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1. STRUCTURE

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

This service manual mainly contains the necessary technical information for operations performed in a service workshop.

For ease of understanding, the manual is divided into the following sections.

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

This section explains the hydraulic circuit, single and combined operation.

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 MECHATRONICS SYSTEM

This section explains the computer aided power optimization system and each component.

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 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.

The specifications contained in this shop manual are subject to change at any time and without any advance notice. Contact your HD Hyundai Construction Equipment 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 HD Hyundai Construction Equipment 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.
   8 - 4
   8 - 4 - 1
   8 - 4 - 2 Added pages
   8 - 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 50 in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.
   (2) Locate the number 5 in 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, 55 mm = 2.165 inches.

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

Millimeters to inches

1 mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

	0	1	2	3	4	5	6	7	8	9
0		0.039	0.079	0.118	0.157	0.197	0.236	0.276	0.315	0.354
10	0.394	0.433	0.472	0.512	0.551	0.591	0.630	0.669	0.709	0.748
20	0.787	0.827	0.866	0.906	0.945	0.984	1.024	1.063	1.102	1.142
30	1.181	1.220	1.260	1.299	1.339	1.378	1.417	1.457	1.496	1.536
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80	3.150	3.189	3.228	3.268	3.307	3.346	3.386	3.425	3.465	3.504
90	3.543	3.583	3.622	3.661	3.701	3.740	3.780	3.819	3.858	3.898

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm² to lbf/in²

1kgf / cm² = 14.2233lbf / in²

	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

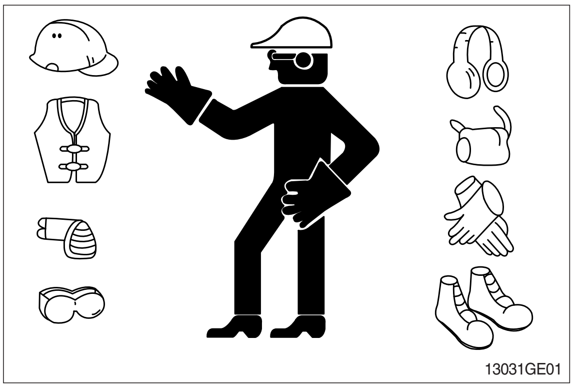
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

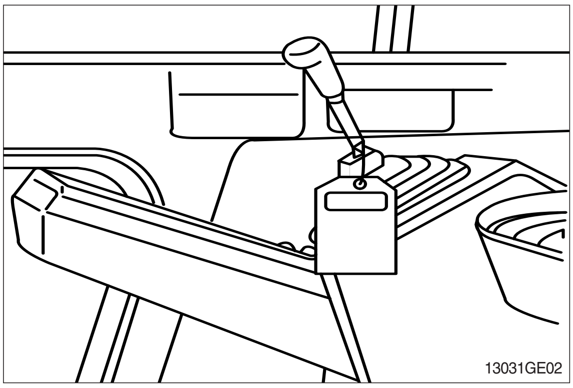
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

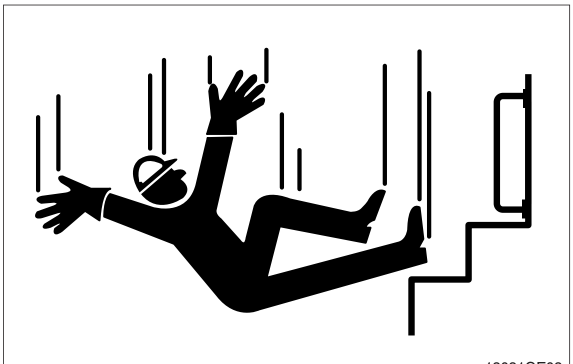
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



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.



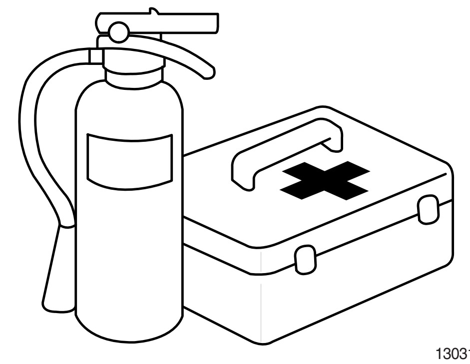
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

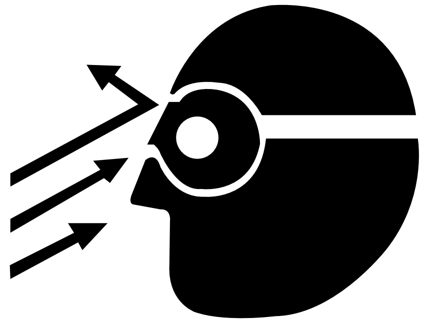
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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



13031GE05

PROTECT AGAINST NOISE

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

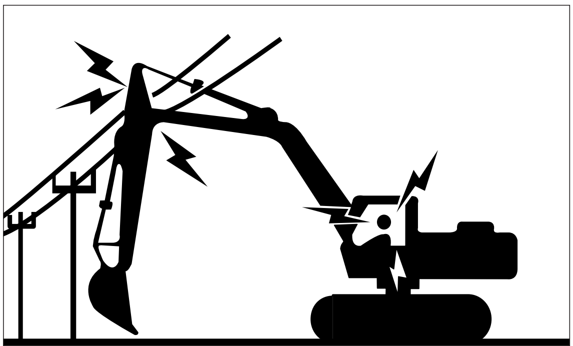
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.

13031GE06

AVOID POWER LINES

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

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

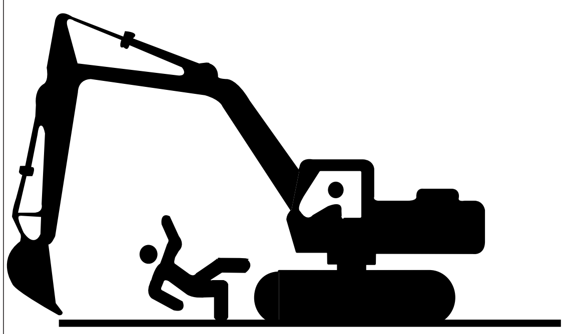


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



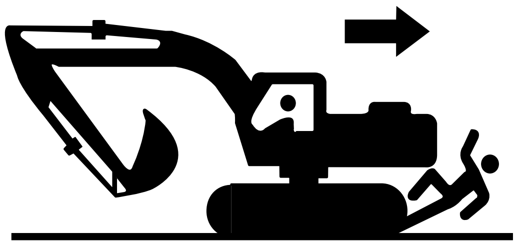
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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

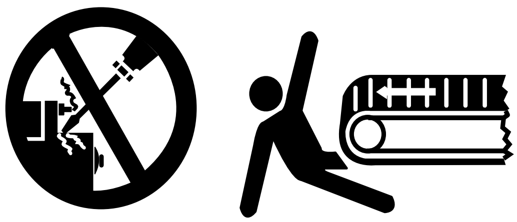


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



13031GE26

PARK MACHINE SAFELY

Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

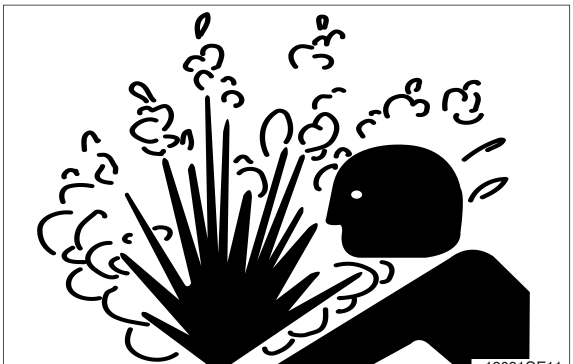
Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under continuous load.
Do not work under a machine that is supported solely by a jack. Follow recommended procedures in this manual.

13031GE10

SERVICE COOLING SYSTEM SAFELY

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

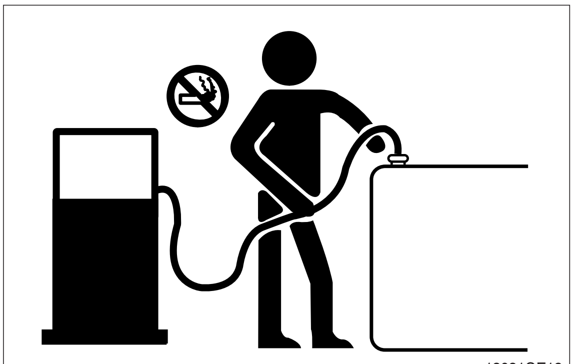
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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



13031GE12

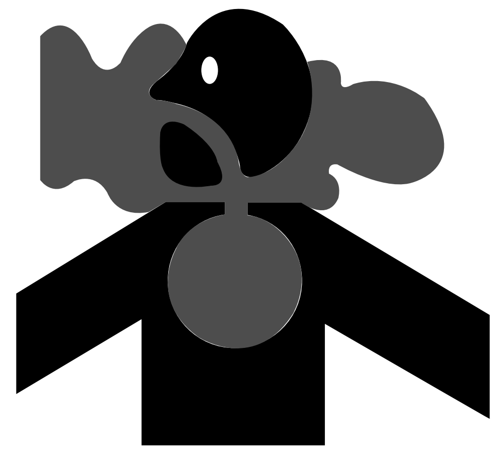
Store flammable fluids away from fire hazards. Do not incinerate or puncture pressurized containers.

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

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

13031GE13

BEWARE OF EXHAUST FUMES


13031GE14

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

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

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

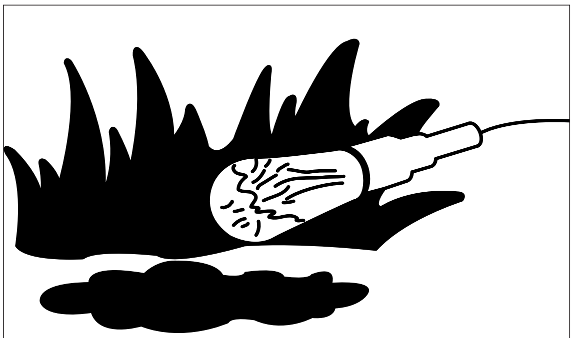
Do all work outside or in a well ventilated area. Dispose of paint and solvent properly.

Remove paint before welding or heating:

· If you sand or grind paint, avoid breathing the dust.
  Wear an approved respirator.

· If you use solvent or paint stripper, remove stripper with soap and water before welding. Remove solvent or paint stripper containers and other flammable material from area. Allow fumes to disperse at least 15 minutes before welding or heating.

ILLUMINATE WORK AREA SAFELY

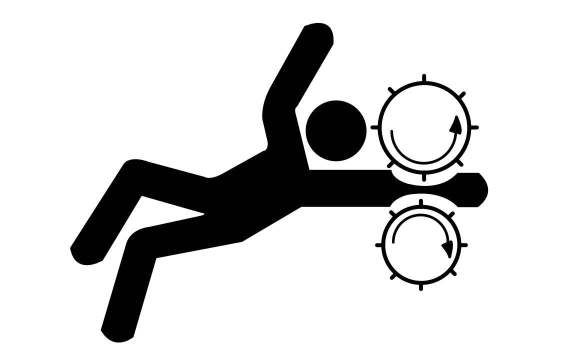

13031GE15

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

SERVICE MACHINE SAFELY

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

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

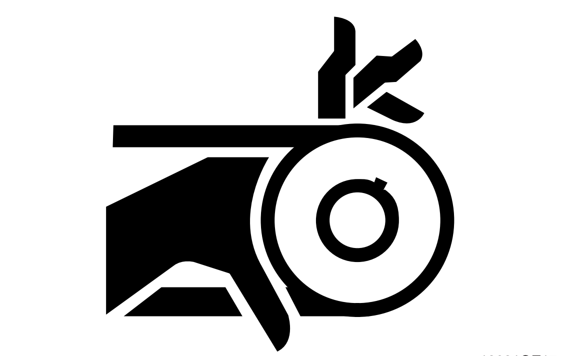


13031GE16

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

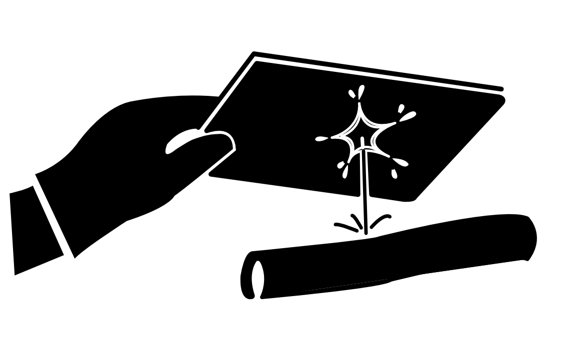
Escaping fluid under pressure can penetrate the skin causing serious injury.

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˚C (60˚F).

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:

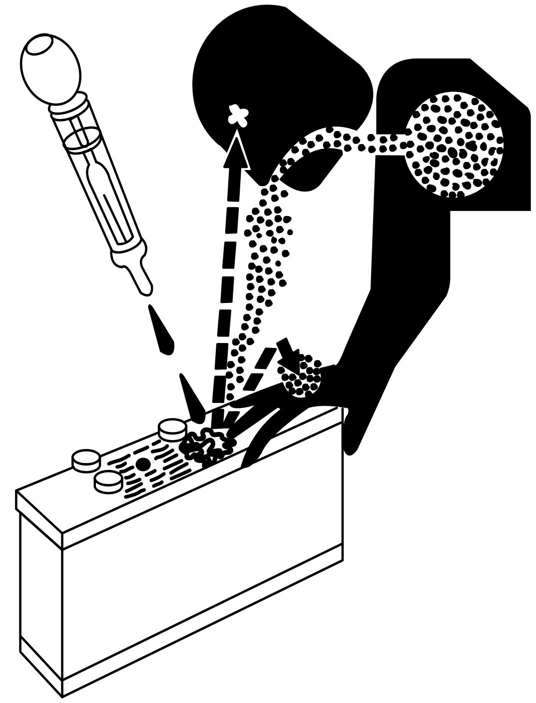
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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.

If acid is swallowed:

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



13031GE22

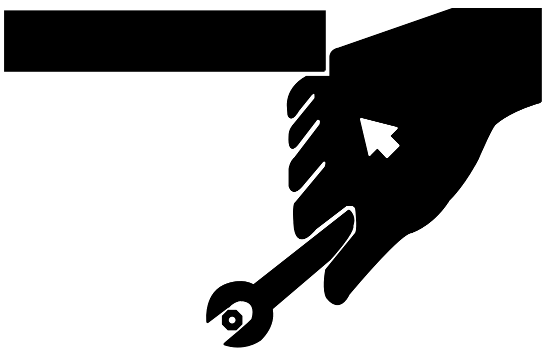
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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



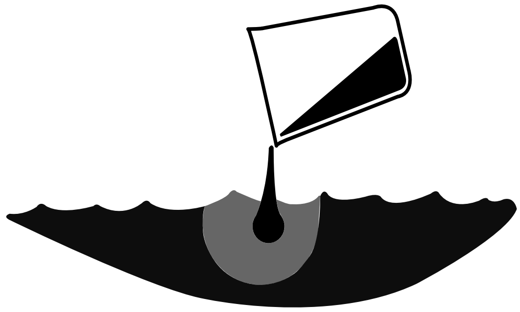
13031GE23

DISPOSE OF FLUIDS PROPERLY

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

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

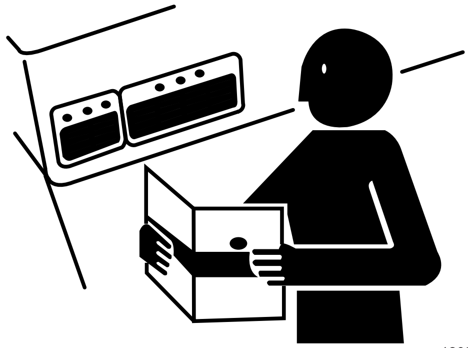
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



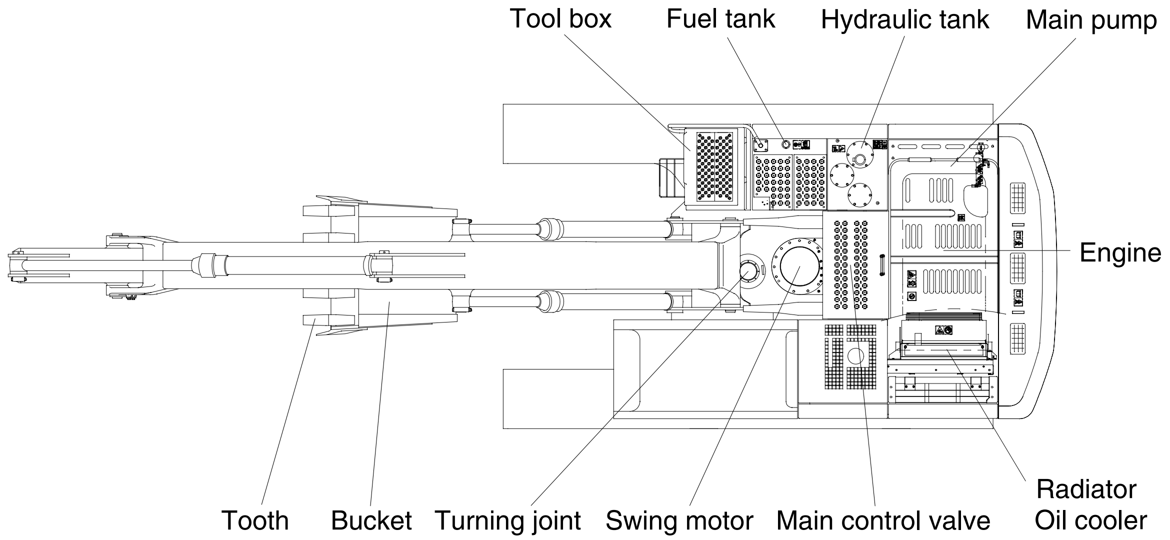
13031GE25

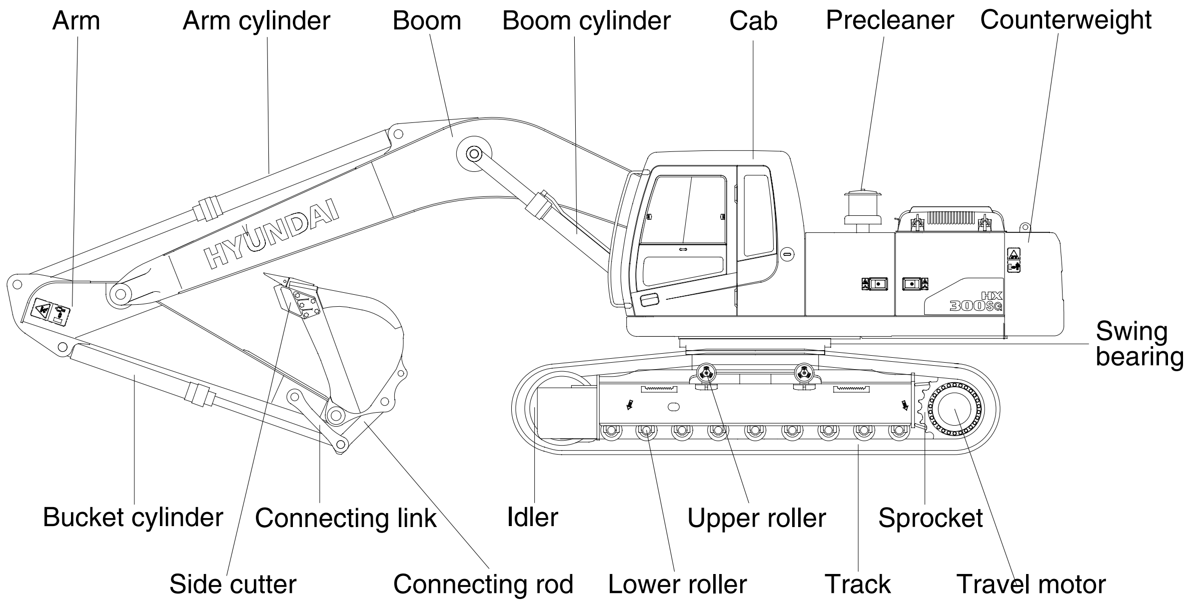
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

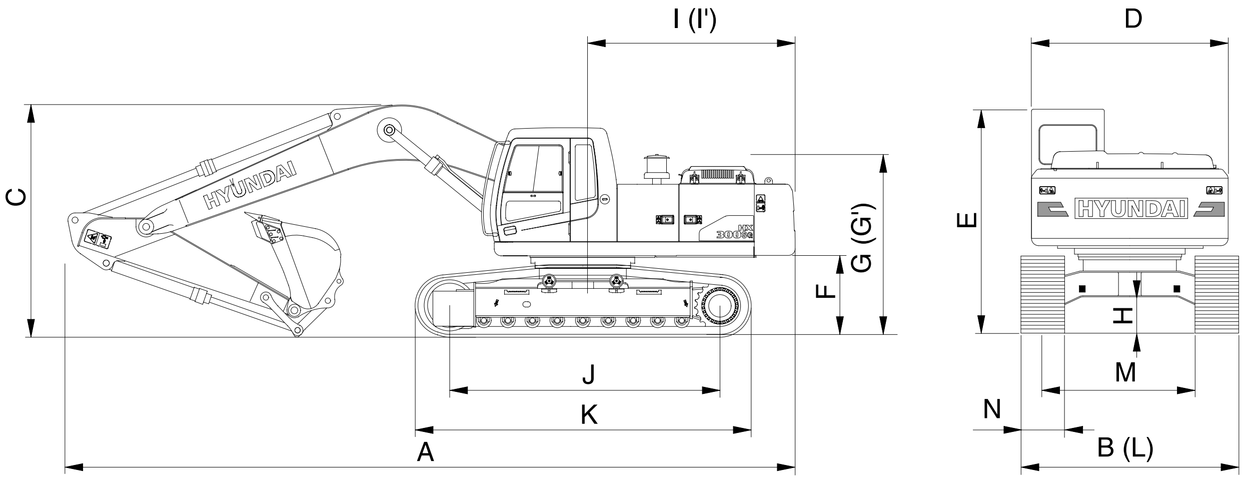




300SG2SP01

2. SPECIFICATIONS

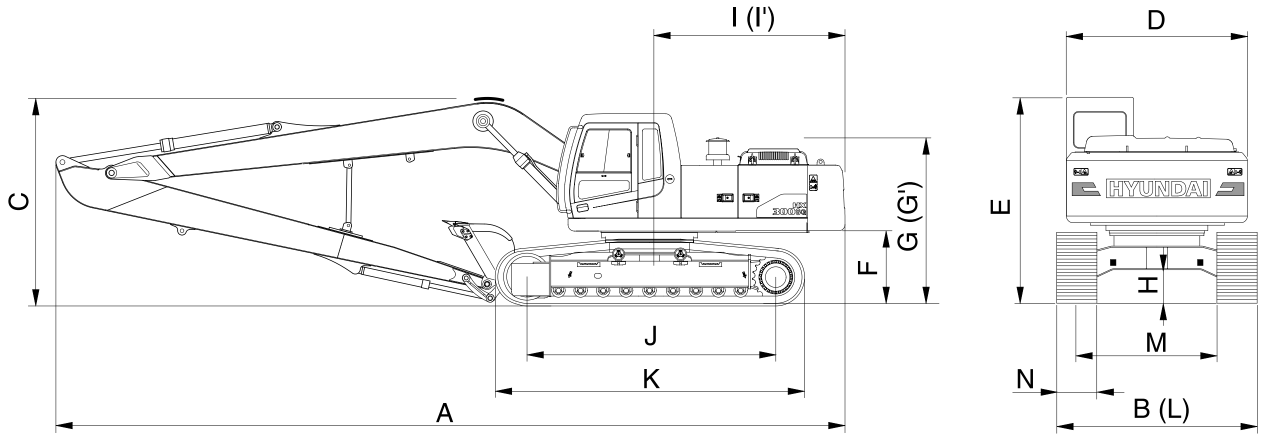
1) HX300SG, MONO BOOM



300SG2SP02A

Description		Unit		Specification			
		m (ft-in)	Boom	6.25 (20' 6")			
			Arm	3.05 (10' 0")	2.10 (6' 11")	2.50 (8' 2")	3.75 (12' 4")
		mm (in)	Shoe	600 (24")	600 (24")	600 (24")	600 (24")
Operating weight		kg (lb)		29540 (65125)	29340 (64684)	29530 (65103)	29850 (65808)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		1.27 (1.66)	1.27 (1.66)	1.27 (1.66)	1.27 (1.66)
Overall length	A	mm (ft-in)		10590 (34' 9")	10750 (35' 3")	10700 (35' 1")	10670 (35' 0")
Overall width	B			3200 (10' 6")	3200 (10' 6")	3200 (10' 6")	3200 (10' 6")
Overall height of boom	C			3330 (10' 11")	3660 (12' 0")	3520 (11' 7")	3530 (11' 7")
Superstructure width	D			2980 (9' 9")	2980 (9' 9")	2980 (9' 9")	2980 (9' 9")
Overall height of cab	E			3100 (10' 2")	3100 (10' 2")	3100 (10' 2")	3100 (10' 2")
Ground clearance of counterweight	F			1190 (3' 11")	1190 (3' 11")	1190 (3' 11")	1190 (3' 11")
Overall height of engine hood	G			3190 (10' 6")	3190 (10' 6")	3190 (10' 6")	3190 (10' 6")
Overall height of handrail	G'			3100 (10' 2")	3100 (10' 2")	3100 (10' 2")	3100 (10' 2")
Minimum ground clearance	H			500 (1' 8")	500 (1' 8")	500 (1' 8")	500 (1' 8")
Rear-end distance	I			3120 (10' 3")	3120 (10' 3")	3120 (10' 3")	3120 (10' 3")
Rear-end swing radius	I'			3200 (10' 6")	3200 (10' 6")	3200 (10' 6")	3200 (10' 6")
Distance between tumblers	J			4030 (13' 3")	4030 (13' 3")	4030 (13' 3")	4030 (13' 3")
Undercarriage length	K			4940 (16' 2")	4940 (16' 2")	4940 (16' 2")	4940 (16' 2")
Undercarriage width	L			3200 (10' 6")	3200 (10' 6")	3200 (10' 6")	3200 (10' 6")
Track gauge	M			2600 (8' 6")	2600 (8' 6")	2600 (8' 6")	2600 (8' 6")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")	600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.2/5.7 (2.0/3.5)	3.2/5.7 (2.0/3.5)	3.2/5.7 (2.0/3.5)	3.2/5.7 (2.0/3.5)
Swing speed		rpm		11.1	11.1	11.1	11.1
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.57 (8.11)	0.57 (8.11)	0.57 (8.11)	0.57 (8.11)
Maximum traction force		kgf (lbf)		25800 (56880)	25800 (56880)	25800 (56880)	25800 (56880)

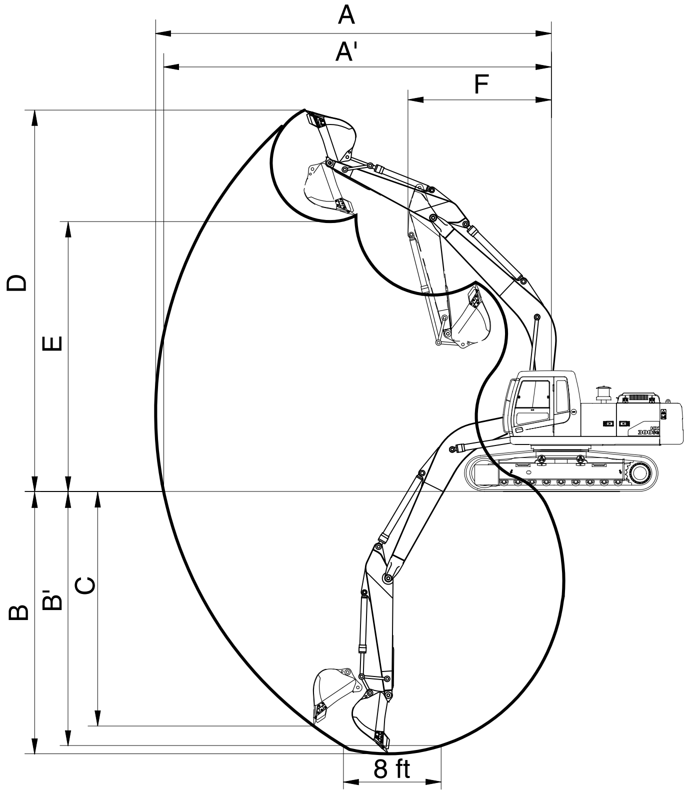
2) HX300SG, LONG REACH



Description		Unit		Specification
		m (ft-in)	Boom	10.2 (33' 6")
			Arm	7.85 (25' 9")
		mm (in)	Shoe	800 (32")
Operating weight		kg (lb)		32610 (71893)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.52 (0.68)
Overall length	A	mm (ft-in)		14550 (47' 9")
Overall width	B			3400 (11' 2")
Overall height of boom	C			3550 (11' 8")
Superstructure width	D			2980 (9' 9")
Overall height of cab	E			3100 (10' 2")
Ground clearance of counterweight	F			1190 (3' 11")
Overall height of engine hood	G			3190 (10' 6")
Overall height of handrail	G'			3100 (10' 2")
Minimum ground clearance	H			500 (1' 8")
Rear-end distance	I			3120 (10' 3")
Rear-end swing radius	I'			3200 (10' 6")
Distance between tumblers	J			4030 (13' 3")
Undercarriage length	K			4940 (16' 2")
Undercarriage width	L			3200 (10' 6")
Track gauge	M			2600 (8' 6")
Track shoe width, standard	N			800 (2' 7")
Travel speed (low/high)		km/hr (mph)		3.2/5.7 (2.0/3.5)
Swing speed		rpm		11.1
Gradeability		Degree (%)		35 (70)
Ground pressure		kgf/cm^2 (psi)		0.47 (6.68)
Maximum traction force		kgf (lbf)		25800 (56880)

3. WORKING RANGE

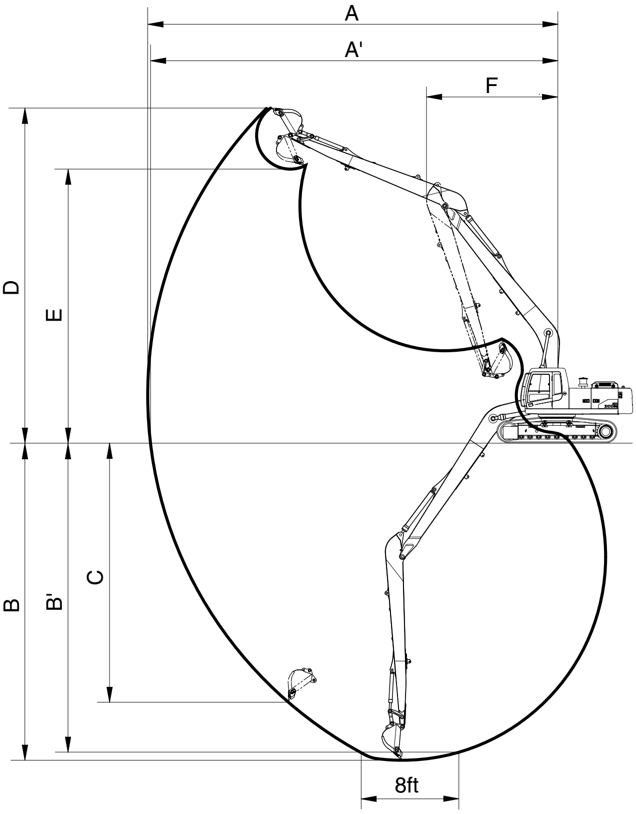
1) HX300SG, MONO BOOM



Description	m (ft-in)	Boom	6.25 (20' 6")			
		Arm	3.05 (10' 0")	2.10 (6' 11")	2.50 (8' 2")	3.75 (12' 4")
Max digging reach	mm (ft-in)	A	10810 (35' 6")	10040 (32' 11")	10310 (33' 10")	11420 (37' 6")
Max digging reach on ground		A'	10610 (34' 10")	9820 (32' 3")	10100 (33' 2")	11230 (36' 10")
Max digging depth		B	7330 (24' 1")	6380 (20' 11")	6780 (22' 3")	8030 (26' 4")
Max digging depth (8 ft level)		B'	7170 (23' 6")	6180 (20' 3")	6600 (21' 8")	7890 (25' 11")
Max vertical wall digging depth		C	6280 (20' 7")	5910 (19' 5")	5760 (18' 11")	6990 (22' 11")
Max digging height		D	10200 (33' 6")	10130 (33' 3")	9980 (32' 9")	10410 (34' 2")
Max dumping height		E	7150 (23' 5")	6990 (22' 11")	6930 (22' 9")	7360 (24' 2")
Min swing radius		F	4270 (14' 0")	4420 (14' 6")	4320 (14' 2")	4220 (13' 10")
Bucket digging force	kN	SAE	169 [184]	169 [184]	169 [184]	169 [184]
	kgf		17200 [18760]	17200 [18760]	17200 [18760]	17200 [18760]
	lbf		37920 [41370]	37920 [41370]	37920 [41370]	37920 [41370]
	kN	ISO	192 [210]	192 [210]	192 [210]	192 [210]
	kgf		19600 [21380]	19600 [21380]	19600 [21380]	19600 [21380]
	lbf		43210 [47140]	43210 [47140]	43210 [47140]	43210 [47140]
Arm digging force	kN	SAE	124 [135]	170 [185]	147 [161]	109 [119]
	kgf		12600 [13750]	17300 [18870]	15000 [16360]	11100 [12110]
	lbf		27780 [30310]	38140 [41610]	33070 [36080]	24470 [26690]
	kN	ISO	129 [140]	178 [194]	154 [168]	112 [122]
	kgf		13100 [14290]	18100 [19750]	15700 [17130]	11400 [12440]
	lbf		28880 [31510]	39900 [43530]	34610 [37760]	25130 [27410]

[ ] : Power boost

2) HX300SG, LONG REACH



Description	m (ft-in)	Boom	10.2 (33' 6")
		Arm	7.85 (25' 9")
Max digging reach	mm (ft-in)	A	18530 (60' 10")
Max digging reach on ground		A'	18410 (60' 5")
Max digging depth		B	14740 (48' 4")
Max digging depth (8 ft level)		B'	14660 (48' 1")
Max vertical wall digging depth		C	13700 (44' 11")
Max digging height		D	14590 (47' 10")
Max dumping height		E	12270 (40' 3")
Min swing radius		F	6270 (20' 7")
Bucket digging force	kN	SAE	70 [76]
	kgf		7100 [7750]
	lbf		15650 [17090]
	kN	ISO	80 [88]
	kgf		8200 [8950]
	lbf		18080 [19730]
Arm digging force	kN	SAE	43 [47]
	kgf		4420 [4820]
	lbf		9740 [10630]
	kN	ISO	44 [48]
	kgf		4500 [4910]
	lbf		9920 [10830]

[ ] : Power boost

4. WEIGHT

Item	HX300SG		HX300SG Long reach	
	kg	lb	kg	lb
Upperstructure assembly				
· Main frame weld assembly	2361	5210	2361	5210
· Engine assembly	485	1069	485	1069
· Main pump assembly	133	293	133	293
· Main control valve assembly	230	507	230	507
· Swing motor assembly	408	900	408	900
· Hydraulic oil tank assembly	224	494	224	494
· Fuel tank assembly	275	606	275	606
· Counterweight	5200	11460	7000	15450
· Cab assembly	310	680	310	680
Lower chassis assembly				
· Track frame weld assembly	3765	8300	3765	8300
· Swing bearing	433	950	433	950
· Travel motor assembly	433	950	433	950
· Turning joint	38	84	38	84
· Sprocket (2 EA)	141	311	141	311
· Track recoil spring (2 EA)	450	992	450	992
· Idler (2 EA)	500	1102	500	1102
· Upper roller (4 EA)	140	309	140	309
· Lower roller (18 EA)	972	2143	972	2143
· Track-chain assembly (600 mm triple grouser shoe) (2 EA)	3758	8285	-	-
· Track-chain assembly (800 mm triple grouser shoe) (2 EA)	3758	8285	4706	10375
Front attachment assembly				
· 6.25 m boom assembly	2200	4860	-	-
· 3.05 m arm assembly	1025	2260	-	-
· 1.27 m^3 SAE heaped bucket	1010	2230	-	-
· 10.2 m boom assembly	-	-	2960	6530
· 7.85 m arm assembly	-	-	1340	2960
· 0.52 m^3 SAE heaped bucket	-	-	460	1010
· Boom cylinder assembly	263	580	263	580
· Arm cylinder assembly	368	811	368	811
· 1.27 m^3 bucket cylinder assembly	224	494	-	-
· 0.52 m^3 bucket cylinder assembly	-	-	103	227
· Bucket control linkage total	112	248	112	248

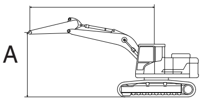
※ This information is different with operating and transportation weight because it is not including harness, pipe, oil, fuel so on.

※ Refer to Transportation for actual weight information and Specifications for operating weight.

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX300SG	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6250	2100	5200	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
												m (ft)
7.5 m	kg					*7150	*7150			*7350	7030	6.40
(24.6 ft)	lb					*15760	*15760			*16200	15500	(21.0)
6.0 m	kg					*7360	*7360			*7240	5430	7.44
(19.7 ft)	lb					*16230	*16230			*15960	11970	(24.4)
4.5 m	kg					*8330	7420	*7370	5280	7290	4670	8.06
(14.8 ft)	lb					*18360	16360	*16250	11640	16070	10300	(26.5)
3.0 m	kg					*9550	7010	*7900	5100	6770	4310	8.37
(9.8 ft)	lb					*21050	15450	*17420	11240	14930	9500	(27.5)
1.5 m	kg					*10560	6700	7850	4940	6640	4210	8.40
(4.9 ft)	lb					*23280	14770	17310	10890	14640	9280	(27.6)
0.0 m	kg					10810	6550	7750	4840	6890	4350	8.16
(0.0 ft)	lb					23830	14440	17090	10670	15190	9590	(26.8)
-1.5 m	kg			*14440	9990	10800	6540	7780	4870	7650	4800	7.60
(-4.9 ft)	lb			*31830	22020	23810	14420	17150	10740	16870	10580	(24.9)
-3.0 m	kg	*17130	*17130	*13040	10180	*9850	6690			*8410	5860	6.66
(-9.8 ft)	lb	*37770	*37770	*28750	22440	*21720	14750			*18540	12920	(21.9)
-4.5 m	kg			*9810	*9810					*8120	*8120	5.12
(-14.8 ft)	lb			*21630	*21630					*17900	*17900	(16.8)

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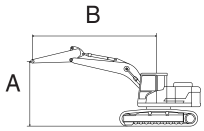
Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX300SG	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6250	2500	5200	600	-	-	-	-	-

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



Lift-point height (A)		Lift-point radius (B)								At max. reach		
		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		Capacity		Reach
		F	S	F	S	F	S	F	S	F	S	m (ft)
7.5 m	kg					*6510	*6510			*6350	*6350	6.74
(24.6 ft)	lb					*14350	*14350			*14000	*14000	(22.1)
6.0 m	kg					*6870	*6870	*6670	5440	*6040	5140	7.74
(19.7 ft)	lb					*15150	*15150	*14700	11990	*13320	11330	(25.4)
4.5 m	kg			*9930	*9930	*7880	7490	*6990	5310	*6030	4450	8.34
(14.8 ft)	lb			*21890	*21890	*17370	16510	*15410	11710	*13290	9810	(27.4)
3.0 m	kg			*12770	10610	*9150	7060	*7600	5110	*6240	4110	8.64
(9.8 ft)	lb			*28150	23390	*20170	15560	*16760	11270	*13760	9060	(28.3)
1.5 m	kg					*10270	6710	7850	4920	6320	4000	8.67
(4.9 ft)	lb					*22640	14790	17310	10850	13930	8820	(28.4)
0.0 m	kg			*15040	9840	10790	6520	7710	4800	6530	4110	8.43
(0.0 ft)	lb			*33160	21690	23790	14370	17000	10580	14400	9060	(27.7)
-1.5 m	kg	*10480	*10480	*14670	9870	10730	6470	7690	4790	7170	4490	7.89
(-4.9 ft)	lb	*23100	*23100	*32340	21760	23660	14260	16950	10560	15810	9900	(25.9)
-3.0 m	kg	*18430	*18430	*13520	10030	*10200	6570			*8350	5380	6.99
(-9.8 ft)	lb	*40630	*40630	*29810	22110	*22490	14480			*18410	11860	(22.9)
-4.5 m	kg	*14820	*14820	*10960	10410					*8540	7690	5.55
(-14.8 ft)	lb	*32670	*32670	*24160	22950					*18830	16950	(18.2)

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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX300SG	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6250	3050	5200	600	-	-	-	-	-

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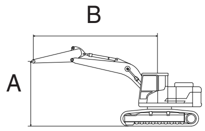

Lift-point height (A)		Lift-point radius (B) 3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		At max. reach Capacity		Reach
														m (ft)
7.5 m	kg											*4120	*4120	7.38
(24.6 ft)	lb											*9080	*9080	(24.2)
6.0 m	kg							*6020	5510			*3940	*3940	8.30
(19.7 ft)	lb							*13270	12150			*8690	*8690	(27.2)
4.5 m	kg			*8800	*8800	*7220	*7220	*6480	5350			*3930	*3930	8.86
(14.8 ft)	lb			*19400	*19400	*15920	*15920	*14290	11790			*8660	*8660	(29.1)
3.0 m	kg			*11640	10880	*8560	7140	*7170	5130	*5140	3850	*4060	3740	9.14
(9.8 ft)	lb			*25660	23990	*18870	15740	*15810	11310	*11330	8490	*8950	8250	(30.0)
1.5 m	kg			*13860	10120	*9800	6740	7840	4910	*5800	3750	*4340	3640	9.17
(4.9 ft)	lb			*30560	22310	*21610	14860	17280	10820	*12790	8270	*9570	8020	(30.1)
0.0 m	kg			*14820	9790	*10630	6490	7670	4760			*4830	3720	8.94
(0.0 ft)	lb			*32670	21580	*23440	14310	16910	10490			*10650	8200	(29.3)
-1.5 m	kg	*10440	*10440	*14830	9740	10650	6390	7600	4690			*5670	4010	8.44
(-4.9 ft)	lb	*23020	*23020	*32690	21470	23480	14090	16760	10340			*12500	8840	(27.7)
-3.0 m	kg	*16850	*16850	*14030	9850	*10490	6430	7680	4760			*7280	4680	7.61
(-9.8 ft)	lb	*37150	*37150	*30930	21720	*23130	14180	16930	10490			*16050	10320	(25.0)
-4.5 m	kg	*16800	*16800	*12100	10140	*8850	6670					*8160	6240	6.32
(-14.8 ft)	lb	*37040	*37040	*26680	22350	*19510	14700					*17990	13760	(20.7)

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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX300SG	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		6250	3750	5200	600	-	-	-	-	-

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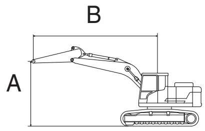

Lift-point height (A)		Lift-point radius (B)												At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
																m (ft)
9.0 m	kg													*3570	*3570	6.87
(29.5 ft)	lb													*7870	*7870	(22.6)
7.5 m	kg									*4790	*4790			*3260	*3260	8.14
(24.6 ft)	lb									*10560	*10560			*7190	*7190	(26.7)
6.0 m	kg									*5290	*5290			*3140	*3140	8.97
(19.7 ft)	lb									*11660	*11660			*6920	*6920	(29.4)
4.5 m	kg							*6340	*6340	*5830	5430	*4900	3990	*3140	*3140	9.50
(14.8 ft)	lb							*13980	*13980	*12850	11970	*10800	8800	*6920	*6920	(31.2)
3.0 m	kg					*10190	*10190	*7750	7280	*6590	5180	*5990	3860	*3250	*3250	9.76
(9.8 ft)	lb					*22470	*22470	*17090	16050	*14530	11420	*13210	8510	*7170	*7170	(32.0)
1.5 m	kg					*12770	10320	*9140	6820	*7380	4920	5940	3730	*3470	3260	9.79
(4.9 ft)	lb					*28150	22750	*20150	15040	*16270	10850	13100	8220	*7650	7190	(32.1)
0.0 m	kg			*6390	*6390	*14290	9810	*10190	6480	7650	4730	5820	3630	*3830	3310	9.58
(0.0 ft)	lb			*14090	*14090	*31500	21630	*22470	14290	16870	10430	12830	8000	*8440	7300	(31.4)
-1.5 m	kg	*6630	*6630	*9930	*9930	*14790	9620	10580	6310	7520	4610	*5340	3580	*4440	3530	9.11
(-4.9 ft)	lb	*14620	*14620	*21890	*21890	*32610	21210	23320	13910	16580	10160	*11770	7890	*9790	7780	(29.9)
-3.0 m	kg	*10420	*10420	*14550	*14550	*14440	9650	10550	6290	7520	4610			*5520	4010	8.35
(-9.8 ft)	lb	*22970	*22970	*32080	*32080	*31830	21270	23260	13870	16580	10160			*12170	8840	(27.4)
-4.5 m	kg	*15040	*15040	*18840	*18840	*13120	9850	*9740	6420					*7630	5040	7.19
(-14.8 ft)	lb	*33160	*33160	*41540	*41540	*28920	21720	*21470	14150					*16820	11110	(23.6)
-6.0 m	kg			*14260	*14260	*10040	*10040							*8020	7950	5.38
(-19.7 ft)	lb			*31440	*31440	*22130	*22130							*17680	17530	(17.6)

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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX300SG Long reach	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		10200	7850	7000	800	-	-	-	-	-

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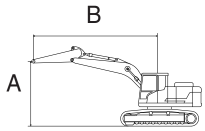

Lift-point height (A)		Lift-point radius (B)												At max. reach		
		1.5 m (4.9 ft)		3.0 m (9.8 ft)		4.5 m (14.8 ft)		6.0 m (19.7 ft)		7.5 m (24.6 ft)		9.0 m (29.5 ft)		Capacity		Reach
																m (ft)
3.0 m (9.8 ft)	kg					*7270	*7270			*4130	*4130	*3510	*3510	*860	*860	17.26
	lb					*16030	*16030			*9110	*9110	*7740	*7740	*1900	*1900	(56.6)
1.5 m (4.9 ft)	kg					*4330	*4330	*6440	*6440	*4920	*4920	*4040	*4040	*910	*910	17.27
	lb					*9550	*9550	*14200	*14200	*10850	*10850	*8910	*8910	*2010	*2010	(56.7)
0.0 m (0.0 ft)	kg			*1390	*1390	*3240	*3240	*7450	6590	*5610	4960	*4530	3900	*970	*970	17.15
	lb			*3060	*3060	*7140	*7140	*16420	14530	*12370	10930	*9990	8600	*2140	*2140	(56.3)
-1.5 m (-4.9 ft)	kg	*1450	*1450	*1960	*1960	*3330	*3330	*6240	6110	*6160	4600	*4950	3620	*1050	*1050	16.90
	lb	*3200	*3200	*4320	*4320	*7340	*7340	*13760	13470	*13580	10140	*10910	7980	*2310	*2310	(55.4)
-3.0 m (-9.8 ft)	kg	*2110	*2110	*2620	*2620	*3800	*3800	*6180	5850	*6560	4360	*5270	3430	*1170	*1170	16.51
	lb	*4650	*4650	*5780	*5780	*8380	*8380	*13620	12900	*14460	9610	*11620	7560	*2580	*2580	(54.2)
-4.5 m (-14.8 ft)	kg	*2790	*2790	*3340	*3340	*4470	*4470	*6670	5750	*6800	4230	*5490	3320	*1310	*1310	15.96
	lb	*6150	*6150	*7360	*7360	*9850	*9850	*14700	12680	*14990	9330	*12100	7320	*2890	*2890	(52.4)
-6.0 m (-19.7 ft)	kg	*3510	*3510	*4130	*4130	*5310	*5310	*7520	5750	*6890	4200	*5600	3270	*1520	*1520	15.25
	lb	*7740	*7740	*9110	*9110	*11710	*11710	*16580	12680	*15190	9260	*12350	7210	*3350	*3350	(50.0)
-7.5 m (-24.6 ft)	kg	*4290	*4290	*5010	*5010	*6320	*6320	*8650	5830	*6830	4230	*5590	3280	*1830	1750	14.34
	lb	*9460	*9460	*11050	*11050	*13930	*13930	*19070	12850	*15060	9330	*12320	7230	*4030	3860	(47.0)
-9.0 m (-29.5 ft)	kg	*5160	*5160	*6030	*6030	*7570	*7570	*8260	6000	*6590	4330	*5420	3350	*2310	2030	13.19
	lb	*11380	*11380	*13290	*13290	*16690	*16690	*18210	13230	*14530	9550	*11950	7390	*5090	4480	(43.3)
-10.5 m (-34.4 ft)	kg	*6140	*6140	*7250	*7250	*9180	*9180	*7610	6240	*6120	4510	*5030	3500	*3210	2480	11.74
	lb	*13540	*13540	*15980	*15980	*20240	*20240	*16780	13760	*13490	9940	*11090	7720	*7080	5470	(38.5)
-12.0 m (-39.4 ft)	kg			*8780	*8780	*8430	*8430	*6570	*6570	*5290	4790	*4280	3740	*3750	3340	9.86
	lb			*19360	*19360	*18580	*18580	*14480	*14480	*11660	10560	*9440	8250	*8270	7360	(32.3)

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Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outrigger	
HX300SG Long reach	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		10200	7850	7000	800	-	-	-	-	-

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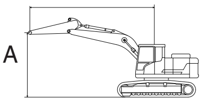
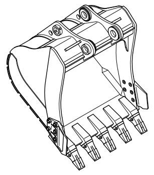
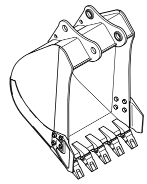


Lift-point height (A)		Lift-point radius (B)										At max. reach		
		10.5 m (34.4 ft)		12.0 m (39.4 ft)		13.5 m (44.3 ft)		15.0 m (44.3 ft)		16.5 m (54.1 ft)		Capacity		Reach
														m (ft)
13.5 m	kg											*900	*900	12.91
(44.3 ft)	lb											*1980	*1980	(42.4)
12.0 m	kg					*1170	*1170					*850	*850	14.12
(39.4 ft)	lb					*2580	*2580					*1870	*1870	(46.3)
10.5 m	kg					*1470	*1470	*860	*860			*810	*810	15.07
(34.4 ft)	lb					*3240	*3240	*1900	*1900			*1790	*1790	(49.4)
9.0 m	kg					*1670	*1670	*1260	*1260			*800	*800	15.82
(29.5 ft)	lb					*3680	*3680	*2780	*2780			*1760	*1760	(51.9)
7.5 m	kg					*1850	*1850	*1520	*1520			*790	*790	16.40
(24.6 ft)	lb					*4080	*4080	*3350	*3350			*1740	*1740	(53.8)
6.0 m	kg			*2220	*2220	*2060	*2060	*1730	*1730	*1060	*1060	*800	*800	16.83
(19.7 ft)	lb			*4890	*4890	*4540	*4540	*3810	*3810	*2340	*2340	*1760	*1760	(55.2)
4.5 m	kg	*2740	*2740	*2560	*2560	*2330	*2330	*1950	*1950	*1290	*1290	*830	*830	17.11
(14.8 ft)	lb	*6040	*6040	*5640	*5640	*5140	*5140	*4300	*4300	*2840	*2840	*1830	*1830	(56.1)
3.0 m	kg	*3100	*3100	*2820	*2820	*2620	2380	*2180	1940	*1460	*1460	*860	*860	17.26
(9.8 ft)	lb	*6830	*6830	*6220	*6220	*5780	5250	*4810	4280	*3220	*3220	*1900	*1900	(56.6)
1.5 m	kg	*3470	3380	*3090	2740	*2820	2240	*2430	1850	*1570	1520	*910	*910	17.27
(4.9 ft)	lb	*7650	7450	*6810	6040	*6220	4940	*5360	4080	*3460	3350	*2010	*2010	(56.7)
0.0 m	kg	*3830	3140	*3360	2560	*3020	2120	*2670	1760	*1600	1470	*970	*970	17.15
(0.0 ft)	lb	*8440	6920	*7410	5640	*6660	4670	*5890	3880	*3530	3240	*2140	*2140	(56.3)
-1.5 m	kg	*4150	2940	*3600	2420	*3200	2010	*2850	1690	*1500	1420	*1050	*1050	16.90
(-4.9 ft)	lb	*9150	6480	*7940	5340	*7050	4430	*6280	3730	*3310	3130	*2310	*2310	(55.4)
-3.0 m	kg	*4410	2790	*3800	2300	3310	1930	2840	1630	*1170	*1170	*1170	*1170	16.51
(-9.8 ft)	lb	*9720	6150	*8380	5070	7300	4250	6260	3590	*2580	*2580	*2580	*2580	(54.2)
-4.5 m	kg	*4600	2690	3840	2230	3260	1880	*2620	1600			*1310	*1310	15.96
(-14.8 ft)	lb	*10140	5930	8470	4920	7190	4140	*5780	3530			*2890	*2890	(52.4)
-6.0 m	kg	4570	2640	3800	2200	3240	1860	*1920	1610			*1520	*1520	15.25
(-19.7 ft)	lb	10080	5820	8380	4850	7140	4100	*4230	3550			*3350	*3350	(50.0)
-7.5 m	kg	4570	2650	3810	2210	3270	1890					*1830	1750	14.34
(-24.6 ft)	lb	10080	5840	8400	4870	7210	4170					*4030	3860	(47.0)
-9.0 m	kg	*4550	2710	*3850	2270							*2310	2030	13.19
(-29.5 ft)	lb	*10030	5970	*8490	5000							*5090	4480	(43.3)
-10.5 m	kg	*4180	2850									*3210	2480	11.74
(-34.4 ft)	lb	*9220	6280									*7080	5470	(38.5)

6. BUCKET SELECTION GUIDE

1) GENERAL BUCKET

	
1.27 SAE heaped bucket	★0.52 m^3 SAE heaped bucket

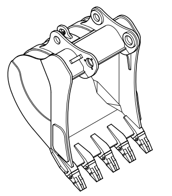
Capacity		Width		Weight	Recommendation				
					6.25 m (20' 6") boom				10.2 m (33' 6") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.05 m arm (10' 0")	3.75 m arm (12' 4")	7.85 m arm (25' 9")
1.27 m^3 (1.66 yd^3)	1.11 m^3 (1.45 yd^3)	1325 mm (52")	1410 mm (56")	1135 kg (2500 lb)	●	●	◐	■	X
★ 0.52 m^3 (0.68 yd^3)	0.45 m^3 (0.59 yd^3)	945 mm (37")	1035 mm (41")	470 kg (1040 lb)	X	X	X	X	◐

★ : Long reach bucket

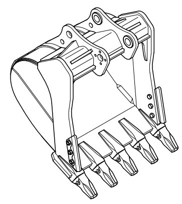
●	Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less
◐	Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less
■	Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less
▲	Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less
X	Not recommended

※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult your HD Hyundai Construction Equipment dealer for information on selecting the correct boom－arm－bucket combination.

2) HEAVY DUTY AND ROCK-HEAVY DUTY BUCKET



◈ 1.46 m^3 SAE
heaped bucket



◆ 1.50 m^3 SAE
heaped bucket

Capacity		Width		Weight	Recommendation				
					6.25 m (20' 6") boom				10.2 m (33' 6") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		2.1 m arm (6' 11")	2.5 m arm (8' 2")	3.05 m arm (10' 0")	3.75 m arm (12' 4")	7.85 m arm (25' 9")
◈ 1.46 m^3 (1.91 yd^3)	1.28 m^3 (1.67 yd^3)	1535 mm (60")	-	1395 kg (3080 lb)	◐	◐	■	▲	X
◆ 1.50 m^3 (1.96 yd^3)	1.30 m (1.70 yd^3)	1550 mm (61")	-	1575 kg (3470 lb)	◐	■	■	▲	X

◈ : Heavy duty bucket
◆ : Rock-Heavy duty bucket

●	Applicable for materials with density of 2100 kg/m^3 (3500 lb/yd^3) or less
◐	Applicable for materials with density of 1800 kg/m^3 (3000 lb/yd^3) or less
■	Applicable for materials with density of 1500 kg/m^3 (2500 lb/yd^3) or less
▲	Applicable for materials with density of 1200 kg/m^3 (2000 lb/yd^3) or less
X	Not recommended

7. UNDERCARRIAGE

1) TRACKS

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

2) TYPES OF SHOES

Model	Description	Unit	Triple grouser		
	width	mm (in)	600 (24")	700 (28")	800 (32")
HX300SG	Operating weight	kg (lb)	29540 (65125)	30090 (66337)	30460 (67153)
	Ground pressure	kgf/cm^2 (psi)	0.57 (8.09)	0.50 (7.11)	0.44 (6.26)
	Overall width	mm (ft-in)	3200 (10' 6")	3300 (10' 10")	3400 (11' 1")
HX300SG Long reach	Operating weight	kg (lb)	-	-	32610 (71893)
	Ground pressure	kgf/cm^2 (psi)	-	-	0.47 (6.68)
	Overall width	mm (ft-in)	-	-	3400 (11' 2")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Upper rollers	2 EA
Lower rollers	9 EA
Track shoes	48 EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

Confirm the category from the list of applications in **table 2**, then use **table 1** to select the shoe. Wide shoes (categories B and C) have limitations on applications. Before using wide shoes, check the precautions, then investigate and study the operating conditions to confirm if these shoes are suitable.

Select the narrowest shoe possible to meet the required flotation and ground pressure.

Application of wider shoes than recommendations will cause unexpected problem such as bending of shoes, crack of link, breakage of pin, loosening of shoe bolts and the other various problems.

※ Table 1

Track shoe	Specification	Category
600 mm triple grouser	Standard	A
700 mm triple grouser	Option	B
800 mm triple grouser	Option	C
800 mm triple grouser (long reach)	Standard	C

※ 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 or a wide range of general civil engineering work
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles
C	Extremely soft ground (swampy ground)	· Use the shoes only in the conditions that the machine sinks and it is impossible to use the shoes of category A or B · These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	HD Hyundai Construction Equipment / HE6.7
Type	4-cycle, turbocharged, charge air cooled, electronic controlled diesel engine
Cooling method	Water cooled
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	107×124 mm (4.21 "×4.88 ")
Piston displacement	6.7 ℓ (408 cu in)
Compression ratio	17.2 : 1
Gross power	227 Hp (169 kW) at 1900rpm
Net power	197 Hp (147 kW) at 1900 rpm
Peak torque	952 N·m (702 lbf·ft) at 1400 rpm
Engine oil quantity	23.1 ℓ (6.1 U.S. gal)
Wet weight	485 kg (1069 lb)
Starting motor	24 V - 4.8 kW
Alternator	24 V - 90 A
Battery	2×12V×150Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2×140 cc/rev
Maximum pressure	330 kgf/cm^2 (4690 psi) [360 kgf/cm^2 (5120 psi)]
Rated oil flow	2×266 ℓ/min (70.3 U.S. gpm/ 58.5 U.K. gpm)

[ ] : Power boost

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	35 kgf/cm^2 (500 psi)
Rated oil flow	28.5 ℓ/min (7.5 U.S. gpm/6.3 U.K. gpm)

4) MAIN CONTROL VALVE

Item		Specification	
		HX300SG	HX300SG Long reach
Type		10 spools	
Operating method		Hydraulic pilot system	
Main relief valve pressure		330 kgf/cm² (4695 psi) [360 kgf/cm² (5120 psi)]	
Overload relief valve pressure	Boom	390 kgf/cm² (5550 psi)	390 kgf/cm² (5550 psi)
	Arm	390 kgf/cm² (5550 psi)	In : 230 kgf/cm² (3270 psi) Out : 260 kgf/cm² (3700 psi)
	Bucket	390 kgf/cm² (5550 psi)	270 kgf/cm² (3840 psi)

[ ] : Power boost

5) SWING MOTOR

Item	Specification
Type	Axial piston motor
Capacity	156.9 cc/rev
Relief pressure	300 kgf/cm² (4267 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	84 kgf·m (608 lbf·ft)
Brake release pressure	22 kgf/cm² (313 psi)
Reduction gear type	2 - stage planetary

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	350 kgf/cm² (4978 psi)
Capacity (max/min)	282.6/156.9 cc/rev
Reduction gear type	2-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	11 kgf/cm² (156 psi)
Braking torque	115 kgf·m (832 lbf·ft)

7) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5 kgf/cm^2 (92 psi)
	Maximum	25 kgf/cm^2 (356 psi)
Single operation stroke	Lever	61 mm (2.4 in)
	Pedal	123 mm (4.84 in)

8) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	Ø140 × Ø100 × 1465 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	Ø150 × Ø110 × 1765 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	Ø140 × Ø95 × 1185 mm
	Cushion	Extend only
Bucket cylinder (Long reach)	Bore dia × Rod dia × Stroke	Ø100 × Ø70 × 870 mm
	Cushion	Extend and retract

※ 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. RECOMMENDED OILS

HD Hyundai Construction Equipment genuine lubricating oils have been developed to offer the best performance and service life for your equipment. These oils have been tested according to the specifications of HD Hyundai Construction Equipment and, therefore, will meet the highest safety and quality requirements.

We recommend that you use only HD Hyundai Construction Equipment genuine lubricating oils and grease officially approved by HD Hyundai Construction Equipment.

Service point	Kind of fluid	Capacity ℓ (U.S. gal)	Ambient temperature ˚C(˚F) -50 (-58), -30 (-22), -20 (-4), -10 (14), 0 (32), 10 (50), 20 (68), 30 (86), 40 (104)
Engine oil pan	Engine oil	23.1 (6.1)	★SAE 0W-30
			SAE 5W-30
			SAE 10W-30
			SAE 15W-40
Swing drive	Gear oil	11 (2.9)	★SAE 75W-90
Final drive		7.8×2 (2.1×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 210 (55.5) System : 320 (84.5)	★ISO VG 15
			ISO VG 32
			ISO VG 46
			ISO VG 68
Fuel tank	Diesel fuel	480 (126.8)	★ASTM D975 NO.1
			ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★NLGI NO.1
			NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★1	50 (13.2)	Ethylene glycol base permanent type (50 : 50)
			★Ethylene glycol base permanent type (60 : 40)

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

★ : Cold region
Russia, CIS, Mongolia
★1 : Soft water
City water or distilled water

※ Using any lubricating oils other than HD Hyundai Construction Equipment genuine products may lead to a deterioration of performance and cause damage to major components.

※ Do not mix HD Hyundai Construction Equipment genuine oil with any other lubricating oil as it may result in damage to the systems of major components.

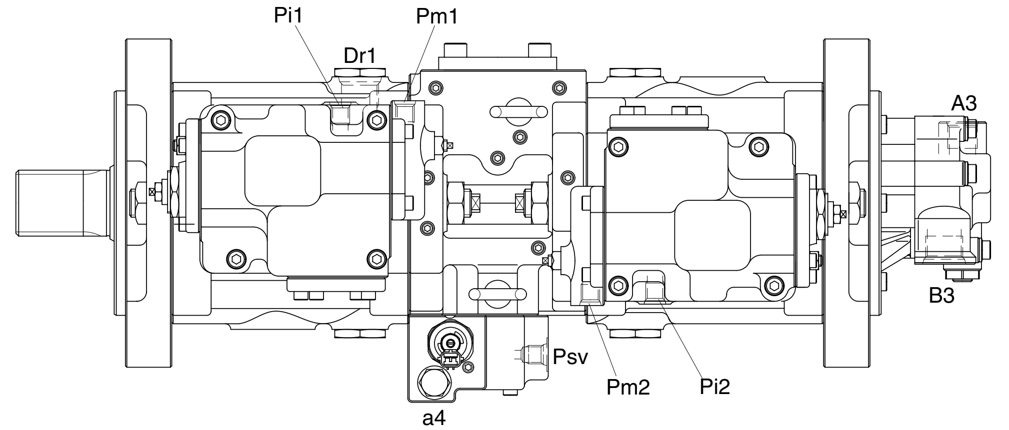
※ For HD Hyundai Construction Equipment genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HD Hyundai Construction Equipment dealers.

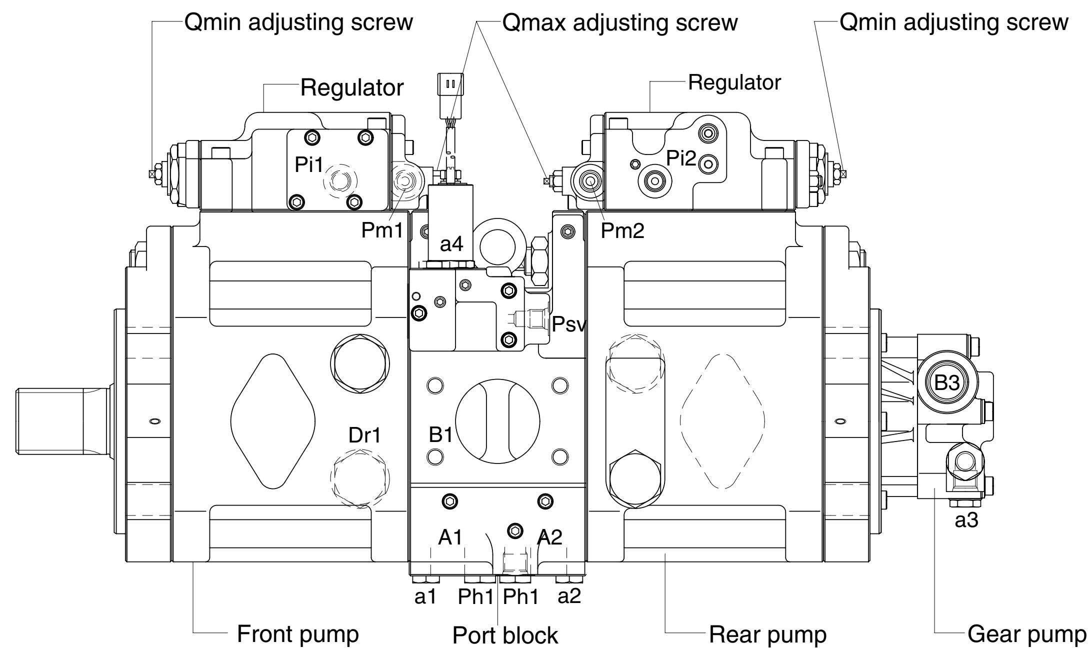
SECTION 2 STRUCTURE AND FUNCTION

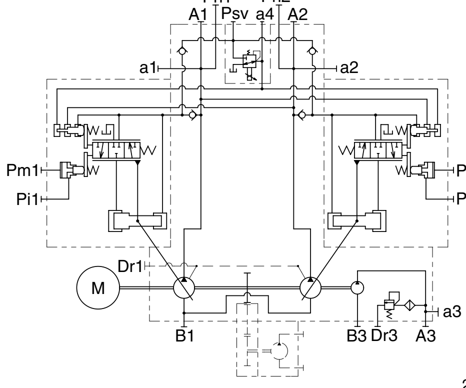
GROUP 1 PUMP DEVICE

1. STRUCTURE

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





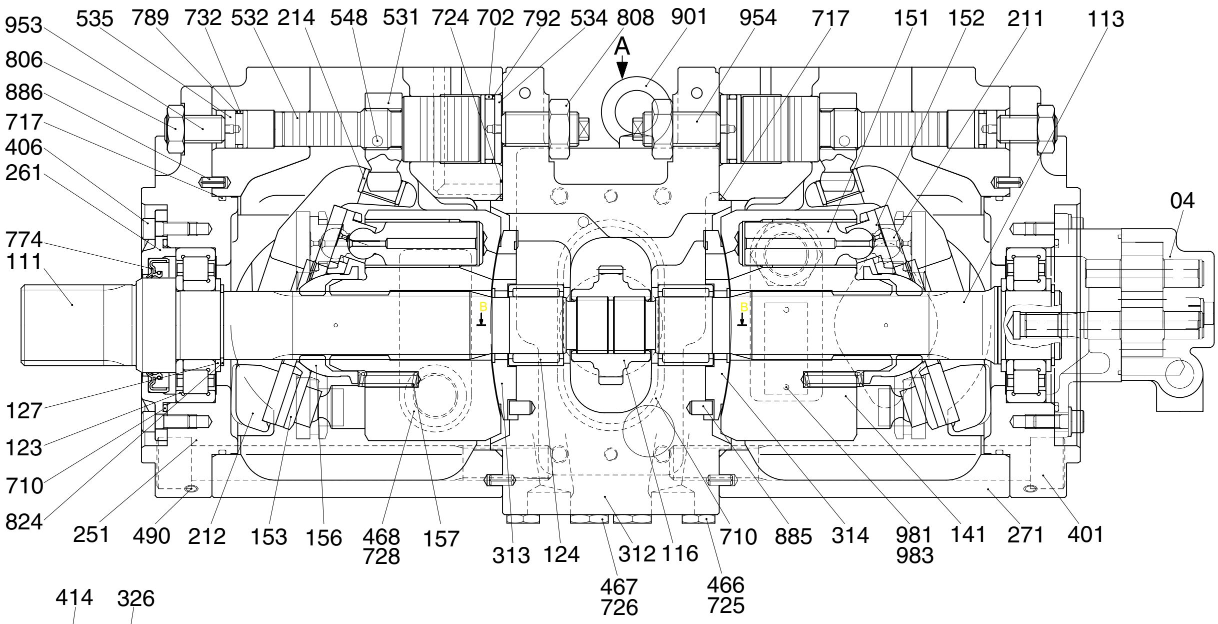


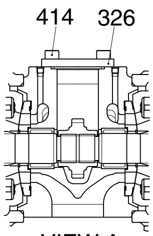
2907A2MP01

Port	Port name	Port size
A1, 2	Delivery port	SAE6000psi 1"
B1	Suction port	SAE2500psi 2 1/2"
Dr1	Drain port	PF 3/4 - 20
Ph1, h2	Pressure sensor port	PF 3/8 - 17
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 - 20.5
Dr3	Gear pump drain port	PF 3/8 - 15

1) MAIN PUMP(1/2)

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



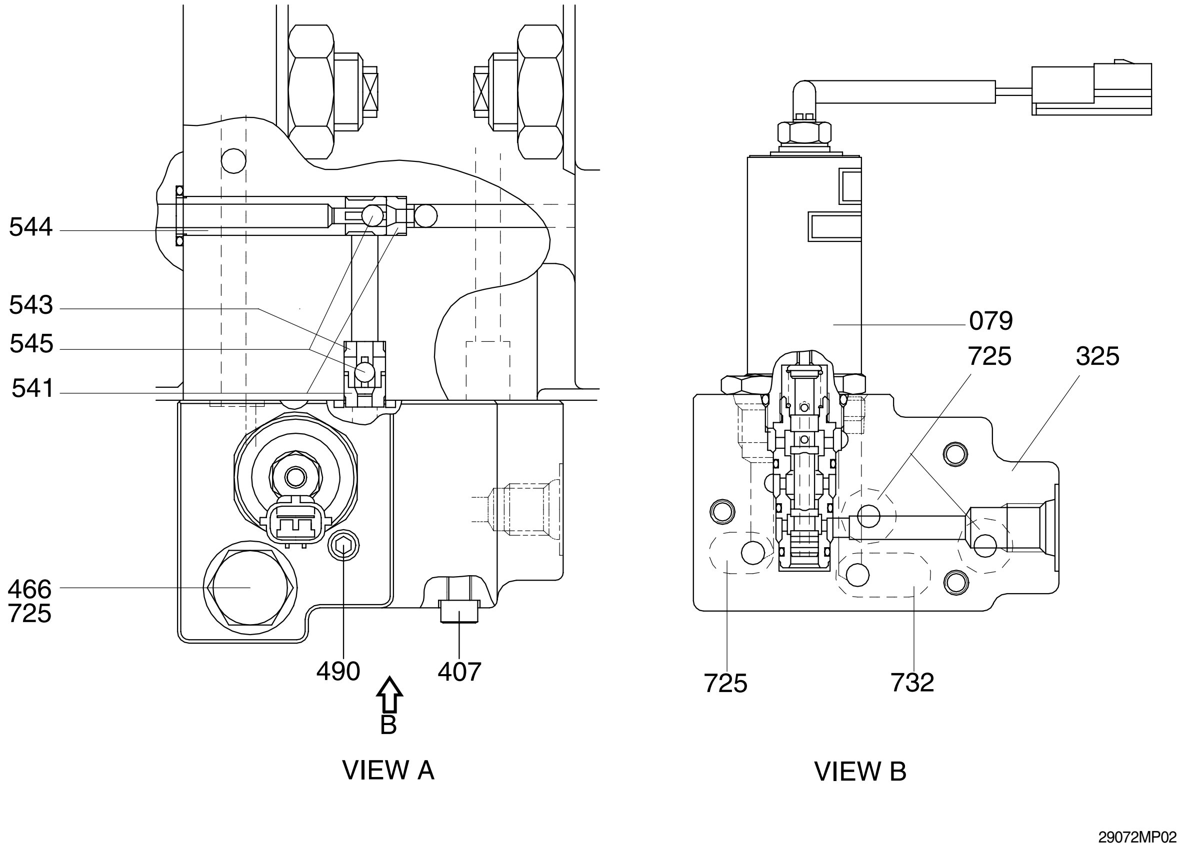


VIEW A

2907A2MP02

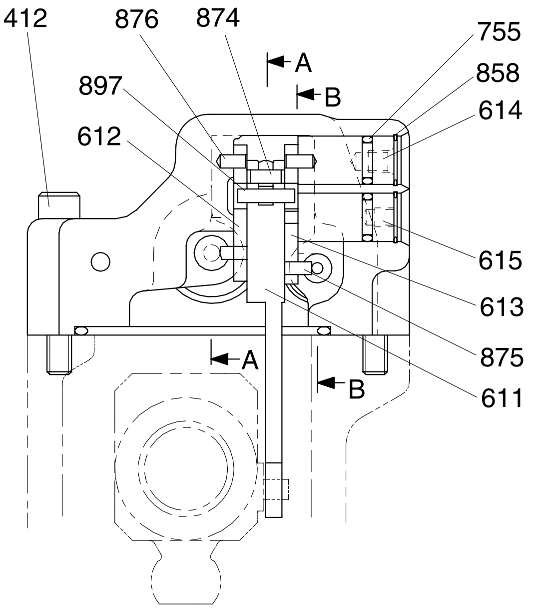
04	Gear pump	271	Pump casing	710	O-ring
111	Drive shaft(F)	312	Valve block	717	O-ring
113	Drive shaft(R)	313	Valve plate(R)	724	O-ring
114	Spline coupling	314	Valve plate(L)	725	O-ring
123	Roller bearing	326	Cover	728	O-ring
124	Needle bearing	401	Hexagon socket bolt	732	O-ring
127	Bearing spacer	406	Hexagon socket bolt	774	Oil seal
141	Cylinder block	414	Hexagon socket bolt	789	Back up ring
151	Piston	466	VP plug	792	Back up ring
152	Shoe	467	VP plug	806	Hexagon head nut
153	Set plate	468	VP plug	808	Hexagon head nut
156	Bushing	490	VP plug	824	Snap ring
157	Cylinder spring	531	Tilting pin	885	Pin
211	Shoe plate	532	Servo piston	886	Spring pin
212	Swash plate	534	Stopper(L)	901	Eye bolt
214	Bushing	535	Stopper(S)	953	Set screw
251	Swash plate support	548	Pin	954	Set screw
261	Seal cover(F)	702	O-ring		

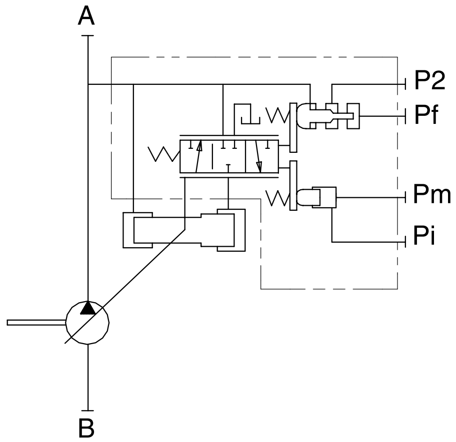
MAIN PUMP(2/2)

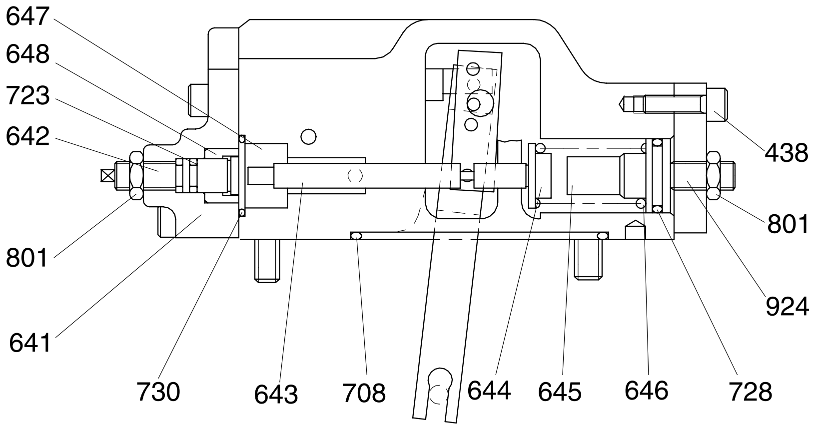


079	Proportional reducing valve	490	Plug	545	Steel ball
325	Casing assy	541	Seat	725	O-ring
407	Hexagon screw	543	Stopper 1	732	O-ring
466	Plug	544	Stopper 2		

2) REGULATOR(1/2)

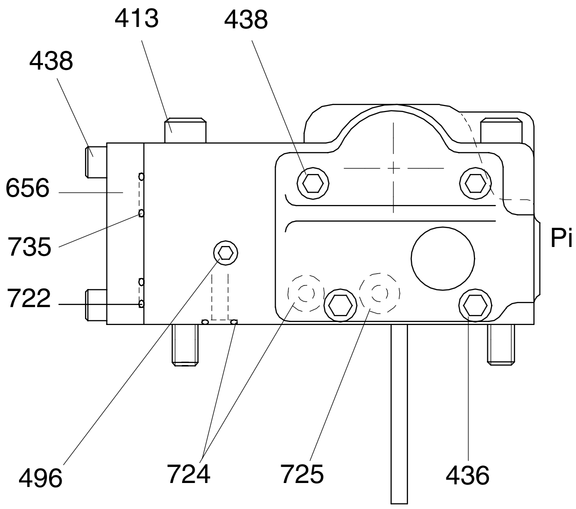






SECTION B-B

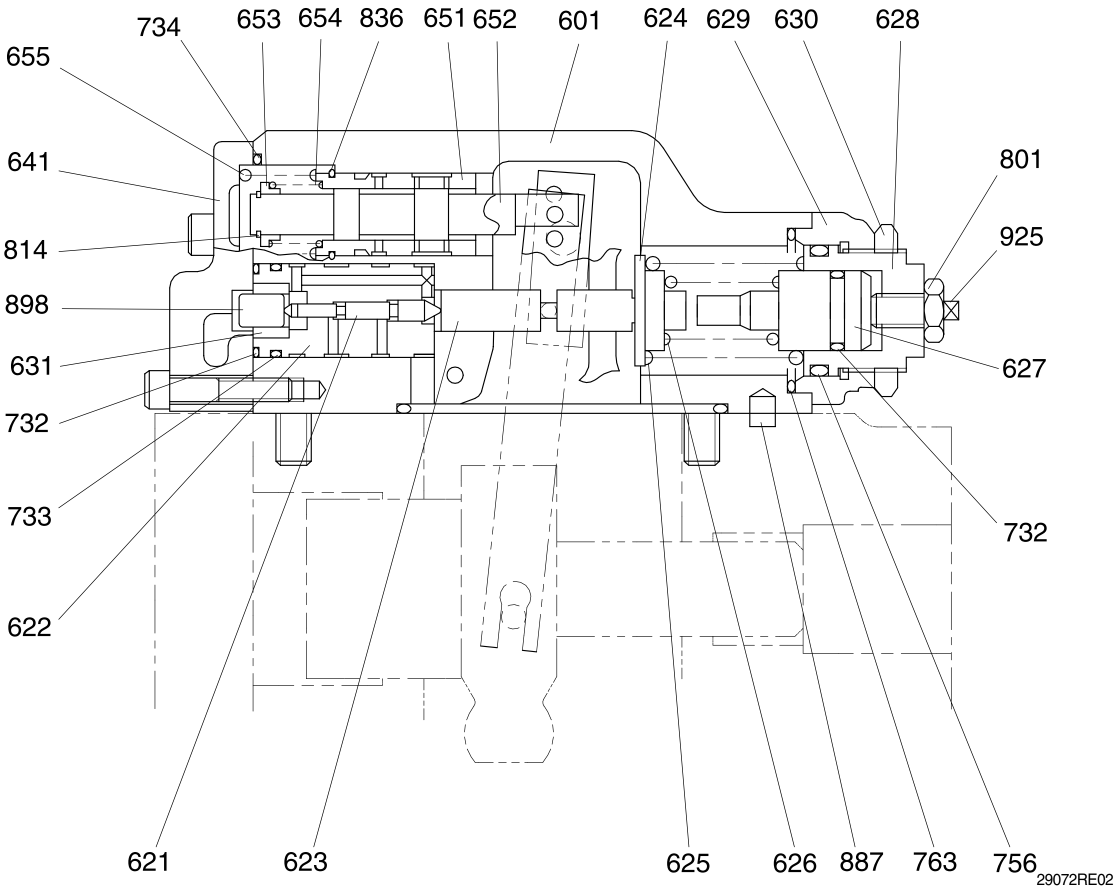
2907A2RE01



VIEW C

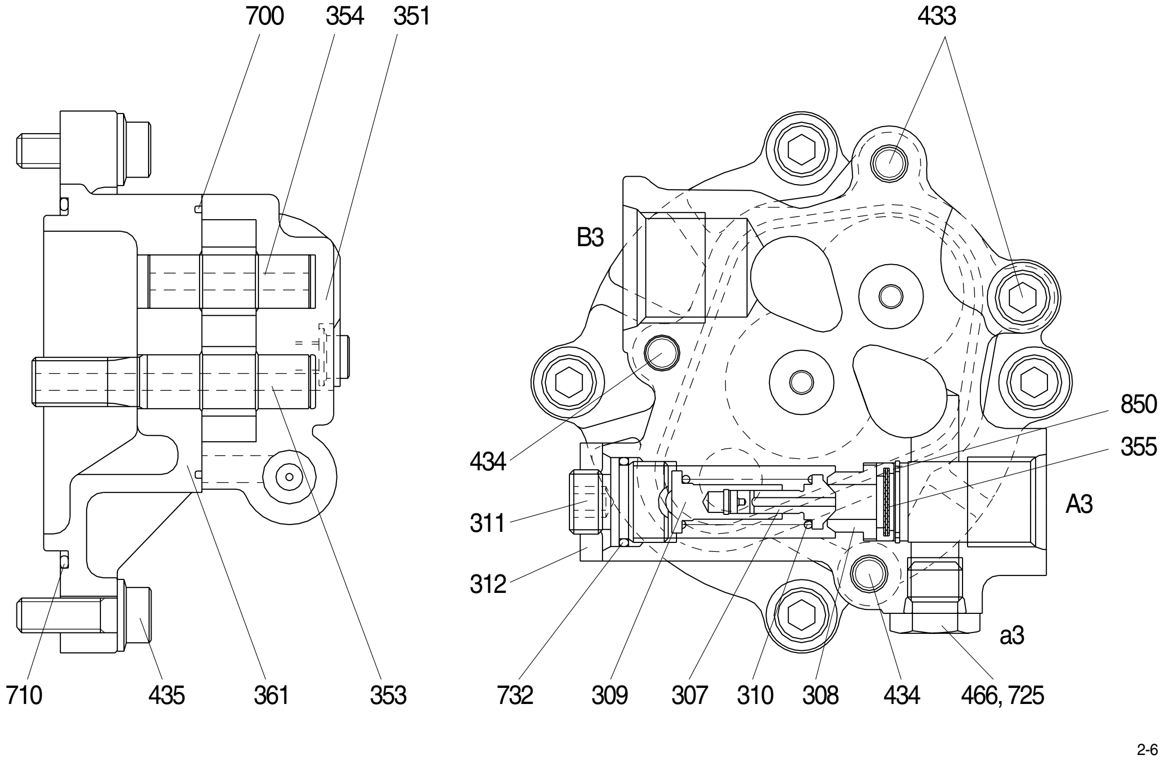
Port	Port name	Port size
A	Delivery port	1"
B	Suction port	2 1/2"
Pi	Pilot port	PF 1/4-15
Pm	Qmax cut port	PF 1/4-15

REGULATOR(2/2)



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 screw(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	876	Pin
625	Outer spring	708	O-ring	887	Pin
626	Inner spring	722	O-ring	897	Pin
627	Adjust stem(C)	723	O-ring	898	Pin
628	Adjust screw(C)	724	O-ring	924	Set screw
629	Cover(C)	725	O-ring	925	Adjust screw(QI)
630	Lock nut	728	O-ring		

3) GEAR PUMP



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

2. FUNCTION

1) MAIN PUMP

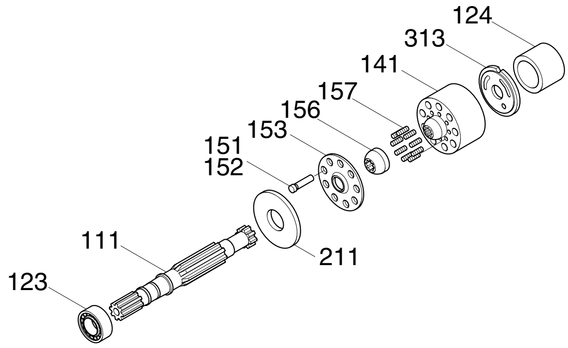
The pumps may classified roughly into the rotary group performing a rotary motion and working as the major part of the whole pump function: the swash plate group that varies the delivery rates: and the valve cover group that changes over oil suction and discharge.

(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.



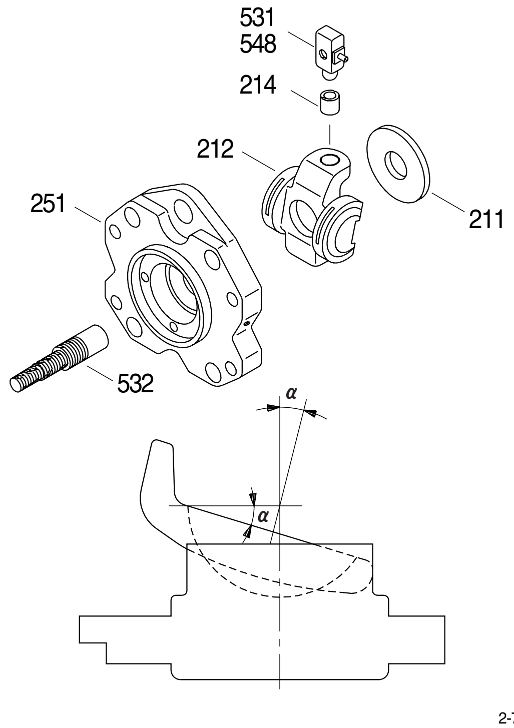
2907A2MP03

(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

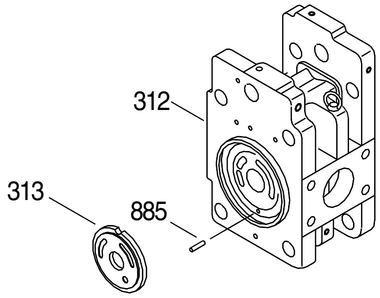
The valve block group consists of valve block(312), valve plate(313) and valve plate pin(885).

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

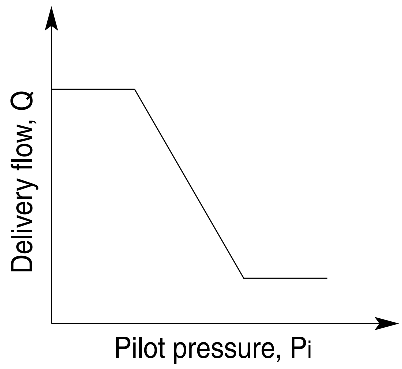
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

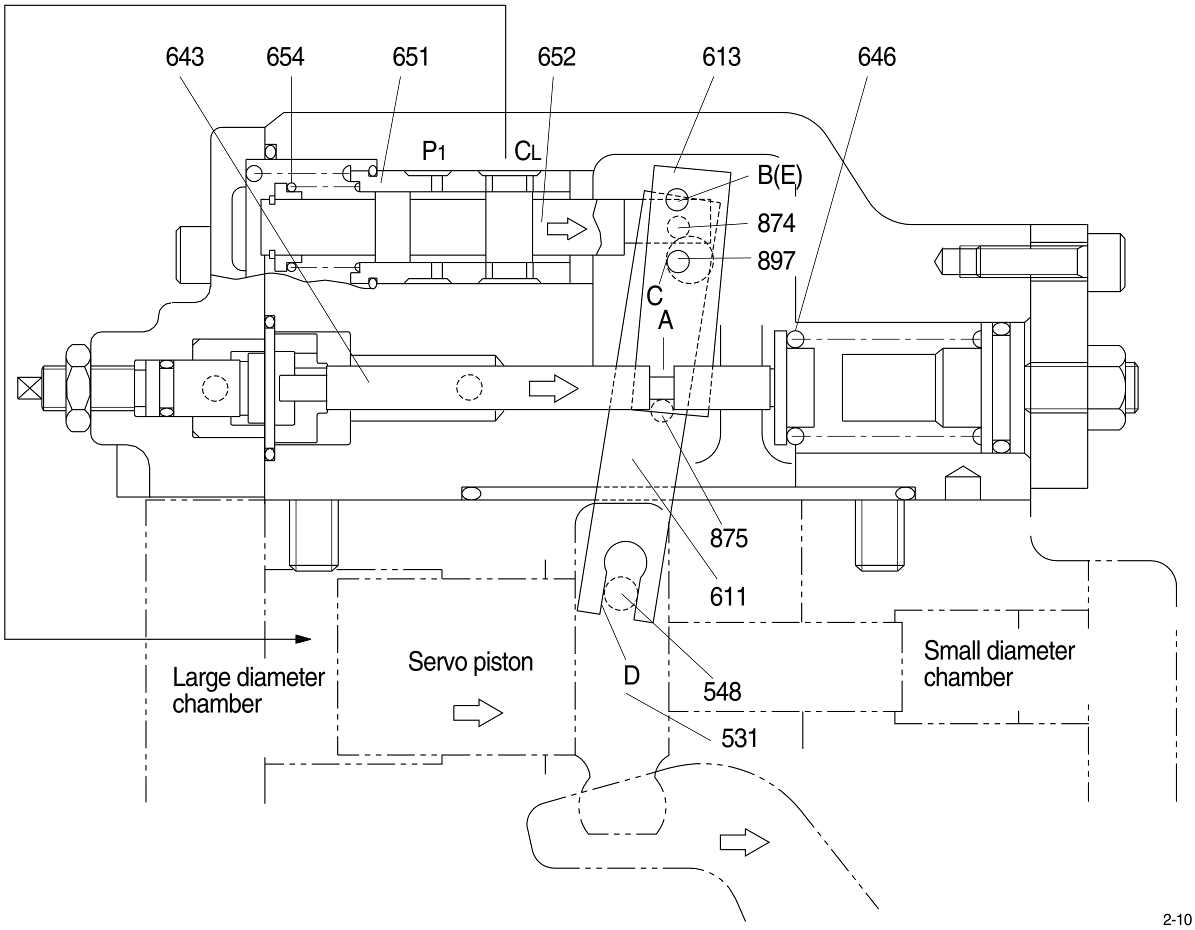
By changing the pilot pressure Pi, the pump tilting angle(delivery flow) is regulated arbitrarily, as shown in the figure.

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.

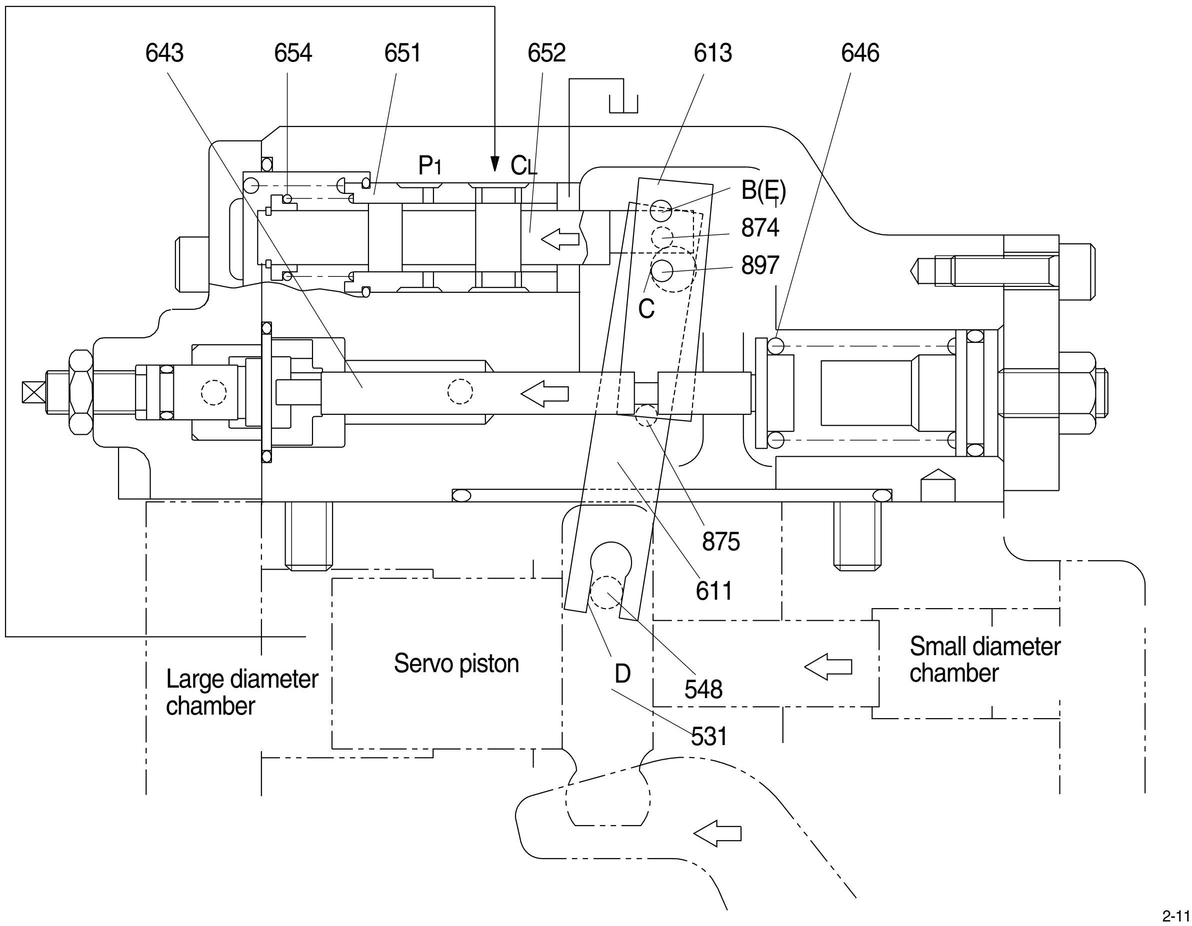
Since the feedback lever is connected with the spool(652) via the pin(874), the spool moves to the right.

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**

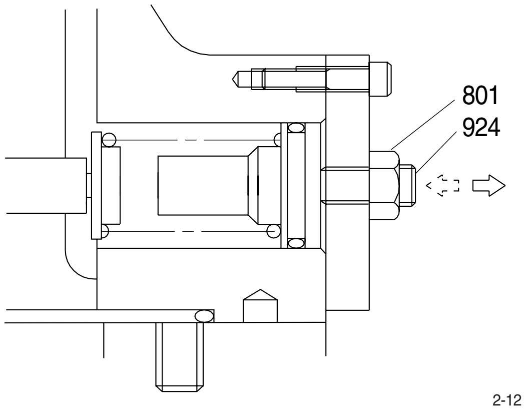
The flow control characteristic can be adjusted with the adjusting screw.

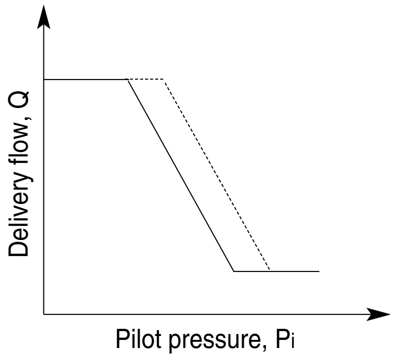
Adjust it by loosening the hexagon nut (801) and by tightening(or loosening) the hexagonal socket head screw(924).

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)
1800	+1/4	+1.5	+14.6





(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.)

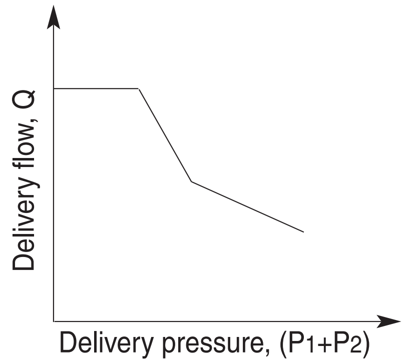
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control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

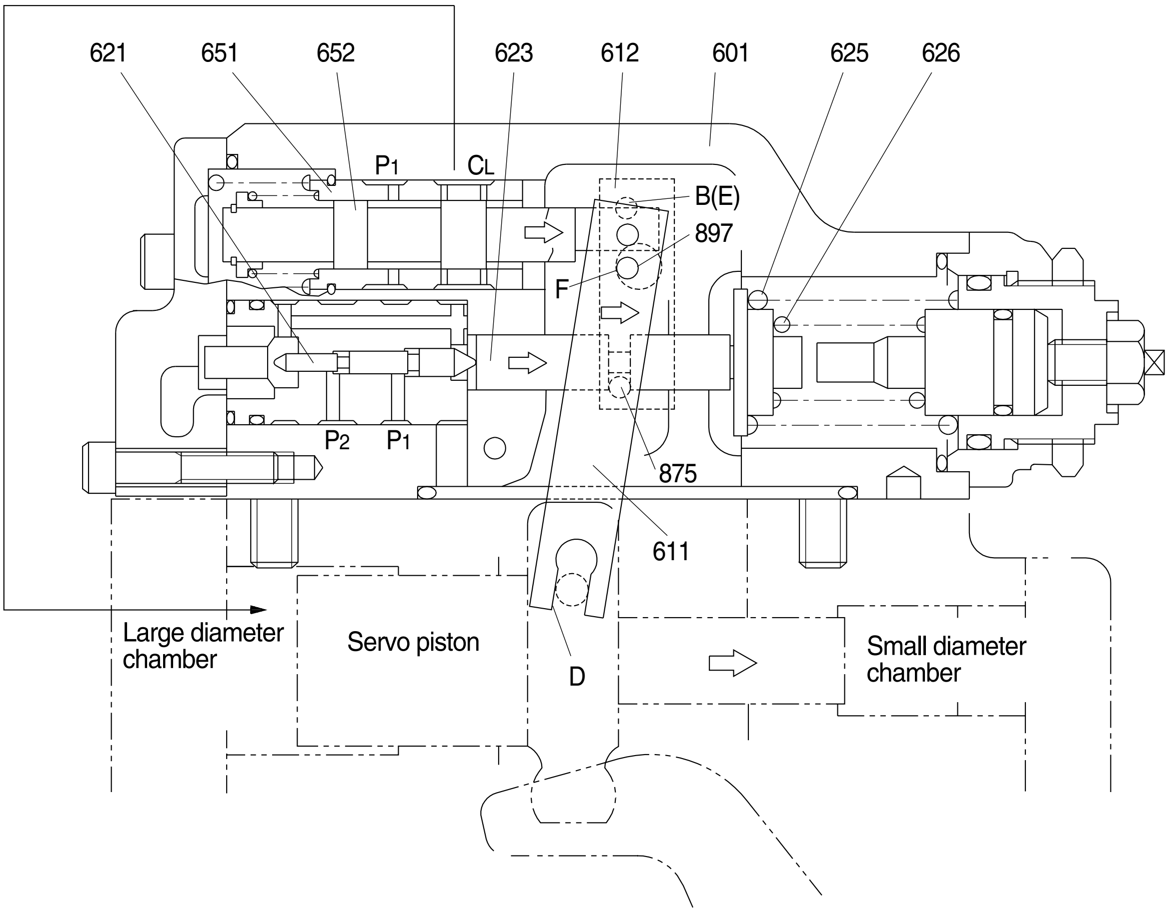
$Tin = P1 \times q/2\pi + P2 \times q/2\pi$

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

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).



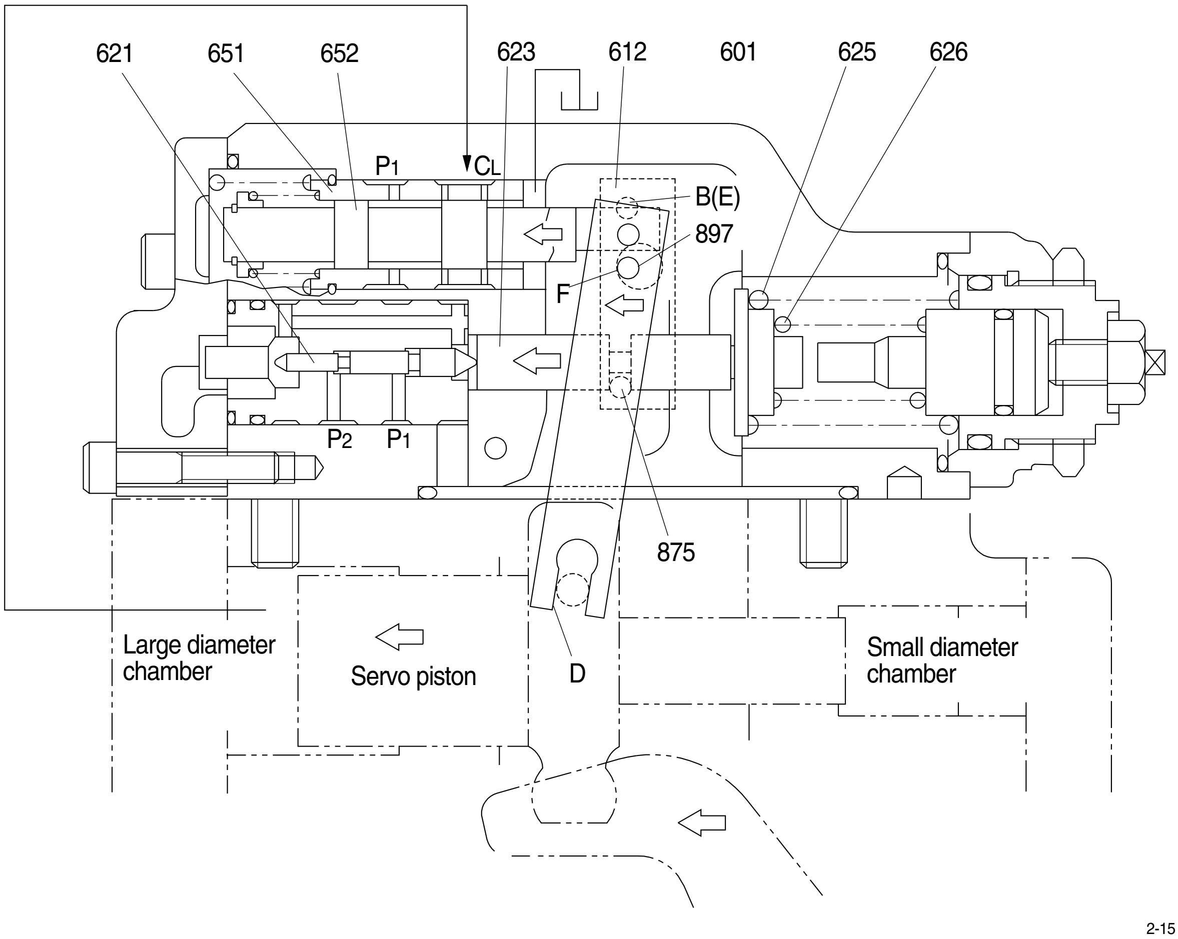
① **Overload preventive function**



2-14

When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston(621). It presses the compensating rod(623) to the right till the force of the outer spring(625) and inner spring(626) balances with the hydraulic force. The movement of the compensating rod is transmitted to lever 1(612) via pin(875).
Lever 1 rotates around the pin(875) (E) fixed to the casing(601).
Since the large hole section(F) of lever 1 contains a protruding pin(897) fixed to the feedback lever(611), the feedback lever rotates around the fulcrum of point D as lever 1 rotates, and then the spool(652) is shifted to the right. As the spool moves, the delivery pressure P1 is admitted to the large diameter section of the servo piston via port CL, causes the servo piston move to the right, reduces the pump delivery, flow rate, and prevents the prime mover from being overloaded.
The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool(652) and sleeve(651) is closed.

② **Flow reset function**



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

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

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

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

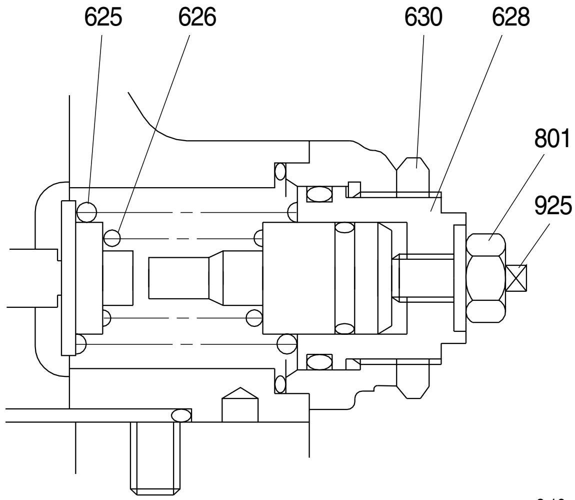
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections(C & F) of levers 1 and 2. However, since sections C and F have the pins(ø4) protruding from the large hole(ø8), only the lever lessening the tilting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

④ **Adjustment of input horsepower**

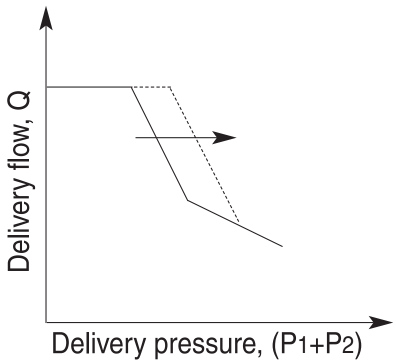
Since the regulator is of total cumulative horsepower type, adjust the adjusting screws of both the front and rear pumps, when changing the horsepower set values. The pressure change values by adjustment are based on two pumps pressurized at the same time, and the values will be doubled when only one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

a. **Adjustment of outer spring**

Adjust it by loosening the hexagon nut(630) and by tightening(or loosening) the adjusting screw C(628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring(626), return the adjusting screw QI(925) by N×A turns at first.(A=1.9)



2-16



※ **Adjusting values are shown in table.**

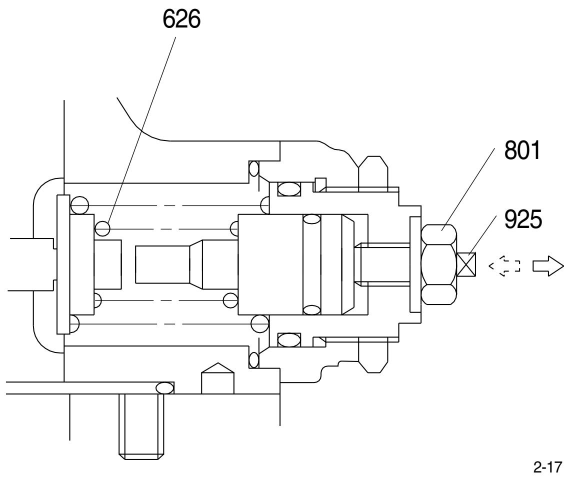
Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw(C) (925)	Compens-ating control starting pressure change amount	Input torque change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(kgf · m)
1800	+1/4	+19.2	+6.3

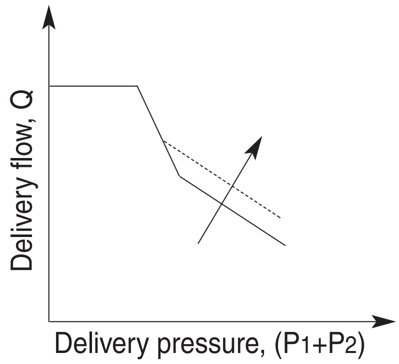
b. Adjustment of inner spring

Adjust it by loosening the hexagon nut (801) and by tightening(or loosening) the adjusting screw QI(925). Tightening the screw increases the flow and then the input horsepower as shown in the figure.

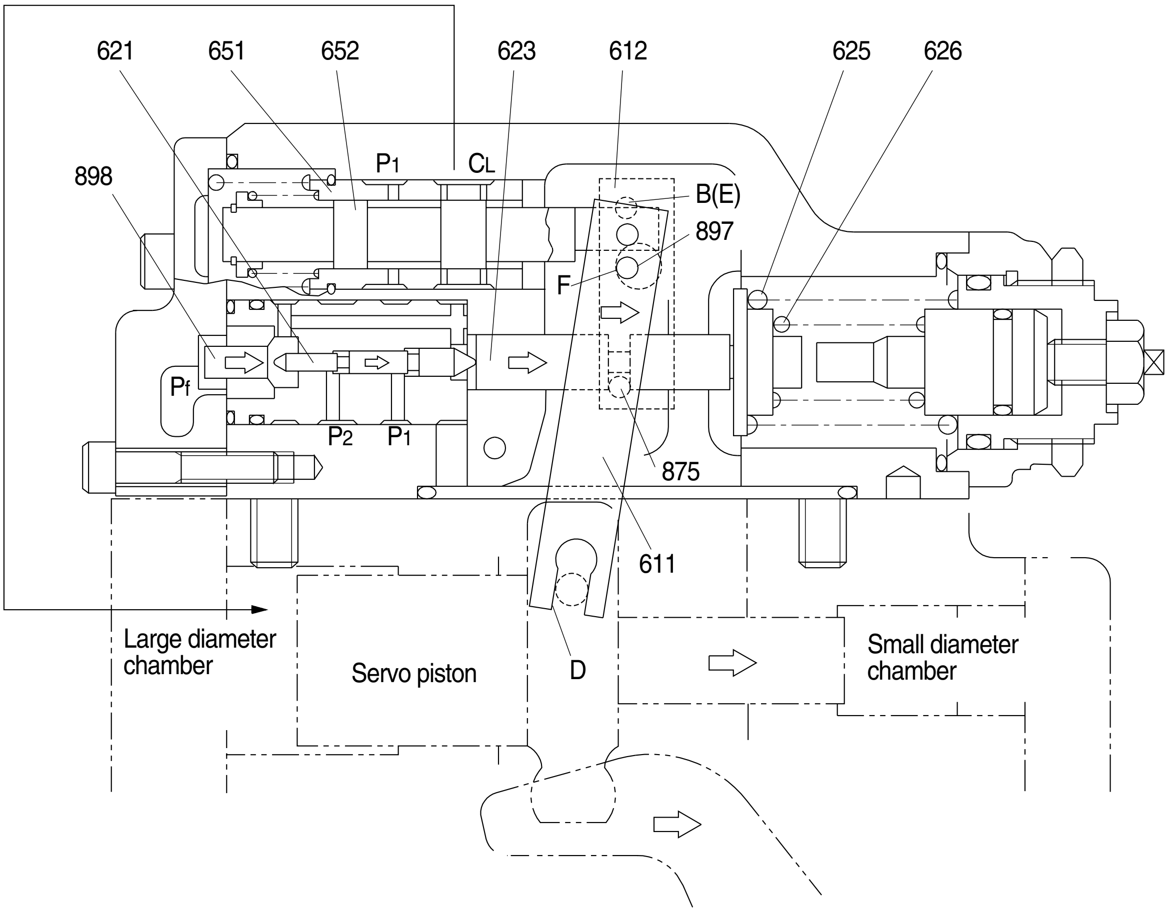
※ **Adjusting valves are shown in table.**

Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw(QI) (925)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(ℓ/min)	(kgf · m)
1800	+1/4	+10.4	+5.3

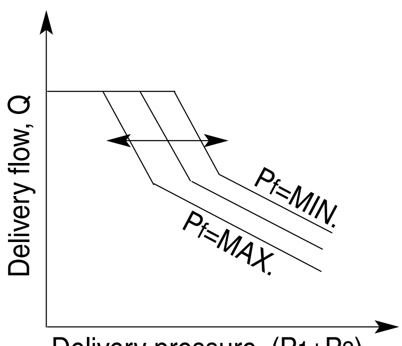




(3) Power shift control



2-18



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

Only one proportional pressure reducing valve is provided.

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

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

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

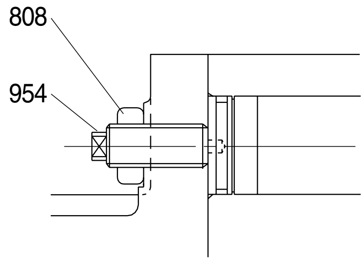
As the power shift pressure Pf rises, the compensating rod(623) moves to the right via the pin(898) and compensating piston(621).

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

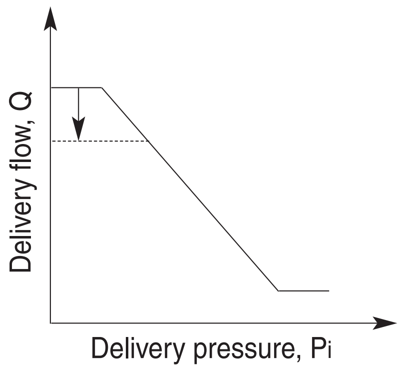
(4) Adjustment of maximum and minimum flows

① Adjustment of maximum flow

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



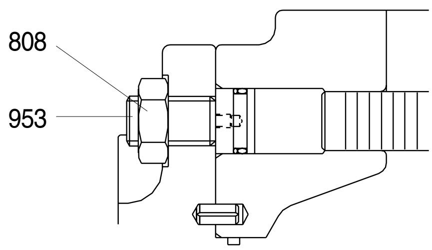
2-19(1)



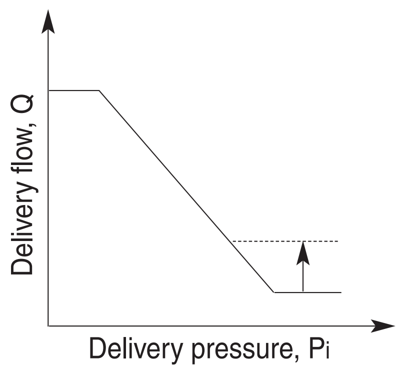
Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min $^{-1}$)	(Turn)	(l /min)
1800	+1/4	-5.6

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.



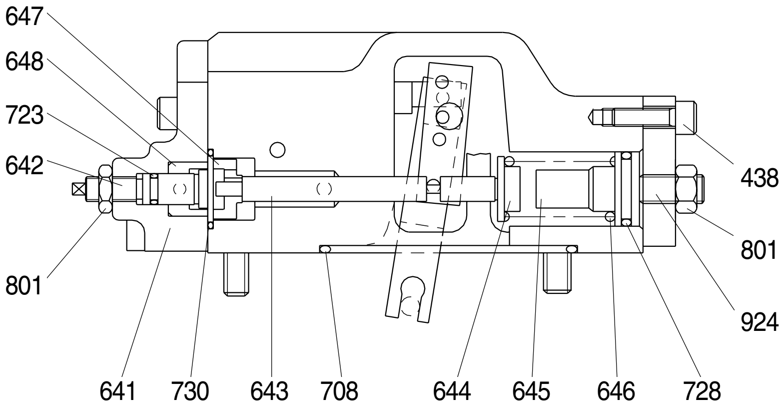
2-19(2)



Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min $^{-1}$)	(Turn)	(l /min)
1800	+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.)



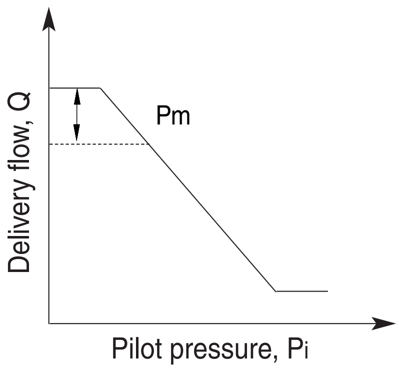
2-4

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.

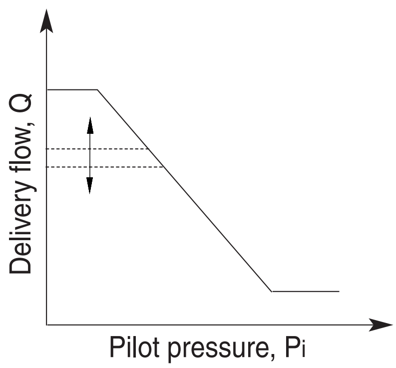
Since the adjusting screw QMC(642) is provided with a flange, the piston QMC stops upon contact with the flange, and the position of the pilot piston at this time determines the maximum flow of the pump.



② **Adjustment of Qmax cut flow**

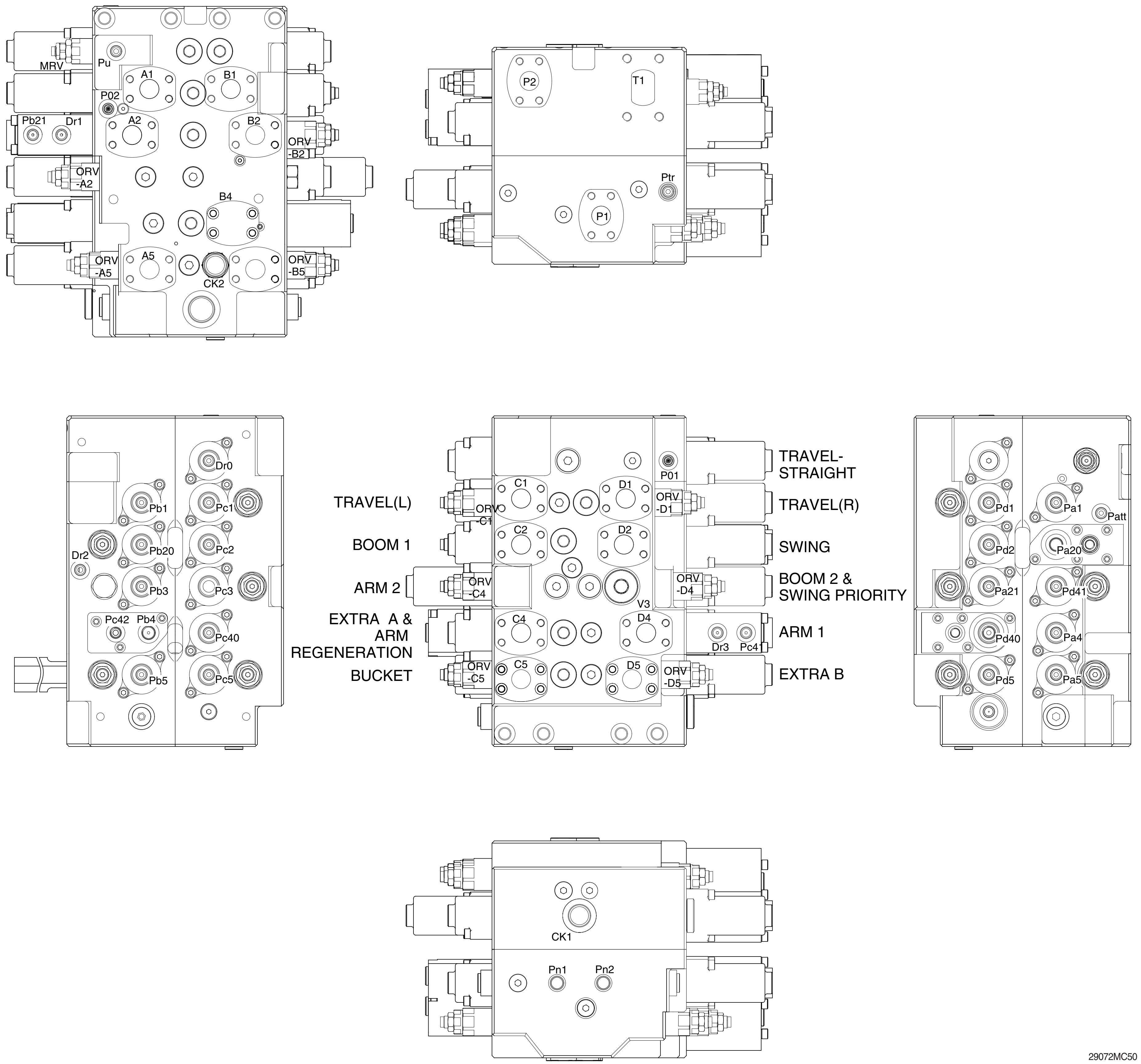
Adjust it by loosening the hexagon nut(801) and by tightening(or loosening) the adjusting screw QMC(642).

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

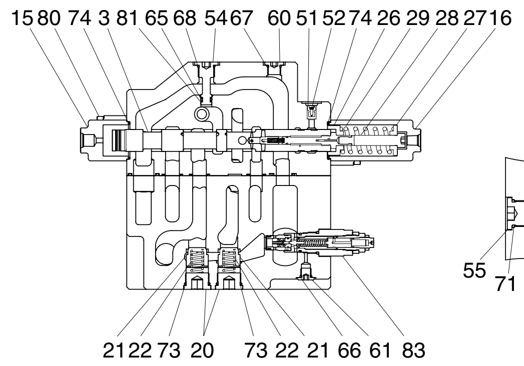


GROUP 2 MAIN CONTROL VALVE

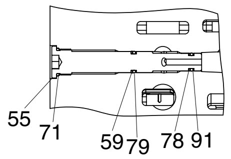
1. STRUCTURE

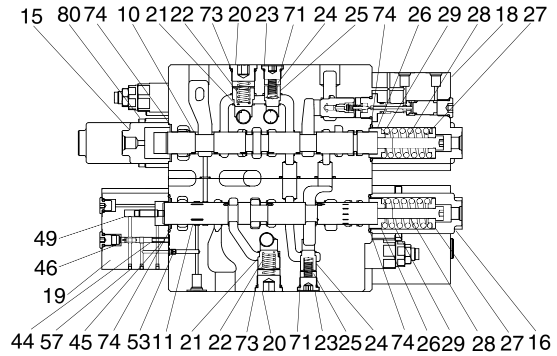


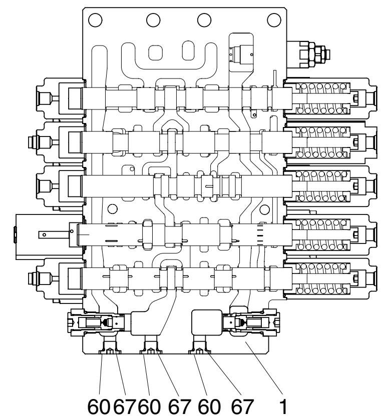
Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	G1	20~25kgf · m (145~180lbf · ft)
Patt	Auto idle-attachment	G1/4	3.5~3.9kgf · m (25.3~28.2lbf · ft)
Pb21	Lock valve pilot port(Boom)		
Pcb	Bucket in confluence port		
Pd40	Arm out pilot port		
Pd41	Arm out confluence pilot port		
Po1	Pilot pressure		
Po2	Pilot pressure		
Ptr	Auto idle-travel		
Dr1	Drain port		
Dr2	Drain port		
Dr3	Drain port		
Ck1	Bucket confluence	G3/4	17~19kgf · m (123~137.4lbf · ft)
Ck2	Bucket confluence		
Pa1	Travel pilot port-LH(FW)	G3/8	7~8kgf · m (50.6~57.8lbf · ft)
Pb1	Travel pilot port-LH(BW)		
Pc1	Travel pilot port-RH(BW)		
Pd1	Travel pilot port-RH(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		
Pc41	Lock valve pilot port(Arm)		
Pc42	Arm in regen-cut signal selector port		
Pa5	Bucket in pilot port		
Pb5	Bucket out pilot port		
Pc5	Option B pilot port		
Pd5	Option B pilot port		
Po	Pilot pressure port		
Pu	Main relief pressure up port		
Dr0	Drain port		
Pn1	Negative control signal port(P1 port side)		
Pn2	Negative control signal port(P2 port side)		
A1	Travel motor port-LH(FW)	SAE 5000, 1	7.5~9.2kgf · m (54.2~66.5lbf · 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(P1 side)		
P2	Pump port(P2 side)		
T1	Return port	SAE 3000, 2 (M12)	6.4~8.6kgf · m (46.2~62.2lbf · ft)



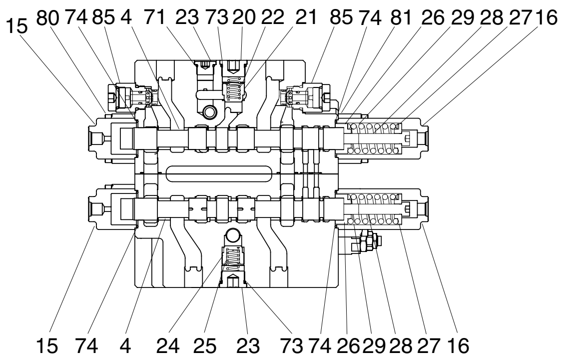
A-A (STRAIGHT-TRAVEL & SUPPLY)



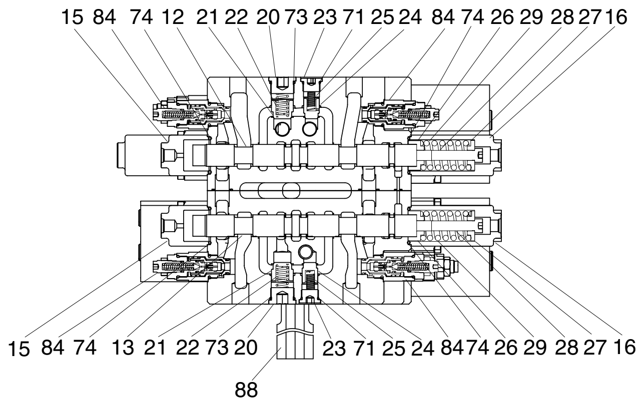




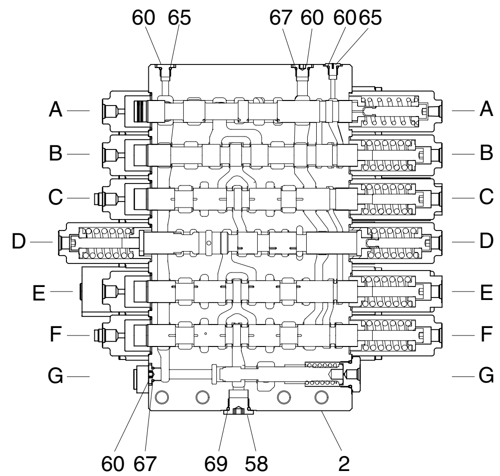
P1 BLOCK SPOOL SECTION



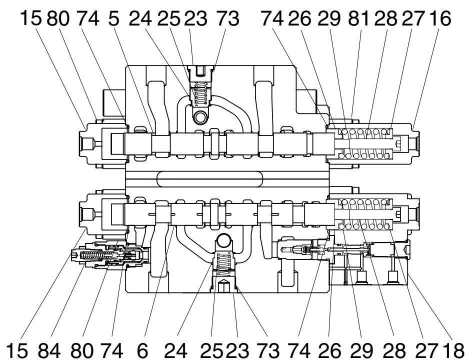
B-B (TRAVEL RIGHT& LEFT)



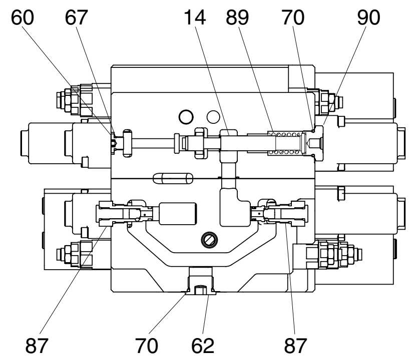
F-F (OPTION & BUCKET)



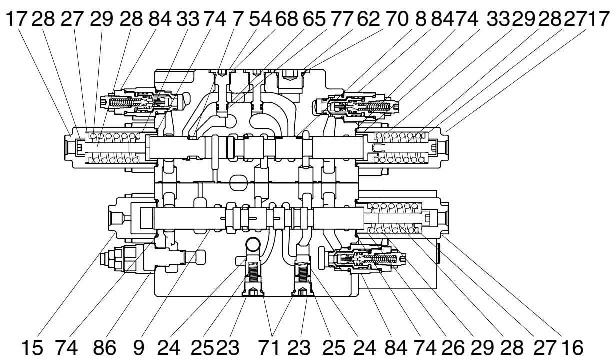
P2 BLOCK SPOOL SECTION



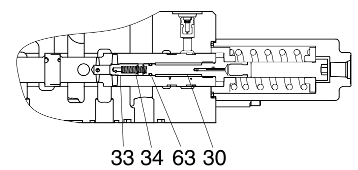
C-C (SWING & BOOM)



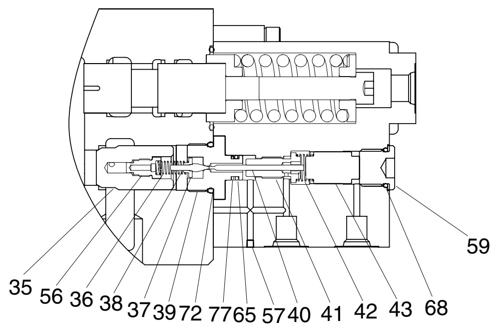
G-G (CENTER BYPASS CUT-OFF & NEGATIVE CONTROL)



D-D (SWING PRIORITY & BOO2 & ARM2)



STRAIGHT-TRAVEL SPOOL DETAIL

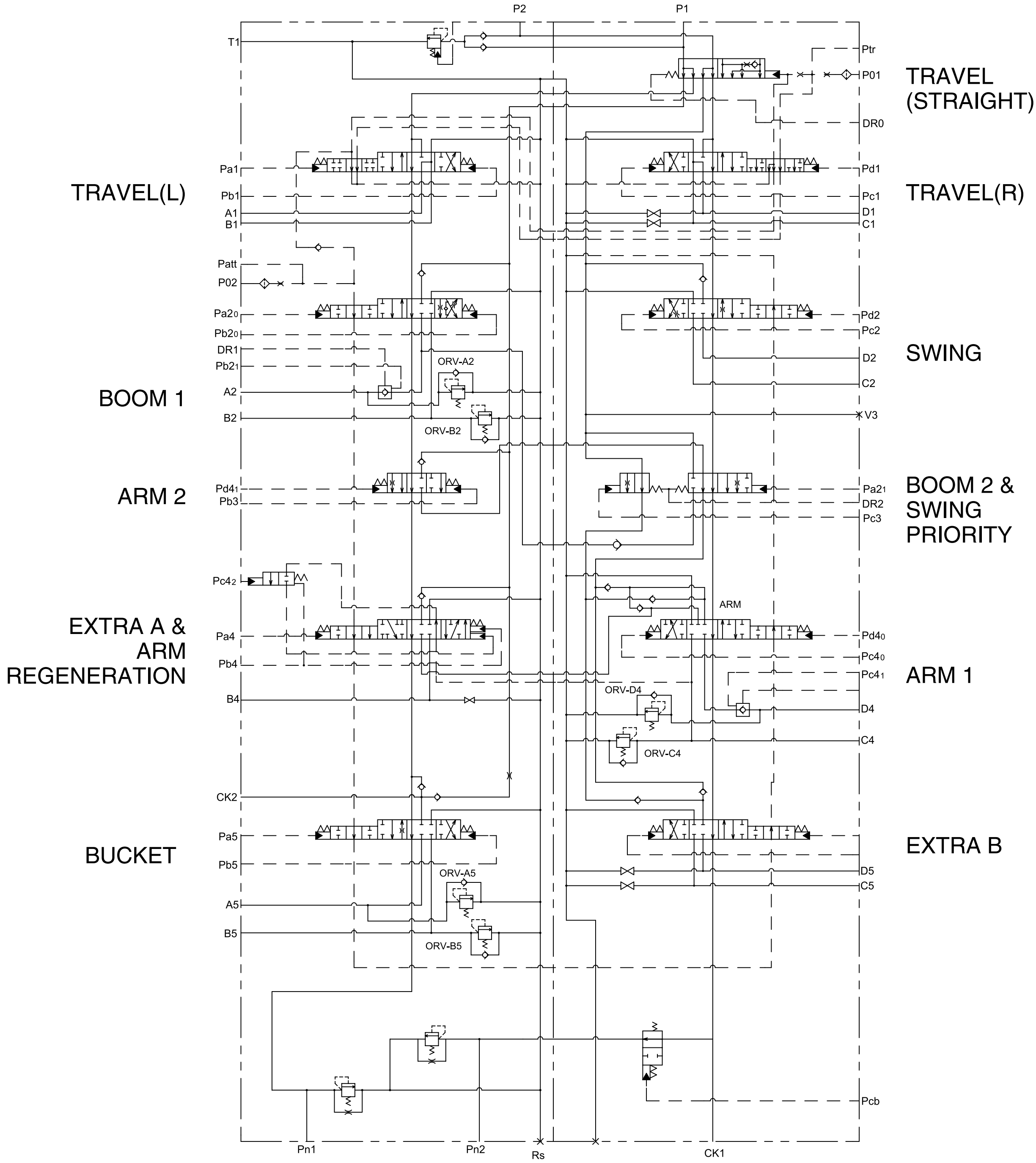


DETAIL OF LOCK VALVE (BOOM & ARM)

300072MCV02

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

2. HYDRAULIC CIRCUIT

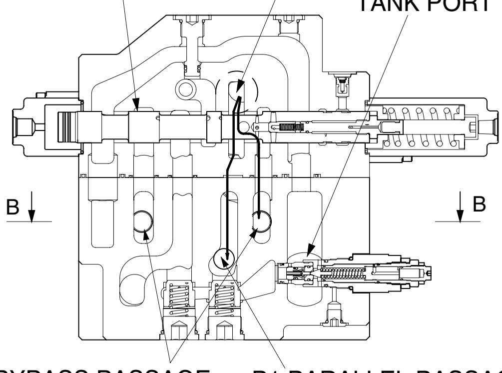


29072MC51

3. FUNCTION

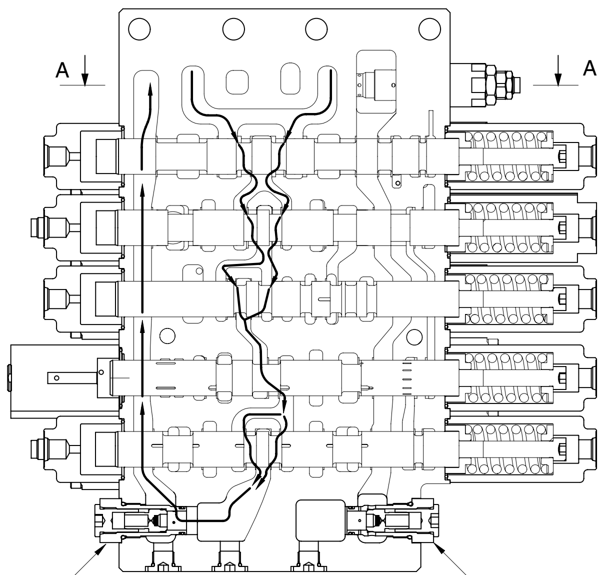
1) CONTROL IN NEUTRAL FUNCTION

(1) P1 SIDE



SECTION A-A

29072MC53



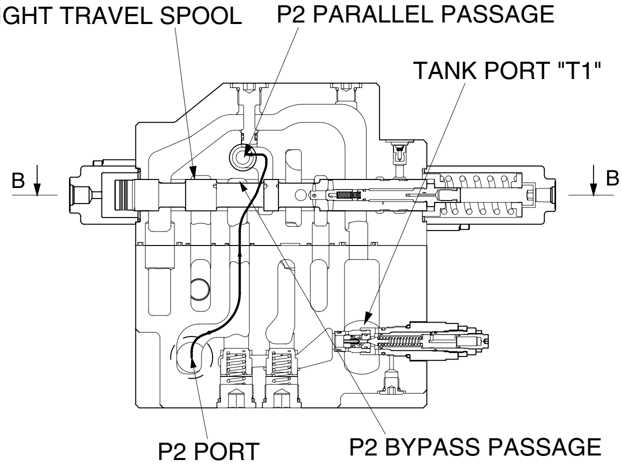
SECTION B-B

29072MC52

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

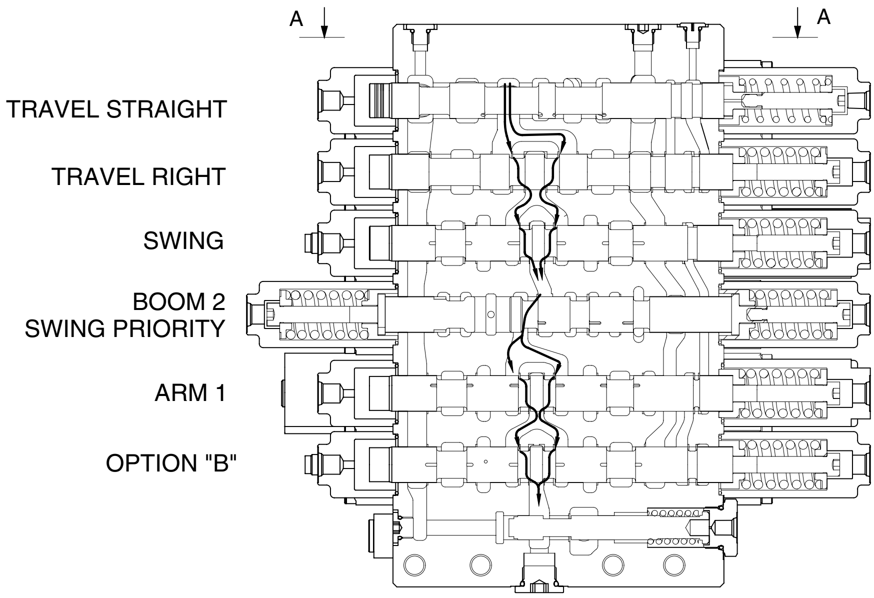
The hydraulic fluid from the pump P1 is directed to the tank through the bypass passage of spools : travel left, boom1, arm2, arm regeneration & option A and bucket, the negative relief valve, tank passage, and the tank port "T1"

(2) P2 SIDE



SECTION A-A

29072MC54



SECTION B-B

29072MC55

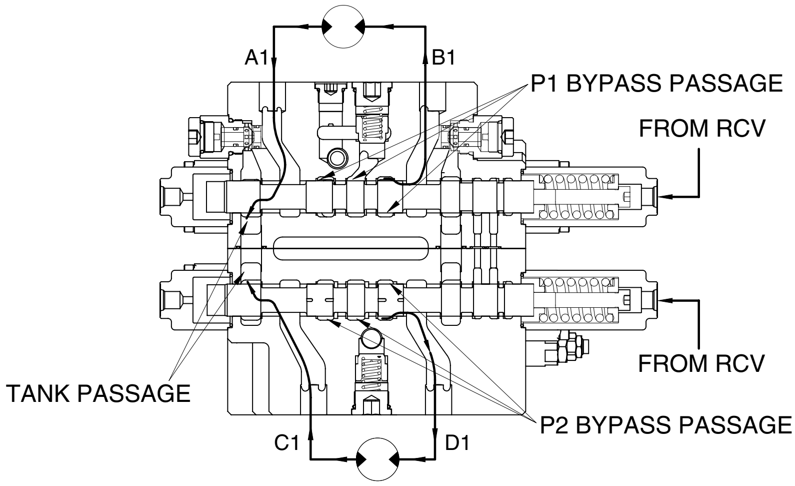
The hydraulic fluid from pump P2 flows into the main control valve through the inlet port "P2", pass the straight travel spool, into the P2 bypass passage and P2 parallel passage.

The hydraulic fluid from the pump P2 is directed to the tank through the bypass passage of spools : travel right, swing, boom2 & swing priority, arm1, option "B" and bypass passage of bucket summation, and the negative relief valve with the tank passage.

2) EACH SPOOL OPERATION

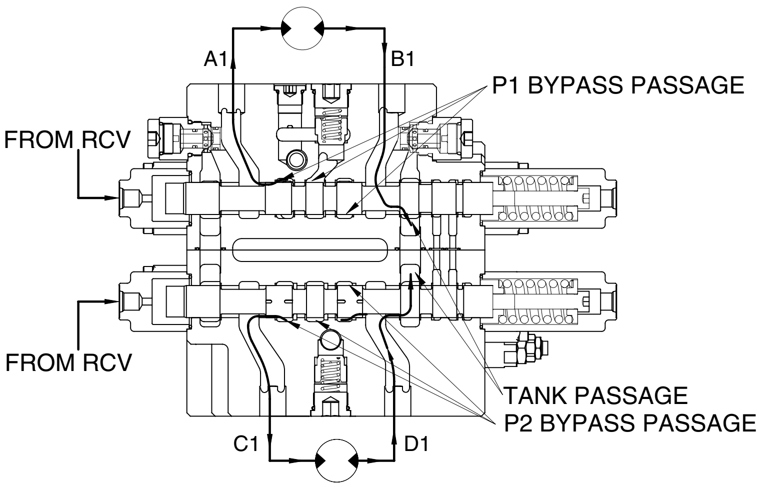
(1) TRAVEL OPERATION

① Travel forward operation



29072MC56

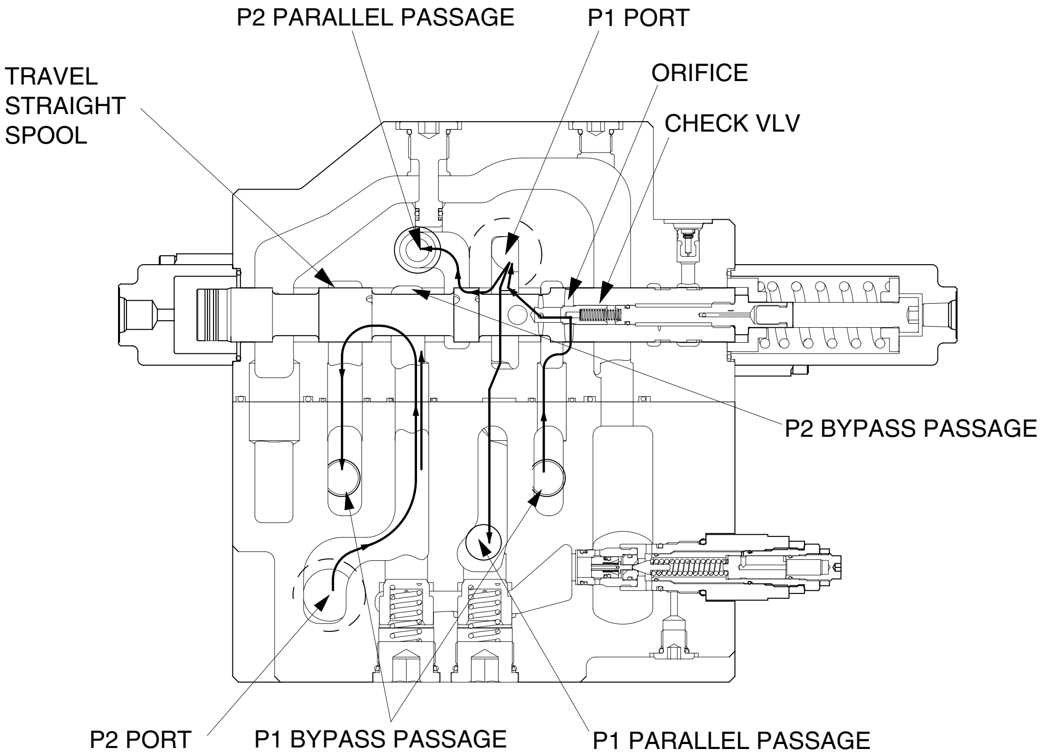
② Travel backward operation



29072MC57

During the travel operation, the hydraulic fluid of the pump P1 is supplied to the travel motor and the hydraulic fluid of the pump P2 is supplied to the other travel motor.
The pilot pressure from the pilot control valve is supplied to the spring side of pilot port (pa1, pd1).
And it shifts travel right and left spools in the left direction against springs. Hydraulic fluid from the pump P1 flow into the travel left spool through the bypass passage and hydraulic fluid from the pump P2 flow into the travel right spool through the bypass passage.
Then they are directed to the each travel motor through port A1 and D1. As a result, the travel motors turn and hydraulic fluid returns to the tank passage through the travel spools.
In case of the opposite operation, the operation is similar.

(2) TRAVEL STRAIGHT FUNCTION



29072MC58

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 travel motor and the pump P2 is supplied to the other motor.

Thus, the machine keep travel straight.

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

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

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

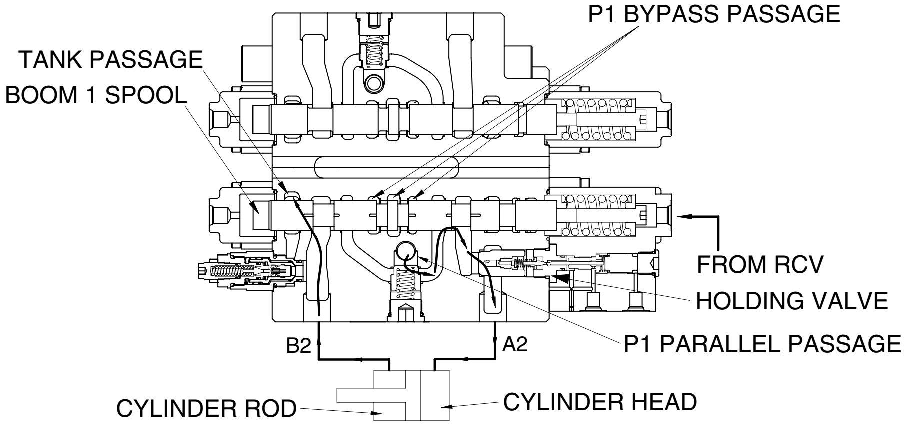
The hydraulic oil fluid from pump P2 is supplied to travel motors(left/right).

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).

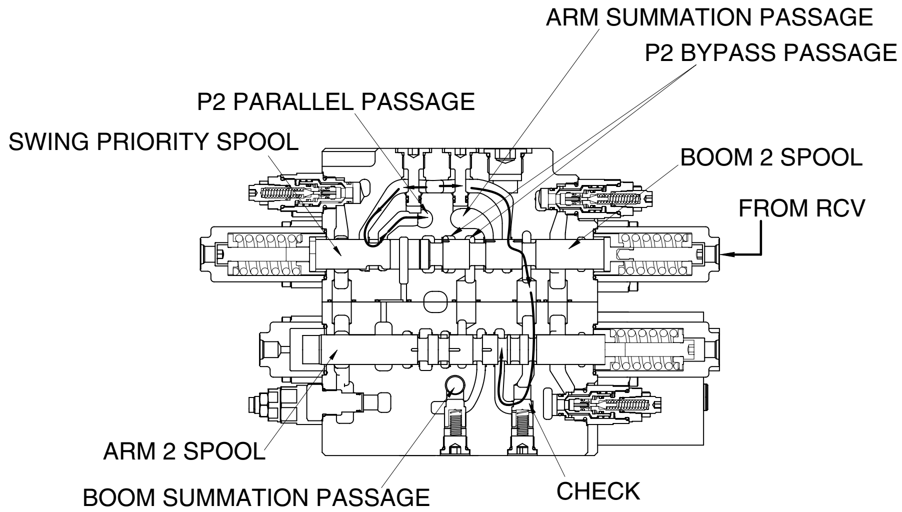
Then the machine keeps straight travel.

(3) BOOM OPERATION

① Boom up operation



29072MC59



29072MC60

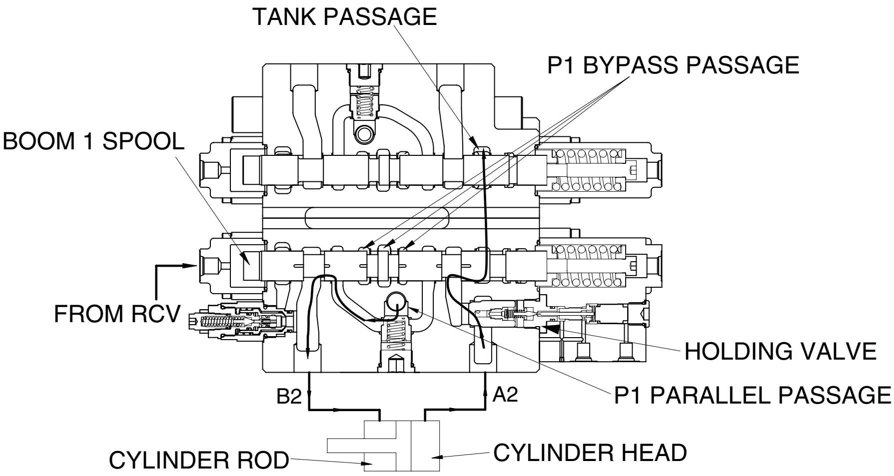
During boom up operation, the pilot pressure from RCV is supplied into the port Pa20 and shift the boom1 spool in the left direction. The hydraulic oil fluid from pump P1 is entered P1 parallel passage and then passes through the load check valve and boom holding valve then flows into the port A2. Following this it flows into the head side of the boom cylinder.

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

At the same time the pilot pressure through the port Pa21 shifts the boom2 spool. The hydraulic oil fluid from pump P2 entered boom summation passage via the P2 parallel passage, the swing priority spool, the boom2 spool, arm1 spool and the check. The flows combine in passage and are directed to port A2 and head side of boom cylinder.

The flow from rod side of the boom cylinder return to the boom1 spool through the port B2. There after it is directed to the hydraulic oil tank through the tank passage.

② **Boom down operation**



29072MC61

During the boom lowing operation, the pilot pressure from RCV is supplied to the port Pb20 and shift the boom1 spool in the right direction.

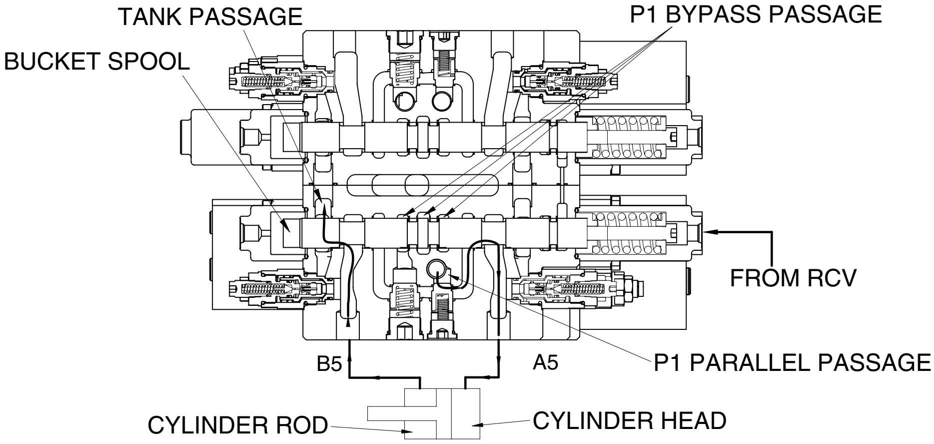
The hydraulic fluid from the pump P1 enters the parallel passage and is directed to the port B2 through the load check valve. Following this, it flows into the rod side of the boom cylinder.

The return flow from the head side of the boom cylinder returns to the boom1 spool through the port A2 and boom holding valve. Thereafter it is directed to the hydraulic oil tank through tank passage.

For details of the boom holding valve, see page 2-46-17.

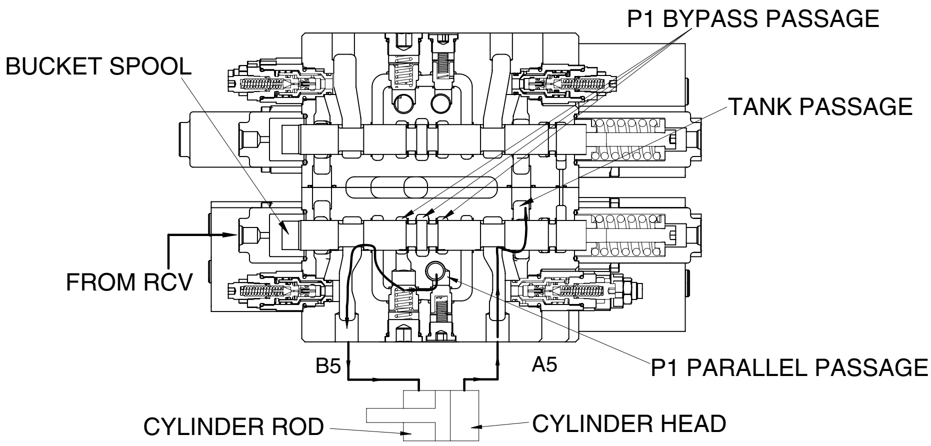
(4) BUCKET OPERATION

① Bucket roll in operation



29072MC62

② Bucket roll out operation



29072MC63

① **Bucket roll in operation**

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

The hydraulic fluid from pump 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 roll out operation**

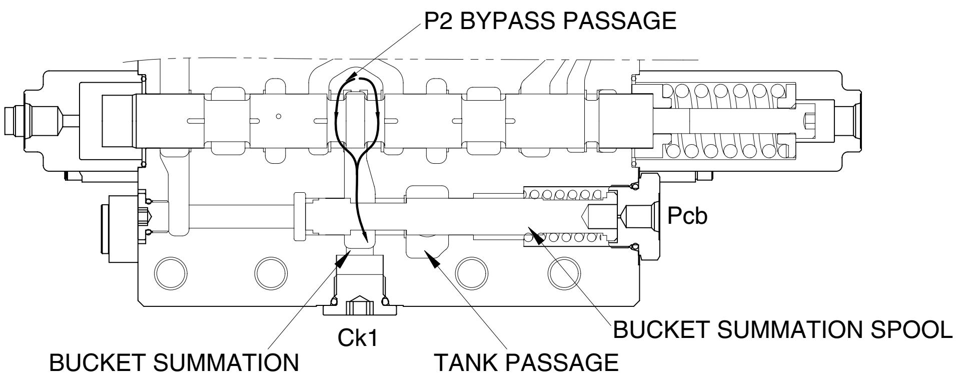
In case of the bucket roll out operation, the operation is similar

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

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

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

④ **Bucket summation**



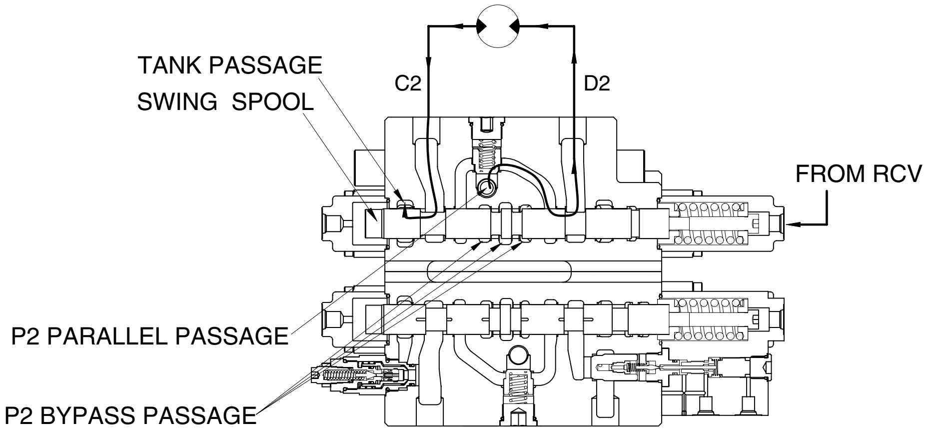
29072MC64

When bucket single operation, the pilot pressure from RCV is supplied to spring side port(pcb) of bucket summation spool and then bucket summation spool shift left direction. So the tank passage is blocked, and the hydraulic fluid from P2 by pass passage is joined with the hydraulic fluid of P1 via the check CK1 and external piping.

(Refer to hydraulic circuit page 3-1)

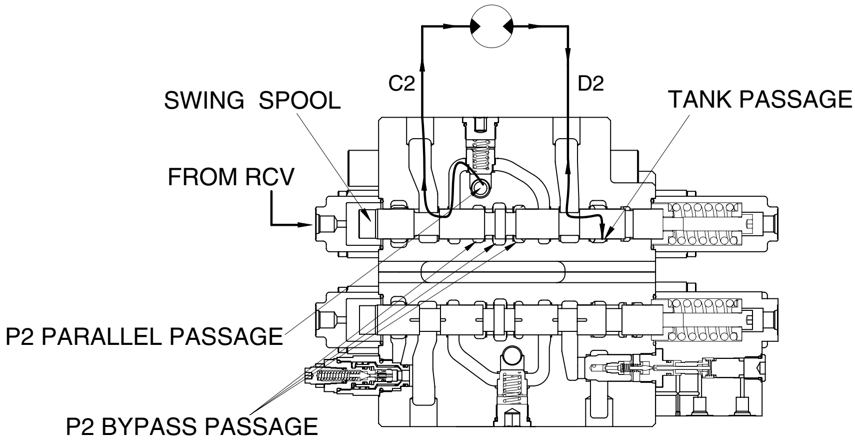
(5) SWING OPERATION

① Swing left operation



29072MC65

② Swing right operation

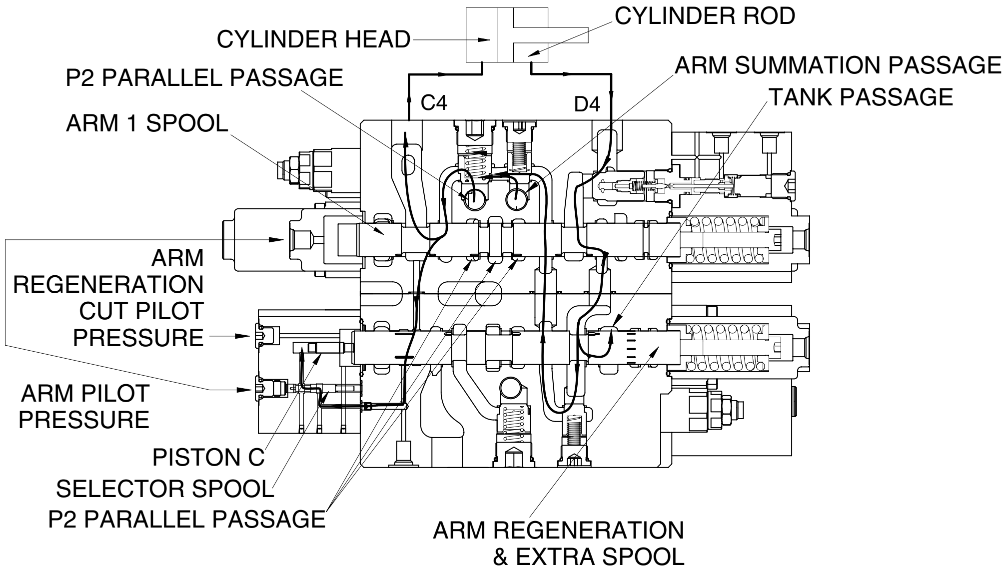


29072MC66

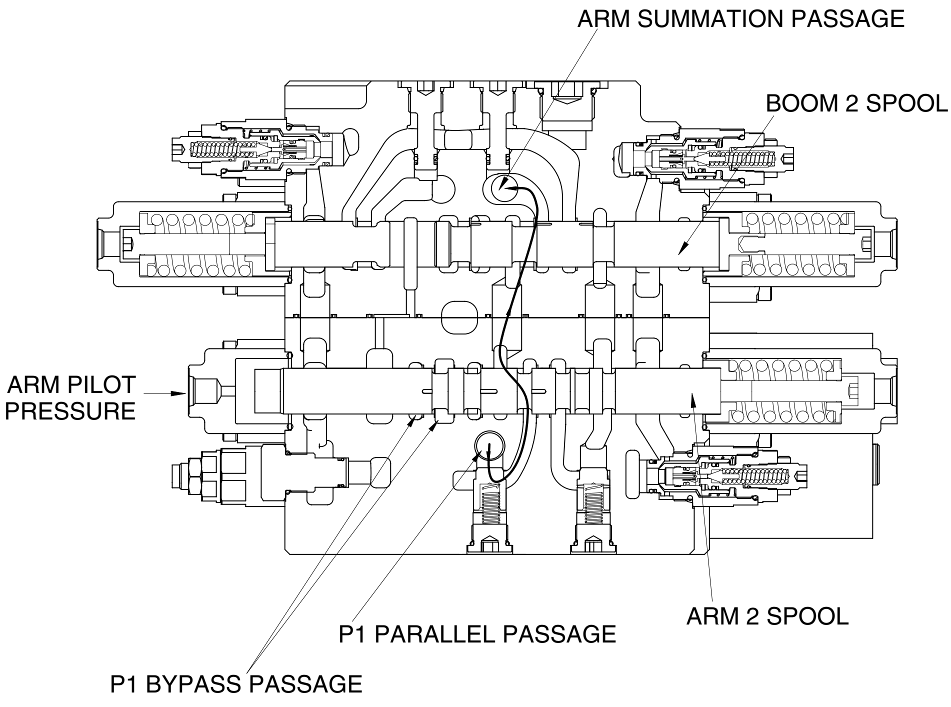
The pilot pressure from the RCV is supplied to the Pd2 and shift the swing spool in left direction. The hydraulic fluid from pump P2 flows into swing spool through the parallel passage. Then it is directed to swing motor through the port D2. As the result, swing motor turns and flow from the swing motor returns to the hydraulic oil tank through the port C2, swing spool and the tank passage .
In case of swing right operation, the operation is similar.

(6) ARM OPERATION

① Arm roll in operation



29072MC67



29072MC68

· **Arm roll in operation :**

During arm roll in operation the pilot pressure from the RCV is supplied to the port Pc40 and Pb3 and shifts arm1 spool and arm2 spool in the right direction.

The hydraulic oil from the pump P2 flows into the arm cylinder head side through P2 parallel passage, the load check valve and the port C4.

At same time, the hydraulic fluid from the pump P1 flows into the arm summation passage through parallel passage, the check valve, the arm2 spool and the boom2 spool. Then it entered the arm cylinder head side with hydraulic fluid from arm1 spool.

· **Arm regeneration :**

The return flow from the arm cylinder rod side is pressurized by self weight of arm and so, returns to port D4. The pressurized oil returning to port D4 enters the arm regeneration & breaker spool through the arm holding valve and the arm1 spool. It is suppled the arm cylinder head through internal passage. This is called the arm regeneration function.

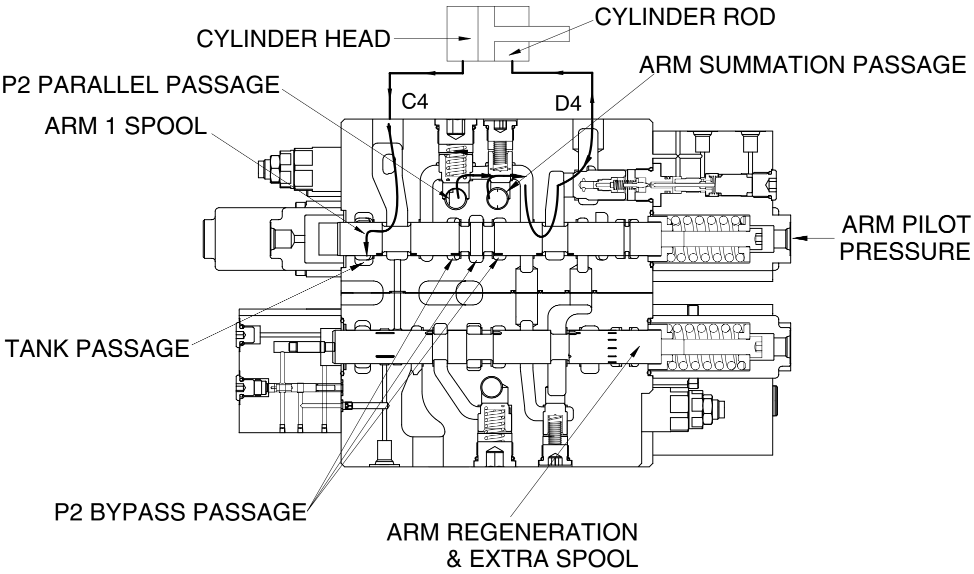
The amount of regeneration fluid are changed by movement of the arm regeneration & breaker spool.

A few fluid after 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.

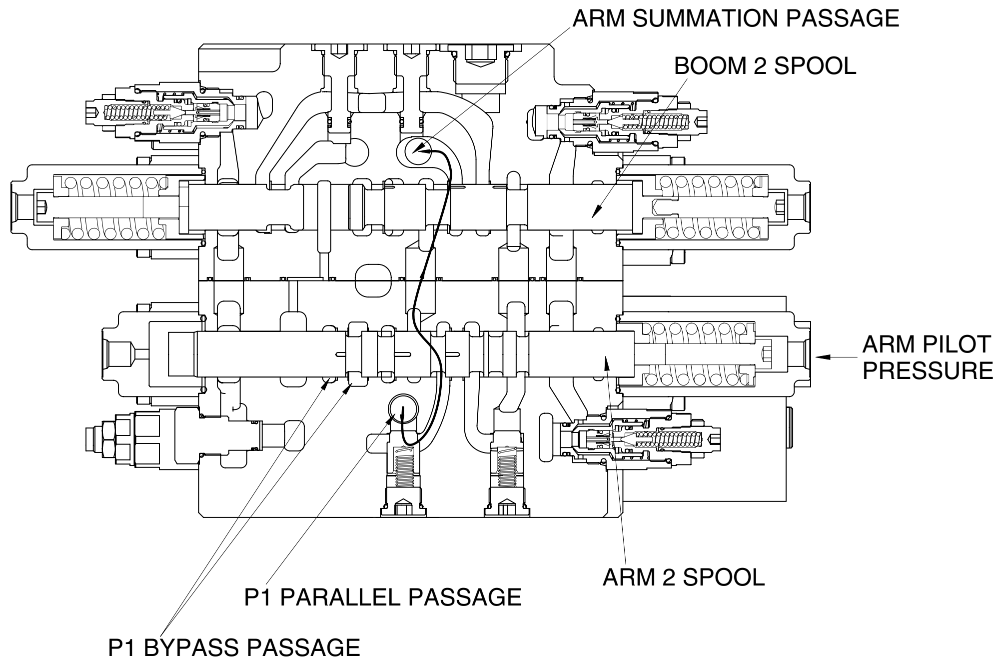
Then, the arm regeneration spool shift to right side and flow to tank pass increases and regeneration flow decreases. Therefore, pressure of arm cylinder head increases, then, arm regeneration flow decreases.

Furthermore, the arm regeneration cut pressure is supplied to port and arm regeneration spool is move into the right direction fully. The flow from the arm cylinder rod is returned to the hydraulic oil tank and regeneration function is not activated.

② **Arm roll out operation**



29072MC69



29072MC70

During arm roll out operation the pilot pressure from RCV is supplied to the port Pd40 and the Pd41 and shifts arm1 spool and arm2 spool in the right direction.

The hydraulic fluid from pump P2 flows into arm1 spool through the parallel passage. Then it enters into the arm cylinder rod side through the load check valve, bridge passage, arm holding valve and the port D4.

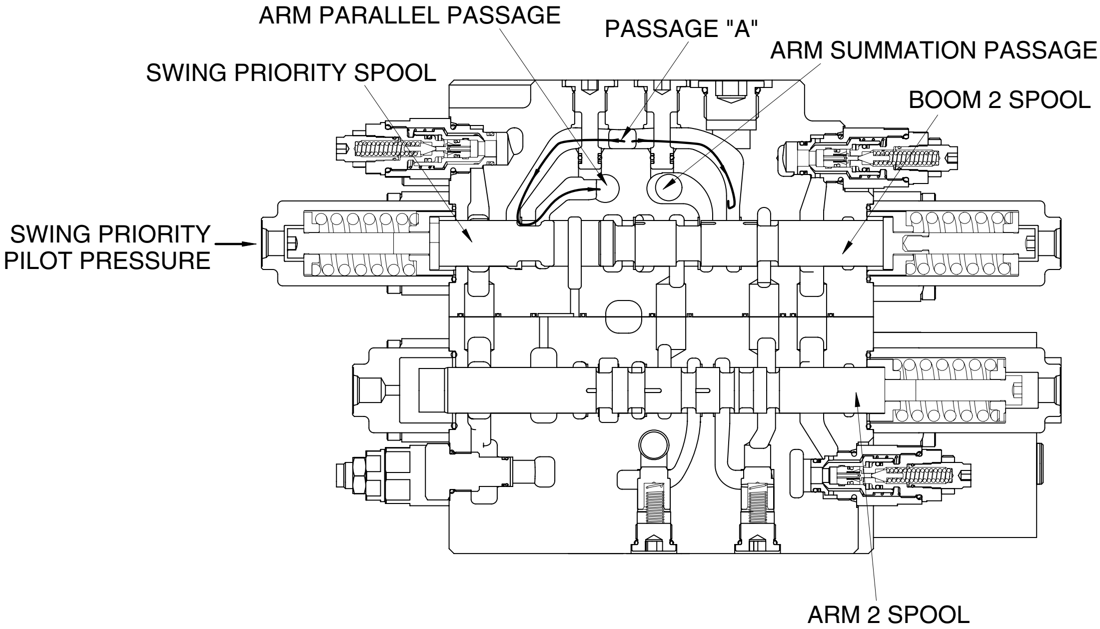
Some of the hydraulic fluid from pump P2 bypassed through bypass notch.

The rest of hydraulic fluid from pump P2 flows into the arm summation passage through P1 parallel passage the check valve arm2 spool and boom2 spool.

Then it enters into the arm cylinder rod side with the fluid from the arm1 spool.

The return flow from the arm cylinder head side returns to the hydraulic tank through the port C4 the arm1 spool and tank passage.

(7) SWING PRIORITY FUNCTION



29072MC71

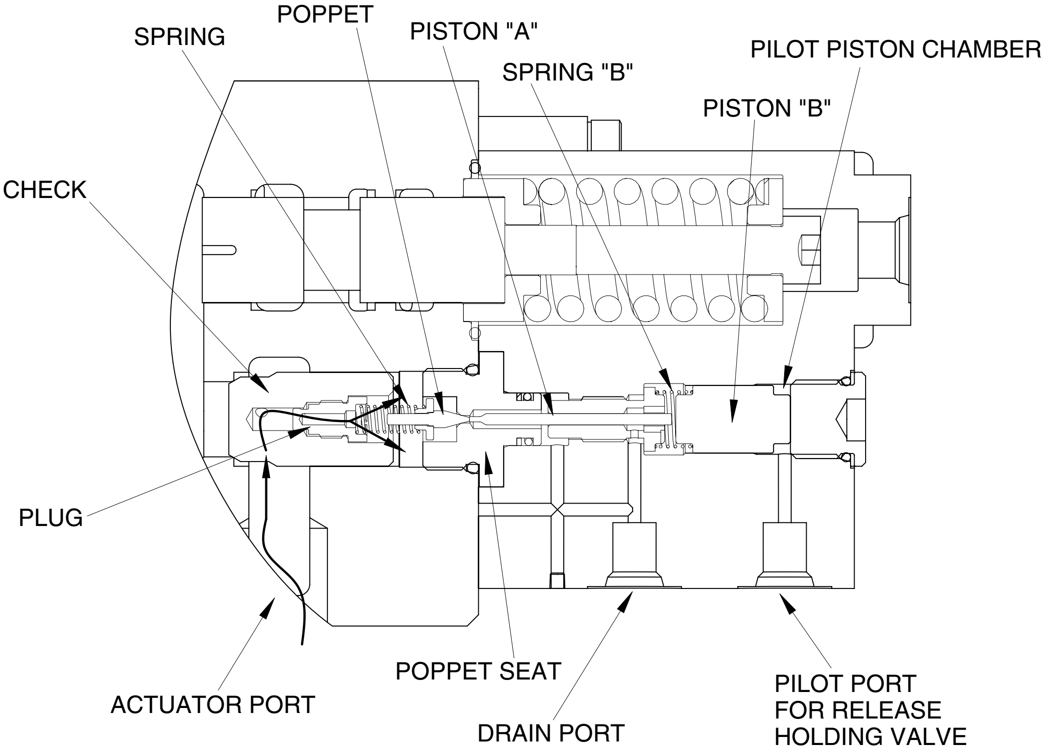
During swing priority operation, the pilot pressure is supplied to the port Pc3 and shift swing priority spool in the right direction.

The hydraulic fluid from P2 parallel passage flows into the parallel passage of arm1 side through swing priority spool and the passage "A" and also flows into the boom2 spool.

Due to shifting of the swing priority spool, the fluid from pump P2 flows to swing side more then next spools to make the swing operation most preferential.

(8) HOLDING VALVE OPERATION

① Holding operation



29072MC72

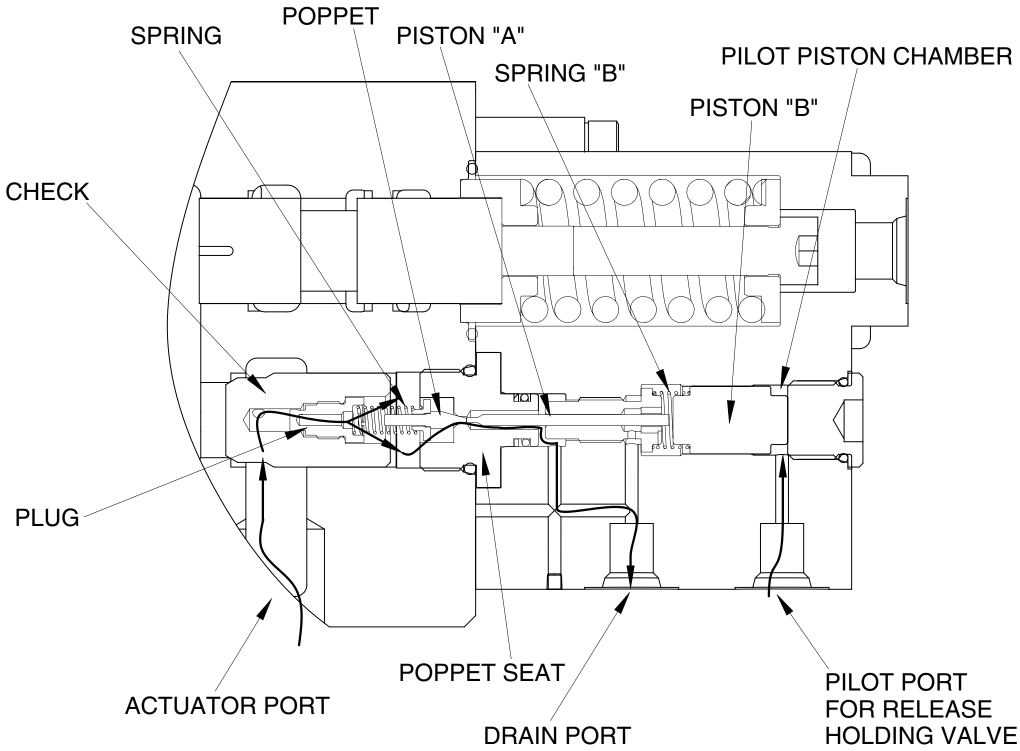
At neutral condition, the pilot piston chamber is connected to drain port through the pilot port.

And the piston "B" is supported with spring "B" and the pressured fluid from actuator entered to inside of the holding valve through the periphery hole of check, crevice of the check and the plug and the periphery hole of plug.

Then, this pressured oil pushed the poppet to the poppet seat and the check to the seat of body.

So the hydraulic fluid from actuator is not escaped and the actuator is not moved.

② **Release holding operation**



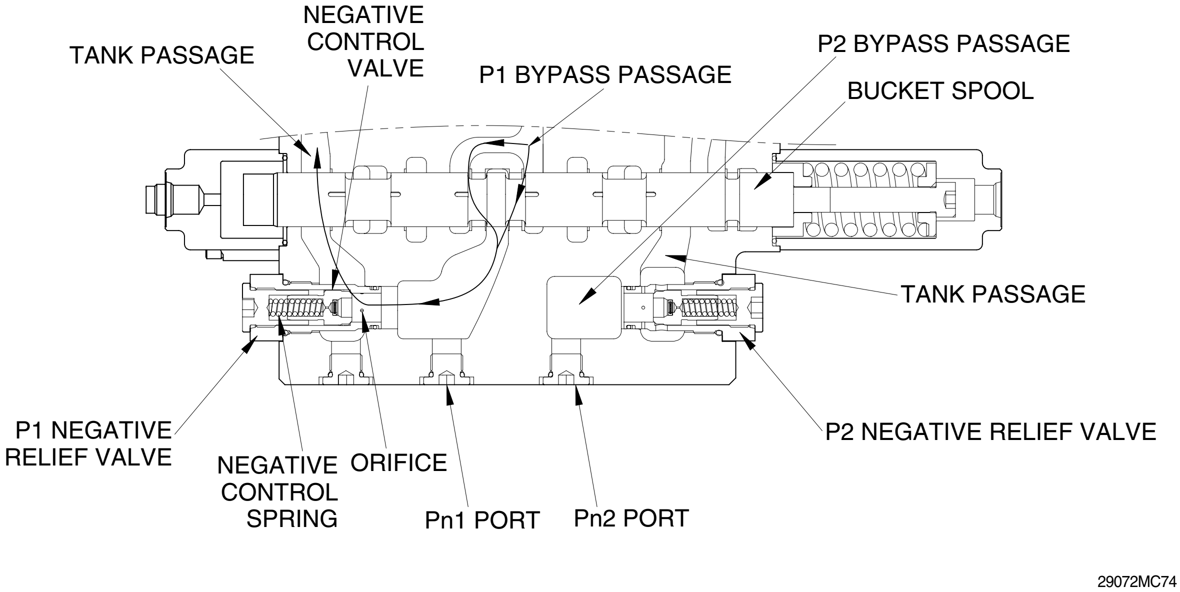
29072MC73

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.

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

(9) NEGATIVE CONTROL



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 become zero and the discharge of the pump P1 become maximum.

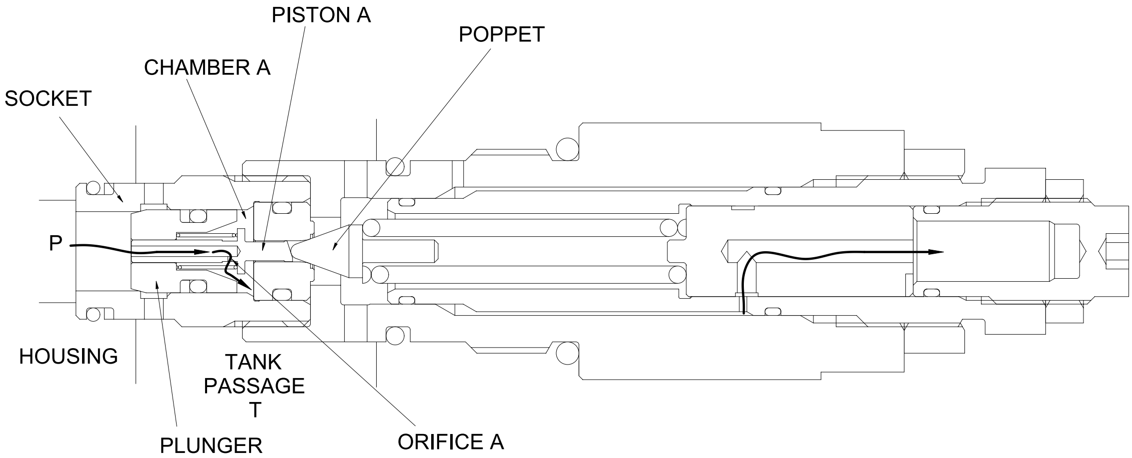
The negative control pressure reaches to the set level, the hydraulic fluid in the passage pushes open negative control valve and escapes into the return passage.

For the pump P2 the same negative control principle.

(10) OPERATION OF MAIN RELIEF VALVE

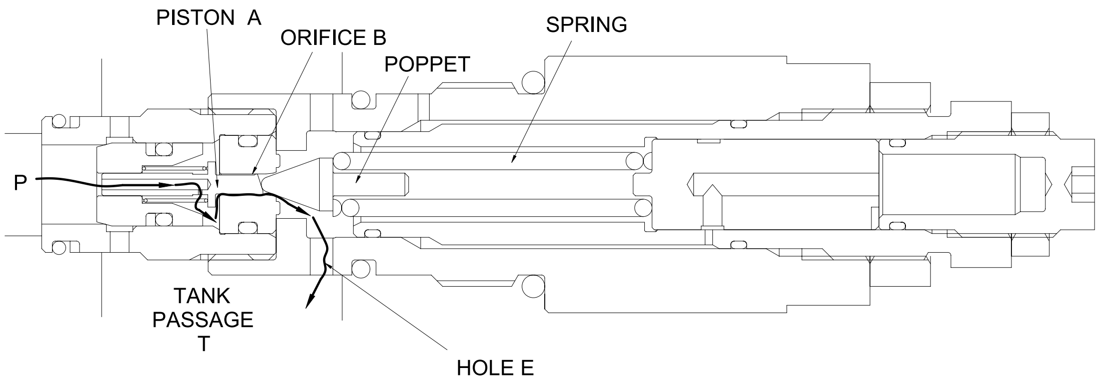
The main relief valve is fitted to the straight travel valve block and functions as follows :

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



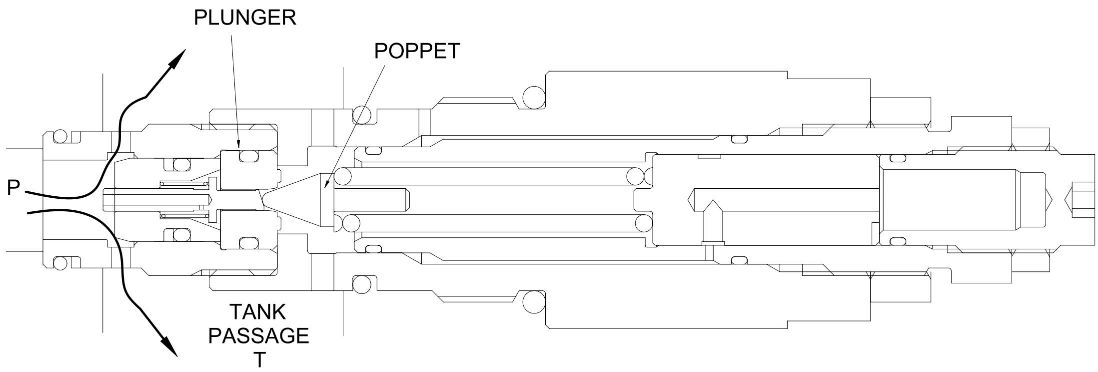
14072SF36

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



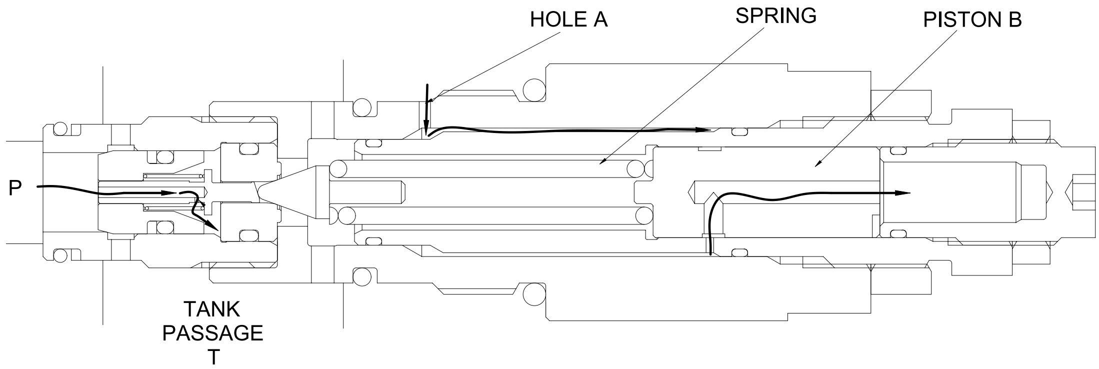
14072SF37

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)



14072SF38

④ High pressure setting pilot signal(Pu) : ON
When the power boost switch is ON, the pilot pressure enters through hole A.
It pushes the piston(B) in the left direction to increase the force of the spring and change the relief set pressure to the high pressure.

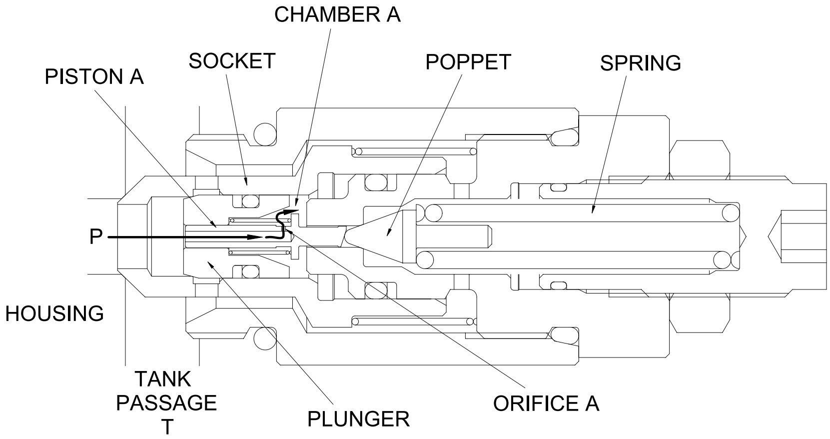


14072SF36

(11) OPERATION OF PORT RELIEF VALVE

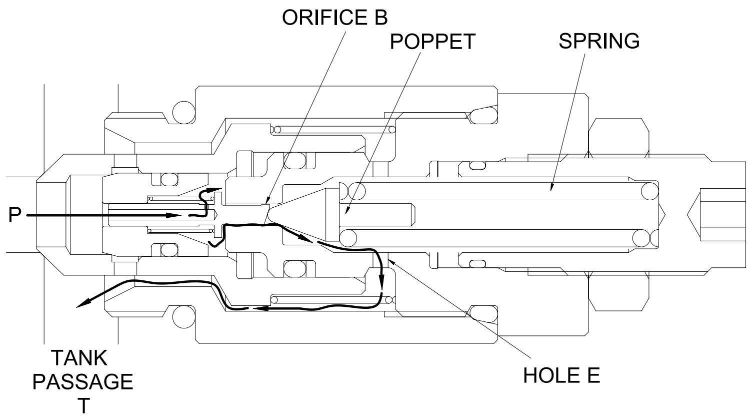
① Function as relief valve

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



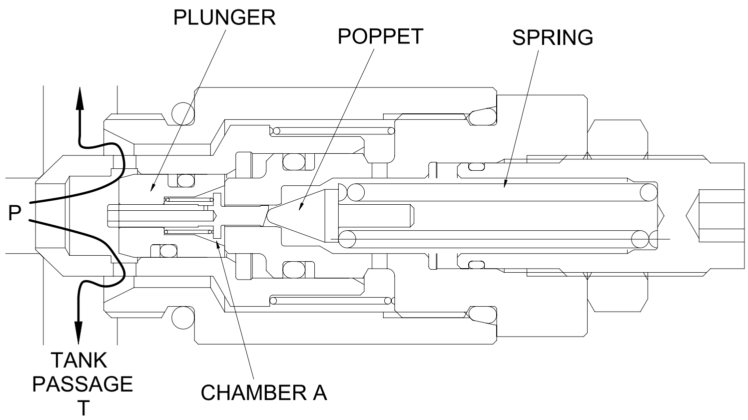
14072SF39

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



14072SF40

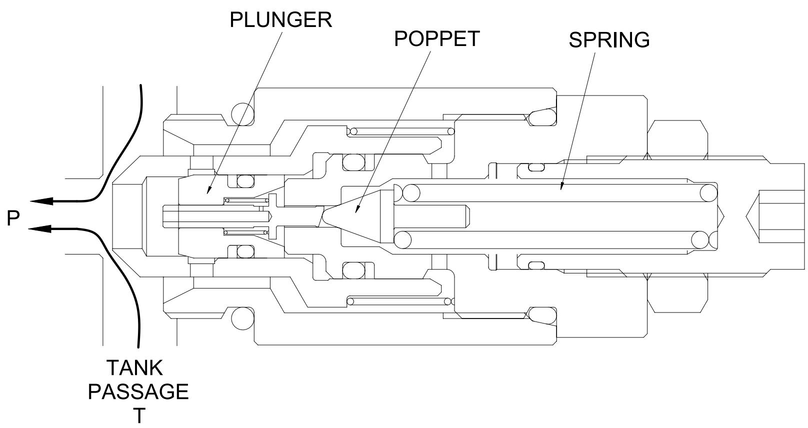
ⓒ Opening of the poppet causes the pressure in chamber A to fall and the plunger to open. As the result the pressurized oil at port P runs into tank passage (T).



14072SF41

② **Make-up function**

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



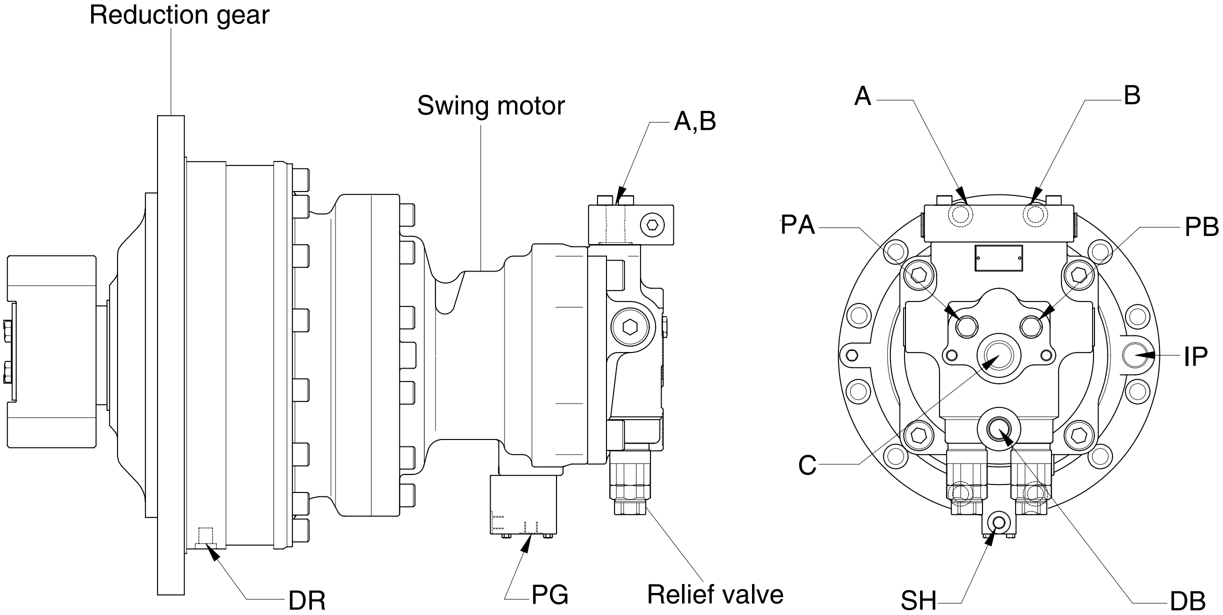
14072SF42

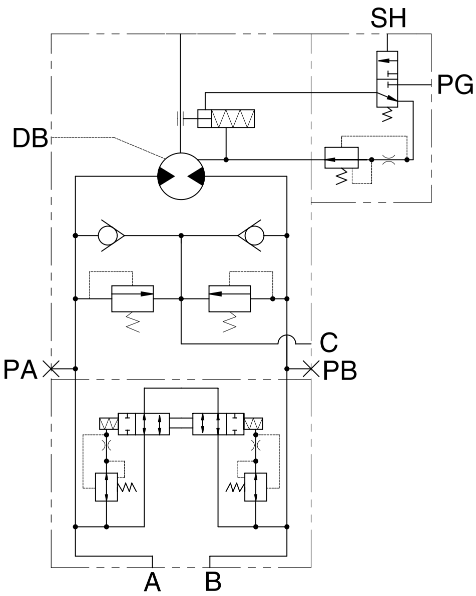
GROUP 3 SWING DEVICE

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.

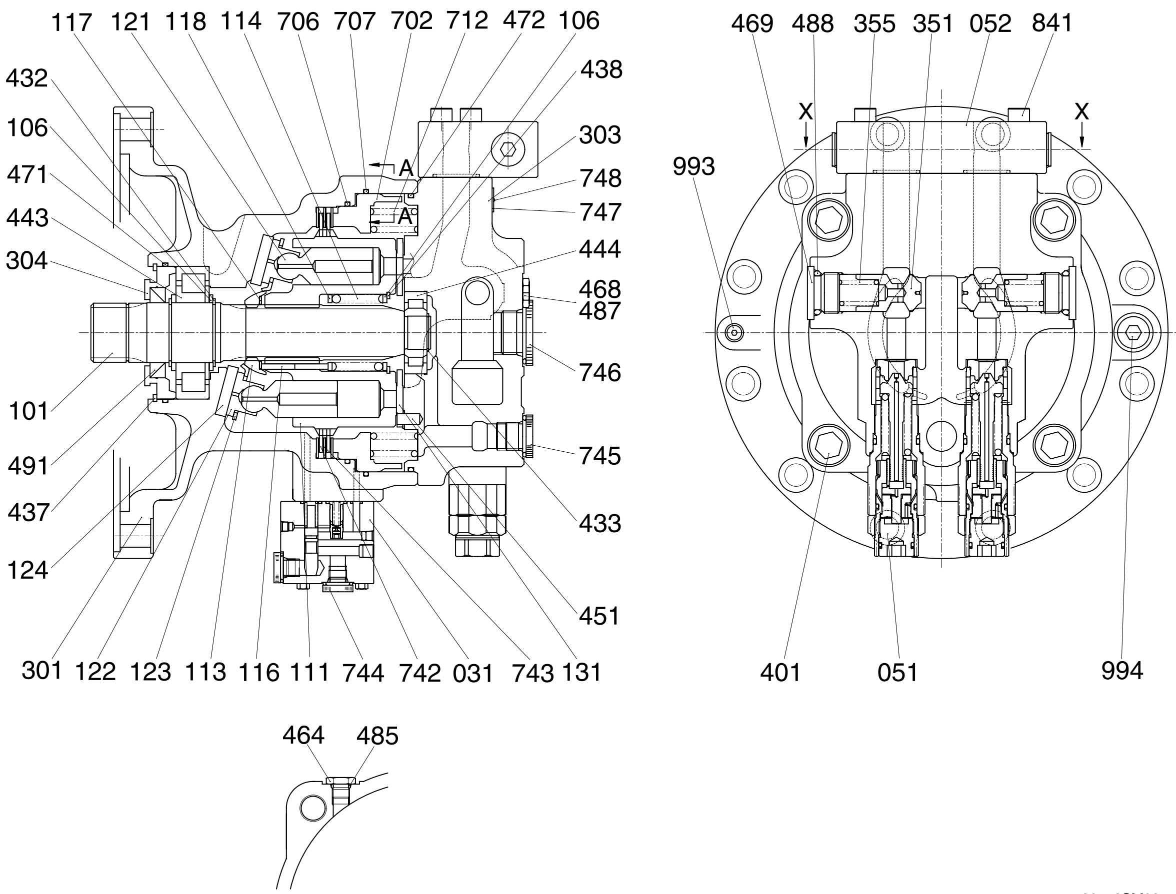




Port	Port name	Port size
A, B	Main port	ø 20
DB	Drain port	PF 1/2-19
C	Make up port	PF 1-24
PA, PB	Gauge port	PF 1/4-15
PG	Brake release port	PF 1/4-12
SH	Brake pilot port	PF 1/4-12
IP	Gear oil inlet port	PT 3/4-19
DR	Gear oil drain port	PT 1/2

30572SM01

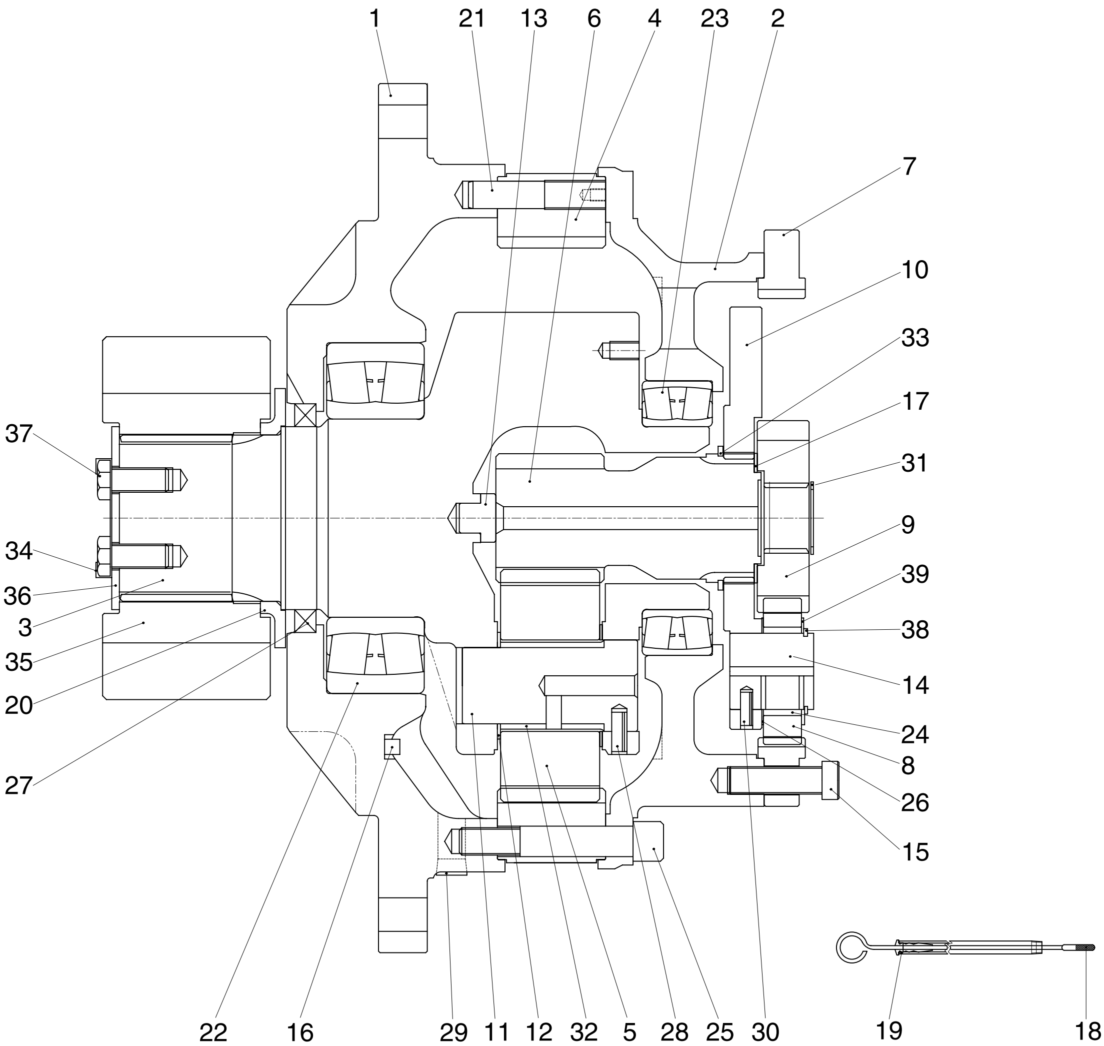
1) SWING MOTOR



30572SM02

031	Brake valve	304	Front cover	488	O-ring
051	Relief valve	351	Plunger	491	Oil seal
052	Valve assy	355	Spring	702	Piston
101	Drive shaft	401	Socket bolt	706	O-ring
106	Spacer	432	Snap ring	707	O-ring
111	Cylinder block	433	Snap ring	712	Brake spring
113	Bushing	437	Snap ring	742	Lining plate
114	Spring	438	Snap ring	743	Separate plate
116	Push rod	443	Roller bearing	744	Plug
117	Spacer	444	Roller bearing	745	Plug
118	Spacer	451	Spring pin	746	Plug
121	Piston	464	Plug	747	Name plate
122	Shoe	468	Plug	748	Rivet screw
123	Retainer	469	Plug	841	Socket bolt
124	Shoe plate	471	O-ring	993	Plug
131	Valve plate	472	O-ring	994	Plug
301	Casing	485	O-ring		
303	Casing	487	O-ring		

2) REDUCTION GEAR



30572SR01

1	Front casing	14	Pin 1	27	Oil seal
2	Middle casing	15	Side plate 1	28	Spring pin
3	Drive shaft	16	Magnet	29	Pressure plug
4	Ring gear 2	17	Side plate 3	30	Spring pin
5	Planet gear 2	18	Gauge bar	31	Stop ring
6	Sun gear 2	19	Gauge pipe	32	Bushing 2
7	Ring gear 1	20	Spacer ring	33	Stop ring
8	Planet gear 1	21	Knock pin	34	Lock washer
9	Sun gear 1	22	Roller bearing	35	Pinion gear
10	Carrier	23	Roller bearing	36	Lock plate
11	Pin 2	24	Needle cage	37	Hexagon bolt
12	Thrust washer	25	Socket bolt	38	Stop ring
13	Thrust button	26	Socket bolt	39	Side plate 2

2. FUNCTION

1) ROTARY PART

When high pressurized oil enters a cylinder through port(a), which is the inlet of balance plate(131), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston(121) upon the return plate(123) which acts upon the swash plate(124) via an hydrostatic bearing. Force F1 perpendicular to swash plate(124) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block(111) through piston, force F2 causes rotational moment at surroundings of cylinder.

Since cylinder block has 9 equidistantly arrayed pistons, rotational torque is transmitted to cylinder shaft in order by several pistons connected to the inlet port of high pressurized oil. When the direction of oil flow is reversed, rotational direction of cylinder is also reversed. Output torque is given by the equation.

$$T = \frac{p \times q}{2\pi},\ q = Z \cdot A \cdot PCD \cdot \tan\theta,\ F1 = \frac{F}{\cos\theta},\ F_2 = F\tan\theta,\ S = PCD \times \tan\theta$$

Where p : Effective difference of pressure(kgf/cm^2)

q : Displacement(cc/rev)

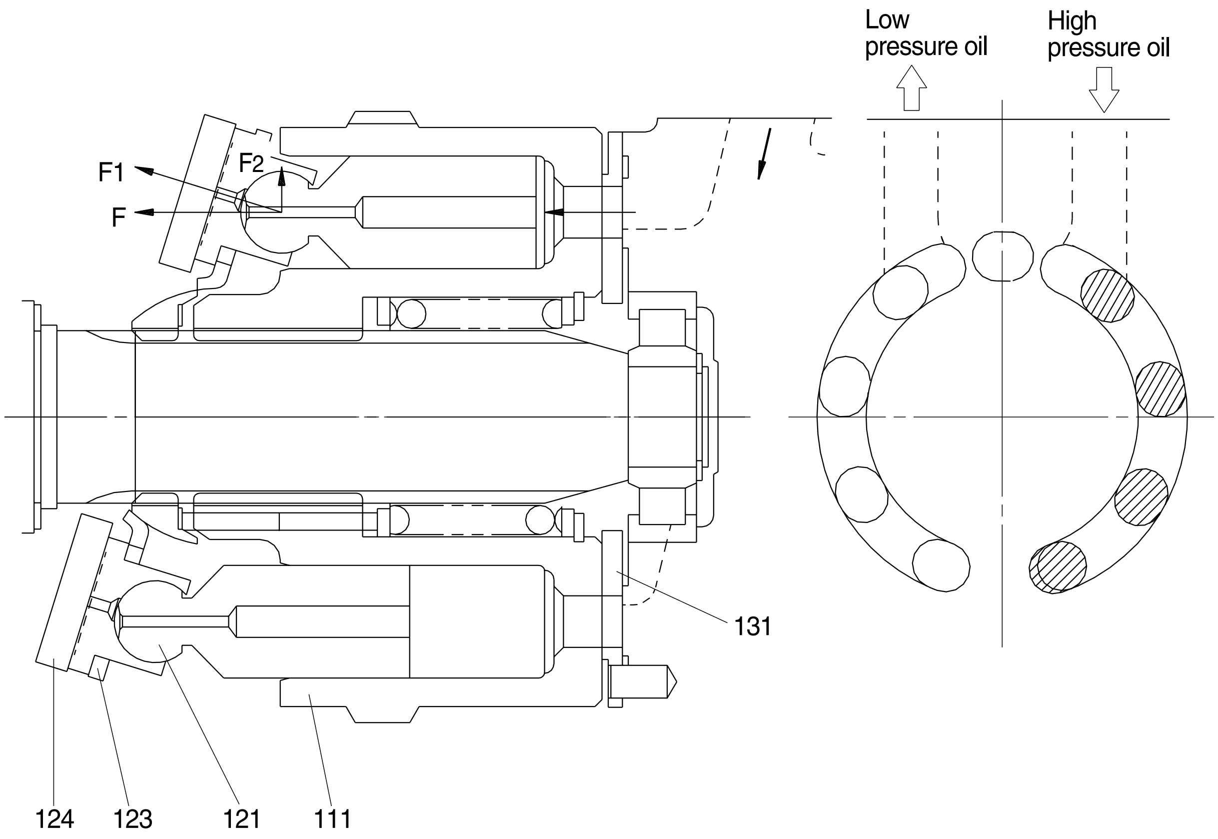
T : Output torque(kgf · cm)

Z : Piston number(9EA)

A : Piston area(cm^2)

θ : Tilting angle of swash plate(degree)

S : Piston stroke(cm)



R290SM05(2)

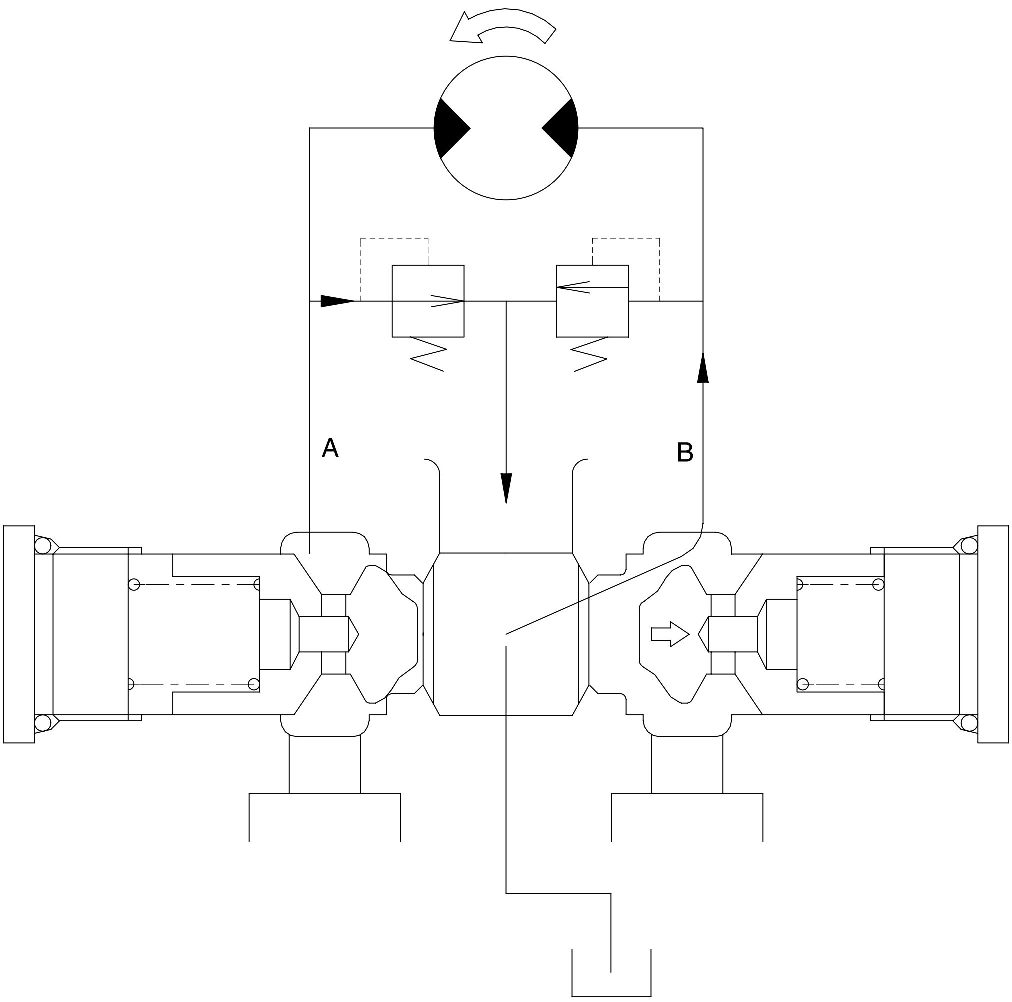
2) MAKE UP VALVE

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

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

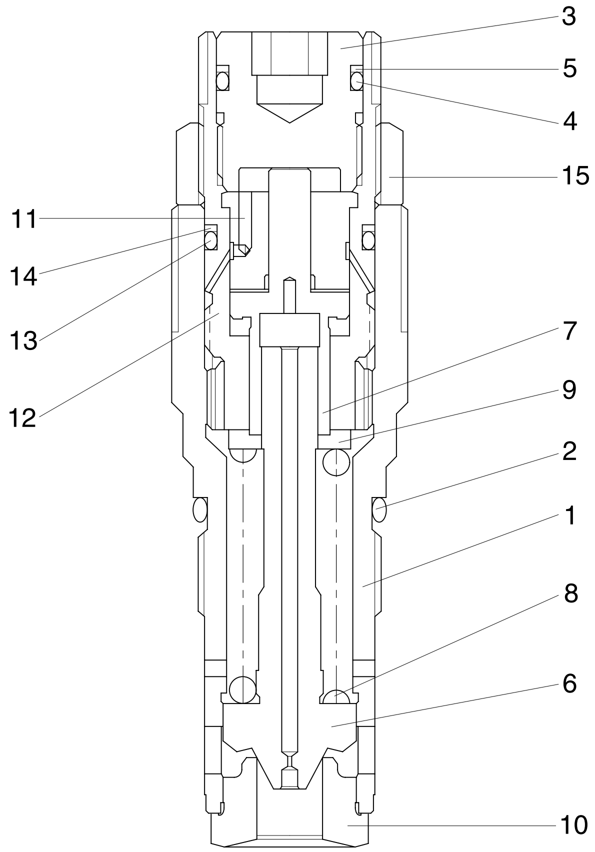
Pressurized oil into the port B, the motor rotate counterclockwise.

If the plunger of MCV moves neutral position, the oil in the motor is drain via left relief valve, the drain oil run into motor via right make up valve, which prevent the cavitation of motor.



29072SM09

3) RELIEF VALVE



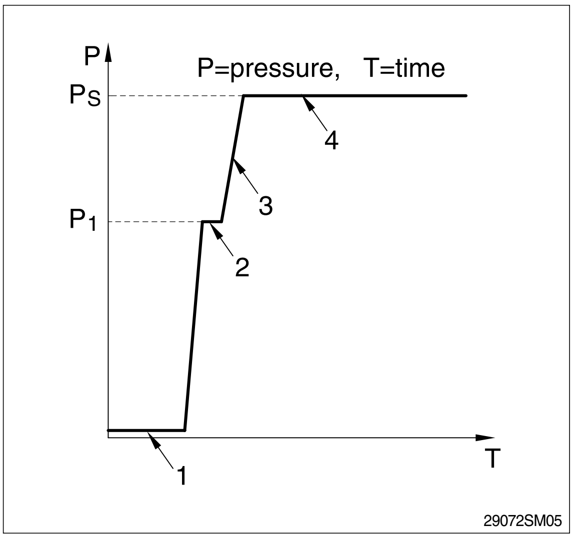
1	Body
2	O-ring
3	Plug
4	O-ring
5	Back up ring
6	Plunger
7	Piston
8	Spring
9	Seat spring
10	Seat
11	Sleeve
12	Adjust plug
13	O-ring
14	Back up ring
15	Nut

(1) Construction of relief valve

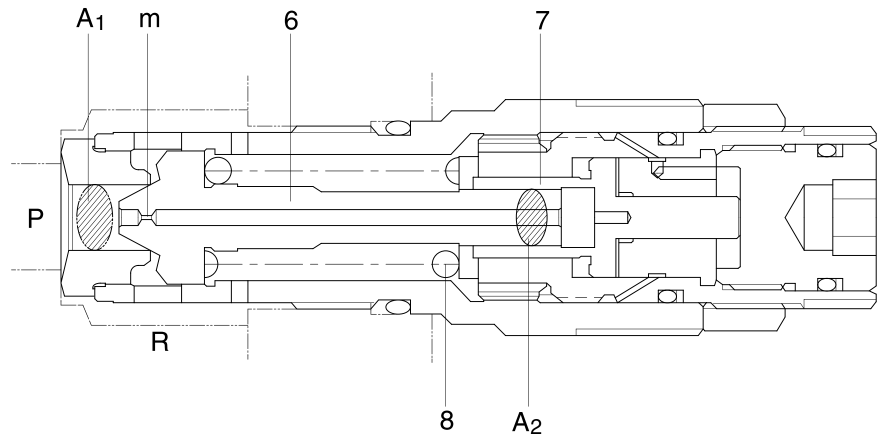
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



① Ports (P,R) at tank pressure.

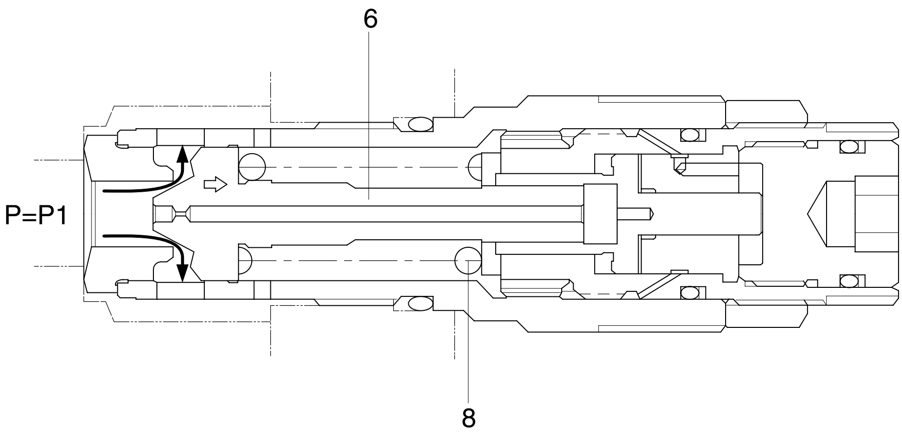


29072SM04

② When hydraulic oil pressure($P \times A_1$) reaches the preset force(F_{SP}) of spring(8), the plunger (6) moves to the right as shown.

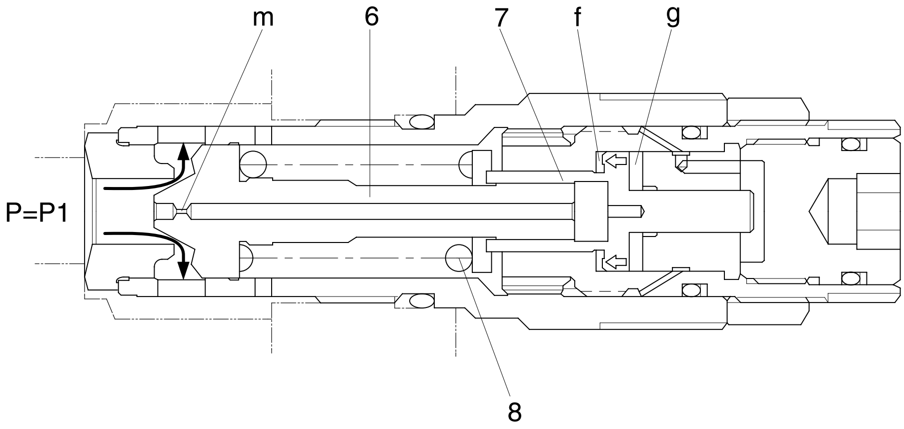
$$P_1 \times A_1 = Fsp + P_1 \times A_2$$

$$P_1 = \frac{Fsp}{A_1 - A_2}$$



29072SM06

③ When the pressure of chamber g reaches the preset force(Fsp) of spring(8), the piston(7) moves right and stop the piston(7) hits the end of body.

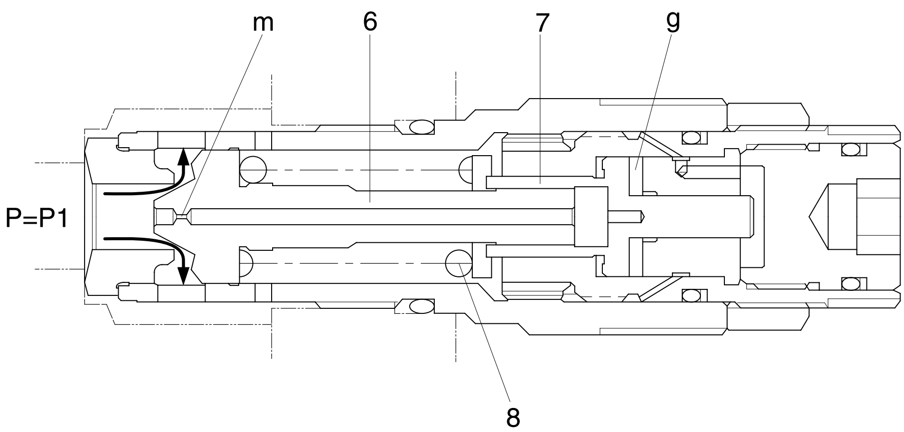


29072SM07

④ When piston(7) hits the end of body, it stops moving to the right any further. As the result, the pressure in chamber(g) equals(Ps).

$$Ps \times A_1 = Fsp + Ps \times A_3$$

$$Ps = \frac{Fsp}{A_1 - A_3}$$

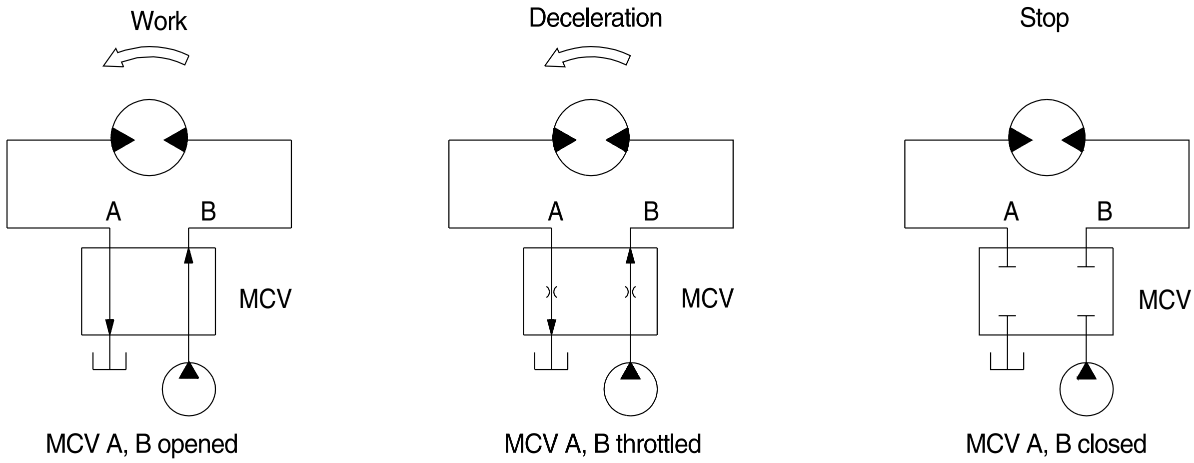


29072SM08

4) BRAKE SYSTEM

(1) Control valve swing brake system

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



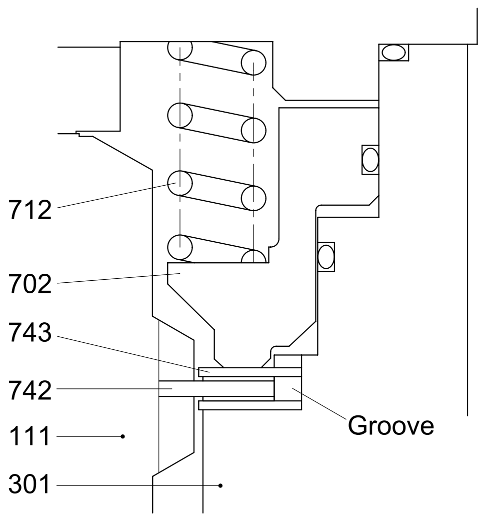
(2) Mechanical swing parking brake system

The mechanical swing parking brake system is installed to prevent the upper structure from swinging downhill because of its own weight when the excavator is parked on a slope since it completely eliminates the hydraulic drift of swing motion while the excavator is on a slop, work can be done more easily and safely.

① **Brake assembly**

Circumferential rotation of separate plate(743) is constrained by the groove located at casing(301). When housing is pressed down by brake spring(712) through lining plate(742), separate plate(743) and brake piston(702), friction force occurs there.

Cylinder(111) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



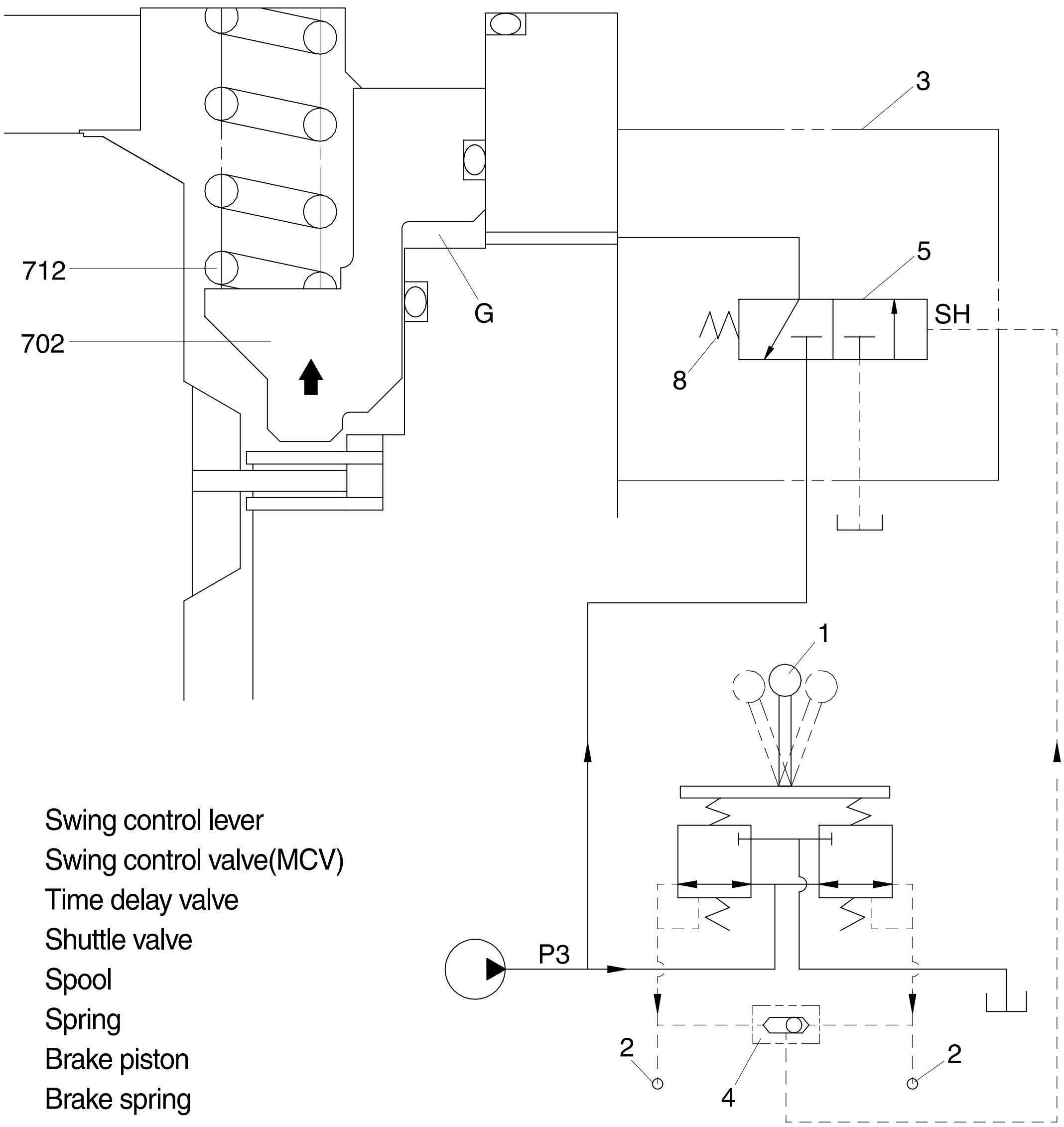
30572SM03

111	Cylinder	712	Brake spring
301	Casing	742	Lining plate
702	Brake piston	743	Separate plate

② **Operating principle**

a. When the swing control lever(1) is set to the swing position, the pilot oil go to the swing control valve(2) and to SH of the time delay valve(3) via the shuttle valve(4), this pressure move spool(5) to the leftward against the force of the spring(8), so pilot pump charged oil(P3) goes to the chamber G.

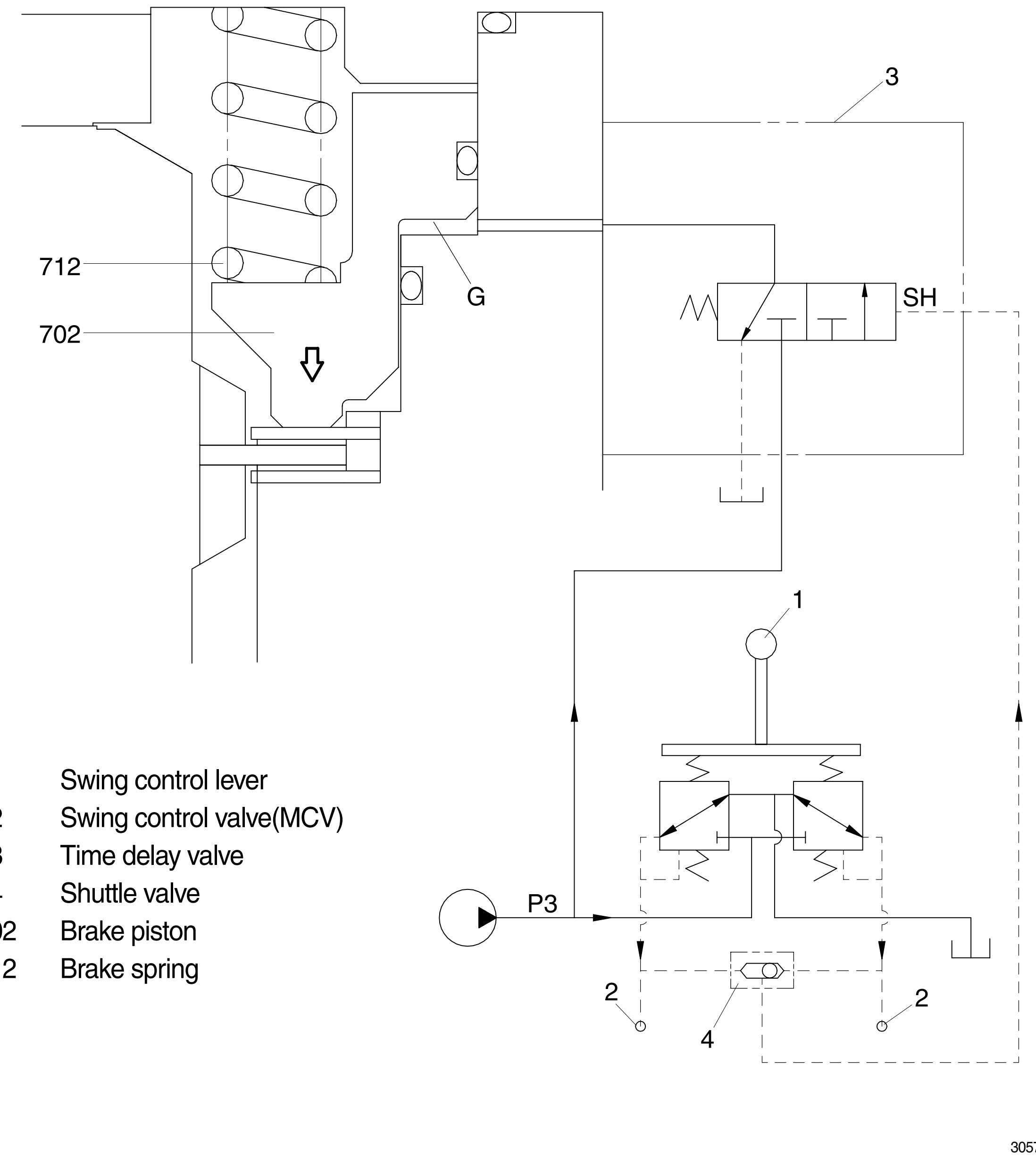
This pressure is applied to move the piston(702) to the upward against the force of the spring(712). Thus, it releases the brake force.



1	Swing control lever
2	Swing control valve(MCV)
3	Time delay valve
4	Shuttle valve
5	Spool
8	Spring
702	Brake piston
712	Brake spring

30572SM04

b. When the swing control lever(1) is set the neutral position, the time delay valve(3) shifts the neutral position and the pilot oil blocked chamber G.
Then, the piston(702) is moved lower by spring(712) force and the return oil from the chamber G is drain.



1	Swing control lever
2	Swing control valve(MCV)
3	Time delay valve
4	Shuttle valve
702	Brake piston
712	Brake spring

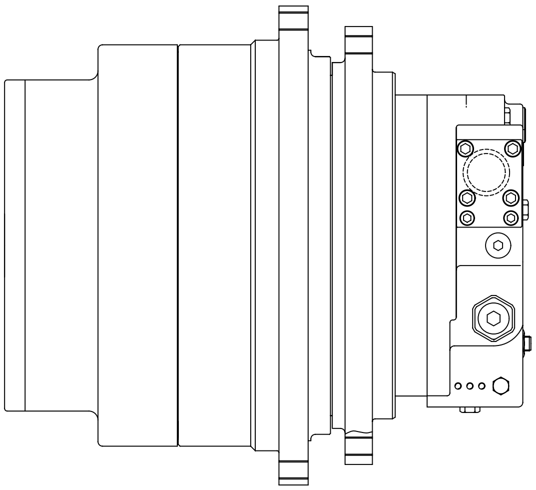
30572SM05

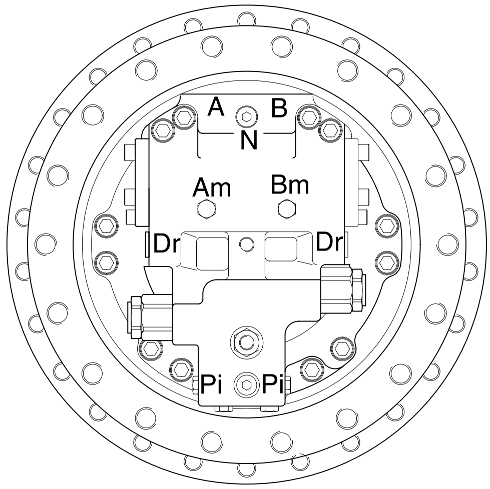
GROUP 4 TRAVEL DEVICE

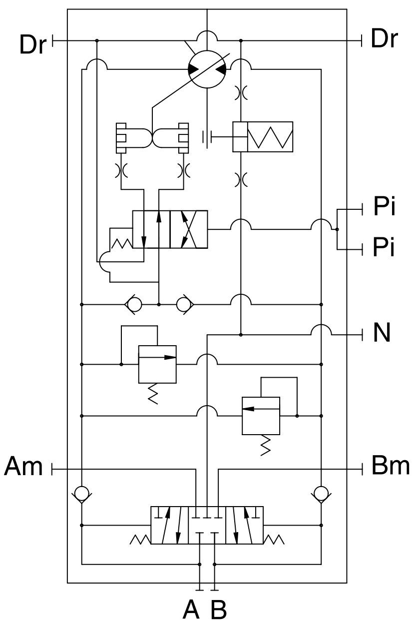
1. CONSTRUCTION

Travel device consists travel motor and gear box.

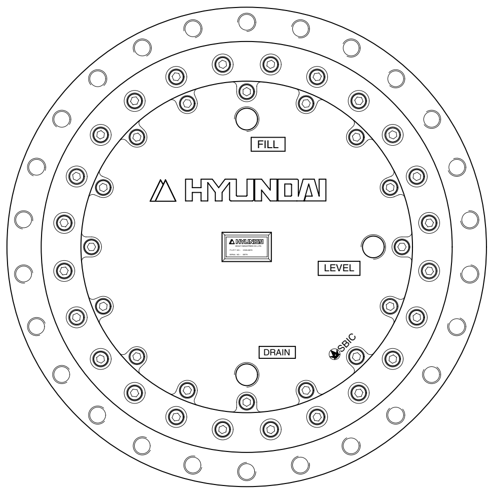
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







CIRCUIT DIAGRAM

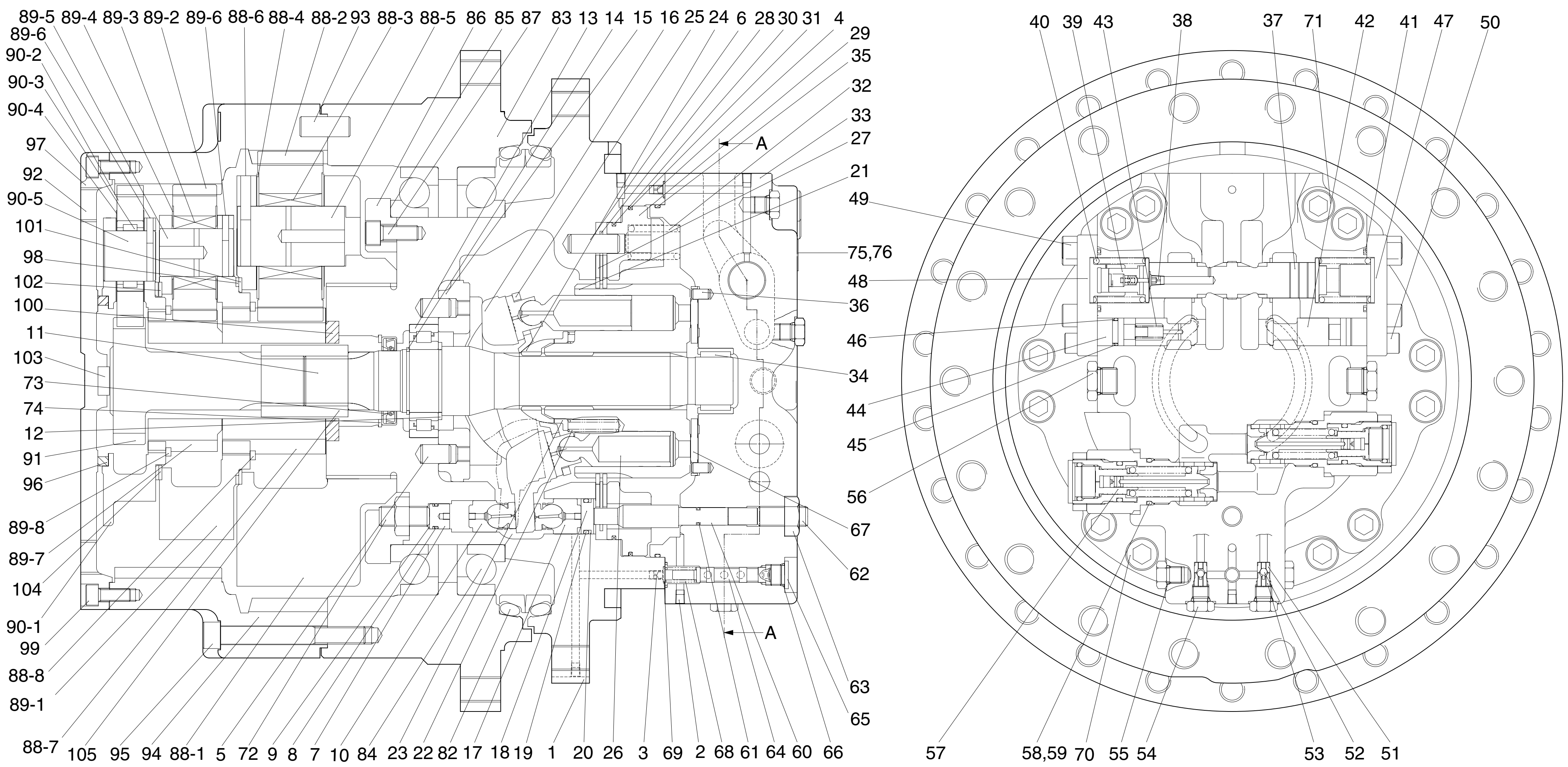


300072TM01A

Port	Port name	Port size
A, B	Valve port	PF 1
Pi	Pilot port	PF 1/4
Dr	Drain port	PF 1/2
Am, Bm	Gage port	PF 1/4
N	Parking release port	PF 1/4

2. SPECIFICATION

1) TRAVEL MOTOR



SECTION A-A

2907A2TM01

1	Casing	16	Plate	31	Ring	46	Back up ring	61	O-ring	83	Housing	89-1	Carrier No.2	92	Plug
2	Plug	17	Piston	32	Spring	47	Cap	62	Lock screw	84	Bearing	89-2	Planetary gear No.2	93	Lock pin
3	Screw	18	Stopper	33	Valve casing	48	Cap	63	Nut	85	Shim	89-3	Needle No.2	94	Ring gear
4	Screw	19	O-ring	34	Needle bearing	49	Bolt	64	Spool	86	Retainer	89-4	Thrust washer No.2	95	Bolt
5	Pin	20	Back up ring	35	O-ring	50	Socket bolt	65	Plug	87	Bolt	89-5	Pin No.2	96	Thrust ring No.1
6	Pin	21	Cylinder block	36	Pin	51	Seat	66	O-ring	88	Carrier No.3	89-6	Spring pin No.2	97	Cover
7	Stopper	22	Cylinder spring	37	Spool	52	Steel ball	67	Valve plate	88-1	Carrier No.3	89-7	Sun gear No.2	98	Thrust ring No.2
8	O-ring	23	Spacer	38	Screw	53	Stopper	68	Spring	88-2	Planetary gear No.3	89-8	Snap ring No.2	99	Bolt
9	Back up ring	24	Guide	39	Damping check	54	Plug	69	O-ring	88-3	Needle No.3	90	Carrier No.1	100	Motor ring
10	Piston	25	Plate	40	Spring	55	O-ring	70	Socket bolt	88-4	Thrust washer No.3	90-1	Carrier No.1	101	Thrust ring No.3
11	Shaft	26	Piston & Shoe assy	41	O-ring	56	Plug	71	Socket bolt	88-5	Pin No.3	90-2	Planetary gear No.1	102	Thrust ring No.1
12	Spacer	27	Plate	42	Plunger	57	Relief valve	72	Lock screw	88-6	Spring pin No.3	90-3	Needle bearing No.1	103	Pad
13	Roller bearing	28	Plate	43	Spring	58	O-ring	73	Oil seal	88-7	Sun gear No.3	90-4	Thrust washer No.1	104	Thrust ring No.2
14	Stop ring	29	Brake	44	Stopper	59	Back up ring	74	Lock ring	88-8	Snap ring No.3	90-5	Pin No.1	105	Coupling
15	Support	30	Ring	45	O-ring	60	Rod	82	Floating Seal	89	Carrier No.2	91	Sun gear No.1		

3. PRINCIPLE OF DRIVING

1) WORKING OF ROTARY GROUP

The high pressurized hydraulic oil which is supplied from a hydraulic pump is flows into a cylinder(21) through the valve casing(33) of motor, and valve plate(67).

The rotary group has a construction that the above high pressurized hydraulic oil is flow only one side of the line Y-Y which connect the upper and lower dead point of the piston(26).

This high pressurized hydraulic oil works on the piston and generating the force F1, F1 = P * A(P : supplied pressure, A : pressure receving area), like following pictures.

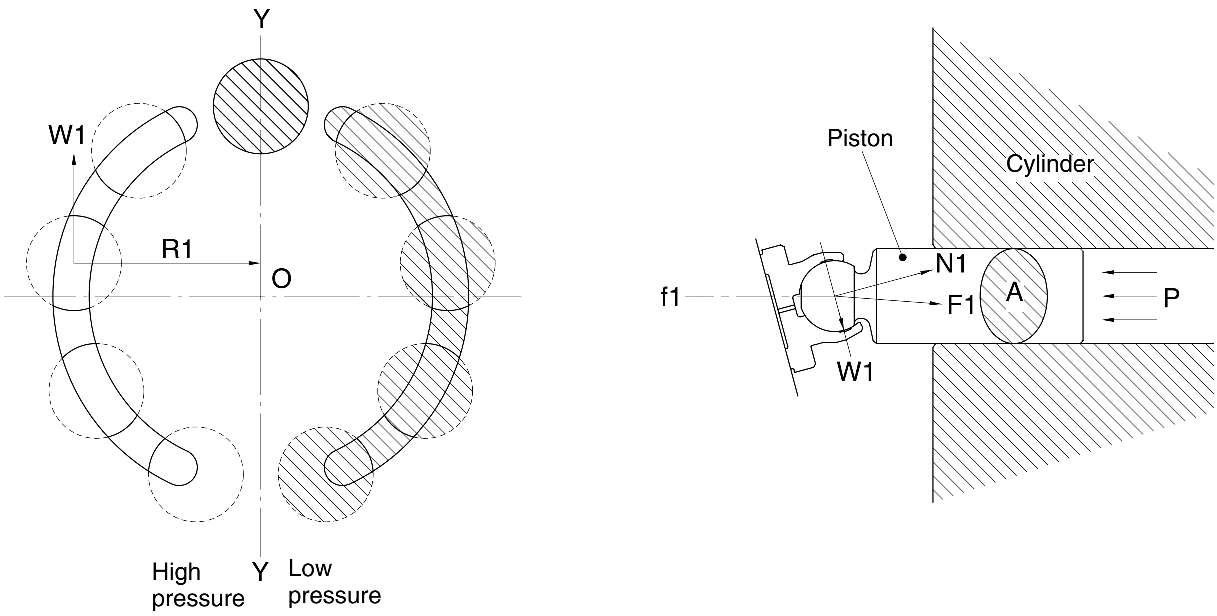
This force, F1, is devided by the swash plate(16) having a tilting angle α into the thrust component N1 and radial component W1.

The W1 generates torque, T = W1 * R1, in respect to the line Y-Y.

This torque generated by each piston on the high pressurized hydraulic oil side is summed up onto a resultant torque Σ(W1 * R1), which prodeces torque for rotation.

This torque transfers the rotation force to the cylinder(21) through the pistons.

Since the cylinder block is spline-coupled with the shaft, the rotation force is transmitted to the shaft accordingly.



2907A2TM07

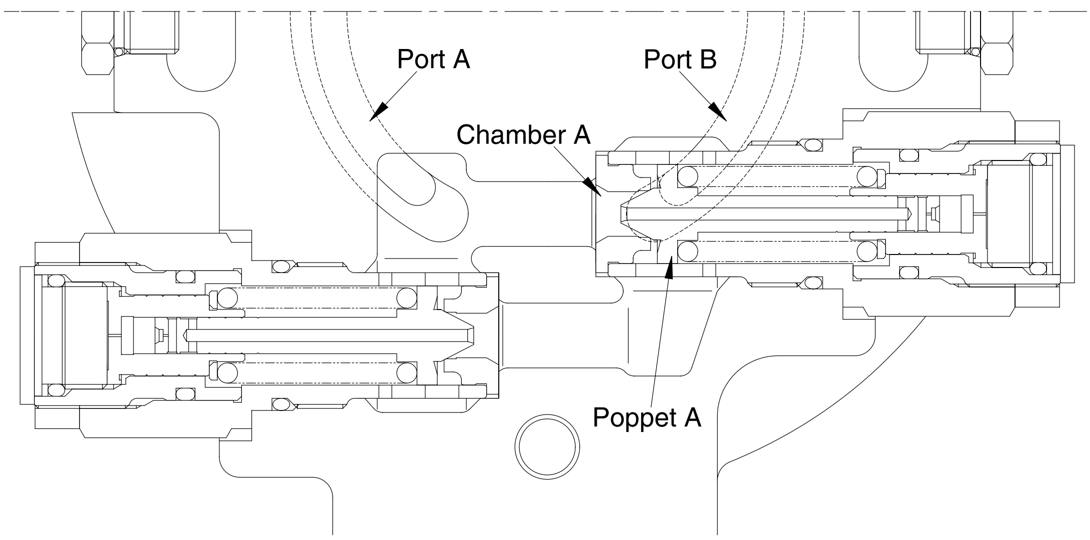
2) WORKING OF RELIEF VALVE

Relief valve carries on two function of following.

(1) Relief valve is to keep the starting pressure of the hydraulic motor at a constant value and bypass to the return line excessive oil generated at the motor inlet depending upon the acceleration speed of the inertia object.

(2) In case of an inertia object stopped, relief valve is generating a break pressure at the outlet and stop it forcedly.

The chamber A is always connect with port A of a motor. When the pressure at port A increase and the force pushing poppet A is higher than the pressure of the spring, then poppet A is pushed up from the contact surface of seat A, and oil flows from chamber A to port B.



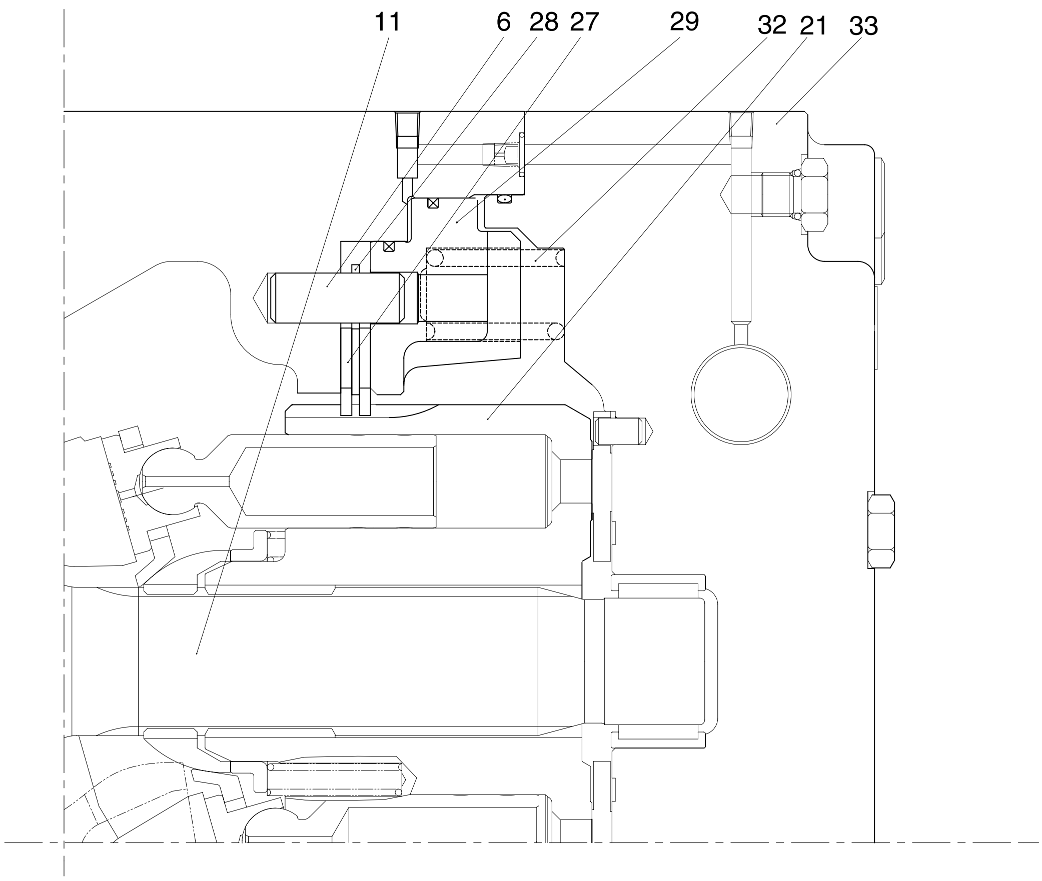
2907A2TM04

3) WORKING OF NEGATIVE BRAKE

The negative brake is released applying to the brake piston(29) the pressure led through built in the valve casing(33) spool. With no pressure working, the brake force is always ensured.

The brake force is generated by the frictional force among a plate(28) fixed by pin(6) and shaft casing, brake piston(29) and a frictional plate(27) connected through spline outside the cylinder block(21).

Without pressure being applied to the brake piston, the brake piston is pushed by ten brake springs(32) and the friction plate and separator plate are held between the brake piston and casing. This friction force restrains the shaft(11) spline-coupled with the cylinder block, and thus functions the brake.



300075TM05

4) COUNTERBALANCE VALVE

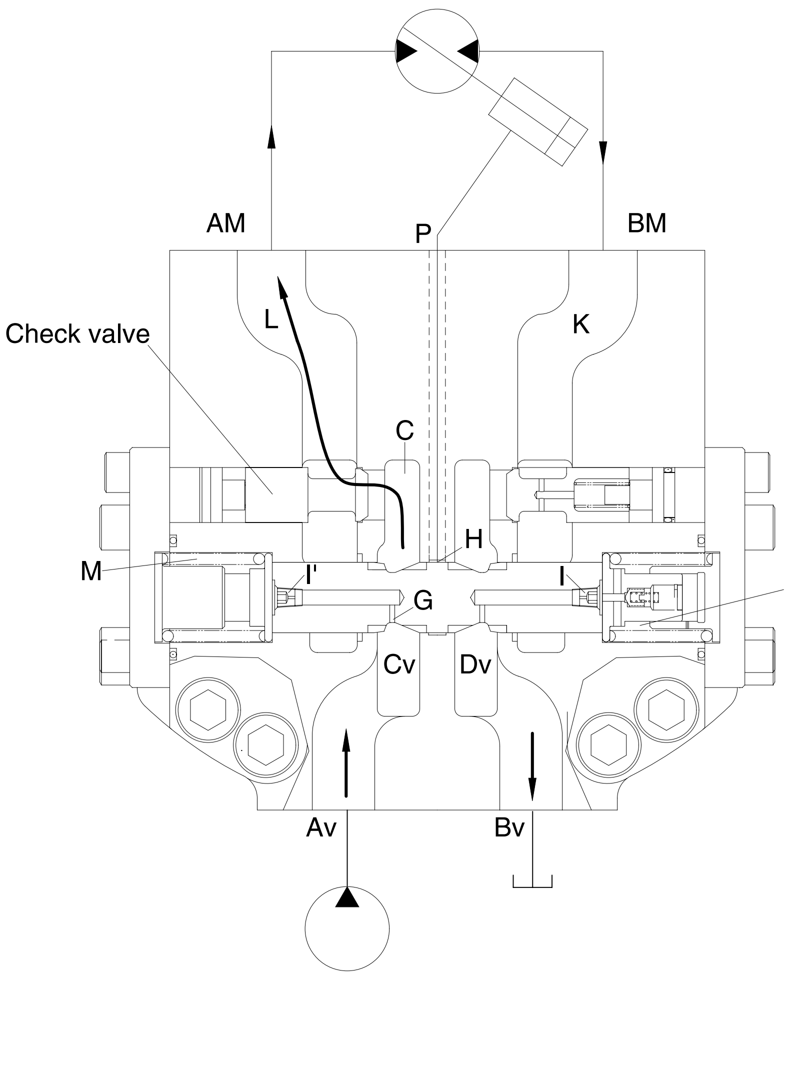
Av port is connected to a hydraulic pump : Bv port is connected to a tank.

The oil supplied from the hydraulic pump passed through Av → Cv → C sequence, pushed up the poppet of the check valve, passed through L to port AM, and is supplied to the hydraulic motor to turn it. But the brake is operated. Therefore, the pump discharge oil pressure is increases. And the pressure is led via passage G to spring room M. When the pressure in room M exceed the value equivalent to the force of the spring which holds the spool at its neutral position, the spool begins to move right.

The oil in room N is sent to room Dv by orifice I and discharged from Bv port to a tank. So spool moves to the right. The oil flows as the way of K → Dv → Bv sequence. Also according to the oil path as composed way Cv → H → P sequence, the pressure of Av pump is provided to the port P. An working oil in room N is discharged through orifice and a gap. Therefore the switching operation of spool is driving slowly.

When the pump discharge pressure fall, spool moves to the left side by a spring at the side of room N. Also spool moves to the left, the hydraulic oil in room M is sent to Cv room through orifice I' and discharged to the Av port.

When the pressure at port Av fall down to the tank pressure, the pressure of room M is as the same as that the tank pressure and becomes equal to that in room N, and so the spool returns to its neutral position.



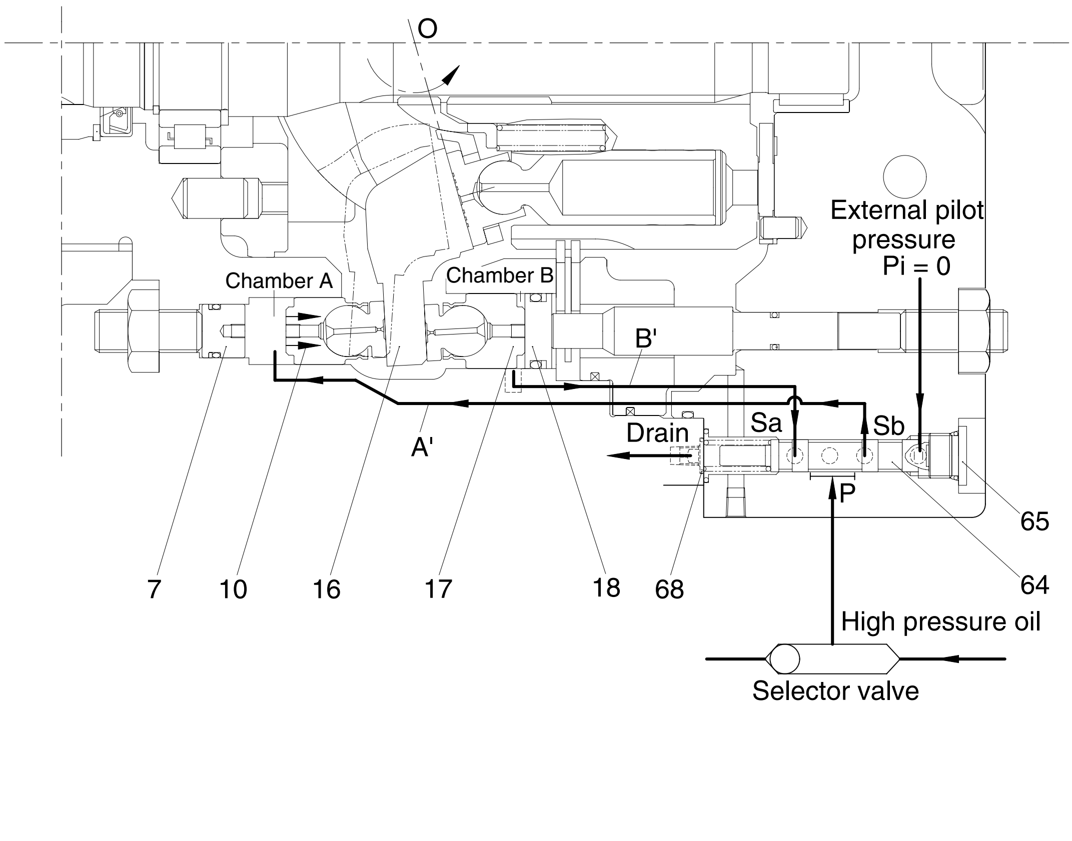
300072TM06

5) WORKING OF DISPLACEMENT CHANGEOVER

The capacity of the travel motor is changed by changing the tilting angle of this swash plate(16).
The tilting angle changes by displacement changeover valve.

(1) External pilot pressure : Pi = 0(Large displacement)

By means of the built-in high pressure selector mechanism in the valve casing(33), the high pressure oil working on the motor function to port P of the displacement-changeover valve.
A the spool(64) assembled in the displacement changeover valve is pressed to plug(65) by the spring(68), the high pressure oil at port P flows to port Sb.
This high pressure oil flows through oil passage(passage A') of valve casing(33) and shaft casing works to chamber A.
This oil in chamber B flows through passage B' and port Sa into the drain line. The displacement changeover piston(17) is pushed right and the swash plate(16) moves in the arrowed direction around rotation center 'O'. The swash plate moves until it touched stopper(18), and then is fixed there.



2907A2TM05

(2) External pilot pressure : Pi $\geq$ 20kgf/cm^2(small displacement)

If the force operating on spool(64) of the displacement changeover valve is stronger than the spring(68), and the spool moves to the left side.

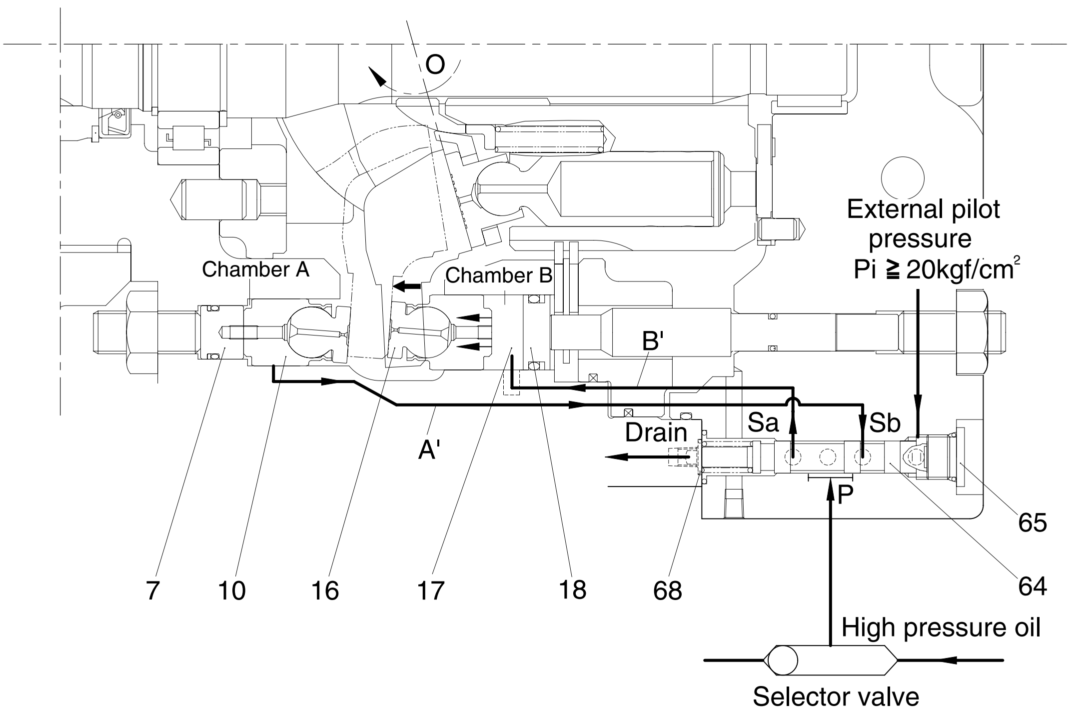
The high pressure oil is works on room B through passage Sa → B' from port P.

The oil in chamber A flows into the drain line through the passage A' → Sb.

The displacement changeover piston(17) is pushed left and the swash plate(16) moves in the arrowed direction around rotation center 'O'. The swash plate moves until it touches stopper(7), and then is fixed there.

If the load increase while the motor is working with its small displacement(Pi $\geq$ 20kgf/cm^2, 2nd speed) until the motor inlet port pressure reaches the preset value, the motor increase its displacement in response to the load, while maintaining the pressure at the preset value(automatic 2 -speed function). As motor inlet port pressure reaches the preset value and then spool(64) moves right side, inlet pressure oil flows into chamber A through port Sb and the swash plate moves until it touches stopper(17). If the load further increase until the displacement of the motor reaches the maximum value, the inlet port pressure increase further.

If the load decreases under this condition, the motor continues reducing its displacement in the reverse sequence. As the load and inlet port pressure decreases and reaches the preset value, spool(64) moves left side by the pilot pressure(Pi). Therefore inlet port pressure flow into chamber B through port Sa and the swash plate moves until it touches stopper(10).



2907A2TM06

6) REDUCTION GEAR

(1) Planetary gear mechanism

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

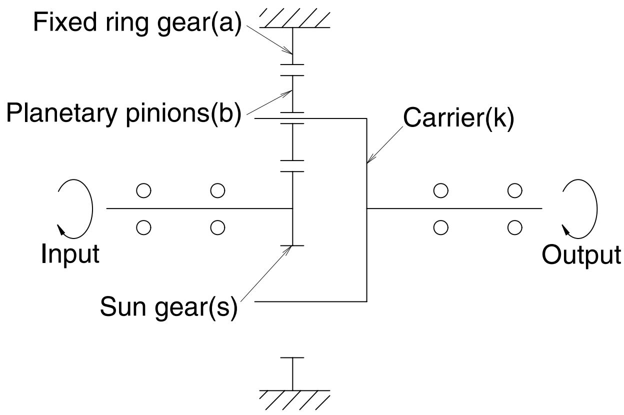
This reduction unit utilizes two stages, planetary reduction system.

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

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

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

This mechanism is called planetary gear mechanism.



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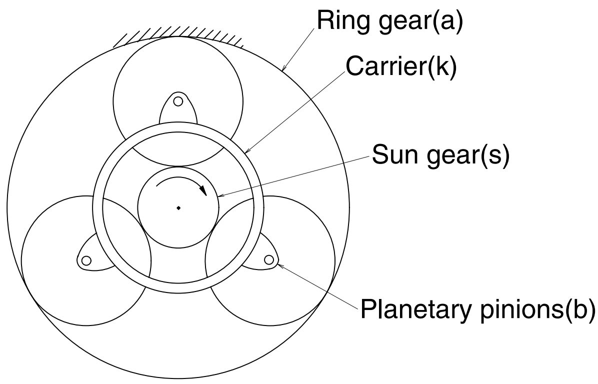
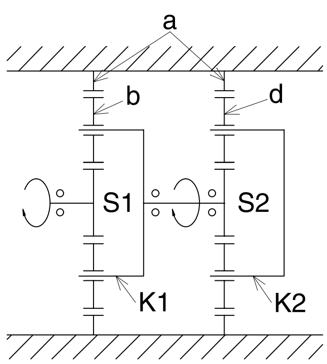


29072TM11

(2) Two stages reduction gear

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

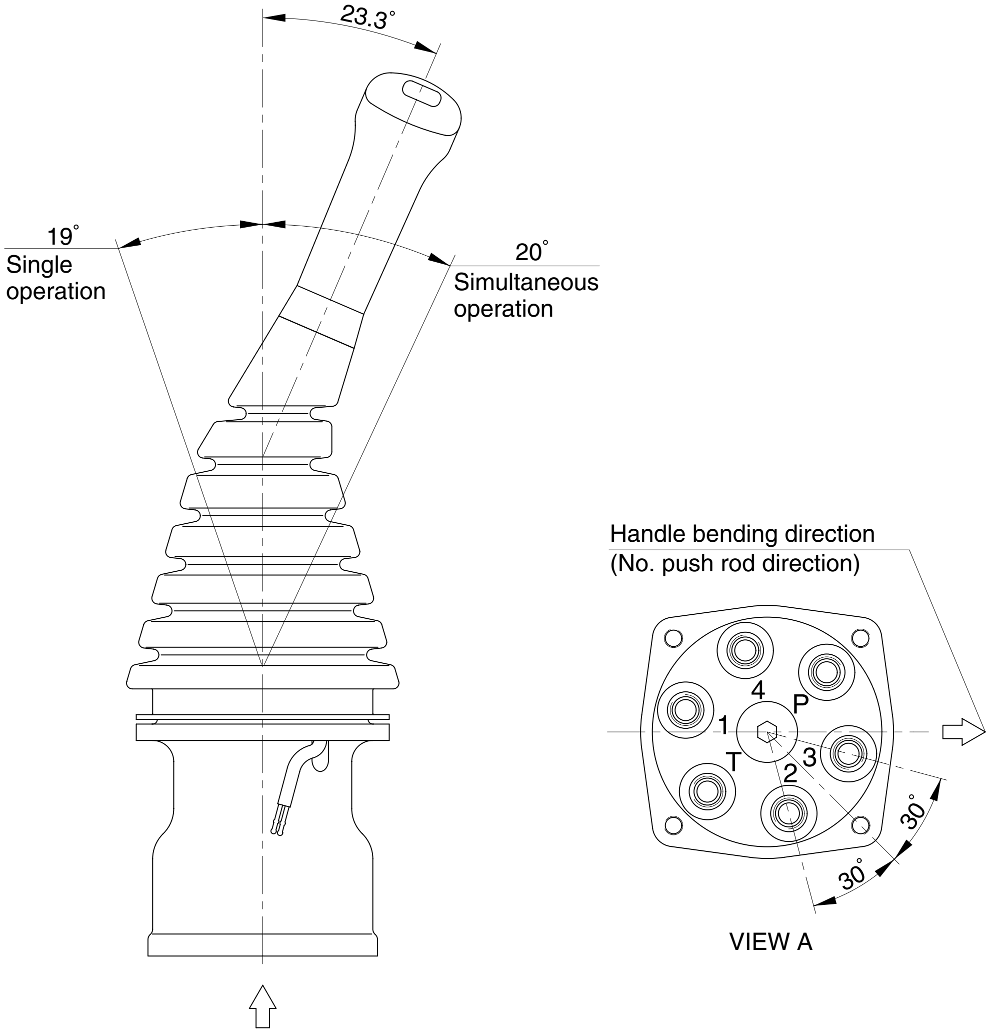
This time, because carrier **K2** is fixed to frame, gear **d** drives ring gear **a** and then ring gear a rotates to drive sprocket.



29072TM12

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.



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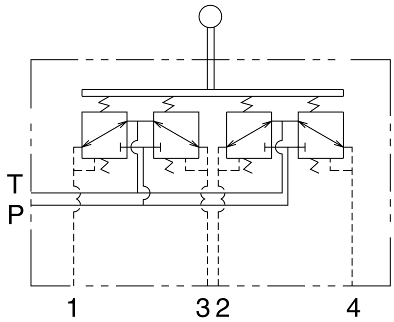


Hydraulic circuit

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

CROSS SECTION

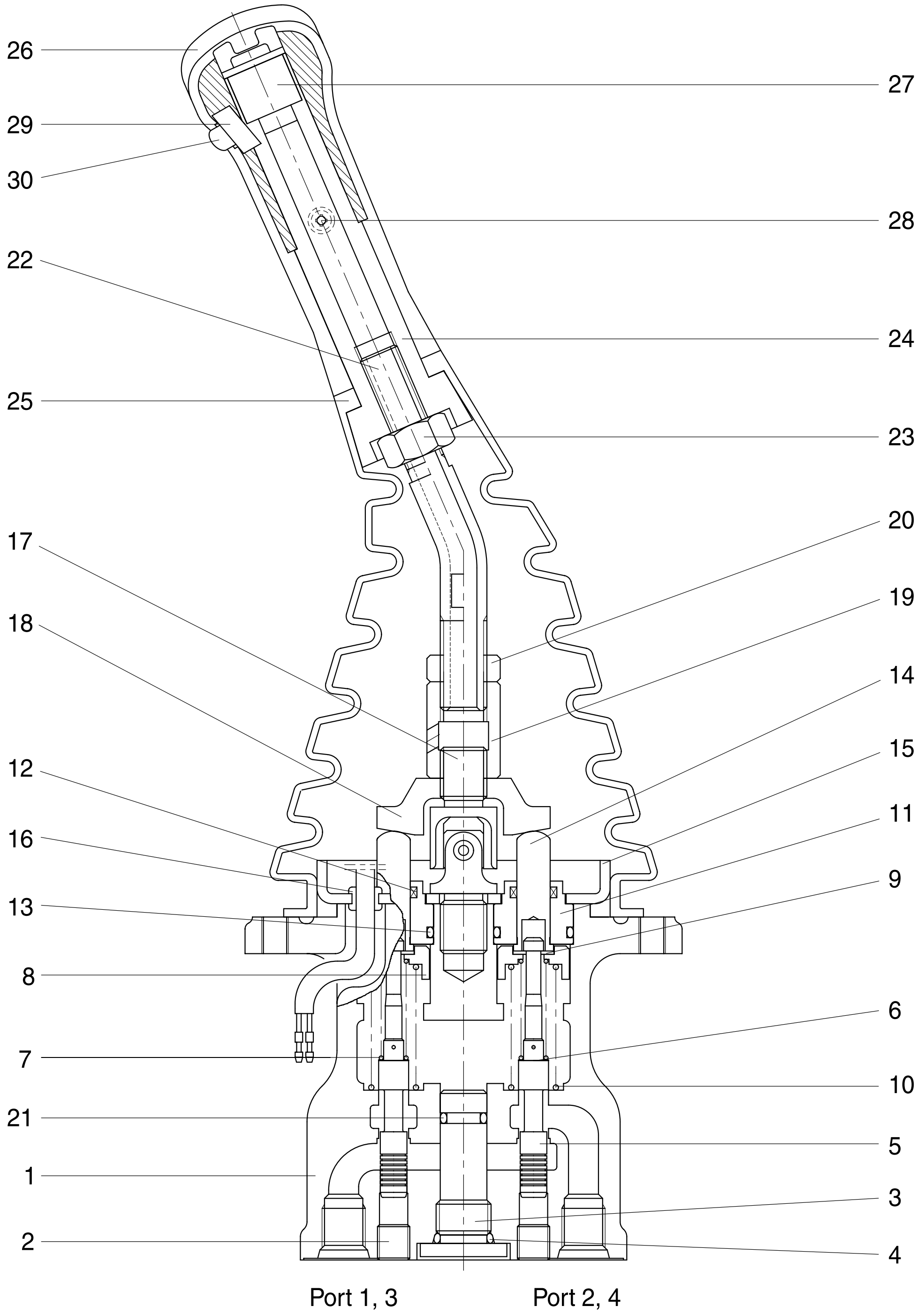
The construction of the pilot valve is shown in the attached cross section drawing. The casing has vertical holes in which reducing valves are assembled.

The pressure reducing section is composed of the spool(5), spring(7) for setting secondary pressure, return spring(10), stopper(9), spring seat(8) and shim(6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5kgf/cm^2(Depending on the type). The spool is pushed against the push rod(14) by the return spring.

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

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

CROSS SECTION



21072SF06

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.

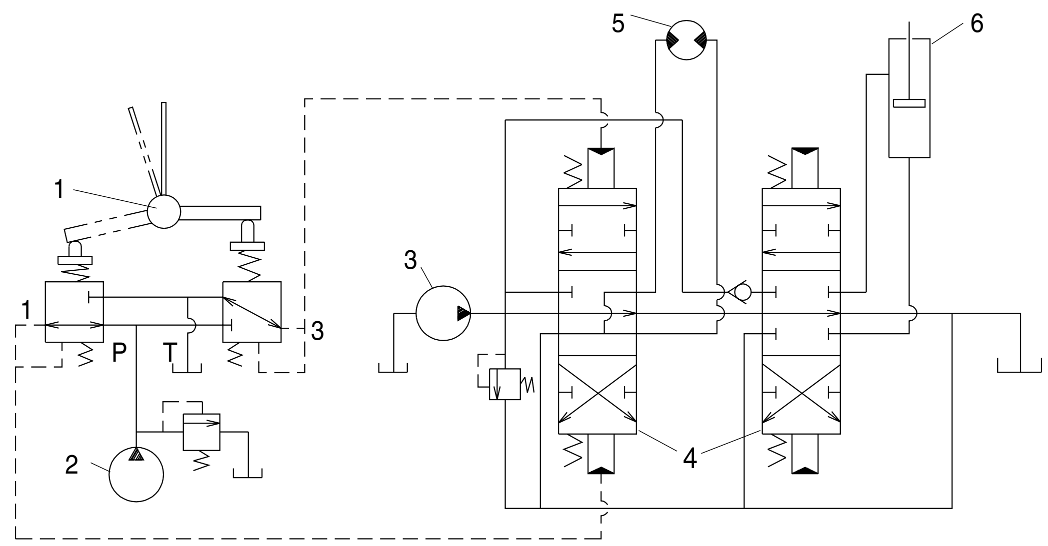
The spring(10) works on the case(1) and spring seat(8) and tries to return the push rod(14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

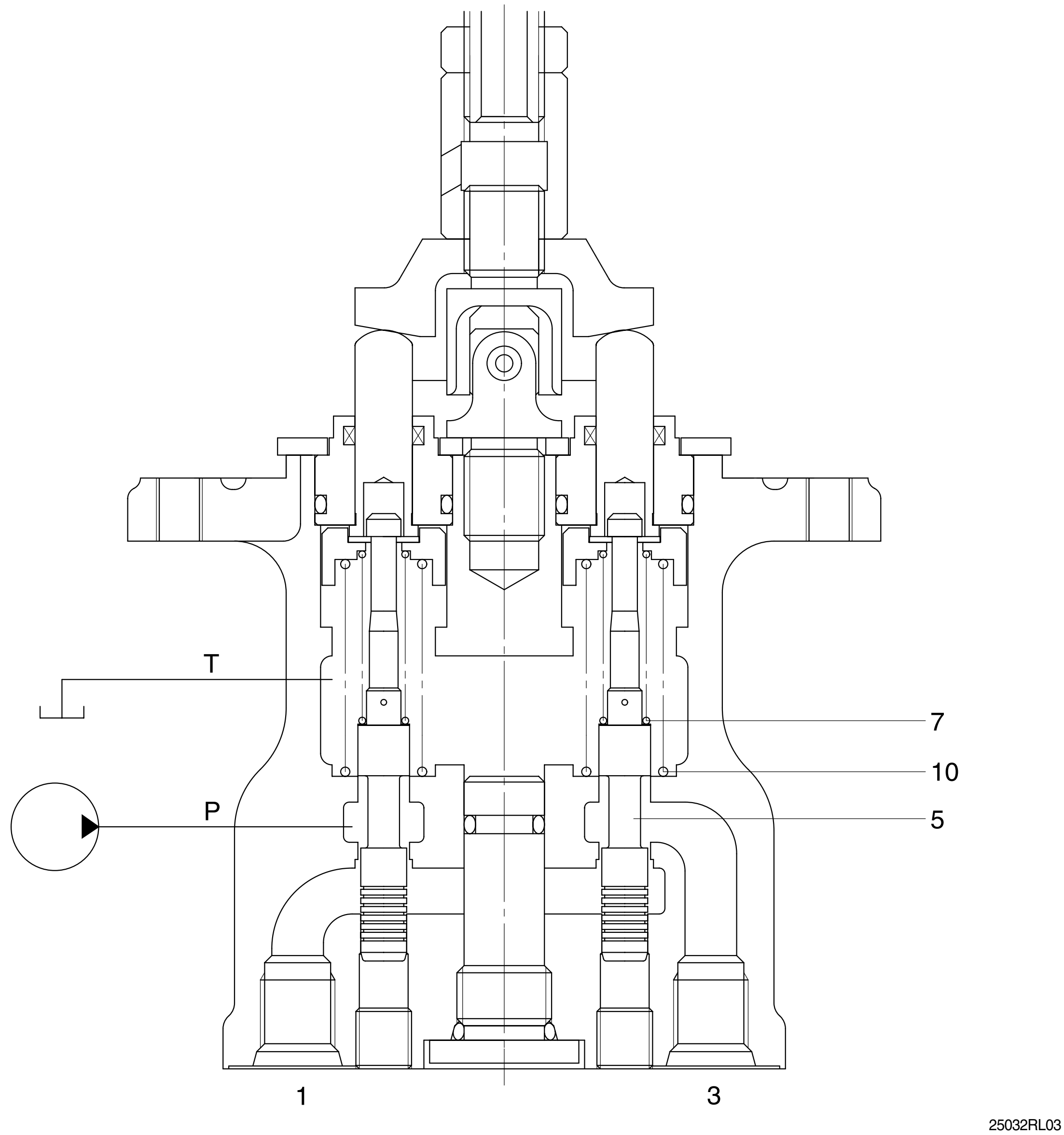
The diagram shown below is the typical application example of the pilot valve.



2-70

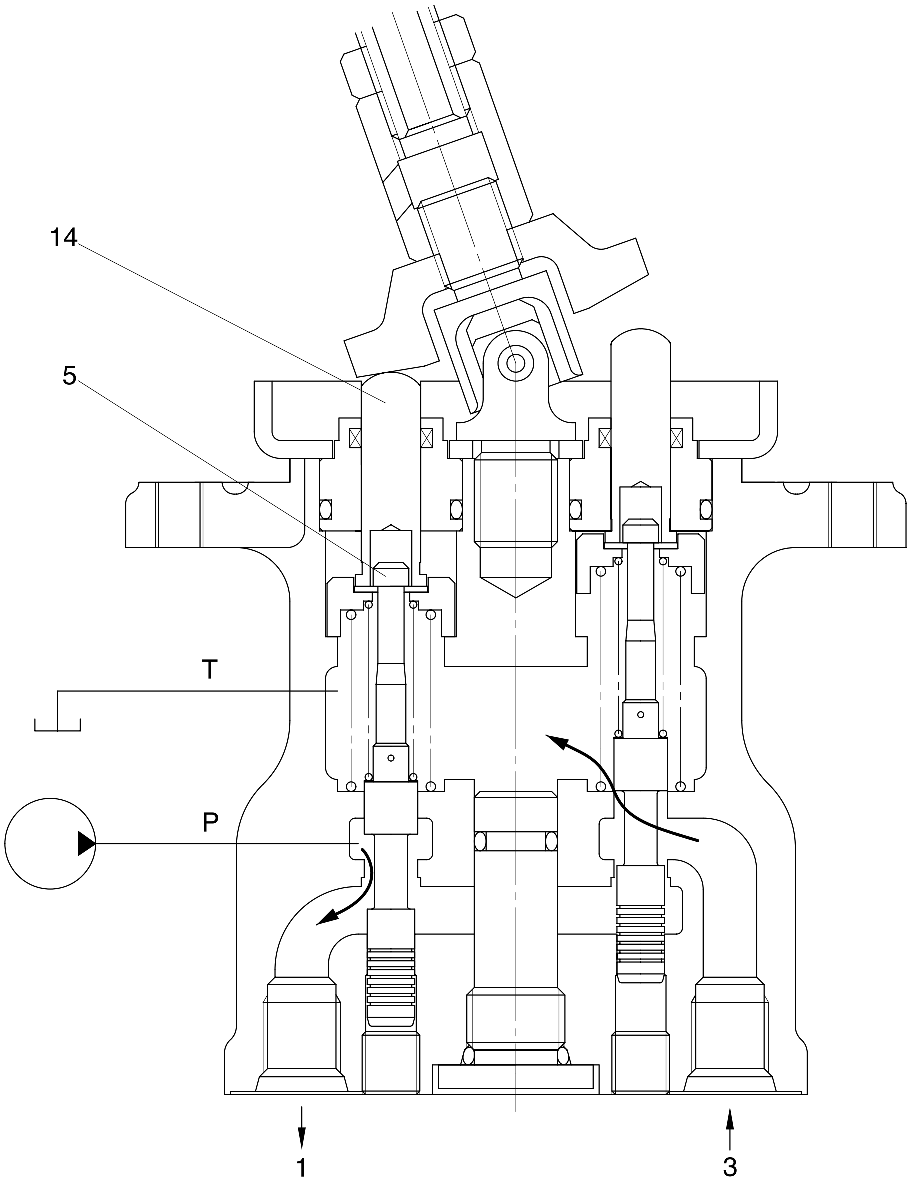
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(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



29072RL04

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.

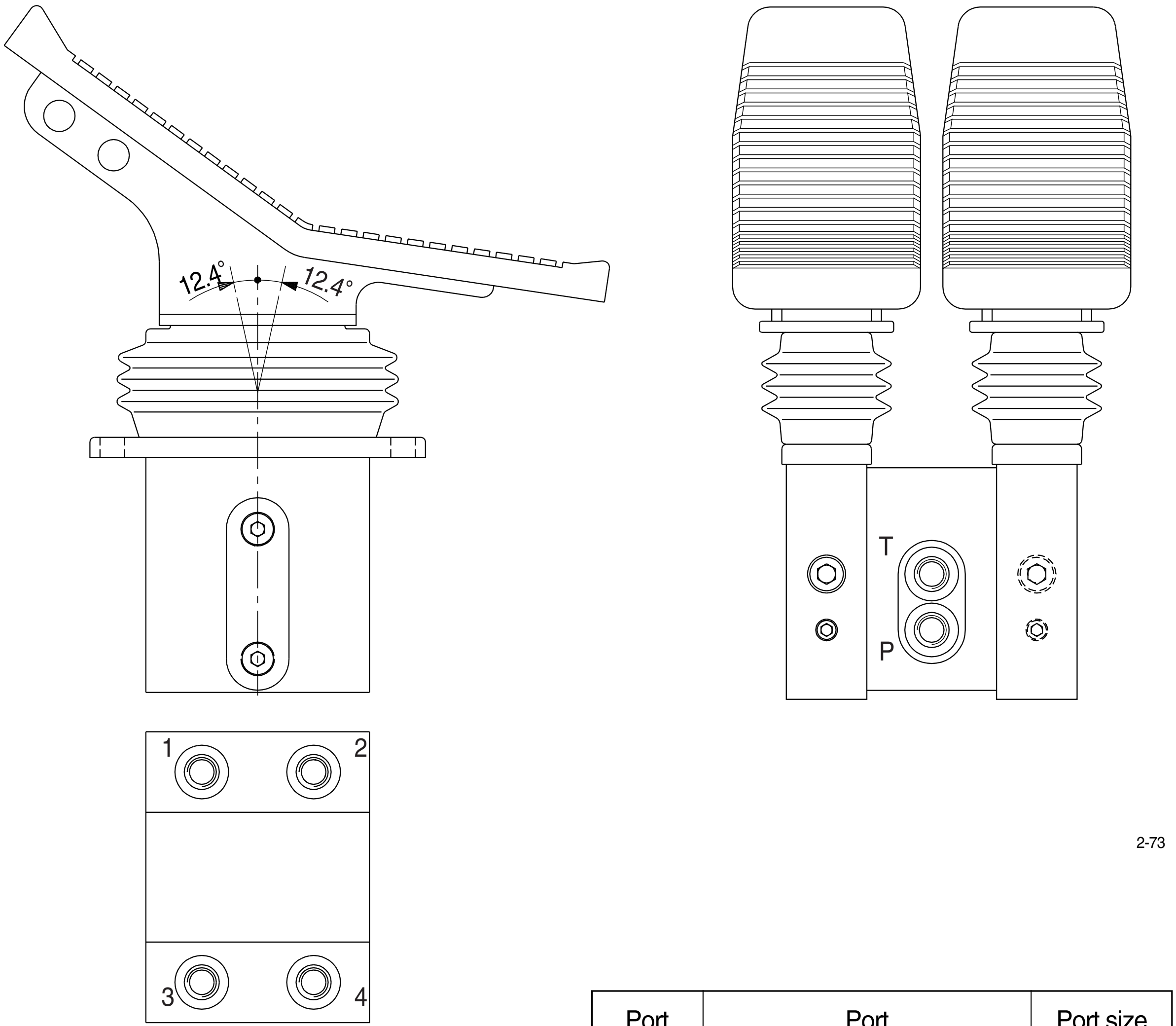
In this manner the secondary pressure is kept at the constant value.

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.

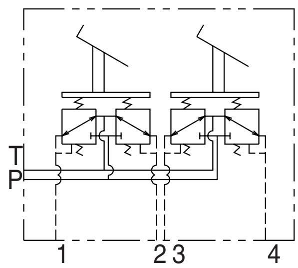
GROUP 6 RCV PEDAL

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.



2-73



Hydraulic circuit

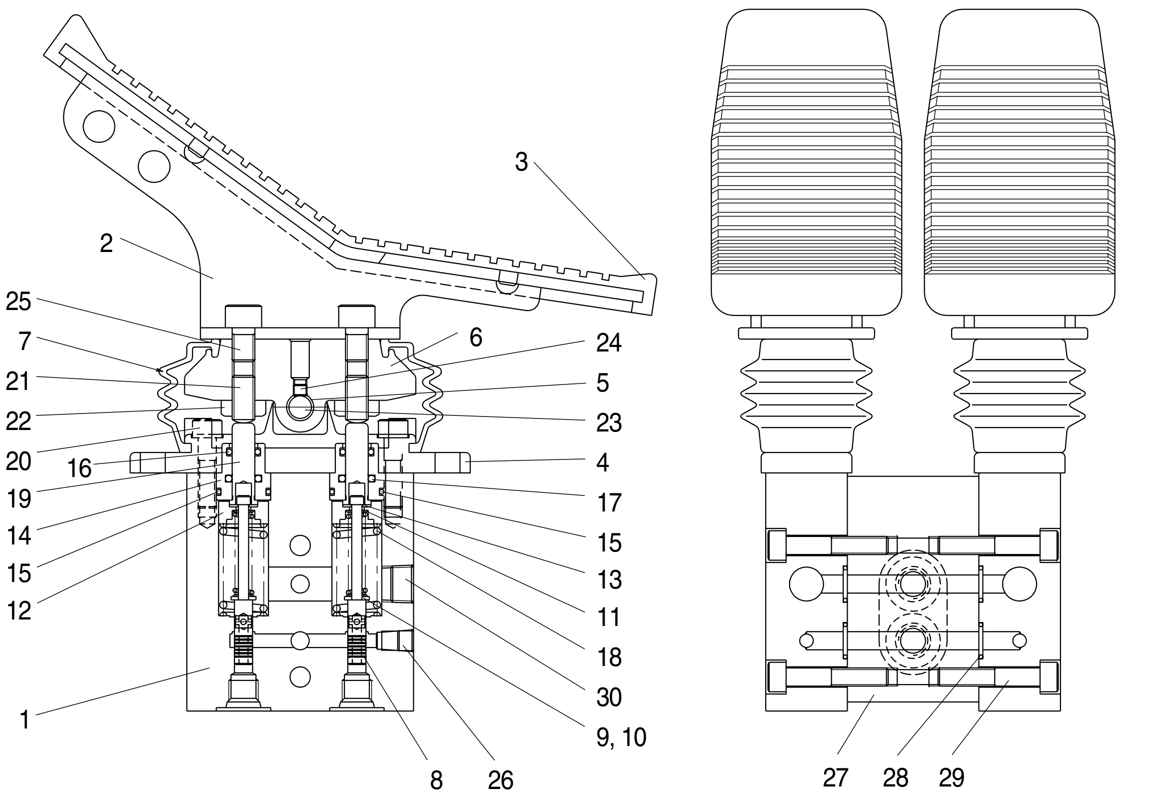
Port	Port	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Travel(LH, Forward)	
2	Travel(LH, Backward)	
3	Travel(RH, Forward)	
4	Travel(RH, Backward)	

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(11) for setting secondary pressure, return spring(18), stopper(13), spring seat(12) and shim(9). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 19 kgf/cm^2 (depending on the type). The spool is pushed against the push rod(19) by the return spring.

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



1	Casing	11	Spring	21	Set screw
2	Pedal	12	Spring seat	22	Nut
3	Pedal cover	13	Stopper	23	Cam shaft
4	Cover	14	Plug	24	Set screw
5	Bushing	15	O-ring	25	Hexagon socket bolt
6	Cam	16	Dust seal	26	Plug
7	Bellows	17	Rod seal	27	Spacer
8	Spool	18	Spring	28	O-ring
9	Shim	19	Push rod	29	Hexagon socket bolt
10	Spring seat	20	Hexagon socket bolt	30	Plug

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(11) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod(19) is inserted and can slide in the plug(14).

For the purpose of changing th displacement of the push rod through the cam(6) and adjusting nut(22) are provided the pedal(2) that can be tilted in any direction around the fulcrum of the cam(6) center.

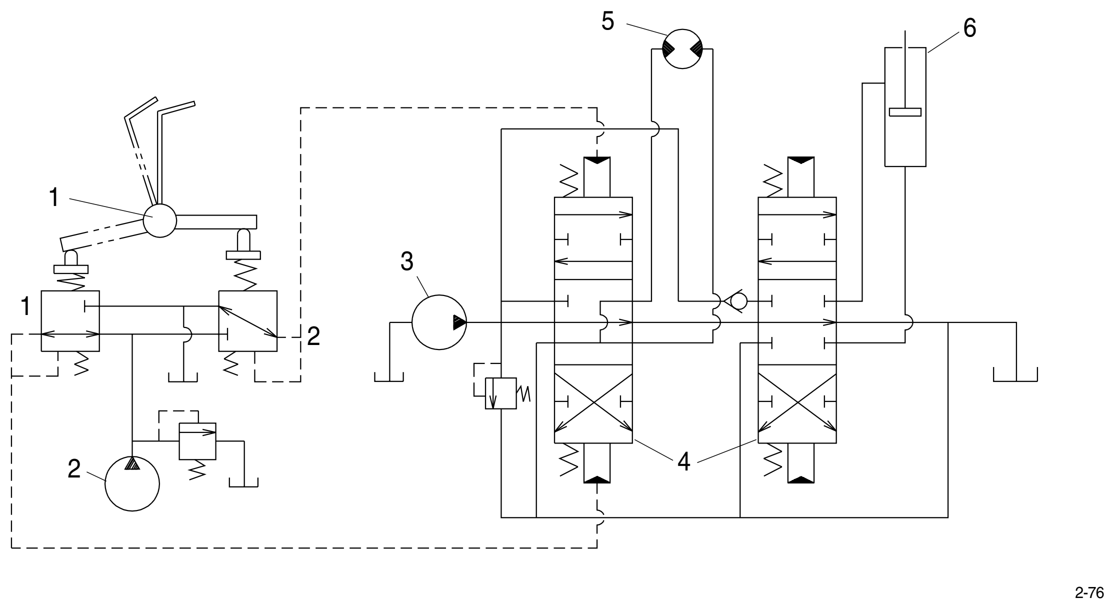
The spring(18) works on the casing(1) and spring seat(12) and tries to return the push rod(19) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

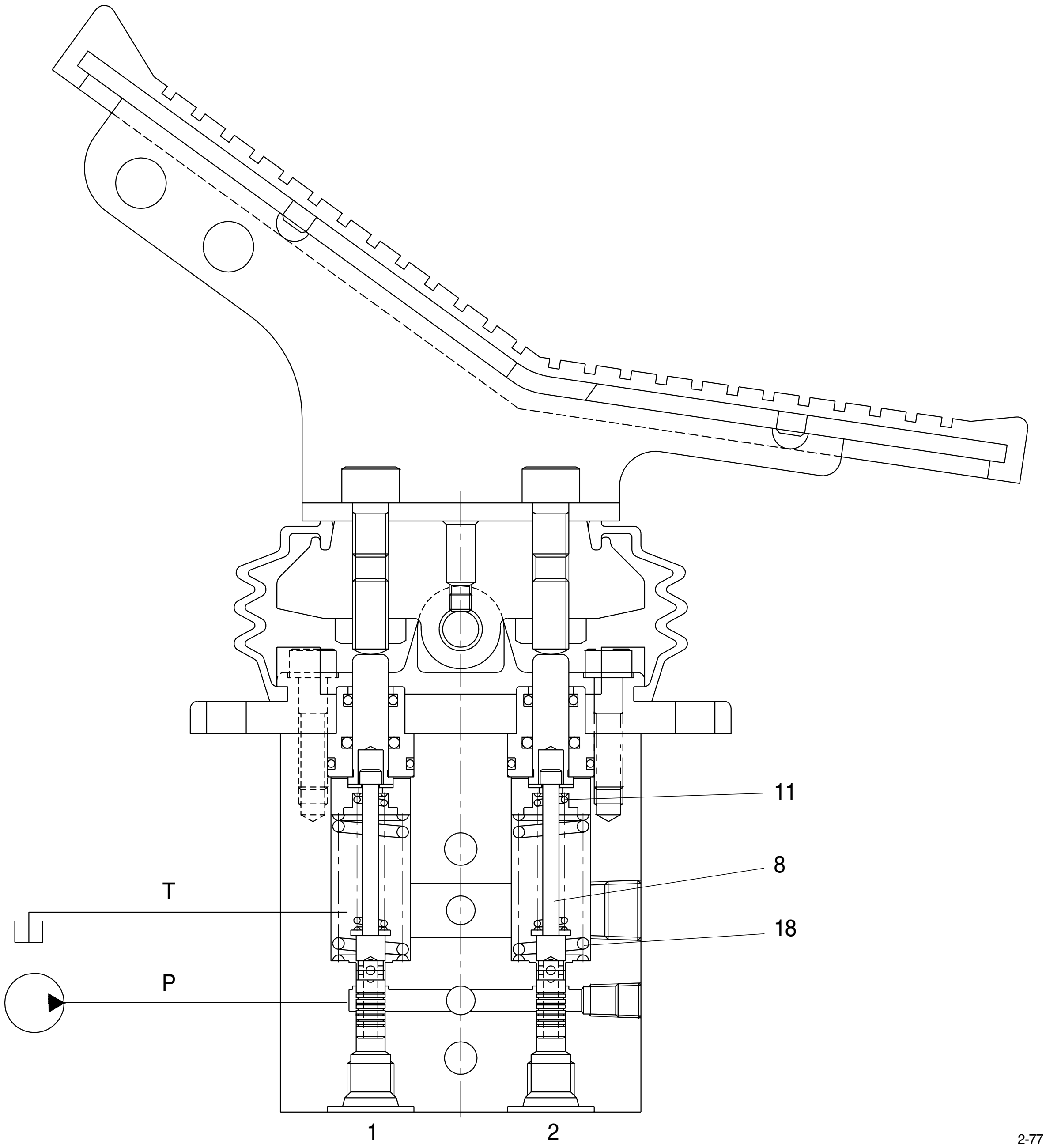
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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



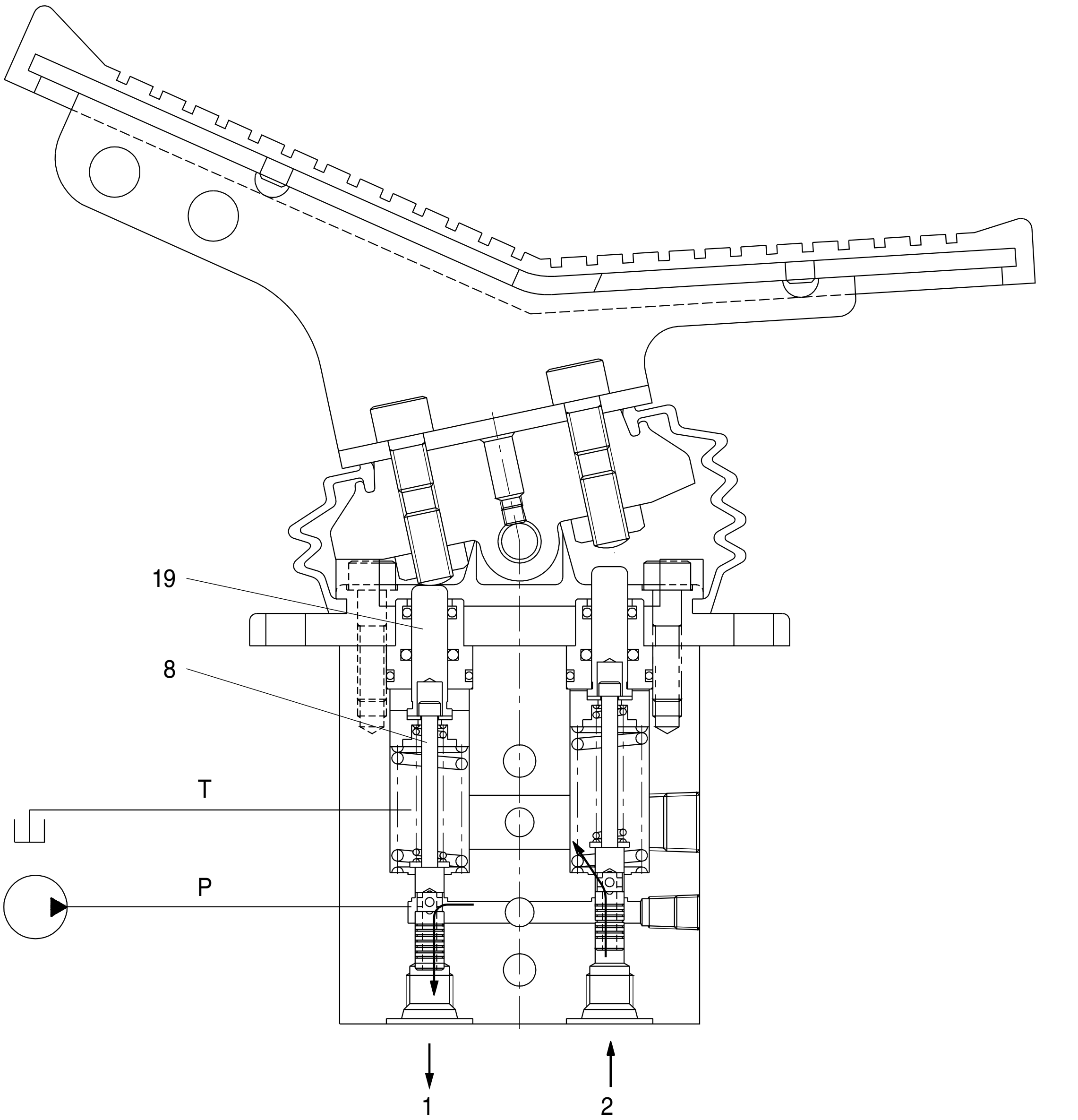
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



The force of the spring(11) 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(18) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

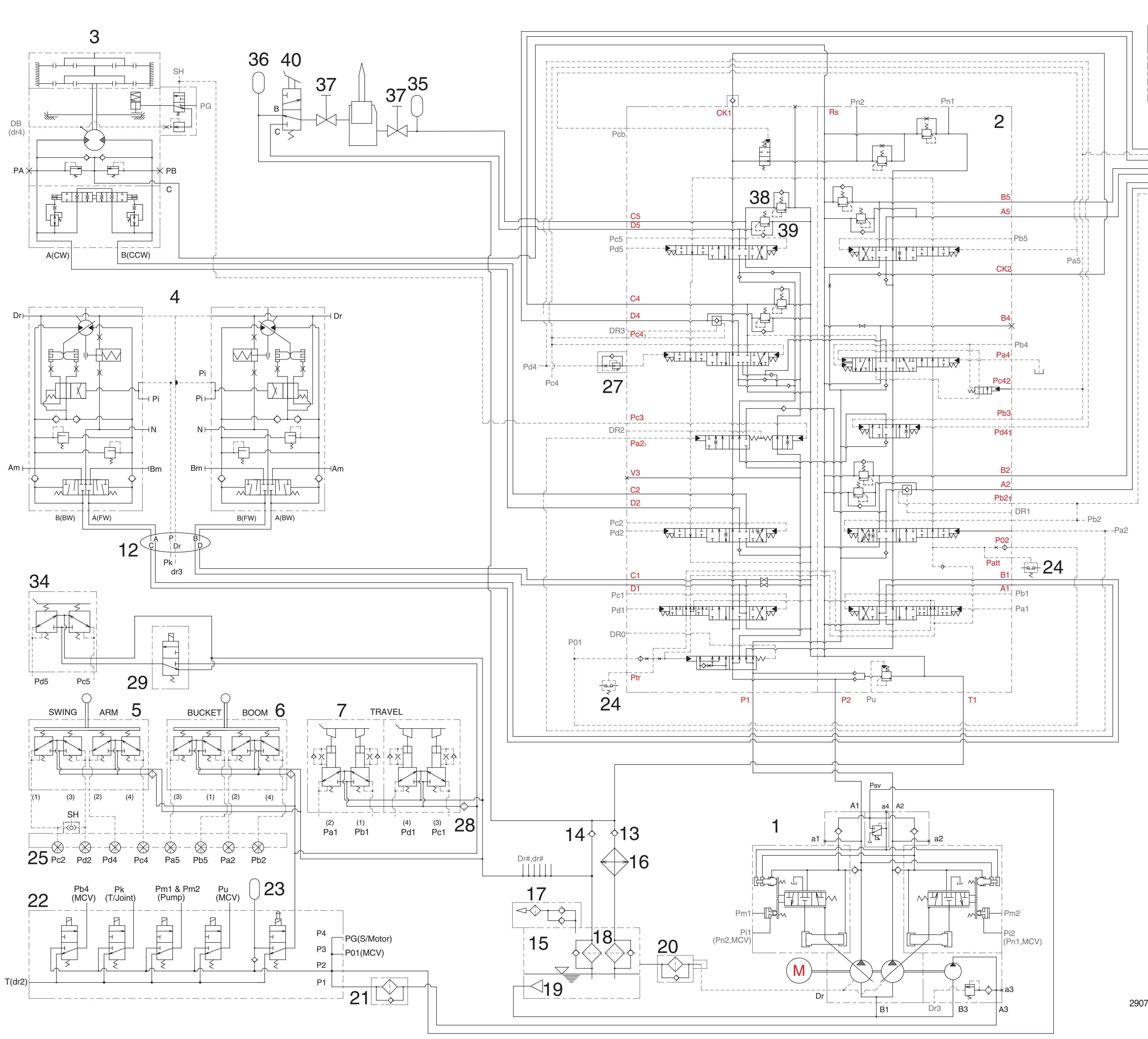
(2) Case where pedal is tilted



When the push rod(19) 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

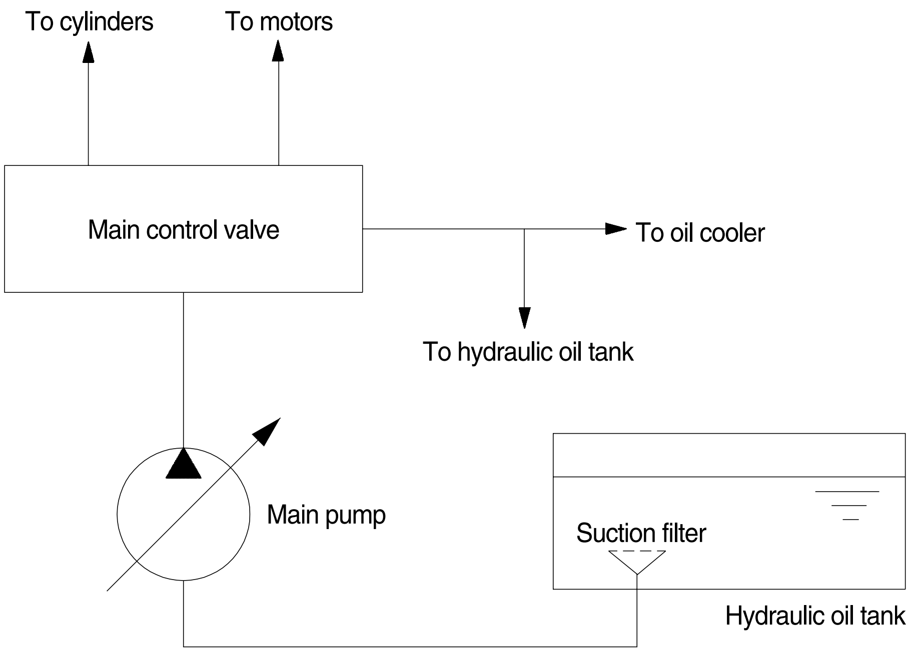


1	Main pump	21	Line filter
2	Main control valve	22	Solenoid valve
3	Swing motor	23	Accumulator
4	Travel motor	24	Pressure switch
5	RCV lever(LH)	25	Shuttle valve
6	RCV lever(RH)	27	Shockless valve
7	Rcv pedal	28	Last guard filter
8	Boom cylinder(LH)	29	Solenoid valve
9	Boom cylinder(RH)	30	Safety valve
10	Arm cylinder	31	Safety valve
11	Bucket cylinder	32	Press switch
12	Turning joint	33	Shut off valve
13	Check valve	34	Pedal
14	Check valve	35	Accumulator
15	Hydraulic tank	36	Accumulator
16	Oil cooler	37	Stop valve
17	Air breather	38	Port relief valve
18	Bypass valve	39	Port relief valve
19	Return element	40	Selector valve
20	Strainer		

GROUP 2 MAIN CIRCUIT

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

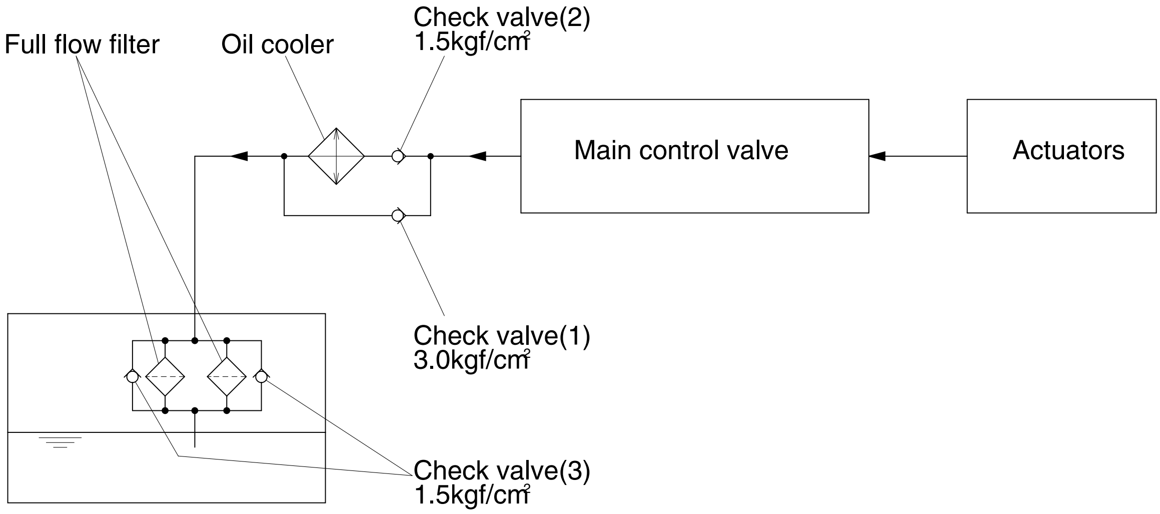
1. SUCTION AND DELIVERY CIRCUIT



3-02

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



29073CI01

All oil from each actuator returns to the hydraulic tank through the control valve.

The bypass check valves are provided in the return circuit.

The setting pressure of bypass check valves are 1.5kgf/cm^2(21psi) and 3.0kgf/cm^2(43psi). Usually, oil returns to the hydraulic tank from the left side of control valve through oil cooler.

When oil temperature is low, viscosity becomes higher and flow resistance increases when passing through the oil cooler. The oil pressure exceeds 3.0kgf/cm^2(43psi), the oil returns directly to the hydraulic tank, resulting in the oil temperature being raised quickly at an appropriate level.

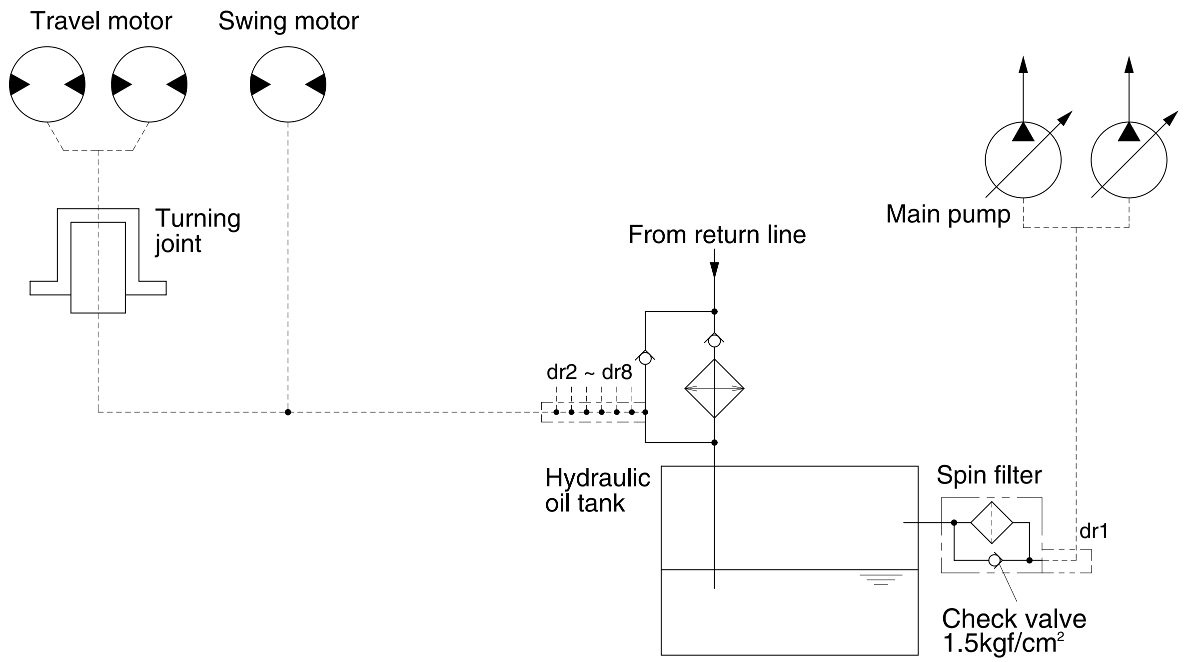
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve(1).

The full-flow filter and bypass relief valve are provided in the hydraulic tank.

The oil from right and left side of control valve is combined and filtered by the return filter. A bypass relief valve is provided in the full-flow filter.

When the filter element is clogged, the bypass relief valve opens at 1.5kgf/cm^2(21psi) differential pressure.

3. DRAIN CIRCUIT



R29073CL02

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

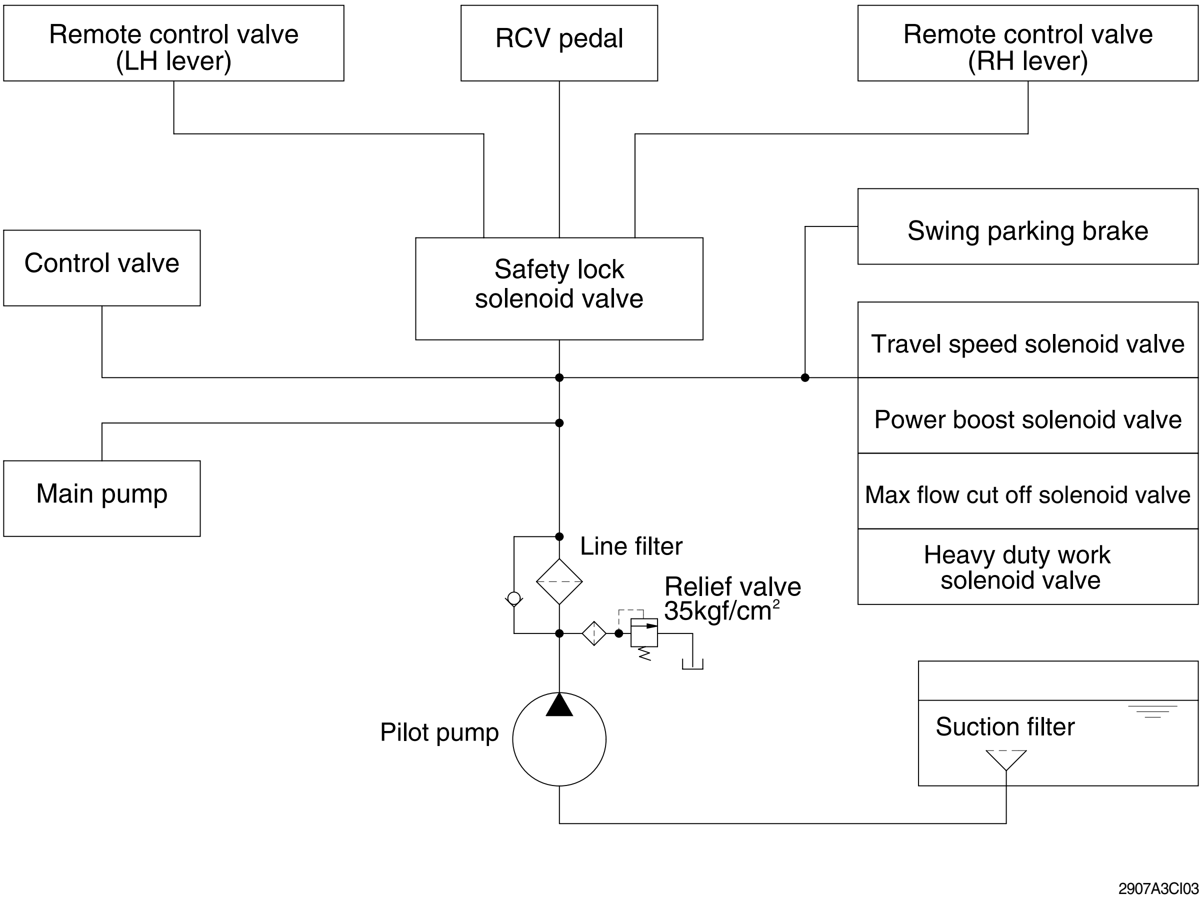
2) SWING MOTOR DRAIN CIRCUIT

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

3) MAIN PUMP DRAIN CIRCUIT

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

GROUP 3 PILOT CIRCUIT

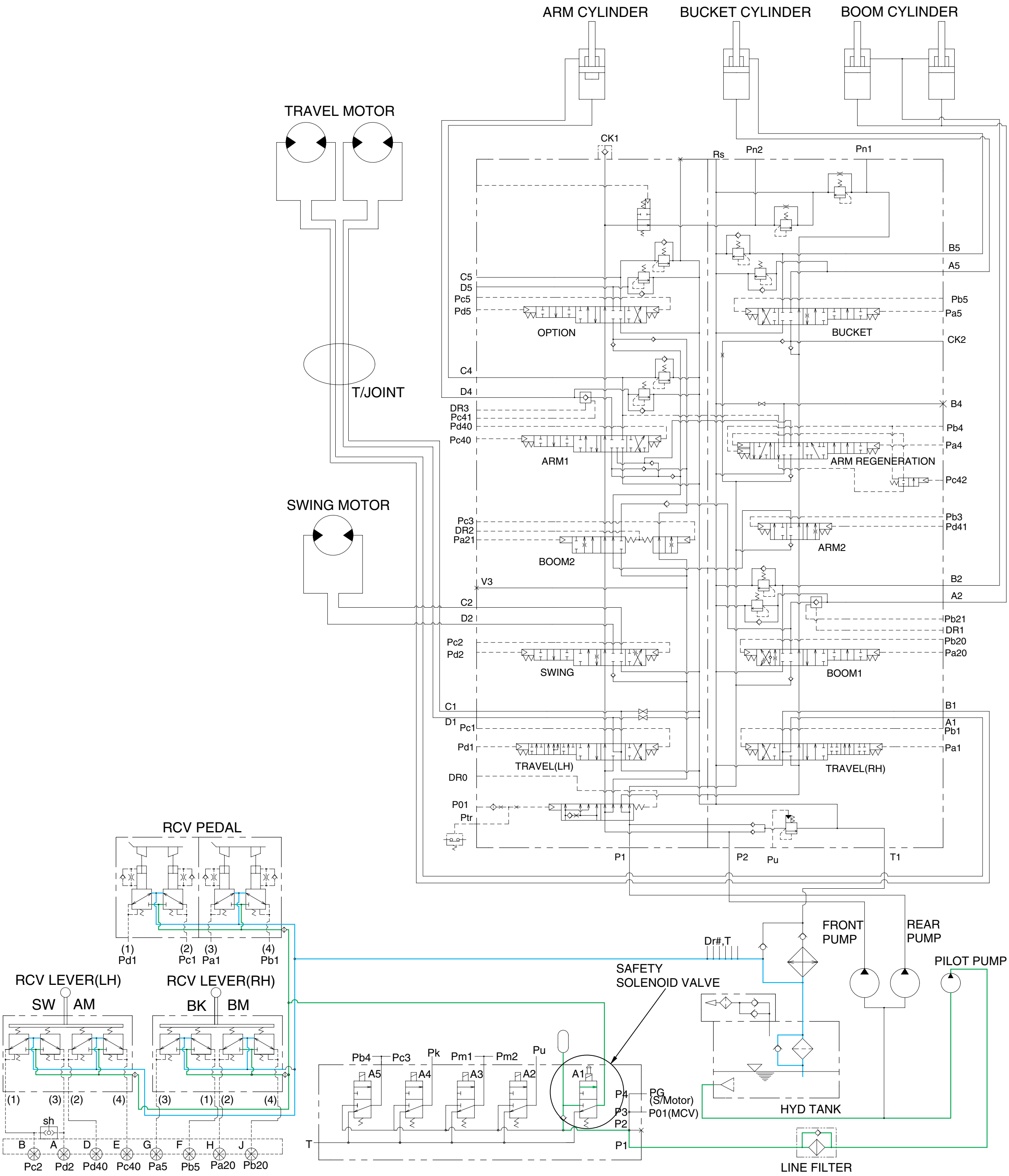


The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



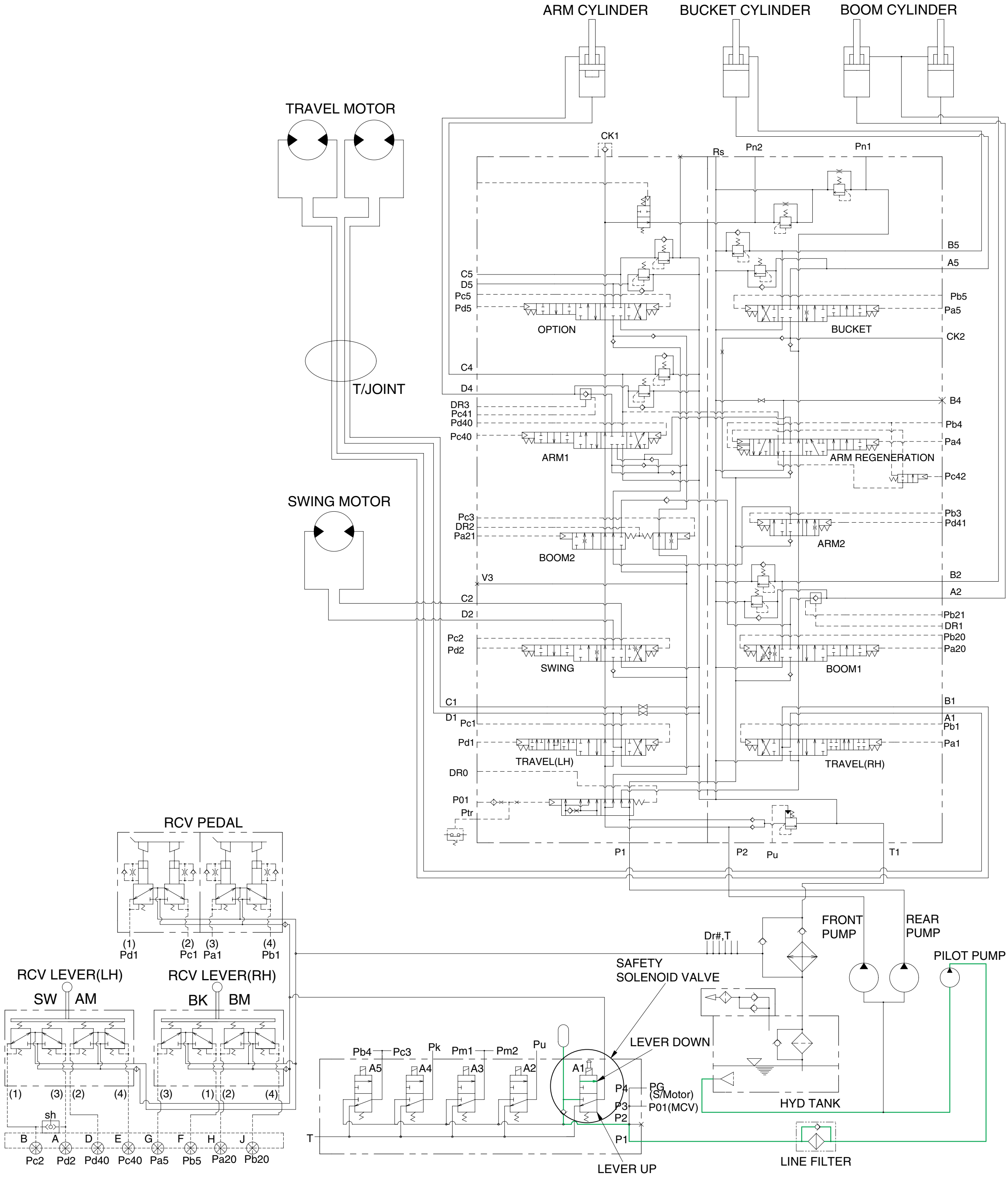
2907A3HC02

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 from remote control valve returned to hydraulic tank.

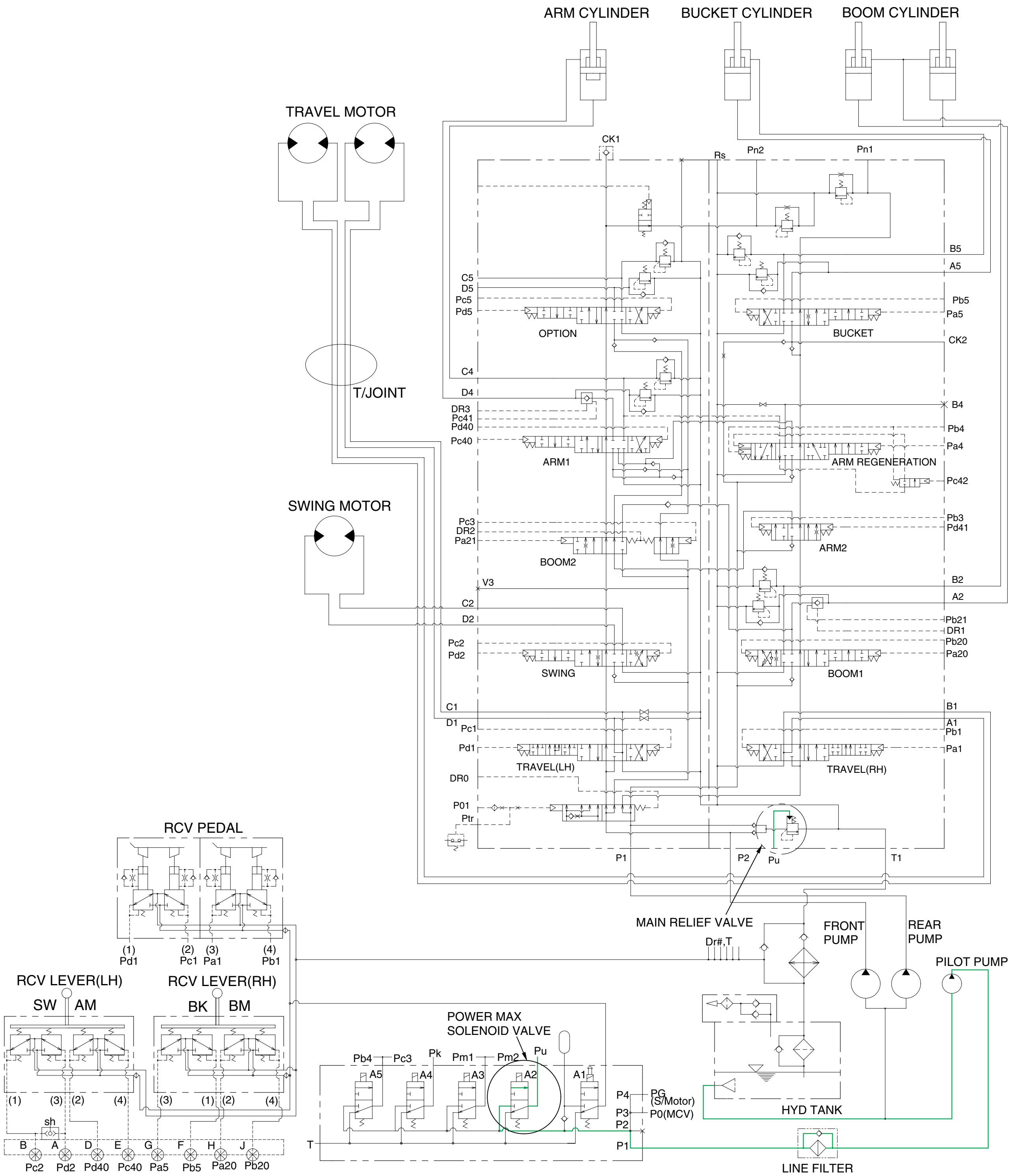
2. SAFETY SOLENOID VALVE(SAFETY LEVER)



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 moved upward, oil does not flows into the remote control valve, because of blocked by the spool.

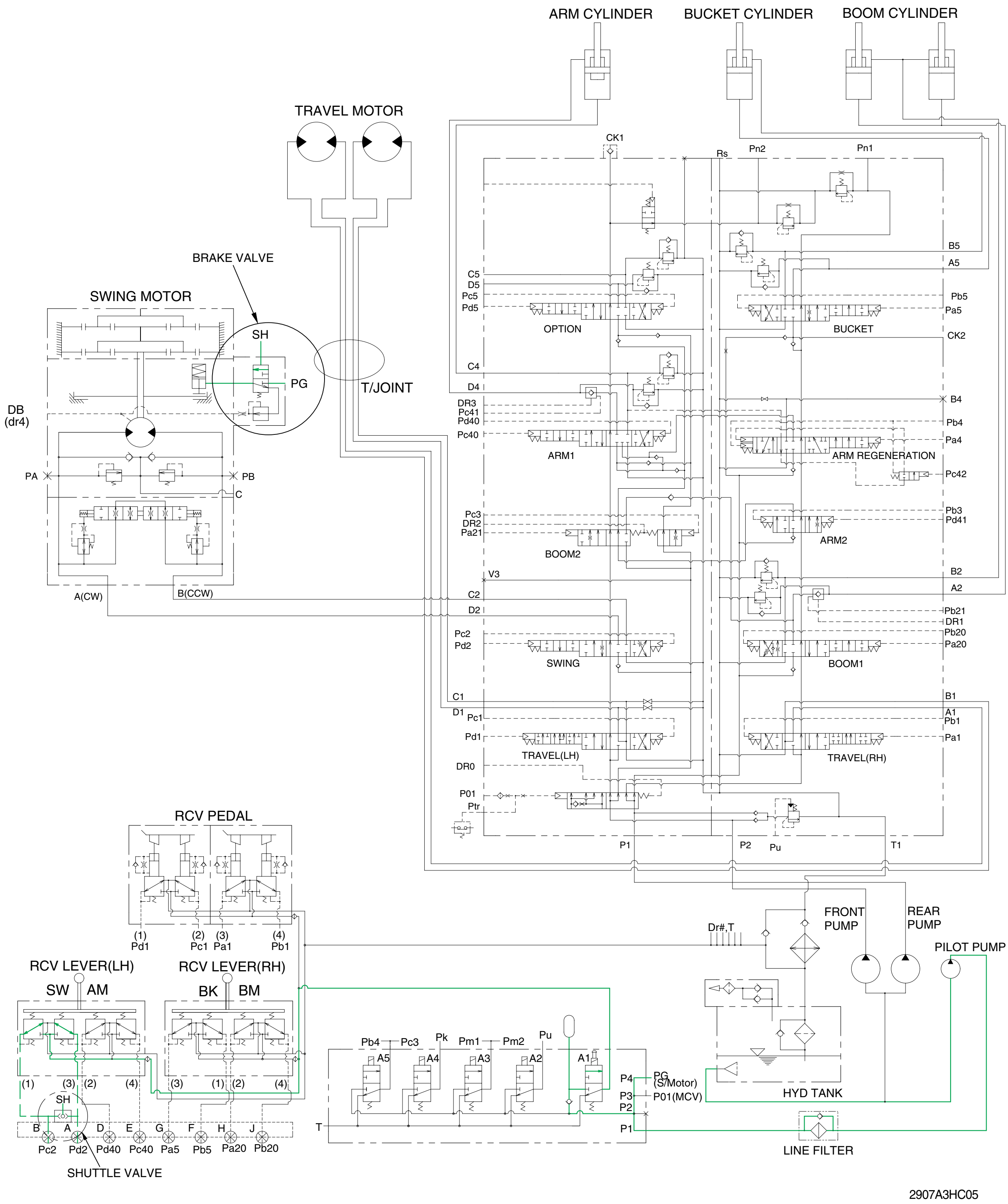
3. MAIN RELIEF PRESSURE CHANGE CIRCUIT



2907A3HC04

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

4. SWING PARKING BRAKE RELEASE

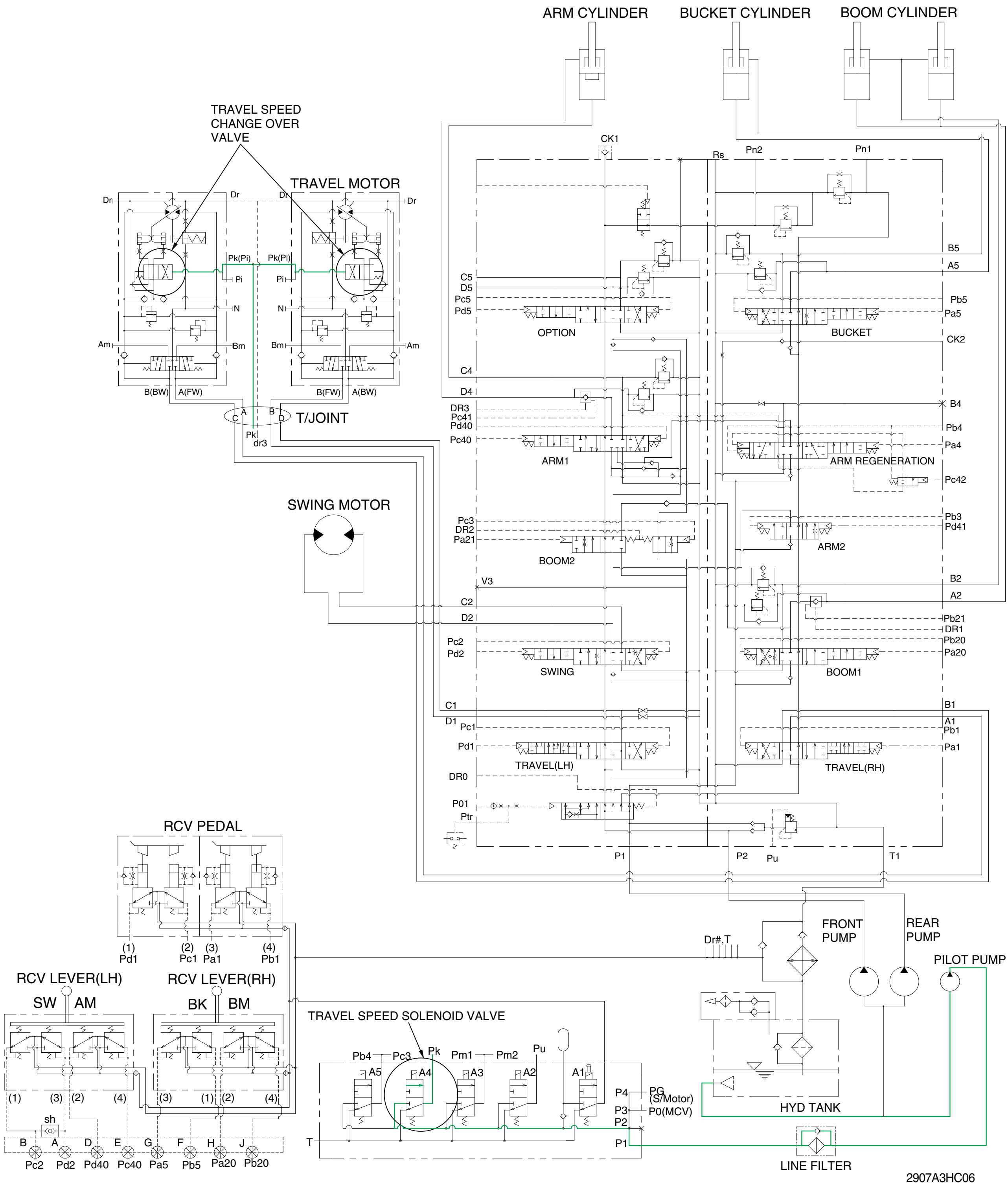


When the swing control lever is operated, the pilot oil flows to SH port of shuttle valve, this pressure move spool so, discharged oil from pilot pump flows to PG port.

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

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

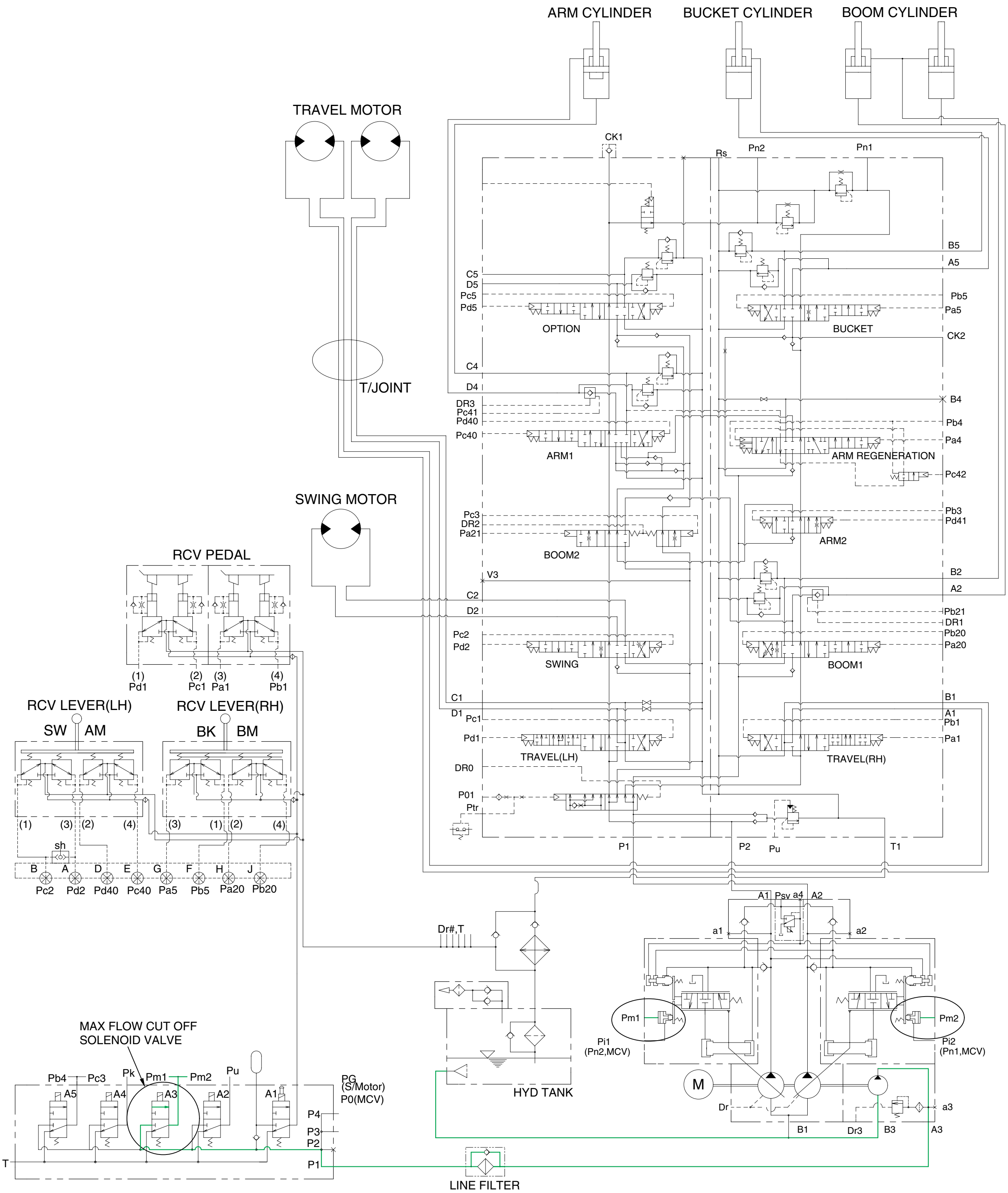
5. TRAVEL SPEED CONTROL PRESSURE



When the travel speed solenoid valve was placed in the Hi position, the pressure oil from pilot pump through line filter flows to port(Pk) of travel speed change over valve, and the control piston is pushed up, thus minimizing the displacement.

When the travel speed solenoid valve was placed in the Lo position, the oil of Pk port return to the tank and the control piston is returned, thus maximizing the displacement.

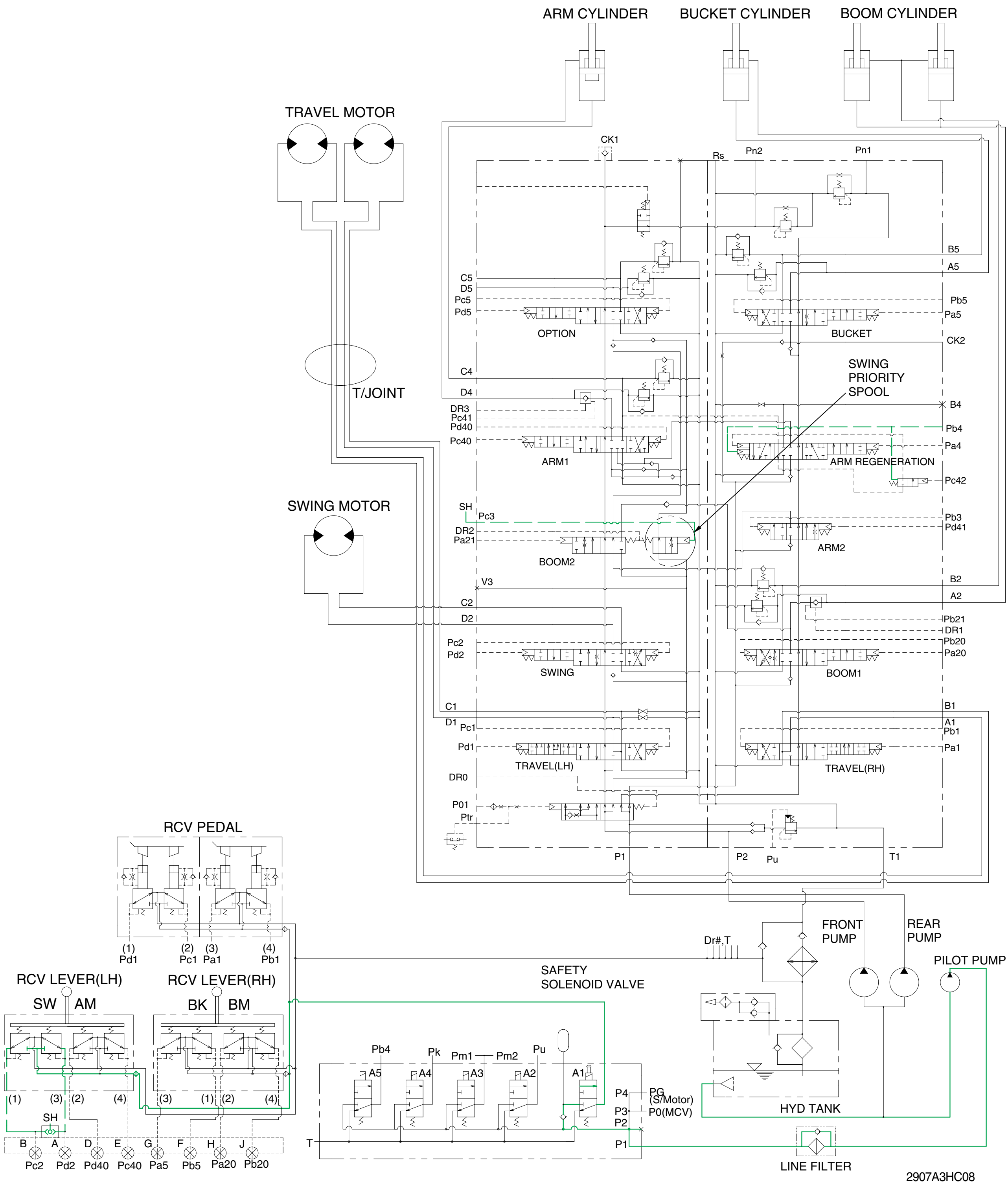
6. MAX FLOW CUT OFF SYSTEM



2907A3HC07

When the breaker operation mode is selected on the cluster, max flow cut off solenoid valve actuates automatically. Thus pilot pressure(Pm1,Pm2) is sent to the regulator and pump discharge volume is decreased.

7. SWING PRIORITY SYSTEM



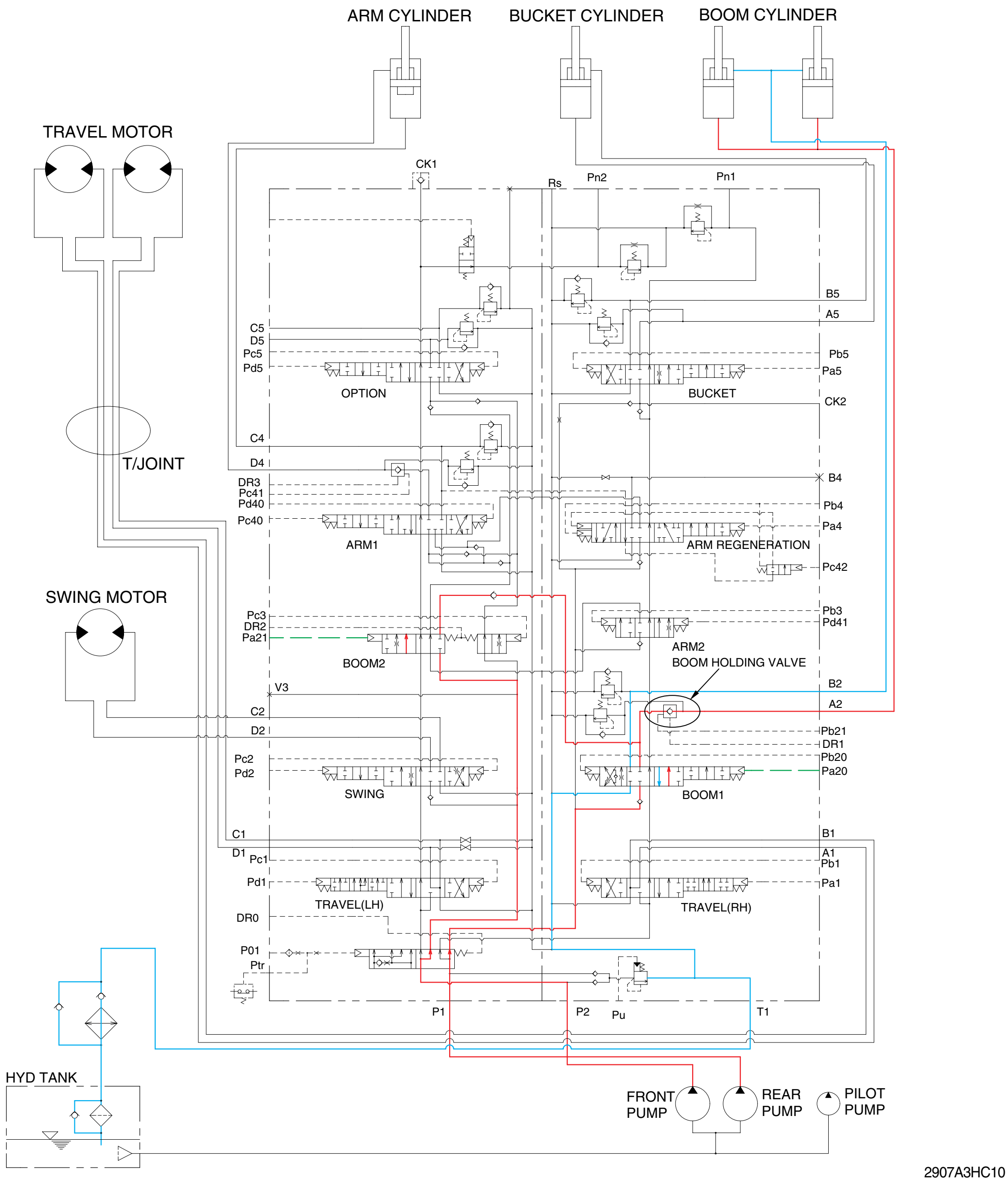
When carrying out the combined operation of swing and arm of the left control valve, the swing speed can be lowered than operating speed of arm.

Pc3 pressure from the swing shuttle port(SH) of LH control lever 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 2-36.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



2907A3HC10

When the RH 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.

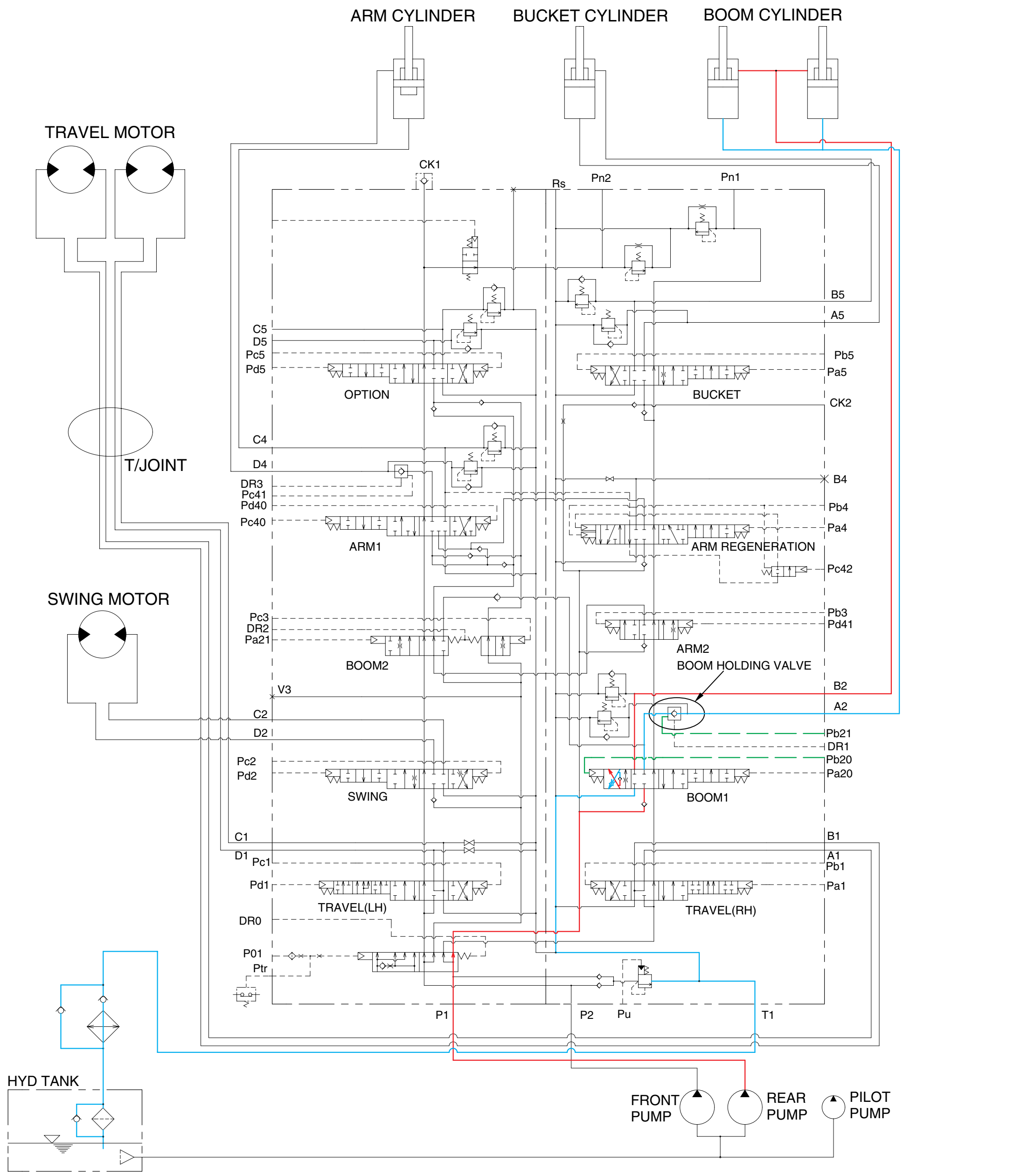
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up.

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



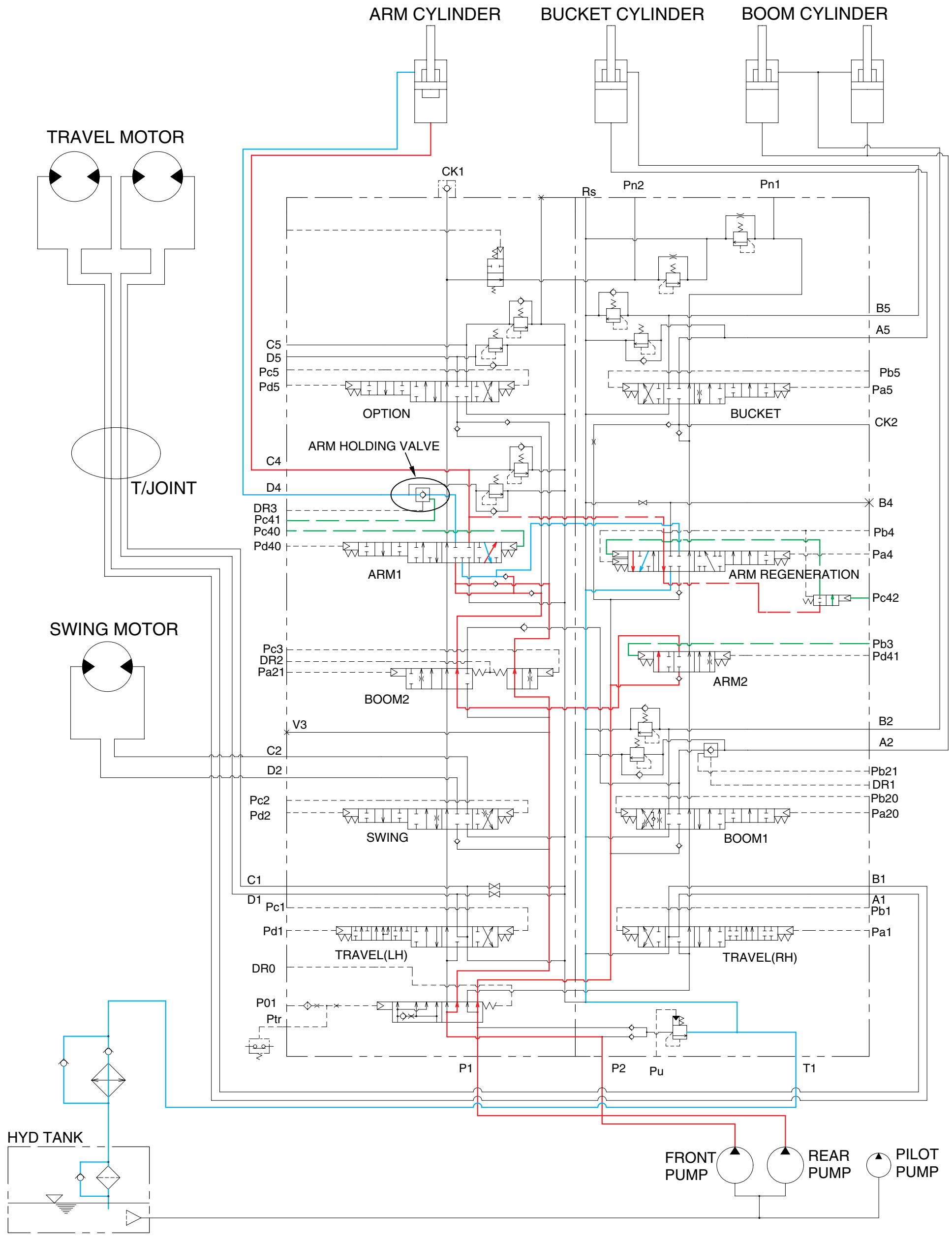
When the RH control lever is pushed forward, the boom spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

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 boom 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



2907A3HC12

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

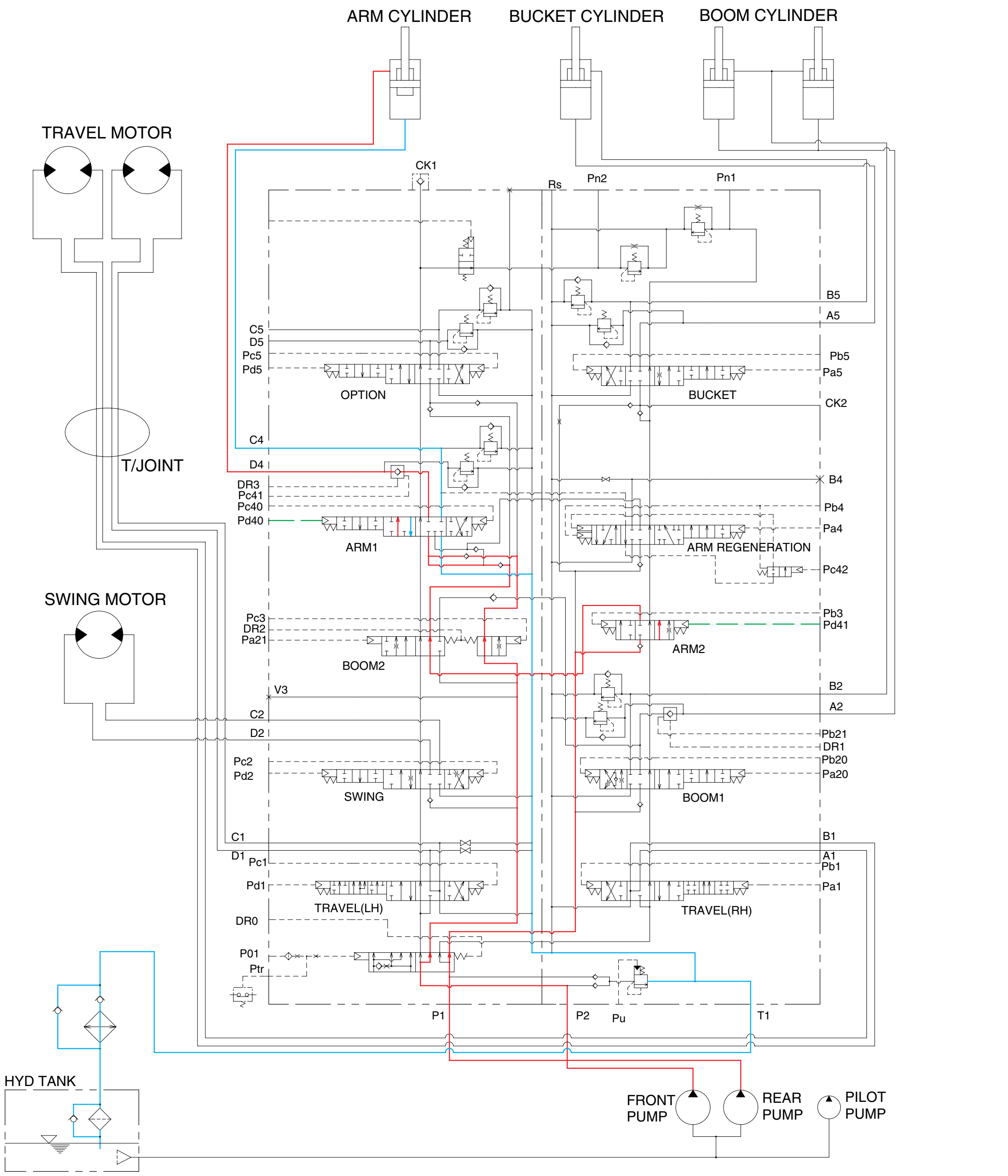
The oil from the front and rear pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from the 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 roll in.

When the roll in speed of arm is faster, the oil returned from the small chamber of arm cylinder combines with the oil from both pump, and flows into the large chamber of the arm cylinder by a make up valve.

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

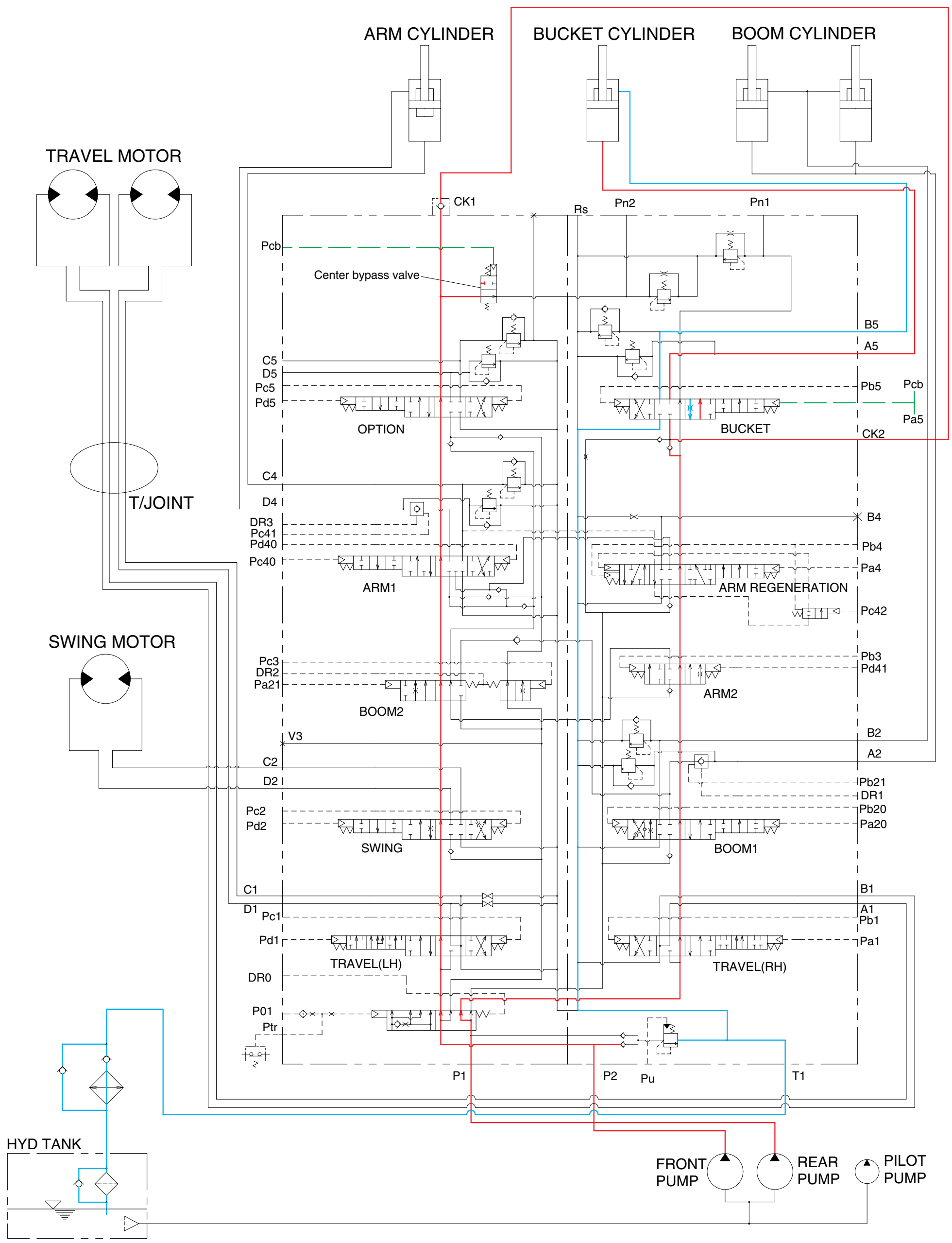
4. ARM ROLL OUT OPERATION



2907A3HC13

When the LH control lever is pushed forward, the arm spools 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 roll out. When the roll out speed of arm is faster, the oil returned from the large chamber of arm cylinder combines with the oil from both pump, and flows into the small chamber of the arm cylinder by a make up valve.
The excessive pressure in the arm cylinder rod end circuit is prevented by relief valve.
When the arm is rolled out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod end of the arm cylinder is closed by the arm holding valve.
This prevents the hydraulic drift of arm cylinder.

5. BUCKET ROLL IN OPERATION



2907A3HC14

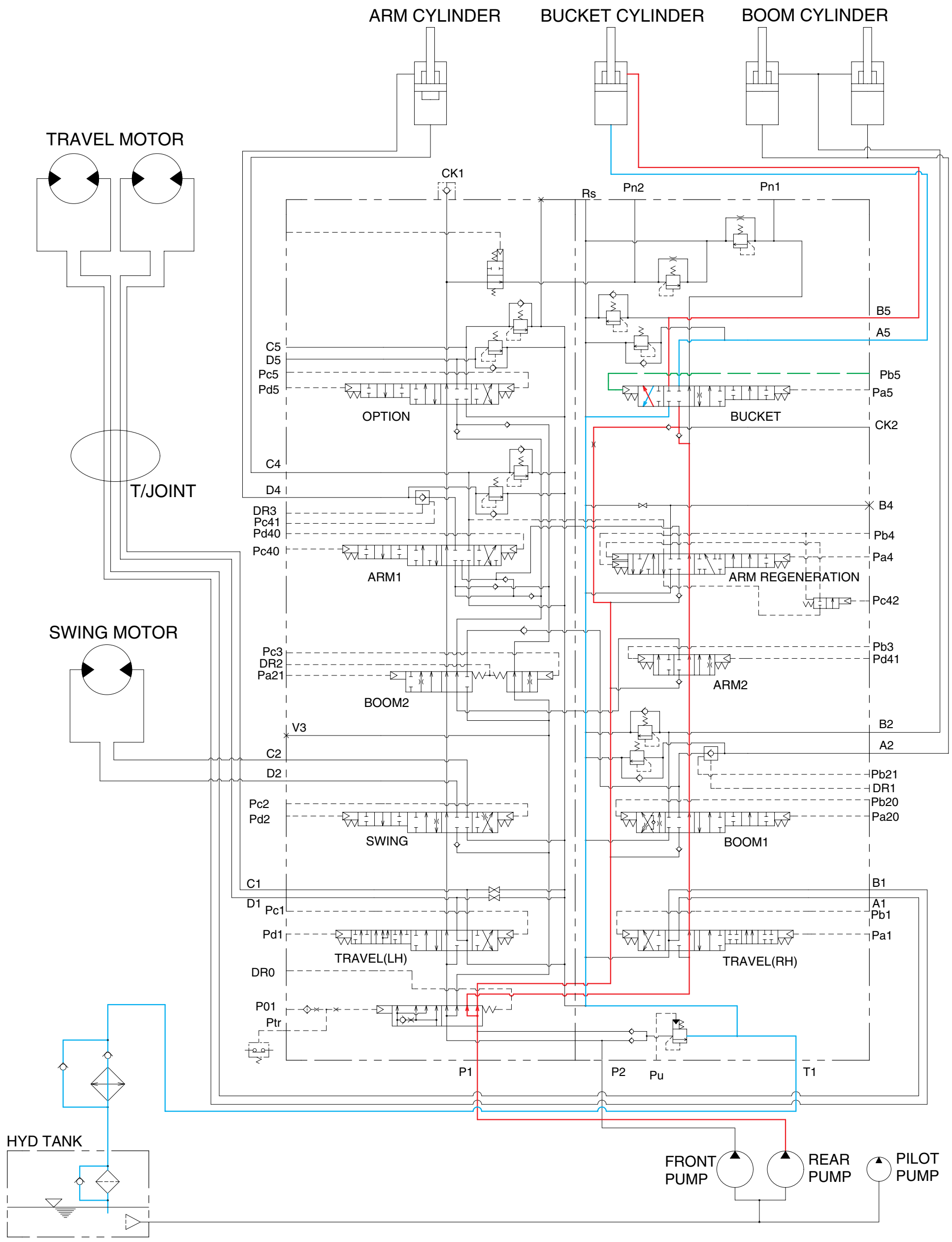
When the RH control lever is manually placed in the bucket roll in position. Then the oil flows from pilot pump through the pilot valve to bucket section of the main control valve. Here the spool position is moved to bucket roll in position.

The center bypass valve is change over by the pilot pressure(Pcb) and then the oil from front pump is joint to the flow of rear pump via check 1 and external piping.

The oil flows from both pump through rod end of the cylinder through the bucket section returned to the hydraulic tank.

The cavitation which will happen to the bottom of the bucket cylinder is prevented by a make up valve, on other hand. The excessive pressure is also prevented by an overload relief valve in the main control valve.

6. BUCKET ROLL OUT OPERATION



2907A3HC15

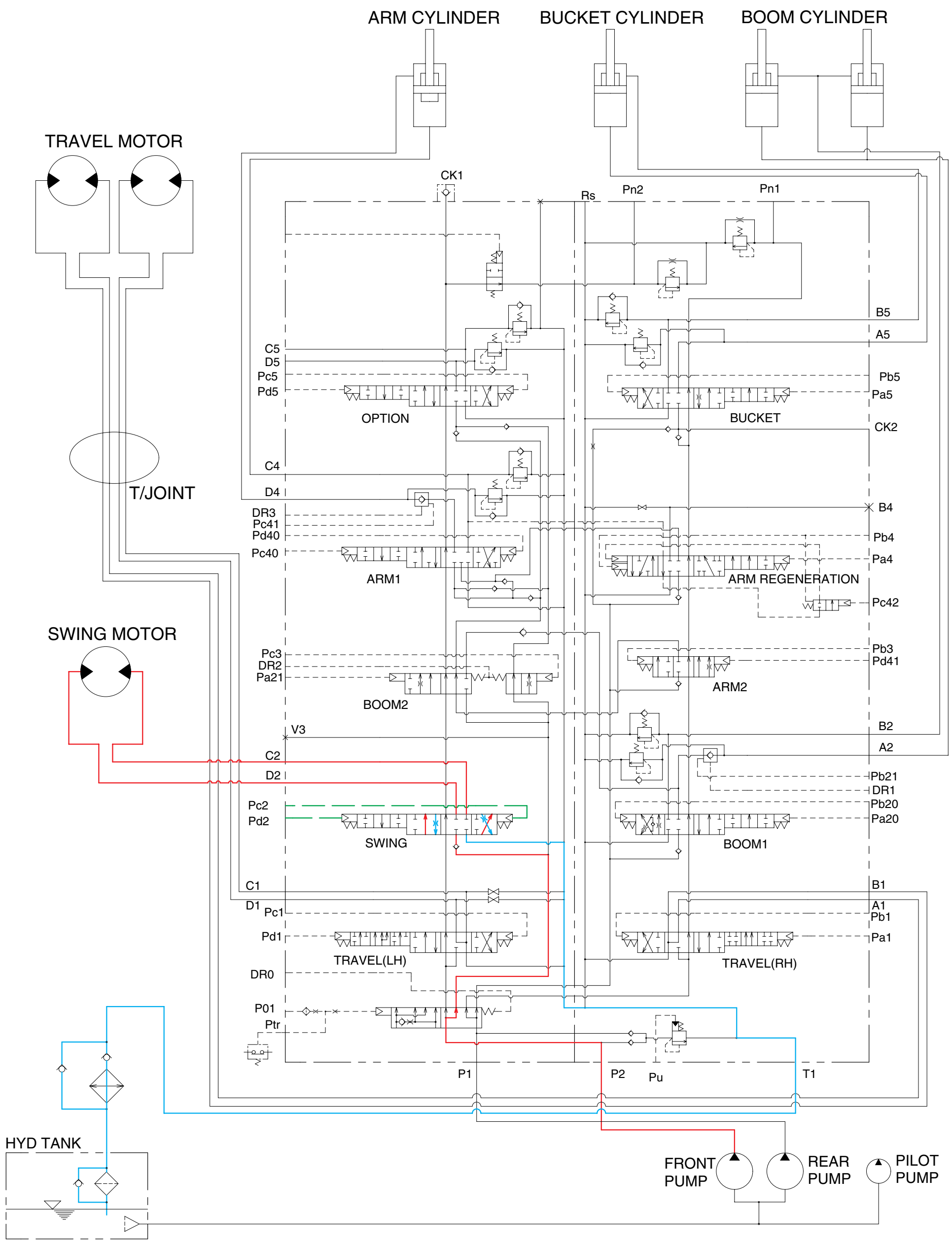
When the RH control lever is manually placed in the bucket roll out position. Then the oil flows from pilot pump through the pilot valve to bucket section of the main control valve. Here the spool position is moved to bucket roll out position.

The oil flows from rear pump through bucket section of main control valve to the rod end of the bucket cylinder, and to roll out bucket.

The return oil flows from the bottom end of the cylinder through the bucket section returned to the hydraulic tank.

The cavitation which will happen to the rod of the bucket cylinder is prevented by a make up valve, on other hand. The excessive pressure is also prevented by an overload relief valve in the main control valve.

7. SWING OPERATION



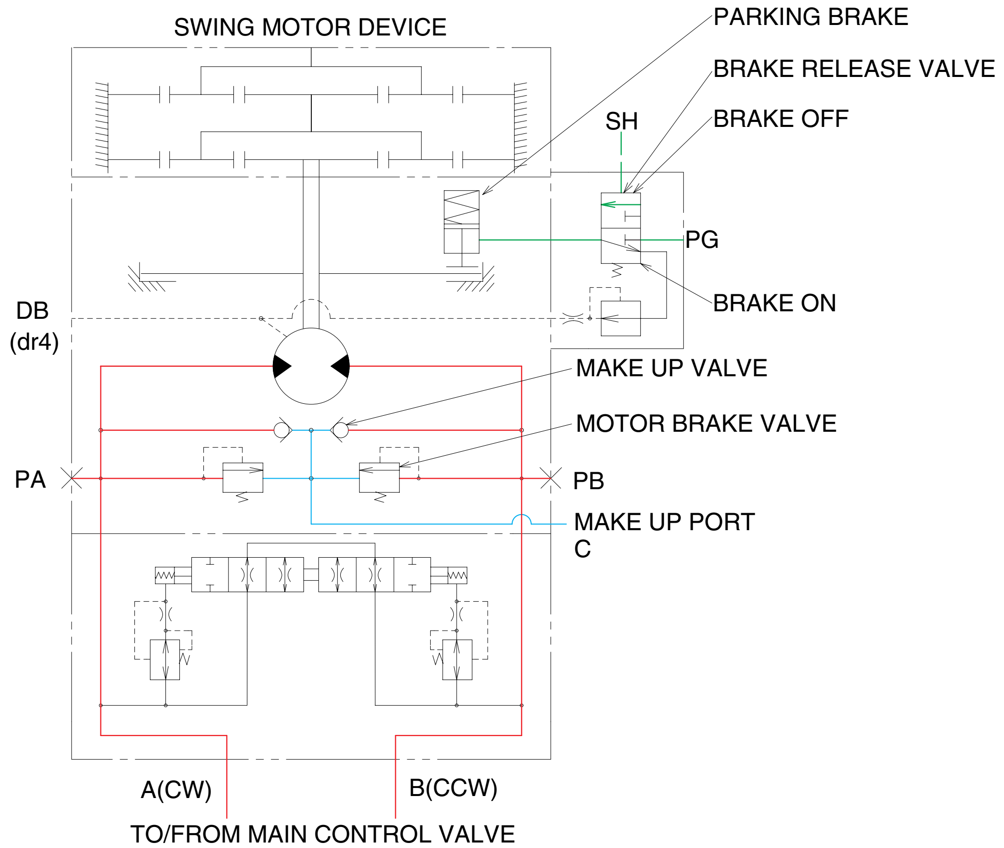
2907A3HC16

When the LH control lever is manually placed in the left(Right) swing position. Then the oil flows from front pump through the swing section of the main control valve to swing motor to left(Right) swing the superstructure. The return oil flows from swing motor through the swing section of the main control valve returned to the tank.

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". The swing parking brake, make up valve and the overload relief valve are provide in the swing motors. The cavitation which will happen to the swing motor is prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



2907A3HC17

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.

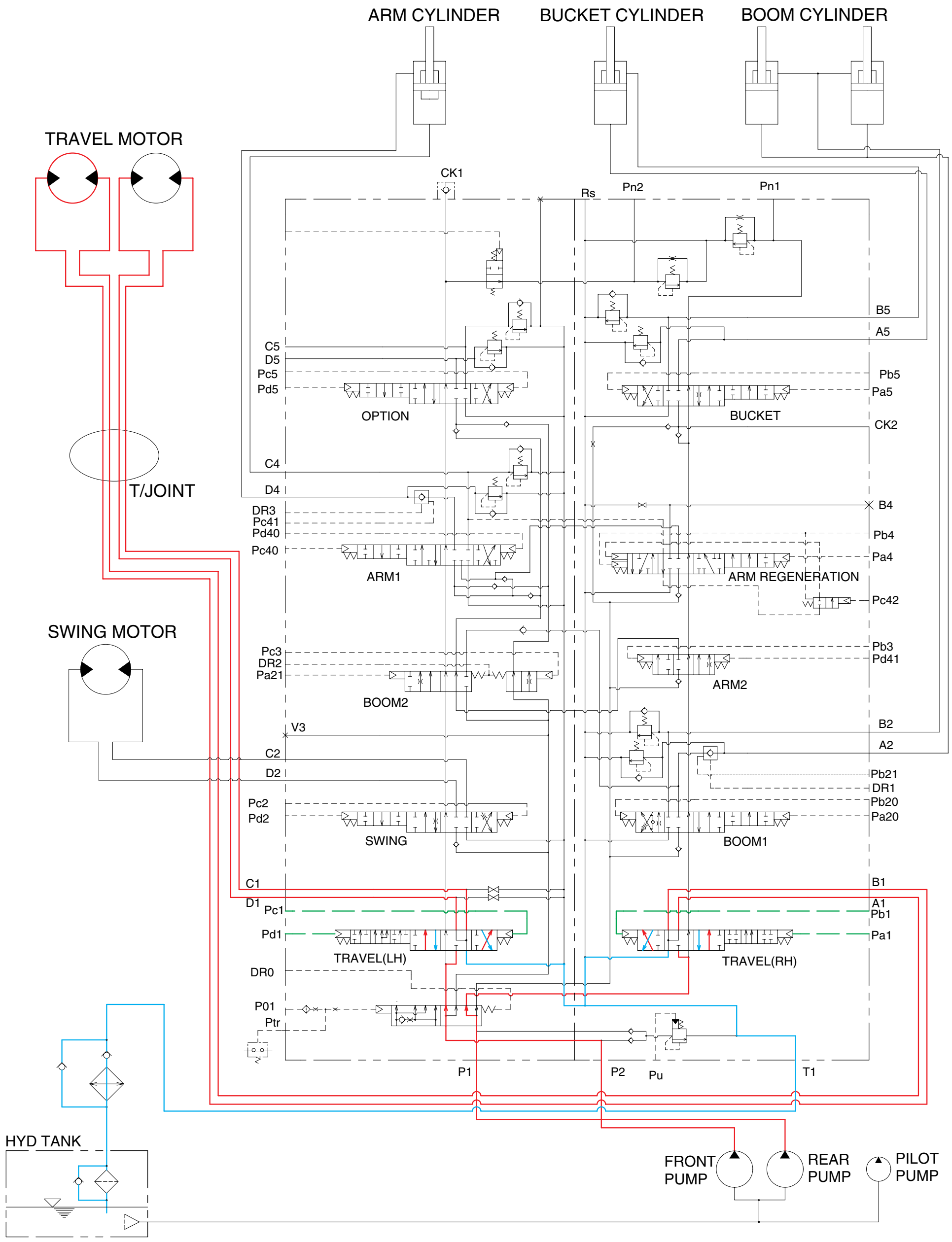
PARKING BRAKE "ON" OPERATION

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



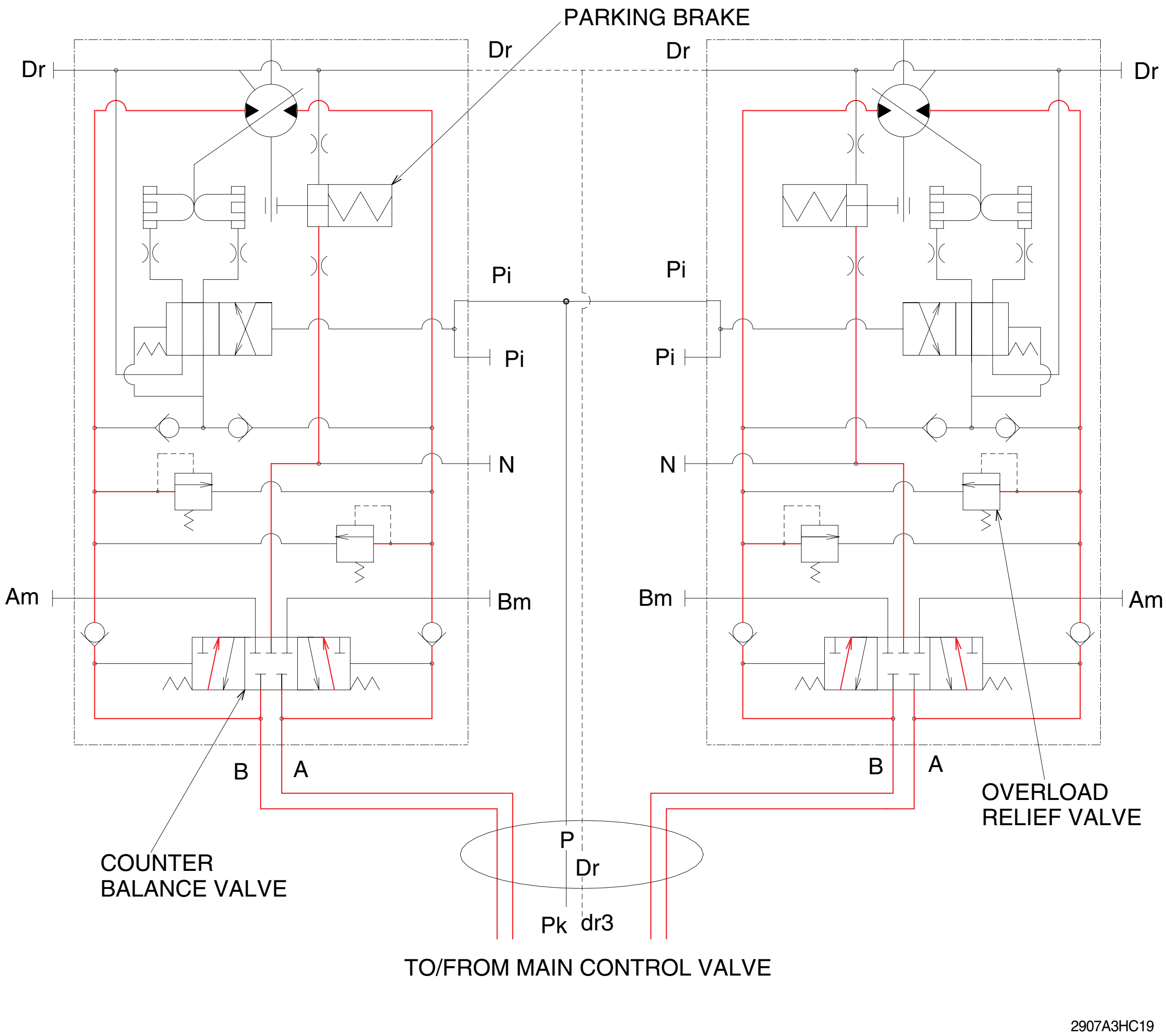
2907A3HC18

When the right and left travel levers are manually placed to the forward or reverse position, the oil flows from pilot pump through the pilot valve to travel sections of the main control valve.

Here, spool position is moved to forward and reverse position. The oil flows from rear pump through the travel(RH) section of the main control valve and turning joint to the right travel motor and oil flows from front pump through the travel(LH) section of the main control valve and turning joint to the left travel motor and move the machine forward or reverse.

The return oil flows from both travel motor through the turning joint and travel(RH, LH) sections returned to the tank.

TRAVEL CIRCUIT OPERATION



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

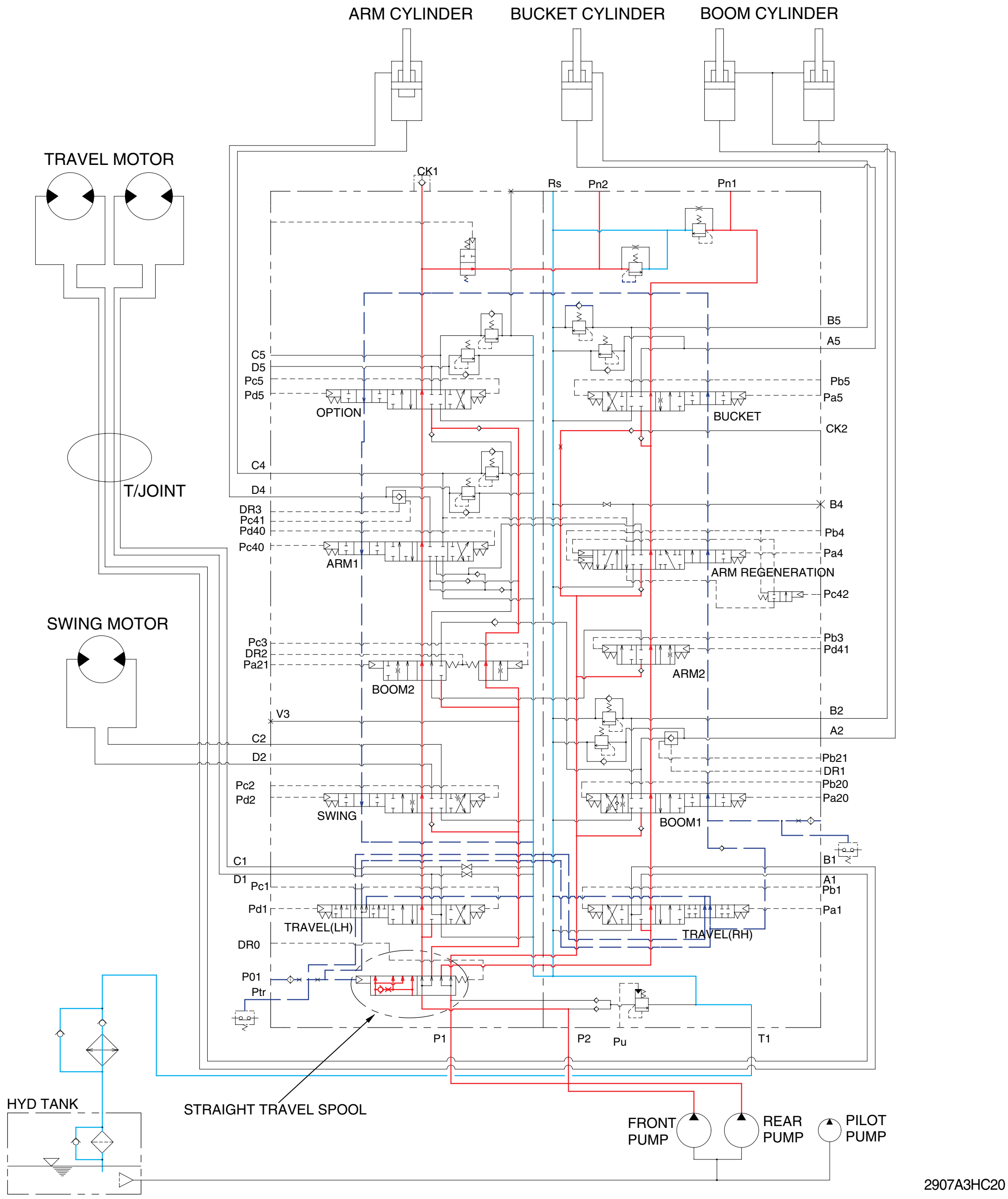
1) COUNTER BALANCE VALVE

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 a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

1. OUTLINE



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.

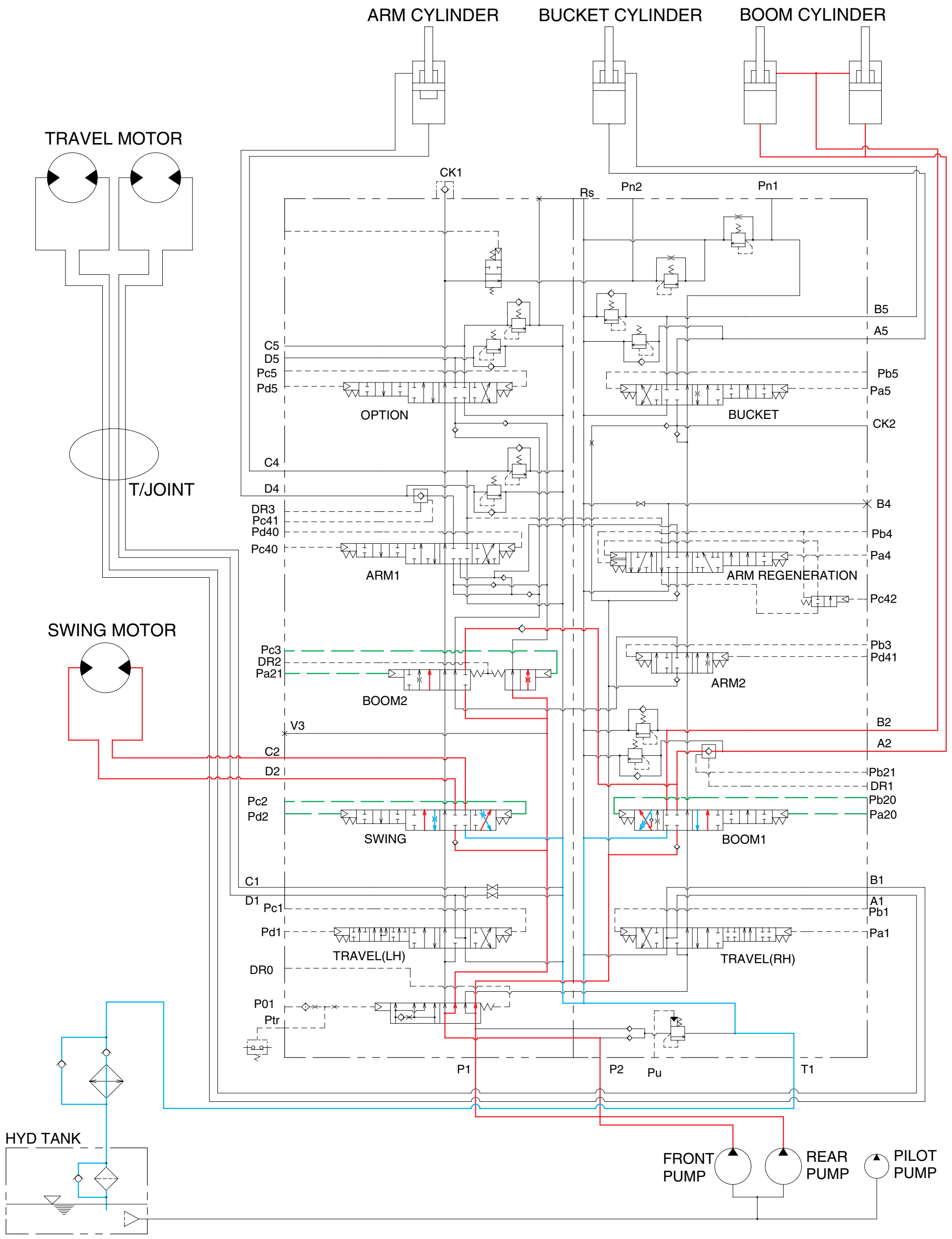
STRAIGHT TRAVEL SPOOL

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

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

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



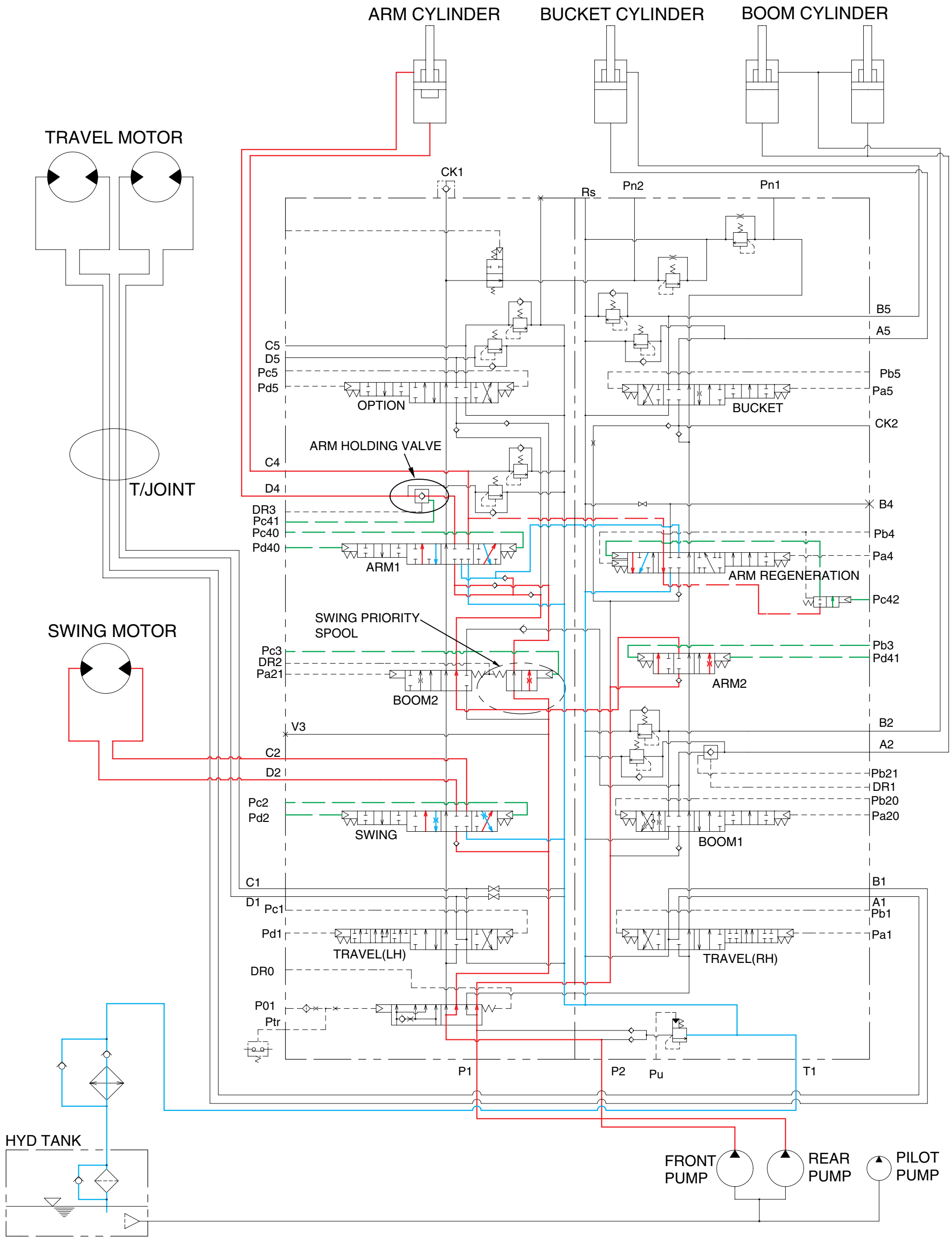
2907A3HC21

When the swing and boom functions are operated, simultaneously the swing spool and boom spools changed. The oil flows from the rear pump through boom1 section of the main control valve to boom cylinders and the boom functions.

The oil flows from front pump through swing section to swing motor.

At the same time, the pressure in the boom circuits can be high while the swing pressure is low, therefore the oil flows from front pump to boom cylinders through boom2 section via confluence passage in case boom raise operation.

3. COMBINED SWING AND ARM OPERATION



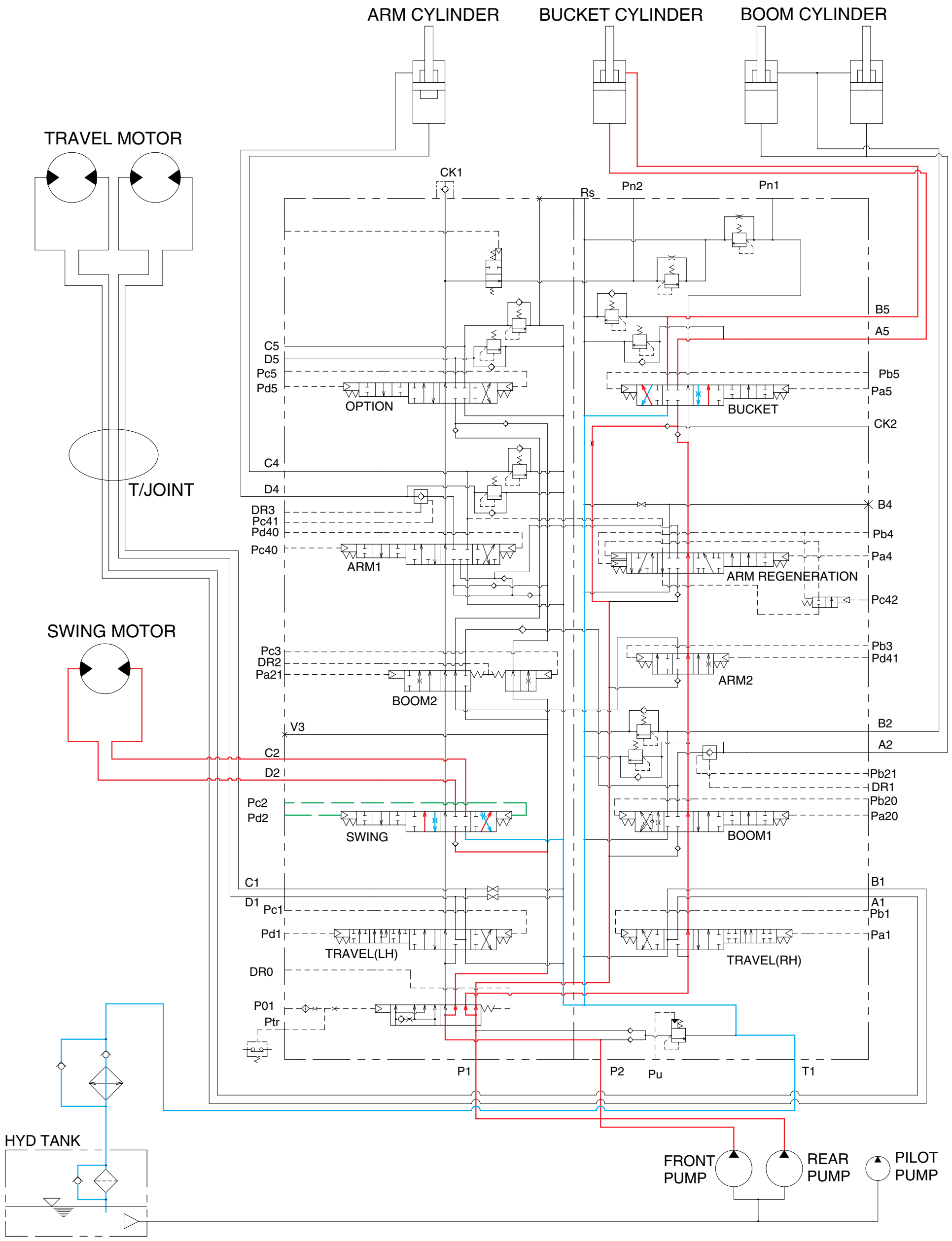
2907A3HC22

When the swing and arm functions are operated, simultaneously the swing spool and arm spools changed. The oil flows from the front pump through arm1 and swing section of the main control valve to arm cylinder and swing motor, and the arm and swing functions.

At the same time, the pressure in the arm circuit can be high while the swing pressure is low, therefore the oil flows from front pump to arm cylinder is reduced by swing priority spool.

Refer to page 3-12 for swing priority function.

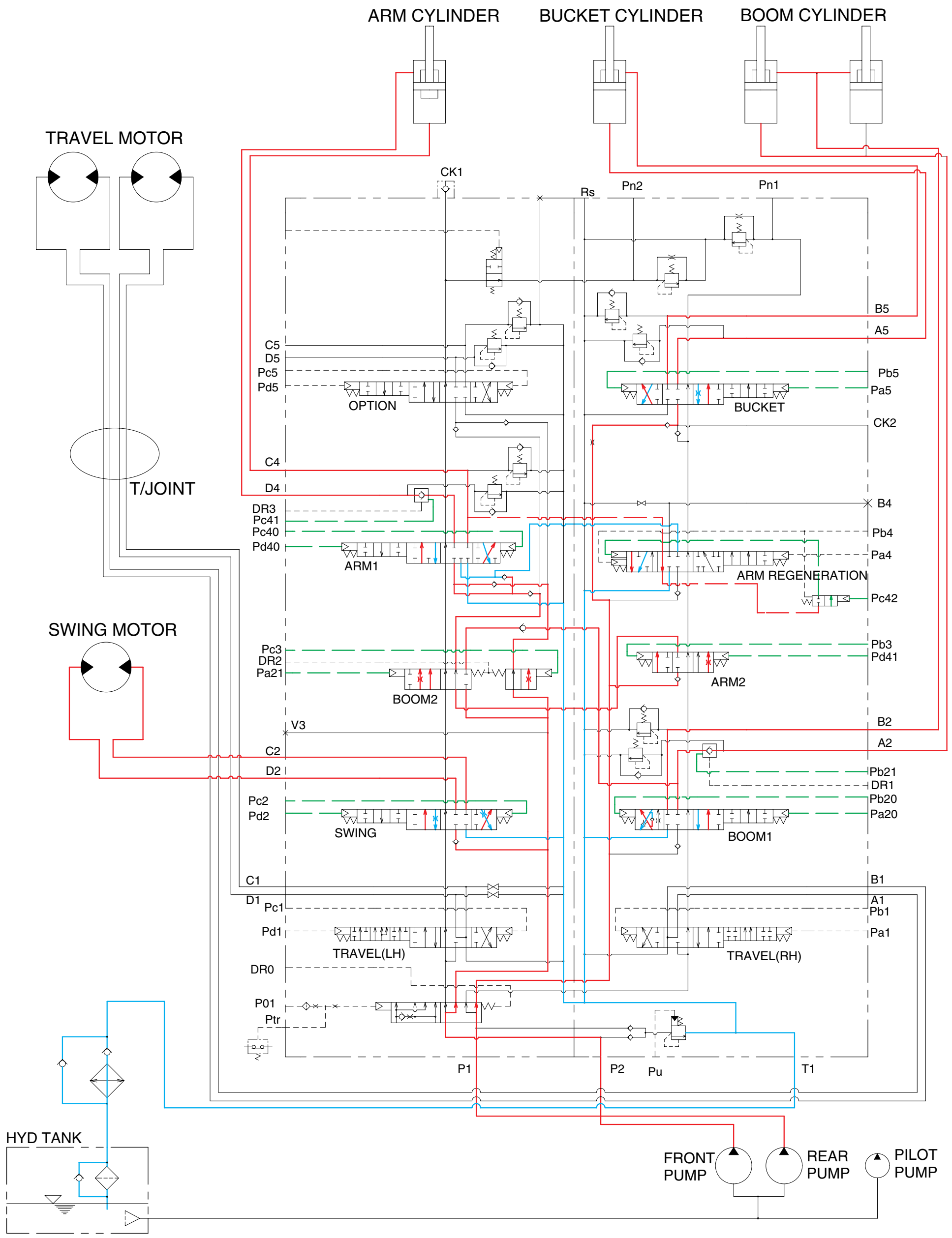
4. COMBINED SWING AND BUCKET OPERATION



2907A3HC23

When the swing and bucket functions are operated, the swing and bucket spools changed. The oil flows from the rear pump through the bucket section of the main control valve to the bucket cylinder and the bucket functions. The oil flows from front pump through swing section of the main control valve to the swing motor and swing the superstructure.

5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



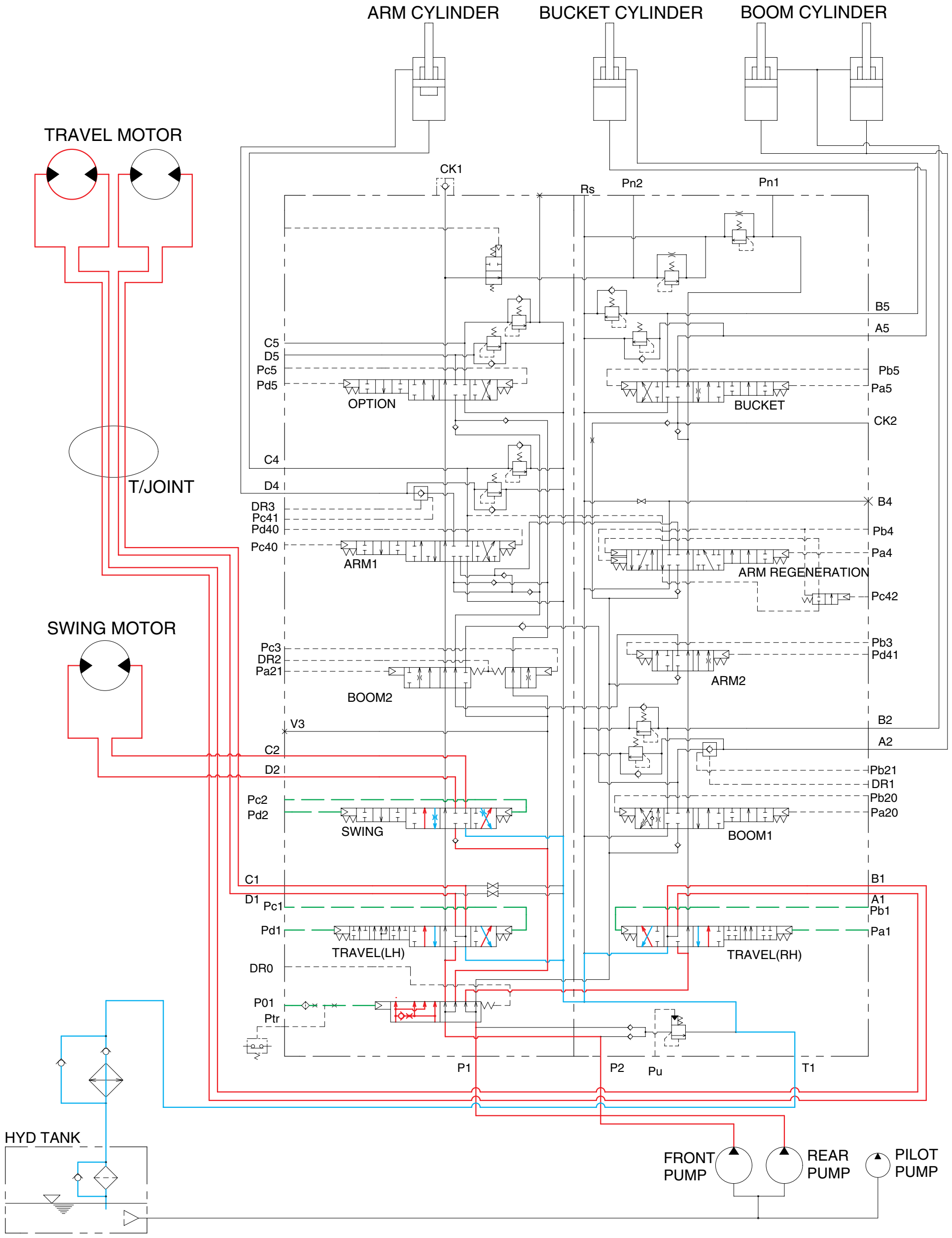
2907A3HC24

When the swing, boom, arm and bucket functions are operated, the each spools of the main control valve changed.

The oil flows from rear pump through arm2, boom1 and bucket section to boom, arm and bucket cylinders. The oil flows from front pump through swing, boom2 and arm1 section to swing motor, boom and arm cylinder. Then the functions to each actuators.

According to the state of each actuators functioning, the oil flows from front and rear pump through the confluence oil passage to the each actuators.

6. COMBINED SWING AND TRAVEL OPERATION



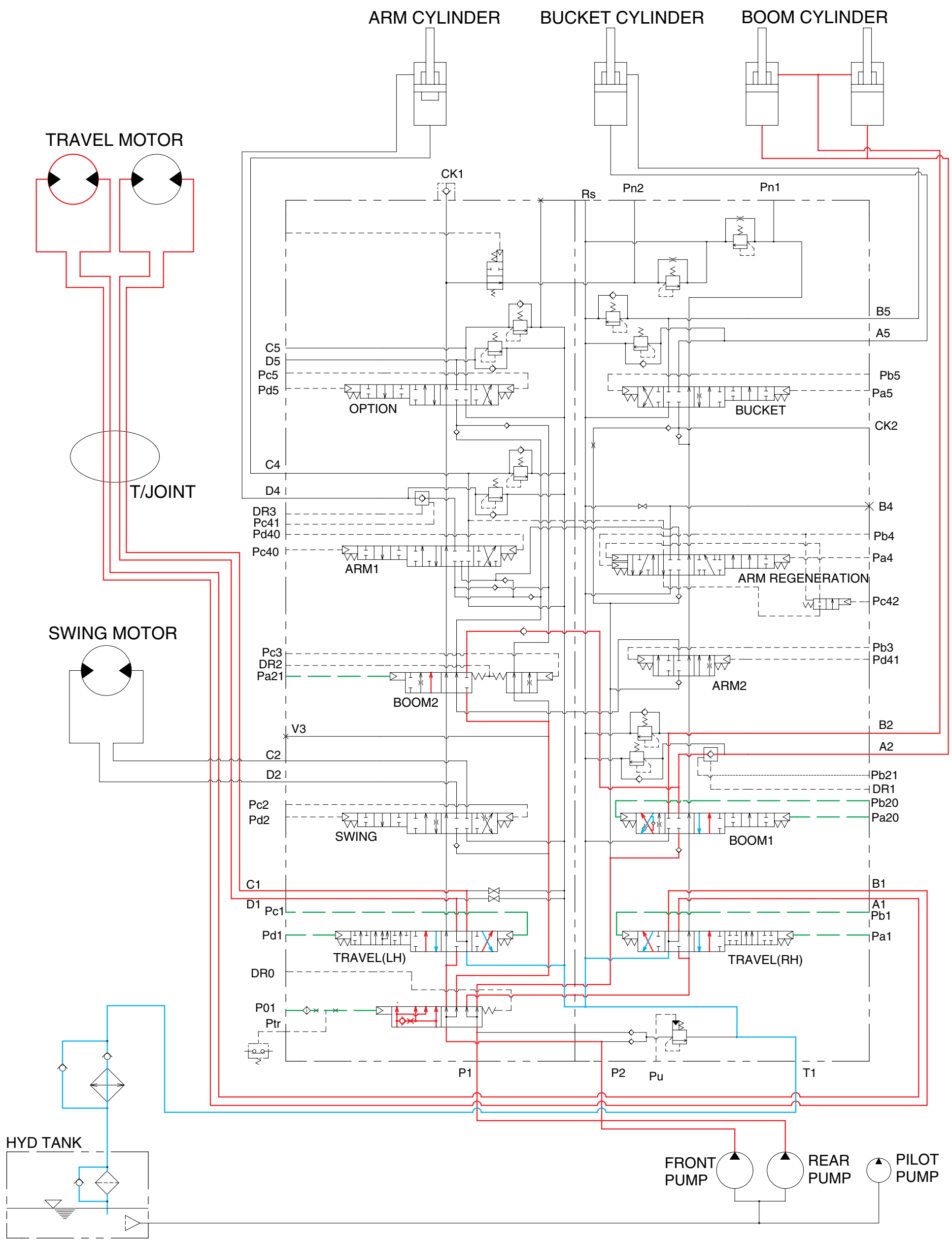
2907A3HC25

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. At the same time, the straight travel spool is pushed to the right 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

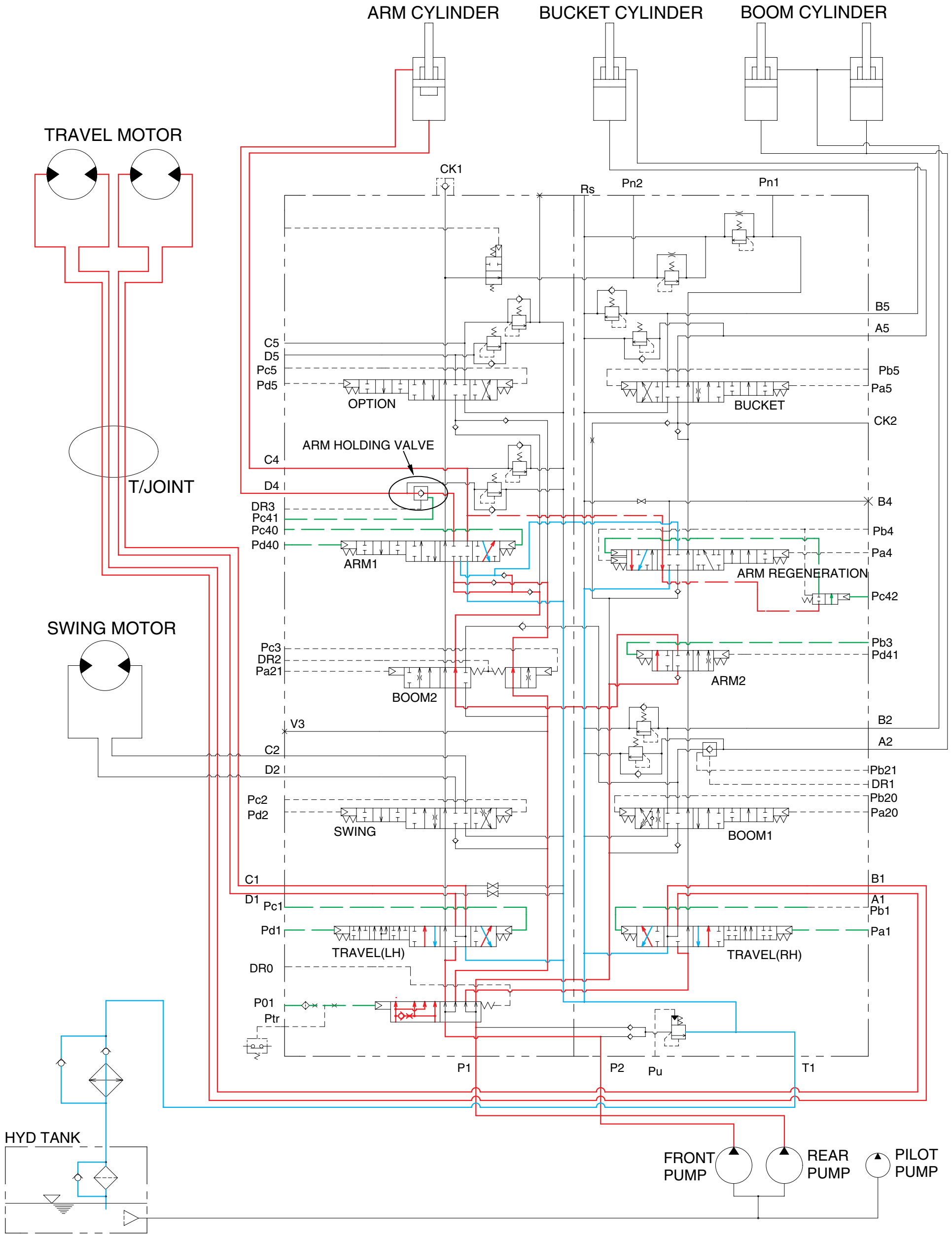


2907A3HC26

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. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure from the 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 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.

When the travel circuit pressure drops lower than boom pressure, as when traveling downhill, boom priority and smoothness are maintained because of the orifice in the straight travel spool. Thus the machine will continue to travel straight.

8. COMBINED ARM AND TRAVEL OPERATION

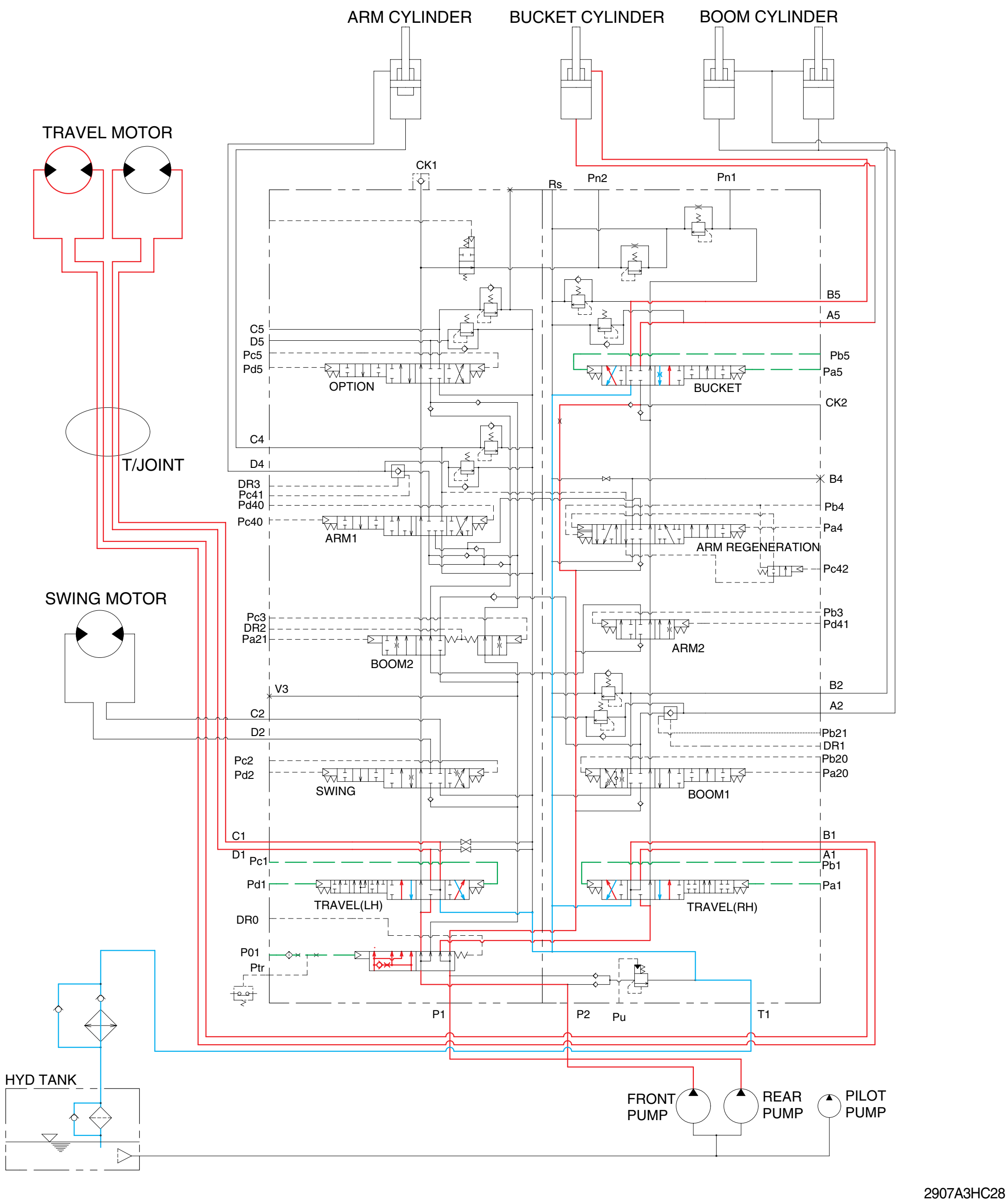


2907A3HC27

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. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure from the 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.

When the travel circuit pressure drops lower than arm pressure, as when traveling downhill, arm priority and smoothness are maintained because of the orifice. Thus the machine will continue to travel 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. At the same time, the straight travel spool is pushed to the right by the pilot oil pressure from the 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.

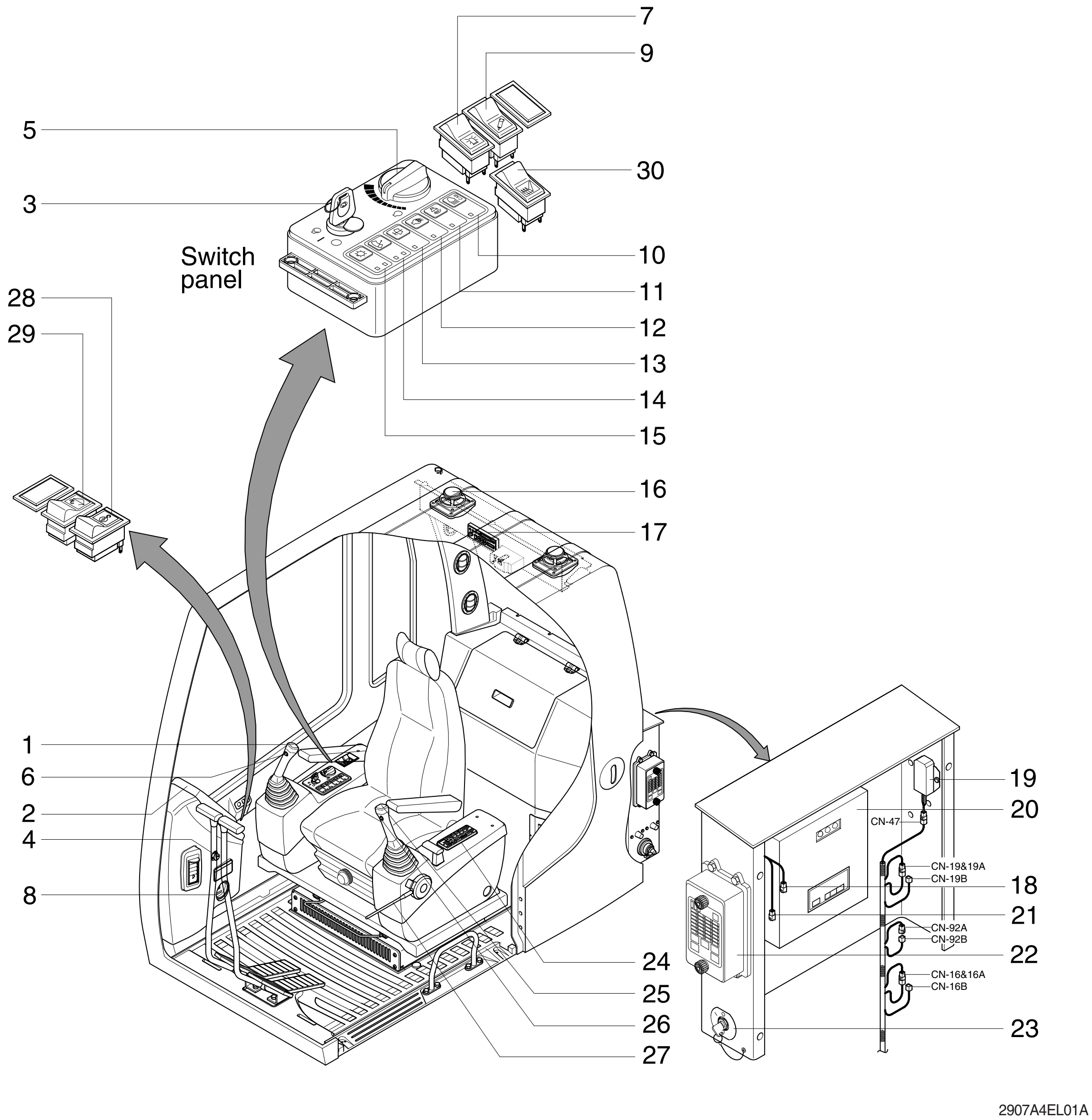
When the travel circuit pressure drops lower than bucket pressure, as when traveling downhill, bucket priority and smoothness are maintained because of the orifice.

In either case, the machine will continue to travel straight.

SECTION 4 ELECTRICAL SYSTEM

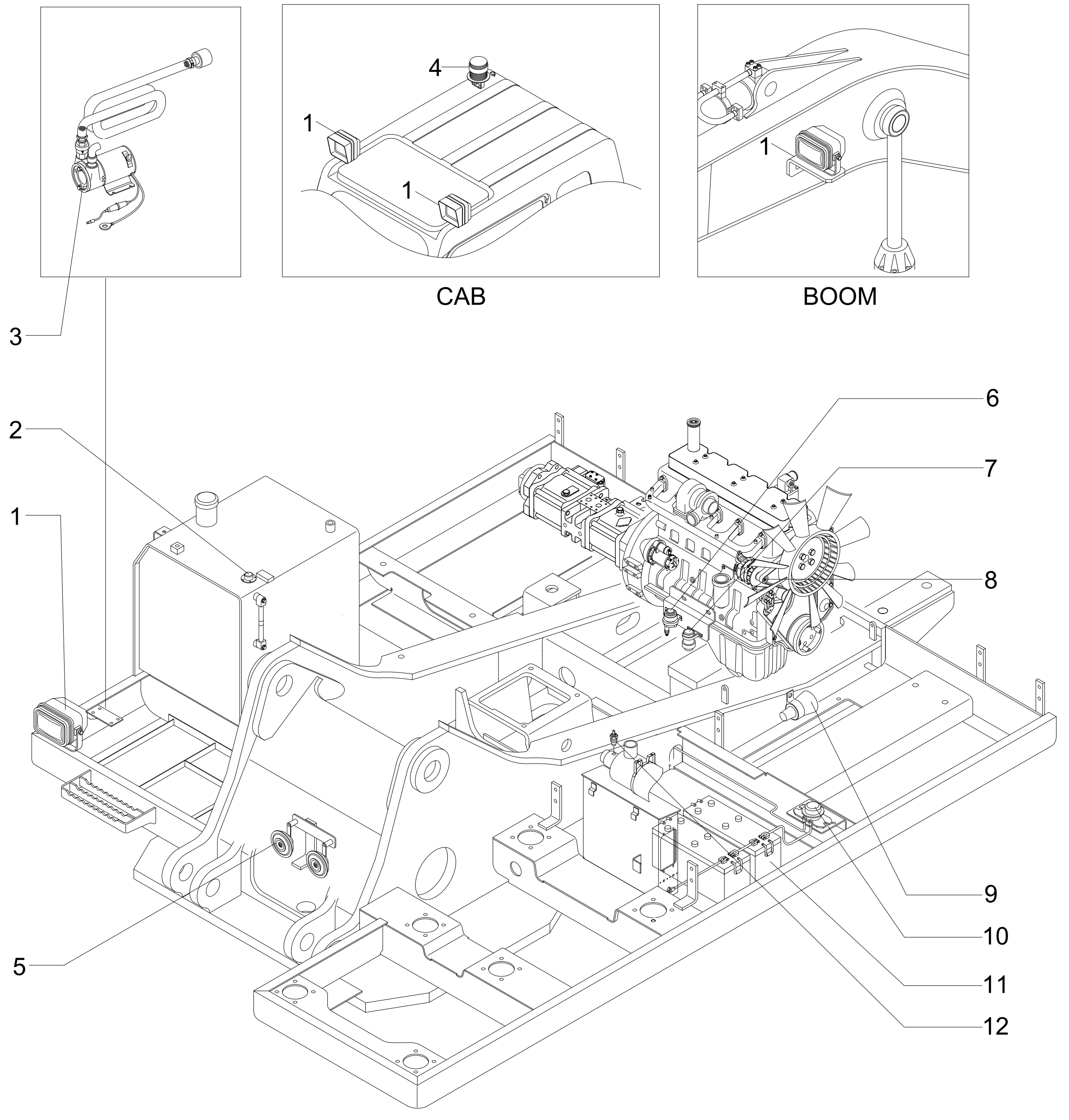
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1 Horn switch
2 Cluster
3 Starting switch
4 Cigar lighter
5 Accel dial
6 Breaker switch
7 Beacon switch
8 Service meter
9 Breaker selection switch
10 Cab light switch
11 Travel alarm stop switch
12 Preheat switch
13 Washer switch
14 Wiper switch
15 Main light switch
16 Speaker
17 Cassette & radio
18 RS232 serial connector
19 Prolix resistor
20 CPU controller
21 J1939 serial connector
22 Fuse box
23 Master switch
24 Air con & heater switch panel
25 One touch decel switch
26 Power max switch
27 Safety lever
28 Overload switch
29 Quick coupler switch
30 Heated seat switch

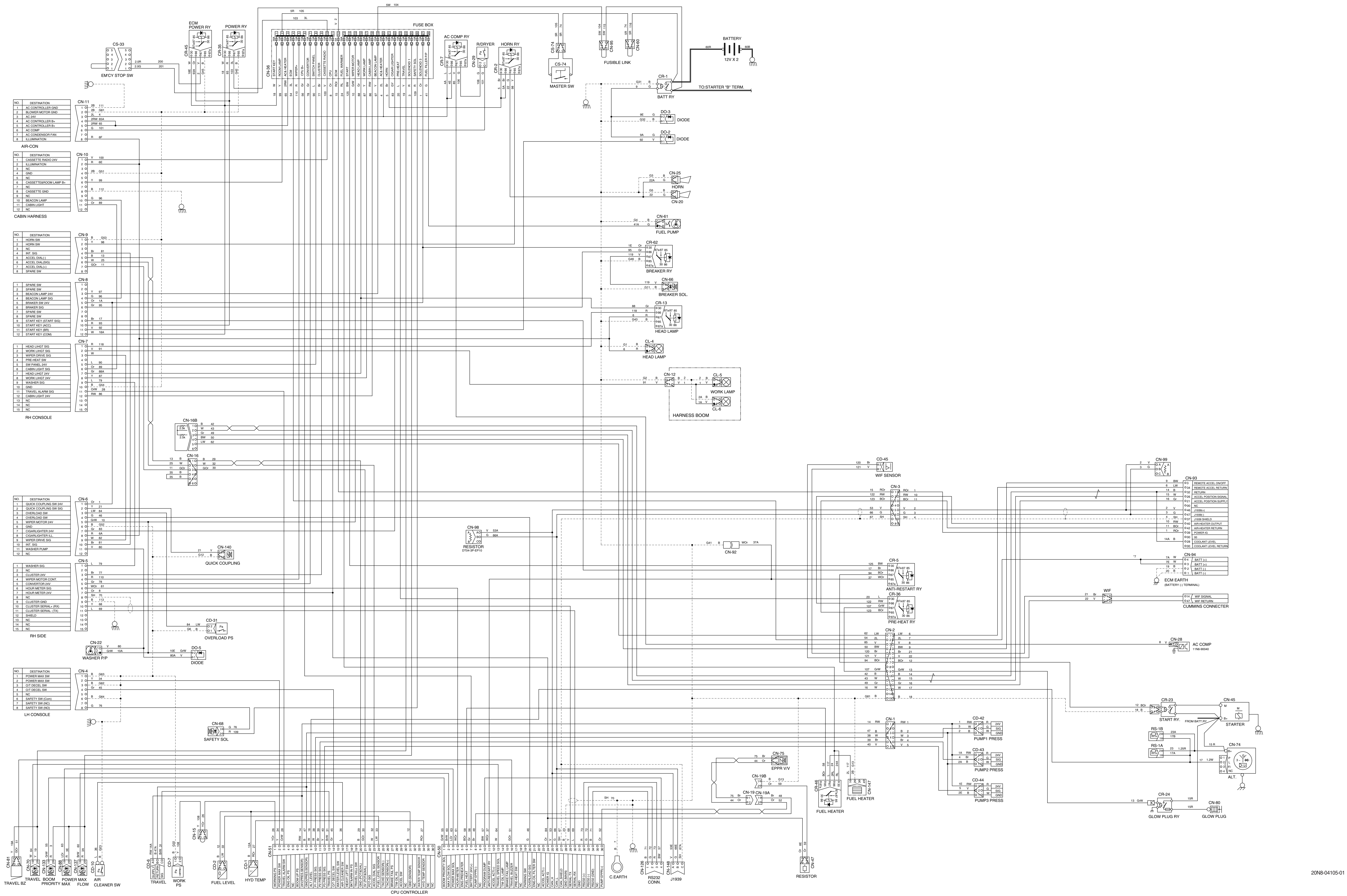
2. LOCATION 2



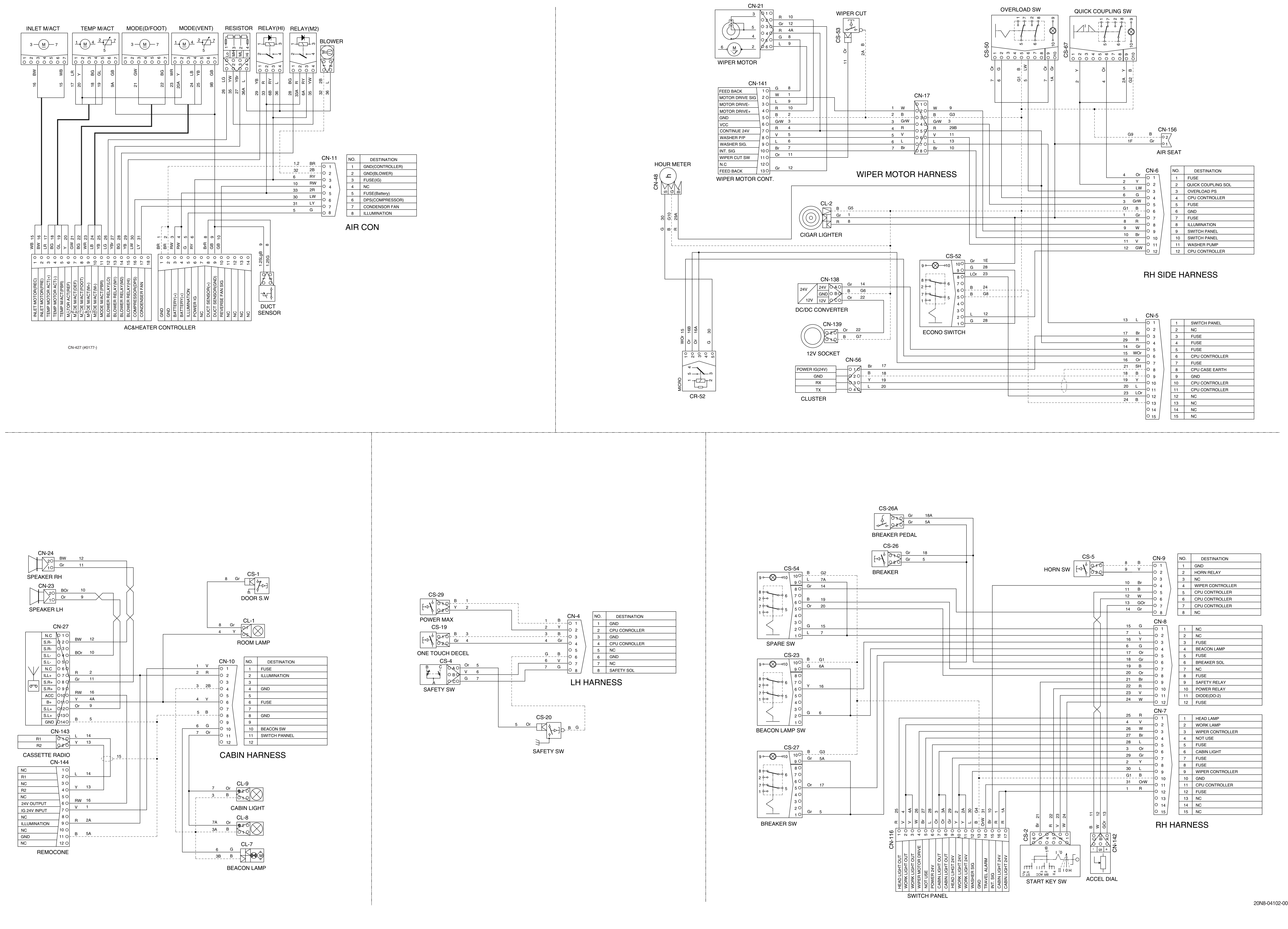
1	Lamp	5	Horn	9	Travel alarm buzzer
2	Fuel sender	6	Start relay	10	Battery relay
3	Fuel filler pump	7	Heater relay	11	Battery
4	Beacon lamp	8	Alternator	12	Air cleaner switch

GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/2)



· ELECTRICAL CIRCUIT (2/2)



1. POWER CIRCUIT

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

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 [CR-1] → Fusible link [CN-60] → Master switch [CS-74]

- → Fuse box [No.1]
  - → I/conn [CN-8 (12)] → Start switch [CS-2 (1)]
  - → Power relay [CR-35 (30)]
  - → ECM power relay [CR-45 (30)]
- → Fuse box [No.2] → I/conn [CN-10 (6)]
  - → Room lamp [CL-1 (2)] → Door switch [CS-1]
  - → Cassette radio [CN-27 (11)]
- → Fuse box [No.3]
  - → I/conn [CN-11 (4)] → AC & Heater controller [CN -116 (10)]
  - → I/conn [CN-11 (5)]
    - → AC & Heater controller [CN -116 (3, 4)]
    - → Relay [(HI, 2),(M2, 2)]
- → Fuse box [No.4] → I/conn [CN-2 (2)] → ECM earth [CN -94 (3, 4)]
- → Fuse box [No.5] → I/conn [CN - 5 (4)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.6] → CPU controller [CN-50 (7)]

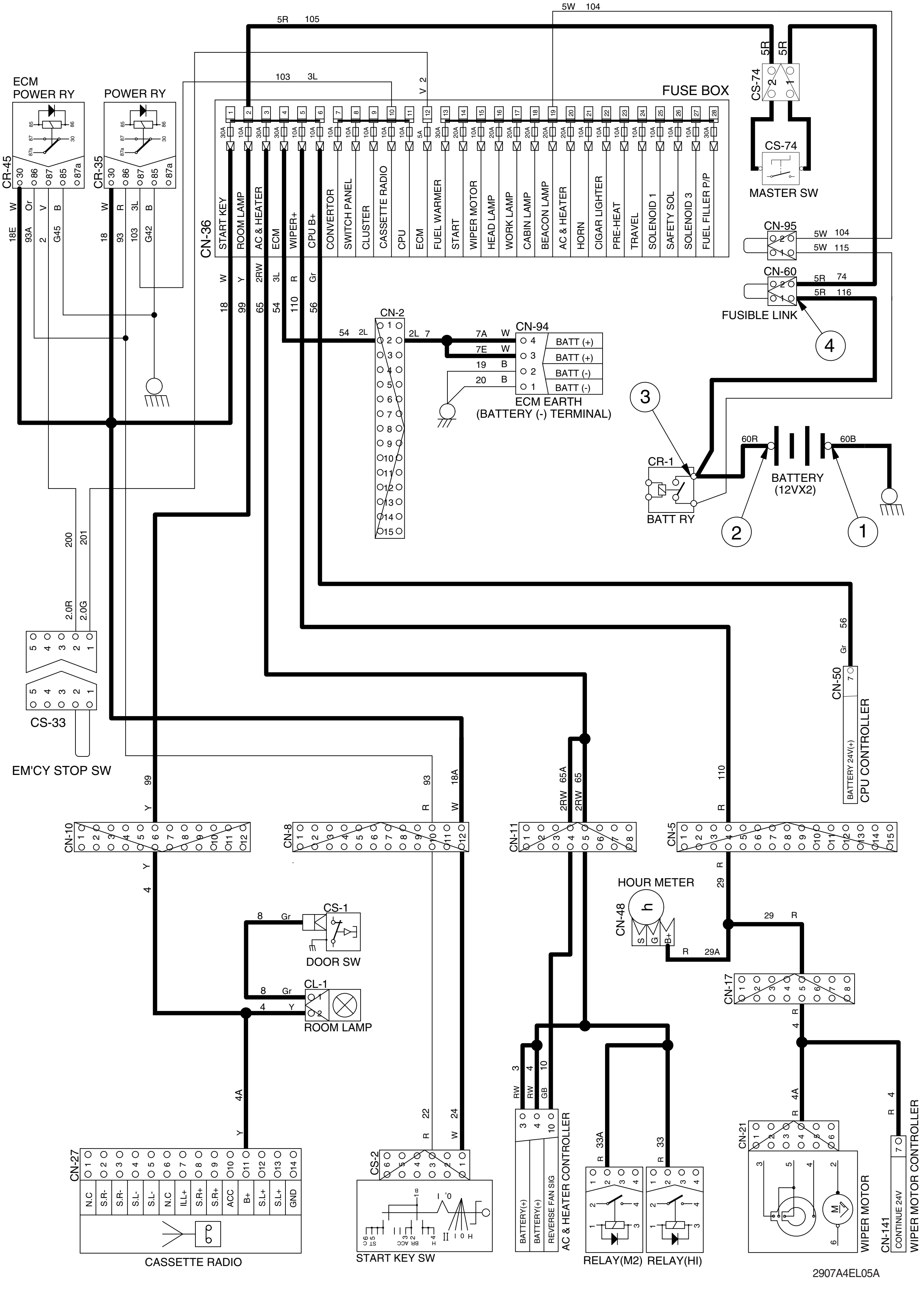
※ I/conn : Intermediate connector

2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

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

(1) When start key switch is in ON position

→ Start switch ON [CS-2 (2)] → I/conn [CN-8 (11)] → Battery relay [CR-1] → Battery relay operating (all power is supplied with the electric component)

→ Start switch ON [CS-2 (3)] → I/conn [CN-8 (10)]

→ Power relay [CR-35 (86) → (87)] → Fuse box [No.11] → Cpu controller [CN-50 (24)]

→ ECM power relay [CR-45 (86) → (87)] → Emergency stop switch [CS-33 (2) → (1)] → Fuse box [No.12] → I/conn [CN-3 (1)] → ECM [CN-93 (39)]

(2) When start key switch is in START position

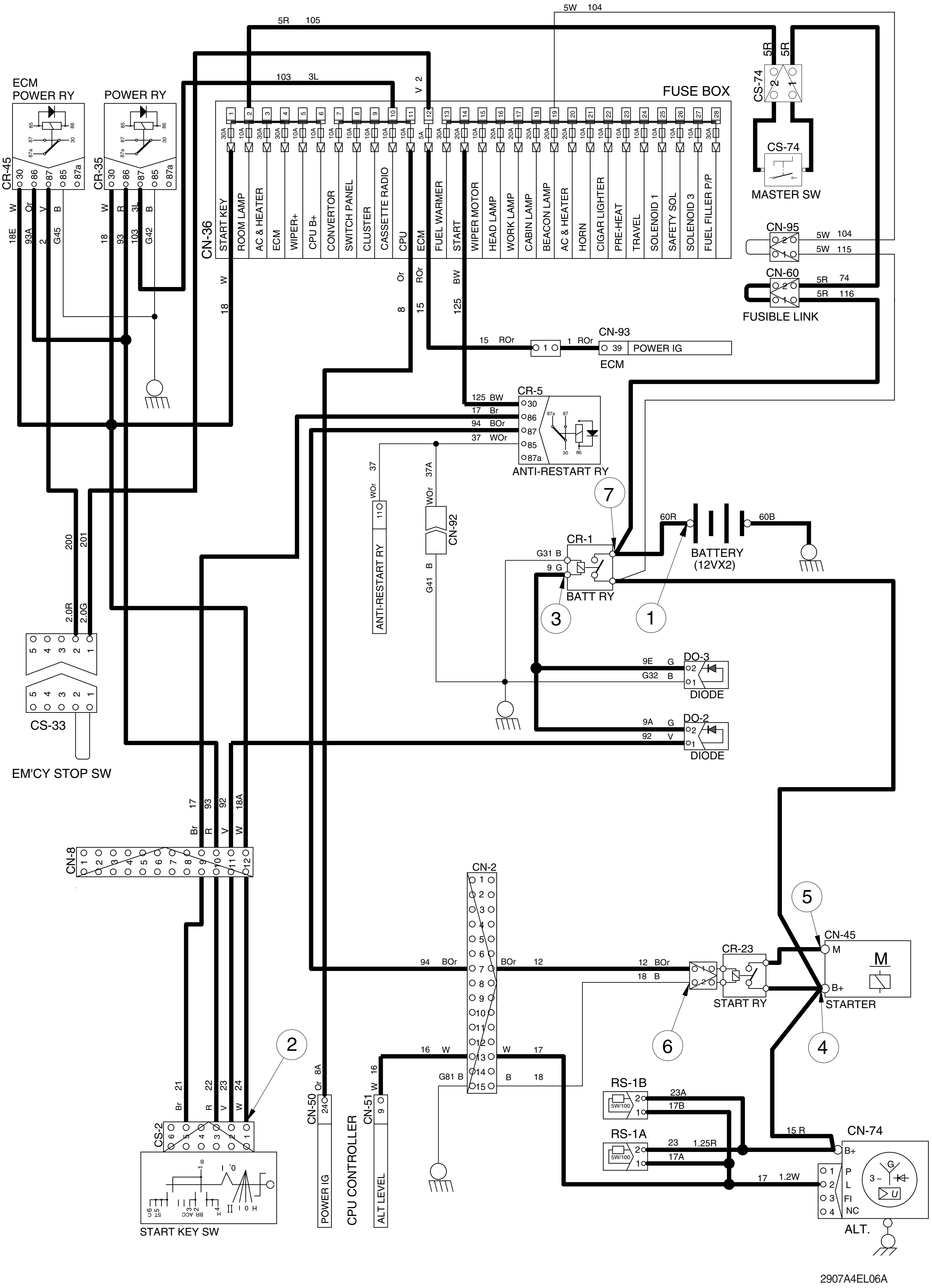
Start switch START [CS-2 (5)] → I/conn [CN-8 (9)] → Anti-restart relay [CR-5 (86) → (87)] → I/conn [CN-2 (7)] → Start relay [CR-23] → Start motor operating

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 start 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 [CN-74 (2)] → I/conn [CN-2 (13)] → CPU alternator level [CN-51 (9)]
Cluster charging warning lamp (Via serial interface)

(2) Charging flow

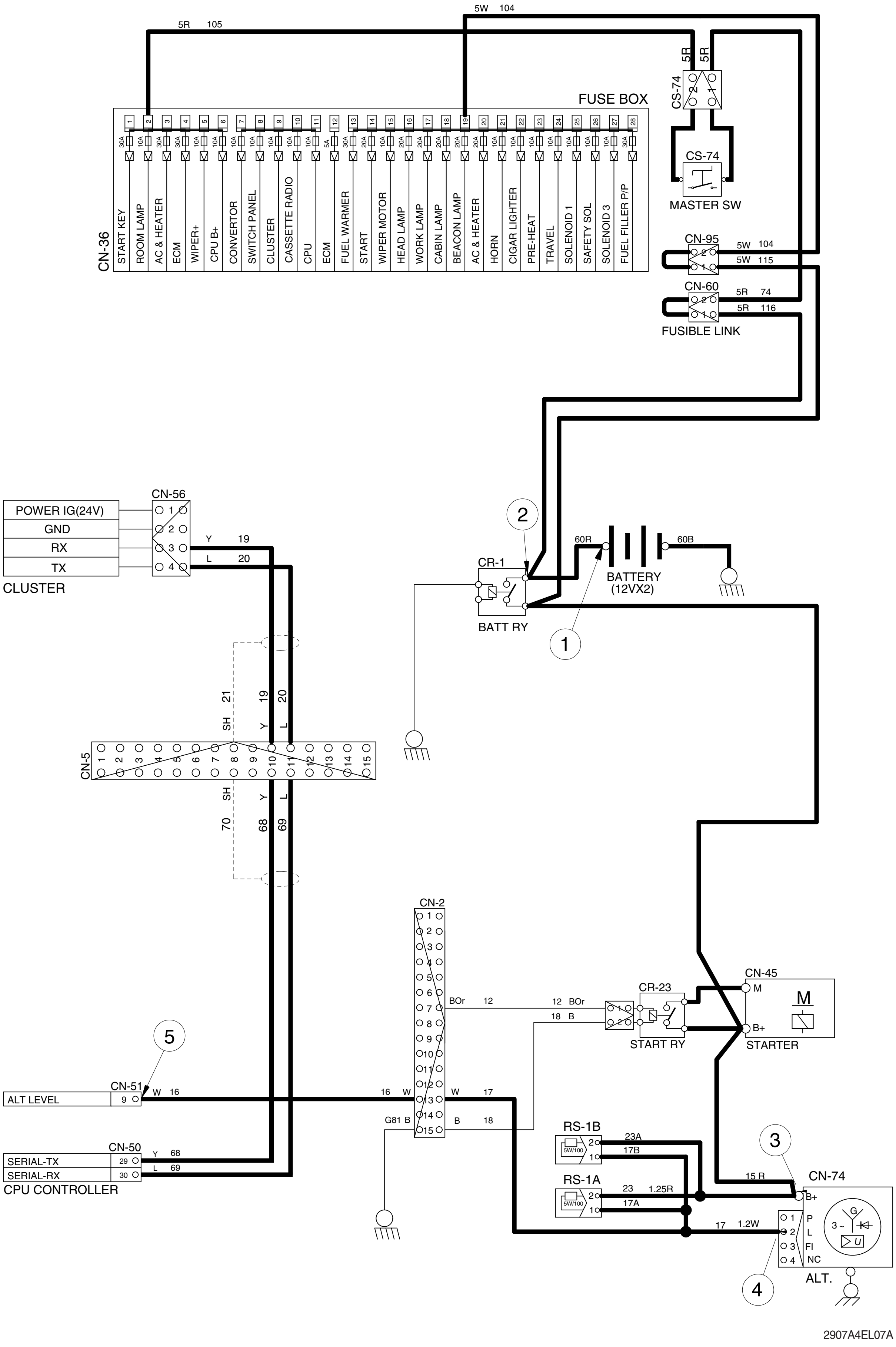
Alternator "B^+" terminal → Battery relay (CR-1) → Battery (+) terminal
→ Fusible link [CN-60] → Master switch [CS-74]
→ Fuse box [No.1~6]
→ Fusible link [CN-95] → Fuse box [No.13~28]

2) CHECK POINT

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

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.16) → I/conn [CN-7 (7)] ┬→ Switch panel [CN-116 (9)]
└→ Head light relay [CR-13 (30)]

Fuse box (No.17) → I/conn [CN-7 (8)] → Switch panel [CN-116 (10, 11)]

(1) Head light switch ON

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

→ Head light ON [CL-4 (1)]
→ I/conn [CN-10 (2)] ┬→ Cassette radio illumination ON [CN-27 (7)]
└→ Remote controller illumination ON [CN-114 (9)]
→ I/conn [CN-11 (8)] → AC & Heater controller illumination ON [CN-116 (5)]
→ I/conn [CN-6 (8)] → Cigar lighter [CL-2]

(2) Work light switch ON

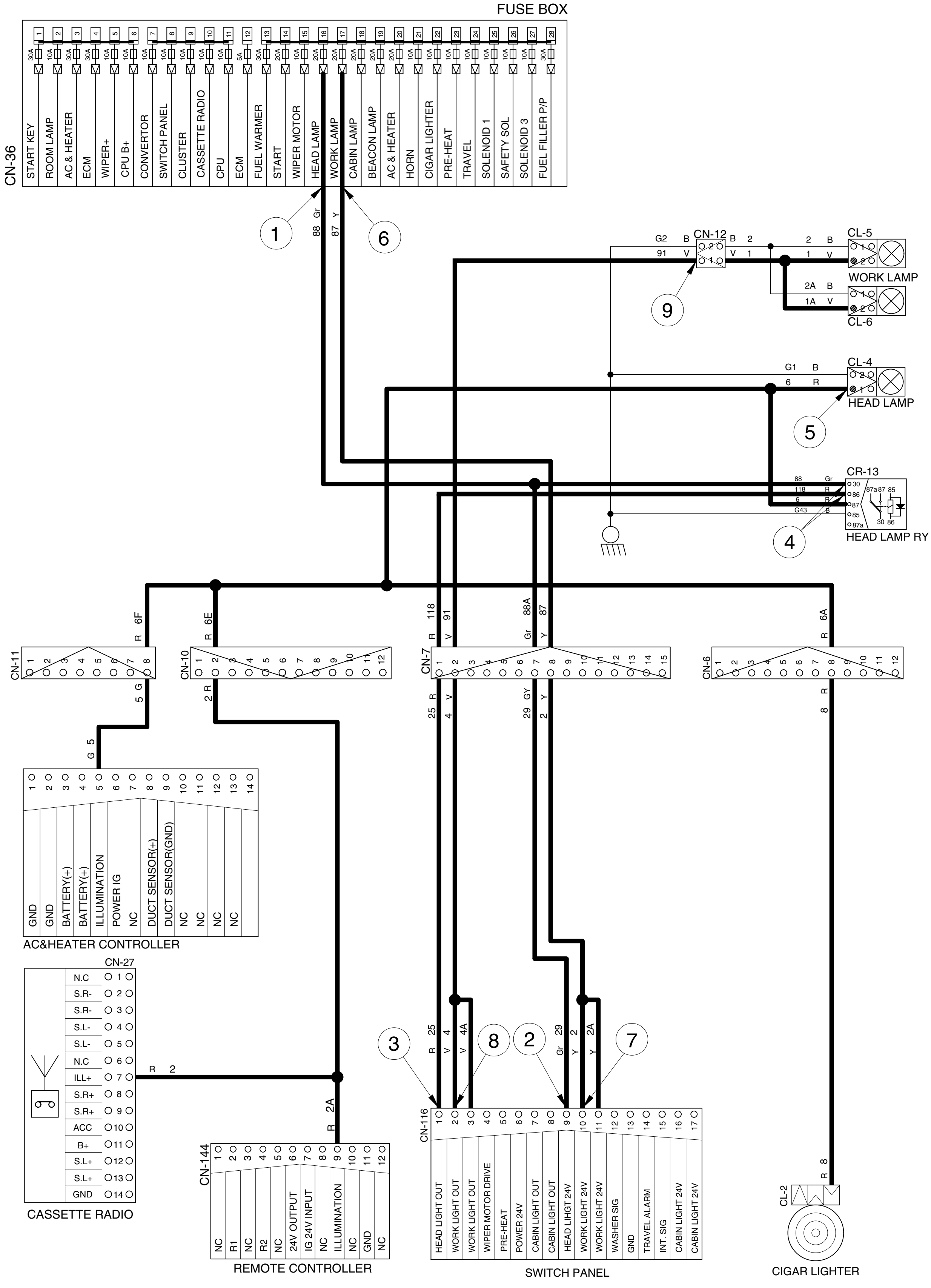
Work light switch ON [CN-116 (2, 3)] → I/conn [CN-7 (2)] → I/conn [CN-12 (1)]
→ Work light ON [CL-5 (2), CL-6 (2)]

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 (head light relay)	20~25V
STOP	ON	⑤ - GND (head light) ⑥ - GND (fuse box) ⑦ - GND (switch power input) ⑧ - GND (switch power output) ⑨ - GND (work light)	20~25V

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



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5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.19) → I/conn [CN-8 (3)] → Beacon lamp switch [CS-23 (6)]
Fuse box (No.18) → I/conn [CN-7 (12)] → Switch panel [CN-116 (16, 17)]

(1) Beacon lamp switch ON

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

(2) Cab light switch ON

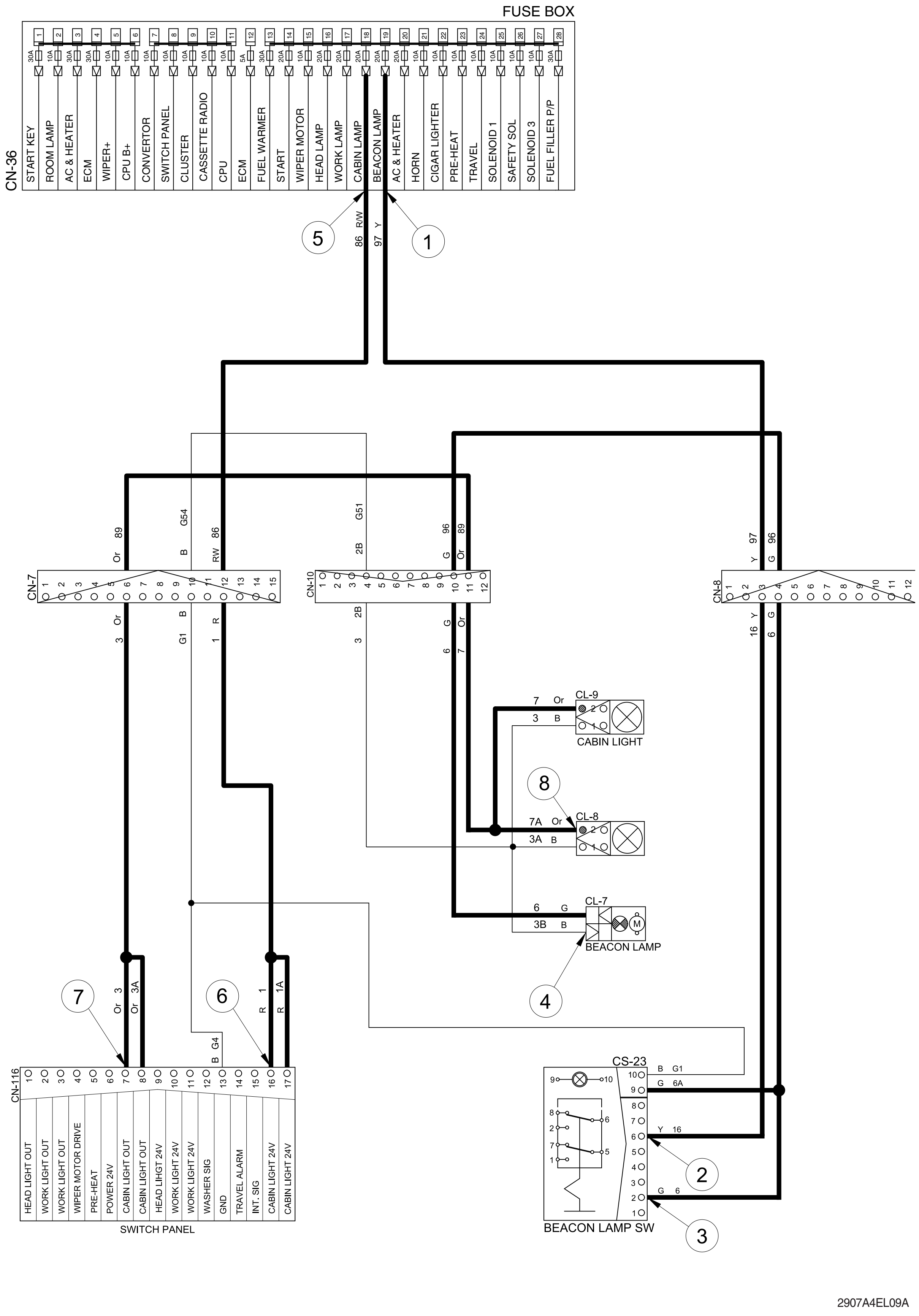
Cab light switch ON [CN-116 (7, 8)] → I/conn [CN-7 (6)] → I/conn [CN-10 (11)]
→ Cab light ON [CL-8 (2), CL-9 (2)]

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 (beacon lamp)	20~25V
STOP	ON	⑤ - GND (fuse box) ⑥ - GND (switch power input) ⑦ - GND (switch power output) ⑧ - GND (cab light)	20~25V

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.8) → I/conn [CN-7 (5)] → Switch panel [CN-116 (6)]

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

Fuse box (No.15) ┬→ I/conn [CN-6 (5)] → I/conn [CN-17 (4)] → Wiper motor controller [CN-141 (6)]
└→ Washer pump [CN-22 (2)]

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

Wiper switch ON [CN-116 (15)] → I/conn [CN-9 (4)] → I/conn [CN-6 (10)] → I/conn [CN-17 (8)] → Wiper motor controller [CN-141 (10) → (3)] → Wiper motor intermittently operating [CN-21 (6)]

(3) Wiper switch ON : 2nd step (Low speed)

Wiper switch ON [CN-116 (4)] → I/conn [CN-7 (3)] → I/conn [CN-6 (9)] → I/conn [CN-17 (2)]
Wiper motor controller [CN-141 (2) → (4)] → Wiper motor operating [CN-21 (2)]

(4) Washer switch ON

Washer switch ON [CN-116 (12)] → I/conn [CN-7 (9)] → I/conn [CN-5 (1)] → I/conn [CN-17 (7)] → Wiper motor controller [CN-141 (9) → (8)] → I/conn [CN-17 (6)] → I/conn [CN-6 (11)] → Washer pump [CN-22 (1)] → Washer operating

Wiper switch ON [CN-116 (4)] → I/conn [CN-7 (3)] → I/conn [CN-6 (9)] → I/conn [CN-17 (2)]
Wiper motor controller [CN-141 (2) → (4)] → Wiper motor operating [CN-21 (2)]

(5) Auto parking (When switch OFF)

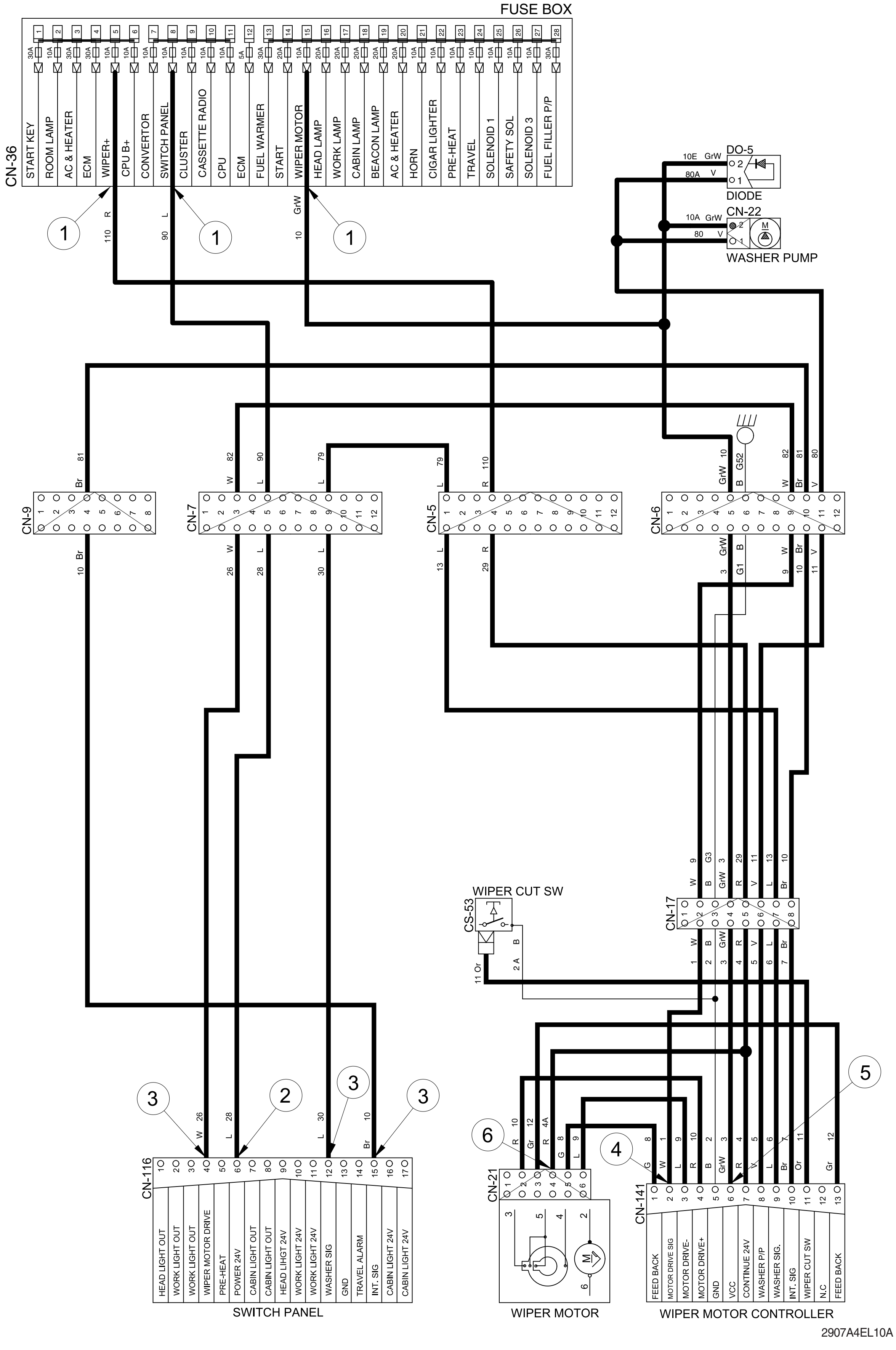
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

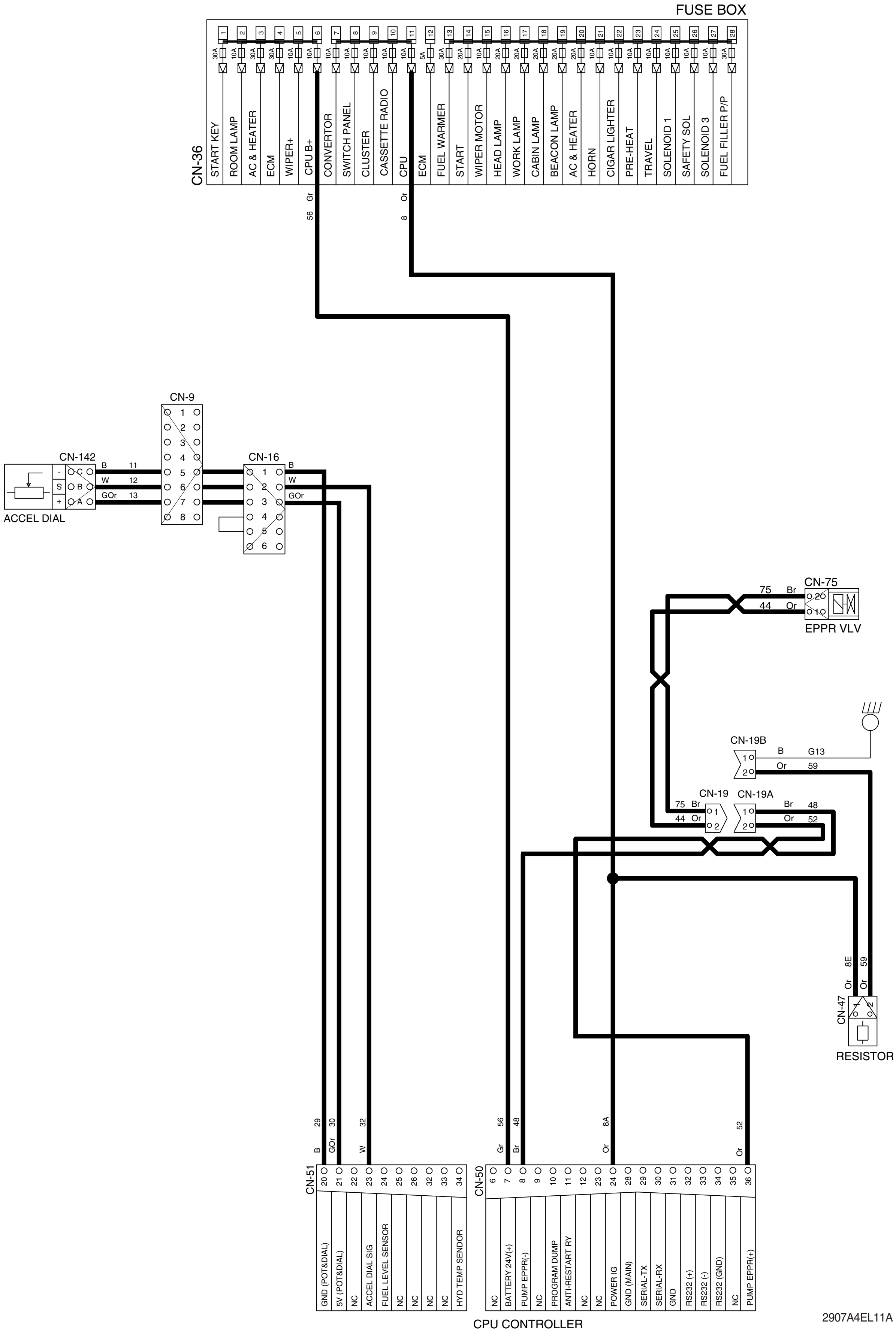
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	24V
		③ - GND (switch power output) ④ - GND (wiper Power input)	0 ~ 5V
		⑤ - GND (wiper power output) ⑥ - GND (wiper motor)	0 or 24V

※ GND : Ground

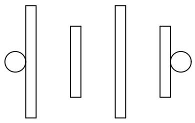
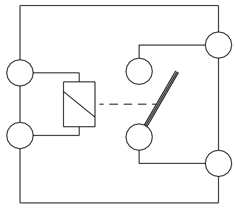
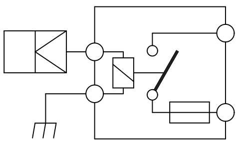
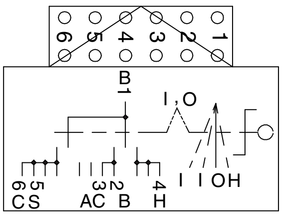
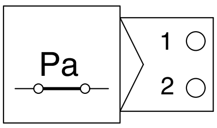
WIPER AND WASHER CIRCUIT

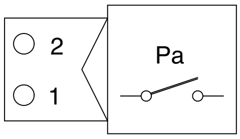
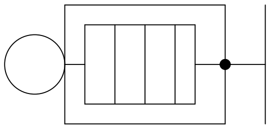
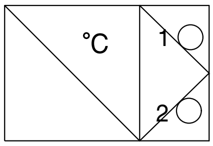
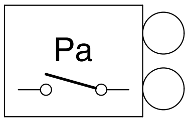
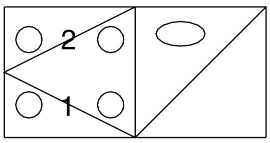
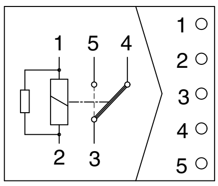


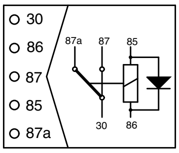
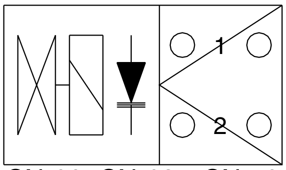
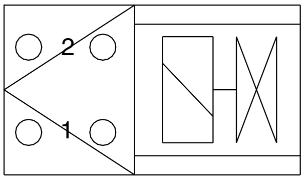
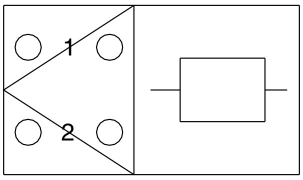
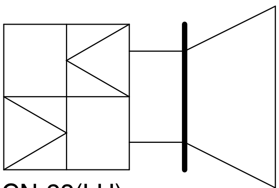
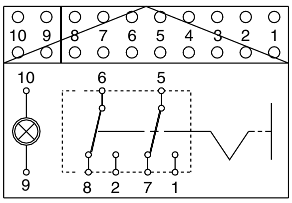
7. CONTROLLER CIRCUIT

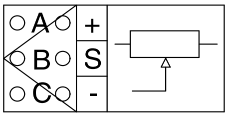
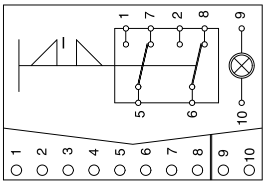
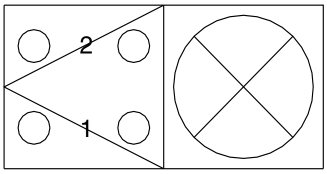
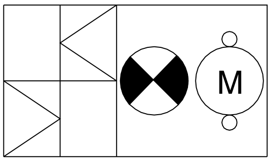
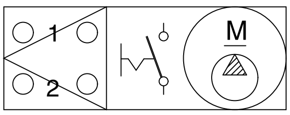
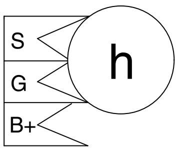


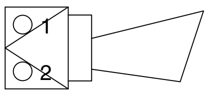
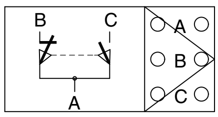
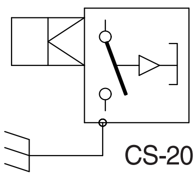
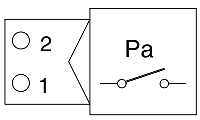
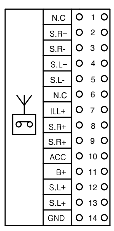
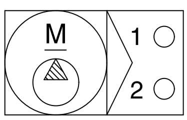
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

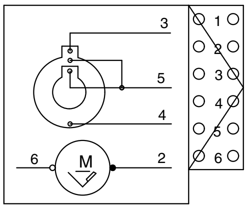
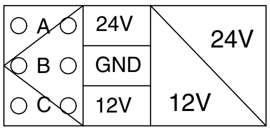
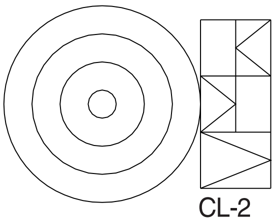
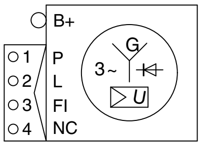
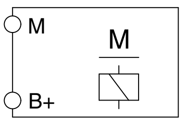
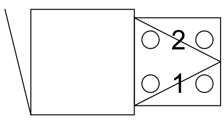
Part name	Symbol	Specifications	Check
Battery		12V × 160Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A(continuity) 1000A(30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942Ω (For terminal 1-GND)
Start key		B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞Ω(For each terminal) ON : 0Ω(For terminal 1-3 and 1-2) START : 0Ω(For terminal 1-5)
Pressure switch (Working)	 CD-7	10kgf/cm^2 (N.C TYPE)	※ Check contact Normal : 0.1Ω

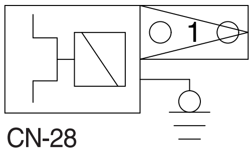
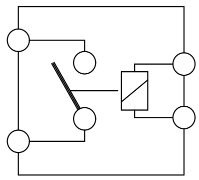
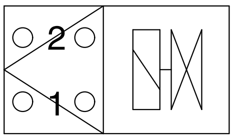
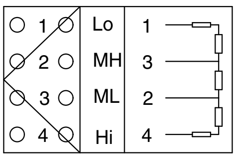
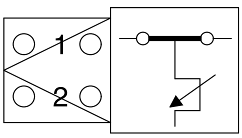
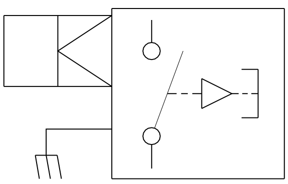
Part name	Symbol	Specifications	Check
Pressure switch (For overload)	 CD-31	3~6kgf/cm^2 (N.O TYPE)	※ Check contact Normal : ∞Ω
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12Ω
Temperature sensor (Hydraulic)	 CD-1	-	※ Check resistance 50 ℃ : 804Ω 80 ℃ : 310Ω 100 ℃ : 180Ω
Air cleaner pressure switch	 CD-10	-	※ Check contact High level : ∞Ω Low level : 0Ω
Fuel sender	 CD-2	-	※ Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning : 700Ω
Relay	 CR-52	24V 20A	※ Check resistance Normal : About 160Ω (For terminal 1-2) 0 Ω (For terminal 3-4) ∞Ω (For terminal 3-5)

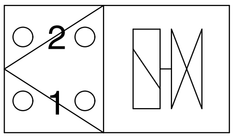
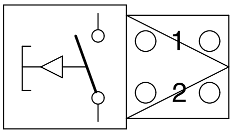
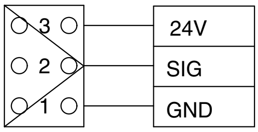
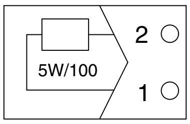
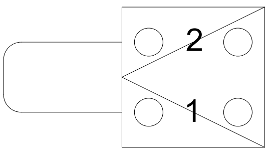
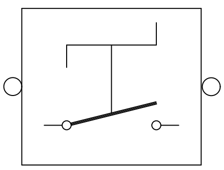
Part name	Symbol	Specifications	Check
Relay	 CR-2 CR-5 CR-7 CR-13 CR-35 CR-36 CR-45 CR-46 CR-62	24V 16A	※ Check resistance Normal : About 160 Ω (For terminal 85-86) 0Ω(For terminal 30-87a) ∞Ω(For terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-133 CN-137	24V 1A	※ Check resistance Normal : 15~25Ω (For terminal 1-2)
EPPR valve	 CN-75	700mA	※ Check resistance Normal : 15~25Ω (For terminal 1-2)
Resistor	 CN-47	45Ω 20W±5%	※Check resistance Normal : 45Ω
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check disconnection Normal : A fewΩ
Switch (Locking type)	 CS-23 CS-27 CS-50 CS-52 CS-54	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)

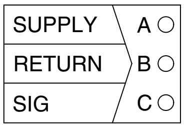
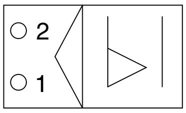
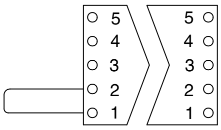
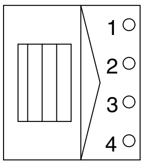
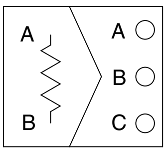
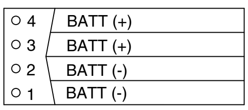
Part name	Symbol	Specifications	Check
Accel dial	 CN-142	-	※ Check resist Normal : About 5kΩ (For terminal A-C) Normal : Abowt 5V (For terminal A-C) : 2~4.5V (For terminal C-B)
Switch	 CS-67	24V 8A	※ Check disconnection Normal : 1.0Ω ON : 0Ω(For terminal 1-5, 2-6) ∞Ω(For terminal 5-7, 6-8) OFF : ∞Ω(For terminal 1-5, 6-8) 0Ω(For terminal 5-7, 6-8)
Head lamp, Work lamp, Room lamp, Cab lamp	 CL-1 CL-4 CL-5 CL-6 CL-8 CL-9	24V 70W (H3 Type) 24V 10W (Room lamp)	※ Check disconnection Normal : A few Ω
Beacon lamp	 CL-7	21V 70A (H1 type)	※Check disconnection Normal : A fewΩ
Fuel filler pump	 CN-61	24V 10A 35 ℓ /min	※Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16~32V	※Check operation Supply power(24V) to terminal No.2 and connect terminal No.B and ground

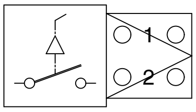
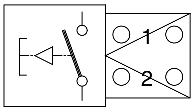
Part name	Symbol	Specifications	Check
Horn	 CN-20 CN-25	DC22~28V 2A	※Check operation Supply power(24V) to each terminal and connect ground.
Safety switch 1	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 0Ω(For terminal 1-2) ∞Ω(For terminal 1-3) Operating : ∞Ω(For terminal 1-2) 0Ω(For terminal 1-3)
Safety switch 2	 CS-20	24V (N.C TYPE)	※Check contact Normal : 0Ω(One pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※Check contact Normal : ∞Ω
Cassette radio	 CN-27	24V 2A	※Check voltage 20~25V (For terminal 10-14, 11-14)
Washer pump	 CN-22	24V 3.8A	※Check contact Normal : 10.7Ω(For terminal 1-2)

Part name	Symbol	Specifications	Check
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7Ω (For terminal 2-6)
DC/DC Converter	 CN-138	12V 3A	24V(A-B) 12V (B-C)
Cigar lighter	 CL-2	24V 5A 1.4W	※Check coil resistance Normal : About 1MΩ ※Check contact Normal : ∞Ω Operating time : 5~15sec
Alternator	 CN-74	24V 55A	※Check contact Normal : 0Ω (For terminal B^+-2) Normal : 24~27.5V
Starter	 CN-45	Delco Remy 28MT 24V	※Check contact Normal : 0.1Ω
Travel alarm	 CN-81	24V 0.5A	※Check contact Normal : 5.2Ω

Part name	Symbol	Specifications	Check
Aircon compressor	 CN-28	24V 79W	※Check contact Normal : 13.4Ω
Start relay	 CR-23	24V 300A	※Check contact Normal : 0.94Ω(For terminal 1-2)
Blower		24V 9.5A	※Check resistance Normal : 2.5Ω(For terminal 1-2)
Aircon resistor		-	※Check resistance Normal : 1.12Ω(For terminal 4-2) 2.07Ω(For terminal 2-3) 3.17Ω(For terminal 3-1)
Duct sensor		1 ℃ OFF 4 ℃ ON	※Check resistance Normal : 0Ω(For terminal 1-2), the atmosphere temp : Over 4 ℃
Switch (Door, wiper cut)	 CS-1 CS-53	24V 2W	※Check resistance Normal : About 5MΩ

Part name	Symbol	Specifications	Check
Quick coupler	 CN-140	24V 6A	※Check contact Normal : 28.9MΩ (For terminal 1-2)
Switch (Power max, one touch decal, horn)	 CS-26 CS-29	24V 6A	※Check resistance Normal : ∞Ω
Transducer	 CD-32 CD-33 CD-42 CD-43 CD-44	500bar	0bar : 1V(For terminal 1-2) 500bar : 5V(For terminal 1-2)
Resistor	 RS-1A RS-1B	5W 100Ω	※Check resistance Normal : 100Ω
Fusible link	 CN-60 CN-95	60A	※Check disconnection normal : 0Ω (Connect ring terminal and check resist between terminal 1 and 2)
Master switch	 CS-74	6-36V	※Check disconnection Normal : 0.1Ω

Part name	Symbol	Specifications	Check
Pressure switch (working)	 CD-6	8~30V	※Check contact Normal : 0.1Ω
WIF sensor	 CD-45	-	-
Em'cy stop switch	 CS-33	-	-
Fuel heater	 CN-147	-	-
Resistor	 CN-98 CN-99	3W 120Ω	※Check resistance Normal - A-B : 120Ω
ECM earth	 CN-94	-	-

Part name	Symbol	Specifications	Check
Breaker pedal	 CS-26A	24V 6A	※Check resistance Normal : ∞Ω
Horn switch	 CS-5 CS-19	24V 6A	※Check resistance Normal : ∞Ω

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	6	I/conn(Frame harness-Engine harness)	S816-006002	S816-106002
CN-2	AMP	15	I/conn(Frame harness-Engine harness)	2-85262-1	368301-1
CN-3	AMP	8	I/conn(Frame harness-Engine harness)	S816-008002	S816-108002
CN-4	AMP	8	I/conn(Frame harness-Console harness LH)	S816-008002	S816-108002
CN-5	AMP	15	I/conn(Frame harness-Side harness RH)	2-85262-1	368301-1
CN-6	AMP	12	I/conn(Frame harness-Side harness RH)	S816-012002	S816-112002
CN-7	AMP	15	I/conn(Frame harness-Console harness RH)	2-85262-1	368301-1
CN-8	AMP	12	I/conn(Frame harness-Console harness RH)	S816-012002	S816-112002
CN-9	AMP	8	I/conn(Frame harness-Console harness RH)	S816-008002	S816-108002
CN-10	DEUTSCH	12	I/conn(Frame harness-Cab harness)	DT06-12S	DT04-12P
CN-11	DEUTSCH	8	I/conn(Frame harness-Aircon harness)	DT06-8S	-
CN-12	DEUTSCH	2	I/conn(Frame harness-Boom wire harness)	DT06-2S-P012	DT04-2P
CN-15	AMP	2	Auto idle pressure	S816-002002	S816-102002
CN-16	AMP	6	Emergency engine speed control	-	S816-106002
CN-16A	AMP	6	Emergency engine speed control	S816-006002	-
CN-16B	AMP	6	Emergency engine speed control	S816-006002	-
CN-17	DEUTSCH	8	I/conn(wiper harness)	DT06-8S	DT04-8P
CN-19	AMP	2	Emergency CPU controller	-	S816-102002
CN-19A	AMP	2	Emergency CPU controller	S816-002002	-
CN-19B	AMP	2	Emergency CPU controller	-	S816-102002
CN-20	MOLEX	2	Horn	35825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-21A	AMP	6	Wiper motor	S816-006202	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27	AMP	14	Cassette radio	173852	-
CN-28	MWP	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	DEUTSCH	3	Fuse box	21N8-20041	-
CN-45	RING-TERM	-	Starter	S820-414000	-
CN-47	FASTEN	2	Resistor	S810-002202	-
CN-48	AMP	2	Hour meter	GP890469	-
CN-50	AMP	36	CPU controller	3441111-1	-
CN-51	AMP	36	CPU controller	3441111-1	-
CN-56	DEUTSCH	4	Cluster	-	DT04-4P-E004

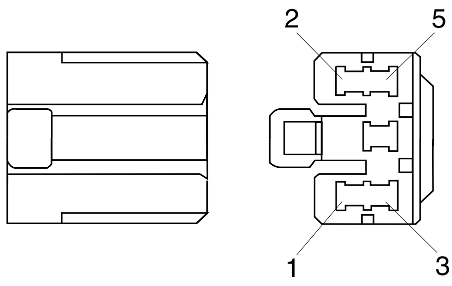
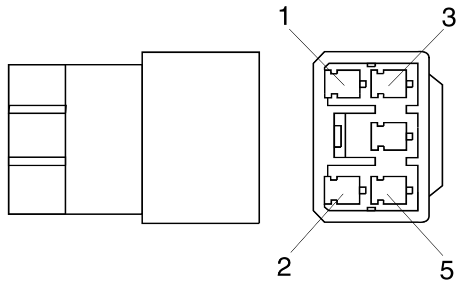
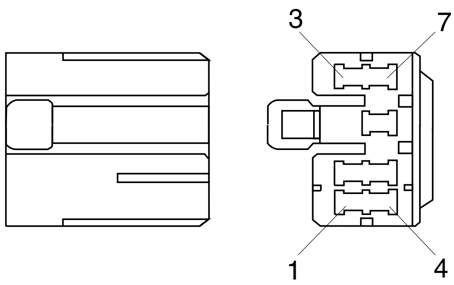
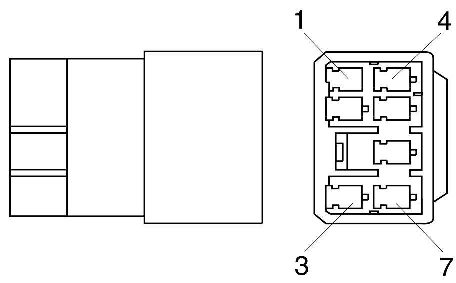
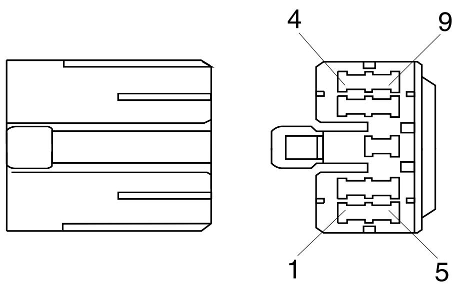
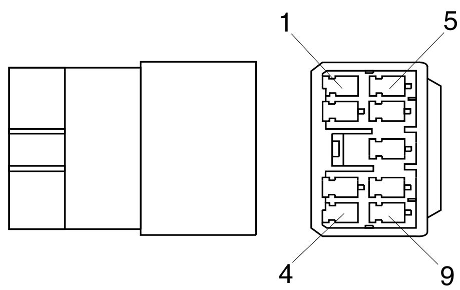
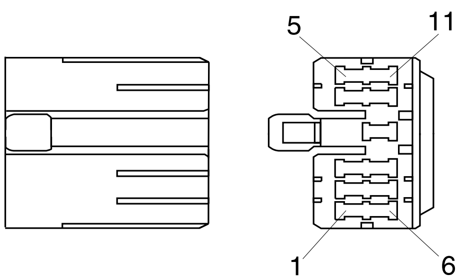
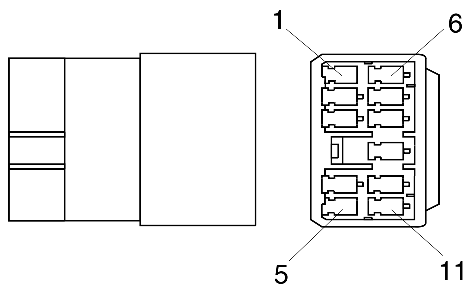
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-60	YAZAKI	2	Fusible link	21N4-01320	7122-4125-50
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-P012	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-P012	DT04-2P-E004
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-P012	-
CN-70	DEUTSCH	2	Travel solenoid	DT06-2S-P012	-
CN-74	-	4	Alternator	1218-6568	S820-108000
CN-75	AMP	2	EPPR valve	S816-002002	-
CN-80	RING-TERM	-	Glow	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer	DT06-2S-P012	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-P012	-
CN-92	SWP	1	Emergency engine starting connector	S814-001100	S814-101100
CN-93	DEUTSCH	50	ECM	DRC26-50S-04	-
CN-94	AMP	4	ECM earth	DT06-4S-EP06	-
CN-95	KET	2	Fusible link	21N4-01311	S813-130200
CN-96	AMP	4	I/conn [Frame harness-Feul warmer harness]	-	2-967402-2
CN-96A	AMP	4	Fuel warmer	368523-1	-
CN-96B	AMP	3	Fuel warmer	2-967325-2	-
CN-99	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-116	PA	17	Switch panel	S811-017002	-
CN-126	DEUTSCH	4	RS 232 connector	DT06-4S-P012	DT04-4P-E004
CN-133	DEUTSCH	2	Boom prioity solenoid	DT06-2S-P012	-
CN-137	DEUTSCH	2	Max flow solenoid	DT06-2S-P012	-
CN-138	DEUTSCH	3	DC/DC converter	DT06-3S-P012	-
CN-139	DEUTSCH	2	12V socket	-	DT04-2P-E004
CN-140	DEUTSCH	2	Quick coupler	DT06-2S-P012	DT04-2P-E004
CN-141	AMP	13	Wiper motor controller	172498-1	-
CN-142	DEUTSCH	3	Accel dial	DT06-3S-P012	-
CN-143	KET	2	Cassette radio(with remocon)	S816-002002	-
CN-144	AMP	12	Remocon-cassette radio	174045-2	-
CN-147	PACKARD	4	Fuel heater	2-967325-3	-
CN-148	DEUTSCH	3	Data link	DT06-3S-P012	DT04-3P-E004
CN-156	AMP	2	Air seat	-	S816-102002
CN-156A	AMP	2	Air seat	S816-002002	-
CN-164	AMP	8	Ext-USB harness	S816-008002	S816-108002
CN-164	-	10	USB	316988-6	-
CN-170	KET	2	Heat seat	MG630676	-
CN-170A	DEUTSCH	2	Heat seat	-	DT04-2P-E005
CN-174	DEUTSCH	3	Resistor	DT06-3S-P012	-

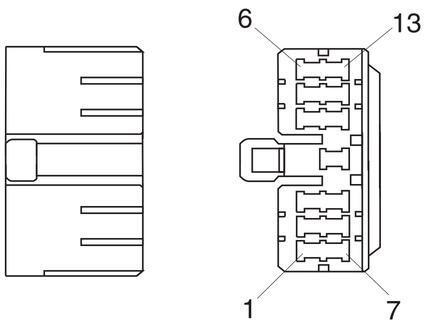
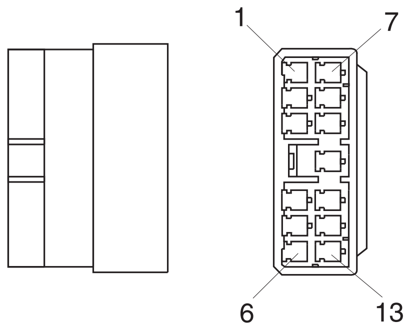
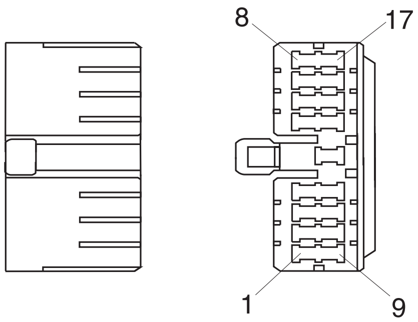
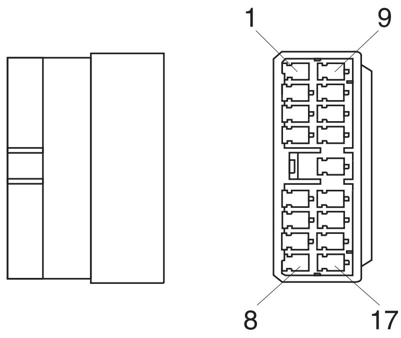
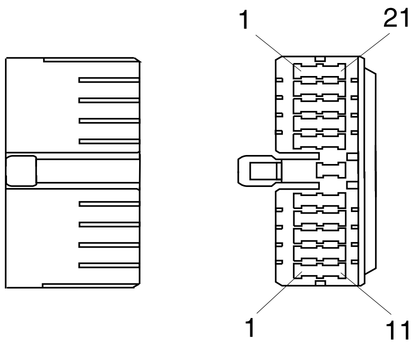
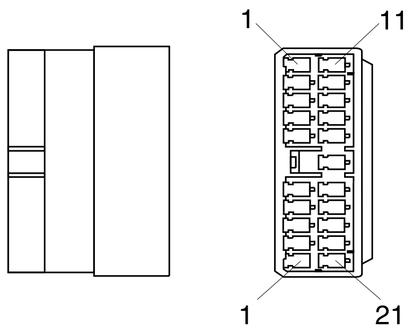
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Relay					
CR-1	RING-TERM	-	Battery relay (IG)	-	S820-208002
CR-1	RING-TERM	-	Battery relay (B+)	-	S820-308002
CR-13	KET	4	Head lamp relay	MG640927	-
CR-23	KET	2	Start relay	S814-002001	-
CR-24	RING-TERM	-	Preheater relay	S822-014000	-
CR-45	KET	4	ECM power	MG640927	-
CR-46	KET	4	Fuel heater relay	MG640927	-
CR-62	KET	4	Breaker relay	MG640927	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014004	-
CS-2	SWP	6	Start key switch	S814-006000	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-P012	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E004
CS-19	DEUTSCH	2	One touch decel	-	DT04-2P-E004
CS-20	AMP	1	Safety switch	S822-014002	-
CS-23	SWF	10	Beacon lamp switch	SWF 593757	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-P012	-
CS-26A	-	2	Breaker pedal	S816-002002	S816-102002
CS-27	SWF	10	Breaker switch	SWF 593757	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S-P012	-
CS-33	-	6	Emergency stop switch	174262-2	174264-2
CS-50	SWF	10	Overload switch	SWF 593757	-
CS-52	SWF	10	Econo switch	SWF 593757	-
CS-53	SHUR	1	Wiper cut switch	S822-014002	-
CS-54	SWF	10	Spear switch	SWF 593757	-
CS-67	SWF	10	Quick coupler switch	SWF593757	-
CS-74	AMP	2	Master switch	S813-030201	S816-130201
CS-82	SWF	10	Seat heater switch	SWF593757	-
CS-83	SWF	10	Seat switch	SWF593757	-
CS-84	SWF	10	Fuel warmer switch	SWF593757	-
· Light					
CL-1	KET	2	Room lamp	MG 610392	-
CL-2	AMP	1	Cigar lighter	S822-014002	-
CL-4	DEUTSCH	2	Head lamp	-	DT04-EP-E004
CL-5	DEUTSCH	2	Work lamp-LH	-	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	-	DT04-2P
CL-7	SHUR	1	Beacon lamp	DT06-2S	DT04-2P
CL-8	DEUTSCH	2	Cab light-LH	DT04-2S	DT04-2P-E005

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CL-9	DEUTSCH	2	Cab light-RH	DT04-2S	DT04-2P-E005
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-P012	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-2S-EP06	DT04-2P-E004
CD-7	KET	2	Working pressure switch	MG640795	-
CD-10	RING-TERM	-	Air cleaner switch	-	S820-104002
CD-31	DEUTSCH	2	Overload pressure switch	DT06-2S-P012	DT04-2P-E004
CD-42	AMP	3	Pump pressure 1	S816-003002	-
CD-43	AMP	3	Pump pressure 2	S816-003002	-
CD-44	AMP	3	Pump pressure 3	S816-003002	-
CD-45	DEUTSCH	2	WIF sensor	DT06-2S-P012	-

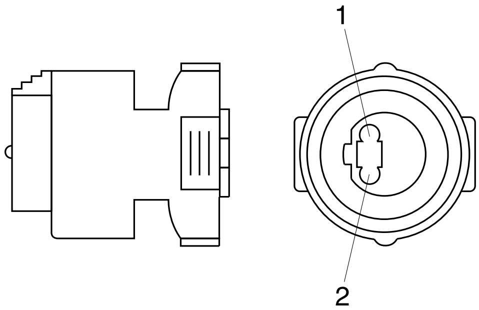
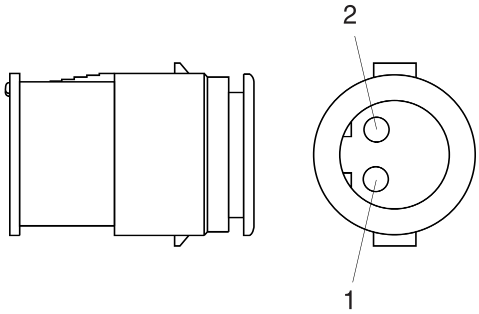
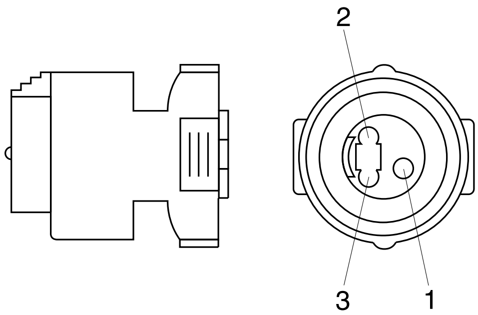
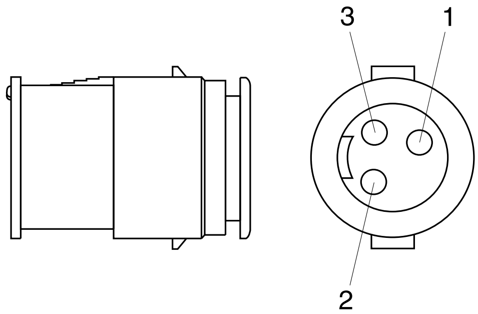
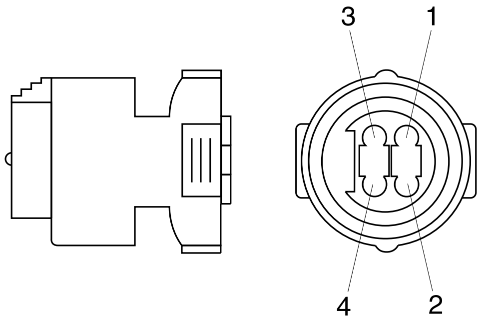
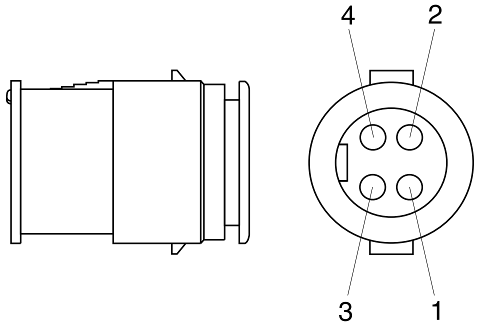
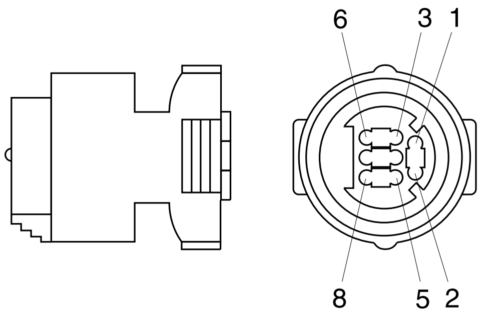
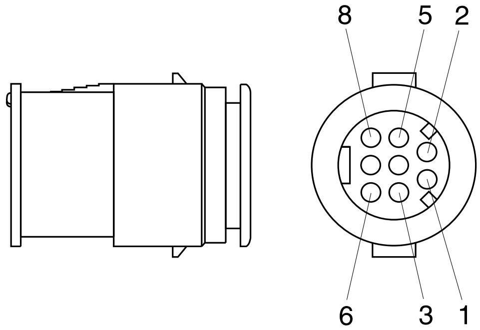
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

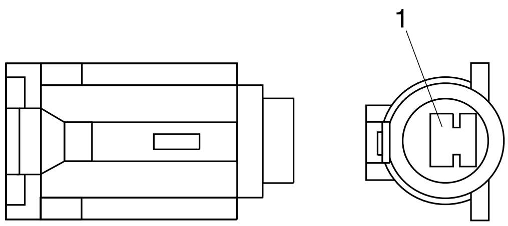
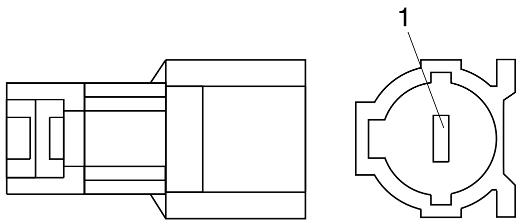
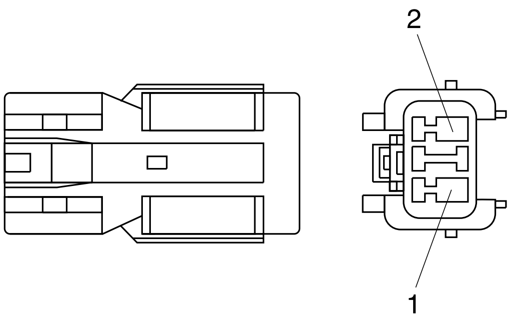
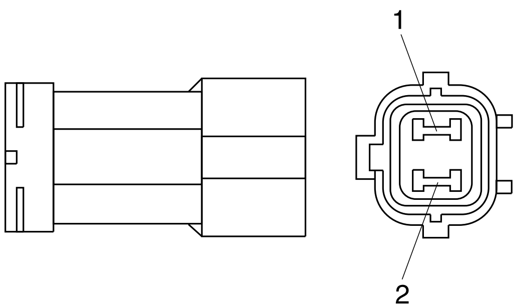
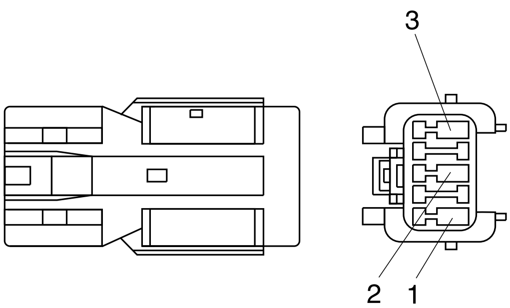
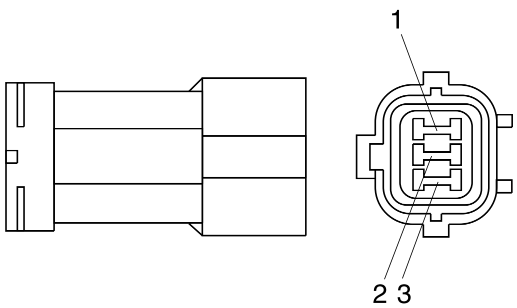
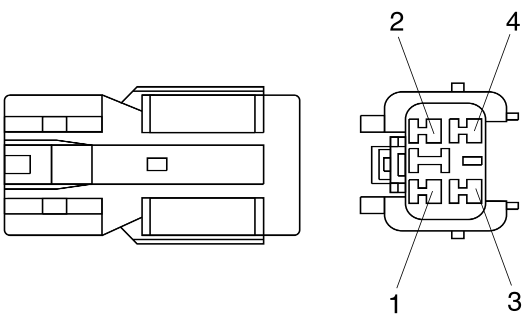
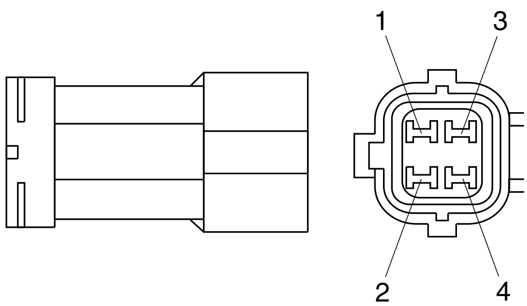
No. of pin	Receptacle connector(Female)	Plug connector(Male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

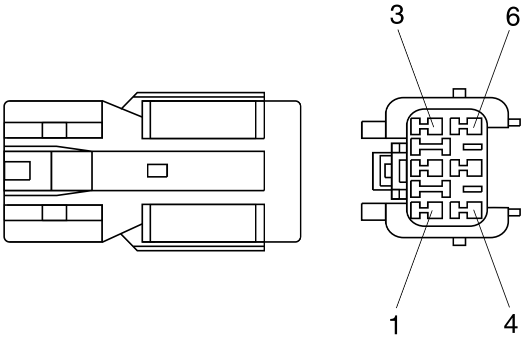
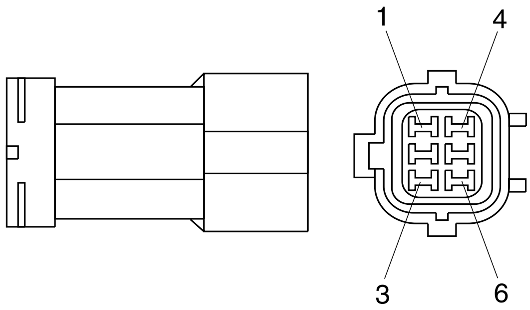
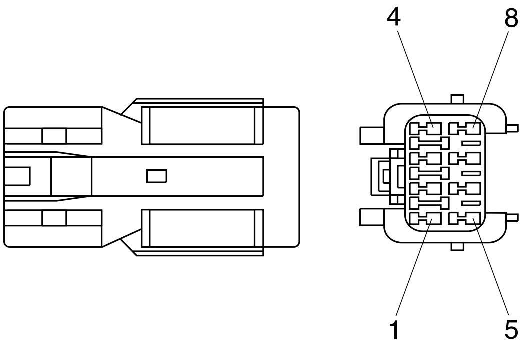
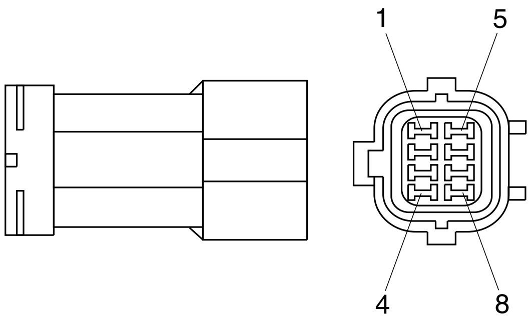
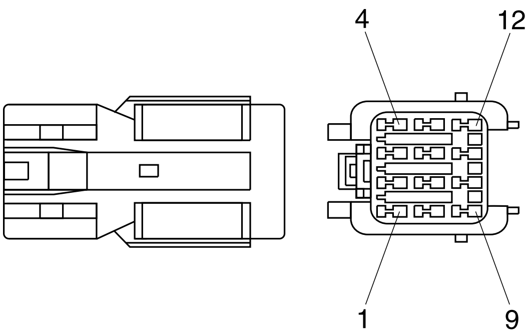
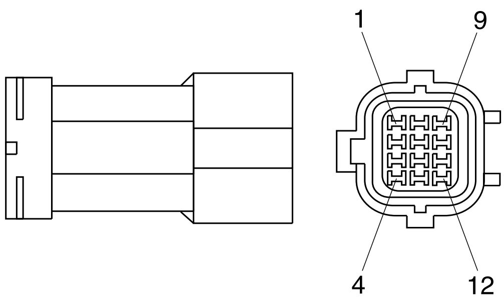
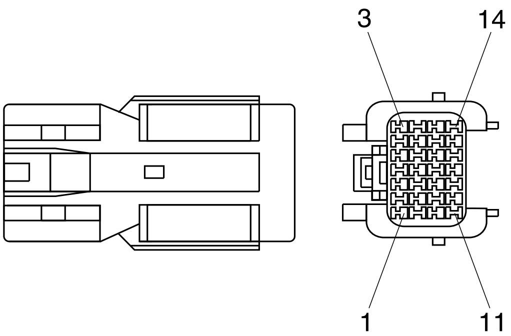
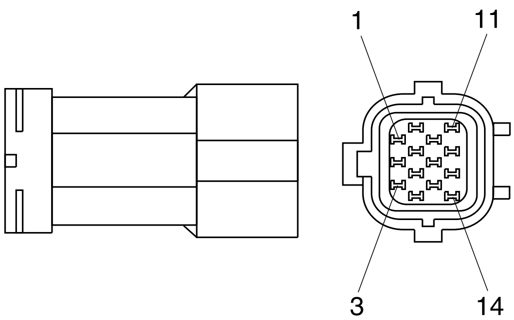
No. of pin	Receptacle connector(Female)	Plug connector(Male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

J 2) TYPE CONNECTOR

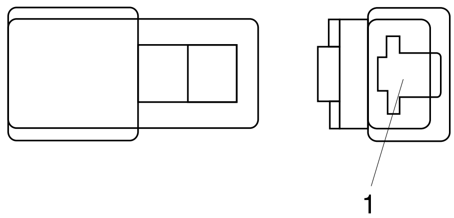
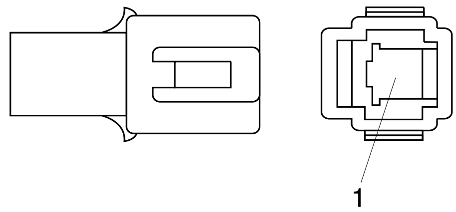
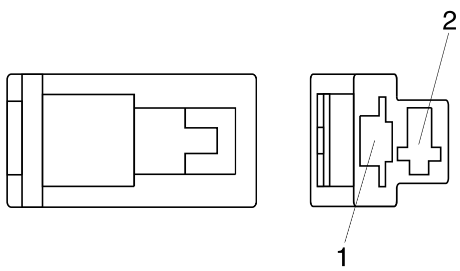
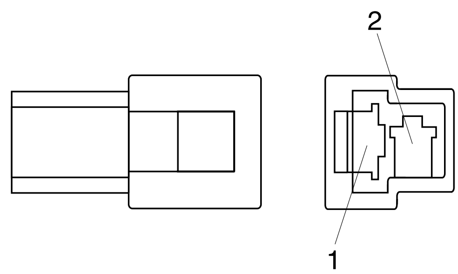
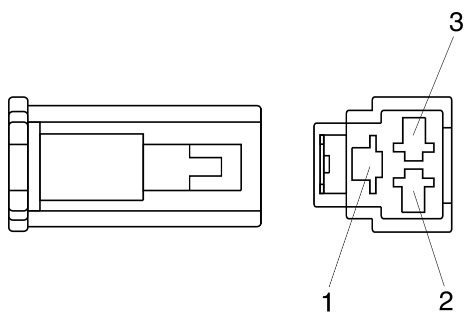
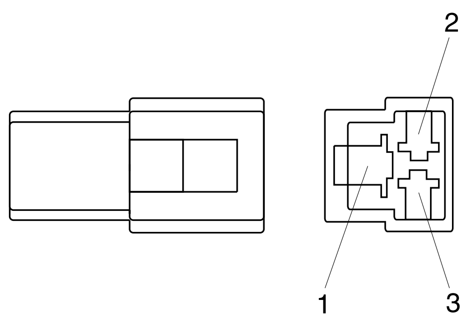
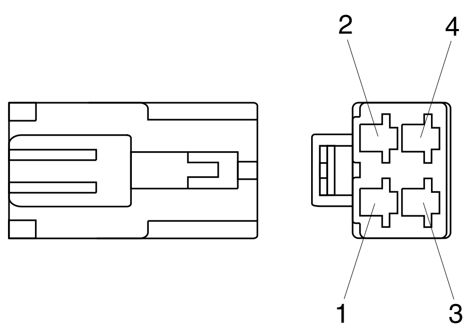
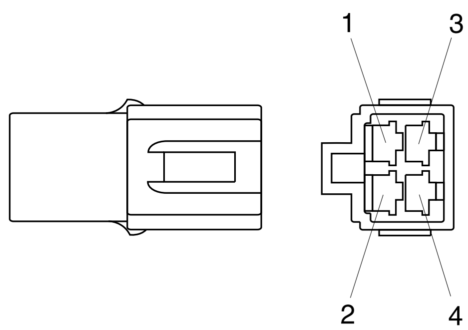
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

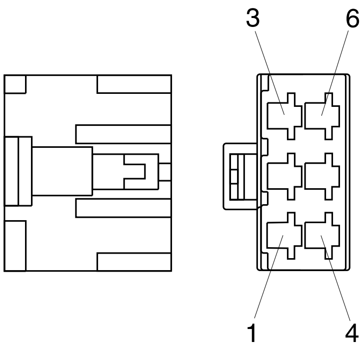
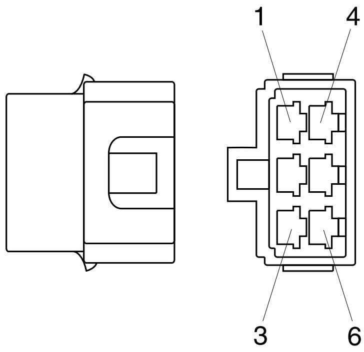
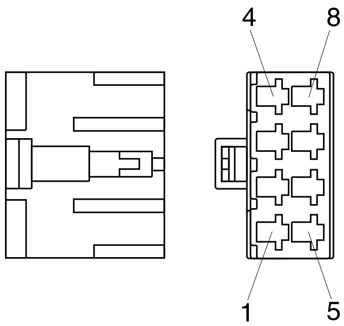
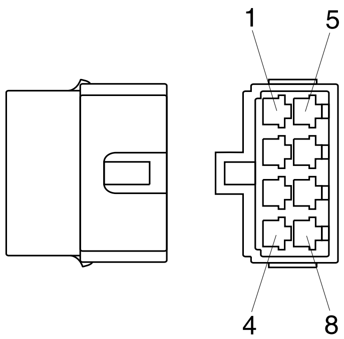
3) SWP TYPE CONNECTOR

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

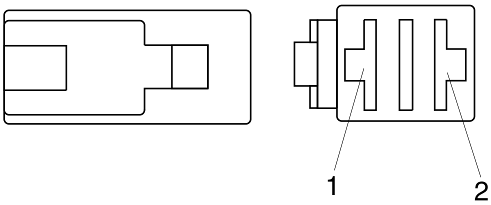
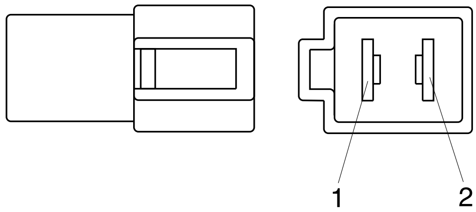
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

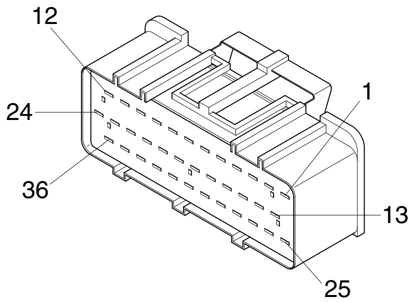
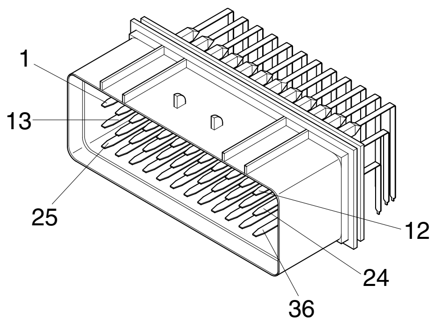
No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

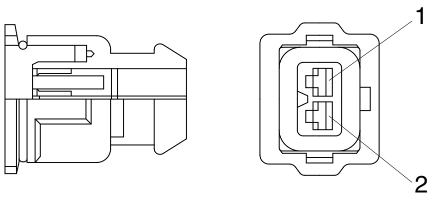
5) 375 FASTEN TYPE CONNECTOR

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

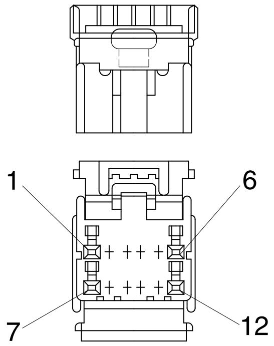
6) AMP ECONOSEAL CONNECTOR

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

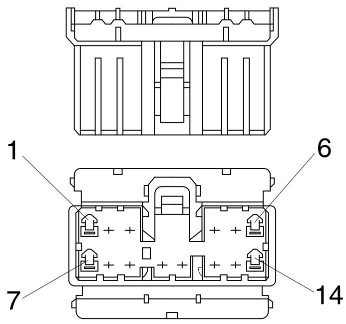
7) AMP TIMER CONNECTOR

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

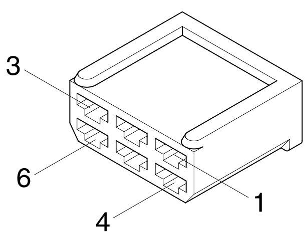
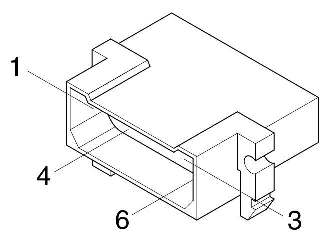
8) AMP 040 MULTILOCK CONNECTOR

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

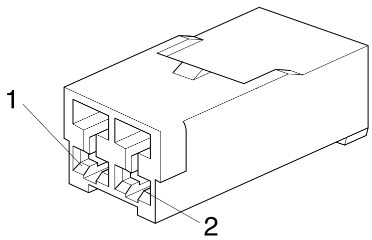
9) AMP 070 MULTILOCK CONNECTOR

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

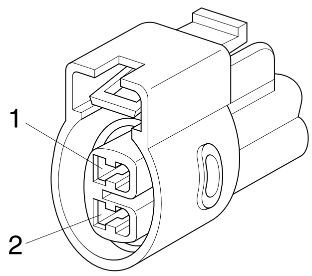
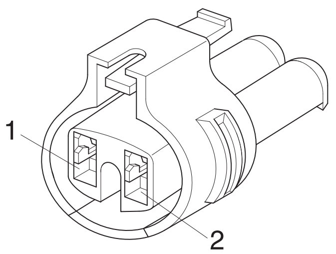
10) AMP FASTIN - FASTON CONNECTOR

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

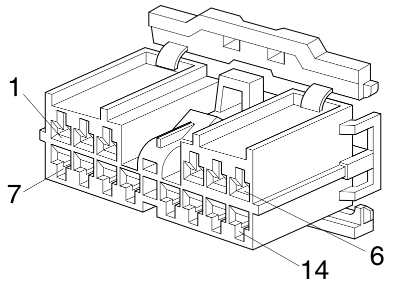
11) KET 090 CONNECTOR

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

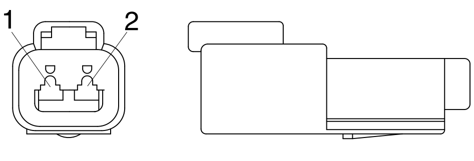
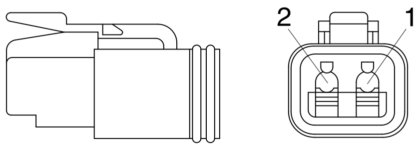
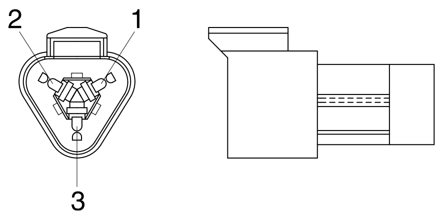
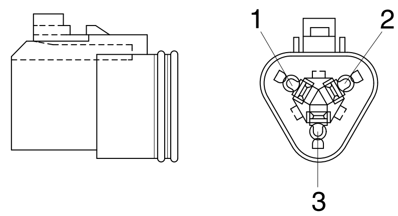
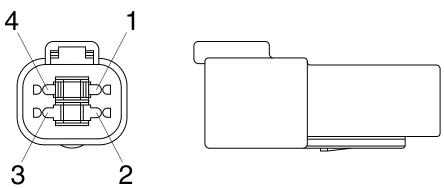
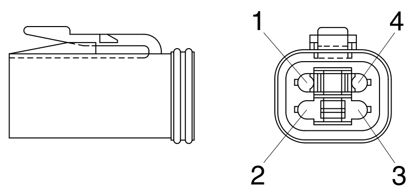
No. of pin	Receptacle connector(Female)	Plug connector(Male)
14	 MG610406	

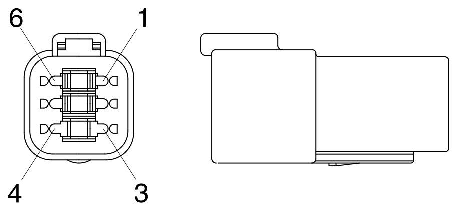
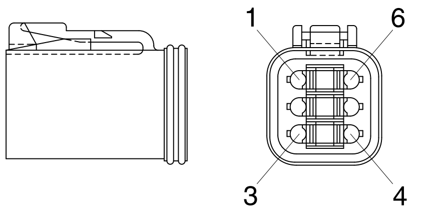
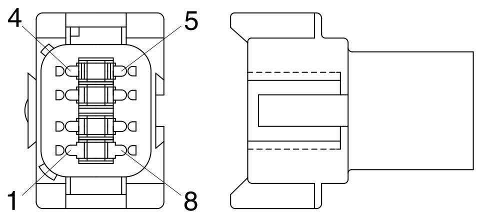
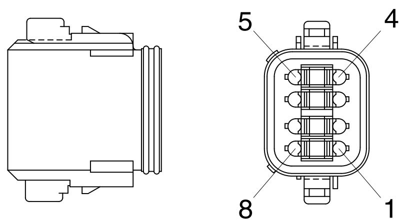
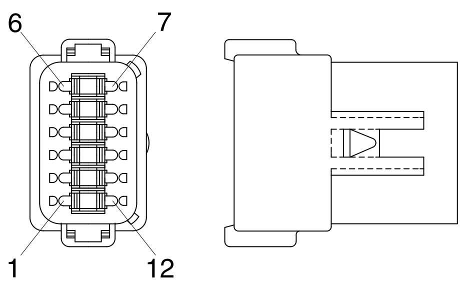
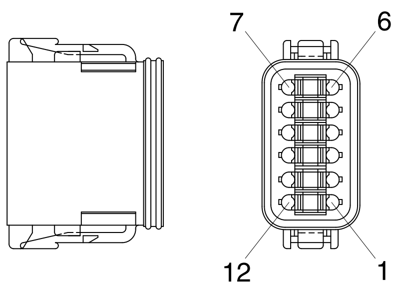
14) DEUTSCH DT CONNECTORS

DT 06 - 3S - ★★★★

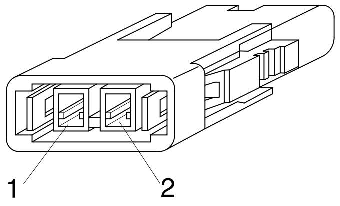
- ★★★★ : Modifications(See below)
- 3S : Number of contacts(P : Pin, S : Socket)
- 06 : 04 : Receptacle, 06 : Plug
- DT : Deutsch connetors

※ 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

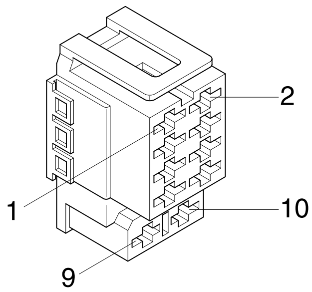
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

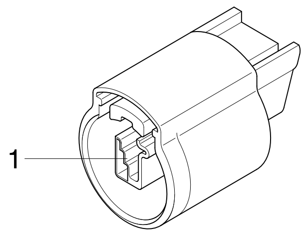
15) MOLEX 2CKTS CONNECTOR

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

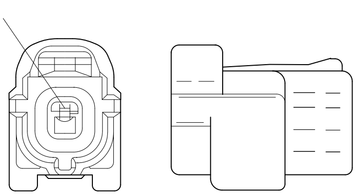
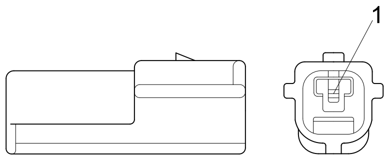
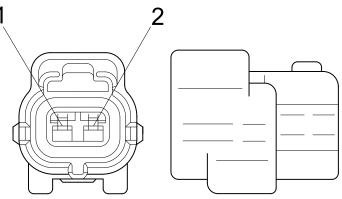
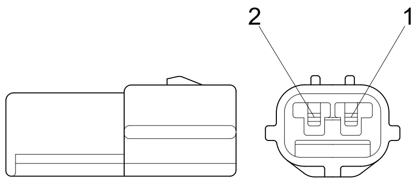
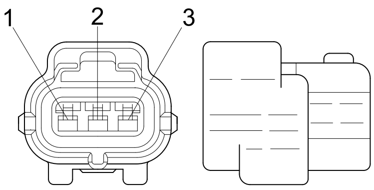
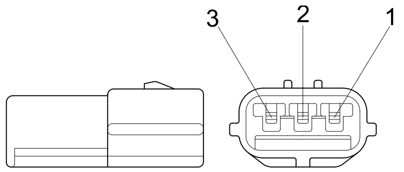
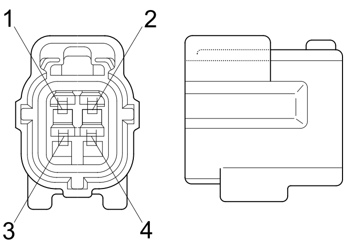
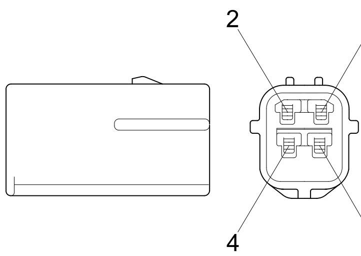
16) ITT SWF CONNECTOR

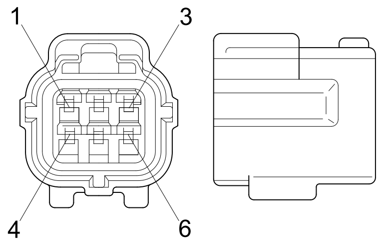
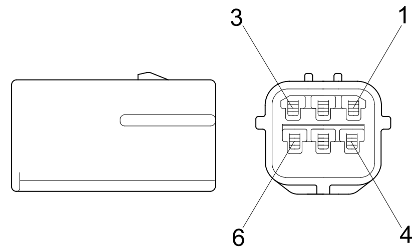
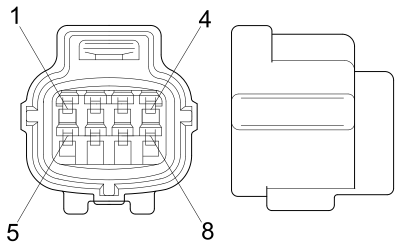
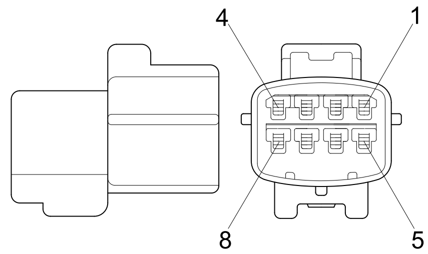
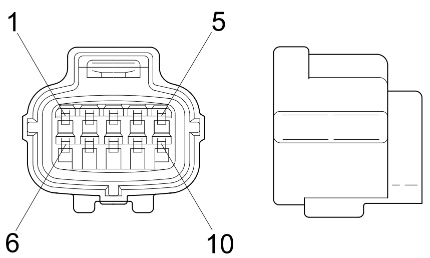
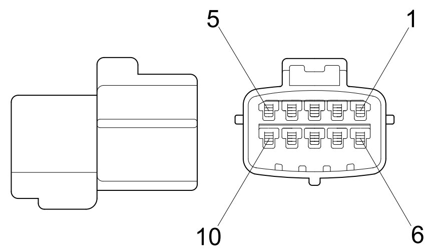
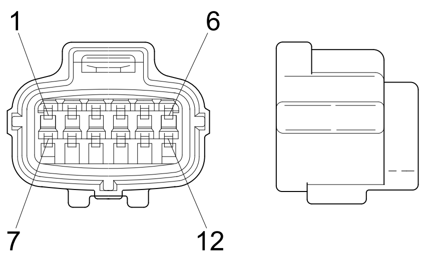
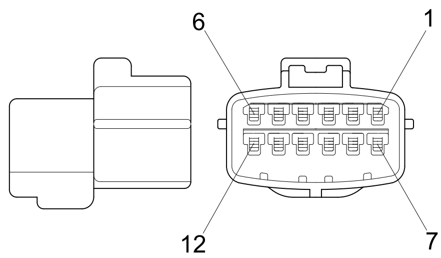
No. of pin	Receptacle connector(Female)	Plug connector(Male)
10	 SWF593757	

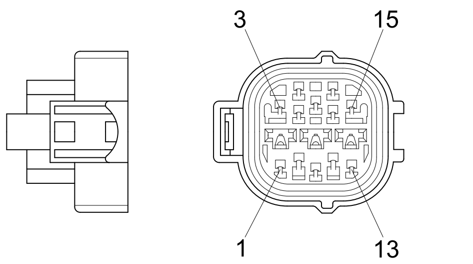
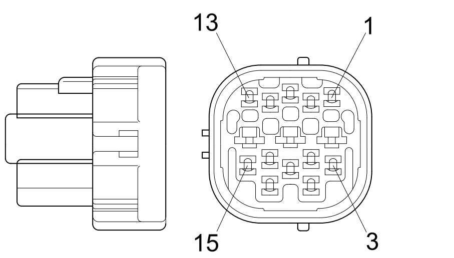
17) MWP NMWP CONNECTOR

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

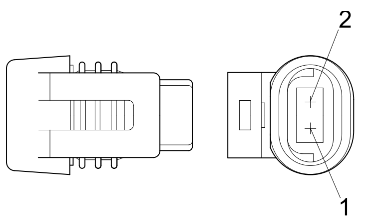
18) ECONOSEAL J TYPE CONNECTORS

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

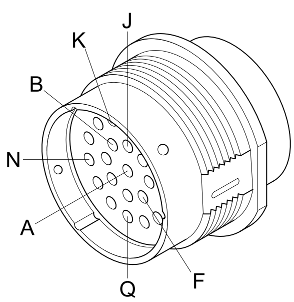
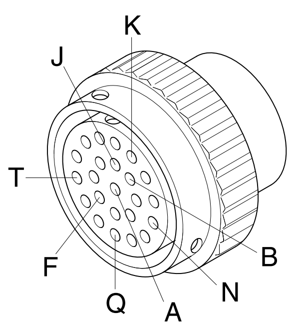
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

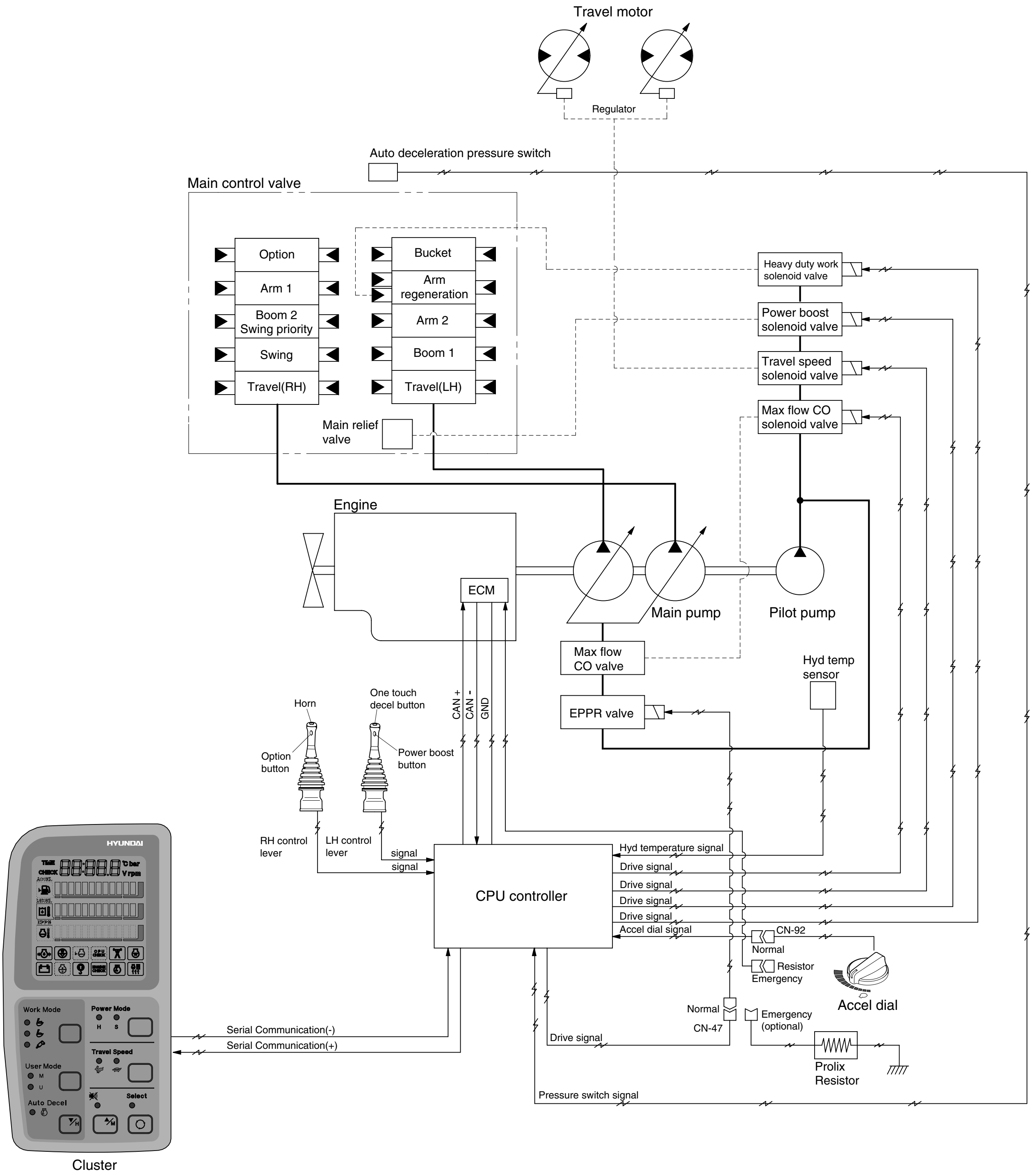
SECTION 5 MECHATRONICS SYSTEM

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 of 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
    - User mode system(M, U)
  - Auto deceleration system
  - Power boost 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
    - ECM Fault code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system
  - Heavy duty work system

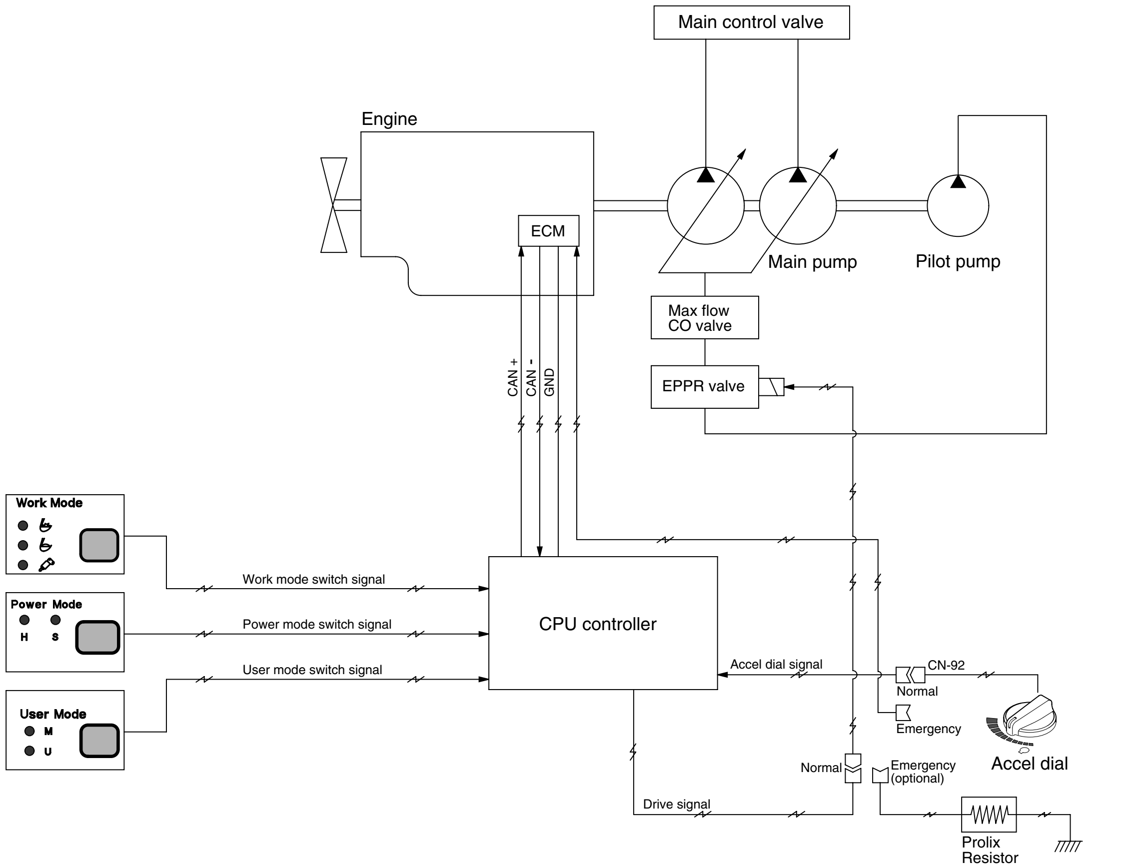
SYSTEM DIAGRAM



2907A5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



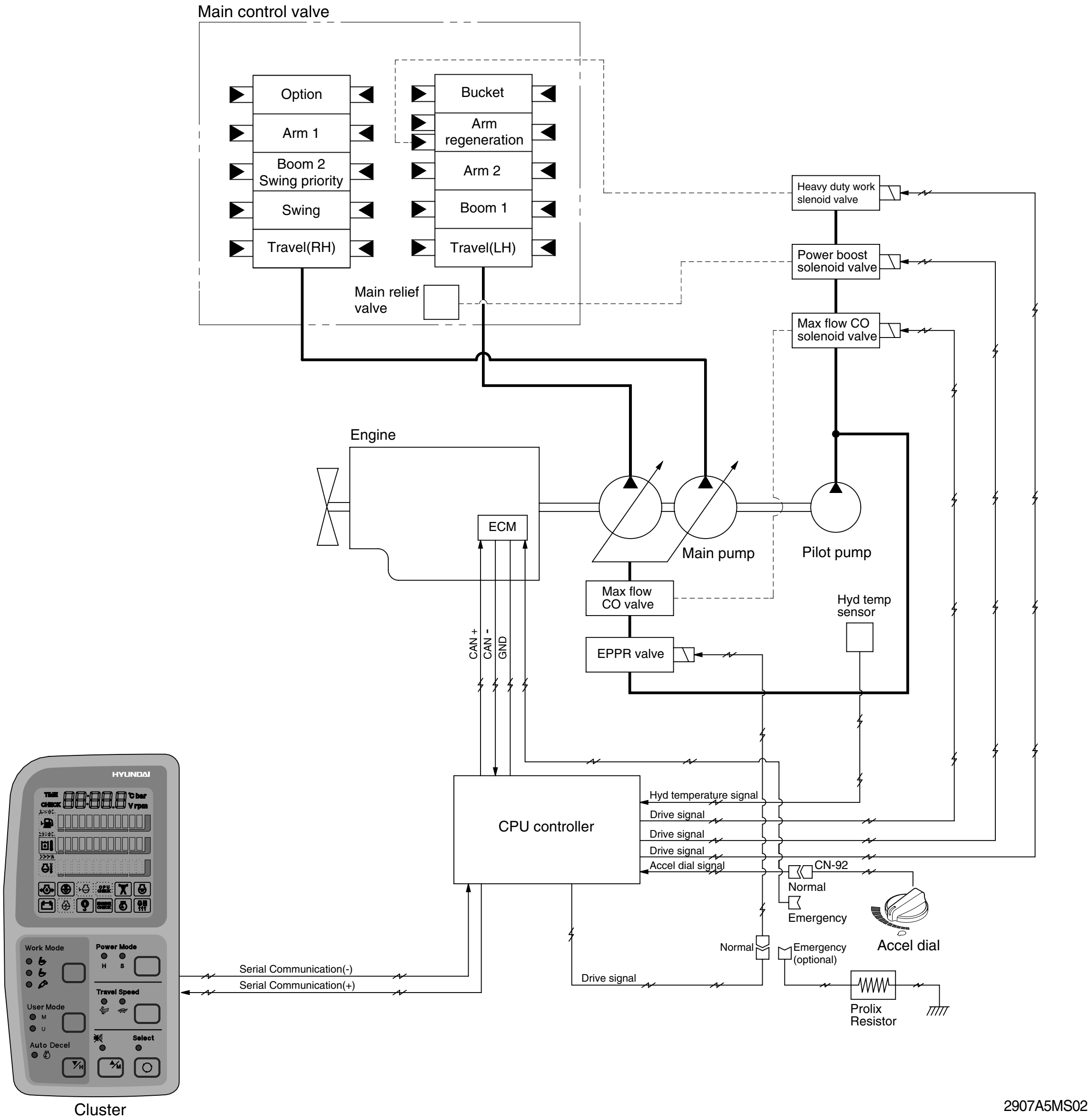
50075MS02

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)
M	Maximum power	95	1850±50	1800	250±30	5	160	0
H	High power	85	1850±50	1800	270±30	7	200	2
S	Standard power	70	1750±50	1700	330±30	10	225	4
AUTO DECEL	Engine deceleration	-	1050±100	-	700±30	35	700±30	35
One touch decel	Engine quick deceleration	-	800±100	-	700±30	35	700±30	35
KEY START	Key switch start position	-	800±100	-	700±30	35	700±30	35

2. WORK MODE SELECTION SYSTEM

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



1) HEAVY DUTY WORK MODE

The heavy duty work solenoid is activated to make the arm operation speed faster.

2) GENERAL WORK MODE

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

3) BREAKER OPERATION MODE

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

Work mode	Heavy duty work solenoid	Max flow cut-off solenoid
Heavy duty	OFF	OFF
General	ON	OFF
Breaker	OFF	ON

3. USER MODE SELECTION SYSTEM

An operator can change the engine and pump and memorize it for his preference.

Mode	Operation
U	High idle rpm, auto decel rpm EPPR pressure can be modulated and memorized separately

HOW TO MODULATE THE MEMORY SET

140W74OP03G

1) User mode has a initial set which are mid-range of max engine speed, auto decel rpm, and EPPR valve input current. When you select "U", cluster LCD displays.

2) To change the engine high idle speed, press the USER mode switch and SELECT switch at the same time and then ACCEL blinks at 0.5 seconds interval.
   - By pressing ▲ or ▼ switch, ▮ will increase or decrease.

3) To change DECEL rpm, press the USER mode switch and SELECT switch once more and then DECEL blinks at 0.5 seconds interval.
   - By pressing ▲ or ▼ switch, ▮ will increase or decrease.

4) To change EPPR current, press the USER mode switch and SELECT switch one more and then EPPR blinks at 0.5 seconds interval.
   - By pressing ▲ or ▼ switch, ▮ will increase or decrease.

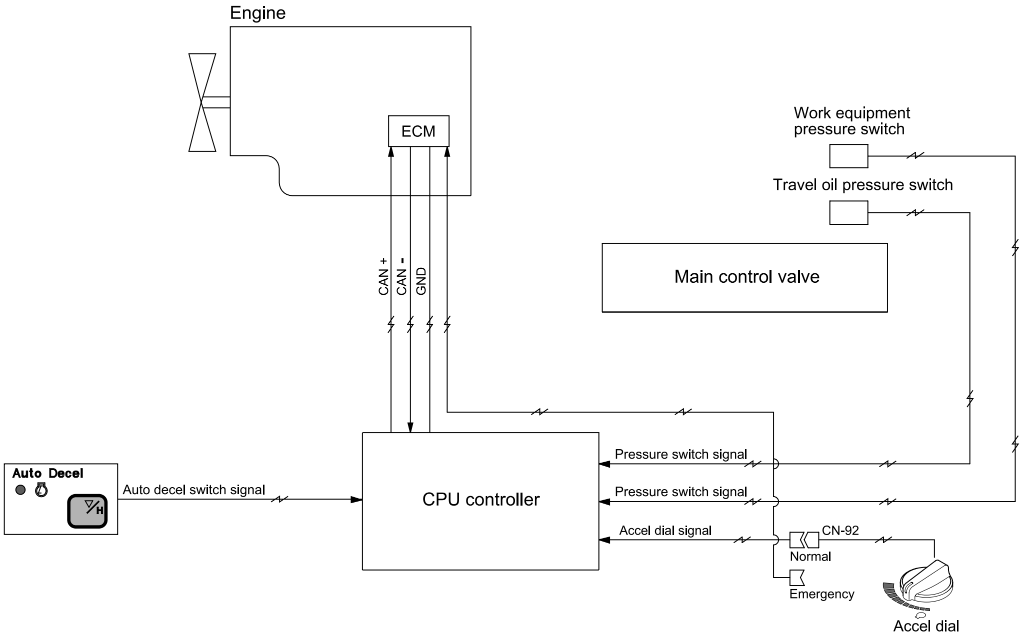
   · **LCD segment vs parameter setting**

Segment (▮)	ACCEL (rpm)	DECEL (rpm)	EPPR (mA)
1	1400	700	150
2	1450	800	200
3	1500	850	250
4	1550	900	300
5	1600	950	350
6	1650	1000	400
7	1700	Decel rpm(1050)	450
8	1750	1100	500
9	1800	1150	550
10	1850	1200	600

5) To memorize the final setting, press the USER mode switch and SELECT switch one more time.

45074OP06

GROUP 3 AUTOMATIC DECELERATION SYSTEM

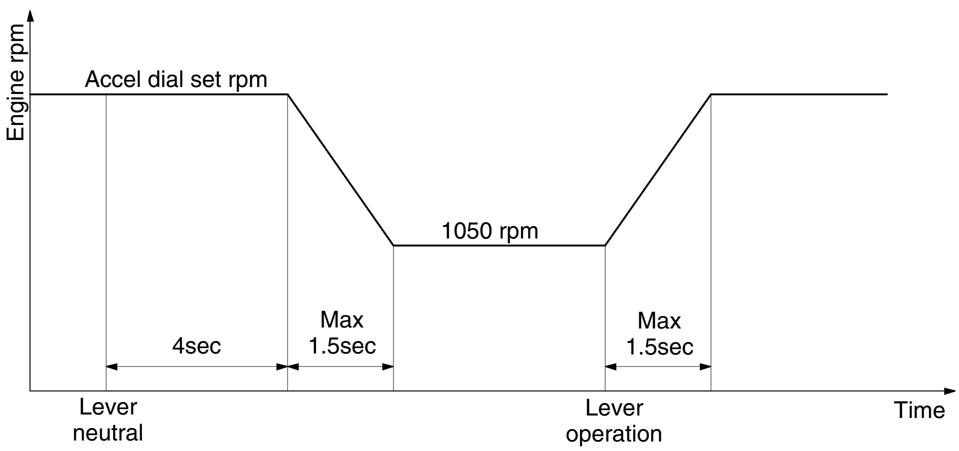


36075MS04

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 sends throttle command to ECM to reduce the engine speed to 1050rpm. 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.



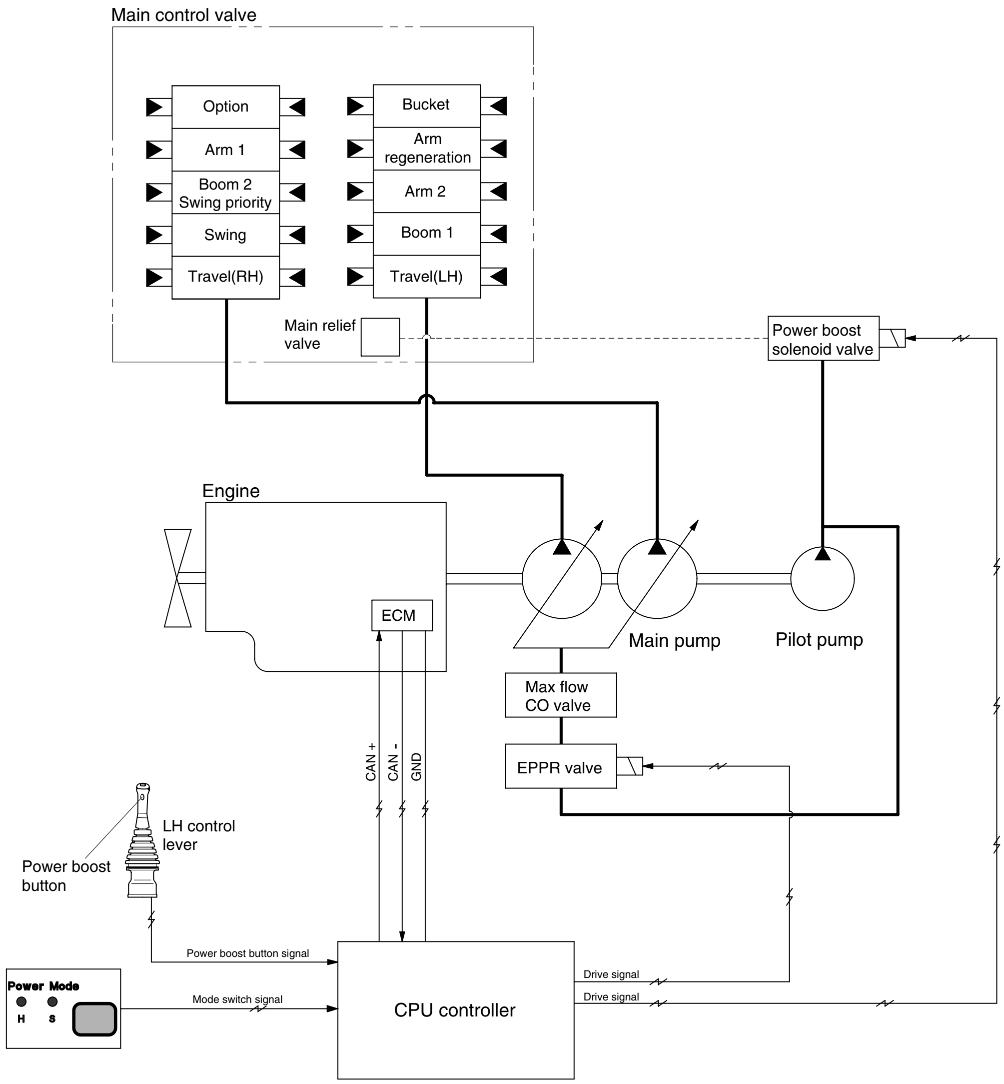
29075MS03

2. WHEN AUTO DECEL LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



2907A5MS04

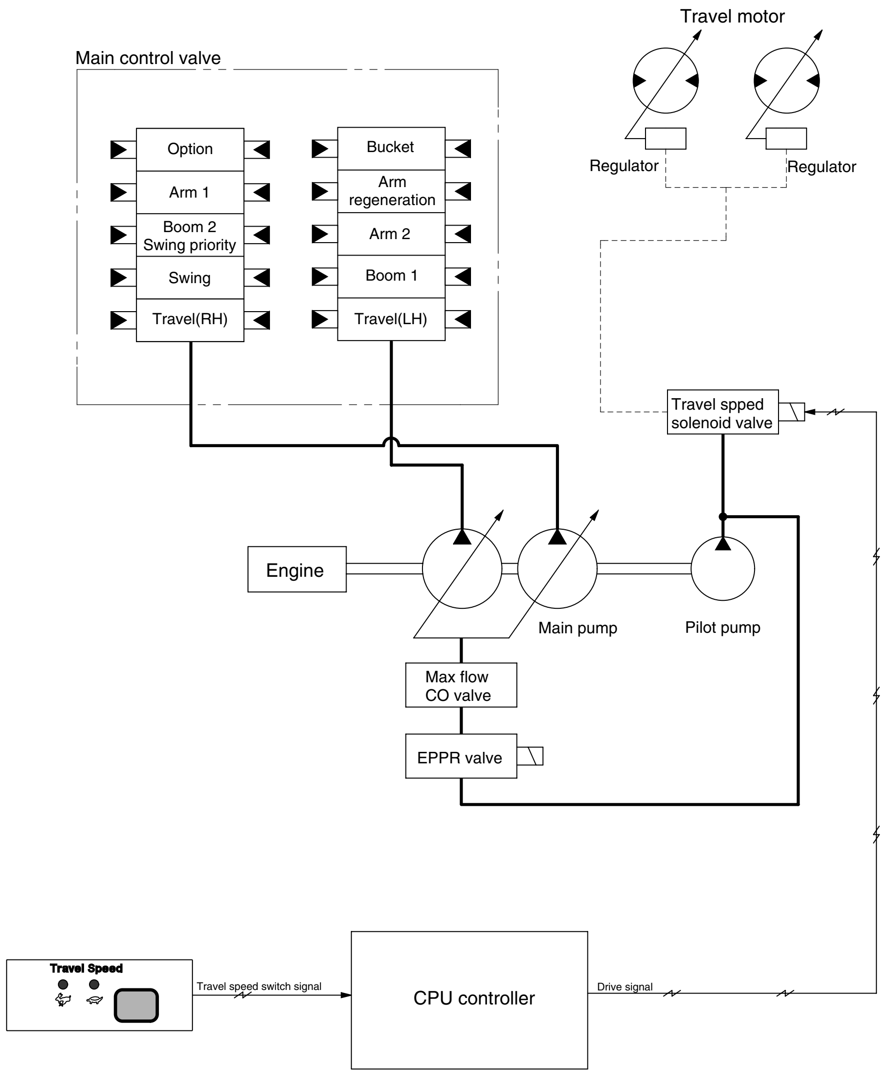
· When the power boost switch on the left control lever knob is pushed ON, the maximum digging power is increased by 10%.

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

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

※ Default - Power boost solenoid valve : OFF

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



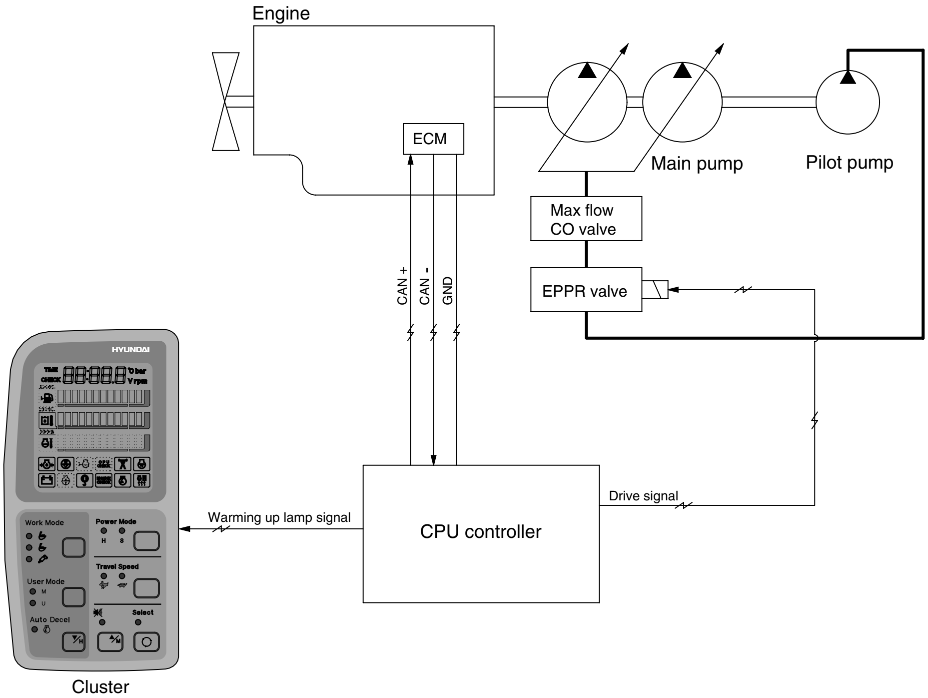
2907A5MS05

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

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

※ Default : Turtle(Lo)

GROUP 6 AUTOMATIC WARMING UP FUNCTION



2907A5MS06

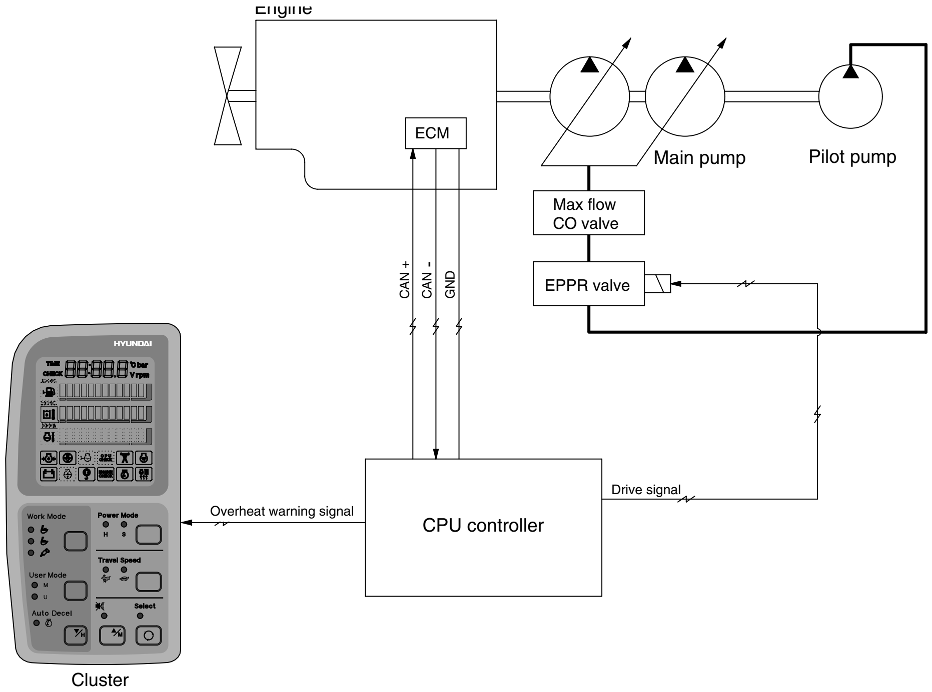
1. CPU controller receives engine coolant temperature from the ECM, and if the coolant temperature is less than 30°C, it increases the engine speed from key start rpm to 1050rpm.   At this time the mode does not change.

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 7 ENGINE OVERHEAT PREVENTION FUNCTION



2907A5MS07

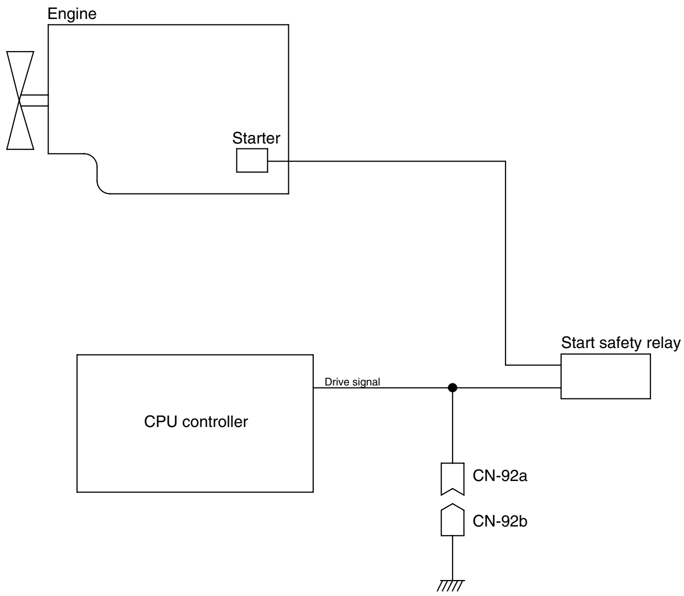
1. CPU controller receives engine coolant temperature from the ECM and when the engine coolant boils up to 110°C, it sends overheat warning signal to the cluster and decrease the engine speed same as accel dial **7** position.

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 8 ANTI-RESTART SYSTEM



21075MS10

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.

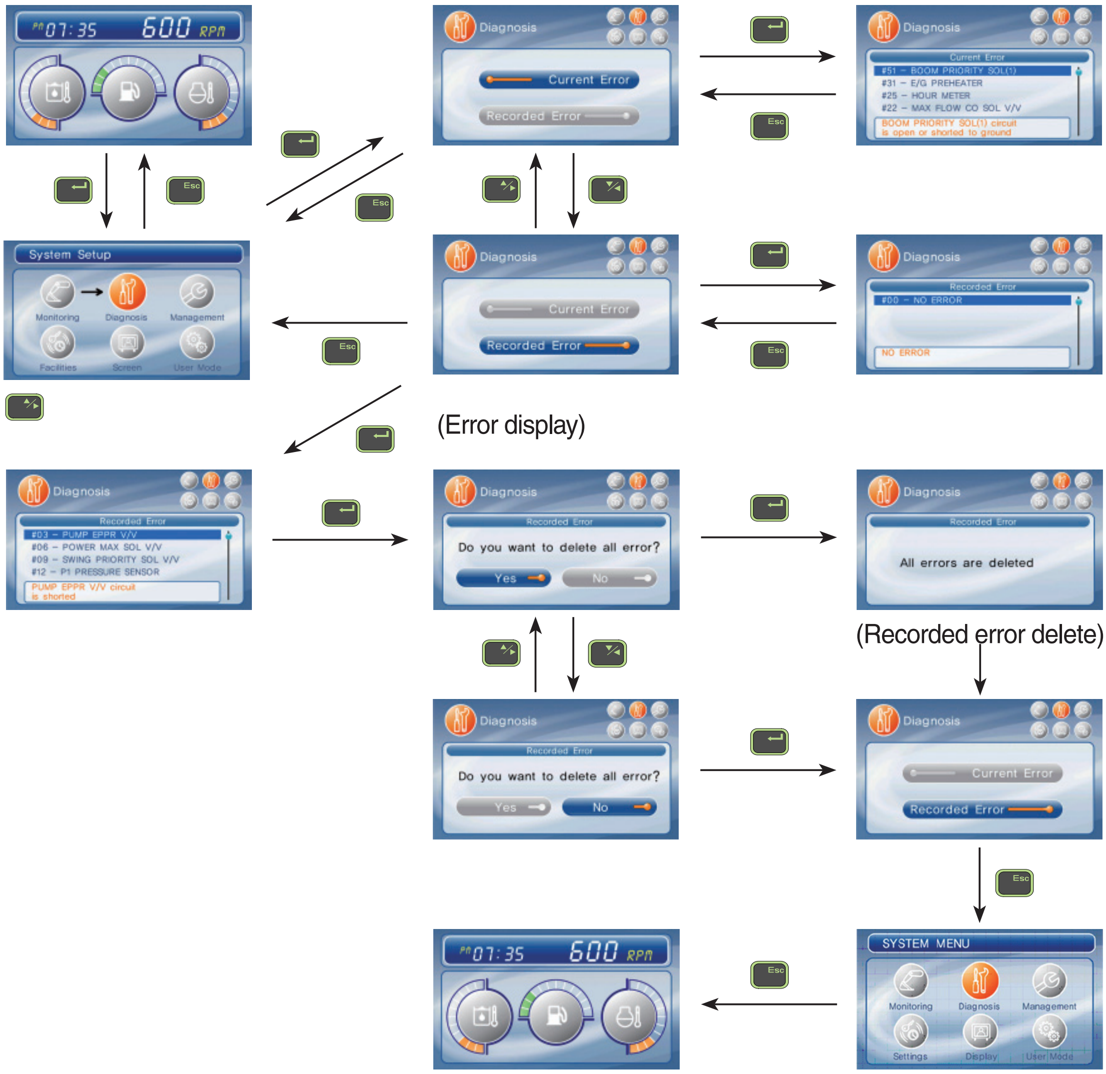
2. When a replacement or taking-off of the CPU controller is needed, connect CN-92a and CN-92b to ensure the engine start without the CPU controller.

GROUP 9 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

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

2. CURRENT ERROR DISPLAY



6. ECM FAULT CODES DISPLAY

If any fault code is received from ECM, cluster turns ON the “Engine check warning lamp” and sound the buzzer.

The fault codes are displayed on the cluster as the same as current error display.

ex) CHECK Er : 143

7. ERROR CODES TABLE

Error code No.	Description
1	Short circuit in accel actuator system
2	Potentiometer circuit is shorted to Vcc(5V) or battery +
3	Short circuit in pump EPPR valve system
4	Short circuit in boom down EPPR valve system
5	Short circuit in travel speed solenoid system
6	Short circuit in power boost solenoid system
7	Short circuit in max flow solenoid system
10	Short circuit in hour-meter system
11	Accel dial circuit is shorted to Vcc(5V) or battery +
12	P1 pressure sensor circuit is shorted to power supply(24V) line
13	P2 pressure sensor circuit is shorted to power supply(24V) line
14	P3 pressure sensor circuit is shorted to power supply(24) line
15	Boom down pressure circuit is shorted to power supply(24V) line
16	Accel actuator circuit is open or shorted to ground
17	Potentiometer circuit is open or shorted to ground
18	Pump EPPR valve circuit is open or shorted to ground
19	Boom down EPPR valve circuit is open or shorted to ground
20	Travel speed solenoid circuit is open or shorted to ground
21	Power boost solenoid circuit is open or shorted to ground
22	Max flow solenoid circuit is open or shorted to ground
25	Hour-meter circuit is open or shorted to ground
26	Accel dial circuit is open or shorted to ground
27	P1 pressure sensor circuit is open or shorted to ground
28	P2 pressure sensor circuit is open or shorted to ground
29	P3 pressure sensor circuit is open or shorted to ground
30	Boom down pressure sensor circuit is open or shorted to ground
31	Engine preheater circuit is open or shorted to ground
32	Travel alarm buzzer circuit is open or shorted to ground
33	Alternator circuit is open or shorted to ground
34	Controller input voltage is below 18V

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

8. ENGINE FAULT CODE INFORMATION

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
111 629 12	Engine control module critical internal failure - Bad intelligent device or component. Error internal to the ECM related to memory hardware failures or internal ECM voltage supply circuits.	Possible no noticeable performance effects, engine dying, or hard starting.
115 612 2	Engine magnetic crankshaft speed/position lost both of two signals - Data erratic, intermittent, or incorrect. The ECM has detected that the primary engine speed sensor and the backup engine speed sensor signals are reversed.	Fueling to injectors is disabled and the engine can not be started.
122 102 3	Intake manifold 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the intake manifold pressure circuit.	Engine power derate.
123 102 4	Intake manifold 1 pressure sensor circuit - Voltage below normal, or shorted to low Source. Low signal voltage or open circuit detected at the intake manifold pressure circuit.	Engine power derate.
124 102 16	Intake manifold 1 pressure - Data valid but above normal operational range - Moderately severe level. Intake manifold pressure has exceeded the maximum limit for the given engine rating.	Engine power derate.
131 91 3	Accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at accelerator pedal position circuit.	Severe derate in power output of the engine. Limp home power only.
132 91 4	Accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at accelerator pedal position signal circuit.	Severe derate in power output of the engine. Limp home power only.
133 974 3	Remote accelerator pedal or lever position sensor 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at remote accelerator pedal position circuit.	Remote accelerator will not operate. Remote accelerator position will be set to zero percent.
134 974 4	Remote accelerator pedal or lever position sensor 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at remote accelerator pedal position signal circuit.	Remote accelerator will not operate. Remote accelerator position will be set to zero percent.
135 100 3	Engine oil rifle pressure 1 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
141 100 4	Engine oil rifle pressure 1 sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at engine oil pressure circuit.	None on performance. No engine protection for oil pressure.
143 100 18	Engine oil rifle pressure - Data valid but below normal operational range - Moderately severe level.	None on performance.
144 110 3	Engine coolant temperature 1 sensor circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at engine coolant temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
145 110 4	Engine Coolant Temperature 1 Sensor Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at engine coolant temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for engine coolant temperature.
146 110 16	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Moderately Severe Level. Engine coolant temperature signal indicates engine coolant temperature is above engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
147 91 1	Accelerator Pedal or Lever Position 1 Sensor Circuit Frequency - Data Valid but Below Normal Operational Range - Most Severe Level. A frequency of less than 100 Hz has been detected at the frequency throttle input to the ECM.	Severe derate in power output of the engine. Limp home power only.
148 91 0	Accelerator Pedal or Lever Position Sensor 1 - Data Valid but Above Normal Operational Range - Most Severe Level. A frequency of more than 1500 Hz has been detected at the frequency throttle input to the ECM.	Severe derate in power output of the engine. Limp home power only.
151 110 0	Engine Coolant Temperature - Data Valid but Above Normal Operational Range - Most Severe Level. Engine coolant temperature signal indicates engine coolant temperature above engine protection critical limit.	Progressive power derate increasing in severity from time of alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after Red Stop Lamp starts flashing.
153 105 3	Intake Manifold 1 Temperature Sensor Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage detected at intake manifold air temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
154 105 4	Intake Manifold 1 Temperature Sensor Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at intake manifold air temperature circuit.	Possible white smoke. Fan will stay ON if controlled by ECM. No engine protection for intake manifold air temperature.
155 105 0	Intake Manifold 1 Temperature - Data Valid but Above Normal Operational Range - Most Severe Level. Intake manifold air temperature signal indicates intake manifold air temperature above engine protection critical limit.	Progressive power derate increasing in severity from time of alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after Red Stop Lamp starts flashing.
187 520195 4	Sensor Supply 2 Circuit - Voltage Below Normal, or Shorted to Low Source. Low voltage detected at the sensor supply number 2 circuit.	Engine power derate.
195 111 3	Coolant Level Sensor 1 Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage detected at engine coolant level circuit.	None on performance.
196 111 4	Coolant Level Sensor 1 Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at engine coolant level circuit.	None on performance.
197 111 18	Coolant Level - Data Valid but Below Normal Operational Range - Moderately Severe Level. Low coolant level has been detected.	None on performance.
221 108 3	Barometric Pressure Sensor Circuit - Voltage Above Normal, or Shorted to High Source. High signal voltage detected at barometric pressure circuit.	Engine power derate.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
222 108 4	Barometric Pressure Sensor Circuit - Voltage Below Normal, or Shorted to Low Source. Low signal voltage detected at barometric pressure circuit.	Engine power derate.
227 520195 3	Sensor Supply 2 Circuit - Voltage Above Normal, or Shorted to High Source. High voltage detected at sensor supply number 2 circuit.	Engine power derate.
234 190 0	Engine Crankshaft Speed/Position - Data Valid but Above Normal Operational Range - Most Severe Level. Engine speed signal indicates engine speed above engine protection limit.	Fuel injection disabled until engine speed falls below the overspeed limit.
235 111 1	Coolant Level - Data Valid but Below Normal Operational Range - Most Severe Level. Low engine coolant level detected.	Progressive power derate increasing in severity from time of alert. If Engine Protection Shutdown feature is enabled, engine will shut down 30 seconds after Red Stop Lamp starts flashing.
237 644 2	External Speed Command Input (Multiple Unit Synchronization) - Data Erratic, Intermittent, or Incorrect. Communication between multiple engines may be intermittent.	
238 520196 4	Sensor Supply 3 Circuit - Voltage Below Normal, or Shorted to Low Source. Low voltage detected on the +5 volt sensor supply circuit to the engine speed sensor.	Possible hard starting and rough running.
241 84 2	Wheel-based vehicle speed - Data erratic, intermittent, or incorrect. The ECM lost the vehicle speed signal.	Engine speed limited to ,maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed governor will not work.
242 84 10	Wheel-based vehicle speed sensor circuit tampering has been detected - Abnormal rate of change. Signal indicates an intermittent connection or VSS tampering.	Engine speed limited to maximum engine speed without VSS parameter value. Cruise control, gear-down protection, and road speed g+H53overnor will not work.
245 647 4	Fan control circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fan control circuit when commanded on.	The fan may stay on continuously or not run at all.
271 1347 4	Fuel pump pressurizing assembly 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fuel pump actuator circuit.	Engine will run poorly at idle. Engine will have low power. Fuel pressure will be higher than commanded.
272 1347 3	Fuel pump pressurizing assembly 1 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the fuel pump actuator circuit.	Engine will not run or engine will run poorly.
281 1347 7	Fuel pump pressurizing assembly 1 - Mechanical system not responding properly or out of adjustment.	Engine will not run or possible low power.
285 639 9	SAE J1939 multiplexing PGN timeout error - Abnormal update rate. The ECM expected information from a multiplexed device but did not receive it soon enough or did not receive it at all.	At least one multiplexed device will not operate properly.
286 639 13	SAE J1939 multiplexing configuration error - Out of calibration. The ECM expected information from a multiplexed device but only received a portion of the necessary information.	At least one multiplexed device will not operate properly.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
287 91 19	SAE J1939 multiplexed accelerator pedal or lever sensor system - received network data In error. The OEM vehicle electronic control unit (VECU) detected a fault with its accelerator pedal.	Engine may only idle or engine will not accelerate to full speed.
288 974 19	SAE J1939 Multiplexing Remote Accelerator Pedal or Lever Position Sensor Circuit - Received Network Data In Error. The OEM vehicle electronic control unit (VECU) detected a fault with the remote accelerator.	The engine will not respond to the remote throttle. Engine may only idle. The primary or cab accelerator may be able to be used.
292 441 14	Auxiliary temperature Sensor Input 1 - Special instructions.	Possible engine power derate.
293 441 3	Auxiliary temperature sensor input 1 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit detected at the OEM auxiliary temperature circuit.	None on performance.
294 441 4	Auxiliary temperature sensor input 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the OEM auxiliary temperature circuit.	None on performance.
296 1388 14	Auxiliary pressure sensor input 1 - Special instructions.	Possible engine power derate.
297 1388 3	Auxiliary pressure sensor input 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the OEM pressure circuit.	None on performance.
298 1388 4	Auxiliary pressure sensor input 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage or open circuit detected at the OEM pressure circuit.	None on performance.
319 251 2	Real time clock power interrupt - Data erratic, intermittent, or incorrect. Real time clock lost power.	None on performance. Data in the ECM will not have accurate time and date information.
322 651 5	Injector solenoid driver cylinder 1 circuit - Current below normal, or open circuit. High resistance detected on injector number 1 circuit or no current detected at number 1 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
323 655 5	Injector solenoid driver cylinder 5 circuit - Current below normal, or open circuit. High resistance detected on injector number 5 circuit or no current detected at number 5 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
324 653 5	Injector solenoid driver cylinder 3 circuit - Current below normal, or open circuit. High resistance detected on injector number 3 circuit or no current detected at number 3 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
325 656 5	Injector solenoid driver cylinder 6 circuit - Current below normal, or open circuit. High resistance detected on injector number 6 circuit or no current detected at number 6 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
331 652 5	Injector solenoid driver cylinder 2 circuit - Current below normal, or open circuit. High resistance detected on injector number 2 circuit or no current detected at number 2 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
332 654 5	Injector solenoid driver cylinder 4 circuit - Current below normal, or open circuit. High resistance detected on injector number 4 circuit or no current detected at number 4 injector driver or return pin when the voltage supply at the harness is on.	Engine can possibly misfire or run rough.
334 110 2	Engine coolant temperature - Data erratic, intermittent, or incorrect. The engine coolant temperature reading is not changing with engine operating conditions.	The ECM will estimate engine coolant temperature.
342 630 13	Electronic calibration code incompatibility - Out of calibration. An incompatible calibration has been detected in the ECM.	Possible no noticeable performance effects, engine dying, or hard starting.
343 620 12	Engine control module warning internal hardware failure - Bad intelligent device or component. Internal ECM failure.	No performance effects or possible severe power derate.
351 627 12	Injector power supply - Bad intelligent device or component. The ECM measured injector boost voltage is low.	Possible smoke, low power, engine misfire, and/or engine will not start.
352 1079 4	Sensor supply 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at sensor supply number 1 circuit.	Engine power derate.
386 1079 3	Sensor supply 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at sensor supply number 1 circuit.	Engine power derate.
415 100 1	Engine oil rifle pressure - Data valid but below normal operational range - Most severe level. Oil pressure signal indicates oil pressure below the engine protection critical limit.	Progressive power derate increasing in severity from time of alert. If engine protection shutdown feature is enabled, engine will shut down 30 seconds after red stop lamp starts flashing.
418 97 15	Water in fuel indicator - Data valid but above normal operational range - Least severe level. water has been detected in the fuel filter.	Possible white smoke, loss of power, or hard starting.
428 97 3	Water in fuel indicator sensor circuit - Voltage above normal, or shorted to high source. High voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
429 97 4	Water in fuel indicator sensor circuit - Voltage below normal, or shorted to low source. Low voltage detected at the water in fuel circuit.	None on performance. No water in fuel warning available.
431 558 2	Accelerator pedal or lever idle validation switch - Data erratic, intermittent, or incorrect. Voltage detected simultaneously on both idle validation and off-idle validation switches.	Engine will only idle.
432 558 13	Accelerator pedal or lever idle validation circuit - Out of calibration. Voltage at idle validation on-idle and off-idle circuit does not match accelerator pedal position.	Engine will only idle.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
435 100 2	Engine oil rifle pressure - Data erratic, intermittent, or incorrect. An error in the engine oil pressure switch signal was detected by the ECM.	None on performance. No engine protection for oil pressure.
441 168 18	Battery 1 voltage - Data valid but below normal operational range - Moderately severe level. ECM supply voltage is below the minimum system voltage level.	Engine may stop running or be difficult to start.
442 168 16	Battery 1 Voltage - Data valid but above normal operational range - Moderately severe level. ECM supply voltage is above the maximum system voltage level.	Possible electrical damage to all electrical components.
449 157 0	Injector metering rail 1 pressure - Data valid but above normal operational range - Most severe level.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced.
451 157 3	Injector metering rail 1 pressure sensor circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the rail fuel pressure sensor circuit.	Power and or speed derate.
452 157 4	Injector metering rail 1 pressure sensor circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the rail fuel pressure sensor circuit.	Power and or speed derate.
488 157 16	Intake manifold 1 temperature - Data valid but above normal operational range - Moderately severe level. Intake manifold air temperature signal indicates intake manifold air temperature is above the engine protection warning limit.	Progressive power derate increasing in severity from time of alert.
497 1377 2	Multiple unit synchronization switch - Data erratic, intermittent, or incorrect.	
523 611 2	Auxiliary intermediate (PTO) speed switch validation - Data erratic, intermittent, or incorrect.	None on performance.
527 702 3	Auxiliary input/output 2 circuit - Voltage above normal, or shorted to high source. High signal voltage or open circuit has been detected at the auxiliary input/output 2 circuit.	None on performance.
528 93 2	Auxiliary alternate torque validation switch - Data erratic, intermittent, or incorrect.	None on performance.
529 703 3	Auxiliary input/output 3 circuit - Voltage above normal, or shorted to high source. Low signal voltage has been detected at the auxiliary input/output 2 circuit.	
553 157 16	Injector metering rail 1 pressure - Data valid but above normal operational range - Moderately severe level. The ECM has detected that fuel pressure is higher than commanded pressure.	The ECM will estimate fuel pressure and power is reduced.
554 157 2	Injector metering rail 1 pressure - Data erratic, Intermittent, or incorrect. The ECM has detected that the fuel pressure signal is not changing.	Possibly hard to start, low power, or engine smoke.

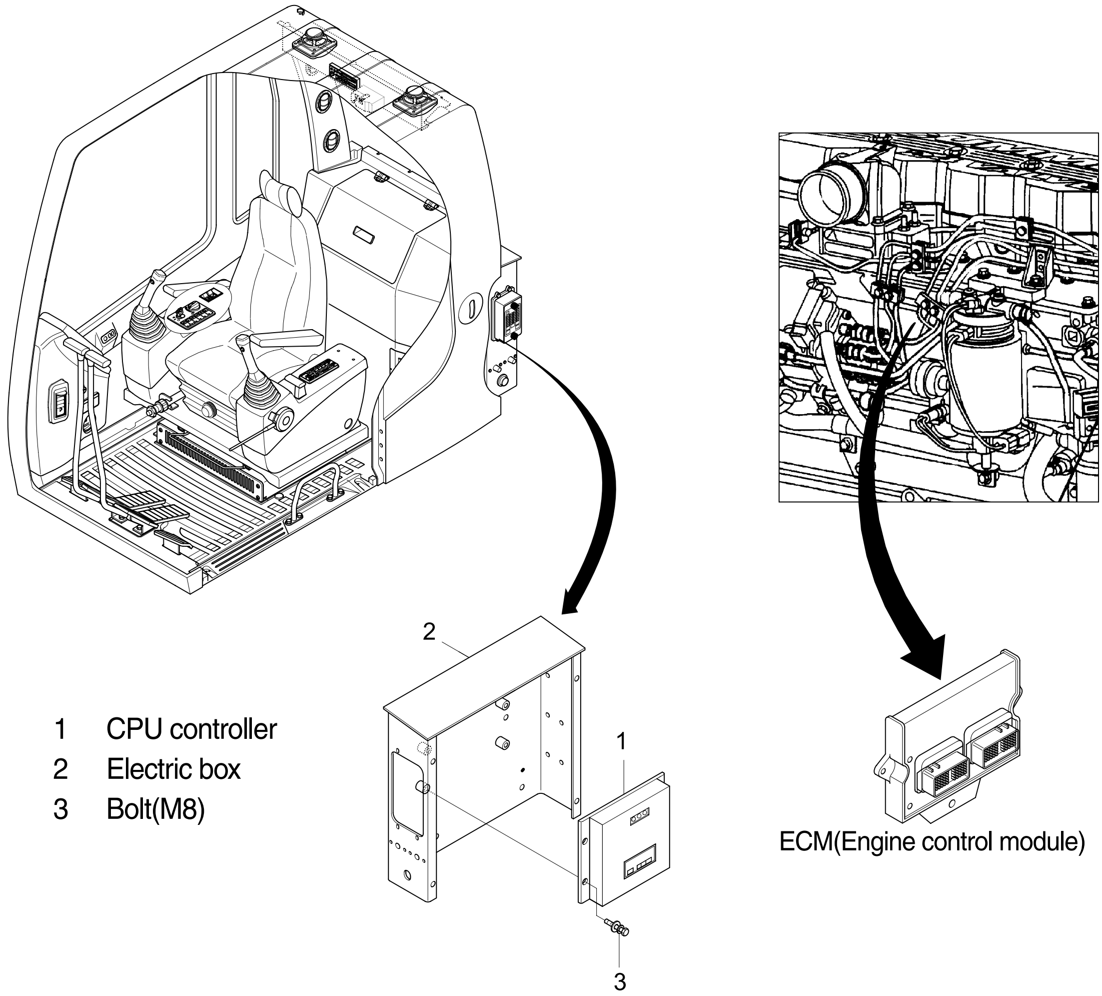
Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
559 157 18	Injector metering rail 1 pressure - Data Valid but Below Normal Operational Range - Moderately Severe Level. The ECM has detected that fuel pressure is lower than commanded pressure.	Either the engine will not start or the engine will not have starter lockout protection.
584 677 3	Starter relay driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at starter lockout circuit.	The engine will not have starter lockout protection.
585 677 4	Starter relay driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at starter lockout circuit.	Engine power derate. The ECM uses an estimated turbocharger speed.
595 103 16	Turbocharger 1 speed - Data valid but above normal operational range - Moderately severe level. High turbocharger speed has been detected.	Amber lamp will light until high battery voltage condition is corrected.
599 640 14	Auxiliary commanded dual output shutdown - Special instructions.	None or possible engine noise associated with higher injection pressures (especially at idle or light load). Engine power is reduced.
687 103 18	Turbocharger 1 speed - Data valid but below normal operational range - Moderately severe level. Low turbocharger speed detected by the ECM.	Engine can run rough. Possibly poor starting capability. Engine runs using backup speed sensor. Engine power is reduced.
689 190 2	Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. Loss of signal from crankshaft sensor.	Engine power derate.
691 1172 3	Turbocharger 1 compressor inlet temperature circuit - Voltage above normal, or shorted to high source. High signal voltage detected at turbocharger compressor inlet air temperature circuit.	Engine power derate.
692 1172 4	Turbocharger 1 compressor inlet temperature circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at turbocharger compressor inlet air tempera	Engine will run derated. Excessive black smoke, hard start, and rough idle possible.
731 723 7	Engine speed / position camshaft and crankshaft misalignment - Mechanical system not responding properly or out of adjustment. mechanical misalignment between the crankshaft and camshaft engine speed sensors.	Possible no noticeable performance effects, engine dying, or hard starting.
757 611 31	Electronic control module data lost - Condition exists. Severe loss of data from the ECM.	Possible poor starting. Engine power derate.
778 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. The ECM has detected an error in the camshaft position sensor signal.	Possible engine power derate.
779 703 11	Auxiliary equipment sensor input 3 - Root cause not known.	Possible no noticeable performance effects or engine dying or hard starting. Fault information, trip information, and maintenance monitor data may be inaccurate.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
1117 627 2	Power supply lost with ignition on - Data erratic, intermittent, or incorrect. Supply voltage to the ECM fell below 6.2 volts momentarily, or the ECM was not allowed to power down correctly (retain battery voltage for 30 seconds after key OFF).	Engine will shut down.
1633 625 2	OEM datalink cannot transmit - Data erratic, intermittent, or incorrect. Communications within the OEM datalink network is intermittent.	Engine will only idle.
2185 520197 3	Sensor supply 4 circuit - Voltage above normal, or shorted to high source. High voltage detected at +5 volt sensor supply circuit to the accelerator pedal position sensor.	Engine will only idle.
2186 520197 4	Sensor supply 4 circuit - Voltage below normal, or shorted to low source. Low voltage detected at +5 volt sensor supply circuit to the accelerator pedal position sensor.	Possibly hard to start, low power, or engine smoke.
2249 157 1	Injector metering rail 1 pressure - Data valid but below normal operational range - Most severe level. The ECM has detected that fuel pressure is lower than commanded pressure.	Engine may be difficult to start.
2265 1075 3	Electric lift pump for engine fuel supply circuit - Voltage above normal, or shorted to high source. High voltage or open detected at the fuel lift pump signal circuit.	Engine may be difficult to start.
2266 1075 4	Electric lift pump for engine fuel supply circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the fuel lift pump circuit.	Possible low power.
2311 633 31	Electronic fuel injection control valve circuit - Condition exists. Fuel pump actuator circuit resistance too high or too low.	Engine may exhibit misfire as control switches from the primary to the backup speed sensor. Engine power is reduced while the engine operates on the backup speed sensor.
2321 190 2	Engine crankshaft speed/position - Data erratic, intermittent, or incorrect. crankshaft engine speed sensor intermittent synchronization.	Possible low power.
2322 723 2	Engine camshaft speed / position sensor - Data erratic, intermittent, or incorrect. Camshaft engine speed sensor intermittent synchronization.	Engine power derate.
2345 103 10	Turbocharger 1 Speed - Abnormal rate of change. The turbocharger speed sensor has detected an erroneous speed value.	Engine power derate.
2346 2789 15	Turbocharger turbine inlet temperature (Calculated) - Data valid but above normal operational range - Least severe level. Turbocharger turbine inlet temperature has exceeded the engine protection limit.	Engine power derate.
2347 2790 15	Turbocharger compressor outlet temperature (Calculated) - Data valid but above normal operational range - Least severe level.	Engine brake on cylinders 1, 2, and 3 can not be activated or exhaust brake will not operate.
2377 647 3	Fan control circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at the fan control circuit.	Variable geometry turbocharger will go to the open position.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
2384 641 4	VGT actuator driver circuit - Voltage below normal, or shorted to low source. Low voltage detected at turbocharger control valve circuit.	Variable geometry turbocharger may be in either the open or closed position.
2385 641 3	VGT actuator driver circuit - Voltage above normal, or shorted to high source. Open circuit or high voltage detected at turbocharger control valve circuit.	The intake air heaters may be ON or OFF all the time.
2555 729 3	Intake air heater 1 circuit - Voltage above normal, or shorted to high source. High voltage detected at the intake air heater signal circuit.	The intake air heaters may be ON or OFF all the time.
2556 729 4	Intake air heater 1 circuit - Voltage below normal, or shorted to low source. Low voltage detected at the intake air heater signal circuit.	Can not control transmission.
2557 697 3	Auxiliary PWM driver 1 circuit - Voltage above normal, or shorted to high source. High signal voltage detected at the analog torque circuit.	Can not control transmission.
2558 697 4	Auxiliary PWM driver 1 circuit - Voltage below normal, or shorted to low source. Low signal voltage detected at the analog torque circuit.	Power derate and possible engine shutdown if engine protection shutdown feature is enabled.
2973 102 2	Intake manifold 1 pressure - Data erratic, intermittent, or incorrect. The ECM has detected an intake manifold pressure signal that is too high or low for current engine operating conditions.	

GROUP 10 ENGINE CONTROL SYSTEM

1. CPU CONTROLLER AND ECM



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.

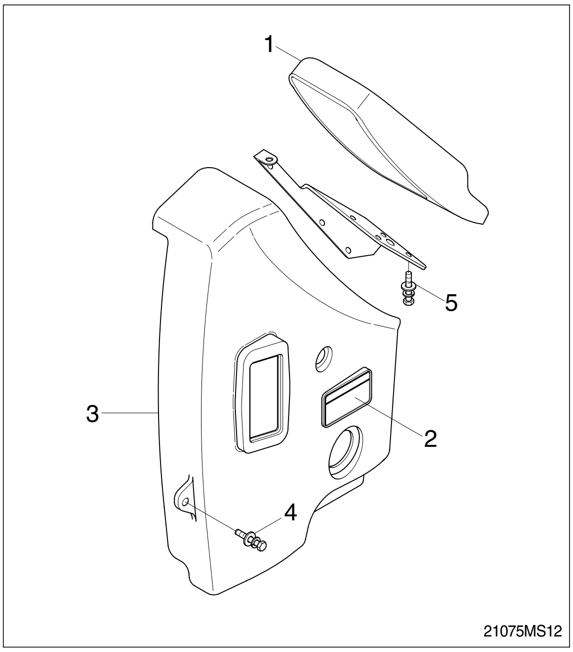
(2) If not, but CAPO system does not work please report it to HHI dealer or A/S department.

3. EXCHANGE METHOD OF THE ROM IN THE CLUSTER

1) Disassemble the ash tray(2).

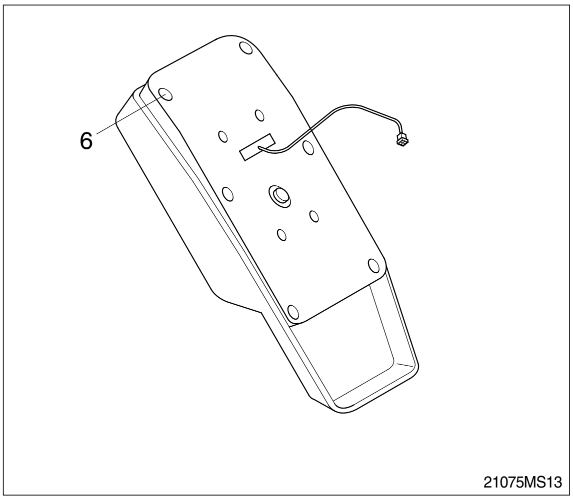
2) Disassemble the wiper motor cover(3).

3) Disassemble the cluster(1).

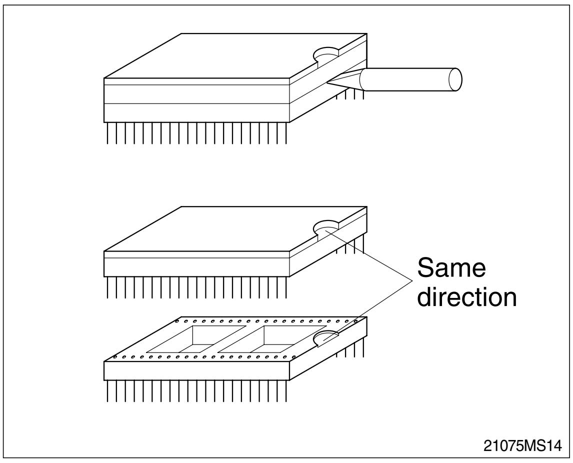


4) Loosen the screws(6EA) located back of the cluster.

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



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



GROUP 11 EPPR VALVE

1. COMPOSITION OF EPPR VALVE

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

1) ELECTRO MAGNET VALVE

Receive electric current from 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

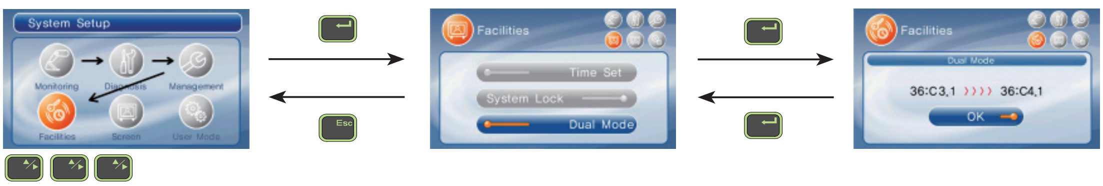
Mode		Pressure		Electric current (mA)	Engine rpm (At accel dial 10)
		kgf/cm^2	psi		
Standard (Ver : 3.1)	M	5 ± 3	71 ± 40	250 ± 30	1850 ± 50
	H	7 ± 3	100 ± 40	270 ± 30	1850 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1750 ± 50
Option (Ver : 4.1)	M	0 ± 3	0 ± 40	160 ± 30	1850 ± 50
	H	2 ± 3	28± 40	200 ± 30	1850 ± 50
	S	4 ± 3	57 ± 40	225 ± 30	1750 ± 50
★		20 ± 3	284 ± 40	453 ± 30	-

★ Manually operated condition when prolix switch is selected emergency position.

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

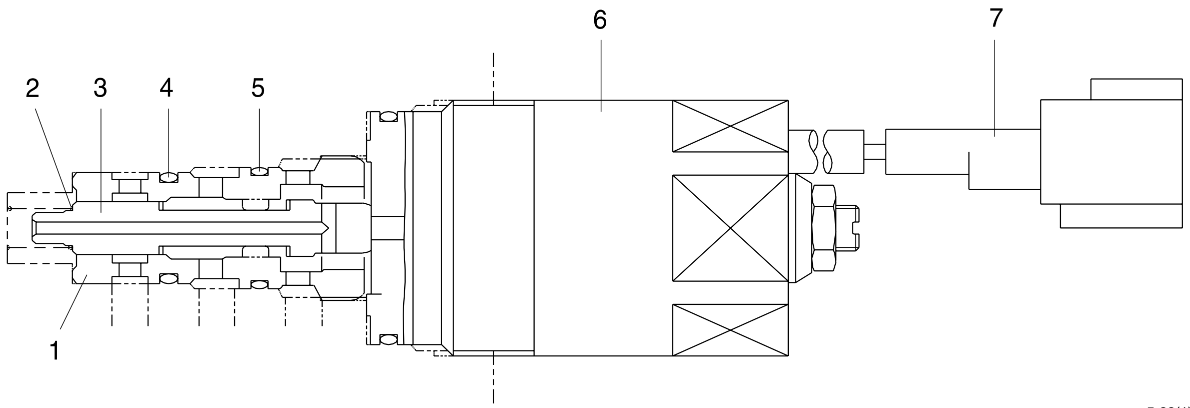
You can switch the EPPR valve pressure set by selecting the version(3.1 ↔ 4.1).

- Dual mode
  · Changing the MCU mode



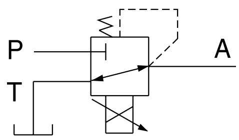
2. OPERATING PRINCIPLE

1) STRUCTURE



5-22(1)

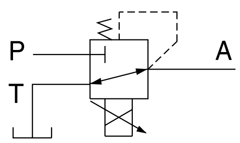
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

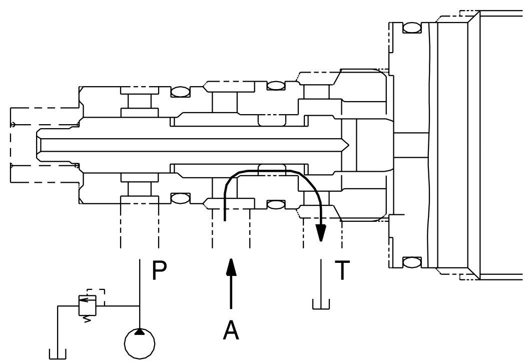


P Pilot oil supply line(Pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at hydraulic pump

2) AT H MODE

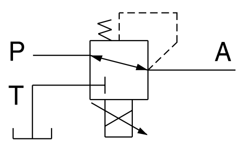
Pressure line is blocked and A oil returns to tank.

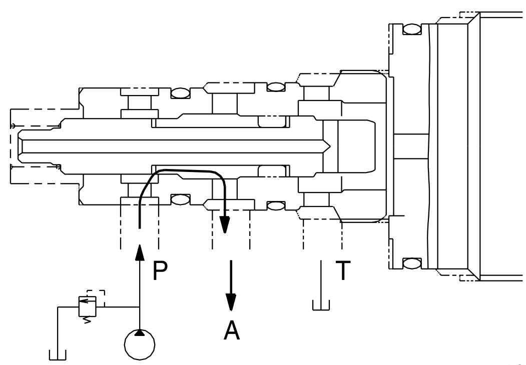




3) AT S MODE

Secondary pressure enters into A.





5-22(2)

3. EPPR VALVE CHECK PROCEDURE

1) CHECK ELECTRIC VALUE AT EPPR VALVE

(1) Start engine.

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

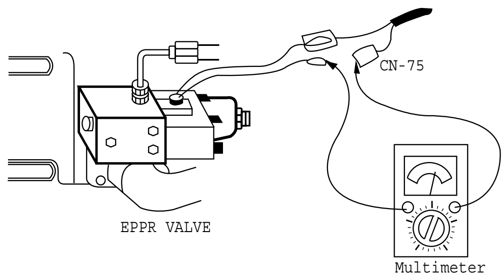
(3) Position the accel dial at 10.

(4) If tachometer show approx 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)

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.

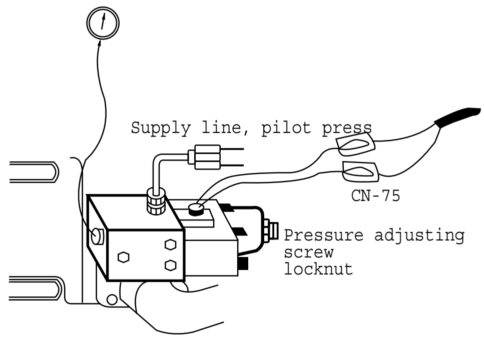
(4) Position the accel dial at 10.

(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)

GROUP 12 MONITORING SYSTEM

1. OUTLINE

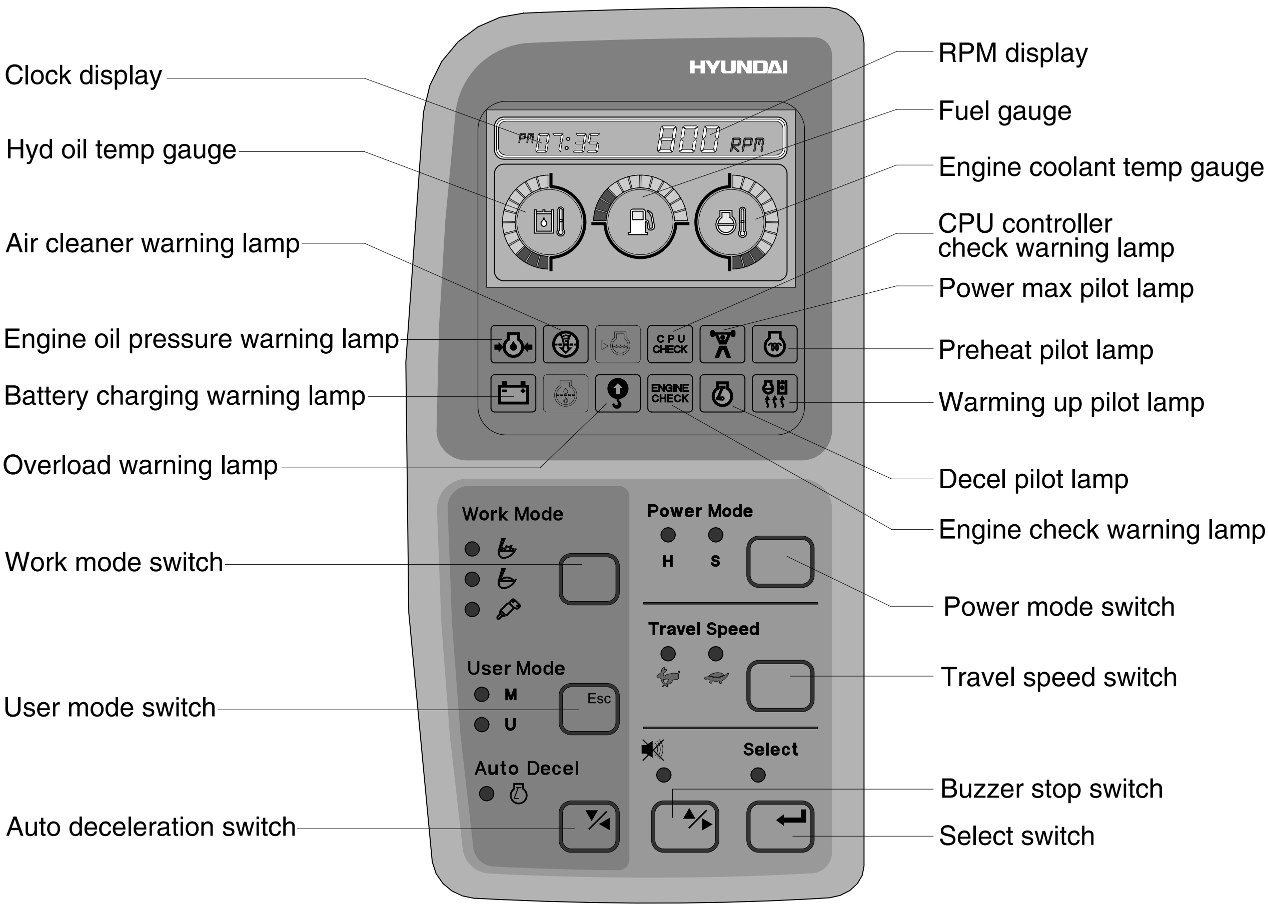
Monitoring system consists of the monitor part and switch part.

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

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

2. CLUSTER

1) MONITOR PANEL



2507A5MS10

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor initial 5 seconds

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

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

a. Cluster program version : 「1.00」 ← Indicates program version 「1.00」 for 5 seconds.
b. Tachometer : 0rpm
c. Fuel gauge : All light up below appropriate level
d. Hydraulic temperature : All light up below appropriate level
e. Engine coolant temperature gauge : All light up below appropriate level
f. Warning lamp
※ During start key **ON** the engine oil pressure lamp and battery charging lamp go on, but it is not abnormal.
※ When engine coolant temperature below 30℃, the warming up lamp lights up.

③ Indicating lamp state

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

(2) Start of engine

① Check machine condition

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

② When warming up operation

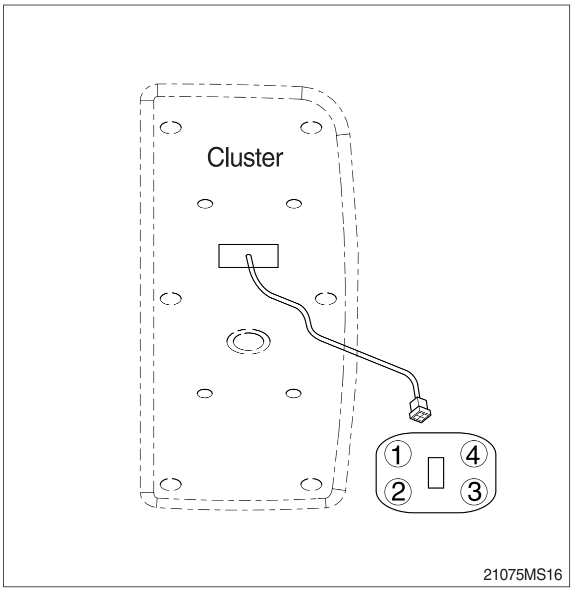
a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to1200 rpm(Auto decel LED : ON)
※ Others same as above ①.

③ When abnormal condition

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

3. CLUSTER CONNECTOR

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

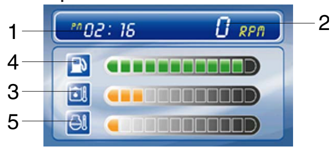


2) LCD main operation display

Default screen

1607A3CD02A

Option screen



1607A3CD02B

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

(1) Time display

1607A3CD02C

① This displays the current time.

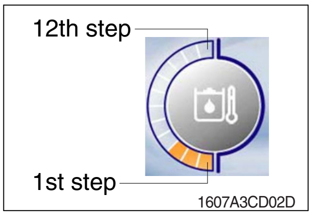
※ **Refer to page 5-36 to set time for details.**

(2) RPM display

1607A3CD02C

① This displays the engine rpm.

(3) Hydraulic oil temperature gauge



1607A3CD02D

① This gauge indicates the temperature of hydraulic oil in 12 step gauge.

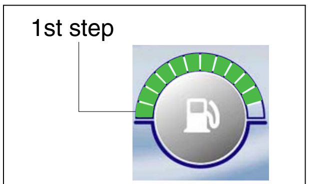
- 1st step : Below 30℃ (86°F)
- 2nd~10th step : 30-105℃ (86-221°F)
- 11th~12th step : Above 105℃ (221°F)

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

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

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

(4) Fuel level gauge



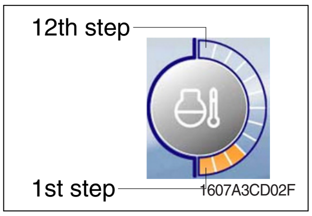
1607A3CD02E

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

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

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

(5) Engine coolant temperature gauge



1607A3CD02F

① This gauge indicates the temperature of coolant in 12 step gauge.

- 1st step : Below 30℃ (86°F)
- 2nd~10th step : 30-105℃ (86-221°F)
- 11th~12th step : Above 105℃ (221°F)

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

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

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

3) Warning of main operation screen

(1) Warning display

① Engine coolant temperature


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

② Fuel level


- This lamp blinks and the buzzer sounds when the level of fuel is below 40 ℓ (10.6U.S. gal).
- Fill the fuel immediately when the lamp blinks.

③ Hydraulic oil temperature


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

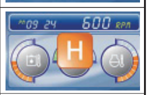
④ All gauge


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

⑤ Communication error

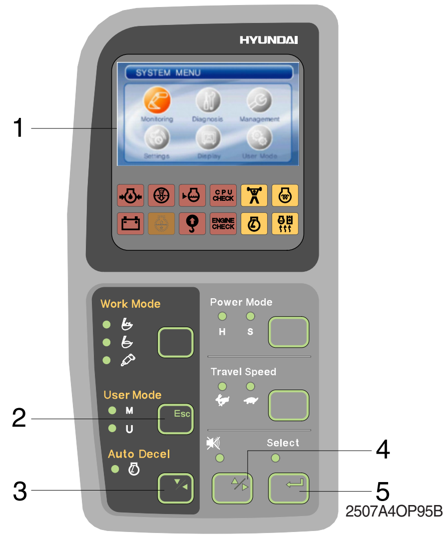
- Communication problem between CPU controller and cluster makes the lamp blinks and the buzzer sounds.
- Check if any fuse for CPU burnt off.
  If not check the communication line between them.

(2) Pop-up icon display

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

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

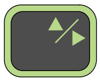
4) LCD

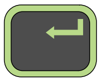


1  : LCD

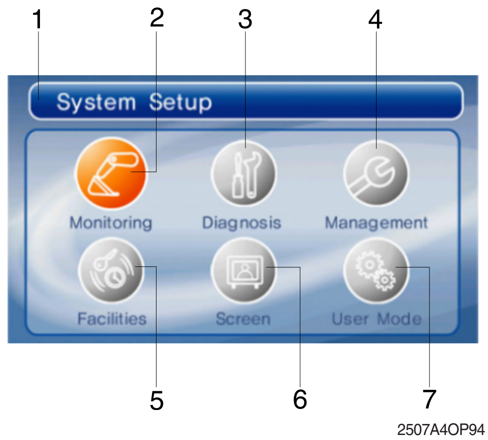
2  : Escape, Return to the previous menu

3  : Down/Left Direction

4  : Up/Right Direction

5  : Select(Enter) Activate the currently chosen item

(1) Main menu



1  : Menu information

2  : Monitoring
- Equipment, Switch, Output

3  : Diagnosis
- Current error, Recorded error

4  : Maintenance

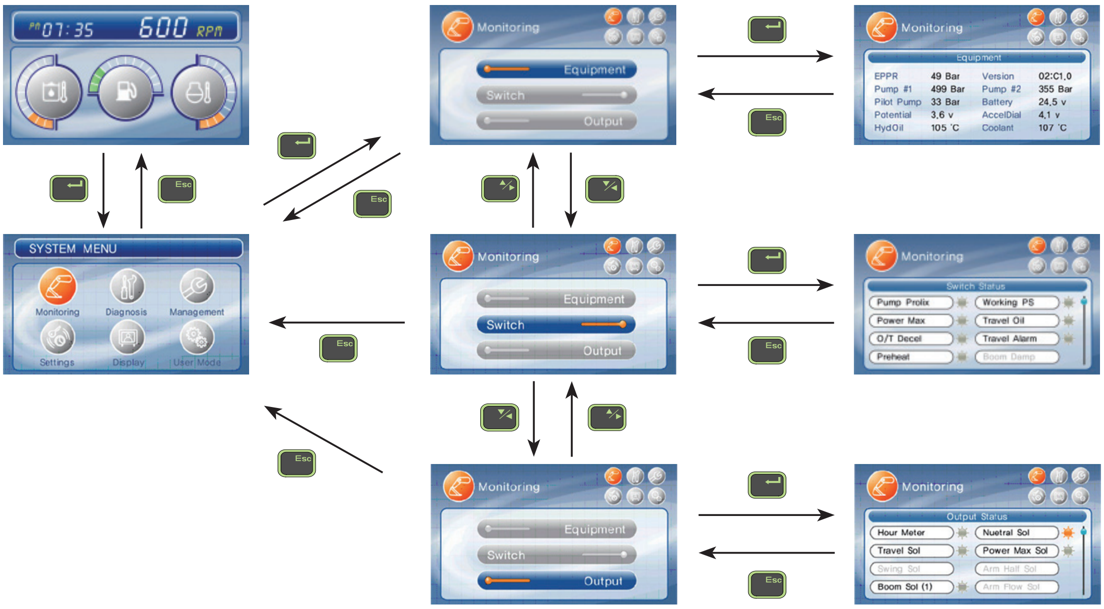
5  : Settings
- Time set, Dual mode
- System lock(Reserved)

6  : Display
- Operation skin, Brightness, Language

7  : User mode

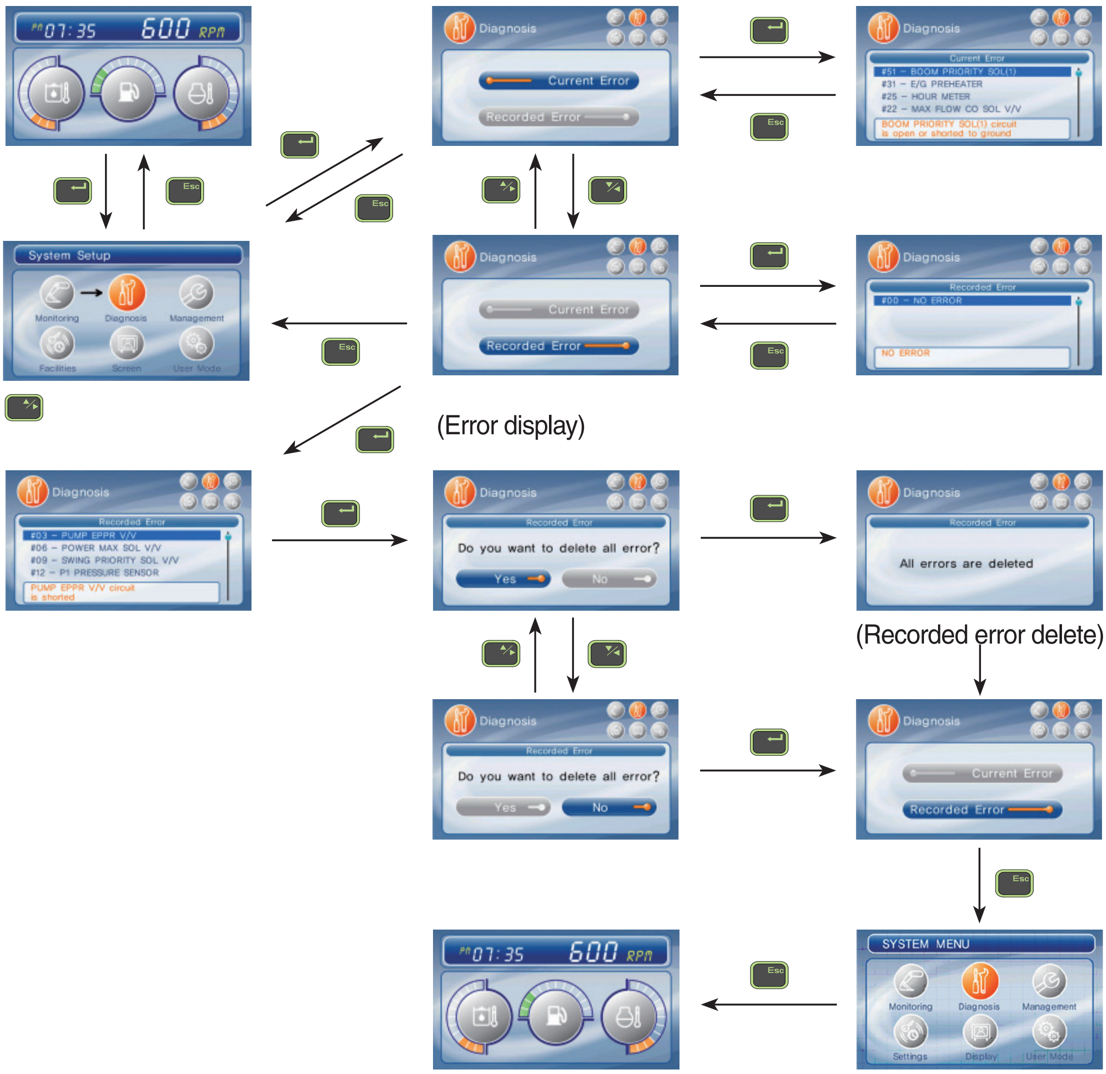
(2) Display map

① Monitoring



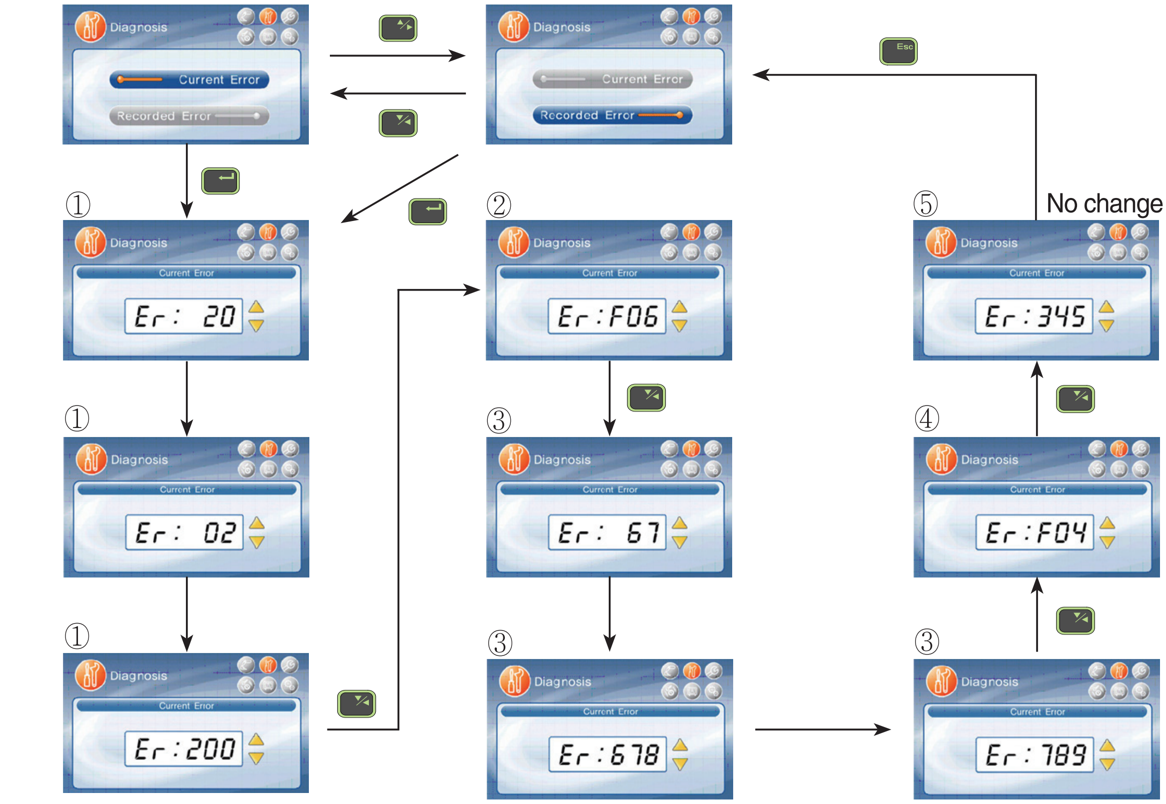
② Diagnosis

a. Protocol type 1

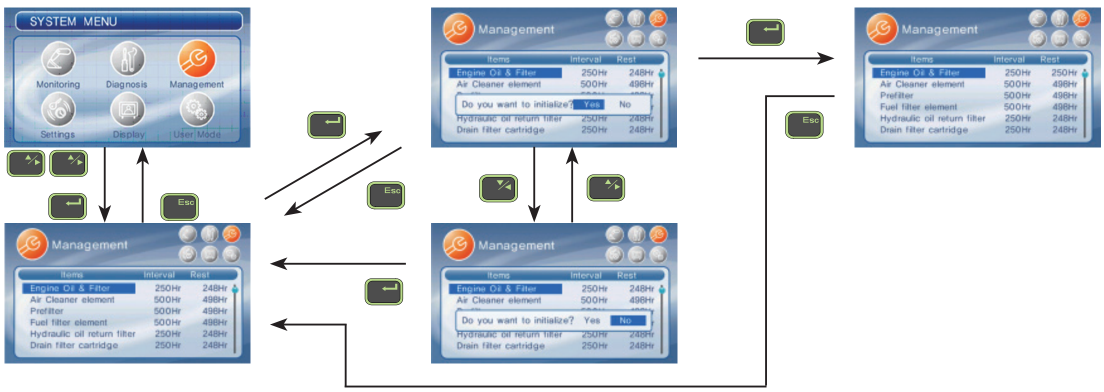


b. Protocol type 2

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



③ Maintenance



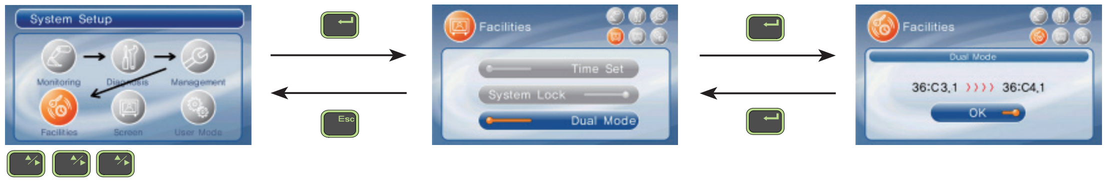
④ Setting

a. Time set

b. System lock - Reserved

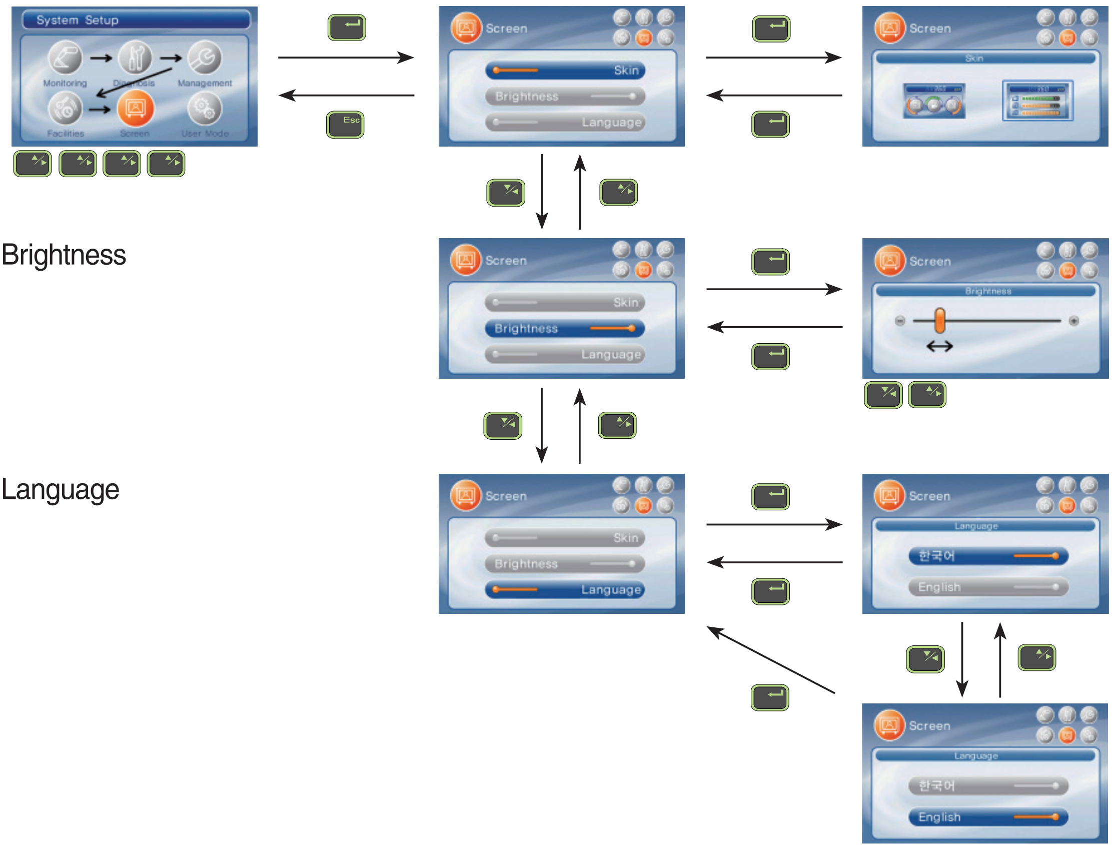
c. Dual mode

- Changing the MCU mode



⑤ Display

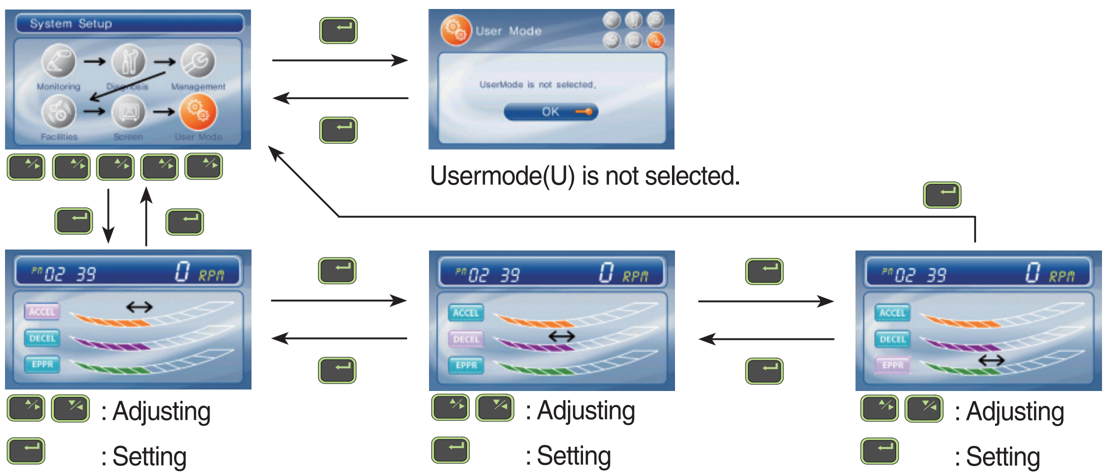
a. Operation skin



b. Brightness

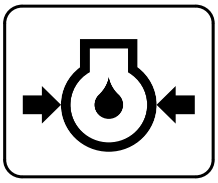
c. Language

⑥ User mode



5) Warning and pilot lamp

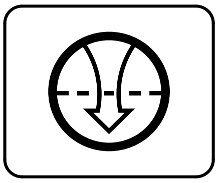
(1) Engine oil pressure warning lamp



21073CD07

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

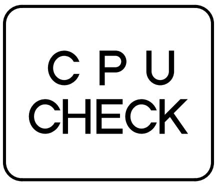
(2) Air cleaner warning lamp



21073CD08

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

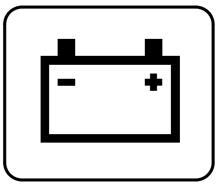
(3) CPU controller check warning lamp



21073CD10

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

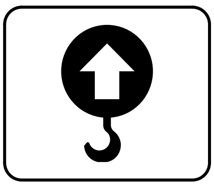
(4) Battery charging warning lamp



21073CD13

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

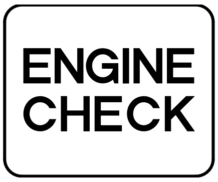
(5) Overload warning lamp



21073CD15

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

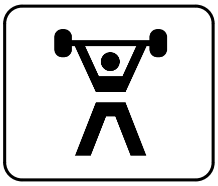
(6) Engine check warning lamp



29073CD10

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

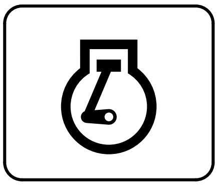
(7) Power max pilot lamp



21073CD11

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

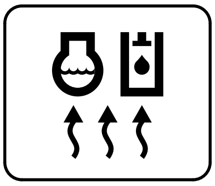
(8) Decel pilot lamp



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.

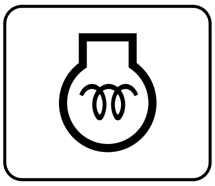
(9) Warming up pilot lamp



21073CD18

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

(10) Preheat pilot lamp



21073CD12

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

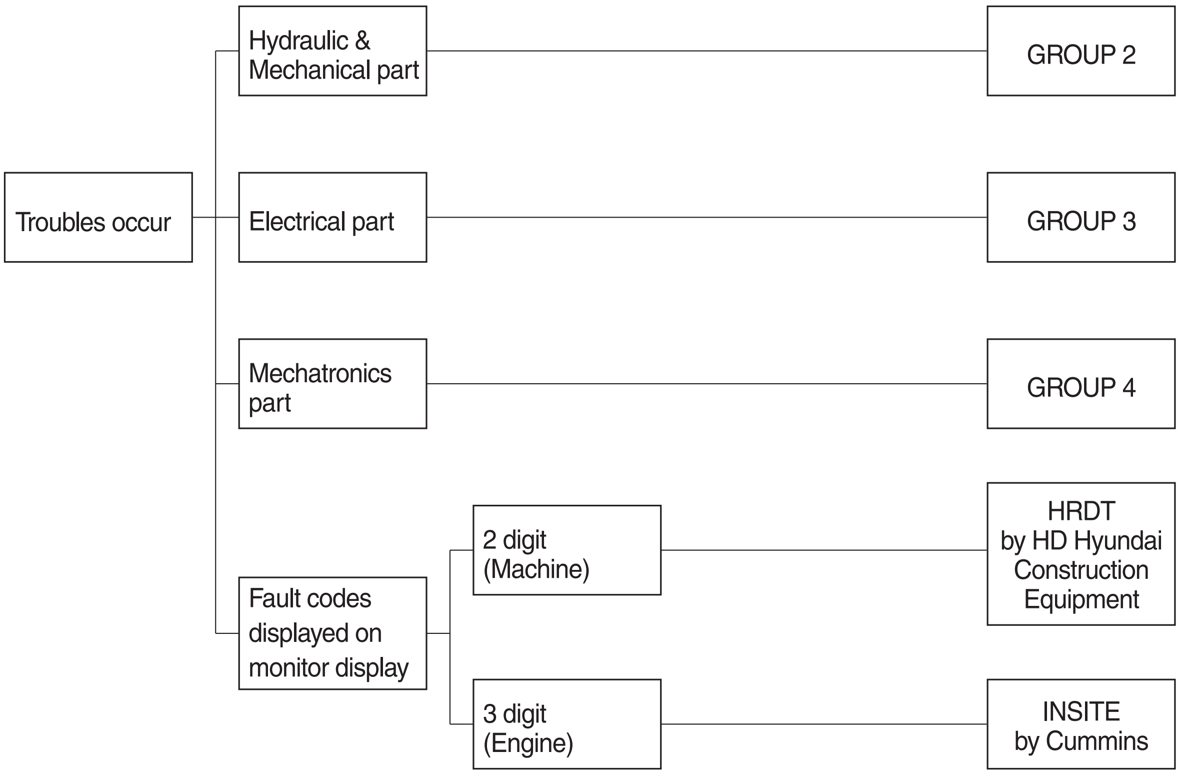
SECTION 6 TROUBLESHOOTING

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.



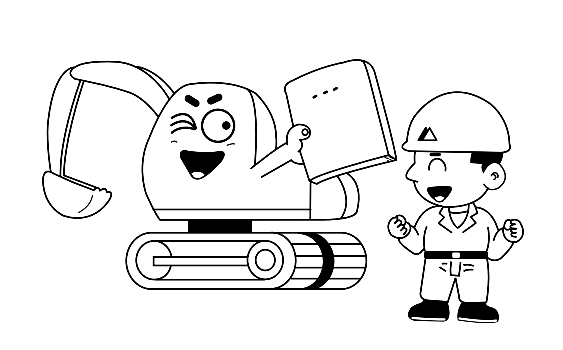
※ If fault codes (2 or 3 digits) are displayed on the monitor, please contact HD Hyundai Construction Equipment or Cummins.

2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

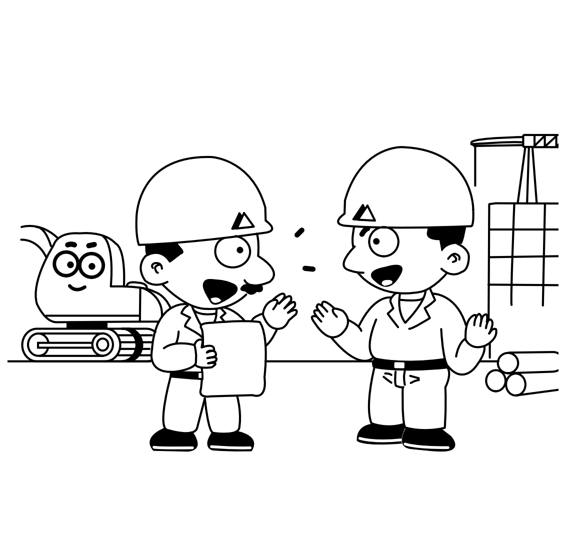


13031SH02

STEP 2. Ask the operator

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

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

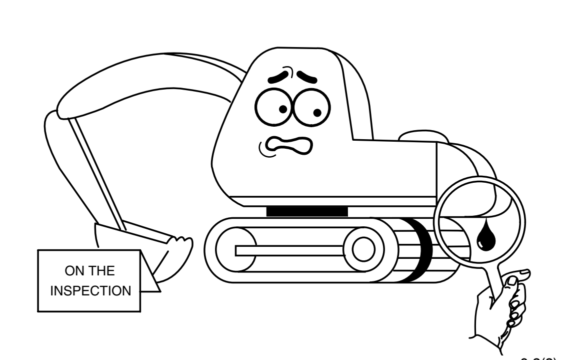


13031SH03

STEP 3. Inspect the machine

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

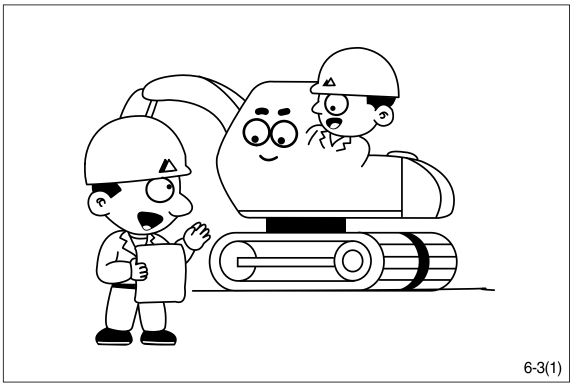
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



6-2(3)

STEP 4. Inspect the trouble actually on the machine

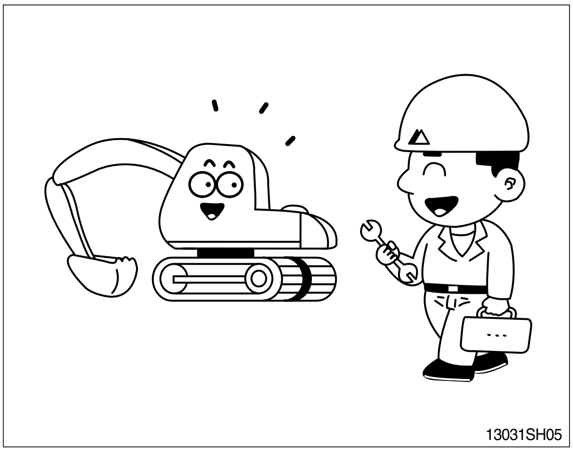
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



6-3(1)

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.

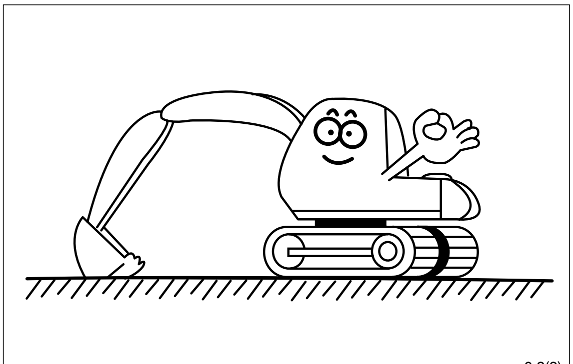


13031SH05

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.



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.

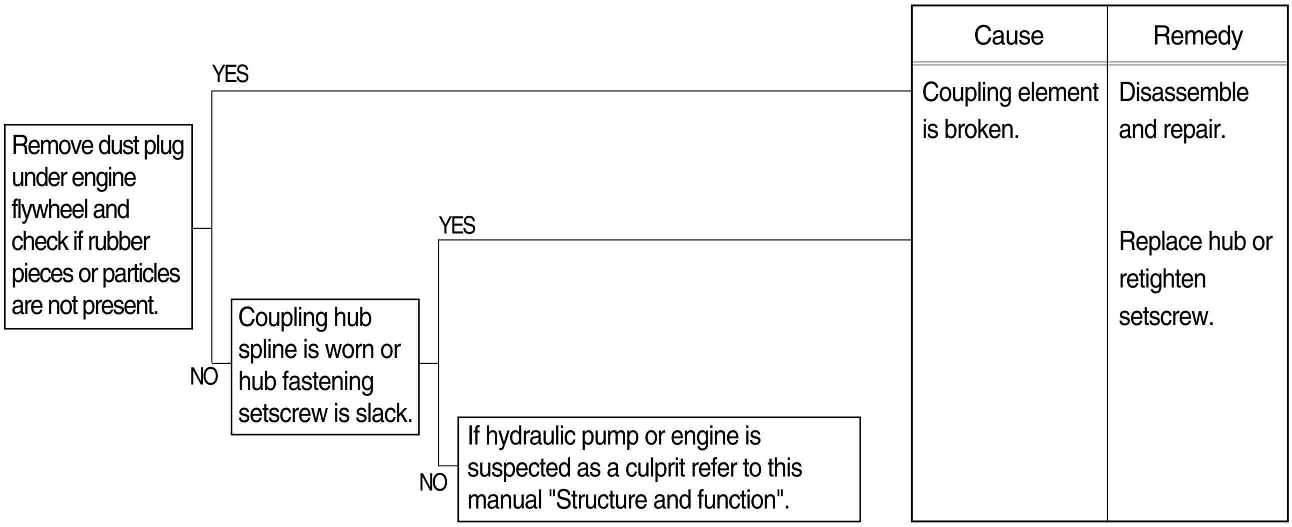
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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?

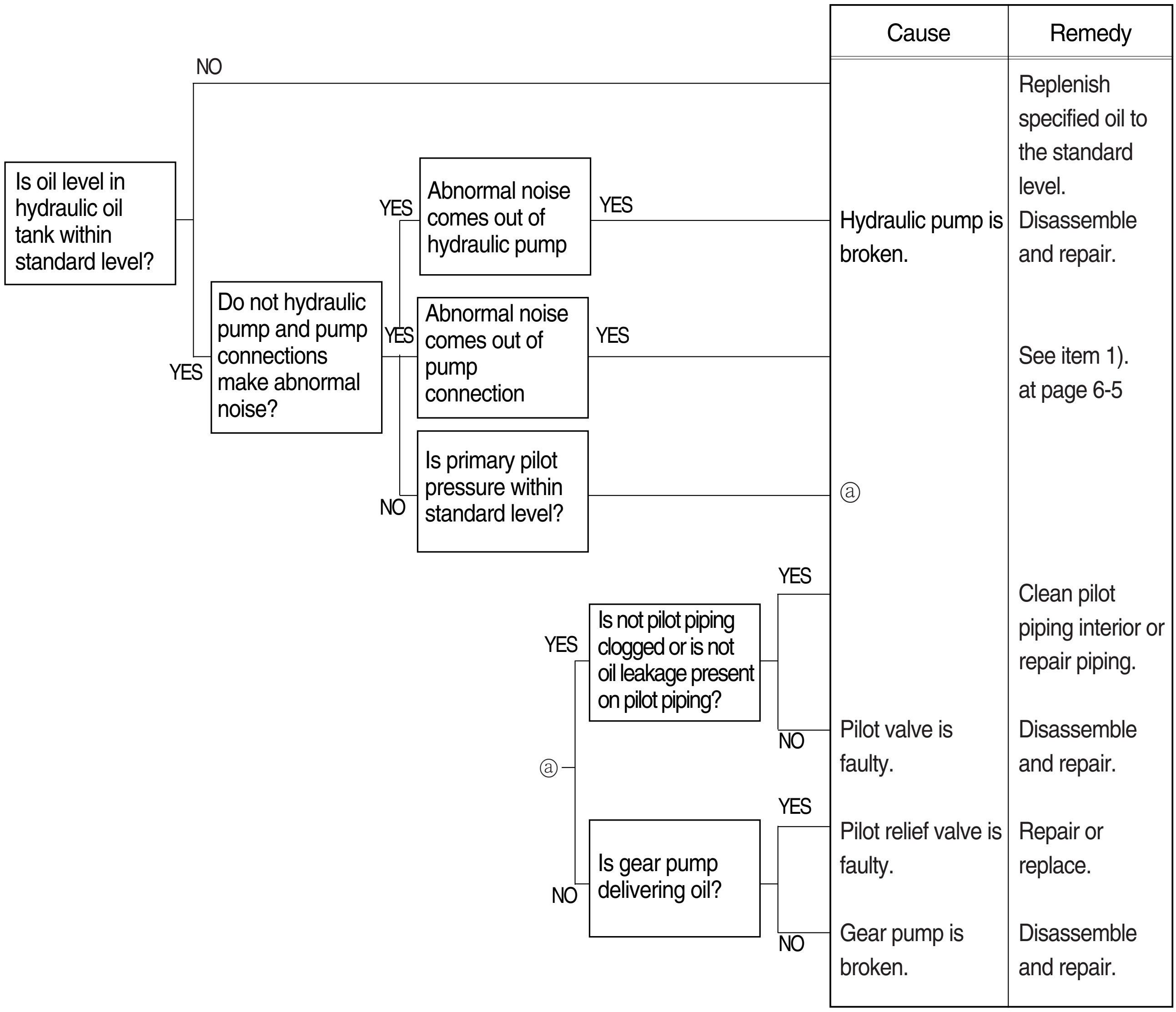
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION

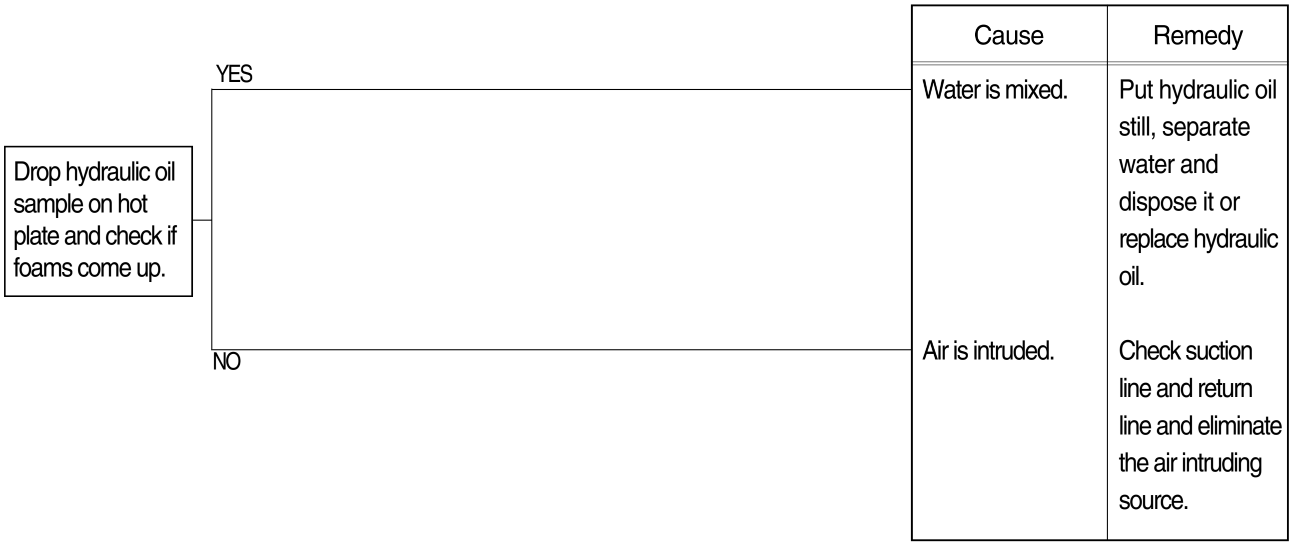


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

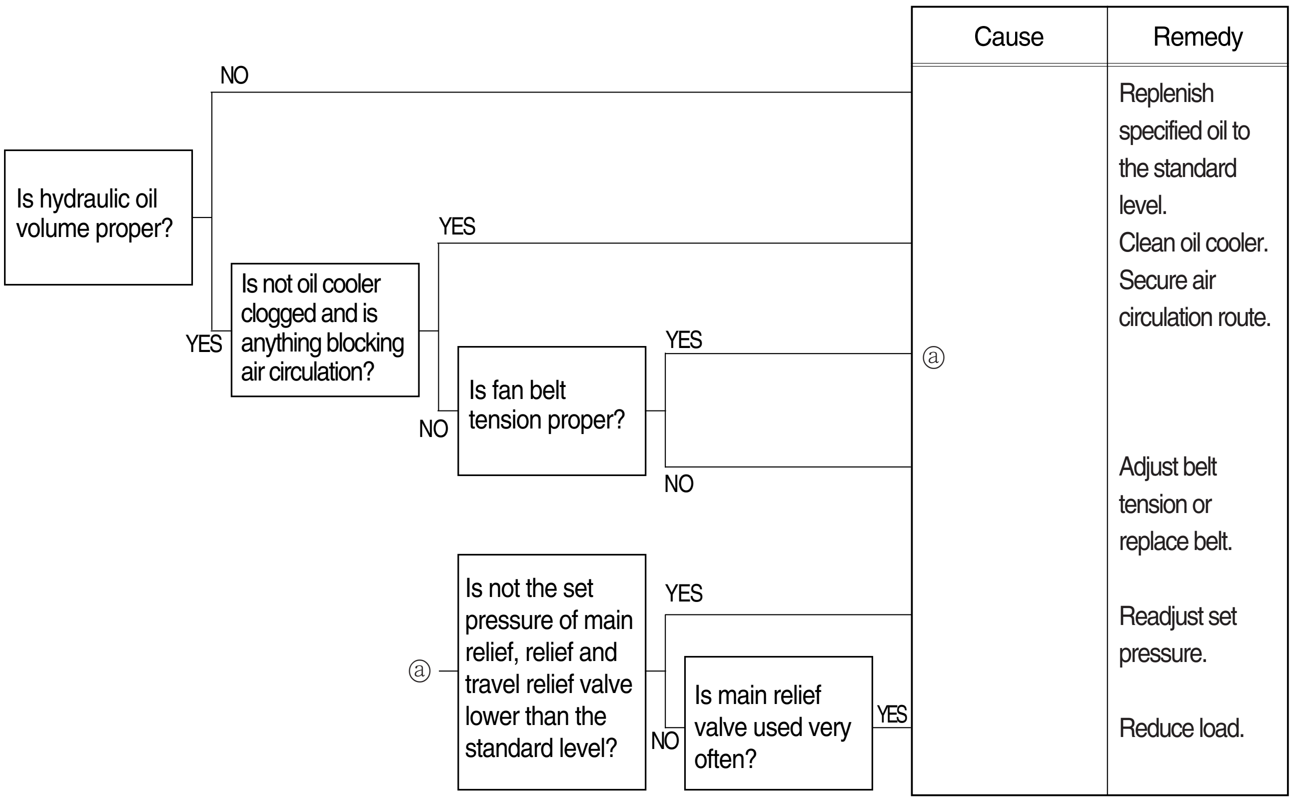


3. HYDRAULIC SYSTEM

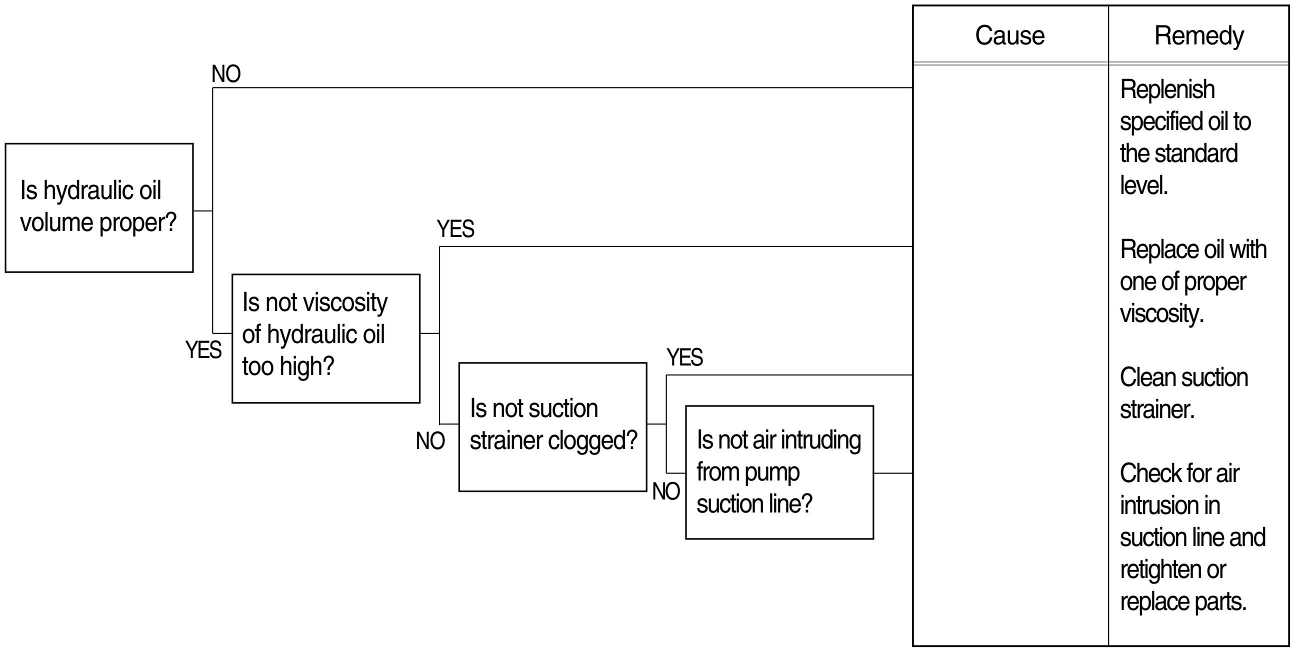
1) HYDRAULIC OIL IS CLOUDY



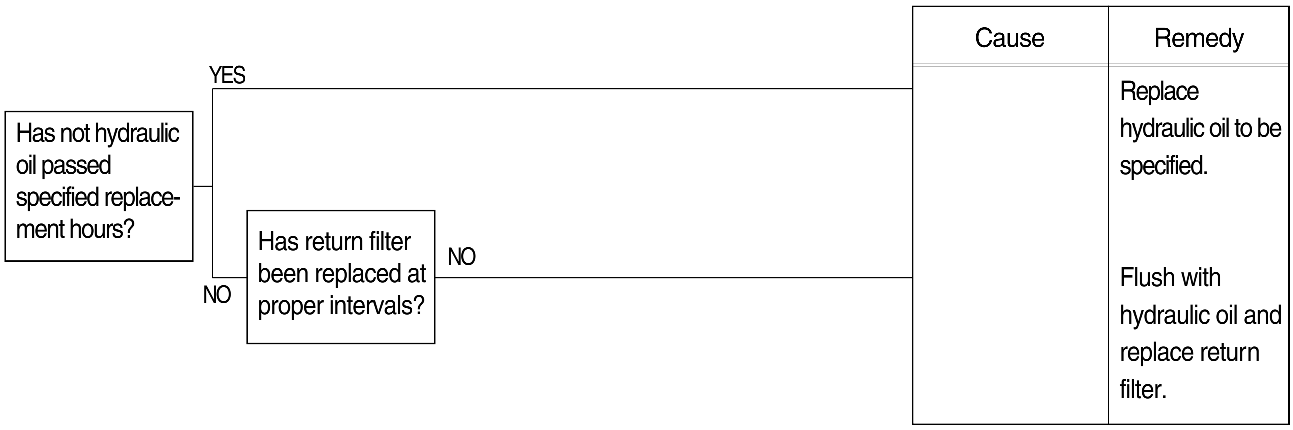
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

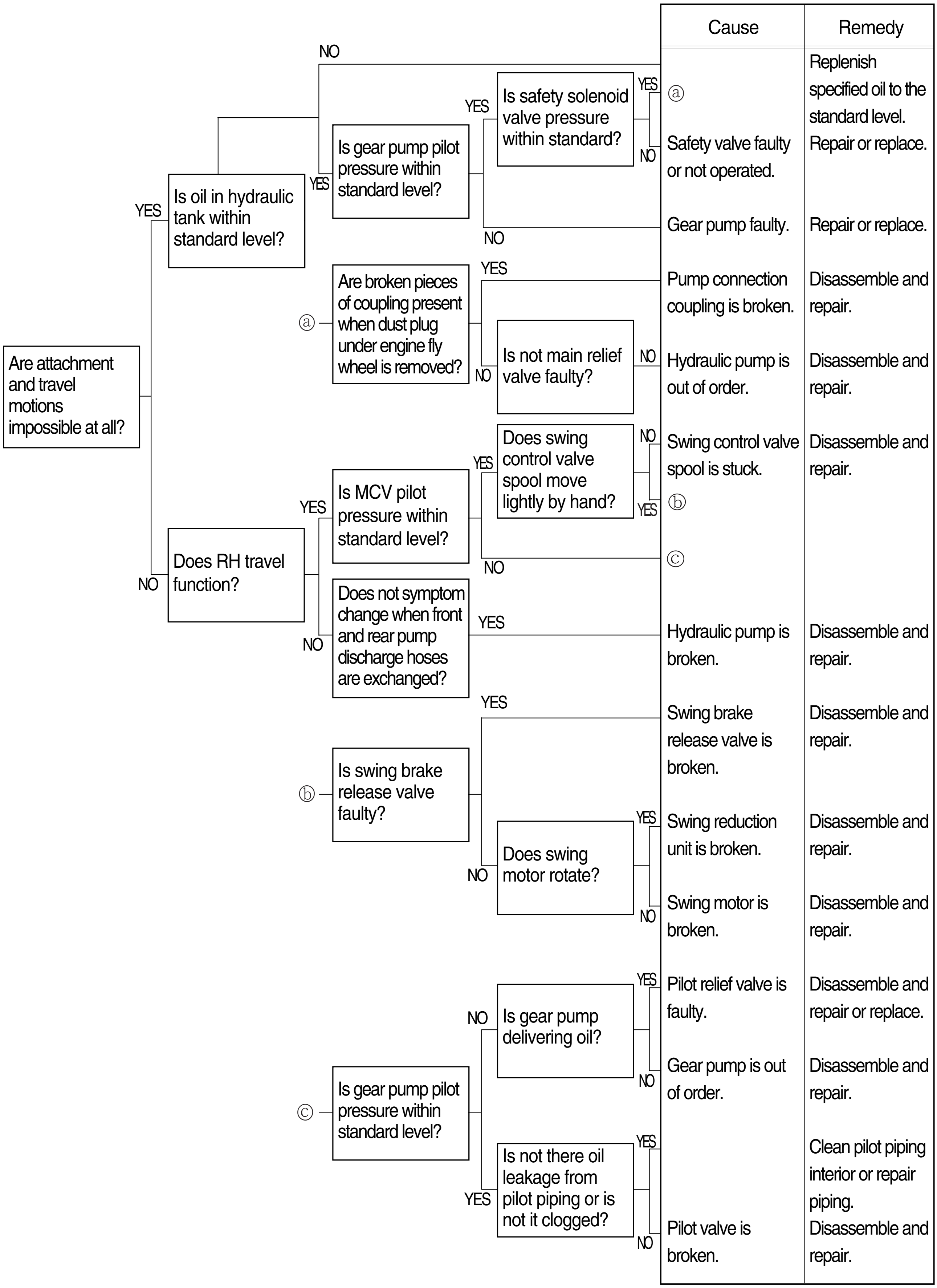


4) HYDRAULIC OIL IS CONTAMINATED

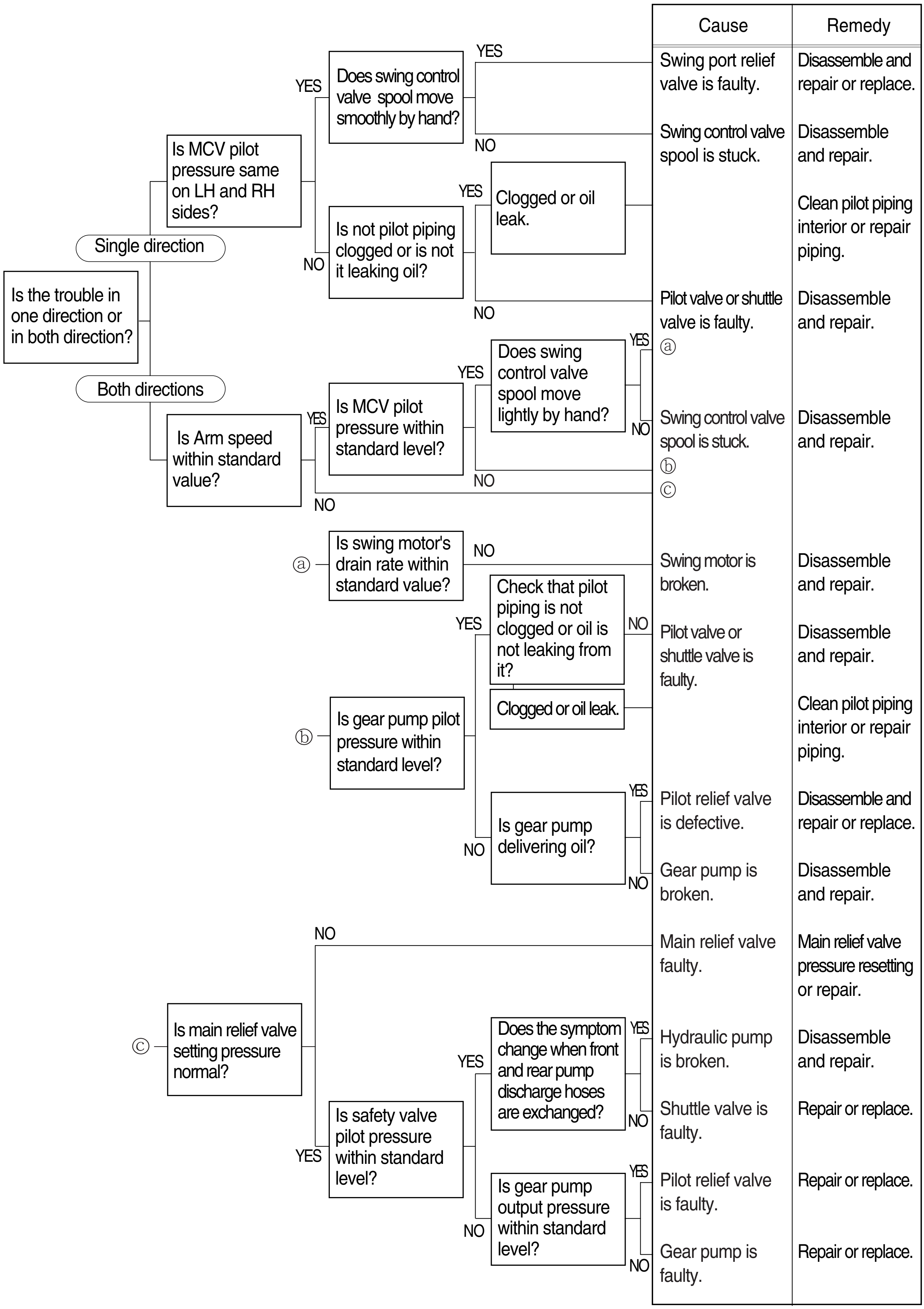


4. SWING SYSTEM

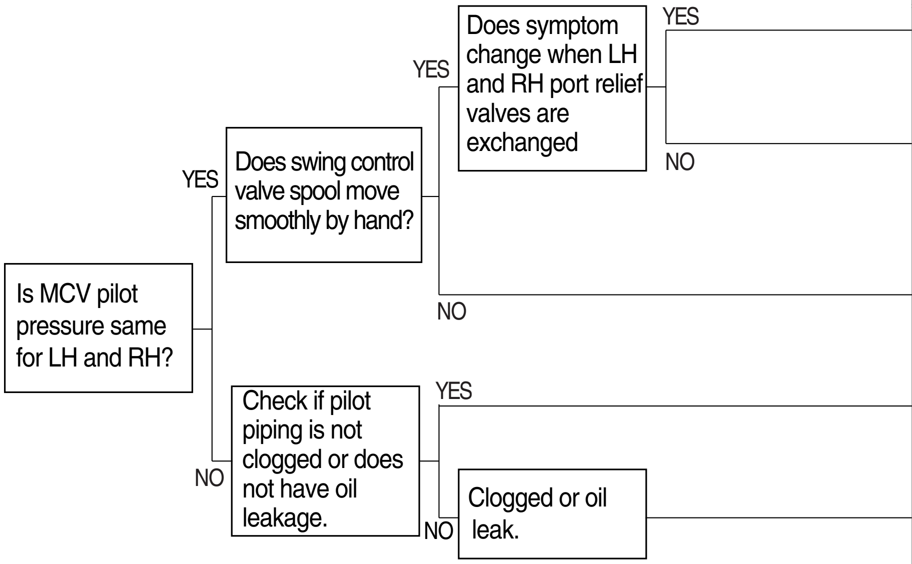
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



2) SWING SPEED IS LOW

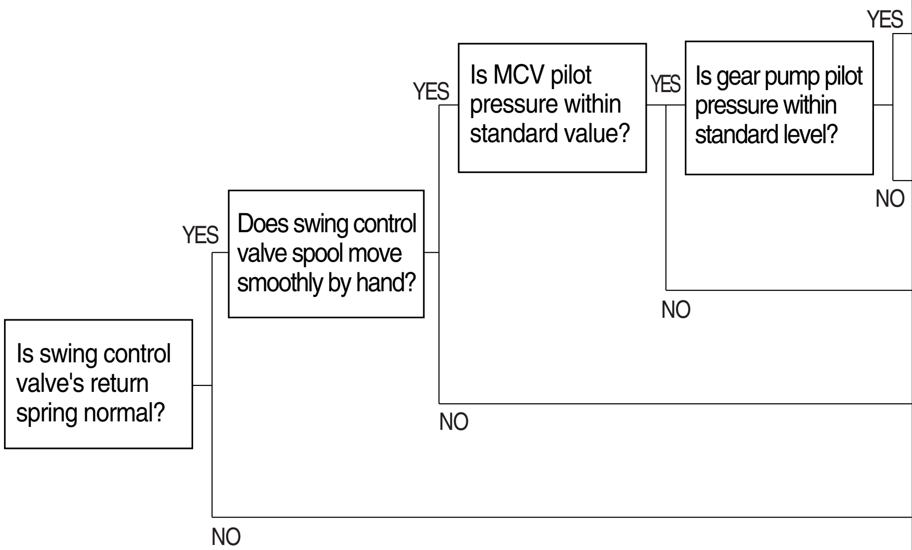


3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



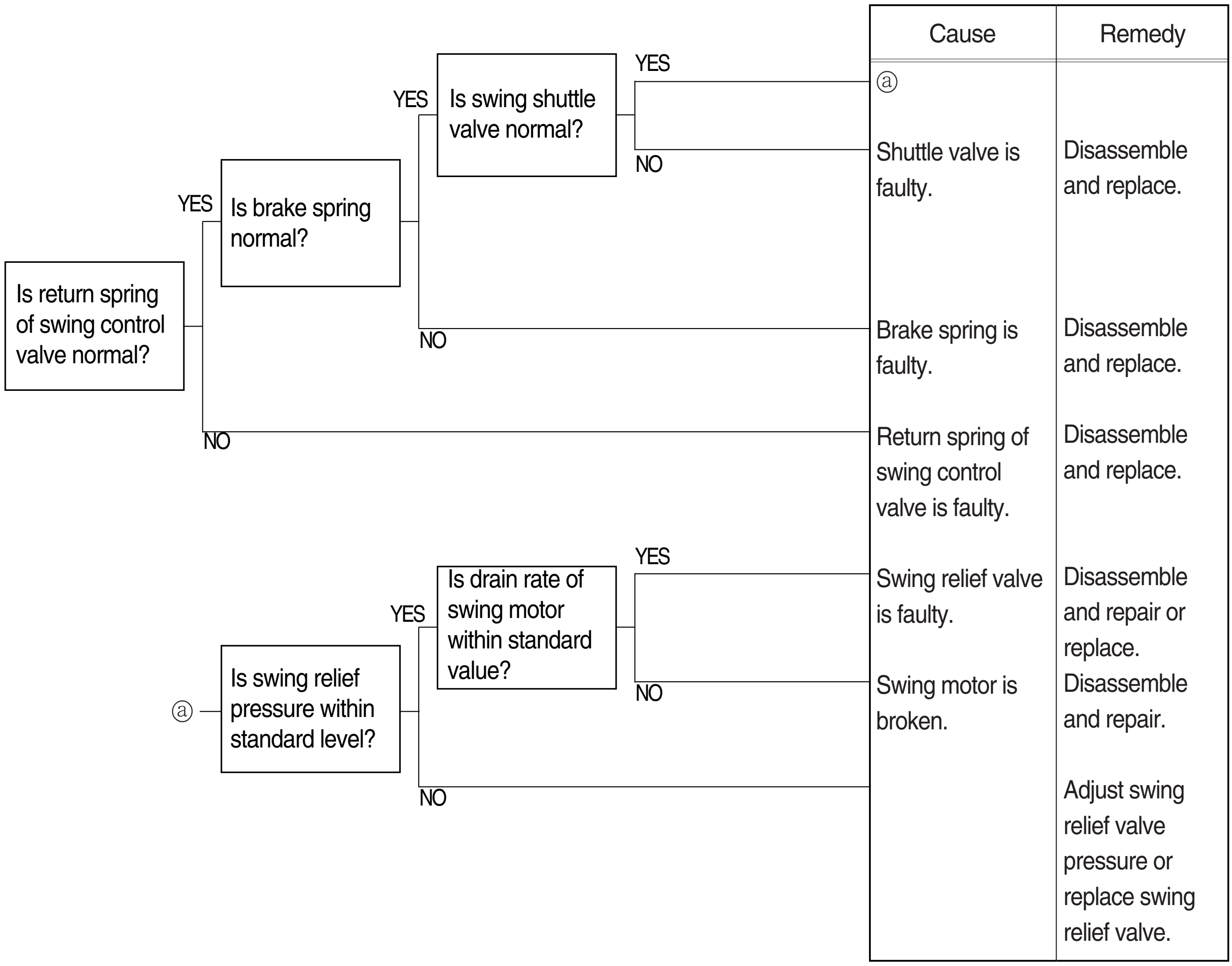
Cause	Remedy
Swing port relief valve is faulty.	Disassemble and repair.
Shuttle valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
Pilot valve is faulty.	Disassemble and repair.
	Clean pilot piping interior or repair piping.

4) MACHINE SWINGS BUT DOES NOT STOP



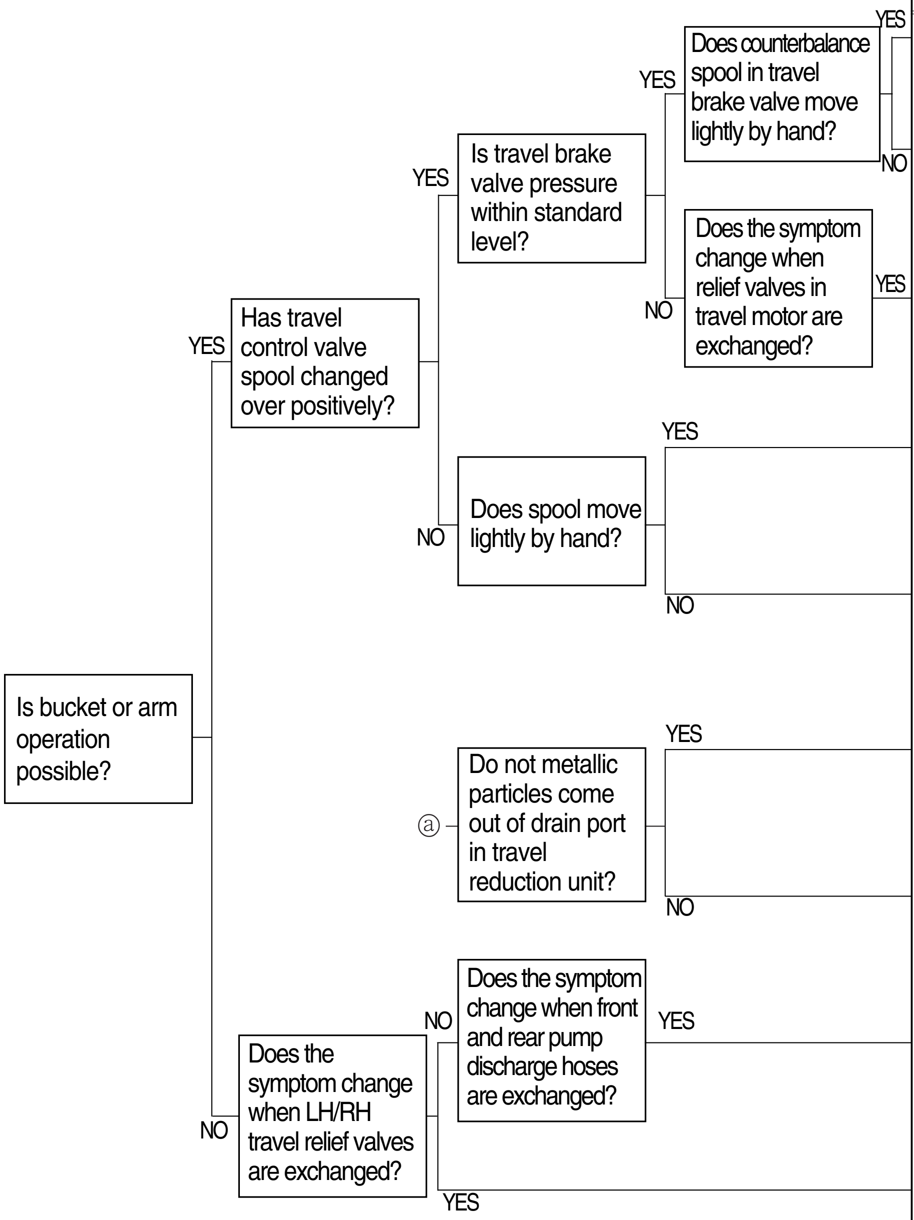
Cause	Remedy
Pilot relief valve is faulty.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.
Pilot valve is faulty.	Disassemble and repair.
Swing control valve spool is stuck.	Disassemble and repair.
Return spring is faulty.	Disassemble and replace.

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



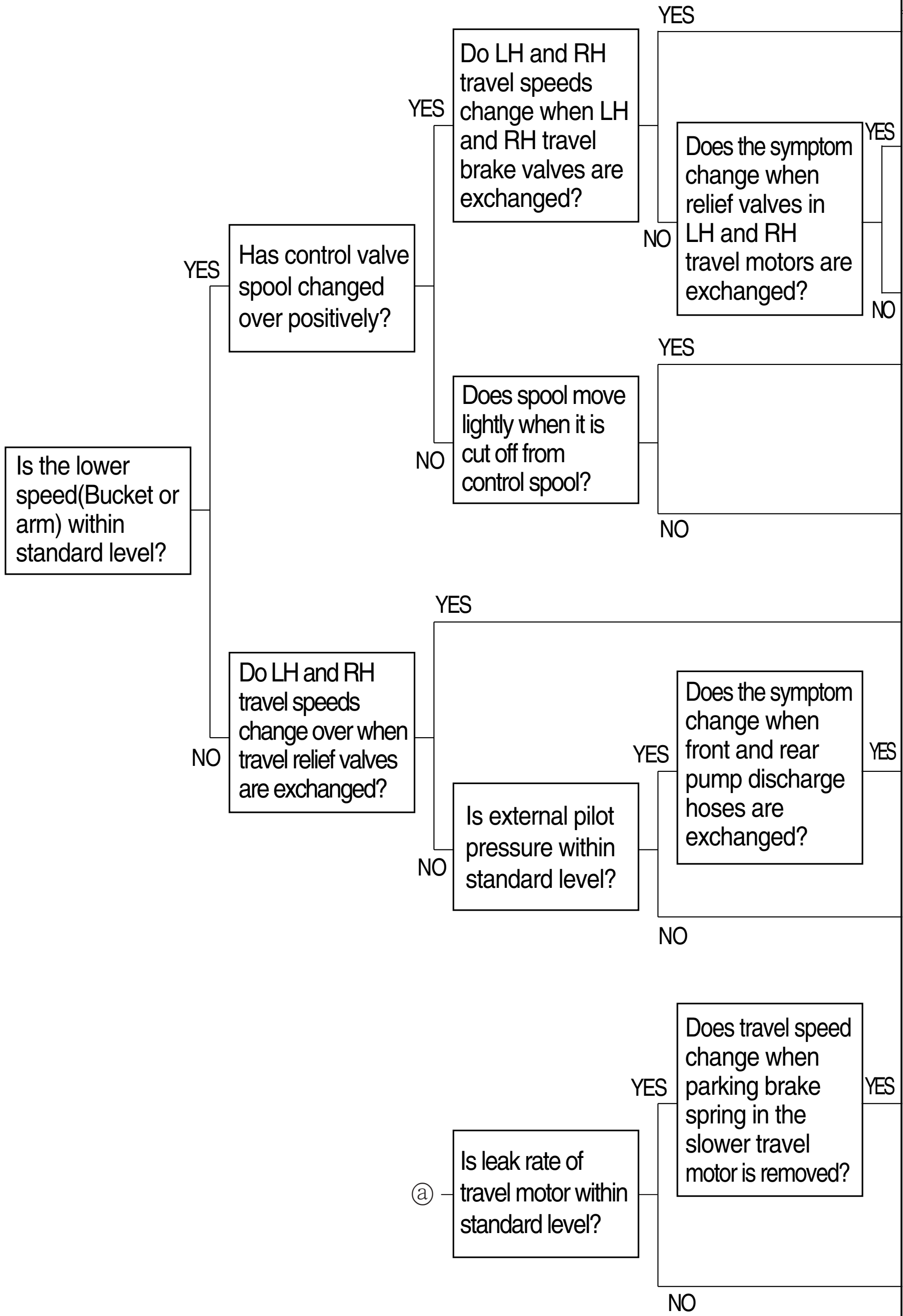
5. TRAVEL SYSTEM

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.

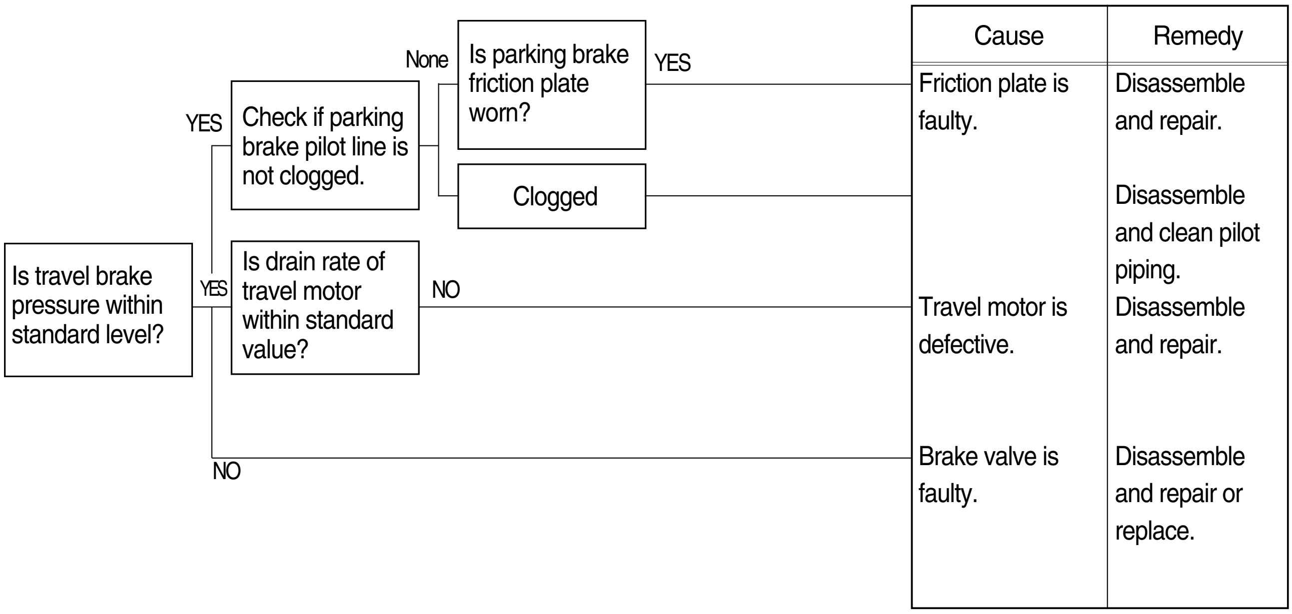
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



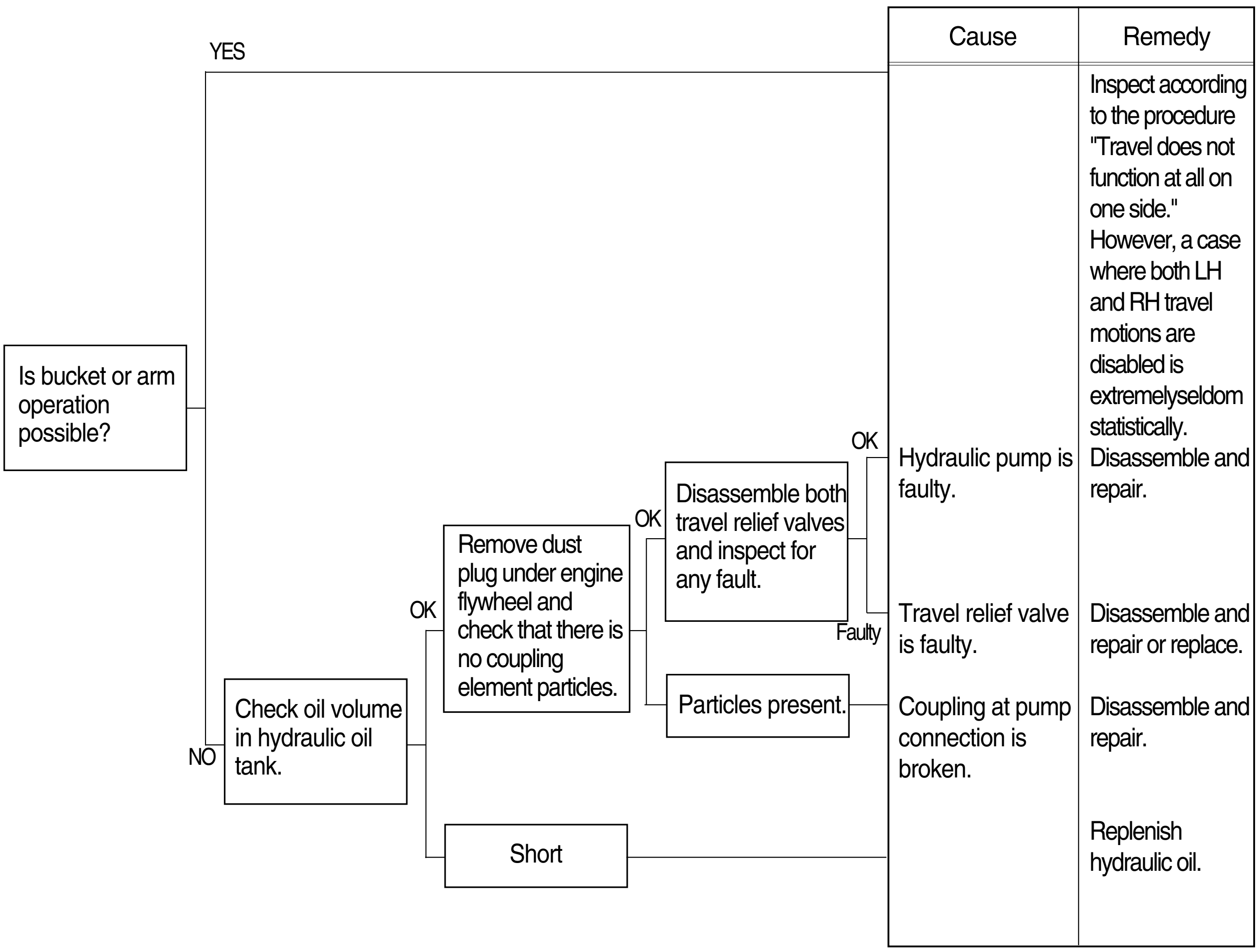
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
ⓐ	
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble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

3) MACHINE DOES NOT STOP ON A SLOPE

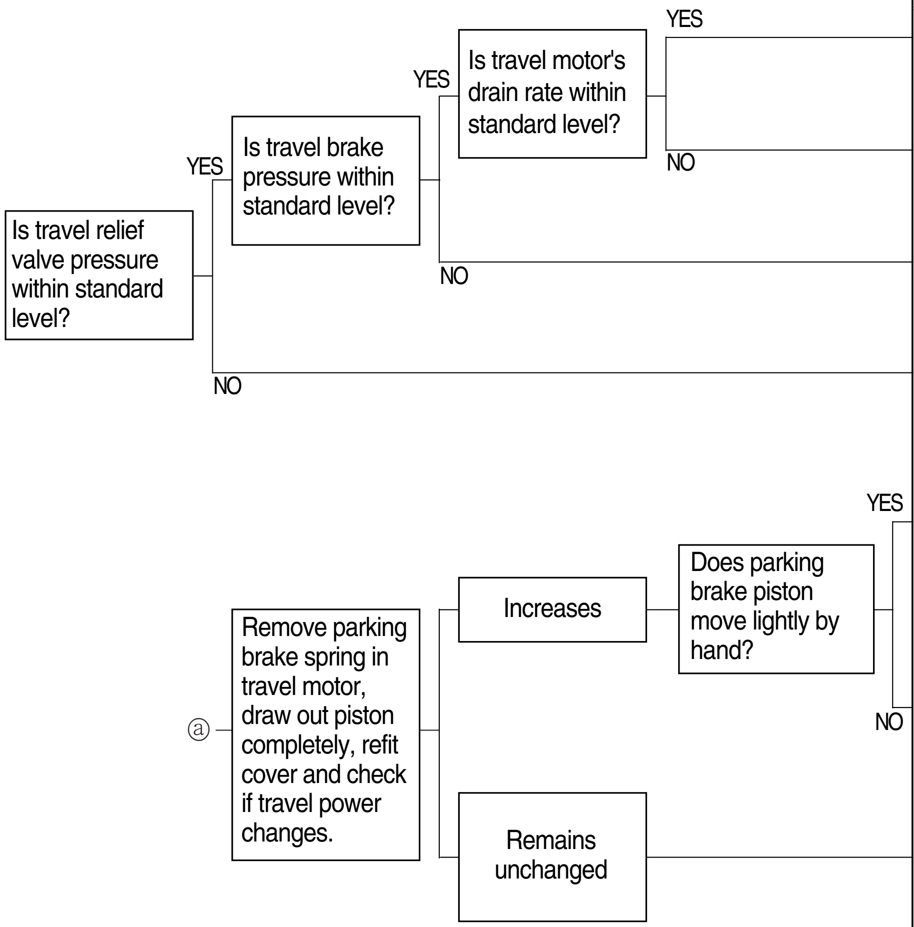
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



5) TRAVEL ACTION IS POWERLESS(Travel only)

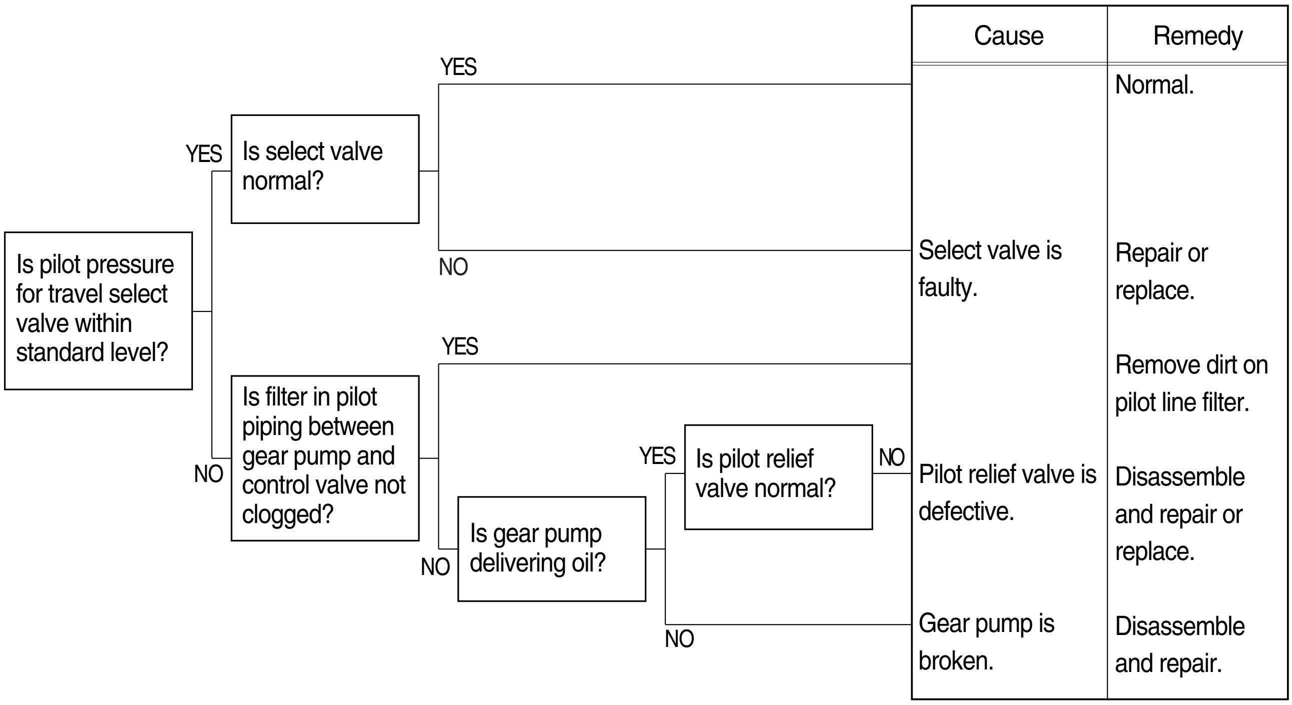


Cause	Remedy
ⓐ	
Travel motor is faulty.	Disassemble and repair.
Travel brake valve is defective.	Disassemble and repair or replace.
Travel relief valve is faulty.	Disassemble and repair or replace.
Hydraulic circuit that releases travel parking brake is clogged with dirt.	Disassemble and clean.
Parking brake piston in travel motor is stuck.	Disassemble and repair.
Travel reduction unit is defective.	Disassemble and repair.

6) MACHINE RUNS RECKLESSLY ON A SLOPE

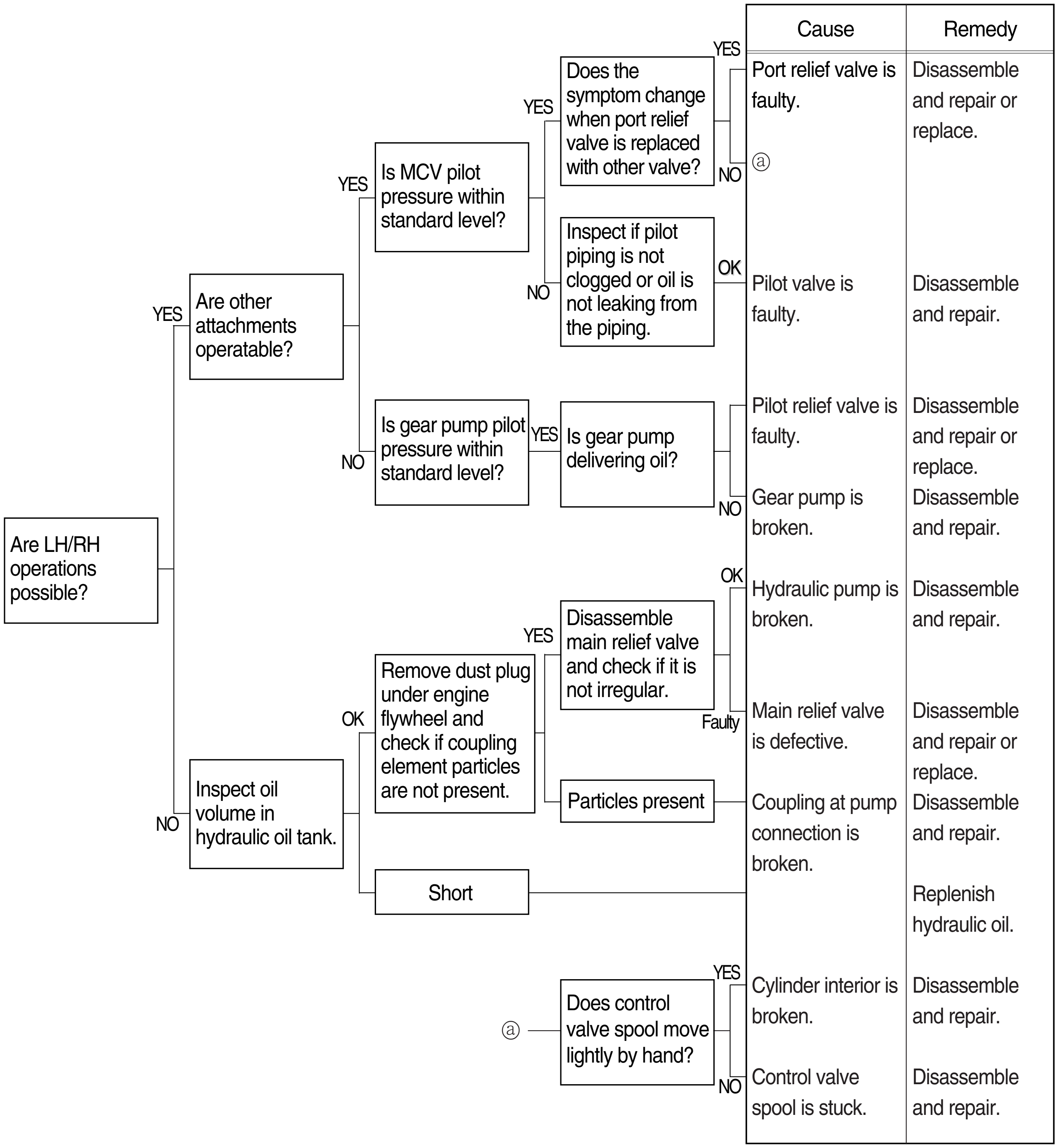
Cause	Remedy
	Disassemble and repair or replace.

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

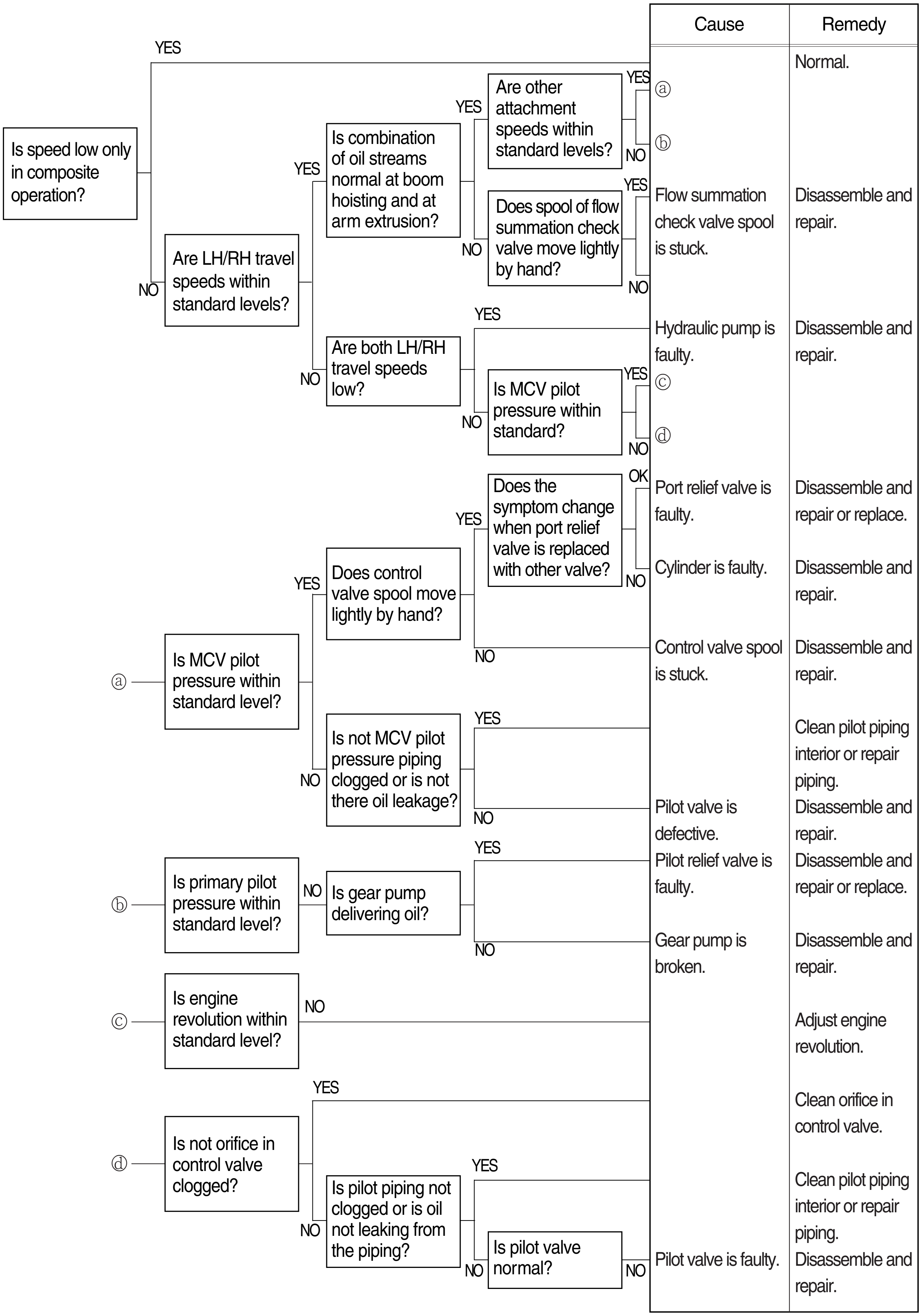


6. ATTACHMENT SYSTEM

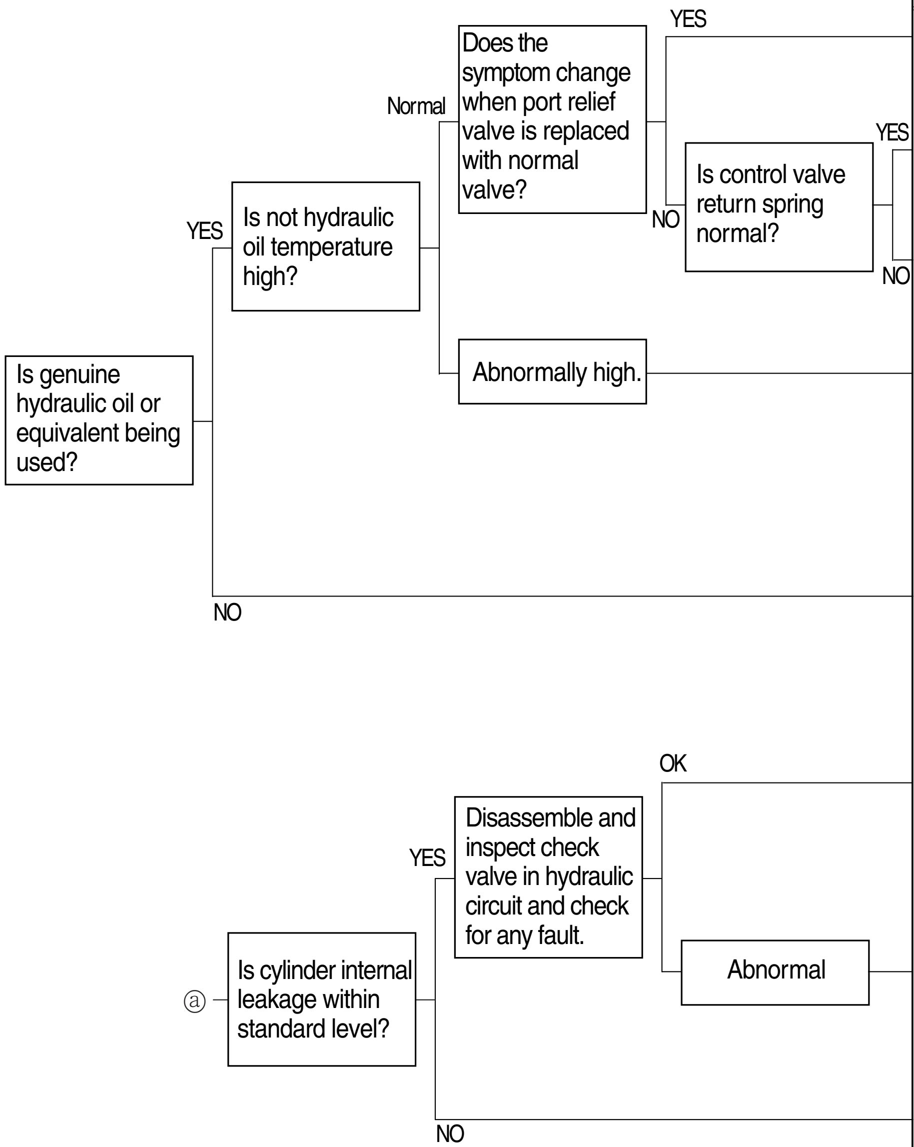
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

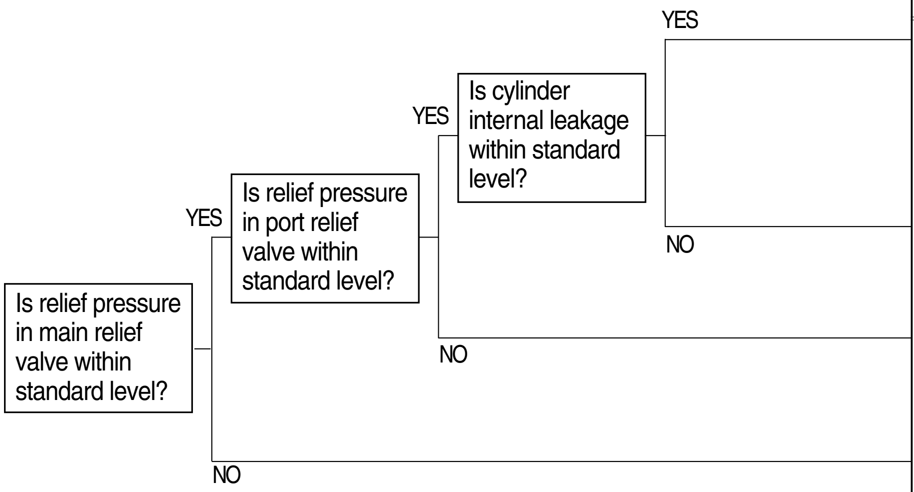


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



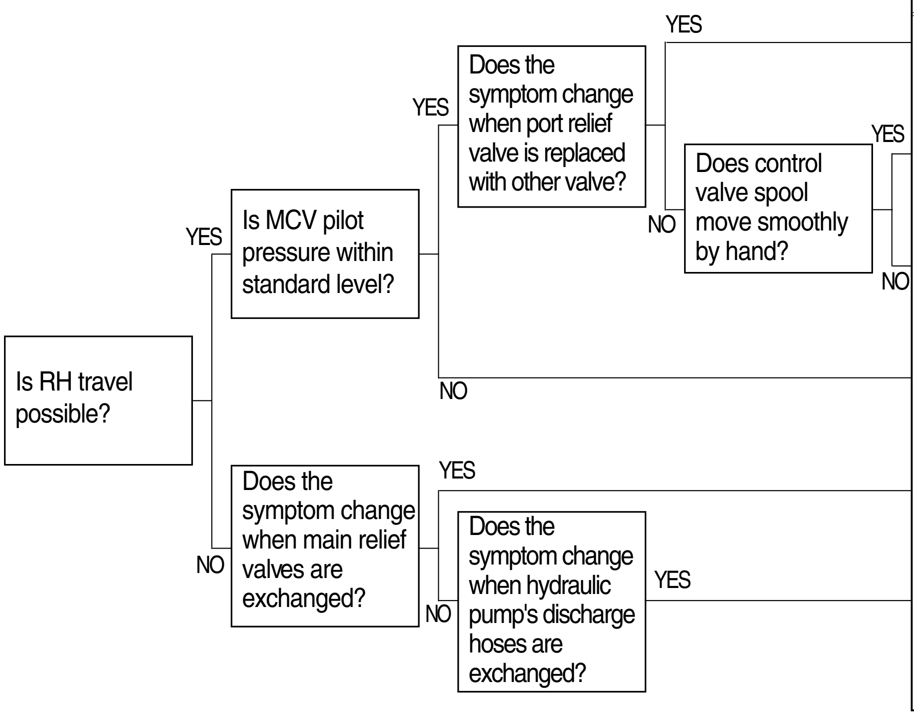
Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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



Cause	Remedy
	Check according to the procedure in Item "Speed is low".
Cylinder is faulty.	Disassemble and repair.
Port relief valve is faulty.	Adjust pressure, repair or replace.
Main relief valve is defective.	Adjust pressure, repair or replace.

5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



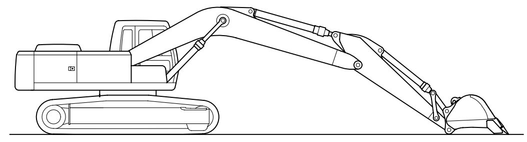
Cause	Remedy
Port relief valve is defective.	Disassemble and repair or replace.
Cylinder interior is broken.	Disassemble and repair.
Control valve spool is stuck.	Disassemble and repair.
Pilot valve is faulty.	Disassemble and repair.
Main relief valve is faulty.	Adjust pressure, repair or replace.
Hydraulic pump is broken.	Disassemble and repair.

6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

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

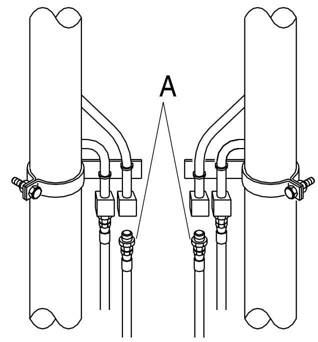
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



R29076TS01

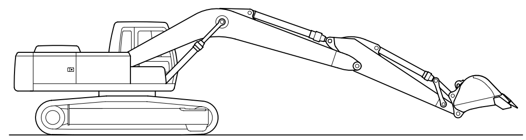
2. Disconnect hose(A) from rod side of boom cylinder and drain oil from cylinders and hose.(Put cups on piping and hose ends)



6-20(2)

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.

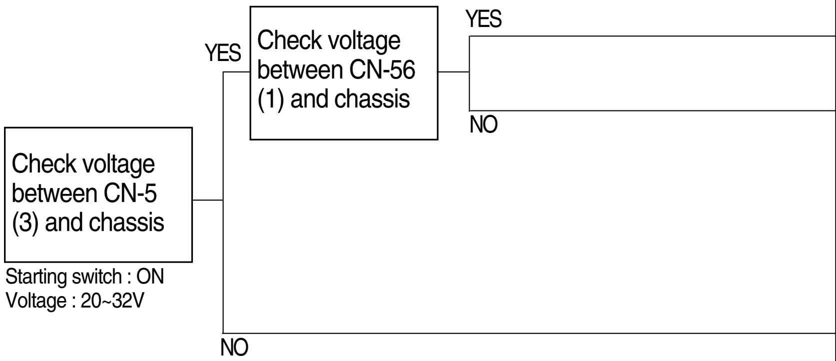


R29076TS01

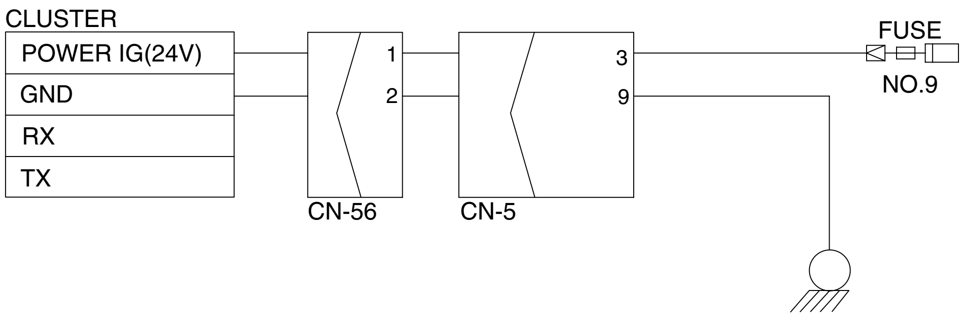
GROUP 3 ELECTRICAL SYSTEM

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.9.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective clucter	Replace
Disconnection in wiring harness or poor contact between CN-5 (3)-CN-56(1)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-5(3) and fuse No.9	Repair or replace (After clean)



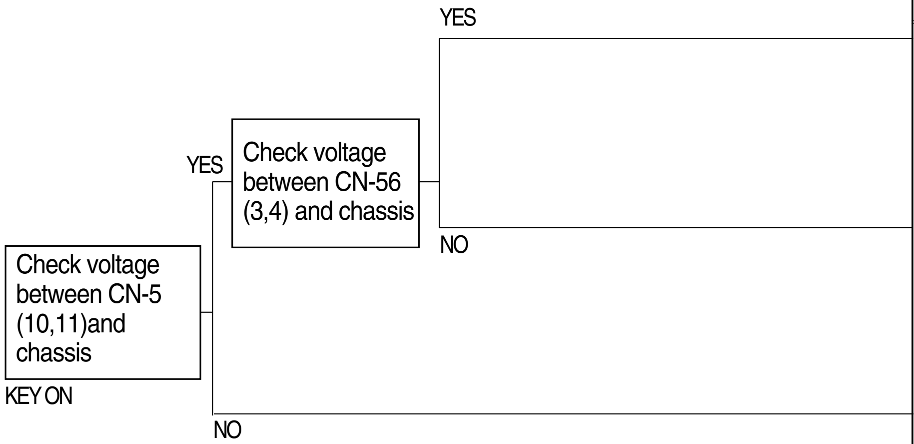
Check voltage

YES	20 ~ 32V
NO	0V

4507A6ES01

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

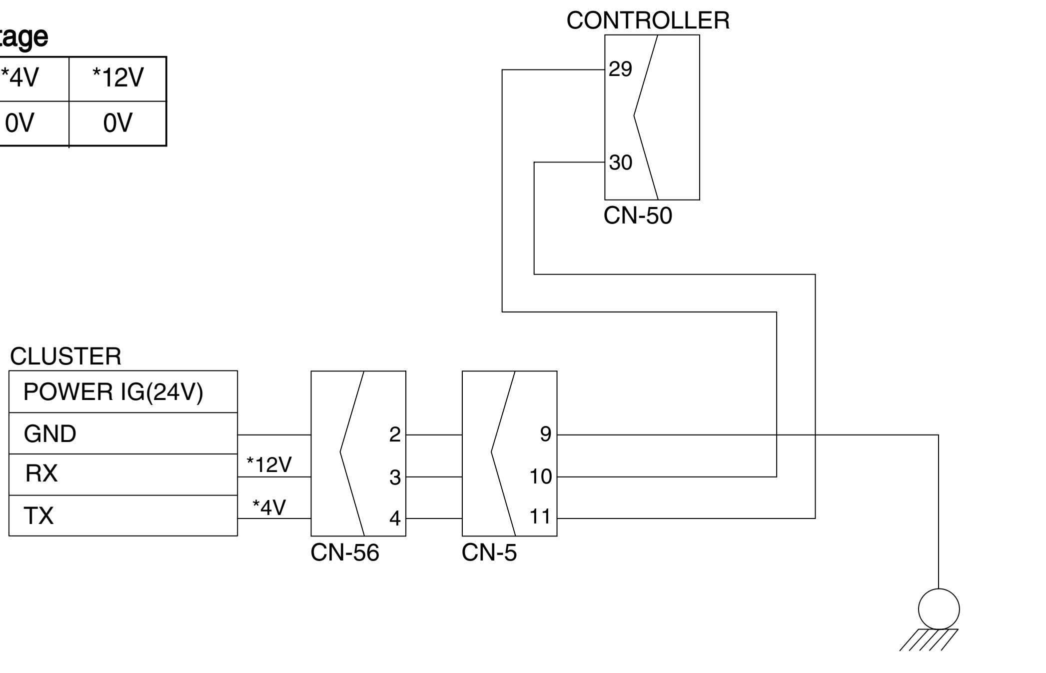
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

Check voltage

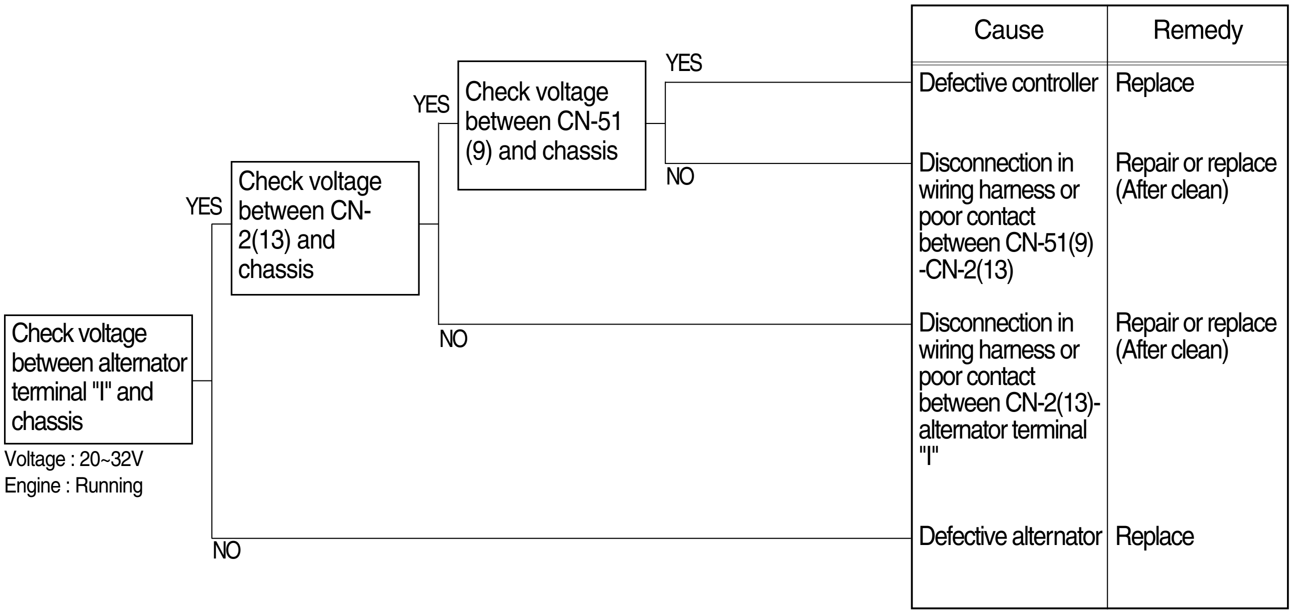
YES	*4V	*12V
NO	0V	0V



R26076ES02

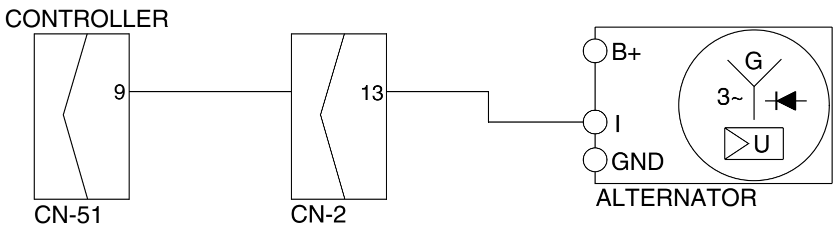
3. BATTERY CHARGING WARNING LAMP LIGHTS UP(Starting switch : ON)

- 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

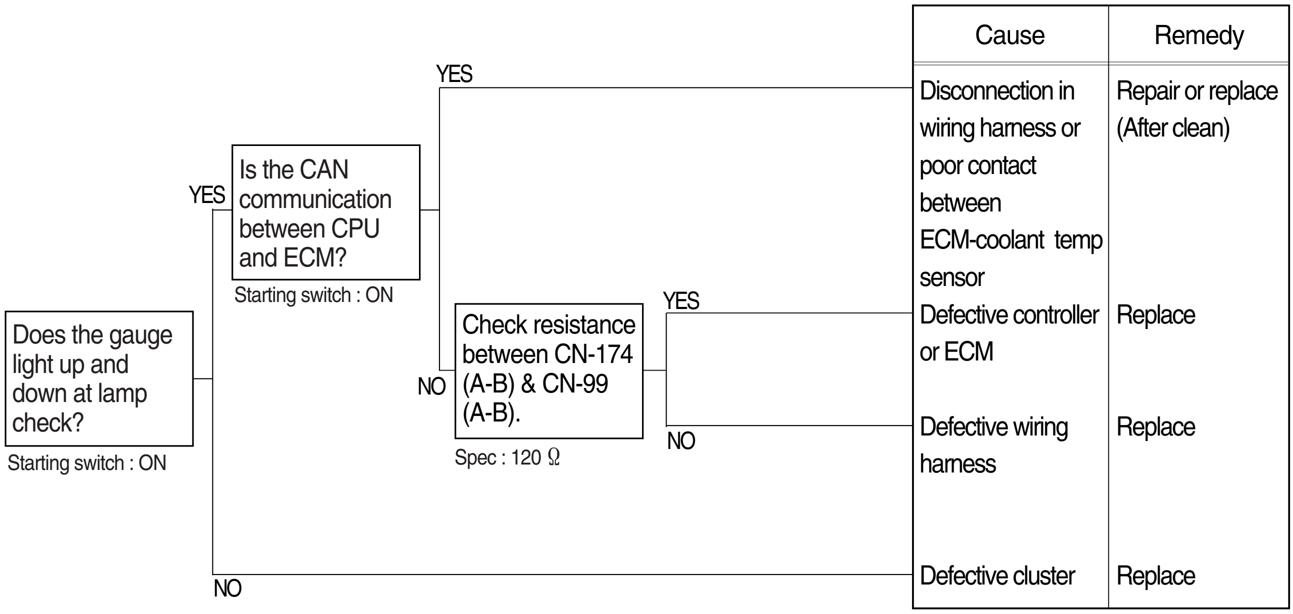
YES	20 ~ 32V
NO	0V

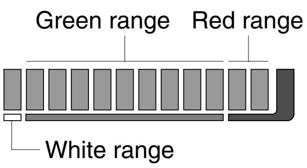


2907A6ES01

4. WHEN COOLANT OVERHEAT WARNING LAMP LIGHTS UP(Engine is started)

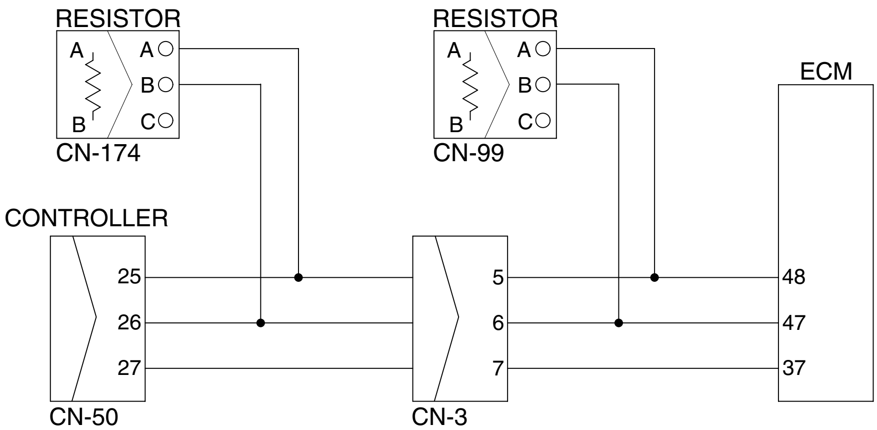
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

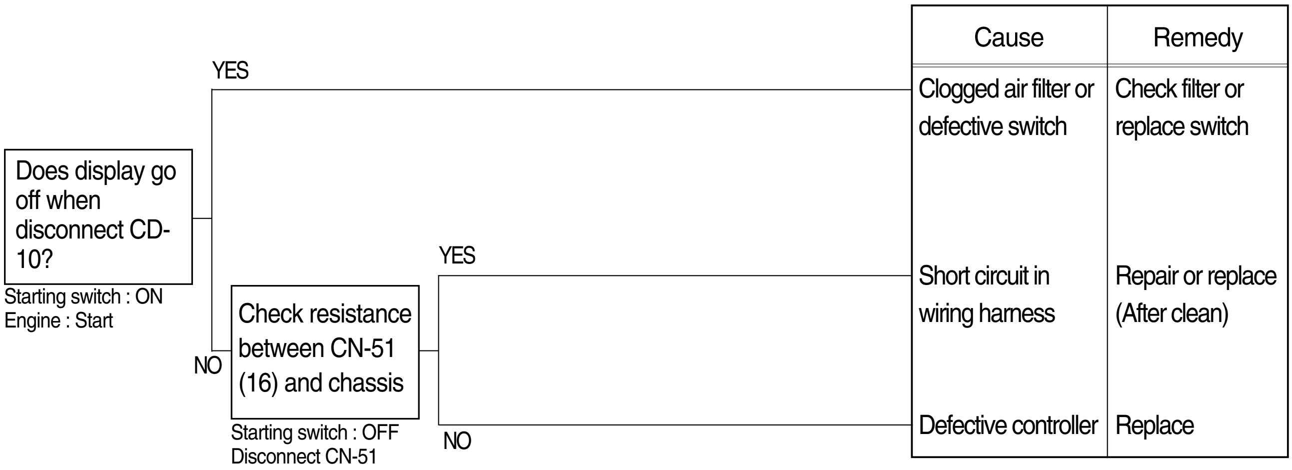
Temperature / Item	White range (~29˚C)	Green range (30~105˚C)	Red range (105˚C ~)



2907A6ES02

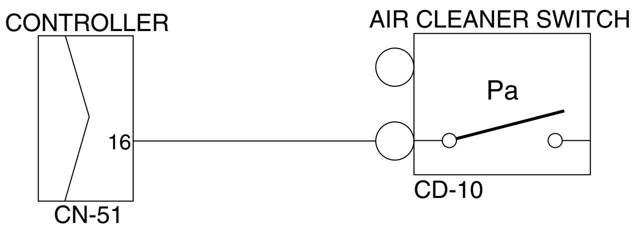
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP(Engine is started)

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



Check resistance

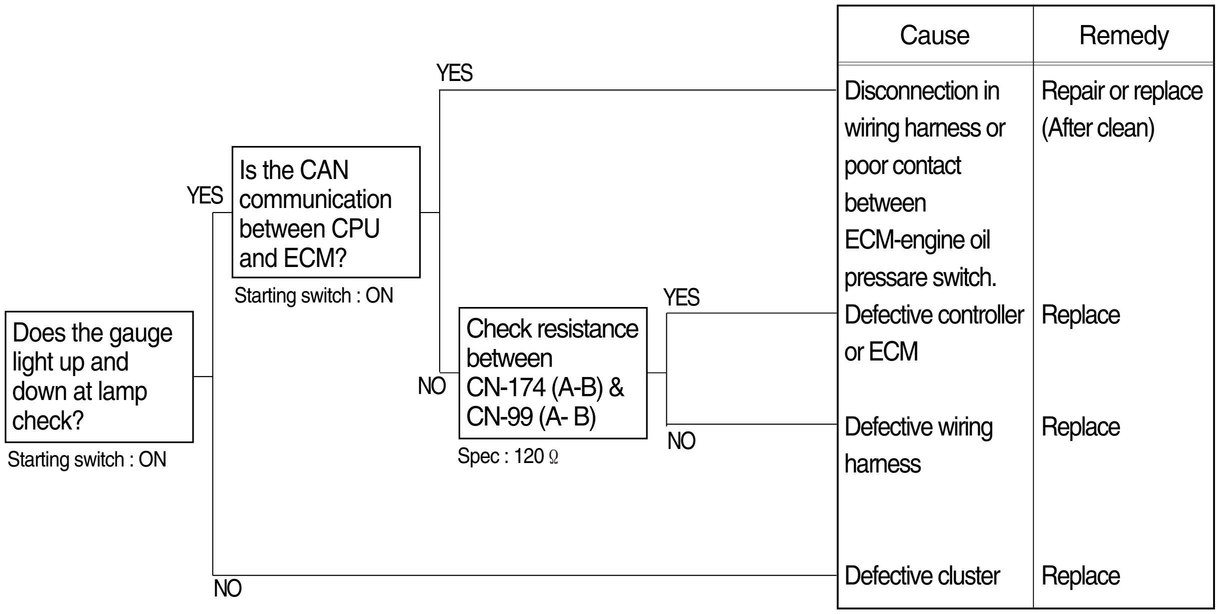
YES	MAX 1Ω
NO	MIN 1M Ω



2907A6ES07

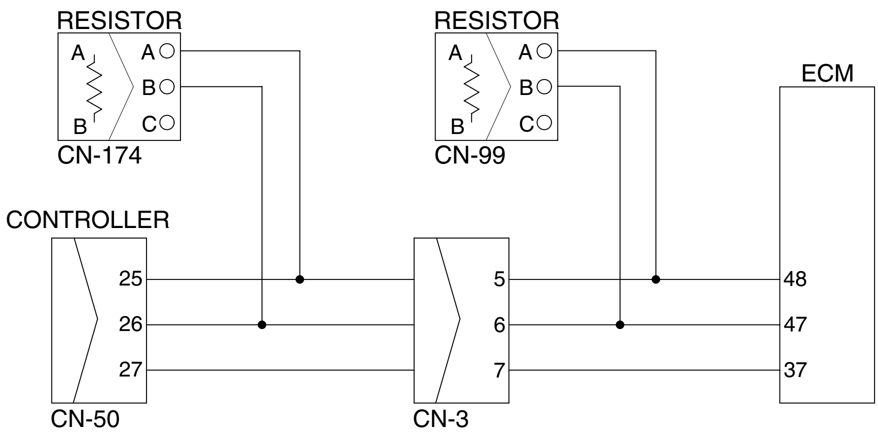
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP(Engine is started)

· 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

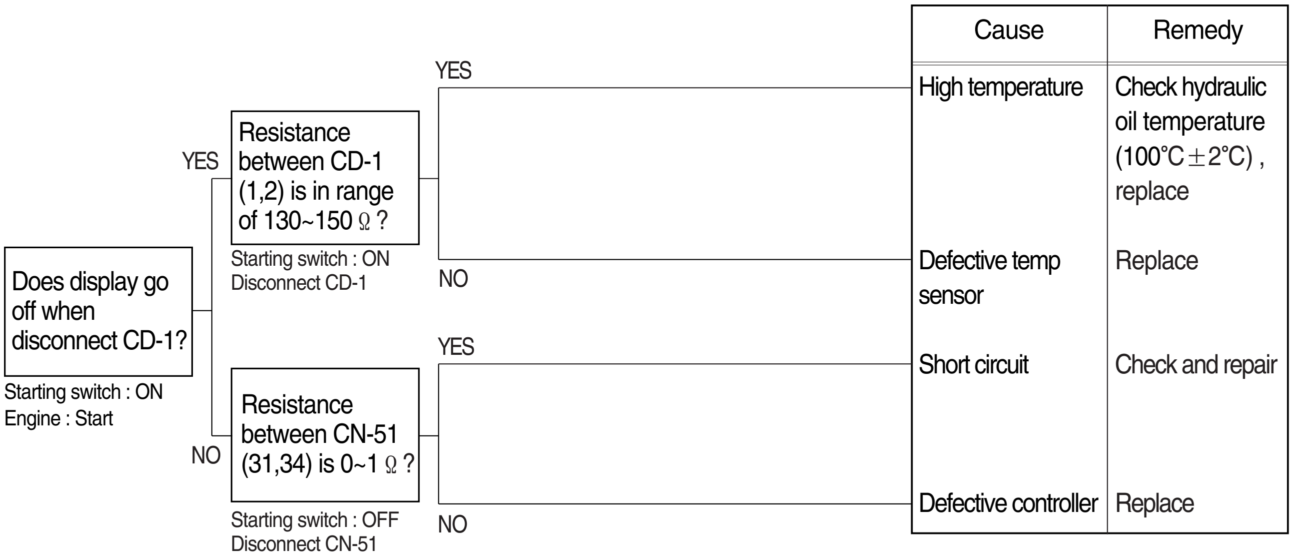
YES	MAX 1Ω
NO	MIN 1MΩ

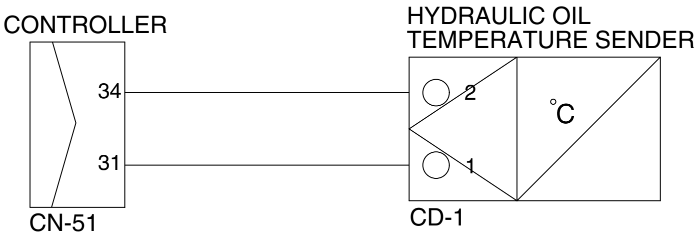


2907A6ES02

7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP(Engine is started)

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

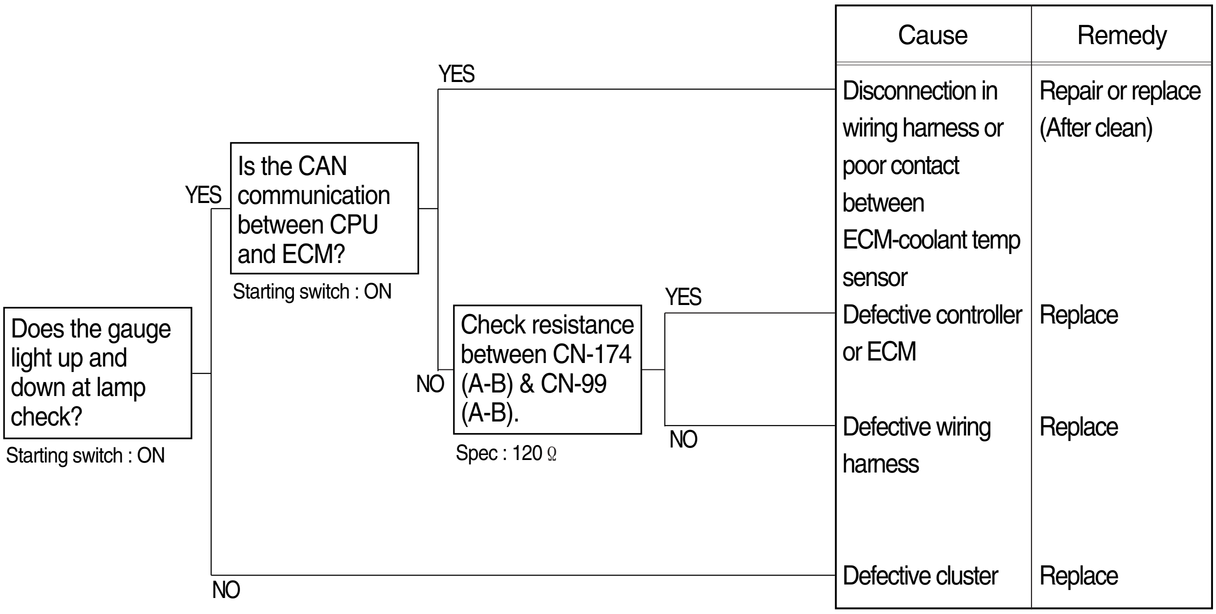




R29076ES04

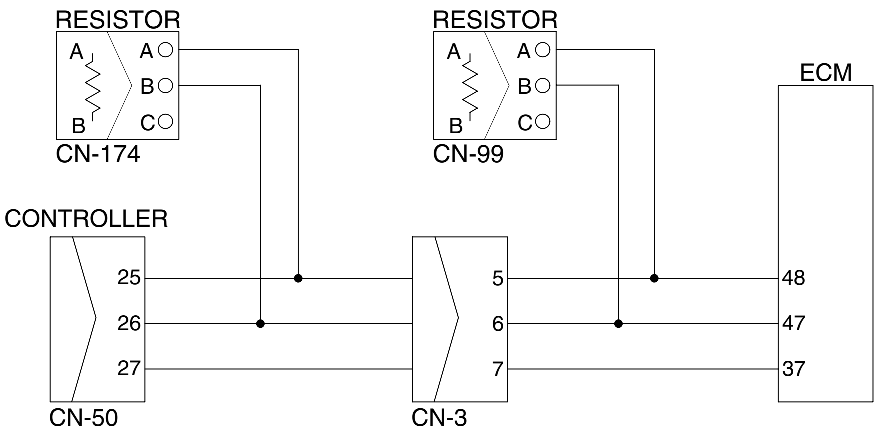
8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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



Check Table

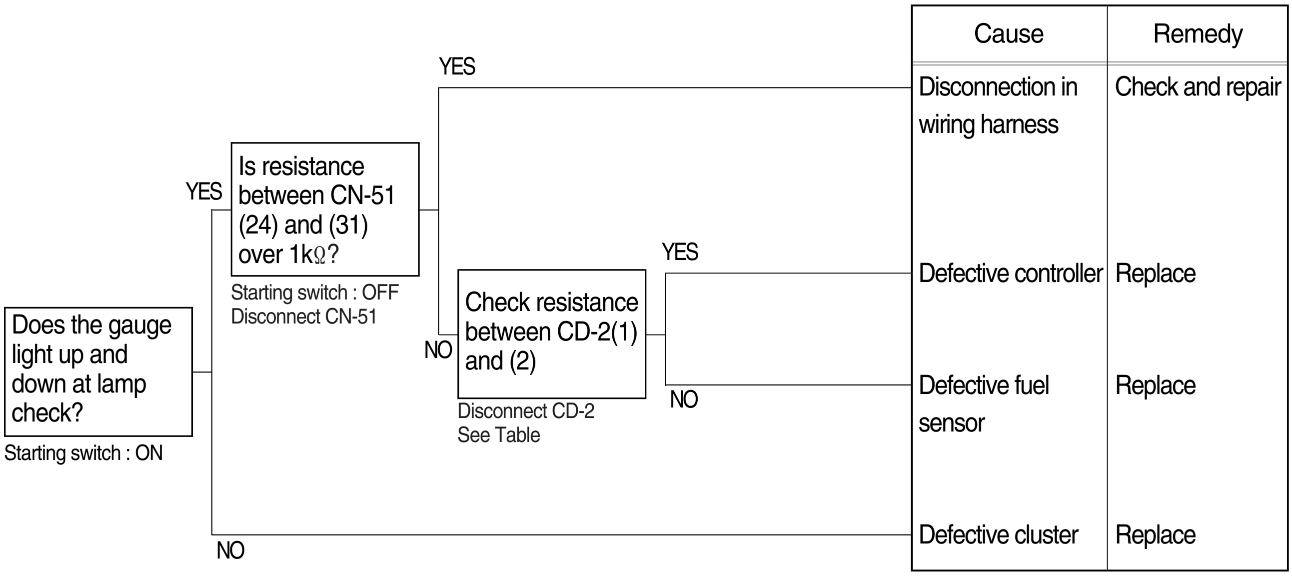
Item \ Temperature	White range (~29°C)	Green range (30~105°C)	Red range (105°C ~)



2907A6ES02

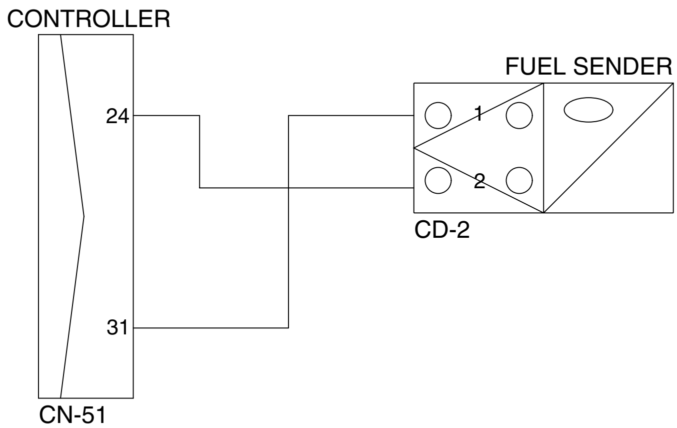
9. WHEN FUEL GAUGE DOES NOT OPERATE(Check warning lamp ON/OFF)

- 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

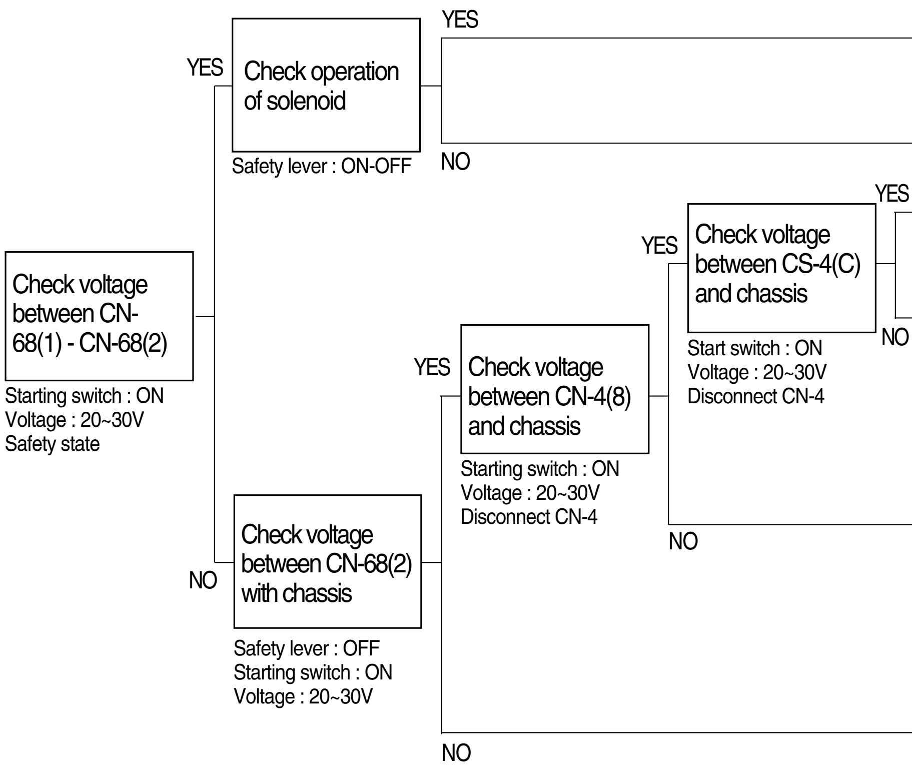
Item \ Level	White range	Green range	Red range
Unit Resistance(Ω)	700~601	600~101	~100
Tolerance(%)	±5	±5	±5



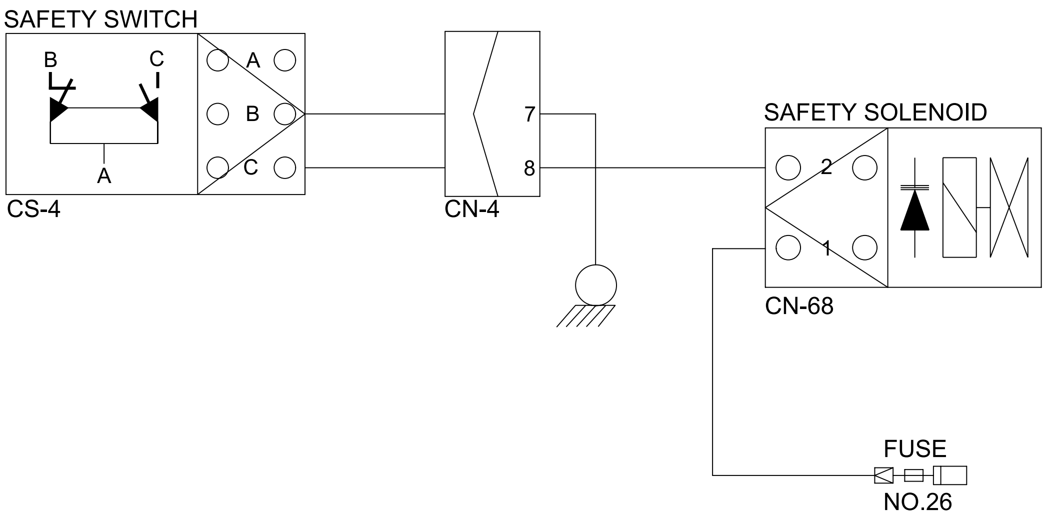
R29076ES06

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

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

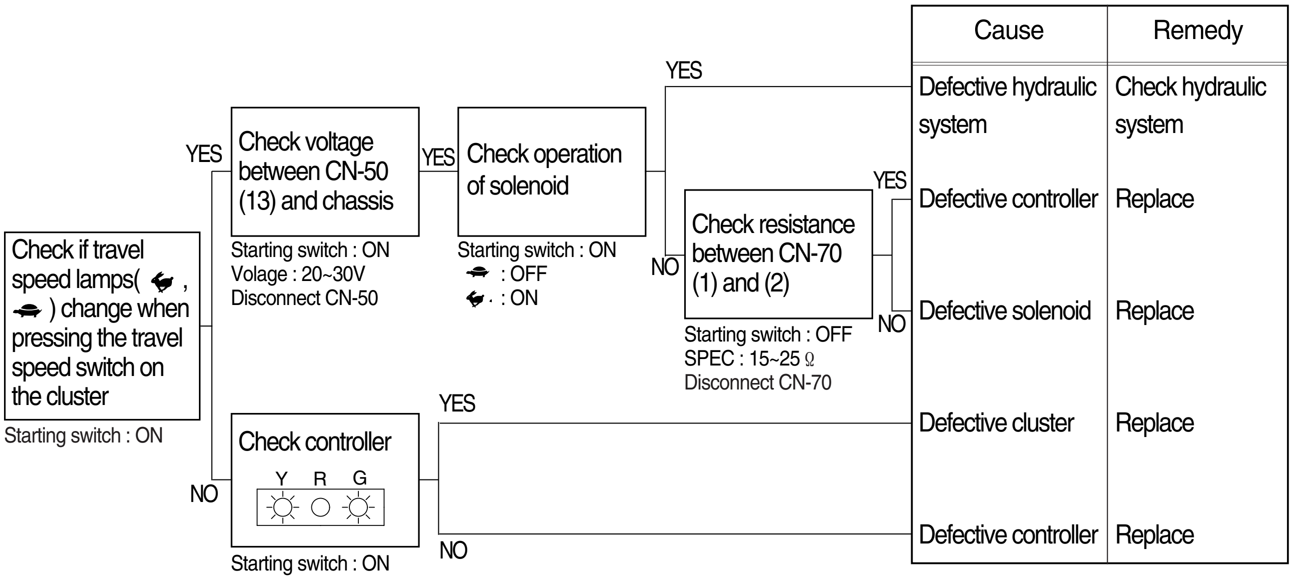


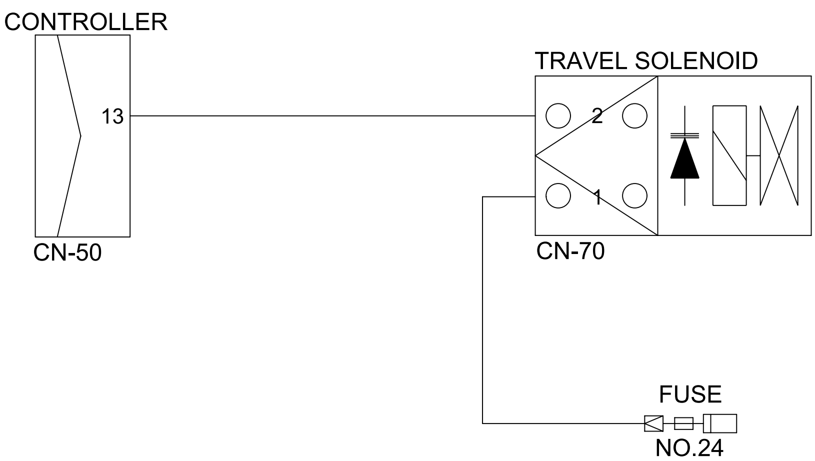
Cause	Remedy
Hydraulic malfunction	Check hydraulic system
Defective solenoid	Replace
Defective switch	Replace
Disconnection in wiring harness or poor contact between CS-4(C)-CN-68(2)	Repair or replace (After clean)
Disconnect in wiring harness or poor contact between CN-4(8)-CN-68(2)	Repair or replace (After clean)
Disconnection in fuse No. 26	Replace



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

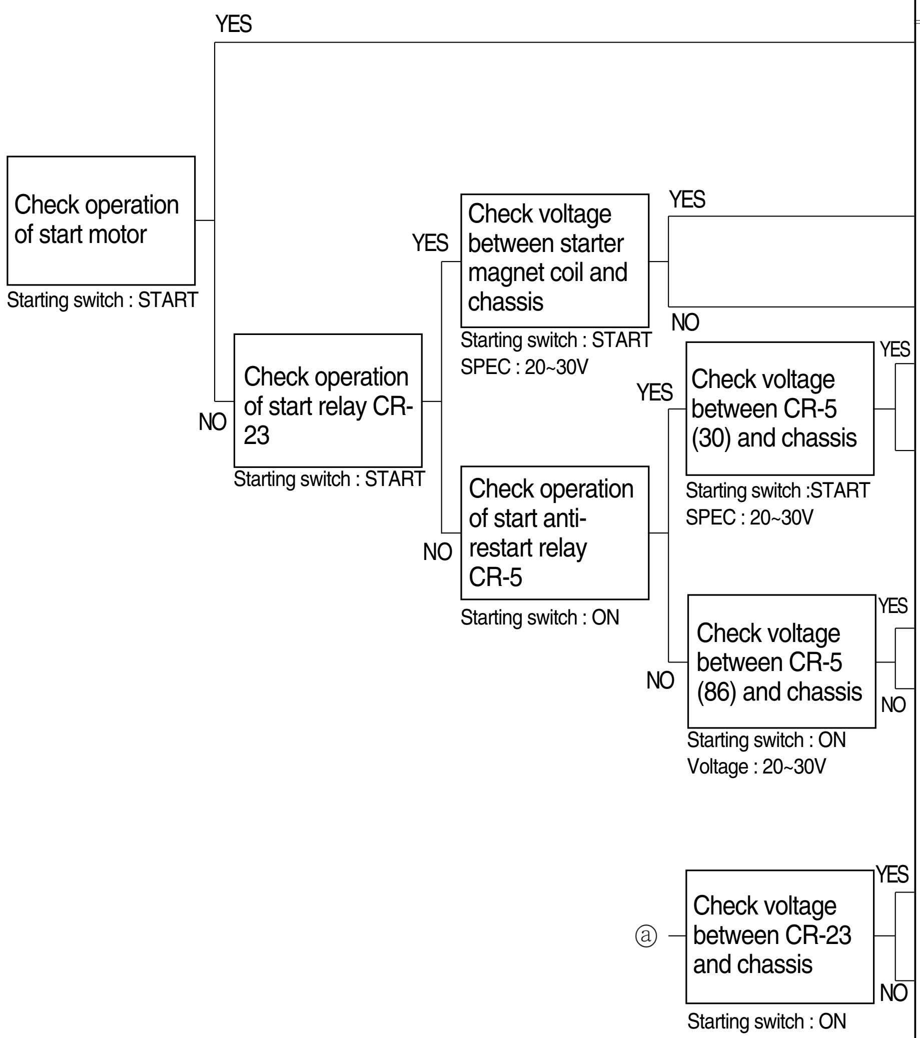




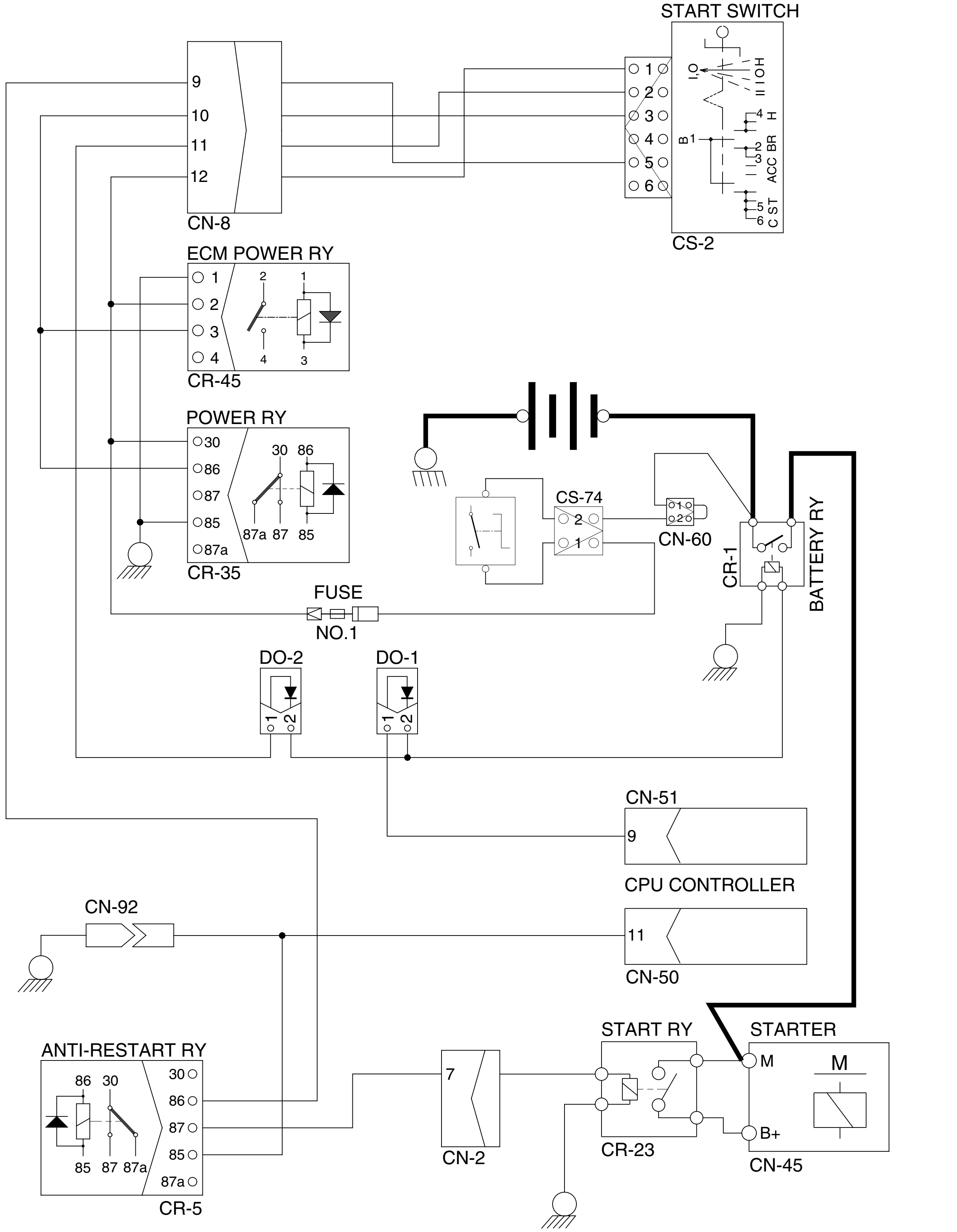
45076ES03

12. WHEN ENGINE DOES NOT START

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



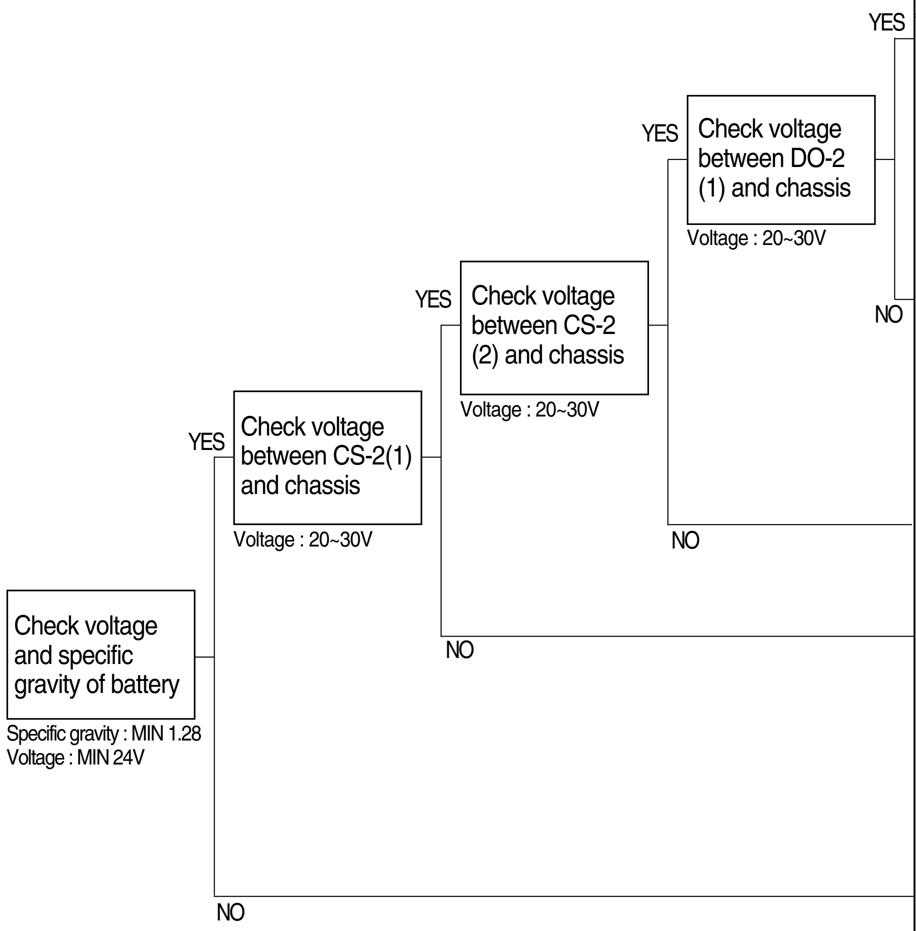
Cause	Remedy
Defective battery	Check engine system charge or replace(After checking specific gravity of battery)
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ	
Defective start anti-restart relay	Repair or replace (After clean)
Defective relay	Replace
Disconnection in wiring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



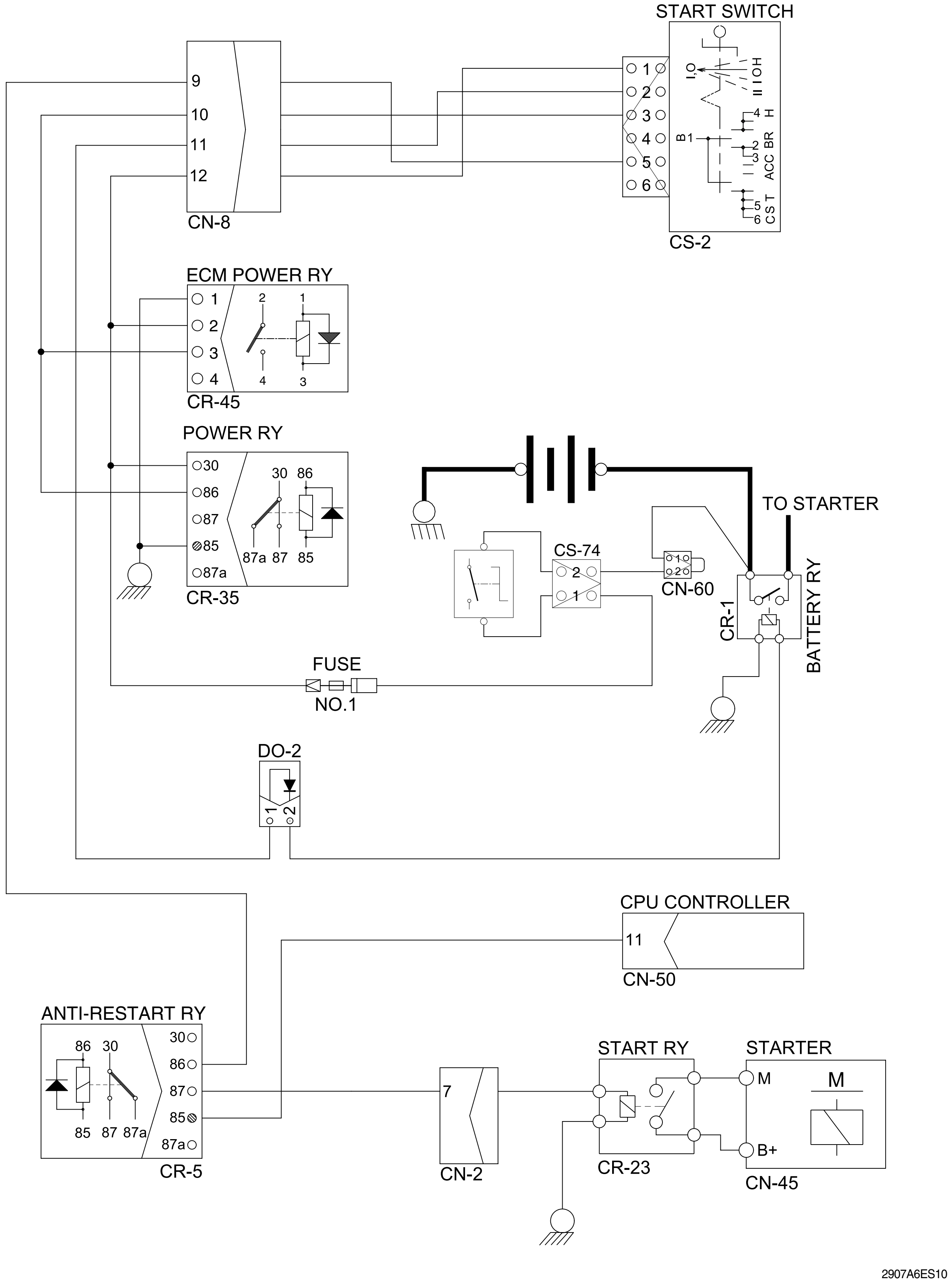
2907A6ES08

13. WHEN STARTING SWITCH ON DOES NOT OPERATE

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

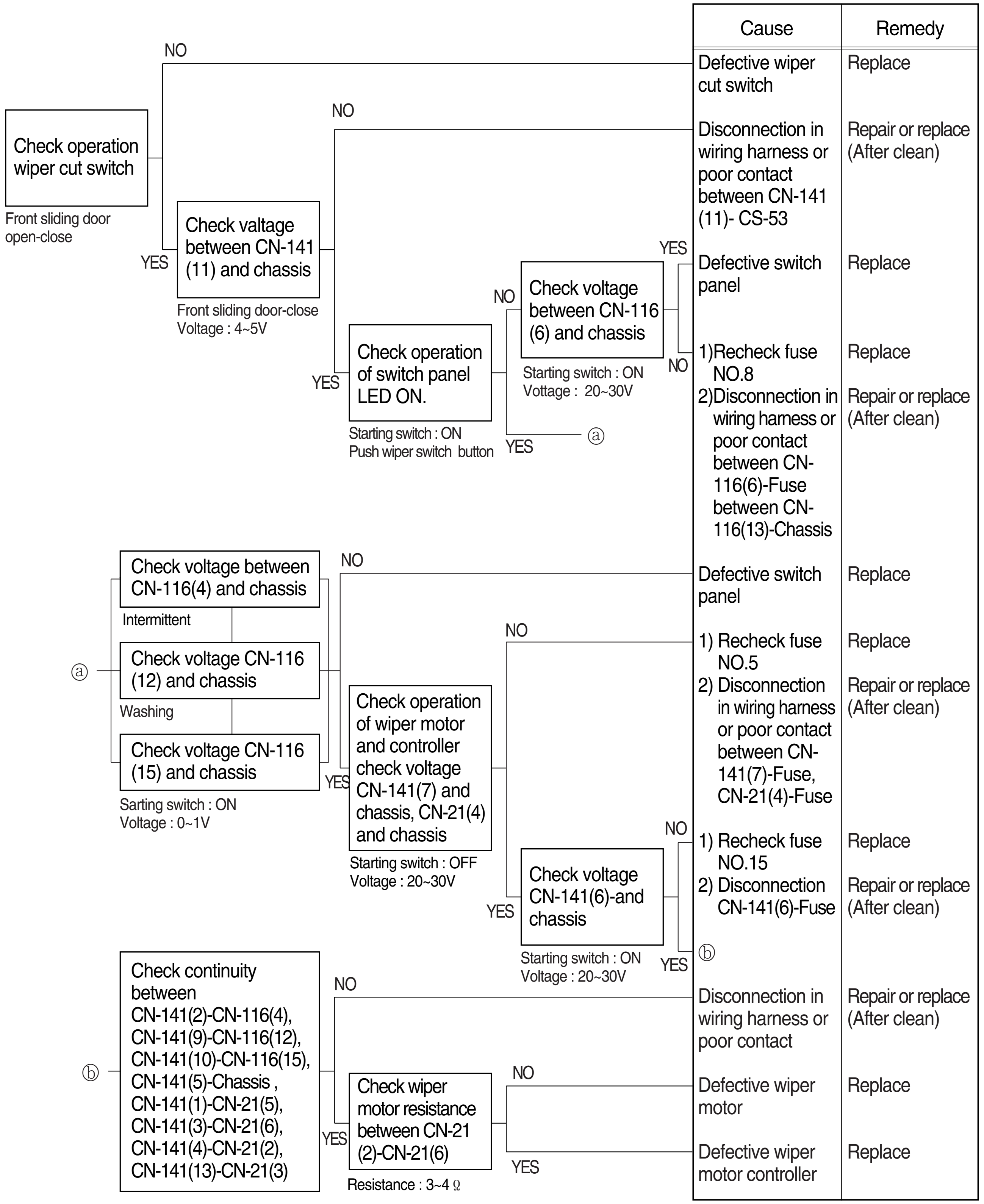


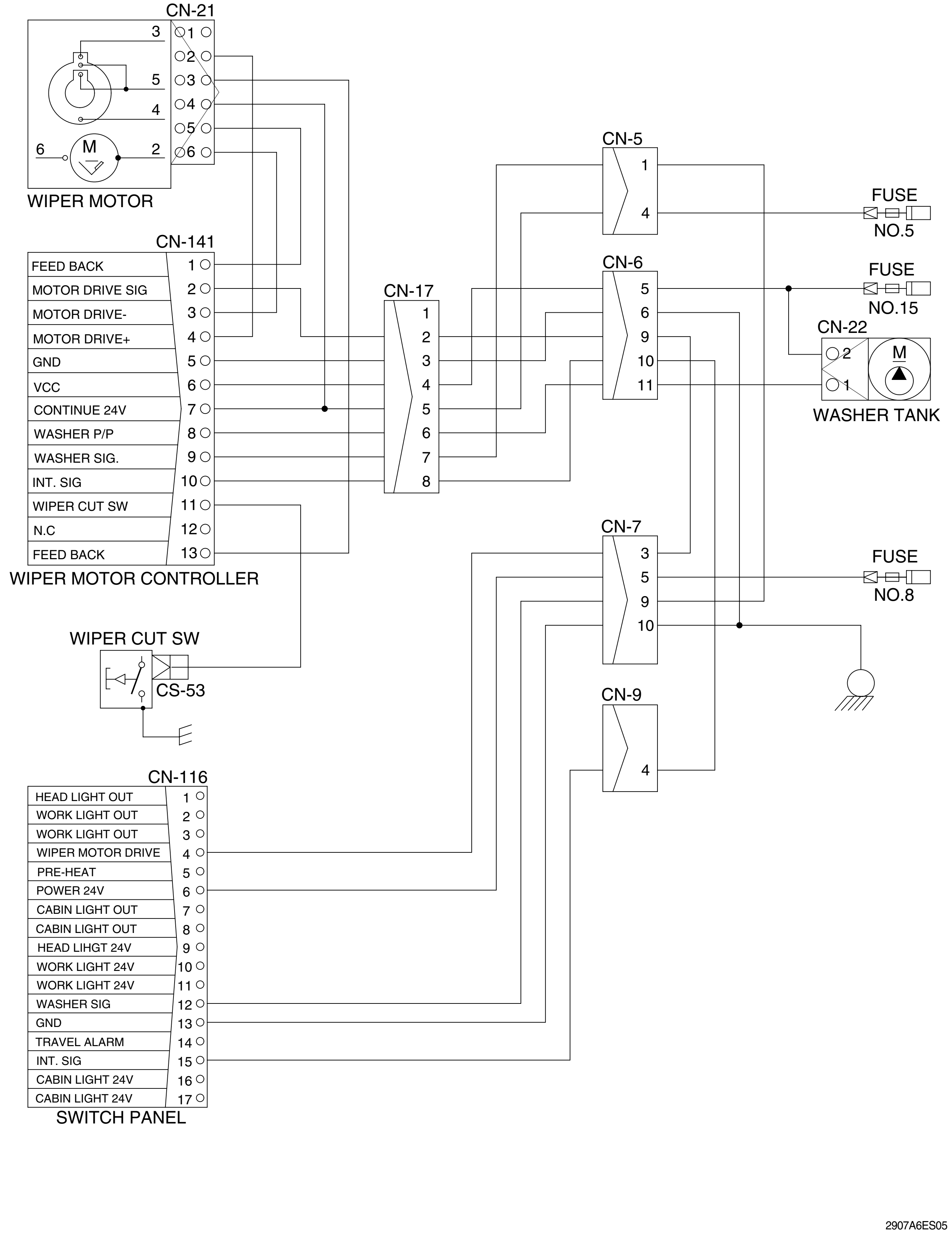
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-2(1)-CR-1 or defective battery relay	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-2(2)-CN-8(11)- DO-2(1)	Replace
Defective start switch	Replace
Disconnection in wiring harness or poor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



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

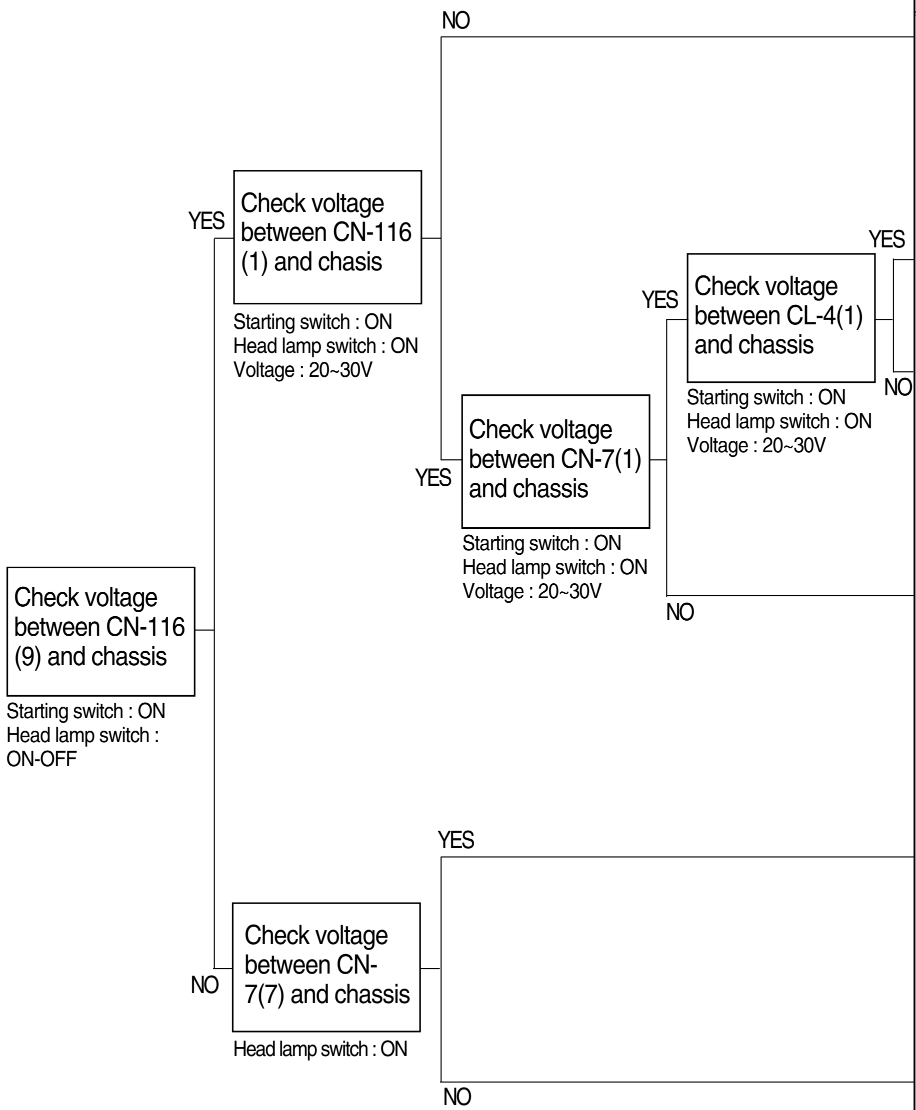
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.5, 8 and 15 is not blown out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



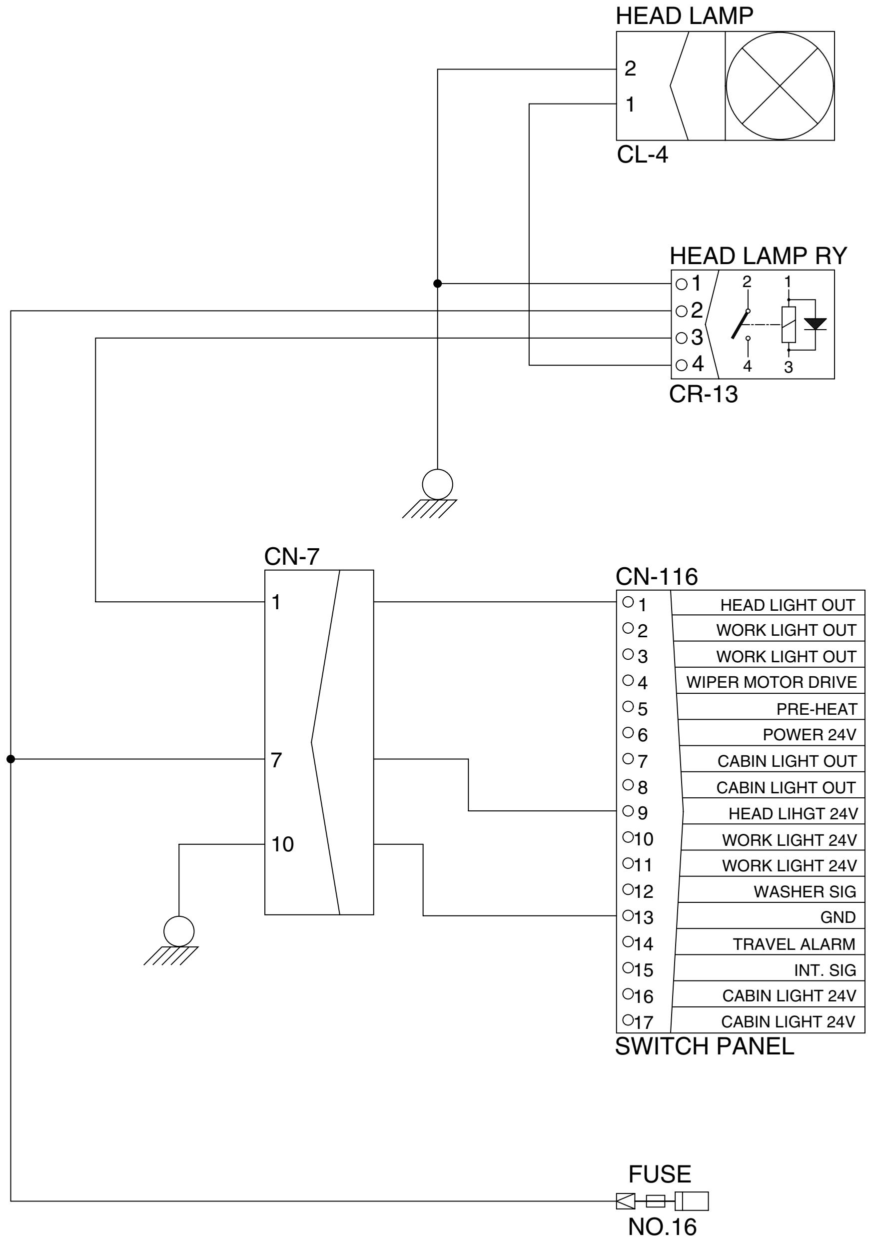


15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

- 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.16.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



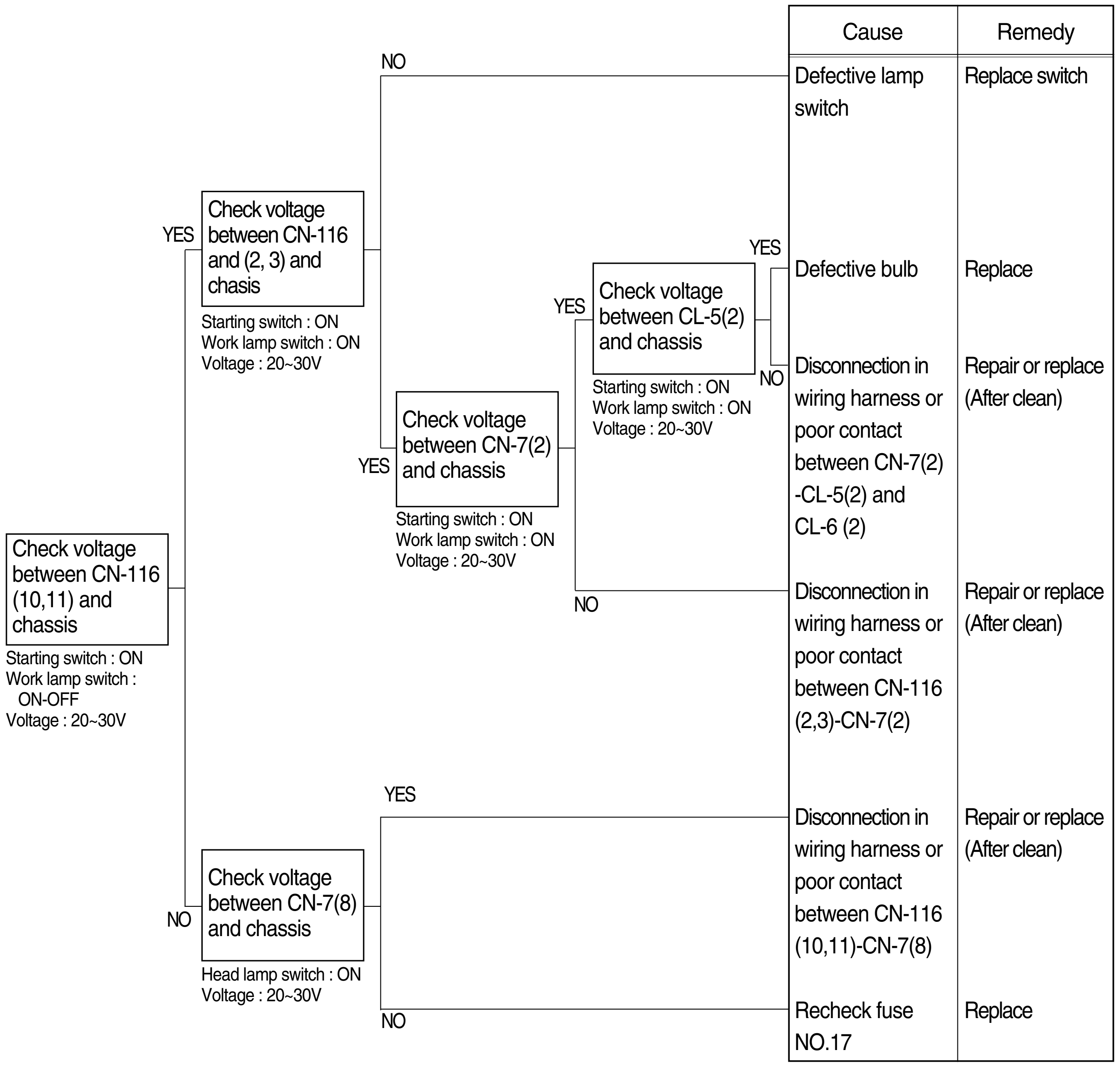
Cause	Remedy
Defective lamp switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-7(1)-CL-4(1)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-116(1)-CN-7(1)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-116 (9)-CN-7(7)	Repair or replace (After clean)
Recheck fuse	Replace

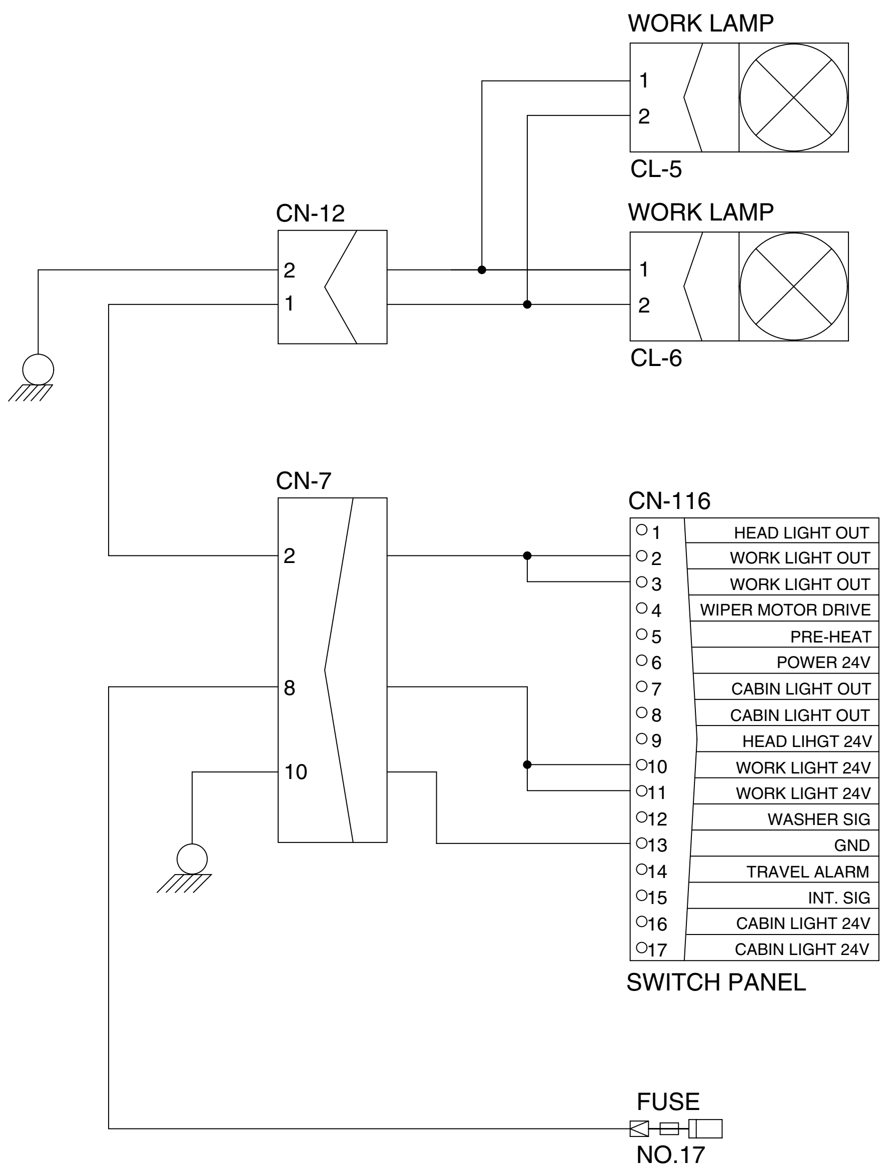


2907A6ES06

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.17.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





36076ES09

GROUP 4 MECHATRONICS SYSTEM

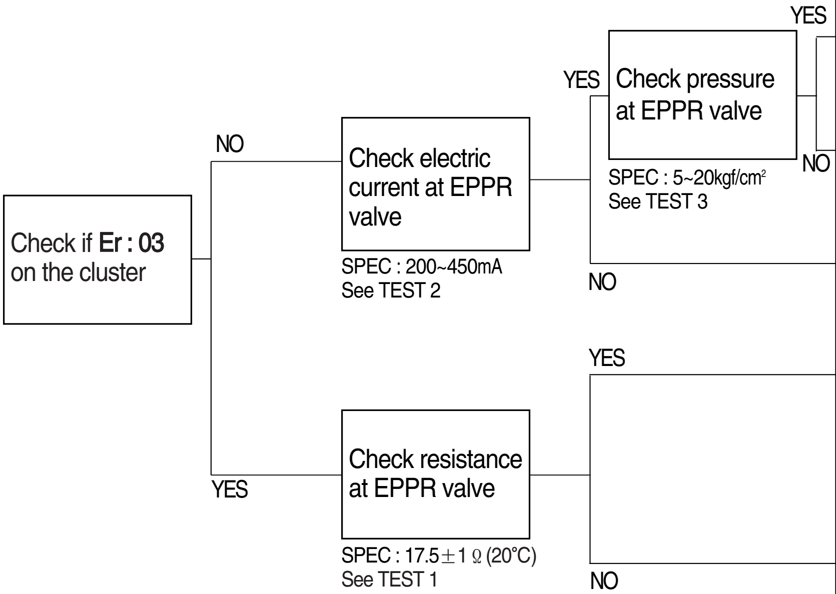
1. ALL ACTUATORS SPEED ARE SLOW

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

※ Spec : M-mode 1850 ± 50rpm H -mode 1850 ± 50rpm S-mode 1750 ± 50rpm

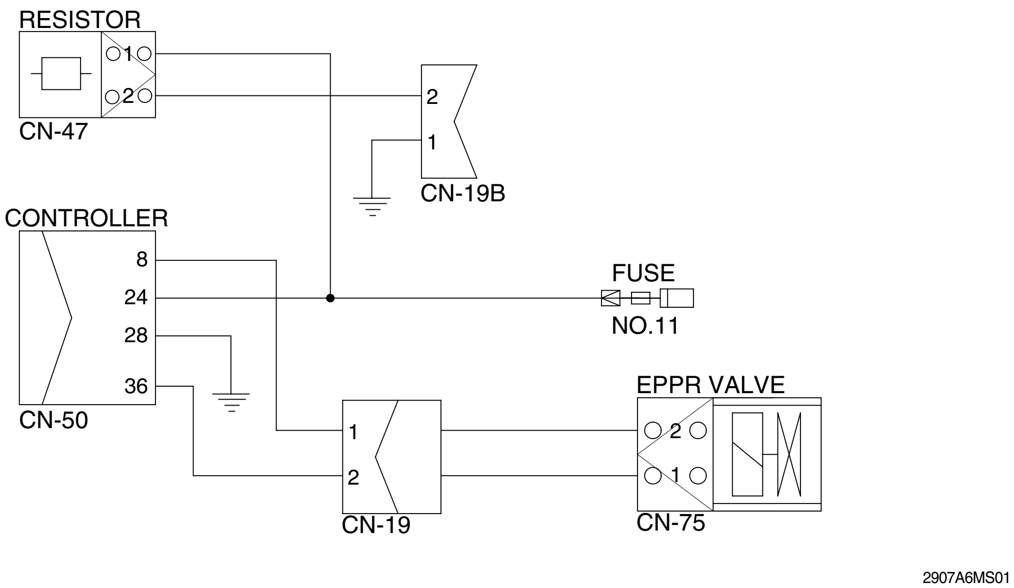
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective hydraulic system	
Defective EPPR valve	Replace
Defective CPU controller	Replace
Short circuit or poor connection between CN-50 - CN-75	Check & repair wire harness or between CN-50- CN-75
Defective EPPR valve	Replace

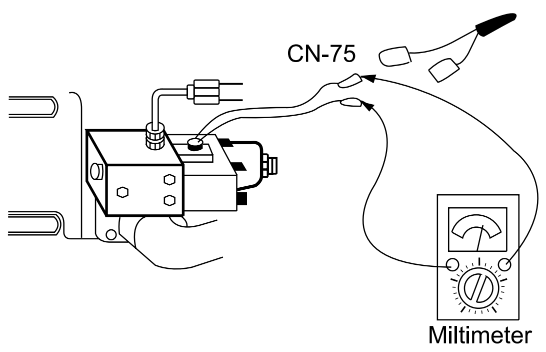
Wiring diagram



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

① Starting key OFF.
② Disconnect connector CN-75 from EPPR valve at main hydraulic pump.
③ Check resistance between 2 lines as figure.

SPEC : 17.5±1 Ω (20°C)

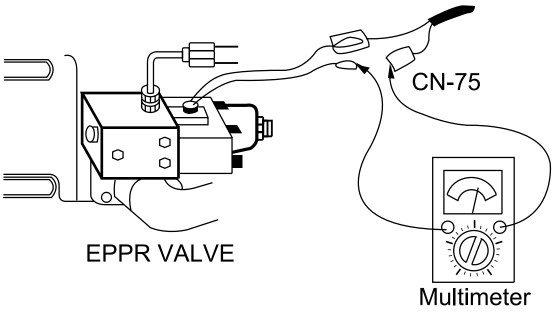


6-38(2)

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

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at "10"(MAX)
④ Set S-mode and cancel auto decel mode.
⑤ If tachometer show approx 1750±50rpm check electric current.

SPEC : 200~450mA(S mode)

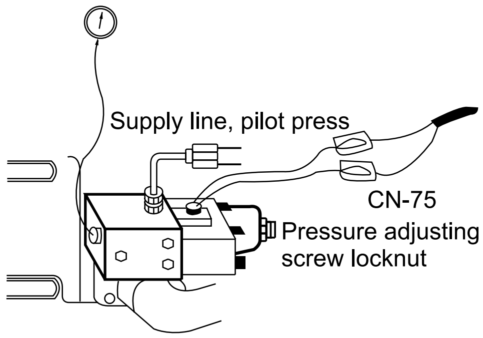


6-38(3)

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

① Remove plug and connect pressure gauge as figure.
 · Gauge capacity : 0 to 40~50kgf/cm² (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/cm²(70~280psi)

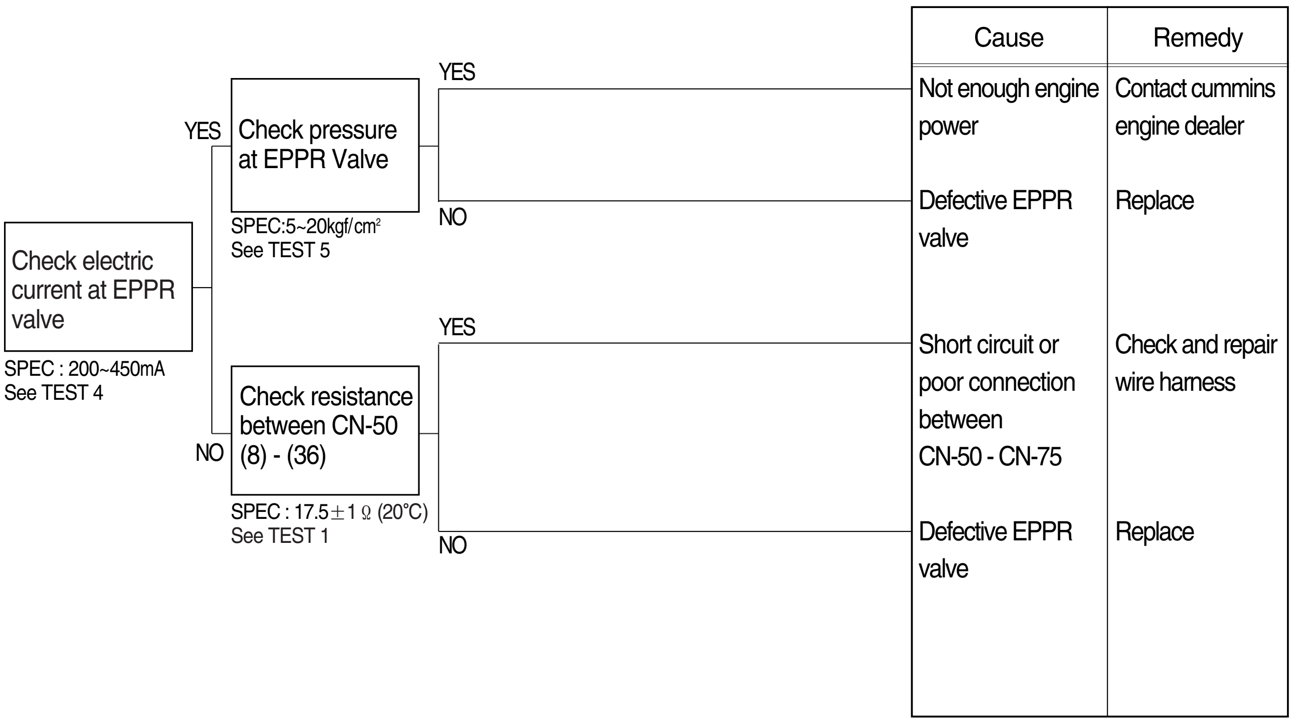


6-39(1)

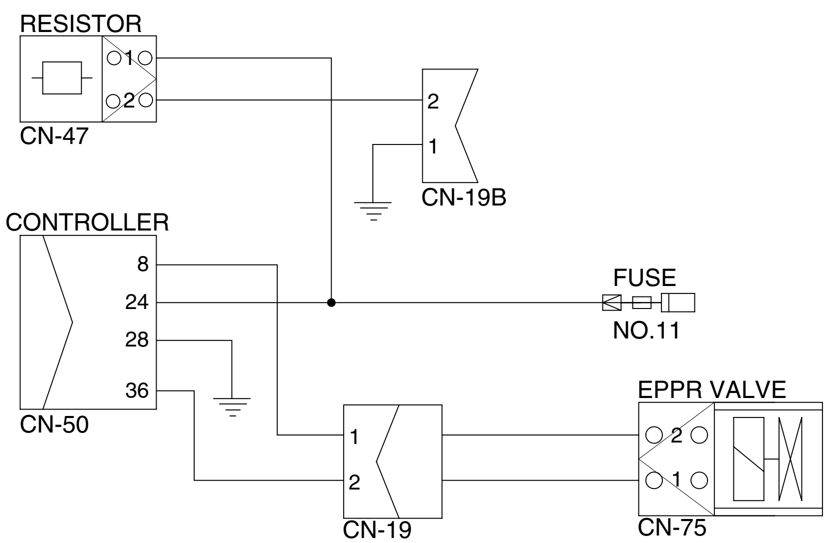
2. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram



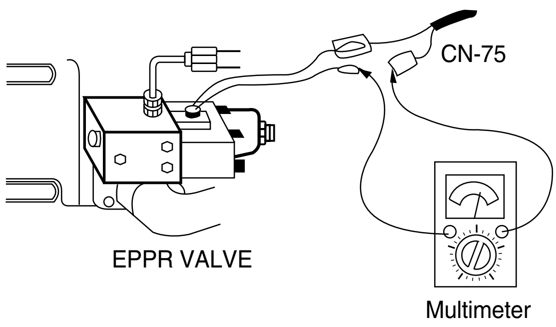
2907A6MS01

2) TEST PROCEDURE

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

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at "10"(max)
④ Set S-mode with 1750±50rpm.
⑤ Check electric current.

SPEC : 200~450mA

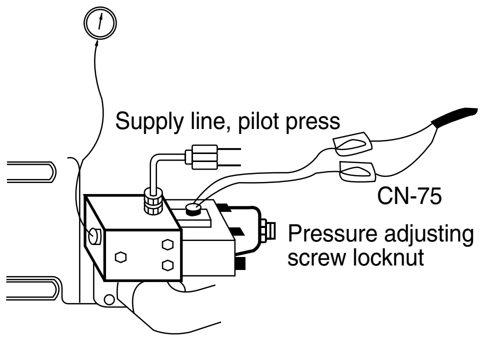


6-44(1)

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

① Connect pressure gauge at EPPR valve.
② Start engine.
③ Set the accel dial at "10"(max)
④ Set S-mode with 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/cm²(70~280psi)

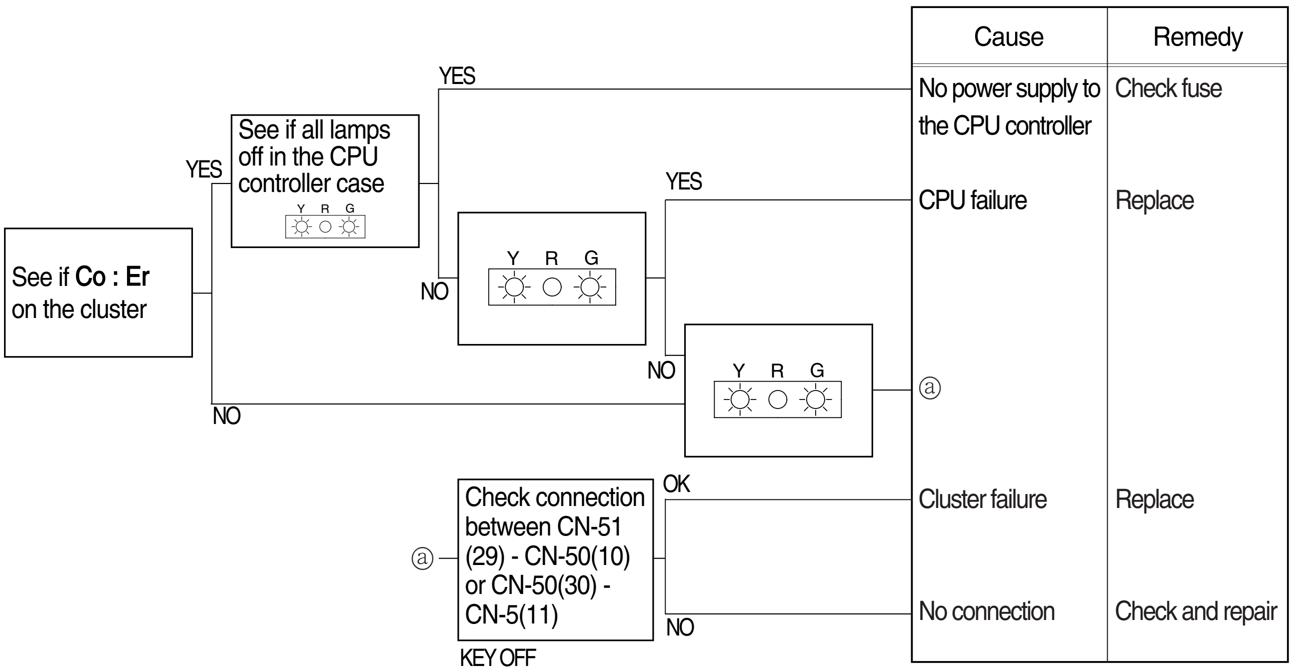


6-44(2)

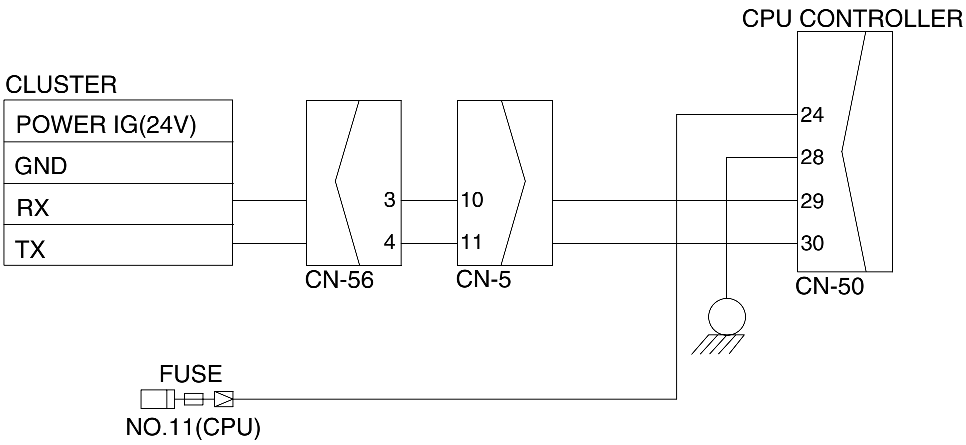
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram



36076MS02

4. AUTO DECEL SYSTEM DOES NOT WORK

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

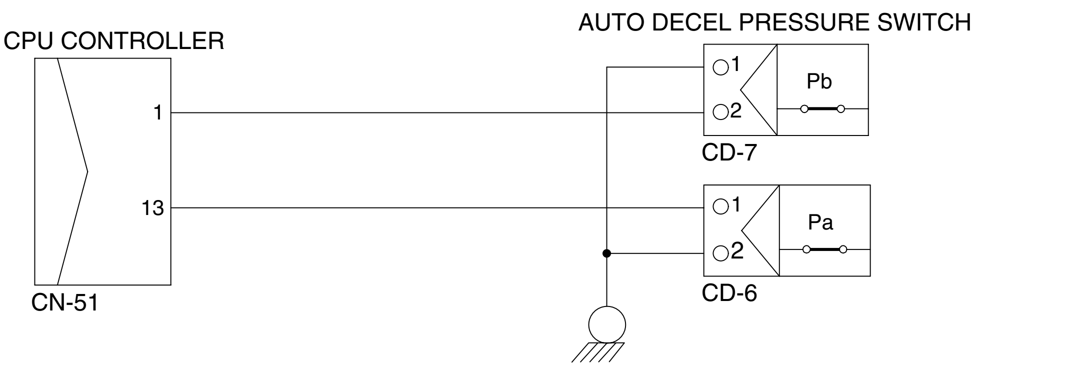
1) INSPECTION PROCEDURE

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

SPEC :
Actuator operating : 11~13V
Actuator stop :0~2V
See TEST 6
See TEST 7

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

Wiring diagram



R29076MS10

2) TEST PROCEDURE

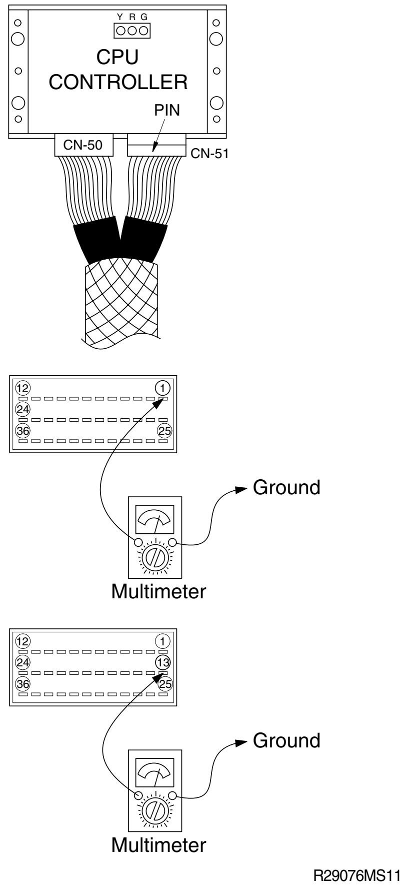
(1) Test 6 : Check voltage at CN-51(1) and ground.

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 7 : 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.

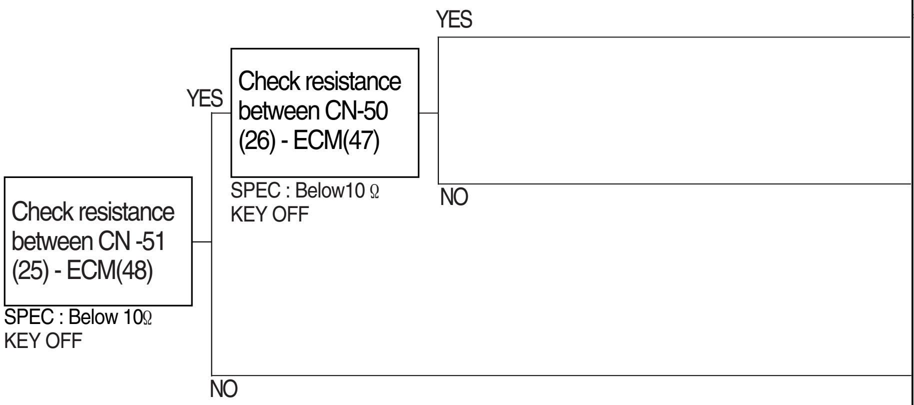
SPEC : Actuator stop : 11~13V
Actuator operating : 0~2V



5. MALFUNCTION OF WARMING UP

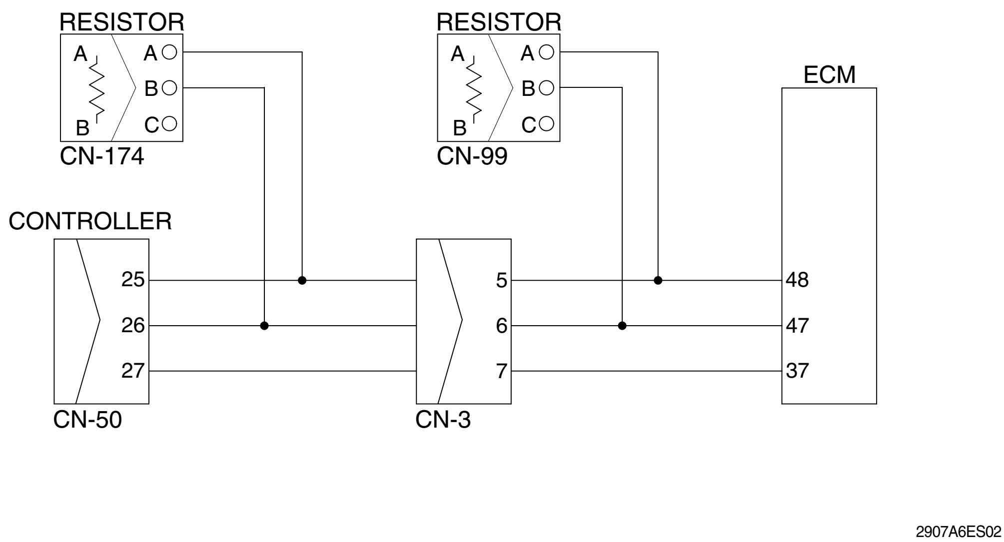
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective cluster or CPU controller or ECM	Repair or Replace
Poor connection between CN-51(26) - ECM(47)	Repair
Poor connection between CN-51(25) - ECM(48)	Repair

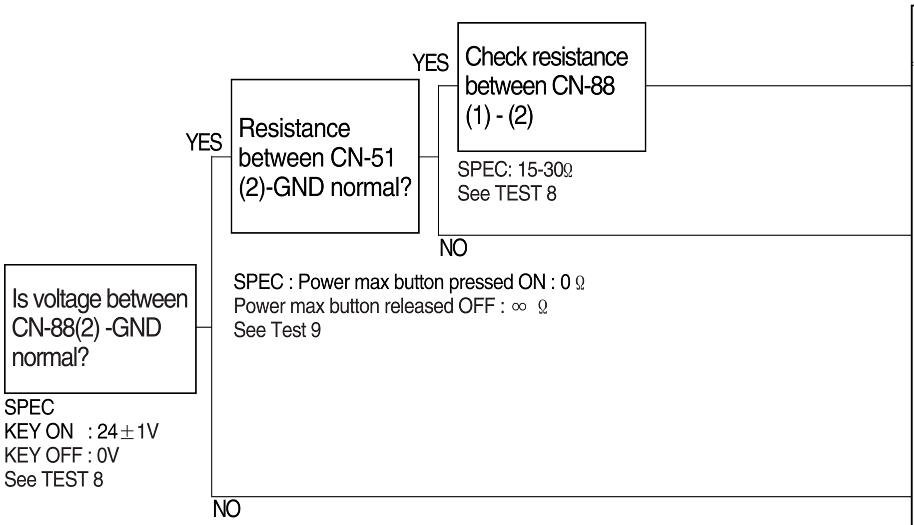
Wiring diagram



6. MALFUNCTION OF POWER MAX

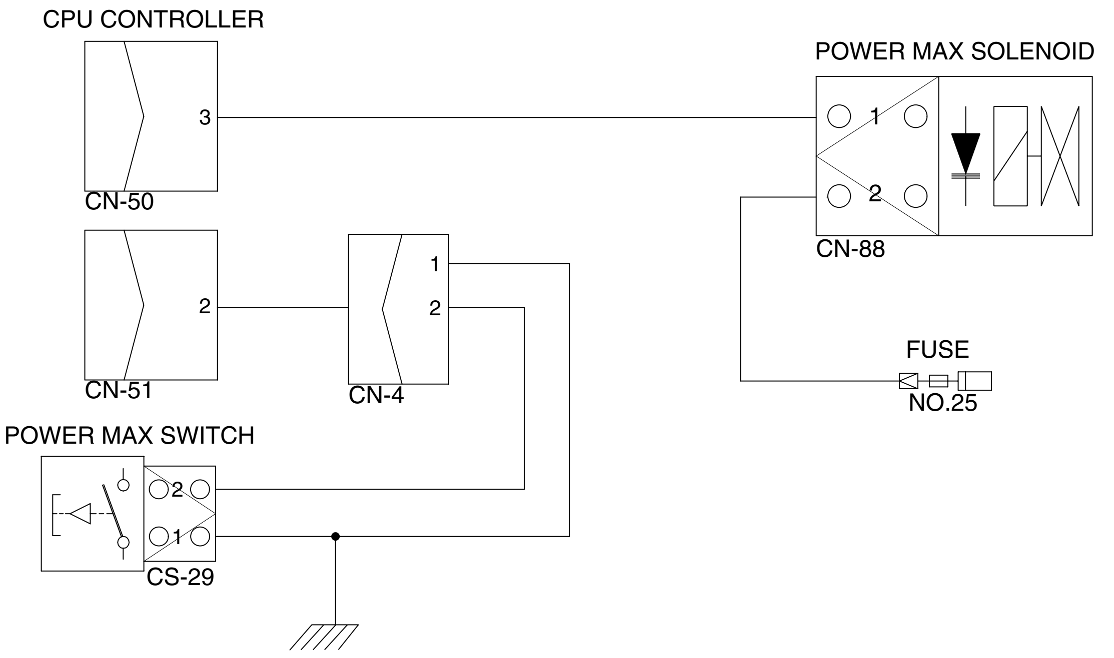
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



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

Wiring diagram



50076MS04

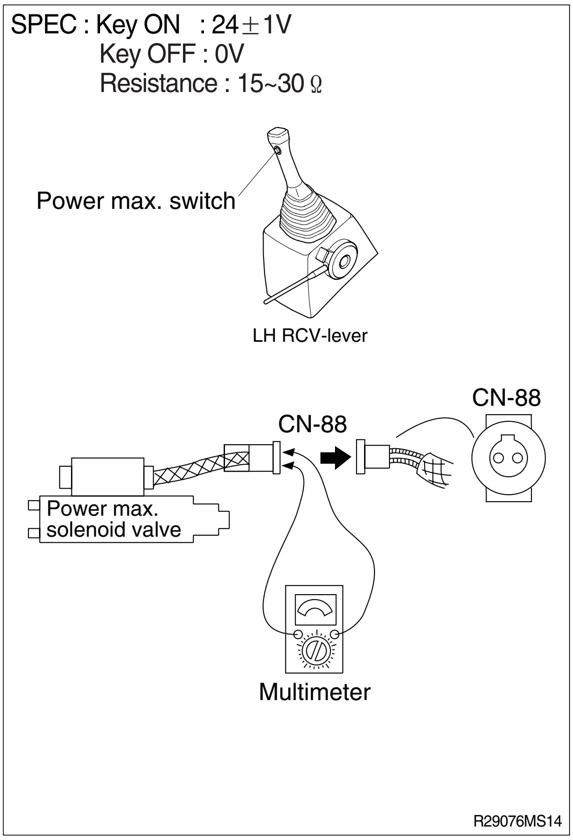
2) TEST PROCEDURE

(1) **Test 8:** Check voltage between connector CN-88 - GND.

① Start key ON.

② Disconnect connector CN-88 from power max solenoid valve.

③ Check voltage as figure.

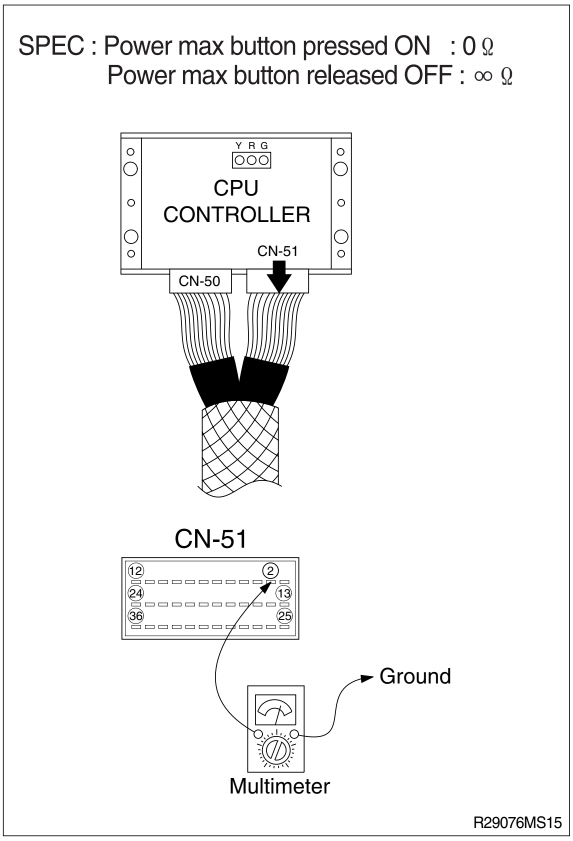


(2) **Test 9:** Check resistance between connector CN-51(2)-GND.

① Starting key OFF.

② Remove CPU controller and disconnect connector CN-51 from CPU controller.

③ Check resistance as figure.



SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

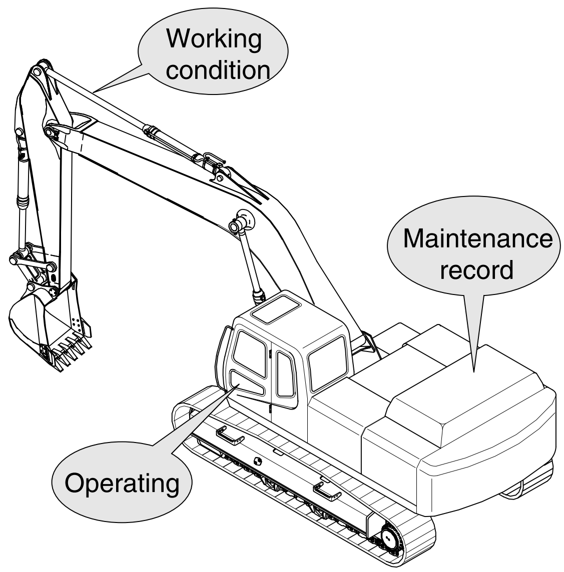
1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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 HD Hyundai Construction Equipment 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).



21077MS01

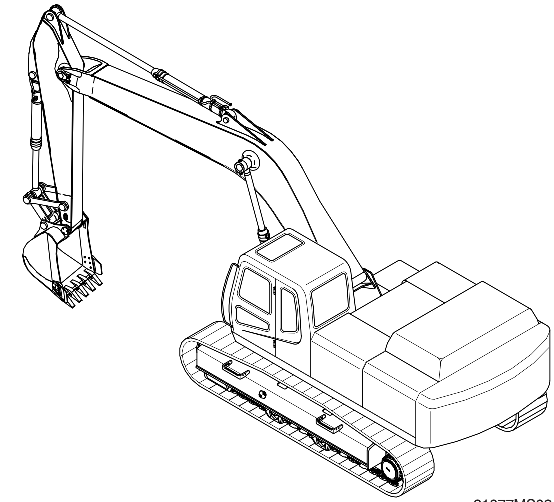
3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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

2. TERMINOLOGY

1) STANDARD

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



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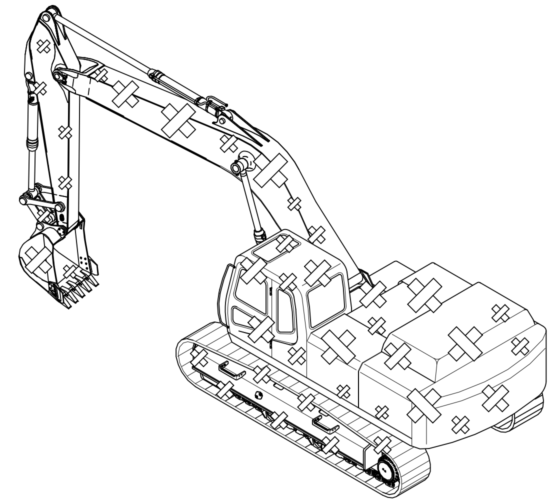
2) SERVICE LIMIT

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.



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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.

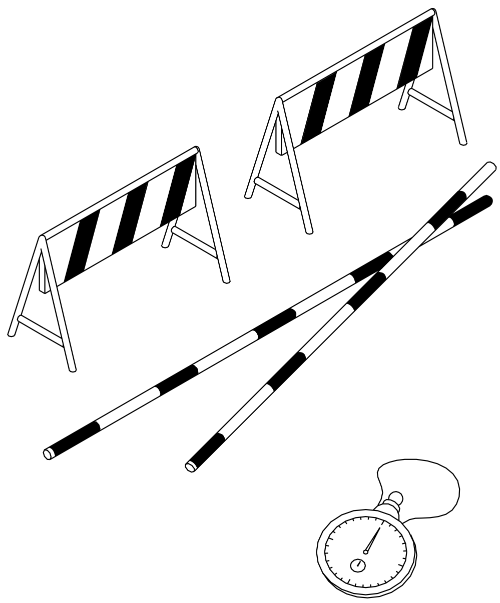
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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.



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(M, 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
HX300SG	Start idle	800±100	
	M mode	1850±50	
	H mode	1850±50	
	S mode	1750±50	
	Auto decel	1050±50	
	One touch decel	800±50	

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.

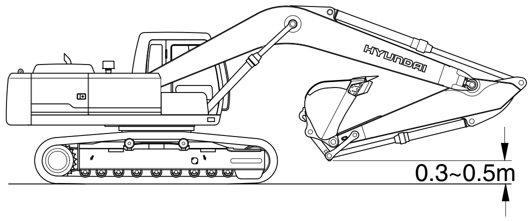
(2) Preparation

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.



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(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.

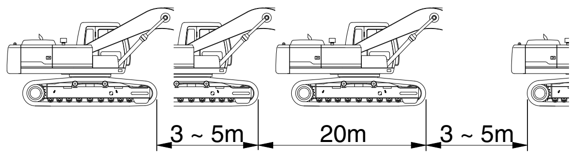
· Mode selector : H mode

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.



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(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX300SG	1 Speed	22.5±2.0	29	
	2 Speed	12.6±1.0	17.3	

4) TRACK REVOLUTION SPEED

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

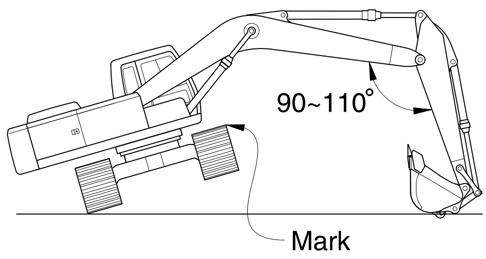
(2) Preparation

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.



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(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
HX300SG	1 Speed	35.0±2.0	46.1
	2 Speed	19.6±2.0	26.3

5) TRAVEL DEVIATION

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

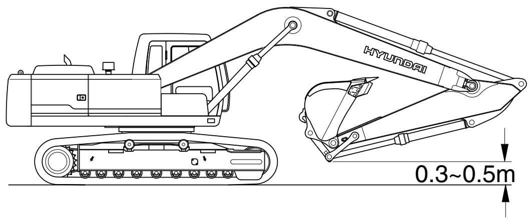
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Provide a flat, solid test yard 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.



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(3) Measurement

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

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

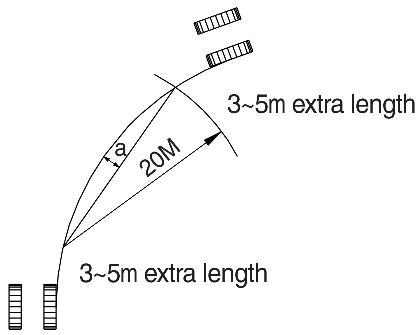
· Mode selector : H mode

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.



7-7(2)

(4) Evaluation

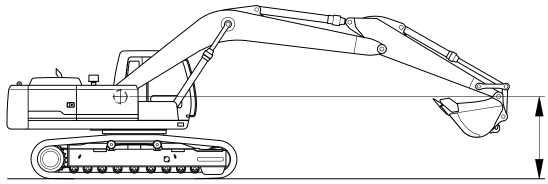
Mistrack should be within the following specifications.

Unit : mm / 20m

Model	Standard	Maximum allowable	Remarks
HX300SG	200 below	240	

6) SWING SPEED

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



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(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 : Each 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

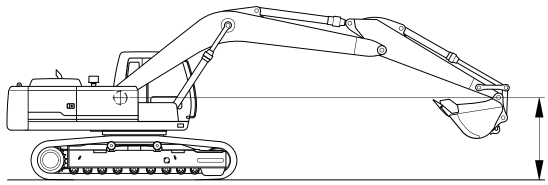
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power selector switch	Standard	Maximum allowable
HX300SG	H mode	16.2±1.5	21.0

7) SWING FUNCTION DRIFT CHECK

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



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(2) Preparation

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

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

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

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

⑤ Swing the upperstructure 360˚.

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

(3) Measurement

① Conduct this test in the H mode.

② Select the following switch positions.

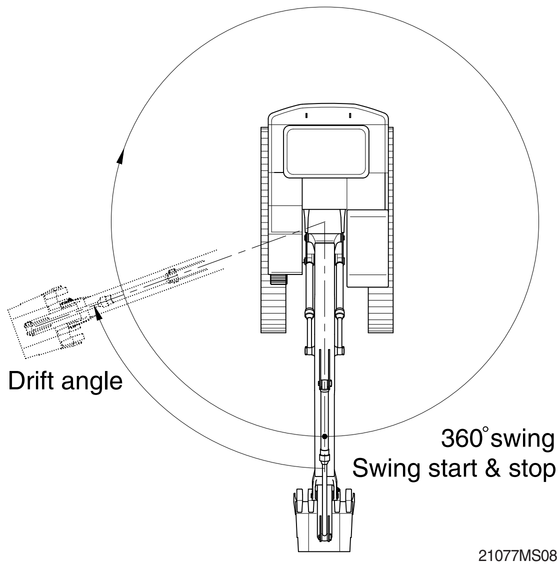
· Mode selector : H mode

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.



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(4) Evaluation

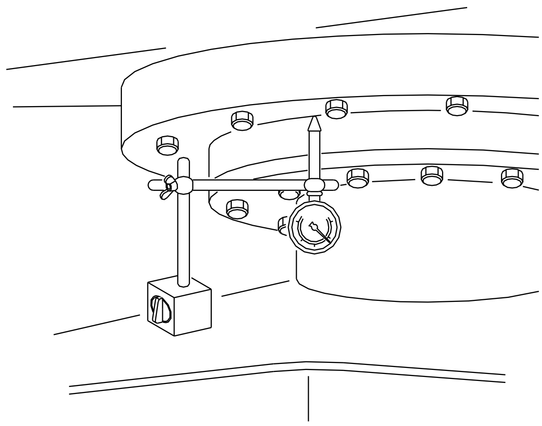
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Mode select switch	Standard	Maximum allowable	Remarks
HX300SG	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.



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.

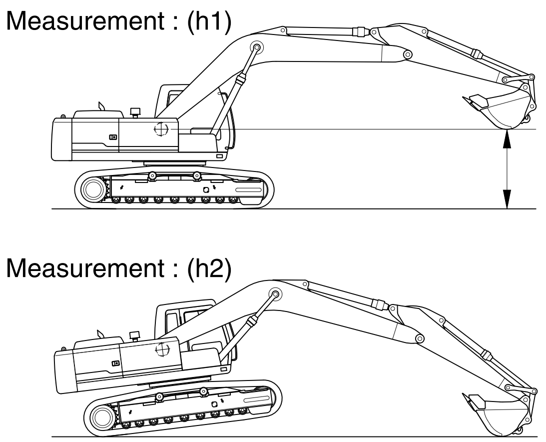
⑥ Bucket should be empty.

(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



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(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX300SG	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.

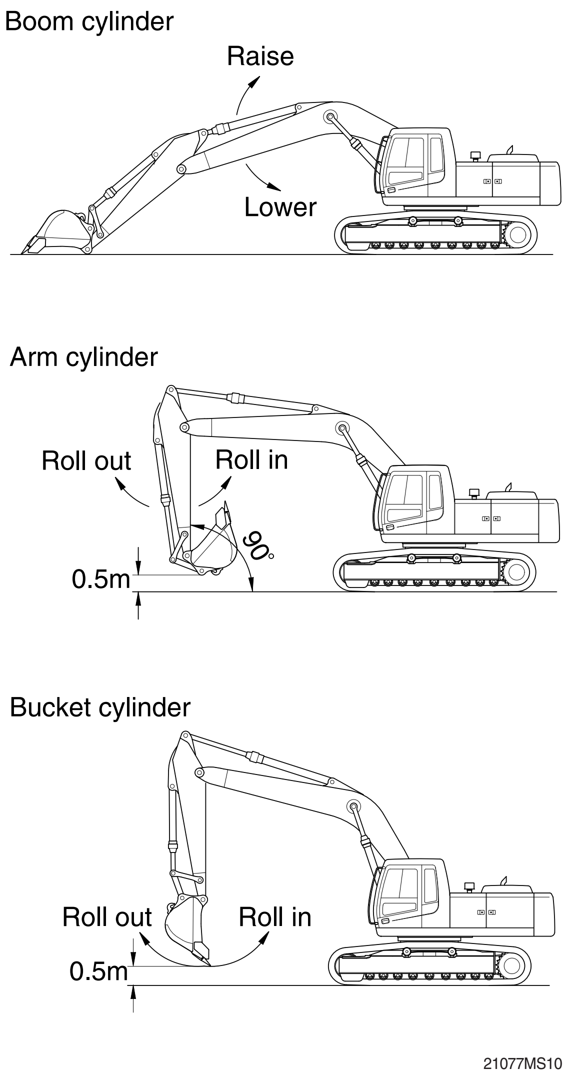
(2) Preparation

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.



(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
HX300SG	Boom raise	4.0±0.4	5.0	
	Boom lower	3.0±0.4	3.8	
	Arm in	3.5±0.4	4.6	
	Arm out	3.2±0.3	4.0	
	Bucket load	2.9±0.4	3.5	
	Bucket dump	2.8±0.3	3.3	

Unit : Seconds

Model	Function	Standard	Maximum allowable	Remarks
HX300SG LONG REACH	Boom raise	4.0±0.4	5.0	
	Boom lower	3.0±0.4	3.8	
	Arm in	3.5±0.4	4.6	
	Arm out	4.1±0.3	4.8	
	Bucket load	1.4±0.4	3.5	
	Bucket dump	1.5±0.3	3.5	

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)

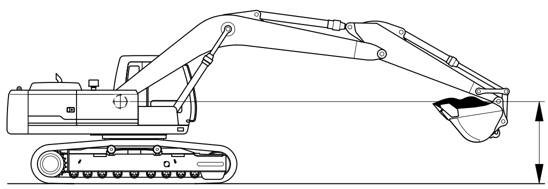
1.5 = Soil specific gravity

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

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

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

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



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(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) Evaluation

The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX300SG	Boom cylinder	40 below	50	
	Arm cylinder	60 below	75	
	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 ℃.

(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
HX300SG	Boom lever	1.6 or below	5.7	
	Arm lever	1.6 or below	5.7	
	Bucket lever	1.6 or below	5.7	
	Swing lever	1.6 or below	5.7	
	Travel lever	4.2 or below	11.1	

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 $50 \pm 5 ^{\circ}C$.

(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.

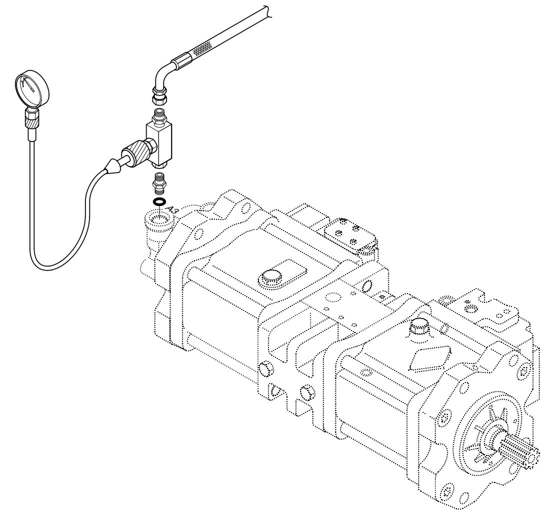
Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX300SG	Boom lever	87±10	117	
	Arm lever	87±10	117	
	Bucket lever	87±10	117	
	Swing lever	87±10	117	
	Travel lever	148±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.



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(2) Measurement

① Select the following switch positions.
· Mode selector : M 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
HX300SG	M mode	35±5	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE

(1) Preparation

① Stop the engine.

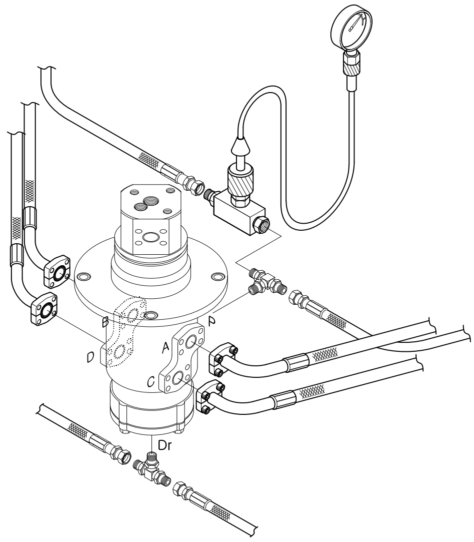
② Remove the top cover of the hydraulic tank oil supply port with a wrench.

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.



(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.

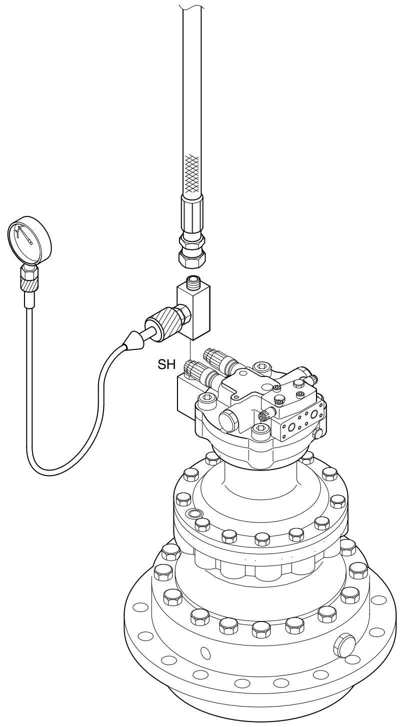
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX300SG	1 Speed	0	-	
	2 Speed	35±5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

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.



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(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.

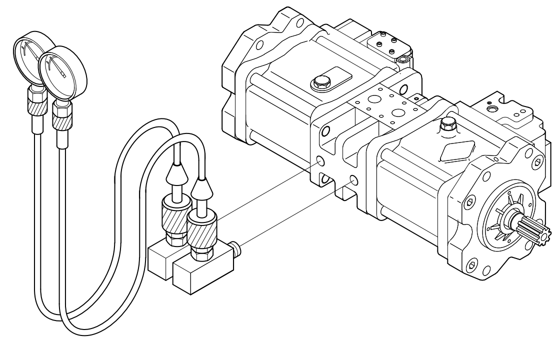
Unit : kgf / cm²

Model	Description	Standard	Allowable limits	Remarks
HX300SG	Brake disengaged	35	22~44	
	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.



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(2) Measurement

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

(3) Evaluation

The average measured pressure should meet the following specifications.

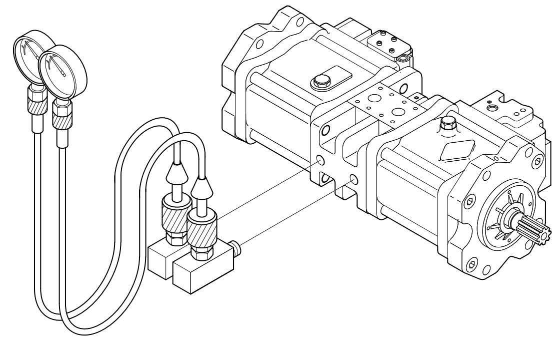
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
HX300SG	High ilde	40±5	-	

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.



(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.

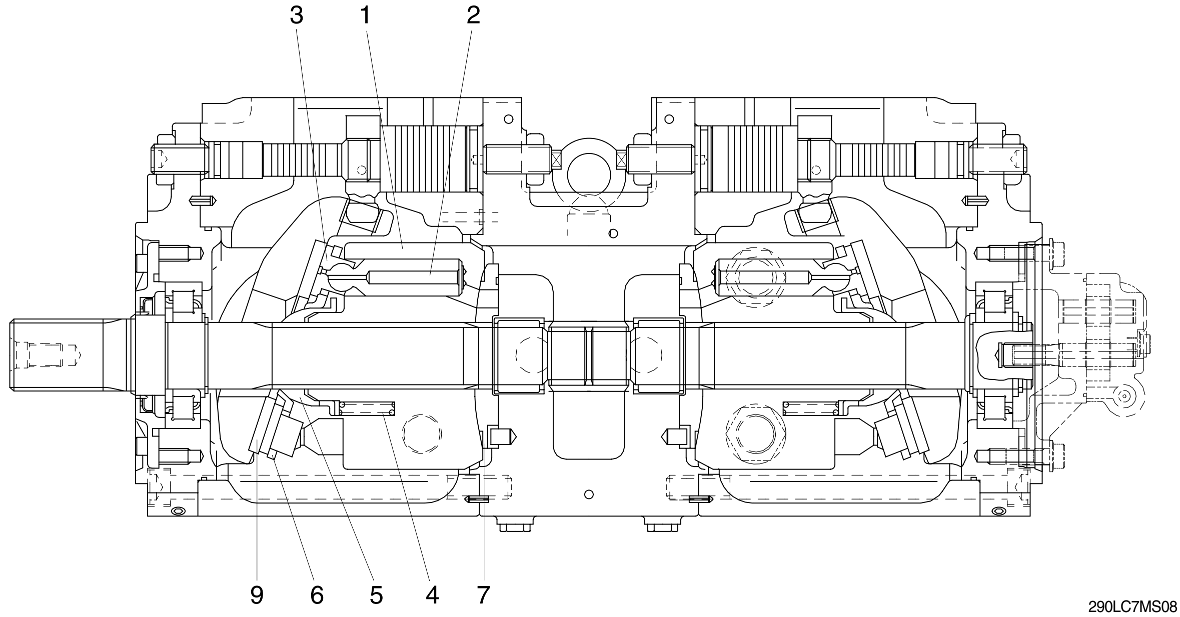
Unit : kgf / cm^2

Model	Function to be tested	Standard	Maximum allowable
HX300SG	Boom, Arm, Bucket	330(360)±10	390±10
	Travel	350±10	-
	Swing	300±10	-

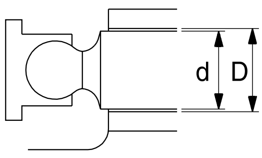
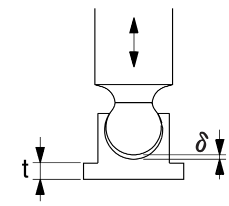
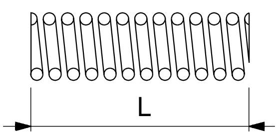
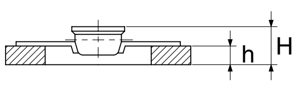
(　) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



290LC7MS08

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.043	0.070	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)		5.4	5.0	
Free height of cylinder spring(4) (L)		47.9	47.1	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)		23.8	22.8	Replace retainer or set plate.
Surface roughness for valve plate(Sliding face)(7,8), swash plate (shoe plate area)(9), & cylinder(2)(Sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (Corrected value)	0.4z or lower		

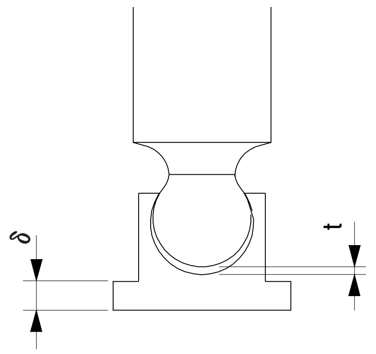
2. MAIN CONTROL VALVE

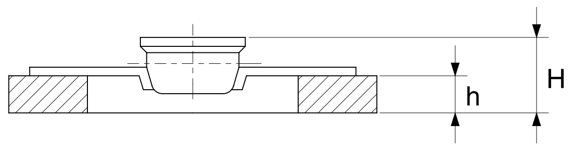
Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · O-ring seal sections at both ends. · Insert spool in casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch(Especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of poppet or spring · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & negative control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.
Balance plate	· Worn less than 0.03mm · Worn more than 0.03mm · Sliding surface has a seizure(Even through small).	· Lapping · Replace · Replace

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-h)	6.5	6.0	Replace set of retainer plate and sperical bushing
Thickness of friction plate	4.0	3.6	Replace





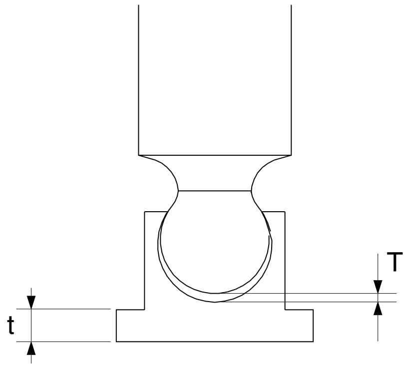
2) SLIDING PARTS

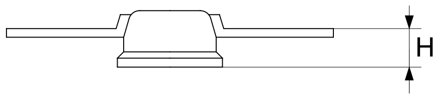
Part name	Standard roughness	Allowable roughness	Remark
Shoe	0.8-Z(Ra=0.2) (LAPPING)	3-Z(Ra=0.8)	
Shoe plate	0.4-Z(Ra=0.1) (LAPPING)	3-Z(Ra=0.8)	
Cylinder	1.6-Z(Ra=0.4) (LAPPING)	12.5-Z(Ra=3.2)	
Valve plate	0.8-Z(Ra=0.2) (LAPPING)	6.3-Z(Ra=1.6)	

4. TRAVEL MOTOR

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-h)	7.3	7.0	Replace set of set plate and ball guide
Thickness of friction plate	3.0	2.6	Replace

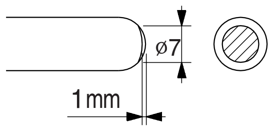




2) SLIDING PARTS

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

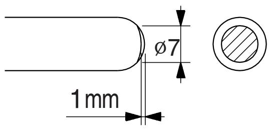
5. RCV LEVER

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.

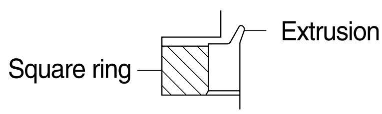
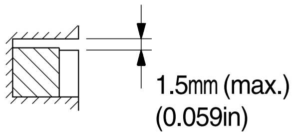
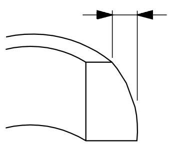
2. When loosening the hexagon socket head cap screw(125), replace the seal washers(121) without fail.

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/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.

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

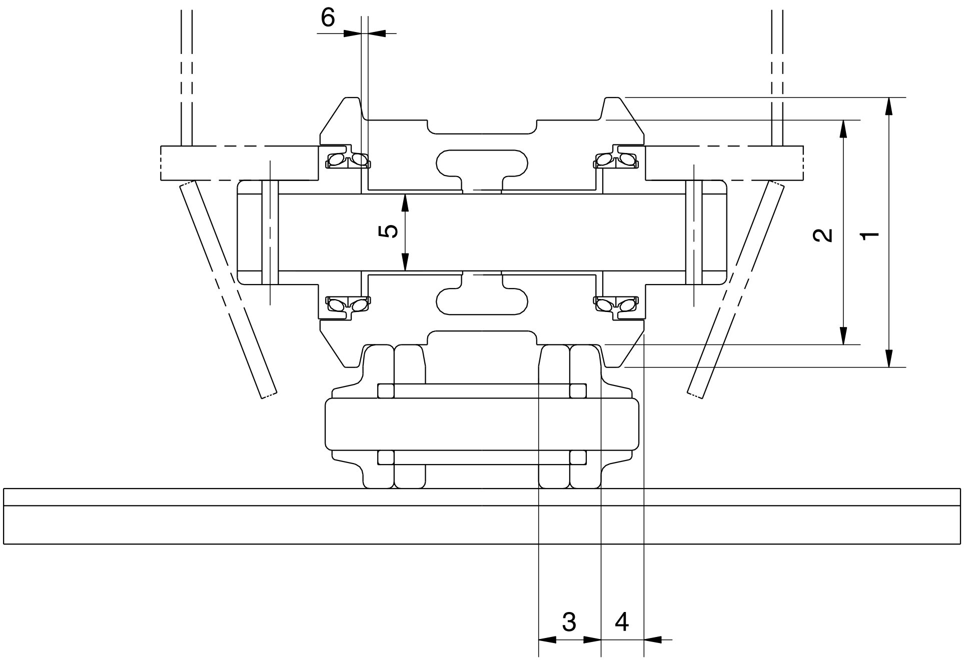
8. CYLINDER

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

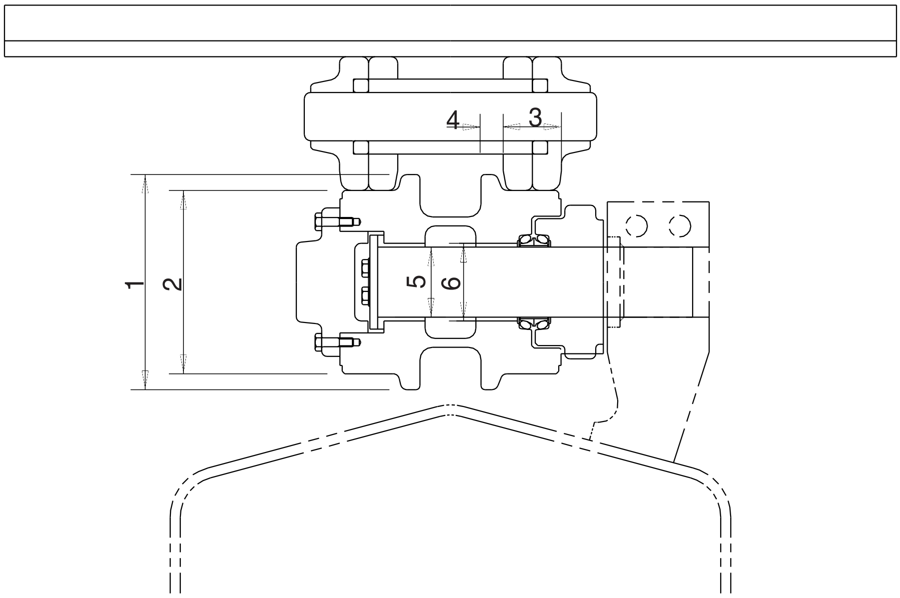


21037MS01

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø216		–		
2	Outside diameter of tread	Ø180		Ø168		
3	Width of tread	51		56		
4	Width of flange	26		21		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		$\varnothing 75^{\,0}_{-0.03}$	$\varnothing 75.35^{+0.05}_{\,0}$	0.35 to 0.40	2.0	
6	Side clearance of roller (Both side)	Standard clearance		Clearance limit		Replace
		0.21~1.19		2.0		

2) CARRIER ROLLER

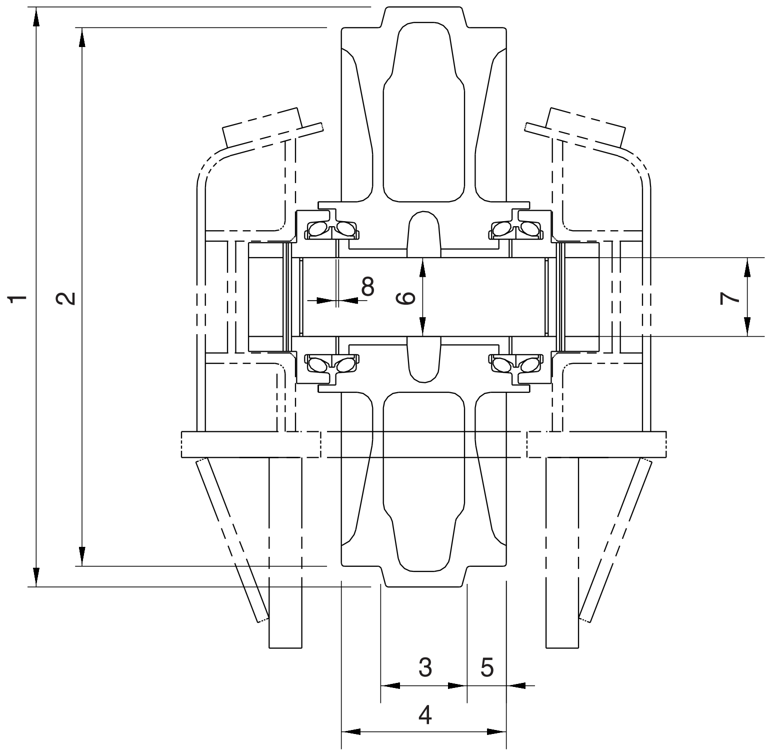


32037MA37

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">Ø200</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø168</td><td colspan="2">Ø158</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">54</td><td colspan="2">59</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">19</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>Ø55 $^{+0.085}_{+0.066}$</td><td>Ø55 $^{+0.37}_{+0.33}$</td><td>0.245 to 0.304</td><td>2.0</td></tr>
<tr><td>6</td><td>Clearance between shaft and support</td><td>Ø58 $^{0}_{-0.1}$</td><td>Ø58 $^{+0.5}_{+0.3}$</td><td>0.3 to 0.6</td><td>1.2</td><td>Replace</td></tr>
</table>

3) IDLER

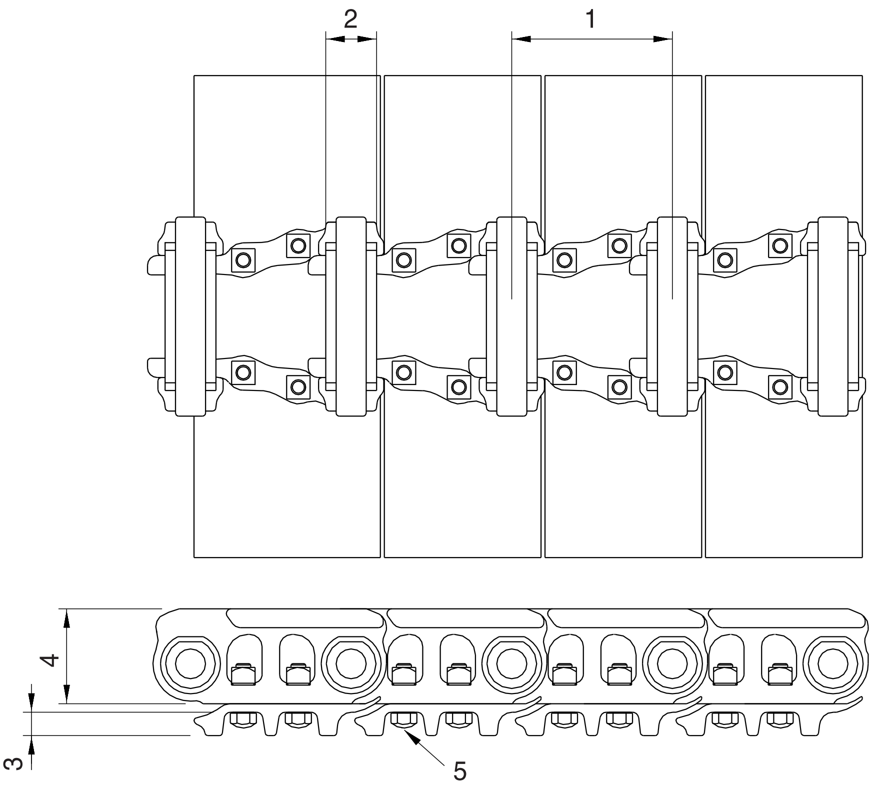


21037MS03

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of protrusion	Standard size		Repair limit		Rebuild or replace
		Ø646		–		
2	Outside diameter of tread	Ø594		Ø588		
3	Width of protrusion	98		–		
4	Total width	203		–		
5	Width of tread	52.5		58.5		
6	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø90 $^{0}_{-0.035}$	Ø90.35 $^{+0.05}_{0}$	0.35 to 0.435	2.0	
7	Clearance between shaft and support	Ø90 $^{0}_{-0.035}$	Ø90 $^{+0.09}_{+0.036}$	0.036 to 0.125	1.2	Replace
8	Side clearance of idler (Both side)	Standard clearance		Clearance limit		Replace
		0.4 to 1.2		2.0		

4) TRACK

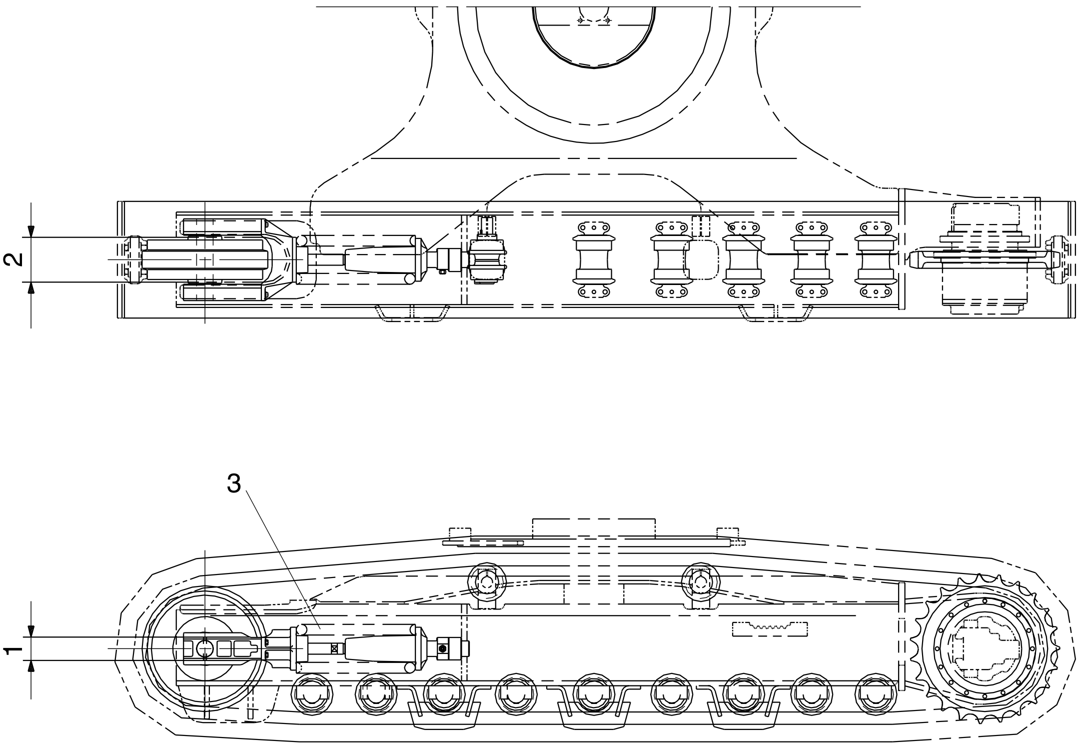


21037MS04

Unit : mm

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		216	221	
2	Outside diameter of bushing	Ø66.5	Ø60.9	Rebuild or replace
3	Height of grouser	30	23	
4	Height of link	116	111	
5	Tightening torque	Initial tightening torque : 123±6kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING

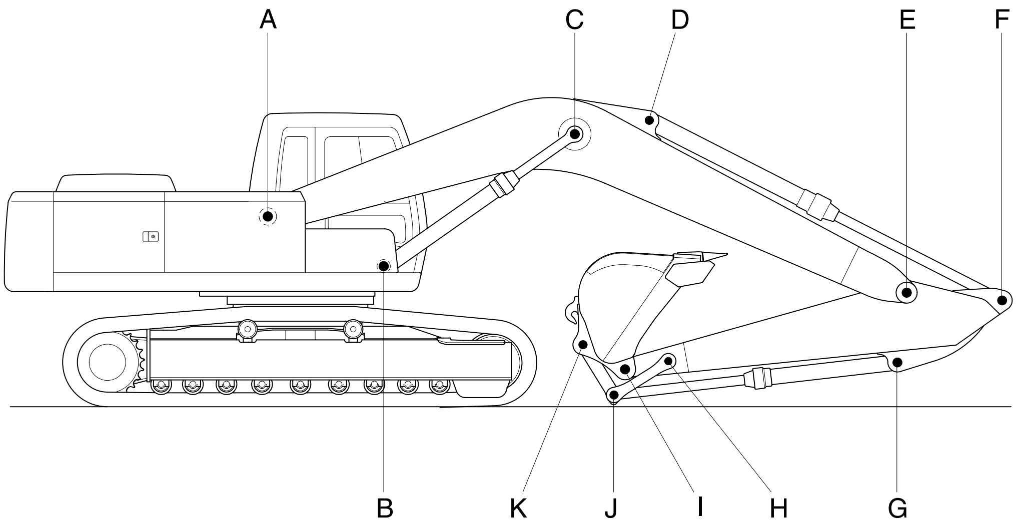


21037MS05

Unit : mm

<table>
<tr><th>No.</th><th>Check item</th><th colspan="5">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="3">1</td><td rowspan="3">Vertical width of idler guide</td><td></td><td>Standard size</td><td colspan="2">Tolerance</td><td>Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td>Track frame</td><td>132</td><td colspan="2">+2
0</td><td>136</td></tr>
<tr><td>Idler support</td><td>130</td><td colspan="2">0
- 1.5</td><td>126</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td>292</td><td colspan="2">+2
0</td><td>297</td></tr>
<tr><td>Idler support</td><td>290</td><td colspan="2">-</td><td>288</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installation length</td><td>Installation load</td><td>Free length</td><td>Installation load</td></tr>
<tr><td>Ø255×690</td><td>565</td><td>22285kg</td><td>–</td><td>17828kg</td></tr>
</table>

2. WORK EQUIPMENT



21077MS20

1) HX300SG

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	110	109	108.5	110.5	111	Replace
B	Boom Cylinder Head	90	89	88.5	90.5	91	〃
C	Boom Cylinder Rod	100	99	98.5	100.5	101	〃
D	Arm Cylinder Head	90	89	88.5	90.5	91	〃
E	Boom Front	100	99	98.5	100.5	101	〃
F	Arm Cylinder Rod	90	89	88.5	90.5	91	〃
G	Bucket Cylinder Head	90	89	88.5	90.5	91	〃
H	Arm Link	80	79	78.5	80.5	81	〃
I	Bucket and Arm Link	90	89	88.5	90.5	91	〃
J	Bucket Cylinder Rod	80	79	78.5	80.5	81	〃
K	Bucket Link	90	89	88.5	90.5	91	〃

2) HX300SG LONG REACH

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	110	109	108.5	110.5	111	Replace
B	Boom Cylinder Head	90	89	88.5	90.5	91	〃
C	Boom Cylinder Rod	100	99	98.5	100.5	101	〃
D	Arm Cylinder Head	90	89	88.5	90.5	91	〃
E	Boom Front	90	89	88.5	90.5	91	〃
F	Arm Cylinder Rod	90	89	88.5	90.5	91	〃
G	Bucket Cylinder Head	70	69	68.5	70.5	71	〃
H	Arm Link	65	64	63.5	65.5	66	〃
I	Bucket and Arm Link	65	64	63.5	65.5	66	〃
J	Bucket Cylinder Rod	70	69	68.5	70.5	71	〃
K	Bucket Link	65	64	63.5	60.5	66	〃

SECTION 8 DISASSEMBLY AND ASSEMBLY

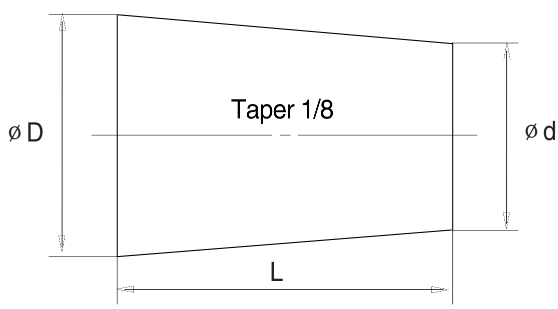
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

1) Lower the work equipment completely to the ground.
   If the coolant contains antifreeze, dispose of it correctly.
2) After disconnecting hoses or tubes, cover them or fit blind plugs to prevent dirt or dust from entering.
3) When draining oil, prepare a container of adequate size to catch the oil.
4) Confirm the match marks showing the installation position, and make match marks in the necessary places before removal to prevent any mistake when assembling.
5) To prevent any excessive force from being applied to the wiring, always hold the connectors when disconnecting the connectors.
6) Fit wires and hoses with tags to show their installation position to prevent any mistake when installing.
7) Check the number and thickness of the shims, and keep in a safe place.
8) When raising components, be sure to use lifting equipment of ample strength.
9) When using forcing screws to remove any components, tighten the forcing screws alternately.
10) Before removing any unit, clean the surrounding area and fit a cover to prevent any dust or dirt from entering after removal.
11) When removing hydraulic equipment, first release the remaining pressure inside the hydraulic tank and the hydraulic piping.
12) If the part is not under hydraulic pressure, the following corks can be used.

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

(2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100mm before the end of the stroke.

(3) Next, operate the piston rod to the end of its stroke to relieve the circuit. (The air bleed valve is actuated to bleed the air.)

(4) After completing this operation, raise the engine speed to the normal operating condition.

※ If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to the work equipment.

※ Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

1) If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.
2) If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.
3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.
4) Add the specified amount of grease(Molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt, nut(Front)	M20 × 2.5	55 ± 3.5	398 ± 25
2		Engine mounting bolt, nut(Rear)	M24 × 3.0	90 ± 7.0	651 ± 51
3		Radiator mounting bolt	M16 × 2.0	25.7 ± 4.0	186 ± 29
4		Coupling mounting socket bolt	M20 × 2.5	46.5 ± 2.5	336 ± 18
5		Main pump housing mounting bolt	M10 × 1.5	4.8 ± 0.3	34.7 ± 2.2
6	Hydraulic system	Main pump mounting socket bolt	M20 × 2.5	42 ± 4.5	304 ± 32.5
7		Main control valve mounting nut	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
8		Fuel tank mounting bolt	M20 × 2.5	46 ± 5.0	333 ± 36
9		Hydraulic oil tank mounting bolt	M20 × 2.5	46 ± 5.0	333 ± 36
10		Turning joint mounting bolt, nut	M12 × 1.75	12.3 ± 1.3	88.9 ± 9.4
11	Power train system	Swing motor mounting bolt	M20 × 2.5	58.4 ± 6.4	422 ± 46.2
12		Swing bearing upper part mounting bolt	M24 × 3.0	97.8 ± 10	707 ± 72.3
13		Swing bearing lower part mounting bolt	M24 × 3.0	97.8 ± 10	707 ± 72.3
14		Travel motor mounting bolt	M24 × 3.0	84 ± 8.0	607 ± 57.8
15		Sprocket mounting bolt	M20 × 2.5	51 ± 4.0	369 ± 28.9
16	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 4.4	126 ± 31.8
17		Track roller mounting bolt	M20 × 2.5	57.9 ± 8.6	419 ± 62.2
18		Track tension cylinder mounting bolt	M12 × 1.25	15 ± 0.5	108 ± 3.6
19		Track shoe mounting bolt, nut	M22 × 1.5	115 ± 5.0	831 ± 36
20		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 63
21	Others	Counterweight mounting bolt	M36 × 3.0	308 ± 46	2228 ± 333
22		Cab mounting bolt	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
23		Operator's seat mounting bolt	M 8 × 1.25	2.5 ± 0.5	18.1 ± 3.6

※ 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 - 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	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60.0
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.0	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.2 ~ 3.4	15.9 ~ 24.6	3.0 ~ 4.4	21.7 ~ 31.8
M10 × 1.2	4.5 ~ 6.7	32.5 ~ 48.5	5.9 ~ 8.9	42.7 ~ 64.4
M12 × 1.25	7.8 ~ 11.6	56.4 ~ 83.9	10.6 ~ 16.0	76.7 ~ 116
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 131	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 195	26.6 ~ 36.0	192 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 391	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 516	70.7 ~ 95.7	511 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 665	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1339	182 ~ 248	1314 ~ 1796
M36 × 3.0	192 ~ 260	1390 ~ 1880	262 ~ 354	1894 ~ 2562

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

13031GE18

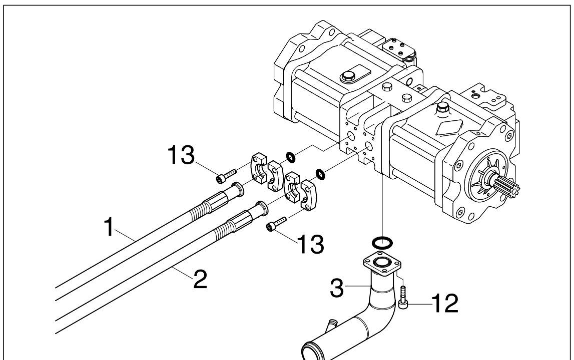
(1) Lower the work equipment to the ground and stop the engine.

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

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

(3) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.

· Hydraulic tank quantity : 210 l



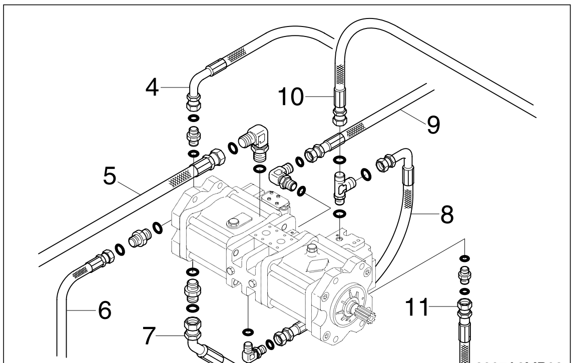
2907A8MP01

(4) Remove bolts(13) and disconnect pipe (1,2).

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

(6) Remove bolts(12) 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.



2907A8MP02

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

· Weight : 130kg(286lb)

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

2) INSTALL

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

(2) Remove the suction strainer and clean it.

(3) Replace the return filter with a 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.

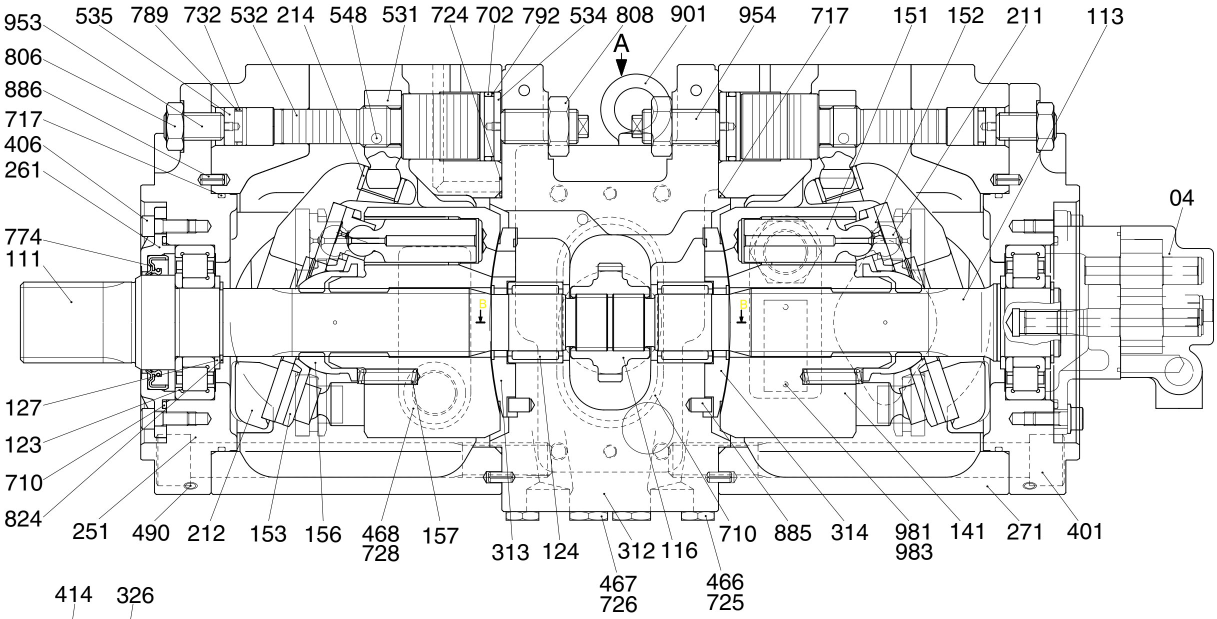
④ Tighten plug.

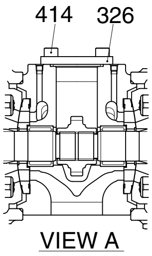
(7) Start the engine, run at low idling(3~5 minutes) to circulate the oil through the system.

(8) Confirmed the hydraulic oil level and check the hydraulic oil leaks or not.

2. MAIN PUMP(1/2)

1) STRUCTURE

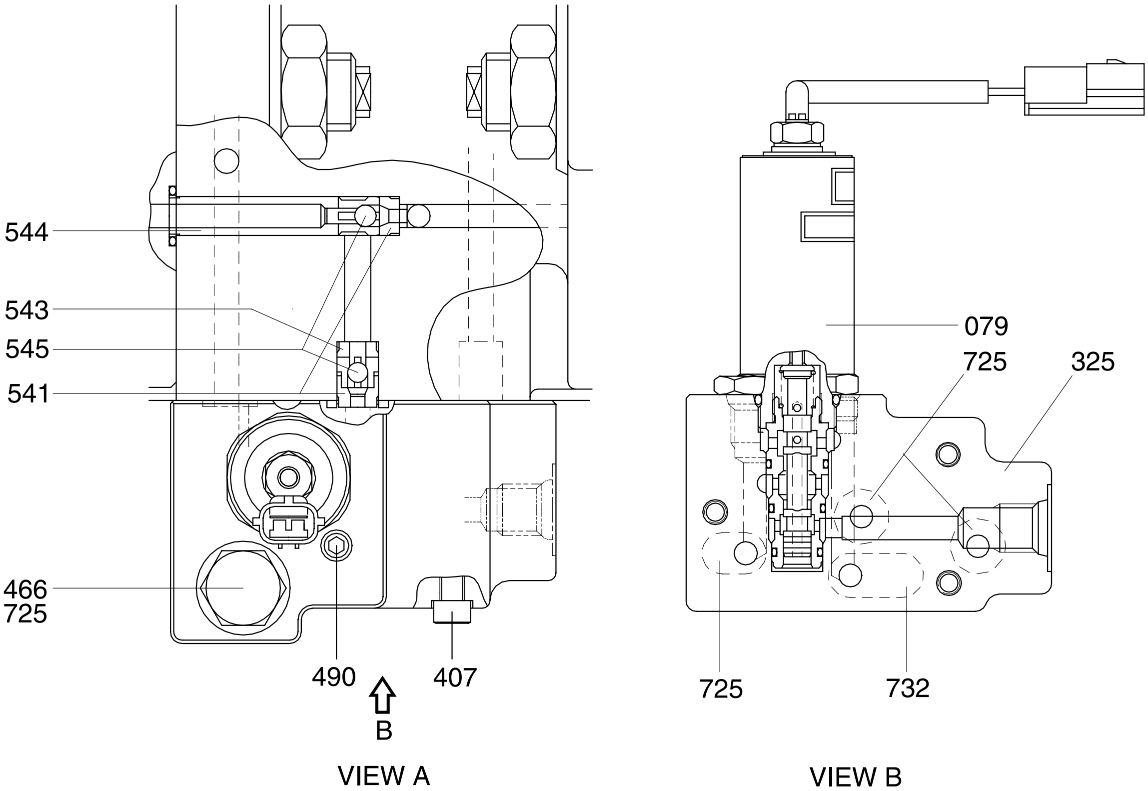




2907A2MP02

04	Gear pump	271	Pump casing	710	O-ring
111	Drive shaft(F)	312	Valve block	717	O-ring
113	Drive shaft(R)	313	Valve plate(R)	724	O-ring
114	Spline coupling	314	Valve plate(L)	725	O-ring
123	Roller bearing	326	Cover	728	O-ring
124	Needle bearing	401	Hexagon socket bolt	732	O-ring
127	Bearing spacer	406	Hexagon socket bolt	774	Oil seal
141	Cylinder block	414	Hexagon socket bolt	789	Back up ring
151	Piston	466	VP plug	792	Back up ring
152	Shoe	467	VP plug	806	Hexagon head nut
153	Set plate	468	VP plug	808	Hexagon head nut
156	Bushing	490	VP plug	824	Snap ring
157	Cylinder spring	531	Tilting pin	885	Pin
211	Shoe plate	532	Servo piston	886	Spring pin
212	Swash plate	534	Stopper(L)	901	Eye bolt
214	Bushing	535	Stopper(S)	953	Set screw
251	Swash plate support	548	Pin	954	Set screw
261	Seal cover(F)	702	O-ring		

MAIN PUMP(2/2)



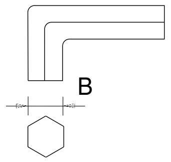
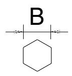
29072MP03

079	Proportional reducing valve	490	Plug	545	Steel ball
325	Casing assy	541	Seat	725	O-ring
407	Hexagon screw	543	Stopper 1	732	O-ring
466	Plug	544	Stopper 2		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

<table>
<tr><th colspan="2">Tool name & size</th><th colspan="12">Part name</th></tr>
<tr><td rowspan="6">Allen wrench
</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>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">BP1/ 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 head bolt</td><td colspan="4">Hexagon head bolt</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. $10 \times 8 \times 200$</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	115.7	0.47	12
	M16	24.0	173.6	0.55	14
	M18	34.0	245.9	0.55	14
	M20	44.0	318.3	0.67	17
PT plug(Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	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	108.5	0.55	14
	PF 1	19.0	137.4	0.67	17
	PF 1 1/4	27.0	195.3	0.67	17
	PF 1 1/2	28.0	202.5	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

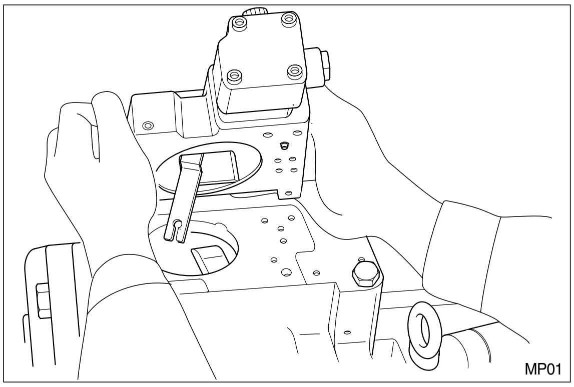
※ Select clean place.

※ 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.
Remove hexagon socket head bolts(416) and remove gear pump.

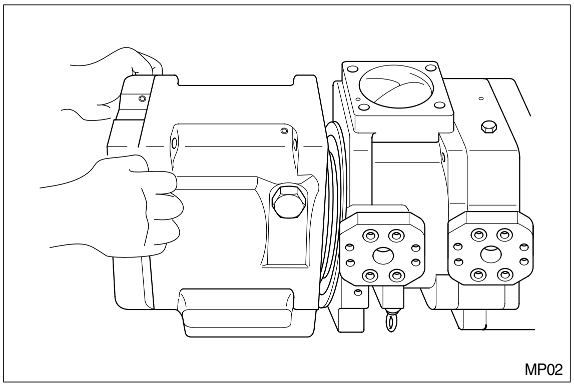


MP01

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

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

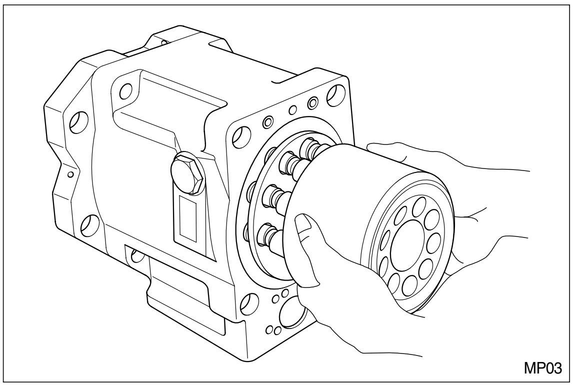
※ Before bringing this surface down, spread rubber sheet on workbench without failing to prevent this surface from being damaged.



MP02

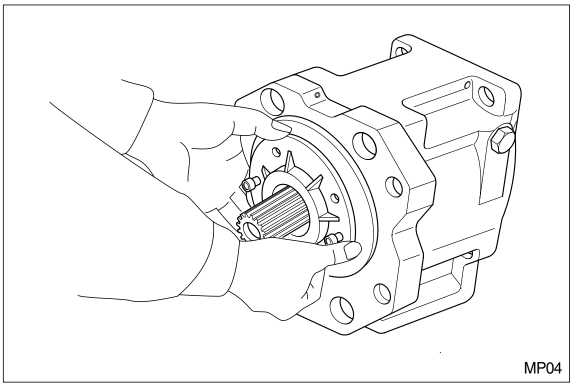
(7) Pull cylinder(141) out of pump casing (271) straightly over drive shaft(111). Pull out also pistons(151), set plate(153), spherical bush(156) and cylinder springs (157) simultaneously.

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



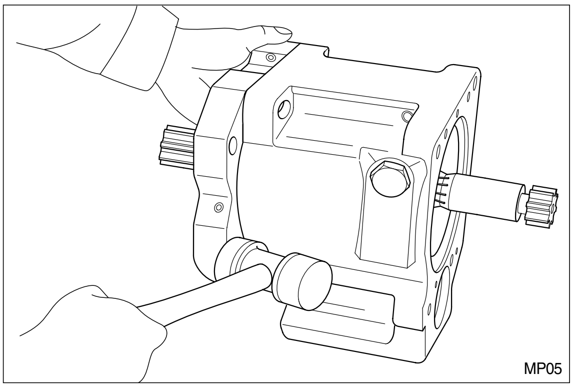
(8) Remove hexagon socket head bolts(406) and then seal cover(F) (261).
Fit bolt into pulling out tapped hole of seal cover(F), and cover can be removed easily.

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

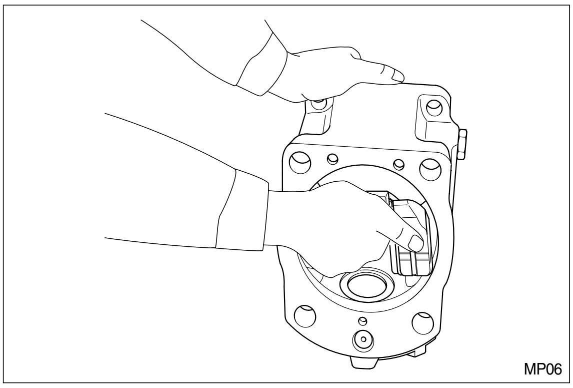


(9) Remove hexagon socket head bolts(408) and then seal cover(R, 262).
In case of fitting a gear pump, first, remove gear pump.

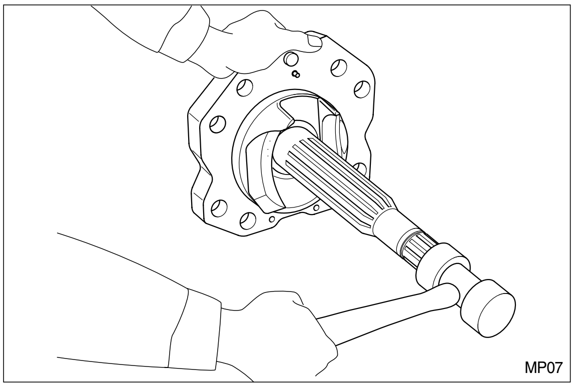
(10) Tapping lightly fitting flange section of swash plate support(251) on its pump casing side, separate swash plate support from pump casing.



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

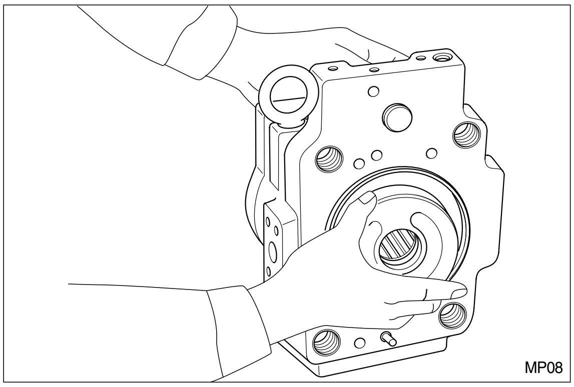


(12) Tapping lightly shaft's end of drive shafts (111, 113) with plastic hammer, take out drive shafts from swash plate supports.



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

※ These may be removed in work 6.



(14) If necessary, remove stopper(L, 534), stopper(S, 535), servo piston(532) and tilting pin(531) from pump casing(271), and needle bearing(124) and splined coupling(114) from valve block(312).

※ In removing tilting pin, use a protector to prevent pin head from being damaged.

※ Since loctite is applied to fitting areas of tilting pin and servo piston, take care not to damage servo piston.

※ Do not remove needle bearing as far as possible, except when it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve block and swash plate support.

Once 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.

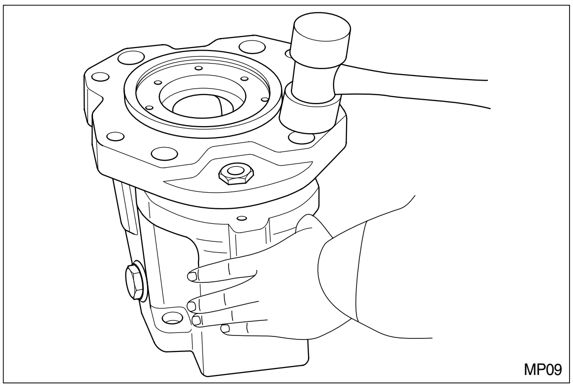
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in Section 2-3.

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

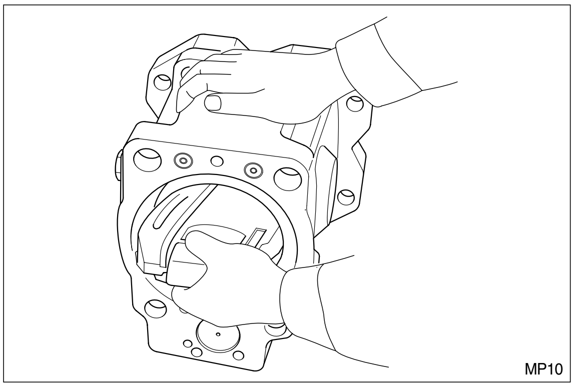
(2) Fit swash plate support(251) to pump casing(271), tapping the former lightly with a hammer.

※ After servo piston, tilting pin, stopper(L) and stopper(S) are removed, fit them soon to pump casing in advance for reassembling.

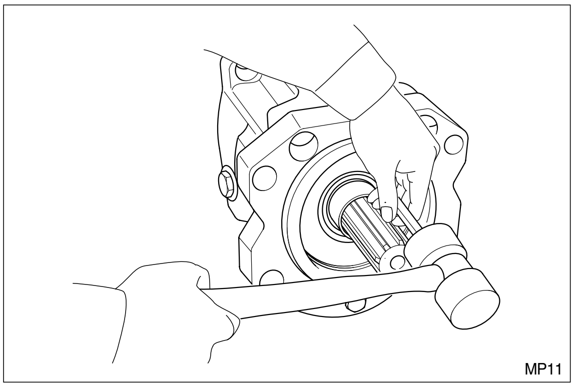
※ In tightening servo piston and tilting pin, use a protector to prevent tilting pin head and feedback pin from being damaged. In addition, apply lock-tight(Medium strength) to their threaded sections.



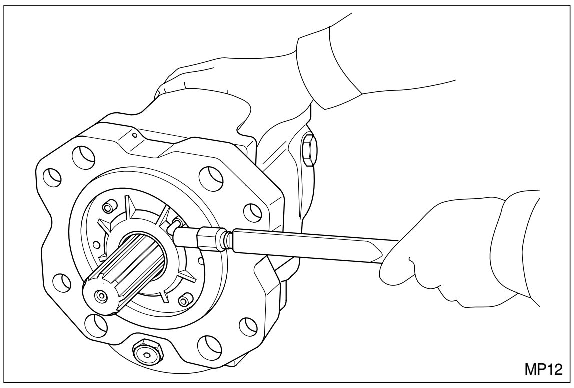
(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin(531), and fit swash plate (212) to swash plate support(251) correctly.
※ Confirm with fingers of both hands that swash plate can be removed smoothly.
※ Apply grease to sliding sections of swash plate and swash plate support, and drive shaft can be fitted easily.


MP10

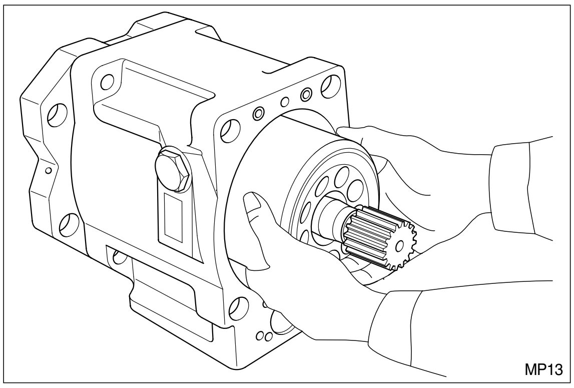
(4) To swash plate support(251), fit drive shaft (111) set with bearing(123), bearing spacer(127) and snap ring(824).
※ Do not tap drive shaft with hammer or so on.
※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.
※ Fit them fully, using steel bar or so on.


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).

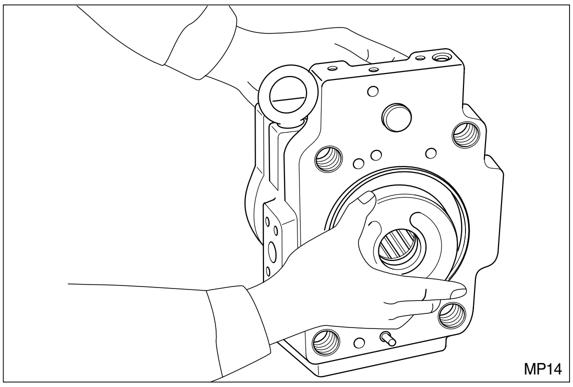

MP12

(6) Assemble piston cylinder subassembly 〔Cylinder(141), piston subassembly(151, 152), set plate(153), spherical bush(156), spacer(158) and cylinder spring(157).〕
Fit spline phases of retainer and cylinder. Then, insert piston cylinder subassembly into pump casing.


MP13

(7) Fit valve plate(313) to valve block(312), entering pin into pin hole.

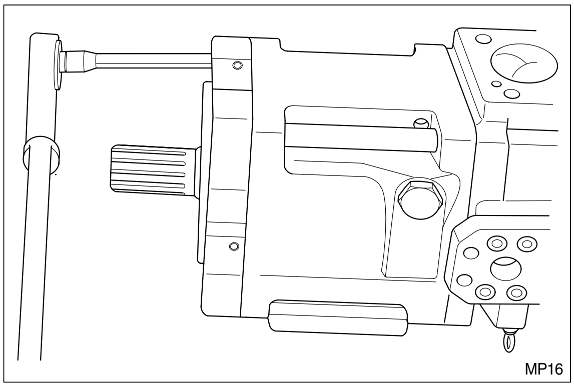
※ Take care not to mistake suction / delivery directions of valve plate.



(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.

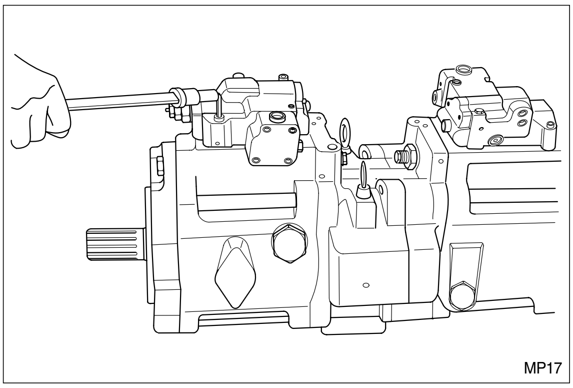


※ Clockwise rotation(Viewed from input shaft side)

※ Fit block with regulator up and with delivery flange left, viewed from front side.

(9) Putting feedback pin of tilting pin into feedback lever of regulator, fit regulator and tighten hexagon socket head bolts (412, 413).

※ Take care not to mistake regulator of front pump for that of rear pump.

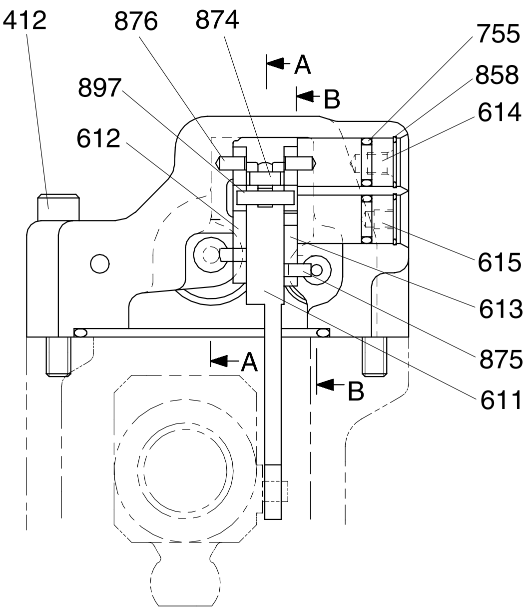


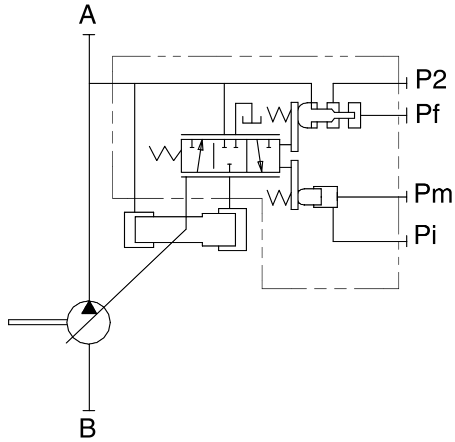
(10) Fit drain port plug(468).

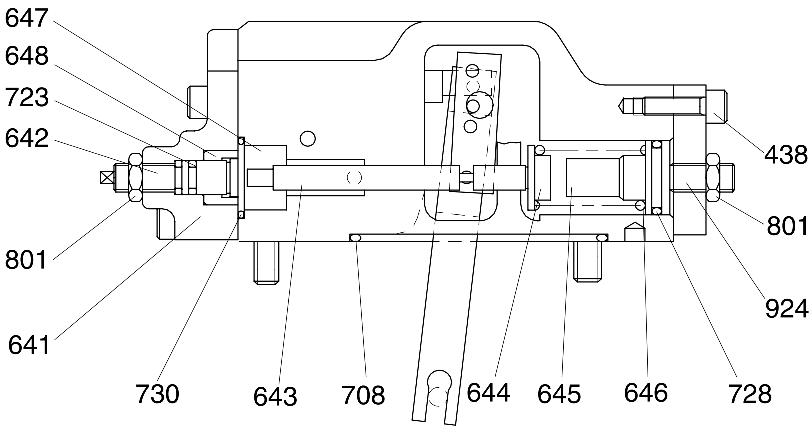
This is the end of reassembling procedures.

3. REGULATOR

1) STRUCTURE(1/2)

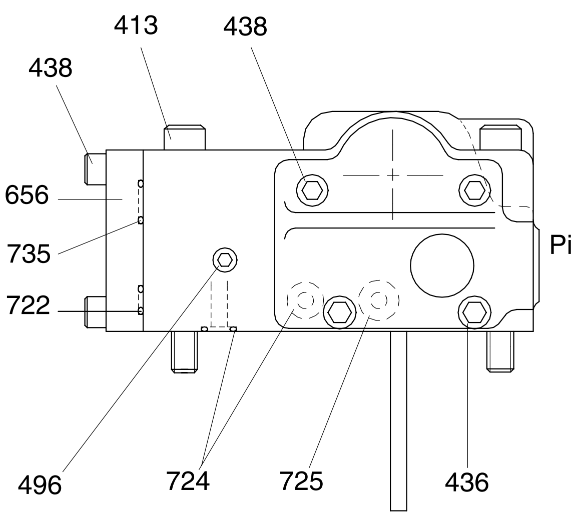






SECTION B-B

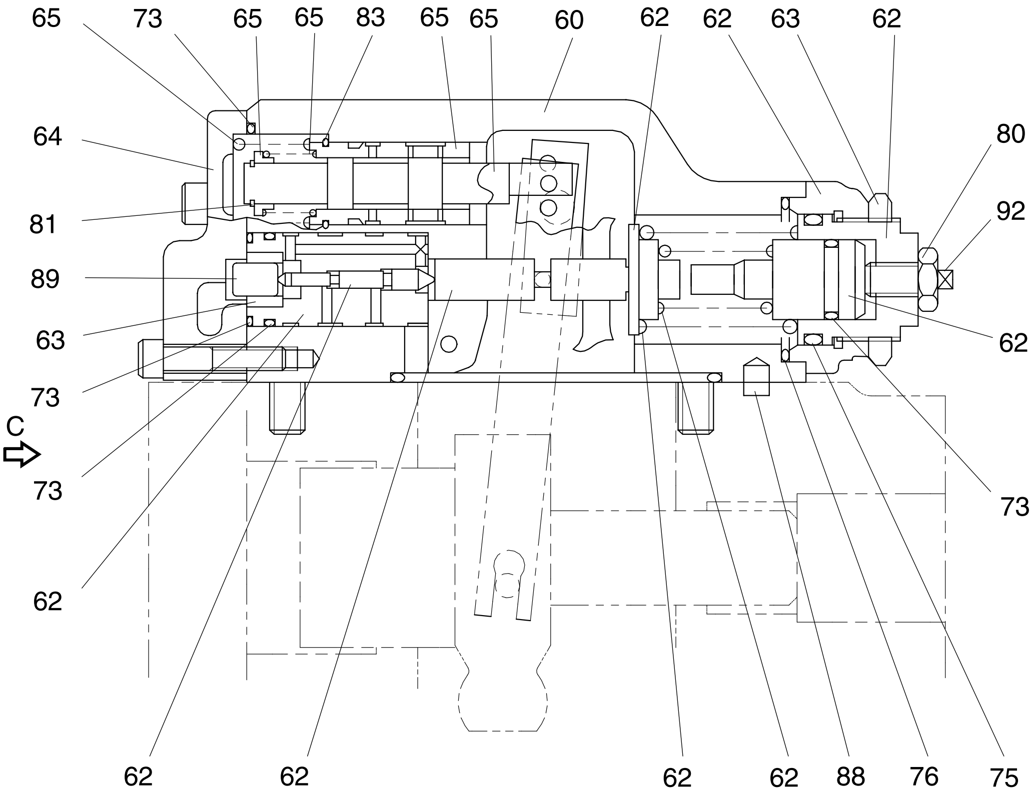
2907A2RE01



VIEW C

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

REGULATOR(2/2)



SECTION A-A

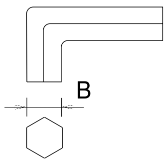
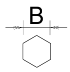
29072RE02

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 screw(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	876	Pin
625	Outer spring	708	O-ring	887	Pin
626	Inner spring	722	O-ring	897	Pin
627	Adjust stem(C)	723	O-ring	898	Pin
628	Adjust screw(C)	724	O-ring	924	Set screw
629	Cover(C)	725	O-ring	925	Adjust screw(QI)
630	Lock nut	728	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

Tool name & size		Part name			
Allen wrench 	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
	4	M 5	BP-1/16	-	M 8
	5	M 6	BP1/ 8	-	M10
	6	M 8	BP-1/ 4	PO-1/4	M12, M14
Socket wrench, double(single) open end 	-	Hexagon head bolt	Hexagon nut	VP plug (PF thread)	
	6	M 8	M 8	-	
Adjustable angle wrench		Small size, Max 36mm			
Screw driver		Minus type screw driver, Medium size, 2 sets			
Hammer		Plastic hammer, 1 set			
Pliers		For snap ring, TSR-160			
Steel bar		Steel bar of key material approx. 10×8×200			
Torque wrench		Capable of tightening with the specified torques.			
Pincers		-			
Bolt		M4, Length : 50mm			

(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	115.7	0.47	12
PT plug(Material : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT 1/16	0.7	5.1	0.16	4
	PT 1/ 8	1.05	7.59	0.20	5
	PT 1/ 4	1.75	12.66	0.24	6
PF plug(Material : S45C)	PT 1/ 4	3.0	21.7	0.24	6

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 not 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.

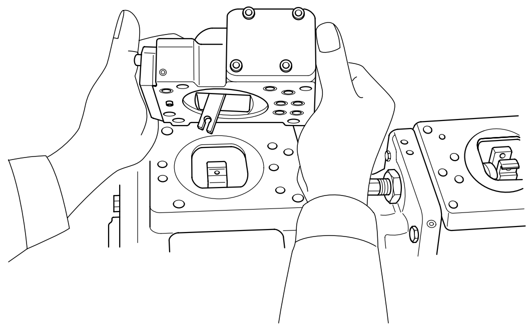
※ Choose a clean place.

※ 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.



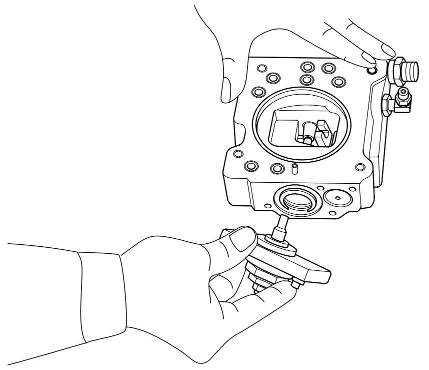
REG01

(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.

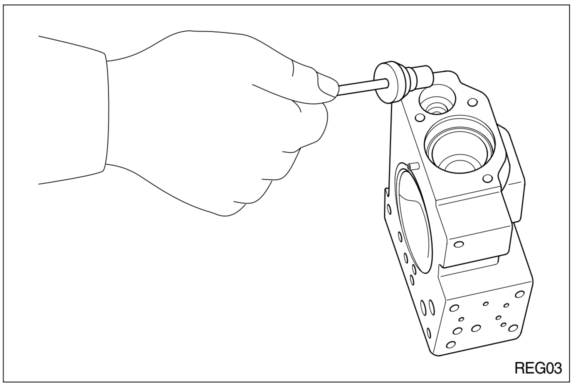


REG02

(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.

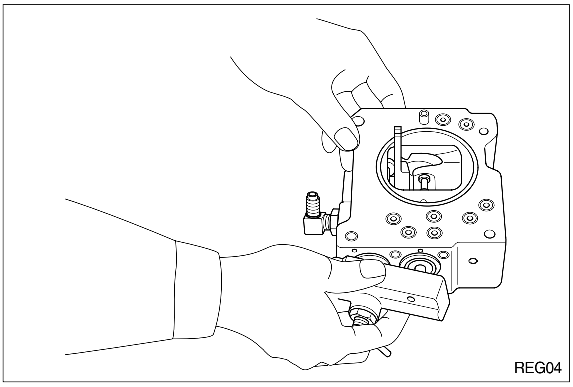
※ Adjusting ring(Q,645) can easily be drawn out with M4 bolt.



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.



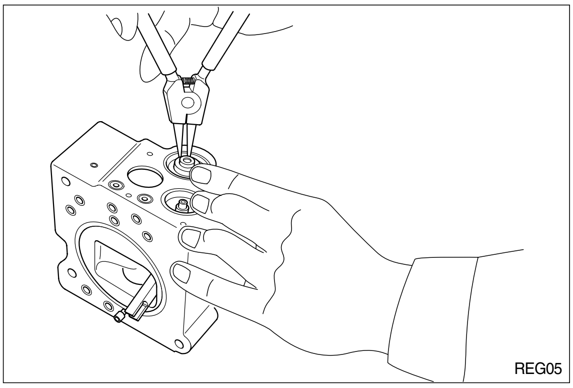
REG04

(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.

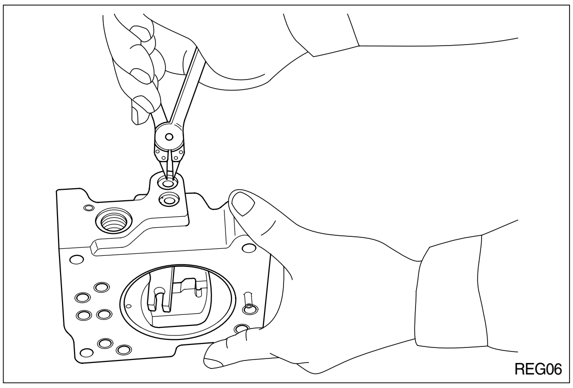
※ Take care not to lose it.



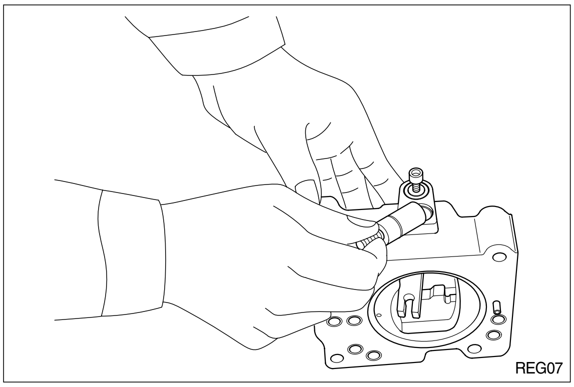
REG05

(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.

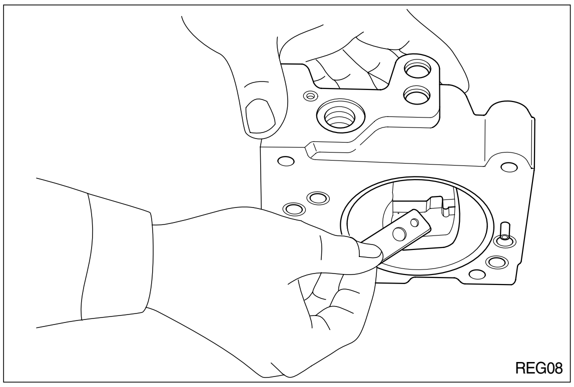


REG06



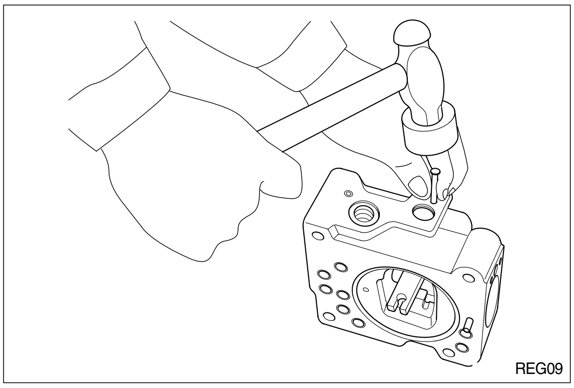
(9) Remove lever(2, 613). Do not draw out pin(875).

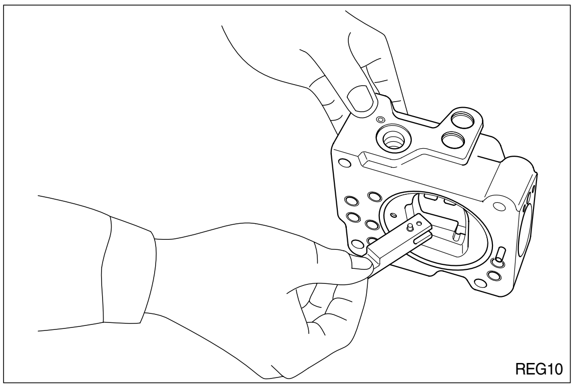
※ Work will be promoted by using pincers or so on.



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

※ Push out pin(874, 4mm in dia.) from above with slender steel bar so that it may not interfere with lever(1, 612).





(11) Remove lever(1, 612). Do not draw out pin(875).

(12) Draw out pilot piston(643) and spool(652).

(13) Draw out piston case(622), compensating piston(621) and compensating rod(623).

※ Piston case(622) can be taken out by pushing compensating rod(623) at opposite side of piston case.

This completes operation.

4) ASSEMBLY

(1) For assembly, reverse disassembly procedures, but pay attention to the following items.

① Always repair parts that were scored at disassembly.
Get replacement parts ready beforehand.

② 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.

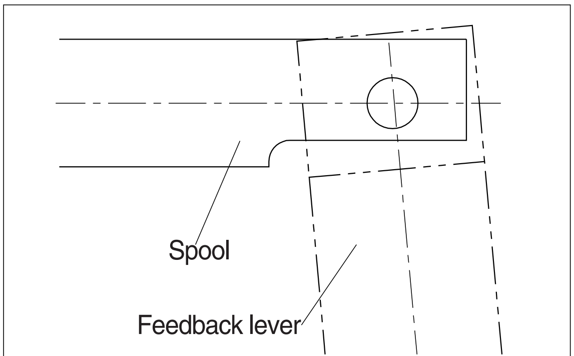
(2) Put compensating rod(623) into compensating hole of casing(601).

(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.

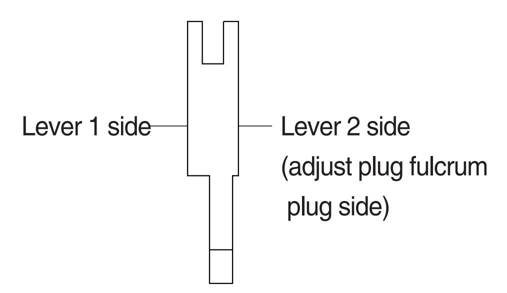
※ Confirm that spool and sleeve slide smoothly in casing without binding.

※ Pay attention to orientation of spool.



8-26

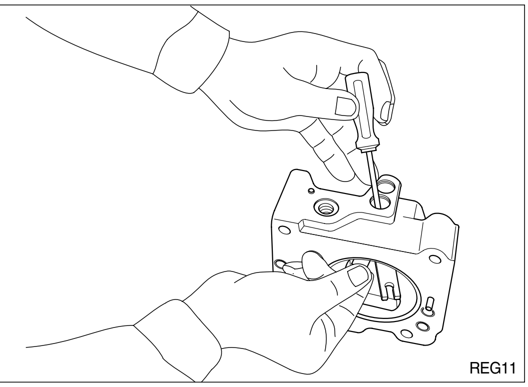
(5) Fit feedback lever(611), matching its pin hole with pin hole in spool.
Then insert pin(874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



8-27

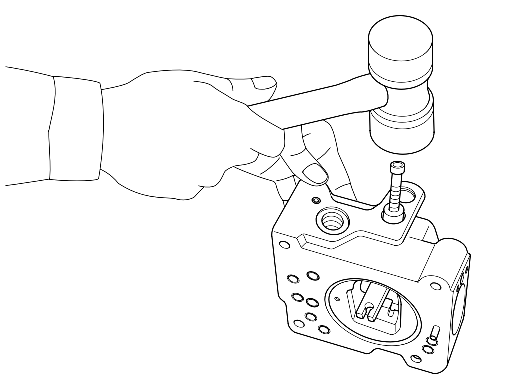
(6) Put pilot piston(643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

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

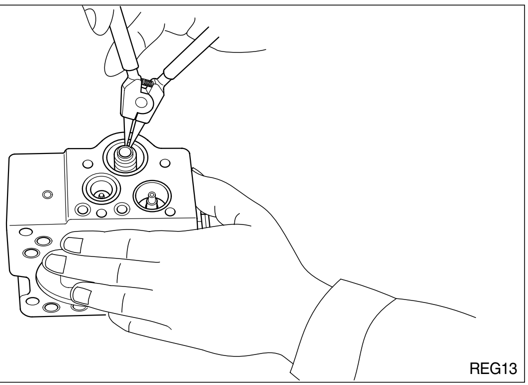

REG11

(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).

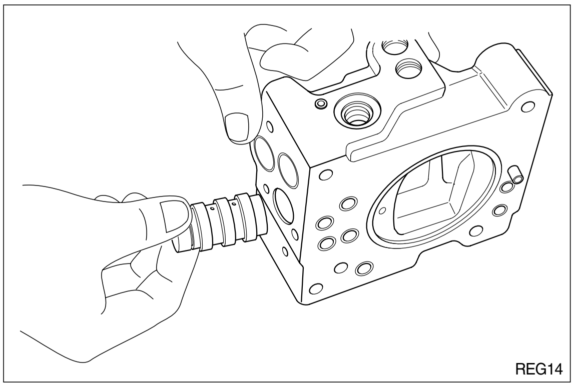
(9) Insert adjusting plug(615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


REG12

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


REG13

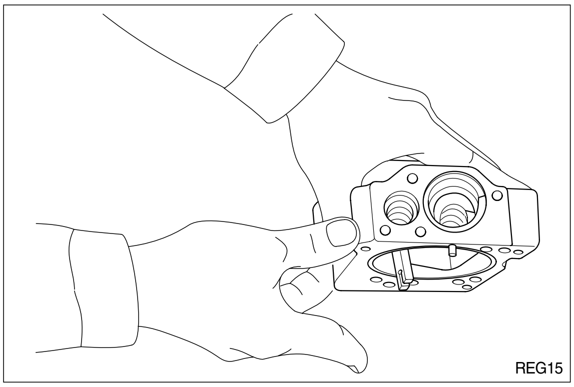
(11) Fit set spring(655) to spool hole and put compensating piston(621) and piston case(622) into compensating hole.
Fit pilot cover(641) and tighten it with hexagonal socket head screws(436, 438).



REG14

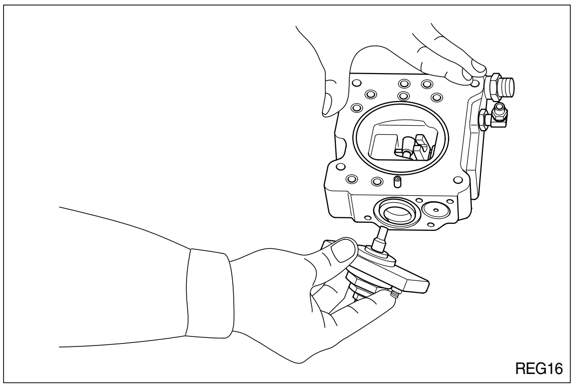
(12) Put spring seat(644), pilot spring(646) and adjusting ring(Q, 645) into pilot hole.
Then fix spring seat(624), inner spring(626) and outer spring(625) into compensating hole.

※ When fitting spring seat, take care not to mistake direction of spring seat.



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).
This completes assembly.



REG16

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.**

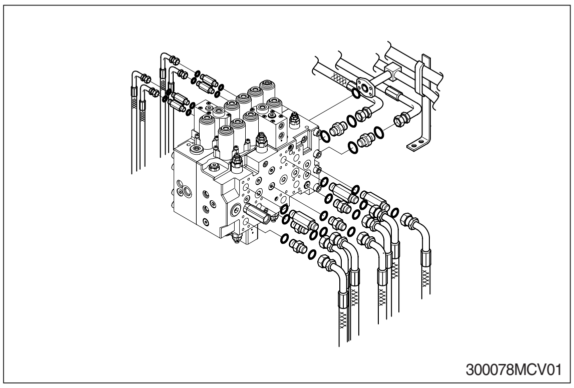
※ **When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.**

13031GE18

(4) Remove bolts and disconnect pipe.

(5) Disconnect pilot line hoses.

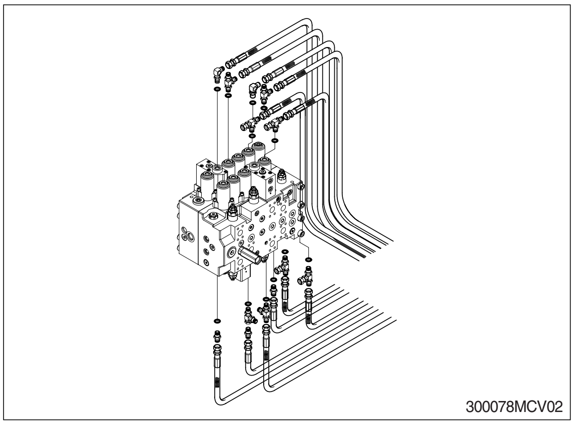
(6) Disconnect pilot piping.



300078MCV01

(7) Sling the control valve assembly and remove the control valve mounting bolt.
  · Weight : 200kg(441lb)

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



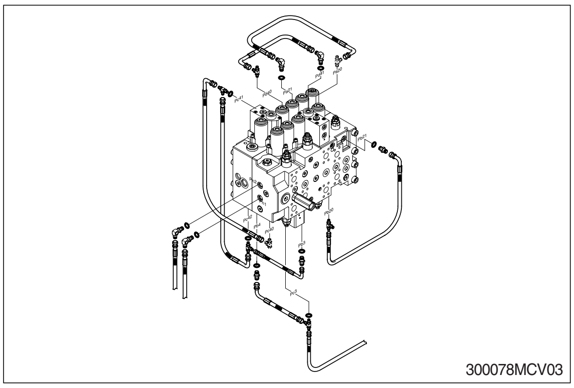
300078MCV02

2) INSTALL

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

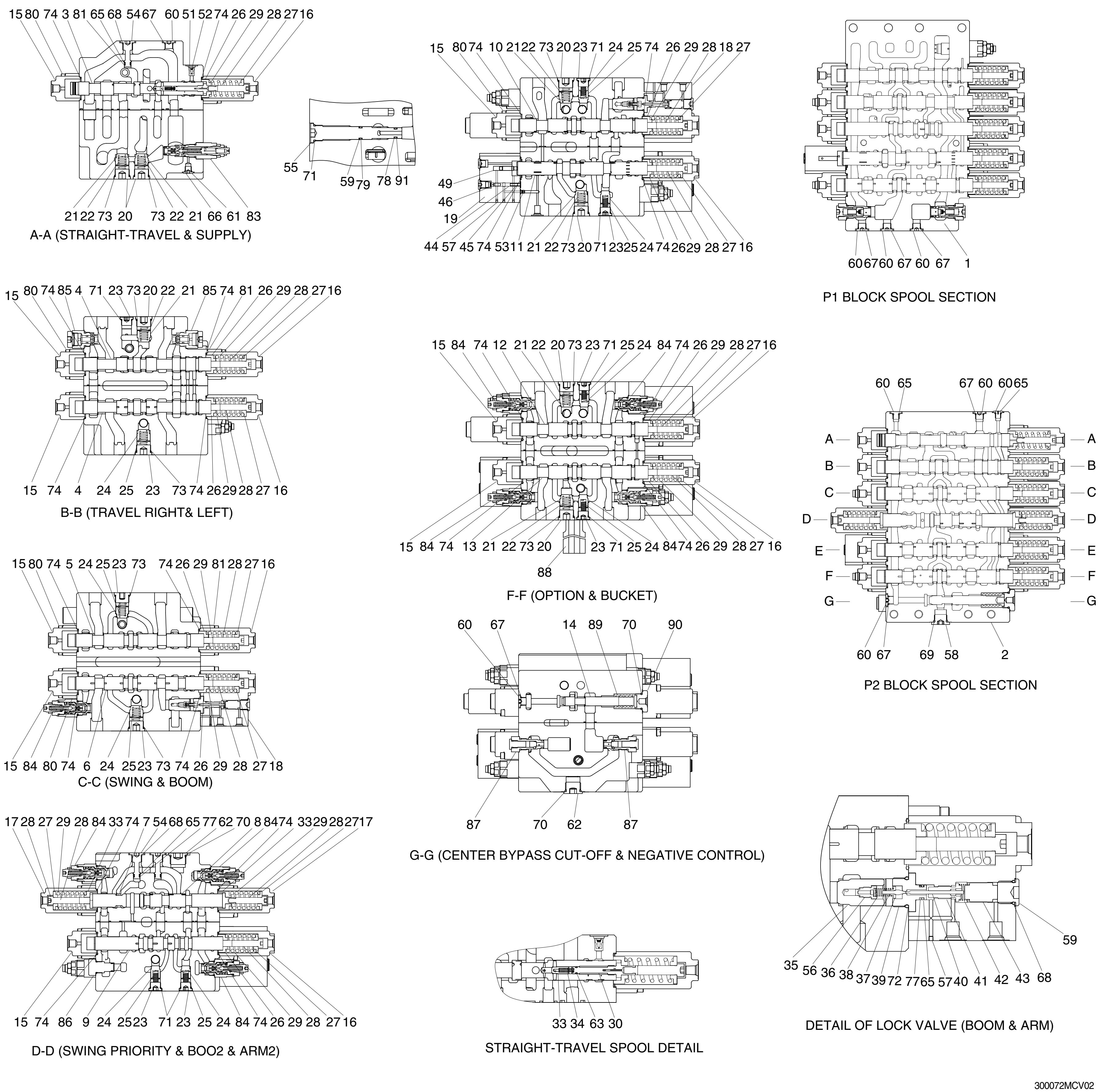
(2) Bleed the air from below items.
① Cylinder(Boom, arm, bucket)
② Swing motor
③ Travel motor
※ See each item removal and install.

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



300078MCV03

2. STRUCTURE



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

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.

(2) In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

(3) When a control valve is to be remove from the machine, apply caps and masking seals to all ports. Before disassembling the valve, recheck that these caps and masking seals are fitted completely, and then clean the outside of the assembly. Use a proper bench for working. Spread paper or a rubber mat on the bench, and disassemble the valve on it.

(4) Support the body section carefully when carrying or transferring the control valve. Do not lift by the exposed spool, end cover section etc.

(5) After disassembling and assembling of the component it is desired to carry out various tests(For the relief characteristics, leakage, flow resistance, etc.), but hydraulic test equipment is necessary for these tests. Therefore, even when its disassembling can be carried out technically, do not disassemble such components that cannot be tested, adjusted, and so on. Additionally one should always prepare clean cleaning oil, hydraulic oil, grease, etc. beforehand.

2) TOOLS

Before disassembling the control valve, prepare the following tools beforehand.

Name of tool	Quantity	Size(mm)
Vice mounted on bench(Soft jaws)	1 unit	
Hexagon wrench	Each 1 piece	5, 6, 10, 12 and 14
Socket wrench	Each 1 piece	27 and 32
Spanner	Each 1 piece	26 and 32(Main relief valve)

3) DISASSEMBLY

(1) Disassembly of spools without holding valve

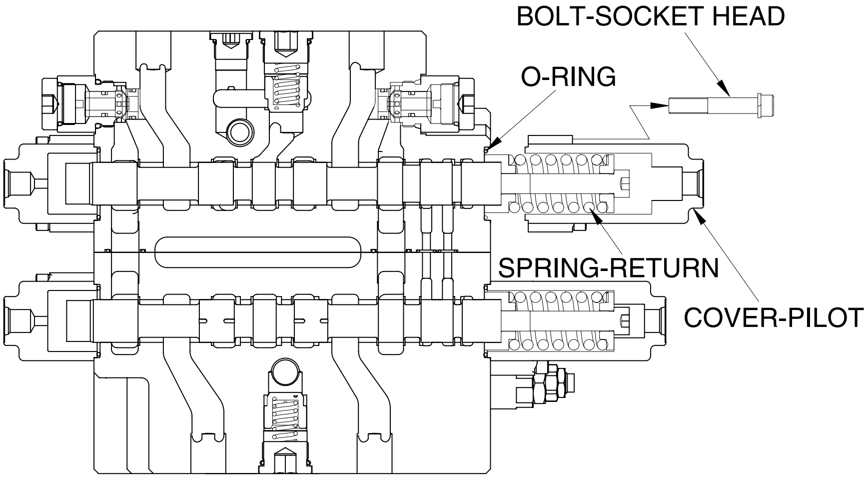
① Loosen hexagon socket head bolts with washer
(Hexagon wrench : 5㎜)

② Remove the pilot cover.

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

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completly new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



29078MC20

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

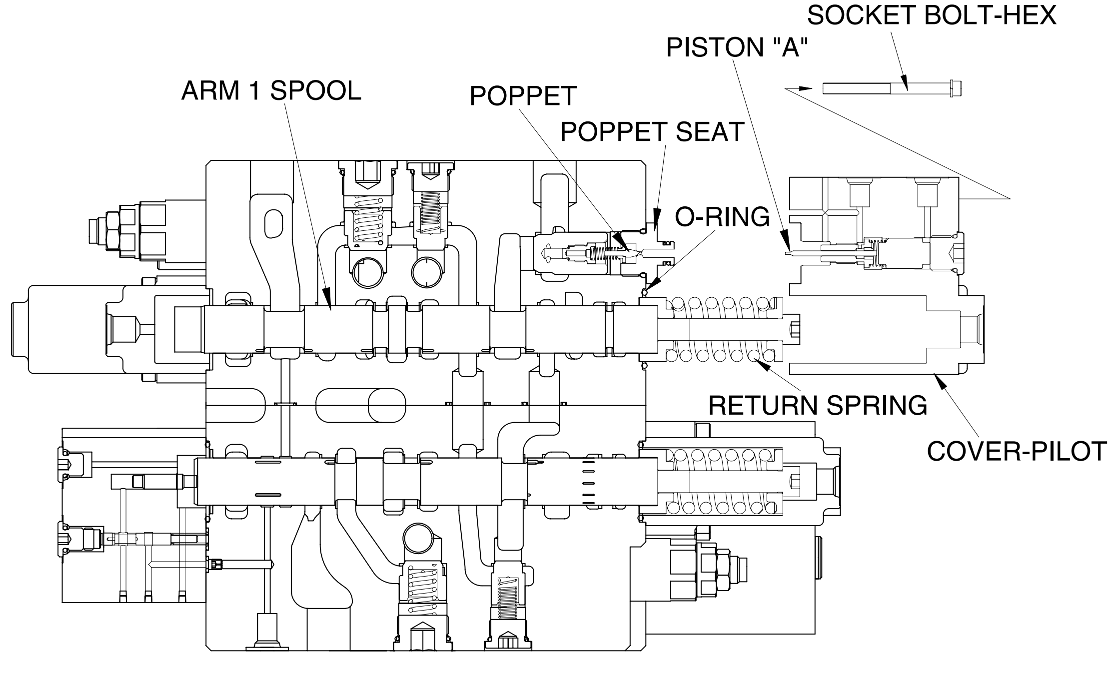
① Loosen hexagon socket head bolts with washer
(Hexagon wrench : 5㎜)

② Remove the pilot cover with internal parts.

※ Pay attention not to lose the O-ring and the poppet under the pilot cover.
※ Pay attention not to damage the "piston A" under pilot cover.

③ Remove the spool assembly from the body by hand slightly.

※ When extracting each spool from its body, pay attention not to damage the body.
※ When extracting each spool assembly, it must be extracted from spring side only.
※ When any abnormal parts are found, replace it with completly new spool assembly.
※ When disassembled, tag the components for identification so that they can be reassembled correctly.



29078MC21

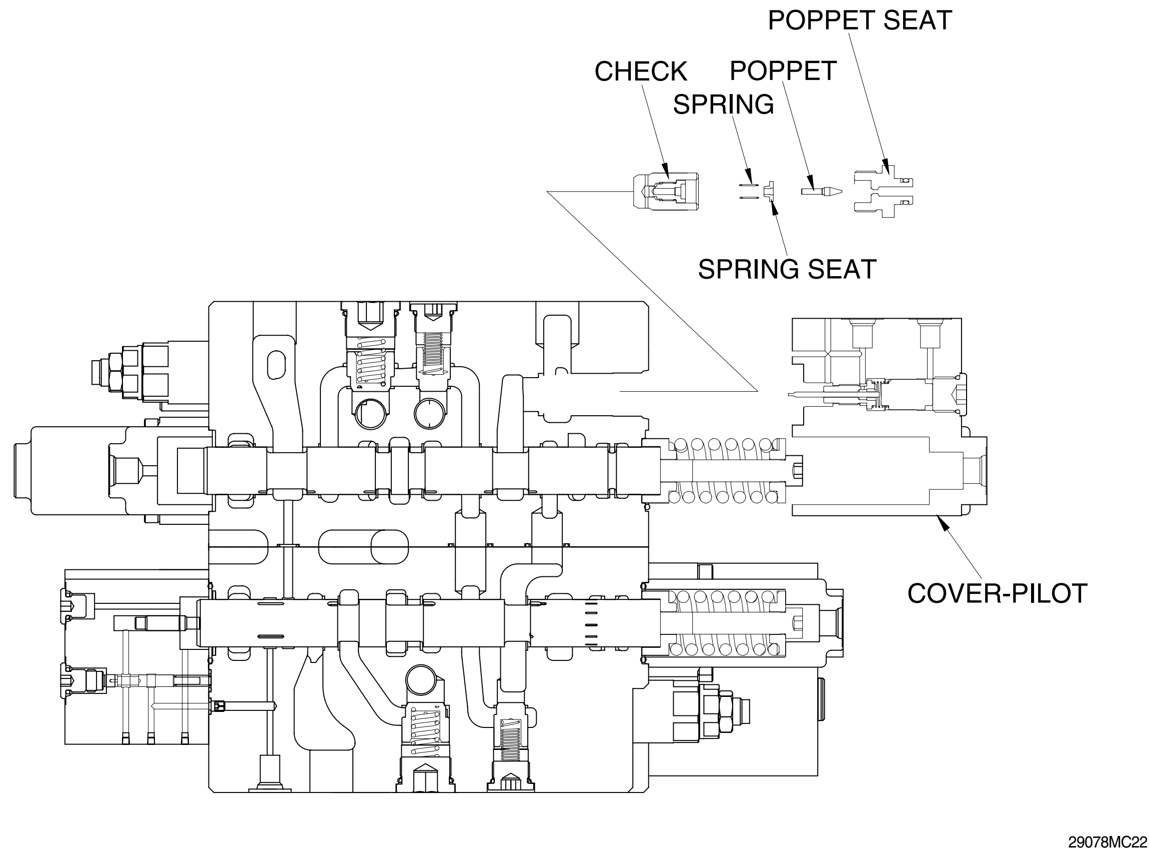
(3) Disassembly of the holding valve

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

※ Do not disassembled internal parts of the pilot cover.

② Loosen the poppet seat and remove the poppet, the spring seat, the spring and the check.
(Spanner : 32㎜)

※ Pay attention not to lose the poppet.
※ Do not disassembled internal parts of the check.



(4) Disassembly of the load check valve and the negative relief valve

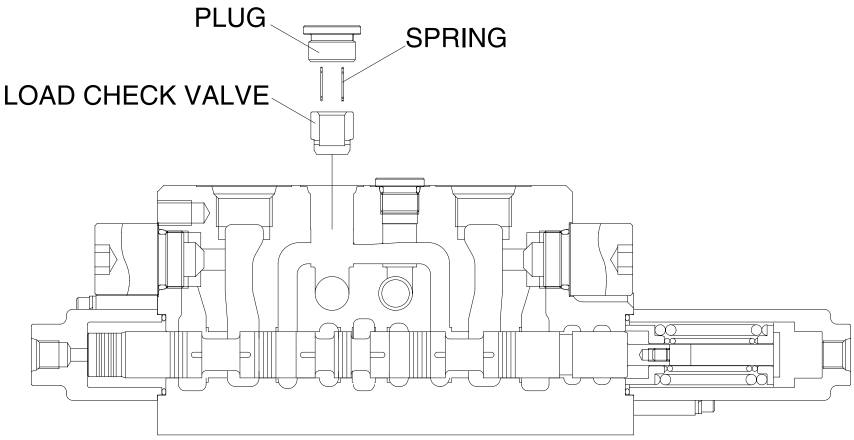
① The load check valve

a. Fix the body to suitable work bench.

※ Pay attention not to damage the body.

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

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

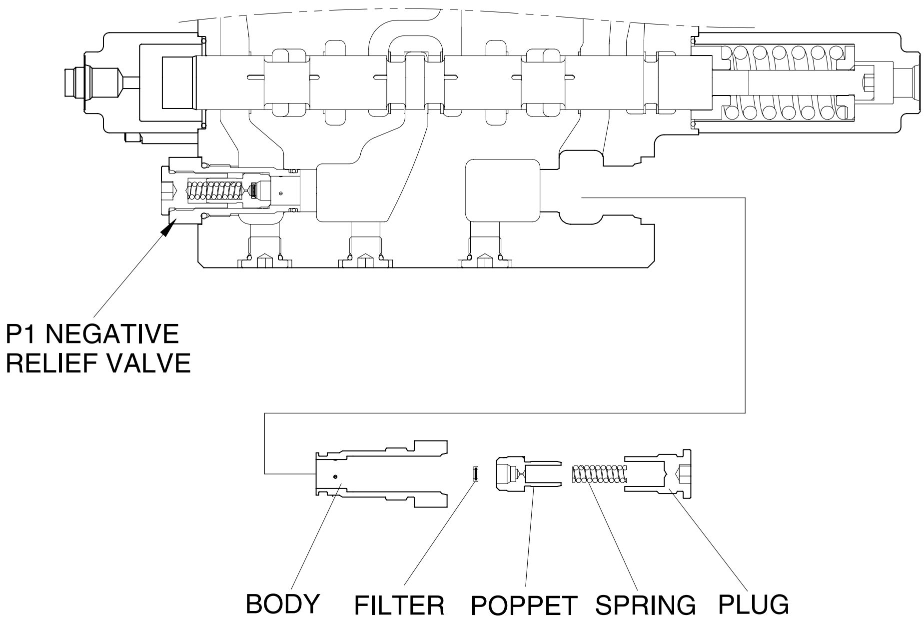


29078MC23

② The negative relief valve

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

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



29078MC24

(5) Disassembly of the main and overload relief valve

① Fix the body to suitable work bench.

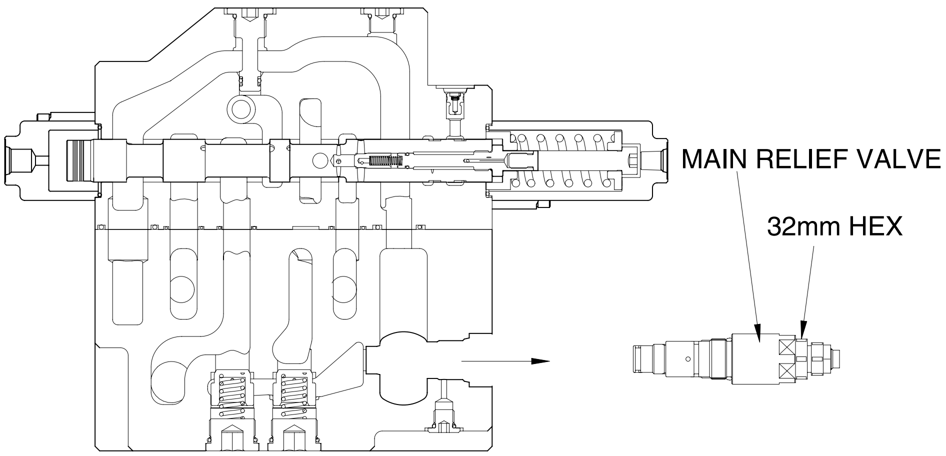
② Remove the main relief valve.
(Spanner : 32㎜)

③ Remove the overload relief valve.
(Spanner : 32㎜)

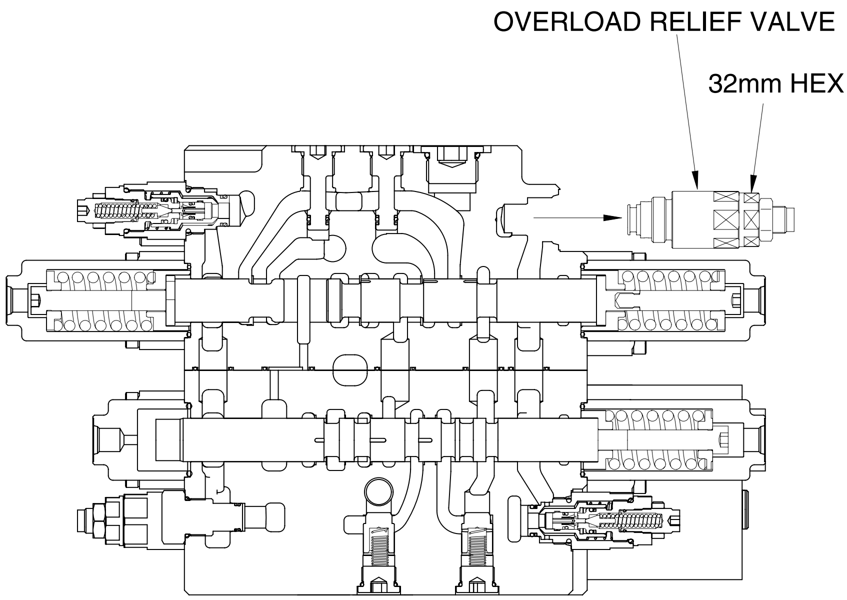
※ When disassembled, tag the relief valve for identification so that they can be reassembled correctly.

※ Pay attention not to damage seat face.

※ When any abnormal parts are found, replace it with completly new relief valve assembly.



29078MC25



29078MC26

(6) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that seal groove faces of body and block are smooth and free of dust, dent, rust etc.
c. Correct dents and damages and check seat faces within the body, if any, by lapping.
※ Pay careful attention not to leave any lapping agent within the body.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and path's are free foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following it's the prescribed disassembly and assembly procedures.
g. Replace all seals and O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and show uniform and consistent contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that springs are free from breakage, deformation, and wear.
e. Confirm that orifices of main poppet and seat section are not clogged with foreign matter.
f. Replace all O-rings with new ones.
g. When any light damage is found in above inspections, correct it by lapping.
h. When any abnormal part is found, replace it with a completely new relief valve assembly.

4) ASSEMBLY

(1) General precaution

① In this assembly section, explanation only is shown.
For further understanding, please refer to the figures shown in the previous structure & disassembly section.

② Pay close attention to keeping all seals free from handling damage and inspect carefully for damage before using them.

③ Apply clean grease or hydraulic oil to the seal so as to ensure it is fully lubricated before assembly.

④ Do not stretch seals so much as to deform them permanently.

⑤ In fitting O-rings, pay close attention not to roll them into their final position in addition, a twisted O-ring cannot easily untwist itself naturally and could thereby cause inadequate sealing and thereby both internal and external oil leakage.

⑥ Tighten fitting bolts for all sections with a torque wrench adjusted to the respective tightening torque.

⑦ Do not reuse removed O-rings and seals.

(2) Load check valve

① Assemble the load check valve and spring.

② Put O-rings on to plug.

③ Tighten plug to the specified torque.
- Hexagon wrench : 10mm
- Tightening torque : 6~7kgf · m(43.4~50.6lbf · ft)

(3) Negative control relief valve

① Assemble the nega-con poppet, piston, spring holder and spring together into body.

② Put O-ring on to plug and tighten the latter to its specified torque.
- Hexagon wrench : 12mm
- Tightening torque : 8~9kgf · m(57.8~65.1lbf · ft)

(4) Main relief, port relief valves

Install main relief valve, overload relief valve into the body and tighten to the specified torque.

Component	Tools	Tightening torque	
		kgf · m	lbf · ft
Main relief valve(81)	Spanner 32mm	8~9	57.8~65.1
Overload relief valve(82)	Spanner 32mm	8~9	57.8~65.1

(5) Main spools

① Carefully insert the previously assembled spool assemblies into their respective bores within of body.

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

(6) Covers

① Fit spool covers to the non-spring assembly end of the spool, and tighten the hexagonal socket head bolts to the specified torque.
  · Hexagon wrench : 5mm
  · Tightening torque : 1~1.1kgf · m(7.2~7.9lbf · ft)

※ Confirm that O-rings have been fitted.

② Fit spring covers to the spring end for the spools, and tighten hexagon socket head bolts to the specified torque.
  · Hexagon wrench : 5mm
  · Tightening torque : 1~1.1kgf · m(7.2~7.9lbf · ft)

※ Confirm that O-rings have been fitted.

(7) Holding valves

① Assemble the check, spring seat and poppet together into body.

② Tighten the poppet seat to the specified torque.
  · Spanner : 26mm
  · Tightening torque : 6~7kgf · m(43.4~50.6lbf · ft)

③ Fit the "piston A" under pilot cover with internal parts into hole on the poppet seat.

④ Tighten hexagon socket head bolt to specified torque.
  · Hexagon wrench : 5mm
  · Tightening torque : 1~1.1kgf · m(7.2~7.9lbf · ft)

GROUP 5 SWING DEVICE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

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

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

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

(3) Disconnect pipe assy(2, 3).

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

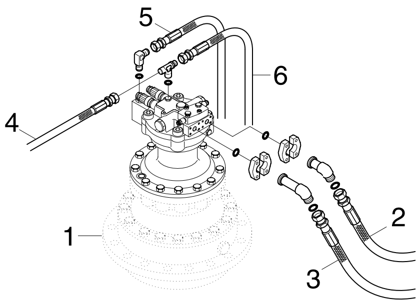
(5) Sling the swing motor assembly(1)and remove the swing motor mounting bolts(9).

- Motor device weight : 190kg(420lb)
- Tightening torque : 58.4kgf · m (422.4lbf · ft)

(6) Remove the swing motor assembly.

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

13031GE18



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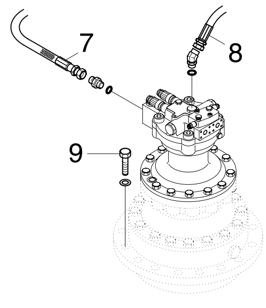


29078SM02

2) INSTALL

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

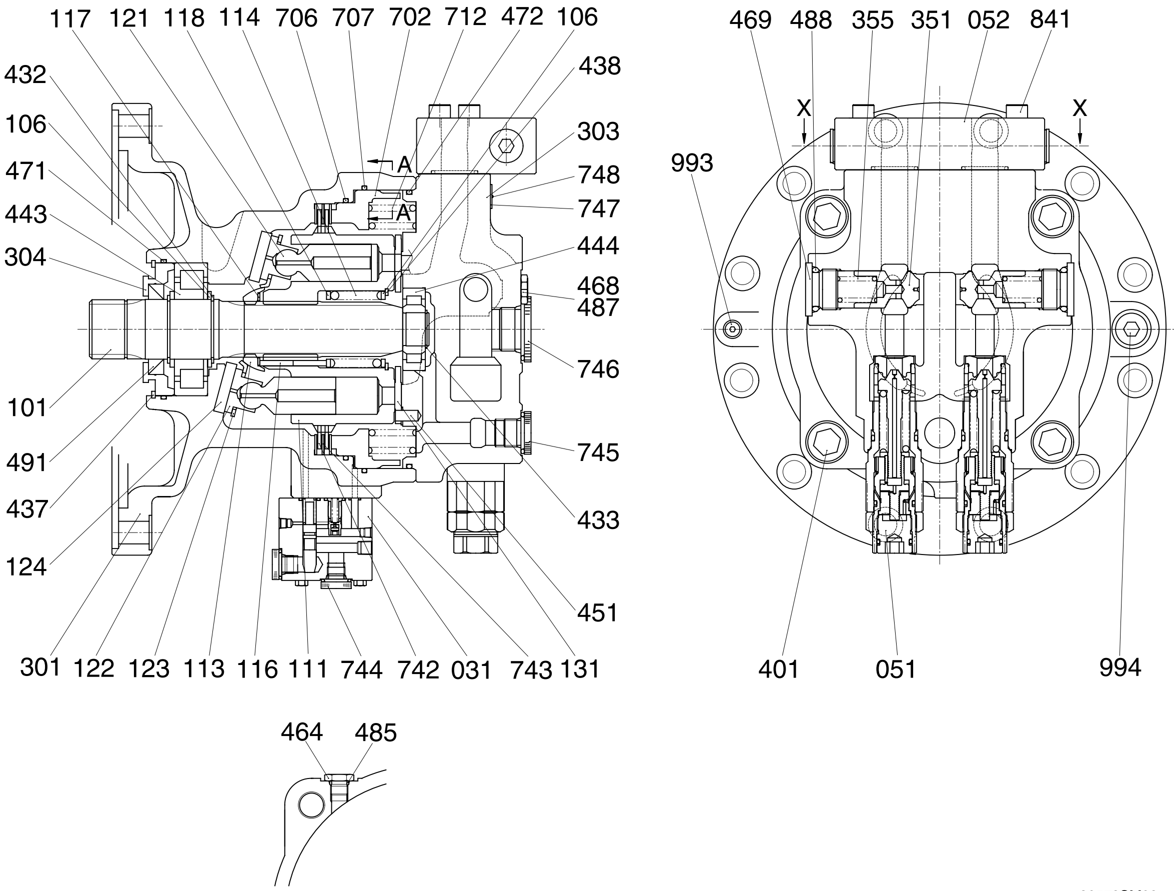
(2) Bleed the air from the swing motor.

① Remove the air vent plug.
② Pour in hydraulic oil until it over flows 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) Confirmed the hydraulic oil level and check the hydraulic oil leak or not.

2. SWING MOTOR

1) STRUCTURE



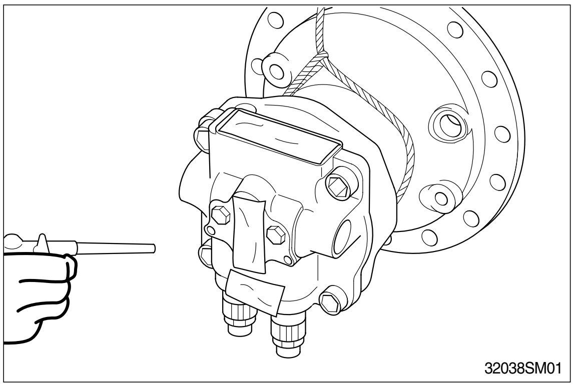
30572SM02

031	Brake valve	304	Front cover	488	O-ring
051	Relief valve	351	Plunger	491	Oil seal
052	Valve assy	355	Spring	702	Piston
101	Drive shaft	401	Socket bolt	706	O-ring
106	Spacer	432	Snap ring	707	O-ring
111	Cylinder block	433	Snap ring	712	Brake spring
113	Bushing	437	Snap ring	742	Lining plate
114	Spring	438	Snap ring	743	Separate plate
116	Push rod	443	Roller bearing	744	Plug
117	Spacer	444	Bearing	745	Plug
118	Spacer	451	Spring pin	746	Plug
121	Piston	464	Plug	747	Name plate
122	Shoe	468	Plug	748	Rivet screw
123	Retainer	469	Plug	841	Socket bolt
124	Shoe plate	471	O-ring	993	Plug
131	Valve plate	472	O-ring	994	Plug
301	Casing	485	O-ring		
303	Casing	487	O-ring		

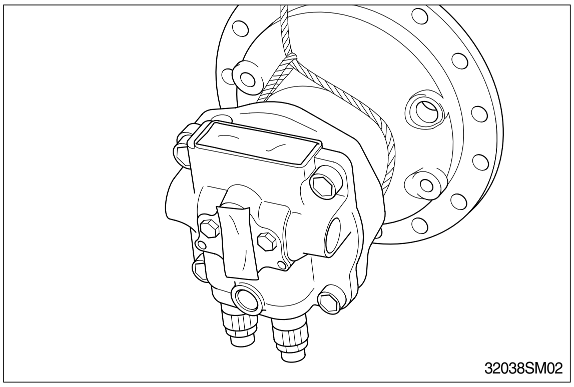
2) DISASSEMBLY

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

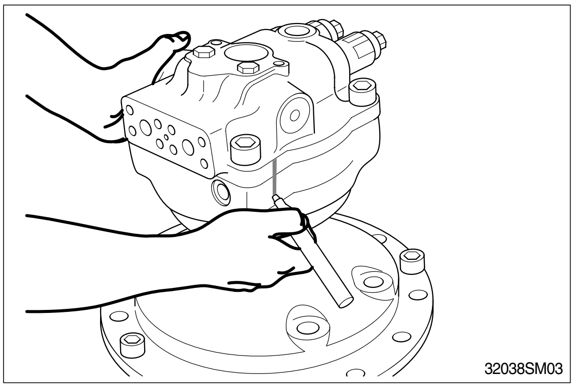
※ To avoid dust inside the motor, mask all the ports of the motor with tapes.



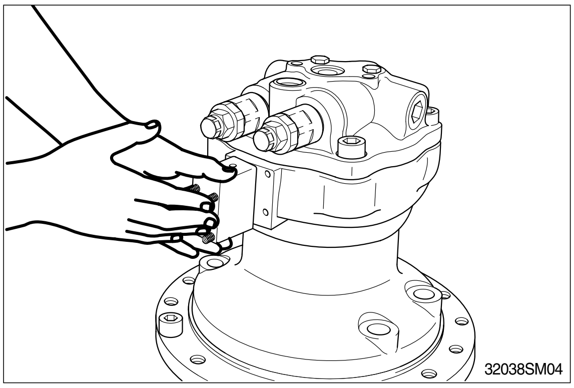
(2) Loosen the drain plug to discharge oil in the casing(301).



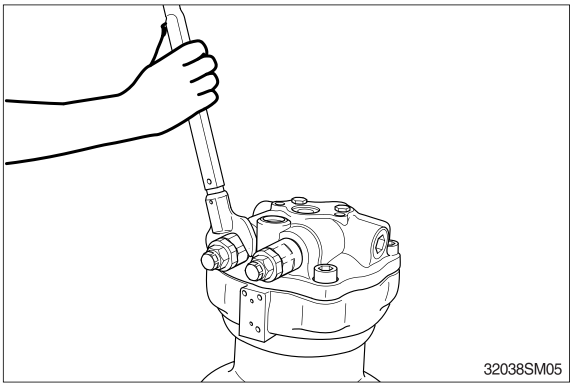
(3) Fix the drive shaft(101) on the workbench with the end of output shaft down. Put matching marks on casing (301) and valve casing(303) for easy reassembly.



(4) Remove the valve(052).

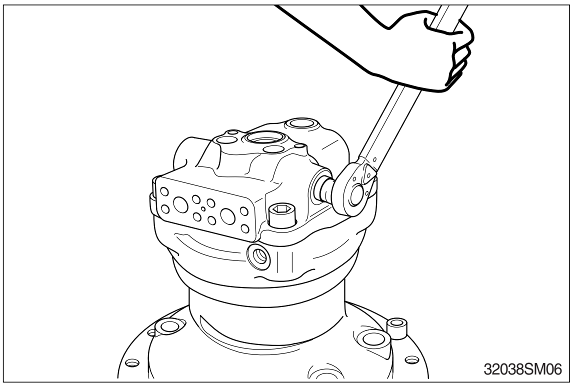


(5) Remove the relief valve(051) from valve casing(303).

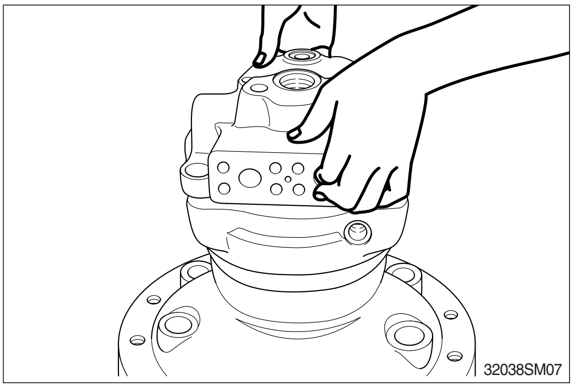


(6) Remove plug(469) from valve casing (303) and spring(355), plunger(351).

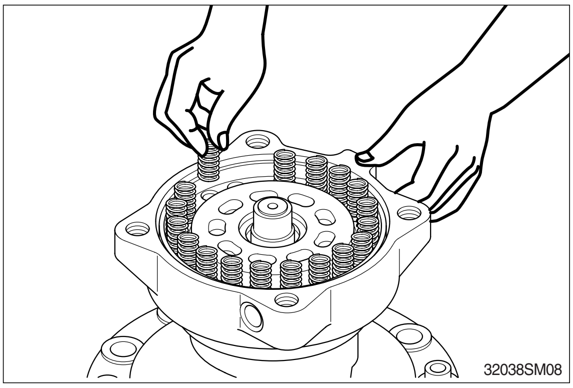
※ Be careful not to damage the plunger seat assembly.



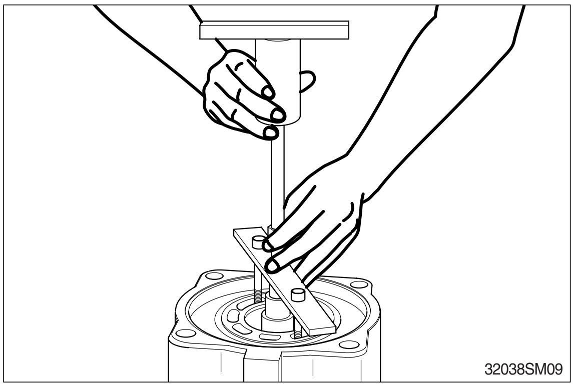
(7) Remove valve casing(303) from casing (301). Then, remove the valve plate(131) from valve casing(303) with care.



(8) Remove the brake spring(712) from brake piston(702).

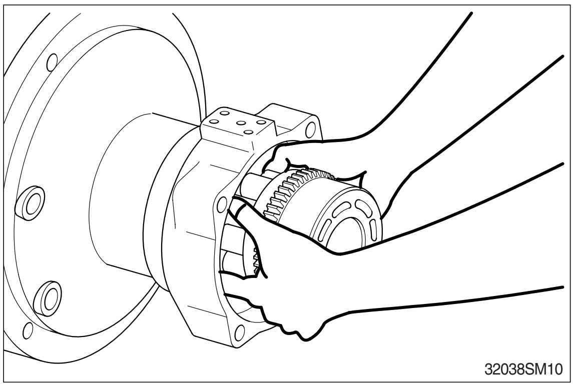


(9) Remove brake piston(702) from casing (301).

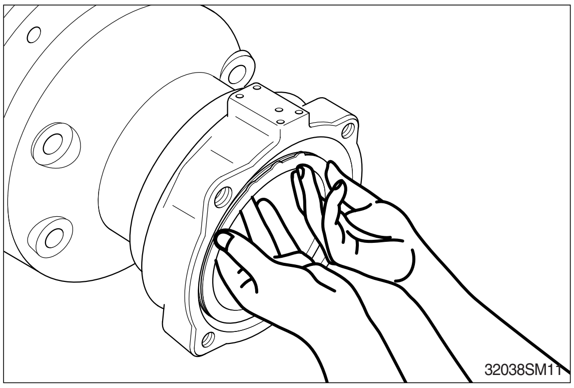


(10) Remove the cylinder(111) from the output shaft (101) with the motor positioned horizontally. Remove piston(121), pushing plate(123), retainer(113), spacer (117) and shoe plate(124).

※ If shoe plate would not removed easily, try again after procedure(14).

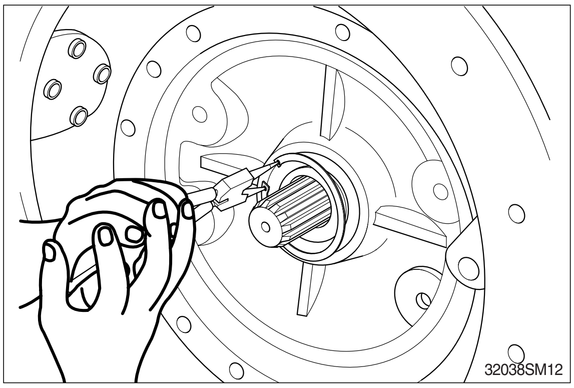


(11) Remove friction plate(742) and separate plate(743) from casing(301).

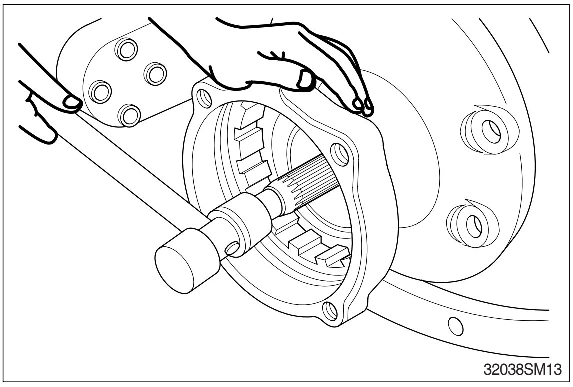


(12) Remove snap ring(437) with plier and remove the front cover(304) from casing(301).

※ Front cover could be removed with sliding shaft if necessary.

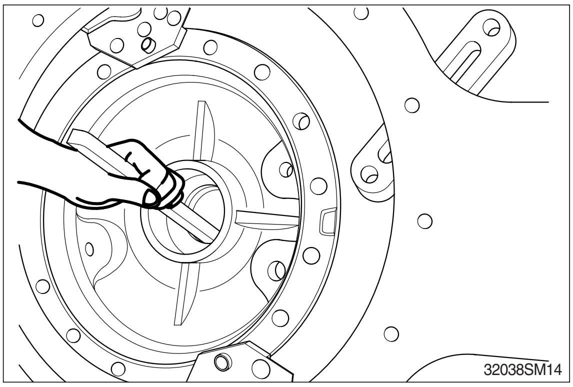


(13) Remove drive shaft(101) from casing (301).



32038SM13

(14) Remove the shoe plate(124) from casing (301).

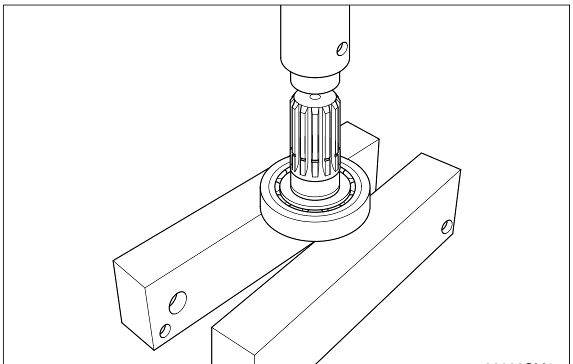


32038SM14

(15) Proceed with following job only when necessary.

① Remove the snap ring(432), spacer(106) from drive shaft(101) and remove the cone of roller bearing(443) by press.

※ Do not reuse bearings.



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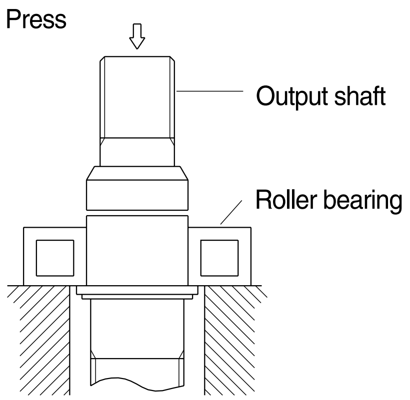
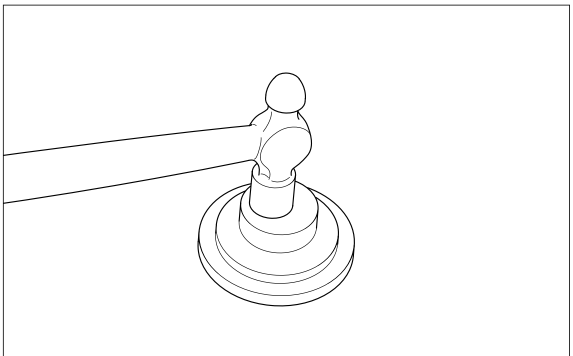
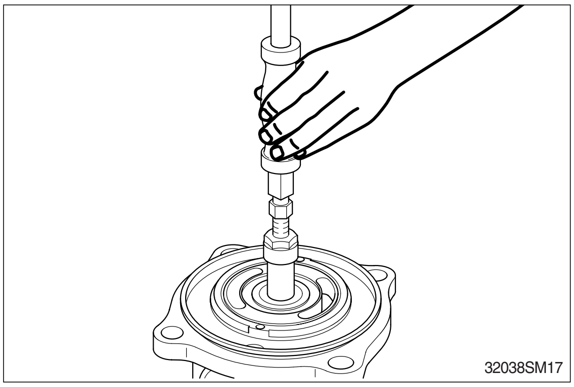


② Remove oil seal(491) from front cover (304).



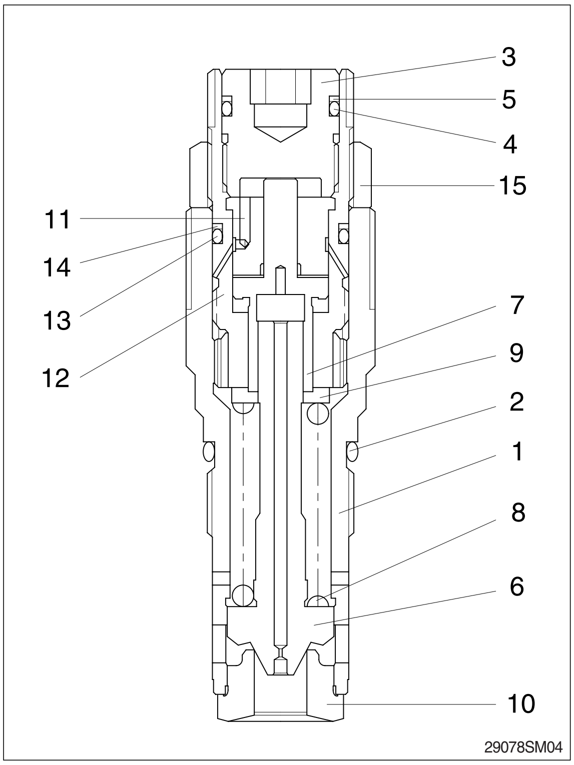
32038SM16

③ Remove the roller bearing(444) from the valve casing(303) by using slide hammer bearing puller.



④ When disassembling the relief valve, release the plug(3).
Remove the piston(7), spring seat(9), spring(8) and plunger(6) with the body(1) downwards.

※ Do not release the lock nut(15).

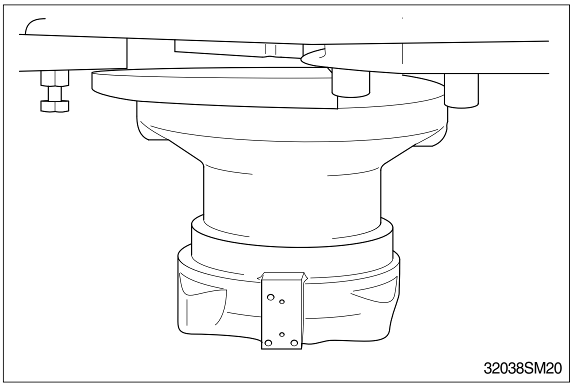


This completes disassembly.

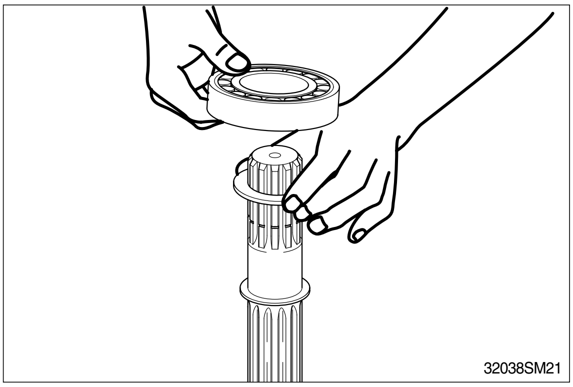
3) ASSEMBLY

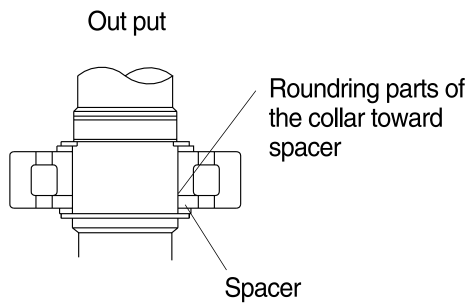
Do the reassembly in the reverse procedure of the disassembly.

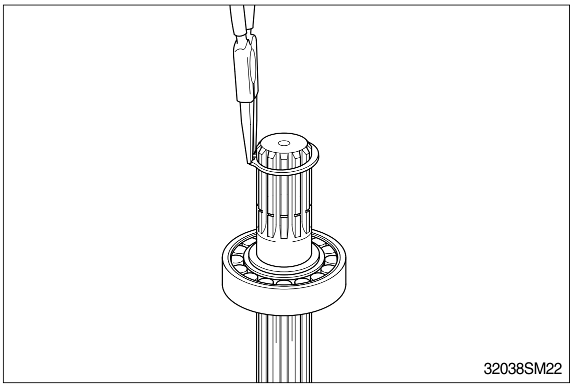
(1) Place the casing(301) on the workbench with the valve casing(303) downward.



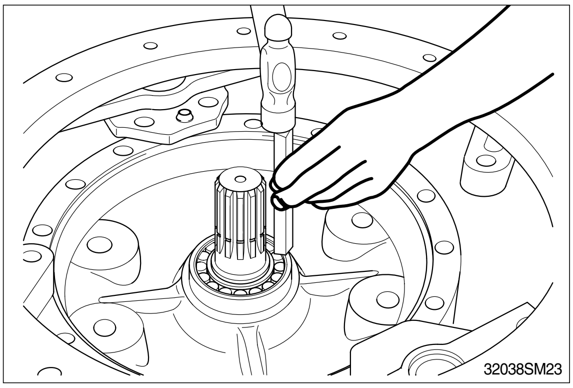
(2) When reassembling the roller bearing, install the snap ring(432), and spacer(106) to the drive shaft(101). Insert the collar and cone of the roller bearing(443). Install the spacer(106) and stop ring(432). Install stop ring(433) to the output shaft (101) by heating the cone of the roller bearing(444).



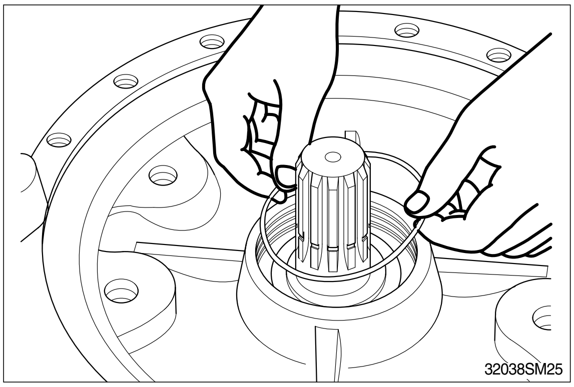




(3) Insert the drive shaft(101) into the casing (301) with the end of output shaft upward and tap the outer race of roller bearing with the hammer.

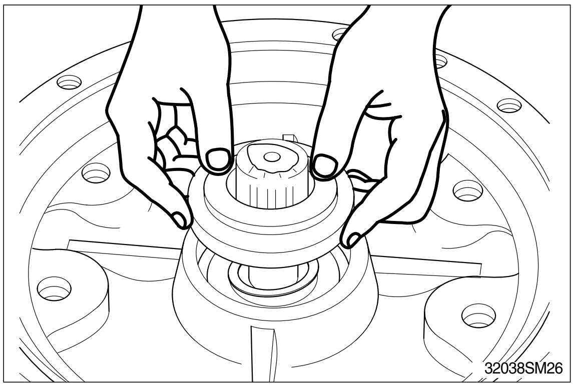


(4) Tack O-ring(471) to the casing(301).

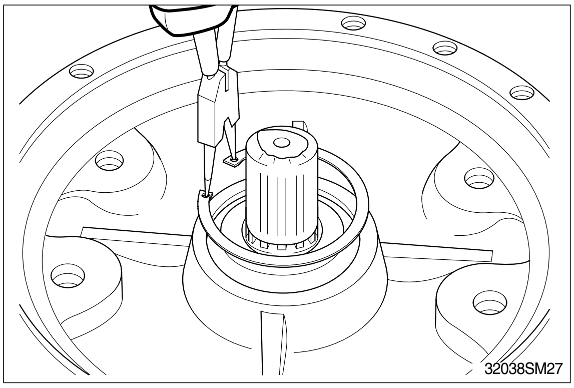


(5) Reassemble the front cover(304) to the casing(301).

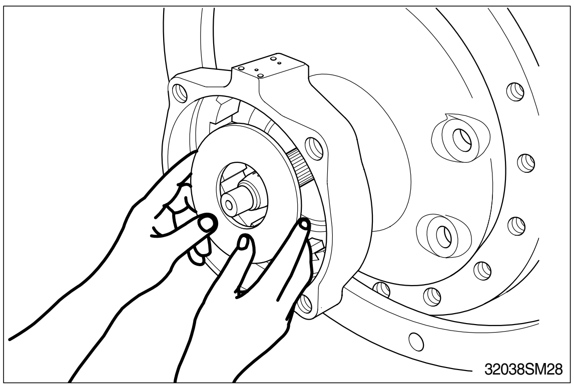
※ Apply grease to the rib of oil seal to avoid damage to the rib.



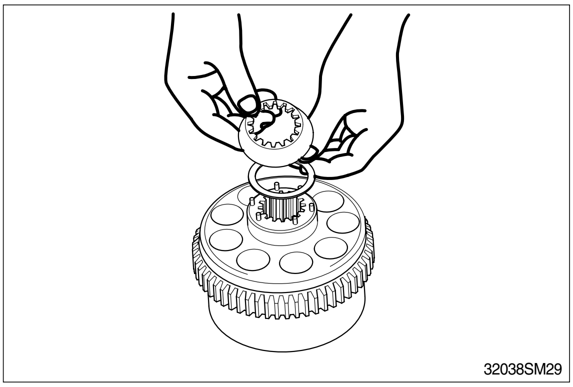
(6) Install the snap ring(437) to the casing (301).



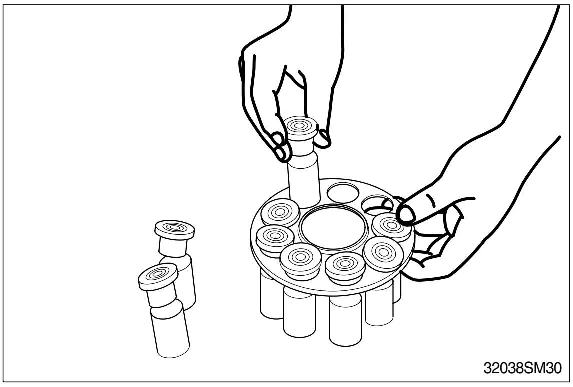
(7) Insert the shoe plate(124) with the casing (301) position horizontally.



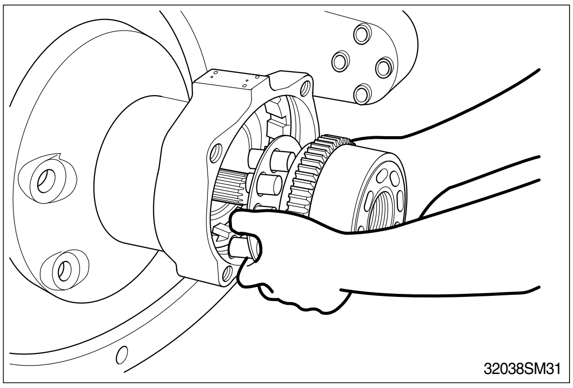
(8) Insert the push rod(116) into the cylinder (111). Place the retainer(113) assembled with spacer(117) onto the cylinder.
※ Insert two push rods in each hole.



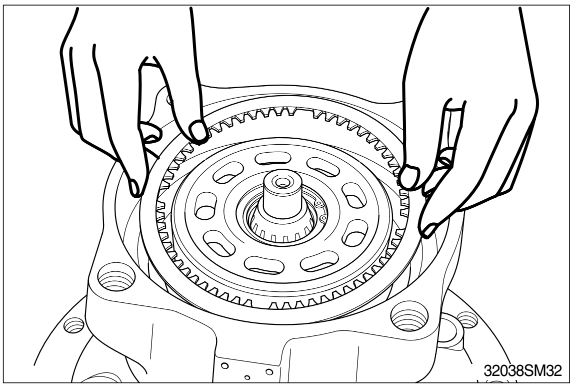
(9) Install the piston sub-assembly(121, 122) to the set plate(123).



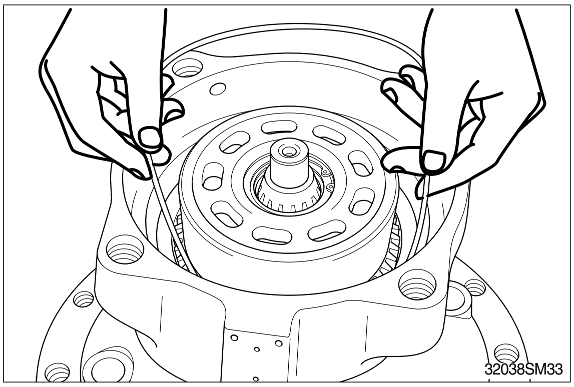
(10) Reassemble the piston assembly(121, 122) to the cylinder(111).



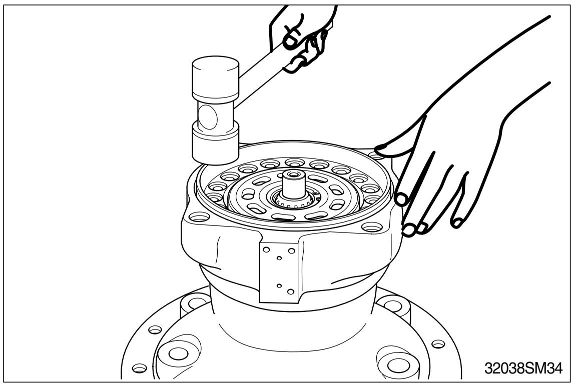
(11) Place the casing(301) under the front cover(304) and reassemble 3 sheets of separate plate(743) and then 2 sheets of friction plate(742) to the casing(301).



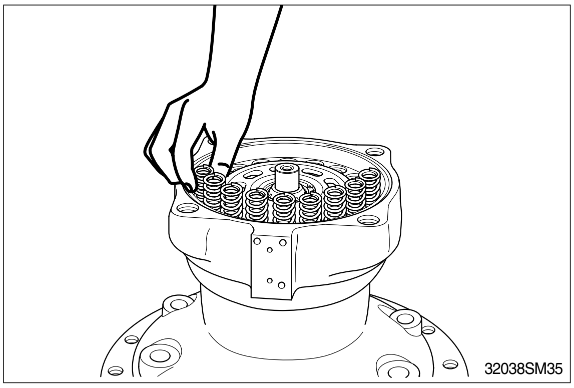
(12) Insert O-ring(706, 707) inside the casing (301).



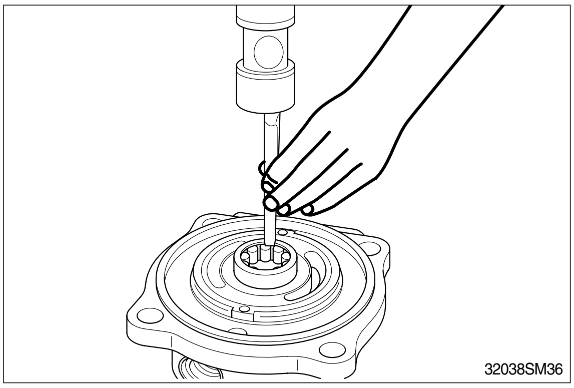
(13) Reassemble brake piston(702) to the casing(301).



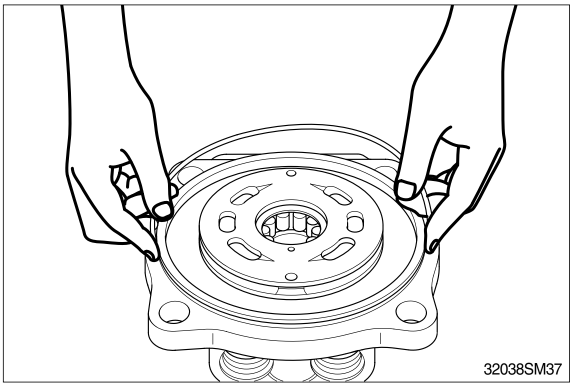
(14) Reassemble brake spring(712) to the brake piston(702).



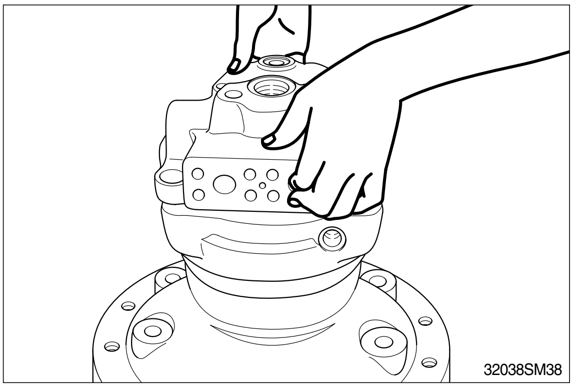
(15) When assembling the roller bearing(444), insert the roller bearing(444) into valve casing(303) by hammering.



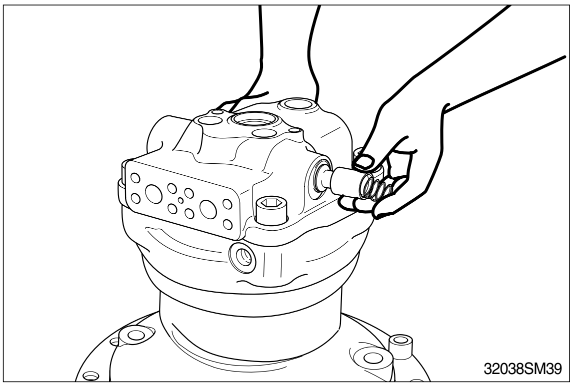
(16) Reassemble valve plate(131) to the valve casing(303) and reassemble O-ring(472).



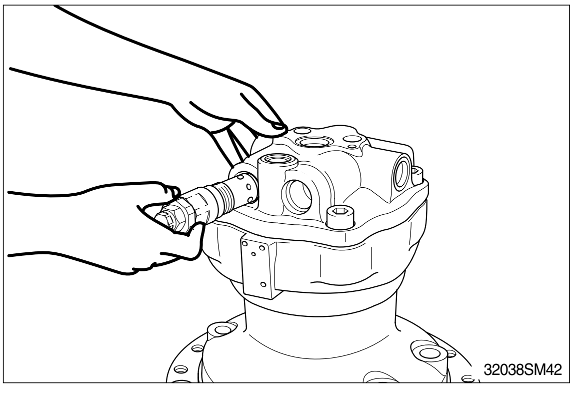
(17) Connect the valve casing(303) with the casing(301) and tighten the hexagon screw(401).



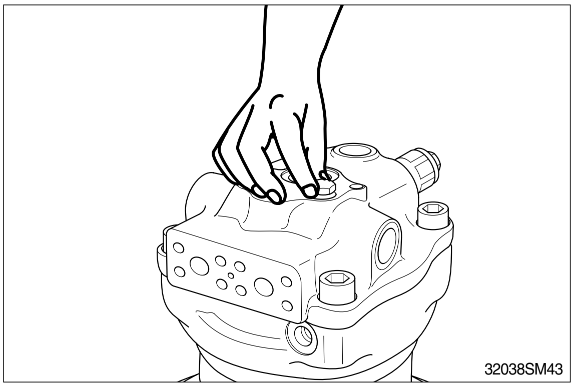
(18) Insert plunger(351) and spring(355) in the valve casing and install O-ring(488). Tighten plug(469) to the valve casing.



(19) Insert O-rings(051-1) to the relief valve (051) and reassemble them to valve casing(303).



(20) Tighten the plug(468) to valve casing(303) with O-ring(487) and tighten the plug(464) to casing(301) with O-ring(485).


32038SM43

(21) Connect the valve casing(303) with the casing(301).

This completes assembly.

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

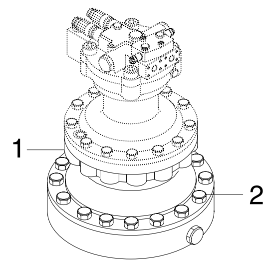
REMOVAL

(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 : 260kg (573lb)

13031GE18



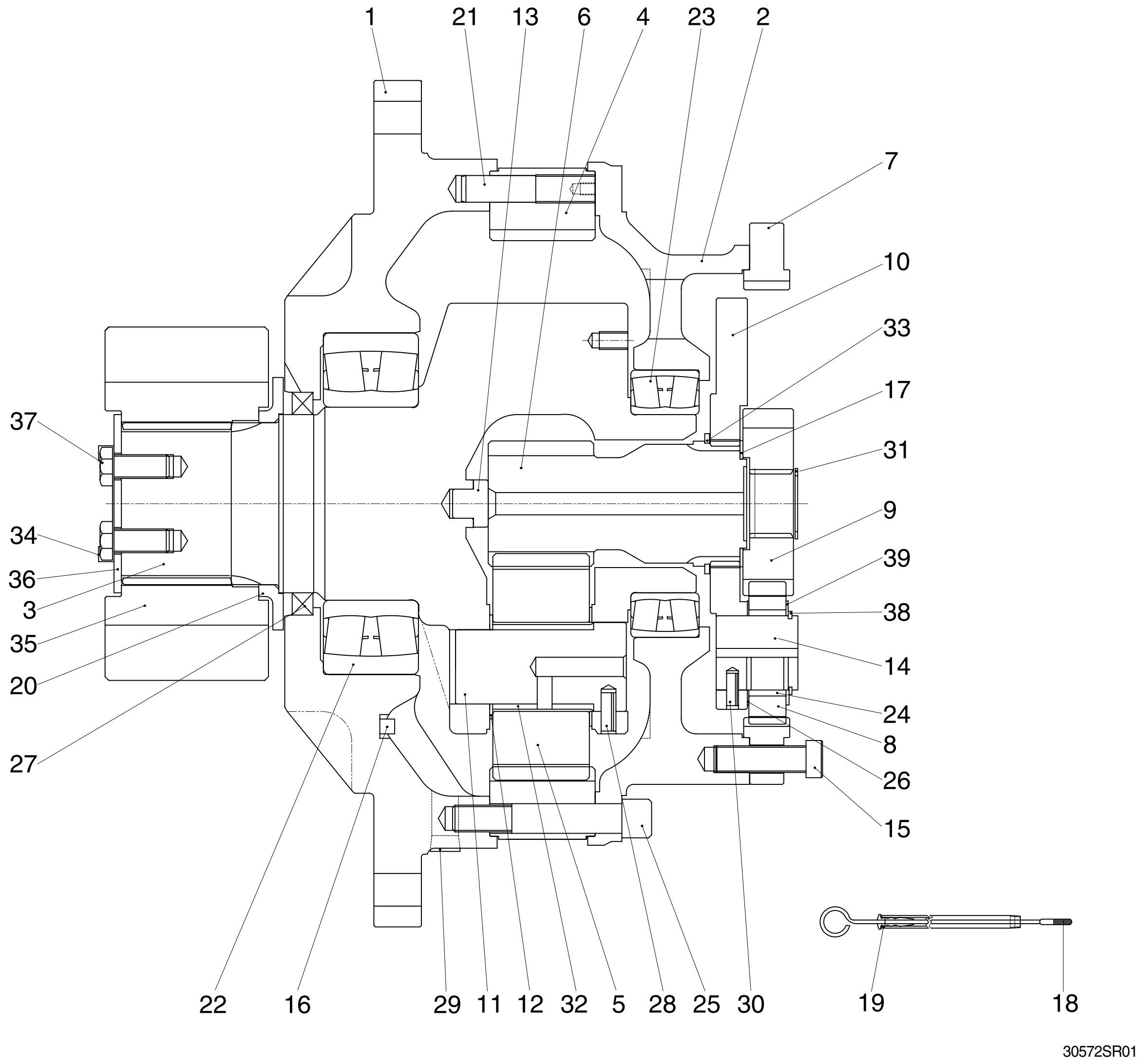
29078SR01

2) INSTALL

(1) Carry out installation in the reverse order to removal.
- Mounting bolt : 49.2~66.6kgf · m (356~481lbf · ft)

4. REDUCTION GEAR

1) STRUCTURE



1	Front casing	14	Pin 1	27	Oil seal
2	Middle casing	15	Side plate 1	28	Spring pin
3	Drive shaft	16	Magnet	29	Pressure plug
4	Ring gear 2	17	Side plate 3	30	Spring pin
5	Planet gear 2	18	Gauge bar	31	Stop ring
6	Sun gear 2	19	Gauge pipe	32	Bushing 2
7	Ring gear 1	20	Spacer ring	33	Stop ring
8	Planet gear 1	21	Knock pin	34	Lock washer
9	Sun gear 1	22	Roller bearing	35	Pinion gear
10	Carrier	23	Roller bearing	36	Lock plate
11	Pin 2	24	Needle cage	37	Hexagon bolt
12	Thrust washer	25	Socket bolt	38	Stop ring
13	Thrust button	26	Socket bolt	39	Side plate 2

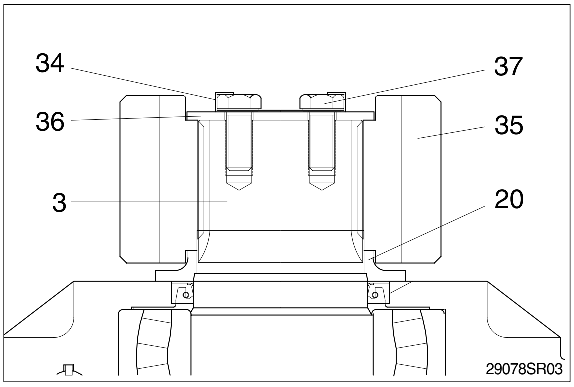
2) DISASSEMBLY

(1) Spread off the 4 corners of lock washer (34) with a tool.

※ Do not reuse lock washer(34).

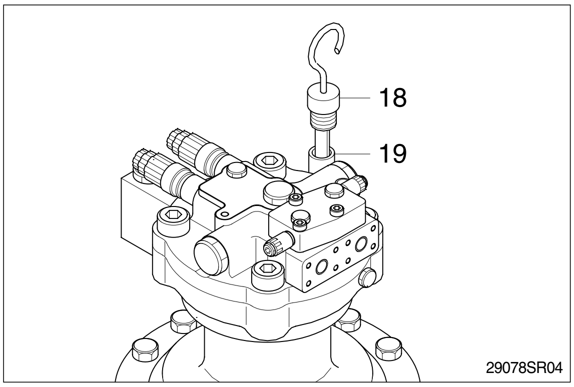
Loosen the hexagon bolts(37) and then remove lock washer(34) and lock plate(36) from the pinion gear(35).

Remove pinion gear(35) and spacer ring (20) from the drive shaft(3).

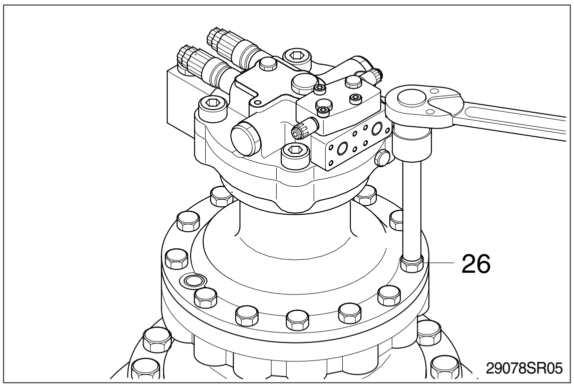


(2) Remove gauge bar(18) and gauge pipe (19) from the swing motor casing.

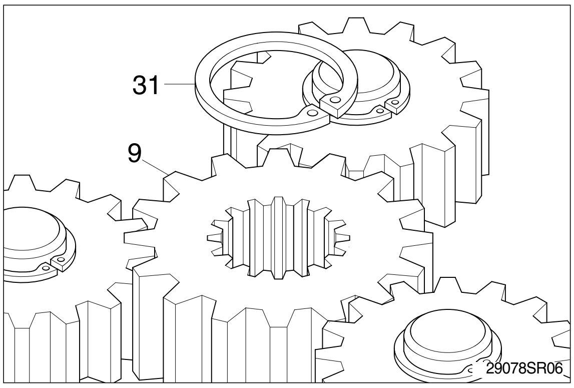
Pour the gear oil out of reduction gear into the clean bow1 to check out the friction decrease.



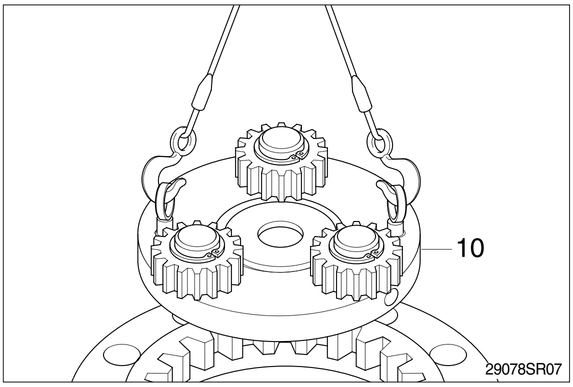
(3) Loosen the socket bolt(26) to separate swing motor from reduction gear.



(4) Remove stop ring(31) and then sun gear 1(9).



(5) Tighten two M10 eye bolts to carrier(10) and lift up and remove carrier(10) as subassembly.



(6) Disassembling carrier assembly

① Remove stop ring(38).

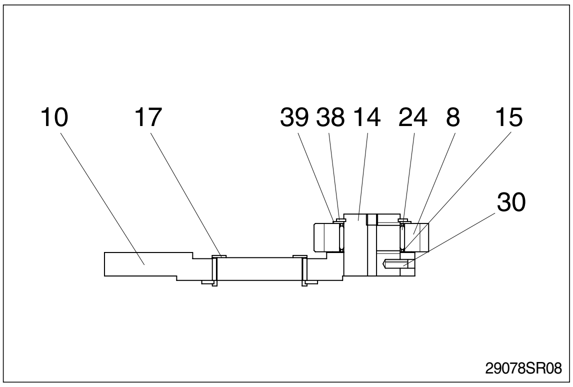
② Remove side plate2(39), planet gear1(8), needle cage(24), side plate1(15) and side plate3(17).

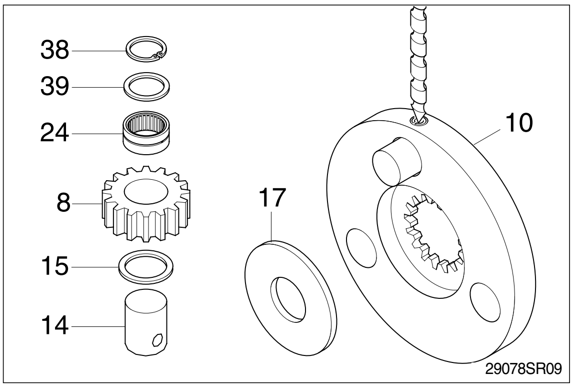
③ Using M8 solid drill, crush spring pin(30) so that the pin1(14) can be removed by hammering.

※ Do not reuse spring pin(30).

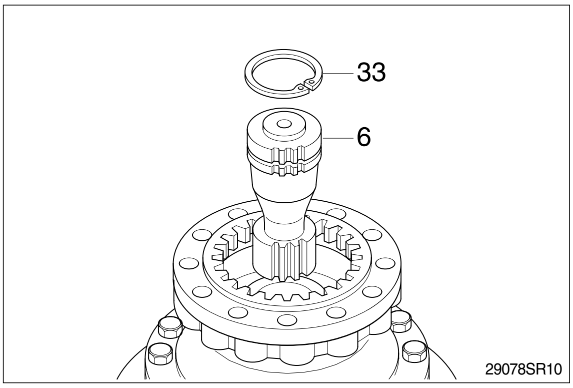
※ Do not remove pin1(14), carrier(10) and spring pin(30) but in case of replacement.

※ Put matching marks on the planet gear1 (8) and the pin1(14) for easy reassembly.



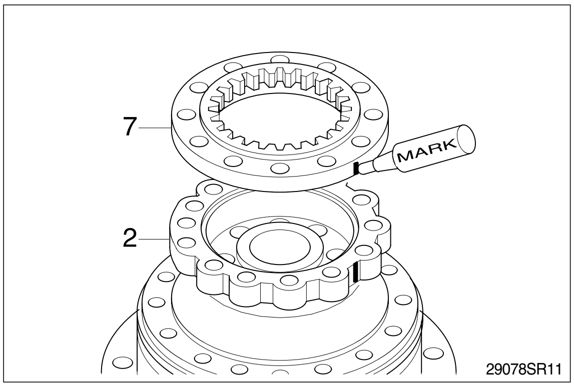


(7) Remove sun gear2(6) and then remove stop ring(33) when needed.

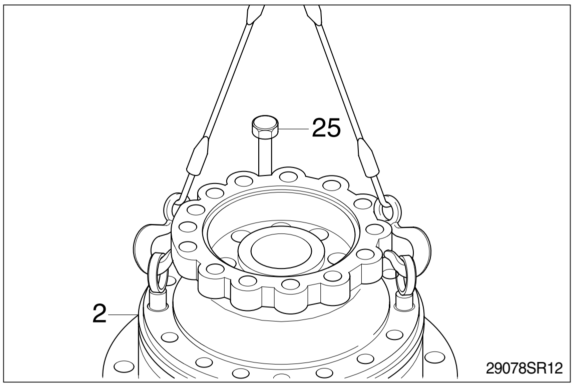


(8) Remove ring gear(7) from middle casing (2).

※ Put matching mark for easy reassembly.

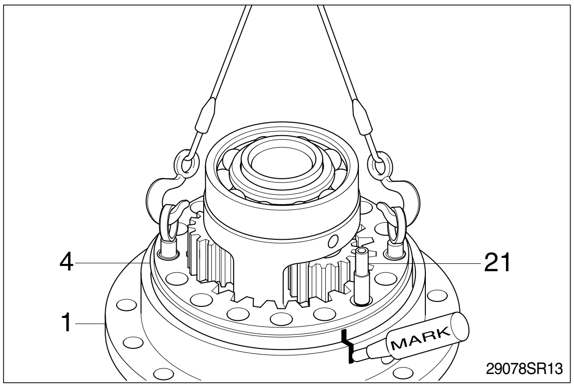


(9) Loosen the socket bolt(25) and tighten 2 M18 eye bolts to middle casing(2) and then lift up and remove middle casing(2).

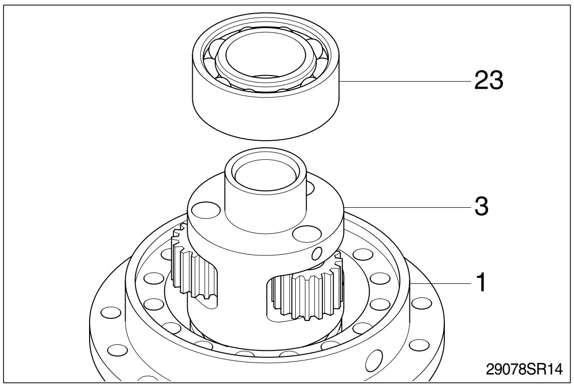


(10) Remove knock pin(21) and then remove ring gear2(4).

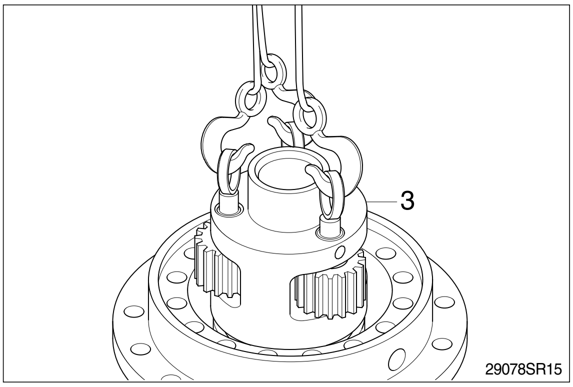
※ Put marks at the knock pin hole and across the matching line between ring gear2(4) and front casing(1) and then remove ring gear2(4) for easy reassembly.



(11) Using the bearing disassembly tool, remove roller bearing(23).



(12) Tighten three M12 eye bolts to drive shaft (3) and remove drive shaft(3) as subassembly.



(13) Disassembling drive shaft assembly.

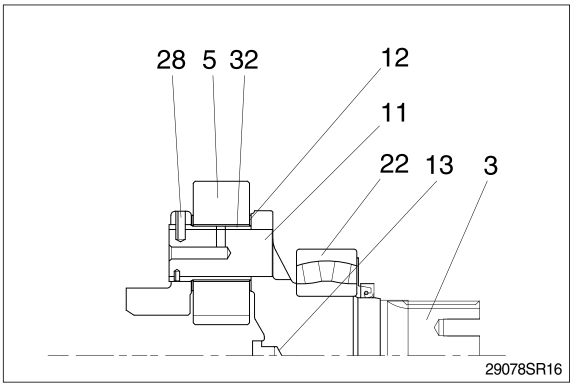
① Insert the spring pin(28) into the pin2(11) by hammering.

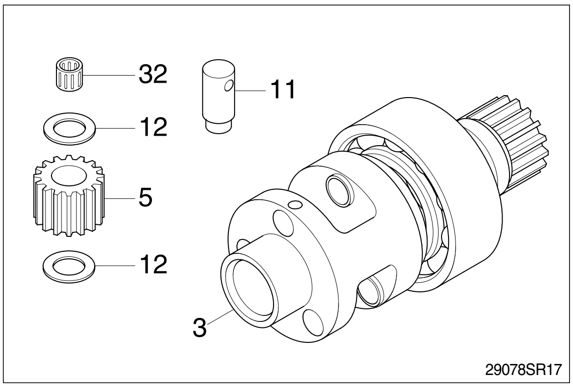
② Remove pin2(11), thrust washer(12), bush2(32) and planet gear2(5) from the drive shaft(3).

※ Do not proceed and but in case of replacement.

※ Thrust button(13) is assembled in the drive shaft(3) and when replacement needed, use M8 trimming screw of 25㎜ depth and remove it.

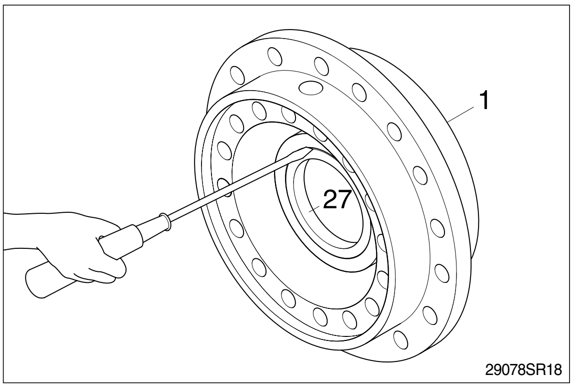
※ Do not remove roller bearing(22). When replacement needed, exchange the roller bearing(22) with drive shaft assembled.





(14) Remove oil seal(27) from the front casing (1).

※ Do not reuse oil seal once removed.



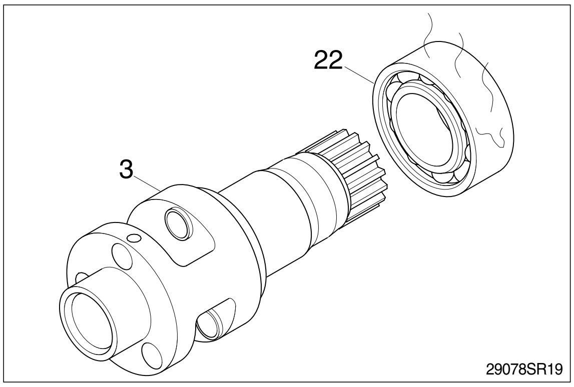
3) ASSEMBLY

(1) Assembling drive shaft assembly.

① Soak the roller bearing(22) in boiled oil (80~100°C) and then take out and install it to the drive shaft(3).

※ Confirm assembly coincidence.

② Put pinion shaft of drive shaft(3) downwards.

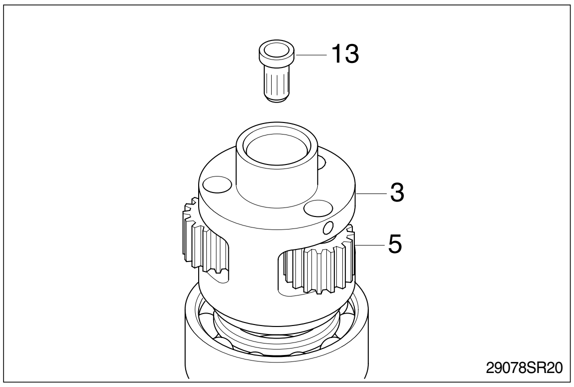


③ Assemble thrust button(13) into the drive shaft(3) hole.

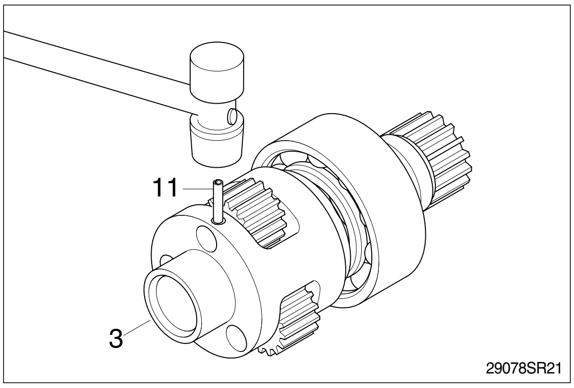
※ Depth from the drive shaft(3) outer section to the thrust button(13) is 135mm.

※ Take care not to damage oil seal.

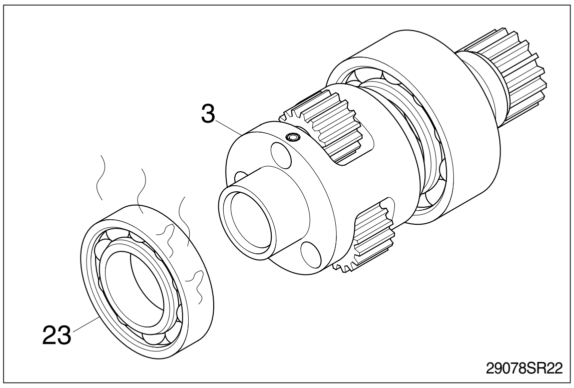
④ Assemble bush2(32) and two thrust washers(12) to the planet gear2(5) and then install them to the drive shaft(3).



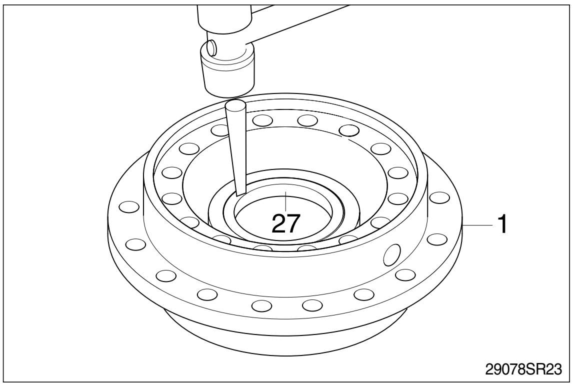
⑤ Assemble pin2(11) to the drive shaft(3) and then press the spring pin(28) into the pin2(11) by hammering.



⑥ Heat the roller bearing(23) in the boiled oil and the take out and assemble it to the drive shaft(3).



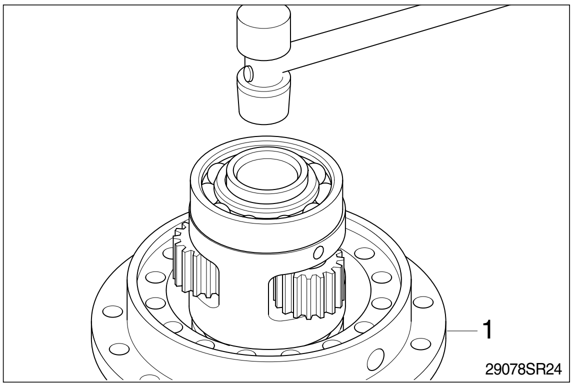
(2) Fit oil seal(27) to the inside of front casing (1).



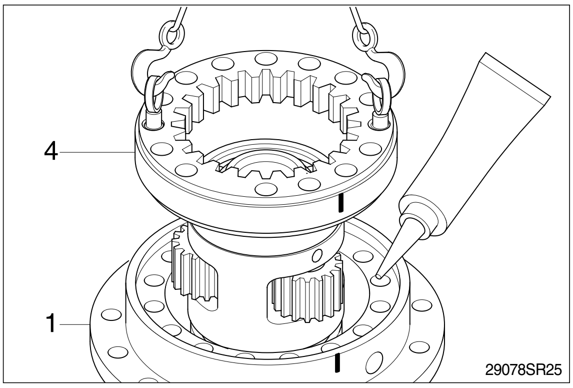
(3) Mount drive shaft assembly to the front casing(1).

※ Take care not to damage oil seal(27).

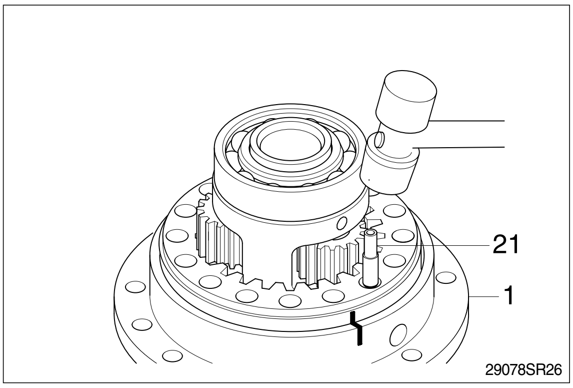
※ Assemble drive shaft straightly to the front casing(1).



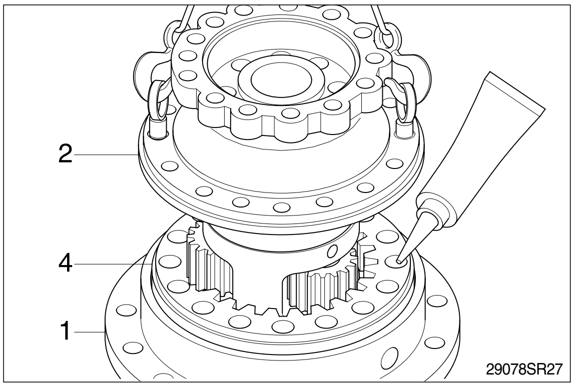
(4) Apply loctite to the front casing(1) and then coincide the matching mark and assemble ring gear2(4).



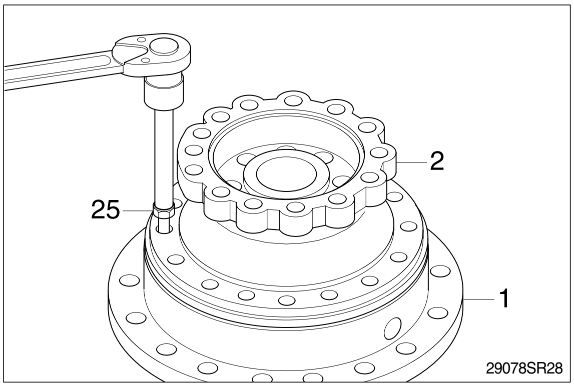
(5) Hammer 4 knock pins(21) around the front casing(1).



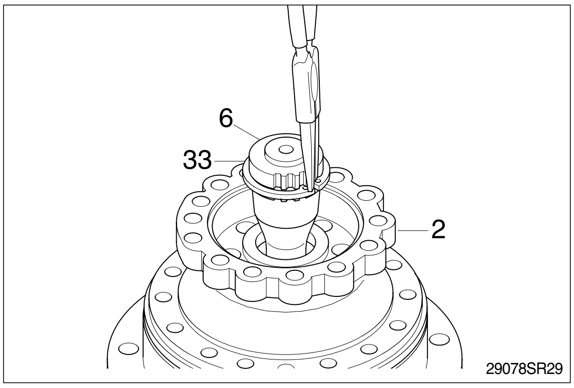
(6) Apply loctite to the ring gear2(4) and then mount middle casing(2) on the front casing(1).



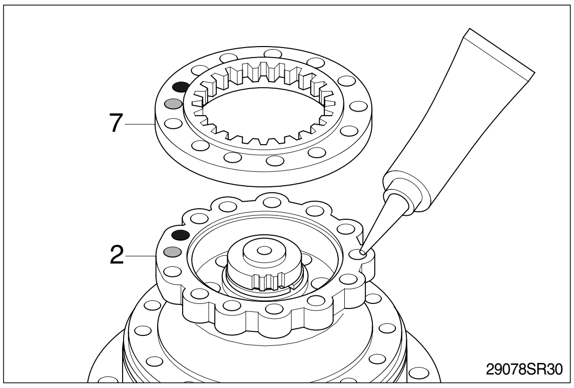
(7) Tighten socket bolts(25) around the middle casing(2).



(8) Assemble stop ring(33) to the sun gear2 (6) and then insert sun gear2(6) into the drive shaft(3).



(9) Apply loctite to the tapped holes of the middle casing(2) and then assemble ring gear1(7).
There is just one tapped hole which has different pitch value.
Don't fail to coincide this hole.



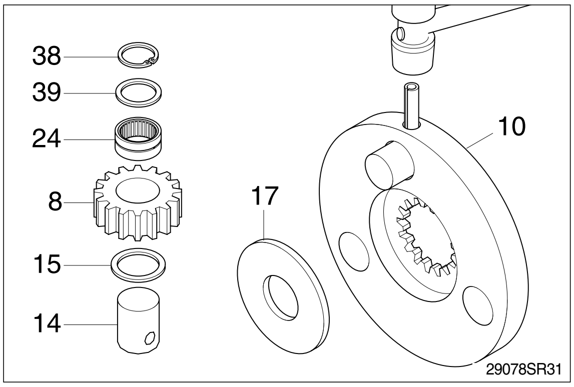
(10) Assembling carrier assembly.

① Assemble the pin1(14) to the carrier(10) and then press the spring pin(30) by hammering.

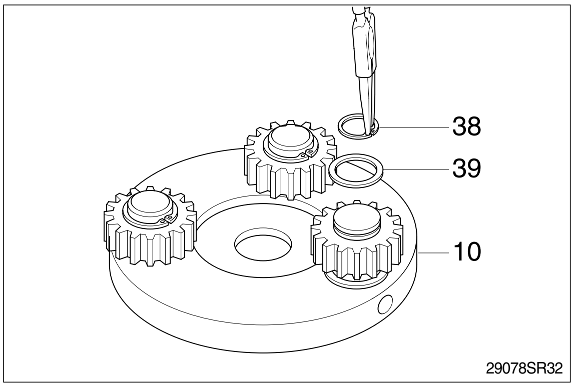
② Punch 2 points of the spring pin(30) lip.

③ Assemble side plate3(17) onto the center of the carrier(10) and then assemble side plate1(15) to the pin1(14).

④ Assemble needle gauge(24) and planet gear1(8) to the pin1(14).

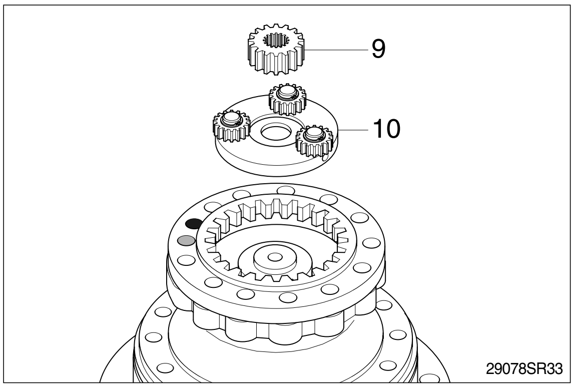


⑤ Install side plate2(39) and stop ring(38) to the pin1(14).

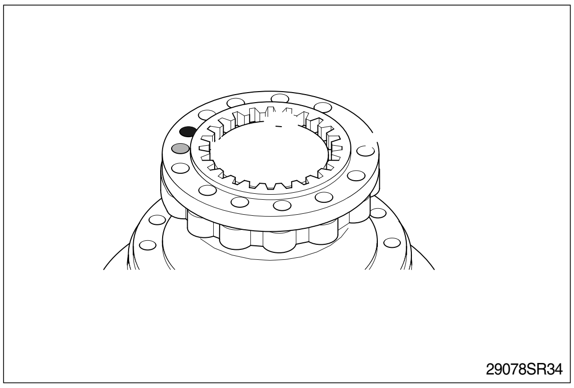


(11) Assemble carrier(10) correctly so that the side plate3(17) can be fixed on the sun gear2(6).

(12) Assemble sun gear1(9) onto the side plate 3(17).



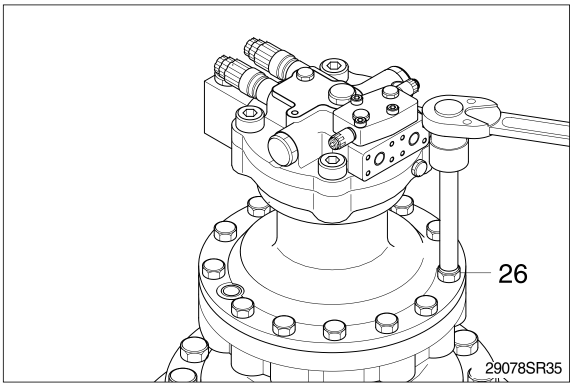
(13) Assemble stop ring(31) to the drive shaft of the swing motor.



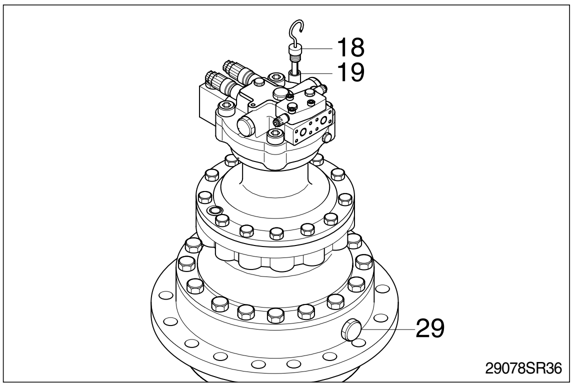
(14) Apply loctite to the tapped holes of the ring gear1(17) and then mount swing motor.

※ Don't fail to coincide the gauge bar hole. Tighten socket bolts(26) around the swing motor.

· Tightening torque : 34kgf · m(246lbf · ft)



(15) Assemble pressure plug(29), gauge bar(18) and gauge pipe(19).



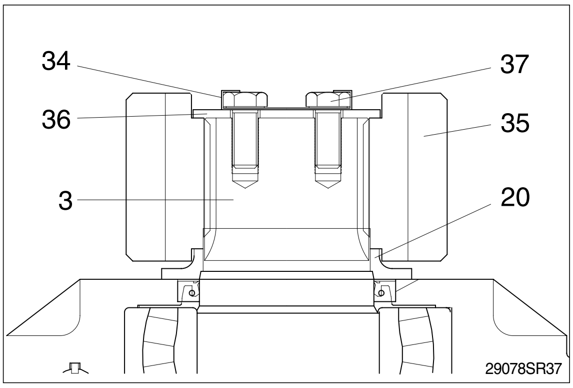
(16) Turn the swing motor assembly upside down and install spacer ring(20) and pinion gear(35) to drive shaft(3) end.

Assemble lock plate(36) on the pinion gear(35).

Assemble 2 lock washers(34) on the lock plate(36) with their 2 holes coincided individually.

Tighten hexagon bolts(37) to the drive shaft(3) and then fold all the lock washer (34) corners over the hexagon bolts(37).

· Tightening torque : 24kgf · m(173lbf · ft)



(17) 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.

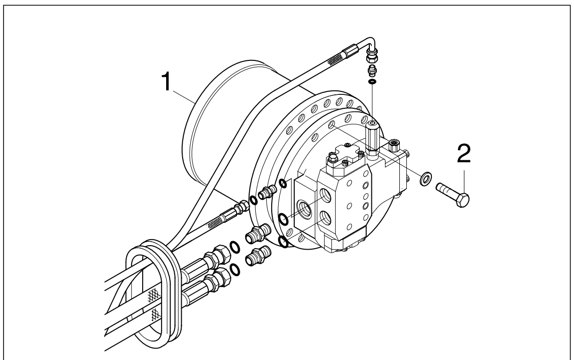
※ Fit blind plugs to the disconnected hoses.

(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 : 305kg(670lb)

13031GE18



29078TM01

2) INSTALL

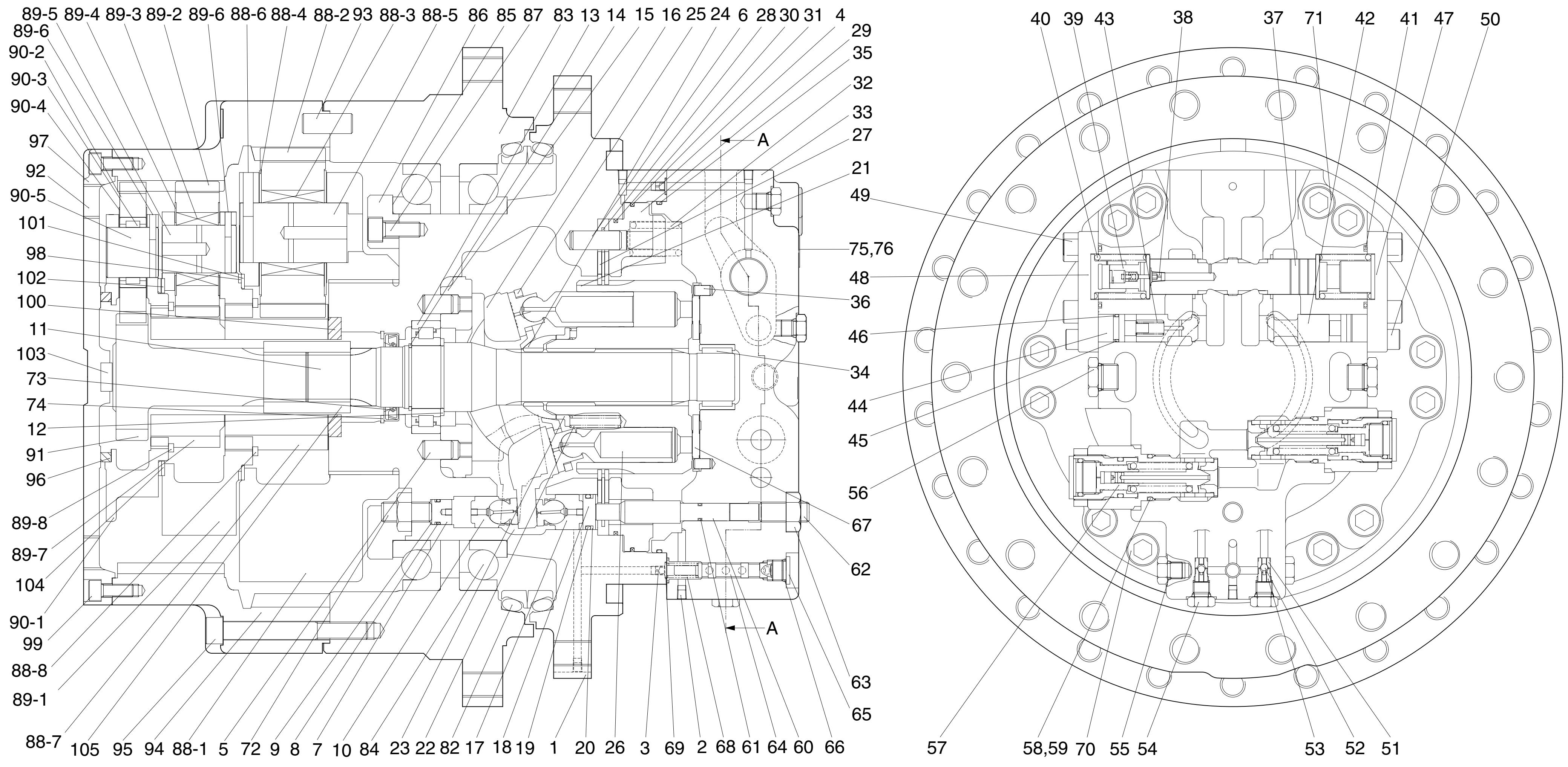
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

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

2. TRAVEL MOTOR

1) STRUCTURE



SECTION A-A

2907A2TM01

1	Casing	16	Plate	31	Ring	46	Back up ring	61	O-ring	83	Housing	89-1	Carrier No.2	92	Plug
2	Plug	17	Piston	32	Spring	47	Cap	62	Lock screw	84	Bearing	89-2	Planetary gear No.2	93	Lock pin
3	Screw	18	Stopper	33	Valve casing	48	Cap	63	Nut	85	Shim	89-3	Needle No.2	94	Ring gear
4	Screw	19	O-ring	34	Needle bearing	49	Bolt	64	Spool	86	Retainer	89-4	Thrust washer No.2	95	Bolt
5	Pin	20	Back up ring	35	O-ring	50	Socket bolt	65	Plug	87	Bolt	89-5	Pin No.2	96	Thrust ring No.1
6	Pin	21	Cylinder block	36	Pin	51	Seat	66	O-ring	88	Carrier No.3	89-6	Spring pin No.2	97	Cover
7	Stopper	22	Cylinder spring	37	Spool	52	Steel ball	67	Valve plate	88-1	Carrier No.3	89-7	Sun gear No.2	98	Thrust ring No.2
8	O-ring	23	Spacer	38	Screw	53	Stopper	68	Spring	88-2	Planetary gear No.3	89-8	Snap ring No.2	99	Bolt
9	Back up ring	24	Guide	39	Damping check	54	Plug	69	O-ring	88-3	Needle No.3	90	Carrier No.1	100	Motor ring
10	Piston	25	Plate	40	Spring	55	O-ring	70	Socket bolt	88-4	Thrust washer No.3	90-1	Carrier No.1	101	Thrust ring No.3
11	Shaft	26	Piston & Shoe assy	41	O-ring	56	Plug	71	Socket bolt	88-5	Pin No.3	90-2	Planetary gear No.1	102	Thrust ring No.1
12	Spacer	27	Plate	42	Plunger	57	Relief valve	72	Lock screw	88-6	Spring pin No.3	90-3	Needle bearing No.1	103	Pad
13	Roller bearing	28	Plate	43	Spring	58	O-ring	73	Oil seal	88-7	Sun gear No.3	90-4	Thrust washer No.1	104	Thrust ring No.2
14	Stop ring	29	Brake	44	Stopper	59	Back up ring	74	Lock ring	88-8	Snap ring No.3	90-5	Pin No.1	105	Coupling
15	Support	30	Ring	45	O-ring	60	Rod	82	Floating Seal	89	Carrier No.2	91	Sun gear No.1		

2) TOOL AND TIGHTENING TORQUE

(1) Tools

Name of tools	B-size	Name of part applied
Hexagonal L-Wrench	4	Plug(2), Orifice screw(3, 4, 38)
	8	Hex socket bolt(50), Lock screw(62, 72), Plug(65)
	10	Hex socket bolt(49)
	46	Hex(57)
Socket wrench/spanner	19	Hp plug(54)
	24	Hex nut(63)
	27	Hp plug(56)
Snap-ring plier(for holes, axis)		Ring stop(14), Ring lock(74)
Solder hammer		Needle bearing(34), Pin(5, 6, 36)
Torque wrench		Size : 500, 3000
Jig for assembling oil seal		Oil seal(73)
Induction heating apparatus for bearing		Roller bearing(13)

(2) Tightening torque

NO.	Part name	Standard	Size	Torque	
				kgf · m	lbf · ft
2	Plug	NPTF 1/16	4	0.9±0.2	6.51±1.45
3, 4, 38	Orifice screw	NPTF 1/16	4	0.7	5.06
49	Hex socket bolt	M12	10	10	72.33
50	Hex socket bolt	M10	8	6.7	48.46
54	Plug	PF 1/4	19	3.7	26.76
56	Plug	PF 1/2	27	11	79.56
57	Relief valve	HEX 46	46	18±1.0	130±7.0
63	Nut	M16	24	24	173.59
65	Plug	PF 3/8	8	7.5	54.25
70, 72	Hex socket bolt	M16	14	24	173.59
71	Hex socket bolt	M16	14	24	173.59

2. DISASSEMBLING

1) GENERAL INSTRUCTIONS

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

(3) Before disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

⚠ **Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.**

2) DISASSEMBLEING TRAVEL MOTOR

(1) Fix a hydraulic motor on jig with four pieces of bolts(M16×60L).

※ When rotating jig up to 90° in disassembling and assembling, fix a motor making drain plug(56) faced to the bottom.

300072TM20

(2) After disassembling drain plug(56), let an oil in a case of a motor discharged.

※ Check whether manufactured chips or metal dust are added in a drain oil.

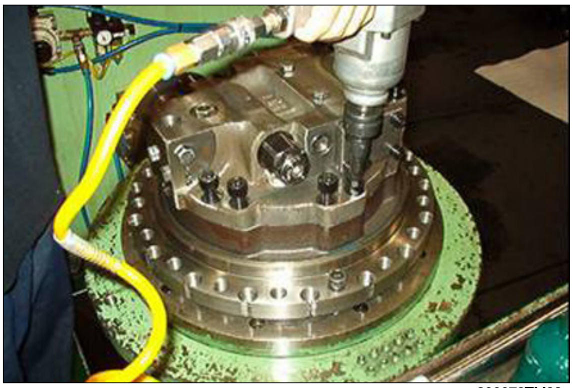
300072TM21

300072TM21A

(3) In order to making the out-put axis of a hydraulic motor faced upward, disassemble ring lock(74) with a plier after rotating jig up to 90° in disassembling and assembling.

300072TM22

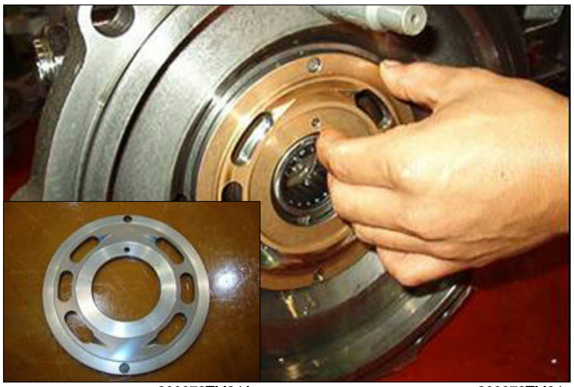
(4) Disassemble hexgon socket bolts(70, 71) holding valve casing.



300072TM23

(5) After detaching valve casing sub, disassemble valve plate(67).

※ In case of serious abrasion of valve plate, exchange it to a new one.



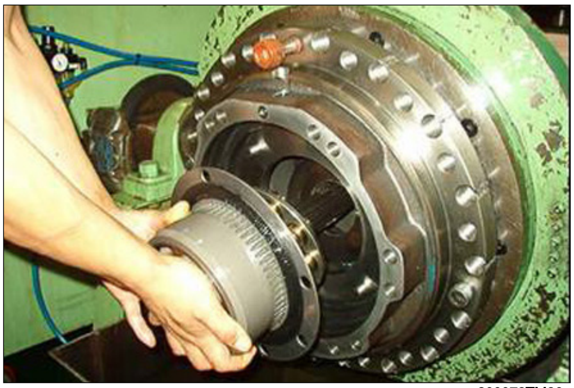
300072TM24A 300072TM24

(6) After taking brake spring(32) and then bonding two pieces of M16 bolts to brake piston(29), disassemble it pulling it upward.

※ There are 10 pieces of brake spring.

300072TM25
300072TM25A
300072TM25B

(7) First, rotate jig in disassembling and assembling up to 90˚, then let a motor faced toward the horizon. then disassemble a cylinder and piston sub.



300072TM26

(8) disassemble stopper L(18) and piston swash(17).

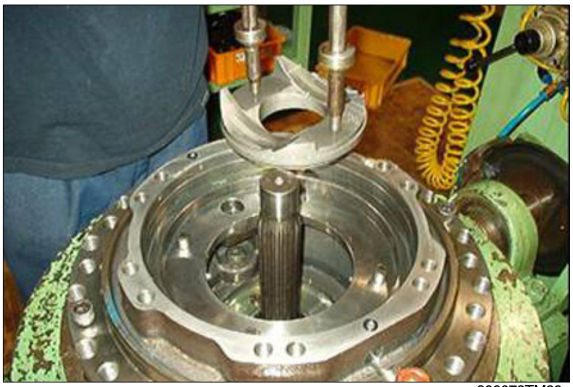
※ Piston swash : Use M5 bolt

300072TM27

(9) Disassemble swash plate(16).

300072TM28

(10) After put M12 into support(15), disassemble support.



300072TM29

(11) disassemble piston swash(10) and stopper(7).

300072TM30

(12) In order to making the turning axis(11) faced upward, put it way from shaft casing tapping the bottom of the turning axis with hammer, after rotating jig up to 90° in disassembling and assembling.

※ Try to deal with roller bearing(13) without any damage.

300072TM31

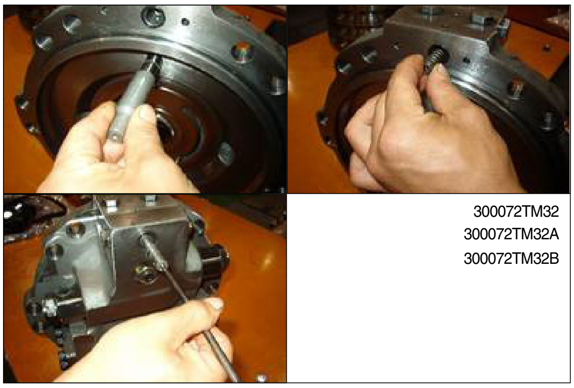
(13) Disassemble valve casing sub.

※ Try to deal with needle bearing(3) without any damage.

① Disassemble plowing road(60), automatic changeover spring(68), and automatic changeover spool(64).

※ Do not touch hexagon nut(63) for controlling the amount of an oil and lock screw(62).

If there is any abnormality on plowing spool and spring, exchange them to new ones.



300072TM32
300072TM32A
300072TM32B

② After unloading hexagon socket bolts(49, 50) and taking caps(47,48) away, disassemble parts of counter balance valve(37~46).

※ In disassembling counter balance valve, be careful of figuring out the directions such as the right or the left of finger.

If there is any abnormality in spool spring check, exchange it to new one.

300072TM33
300072TM33A
300072TM33B
300072TM33C
300072TM33D

(14) Disassemble cylinder sub.

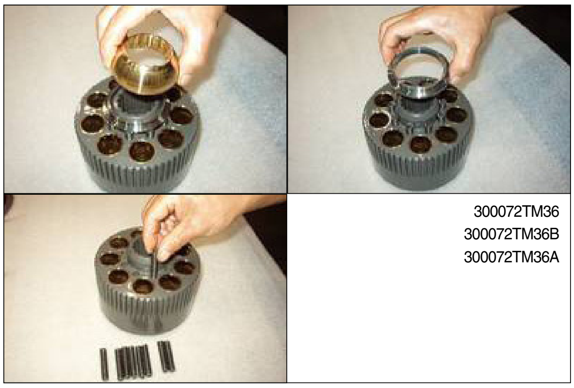
① Disassemble set plate(25) and piston(26) sub.

300072TM34

② Disassemble friction plate(27) and lee plate(28) in cylinder block(21).

300072TM35

③ Dismantle ball guide(24), spacer(23), and cylinder spring(22).



300072TM36
300072TM36B
300072TM36A

3) ASSEMBLING TRAVEL MOTOR

(1) Assemble the sub of a turning axis.

① After assembling bearing spacer(12) into a turning axis(11), have cylinder roller bearing(13) thermal-reacted.

a. In the thermal reaction of cylinder roller bearing, use and induction heating apparatus and adjust the temperature as about 100℃.

b. Deal moisturized copper part oil seal in a turning axis without any damage of it.

300072TM51
300072TM51A
300072TM51B

(2) Assemble ring stop(14) with a plier.

※ Be careful of the direction of ring stop. (The direction of round is the side of bearing)

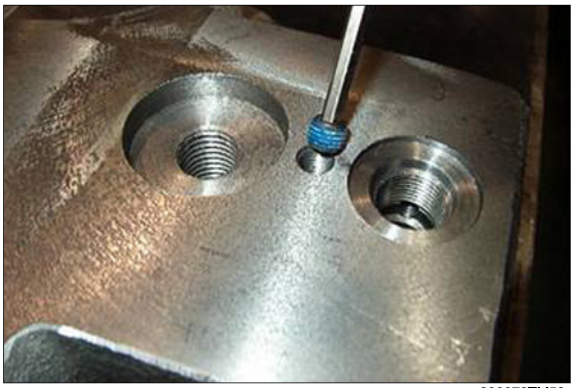
300072TM52

(3) Assemble valve casing sub.

① Bond seven pieces of plug(2) in valve casing(33) with standard torque.

② After taping plug with seal taper and spread rock tight, assemble it.

· Tightening torque : 7~11kgf · m (50.63~79.5lbf · ft)



300072TM53

(4) Compress pin(36) into.

※ Using a hammer, make the height of pin 5mm from the a contact surface of valve plate.

300072TM54

(5) Assemble needle bearing(34).

300072TM55

(6) Assemble seat(51), ball(52), stopper(53), and hp plug(54) with O-ring(55), respectively.

① Be careful of the procedure and direction of assembling seat and stopper.

· Tightening torque : 37kgf · m (267.6lbf · ft)

300072TM56

300072TM56A

(7) Assemble hp plug(54) set up with O-ring(55).

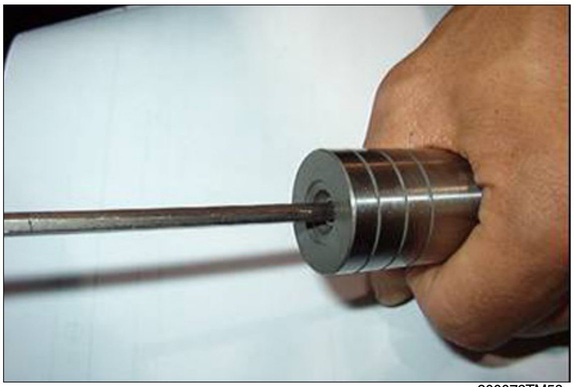
· 5sites

· Tightening torque : 37kgf · m (267.6lbf · ft)

300072TM57

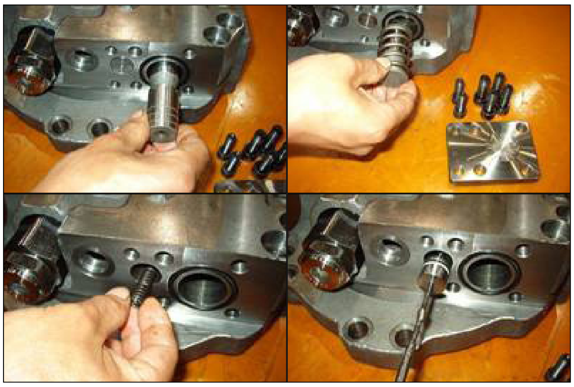
(8) Bond orifice screw(38) on the right and left side of spool c.b(37) with a standard torque.

· Tightening torque : 7kgf · m (50.63lbf · ft)



300072TM58

(9) Insert hold spool c.b(37) and damper check(39) into valve casing.



300072TM59 300072TM59A
300072TM59B 300072TM59C

(10)Bond cap R(47) and cap L(48) with hexagon socket bolts(49, 50).

① Remember not to exchange cap R, L each other in assembling.
Tightening torque
· M12 : 100kgf · m (item 49)
· M10 : 67kgf · m (item 50)

300072TM60

(11)After fastening with torque, insert automatic plowing spool(04), spring(68) and O-ring(69).

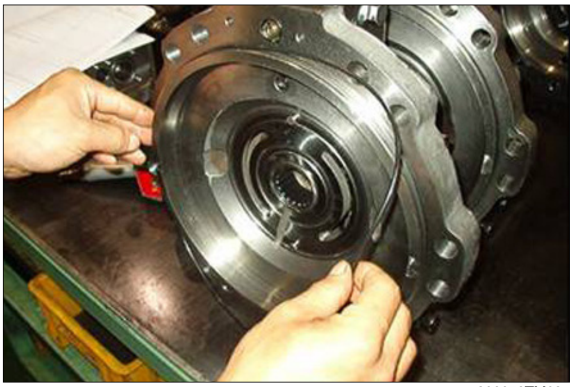
· Tightening torque : 75kgf · m (542.4lbf · ft)

300072TM61 300072TM61A

(12)Assemble swash road(60) inserted by O-ring(61).

300072TM62

(13)Insert O-ring(32) into valve casing.



300072TM63

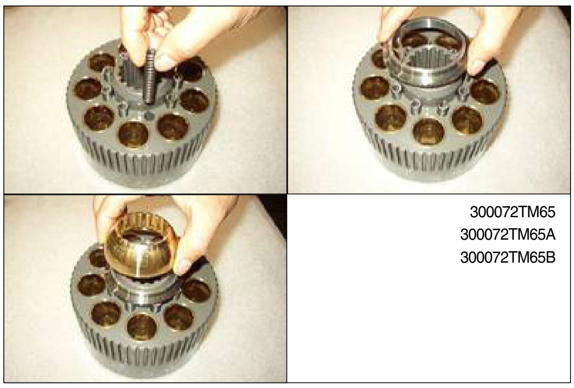
(14)Bond drain plug(30) inserted by O-ring(31) with standard torque.

· Tightening torque : 100kgf · m (723.3lbf · ft)

300072TM64

(15)Assemble cylinder sub.

① Assemble cylinder spring(22), spacer (23), and spherical surface bush(24) into cylinder(21).
Set the position of spline of spherical surface bush and cylinder.



300072TM65
300072TM65A
300072TM65B

(16)Assemble friction plate(27) and separated plate(28) into cylinder.


300072TM66

(17)After insert piston shoe(26) into set plate(25), assemble it into cylinder.


300072TM67


300072TM67A

(18)Using jig, compress oil seal(73) into shaft casing(01).


300072TM68

(19)Assemble the body of a motor.

① Bond seven piece of plug(02) in shaft casing plug with standard torque.

a. After taping plug with seal taper and spread rock tight, assemble it.

· Tightening torque : 7~11kgf · m (50.63~79.5lbf · ft)


300072TM69


300072TM69A

(20) Using a hammer and a handle, compress pin(5, 6).

① Pin(5) : Set the height as 10mm from the contact surface of a plate supporter. - 2pieces.

Pin(6) : Set the height as 19mm from the manufactured surface of shaft casing. - 4pieces.

300072TM70

300072TM70A

(21) Assemble sub of a turning axis.

300072TM71

(22) Assemble plate supporter(15) with M12 bolt.

※ Be careful of the direction of plate supporter driven.

300072TM72

(23) Assemble plate(16) into plate supporter.

① Spread grease in moisturized copper part of plate.

② Confirm the soft movement of plate.

300072TM73

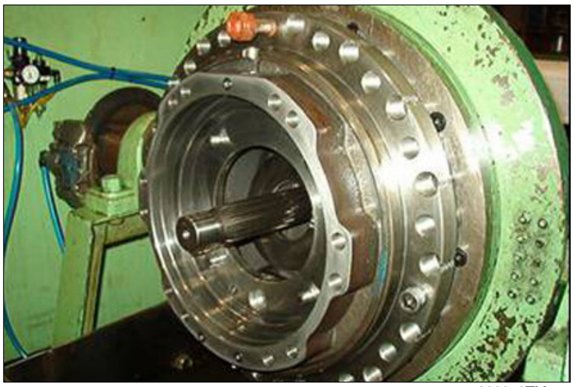
(24) Assemble stopper L(36) combined by plowing piston(35) and O-ring(42).

300072TM74

300072TM74A

(25) Rotating dismantling and assembling jig up to 90˚ make shaft from perpendicular to horizontal.

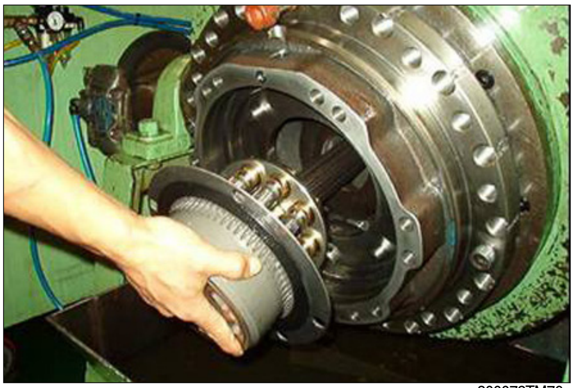
※ Be careful that plate is not segregated from plate supporter.



300072TM75

(26) Assemble cylinder sub.

※ Adjusting pin into holes of separated plate, assemble it.



300072TM76

(27) Rotating dismantling and assembling jig up to 90˚, make the direction of shaft from the horizon to the perpendicular.

300072TM77

(28)Assemble piston ring(30), piston ring 252(30) and 278(31) into brake piston(29).


300072TM78

(29)Assemble brake piston into shaft casing.

※ Be careful of the direction of assembling brake piston.


300072TM79

(30)Assemble brake spring(32).

※ Quantity : Spring-10pieces, Holes-11pieces

※ Do not assemble on the top of brake piston.


300072TM80

(31)Insert O-ring(69), after fastening orifice screw(4) with standard torque.

· Quantity and size : (4)2 pieces- ø 1.0
(56)1pieces- ø 1.5

· Tightening torque : 7kgf · m (50.63lbf · ft)


300072TM81

(32)After inserting valve plate(67) into valve casing, bond it into shaft casing with hexagon socket bolt(70).

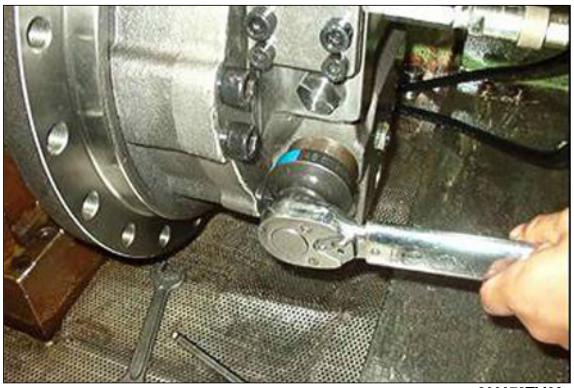
① Spread grease on the back side of valve plate, in order for valve plate to be adhered well.
② Use a crane in assembling it into valve plate shaft casing.
③ Set holes, ø5, of valve plate heading toward the port of the inlet and outlet of valve casing.
④ Spread grease in the side of plowing spool of plowing spring in order that plowing spring can not be detached.

· Tightening torque : 240kgf · m (1736lbf · ft)

· Tightening torque : 180±10kgf · m (1302±72.3lbf · ft)

300072TM82

(33)Bond relief valve(57) with standard torque.



300072TM83

(34)Unloosen four pieces of bolts(M20×50L) fixing a motor and remove the motor away from jig.

300072TM84

3. 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.

300078RD01

2) Setting reduction unit(or whole propelling unit) on work stand for disassembling

(1) Remove hexagon socket head bolts(M10, 19) at 3 places from cover(17) almost equally each other, and then install eye bolts(M10).

Lift up the unit using them and place it on work stand with cover upward.

※ Take great care not th pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

3) Removing cover

(1) Remove the rest of hexagon socket head bolts(M10, 19) that secure ring gear.

Loosen all the socket bolts and then, disassemble cover.

(2) As the cover(17) is adhered to ring gear(14), dissemble ring gear(14) and cover(17) by lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.

4) Removing NO.1 carrier sub assy

(1) Remove No.1 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.

300078RD02

(2) Screw three eye bolt(M10, 15) in No.1 carrier and lift up and remove No.1 carrier assy.

300078RD03

5) Removing No. 2 carrier sub assy

(1) Remove No.2 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.2 sun gear.

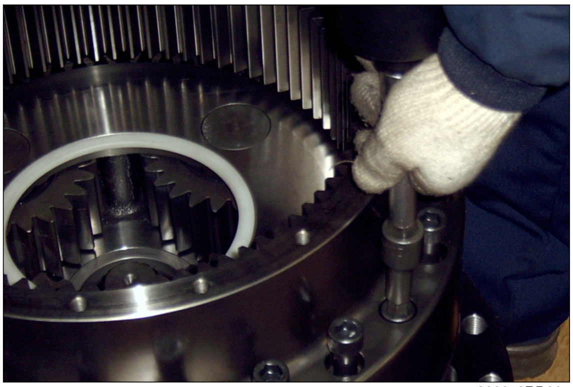
300078RD04

(2) Screw three M10 eye bolt in No.2 carrier and lift up and remove No.2 carrier assy.

300078RD05

6) Removing ring gear

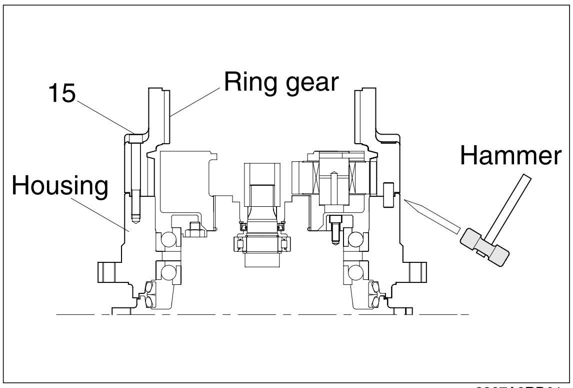
(1) Remove hexagon socket head bolts(M14, 15) that secure ring gear and housing.



300078RD06

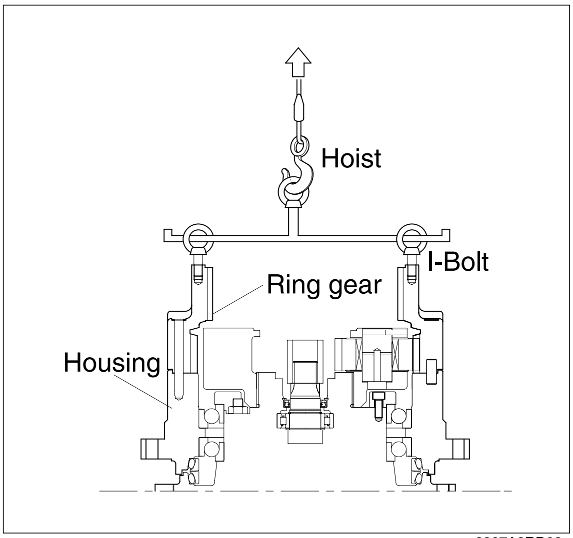
(2) As the ring gear(14) is adhered to housing(3), disassemble ring gear(14) and housing(3) by lightly hammering slantwise upward using sharpen punch inserted between the ring gear and housing.

※ Carefully disassembling ring gear not to make scratch on it.



2907A8RD01

(3) Screw three eye bolt(M10) in ring gear and lift up and remove it.



2907A8RD02

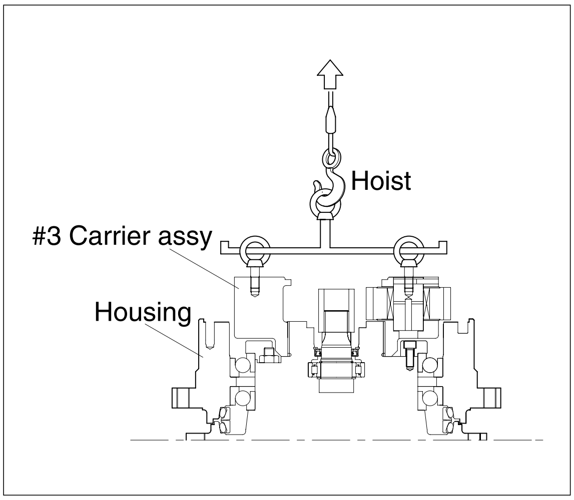
7) Remove No.3 carrier sub assy

(1) Removing No.3 sun gear

※ Be sure to maintain it vertical with the ground when disassembling No.3 sun gear.

300078RD09

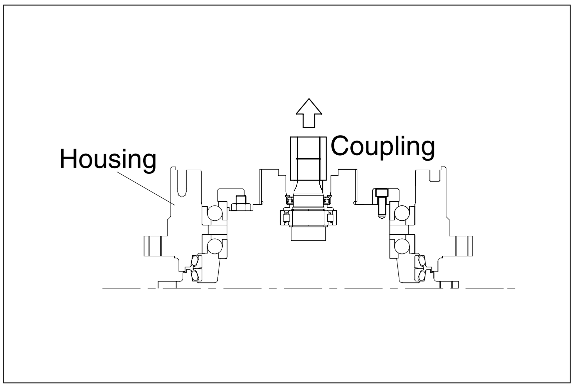
(2) Screw three eye bolt(M10) in No.3 carrier and lift up and remove No.3 carrier assy.



2907A8RD03

8) Remove coupling

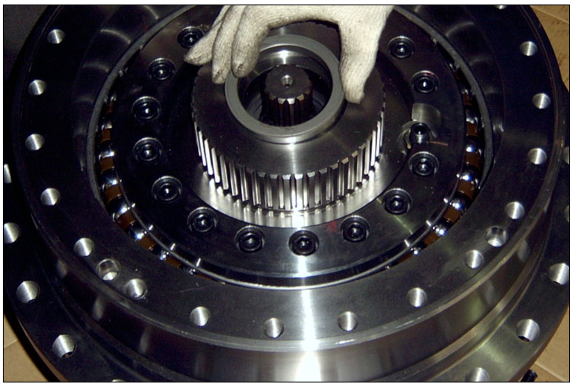
(1) Remove coupling



2907A8RD04

9) Remove motor ring

(1) Remove motor ring using hand.

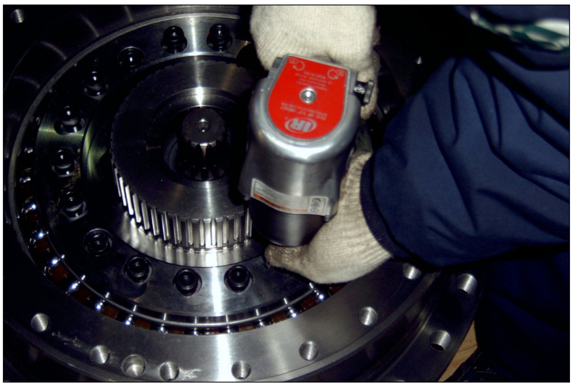


300078RD12

10) Removing retainer & shim

(1) Remove hexagon socket(M12) head bolts that retainer and motor.

(2) Remove retainer & shim.



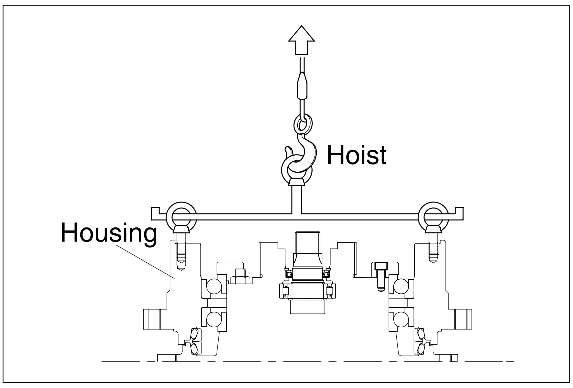
300078RD13

11) Removing housing sub assy

(1) Screw eye bolt(M14) in housing and lift up housing assembly including angular bearing and floating seal.

12) Removing floating seal

(1) Lift up a piece of floating seal of motor side.

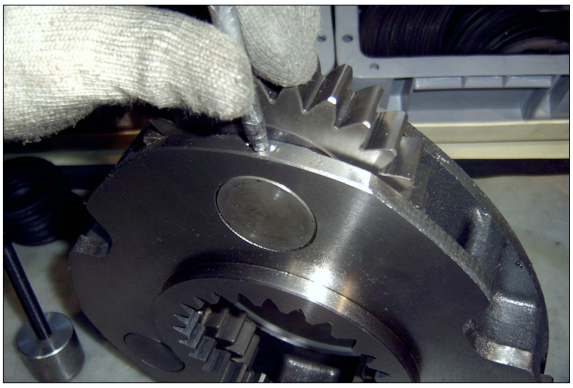


2907A8RD05

13) Dissembling housing assembly

(1) After turning housing, lift up a piece of floating seal from housing and then remove it.

※ Don't disassemble angular bearing.



300078RD15

14) Dissembling No.1 carrier

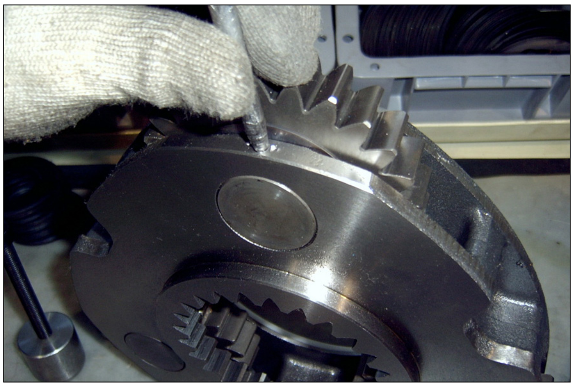
(1) Remove thrust ring(16) from carrier.

(2) Knock spring pin(89-6) fully into No.1 pin(90-5).

(3) Remove planetary, thrust washer, No.1 pin, bearing from carrier.

15) Disassembling No.2,3 carrier

(1) Disassemble(14) carriers, using the same method for No.1 carrier assembly.



300078RD15

6. ASSEMBLING REDUCTION GEAR

- **General precautions**

  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. 242 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 surface or on O-rings.

1) Assembling No.1 carrier

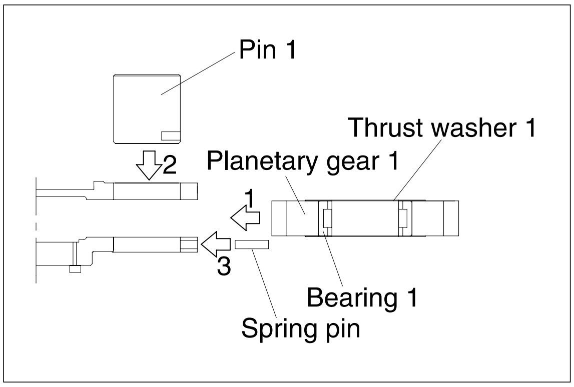
(1) Put No.1 carrier(90-1) on a flat place.

(2) Install No.1 needle bearing(90-3) into No.1 planetary gear(90-2), put 2 ea of No.1 thrust washer(90-4) on both sides of bearing, and then install it into carrier.

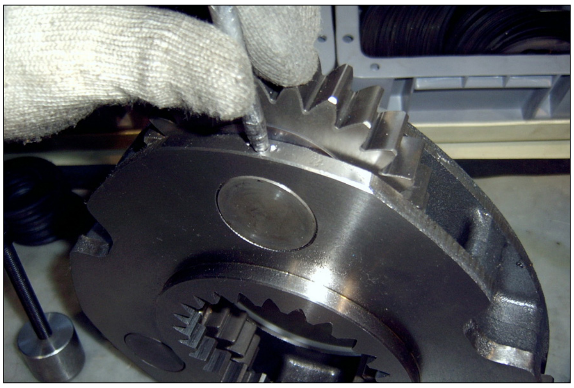
(3) Install No.1 pin(90-5) into No.1 carrier where the holes for No.1 pin(90-5) are to be in line with those of No.1 carrier, and then, install spring pins into the holes.

(4) Caulk carrier holes as shown on the picture.

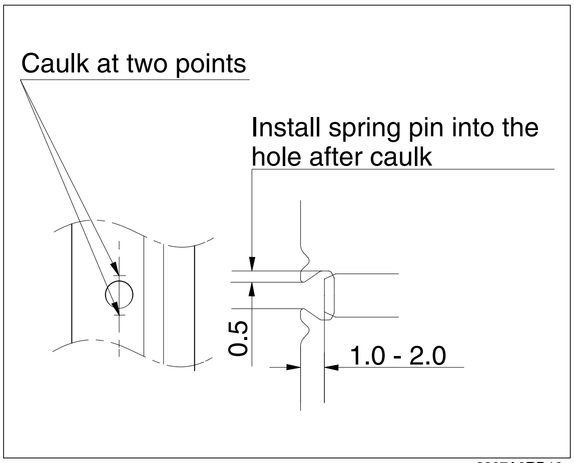
(5) Assembly ring thrust(96) into carrier.



2907A8RD06



300078RD15



2907A8RD19

2) Assembling No.2 carrier

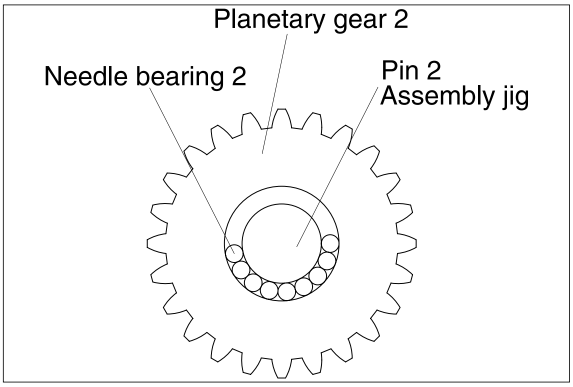
(1) Make No.2 planetary gear(89-2) vertical, assemble 8-9 ea of No.2 needle(89-3), and then, assemble the remaining No.2 needle by use of the assembly jig for No.2 pin(89-5).

(2) Remove out the assembly jig for No.2 pin and assemble 2 ea of No.2 thrust washer(89-4) into No.2 carrier(89-1).

(3) Insert No.2 pin(89-5) into carrier where the holes of No.2 pin(89-5) are in line with those of carrier.

(4) Hammer spring pin(89-6) to insert into carrier hole and No.2 pin hole, and then, caulk. Assemble 2 sets using the same method.

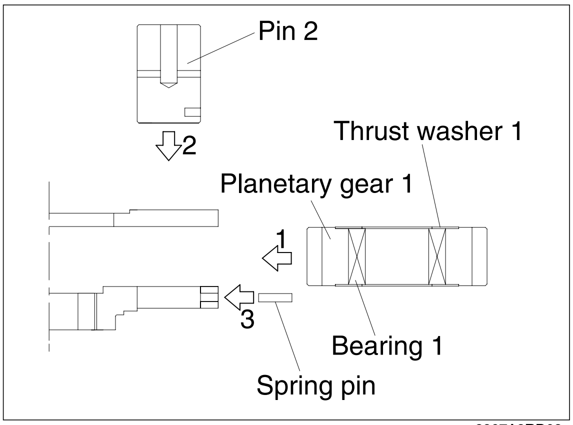
(5) Assemble ring thrust(98) into carrier.



2907A8RD07

3) Assembling No.3 carrier

(1) Assemble 4 sets, using the same method for assembly of No.2 carrier.

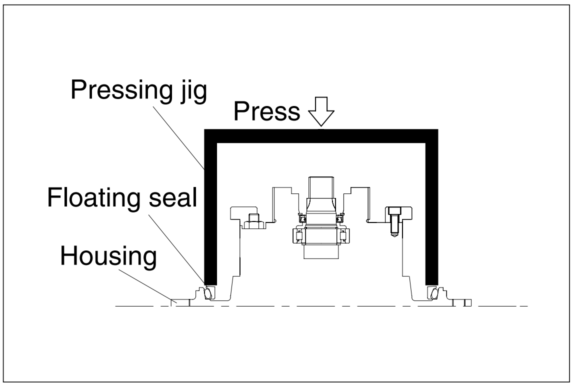


2907A8RD08

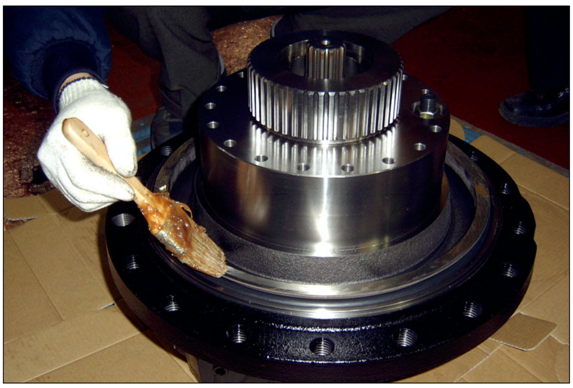
4) Installing floating seal

(1) Assemble floating seal into motor by use of pressing jig.

(2) Grease the contact parts for floating seal which is assembled into motor.



2907A8RD09



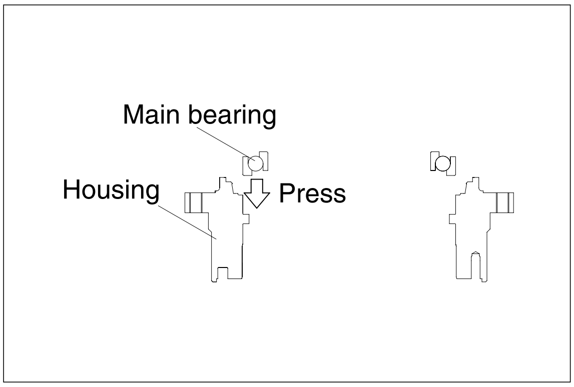
300078RD21

5) Assembling housing

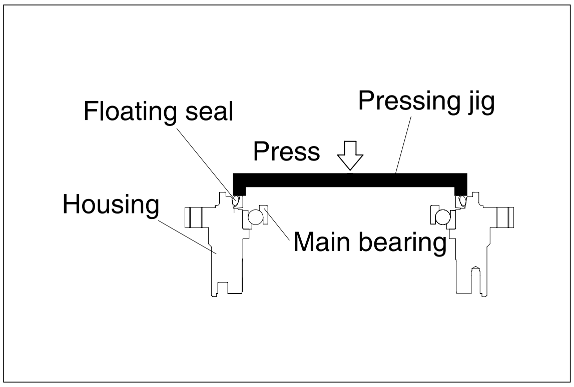
(1) Heat housing at 60~70°C while clearing it out and then, assemble bearing.

(2) Assemble floating seal into housing by use of pressing jig as shown on the picture.

※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.



2907A8RD10



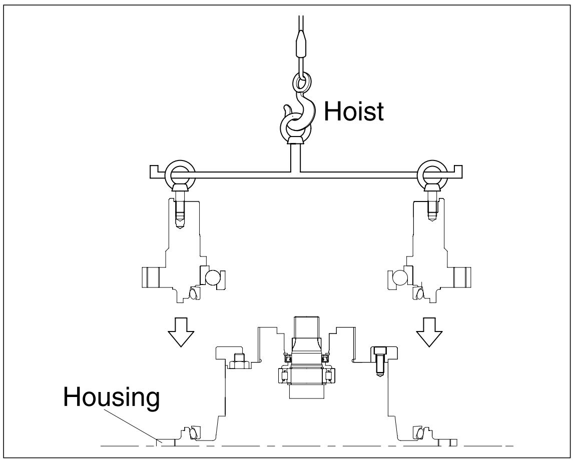
2907A8RD11

6) Installing housing assembly

(1) Install 2 ea of eye bolt(M14) into housing assembly.

(2) Assemble housing into motor by use of hoist and eye bolt.

※ Be sure to tighten eye bolt deep enough.

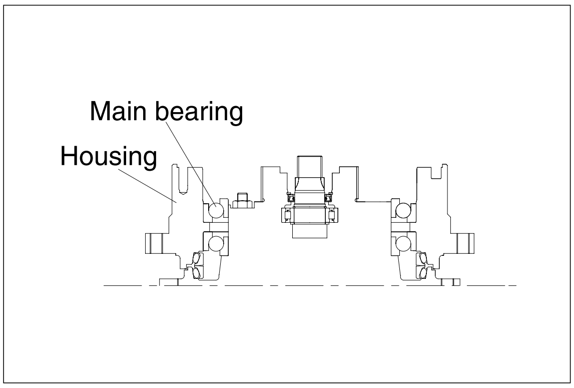


2907A8RD12

7) Installing main bearing

(1) Heat main bearing at 60~70°C and then, install.

※ Be sure to maintain it vertical with the ground when assembling bearing.

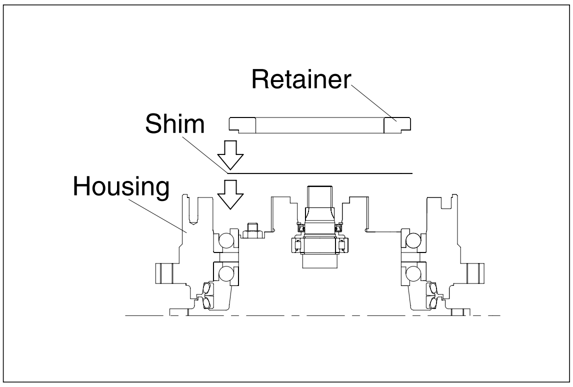


2907A8RD13

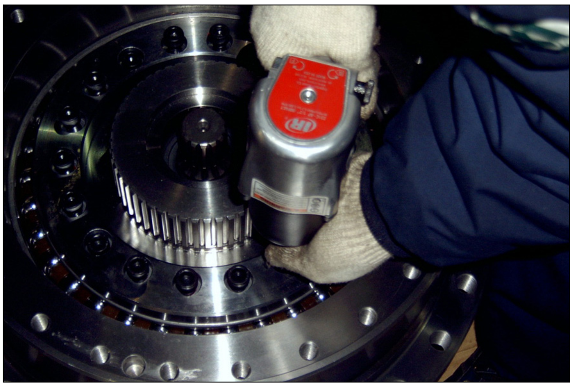
8) Installing retainer(86) and shim(85)

(1) Measure clearance between main bearing and retainer by use of jig to decide the thickness of shim and select and appropriate shim, and then, assemble retainer.

(2) Apply locktite(#242) on hexagon socket head bolt(M12), and then, bolt.



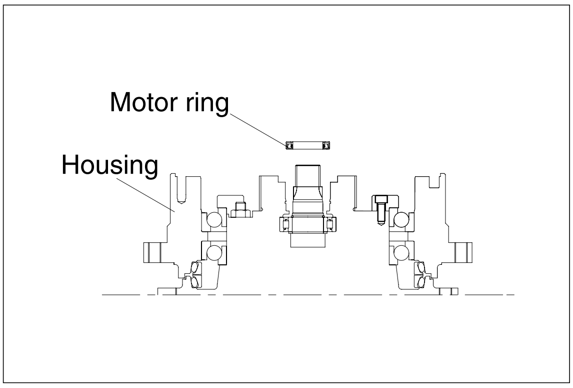
2907A8RD14



300078RD13

9) Installing motor ring

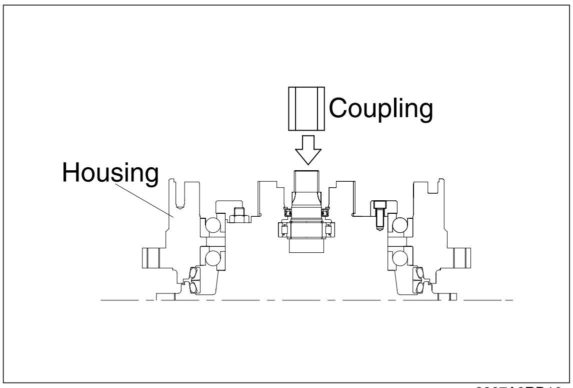
(1) Insert motor ring into motor to install.



2907A8RD15

10) Installing coupling

(1) Install coupling on spline of the motor.



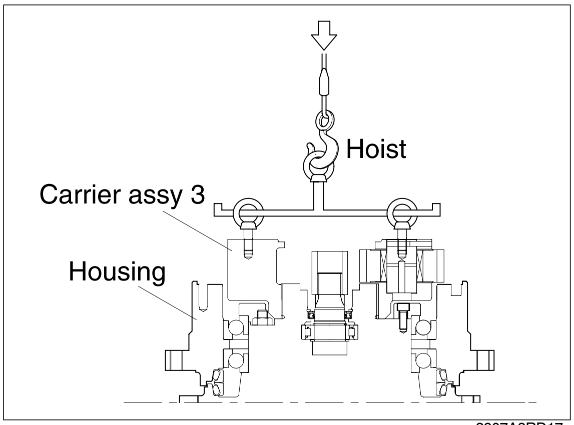
2907A8RD16

11) Installing No.3 carrier sub assy

(1) Install eye bolt(M10) on No.3 carrier assembly.

(2) Lift No.3 carrier assembly and then, assemble it into reducer.

※ Match it vertical with the spline of the motor and the, slowly lower.



2907A8RD17

12) Installing ring gear

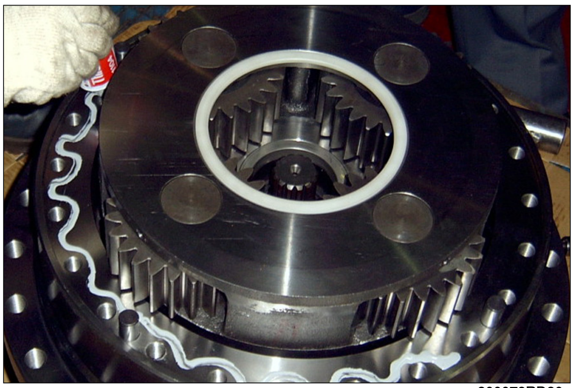
(1) Apply three bond #1104(Locktite #515) on housing for ring gear without gap.

(2) Insert lock pin into housing hole.

(3) Install eye bolt(M12) on the tap for cover of ring gear.

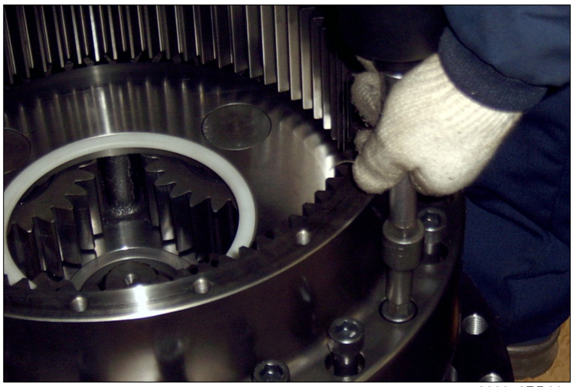
(4) Lift ring gear and then, assemble into housing.

(5) Apply locktite to hexagon socket bolt(M14) and then, bolt, having appropriate torque.



300078RD30

300078RD31

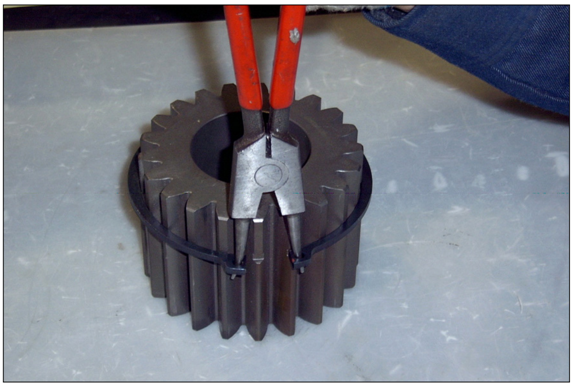


300078RD06

13) Installing No.3 sun gear(88-7)

(1) Install snap ring(88-8) in No.3 sun gear(88-7) by use if snap ring flier.

(2) Install No.3 sun gear on the spline of No.3 carrier, matching teeth of them.



300078RD32

300078RD09

14) Installing No.2 carrier sub assy

(1) Install eye bolt(M10) on No.2 carrier assembly.

(2) Lift No.2 carrier assembly and then, slowly put it down on ring gear.

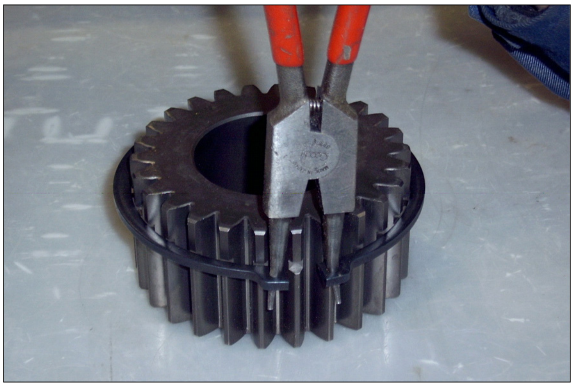
(3) Rotate planetary gear by hands and install in ring gear.

300078RD05

15) Installing No.2 sun gear(89-7)

(1) Install snap ring(89-8) on No.2 sun gear(89-7) by use of snap ring flier.

(2) Install No.2 sun gear on the spline of No.2 carrier and No.2 planetary gear, matching teeth of them.



300078RD33

300078RD04

16) Installing No.1 carrier sub assy

(1) Install eye bolt(M10) on No.1 carrier assembly.

(2) Lift No.1 carrier assembly and then, put it down on ring gear slowly.

(3) Rotate planetary gear by hands to install on ring gear, matching their teeth.

300078RD03

17) Installing No.1 sun gear(91)

(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.

300078RD02

18) Installing cover(97)

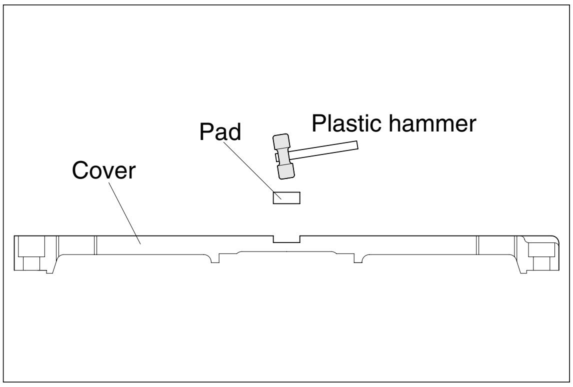
(1) Beat pad with plastic hammer, and press it into the center of cover.

(2) Apply three bond #104(locktite #515) on the ring gear for without gap.

(3) Put cover on ring gear, apply locktite(#242) in hexagon socket head bolt(M10), and then, bolt.

(4) Fill gear oil(8L) into drain port.

(5) Apply sealing tape(teflon) on PT3/4 plug and then, bolt.



2908ARD18

300078RD35

GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

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

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

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

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

(4) Loosen the socket bolt(2).

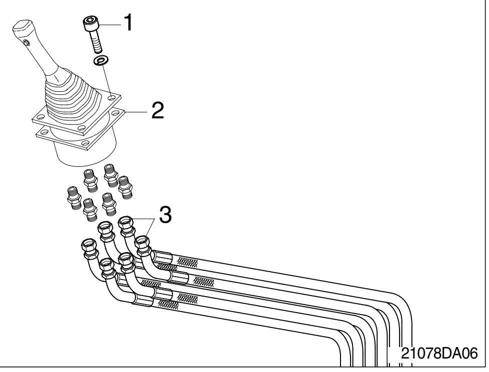
(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses(3).

(7) Remove the pilot valve assembly(1).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.

13031GE18



21078DA06

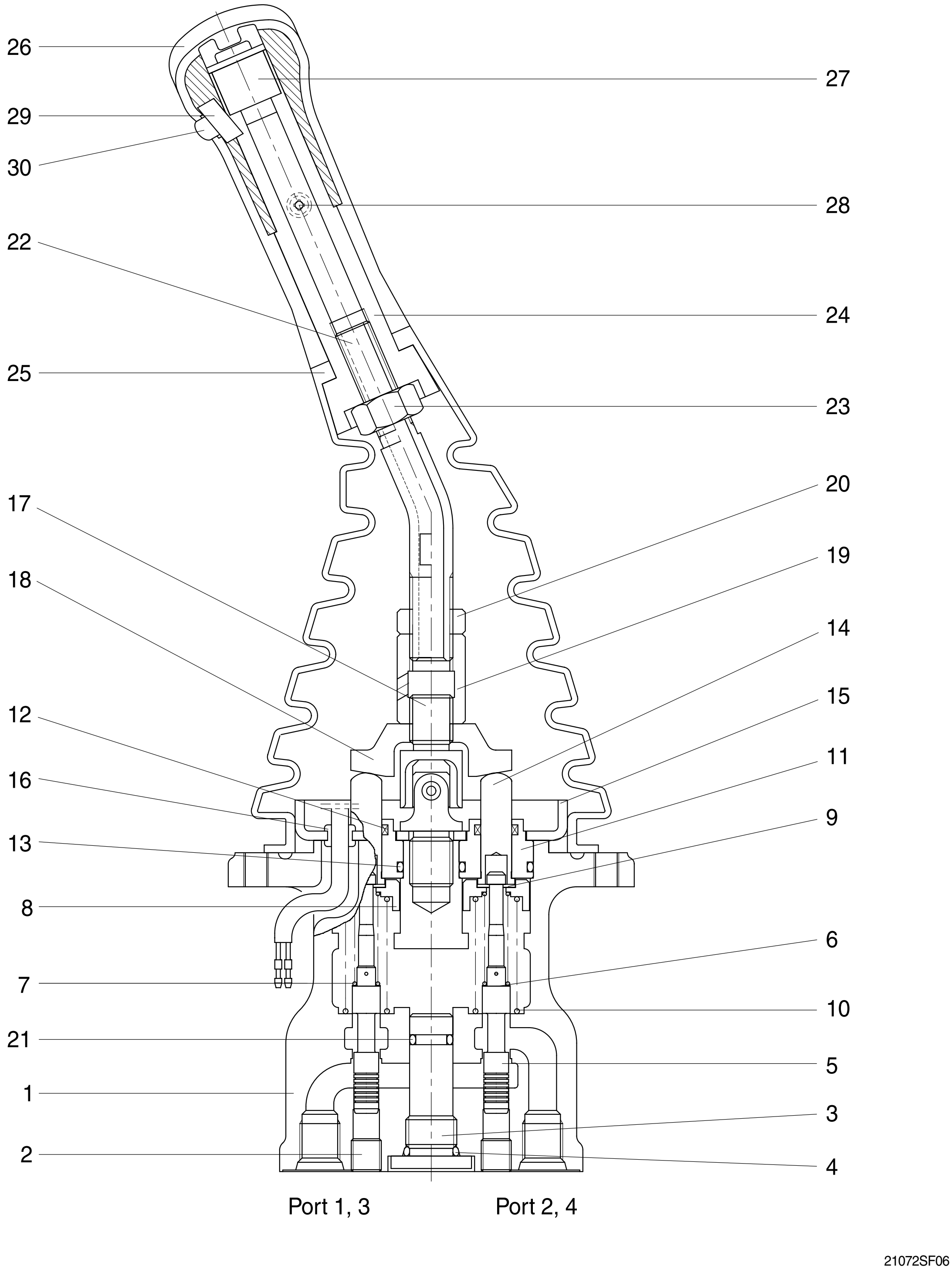
2) INSTALL

(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

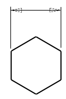
1) STRUCTURE



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

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	17	M14	3.5	25.3
Swash plate	18	M14	5.0±0.35	36.2±2.5
Adjusting nut	19	M14	5.0±0.35	36.2±2.5
Lock nut	20	M14	5.0±0.35	36.2±2.5
Screw	28	M 3	0.05	0.36

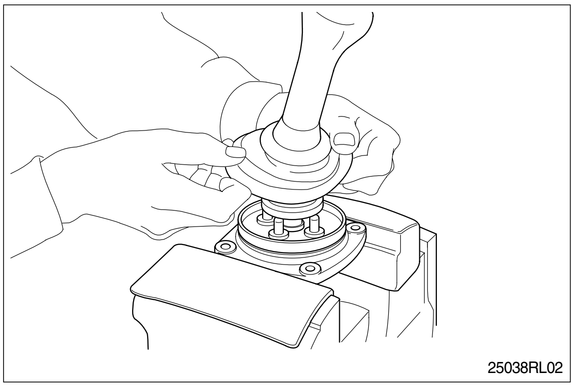
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

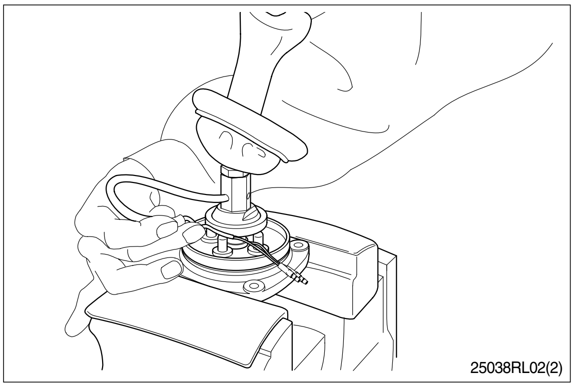
(2) Fix pilot valve in a vise with copper(or lead) sheets.

(3) Remove end of boot(25) from case(1) and take it out upwards.



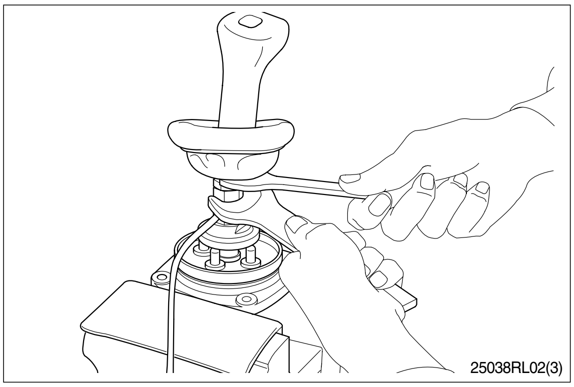
25038RL02

※ For valve with switch, remove cord also through hole of casing.



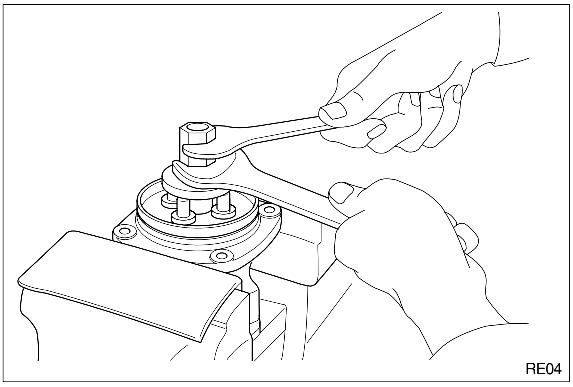
25038RL02(2)

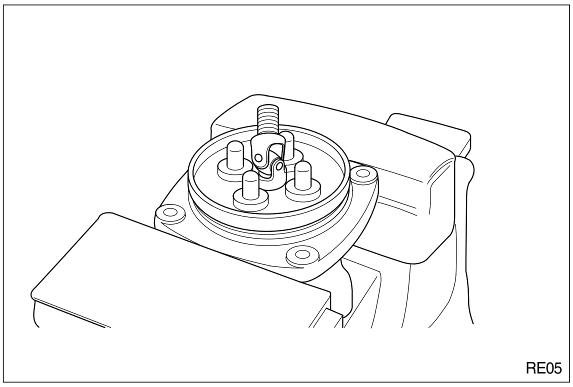
(4) Loosen lock nut(20) and adjusting nut(19) with spanners on them respectively, and take out handle section as one body.



25038RL02(3)

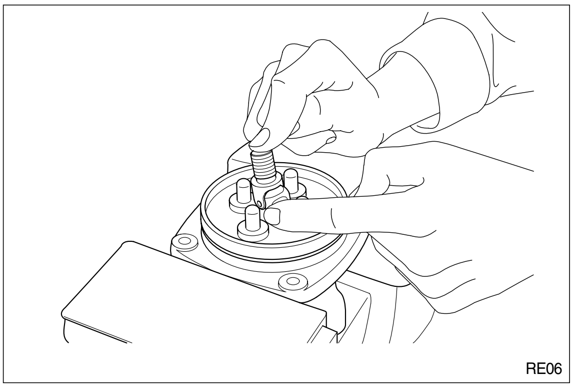
(5) Loosen adjusting nut(19) and plate(18) with spanners on them respectively, and remove them.

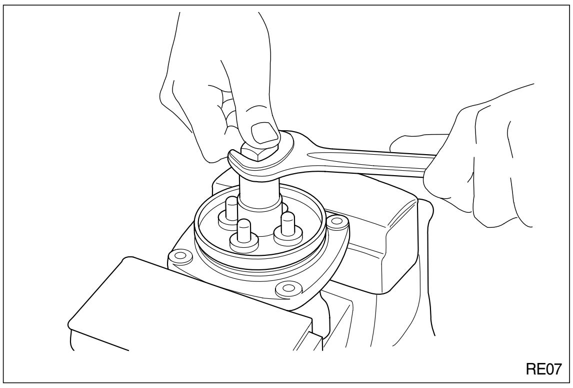




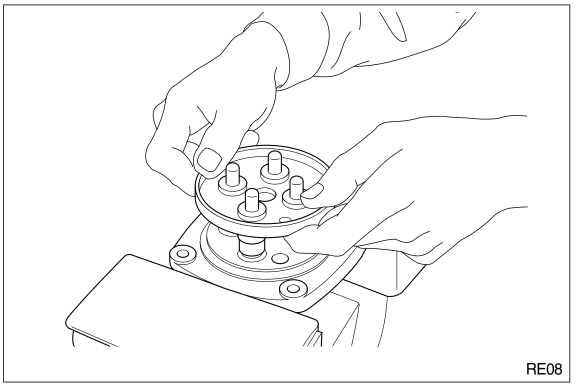
(6) Turn joint anticlockwise to loosen it, utilizing jig(Special tool).

※ 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.





(7) Remove plate(15).

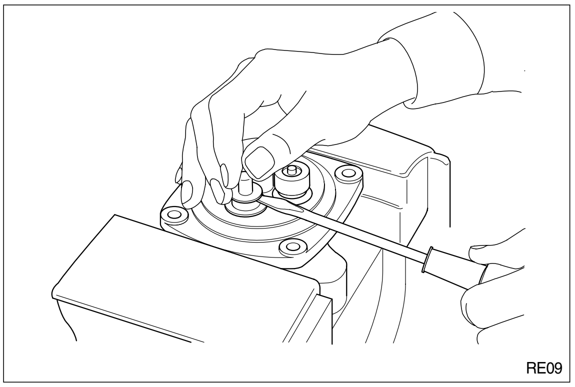


RE08

(8) 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.

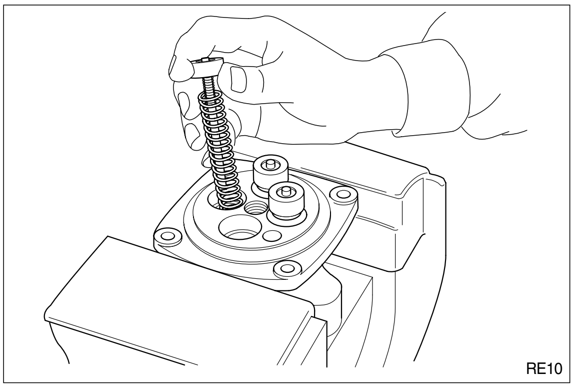
※ During taking out, plug may jump up due to return spring(10) force.
Pay attention to this.



RE09

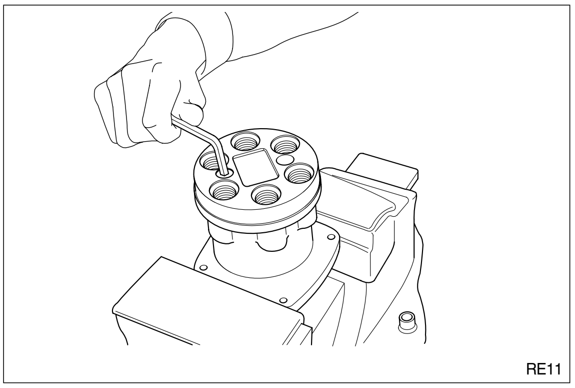
(9) Remove reducing valve subassembly and return spring(10) out of casing.

※ Record relative position of reducing valve subassembly and return springs.



RE10

(10) Loosen hexagon socket head plug(2) with hexagon socket screw key.



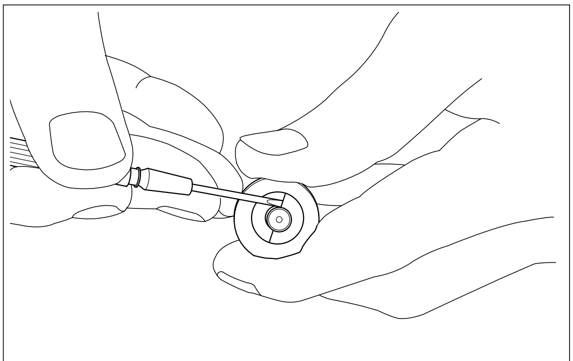
RE11

(11) For disassembling reducing valve section, stand it vertically with spool(5) bottom placed on flat workbench. Push down spring seat(8, 30) 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, 30).

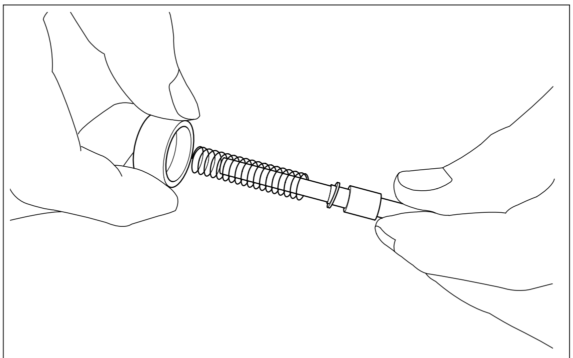
※ Do not push down spring seat more than 6mm.



RE14

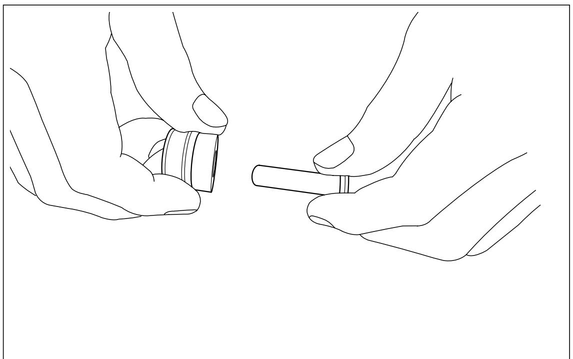
(12) Separate spool(5), spring seat(8, 30), spring(7, 29) and shim(6) individually.

※ Until being assembled, they should be handled as one subassembly group.



RE15

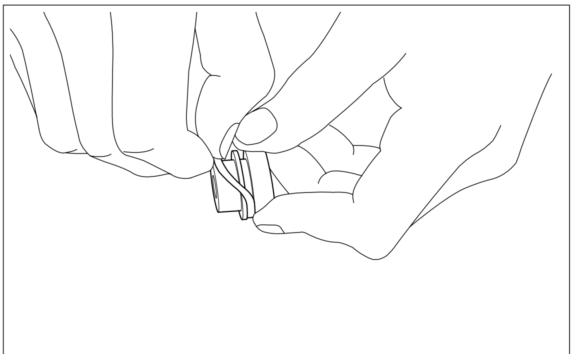
(13) Take push rod(14) out of plug(11).



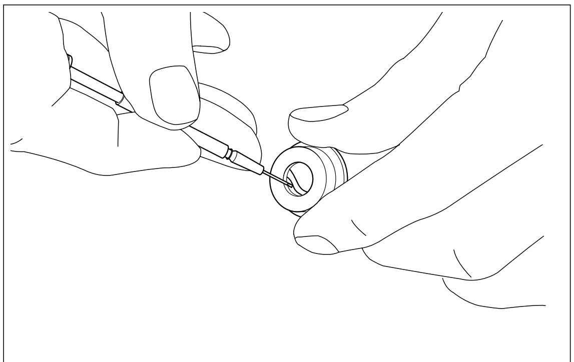
RE16

(14) Remove O-ring(13) and seal(12) from plug(11).

Use small minus screwdriver or so on to remove this seal.

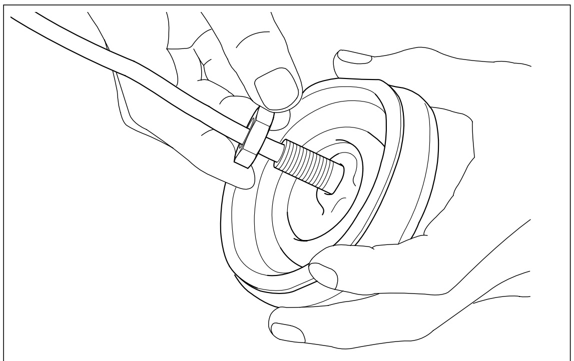


RE17

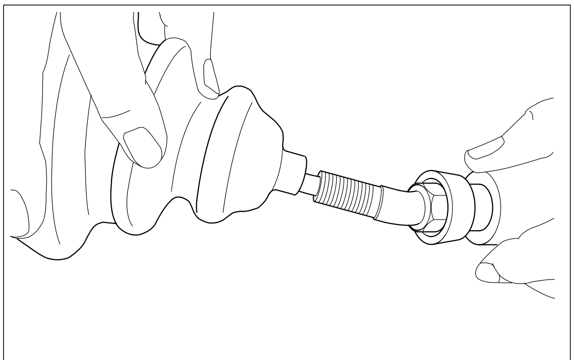


RE18

(15) Remove lock nut(20) and then boot(25).



RE19



RE20

(16) Cleaning of parts

① Put all parts in rough cleaning vessel filled with kerosene and clean them (Rough cleaning).

※ If dirty part is cleaned with kerosene just after putting it in vessel, it may be damaged. Leave it in kerosene for a while to loosen dust and dirty oil.

※ If this kerosene is polluted, parts will be damaged and functions of reassembled valve will be degraded.
Therefore, control cleanliness of kerosene fully.

② Put parts in final cleaning vessel filled with kerosene, turning it slowly to clean them even to their insides(Finish cleaning).

※ Do not dry parts with compressed air, since they will be damaged and/or rusted by dust and moisture in air.

(17) Rust prevention of parts.

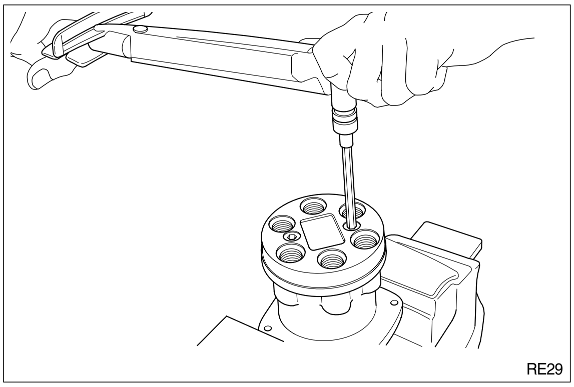
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

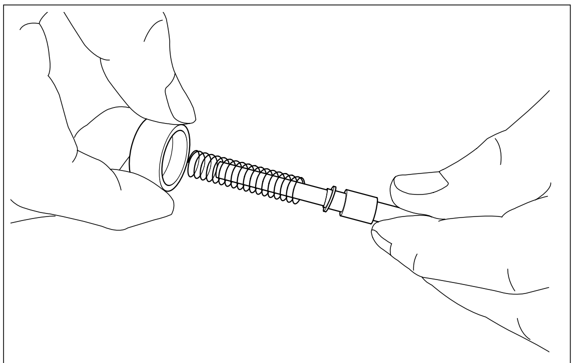
4) ASSEMBLY

(1) Tighten hexagon socket head plug(2) to the specified torque.

※ Tighten two bolts alternately and slowly.

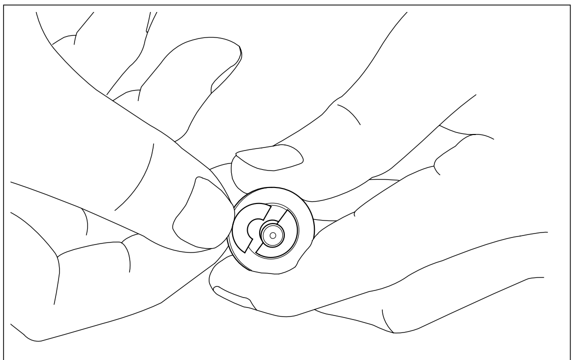

RE29

(2) Put shim(6), springs(7, 29) and spring seat(8, 30) onto spool(5) in this order.


RE30

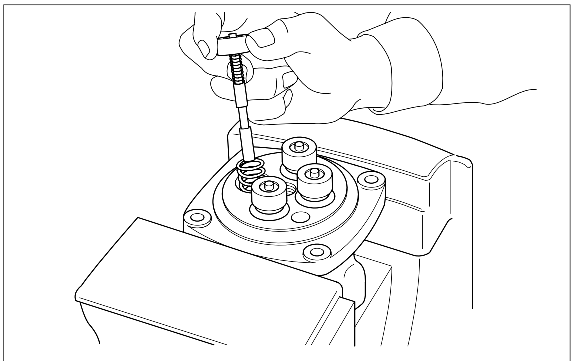
(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper(9) on spring seat without piling them on.

※ 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.

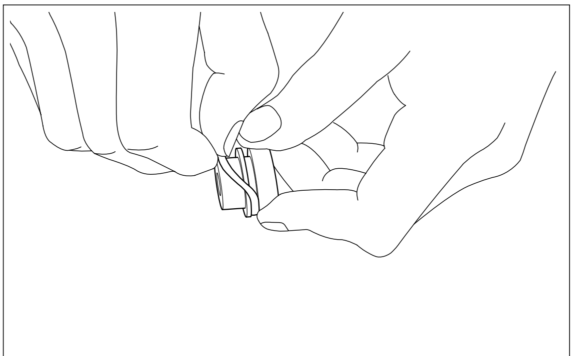

RE31

(4) Assemble spring(10) into casing. Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.

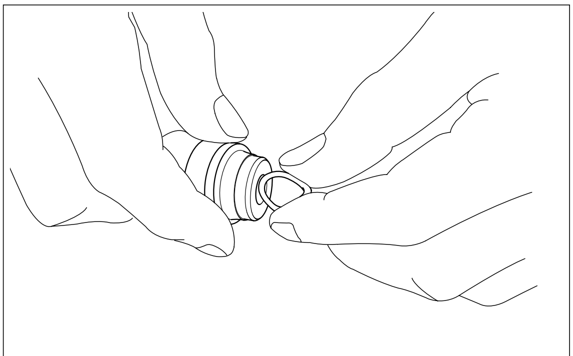

RE32

(5) Assemble O-ring(13) onto plug(11).


RE33

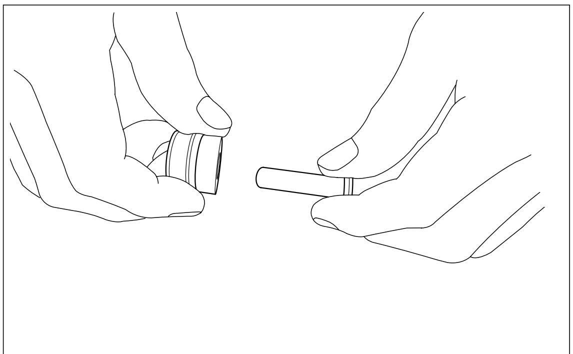
(6) Assemble seal(12) to plug(11).

※ Assemble seal in such lip direction as shown below.


RE34

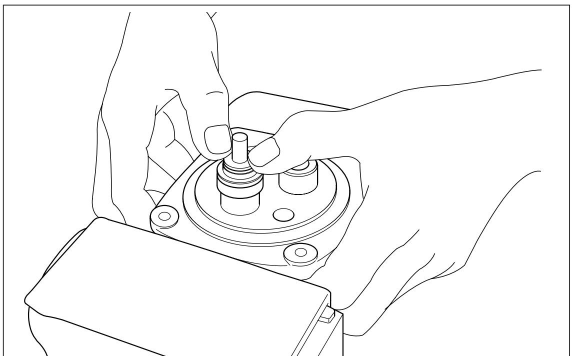
(7) Assemble push rod(14) to plug(11).

※ Apply working oil on push-rod surface.

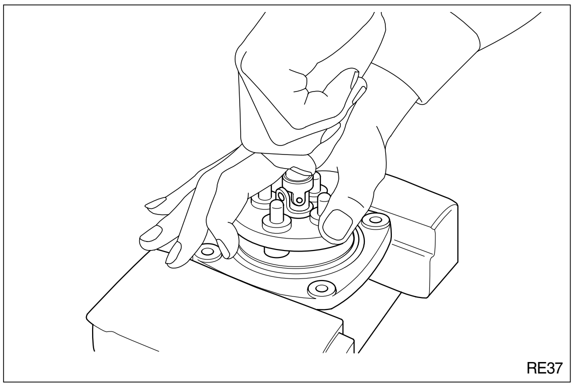

RE35

(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, subassembly stops due to resistance of O-ring.


RE36

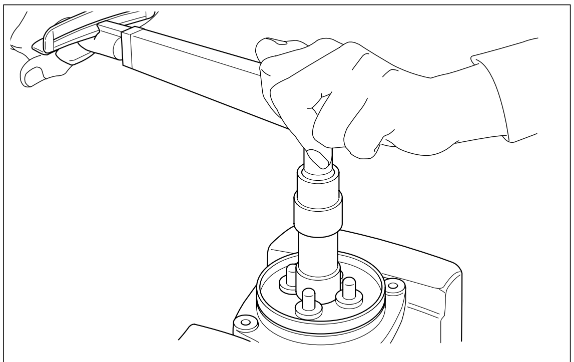
(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate(15), and tighten joint(17) temporarily.



RE37

(10) Fit plate(15).

(11) Tighten joint(17) with the specified torque to casing, utilizing jig.

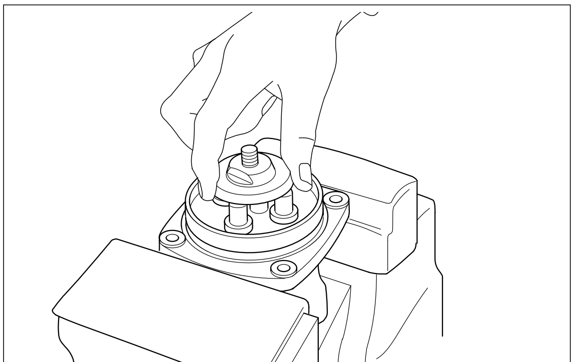


RE38

(12) Assemble plate(18) to joint(17).

※ Screw it to position that it contacts with 4 push rods evenly.

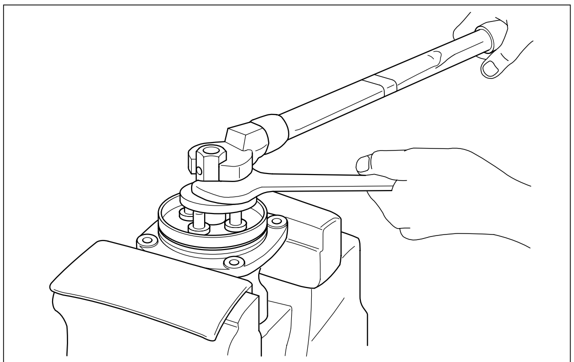
※ Do not screw it over.



RE39

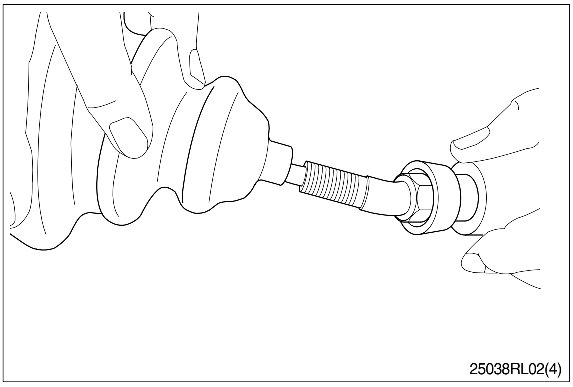
(13) Assemble adjusting nut(19), apply spanner to width across flat of plate(18) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.

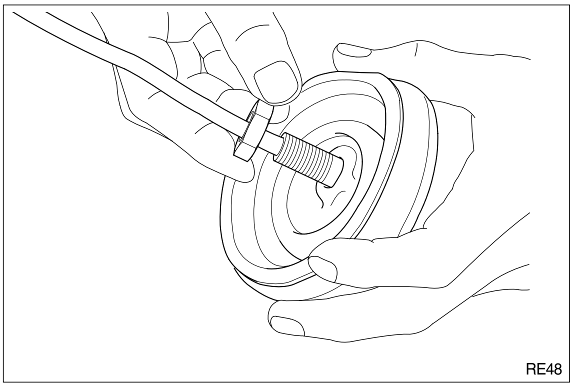


RE40

(14) Fit boot(25) and lock nut(20), and handle subassembly is assembled completely.

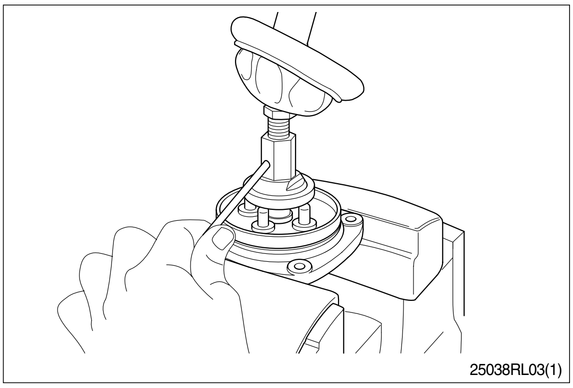


25038RL02(4)



RE48

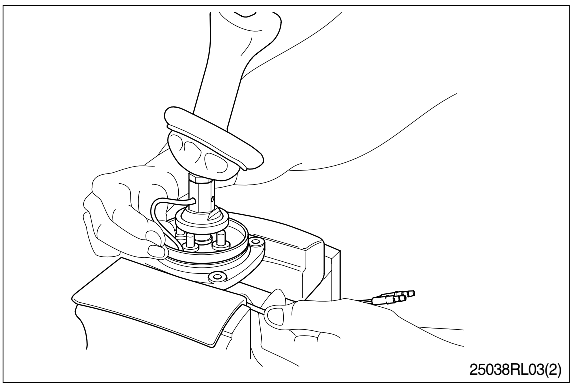
(15) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



25038RL03(1)

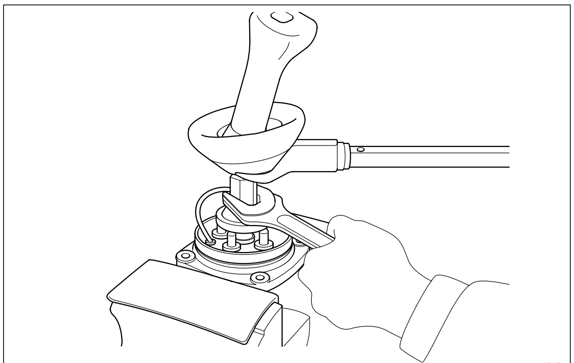
(16) Assemble bushing(16) to plate and pass cord and tube through it.

※ Provide margin necessary to operation.



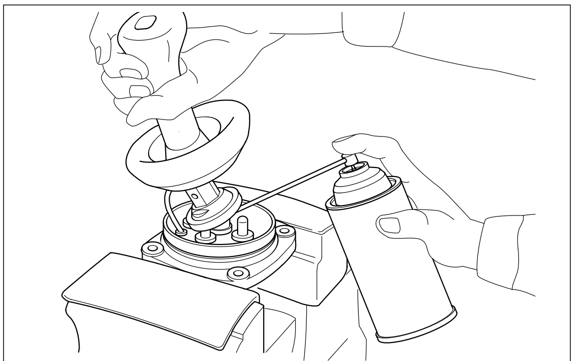
25038RL03(2)

(17) Determine handle direction, tighten lock nut(20) to specified torque to fix handle.



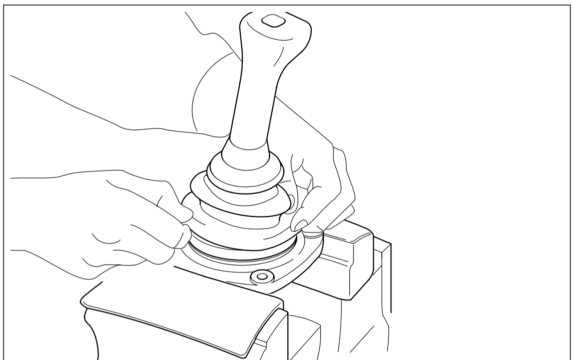
25038RL03(3)

(18) Apply grease to rotating section of joint and contacting faces of disk and push rod.



25038RL03(4)

(19) Assemble lower end of bellows to casing.



25038RL04

(20) Inject volatile rust-preventives through all ports and then put blind plugs in ports.

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

13031GE18

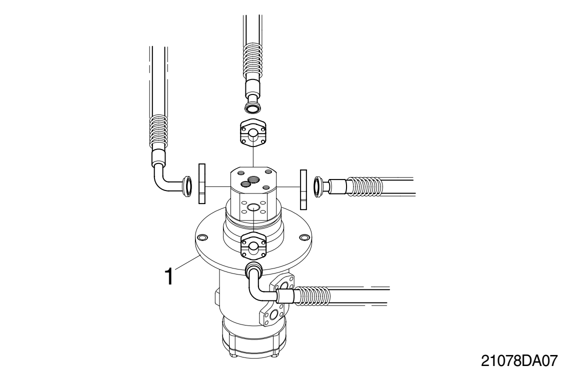
(1) Lower the work equipment to the ground and stop the engine.

(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.



21078DA07

(4) Disconnect all hoses .

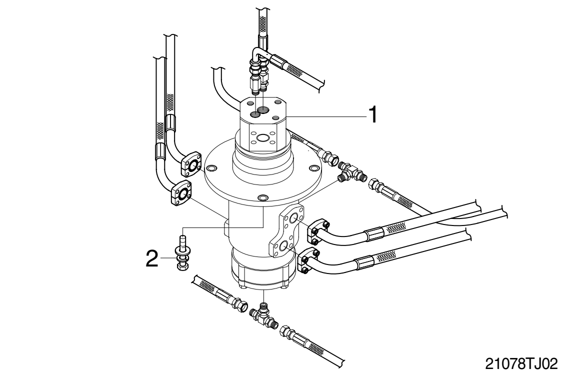
(5) Sling the turning joint assembly (1) and remove the mounting bolt(2).

- Weight : 54kg(119lb)
- Tightening torque : 12± 1.3kgf · m (88± 9.4lbf · ft)

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

2) INSTALL



21078TJ02

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

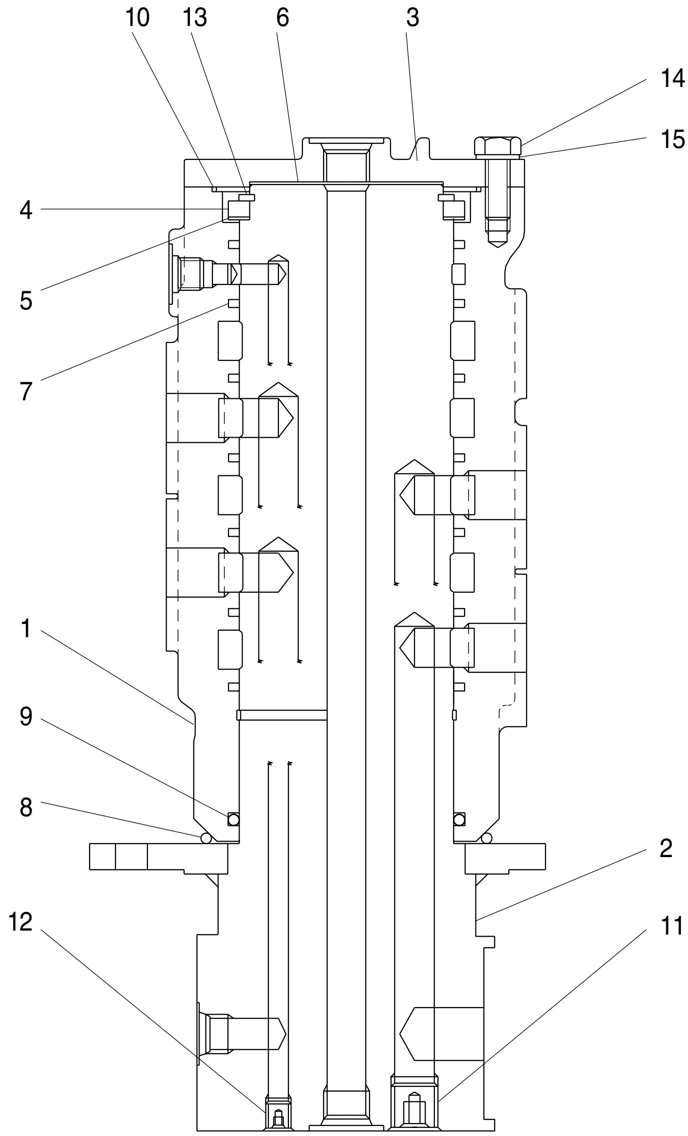
※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



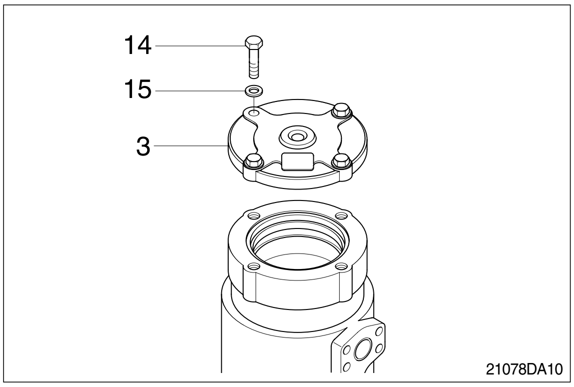
R210TJT2

1	Hub	6	Shim	11	Wear ring
2	Shaft assembly	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

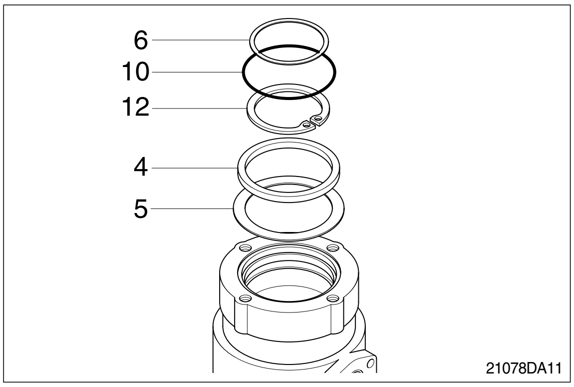
※ Before the disassembly, clean the turning joint.

(1) Remove bolts(14), washer(15) and cover(3).



(2) Remove shim(6) and O-ring(10).

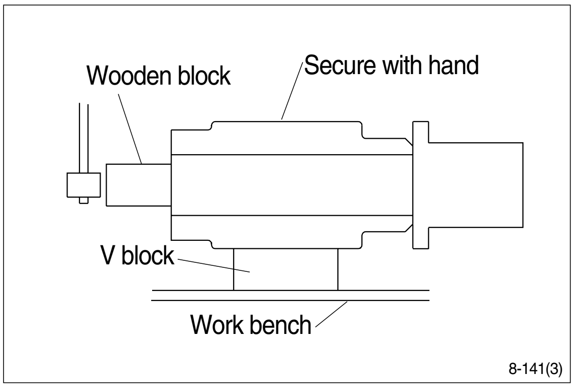
(3) Remove retainer ring(12), spacer(4) and shim(5).



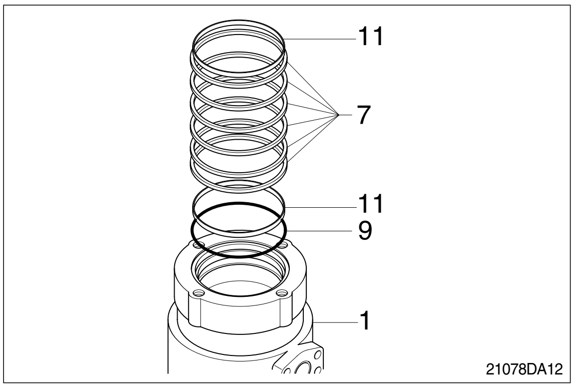
(4) Place body(1) on a V-block and by using a wood buffer at the shaft end, hit out shaft(2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft(2) when remove body(1) or rest it sideway.

※ Put a fitting mark on body(1) and shaft(2).



(5) Remove six slipper seals(7) and O-ring(9), two ring wear(11) from body(1).



3) ASSEMBLY

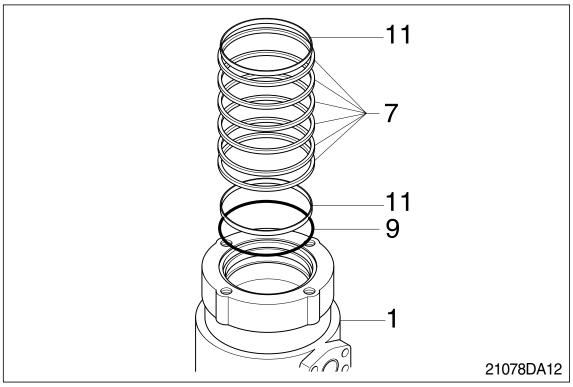
※ Clean all parts.

※ As a general rule, replace oil seals and O-ring.

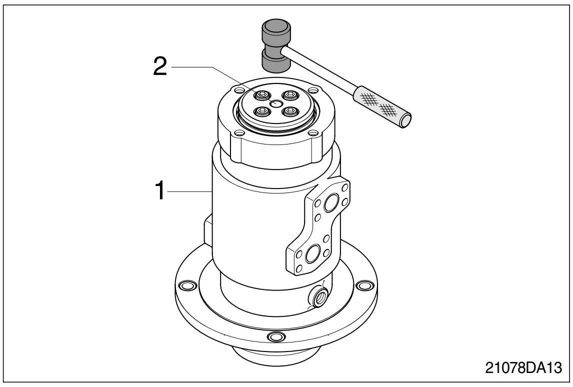
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal(7) and O-ring(9), two ring wear(11) to body(1).

(2) Fit O-ring(8) to shaft(2).



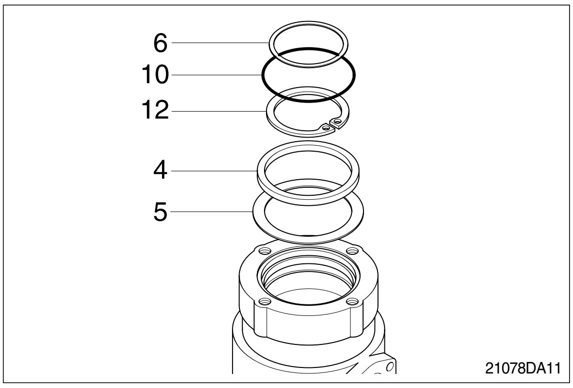
(3) Set shaft(2) on block, tap body(1) with a plastic hammer to install.



(4) Fit shim(5), spacer(4) and retainer ring (12) to shaft(2).

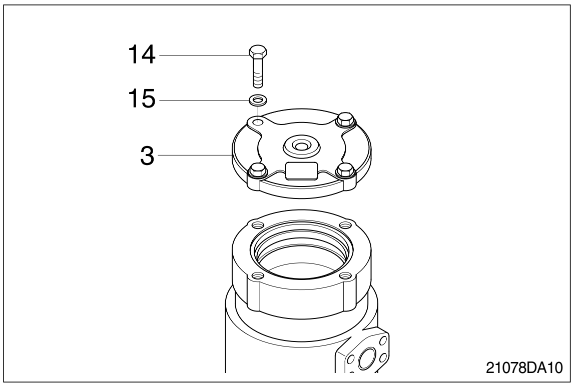
(5) Fit O-ring(10) to body(1).

(6) Fit shim(6) to shaft(2).



(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

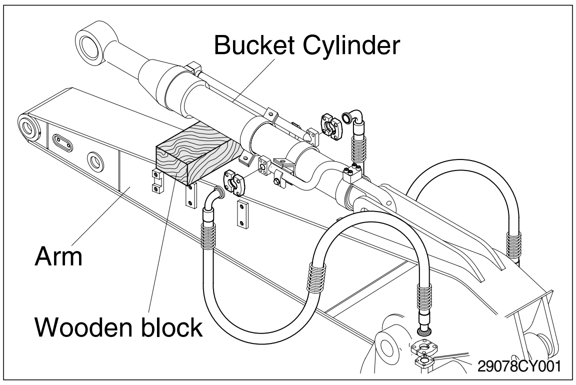
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ 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.

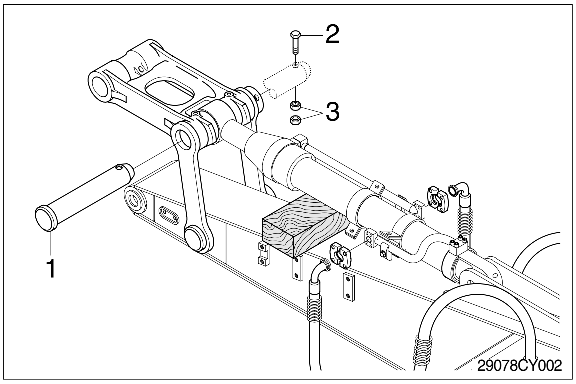
※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between bucket cylinder and arm.

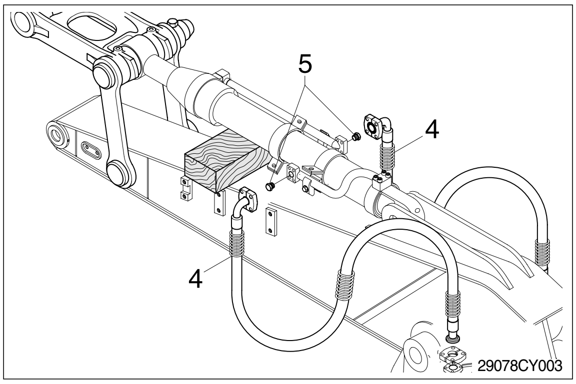


② Remove bolt(2), nut(3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



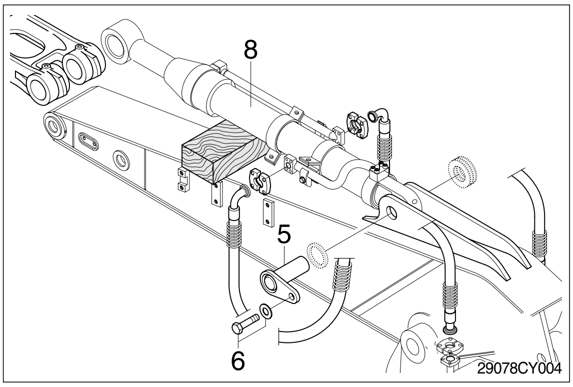
③ Disconnect bucket cylinder hoses(4) and put plugs(5) on cylinder pipe.



④ Sling bucket cylinder assembly(8) and remove bolt(6) then pull out pin (5).

⑤ Remove bucket cylinder assembly(8).

· Weight : 250㎏(551lb)



(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

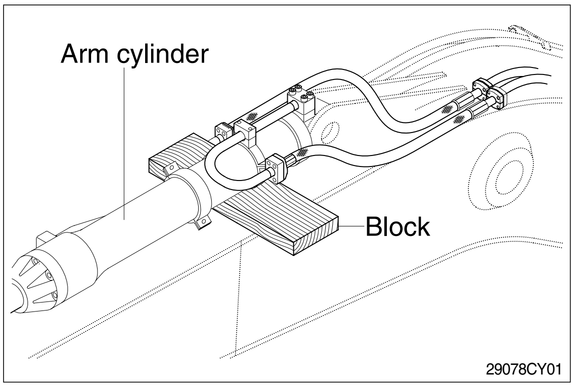
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ 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.

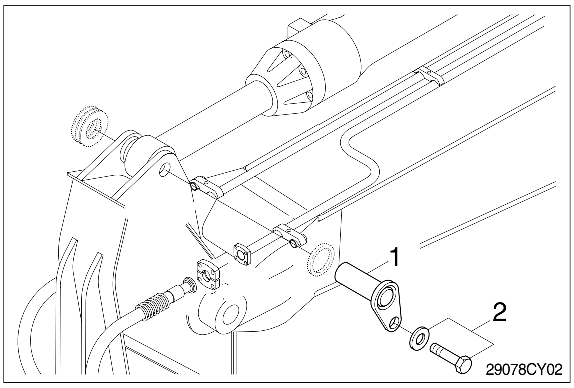
※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



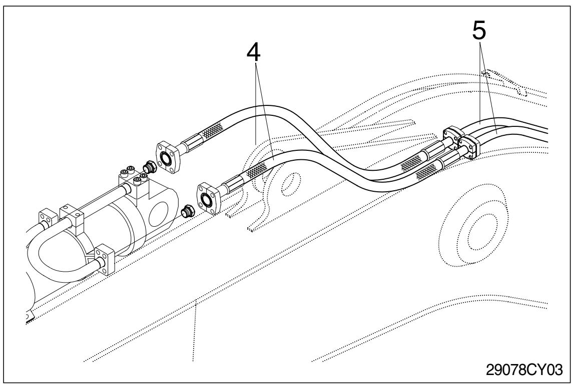
② Remove bolt(2) and pull out pin(1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses(4) and put plugs on cylinder pipe.

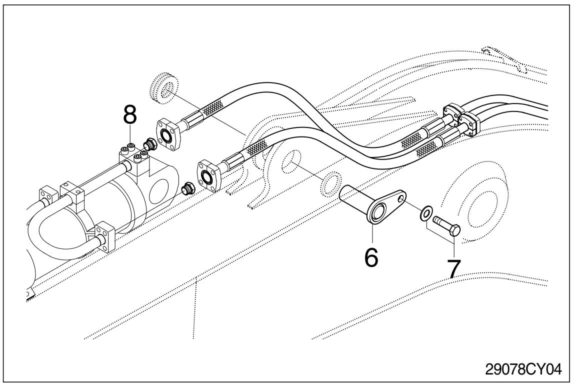
④ Disconnect greasing pipings(5).



⑤ Sling arm assembly(8) and remove bolt (7) then pull out pin(6).

⑥ Remove arm cylinder assembly(8).

· Weight : 375㎏(826lb)



29078CY04

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

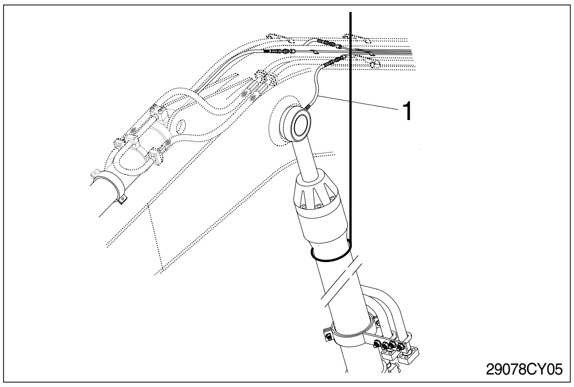
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

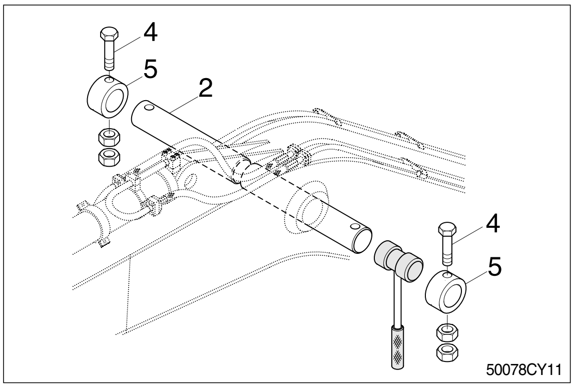
① Disconnect greasing hoses(1).

② Sling boom cylinder assembly.

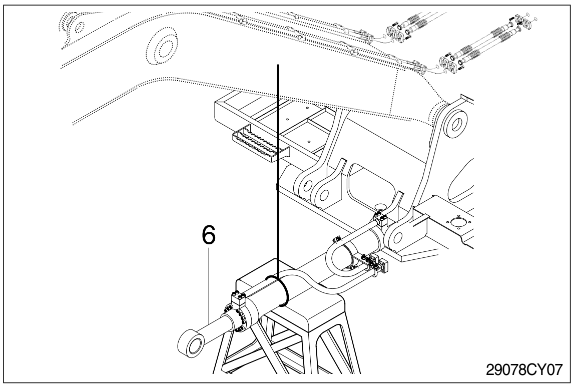


③ Remove bolt(4), pin stopper(5) and pull out pin(2).

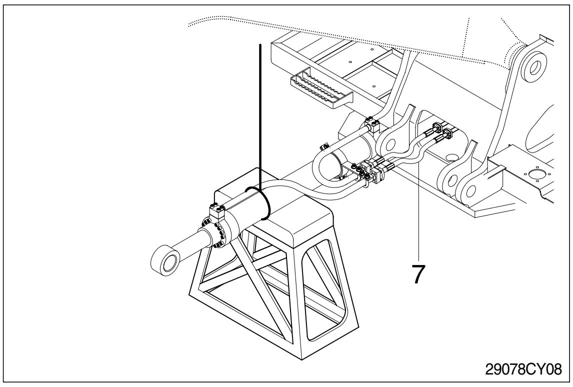
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly(6) on a stand.



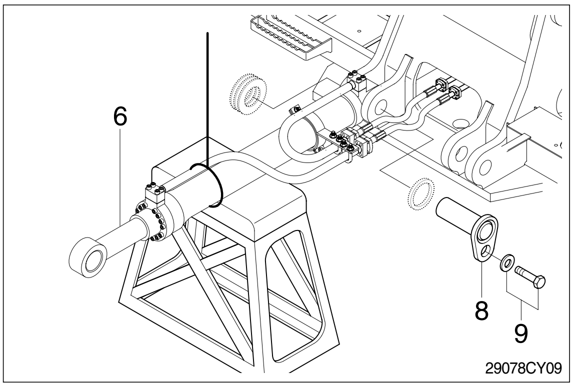
⑤ Disconnect boom cylinder hoses(7) and put plugs on cylinder pipe.



⑥ Remove bolt(9) and pull out pin(8).

⑦ Remove boom cylinder assembly(6).

· Weight : 290kg(640lb)



(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.

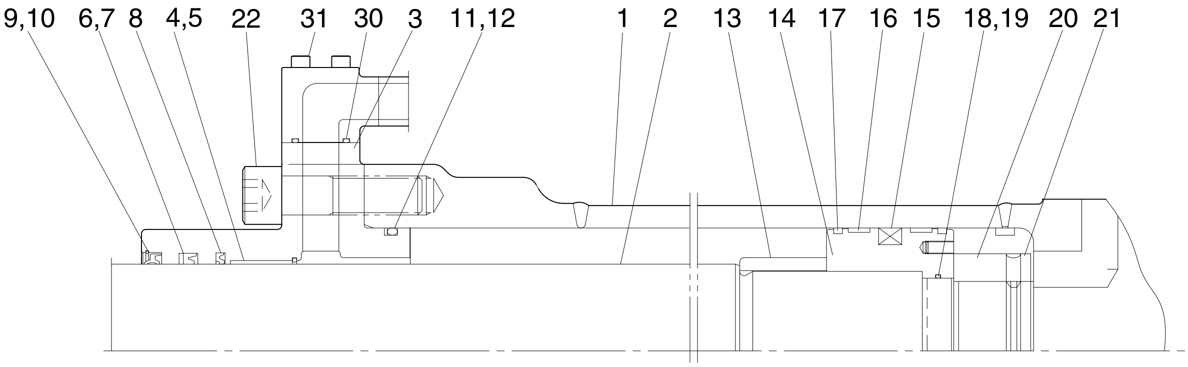
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

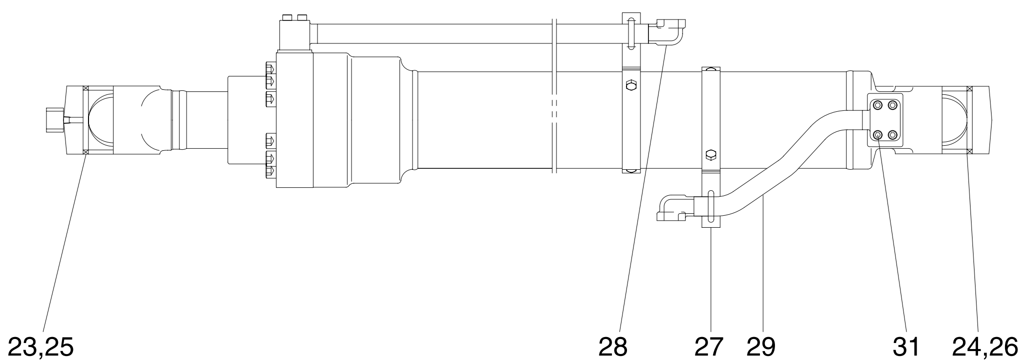
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder



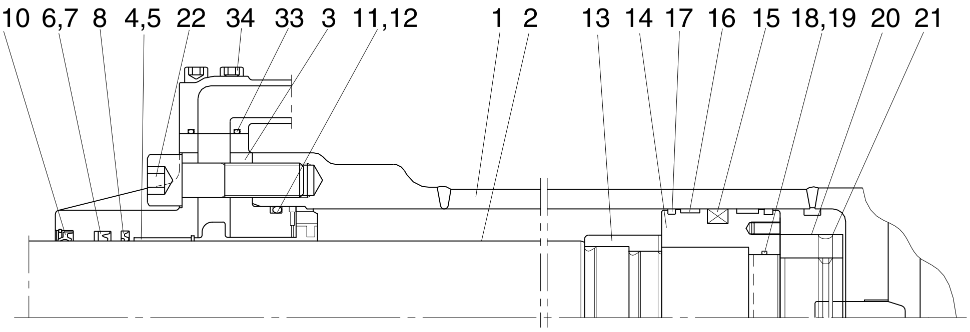
Internal detail



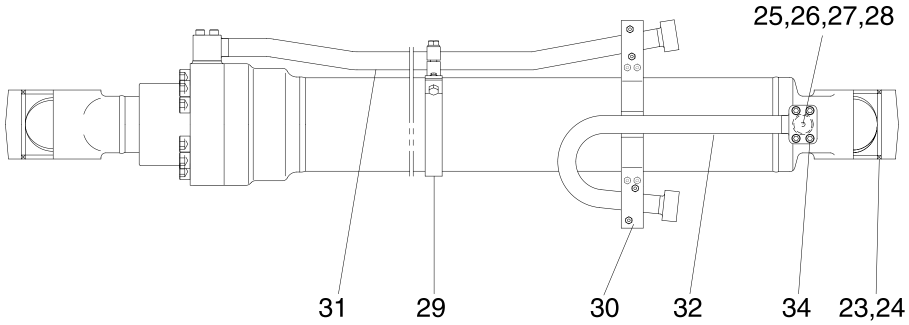
2907A8BY01

1	Tube assembly	12	Back up ring	23	Pin bushing
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly
7	Back up ring	18	O-ring	29	Pipe assembly
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	Hexagon socket head bolt		

(2) Arm cylinder



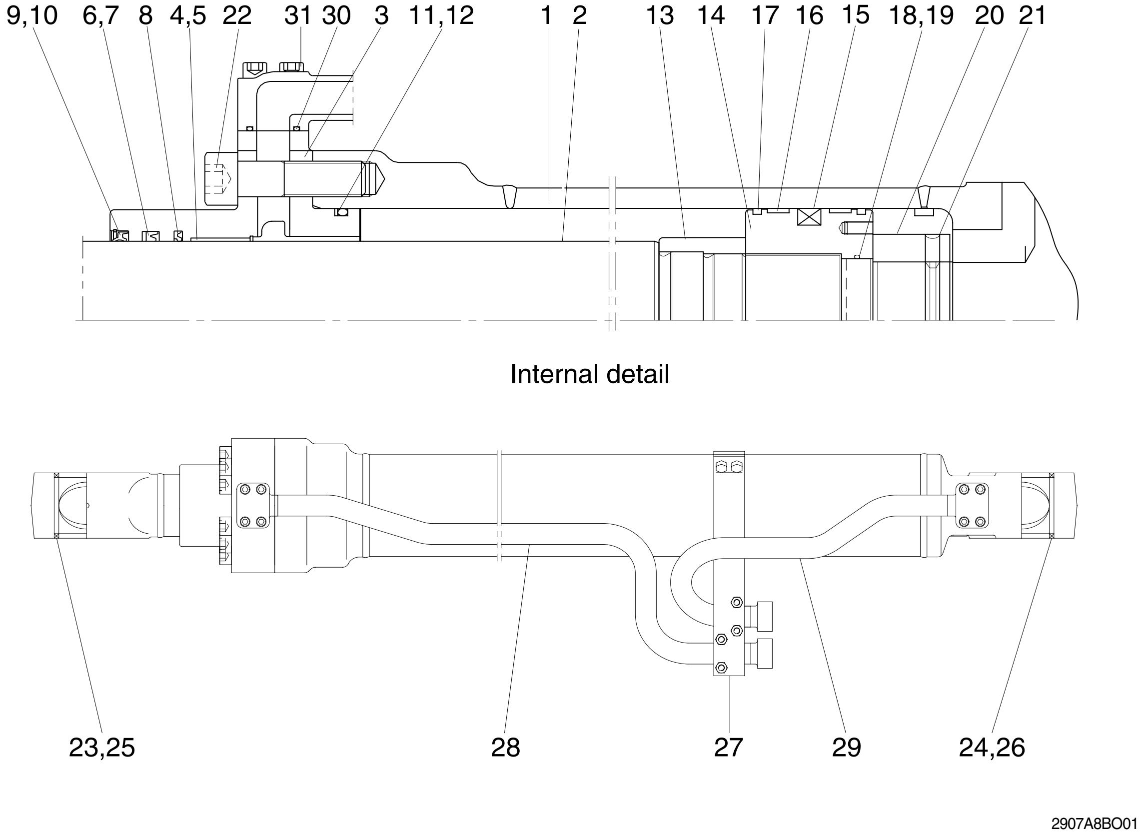
Internal detail



2907A8AM01

1 Tube assembly
2 Rod assembly
3 Gland
4 DD2 bushing
5 Snap ring
6 Rod seal
7 Back up ring
8 Buffer ring
9 Dust wiper
10 Snap ring
11 O-ring
12 Back up ring
13 Cushion ring
14 Piston
15 Piston seal
16 Wear ring
17 Dust ring
18 O-ring
19 Back up ring
20 Lock nut
21 Hexagon socket set screw
22 Hexagon socket head bolt
23 Pin bushing
24 Dust seal
25 Check valve
26 Coil spring
27 O-ring
28 Plug
29 Band assembly
30 Band assembly
31 Pipe assembly
32 Pipe assembly
33 O-ring
34 Hexagon socket head bolt

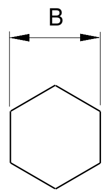
(3) Boom cylinder



1	Tube assembly	12	Back up ring	23	Pin bushing
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Dust seal
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly
7	Back up ring	18	O-ring	29	Pipe assembly
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	Hexagon socket head bolt		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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	M18	32.0±3.0	232±21.7
		31	M12	9.4±1.0	68.0±7.2
	Boom cylinder	22	M18	32.0±3.0	232±21.7
		31	M12	9.4±1.0	68.0±7.2
	Arm cylinder	22	M20	46.0±35.0	333±36.2
		34	M12	9.4±1.0	68.0±7.2
Lock nut	Bucket cylinder	20	-	200±10.0	1447±145
	Boom cylinder	20	-	200±10.0	1447±145
	Arm cylinder	20	-	200±10.0	1447±145
Piston	Bucket cylinder	14	-	100±10.0	723±72.3
	Boom cylinder	14	-	100±10.0	723±72.3
	Arm cylinder	14	-	100±10.0	723±72.3

3) DISASSEMBLY

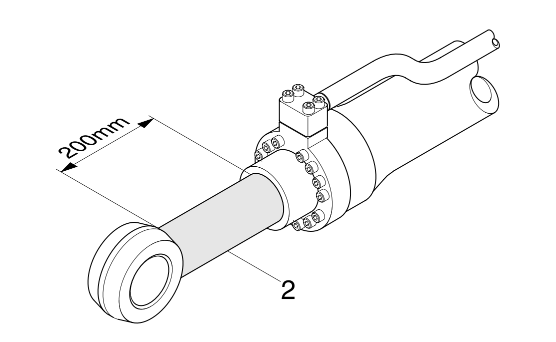
(1) Remove cylinder head and piston rod

※ **Procedures are based on the bucket cylinder.**

① Hold the clevis section of the tube in a vise.

※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

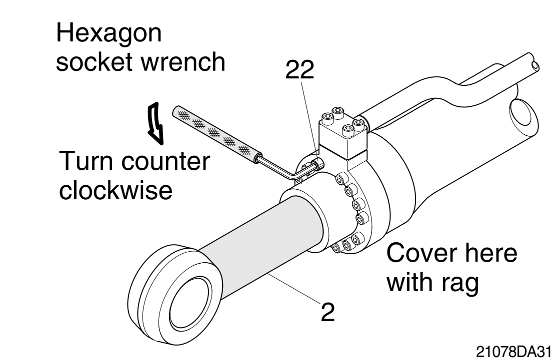
② Pull out rod assembly(2) about 200㎜ (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



21078DA30

③ Loosen and remove socket bolts(22) of the gland in sequence.

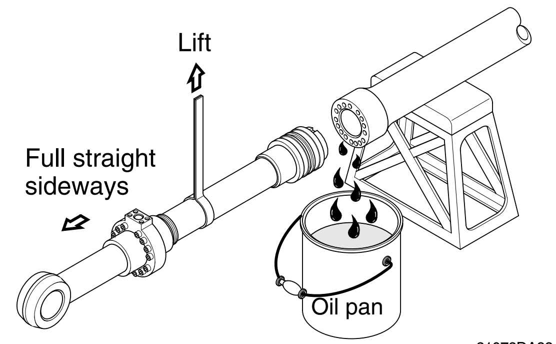
※ Cover the extracted rod assembly(2) with rag to prevent it from being accidentally damaged during operation.



21078DA31

④ Draw out cylinder head and rod assembly together from tube assembly(1).

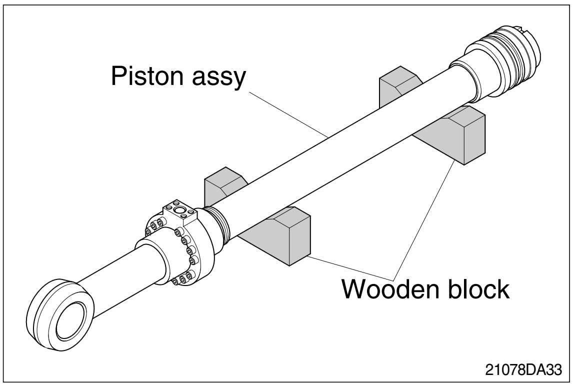
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly(2) with a crane or some means and draw it out. However, when rod assembly(2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



21078DA32

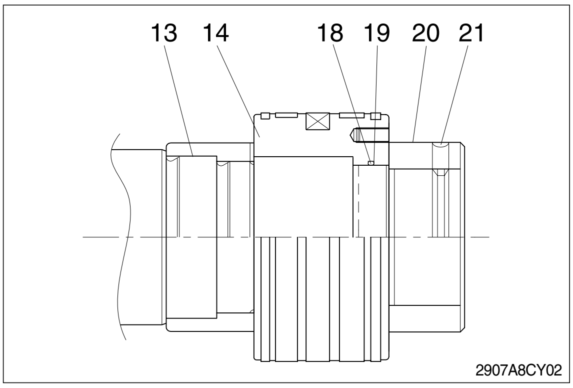
Note that the plated surface of rod assembly(2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.

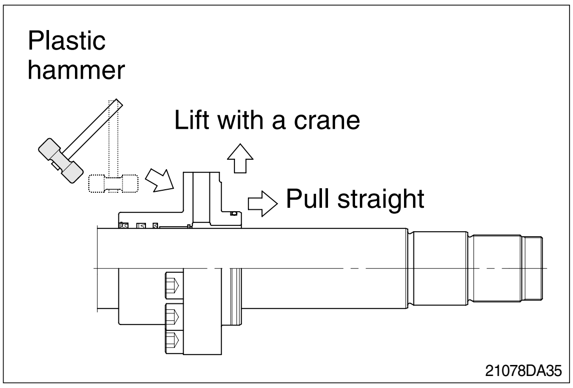


(2) Remove piston and cylinder head

① Remove lock nut(21).
※ Since lock nut(20) and lock washer(20) 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 (20).
② Remove piston assembly(14), back up ring(19), and O-ring(18).



③ Remove the cylinder head assembly from rod assembly(2).
※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.
※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing(4) and packing (5,6,7,8,9,10) by the threads of rod assembly(2).

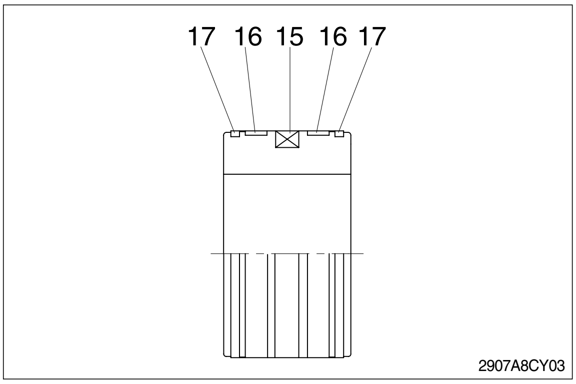


(3) Disassemble the piston assembly

① Remove wear ring(16).

② Remove dust ring(17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

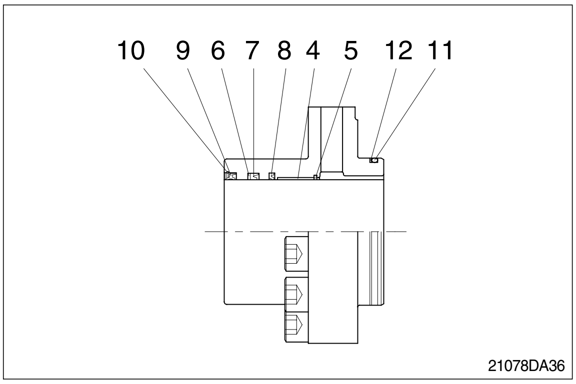
① Remove back up ring(12) and O-ring (11).

② Remove snap ring(10), dust wiper(9).

③ Remove back up ring(7), rod seal(6) and buffer ring(8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

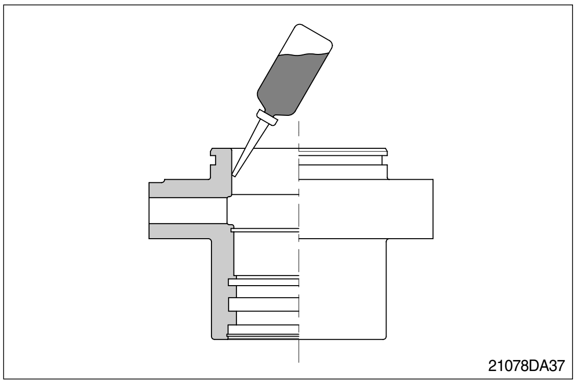


3) ASSEMBLY

(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.



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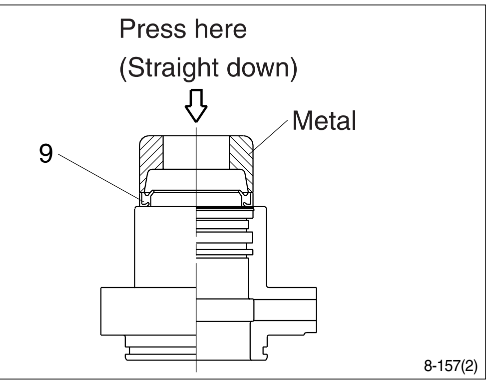
② Coat dust wiper(9) with grease and fit dust wiper(9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit snap ring(10) to the stop face.

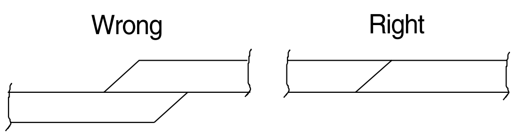


8-157(2)

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.

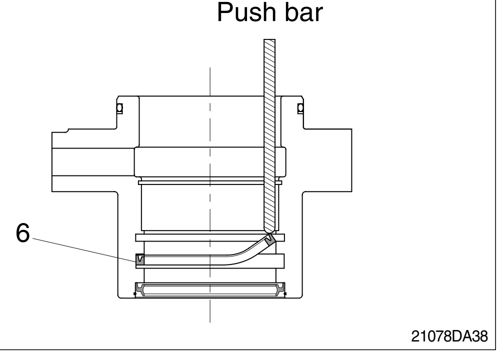
※ Insert the backup ring until one side of it is inserted into groove.



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.



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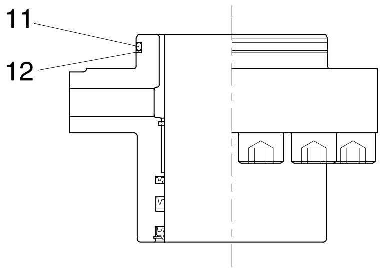
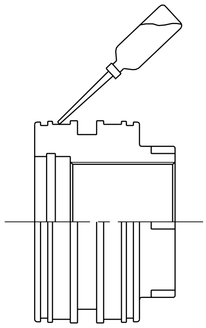
⑤ Fit back up ring(12) to gland(3).
※ Put the backup ring in the warm water of 30~50°C.
⑥ Fit O-ring(11) to gland(3).



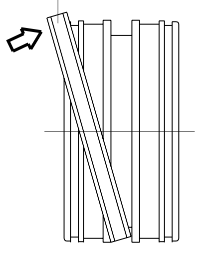
21078DA39

(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.



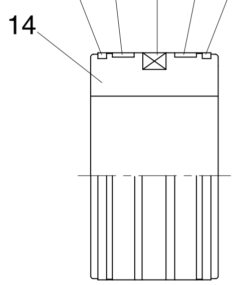
8-158(2)

② Fit piston seal(15) to piston.
※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
※ After assembling the piston seal, press its outer diameter to fit in.



2907A8CY04

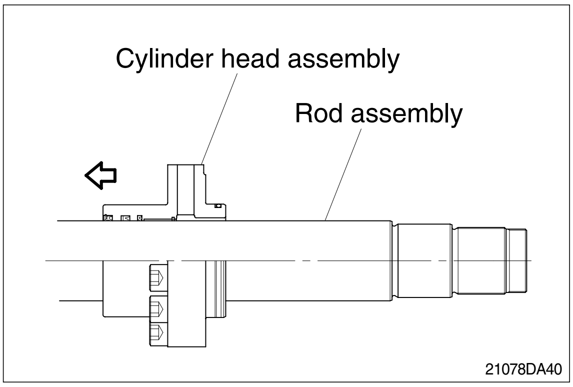
③ Fit wear ring(16) and dust ring(17) to piston(14).



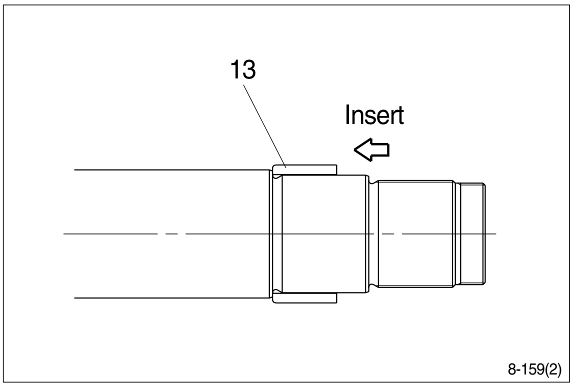
2907A8CY05

(3) Install piston and cylinder head

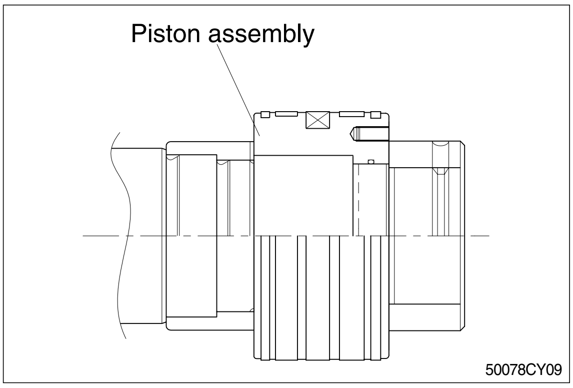
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly(2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring(13) to rod assembly.
※ Note that cushion ring(13) has a direction in which it should be fitted.

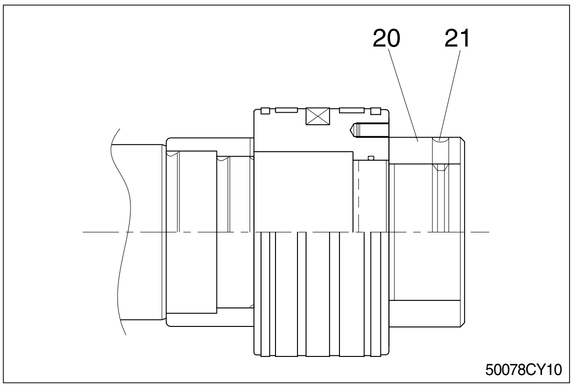


⑤ Fit piston assembly to rod assembly.
· Tightening torque : 100±10.0kgf · m (723±72.3lbf · ft)



⑥ Fit lock nut(20) and tighten the screw(21).
· Tightening torque :

Item		kgf · m	lbf · ft
Bucket Boom Arm	20	200±20	1447±147
	21	5.4±0.5	39.1±3.6



(3) Overall assemble

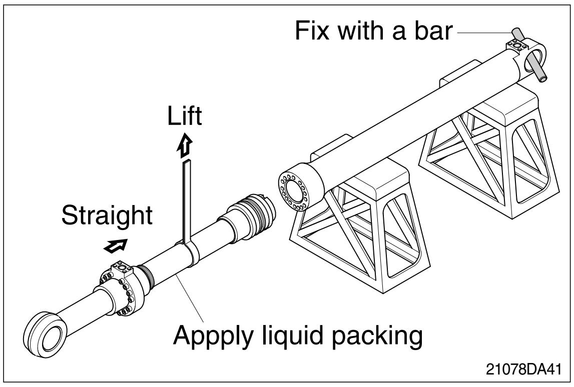
① Place a V-block on a rigid work bench. Mount the tube assembly(1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

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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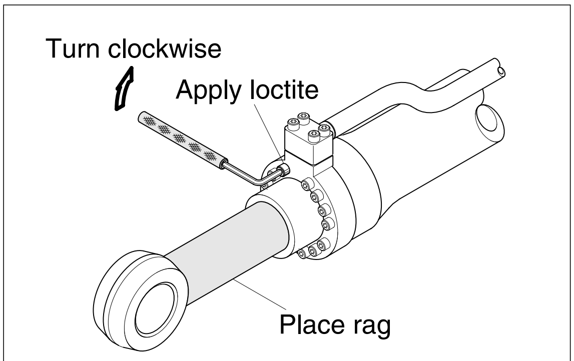


21078DA42

GROUP 10 UNDERCARRIAGE

1. TRACK LINK

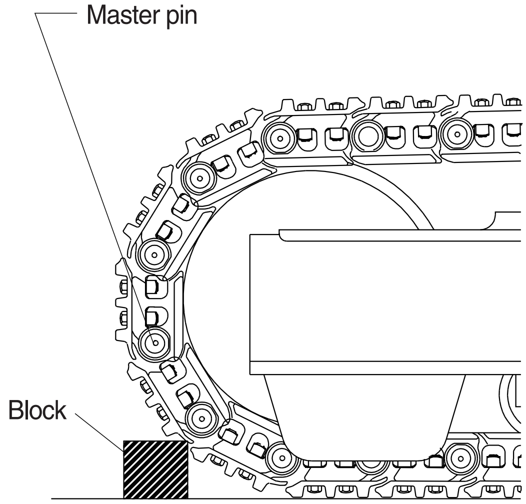
1) REMOVAL

(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.

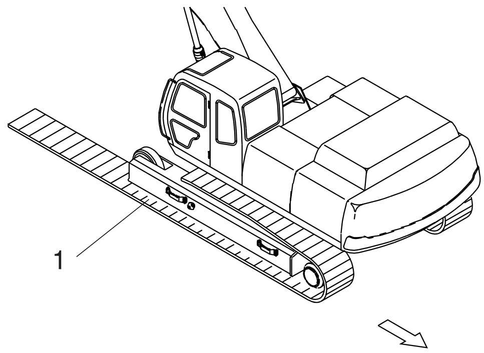


8-161(1)

(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.

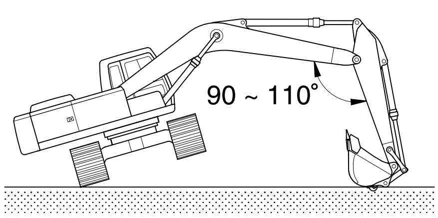


8-161(2)

2) INSTALL

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

※ Adjust the tension of the track link.



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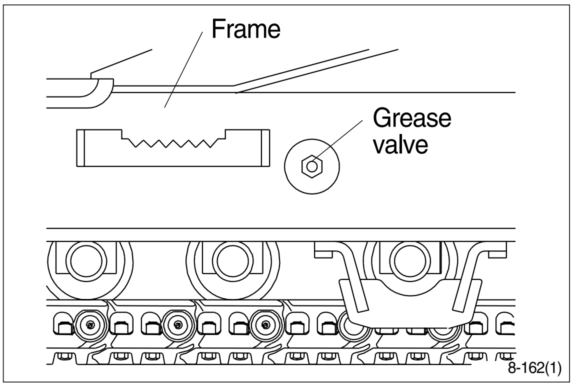
2. CARRIER ROLLER

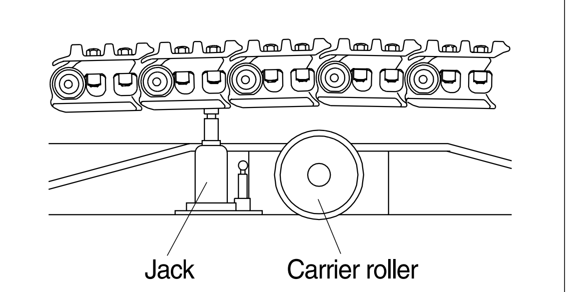
1) REMOVAL

(1) Loosen tension of the track link.



8-162(1)

(2) Jack up the track link height enough to permit carrier roller removal.

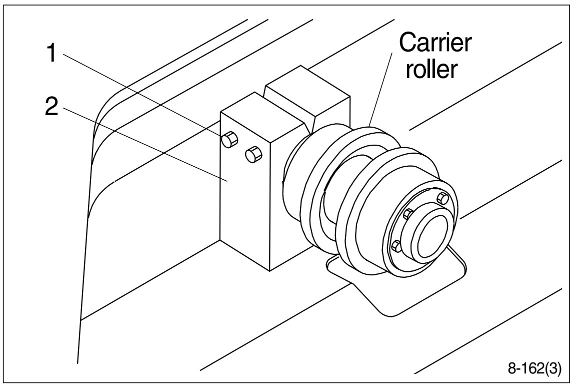


8-162(2)

(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.

· Weight : 48kg(88lb)



8-162(3)

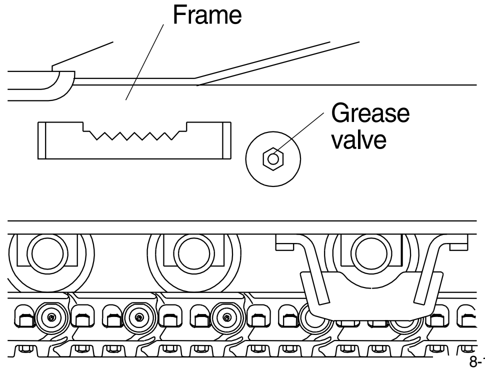
2) INSTALL

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

3. TRACK ROLLER

1) REMOVAL

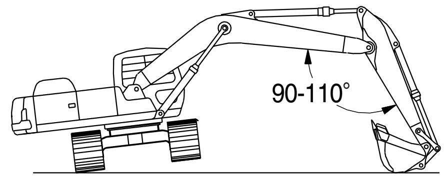
(1) Loosen tension of the track link.



8-163(1)

(2) Using the work equipment, push up track frame on side which is to be removed.

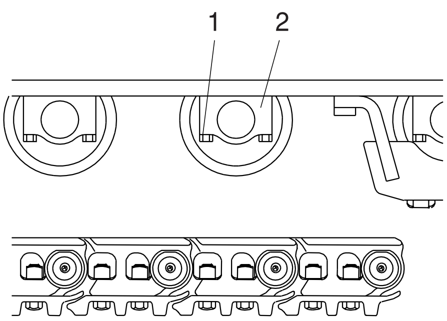
※ After jack up the machine, set a block under the unit.



8-163(2)

(3) Remove the mounting bolt(1) and draw out the track roller(2).

· Weight : 54kg(119lb)



8-163(3)

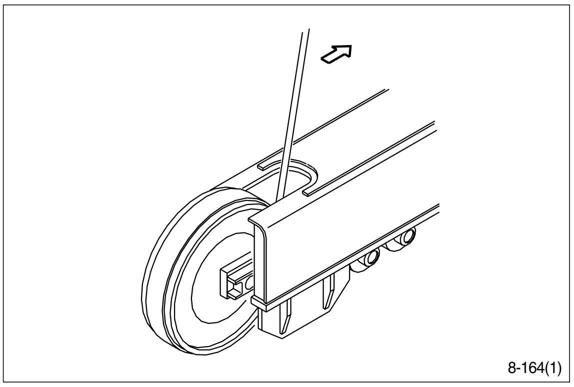
2) INSTALL

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

4. IDLER AND RECOIL SPRING

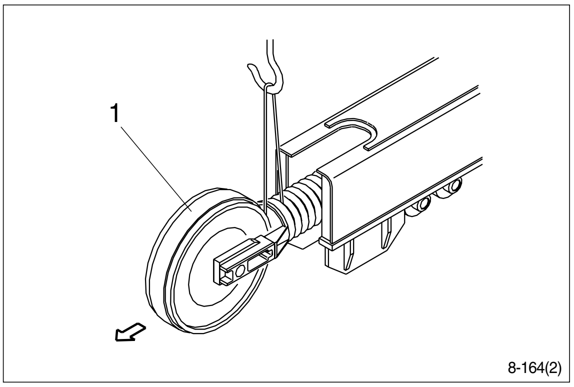
1) REMOVAL

(1) Remove the track link.
For detail, see **removal of track link**.



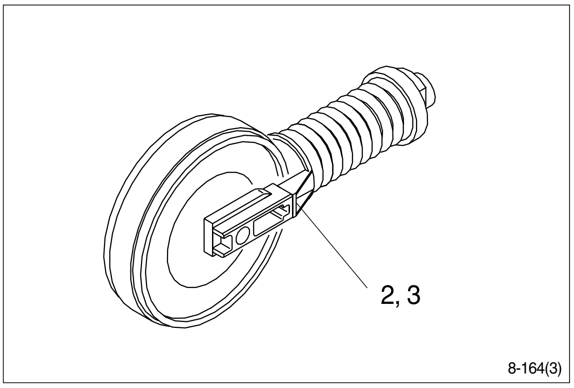
8-164(1)

(2) Sling the recoil spring(1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 457㎏(1010lb)



8-164(2)

(3) Remove the bolts(2), washers(3) and separate ilder from recoil spring.

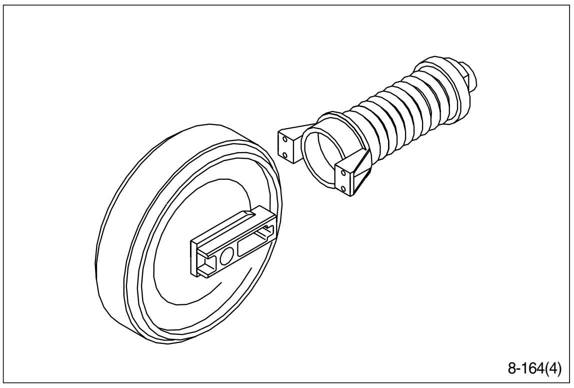


8-164(3)

2) INSTALL

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

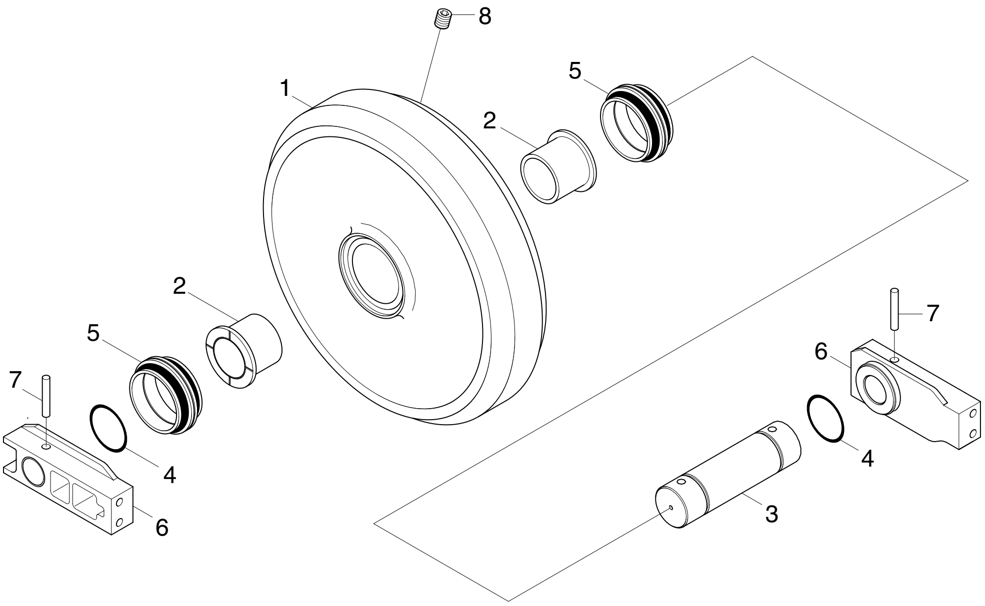
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



8-164(4)

3) DISASSEMBLY AND ASSEMBLY OF IDLER

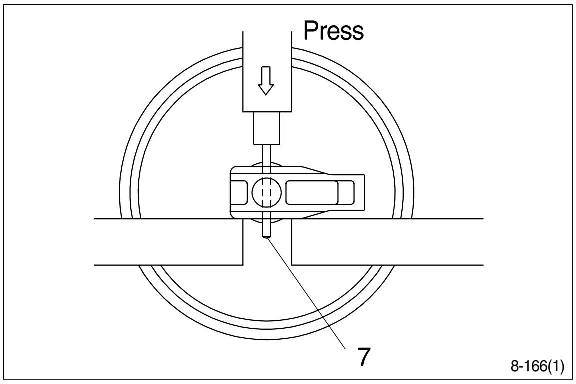
(1) Structure



1	Shell	4	O-ring	7	Spring pin
2	Bushing	5	Seal assembly	8	Plug
3	Shaft	6	Bracket		

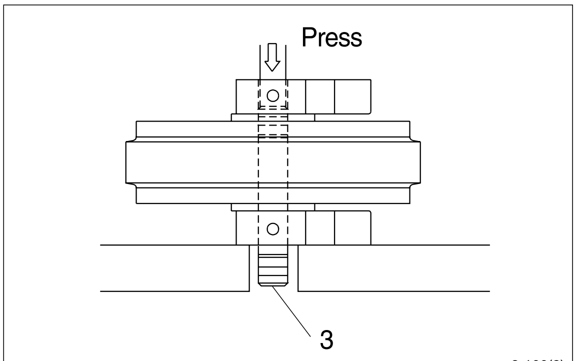
(2) Disassembly

① Remove plug and drain oil.
② Draw out the spring pin(7), using a press.



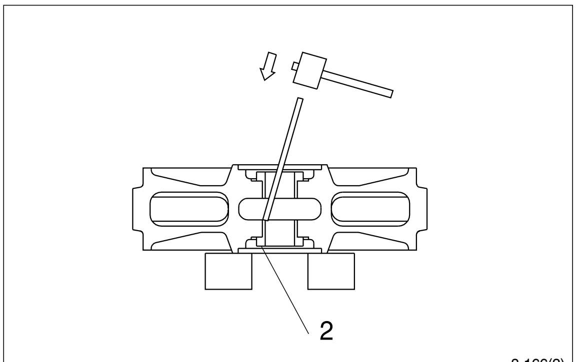
8-166(1)

③ Pull out the shaft(2) with a press.
④ Remove seal(5) from shell(1) and bracket(6).
⑤ Remove O-ring(4) from shaft.



8-166(2)

⑥ Remove the bushing(2) from idler, using a special tool.
※ Only remove bushing if replacement is necessity.



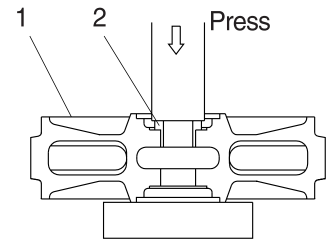
8-166(3)

(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

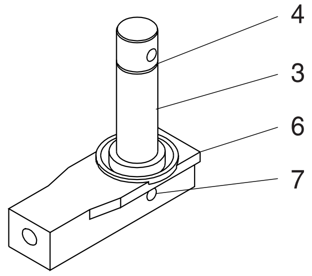
① Cool up bushing(2) fully by some dry ice and press it into shell(1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8-167(1)

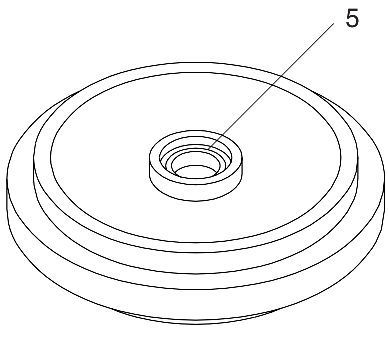
② Coat O-ring(4) with grease thinly, and install it to shaft(3).

③ Insert shaft(3) into bracket(6) and drive in the spring pin(7).



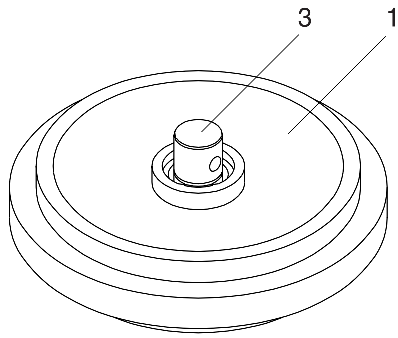
8-167(2)

④ Install seal(5) to shell(1) and bracket(6).



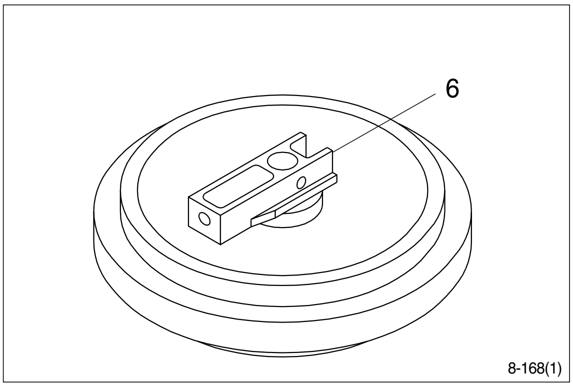
8-167(3)

⑤ Install shaft(3) to shell(1).

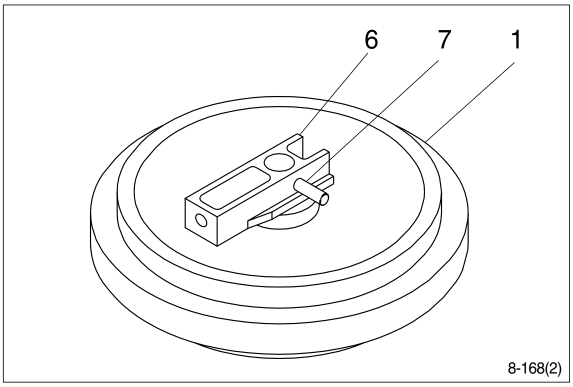


8-167(4)

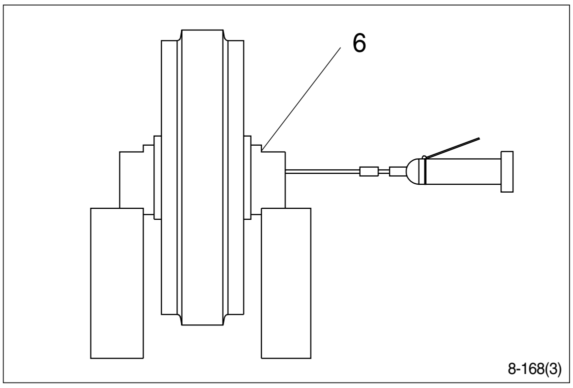
⑥ Install bracket(6) attached with seal(5).



⑦ Knock in the spring pin(7) with a hammer.

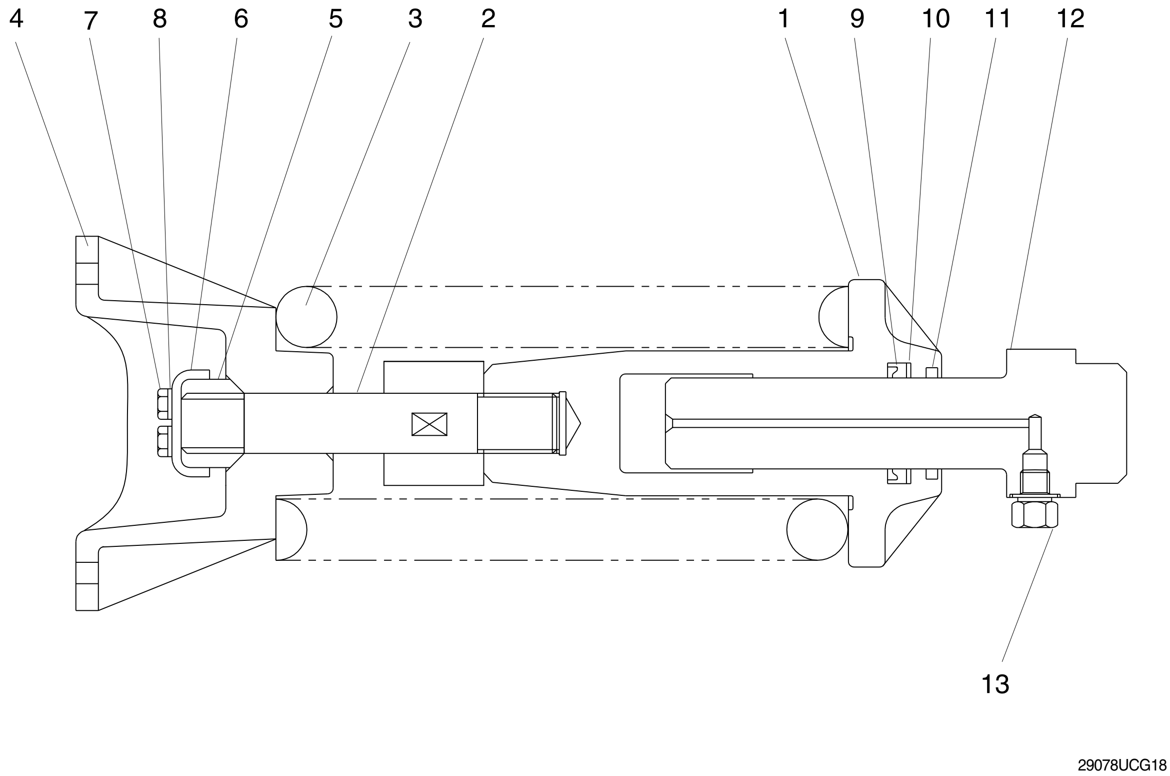


⑧ Lay bracket(6) on its side.
Supply engine oil to the specified level, and tighten plug.



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	14	Stopper tube
5	Lock nut	10	Back up ring		

(2) Disassembly

① Apply pressure on spring(3) with a press.

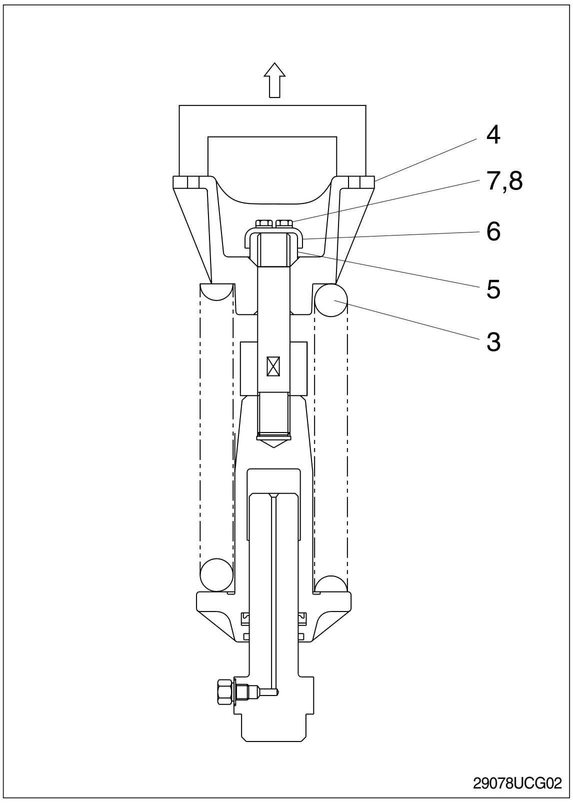
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 19012㎏(41826lb)

② Remove bolt(7), spring washer(8) and lock plate(6).

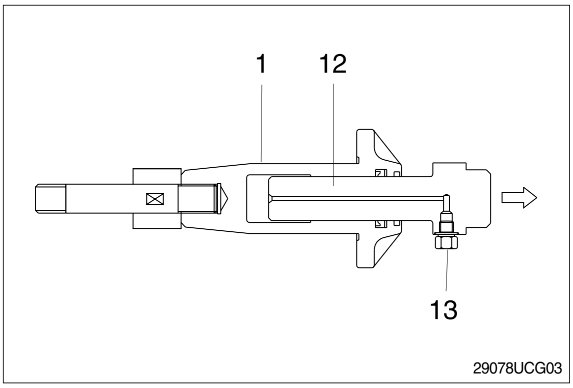
③ Remove lock nut(5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket(4) and spring(3).

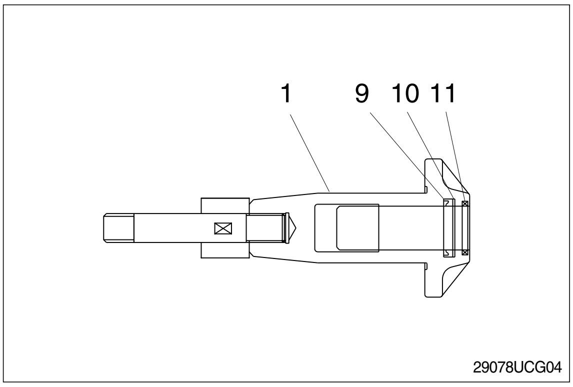


⑤ Remove rod(12) from body(1).

⑥ Remove grease valve(13) from rod(12).



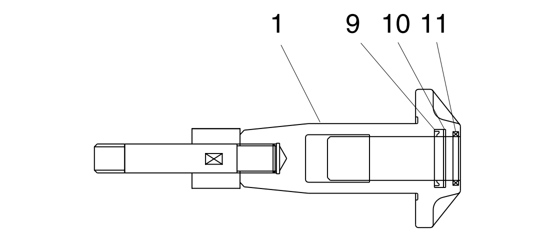
⑦ Remove rod seal(9), back up ring(10) and dust seal(11).



(3) Assembly

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.

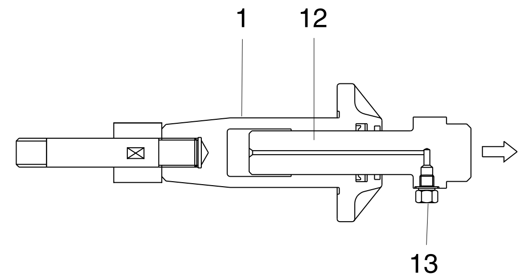


29078UCG05

② Pour grease into body(1), then push in rod(12) by hand.
After take grease out of grease valve mounting hole, let air out.

※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve(13) to rod(12).
· Tightening torque : 13.0±1.0kgf · m (94±7.2lbf · ft)



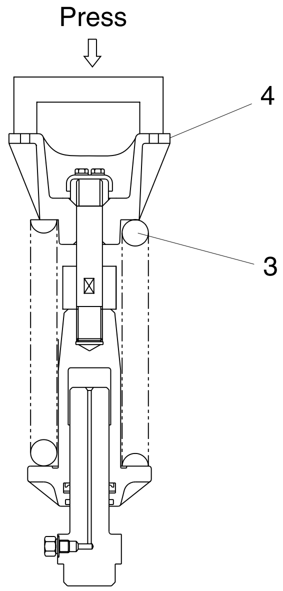
29078UCG06

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.

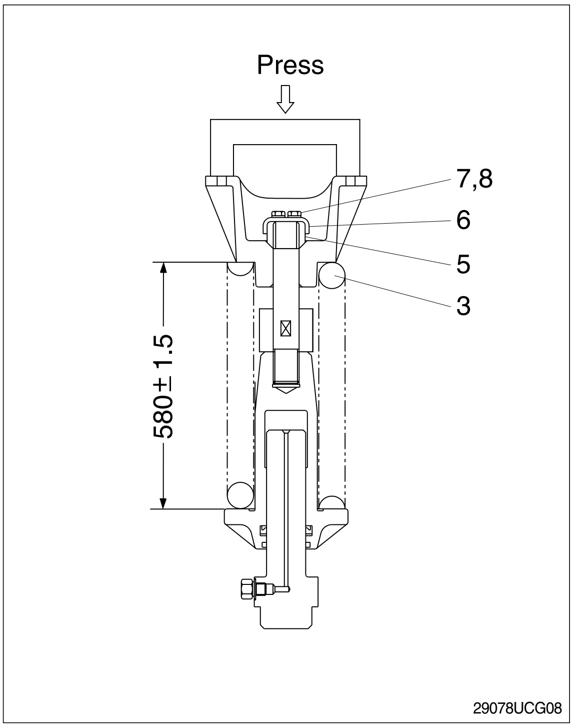
※ During the operation, pay attention specially to prevent the press from slipping out.



29078UCG07

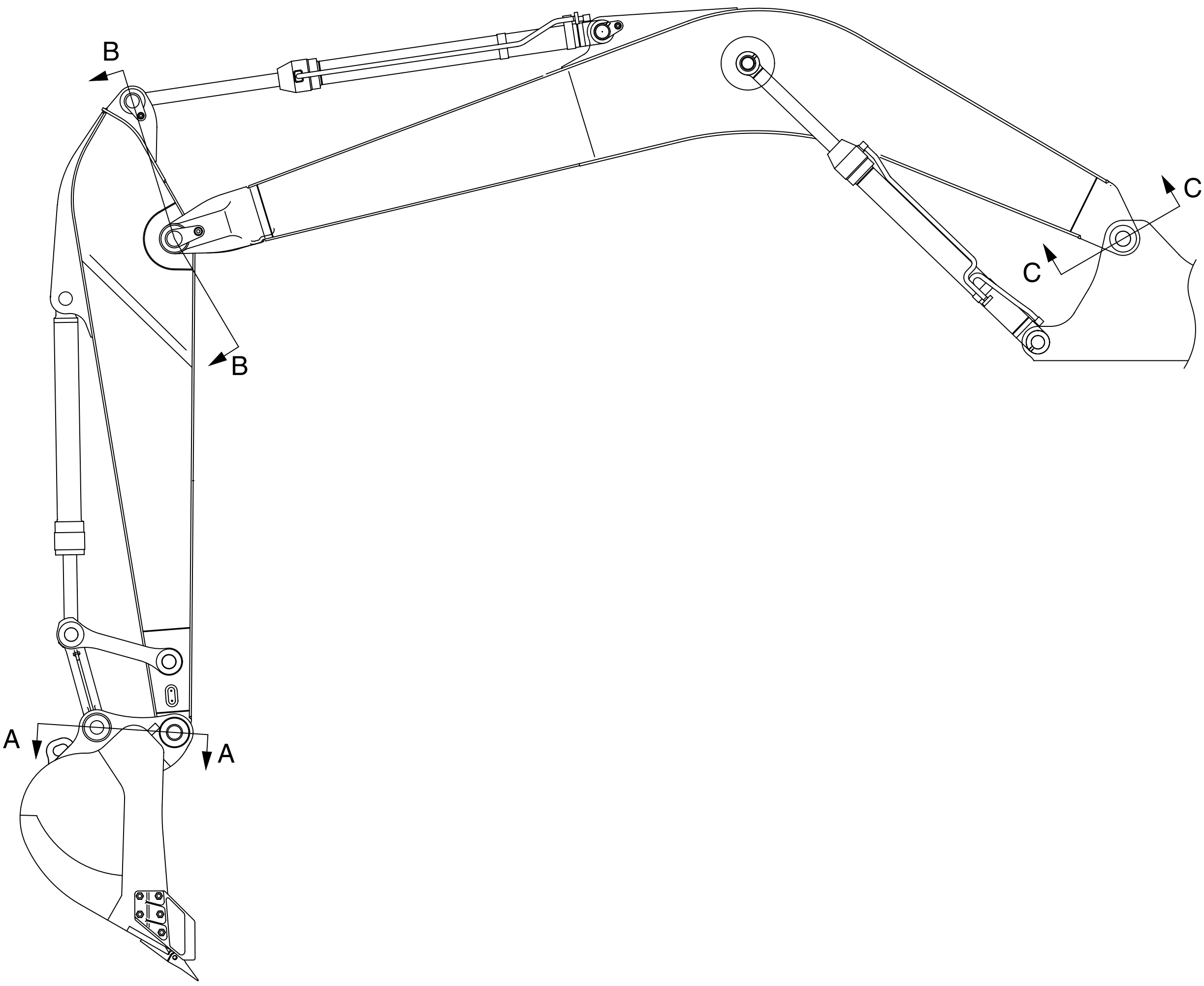
⑥ Lighten the press load and confirm the set length of spring(3).

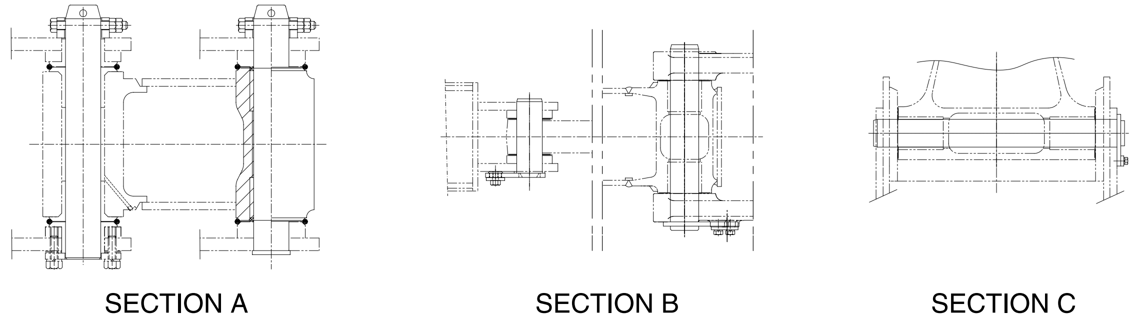
⑦ After the setting of spring(3), install lock plate(6), spring washer(8) and bolt(7).



GROUP 11 WORK EQUIPMENT

1. STRUCTURE





SECTION A SECTION B SECTION C

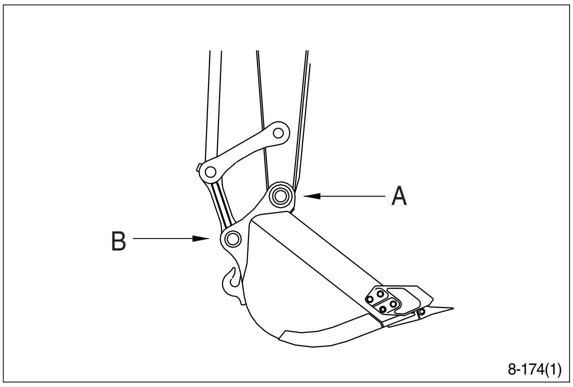
29078WE01

2. REMOVAL AND INSTALL

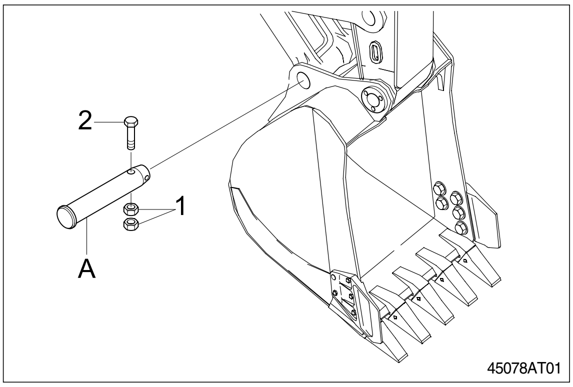
1) BUCKET ASSEMBLY

(1) Removal

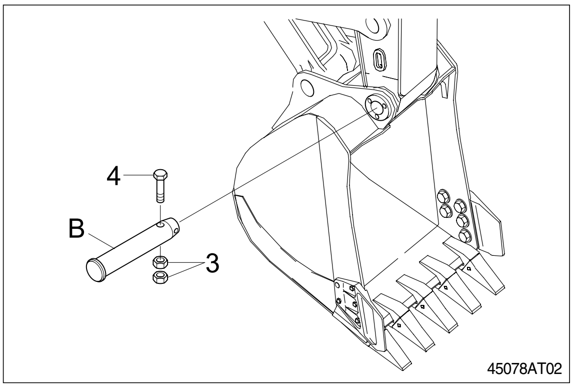
① Lower the work equipment completely to ground with back of bucket facing down.



② Remove nut(1), bolt(2) and draw out the pin(A).



③ Remove nut(3), bolt(4) and draw out the pin(B).

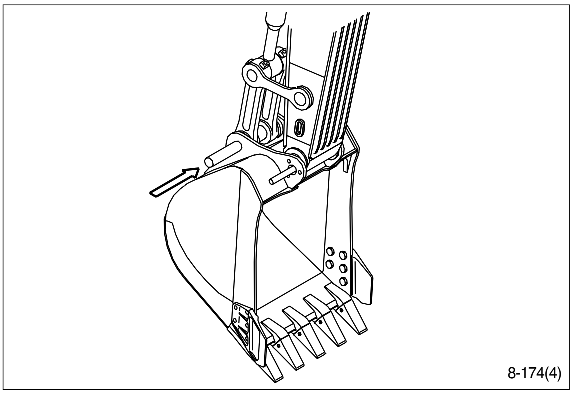


(2) Install

① Carry out installation in the reverse order to removal.

⚠ When aligning the mounting position of the pin, do not insert your fingers in the pin hole.

※ Adjust the bucket clearance.
For detail, see **operation manual.**



2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

① Remove bucket assembly.
For details, see **removal of bucket assembly.**

② Disconnect bucket cylinder hose(1).

⚠ Fit blind plugs in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.

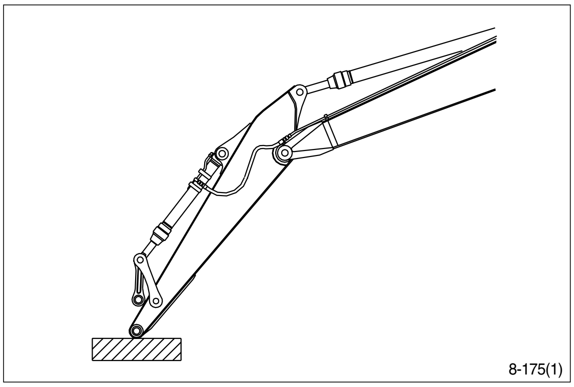
③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

※ Tie the rod with wire to prevent it from coming out.

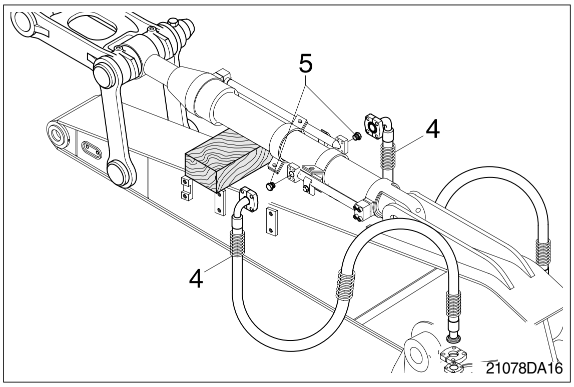
④ For details, see **removal of arm cylinder assembly.**
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt(2), plate(3) and pull out the pin(4) then remove the arm assembly.
· Weight : 1025kg(2260lb)

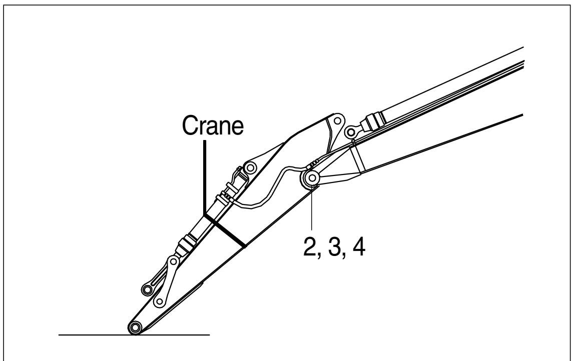
※ When lifting the arm assembly, always lift the center of gravity.



8-175(1)



21078DA16



8-175(3)

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the arm assembly, always lift the center of gravity.

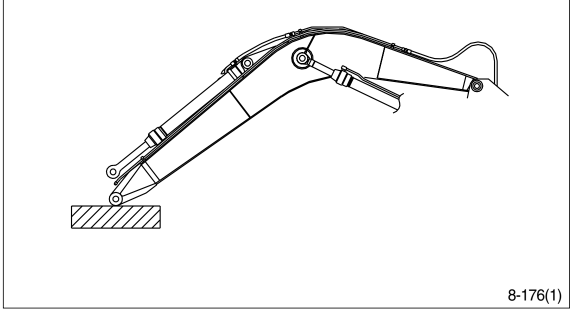
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.
For details, see **removal of arm and bucket assembly.**

② Remove boom cylinder assembly from boom.
For details, see **removal of arm cylinder assembly.**



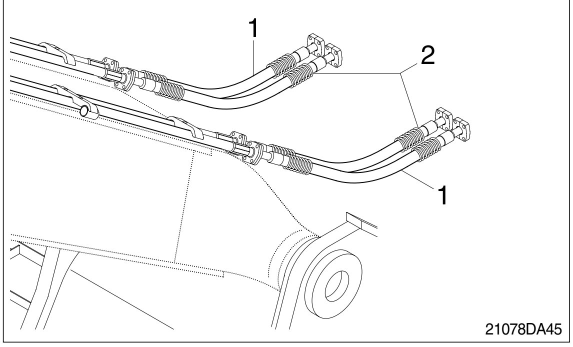
8-176(1)

③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose(2) and arm cylinder hose(1).

※ When the hose are disconnected, oil may spurt out.

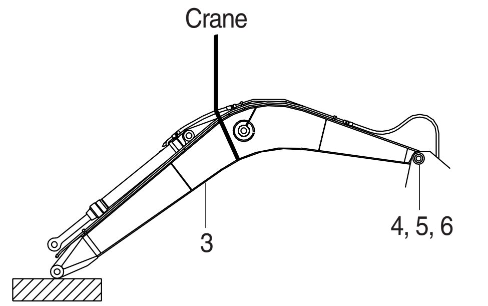
⑤ Sling boom assembly(3).



21078DA45

⑥ Remove bolt(4), plate(5) and pull out the pin(6) then remove boom assembly.
· Weight : 2200㎏(4860㏈)

※ When lifting the boom assembly always lift the center of gravity.



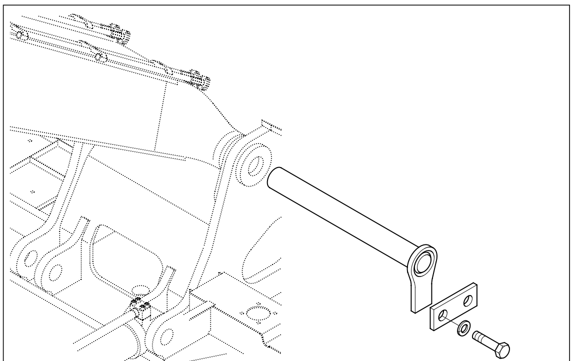
8-176(3)

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the arm assembly, always lift the center of gravity.

※ Bleed the air from the cylinder.



21078DA46

SECTION 9 COMPONENT MOUNTING TORQUE

SECTION 9 COMPONENT MOUNTING TORQUE

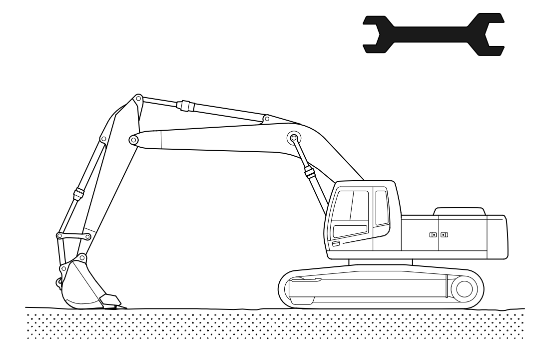
GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.

2. Use genuine HD Hyundai Construction Equipment spare parts.
   We expressly point out that HD Hyundai Construction Equipment will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases HD Hyundai Construction Equipment cannot assume liability for any damage.

※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.

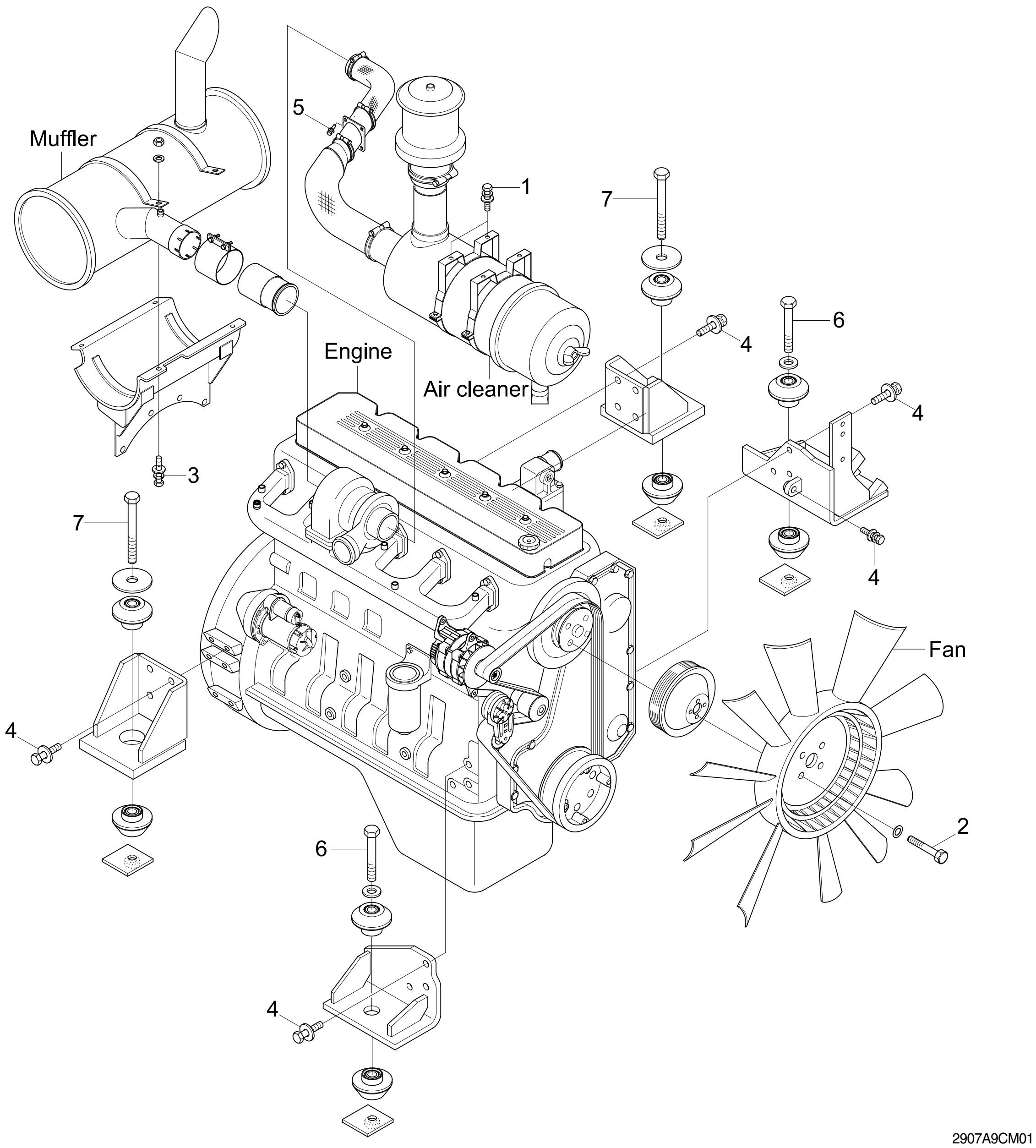
※ Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



29079CM00

GROUP 2 ENGINE SYSTEM

ENGINE AND ACCESSORIES MOUNTING

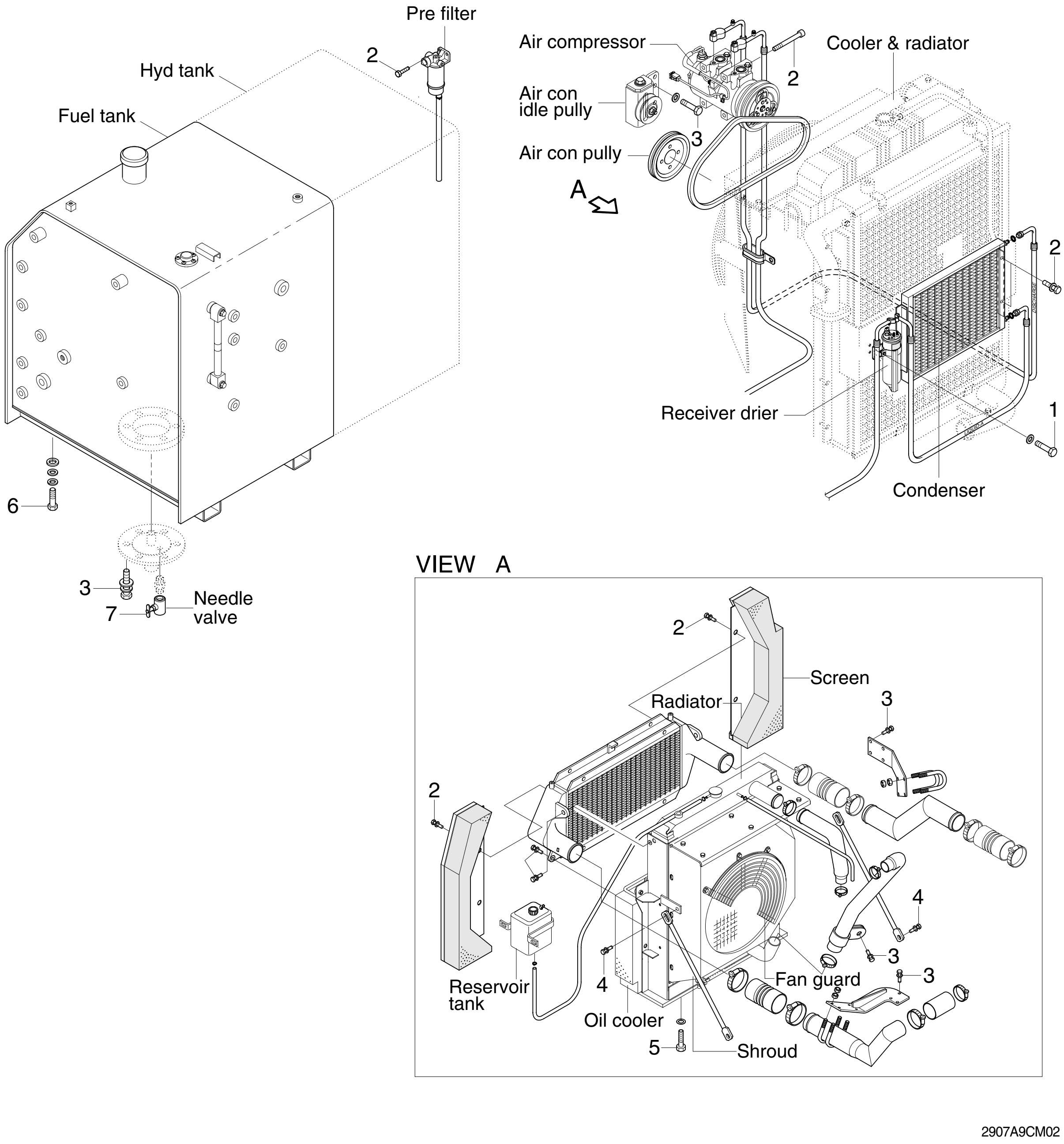


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	4.4±0.9	31.8±6.5
3	M10×1.5	6.9±1.4	49.9±10.1
4	M12×1.75	10.0±2.0	72.3±14.5

Item	Size	kgf · m	lbf · ft
5	M12×1.75	12.8±3.0	92.6±21.7
6	M20×2.5	55±3.5	398±25.3
7	M24×3.0	90±7.0	651±51
-	-	-	-

COOLING SYSTEM AND FUEL TANK MOUNTING



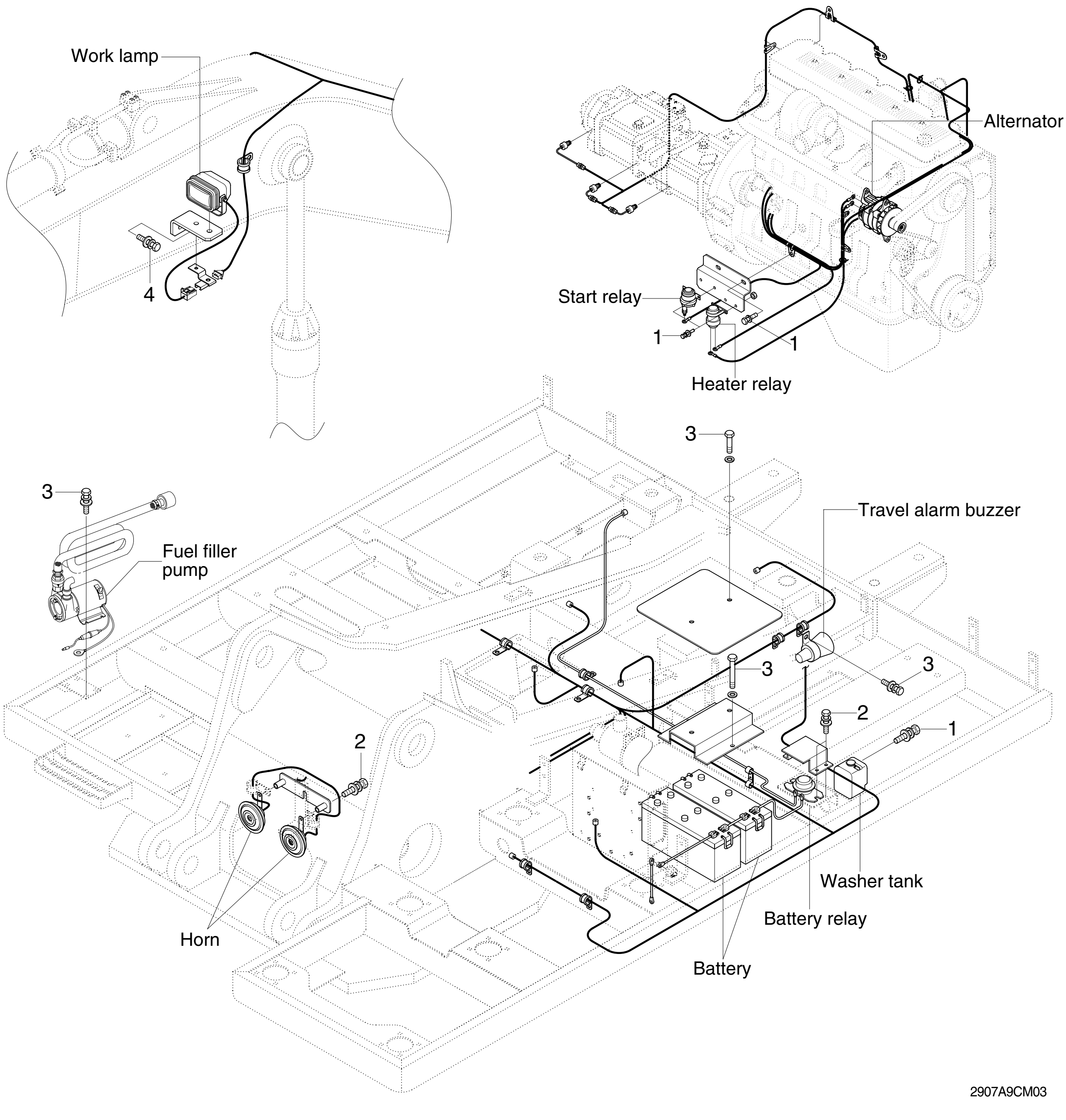
· Tightening torque

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
4	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
5	M16×2.0	29.7±4.5	215±32.5
6	M20×2.5	45±5.1	325±36.9
7	-	2.3±0.6	16.6±4.3
-	-	-	-

GROUP 3 ELECTRIC SYSTEM

ELECTRIC COMPONENTS MOUNTING 1

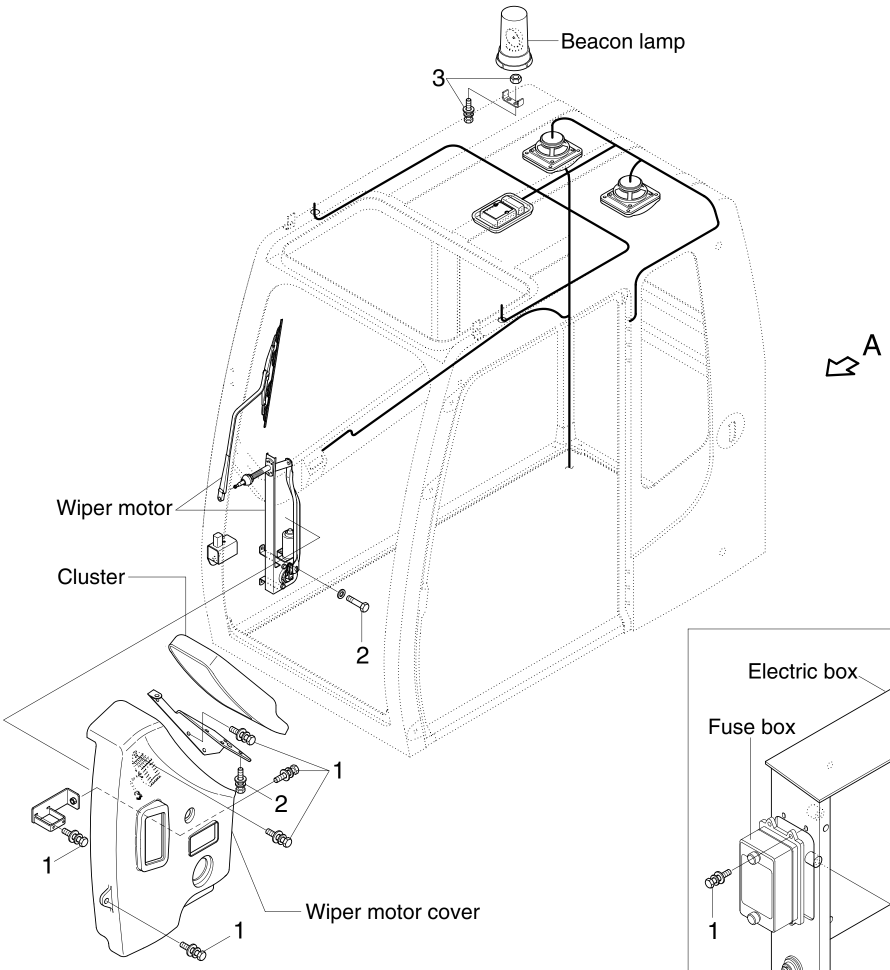


· Tightening torque

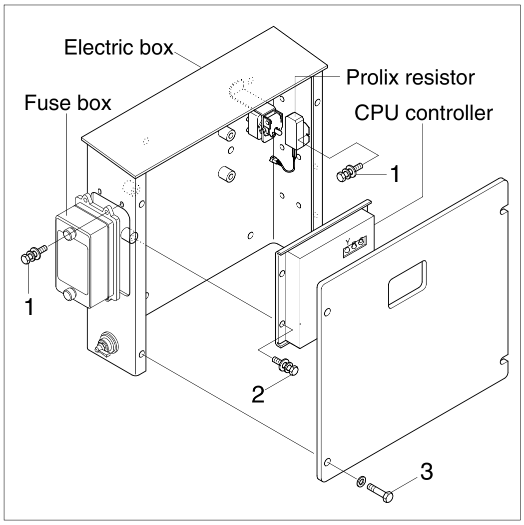
Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

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



VIEW A



36079CM04

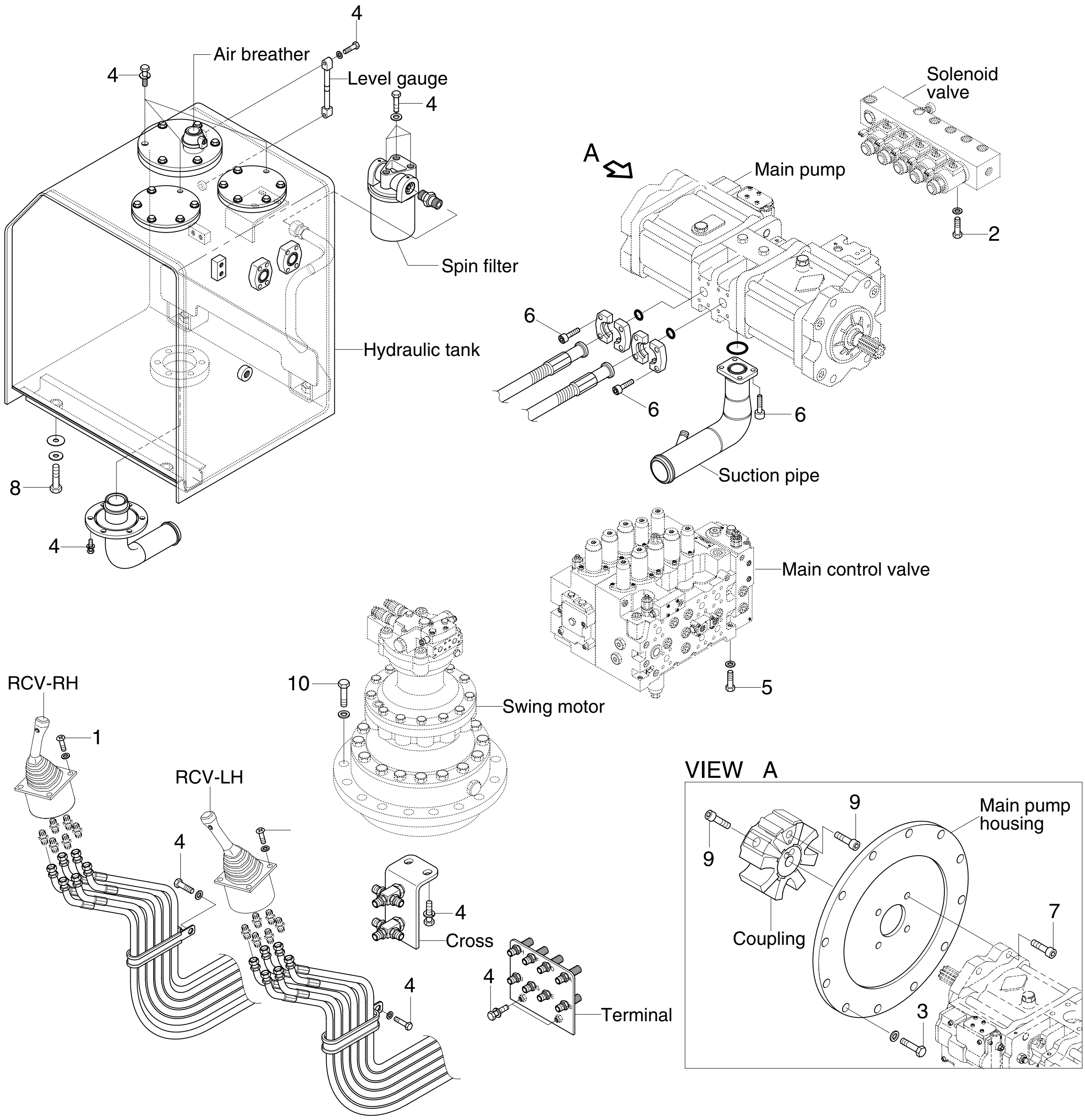
· Tightening torque

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

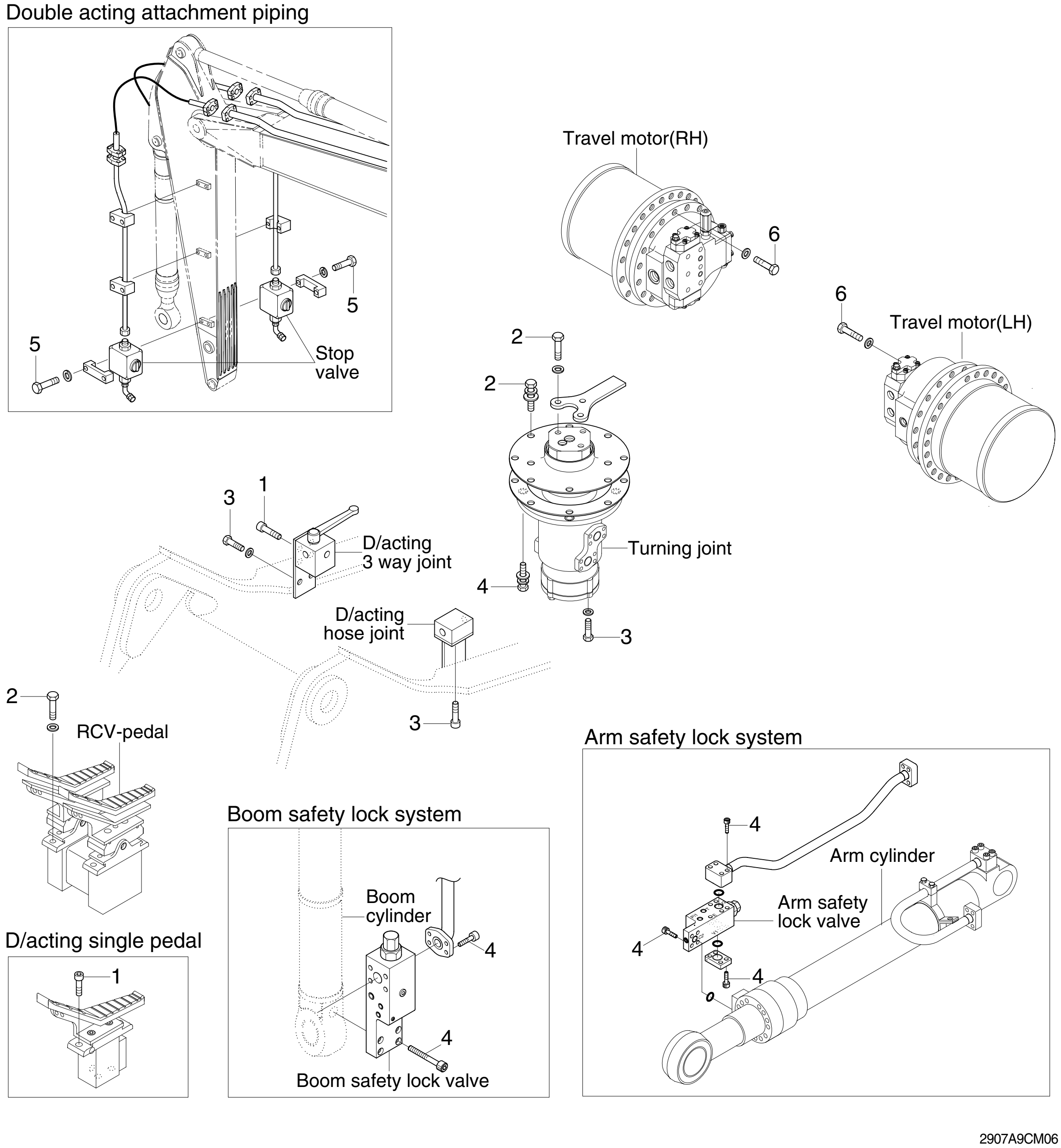


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	4.8±0.3	34.7±2.2
4	M10×1.5	6.9±1.4	49.9±10.1
5	M12×1.75	12.2±1.3	88.9±9.4

Item	Size	kgf · m	lbf · ft
6	M12×1.75	12.8±3.0	92.5±21.6
7	M20×2.5	42±4.5	304±32.5
8	M20×2.5	46±5.0	333±36
9	M20×2.5	46.5±2.5	336±18.1
10	M20×2.5	58.4±6.4	422±46.2

HYDRAULIC COMPONENTS MOUNTING 2

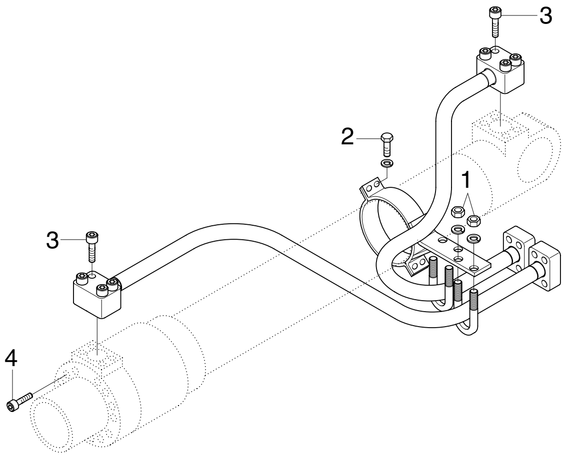


· Tightening torque

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	12.3±1.3	88.9±9.4

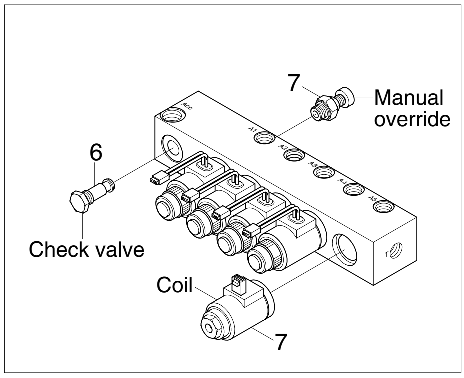
Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	92.6±21.7
5	M16×2.0	29.7±4.5	215±32.5
6	M24×3.0	100±10	723±72.3

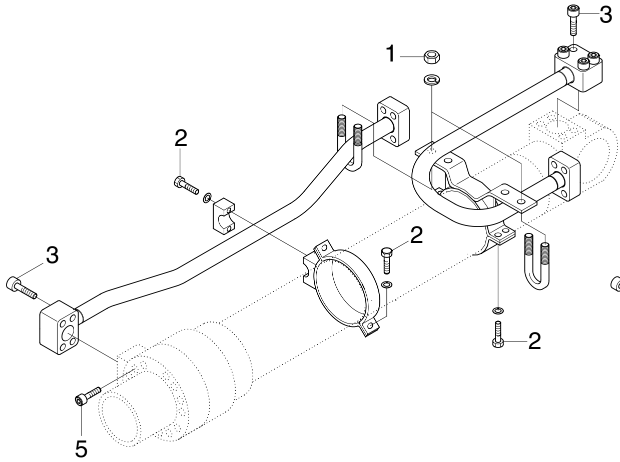
HYDRAULIC COMPONENTS MOUNTING 3



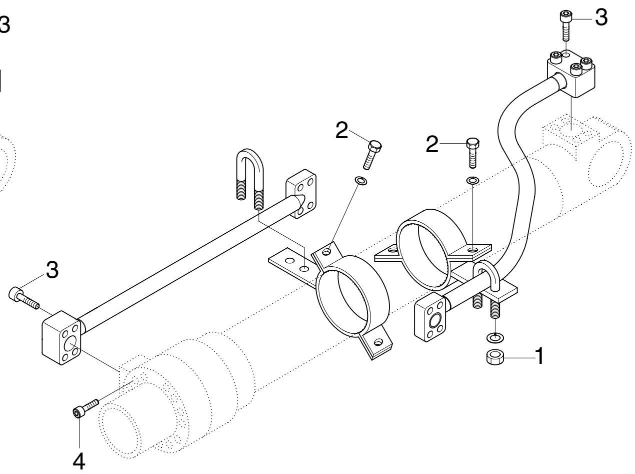
BOOM CYLINDER

Solenoid valve





ARM CYLINDER



BUCKET CYLINDER

2907A9CM07

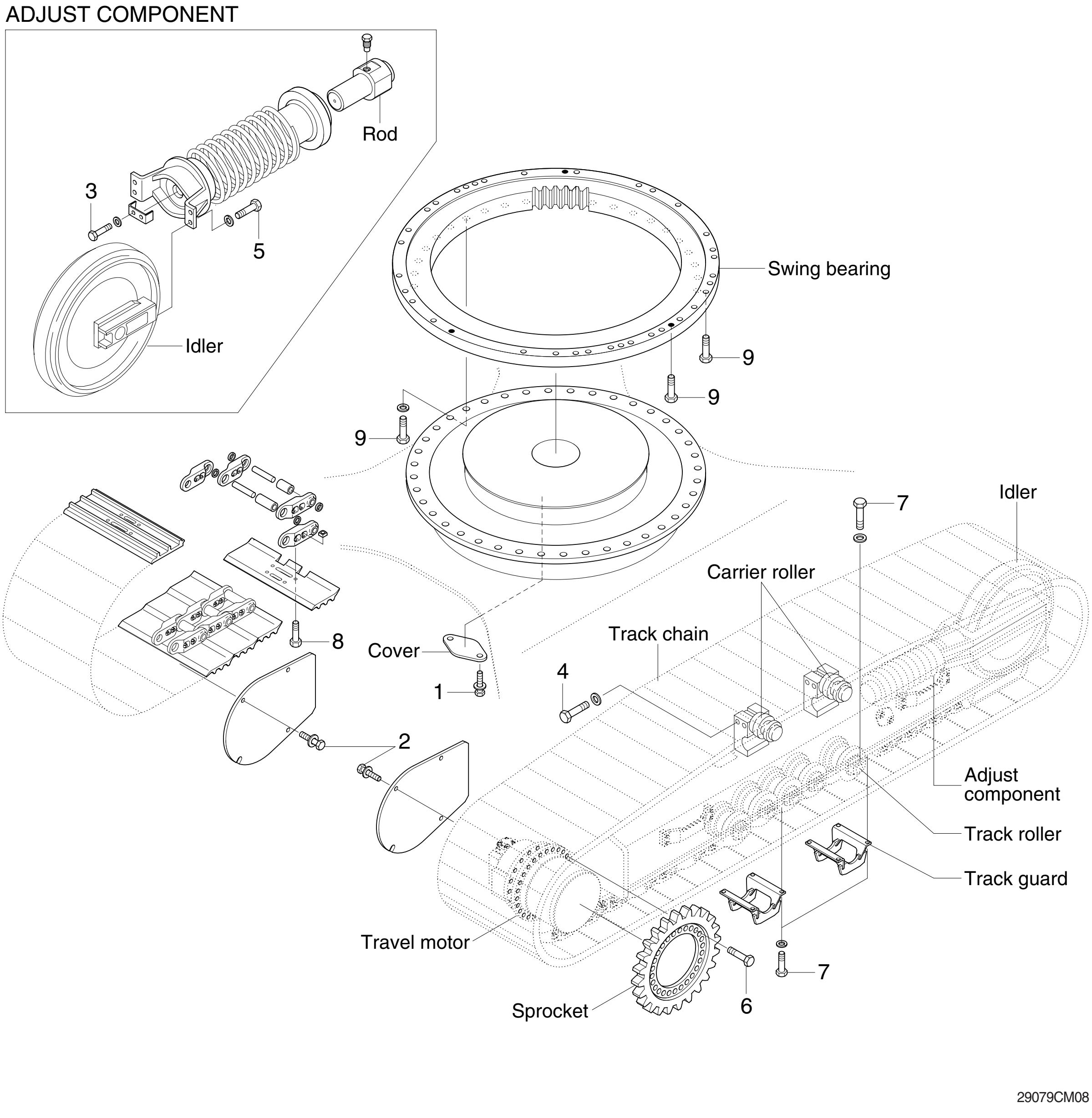
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	3.2±0.3	23.1±2.2
2	M12×1.75	5.5±0.6	39.8±4.3
3	M12×1.75	9.4±1.0	68.0±7.2
4	M18×2.5	32±3.0	232±21.7

Item	Size	kgf · m	lbf · ft
5	M20×2.5	46±5.0	333±36.2
6	M22×2.5	4.1	29.6
7	M27×3.0	5.1	36.9
-	-	-	-

GROUP 5 UNDERCARRIAGE

UNDERCARRIAGE MOUNTING

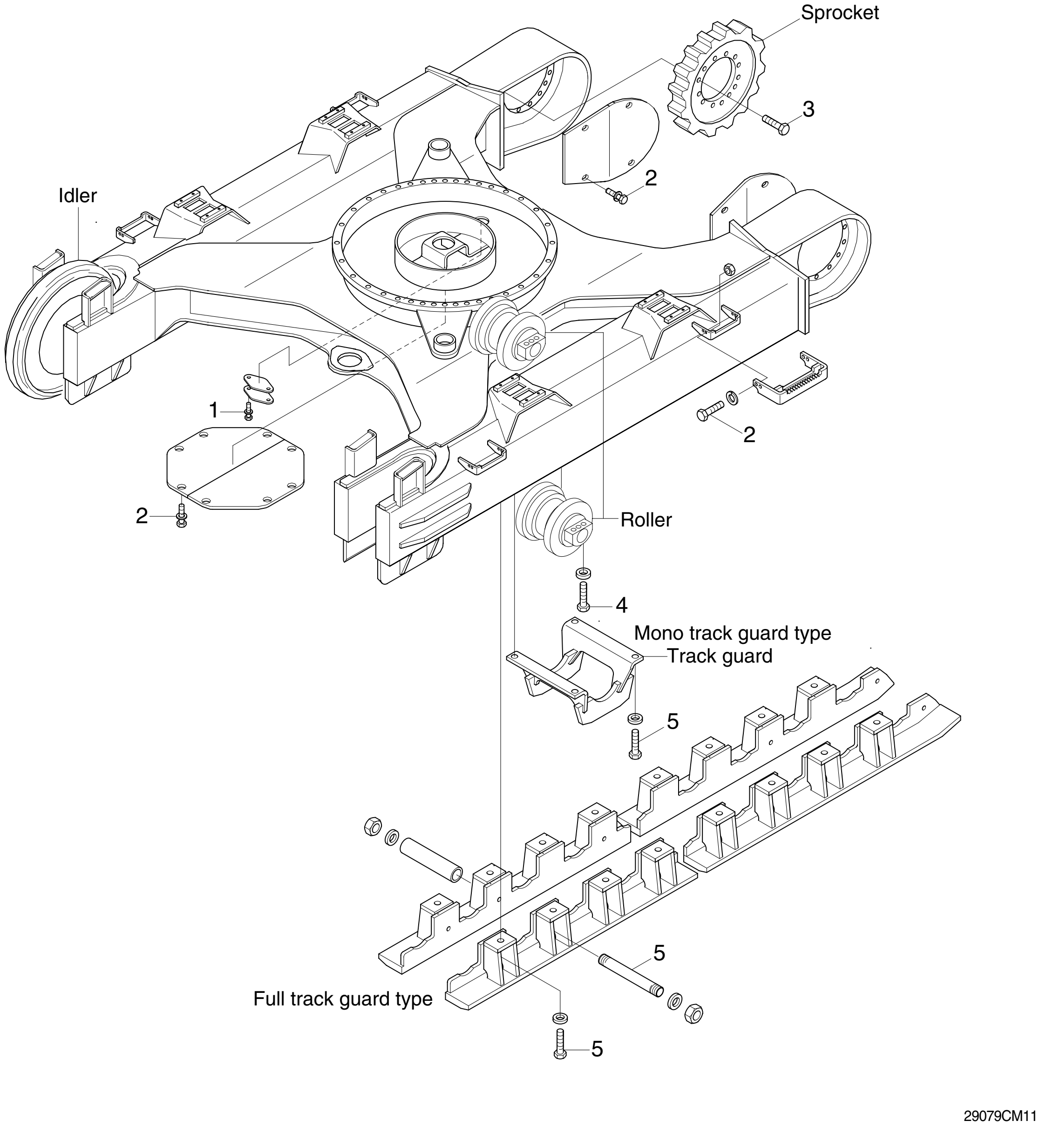


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.8±3.0	92.6±21.7
3	M12×1.75	15±0.5	108±3.6
4	M16×2.0	29.7±4.5	215±32.5
5	M16×1.5	31.3±4.7	226±34

Item	Size	kgf · m	lbf · ft
6	M20×2.5	57±6.0	412±43.3
7	M20×2.5	57.9±8.7	419±62.9
8	M22×1.5	115±5.0	831±36
9	M24×3.0	97.8±10	707±72.3
-	-	-	-

UNDERCARRIAGE MOUNTING(HIGH WALKER)

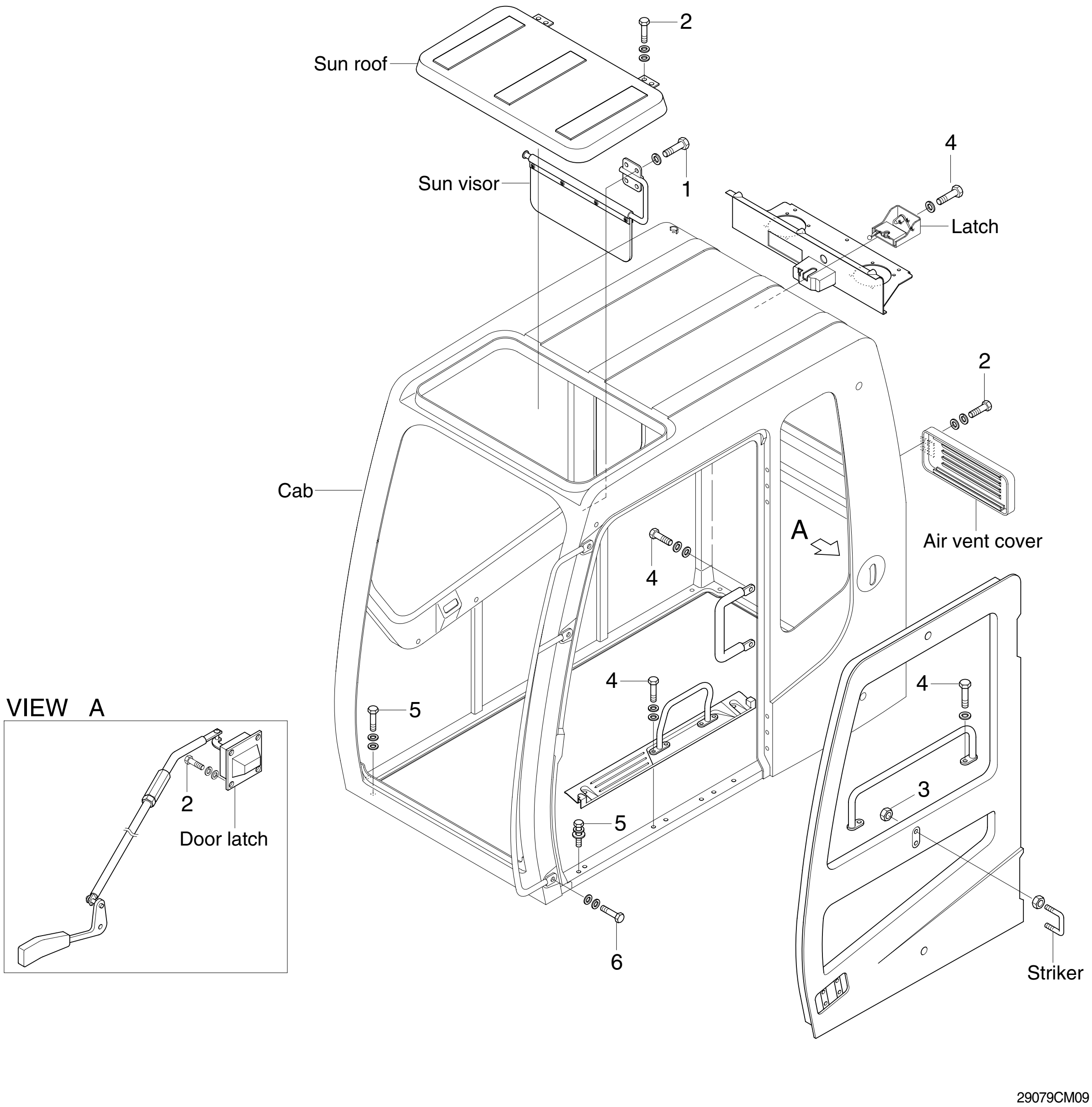


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.2±1.3	88.2±9.4
3	M20×2.5	51±4.0	369±28.9
4	M20×2.5	57.9±8.6	419±62.2
5	M24×3.0	100±15	723±108
6	-	-	-

GROUP 6 STRUCTURE

CAB AND ACCESSORIES MOUNTING

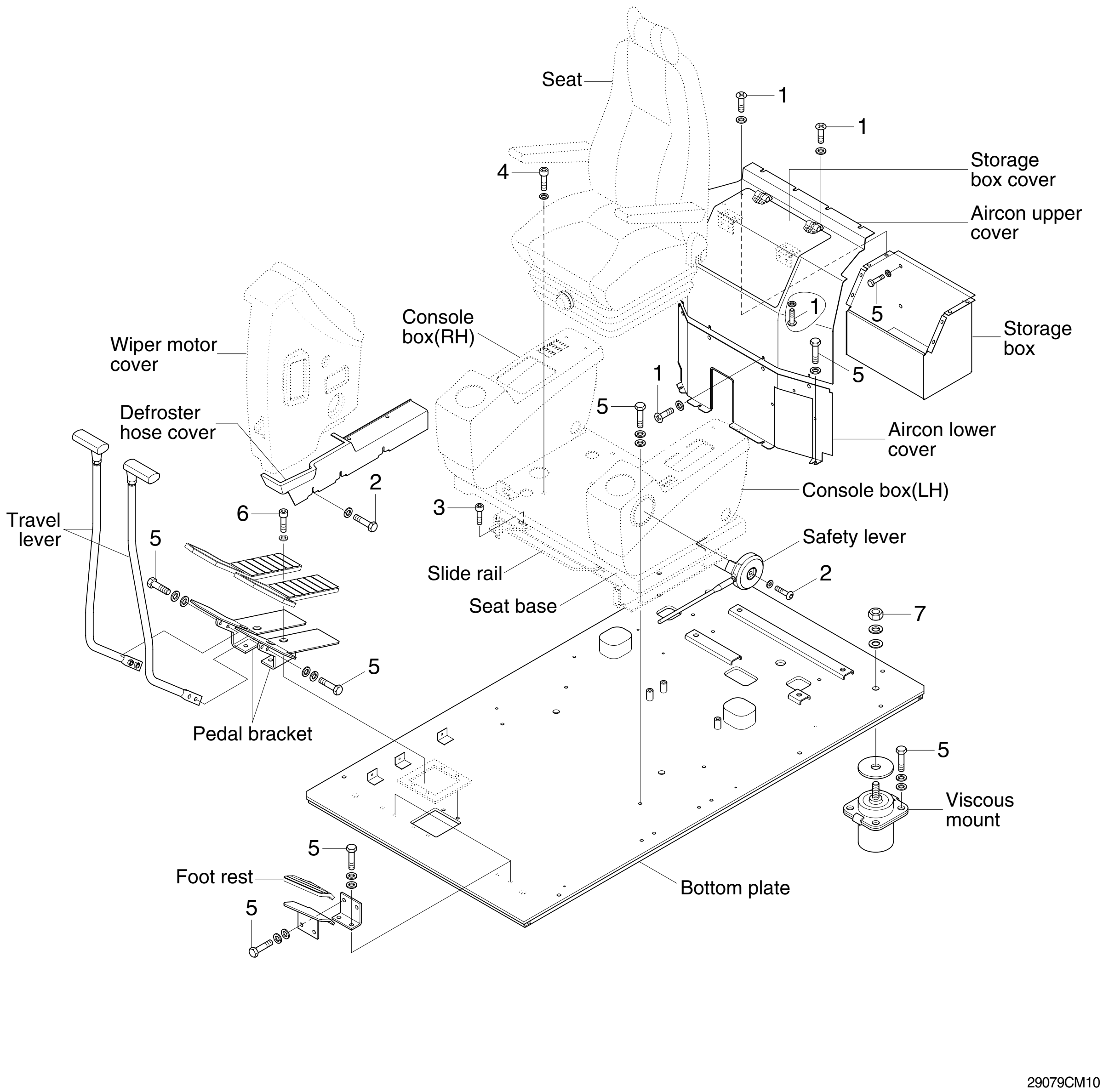


· Tightening torque

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

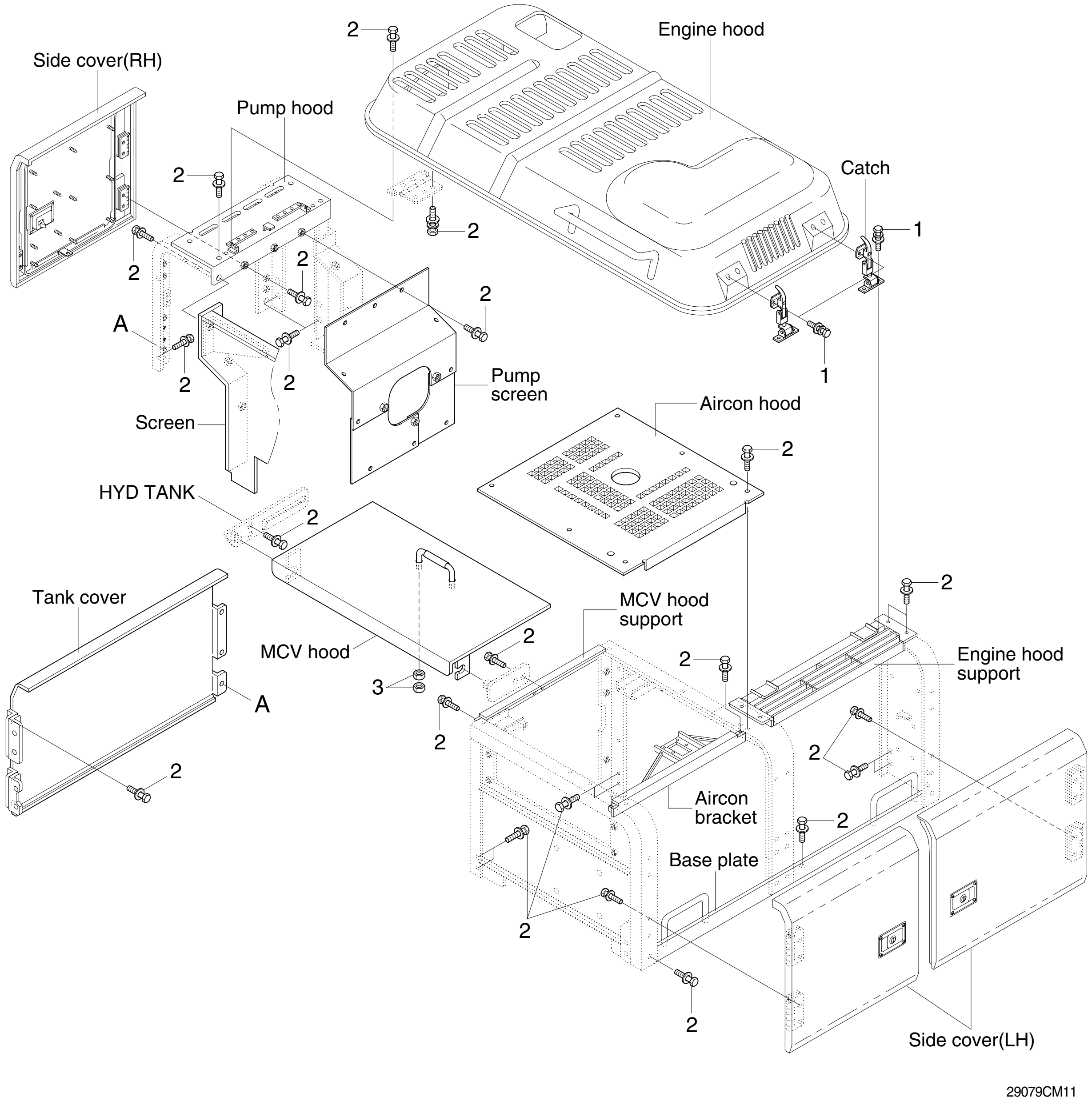


· Tightening torque

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	2.5±0.5	18.1±3.6

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

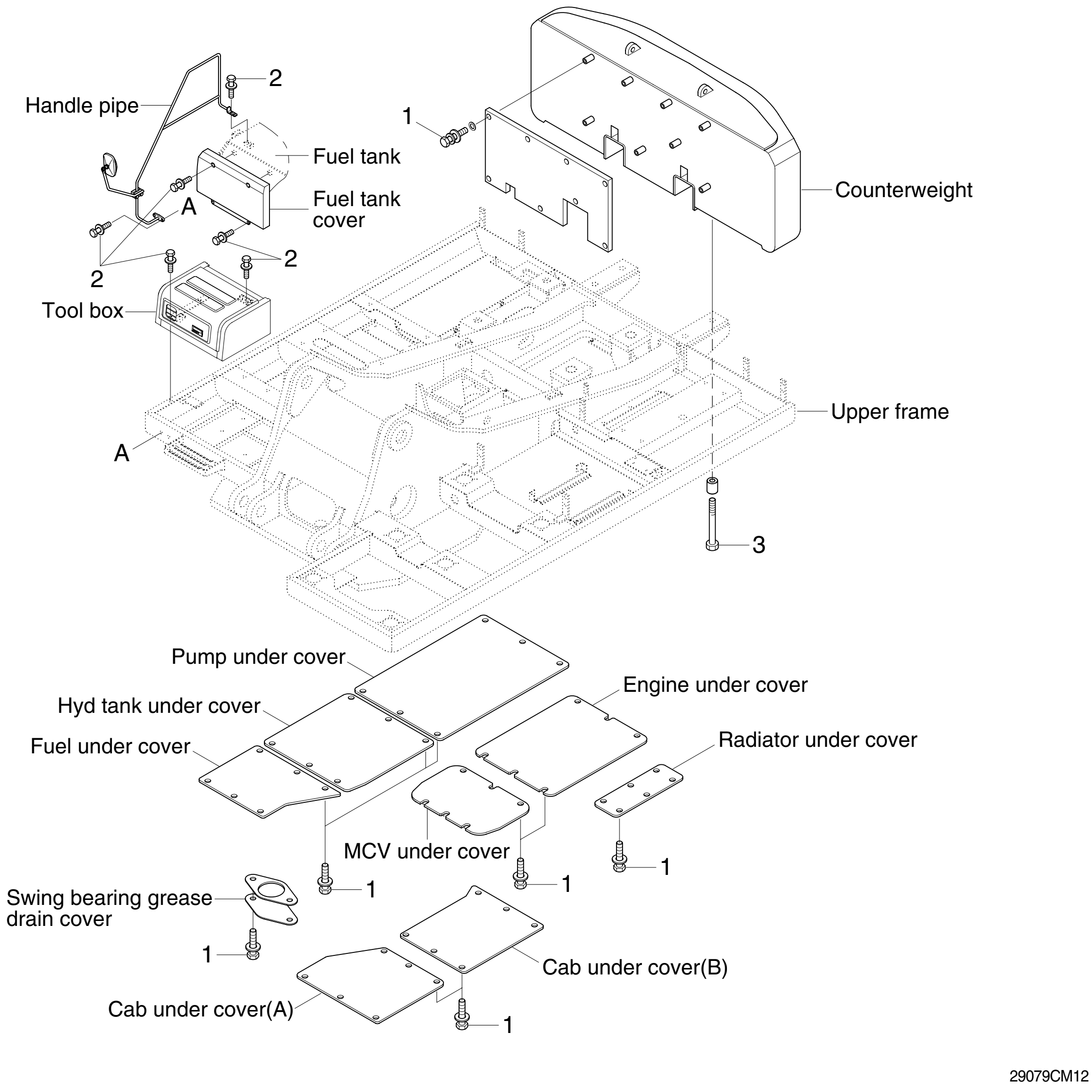


· Tightening torque

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

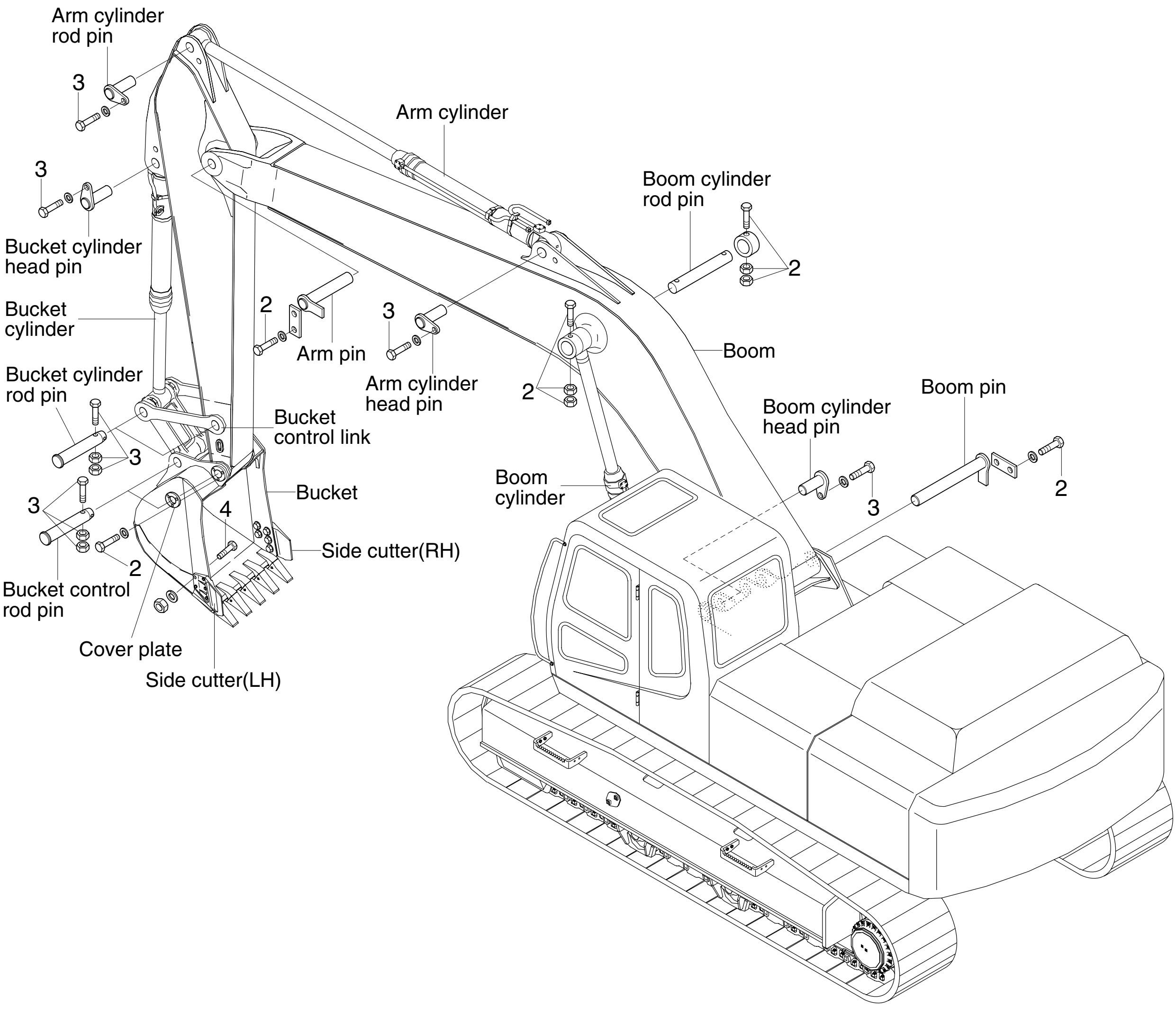


· Tightening torque

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
4	M22×2.5	81.9±16.1	592±116