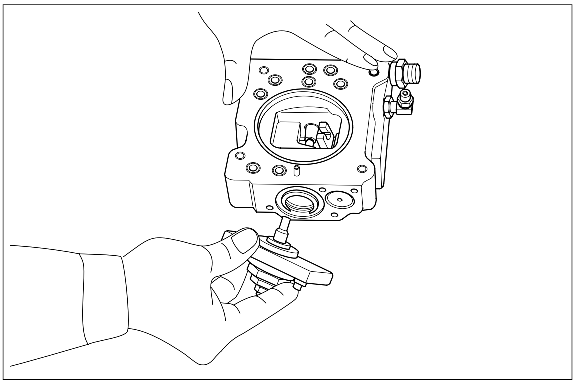


(4) Remove hexagon socket head screw (438) and remove cover(C,629)

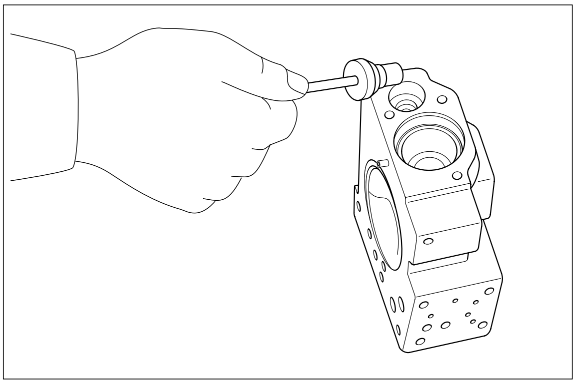
※ Cover(C) is fitted with adjusting screw (C,QI) (628, 925), adjusting ring(C, 627), lock nut(630), hexagon nut(801) and adjusting screw(924).

Do not loosen these screws and nuts.

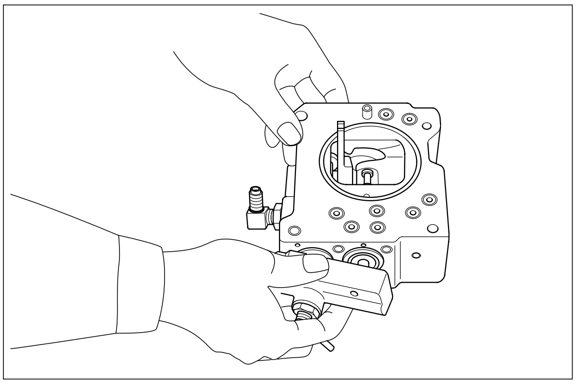
If they are loosened, adjusted pressure-flow setting will vary.



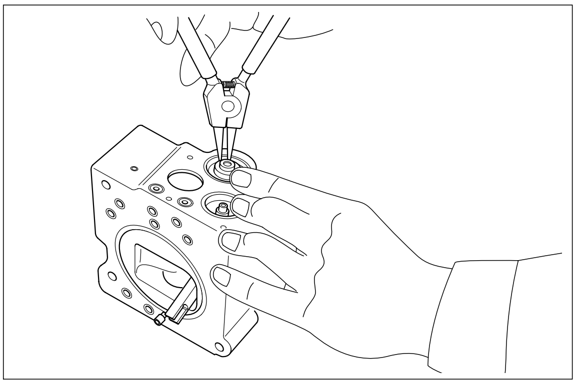
(5) After removing cover(C, 629) subassembly, take out outer spring(625), inner spring (626) and spring seat(C, 624) from compensating section.
Then draw out adjusting ring(Q, 645), pilot spring(646) and spring seat(644) from pilot section.
※ Adjusting ring(Q,645) can easily be drawn out with M4 bolt.



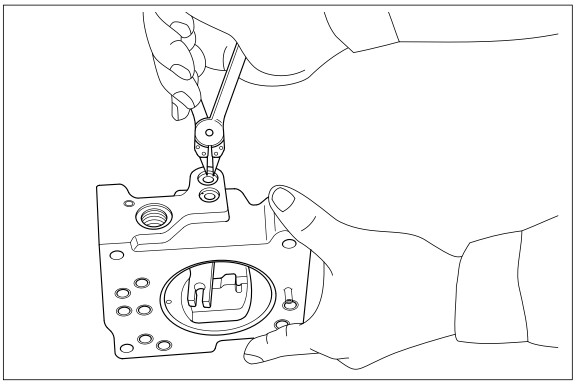
(6) Remove hexagon socket head screws (436, 438) and remove pilot cover(641).
After removing pilot cover, take out set spring(655) from pilot section.

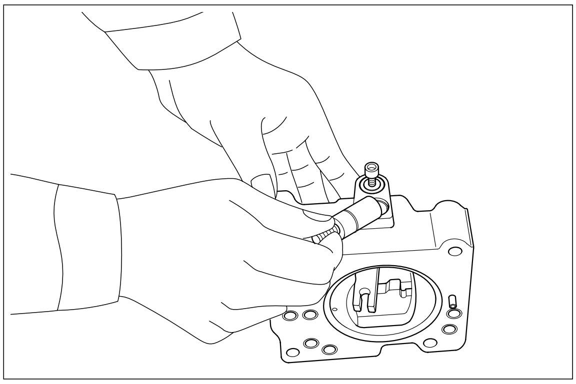


(7) Remove snap ring(814) and take out spring seat(653), return spring(654) and sleeve(651).
※ Sleeve(651) is fitted with snap ring(836).
※ When removing snap ring(814), return spring(654) may pop out.
Take care not to lose it.



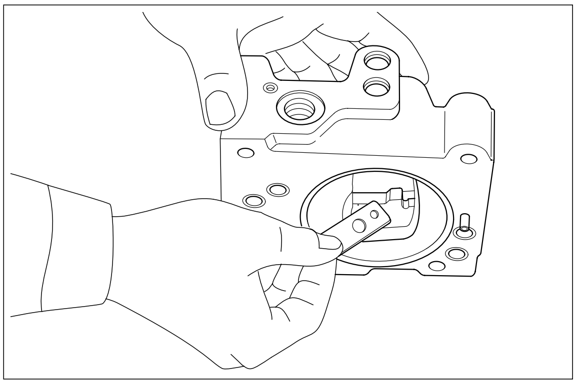
(8) Remove locking ring(858) and take out fulcrum plug(614) and adjusting plug (615).
※ Fulcrum plug(614) and adjusting plug (615) can easily be taken out with M6 bolt.





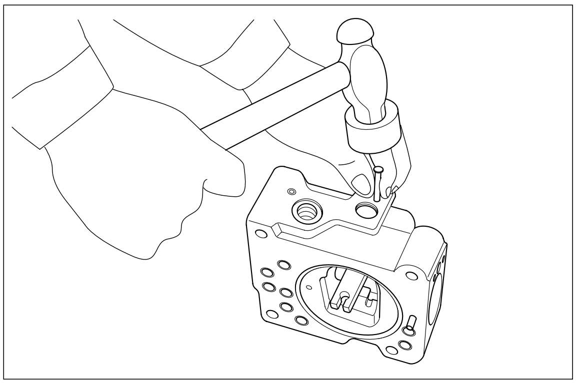
(9) Remove lever(2, 613). Do not draw out pin(875).

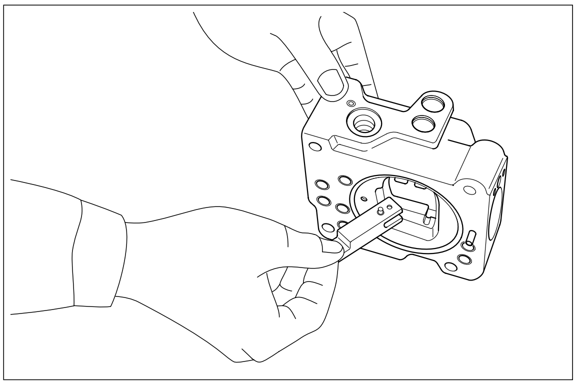
※ Work will be promoted by using pincers or so on.



(10) Draw out pin(874) and remove feedback lever(611).

Push out pin(874, 4mm 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.

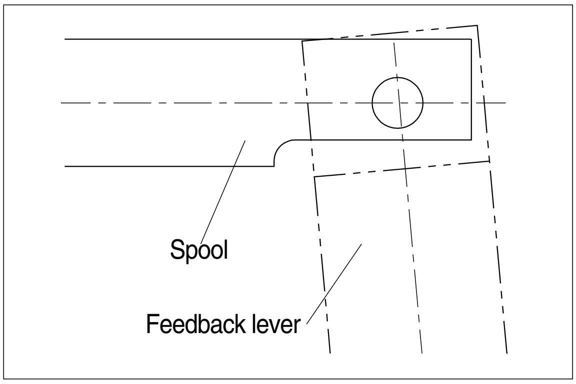
(2) Put compensating rod(623) into compensating hole of casing(601).

(3) Put pin force-fitted in lever(1, 612) into groove of compensating rod and fit lever (1) to pin force-fitted in casing.

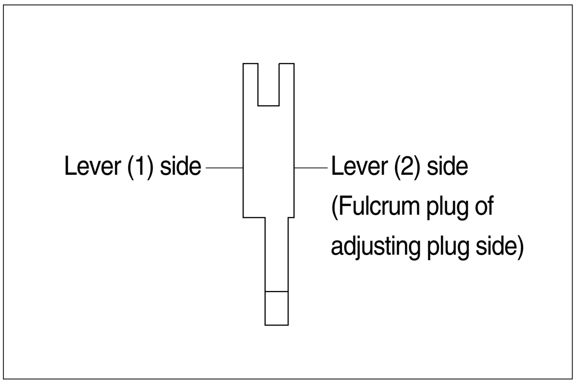
(4) Fit spool(652) and sleeve(651) into hole in spool of casing.

※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.

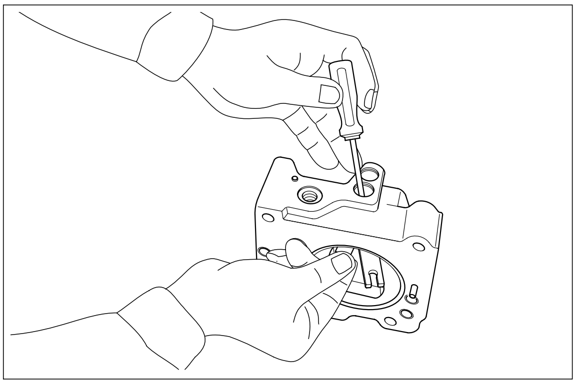


(5) Fit feedback lever(611), matching its pin hole with pin hole in spool.
Then insert pin(874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



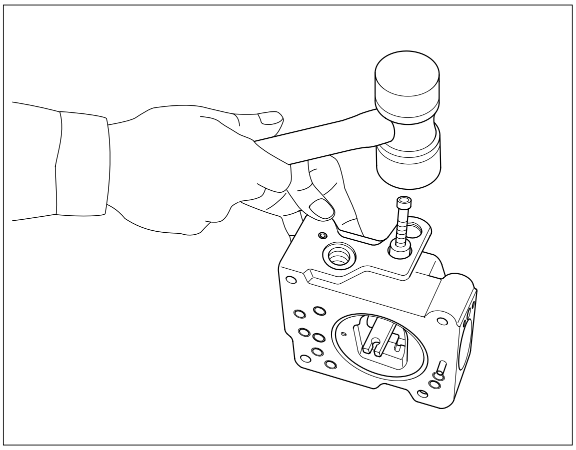
(6) Put pilot piston(643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

(7) Put pin force-fitted in lever(2, 613) into groove of pilot piston.
Then fix lever(2).

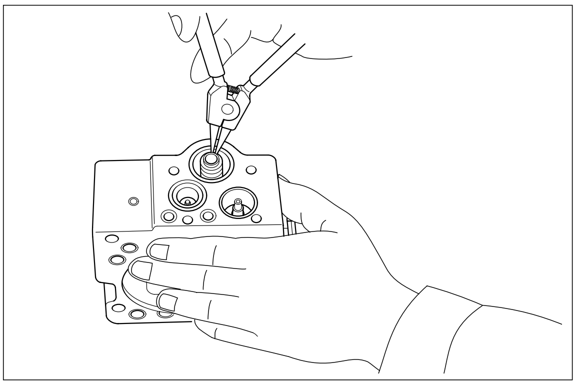


(8) Fit fulcrum plug(614) so that pin force-fitted in fulcrum plug(614) can be put into pin hole of lever(2).
Then fix locking ring(858).

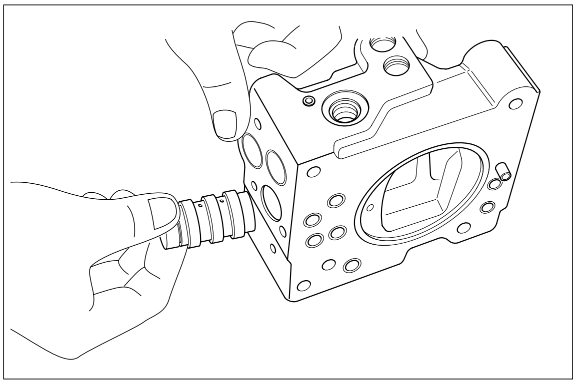
(9) Insert adjusting plug(615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.



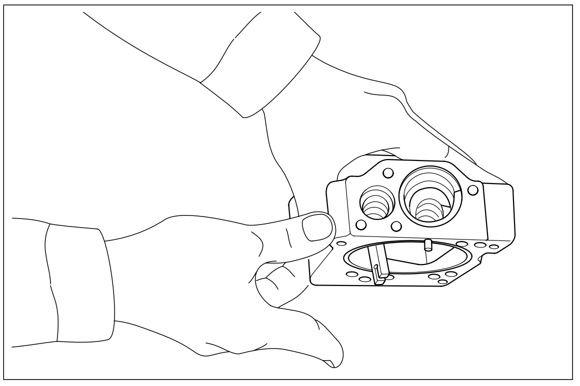
(10) Fit return spring(654) and spring seat (653) into spool hole and attach snap ring (814).



(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).

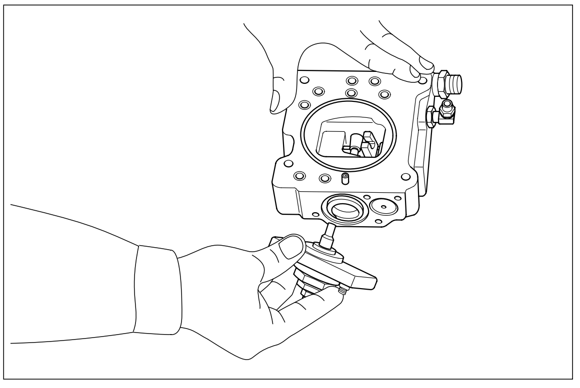


(12) Put spring seat(644), pilot spring(646) and adjusting ring(Q, 645) into pilot hole.
Then fix spring seat(624), inner spring (626) and outer spring(625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.



(13) Install cover(C, 629) fitted with adjusting screws(628, 925), 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 bolts and disconnect pipe.

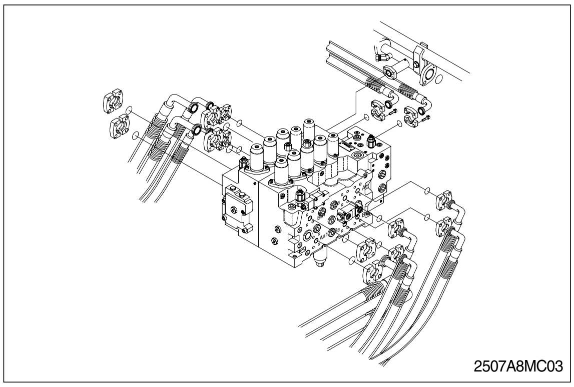
(5) Disconnect pilot line hoses.

(6) Disconnect pilot piping.

(7) Sling the control valve assembly and remove the control valve mounting bolt.
 · Weight : 80㎏(180㏈)

(8) Remove the control valve assembly.
When removing the control valve assembly, check that all the piping have been disconnected.

13031GE18



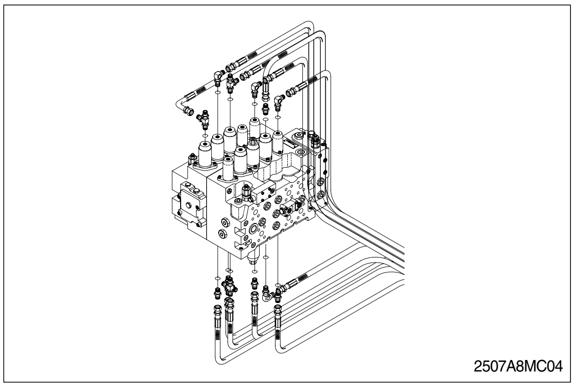
2507A8MC03

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.



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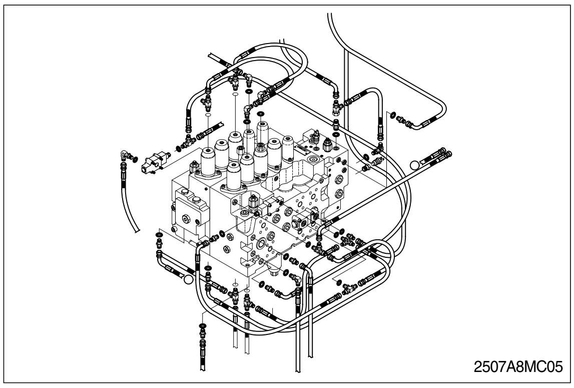

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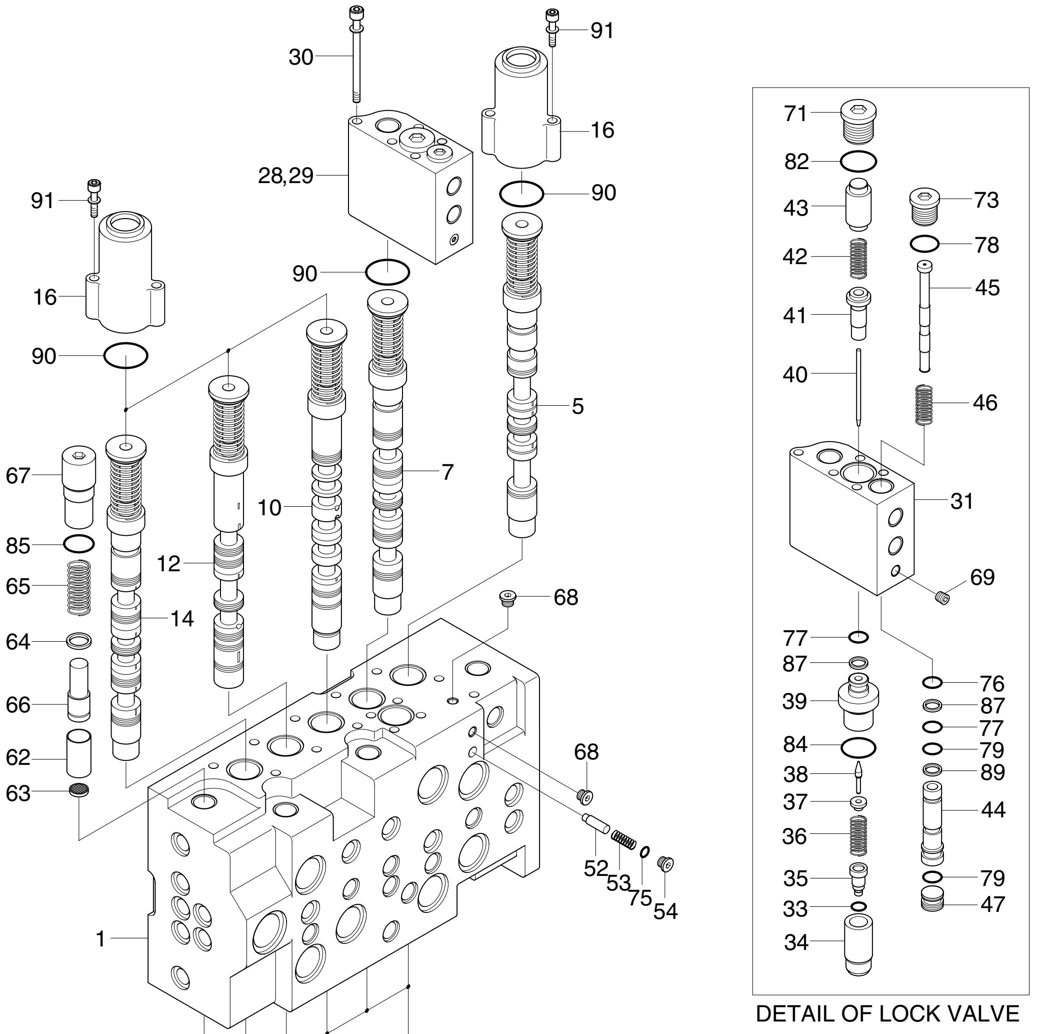
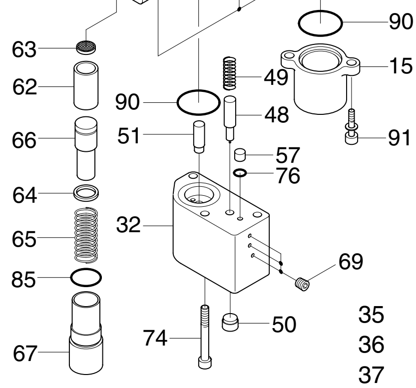
2. STRUCTURE(1/4)



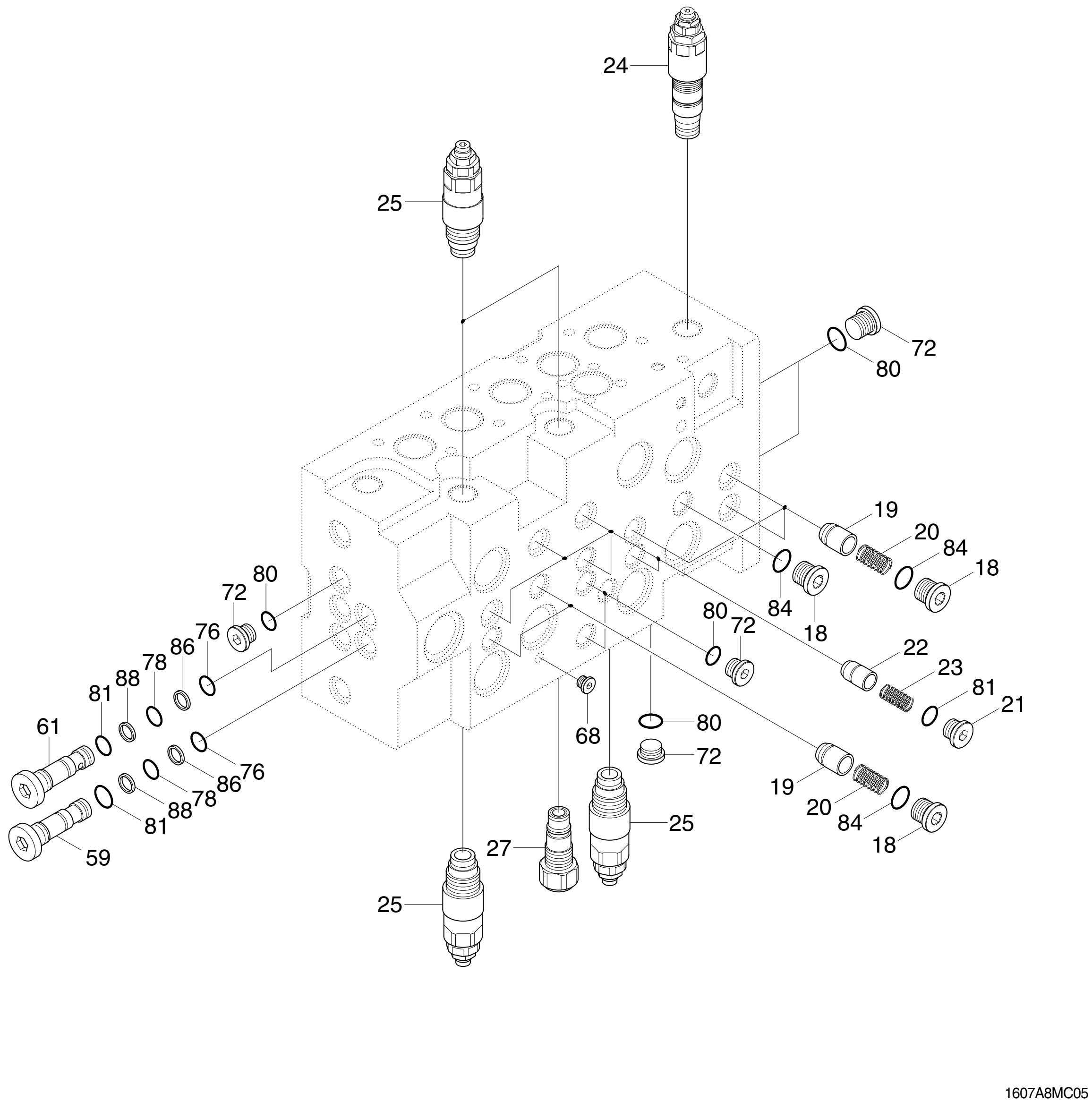
DETAIL OF LOCK VALVE

1607A8MC04



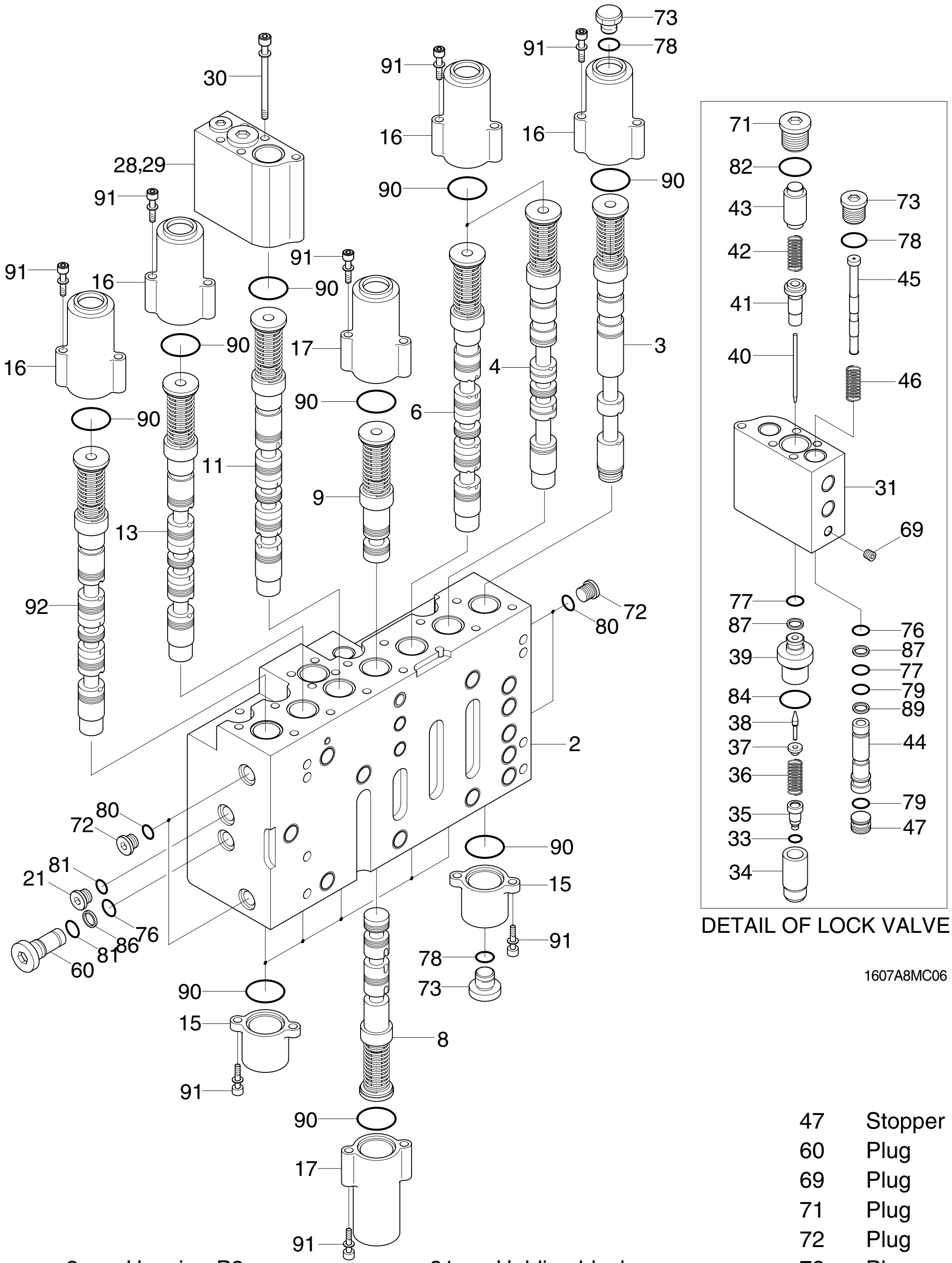
1	Housing-P1
5	Spool assy
7	Spool assy
10	Spool assy
12	Spool assy
14	Spool assy
15	Pilot cover A
16	Pilot cover B1
28	Lock valve kit A
29	Lock valve kit B
30	Socket head bolt
31	Holding block
32	Regeneration block
33	C-ring
34	Poppet
35	Restrictor
36	Spring
37	Poppet guide
38	Pilot poppet
39	Poppet seat
40	Piston 1
41	Piston guide
42	Spring 1
43	Piston 2
44	Sleeve
45	Spool
46	Spring 2
47	Stopper
48	Regeneration selector spool
49	Spring
50	Stopper
51	Piston
52	Poppet
53	Spring
54	Plug
57	Plug
62	Poppet
63	Filter
64	Spring seat
65	Spring
66	Piston
67	Socket
68	Plug
69	Plug
71	Plug
73	Plug
74	Socket head bolt
75	O-ring
76	O-ring
77	O-ring
78	O-ring
79	O-ring
82	O-ring
84	O-ring
85	O-ring
87	Back up ring
89	Back up ring
90	O-ring
91	Socket head bolt

STRUCTURE(2/4)



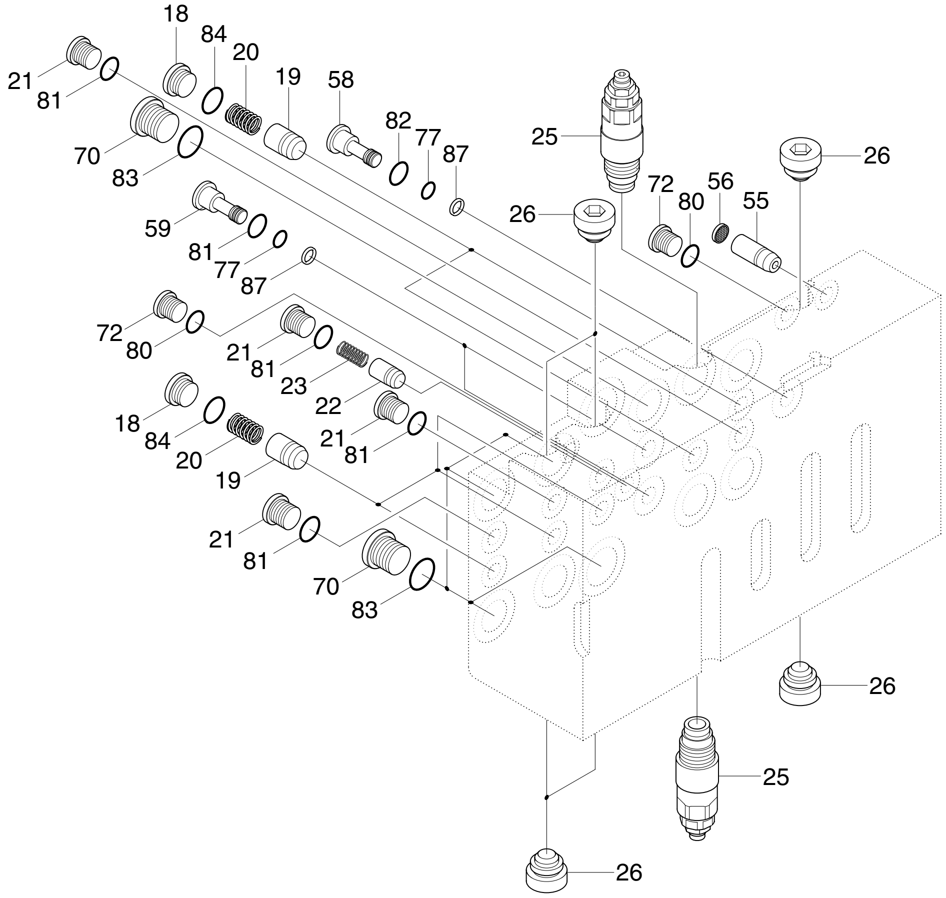
18	Plug	25	Overload relief valve	78	O-ring
19	Poppet 1	27	Plug	80	O-ring
20	Spring	59	Plug	81	O-ring
21	Plug	61	Plug	84	O-ring
22	Poppet 2	68	Plug	86	Back-up ring
23	Spring	72	Plug	88	Back-up ring
24	Main relief valve	76	O-ring		

STRUCTURE(3/4)



2	Housing-P2
3	Spool assy
4	Spool assy
6	Spool assy
8	Spool assy
9	Spool assy
11	Spool assy
13	Spool assy
15	Pilot cover A
16	Pilot cover B1
17	Lock valve kit B2
21	Plug
28	Lock valve kit A
29	Lock valve kit B
31	Holding block
34	Poppet
35	Restrictor
36	Spring
37	Poppet guide
38	Pilot poppet
39	Poppet seat
40	Piston 1
41	Piston guide
42	Spring 1
43	Piston 2
44	Sleeve
45	Spool
46	Spring 2
47	Stopper
60	Plug
69	Plug
71	Plug
72	Plug
73	Plug
74	Socket head bolt
76	O-ring
77	O-ring
78	O-ring
79	O-ring
80	O-ring
81	O-ring
82	O-ring
87	Back up ring
89	Back up ring
90	O-ring
91	Socket head bolt
92	Spool assy

STRUCTURE(4/4)



1607A8MC07

18	Plug	26	Plug	77	O-ring
19	Poppet 1	55	Orifice	80	O-ring
20	Spring	56	Coin type filter	81	O-ring
21	Plug	58	Plug	82	O-ring
22	Poppet 2	59	Plug	83	O-ring
23	Spring	70	Plug	84	O-ring
25	Overload relief valve	72	Plug	87	Back-up 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)

3) DISASSEMBLY

(1) Disassembly of spools without holding valve

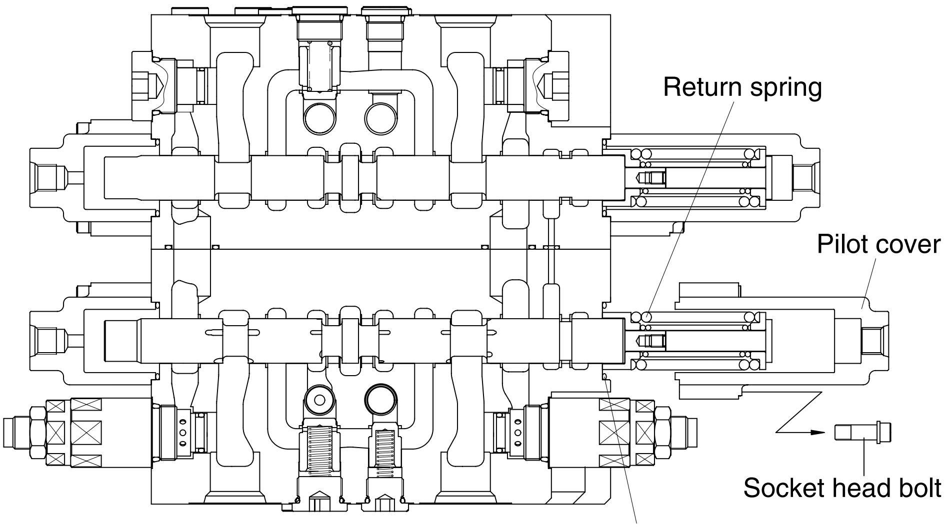
① Loosen hexagon socket head bolts with washer
(Hexagon wrench : 5㎜)

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.



1607A8MC10

(2) Disassembly of spools with holding valve(Boom 1, Arm 1 spool)

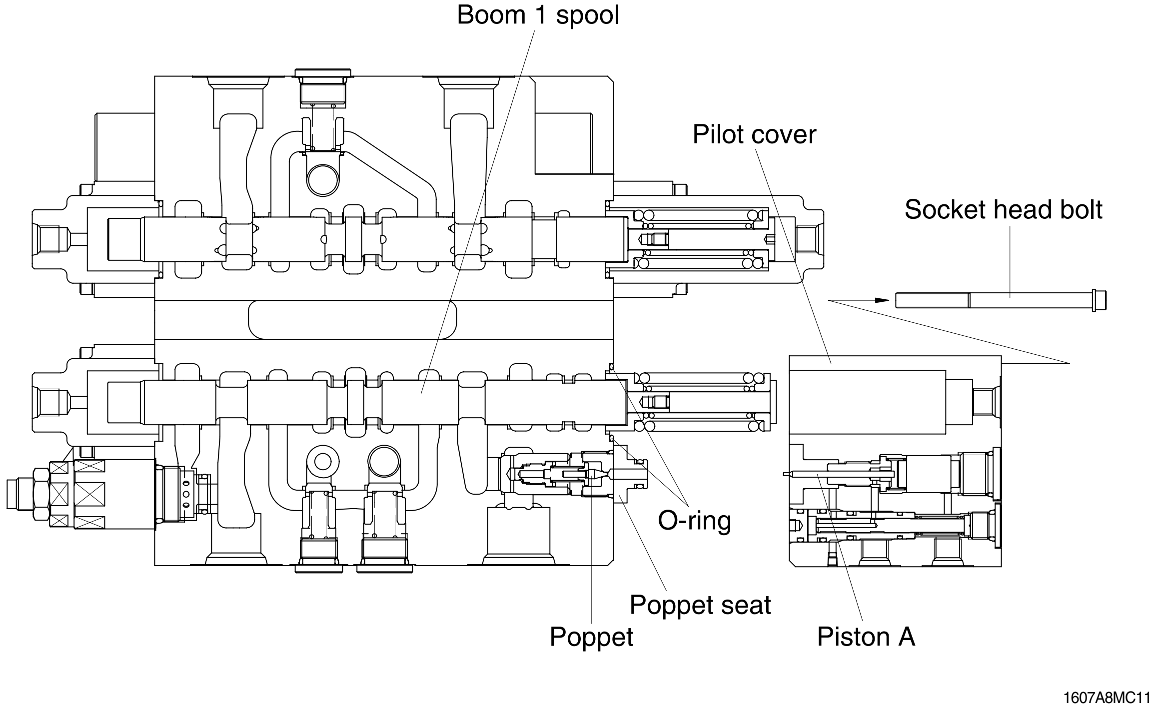
① Loosen hexagon socket head bolts with washer
(Hexagon wrench : 5㎜)

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

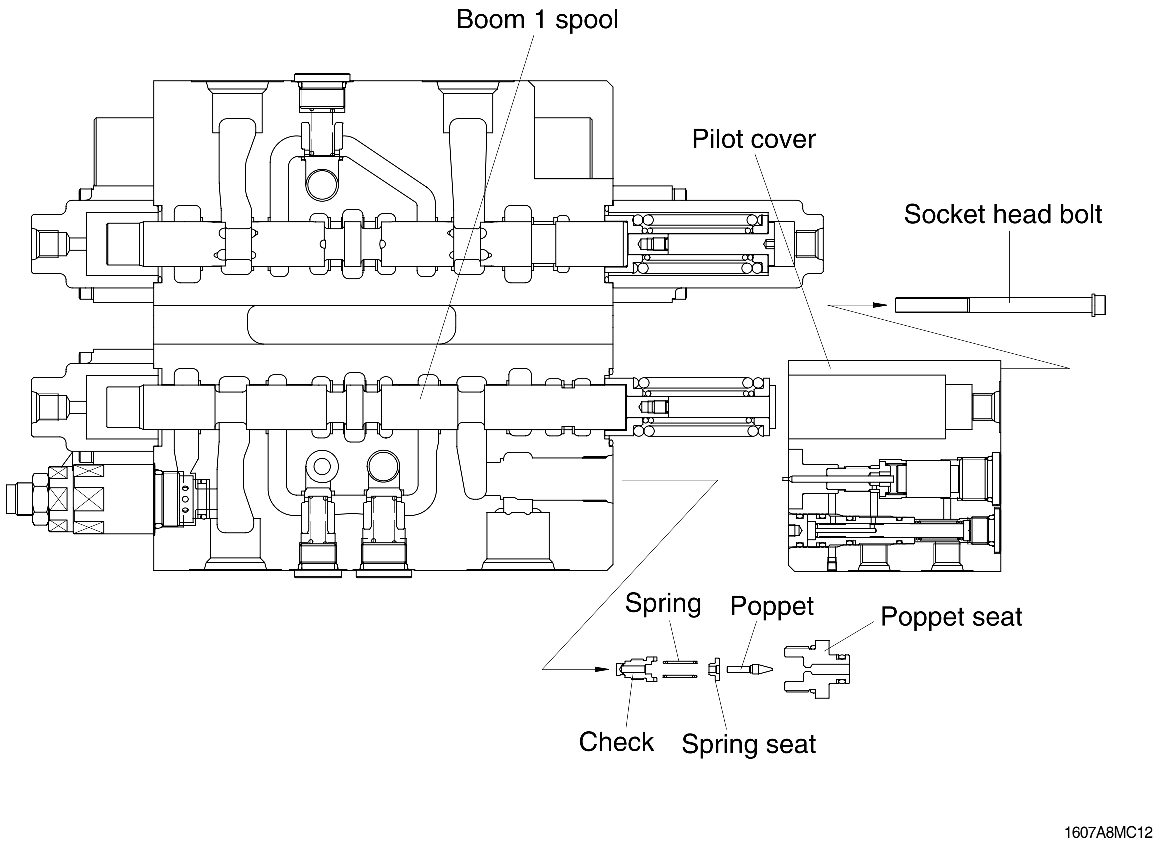
① Remove the pilot cover with the holding valve as described on previous page.

※ Do not disassembled internal parts of the pilot cover.

② Loosen the poppet seat and remove the poppet, the spring seat, the spring and the 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.

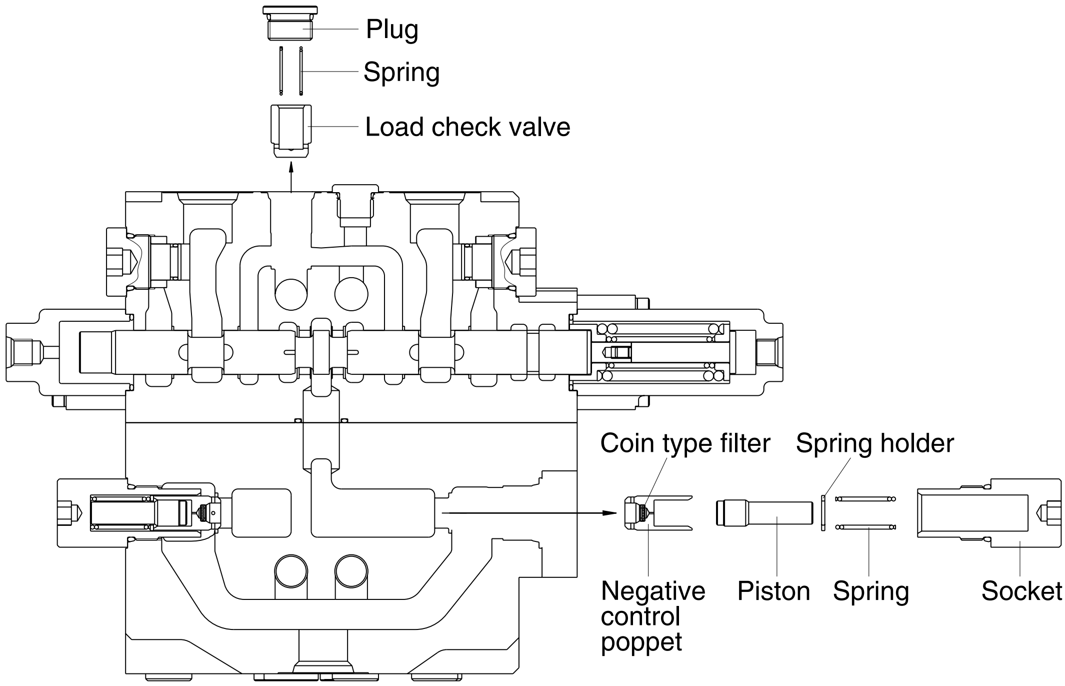
b. Loosen the plug (Hexagon wrench : 10㎜).

c. Remove the spring and the load check valve with pincers or magnet.

② **The negative relief valve**

a. Loosen the socket (Hexagon wrench : 12㎜).

b. Remove the spring, the spring holder, the piston and the negative control poppet.



1607A8MC13

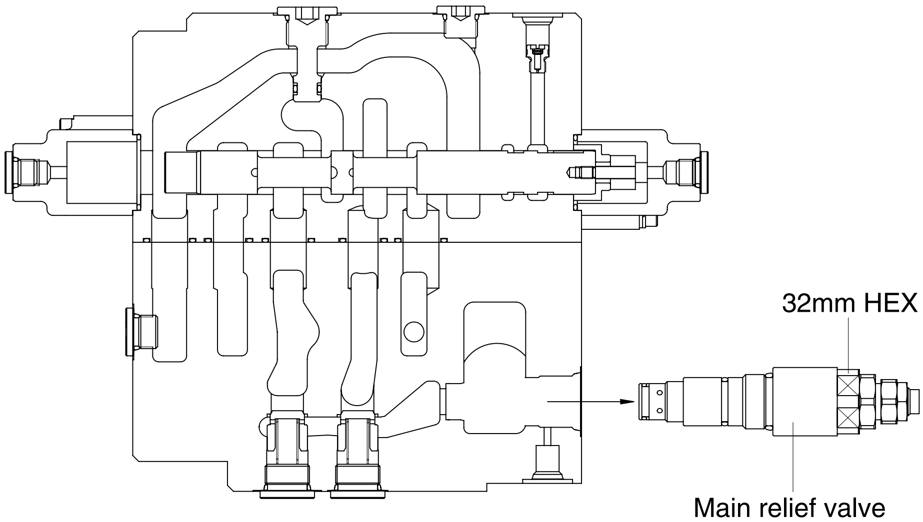
(5) Disassembly of the main and overload relief valve

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.



1607A8MC14

(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.
④ Do not stretch seals so much as to deform them permanently.
⑤ In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted 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 : 10mm
· Tightening torque : 6~7kgf · m(43.4~50.6lbf · 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 : 12mm
· Tightening torque : 8~9kgf · m(57.8~65.1lbf · ft)

(4) Main relief, port 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 32mm	8~9	57.8~65.1
Overload relief valve	Spanner 32mm	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) 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 : 5mm
 · Tightening torque : 1.0~1.1kgf · m(7.2~7.9lbf · 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 : 1.0~1.1kgf · m(7.2~7.9lbf · 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 : 26mm
 · Tightening torque : 6~7kgf · m(43.4~50.6lbf · 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 : 1.0~1.1kgf · m(7.2~7.9lbf · 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.

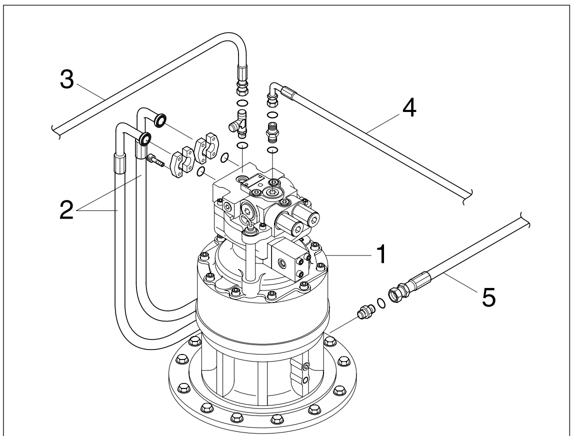
13031GE18

(4) Disconnect hose assembly (2).

(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 9).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (10).

· Motor device weight : 32kg (71lb)



14W98SM01

(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.

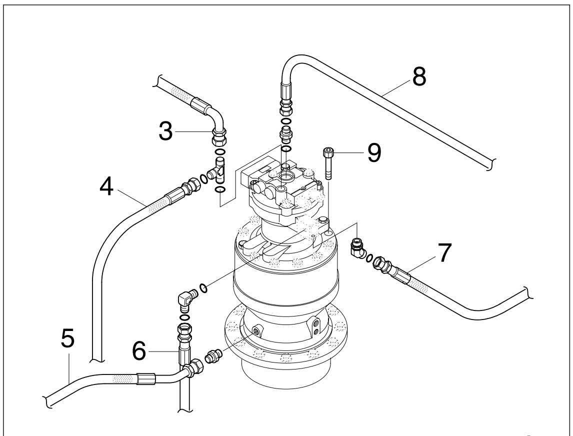
① Remove the air vent plug.

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.



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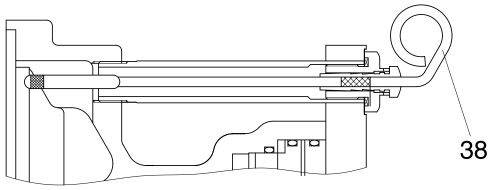
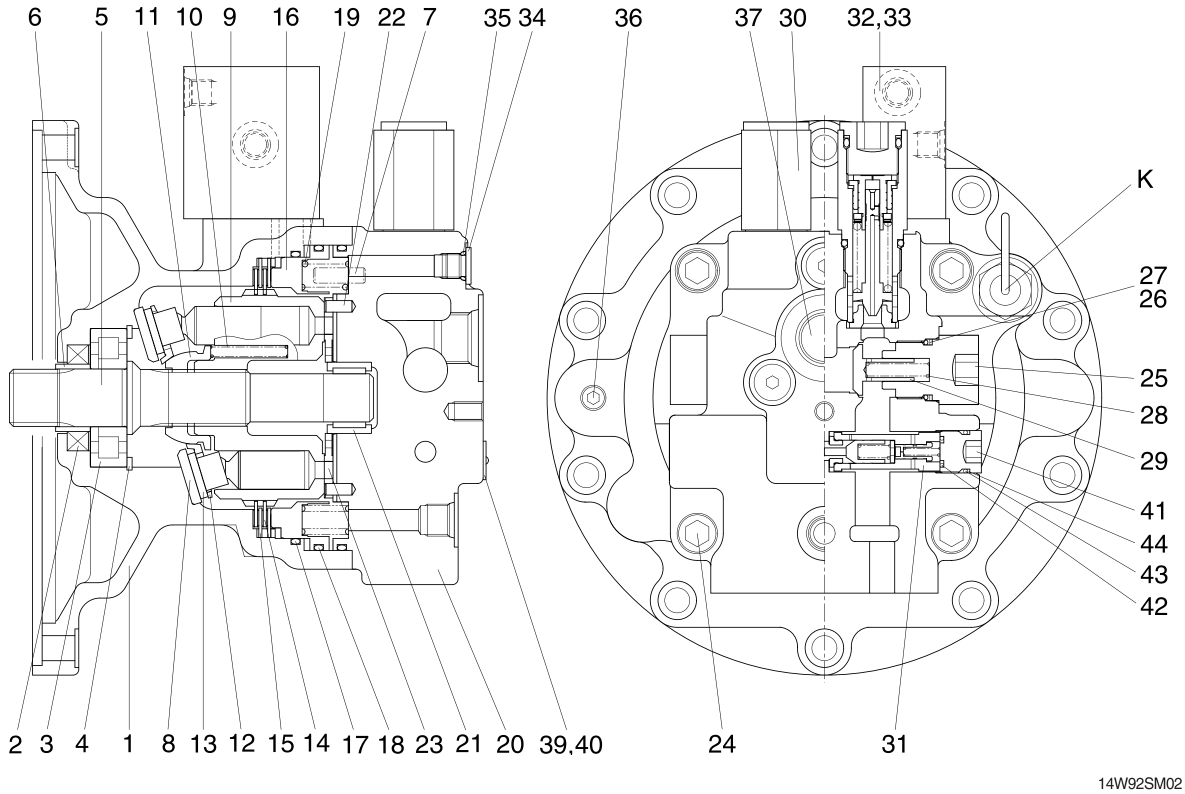
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



DETAIL K

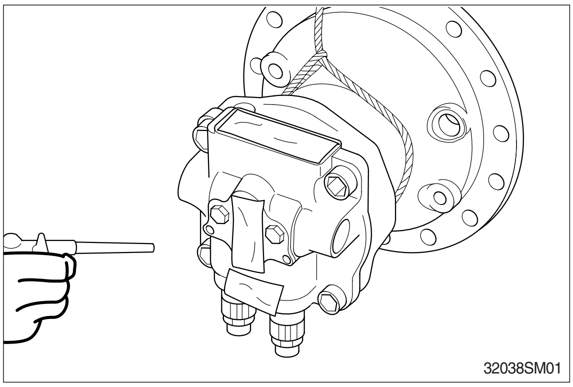


1 Body
2 Oil seal
3 Roller bearing
4 Snap ring
5 Drive shaft
6 Bushing
7 Pin
8 Shoe plate
9 Cylinder block
10 Spring
11 Ball guide
12 Set plate
13 Piston assembly
14 Friction plate
15 Separate plate
16 Brake piston
17 O-ring
18 O-ring
19 Brake spring
20 Rear cover
21 Needle bearing
22 Pin
23 Valve plate
24 Wrench bolt
25 Plug
26 Back up ring
27 O-ring
28 Spring
29 Check
30 Relief valve
31 Anti-rotating valve
32 Time delay valve
33 Wrench bolt
34 Plug
35 O-ring
36 Plug
37 Plug
38 Level gauge
40 Rivet
41 Plug
42 O-ring
43 O-ring
44 Back up ring

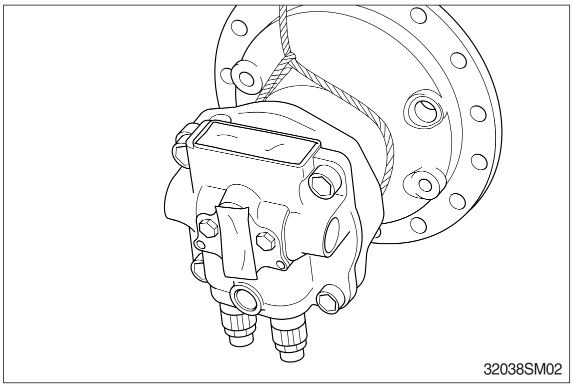
2) DISASSEMBLY

(1) Lift the motor out. Clean the motor in kerosene and dry with compressed air.

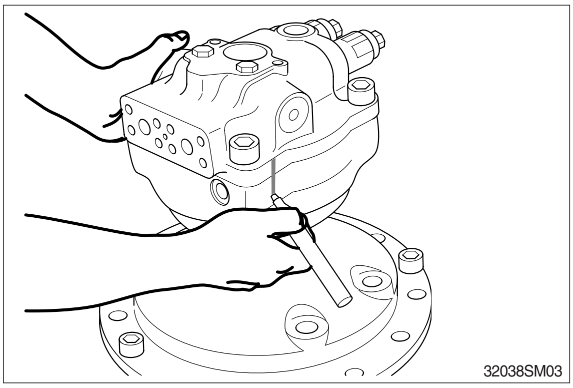
※ To avoid dust inside the motor, mask all the ports of the motor with tapes.



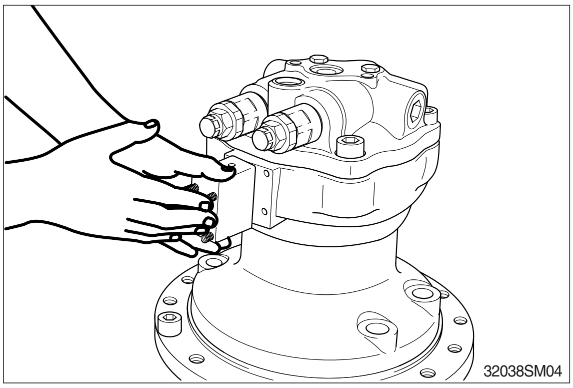
(2) Loosen the drain plug to discharge oil in the body(1).



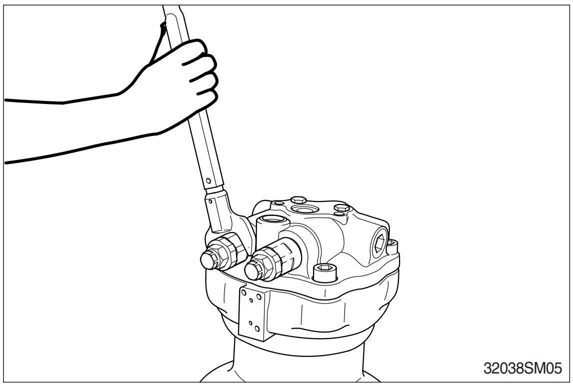
(3) Fix the drive shaft (5) on the workbench with the end of output shaft down. Put matching marks on body (1) and valve rear cover (20) for easy reassembly.



(4) Remove the valve (32).



(5) Remove the relief valve (30) from rear cover (20).



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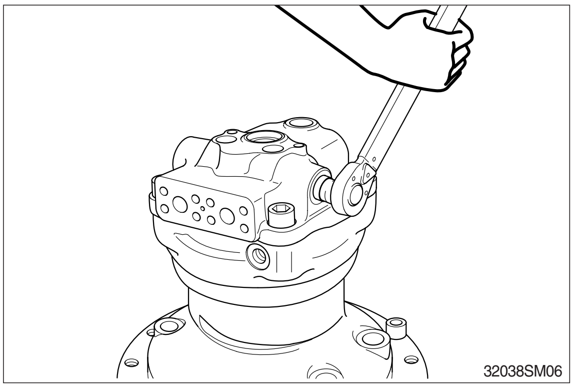
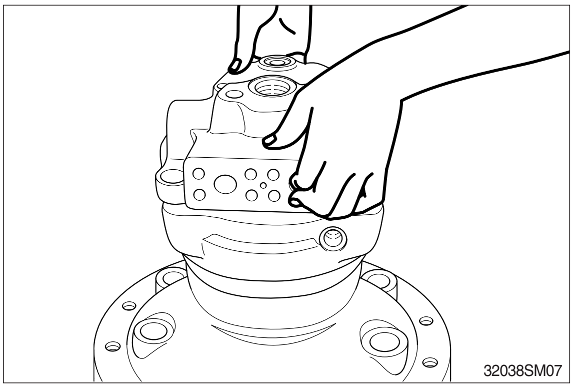
(6) Remove plug (25) from rear cover (20) and spring (28), check (29).

※ Be careful not to damage the check seat assembly.



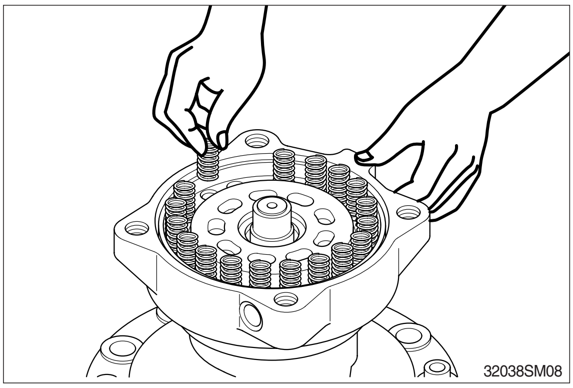
32038SM06

(7) Remove rear cover (20) from body (1). Then, remove the valve plate (23) from rear cover (20) with care.



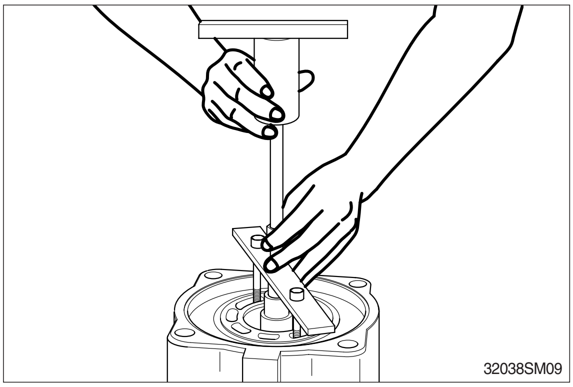
32038SM07

(8) Remove the brake spring (19) from brake piston (16).

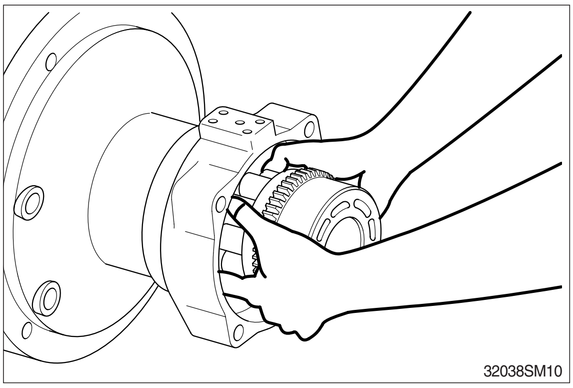


32038SM08

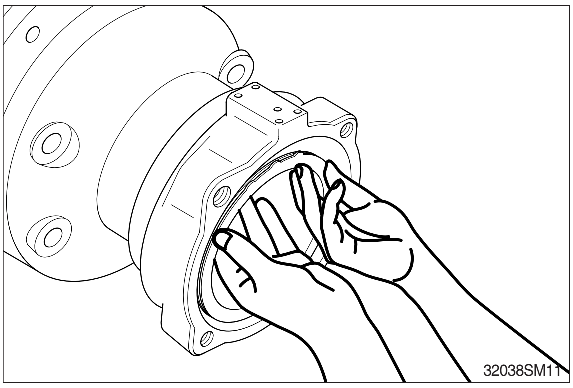
(9) Remove brake piston (16) from body (1).


32038SM09

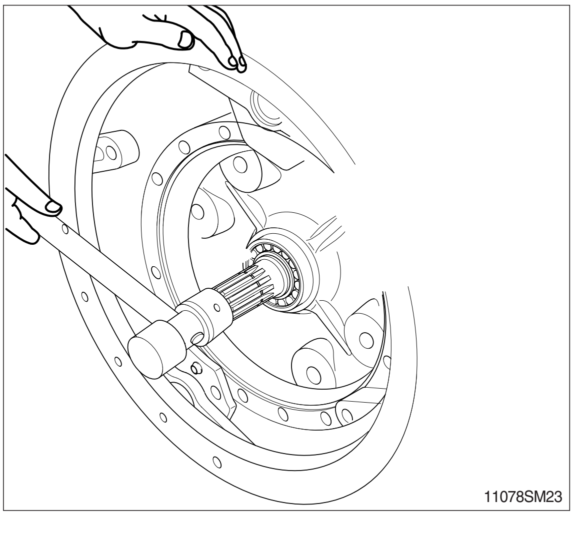
(10) Remove the cylinder (9) from the drive shaft (5) with the motor positioned horizontally. Remove ball guide (11), set plate (12), piston (13) and shoe plate (8).


32038SM10

(11) Remove friction plate (14) and separate plate (15) from body (1).

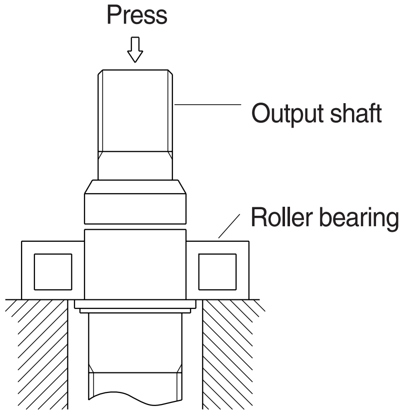

32038SM11

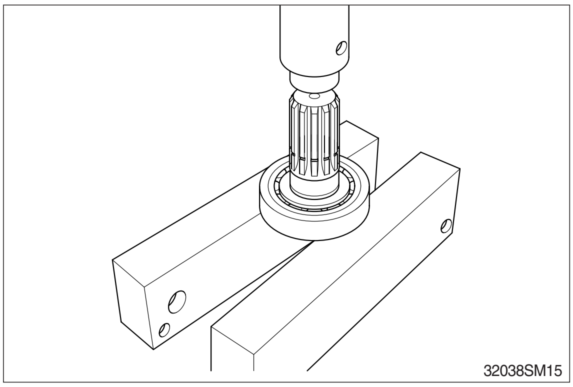
(12) Remove snap ring (4) and remove drive shaft (5) from body (1).


11078SM23

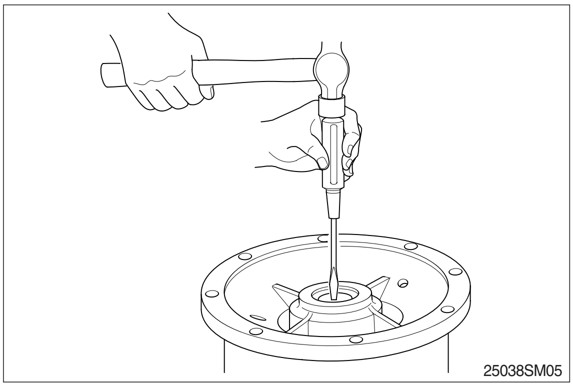
(13) Remove the cone of roller bearing (3) by press.

※ Do not reuse bearings.

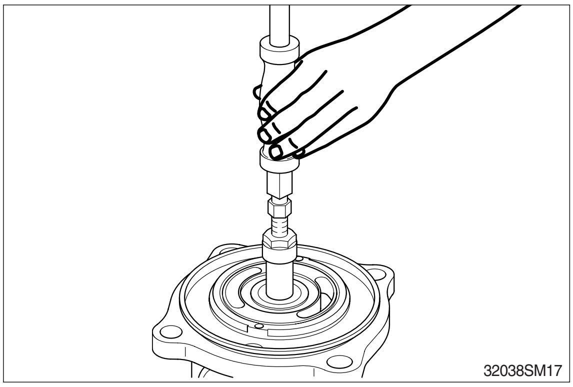




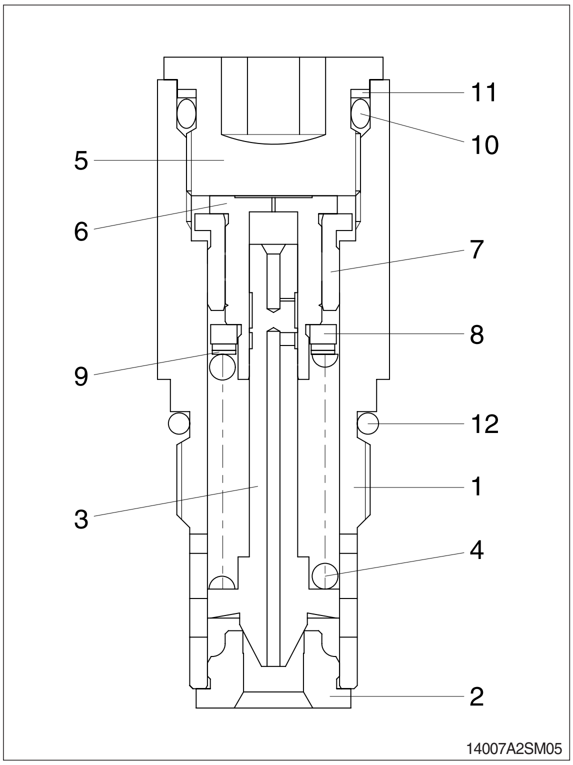
(14) Remove bushing (6) and oil seal (2) from body (1).



(15) Remove the needle bearing (21) from the rear cover (20) by using slide hammer bearing puller.



(16) When disassembling the relief valve, release the adjusting screw (5).
Remove the piston (6), spring seat (8), spring (4) and plunger (3) with the body (1) downwards.

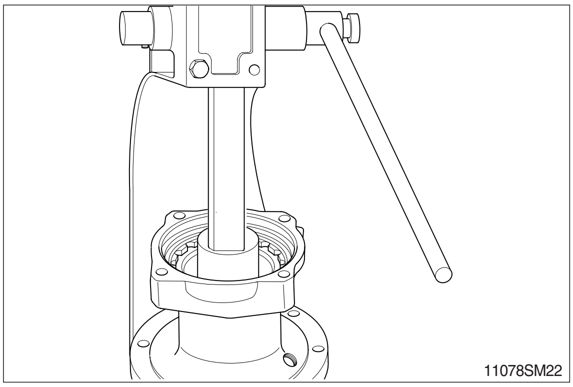


This completes disassembly.

3) ASSEMBLY

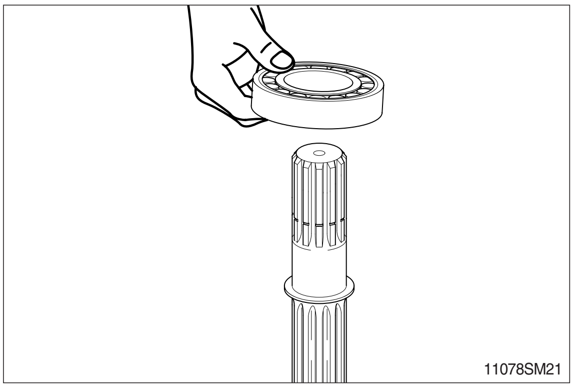
Do the reassembly in the reverse procedure of the disassembly.

(1) Apply three bond of white color on outer surface of oil seal (2) and insert it to the body (1).



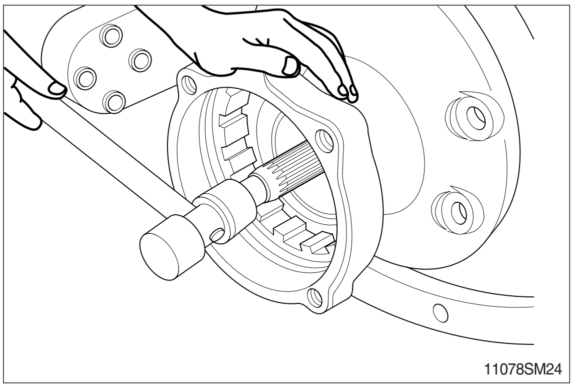
11078SM22

(2) Install the roller bearing (3) to the drive shaft (5).



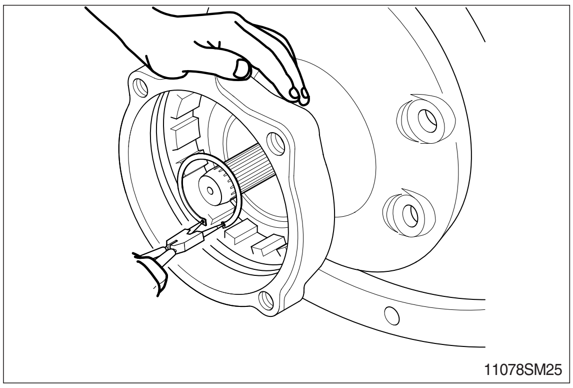
11078SM21

(3) Insert the drive shaft (5) into the body (1) with the plastic hammer lightly.



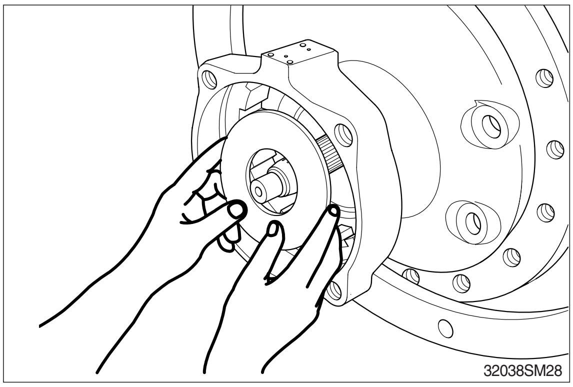
11078SM24

(4) Install the snap ring (4) to the body (1).



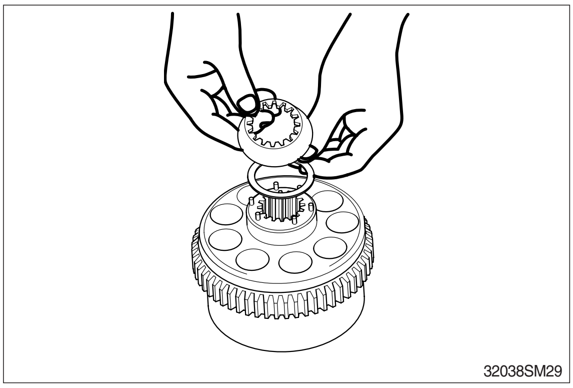
11078SM25

(5) Insert the shoe plate (8) with the body (1) position horizontally.



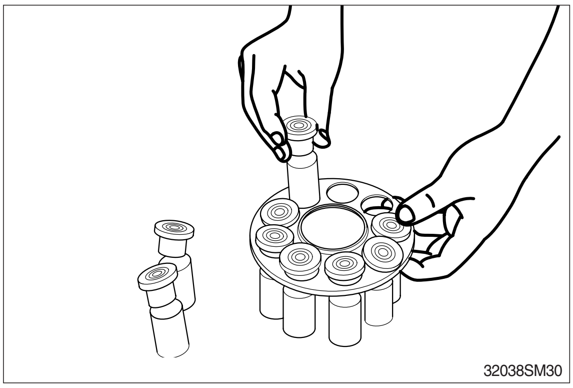
32038SM28

(6) Insert the ball guide (11) into the cylinder (9).



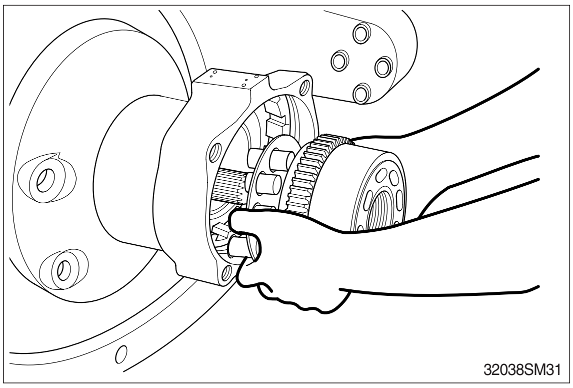
32038SM29

(7) Install the piston sub-assembly (13) to the set plate (12).



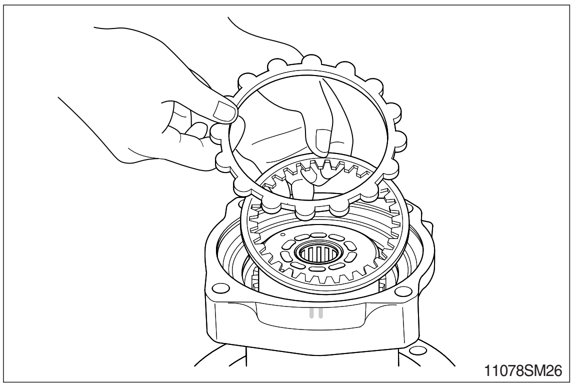
32038SM30

(8) Reassemble the piston assembly (9) to the body (1).



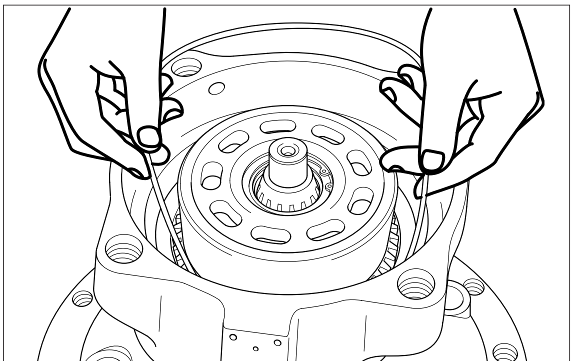
32038SM31

(9) Assembly friction plate (14) and separate plate (15) to the body (1).



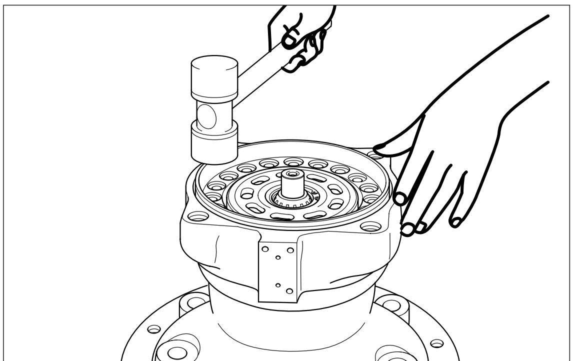
11078SM26

(10) Insert O-ring (17) inside the body (1).



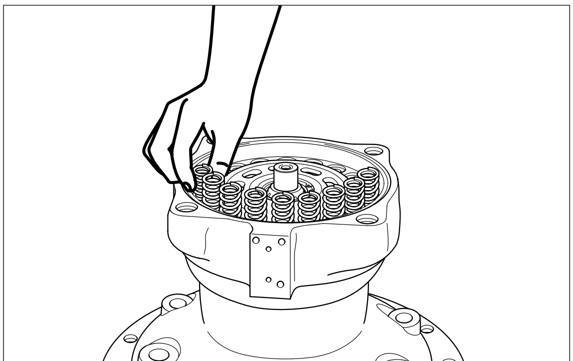
32038SM33

(11) Reassemble brake piston (16) to the body (1).



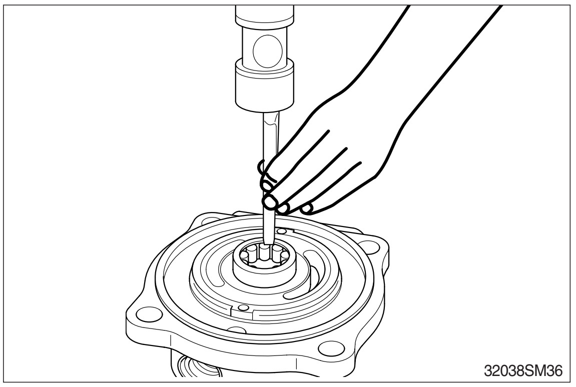
32038SM34

(12) Reassemble brake spring (19) to the brake piston (16).

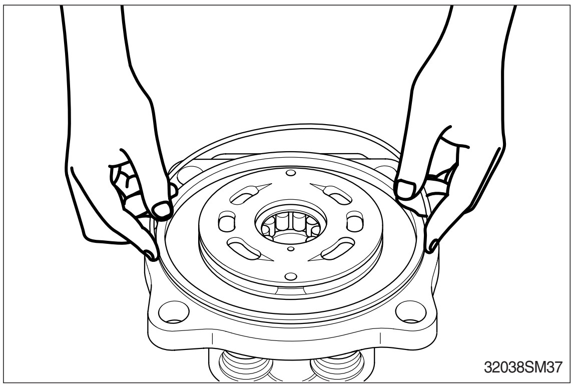


32038SM35

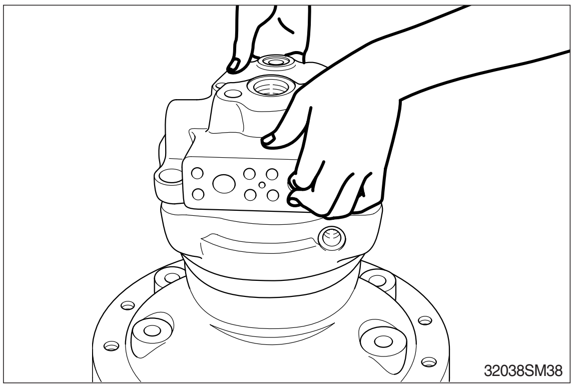
(13) When assembling the needle bearing (21), insert the needle bearing (21) into rear cover (20) by hammering.



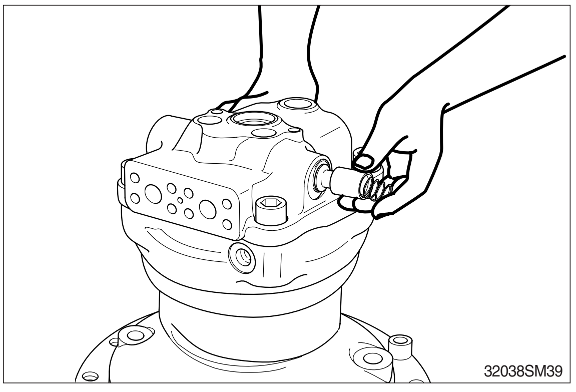
(14) Reassemble valve plate (23) to the rear cover (20) and reassemble O-ring (18).



(15) Connect the rear cover (20) with the body (1) and tighten the wrench bolt (24).

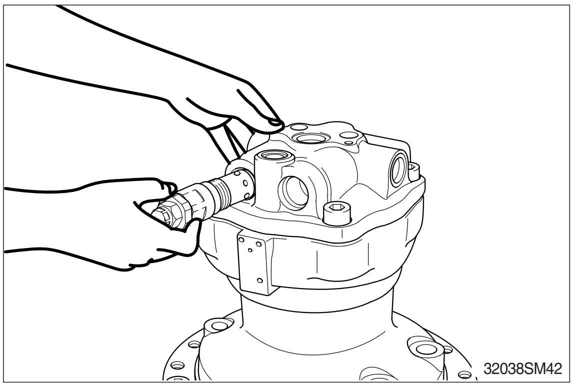


(16) Insert check (29) and spring (28) in the valve casing and install O-ring (27) and back up ring (26). Tighten plug (25) to the rear cover (20).



(17) Insert O-rings to the relief valve (30) and reassemble them to rear cover (20).

This completes assembly.


32038SM42

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

(1) Remove the swing motor assembly.
For details, see removal of swing motor assembly.

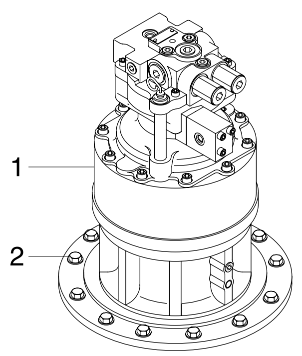
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 60 kg (132 lb)

13031GE18

2) INSTALL

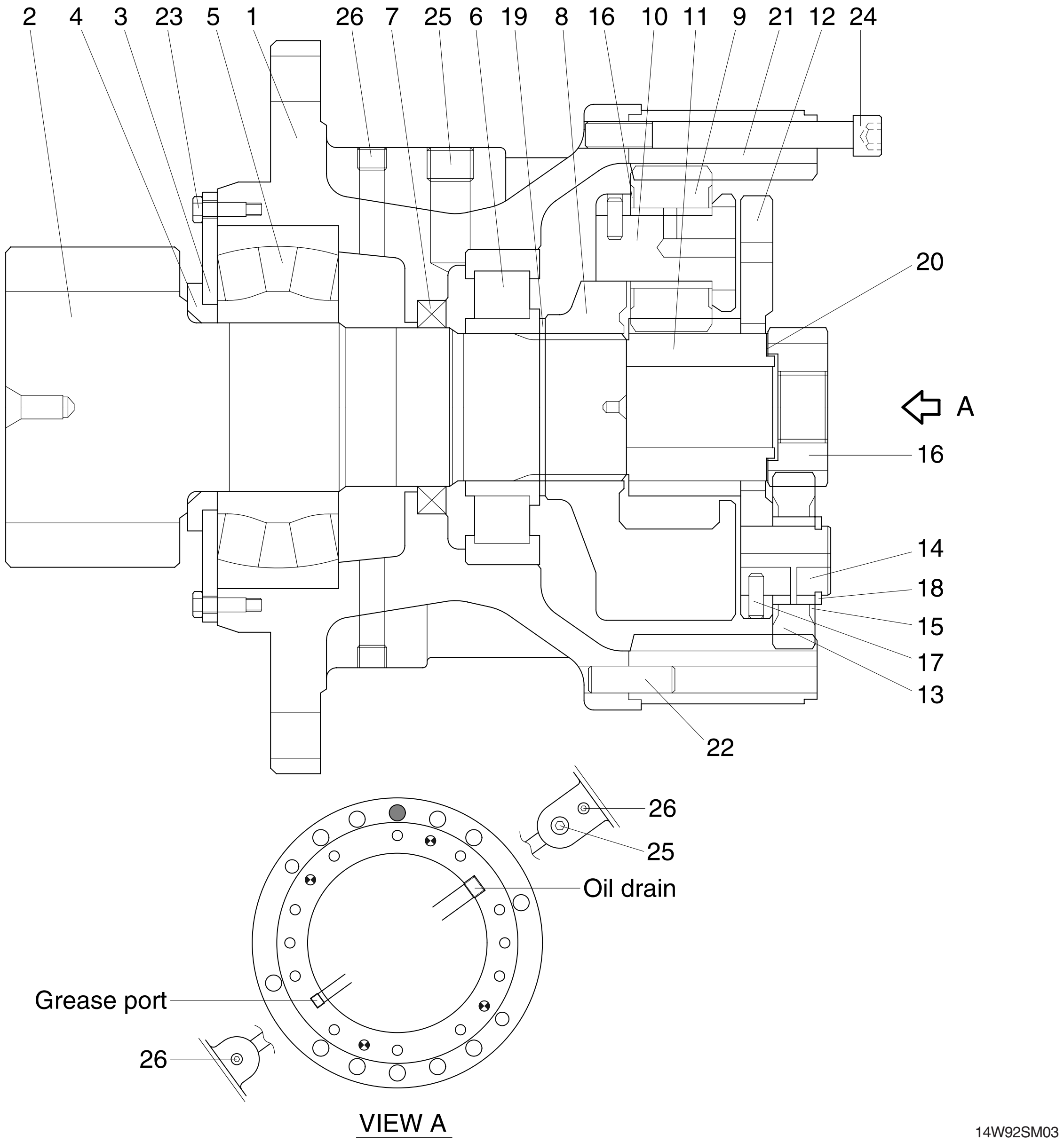
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 29.6±3.2 kgf · m (214±23.1 lbf · ft)



14W98SM03

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE

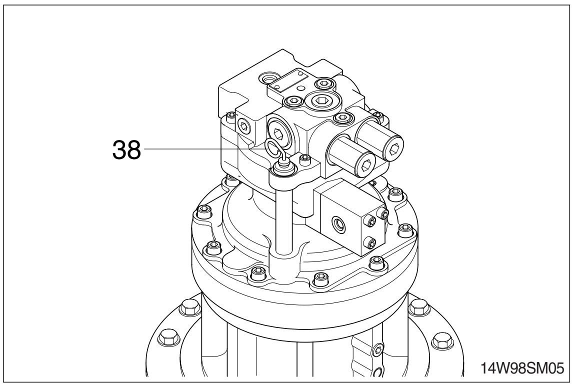


1	Casing	10	Pin No.2 assembly	19	Stop ring
2	Drive shaft	11	Sun gear No. 2	20	Side plate No. 1
3	Cover plate	12	Carrier No. 1	21	Ring gear
4	Spacer	13	Planet gear No. 1	22	Knock pin
5	Roller bearing	14	Pin No.1	23	Hexagonal bolt
6	Roller bearing	15	Thrust washer (B)	24	Socket head bolt
7	Oil seal	16	Sun gear No. 1	25	Plug
8	Carrier No. 2	17	Spring pin	26	Plug
9	Planet gear No. 2	18	Stop ring		

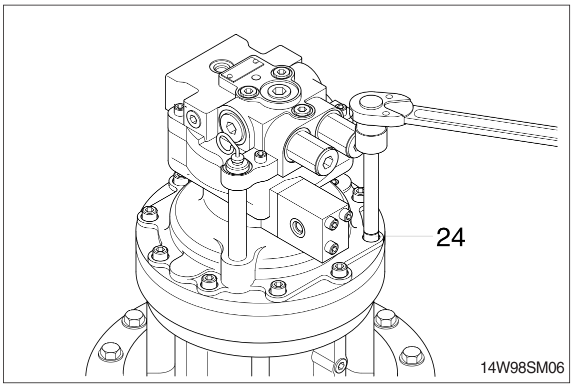
2) DISASSEMBLY

(1) Remove level gauge (38) from the swing motor casing.

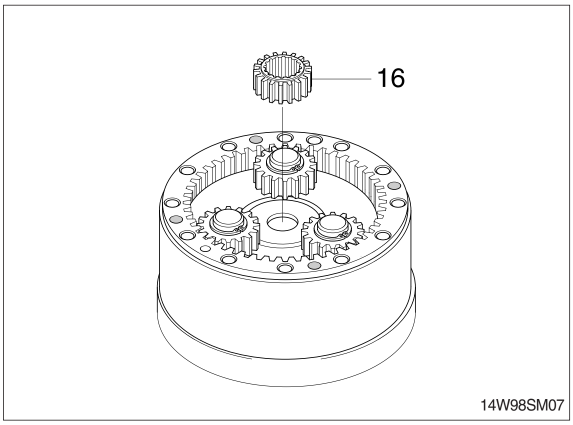
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



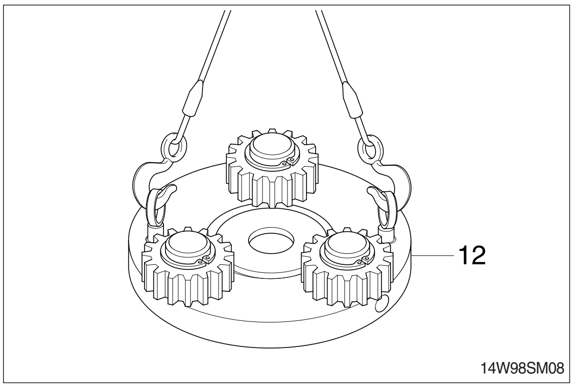
(2) Loosen the socket bolts (24) to separate swing motor from reduction gear.



(3) Remove sun gear 1 (16).



(4) Tighten two M10 eye bolts to carrier 1 (12) and lift up and remove carrier 1 (12) as subassembly.



(5) Disassembling carrier 1 (12) assembly.

① Remove stop ring (18).

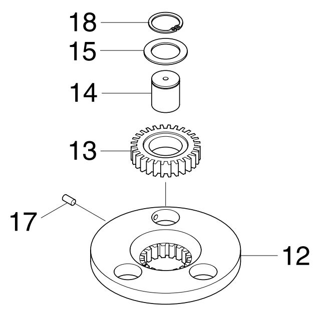
② Remove thrust washer (15) and planet gear 1(13) from the carrier 1 (12).

③ Using M8 solid drill, crush spring pin (17) so that the pin 1 (14) can be removed by hammering.

※ Do not reuse spring pin (17).

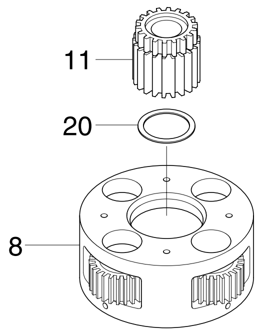
※ Do not remove pin 1 (14), carrier 1 (12) and spring pin (17) but in case of replacement.

※ Put matching marks on the planet gear 1 (13) and the pin 1 (14) for easy reassembly.



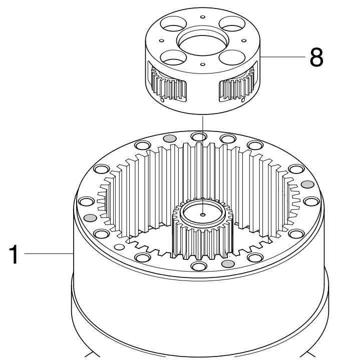
14W98SM09

(6) Remove sun gear 2 (11) and side plate 1 (20) from carrier 2 (8).



14W98SM10

(7) Remove carrier 2 (8) assembly from casing (1).



14W98SM11

(8) Disassembling carrier 2 (8) assembly.

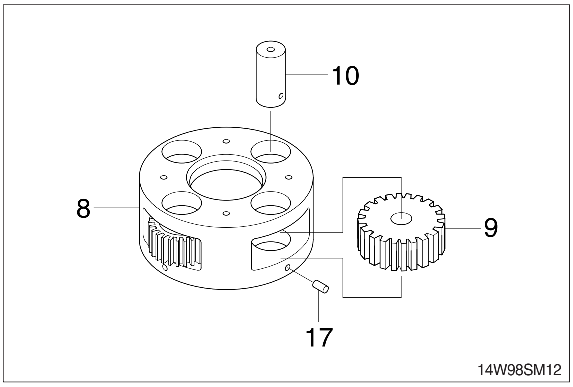
① Using M8 solid drill, crush spring pin (17) so that the pin 2 (10) can be removed.

※ Do not reuse spring pin (17).

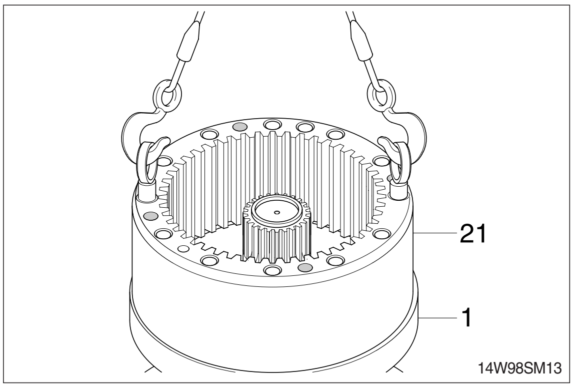
② Remove pin 2 (10) and planet gear 2 (9) from the carrier 2 (8).

※ Put matching marks on the planet gear 2 (9) and the pin 2 (17) for easy reassembly.

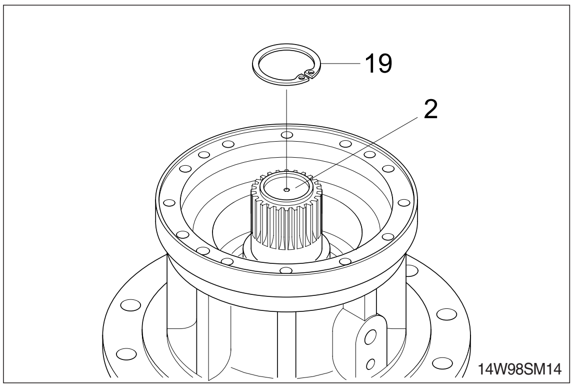
※ Do not disassemble pin 2 (10), carrier 2 (8) and spring pin (17) but in case of replacement.



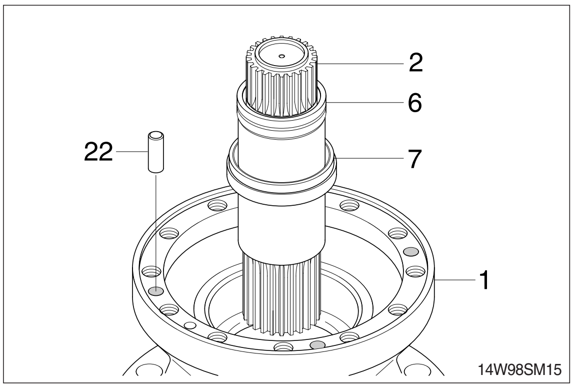
(9) Tighten two M16 eyebolt to the ring gear (21) and then lift the ring gear (21) out of casing (1).



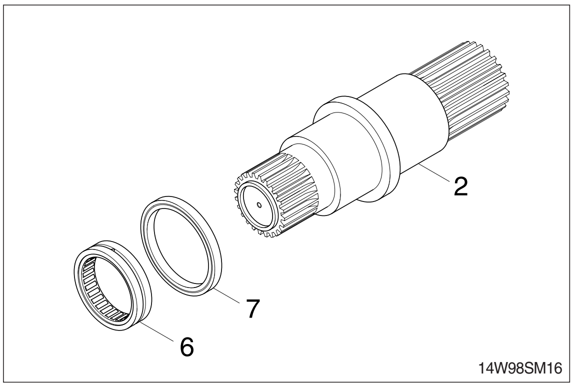
(10) Remove stop ring (19) from the drive shaft (2).



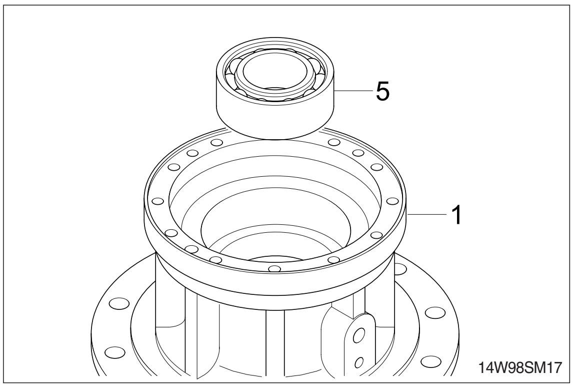
(11) Remove drive shaft (2) with roller bearing (6) and oil seal (7) assembled.
Remove knock pin (22) from the casing (1).



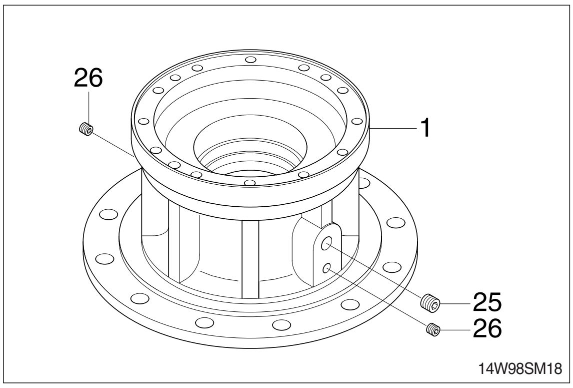
(12) Remove roller bearing (6) and oil seal (7) from the drive shaft (2).
※ Do not reuse oil seal (20) once removed.



(13) Using the bearing disassembly tool, remove roller bearing (5).

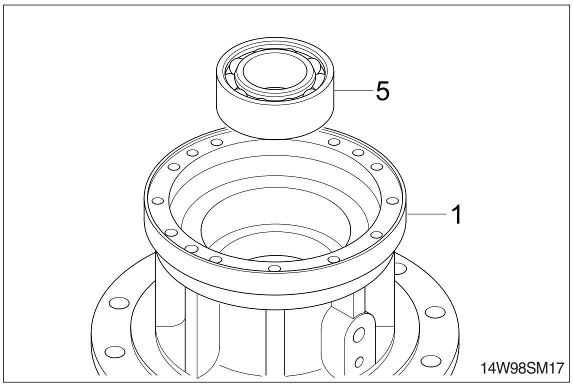


(14) Remove plugs (25, 26) from the casing (1).

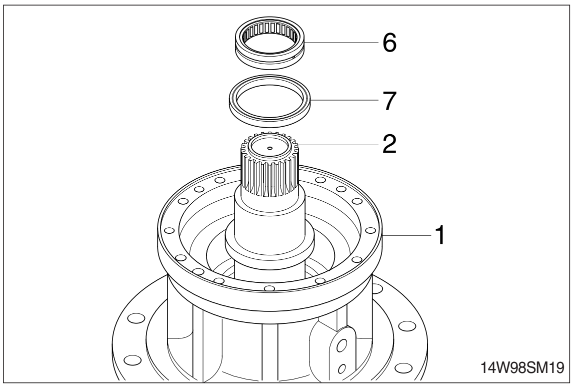


3) ASSEMBLY

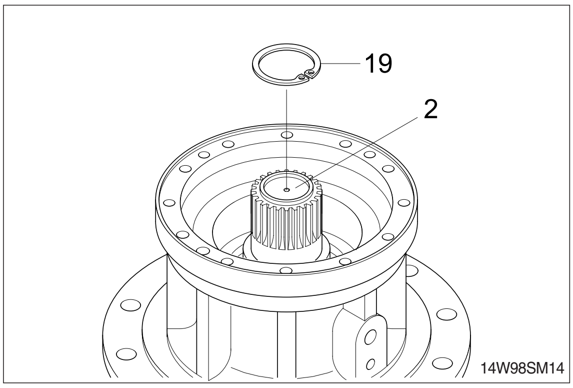
(1) Assemble roller bearing (5) inside the casing (1).



(2) Assemble the drive shaft (2) into the casing (1) and then install oil seal (7) and roller bearing (6).



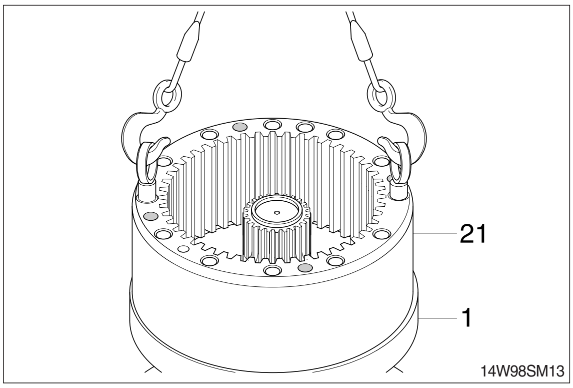
(3) Install stop ring (19) on top of drive shaft (2).



(4) Apply loctite to the tapped holes of casing (1).

(5) Tighten 2 M16 eye bolts to the ring gear (21) and lift up and then assemble it onto the casing (1).

※ Don't fail to coincide the knock pin (22) holes.



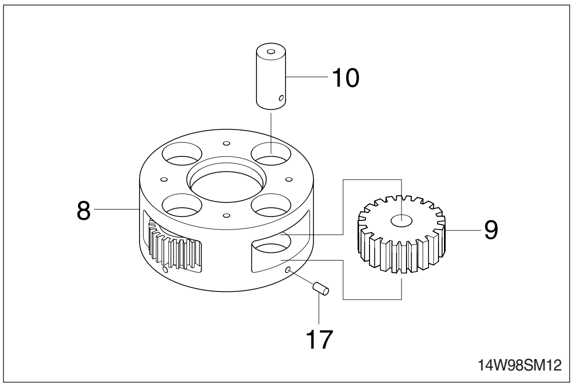
(6) Assembling carrier 2 (8) assembly.

① Install the planet gear 2 (9) inside the carrier 2 (8).

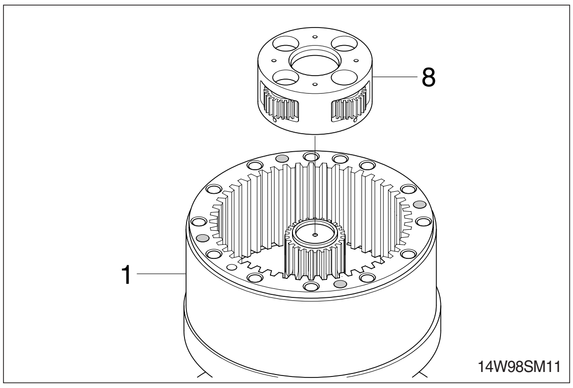
② Assemble the pin 2 (10) to the carrier 2 (8) and then press the spring pin (17) by hammering.

③ Punch 2 points of the spring pin (17) lip.

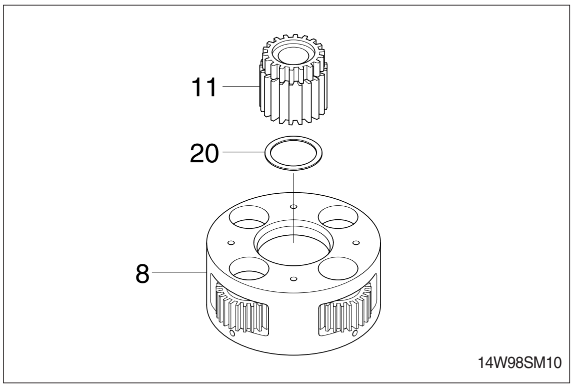
※ Take care not to mistake the matching marks of each part.



(7) Assemble carrier 2 (8) assembly correctly to the casing (1).



(8) Assemble sun gear 2 (11) and side plate 1 (20) to the center of the carrier 2 (8) assembly.



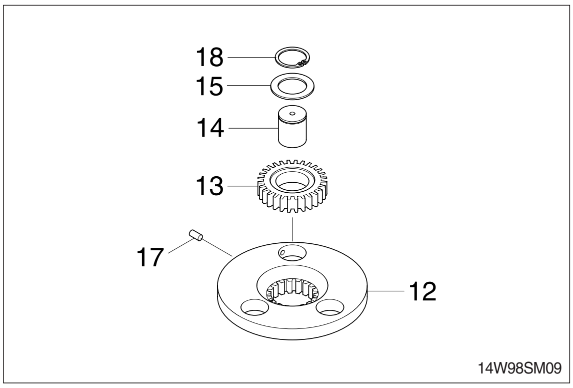
(9) Assembling carrier 1 (12) assembly.

① Assemble the pin1 (14) to the carrier 1 (12) and then press the spring pin (17) by hammering.

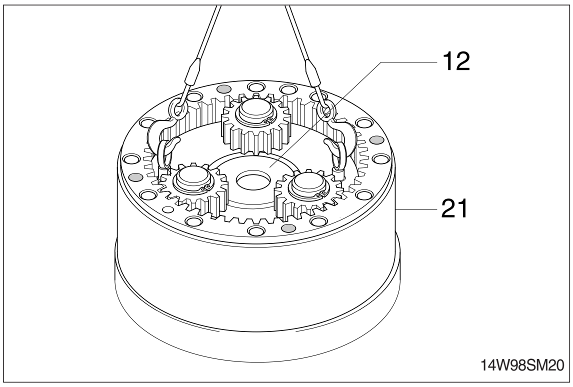
② Punch 2 points of the spring pin's (17) lip.

③ Assemble thrust washer (15), planet gear 1 (13), and then stop ring (18) to the pin 1 (11).

※ Take care not to mistake the matching marks of each part.

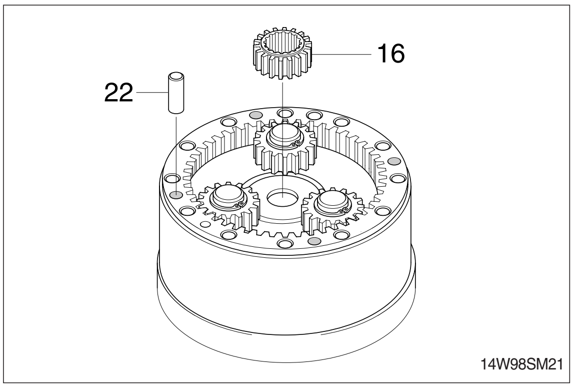


(10) Assemble carrier 1 (12) assembly into the ring gear (21).



(11) Hammer 4 knock pins (22) around the ring gear (21).

(12) Assemble sun gear 1 (16) to the drive shaft of the swing reduction gear.

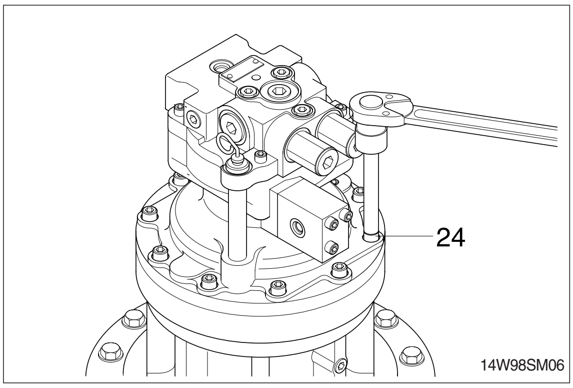


(13) Apply loctite to the tapped holes of the ring gear (21) and then mount swing motor onto the ring gear (21).

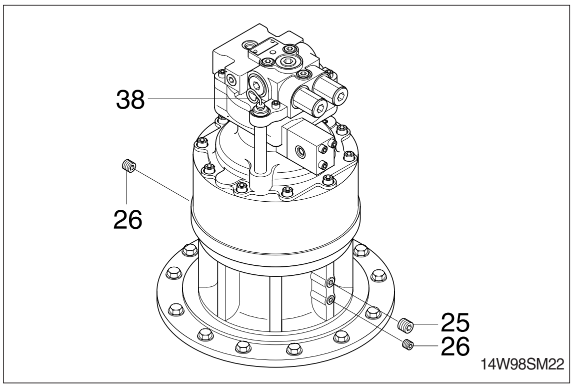
※ Don't fail to coincide the gauge bar hole.

(14) Tighten socket bolts (24) around the swing motor assembly.

· Tightening torque : 13.5 kgf · m (98 lbf · ft)



(15) Assemble plugs (25, 26) and level gauge (38).



GROUP 6 TRAVEL DEVICE (TYPE1)

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.**

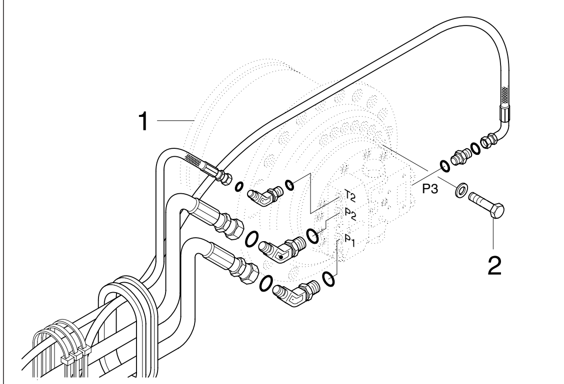
※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

13031GE18

(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.



14098TM01

(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

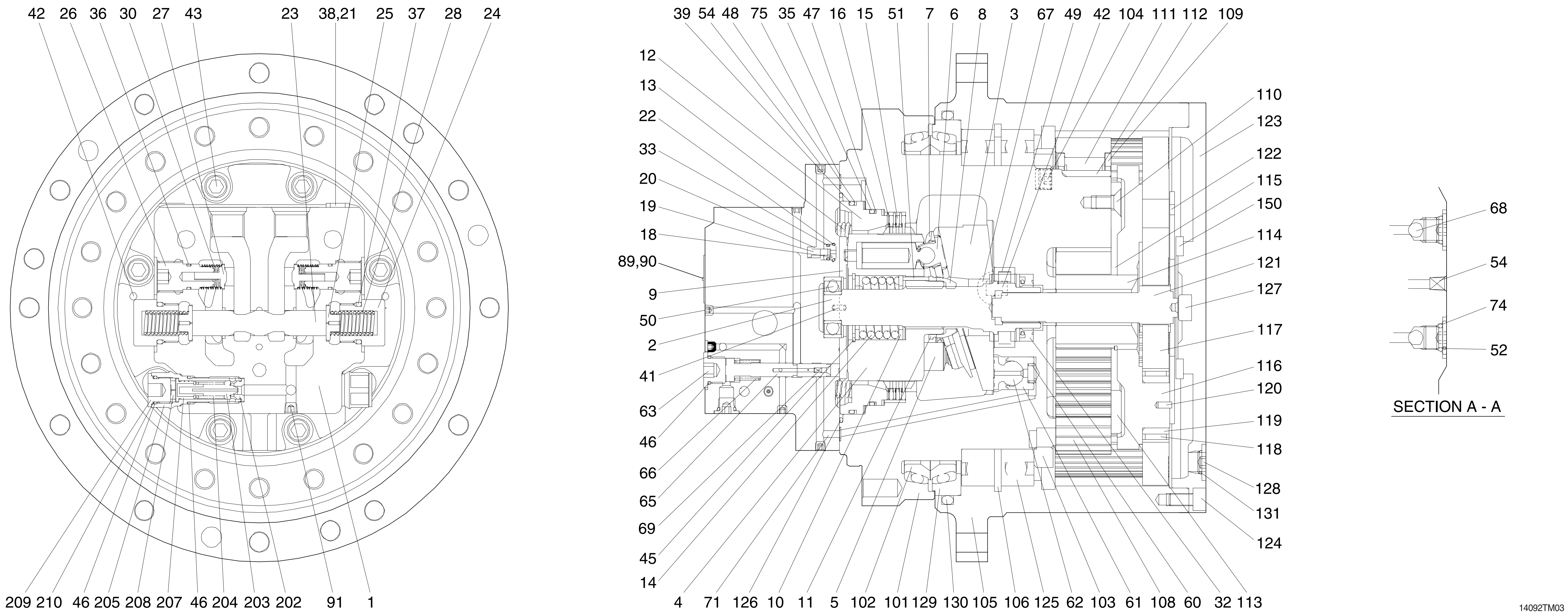
(1) Carry out installation in the reverse order to removal.

(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



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		

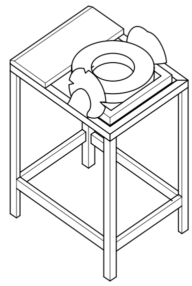
2) TOOLS

(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

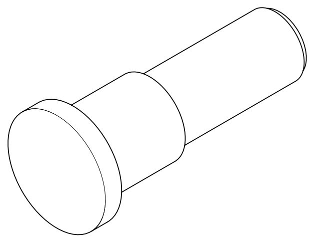
(2) Special tools

① Inversion working bench



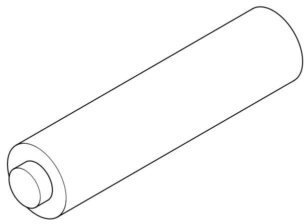
25098TM101

② Pressurize jig (Ⅰ)



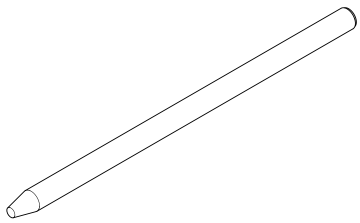
14098TM90

③ Pressurize jig (Ⅱ)



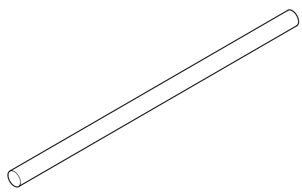
25098TM102

④ Aluminum bar



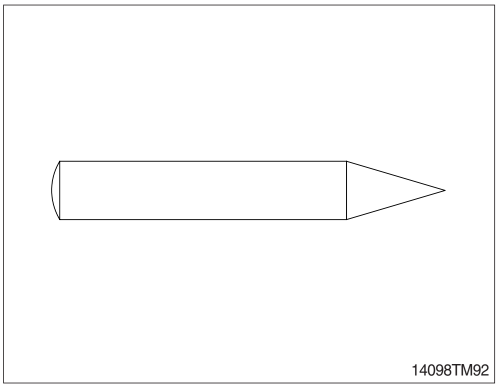
14098TM91

⑤ Steel bar



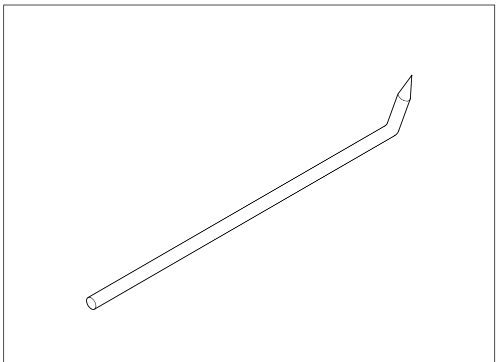
25098TM103

⑥ Sharp punch



14098TM92

⑦ Draw bar



14098TM93

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.

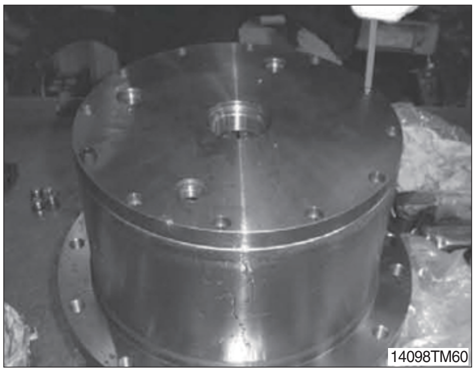
(2) Loosen socket bolts (124, 16EA) and remove the cover (123).

※ 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).

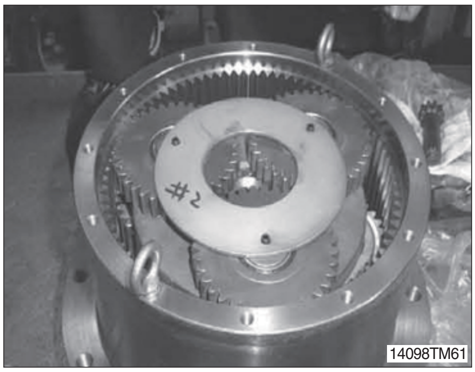
※ Tools

· Hexagon wrench 6, 8



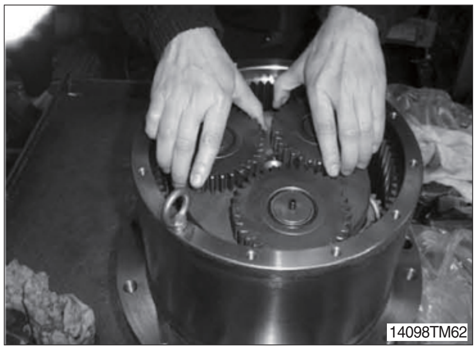
14098TM60

(3) Remove thrust plate R (122) and drive gear (121).

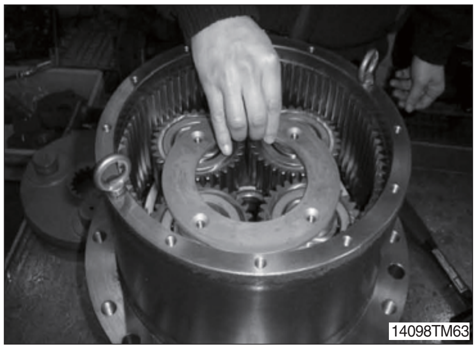


14098TM61

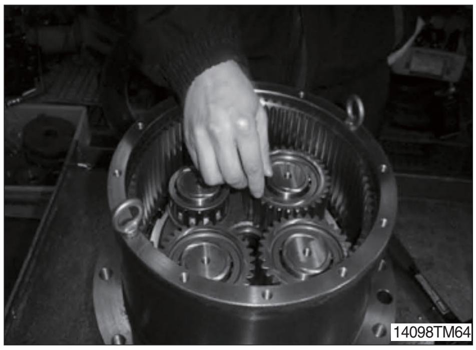
(4) Remove planetary gear R (117), needle bearing, inner race (119) and holder (116) from hub (105).



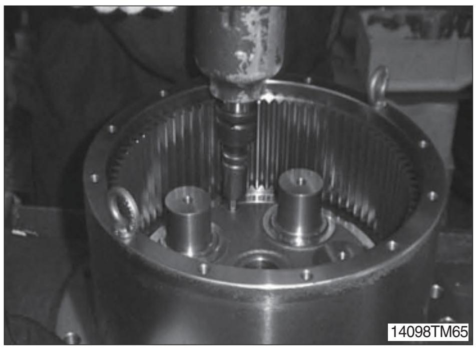
(5) Remove sun gear (114), screw (110) and thrust plate F (113).



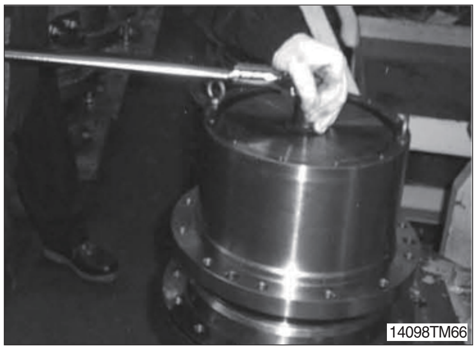
(6) Remove the thrust washer (109), planetary gears F (108), needle bearings (111) and collar (112) from hub (105).



(7) Remove the plugs (104, 3EA).

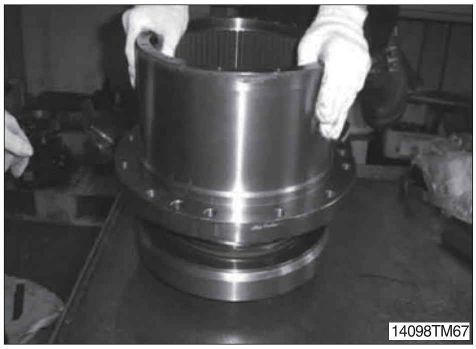


(8) Remove the nut ring (103) from hub (105).

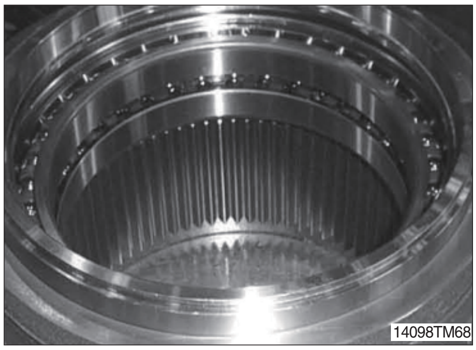


(9) Remove the spindle (101) from the hub (105).

※ Remove it using a crane after eye bolt is assembled at the hub (105).

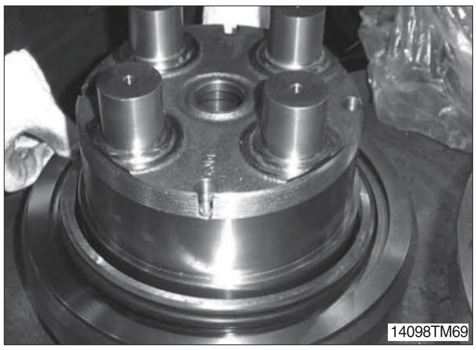


(10) Remove the floating seal (102), seal ring (129), angular bearings (125, 2EA), snap ring (106) and O-ring (130) from the hub (105).

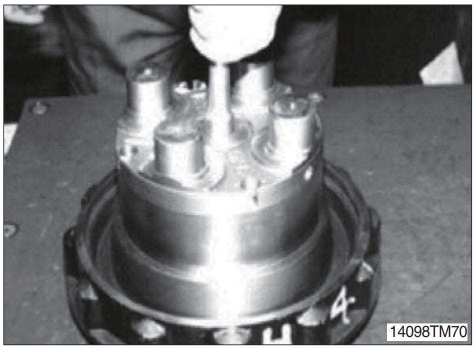


(11) Remove the floating seal (102) from the spindle (101).

※ User can remove easily if using (-) drivers.



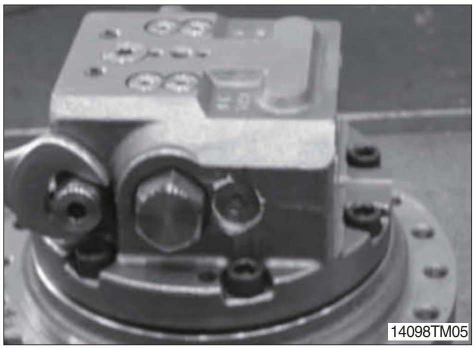
(12) Remove the oil seal (32) from spindle (101).


14098TM70

2) DISASSEMBLING THE HYDRAULIC MOTOR PART

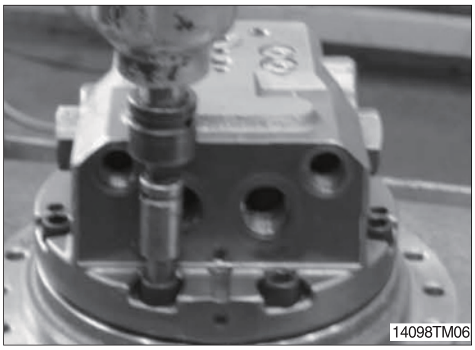
(1) Remove the relief valve (70, 2EA) from rear flange (1).

※ Tools
- · Hexagon socket
- · Torque wrench


14098TM05

(2) Remove hexagon socket head bolts (43, 8EA) from the rear flange (1).

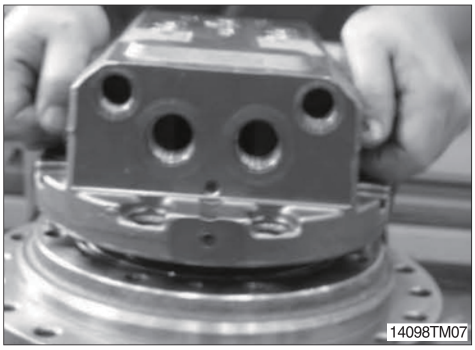
※ Tools
- · Hexagon wrench 8


14098TM06

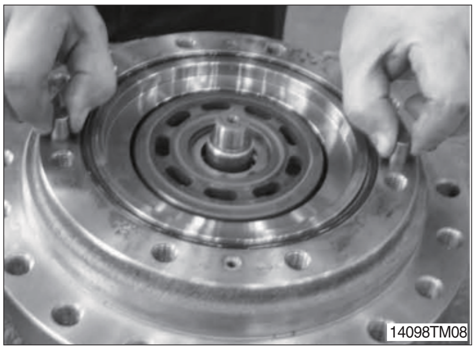
(3) Remove the rear flange (1) from the spindle (101).

(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.

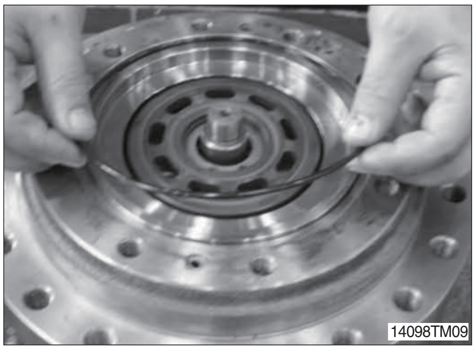

14098TM07

(5) Remove the parallel pin (42) from the spindle (101).


14098TM08

(6) Remove the O-ring (126) from the spindle (101).

※ Do not reuse the O-ring (126).


14098TM09

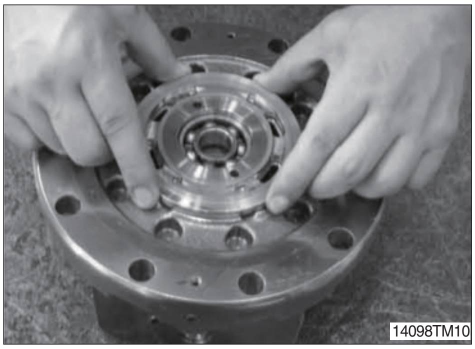
(7) Disassembling the rear flange (1) part

① Place the rear flange with the contact surface of the spindle upward.

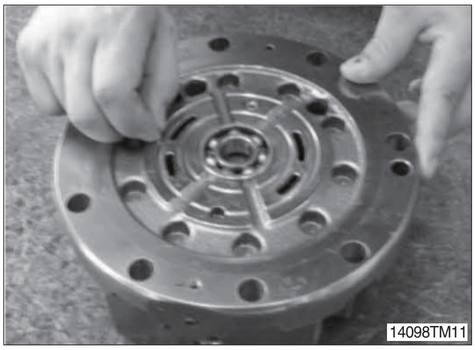
② Remove the timing plate (9) from the rear flange (1).

※ 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.

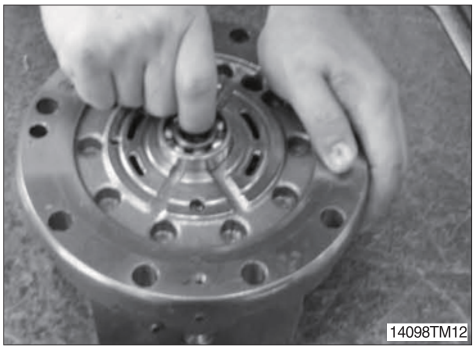
※ Be careful of the leakage due to both surface scratch if using a sharp tool.


14098TM10

③ Remove the paralell pin (41) from the rear flange (1).


14098TM11

④ Remove the ball bearing (50) from the rear flange (1).


14098TM12

(8) Disassembling the brake valve part

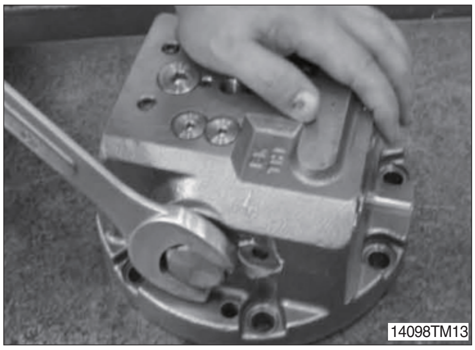
① Remove two plugs (24) from the rear flange (1).

※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools

· Hexagon wrench 36

· Torque wrench

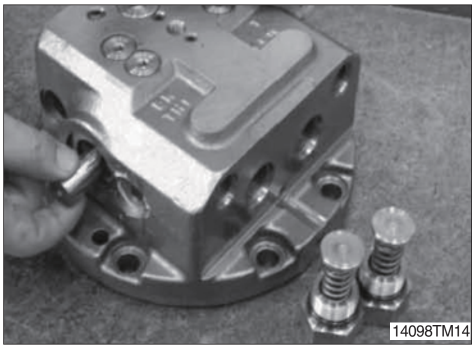

14098TM13

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.

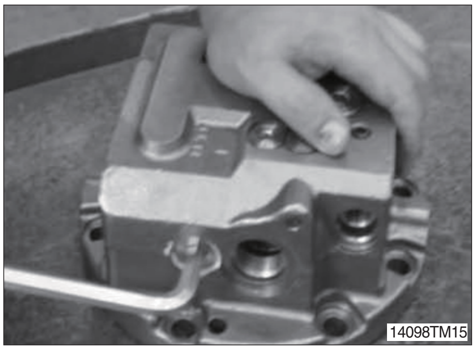

14098TM14

④ Remove two plugs (26) from the rear flange (1).

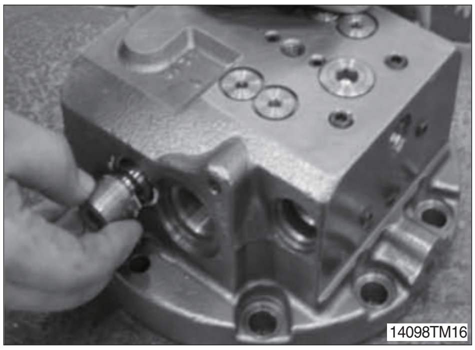
※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools

· Hexagon wrench 10

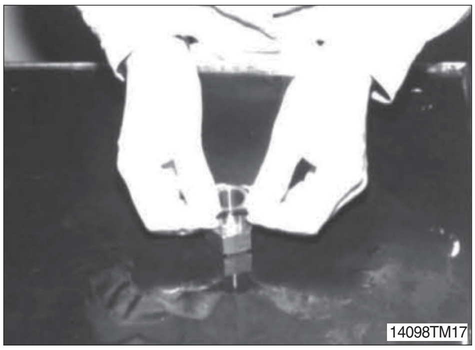

14098TM15

⑤ Remove the springs (30, 2EA), valves (27, 2EA) from rear flange (1).


14098TM16

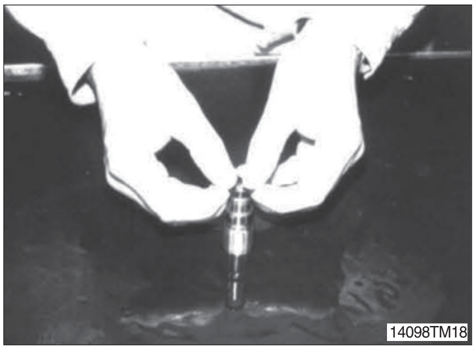
⑥ Remove the O-ring (37) from plug (24).

※ Do not reuse the O-ring (37).


14098TM17

⑦ Remove the O-ring (36) from plug (26).

※ Do not reuse the O-ring (36).


14098TM18

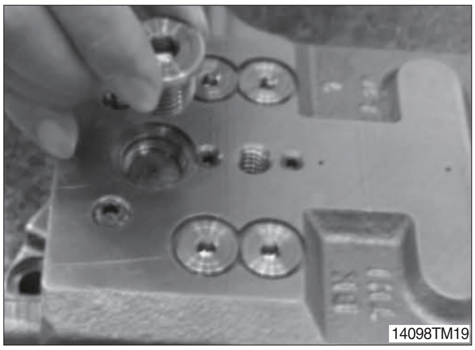
(9) Disassembling the two speed change valve

① Remove the plug (63) from the rear flange (1).

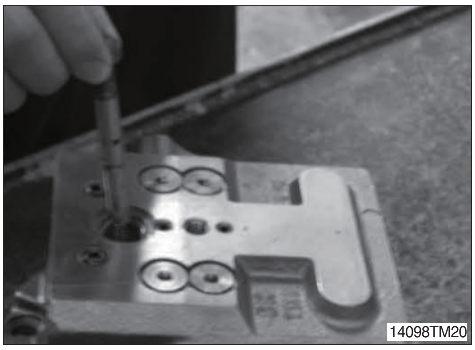
※ User can work easily if sub-disassembly was done on the reversal table.

※ Tools

  · Hexagon wrench 10


14098TM19

② Remove the spool (65) and spring (66) from rear flange (1).



14098TM20

(10) Disassembling the plug (52).

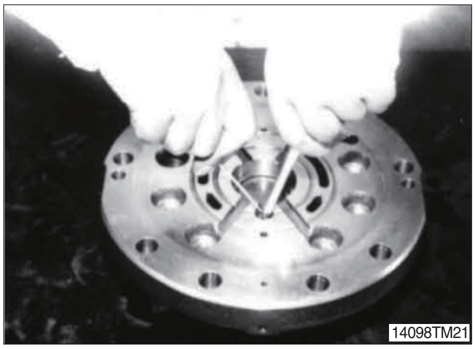
① Do not remove plug (52) if it not to be necessary.
Disassembling the plug (52) if it was malfunction because of get mixed with dust.
Clean the plug (52) after disassembled.

※ 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.

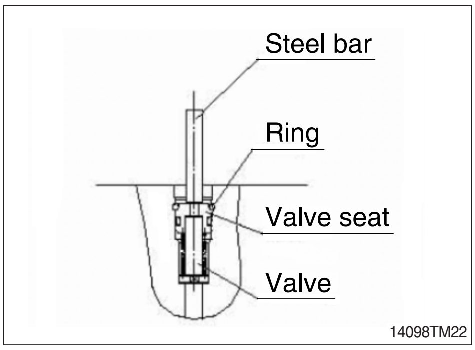
② Pushing valve seat (18) by a steel bar, disassemble ring (22) from rear flange (1).



14098TM21

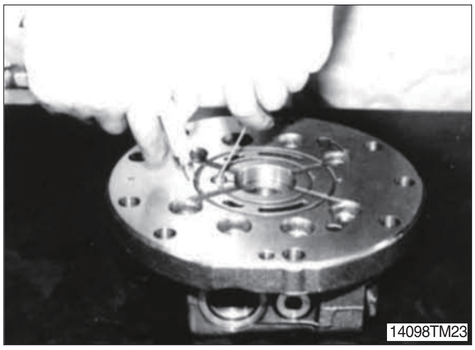
※ Do not remove ring (22) if it not to be replace.

※ Do not reuse the ring (22), valve seat (18) and O-ring (33).



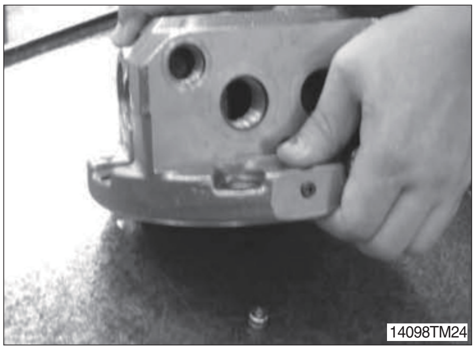
14098TM22

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).



14098TM23

④ Remove the valve (19) and spring (20) from rear flange (1) downside hole with shaking lightly.



14098TM24

⑤ Remove the O-ring (33) and valve seat (18).

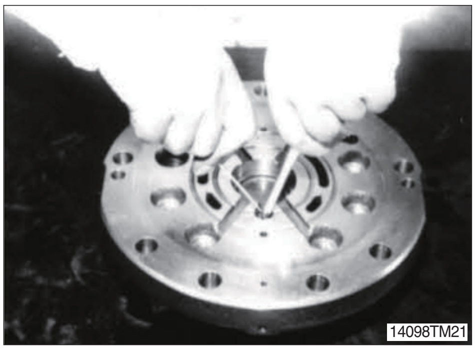
※ Do not reuse the O-ring (33).

14098TM25

(12) Disassembling the parking brake

① Remove the piston (12) by injecting compressed air from the parking brake access hole in the spindle (101).

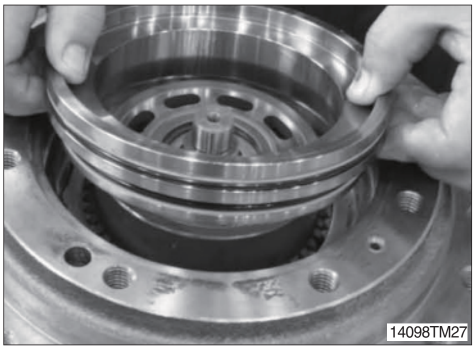
※ Use the protection cover on the upper part of spindle (101) when users put the pressed air into suddenly. Otherwise part damage and accident might go on because the piston (12) is rushed out of the spindle (101).



14098TM21

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.



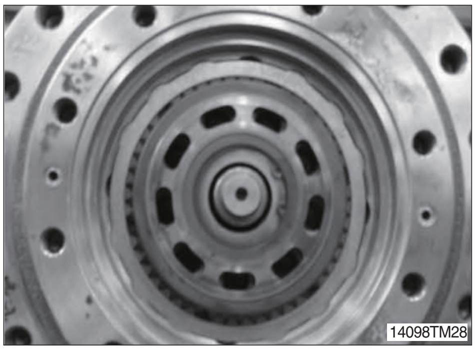
14098TM27

(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.



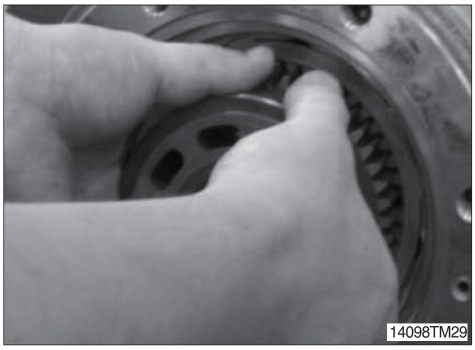
14098TM28

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).

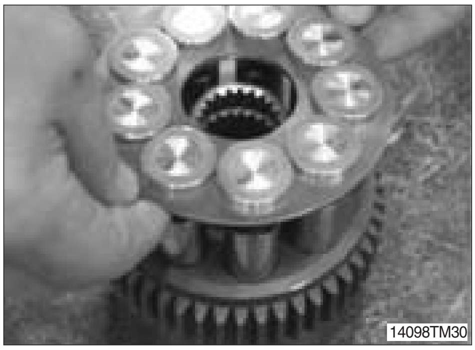
※ Be careful that if an attempt is made to remove the cylinder block (4) without detaching the shoe (6) from the swash plate (3), then the piston, shoe and other parts that are connected to the cylinder block may come the cylinder loose and fall into the spindle (101).



14098TM29

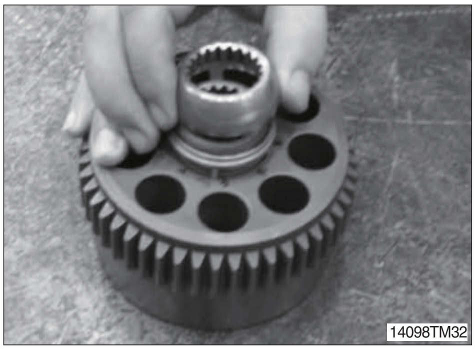
(14) Disassembling the cylinder block kit

① Piston assembly [piston (5), shoe (6)] from the removed cylinder block (4).

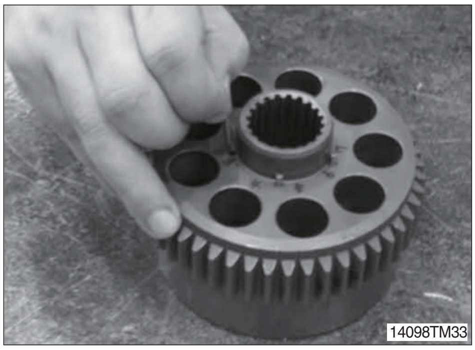


② Piston (5) and shoe (6) from the removed retainer plate (7).

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

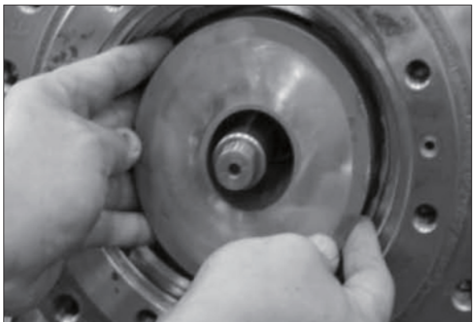
① Put the cylinder block (4) on the pressurize jig.
② Press the washer (10) with pressurize jig, and remove the spring (14) after snap ring (45) removed.
※ Put a vinyl cover on the sliding surface of cylinder block (4) for protection.
※ Do not remove spring (14) if it not to be replace.


14098TM34

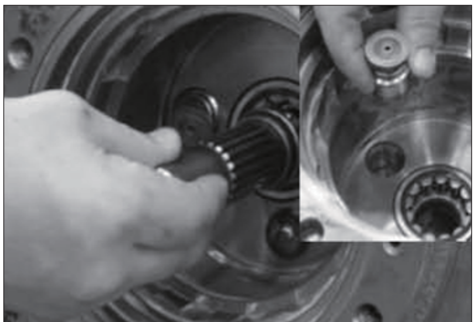
③ Remove the snap ring (45), washer (10), spring (14) and washer (10) from cylinder block (4).


14098TM35

(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.


14098TM36

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.


14098TM37

4. REASSEMBLY

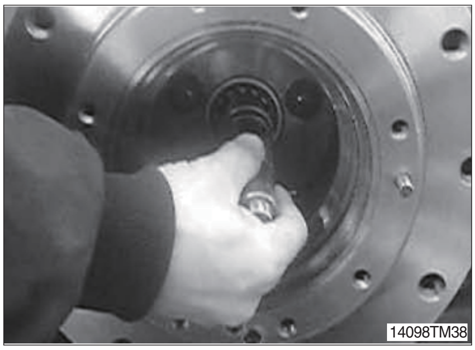
4.1 GENERAL PRECAUTIONS

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

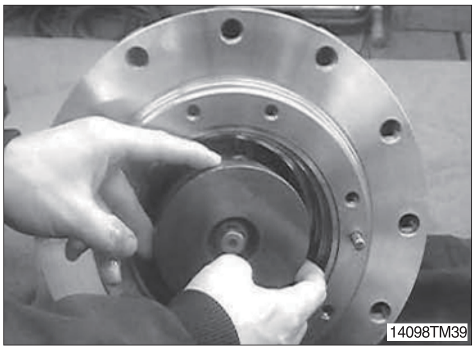
1) REASSEMBLE THE HYDRAULIC MOTOR PART

(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.



14098TM38

(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).



14098TM39

(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.

14098TM35

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.

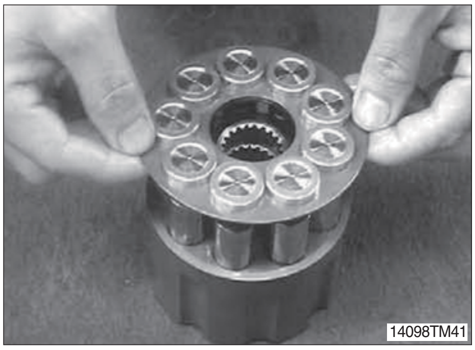
14098TM34

(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.

14098TM40

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).



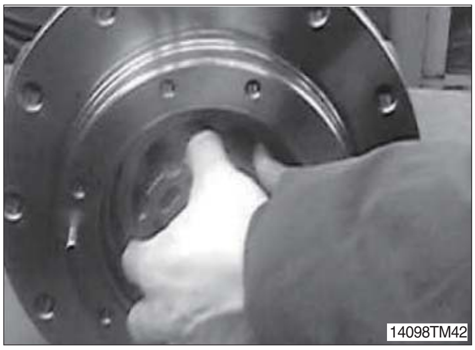
14098TM41

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.

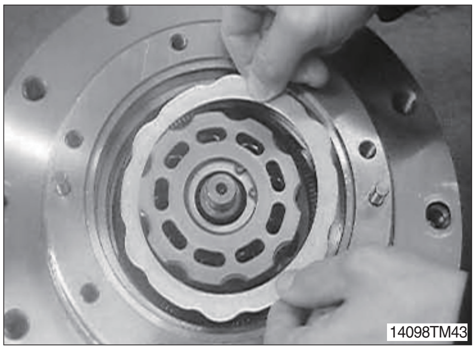


14098TM42

(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.



14098TM43

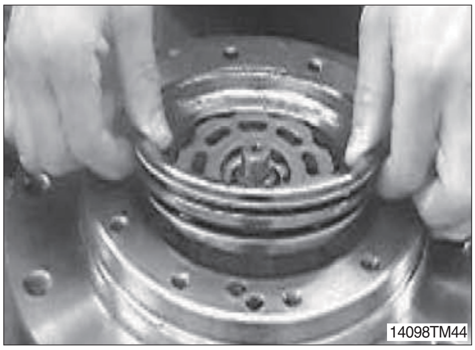
② Install two O-rings (35, 39) and two back up ring (47, 48) into O-ring grooves.

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.



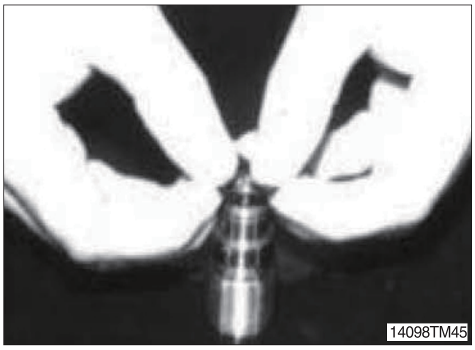
14098TM44

2) REASSEMBLE THE REAR FLANGE (1) PART

(1) Reassemble the check valve

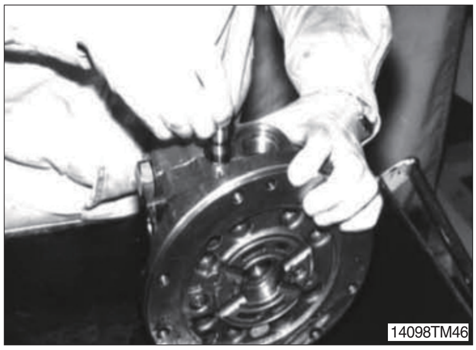
① Install O-ring (36, 2EA) on the plug (26, 2EA).

※ Apply grease to the O-ring (36).



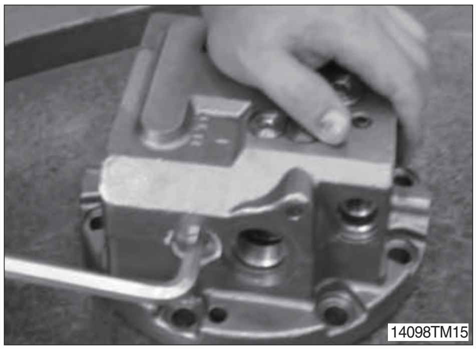
14098TM45

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.


14098TM46

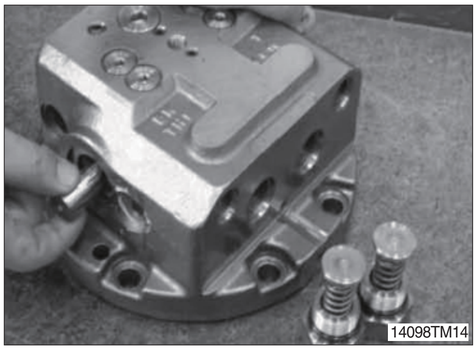
④ Install plug (26) in conjunction with the spring (30) and the valve (27) into the rear flange (1), and tighten the plug to the required torque.

※ Tightening torque : 17±2.6 kgf · m (123±18.8 lbf · ft)
※ Tools
  · Adapter for hexagon wrench 10
  · Torque wrench

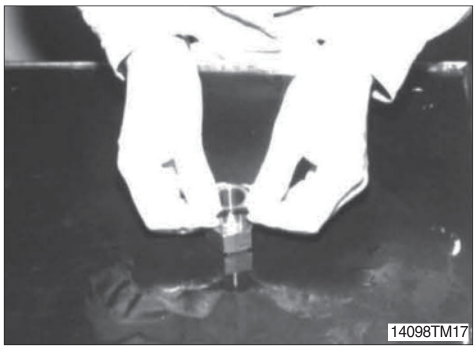

14098TM15

⑤ Install spool (23) into the rear flange (1).

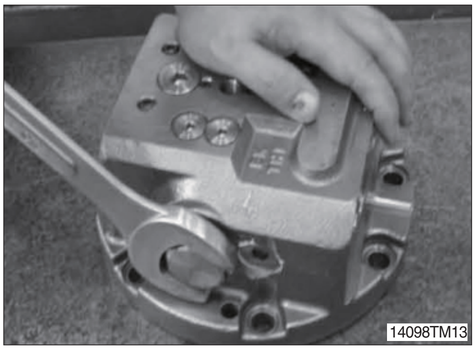
※ Before installing the spool (23), apply hydraulic oil to the spool. Be careful not to damage the spool's surface and the inner of rear flange (1).


14098TM14

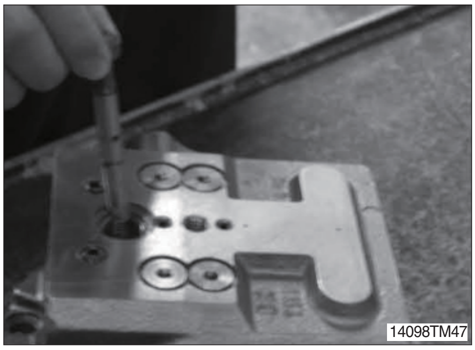
⑥ Install O-ring (37) on the plug (24).
Apply grease to the O-ring (37).


14098TM17

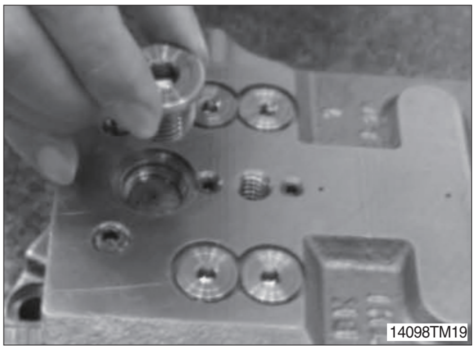
⑦ Install spring retainer (25) and spring (28) into the plug (24).
⑧ Install plug (24) into the rear flange (1).
⑨ Tighten the plug (24) to the required torque.
※ Tightening torque : 36±5.4 kgf · m (260±39 lbf · ft)
※ Socket (#36) / Torque for hexagon wrench.
※ Tools
· Hexagon socket 36
· Torque wrench


14098TM13

(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).


14098TM47

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

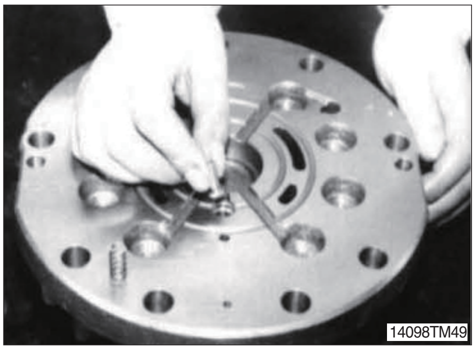

14098TM19

(3) Reassembe the parking brake valve
① Install O-ring (33) on the valve seat (18).
※ Do not reuse the O-ring (33).


14098TM48

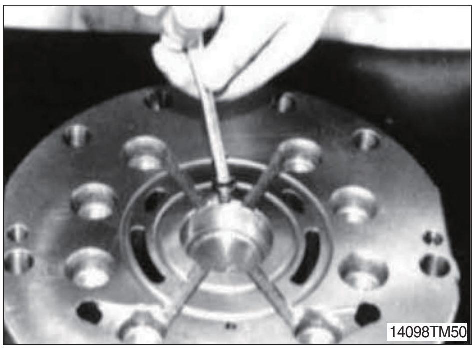
② Mount the rear flange (1) on a working bench that the mounting side of the spindle (101) faces upward.

③ Install valve (19), spring (20) and valve seat (18) in that order.



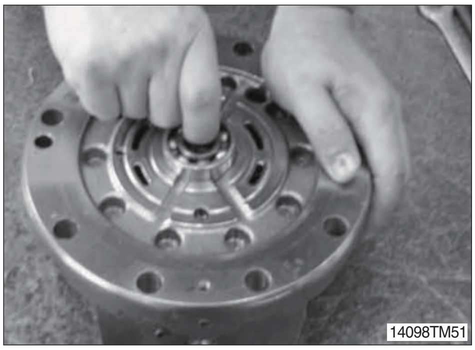
④ After new ring (22) bend somewhat and put the valve seat (18), then into the rear flange (1) ring's groove.

※ Do not reuse the ring (22).

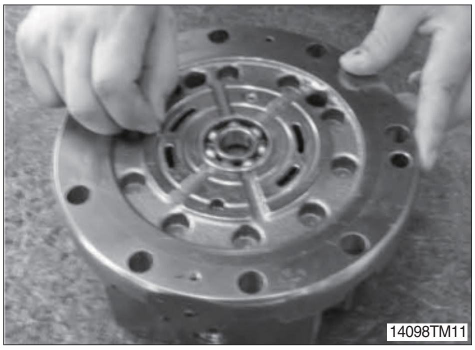


⑤ Install ball bearing (50) into the rear flange (1).

※ Apply hydraulic oil to the ball bearing (50).

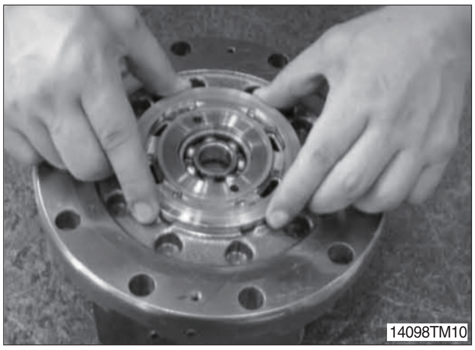


⑥ Install parallel pin (41) into the pin hole of rear flange (1).



⑦ Install timing plate (9) into the rear flange (1).

※ Apply hydraulic oil to the contact surface of rear flange.



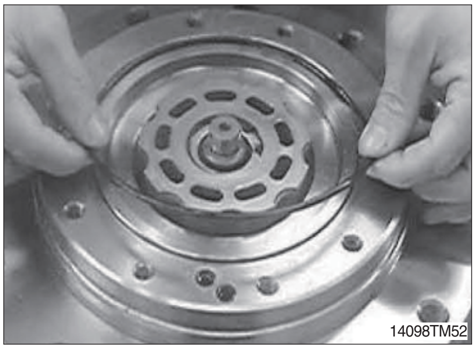
14098TM10

(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.



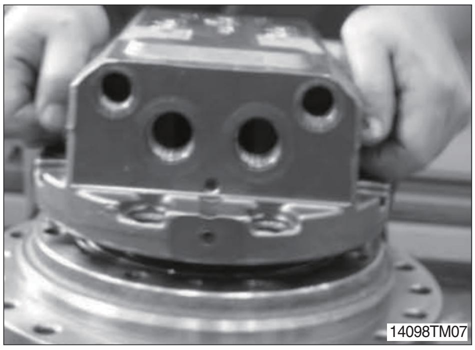
14098TM52

③ Install parallel pins (42, 2EA) into the spindle (101).

14098TM53

④ Mount the rear flange (1) on the spindle (101).

※ When the rear flange (1) is mounted on the spindle (101), fix the spring (13) applied grease to not drop.

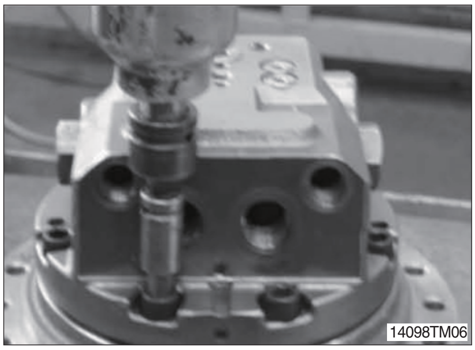


14098TM07

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)

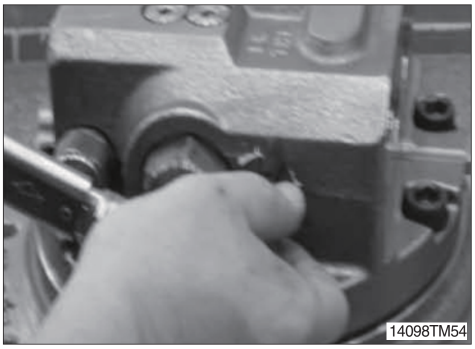
※ Tools
- Adapter for hexagon wrench 8
- Torque wrench


14098TM06

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


14098TM54

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)

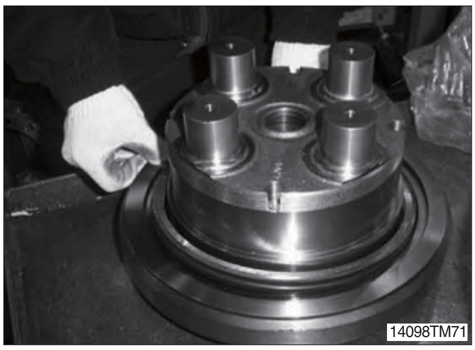
※ Tools
- Hexagon socket 10
- Torque wrench


14098TM55

3) REASSEMBLE THE REDUCTION GEAR ASSEMBLY

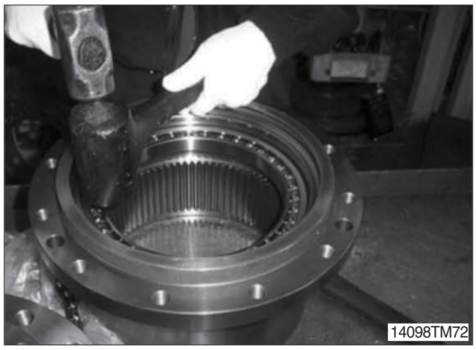
(1) Install floating seal (102) on the spindle (101).

※ Apply grease to the floating seal (102).


14098TM71

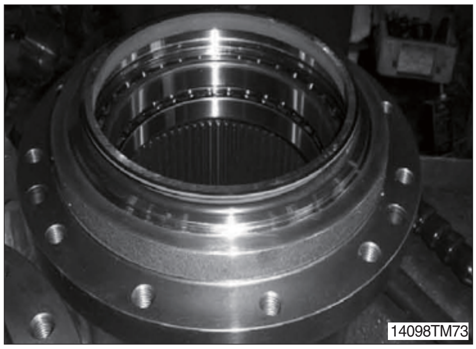
(2) Install angular bearing (125) and snap ring (106) into the hub (105).

※ Be careful for the insert direction.

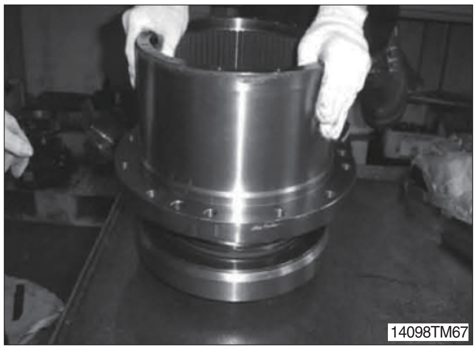


(3) Insert the O-ring (130), the sealing (129) and floating seal (102) in the hub (105).

※ 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.

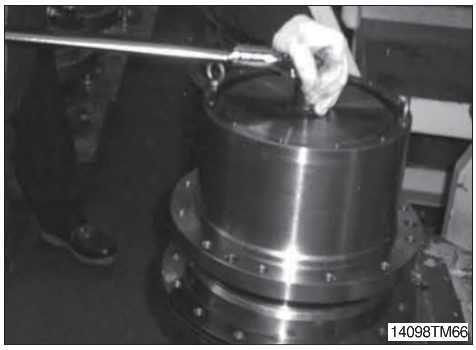
※ Do not wind the seal tape to the plug (104).

※ Punch two place for not to loosen the plug (104).

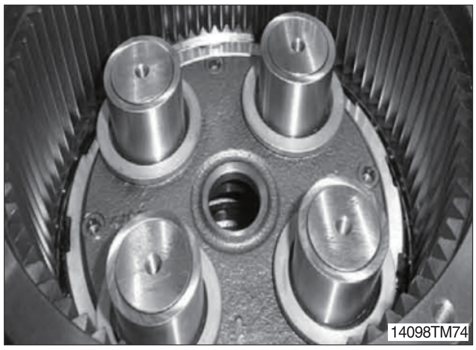
※ Tightening torque : 3.5±0.7 kgf · m (25.3±5.1 lbf · ft)

· Hexagon socket 8

· Torque wrench



(6) Install thrust washer (109) and collar (112) into the hub (105).

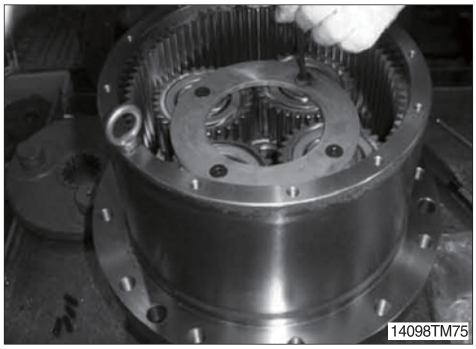

14098TM74

(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)

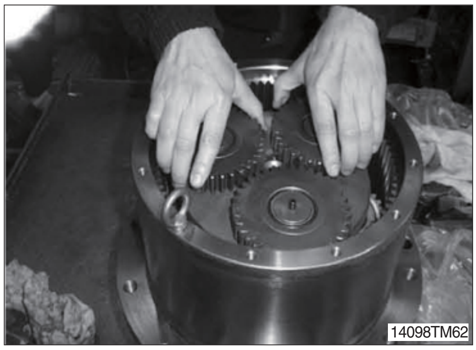
· Hexagon socket 5

· Torque wrench

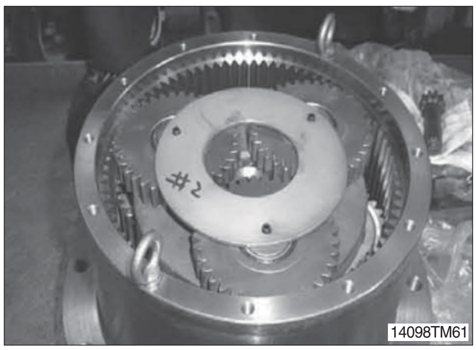

14098TM75

(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)

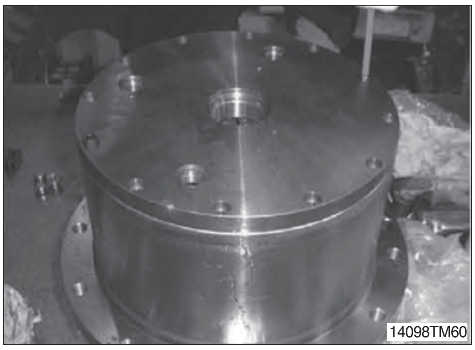

14098TM62

(9) Install drive gear (121) and thrust plate R (122) into the hub (105).


14098TM61

(10) Install cover (123), thrust plate (150), plug (301, 128) and socket bolt (124) into the hub (105).

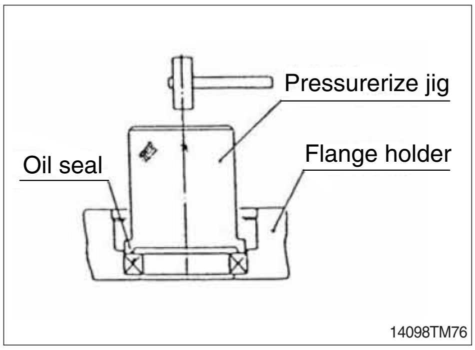
※ Apply grease to the cover (123) after installed O-ring (127).



(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)

■ TRAVEL MOTOR (TYPE 2)

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.


13031GE18

⚠ **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.**

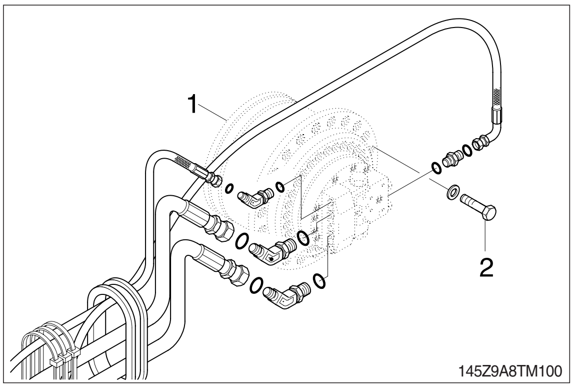
(5) Remove the cover.

(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 : 185 kg (410 lb)



145Z9A8TM100

2) INSTALL

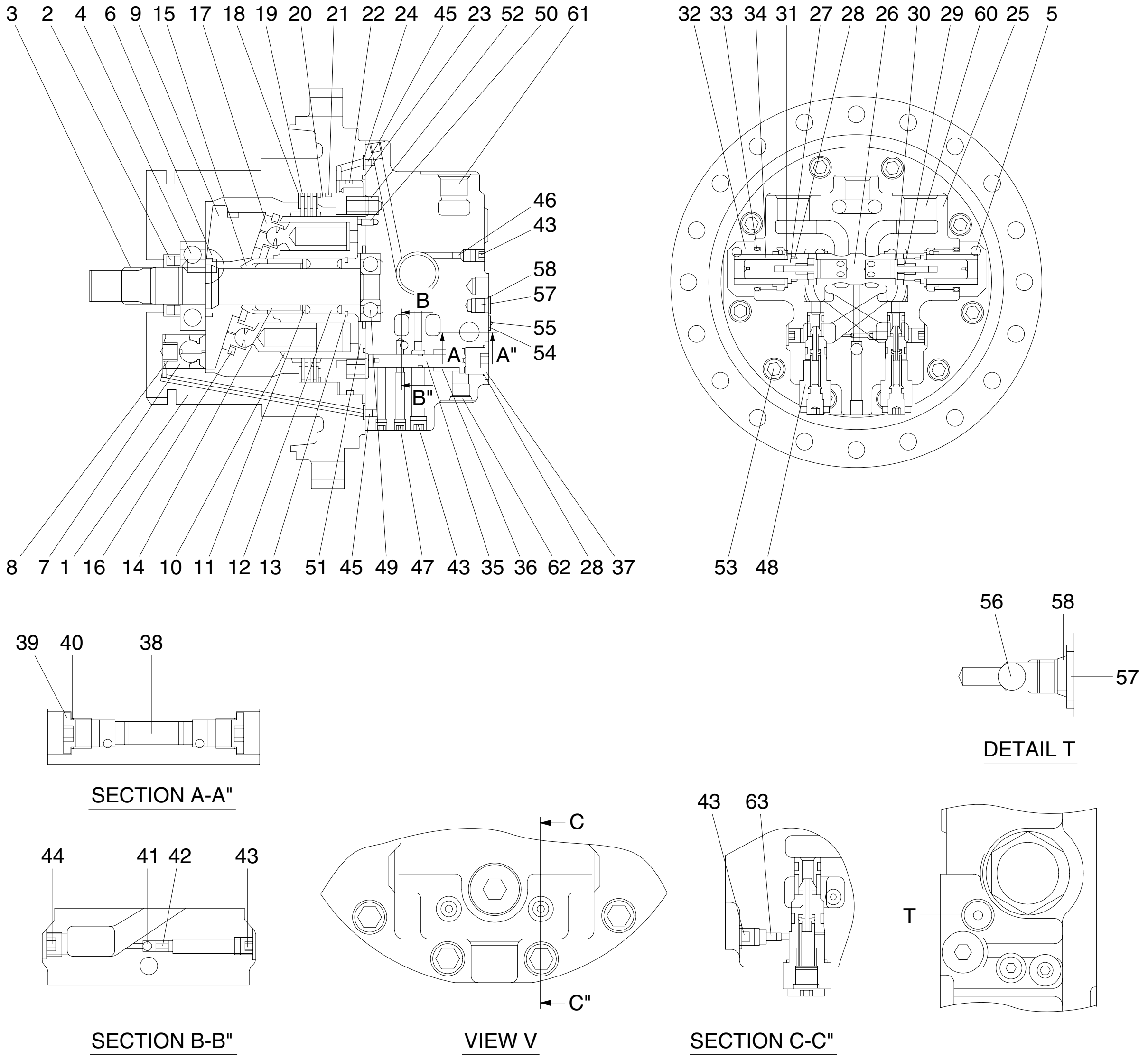
(1) Carry out installation in the reverse order to removal.

(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.

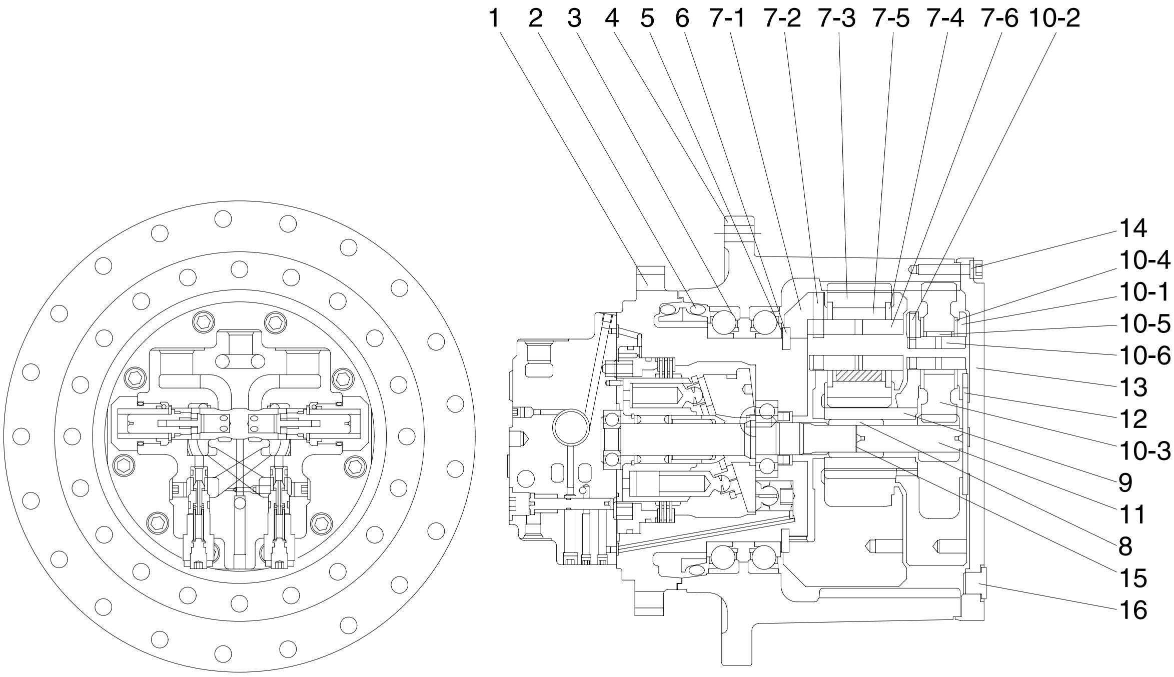
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. SPECIFICATION

1) STRUCTURE



1	Shaft casing	17	Piston assy	33	O-ring	49	Bearing
2	Oil seal	18	Steel plate	34	Spring	50	Pin
3	Shaft	19	Friction plate	35	Spool	51	Valve plate
4	Bearing	20	Brake piston	36	Spring	52	Spring
5	Pin	21	Ring	37	Plug	53	Wrench bolt
6	Swash ball	22	Ring	38	Piston	54	Name plate
7	Swash piston	23	O-ring	39	Plug	55	Rivet
8	Spring	24	O-ring	40	O-ring	56	Steel ball
9	Swash plate	25	Valve casing	41	Steel ball	57	Plug
10	Cylinder block	26	Main spool	42	Orifice	58	O-ring
11	Spring seat	27	Plug	43	Plug	60	Plastic plug
12	Spring	28	O-ring	44	Plug	61	Plastic plug
13	Snap ring	29	Spring	45	Orifice	62	Plastic plug
14	Pin	30	Check	46	Orifice	63	Orifice
15	Ball guide	31	Plate	47	Plug		
16	Set plate	32	Plug	48	Relief valve assy		



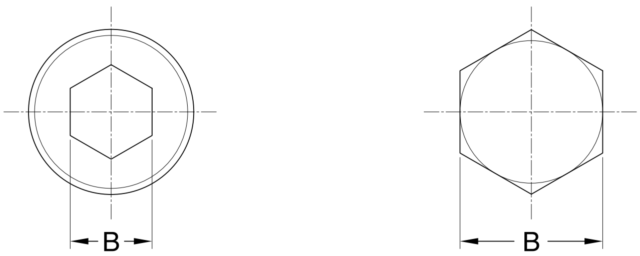
145Z9A2TM02A

1	Spindle	7-4	Washer 2	10-5	Bearing 1
2	Floating sesal	7-5	Bearing 2	10-6	Pin 1
3	Ball bearing	7-6	Pin 2	11	Sun gear 1
4	Housing	8	Coupling	12	Plate 1
5	Shim	9	Sun gear 2	13	Cover
6	Shim	10	Carrier assy 1	14	Bolt
7	Carrier assy 2	10-1	Carrier 1	15	Snap ring
7-1	Carrier 2	10-2	Spring pin 1	16	Plug
7-2	Spring pin 2	10-3	Planetary gear 1		
7-3	Planetary gear 2	10-4	Washer 1		

2) TOOL AND TIGHTENING TORQUE

(1) Tools

Name of tools	B (mm)	Name of part applied
Hexagonal L-Wrench	4	Plug (42, 45, 46, 47)
	6	Plug (43, 44)
	8	Plug (39)
	10	Plug (37, 57), Wrench bolt (53)
Socket wrench/ spanner	24	Relief plug (48)
	41	Main spool plug (32)
Snap ring plier (for holes, axis)		ø 42 (13)
Hammer		Ball bearing (49), Pin (50)
Torque wrench		Size : 5 kgf · m, 100 kgf · m
Jig for oil seal assembling		Oil seal (2)
Heating tool for bearing		Parking spring (20)



Size B

145Z9A8TM99

(2) Tightening torque

Item no.	Part name	Size	B (mm)	Torque	
				kgf · m	lbf · ft
25	Wrench bolt	-	-	68	491.8
32	Main spool plug	M36	41	45	325.5
37	Plug	PF 3/8	10	6	43.4
39	Plug	PF 1/4	8	3	21.7
42, 45, 46, 47	Plug	PT 1/16	4	0.7~1.1	5.1~8.0
43	Plug	PT 1/8	6	1.25	9.0
48	Relief valve plug	PF 1/2	24	10	72.3
53	Wrench bolt	M12×30	10	10.4	75.2

3. DISASSEMBLING AND ASSEMBLING

1) GENERAL INSTRUCTIONS

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

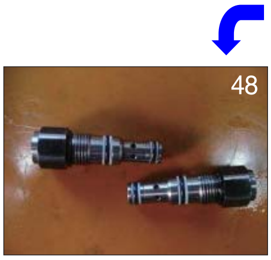
(3) Before disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

2) DISASSEMBLING MOTOR UNIT

(1) Disassemble relief valve (48) from valve casing (25) using a torque wrench.



145Z9A8TM01

145Z9A8TM02

(2) Disassemble wrench bolt (53) (M12 × 30) and take out valve casing sub assembly.

145Z9A8TM03

(3) Remove parking spring (52) - 12EA.

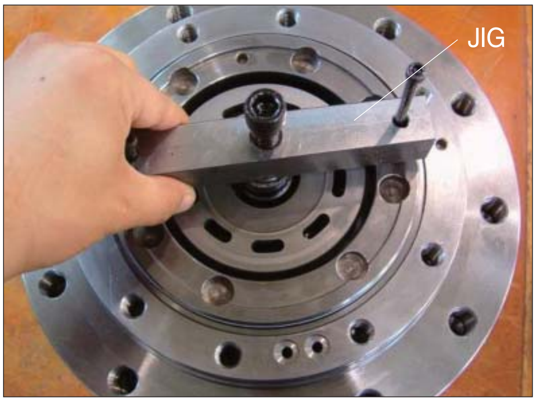
145Z9A8TM04

(4) Remove O-ring (23).

145Z9A8TM05

(5) Disassemble brake piston (20) using a jig.

145Z9A8TM06



145Z9A8TM07

(6) Disassemble friction plate (19)-3EA, steel plate (18)-4EA.

145Z9A8TM09

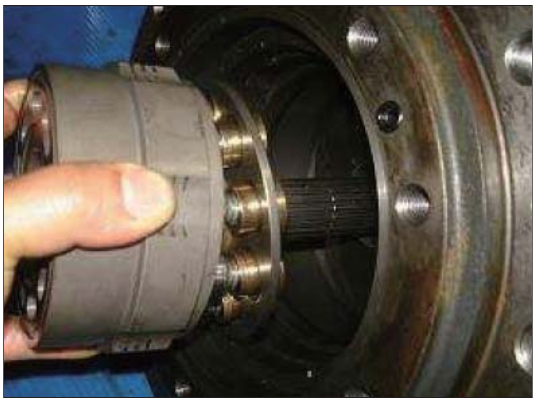
145Z9A8TM08

145Z9A8TM10

(7) Remove the cylinder block kit (II).

※ It is easier to work by placing the shaft casing (1) horizontal.

145Z9A8TM12



145Z9A8TM11

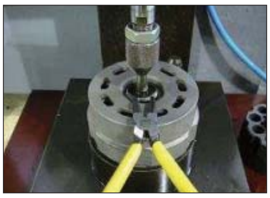
(8) Disassemble cylinder block (10), ball guide (15), set plate (16), piston assy (17), pin (14) from cylinder block kit (II).
Press spring (12) using a jig and take out snap ring (14) using a plier.
Disassemble snap ring (13), spring seat (11), spring (12) from cylinder block kit (II).

145Z9A8TM13

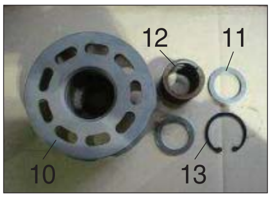
145Z9A8TM14

145Z9A8TM15

145Z9A8TM16



145Z9A8TM17



145Z9A8TM18

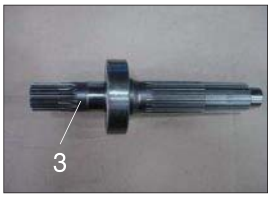
(9) Disassemble swash plate (9).

145Z9A8TM19

(10) Disassemble swash ball (6).

145Z9A8TM20

(11) Disassemble shaft (3) from shaft casing (1).



145Z9A8TM21

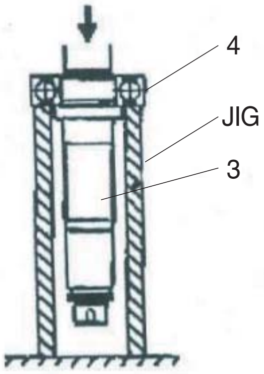
145Z9A8TM22

- After disassembled shaft (3) is placed on a jig, top of shaft is pressed down using a press.
  It can remove ball bearing (4) portion.

※ Remove ball bearing (4) in case it is replaced only.

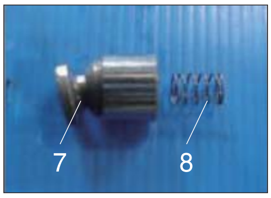
- Dismantled bearing can't be reused.

145Z9A8TM23



145Z9A8TM24

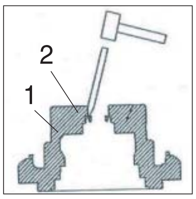
(12) Disassemble swash piston (7), spring (8) into shaft casing(1).



145Z9A8TM25

145Z9A8TM26

(13) Disassemble oil seal (2) from shaft casing (1) using a tool.

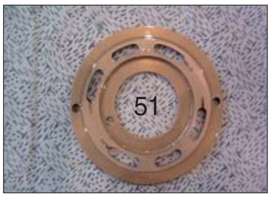


145Z9A8TM27

145Z9A8TM28


145Z9A8TM29

(14) Disassemble valve plate (51) and ball bearing (49) from valve casing (25).



145Z9A8TM30

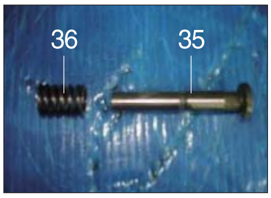
145Z9A8TM31

145Z9A8TM32

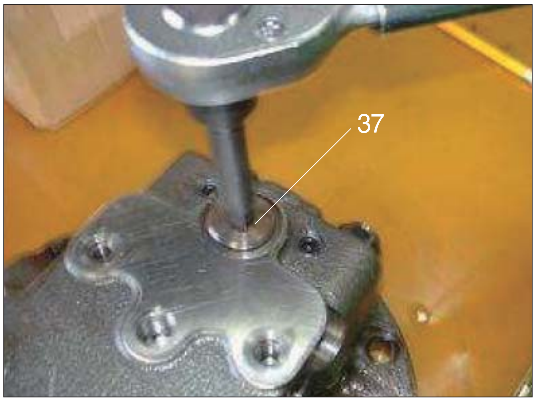
(15) Disassemble plug (47) from valve casing (25).

145Z9A8TM33

(16) Disassemble plug (37) from valve casing (25) using a torque wrench and disassemble two speed control spool (35), spring (36) in regular sequence.

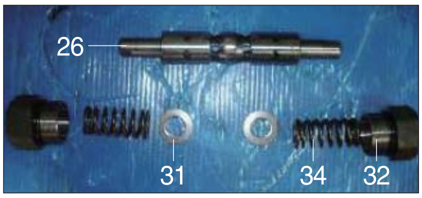


145Z9A8TM34



145Z9A8TM35

(17) Disassemble main spool plug (32) from valve casing (25) using a torque wrench and disassemble spring (34), plate (31), main spool (26) in regular sequence.



145Z9A8TM36

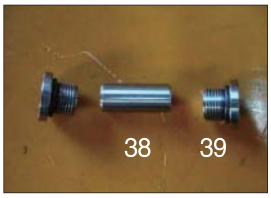
145Z9A8TM37

(18) Disassemble plug (43) from valve casing (25) and then disassemble orifice (42), steel ball (41) one by one.

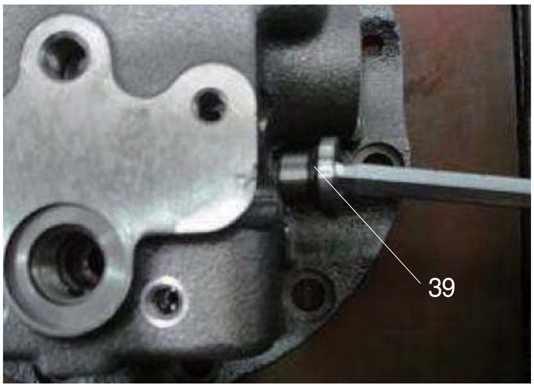
145Z9A8TM38

145Z9A8TM39

(19) Disassemble plug (39), relief valve damping piston (38) from valve casing (25).



145Z9A8TM40



145Z9A8TM41

(20) Disassemble plug (43) from valve casing (25) and disassemble orifice (63).

145Z9A8TM42

(21) Disassemble plug (57), steel ball (56) from valve casing (25).

145Z9A8TM43

145Z9A8TM44

3) ASSEMBLING MOTOR UNIT

(1) Put oil seal into shaft casing (1) using a jig.

※ Caution direction of oil seal.

145Z9A8TM45

145Z9A8TM46

(2) Assemble swash spring (8) into shaft casing (1) and put swash piston (7) into shaft casing (1).

145Z9A8TM47

145Z9A8TM48

(3) Press the ball bearing (4) into shaft (3) after preheating of ball bearing (4).

① Induction heating apparatus temperature : 100˚C

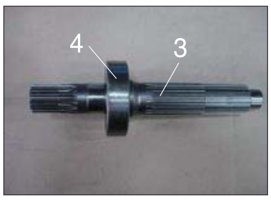
② Be careful not to damage the sliding surface for the seal on the shaft.

145Z9A8TM49

145Z9A8TM50

145Z9A8TM51

(4) Assemble shaft into shaft casing (1).



145Z9A8TM52

145Z9A8TM53

(5) Assemble swash ball (6)-2EA.

145Z9A8TM54

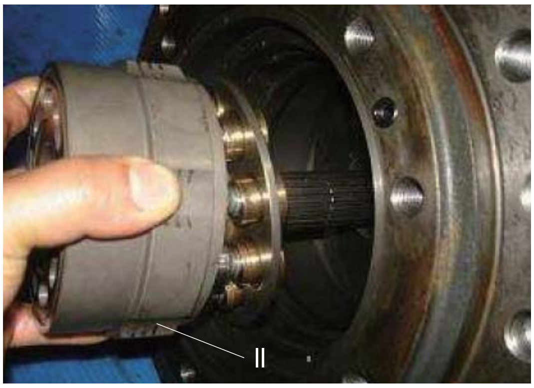
(6) Apply grease to swash plate (9) and assemble swash plate (9) into shaft casing (1).

145Z9A8TM55

145Z9A8TM56

(7) Slant the shaft casing (1) and then assemble cylinder block kit (II).

- Assemble spring seat (11), spring (12), spring seat (11) into cylinder block kit (II) in regular sequence.
  Push down spring(12) and then assemble snap ring (13) into gap of cylinder block(10) using a plier.
- Assemble pin (14), ball guide (15), set plate (16), piston assy (17) into cylinder block (10) in regular sequence.



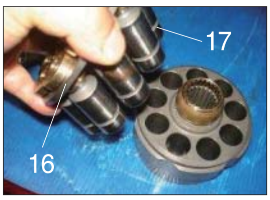
145Z9A8TM57

145Z9A8TM58


145Z9A8TM59

145Z9A8TM60

145Z9A8TM61



145Z9A8TM62

145Z9A8TM63

(8) Assemble friction plate (19), steel plate (18) into cylinder block in regular sequence.
Friction plate : 3 EA
Steel Plate : 4 EA

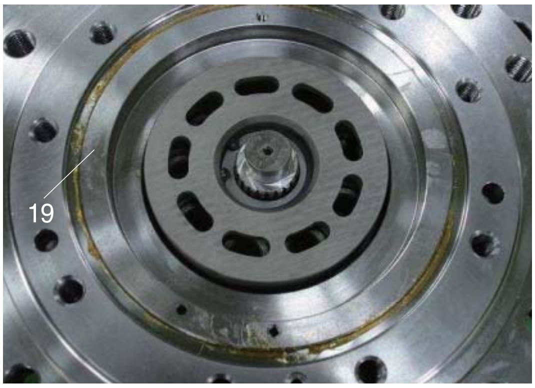
145Z9A8TM65

145Z9A8TM64

145Z9A8TM66

(9) Assemble parking piston (20) into shaft casing (1) using a jig.

145Z9A8TM68



145Z9A8TM67

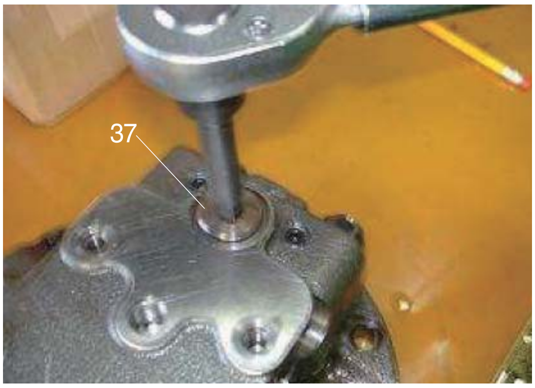
(10) Put O-ring (23) into shaft casing (1).
Apply the grease to O-ring.

145Z9A8TM69

(11) Put spring (36), two speed control spool (35) into valve casing (25) in regular sequence and assemble plug (37) into valve casing (25) using a torque wrench.

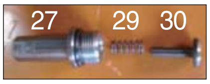
- Tighten torque : 10 kgf-m (72.3 lbf-ft)

145Z9A8TM70



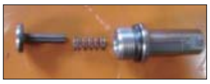
145Z9A8TM71

(12) Assemble check (30), spring (29), plug (27) into main spool (26) in regular sequence.



145Z9A8TM72

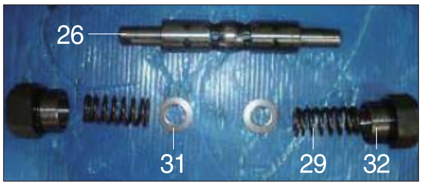
145Z9A8TM73


145Z9A8TM74

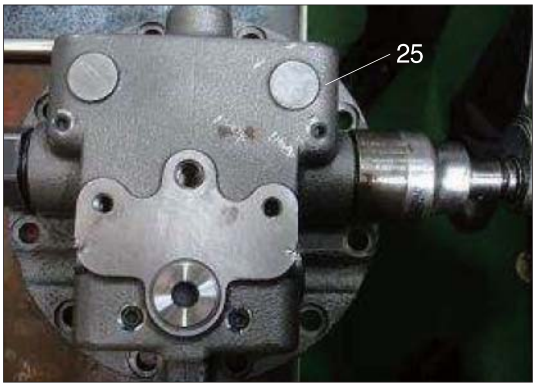

145Z9A8TM75

(13) Put the main spool (26) into valve casing (25) and assemble plate (31), spring (29) into it. Tighten main spool plug (32) using a torque wrench.

- Tighten torque : 45 kgf-m (325.5 lbf-ft)



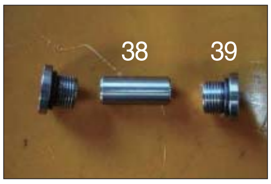
145Z9A8TM76



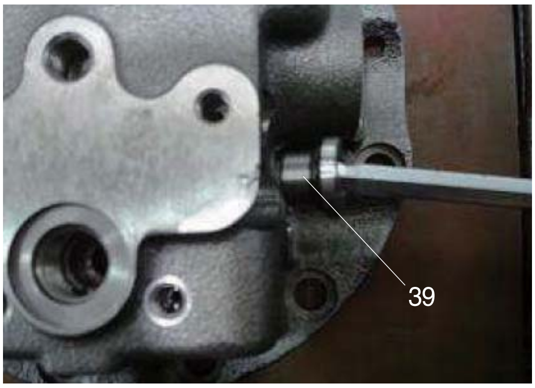
145Z9A8TM77

(14) Put relief valve damping piston (38) into valve casing (25) and assemble plug (39) into valve casing (25).

- Tighten torque : 6 kgf-m (43.4 lbf-ft)



145Z9A8TM78



145Z9A8TM79

(15) Put steel ball (41), orifice (42) into valve casing (25) and tighten the plug (43).
- Tighten torque : 1.25 kgf-m (9.0 lbf-ft)

145Z9A8TM80

145Z9A8TM81

(16) Put steel ball (56) into valve casing (25) and tighten the plug (57).
- Tighten torque : 1.25 kgf-m (9.0 lbf-ft)

145Z9A8TM82

145Z9A8TM83

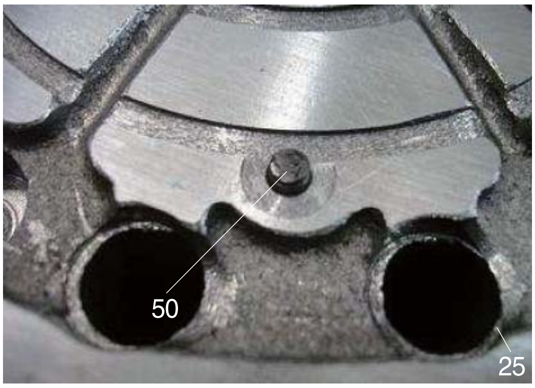
(17) Assemble orifice (63) into valve casing (25) and tighten the plug (43).
- Tighten torque : 1.25 kgf-m (9.0 lbf-ft)

145Z9A8TM84

(18) Assemble orifice (63) into valve casing (25) and tighten the plug (47).
- Tighten torque : 0.7~1.1 kgf-m (5.1~8.0 lbf-ft)

145Z9A8TM85

(19) Assemble pin (50) into valve casing (25).



145Z9A8TM86

(20) Assemble pin (5) into valve casing (25).

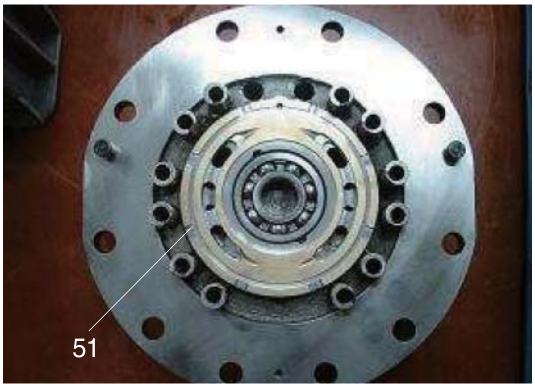
145Z9A8TM87

(21) Assemble ball bearing (49) into valve casing (25).

145Z9A8TM88

(22) Apply grease on the face of valve plate and assemble valve plate (51) into valve casing (25).

145Z9A8TM89



145Z9A8TM90

(23) Apply grease to brake spring (52)-12EA and assemble brake spring (52)-12EA into valve casing (25).

145Z9A8TM91

(24) Assemble valve casing (25) into shaft casing (1) and tighten the wrench bolt (53) using a torque wrench.

· Tighten torque : 10.4 kgf-m (75.2 lbf-ft)

145Z9A8TM92

(25) Assemble relief valve (48) into valve casing (25) using a torque wrench.

· Tighten torque : 10 kgf-m (72.3 lbf-ft)

145Z9A8TM93

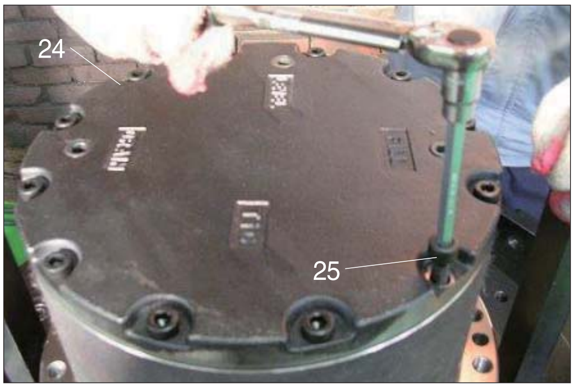
145Z9A8TM94

4) DISASSEMBLING REDUCTION GEAR

(1) Loose plug (26)-3EA and drain reduction oil.

145Z9A8TR02

(2) Loose wrench bolt (25) using a tool.



145Z9A8TR03

(3) Disassemble end cover (24).

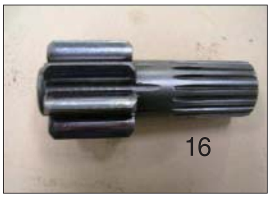
145Z9A8TR04

(4) Disassemble trust plate (23).

145Z9A8TR05

145Z9A8TR06

(5) Disassemble driver gear (16).



145Z9A8TR07

145Z9A8TR08

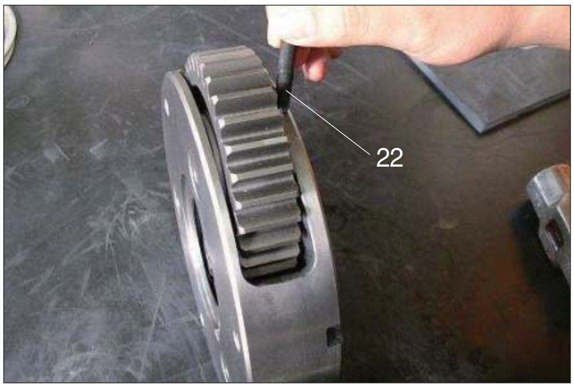
(6) Disassemble carrier No.1 (17) sub assy.

※ Assemble eyebolt into carrier No.1 tap hole and disassemble carrier No.1 (17) sub assy using a hoist.

145Z9A8TR09

(7) Disassemble carrier No.1 sub assy.

※ Remove spring pin No.1 (22) from carrier No.1 (17) and planetary gear No.1 (18), washer No.1 (19), needle bearing No.1 (20), carrier pin No.1 (21) in regular sequence.



145Z9A8TR10

145Z9A8TR11

145Z9A8TR12

145Z9A8TR13

145Z9A8TR14

(8) Disassemble carrier No.2 (7) sub assy.

※ Assemble eyebolt into carrier No.2 tap hole and disassemble carrier No.2 (7) sub assy using a hoist.

145Z9A8TR15

(9) Disassemble carrier No.2 (7) sub assy.

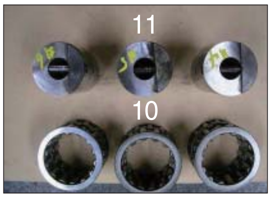
※ Remove spring pin No.2 (12) from carrier No.2 (7) and disassemble planetary gear No.2 (8), washer No.2 (9), needle bearing No.2 (10), carrier pin No.2 (11) in regular sequence.

145Z9A8TR16

145Z9A8TR17

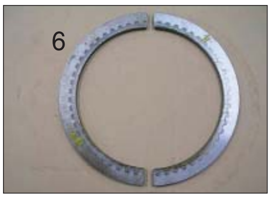
145Z9A8TR18

145Z9A8TR19



145Z9A8TR20

(10) Push down ring gear (4) using a jig and disassemble shim (6).



145Z9A8TR21

145Z9A8TR22

(11)Disassemble ring gear sub assy (4) into motor assy.

※ Assemble eye bolt into tap hole of ring gear sub assy (4) and disassemble ring gear sub assy (4) using a hoist.

145Z9A8TR23

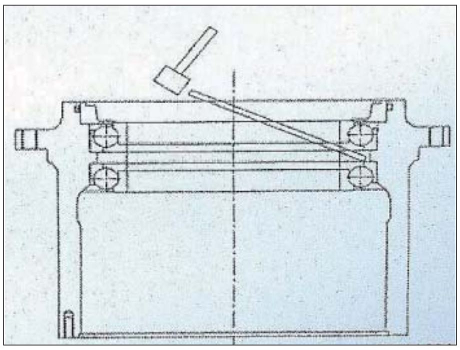
(12)Disassemble floating seal (2) from ring gear sub assy (4).

145Z9A8TR24

145Z9A8TR25

(13)Disassemble angular bearing (3) from ring gear sub assy (4).

※ Be careful not to damage the parts using a hammer.



145Z9A8TR26

5) ASSEMBLING REDUCTION GEAR

Before assembing please observe following item.

- Wash all parts cleanly using solvent and dry all parts perfectly using compressed air.
- Check metal dust in casing and cleansing solution.
- Before application packing, please remove oil certainly.
- Before insert needle bearing, apply grease to bearing inlet enough.
- Apply lubricant to rotation part and sliding part.
- Damaged part or discolored part exchanges by new parts.

(1) Assemble hub

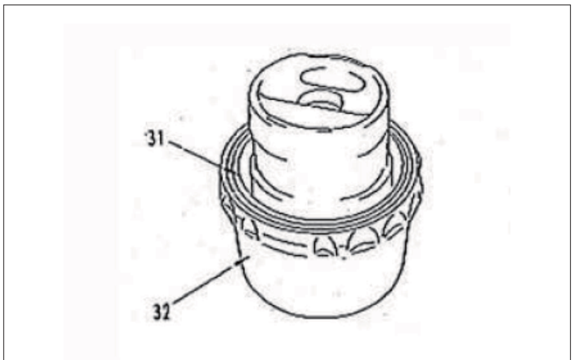
① Place the motor assy on the bench and assemble floating seal (2) into motor (1) using a jig.

145Z9A8TR27

145Z9A8TR28

② Remove completely the oil of surface that O-ring and O-ring contact.

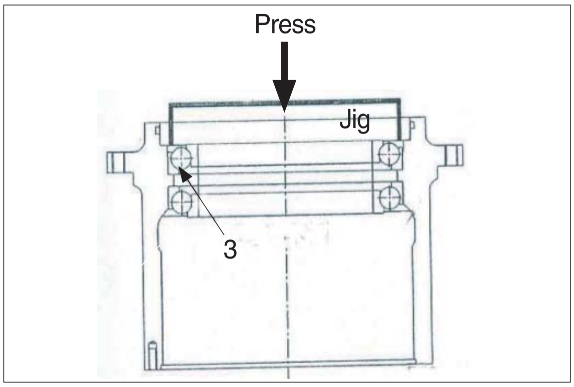
- Dry completely the floating seal.
- After assembling the floating seal, coat lubricant to the sliding surface of the floating seal.



145Z9A8TR29

(2) Press angular bearing (3) into ring gear (4) using a jig.

145Z9A8TR30



145Z9A8TR31

(3) Assemble floating seal(2) into ring gear(4) using a jig.

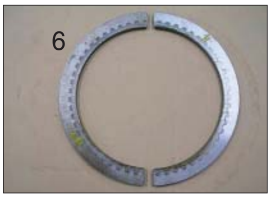
145Z9A8TR32

145Z9A8TR33

(4) Assemble ring gear sub assy (4) into motor assy using a assembly epuipment.

145Z9A8TR34

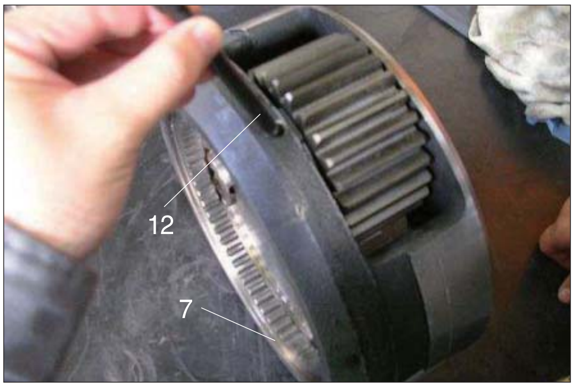
(5) Push down ring gear (4) using a jig and assemble shim (6).



145Z9A8TR35

145Z9A8TR36

(6) Assemble carrier No.2 sub assy.
- Assemble planetary gear No.2 (8), washer No.2 (9), needle bearing No.2 (10) and carrier pin No.2 (11) into carrier No.2 (7) in regular sequence.
  Assemble spring pin No.2 (12).
- Assemble spring pin No.2 (12) and caulk spring pin into pin hole.

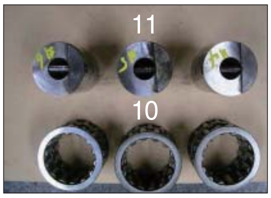


145Z9A8TR37

145Z9A8TR38

145Z9A8TR39

145Z9A8TR40

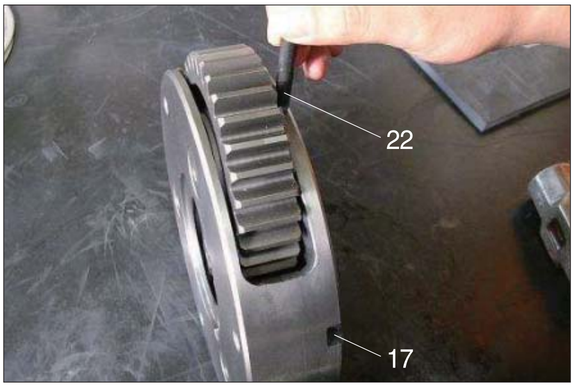


145Z9A8TR41

(7) Disassemble carrier No.2 (7) sub assy.
- Assemble eyebolt into carrier No.2 and assemble carrier No.2 (7) sub assy into ring gear using hoist.

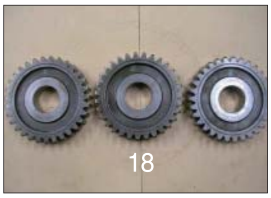
145Z9A8TR42

(8) Disassemble carrier No.2 (7) sub assy.
- Assemble planetary gear No.1 (18), washer No.1 (19), needle bearing No.1 (20) and carrier pin No.1 (21) into carrier No.1 (17) in regular sequence.
  Assemble spring pin No.1 (22)
- Assemble spring pin No.1 (22) and caulk spring pin into pin hole.



145Z9A8TR43

145Z9A8TR44



145Z9A8TR45

145Z9A8TR46

145Z9A8TR47

(9) Assemble carrier No.1 (17) sub assy.
- Assemble eyebolt into carrier No.1 and assemble carrier No.1 (17) sub assy into ring gear using hoist.

145Z9A8TR48

(10) Assemble driver gear(16).

145Z9A8TR49

145Z9A8TR50

(11) Assemble trust plate (23).

145Z9A8TR51

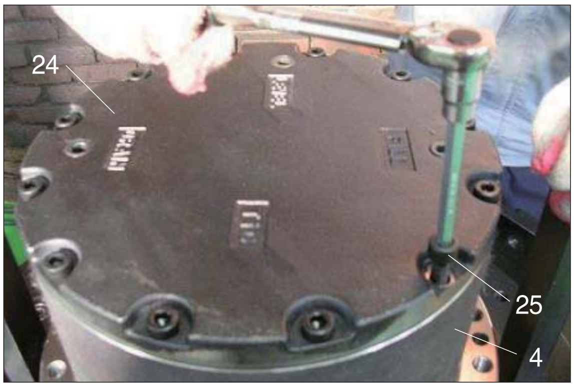
145Z9A8TR52

(12) Assemble end cover (24).

145Z9A8TR53

(13)Tighten wrench bolt (25) using a air impact.

· Tighten torque : 68 kgf-m (491.8 lbf-ft)

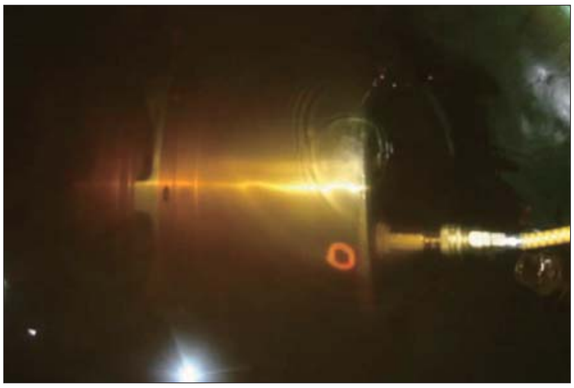


145Z9A8TR54

(14)Adjust control lever to be sunk the product under the test oil and then check the air leak.

*TEST : Air pressure 0.7 kgf/cm² × 30sec

145Z9A8TR55



145Z9A8TR56

(15)Inject gear oil and assemble plug (26)-3EA.

- Volume of gear oil : 2.2 ℓ

· Tightening torque : 10 kgf-m (72.3 lbf-ft)

145Z9A8TR57

■ TRAVEL MOTOR (TYPE 3, 4)

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.

13031GE18

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**

(5) Remove the cover.

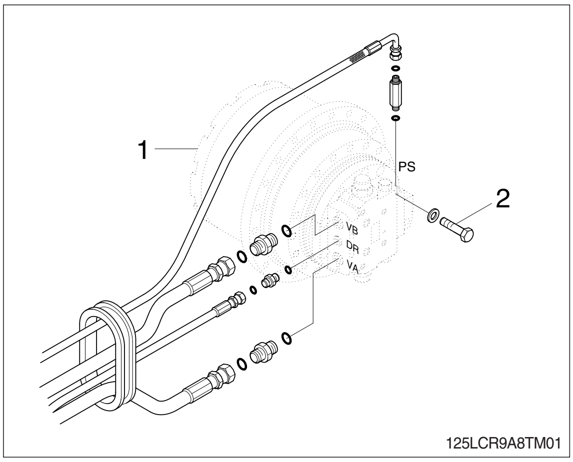
(6) Remove the hose.

※ 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 : 140 ㎏ (310 ㏓)



125LCR9A8TM01

2) INSTALL

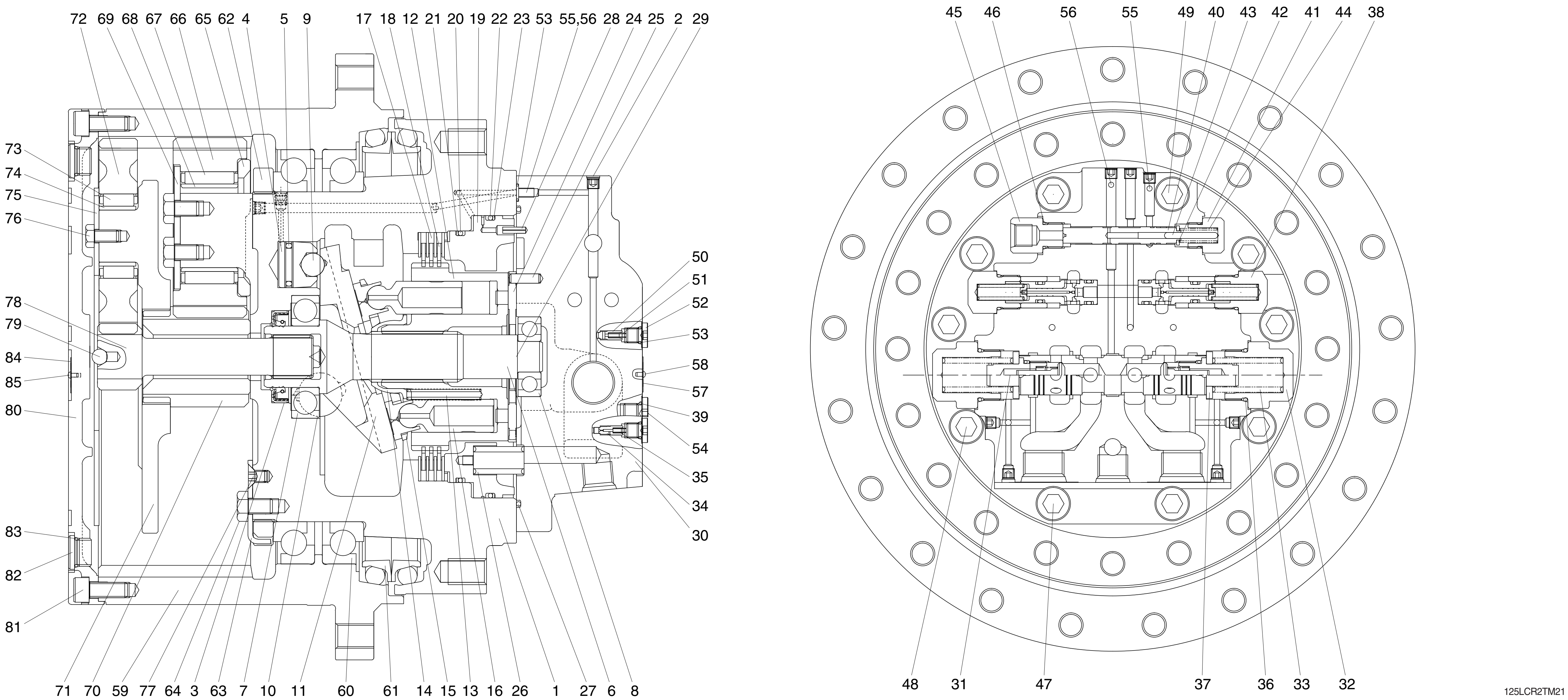
(1) Carry out installation in the reverse order to removal.

(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



1 Casing
2 Plug
3 Oil seal
4 Piston
5 Piston seal
6 Shaft
7 Front ball bearing
8 Rear ball bearing
9 Steel ball
10 Steel ball
11 Swash plate
12 Cylinder block
13 Spring
14 Ball guide
15 Retainer plate
16 Piston assy
17 Friction plate
18 Separated plate
19 Parking piston
20 O-ring
21 Back up ring
22 O-ring
23 Back up ring
24 Valve plate
25 Spring pin
26 Spring
27 O-ring
28 Spring pin
29 Parallel pin
30 Rear cover
31 Main spool assy
32 Cover
33 Spring
34 Restrictor
35 Spring
36 O-ring
37 Spring seat
38 Relief valve assy
39 O-ring
40 Spool
41 Plug
42 Spring seat
43 Parallel pin
44 Spring
45 Connector
46 O-ring
47 Hexagon socket head bolt
48 Hexagon socket head bolt
49 Hexagon socket head bolt
50 Check valve
51 Spring
52 Plug
53 O-ring
54 Plug
55 Restrictor
56 Restrictor
57 Name plate
58 Rivet
59 Ring gear
60 Bearing
61 Floating seal assy
62 Nut ring
63 Lock plate
64 Hexagon head bolt
65 Thrust plate No. 2
66 Planetary gear No.2
67 Needle bearing No.2
68 Inner race No. 2
69 Thrust washer No. 2
70 Sun gear No.2
71 Carrier No.1
72 Planetary gear No.1
73 Needle bearing No.1
74 Inner race No. 1
75 Thrust plate No. 1
76 Hexagon head bolt
77 Countersunk head screw
78 Sun gear No.1
79 Steel ball
80 Cover
81 Hex socket head bolt
82 Plug
83 O-ring
84 Name plate
85 Rivet

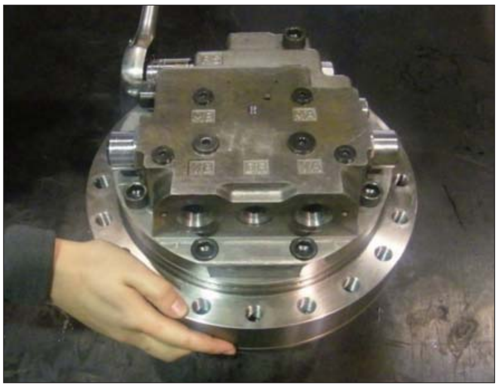
2) DISASSEMBLY

(1) Choose a clean place, remove contaminants (dust, etc) and cleans motor before placing it on worktable.

※ Lay the rubber plate on worktable and take care not to damage the component.

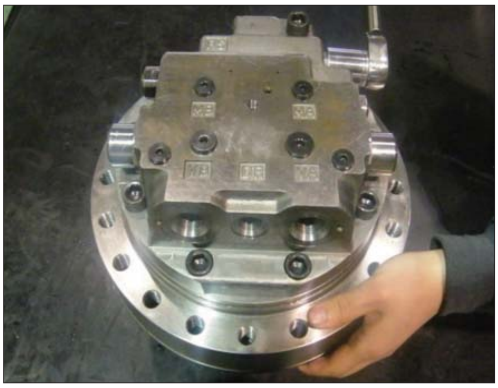
125LCR8TM02

(2) Remove the connector (45) using 21 mm socket wrench.



125LCR8TM03

(3) Remove plug (41) using 21 mm socket wrench.

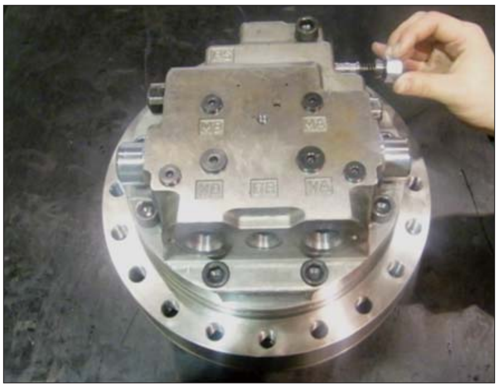


125LCR8TM04

(4) Disassemble parallel pin (43) and spring (44).

※ Do not lose spring.

※ Do not mix spring with other springs.

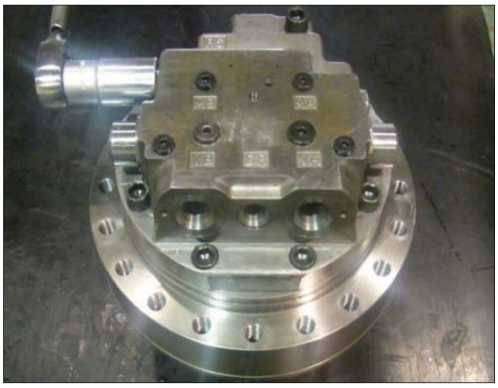


125LCR8TM05

(5) Remove spring seat (42) and spool (40).

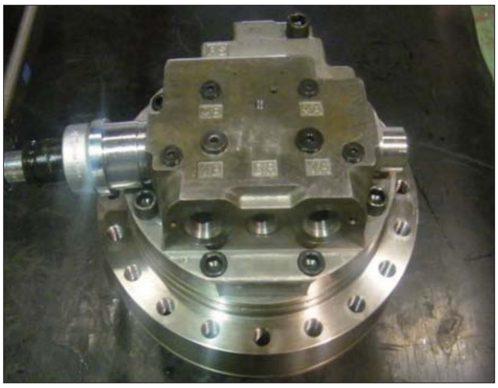
125LCR8TM06

(6) Disassemble relief valve assembly (38) using 26 mm socket wrench. (2 sets)



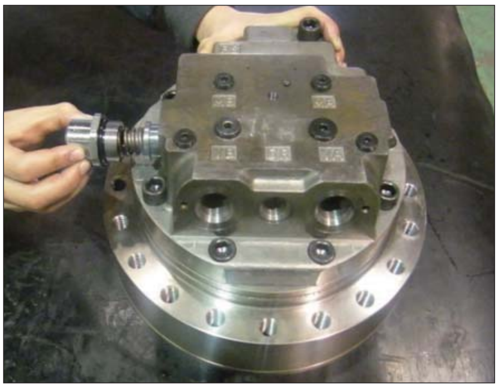
125LCR8TM07

(7) Disassemble cover (32) using 41 mm socket wrench.



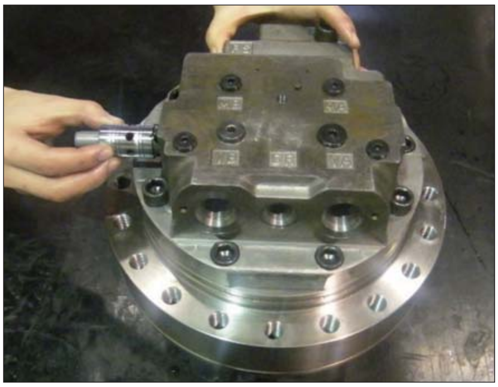
125LCR8TM08

(8) Disassemble spring seat (37) and spring (33). (2 sets)



125LCR8TM09

(9) Separate main spool assembly (31) from rear cover.



125LCR8TM10

(10) Unscrew socket bolt (47) (1EA), (48) (3EA), (49) (6EA) from rear cover.

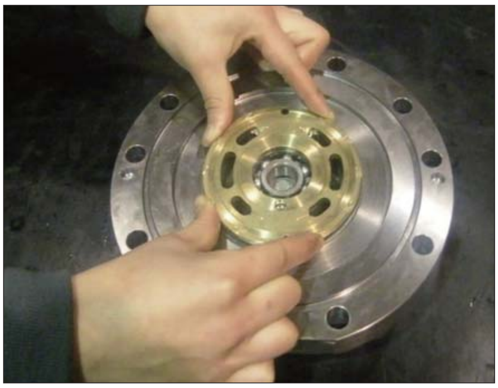
125LCR8TM11

(11) Remove parallel pin (29).

125LCR8TM12

(12) From rear cover, disassemble valve plate (24) and O-ring (27).

※ Take care not to damage assembly surface of rear cover.

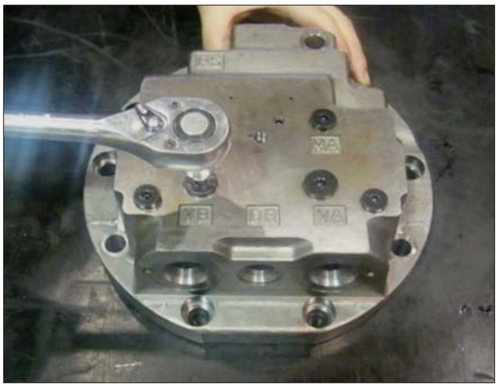


125LCR8TM13

(13) Disassemble restrictor (55, 56) (2EA).
※ Mark the number on restrictor and its hole to avoid confusing (55) and (56).

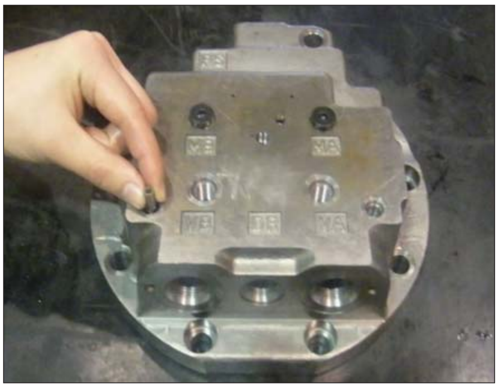
125LCR8TM14

(14) Remove plug (52).



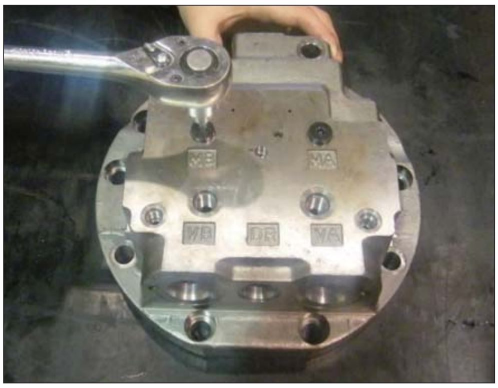
125LCR8TM15

(15) Remove restrictor (34) and spring (35). (2 sets)
※ Do not confuse restrictor (34) and check valve (50).
※ Do not confuse spring (35) and spring (51).
※ Do not lose spring.
※ Do not mix spring with other springs.



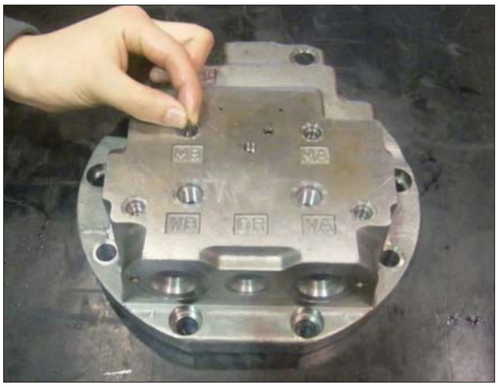
125LCR8TM16

(16) Remove plug (52) using 5 mm hexagon wrench.



125LCR8TM17

(17) Remove check valve (50) and spring (51). (2 sets)
※ Do not confuse restrictor (34) and check valve (50).
※ Do not confuse spring (35) and spring (51).
※ Do not lose spring.
※ Do not mix spring with other springs.



125LCR8TM18

(18) From parking piston, remove spring (26) (12ea).
※ Do not lose spring.
※ Do not mix spring with other springs.

125LCR8TM19

(19) Disassemble parking piston (19) using air gun or jig.

125LCR8TM20

(20) From parking piston, separate O-ring (22) and back-up ring (23).

125LCR8TM21

(21) From parking piston separate O-ring (20) and back-up ring (21).

125LCR8TM22

(22) Lay casing down horizontally and remove cylinder block assembly, friction plate (17) (3EA) and separator plate (18) (4EA).

125LCR8TM23

(23) Separate retainer plate (15) and piston assembly (16).

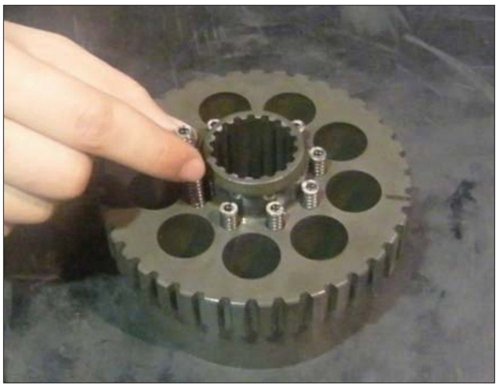
※ Take care not to damage sliding surface of each component.

125LCR8TM24

(24) Disassemble ball guide (14) and spring (13) (9EA).

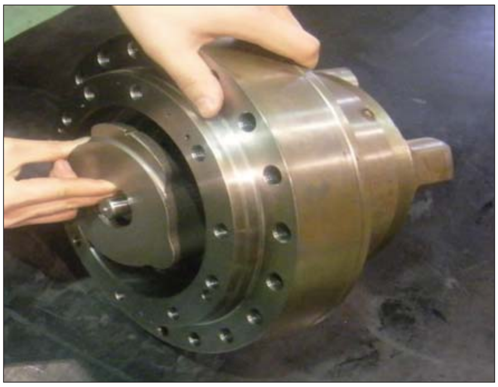
※ Do not lose spring.

※ Do not mix spring with other springs.



125LCR8TM25

(25) Disassemble swash plate (11) and steel ball (10).
※ Take care not to damage sliding surface.


125LCR8TM26

(26) Disassemble shaft (6) and ball bearing (7).
※ Do not remove ball bearing unless malfunction is detected, since it is mounted by shrink fit.


125LCR8TM27

(27) Disassemble 1, 2 speed piston (4) and steel ball (9) using air gun.


125LCR8TM28

(28) Disassemble piston seal (5).


125LCR8TM29

(29) Turn casing (1) upside down and remove oil seal (3) using jig.

125LCR8TM30

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 sealwith new parts is generally recommended.
⑤ Use a torque wrench to make sure that assembly fasteners are tightened to specified values shown table1.
⑥ When assembling bolt, spread Loctite.

(1) Put casing (1) on the worktable.

125LCR8TM31

(2) After applying grease on the external diameter of oil seal (3), insert oil seal in casing.

125LCR8TM32

(3) After applying grease on steel ball (10), insert steel ball in casing.

125LCR8TM33

(4) After assembling piston seal (5) and steel ball (9) in 1, 2 speed piston (4), insert piston in hole of casing.

※ Check whether piston sticks in hole.

※ Use piston seal jig.

125LCR8TM34

(5) Mount ball bearing (7) on shaft (6) by shrink fit. Insert shaft in casing.

※ Take care not to damage oil seal.

125LCR8TM35

(6) Assemble swash plate (11) by matching its hole and steel ball.

※ Take care not to damage sliding surface.

125LCR8TM36

(7) Assemble spring (13) (9ea) and ball guide (14) in cylinder block (12) in that order.

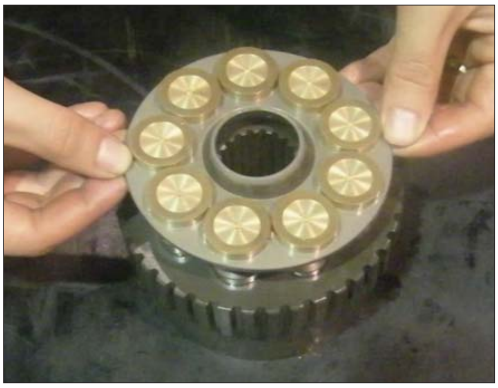
125LCR8TM37

(8) Insert piston assembly (16) in retainer plate (15) and assemble them in cylinder block.

※ Spread hydraulic oil on piston assembly.

※ Take care not to damage each component.

※ Check cylinder block and piston assembly runs properly.

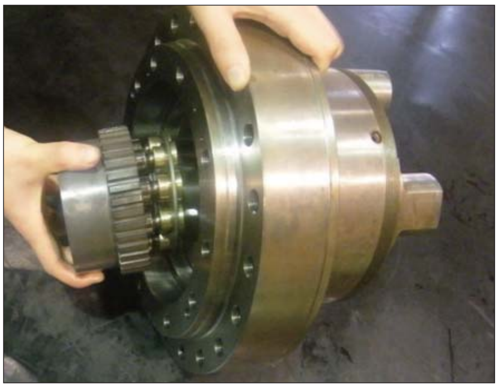


125LCR8TM38

(9) Lay casing down horizontally and assemble cylinder block assembly by matching its spline with shaft.

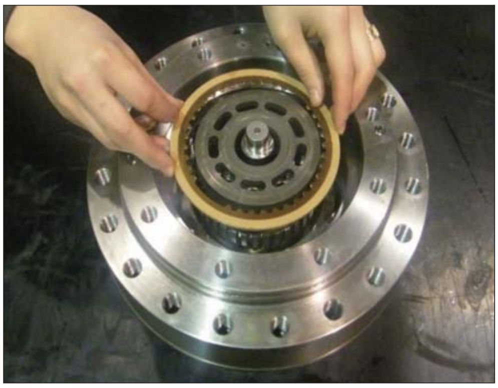
※ Make sure swash plate stays in place.

※ Check the assembling status of cylinder block by pressing it.



125LCR8TM39

(10) Assemble separator plate (18) (4EA) and friction plate (17) (3EA) alternately.



125LCR8TM40

(11) Insert back-up ring & O-ring in parking piston.

125LCR8TM41

(12) Align the pin hole of parking piston (19) with oil hole of casing, assemble them using jig.

※ Spread grease on O-ring and back-up ring.

※ Take care not to damage components.

125LCR8TM42

(13) Insert spring (26) (12EA) in parking piston.

125LCR8TM43

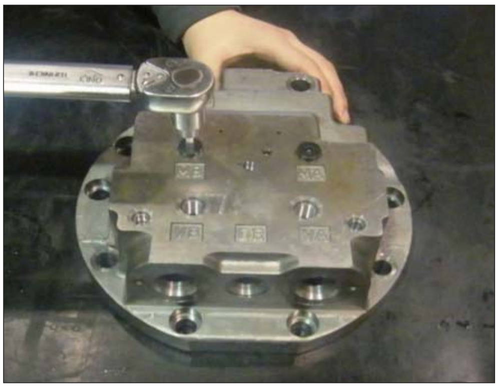
(14) Insert parallel pin (29) (2EA) in casing.

125LCR8TM44

(15) Assemble check valve (50) and spring (51) in order.
※ Do not confuse check valve (50) and restrictor (34).
※ Do not confuse spring (51) and spring (35)

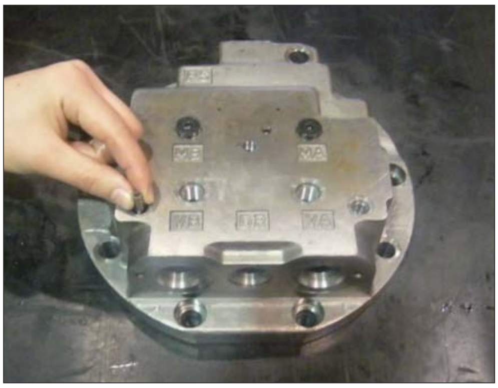
125LCR8TM45

(16) Clamp plug (52) using 5 mm hexagon wrench.
※ Tightening torque : 1.5 kgf · m (10.9 lbf · ft)



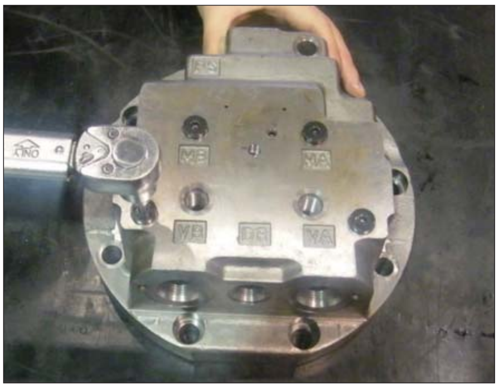
125LCR8TM46

(17) Assemble restrictor (34) and spring (35) in order.
※ Do not confuse check valve (50) and restrictor (34).
※ Do not confuse spring (51) and spring (35).



125LCR8TM47

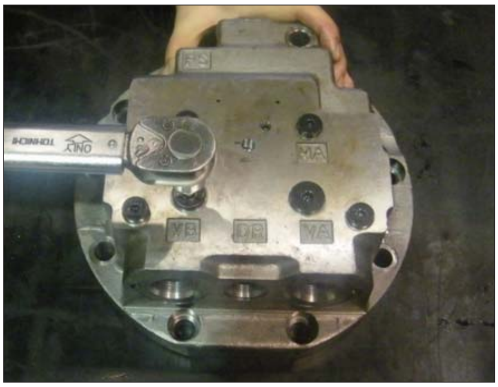
(18) Clamp plug (52).
※ Tightening torque : 1.5 kgf · m (10.9 lbf · ft)



125LCR8TM48

(19) Clamp plug (54).

※ Tightening torque : 3 kgf · m (21.7 lbf · ft)

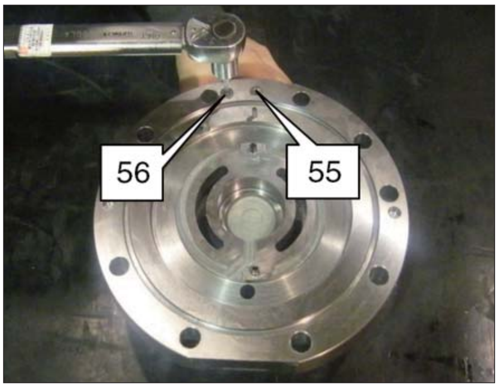


125LCR8TM49

(20) Assemble restrictor (55) and (56) in rear cover.

※ Check whether the restrictor is placed in exact hole.

※ Do not confuse (55) and (56).



125LCR8TM50

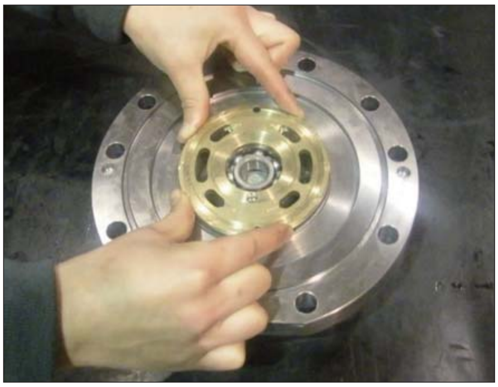
(21) Assemble ball bearing (8) in rear cover using jig.

125LCR8TM51

(22) Insert spring pin (25) (2ea) and (28) in rear cover using jig.

125LCR8TM52

(23) After spreading grease sufficiently to the bottom side of valve plate (24), assemble valve plate in rear cover by matching its holes with pins.
※ Take care not to damage sliding surface.
※ Pay attention to the assembly direction.



125LCR8TM53

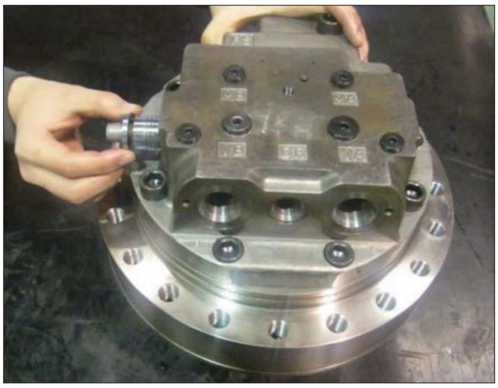
(24) Assemble O-ring (27) in rear cover.
※ Spread grease on O-ring.

125LCR8TM54

(25) Put rear cover upon casing, paying attention to the location of pin and hole. And tighten bolt (47), (48) and (49).
※ Tightening torque : 17.5 kgf · m (127 lbf · ft)
※ Make sure valve plate stays in place.
※ Check bolt position.

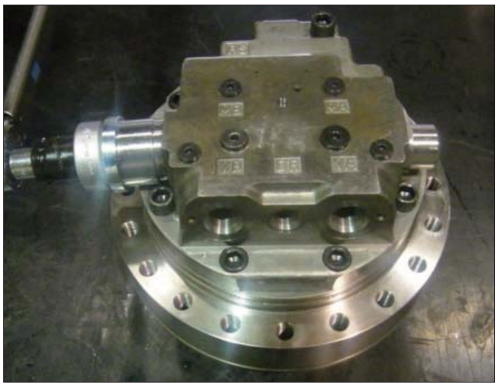
125LCR8TM55

(26) Assemble main spool assembly (31), spring seat (37) and spring (33) in rear cover.



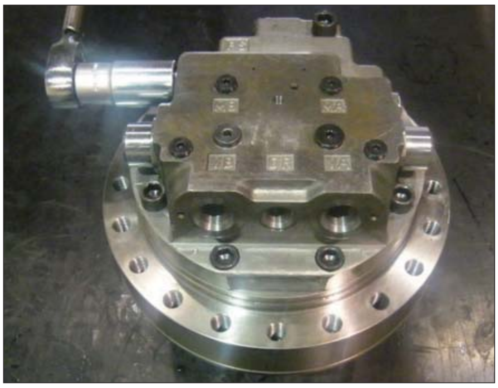
125LCR8TM56

(27) Settle cover (32).
※ Tightening torque : 15 kgf · m (108 lbf · ft)



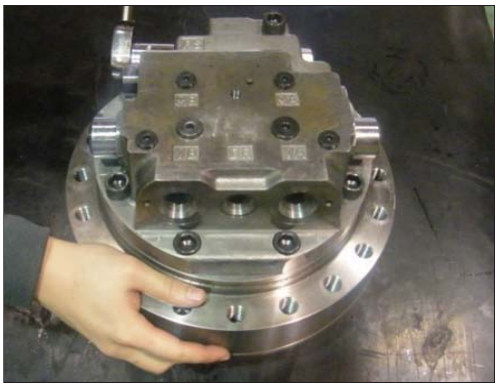
125LCR8TM57

(28) Insert relief valve (38) in rear cover.
※ Tightening torque : 15 kgf · m (108 lbf · ft)



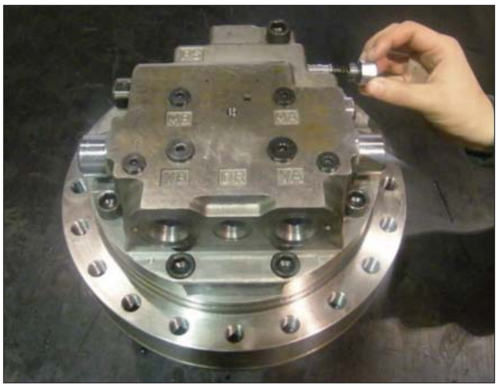
125LCR8TM58

(29) After clamping connector (45) to rear cover, assemble spool (40).
※ Tightening torque : 5 kgf · m (36 lbf · ft)



125LCR8TM59

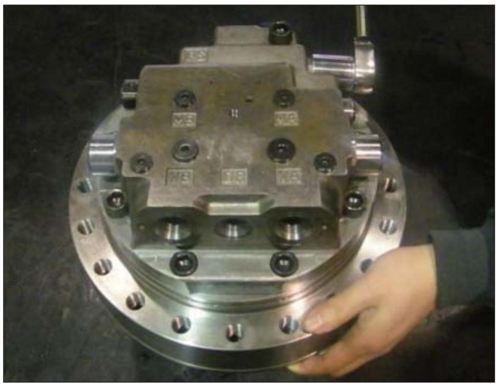
(30) After inserting parallel pin (43), assemble seat-spring (42).



125LCR8TM60

(31) After assembling spring (44) in order, clamp plug (41).

※ Tightening torque : 5 kgf · m (36 lbf · ft)



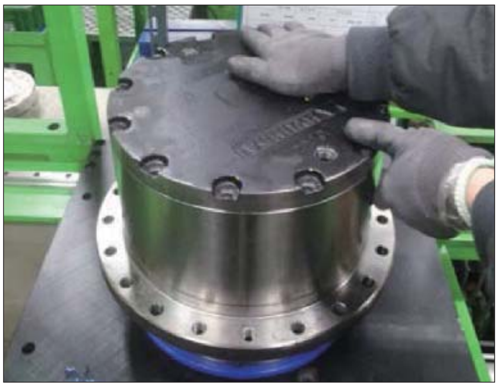
125LCR8TM61

3. TRAVEL REDUCTION GEAR DISASSEMBLY

1) While travel reduction gear is tilted to one side disassemble PF3/8 plug (24), remove gear oil and place motor sideto the bench.

125LCR8TM70

2) Disassemble cover (22) by unscrewing the M10 bolts (23) (12 pcs).



125LCR8TM71

3) Disassemble sun gear No.1 (20), steel ball (21).

125LCR8TM72

4) Disassemble carrier No.1 assembly.

125LCR8TM73

Carrier No. 1 sub assy disassembly

5) Disassemble M8 bolt (18) from the carrier assembly. (3 pcs)

125LCR8TM74

6) Disassemble thrust plate No.1 (17) from the carrier assembly.

125LCR8TM75

7) Disassemble planetary gear No.1 (14).(3 pcs)

125LCR8TM76

8) Disassemble needle bearing (15).(3 pcs)

※ Do not disassemble inner race in the absence of abnormalities.

125LCR8TM77

9) Disassemble Sun gear No.2 (12).

125LCR8TM78

10) Disassemble M10 bolt (6).(4 pcs)

125LCR8TM79

11) Disassemble thrust washer No.2 (11).(4 pcs)

125LCR8TM80

12) Disassemble planetary gear No.2 (8).(4 pcs)

125LCR8TM81

13) Disassemble needle bearing No.2 (9).(4 pcs)

125LCR8TM82

14) Disassemble thrust plate No.2 (7).(4 pcs)

※ Do not disassemble inner race in the absence of abnormalities.

125LCR8TM83

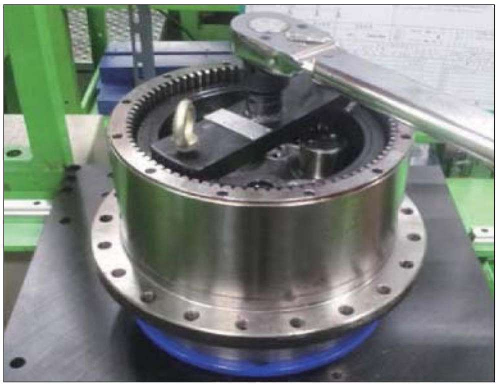
15) Disassemble M10 bolt (6) and M8 screw bolt (19).

125LCR8TM84

16) Disassemble lock plate (5).

125LCR8TM85

17) Disassemble nut ring (4) by using the jig.



125LCR8TM86

18) Disassemble ring gear sun assembly from motor assembly.

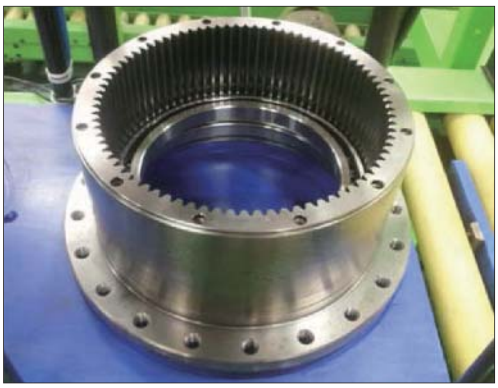
125LCR8TM87

19) Disassemble folating seal assembly (3) from ring gear sun assembly and motor assembly.

125LCR8TM88

20) Disassemble bearing (2) (2ea) from ring gear assembly.

※ Do not disassemble bearing in the absence of abnormalities.



125LCR8TM89

4. TRAVEL REDUCTION GEAR 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 carrier No.1 (13) on the jig, and shrink-fit inner race No.1 (16) to carrier pin.(3 places)
※ Do not tilt inner race to one side.
※ Match inner race and end of carrier pin.

125LCR8TM90

2) Assemble needle bearing No.1 (15).(3 pcs)

125LCR8TM91

3) Assemble planetary gear No.1 (14) of which groove is faced downward. (3 places)

125LCR8TM92

4) Assemble thrust plate No.1(17).

125LCR8TM93

5) After spreading loctite #242, assemble the M8 bolt (18).(3 pcs)

※ Tightening torque : 2.7 ± 0.3 kgf · m

※ After the assembly, instantly check the noise and interference by rotatong the gear.

125LCR8TM94

6) First, place bearing (2) on the ring gear (1), then put jig on it, then press it with press machine.

125LCR8TM95

7) After turning ring gear over, assemble bearing the same way.
※ Be care of nick and safety when turn ring gear over.


125LCR8TM96

8) Assemble folating seal assembly (3) by usingthe jig.
※ After assembling, wipe steel-lined section with alcohol.
※ Flatness deviation has to be less than 1 mm.


125LCR8TM97

9) Place folating seal assembly on the motor assembly then assemble it.
※ After assembling, wipe steel-lined section with alcohol.
※ Flatness deviation has to be less than 1 mm.


125LCR8TM98

10) After arriving safely ring gear sun assembly inthe motor assembly, press it with press machine.
※ After press-fitting, clamp ring gear to fixit.
※ When using the press pay attention to bearing damage.


125LCR8TM99

11) After assembling nut ring (4) by using the jig, disassemble the clamping.

※ Tightening torque : 60 kgf · m (434 lbf · ft)

125LCR8TM100

12) Place lock plate (5) on the nut ring groove.

※ Select best position from one of 4 casing hole to assemble lock plate.

125LCR8TM101

13) Place lock plate th the direction which nut ring is loosed and then assemble M10 bolt (6) with M8 screw (19) after spreading loctite #242.(Refer to assembly detail drawing)

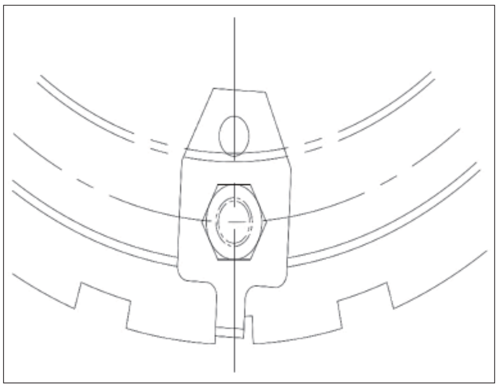
※ Tightening torque (M10) : 5.5 ± 0.6 kgf · m (39.8 ± 4.3 lbf · ft)

※ Tightening torque (M8) : 2.7 ± 0.3 kgf · m (19.5 ± 2.2 lbf · ft)

※ Make sure that M8 bolt doesn't stick out of lock plate.

125LCR8TM102

※ Assembly detail drawing lock plate.



125LCR8TM103

14) Shrink fit the inner race No.2 (10).(4 pcs)

125LCR8TM104

15) Assemble thrust plate No.2 (7).(4 pcs)

125LCR8TM105

16) Assemble needle bearing No.2 (9).(4 pcs)

125LCR8TM106

17) Assemble planetary gear No.2 (8).(4 pcs)

※ Grooves of planetary gear will be facingup.

125LCR8TM107

18) Assemble thrust washer No.2 (11).(4 pcs)

125LCR8TM108

19) After spreading loctite #242, assemble the M10 bolt (6).(4 pcs)

※ Tightening torque : 5.5 ± 0.6 kgf · m (39.8 ± 4.3 lbf · ft)

125LCR8TM109

20) Assemble sun gear No.2 (12).

125LCR8TM110

21) Assemble carrier No.1 assembly.

125LCR8TM111

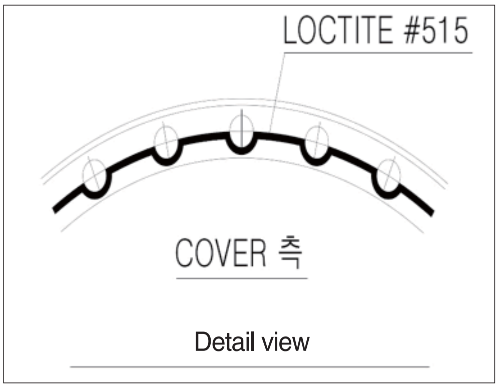
22) Assemble sun gear No.1 (20).

125LCR8TM112

23) Place steel ball (21) on the sun gear No.1.

125LCR8TM113

24) Spread the loctite #515 on the cover (22) with reference to the right detail view.



125LCR8TM114

25) Place cover (22) to fit the bolt holes.

125LCR8TM115

26) After spreading loctite #242, assemble the M10 bolt (23).(12 pcs)
※ Tightening torque : 6.3 ± 0.7 kgf · m
(45.6 ± 5.1 lbf · ft)


125LCR8TM116

27) Inject the 2.5 ± 0.3 liter gear oil to PF3/8 tap section.


125LCR8TM117

28) After assembling the O-ring (25) to the plug (24), assemble it to the cover.(3 pcs)
※ Tightening torque : 5 ± 0.5 kgf · m
(36.2 ± 3.6 lbf · ft)


125LCR8TM118

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

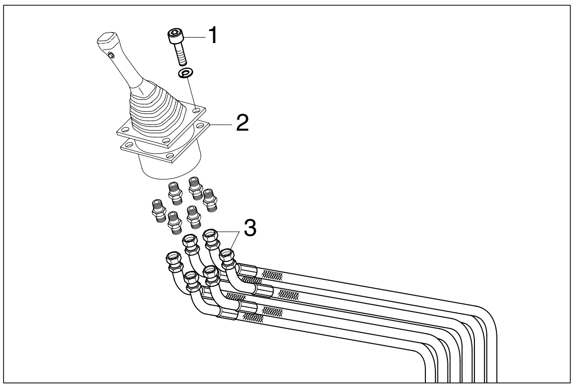
1) REMOVAL

(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(2).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses(3).

(7) Remove the pilot valve assembly(1).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.

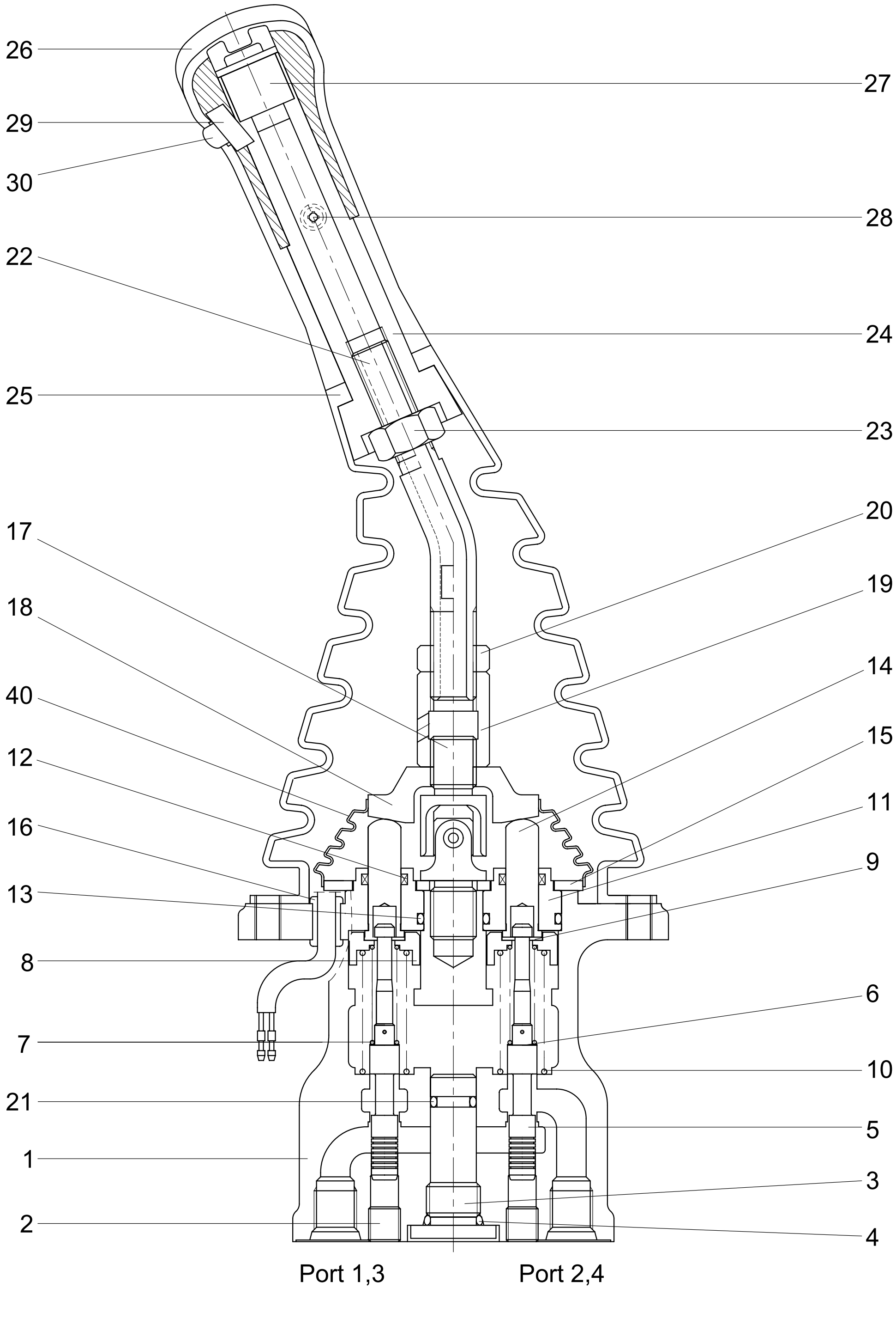
2) INSTALL

(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

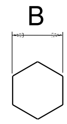
1) STRUCTURE



1	Case	11	Plug	21	O-ring
2	Plug	12	Rod seal	22	Handle connector
3	Plug	13	O-ring	23	Nut
4	O-ring	14	Push rod	24	Insert
5	Spool	15	Plate	25	Boot
6	Shim	16	Bushing	26	Handle
7	Spring	17	Joint assembly	27	Switch assembly
8	Spring seat	18	Swash plate	28	Screw
9	Stopper	19	Adjusting nut	29	Switch assembly
10	Spring	20	Lock nut	30	Switch cover
				40	Boot

2) TOOLS AND TIGHTENING TORQUE

(1)

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	18	M14	3.5	25.3
Swash plate	19	M14	5.0±0.35	36.2±2.5
Adjusting nut	20	M14	5.0±0.35	36.2±2.5
Lock nut	21	M14	5.0±0.35	36.2±2.5
Screw	29	M 3	0.05	0.36

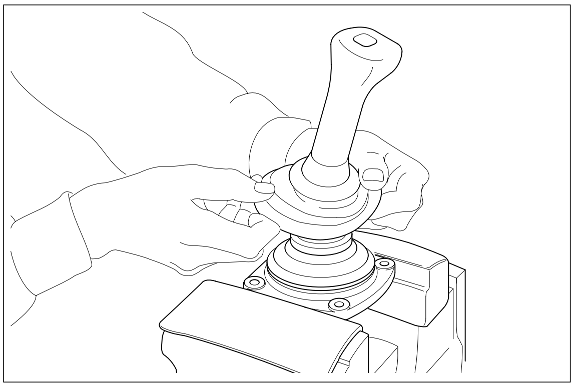
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

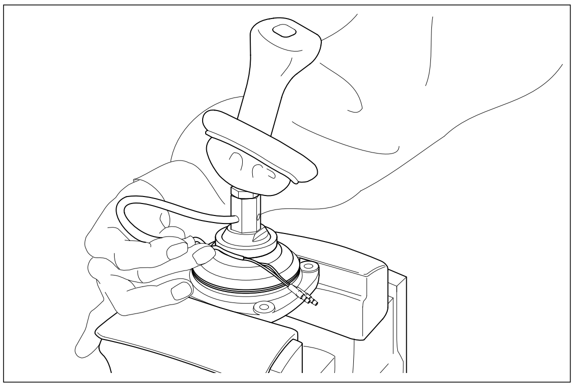
※ Put blind plugs into all ports

(2) Fix pilot valve in a vise with copper(or lead) sheets.

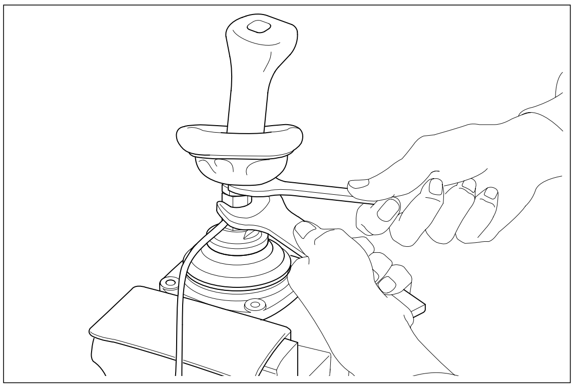
(3) Remove end of boot(26) from case(1) and take it out upwards.



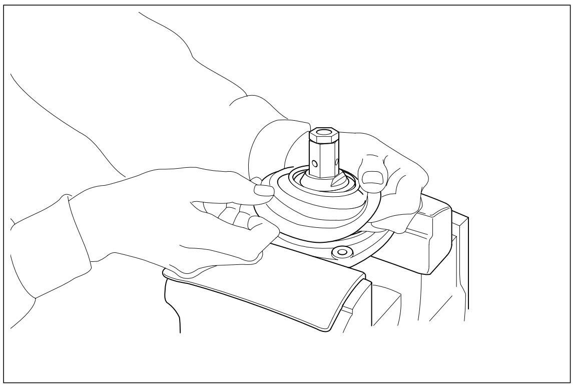
※ For valve with switch, remove cord also through hole of casing.



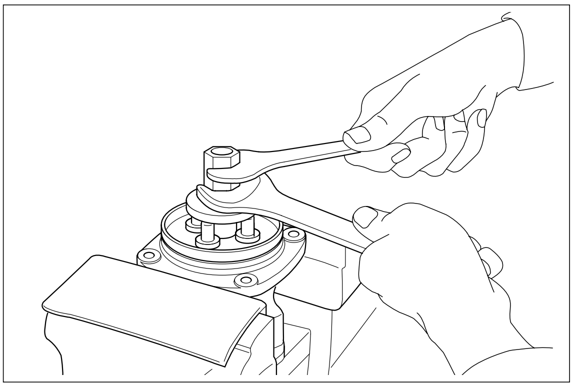
(4) Loosen lock nut(21) and adjusting nut(20) with spanners on them respectively, and take out handle section as one body.

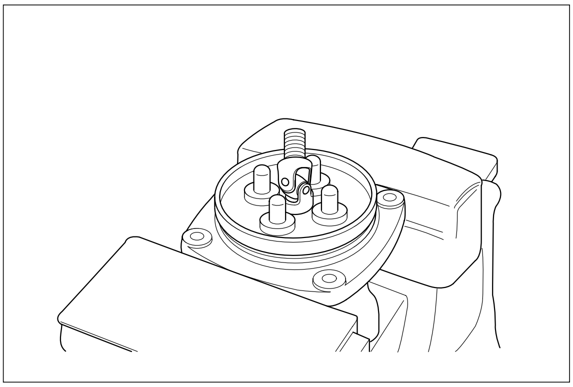


(5) Remove the boot(40)



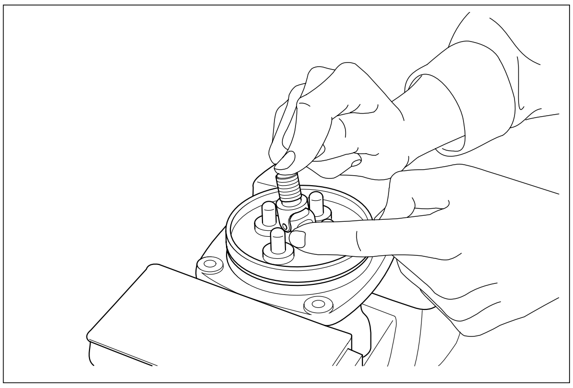
(6) Loosen adjusting nut(20) and plate(19) with spanners on them respectively, and remove them.

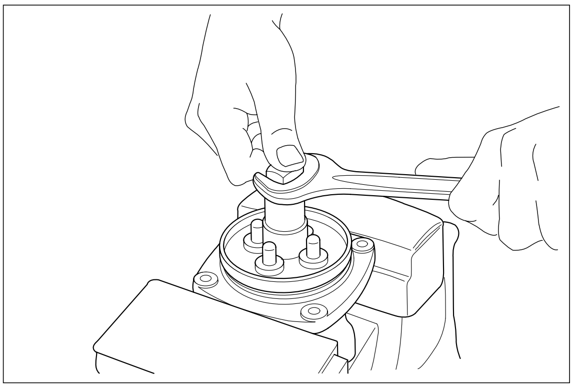




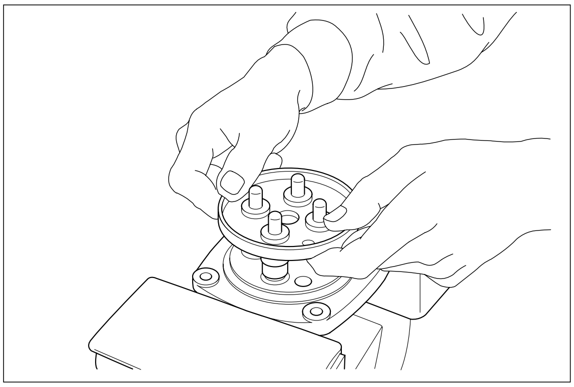
(7) Turn joint anticlockwise to loosen it, utilizing jig(Special tool).

※ When return spring(10) is strong in force, plate(16), plug(11) and push rod(14, 15) will come up on loosening joint.
Pay attention to this.





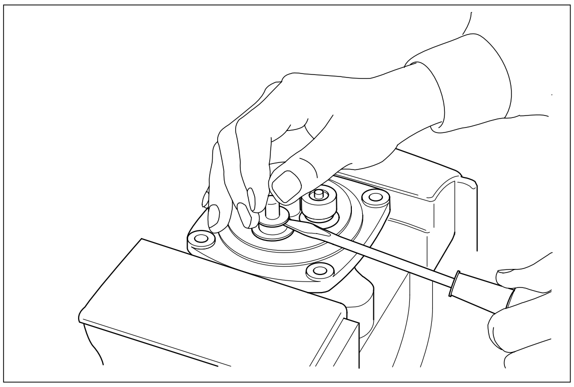
(8) Remove plate(16).



(9) When return spring(10) is weak in force, plug(11) stays in casing because of sliding resistance of O-ring.

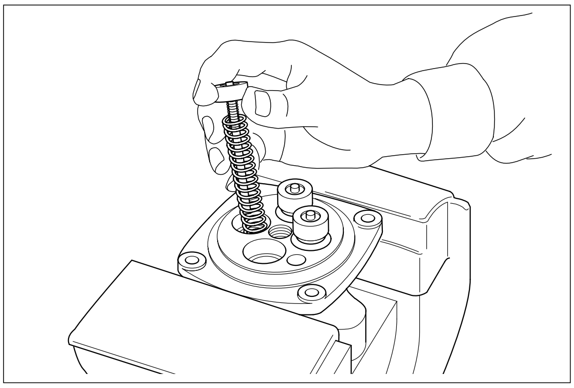
※ Take it out with minus screwdriver. Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ During taking out, plug may jump up due to return spring(10) force. Pay attention to this.

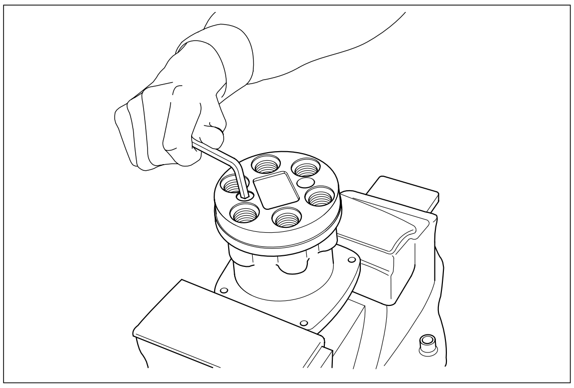


(10) Remove reducing valve subassembly and return spring(10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

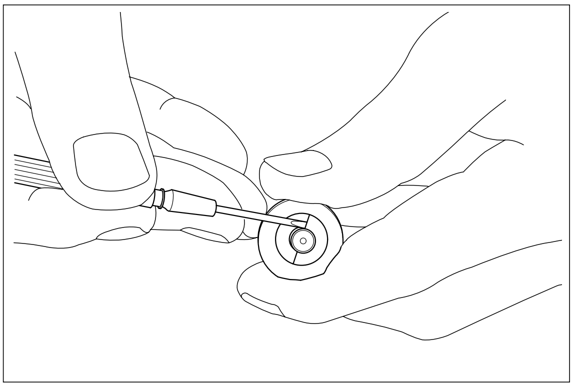


(12) For disassembling reducing valve section, stand it vertically with spool(5) bottom placed on flat workbench. Push down spring seat(8, 31) and remove two pieces of semicircular stopper(9) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

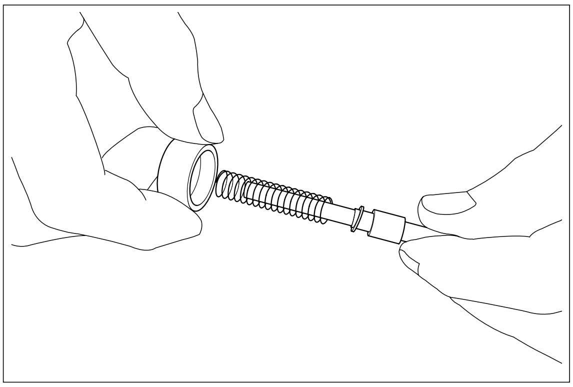
※ Record original position of spring seat(8, 31).

※ Do not push down spring seat more than 6mm.

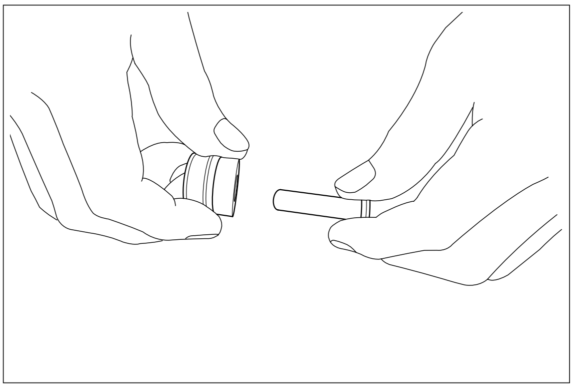


(13) Separate spool(5), spring seat(8, 31), spring(7, 30) and shim(6) individually.

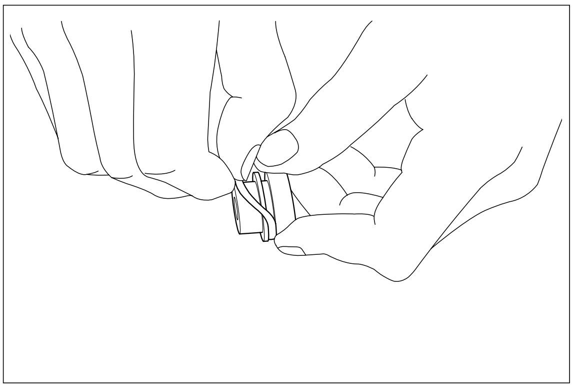
※ Until being assembled, they should be handled as one subassembly group.

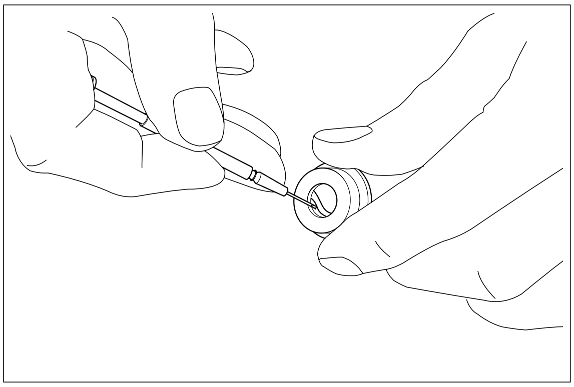


(14) Take push rod(14, 15) out of plug(11).

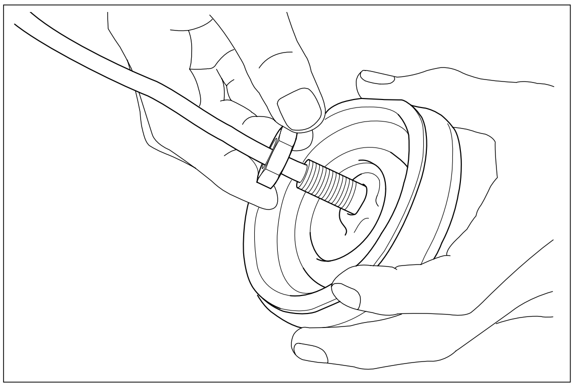


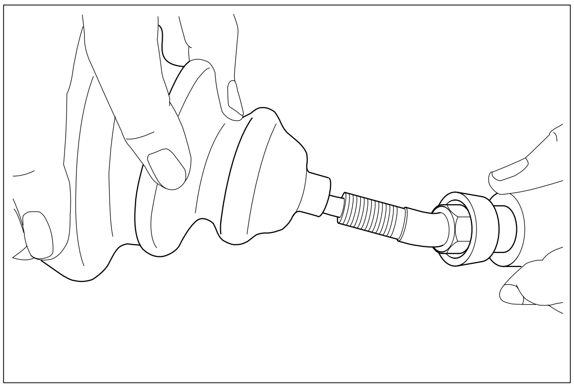
(15) Remove O-ring(13) and seal(12) from plug(11).
Use small minus screwdriver or so on to remove this seal.





⒃ Remove lock nut(21) and then boot(26).





(17) 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.

(18) Rust prevention of parts.

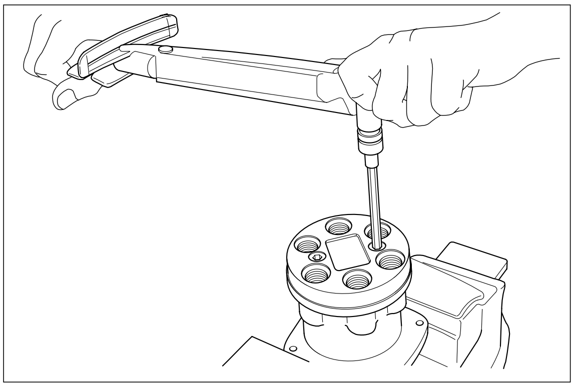
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

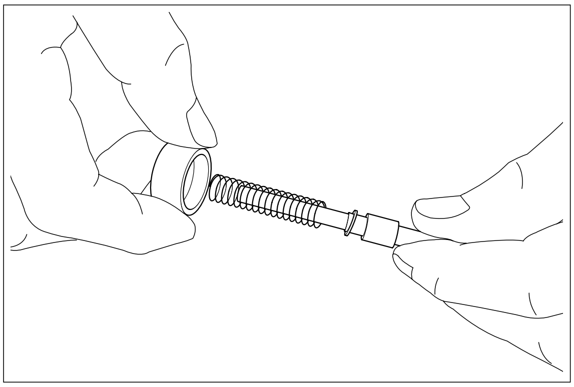
4) ASSEMBLY

(1) Tighten hexagon socket head plug(2) to the specified torque.

※ Tighten two bolts alternately and slowly.

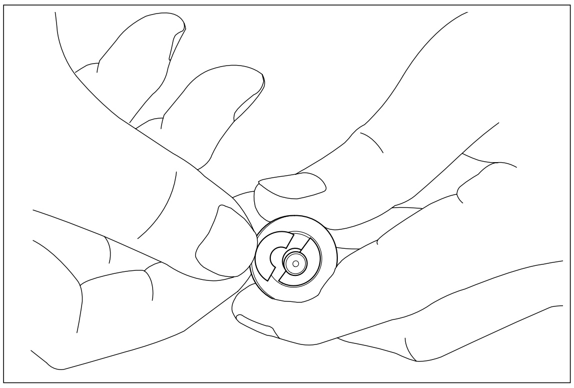


(2) Put shim(6), springs(7, 30) and spring seat(8, 31) onto spool(5) in this order.



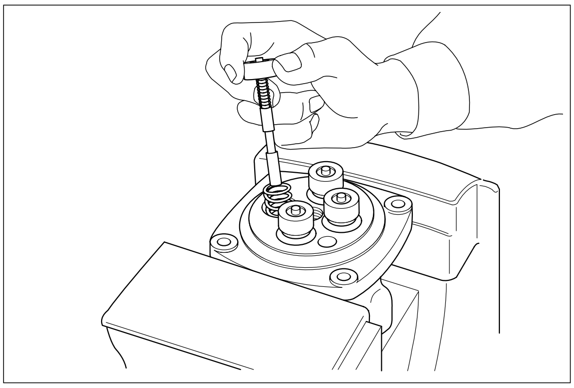
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper(9) on spring seat without piling them on.

※ Assemble stopper(9) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.

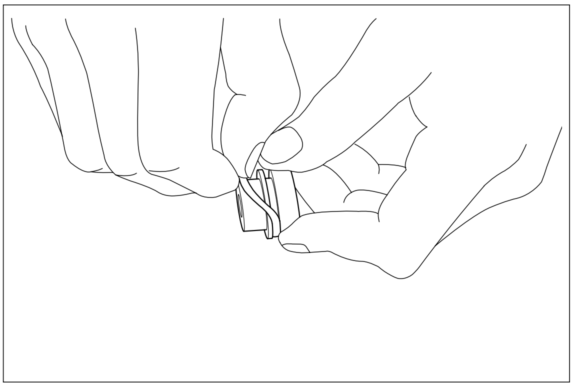


(4) Assemble spring(10) into casing. Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

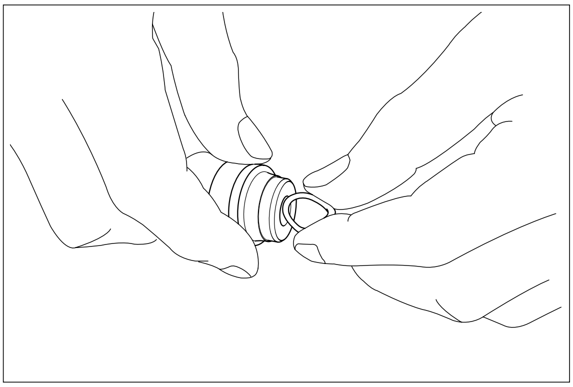


(5) Assemble O-ring(13) onto plug(11).



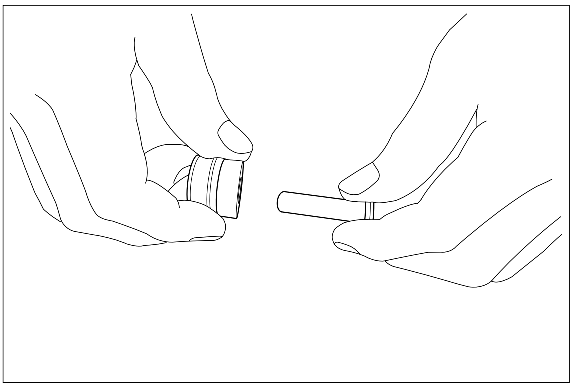
(6) Assemble seal(12) to plug(11).

※ Assemble seal in such lip direction as shown below.



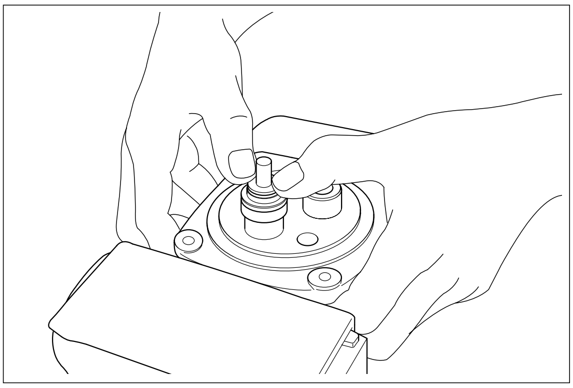
(7) Assemble push rod(14, 15) to plug(11).

※ Apply working oil on push-rod surface.

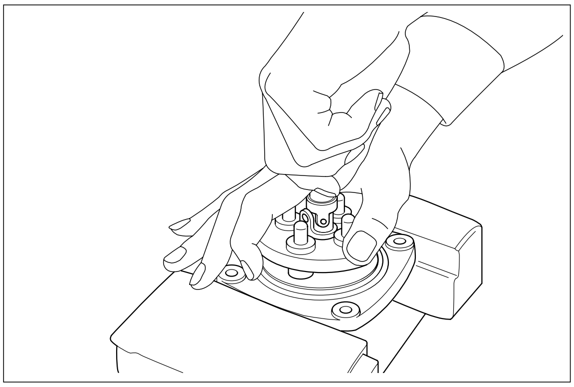


(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

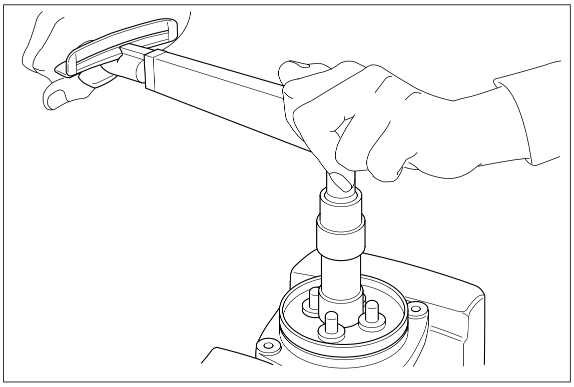


(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate(16), and tighten joint(18) temporarily.



(10) Fit plate(16).

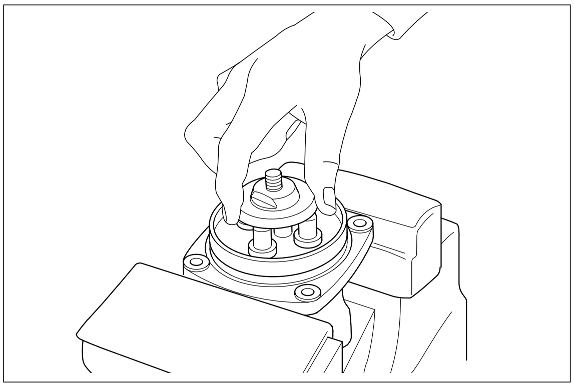
(11) Tighten joint(18) with the specified torque to casing, utilizing jig.



(12) Assemble plate(19) to joint(18).

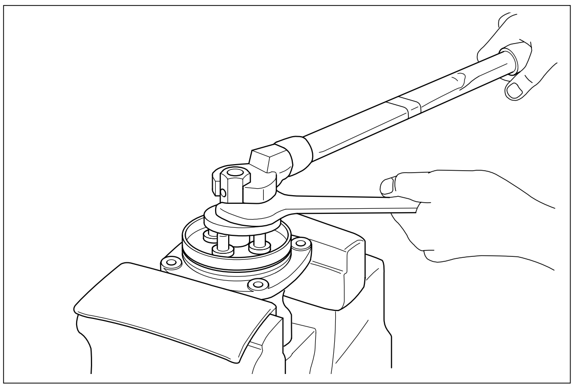
※ Screw it to position that it contacts with 4 push rods evenly.

※ Do not screw it over.

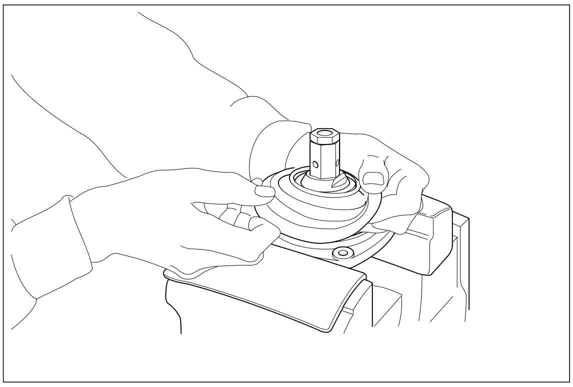


(13) Assemble adjusting nut(20), apply spanner to width across flat of plate(19) to fix it, and tighten adjusting nut to the specified torque.

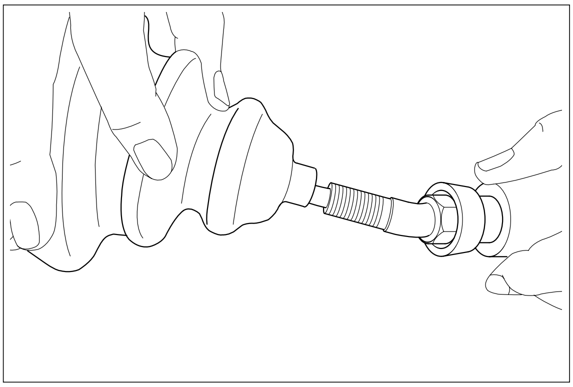
※ During tightening, do not change position of disk.

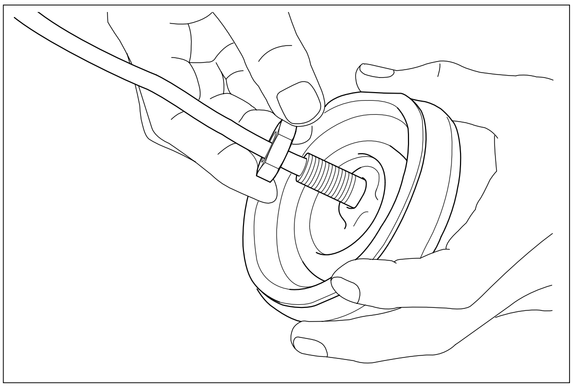


(14) Fit boot(40) to plate.

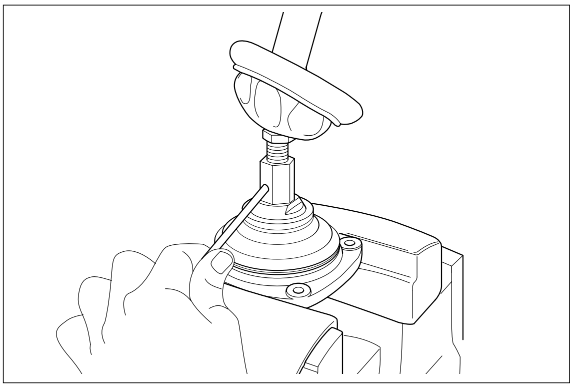


(15) Fit boot(26) and lock nut(21), and handle subassembly is assembled completely.



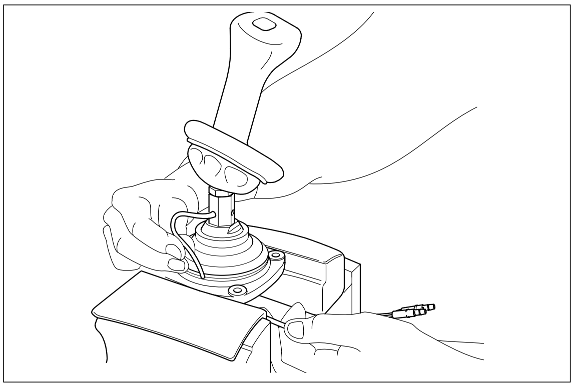


(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.

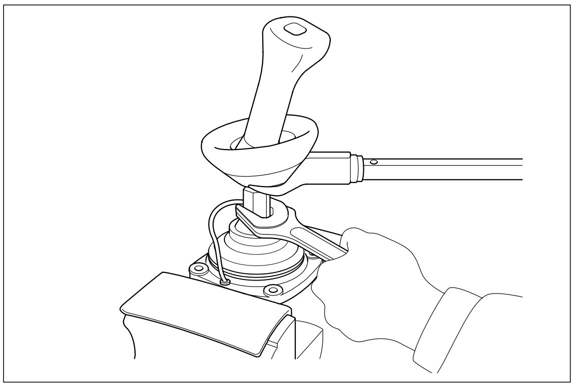


(17) Assemble bushing(17) to plate and pass cord and tube through it.

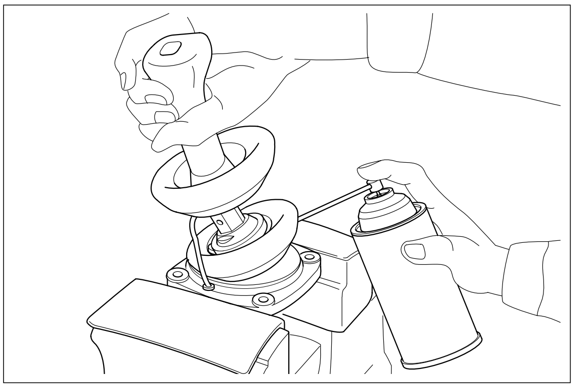
※ Provide margin necessary to operation.



(18) Determine handle direction, tighten lock nut(21) to specified torque to fix handle.

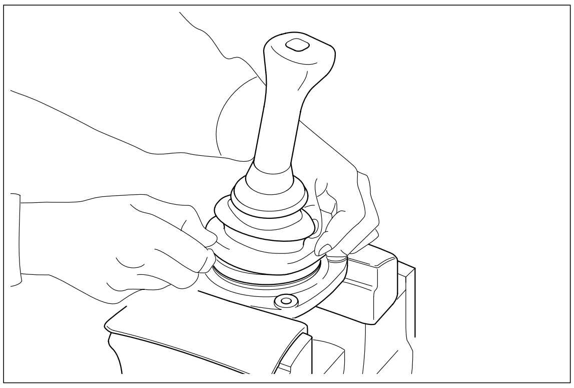


(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(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.

13031GE18

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

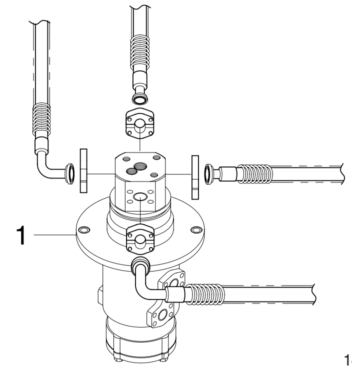
※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight : 50 kg (110 lb)

· Tightening torque : 12.3± 1.3 kgf · m
(88.9± 9.4 lbf · ft)



14098TJ01

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

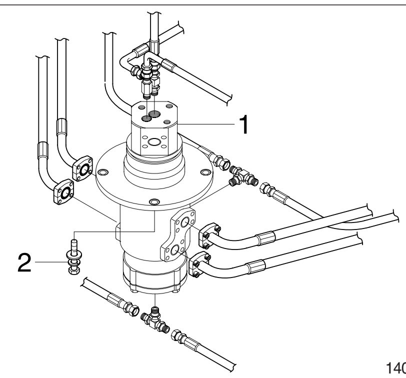
2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

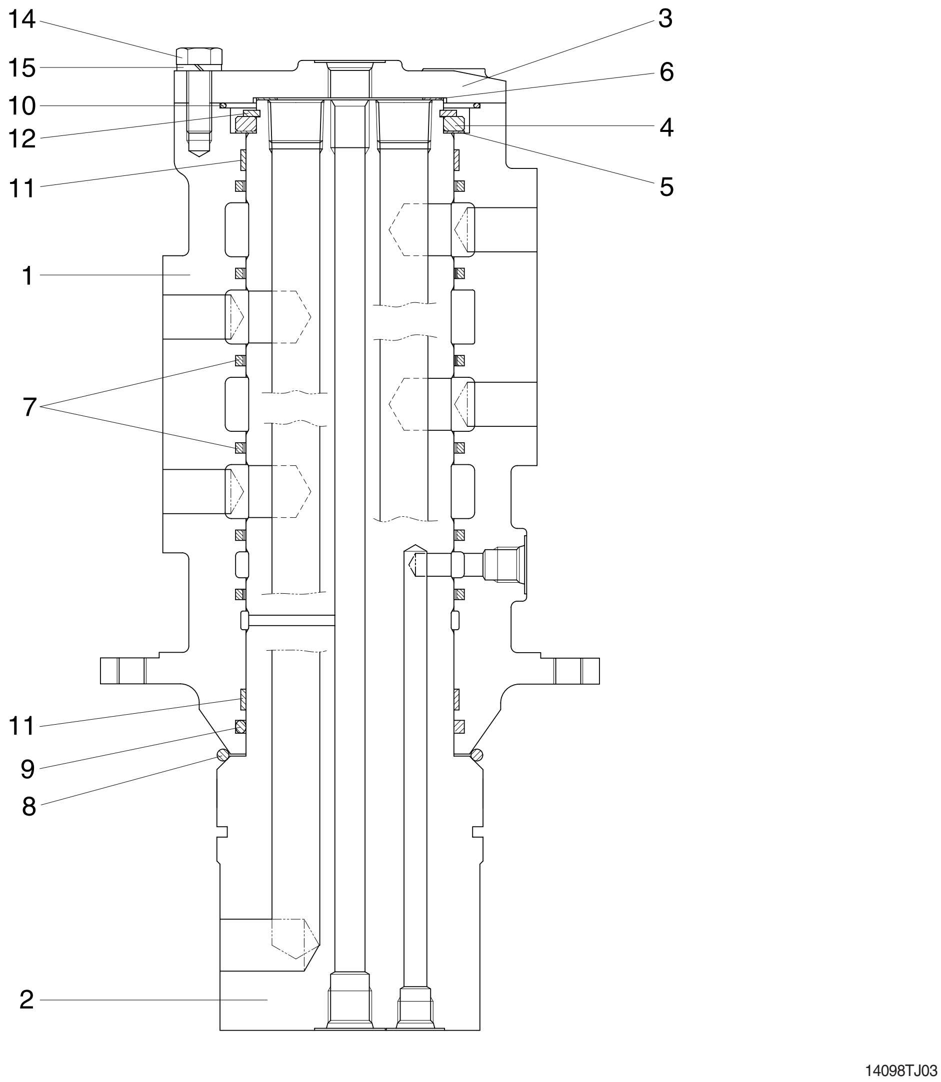
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



14098TJ02

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

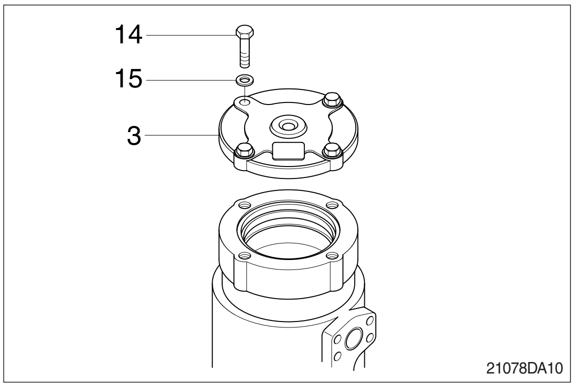


1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

※ Before the disassembly, clean the turning joint.

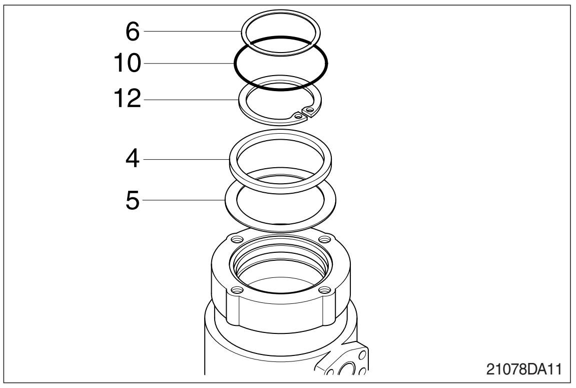
(1) Remove bolts (14), washer (15) and cover (3).



21078DA10

(2) Remove shim (6) and O-ring (10).

(3) Remove retainer ring (12), spacer (4) and shim (5).

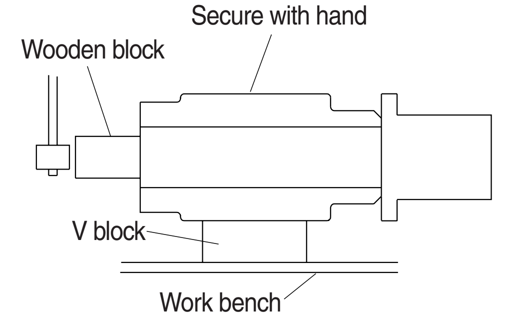


21078DA11

(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.

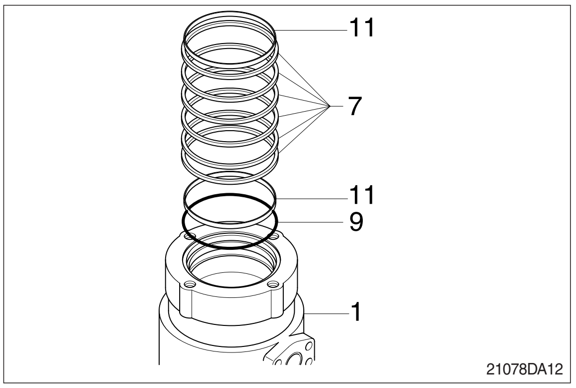
※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



8-14(3) (360-7)

(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).



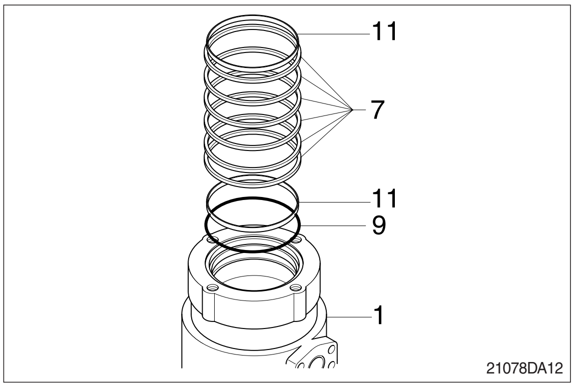
21078DA12

3) ASSEMBLY

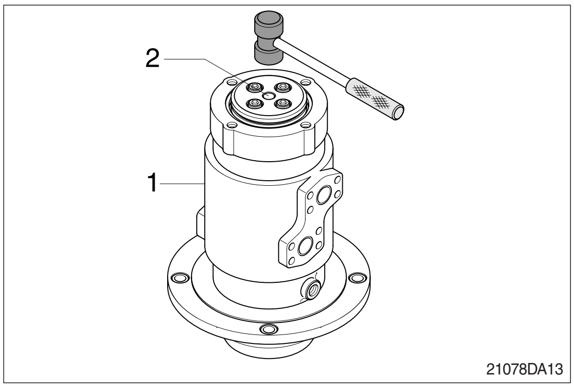
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(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).



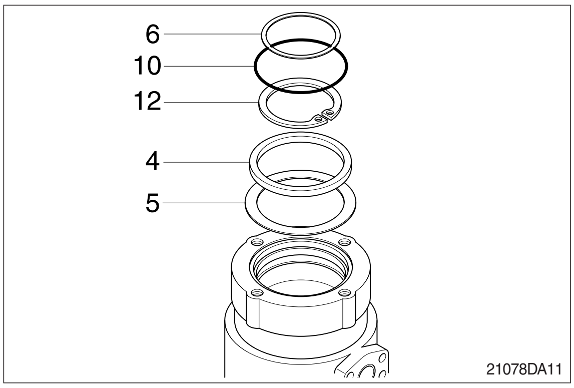
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

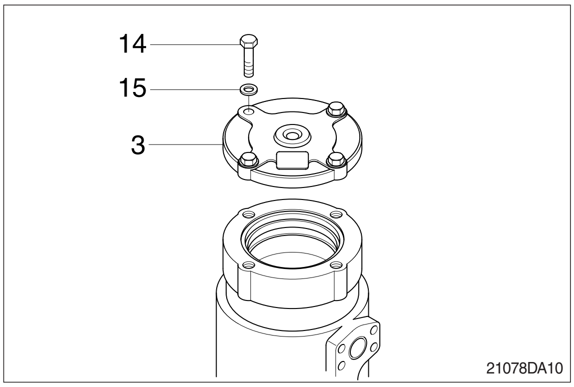
(5) Fit O-ring (10) to hub (1).

(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 CYLINDERS

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.

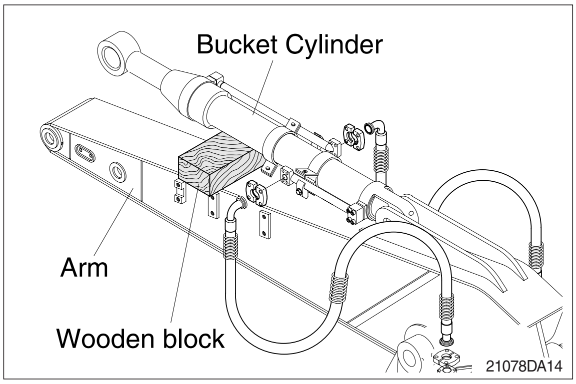
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ **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.

13031GE18

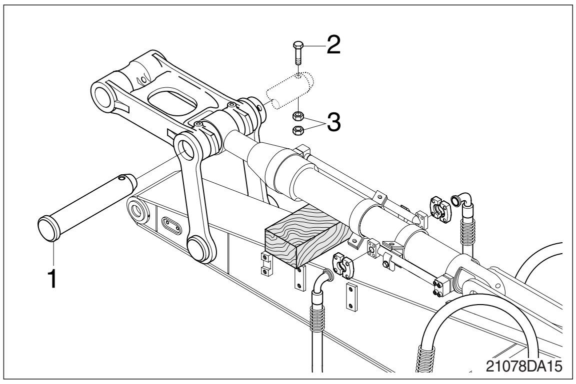
① Set block between bucket cylinder and arm.



21078DA14

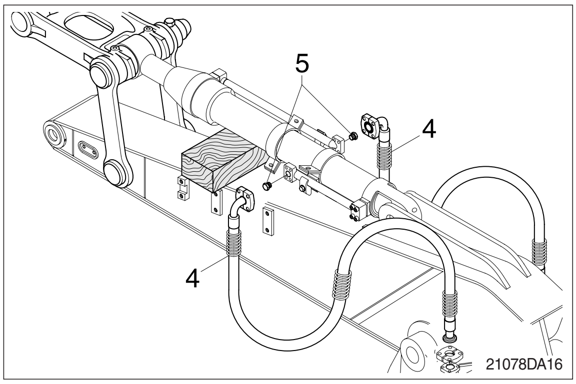
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



21078DA15

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

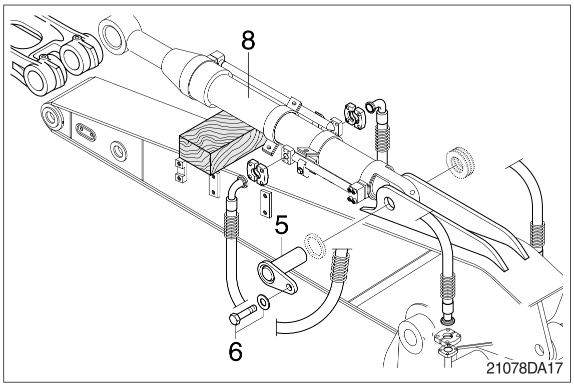


21078DA16

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 100 ㎏ (220 ℔)



(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.

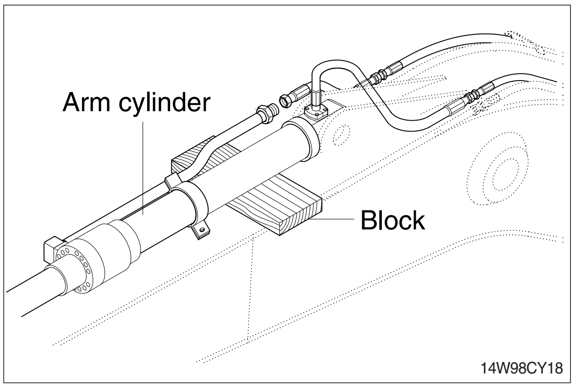
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

※ 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.

13031GE18

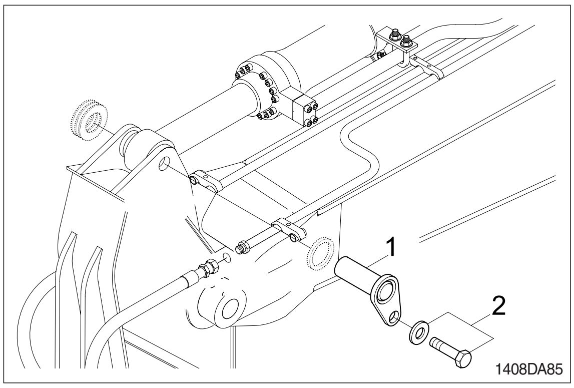
① Set block between arm cylinder and boom.



14W98CY18

② Remove bolt (2) and pull out pin (1).

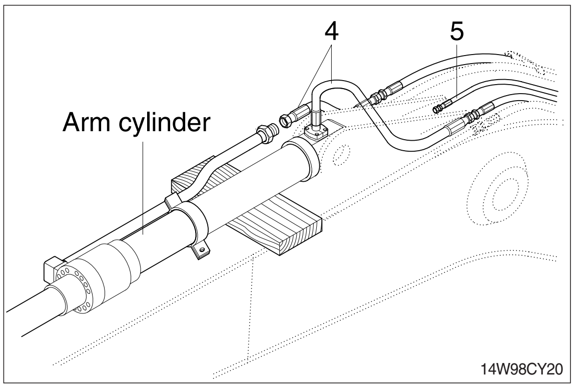
※ Tie the rod with wire to prevent it from coming out.



1408DA85

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).

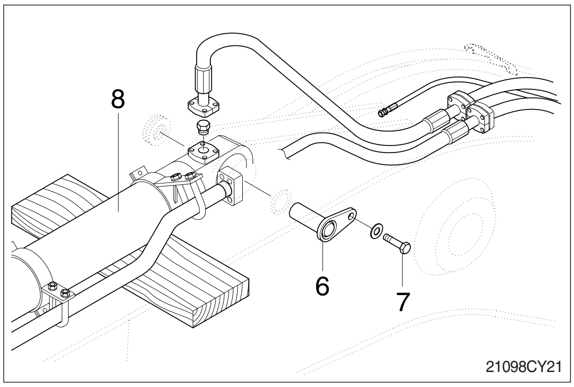


14W98CY20

⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 160 ㎏ (350 ㏈)



(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.

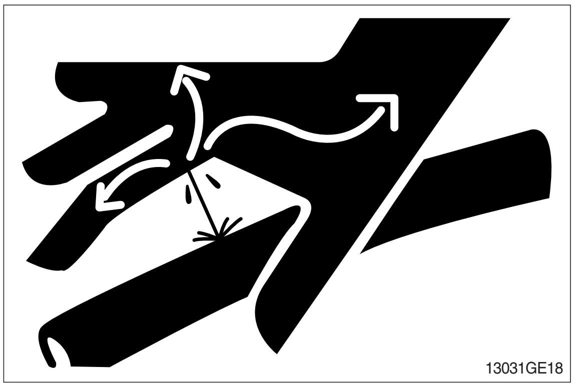
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

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.



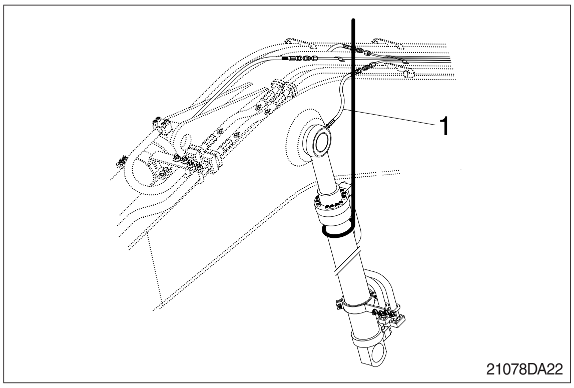
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ 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.

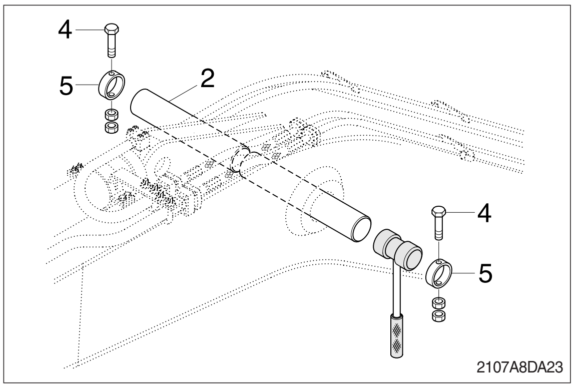
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

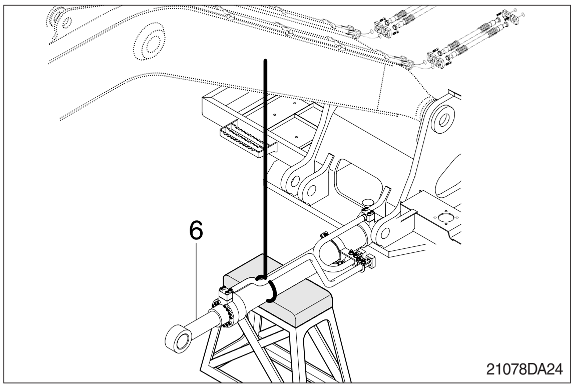


③ Remove bolt (4), stopper (5) and pull out pin (2).

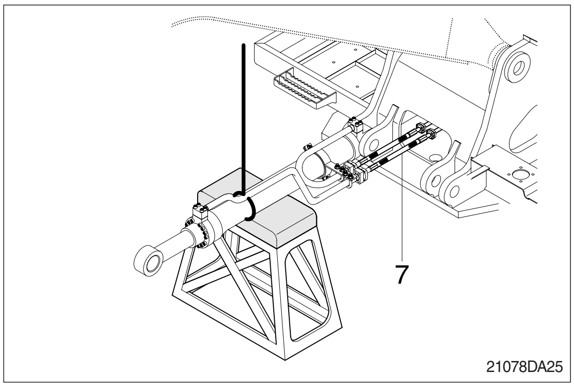
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly (6) on a stand.



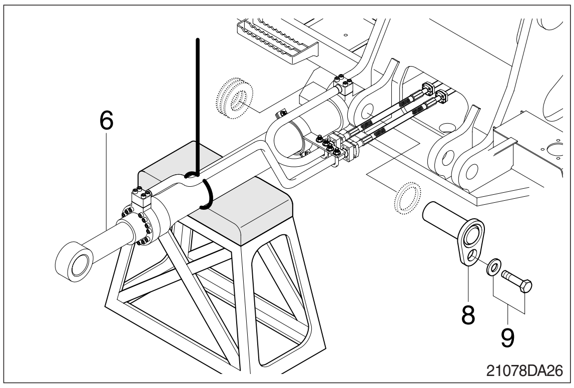
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 130 ㎏ (285 ℔)



(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.**

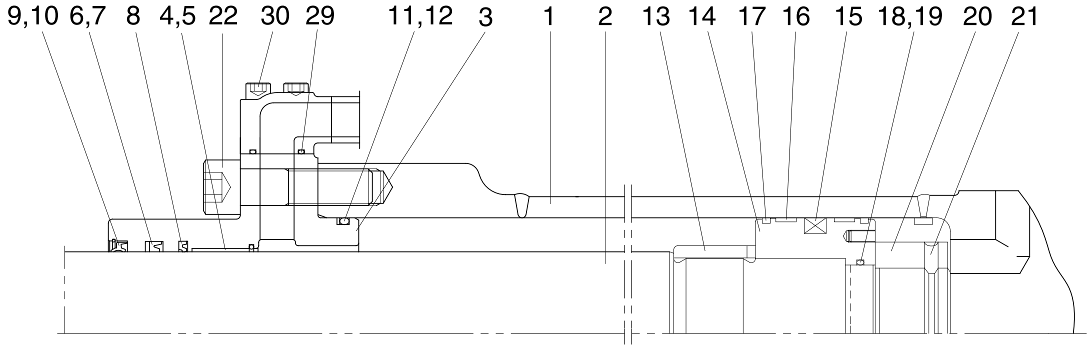
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

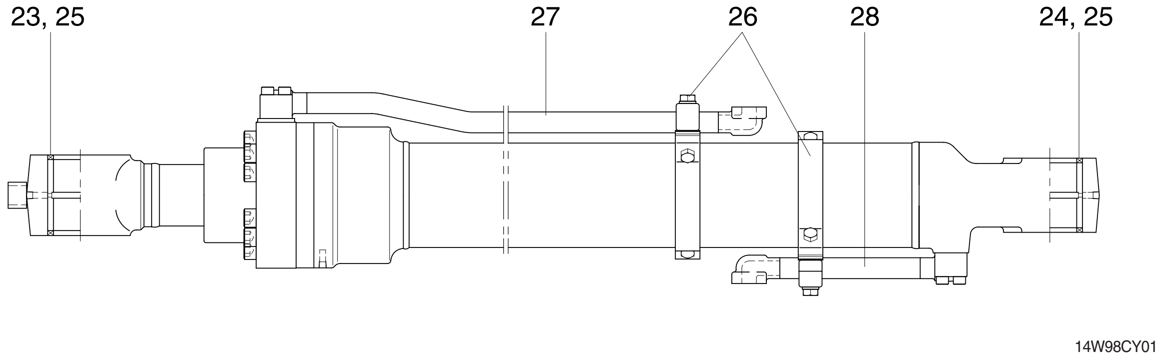
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

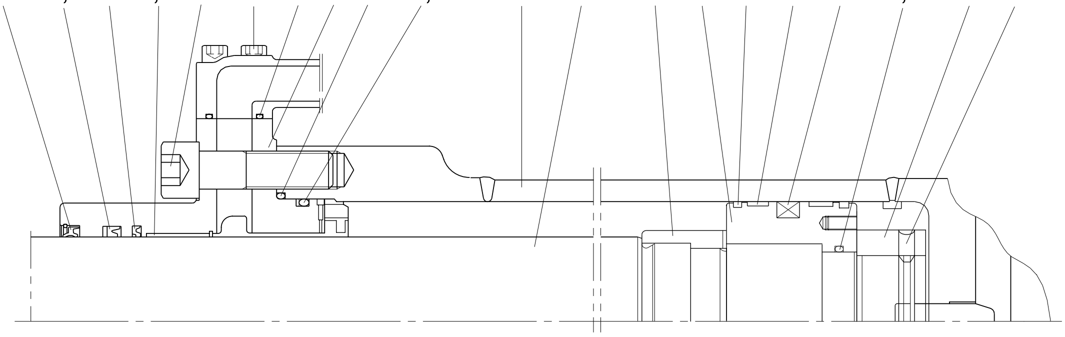


Internal detail

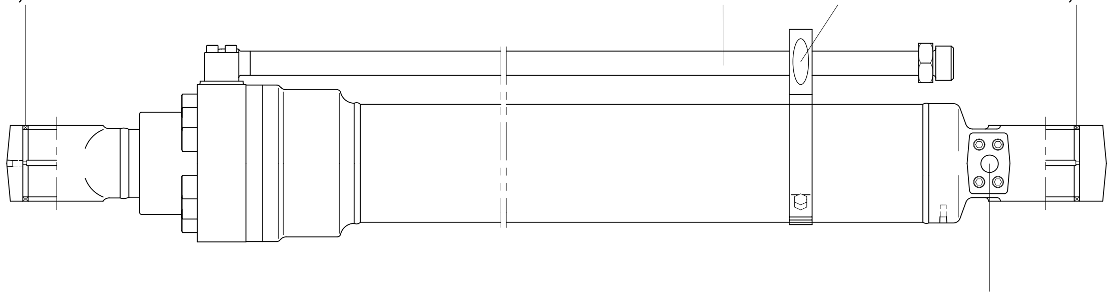


1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Pin bushing
5	Snap ring	15	Piston seal	25	Dust seal
6	Rod seal	16	Wear ring	26	Band assembly
7	Back up ring	17	Dust ring	27	Pipe assembly-R
8	Buffer ring	18	O-ring	28	Pipe assembly-B
9	Dust wiper	19	Back up ring	29	O-ring
10	Snap ring	20	Lock nut	30	Hexagon socket head bolt

(2) Arm cylinder

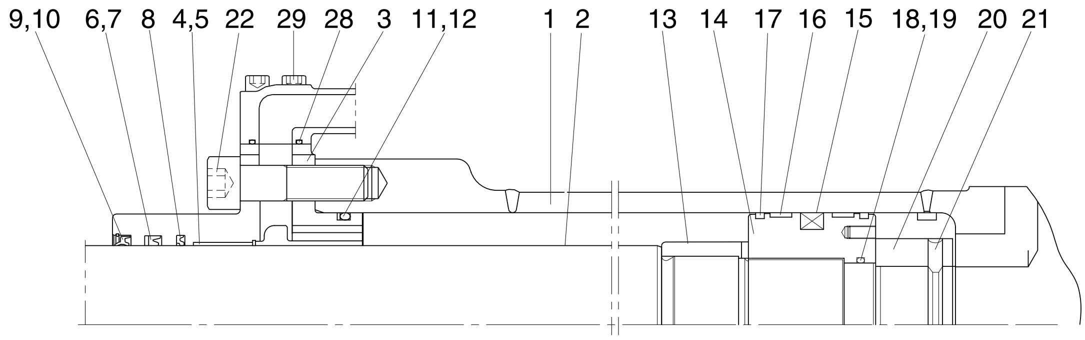


Internal detail

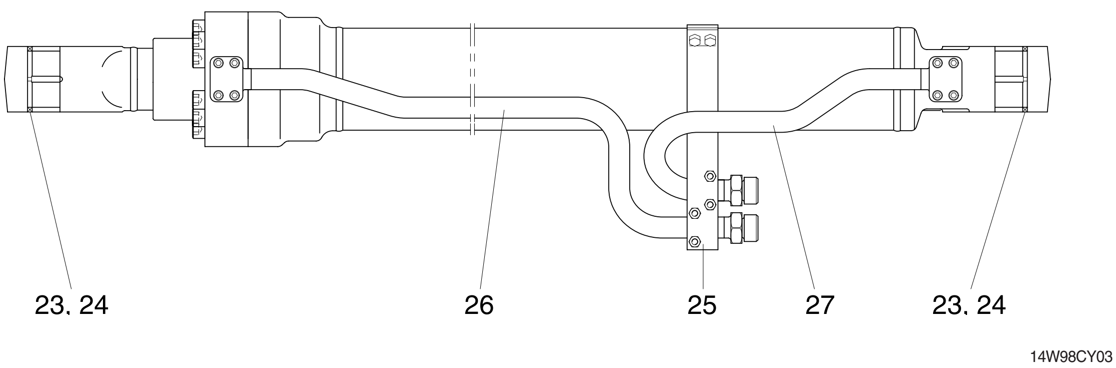


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DD2 bushing	15	Piston seal	26	Check valve
5	Snap ring	16	Wear ring	27	Coil spring
6	Rod seal	17	Dust ring	28	O-ring
7	Back up ring	18	O-ring	29	Plug
8	Buffer ring	19	Back up ring	30	Band assembly
9	Dust wiper	20	Lock nut	31	Pipe assembly-R
10	Snap ring	21	Hexagon socket set screw	32	O-ring
11	O-ring	22	O-ring	33	Hexagon socket head bolt

(3) Boom cylinder



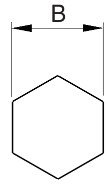
Internal detail



1	Tube assembly	11	O-ring	21	Hexagon socket set screw
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Pin bushing
4	DD2 bushing	14	Piston	24	Dust seal
5	Snap ring	15	Piston seal	25	Band assembly
6	Rod seal	16	Wear ring	26	Pipe assembly-R
7	Back up ring	17	Dust ring	27	Pipe assembly-B
8	Buffer ring	18	O-ring	28	O-ring
9	Dust wiper	19	Back up ring	29	Hexagon socket head bolt
10	Snap ring	20	Lock nut		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

<table>
<tr><th>Tool name</th><th colspan="2">Remark</th></tr>
<tr><td rowspan="4">Allen wrench</td><td>6</td><td rowspan="6">
</td></tr>
<tr><td>8</td></tr>
<tr><td>14</td></tr>
<tr><td>17</td></tr>
<tr><td rowspan="2">Spanner</td><td>7</td></tr>
<tr><td>8</td></tr>
<tr><td>(-) Driver</td><td colspan="2">Small and large sizes</td></tr>
<tr><td>Torque wrench</td><td colspan="2">Capable of tightening with the specified torques</td></tr>
</table>

(2) Tightening torque

<table>
<tr><th colspan="2" rowspan="2">Part name</th><th rowspan="2">Item</th><th rowspan="2">Size</th><th colspan="2">Torque</th></tr>
<tr><th>kgf · m</th><th>lbf · ft</th></tr>
<tr><td rowspan="3">Socket head bolt</td><td>Bucket cylinder</td><td rowspan="2">22</td><td>M14</td><td>15±2.0</td><td>108±14.5</td></tr>
<tr><td>Boom cylinder</td><td>M14</td><td>15±2.0</td><td>108±14.5</td></tr>
<tr><td>Arm cylinder</td><td>23</td><td>M16</td><td>23±2.0</td><td>166±14.5</td></tr>
<tr><td rowspan="3">Pipe mounting socket head bolt</td><td>Bucket</td><td>30</td><td>M10</td><td>5.4±0.5</td><td>39.1±3.6</td></tr>
<tr><td>Boom</td><td>29</td><td>M8</td><td>2.7±0.3</td><td>19.6±2.2</td></tr>
<tr><td>Arm</td><td>33</td><td>M10</td><td>5.4±0.5</td><td>39.1±3.6</td></tr>
<tr><td rowspan="3">Lock nut</td><td>Bucket cylinder</td><td rowspan="3">20</td><td>M45</td><td rowspan="3">100±10.0</td><td rowspan="3">723±72.3</td></tr>
<tr><td>Boom cylinder</td><td>M50</td></tr>
<tr><td>Arm cylinder</td><td>M55</td></tr>
<tr><td rowspan="3">Piston</td><td>Bucket cylinder</td><td rowspan="3">14</td><td rowspan="3">-</td><td rowspan="3">150±15.0</td><td rowspan="3">1085±109</td></tr>
<tr><td>Boom cylinder</td></tr>
<tr><td>Arm cylinder</td></tr>
</table>

3) DISASSEMBLY

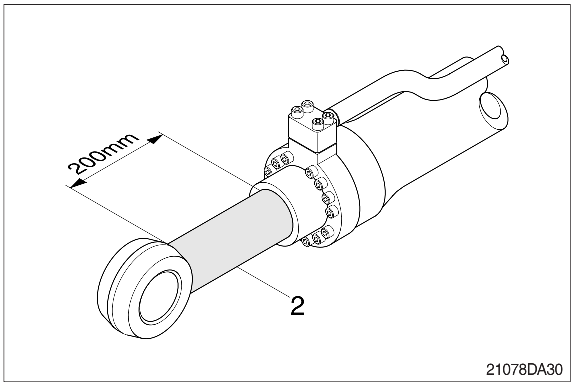
(1) Remove cylinder head and piston rod

※ Procedures are based on the bucket cylinder.

① Hold the clevis section of the tube in a vise.

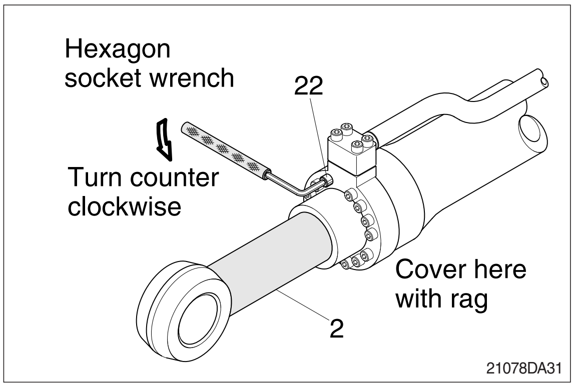
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

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.



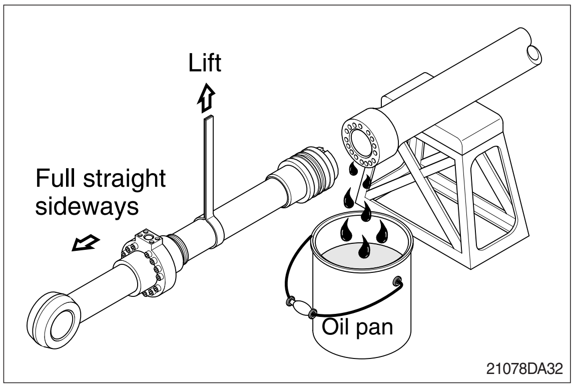
③ Loosen and remove socket bolts (22) of the gland in sequence.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



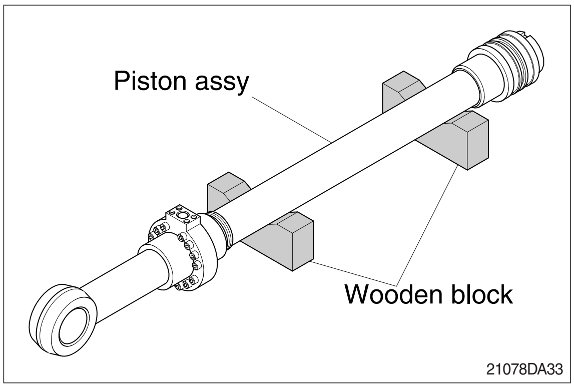
④ Draw out cylinder head and rod assembly together from tube assembly (1).

※ 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.

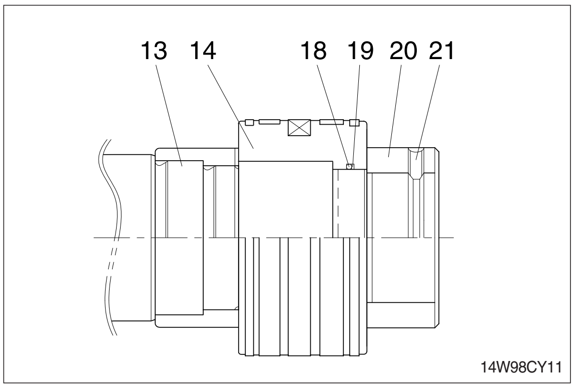


Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

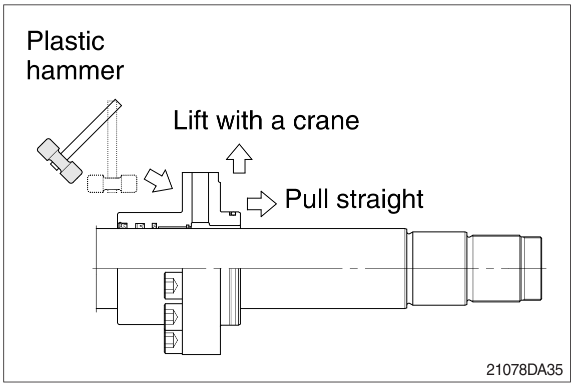
⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.



(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).

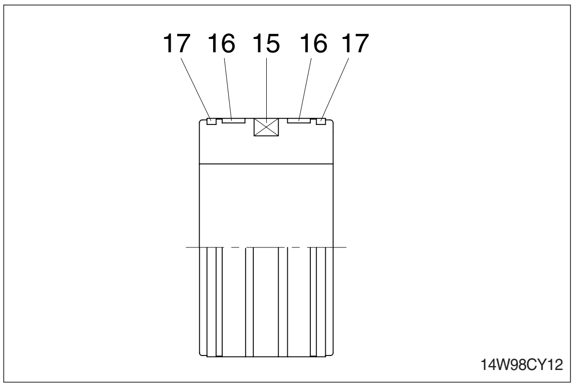


(3) Disassemble the piston assembly

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).

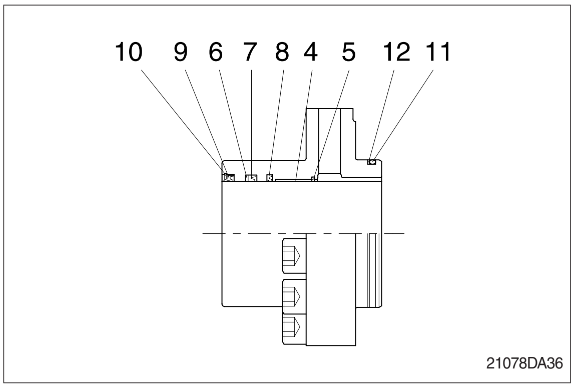
② Remove snap ring (10), dust wiper (9).

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).

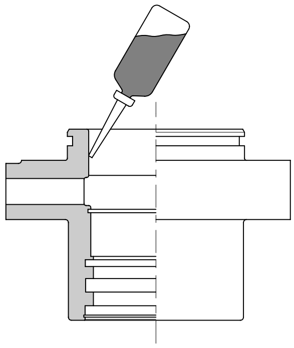


3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

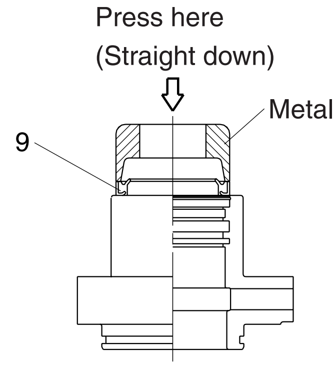
① Coat the inner face of gland (3) with hydraulic oil.



21078DA37

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.

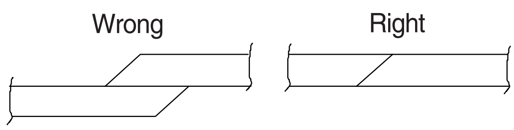


8-157(2)

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.

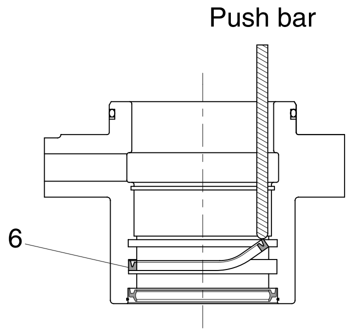
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3)

※ 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.

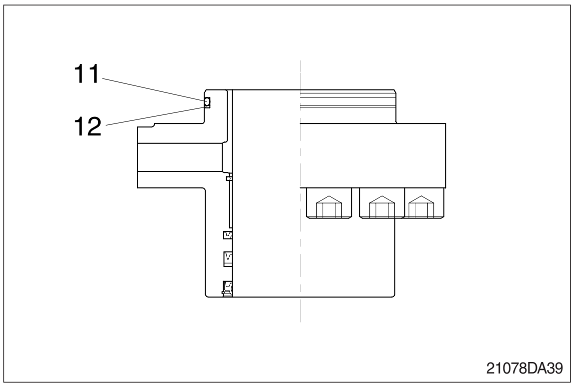


21078DA38

⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

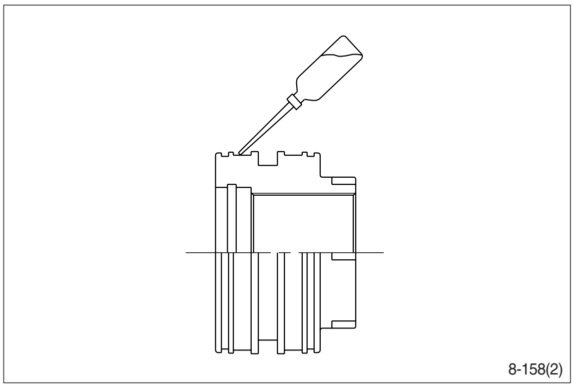
⑥ Fit O-ring (11) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

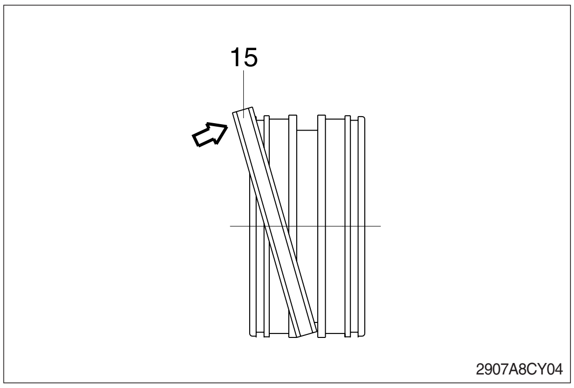
① Coat the outer face of piston (14) with hydraulic oil.



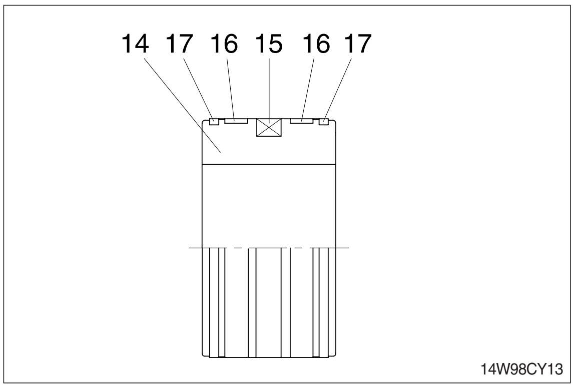
② Fit piston seal (15) to piston.

※ 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).

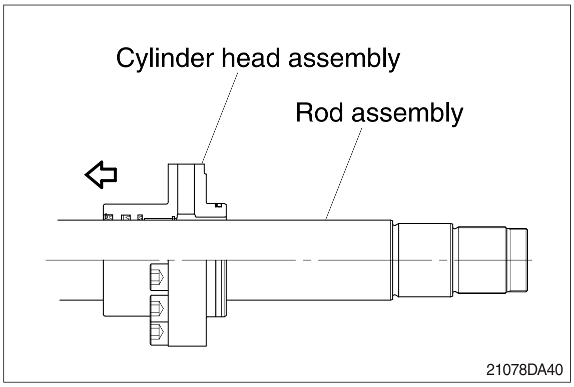


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

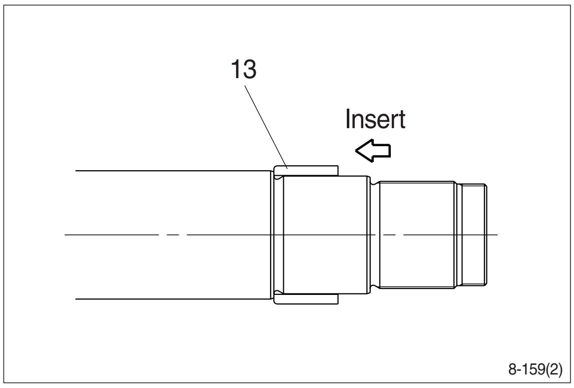
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



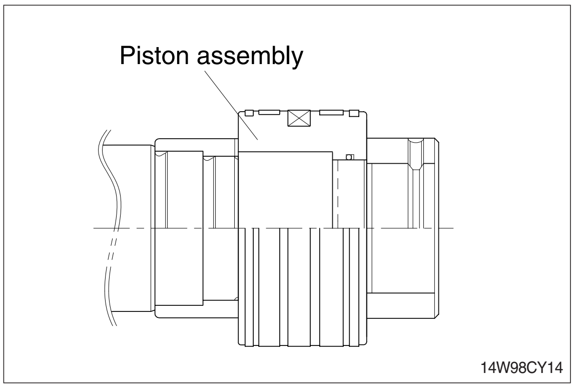
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

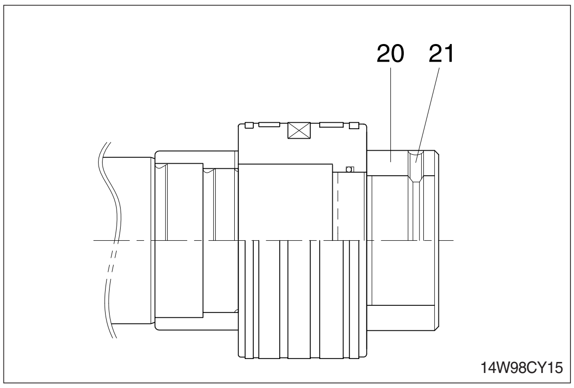
· Tightening torque : 150±15 kgf · m (1085±108 lbf · ft)



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		
	Arm		
21		2.7±0.3	19.6±2.2



(3) Overall assemble

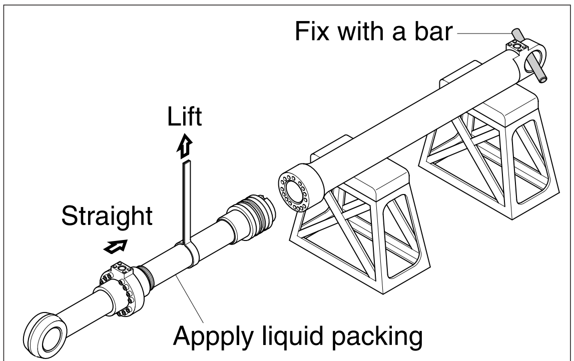
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

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.



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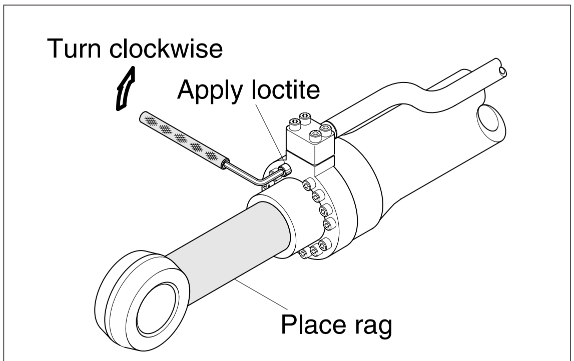


21078DA42

GROUP 10 UNDERCARRIAGE

1. TRACK LINK

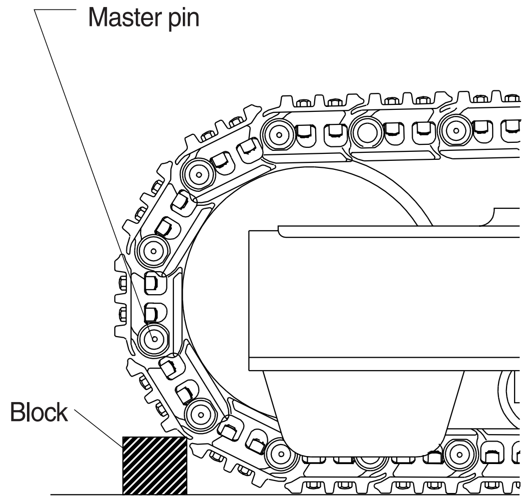
1) REMOVAL

(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.

(3) Push out master pin by using a suitable tool.

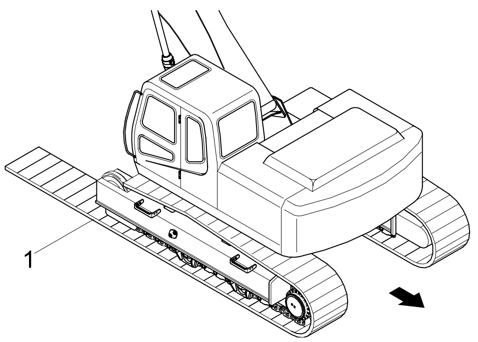


8-161(1)

(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.

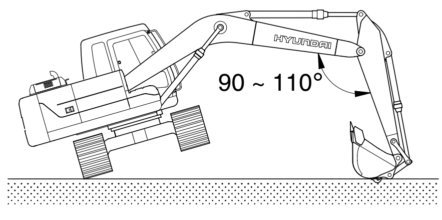


1408DA100

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.

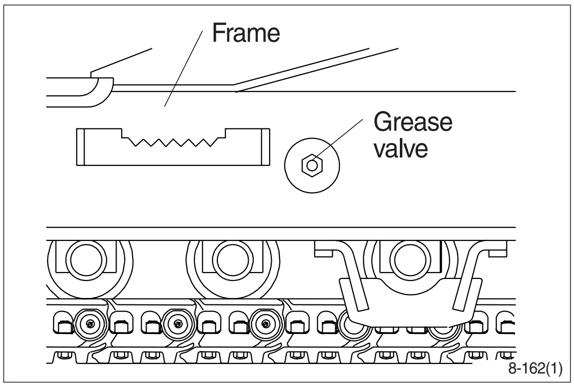


14098UC05

2. CARRIER ROLLER

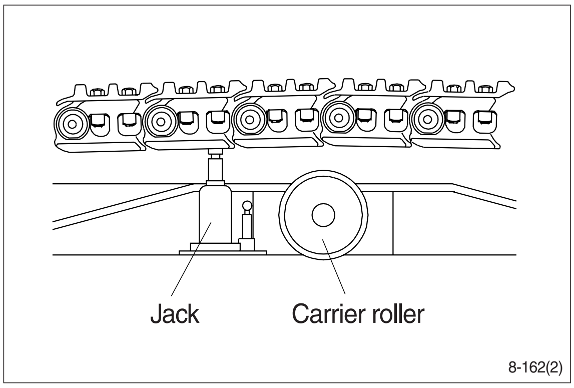
1) REMOVAL

(1) Loosen tension of the track link.



8-162(1)

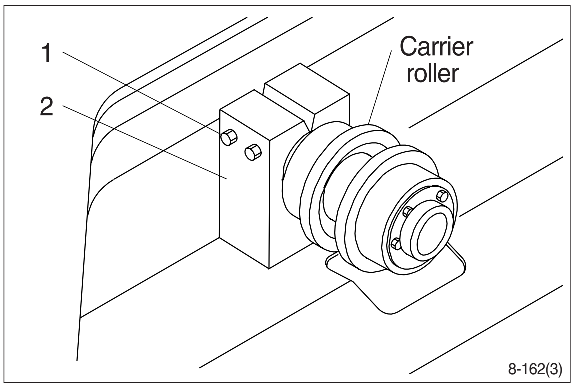
(2) Jack up the track link height enough to permit carrier roller removal.



8-162(2)

(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
   · Weight : 21 kg (46 lb)



8-162(3)

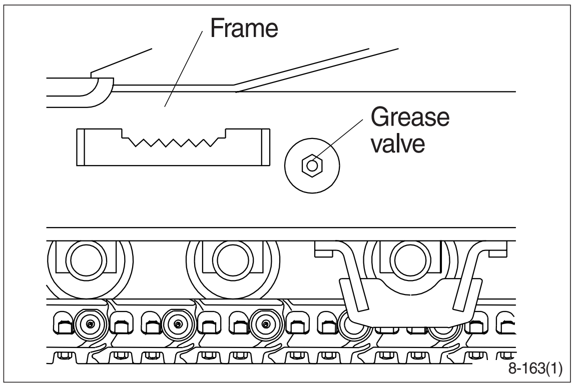
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

1) REMOVAL

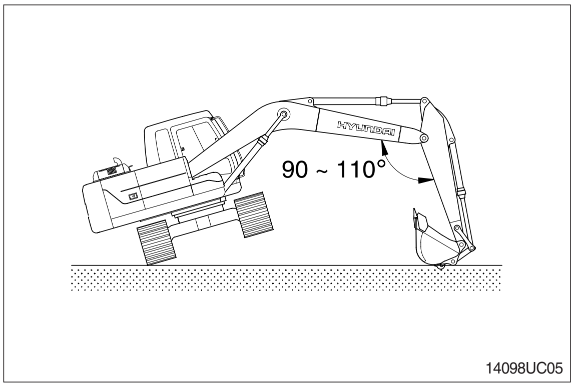
(1) Loosen tension of the track link.



8-163(1)

(2) Using the work equipment, push up track frame on side which is to be removed.

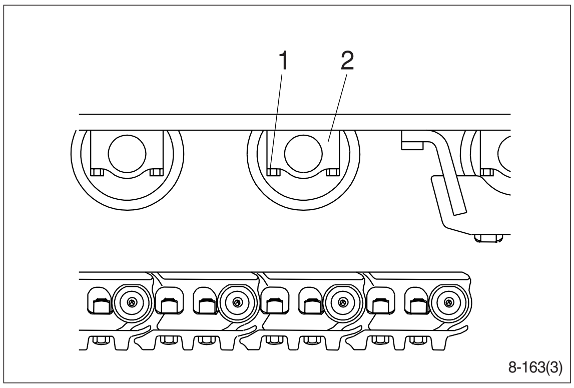
※ After jack up the machine, set a block under the unit.



14098UC05

(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 38.3 kg (84.4 lb)



8-163(3)

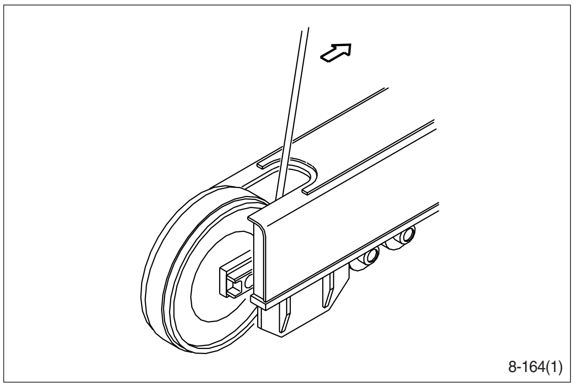
2) INSTALL

(1) Carry out installation in the reverse order to removal.

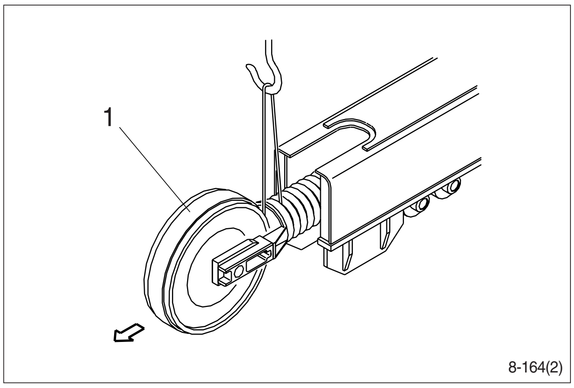
4. IDLER AND RECOIL SPRING

1) REMOVAL

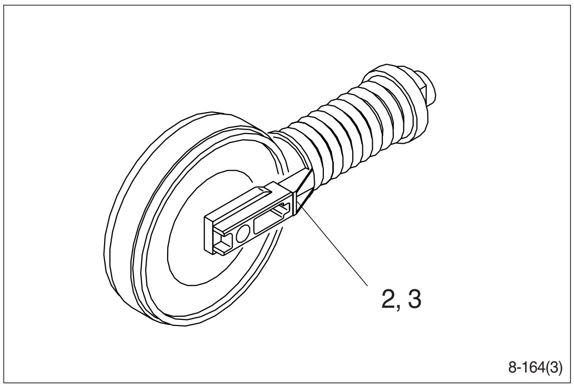
(1) Remove the track link.
For detail, see removal of track link.



(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 192 kg (423 lb)

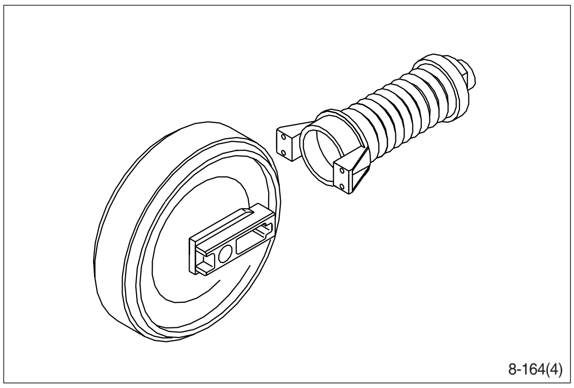


(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.



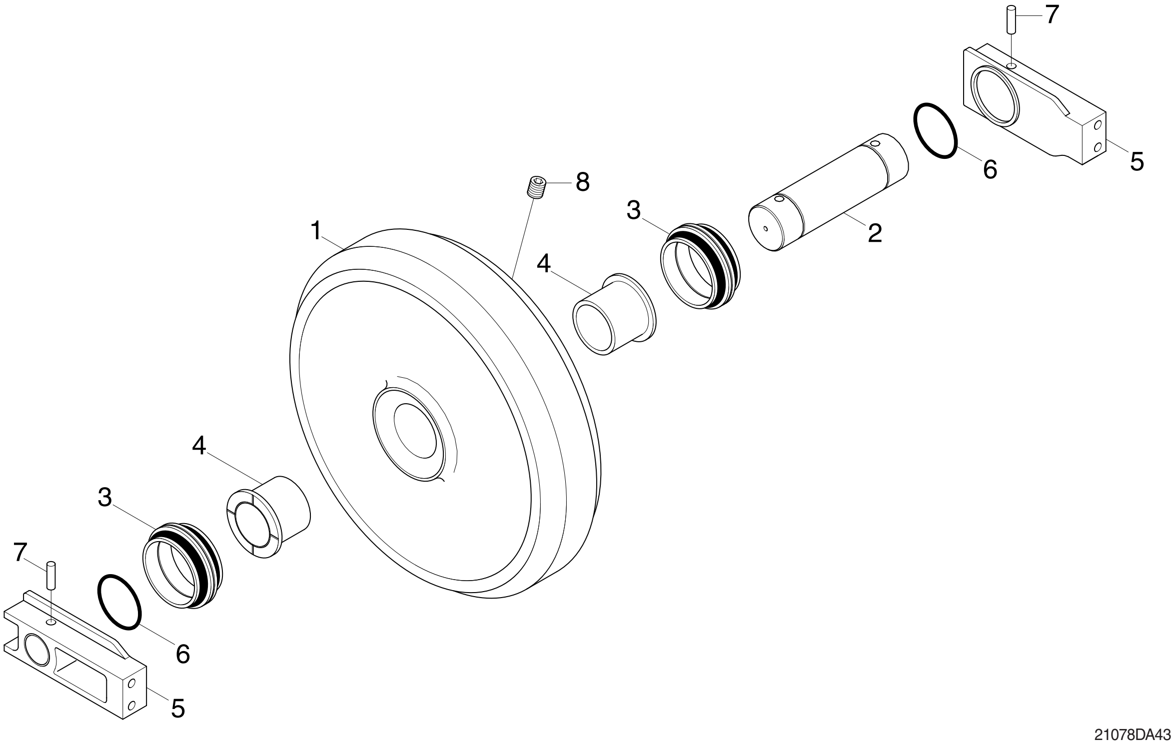
2) INSTALL

(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

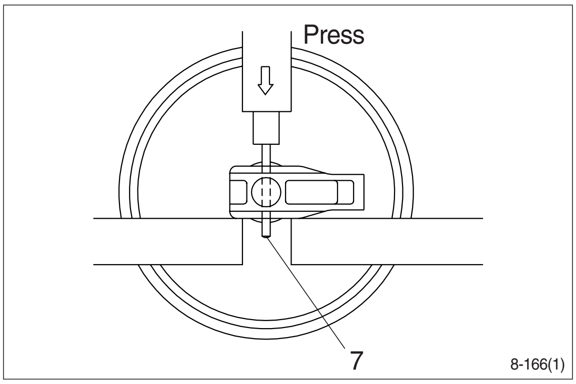


1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

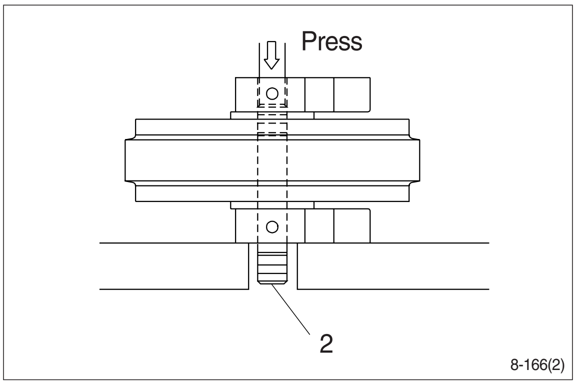
② Draw out the spring pin (7), using a press.



③ Pull out the shaft (2) with a press.

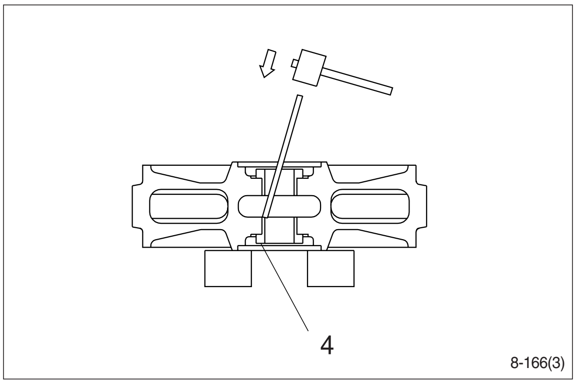
④ Remove seal (3) from idler (1) and bracket (5).

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.

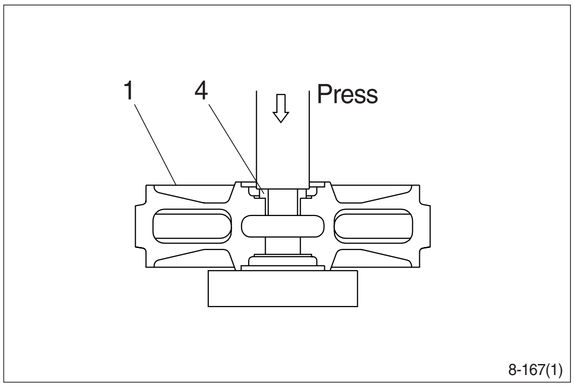


(3) Assembly

※ Before assembly, clean the parts.

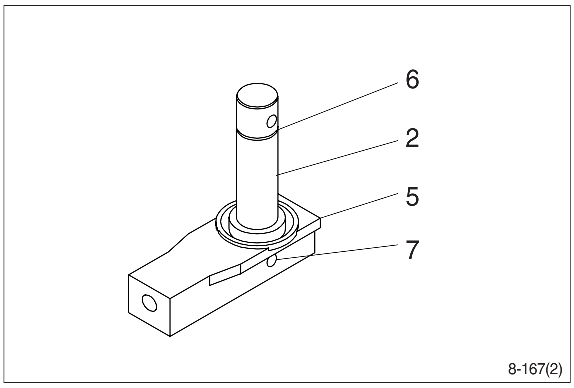
※ Coat the sliding surfaces of all parts with oil.

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.

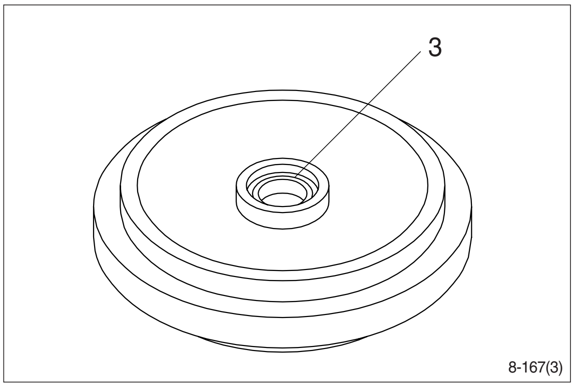


② Coat O-ring (6) with grease thinly, and install it to shaft (2).

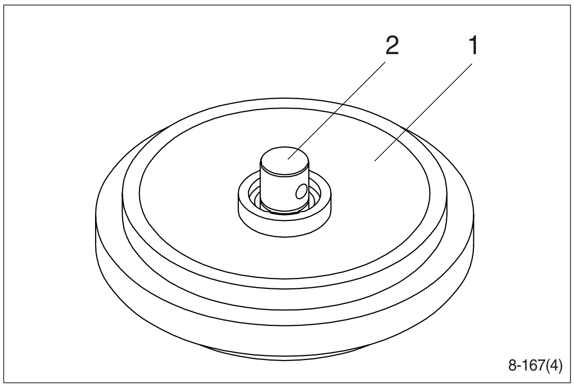
③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



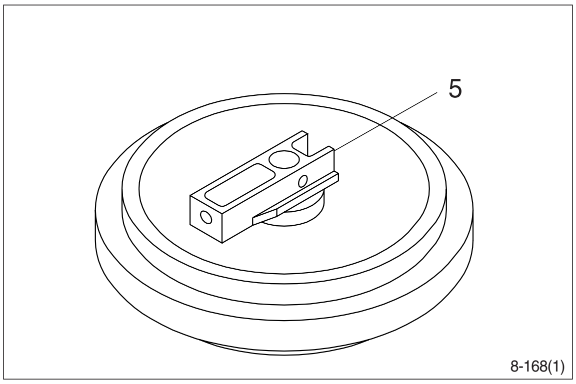
④ Install seal (3) to shell (1) and bracket (5).



⑤ Install shaft (2) to shell (1).

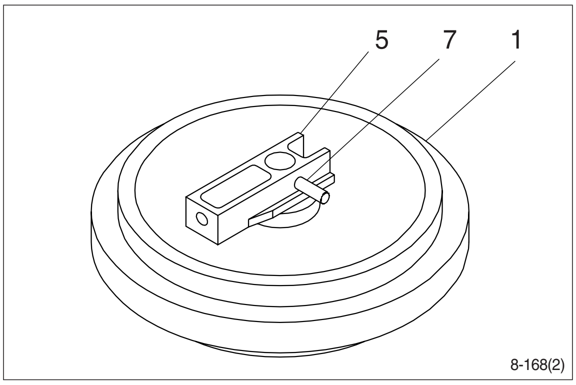


⑥ Install bracket (5) attached with seal (3).



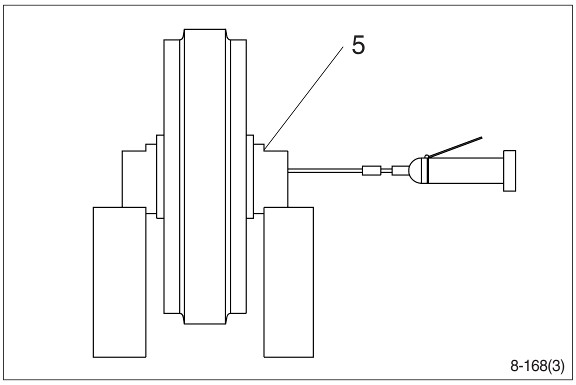
8-168(1)

⑦ Knock in the spring pin (7) with a hammer.



8-168(2)

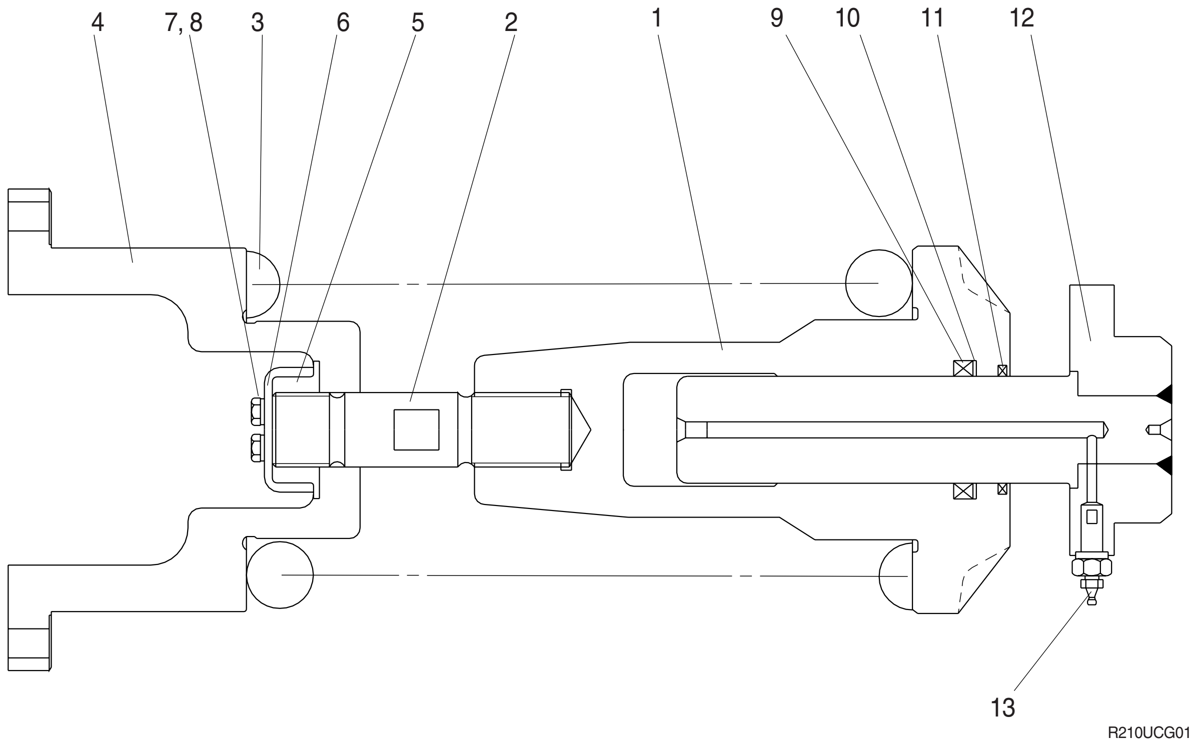
⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug.



8-168(3)

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.

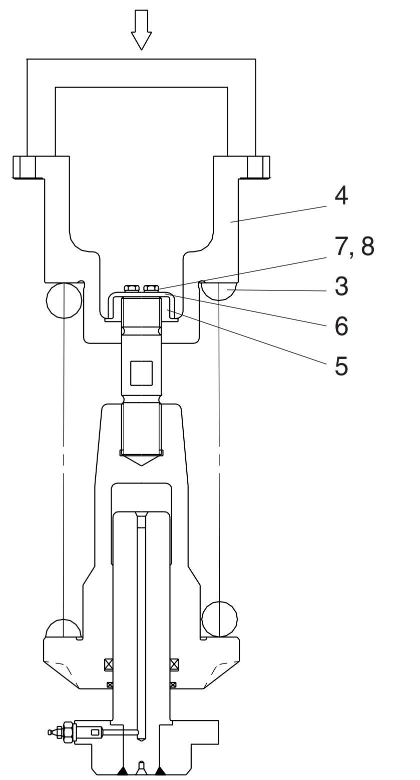
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 11132 ㎏ (24542 ㏈)

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.

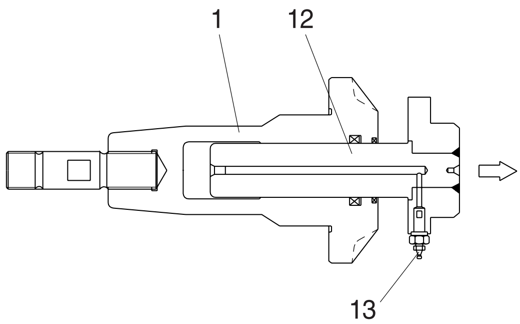
④ Lighten the press load slowly and remove bracket (4) and spring (3).



R210UCG2(1)

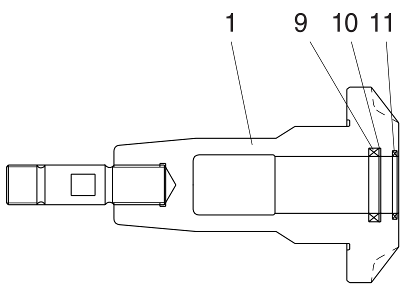
⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



R210UCG2(2)

⑦ Remove rod seal (9), back up ring (10) and dust seal (11).

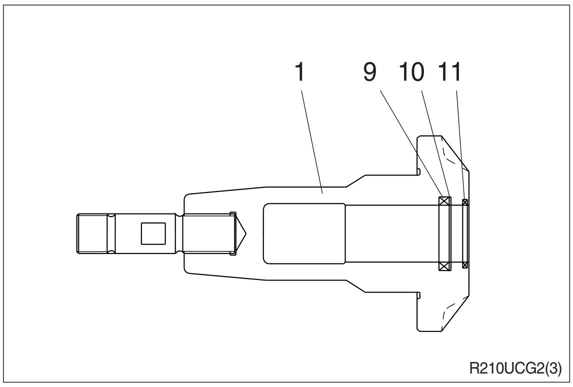


R210UCG2(3)

(3) Assembly

Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

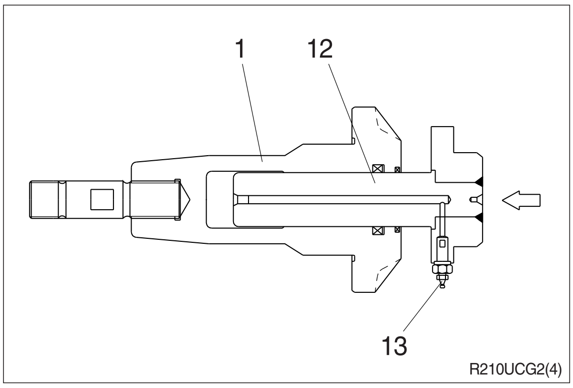
※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



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)

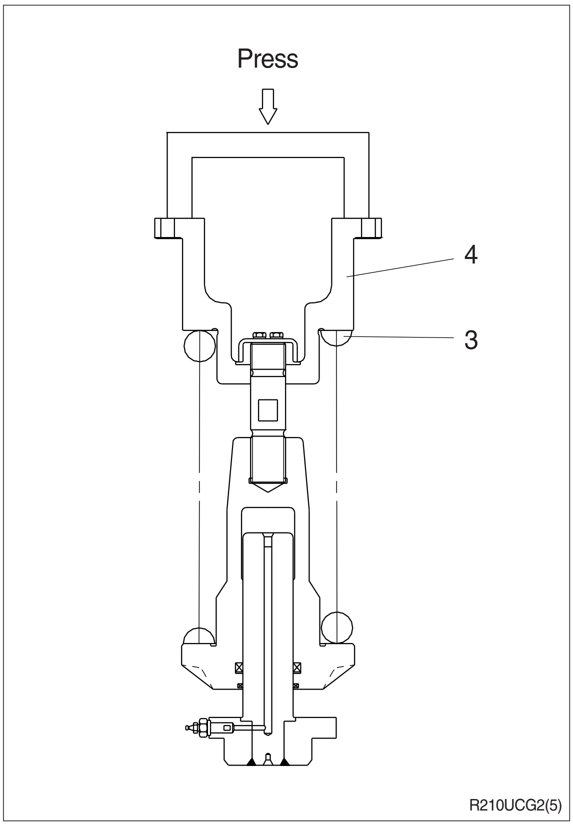


④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

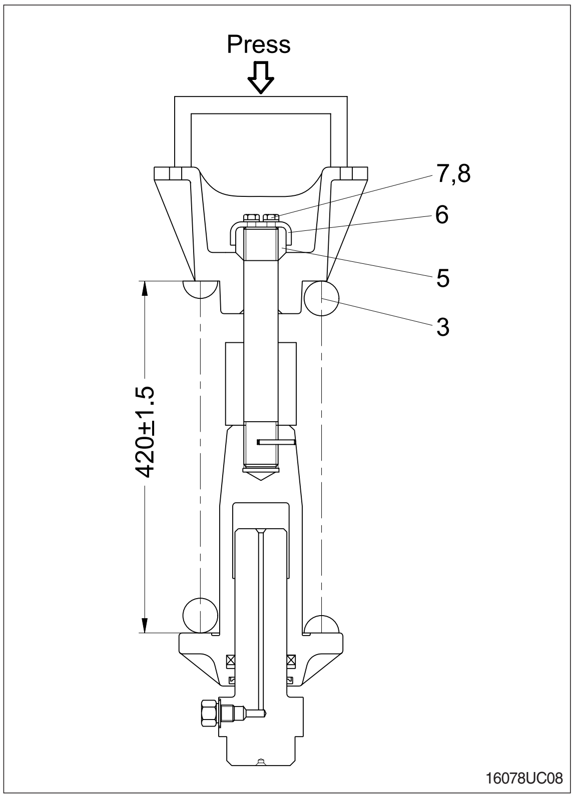
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.



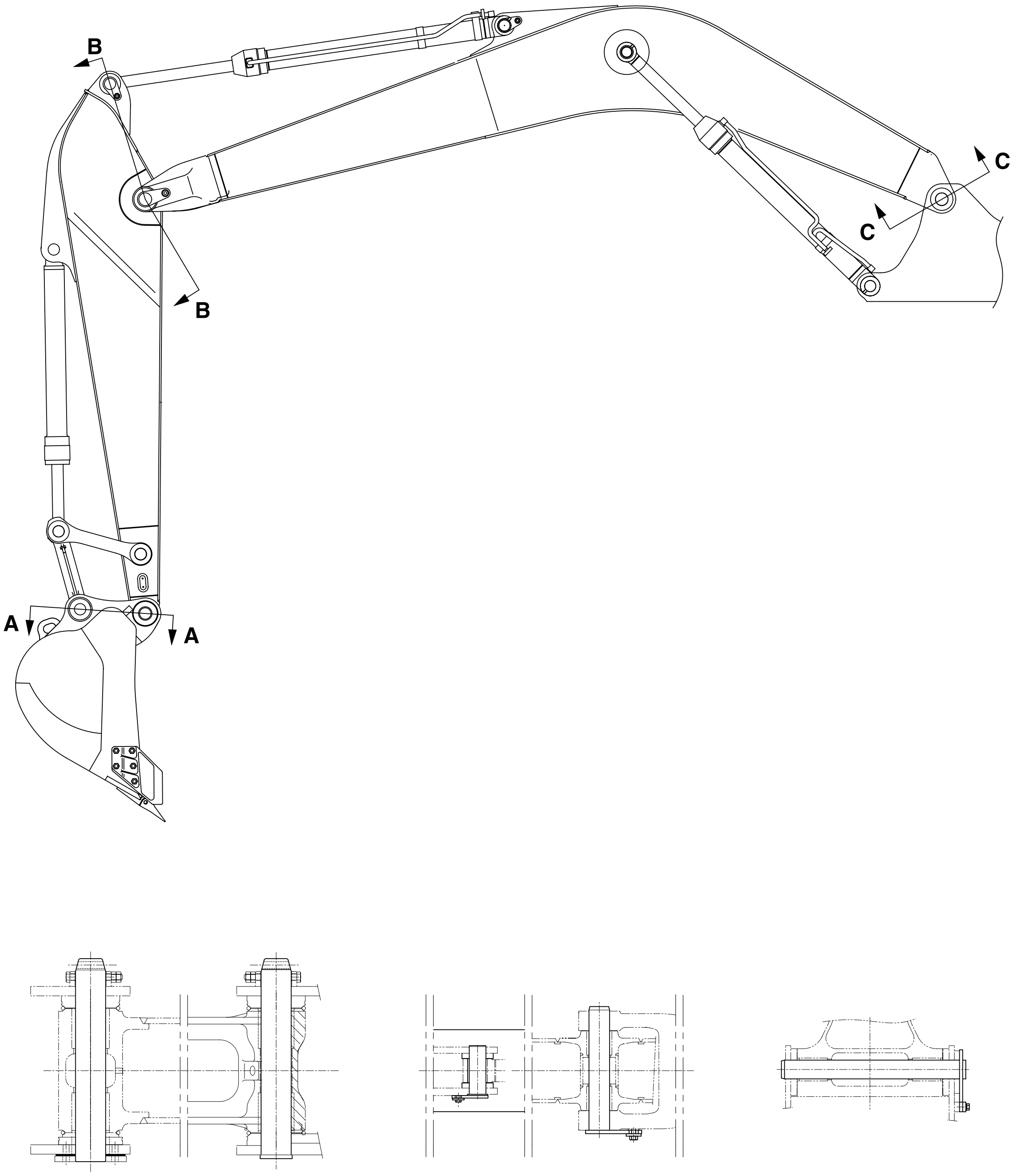
⑥ Lighten the press load and confirm the set length of spring (3).

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

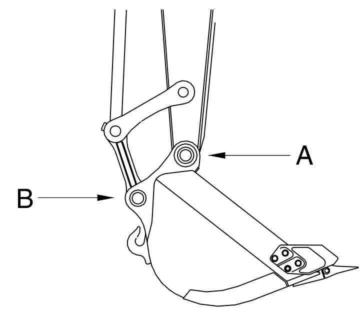
21078DA44

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

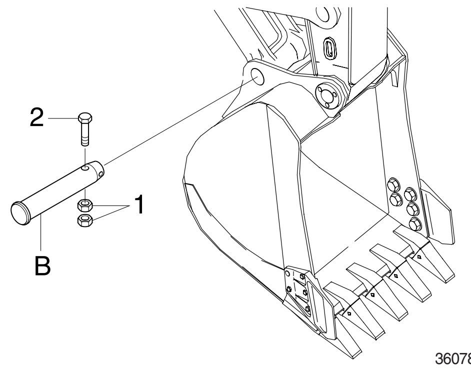
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



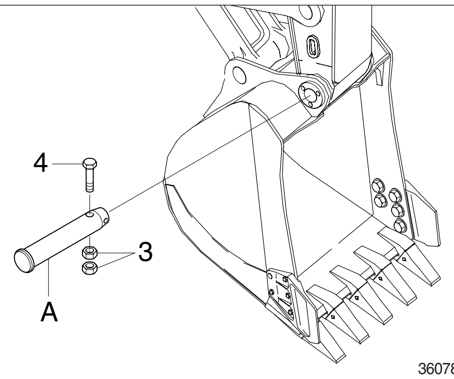
36078AT04

② Remove nut (1), bolt (2) and draw out the pin (B).



36078AT01

③ Remove nut (3), bolt (4) and draw out the pin (A) then remove the bucket assembly.
· Weight : 480 ㎏ (1060 ㏈)



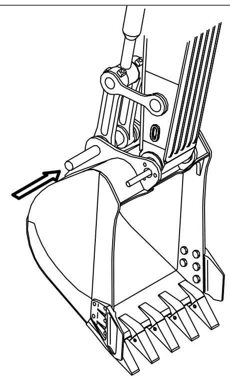
36078AT02

(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.



36078AT05

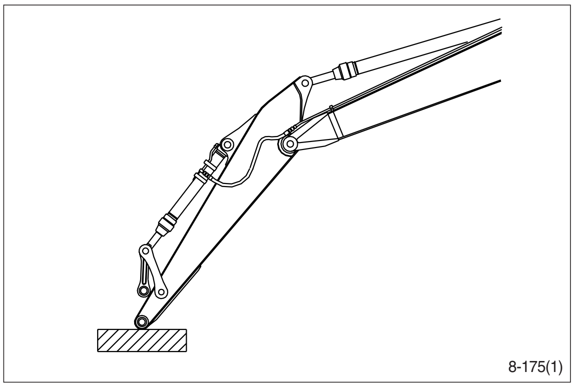
2) ARM ASSEMBLY

(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.


8-175(1)

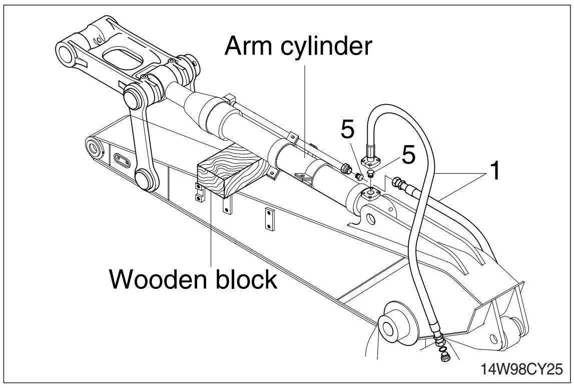
② Disconnect bucket cylinder hose (1).

⚠ **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.

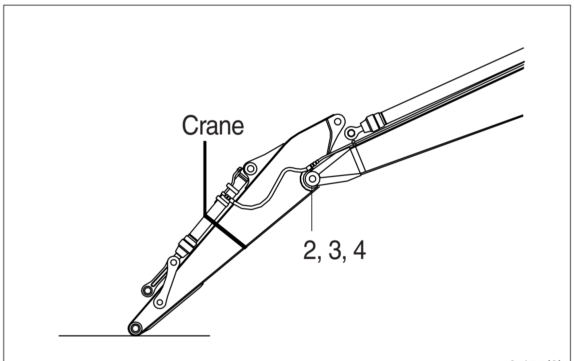
④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.



14W98CY25

⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

※ · Weight : 385 ㎏ (850 ℔)
When lifting the arm assembly, always lift the center of gravity.



8-175(3)

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

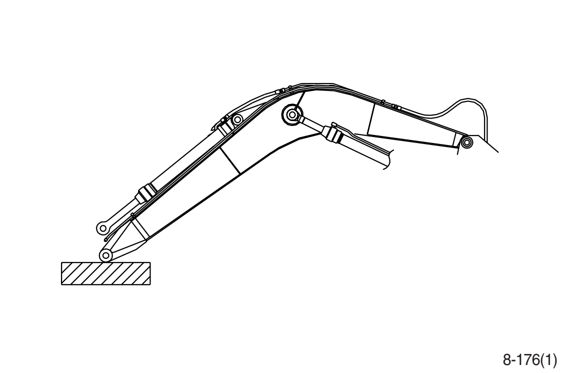
※ Bleed the air from the cylinder.

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.



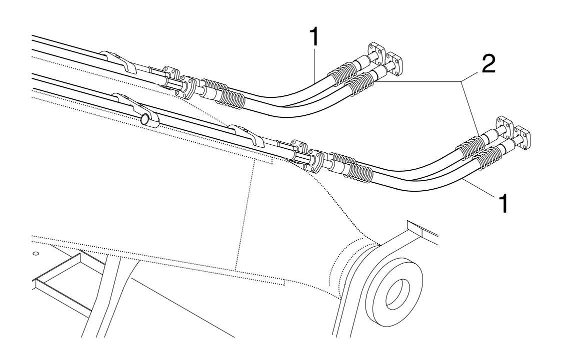
8-176(1)

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.

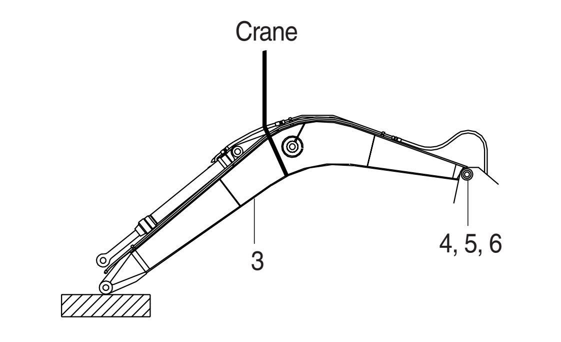
⑤ Sling boom assembly (3).



21078DA45)

⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.
· Weight :760 ㎏ (1675 ℔)

※ When lifting the boom assembly always lift the center of gravity.



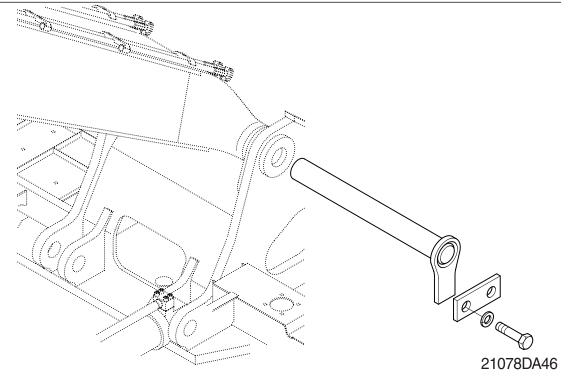
8-176(3)

(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.



21078DA46

SECTION 9 COMPONENT MOUNTING TORQUE

SECTION 9 COMPONENT MOUNTING TORQUE

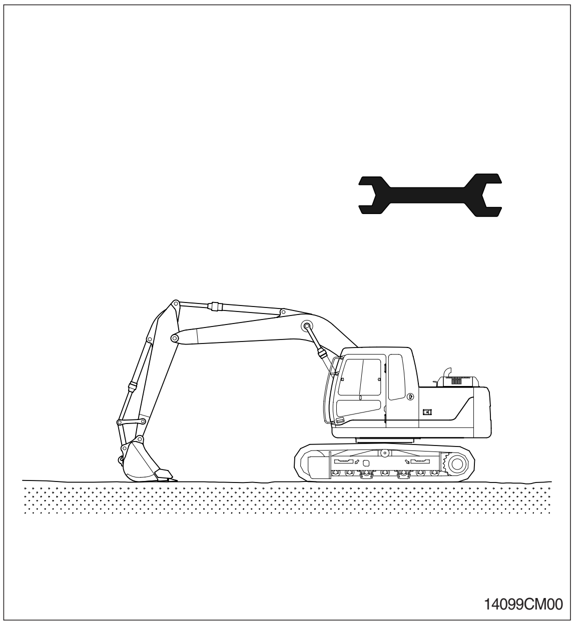
GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.

2. Use genuine Hyundai spare parts.
   We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases Hyundai cannot assume liability for any damage.

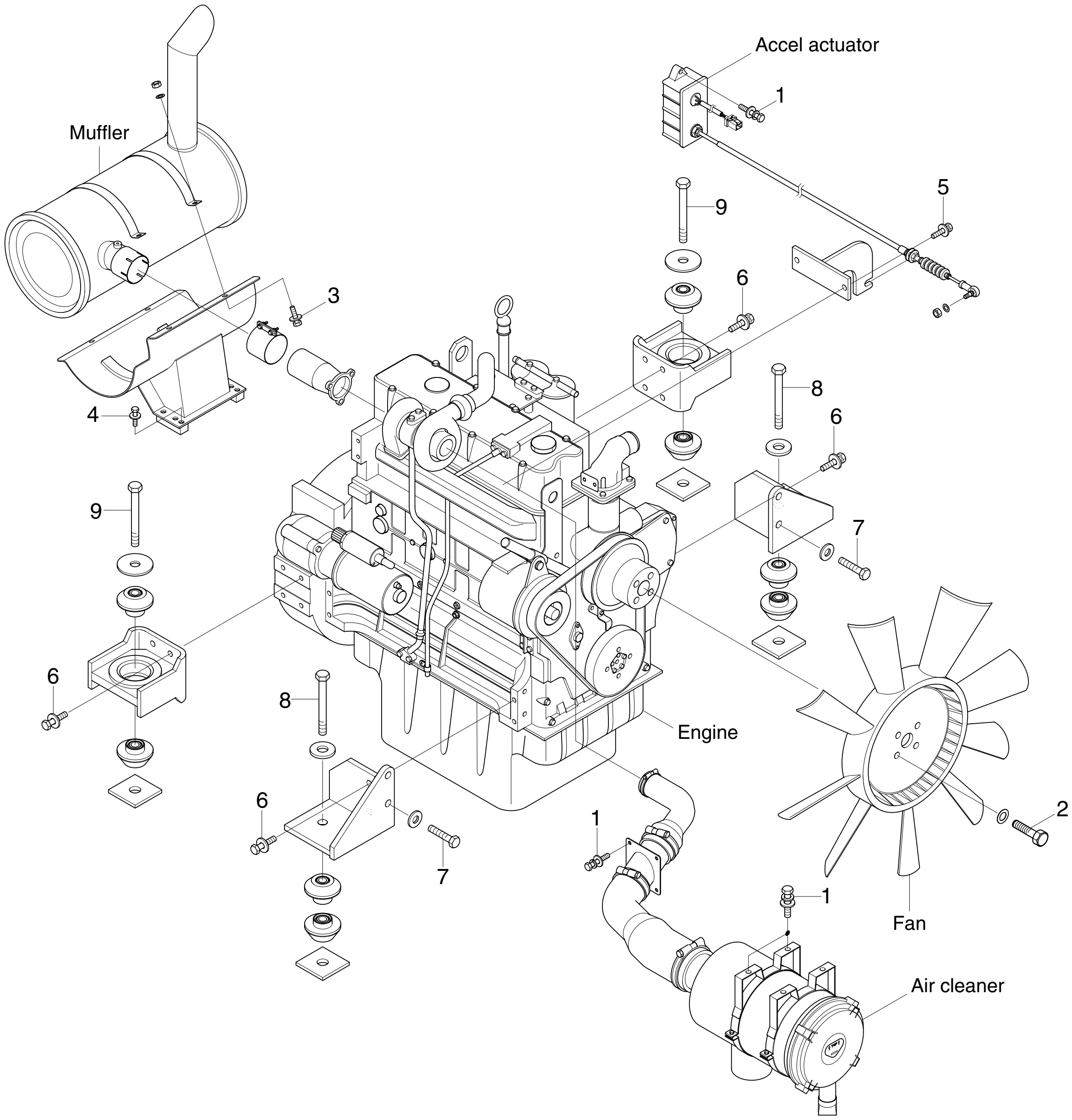
※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.

※ Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



GROUP 2 ENGINE SYSTEM

1. ENGINE AND ACCESSORIES MOUNTING



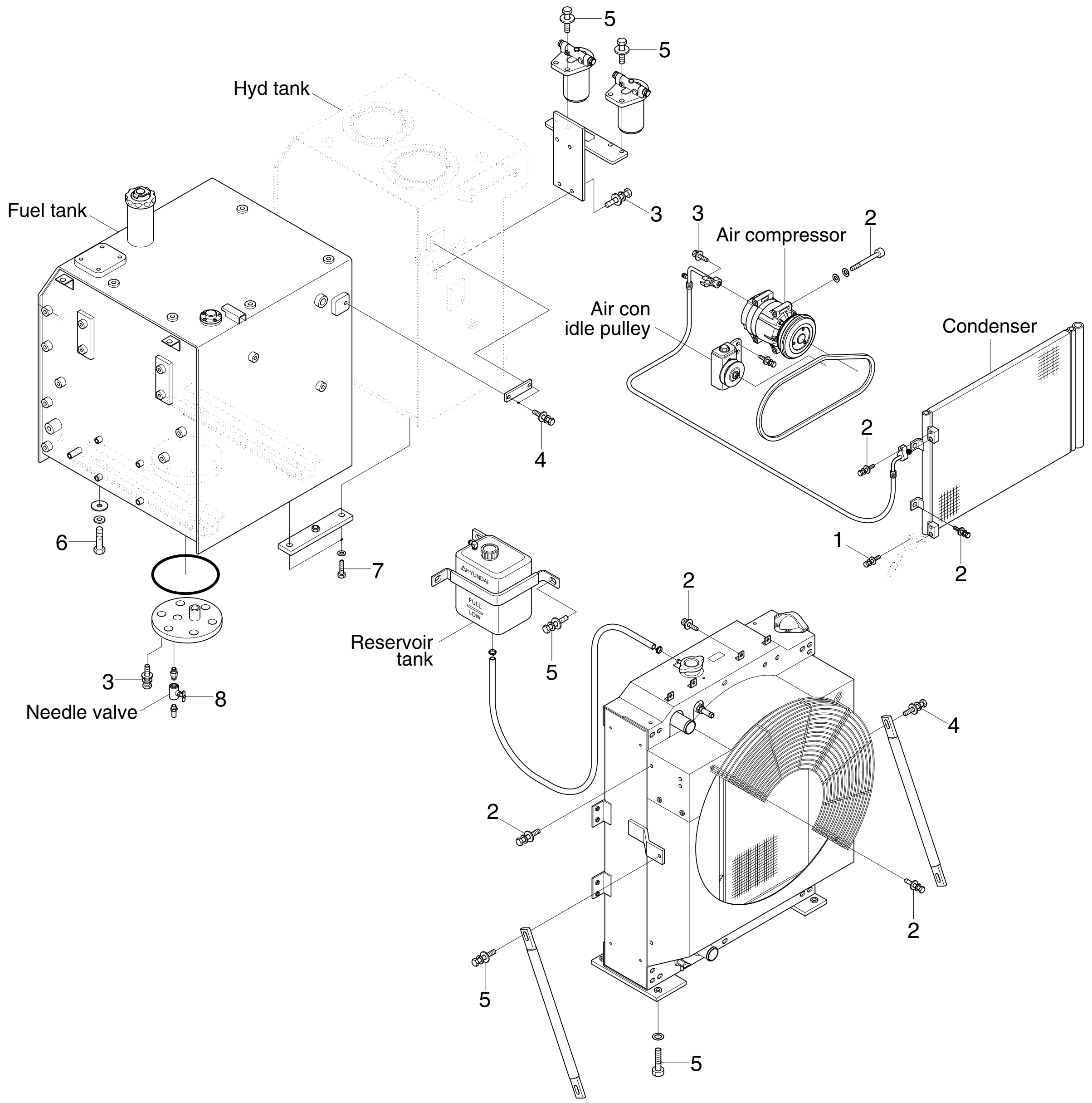
RD14099CM01

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	4.4±0.5	31.8±3.6
3	M10×1.5	5.0±1.0	36.2±7.2
4	M10×1.5	6.9±1.4	49.9±10.1
5	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
6	M12×1.75	10.0±0.5	72.3±3.6
7	M14×2.0	18±0.5	130±3.6
8	M16×2.0	30±3.5	217±25.3
9	M20×2.5	55±3.5	398±25.3

2. COOLING SYSTEM AND FUEL TANK MOUNTING



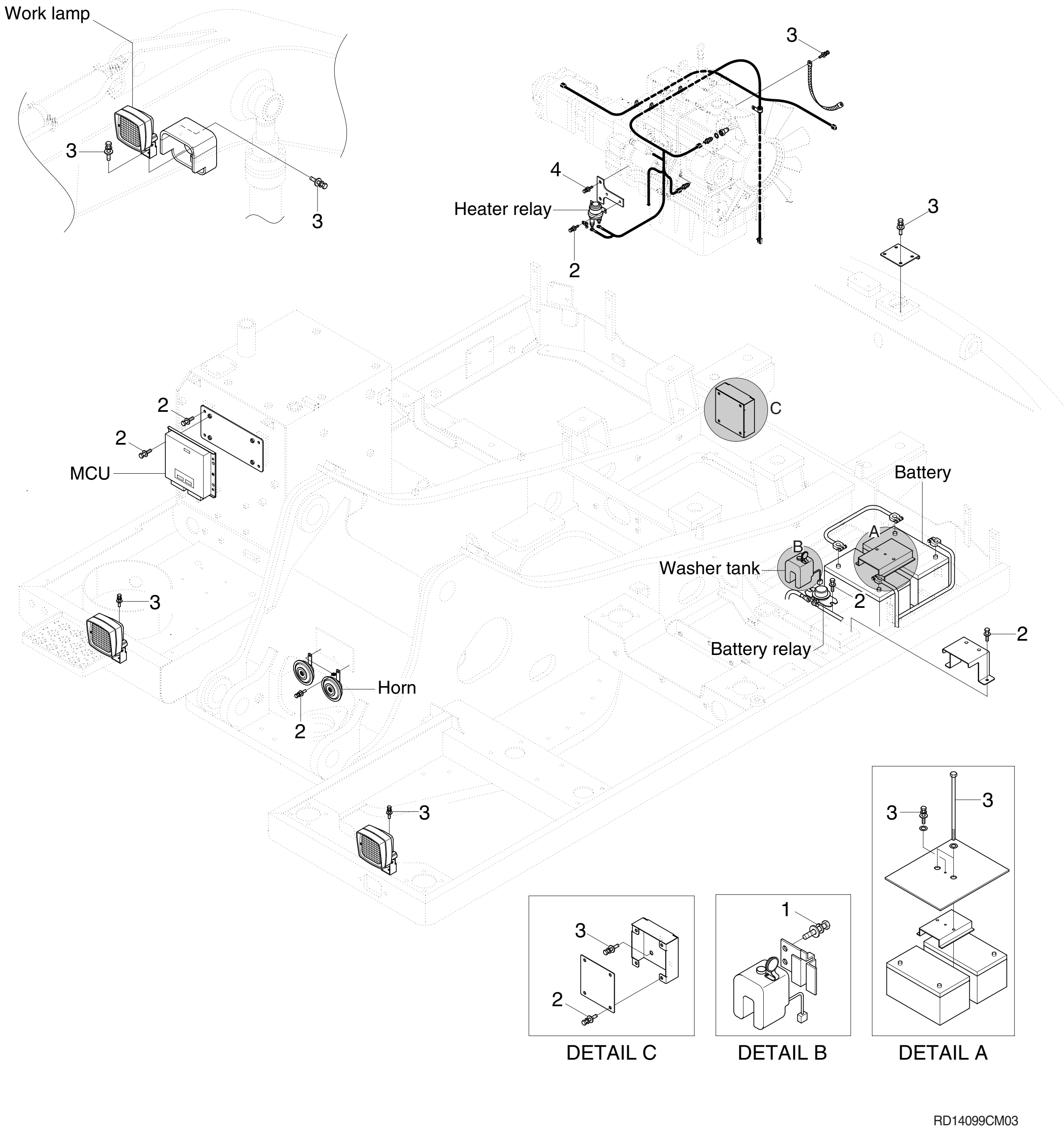
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
5	M16×2.0	29.7±4.5	215±32.5
6	M20×2.5	46±5.1	333±36.9
7	M20×2.5	57.9±8.7	419±62.9
8	-	2.3±0.6	16.6±4.3

GROUP 3 ELECTRIC SYSTEM

1. ELECTRIC COMPONENTS MOUNTING 1

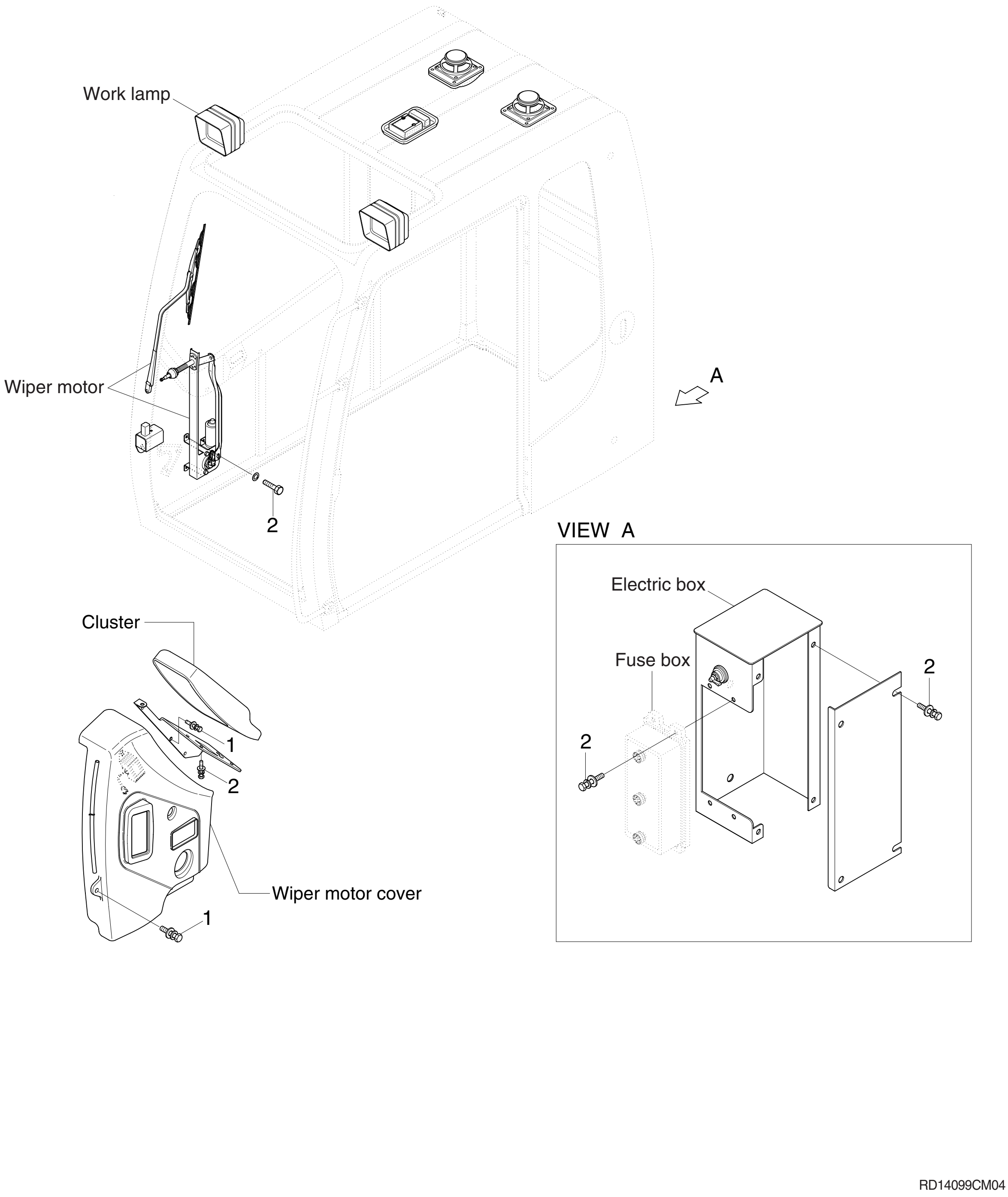


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6 × 1.0	1.05 ± 0.2	7.6 ± 1.45
2	M 8 × 1.25	2.5 ± 0.5	18.1 ± 3.6

Item	Size	kgf · m	lbf · ft
3	M10 × 1.5	6.9 ± 1.4	49.9 ± 10.1
4	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7

2. ELECTRIC COMPONENTS MOUNTING 2

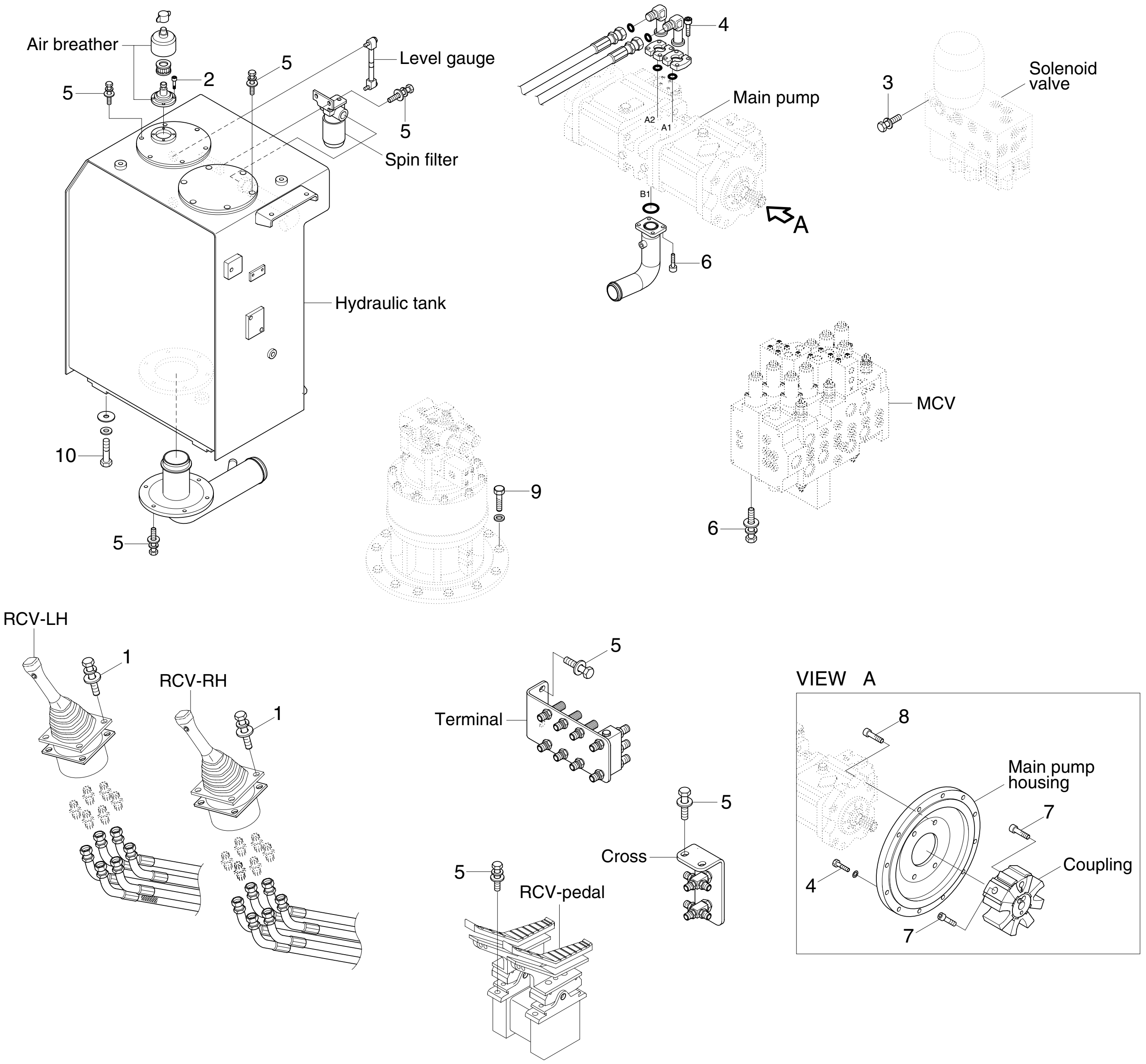


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6 × 1.0	1.05 ± 0.2	7.6 ± 1.45
2	M 8 × 1.25	2.5 ± 0.5	18.1 ± 3.6

GROUP 4 HYDRAULIC SYSTEM

1. HYDRAULIC COMPONENTS MOUNTING 1



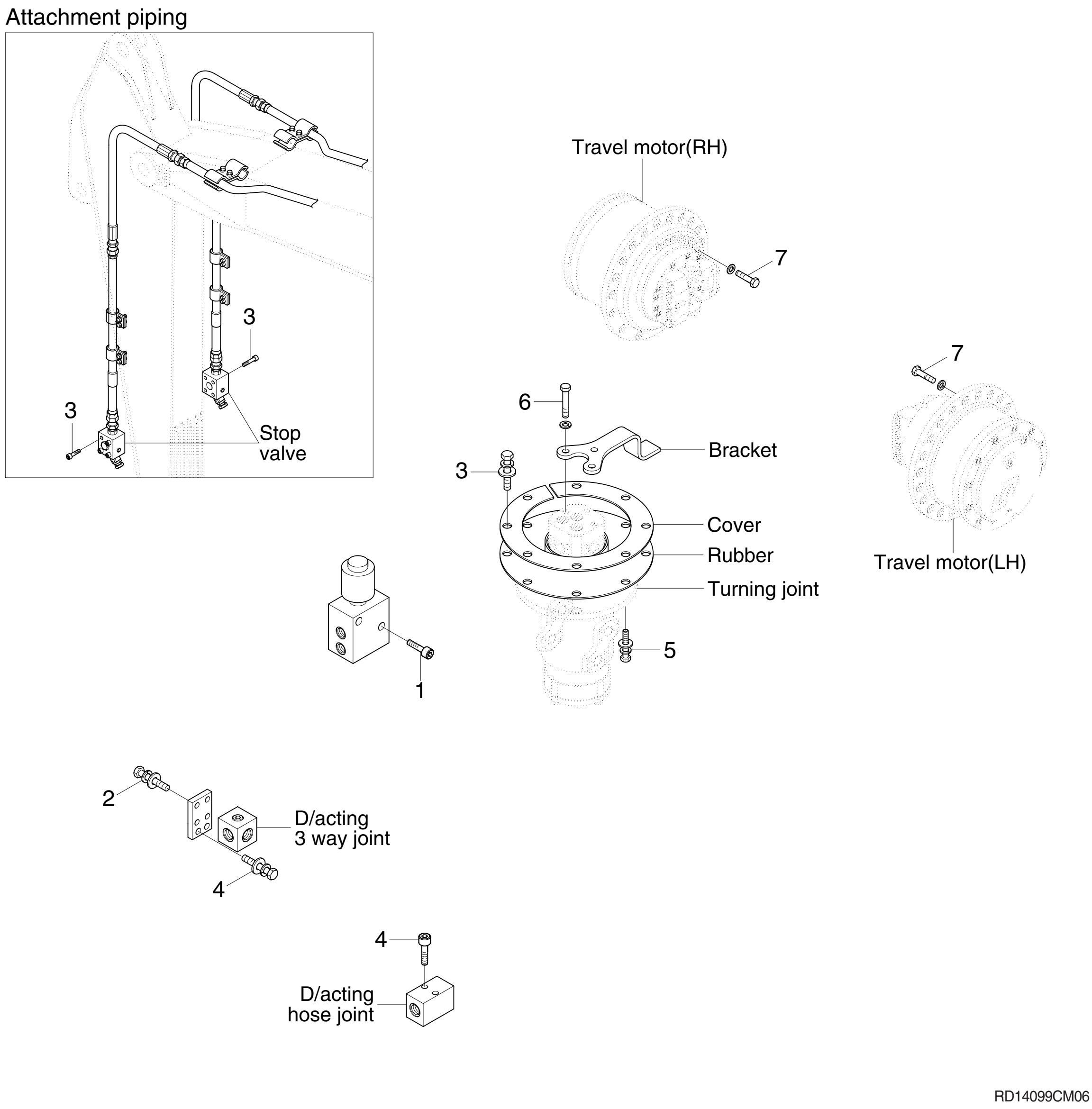
RD14099CM05

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 6×1.0	1.44±0.3	10.4±2.2
3	M 8×1.25	2.5±0.5	18.1±3.6
4	M10×1.5	6.0±0.3	43.4±2.2
5	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
6	M12×1.75	12.2±1.3	88.2±9.4
7	M16×2.0	22±1.0	159±7.2
8	M16×2.0	22.5±0.5	163±3.6
9	M16×2.0	29.6±3.2	214±23.1
10	M20×2.5	46±5.1	333±36.9

2. HYDRAULIC COMPONENTS MOUNTING 2

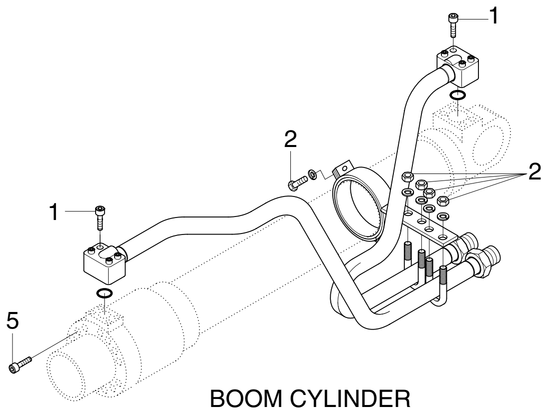


· Tightening torque

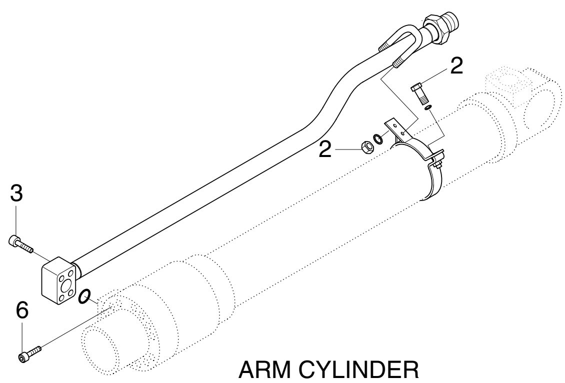
Item	Size	kgf · m	lbf · ft
1	M 8×1.25	3.43±0.7	24.8±5.1
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
5	M12×1.75	12.3±1.3	88.9±9.4
6	M14×2.0	19.6±2.9	142±21.0
7	M16×2.0	25.7±4.0	186±28.9

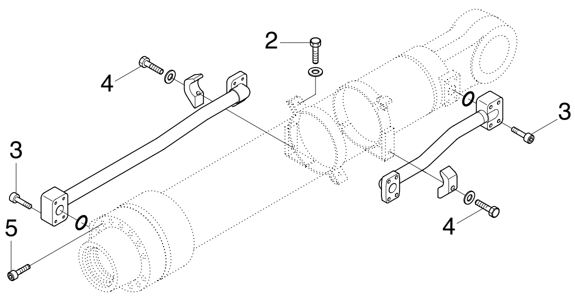
3. HYDRAULIC COMPONENTS MOUNTING 3



BOOM CYLINDER



ARM CYLINDER



BUCKET CYLINDER

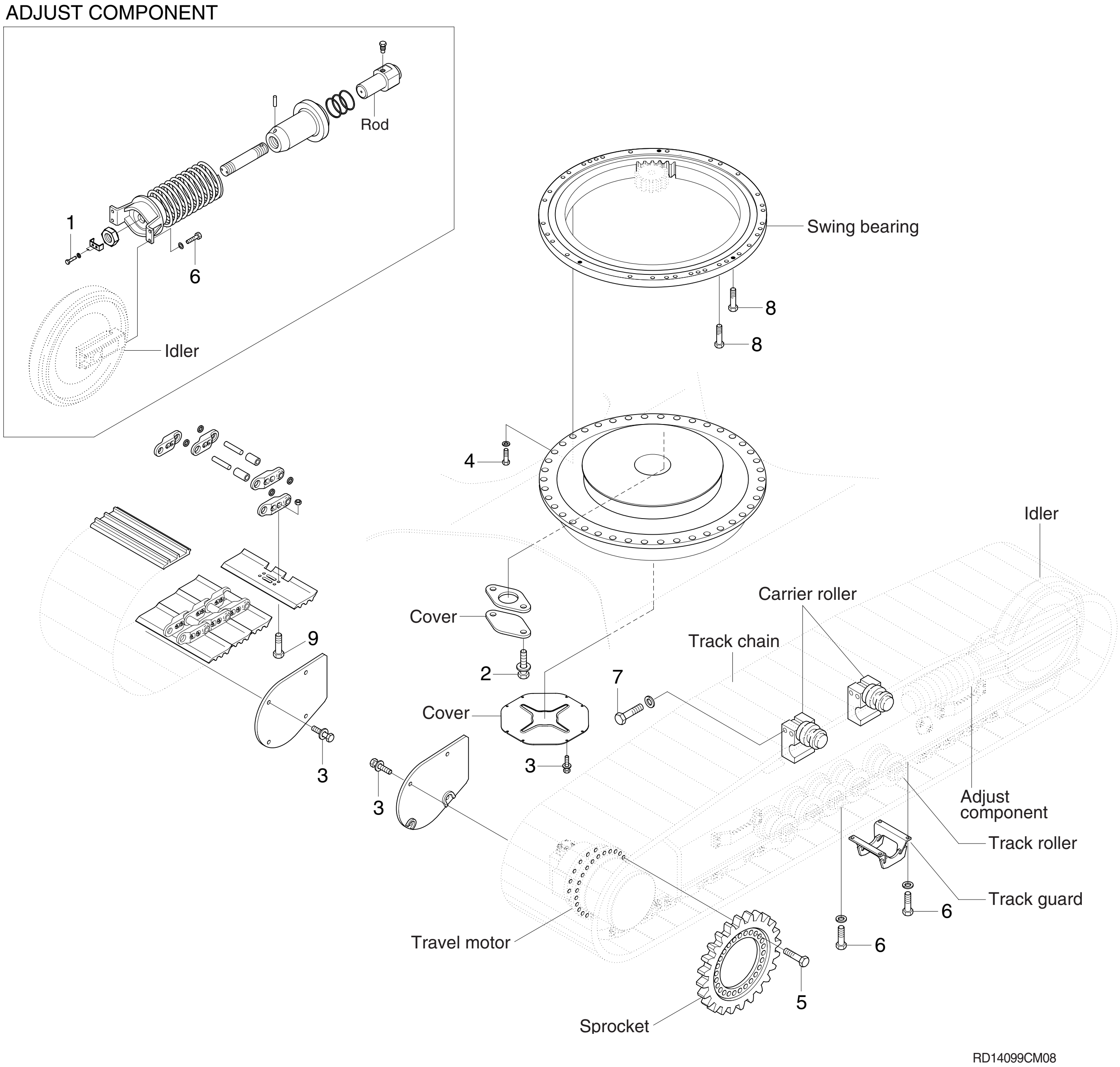
RD14099CM07

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.7±0.3	19.5±2.2
2	M10×1.5	3.2±0.3	23.1±2.2
3	M10×1.5	5.4±0.5	39.1±3.6

Item	Size	kgf · m	lbf · ft
4	M12×1.75	9.3±1.9	67.3±13.7
5	M14×2.0	15±2.0	108±14.5
6	M16×2.0	23±2.0	166±14.5

GROUP 5 UNDERCARRIAGE



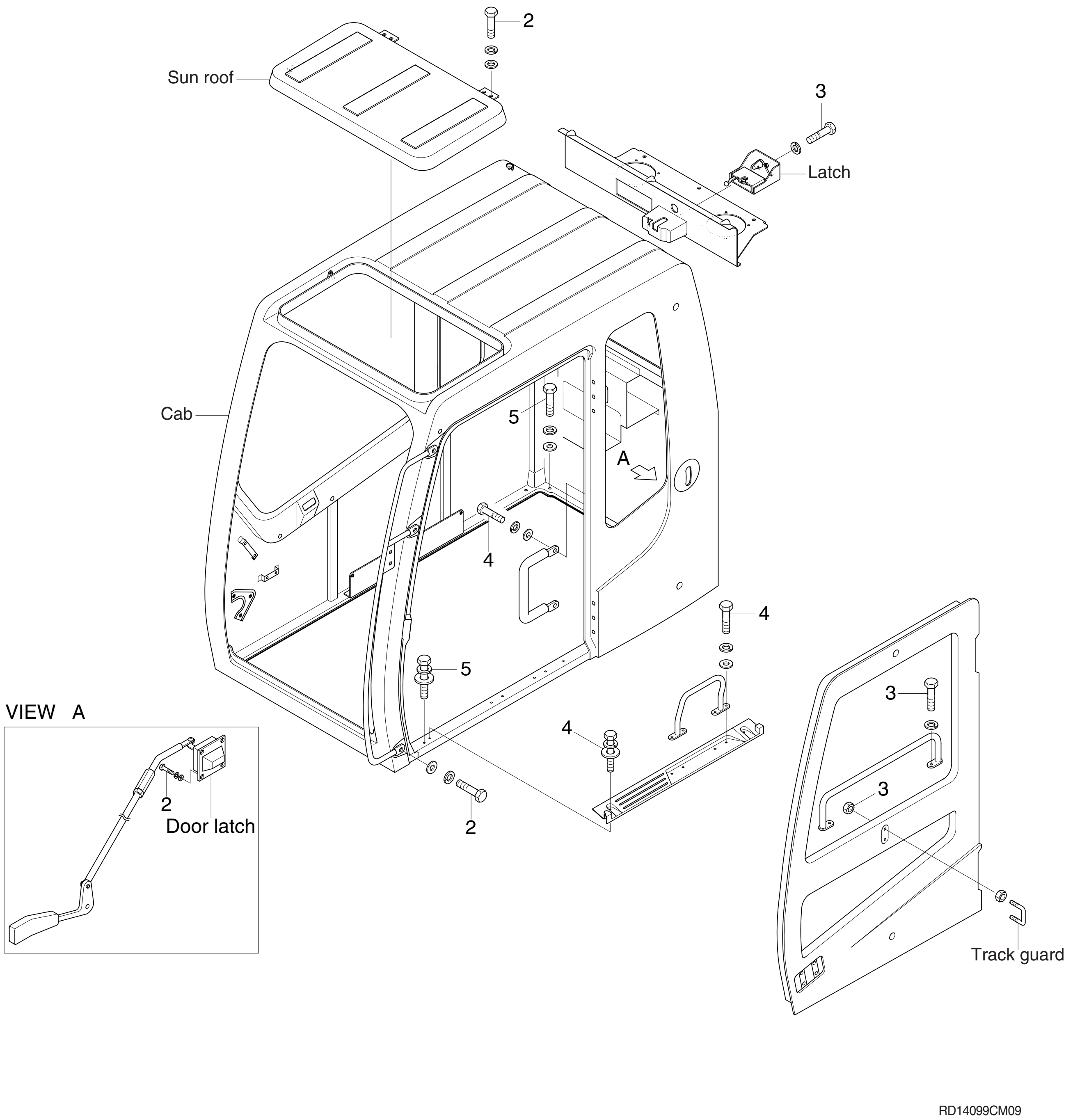
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.0	3.74±0.7	27.1±5.1
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.8±3.0	92.6±21.7
4	M16×1.5	31.3±3.2	226±23.1
5	M16×2.0	23±2.5	166±18.1

Item	Size	kgf · m	lbf · ft
6	M16×2.0	29.6±3.2	214±23.1
7	M16×2.0	29.7±4.4	215±31.8
8	M18×2.5	41.3±4.5	299±32.5
9	5/8" UNF	42±4.0	304±29

GROUP 6 STRUCTURE

1. CAB AND ACCESSORIES MOUNTING

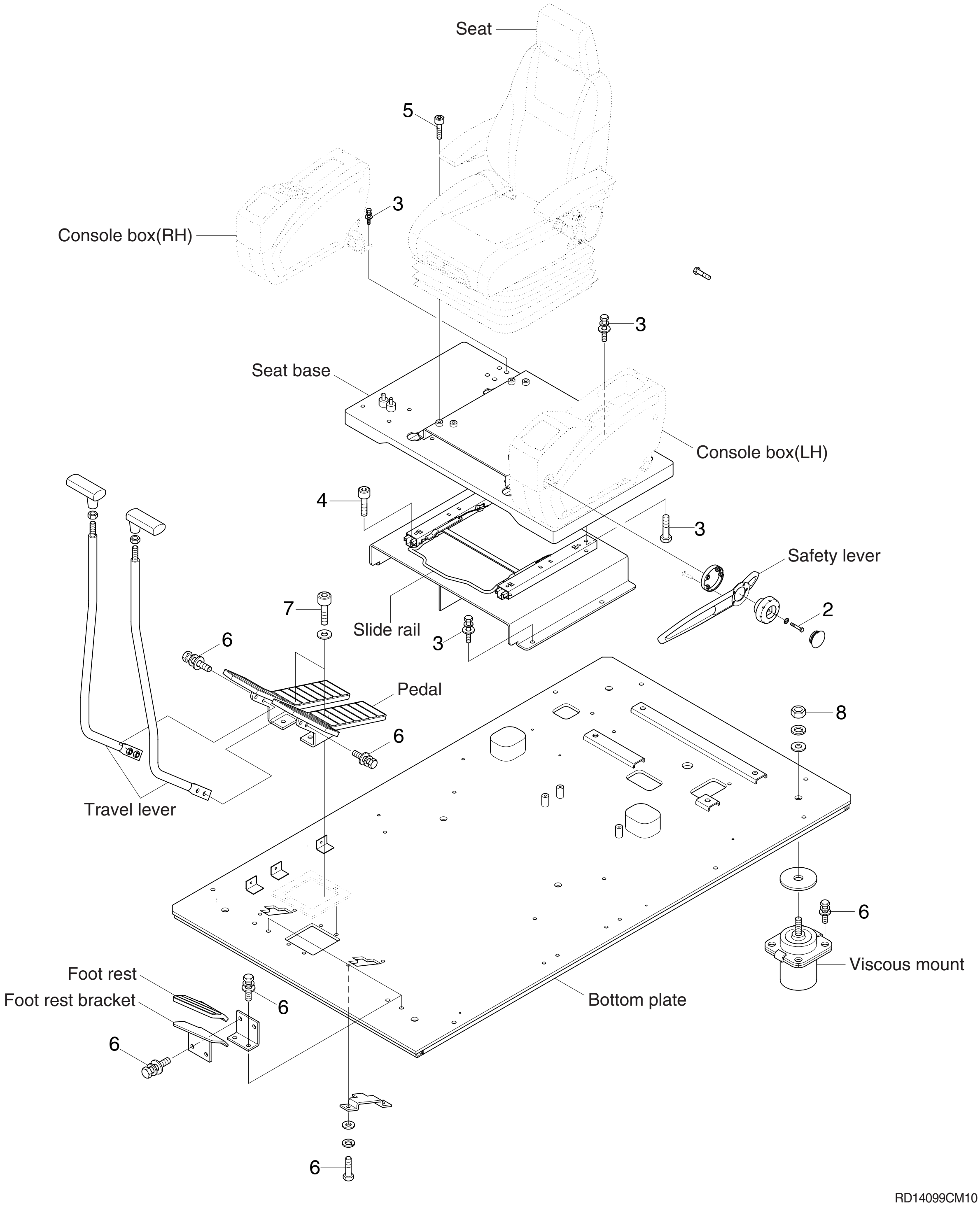


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.44±0.3	10.4±2.2
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	4.7±0.9	34±6.5

Item	Size	kgf · m	lbf · ft
4	M10×1.5	6.9±1.4	49.9±10.1
5	M12×1.75	12.8±3.0	92.6±21.7

2. CAB INTERIOR MOUNTING

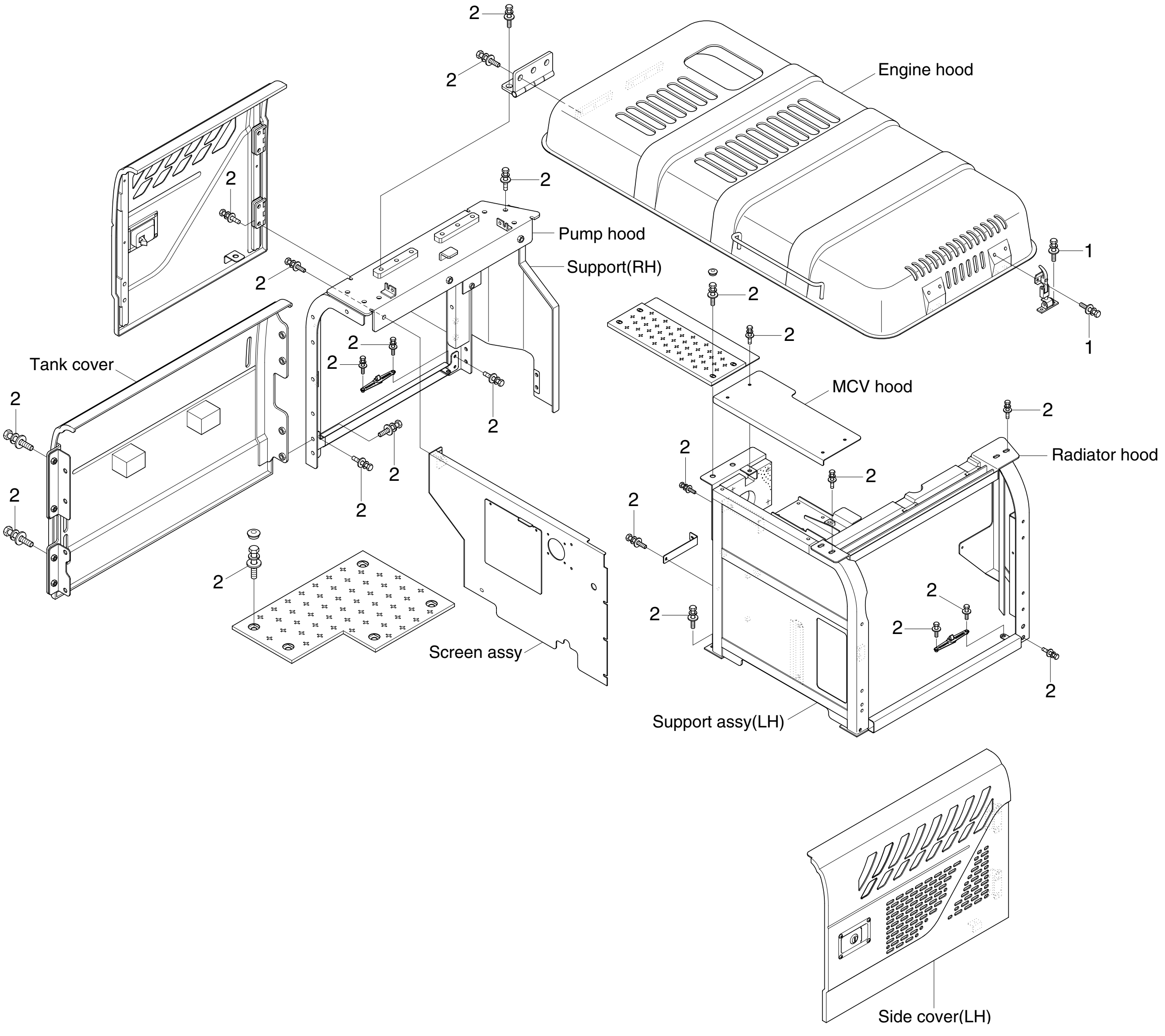


· Tightening torque

Item	Size	kgf · m	lbf · ft
2	M 6×1.0	1.05±0.2	7.6±1.4
3	M 8×1.25	2.5±0.5	18.1±3.6
4	M 8×1.25	3.43±0.7	24.8±5.1
5	M 8×1.25	4.05±0.8	29.3±5.8

Item	Size	kgf · m	lbf · ft
6	M10×1.5	6.9±1.4	49.9±10.1
7	M10×1.5	8.3±1.7	60.0±12.3
8	M16×2.0	29.7±4.5	215±32.5

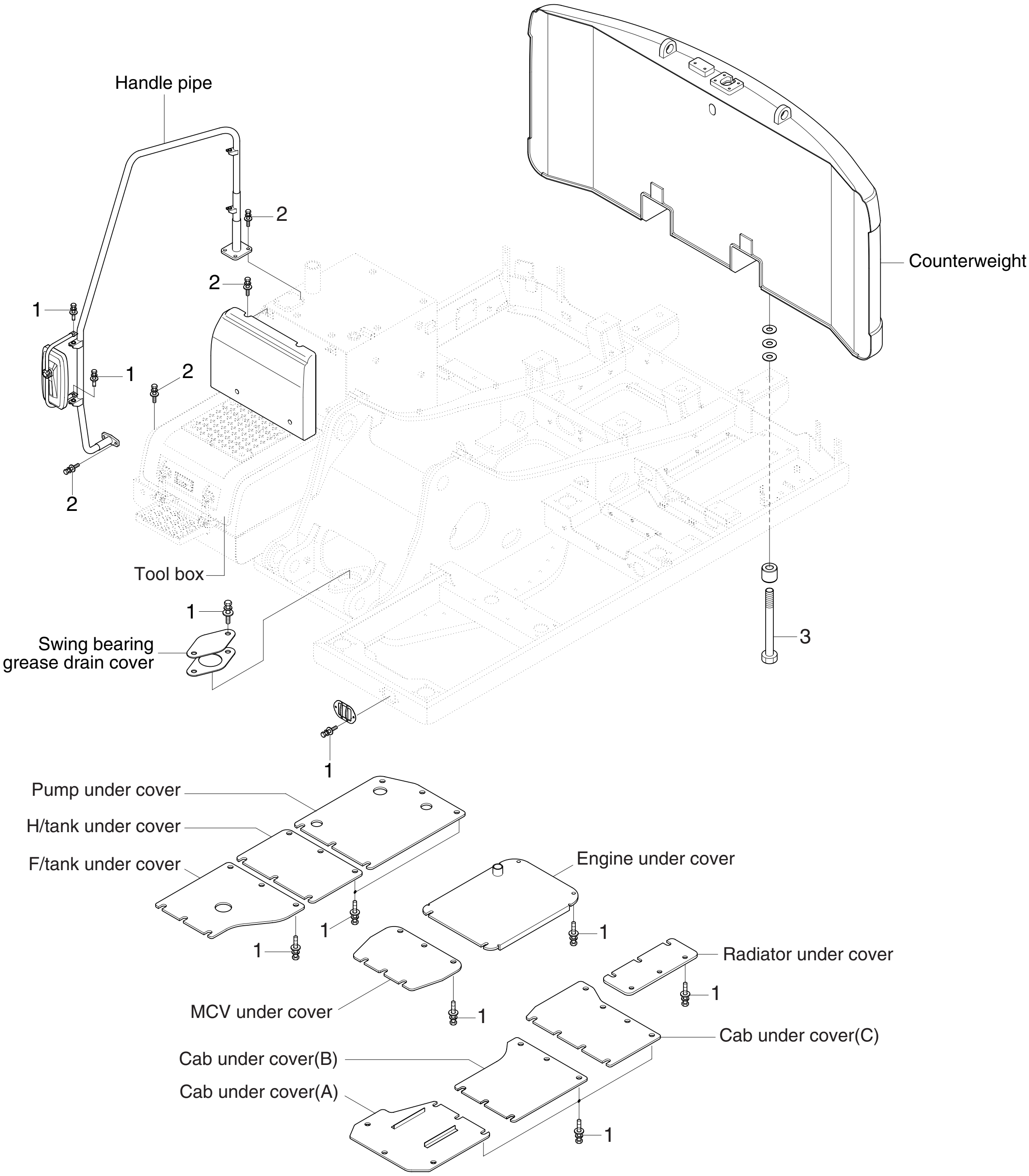
3. COWLING MOUNTING



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	1.05±0.2	7.6±1.4
2	M12×1.75	12.8±3.0	92.6±21.7

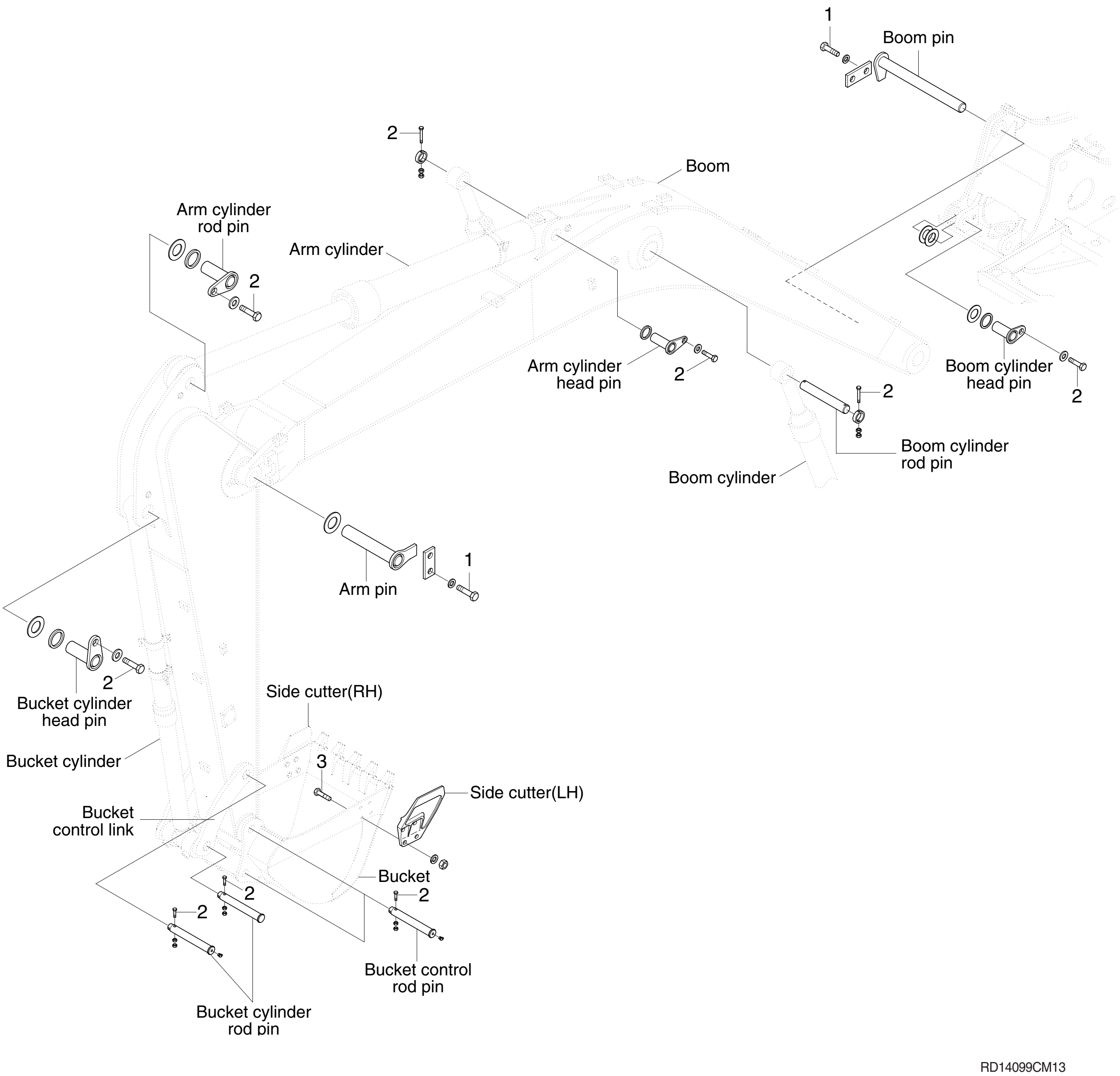
4. COUNTERWEIGHT AND COVERS MOUNTING



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M27×3.0	140±15	1013±108

GROUP 7 WORK EQUIPMENT



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M12×1.75	12.8±3.0	92.6±21.7
2	M16×2.0	29.7±4.5	215±32.5
3	M20×2.5	57.9±8.7	419±62.9