CONTENTS

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	ⓒ $\boxed{2.165}$	2.205	2.244	2.283	2.323
60	2.362	2.402	2.441	2.480	2.520	2.559	2.598	2.638	2.677	2.717
70	2.756	2.795	2.835	2.874	2.913	2.953	2.992	3.032	3.071	3.110
80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

	0	1	2	3	4	5	6	7	8	9
0		2.20	4.41	6.61	8.82	11.02	13.23	15.43	17.64	19.84
10	22.05	24.25	26.46	28.66	30.86	33.07	35.27	37.48	39.68	41.89
20	44.09	46.30	48.50	50.71	51.91	55.12	57.32	59.5.	61.73	63.93
30	66.14	68.34	70.55	72.75	74.96	77.16	79.37	81.57	83.78	85.98
40	88.18	90.39	92.59	94.80	97.00	99.21	101.41	103.62	105.82	108.03
50	110.23	112.44	114.64	116.85	119.05	121.25	123.46	125.66	127.87	130.07
60	132.28	134.48	136.69	138.89	141.10	143.30	145.51	147.71	149.91	152.12
70	154.32	156.53	158.73	160.94	163.14	165.35	167.55	169.76	171.96	174.17
80	176.37	178.57	180.78	182.98	185.19	187.39	189.60	191.80	194.01	196.21
90	198.42	200.62	202.83	205.03	207.24	209.44	211.64	213.85	216.05	218.26

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

	0	1	2	3	4	5	6	7	8	9
0		0.264	0.528	0.793	1.057	1.321	1.585	1.849	2.113	2.378
10	2.642	2.906	3.170	3.434	3.698	3.963	4.227	4.491	4.755	5.019
20	5.283	5.548	5.812	6.6076	6.340	6.604	6.869	7.133	7.397	7.661
30	7.925	8.189	8.454	8.718	8.982	9.246	9.510	9.774	10.039	10.303
40	10.567	10.831	11.095	11.359	11.624	11.888	12.152	12.416	12.680	12.944
50	13.209	13.473	13.737	14.001	14.265	14.529	14.795	15.058	15.322	15.586
60	15.850	16.115	16.379	16.643	16.907	17.171	17.435	17.700	17.964	18.228
70	18.492	18.756	19.020	19.285	19.549	19.813	20.077	20.341	20.605	20.870
80	21.134	21.398	21.662	21.926	22.190	22.455	22.719	22.983	23.247	23.511
90	23.775	24.040	24.304	24.568	24.832	25.096	25.631	25.625	25.889	26.153

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

	0	1	2	3	4	5	6	7	8	9
0		0.220	0.440	0.660	0.880	1.100	1.320	1.540	1.760	1.980
10	2.200	2.420	2.640	2.860	3.080	3.300	3.520	3.740	3.950	4.179
20	4.399	4.619	4.839	5.059	5.279	5.499	5.719	5.939	6.159	6.379
30	6.599	6.819	7.039	7.259	7.479	7.969	7.919	8.139	8.359	8.579
40	8.799	9.019	9.239	9.459	9.679	9.899	10.119	10.339	10.559	10.778
50	10.998	11.281	11.438	11.658	11.878	12.098	12.318	12.528	12.758	12.978
60	13.198	13.418	13.638	13.858	14.078	14.298	14.518	14.738	14.958	15.178
70	15.398	15.618	15.838	16.058	16.278	16.498	16.718	16.938	17.158	17.378
80	17.598	17.818	18.037	18.257	18.477	18.697	18.917	19.137	19.357	19.577
90	19.797	20.017	20.237	20.457	20.677	20.897	21.117	21.337	21.557	21.777

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

	0	1	2	3	4	5	6	7	8	9
		7.2	14.5	21.7	28.9	36.2	43.4	50.6	57.9	65.1
10	72.3	79.6	86.8	94.0	101.3	108.5	115.7	123.0	130.2	137.4
20	144.7	151.9	159.1	166.4	173.6	180.8	188.1	195.3	202.5	209.8
30	217.0	224.2	231.5	238.7	245.9	253.2	260.4	267.6	274.9	282.1
40	289.3	396.6	303.8	311.0	318.3	325.5	332.7	340.0	347.2	354.4
50	361.7	368.9	376.1	383.4	390.6	397.8	405.1	412.3	419.5	426.8
60	434.0	441.2	448.5	455.7	462.9	470.2	477.4	484.6	491.8	499.1
70	506.3	513.5	520.8	528.0	535.2	542.5	549.7	556.9	564.2	571.4
80	578.6	585.9	593.1	600.3	607.6	614.8	622.0	629.3	636.5	643.7
90	651.0	658.2	665.4	672.7	679.9	687.1	694.4	701.6	708.8	716.1
100	723.3	730.5	737.8	745.0	752.2	759.5	766.7	773.9	781.2	788.4
110	795.6	802.9	810.1	817.3	824.6	831.8	839.0	846.3	853.5	860.7
120	868.0	875.2	882.4	889.7	896.9	904.1	911.4	918.6	925.8	933.1
130	940.3	947.5	954.8	962.0	969.2	976.5	983.7	990.9	998.2	10005.4
140	1012.6	1019.9	1027.1	1034.3	1041.5	1048.8	1056.0	1063.2	1070.5	1077.7
150	1084.9	1092.2	1099.4	1106.6	1113.9	1121.1	1128.3	1135.6	1142.8	1150.0
160	1157.3	1164.5	1171.7	1179.0	1186.2	1193.4	1200.7	1207.9	1215.1	1222.4
170	1129.6	1236.8	1244.1	1251.3	1258.5	1265.8	1273.0	1280.1	1287.5	1294.7
180	1301.9	1309.2	1316.4	1323.6	1330.9	1338.1	1345.3	1352.6	1359.8	1367.0
190	1374.3	1381.5	1388.7	1396.0	1403.2	1410.4	1417.7	1424.9	1432.1	1439.4

kgf/cm^2 to lbf/in^2

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

	0	1	2	3	4	5	6	7	8	9
		14.2	28.4	42.7	56.9	71.1	85.3	99.6	113.8	128.0
10	142.2	156.5	170.7	184.9	199.1	213.4	227.6	241.8	256.0	270.2
20	284.5	298.7	312.9	327.1	341.4	355.6	369.8	384.0	398.3	412.5
30	426.7	440.9	455.1	469.4	483.6	497.8	512.0	526.3	540.5	554.7
40	568.9	583.2	597.4	611.6	625.8	640.1	654.3	668.5	682.7	696.9
50	711.2	725.4	739.6	753.8	768.1	782.3	796.5	810.7	825.0	839.2
60	853.4	867.6	881.8	896.1	910.3	924.5	938.7	953.0	967.2	981.4
70	995.6	1010	1024	1038	1053	1067	1081	1095	1109	1124
80	1138	1152	1166	1181	1195	1209	1223	1237	1252	1266
90	1280	1294	1309	1323	1337	1351	1365	1380	1394	1408
100	1422	1437	1451	1465	1479	1493	1508	1522	1536	1550
110	1565	1579	1593	1607	1621	1636	1650	1664	1678	1693
120	1707	1721	1735	1749	1764	1778	1792	1806	1821	1835
130	1849	2863	1877	1892	1906	1920	1934	1949	1963	1977
140	1991	2005	2020	2034	2048	2062	2077	2091	2105	2119
150	2134	2148	2162	2176	2190	2205	2219	2233	2247	2262
160	2276	2290	2304	2318	2333	2347	2361	2375	2389	2404
170	2418	2432	2446	2460	2475	2489	2503	2518	2532	2546
180	2560	2574	2589	5603	2617	2631	2646	2660	2674	2688
200	2845	2859	2873	2887	2901	2916	2930	2944	2958	2973
210	2987	3001	3015	3030	3044	3058	3072	3086	3101	3115
220	3129	3143	3158	3172	3186	3200	3214	3229	3243	3257
230	3271	3286	3300	3314	3328	3343	3357	3371	3385	3399
240	3414	3428	3442	3456	3470	3485	3499	3513	3527	3542

TEMPERATURE

Fahrenheit-Centigrade Conversion.
A simple way to convert a fahrenheit temperature reading into a centigrade temperature reading or vice verse is to enter the accompanying table in the center or boldface column of figures.
These figures refer to the temperature in either Fahrenheit or Centigrade degrees.
If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.
If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

°C		°F	°C		°F	°C		°F	°C		°F
-40.4	-40	-40.0	-11.7	11	51.8	7.8	46	114.8	27.2	81	117.8
-37.2	-35	-31.0	-11.1	12	53.6	8.3	47	116.6	27.8	82	179.6
-34.4	-30	-22.0	-10.6	13	55.4	8.9	48	118.4	28.3	83	181.4
-31.7	-25	-13.0	-10.0	14	57.2	9.4	49	120.2	28.9	84	183.2
-28.9	-20	-4.0	-9.4	15	59.0	10.0	50	122.0	29.4	85	185.0
-28.3	-19	-2.2	-8.9	16	60.8	10.6	51	123.8	30.0	86	186.8
-27.8	-18	-0.4	-8.3	17	62.6	11.1	52	125.6	30.6	87	188.6
-27.2	-17	1.4	-7.8	18	64.4	11.7	53	127.4	31.1	88	190.4
-26.7	-16	3.2	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-26.1	-15	5.0	-6.7	20	68.0	12.8	55	131.0	32.2	90	194.0
-25.6	-14	6.8	-6.1	21	69.8	13.3	56	132.8	32.8	91	195.8
-25.0	-13	8.6	-5.6	22	71.6	13.9	57	134.6	33.3	92	197.6
-24.4	-12	10.4	-5.0	23	73.4	14.4	58	136.4	33.9	93	199.4
-23.9	-11	12.2	-4.4	24	75.2	15.0	59	138.2	34.4	94	201.2
-23.3	-10	14.0	-3.9	25	77.0	15.6	60	140.0	35.0	95	203.0
-22.8	-9	15.8	-3.3	26	78.8	16.1	61	141.8	35.6	96	204.8
-22.2	-8	17.6	-2.8	27	80.6	16.7	62	143.6	36.1	97	206.6
-21.7	-7	19.4	-2.2	28	82.4	17.2	63	145.4	36.7	98	208.4
-21.1	-6	21.2	-1.7	29	84.2	17.8	64	147.2	37.2	99	210.2
-20.6	-5	23.0	-1.1	35	95.0	21.1	70	158.0	51.7	125	257.0
-20.0	-4	24.8	-0.6	31	87.8	18.9	66	150.8	40.6	105	221.0
-19.4	-3	26.6	0	32	89.6	19.4	67	152.6	43.3	110	230.0
-18.9	-2	28.4	0.6	33	91.4	20.0	68	154.4	46.1	115	239.0
-18.3	-1	30.2	1.1	34	93.2	20.6	69	156.2	48.9	120	248.0
-17.8	0	32.0	1.7	35	95.0	21.1	70	158.0	51.7	125	257.0
-17.2	1	33.8	2.2	36	96.8	21.7	71	159.8	54.4	130	266.0
-16.7	2	35.6	2.8	37	98.6	22.2	72	161.6	57.2	135	275.0
-16.1	3	37.4	3.3	38	100.4	22.8	73	163.4	60.0	140	284.0
-15.6	4	39.2	3.9	39	102.2	23.3	74	165.2	62.7	145	293.0
-15.0	5	41.0	4.4	40	104.0	23.9	75	167.0	65.6	150	302.0
-14.4	6	42.8	5.0	41	105.8	24.4	76	168.8	68.3	155	311.0
-13.9	7	44.6	5.6	42	107.6	25.0	77	170.6	71.1	160	320.0
-13.3	8	46.4	6.1	43	109.4	25.6	78	172.4	73.9	165	329.0
-12.8	9	48.2	6.7	44	111.2	26.1	79	174.2	76.7	170	338.0
-12.2	10	50.0	7.2	45	113.0	26.7	80	176.0	79.4	172	347.0

SECTION 1 GENERAL

SECTION 1 GENERAL

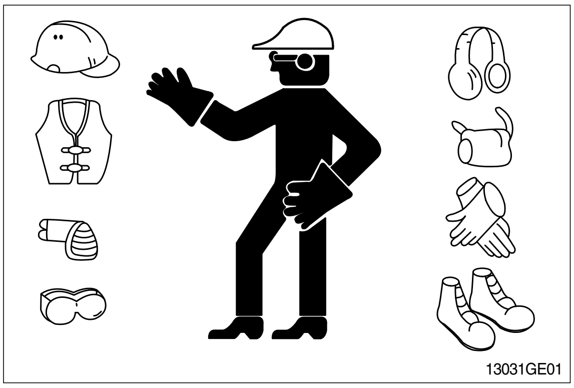
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

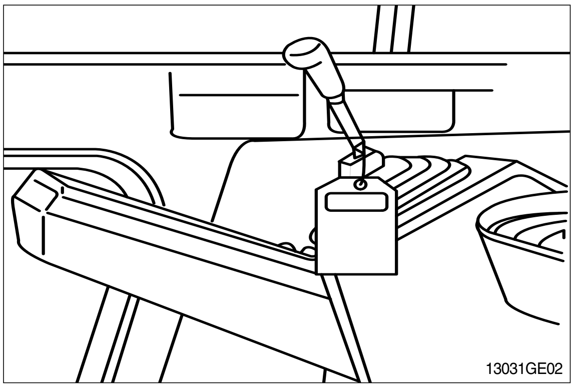
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

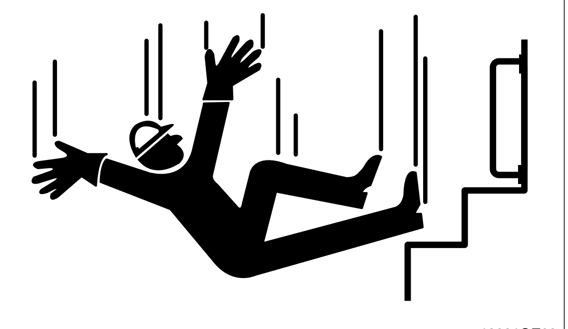
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



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.



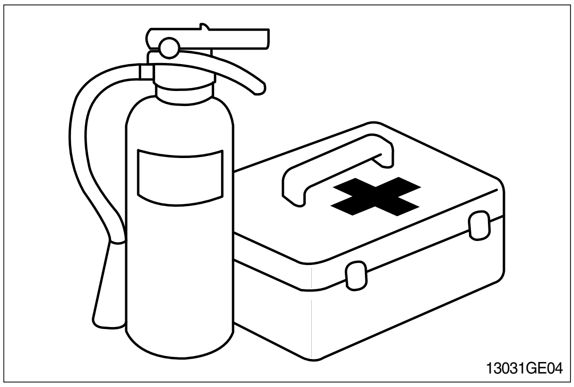
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

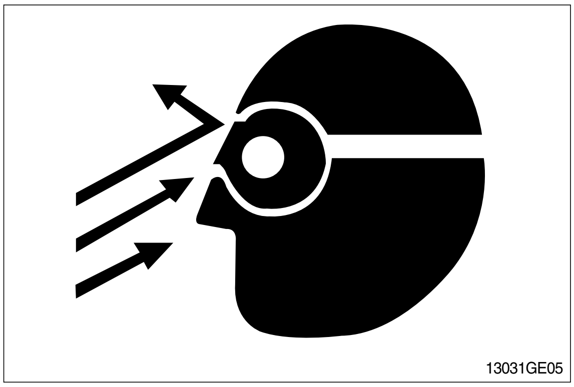
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

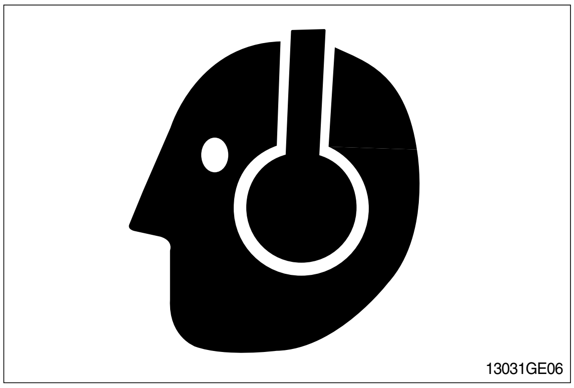
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

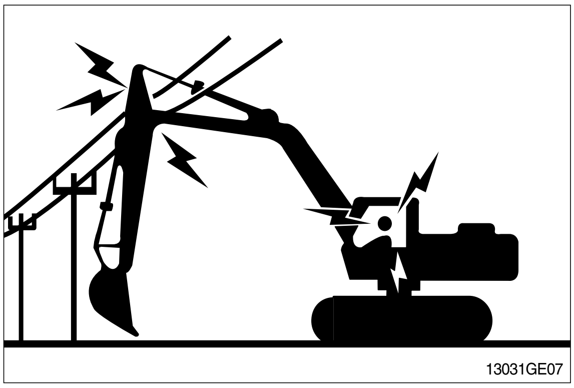
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

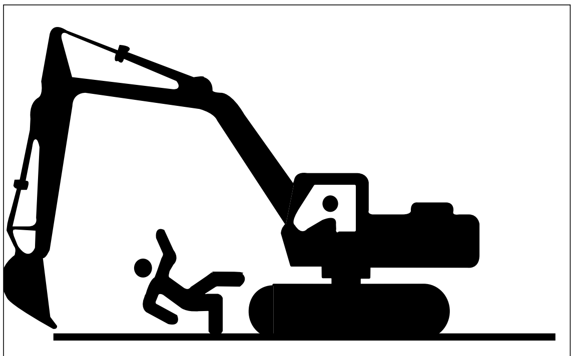
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

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

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



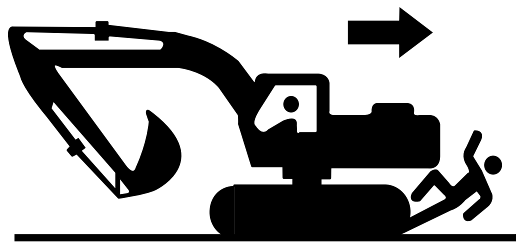
13031GE08

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.

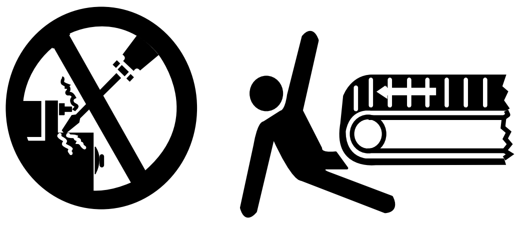


13031GE09

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

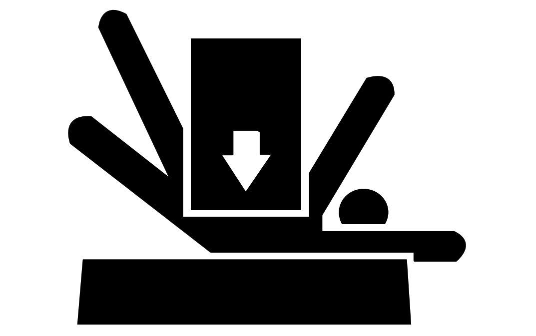
Before working on the machine:

· 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.

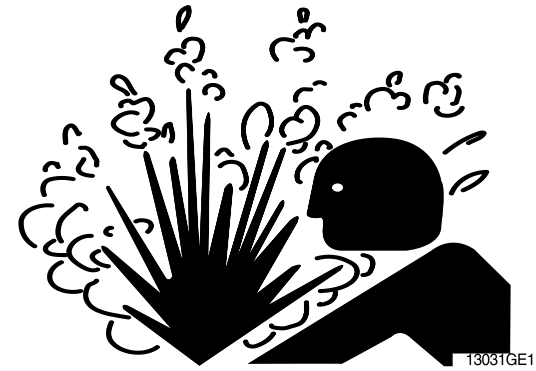


13031GE10

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.

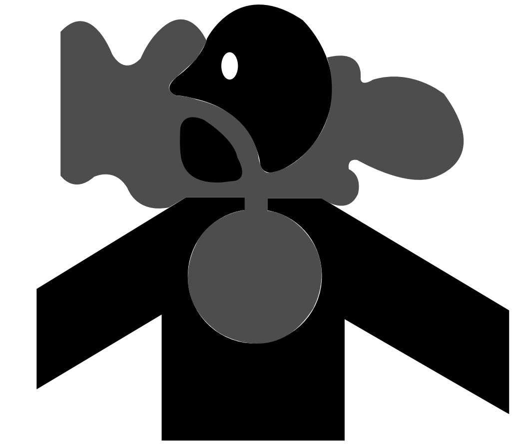
Do not store oily rags; They can ignite and burn spontaneously.

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

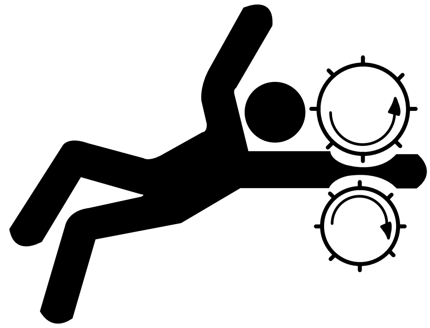
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

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.

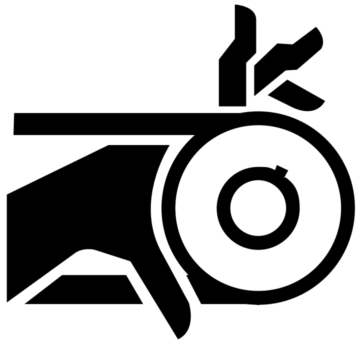


13031GE16

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

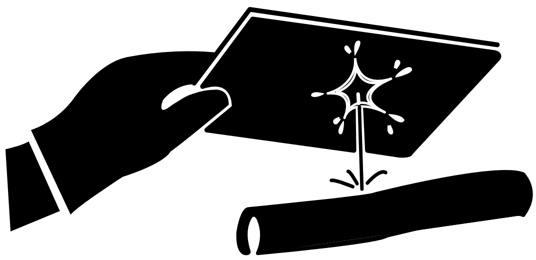
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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.

13031GE20

PREVENT BATTERY EXPLOSIONS

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

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

Do not charge a frozen battery; It may explode. Warm battery to 16℃ (60℉).

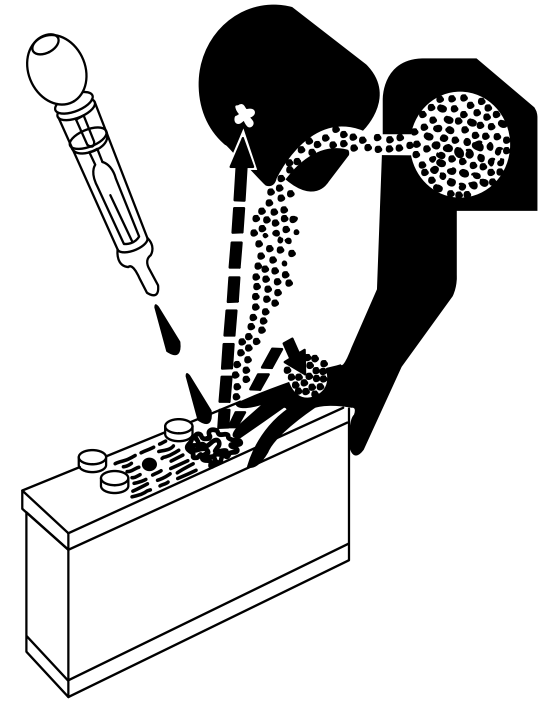
13031GE21

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.


13031GE22

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

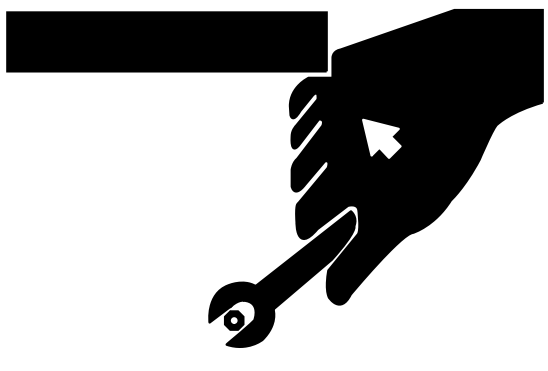
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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

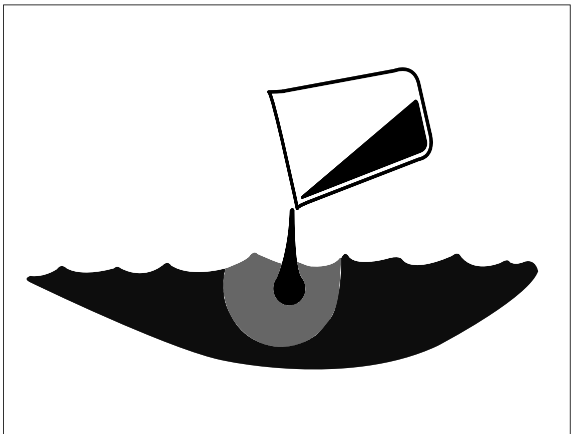

13031GE23

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.

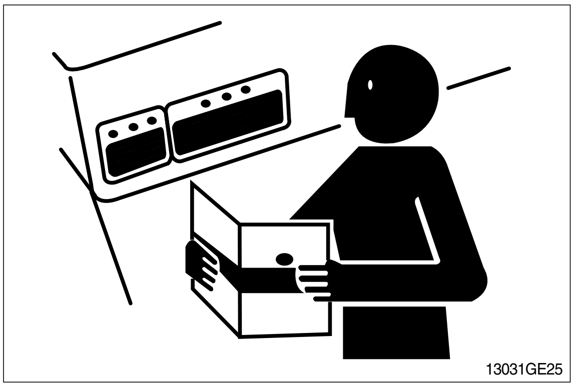
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



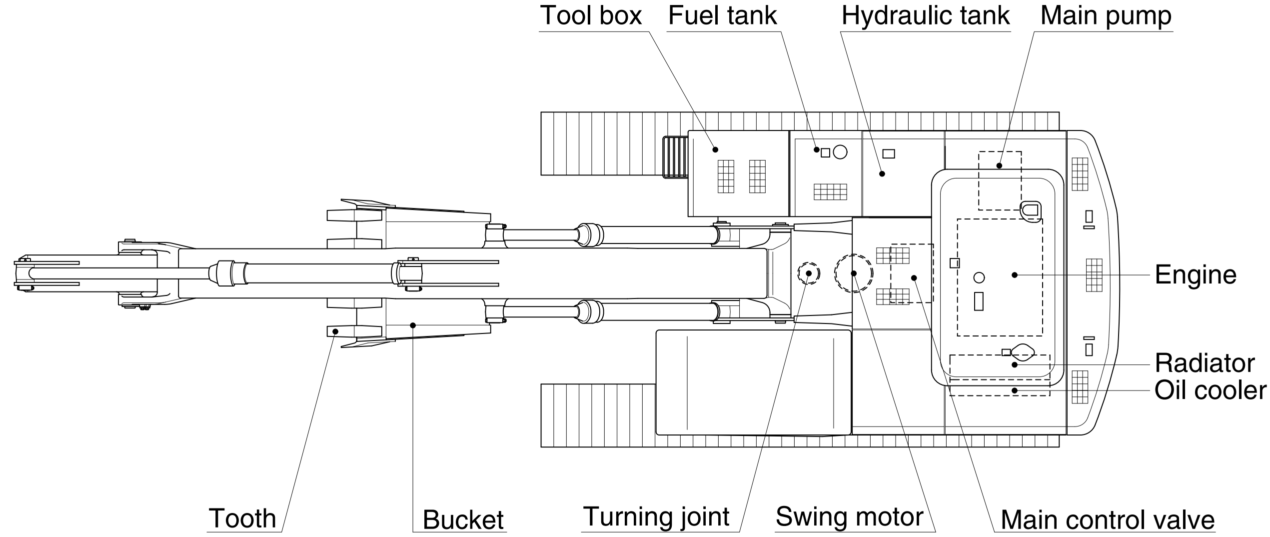
13031GE25

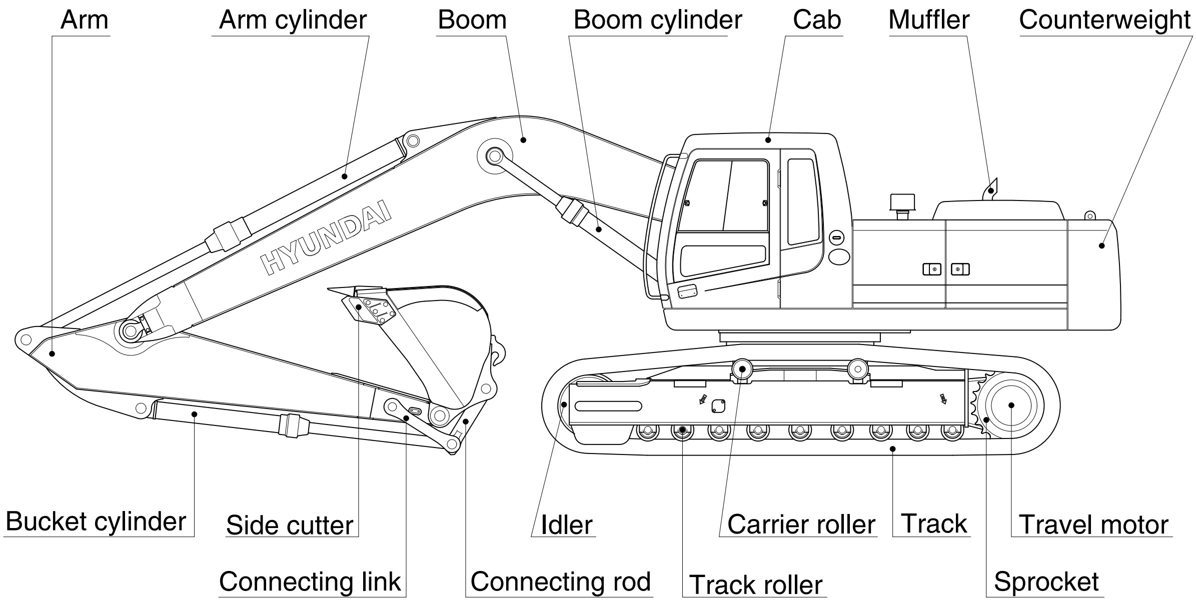
LIVE WITH SAFETY

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

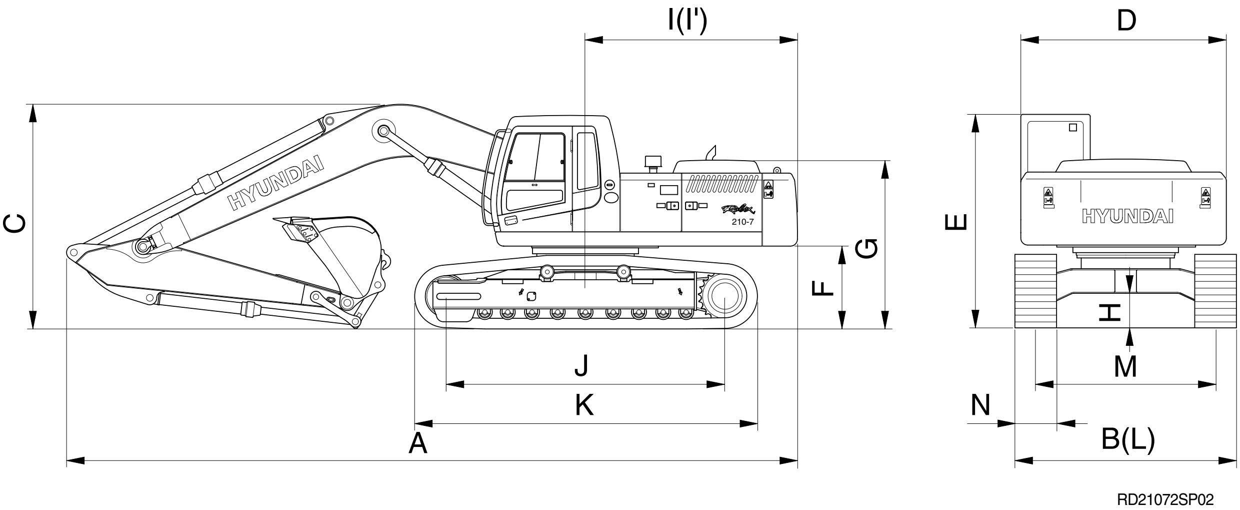




RD21072SP01

2. SPECIFICATIONS

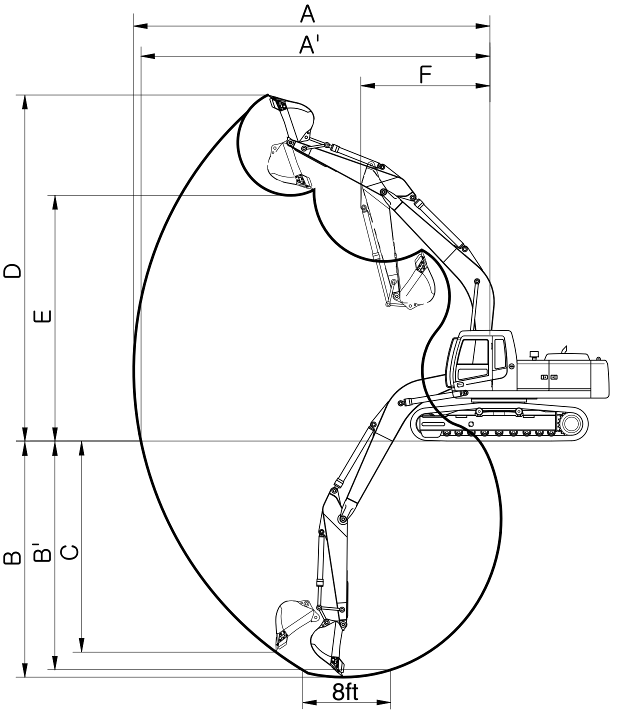
1) ROBEX 210-7



Description		Unit	Specification
Operating weight		kg(lb)	20360(44890)
Bucket capacity(SAE heaped), standard		$m^3(yd^3)$	0.92(1.20)
Overall length	A	mm(ft-in)	9570(31' 5")
Overall width, with 500mm shoe	B		2700(8' 10")
Overall height	C		3110(10' 2")
Superstructure width	D		2700(8' 10")
Overall height of cab	E		2920(9' 7")
Ground clearance of counterweight	F		1060(3' 6")
Engine cover height	G		2320(7' 7")
Minimum ground clearance	H		480(1' 7")
Rear-end distance	I		2770(9' 1")
Rear-end swing radius	I'		2830(9' 3")
Distance between tumblers	J		3370(11' 1")
Undercarriage length	K		4160(13' 8")
Undercarriage width	L		2700(8' 10")
Track gauge	M		2200(7' 3")
Track shoe width, standard	N		500(20")
Travel speed(Low/high)		km/hr(mph)	3.5/5.2(2.2/3.2)
Swing speed		rpm	13.0
Gradeability		Degree(%)	35(70)
Ground pressure(500mm shoe)		$kgf/cm^2(psi)$	0.54(7.68)

3. WORKING RANGE

1) R210-7 [5.68m(18' 8") BOOM]



21072SP03

Description		2.0m(6' 7") Arm	*2.40m(7' 10") Arm	2.92m(9' 7") Arm	3.90m(12' 10") Arm
Max digging reach	A	9140mm (30' 0")	9500mm (31' 2")	9940mm (32' 7")	10910mm (35' 10")
Max digging reach on ground	A'	8960mm (29' 5")	9330mm (30' 7")	9780mm (32' 1")	10770mm (35' 4")
Max digging depth	B	5820mm (19' 1")	6220mm (20' 5")	6740mm (22' 1")	7720mm (25' 4")
Max digging depth(8ft level)	B'	5580mm (18' 4")	6010mm (19' 9")	6550mm (21' 6")	7580mm (24' 10")
Max vertical wall digging depth	C	5280mm (17' 4")	5720mm (18' 9")	6120mm (20' 1")	7240mm (23' 9")
Max digging height	D	9140mm (30' 0")	9340mm (30' 8")	9470mm (31' 1")	10110mm (33' 2")
Max dumping height	E	6330mm (20' 9")	6520mm (21' 5")	6670mm (21' 11")	7290mm (23' 11")
Min swing radius	F	3750mm (12' 4")	3740mm (12' 3")	3640mm (11' 11")	3650mm (11' 12")
Bucket digging force	SAE	133 kN	133 kN	133 kN	133 kN
		13600 kgf	13600 kgf	13600 kgf	13600 kgf
		29980 lbf	29980 lbf	29980 lbf	29980 lbf
	ISO	152 kN	152 kN	152 kN	152 kN
		15500 kgf	15500 kgf	15500 kgf	15500 kgf
		34170 lbf	34170 lbf	34170 lbf	34170 lbf
Arm digging force	SAE	135 kN	113 kN	97 kN	79 kN
		13800 kgf	11500 kgf	9900 kgf	8100 kgf
		30420 lbf	25350 lbf	21830 lbf	17860 lbf
	ISO	142 kN	118 kN	101 kN	85 kN
		14500 kgf	12000 kgf	10300 kgf	8700 kgf
		31970 lbf	26460 lbf	22710 lbf	19170 lbf

* : Standard

4. WEIGHT

1) R210-7

Item	R210-7	
	kg	lb
Upperstructure assembly	8950	19730
Main frame weld assembly	1720	3790
Engine assembly	430	950
Main pump assembly	120	265
Main control valve assembly	200	440
Swing motor assembly	190	420
Hydraulic oil tank assembly	240	530
Fuel tank assembly	195	430
Counterweight	3800	8380
Cab assembly	310	680
Lower chassis assembly	8700	19180
Track frame weld assembly	2720	6000
Swing bearing	260	570
Travel motor assembly	305	670
Turning joint	55	120
Track recoil spring	140	310
Idler	170	370
Carrier roller	20	45
Track roller	50	110
Track-chain assembly(500mm standard triple grouser shoe)	1190	2620
Front attachment assembly(5.68m boom, 2.4m arm, 0.92m^3 SAE heaped bucket)	4025	8870
5.68m boom assembly	1530	3370
2.4m arm assembly	670	1480
0.92m^3 SAE heaped bucket	765	1690
Boom cylinder assembly	180	400
Arm cylinder assembly	290	640
Bucket cylinder assembly	175	390
Bucket control link assembly	170	370

5. LIFTING CAPACITIES

1) ROBEX 210-7

(1) 5.68m(18' 8") boom, 2.00m(6' 7") arm equipped with 0.92m^3(SAE heaped) bucket, 500mm (20") triple grouser shoe and 3800kg counterweight.

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

Load point height		Load radius								At max. reach		
		3.0m(10ft)		4.5m(15ft)		6.0m(20ft)		7.5m(25ft)		Capacity		Reach
												m(ft)
7.5m (25ft)	kg lb									*3750 *8270	*3750 *8270	6.64 (21.8)
6.0m (20ft)	kg lb					*4150 *9150	*4150 *9150			*3800 *8380	2900 6390	7.78 (25.5)
4.5m (15ft)	kg lb			*5360 *11820	*5360 *11820	*4540 *10010	4420 9740			*3910 *8620	2420 5340	8.43 (27.7)
3.0m (10ft)	kg lb			*6970 *15370	6520 14370	*5240 *11550	4160 9170	*4500 *9920	2850 6280	3830 8440	2200 4850	8.74 (28.7)
1.5m (5ft)	kg lb			*8380 *18470	6000 13230	*5950 *13120	3910 8620	4790 10560	2740 6040	3770 8310	2150 4740	8.73 (28.6)
Ground Line	kg lb			*9020 *19890	5770 12720	*6430 *14180	3740 8250	4700 10360	2660 5860	3980 8770	2260 4980	8.42 (27.6)
-1.5m (-5ft)	kg lb	*13020 *28700	11600 25570	*8960 *19750	5740 12650	*6510 *14350	3690 8140			*4550 *10030	2610 5750	7.76 (25.5)
-3.0m (-10ft)	kg lb	*11620 *25620	*11620 *25620	*8210 *18100	5850 12900	*5910 *13030	3780 8330			*4510 *9940	3470 7650	6.61 (21.7)
-4.5m (-15ft)	kg lb	*8770 *19330	*8770 *19330									

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

(2) 5.68m(18' 8") boom, 2.40m(7' 10") arm equipped with 0.92m³(SAE heaped) bucket, 500mm (20") triple grouser shoe and 3800kg counterweight.

Load point height		Load radius										At max. reach		
		1.5m(5ft)		3.0m(10ft)		4.5m(15ft)		6.0m(20ft)		7.5m(25ft)		Capacity		Reach
														m(ft)
7.5m (25ft)	kg lb											*3450 *7610	*3450 *7610	7.15 (23.5)
6.0m (20ft)	kg lb							*3750 *8270	*3750 *8270			*3520 *7760	2630 5800	8.20 (26.9)
4.5m (15ft)	kg lb							*4190 *9240	*4190 *9240	*3940 *8690	2970 6550	*3630 *8000	2220 4890	8.82 (28.9)
3.0m (10ft)	kg lb					*6420 *14150	*6420 *14150	*4920 *10850	4190 9240	*4240 *9350	2860 6310	3560 7850	2020 4450	9.11 (29.9)
1.5m (5ft)	kg lb					*7960 *17550	6040 13320	*5690 *12540	3910 8620	*4620 *10190	2720 6000	3500 7720	1970 4340	9.10 (29.9)
Ground Line	kg lb			*8300 *18300	*8300 *18300	*8820 *19440	5730 12630	*6260 *13800	3710 8180	4670 10300	2620 5780	3670 8090	2060 4540	8.81 (28.9)
-1.5m (-5ft)	kg lb	*9220 *20330	*9220 *20330	*12750 *28110	11370 25070	*8970 *19780	5650 12460	*6460 *14240	3630 8000			4140 9130	2350 5180	8.18 (26.8)
-3.0m (-10ft)	kg lb	*13340 *29410	*13340 *29410	*12280 *27070	11580 25530	*8430 *18580	5730 12630	*6110 *13470	3670 8090			*4360 *9610	3020 6660	7.12 (23.4)
-4.5m (-15ft)	kg lb			*9840 *21690	*9840 *21690	*6850 *15100	5980 13180							

(3) 5.68m(18' 8") boom, 2.92m(9' 7") arm equipped with 0.92m³(SAE heaped) bucket, 500mm (20") triple grouser shoe and 3800kg counterweight.

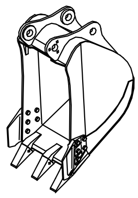
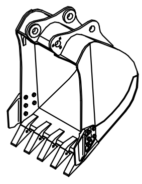
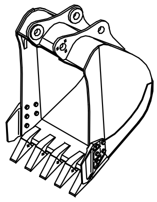
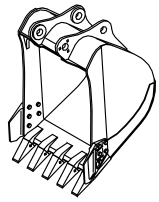
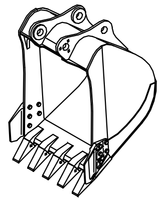
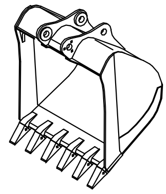
Load point height		Load radius										At max. reach		
		1.5m(5ft)		3.0m(10ft)		4.5m(15ft)		6.0m(20ft)		7.5m(25ft)		Capacity		Reach
														m(ft)
7.5m (25ft)	kg lb											*3120 *6880	3080 6790	7.72 (25.3)
6.0m (20ft)	kg lb											*3210 *7080	2390 5270	8.69 (28.5)
4.5m (15ft)	kg lb							*3770 *8310	*3770 *8310	*3590 *7910	3040 6700	*3340 *7360	2040 4500	9.27 (30.4)
3.0m (10ft)	kg lb			*9160 *20190	*9160 *20190	*5760 *12700	*5760 *12700	*4530 *9990	4270 9410	*3950 *8710	2900 6390	3300 7280	1860 4100	9.55 (31.3)
1.5m (5ft)	kg lb			*8660 *19090	*8660 *19090	*7430 *16380	6180 13620	*5380 *11860	3960 8730	*4390 *9680	2750 6060	3240 7140	1810 3990	9.54 (31.3)
Ground Line	kg lb			*9310 *20530	*9310 *20530	*8550 *18850	5780 12740	*6060 *13360	3730 8220	4670 10300	2620 5780	3370 7430	1870 4120	9.26 (30.4)
-1.5m (-5ft)	kg lb	*8550 *18850	*8550 *18850	*12160 *26810	11240 24780	*8950 *19730	5630 12410	*6400 *14110	3610 7960	4590 10120	2560 5640	3740 8250	2100 4630	8.67 (28.4)
-3.0m (-10ft)	kg lb	*11700 *25790	*11700 *25790	*13020 *28700	11400 25130	*8680 *19140	5640 12430	*6280 *13850	3600 7940			*4230 *9330	2610 5750	7.69 (25.2)
-4.5m (-15ft)	kg lb			*11040 *24340	*11040 *24340	*7560 *16670	5820 12830					*4140 *9130	3950 8710	6.09 (20.0)

(4) 5.68m(18' 8") boom, 3.90m(12' 10") arm equipped with 0.92m³(SAE heaped) bucket, 500mm (20") triple grouser shoe and 3800kg counterweight.

Load point height		Load radius												At max. reach		
		1.5m(5ft)		3.0m(10ft)		4.5m(15ft)		6.0m(20ft)		7.5m(25ft)		9.0m(30ft)		Capacity		Reach
																m(ft)
9.0m	kg													*2590	*2590	7.66
(30ft)	lb													*5710	*5710	(25.1)
7.5m	kg									*1870	*1870			*2640	2340	8.94
(25ft)	lb									*4120	*4120			*5820	5160	(29.3)
6.0m	kg									*2670	*2670			*2720	1890	9.77
(20ft)	lb									*5890	*5890			*6000	4170	(32.1)
4.5m	kg									*2910	*2910	*1930	*1930	*2830	1640	10.28
(15ft)	lb									*6420	*6420	*4250	*4250	*6240	3620	(33.7)
3.0m	kg							*3710	*3710	*3340	2970	*2750	2060	2760	1500	10.52
(10ft)	lb							*8180	*8180	*7360	6550	*6060	4540	6080	3310	(34.5)
1.5m	kg			*10430	*10430	*6230	*6230	*4640	4050	*3860	2770	*3260	1960	2710	1460	10.52
(5ft)	lb			*22990	*22990	*13730	*13730	*10230	8930	*8510	6110	*7190	4320	5970	3220	(34.5)
Ground	kg	*4950	*4950	*9990	*9990	*7720	5850	*5490	3740	*4360	2600	*3340	1870	2790	1490	10.27
Line	lb	*10910	*10910	*22020	*22020	*17020	12900	*12100	8250	*9610	5730	*7360	4120	6150	3280	(33.7)
-1.5m	kg	*7060	*7060	*10980	10970	*8560	5540	*6070	3540	4520	2470	*2240	1820	3030	1640	9.75
(-5ft)	lb	*15560	*15560	*24210	24180	*18870	12210	*13380	7800	9960	5450	*4940	4010	6680	3620	(32.0)
-3.0m	kg	*9410	*9410	*13520	10960	*8760	5440	*6270	3460	4470	2430			3530	1940	8.91
(-10ft)	lb	*20750	*20750	*29810	24160	*19310	11990	*13820	7630	9850	5360			7780	4280	(29.2)
-4.5m	kg	*12210	*12210	*12480	11190	*8250	5520	*5920	3500					*3770	2610	7.62
(-15ft)	lb	*26920	*26920	*27510	24670	*18190	12170	*13050	7720					*8310	5750	(25.0)
-6.0m	kg			*9890	*9890	*6620	5790									
(-20ft)	lb			*21800	*21800	*14590	12760									

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

					
0.51m^3 SAE heaped bucket	0.80m^3 SAE heaped bucket	※0.92m^3 SAE heaped bucket	1.05m^3 SAE heaped bucket	1.20m^3 SAE heaped bucket	1.34m^3 SAE heaped bucket

Capacity		Width		Weight	Recommendation			
					5.68m (18' 8") boom			
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.0m arm (6' 7")	2.4m arm (7' 10")	2.92m arm (9' 7")	3.90m arm (12' 10")
0.51m^3 (0.67yd^3)	0.45m^3 (0.59yd^3)	700mm (27.6")	820mm (32.3")	570kg (1260lb)				
0.80m^3 (1.05yd^3)	0.70m^3 (0.92yd^3)	1000mm (39.4")	1120mm (44.1")	700kg (1540lb)				
※0.92m^3 (1.20yd^3)	0.80m^3 (1.05yd^3)	1150mm (45.3")	1270mm (50.0")	770kg (1700lb)				
1.05m^3 (1.37yd^3)	0.90m^3 (1.18yd^3)	1250mm (49.2")	1370mm (53.9")	810kg (1790lb)				
1.20m^3 (1.57yd^3)	1.00m^3 (1.31yd^3)	1400mm (55.1")	1520mm (59.8")	850kg (1870lb)				
1.34m^3 (1.75yd^3)	1.15m^3 (1.50yd^3)	1550mm (61.0")	1670mm (65.7")	920kg (2030lb)				

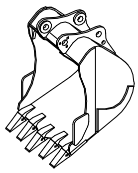
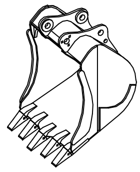
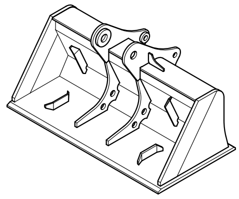
※ : Standard bucket

Applicable for materials with density of 2000kgf/m^3 (3370lbf/yd^3) or less

Applicable for materials with density of 1600kgf/m^3 (2700lbf/yd^3) or less

Applicable for materials with density of 1100kgf/m^3 (1850lbf/yd^3) or less

2) HEAVY DUTY, ROCK-HEAVY DUTY AND SLOPE FINISHING BUCKET

		
◈0.74, 0.90, 1.05m³ SAE heaped bucket	⊙0.87, 1.20m³ SAE heaped bucket	▣0.75m³ SAE heaped bucket

Capacity		Width		Weight	Recommendation			
					5.68m (18' 8") boom			
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.0m arm (6' 7")	2.4m arm (7' 10")	2.92m arm (9' 7")	3.90m arm (12' 10")
◈0.74m³ (0.97yd³)	0.65m³ (0.85yd³)	985mm (38.8")	-	770kg (1700lb)				
◈0.90m³ (1.18yd³)	0.80m³ (1.05yd³)	1070mm (42.0")	-	810kg (1790lb)				
◈1.05m³ (1.37yd³)	0.92m³ (1.20yd³)	1290mm (50.8")	-	890kg (1960lb)				
⊙0.87m³ (1.14yd³)	0.75m³ (0.98yd³)	1140mm (44.9")	-	900kg (1980lb)				
⊙1.20m³ (1.57yd³)	1.00m³ (1.31yd³)	1410mm (55.5")	-	1030kg (2270lb)				
▣0.75m³ (0.98yd³)	0.65m³ (0.85yd³)	1790mm (70.5")	-	880kg (1940lb)				

◈ : Heavy duty bucket ⊙: Rock-Heavy duty bucket ▣ : Slope finishing bucket

Applicable for materials with density of 2000kgf/m³ (3370lbf/yd³) or less

Applicable for materials with density of 1600kgf/m³ (2700lbf/yd³) or less

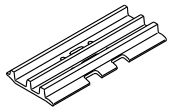
Applicable for materials with density of 1100kgf/m³ (1850lbf/yd³) or less

7. UNDERCARRIAGE

1) TRACKS

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

2) TYPES OF SHOES

Model	Shapes		Triple grouser
			
R210-7	Shoe width	mm(in)	500(20)
	Operating weight	kg(lb)	20360(44886)
	Ground pressure	kgf/cm^2(psi)	0.54(7.68)
	Overall width	mm(ft-in)	2700(8' 10")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	2EA
Track rollers	7EA
Track shoes	46EA

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.

※ **Table 1**

Track shoe	Specification	Category
500mm triple grouser	Standard	A

※ **Table 2**

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

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Cummins 6BT5.9 (Cummins-India)
Type	4-cycle turbocharged diesel engine, low emission
Cooling method	Water cooling
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	102 × 120mm(4.02" × 4.72")
Piston displacement	5880cc(359cu in)
Compression ratio	17.4 : 1
Rated gross horse power (SAE J1995)	140Hp at 2000rpm(104kW at 2000rpm)
Maximum torque at 1600rpm	57.6kgf · m(416lbf · ft)
Engine oil quantity	15 ℓ (4.0U.S. gal)
Dry weight	432kg(952lb)
High idling speed	2200+50rpm
Low idling speed	1000±100rpm
Rated fuel consumption	166.3g/Hp · hr at 2000rpm
Starting motor	24V-4.5kW
Alternator	Lucas TVS(24V-4.5A)
Battery	2 × 12V × 100Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2 × 113cc/rev
Maximum pressure	330kgf/cm^2 (4694psi)
Rated oil flow	2 × 210 ℓ/min (55.5U.S. gpm/ 46.2U.K. gpm)

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	10cc/rev
Maximum pressure	35kgf/cm^2(500psi)
Rated oil flow	19.5 l/min(5.2U.S. gpm/4.2U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	9 spools mono-block
Operating method	Hydraulic pilot system
Main relief valve pressure	330kgf/cm^2(4695psi)
Overload relief valve pressure	390kgf/cm^2(5550psi)

5) SWING MOTOR

Item	Specification
Type	Two fixed displacement axial piston motor
Capacity	151cc/rev
Relief pressure	240kgf/cm^2(3414psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	59kgf · m(427lbf · ft)
Brake release pressure	33~50kgf/cm^2(470~711psi)
Reduction gear type	2 - stage planetary
Swing speed	13.0rpm

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	330kgf/cm^2(4695psi)
Reduction gear type	2-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	11kgf/cm^2(156psi)
Braking torque	49.3kgf · m(357lbf · ft)

7) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5kgf/cm²(92psi)
	Maximum	26kgf/cm²(370psi)
Single operation stroke	Lever	61mm(2.4in)
	Pedal	123mm(4.84in)

8) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 120 × ø 85 × 1290mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 140 × ø 100 × 1510mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 125 × ø 85 × 1055mm
	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.**

9) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R210-7	Standard	500mm(20")	0.54kgf/cm²(7.68psi)	46	2700mm(8' 10")

10) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
R210-7	STD	0.92m³(1.20yd³)	0.80m³(1.05yd³)	5	1150mm(45.3")	1270mm(50.0")
	OPT	0.51m³(0.67yd³)	0.45m³(0.59yd³)	3	700mm(27.6")	820mm(32.3")
		0.80m³(1.05yd³)	0.70m³(0.92yd³)	5	1000mm(39.4")	1120mm(44.1")
		1.05m³(1.37yd³)	0.90m³(7.18yd³)	5	1250mm(49.2")	1370mm(53.9")
		1.20m³(1.57yd³)	1.00m³(1.31yd³)	6	1400mm(55.1")	1520mm(59.8")
		1.34m³(1.75yd³)	1.15m³(1.50yd³)	6	1550mm(61.0")	1670mm(65.7")
		◈0.74m³(0.97yd³)	0.65m³(0.85yd³)	5	985mm(38.8")	-
		◈0.90m³(1.18yd³)	0.80m³(1.05yd³)	5	1070mm(42.0")	-
		◈1.05m³(1.37yd³)	0.92m³(1.20yd³)	5	1290mm(50.8")	-
		⊙0.87m³(1.14yd³)	0.75m³(0.98yd³)	5	1140mm(44.9")	-
		⊙1.20m³(1.57yd³)	1.00m³(1.31yd³)	5	1410mm(55.5")	-
		▣0.75m³(0.98yd³)	0.65m³(0.85yd³)	-	1790mm(70.5")	-

◈ : Heavy duty bucket
⊙ : Rock-Heavy duty bucket
▣ : Slope finishing bucket

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	15.0(4.0)	SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	5.0(1.3)	SAE 85W-140
Final drive	Gear oil	5.8×2 (1.5×2)	SAE 85W-140
Hydraulic tank	Hydraulic oil	Tank; 180(48) System; 290(77)	ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	340(90)	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	35(9.2)	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

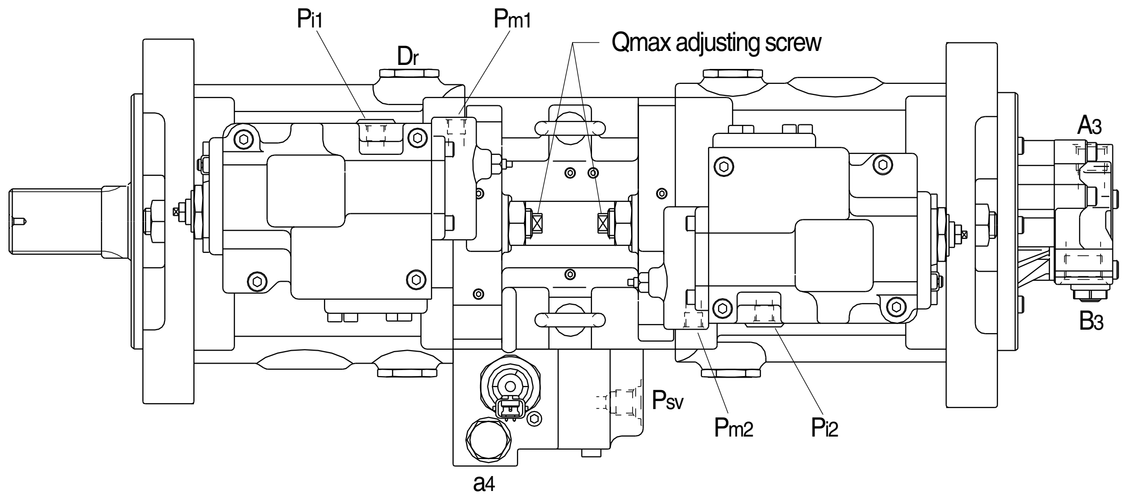
SECTION 2 STRUCTURE AND FUNCTION

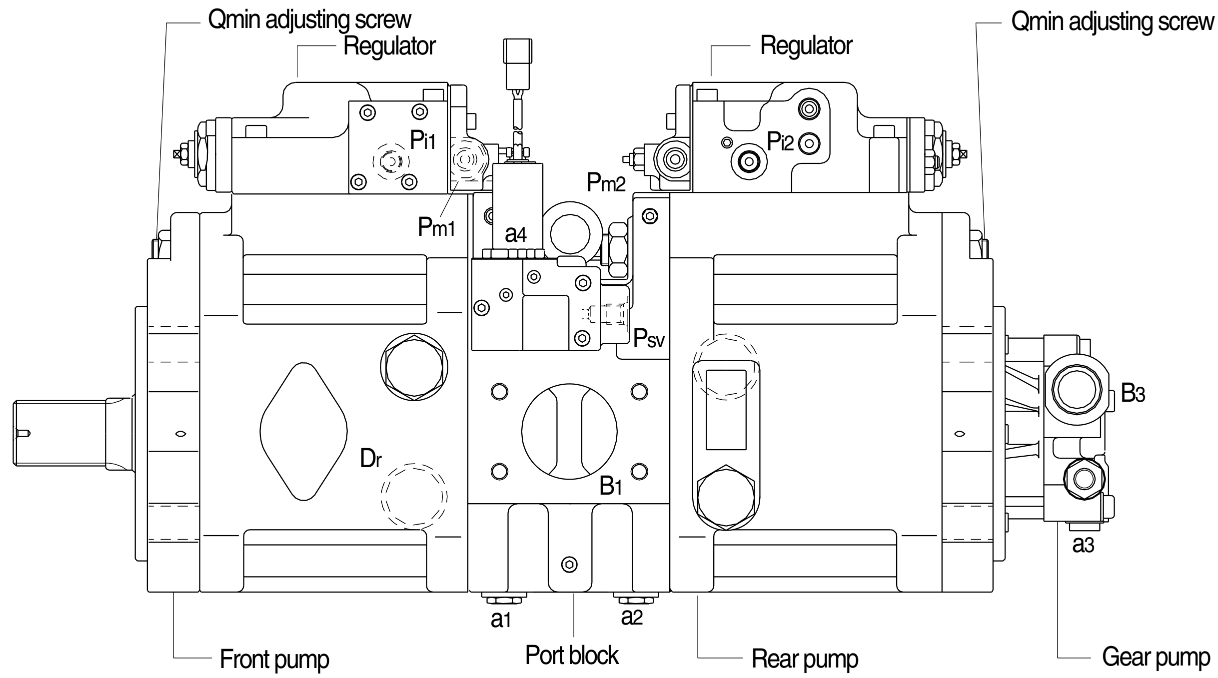
SECTION 2 STRUCTURE AND FUNCTION

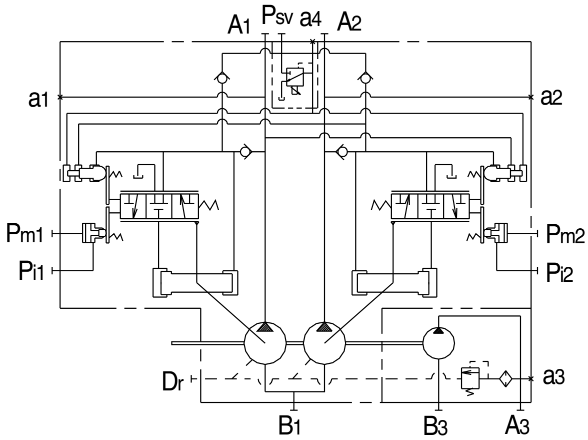
GROUP 1 PUMP DEVICE

1. STRUCTURE

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



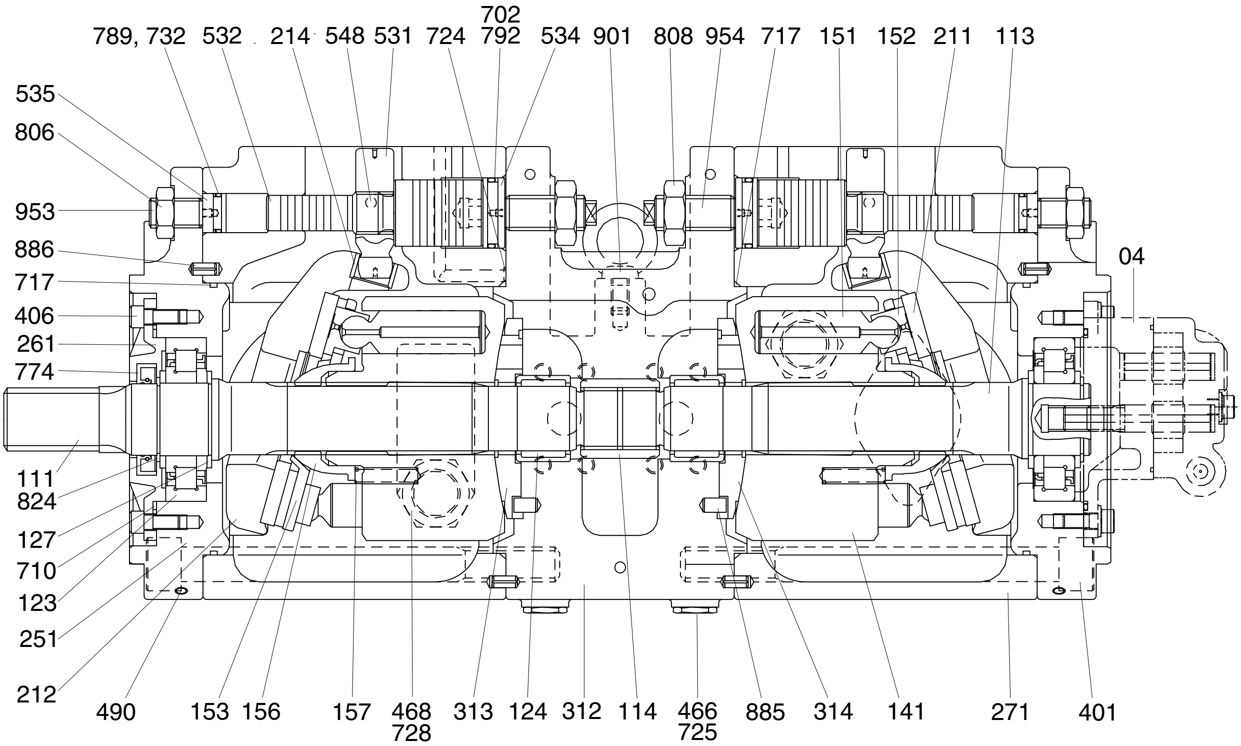




Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 3/4"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 3/4 - 20
Pi1,i2	Pilot port	PF 1/4 - 15
Pm1,m2	Qmax cut port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1,2,4	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20

1) MAIN PUMP(1/2)

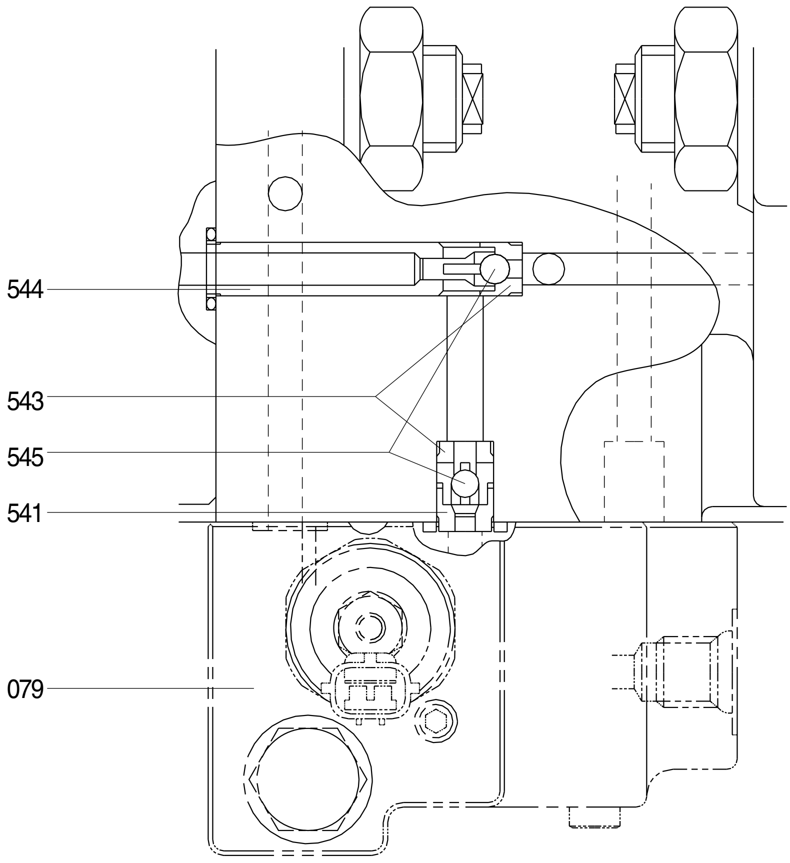
The main pump consists of two piston pumps(front & rear) and valve block.



RD21072SF02

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

MAIN PUMP(2/2)

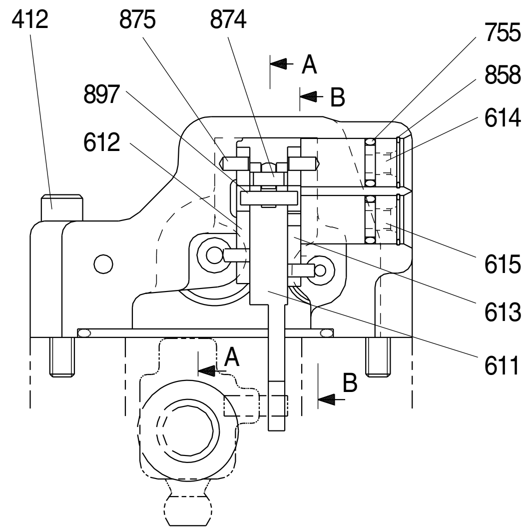


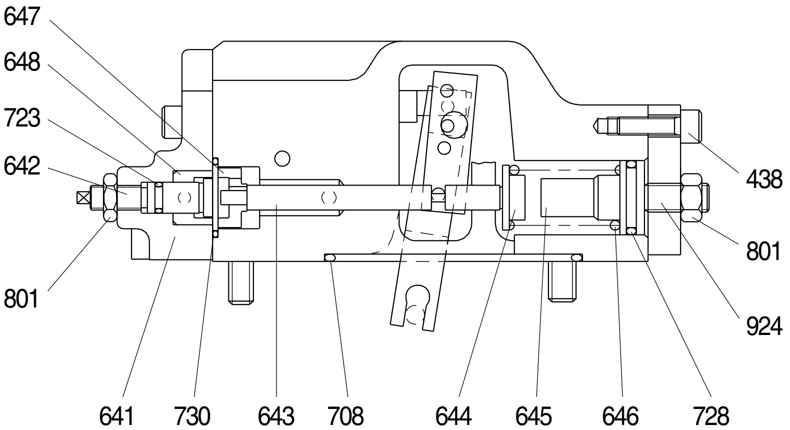
VIEW A

2-3

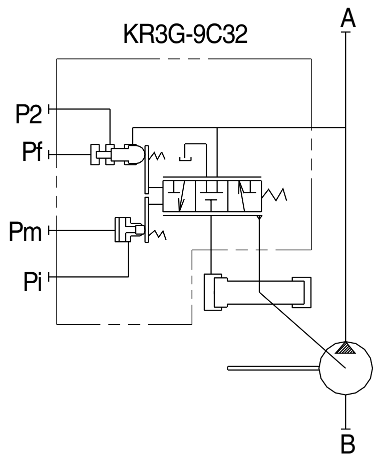
079	Proportional reducing valve	543	Stopper 1	545	Steel ball
541	Seat	544	Stopper 2		

2) REGULATOR(1/2)

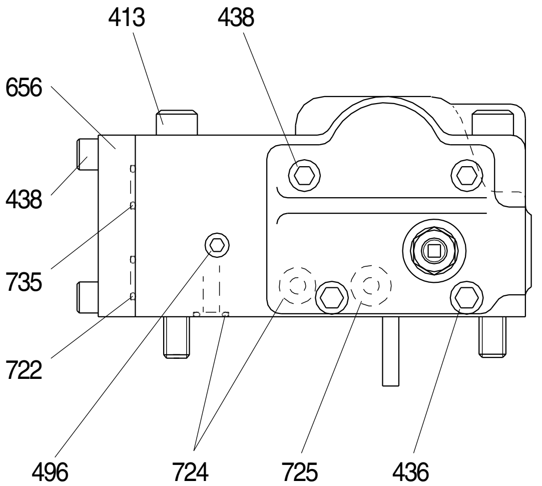




SECTION B-B



2-4

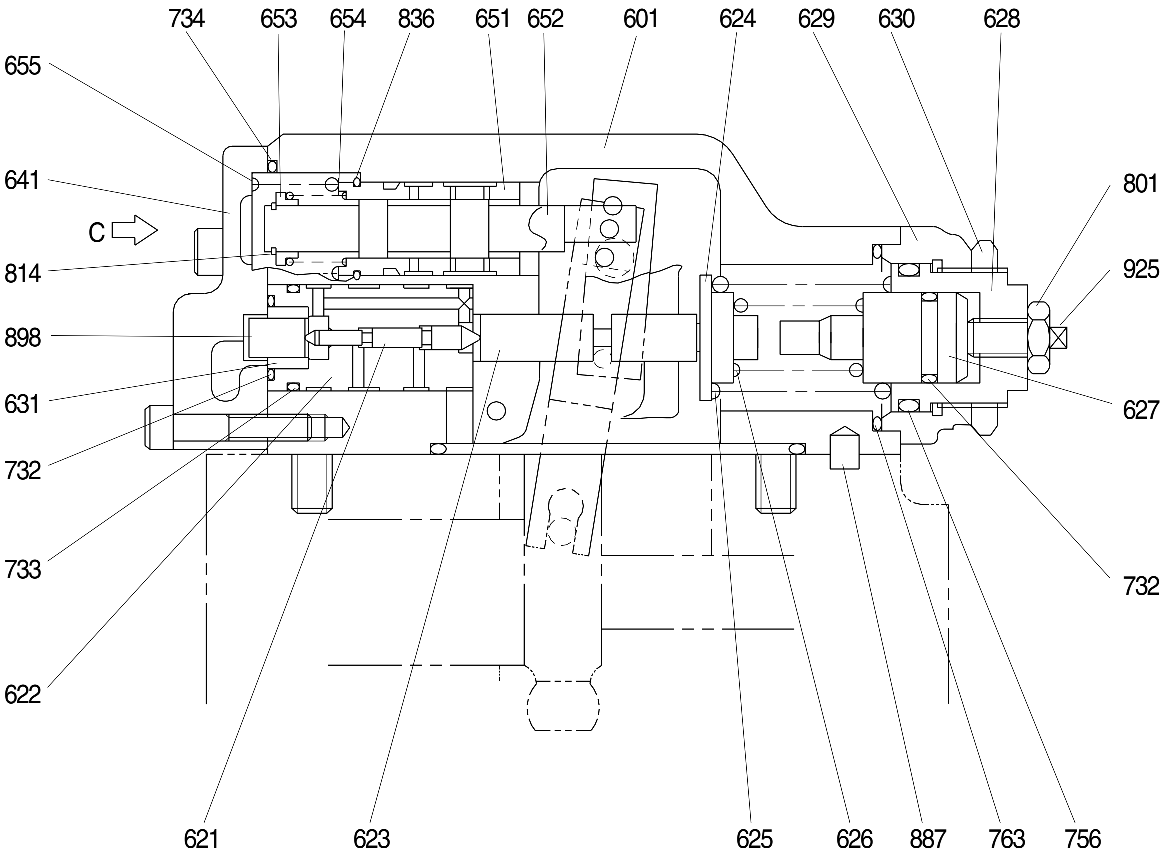


VIEW C

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

2-4

REGULATOR(2/2)

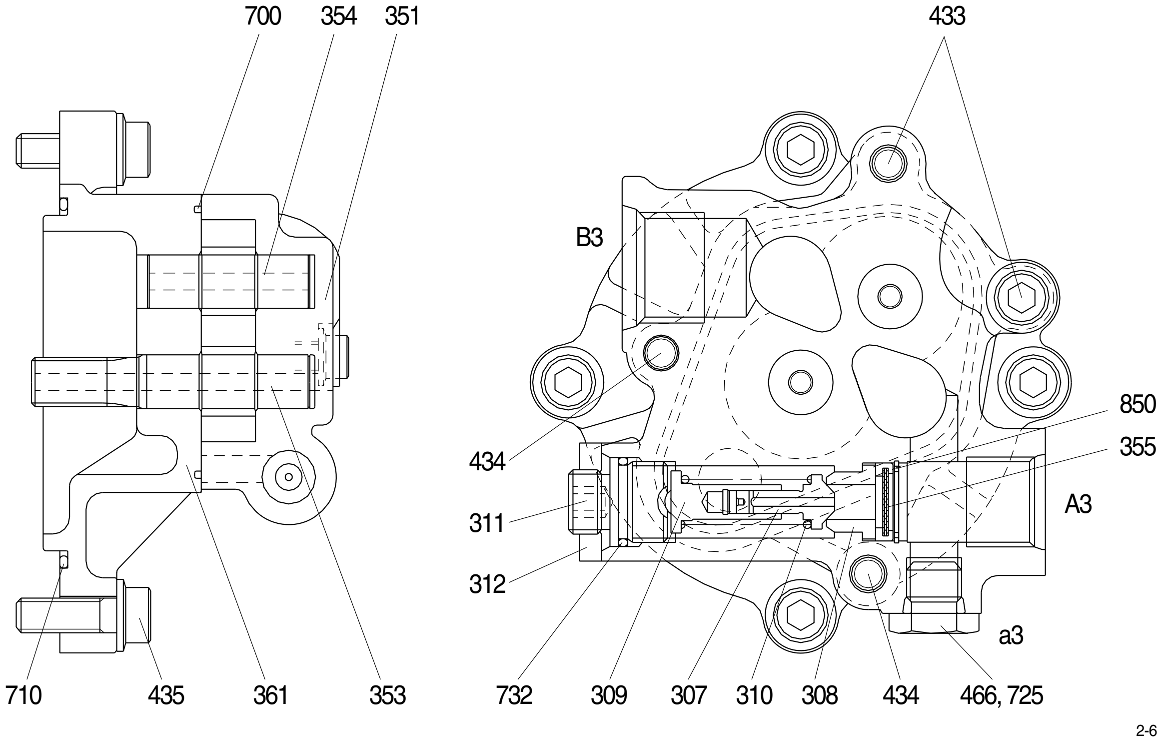


SECTION A-A

2-5

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		

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

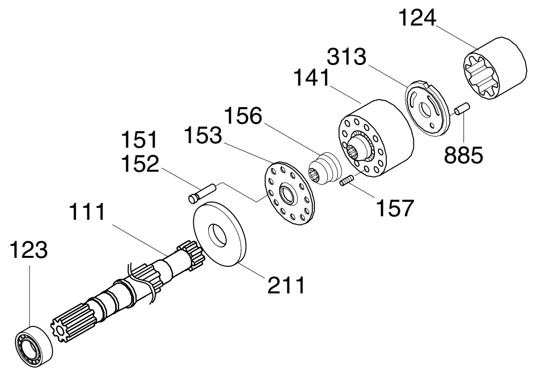
1) MAIN PUMP

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.



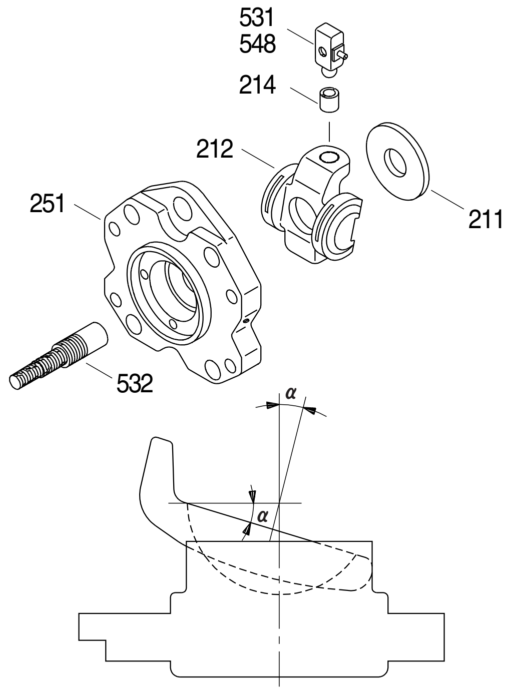
RD210722-71

(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)



2-7

(3) **Valve block group**

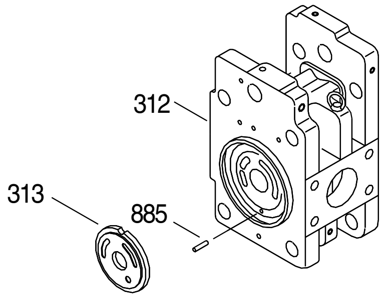
The valve block group consists of valve block(312), valve plate(313) and valve plate pin(885).

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.



2-8

2) REGULATOR

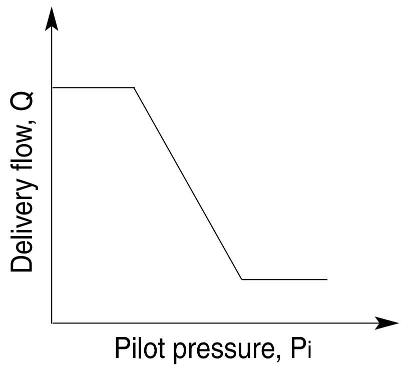
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

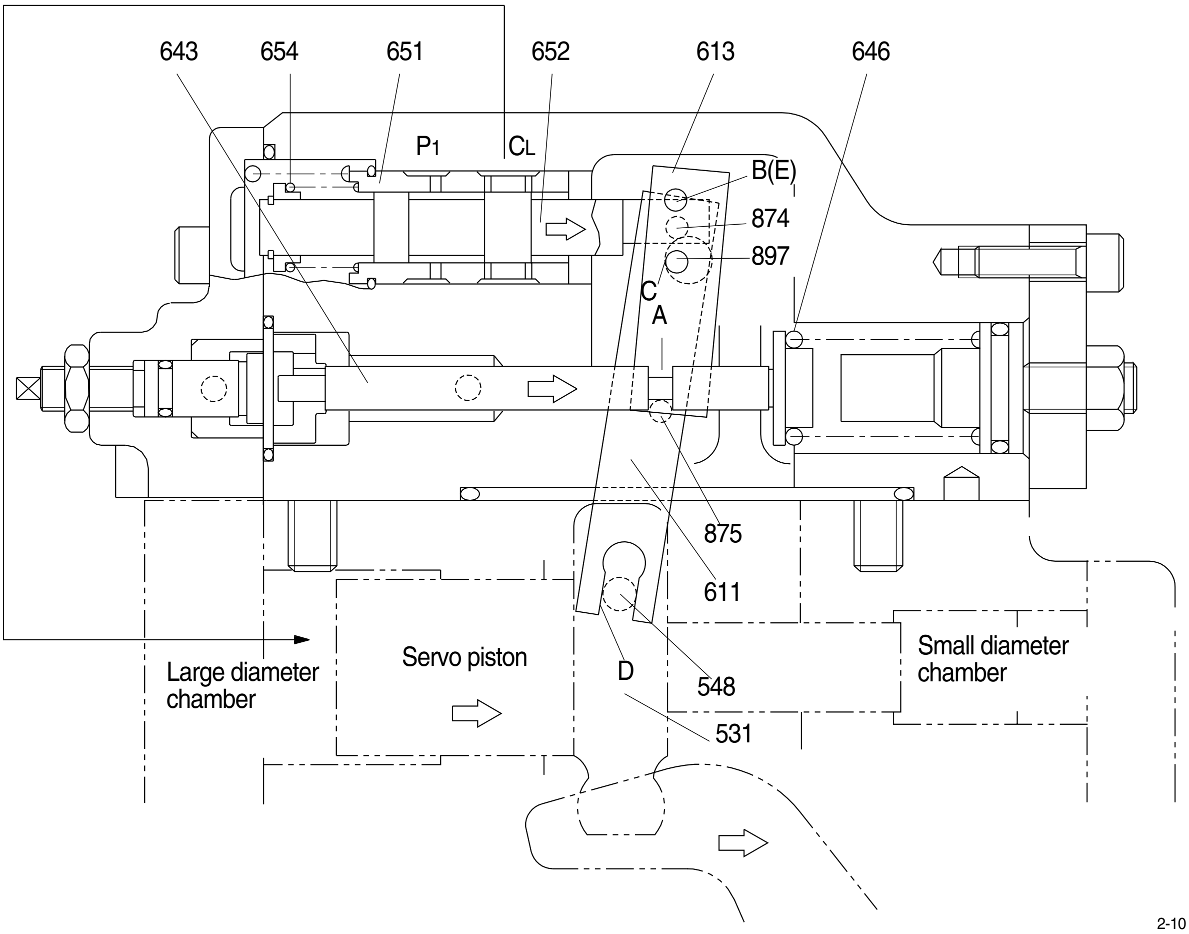
By changing the pilot pressure Pi, the pump tilting angle(delivery flow) is regulated arbitrarily, as shown in the figure.

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

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



① Flow reducing function



As the pilot pressure Pi rises, the pilot piston(643) moves to the right to a position where the force of the pilot spring(646) balances with the hydraulic force.

The groove(A) in the pilot piston is fitted with the pin(875) that is fixed to lever 2(613). Therefore, when the pilot piston moves, lever 2 rotates around the fulcrum of point B [fixed by the fulcrum plug(614) and pin(875)]. Since the large hole section(C) of lever 2 contains a protruding pin(897) fixed to the feedback lever(611), the pin(897) moves to the right as lever 2 rotates. Since the opposing-flat section(D) of the feedback lever is fitted with the pin(548) fixed by the tilting pin(531) that swings the swash plate, the feedback lever rotates around the fulcrum of point D, as the pin(897) moves.

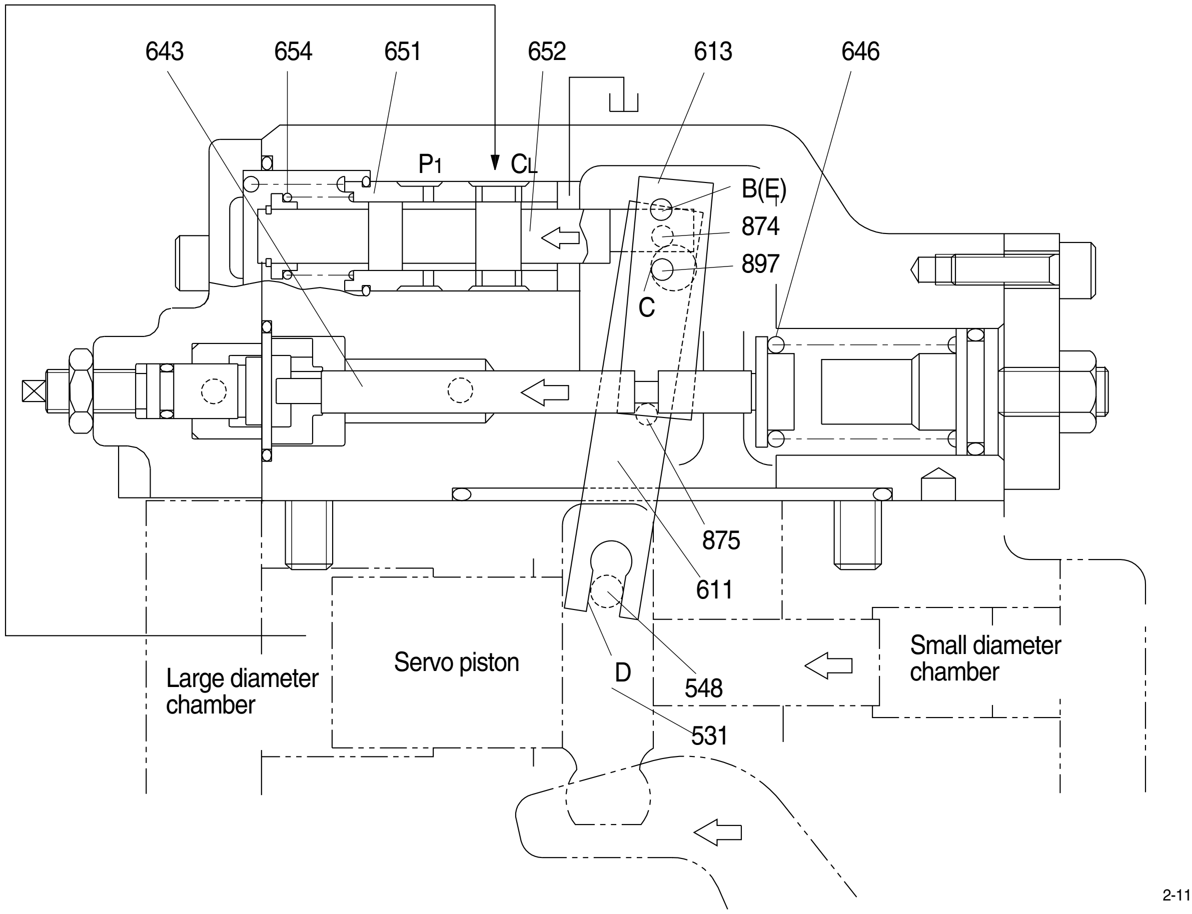
Since the feedback lever is connected with the spool(652) via the pin(874), the spool moves to the right.

The movement of the spool causes the delivery pressure P1 to connect to port CL through the spool and to be admitted to the large diameter section of the servo piston. The delivery pressure P1 that is constantly admitted to the small diameter section of the servo piston moves the servo piston to the right due to the area difference, resulting in decrease of the tilting angle.

When the servo piston moves to the right, point D also moves to the right. The spool is fitted with the return spring(654) and is tensioned to the left at all times, and so the pin(897) is pressed against the large hole section(C) of lever 2.

Therefore, as point D moves, the feedback lever rotates around the fulcrum of point C, and the spool is shifted to the left. This causes the opening between the sleeve(651) and spool(652) to close slowly, and the servo piston comes to a complete stop when it closes completely.

② Flow increasing function



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

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

③ **Adjustment of flow control characteristic**

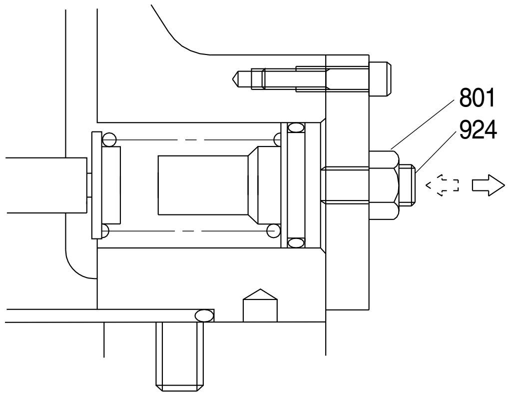
The flow control characteristic can be adjusted with the adjusting screw.

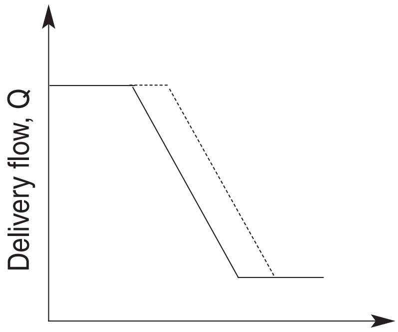
Adjust it by loosening the hexagon nut(801) and by tightening(or loosening) the hexagonal socket head screw(924).

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

※ **Adjusting 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)
1950	+1/4	+1.5	+12.6





(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.)

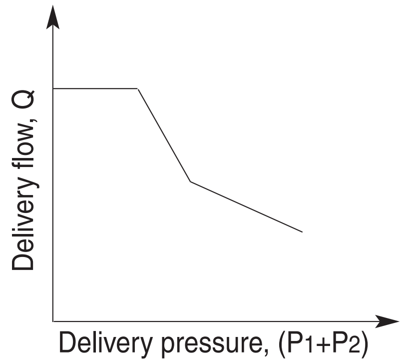
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control 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 :

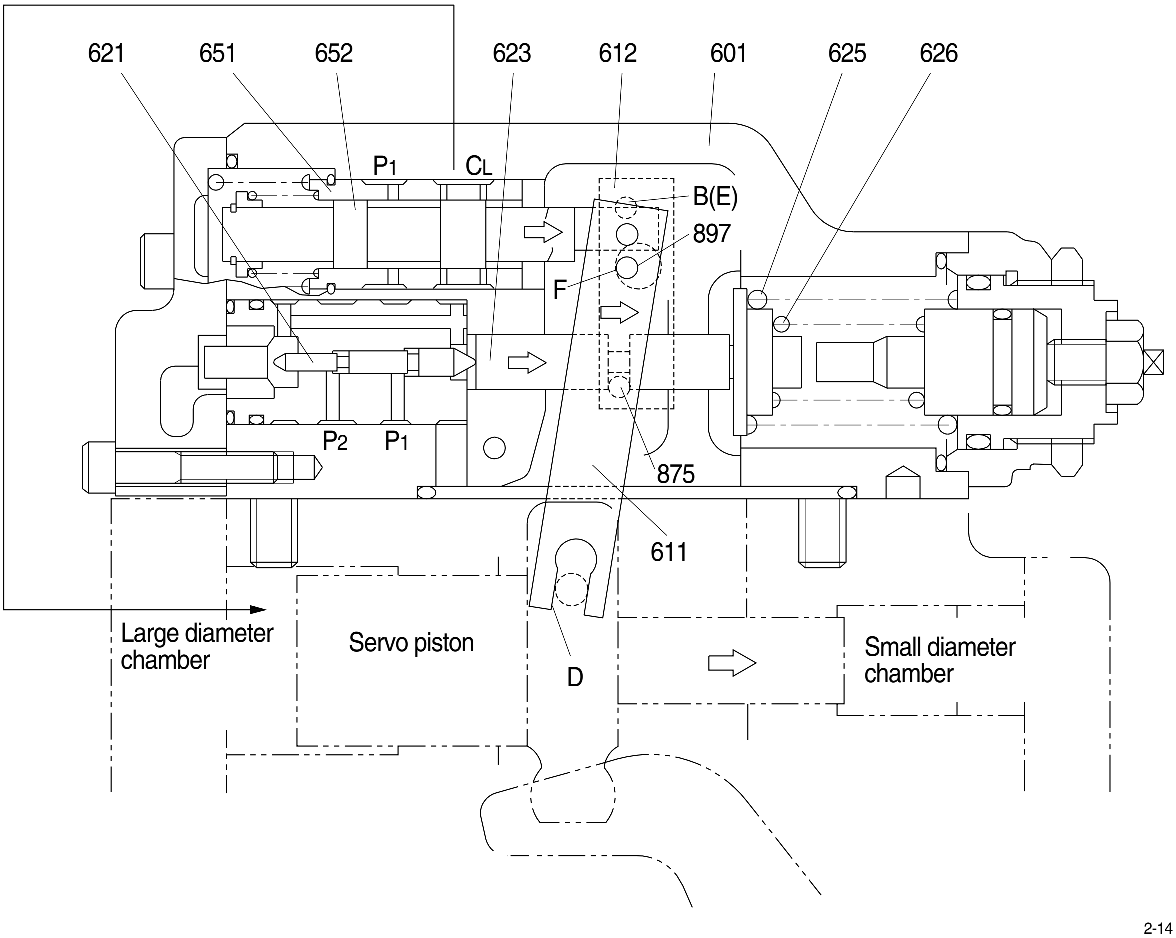
$Tin = P1 \times q/2\pi + P2 \times q/2\pi$

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

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).

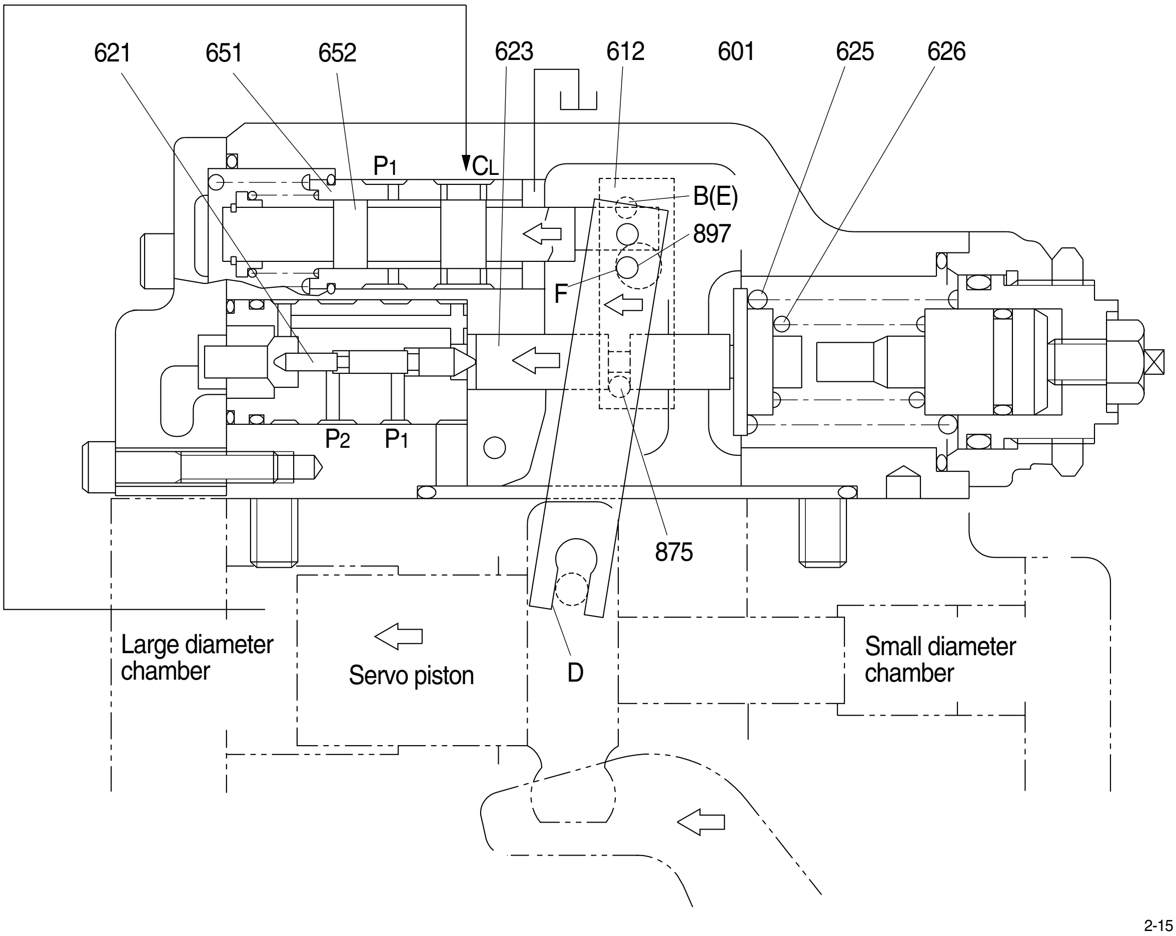


① **Overload preventive function**



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**

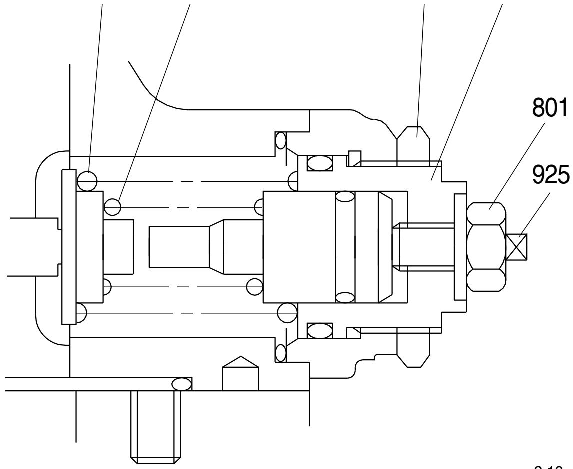
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections(C & F) of levers 1 and 2. However, since sections C and F have the pins(ø 4) protruding from the large hole(ø 8), only the lever lessening the tilting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

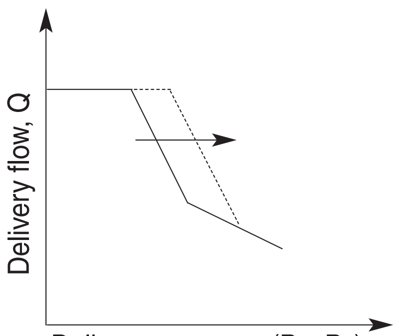
Adjust it by loosening the hexagon nut(630) and by tightening(or loosening) the adjusting screw C(628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring(626), return the adjusting screw QI(925) by N×A turns at first.(A=2.06)



2-16

※ **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/cm²)	(l /min)
1950	+1/4	+15.9	+3.9



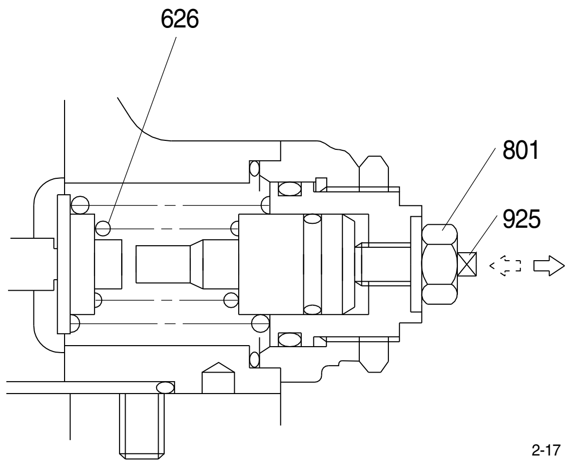
b. Adjustment of inner spring

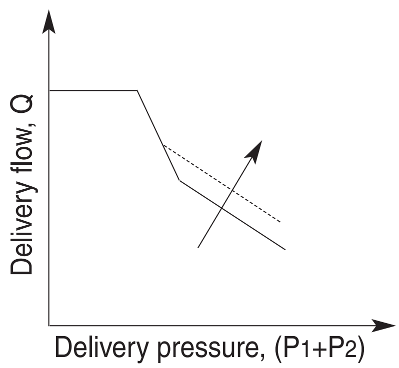
Adjust it by loosening the hexagon nut (801) and by tightening(or loosening) the adjusting screw QI(925).

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

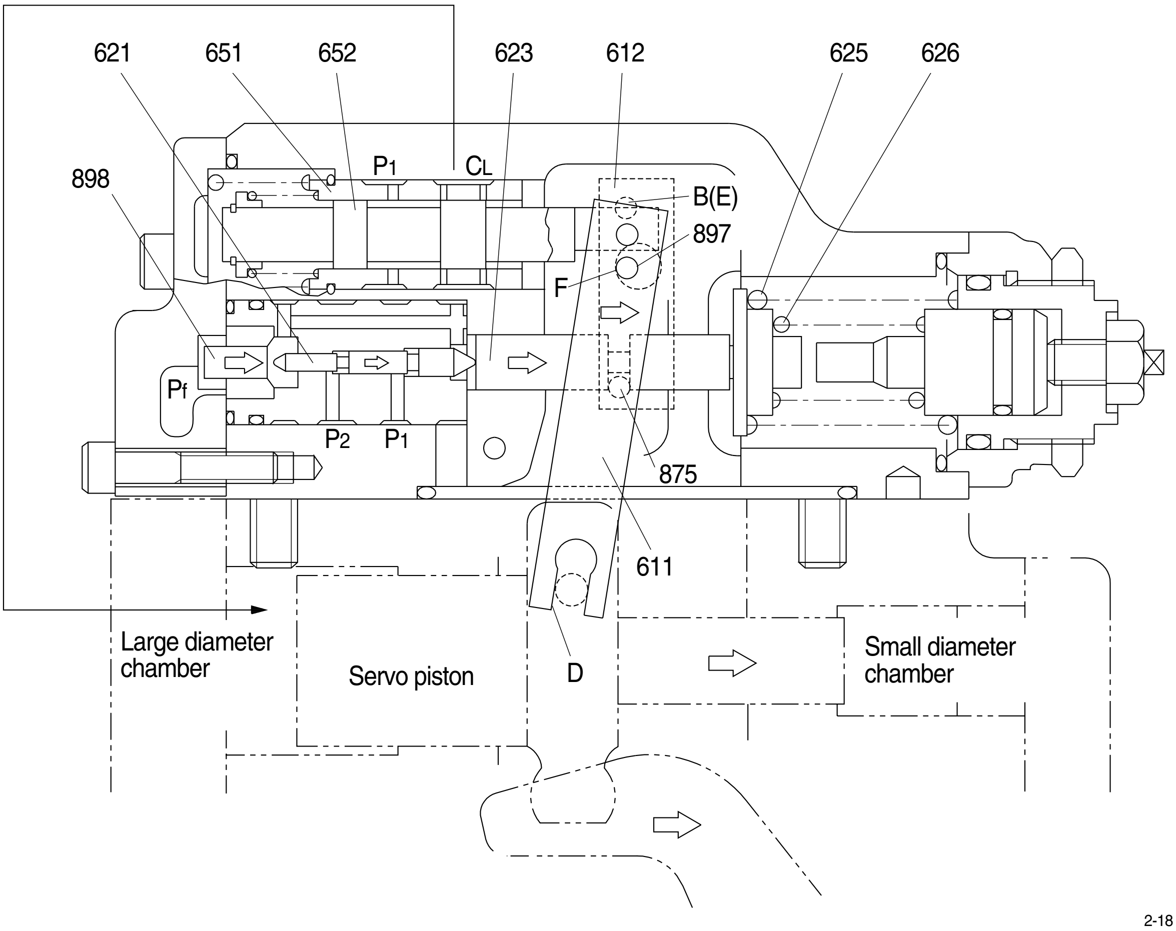
※ **Adjusting valves are shown in table**

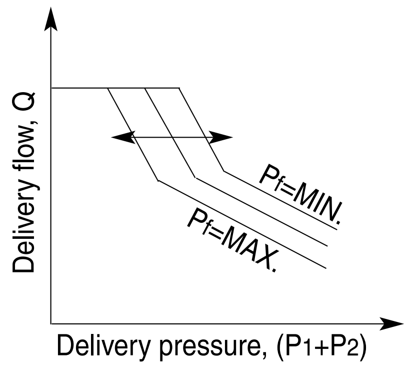
Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw(925)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(l /min)	(kgf · m)
1950	+1/4	+8.4	+2.87





(3) Power shift control





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

Only one proportional pressure reducing valve is provided.

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

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

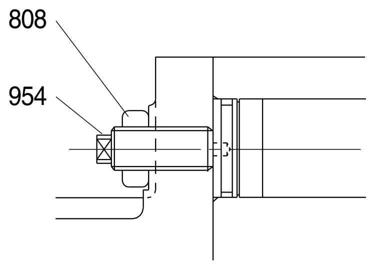
The power shift pressure Pf controls the set horsepower of the pump to a desired level, as shown in the figure.

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

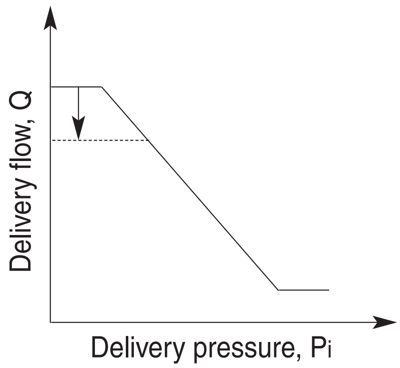
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

① 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.

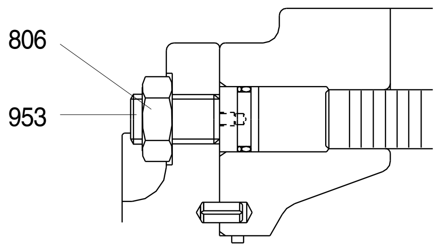


2-19(1)

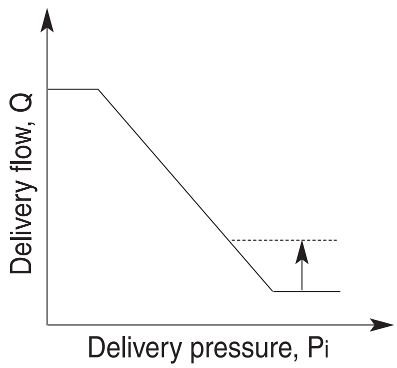


Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1950	+1/4	-5.6

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.



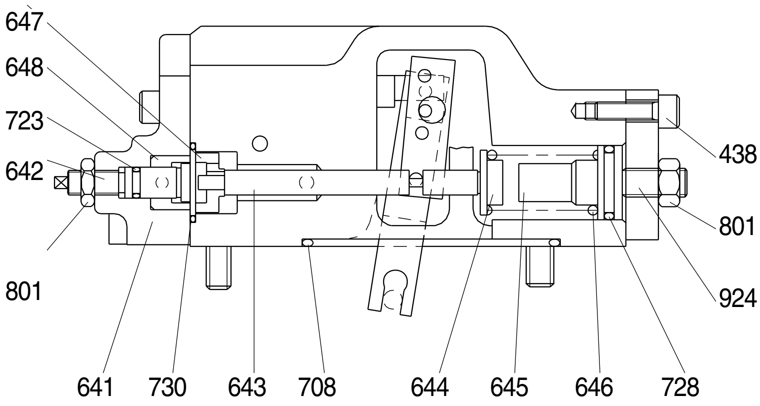
2-19(2)



Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1950	+1/4	+4.5

(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.)



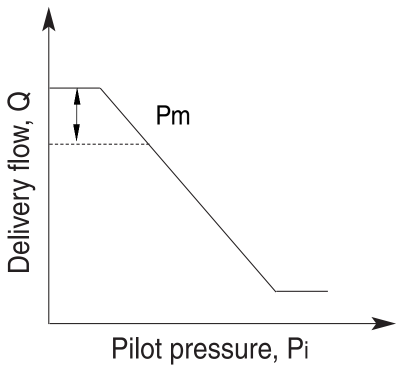
2-4

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.

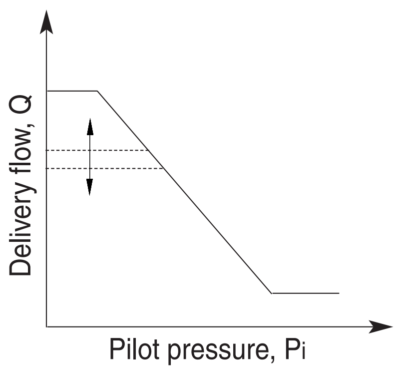
Since the adjusting screw QMC(642) is provided with a flange, the piston QMC stops upon contact with the flange, and the position of the pilot piston at this time determines the maximum flow of the pump.



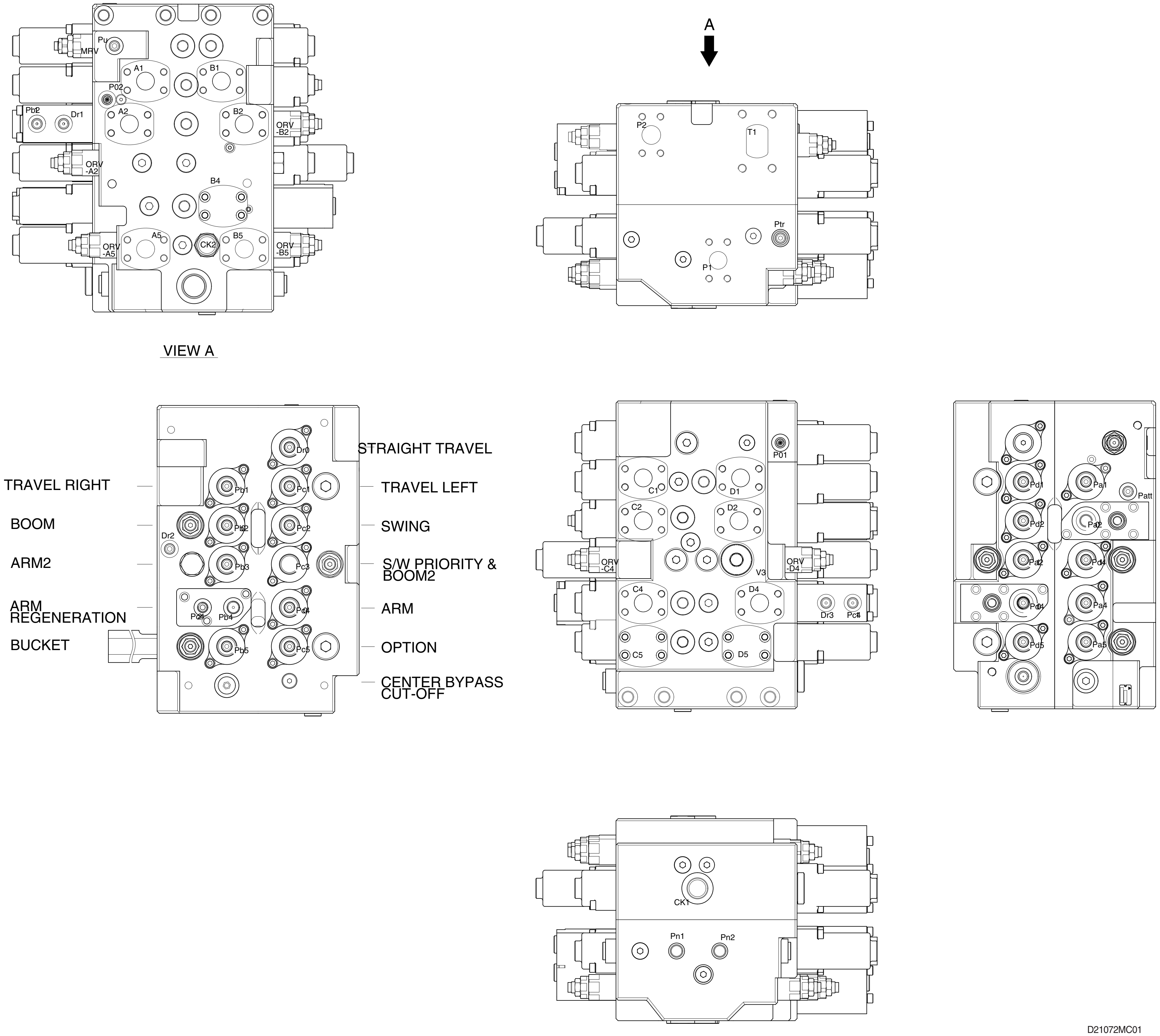
② Adjustment of Qmax cut flow

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

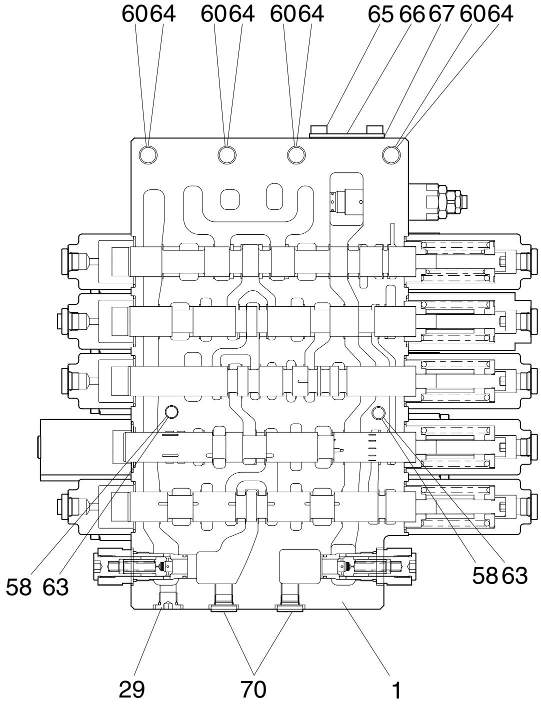
Tightening the screw decreases the Qmax cut flow as shown in the figure.



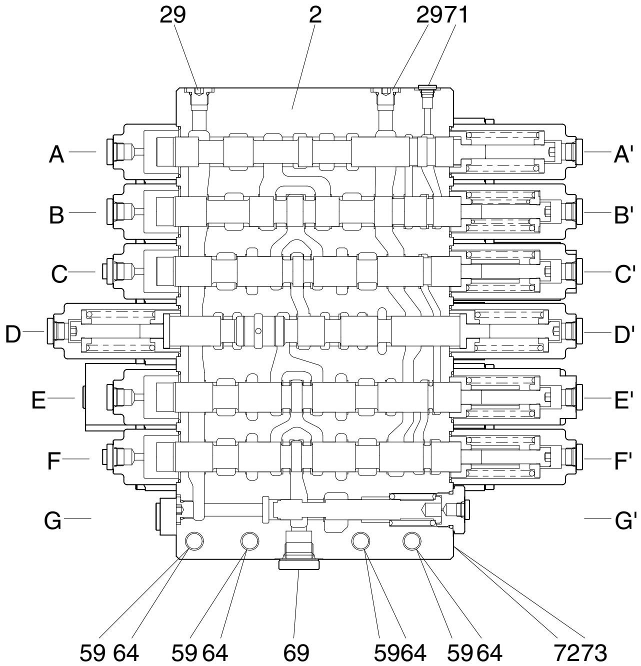
1. STRUCTURE



Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	G1	20~25 kgf · m (145~180 lbf · ft)
Patt	Auto idle signal-attachment	G1/4	3.5~3.9 kgf · m (25.3~28.2 lbf · ft)
Pb21	Lock valve pilot port (boom)		
Pcb	Bucket in confluence pilot port		
P01	Pilot signal port		
P02	Pilot signal port		
Pc41	Unlock signal		
Pc42	Arm in regen-cut signal selector port		
Ptr	Auto idle signal-travel		
Pu	Power boost		
Dr1	Drain port		
Dr2	Drain port		
Ck1	Bucket confluence	G3/4	17~19 kgf · m (123~137.4 lbf · ft)
Ck2	Bucket confluence		
Pa1	Travel pilot port-RH (FW)	G3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
Pb1	Travel pilot port-RH (BW)		
Pc1	Travel pilot port-LH (BW)		
Pd1	Travel pilot port-LH (FW)		
Pa20	Boom up pilot port		
Pa21	Boom up confluence pilot port		
Pb20	Boom down pilot port		
Pc2	Swing pilot port (LH)		
Pd2	Swing pilot port (RH)		
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		
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		
Dr0	Drain port		
Pn1	Negative control signal port (A2 port side)		
Pn2	Negative control signal port (A1 port side)		
A1	Travel motor port-LH (FW)	SAE 5000 psi 1"	7.5~9.2 kgf · m (54.2~66.5 lbf · ft)
B1	Travel motor port-LH (BW)		
C1	Travel motor port-RH (BW)		
D1	Travel motor port-RH (FW)		
A2	Boom up port		
B2	Boom down port		
C2	Swing motor port (LH)		
D2	Swing motor port (RH)		
B4	Option A port (breaker)		
C4	Arm in port		
D4	Arm out port		
A5	Bucket in port		
B5	Bucket out port		
C5	Option B port		
D5	Option B port		
P1	Pump port (A2 side)		
P2	Pump port (A1 side)		
Dr5	Drain port	G1/8	1.5~1.9 kgf · m (10.8~13.7 lbf · ft)
T1	Return port	SAE 3000 psi 2" (M12)	6.4~8.6 kgf · m (46.2~62.2 lbf · ft)



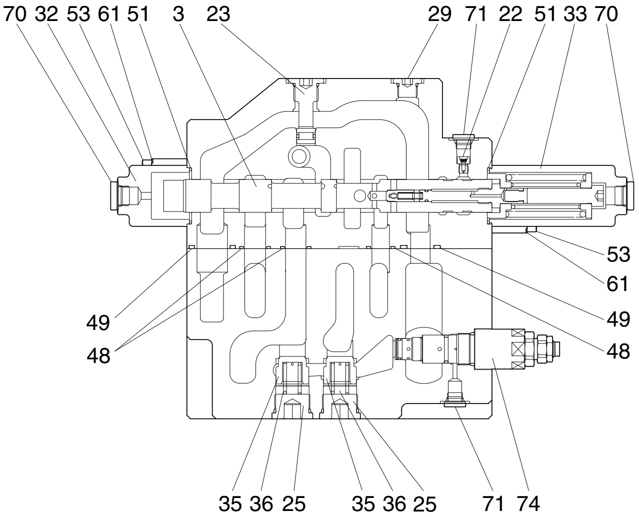
P1 BLOCK SPOOL SECTION



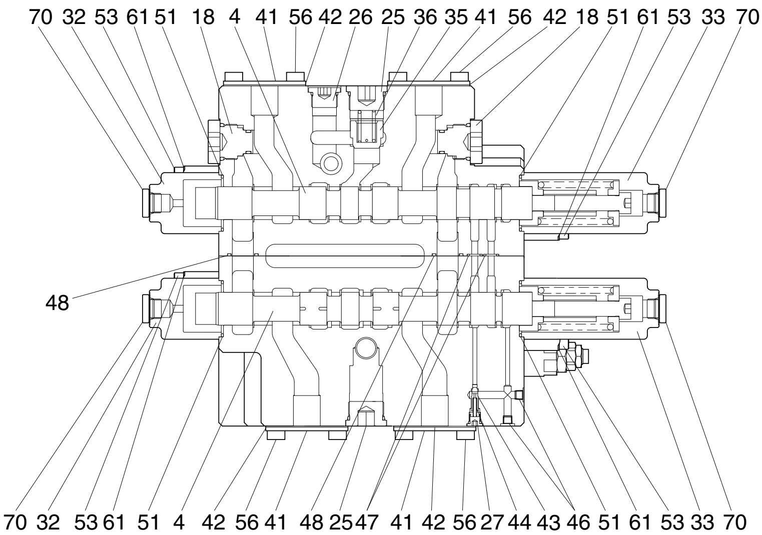
P2 BLOCK SPOOL SECTION

1	Housing P1
2	Housing P2
29	Plug kit
58	Socket bolt
59	Socket bolt
60	Socket bolt
63	Spring washer
64	Spring washer
65	Hexagon bolt
66	Cover 2
67	Gasket 2
69	Dust cap
70	Dust cap
71	Dust cap
72	Name plate
73	Rivet

D21072MC40



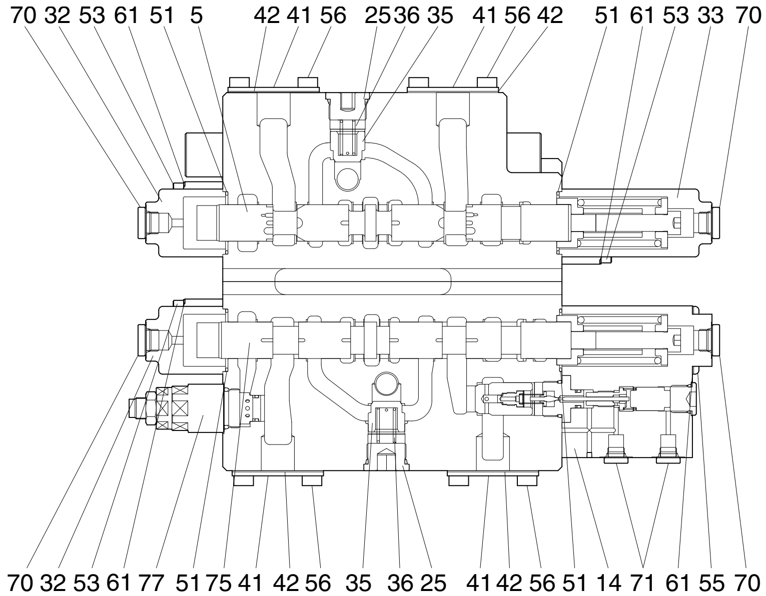
A-A ' (STRAIGHT-TRAVEL & SUPPLY)



B-B ' (TRAVEL RIGHT & LEFT)

D21072MC41

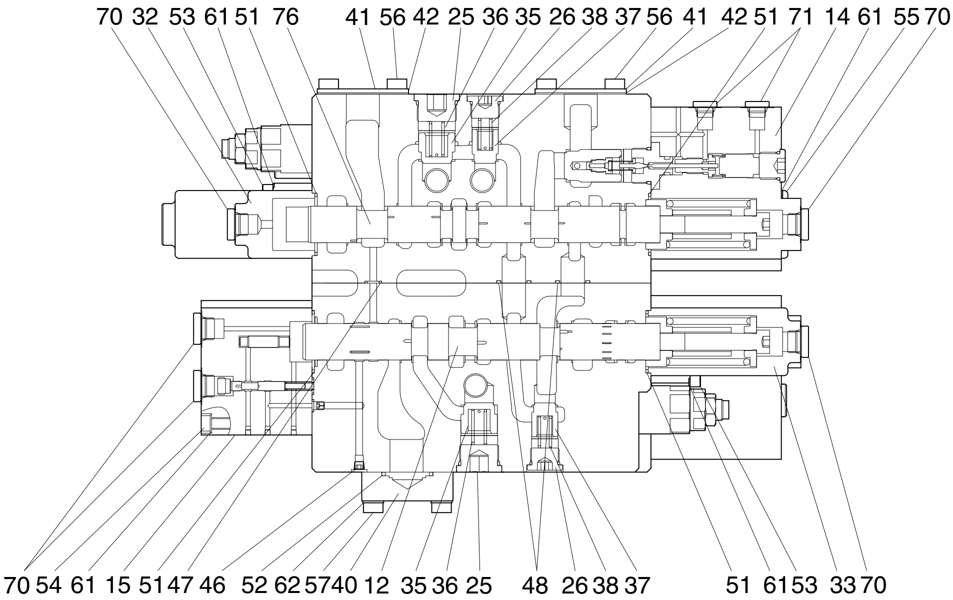
3	Spool assy
4	Spool assy
18	Overload R/V plug assy
22	Signal orifice assy
23	Parallel block plug assy
25	Load check plug kit
27	Plug kit
29	Plug kit
32	Pilot cover A
33	Pilot cover B1
35	Load check poppet 1
36	Load check spring 1
41	Cover 1
42	Gasket 1
43	Poppet signal
44	Spring signal
46	Plug
47	O-ring
48	O-ring
49	O-ring
51	O-ring
53	Socket bolt
56	Hexagon bolt
61	Spring washer
70	Dust cap
71	Dust cap
74	Main relief valve assy



C-C ' (SWING & BOOM)

D21072MC42

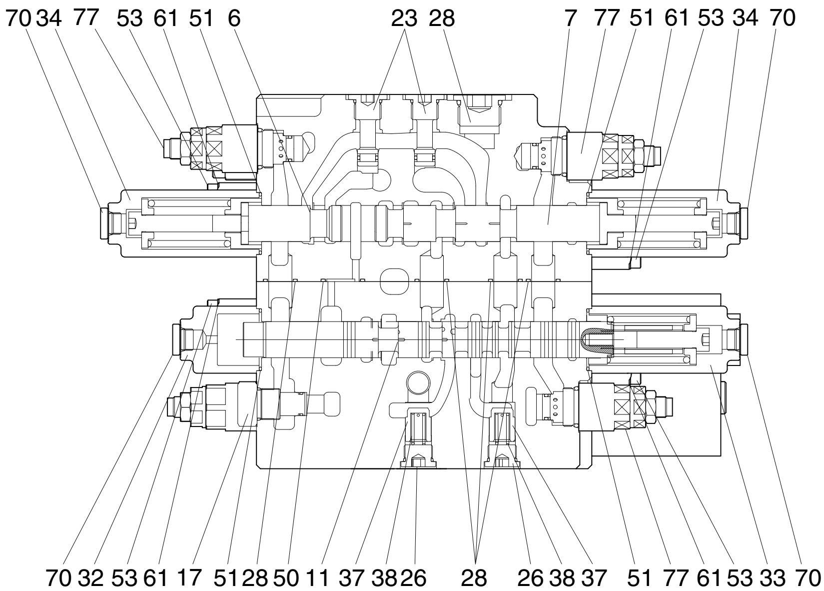
5	Swing spool assy	36	Load check spring 1	56	Haxagon bolt
14	Holding valve assy	41	Cover 1	61	Spring washer
25	Load check plug kit	42	Gasket 1	70	Dust cap
32	Pilot cover A	51	O-ring	71	Dust cap
33	Pilot cover B1	53	Socket bolt	75	Boom 1 spool
35	Load check poppet 1	55	Socket bolt	77	Overload R/V assy



E-E ' (ARM & ARM REGENRATION)

D21072MC44

12	Arm regen spool assy	38	Load check spring 2	54	Socket bolt
14	Holding valve assy	40	Flange	55	Socket bolt
15	Regen valve assy	41	Cover 1	56	Haxagon bolt
25	Load check plug kit	42	Gasket 1	57	Socket bolt
26	Load check plug kit	46	Plug	61	Spring washer
32	Pilot cover A	47	O-ring	62	Spring washer
33	Pliot cover B1	48	O-ring	70	Dust cap
35	Load check poppet 1	51	O-ring	71	Dust cap
36	Load check spring 1	52	O-ring	76	Arm 1 spool assy
37	Load check poppet 1	53	Socket bolt		

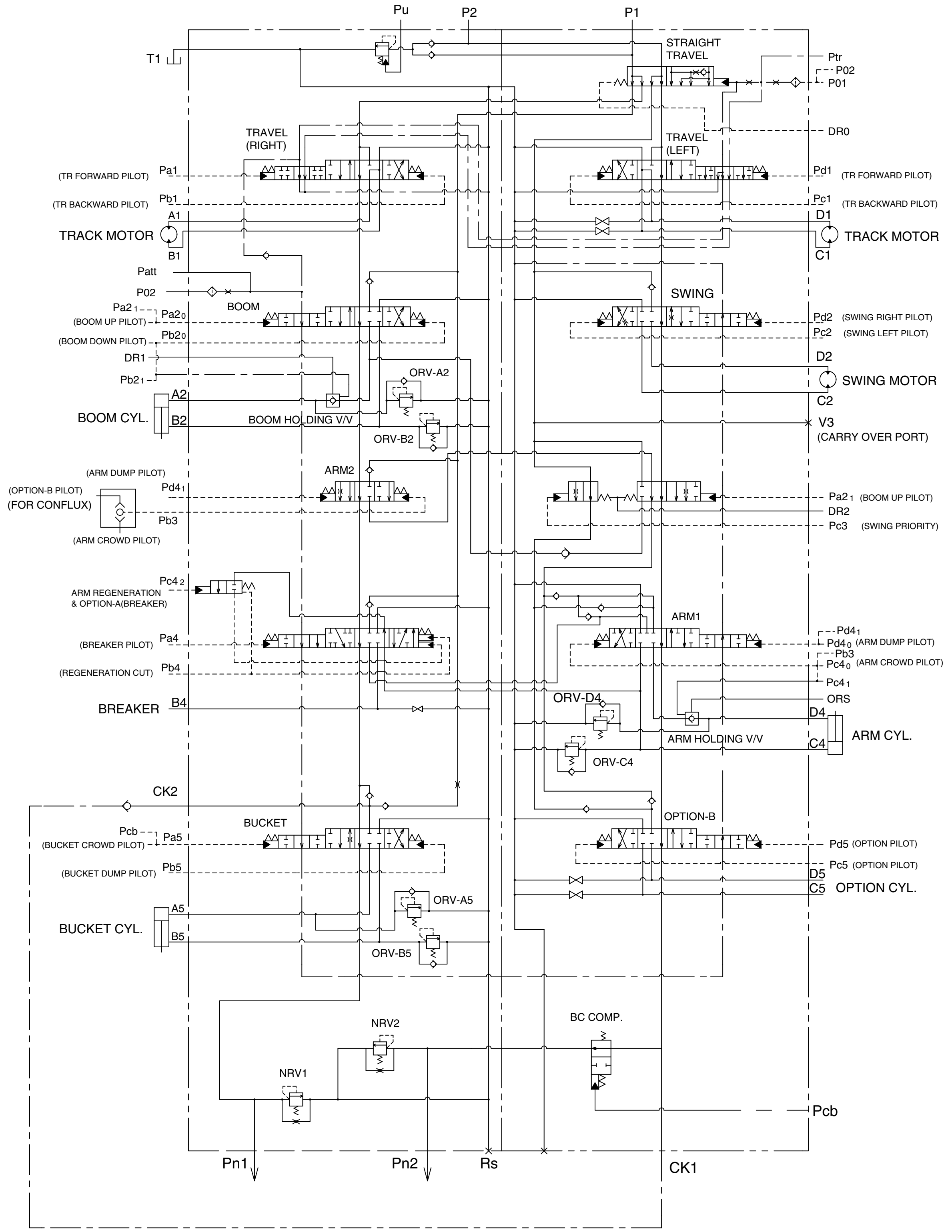


D-D ' (SWING PRIORITY & BOOM2 & ARM2)

D21072MC43

6	Swing PRI. spool assy	32	Pilot cover A	53	Socket bolt
7	Boom 2 spool assy	33	Pilot cover B1	61	Spring washer
11	Arm 2 spool assy	34	Pilot cover B2	70	Dust cap
17	Overload R/V plug assy	37	Load check poppet 2	75	Boom 1 spool assy
23	Parallel block plug assy	38	Load check spring 2	77	Overload R/V assy
26	Load check plug kit	50	O-ring		
28	Plug kit	51	O-ring		

2. HYDRAULIC CIRCUIT



D21072MC02

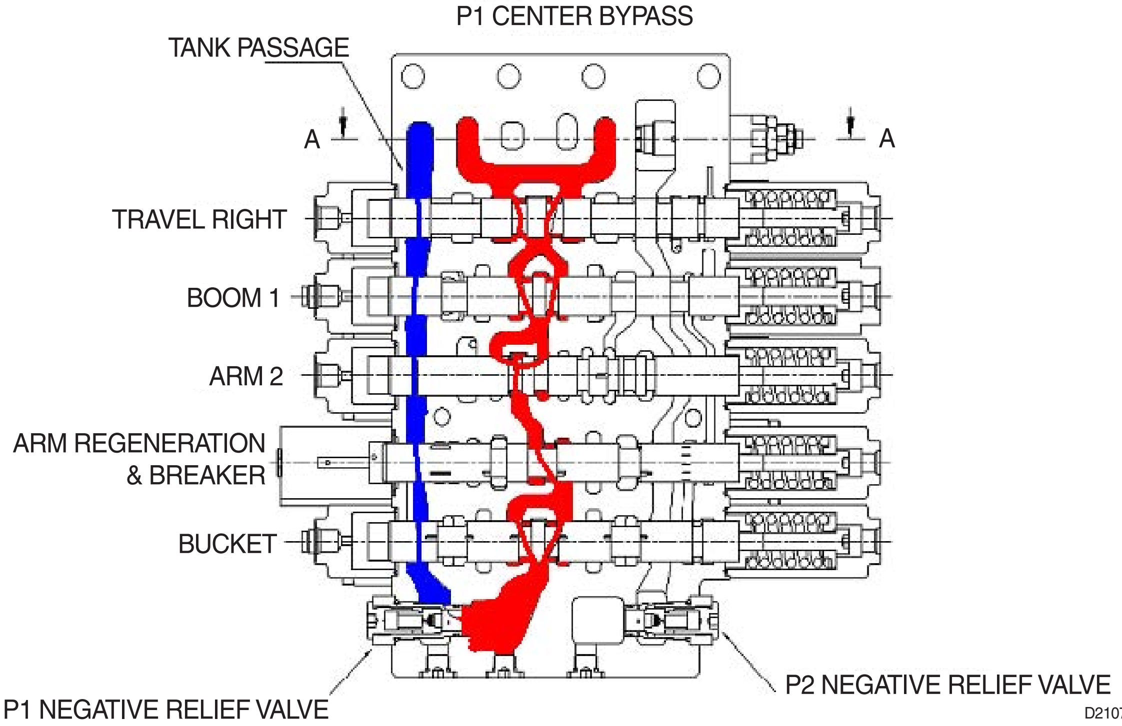
3. FUNCTION

1) CONTROL IN NEUTRAL

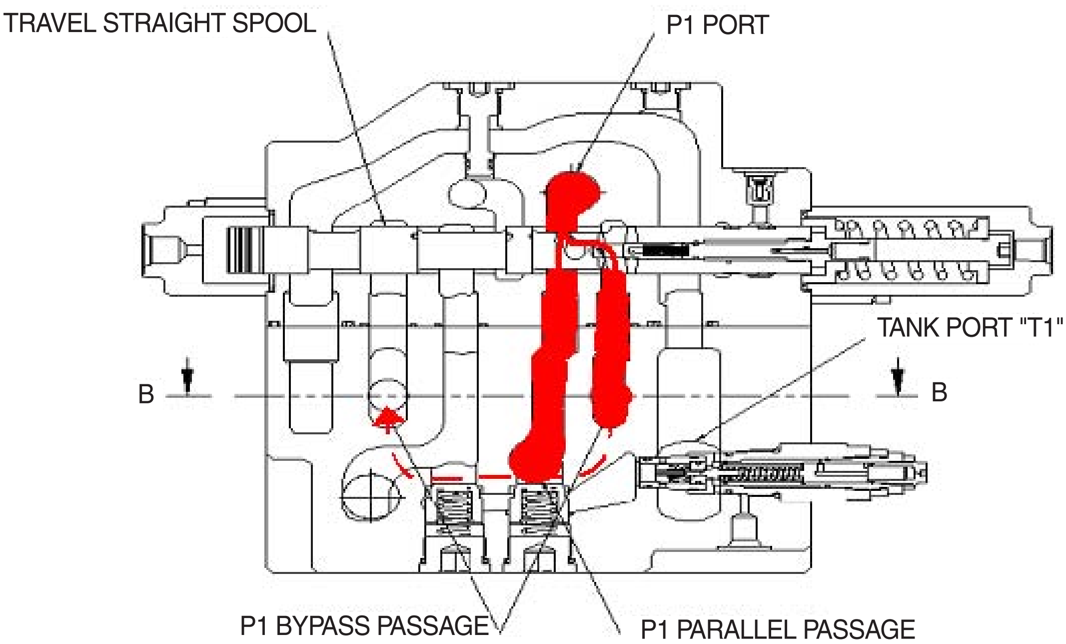
(1) P1 SIDE

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

When the straight travel spool is in neutral position, the bypass passage is not shut off. Then the hydraulic fluid from the pump P1 is directed to the tank through the bypass passage of spools : travel right, boom 1, arm 2, arm regeneration & option A and bucket, the negative relief valve of P1, tank passage, and the tank port "T1"



D21072MC03

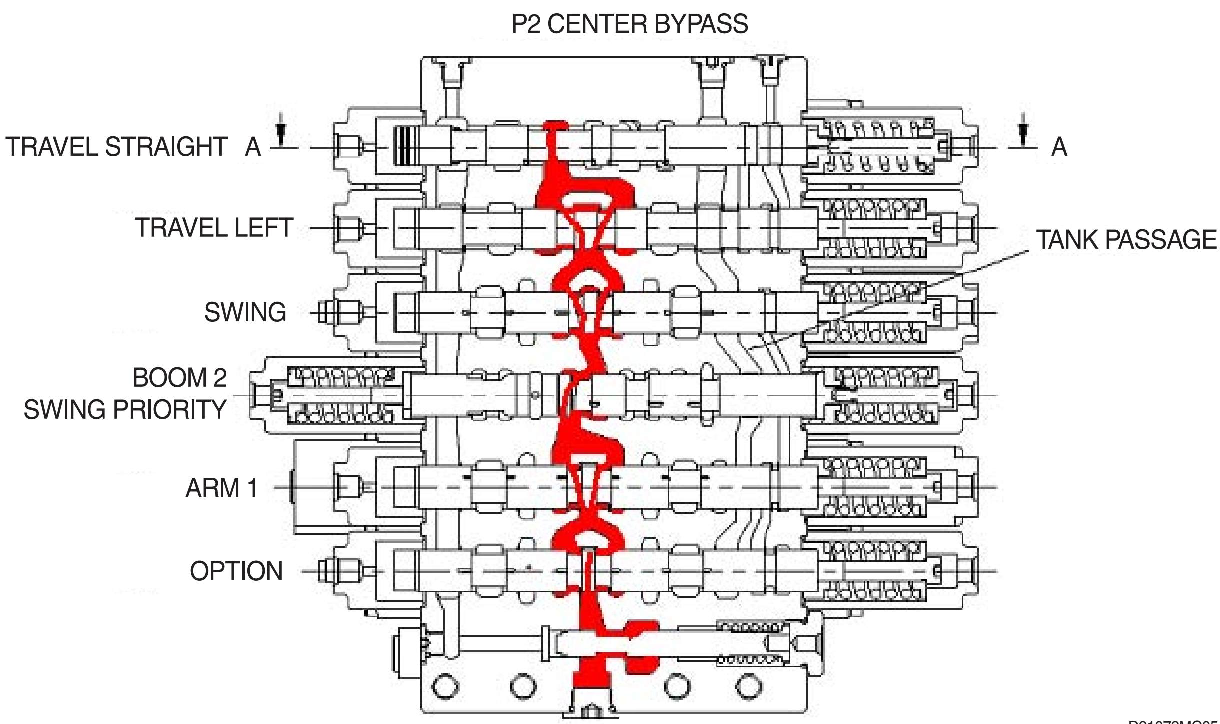


D21072MC03A

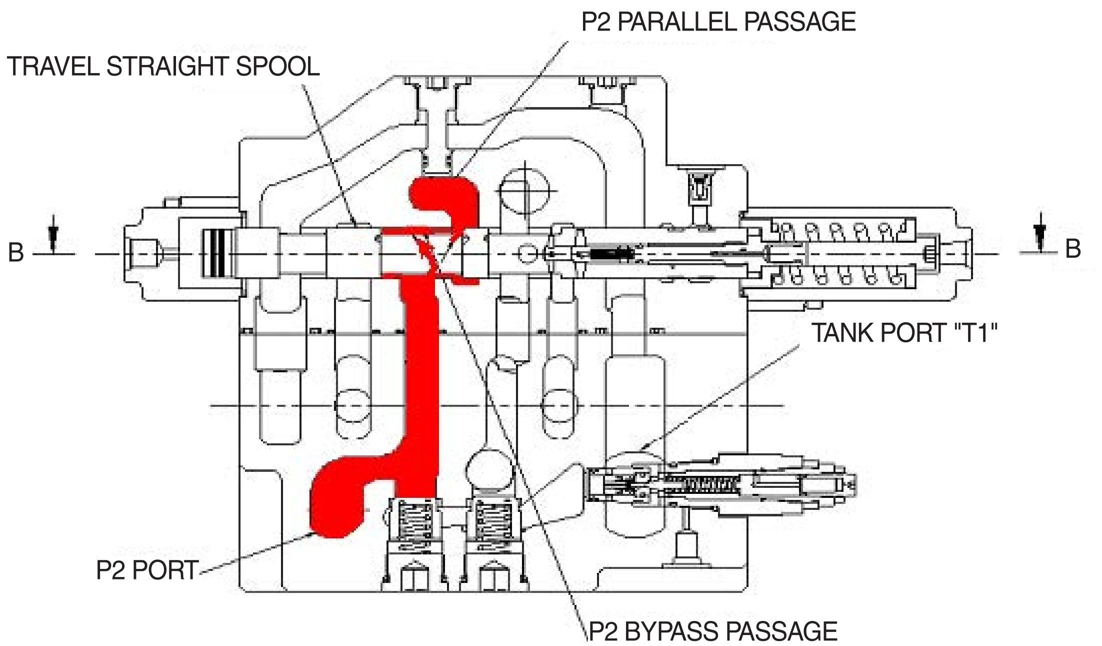
(2) P2 SIDE

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

When the straight travel spool is in neutral position, the bypass passage is not shut off. Then the hydraulic fluid from the pump P2 is directed to the tank through the bypass passage of spools : travel left, swing, boom 2 & swing priority, arm 1, option "B" and bucket summation and the negative relief valve of P2, the tank passage and the tank port "T1".



D21072MC05



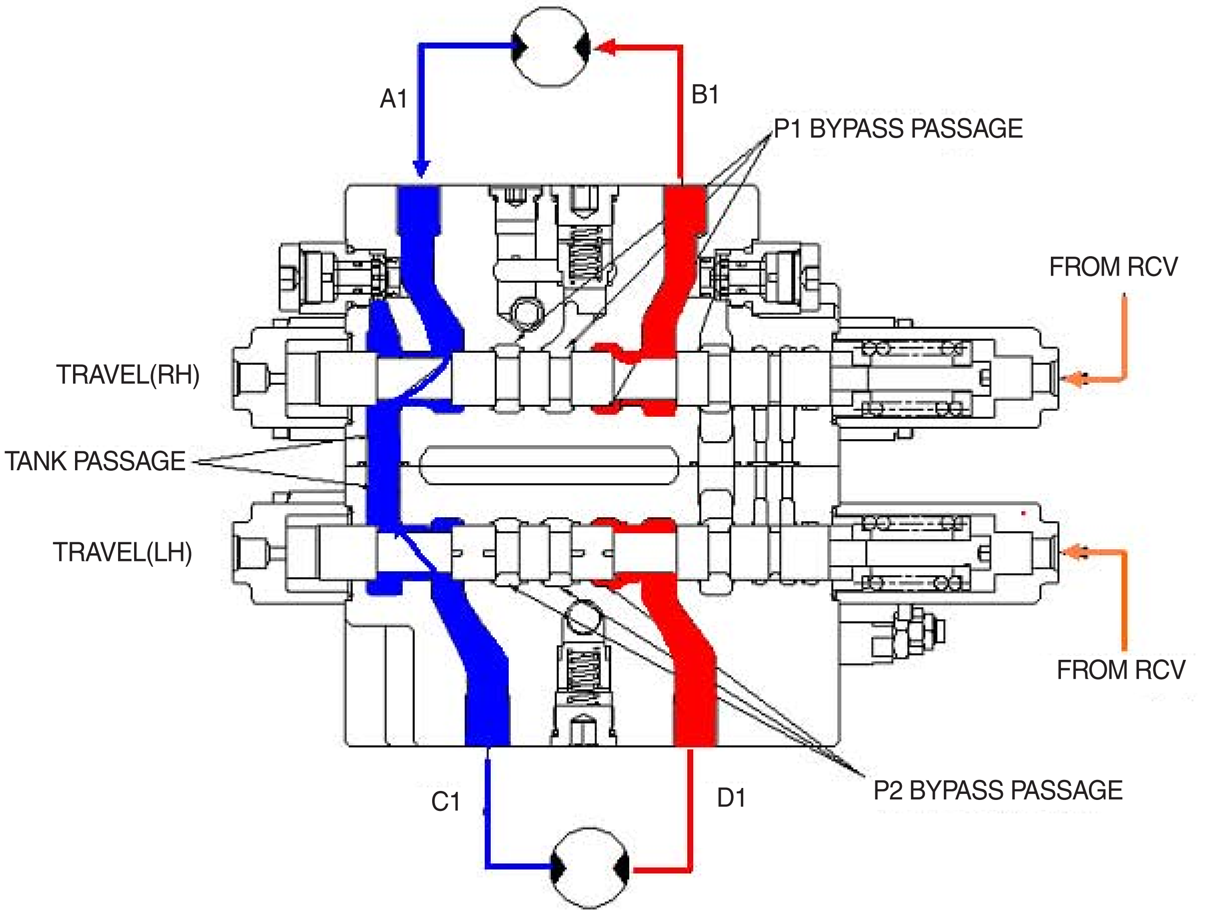
D21072MC04

2) TRAVEL OPERATION

(1) TRAVEL FORWARD OPERATION

During the travel forward operation, the pilot pressure of RCV is supplied to the port of the spring side, and it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump flows into the bypass passage of travel spool through the land of the straight travel spool.

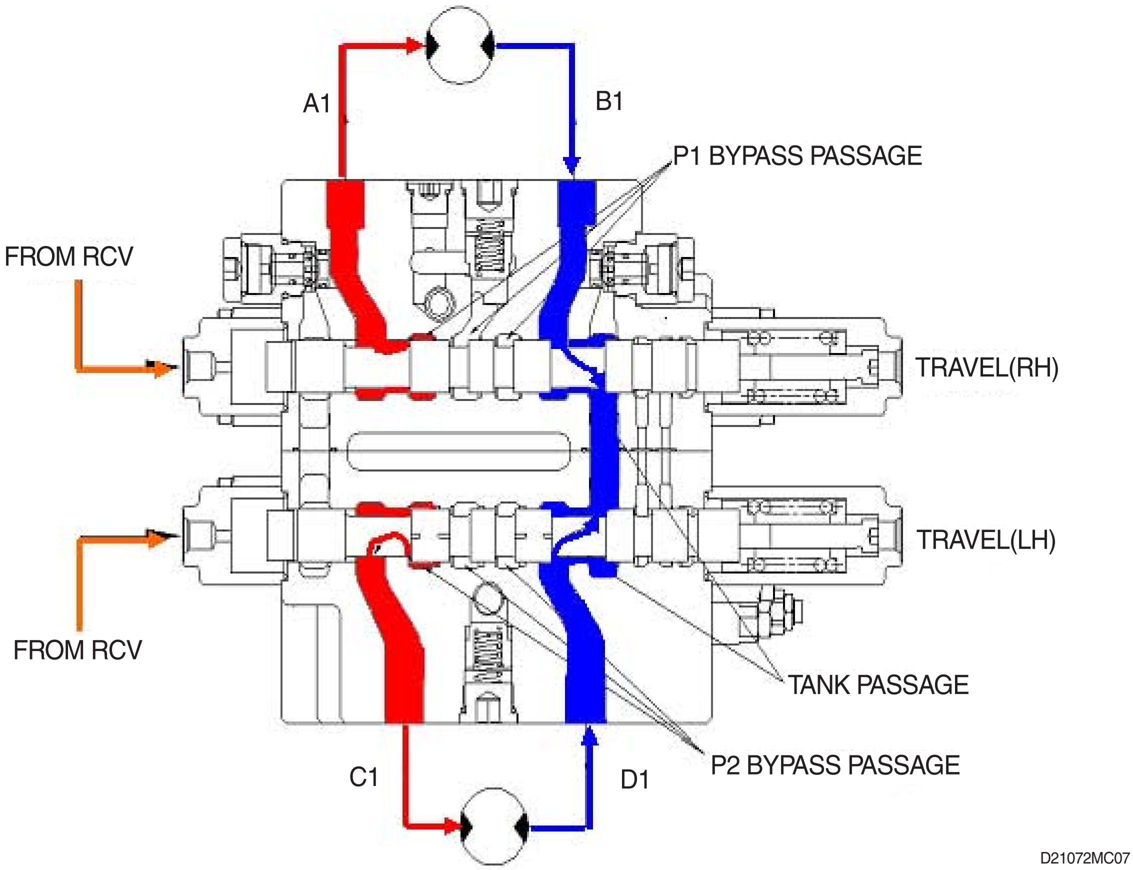
Then the bypass passage is shut off by the movement of the spool, they are directed to the each travel motor through port B1 and D1. At the same time, the hydraulic fluid from the each travel motor through port A1 and C1 returns to the tank passage through the travel spools.



(2) TRAVEL REVERSE OPERATION

During the travel reverse operation, the pilot pressure of RCV is supplied to the port of the spring opposite side, and it shifts travel right and left spools in the right direction against springs. Hydraulic fluid from the pump flows into the bypass passage of travel spool through the land of the straight travel spool.

Then the bypass passage is shut off by the movement of the spool, they are directed to the each travel motor through port A1 and C1. At the same time, the hydraulic fluid from the each travel motor through port B1 and D1 returns to the tank passage through the travel spools.



(3) TRAVEL STRAIGHT FUNCTION

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

① **During travel only :**

The hydraulic fluid of the pump P1 is supplied to the RH travel motor and the pump P2 is supplied to the LH travel motor.

Thus, the machine keep travel straight.

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

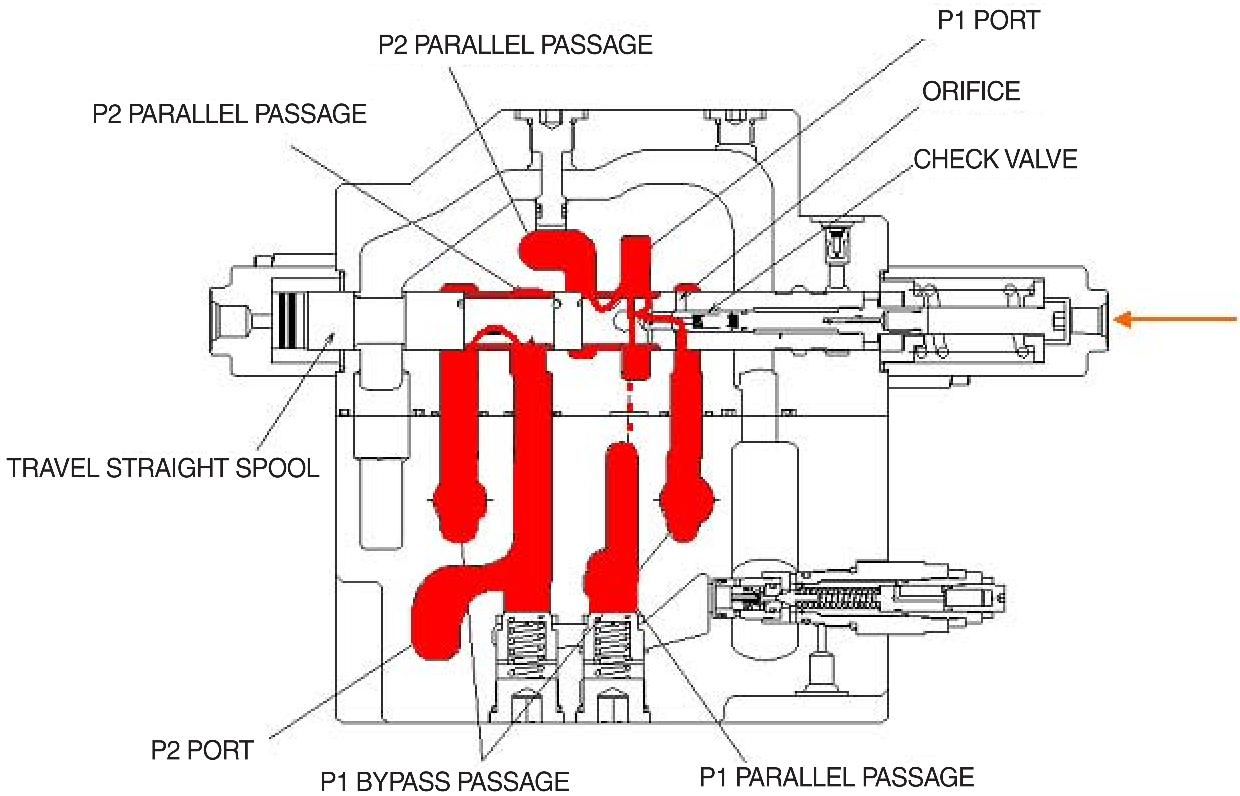
When the other actuator spool (S) is selected under straight travel operation, the straight travel spool is moved.

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

The hydraulic oil fluid from pump P2 is supplied to travel motors (left/right).

Therefore, the other actuator operation with straight travel operation, hydraulic oil fluid from pump P1 is mainly supplied to actuator, and the hydraulic oil fluid form pump P2 is mainly supplied to travel motors (left/right).

Then the machine keeps straight travel.



D21072MC08

3) BOOM OPERATION

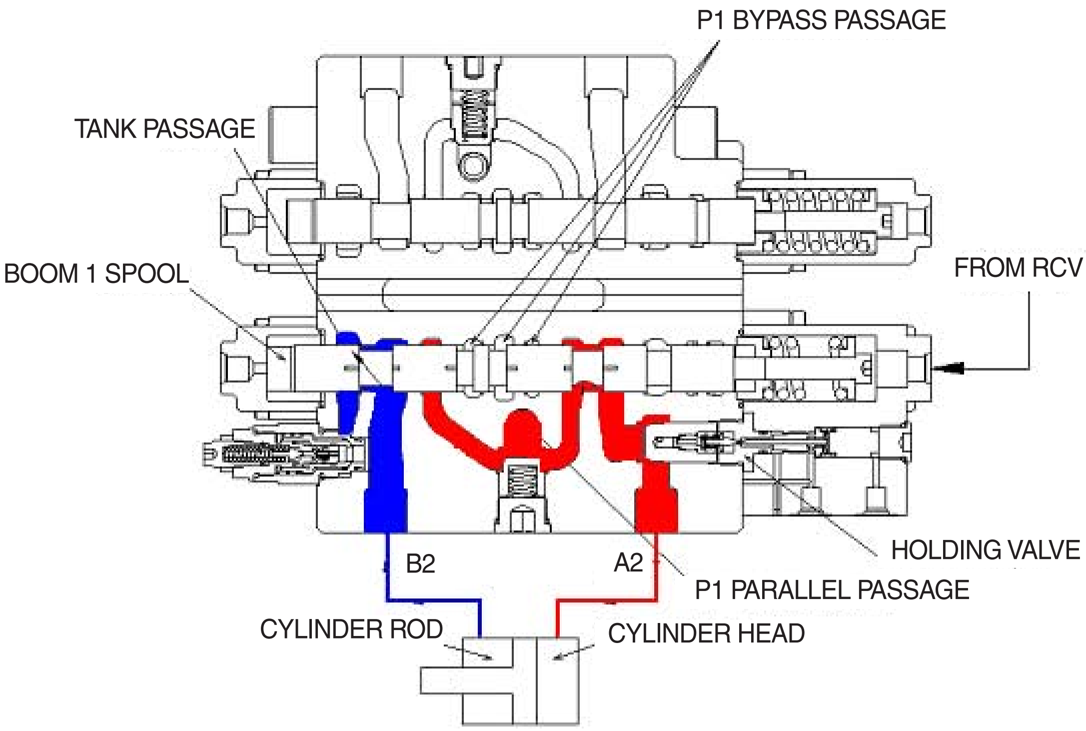
(1) BOOM UP OPERATION

During boom up operation, the pilot secondary pressure from RCV is supplied to the port of the spring side and shifts the boom 1 spool in the left direction. The bypass passage is shut off by the movement of the spool and the hydraulic oil fluid from pump P1 is entered P1 parallel passage and then passes through the load check valve, bridge passage and boom holding valve then flows into the port A2.

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

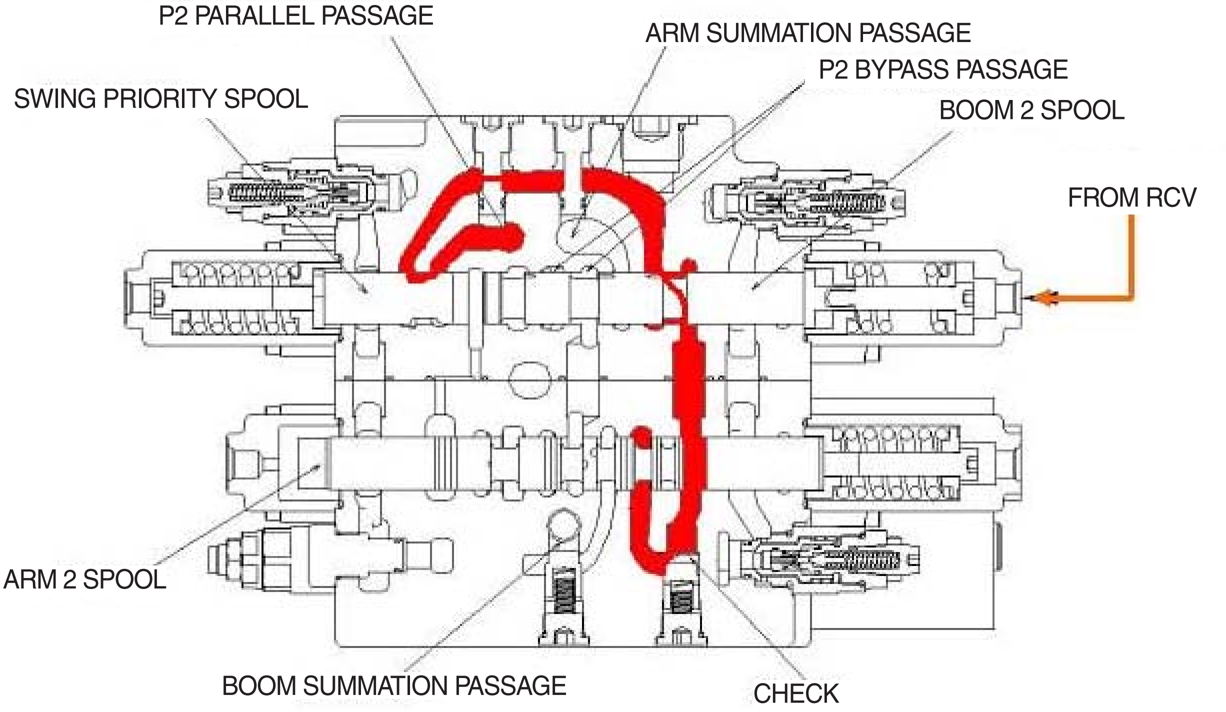
(In this case, the boom holding valve is free flow condition)

At the same time, the pilot pressure from RCV is supplied to the port of the spring side of boom 2 and shifts the boom 2 spool. The bypass passage is shut off by the movement of the spool and the hydraulic oil fluid from pump P2 entered boom summation passage via the P2 parallel passage, the land of the swing priority spool, notch of the boom 2 spool, arm 2 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder. At the same time, the flow from rod side of the boom cylinder return to the boom 1 spool through the port B2. There after it is directed to the hydraulic oil tank through the tank passage.



BOOM 1 SPOOL SIDE

D21072MC09



BOOM 2 SPOOL SIDE

D21072MC10

(2) BOOM DOWN OPERATION

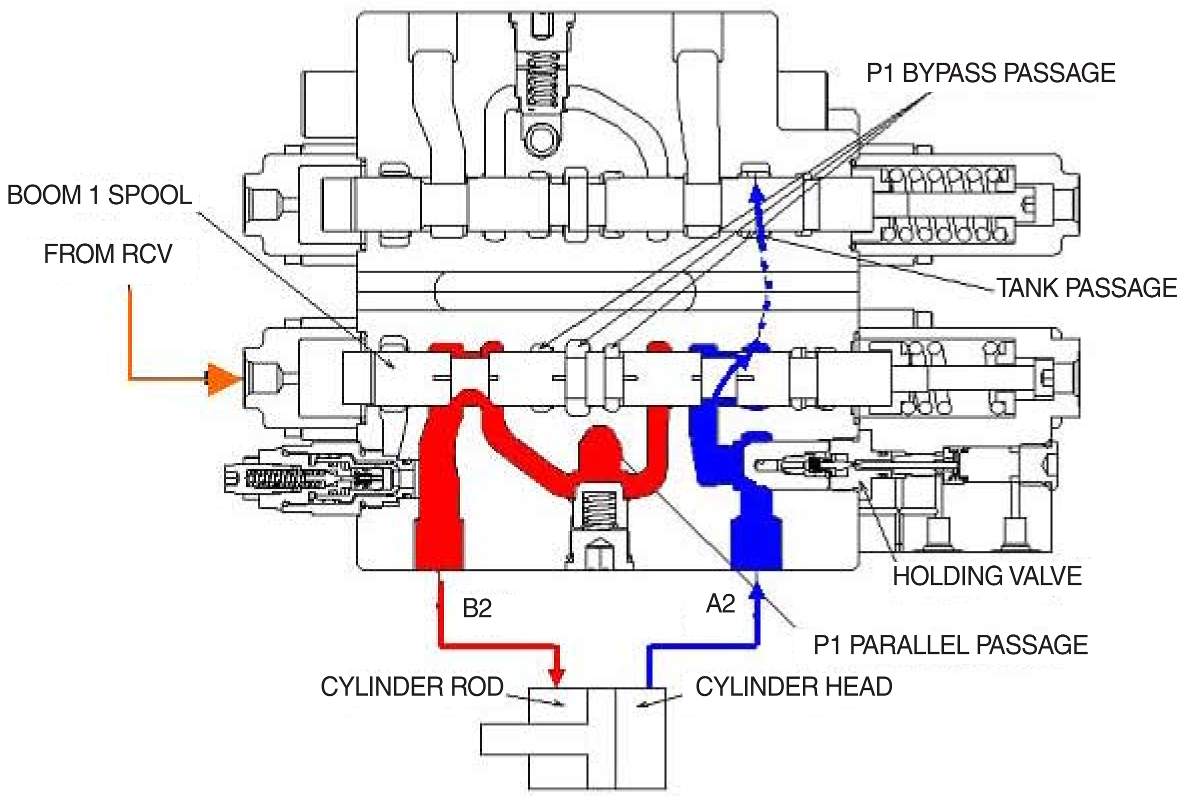
During the boom lowing operation, the pilot pressure from RCV is supplied to the port of the spring opposite side and shifts the boom 1 spool in the right direction.

The bypass passage is shut off by the movement of the spool and the hydraulic fluid from the pump P1 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.

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

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

During the boom lowering operation, the fluid from P2 pump is not summation.

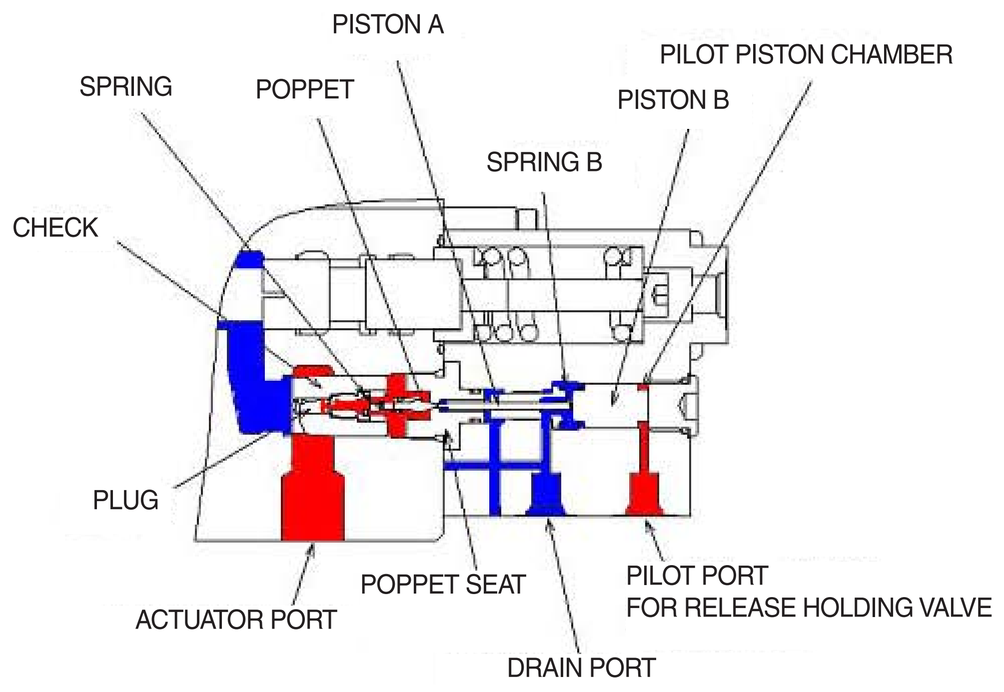


D21072MC11

4) HOLDING VALVE OPERATION

(1) HOLDING OPERATION

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



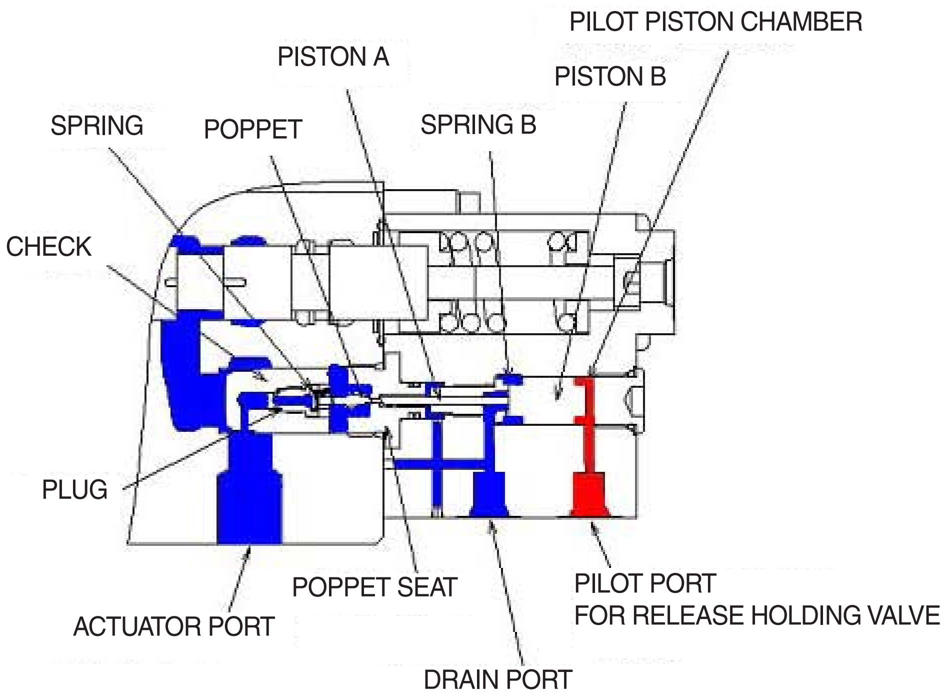
D21072MC12

(2) RELEASE HOLDING OPERATION

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

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

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



D21072MC13

5) BUCKET OPERATION

(1) BUCKET IN OPERATION

① Bucket operation only

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

The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P1 entered P1 parallel passage and is directed to the port A5 through the check1.

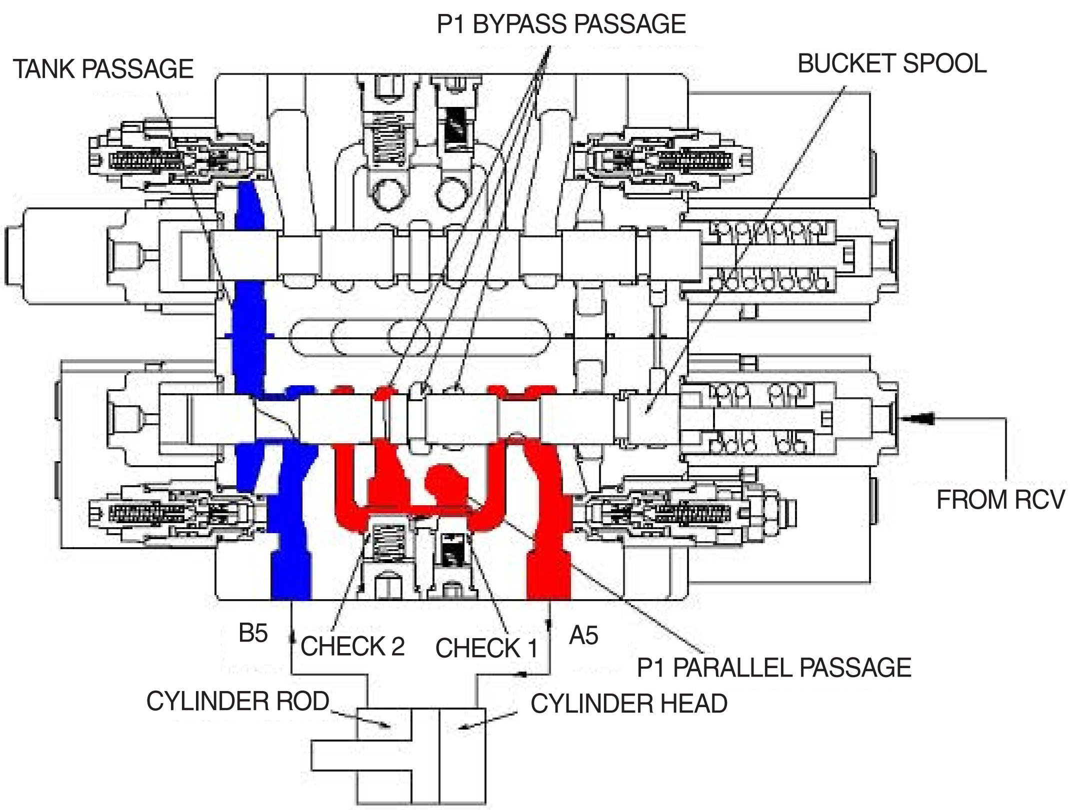
At the same time, the hydraulic fluid from P1 bypass passage is directed to the port A5 through the check2.

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 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.



D21072MC14

(2) BUCKET OUT OPERATION

① Bucket operation only

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

The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P1 entered P1 parallel passage and is directed to the port B5 through the check1.

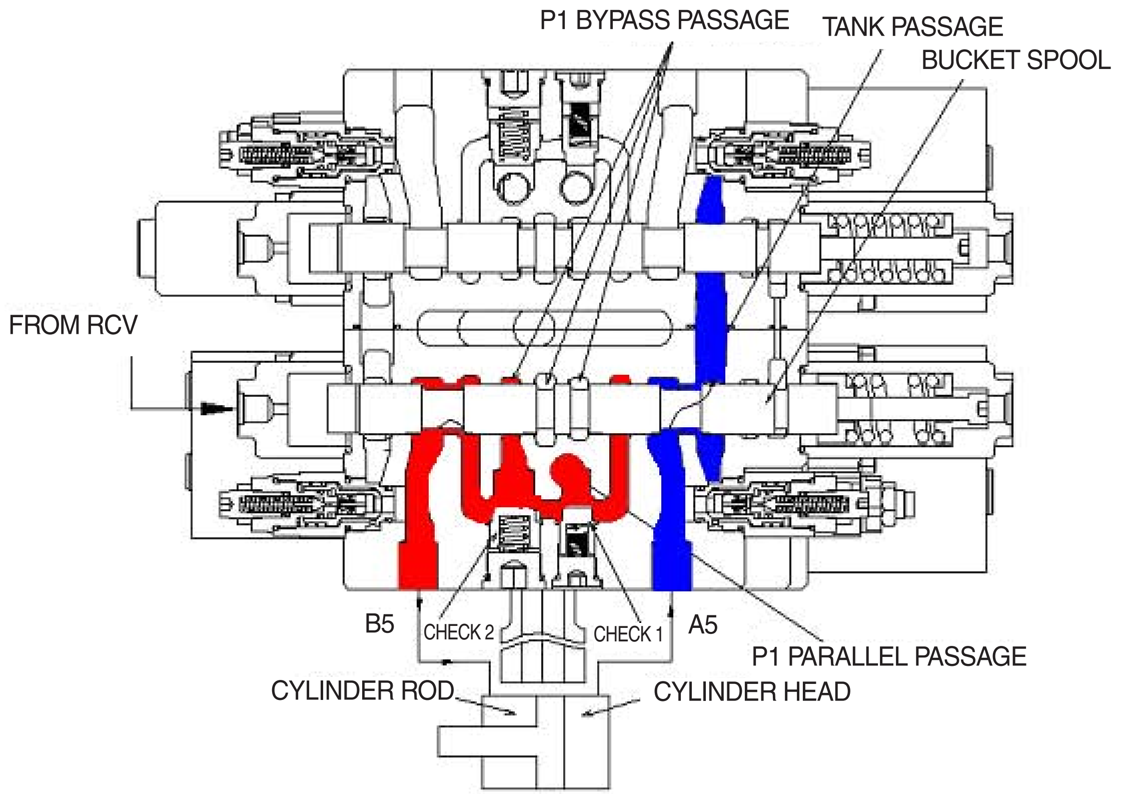
At the same time the hydraulic fluid from bypass passage is directed to the port B5 through the check 2.

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

② 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.

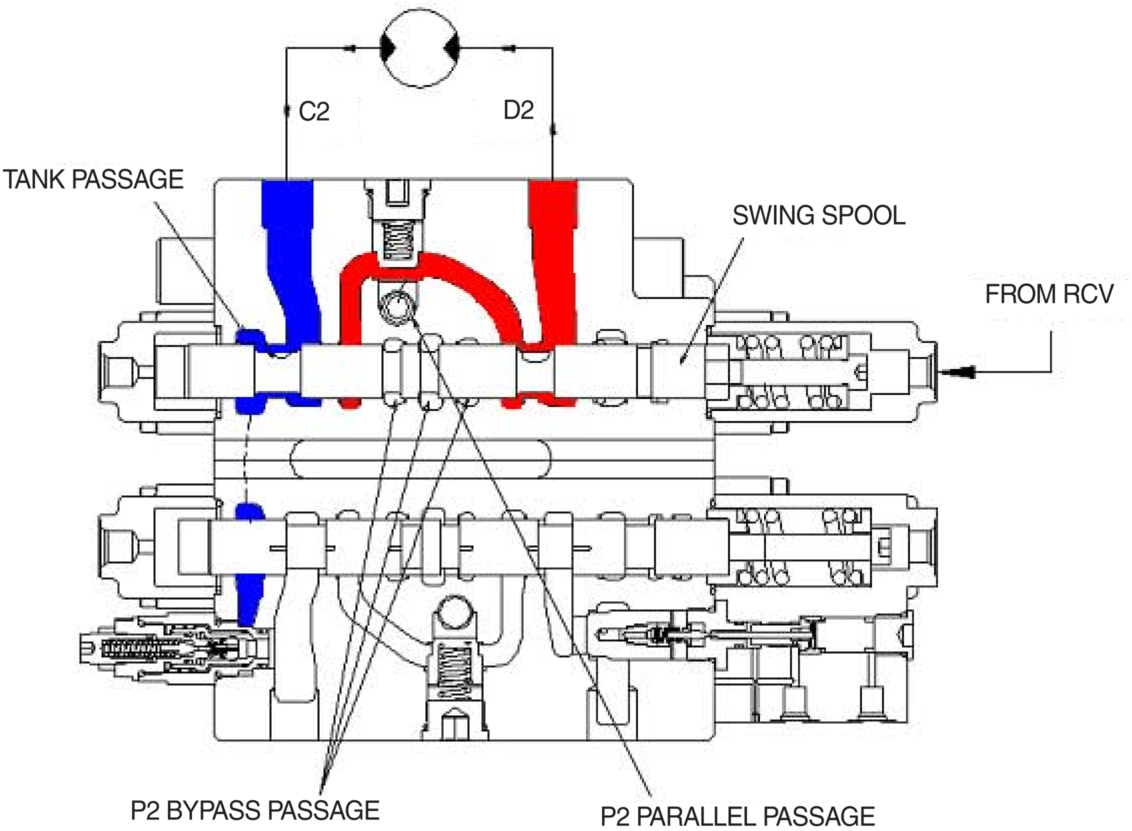


6) SWING OPERATION

(1) SWING LEFT OPERATION

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shift the swing spool in left direction. The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P2 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.

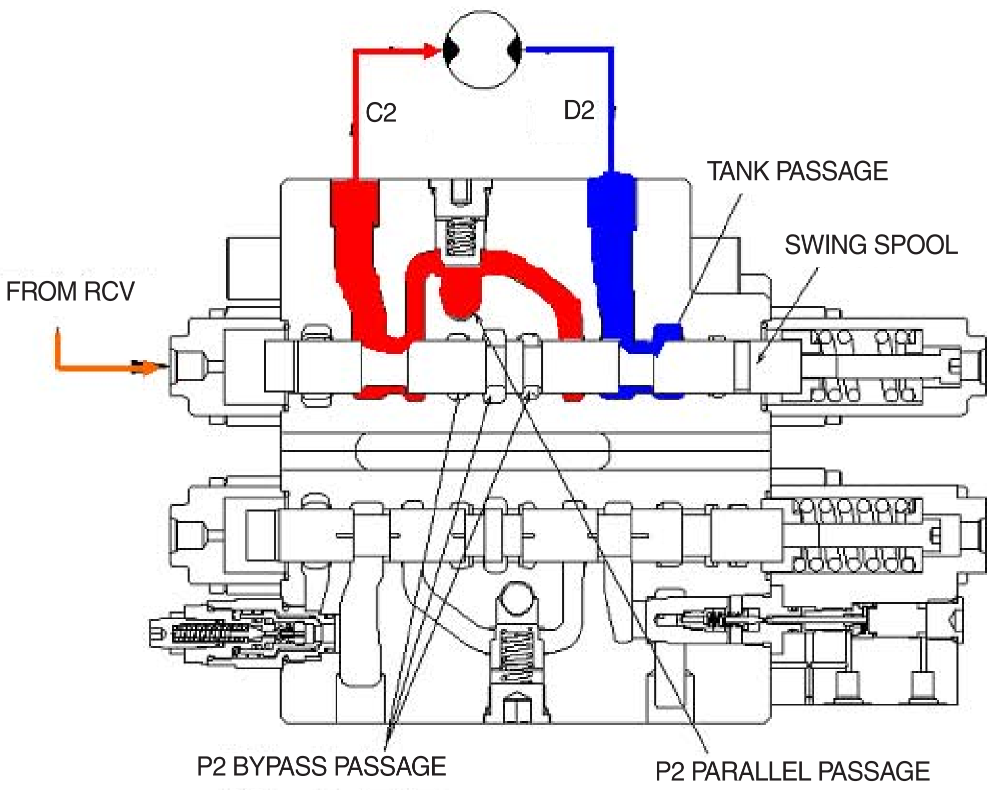


D21072MC16

(2) SWING RIGHT OPERATION

During the swing right operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shift the swing spool in left direction. The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P2 flows into swing spool through the parallel passage. Then it is directed to swing motor through the port C2.

As the result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port B2, swing spool and the tank passage.



D21072MC17

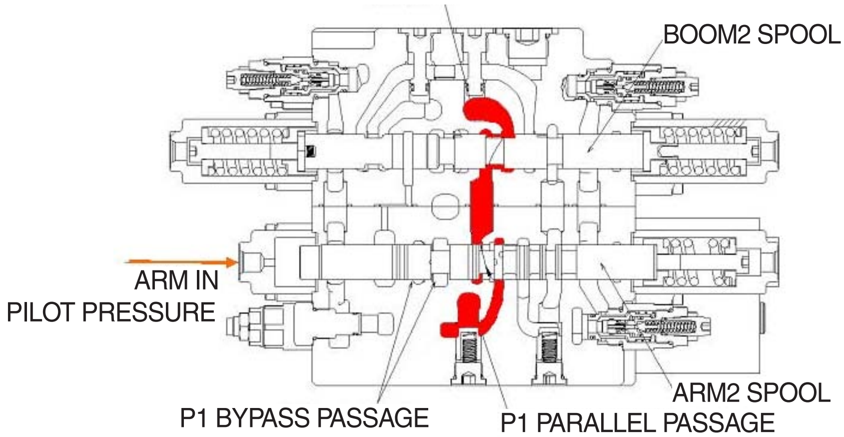
7) ARM OPERATION

(1) ARM IN OPERATION

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

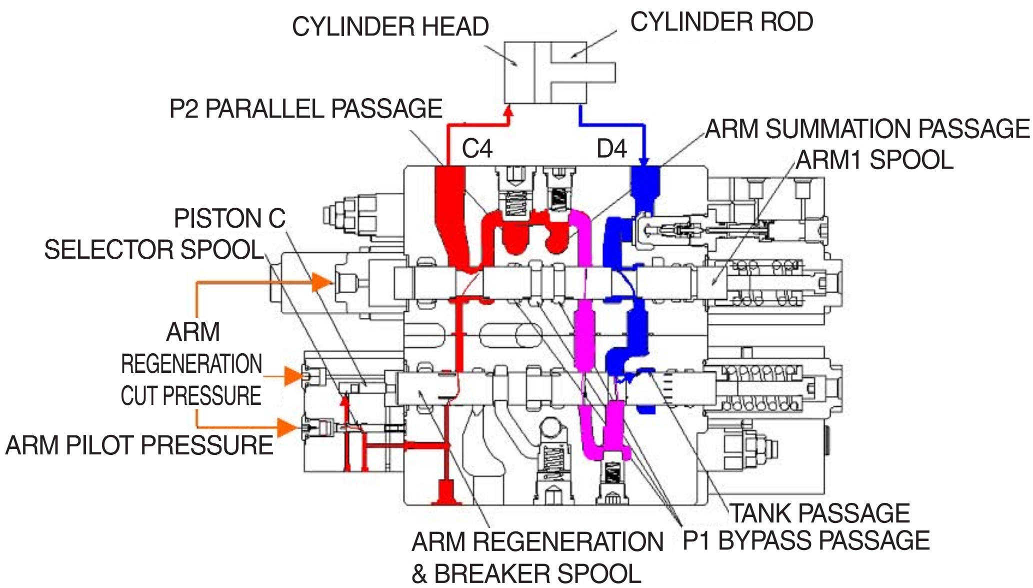
The bypass passage is shut off by the movement of the arm 1 spool and the hydraulic oil from the pump P2 flows into the arm cylinder head side through P2 parallel passage, the load check valve, bridge passage and the port C4.

At same time, the pilot secondary pressure from the RCV is supplied to the port of spring opposite side and shifts arm 2 spool in the right direction. The bypass passage is shut off by the movement of the spool and the hydraulic fluid from the pump P1 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 2 SPOOL SIDE

D21072MC19



ARM 1 SPOOL SIDE

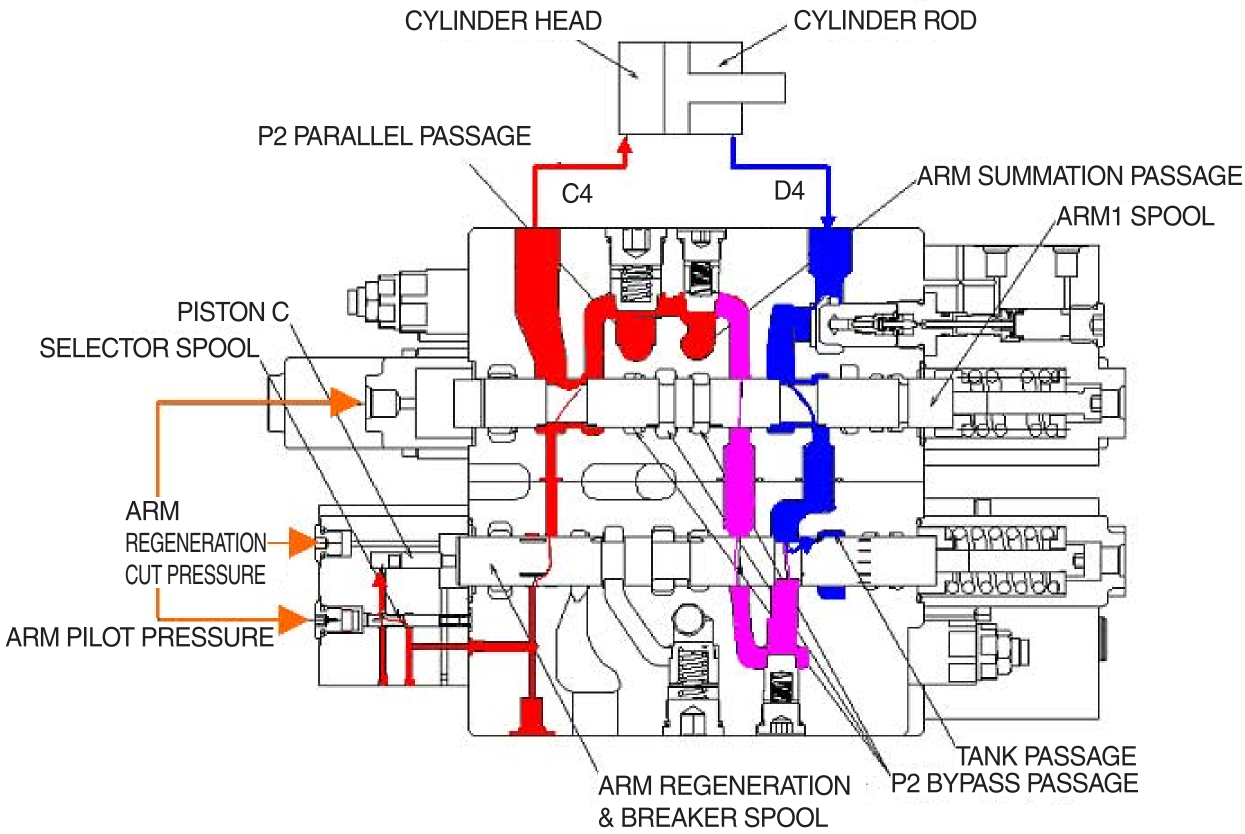
D21072MC18

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 spool through the arm holding valve and the arm 1 spool. It is supplied the arm cylinder head through internal passage. This is called the arm regeneration function.

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

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



D21072MC18

(2) ARM OUT OPERATION

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

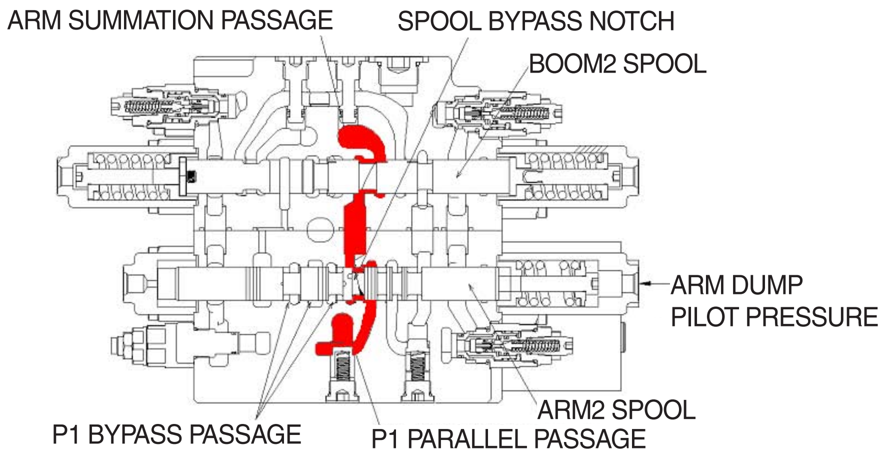
The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P2 flows into arm 1 spool through the parallel passage. Then it enters into the arm cylinder rod side through the load check valve, bridge passage, arm holding valve and the port D4.

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

The bypass passage is shut off by the movement of the spool and some of the hydraulic fluid from pump P2 bypassed through bypass notch. The rest of hydraulic fluid from pump P2 flows into the arm summation passage through P1 parallel passage the check valve arm 2 spool and boom 2 spool.

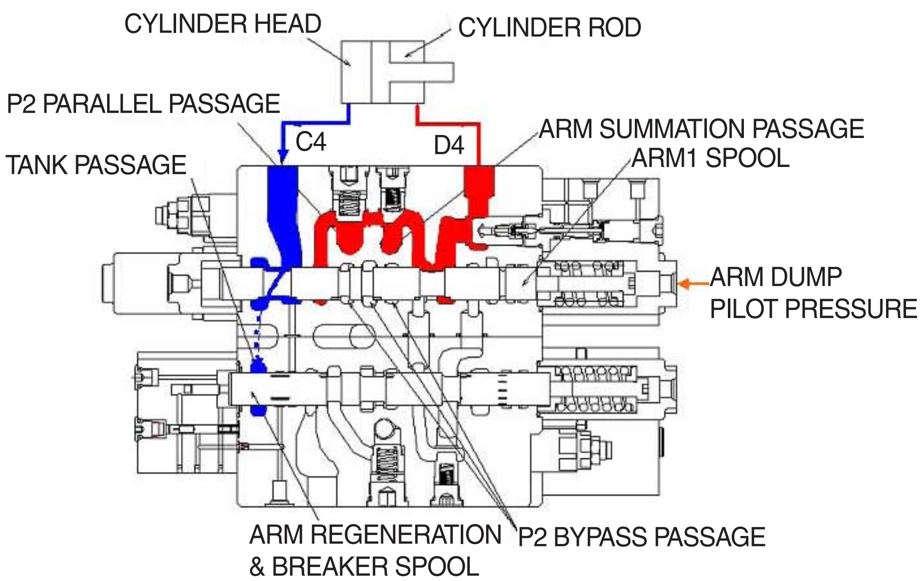
Then it enters into the arm cylinder rod side with the fluid from the arm 1 spool.

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



ARM 2 SPOOL SIDE

D21072MC21



ARM 1 SPOOL SIDE

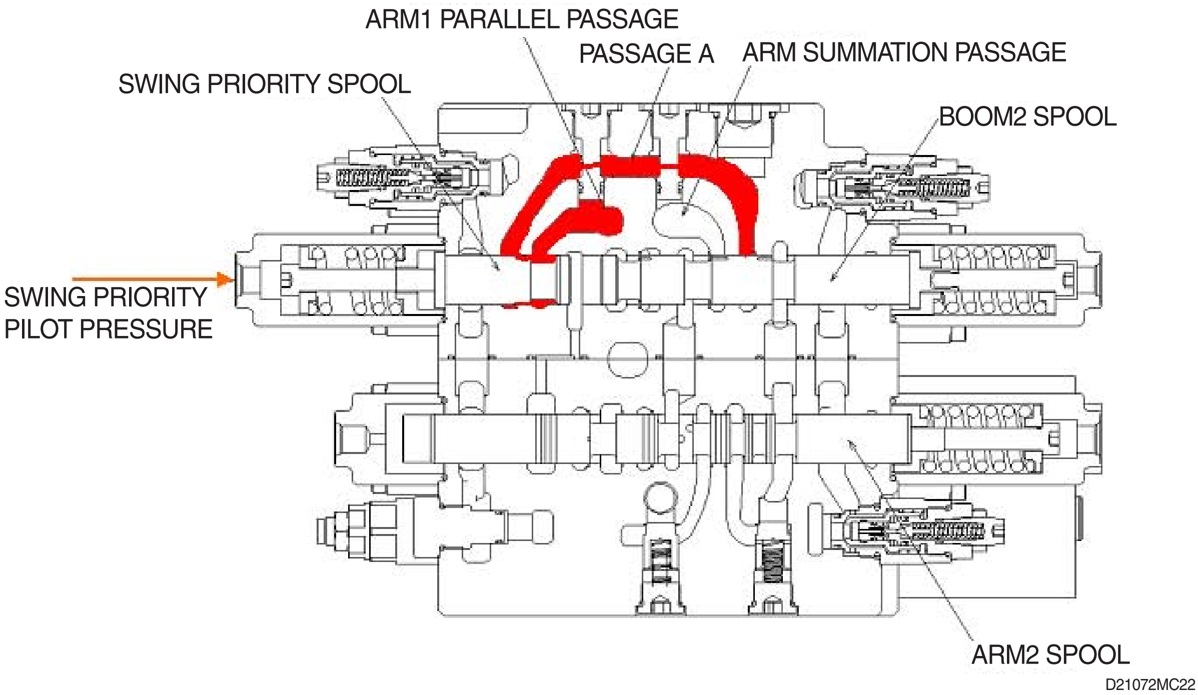
D21072MC20

8) SWING PRIORITY FUNCTION

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

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

When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the fluid from pump P2 flows to swing side more then the boom 2, arm 1, option B and bucket summation spools to make the swing operation most preferential.

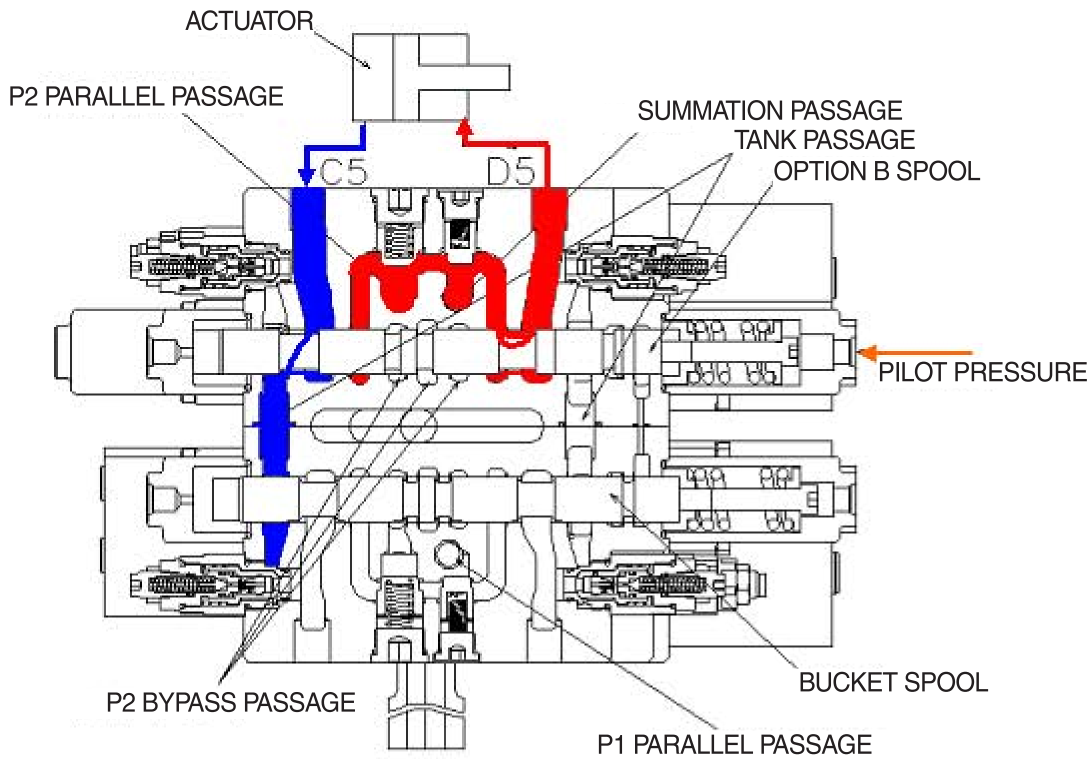


9) OPTION B OPERATION

The pilot secondary pressure from RCV is supplied to the port of spring side and shifts option spool as the figure.
The bypass passage is shut off by the movement of the spool and the hydraulic fluid from pump P2 flows into actuator through the load check valve, bridge passage and port D5.

At the same time, the fluid from actuator returns to the tank passage through port C5 and notch of the option spool.

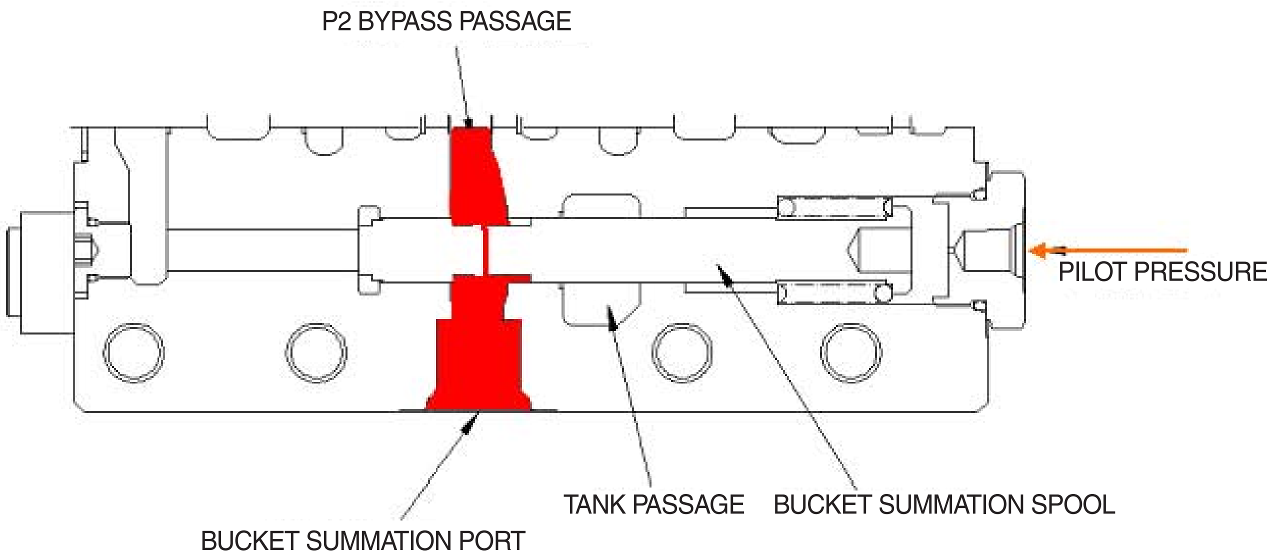
In case of reverse operation, the operating principle is same as above.



D21072MC24

10) BUCKET SUMMATION OPERATION

During bucket single operation, the bucket pilot pressure from RCV is supplied to the port of the spring side of the bucket summation spool and shift the spool in the left direction. As the spool moves, return line will be blocked and bypass pressure will open the check valve CK1 and join the parallel flow of the bucket from the P1 pump.



D21072MC25

11) NEGATIVE RELIEF VALVE OPERATION

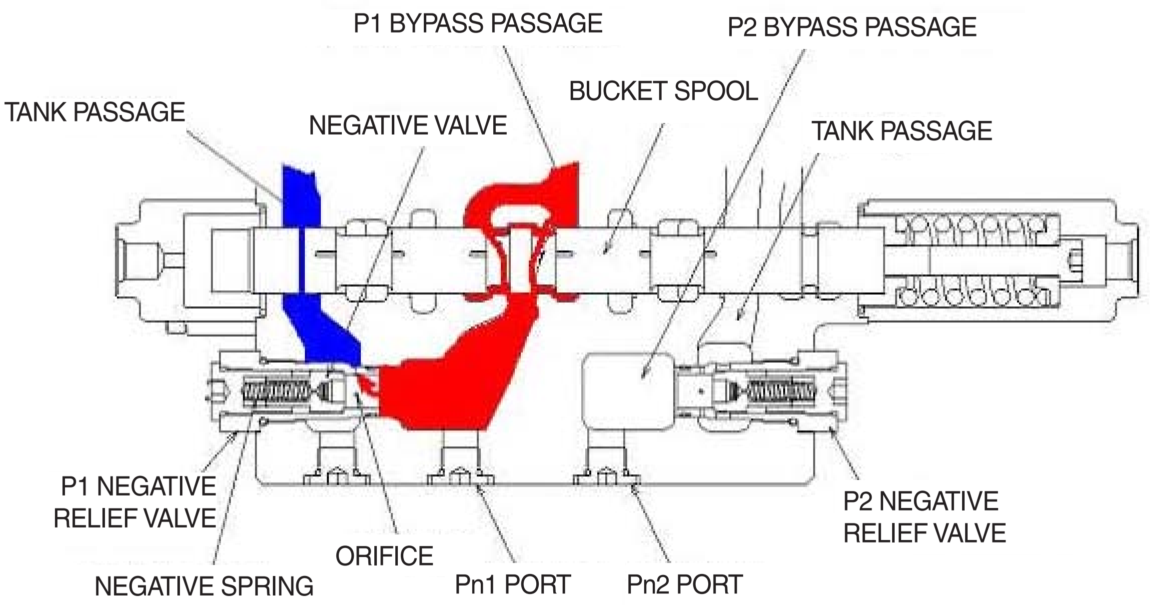
When no function is being actuated on P1 side, the hydraulic fluid from the pump P1, flows into the tank passage through the bypass passage and orifice. The restriction caused by this orifice thereby pressurizes. This pressure is transferred as the negative control signal pressure Pn1 to the pump P1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

It controls the pump regulator so as to minimize the discharge of the pump P1.

The bypass passage is shut off when the shifting of one or more spools and the flow through bypass passage became zero. The pressure of negative control signal becomes zero and the discharge of the pump P1 becomes maximum.

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

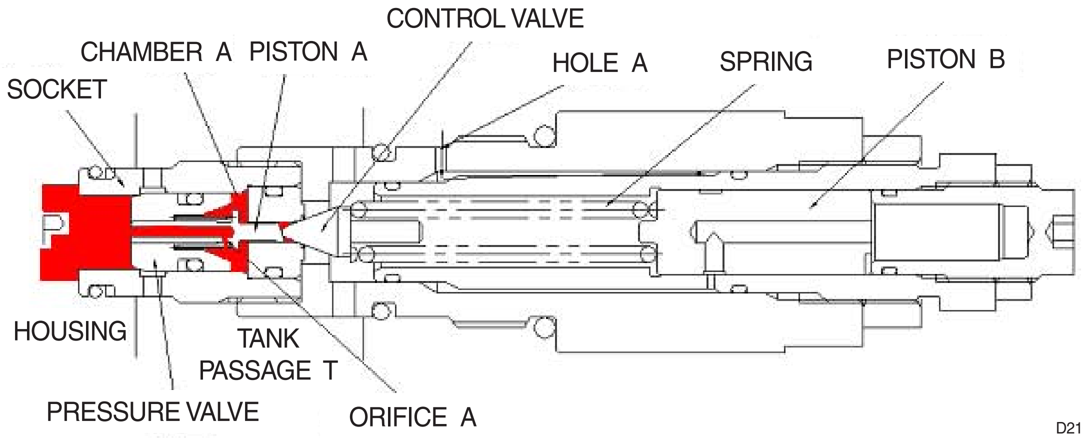
For the pump P2 the same negative control principle.



D21072MC26

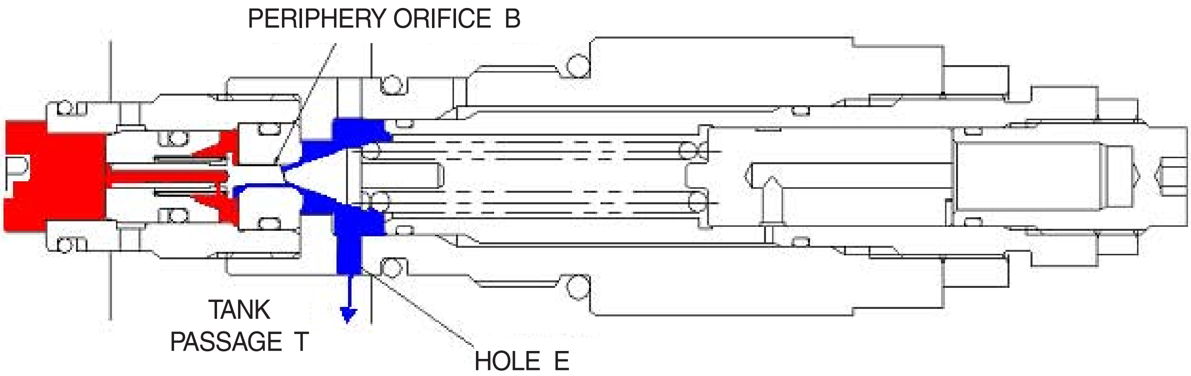
12) OPERATION OF MAIN RELIEF VALVE

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



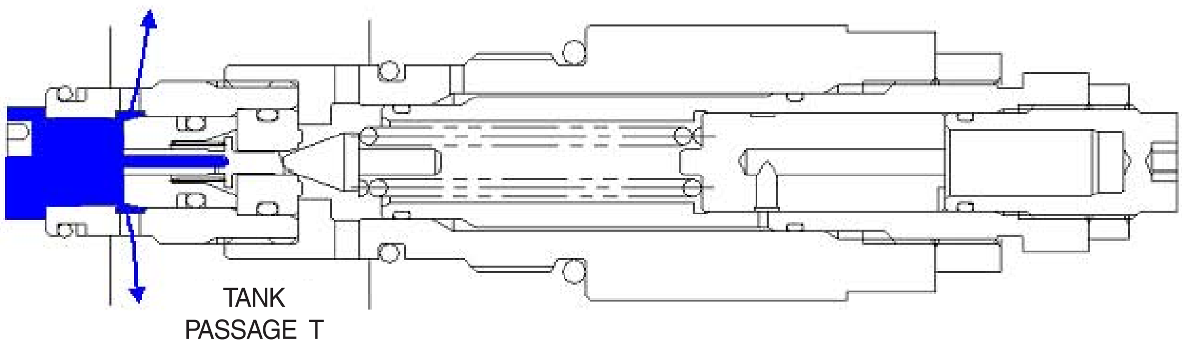
D21072MC27

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



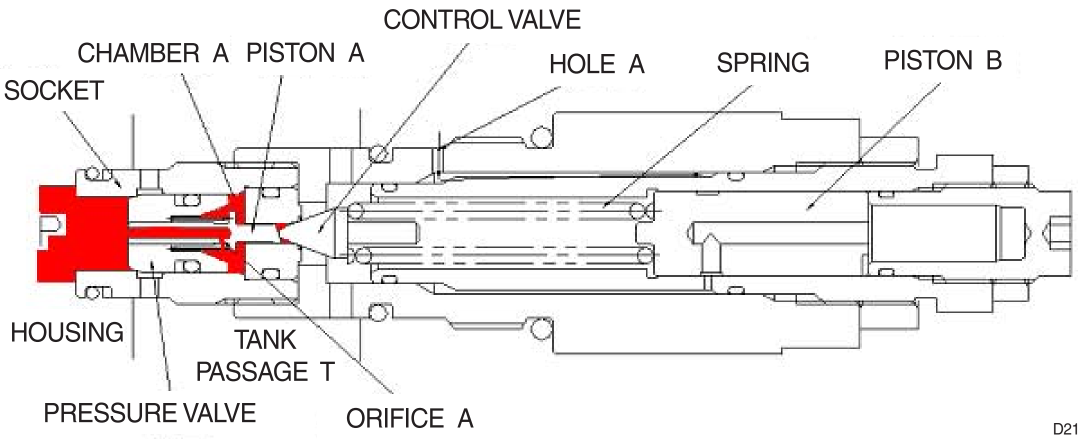
D21072MC28

(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).



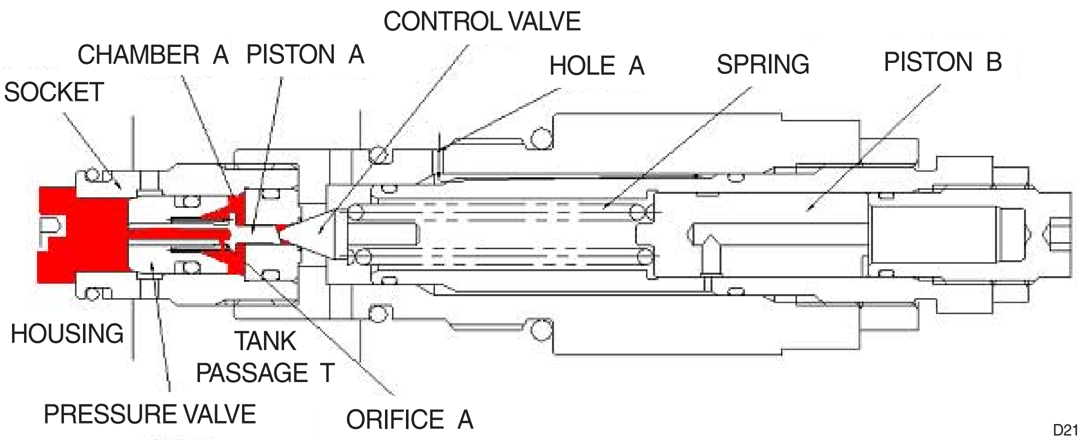
D21072MC29

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



D21072MC27

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

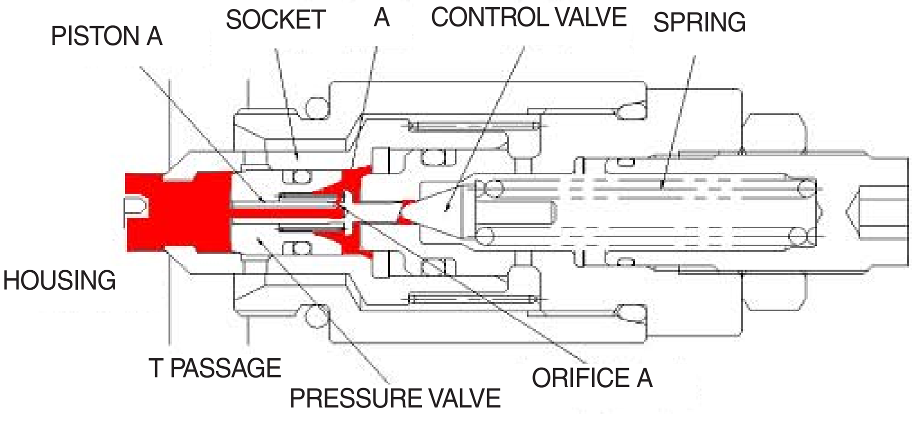


D21072MC27

13) OPERATION OF OVERLOAD RELIEF VALVE

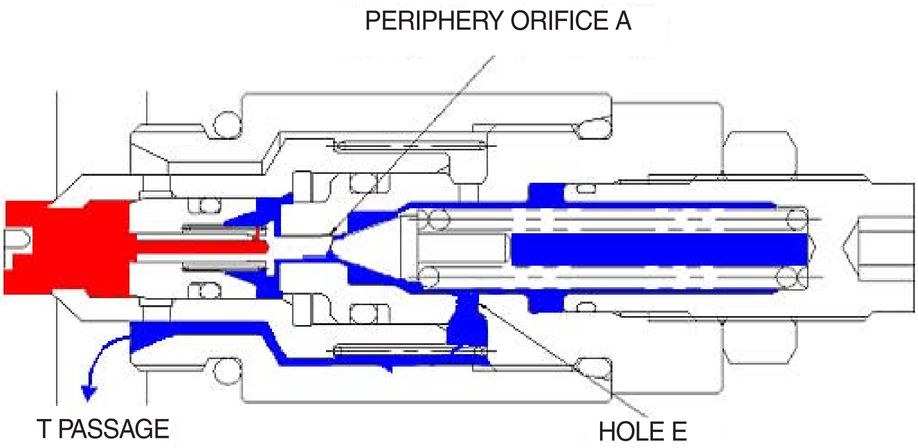
FUNCTION AS RELIEF VALVE

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



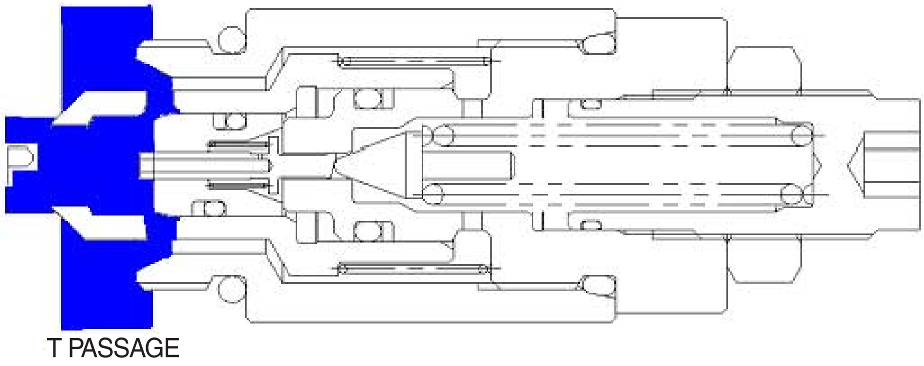
D21072MC30

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



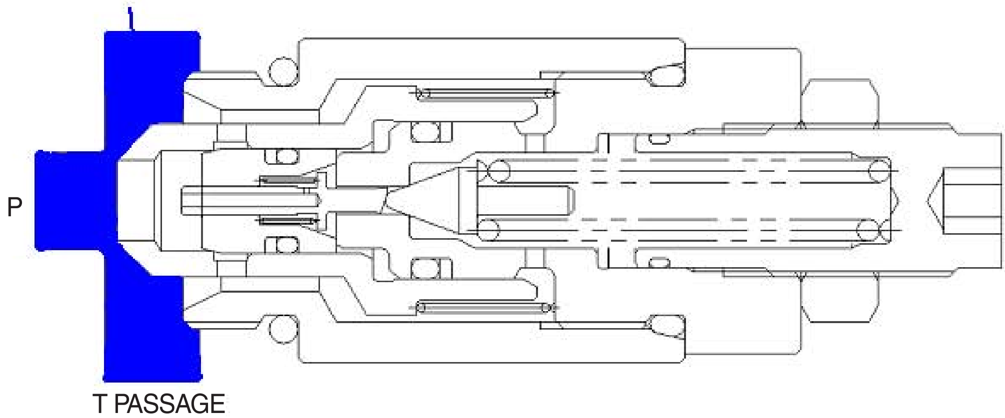
D21072MC31

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



D21072MC32

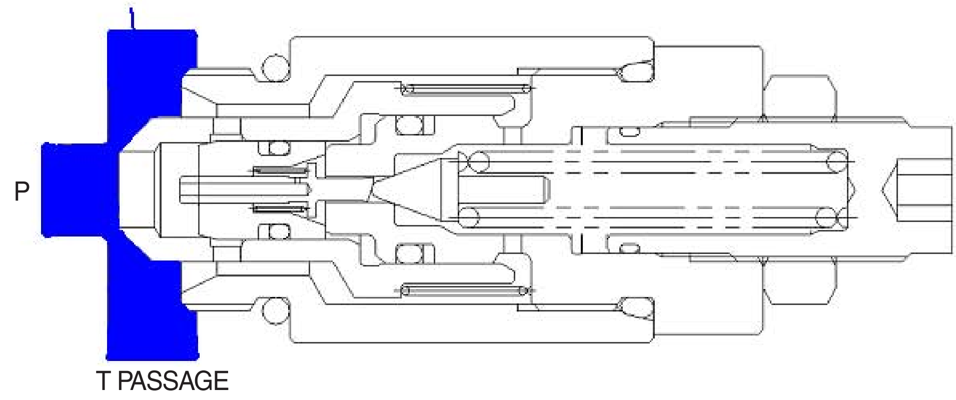
(4) The pressure at port P becomes lower than set pressure of the spring, the poppet is seated by spring force. Then the pressure at port P becomes equal to set pressure of the spring and the plunger is seated to the socket.



D21072MC33

MAKE-UP FUNCTION

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



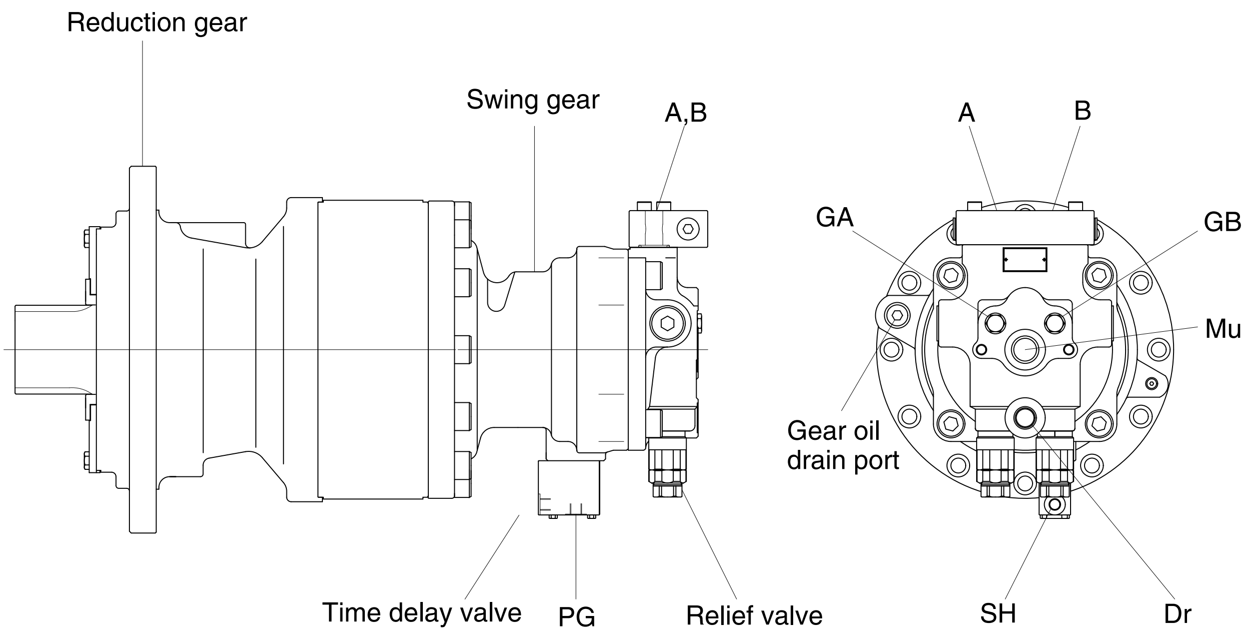
D21072MC33

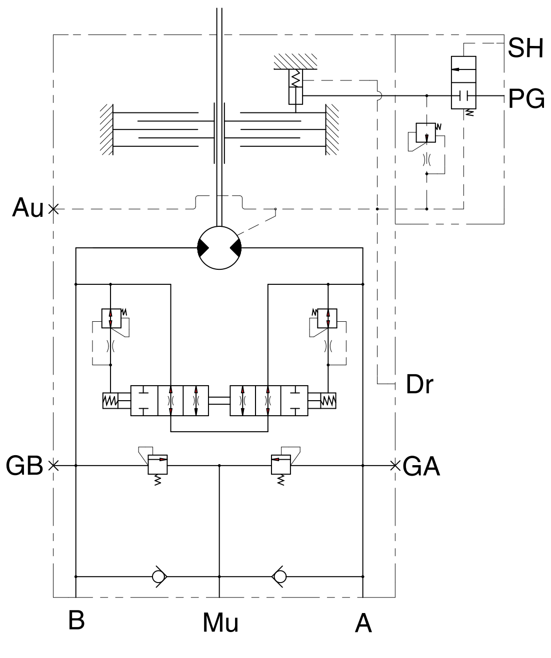
GROUP 3 SWING DEVICE

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.

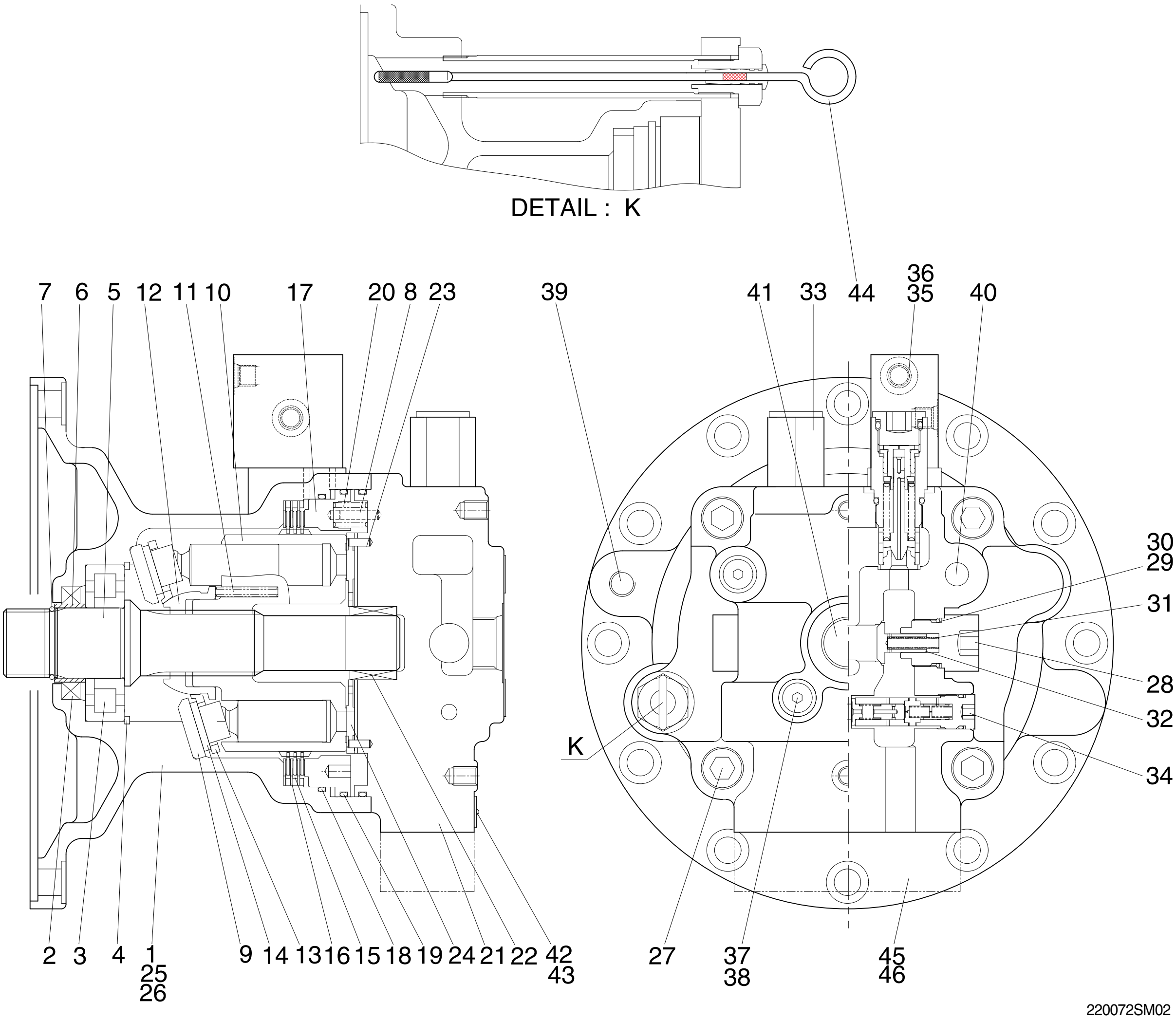




Port	Port name	Port size
A	Main port	ø 20
B	Main port	ø 20
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1
PG	Brake release port	PF 1/4
SH	Stand by port	PF 1/4
GA, GB	Gage port	PF 1/4
Au	Air vent port	PF 1/4

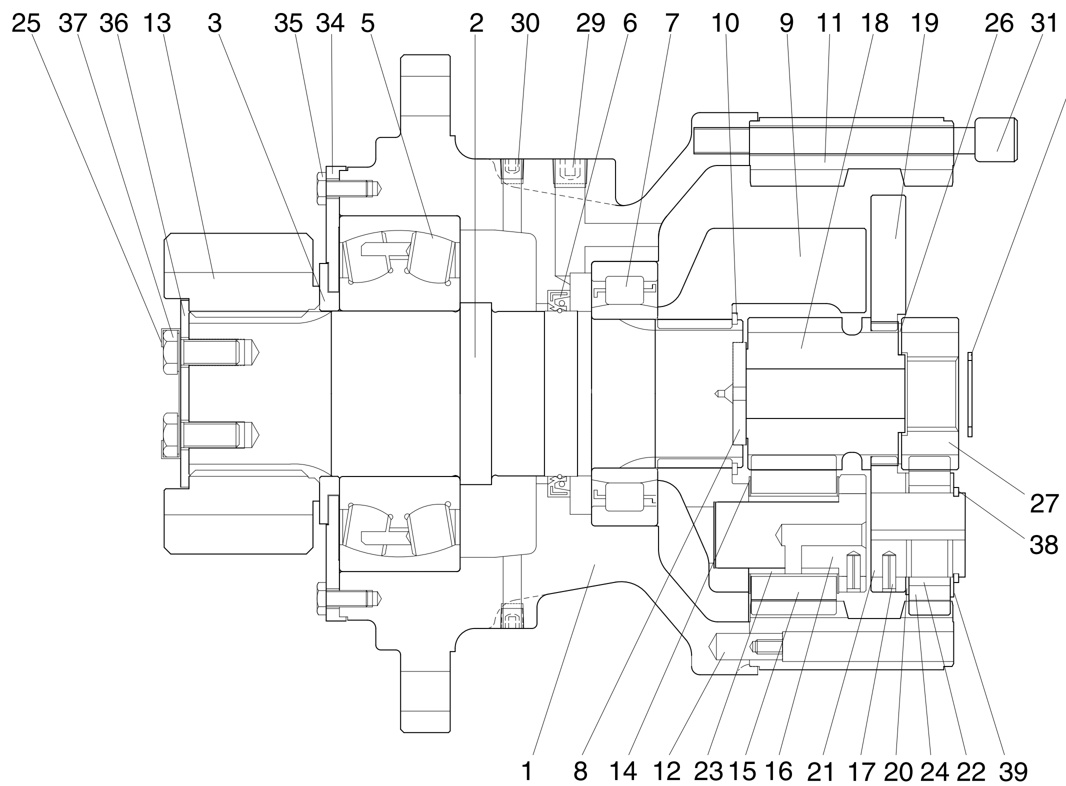
22007SF03A(1)

1) SWING MOTOR



1	Body	18	O-ring	35	Time delay valve
2	Oil seal	19	O-ring	36	Wrench bolt
3	Roller bearing	20	Spring	37	Plug
4	Snap ring	21	Rear cover	38	O-ring
5	Shaft	22	Needle bearing	39	Plug
6	Bushing	23	Pin	40	Plug
7	Stop ring	24	Valve plate	41	Plug
8	Pin	25	O-ring	42	Name plate
9	Shoe plate	26	O-ring	43	Rivet
10	Cylinder block	27	Wrench bolt	44	Level gauge
11	Spring	28	Plug	45	Flange
12	Ball guide	29	Back up ring	46	O-ring
13	Set plate	30	O-ring	47	Plug
14	Piston assy	31	Spring	48	O-ring
15	Friction plate	32	Check	49	O-ring
16	Plate	33	Relief valve	50	Back up ring
17	Brake piston	34	Anti-inversion valve		

2) REDUCTION GEAR



220072SF05A

1	Casing	14	Thrust washer	26	Side plate 3
2	Drive shaft	15	Planet gear 2	27	Sun gear 1
3	Spacer	16	Pin 2	28	Stop ring
5	Roller bearing	17	Spring pin	29	Plug
6	Oil seal	18	Sun gear 2	30	Plug
7	Roller bearing	19	Carrier 1	31	Socket bolt
8	Thrust plate	20	Side plate 1	34	Cover plate
9	Carrier 2	21	Pin 1	35	Hexagon bolt
10	Stop ring	22	Needle cage	36	Lock plate
11	Ring gear	23	Bush 2	37	Hexagon bolt
12	Knock pin	24	Planet gear 1	38	Stop ring
13	Pinion gear	25	Lock washer	39	Side plate 2

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder(10) through valve casing of motor(21), and valve plate(24).

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

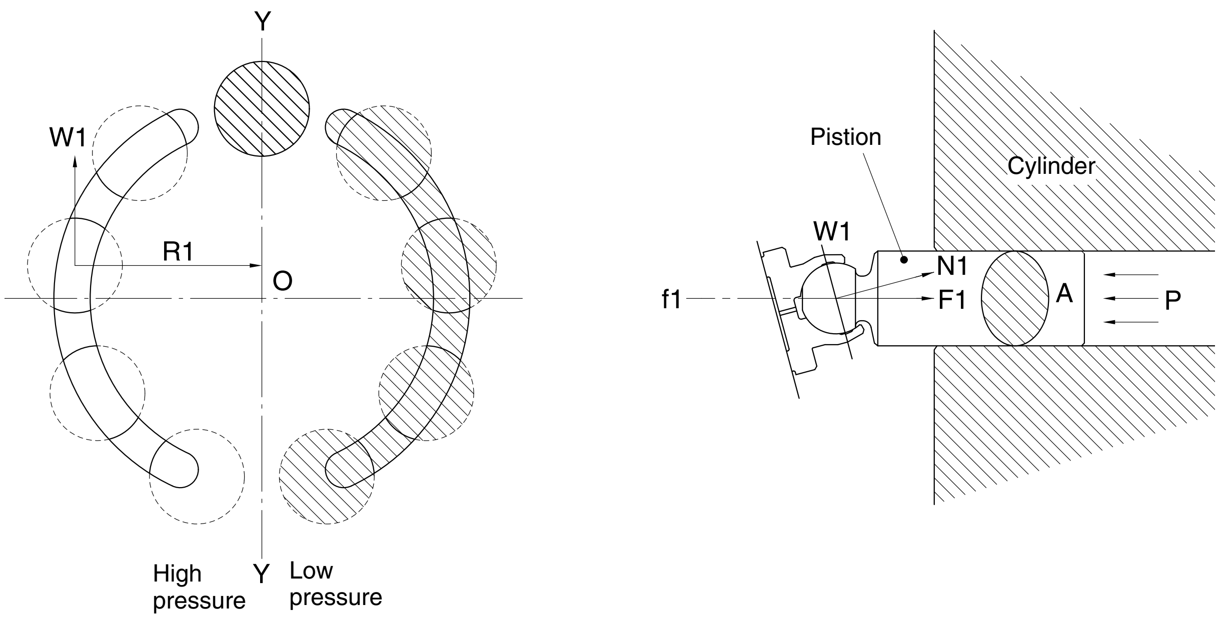
The high hydraulic can generate the force, $F1=P\times A$(P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

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

This torque transfers the turning force to a cylinder(10) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.



21078TM05

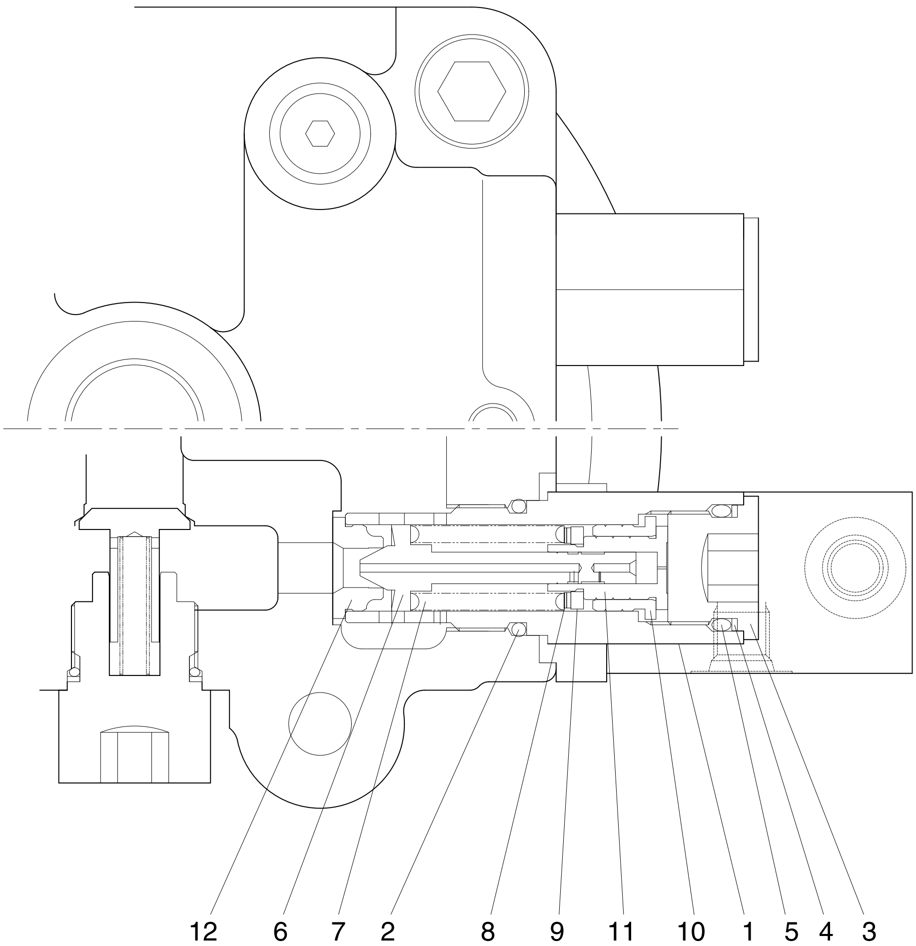
2.2 Working of relief valve

Relief valve carries on two functions of followings

1) It standardizes a pressure in case of driving a hydraulic motor; bypasses an extra oil in a motor inlet related to acceleration of an inertia to an outlet.

2) In case of an inertia stopped, it forces an equipment stopped, according to generating the pressure of a brake on the projected side.

Once high pressure oil supplied to P port, the inside pressure of shock less spool increases.
If the pressure is stronger than the power of the spring, it will be standardized.
In case of driving a hydraulic motor, it standardizes a pressure. And in the event of stopping an inertia, it forces an equipment stopped, according to generating the pressure of break on the projected side.



220072SM10

2.3 Working of parking brake

1) Parking brake OFF

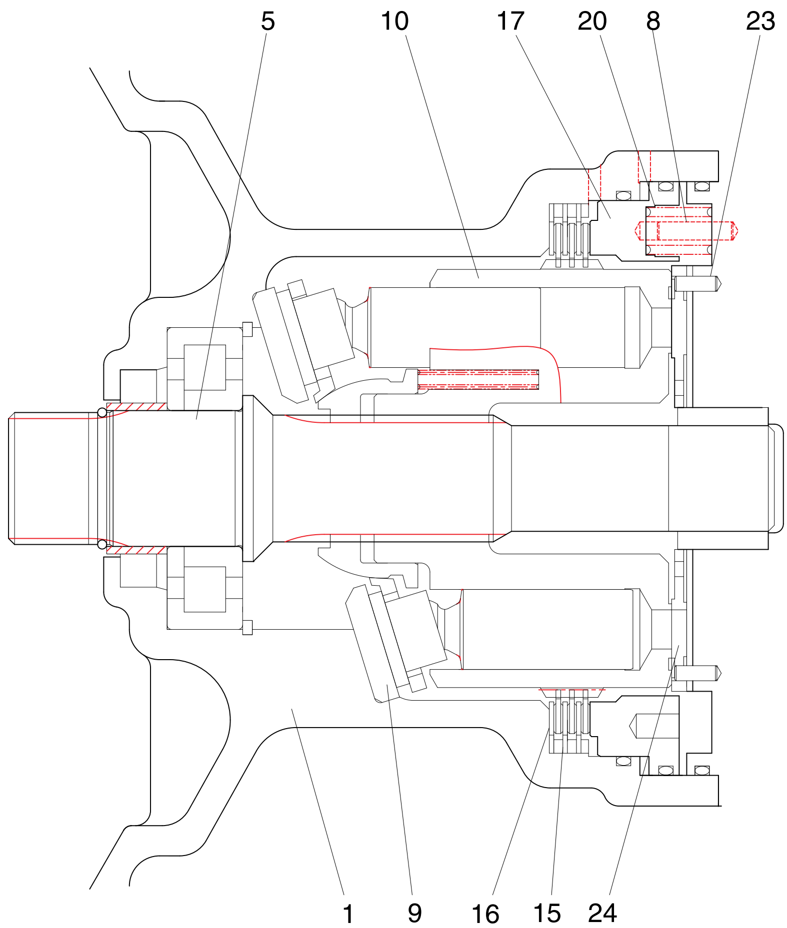
If swing control level sets the swing position, pilot oil will moves swing spool and also it will be supplied to SH port of time delay valve of swing motor through shuttle salve against the power of the spring. The pressure of the spring switches spool to left and moves awaiting PG port oil of delay valve to parking position. After then it moves up parking piston pressing frictional plate to release parking brake.

2) Parking brake ON

If swing control level sets neutrality, swing pilot supplied to SH port of time delay valve through shuttle valve will be stopped.

According to this process, spool is returned by the power of the spring and the pressure of PG port of time delay valve which is always standing by release valve is stopped to parking piston.

In that time, orifice in spool stops leaking out working oil to create 6 second time delay in order to prevent the impact which may be happened at the moment of sudden stop of swing brake.

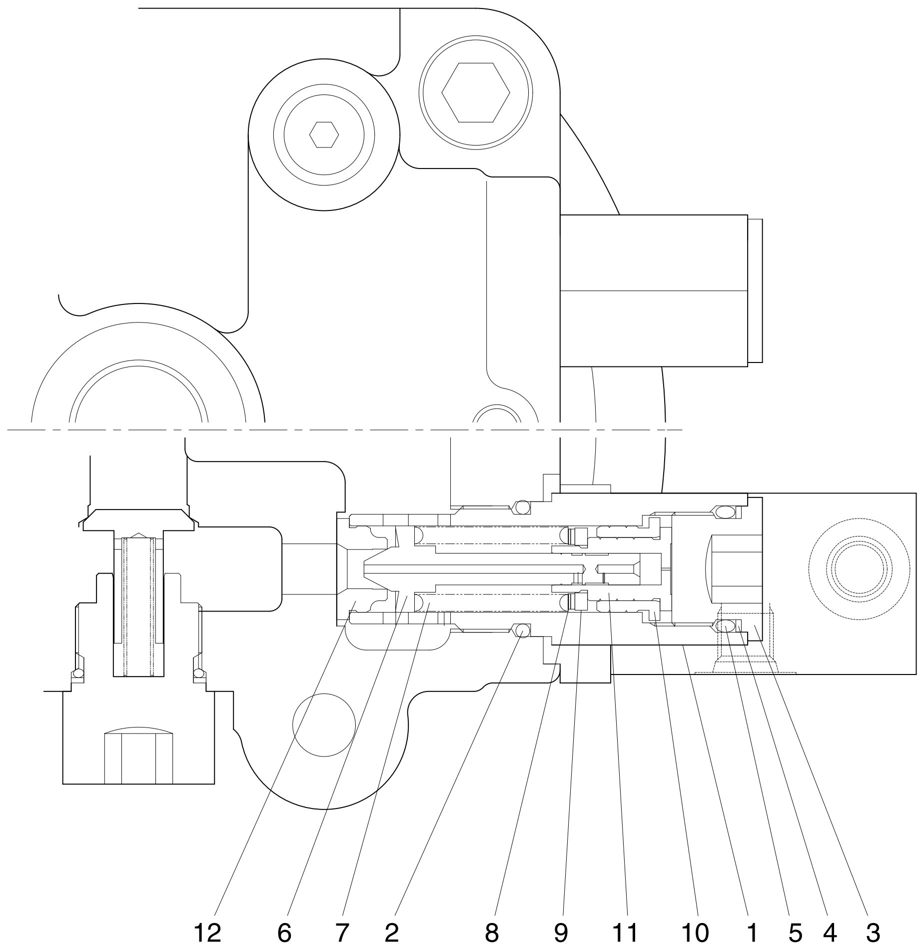


220072SM11

2.4 Make up check valve

In case of rapid rotation which is faster than the amount of supplied oil to swing motor entrance, mounted make up check valve supplies working oil to prevent cavitation according to the shortage of supplying oil.

In the event of sudden stop of the operating excavator, supplying working oil to entrance of swing motor is stopped. However, by means of inertia of rotation, swing motor will be stopped after more rotation. In that time, make up check valve is opened and supplies working oil according to the pressure of hydraulic oil line to the entrance of the motor, which is lower than working oil awaiting in a make up check valve port.



220072SM10

2.5 Working description of plowing switch

The capacity of driving motor is changeable depending on the change of plowing angle of the plate. That is operated by a plowing valve.

1) The pressure of external pilot : when Pi = 0 (large plowing)

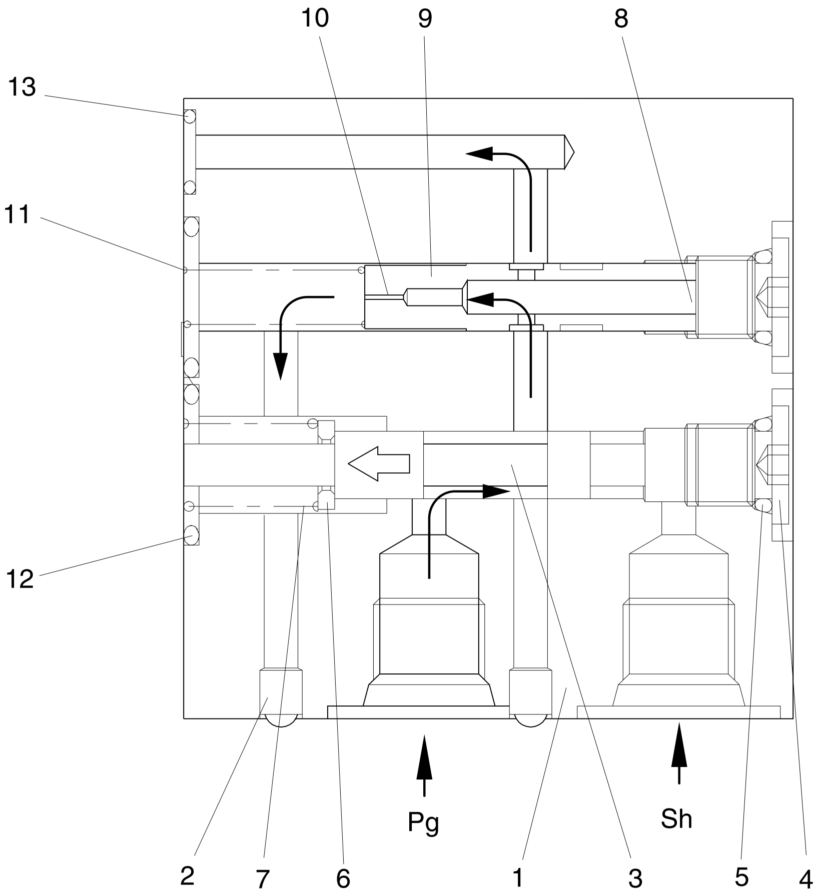
A high pressure oil operated at a motor works on port P of a switching valve, by the highpressure selecting function installed in valve casing.

Spool assembled at the switching part of plowing is adhered to plug by spring.

So the high pressure oil of port P flows to port Sb.

The pressure of this oil can be operated from port Sb to room A, through valve casing and the path A' of shaft casing. An oil in room B flows into a drain line through the path of B → Sa.

Plowing piston moves to the right side because of the high pressure oil; the plate moves to the place adhered to stopper, based on the shaft "0" ; it is fixed.



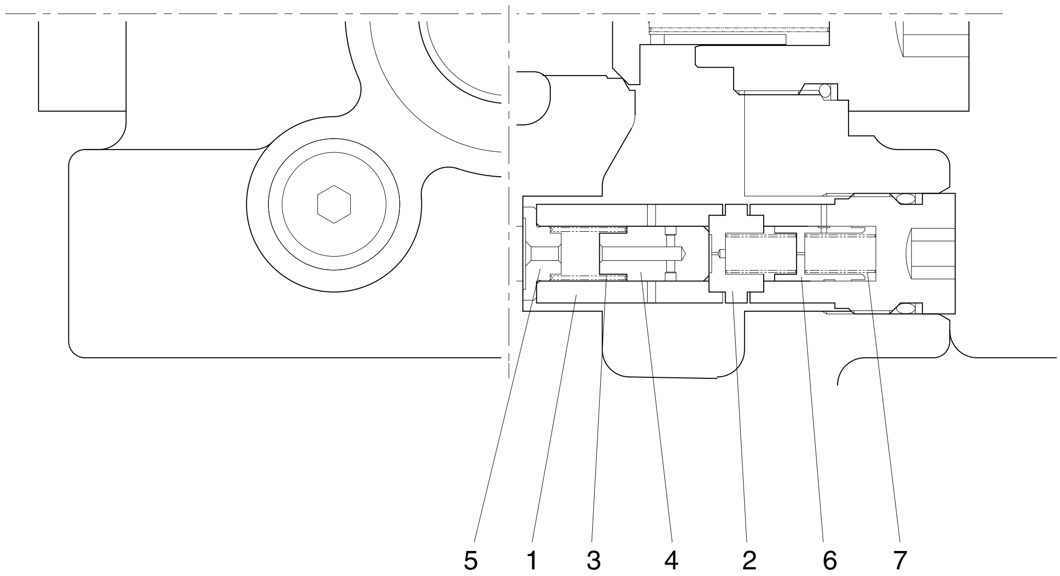
220072SM12

2.6 Working of 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 break 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.



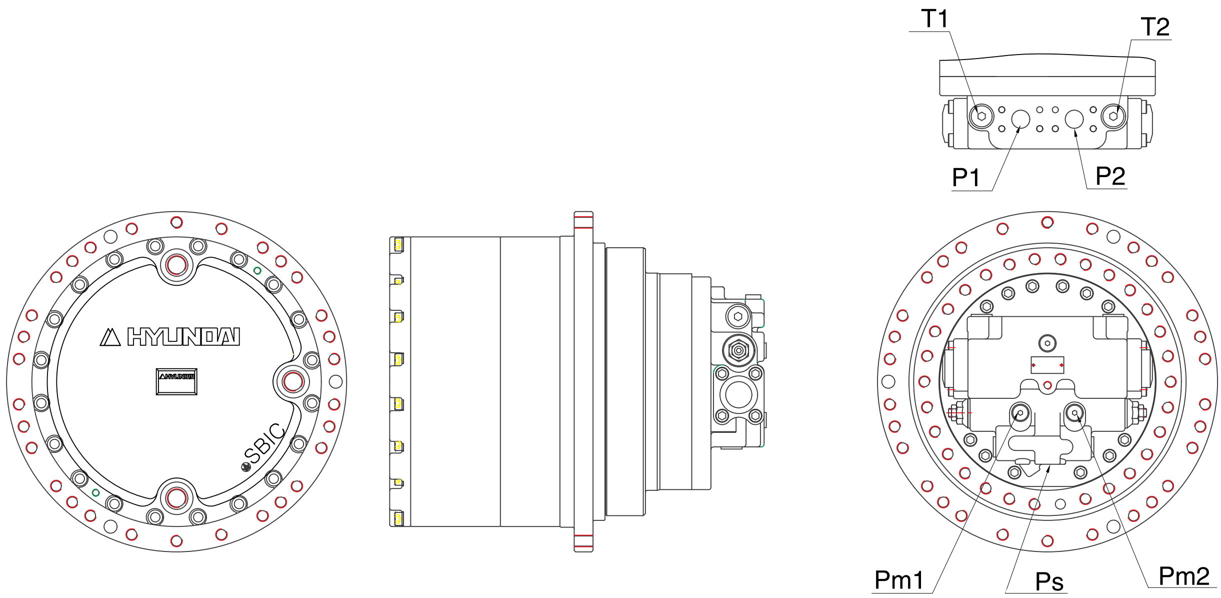
220072SM13

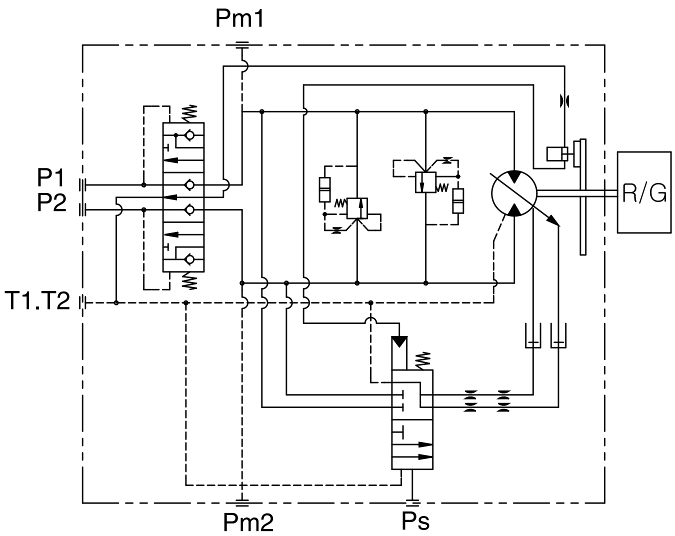
GROUP 4 TRAVEL DEVICE

1. STRUCTURE

A hydraulic motor includes followings.

- Part of rotary generating turning force
- Part of a valve of relief
- Part of Brake
- Part of a valve of counterbalance
- Part of flowing changeover
- Part of auto changeover

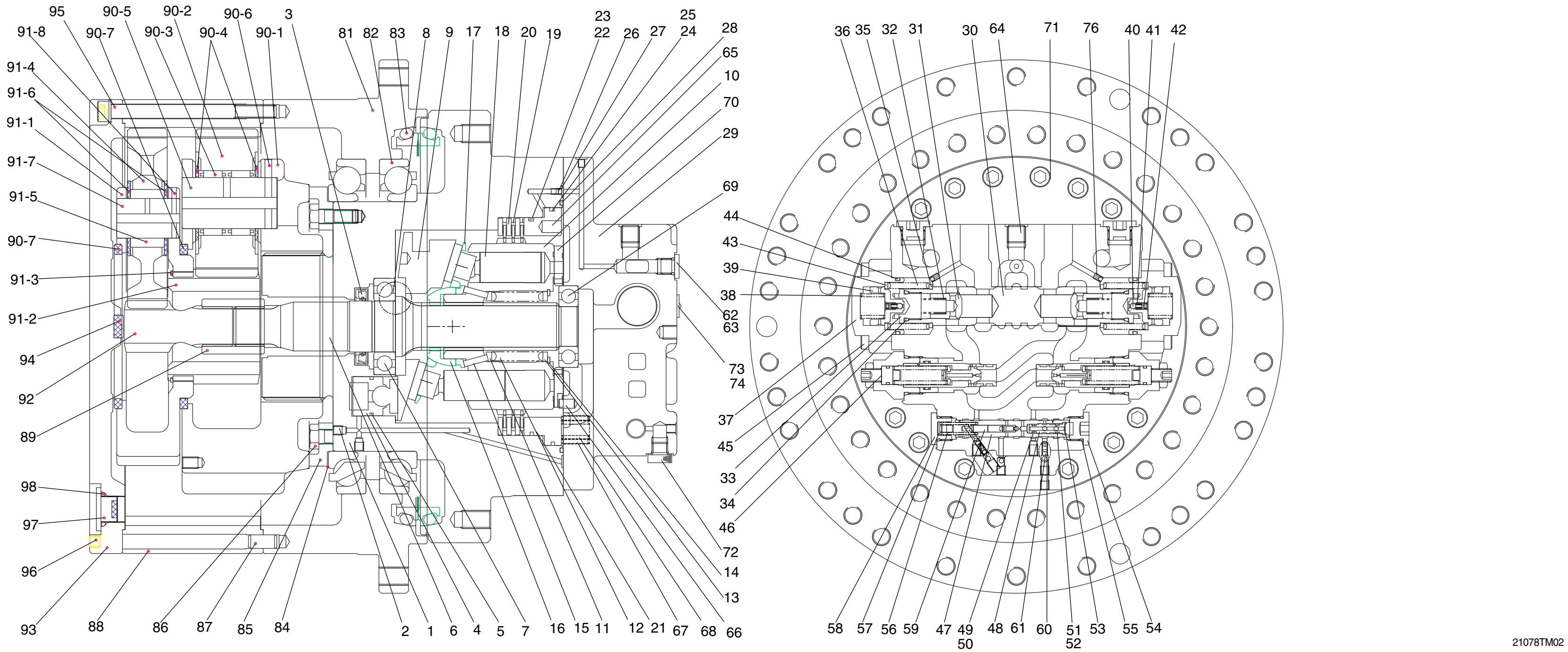




Port	Port name	Port size
P1, P2	Main port	SAE 1"
Pm1, Pm2	Gauge port	PF 1/4
T1, T2	Drain port	PF 1/2
Ps	2 speed control port	PF 1/4

RD21072TM12

2) STRUCTURE



No.	Part name
1	Shaft casing
2	Plug
3	Oil seal
4	Swash piston
5	Piston ring
6	Shaft
7	Bearing
8	Steel ball
9	Swash plate
10	Cylinder block
11	Spring seat
12	Spring
13	End plate
14	Snap ring
15	Pin
16	Ball guide
17	Set plate
18	Piston assy
19	Friction plate
20	Plate
21	Packing piston
22	O-ring
23	Back up ring
24	O-ring
25	Back up ring
26	Orifice
27	O-ring
28	O-ring
29	Rear cover
30	Spool
31	Check
32	Spring
33	Plug
34	O-ring
35	Spring seat
36	Spring
37	Cover
38	Spring
39	Spool
40	Steel ball
41	Spring
42	Plug
43	Spring seat
44	O-ring
45	Wrench bolt
46	Relief valve assy
47	Spool
48	Guide
49	O-ring
50	Back up ring
51	O-ring
52	Back up ring
53	Snap ring
54	plug
55	O-ring
56	Spring
57	Spring seat
58	Plug
59	Spool
60	Orifice
61	Orifice
62	Plug
63	O-ring
64	Plug
65	Pin
66	Pin
67	Spring
68	Spring
69	Bearing
70	Valve plate
71	Wrench bolt
72	Plug
73	Name plate
74	Rivet
75	Seal kit
76	Orifice
81	Housing
82	Main bearing
83	Floating seal
84	Shim
85	Retainer
86	Hex head bolt
87	Parallel pin
88	Ring gear
89	Coupling
90	Carrier assy No.2
90-1	Carrier No.2
90-2	Planetary gear No.2
90-3	Needle bearing No.2
90-4	Thrust washer
90-5	Pin No.2
90-6	Spring pin
90-7	Thrust ring
91	Carrier assy No.1
91-1	Carrier No.1
91-2	Sun-gear No.2
91-3	Retaining ring
91-4	Planetary gear No.1
91-5	Needle bearing No.1
91-6	Thrust washer
91-7	Pin No.1
91-8	Spring pin
92	Sun gear No.1
93	Cover
94	Pad
95	Hex socket head bolt
96	Hex socket Screw
97	Hydraulic plug
98	O-ring
99	Name plate

2. PRINCIPLE OF DRIVING

2.1 Generating the turning force

The high hydraulic supplied from a hydraulic pump flows into a cylinder(10) through valve casing of motor(29), and valve plate(77).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston(18).

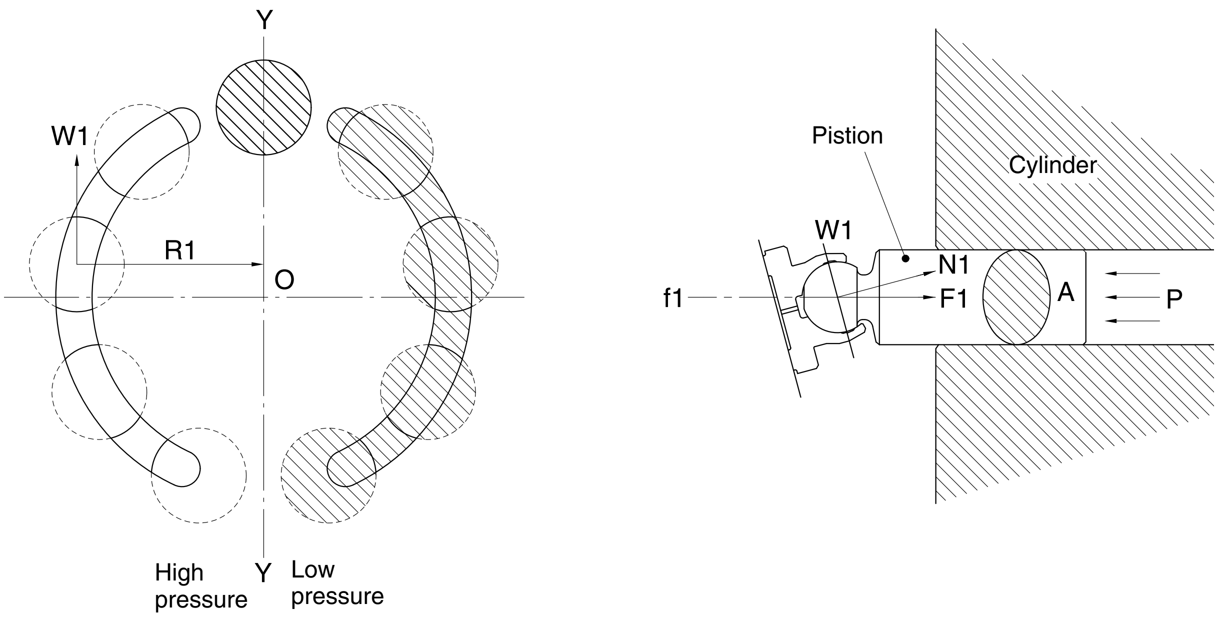
The high hydraulic can generate the force, F1 = P $\times$ A(P : Supplied pressure, A : water pressure area), like following pictures, working on a piston.

This force, F1, is divided as N1 thrust partial pressure and W1 radial partial pressure, in case of the plate(09) of a tilt angle, α.

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

The sum of torque(ΣW1 $\times$ R1), generated from each piston(4~5pieces) on the side of a high hydraulic, generates the turning force.

This torque transfers the turning force to a cylinder(10) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.

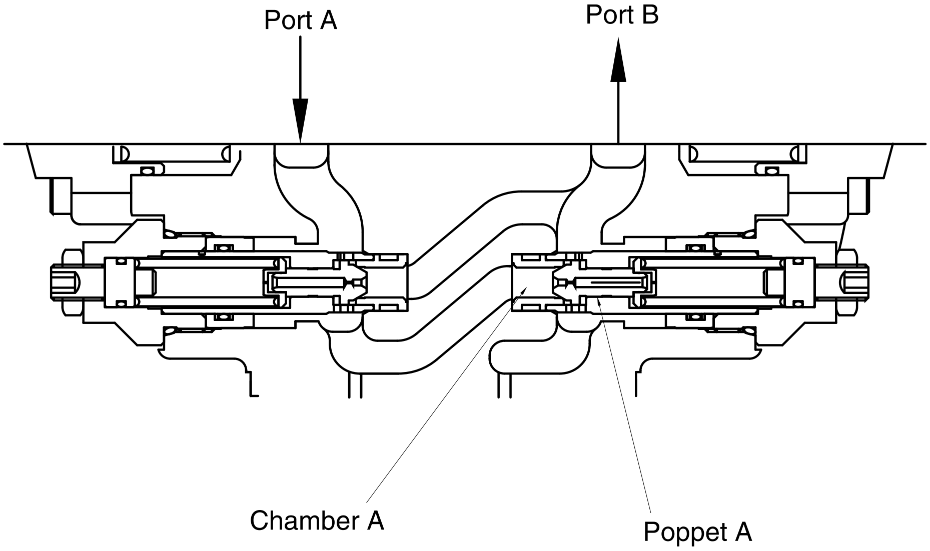


21078TM05

2.2 Working of relief valve

Relief valve carries on two functions of followings.

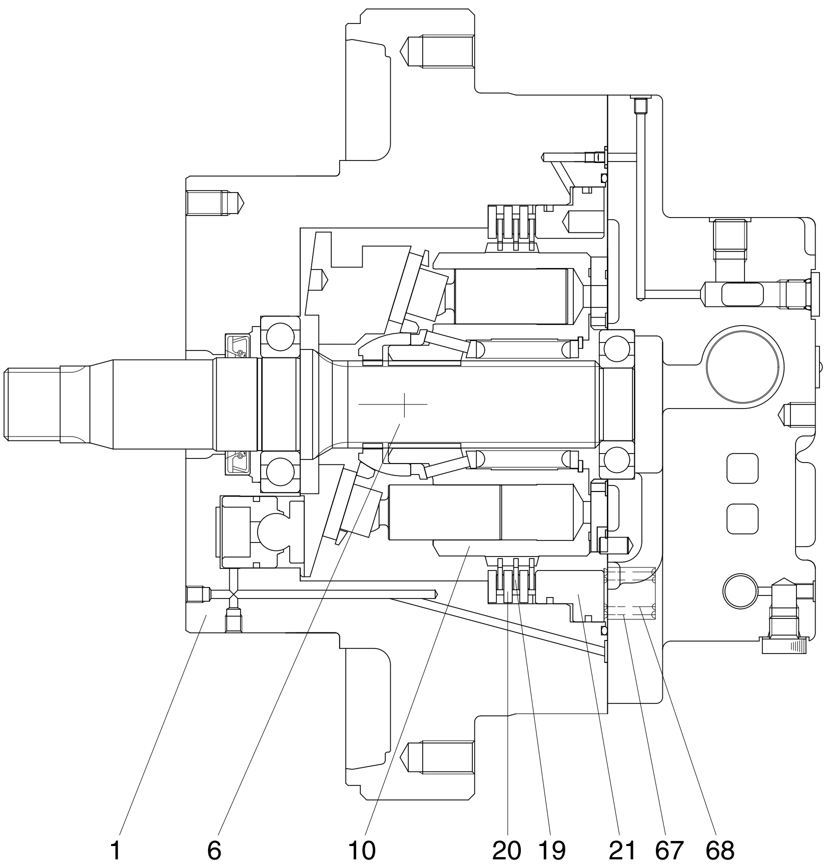
1) It standardizes a pressure in case of driving a hydraulic motor ; bypasses and extra oil in a motor inlet related to acceleration of an inertia to an outlet.
2) In case of an inertia stopped, it forces an equipment stopped, according to generating the pressure of a brake on the projected side.
   Room A is always connected with port A of a motor. If the pressure of port is increased, press poppet A. And if it is higher than the setting pressure of a spring, the oil of an hydraulic flows from room A to port B, because poppet A is detached from the contact surface of seat A.



21078TM06

2.3 Working of negative brake

When the operating pressure is supplied to the brake piston (21) through the spool (simultaneous peripheral operation online) built in the valve casing (29), the negative brake is released.
When the pressure does not work, the brake always runs.
The force of a brake is generated by the frictional force among a separate plate (20) fixed by shaft casing, parking piston (21) and a frictional plate (19) connected through spline outside a cylinder block (10).
When a pressure does not work on the part of piston, brake spring presses brake piston; oil in a brake room flows into the drain of a motor through an orifice; in that time, brake piston compresses a frictional plate and a detached plate in the middle of shaft casing and brake piston according to the force that presses 10 pieces of brake springs (68, 67); finally, it makes a frictional force.
This frictional force helps the brake fixing a turning shaft (6) connected by a cylinder and spline operated.

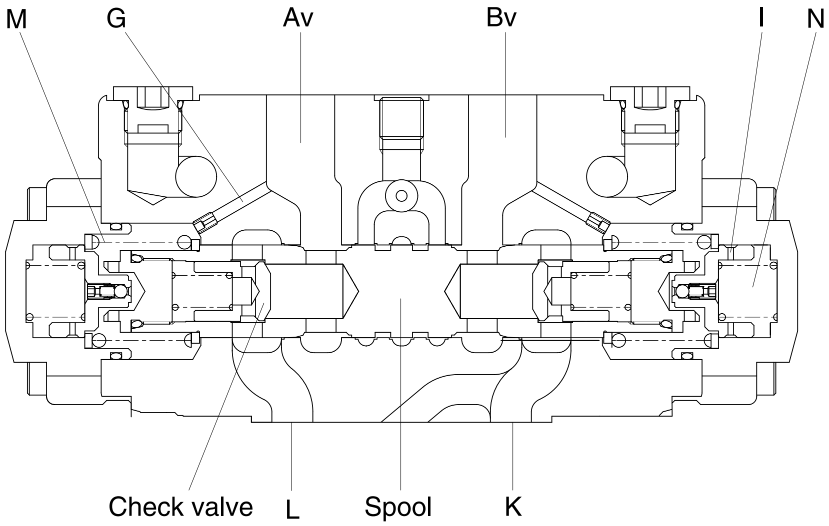


21092TM07

2.4 Counterbalance valve

Av port is connected to a hydraulic pump; Bv port is connected to a tank.

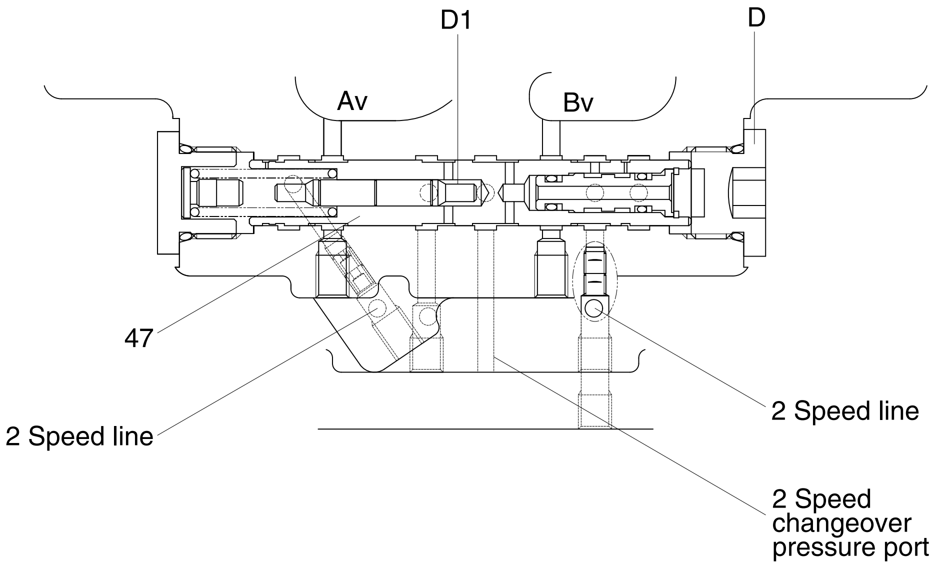
An oil supplied from a hydraulic pump presses check valve and flows into L port. It makes a hydraulic motor circulated. The oil pressure out of a pump is increased and transferred to spring room M through the path G because negative brake is working on. When the pressure of room M exceeds the force of spring that keeps spool at its neutral position, the spool begins to move the right side.
An oil in room N is sent to room M by orifice I and discharged from G line to a tank.
Then the spool moves to the right and the oil flows from K to Bv.



21078TM08

2.5 Working description of automatic switch(at normal speed)

Due to no pressure on pilot now, spool(47) is not working.

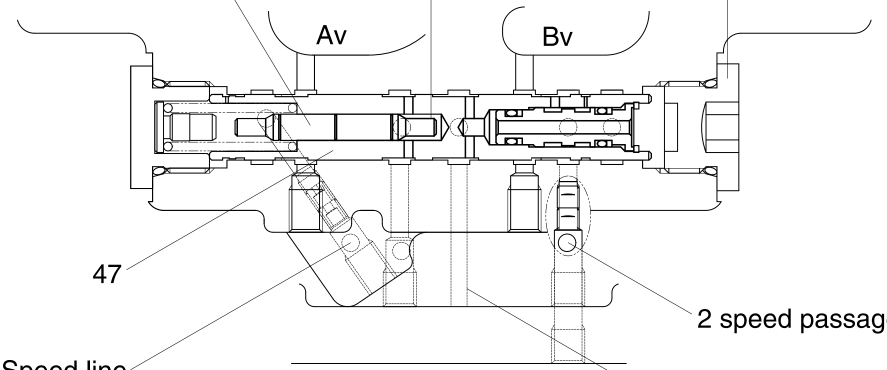


(Normal Speed)

21078TM09

2.6 Working description of automatic switch(at high speed)

At normal speed, once the hydraulic oil which is through the inner path of spool(47) flows into high speed switching pressure port(The pressure of external pilot : Pi = 35kgf/cm^2) spool(47) moves from right to left.
At high speed, turning pressure of motor(D1) is over 250kgf/cm^2, when the power forcing to spool(59) (Pressure, P1) is stronger than spool(47) and spool(59) is pushed out, after then spool(47) moves from left to right. So it is switched.



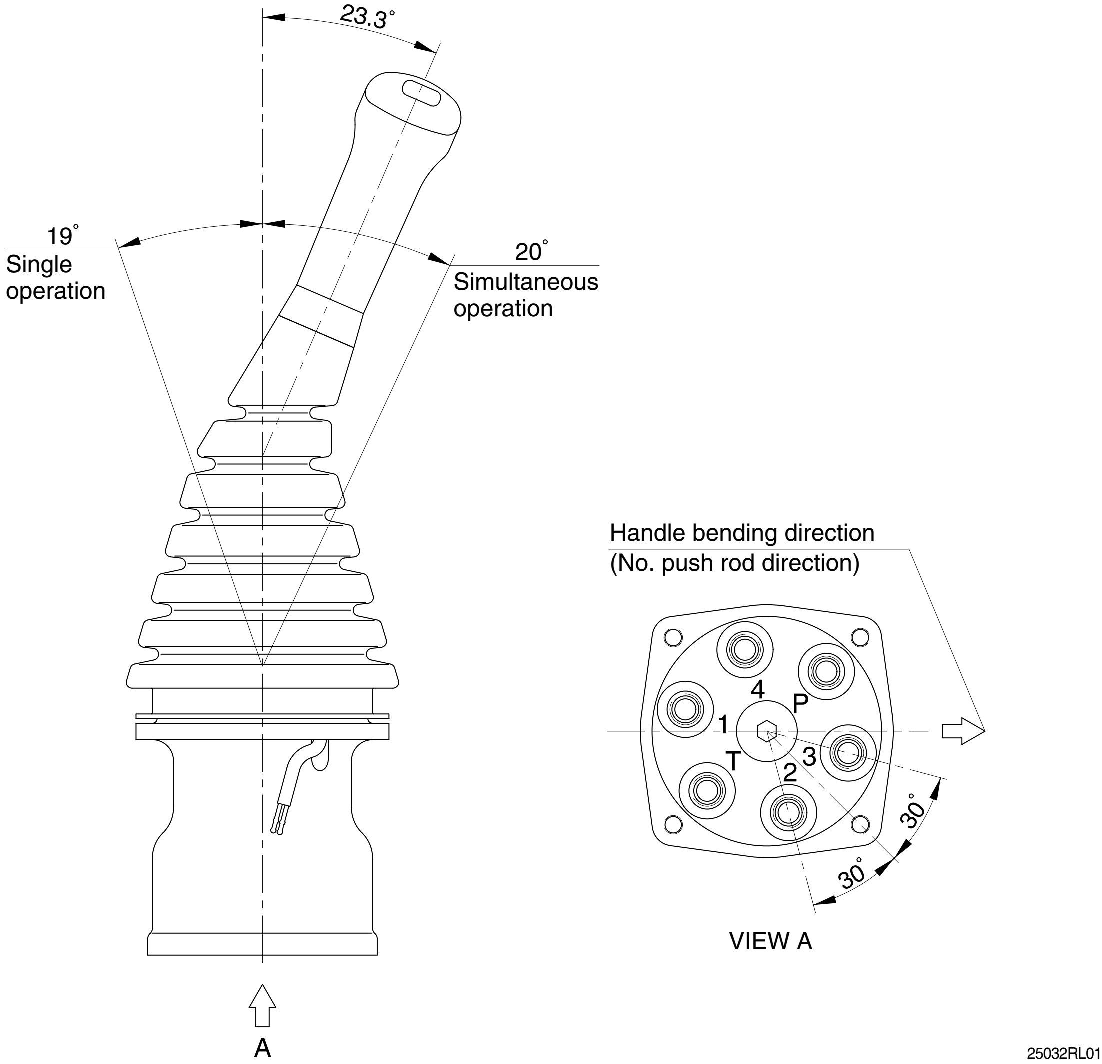
(High Speed)

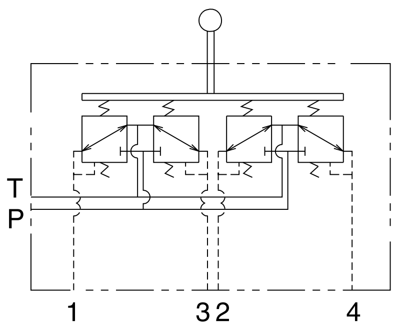
21078TM10

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.





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

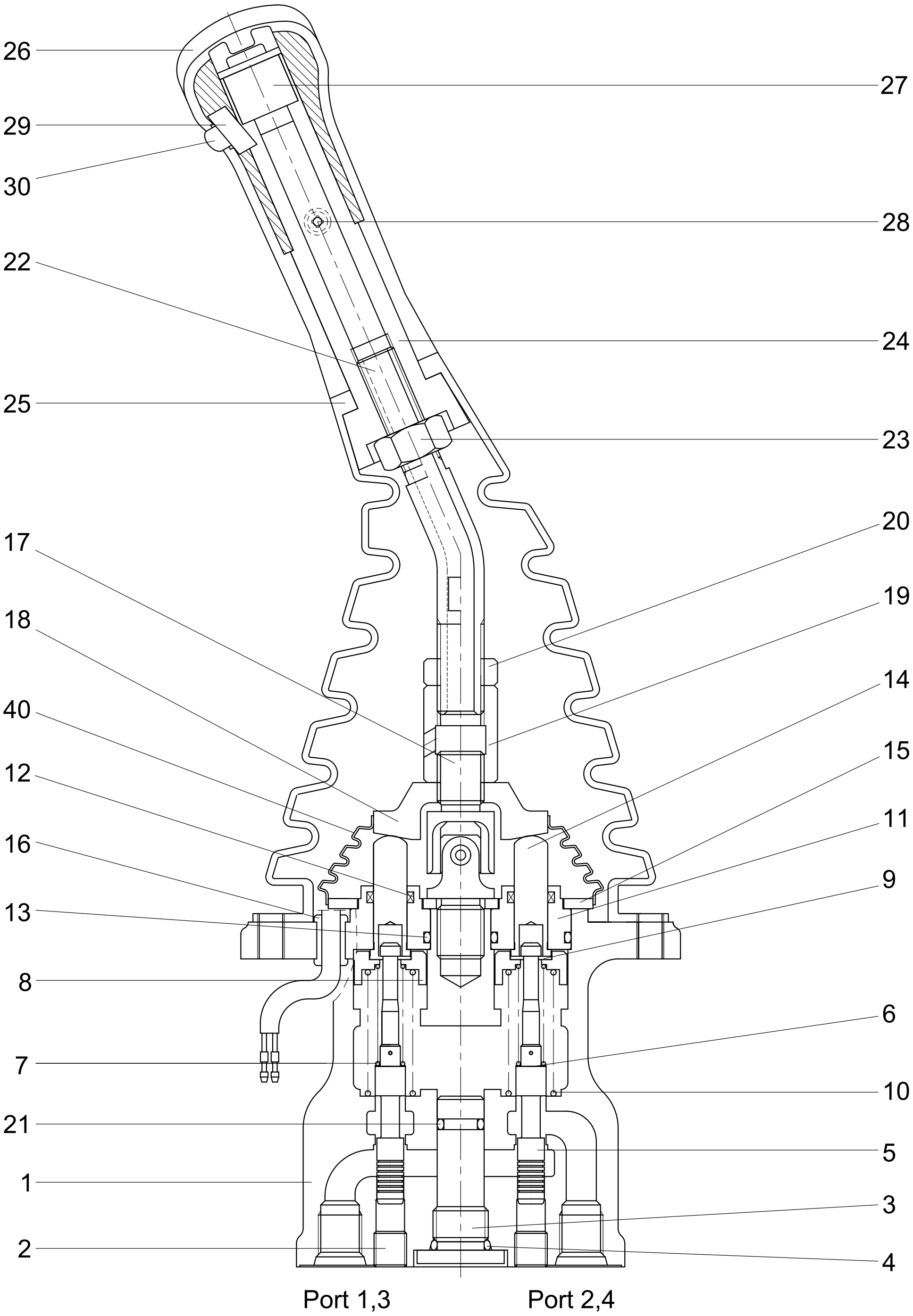
The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

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

CROSS SECTION



14072SF80

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.

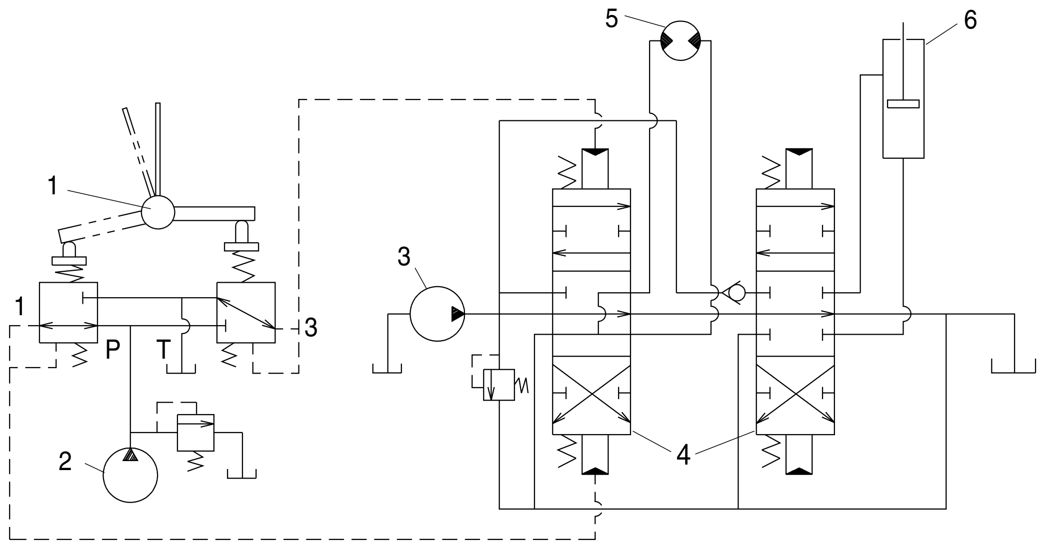
The spring(10) works on the case(1) and spring seat(8) and tries to return the push rod(14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

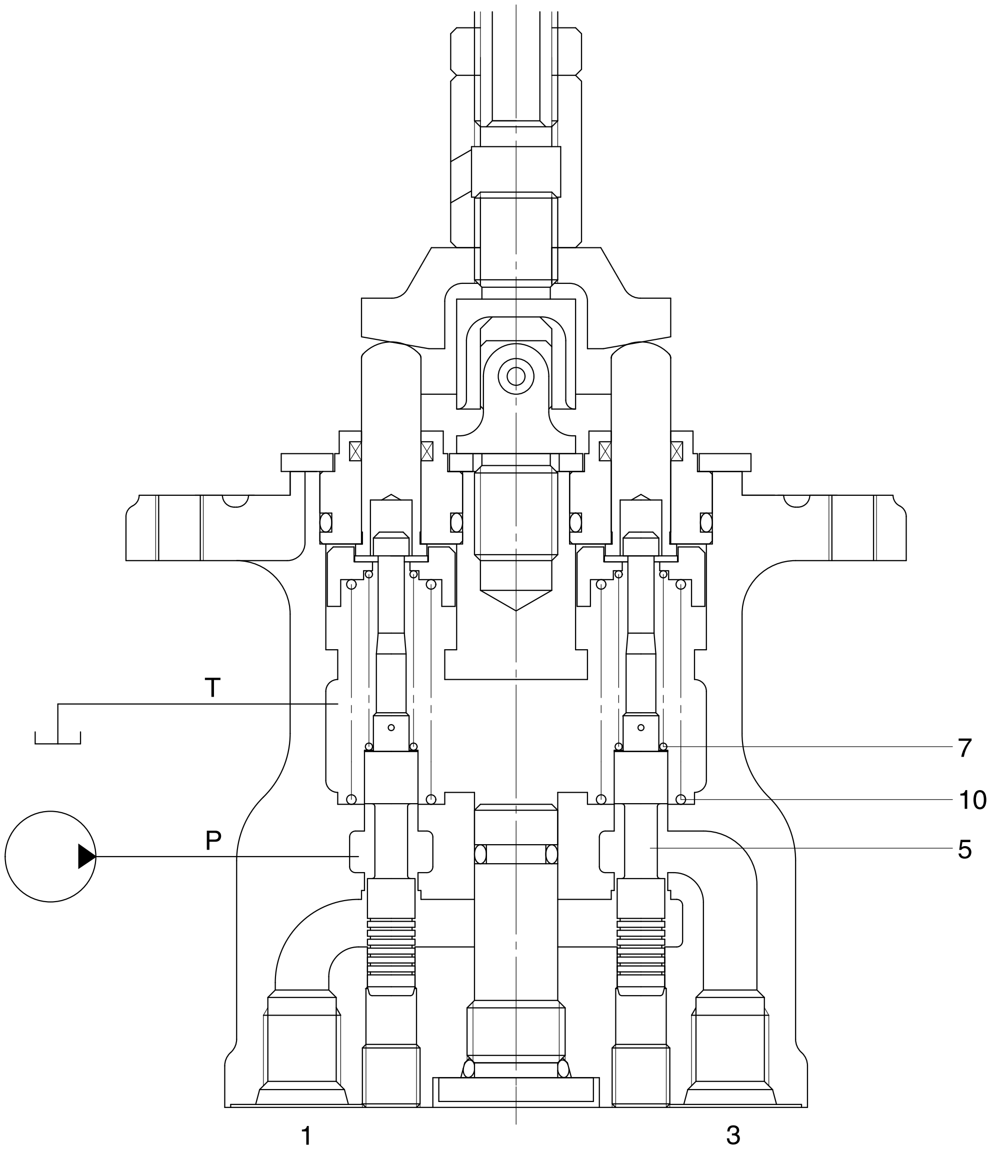
The diagram shown below is the typical application example of the pilot valve.



2-70

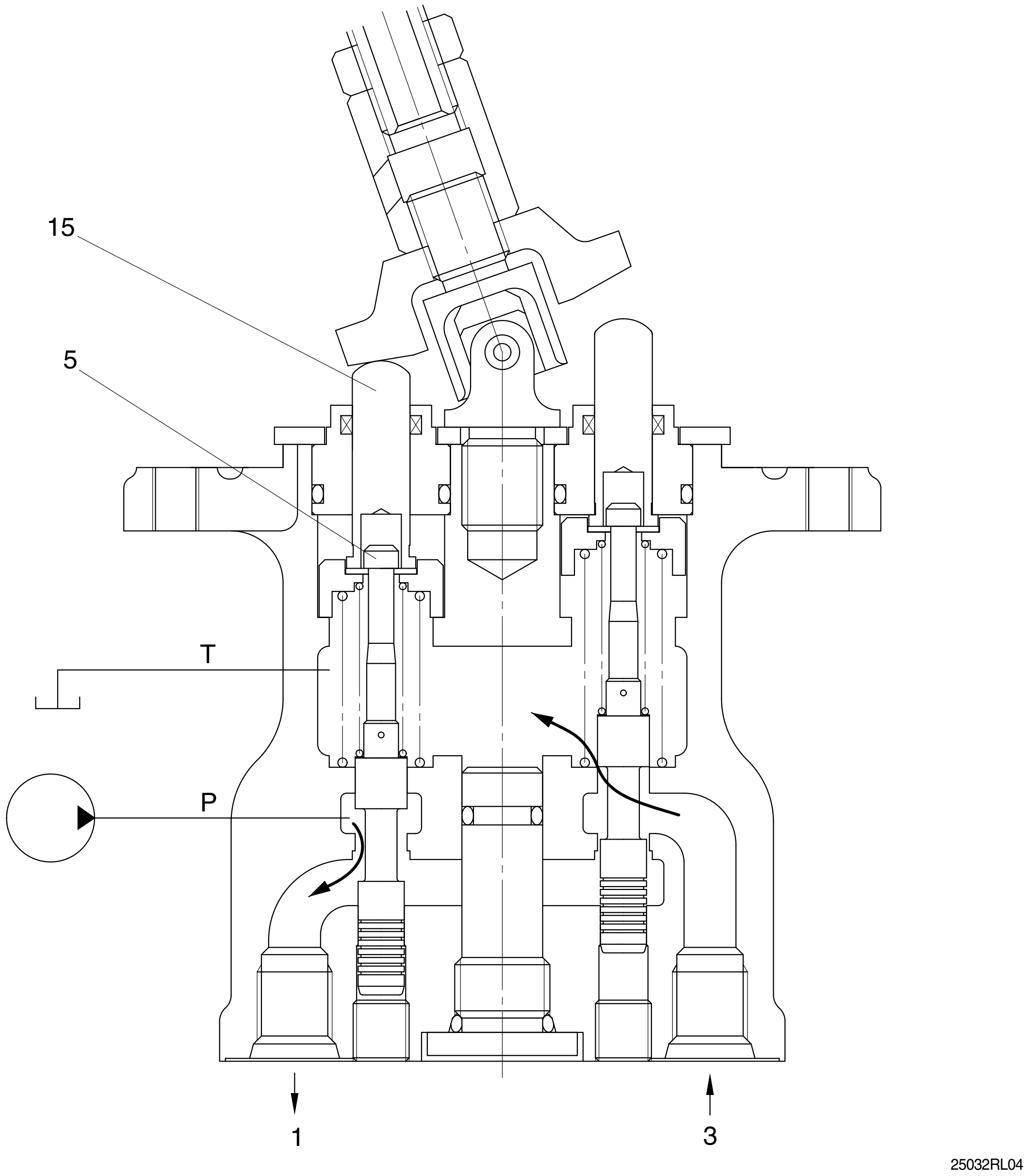
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(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

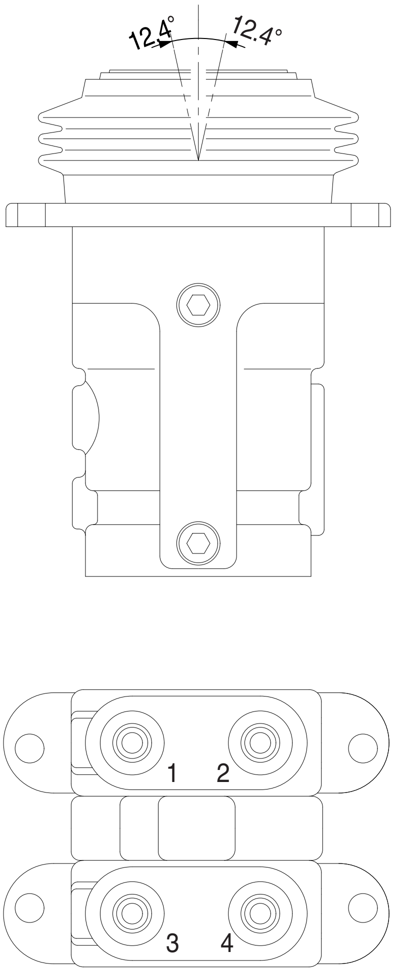


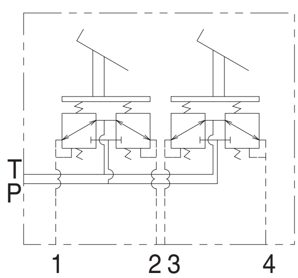
When the push rod(14) is stroked, the spool(5) moves downwards.
Then port P is connected with port(1) and the oil supplied from the pilot pump flows through port(1) to generate the pressure.
When the pressure at port(1) increases to the value corresponding to the spring force set by tilting the handle,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

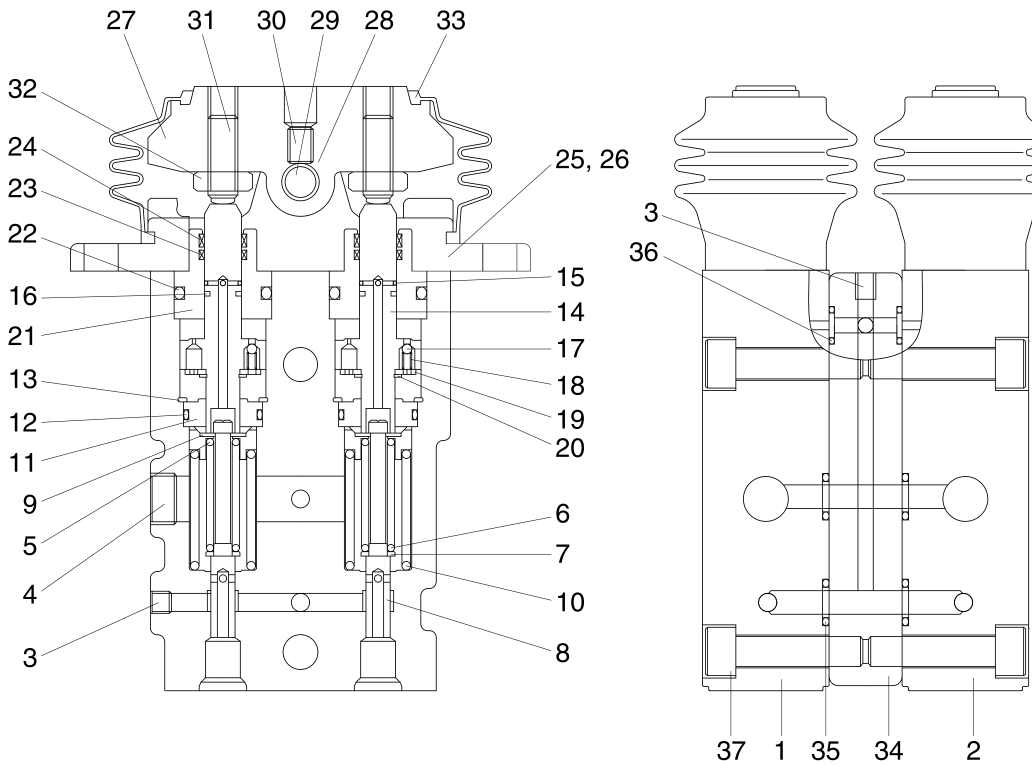
14072SF73

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 19kgf/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.



14072SF70

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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

The pilot valve is a valve controls the spool stroke, direction, etc of a main control valve. This function is carried out by providing the spring at one end of the main control valve spool and applying the output pressure(Secondary pressure) of the pilot valve to the other end.
For this function to be carried out satisfactorily, the pilot valve is composed of the following elements.

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

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

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

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

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

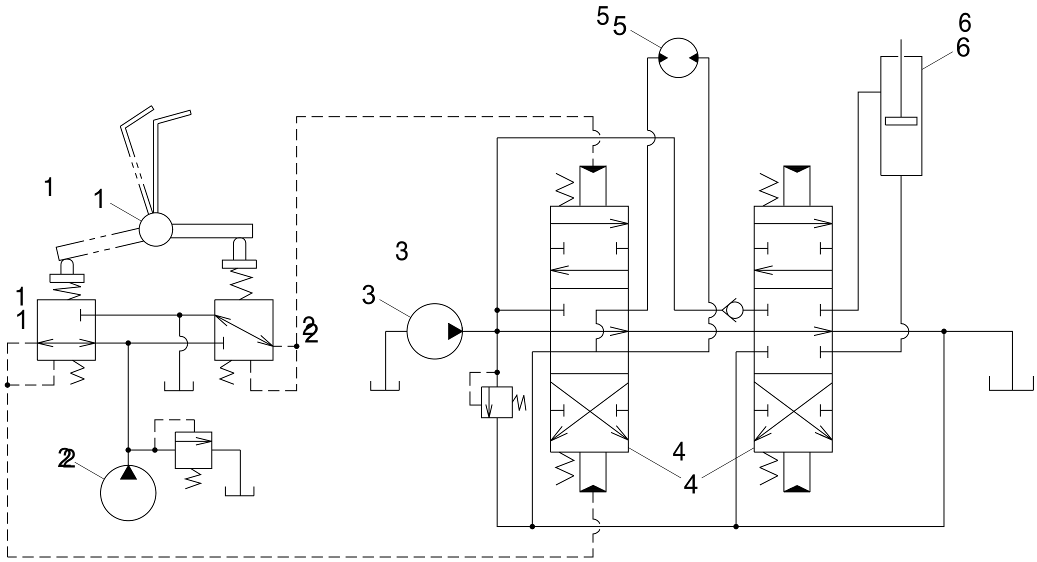
2) FUNCTIONS OF MAJOR SECTIONS

The functions of the spool(8) are to receive the supply oil pressure from the hydraulic pump at its port P, and to change over oil paths to determine whether the pressure oil of port P is led to output ports 1, 2, 3 & 4 or the output spool to determine the output pressure.
The spring(6) works on this spool to determine the output pressure.
The change the deflection of this spring, the push rod(14) is inserted and can slide in the plug(21).
For the purpose of changing th displacement of the push rod through the cam(27) and adjusting nut(32) are provided the pedal that can be tilted in any direction around the fulcrum of the cam(27) center.
The spring(10) works on the casing(1) and spring seat(7) and tries to return the push rod(14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.
This also has the effect of a reaction spring to give appropriate control feeling to the operator.

3) OPERATION

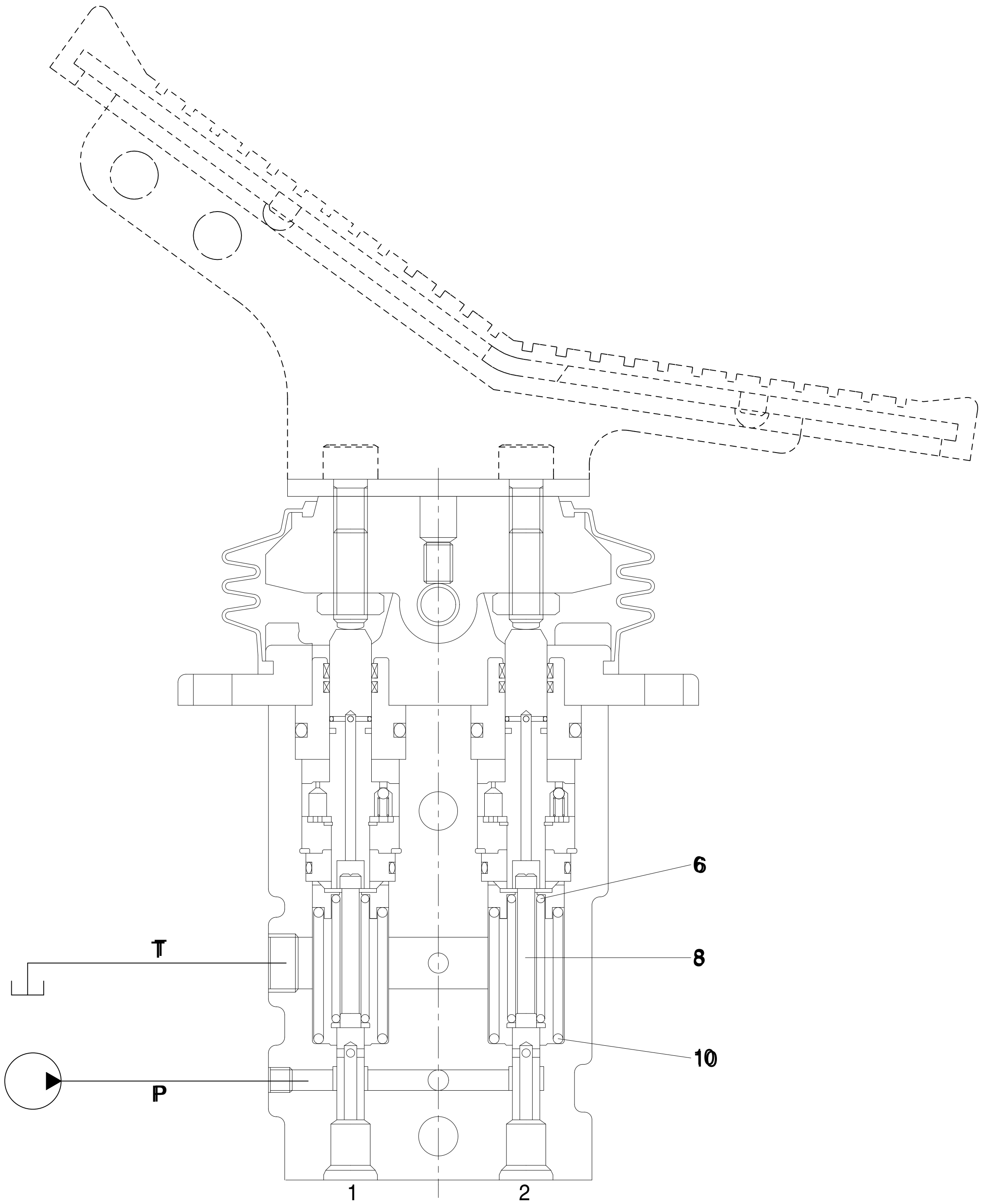
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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



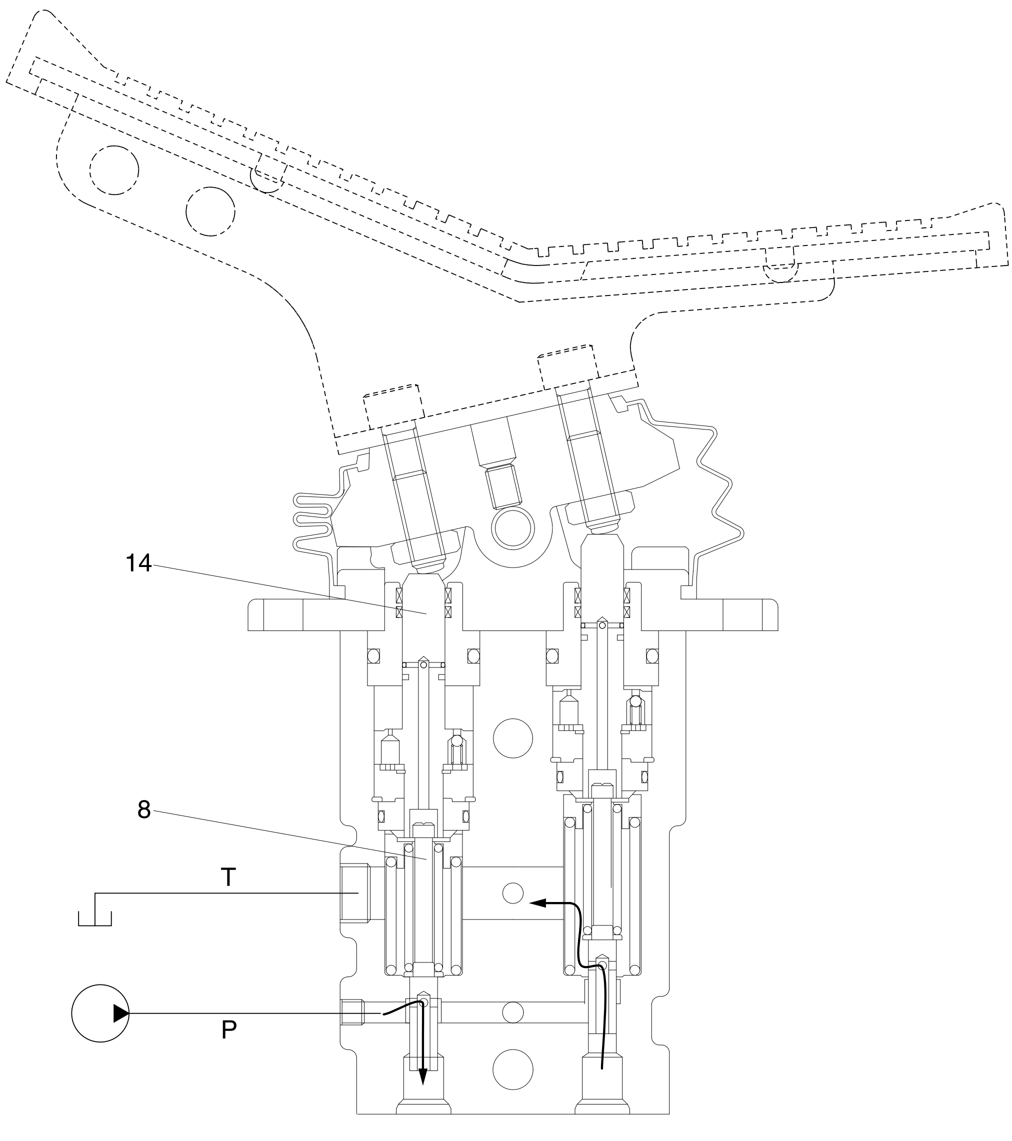
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



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

(2) Case where pedal is tilted

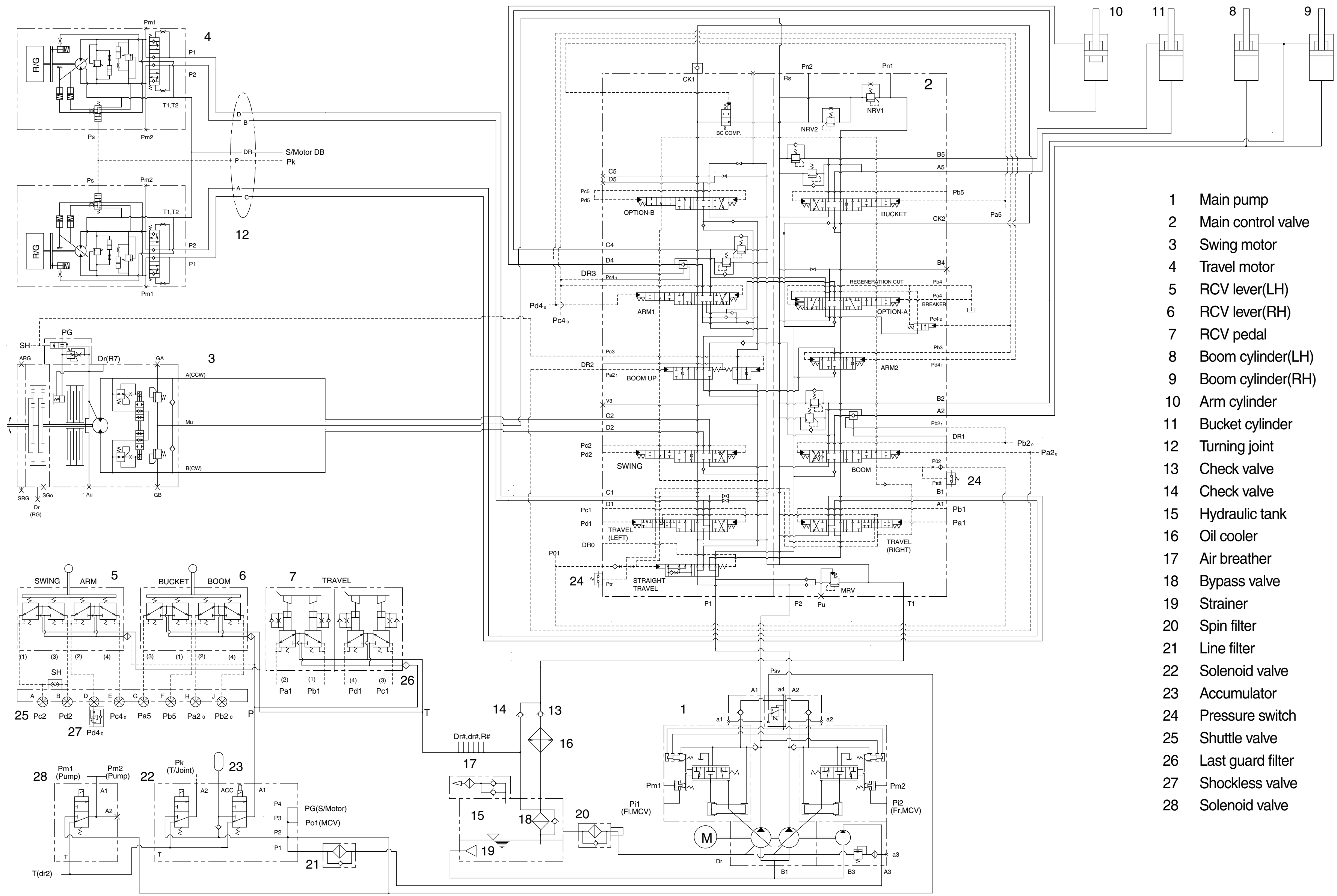


14072SF75

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



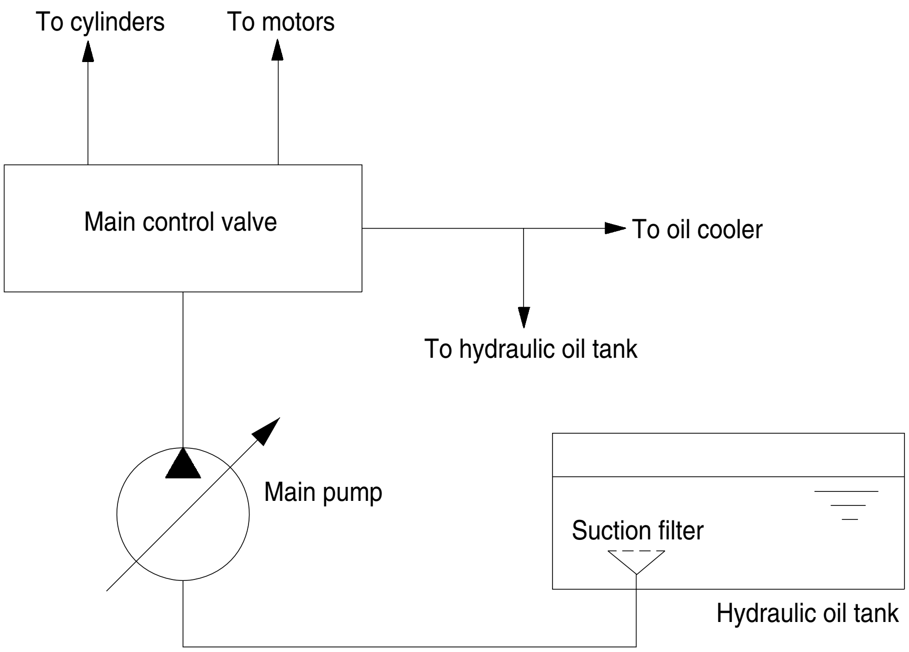
1 Main pump
2 Main control valve
3 Swing motor
4 Travel motor
5 RCV lever(LH)
6 RCV lever(RH)
7 RCV pedal
8 Boom cylinder(LH)
9 Boom cylinder(RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve
19 Strainer
20 Spin filter
21 Line filter
22 Solenoid valve
23 Accumulator
24 Pressure switch
25 Shuttle valve
26 Last guard filter
27 Shockless valve
28 Solenoid valve

D21073HS01

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.

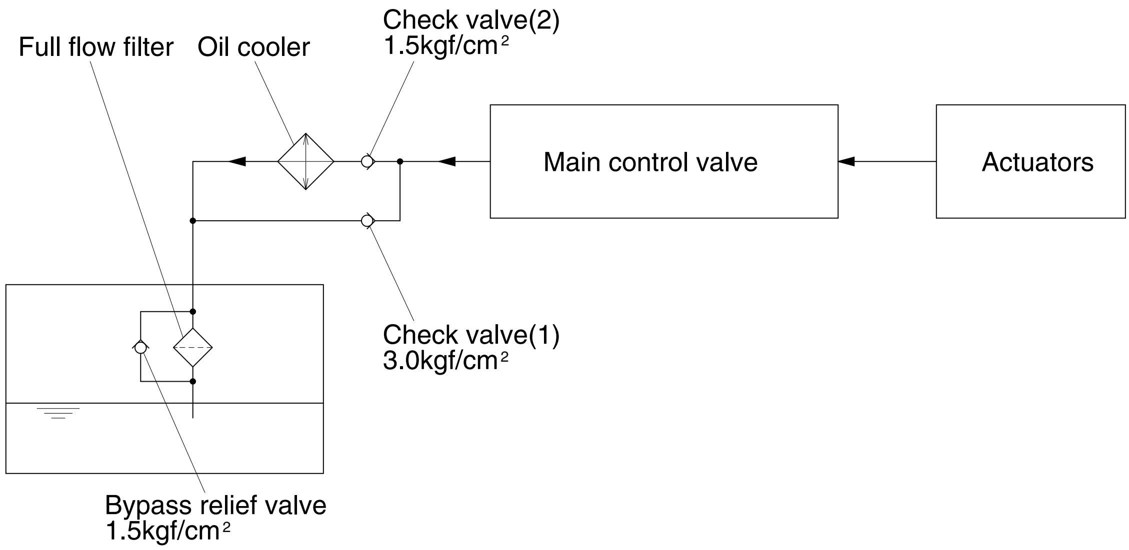
1. SUCTION AND DELIVERY CIRCUIT



(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 control valve.
The control valve controls the hydraulic functions.
The return oil from the actuators flows to the hydraulic tank through the control valve and the oil cooler.

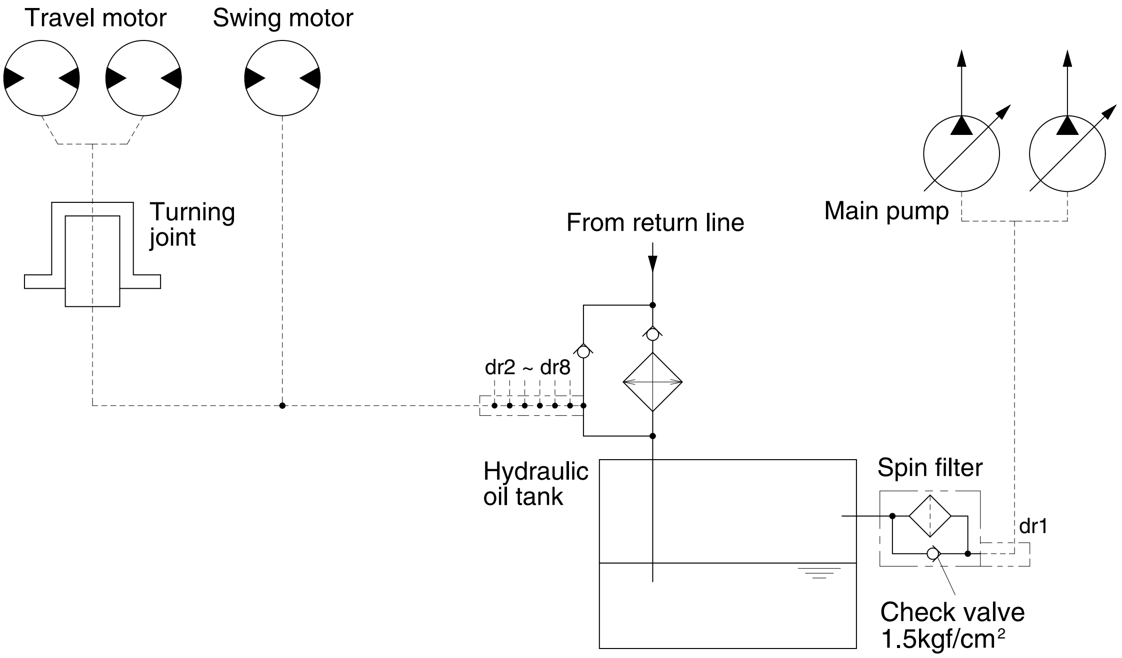
2. RETURN CIRCUIT



21073CI01

All oil returned from each actuator returns to the hydraulic tank through the control valve.
The bypass check valves are provided in the return circuit.
The setting pressure of bypass check valves are 1.5kgf/cm²(21psi) and 3.0kgf/cm²(43psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.
When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. When the oil pressure exceeds 3.0kgf/cm²(43psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve(1).
The full-flow filter and bypass relief valve are provided in the hydraulic tank.
The oil 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 1.5kgf/cm²(21psi) differential pressure.

3. DRAIN CIRCUIT



21073CI02

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 spin filter.
When the drain oil pressure exceed 1.5kgf/cm^2(21psi), 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 spin filter.

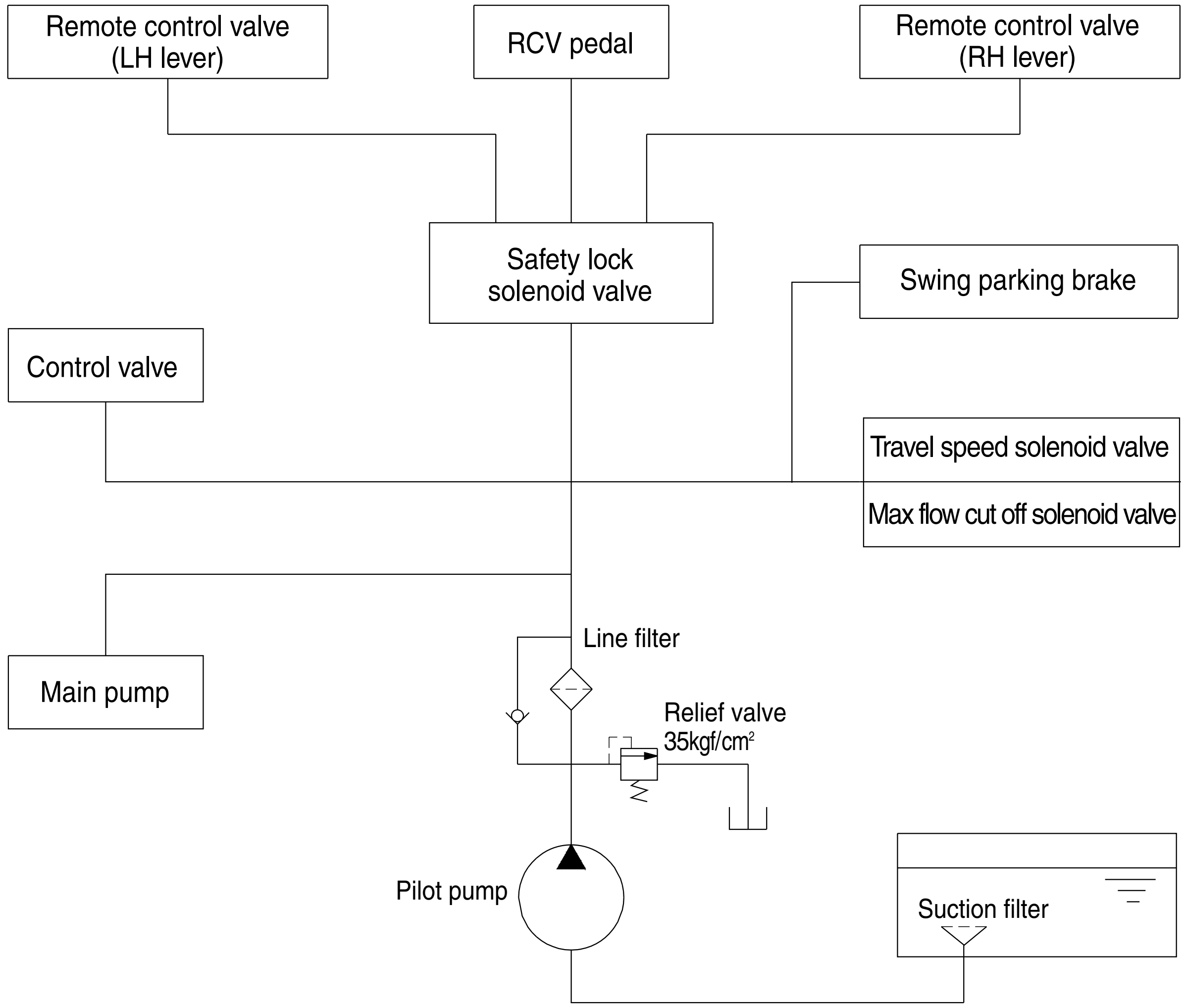
2) SWING MOTOR DRAIN CIRCUIT

Oil leaked from the swing motor returns to the hydraulic tank passing through a spin filter with oil drained from the travel circuit .

3) MAIN PUMP DRAIN CIRCUIT

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

GROUP 3 PILOT CIRCUIT



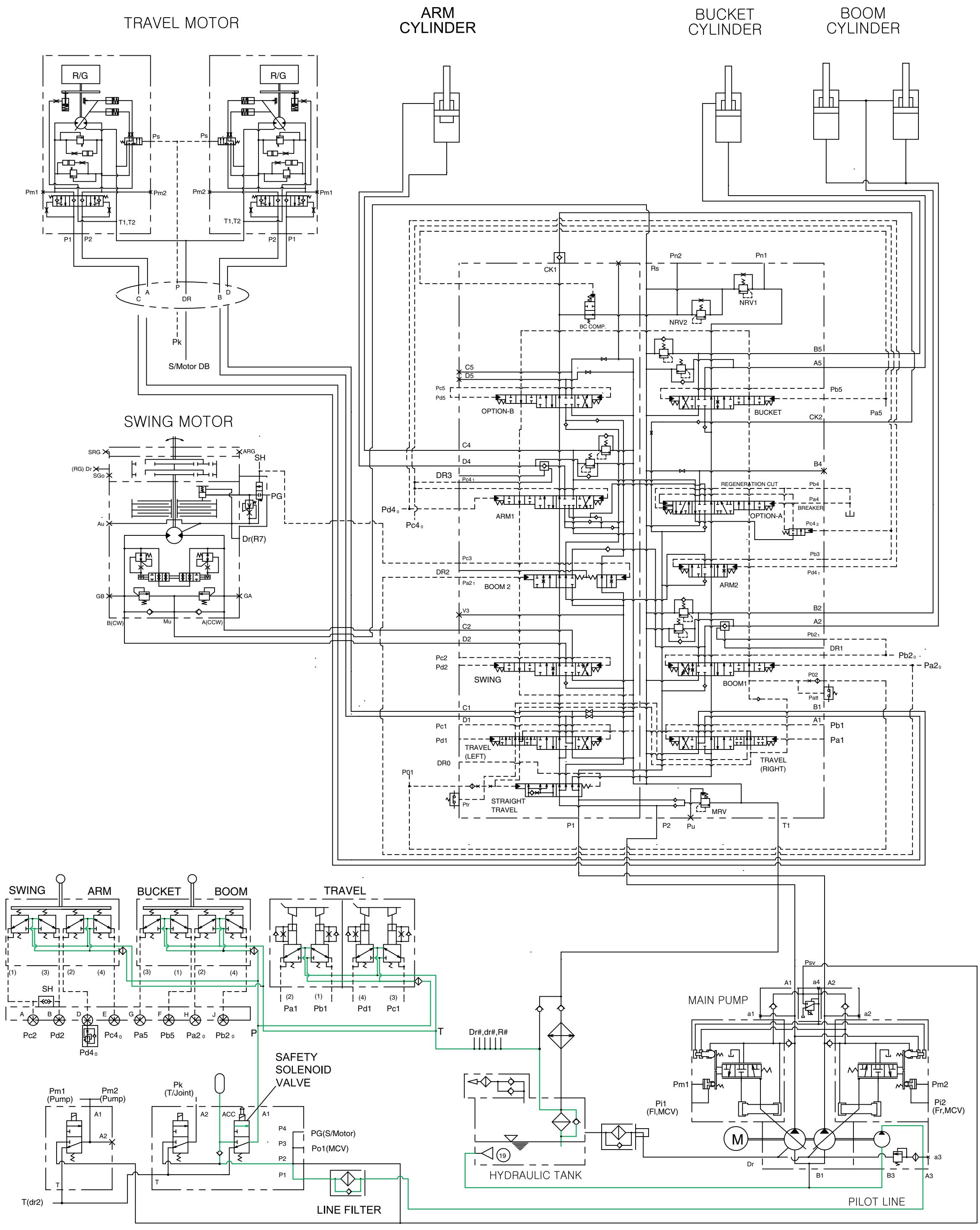
D21073CI05

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



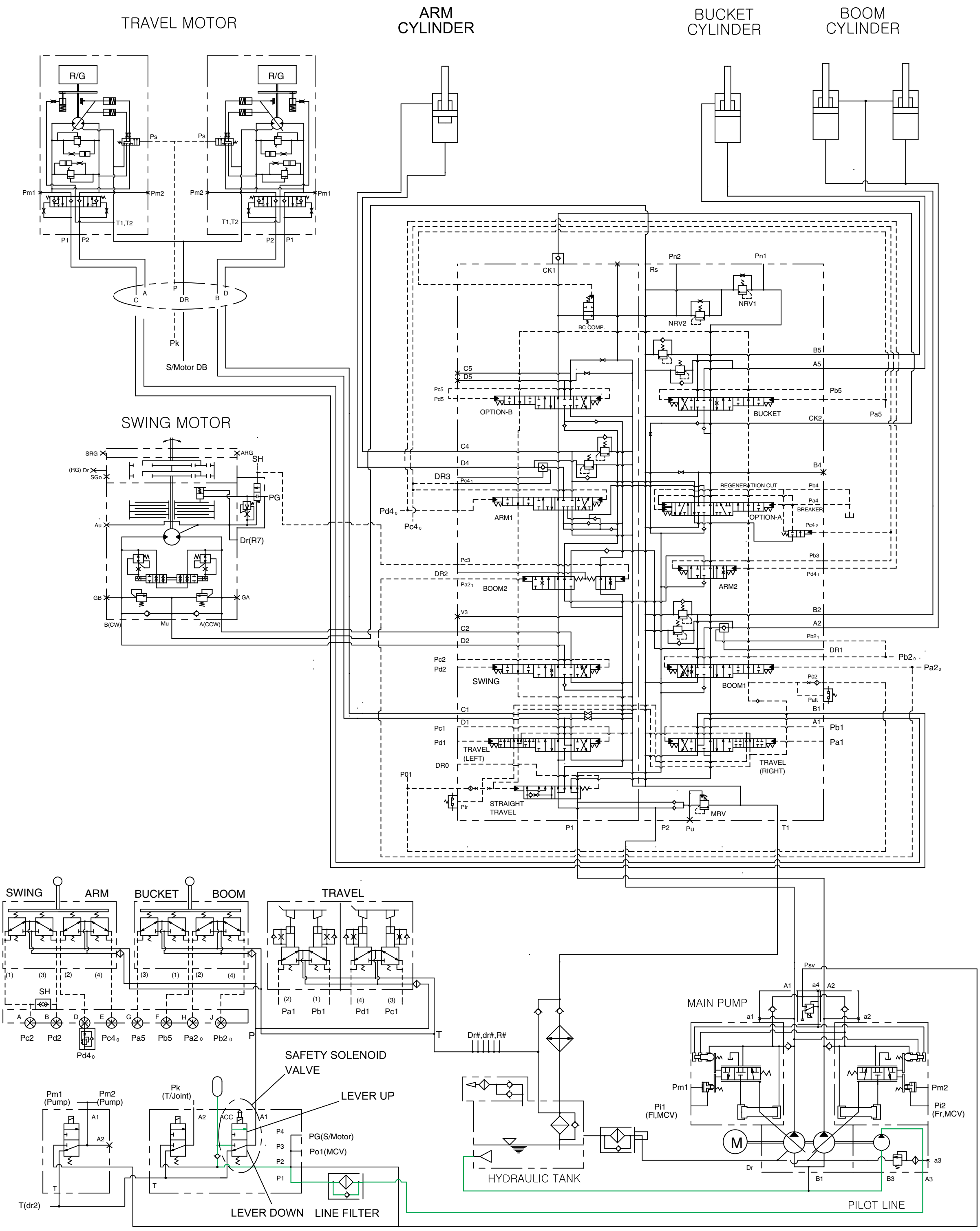
D21073HS02

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 into the hydraulic tank.

2. SAFETY VALVE(SAFETY LEVER)

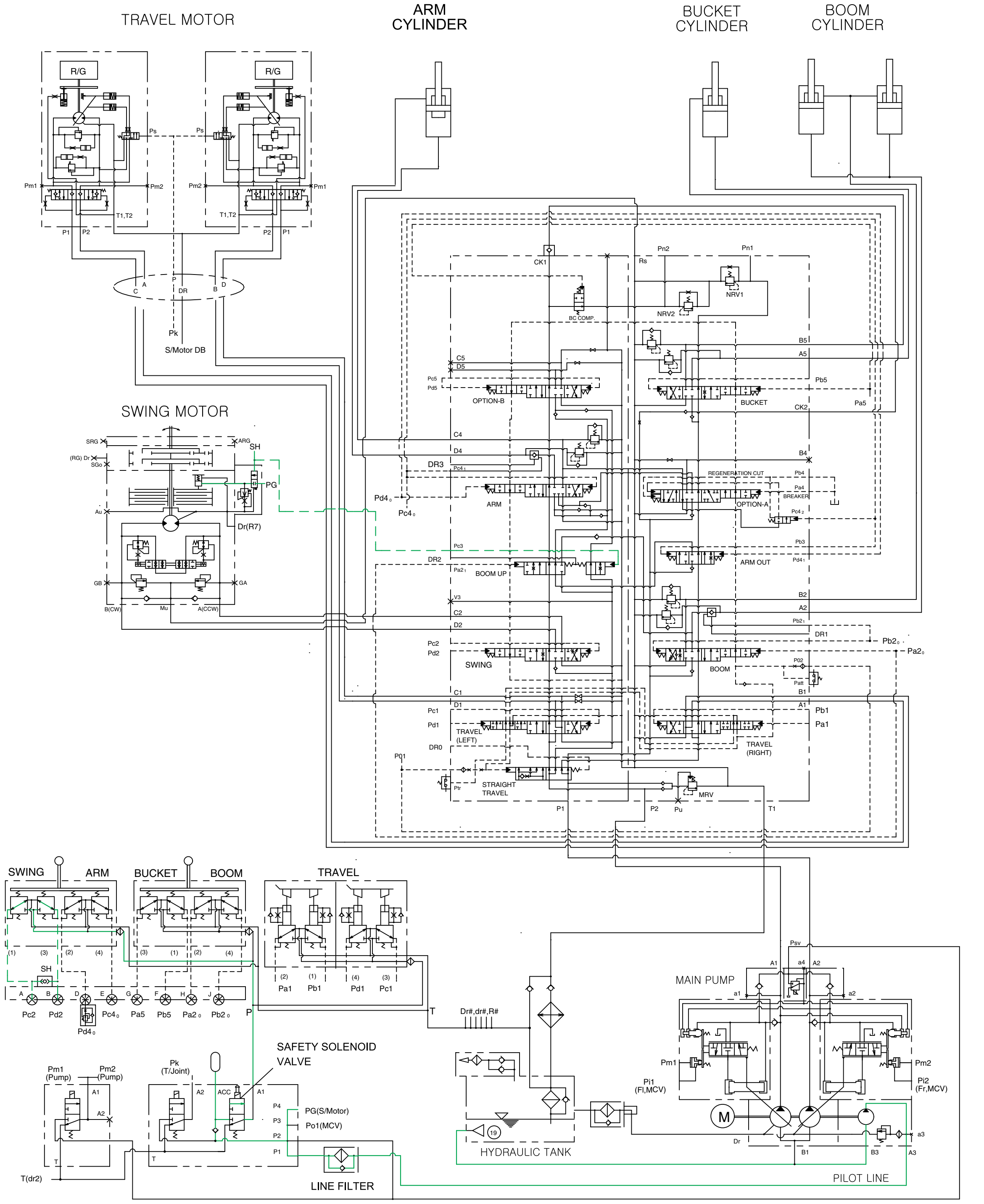


D21073HS03

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

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

3. SWING PRIORITY SYSTEM



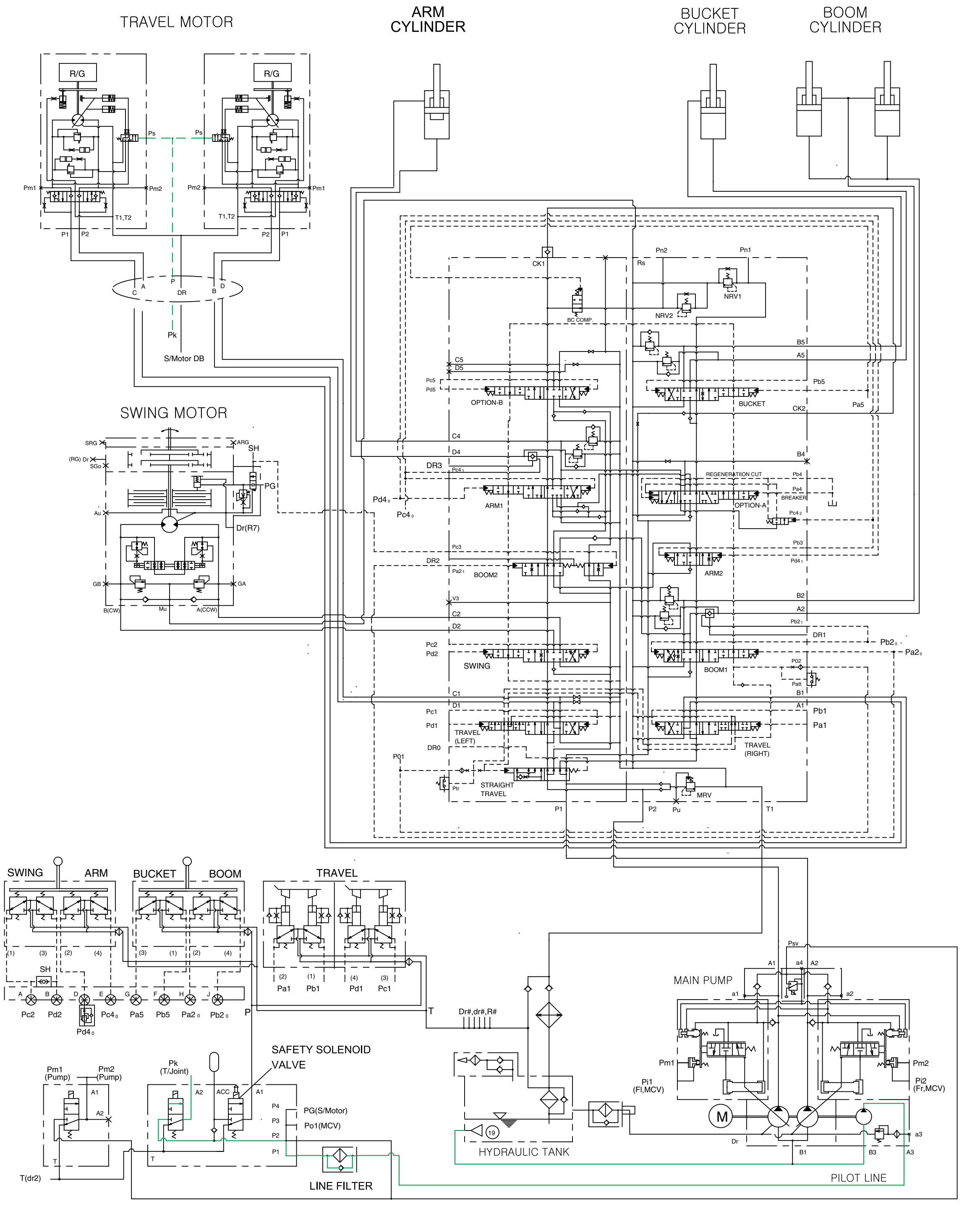
D21073HS04

When carrying out the combined operation of swing and arm of the leftcontrol valve, the swing speed can be lowered than operating speed of arm.

Pc3 pressure from the swing shuttle block change the swing priority spool and decreases the oil flow rate to the next section to make the swing operation most preferential.

This is called the swing priority system. For details, refer to page 2-44.

4. TRAVEL SPEED CONTROL SYSTEM



D21073HS05

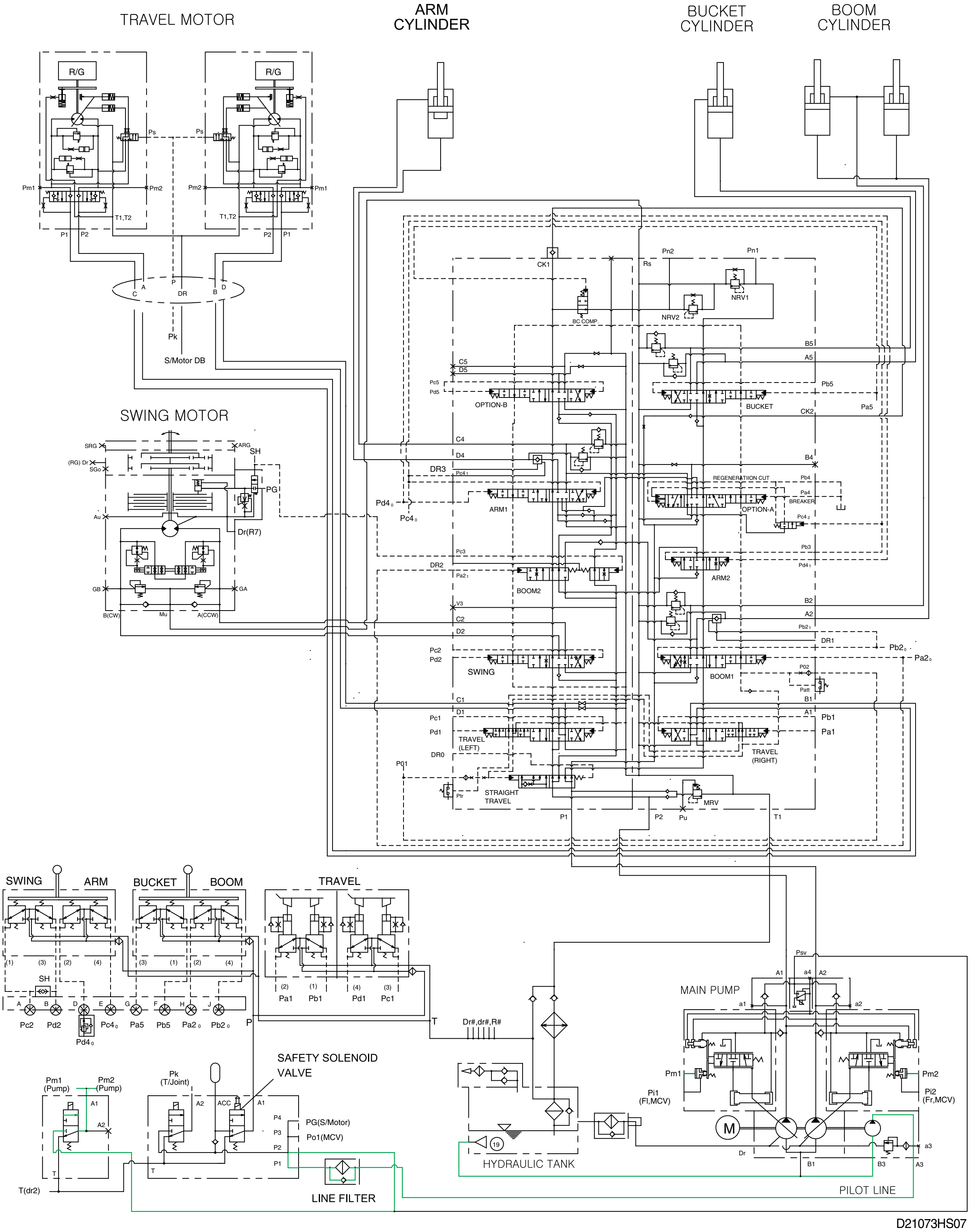
When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the Pk port of pilot valve in the travel motors.

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 Pk port returns to the hydraulic tank.

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

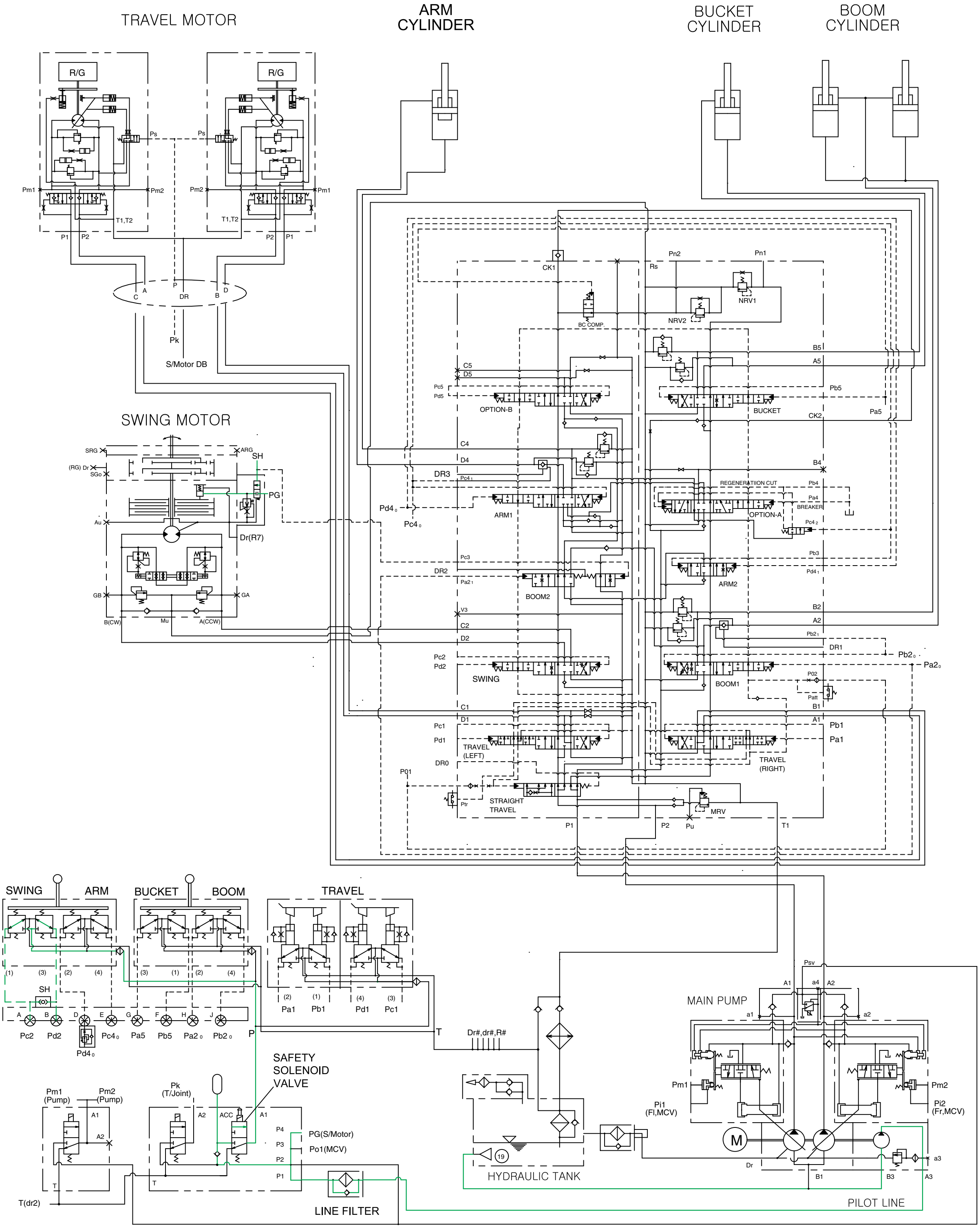
5. MAX FLOW CUT OFF SYSTEM



When the breaker operation mode is selected on the cluster, max flow cut off solenoid valve actuates automatically.

Thus pilot pressure(Pm1,2) is sent to the regulator and pump discharge volume is decreased.

6. SWING PARKING BRAKE RELEASE



D21073HS08

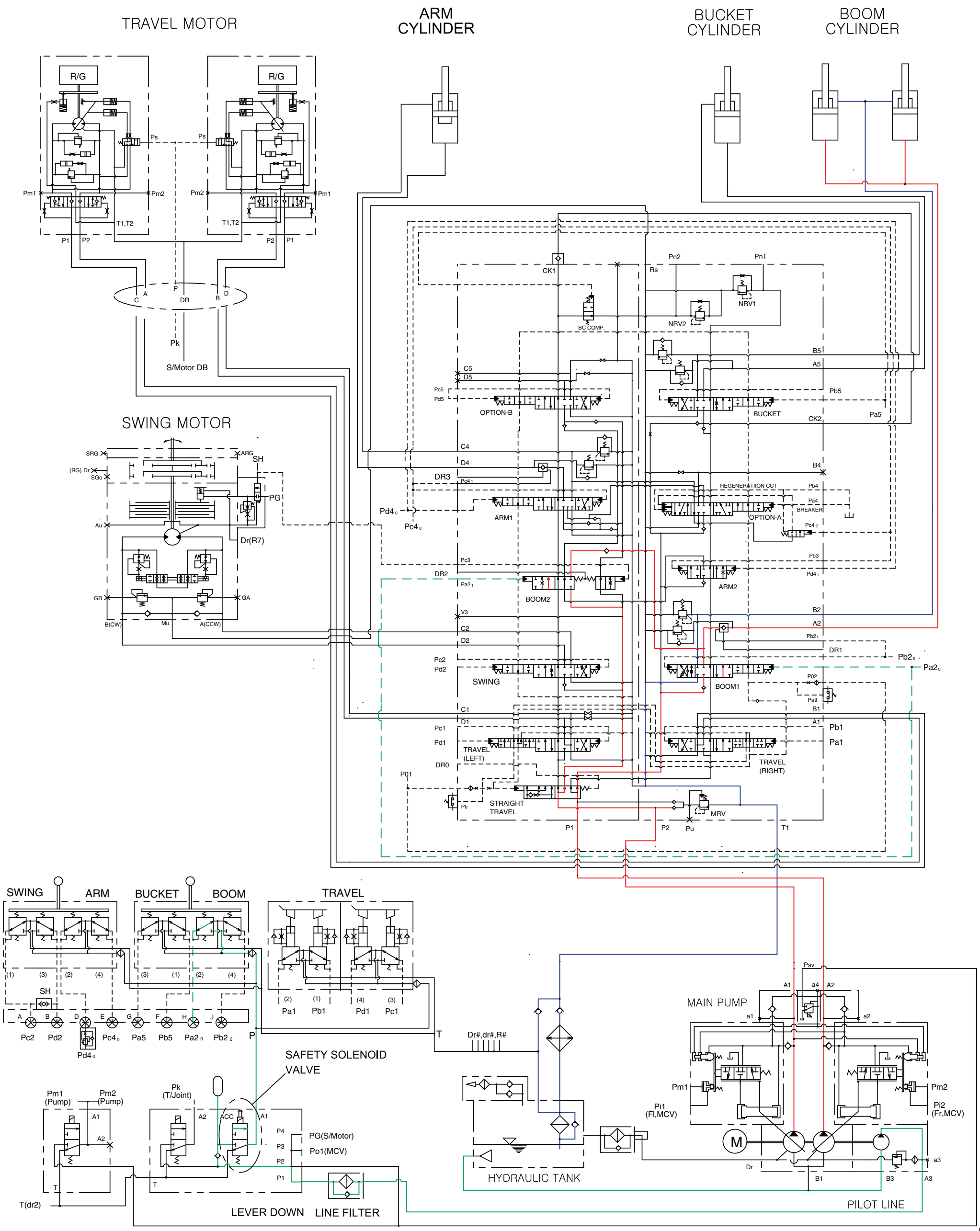
When the swing control lever is tilted, the pilot oil flow into SH port of shuttle valve, this pressure move spool so, discharged oil from pilot valve flow into PG port.

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



D21073HS09

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 front and rear pump flows into the main control valve and then goes to the large chamber of boom cylinders.

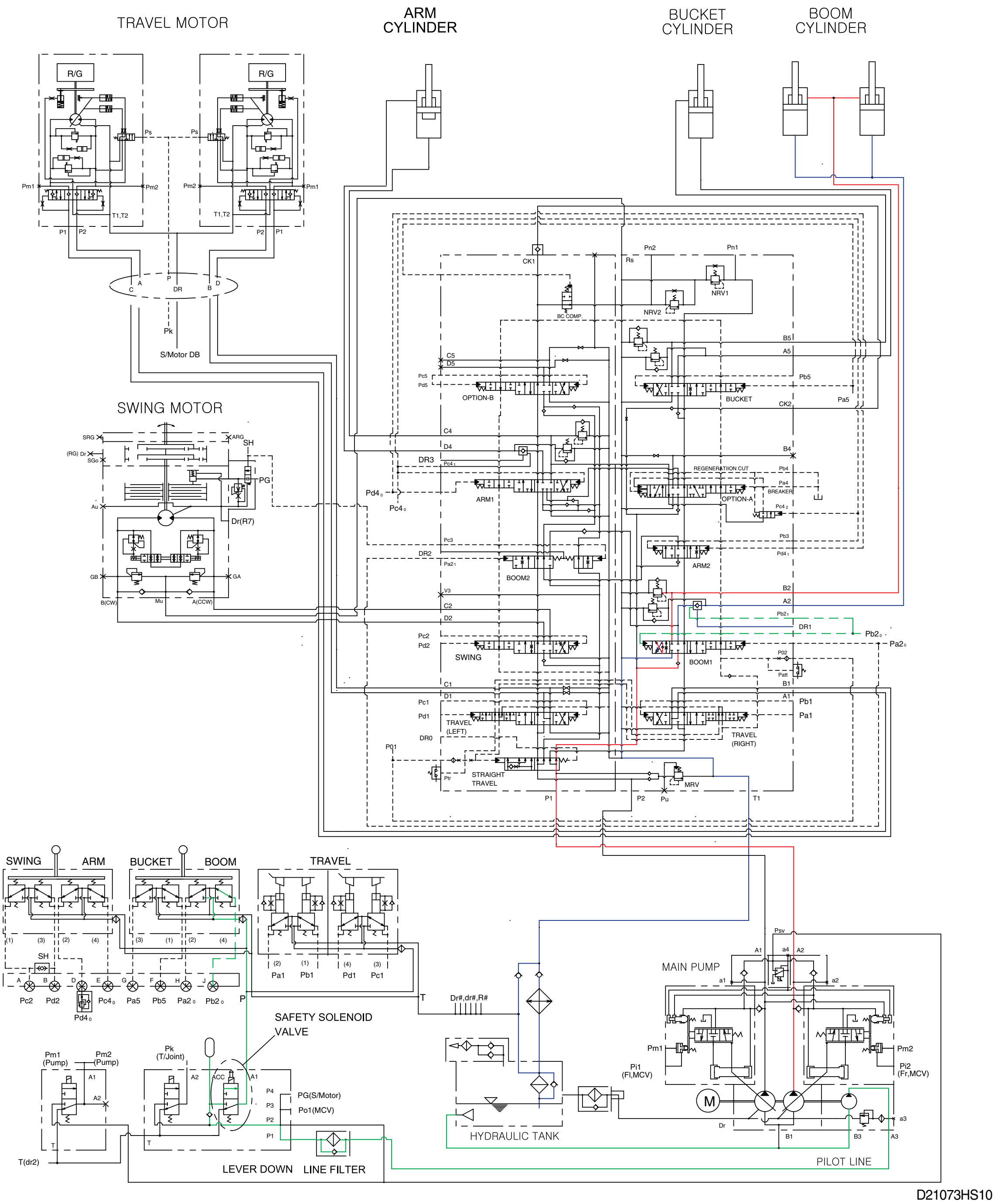
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.

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.

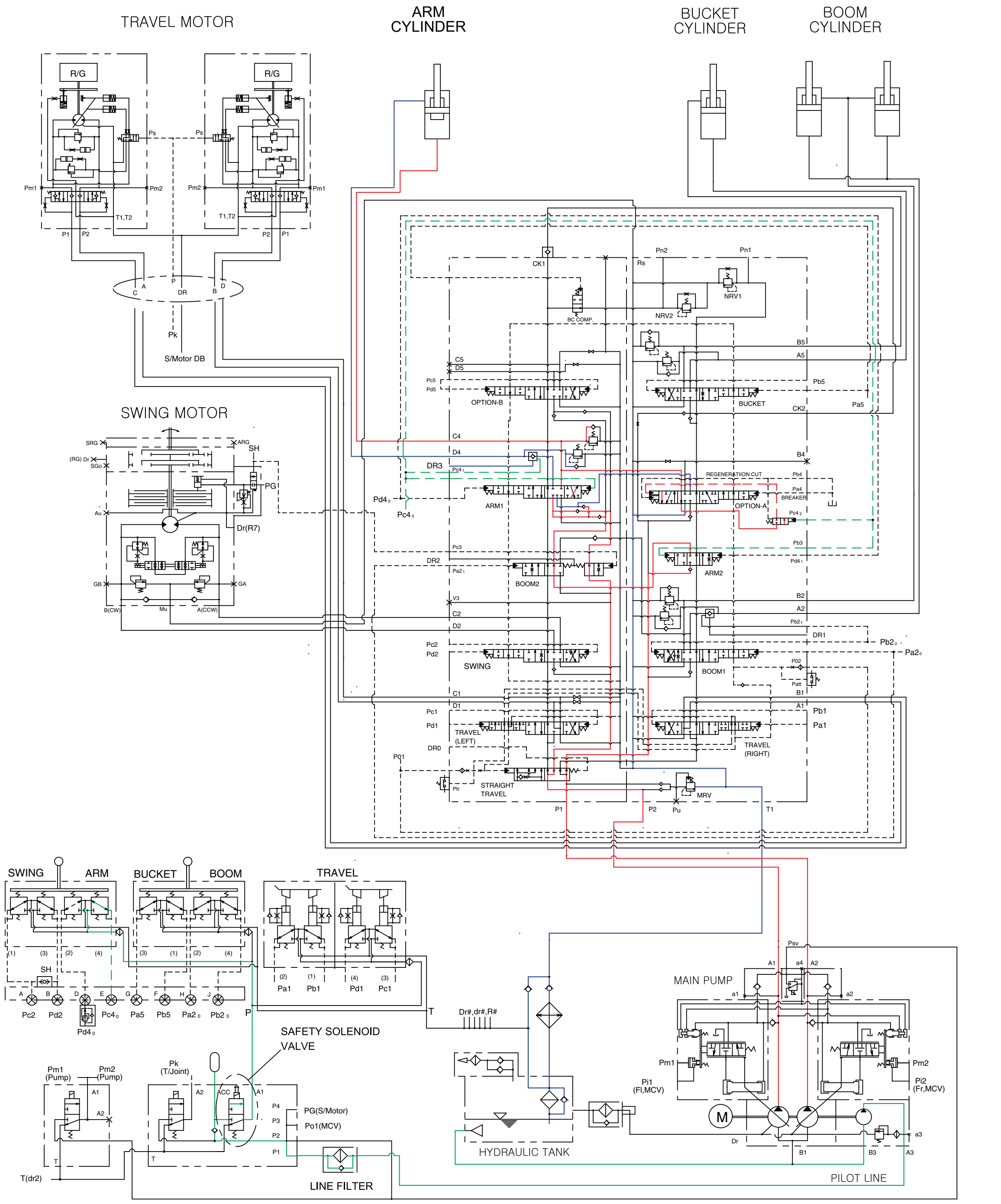
This prevents the hydraulic drift of boom cylinder.

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 rear 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 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 rear pump, and flows into the small chamber of the cylinder.
This prevents cylinder cavitation by the negative pressure when the rear 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



D21073HS11

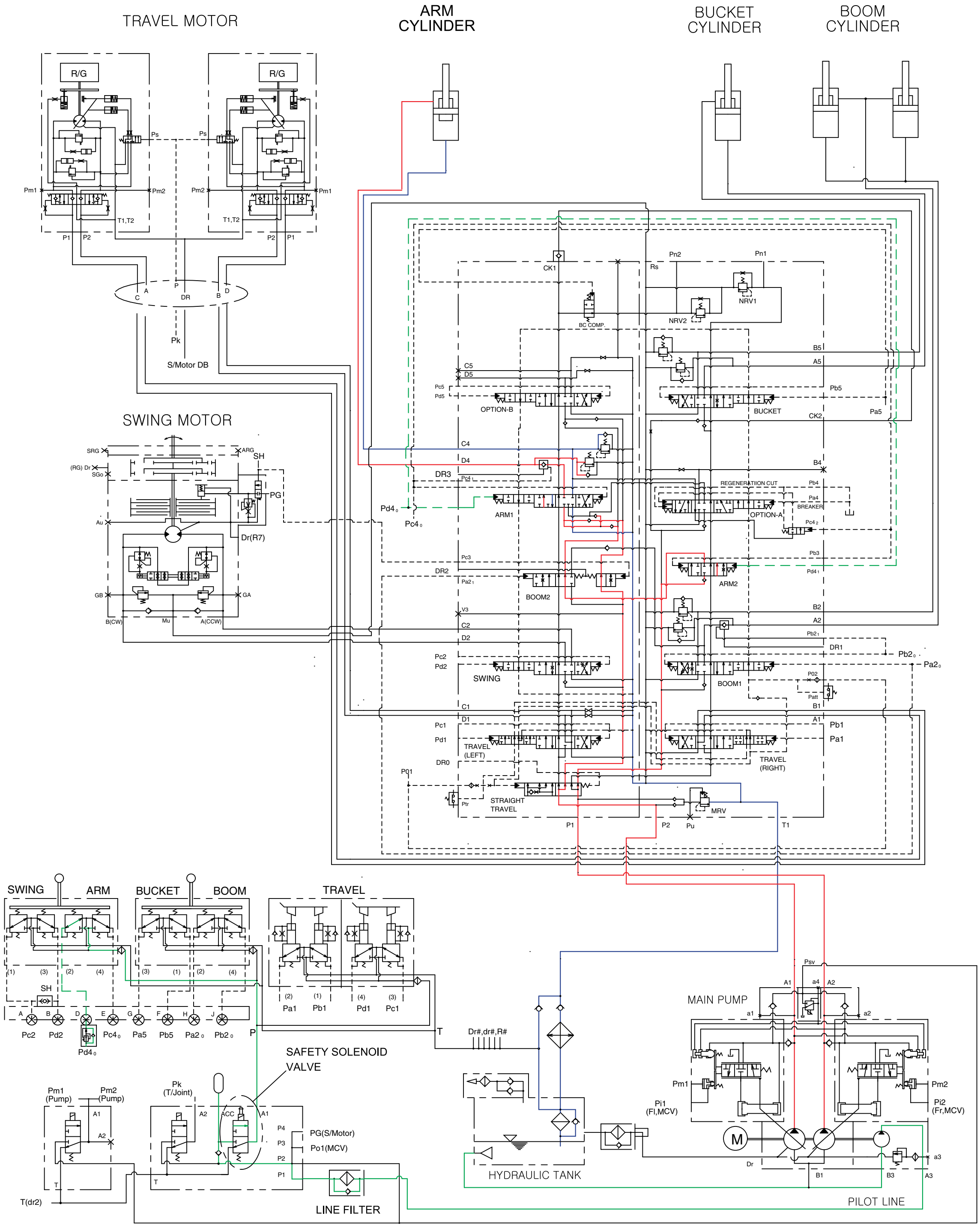
When the left control lever is pulled back, the arm spools in the main control valve are moved the to roll in position by the pilot oil pressure from the remote control valve.

The oil from the front and rear 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



D21073HS12

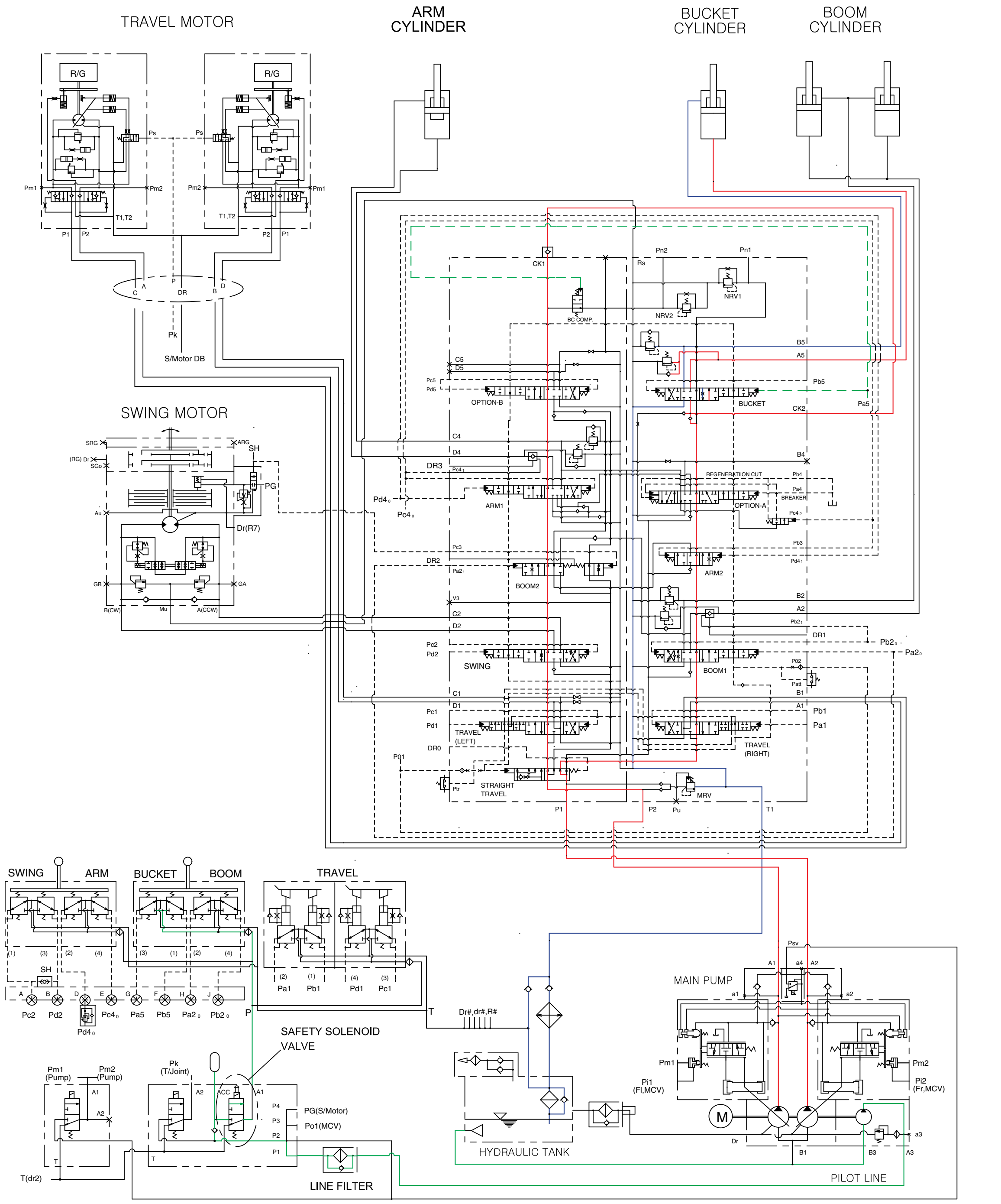
When the left control lever is pushed forward, the arm spool in the main control valve are moved to the roll out position by the pilot oil pressure from the remote control valve.

The oil from the front and rear 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



D21073HS13

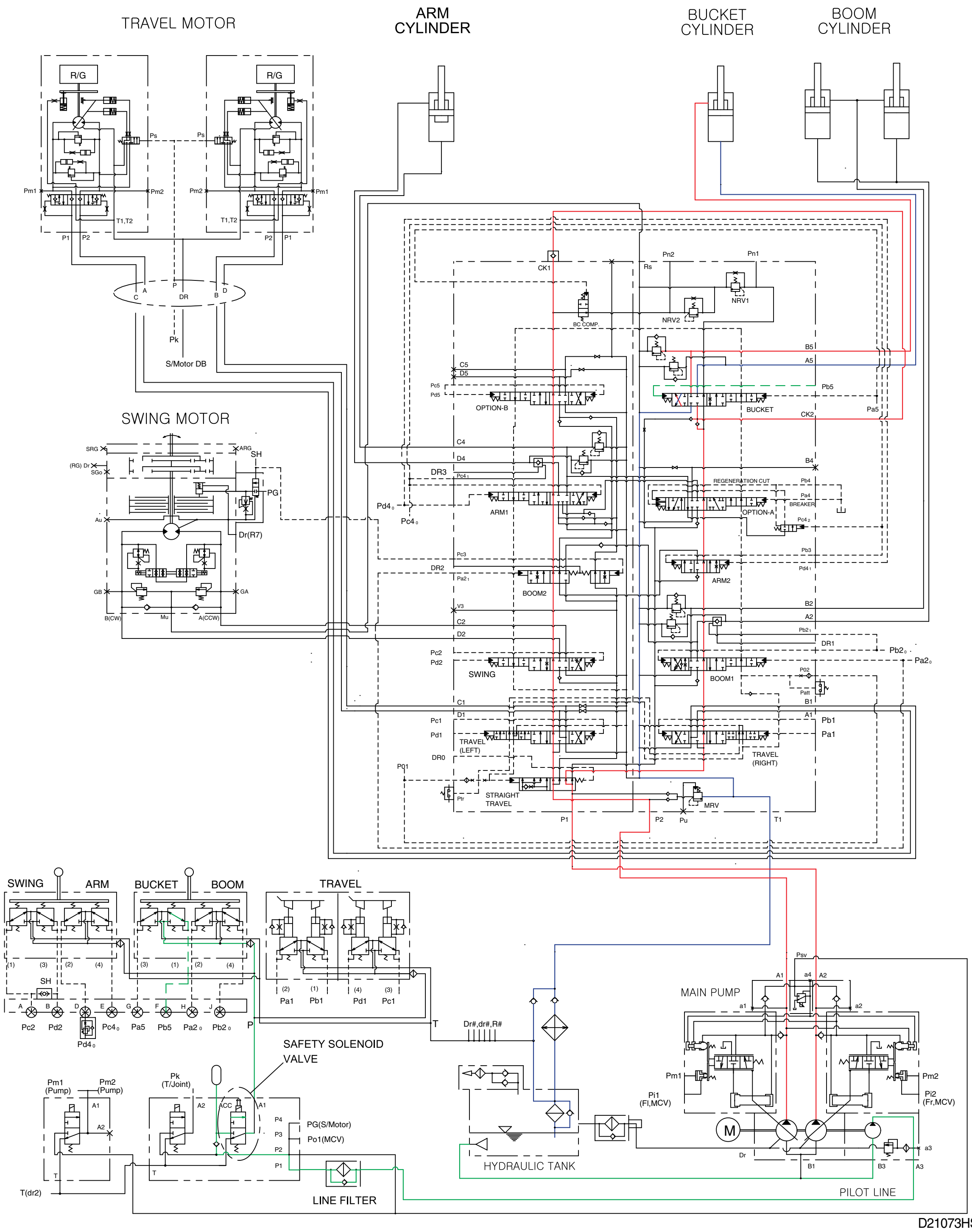
When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure from the remote control valve.

The oil from the rear 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



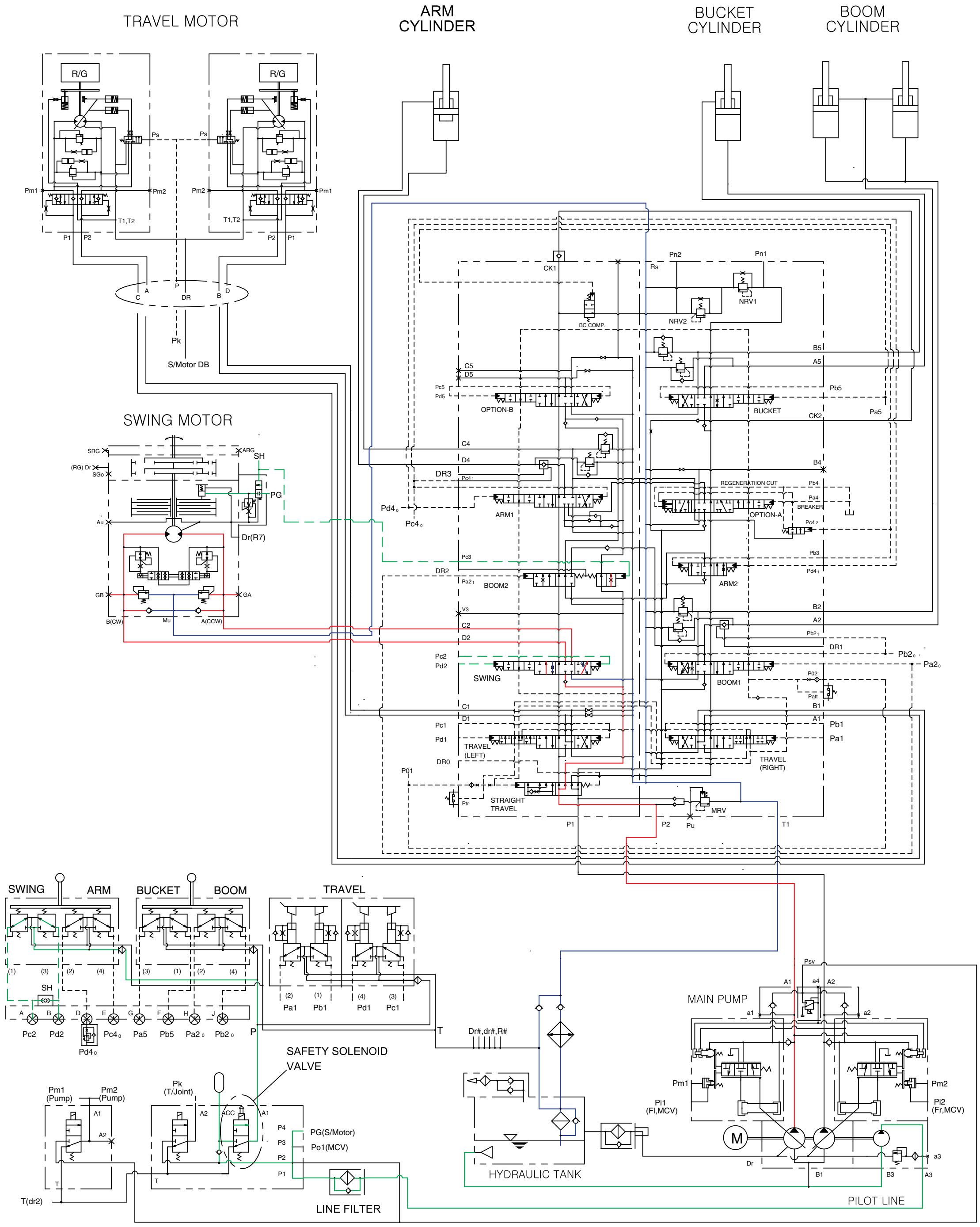
When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure from the remote control valve.

The oil from the front 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



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.

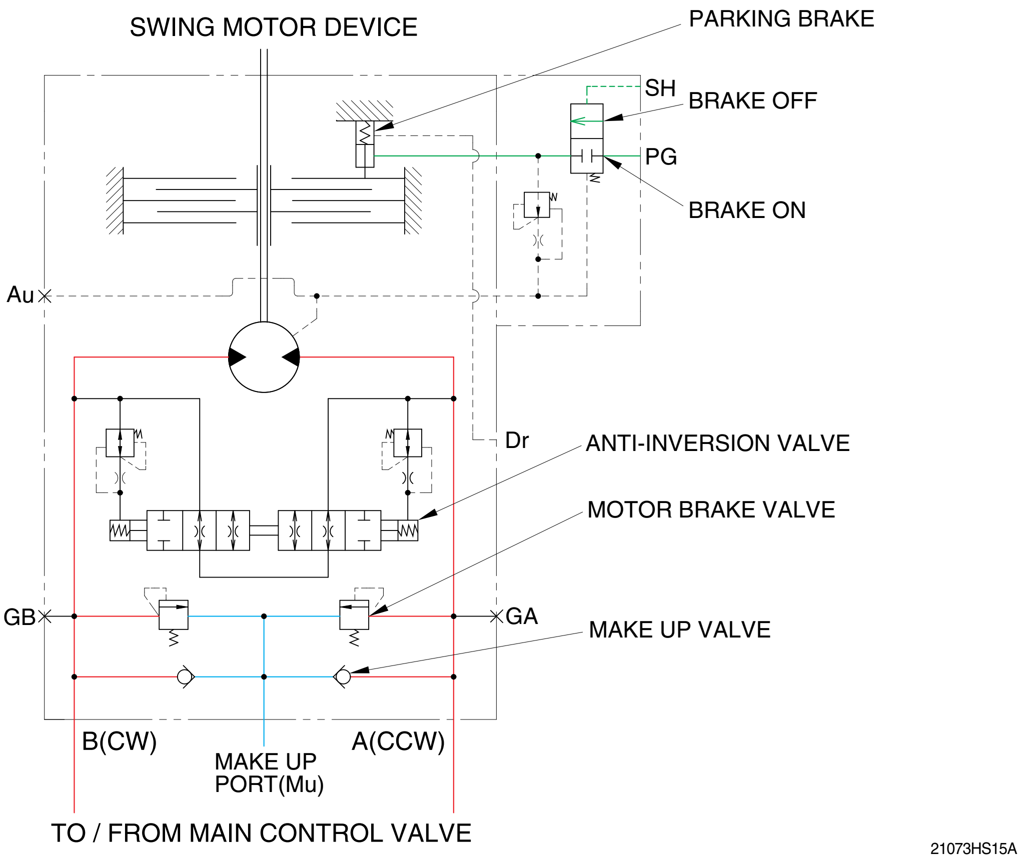
The oil from the rear pump flows into the main control valve and then goes to the swing motor.

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



1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

In case that the parking, of the machine at slope is required during operation, there is the danger of involuntary swing caused by the self weight of the machine. The brake is connected to prevent this involuntary swing.

PARKING BRAKE "OFF" OPERATION

The parking brake is released by the pilot pressure oil from the pilot pump.
When the left control lever placed in the swing position, the pilot pressure at the shuttle valve is transferred to the brake release valve and the brake release valve is change over. Then the pilot pressure lift the brake piston and release the parking brake.

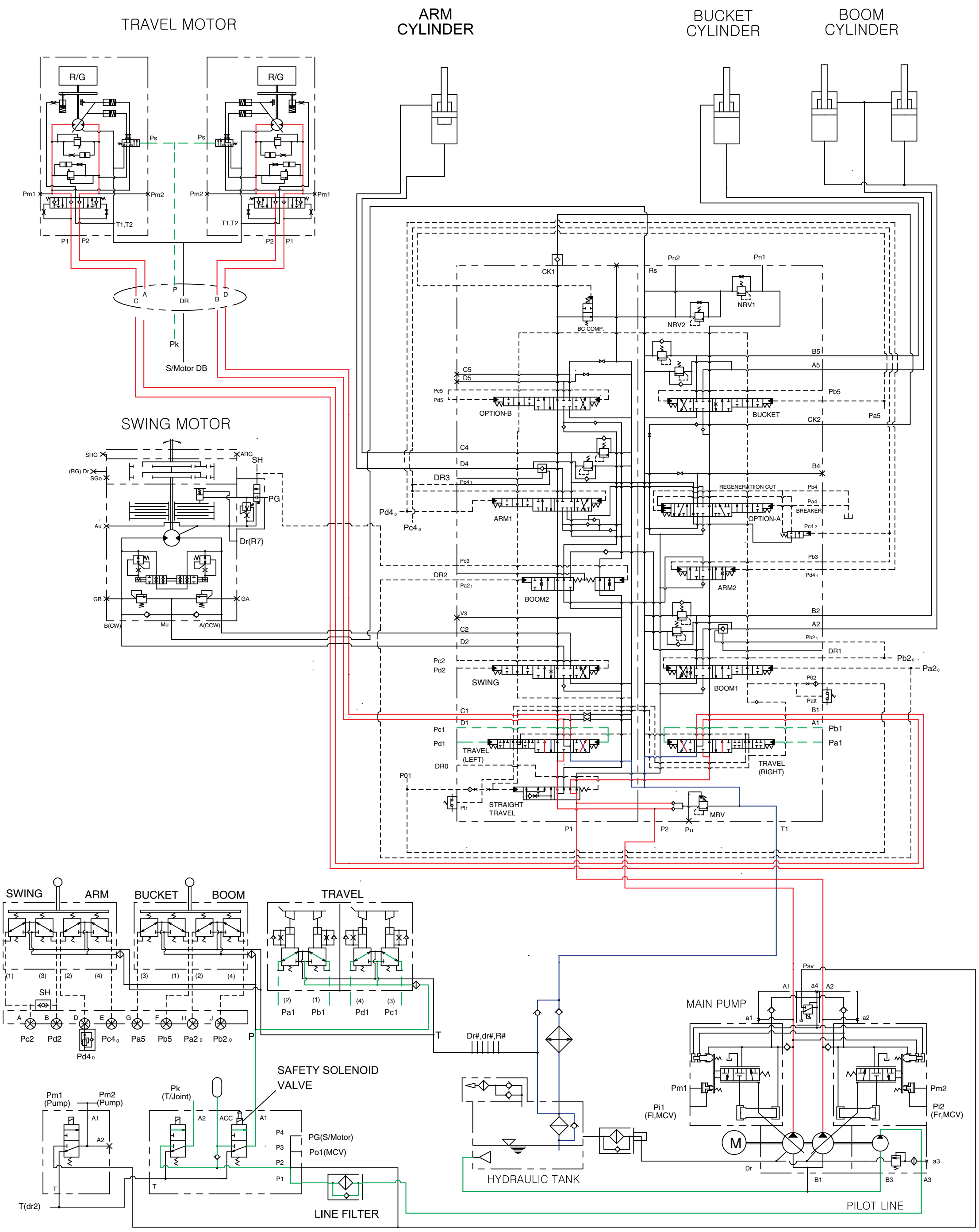
PARKING BRAKE "ON" OPERATION

When the control 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".

BYPASS VALVE

This bypass valve absorbs shocks produced as swing motion stops and reduced oscillation cause by swing motion.

8. TRAVEL FORWARD AND REVERSE OPERATION



D21073HS16

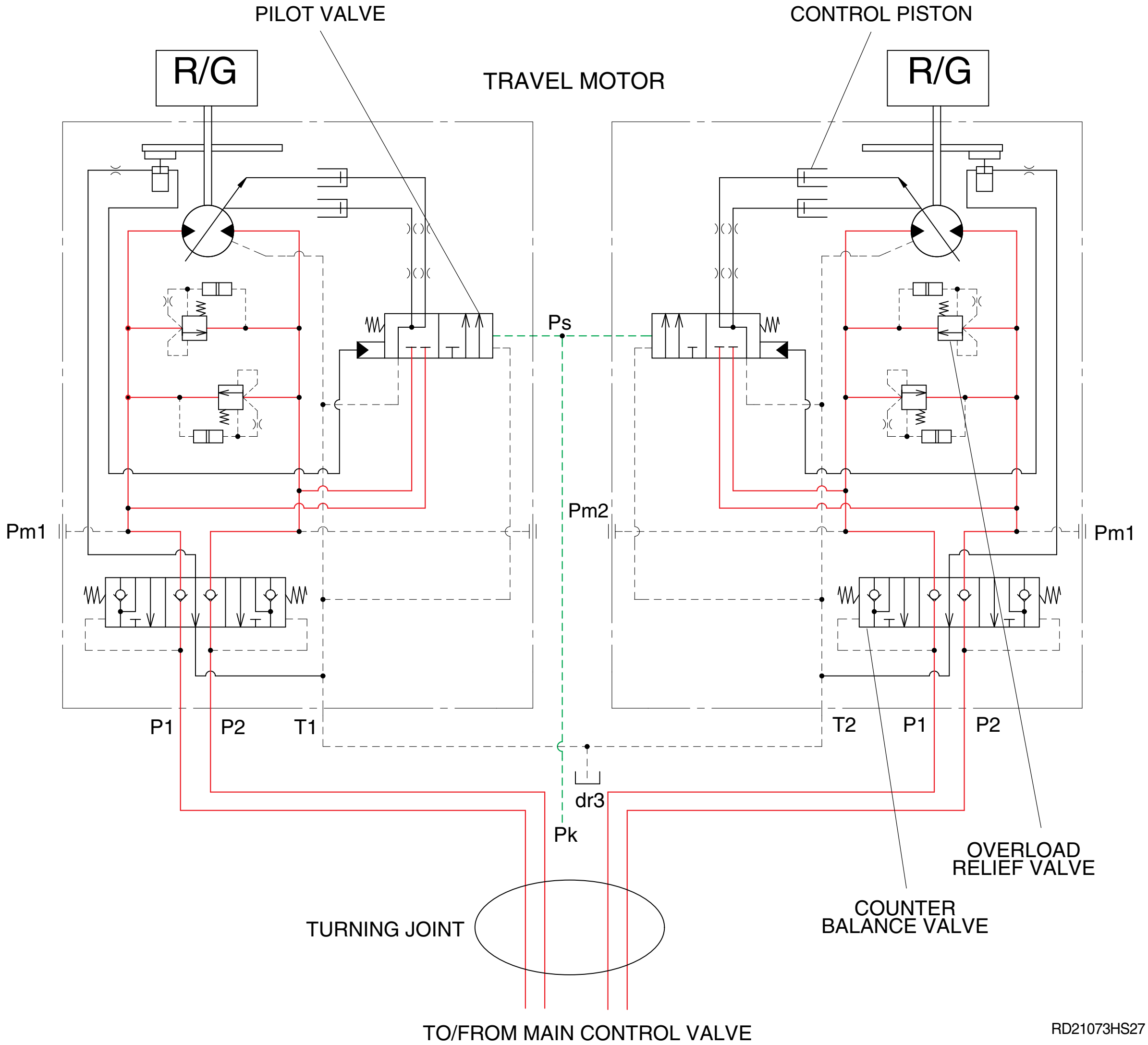
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

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.

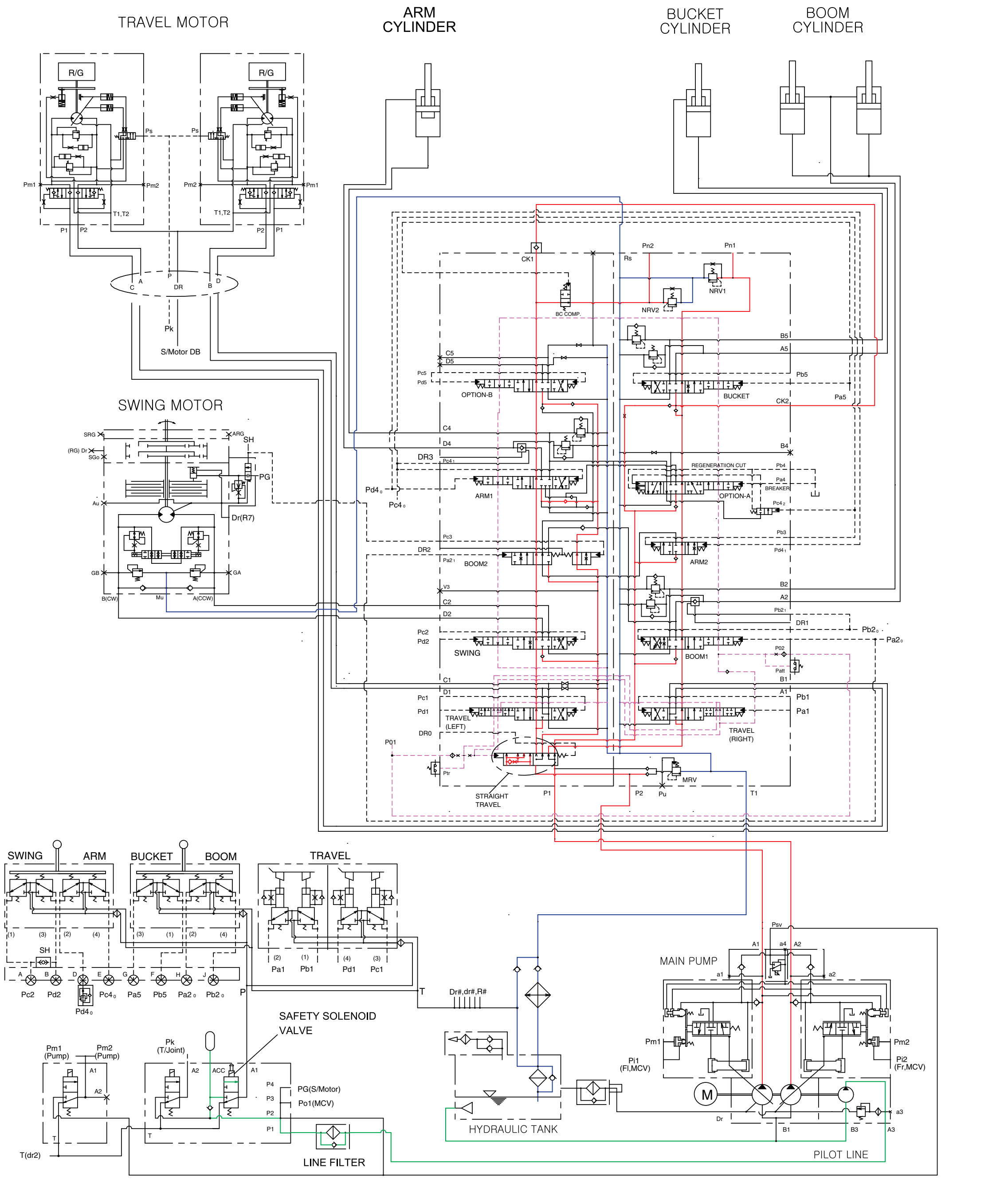
1) COUNTER BALANCE VALVE

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 365kgf/cm^2 to prevent high pressure generated at at 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.

1. OUTLINE



D21073HS17

The oil from the front and rear 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.

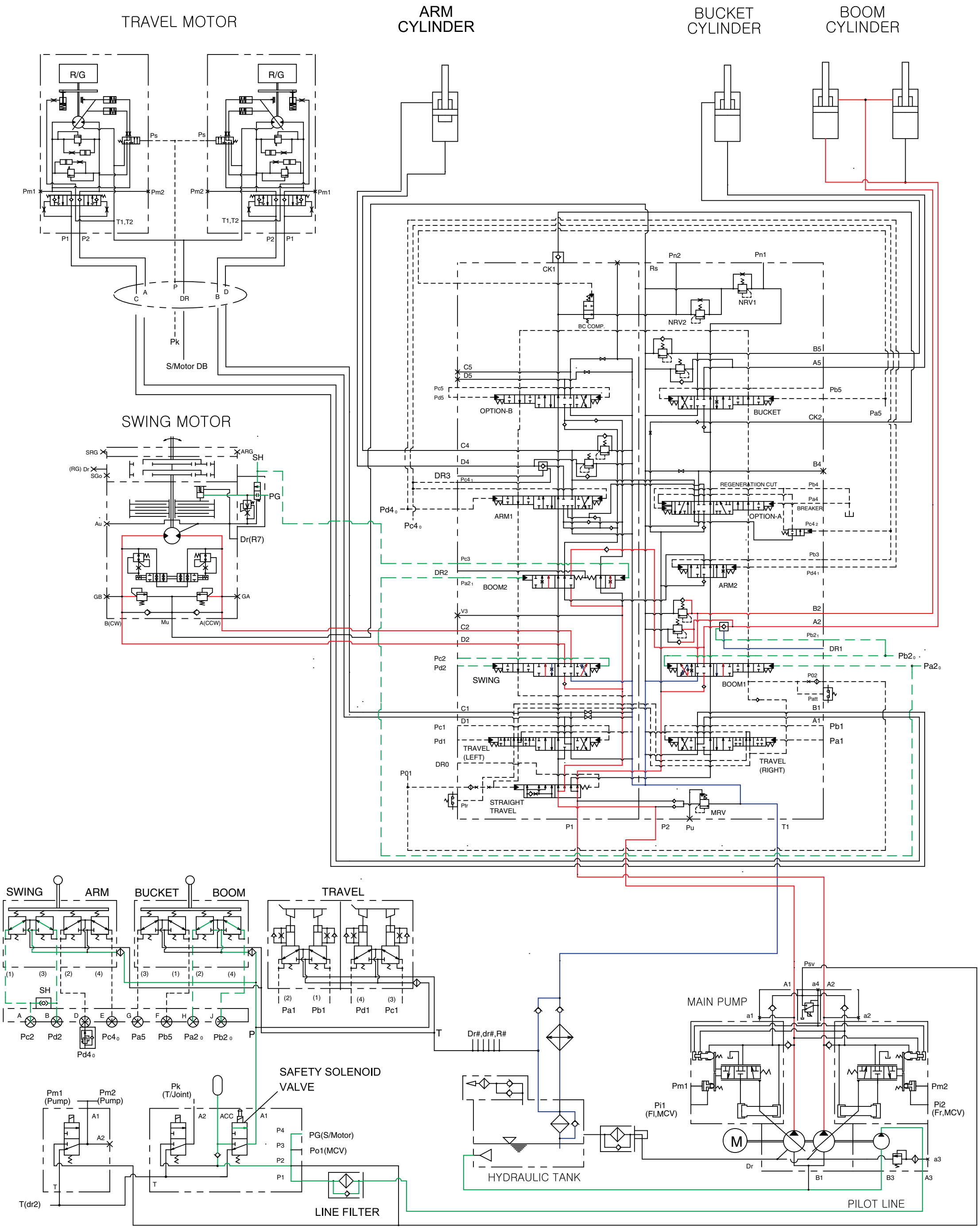
STRAIGHT TRAVEL SPOOL

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 OPERATION



D21073HS18

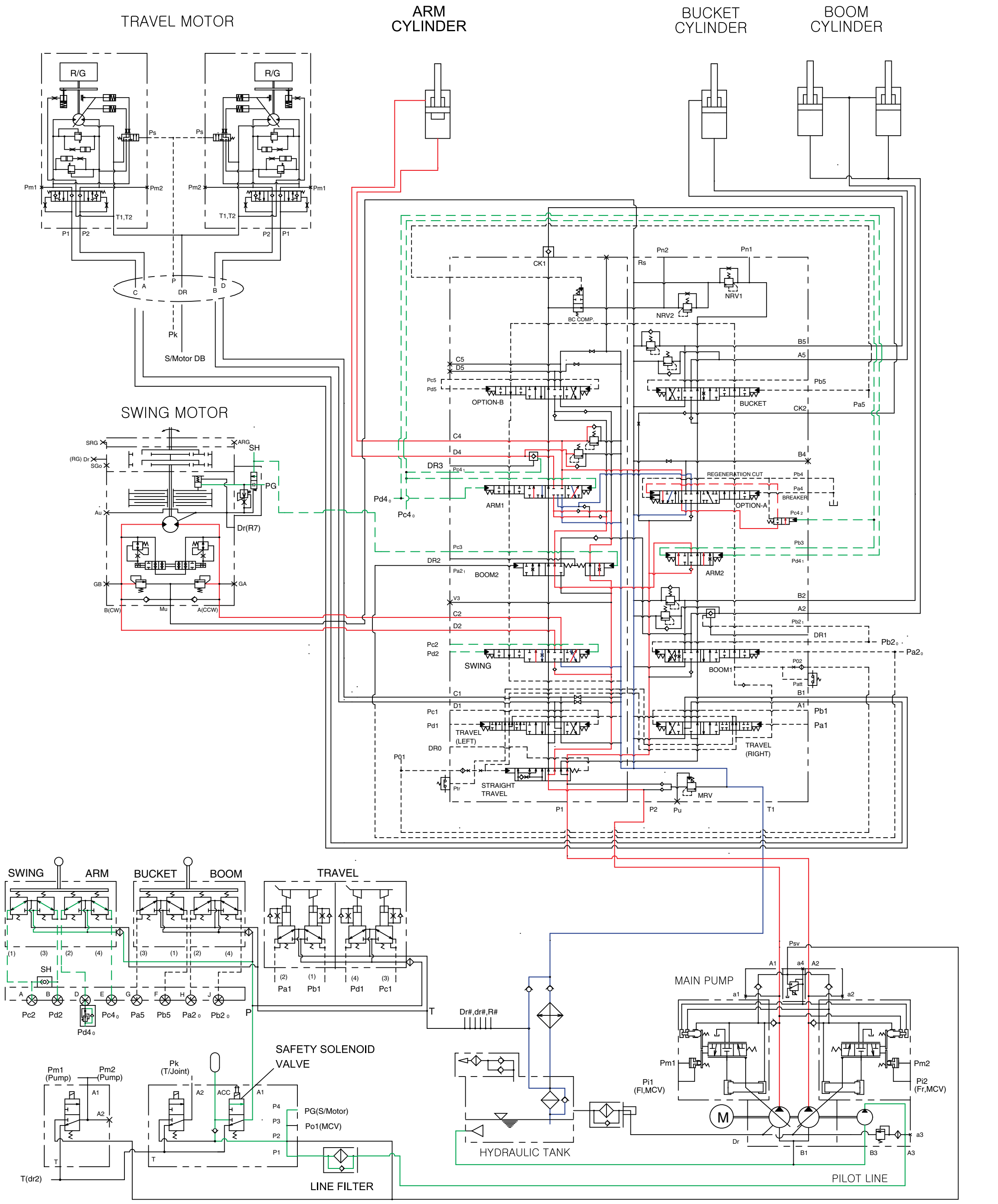
When the swing and boom functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

The oil from the rear pump flows into the boom cylinders through the boom 1 spool in the right control valve.

The superstructure swings and the boom is operated.

3. COMBINED SWING AND ARM OPERATION



D21073HS19

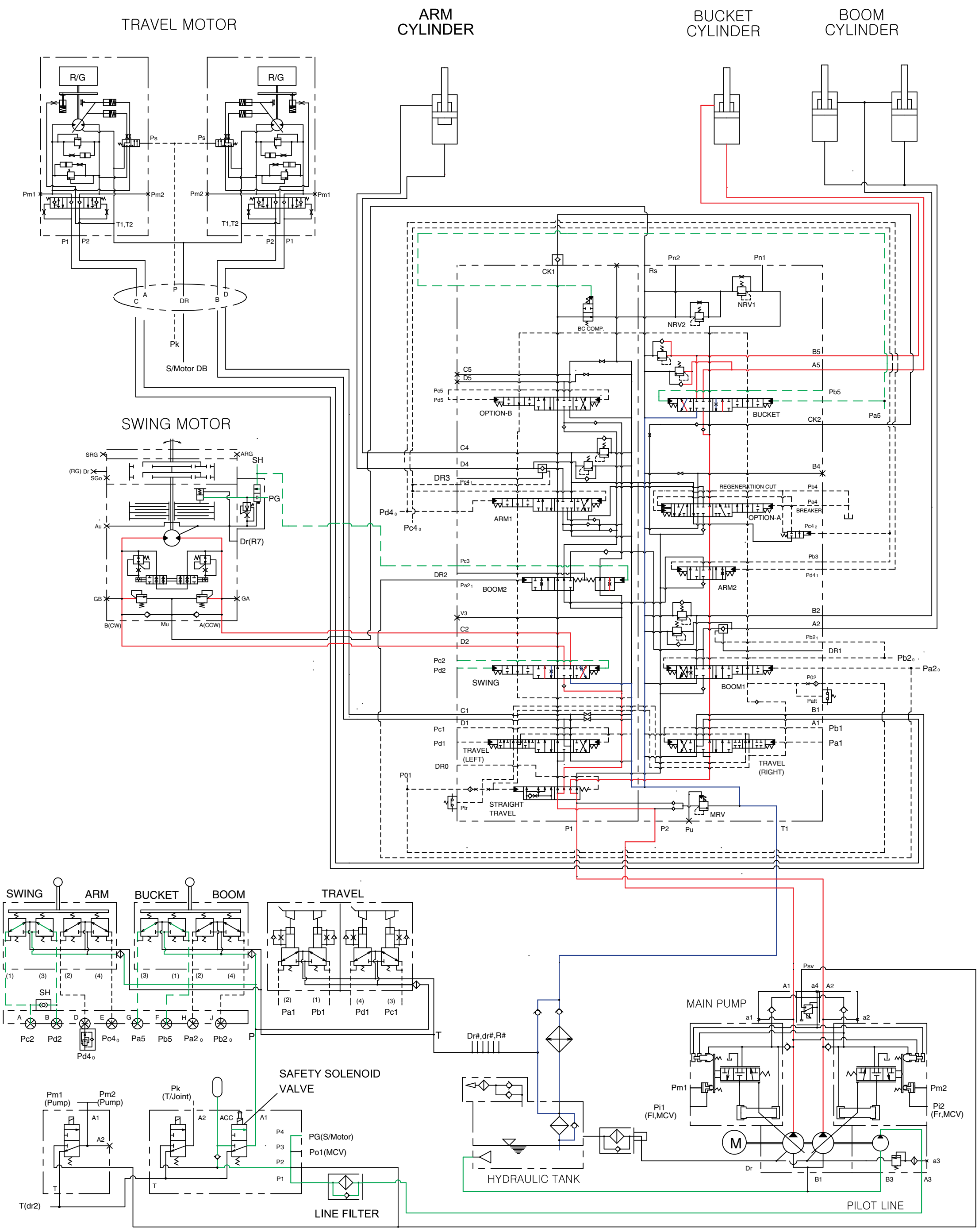
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

The oil from the rear pump flows into the arm cylinder through the arm 2 spool of the right control valve.

The superstructure swings and the arm is operated.

4. COMBINED SWING AND BUCKET OPERATION



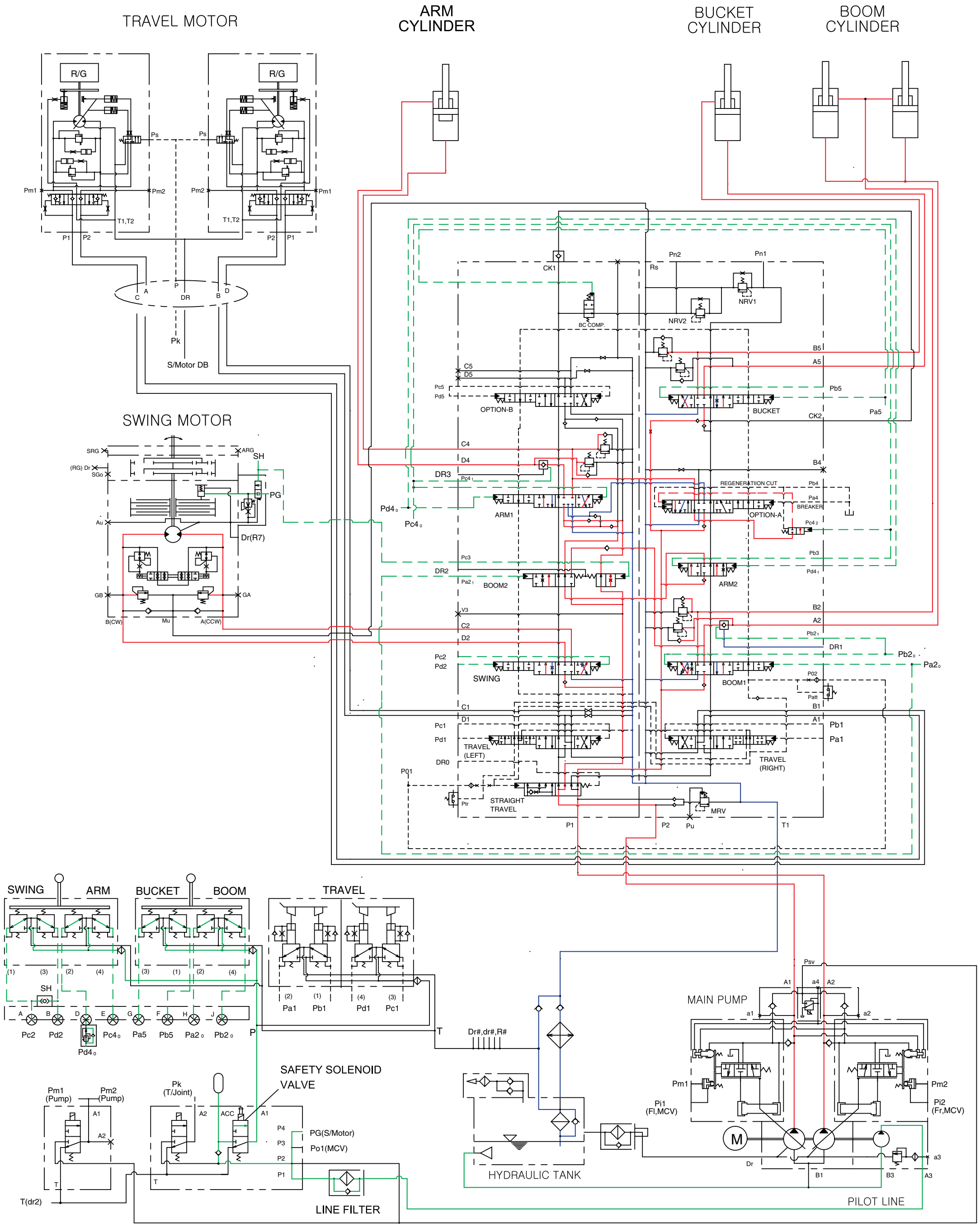
D21073HS20

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 front pump flows into the swing motor through the swing spool in the left control valve.

The oil from the rear pump flows into the bucket cylinder through the bucket spool in the right control valve.

5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



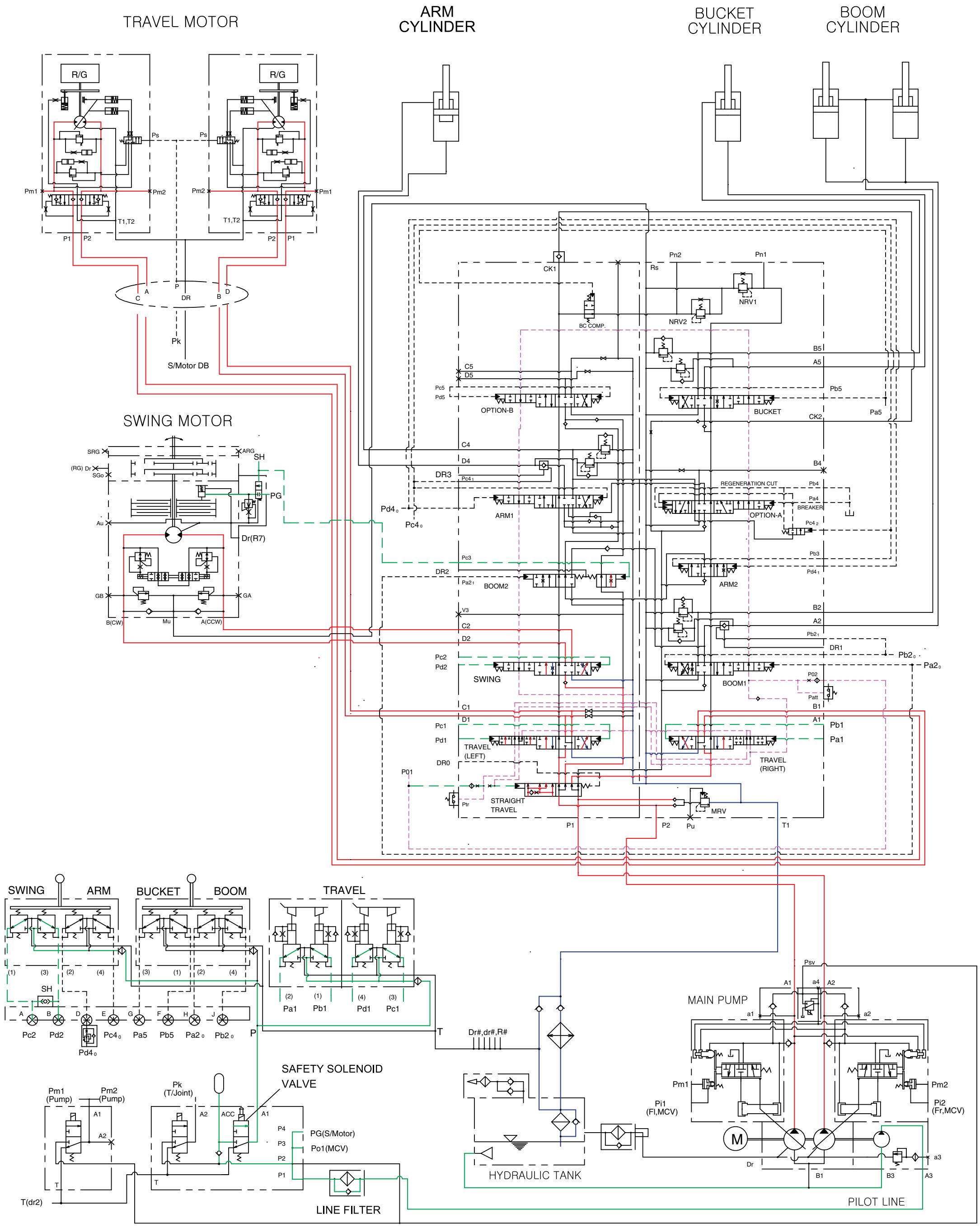
D21073HS21

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 front 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 in the left control valve. The oil from the rear 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 in the right control valve.

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

6. COMBINED SWING AND TRAVEL OPERATION



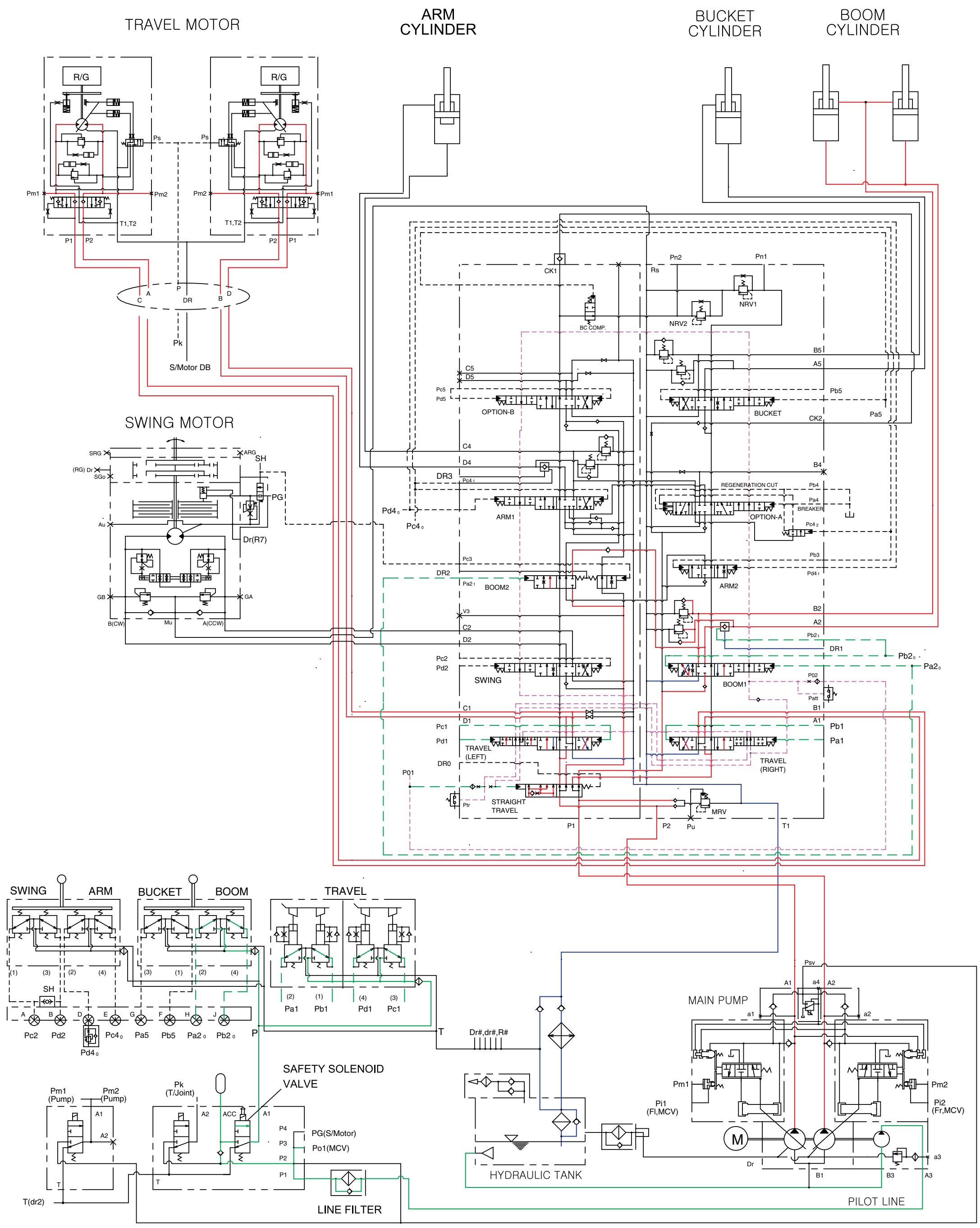
D21073HS22

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 front pump flows into the swing motor through the swing spool. The oil from the rear pump flows into the travel motor through the RH travel spool of the right control valve and the LH travel spool of the left control valve via the straight travel spool.

The superstructure swings and the machine travels straight.

7. COMBINED BOOM AND TRAVEL OPERATION

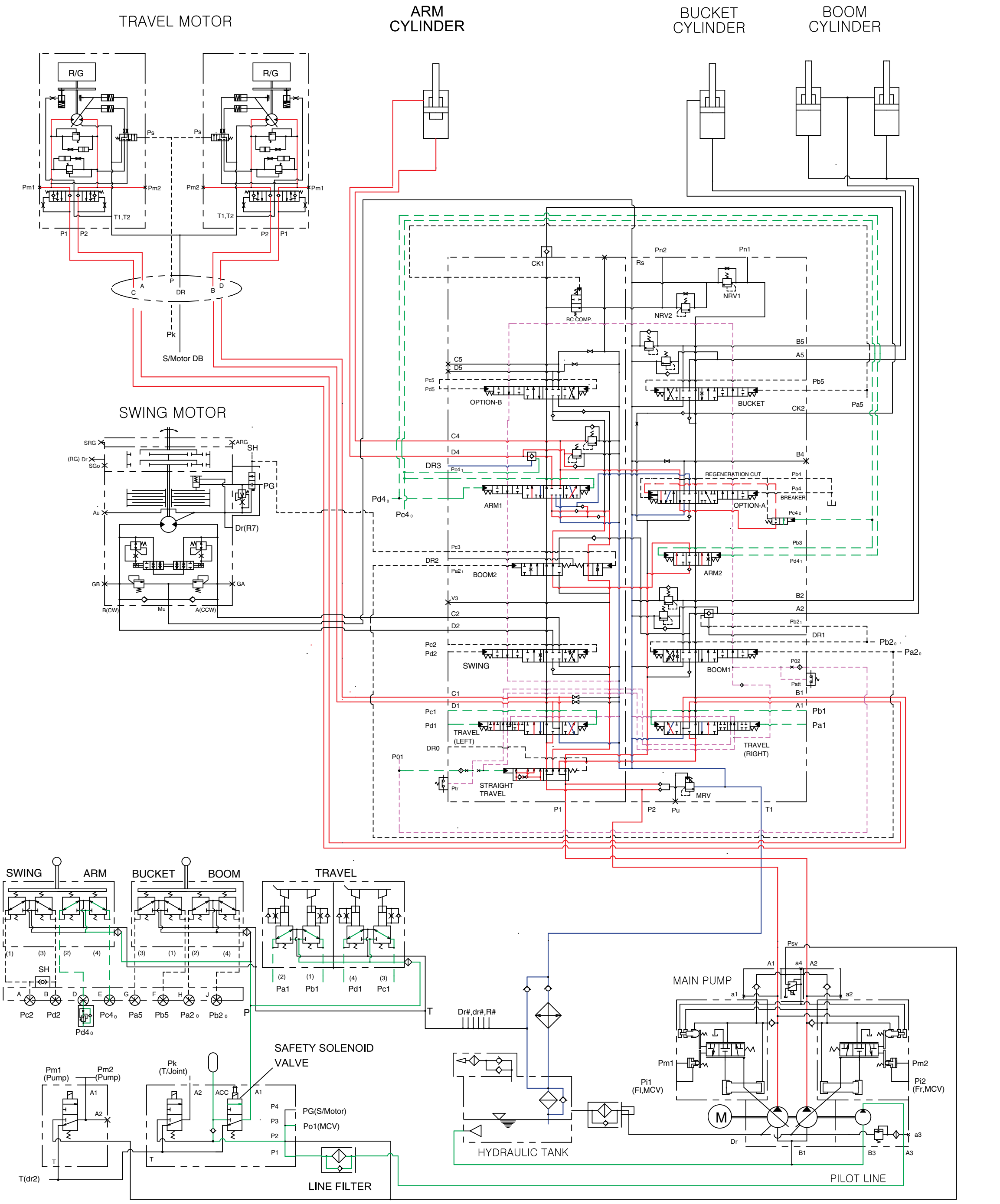


D21073HS23

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 front 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 rear pump flows into the travel motors through the RH travel spool of the right control valve and the LH travel spool of the left control valve via the straight travel spool.

8. COMBINED ARM AND TRAVEL OPERATION



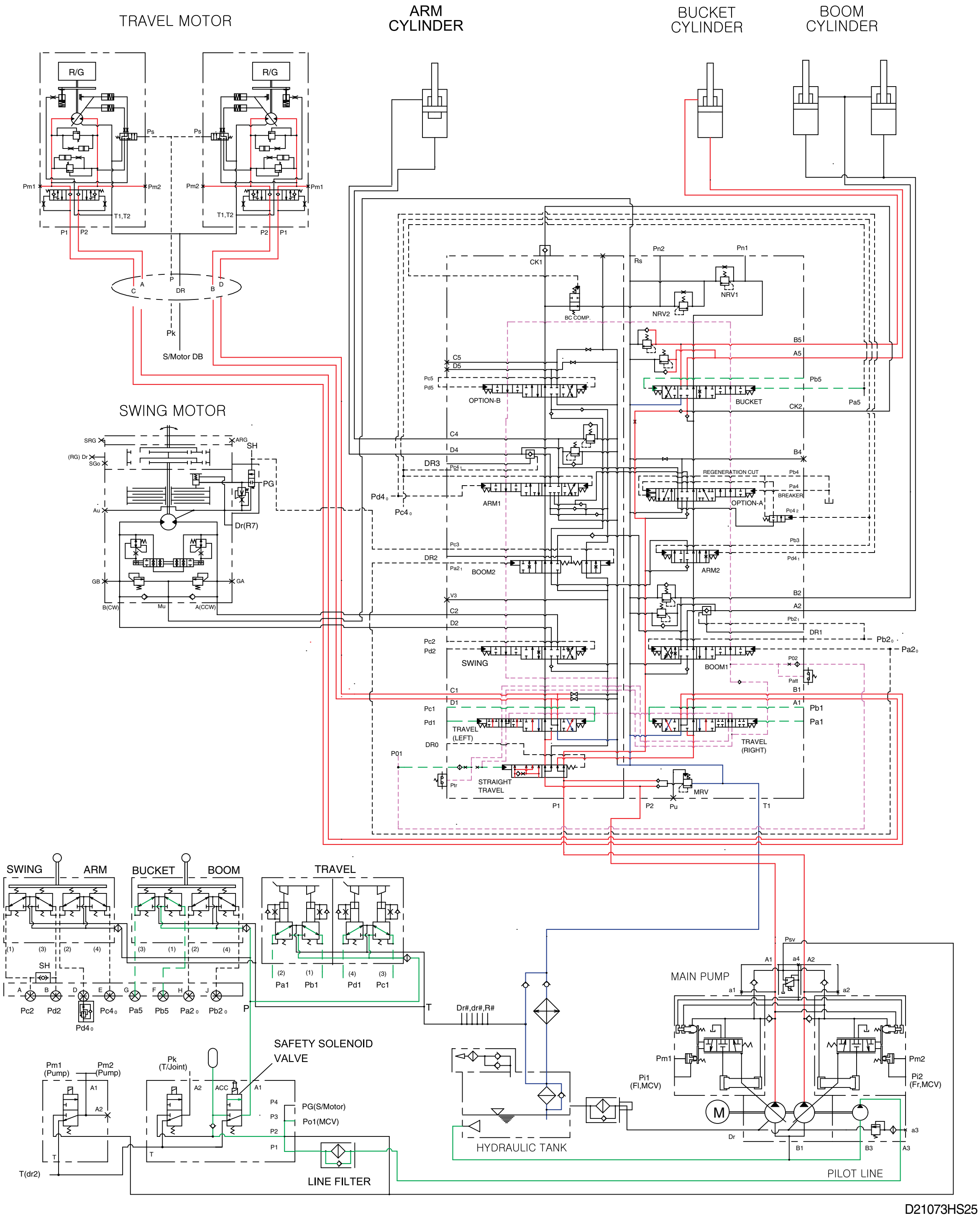
D21073HS24

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 front 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 rear pump flows into the travel motors through the RH travel spool of the right control valve and the LH travel spool of the left control valve via the straight travel spool.

The arm is operated and the machine travels straight.

9. COMBINED BUCKET AND TRAVEL OPERATION



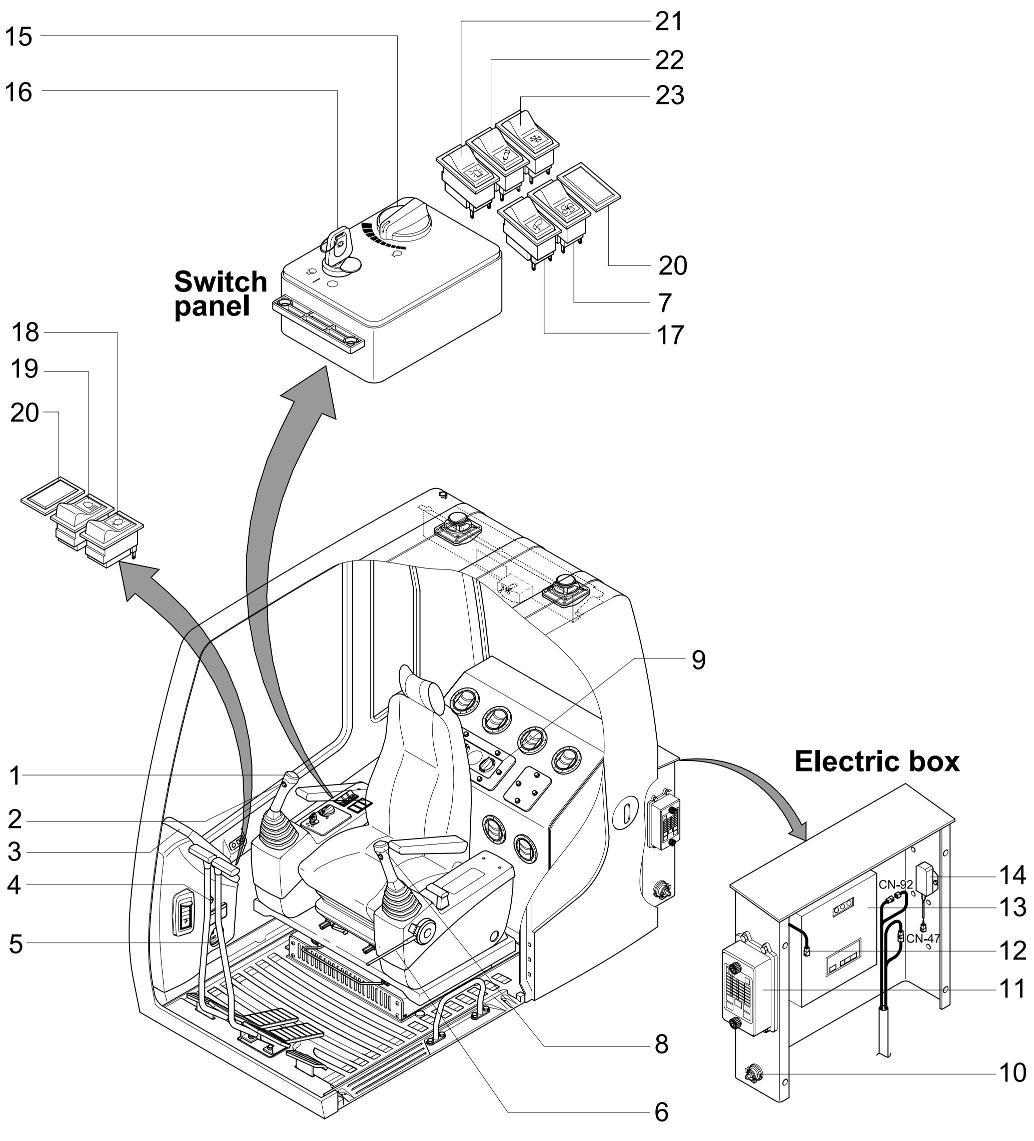
When the bucket and travel functions are operated, simultaneously the bucket spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve, and the straight travel spool is pushed to the left by the oil pressure from pilot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

The bucket is operated and the machine travels straight.

SECTION 4 ELECTRICAL SYSTEM

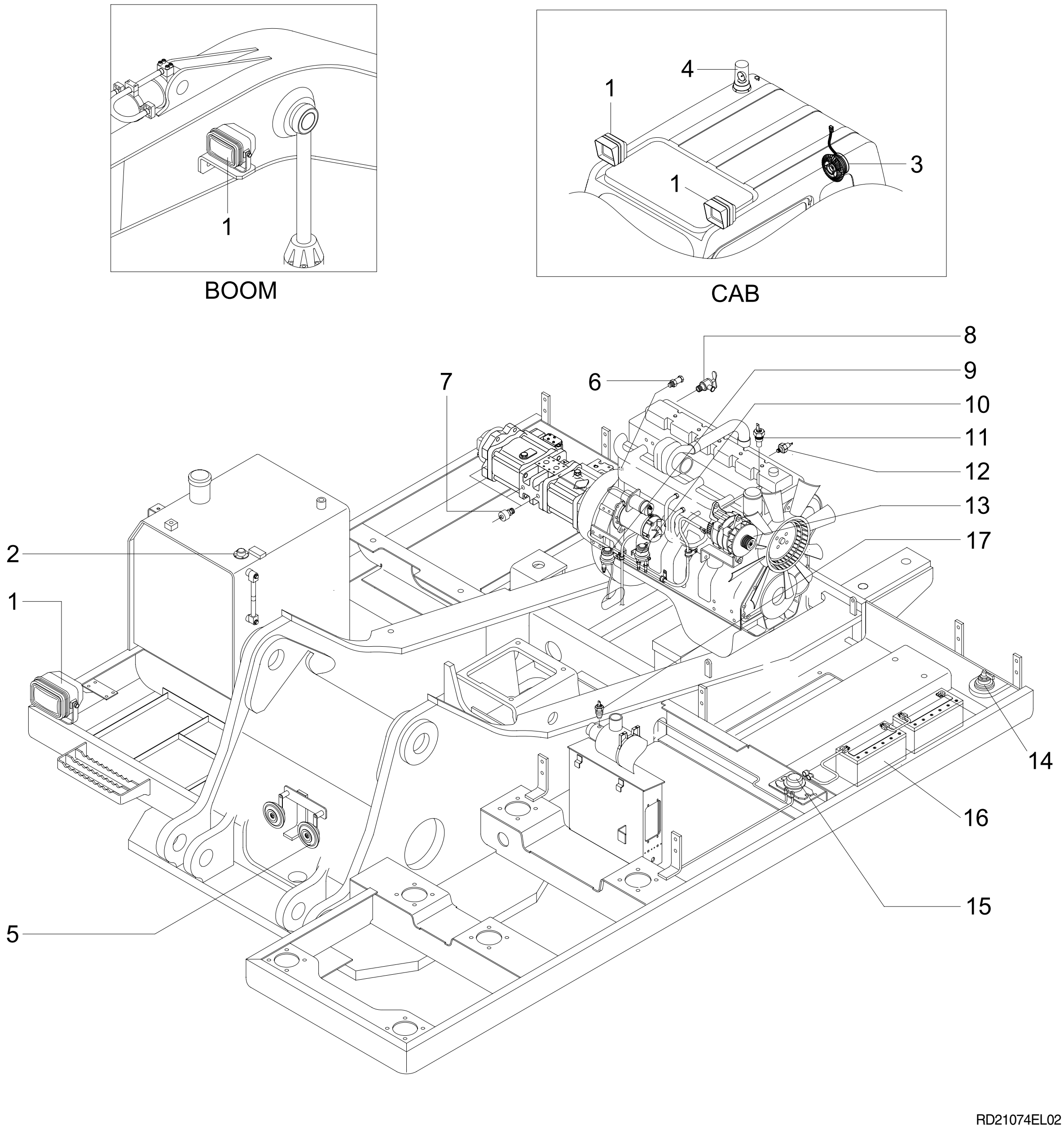
GROUP 1 COMPONENT LOCATION

1. LOCATION 1

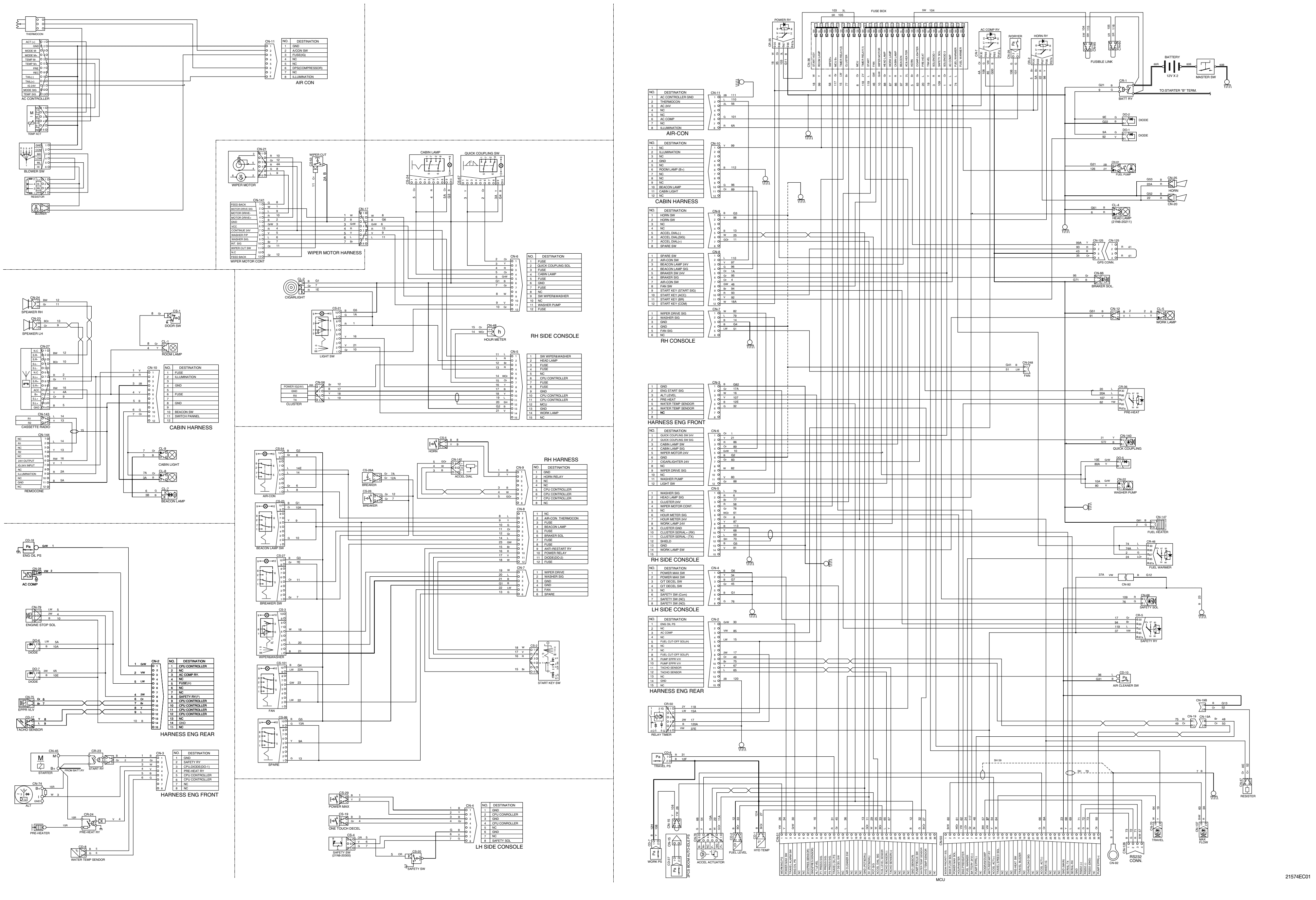


1	Horn switch	9	Air conditioner controller	17	Wiper and washer switch
2	Breaker operation switch	10	Master switch	18	Main light switch
3	Cluster	11	Fuse box	19	Cab light switch
4	Cigar lighter	12	RS232 serial connector	20	Spare cover
5	Hour meter	13	CPU controller	21	Beacon switch
6	Safety lever	14	Prolix resistor	22	Breaker selection switch
7	Fan switch	15	Accel dial switch	23	Air conditioner switch
8	One touch decel switch	16	Start switch		

2. LOCATION 2



1	Lamp	7	Pressure sender	13	Alternator
2	Fuel sender	8	Heater valve	14	Master switch
3	Fan	9	Start relay	15	Battery relay
4	Beacon lamp	10	Heater relay	16	Battery
5	Horn	11	Temp sender	17	Air cleaner switch
6	Speed sensor	12	Engine oil pressure switch		


AIR CON
WIPER MOTOR HARNESS
RH SIDE CONSOLE
CABIN HARNESS
RH HARNESS
HARNESS ENG REAR
HARNESS ENG FRONT
LH SIDE CONSOLE
AIR-CON
CABIN HARNESS
RH CONSOLE
HARNESS ENG FRONT
RH SIDE CONSOLE
LH SIDE CONSOLE
HARNESS ENG REAR
MCU
21574EC01

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〕
- → Fuse box 〔No.1〕
  - → I/conn 〔CN-8(12)〕 → Start switch 〔CS-2(1)〕
  - → Power relay 〔CR-35(30)]
- → Fuse box 〔No.2〕
  - → I/conn 〔CN-10(1)〕
    - → Room lamp 〔CL-1(2)〕 → Door switch 〔CS-1〕
    - → Cassette radio 〔CN-27(11)〕
  - → GPS connector 〔CN-125(1)〕
- → Fuse box 〔No.4〕 → I/conn 〔CN - 5(4)〕 → I/conn 〔CN -17(5)〕
  - → Wiper motor controller 〔CN-141(7)〕
  - → Wiper motor 〔CN-21(4)〕
- → Fuse box 〔No.5〕 → MCU 〔CN-50(7)〕
- → Fuse box 〔No.18〕 → I/conn 〔CN-11(3)〕
  - → AC controller (11)
  - → Blower (2)

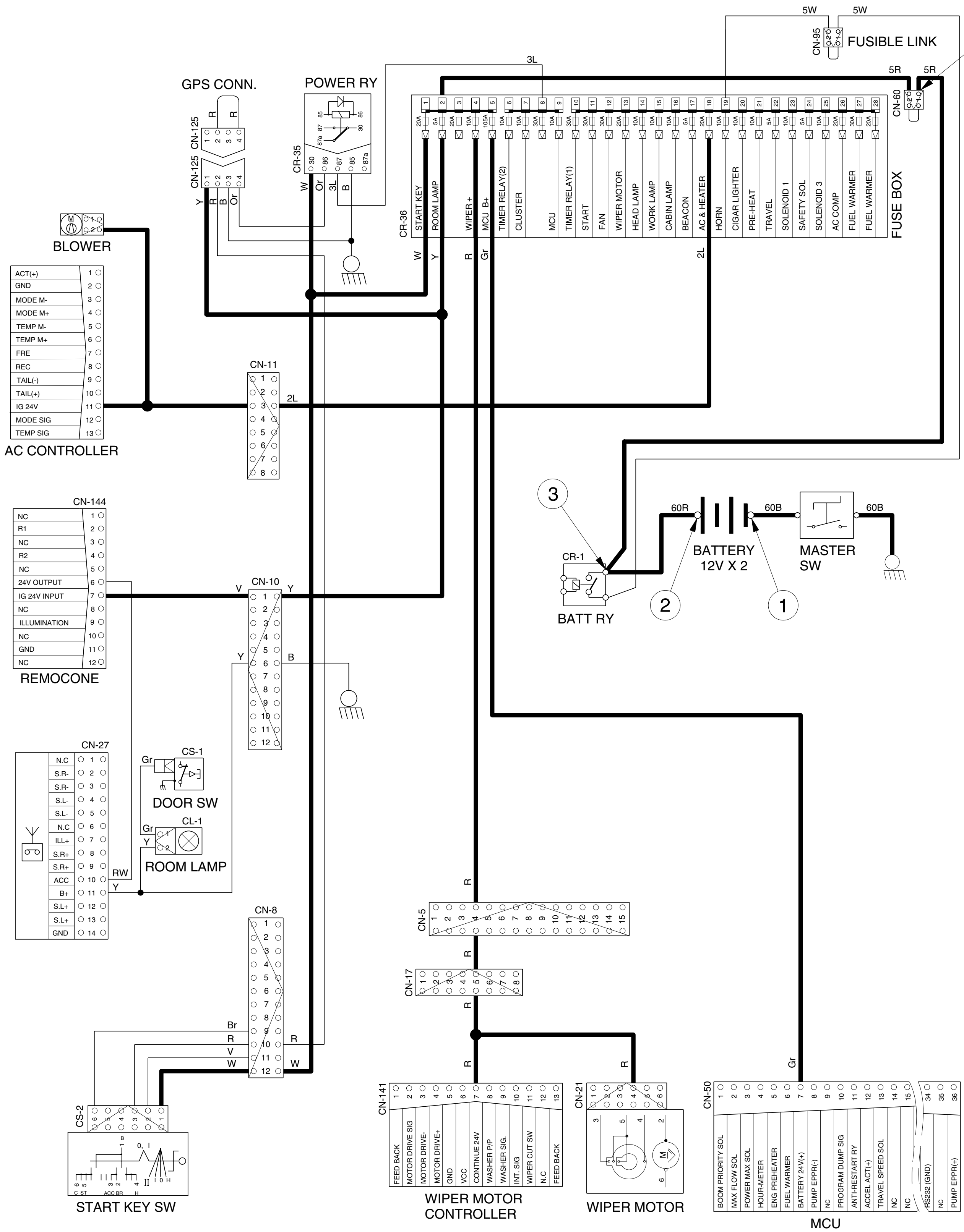
※ I/conn : Intermediate connector

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



21574EL03A

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay[CR-1] → Fusible link[CN-60] → Fuse box [No.1] → I/conn [CN-8(12)] → Start key [CS-2(1)]

※ Start switch : ON

→ Start switch ON [CS-2(2)] → I/conn [CN-8(11)] → Diode[DO-2] → 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)] → GPS connector [CN-125(2)→(4)] → Power relay [CR-35(86)→(87)] → Fuse box [No.6] → Relay timer [CR-50(2)→(4)] → I/conn [CN-2(8)] → Fuel cut-off [CN-79(B)]

※ Start switch : START

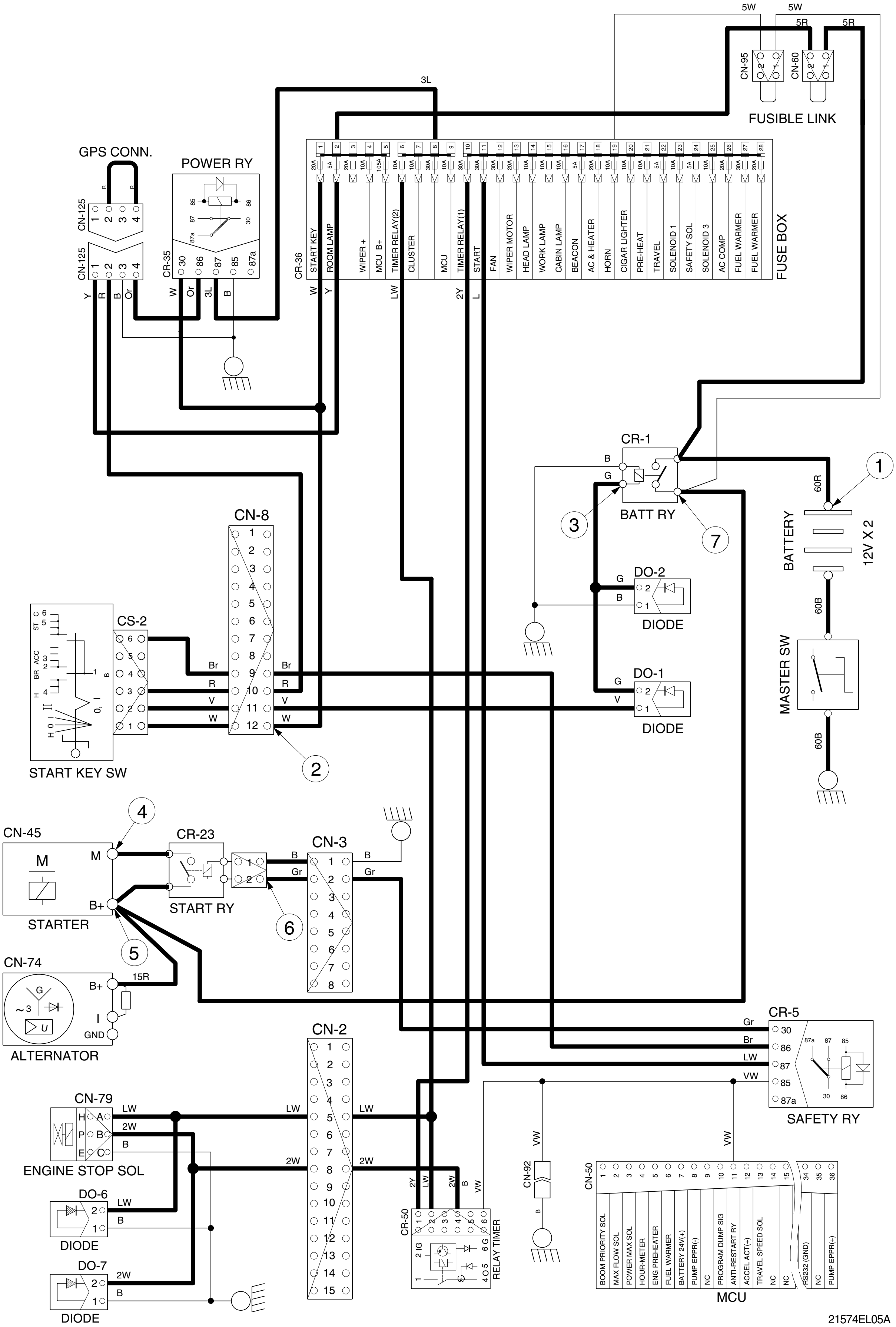
Start switch START[CS-2(6)] → I/conn[CN-8(9)] → Safety relay [CR-5(86) → (30)] → I/conn [CN-3(2)] → Start relay [CR-23]

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



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 → I/conn 〔CN-3(3)〕 → MCU 〔CN-51(9)〕 →
Cluster warning lamp(Via serial interface)

(2) Charging flow

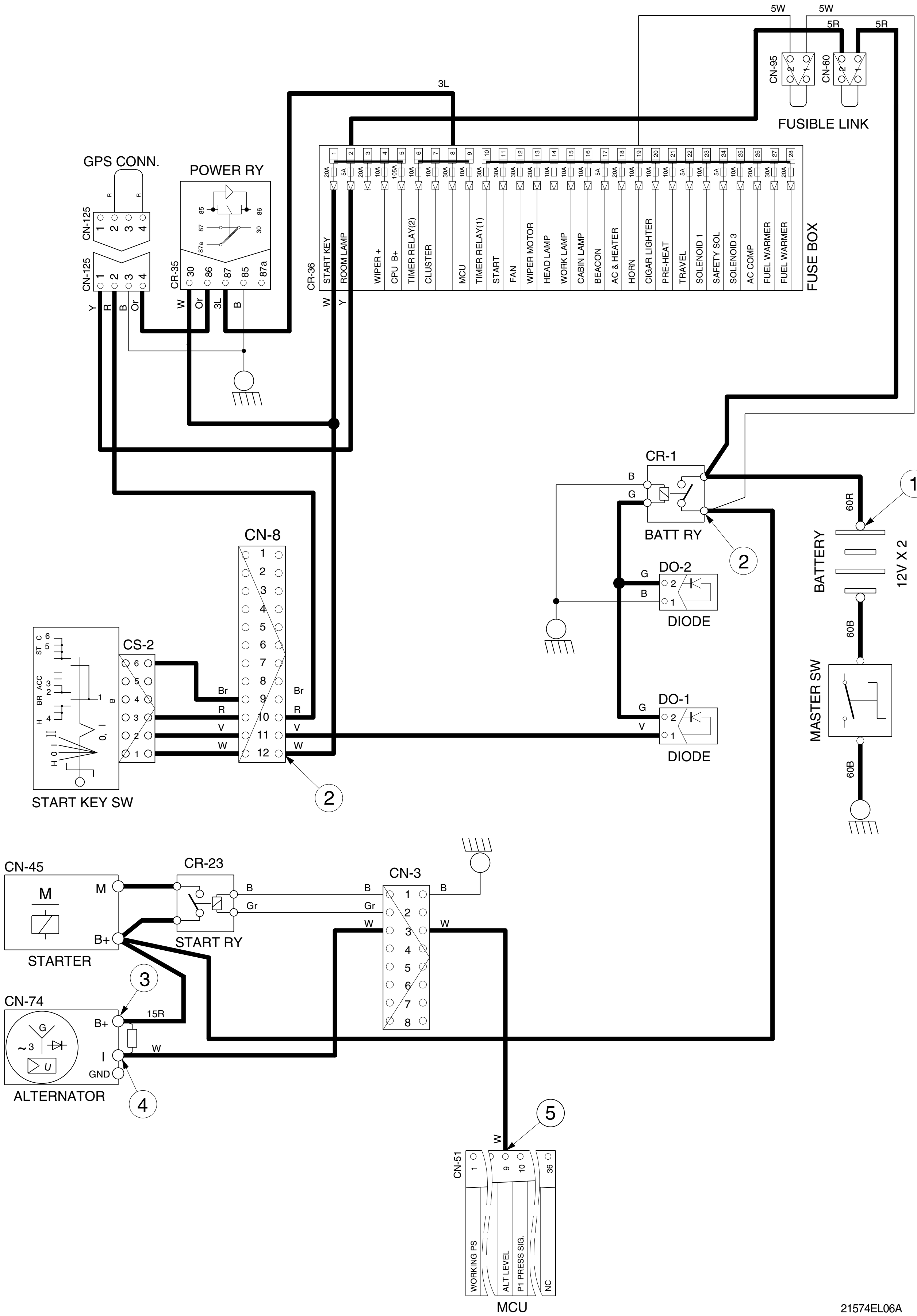
Alternator "B+" terminal → Battery relay(M8) → Battery(+) terminal
→ Fusible link[CN-60] → Fuse box

2) CHECK POINT

Engine	Start switch	Check point	Voltage
ON	ON	① - GND (Battery voltage) ② - GND (Battery relay) ③ - GND (Alternator B terminal) ④ - GND (Alternator I terminal) ⑤ - GND (CPU)	20 ~ 275V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD LAMP CIRCUIT

1) OPERATING FLOW

Fuse box (No.14) → I/conn [CN-6(12)] → CS-21(1)

※ When lamp switch ON

Light switch [CS-21(7)]

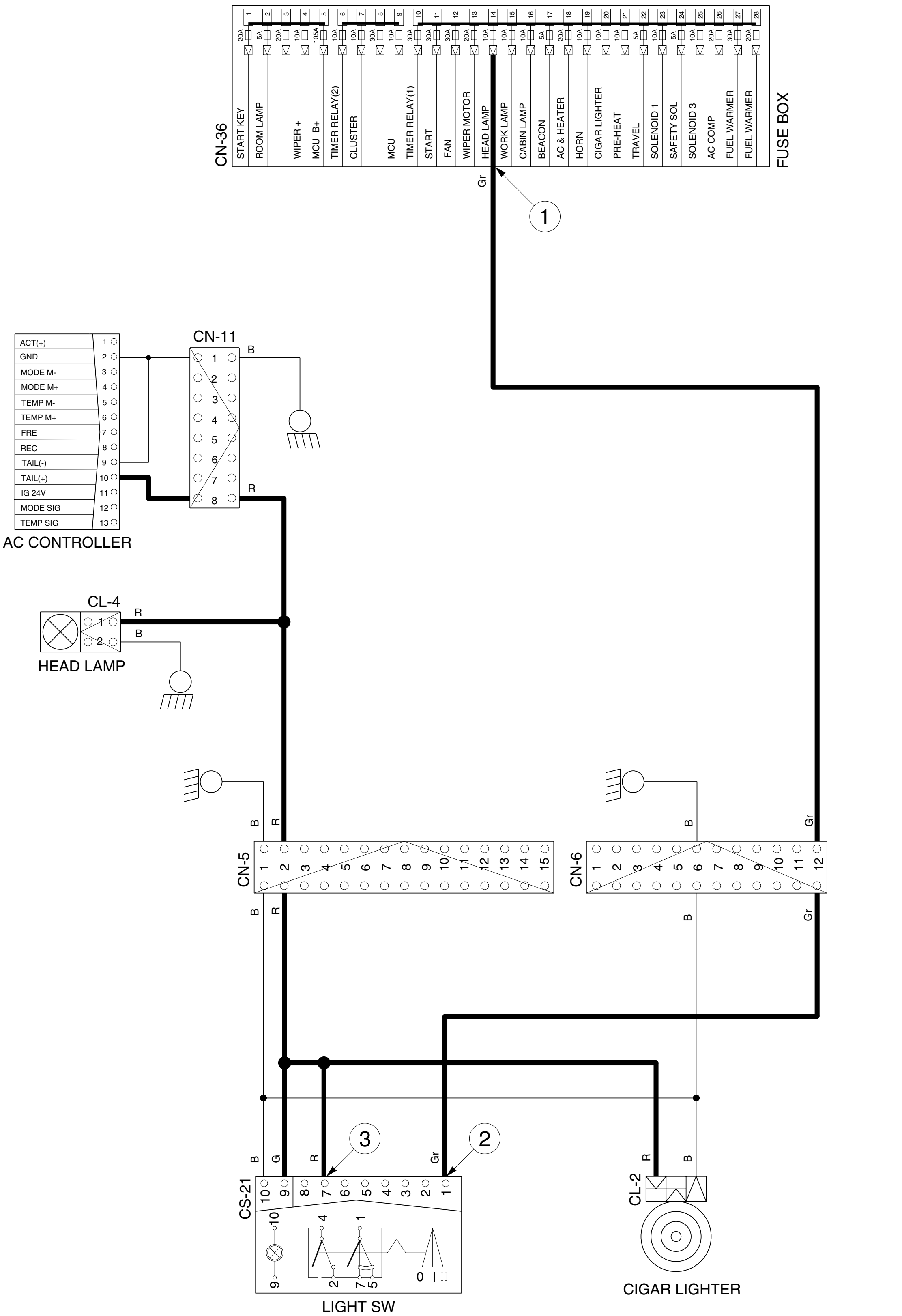
- → I/conn [CN-5(2)]
  - → Head lamp [CL-4(2)] : Head lamp ON
  - → I/conn [CN-11(8)] → Aircon controller illumination ON
- → I/conn [CS-21(9)] → Light switch illumination ON
- → Cigar light [CL-2]

2) CHECK POINT

Engine	Key switch	Check point	Voltage
STOP	ON	① - GND (Fuse box) ② - GND (Switch power input) ③ - GND (Switch power output)	20~25V

※ GND : Ground

HEAD LAMP CIRCUIT



5. WORK LAMP CIRCUIT

1) OPERATING FLOW

Fuse box (No.15) → I/conn [CN-5(8)] → Light switch [CS-21(4)]

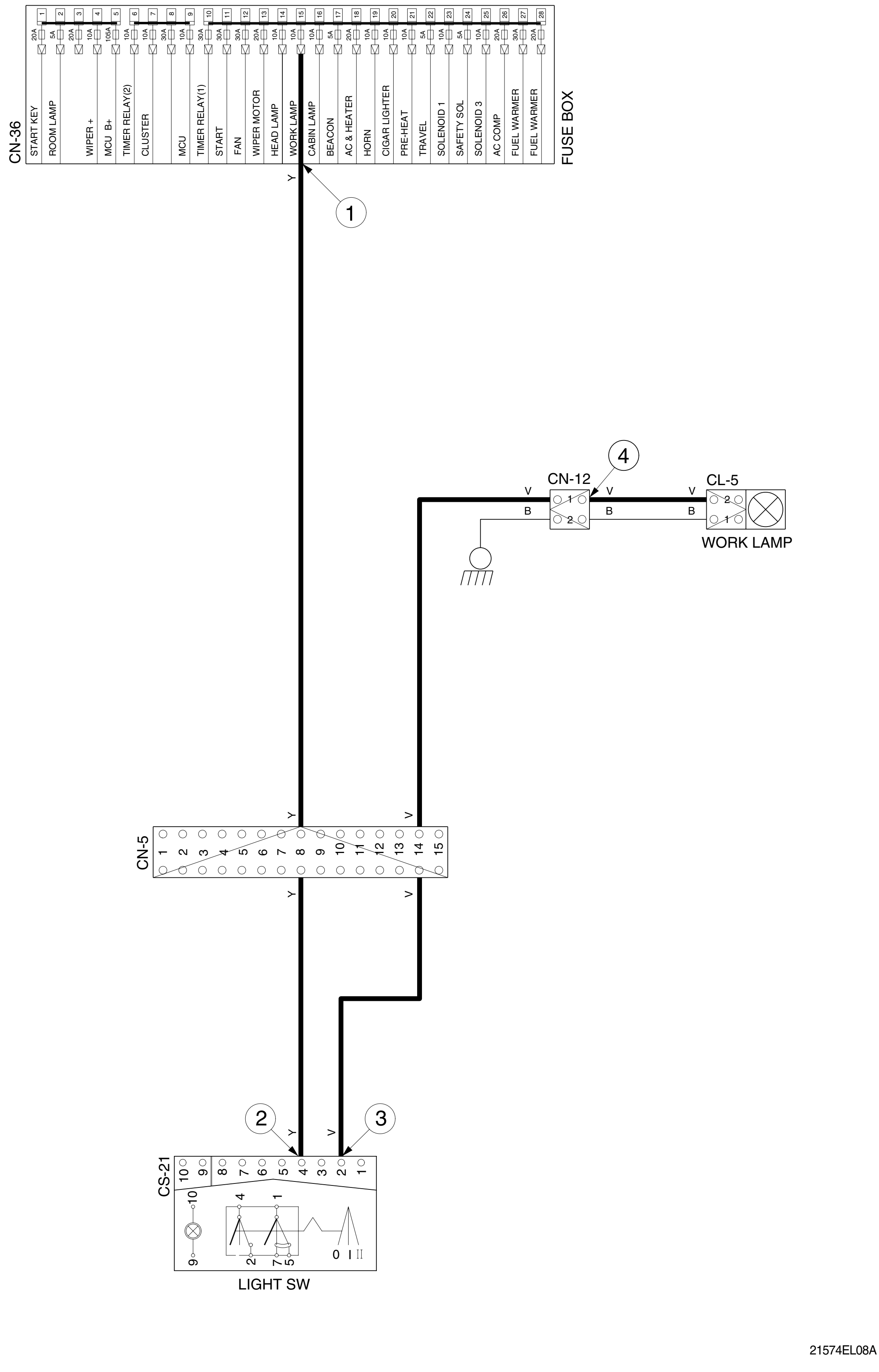
※ When work lamp switch ON
Work lamp switch ON [CS-21(2)] → I/conn [CN-5(14)] → I/conn [CN-12(1)]
→ Work lamp ON [CL-5(2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (Fuse box) ② - GND (Switch power input) ③ - GND (Switch power output) ④ - GND (Work lamp)	20~25V

※ GND : Ground

WORK LAMP CIRCUIT



6. CAB LAMP CIRCUIT

1) OPERATING FLOW

Fuse box (No.16) → I/conn〔CN-6(3)〕→ Cabin lamp switch[CS-24(6)]

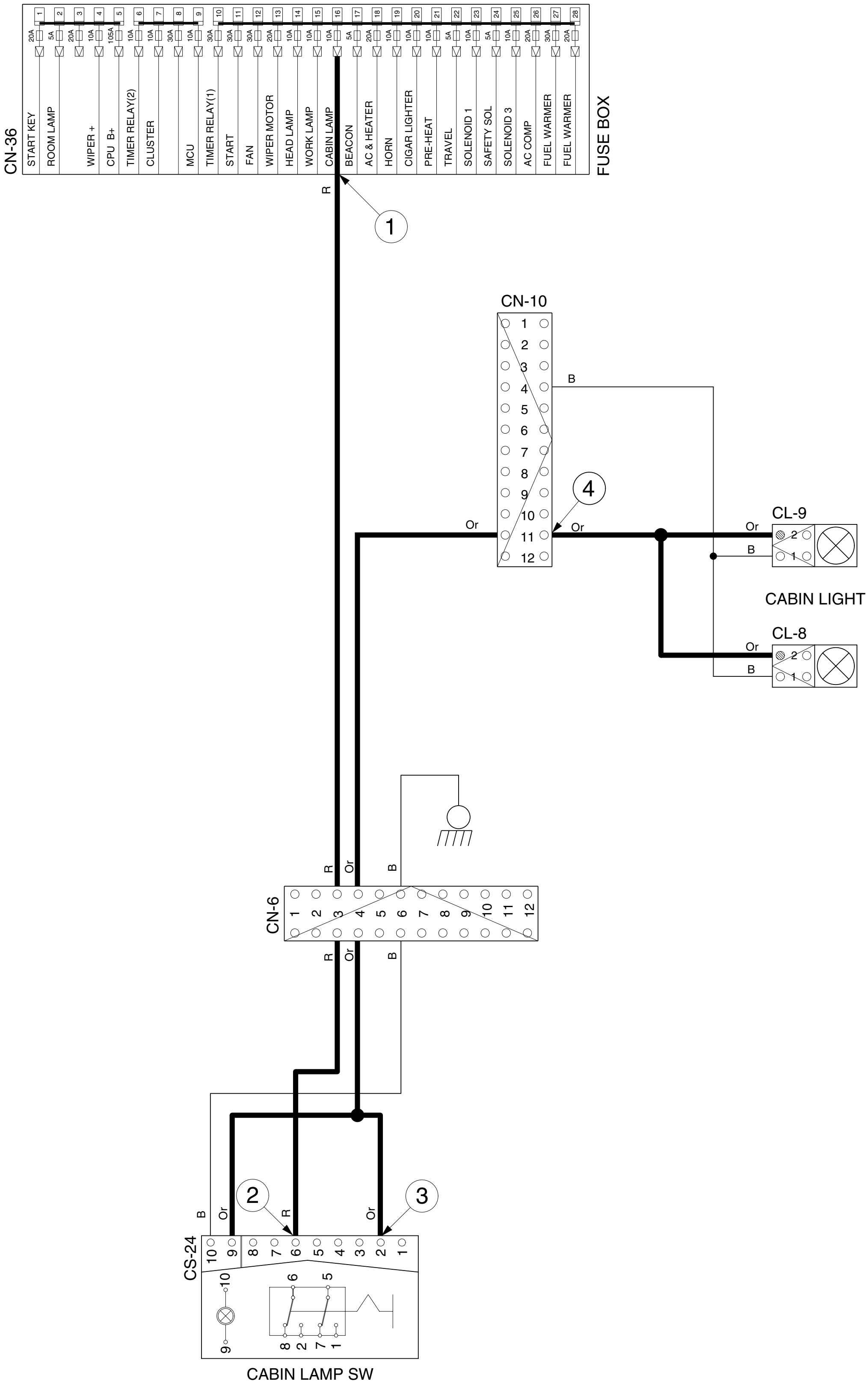
※ When Lamp switch ON
Lamp switch ON [CS-24(2)] → I/conn [CN-6(4)] → I/conn [CN-10(11)] →
Cab light ON [CL-8(2), CL-9(2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (Fuse box) ② - GND (Switch power input) ③ - GND (Switch power output) ④ - GND (Cab lamp)	20 ~ 25V

※ GND : Ground

CAB LAMP CIRCUIT



21574EL09A

7. BEACON LAMP CIRCUIT

1) OPERATING FLOW

Fuse box (No.17) → I/conn［CN-8(3)］→ Beacon lamp switch［CS-23(6)］

※ When lamp switch ON

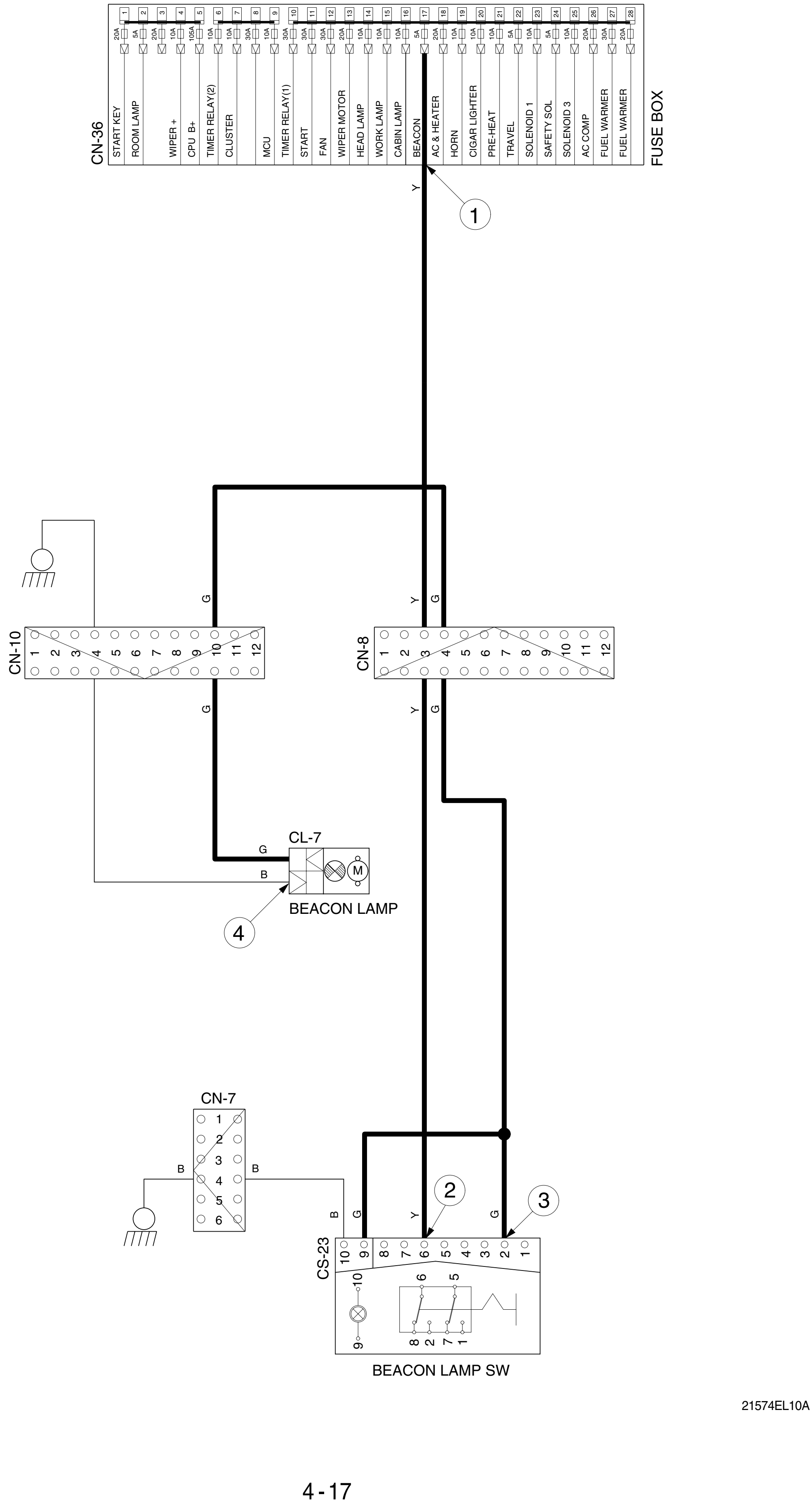
Beacon lamp switch ON［CS-23(2)］→ Switch Indicator lamp ON［CS-23(9)］
→ I/conn［CN-8(4)］→ I/conn［CN-10(10)］
→ Beacon lamp ON［CL-7］

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND(Fuse box) ② - GND(Switch power input) ③ - GND(Switch power output) ④ - GND(Beacon lamp)	20~25V

※ GND : Ground

BEACON LAMP CIRCUIT



8. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

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

Fuse box (No.13) → 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

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

(3) Washer switch ON : 2nd step(washer)

Washer switch ON [CS-3(3)] → I/conn [CN-7(2)] → 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.

(4) Auto parking(When switch OFF)

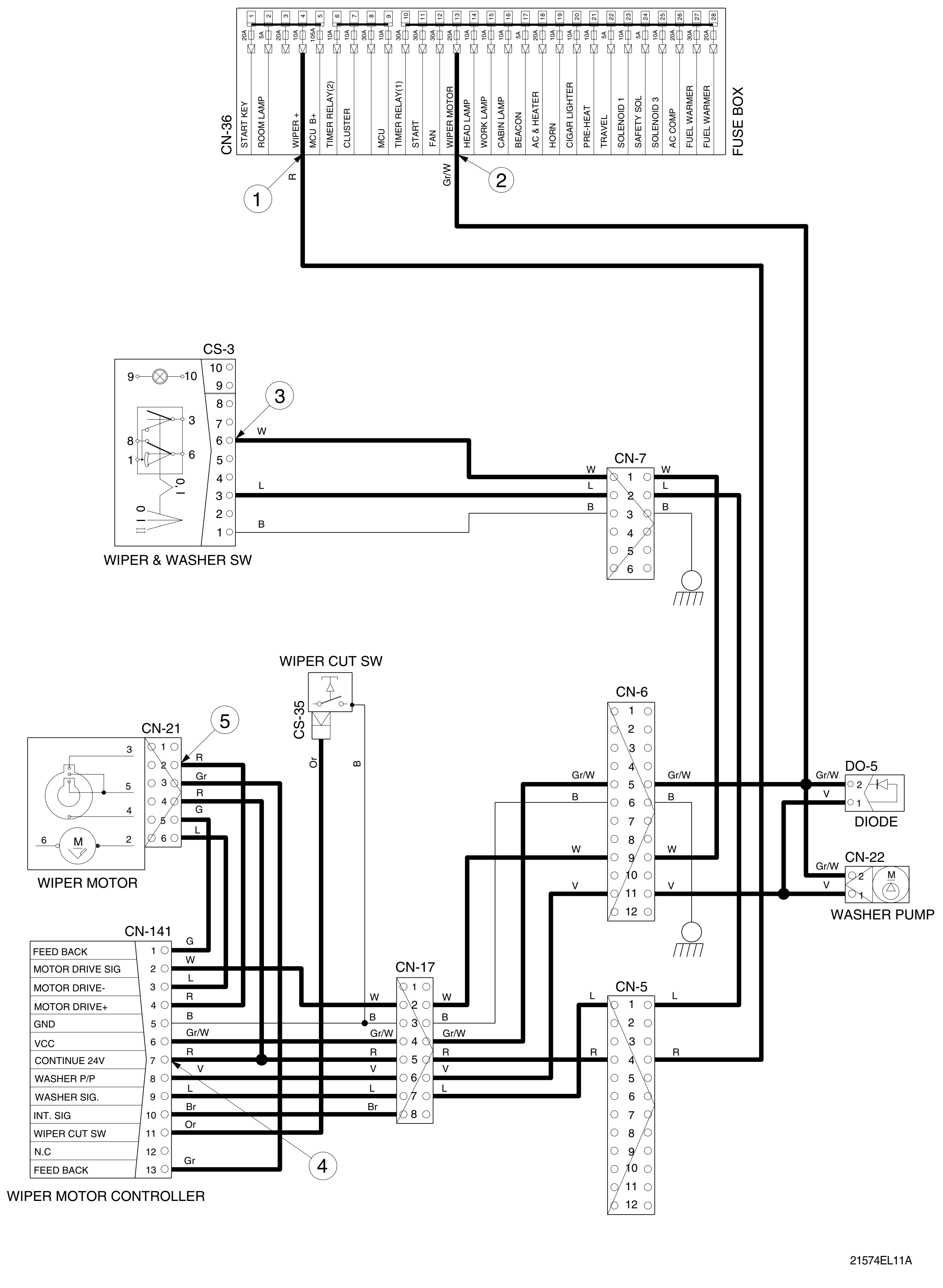
Switch OFF [CS-3(6)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

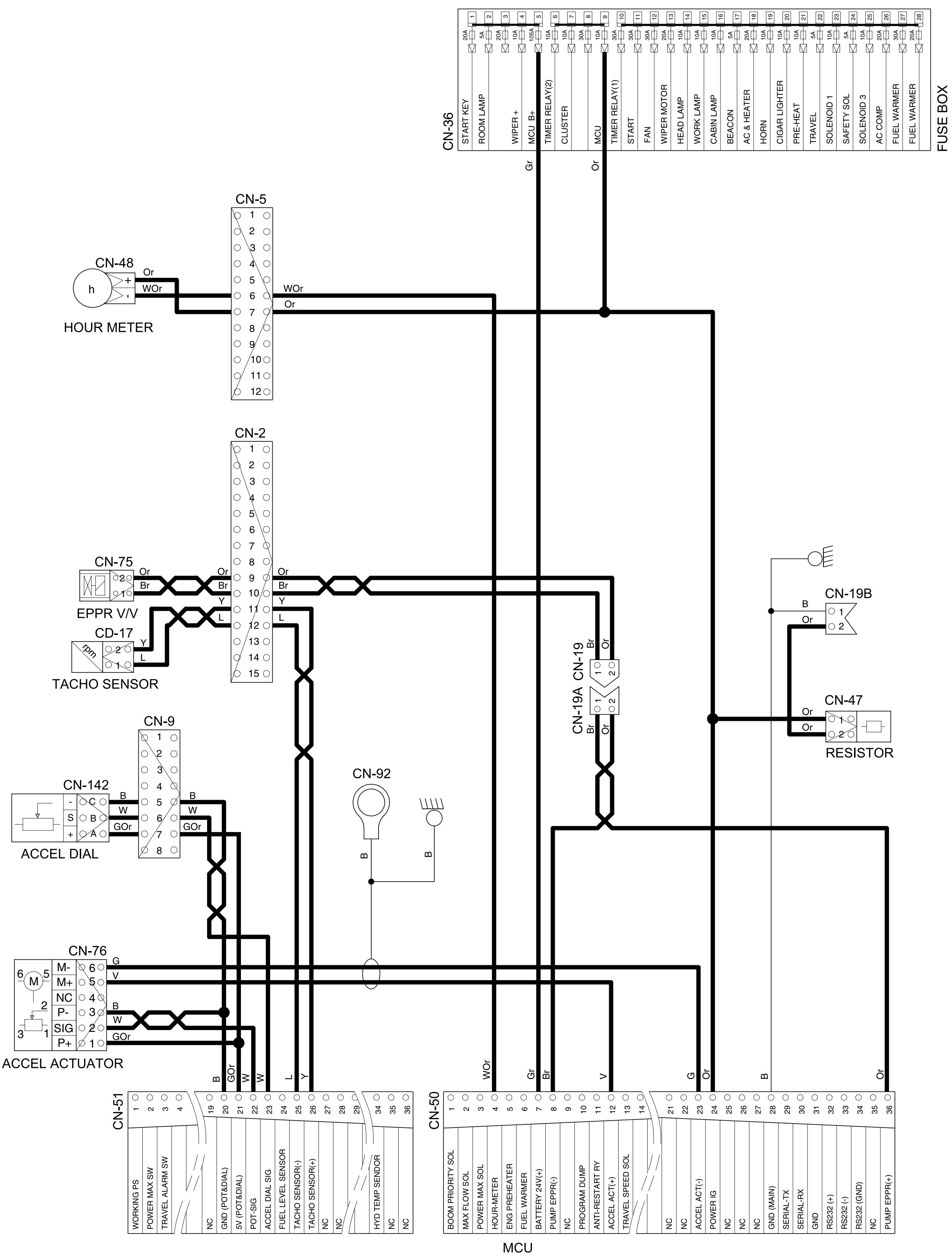
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND(Fuse box) ② - GND(Switch power output) ③ - GND(Wiper Power input) ④ - GND(Wiper power output) ⑤ - GND(Wiper motor)	20~25V

※ GND : Ground

WIPER AND WASHER CIRCUIT

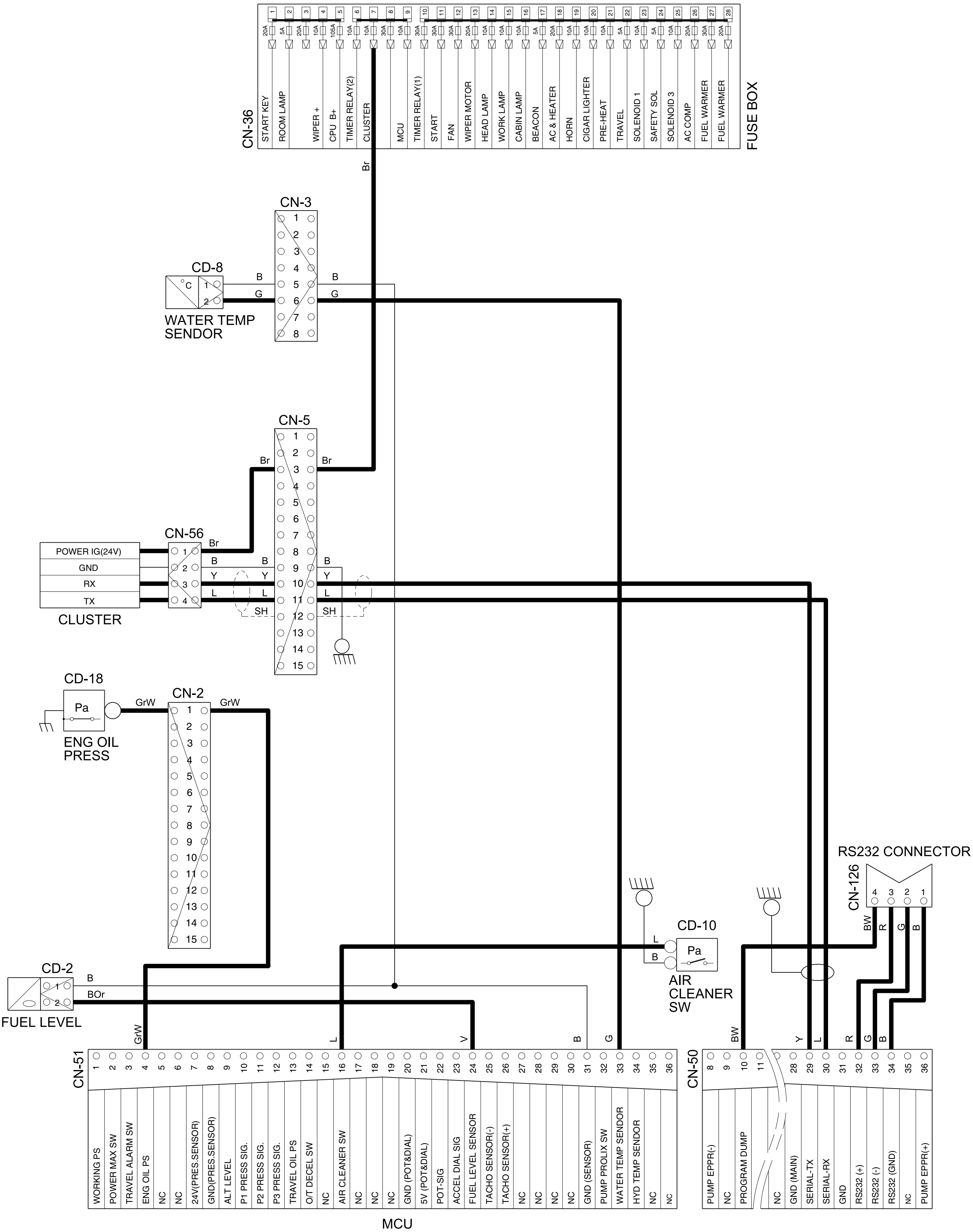


CONTROLLER CIRCUIT



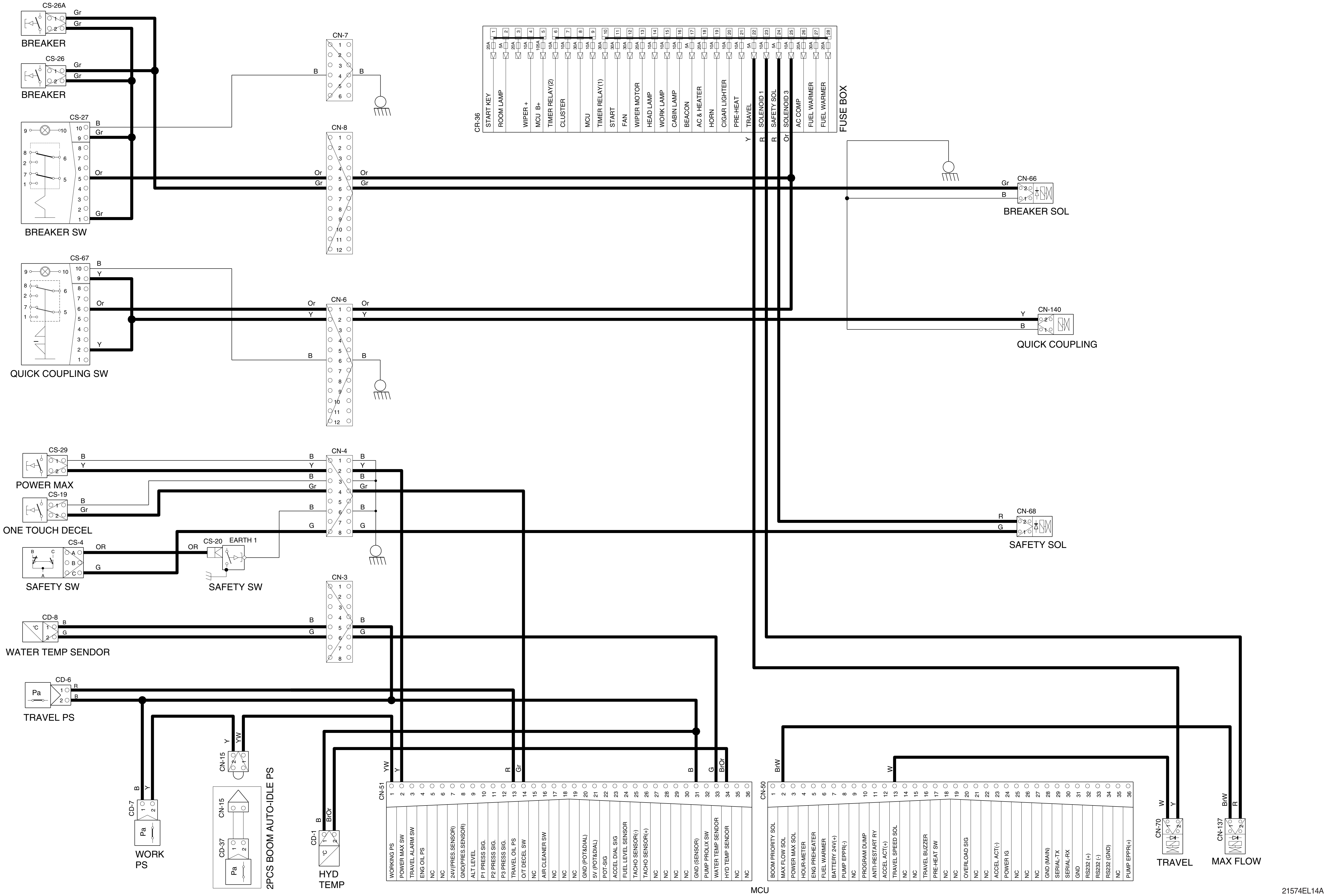
21574EL12A

MONITORING CIRCUIT

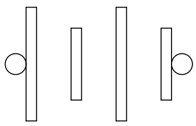
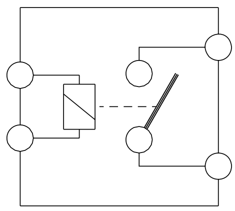
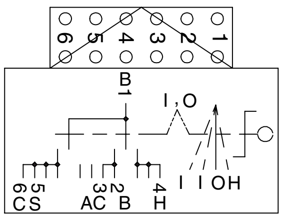
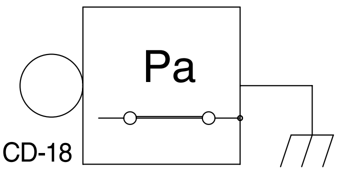
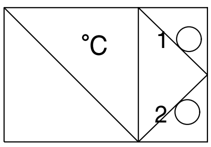


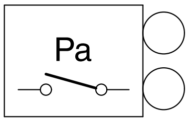
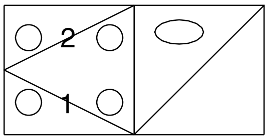
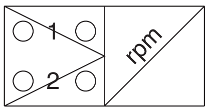
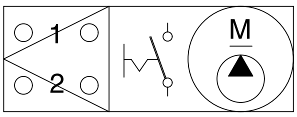
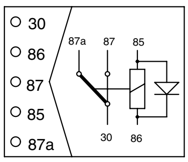
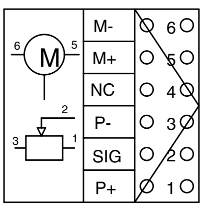
21574EL13A

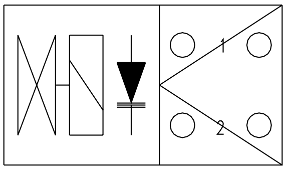
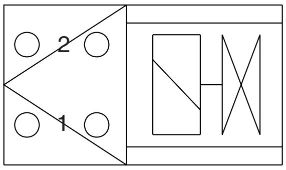
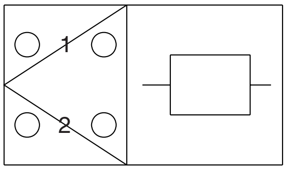
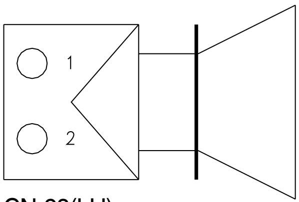
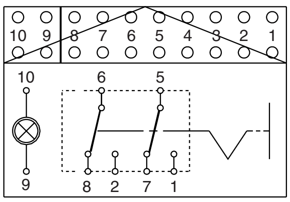
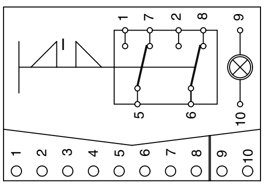
ELECTRIC CIRCUIT FOR HYDRAULIC

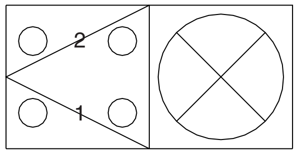
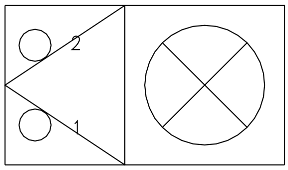
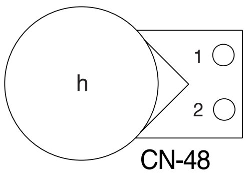
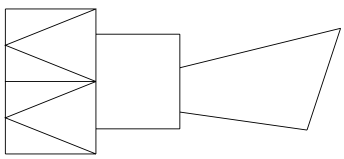
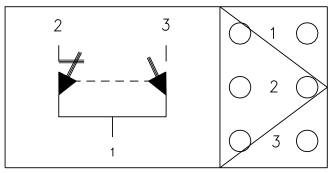
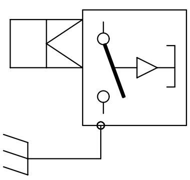


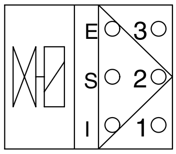
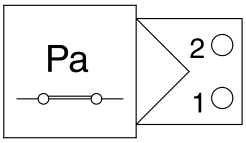
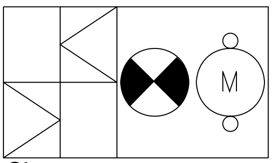
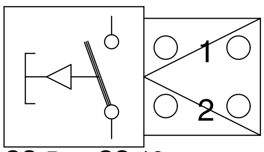
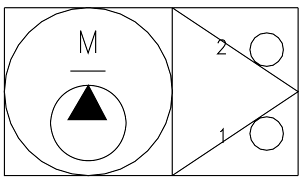
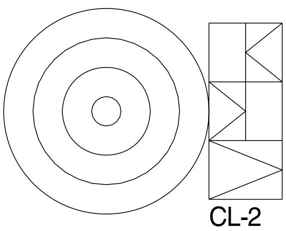
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

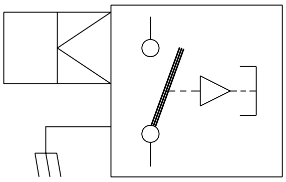
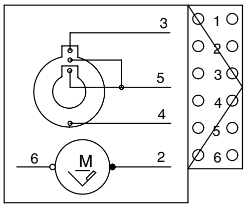
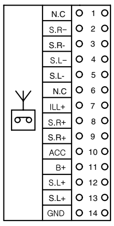
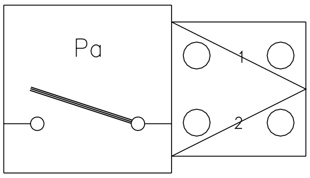
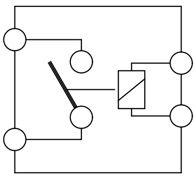
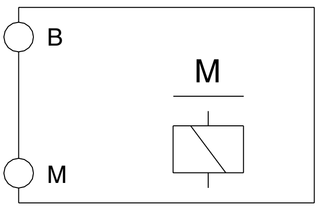
Part name	Symbol	Specification	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A(continuity) 1000A(30seconds)	※ Check coil resistance (M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Start key		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 switch (For engine oil)	 CD-18	0.5 kgf/cm^2 (N.C TYPE)	※ Check resistance Normal : 0 Ω (CLOSE)
Temperature sensor	 CD-1 CD-8	-	※ Check resistance 50°C : 804 Ω 80°C : 310 Ω 100°C : 180 Ω

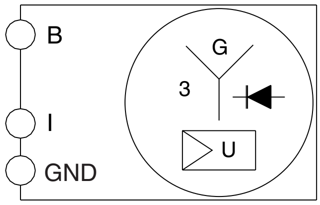
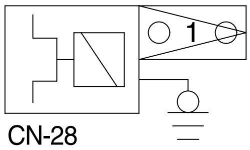
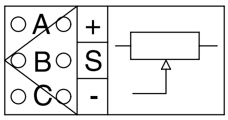
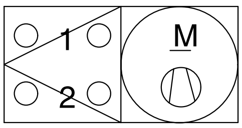
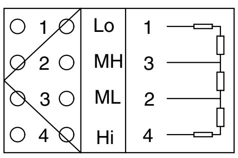
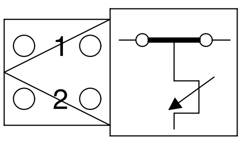
Part name	Symbol	Specification	Check
Air cleaner pressure switch	 CD-10	Pressure: 635mmH2O (N.O TYPE)	※ Check contact Normal : ∞ Ω
Fuel sender	 CD-2	-	※ Check resistance Full : 50 Ω 6/12 : 350 Ω 11/12 : 100 Ω 5/12 : 400 Ω 10/12 : 150 Ω 4/12 : 450 Ω 9/12 : 200 Ω 3/12 : 500 Ω 8/12 : 250 Ω 2/12 : 550 Ω 7/12 : 300 Ω 1/12 : 600 Ω Empty warning :700 Ω
Tacho sensor	 CD-17	-	※ Check resistance Normal : 300 Ω (For terminal 1,2)
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※ Check resistance Normal : 1.0 Ω
Relay (Horn, Safety, Ac comp, Power, Preheat, Fuel warmer)	 CR-2 CR-35 CR-5 CR-36 CR-7 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)
Accel actuator	 CN-76	-	※ Check resistance Normal : 1-2 Ω (For terminal 5-6) 0.8-1.2kΩ (For terminal 1-3)

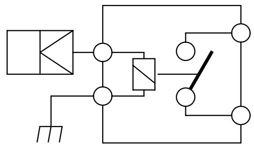
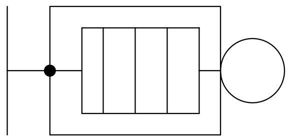
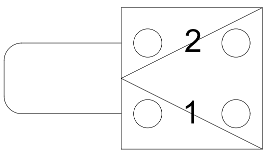
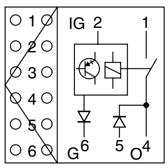
Part name	Symbol	Specification	Check
Solenoid valve	 CN-66 CN-68 CN-70 CN-137	24V 1A	※ Check resistance Normal : 15~25 Ω (For terminal 1-2)
EPPR valve	 CN-75	700mA	※ Check resistance Normal : 18~25 Ω (For terminal 1-2)
Resistor	 CN-47	50 Ω 20W± 5%	※ Check resistance Normal : 50 Ω
Speaker	 CN-23(LH) CN-24(RH)	4 Ω 20W	※Check resistance Normal : 4 Ω
Switch (Locking type)	 CS-23 CS-24 CS-27 CS-54 CS-99 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)
Switch (Quick clamp)	 CS-67	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)

Part name	Symbol	Specification	Check
Head lamp, Work lamp, Cab lamp	 CL-4 CL-5 CL-6 CL-8 CL-9	24V 70W (H3 TYPE)	※ Check disconnection Normal : 1.2 Ω
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : A few Ω
Hour meter	 CN-48	16V ~ 32V	※ Check operation · Supply power(24V) to terminal No. 2 and connect terminal No. 1 and ground.
Horn	 CN-20 CN-25	DC 22.0 ~ 28.0V 2A	※ Check operation · Supply power(24V) to each terminal and connect ground.
Safety switch 1	 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)
Safety switch 2 Wiper cut sw	 CS-20 CS-53	24V (N.C TYPE)	※ Check contact Normal : 0 Ω (one pin to ground)

Part name	Symbol	Specification	Check
Fuel cut-off	 CN-79	24V	※ Check resistance Normal : 15~25 Ω
Pressure switch (Travel, Work)	 CD-6 CD-7	10bar (N.C type)	※ Check contact Normal : 0.1 Ω
Beacon lamp	 CL-7	24V 70W	※ Check disconnection Normal : 1.1 Ω
Switch (Power max, One touch decel, Breaker, Horn)	 CS-5 CS-19 CS-26 CS-26A CS-29	24V 6A	※Check contact Normal : ∞ Ω
Washer tank	 CN-22	24V 3.8A	※Check contact Normal : 10.7 Ω (For terminal 1-2)
Cigar lighter	 CL-2	24V 5A 1.4W	※Check coil resistance Normal : About 1MΩ ※ Check contact Normal : ∞ Ω Operating time : 5~15sec

Part name	Symbol	Specification	Check
Door switch	 CS-1	24V 2W	※Check resistance Normal : About 5MΩ
Wiper motor	 CN-21	24V 2A	※Check contact Normal : 7 Ω (For terminal 2-6)
Cassette radio	 CN-27	24V 2A	※ Check voltage 20 ~ 25V (For terminal 10-14,11-14)
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : 0 Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94 Ω (For terminal 1-2)
Starter	 CN-45	Delco Remy 28MT 24V	※ Check contact Normal : 0.1 Ω

Part name	Symbol	Specification	Check
Alternator	 CN-74	24V 60A	※ Check contact Normal : 0 Ω (For terminal B ⊡1) Normal : 24 ~ 27.5V
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4 Ω
Accel dial	 CN-142	-	※ Check resistance Normal : About 5kΩ (For terminal A-C) ※ Check voltage Normal : About 5V (For terminal A-C) : 2 ~ 4.5V (For terminal C-B)
Blower motor		24V 9.5A	※ Check resistance 2.5 Ω (For terminal 1-2)
Aircon resistor		-	※ Check resistance 1.12 Ω (For terminal 4-2) 2.07 Ω (For terminal 2-3) 3.17 Ω (For terminal 3-1)
Duct sensor (Switch)		1°C OFF 4°C ON	※ Check resistance : 0 Ω (For terminal 1-2, the atmosphere temp : over 4°C)

Part name	Symbol	Specification	Check
Preheater relay	 CR-24	24V 200A	※ Check contact Normal : 0.94 Ω (For terminal 1-GND)
Preheater		24V 200A	※ check resistance : 0.25 ~ 0.12 Ω
Fusible link	 CN-60 CN-95	60A	※Check disconnection Normal : 0 Ω (Connect ring terminal and check resist between terminal 1 and 2)
Relay timer	 CR-50	24V 70A	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

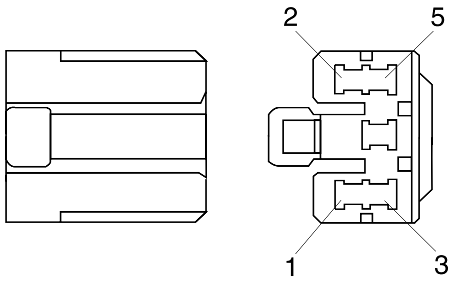
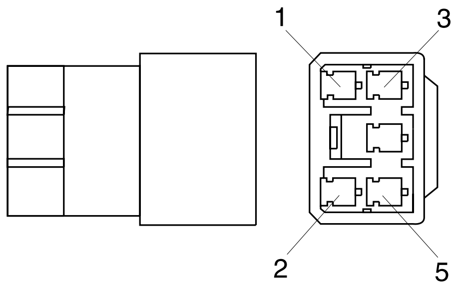
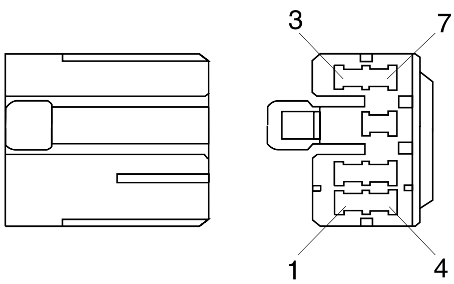
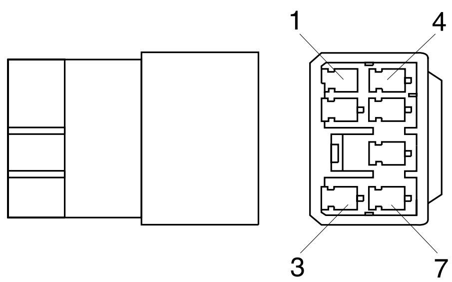
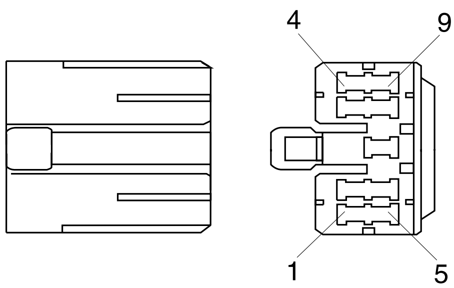
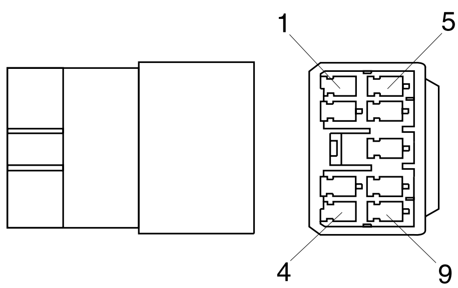
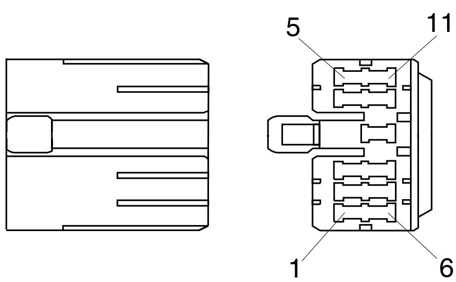
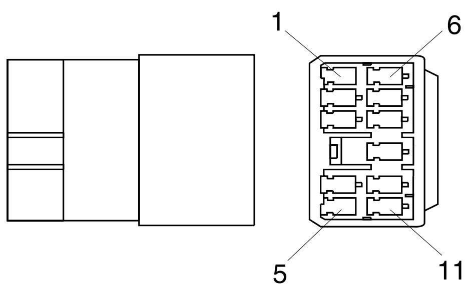
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-2	KET	15	Engine rear harness	2-85262-1	368301-1
CN-3	AMP	8	Engine harness	S816-008002	S816-108002
CN-4	AMP	8	Console LH wire harness	S816-008002	S816-108002
CN-5	AMP	12	RH side harness	2-85262-1	368301-1
CN-6	AMP	12	RH side harness	S816-012002	S816-112002
CN-7	AMP	6	Console RH wire harness	S816-006002	S816-106002
CN-8	AMP	12	Console RH wire harness	S816-012002	S816-112002
CN-9	AMP	8	Console RH wire harness	S816-008002	S816-108002
CN-10	DEUTSCH	12	Cab harness	DT06-12S	DT06-12P
CN-11	DEUTSCH	8	Aircon harness	DT06-8S	DT04-08P
CN-12	DEUTSCH	2	Work lamp harness	DT06-2S-EP06	DT04-2P-E004
CN-15	KET	2	2pcs auto idle pressure	S814-002100	S814-102100
CN-17	DEUTSCH	8	Wiper harness	DT06-8S	DT04-8P
CN-19	AMP	2	Emergency MCU connector	S816-002002	-
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	LH speaker	MG610070	-
CN-24	KET	2	RH speaker	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27	AMP	14	Cassette radio	173852	-
CN-28	MWP	1	Air-con compressor	MWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	DEUTSCH	3	Fuse box	21N8-20041	-
CN-45	RING TERM	-	Start motor B^+	ST710264-2	-
CN-47	AMP	2	Resistor	S810-002202	S810-102202
CN-48	RING TERM	2	Hour meter	GP890469	-
CN-50	AMP	36	MCU	3441110	-
CN-51	AMP	36	MCU	3441110	-
CN-56	DEUTSCH	4	Cluster	-	DT04-4P-E004
CN-60	YAZAKI	2	Fusible link	7123-4125-50	7122-4125-50
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-EP06	DT04-2P-E005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	DT04-2P-E005
CN-70	DEUTSCH	2	Travel speed solenoid	DT06-2S-EP06	-
CN-74	RING-TERM	1	Alternator “1” term	S820-105000	-
CN-75	Econoseal J	2	EPPR valve	S816-002002	-
CN-76	DEUTSCH	6	DC motor	DT06-6S-EP06	-
CN-79	-	3	Fuel cut-off	S810-002201	-
CN-92	AMP	1	Emergency engine starting connector	S814-101100	S814-001100

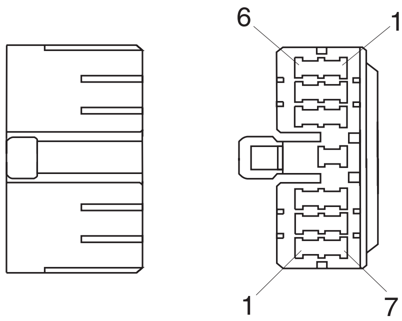
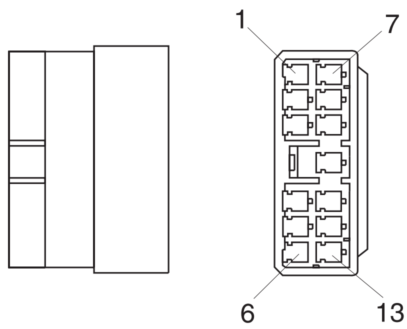
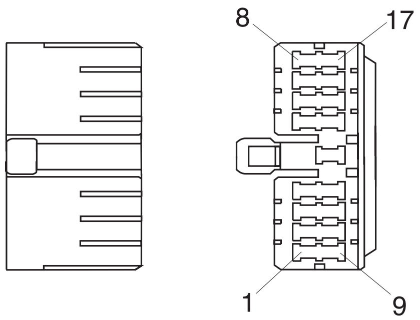
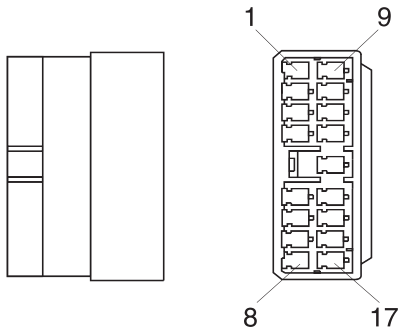
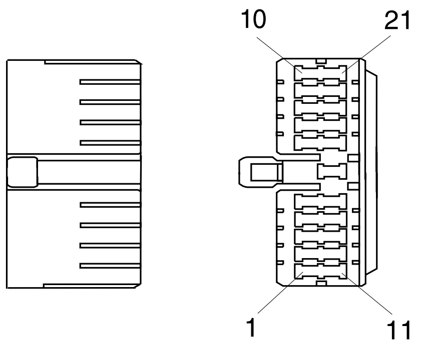
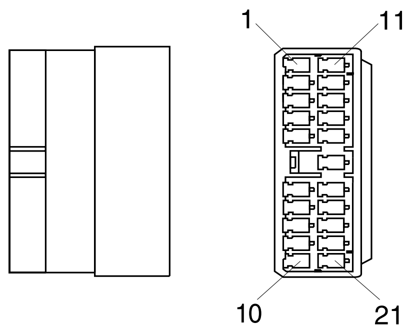
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-95	KET	2	Fusible link	S813-030201	S813-130200
CN-126	DEUTSCH	4	RS232 connector	DT06-4S-EP06	DT04-4P-E005
CN-137	DEUTSCH	2	Max flow solenoid valve	DT06-2S-EP06	-
CN-141	AMP	13	Wiper motor control unit	172498-1	-
CN-142	DEUTSCH	3	Accel dial	DT06-3S-P012	-
CN-143	AMP	2	Cassette radio(with remocon)	S816-002002	-
CN-144	AMP	12	Remocon-cassette radio	174045-2	-
CN-147	-	2	Fuel heater	1530-0027	-
CN-248	-	2	Fan	S816-002002	S816-102002
RELAY					
CR-1	RING TERM	1	Battery relay	S820-104002	-
CR-2	-	5	Horn relay	-	-
CR-5	-	5	Safety relay	-	-
CR-7	-	5	Ac comp relay	-	-
CR-23	KET	2	Start relay	S814-002001	S814-102001
CR-24	RING TERM	1	Pre-heater relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Pre-heat relay	-	-
CR-46	-	4	Fuel warmer	S810-004202	-
CR-50	KET	6	Relay timer	MG610049-5	-
SWITCH					
CS-1	SHUR	1	Door switch	S822-014004	-
CS-2	-	6	Start key switch	S814-006000	S814-106000
CS-3	SWF	10	Wiper & washer switch	SWF593757	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-P012	DT04-3P-E004
CS-5	DEUTSCH	2	Horn switch	DT06-2S-EP06	DT04-2P-E004
CS-19	DEUTSCH	2	One touch decel	DT06-2S-EP06	DT04-2P-E004
CS-20	AMP	1	Safety switch	S822-014002	-
CS-21	SWF	10	Main light switch	SWF593757	-
CS-23	SWF	10	Beacon lamp switch	SWF593757	-
CS-24	SWF	10	Cab light switch	SWF593757	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-P012	DT04-2P-E004
CS-27	SWF	10	Breaker switch	SWF593757	-
CS-53	SHUR	1	Wiper cut switch	S822-014002	-
CS-54	SWF	10	Spare switch	SWF593757	-
CS-99	SWF	10	Spare switch	SWF593757	-
CS-101	SWF	10	Fan switch	SWF593757	-
LAMP					
CL-1	KET	2	Cab room lamp	MG610392	-
CL-2	AMP	1	Cigar light	S822-014002	-
CL-4	DEUTSCH	2	Head lamp	DT06-2S-EP06	DT04-2P-E005
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P-E005

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-7	SHUR	1	Beacon lamp	S822-014004	S822-114004
CL-8	DEUTSCH	2	Cabin light-LH	DT06-2S-EP06	DT04-2P-E005
CL-9	DEUTSCH	2	Cabin light-RH	DT06-2S-EP06	DT04-2P-E005
SENDER					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	DT04-2P-E005
CD-6	KET	3	Travel pressure switch	MG640795	-
CD-7	KET	3	Working pressure switch	MG640795	-
CD-8	AMP	2	Water temp sender	85202-1	-
CD-10	RING TERM	1	Air cleaner switch	GP690469	-
CD-17	-	2	Tacho sensor	-	S818-120221
CD-18	RING TERM	1	Engine oil pressure switch	S820-104000	-
DIODE					
DO-1	AMP	2	-	21EA-50550	-
DO-2	AMP	2	-	21EA-50550	-
DO-5	AMP	2	-	21EA-50570	-

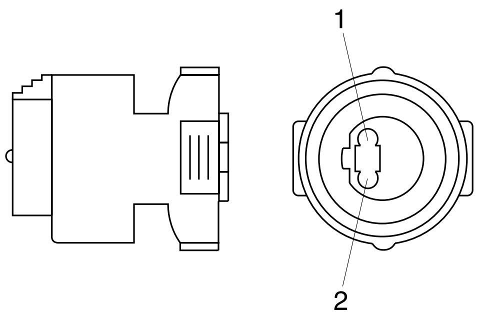
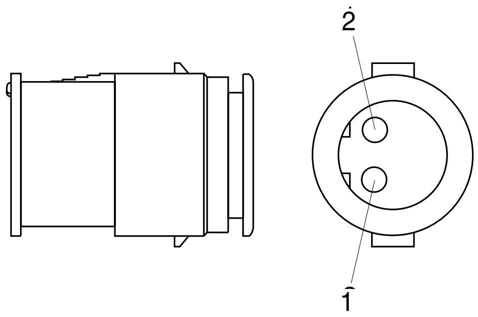
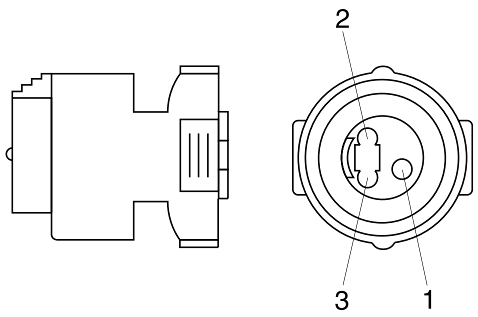
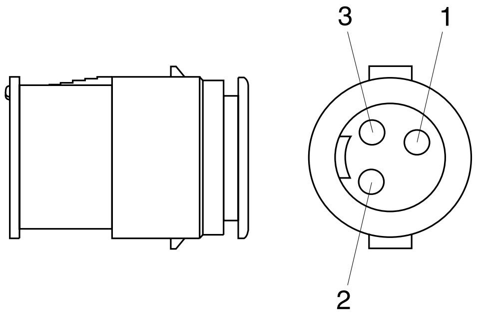
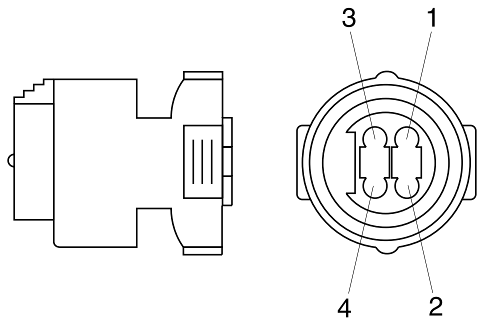
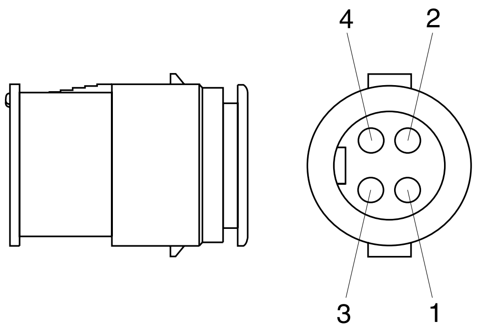
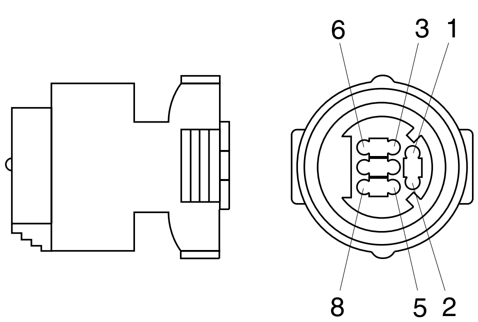
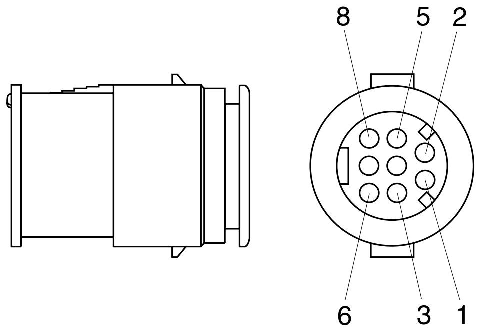
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

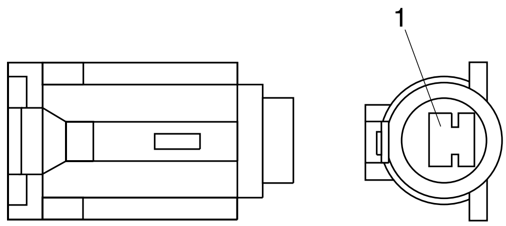
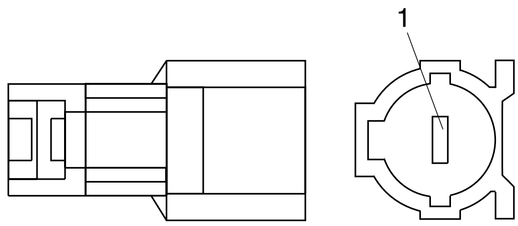
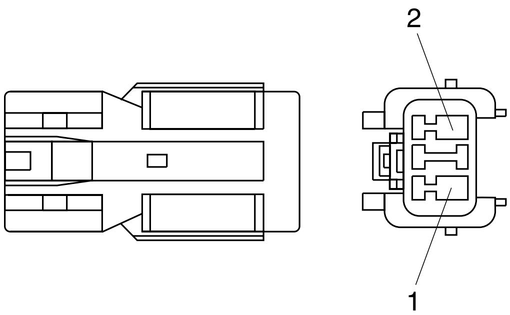
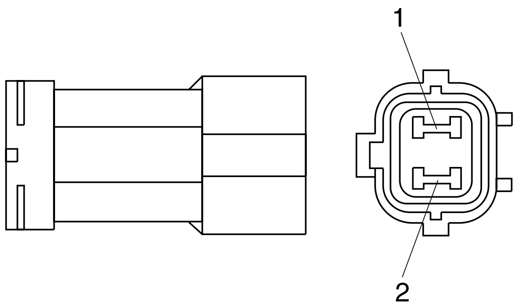
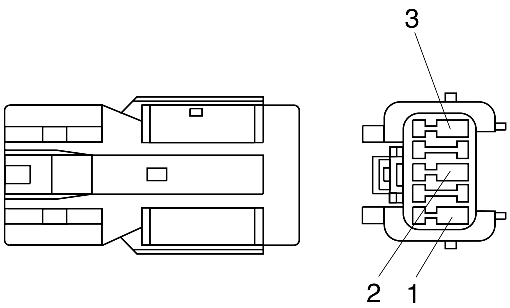
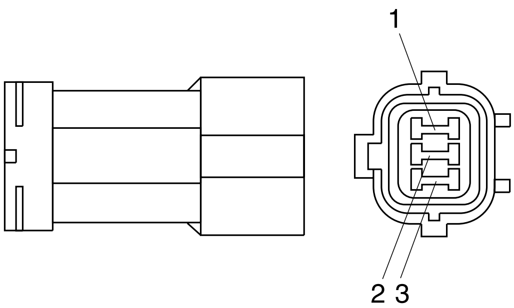
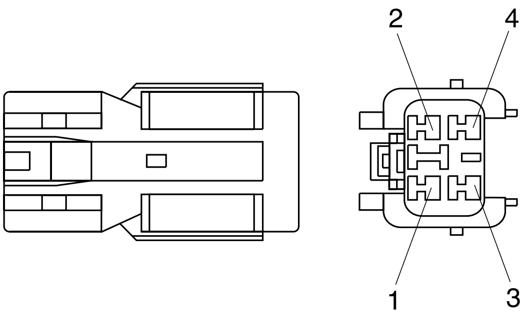
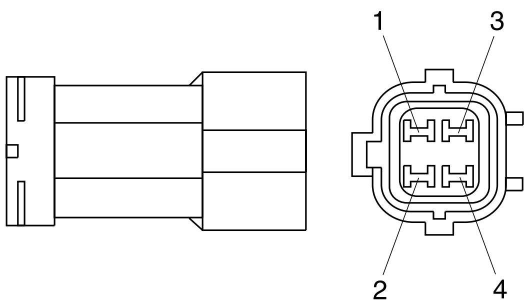
No. of pin	Receptacle connector(Female)	Plug connector(Male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

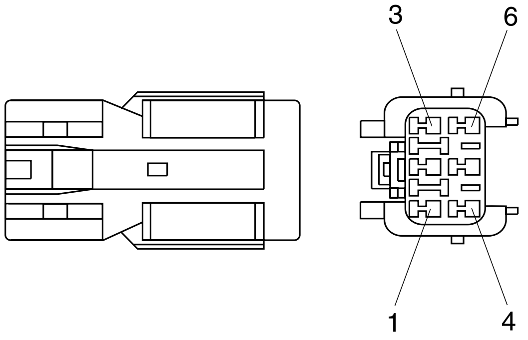
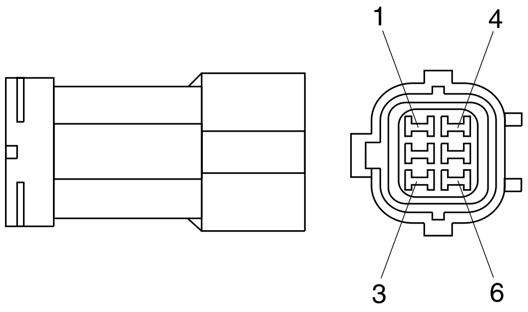
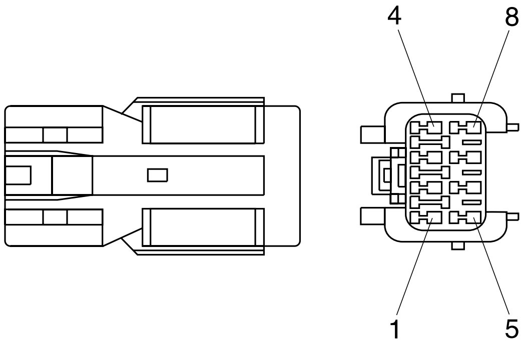
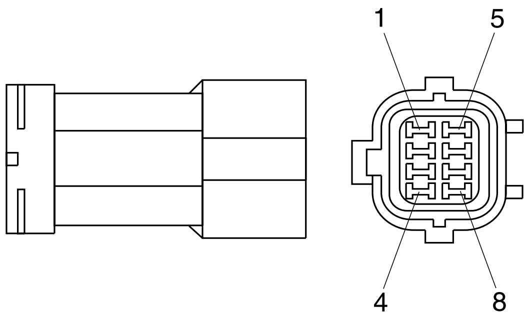
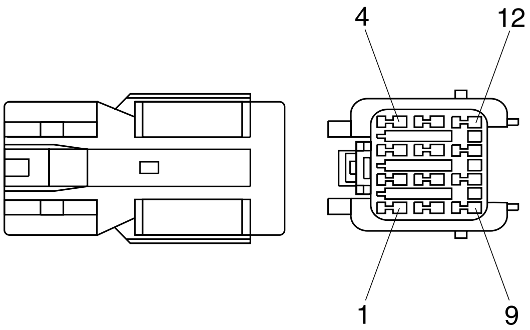
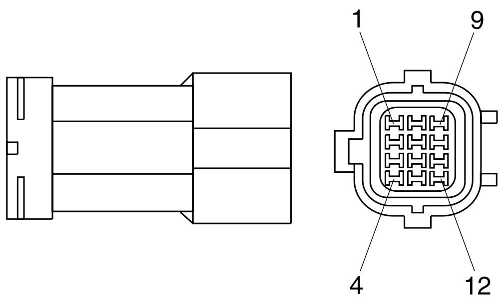
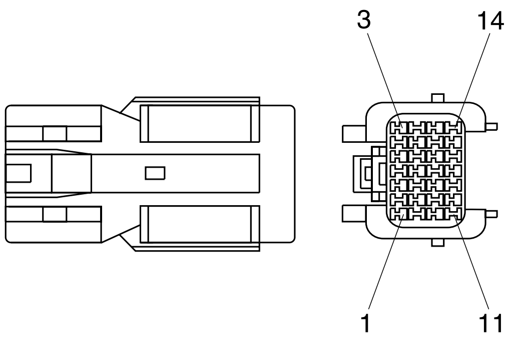
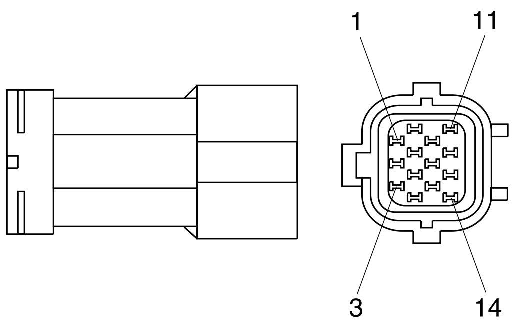
No. of pin	Receptacle connector(Female)	Plug connector(Male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

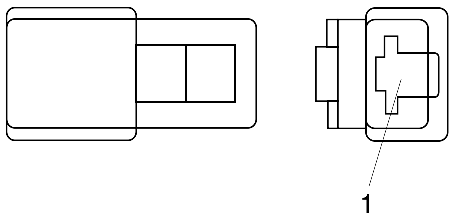
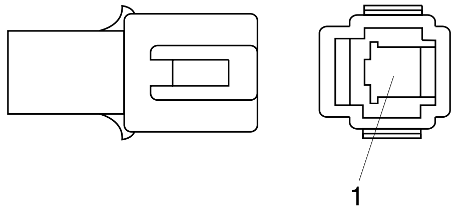
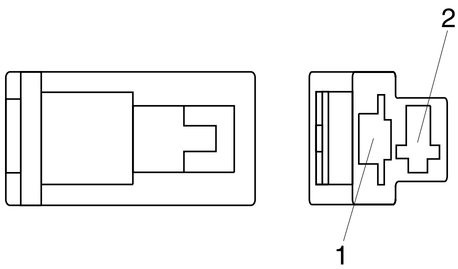
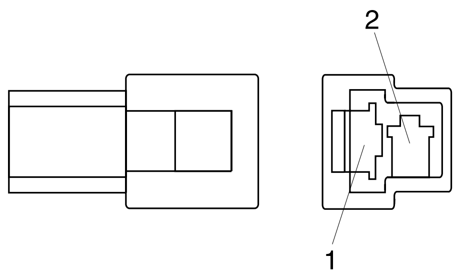
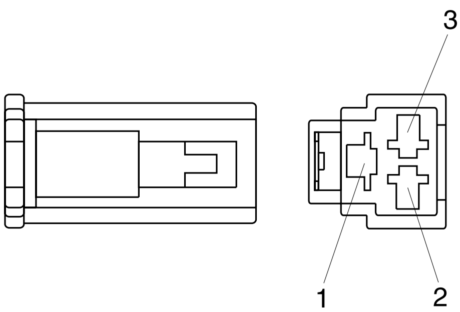
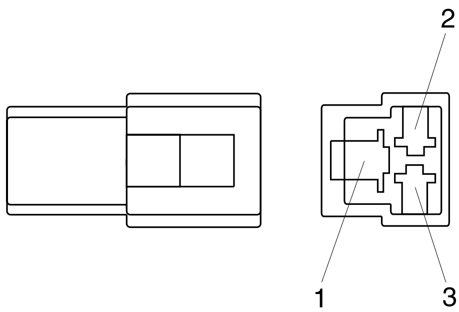
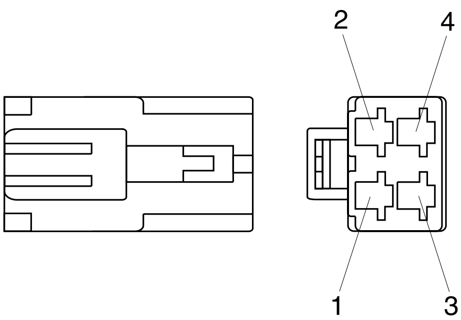
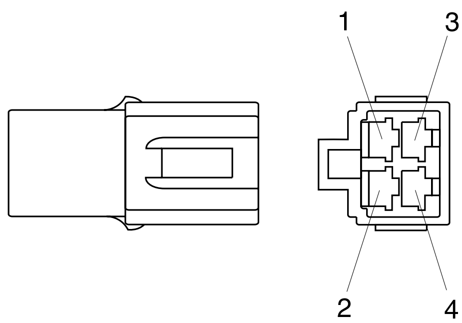
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

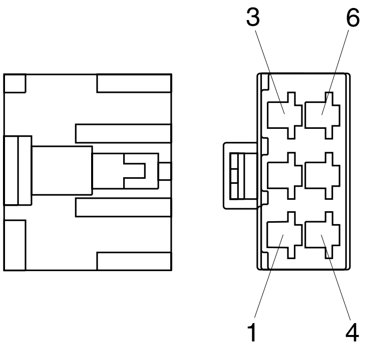
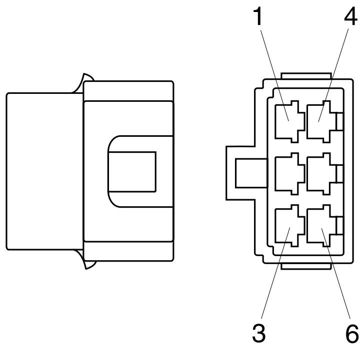
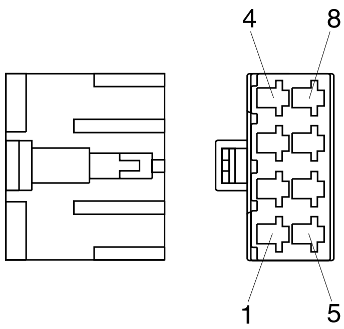
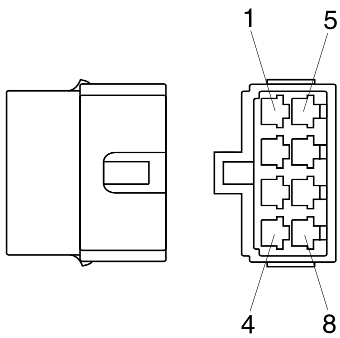
3) SWP TYPE CONNECTOR

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

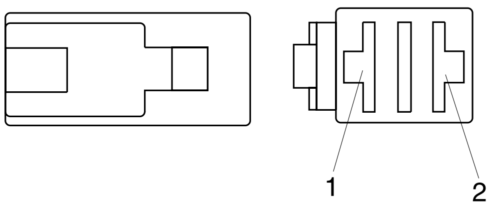
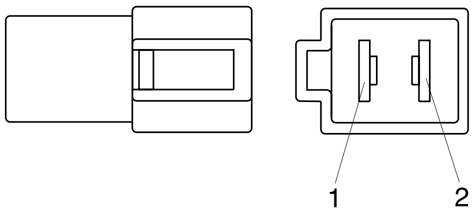
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

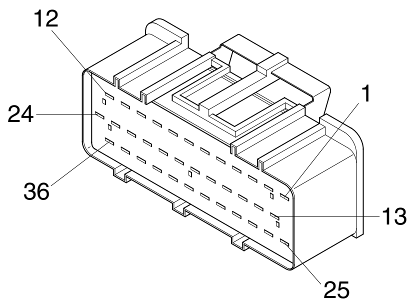
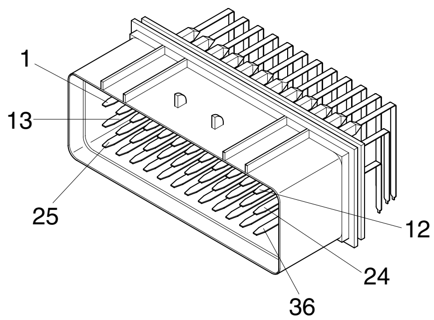
No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

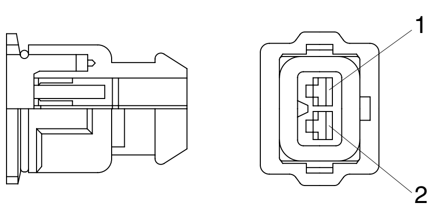
5) 375 FASTEN TYPE CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 S810-002402	 S810-102402

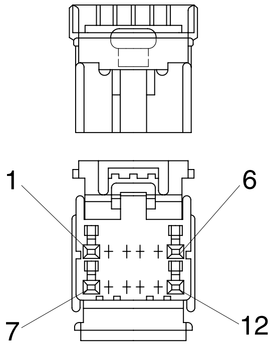
6) AMP ECONOSEAL CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
36	 344111-1	 344108-1

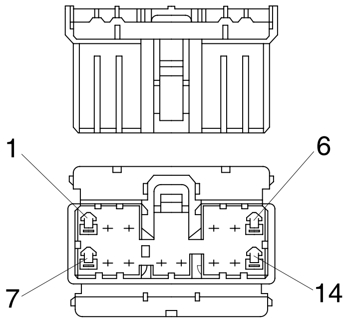
7) AMP TIMER CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 85202-1	

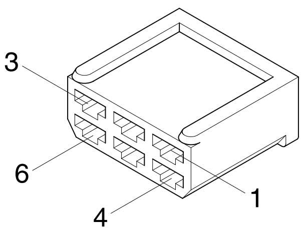
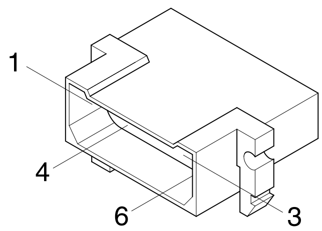
8) AMP 040 MULTILOCK CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
12	 174045-2	

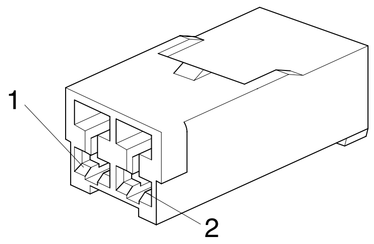
9) AMP 070 MULTILOCK CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
14	 173852	

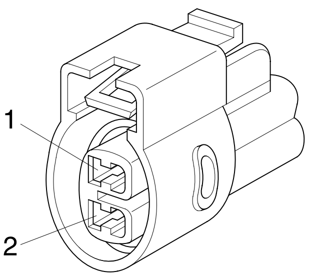
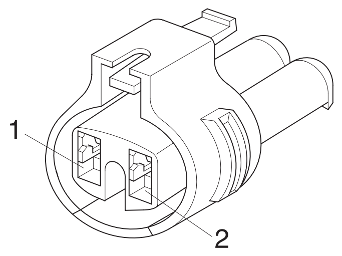
10) AMP FASTIN - FASTON CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 925276-0	 480003-9

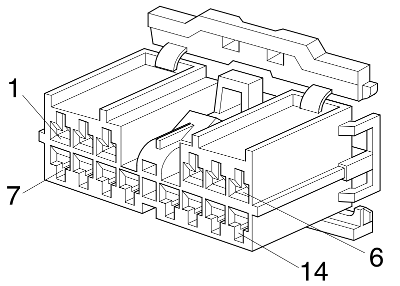
11) KET 090 CONNECTOR

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	

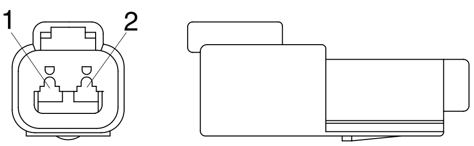
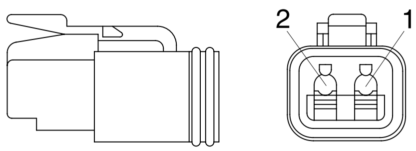
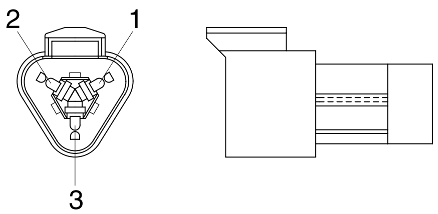
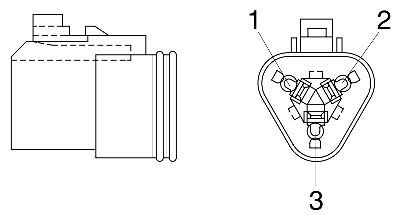
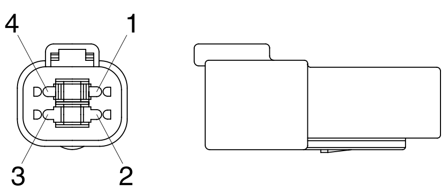
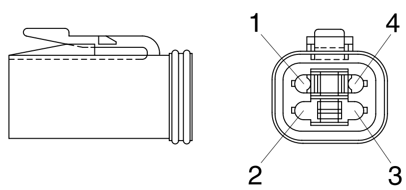
14) DEUTSCH DT CONNECTORS

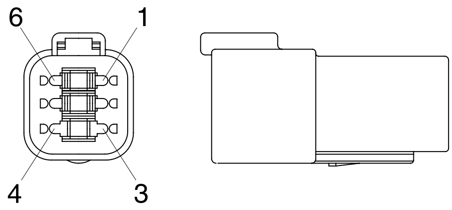
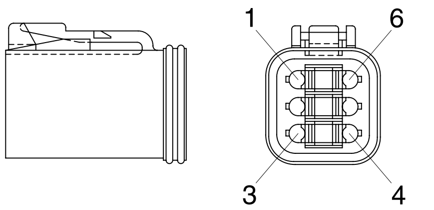
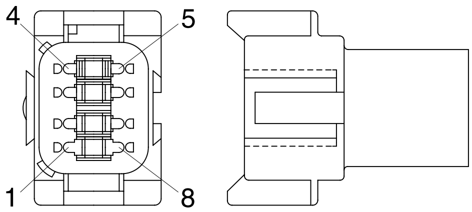
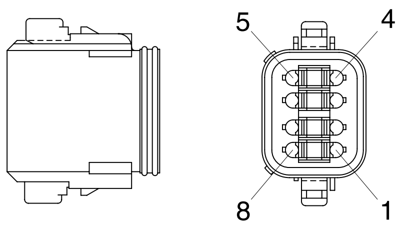
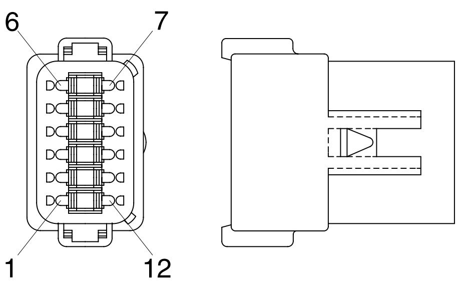
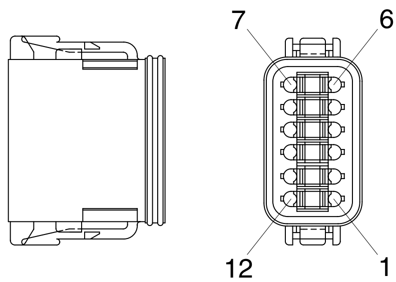
DT 06 - 3S - ★★★★

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

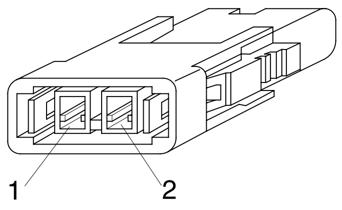
※ Modification

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

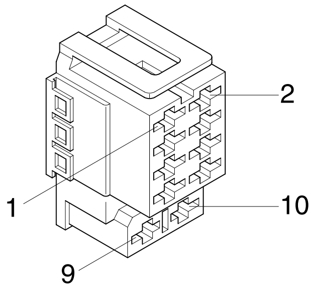
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

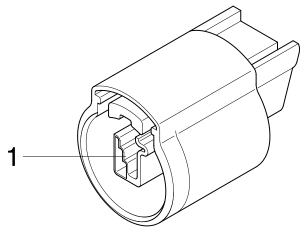
15) MOLEX 2CKTS CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 35215-0200	

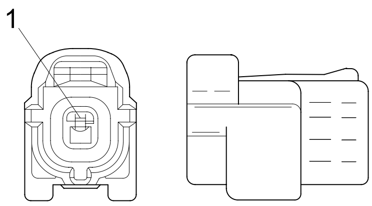
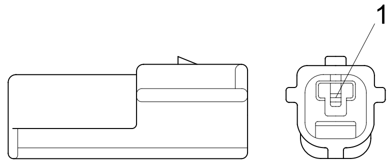
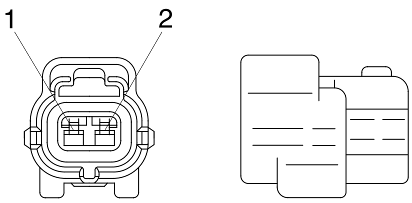
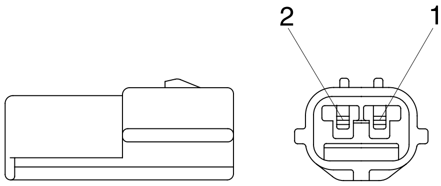
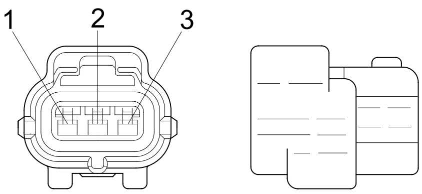
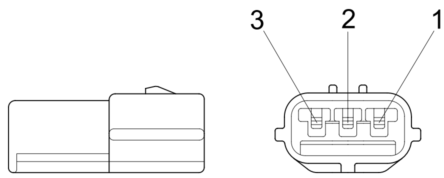
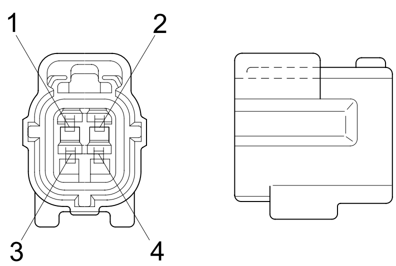
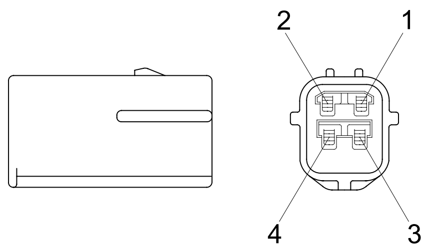
16) ITT SWF CONNECTOR

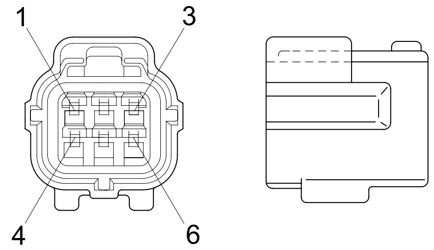
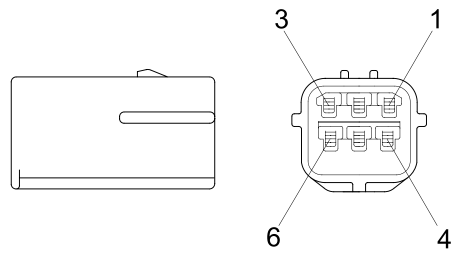
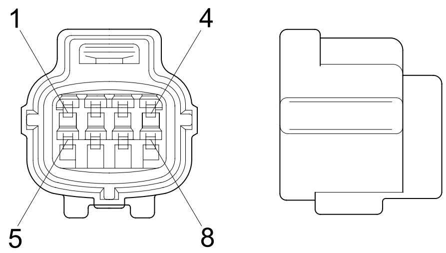
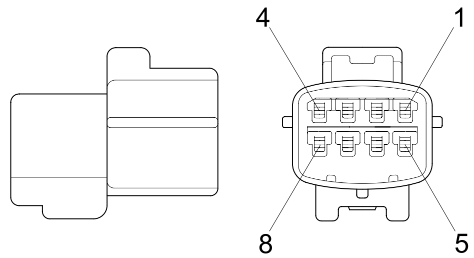
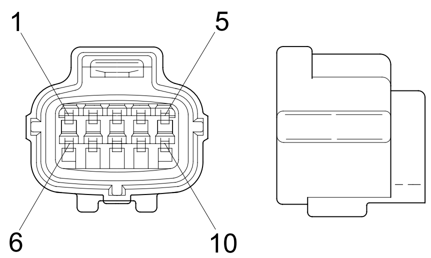
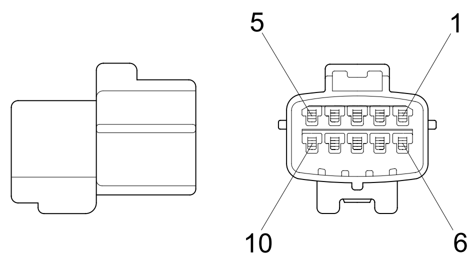
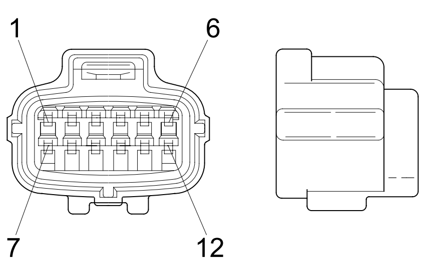
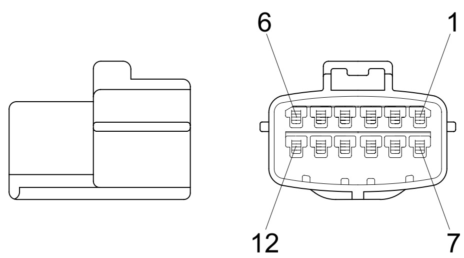
No. of pin	Receptacle connector(Female)	Plug connector(Male)
10	 SWF593757	

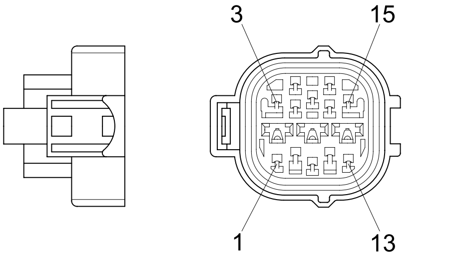
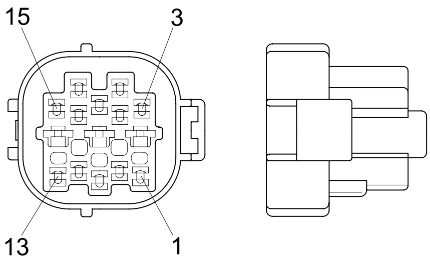
17) MWP NMWP CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 NMWP01F-B	

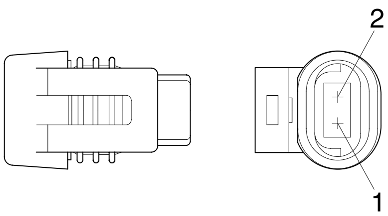
18) ECONOSEAL J TYPE CONNECTORS

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

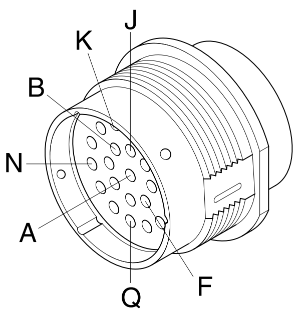
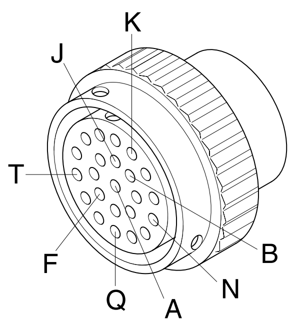
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

SECTION 5 MECHATRONICS SYSTEM

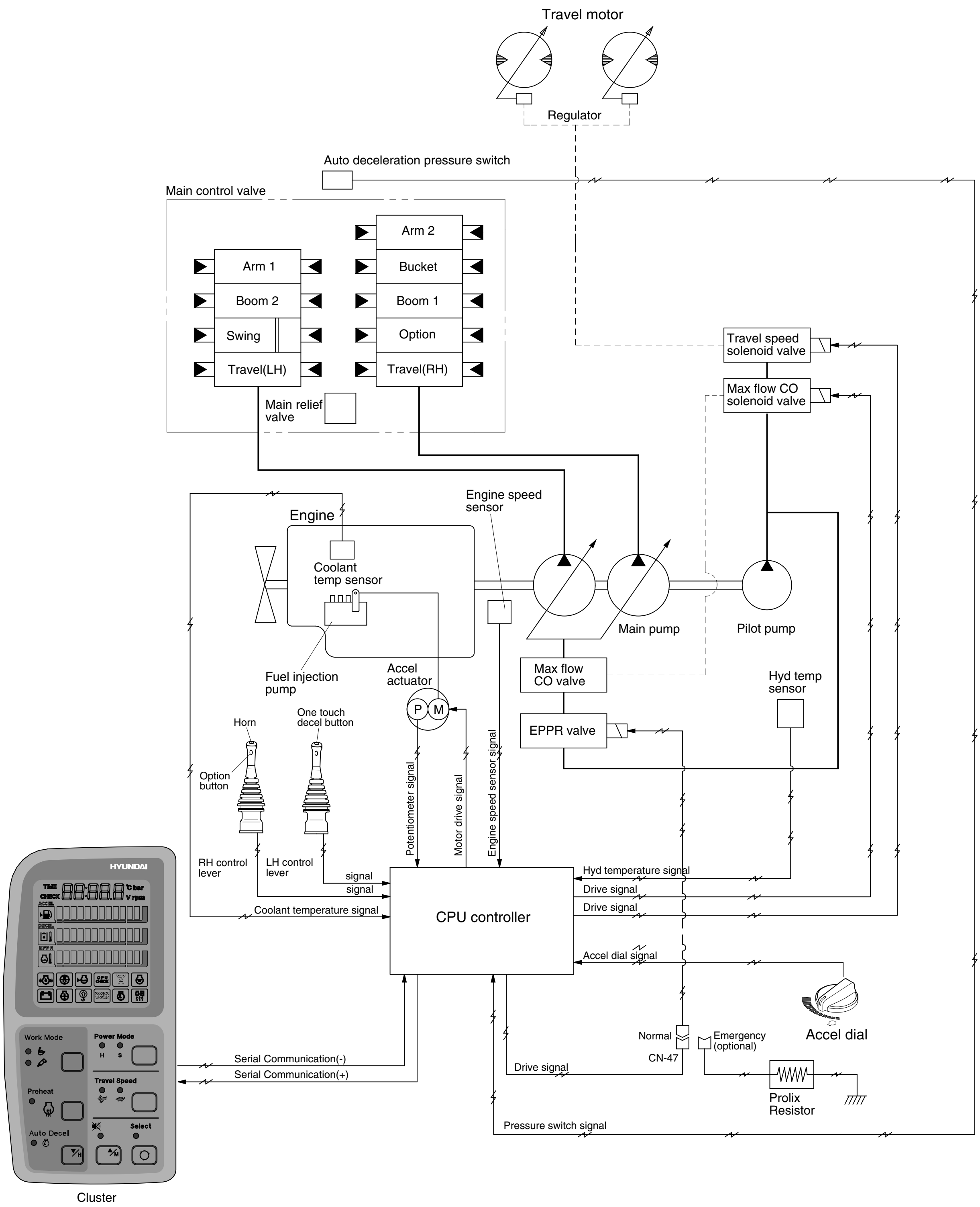
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

The NEW 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 for a CPU controller, a cluster, an accel actuator, an EPPR valve, and other components. The CPU controller 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.

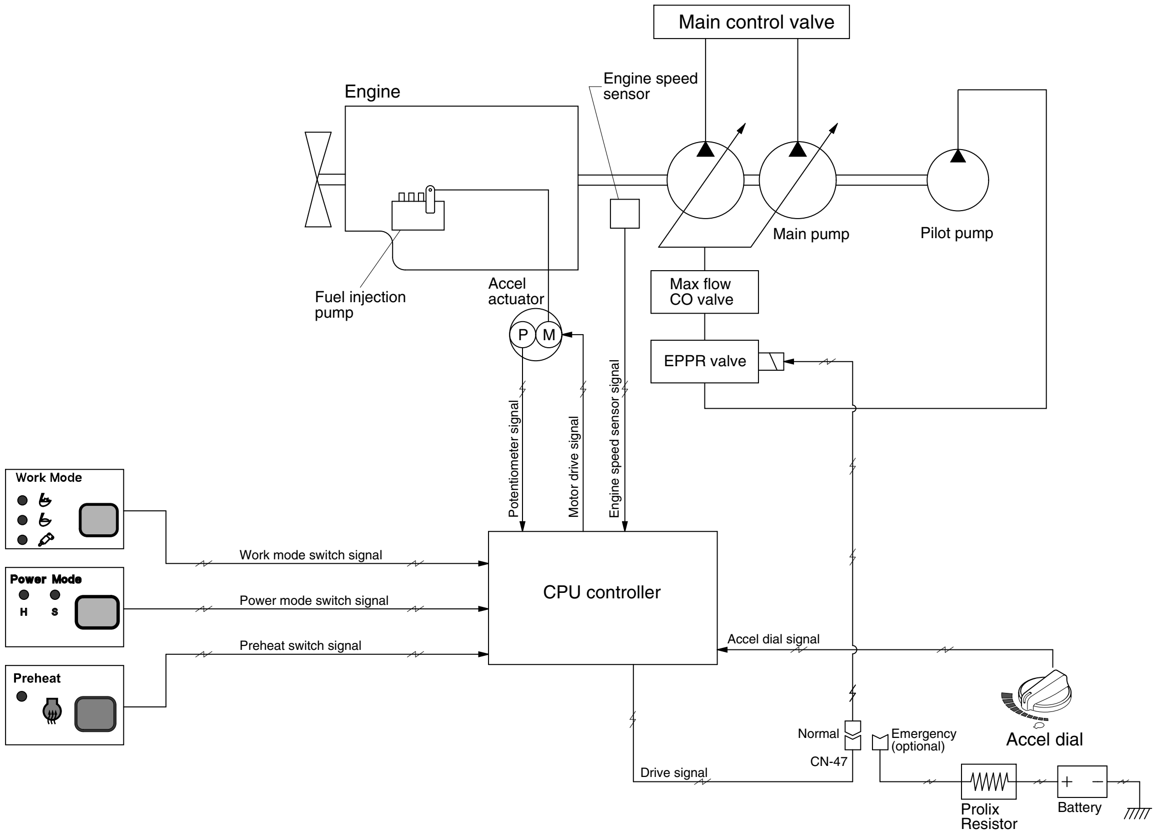
- NEW CAPO SYSTEM
  - Mode selection system
    - Engine control system
    - Pump control system
    - Work mode selection
    - Preheat system
  - Auto deceleration system
  - Travel speed control system
    - Travel speed control system
  - Automatic warming up system
  - Engine overheat prevention system
  - Max flow control system
  - Anti-restart system
  - Self-diagnostic system
    - Controller & cluster protection
    - Open-short diagnosis & error code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system

SYSTEM DIAGRAM



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



RD21075MS02A

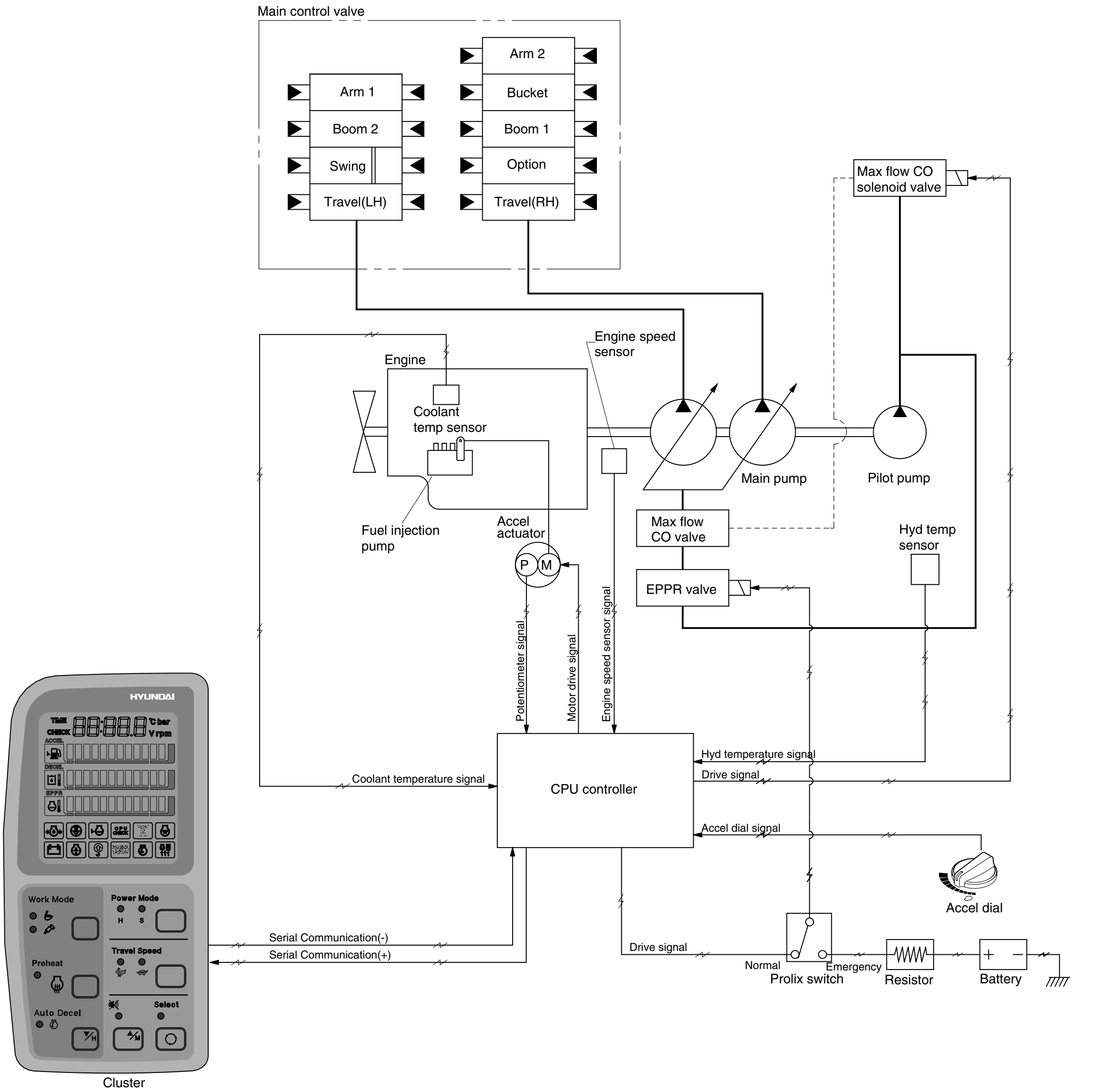
Mode selection system(Micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.

The combination of 2 power modes(H, S) and accel dial position(10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Mode	Application	Power set (%)	Engine rpm		Power shift by EPPR valve			
					Default		Other case	
			Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
H	High power	100	2050±50	-	250±30	5	190	2.5
S	Standard power	85	1750±50	-	330±30	10	300	8
AUTO DECEL	Engine deceleration	-	1200±100	-	670±30	31	670±30	31
One touch decel	Engine quick deceleration	-	1000±100	-	700±30	35	700±30	35
KEY START	Key switch start position	-	1000±100	-	700±30	35	700±30	35

2. WORK MODE SELECTION SYSTEM

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



RD21075MS03

1) GENERAL WORK MODE

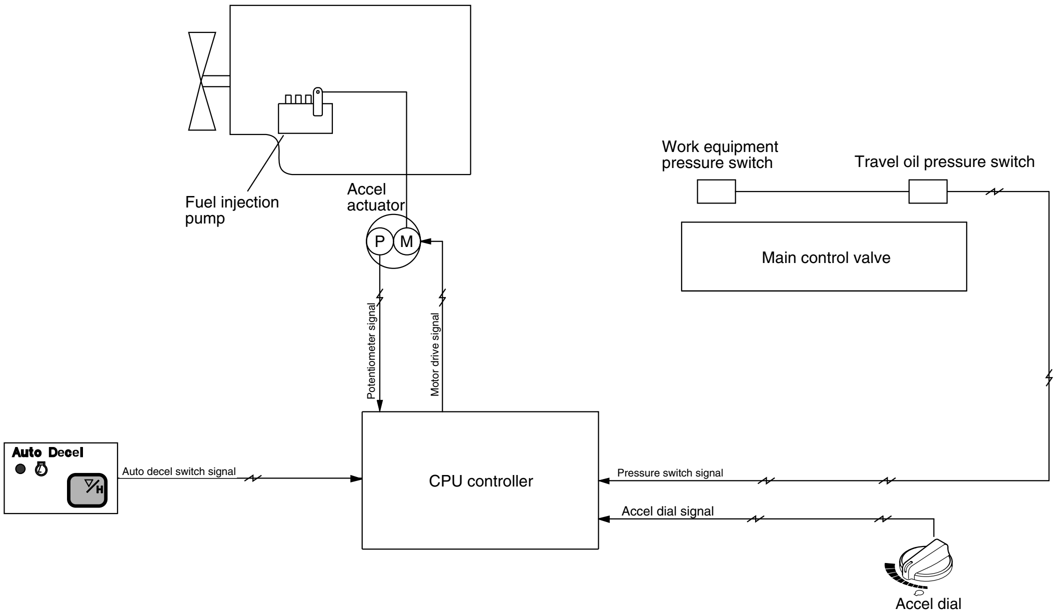
When key switch is turned ON, this mode is selected and swing operation speed is faster than heavy duty work mode.

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	Max flow cut-off solenoid
General	OFF
Breaker	ON

GROUP 3 AUTOMATIC DECELERATION SYSTEM

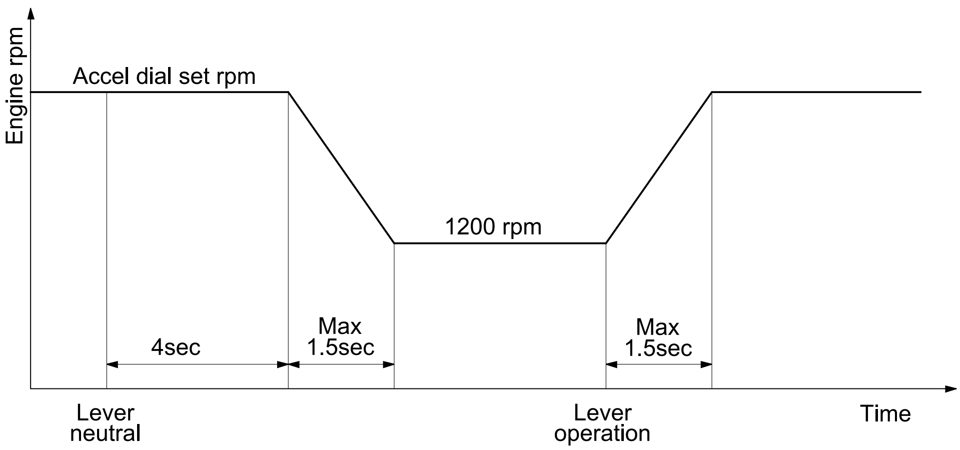


21075MS04

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, CPU controller 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.



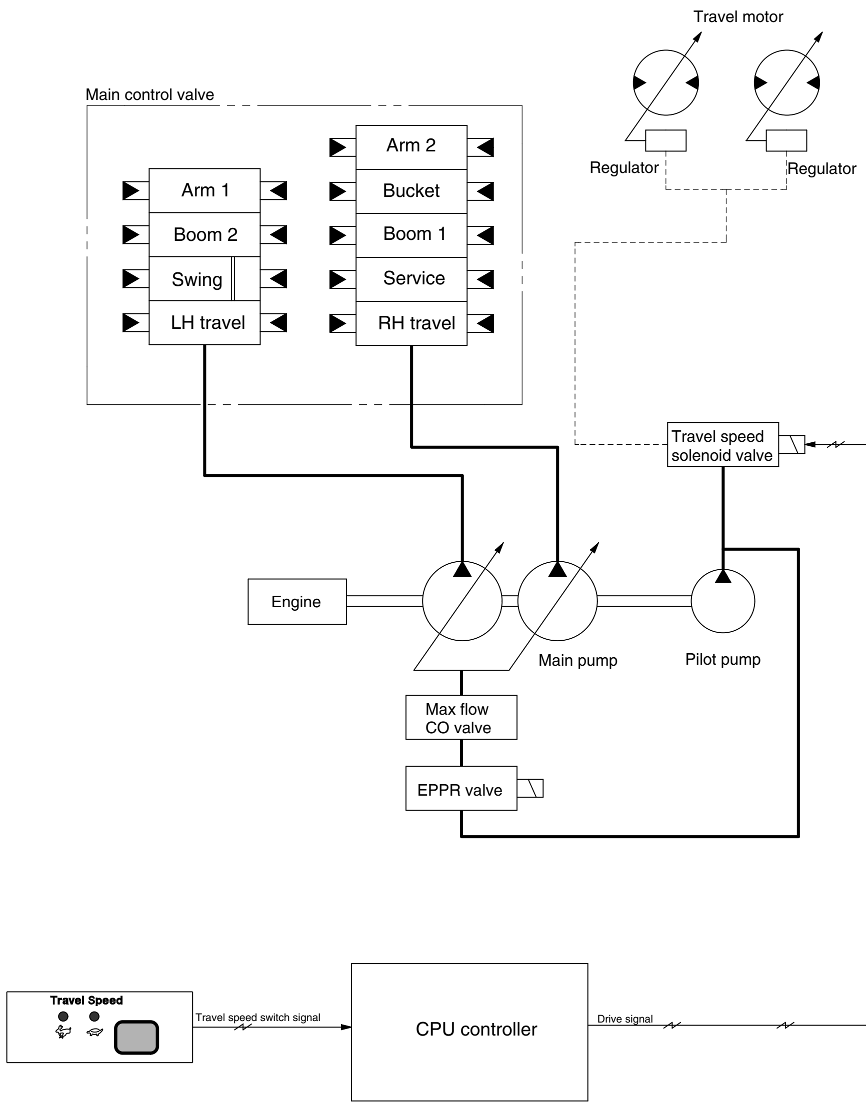
21075MS05

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 TRAVEL SPEED CONTROL SYSTEM



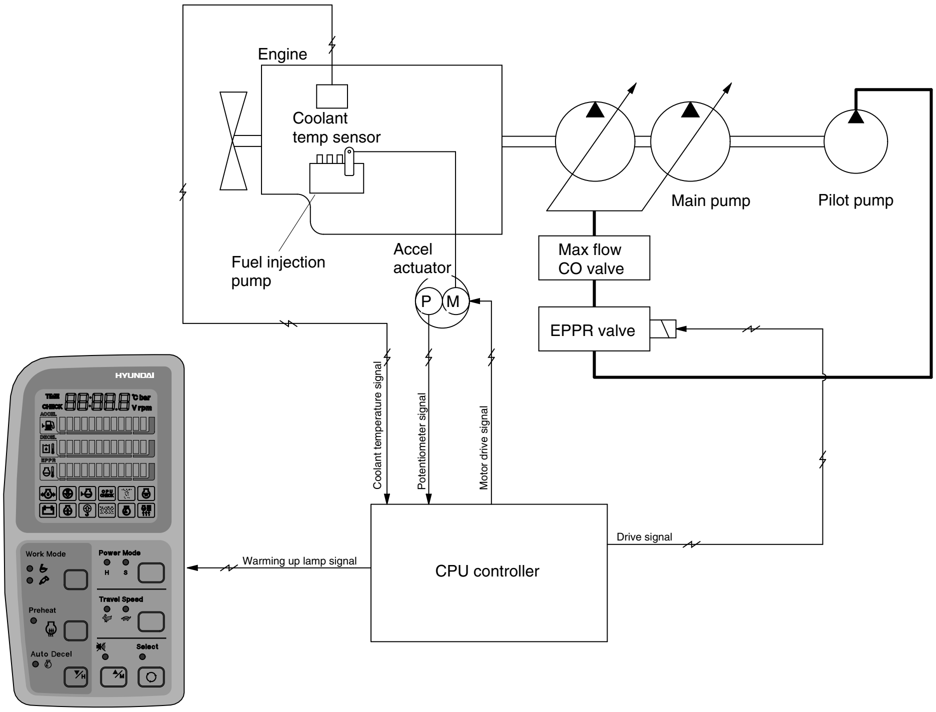
RD21075MS07

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 5 AUTOMATIC WARMING UP FUNCTION



RD21075MS08

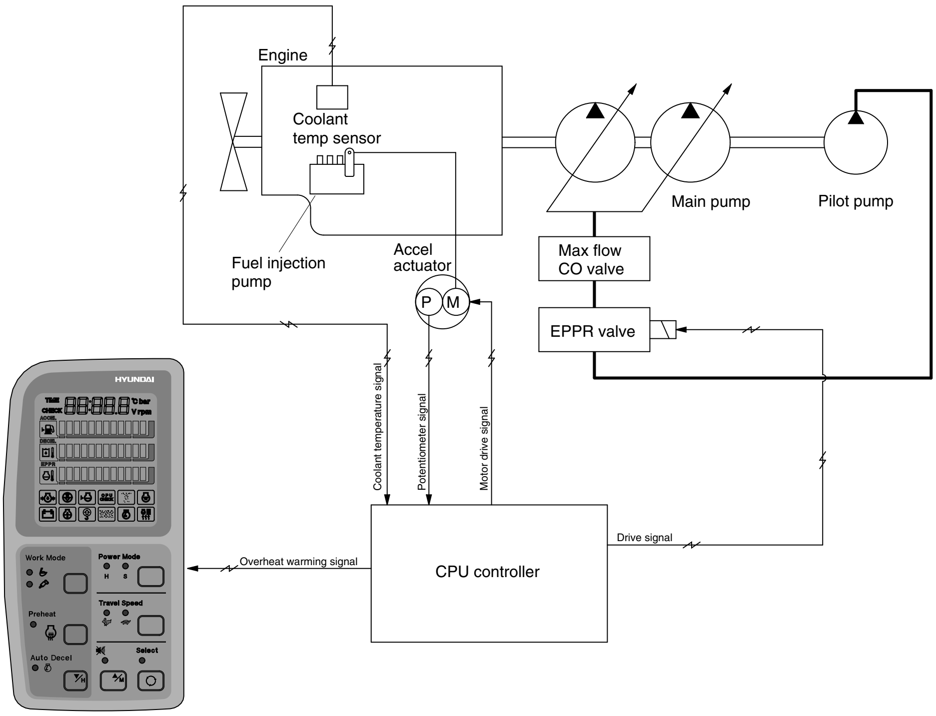
1. CPU controller reads engine coolant temperature through the temperature sensor, and if the coolant temperature is less than 30°C, it increases the engine speed from key start rpm to 1200rpm. At this time the mode does not change.

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 CPU controller 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 6 ENGINE OVERHEAT PREVENTION FUNCTION



RD21075MS09

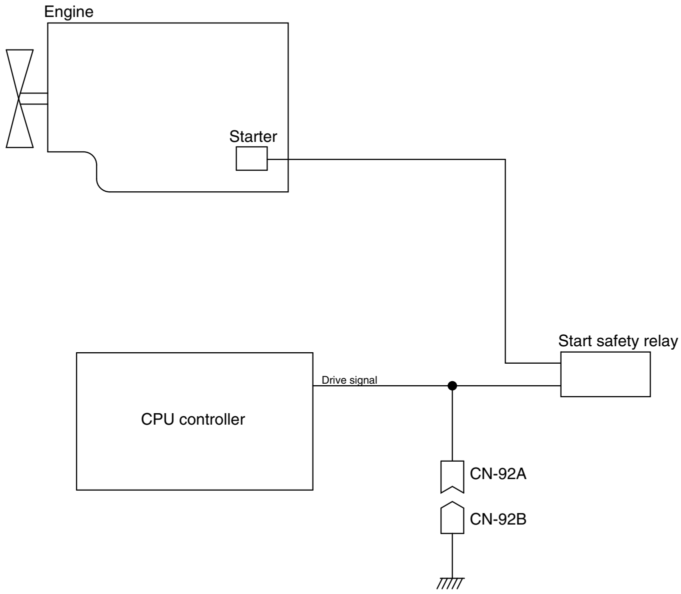
1. CPU controller reads engine coolant temperature through the temperature sensor and when the engine coolant boils up to 110°C, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial **7** position.

2. If the coolant temperature drops less than 100°C, the CPU controller returns the mode to the mode set before. And if mode set is changed during the function, the CPU controller 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 7 ANTI-RESTART SYSTEM



1. ANTI-RESTART FUNCTION

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

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

GROUP 8 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 CPU controller diagnoses the problem and sends the error codes to the cluster and also stores them in the memory.

The current or recorded error codes are displayed at the error display mode selected by touching **SELECT** switch 2 times while pressing **BUZZER STOP** switch.

2. CURRENT ERROR DISPLAY

Cluster displays **Co : Er** and makes buzzer sound itself to warn the communication error when communication problem caused by wire-cut or malfunction of the CPU controller occurs.

Cluster displays real time error codes received from CPU controller through communication. In case of no problem it displays CHECK **Er : 00**.

If there are more than 2 error codes, each one can be displayed by pressing ▲ and ▼ switch respectively.

Examples :

1) Communication Error
   Co : Er & Buzzer sound

2) No problem
   CHECK Er : $\boxed{0}\boxed{0}$

3) 4 Error codes(03, 06, 10, 43) display
   CHECK Er : $\boxed{0}\boxed{3}$

Press ▼ Press ▼ Press ▼

$\boxed{0}\boxed{3}$ ⇄ $\boxed{0}\boxed{6}$ ⇄ $\boxed{1}\boxed{0}$ ⇄ $\boxed{4}\boxed{3}$ → No change

Start Press ▲ Press ▲ Press ▲ Press ▲

3. RECORDED ERROR DISPLAY

The recorded error can be displayed only when the key switch is at ON position.

Examples : 5 Recorded error codes(03, 06, 10, 20, 32) display

TIME Er : $\boxed{0}\boxed{3}$

Press ▼ Press ▼ Press ▼ Press ▼

$\boxed{0}\boxed{3}$ ⇄ $\boxed{0}\boxed{6}$ ⇄ $\boxed{1}\boxed{0}$ ⇄ $\boxed{2}\boxed{0}$ ⇄ $\boxed{3}\boxed{2}$ → No change

Start Press ▲ Press ▲ Press ▲ Press ▲ Press ▲

4. DELETE ALL RECORDED ERROR CODES

Select recorded error(TIME **Er**) display and press engine and select switch at the same time for 2 seconds or more. Cluster display changes to TIME **Er : 00**, which shows that CPU controller deleted all the recorded error codes in the memory.

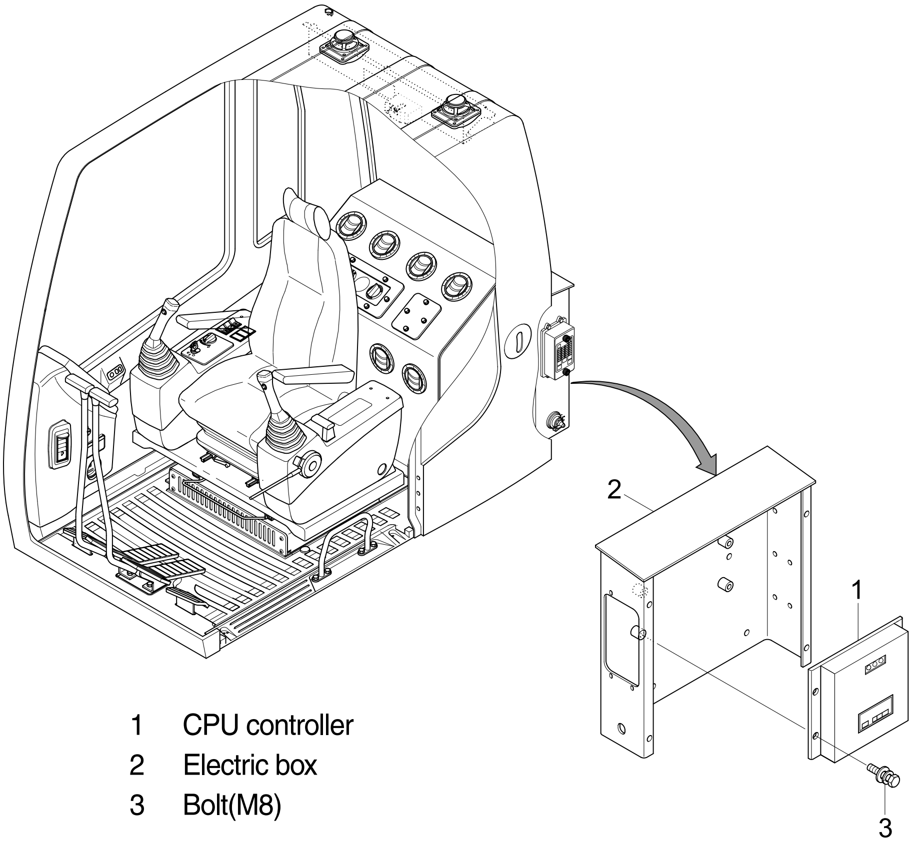
5. ERROR CODES TABLE

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
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
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
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
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

Fault code No.	Description
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 +

GROUP 9 ENGINE CONTROL SYSTEM

1. CPU CONTROLLER MOUNTING



1 CPU controller
2 Electric box
3 Bolt(M8)

RD21075MS11A

2. CPU CONTROLLER ASSEMBLY

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

2) Disconnect 2 connectors from CPU controller.

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

4) Inspection : Check PCB(Printed Circuit Board)

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

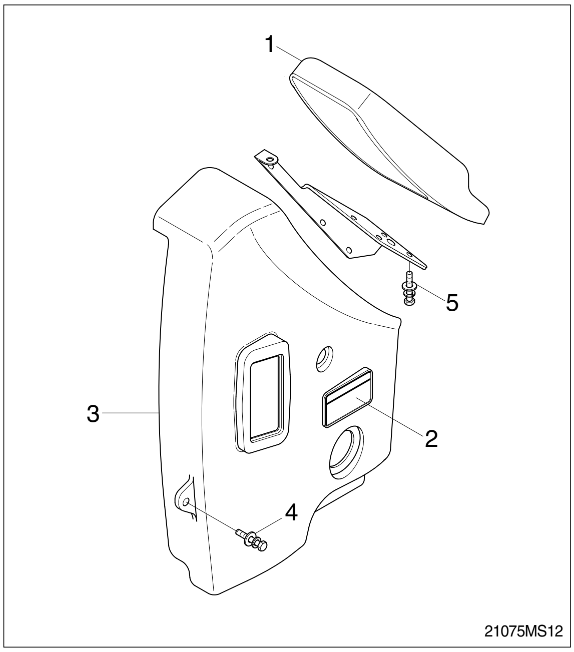
(2) If not, but CAPO system does not work please report it to HHI dealer or A/S department.

3. EXCHANGE METHOD OF THE ROM

1) Disassemble the ash tray(2).

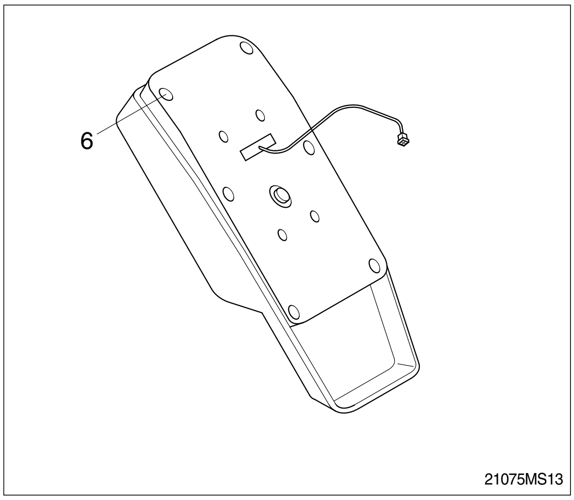
2) Disassemble the wiper motor cover(3).

3) Disassemble the cluster(1).

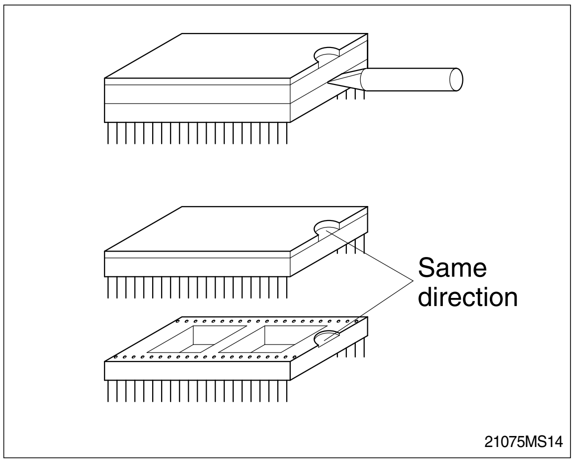


4) Loosen the screws(6EA) located back of the cluster.

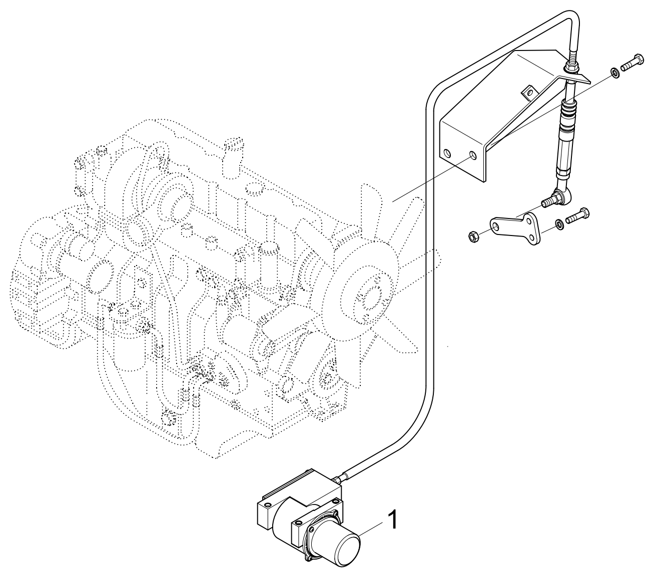
5) Then you can open the upper case of the cluster easily.



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



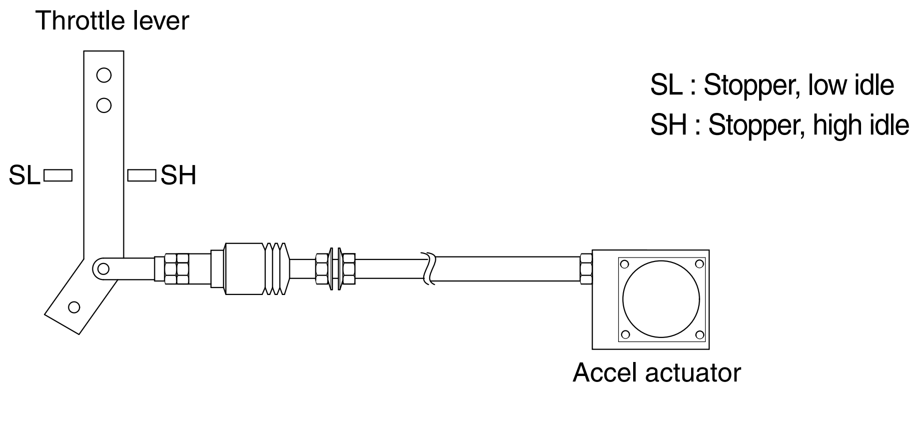
4. ENGINE ACCEL ACTUATOR



1 Accel actuator

RD21075MS60

1) ENGINE THROTTLE LEVER

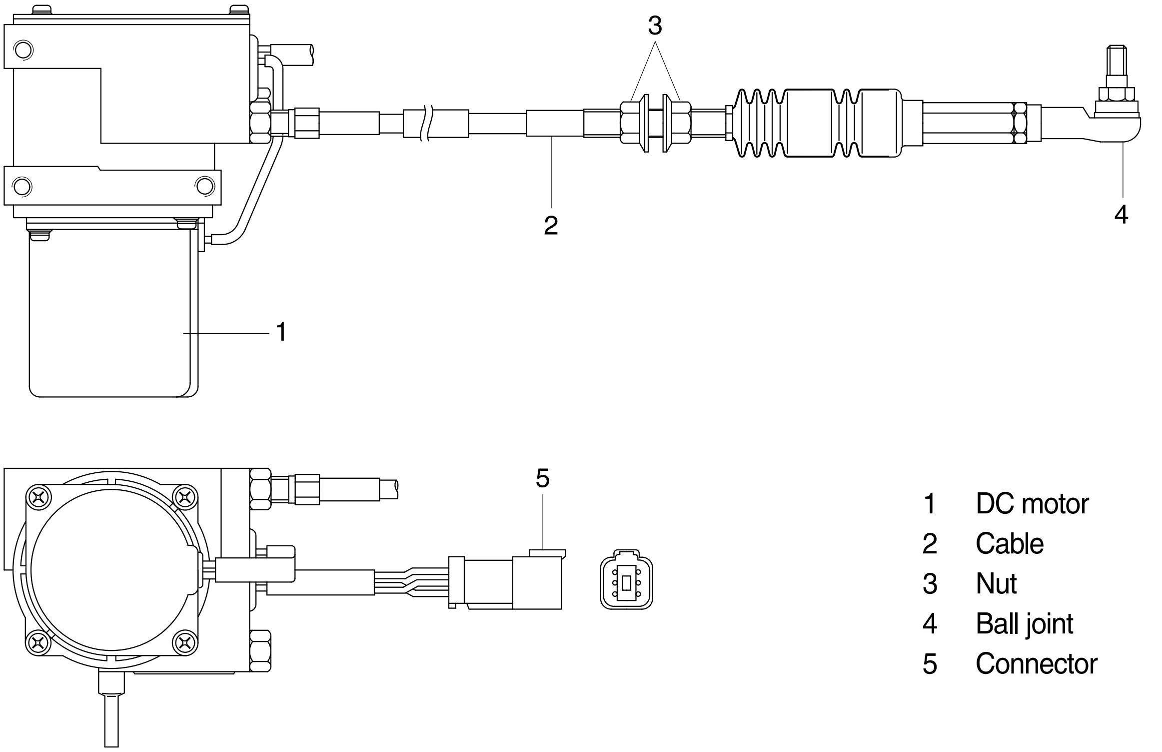


(210-7) 5-18(2)

2) EMERGENCY CABLE (Push-pull cable)

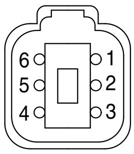
It controls engine speed by connecting onto the lever of the injection pump when the malfunction of the CPU controller or the accel actuator happen.

3) ACCEL ACTUATOR



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

(210-7) 5-19(1)

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)

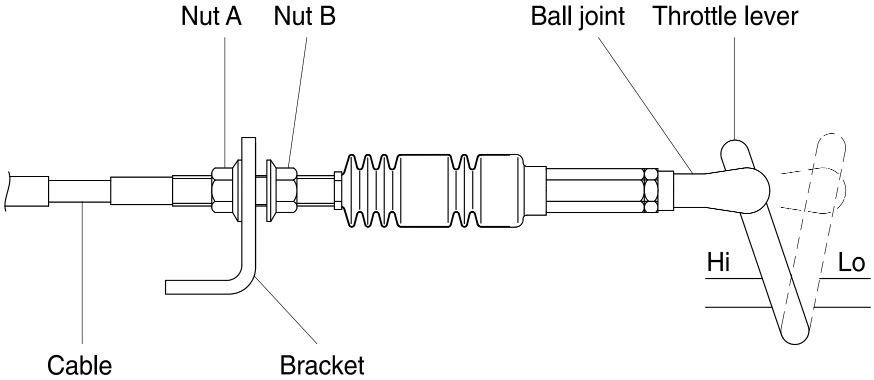
4) ACCEL ACTUATOR CABLE SETTING PROCEDURE

(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 higher 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.

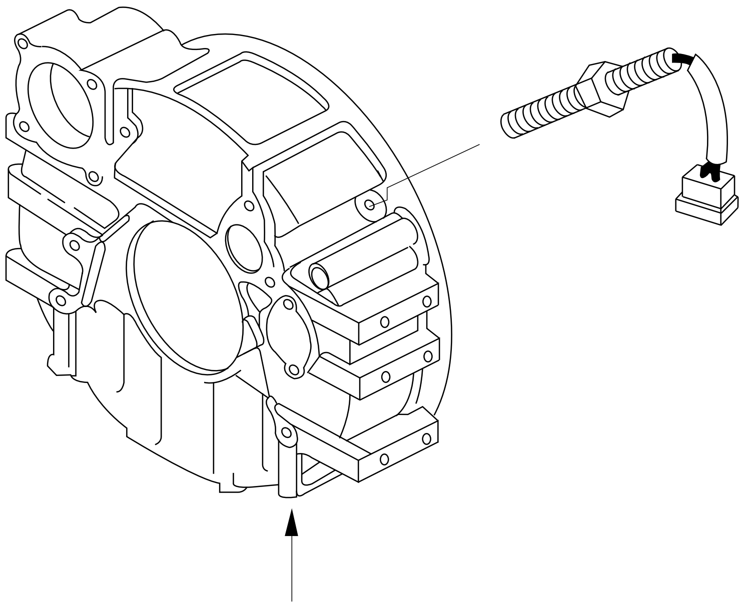


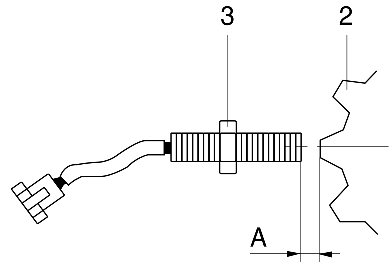
130W5MS05

Mode	RPM
H	2050±50
S	1750±50
Auto decel	1200±100
Key start	1000±100

5. ENGINE SPEED SENSOR

1) DETECT ACTUAL ENGINE RPM AND SEND SIGNAL TO TACHOMETER





2 Gear teeth, flywheel
3 Lock nut, speed sensor
A Clearance

5-20 (210-7)

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

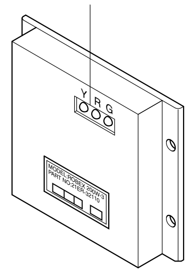
(1) Check resistance

· SPEC : 300±30KΩ

(2) Check voltage while engine run.

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

6. CPU CONTROLLER



20W03CD18

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

(2) Three LED lamps on the CPU controller display as below.

LED lamp	Trouble	Service
G is turned ON	Normal	-
G and R are turned ON	Trouble on CPU or ROM	· Change the controller
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between controller and cluster are disconnected
Three LED are turned OFF	Trouble on CPU controller power	· Check if the input power wire (24V, GND) of controller is disconnected · Check the fuse

G : green, R : red, Y : yellow

GROUP 10 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 CPU controller 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/cm^2	psi		
Standard (Ver : 1.x)	H	5 ± 3	71 ± 40	250 ± 30	2050 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1750 ± 50
Option (Ver : 2.x)	H	3 ± 3	40 ± 40	190 ± 30	2150 ± 50
	S	8 ± 3	114 ± 40	300 ± 30	1950 ± 50

2. HOW TO SWITCH THE VERSION(1.x↔2.x) ON THE CLUSTER

You can switch the EPPR valve pressure set by selecting the version(1.x↔2.x).

Step 1. Turn the key switch **ON**.

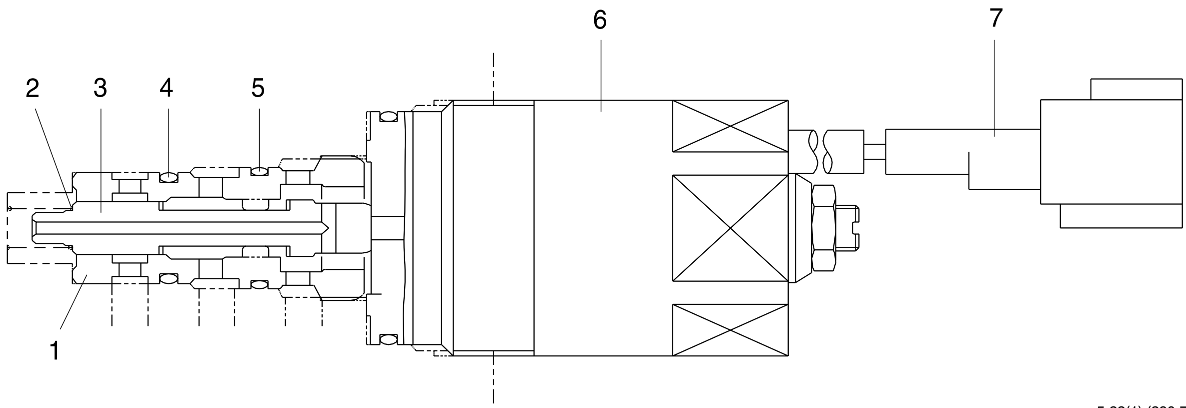
Step 2. Press the **SELECT** switch 3 times.

Step 3. While 7 segment on the cluster shows the version of the CPU controller program, for example **21C1.4** press the buzzer stop switch( ) + travel speed control switch( ) at the same time for 2 seconds.
The display changes to **21C2.4**, and it indicates that version 2.4(Option) is selected.

※ If you want to get back to ver:1.x, go to step 1~3.

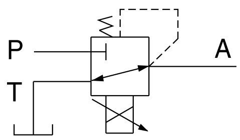
2. OPERATING PRINCIPLE

1) STRUCTURE



5-22(1) (290-7)

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

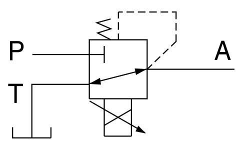


5-22A (290-7)

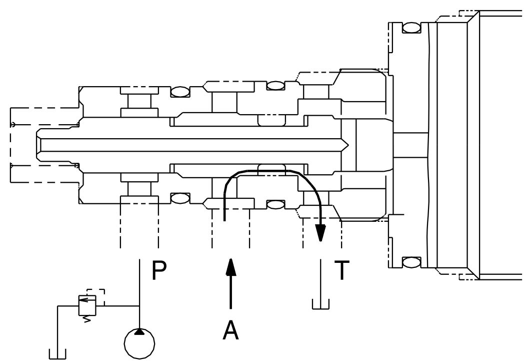
P Pilot oil supply line(Pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at hydraulic pump

2) AT H MODE

Pressure line is blocked and A oil returns to tank.

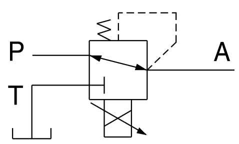


5-22B (290-7)

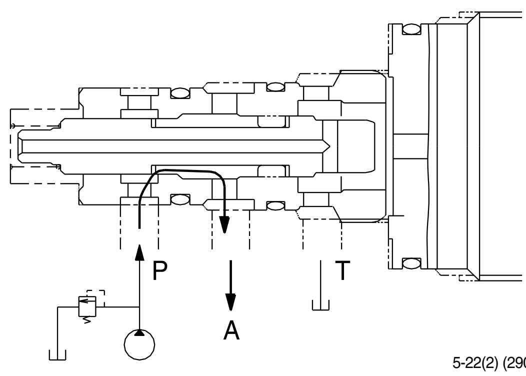


3) AT S MODE

Secondary pressure enters into A.



5-22C (290-7)



5-22(2) (290-7)

3. EPPR VALVE CHECK PROCEDURE

1) CHECK ELECTRIC VALUE AT EPPR VALVE

(1) Start engine.

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

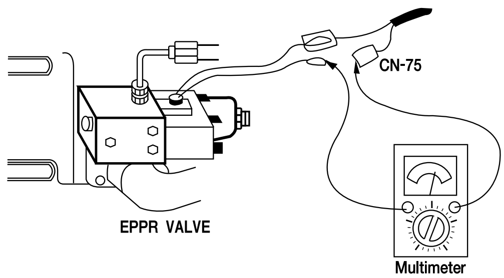
(3) Position the accel dial at 10.

(4) If tachometer show approx 1750±50rpm, disconnect one wire harness from EPPR valve.

(5) Install multimeter as figure.

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

Spec : 200~450mA



5-23(1) (290-7)

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.

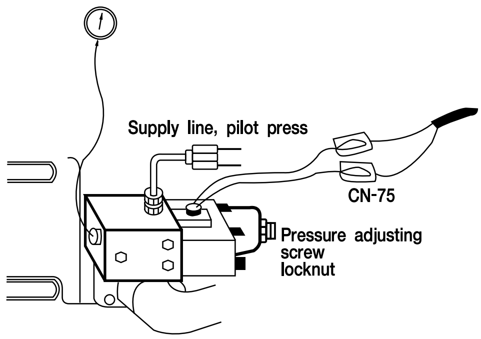
(4) Position the accel dial at 10.

(5) If tachometer show approx 1750±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)



5-23(2) (290-7)

GROUP 11 MONITORING SYSTEM

1. OUTLINE

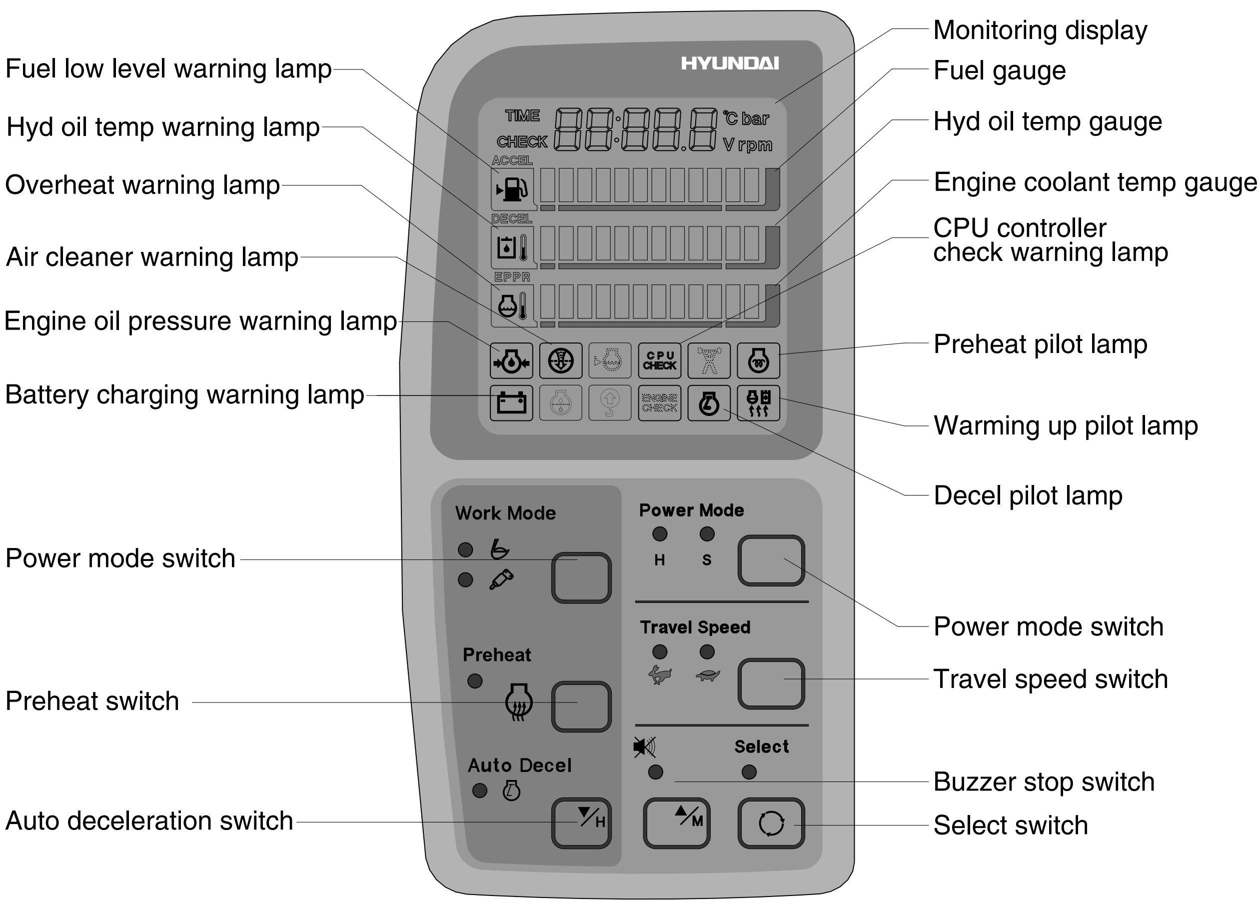
Monitoring system consists of the monitor part and switch part.

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



RD21075MS65A

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 2 seconds : Indicate cluster version and machine condition

a. Cluster program version : CL : 2.0 ← Indicates program version 2.0 for 2 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

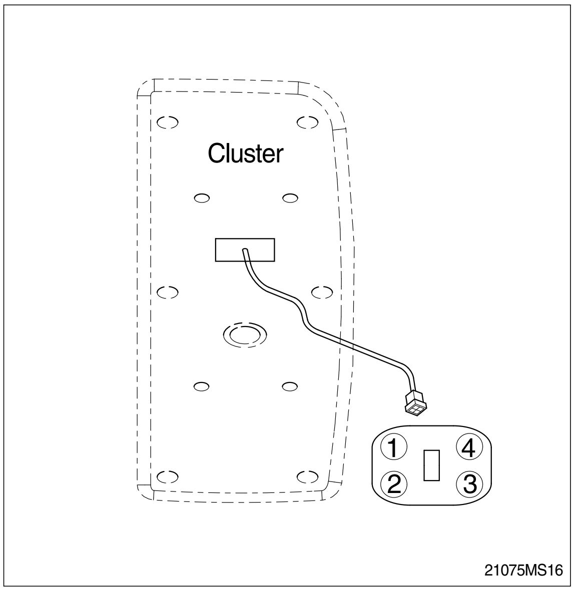
a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to1200 rpm(Auto decel LED : ON)
※ Others same as above ①.

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.

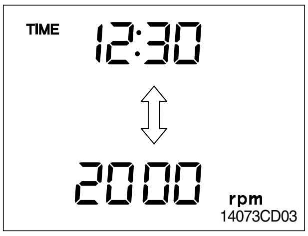
3. CLUSTER CONNECTOR

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)



4. CLUSTER FUNCTION

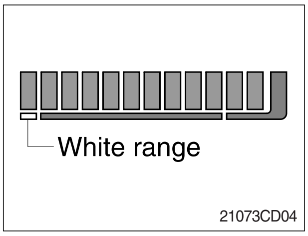
1) MONITORING DISPLAY



(1) This displays the current time and machine information such as engine rpm, coolant/hydraulic oil temperature, hydraulic oil pressure and also error codes.

※ Refer to the page 5-34 for details.

2) FUEL GAUGE

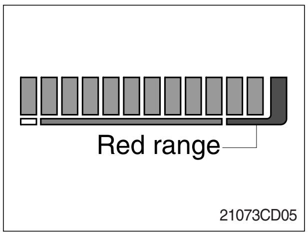


(1) This gauge indicates the amount of fuel in the fuel tank.

(2) Fill the fuel when the white range or warning lamp blinks.

※ **If the gauge illuminates the white range or warning lamp blinks 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.**

3) HYDRAULIC OIL TEMPERATURE GAUGE



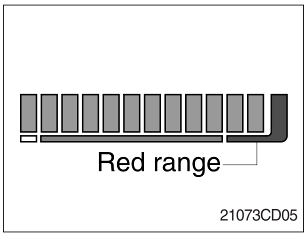
(1) This indicates the temperature of coolant.
- · White range : Below 30°C(86°F)
- · Green range : 30-105 °C(86-221°F)
- · Red range : Above 105°C(221°F)

(2) The green range illuminates when operating.

(3) Keep idling engine at low speed until the green range illuminates before operation of machine.

(4) When the red range illuminates, reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.

4) ENGINE COOLANT TEMPERATURE GAUGE



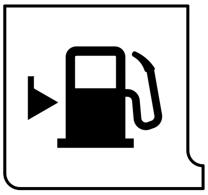
(1) This indicates the temperature of coolant.
- · White range : Below 30°C(86°F)
- · Green range : 30-105 °C(86-221°F)
- · Red range : Above 105°C(221°F)

(2) The green range illuminates when operating.

(3) Keep idling engine at low speed until the green range illuminates before operation of machine.

(4) When the red range illuminates, turn OFF the engine, check the radiator and engine.

5) FUEL LOW LEVEL WARNING LAMP

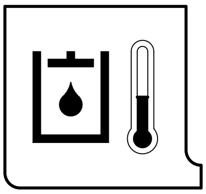


21073CD04A

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

(2) Fill the fuel immediately when the lamp blinks.

6) HYDRAULIC OIL TEMPERATURE WARNING LAMP



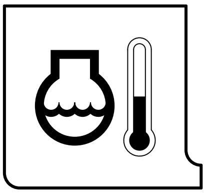
21073CD05A

(1) This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105°C(221°F).

(2) Check the hydraulic oil level when the lamp blinks.

(3) Check for debris between oil cooler and radiator.

7) OVERHEAT WARNING LAMP

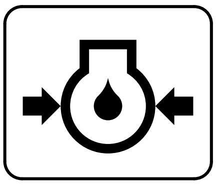


21073CD06A

(1) This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 110°C(230°F) .

(2) Check the cooling system when the lamp blinks.

8) ENGINE OIL PRESSURE WARNING LAMP

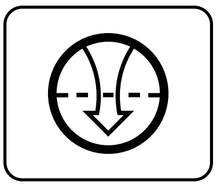


21073CD07

(1) This lamp blinks and the buzzer sounds after starting the engine because of pressure.

(2) If the lamp blinks during engine operation, shut OFF engine immediately. Check oil level.

9) AIR CLEANER WARNING LAMP

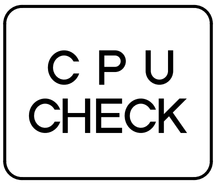


21073CD08

(1) This lamp is operated by the vacuum caused inside when the filter of air cleaner is clogged which supply air to the engine.

(2) Check the filter and clean or replace it when the lamp blinks.

10) CPU CONTROLLER CHECK WARMING LAMP



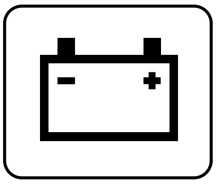
21073CD10

(1) Communication problem with CPU controller makes the lamp blinks and the buzzer sounds.

(2) Check if any fuse for CPU burnt off.

(3) If not check the communication line between them.

11) BATTERY CHARGING WARNING LAMP

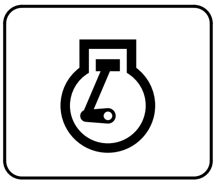


21073CD13

(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.

12) DECEL PILOT LAMP

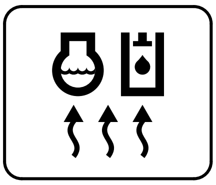


21073CD17

(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.

13) WARMING UP PILOT LAMP

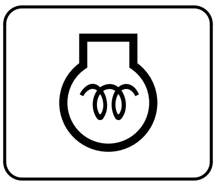


21073CD18

(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 °C, or when 10 minutes have passed since starting.

14) PREHEAT PILOT LAMP

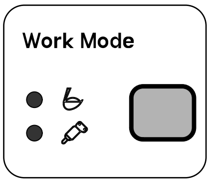


21073CD12

(1) Turning the start key switch ON position starts preheating in cold weather.

(2) Start the engine as this lamp is OFF.

15) WORK MODE SWITCH

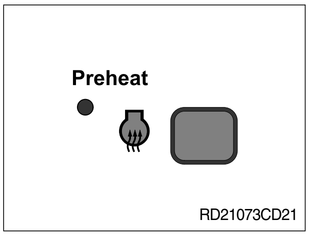


RD21073CD20

(1) This switch is to select the machine operation mode, which shifts from general operation mode to heavy operation mode and breaker mode in a raw by pressing the switch.
- · : General work mode
- · : Breaker operation mode

※ **Refer to the page 5-4 for details.**

16) PREHEAT SWITCH



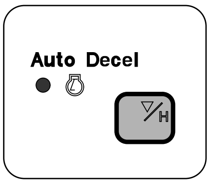
RD21073CD21

(1) This switch is used for starting the engine in cold weather.
If pressed, grid heater is activated to get easier engine starting.

※ **Never hold the push button switch in for more than 30 seconds, as this can damage the grid heater.**

(2) The indicator lamp is turned ON when operating this switch.

17) AUTO DECELERATION SWITCH

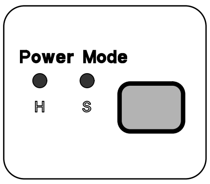


21073CD22

(1) This switch is used to actuate or cancel the auto deceleration function.
When the switch actuated and all control levers and pedals are at neutral position. Engine speed will be lowered automatically to save fuel consumption.
- · Light ON : Auto deceleration function is selected.
- · Light OFF : Auto deceleration function is cancelled so that the engine speed increased to previous setting value.

(2) Operating the auto deceleration function makes the decel indicating lamp on the LCD panel ON.

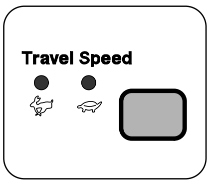
18) POWER MODE SWITCH



21073CD23

(1) The lamp of selected mode is turned ON by pressing the switch( ).
- · H : High power work.
- · S : Standard power work.

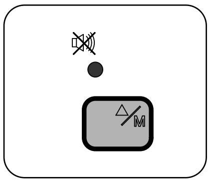
19) TRAVEL SPEED CONTROL SWITCH



21073CD24

(1) This switch is to control the travel speed which is changed to high speed(Rabbit mark) by pressing the switch and low speed(Turtle mark) by pressing it again.

20) BUZZER STOP SWITCH

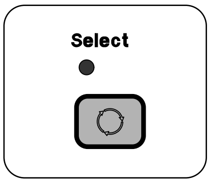


21073CD25

(1) When the starting switch is turned ON first, normally the alarm buzzer sounds for 2 seconds during lamp check operation.

(2) The red lamp lights ON and the buzzer sounds when the machine has a problem.
In this case, press this switch and buzzer stops, but the red lamp lights until the problem is cleared.

21) SELECT SWITCH



21073CD25A

(1) This switch is used to select the monitor display function.

※ **Refer to the page 5-31 for details.**

(2) If the switch is pressed for 3 seconds in time display mode, it is selected time adjusting function, as below.
- · Hour by auto decel( )switch
- · Minute by buzzer stop( ) switch.

(3) After time set, the switch is pressed, it returns to clock display.

5. MONITORING DISPLAY

1) OUTLINE

Information of machine performance as monitored by the CPU controller can be displayed on the cluster when the operator selects a display mode by touching **SELECT** switch alone or with **BUZZER STOP** switch on the cluster as below.

Display group	How to select display mode: Group selection	How to select display mode: Display mode selection	Name	Display on the cluster
Group 0 (Default)	Way 1 Key switch **ON** or **START** Way 2 Touch **AUTO DECEL** switch while pressing **BUZZER STOP** at group 1~4.	Initial	Engine rpm	1000 rpm
		Touch **SELECT** 1 time	Time	TIME 12:30
		Touch **SELECT** 2 times	Power shift pressure (EPPR valve)	EP: 10 bar
		Touch **SELECT** 3 times	CPU model & version	21:C5.1
Group 1 (Volt, temp, EPPR press, version)	Touch **SELECT** switch **once** while pressing **BUZZER STOP.** In this group **SELECT** LED **ON**	Default	Battery voltage(V)	b:24.8 V
		Touch **SELECT** 1 time	Potentiometer voltage(V)	Po: 2.5 V
		Touch **SELECT** 2 times	Accel dial voltage(V)	dL: 3.8 V
		Touch **SELECT** 3 times	Hydraulic oil temperature(°C)	Hd: 50 ℃
		Touch **SELECT** 4 times	Coolant temperature(°C)	Ct: 85 ℃
Group 2 (Error code)	Touch **SELECT** switch **twice** while pressing **BUZZER STOP.** In this group **BUZZER STOP** LED blinks	Default	Current error	CHECK Er: 03
		Touch **SELECT** 1 time	Recorded error (Only key switch ON)	TIME Er: 03
		Press down(▼) & **SELECT** at the same time	Recorded error deletion (Only key switch ON)	TIME Er: 00
Group 3 (Switch input)	Touch **SELECT** switch **3 times** while pressing **BUZZER STOP.** In this group **SELECT** LED blinks at 0.5sec interval	Default	Auto decel pressure switch	dP:on or oFF
		Touch **SELECT** 1 times	Travel oil pressure switch	oP:on or oFF
		Touch **SELECT** 2 times	One touch decel switch	od:on or oFF
		Touch **SELECT** 3 times	Preheat switch	PH:on or oFF
Group 4 (Output)	Touch **SELECT** switch **4 times** while pressing **BUZZER STOP.** In this group **SELECT** LED blinks at 1sec interval	Default	Hourmeter	Ho:on or oFF
		Touch **SELECT** 1 time	Neutral relay (Anti-restart relay)	nr:on or oFF
		Touch **SELECT** 2 times	Travel speed solenoid	tS:on or oFF
		Touch **SELECT** 3 times	Max flow cut off solenoid	FS:on or oFF
		Touch **SELECT** 4 times	Preheat relay	PR:on or oFF

※ By touching **SELECT** switch once while pressing **BUZZER STOP**, display group shifts.
Example : Group 0 → 1 → 2 → 3 → 4 → 0

2) DESCRIPTION OF MONITORING DISPLAY

Group	Display	Name	Description
Group 0	1000 rpm	Engine speed	It displays current engine speed detected by engine speed sensor from 500 to 3000rpm. Range : 500~3000rpm by 10rpm
	TIME 12 : 30	Time	It displays current time(12 is hour and 30 is minute) Range : Hour(1~12), minute(00~59)
	EP : 10bar	Power shift pressure of EPPR valve	It shows that pump power shift pressure of EPPR valve being controlled by the CPU controller is 10bar. Range : 00~50bar by 1bar
	21 : C1.4	Model and CPU program version	It shows that machine model(R210LC-7) and the program version of the CPU controller is 1.4. Version display range : 0.0~9.9 by 0.1
Group 1	b : 24.8V	Battery voltage	It shows that battery power of 24.8V is supplied into CPU controller. Range : 00.0~48.0V by 0.1V
	Po : 2.5V	Potentiometer voltage	It shows that potentiometer signal voltage is 2.5V. Range : 0.0~5.0V by 0.1V
	dL : 3.8V	Accel dial voltage	It shows that accel dial signal voltage is 3.8V. Range : 0.0~5.0V by 0.1V
	Hd : 50°C	Hydraulic oil temperature	It shows that hydraulic oil temperature detected by temperature sensor is 50°C. Range : 0~150°C by 1°C
	Ct : 85°C	Coolant temperature	It shows that coolant oil temperature detected by temperature sensor is 50°C. Range : 0~150°C by 1°C
Group 2	CHECK Er : 03	Current error	It shows that current error of 03(Short circuit in pump EPPR valve system) is diagnosed by self diagnosis system in the CPU controller. If more than 2 errors, when pressing ▼ or ▲ switch, other error codes show. Range : 00~58
	TIME Er : 03	Recorded error	It shows recorded error code of 03 which is diagnosed before. If more than 2 error codes, when pressing ▼ or ▲ switch, other error codes show. Range : 00~58
	TIME Er : 00	Recorded error deletion	It shows all recorded error codes are removed in the CPU controller memory.

Group	Display	Name	Description
Group 3	**dP : on** or **oFF**	Auto decel pressure switch	**dP : on** Shows that auto decel pressure switch is pressed on (No operation of control lever). **dP : oFF** Shows that auto decel pressure switch is released off (Operation of control lever).
	oP : on or **oFF**	Travel oil pressure switch	**oP : on** Shows that travel oil pressure switch is pressed on (No operation of travel control lever). **oP : oFF** Shows that travel oil pressure switch is released off (Operation of travel control lever).
	od : on or **oFF**	One touch decel switch	**od : on** Shows that one touch decel switch is pressed. **od : oFF** Shows that one touch decel switch is released.
	PH : on or **oFF**	Preheat switch	**PH : on** Shows that preheat switch is pressed. **PH : oFF** Shows that preheat switch is released.
Group 4	**Ho : on** or **oFF**	Hourmeter	**Ho : on** Shows that hourmeter is activated by CPU controller. **Ho : oFF** Shows that hourmeter is turned off.
	nr : on or **oFF**	Neutral relay (Anti-restart relay)	**nr : on** Shows that neutral relay for anti-restarting function is activated(Engine start is possible). **nr : oFF** Shows that neutral relay is turned off to disable the engine restart.
	ts : on or **oFF**	Travel speed solenoid	**ts : on** Shows that travel speed solenoid is activated (High speed). **ts : oFF** Shows that travel speed solenoid is released (Low speed).

SECTION 6 TROUBLESHOOTING

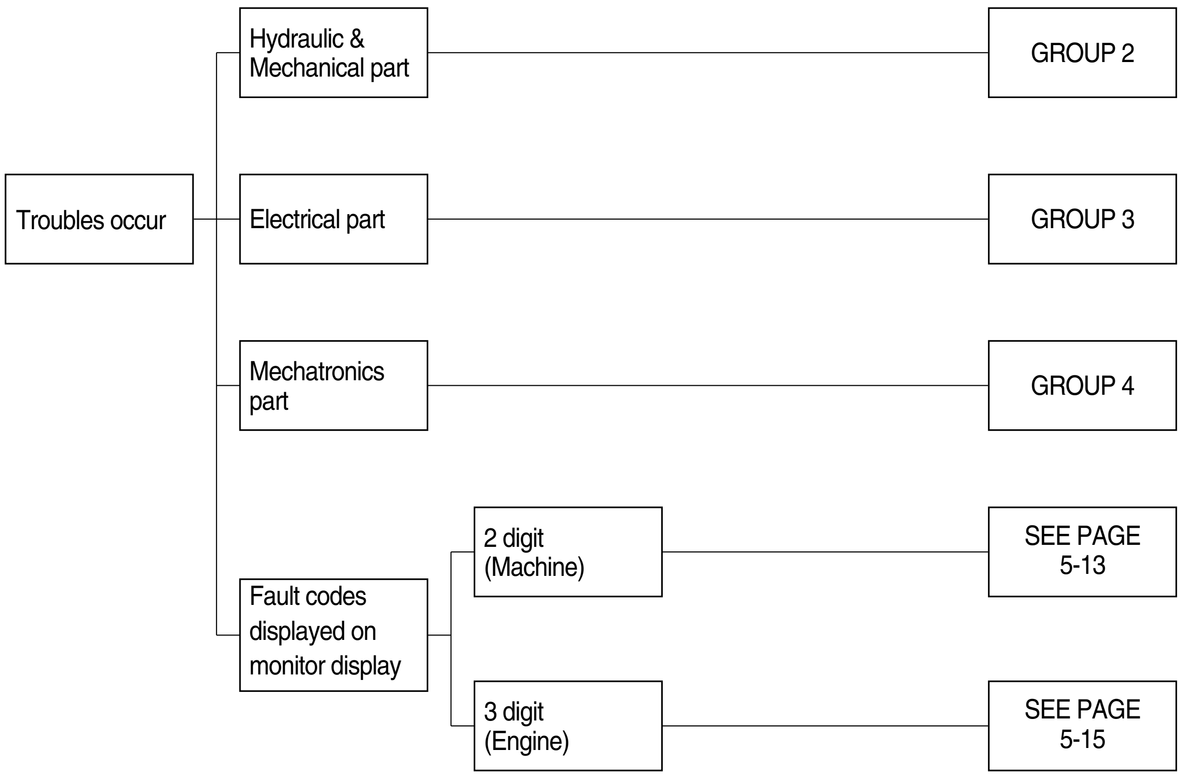
SECTION 6 TROUBLESHOOTING

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.

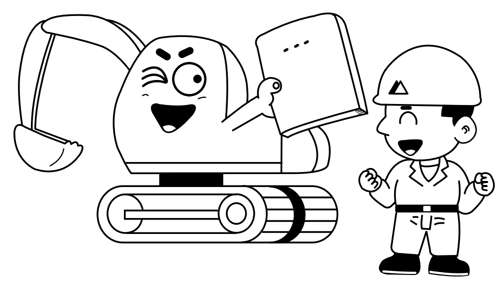


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

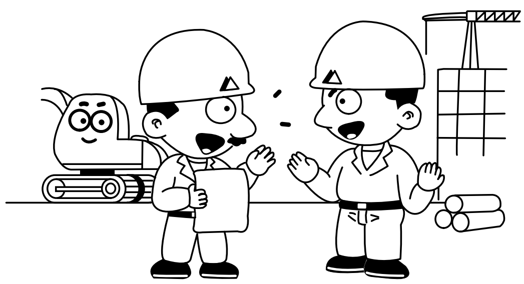
Study and know how the machine is operating, how the system is composing, what kinds of function are installed in the machine and what are specifications of the system components by the machine service manual.
Especially, deepen the knowledge for the related parts of the trouble.


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.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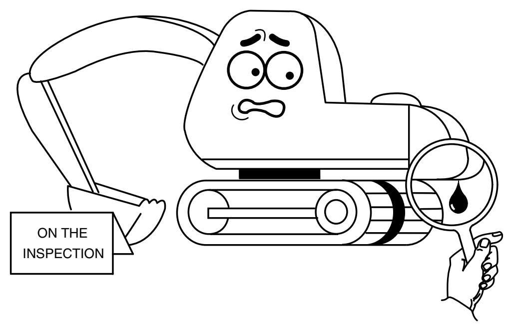
STEP 3. Inspect the machine

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

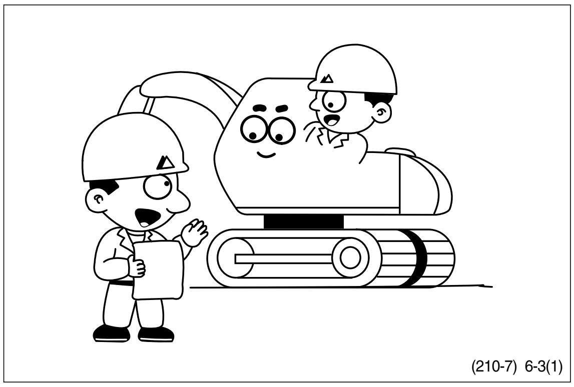
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(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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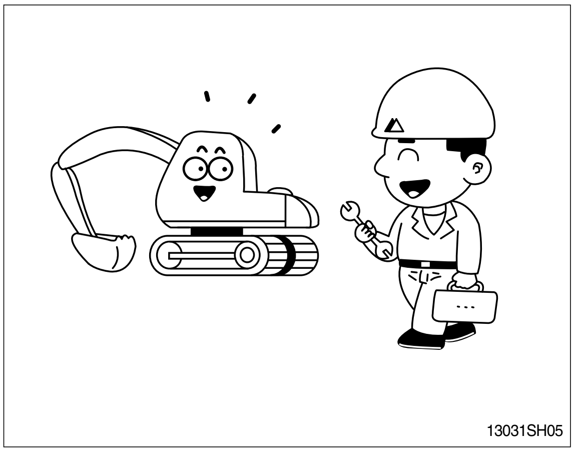
STEP 5. Perform troubleshooting

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.

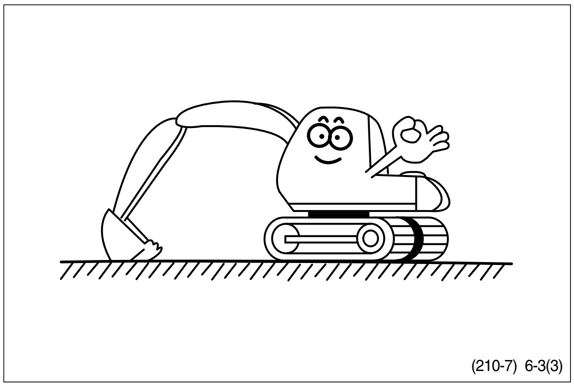


13031SH05

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.



(210-7) 6-3(3)

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.

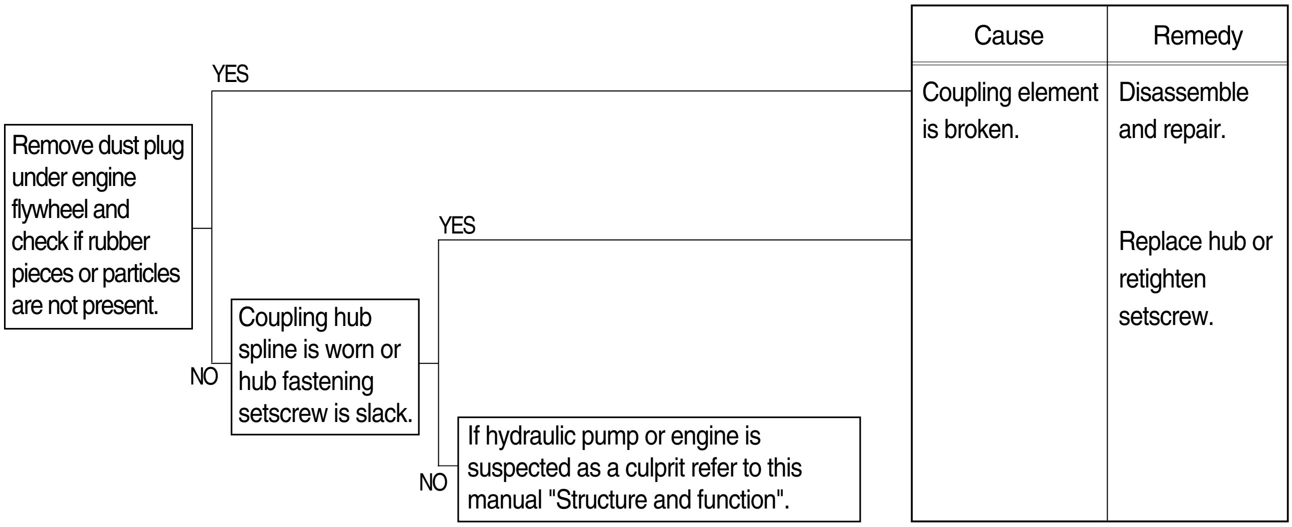
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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?

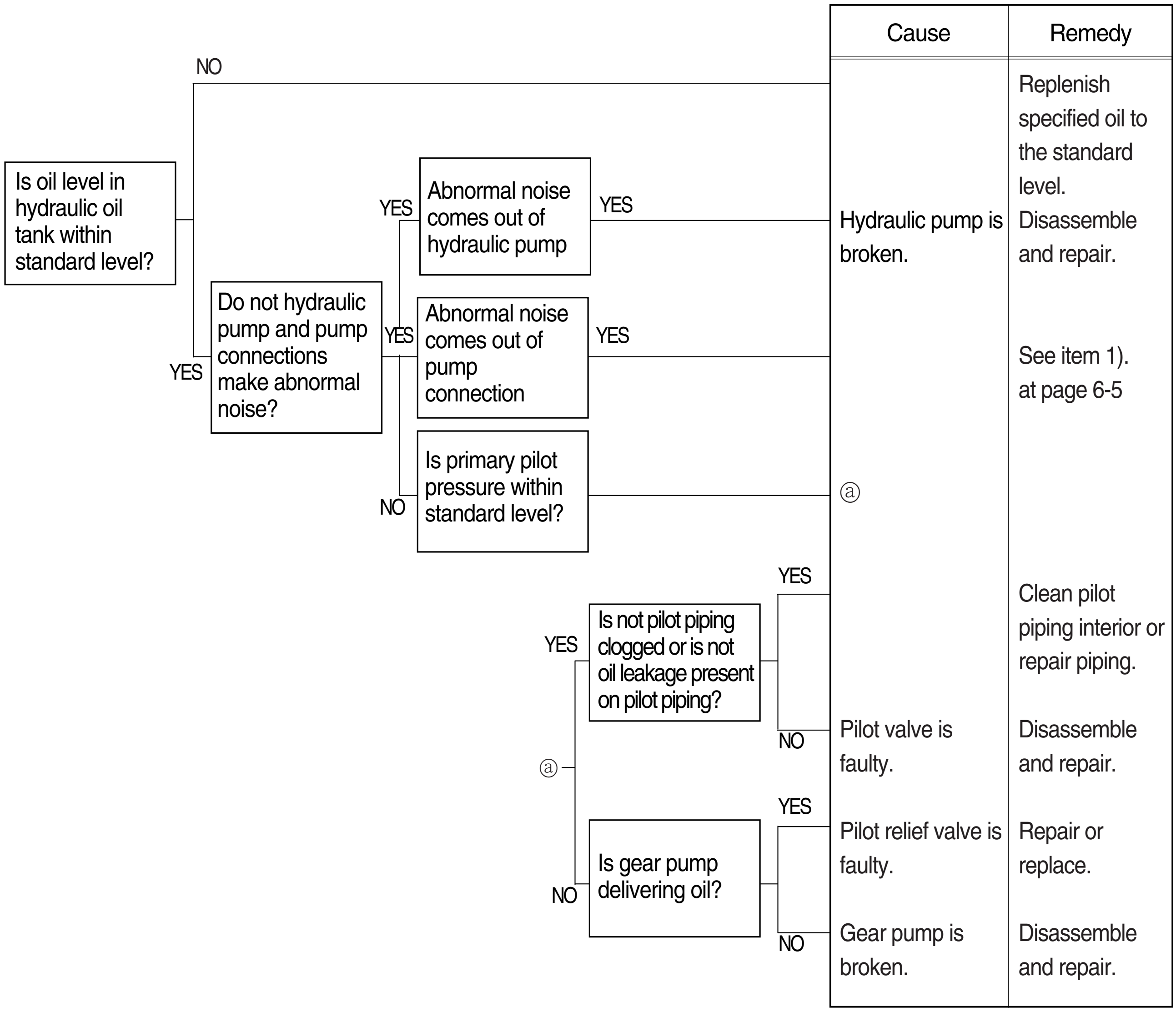
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

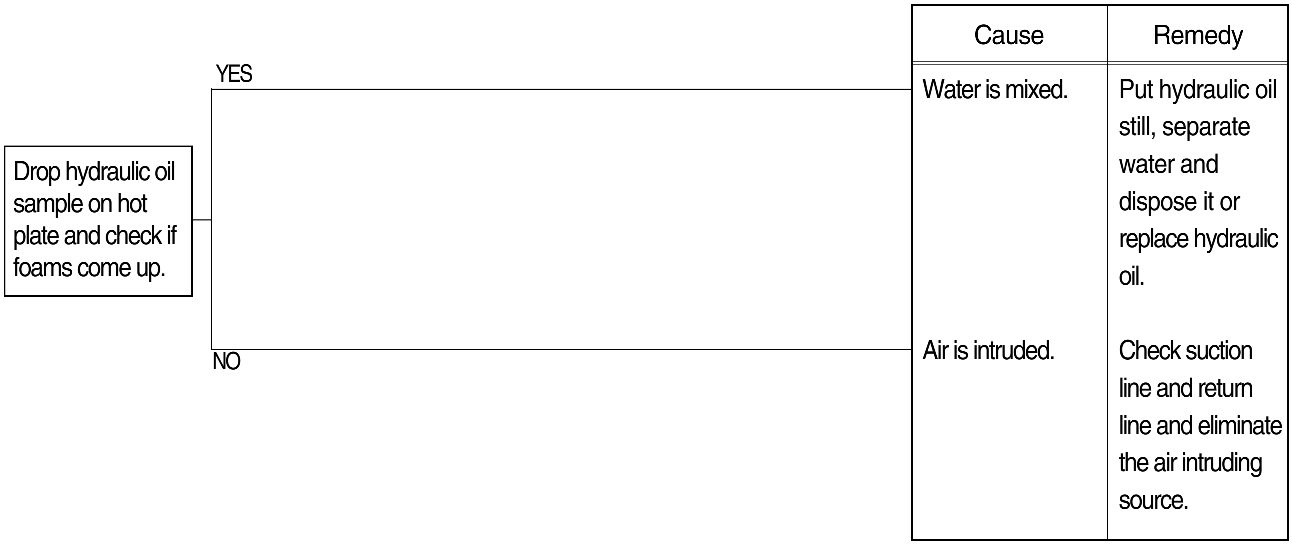


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

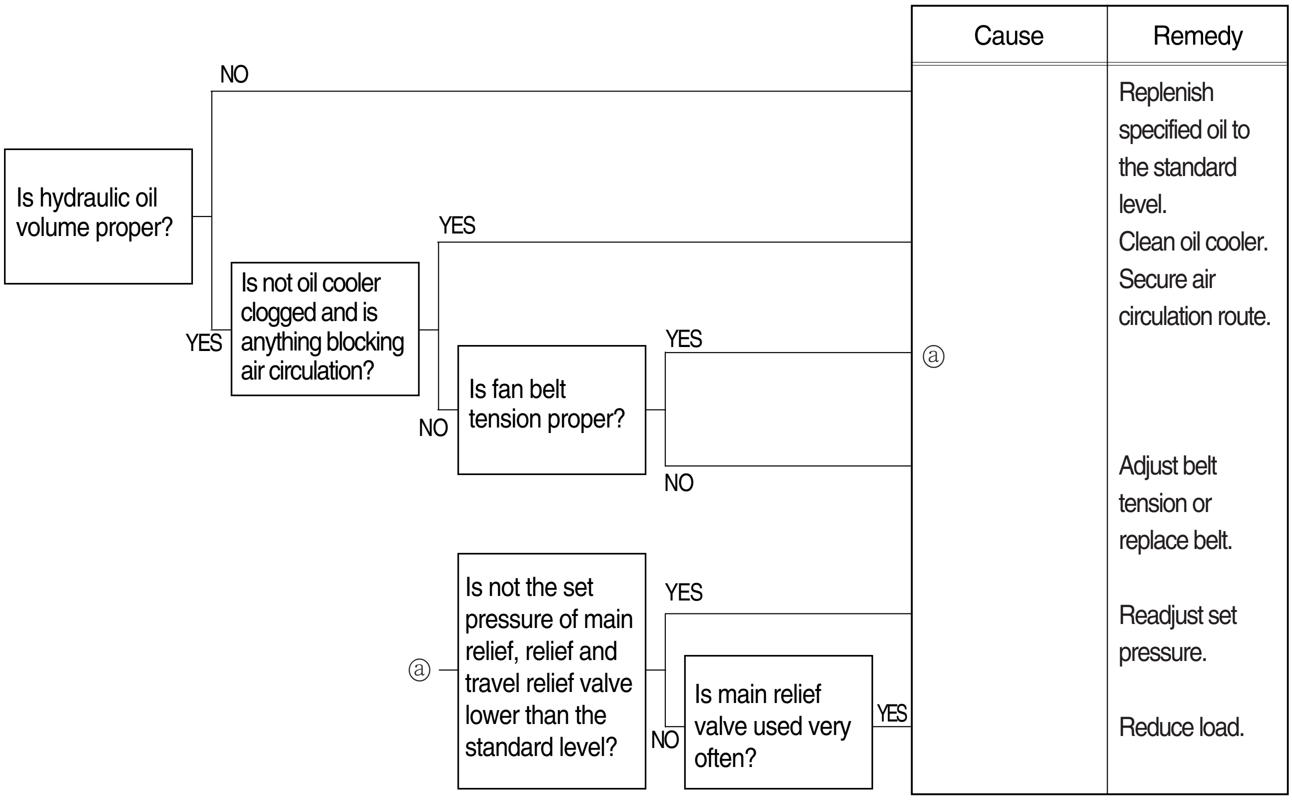


3. HYDRAULIC SYSTEM

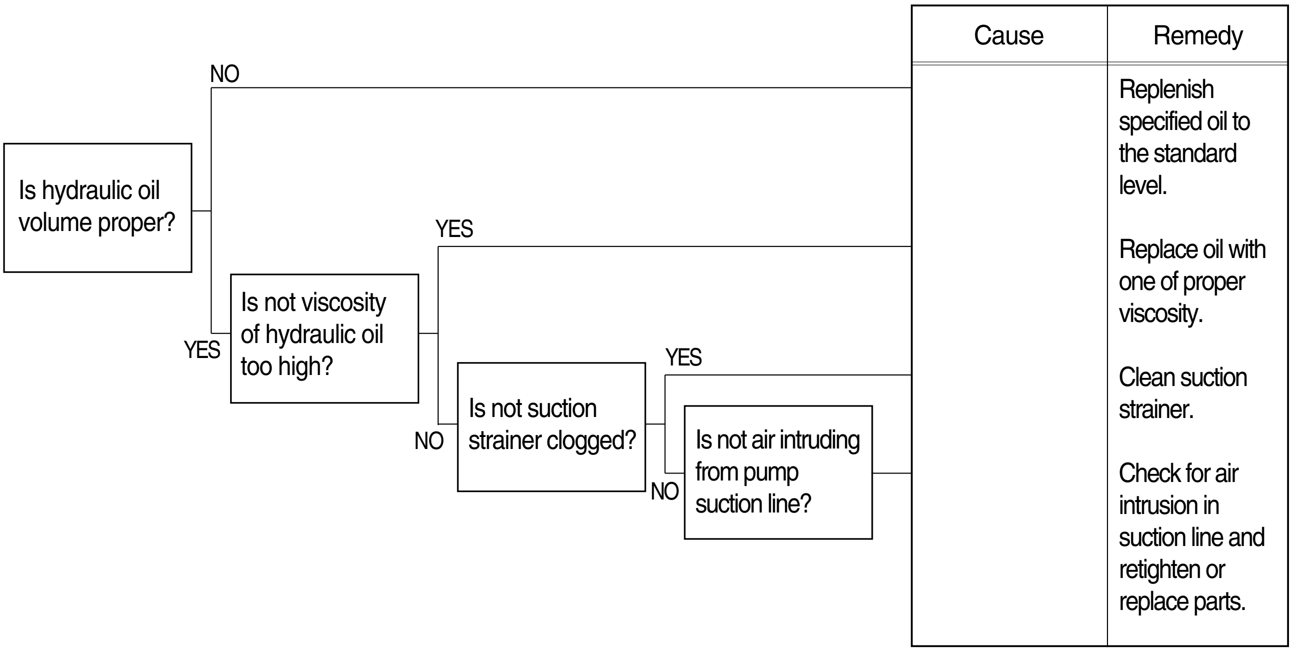
1) HYDRAULIC OIL IS CLOUDY



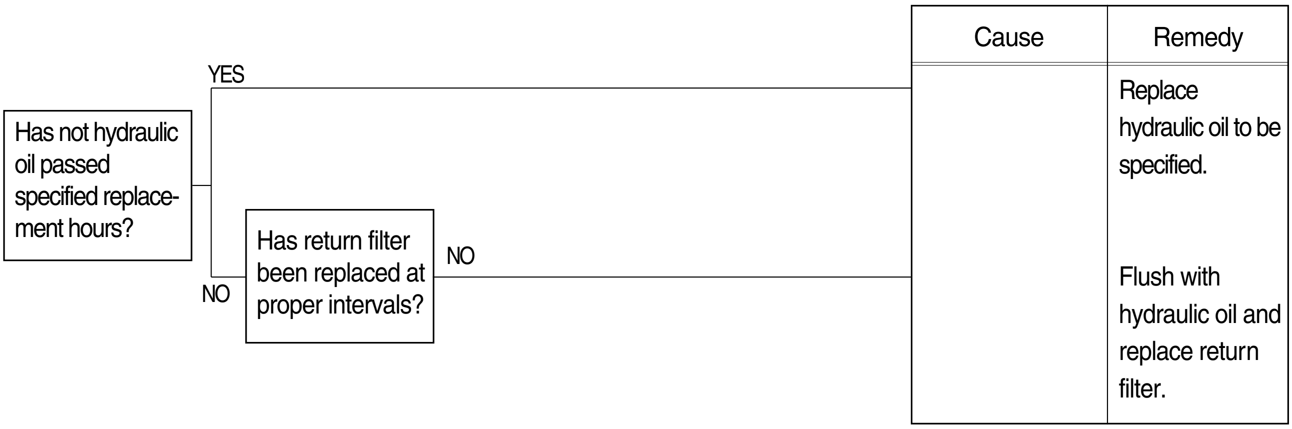
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

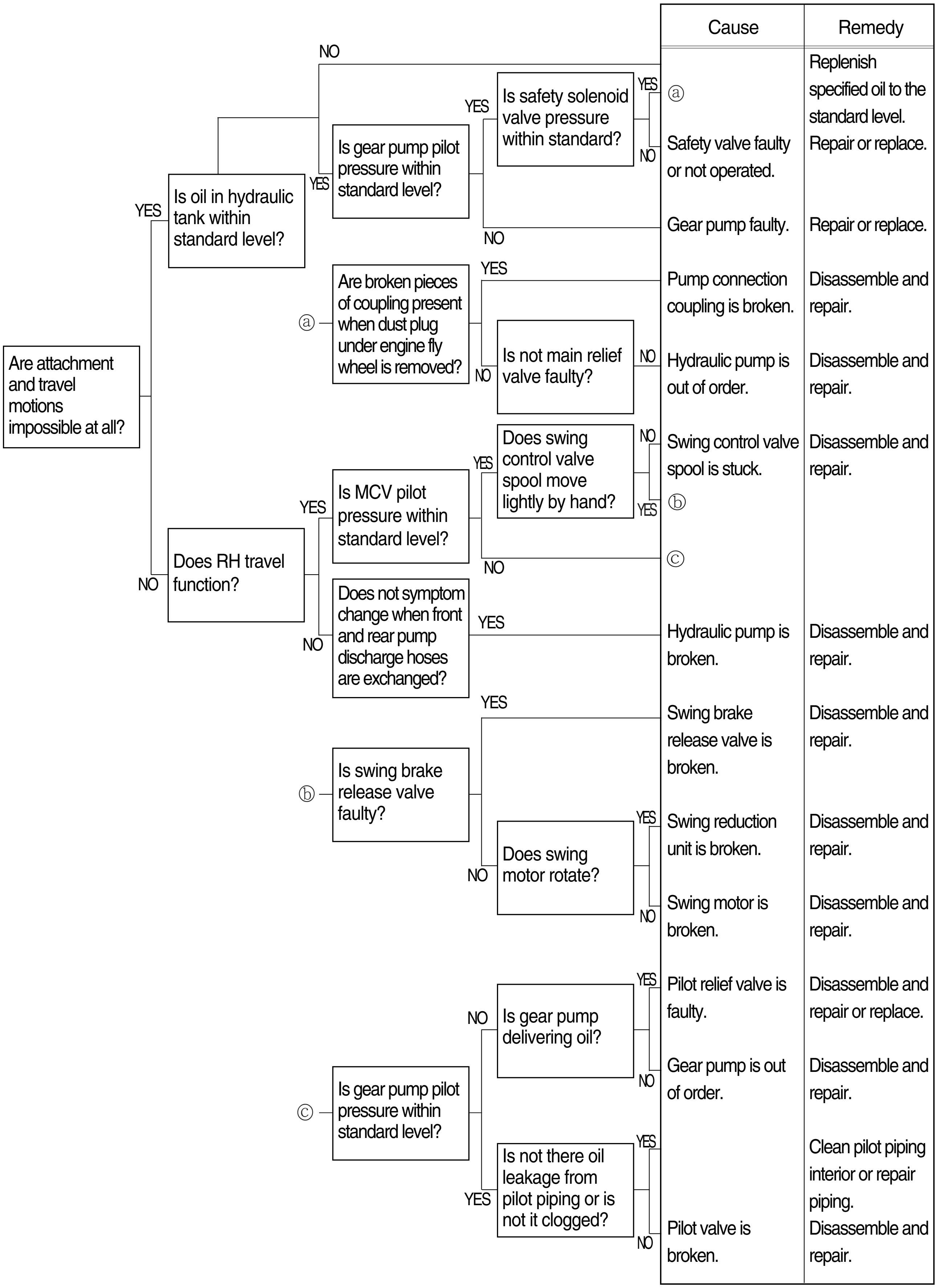


4) HYDRAULIC OIL IS CONTAMINATED

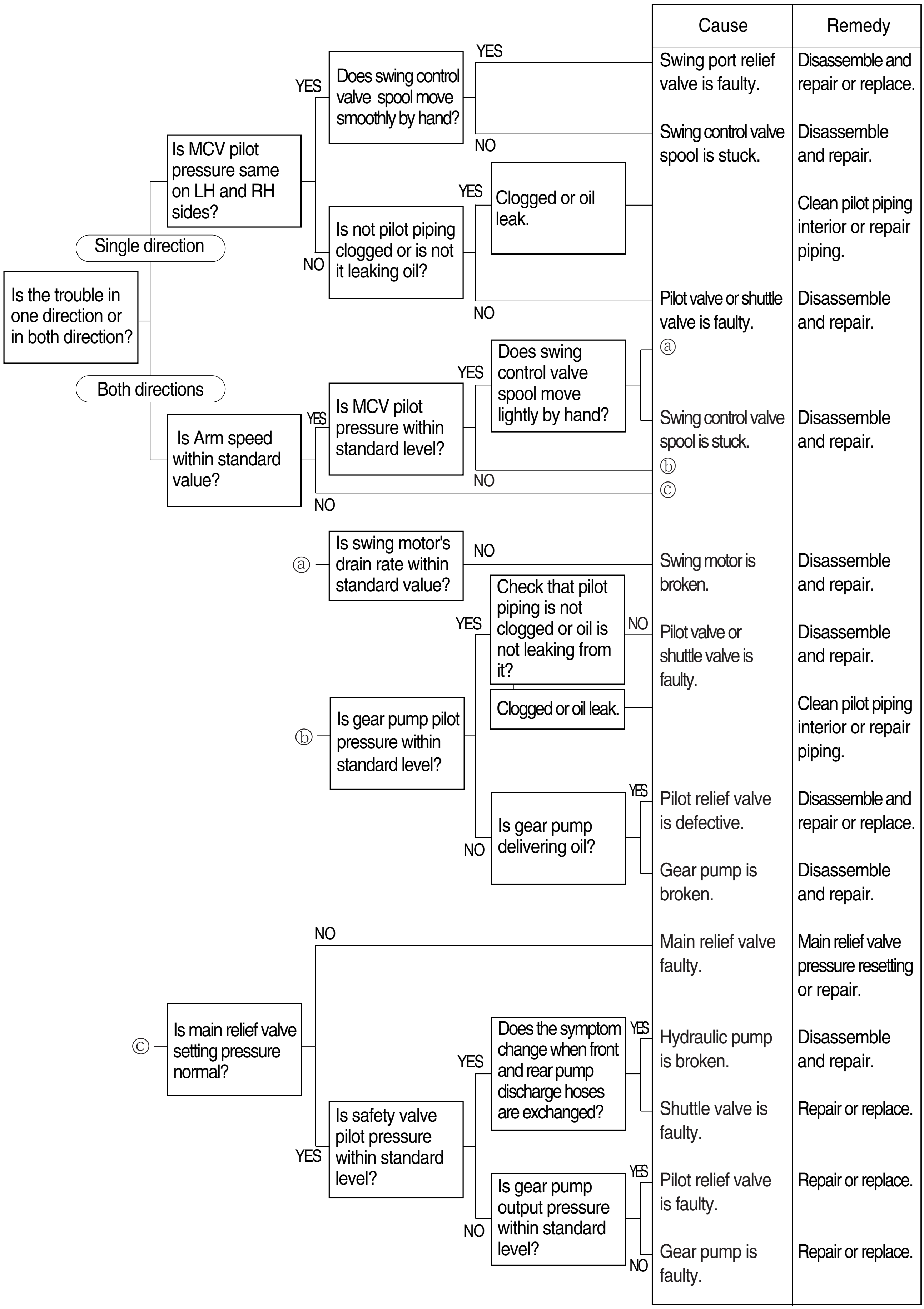


4. SWING SYSTEM

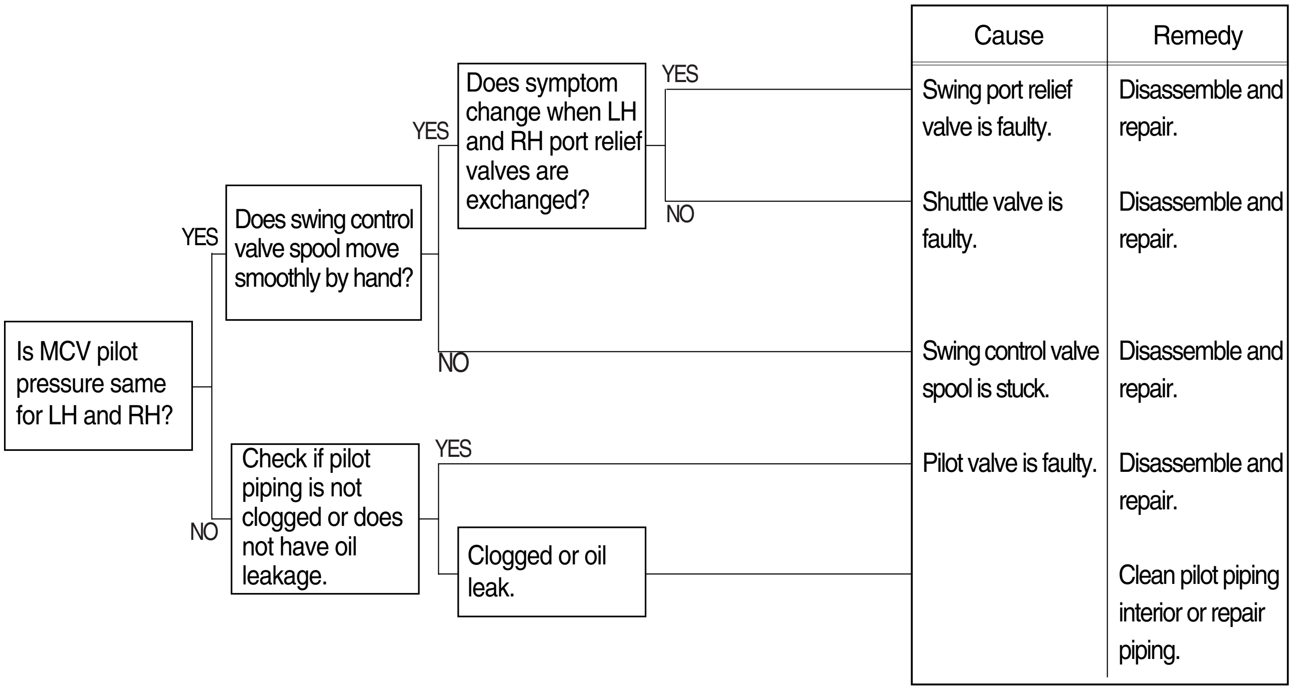
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



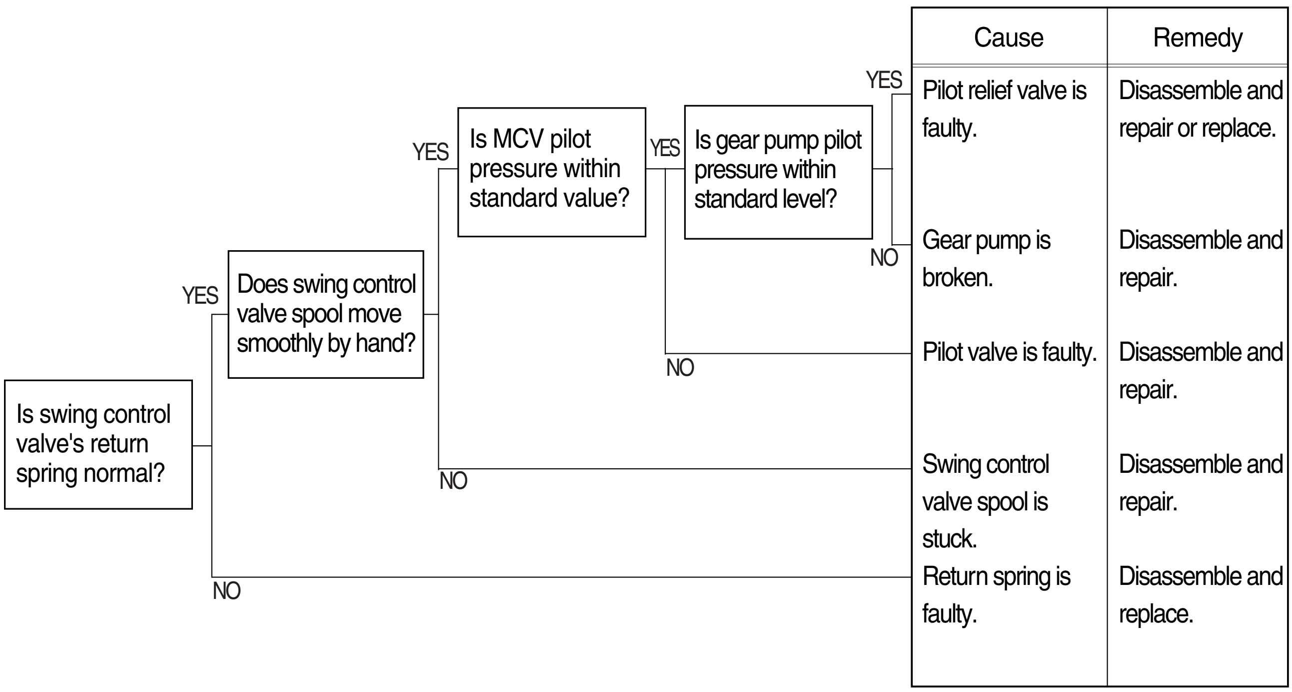
2) SWING SPEED IS LOW



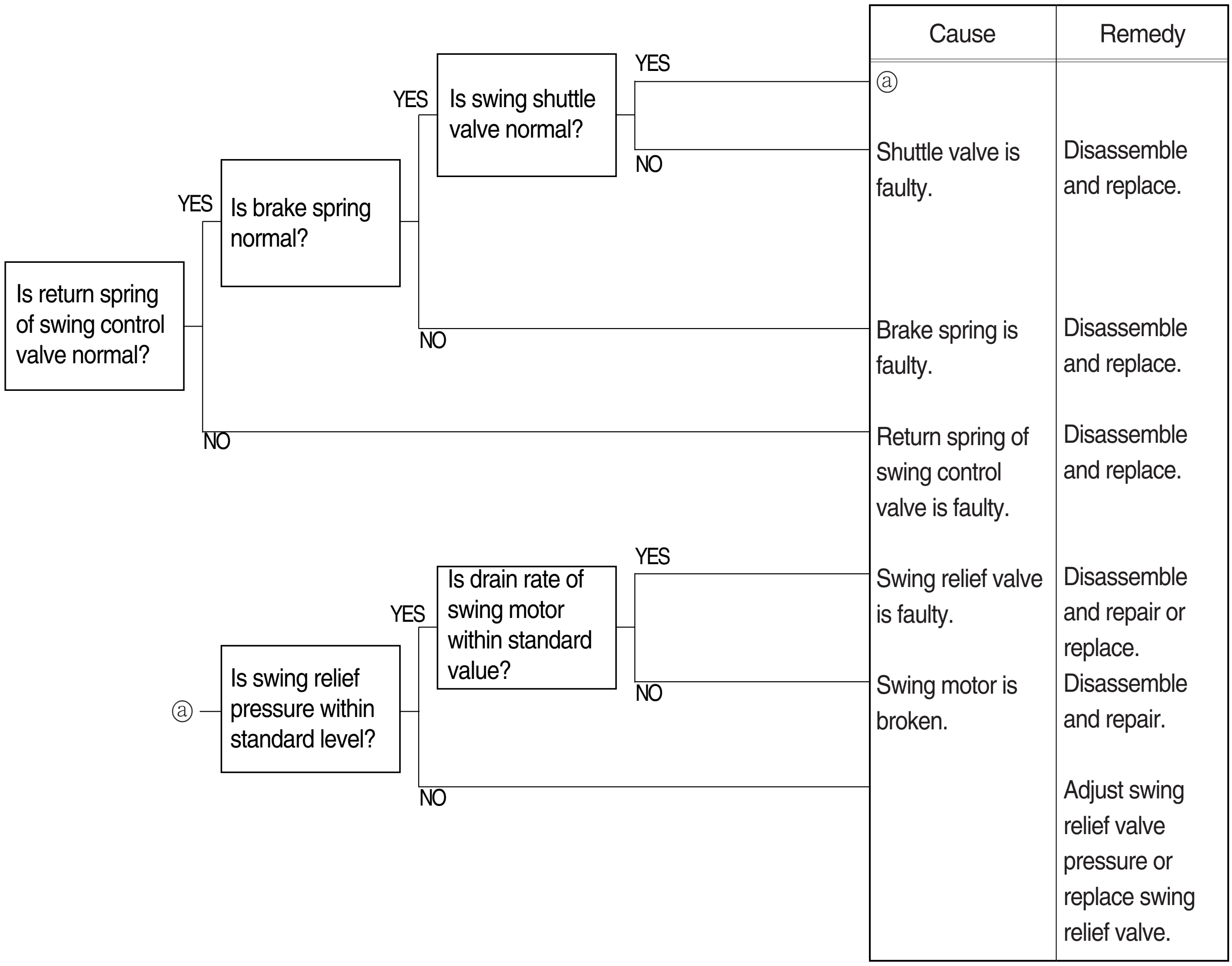
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

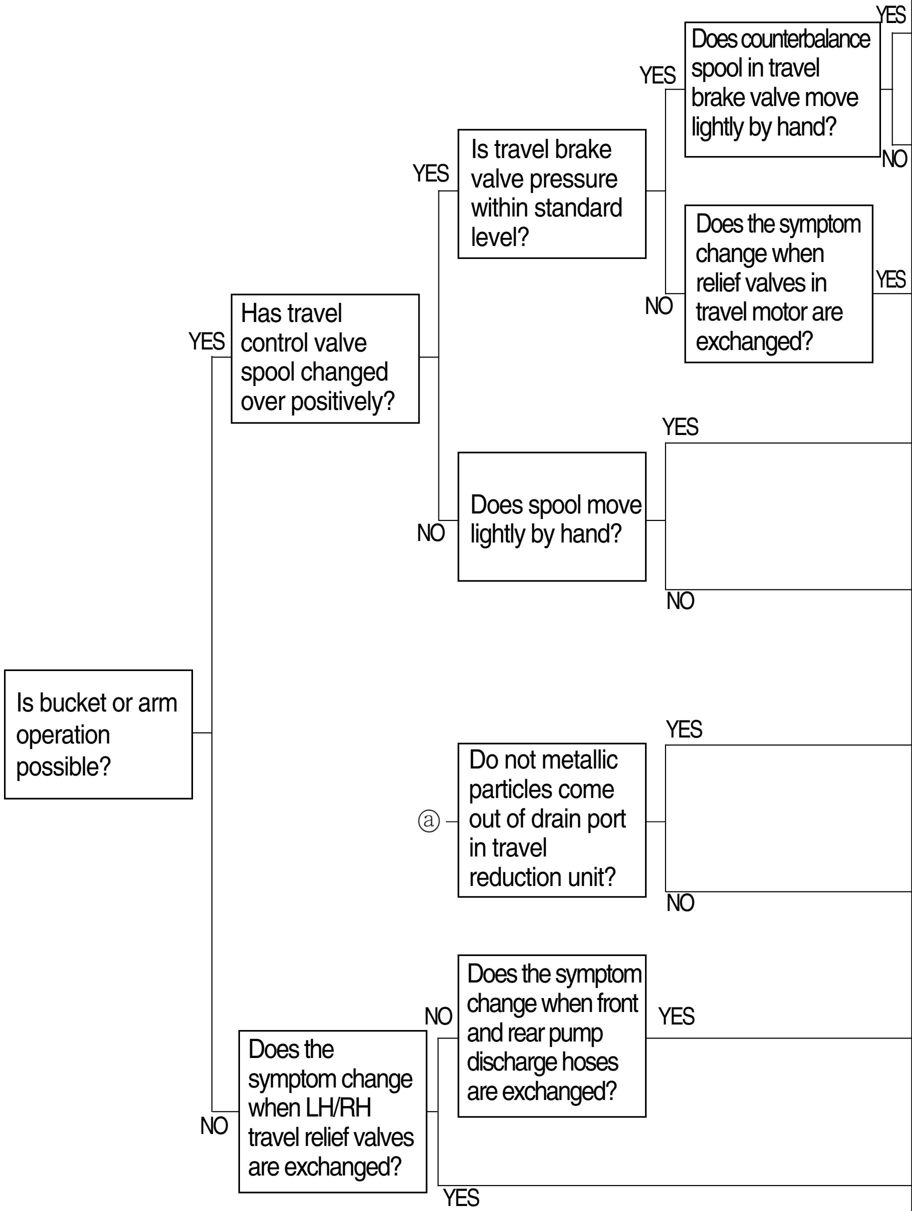


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



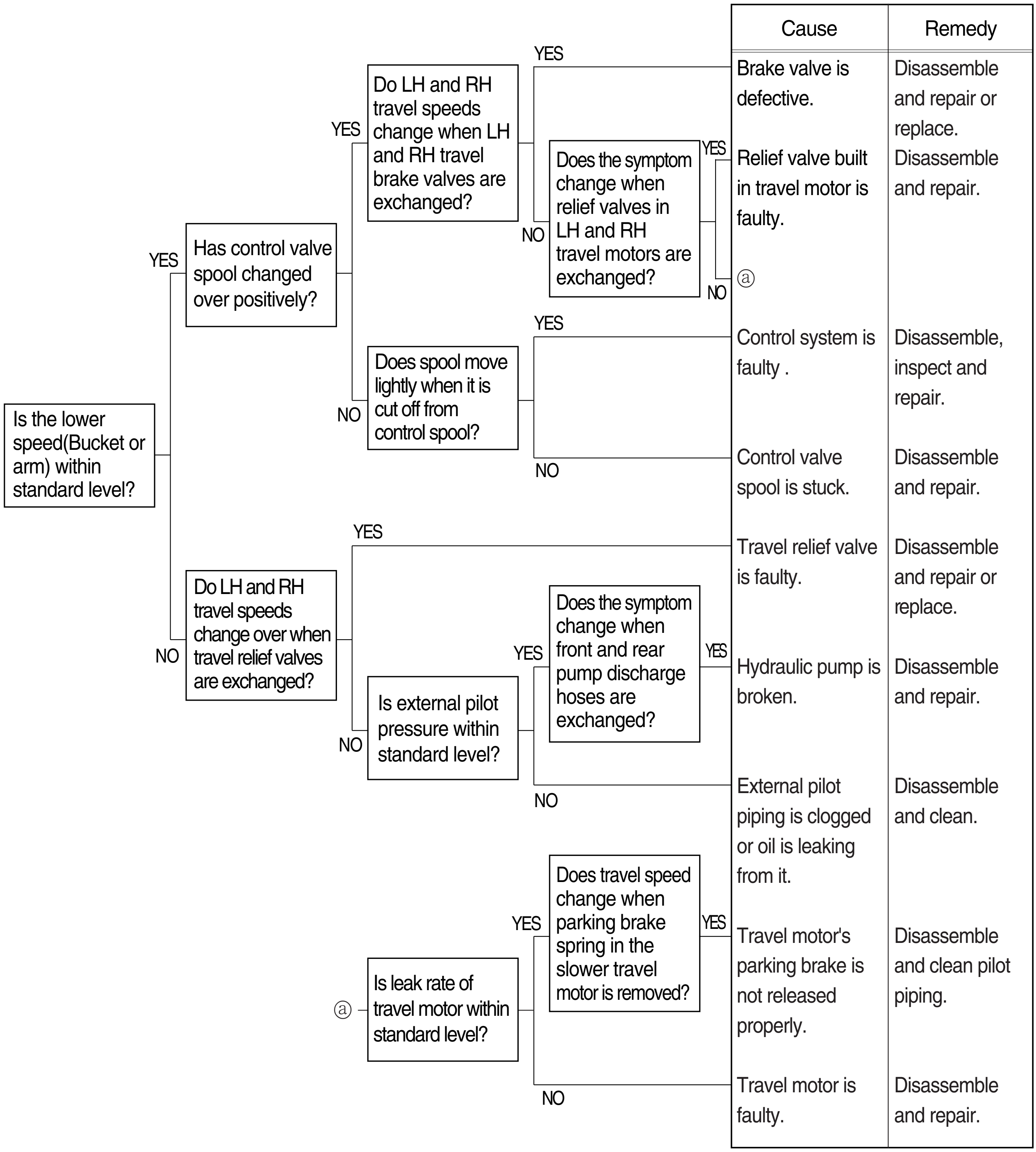
5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE

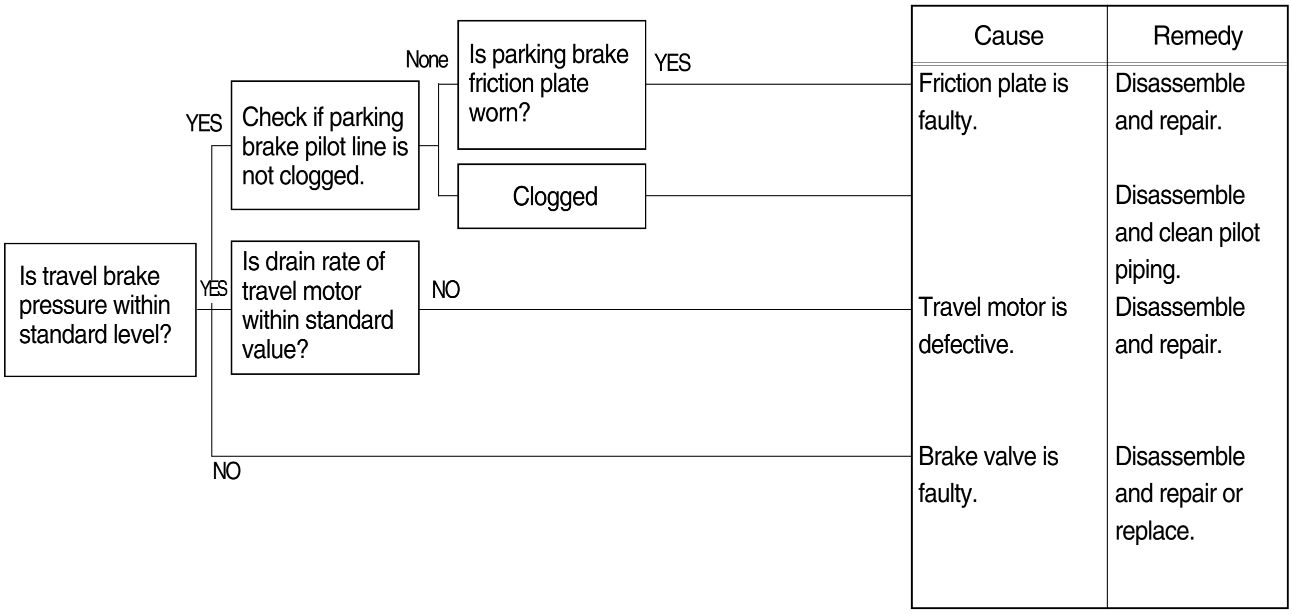


Cause	Remedy
ⓐ	
Counter spool in travel brake valve is stuck.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is defective.	Disassemble inspect and repair.
Travel control valve spool is stuck.	Disassemble and repair.
Travel reduction 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.

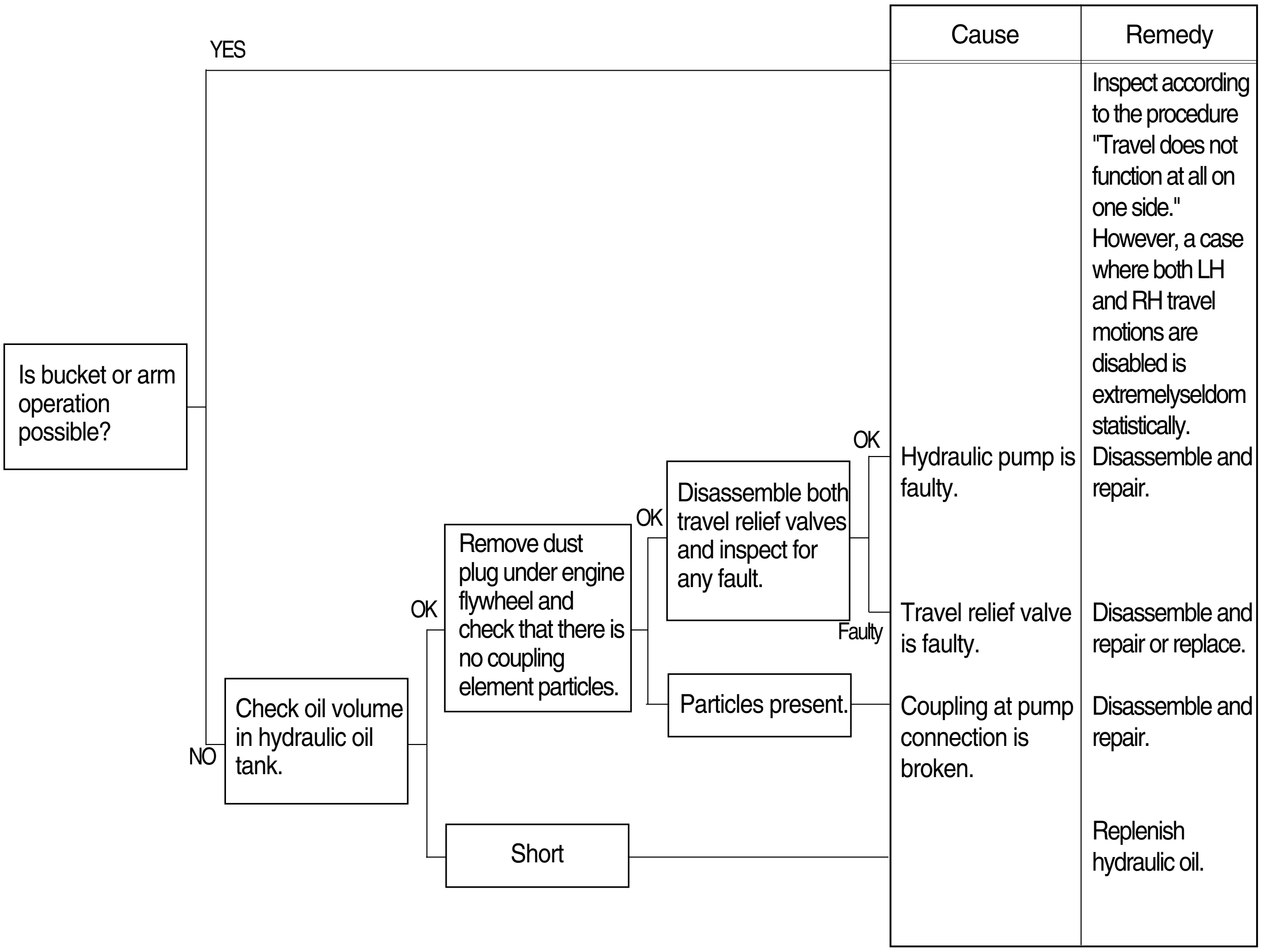
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



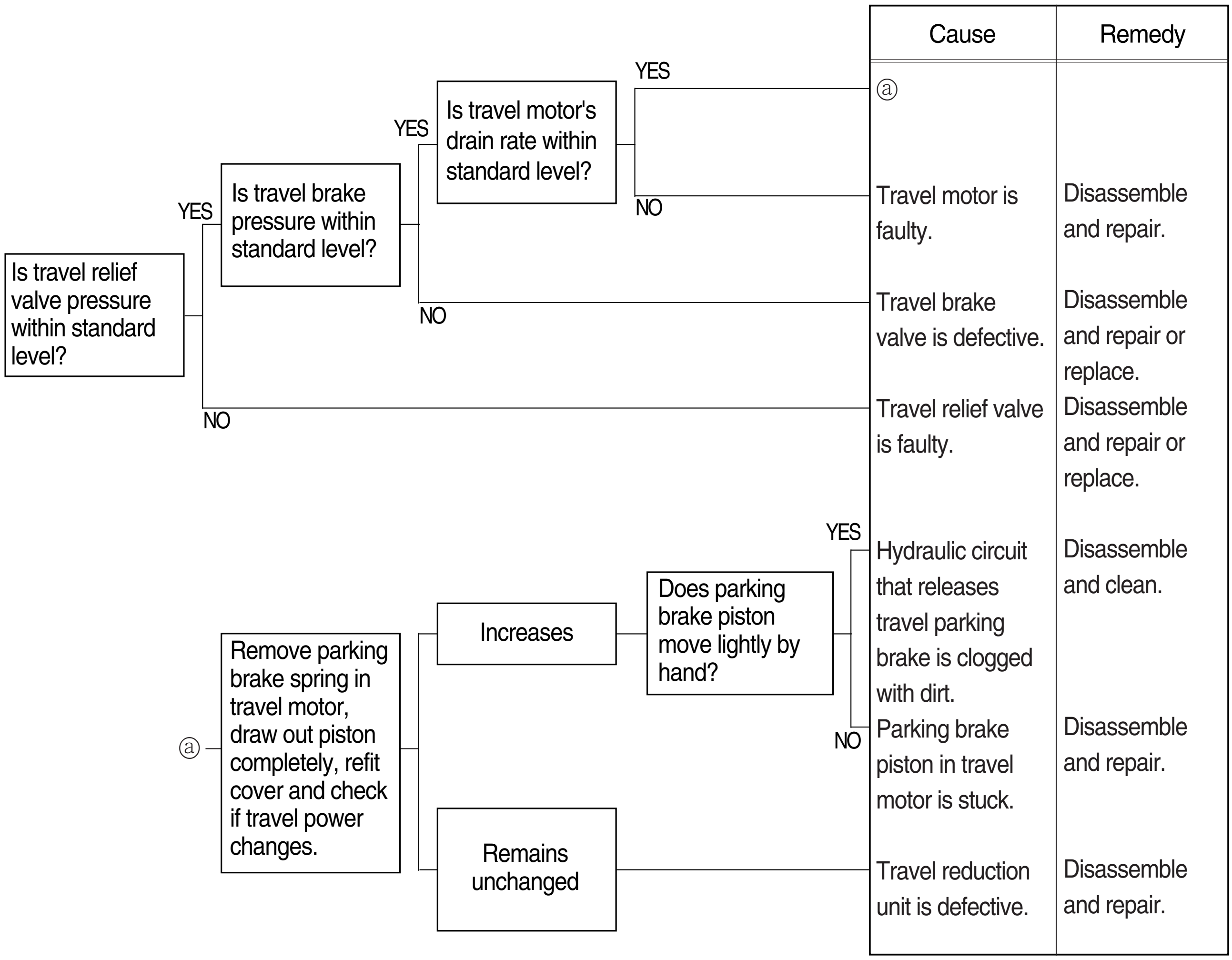
3) MACHINE DOES NOT STOP ON A SLOPE
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

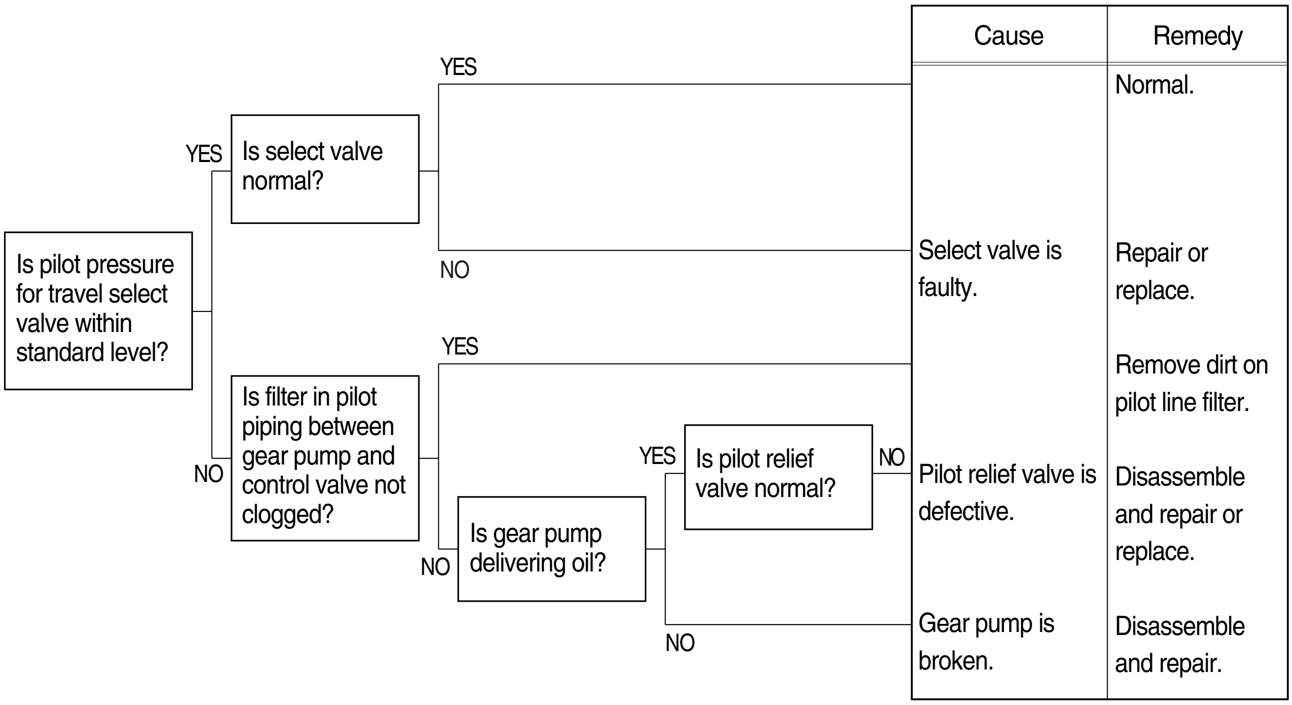


5) TRAVEL ACTION IS POWERLESS(Travel only)



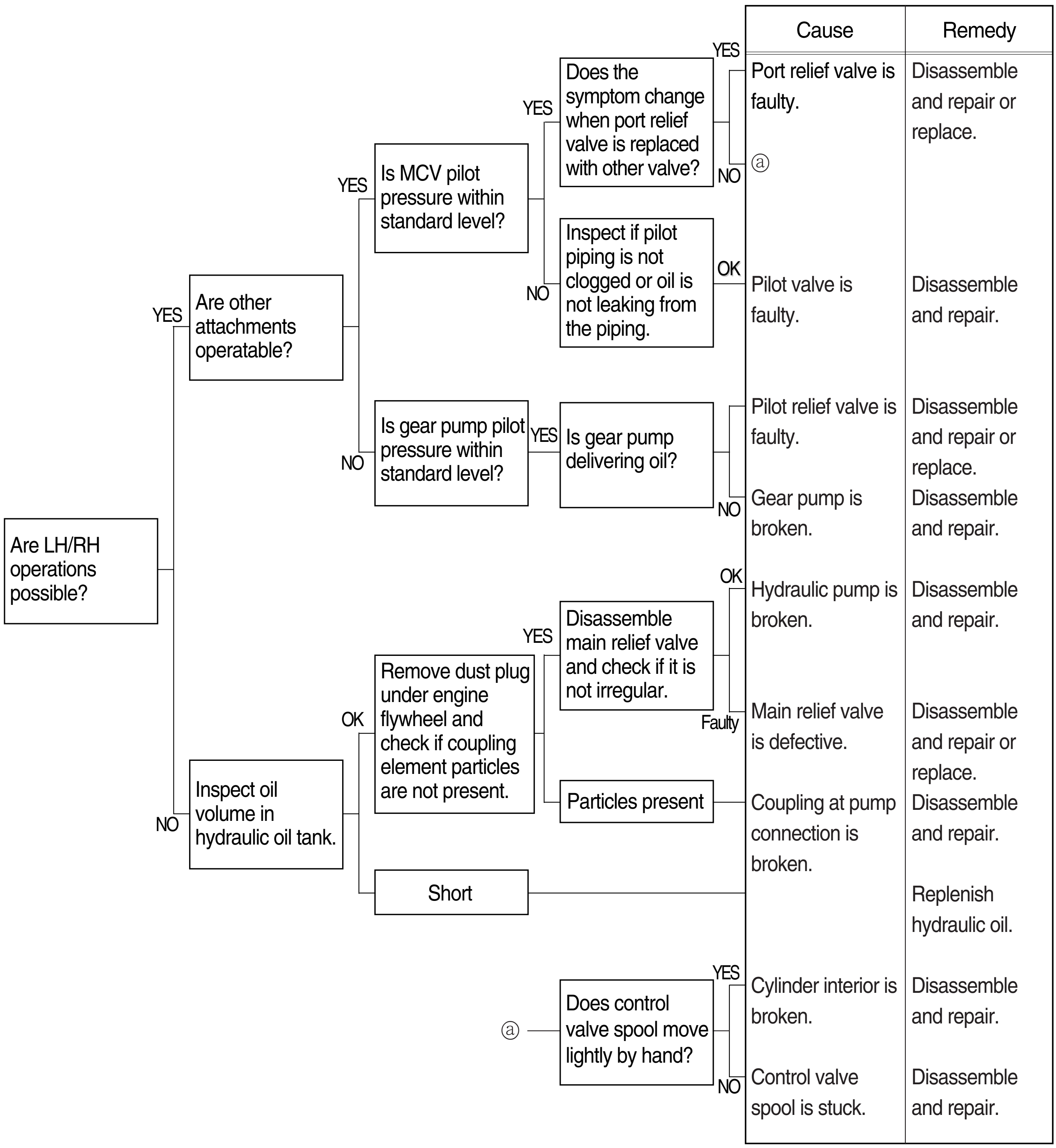
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

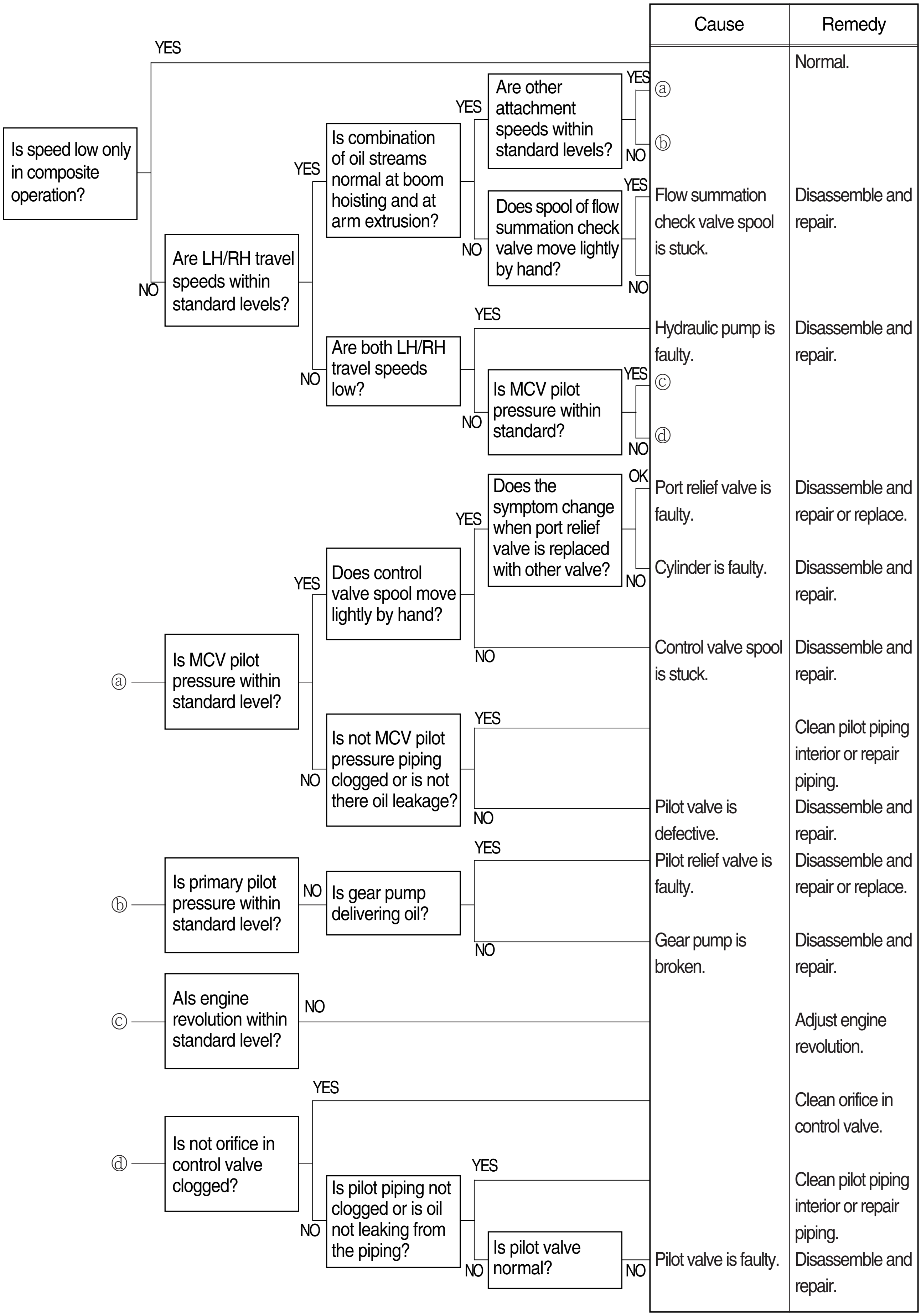


6. ATTACHMENT SYSTEM

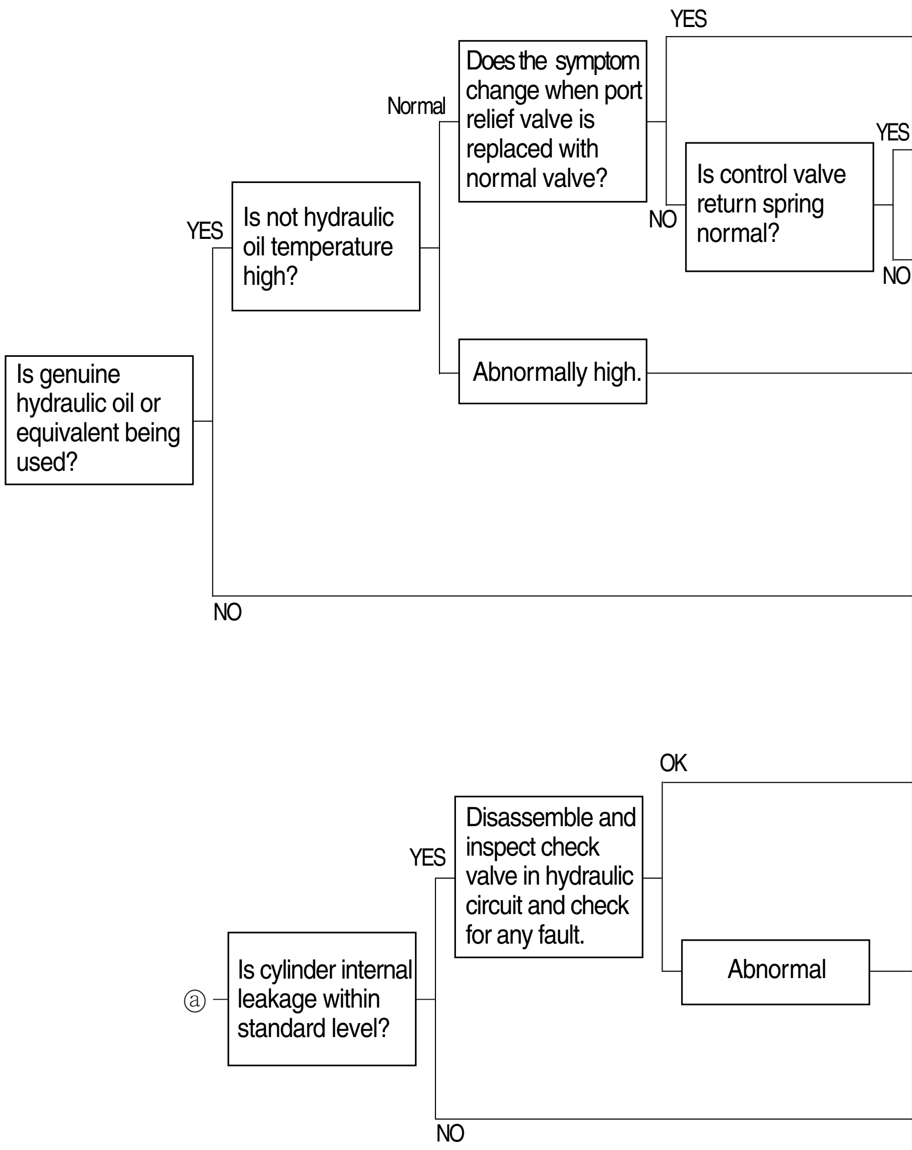
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

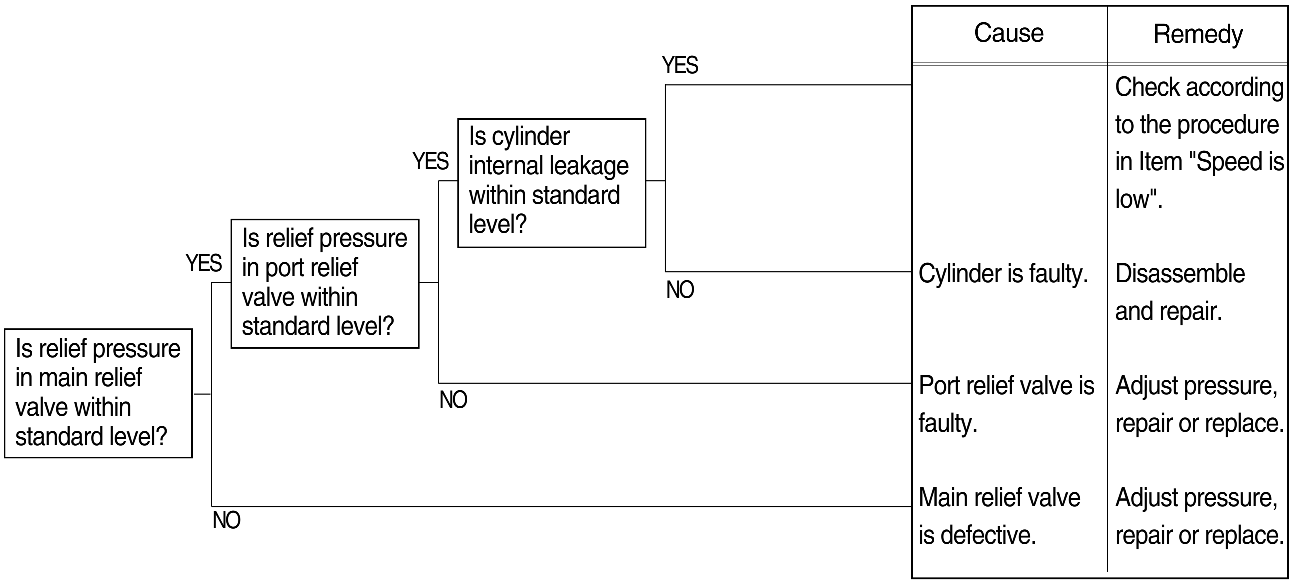


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

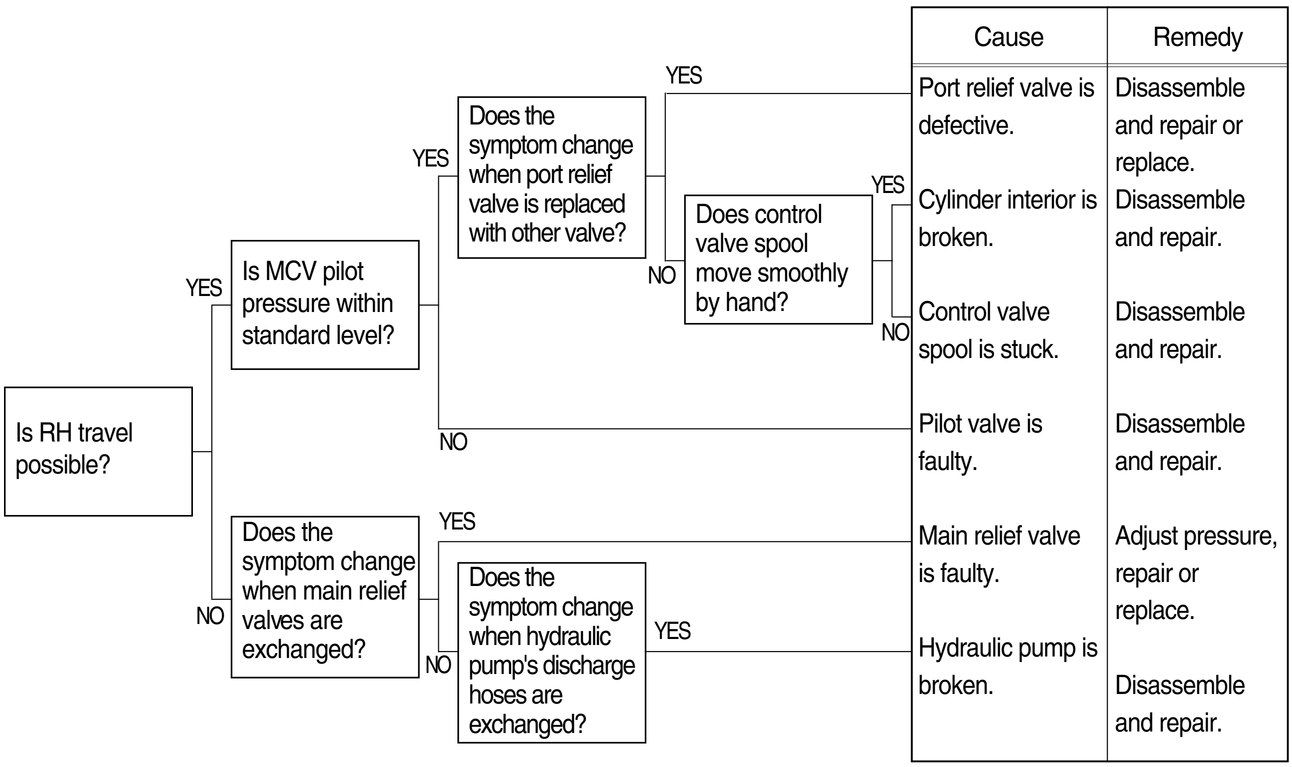


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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



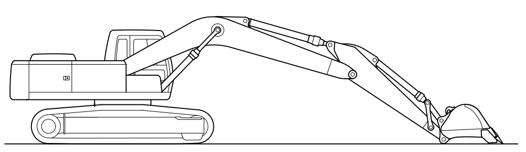
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



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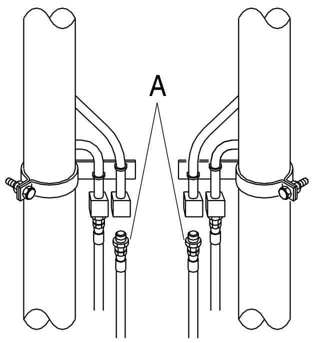
2. Disconnect hose(A) from rod side of boom cylinder and drain oil from cylinders and hose.(Put cups on piping and hose ends)



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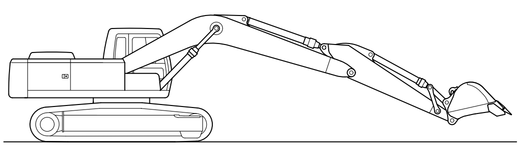
3. Raise bucket OFF the ground by retracting the arm cylinder rod.

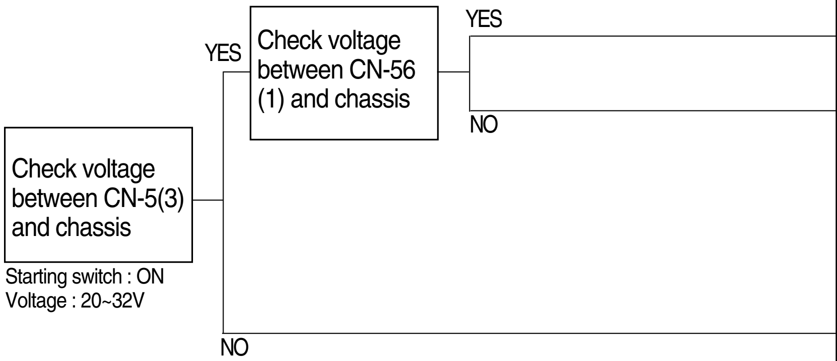
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



29076TS01

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

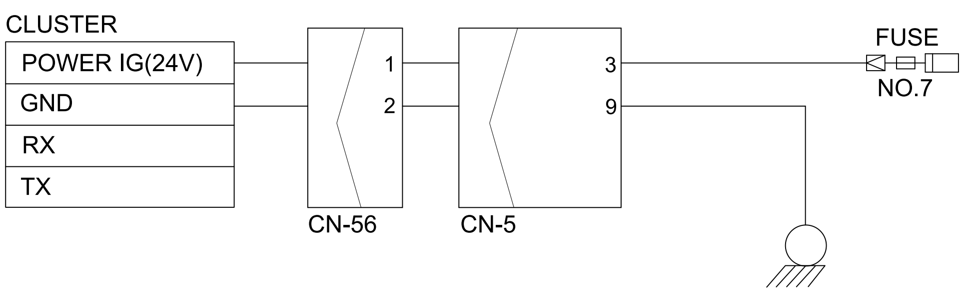
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.7.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	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.7	Repair or replace (After clean)

Check voltage

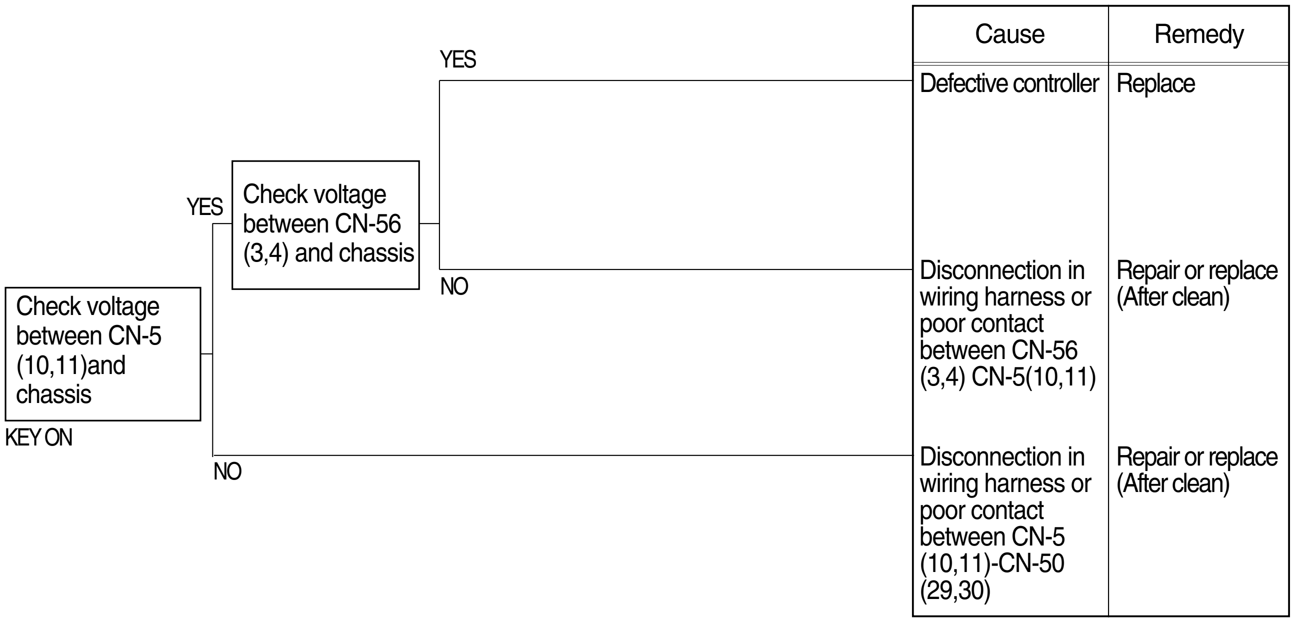
YES	20 ~ 32V
NO	0V



RD21076ES51

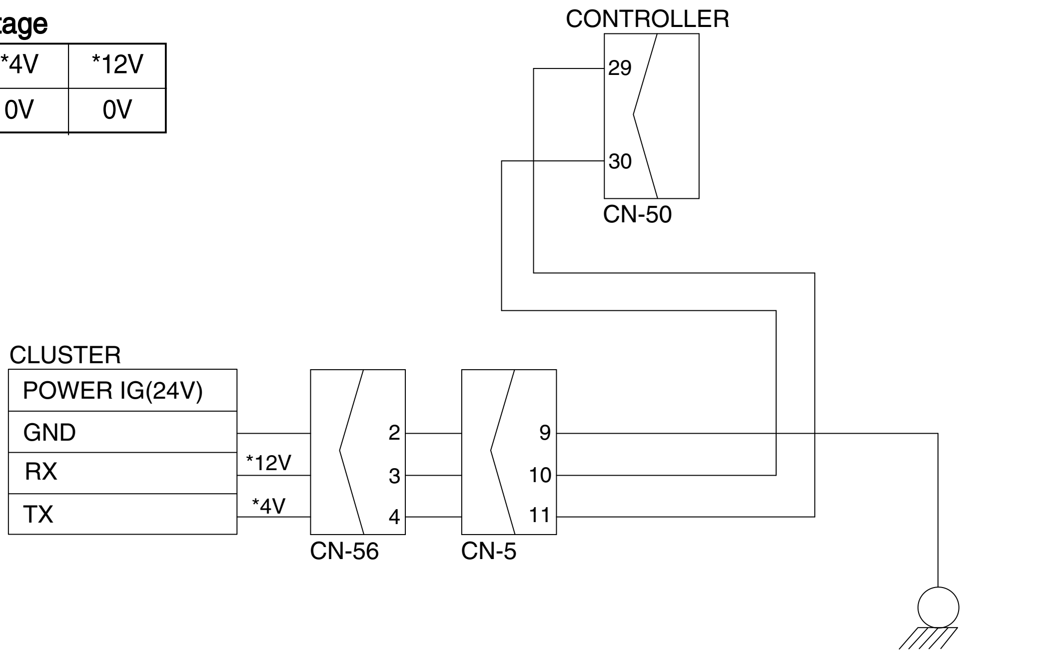
2. COMMUNICATION ERROR "Co : Er" FLASHES ON THE CLUSTER

- 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.



Check voltage

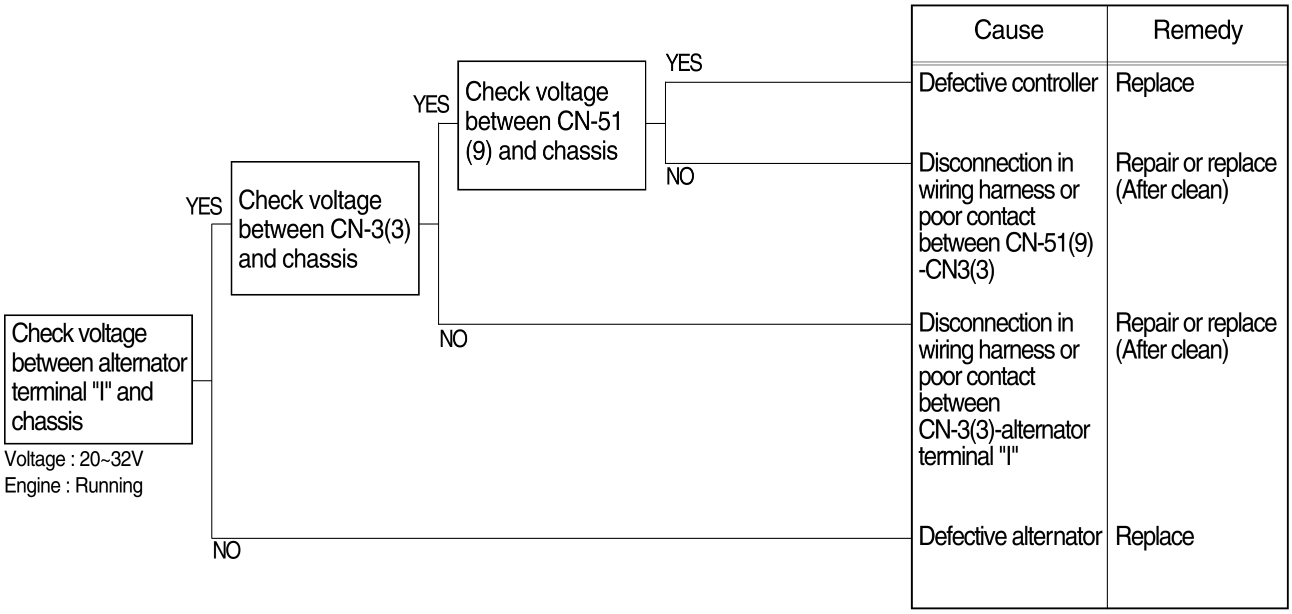
YES	*4V	*12V
NO	0V	0V



29076ES02

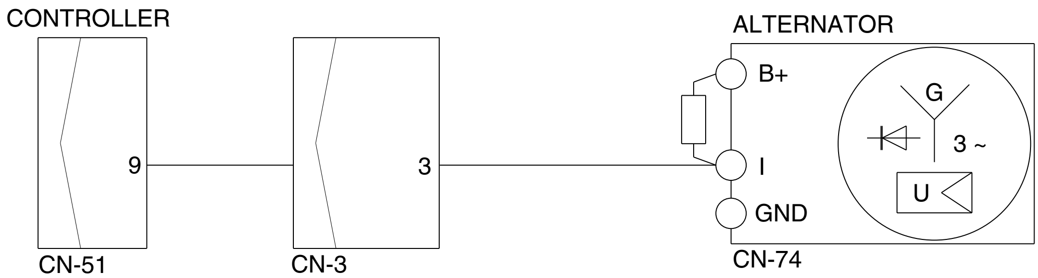
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

· 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

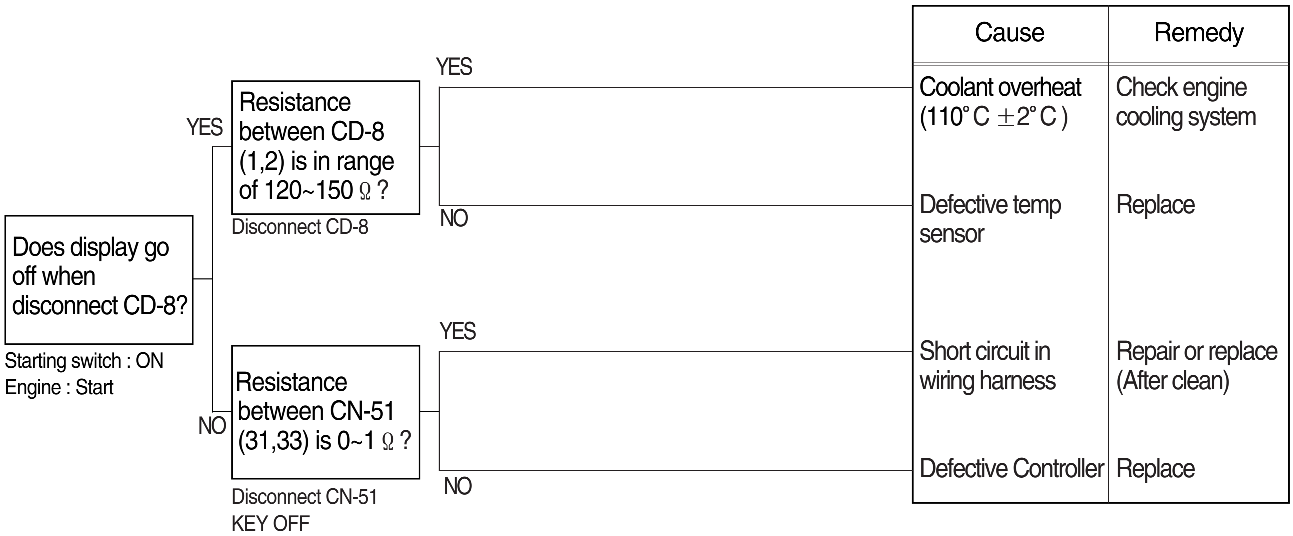
YES	20 ~ 32V
NO	0V

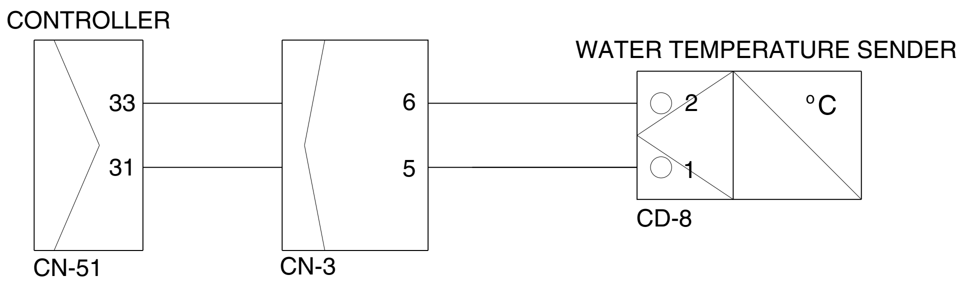


RD21076ES52

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.

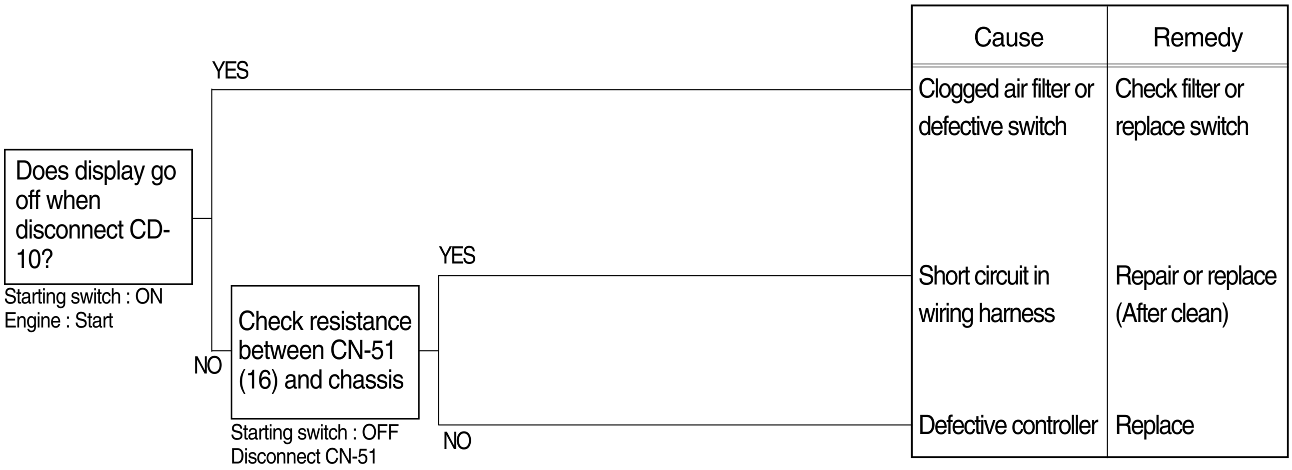


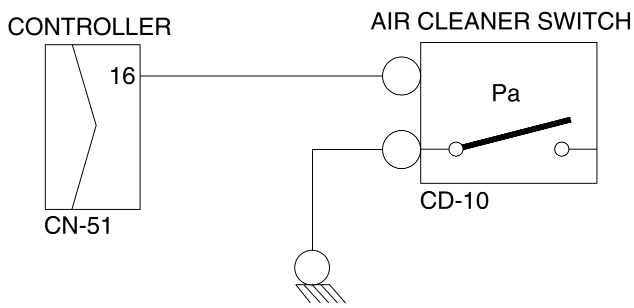


RD21076ES53

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.

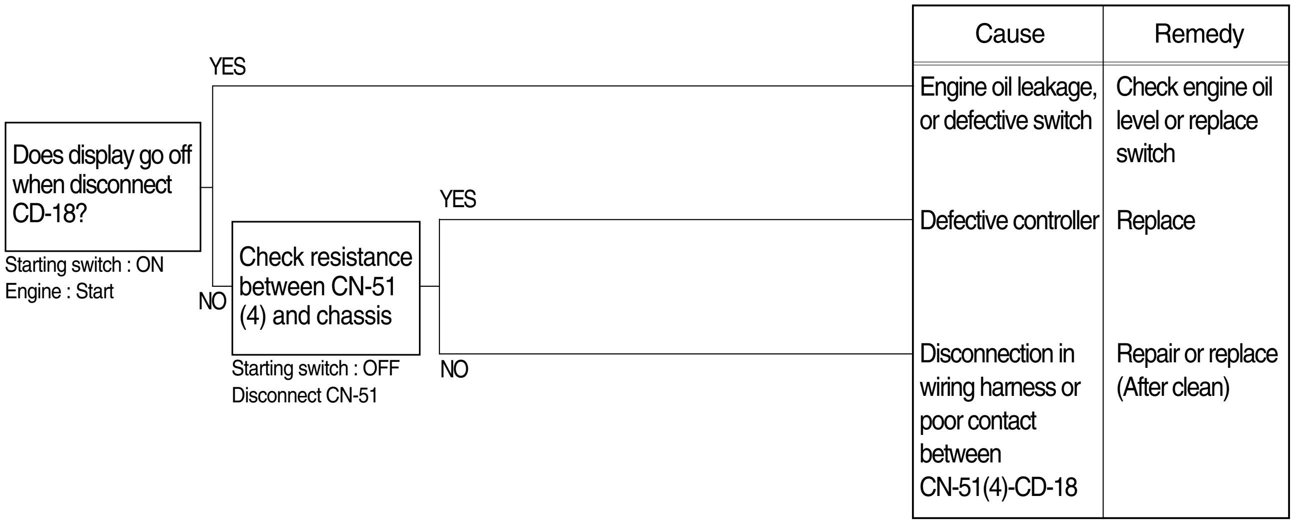




21076ES55

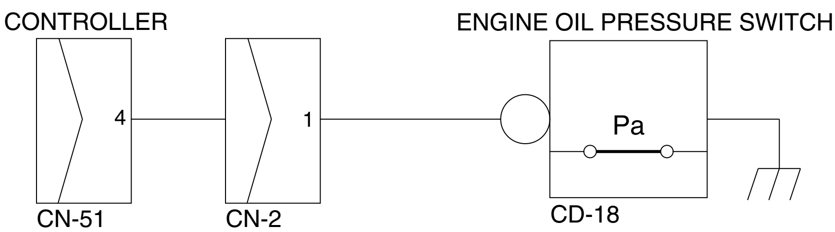
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP(Engine is started)

· 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

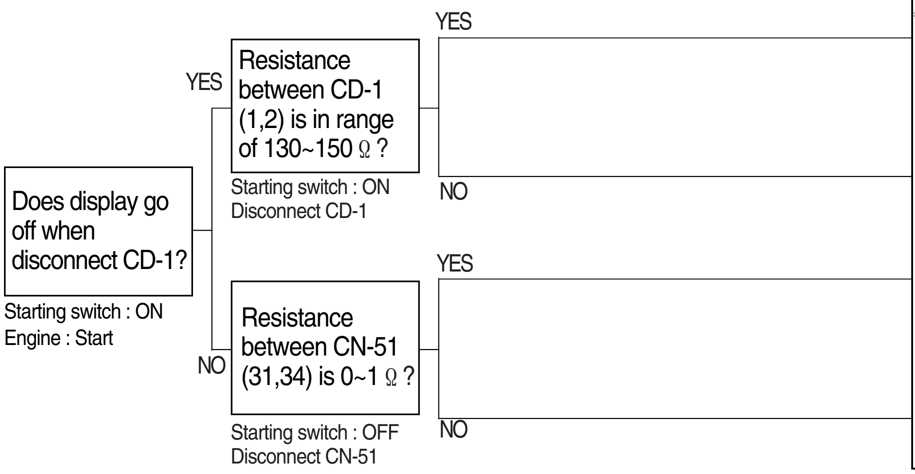
YES	MAX 1Ω
NO	MIN 1MΩ



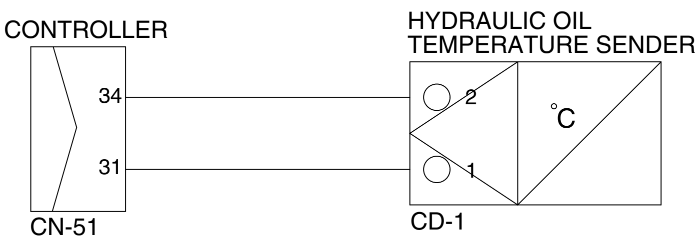
29076ES03

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.



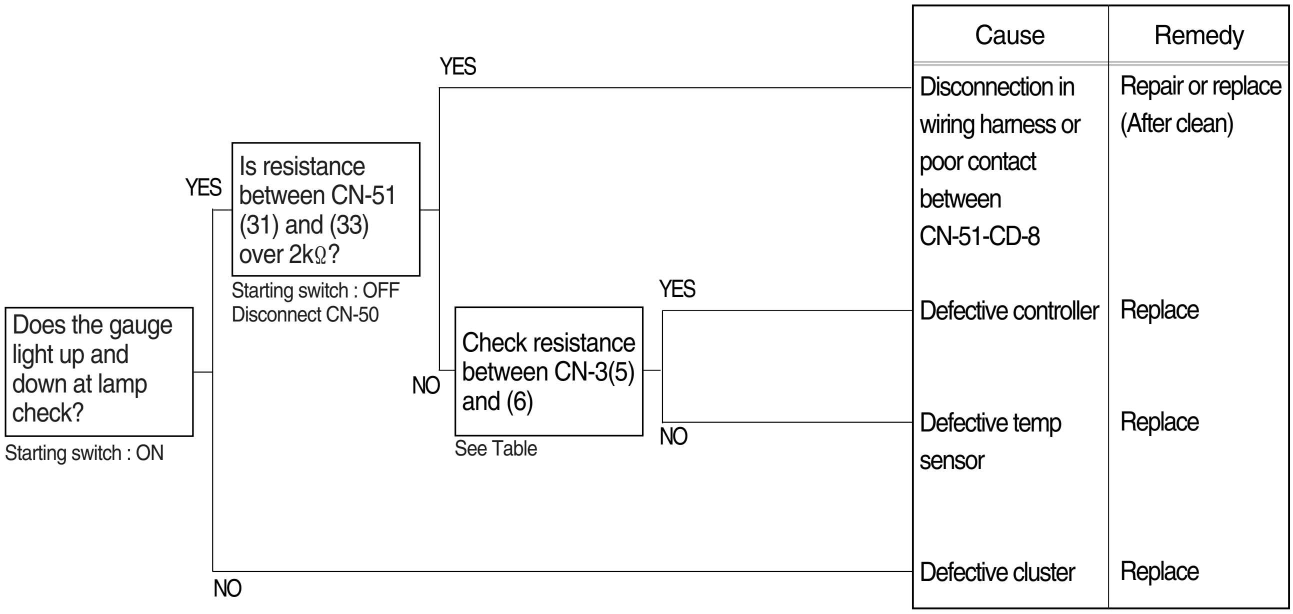
Cause	Remedy
High temperature	Check hydraulic oil temperature (100°C ±2°C), Replace
Defective torque sensor	Replace
Short circuit	Check and repair
Defective controller	Replace

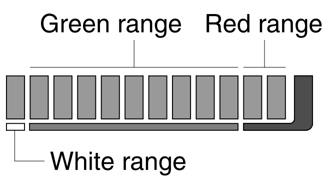


29076ES04

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

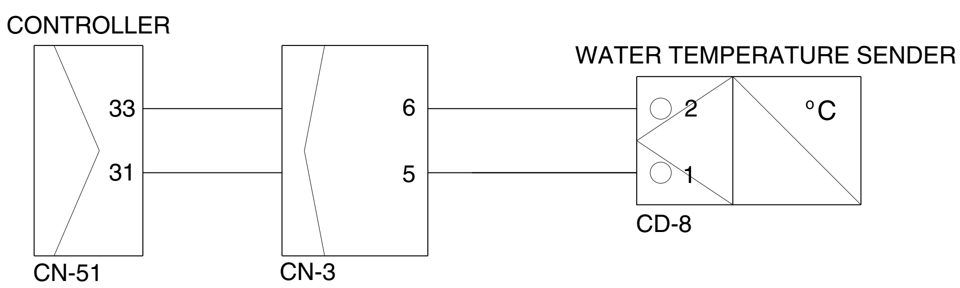
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

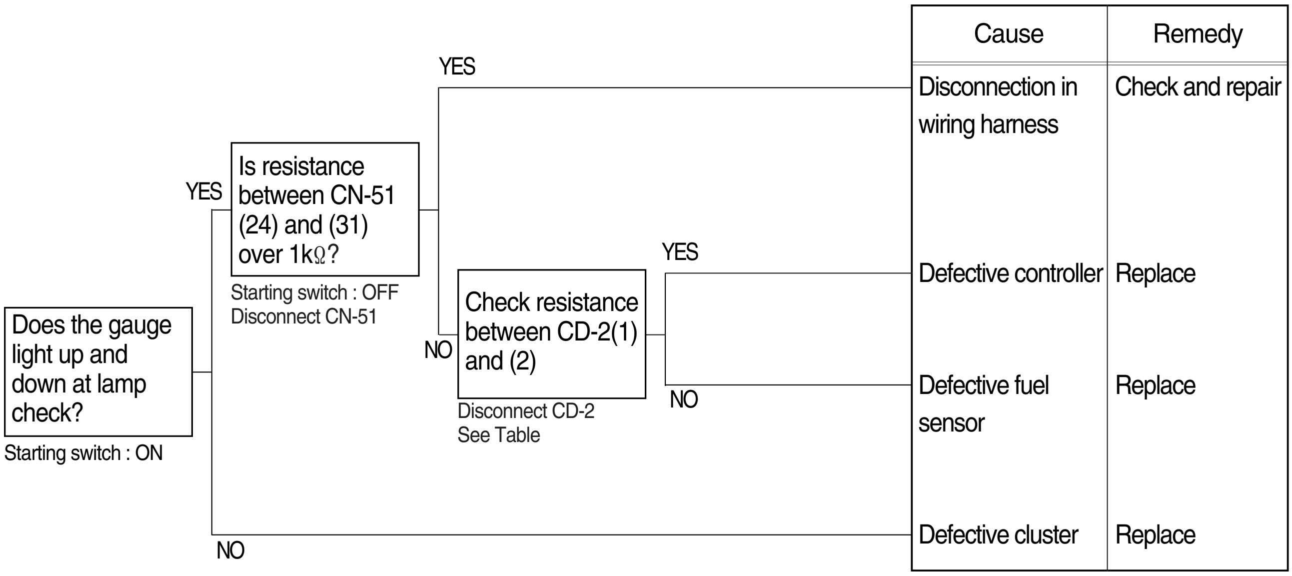
Item \ Temperature	White range (~29°C)	Green range (30~105°C)	Red range (105°C ~)
Unit Resistance(Ω)	1646~	1645~158	~139
Tolerance(%)	±20	±20	±20



RD21076ES53

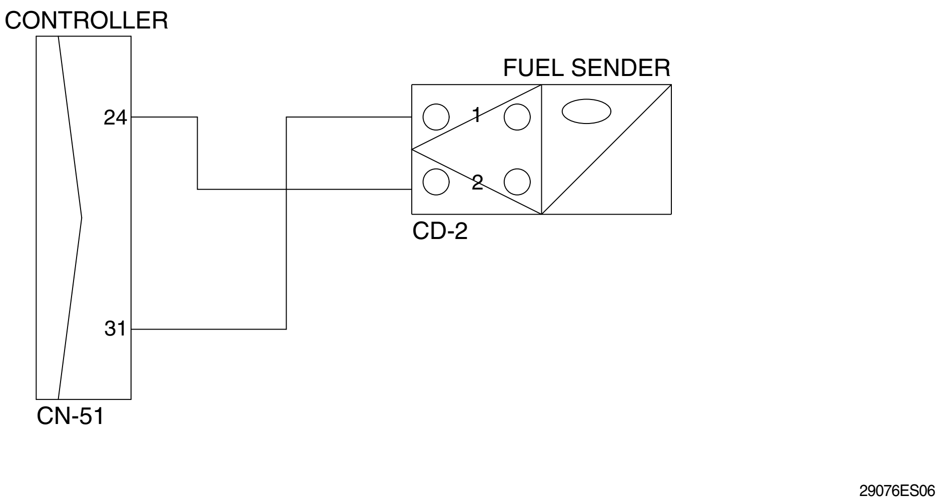
9. WHEN FUEL GAUGE DOES NOT OPERATE(Check warning lamp ON/OFF)

- 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.



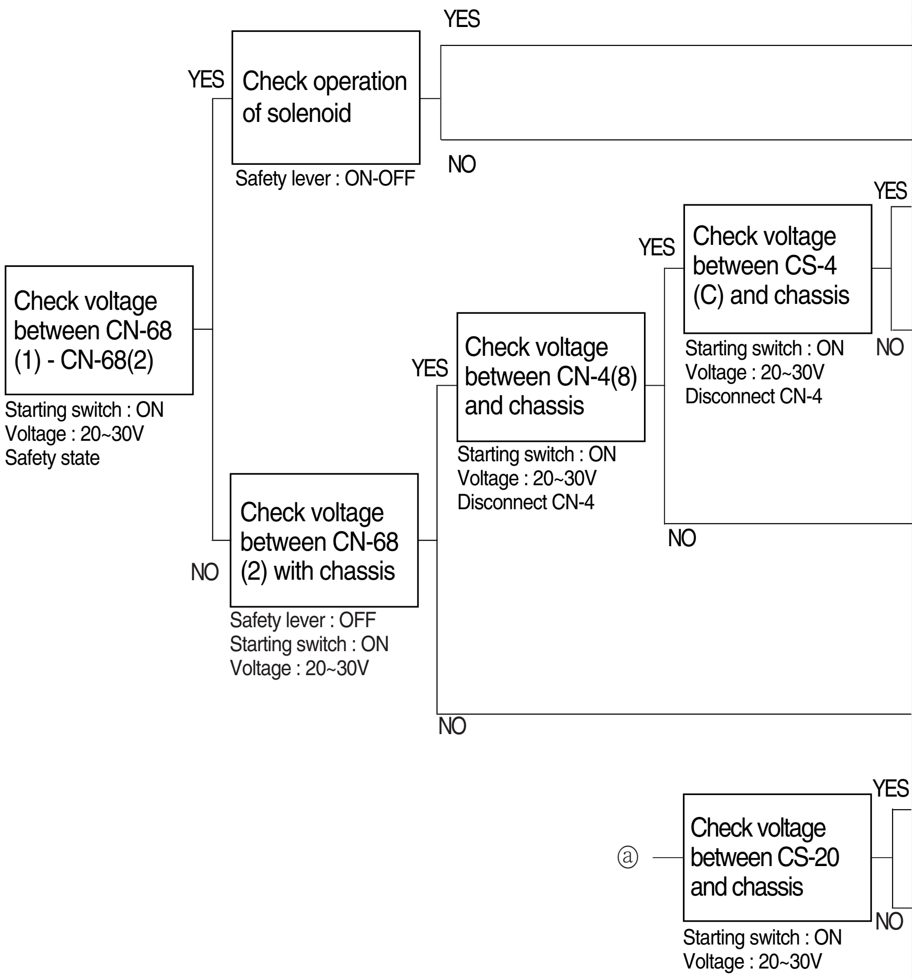
Check Table

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

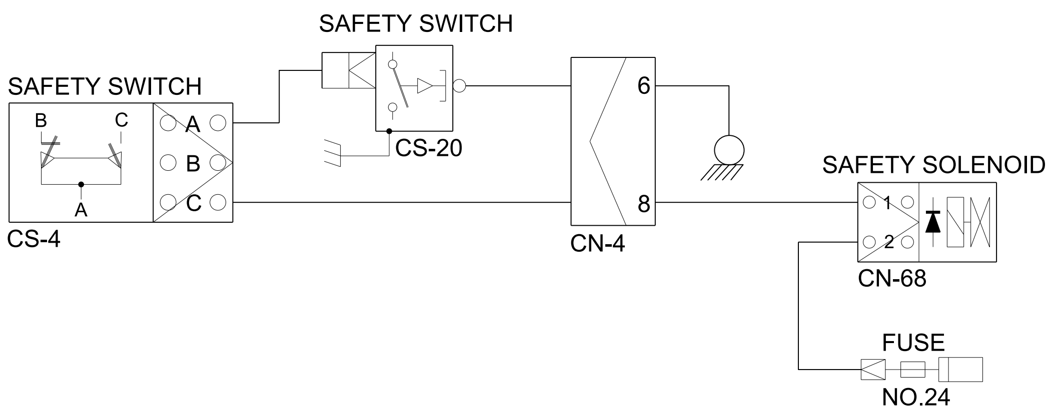


10. WHEN SAFETY SOLENOID DOES NOT OPERATE

· 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.24.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



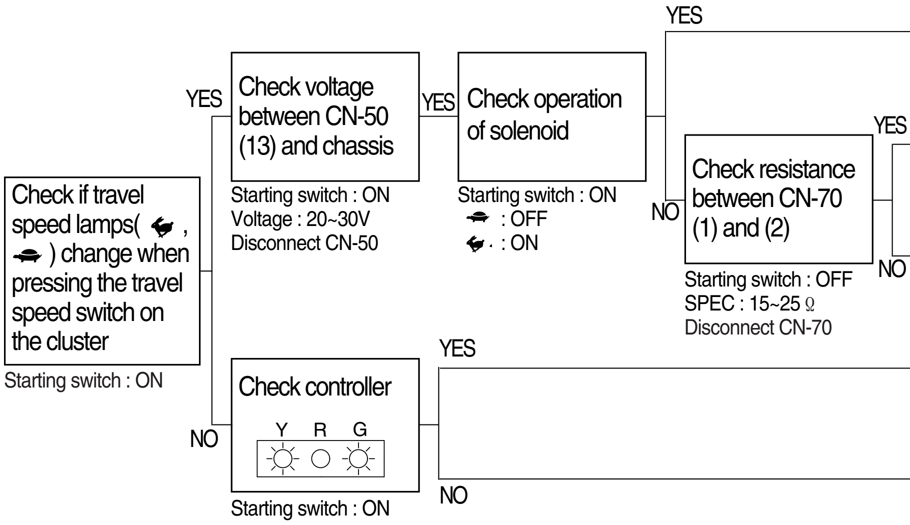
Cause	Remedy
Hydraulic malfunction	Check hydraulic system
Defective solenoid	Replace
ⓐ	
Disconnect in wiring harness or poor contact between CN-4(8)-CS-4(C)	Repair or replace (After clean)
Disconnect in wiring harness or poor contact between CN-4(8)-CN-68(1)	Repair or replace (After clean)
Disconnection in fuse	Replace
Defective switch (CS-20)	Repair or replace
Defective switch (CS-4)	Repair or replace



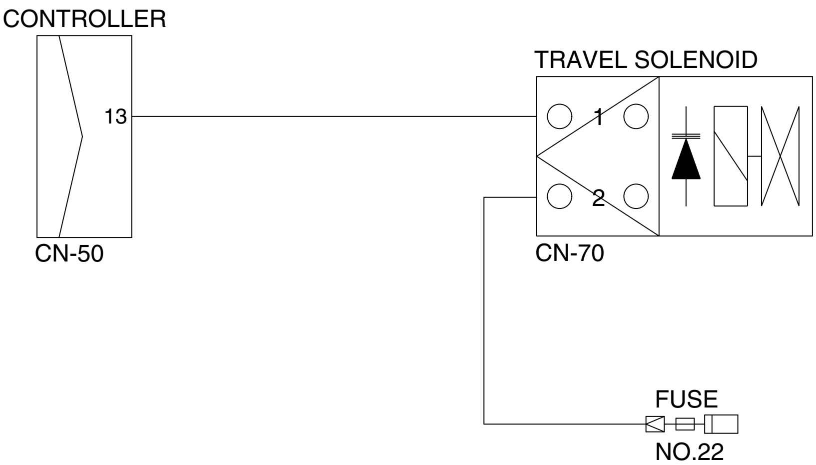
21076ES54

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.22 .
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



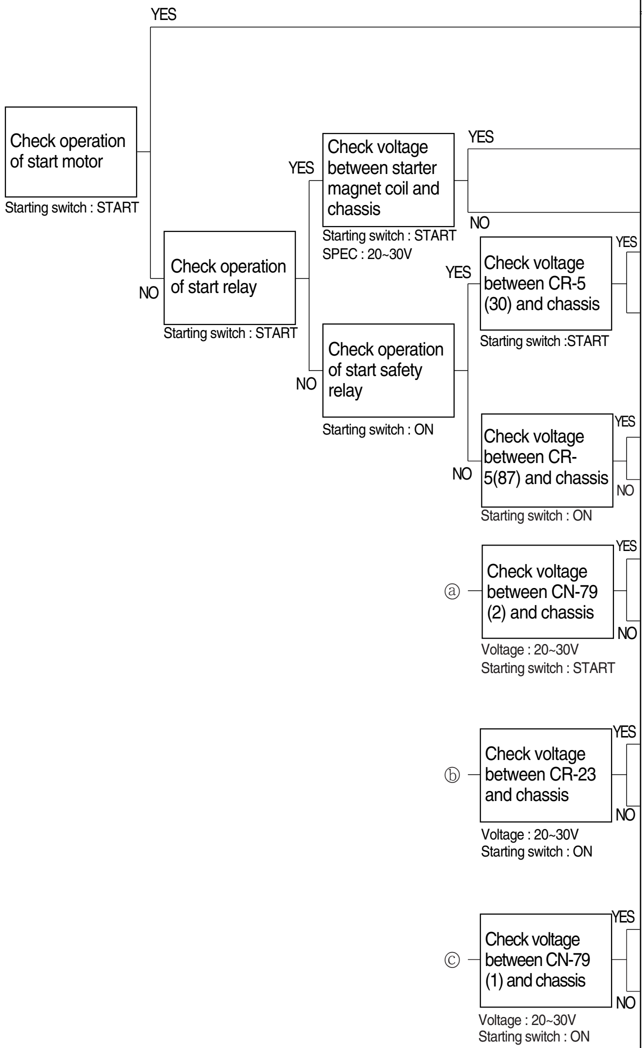
Cause	Remedy
Defective hydraulic system	Check hydraulic system
Defective controller	Replace
Defective solenoid	Replace
Defective cluster	Replace
Defective controller	Replace



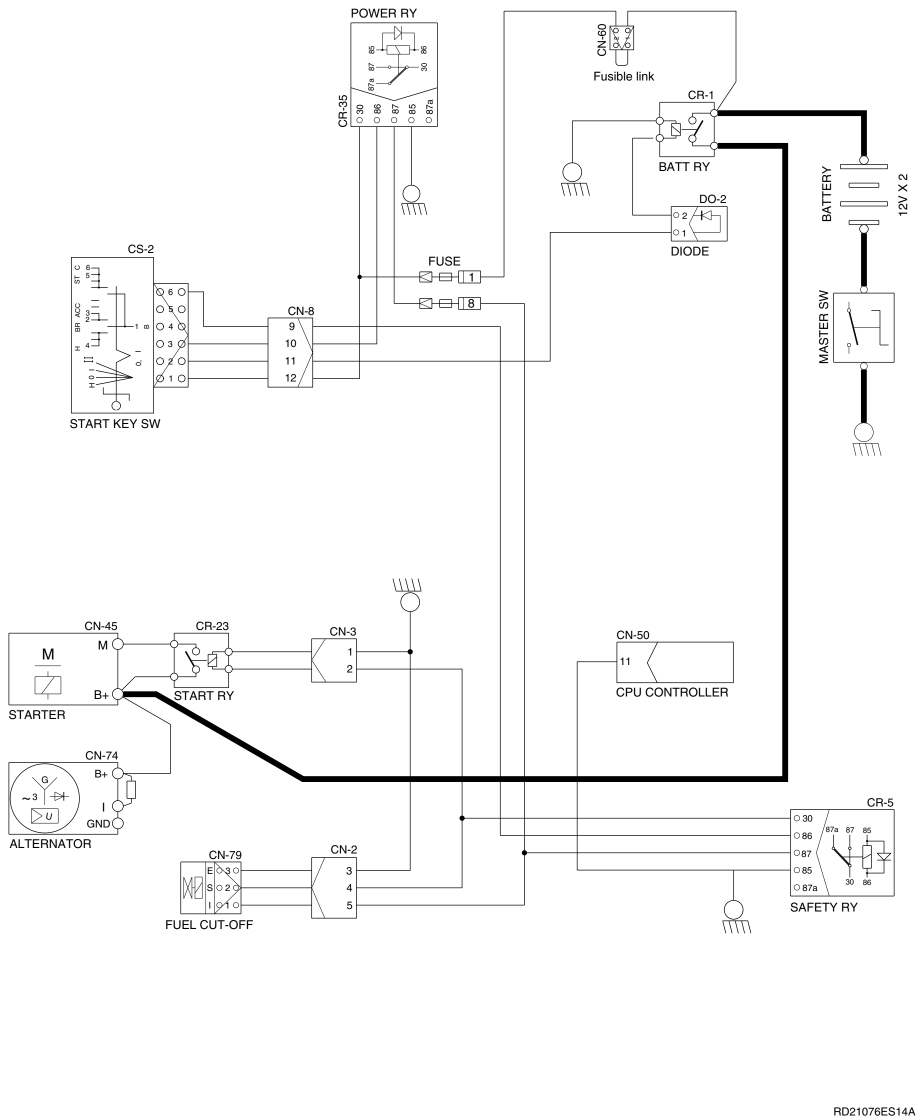
RD21076ES55

12. WHEN ENGINE DOES NOT START

· Check supply of the power at engine stop solenoid while starting switch is 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.

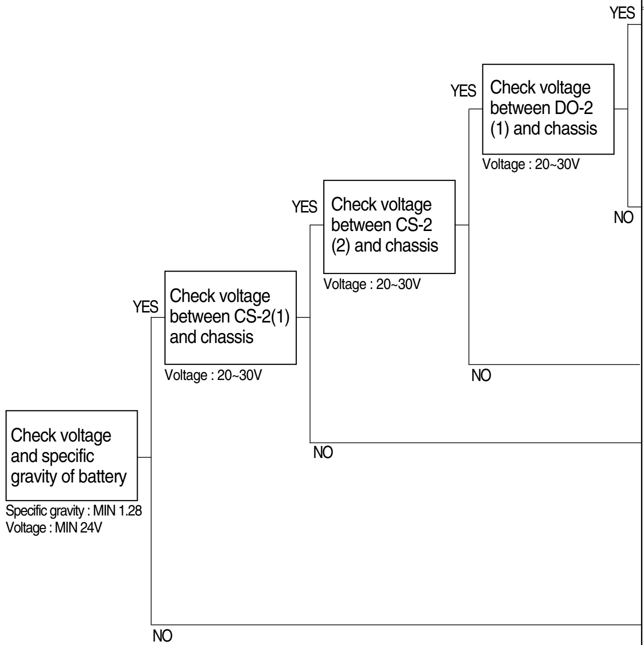


Cause	Remedy
Defective battery	Check engine system charge or replace(After checking specific gravity of battery)
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ, ⓑ	
Disconnection in wiring harness or poor contact between CR-5 (86) and CN-8(9)	Repair or replace (After clean)
Defective relay	Replace
ⓒ	
Defective fuel cut off solenoid	Replace
Disconnection in wiring harness or poor contact between CN-2(4)-CN-79(2)	Repair or replace (After clean)
Defective relay	Replace
Disconnection in wiring harness or poor contact between CR-5(30)-CR-23	Repair or replace (After clean)
Defective fuel cut-off solenoid	Replace
Disconnection in wiring harness or poor contact between CN-2(5) and Fuse No.12	Repair or replace (After clean)

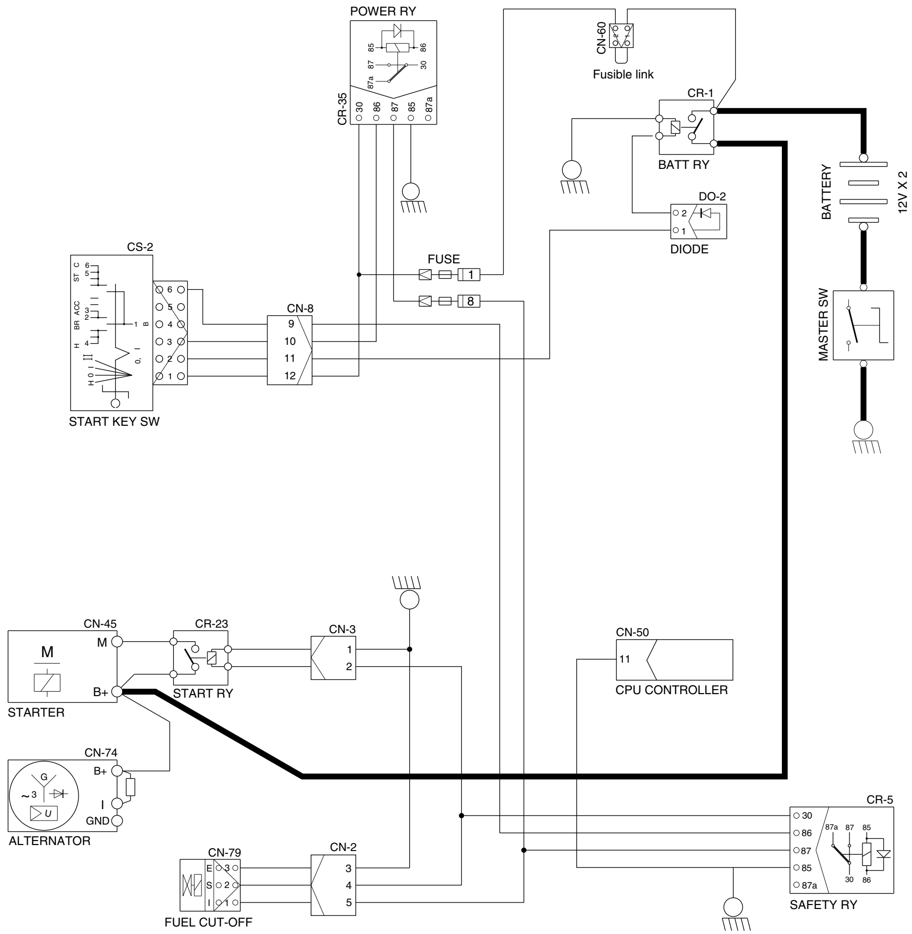


13. WHEN STARTING SWITCH “ON” ELECTRIC PART DOES NOT OPERATE

- 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.



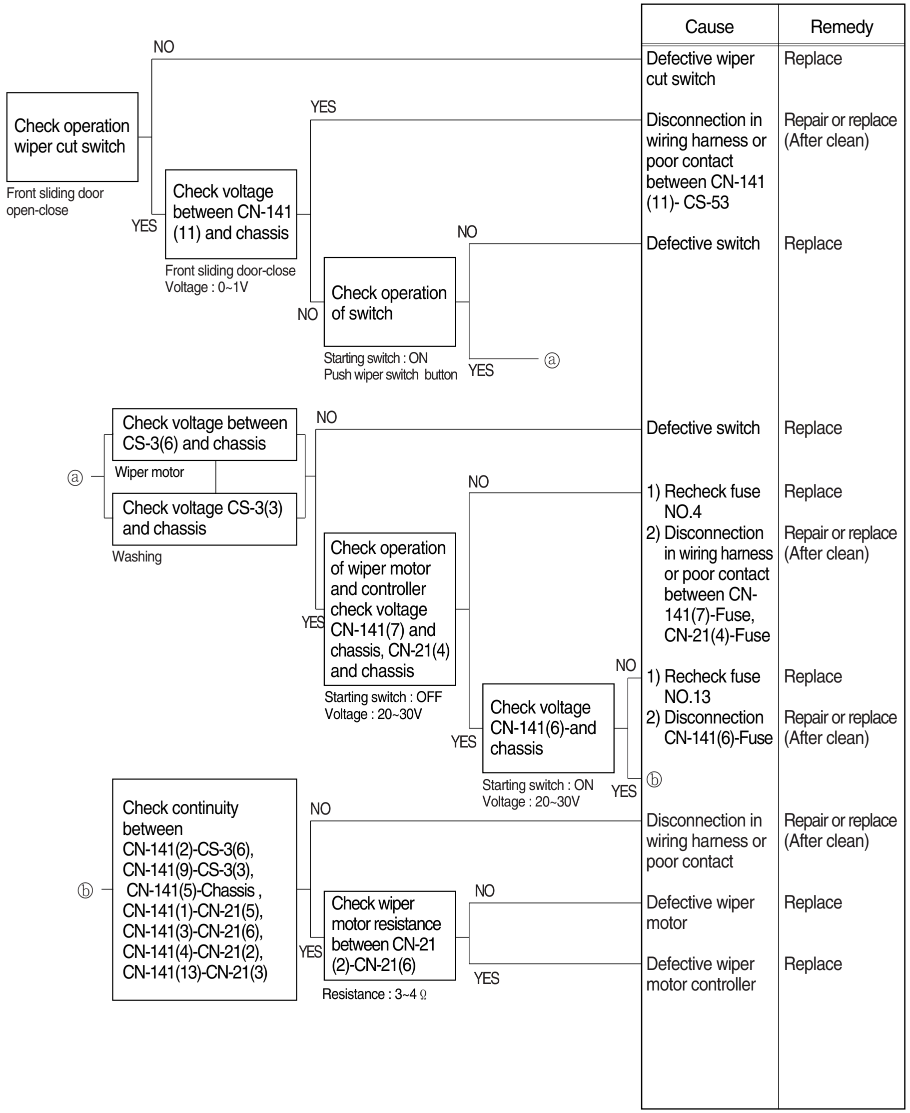
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-2(1)-CR-1 or defective battery relay	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-2(2)-CN-8(11)- DO-2(1)	Replace
Defective start key switch	Replace
Disconnection in wiring harness or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

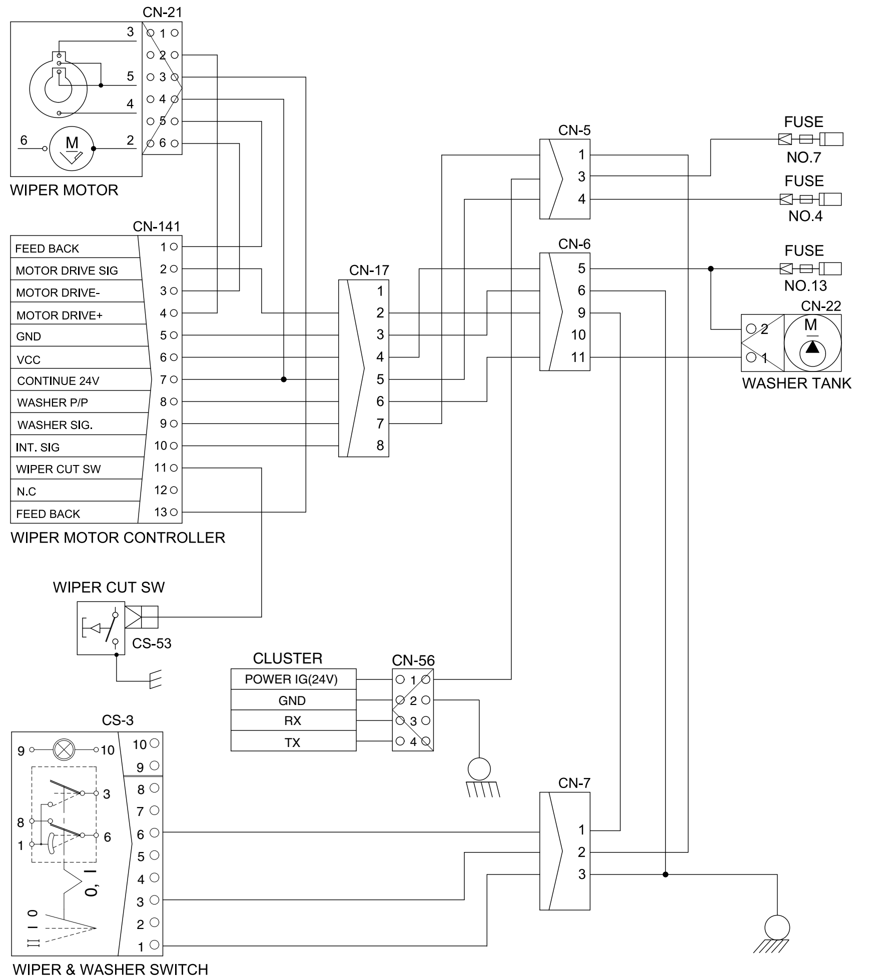


RD21076ES14A

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

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.4,11 and 13 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

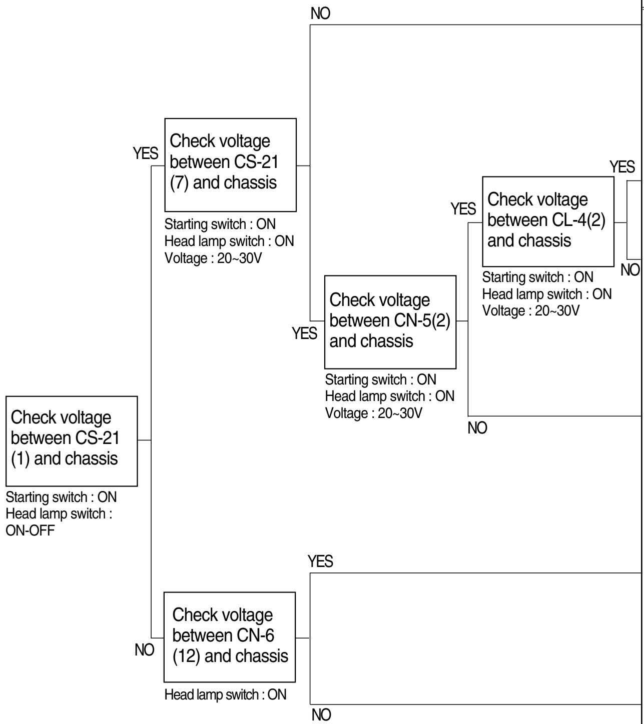




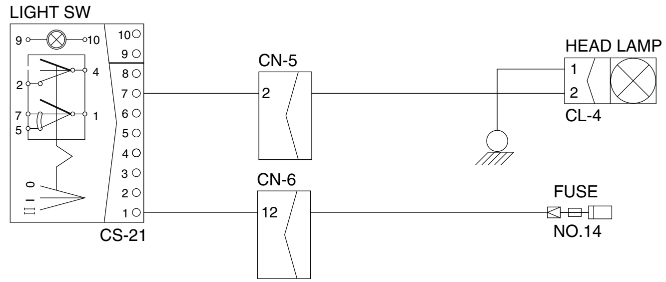
RD21076ES15A

15. 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.14.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



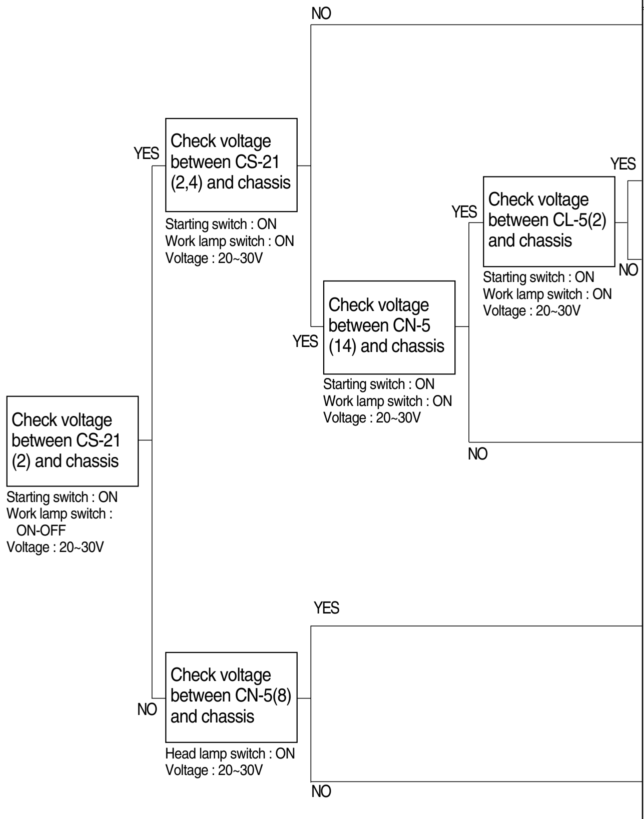
Cause	Remedy
Defective lamp switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-5(2)-CL-4(2)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-21(7)-CN-5(2)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact CS-21(1)-CN-6(12)	Repair or replace (After clean)
Recheck fuse No.14	Replace



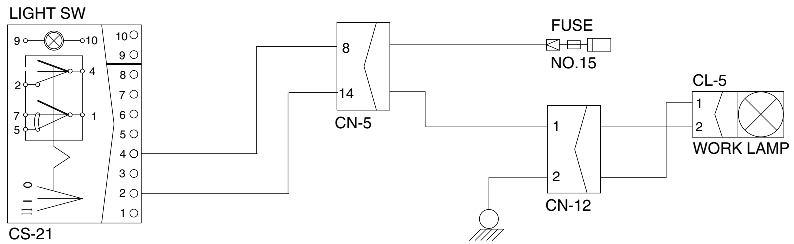
RD21076ES56

16. 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 lamp switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-5(14) -CL-5(2)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-21 (2)-CN-5(14)- CN-7(2)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-21 (2)-CN-5(8)	Repair or replace (After clean)
Recheck fuse No.15	Replace



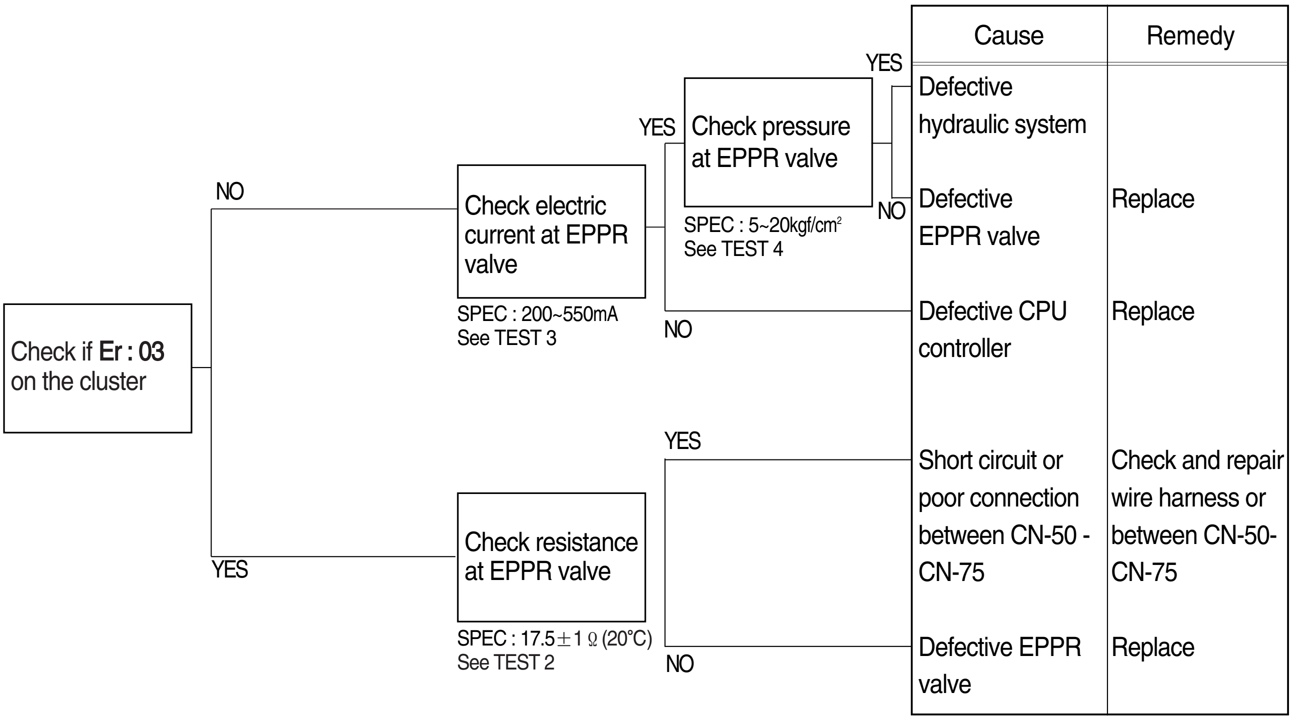
RD21076ES57

GROUP 4 MECHATRONICS SYSTEM

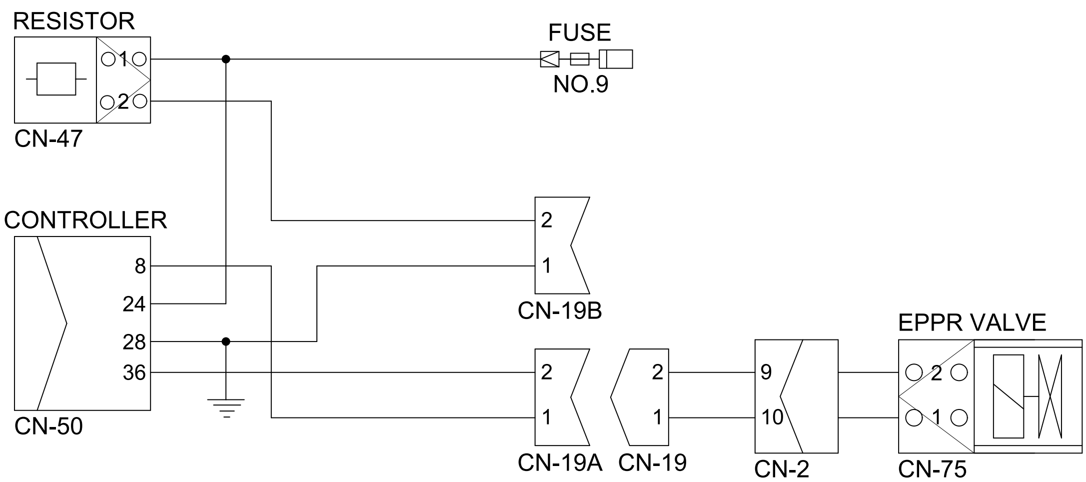
1. ALL ACTUATORS SPEED ARE SLOW

※ Boom, Arm, Bucket, Swing and travel speed are slow, but engine speed is good.
※ Spec : H-mode 2050± 50rpm S-mode 1750 ± 50rpm
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Wiring diagram



21076MS51

2) TEST PROCEDURE

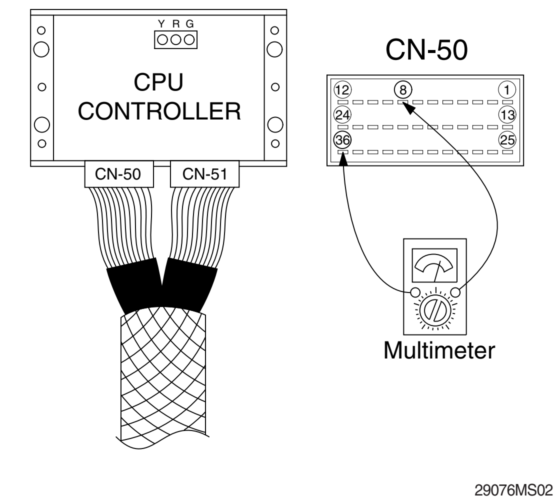
(1) **Test 1 :** Check resistance at connector CN-50(8)-(36).

① Starting key OFF.

② Disconnect connector CN-50.

③ Check resistance between pin and at connector CN-50(8)-(36).

SPEC : 17.5±1Ω (20˚C)



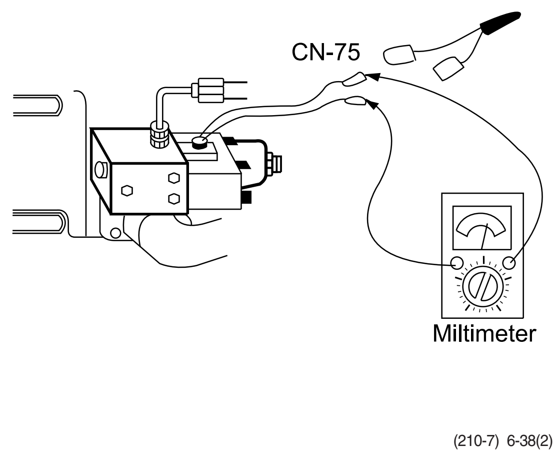
(2) **Test 2 :** Check resistance at connector CN-75.

① Starting key OFF.

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

③ Check resistance between 2 lines as figure.

SPEC : 17.5±1 Ω (20°C)



(3) **Test 3 :** Check electric current at EPPR valve.

① Install multimeter as figure.

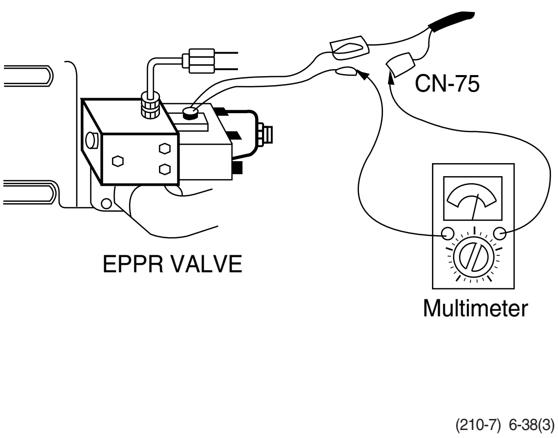
② Start engine.

③ Set the accel dial at "10"(MAX)

④ Set S-mode and cancel auto decel mode.

⑤ If tachometer show approx 1750±50rpm, check electric current.

SPEC : 200~550mA (S mode)



(2) **Test 4 :** Check pressure at EPPR valve.

① Remove plug and connect pressure gauge as figure.

· Gauge capacity : 0 to 40~50kgf/cm^2 (0 to 570~710psi)

② Start engine.

③ Set the accel dial at "10"(Max)

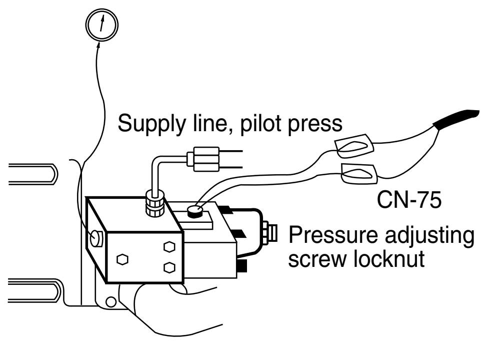
④ Set S-mode and cancel auto decel mode.

⑤ If tachometer show approx 1750±50rpm, check pressure.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

SPEC : 5~20kgf/cm^2(70~280psi)

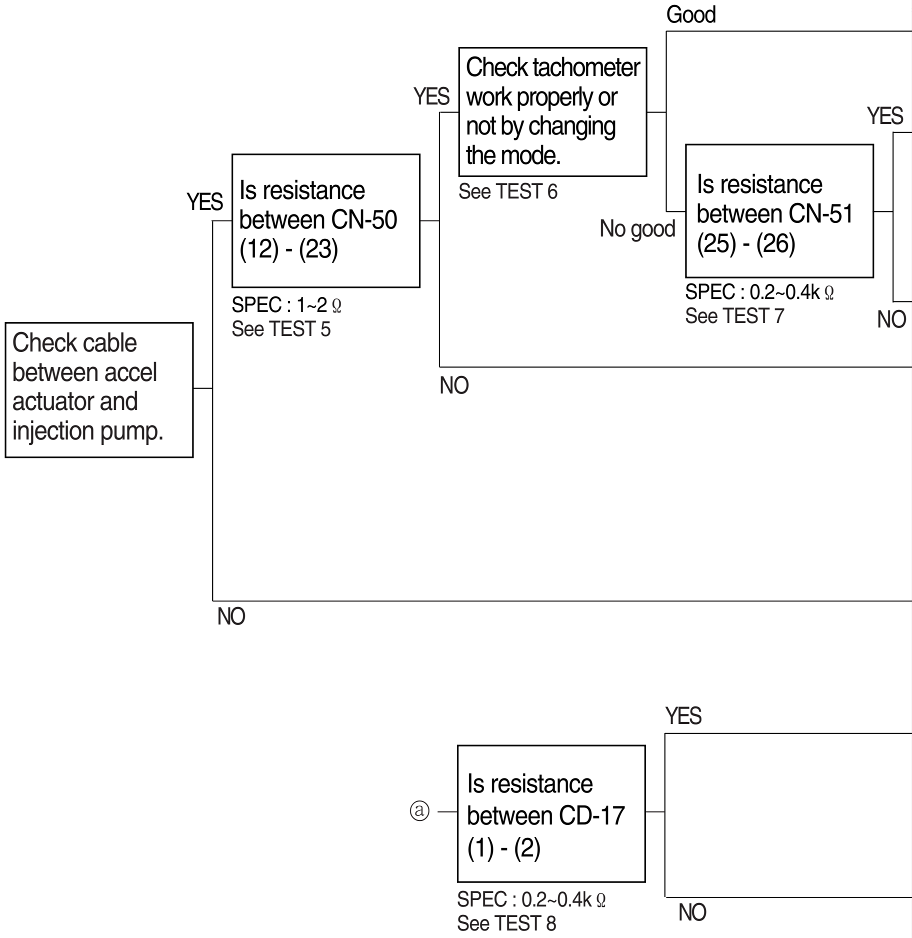


(210-7) 6-39(1)

2. ENGINE SPEED IS SLOW AT ALL MODE

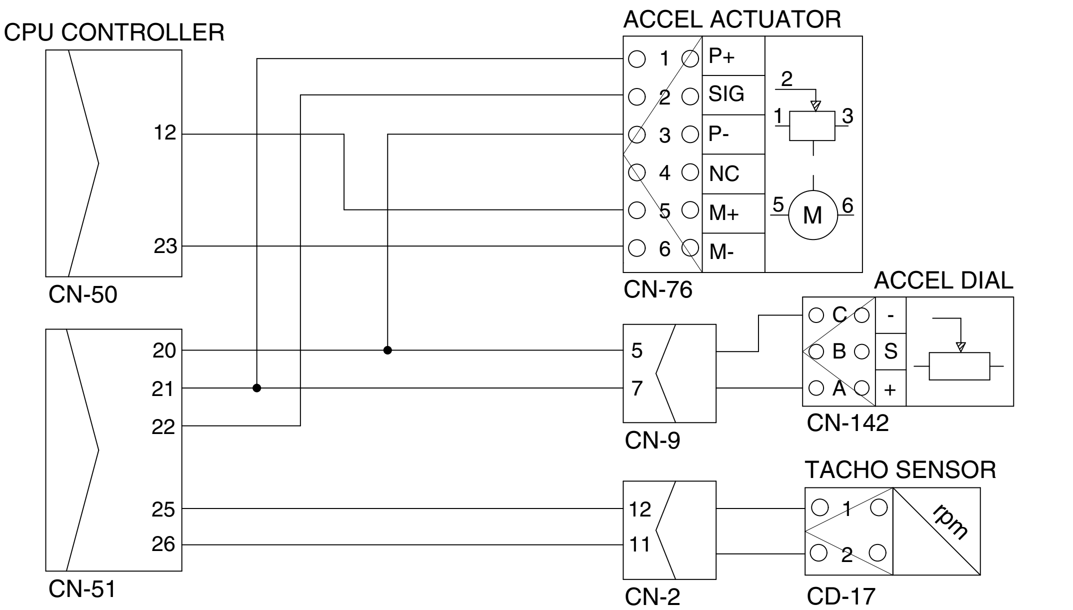
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
If test 7 is good, check TEST 1~4	
Misalignment between speed sensor and fly wheel	Clean speed sensor and adjust See : 5-20page
ⓐ	
Defective accel actuator or short circuit or poor connection between CN-50-CN-76	Replace accel actuator or harness assembly
Improper operation by loosening or interference of cable	Adjust or repair
Short circuit or poor connection between CN-50-CN-2-CD-17	Check and repair
Defective speed sensor	Replace

Wiring diagram



29076MS03

2) TEST PROCEDURE

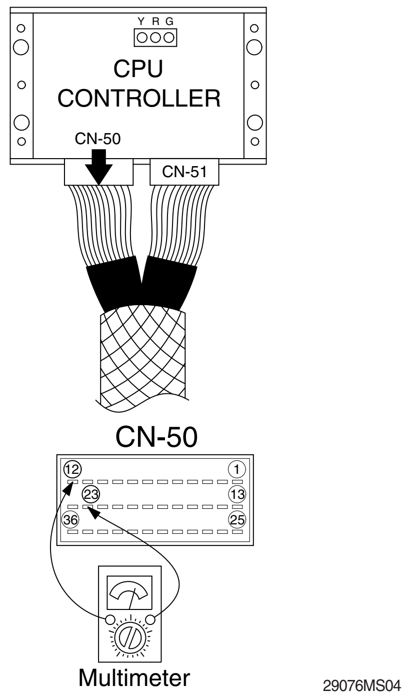
(1) **Test 5 :** Check resistance between CN-50 (12)-(23).

① Starting key OFF.

② Disconnect connector CN-50 from CPU controller.

③ Check resistance as figure.

SPEC : 1~2 Ω



(2) **Test 6 :** Check tachometer(Work properly or not)

① Start engine.

② Check tachometer reading.

Unit : rpm

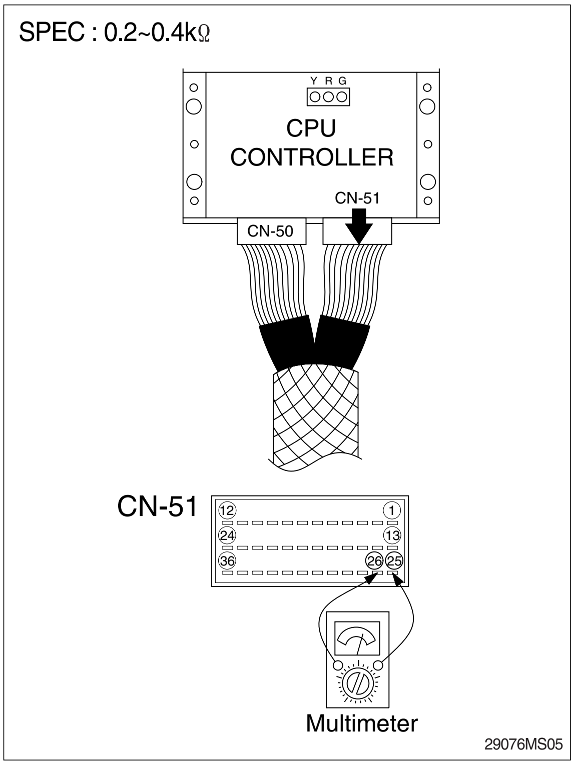
Spec		Remark
H	2050±50	Check rpm after cancel the Auto decel mode.
S	1750±50	

(3) **Test 7 :** Check resistance between CN-51 (25) and CN-51(26).

① Starting key OFF.

② Disconnect connector CN-51 from CPU controller.

③ Check resistance as figure.

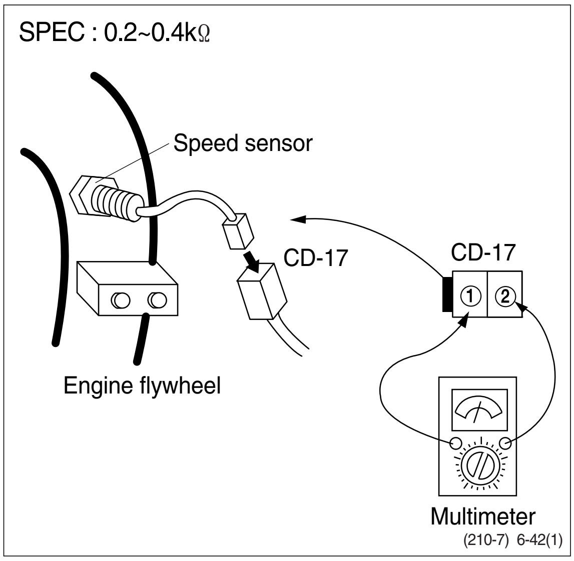


(4) **Test 8 :** Check resistance at speed sensor.

① Starting key OFF.

② Disconnect connector CD-17 of speed sensor at engine flywheel housing.

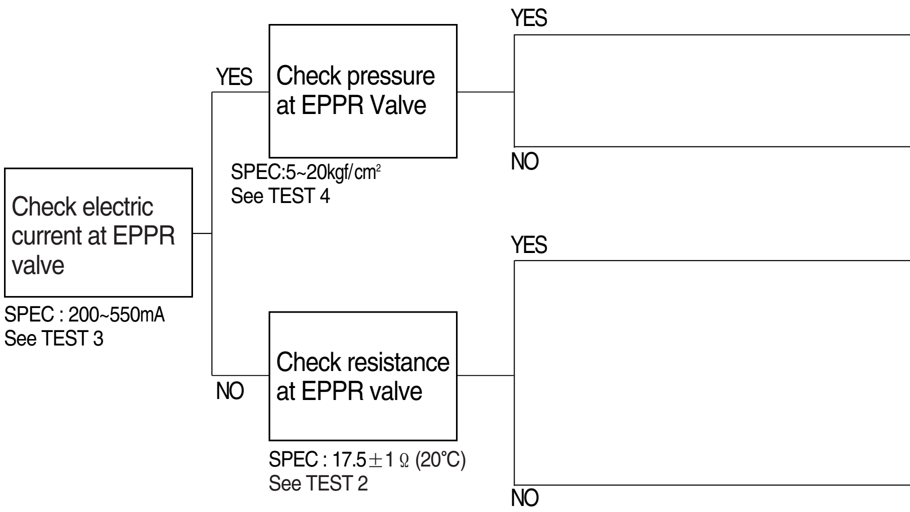
③ Check resistance as figure.



3. ENGINE STALL

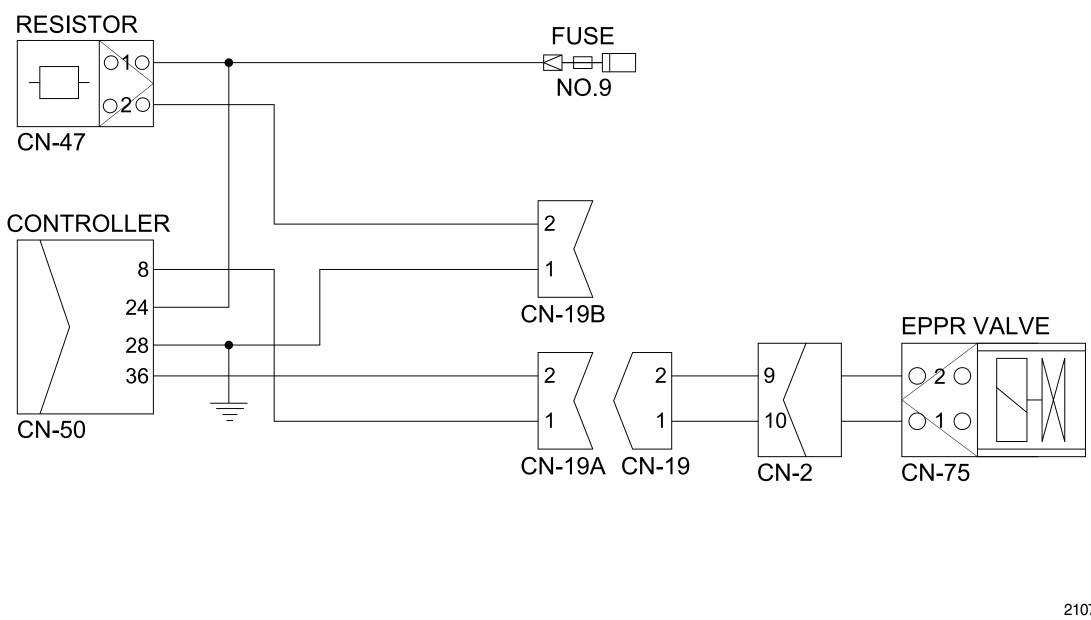
※ Before carrying out below procedure, check all the related connectors are properly inserted.

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-2 or CN-50 - CN-75	Check and repair wire harness
Defective EPPR valve	Replace

Wiring diagram

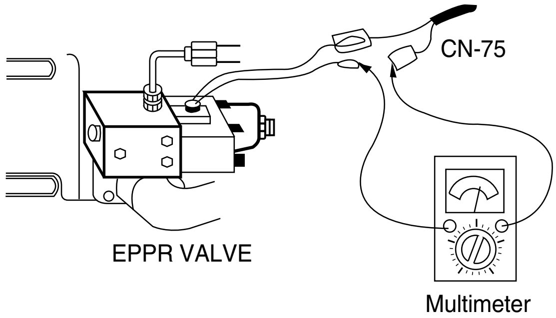


2) TEST PROCEDURE

(1) **Test 9 :** 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 1750±50rpm.
⑤ Check electric current.

SPEC : 200~550mA

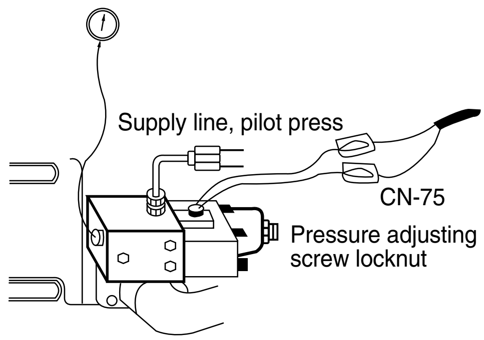


(210-7) 6-44(1)

(2) **Test 10 :** 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 1750±50rpm.
⑤ Operate bucket lever completely push or pull.
⑥ Hold arm lever at the end of stroke.
⑦ Check pressure at relief position.

SPEC : 5~20kgf/cm^2(70~280psi)

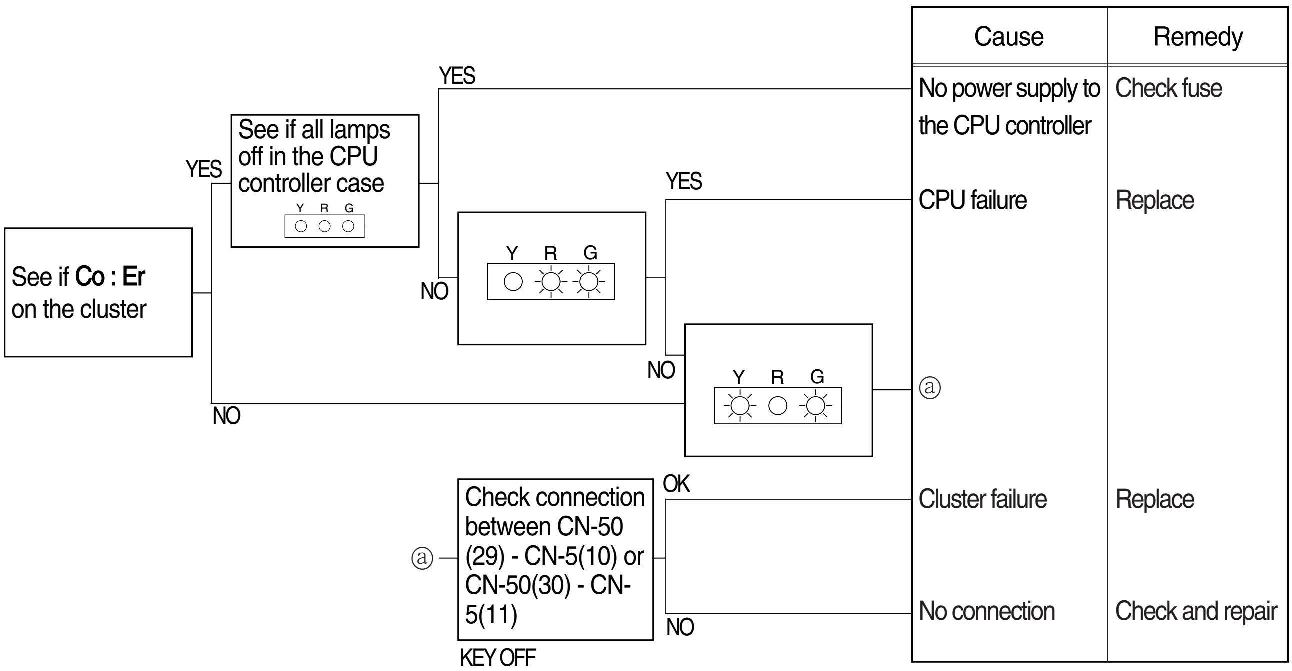


(210-7) 6-44(2)

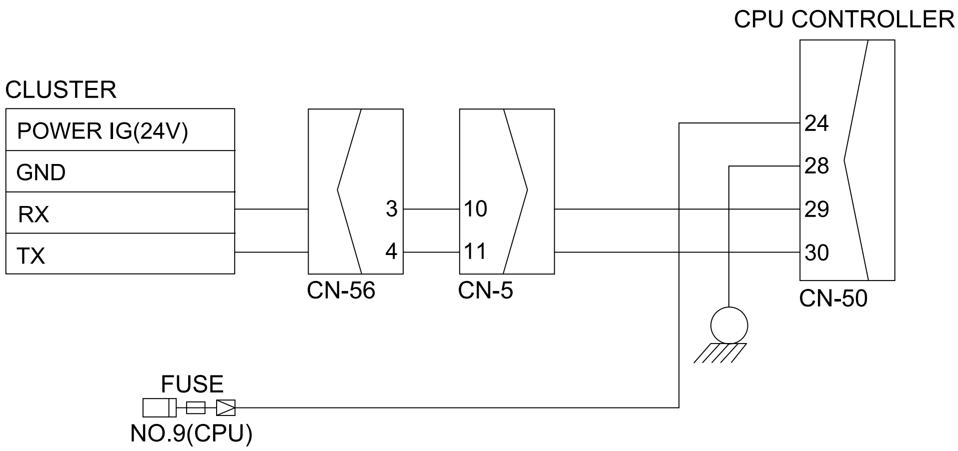
4. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

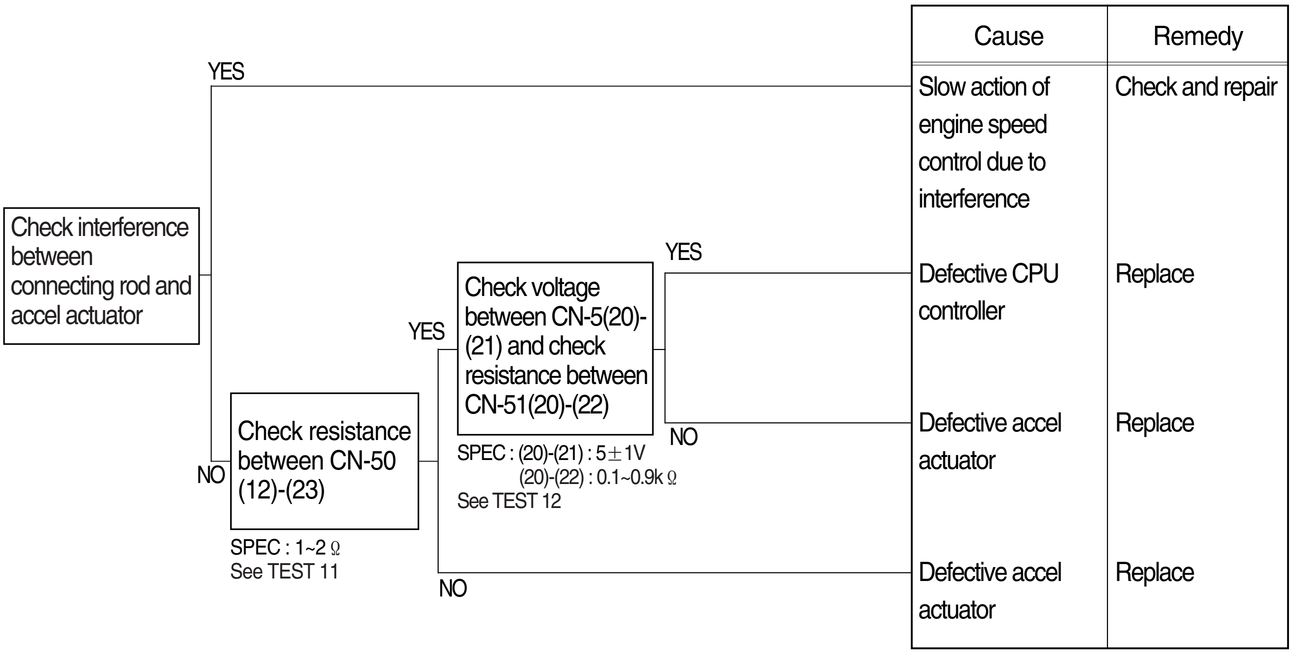


21076MS06

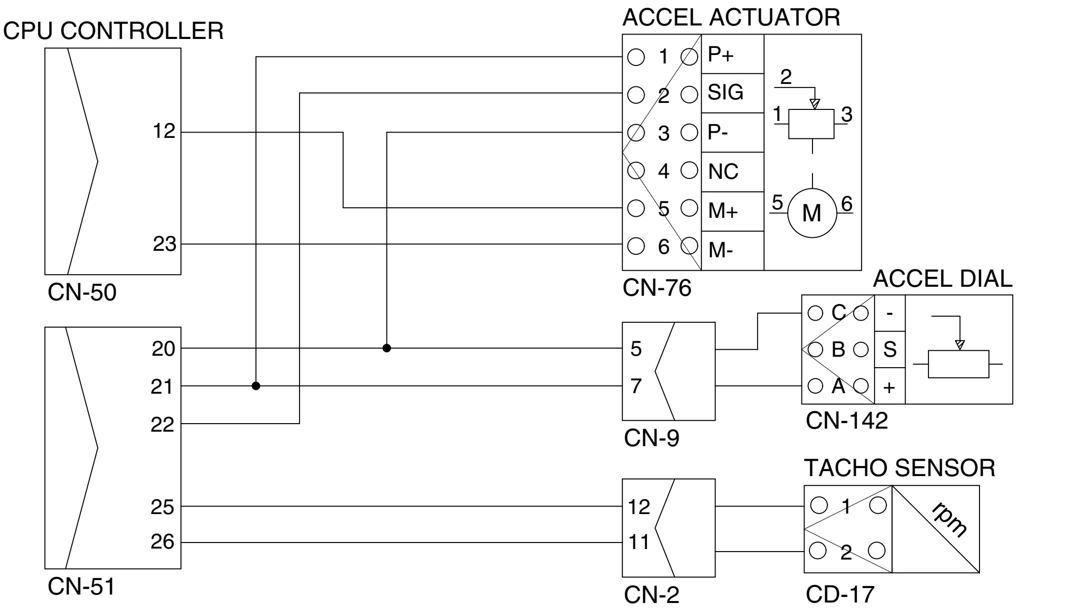
5. SLOW ACTION OF ENGINE SPEED CHANGE WHEN CHANGE THE MODE

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

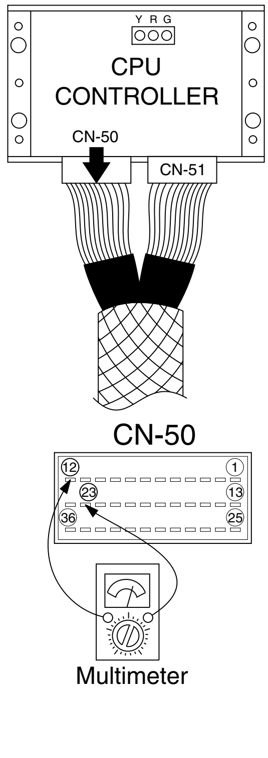
(1) **Test 11 :** Check resistance.

① Starting key OFF.

② Disconnect connector CN-50 from CPU controller.

③ Check resistance between CN-50(12)-(23) as figure.

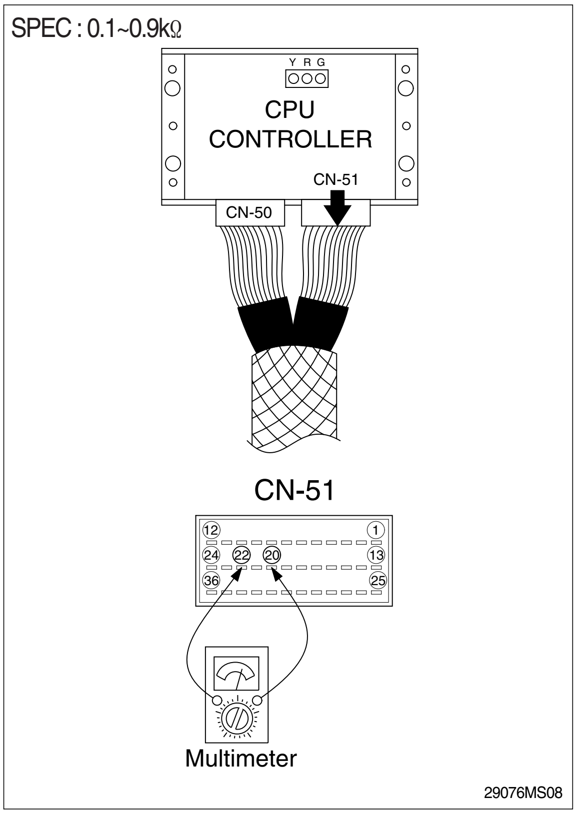
SPEC : 1~2 Ω



(2) **Test 12 :** Check voltage and resistance.

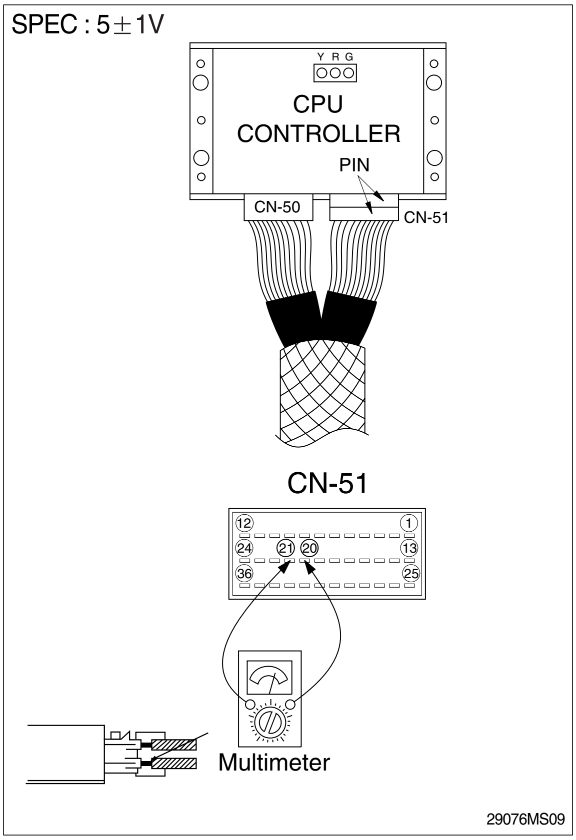
① Check resistance between CN-51(20)-(22).

- Starting key OFF.
- Disconnect connector CN-51 from CPU controller.
- Check resistance value with multimeter as figure.



② Check voltage between CN-51(20) and CN-51(21).

- Prepare 2 pieces of thin sharp pin, steel or copper.
- Starting key ON.
- Insert prepared pins to rear side of connectors : One pin to CN-51(20)
  Other pin to CN-51(21)
- Check voltage.



2) TEST PROCEDURE

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

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

② Starting key ON.

③ Insert prepared pin to rear side of connectors : One pin to (1) of CN-51.

④ Check voltage as figure.

(2) **Test 14** : Check voltage at CN-51(13)and ground.

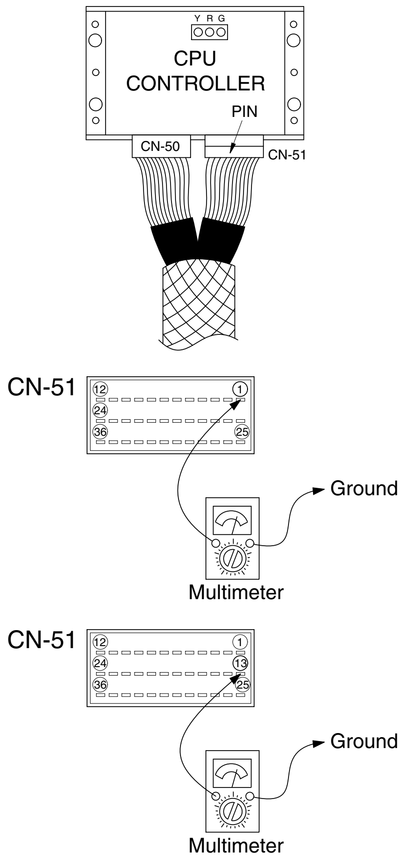
① Prepare 1 piece of thin sharp pin, steel or copper

② Starting key ON.

③ Insert prepared pin to rear side of connectors : One pin to (13)of CN-51.

④ Check voltage as figure.

SPEC : Actuator stop : 4~5V
Actuator operating : 0~1V



29076MS11

6. AUTO DECEL SYSTEM DOES NOT WORK

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

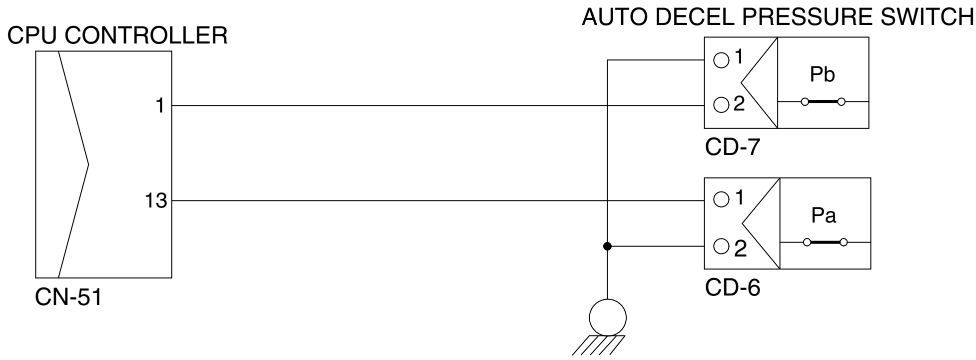
1) INSPECTION PROCEDURE

Check resistance between CN-51 (1)-GND and CN-51(13)-GND

SPEC :
Actuator operating : 4~5V
Actuator stop :0~1V
See TEST 13
See TEST 14

Result	Cause	Remedy
YES	Defective CPU controller	Replace
NO	Short circuit or poor connection between CN-51(1), (13)- pressure switches	Replace or repair
NO	Defective auto decel pressure switch	Replace

Wiring diagram

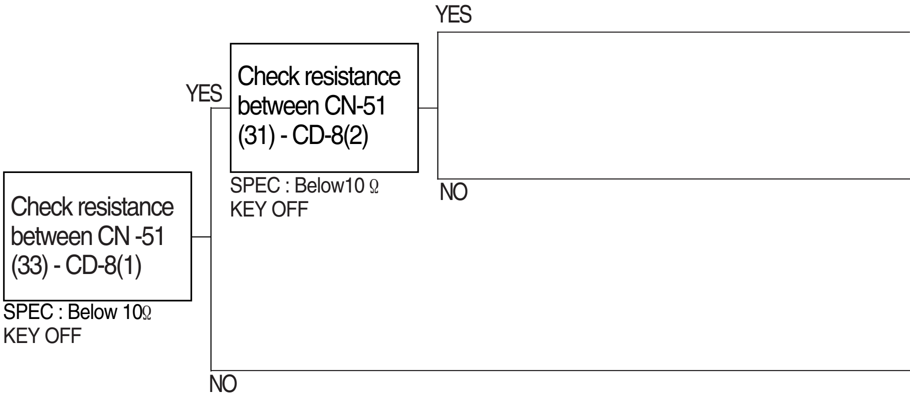


29076MS10

7. MALFUNCTION OF WARMING UP

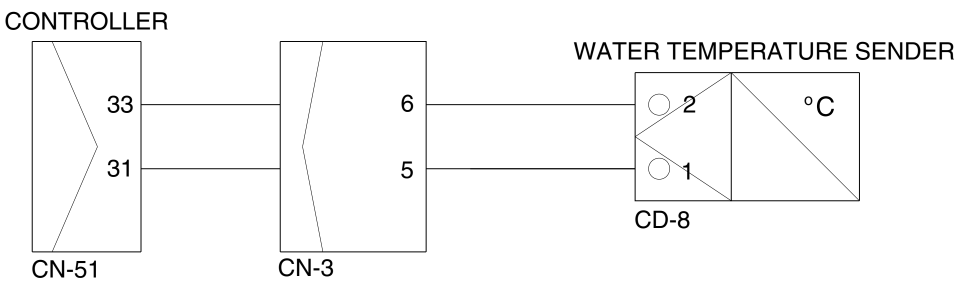
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective cluster or CPU controller or CD8(Sensor)	Repair or Replace
Poor connection between CN-51(31) - CD-8(1)	Repair
Poor connection between CN-51(33) - CD-8(2)	Repair

Wiring diagram



RD21076ES53

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**.

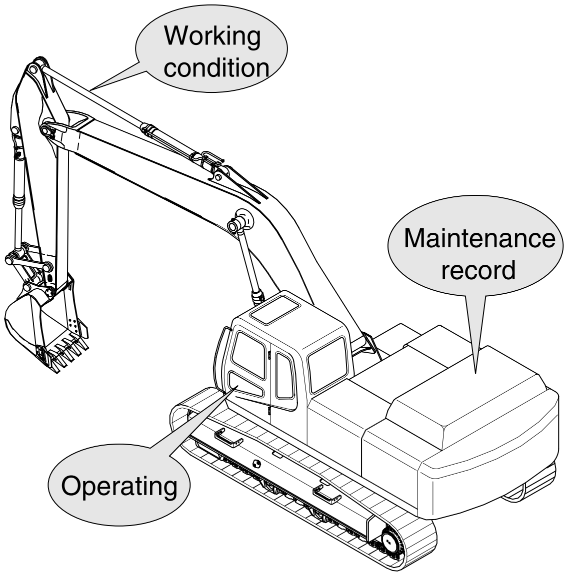
2) **OPERATIONAL PERFORMANCE OF A WORKING MACHINE**

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.

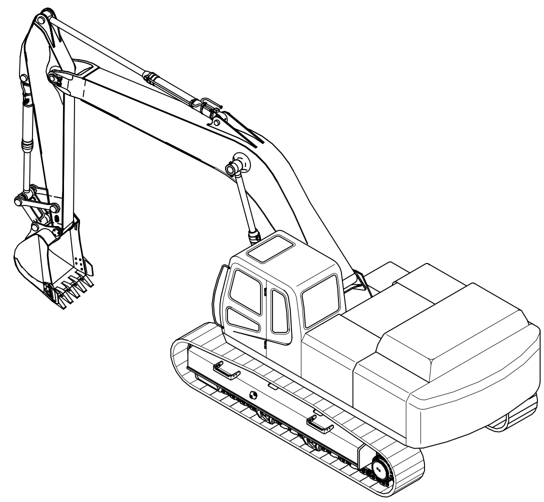


21077MS01

2. TERMINOLOGY

1) STANDARD

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

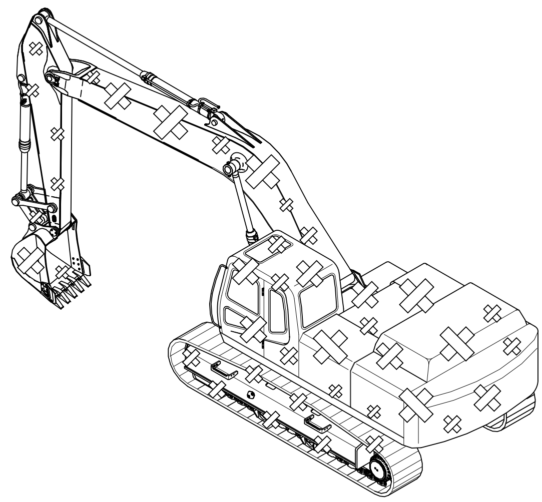


21077MS02

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.



21077MS03

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.

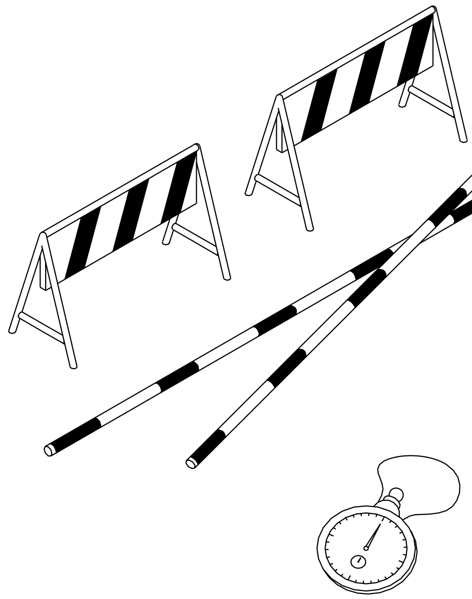
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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.



(210-7) 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 Push the H-mode switch and confirm that the fuel injection pump governor lever comes into contact with the high-idle stopper.

④ Measure the engine RPM.

(3) Measurement

① Start the engine. The engine will run at start idle speed. Measure engine speed with a tachometer.

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

③ Select the H-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
R210-7	Start idle	1000±100	
	H mode	2050±50	
	S mode	1750±50	
	Auto decel	1200±100	

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

3) TRAVEL SPEED

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

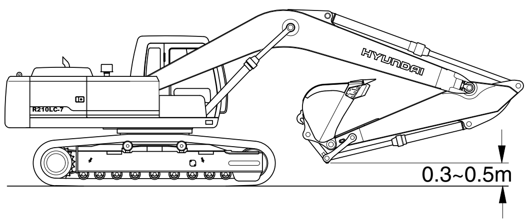
(2) Preparation

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 5m on both ends for machine acceleration and deceleration.

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

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



21077MS04

(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.

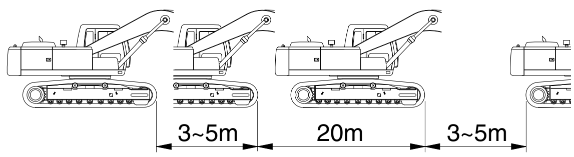
· Mode selector : H mode

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

④ Measure the time required to travel 20m.

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.



21077MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

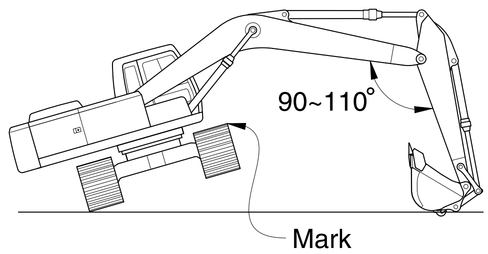
Model	Travel speed	Standard	Maximum allowable	Remarks
R210-7	1 Speed	20.6±2.0	25.7	
	2 Speed	13.8±1.0	17.3	

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.



21077MS06

(3) Measurement

① Select the following switch positions.
· Travel mode switch : 1 or 2 speed
· Mode selector : H mode
· Auto decel 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

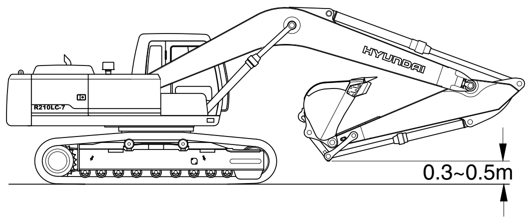
The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Maximum allowable
R210-7	1 Speed	28.0±2.0	35.0
	2 Speed	18.0±2.0	22.5

5) TRAVEL DEVIATION

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



21077MS04

(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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

(3) Measurement

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

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

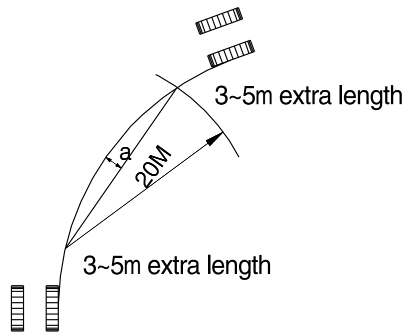
· Mode selector : H mode

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

④ Measure the distance between a straight 20m 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

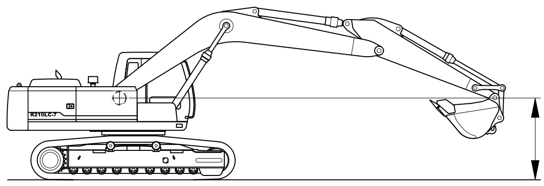
Mistrack should be within the following specifications.

Unit : mm / 20m

Model	Standard	Maximum allowable	Remarks
R210-7	200 below	240	

6) SWING SPEED

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



21077MS07

(2) Preparation

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

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

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

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

(3) Measurement

① Select the following switch positions.

· Mode selector : H 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 selector switch	Standard	Maximum allowable
R210-7	H mode	14.6±1.5	19.0

7) SWING FUNCTION DRIFT CHECK

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

(2) Preparation

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

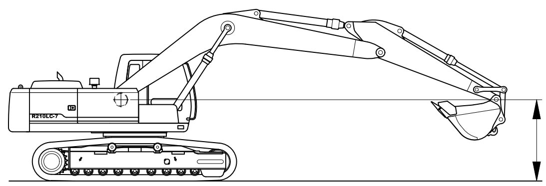
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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

④ Make two chalk marks: one on the swing bearing and one directly below it on the track frame.

⑤ Swing the upperstructure 360°.

⑥ Keep the hydraulic oil temperature at 50±5°C.



21077MS07

(3) Measurement

① Conduct this test in the H mode.

② Select the following switch positions.

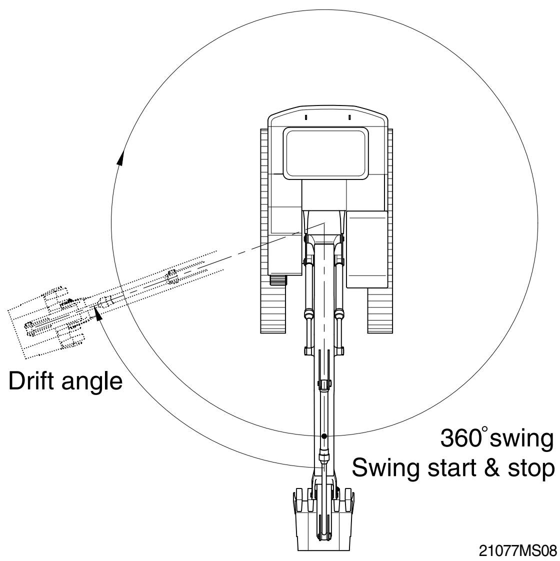
· Mode selector : H mode

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

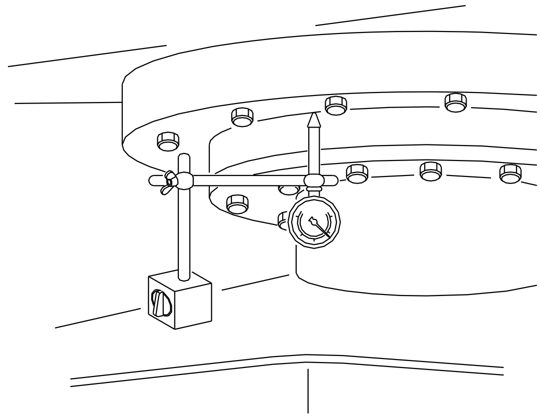
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Mode select switch	Standard	Maximum allowable	Remarks
R210-7	H 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.

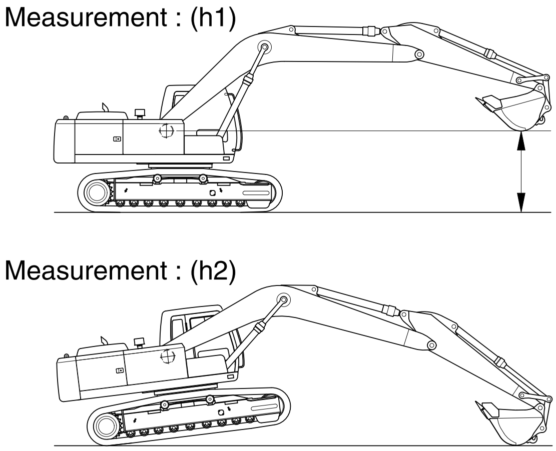
⑥ Bucket should be empty.

(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 50cm.
Record the dial gauge reading(h2).

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



21077MS09

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R210-7	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.

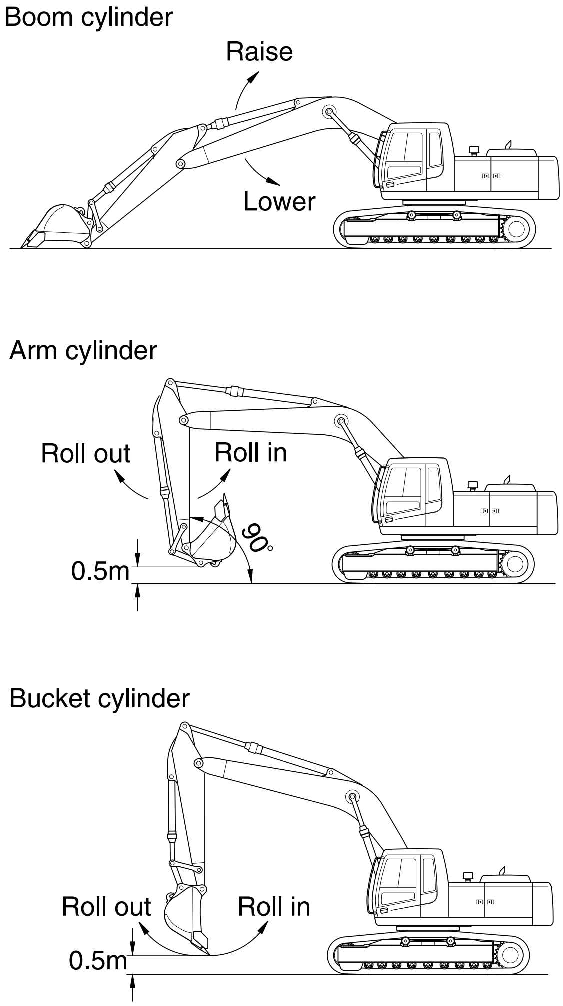
(2) Preparation

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 0.5m 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.



21077MS10

(3) Measurement

① Select the following switch positions.
· Mode selector : H 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
R210-7	Boom raise	3.4±0.4	4.5	
	Boom lower	2.9±0.4	3.6	
	Arm in	3.6±0.4	4.1	
	Arm out	2.9±0.3	3.6	
	Bucket load	3.6±0.4	4.4	
	Bucket dump	2.3±0.3	3.0	

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.

· $W = M^3 \times 1.5$

Where :

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

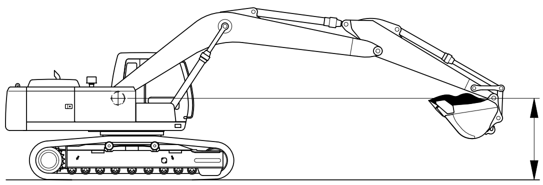
1.5 = Soil specific gravity

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

③ Position the bucket cylinder with the rod 20 to 30㎜ 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.



21077MS11

(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
R210-7	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.

· Mode selector : H 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
R210-7	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.

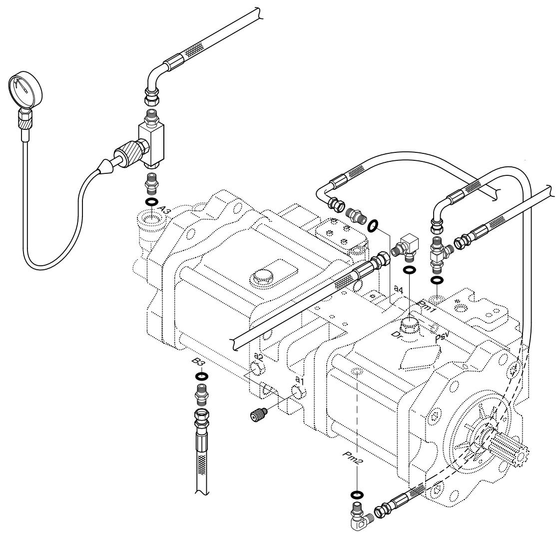
Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
R210-7	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 Remove the top cover of the hydraulic tank oil supply port with a wrench.
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.



21077MS12

(2) Measurement

① Select the following switch positions.
· Mode selector : H mode
· Auto decel switch : OFF
② Measure the primary pilot pressure in the M mode.

(3) Evaluation

The average measured pressure should meet the following specifications:

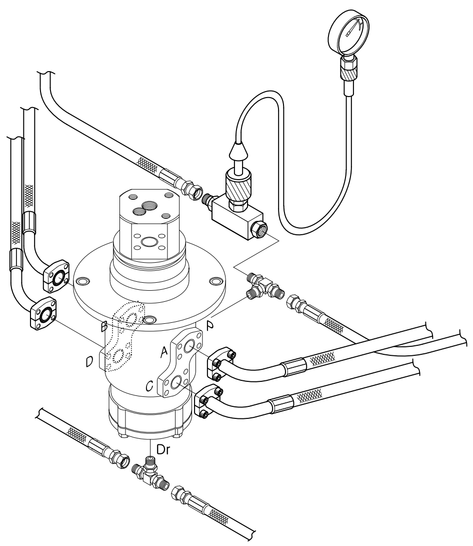
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R210-7	H mode	35^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Push the pressure release button to bleed air.
④ To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P port as shown.
⑤ Start the engine and check for on leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5°C.



21077MS13

(2) Measurement

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

(3) Evaluation

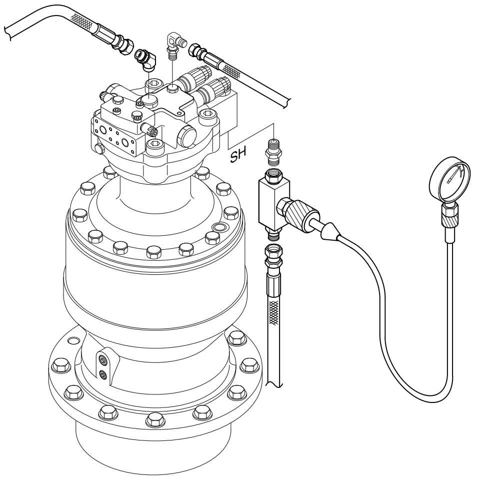
The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R210-7	1 Speed	0	-	
	2 Speed	35±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation



21077MS14

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

(2) Measurement

① Select the following switch positions.
· Mode selector : H mode
② Operate the swing function or arm roll in function and measure the swing brake control pressure with the brake disengaged. Release the control lever to return to neutral and measure the control pressure when the brake is applied.
Repeat step ② three times and calculate the average values.

(3) Evaluation

The average measured pressure should be within the following specifications.

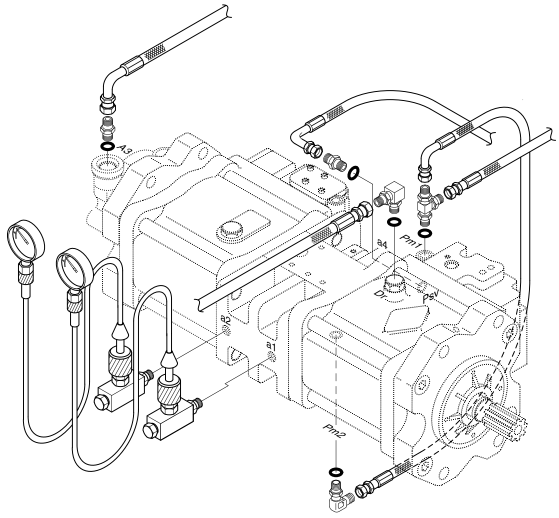
Unit : kgf / cm²

Model	Description	Standard	Allowable limits	Remarks
R210-7	Brake disengaged	35	26~44	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Push the pressure release button to bleed air.
④ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.
⑤ Start the engine and check for oil leakage from the port.
⑥ Keep the hydraulic oil temperature at 50±5°C.



21077MS15

(2) Measurement

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

(3) Evaluation

The average measured pressure should meet the following specifications.

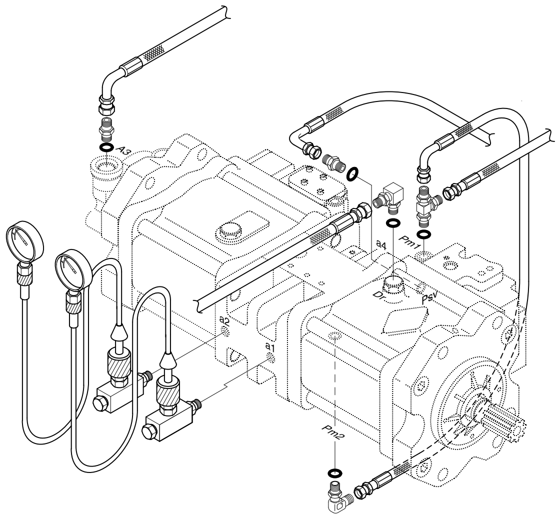
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R210-7	High idle	330±10	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Stop the engine.
② Remove the top cover of the hydraulic tank oil supply port with a wrench.
③ Push the pressure release button to bleed air.
④ To measure the system relief pressure. Install a connector and pressure gauge assembly main pump gauge port, as shown.
⑤ Start the engine and check for oil leakage from the port.
⑥ Keep the hydraulic oil temperature at 50±5°C.



21077MS15

(2) Measurement

① Select the following switch positions.
· Mode selector : H 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

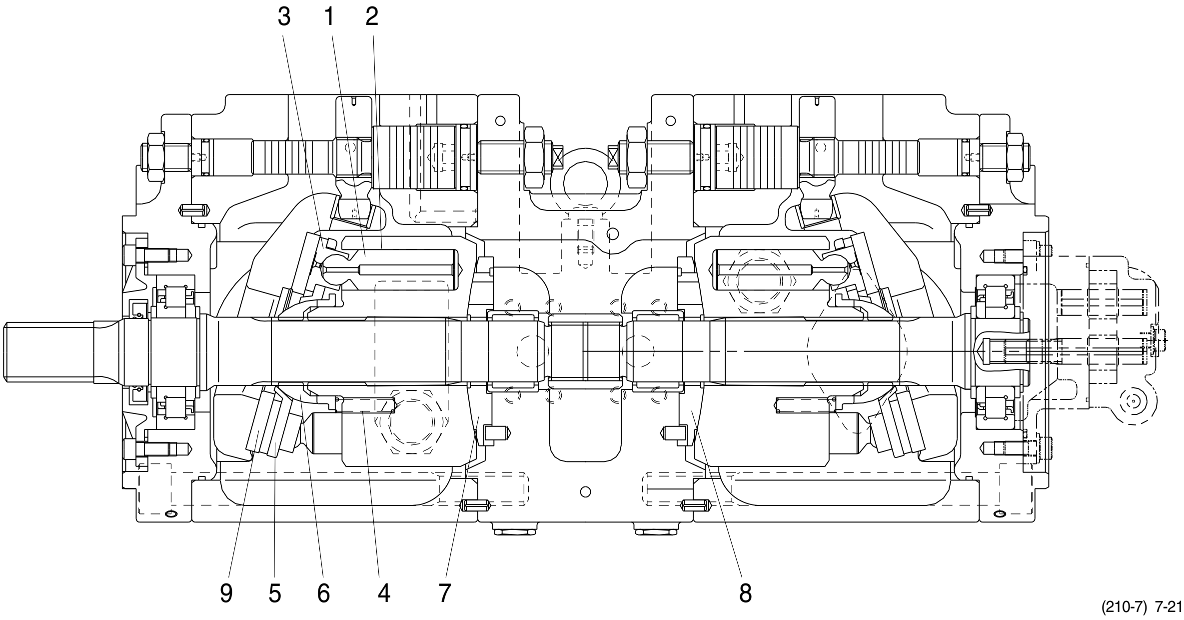
The average measured pressure should be within the following specifications.

Unit : kgf / cm²

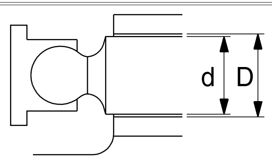
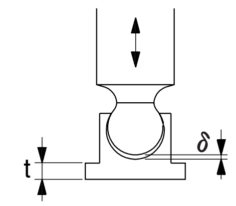
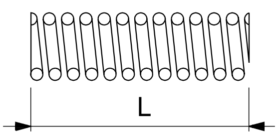
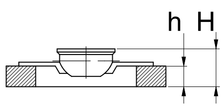
Model	Function to be tested	Standard	Maximum allowable
R210-7	Boom, Arm, Bucket	330±10	390±10
	Travel	330±10	-
	Swing	240±10	-

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



(210-7) 7-21

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.039	0.067	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)		4.9	4.7	
Free height of cylinder spring(4) (L)		41.1	40.3	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)		23.0	22.0	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		

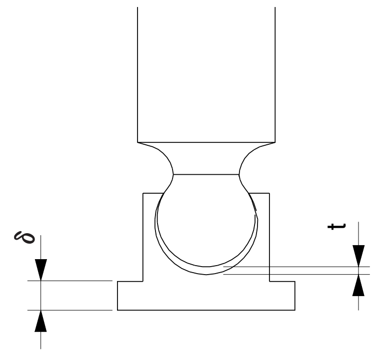
2. MAIN CONTROL VALVE

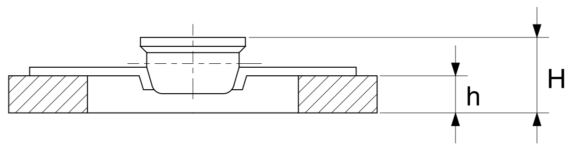
Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part - Sliding sections of casing fore and spool, especially land sections applied with holded pressure - Seal pocket section where spool is inserted - Seal 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. · Insert spool in casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch(Especially on seals-contacting section) · Correction or replacement when O-ring is damaged or when spool does not move smoothly
Load check valve	· Damage of poppet or spring	· Repair or replace of improper seat damage
Around spring	· Rusting, corrosion or deformation of seal plate.	· Replacement for significant damage
Around seal for spool	· External oil leakage.	· Replacement
Main relief valve, Over relief valve	· External rusting or damage. · Contacting face of valve seat.	· Replacement · Replacement when damaged

3. SWING DEVICE

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section(δ)	0	0.3	Replace 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)	6.5	6.0	Replace set of retainer plate and spherical bushing
Thickness of friction plate(h)	4.0	3.6	Replace





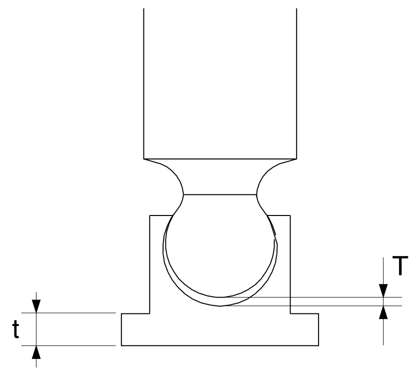
2) SLIDING PARTS

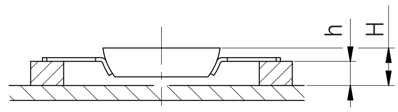
Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z(Ra=0.2) (LAPPING)	3-Z(Ra=0.8)	
Shoe plate	0.4-Z(Ra=0.1) (LAPPING)	3-Z(Ra=0.8)	
Cylinder	1.6-Z(Ra=0.4) (LAPPING)	12.5-Z(Ra=3.2)	
Valve plate	0.8-Z(Ra=0.2) (LAPPING)	6.3-Z(Ra=1.6)	

4. TRAVEL MOTOR

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.025	0.050	Replace piston or cylinder block
Play between piston and shoe caulking section(T)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe(t)	4.5	4.3	Replace assembly of piston and shoe
Combined height of set plate and ball guide(H)	7.3	7.0	Replace set of set plate and ball guide
Thickness of friction plate	3.0	2.6	Replace

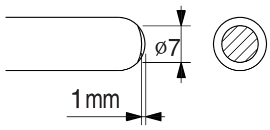




2) SLIDING PARTS

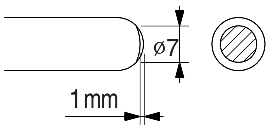
Part name	Standard roughness	Remark
Shoe	0.8S	-
Shoe plate	0.8S	-
Cylinder	0.8S	-
Valve plate	0.8S	-

5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000cc/m at neutral handle position, or more than 2000cc/m during operation.	Conditions : Primary pressure : 30kgf/cm^2 Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10μm, 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 2mm 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.	

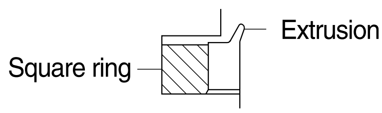
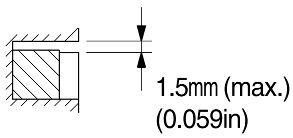
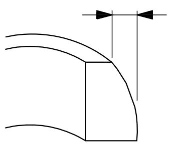
Notes 1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.
2. When loosening the hexagon socket head cap screw(125), replace the seal washers(121) without fail.

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 : 30kgf/cm² Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10㎛, 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 2mm 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 0.1mm (0.0039in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1mm(0.0039in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5mm(0.02in) or abnormality.	Replace
		· Worn less than 0.5mm(0.02in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5mm)(0.02in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5mm(0.02in) or abnormality.	Replace
		· Worn less than 0.5mm(0.02in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5mm)(0.02in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring. 	Replace
	-	· Slipper ring 1.5mm(0.059in) narrower than seal groove, or narrower than back ring. 	Replace
	-	· Worn more than 0.5mm(0.02in) ~ 1.5mm(MAX.) (0.059in) 	Replace

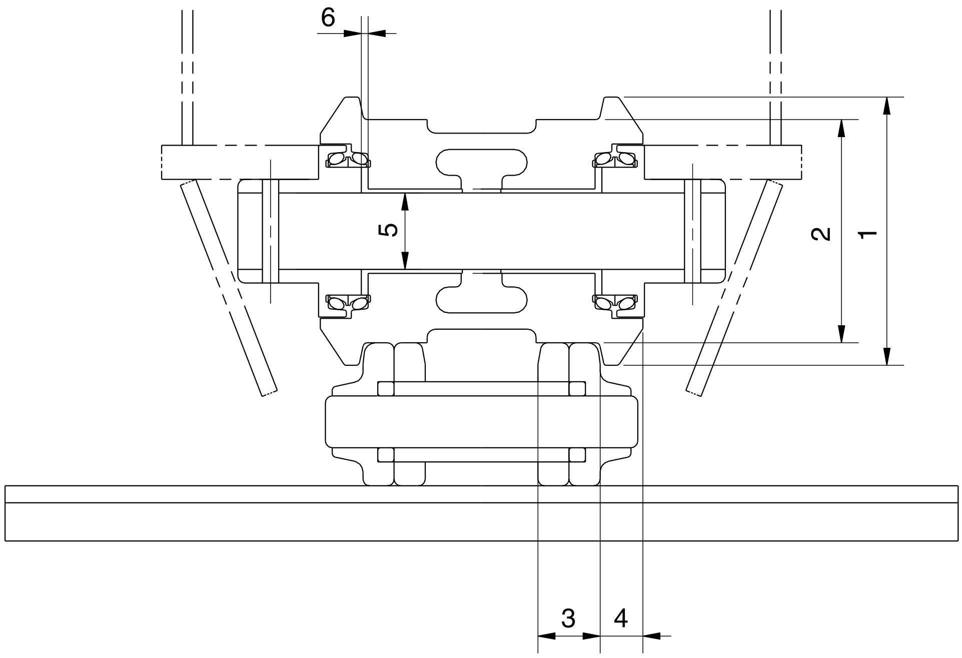
8. CYLINDER

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

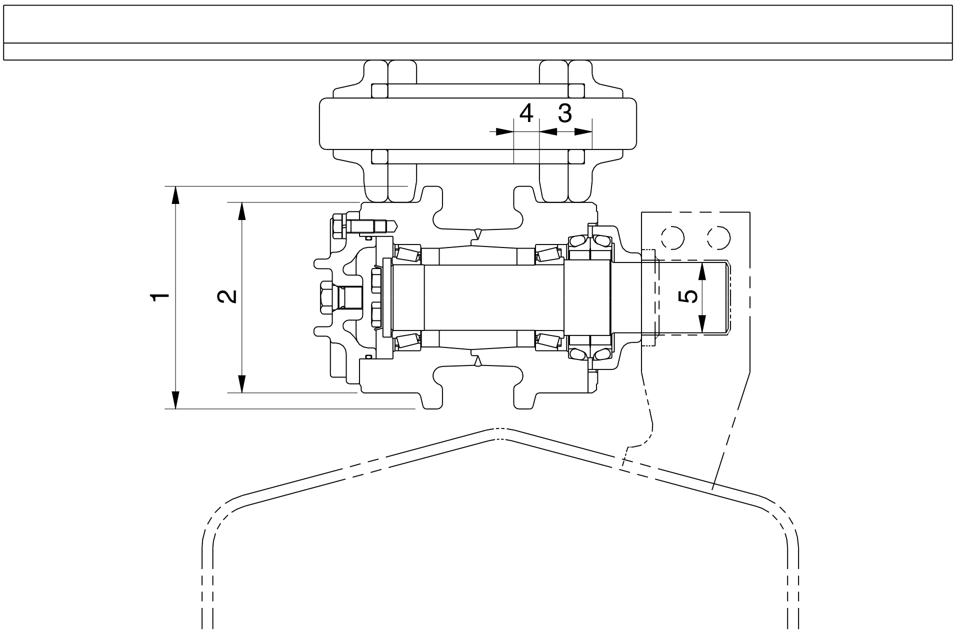


21037MS01

Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">ø 200</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 160</td><td colspan="2">ø 148</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">48</td><td colspan="2">54</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">21.5</td><td colspan="2">-</td></tr>
<tr><td rowspan="3">5</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 -0.29 -0.33</td><td>ø 70.1 +0.046 0</td><td>0.39 to 0.476</td><td>2.0</td></tr>
<tr><td rowspan="2">6</td><td rowspan="2">Side clearance of roller (Both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace</td></tr>
<tr><td colspan="2">0.2 to 1.2</td><td colspan="2">2.0</td></tr>
</table>

2) CARRIER ROLLER



21037MS02

Unit : ㎜

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<tr><td colspan="2">ø 169</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 144</td><td colspan="2">ø 134</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">44</td><td colspan="2">49</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">17</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 55</td><td>-0.05
-0.1</td><td>+0.3
+0.1</td><td>0.15
to 0.4</td><td>1.2</td></tr>
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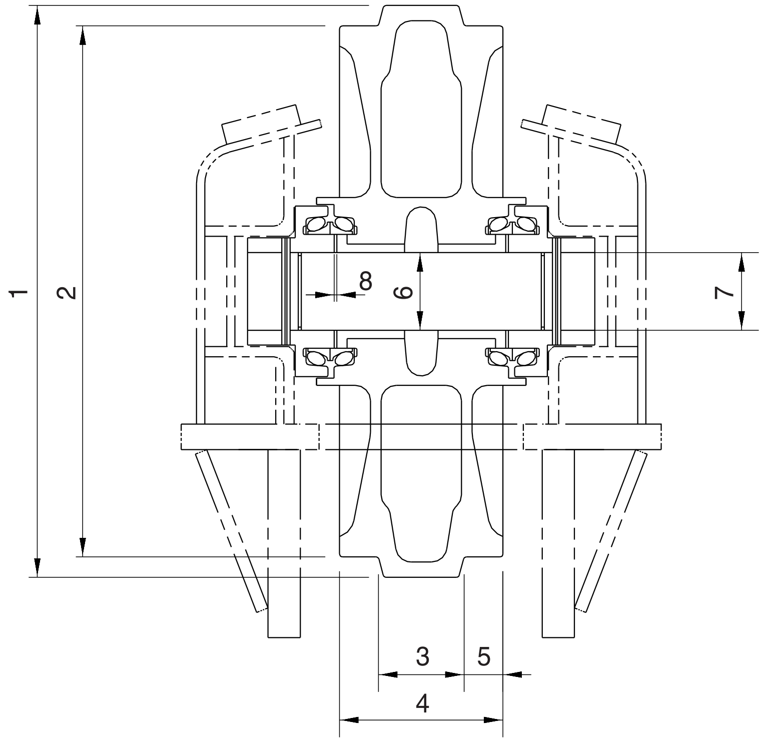
3) IDLER



21037MS03

Unit : mm

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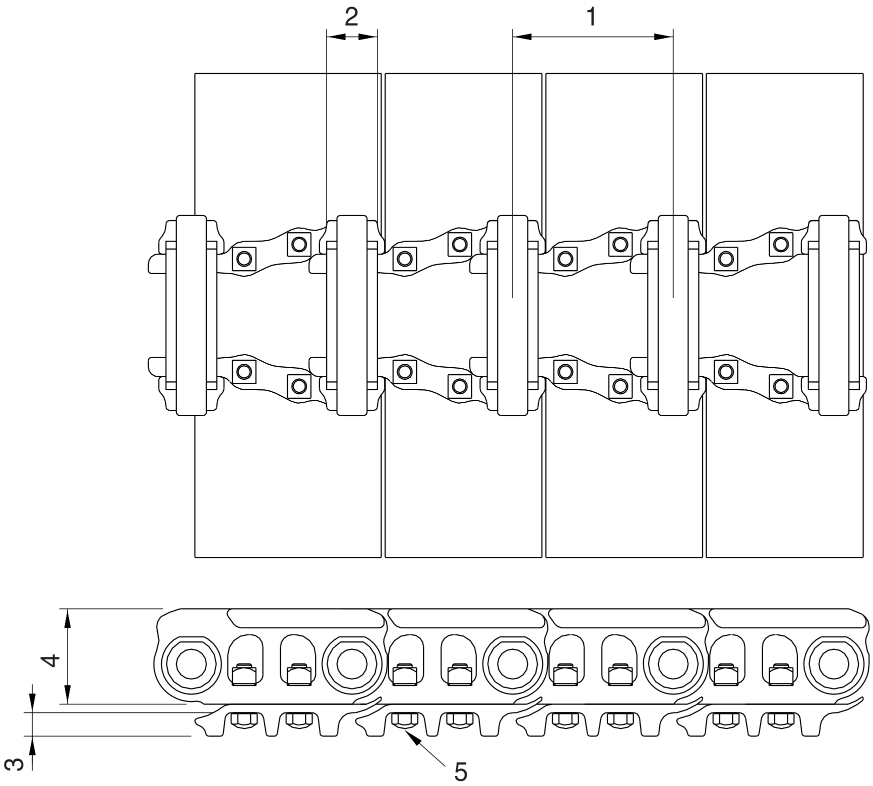
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of protrusion</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="6">Rebuild or replace</td></tr>
<tr><td colspan="2">ø 560</td><td colspan="2">-</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">ø 520</td><td colspan="2">ø 510</td></tr>
<tr><td>3</td><td>Width of protrusion</td><td colspan="2">84</td><td colspan="2">-</td></tr>
<tr><td>4</td><td>Total width</td><td colspan="2">160</td><td colspan="2">-</td></tr>
<tr><td>5</td><td>Width of tread</td><td colspan="2">38</td><td colspan="2">43</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 75 $^{0}_{-0.03}$</td><td>ø 75.35 $^{+0.05}_{0}$</td><td>0.35 to 0.43</td><td>2.0</td></tr>
<tr><td>7</td><td>Clearance between shaft and support</td><td>ø 75 $^{0}_{-0.03}$</td><td>ø 75 $^{+0.07}_{+0.03}$</td><td>0.03 to 0.1</td><td>1.2</td><td>Replace</td></tr>
<tr><td rowspan="2">8</td><td rowspan="2">Side clearance of idler (Both side)</td><td colspan="2">Standard clearance</td><td colspan="2">Clearance limit</td><td rowspan="2">Replace bushing</td></tr>
<tr><td colspan="2">0.25 to 1.2</td><td colspan="2">2.0</td></tr>
</table>

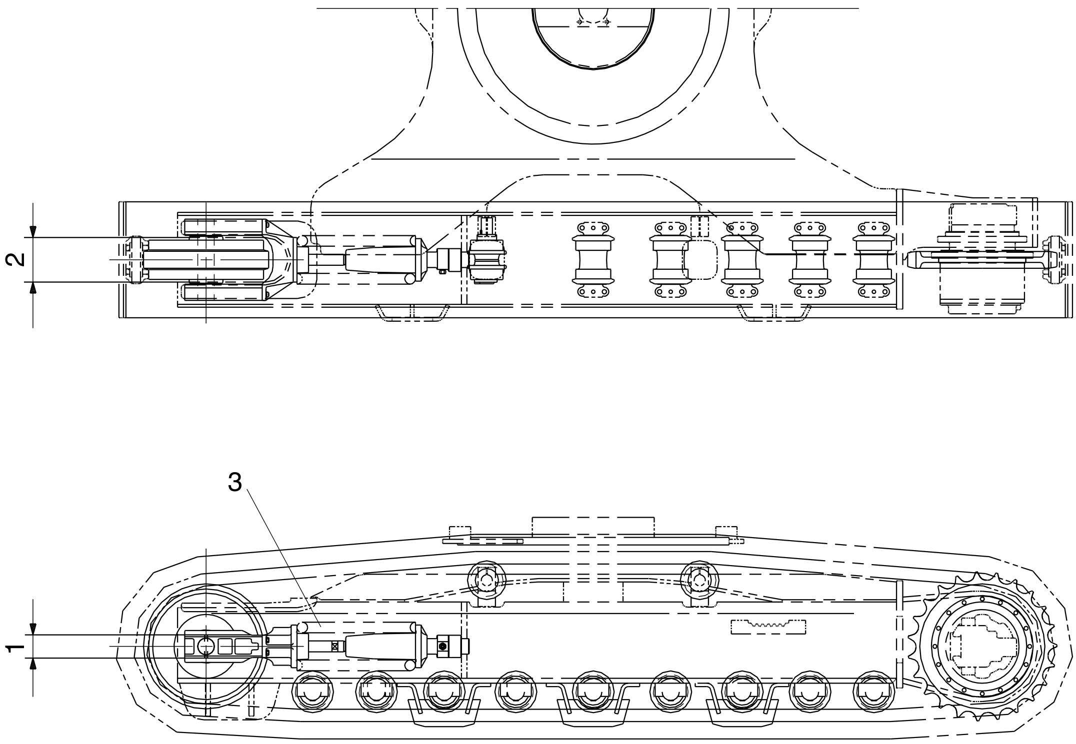
4) TRACK



Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		190	199	
2	Outside diameter of bushing	ø 59	ø 51	Rebuild or replace
3	Height of grouser	26	16	
4	Height of link	105	97	
5	Tightening torque	Initial tightening torque : 78 ± 8kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING

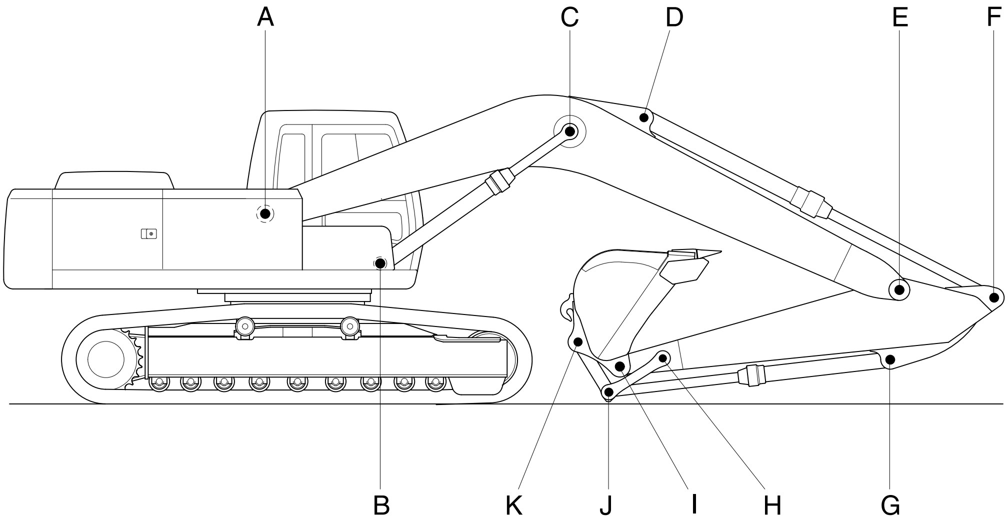


21037MS05

Unit : ㎜

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide		Standard size	Tolerance	Repair limit		Rebuild or replace
		Track frame	113	+2 0	117		
		Idler support	110	- 0.5 - 1.0	106		
2	Horizontal width of idler guide	Track frame	272	+2 0	276		
		Idler support	270	-	267		
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		ø 235 × 515	431	13716kg	-	10973kg	

2. WORK EQUIPMENT



21077MS20

Unit : ㎜

Mark	Measuring point (Pin and Bushing)	Normal value	Pin		Bushing		Remedy & Remark
			Recomm. service limit	Limit of use	Recomm. service limit	Limit of use	
A	Boom Rear	90	89	88.5	90.5	91	Replace
B	Boom Cylinder Head	80	79	78.5	80.5	81	〃
C	Boom Cylinder Rod	80	79	78.5	80.5	81	〃
D	Arm Cylinder Head	80	79	78.5	80.5	81	〃
E	Boom Front	90	89	88.5	90.5	91	〃
F	Arm Cylinder Rod	80	79	78.5	80.5	81	〃
G	Bucket Cylinder Head	80	79	78.5	80.5	81	〃
H	Arm Link	70	69	68.5	70.5	71	〃
I	Bucket and Arm Link	80	79	78.5	80.5	81	〃
J	Bucket Cylinder Rod	80	79	78.5	80.5	81	〃
K	Bucket Link	80	79	78.5	80.5	81	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

1) Lower the work equipment completely to the ground.
   If the coolant contains antifreeze, dispose of it correctly.

2) After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.

3) When draining oil, prepare a container of adequate size to catch the oil.

4) Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.

5) To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.

6) Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.

7) Check the number and thickness of the shims, and keep in a safe place.

8) When raising components, be sure to use lifting equipment of ample strength.

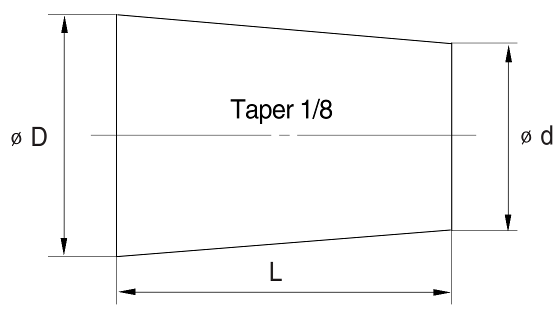
9) When using forcing screws to remove any components, tighten the forcing screws alternately.

10) Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.

11) When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.

12) If the part is not under hydraulic pressure, the following corks can be used.

Nominal number	Dimensions		
	D	d	L
06	6	5	8
08	8	6.5	11
10	10	8.5	12
12	12	10	15
14	14	11.5	18
16	16	13.5	20
18	18	15	22
20	20	17	25
22	22	18.5	28
24	24	20	30
27	27	22.5	34



2. INSTALL WORK

1) Tighten all bolts and nuts(Sleeve nuts) to the specified torque.

2) Install the hoses without twisting or interference.

3) Replace all gaskets, O-rings, cotter pins, and lock plates with new parts.

4) Bend the cotter pin or lock plate securely.

5) When coating with adhesive, clean the part and remove all oil and grease, then coat the threaded portion with 2-3 drops of adhesive.

6) When coating with gasket sealant, clean the surface and remove all oil and grease, check that there is no dirt or damage, then coat uniformly with gasket sealant.

7) Clean all parts, and correct any damage, dents, burrs, or rust.

8) Coat rotating parts and sliding parts with engine oil.

9) When press fitting parts, coat the surface with antifriction compound(LM-P).

10) After installing snap rings, check that the snap ring is fitted securely in the ring groove(Check that the snap ring moves in the direction of rotation).

11) When connecting wiring connectors, clean the connector to remove all oil, dirt, or water, then connect securely.

12) When using eyebolts, check that there is no deformation or deterioration, and screw them in fully.

13) When tightening split flanges, tighten uniformly in turn to prevent excessive tightening on one side.

14) When operating the hydraulic cylinders for the first time after repairing and reassembling the hydraulic cylinders, pumps, or other hydraulic equipment or piping, always bleed the air from the hydraulic cylinders as follows:

(1) Start the engine and run at low idling.

(2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 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, nut, rear	M24 × 3.0	90 ± 7.0	651 ± 51
		Engine mounting bolt, nut, front	M20 × 2.5	55 ± 3.5	398 ± 25
2		Radiator mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
3		Coupling mounting socket bolt	M16 × 2.0	22 ± 1.0	159±7.2
4		Main pump housing mounting bolt	M10 × 1.5	4.8 ± 0.3	34.7 ± 2.2
5	Hydraulic system	Main pump mounting socket bolt	M20 × 2.5	42 ± 4.5	304 ± 32.5
6		Main control valve mounting nut	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
7		Fuel tank mounting bolt	M20 × 2.5	45 ± 5.1	325 ± 36.9
8		Hydraulic oil tank mounting bolt	M20 × 2.5	45 ± 5.1	325 ± 36.9
9		Turning joint mounting bolt, nut	M12 × 1.75	12 ± 1.3	86.8 ± 9.4
10	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
11		Swing bearing upper part mounting bolt	M20 × 2.5	57.8 ± 6.4	418 ± 46.3
12		Swing bearing lower part mounting bolt	M20 × 2.5	57.8 ± 6.4	418 ± 46.3
13		Travel motor mounting bolt	M16 × 2.0	23 ± 2.5	166 ± 18.1
14		Sprocket mounting bolt	M16 × 2.0	26 ± 2.5	188 ± 18.1
15	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 4.4	215 ± 31.8
16		Track roller mounting bolt	M20 × 2.5	54.7 ± 5.0	396 ± 36.2
17		Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
18		Track shoe mounting bolt, nut	M20 × 1.5	78 ± 8.0	564 ± 57.9
19		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
20	Others	Counterweight mounting bolt	M36 × 3.0	308 ± 46	2228 ± 333
21		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
22		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 : 180 l

(5) Remove socket bolts(74) and disconnect pipe(1, 2).

(6) Disconnect pilot line hoses(4, 5, 6, 7, 8, 9, 10, 11).

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

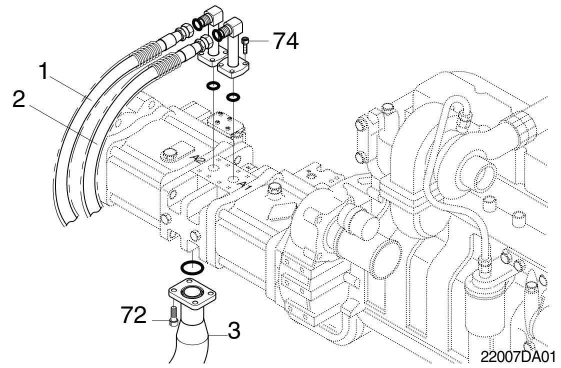
※ When pump suction tube is disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(8) Sling the pump assembly and remove the pump mounting bolts.

- Weight : 120kg(265lb)

※ Pull out the pump assembly from housing. When removing the pump assembly, check that all the hoses have been disconnected.

13031GE18



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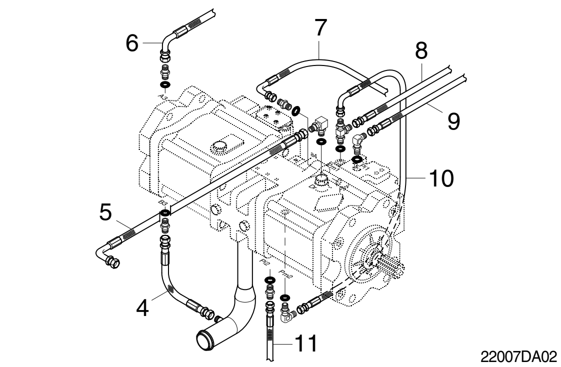

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2) INSTALL

(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.

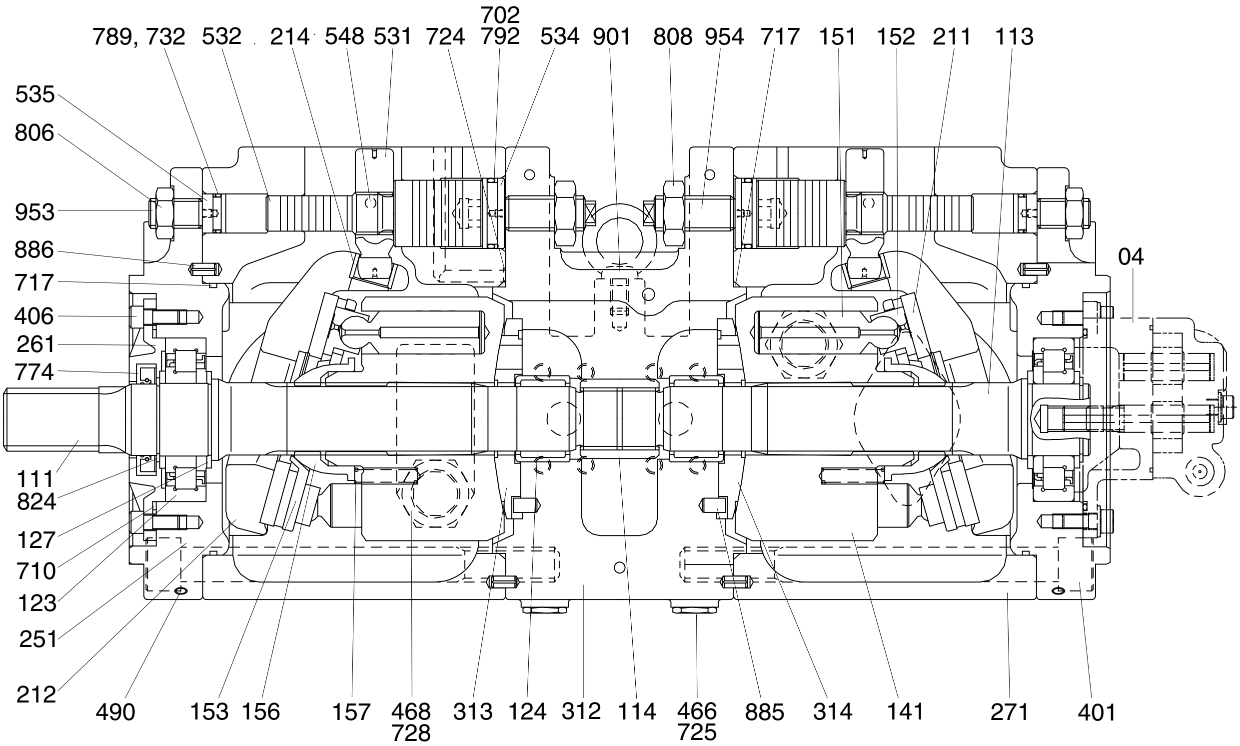
(6) Bleed the air from the hydraulic pump.
 ① Remove the air vent plug(2EA).
 ② Tighten plug lightly.
 ③ Start the engine, run at low idling, and check oil come out from plug.
 ④ Tighten plug.

(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)

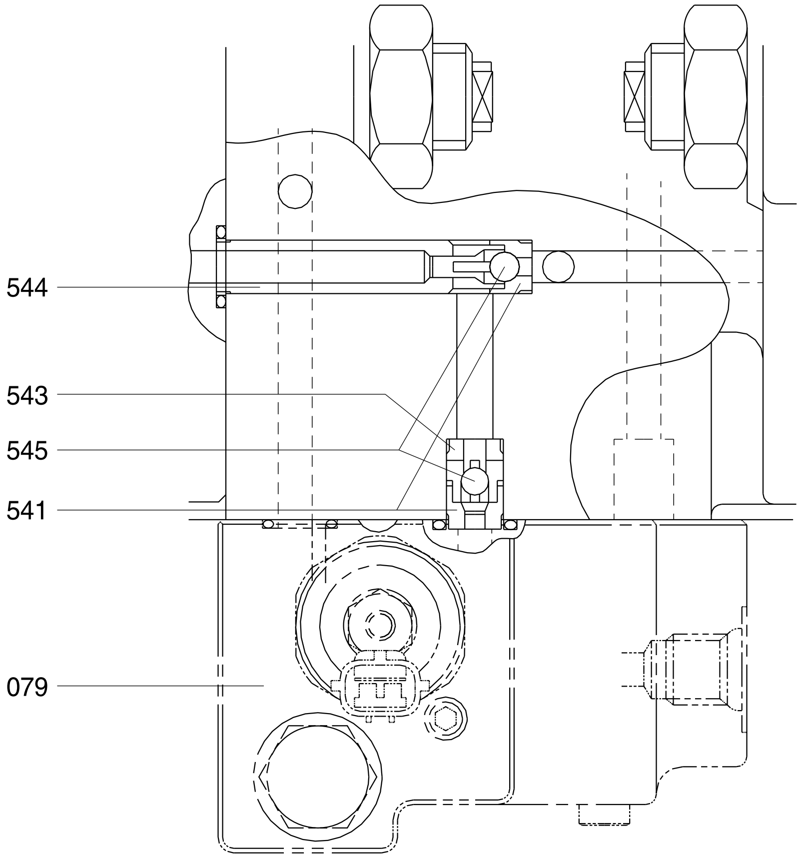
1) STRUCTURE



RD21072SF02

04	Gear pump	261	Seal cover(F)	717	O-ring
111	Drive shaft(F)	271	Pump casing	724	O-ring
113	Drive shaft(R)	312	Valve block	725	O-ring
114	Spline coupling	313	Valve plate(R)	728	O-ring
123	Roller bearing	314	Valve plate(L)	732	O-ring
124	Needle bearing	401	Hexagon socket bolt	774	Oil seal
127	Bearing spacer	406	Hexagon socket bolt	789	Back up ring
141	Cylinder block	466	VP Plug	792	Back up ring
151	Piston	468	VP Plug	806	Hexagon head nut
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	954	Set screw
251	Support	710	O-ring		

MAIN PUMP(2/2)



VIEW A

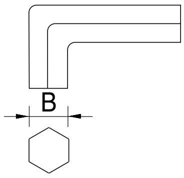
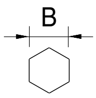
(210-7) 8-10

541 Seat	544 Stopper 2	079 Proportional reducing valve
543 Stopper 1	545 Steel ball	

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="12">Part name</td></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="5">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>8</td><td colspan="3">M10</td><td colspan="3">BP-3/8</td><td colspan="3">PO-3/8</td><td colspan="3">M16, M18</td></tr>
<tr><td>17</td><td colspan="3">M20, M22</td><td colspan="3">BP-1</td><td colspan="3">PO-1, 1 1/4, 1 1/2</td><td colspan="3">-</td></tr>
<tr><td rowspan="6">Double ring spanner,
socket wrench, double(Single)
open end spanner
</td><td>-</td><td colspan="4">Hexagon socket
head bolt</td><td colspan="4">Hexagon nut</td><td colspan="4">VP plug
(PF thread)</td></tr>
<tr><td>19</td><td colspan="4">M12</td><td colspan="4">M12</td><td colspan="4">VP-1/4</td></tr>
<tr><td>24</td><td colspan="4">M16</td><td colspan="4">M16</td><td colspan="4">-</td></tr>
<tr><td>27</td><td colspan="4">M18</td><td colspan="4">M18</td><td colspan="4">VP-1/2</td></tr>
<tr><td>30</td><td colspan="4">M20</td><td colspan="4">M20</td><td colspan="4">-</td></tr>
<tr><td>36</td><td colspan="4">-</td><td colspan="4">-</td><td colspan="4">VP-3/4</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Medium size, 1 set</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">Steel bar of key material approx. 10 × 8 × 200</td></tr>
<tr><td colspan="2">Torque wrench</td><td colspan="12">Capable of tightening with the specified torques</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 Plug(Material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug(Material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

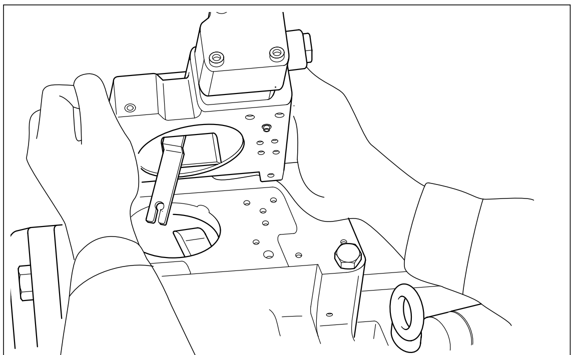
※ Select clean place.

※ Spread rubber sheet, cloth or so on on overhaul workbench top to prevent parts from being damaged.

(2) Remove dust, rust, etc, from pump surfaces with cleaning oil or so on.

(3) Remove drain port plug(468) and let oil out of pump casing(Front and rear pump).

(4) Remove hexagon socket head bolts(412, 413) and remove regulator.



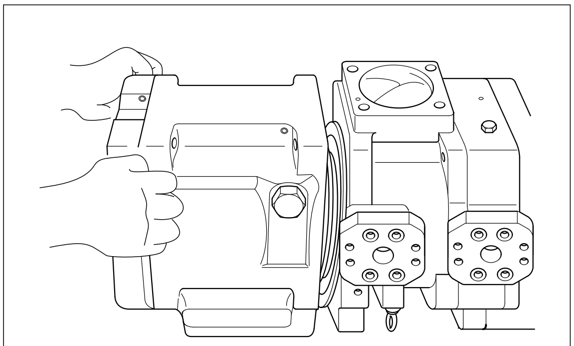
(210-7) MP01

(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).

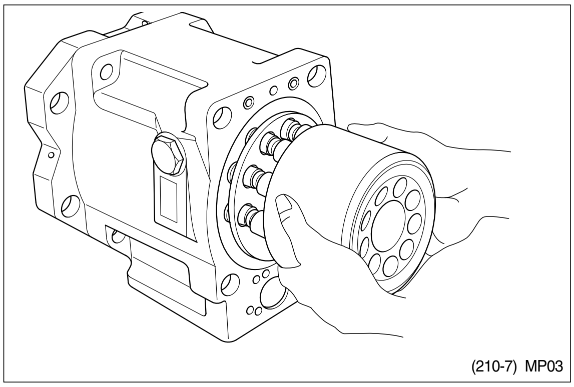
※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



(210-7) MP02

(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.

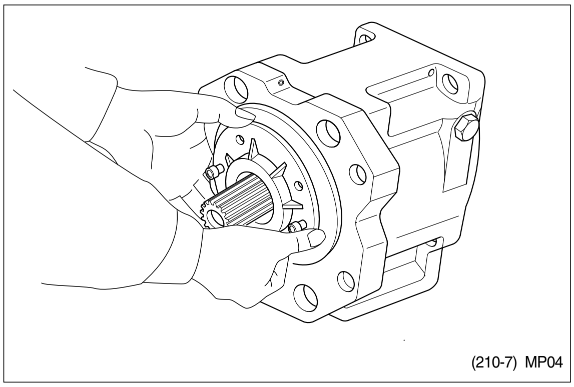


(210-7) MP03

(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.

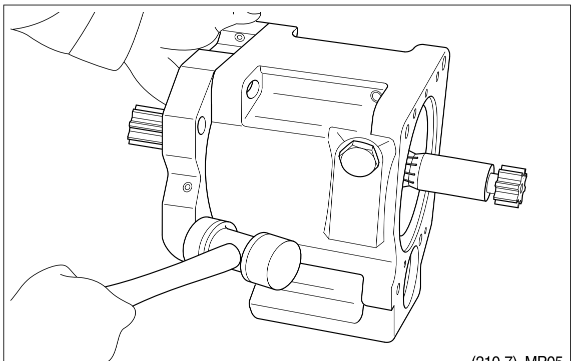
※ Since oil seal is fitted on seal cover(F), take care not to damage it in removing cover.



(210-7) MP04

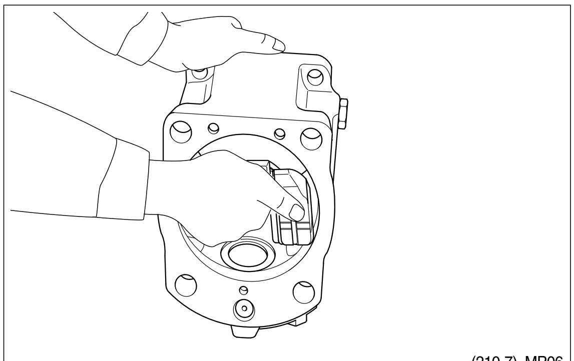
(9) Remove hexagon socket head bolts(408) and then seal cover(R, 262).
In case fitting a gear pump, first, remove gear pump.

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



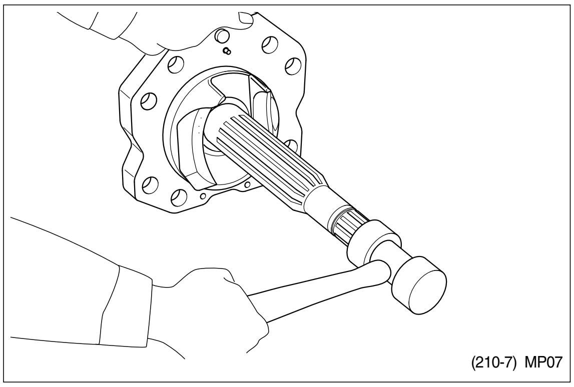
(210-7) MP05

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



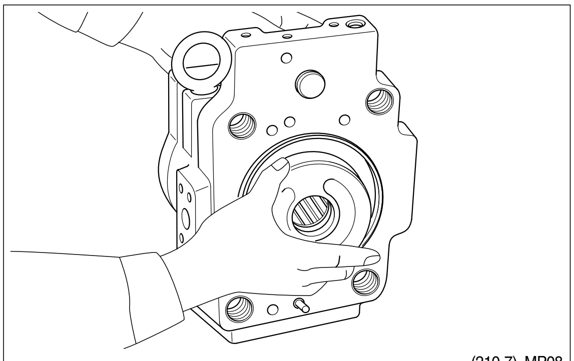
(210-7) MP06

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


(210-7) MP07

(13) Remove valve plates(313, 314) from valve block(312).

※ These may be removed in work(6).


(210-7) MP08

(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.

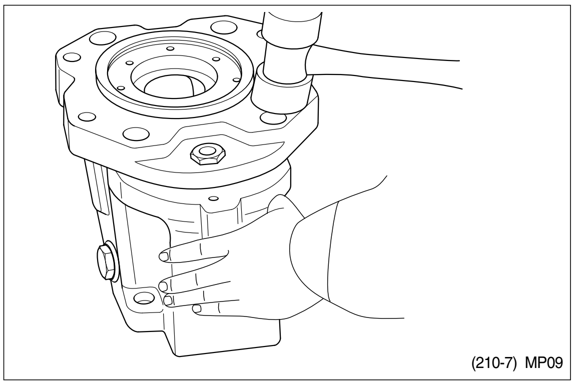
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

⑥ For the double-pump, take care not to mix up parts of the front pump with those of the rear pump.

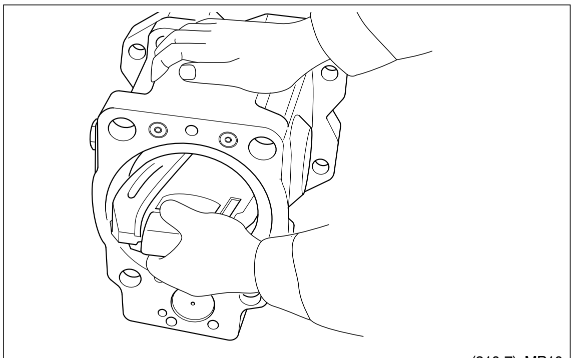
(2) Fit swash plate support(251) to pump casing(271), tapping the former lightly with a hammer.

※ 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.

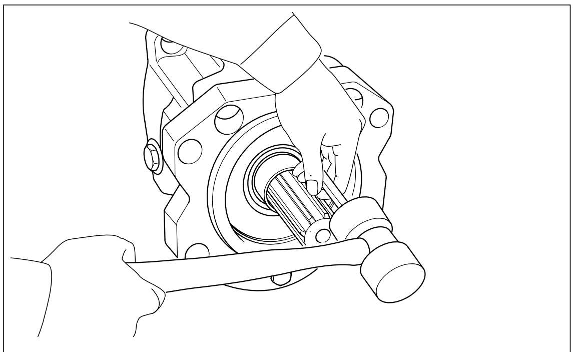

(210-7) MP09

(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.



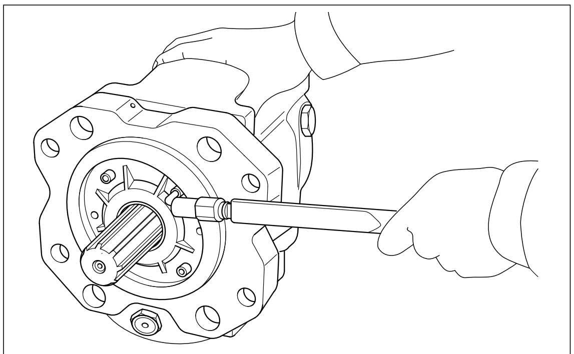
(210-7) MP10

(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.



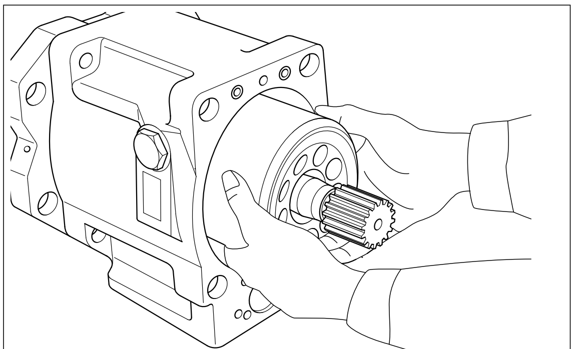
(210-7) MP11

(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.



(210-7) MP12

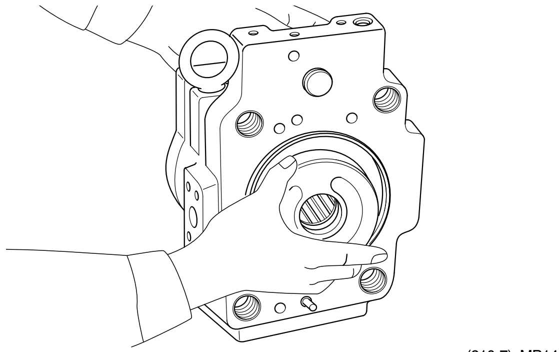
(6) Assemble piston cylinder subassembly 〔cylinder block(141), piston subassembly (151, 152), set plate(153), spherical bush (156) and cylinder spring (157)〕.
Fit spline phases of retainer and cylinder.
Then, insert piston cylinder subassembly into pump casing.



(210-7) MP13

(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.



(210-7) MP14

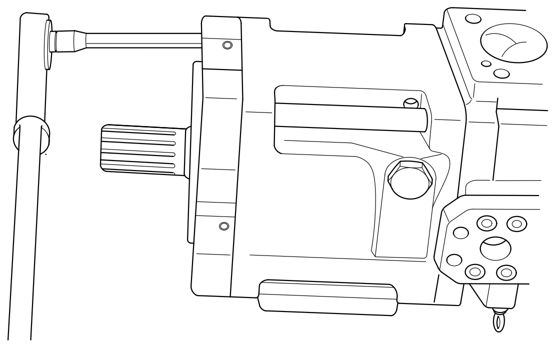
(8) Fit valve block(312) to pump casing(271) and tighten hexagon socket head bolts (401).

※ 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.

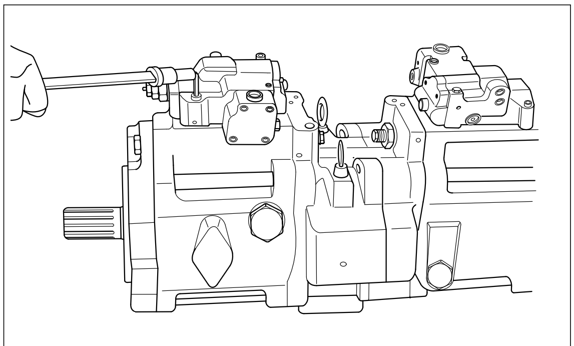
※ Counter clockwise rotation(Viewed from input shaft side) - Fit block with delivery flange right, viewed from front side.



(210-7) MP16

(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.



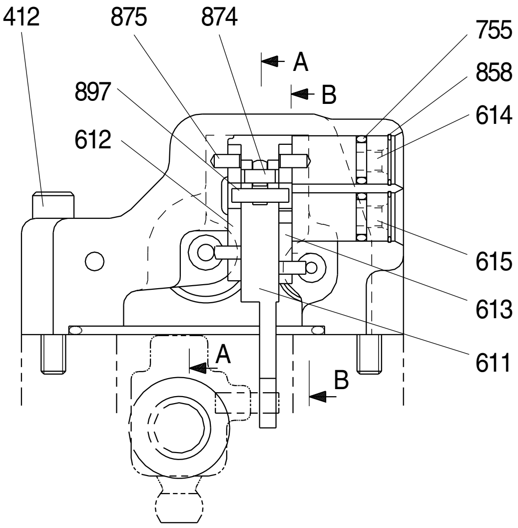
(210-7) MP17

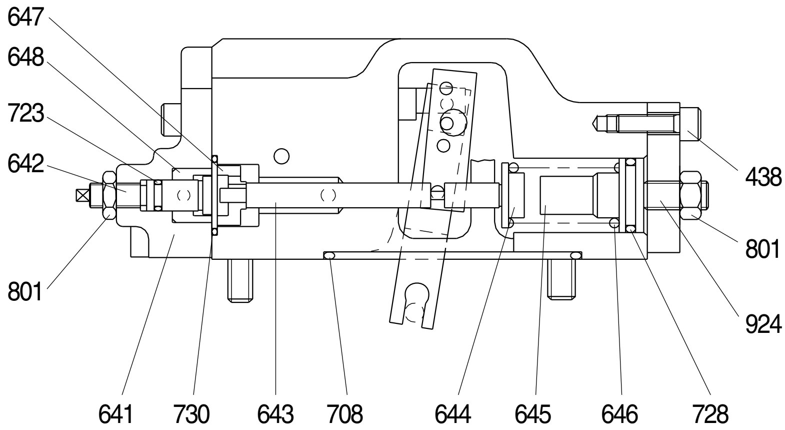
(10) Fit drain port plug(468).

This is the end of reassembling procedures.

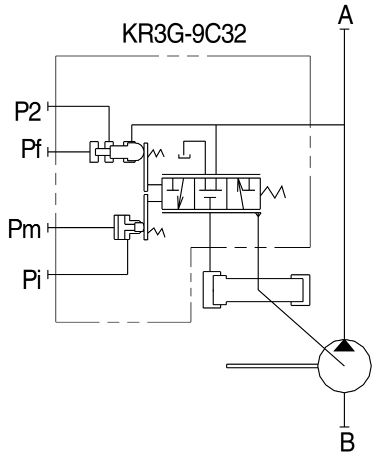
3. REGULATOR

1) STRUCTURE(1/2)

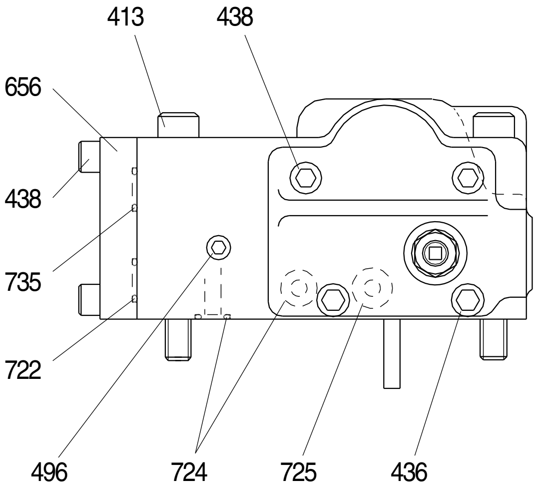




SECTION B-B

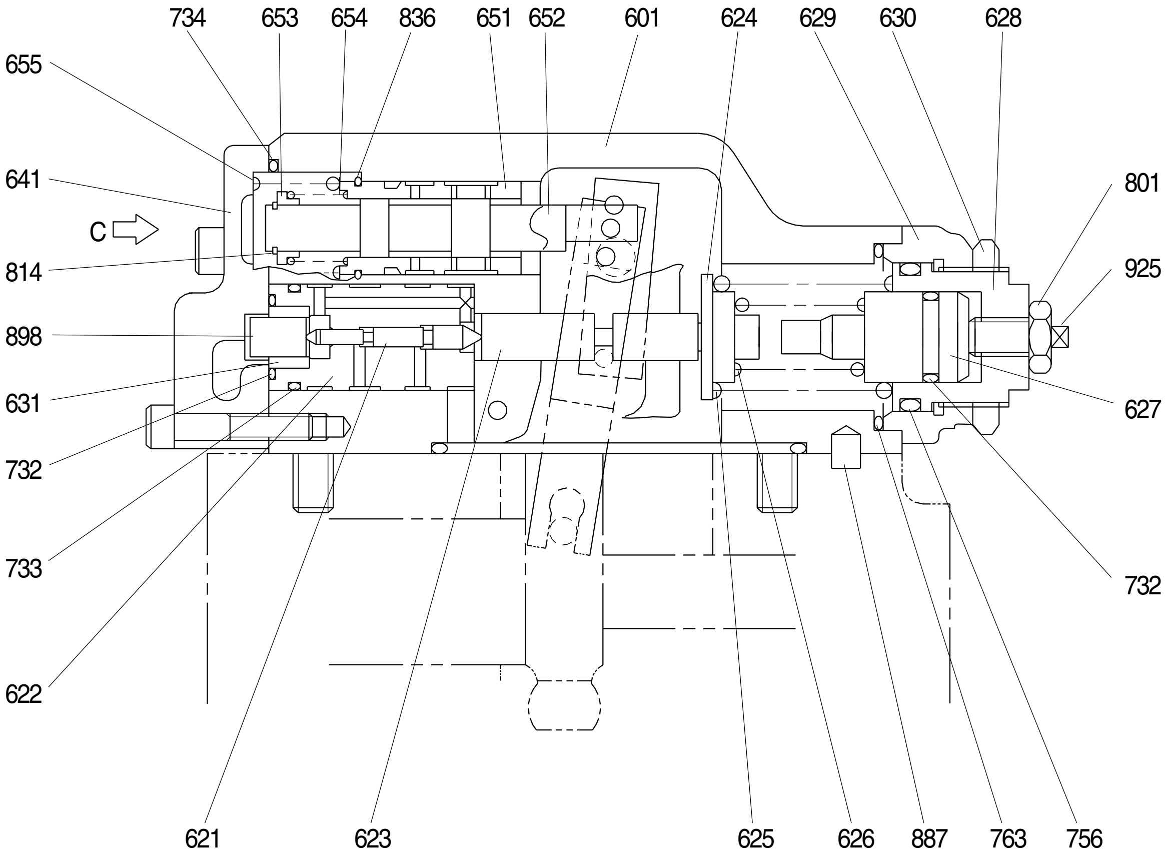


(210-7) 8-19



VIEW C

REGULATOR(2/2)



SECTION A-A

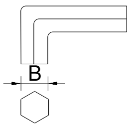
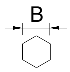
(210-7) 8-20

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

The tools necessary to disassemble/reassemble the pump are shown in the follow list.

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="12">Part name</td></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 Plug(Material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug(Material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

Since the regulator consists of small precision finished parts, disassembly and assembly are rather complicated.

For this reason, replacement of a regulator assembly is recommended, unless there is a special reason, but in case disassembly is necessary for an unavoidable reason, read through this manual to the end before starting disassembly.

(1) Choose a place for disassembly.

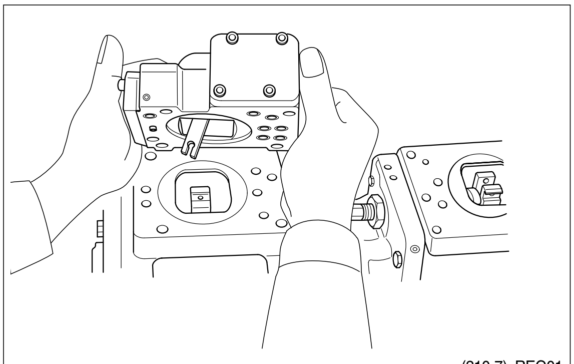
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on on top of work-bench to prevent parts from being damaged.

(2) Remove dust, rust, etc. from surfaces of regulator with clean oil.

(3) Remove hexagon socket head screw (412, 413) and remove regulator main body from pump main body.

※ Take care not to lose O-ring.



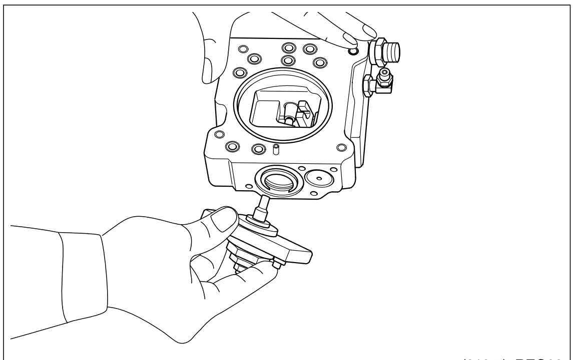
(210-7) REG01

(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).

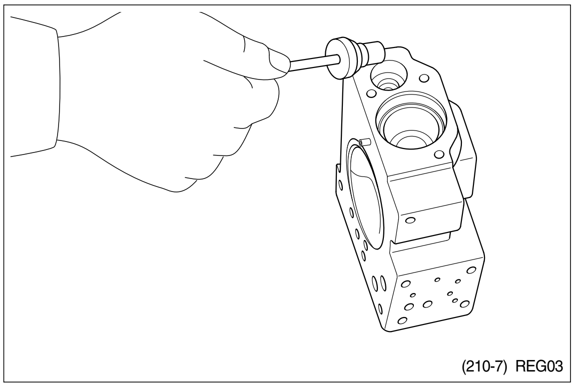
Do not loosen these screws and nuts.

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



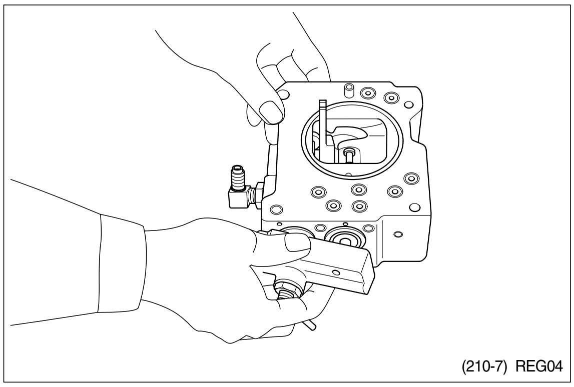
(210-7) REG02

(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.



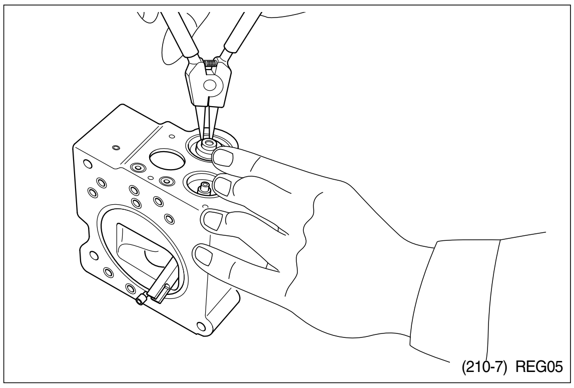
(210-7) REG03

(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.



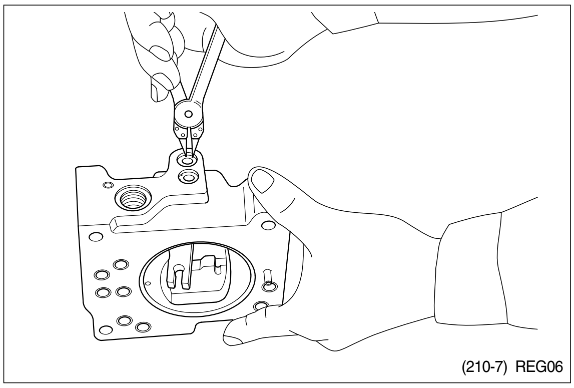
(210-7) REG04

(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.

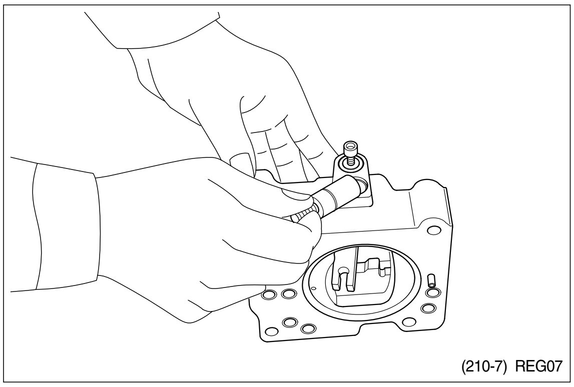


(210-7) REG05

(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.



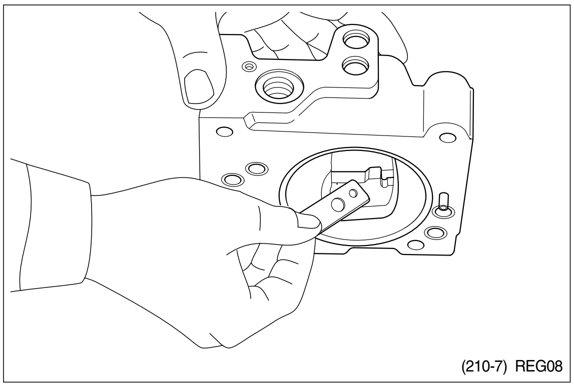
(210-7) REG06



(210-7) REG07

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

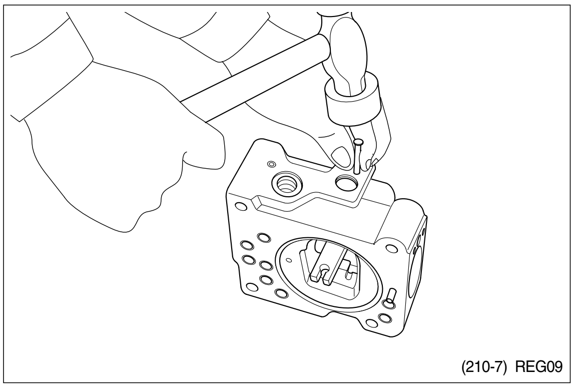
※ Work will be promoted by using pincers or so on.



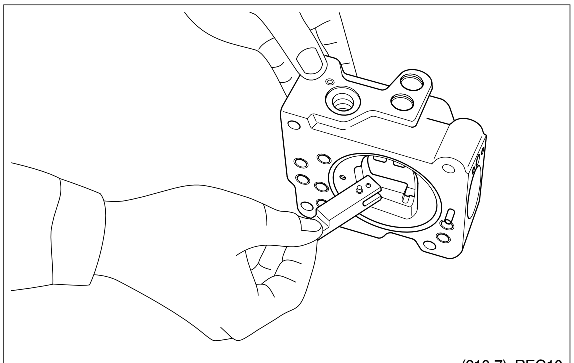
(210-7) REG08

(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).



(210-7) REG09



(210-7) REG10

(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.

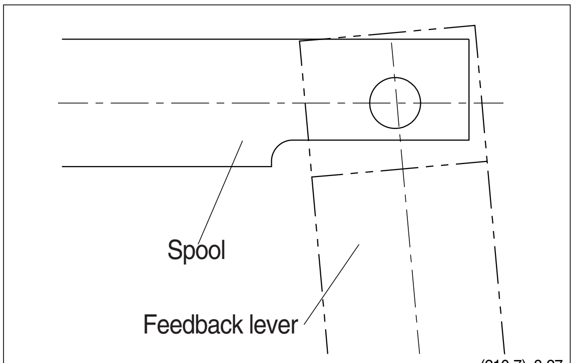
(2) Put compensating rod(623) into compensating hole of casing(601).

(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.

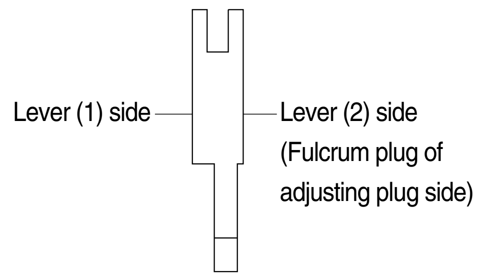
※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



(210-7) 8-27

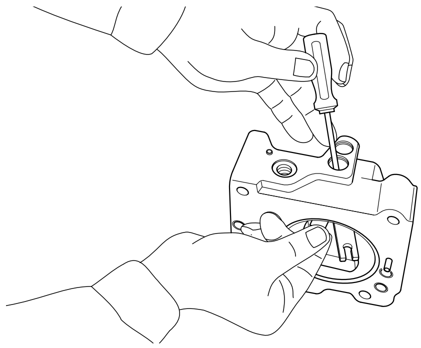
(5) Fit feedback lever(611), matching its pin hole with pin hole in spool.
Then insert pin(874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



(210-7) 8-28

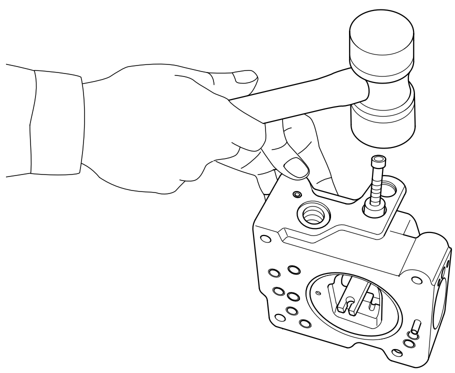
(6) Put pilot piston(643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

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

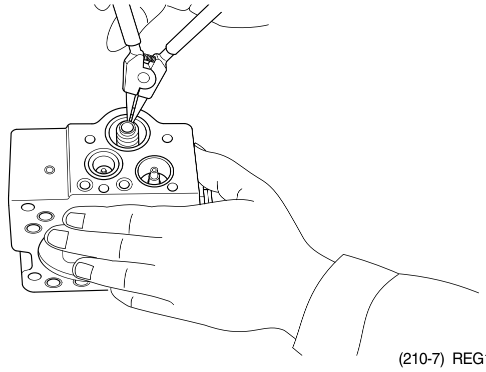

(210-7) REG11

(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).

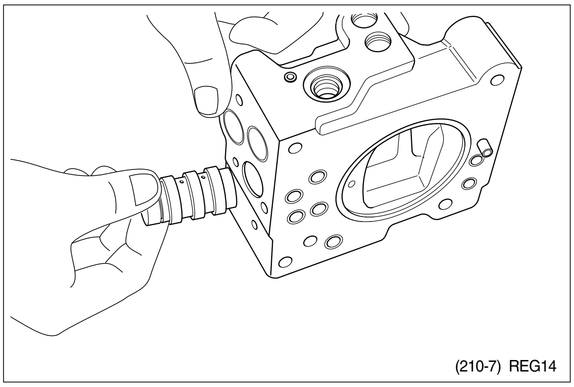
(9) Insert adjusting plug(615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


(210-7) REG12

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

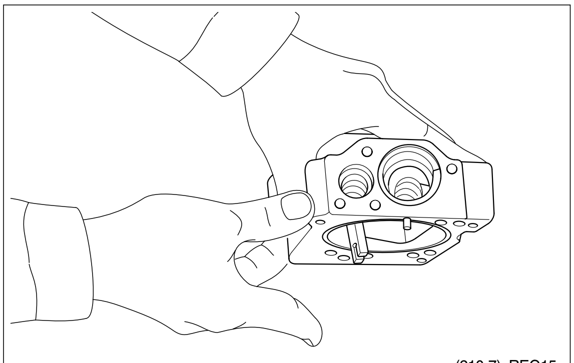

(210-7) REG13

(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).



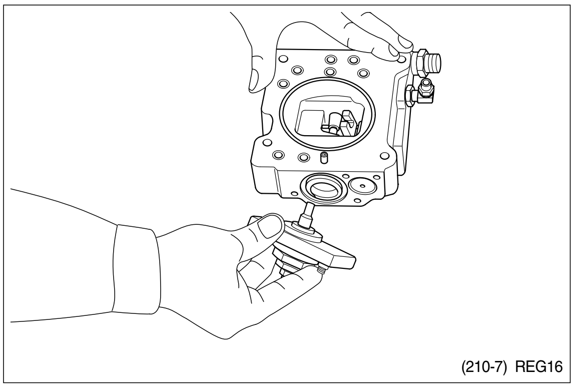
(210-7) REG14

(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.



(210-7) REG15

(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).



(210-7) REG16

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.

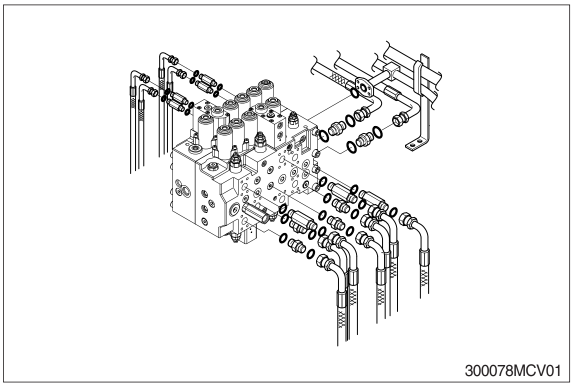
13031GE18

(4) Remove the wirings for the pressure sensor and so on.

(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

(7) Disconnect pilot piping.

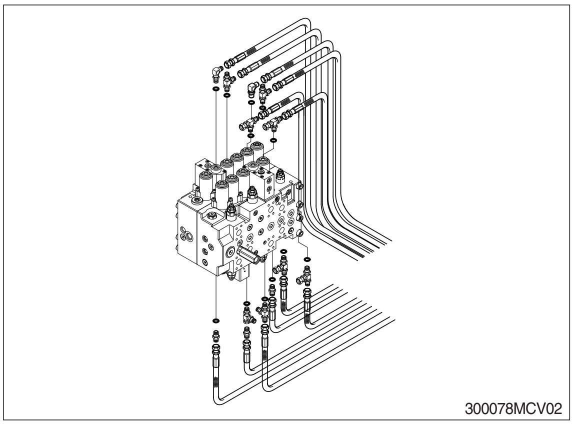


300078MCV01

(8) Sling the control valve assembly and remove the control valve mounting bolt.

· Weight : 200 ㎏ (441㏐)

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



300078MCV02

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from below items.

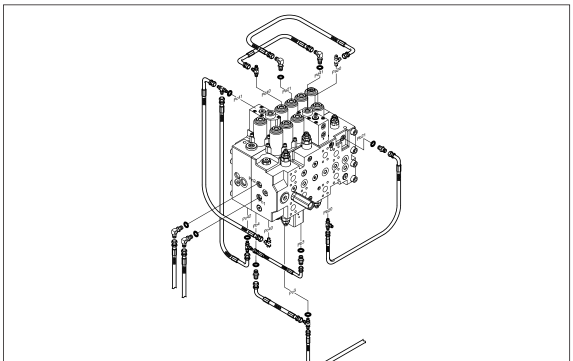
① Cylinder (boom, arm, bucket)

② Swing motor

③ Travel motor

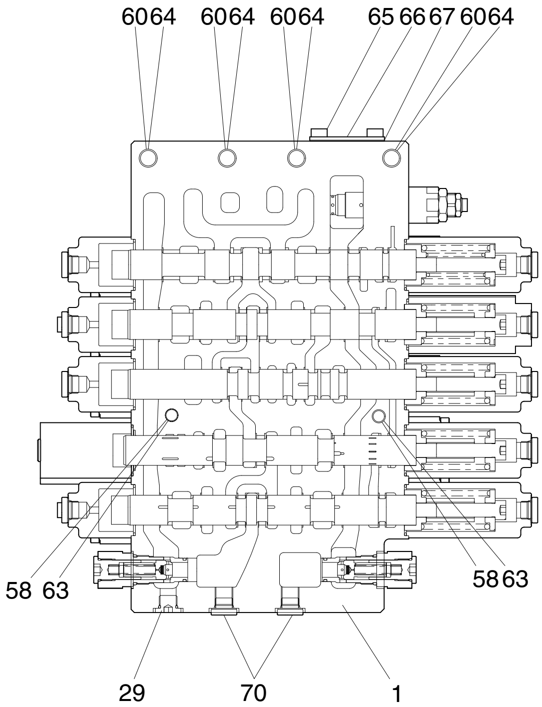
※ See each item removal and install.

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

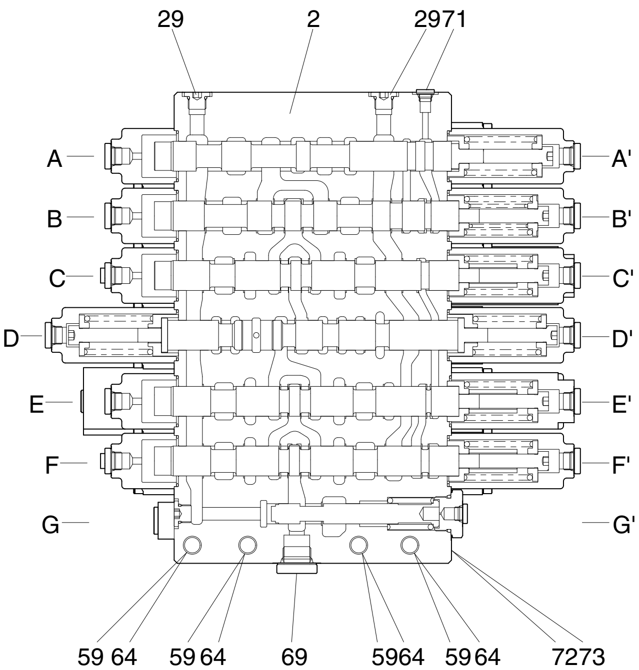


300078MCV03

2. STRUCTURE



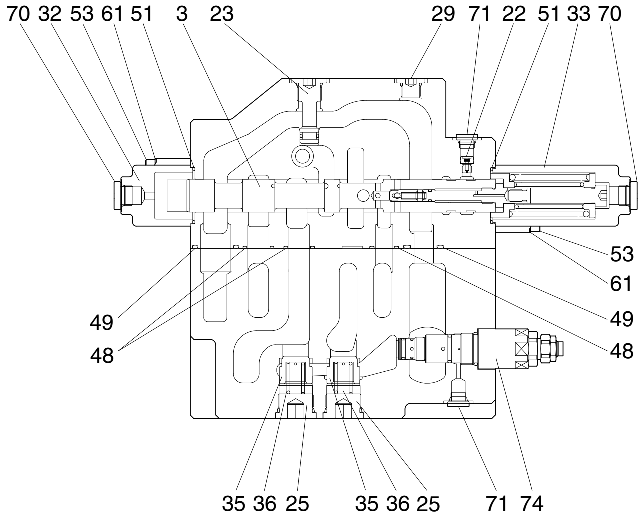
P1 BLOCK SPOOL SECTION



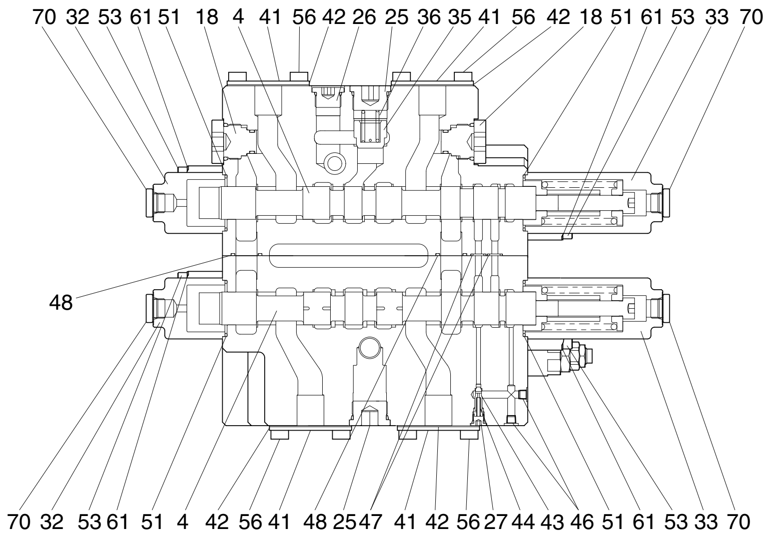
P2 BLOCK SPOOL SECTION

1	Housing P1
2	Housing P2
29	Plug kit
58	Socket bolt
59	Socket bolt
60	Socket bolt
63	Spring washer
64	Spring washer
65	Hexagon bolt
66	Cover 2
67	Gasket 2
69	Dust cap
70	Dust cap
71	Dust cap
72	Name plate
73	Rivet

D21072MC40



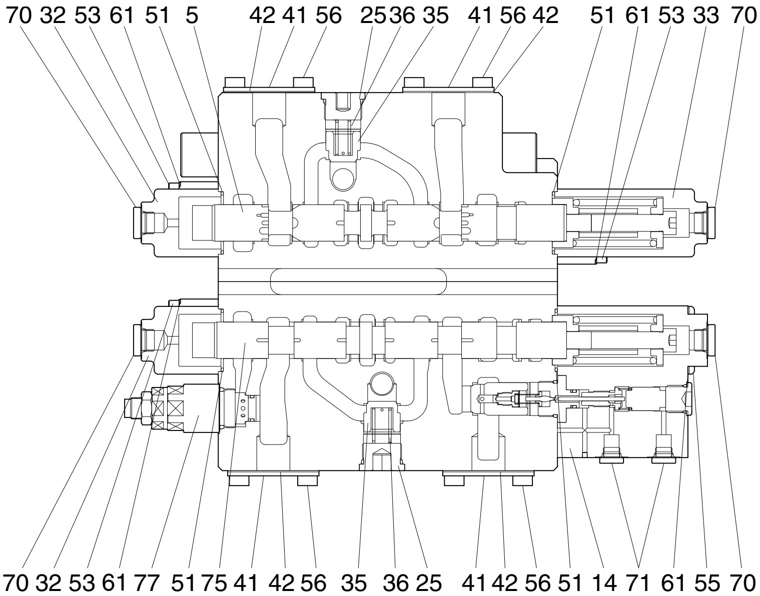
A-A ' (STRAIGHT-TRAVEL & SUPPLY)



B-B ' (TRAVEL RIGHT & LEFT)

D21072MC41

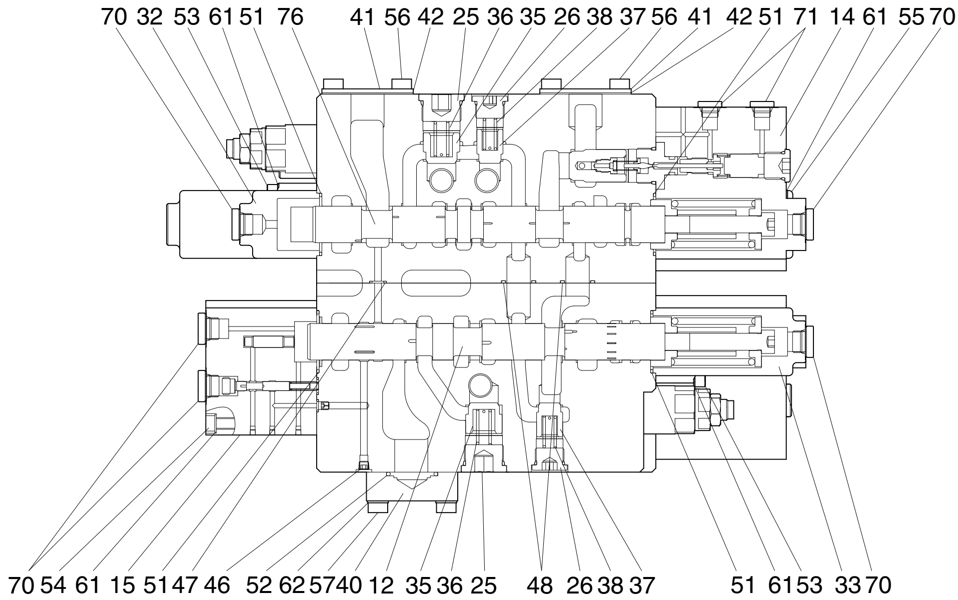
3	Spool assy
4	Spool assy
18	Overload R/V plug assy
22	Signal orifice assy
23	Parallel block plug assy
25	Load check plug kit
27	Plug kit
29	Plug kit
32	Pilot cover A
33	Pilot cover B1
35	Load check poppet 1
36	Load check spring 1
41	Cover 1
42	Gasket 1
43	Poppet signal
44	Spring signal
46	Plug
47	O-ring
48	O-ring
49	O-ring
51	O-ring
53	Socket bolt
56	Hexagon bolt
61	Spring washer
70	Dust cap
71	Dust cap
74	Main relief valve



C-C ' (SWING & BOOM)

D21072MC42

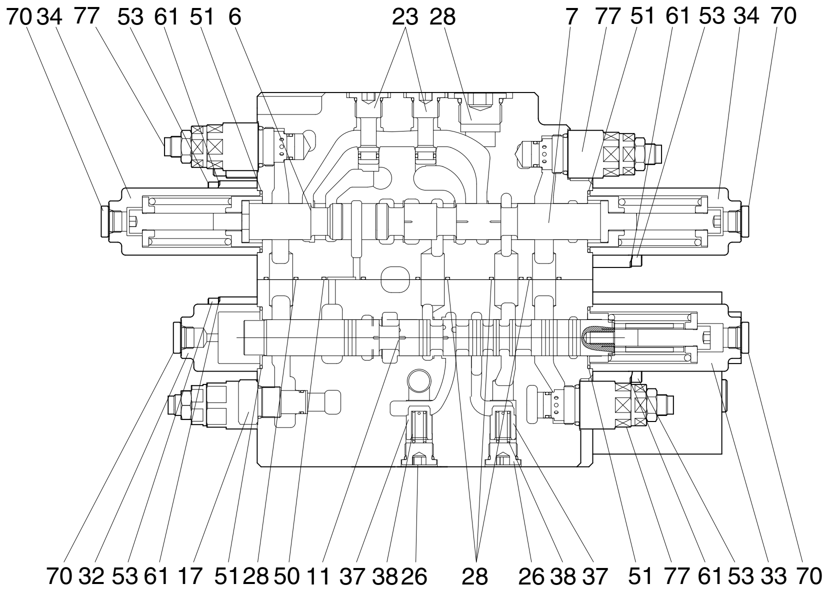
5	Swing spool assy	36	Load check spring 1	56	Haxagon bolt
14	Holding valve assy	41	Cover 1	61	Spring washer
25	Load check plug kit	42	Gasket 1	70	Dust cap
32	Pilot cover A	51	O-ring	71	Dust cap
33	Pilot cover B1	53	Socket bolt	75	Boom 1 spool
35	Load check poppet 1	55	Socket bolt	77	Overload R/V assy



E-E ' (ARM & ARM REGENRATION)

D21072MC44

12	Arm regen spool assy	38	Load check spring 2	54	Socket bolt
14	Holding valve assy	40	Flange	55	Socket bolt
15	Regen valve assy	41	Cover 1	56	Haxagon bolt
25	Load check plug kit	42	Gasket 1	57	Socket bolt
26	Load check plug kit	46	Plug	61	Spring washer
32	Pilot cover A	47	O-ring	62	Spring washer
33	Pliot cover B1	48	O-ring	70	Dust cap
35	Load check poppet 1	51	O-ring	71	Dust cap
36	Load check spring 1	52	O-ring	76	Arm 1 spool assy
37	Load check poppet 1	53	Socket bolt		



D-D ' (SWING PRIORITY & BOOM2 & ARM2)

D21072MC43

6	Swing PRI. spool assy	32	Pilot cover A	53	Socket bolt
7	Boom 2 spool assy	33	Pilot cover B1	61	Spring washer
11	Arm 2 spool assy	34	Pilot cover B2	70	Dust cap
17	Overload R/V plug assy	37	Load check poppet 2	75	Boom 1 spool assy
23	Parallel block plug assy	38	Load check spring 2	77	Overload R/V assy
26	Load check plug kit	50	O-ring		
28	Plug kit	51	O-ring		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) As hydraulic equipments, not only this valve are constructed precisely with very small clearances, disassembling and assembling must be carefully done in a clean place with preventing dusts and contaminants from entering.

(2) Prepare the section drawing and study the structure of MCV and then start disassembly work.

(3) When removing the control valve from the machine, install caps on every ports, and wash the outside of the assembly with confirming the existence of caps before disassembling.
Prepare a suitable table and some clean papers or rubber mat on the table for disassembling.

(4) If the components are left disassembled, they may get rust. Make sure to measure the greasing and sealing.

(5) For carrying the control valve, never hold with pilot cover or relief valve and overload relief valve and carefully treat the valves.

(6) Do not tap the valve even if the spool movement is not smooth.

(7) Several tests for such as relief characteristics, leakage, overload relief valve setting and flow resistance are required after re-assembling, and the hydraulic test equipments for those tests are needed.
Therefore, do not disassemble what cannot perform test adjustment, even if it can disassemble.

※ Be sure to observe the mark (※) description in the disassembly and assembly procedures.

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	26 and 32 (main relief valve)

3) DISASSEMBLY

(1) Removing spool

① **The case of the section without holding valve**

Instruction for removing the travel spool (for instance) is follows :

Remove two hex socket bolts by 5 ㎜ allen key wrench, then remove pilot cover.

※ Pay attention not to lose the O-ring under the pilot cover.

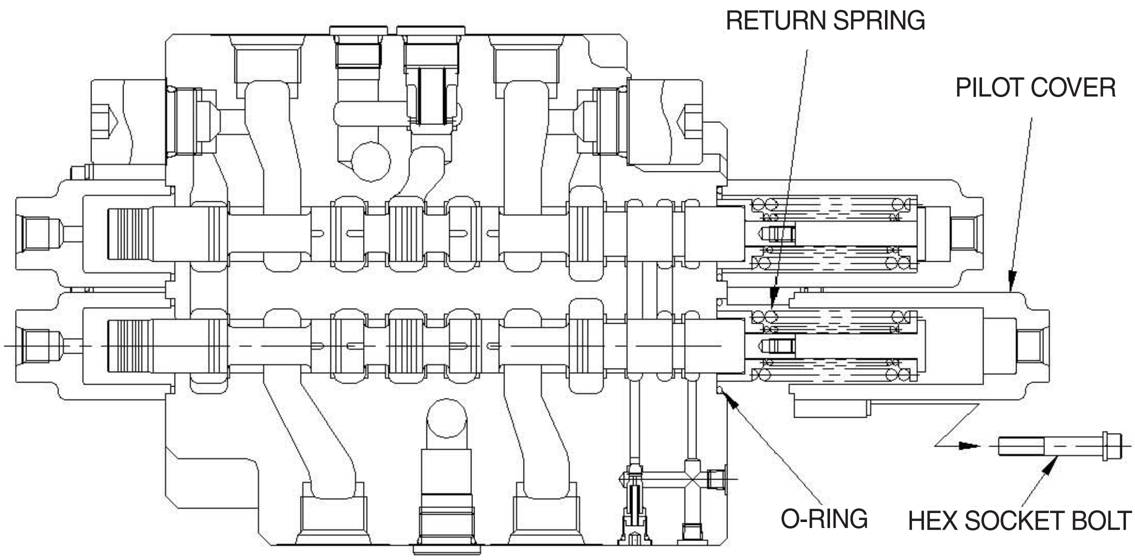
As the return spring portion of travel spool comes out, pull the spring straight slowly, by which spool assembly is removed.

※ The spools have to remove from the spring side.

Other spools (no lock valve type) can be removed in the same manner but the swing priority spool is reversed.

※ When spool replace, do not disassemble of a spool by any cases. Please replace by spool assembly.

※ Please attach using a tag etc. in the case of two or more kinds of spool replace, and understand a position.



D21072MC34

② **The case of the section with holding valve**

Instruction for removing the boom spool (for instance) is follows :

Remove five hex socket bolts with washer by 5 ㎜ allen key wrench. Then remove pilot cover with internal parts below figure.

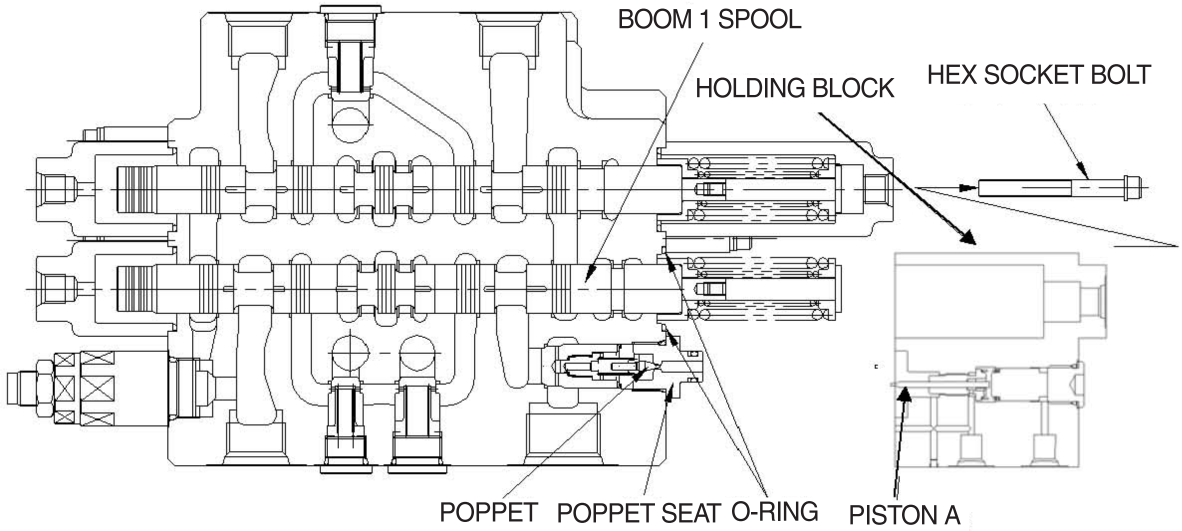
※ Be careful not to separate O-ring and poppet under pilot cover.

※ Pay attention not to damage the exposed piston A under pilot cover.

As the return spring portion of boom 1 spool comes out, pull the spring straight slowly, by which spool assembly is removed.

※ The spools have to remove form the spring side.

※ When spool replace, do not disassemble of a spool by any cases, please replace by spool assembly.



D21072MC35

(2) Removing holding valve

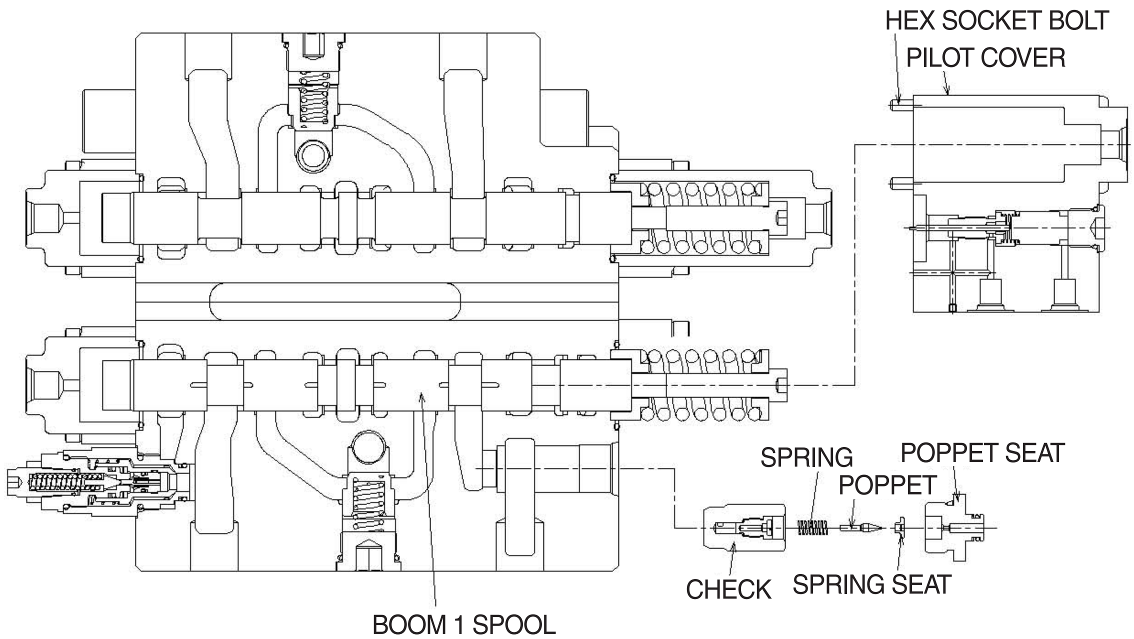
Remove the pilot cover with the holding valve as described on previous page.

※ Do not disassembled internal parts of the pilot cover.

Loosen the poppet seat by 26 ㎜ spanner and remove the poppet, the spring seat, the spring and the check in order.

※ Pay attention not to lose the poppet.

※ Do not disassembled internal parts of the check because the plug, functioning orifice, can damage easily.

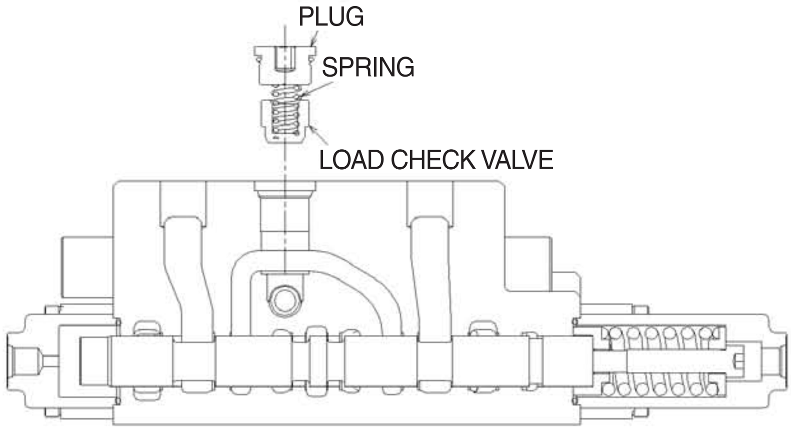


D21072MC36

(3) Removing load check valve and negative relief valve

① **The load check valve**

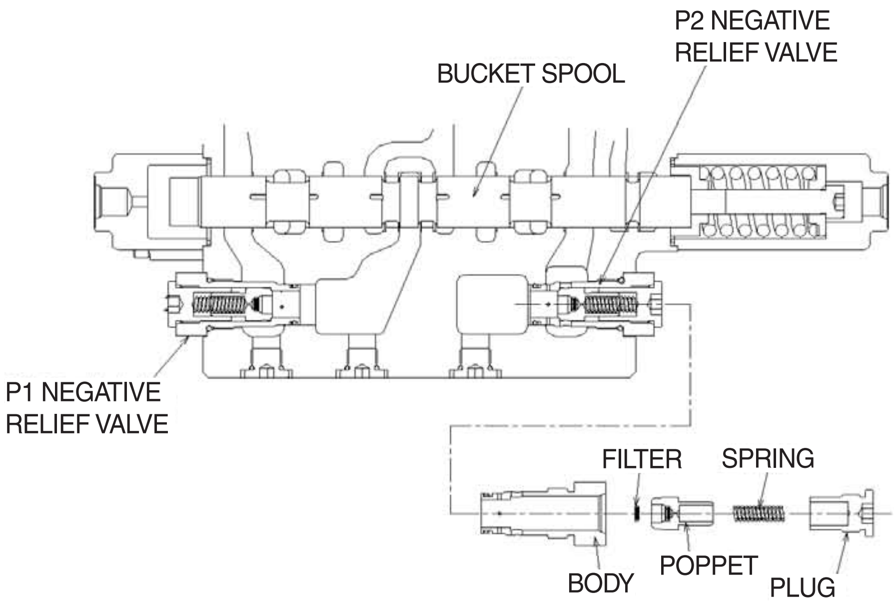
- Fix the body to suitable work bench. Loosen the plug by 10 mm allen key wrench.
- Remove the spring and the load check valve with pincers or magnet.



D21072MC37

② **The negative relief valve**

Loosen the socket by 12 mm allen key wrench.
Remove the spring, the spring holder, the piston and the negative control poppet.



D21072MC38

※ Do not disassemble the coin filter inside the negative control poppet because of forced fit.

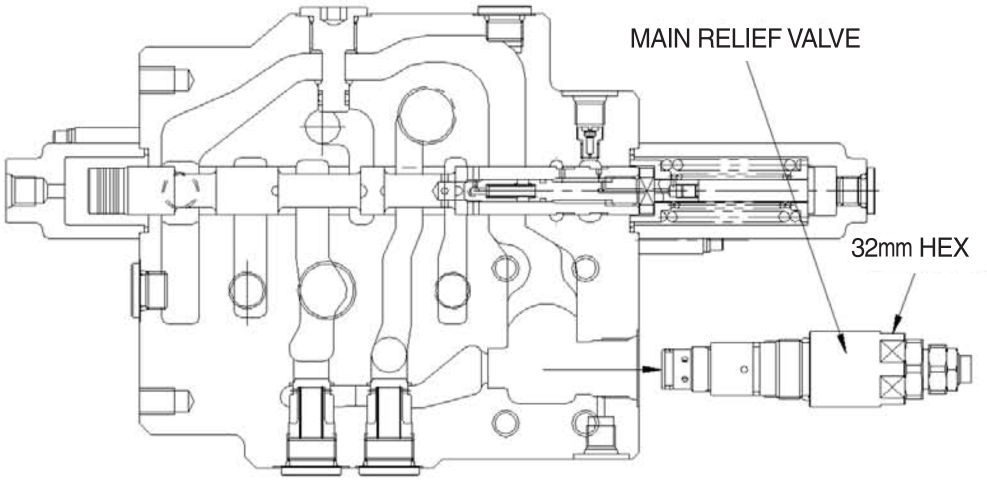
(4) Removing main relief valve and overload relief valve

Fix the valve body to suitable work bench. Remove the main relief valve by 32 ㎜ spanner and remove the overload relief valve 32 ㎜ spanner (standard) or 36 ㎜ spanner (optional).

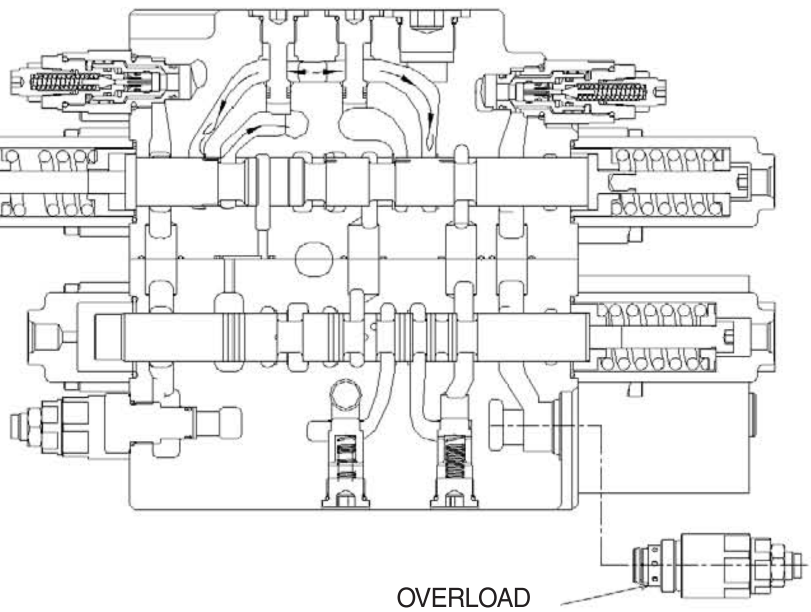
※ When disassembled, tag the relief valve for identification so that they can be reassembled correctly.

※ Pay attention not to damage seat face of disassembled main relief and overload relief valve.

※ Main relief and overload relief valve are very critical parts for performance and safety of the machine. Also, the pressure set is very difficult. Therefore, any abnormal parts are found, replace it with completely new relief valve assembly.



D21072MC39



D21072MC46

4) ASSEMBLY

(1) Precaution

① When you assemble, please wash all parts by pure cleaning liquid.
② For re-assembling, basically use only bland new seals for all portions.
③ Apply grease or hydraulic oil to the seals and seal fitting section to make the sliding smooth, unless otherwise specified.
④ Pay attention not to roll the O-ring when fitting and it may cause oil leakage.
⑤ Do not tap the valve even if the spool movement is not smooth.
⑥ Prepare the section drawing and study the structure of MCV and then start disassembly work.
⑦ Tighten bolt and parts with thread for all section by torque wrench to the respective tightening torque.

(2) Assembly

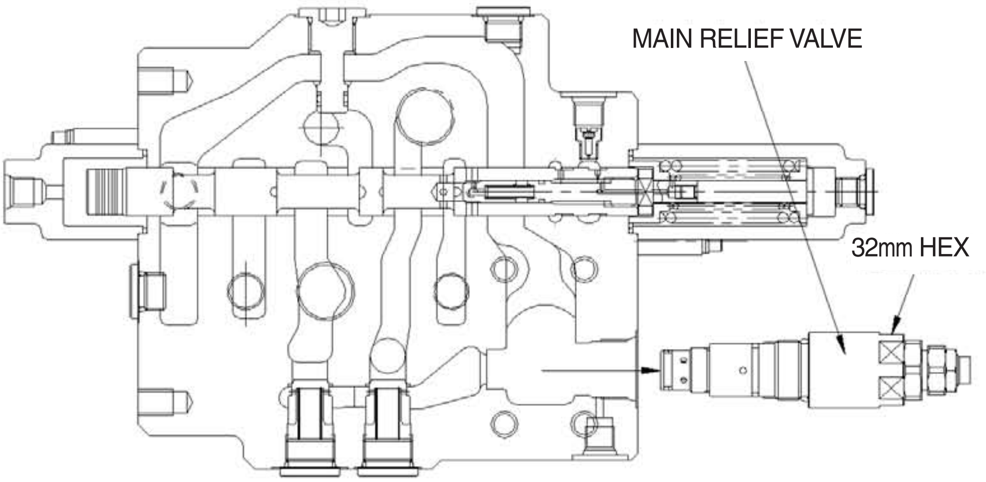
Explanation only is shown for the assembly, refer to the figures shown in the previous disassembly section.

① Main relief and overload relief valve

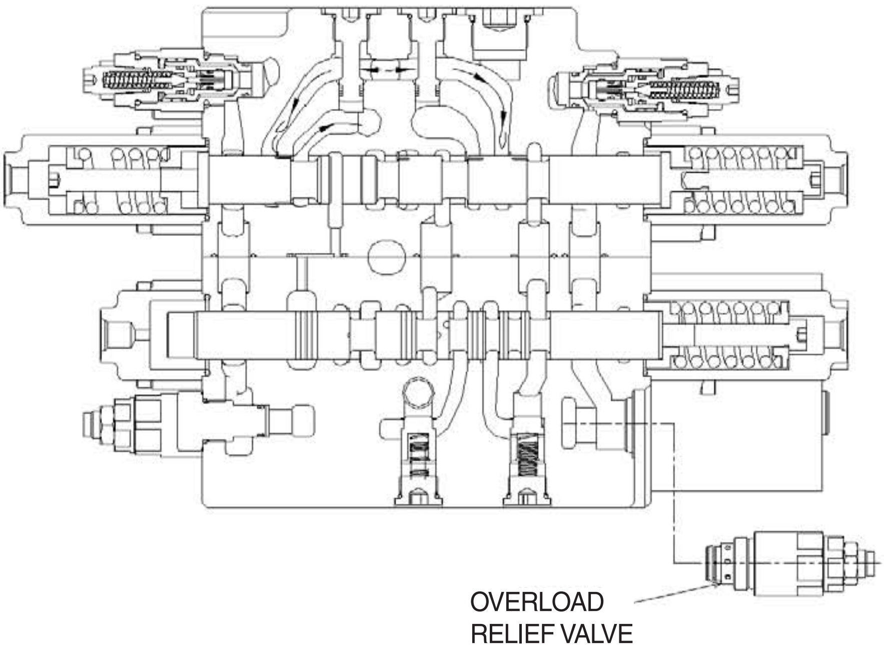
Fix the valve body to suitable work bench.

Install main relief valve and overload relief valve into the body and tighten to the specified torque by 32 mm torque wrench.

· Tightening torque : 8~9 kgf·m (57.8~65.1 lbf·ft)



D21072MC39



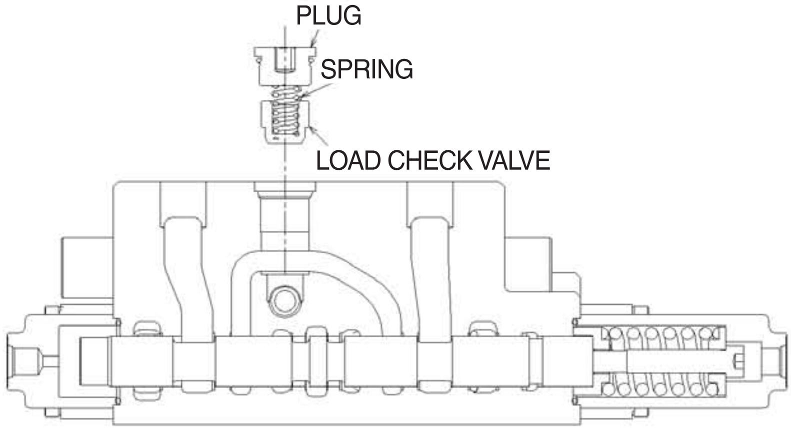
D21072MC46

② Load check valve

Assemble the load check valve and spring.

Put O-rings on to plug and tighten plug to the specified torque by 10 mm torque wrench.

· Tightening torque : 6~7 kgf·m (43.4~50.6 lbf·ft)

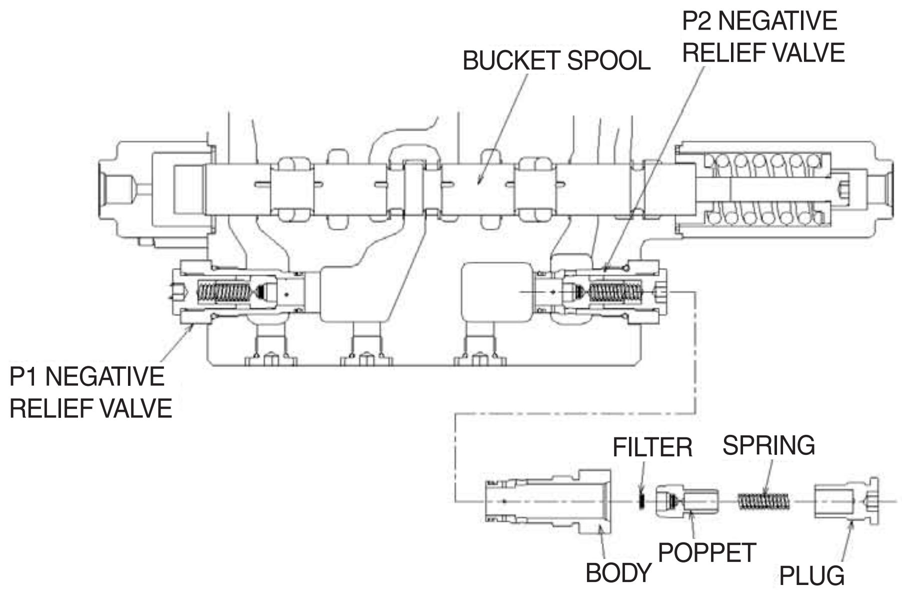


D21072MC37

③ Negative control relief valve

Assemble the nega-con poppet, piston, spring holder and spring into body in order and tighten the socket to the specified torque by 12 mm torque wrench.

· Tightening torque : 8~9 kgf·m (57.8~65.1 lbf·ft)



D21072MC38

④ Holding valves

Assemble the check, spring seat and poppet into the hole of valve body in order.

Tighten the poppet seat to the specified torque by 25 mm torque wrench.

· Tightening torque : 6~7 kgf·m (43.4~50.6 lbf·ft)

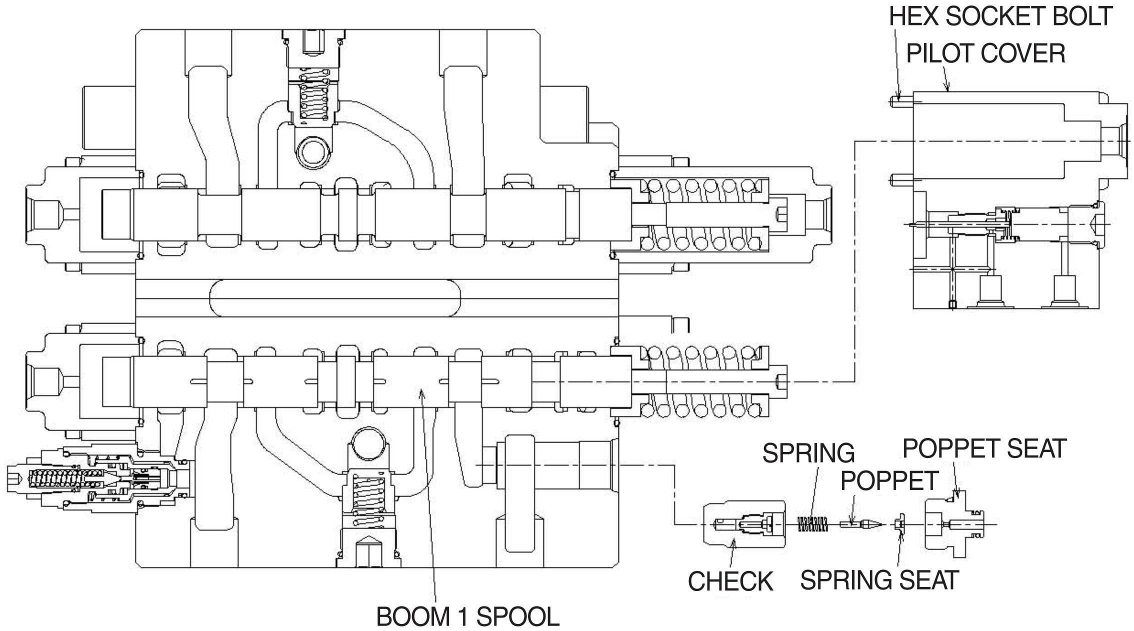
Fit the "piston A" under pilot cover with internal parts into hole on the poppet seat.

Tighten hexagon socket head bolt to specified torque by 5 mm torque wrench.

· Tightening torque : 1~1.1 kgf·m (7.2~7.9 lbf·ft)

※ Pay attention poppet not to separation.

※ Confirm that O-rings have been well fitted on the groove of body. (Apply grease on O-ring)



D21072MC36

⑤ Main spool

Put the spool position upward and fix it to the vise. Carefully insert the previously assembled spool assemblies into their respective bores within of body.

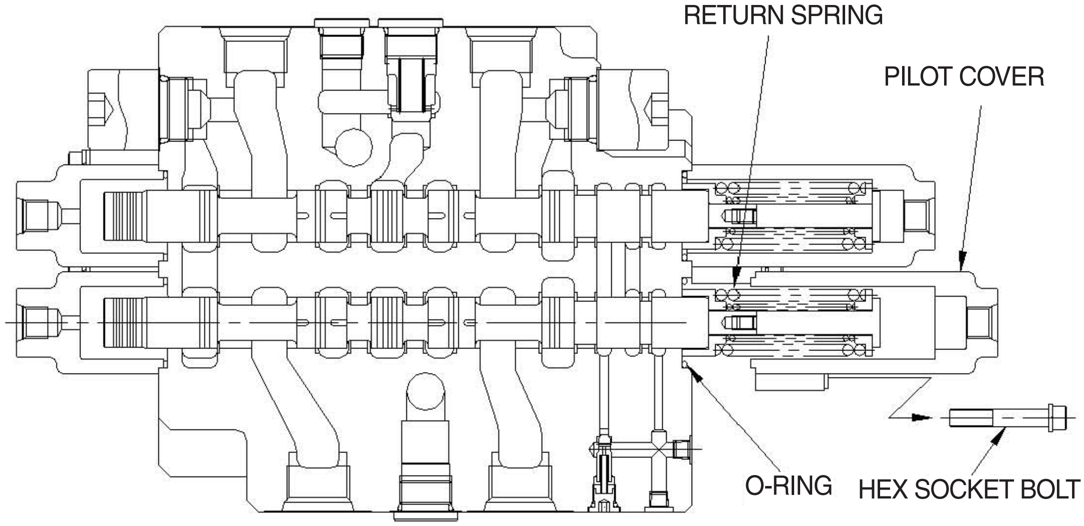
Fit spool assemblies into body carefully and slowly. Do not under any circumstances push them forcibly in.

Fit the pilot cover to the groove of the valve body.

Confirm that O-rings have been fitted on the groove of body. (Apply grease on O-ring)

Tighten the two socket bolt to the specified torque by 5 ㎜ torque wrench.

· Tightening torque : 1~1.1 kgf·m (7.2~7.9 lbf·ft)



D21072MC34

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

(4) Disconnect hose assembly(2).

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

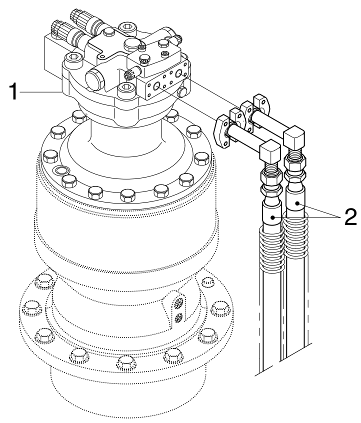
(6) Sling the swing motor assembly(1) and remove the swing motor mounting bolts (8).

· Motor device weight : 230kg(507lb)

(7) Remove the swing motor assembly.

※ When removing the swing motor assembly, check that all the piping have been disconnected.

13031GE18



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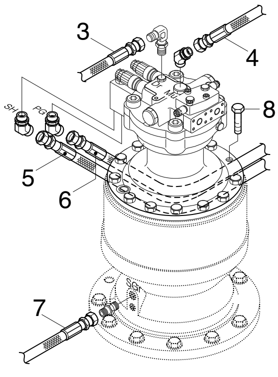


21078DA04

2) INSTALL

(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

② Pour in hydraulic oil until it overflows from the port.

③ Tighten plug lightly.

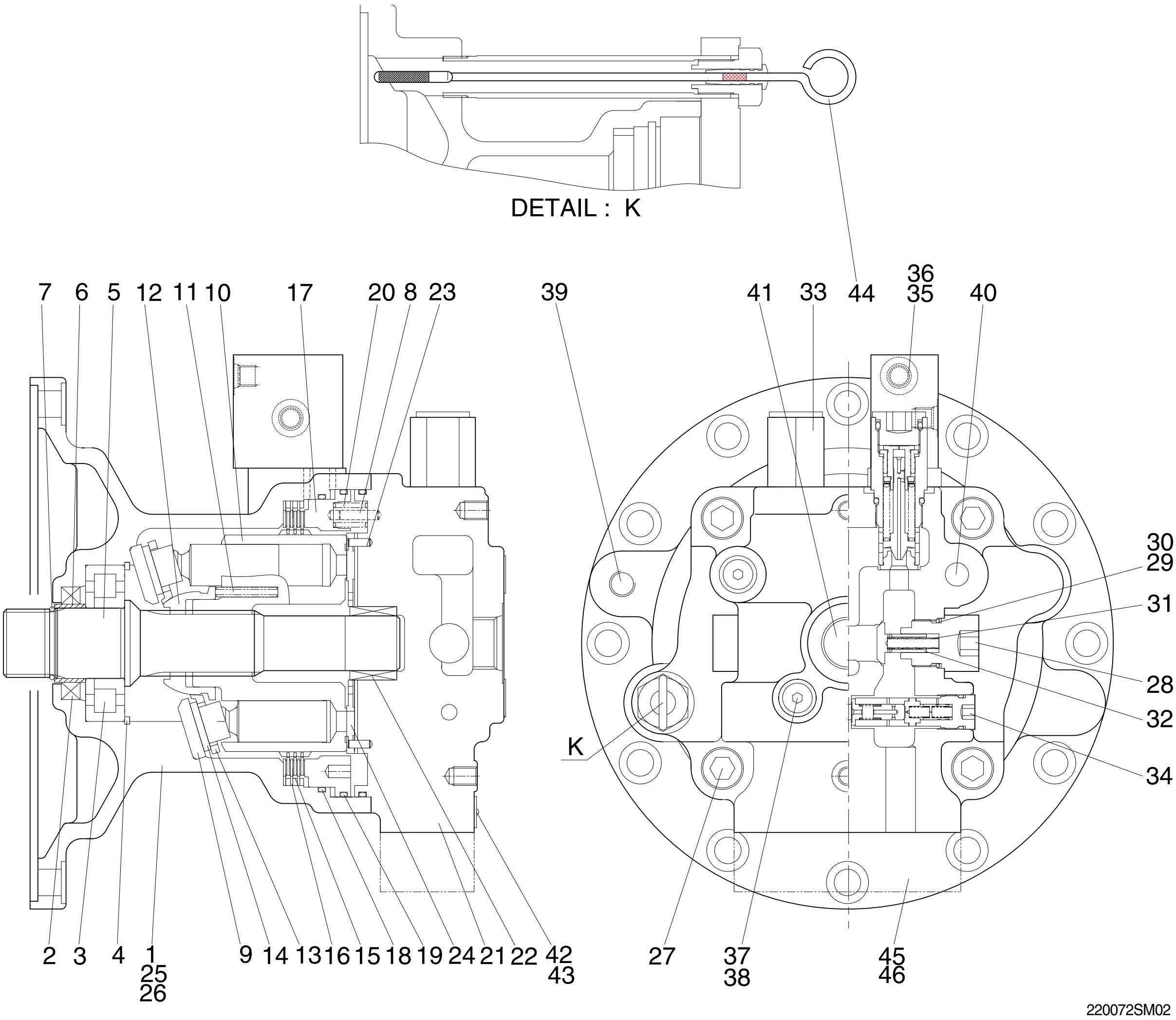
④ Start the engine, run at low idling and check oil come out from plug.

⑤ Tighten plug fully.

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

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE

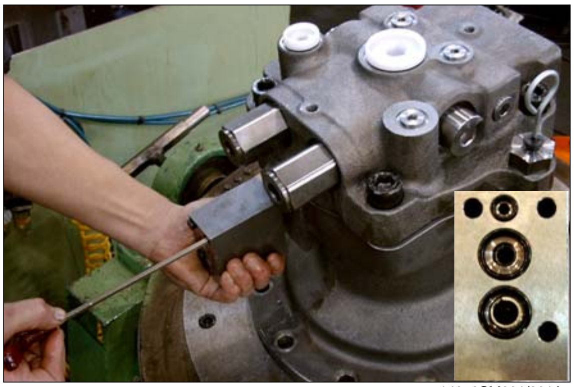


1	Body
2	Oil seal
3	Roller bearing
4	Snap ring
5	Shaft
6	Bushing
7	Stop ring
8	Pin
9	Shoe plate
10	Cylinder block
11	Spring
12	Ball guide
13	Set plate
14	Piston assy
15	Friction plate
16	Plate
17	Brake piston
18	O-ring
19	O-ring
20	Spring
21	Rear cover
22	Needle bearing
23	Pin
24	Valve plate
25	O-ring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

2) DISASSEMBLING

(1) Disassemble the sub of a TURNING AXIS

① Unloosing wrench bolt and disassemble time delay valve assy(35) from rear cover(21)



14078SM201/201A

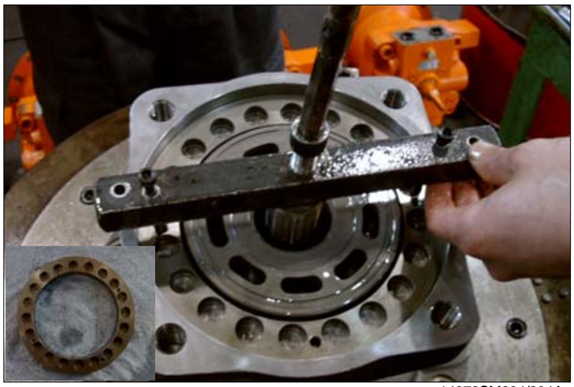
② Disassemble level gauge(44) from body (1).

14078SM202/202A

③ Hang rear cover(21) on hoist, unloose wrench bolt(27) and disassemble from body(1).

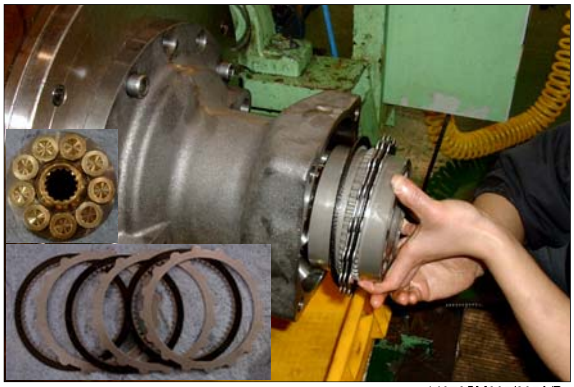
14078SM203/203A

④ Using a jig, disassemble break piston(17) from body(1).



14078SM204/204A

⑤ Disassemble respectively cylinder block assy, friction plate(15), plate(16) from body(1).



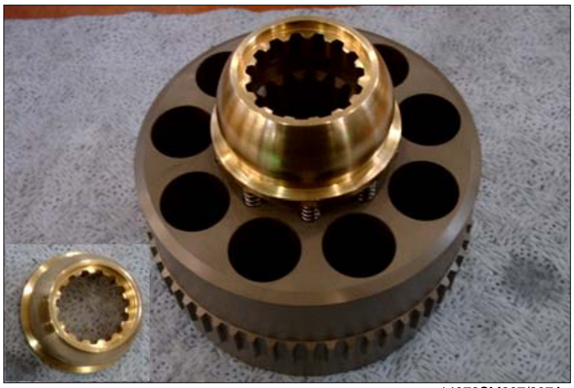
14078SM205/205A/B

(2) Disassemble cylinder block assy sub

① Disassemble piston assy(14), set plate (13) from cylinder block assy.

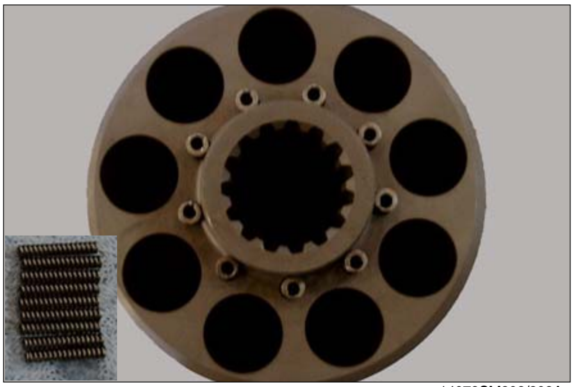
14078SM206/205B

② Disassemble ball guide(12) from cylinder block(10).



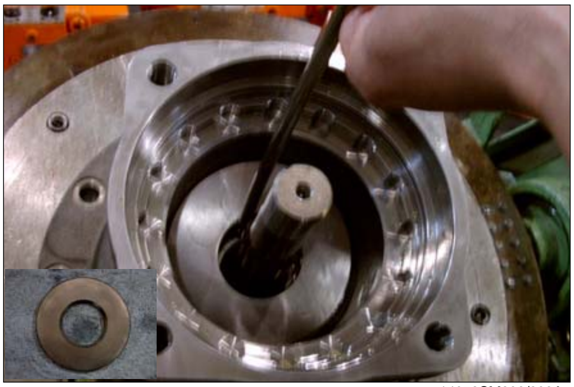
14078SM207/207A

③ Disassemble spring(11) from cylinder block(10).



14078SM208/208A

④ Disassemble shoe plate(9) from body(1).

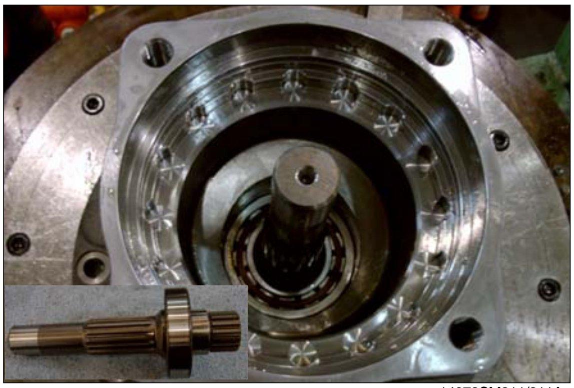


14078SM209/209A

⑤ Using a plier jig, disassemble snap ring (4) from shaft(5).

14078SM210/210A

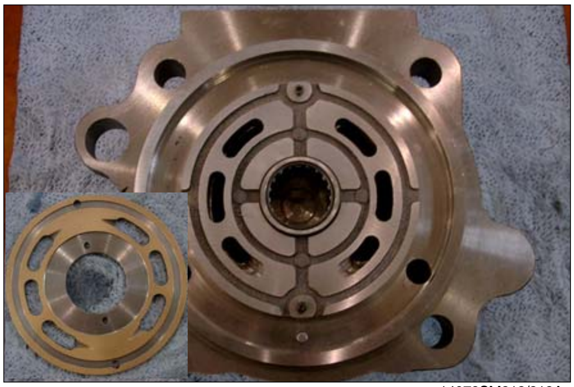
⑥ Disassemble shaft assy from body(1).



14078SM211/211A

(3) Disassemble rear cover assy sub

① Disassemble pin(8, 23), valve plate(24) from rear cover(21).

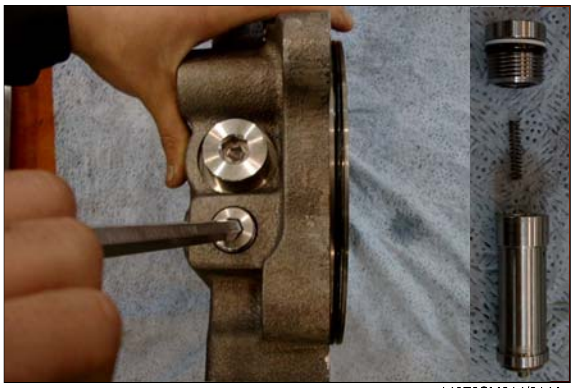


14078SM212/212A

② Using a torque wrench, disassemble relief valve assy(33) 2 set from rear cover(21).

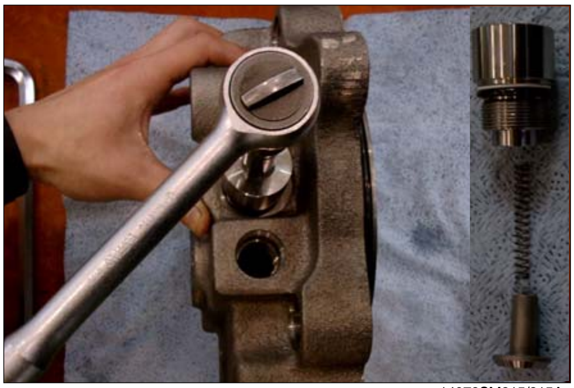
14078SM213/213A

③ After disassembling plug with a L-wrench from rear cover(21), disassemble respectively back up ring, O-ring, O-ring, spring, anti-inversion valve assy(34)



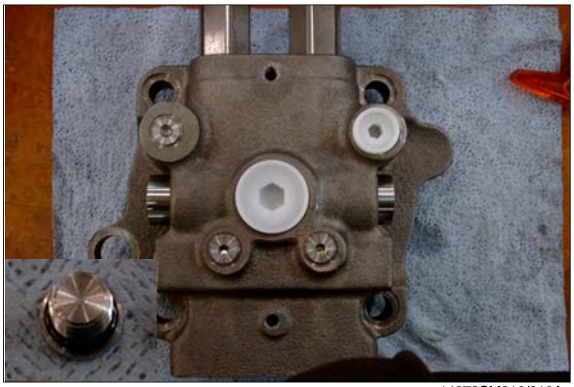
14078SM214/214A

④ Disassemble make up check valve assy with a torque wrench from rear cover(21).



14078SM215/215A

⑤ Disassemble respectively plug(37, 40, 41), with a L-wrench from rear cover(21).



14078SM216/216A

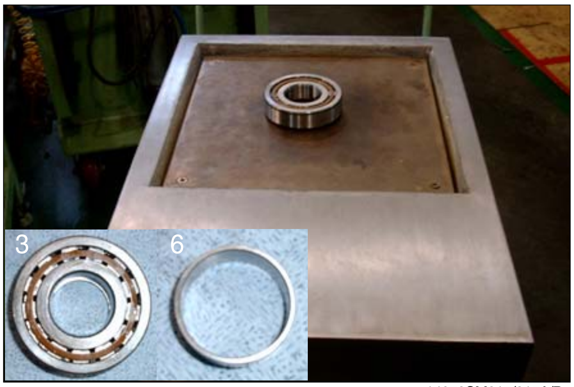
3) ASSEMBLING

(1) Assemble the sub of a turning axles

① Put roller bearing(3), bushing(6) on preheater and provide heat to inner wheel(compressing temp : 290°C for 2minutes)

· Roller bearing ×1EA

· Bushing× 1EA



14078SM217/217A/B

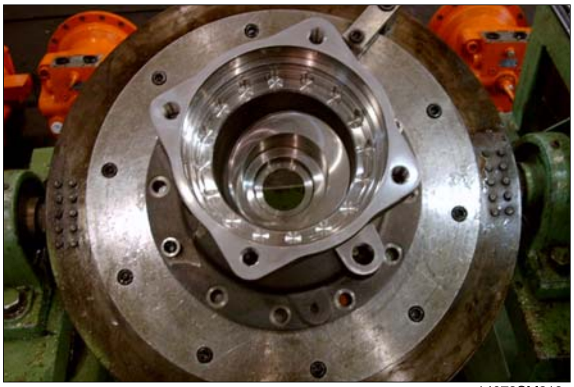
② After assembling and compressing preheated roller bearing(3), bushing(6) into shaft(5).

· Stop ring ×1EA

· Shaft× 1EA

14078SM218/218A/B

③ Put body(1) on a assembling jig, fix it with bolts to prohibit moving.

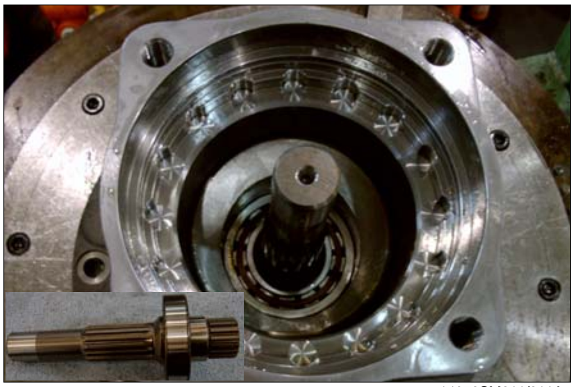


14078SM219

④ Using a compressing tool and steel stick, assemble oil seal(2) into body(1).
· Oil seal × 1EA

14078SM220/220A

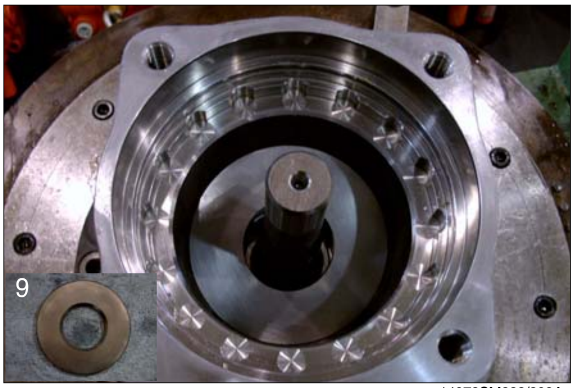
⑤ Insert above shaft sub into body(1) and assemble it with a steel stick.


14078SM211/211A

⑥ Fix snap ring(4) to shaft with a plier jig.
· Snap ring × 1EA

14078SM210/210A

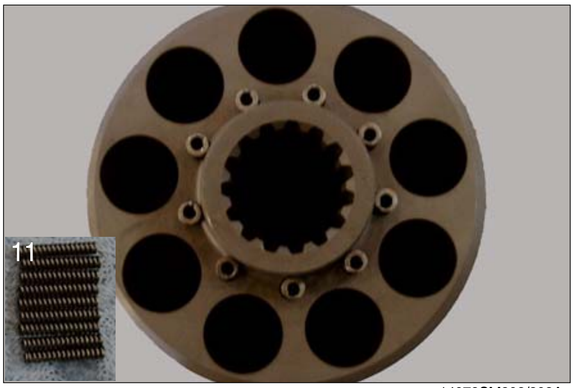
⑦ Spread grease on shoe plate(9) and assemble on the body.
· Shoe plate × 1EA



14078SM222/209A

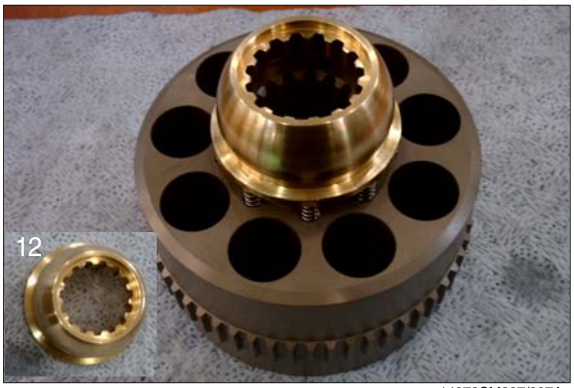
(2) **Assemble the sub of cylinder block assy**

① Assemble spring(11) 9 set into cylinder block(10).
- Spring ×9EA



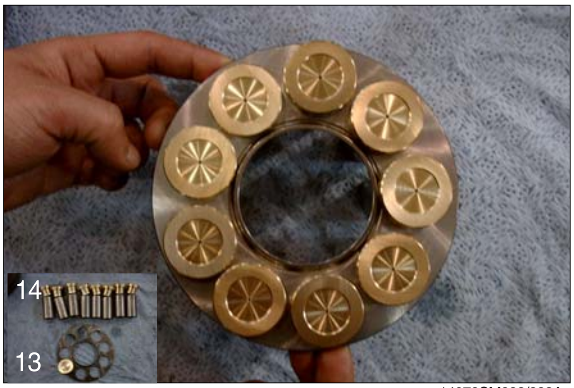
14078SM208/208A

② Assemble ball guide(12) into cylinder.
- Ball guide ×1EA



14078SM207/207A

③ Assemble piston assy(14) 9 set into set plate(13).
- Piston assy ×9EA
- SET plate ×1EA

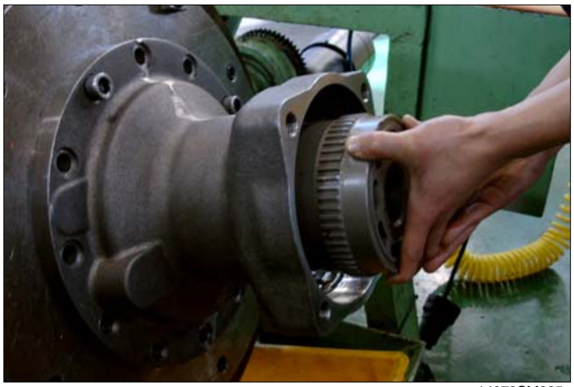


14078SM223/223A

④ Assemble above item ② and ③.

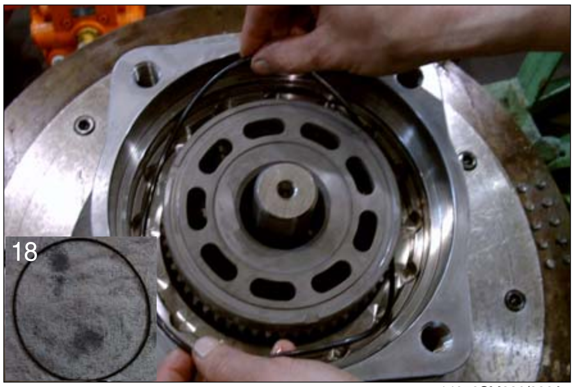

14078SM224

⑤ Assemble cylinder block assy into body (1).



14078SM225

⑥ Assemble O-ring(18) into body(1).
· O-ring ×1EA



14078SM226/226A

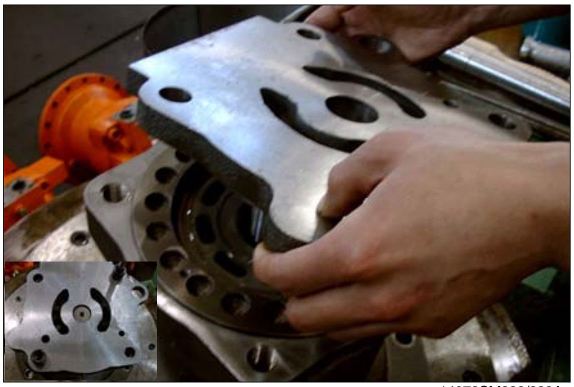
⑦ Assemble 3 set of plate(16), friction plate(15) respectively into body.
· Plate ×3EA
· Friction plate ×3EA

14078SM227/205A

⑧ Assemble O-ring(19) into break piston (17).
· O-ring ×2EA

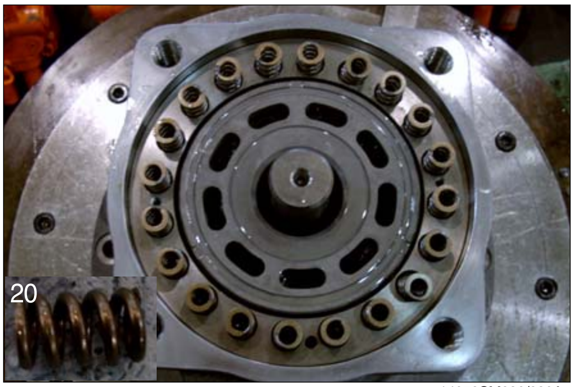
14078SM228/226A

⑨ Insert break piston assy into body(1) and compress it with a jig and hammer.



14078SM229/229A

⑩ Assemble spring(20)(20EA) into break piston(17).
 · Spring ×20EA



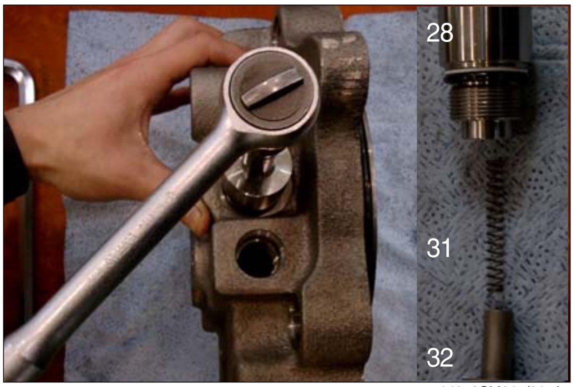
14078SM230/230A

(3) Assemble the sub of rear cover assy sub

① Assemble the sub of make up check valve assy.
Assemble O-ring(30), back up ring(29) into plug(28) with a O-ring assembling jig.
 · Plug×1EA
 · Back up ring×1EA
 · O-ring×1EA

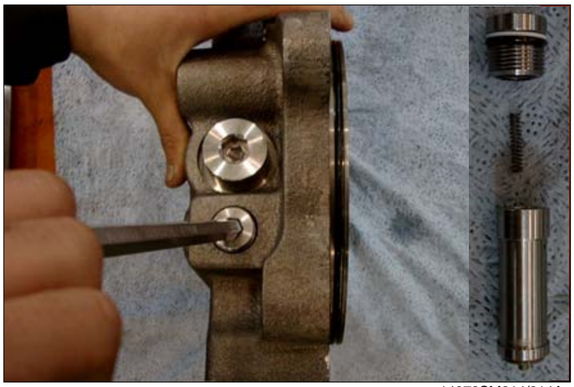
14078SM231/231A/B

② Assemble respectively make up check valve assy spring(31), check(32), plug(28) into rear cover(21) after then screw it torque wrench.
 · Make up check sub ×2set
 · Spring ×2EA
 · Check ×3EA

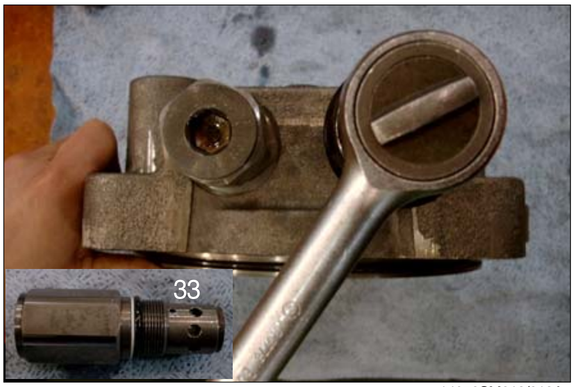


14078SM215/215A

③ Assemble respectively plug(47), back up ring, O-ring, O-ring, spring, anti-rotating valve assy(34) into rear cover(21).
(Bilateral symmetry assembling)
· Anti-Inversion v/v assy × 2set
· O-ring(P12) × 2EA
· O-ring(P18) × 2EA
· Back up ring(P18) × 2EA

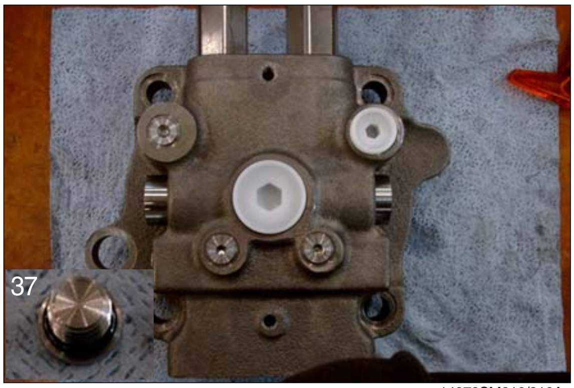

14078SM214/214A

④ Assemble relief valve assy(33) 2set into rear cover(21) with a torque wrench.
(Bilateral symmetry assembling)



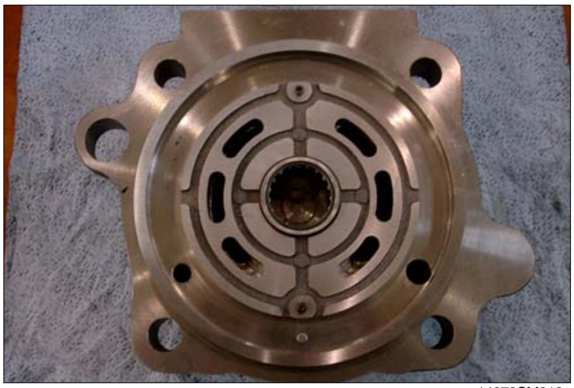
14078SM213/213A

⑤ Assemble plug(37), plug(40, 41) into rear cover(21) with a L-wrench.
* Plug × 3EA(PF1/4)



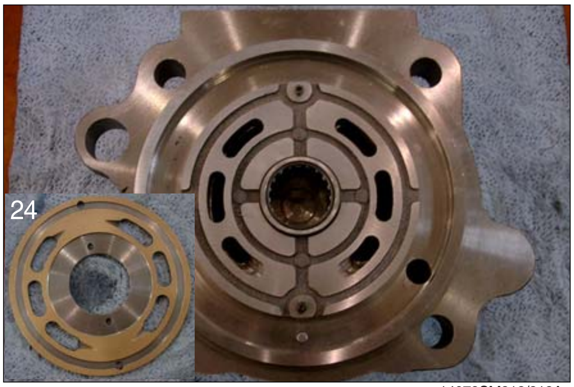
14078SM216/216A

⑥ After assembling needle bearing(22) into rear cover(21), with a hammer assemble pin(8, 23).
* Pin × 1EA
* Pin × 2EA


14078SM212

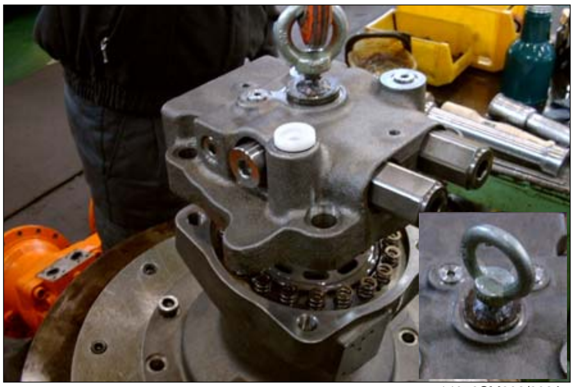
⑦ Spreading grease on valve plate(24), assemble into rear cover(21).

· Valve plate × 1EA



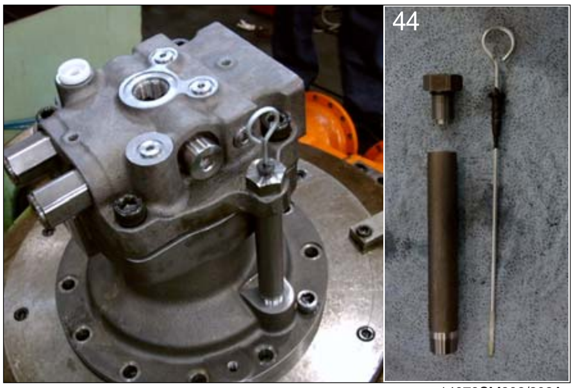
14078SM212/212A

⑧ Lift up rear cover assy on body(1) by a crane and assemble it with a wrench bolt(27).



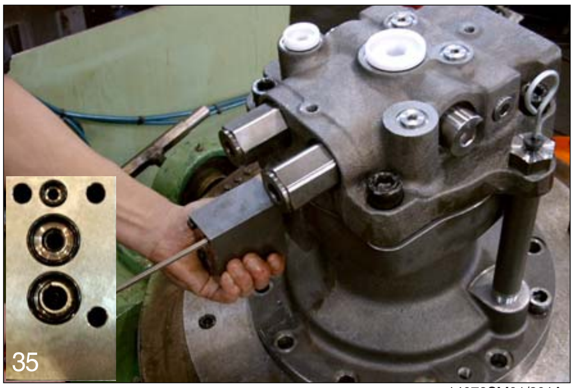
14078SM203/203A

⑨ Assemble level gauge(44) into body(1).



14078SM202/202A

⑩ Assemble time delay valve assy(35) into rear cover(21) with a wrench bolt(36).



14078SM01/201A

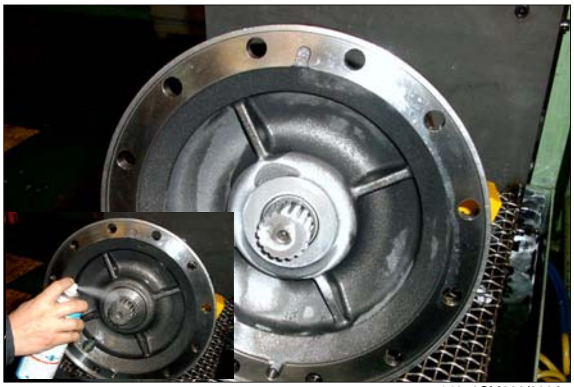
(4) Air pressing test

Be sure of leakage, after press air into assembled motor

14078SM232

(5) Leakage check

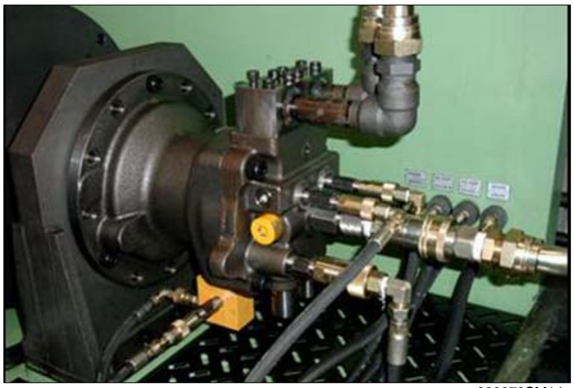
After cleaning motor by color check No.1, paint No.3 and be sure of leakage.



14078SM233/233A

(6) Mount test bench

Mounting motor test bench, test the availability of each part.



220078SM14

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

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

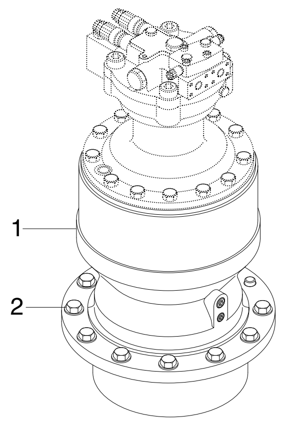
(2) Sling reduction gear assembly(1) and remove mounting bolts(2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 180kg (396lb)

13031GE18

2) INSTALL

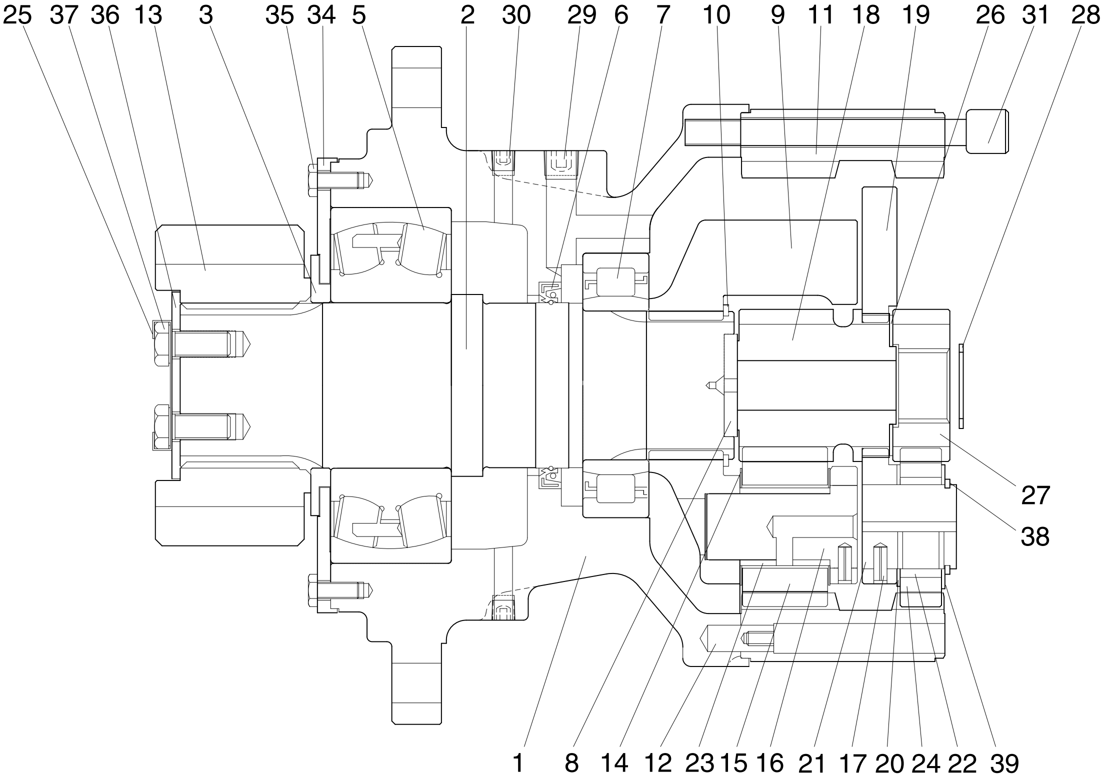
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 49.2~66.6kgf · m (356~481lbf · ft)



21078DA05

4. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



220072SF05A

1	Casing	14	Thrust washer	26	Side plate 3
2	Drive shaft	15	Planet gear 2	27	Sun gear 1
3	Spacer	16	Pin & bushing	28	Stop ring
5	Roller bearing	17	Spring pin	29	Plug
6	Oil seal	18	Sun gear 2	30	Plug
7	Roller bearing	19	Carrier 1	31	Socket bolt
8	Thrust plate	20	Side plate 1	34	Cover plate
9	Carrier 2	21	Pin 1	35	Hexagon bolt
10	Stop ring	22	Needle cage	36	Lock plate
11	Ring gear	23	Bushing 2	37	Hexagon bolt
12	Knock pin	24	Planet gear 1	38	Stop ring
13	Pinion gear	25	Lock washer	39	Side plate 2

2) DISASSEMBLY

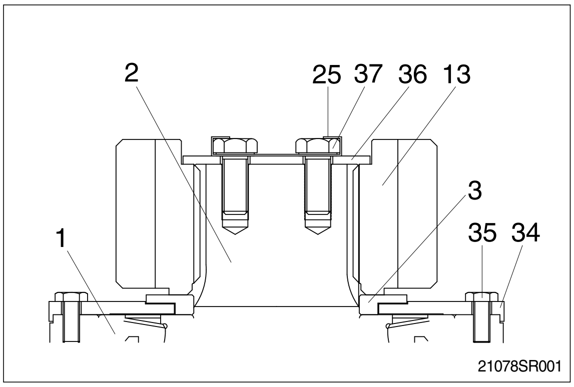
(1) Spread off the 4 corners of lock washer (25) with a tool.

※ Do not reuse lock washer(25).

Loosen the bolts(37) and then remove lock washer(25) and lock plate (36) from the pinion gear(13).

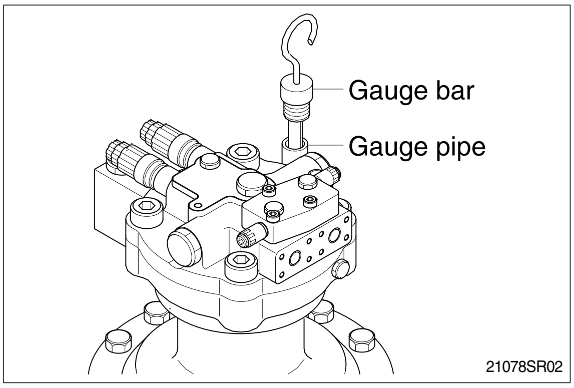
Remove pinion gear(13) and spacer(3) from the drive shaft(2).

Remove cover plate(34) from the casing (1) by loosening the hexagon bolts (35).

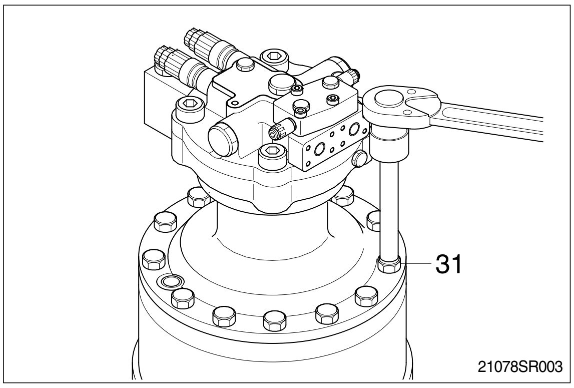


(2) Remove gauge bar and gauge pipe from the swing motor casing.

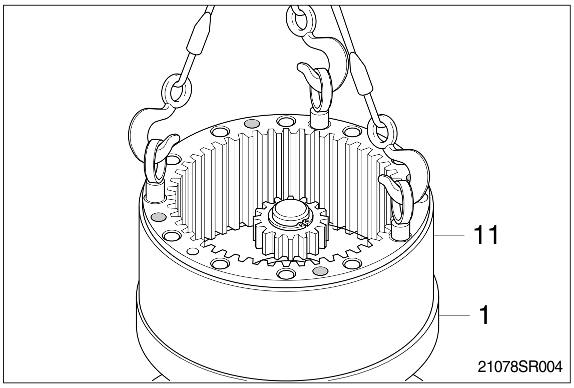
※ Pour the gear oil out of reduction gear into the clean bowl to check out the friction decrease.



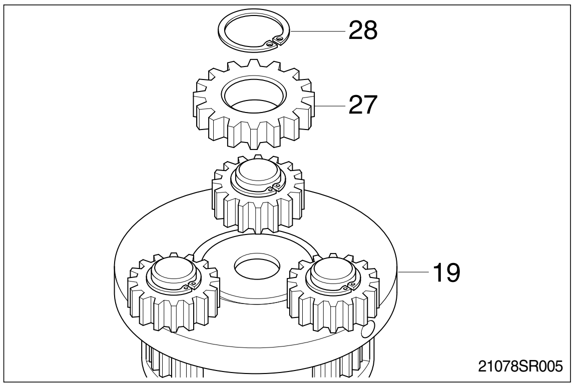
(3) Loosen the socket bolts(31) to separate swing motor from reduction gear.



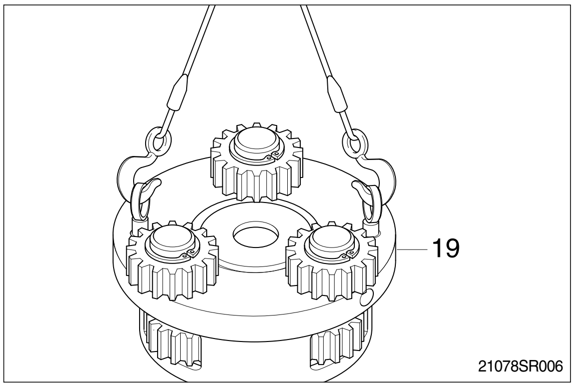
(4) Tighten 3 M16 eye bolts to the ring gear (11) and then lift the ring gear(11) out of the casing(1).



(5) Remove stop ring(28) and then sun gear1 (27).



(6) Tighten two M10 eye bolts to carrier1(19) and lift up and remove carrier1(19) as subassembly.



(7) Disassembling carrier1(19) assembly.

① Remove stop ring(38).

② Remove side plate2(39), planet gear1 (24), needle cage(22), side plate1(20) and side plate3(26) from the carrier.

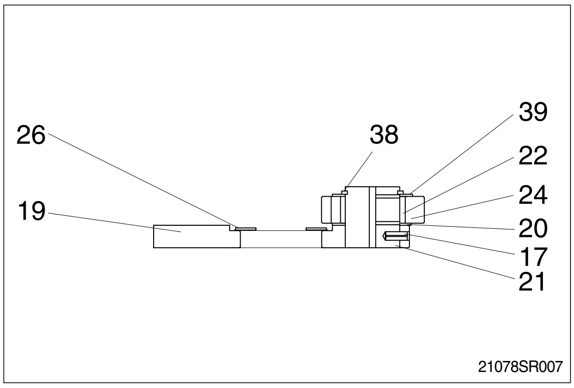
③ Using M8 solid drill, crush spring pin(17) so that the pin1(21) can be removed by hammering.

④ Remove side plate3(26) from carrier1(19).

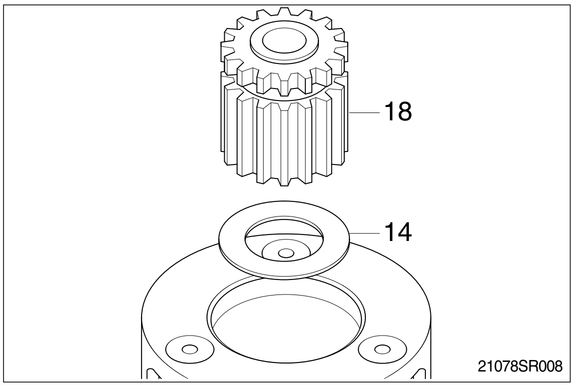
※ Do not reuse spring pin(17).

※ Do not remove pin1(21), carrier1(19) and spring pin(17) but in case of replacement.

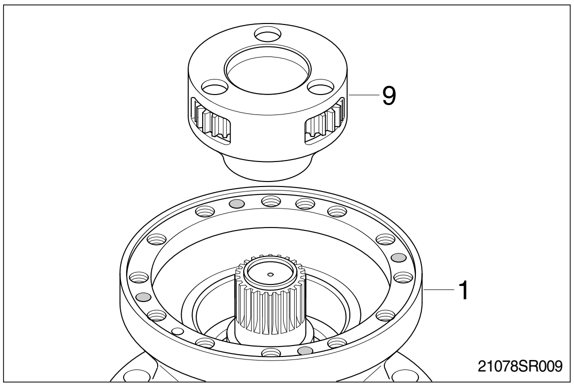
※ Put matching marks on the planet gear1 (24) and the pin1(21) for easy reassembly.



(8) Remove sun gear2(18) and thrust washer (14).

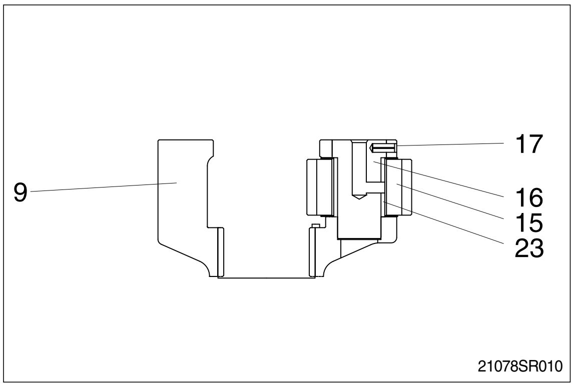


(9) Remove carrier2(9) assembly from casing (1).

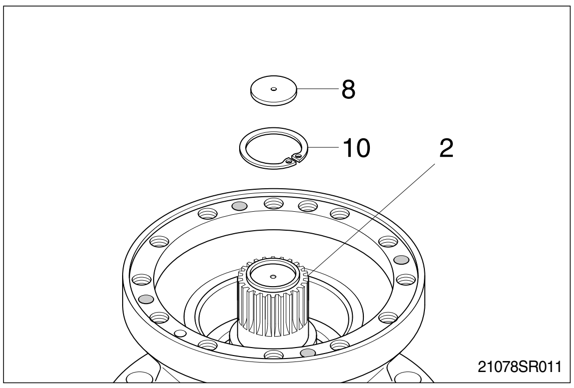


(10) Disassembling carrier2(9) assembly

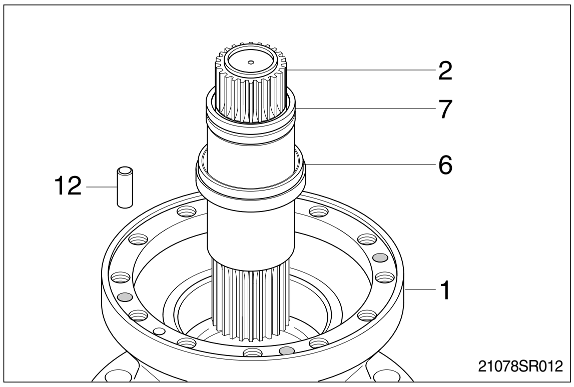
① Using M8 solid drill, crush spring pin(17) so that the pin & bushing(16) can be
※ removed.
② Do not reuse spring pin(17).
Remove pin & bushing(16), planet
※ gear2(15) and bush2(23) from the carrier2(9).
※ Put matching marks on the planet gear2 (15) and the pin & bushing(16) for easy reassembly.
Do not disassemble pin & bushing(16), carrier2(9) and spring pin(17) but in case of replacement.



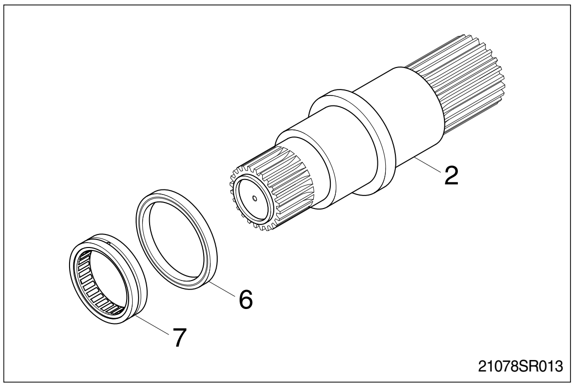
(11) Remove thrust plate(8) and stop ring (10) from the drive shaft(2).



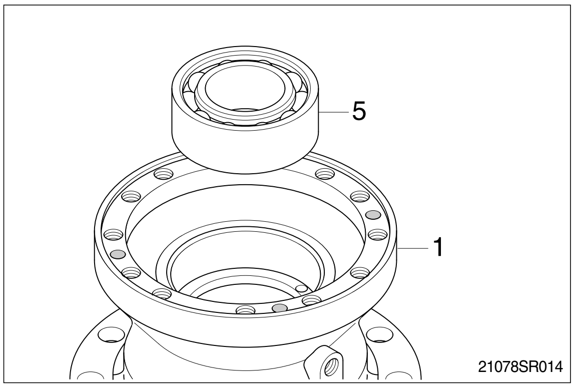
(12) Remove drive shaft(2) with roller bearing(7) and oil seal(6) assembled.
Remove knock pin(12) from the casing(1).



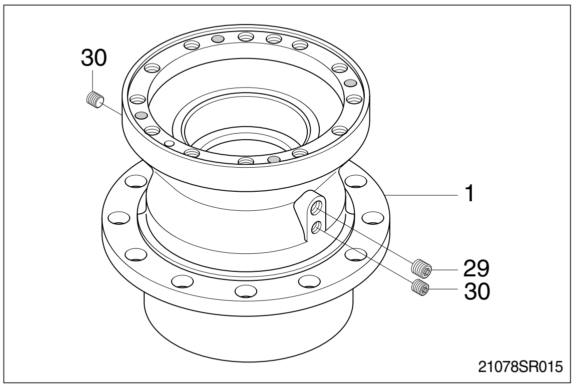
(13) Remove roller bearing(7) and oil seal(6) from the drive shaft(2).
※ Do not reuse oil seal(6) once removed.



(14) Using the bearing disassembly tool, remove roller bearing(5).

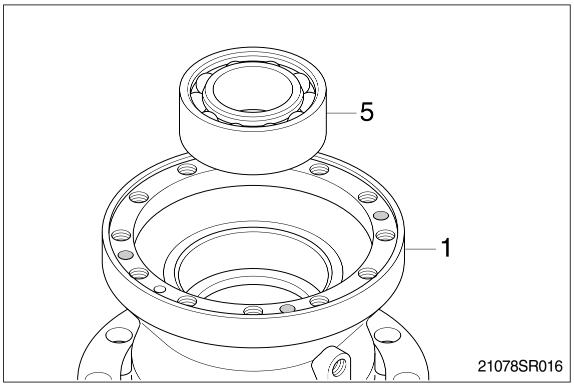


(15) Remove plugs(29, 30) from the casing(1).

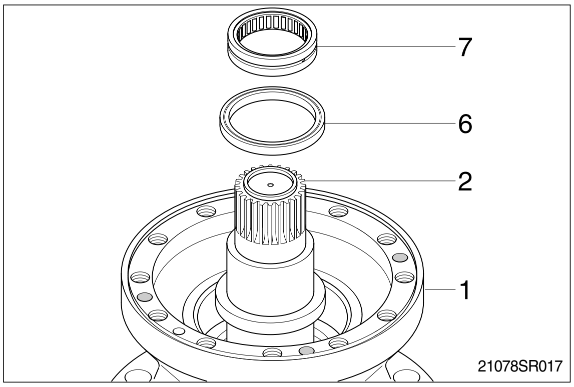


3) ASSEMBLY

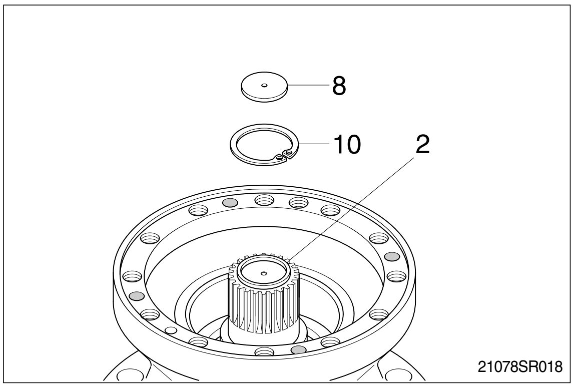
(1) Assemble roller bearing(5) inside the casing(1).



(2) Assemble the drive shaft(2) into the casing(1) and then install oil seal(6) and roller bearing(7).



(3) Install stop ring(10) and thrust plate(8) on top of drive shaft(2).



(4) Assembling carrier2(9) assembly.

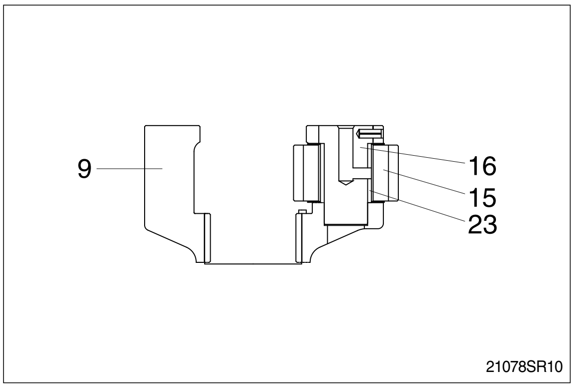
① Install thrust washer(14) inside the carrier2 (9).

② Install bushing2(23) inside the planet gear2 (15) and then assemble them to the carrier2(9).

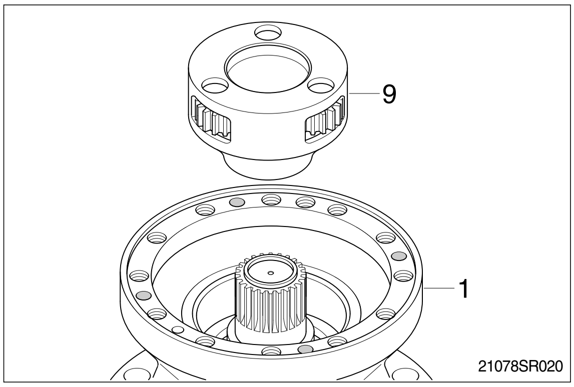
③ Assemble the pin & bushing(16) to the carrier2(9) and then press the spring pin(17) by hammering.

④ Punch 2 points of the spring pin(17) lip.

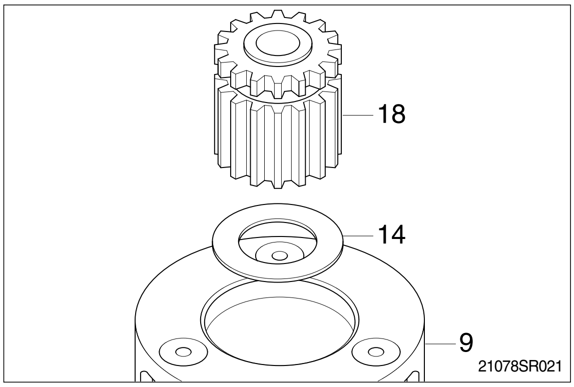
※ Take care not to mistake the matching marks of each part.



(5) Assemble carrier2(9) assembly correctly to the drive shaft(2).



(6) Assemble sun gear2(18) and thrust washer(14) to the center of the carrier2(9) assembly.



(7) Assembling carrier1(19) assembly.

① Assemble the pin1(21) to the carrier1(19) and then press the spring pin(17) by hammering.

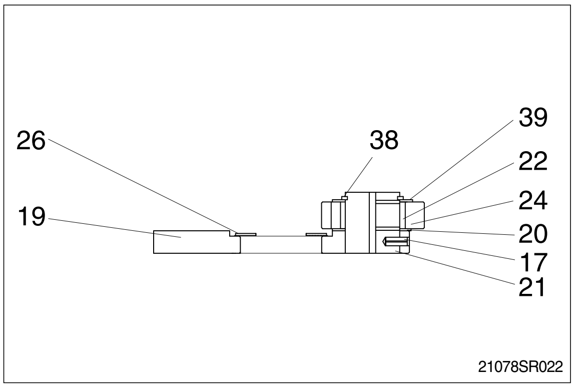
② Punch 2 points of the spring pin's(17) lip.

③ Install side plate3(26) onto the center of carrier1(19).

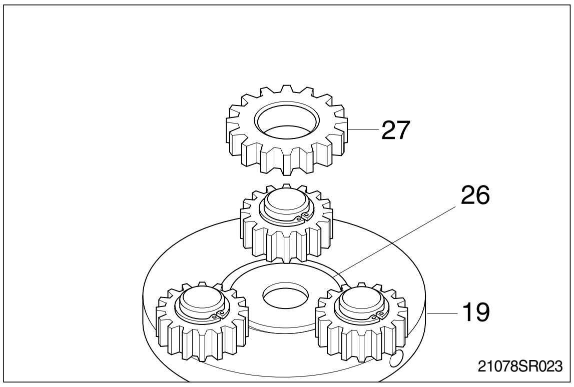
④ Install needle cage(22) into the planet gear1(24).

⑤ Assemble side plate(20), planet gear1 (24), side plate2(39) and then stop ring (38) to the pin1(21).

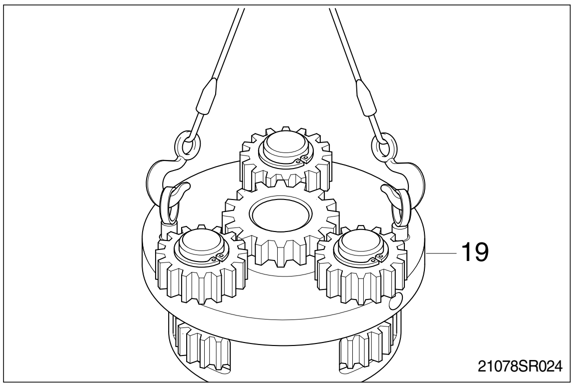
※ Take care not to mistake the matching marks of each part.



(8) Install sun gear1(27) onto the side plate3 (26).



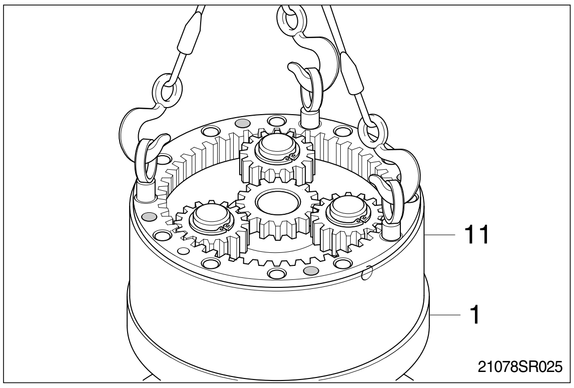
(9) Assemble carrier1(19) assembly onto the carrier2 assembly.



(10) Apply loctite to the tapped holes of casing (1).

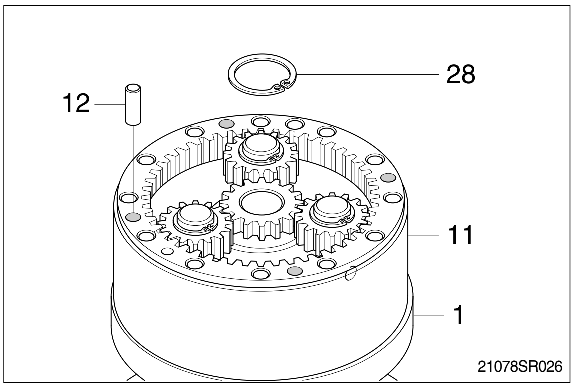
(11) Tighten 3 M16 eye bolts to the ring gear(11) and lift up and then assemble it onto the casing(1).

※ Don't fail to coincide the knock pin(12) holes.



(12) Hammer 4 knock pins(12) around the ring gear(11).

(13) Assemble stop ring(28) to the drive shaft of the swing motor.

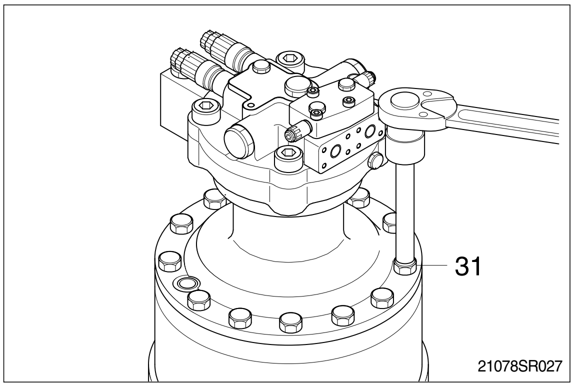


(14) Apply loctite to the tapped holes of the ring gear(11) and then mount swing motor onto the ring gear(11).

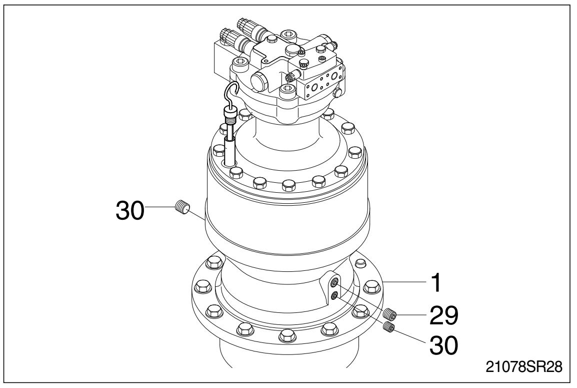
※ Don't fail to coincide the gauge bar(33) hole.

(15) Tighten socket bolts(31) around the swing motor assembly.

· Tightening torque : 24kgf · m(173lbf · ft)



(16) Assemble plugs(29, 30).



(17) Turn the swing motor assembly upside down and assemble cover plate(34) by tightening the hexagon bolts(35).

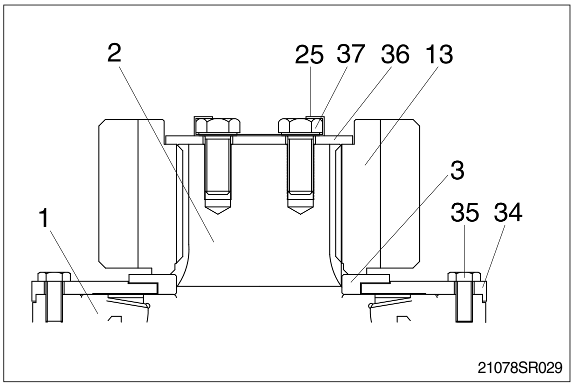
Install spacer(3) and pinion gear(13) to the drive shaft(2).

Assemble lock plate(36) on the pinion gear(13).

Assemble 2 lock washers(25) on the lock plate(36) with their 2 hole coincided individually to the tapped holes of drive shaft(2).

Tighten hexagon bolts(37) to the drive shaft(2) and then fold all the lock washer(25) corners over the hexagon bolts(37).

· Tightening torque : 24kgf · m(173lbf · ft)



(18) Inject oil into the reduction gear.

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

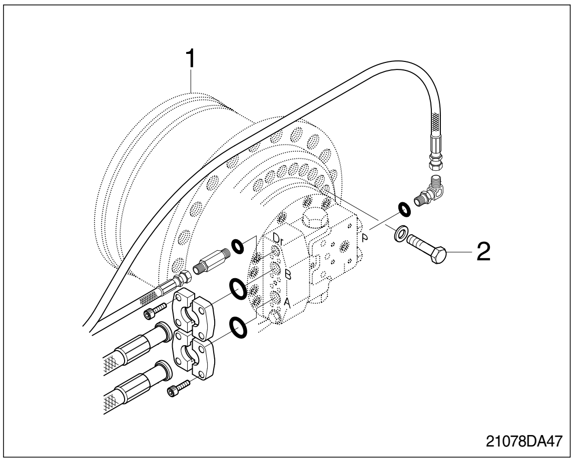
(1) Swing the work equipment 90° and lower it completely to the ground.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.



(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly**.

(5) Remove the cover.

(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly(1).

(9) Remove the mounting bolts(2), then remove the travel device assembly.
· Weight : 300kg(660lb)

2) INSTALL

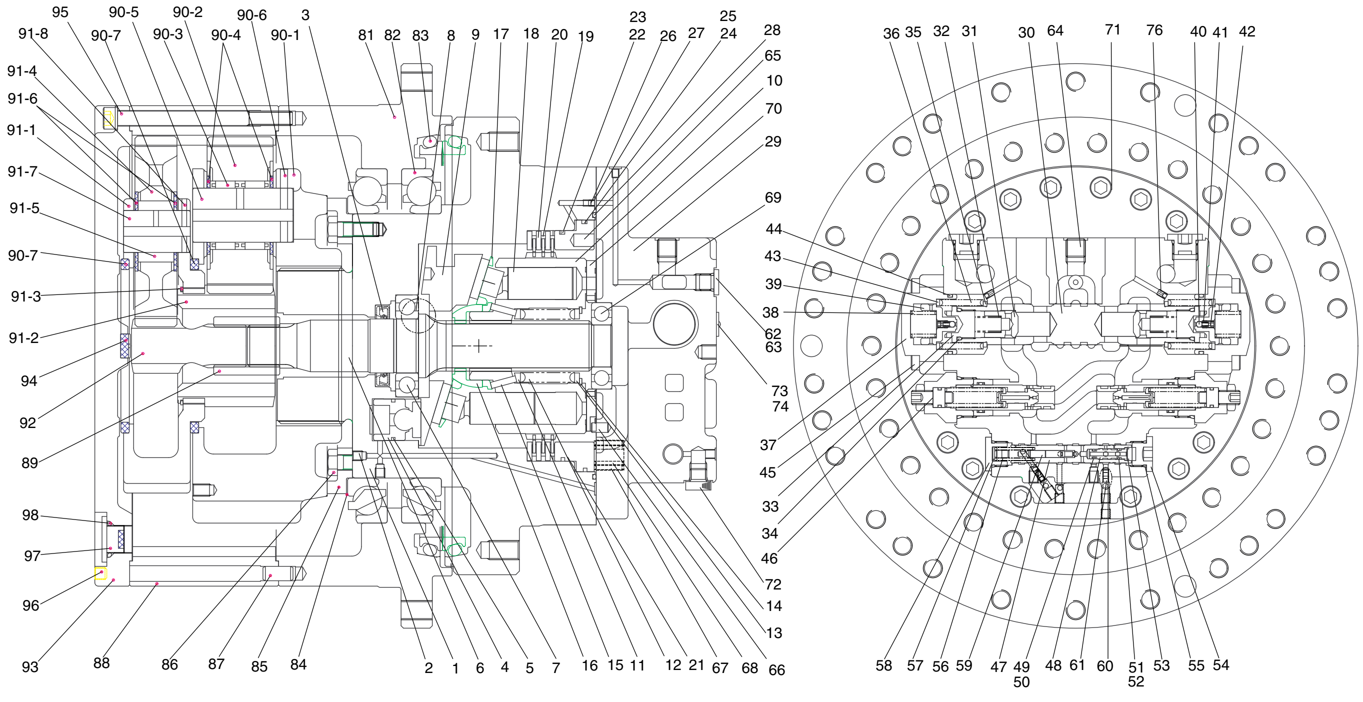
(1) Carry out installation in the reverse order to removal.

(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

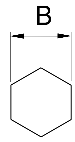
1) STRUCTURE



1	Shaft casing	20	Plate	39	Spool	57	Spring seat	75	Seal kit	90-7	Thrust ring
2	Plug	21	Packing piston	40	Steel ball	58	Plug	76	Orifice	91	Carrier assy No.1
3	Oil seal	22	O-ring	41	Spring	59	Spool	81	Housing	91-1	Carrier No.1
4	Swash piston	23	Back up ring	42	Plug	60	Orifice	82	Main bearing	91-2	Sun-gear No.2
5	Piston ring	24	O-ring	43	Spring seat	61	Orifice	83	Floating seal	91-3	Retaining ring
6	Shaft	25	Back up ring	44	O-ring	62	Plug	84	Shim	91-4	Planetary gear No.1
7	Bearing	26	Orifice	45	Wrench bolt	63	O-ring	85	Retainer	91-5	Needle bearing No.1
8	Steel ball	27	O-ring	46	Relief valve assy	64	Plug	86	Hex head bolt	91-6	Thrust washer
9	Swash plate	28	O-ring	47	Spool	65	Pin	87	Parallel pin	91-7	Pin No.1
10	Cylinder block	29	Rear cover	48	Guide	66	Pin	88	Ring gear	91-8	Spring pin
11	Spring seat	30	Spool	49	O-ring	67	Spring	89	Coupling	92	Sun gear No.1
12	Spring	31	Check	50	Back up ring	68	Spring	90	Carrier assy No.2	93	Cover
13	End plate	32	Spring	51	O-ring	69	Bearing	90-1	Carrier No.2	94	Pad
14	Snap ring	33	Plug	52	Back up ring	70	Valve plate	90-2	Planetary gear No.2	95	Hex socket head bolt
15	Pin	34	O-ring	53	Snap ring	71	Wrench bolt	90-3	Needle bearing No.2	96	Hex socket Screw
16	Ball guide	35	Spring seat	54	plug	72	Plug	90-4	Thrust washer	97	Hydraulic plug
17	Set plate	36	Spring	55	O-ring	73	Name plate	90-5	Pin No.2	98	O-ring
18	Piston assy	37	Cover	56	Spring	74	Rivet	90-6	Spring pin	99	Name plate
19	Friction plate	38	Spring								

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name		Remark	
Allen wrench		2.5, 4, 6, 10	
Socket for socket wrench, spanner	Socket	8, 14, 24, 27	
Torque wrench		Capable of tightening with the specified torques	
Pliers		-	
Plastic and iron hammer		Wooden hammer allowed. Normal 1 or so	
Monkey wrench		-	
Oil seal inserting jig		-	
Bearing pliers		-	
Seal tape		-	
Eye bolt		M10, M12, M14	
Press(0.5 ton)		-	
Oil stone		-	
Bearing assembling jig		-	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Plug	2	NPTF 1/16	1 ± 0.1	7.2 ± 0.7
Orifice	26	M5	0.7 ± 0.1	5 ± 0.7
Wrench bolt	45	M12×40L	10 ± 1.0	72 ± 7.0
Relief valve	46	HEX 27	18 ± 1.0	130 ± 7.0
Plug	54	PF 1/2	8.5 ± 1.0	61 ± 7.0
Plug	58	HEX 24	5 ± 1.0	36 ± 7.0
Plug	62	PF 1/4	5 ± 1.0	36 ± 7.0
Wrench bolt	71	M10×35L	10 ± 1.0	72 ± 7.0
Hex head bolt	-	M12×25L	11 ± 1.5	79 ± 10
Hex socket head bolt	-	M12×155L	11 ± 1.5	79 ± 10
Hex socket head plug	-	PF 3/4	19 ± 1	137 ± 7.0

3. OUTLINE OF DISASSEMBLING

1) GENERAL SUGGESTIONS

(1) Select a clean place for dismantling.
Spread a rubber plate on a working table in order to prohibit the damage of parts.

(2) Clean a deceleration equipment and a motor part, washing out dirt and unnecessary substances.

(3) Without any damage of O-ring, oil seal, the adhered surface of other seals, a gear, a pin, the adhered surface of other bearings, and the surface of moisturized copper, treat each parts.

(4) Numbers written in the parenthesis, ( ), next to the name of a part represent the part numbers of a cross-sectional view annexed with a drawing.

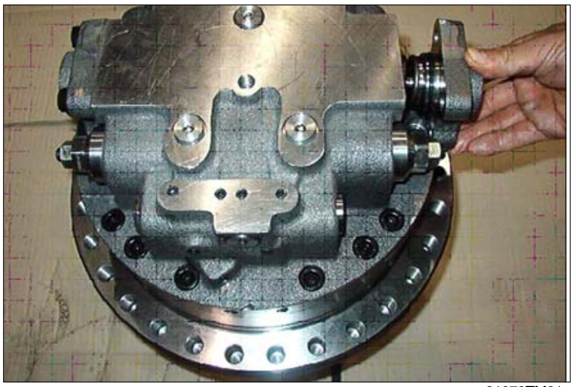
(5) The side of a pipe in a motor can be written as a rear side; the side of out-put as a front side.

(6) Using and combining a liquid gasket, both sides must be dried completely before spraying a liquid gasket.

(7) In case of bonding volts, combine a standard torque by torque wrench after spraying locktight 262 on the tab parts. (It can be dealt as assembling NPTF screws and an acceleration equipment.)

3.1 DISASSEMBLING

1) Unloosing wrench bolt and disassemble cover(37).
※ Wrench bolt = M12×40L-8EA
(Purchasing goods)

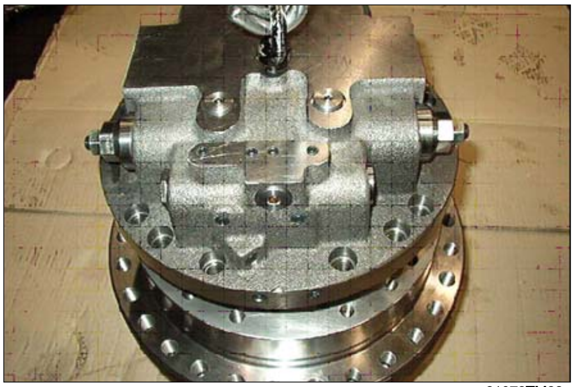


21078TM21

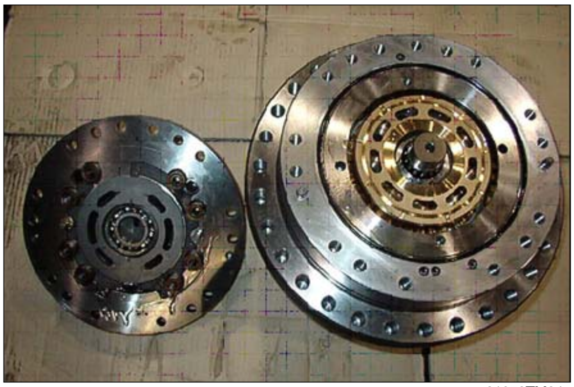
2) Disassemble parts related to C.B.V.

21078TM22

3) Unloosing wrench bolt(M12 × 35L, 16EA) and disassemble rear cover assembly from motor assembly.



21078TM23

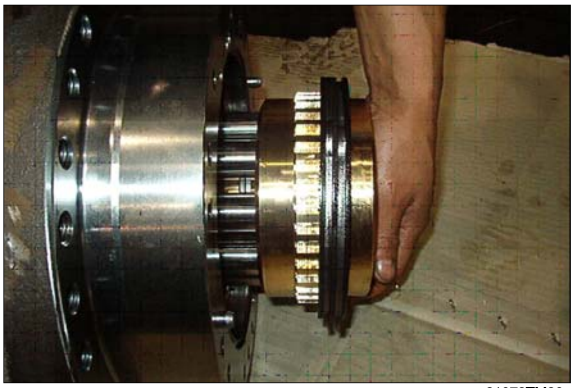


21078TM24

4) Dismantle packing piston(21) using compressed air.

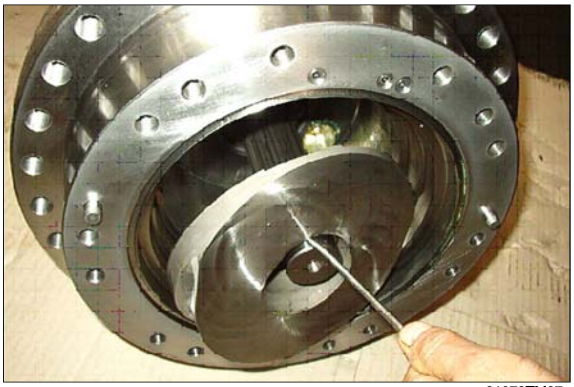
21078TM25

5) Disassembly rotary kit from motor assembly(Cylinder block assembly, piston assembly, ball guide, set plate, friction plate, steel plate...)



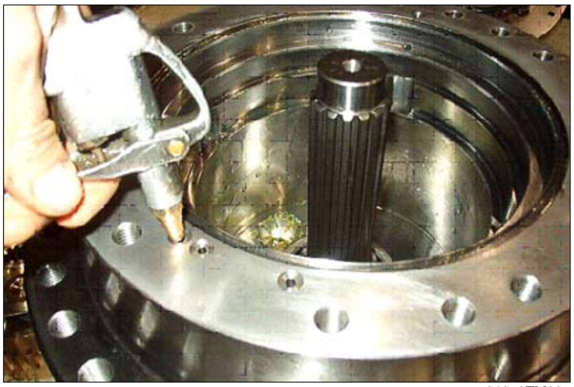
21078TM26

6) Using a jig, disassemble swash plate(9) from shaft casing.



21078TM27

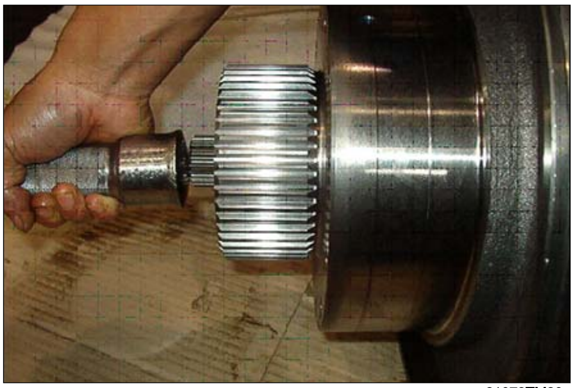
7) Using compressed air, disassemble piston swash(4) piston ring(5), respectively.



21078TM28

21078TM29

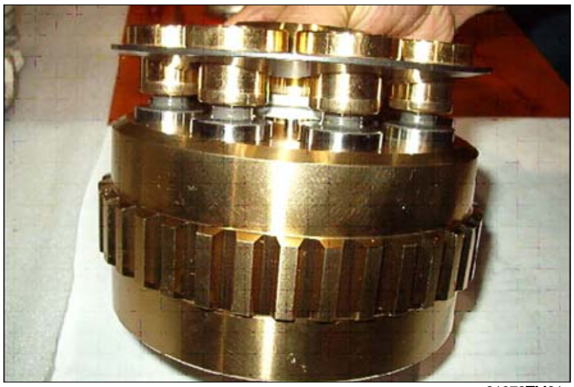
8) Using a hammer, disassemble shaft(6) from shaft casing(1).



21078TM30

■ **Disassemble cylinder sub.**

9) Disassemble cylinder block assembly, piston assembly(9) and seat plate(M).

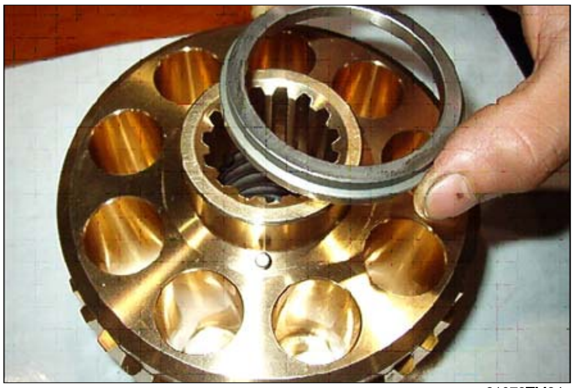


21078TM31

21078TM32

10) Disassemble ball guide(16), ring and pin(15) from cylinder block, respectively.

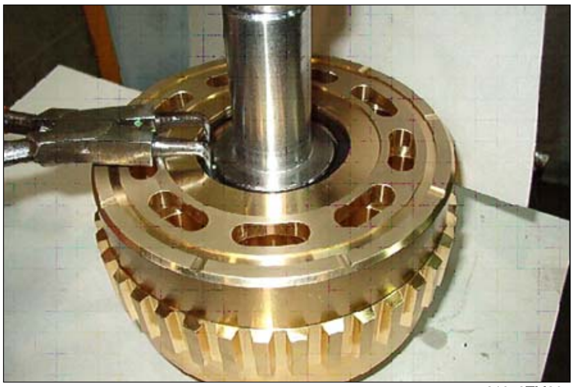
21078TM33



21078TM34

21078TM35

11) Pushing spring(12) by an assembling jig, disassemble snap ring(14), spring seat(13), spring(12) and spring seat(11), respectively.

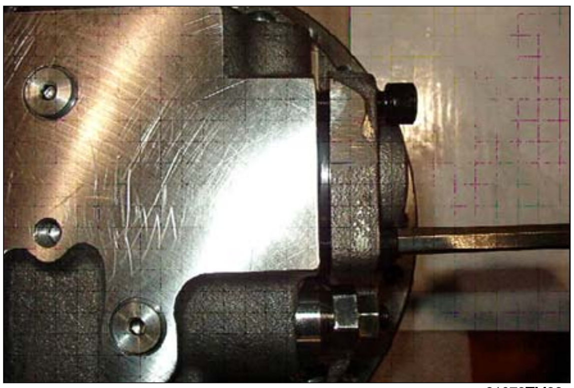


21078TM36

21078TM37

■ **Disassemble valve casing sub.**

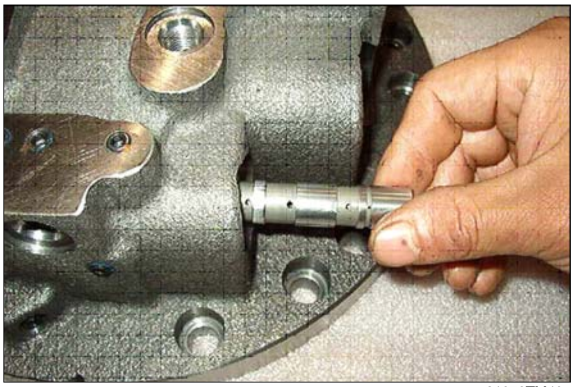
12) Using an hexagon wrench, unloosing wrench bolt(45) and disassemble cover(37), spring(38), spool(39), spring seat(43), spring(36) and spring seat(35), respectively. (Same balance on both sides)



21078TM38

21078TM39

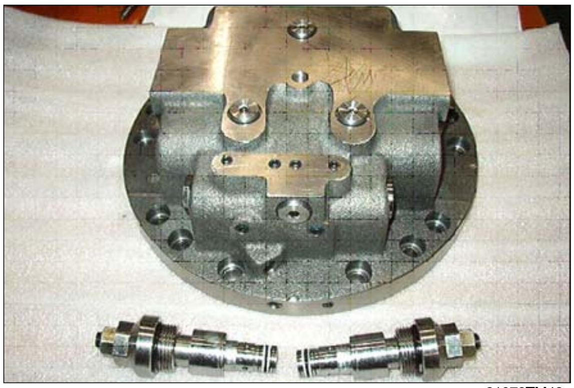
13) Disassemble spool(59), spool(47), O-ring (51), guide(48) and snap ring(53) on rear cover, respectively.



21078TM40

21078TM41

14) Using a torque wrench, disassemble relief assembly(46) on rear cover.



21078TM42

4. OUTLINE FOR ASSEMBLING

1) GENERAL SUGGESTIONS

(1) After washing each parts cleanly, dry it with compressed air.
Provided that you do not wash friction plate with treated oil.

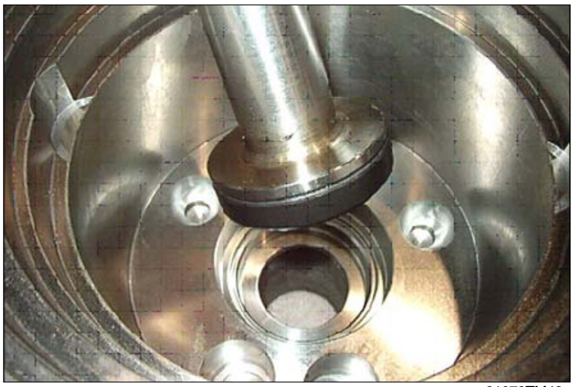
(2) In bonding each part, fasten bond torque.

(3) When using a hammer, do not forget to use a plastic hammer.

4.1 ASSEMBLING

■ Assemble the sub of turning axis

1) Using a jig, assemble oil seal(3) into shaft casing(1)



21078TM43

2) Have a bearing(8) thermal reacted into shaft(6).

21078TM44

21078TM45

21078TM46

3) Using a jig, assemble shaft assembly into shaft casing(1).

21078TM47

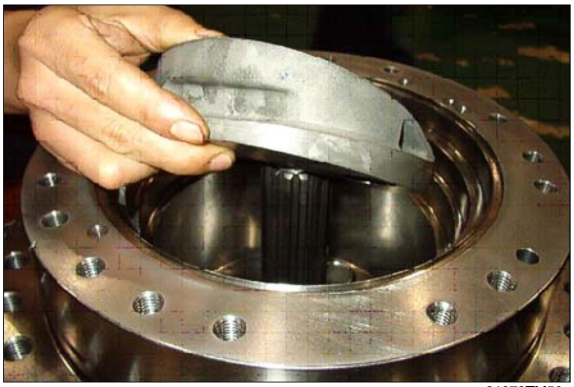
4) After spreading grease on steel ball(8) assemble into shaft casing(1).

21078TM48

5) Assemble swash piston assembly(4, 5) into shaft casing(1).

21078TM49

6) Assemble swash plate(9) into shaft casing (1).



21078TM50

■ **Assemble cylinder block sub.**

7) Assemble spring seat(13), spring(12), spring seat(11) into cylinder block(10) respectively, pushing spring(12) using by a jig, assemble snap ring(14) with a snap ring(14).

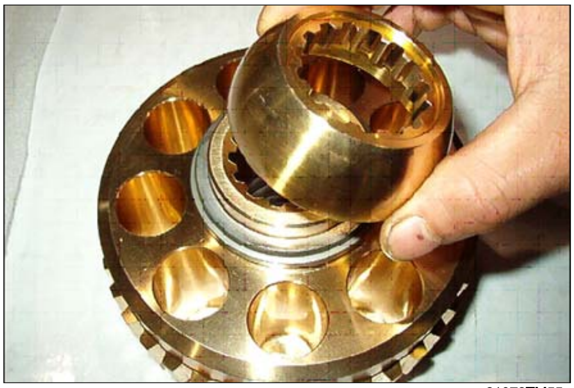
21078TM51

21078TM52

8) Assemble ring, pin(15) on cylinder block(10) ball guide(16) respectively.

21078TM53

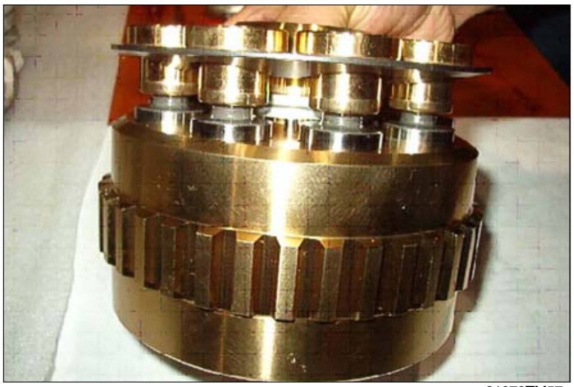
21078TM54



21078TM55

9) Assemble cylinder block assembly, piston assembly(9), seat plate(17).

21078TM56



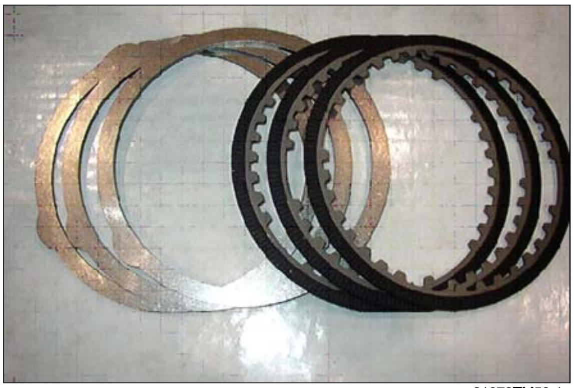
21078TM57

10) Assemble cylinder block assembly(9) into shaft casing(a).

21078TM58

11) Assemble friction plate(19) and plate(20) into shaft casing(1) respectively, prepare 6 set.

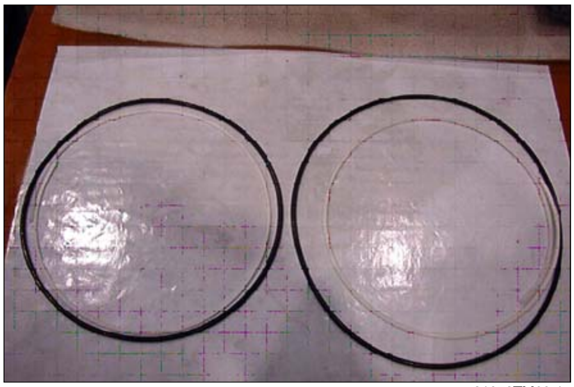
21078TM59



21078TM59-1

12) Assemble O-ring(22, 23) into packing piston (21).

21078TM60



21078TM60-1

13) After spreading grease on packing piston(21) bond wrench bolt and assemble shaft casing(1).

21078TM61

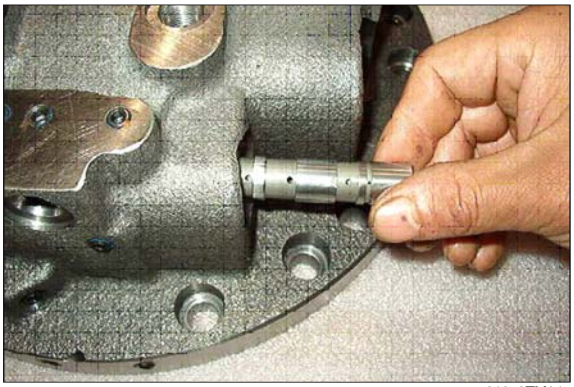
■ **Assemble rear cover sub.**

14) Using a jig, assemble bearing(69) into rear cover(29).

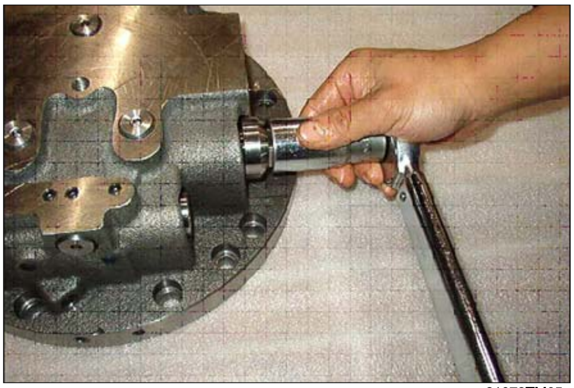
21078TM62

15) After assembling spool(59), spool(47), O-ring(51), guide(48) and snap ring(53) respectively into rear cover(29).
Using torque wrench, assemble it.

21078TM63

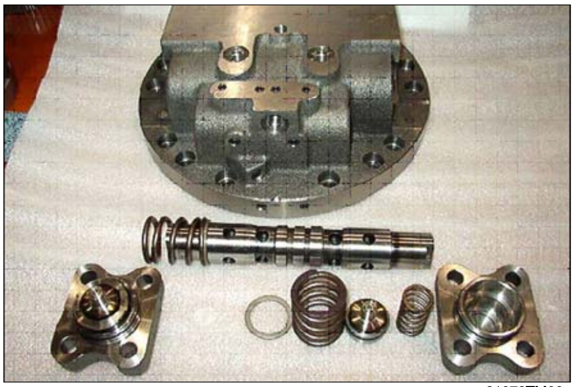


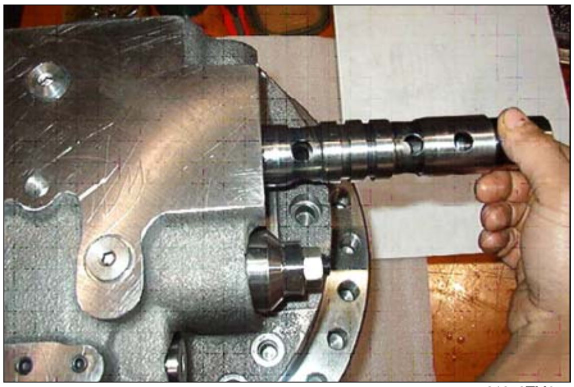
21078TM64

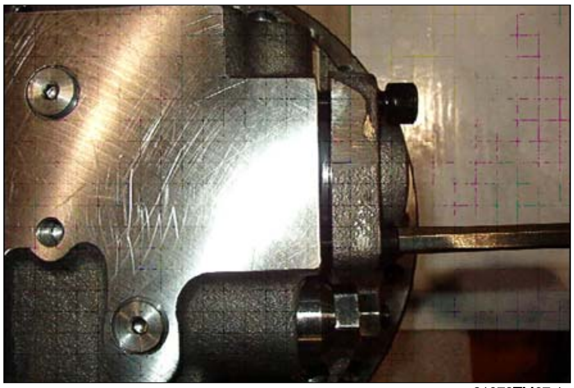


21078TM65

16) Assemble spring seat(35), spring(36), spring seat(43), spool(39), spring(38), cover(37) respectively and assemble wrench bolt(45).
(Same balance on both sides)


21078TM66


21078TM67

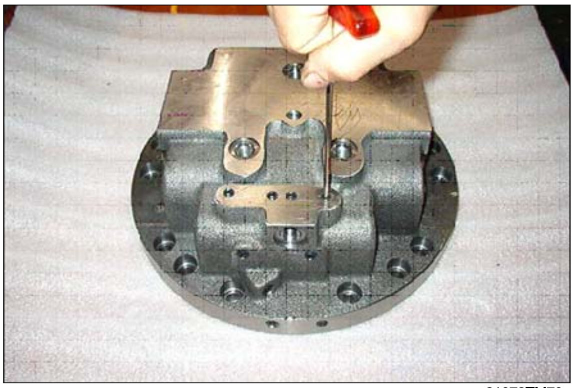

21078TM67-1

17) Assemble plug(2).

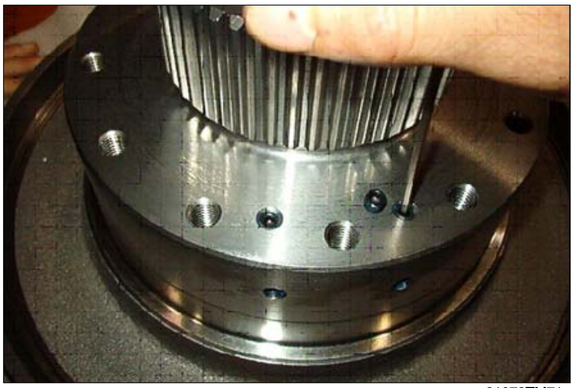
※ Plug(NPT1/16) - 11EA

21078TM68

21078TM69



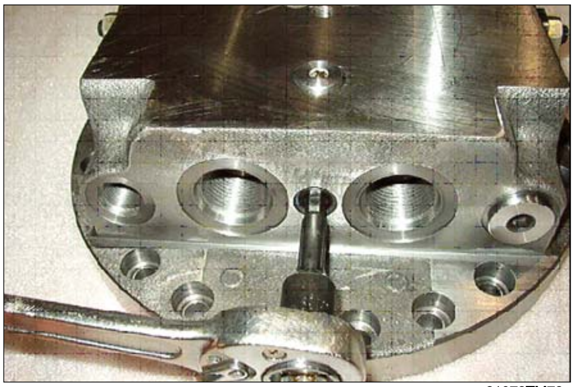
21078TM70



21078TM71

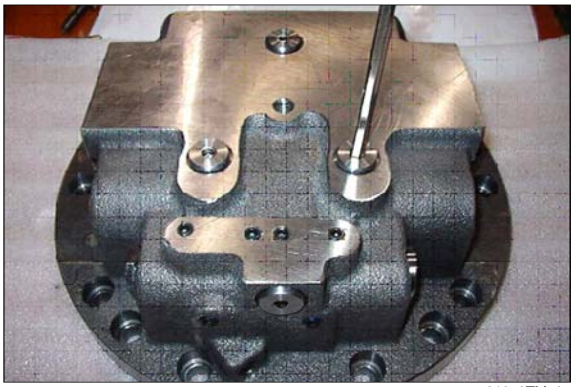
18) Assemble plug(64).

※ Plug(PT3/8) - 11EA

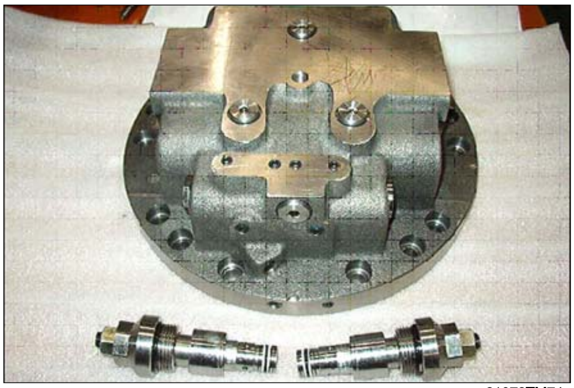


21078TM72

19) Assemble plug(62, 63) into rear cover(29) and assemble relief valve assembly.

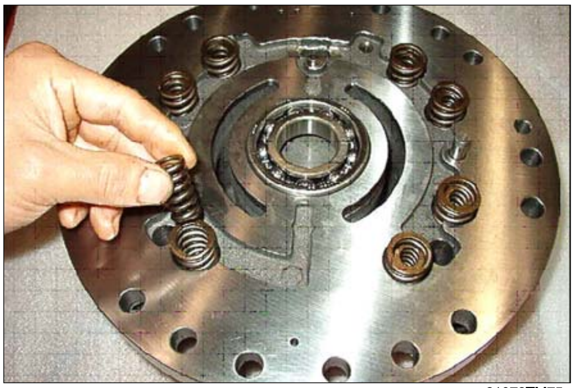


21078TM73



21078TM74

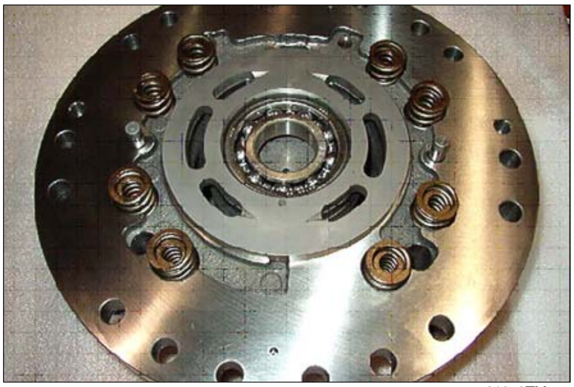
20) Put spring(67, 68) together into rear cover (29), prepare 6 set.



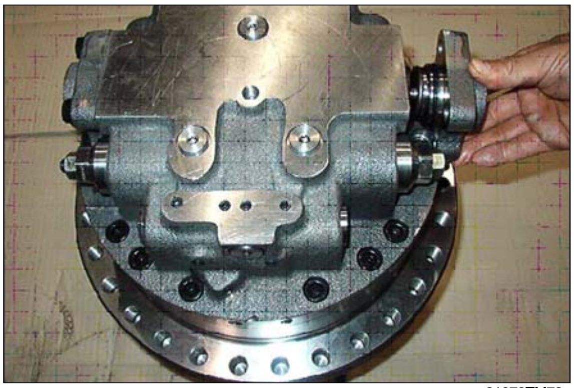
21078TM75


21078TM76

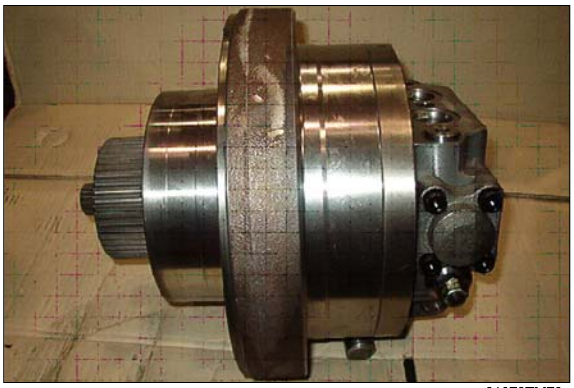
21) Assemble valve plate(70) into rear cover (29).


21078TM77

22) After assembling shaft casing(1) and rear cover(29).
Assemble spool assembly(30), spring(38), spool(39), cover(37) after then complete assembly with wrench bolt(45).


21078TM78

23) Finish assembly.


21078TM79

5.1 DISASSEMBLING REDUCTION UNIT

1) Preparation for disassembling

(1) The reduction units removed from excavator are usually covered with mud. Wash outside of propelling unit and dry it.

(2) Locate reducer in order for drain port to be at the lowest level loosen taper screw plug of drain port, and drain oil from reduction gear.

※ While oil is still hot, inside of the unit may be pressurized.

⚠ **Take care of the hot oil gushing out of the unit when loosening the plug.**

(3) Mark for mating

Put marks on each mating parts when disassembling so as to reassemble correctly as before.

21078TM80

2) Setting reduction unit(or whole propelling unit) on work stand for disassembling

(1) Remove M12 hexagon socket head bolts(95) at 3 places from cover(93) almost equally apart each other, and then install M12×155L eye bolts.

Lift up the unit using them and place it on work stand with cover upward.

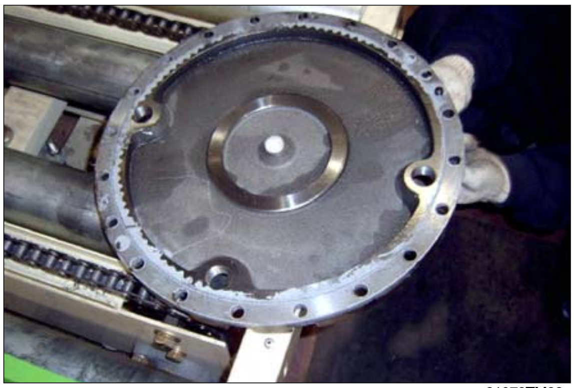
⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

21078TM81

3) Removing cover

(1) Remove the rest of M12 hexagon socket head bolts(95) that securering gear and housing. Loosen all the socket bolts and then, disassemble cover.

(2) As the cover(93) is adhered to ring gear (88), disassemble ring gear(88) and cover (93) vy lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.



21078TM82

4) Removing No.1 carrier sub assembly

(1) Screw three M10 eye-bolt in No.1 carrier and lift up and remove No.1 carrier assy.

21078TM83

(2) Remove No.1 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.

21078TM84

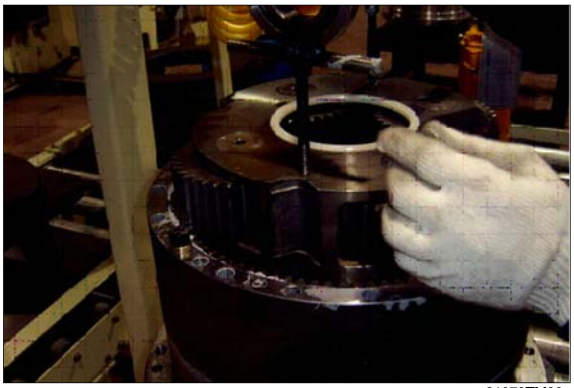
5) Removing No.2 carrier sub assembly

(1) Screw three M10 eye-bolt in No.2 carrier and lift up and remove No.2 carrier assy.

21078TM85

(2) Remove No.2 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.2 sun gear.



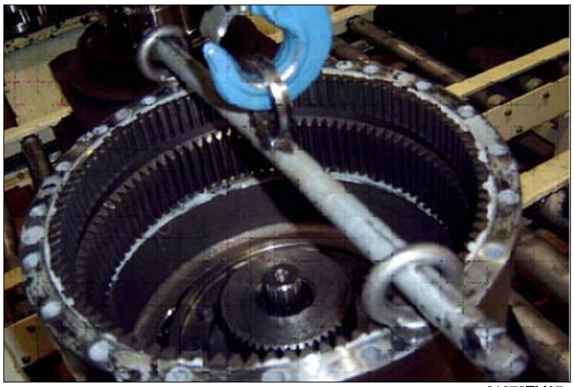
21078TM86

6) Removing ring gear

(1) As the ring gear(88) is adhered to housing(81), disassemble ring gear(88) and housing(81) by lightly hammering slantwise upward using sharpen punch inserted between the ring gear and housing.

※ Carefully disassembling ring gear not to make scratch on it.

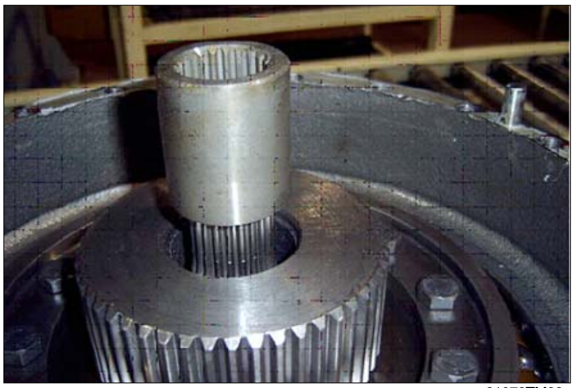
(2) Screw M14 eye-bolt in ring gear and lift up and remove it.



21078TM87

7) Removing coupling

(1) Remove coupling.

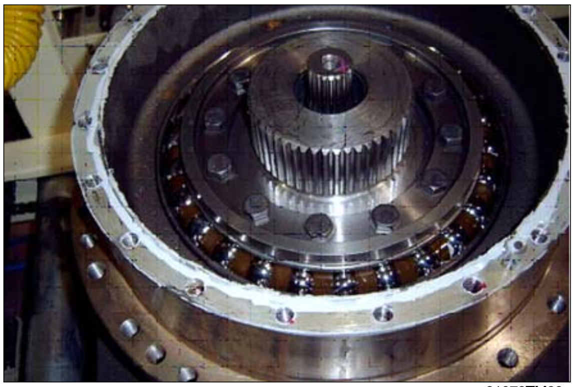


21078TM88

8) Removing retainer & shim

(1) Remove M12 hexagon socket head bolts that secure retainer and motor.

(2) Remove retainer & shim.



21078TM89

9) Removing housing sub assembly

(1) Screw M12 eye bolt in housing and lift up housing assembly including angular bearing and floating seal.

21078TM90

10) Removing floating seal

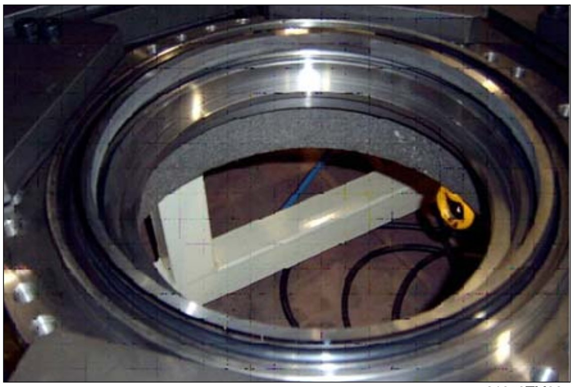
(1) Lift up a piece of floating seal of motor side.

21078TM91

11) Disassembling housing assembly

(1) After turning housing, lift up a piece of floating seal from housing and then remove it.

※ Don't disassemble angular bearing.



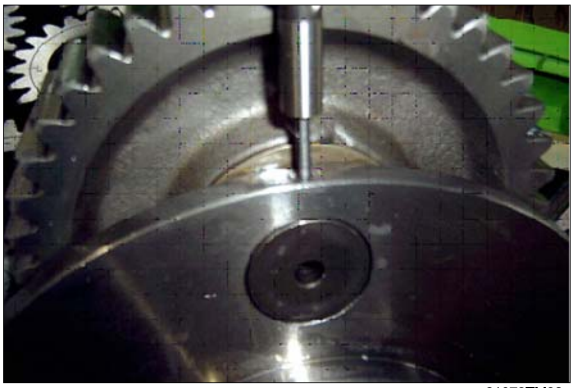
21078TM92

12) Disassembling No.1 carrier

(1) Remove thrust ring(90-7) from carrier.

(2) Knock spring pin(91-8) fully into No.1 pin (91-7).

(3) Remove planetary, thrust washer, No.1 pin, bearing from carrier.



21078TM93

21078TM94

21078TM95

13) Disassembling No.2 carrier

(1) Disassemble No.2 carriers, using the same method for No.1 carrier assembly.

21078TM96

21078TM97

6.1 ASSEMBLY REDUCTION GEAR

■ **General notes**

Clean every part by kerosene and dry them by air blow.
Surfaces to be applied by locktite must be decreased by solvent.
Check every part for any abnormals.
Each hexagon socket head bolt should be used with locktite No.
262 applied on its threads.
Apply gear oil slightly on each part before assembling.
Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.

Inspection before reassembling

Thrust washer

- Check if there are seizure, abnormal wear or uneven wear.
- Check if wear is over the allowable limit.

Gears

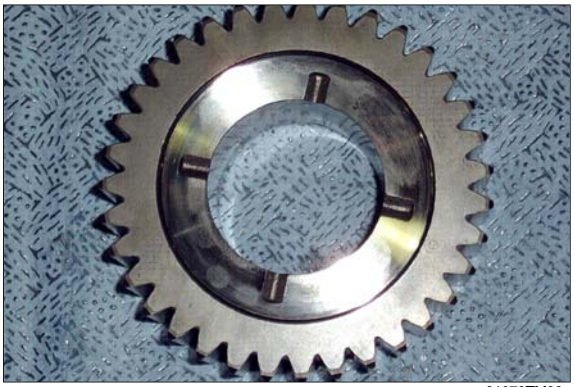
- Check if there are pitting or seizure on the tooth surface.
- Check if there are cracks on the root of tooth by die check.

Bearings

- Rotate by hand to see if there are something unusual such as noise or uneven rotation.

Floating seal

- Check flaw or score on sliding surfaces or O-ring.

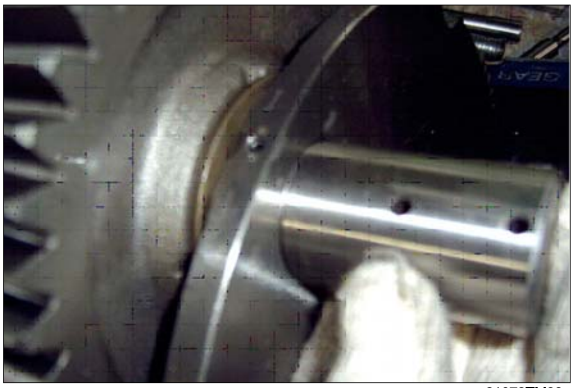


21078TM98

1) Assembling No.1 carrier

(1) Put No.1 carrier(91-1) on a flat place.

(2) Install No.1 needle bearing(91-5) into No.1 planetary gear(91-4), put 2EA of No.1 thrust washer(91-6) on both sides of bearing, and then, install it into carrier.



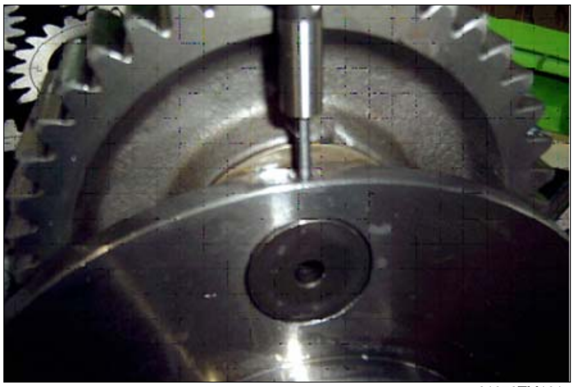
21078TM99

(3) Install No.1 pin(91-5) into No.1 carrier where the holes for No.1 pin(91-5) are to be in line with those of No.1 carrier, and then, install spring pins into the holes.


21078TM100

(4) Caulk carrier holes as shown on the picture.

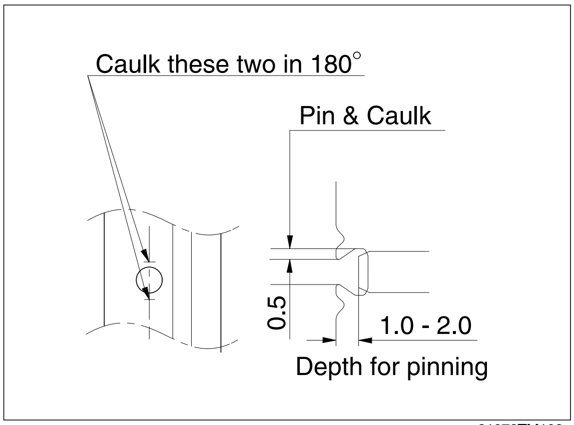
(5) Assembly ring thrust(90-7) into carrier.


21078TM101

2) Assembling No.2 carrier

(1) Put No.2 carrier(90-1) on a flat place.

(2) Install No.2 needle bearing(90-3) into No.2 planetary gear(90-2), put 2EA of No.2 thrust washer(90-4) on both sides of bearing, and then, install it into carrier.



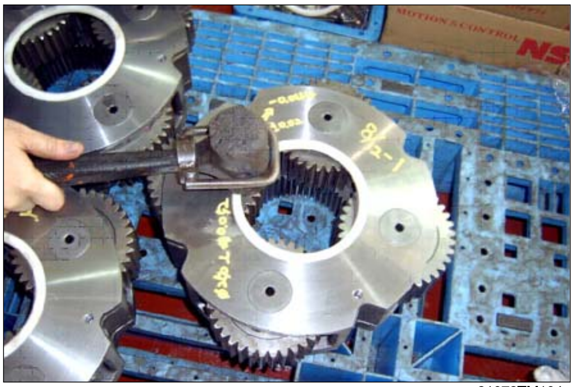
21078TM102

(3) Install No.2 pin(90-5) into No.2 carrier where the holes for No.2 pin(90-5) are to be in line with those of No.2 carrier, and then, install spring pins into the holes.


21078TM103

(4) Caulk carrier holes as shown on the picture.

(5) Assembly ring thrust(90-7) into carrier.



21078TM104

3) Assembling floating seal(83) and main bearing(82)

(1) Assemble floating seal into motor by use of pressing jig. Grease the contact parts for floating seal which is assembled into motor.

(2) Heat bearing at 60~70˚C and then, put into the motor side.

21078TM105

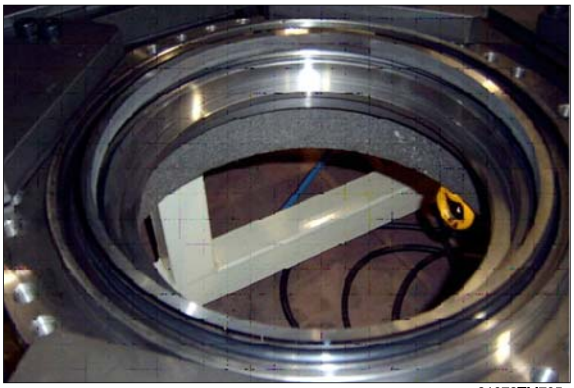
※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.

21078TM106

4) Assembling housing

(1) Heat housing at 60~70˚C while clearing it out and then, assemble floating seal into housing by use of pressing jig.

※ Be sure to maintain it vertical with the ground when assembling floating seal.



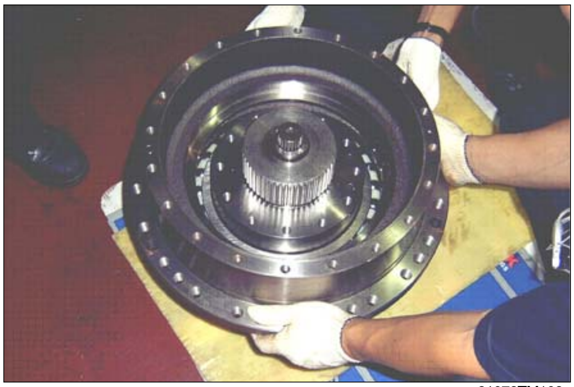
21078TM705

5) Installing housing assembly

(1) Install 2EA of M12 eye-bolt into housing assembly.

(2) Assemble housing into motor by use of hoist and eye-bolt.

※ Be sure to tighten eye-bolt deep enough.



21078TM108

6) Installing main bearing(82)

(1) Heat main bearing at 60~70°C and then, install.

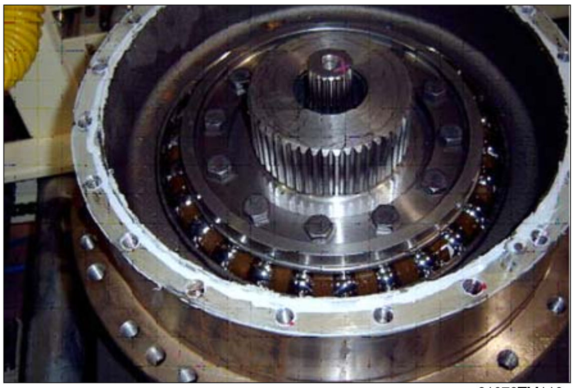
※ Be sure to maintain it vertical with the ground when assembling bearing.

21078TM109

7) Installing retainer(86) and shim(85)

(1) Measure clearance between main bearing and retainer by use of jig to decide the thickness of shim and select an appropriate shim, and then, assemble retainer.

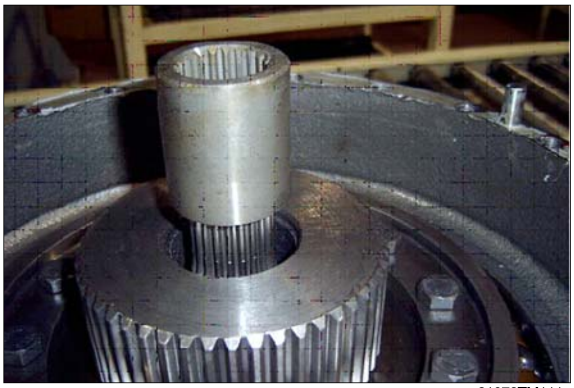
(2) Apply locktite(#262) on M12 hexagon head bolt, and then, bolt.



21078TM110

8) Installing coupling

(1) Install coupling on spline of the motor.



21078TM111

9) Installing ring gear

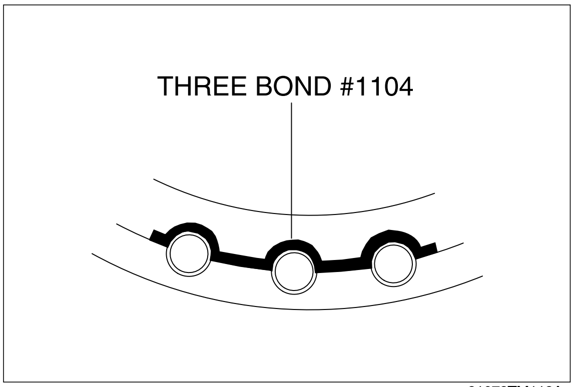
(1) Apply three bone #1104(locktite #515) on housing for ring gear without gap.

(2) Insert lock pin into housing hole.

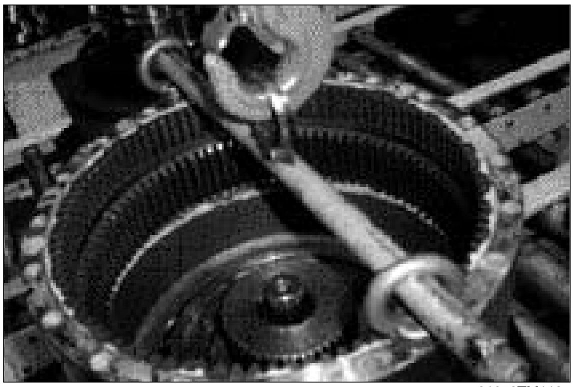
(3) Install M14 eye-bolt on the tap of ring gear.

(4) Lift ring gear and then, assemble into housing in order for hole of ring gear and parallel pin of housing to be in line.

(5) Temporarily secure 4EA of M12 hexagon socket bolt and shim with cover thickness having appropriate torque.



21078TM112A



21078TM113

10) Installing No.2 carrier sub assembly

(1) Install M10 eye-bolt on No.2 carrier assembly.

(2) Lift No.2 carrier assembly and then, slowly put it down on ring gear.

(3) Rotate planetary gear by hands and install on ring gear.

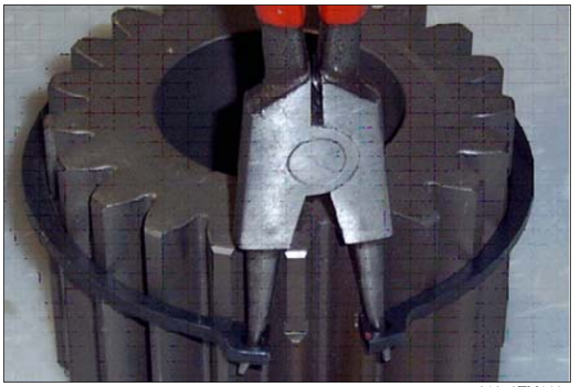
21078TM114

11) Installing No.2 sun gear(91-2)

(1) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.

21078TM115

(2) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.



21078TM116

12) Installing No.1 carrier sub assembly

(1) Install M10 eye-bolt on No.2 carrier assembly.

(2) Lift No.1 carrier assembly and then, slowly put it down on ring gear.

(3) Rotate planetary gear by hands and install on ring gear.

21078TM117

13) Installing No.1 sun gear(92)

(1) Put down No.1 sun gear on No.1 carrier, maintaining it vertical with spline of coupling.

(2) Install No.1 sun gear on No.1 planetary gear, matching their teeth.

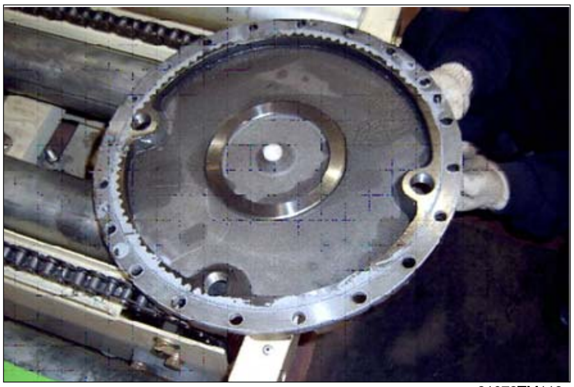
21078TM118

14) Installing cover(93)

(1) Beat pad(94) with plastic hammer, and press it into the center of cover.

(2) Apply three bond #1104(locktite#515) on the ring gear for cover without gap.

(3) Put cover on ring gear, apply locktite (#262) on M12 hexagon socket head bolt, and then, bolt.



21078TM119

(4) Fill gear oil(7.5liter) into drain port.

(5) Apply gear oil on PF3/4 hydraulic plug(97) and then, bolt.

21078TM120

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.

13031GE18

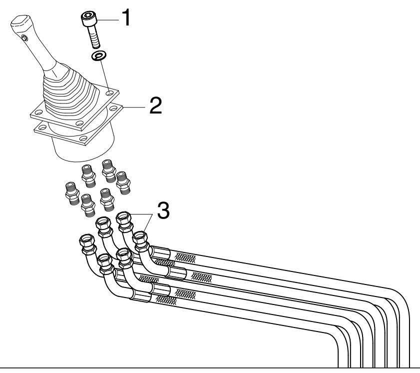
(4) Loosen the socket bolt(1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses(3).

(7) Remove the pilot valve assembly(2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



21078DA06

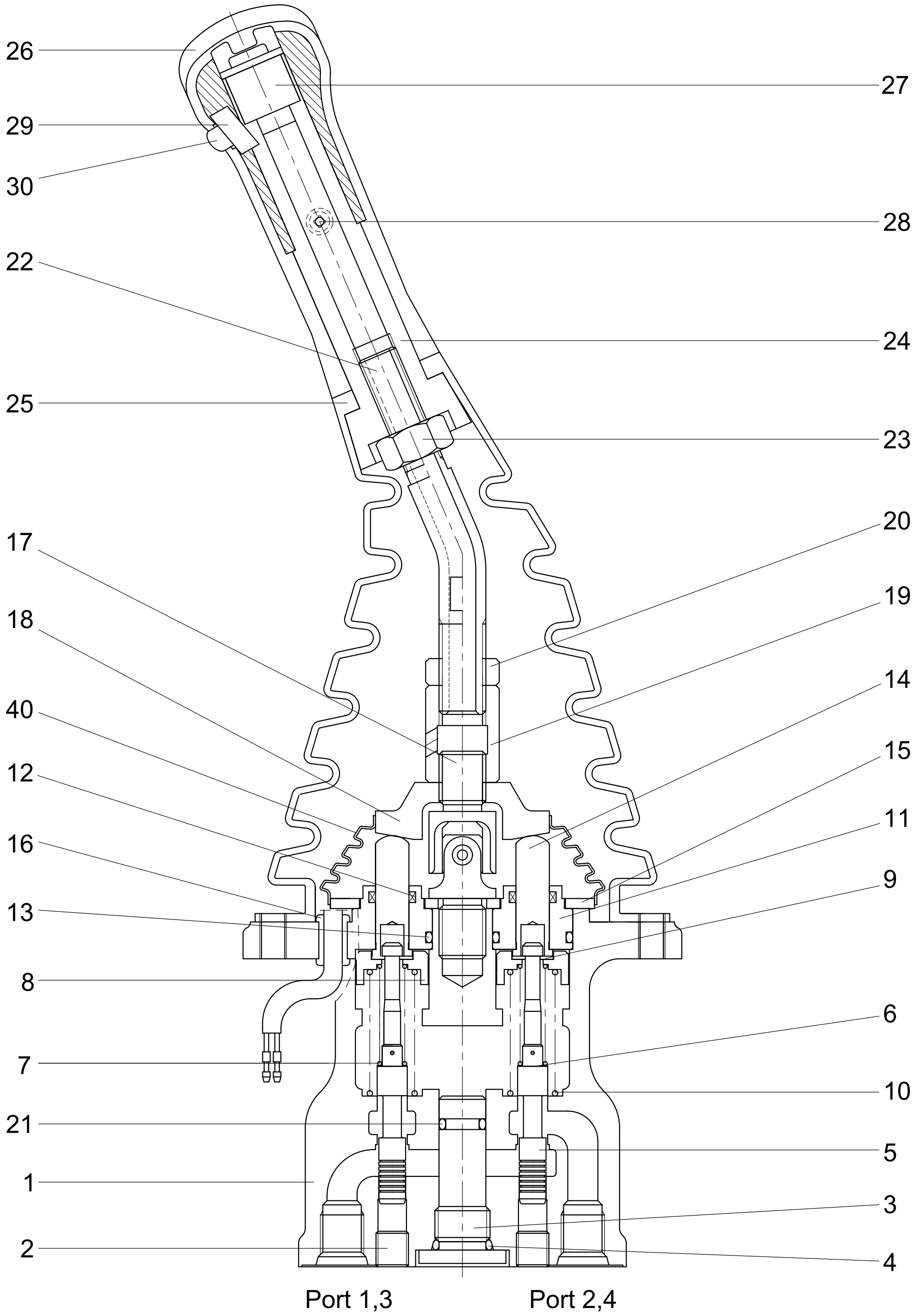
2) INSTALL

(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

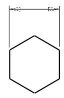


14072SF80

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) Tools

Tool name	Remark	
Allen wrench	6	B 
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

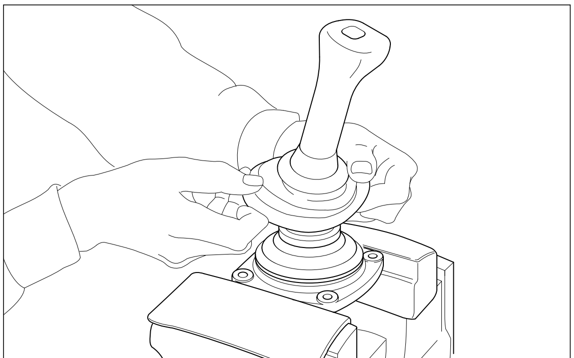
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

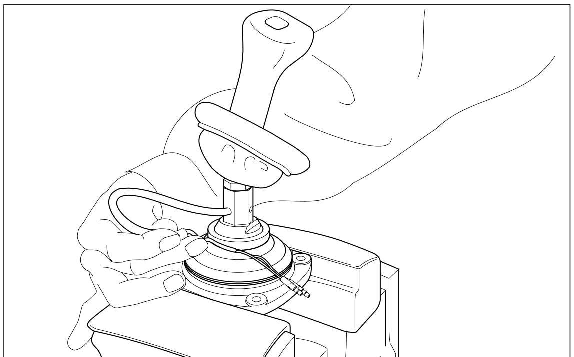
(2) Fix pilot valve in a vise with copper(or lead) sheets.

(3) Remove end of boot(25) from case(1) and take it out upwards.



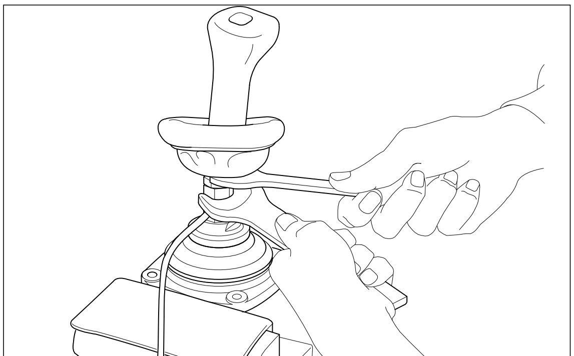
1408DA62

※ For valve with switch, remove cord also through hole of casing.



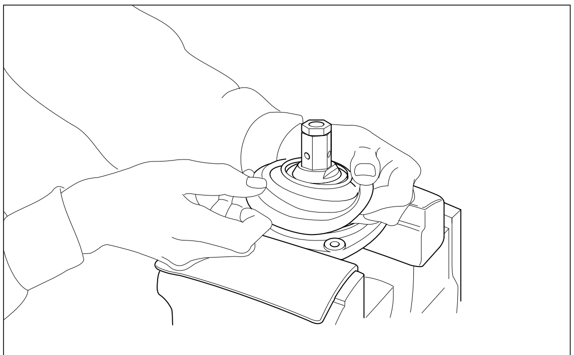
1408DA63

(4) Loosen lock nut(20) and adjusting nut(19) with spanners on them respectively, and take out handle section as one body.



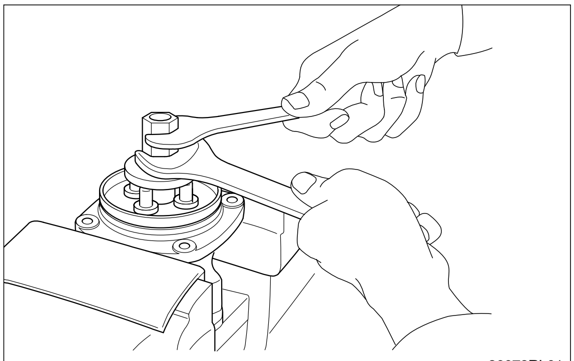
1408DA64

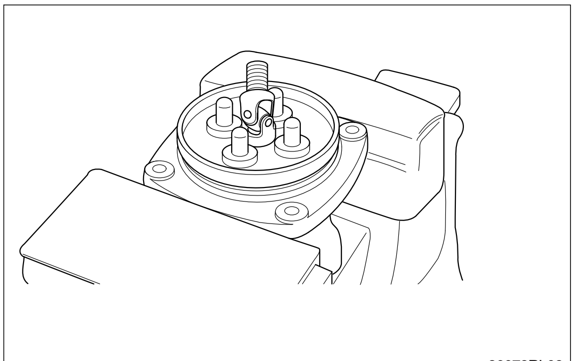
(5) Remove the boot(40)



1408DA61

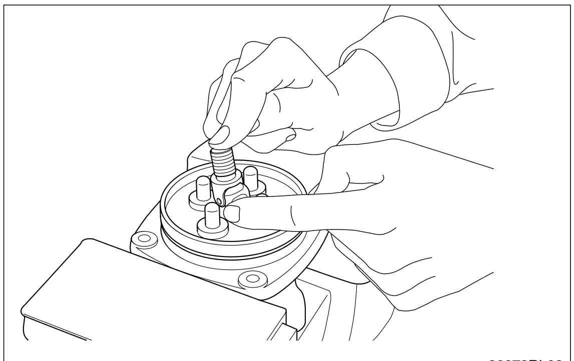
(6) Loosen adjusting nut(19) and plate(18) with spanners on them respectively, and remove them.

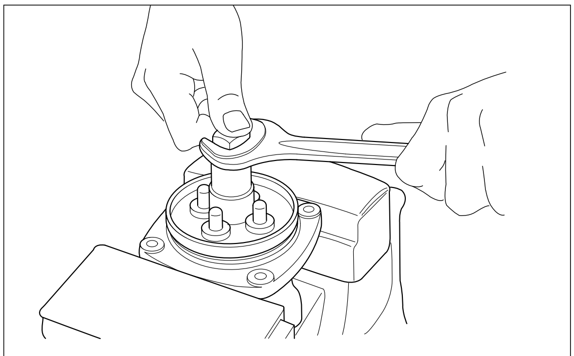

36078RL01


36078RL02

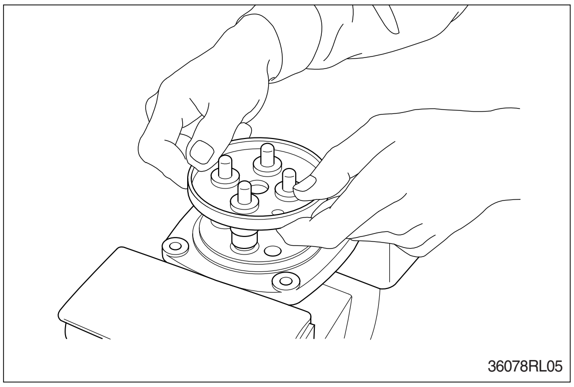
(7) Turn joint anticlockwise to loosen it, utilizing jig(Special tool).

※ When return spring(10) is strong in force, plate(15), plug(11) and push rod(14) will come up on loosening joint.
Pay attention to this.


36078RL03


36078RL04

(8) Remove plate(15).

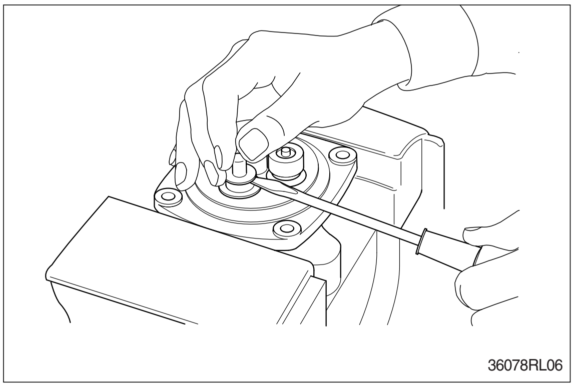


36078RL05

(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.

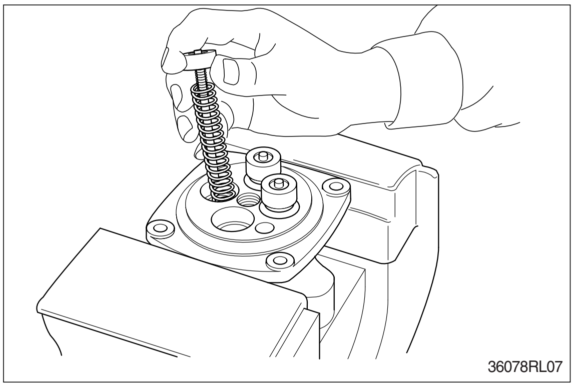
※ During taking out, plug may jump up due to return spring(10) force.
Pay attention to this.



36078RL06

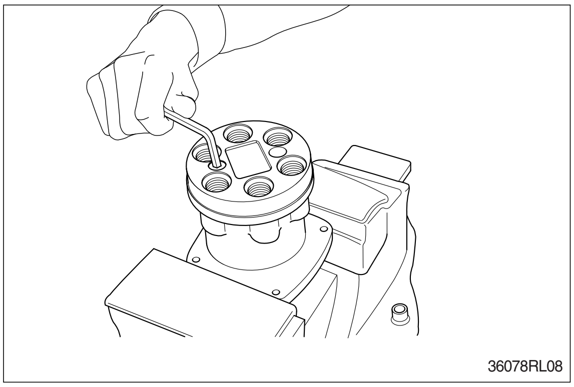
(10) Remove reducing valve subassembly and return spring(10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



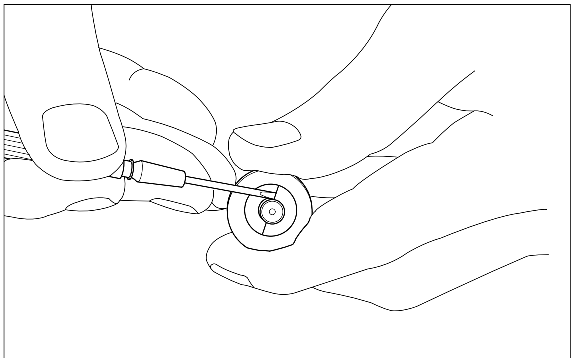
36078RL07

(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.



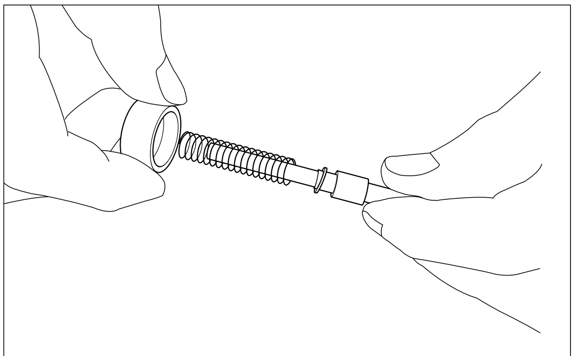
36078RL08

(12) For disassembling reducing valve section, stand it vertically with spool(5) bottom placed on flat workbench. Push down spring seat(8) 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 6㎜.



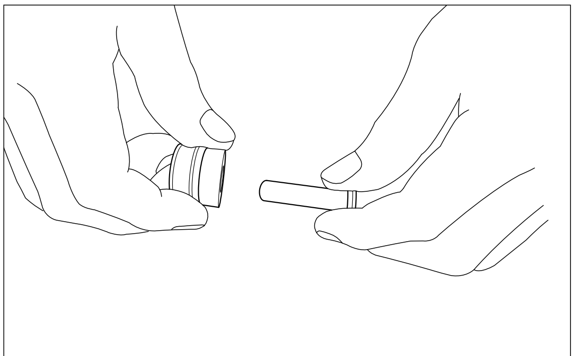
36078RL09

(13) Separate spool(5), spring seat(8), spring(7) and shim(6) individually.
※ Until being assembled, they should be handled as one subassembly group.



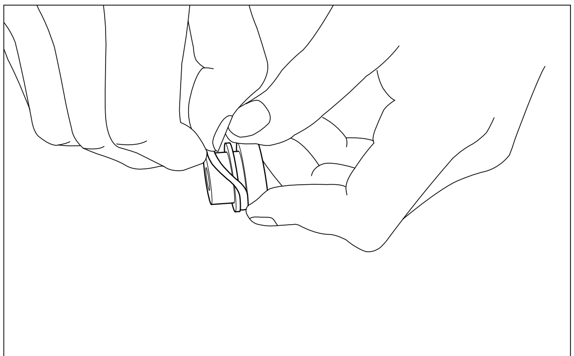
36078RL10

(14) Take push rod(14) out of plug(11).

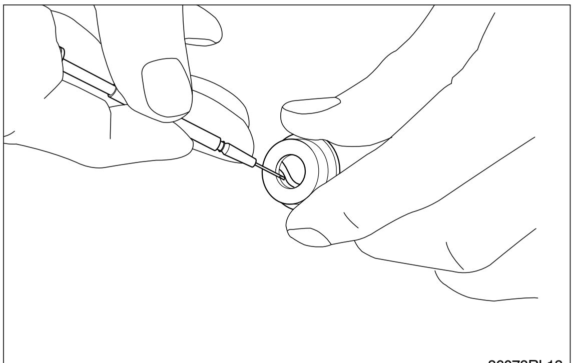


36078RL11

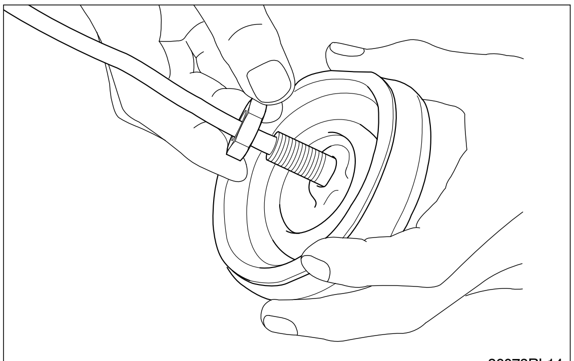
(15) Remove O-ring(13) and seal(12) from plug(11).
Use small minus screwdriver or so on to remove this seal.

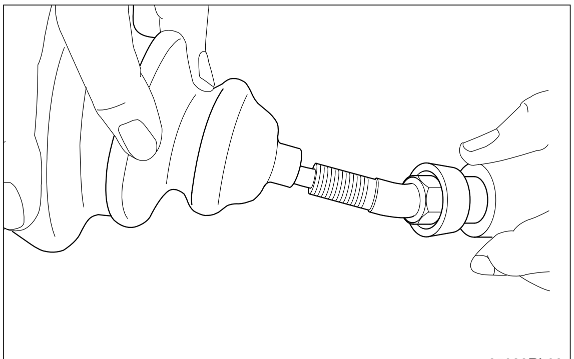


36078RL12


36078RL13

(16) Remove lock nut(20) and then boot(25).


36078RL14


25038RL02

(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.**

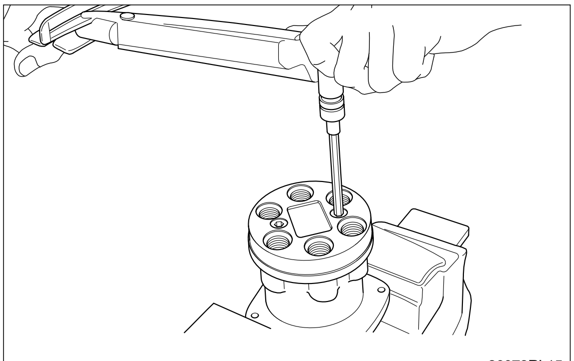
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

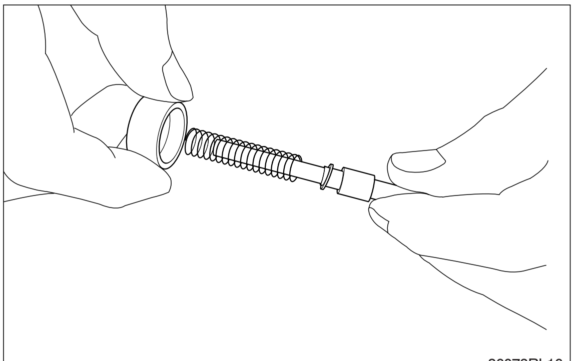
(1) Tighten hexagon socket head plug(2) to the specified torque.

※ Tighten two bolts alternately and slowly.



36078RL15

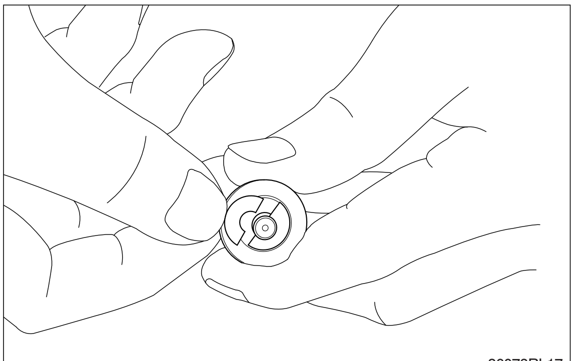
(2) Put shim(6), springs(7) and spring seat(8) onto spool(5) in this order.



36078RL16

(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.

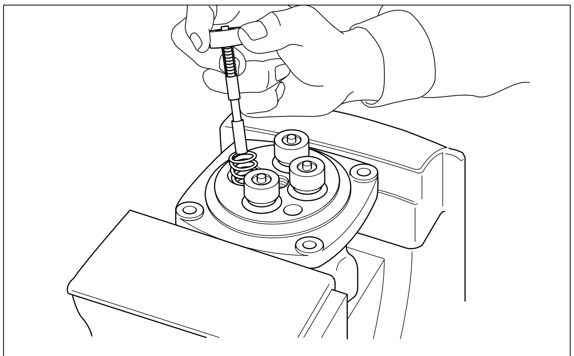
※ Assemble stopper(9) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



36078RL17

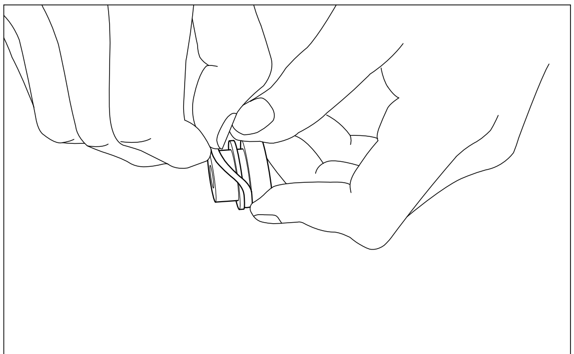
(4) Assemble spring(10) into casing(1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.



36078RL18

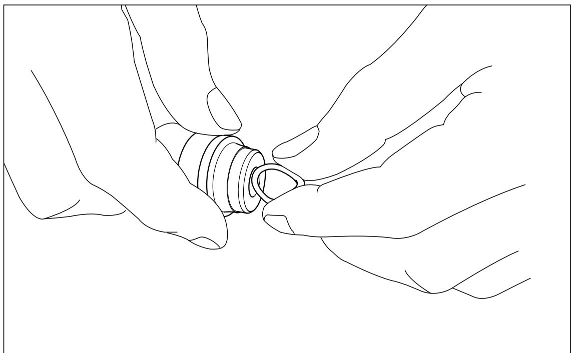
(5) Assemble O-ring(13) onto plug(11).



36078RL19

(6) Assemble seal(12) to plug(11).

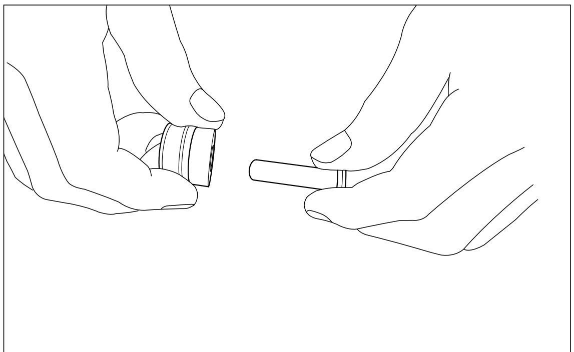
※ Assemble seal in such lip direction as shown below.



36078RL20

(7) Assemble push rod(14) to plug(11).

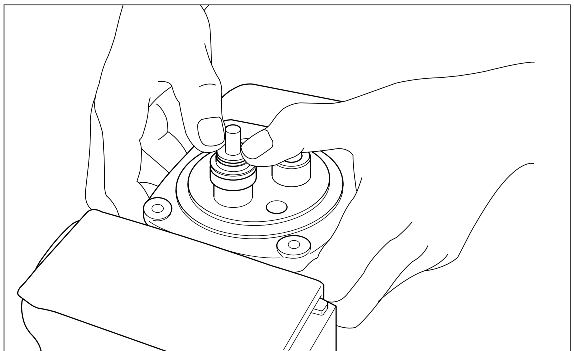
※ Apply working oil on push-rod surface.



36078RL21

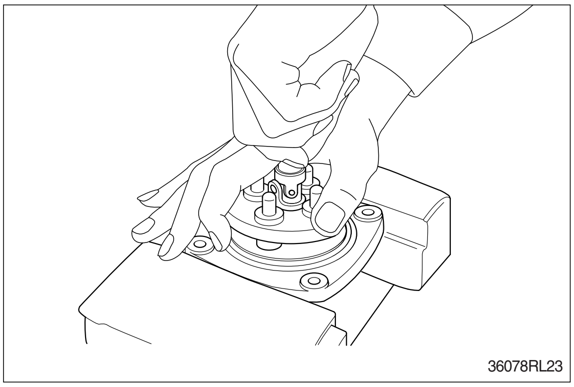
(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.



36078RL22

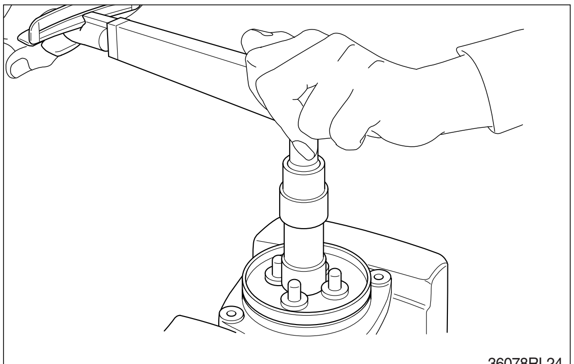
(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate(15), and tighten joint(17) temporarily.



36078RL23

(10) Fit plate(15).

(11) Tighten joint(17) with the specified torque to casing, utilizing jig.

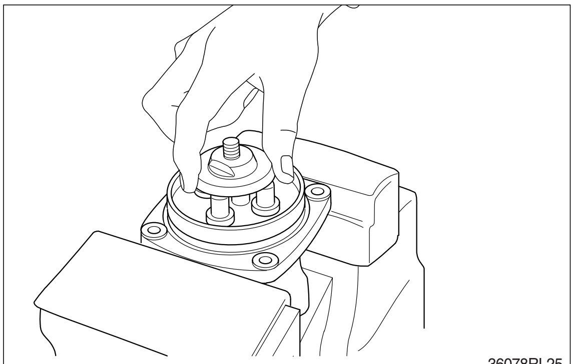


36078RL24

(12) Assemble swash plate(18) to joint(17).

※ Screw it to position that it contacts with 4 push rods evenly.

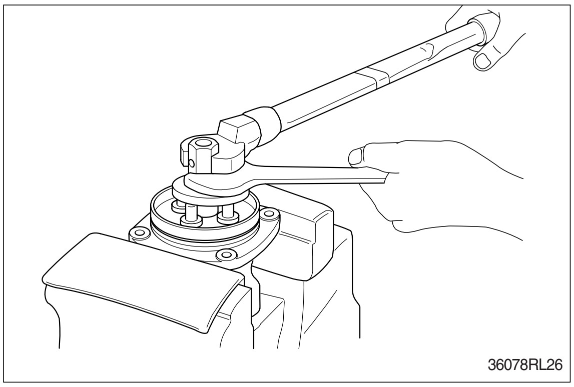
※ Do not screw it over.



36078RL25

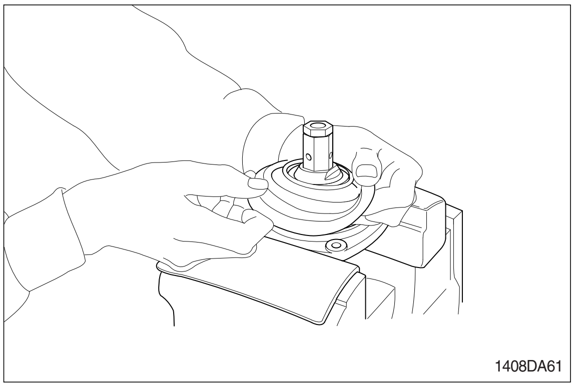
(13) Assemble adjusting nut(19), apply spanner to width across flat of plate(18) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.

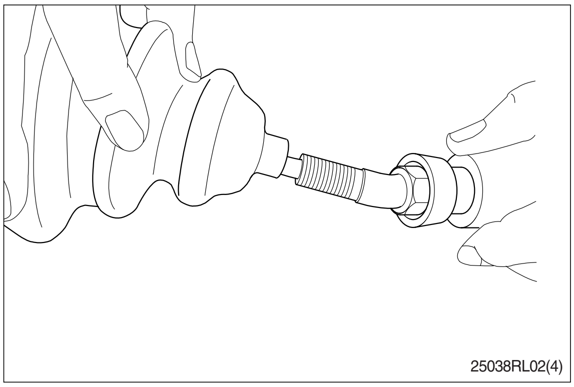


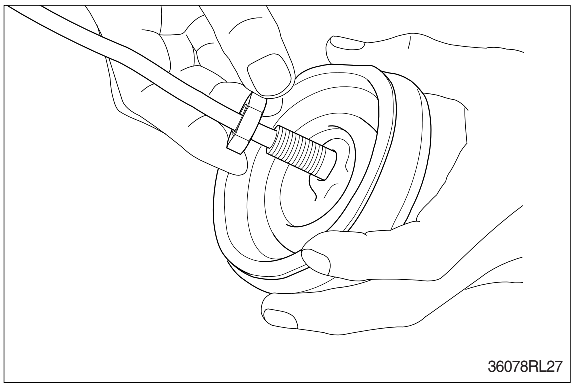
36078RL26

(14) Fit boot(40) to plate.

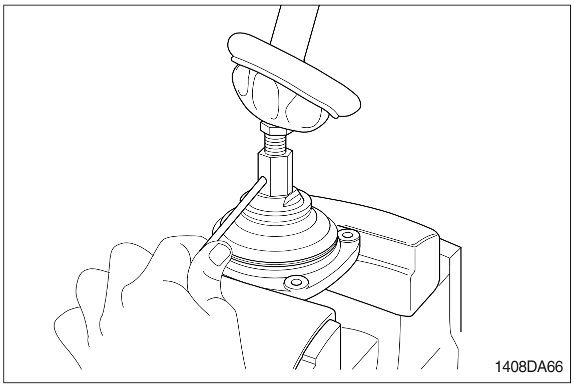


(15) Fit boot(25) and lock nut(20), and handle subassembly is assembled completely.

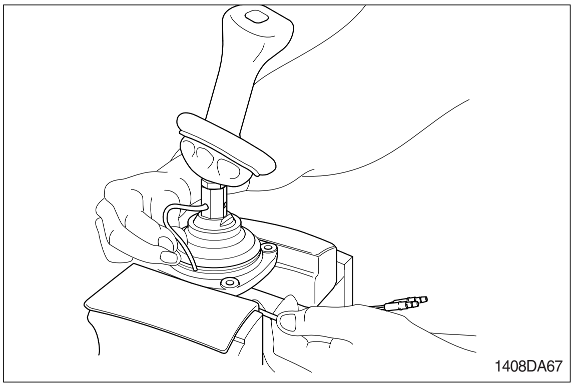




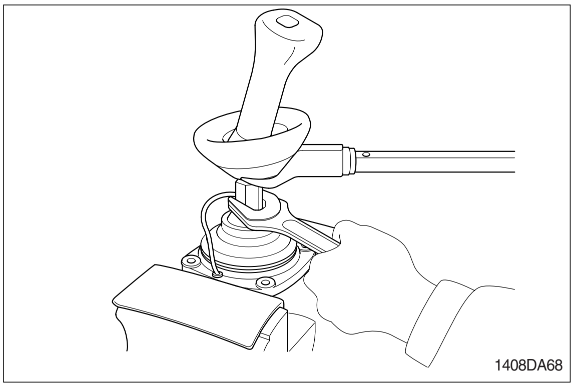
(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



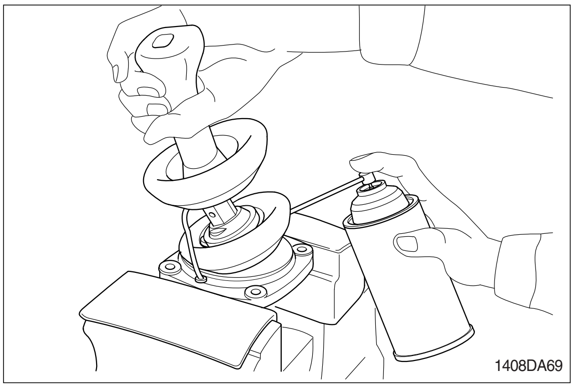
(17) Assemble bushing(16) to plate and pass cord and tube through it.
※ Provide margin necessary to operation.



(18) Determine handle direction, tighten lock nut(20) to specified torque to fix handle.

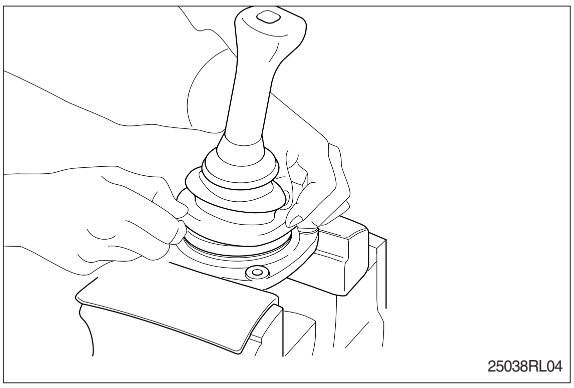


(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Lower the work equipment to the ground and stop the engine.

(2) Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

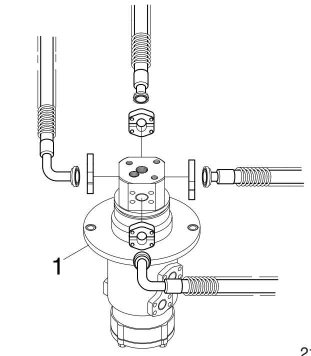
13031GE18

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt(2).

· Weight : 54kg(119lb)

· Tightening torque : 12.3 ± 1.3kgf · m (88.9 ± 9.4lbf · ft)



21078DA07

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

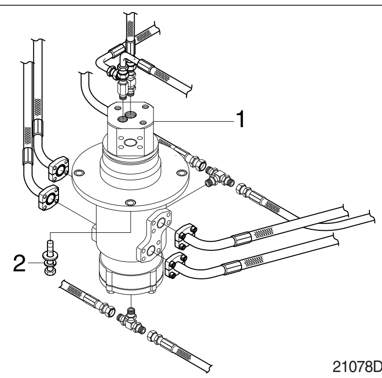
2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

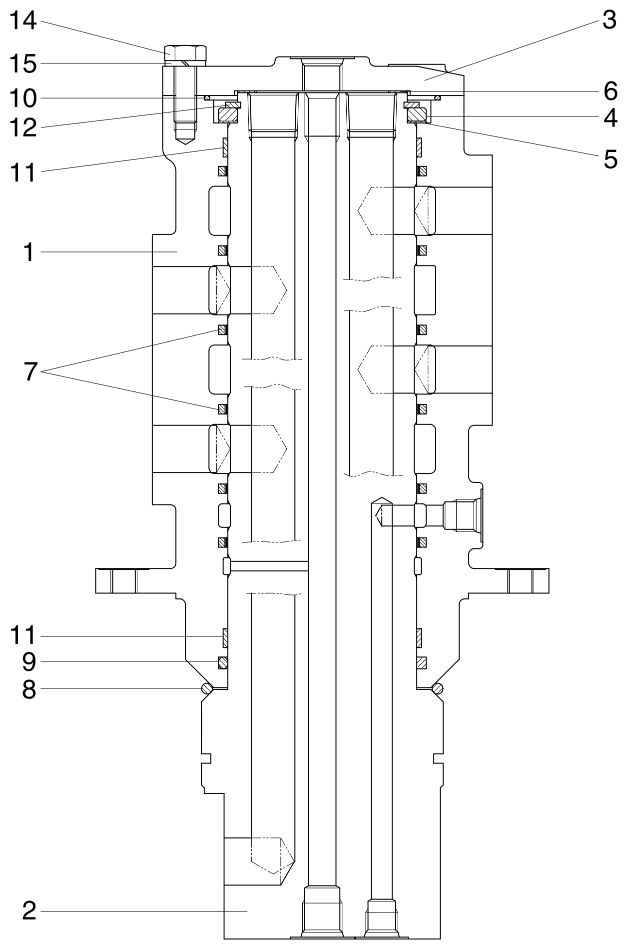
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



21078DA08

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



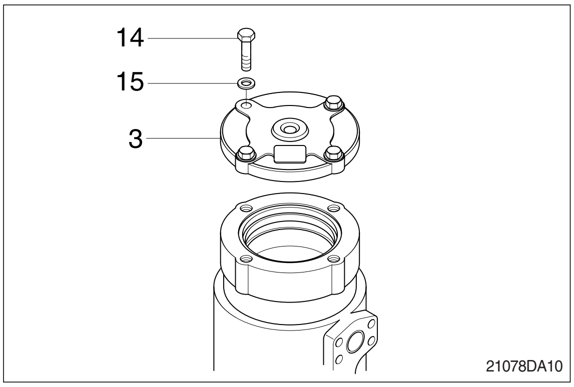
21078DA09

1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

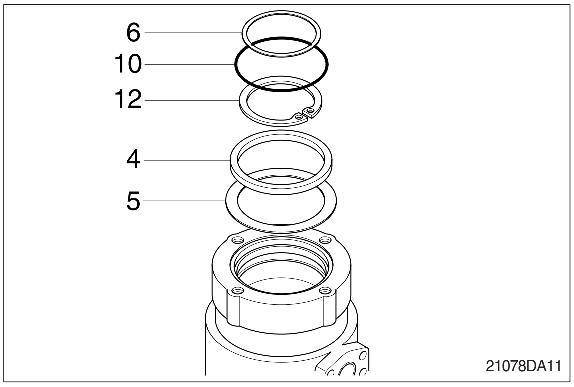
※ Before the disassembly, clean the turning joint.

(1) Remove bolts(14), washer(15) and cover(3).



(2) Remove shim(6) and O-ring(10).

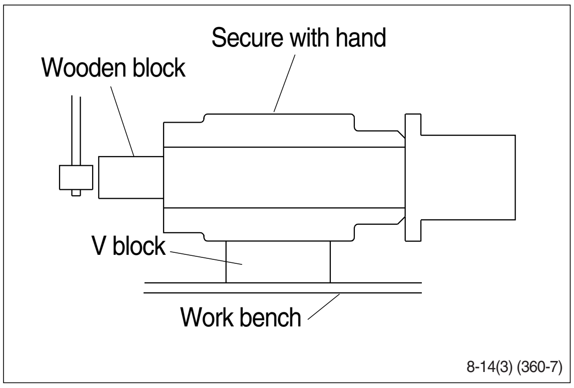
(3) Remove retainer ring(12), spacer(4) and shim(5).



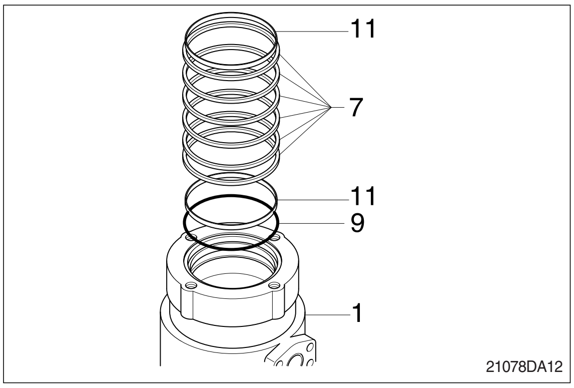
(4) Place hub(1) on a V-block and by using a wood buffer at the shaft end, hit out shaft(2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft(2) when remove hub(1) or rest it sideway.

※ Put a fitting mark on hub(1) and shaft(2).



(5) Remove six slipper seals(7) and O-ring(9), two ring wear(11) from hub(1).



3) ASSEMBLY

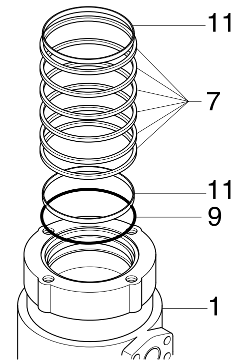
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

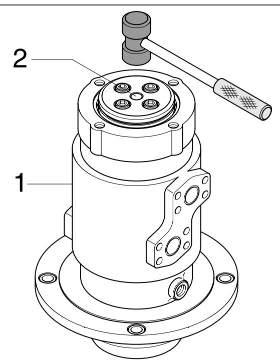
(1) Fix seven slipper seal(7) and O-ring(9), two ring wear(11) to hub(1).

(2) Fit O-ring(8) to shaft(2).



21078DA12

(3) Set shaft(2) on block, tap hub(1) with a plastic hammer to install.

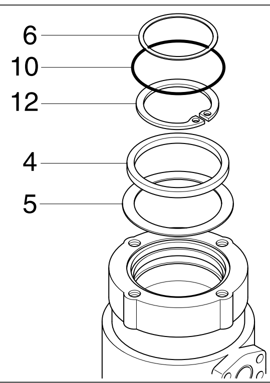


21078DA13

(4) Fit shim(5), spacer(4) and retainer ring (12) to shaft(2).

(5) Fit O-ring(10) to hub(1).

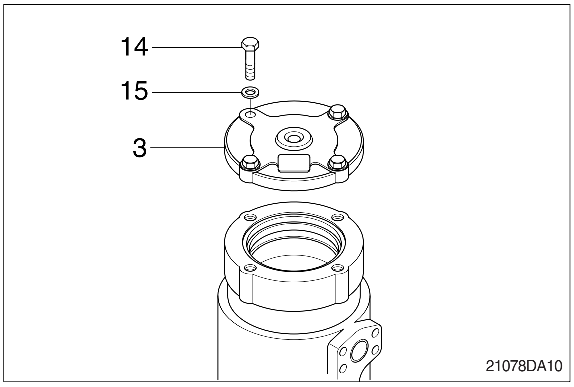
(6) Fit shim(6) to shaft(2).



21078DA11

(7) Install cover(3) to body(1) and tighten bolts(14).

· Torque : 10~12.5kgf · m(72.3~90.4lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

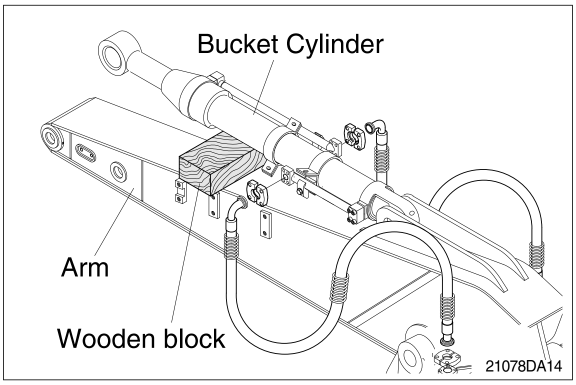
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.


13031GE18

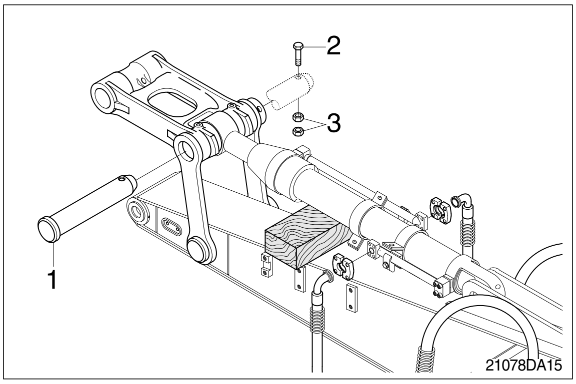
① Set block between bucket cylinder and arm.



21078DA14

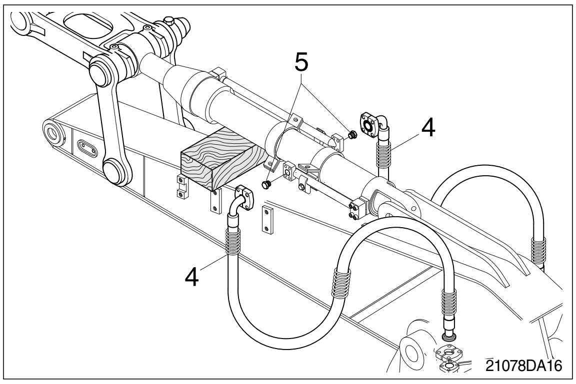
② Remove bolt(2), nut(3) and pull out pin (1).

※ 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.

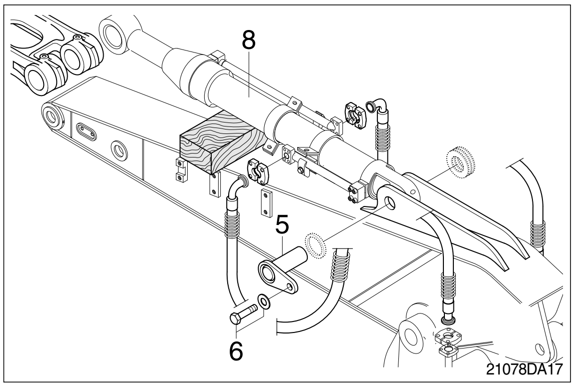


21078DA16

④ Sling bucket cylinder assembly(8) and remove bolt(6) then pull out pin (5).

⑤ Remove bucket cylinder assembly(8).

· Weight : 174㎏(384lb)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

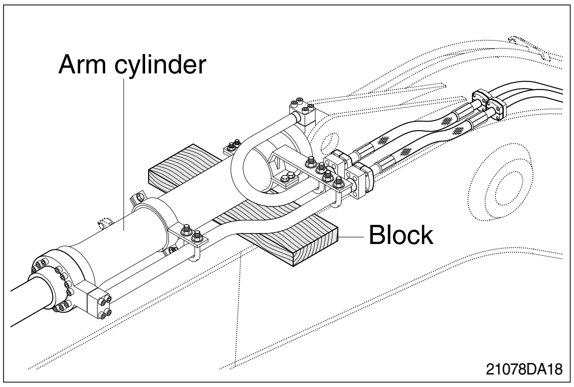
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

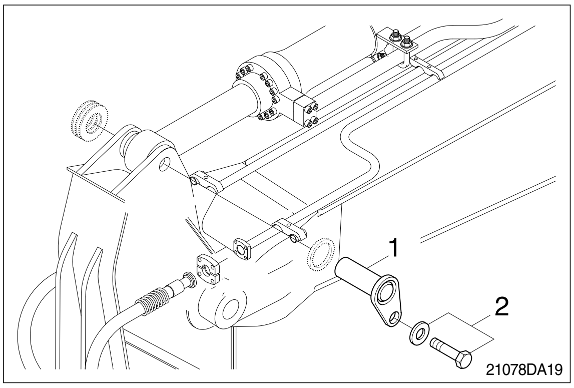
※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



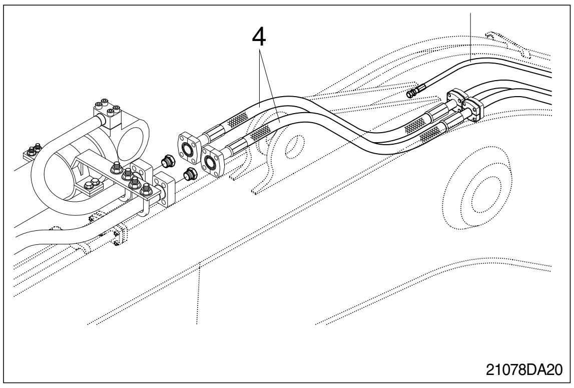
② Remove bolt(2) and pull out pin(1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses(4) and put plugs on cylinder pipe.

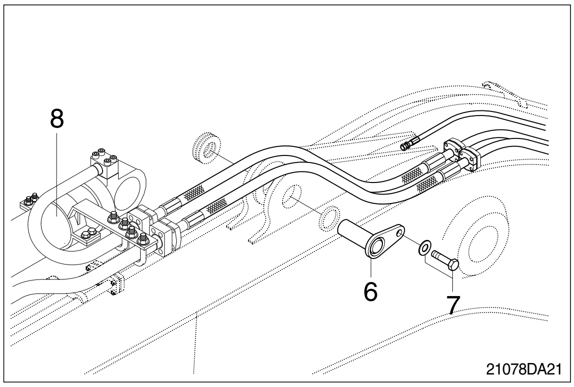
④ Disconnect greasing pipings(5).



⑤ Sling arm assembly(8) and remove bolt (7) then pull out pin(6).

⑥ Remove arm cylinder assembly(8).

· Weight : 288㎏(635lb)



(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.

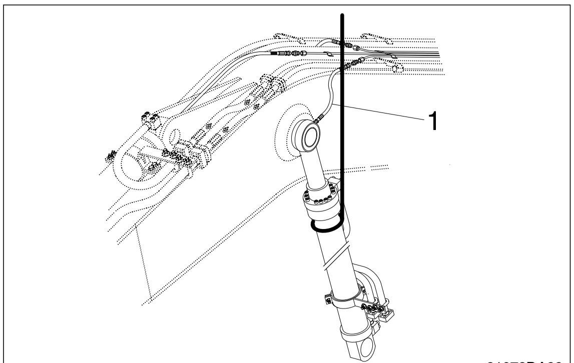
⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ 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.

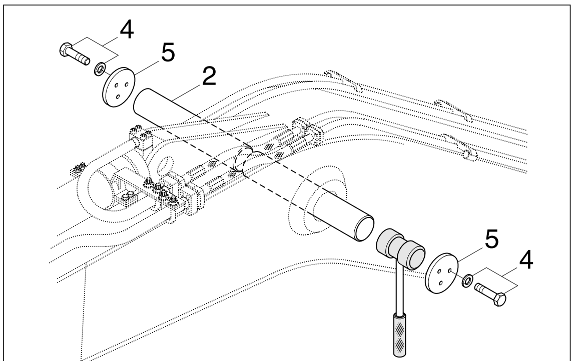
13031GE18



21078DA22

③ Remove bolt(4), stop plate(5) and pull out pin(2).

※ Tie the rod with wire to prevent it from coming out.



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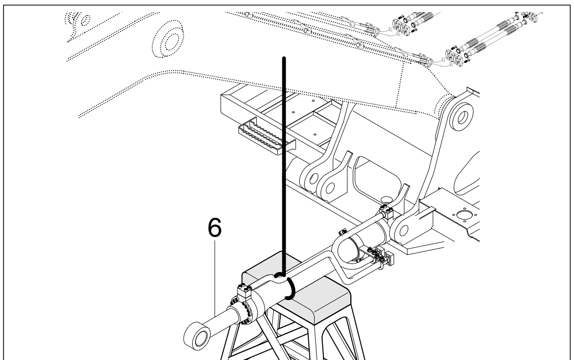
④ Lower the boom cylinder assembly(6) on a stand.



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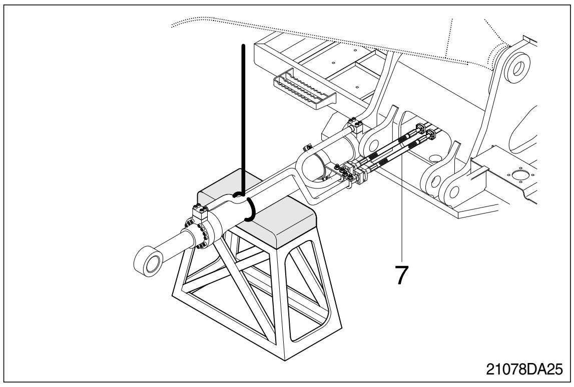
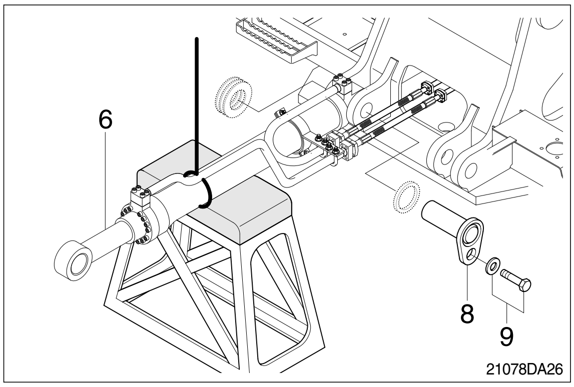
⑤ Disconnect boom cylinder hoses(7) and put plugs on cylinder pipe.



⑥ Remove bolt(9) and pull out pin(8).

⑦ Remove boom cylinder assembly(6).

· Weight : 182kg(386lb)



(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.

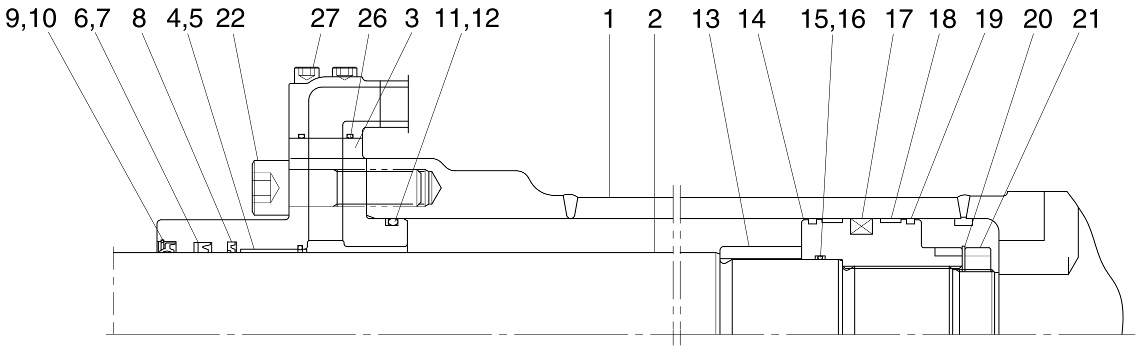
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

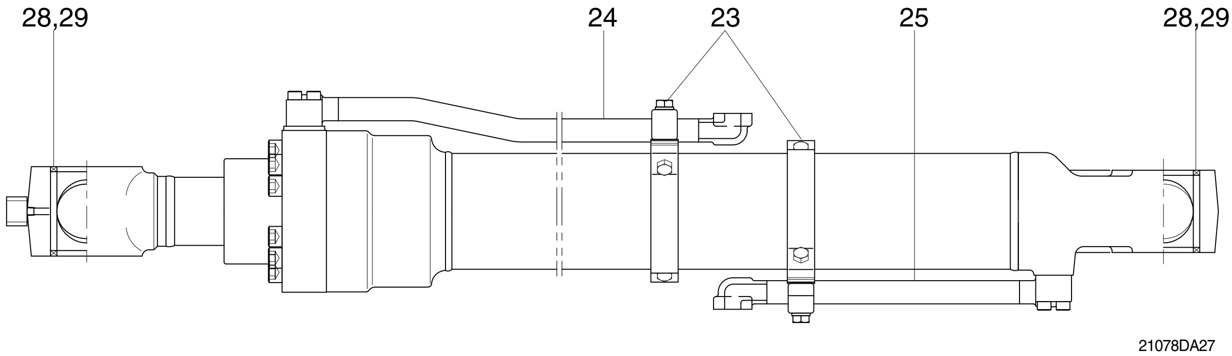
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

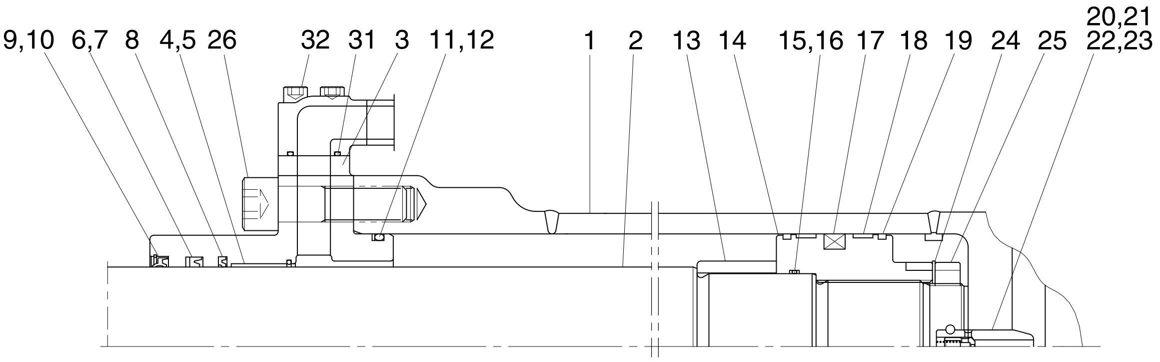


Internal detail

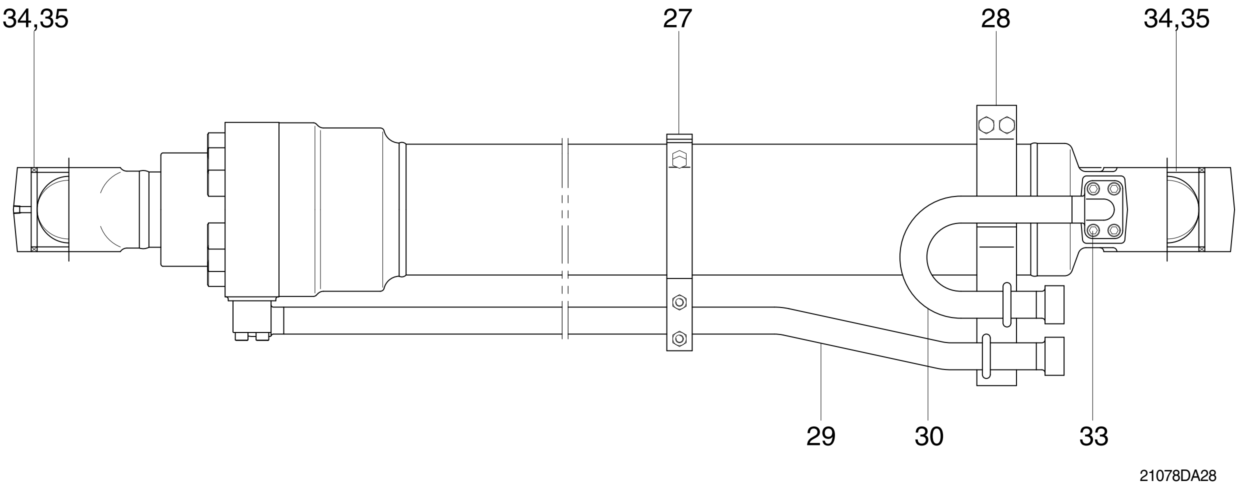


1	Tube assembly	11	O-ring	21	Lock nut
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Band assembly
4	DD2 bushing	14	Piston	24	Pipe assembly(R)
5	Snap ring	15	O-ring	25	Pipe assembly(B)
6	Rod seal	16	Back up ring	26	O-ring
7	Back up ring	17	Piston seal	27	Hexagon socket head bolt
8	Buffer ring	18	Wear ring	28	Pin bushing
9	Dust wiper	19	Dust ring	29	Dust seal
10	Snap ring	20	Lock washer		

(2) Arm cylinder

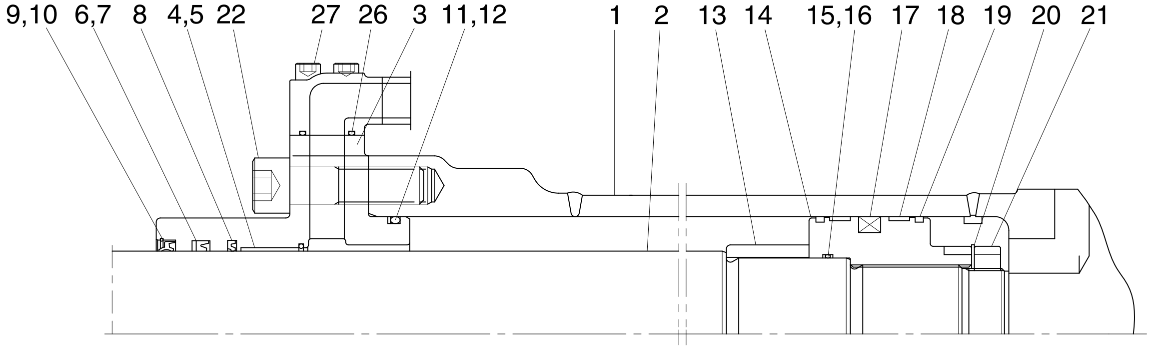


Internal detail

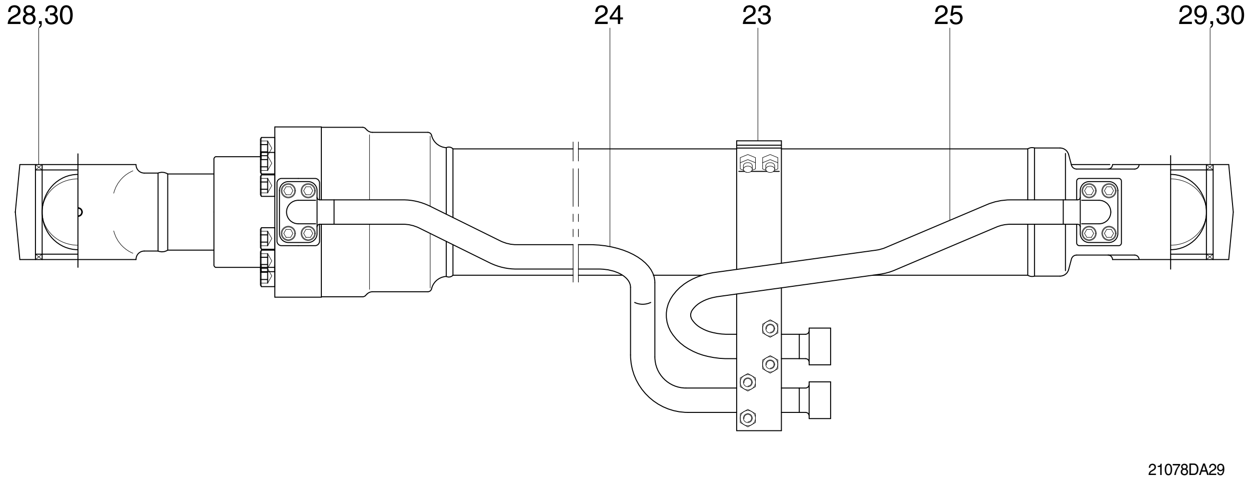


1	Tube assembly	13	Cushion ring	25	Lock nut
2	Rod assembly	14	Piston	26	Hexagon socket head bolt
3	Gland	15	O-ring	27	Band assembly(R)
4	DD2 bushing	16	Back up ring	28	Band assembly(B)
5	O-ring	17	Piston seal	29	Pipe assembly(R)
6	rod seal	18	Wear ring	30	Pipe assembly(B)
7	Back up ring	19	Dust ring	31	O-ring
8	Buffer ring	20	Cushion spear	32	Hexagon socket head bolt
9	Dust wiper	21	Check valve	33	Hexagon socket head bolt
10	Snap ring	22	Coil spring	34	Pin bushing
11	O-ring	23	Stop ring	35	Dust seal
12	Back up ring	24	Lock washer		

(3) Boom cylinder



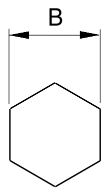
Internal detail



1	Tube assembly	11	O-ring	21	Lock nut
2	Rod assembly	12	Back up ring	22	Hexagon socket head bolt
3	Gland	13	Cushion ring	23	Band assembly
4	DD2 bushing	14	Piston	24	Pipe assembly(R)
5	Snap ring	15	O-ring	25	Pipe assembly(B)
6	Rod seal	16	Back up ring	26	O-ring
7	Back up ring	17	Piston seal	27	Hexagon socket head bolt
8	Buffer ring	18	Wear ring	28	Pin bushing
9	Dust wiper	19	Dust ring	29	Pin bushing
10	Snap ring	20	Lock washer	30	Dust seal

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
	8	
	14	
	17	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder	22	M16	23.0±2.0	166±14.5
	Boom cylinder	22	M16	23.0±2.0	166±14.5
	Arm cylinder	26	M18	32.0±3.0	232±21.7
Socket head bolt	Bucket cylinder	27	M10	5.4±0.5	39.1±3.6
	Boom cylinder	27	M10	5.4±0.5	39.1±3.6
	Arm cylinder	32	M12	9.4±1.0	68.0±7.2
		33	M10	5.4±0.5	39.1±3.6
Lock nut	Bucket cylinder	21	M60	100±10.0	723±72.3
	Boom cylinder	21	M60	100±10.0	723±72.3
	Arm cylinder	25	M70	100±10.0	723±72.3
Piston	Bucket cylinder	14	-	150±15.0	1085±109
	Boom cylinder	14	-	150±15.0	1085±109
	Arm cylinder	14	-	150±15.0	1085±109

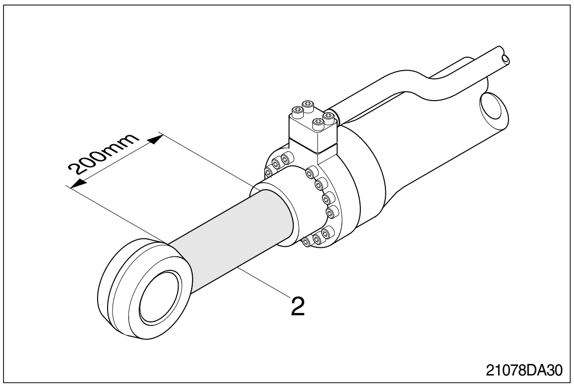
3) DISASSEMBLY

(1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

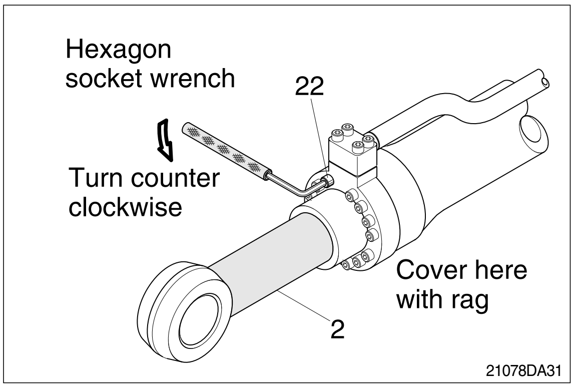
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly(2) about 200㎜ (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



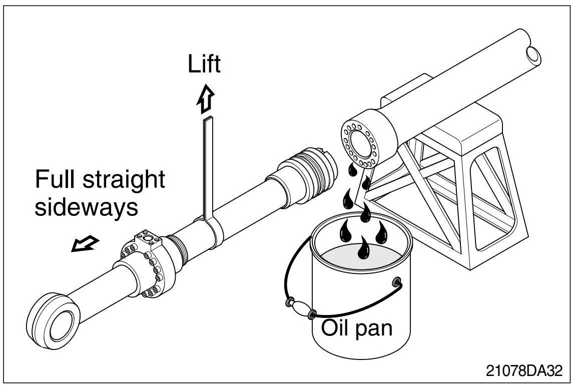
③ Loosen and remove socket bolts(22) of the gland in sequence.

※ 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).

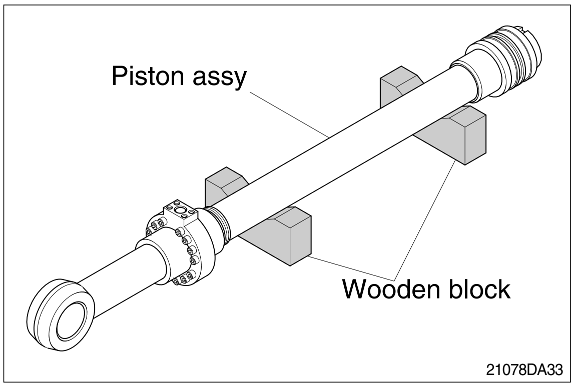
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly(2) with a crane or some means and draw it out. However, when rod assembly(2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



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.

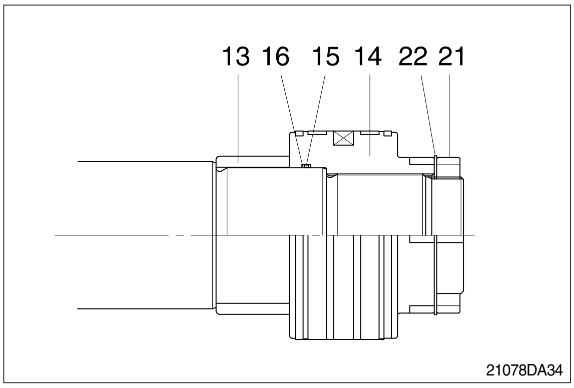


(2) Remove piston and cylinder head

① Remove lock nut(21).

※ Since lock nut(21) and lock washer(22) is tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the lock nut(21) and lock washer (22).

② Remove piston assembly(14), back up ring(16), and O-ring(15).

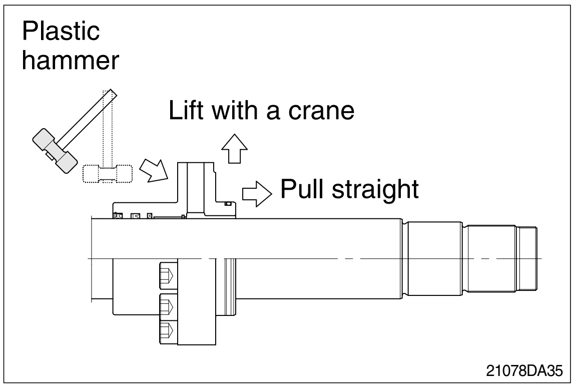


③ Remove the cylinder head assembly from rod assembly(2).

※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.

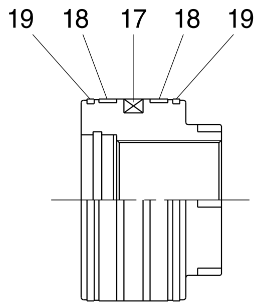
※ Pull it straight with cylinder head assembly lifted with a crane.

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

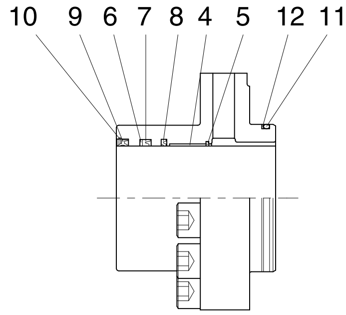
① Remove wear ring(18).
② Remove dust ring(19) and piston seal (17).
※ Exercise care in this operation not to damage the grooves.



8-156(1)

(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.



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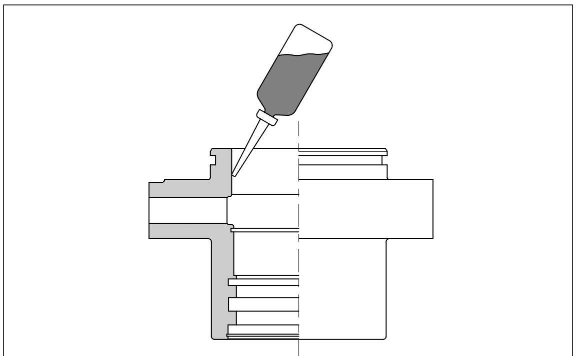
3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

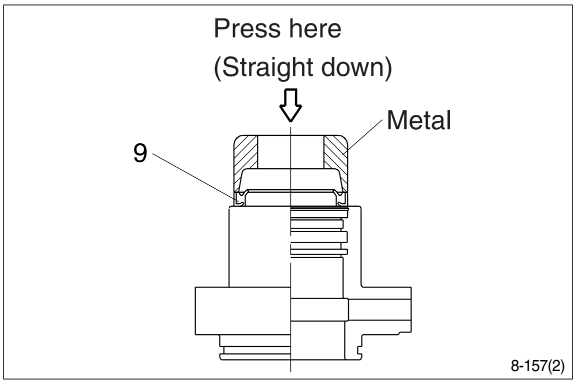
① Coat the inner face of gland(3) with hydraulic oil.



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.

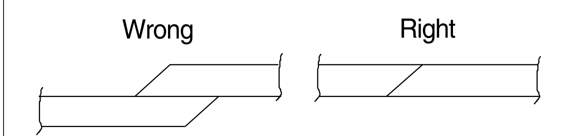


8-157(2)

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.

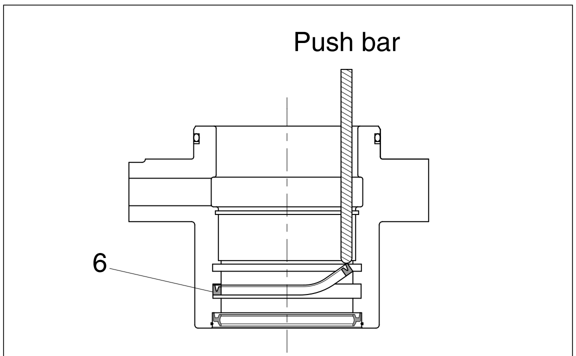
※ Insert the backup ring until one side of it is inserted into groove.



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.

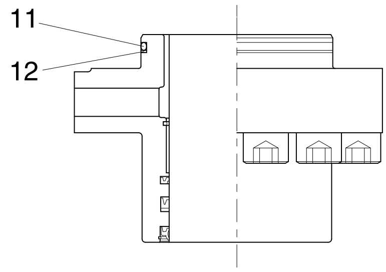


21078DA38

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).

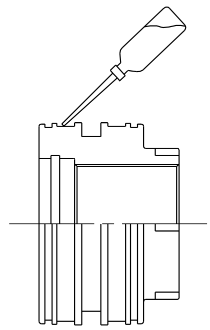


21078DA39

(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.

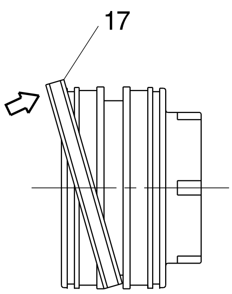


8-158(2)

② Fit piston seal(17) to piston.

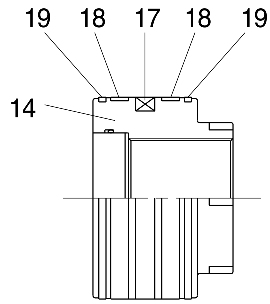
※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



8-158(3)

③ Fit wear ring(18) and dust ring(19) to piston(14).



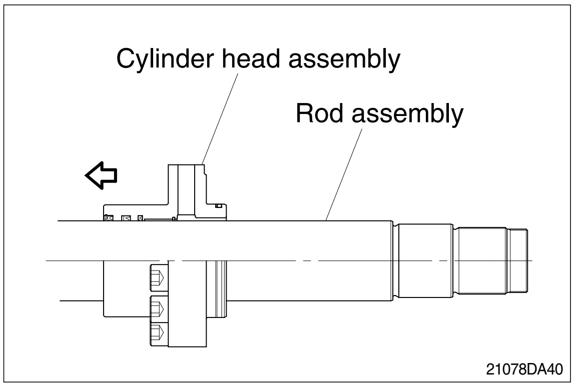
8-158(4)

(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.



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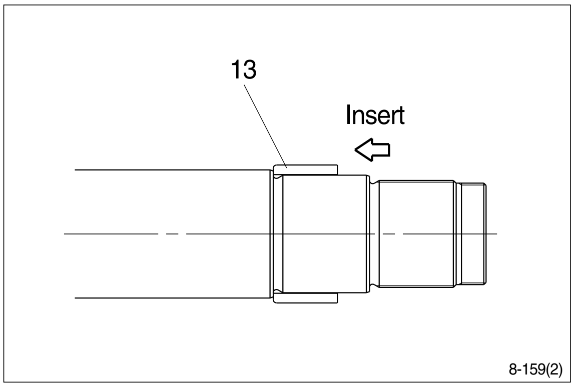
④ Insert cushion ring(13) to rod assembly.

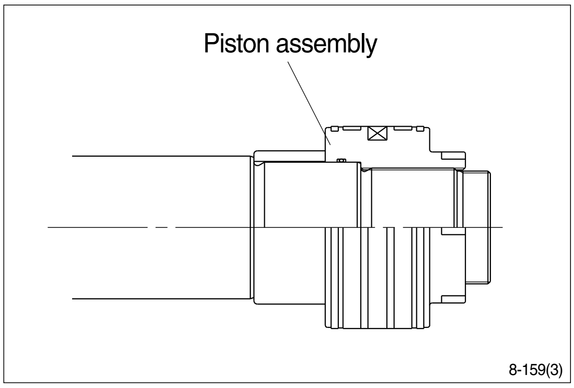
※ Note that cushion ring(13) has a direction in which it should be fitted.



8-159(2)

⑤ Fit piston assembly to rod assembly.

· Tightening torque : 100±10kgf · m (723±72lbf · ft)

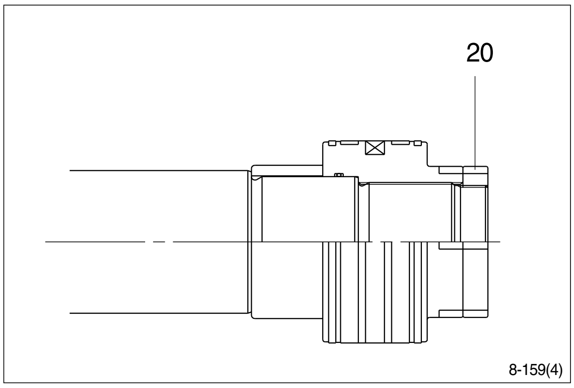


8-159(3)

⑥ Fit lock nut(20) to piston.

· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	21	100±10	723.3±72.3
Boom	21	100±10	723.3±72.3
Arm	25	100±10	723.3±72.3



8-159(4)

(3) Overall assemble

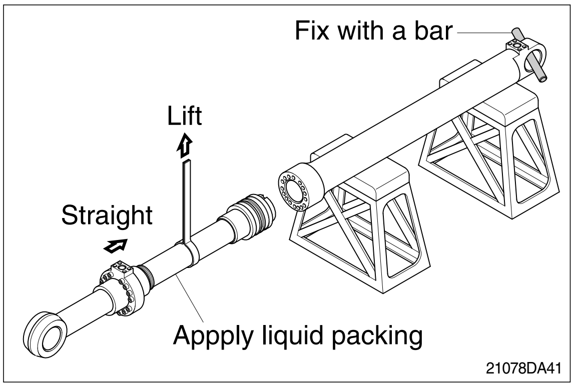
① Place a V-block on a rigid work bench. Mount the tube assembly(1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

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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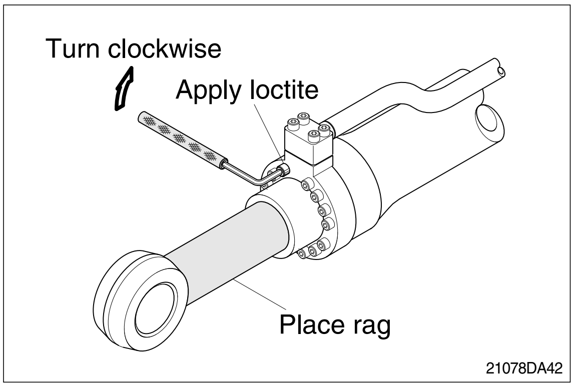


21078DA42

GROUP 10 UNDERCARRIAGE

1. TRACK LINK

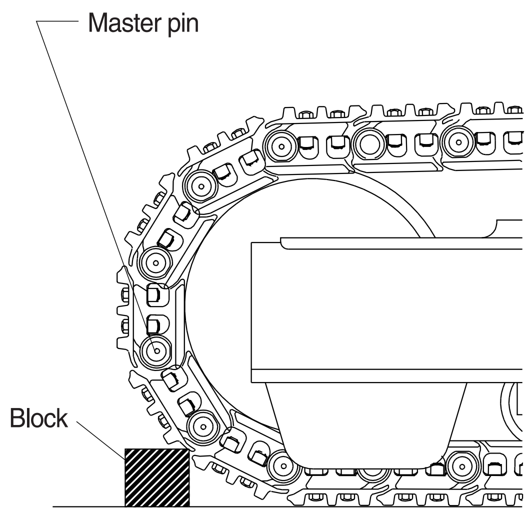
1) REMOVAL

(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.

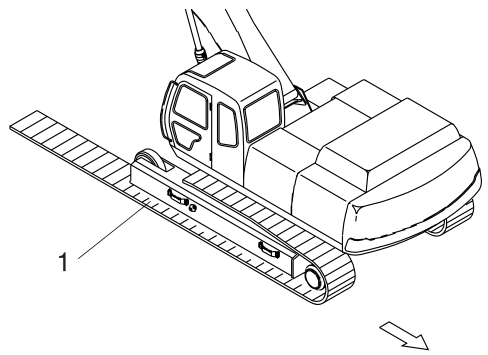


8-161(1)

(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.

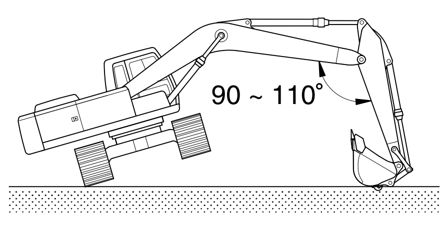


8-161(2)

2) INSTALL

(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.



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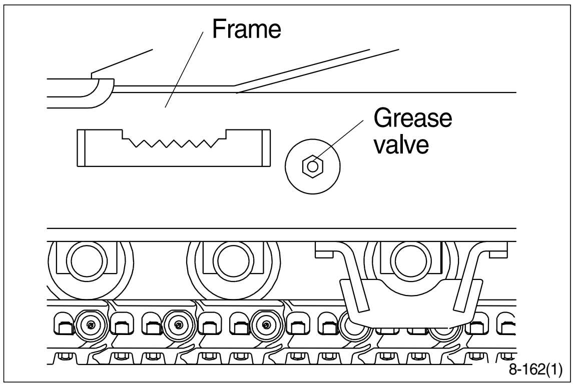
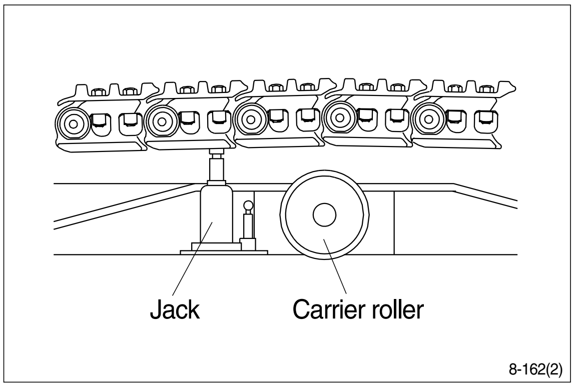
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.

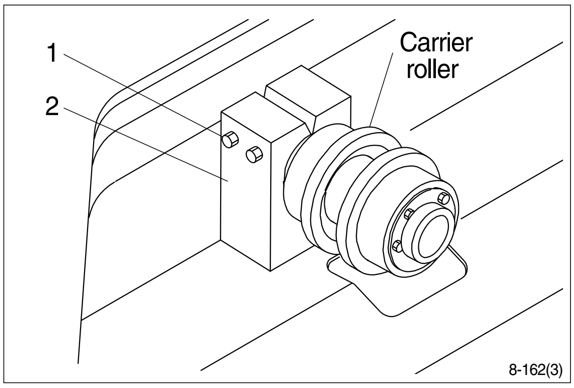


(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
· Weight : 21㎏(46lb)



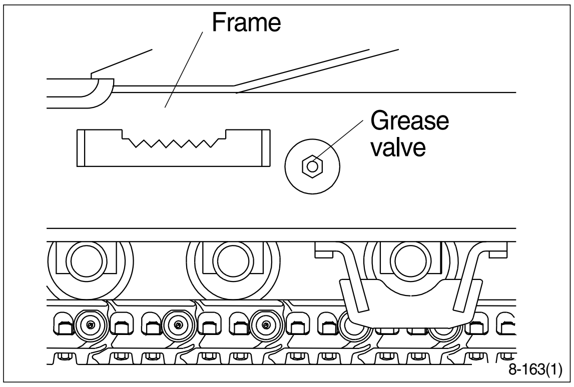
2) INSTALL

(1) Carry out installation in the reverse order to removal.

3. TRACK ROLLER

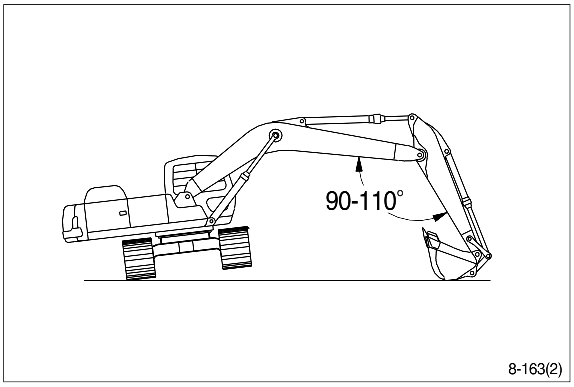
1) REMOVAL

(1) Loosen tension of the track link.



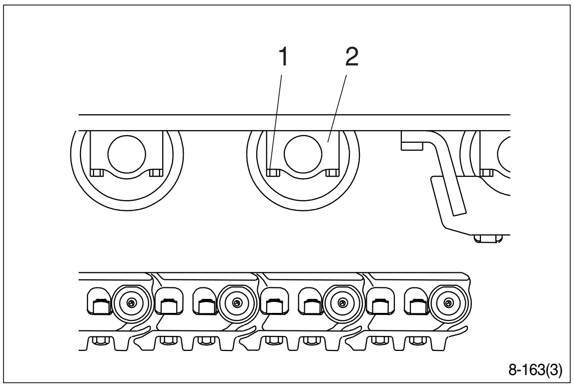
(2) Using the work equipment, push up track frame on side which is to be removed.

※ After jack up the machine, set a block under the unit.



(3) Remove the mounting bolt(1) and draw out the track roller(2).

· Weight : 38.3kg(84.4lb)



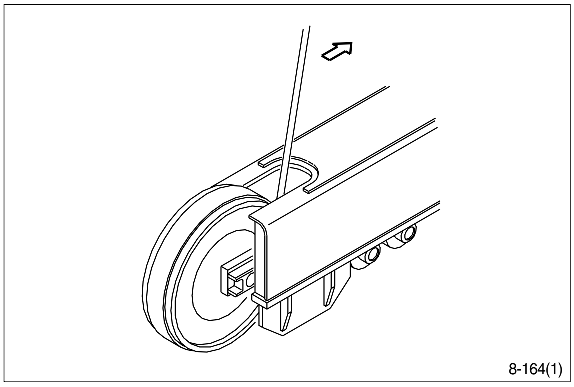
2) INSTALL

(1) Carry out installation in the reverse order to removal.

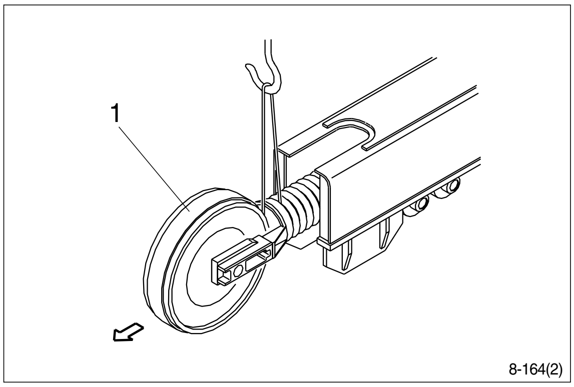
4. IDLER AND RECOIL SPRING

1) REMOVAL

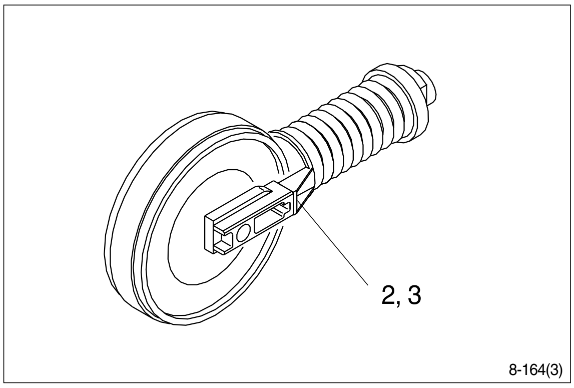
(1) Remove the track link.
For detail, see **removal of track link**.



(2) Sling the recoil spring(1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 270kg(595lb)

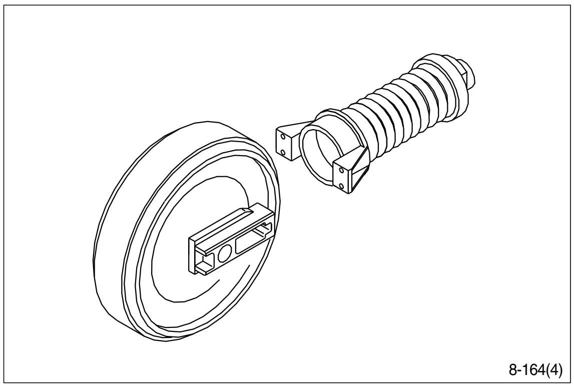


(3) Remove the bolts(2), washers(3) and separate idler from recoil spring.



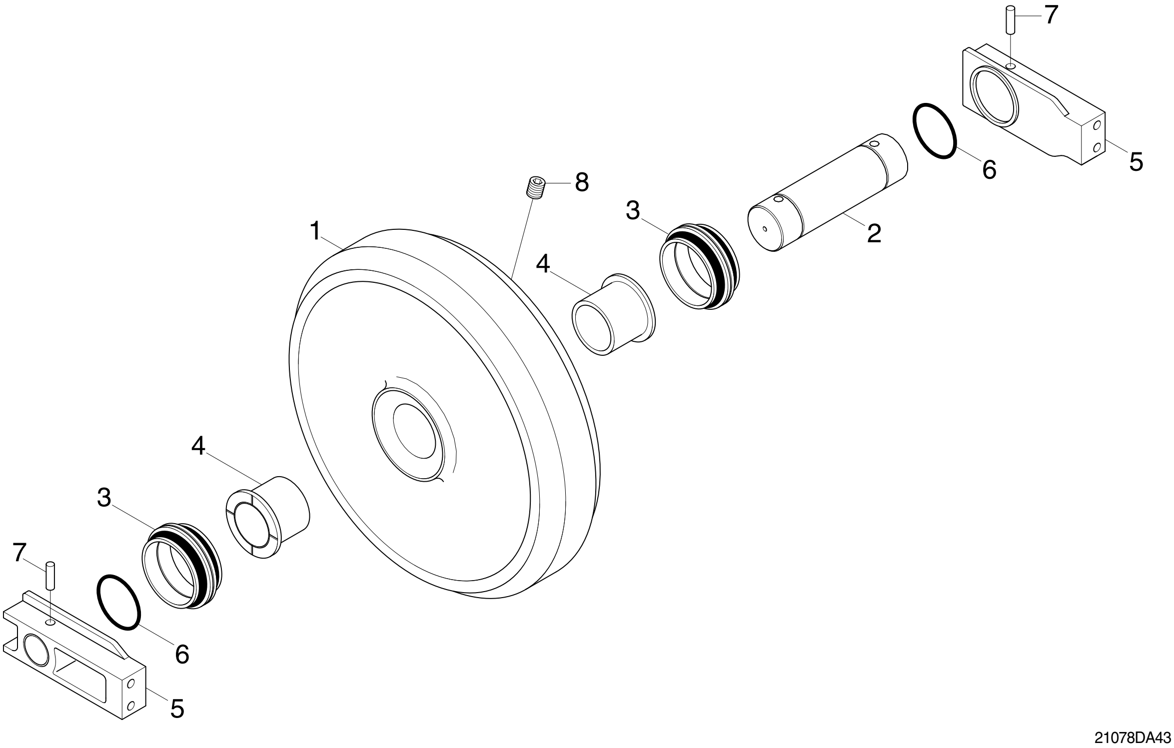
2) INSTALL

(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

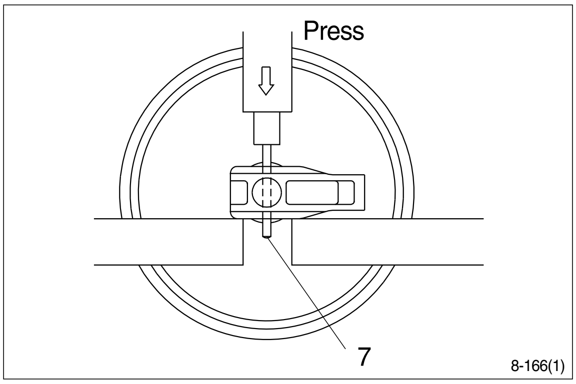


1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

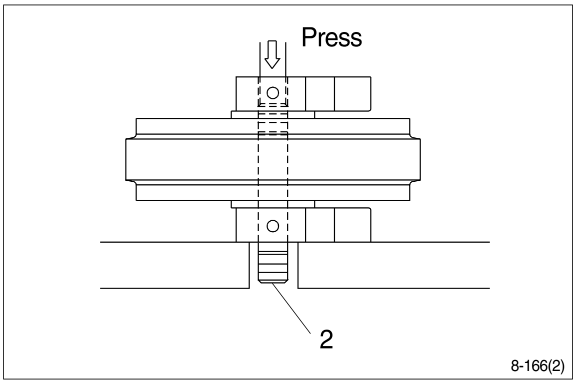
② Draw out the spring pin(7), using a press.



③ Pull out the shaft(2) with a press.

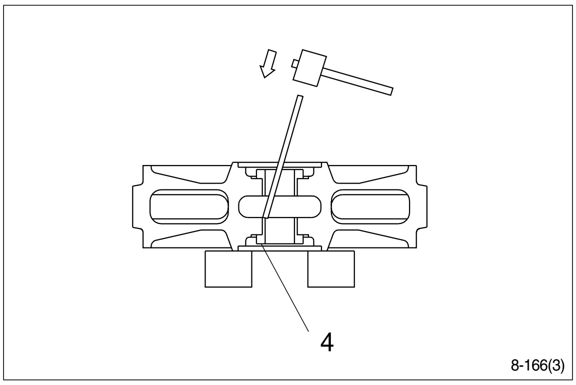
④ Remove seal(3) from idler(1) and bracket (5).

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.

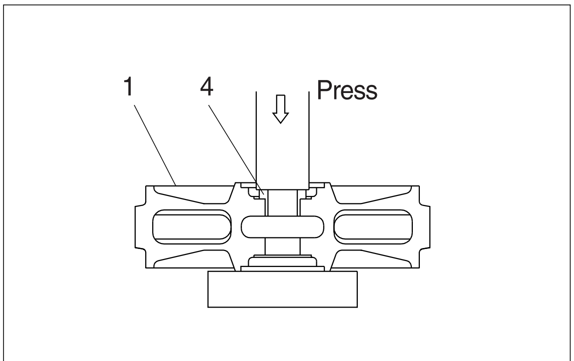


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

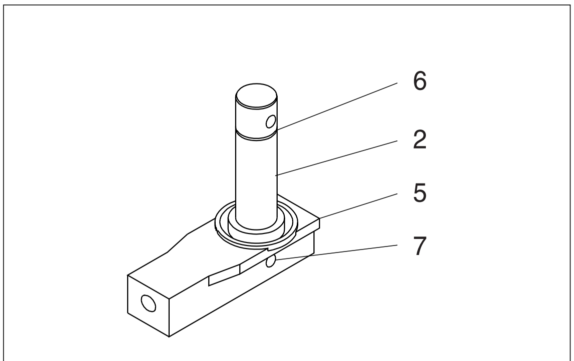
① Cool up bushing(4) fully by some dry ice and press it into shell(1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

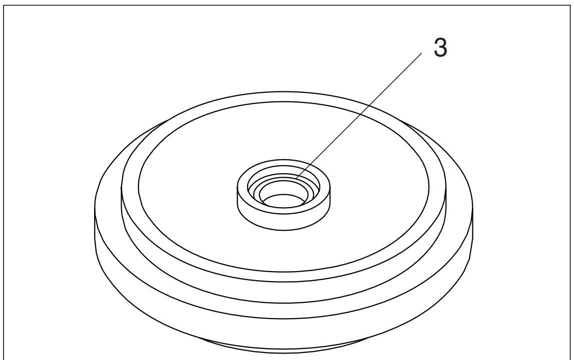
② Coat O-ring(6) with grease thinly, and install it to shaft(2).

③ Insert shaft(2) into bracket(5) and drive in the spring pin(7).



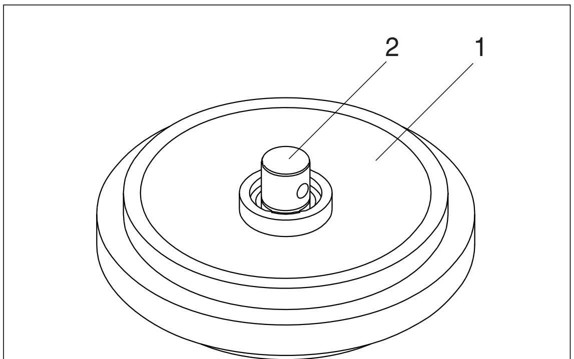
8-167(2)

④ Install seal(3) to shell(1) and bracket(5).



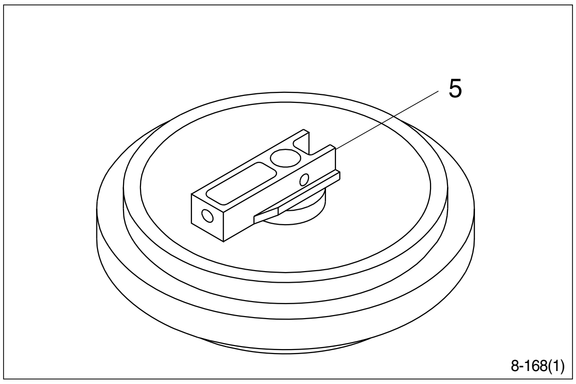
8-167(3)

⑤ Install shaft(2) to shell(1).

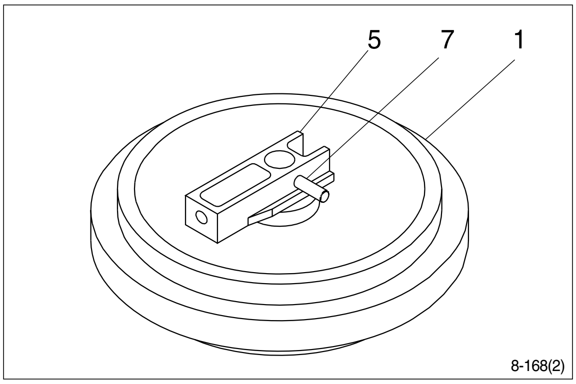


8-167(4)

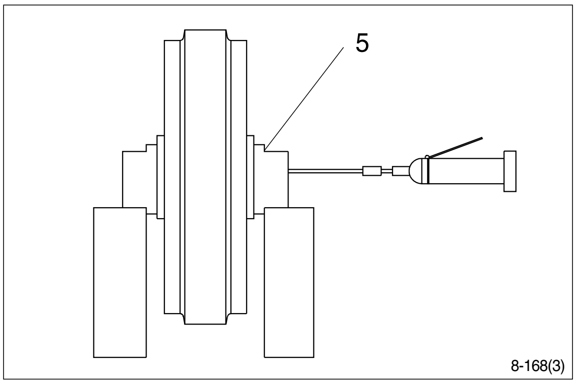
⑥ Install bracket(5) attached with seal(3).



⑦ Knock in the spring pin(7) with a hammer.

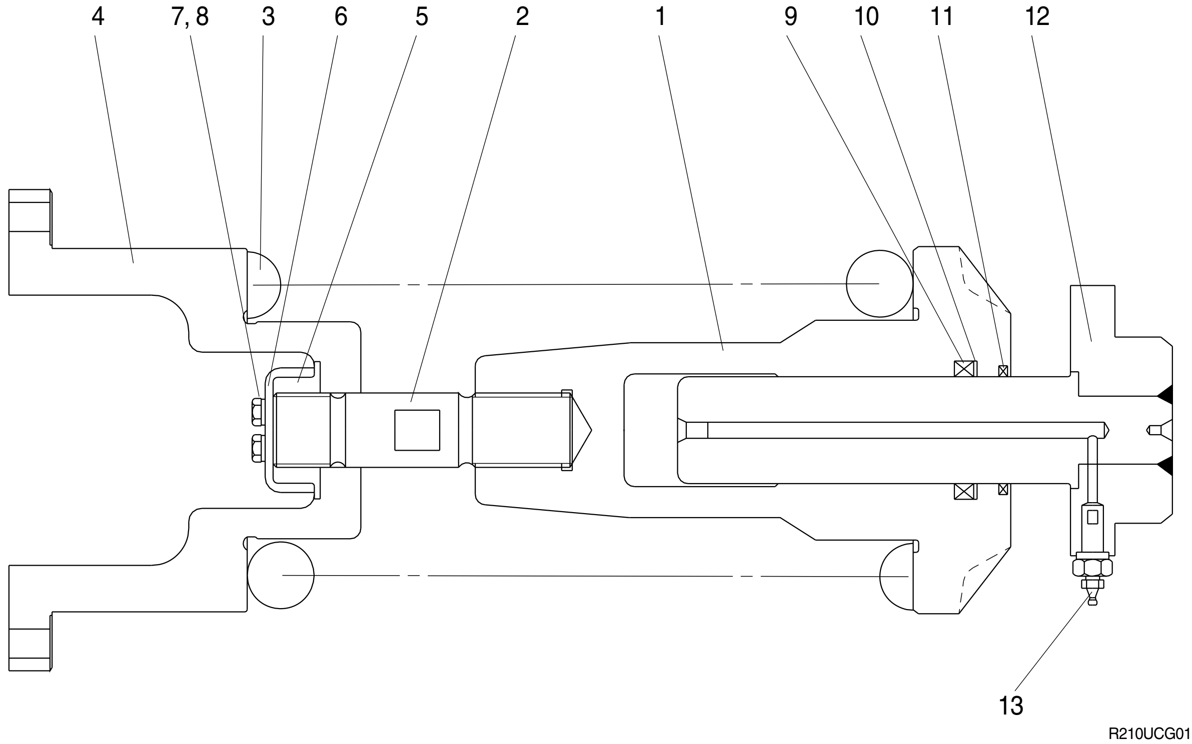


⑧ Lay bracket(5) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod assembly
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal		
5	Lock nut	10	Back up ring		

(2) Disassembly

① Apply pressure on spring(3) with a press.

※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

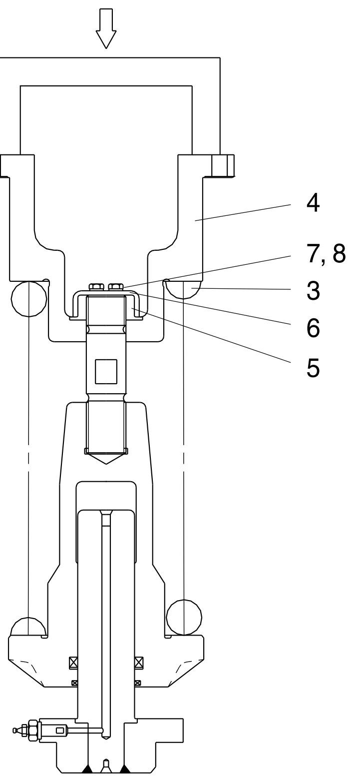
· Spring set load : 13716㎏(30238lb)

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.

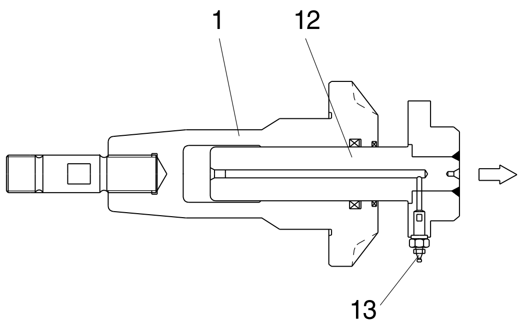
④ Lighten the press load slowly and remove bracket(4) and spring(3).



R210UCG2(1)

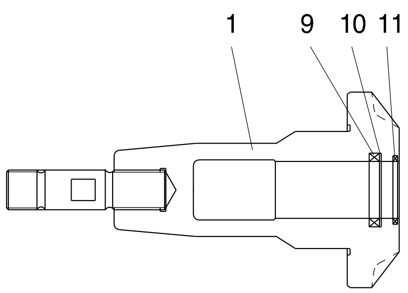
⑤ Remove rod(12) from body(1).

⑥ Remove grease valve(13) from rod(12).



R210UCG2(2)

⑦ Remove rod seal(9), back up ring(10) and dust seal(11).

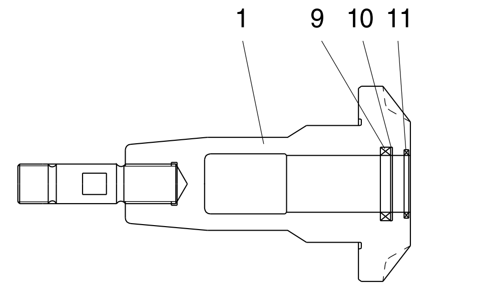


R210UCG2(3)

(3) Assembly

① 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.



R210UCG2(3)

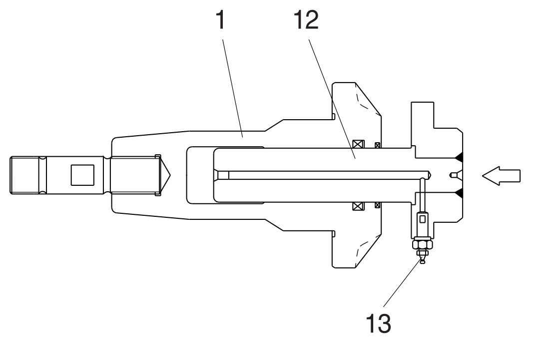
② Pour grease into body(1), then push in rod(12) by hand.

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 : 10±0.5kg · m (72.3±3.6lb · ft)



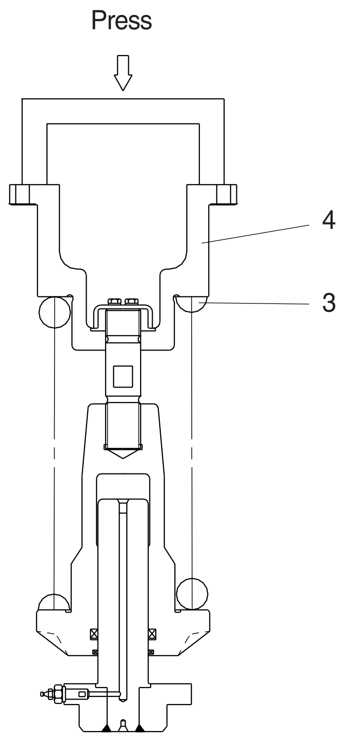
R210UCG2(4)

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.

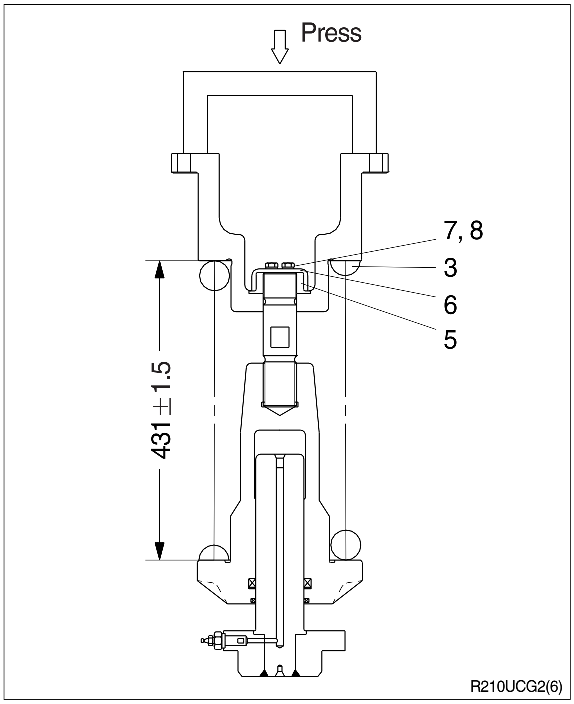
※ During the operation, pay attention specially to prevent the press from slipping out.



R210UCG2(5)

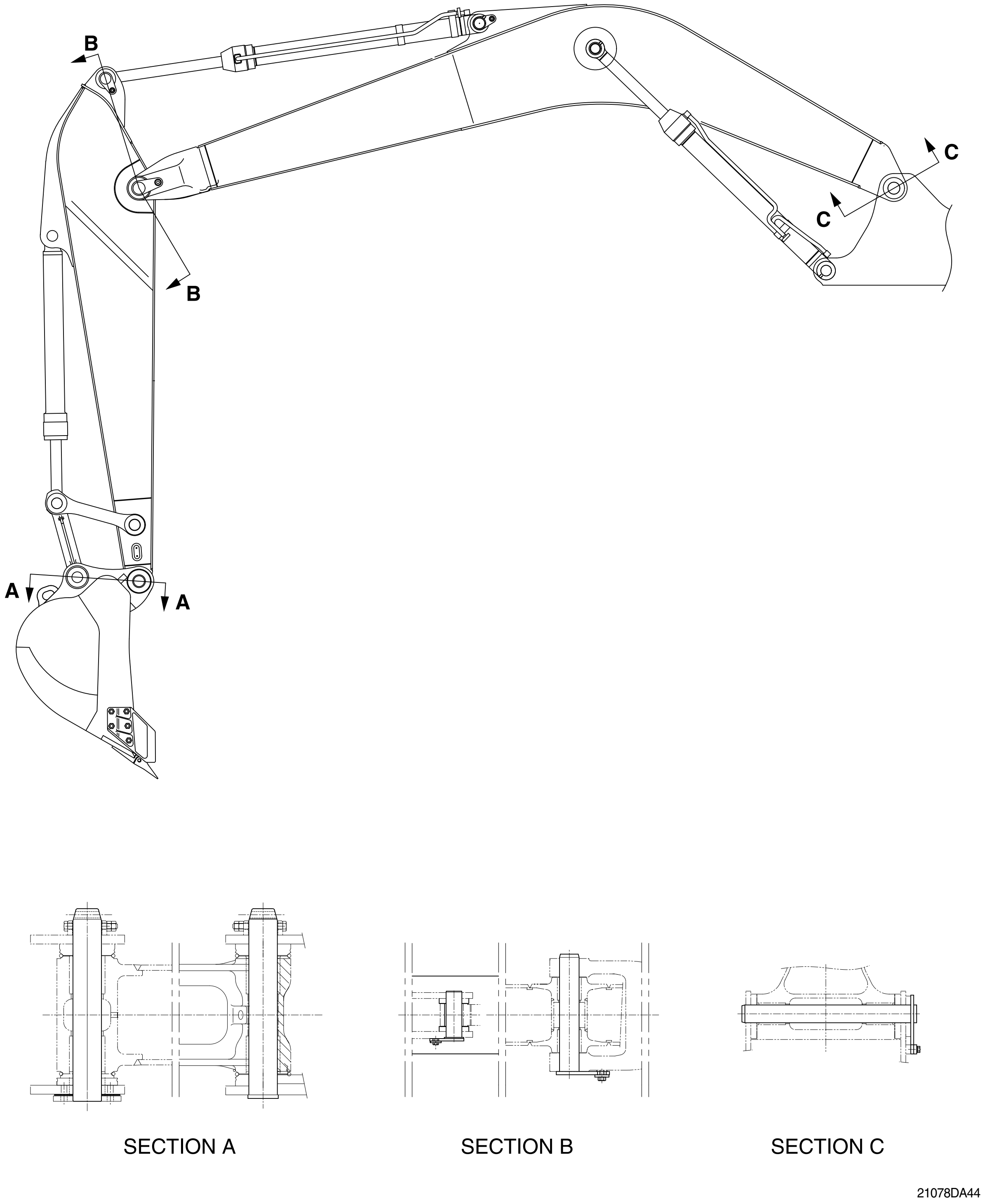
⑥ Lighten the press load and confirm the set length of spring(3).

⑦ After the setting of spring(3), install lock plate(6), spring washer(8) and bolt(7).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE

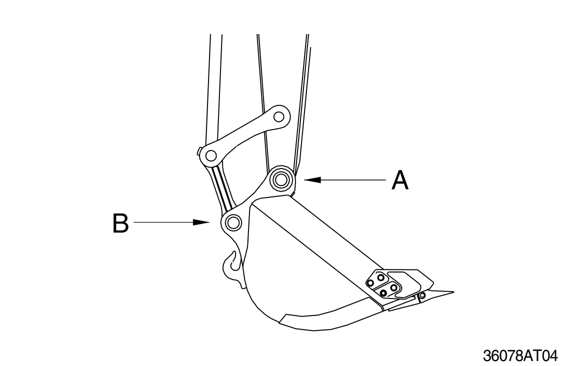


2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

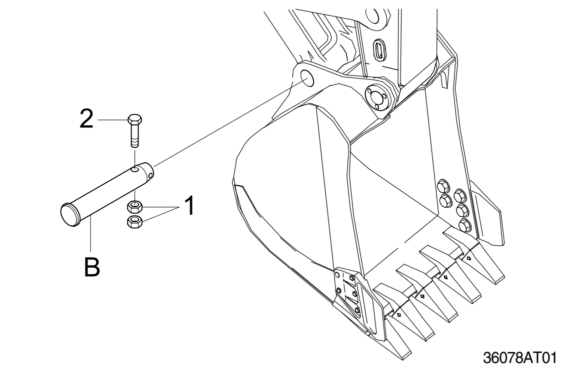
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



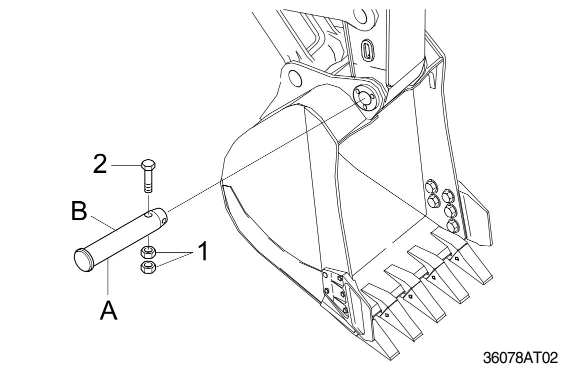
36078AT04

② Remove nut(1), bolt(2) and draw out the pin(A).



36078AT01

③ Remove nut(3), bolt(4) and draw out the pin(B).



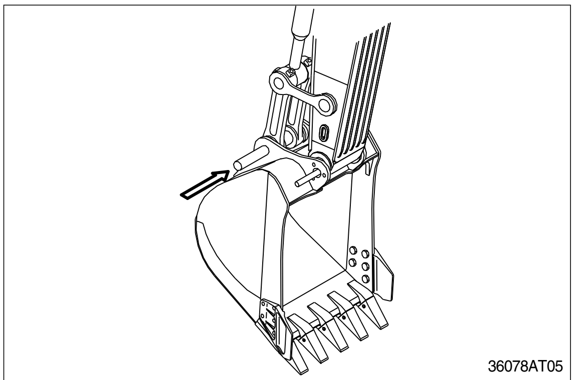
36078AT02

(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

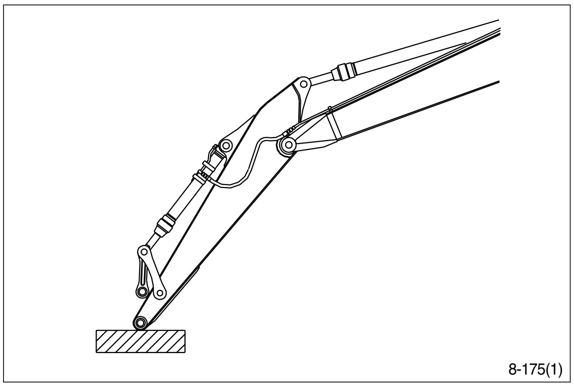
2) ARM ASSEMBLY

(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)

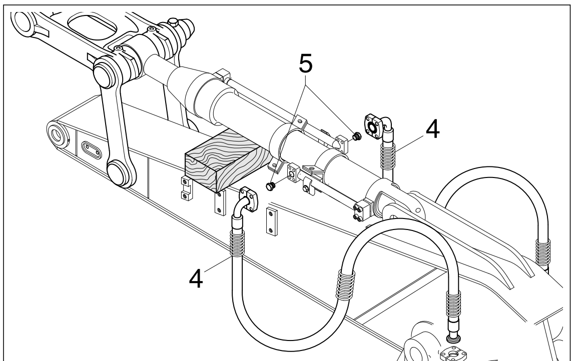
② Disconnect bucket cylinder hose(1).

⚠ 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.

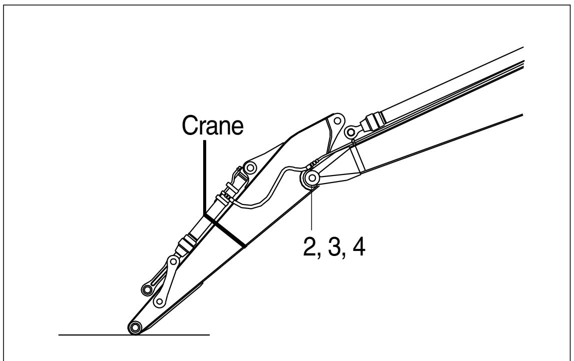
④ For details, see **removal of arm cylinder assembly.**
Place a wooden block under the cylinder and bring the cylinder down to it.



21078DA16

⑤ Remove bolt(2), plate(3) and pull out the pin(4) then remove the arm assembly.
· Weight : 1050kg(2310lb)

※ 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.

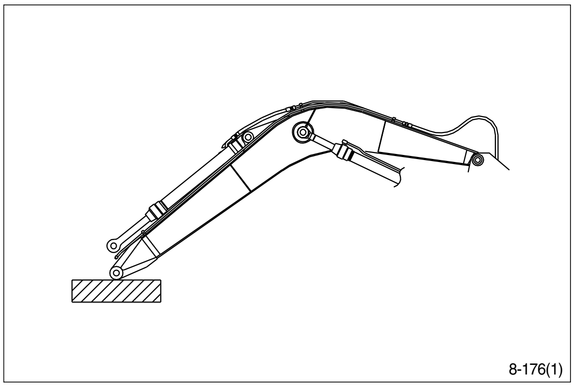
※ Bleed the air from the cylinder.

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.**

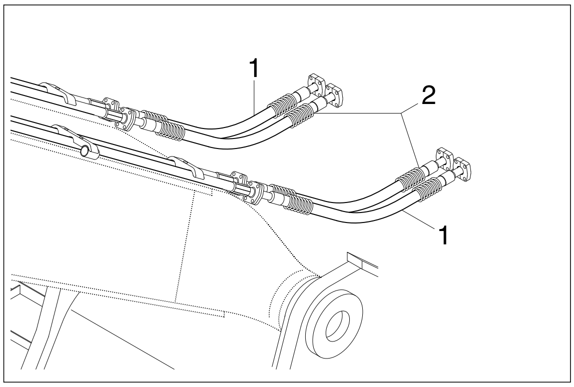


③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose(2) and arm cylinder hose(1).

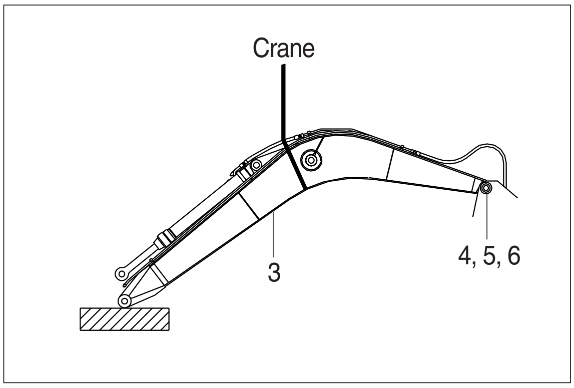
※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly(3).



⑥ Remove bolt(4), plate(5) and pull out the pin(6) then remove boom assembly.
・Weight :1950㎏(4300lb)

※ When lifting the boom assembly always lift the center of gravity.

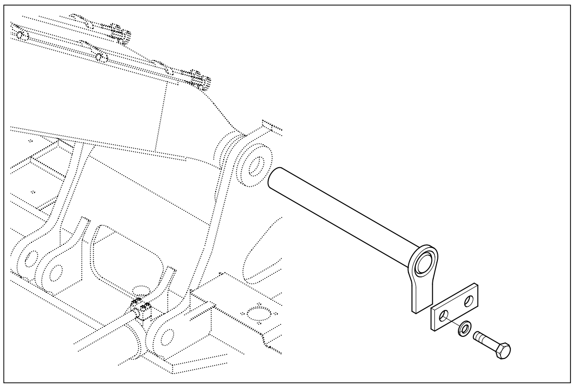


(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the arm assembly, always lift the center of gravity.

※ Bleed the air from the cylinder.



SECTION 9 COMPONENT MOUNTING TORQUE

SECTION 9 COMPONENT MOUNTING TORQUE

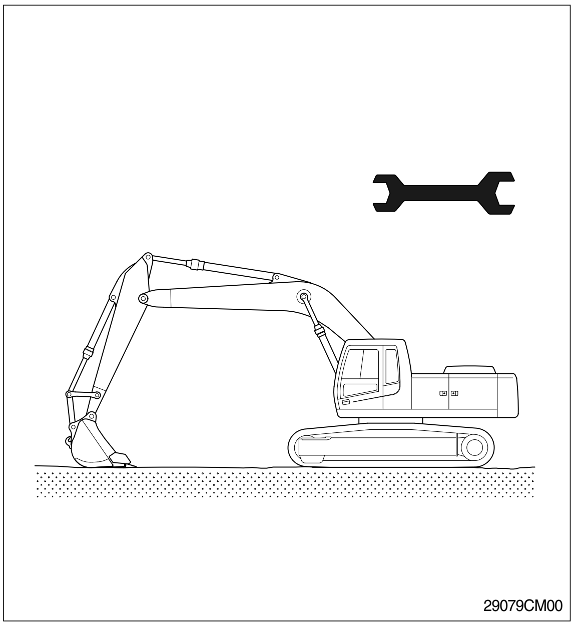
GROUP 1 INTRODUCTION GUIDE

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.

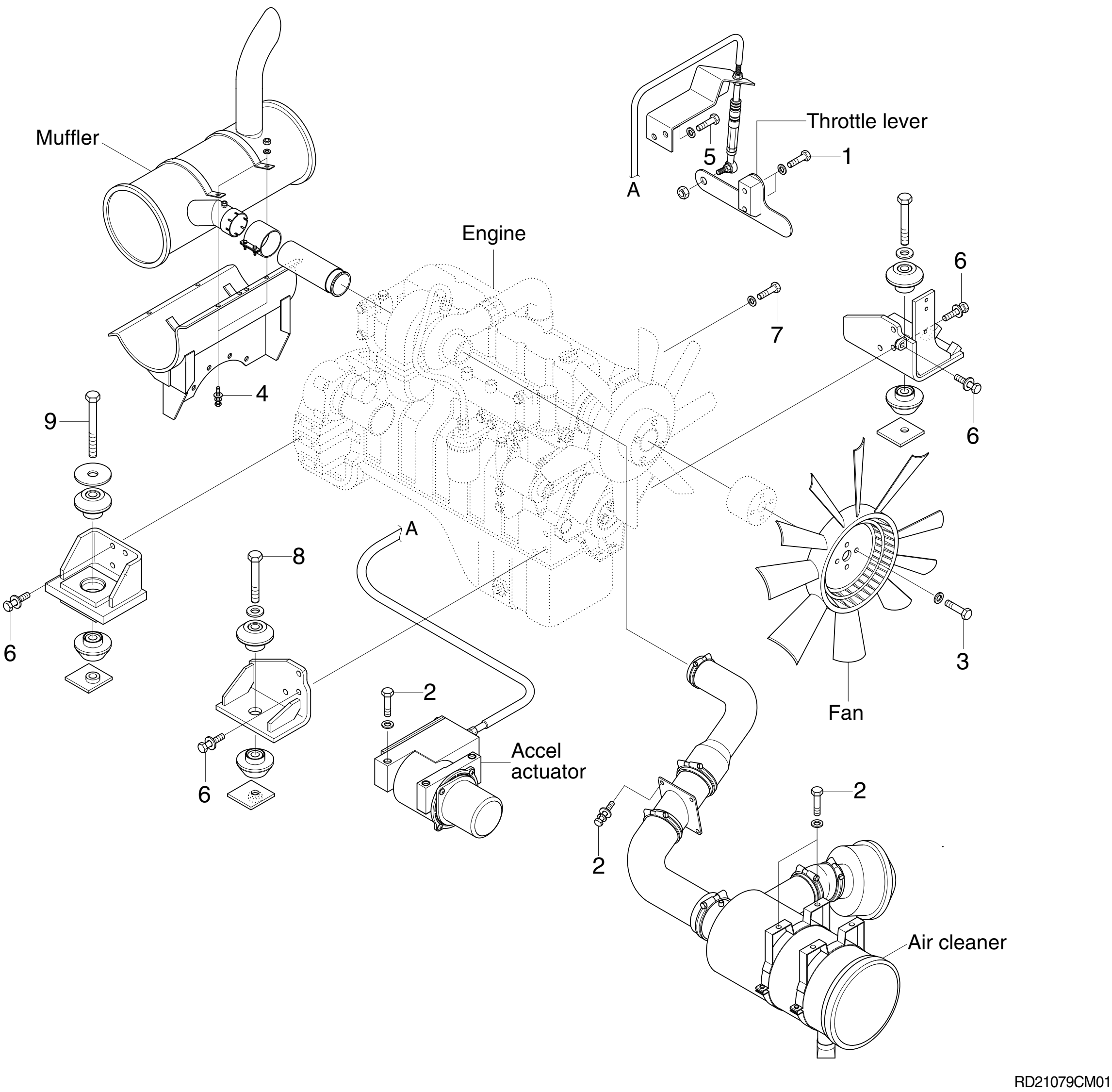
※ **Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.**

※ **Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.**



GROUP 2 ENGINE SYSTEM

ENGINE AND ACCESSORIES MOUNTING

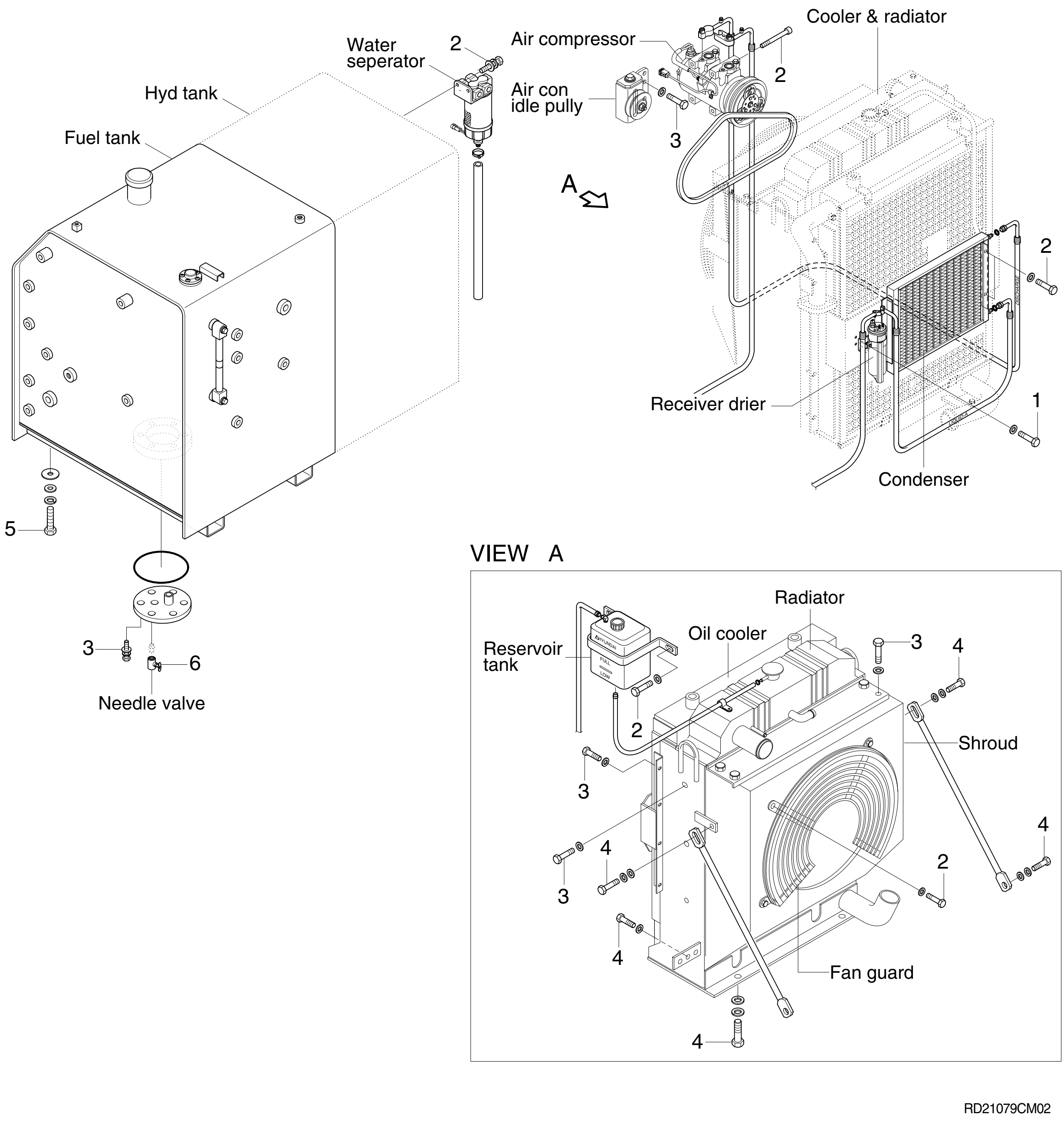


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.92±0.2	6.7±1.4
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	4.4±0.9	31.8±6.5
4	M10×1.5	6.9±1.4	49.9±10.1
5	M12×1.5	12.5±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
6	M12×1.75	10.0±2.0	72.3±14.5
7	M12×1.75	12.8±3.0	92.6±21.7
8	M20×2.5	55±3.5	398±25.3
9	M24×3.0	90±7.0	651±51
-	-	-	-

COOLING SYSTEM AND FUEL TANK MOUNTING



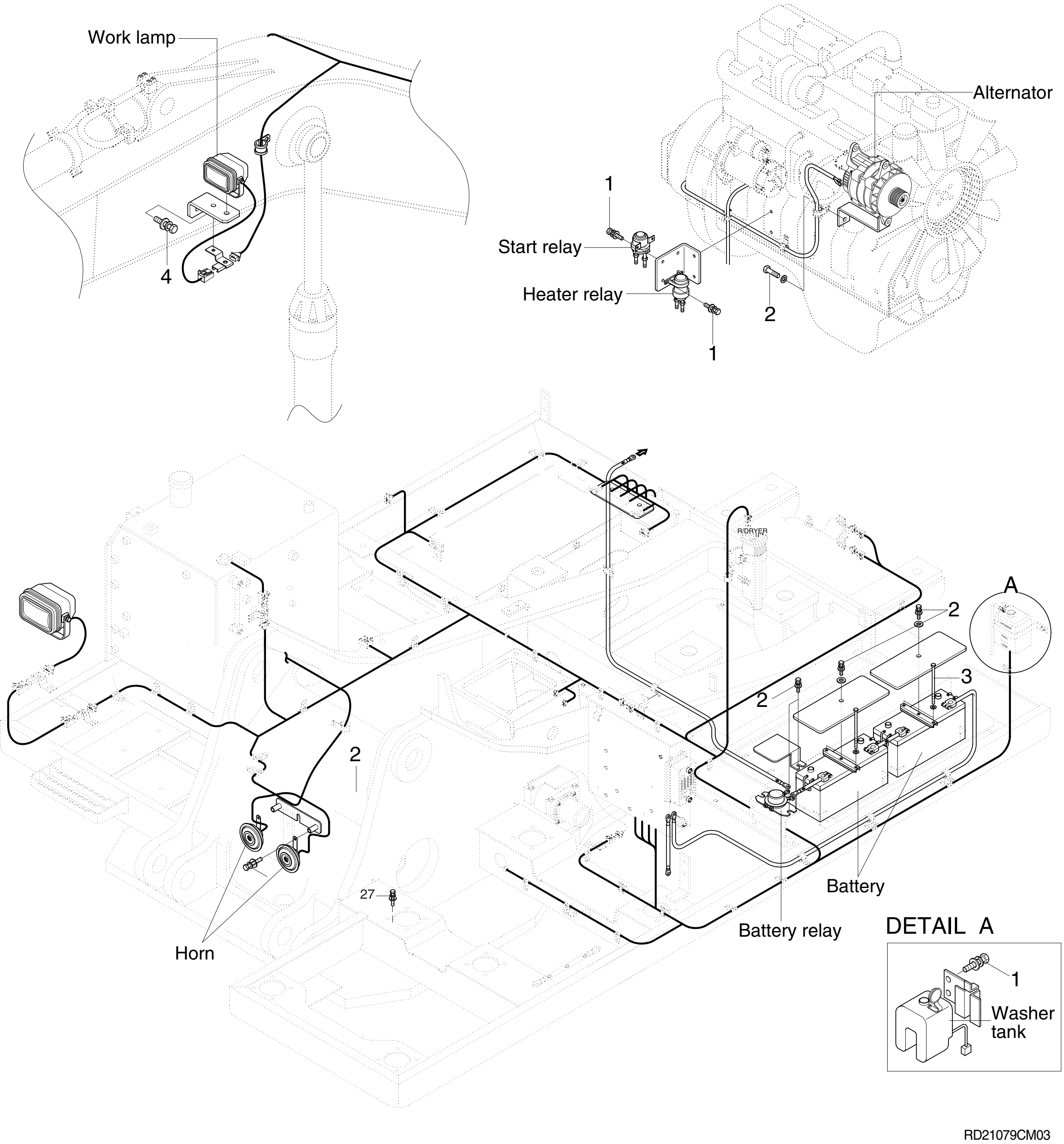
· Tightening torque

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

Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	92.6±21.7
5	M20×2.5	45±5.1	325±36.9
6	-	2.3±0.6	16.6±4.3

GROUP 3 ELECTRIC SYSTEM

ELECTRIC COMPONENTS MOUNTING 1

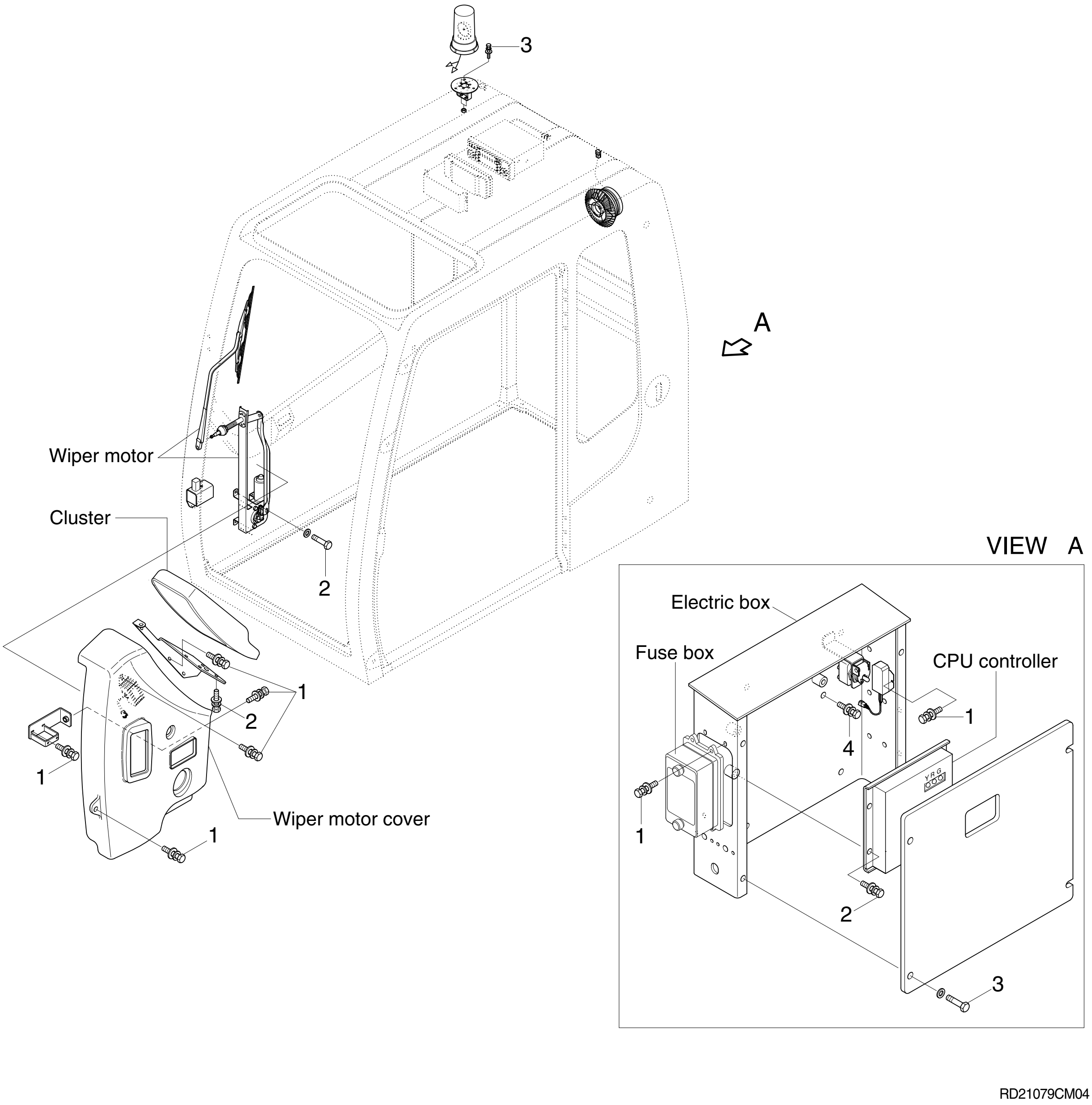


· Tightening torque

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

ELECTRIC COMPONENTS MOUNTING 2



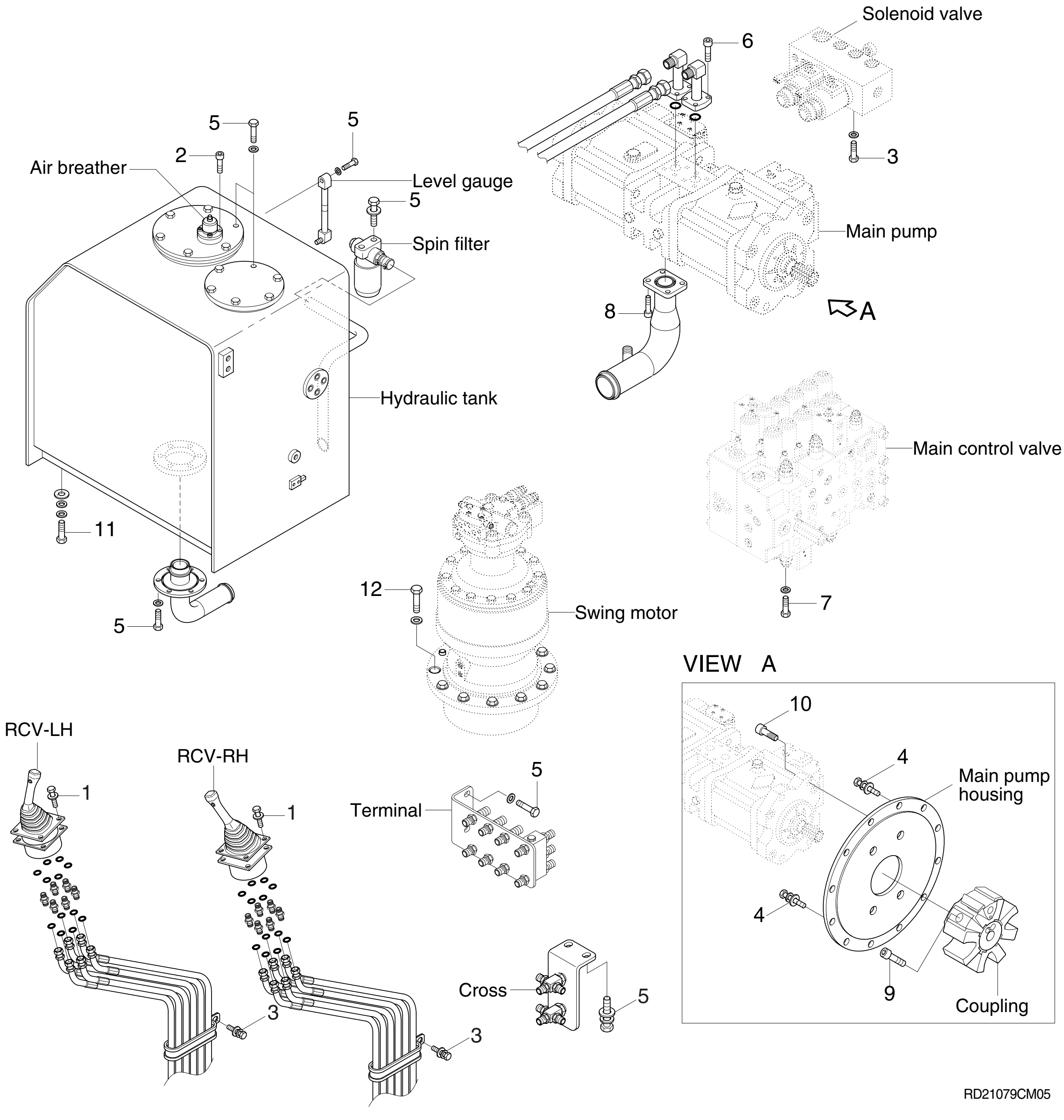
· Tightening torque

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

Item	Size	kgf · m	lbf · ft
3	M10 × 1.5	6.9 ± 1.4	49.9 ± 10.1
-	-	-	-

GROUP 4 HYDRAULIC SYSTEM

HYDRAULIC COMPONENTS MOUNTING 1

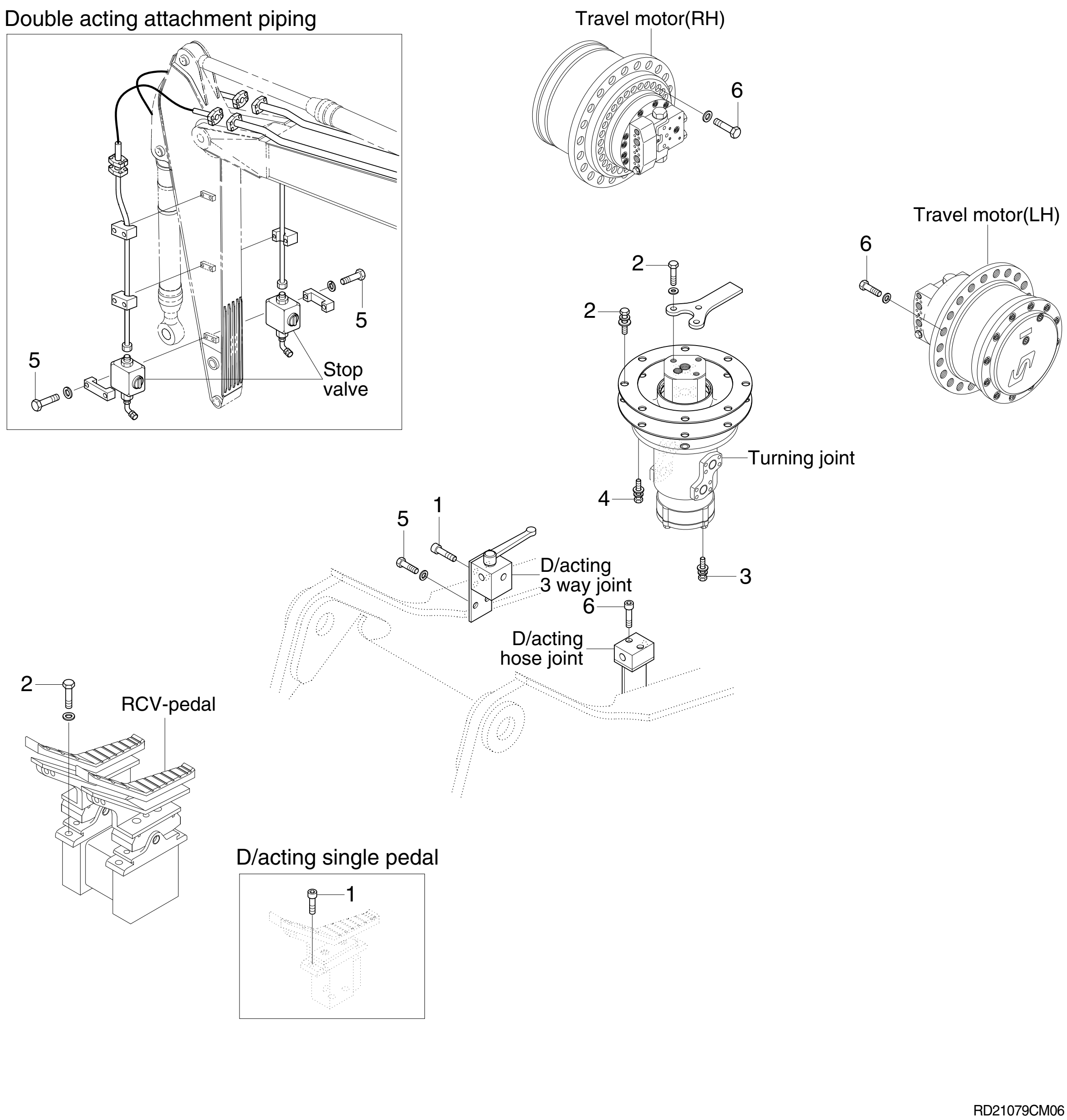


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 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	4.8±0.3	34.7±2.2
5	M10×1.5	6.9±1.4	49.9±10.1
6	M10×1.5	8.27±1.7	59.8±12.3

Item	Size	kgf · m	lbf · ft
7	M12×1.75	12.2±1.3	88.2±9.4
8	M12×1.75	14.7±2.2	106±15.9
9	M16×2.0	22±1.0	159±7.2
10	M20×2.5	42±4.5	304±32.5
11	M20×2.5	45±5.1	325±36.9
12	M20×2.5	57.9±8.7	419±62.9

HYDRAULIC COMPONENTS MOUNTING 2

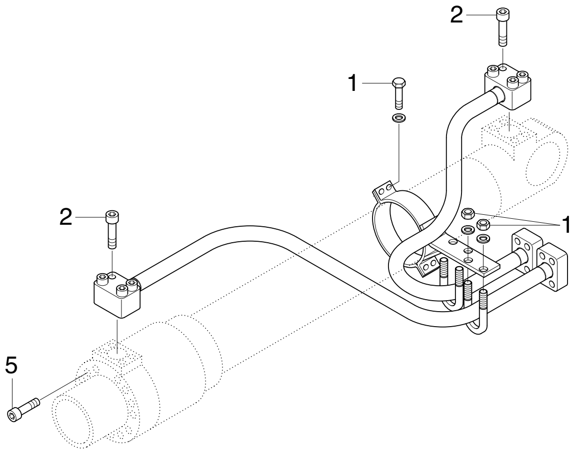


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	4.05±0.8	29.3±5.8
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	11.25±1.25	81.4±9.0
4	M12×1.75	12.3±1.3	88.9±9.4

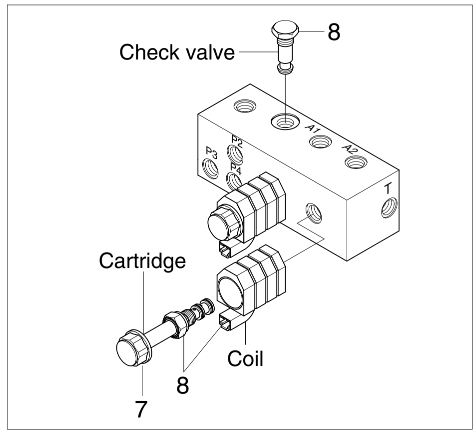
Item	Size	kgf · m	lbf · ft
5	M12×1.75	12.8±3.0	92.6±21.7
6	M12×1.75	14.7±2.2	106±15.9
7	M16×2.0	23.0±2.5	166±18.1
-	-	-	-

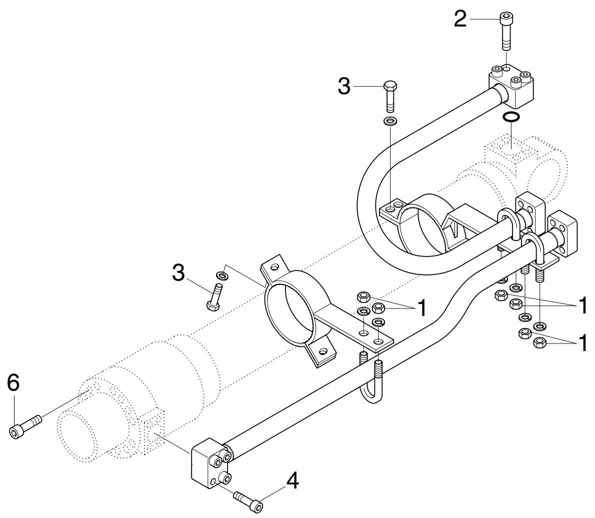
HYDRAULIC COMPONENTS MOUNTING 3



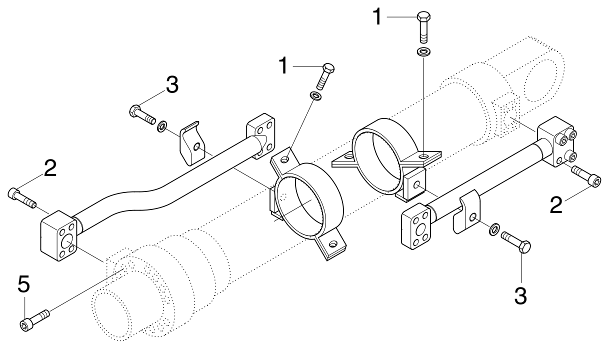
BOOM CYLINDER

Solenoid valve





ARM CYLINDER



BUCKET CYLINDER

RD21079CM07

· Tightening torque

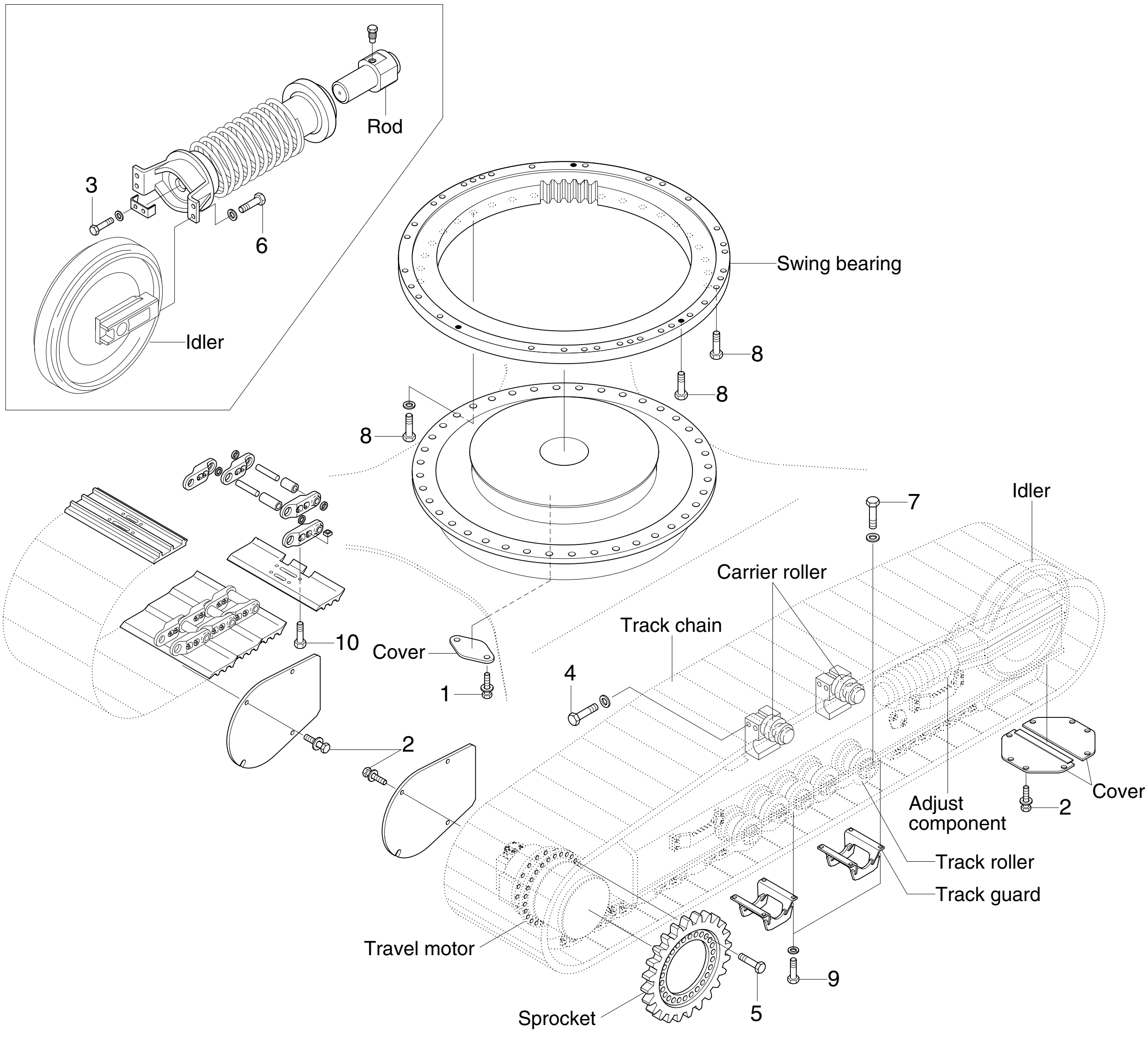
Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±2.2
2	M10×1.5	5.4±0.5	39.1±3.6
3	M12×1.75	5.5±0.6	39.8±4.3
4	M12×1.75	9.4±1.0	68.0±7.2

Item	Size	kgf · m	lbf · ft
5	M16×2.0	23±2.0	166±14.5
6	M18×2.5	32±3.0	232±21.7
7	-	0.5±0.1	3.6±0.7
8	-	2.8±0.2	20.3±1.4

GROUP 5 UNDERCARRIAGE

UNDERCARRIAGE MOUNTING

ADJUST COMPONENT



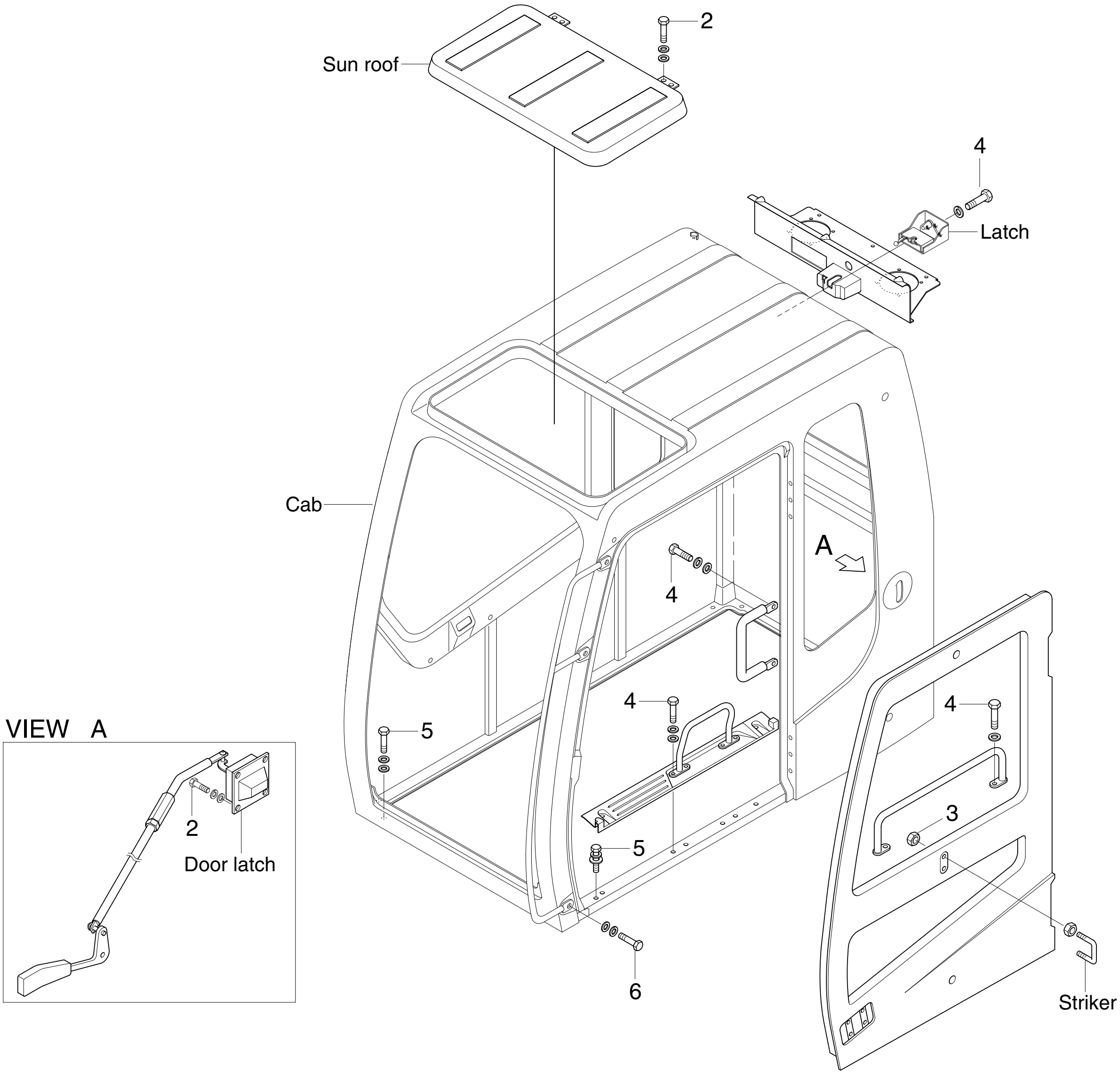
RD21079CM08

· 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	M12×1.75	15±0.5	108±3.6
4	M16×2.0	23±2.5	166±18.1
5	M16×2.0	26±4.0	188±28.9
6	M16×2.0	29.7±4.5	215±32.5
7	M20×2.5	54.7±5.0	396±36.2
8	M20×2.5	57.8±6.4	418±46.3
9	M20×2.5	57.9±8.7	419±62.9
10	M20×2.5	78±8.0	564±57.9

GROUP 6 STRUCTURE

CAB AND ACCESSORIES MOUNTING



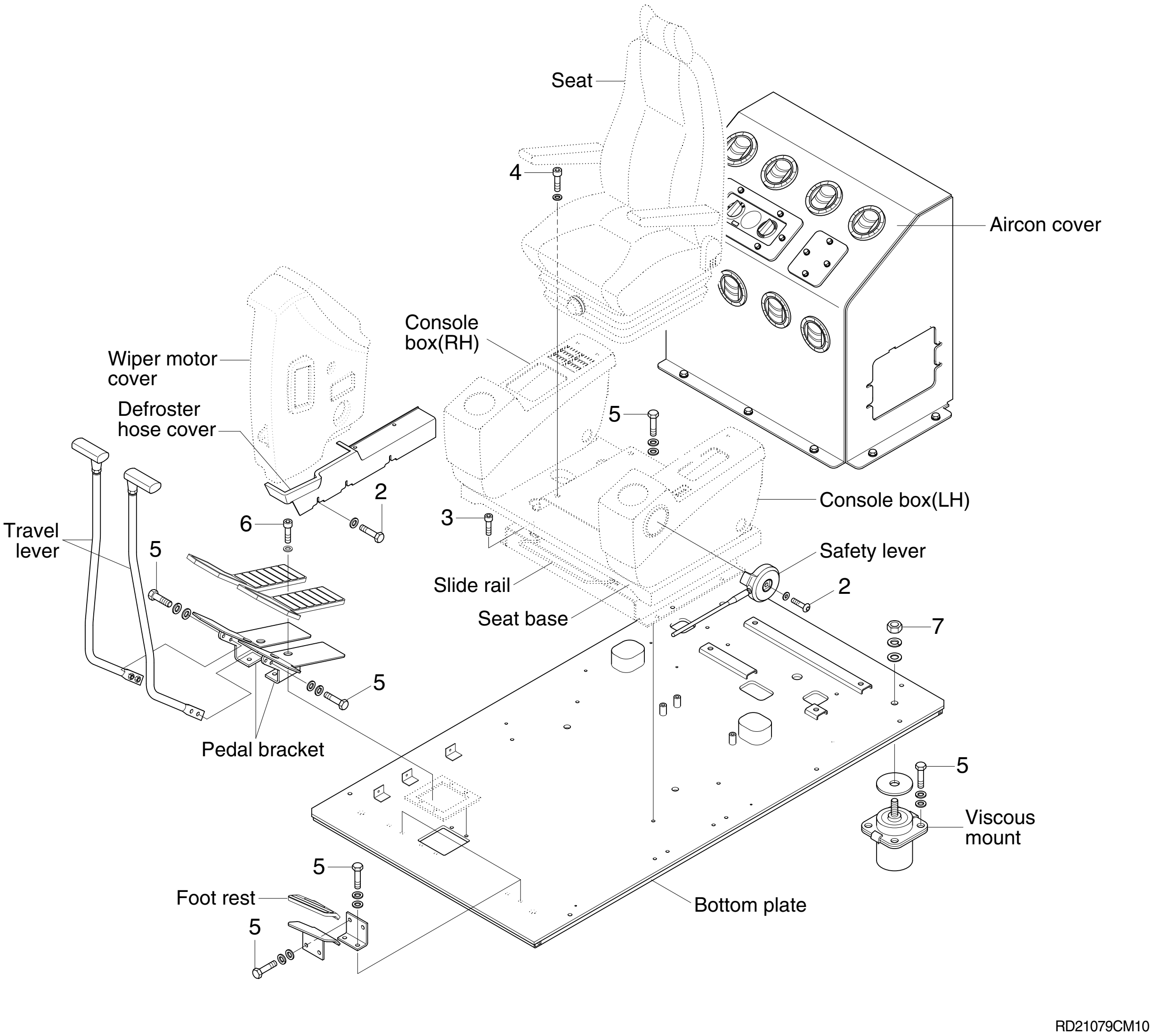
RD21079CM09

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.49±0.1	3.5±0.7
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
6	M16×2.0	29.7±4.5	215±32.5

CAB INTERIOR MOUNTING

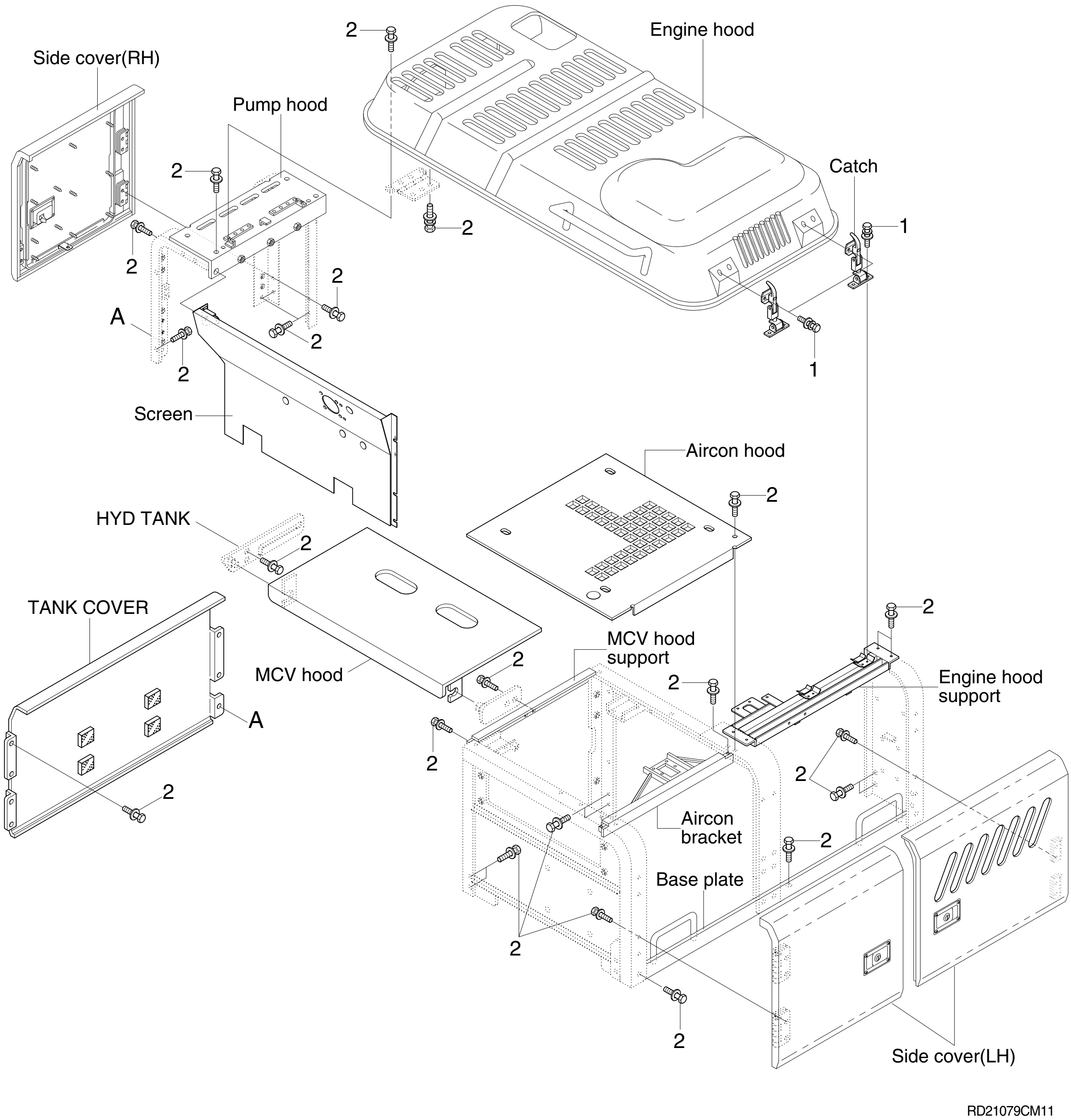


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.49±0.1	3.5±0.7
2	M 6×1.0	1.05±0.2	7.6±1.4
3	M 8×1.25	3.43±0.7	24.8±5.1
4	M 8×1.25	4.05±0.8	29.3±5.8

Item	Size	kgf · m	lbf · ft
5	M10×1.5	6.9±1.4	49.9±10.1
6	M10×1.5	8.27±1.7	59.8±12.3
7	M16×2.0	29.7±4.5	215±32.5
-	-	-	-

COWLING MOUNTING

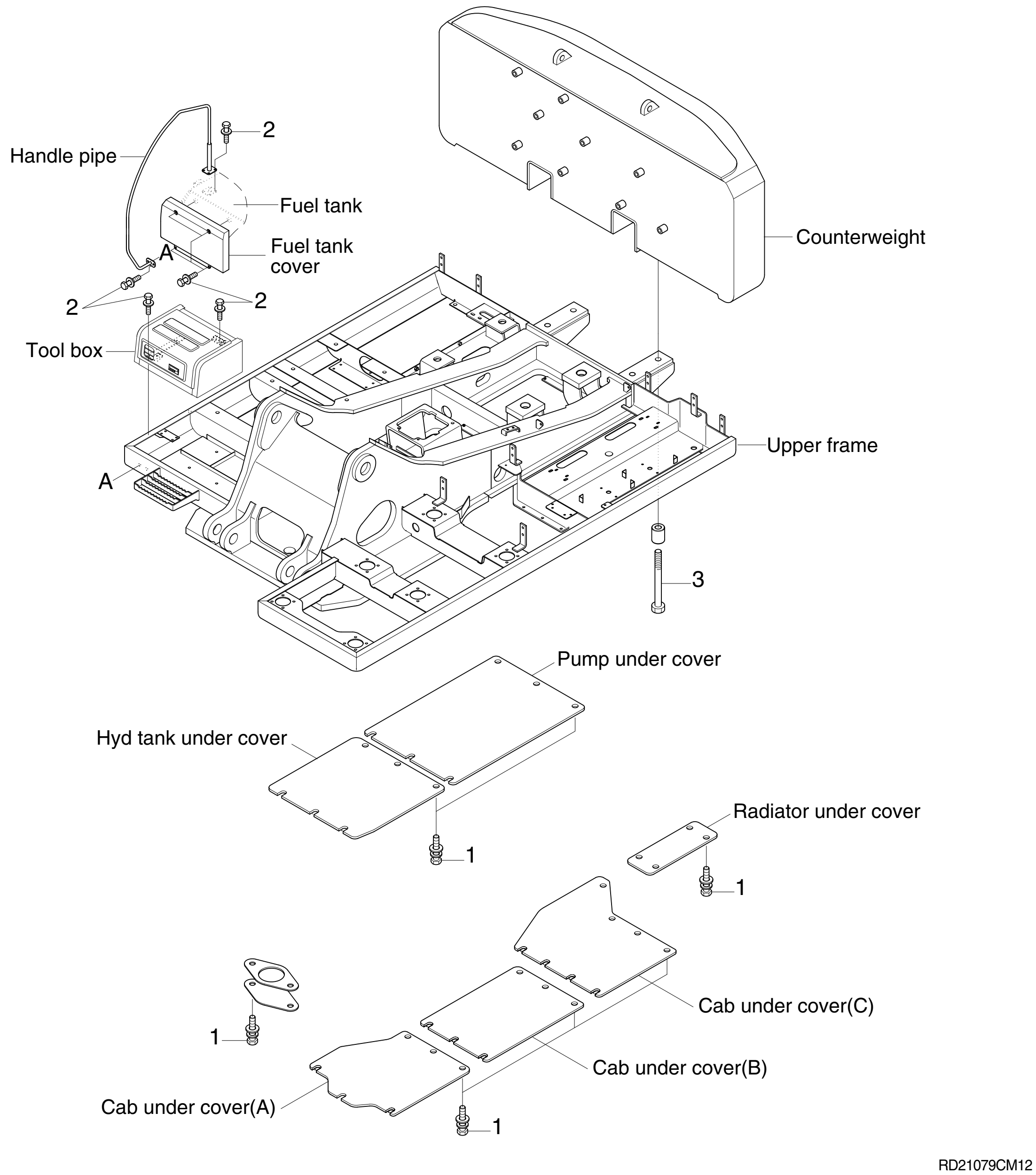


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
3	M16×2.0	29.7±4.5	215±32.5
-	-	-	-

COUNTERWEIGHT AND COVERS MOUNTING

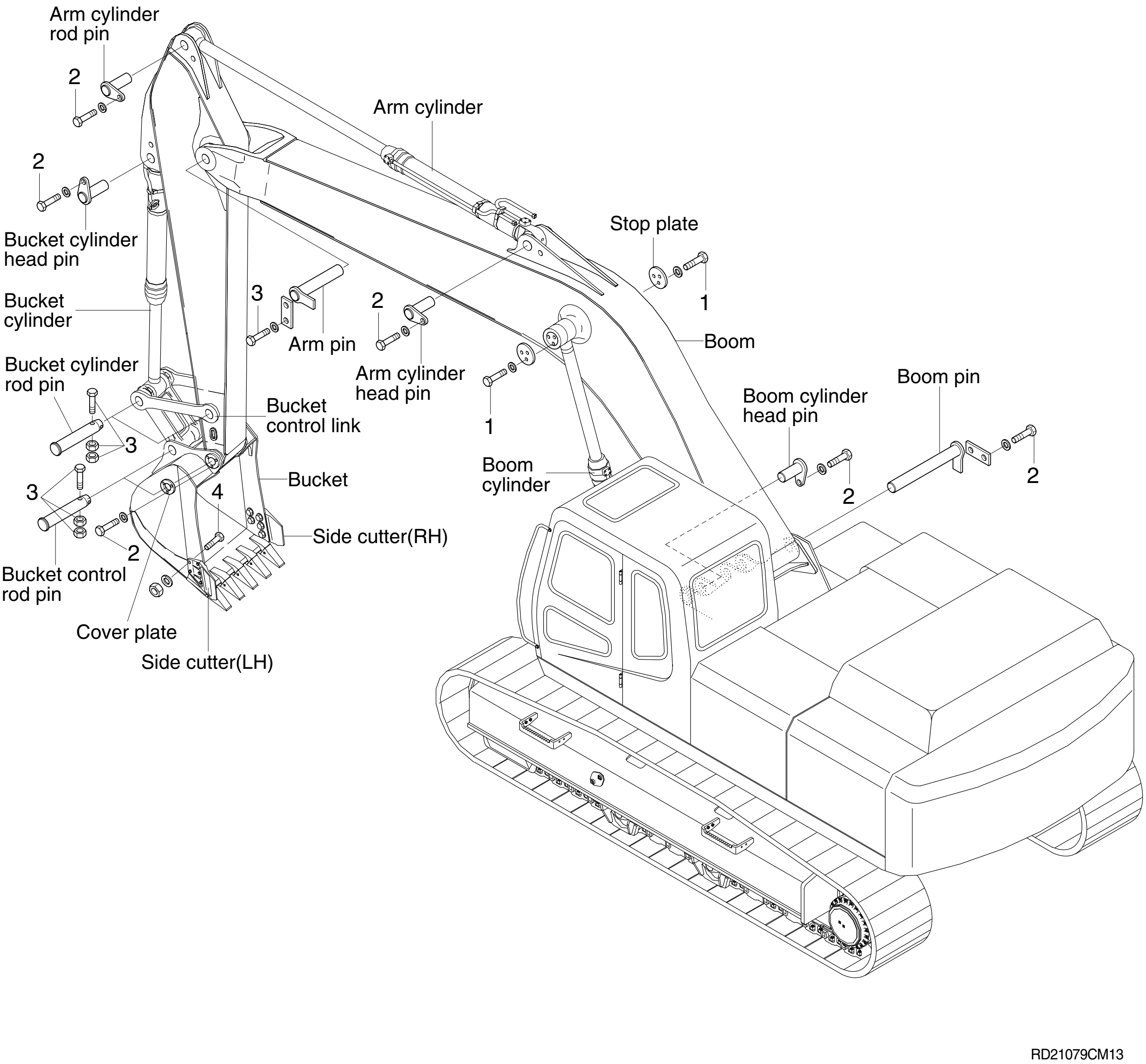


· Tightening torque

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

Item	Size	kgf · m	lbf · ft
3	M36×3.0	308±46	2228±333
-	-	-	-

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

Item	Size	kgf · m	lbf · ft
3	M20×2.5	57.9±8.7	419±62.9
-	M22×2.5	55.8±7.5	404±54.2