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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.

SECTION 9 COMPONENT MOUNTING TORQUE

This section shows bolt specifications and standard torque values needed when mounting components to the machine.

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

Any additions, amendments or other changes will be sent to HYUNDAI distributors.
Get the most up-to-date information before you start any work.

Filing method

1. See the page number on the bottom of the page.
   File the pages in correct order.
2. Following examples shows how to read the page number.
   Example 1
   2 - 3
   - 2: Item number(2. Structure and Function)
   - 3: Consecutive page number for each item.
3. Additional pages : Additional pages are indicated by a hyphen(-) and number after the page number. File as in the example.

   10 - 4
   10 - 4 - 1 ┐ Added pages
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Revised edition mark(①②③…)

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

Revisions

Revised pages are shown at the list of revised pages on the between the contents page and section 1 page.

Symbols

So that the shop manual can be of ample practical use, important places for safety and quality are marked with the following symbols.

Symbol	Item	Remarks
⚠	Safety	Special safety precautions are necessary when performing the work.
		Extra special safety precautions are necessary when performing the work because it is under internal pressure.
※	Caution	Special technical precautions or other precautions for preserving standards are necessary when performing the work.

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

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

   Convert 55mm into inches.

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

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

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

2. Convert 550mm into inches.

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

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

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

Millimeters to inches

ⓑ

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 l = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 l = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/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

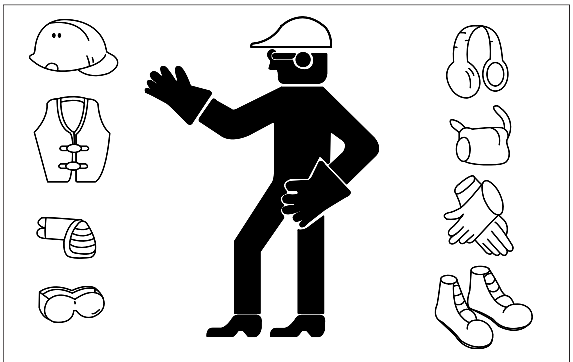
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

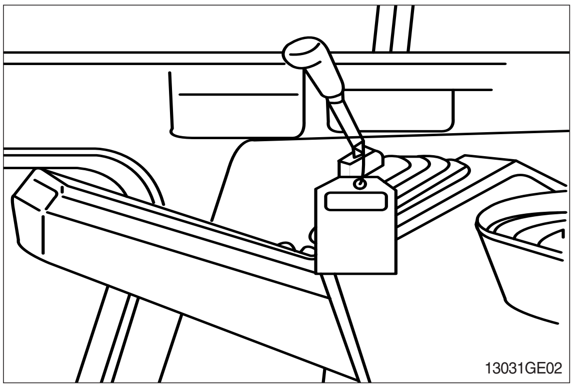
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

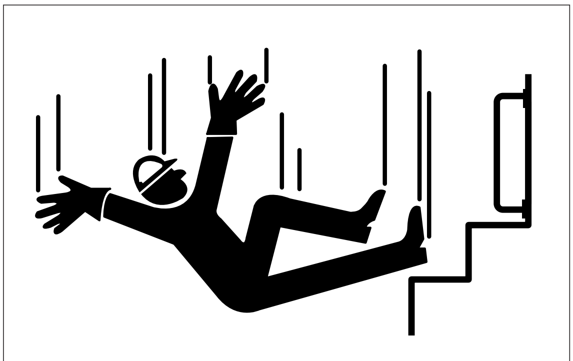
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「Do Not Operate」tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



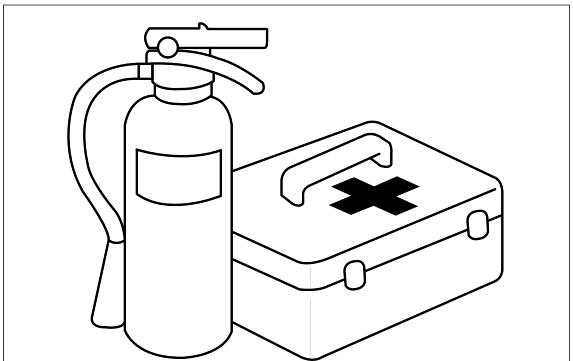
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

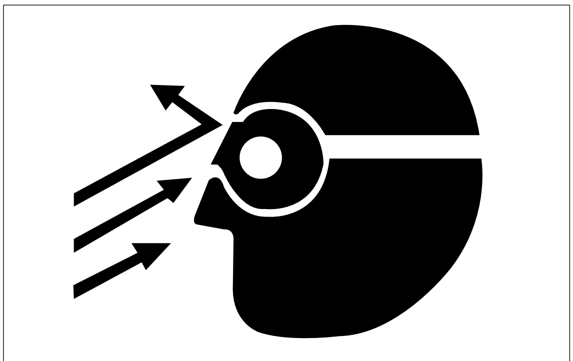
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

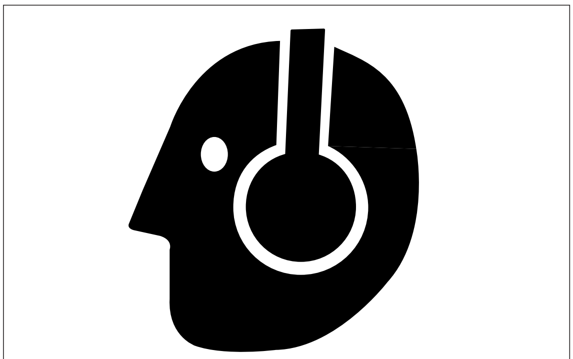


13031GE05

PROTECT AGAINST NOISE

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

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

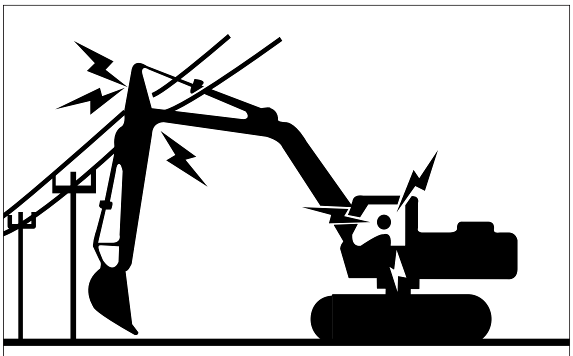


13031GE06

AVOID POWER LINES

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

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

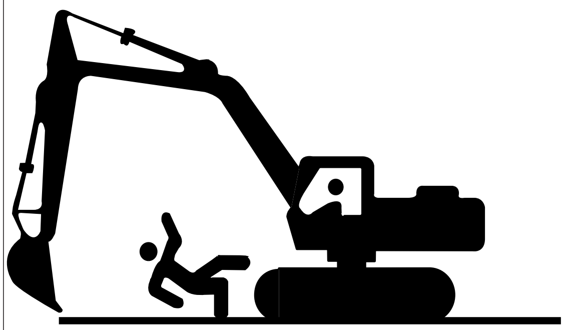


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



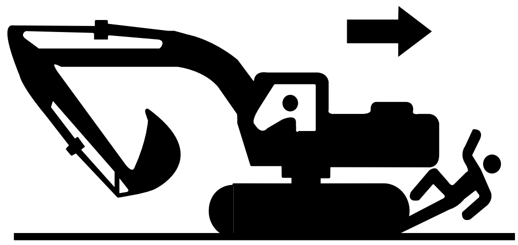
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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

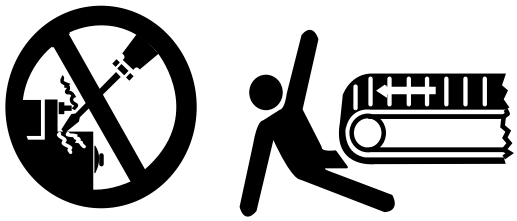


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



13031GE26

PARK MACHINE SAFELY

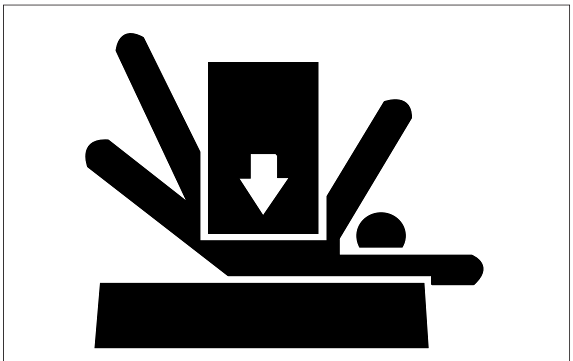
Before working on the machine :

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

SUPPORT MACHINE PROPERLY

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

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

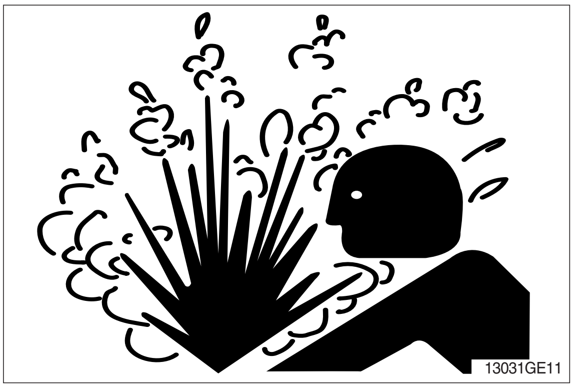


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

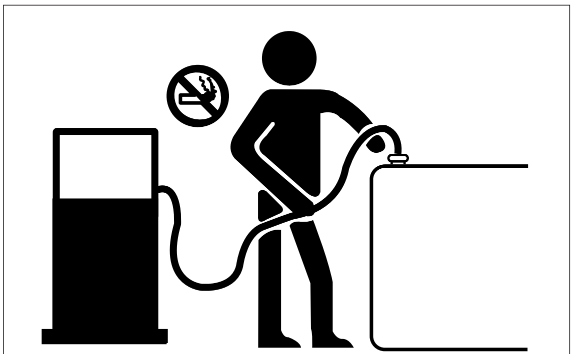
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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



13031GE12

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

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

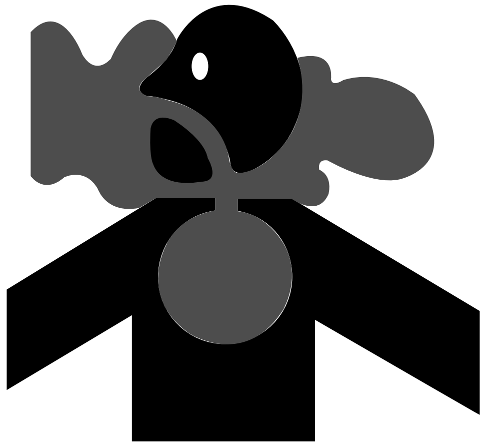
Do not store oily rags; They can ignite and burn spontaneously.

13031GE13

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

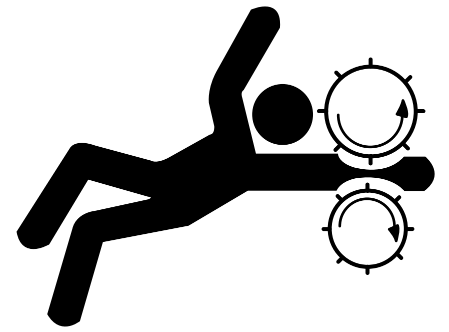
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

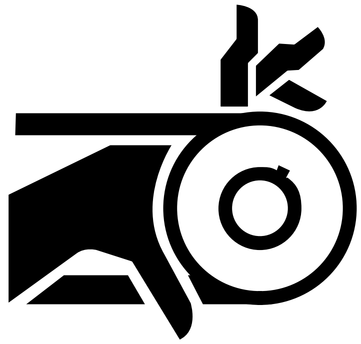


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

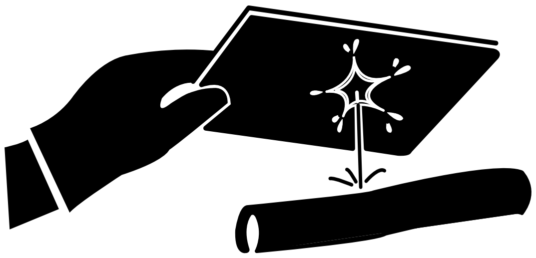
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

13031GE20

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

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

PREVENT BATTERY EXPLOSIONS

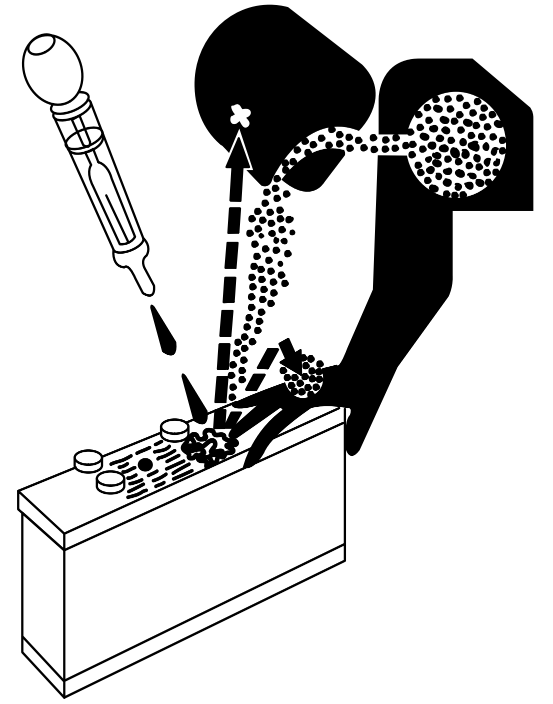
13031GE21

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

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

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

PREVENT ACID BURNS


13031GE22

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

Avoid the hazard by:

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

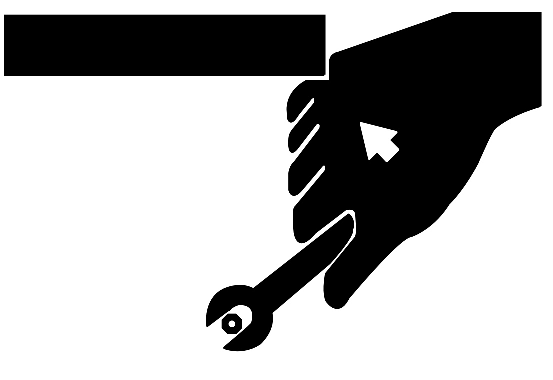
If you spill acid on yourself:

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

If acid is swallowed:

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

USE TOOLS PROPERLY


13031GE23

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

Use power tools only to loosen threaded tools and fasteners.

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

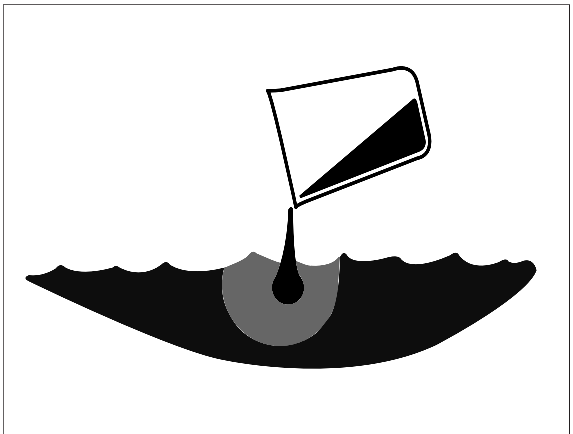
Use only recommended replacement parts. (See Parts catalogue.)

DISPOSE OF FLUIDS PROPERLY

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

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

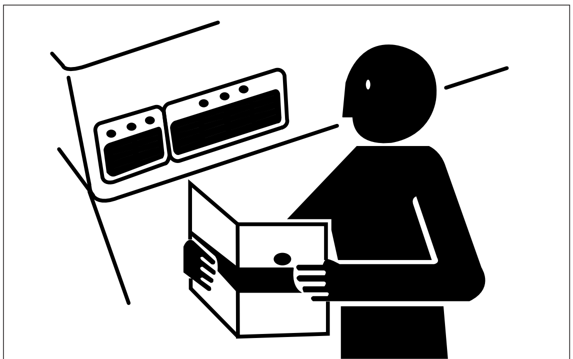
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



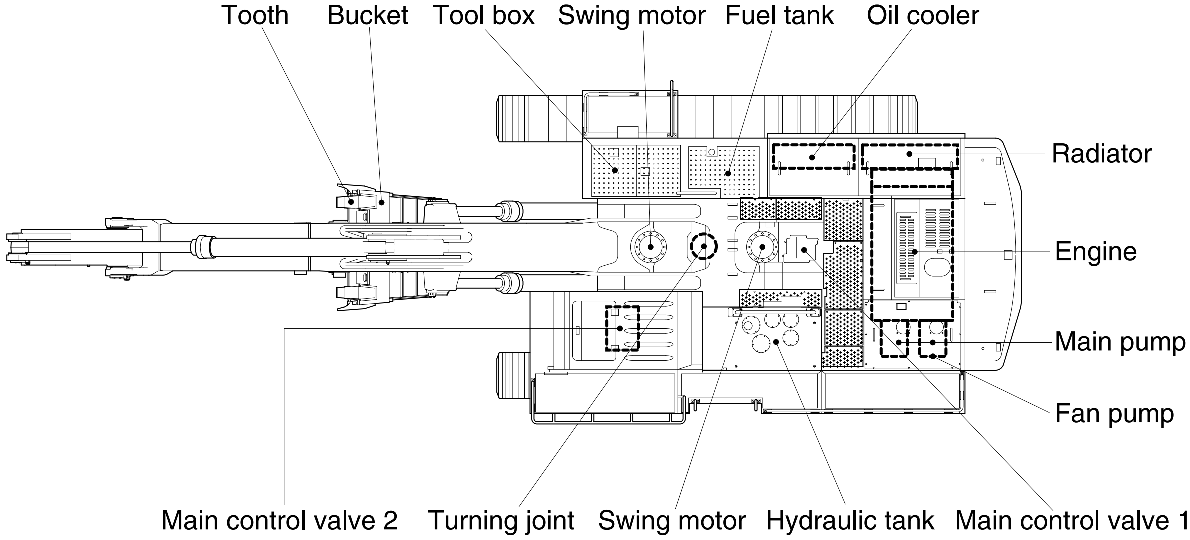
13031GE25

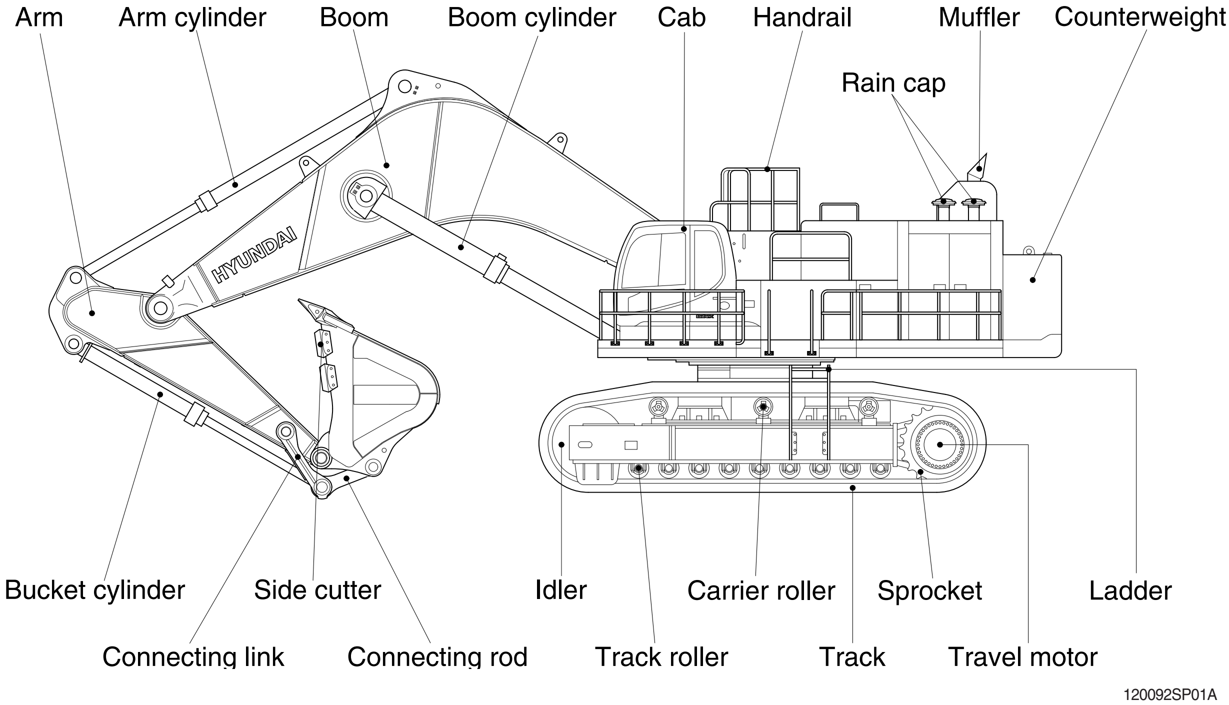
LIVE WITH SAFETY

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

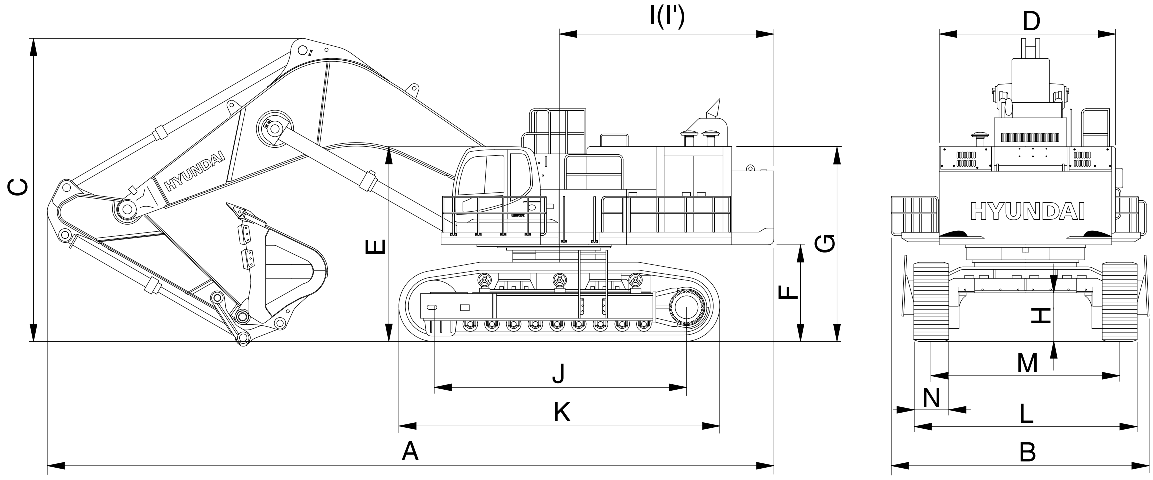




120092SP01A

2. SPECIFICATIONS

· 7.55 m (24' 9") BOOM, 3.40 m (11' 2") ARM



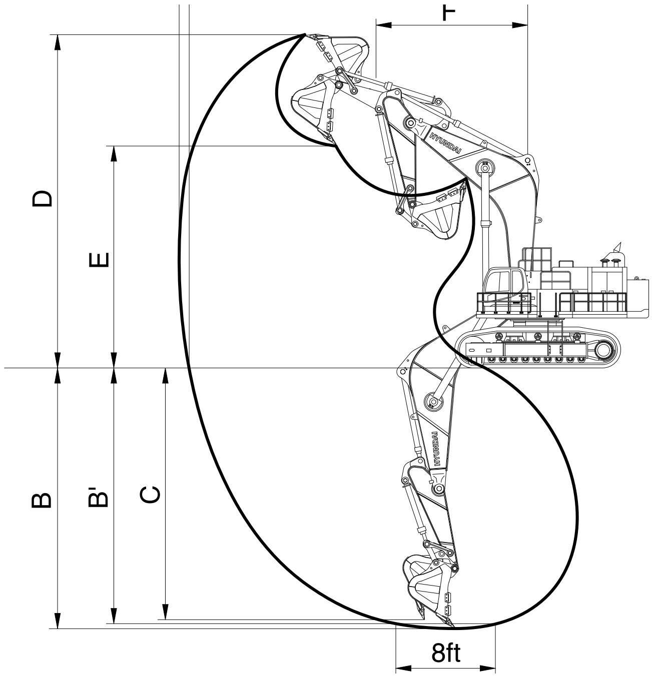
120092SP02A

Description		Unit	Specification
Operating weight		kg (lb)	118000 (260140) <118860 (262036)>
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	6.70 (8.76)
Overall length	A		14580 (47' 10")
Overall width, with 700 mm shoe	B		5560 (18' 3")
Overall height	C		6210 (20' 4")
Superstructure width	D		3520 (11' 7")
Overall height of cab	E		4250 (13' 11") <5450 (17' 11")>
Ground clearance of counterweight	F		1825 (6' 0")
Body height	G		4460 (14' 8")
Minimum ground clearance	H	mm (ft-in)	990 (3' 3")
Rear-end distance	I		4805 (15' 9")
Rear-end swing radius	I'		4870 (16' 0")
Distance between tumblers	J		5010 (16' 5")
Undercarriage length	K		6400 (21' 0")
Undercarriage width	L		4600 (15' 1")
Track gauge	M		3900 (12' 10")
Track shoe width, standard	N		700 (28")
Travel speed (low/high)		km/hr (mph)	2.3/3.2 (1.4/2.0)
Swing speed		rpm	5.6
Gradeability		Degree (%)	35 (70)
Ground pressure (700 mm shoe)		kgf/cm^2(psi)	1.51 (21.47)
Max traction force		kg (lb)	70200 (154760)

< >: Cabin riser

3. WORKING RANGE

· 7.55 m (24' 9") BOOM



120092SP03A

Description		3.40 m (11' 2") Arm
Max digging reach	A	13760 mm (45' 2")
Max digging reach on ground	A'	13380 mm (43'11")
Max digging depth	B	8010 mm (26' 3")
Max digging depth (8ft level)	B'	7840 mm (25' 9")
Max vertical wall digging depth	C	5230 mm (17' 2")
Max digging height	D	12420 mm (40' 9")
Max dumping height	E	7840 mm (25' 9")
Min swing radius	F	6550 mm (21' 6")
Bucket digging force	SAE	511.9[558.5] kN
		52200[56950] kgf
		115080[125550] lbf
	ISO	581.5[636.0] kN
		59300[64690] kgf
		130730[142610] lbf
Arm crowd force	SAE	423.7[462.2] kN
		43200[47130] kgf
		95240[103900] lbf
	ISO	429.5[468.6] kN
		43800[47780] kgf
		96560[105340] lbf

[ ] : Power boost

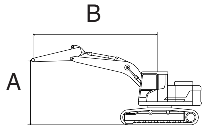
4. WEIGHT

Item	R1250-9	
	kg	lb
Upperstructure assembly	43700	96340
Main frame weld assembly	11960	26370
Engine assembly	2720	6000
Main pump assembly	160	350
Fan pump	55	120
Gear box	580	1280
Main control valve assembly 1	450	990
Main control valve assembly 2	160	350
Swing motor assembly	440	970
Hydraulic oil tank assembly	1770	3900
Fuel tank assembly	1940	4280
Counterweight	20400	44970
Cab assembly	435	960
Cab riser assy	860	1896
Lower chassis assembly	45940	101280
Lower track center frame	17700	39020
Swing bearing	2170	4780
Travel motor assembly	970	2140
Turning joint	75	165
Track recoil spring and tension body	1030	2270
Idler	850	1870
Sprocket	315	700
Carrier roller	70	150
Track roller	210	460
Track-chain assembly (700 mm double grouser shoe)	5070	11180
Front attachment assembly (7.55 m boom, 3.40m arm, 6.70 m^3 SAE heaped bucket)	28360	62520
7.55 m boom assembly	10310	22730
3.40 m arm assembly	4010	8840
6.70 m^3 SAE heaped bucket	5860	12920
Boom cylinder assembly	1190	2620
Arm cylinder assembly	1510	3330
Bucket cylinder assembly	1050	2310
Bucket control rod assembly	1450	3200

5. LIFTING CAPACITIES

Model	Type	Boom	Arm	Counterweight	Shoe	Wheel	Dozer		Outtriger	
R1250-9	MONO BOOM	Length [mm]	Length [mm]	weight [kg]	width [mm]	width [mm]	Front	Rear	Front	Rear
		7550	3400	20400	700	-	-	-	-	-

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



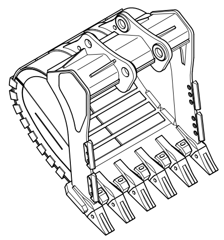
Lift-point height (A)		Lift-point radius (B) 3.0 m (9.8 ft) over-front	3.0 m (9.8 ft) over-side	4.5 m (14.8 ft) over-front	4.5 m (14.8 ft) over-side	6.0 m (19.7 ft) over-front	6.0 m (19.7 ft) over-side	7.5 m (24.6 ft) over-front	7.5 m (24.6 ft) over-side	9.0 m (29.5 ft) over-front	9.0 m (29.5 ft) over-side	10.5 m (34.4 ft) over-front	10.5 m (34.4 ft) over-side	At max. reach Capacity over-front	Capacity over-side	Reach m (ft)
9.0 m	kg									*19580	*19580			*14850	*14850	9.27
(29.5 ft)	lb									*43170	*43170			*32740	*32740	(30.4)
7.5 m	kg									*25900	*25900			*14460	*14460	10.10
(24.6 ft)	lb									*57100	*57100			*31880	*31880	(33.1)
6.0 m	kg							*31100	*31100	*26900	*26900	*17990	*17990	*14490	*14490	10.64
(19.7 ft)	lb							*68560	*68560	*59300	*59300	*39660	*39660	*31940	*31940	(34.9)
4.5 m	kg					*42940	*42940	*33570	*33570	*28140	27500	*24560	21560	*14900	*14900	10.95
(14.8 ft)	lb					*94670	*94670	*74010	*74010	*62040	60630	*54150	47530	*32850	*32850	(35.9)
3.0 m	kg							*35510	34730	*29150	26530	*24820	21030	*15720	*15720	11.03
(9.8 ft)	lb							*78290	76570	*64260	58490	*54720	46360	*34660	*34660	(36.2)
1.5 m	kg					*46700	*46700	*36270	33510	*29500	25740	*24570	20580	*17040	*17040	10.90
(4.9 ft)	lb					*102960	*102960	*79960	73880	*65040	56750	*54170	45370	*37570	*37570	(35.8)
0.0 m	kg					*44880	*44880	*35540	32800	*28800	25240	*21090	20350	*19150	*19150	10.55
(0.0 ft)	lb					*98940	*98940	*78350	72310	*63490	55640	*46500	44860	*42220	*42220	(34.6)
-1.5 m	kg			*50120	*50120	*41080	*41080	*33070	32570	*26540	25090			*22370	21940	9.94
(-4.9 ft)	lb			*110500	*110500	*90570	*90570	*72910	71800	*58510	55310			*49320	48370	(32.6)
-3.0 m	kg	*45200	*45200	*41780	*41780	*35030	*35030	*28320	*28320	*21290	*21290			*21030	*21030	9.04
(-9.8 ft)	lb	*99650	*99650	*92110	*92110	*77230	*77230	*62430	*62430	*46940	*46940			*46360	*46360	(29.7)
-4.5 m	kg			*29670	*29670	*25510	*25510	*19220	*19220					*17860	*17860	7.73
(-14.8 ft)	lb			*65410	*65410	*56240	*56240	*42370	*42370					*39370	*39370	(25.4)

Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

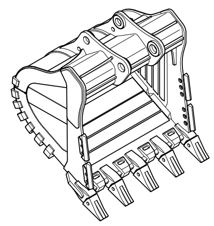
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult with your local HD Hyundai Construction Equipment dealer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

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

6. BUCKET SELECTION GUIDE



Heavy duty



Rock heavy duty

Type	Capacity		Width	Weight	Tooth	MONO Recommendation
	SAE Heaped	CECE heaped	Without side cutter			7.55 m (24' 9") Boom
	m^3 (yd^3)	m^3 (yd^3)	mm (in)	kg (lb)	EA	3.40 m (11' 2') Arm
Heavy duty	6.70 (8.76)	5.90 (7.72)	2535 (99.8")	7385 (16280)	6	◐
	7.00 (9.16)	6.15 (8.04)	2535 (99.8")	7565 (16680)	6	◐
	8.57 (11.21)	7.68 (10.05)	2535 (99.8")	7295 (16080)	6	■
Rock heavy duty	6.00 (7.85)	5.30 (6.93)	2420 (95.3")	6605 (14560)	5	●

●	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
-	Not available

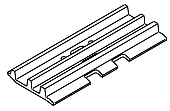
※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult with your local HD Hyundai Construction Equipment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

7. UNDERCARRIAGE

1) TRACKS

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

2) TYPES OF SHOES

Model	Shapes		Double grouser		
					
R1250-9	Shoe width	mm (in)	700 (28)	800 (32)	900 (36)
	Operating weight	kg (lb)	118000 (260140)	118670 (261620)	119470 (263380)
	Ground pressure	kgf/cm^2 (psi)	1.51 (21.47)	1.34 (19.05)	1.20 (17.06)
	Under carriage width	mm (ft-in)	4600 (15' 1")	4700 (15' 5")	4800 (15' 9")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Carrier rollers	3 EA
Track rollers	8 EA
Track shoes	52 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
700 mm double grouser	Standard	A
800 mm double grouser	Option	B
900 mm double grouser	Option	C

※ Table 2

Category	Applications	Applications
A	Rocky ground, river beds, normal soil	· Travel at low speed on rough ground with large obstacles such as boulders or fallen trees
B	Normal soil, soft ground	· These shoes cannot be used on rough ground with large obstacles such as boulders or fallen trees · Travel at high speed only on flat ground · Travel slowly at low speed if it is impossible to avoid going over obstacles
C	Extremely soft gound (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	Cummins QSK 23
Type	4-cycle turbocharged charge air cooled diesel engine
Cooling method	Water cooling
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore × stroke	170 × 170 mm (6.7" × 6.7")
Piston displacement	23000 cc (1404 cu in)
Compression ratio	16 : 1
Rated gross horse power(SAE J1995)	760 hp at 1800 rpm (567 kW at 1800 rpm)
Maximum torque	354 kgf · m (2560 lbf · ft) at 1350 rpm
Engine oil quantity	70 l (18.5 U.S. gal)
Dry weight	2070 kg (6000 lb)
High idling speed	1800 ± 50 rpm
Low idling speed	900 ± 50 rpm
Rated fuel consumption	153.6 g/Hp · hr at 1800 rpm
Starting motor	Nikko (24 V-7.5 kW × 2EA)
Alternator	Sawafuji 24 V-75 A
Battery	4 × 12 V × 160 Ah

2) GEAR BOX

Item	Specification
Model	Stiebel 4325
Ratio	1.05452 (speed increae)

3) MAIN PUMP

Item	Specification
Type	Variable displacement axis piston pumps
Capacity	3 × 280 cc/rev
Maximum pressure	320 kgf/cm^2 (4550 psi) [350 kgf/cm^2 (4980 psi)]
Rated oil flow	3 × 490 l/min (129.4 U.S. gpm / 107.8 U.K. gpm)
Rated speed	1800 rpm

[ ] : Power boost

4) FAN PUMP

Item	Specification
Type	Variable displacement axis piston pumps
Capacity	65 cc/rev
Maximum pressure	270 kgf/cm² (3840 psi)
Rated speed	1800 rpm

5) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	30 cc/rev
Maximum pressure	40 kgf/cm² (570 psi)
Rated oil flow	54 ℓ/min (14.3 U.S. gpm/11.9 U.K. gpm)

6) MAIN CONTROL VALVE

Item	Specification
Type	13 spools
Operating method	Hydraulic pilot system
Main relief valve pressure	320 kgf/cm² (4550 psi) [350 kgf/cm² (4980 psi)]
Overload relief valve pressure	360 kgf/cm² (5120 psi)

[ ]: Power boost

7) SWING MOTOR

Item	Specification
Type	Fixed displacement axial piston motor
Capacity	250 cc/rev
Relief pressure	300 kgf/cm² (4270 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	107 kgf · m (774 lbf · ft)
Brake release pressure	30~50 kgf/cm² (427~711 psi)
Reduction gear type	2 - stage planetary

8) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5 kgf/cm² (92 psi)
	Maximum	25 kgf/cm² (360 psi)
Single operation stroke	Lever	61 mm (2.4 in)
	Pedal	123 mm (4.84 in)

9) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	350 kgf/cm² (4980 psi)
Capacity (max / min)	337.2/228.6 cc/rev
Reduction gear type	3-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	18 kgf/cm² (256 psi)
Braking torque	114 kgf・m (825 lbf・ft)

10) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 230 × ø 160 × 2165 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 260 × ø 180 × 2180 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 240 × ø 170 × 1792 mm
	Cushion	Extend only

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

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

11) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
R1250-9	Standard	※700 mm (28")	1.51 kgf/cm² (21.47 psi)	52	4600 mm (15' 1")
	Option	※800 mm (32")	1.34 kgf/cm² (19.05 psi)	52	4700 mm (15' 5")
		※900 mm (36")	1.20 kgf/cm² (17.06 psi)	52	4800 mm (15' 9")

※ Double grouser

12) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
R1250-9	Standard	6.70 m² (8.76 yd³)	5.88 m² (7.69 yd³)	5	2390 mm (94.1")	-

9. RECOMMENDED OILS

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

Please use HYUNDAI genuine oil and grease.

Service point	Kind of fluid	Capacity ℓ (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	70 (18.5)	★SAE 5W-40
			SAE 30
			SAE 10W
			SAE 10W-30
			SAE 15W-40
Gear box	Heavy duty gear oil	6.0 (1.6)	★SAE 75W-90
			ISO VG 100~220
Swing drive	Gear oil	8.0×2 (2.1×2)	★SAE 75W-90
Final drive		20×2 (5.3×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 670 (177) System: 1160 (306)	★ISO VG 15
			ISO VG 32
			ISO VG 46
			ISO VG 68
Fuel tank	Diesel fuel	1475 (390)	★ASTM D975 NO.1
			ASTM D975 NO.2
Lower roller	Gear oil	1.08 (0.3)	★SAE 75W-90
Upper roller		0.68 (0.18)	SAE 85W-140
Idler		0.83 (0.22)	
Fitting (grease nipple)	Grease	As required	★NLGI NO.1
			NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★1	100 (26.4)	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

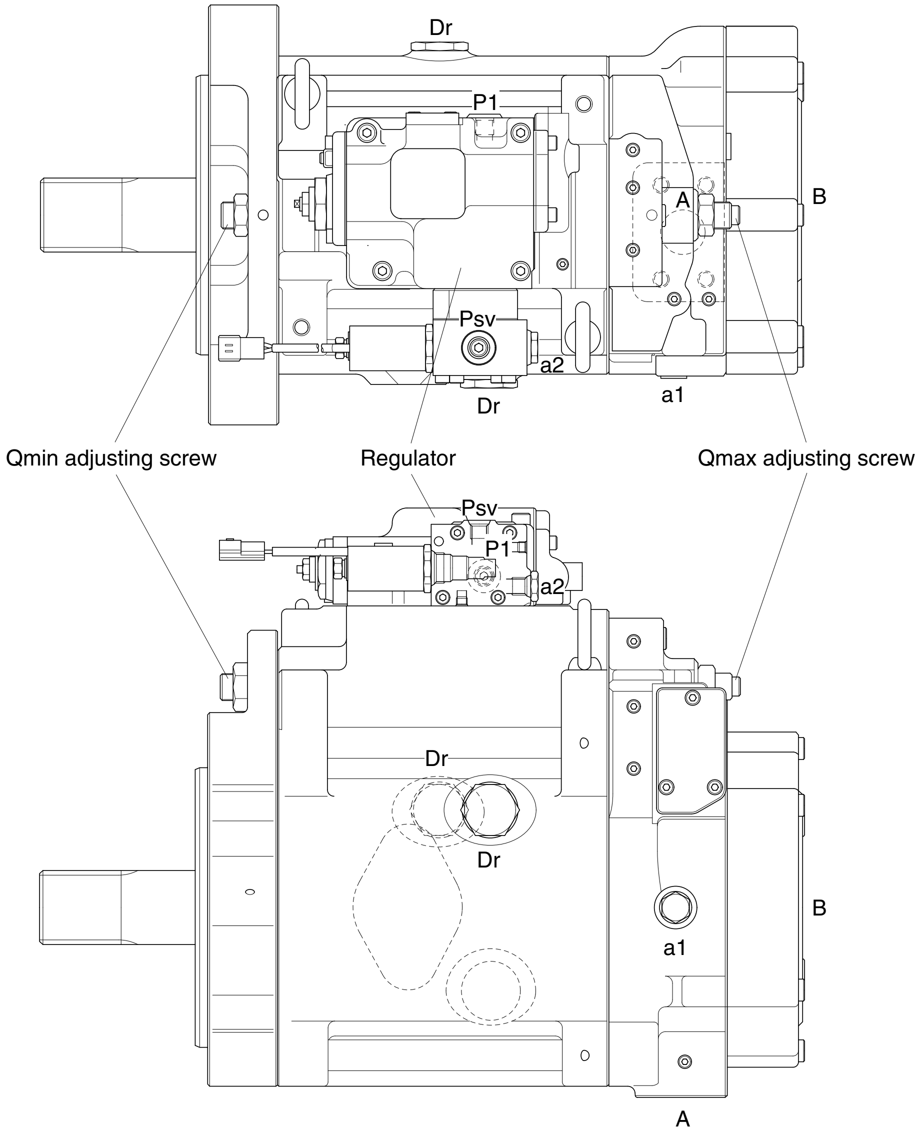
★ : Cold region
Russia, CIS, Mongolia

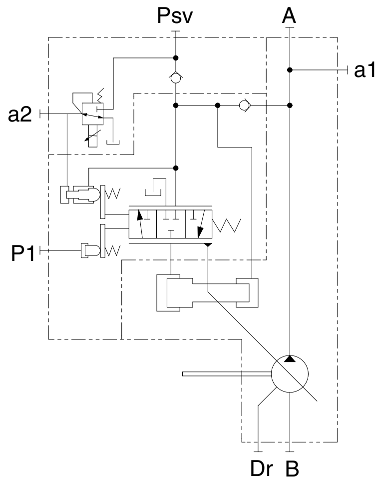
SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. MAIN PUMP STRUCTURE

The pump device consists of main pump, regulator.





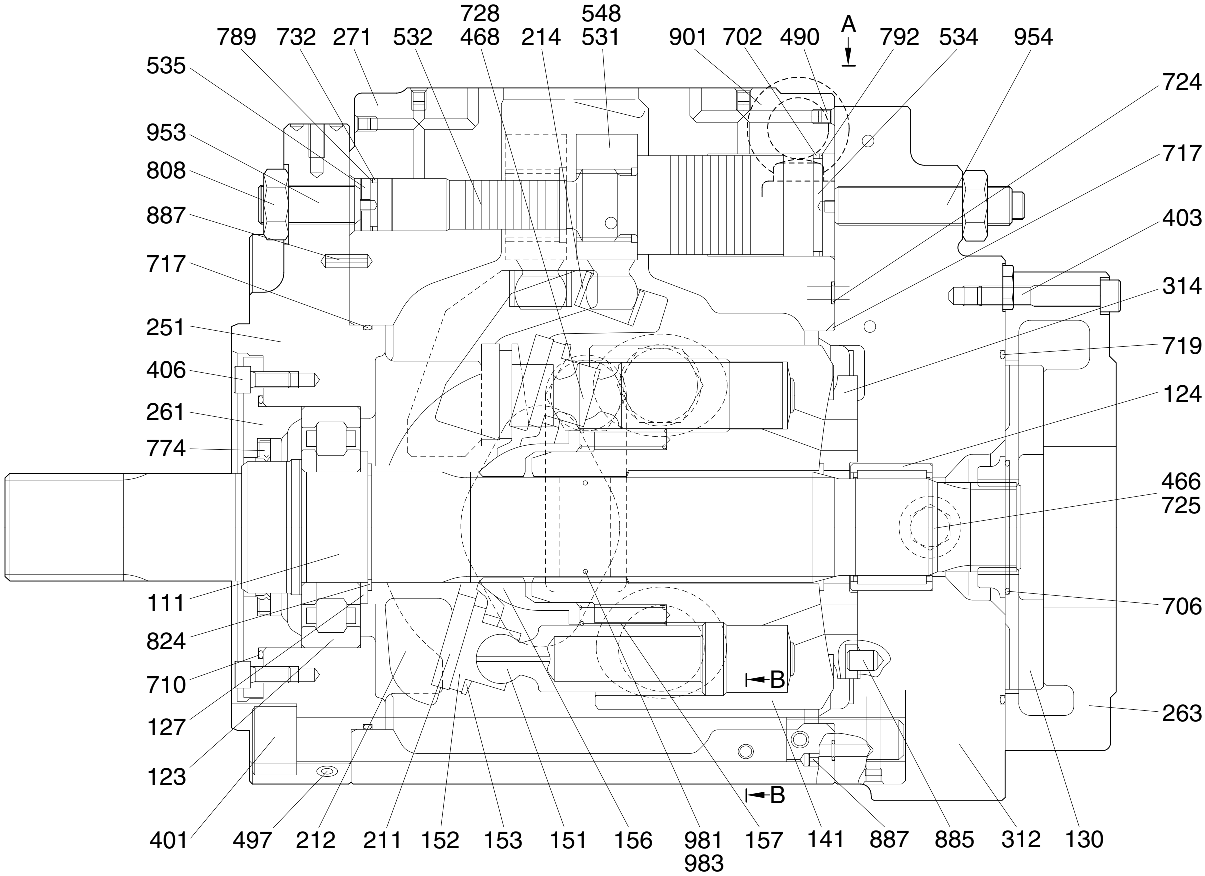
Hydraulic circuit

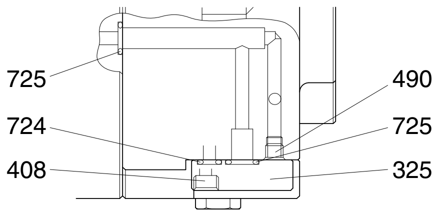
Port	Port name	Port size
A	Delivery port	SEA6000psi 1 1/4"
B	Suction port	SEA2500psi 3 1/2"
Dr	Drain port	PF 3/4 - 23
Psv	Servo assist port	PF 1/4 - 13
a1	Gauge port	PF 1/4 - 15
a2	Sensor port	PF 1/4 - 13
P1	Pilot port	PF 1/4 - 15

120092MP01

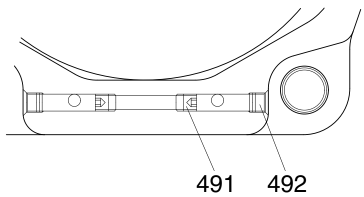
1) **MAIN PUMP**(1/2)

The main pump consists of piston pump and valve block.





VIEW A

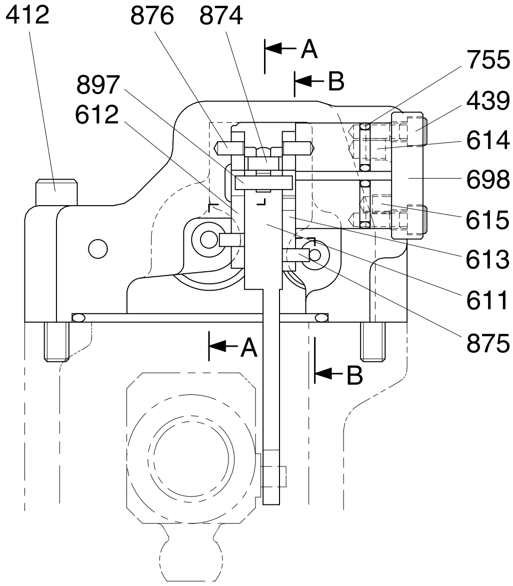


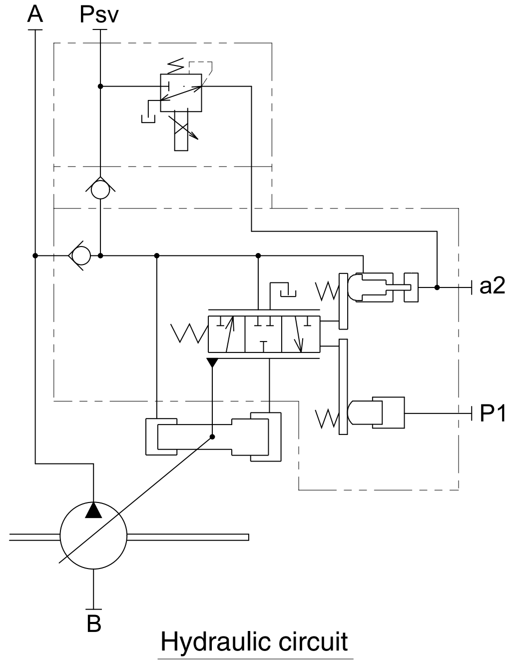
SECTION B -B

120092MP02

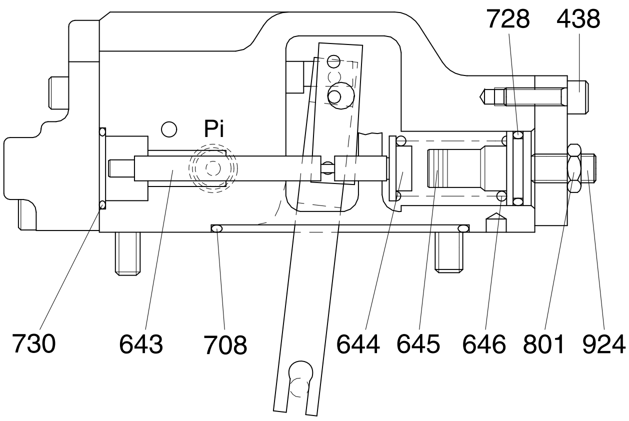
111	Drive shaft	261	Front cover	497	Plug	774	Oil seal
113	Roller bearing	263	Booster cover	531	Tilting pin	789	Back up ring
114	Needle bearing	271	Pump casing	532	Servo piston	792	Back up ring
123	Spacer	312	Valve cover	534	Stopper (L)	808	Nut
130	Booster	314	Valve plate (F)	535	Stopper (S)	824	Snap ring
141	Cylinder block	325	Cover	548	Feed back pin	885	Pin
151	Piston	401	Screw	702	O-ring	887	Spring pin
152	Shoe	403	Hexagon screw	706	O-ring	901	Eye bolt
153	Set plate	406	Hexagon screw	710	O-ring	953	Set screw
156	Bushing	408	Screw	717	O-ring	954	Set screw
157	Cylinder spring	466	Plug	719	O-ring	981	Name plate
211	Shoe plate	468	Plug	724	O-ring	983	Pin
212	Swash plate	490	Plug	725	O-ring		
214	Steel bearing	491	Restrictor	728	O-ring		
251	Support	492	Plug	732	O-ring		

2) REGULATOR (1/2)

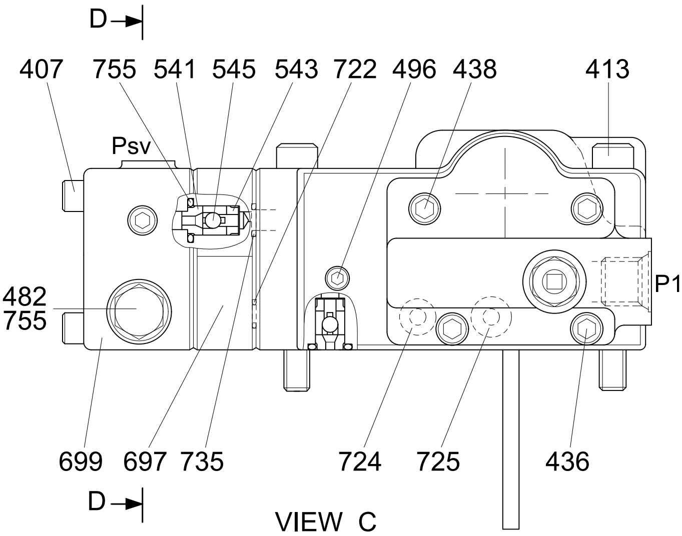




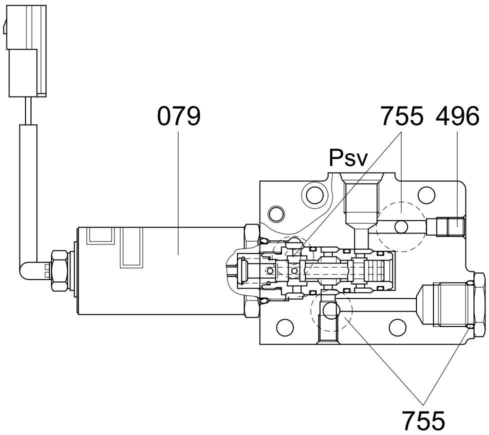
Hydraulic circuit



SECTION B-B



VIEW C

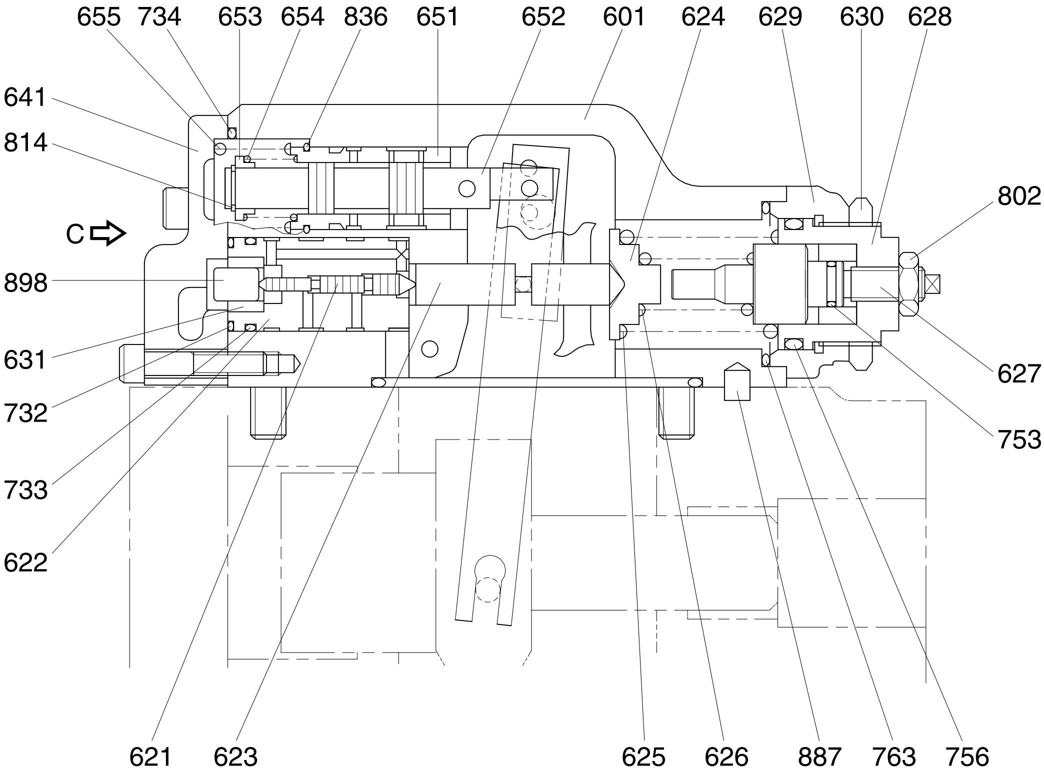


SECTION D-D

Port	Port name	Port size
P1	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 13
a2	Sensor port	PF 1/4 - 13

120092RG01

REGULATOR (2/2)



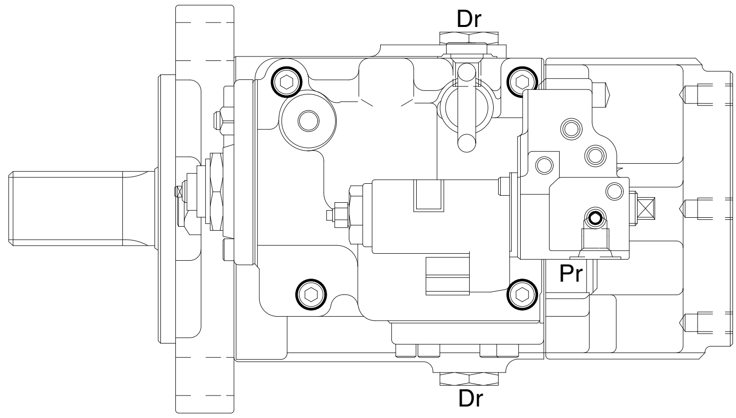
SECTION A-A

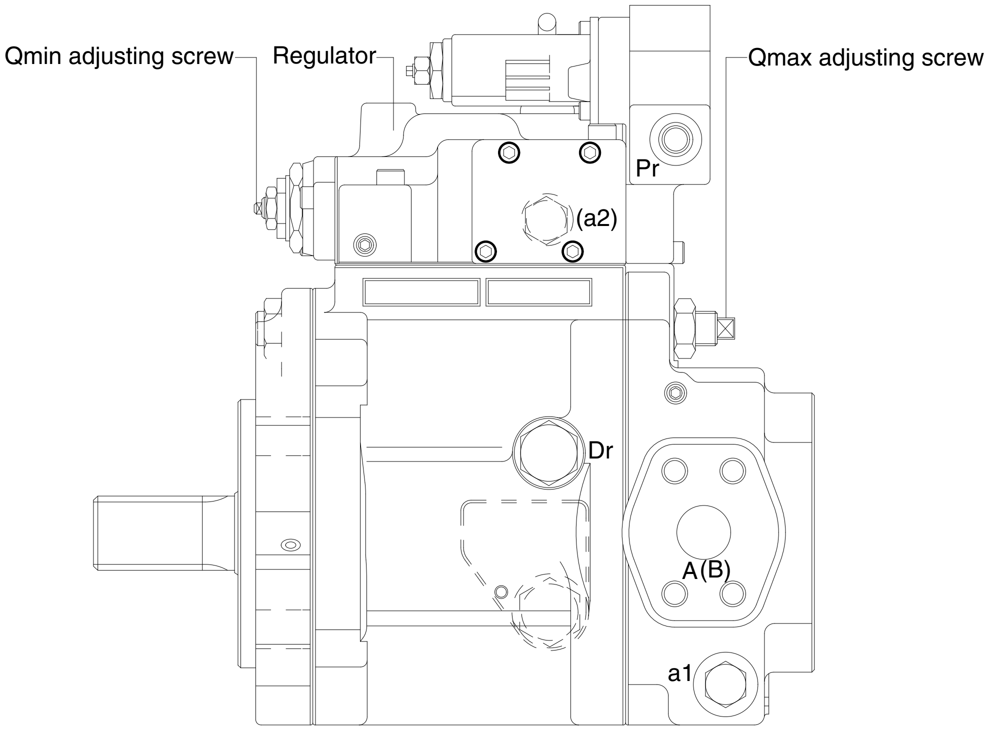
120092RG02

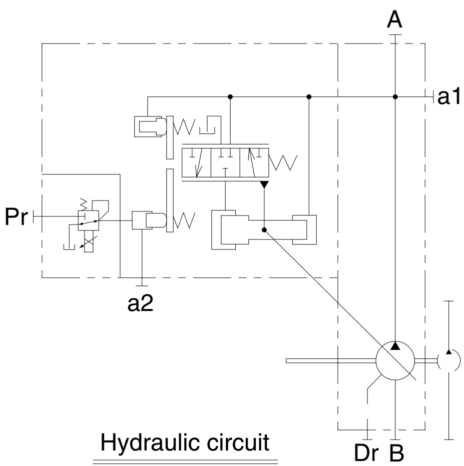
079	EPPR valve	626	Inner spring	728	O-ring
407	Hexagon socket screw	627	Adjust stem (C)	730	O-ring
412	Hexagon socket screw	628	Adjust screw (C)	732	O-ring
413	Hexagon socket screw	629	Cover (C)	733	O-ring
436	Hexagon socket screw	630	Lock nut	734	O-ring
438	Hexagon socket screw	631	Sleeve	735	O-ring
439	Hexagon socket screw	641	Pilot cover	753	O-ring
466	Plug	643	Pilot piston	755	O-ring
496	Plug	644	Spring seat (Q)	756	O-ring
541	Seat	645	Adjust stem (Q)	763	O-ring
543	Stopper	646	Pilot spring	801	Nut
545	Steel ball	651	Sleeve	802	Nut
601	Casing	652	Spool	814	Snap ring
611	Feed back lever	653	Spring seat	836	Snap ring
612	Lever (1)	654	Return spring	874	Pin
613	Lever (2)	655	Set spring	875	Pin
614	Center plug	697	Plate	876	Pin
615	Adjust plug	698	Cover	887	Pin
621	Compensator piston	699	Casing	897	Pin
622	Piston case	708	O-ring	898	Pin
623	Compensator rod	722	O-ring	924	Set screw
624	Spring seat (C)	724	O-ring		
625	Valve casing	725	O-ring		

2. FAN PUMP STRUCTURE

The pump device consists of fan pump, regulator.







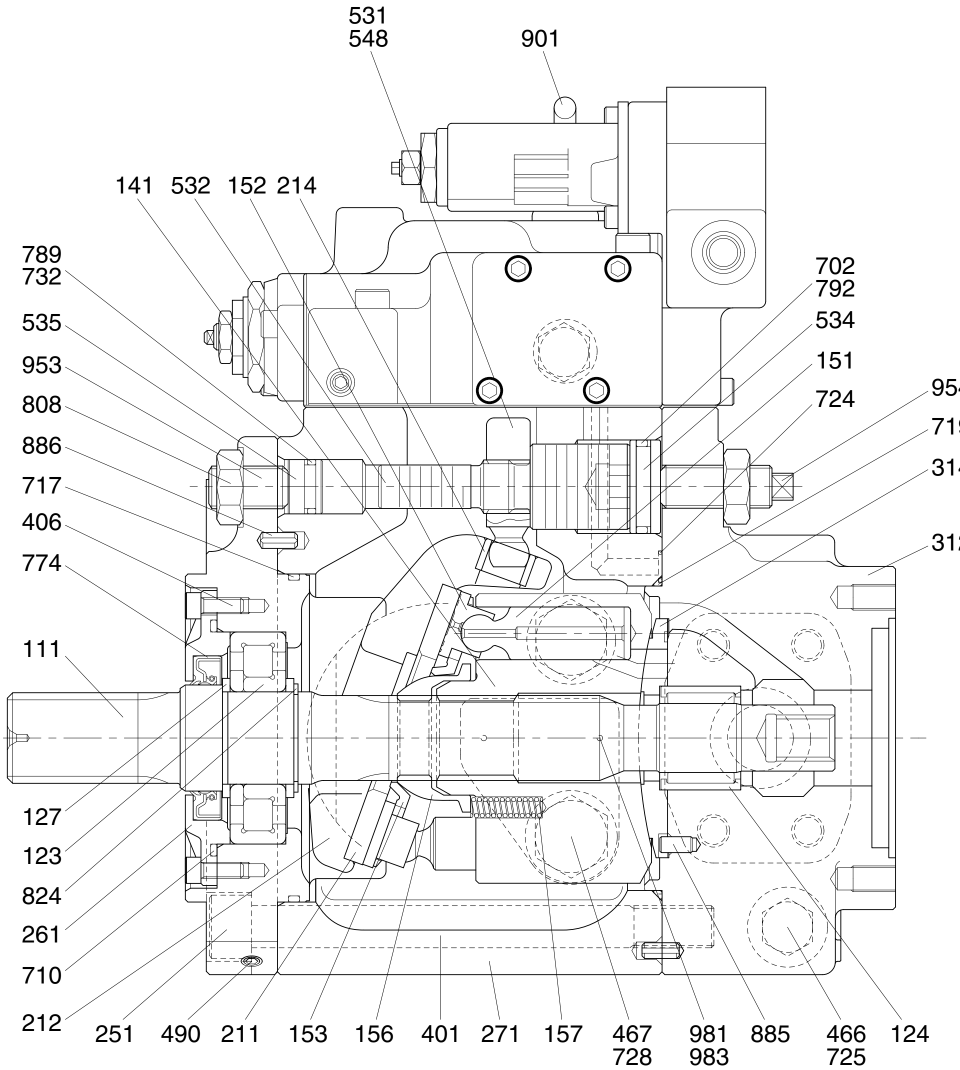
Hydraulic circuit

Port	Port name	Port size
A	Delivery port	SAE 6000psi 1"
B	Suction port	SAE 3000psi 1 1/2"
Dr	Drain port	PF 1/2-19
Pr	Servo assist port	PF 1/4-13
a1,a2	Gauge port	PF 1/4-15

120092FP04

1) **FAN PUMP** (1/2)

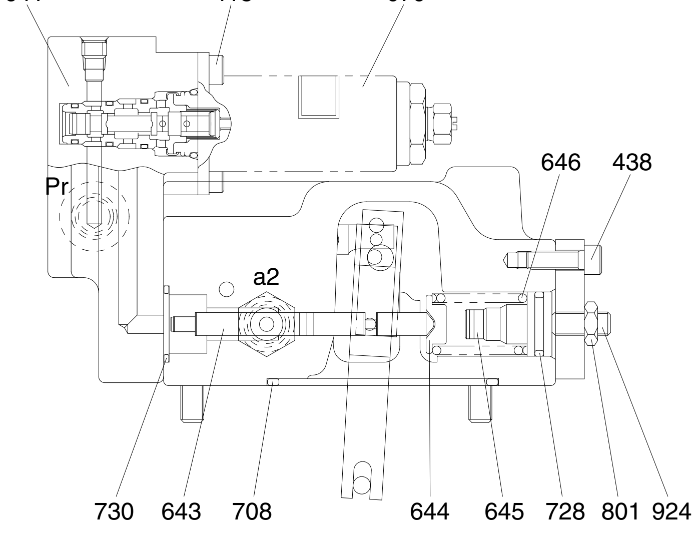
The fan pump consists of piston pump and valve block.



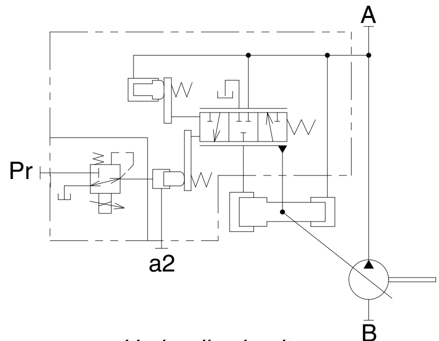
120092FP03

111	Drive shaft	312	Valve cover	724	O-ring
123	Roller bearing	314	Valve plate	725	O-ring
124	Needle bearing	401	Screw	728	O-ring
127	Spacer	406	Screw	732	O-ring
141	Cylinder block	466	Plug	774	Oil seal
151	Piston	467	Plug	789	Back up ring
152	Shoe	490	Plug	792	Back up ring
153	Set plate	531	Tilting pin	808	Hexagon head nut
156	Bushing	532	Servo piston	824	Stop ring
157	Cylinder spring	534	Stopper (L)	885	Pin
211	Shoe plate	535	Stopper (S)	886	Spring pin
212	Swash plate	548	Feed back pin	901	Eye bolt
214	Bushing	702	O-ring	953	Set screw
251	Support	710	O-ring	954	Set screw
261	Cover (FR)	717	O-ring	981	Name plate
271	Pump casing	719	O-ring	983	Pin

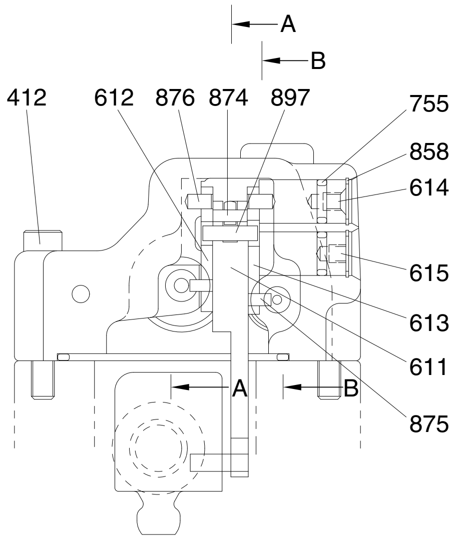
2) REGULATOR (1/2)

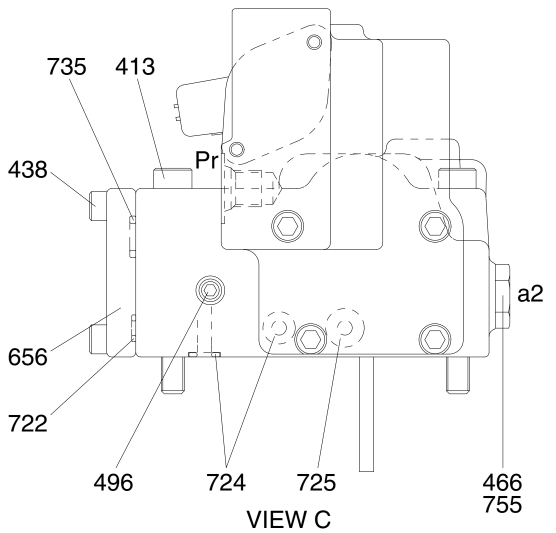


SECTION B-B



Hydraulic circuit



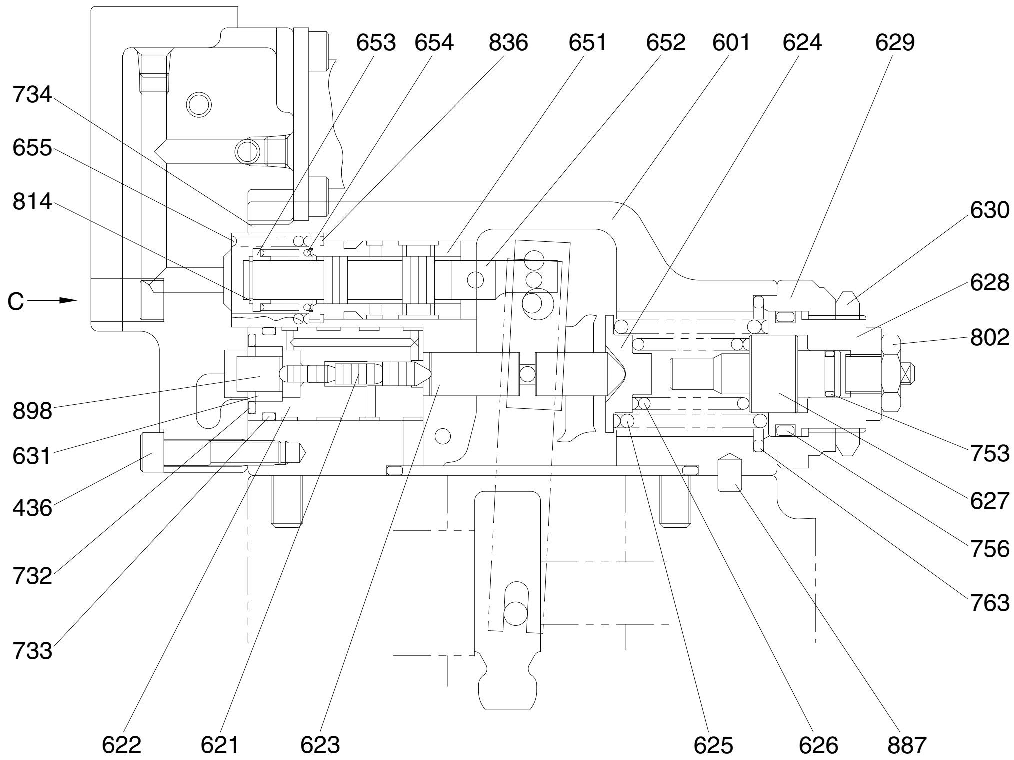


VIEW C

Port	Port name	Port size
Pr	Servo assist	FP 1/4-13
a2	Gauge port	FP 1/4-15

120092FP02

REGULATOR (2/2)

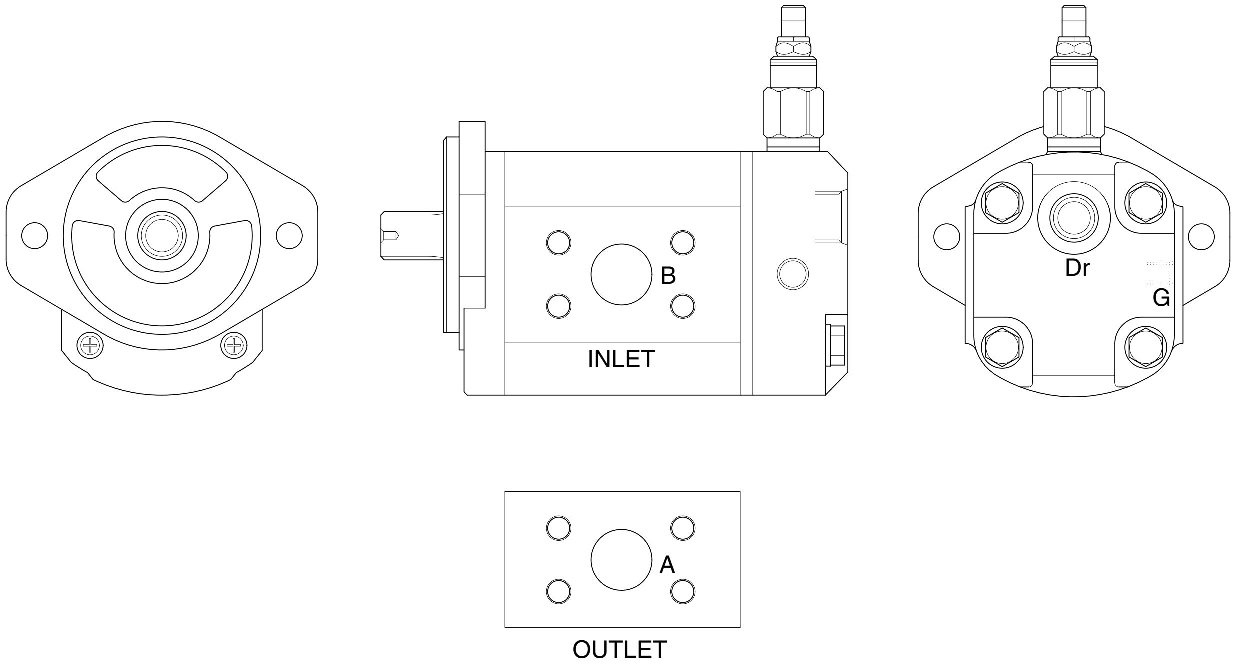


SECTION A-A

120092FP05

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

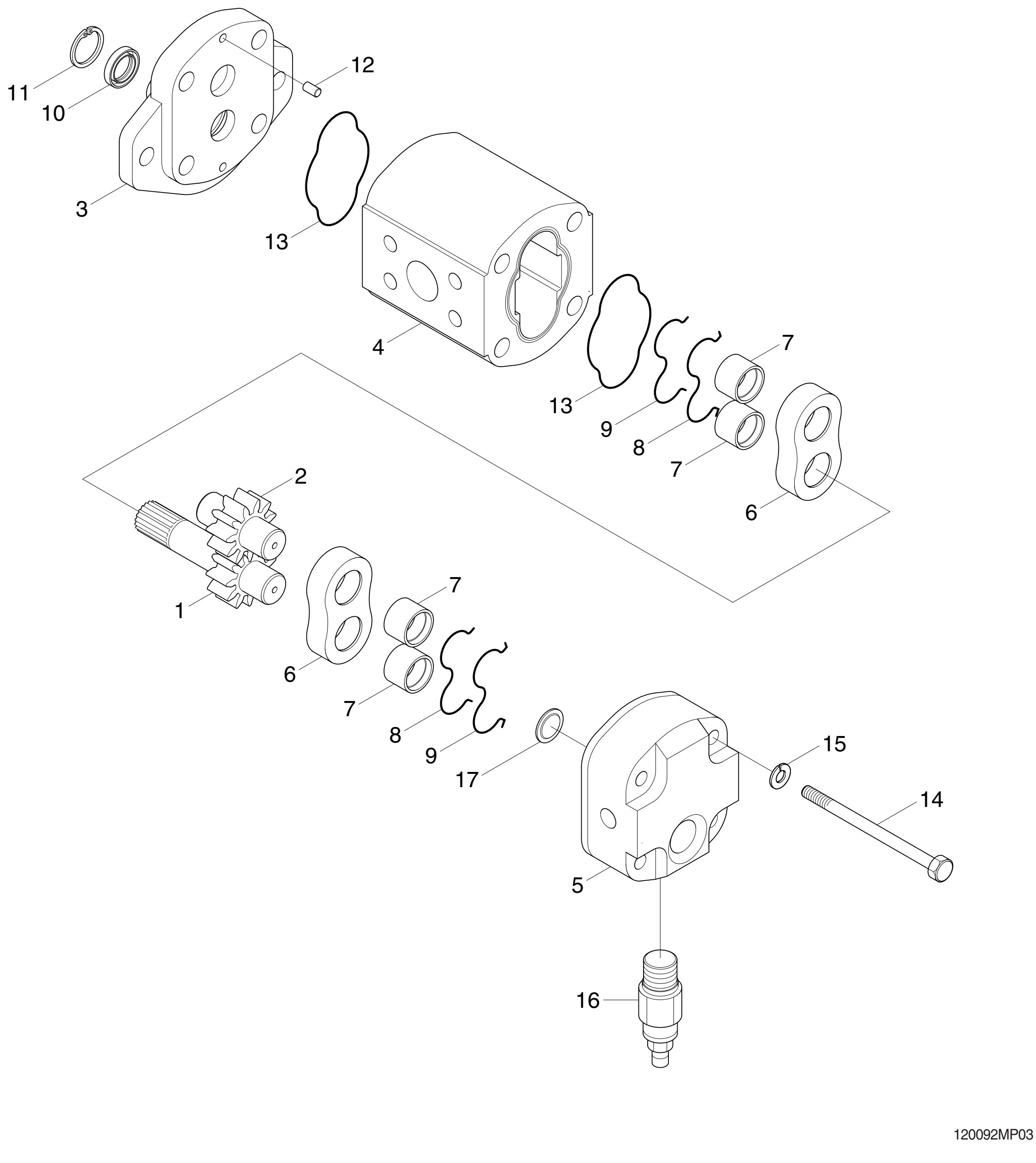
3) GEAR PUMP (1/2)



Port	Name	Size
A	Inlet port	SAE 3000 psi 1 1/2"
B	Outlet port	SAE 500 psi 1"
G	Guage port	PF 1/4
Dr	Drain port	PF 1/2

120092GP01

GEAR PUMP (2/2)



1	Shaft gear	7	Bushing	13	D-ring
2	Driven gear	8	Channel seal	14	Bolt
3	Front cover	9	Back up seal	15	Spring washer
4	Gear housing	10	Retainer seal	16	Relief valve
5	Gear cover	11	Snap ring	17	Filter
6	Bush block	12	Dowel pin		

2. FUNCTION

1) MAIN PUMP

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

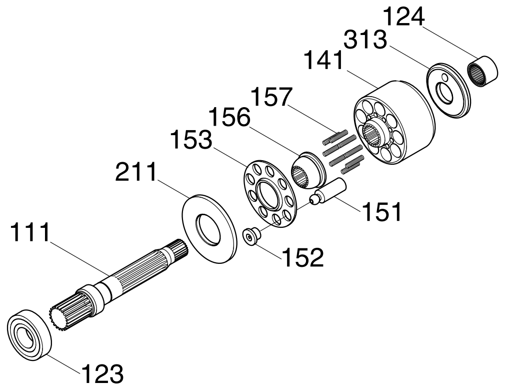
(1) Rotary group

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



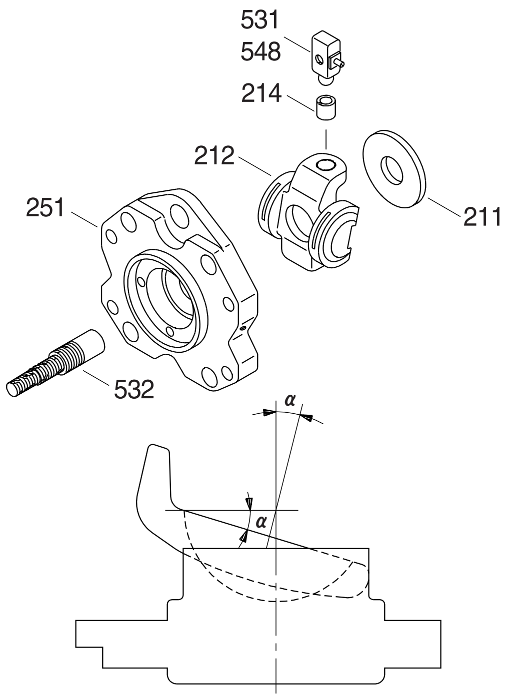
380H2MP04

(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 (210-7)

2) REGULATOR

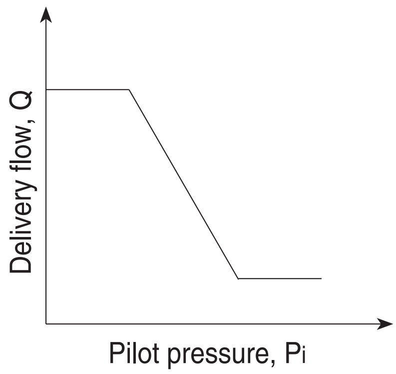
Regulator consists of the negative flow control, total horse power control and power shift control function

(1) Negative flow control

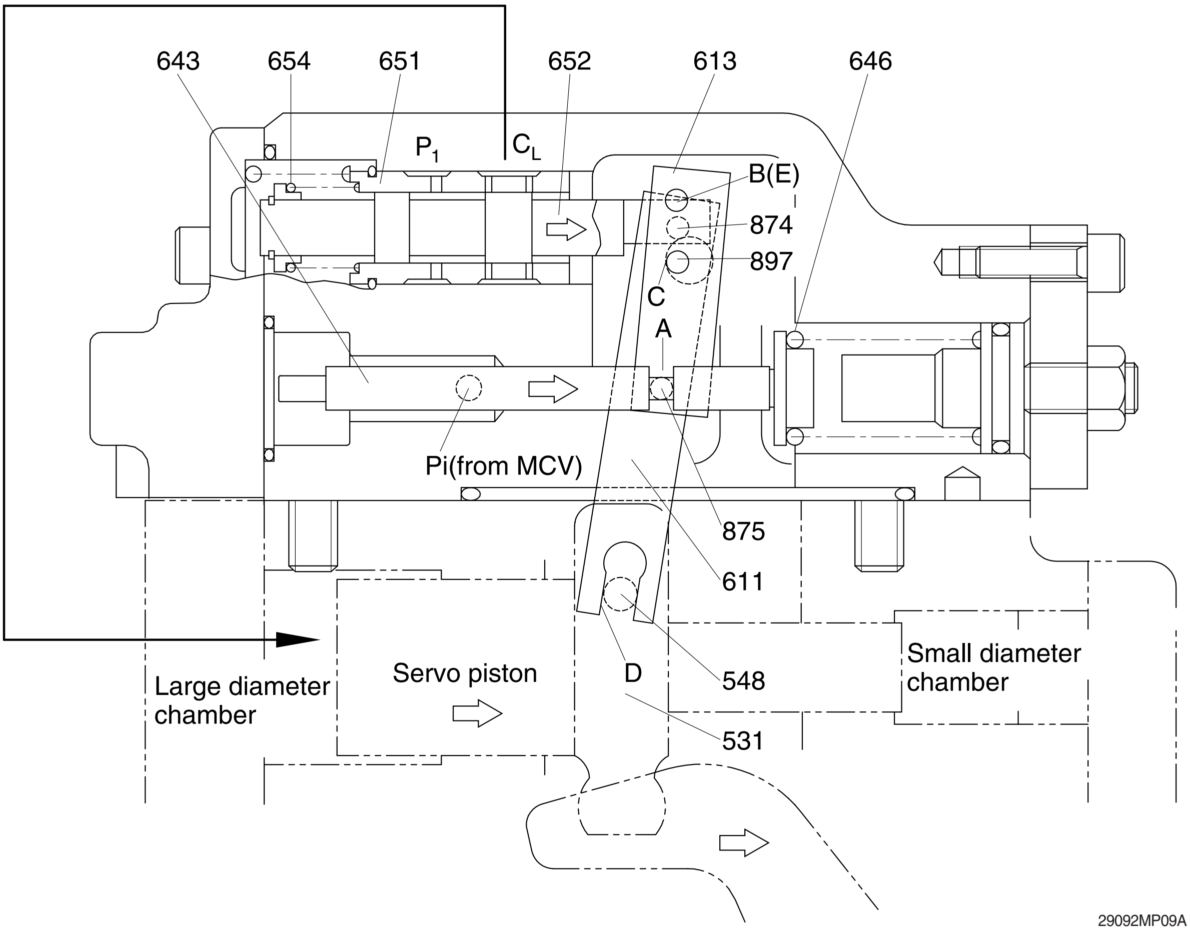
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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 com-manded, 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.

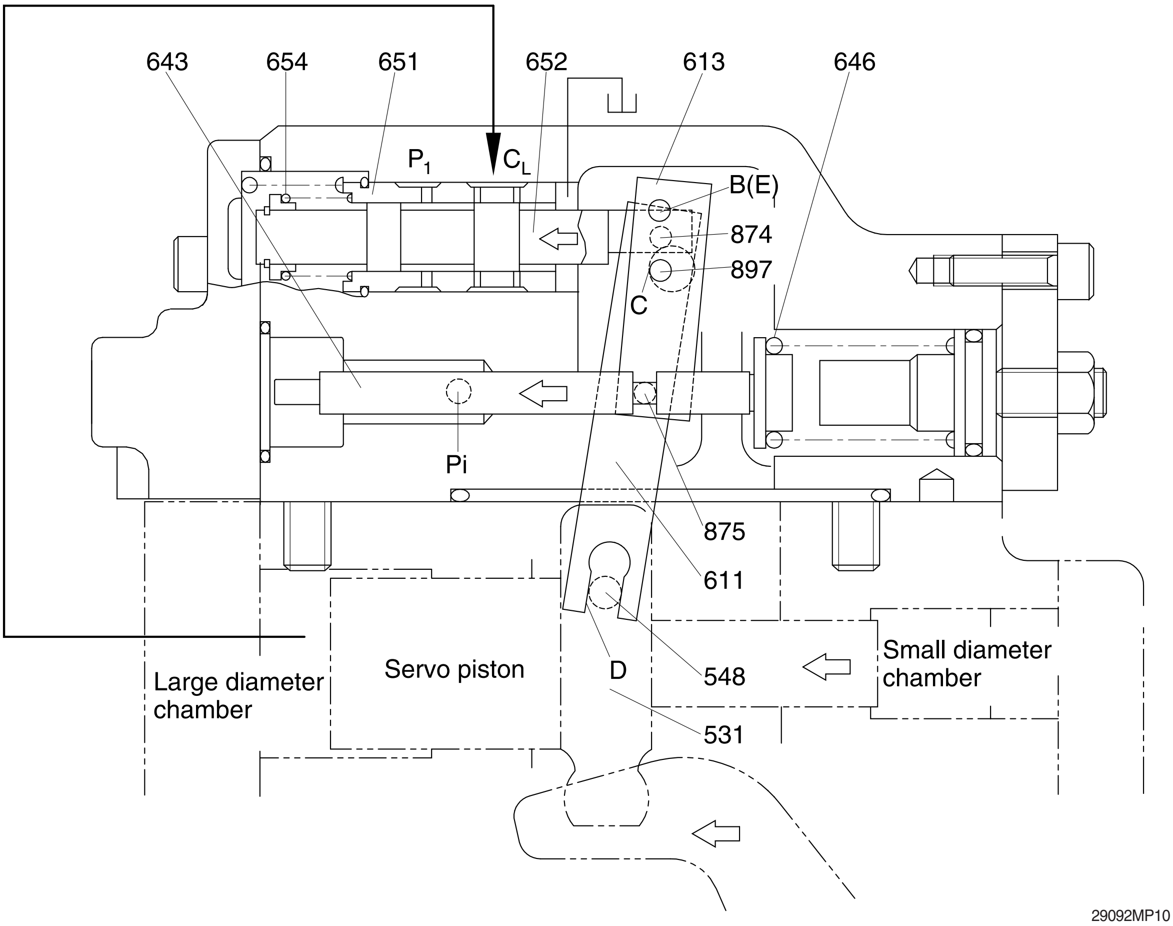
Since the feedback lever is connected with the spool (652) via the pin (874), the spool moves to the right.

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**

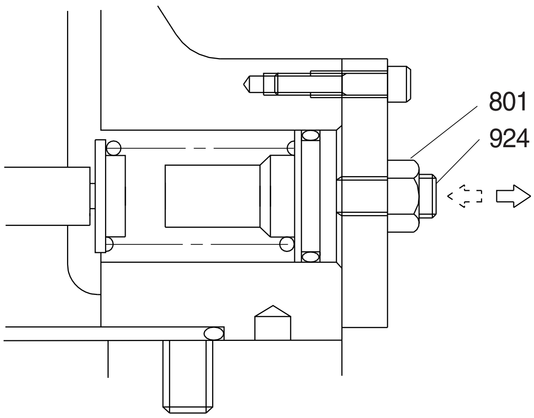
The flow control characteristic can be adjusted with the adjusting screw.

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

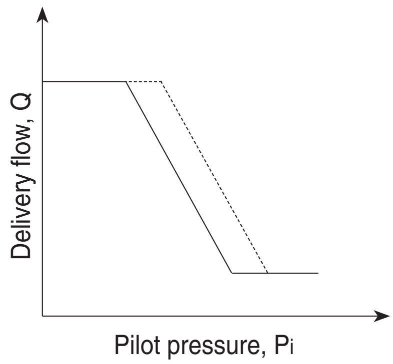
Tightening the screw shifts the control chart to the right as shown in the figure.

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

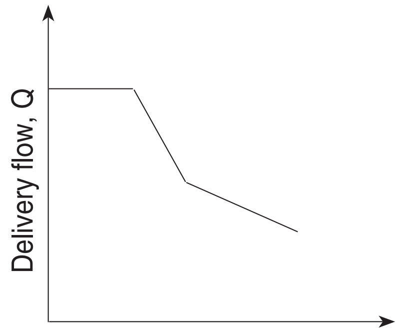
Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw (924)	Flow control starting pressure change amount	Flow change amount
(min $^{-1}$)	(Turn)	(kgf/cm^2)	(l/min)
1800	+1/4	+1.33	+30.2



2-12 (210-7)



(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.)

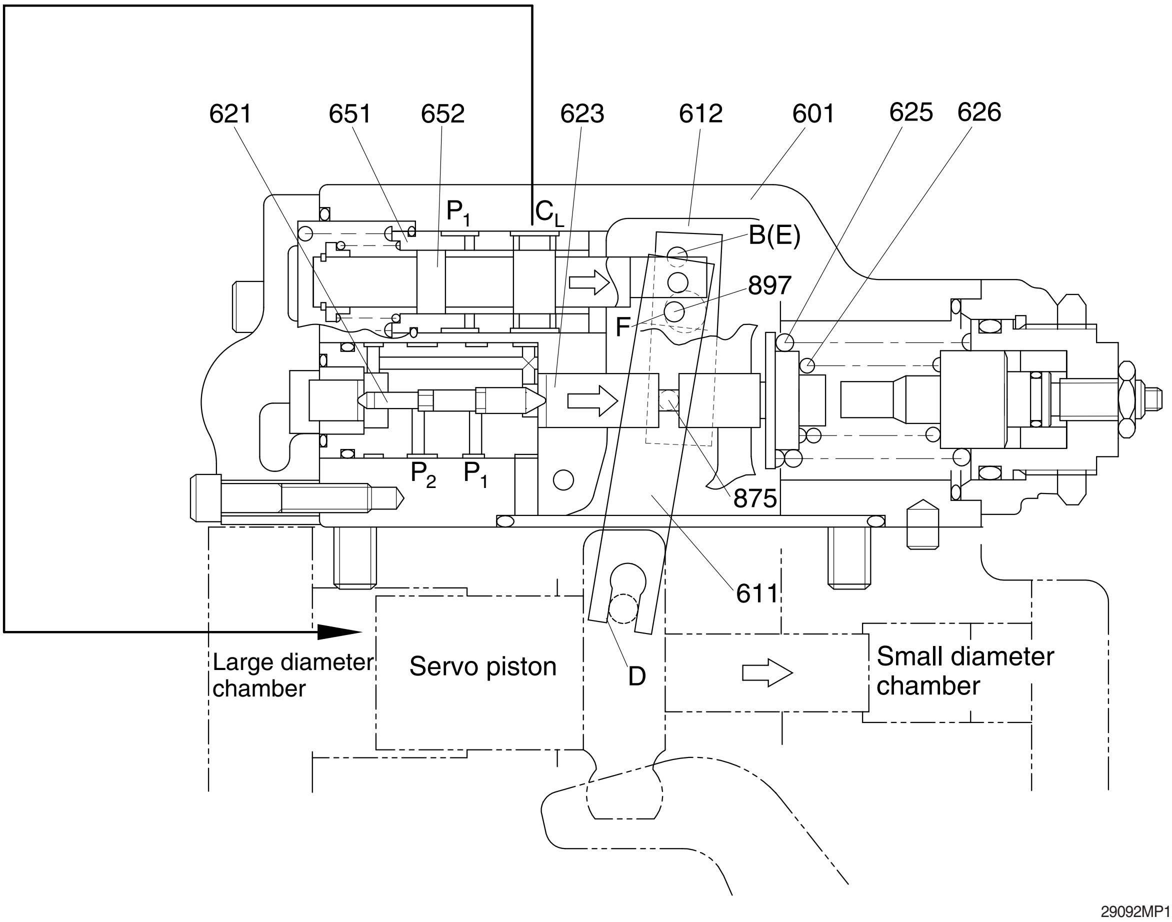
Since the regulator is of the simultaneous total horsepower type that operates by the sum of load pressures of the two pumps in the tandem double-pump system, the prime mover is automatically prevented from being overloaded, irrespective of the load condition of the two pumps, when horsepower control 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 beha-viors of respective parts, refer to the section of flow control).

① Overload preventive function



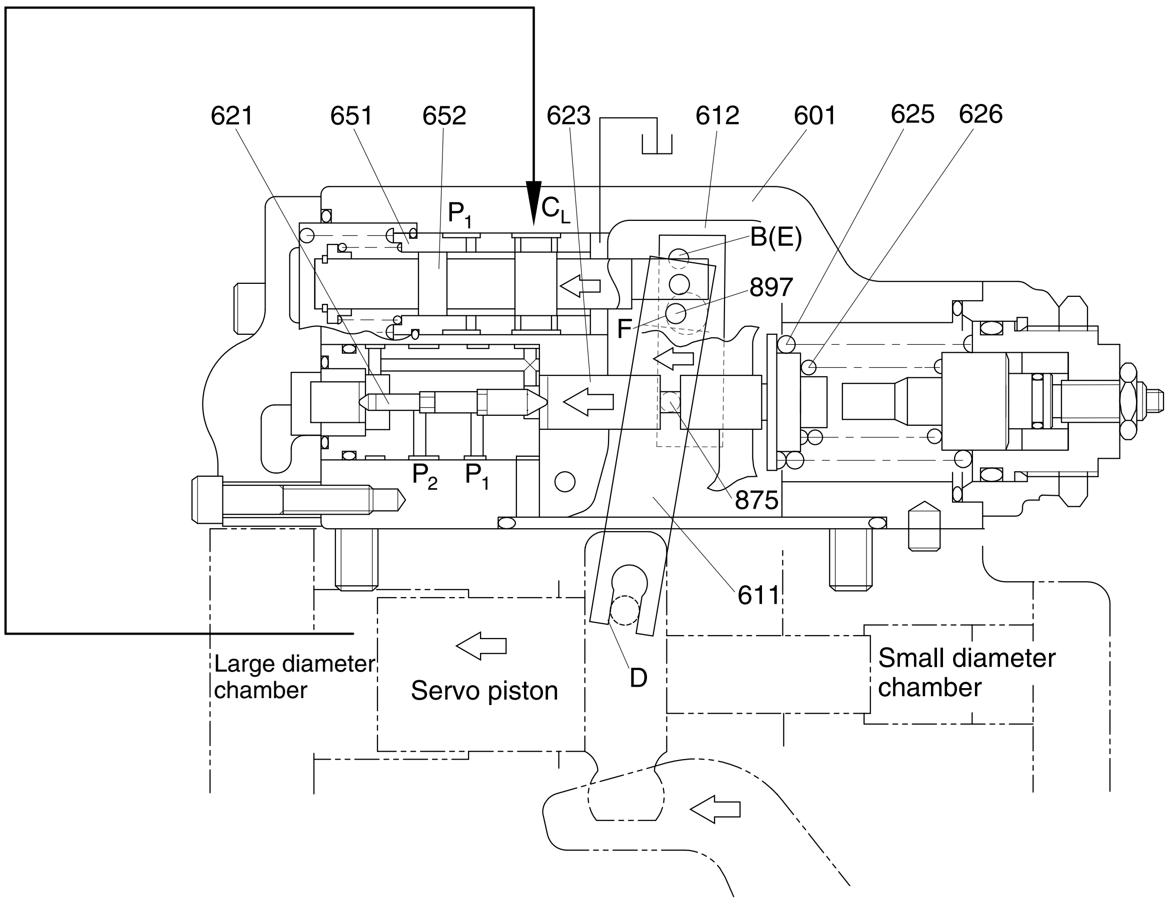
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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

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

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

The movement of the servo piston is transmitted to the feedback lever via point D. Then the feedback lever rotates around the fulcrum of point F and the spool is shifted to the left. The spool moves till the opening between the spool (652) and sleeve (651) is closed.

② Flow reset function



29092MP12

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**

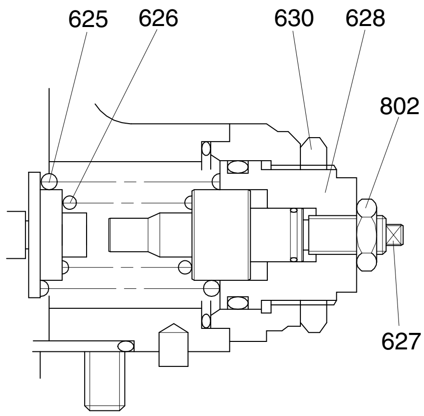
As mentioned above, flow control and horsepower control tilting angle commands are transmitted to the feedback lever and spool via the large-hole sections (C & F) of levers 1 and 2. However, since sections C and F have the pins (ø4) protruding from the large hole (ø8), only the lever lessening the tilting 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

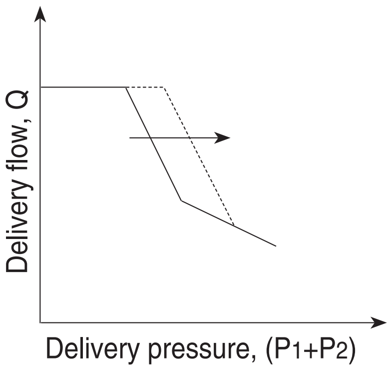
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horse-power as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting screw QI (627) by N×A turns at first. (A=1.85)



8007A2MP03

※ Adjusting values are shown in table.

Speed	Adjustment of outer spring		
	Tightening amount of adjusting screw (C) (627)	Compensating control starting pressure change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1800	+1/4	+17.7	+7.3



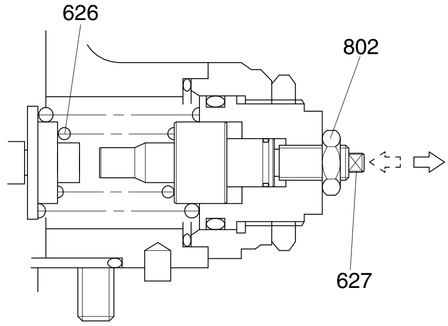
b. Adjustment of inner spring

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

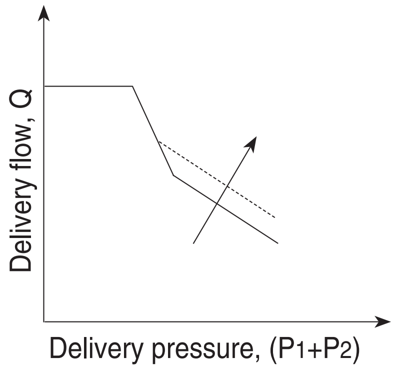
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valves are shown in table.

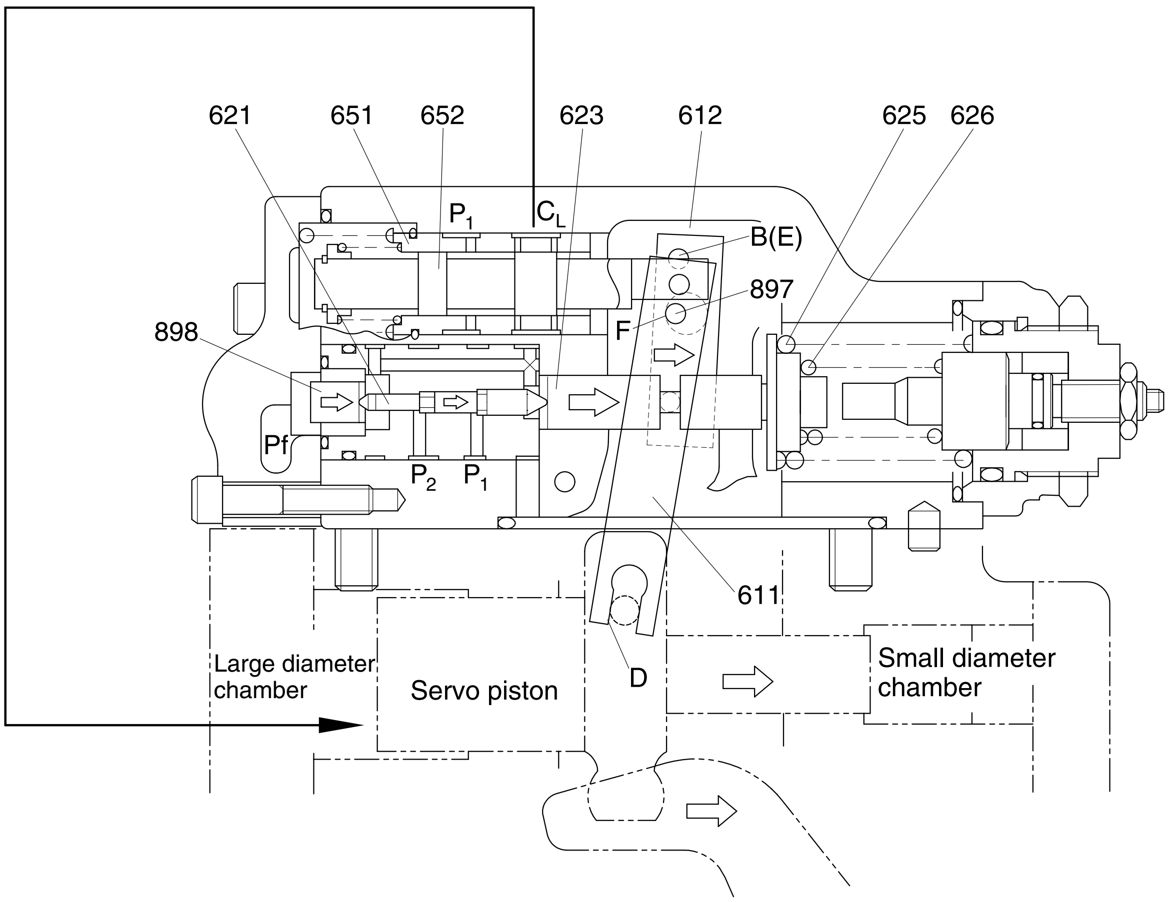
Speed	Adjustment of inner spring		
	Tightening amount of adjusting screw (QI) (627)	Flow change amount (lpm)	Input torque change amount
(min $^{-1}$)	(Turn)	(l /min)	(kgf · m)
1800	+1/4	+22.8	+5.9



8007A2MP04



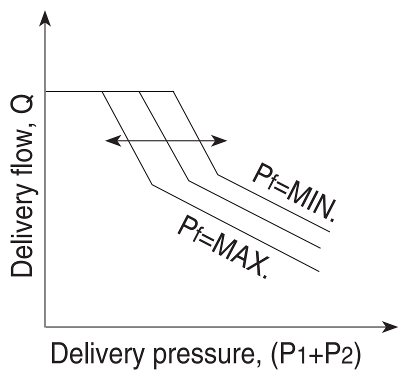
(3) Power shift control



29092MP13

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).

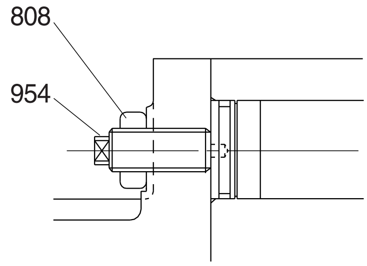
This decreases the pump tilting angle and then the set horsepower in the same way as explained in the overload preventive function of the horsepower control. On the contrary, the set horsepower rises as the power shift pressure Pf falls.

(4) Adjustment of maximum and minimum flows

① **Adjustment of maximum flow**

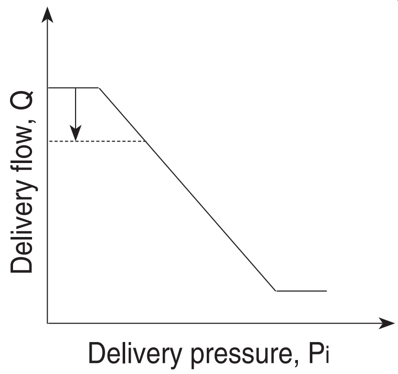
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

The maximum flow only is adjusted without changing other control charac-teristics.



2-19 (1)

Speed	Adjustment of max flow spring	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(l /min)
1800	+1/4	-9.2

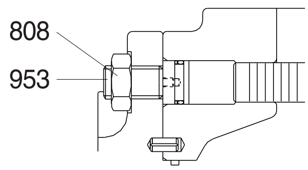


② **Adjustment of minimum flow**

Adjust it by loosening the hexagon nut(808) and by tightening (or loosening) the hex-agonal socket head set screw (953).

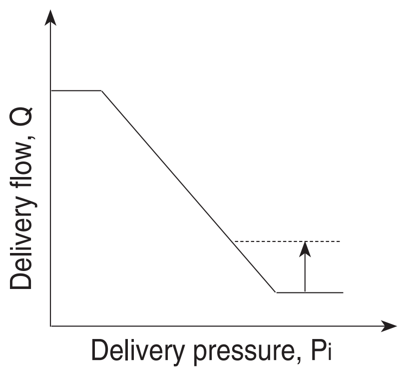
Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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

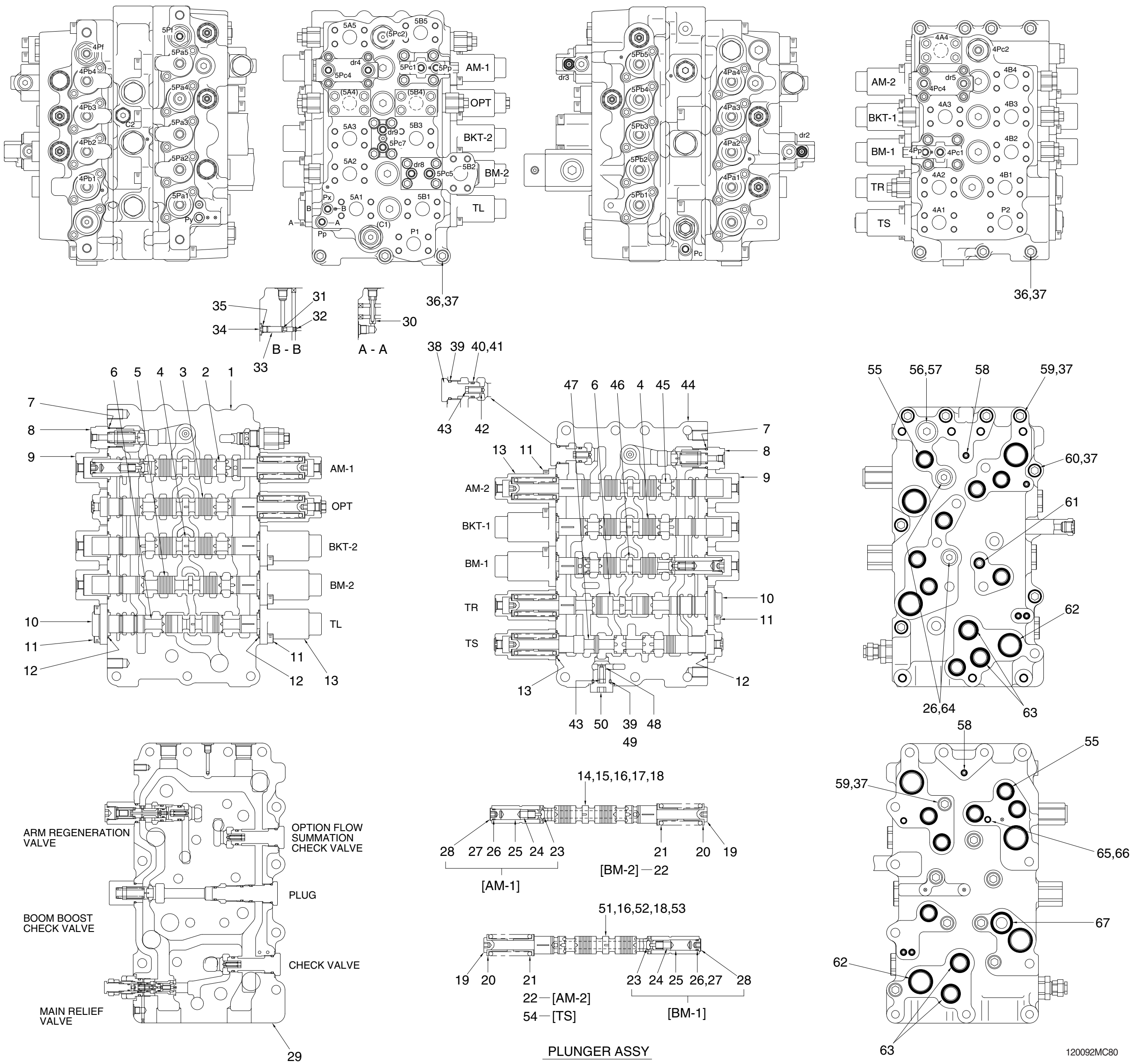


2-19 (2)

Speed	Adjustment of min flow spring	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(l /min)
1800	+1/4	+9.2

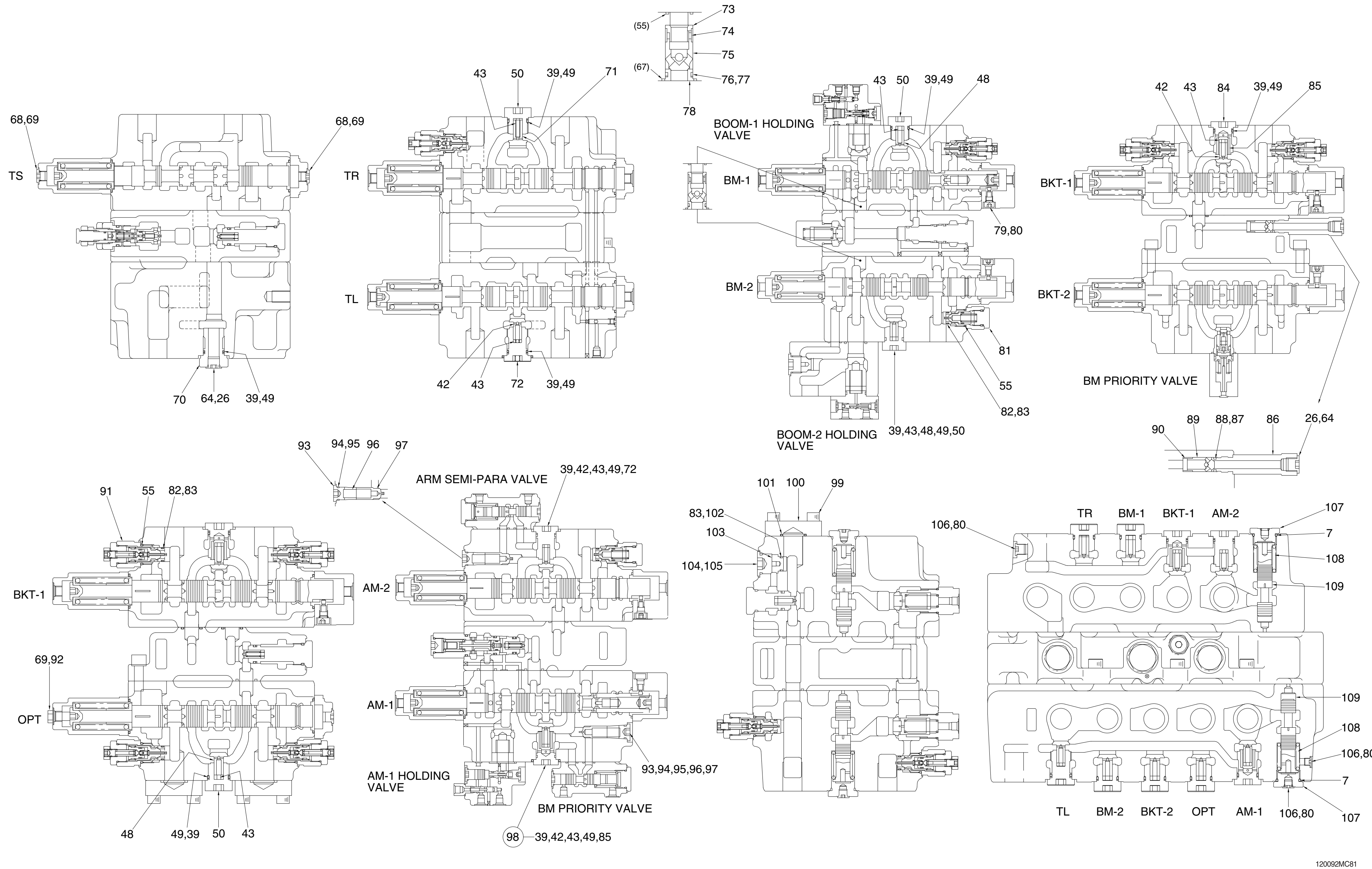


1. STRUCTURE (MCV1)



Port name	Port size
4Pc1, 2, 4, 5Pc1, 2, 4, 5, 7 4Pp, 4Pf, 5Pp, 5Pf, Pc Pg, Pp, Px, Py, dr 1~5, 8, 9	PF 1/4
4Pa 1~4, 4Pb 1~4, 5Pa 1~5 5Pb 1~5	PF 3/8
Rs1, Rs2	PF 1
C1, C2	PF 1/2

1 Housing
2 Plunger A2 assy
3 Plunger D2 assy
4 Plunger C1 assy
5 Plunger B8 assy
6 Plunger M1 assy
7 O-ring
8 Foot relief assy
9 Cover
10 Cover
11 Hex socket head bolt
12 O-ring
13 Cover
14 Plunger A2
15 Plunger D2
16 Plunger C1
17 Plunger B8
18 Plunger M1
19 Plunger cap
20 Spring guide
21 Spring
22 Spring
23 Check
24 Spring
25 Spacer
26 O-ring
27 Back-up ring
28 Cap
29 Manifold
30 Orifice
31 Spring
32 Check
33 Spacer
34 Cap
35 O-ring
36 Hex socket head bolt
37 Washer CD
38 Cap
39 O-ring
40 Back-up ring
41 O-ring
42 Check
43 Spring
44 Housing
45 Plunger A3 assy
46 Plunger A7 assy
47 Plunger G assy
48 Check
49 Back-up ring
50 Cap
51 Plunger A3
52 Plunger B7
53 Plunger G
54 Spring
55 O-ring
56 Cap
57 O-ring
58 O-ring
59 Hex socket head bolt
60 Hex socket head bolt
61 O-ring
62 O-ring
63 O-ring
64 Cap
65 O-ring
66 Back-up ring
67 O-ring
68 Cap
69 O-ring
70 Cap
71 Check
72 Cap
73 Spring guide
74 Spring
75 Check
76 O-ring
77 Back-up ring
78 Seat
79 Plug
80 O-ring
81 Make-up assy
82 O-ring
83 Back-up ring
84 Cap
85 Check
86 Cap
87 Back-up ring
88 O-ring
89 Check
90 Spring
91 Relief assy
92 Plug
93 Cap
94 Back-up ring
95 O-ring
96 Spring
97 Check
98 Cap
99 Hex socket head bolt
100 Plunger
101 O-ring
102 O-ring
103 Plug
104 Cap
105 O-ring
106 Cap
107 Cap
108 Spring
109 Spool CB
110 Cover assy
111 Washer
112 Cap
113 Spring
114 Piston
115 Sleeve
116 Back-up ring
117 O-ring
118 Poppet
119 Spring
120 Cap
121 O-ring
122 Spring
123 Poppet
124 Back-up ring
125 Piston
126 Check
127 Spring
128 Cover
129 Hex socket head bolt
130 Cap
131 Spring
132 Spool
133 Spring
134 Spool
135 Sleeve
136 Spring
137 Spring
138 O-ring
139 Spool
140 Back-up ring
141 O-ring
142 Sleeve
143 O-ring
144 Back-up ring
145 Piston
146 Cap
147 Hex socket head bolt
148 Boost check valve
149 Main relief assy
150 Back-up ring
151 O-ring
152 O-ring
153 Sleeve
154 Cover
155 Spring
156 Spool
157 Back-up ring
158 O-ring
159 Poppet
160 Mainfold
161 O-ring
162 Cover
163 Hex socket head bolt
164 Piston
165 Spring
166 Plate
167 Back-up ring
168 O-ring
169 Spring
170 Spring guide
171 Sleeve
172 Poppet
173 Check
174 Spring
175 Cap
176 O-ring
177 Back-up ring



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(67)
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VALVE
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BM-2
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82,83
BOOM-2 HOLDING
VALVE
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39,49
85
BKT-1
BKT-2
BM PRIORITY VALVE
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96
97
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55
82,83
BKT-1
AM-2
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AM-1 HOLDING
VALVE
BM PRIORITY VALVE
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49,39
50
43
98
39,42,43,49,85
101
100
99
83,102
103
104,105
106,80
TR
BM-1
BKT-1
AM-2
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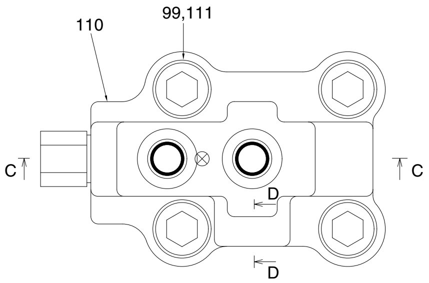
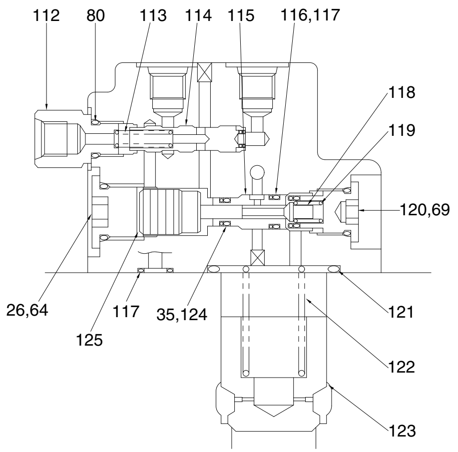
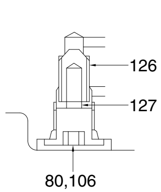
120092MC81

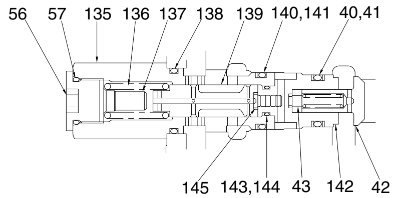




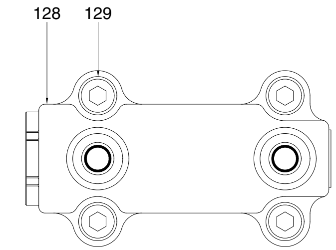
C - C
ARM1. BOOM-1 HOLDING VALVE

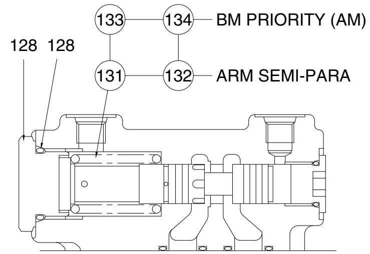


D - D

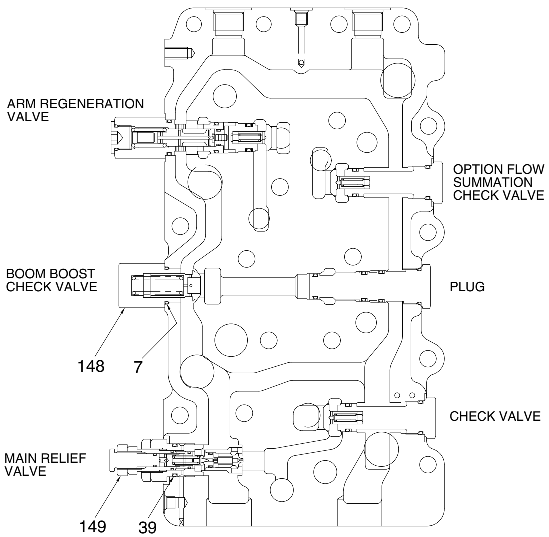


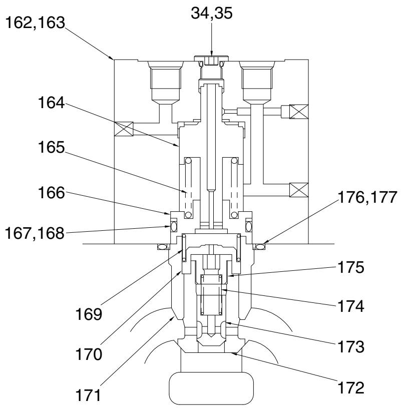
ARM REGENERATION VALVE



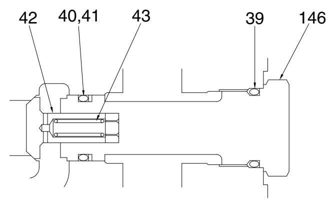


ARM SEMI-PARA VALVE
BOOM PRIORITY VALVE (AM)

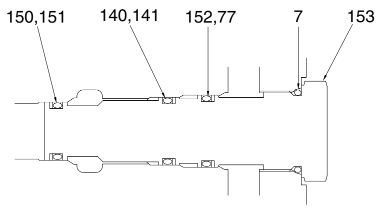




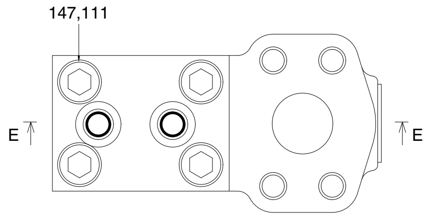
BOOM PRIORITY VALVE (BKT)

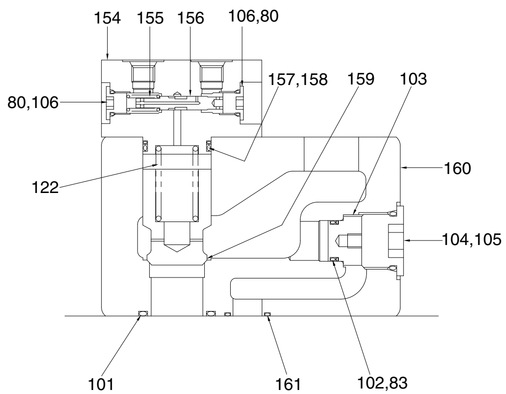


OPTION FLOW SUMMATION CHECK VALVE



PLUG

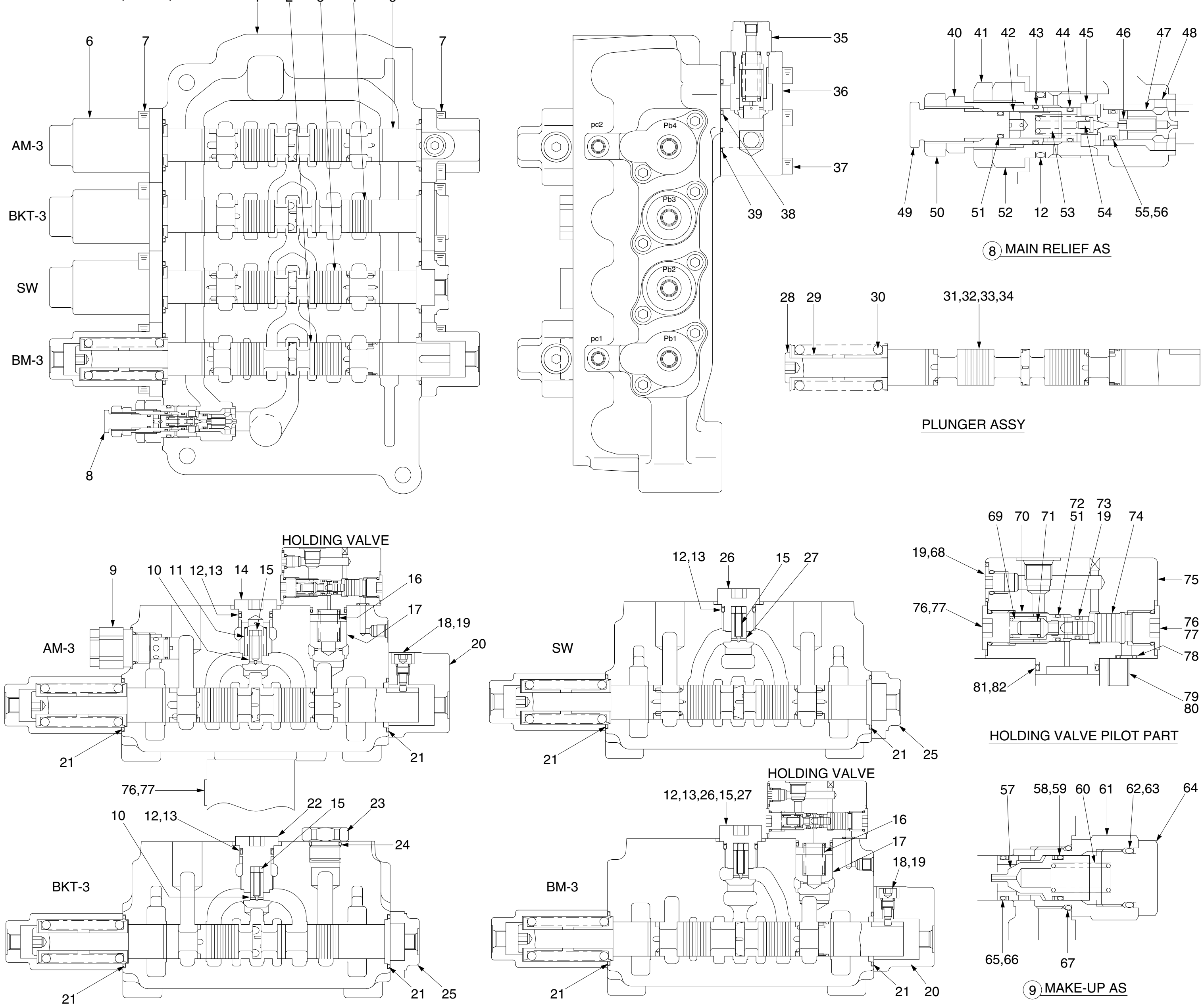




E - E
BOOM-2 HOLDING VALVE

120092MC82

2. STRUCTURE (MCV2)



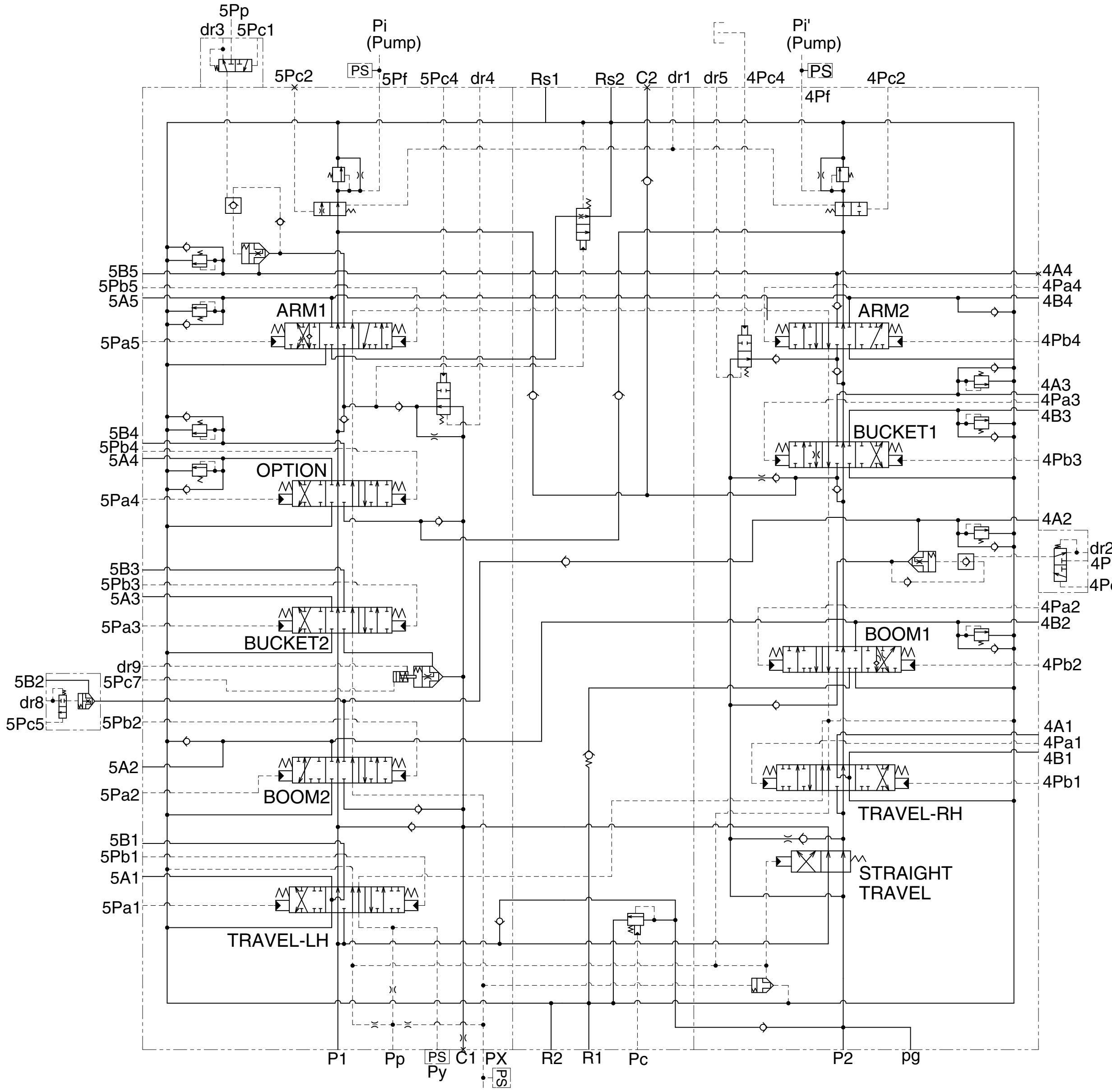
Port name	Port size
Pc1, Pc2, Pf	PF 1/4
Pa 1~4, Pb 1~4	PF 3/8
dr1, dr2	PF 3/8
B3	PF 1

1 Housing
2 Plunger B16 assy
3 Plunger T5 assy
4 Plunger C5 assy
5 Plunger A11 assy
6 Cover
7 Hex socket head bolt
8 Main relief assy
9 Make-up assy
10 Check
11 Check
12 O-ring
13 Make-up ring
14 Cap
15 Spring
16 Spring
17 Poppet
18 Plug
19 O-ring
20 Cover
21 O-ring
22 Cap
23 Cap
24 O-ring
25 Cover
26 Cap
27 Check
28 Plunger cap
29 Spring guide
30 Spring
31 Plunger B16
32 Plunger T5
33 Plunger C5
34 Plunger A11
35 Foot relief assy
36 Manifold
37 Hex socket head bolt
38 O-ring
39 O-ring
40 Sleeve
41 Hex nut
42 Piston
43 O-ring
44 O-ring
45 Pilot sheet
46 Spring
47 Poppet
48 Sleeve
49 Adjust screw
50 Hex nut
51 O-ring
52 Cap
53 Spring
54 Pilot poppet
55 Back-up ring
56 O-ring
57 Poppet
58 Back-up ring
59 O-ring
60 Spring
61 Relief sleeve
62 O-ring
63 Back-up ring
64 Cap
65 O-ring
66 Back-up ring
67 O-ring
68 Cap
69 Spring
70 Sleeve
71 Poppet
72 O-ring
73 Back-up ring
74 Piston
75 Cover assy
76 Cap
77 O-ring
78 O-ring
79 Hex socket head bolt
80 Washer
81 Back-up ring
82 O-ring

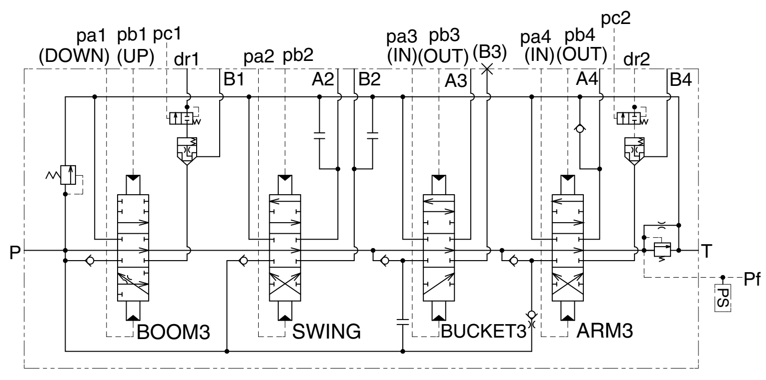
120092MC83

3. HYDRAULIC CIRCUIT

1) MAIN CONTROL VALVE 1



2) MAIN CONTROL VALVE 2



120092MC84

4. BASIC OPERATION

1) STRAIGHT TRAVEL CIRCUIT

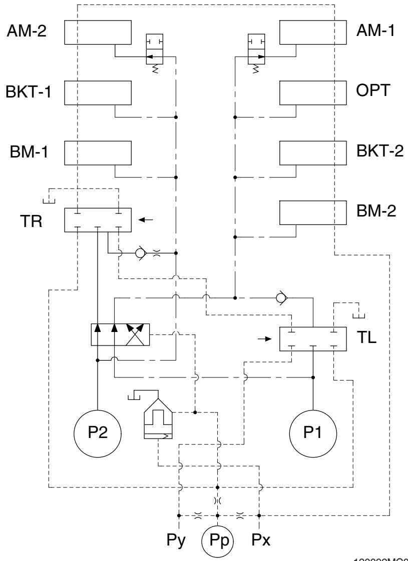
In straight travel operation, this circuit keeps going straight even if the operations other than traverl (AM, BM, BKT, OPT) are done at the same time.

(1) Only travel operation (TR and TL)

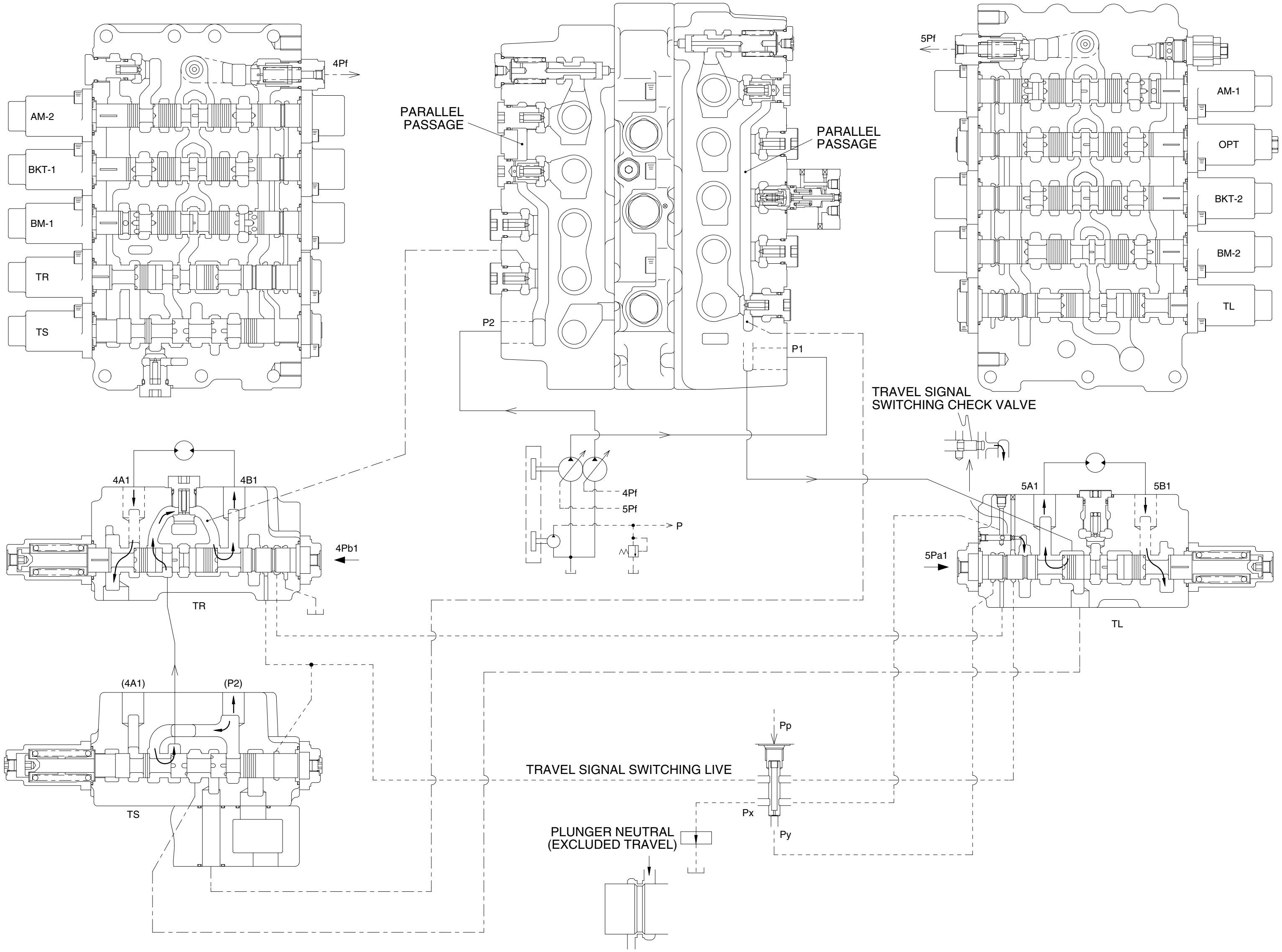
Travel signal line Py is blocked by changing the plunger.

And other plungers are neutralitys, signal line Px is connected with the tank line. Therefore, travel signal switching signal check valve keeps open, and straight travel plunger neutralization is kept.

TR and TL section operated independently and keeps going straight travel.



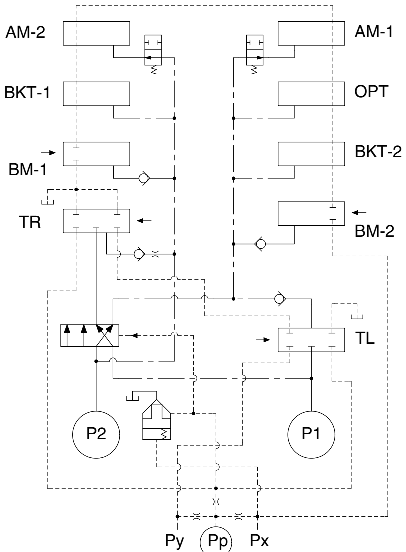
120092MC06



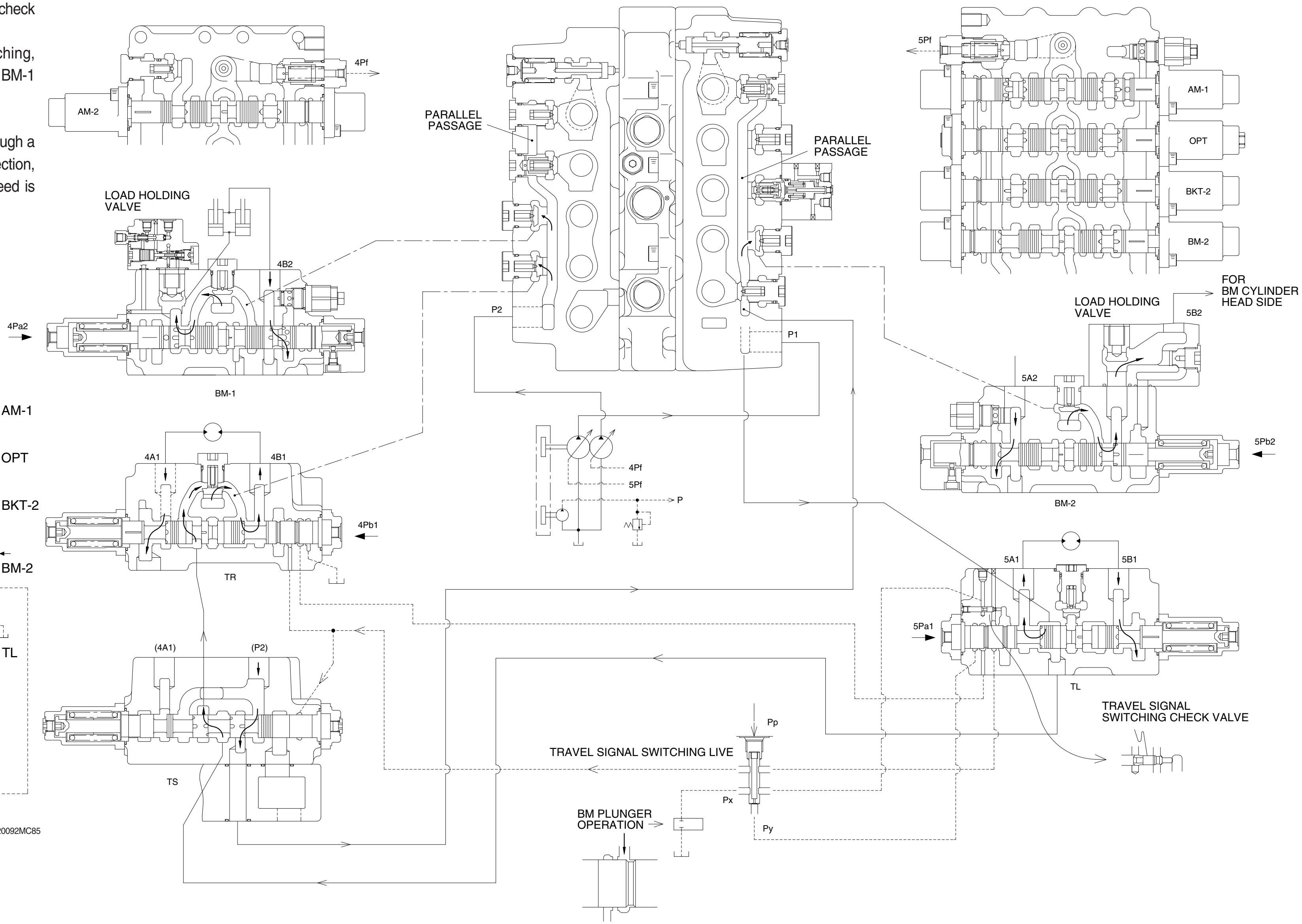
120092MC07

(2) Both travel operation (TR and TL) and for instance BM-up operation

In BM operation, Px is blocked and pilot pressure acts on the travel signal switching check valve, and tank passage is shut.
Therefore, straight travel plunger switching, and P1 acts on TR and TL, P2 acts on BM-1 and BM-2 through a parallel passage.
As the result, straight travel keeps.
Moreover, P2 side surplus oil passes through a parallel passage and supply to travel section, and the sudden change of the travel speed is eased.



120092MC85



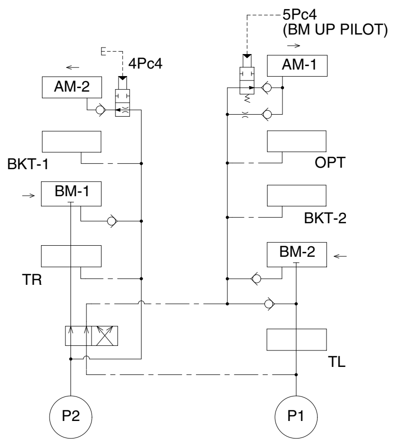
120092MC08

2) ARM SEMI-PARALLEL CIRCUIT

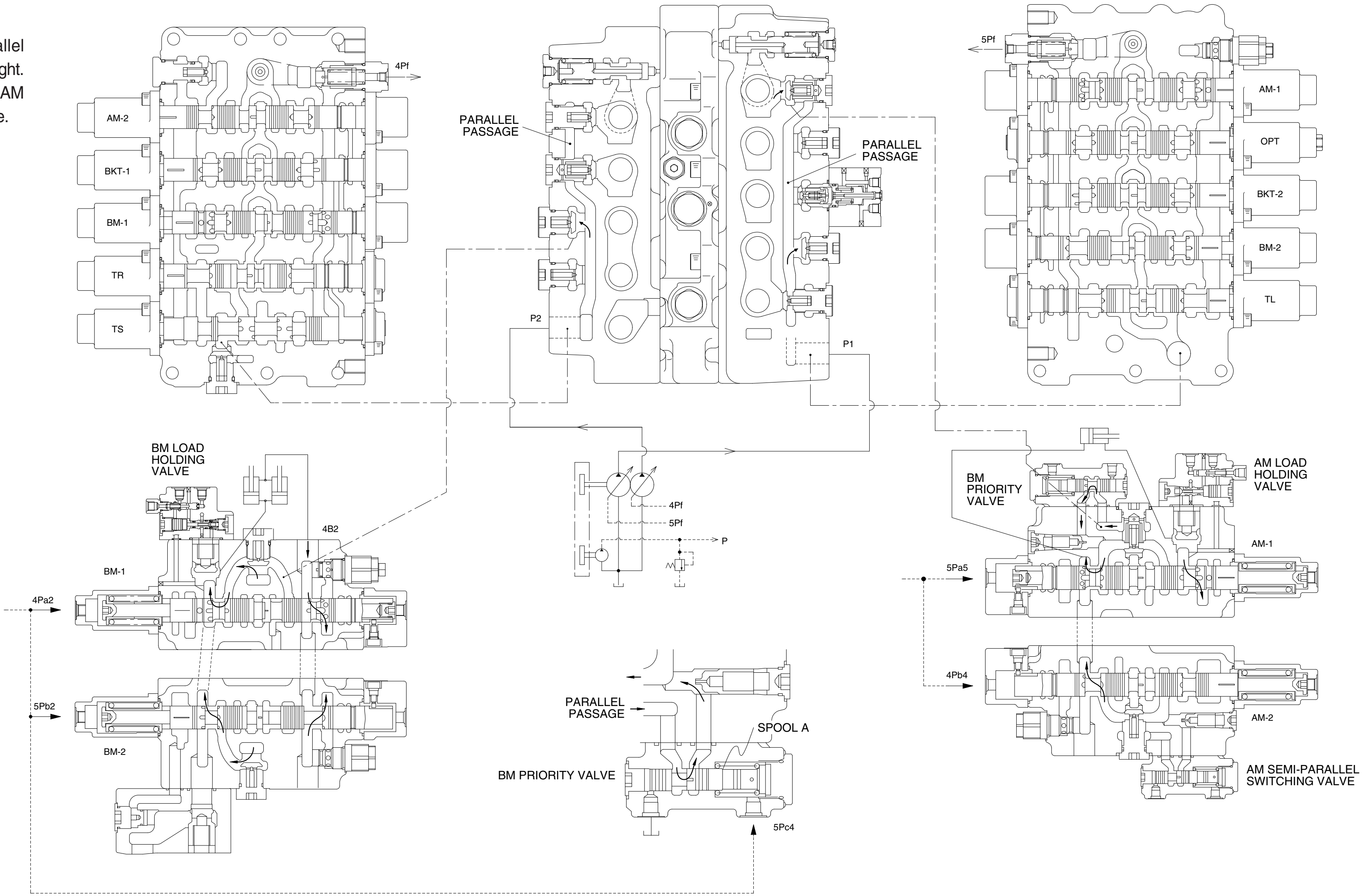
(1) Arm-crowd and BM-up operation

In BM-up operation, BM-up pilot pressure acts on 4Pc4 port, and spool A controls parallel passage open area by the stroke.

P2 is supplied to AM-2 through the parallel passage by priority, because AM-2 load is light. P1 is supplied to BM-2 by priority, because AM parallel valve squeezed the parallel passage.



120092MC09



120092MC10

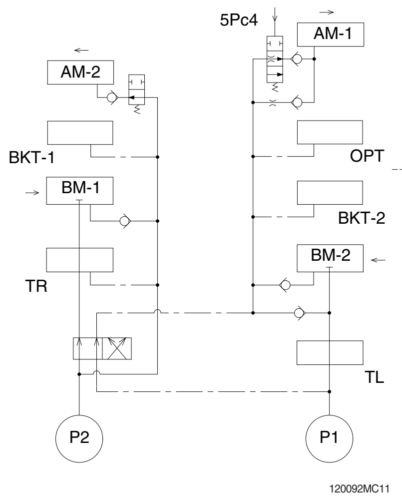
3) BOOM PRIORITY CIRCUIT

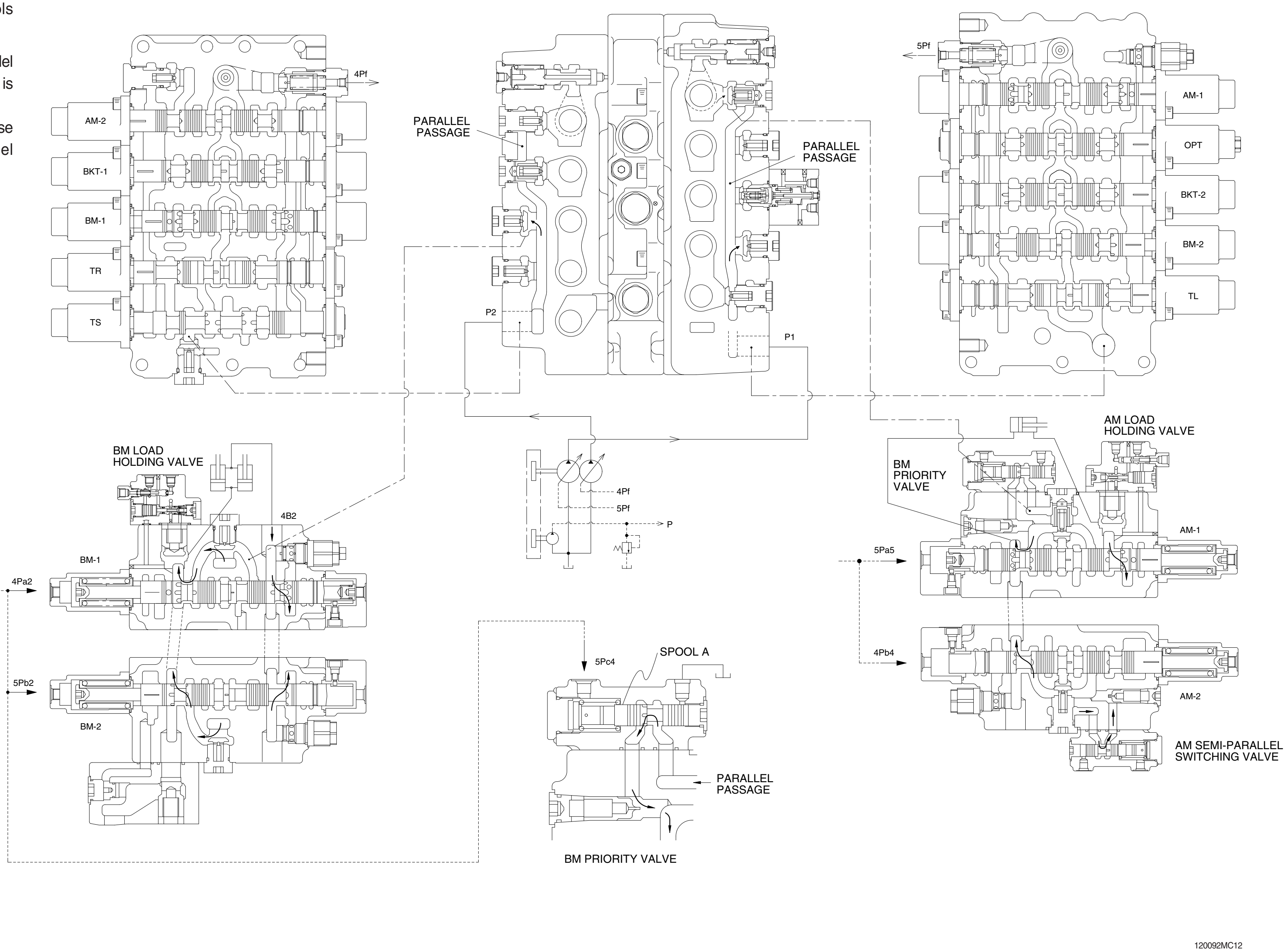
(1) Arm-crowd and Boom-up operation

In BM-up operation, BM-up pilot pressure acts on 5Pc4 port, and spool A controls parallel passage open area by the stroke.

P2 is supplied to AM-2 through the parallel passage by priority, because AM-2 load is light.

P1 is supplied to BM-2 by priority, because BM priority valve squeezed the parallel passage.





4) OPTION SUMMATION CIRCUIT

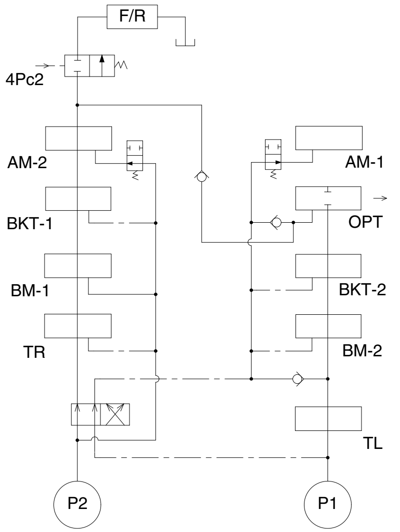
(1) Option single operation

P1 is supplied to 5A4.

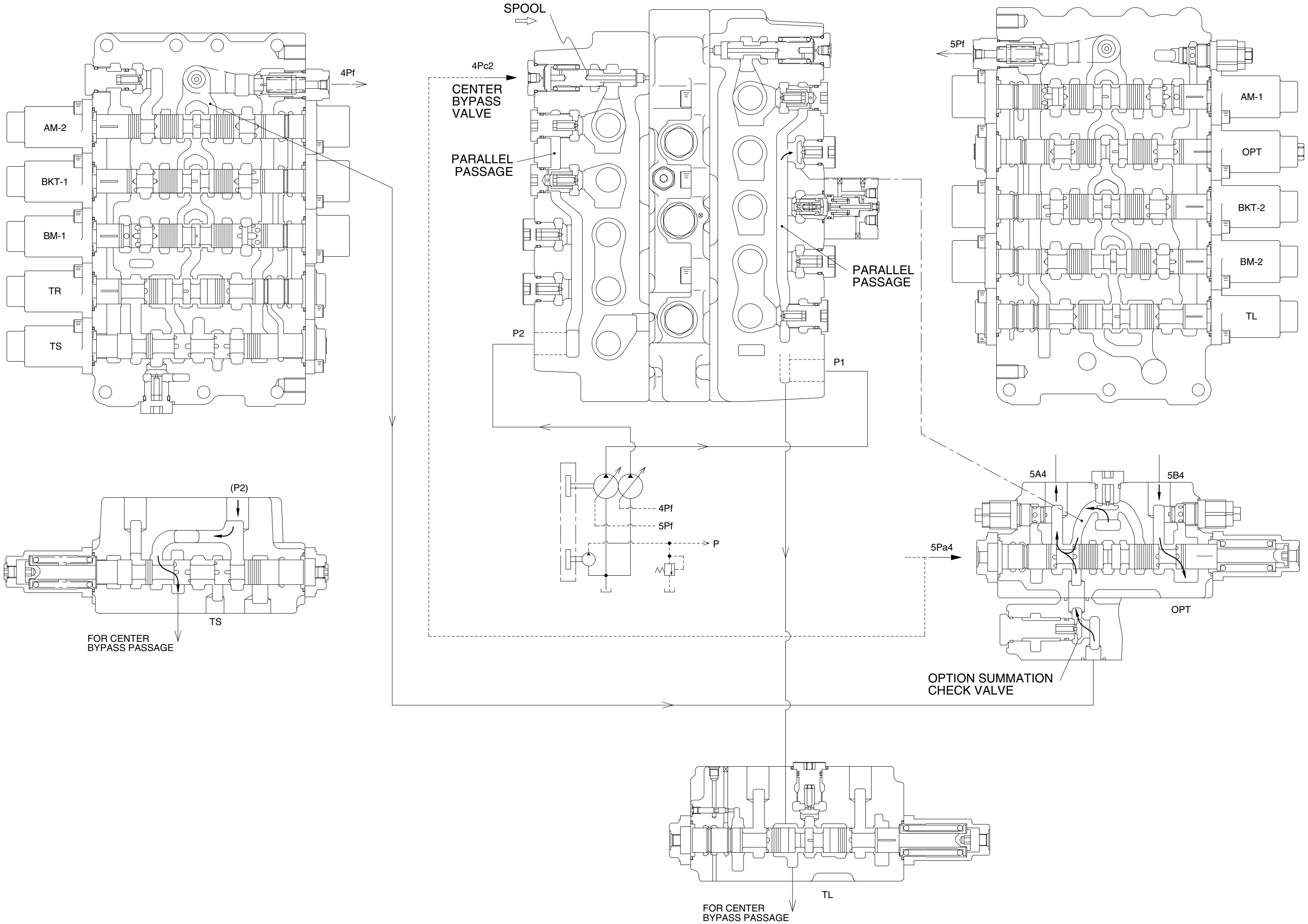
OPT pilot pressure acts on 4Pc2 port, and center bypass spool switch and tank passage shut.

Therefore, P2 supplied OPT port through the center bypass spool and OPT summation check valve.

As a result, two pumps are joined and it flows to OPT port.

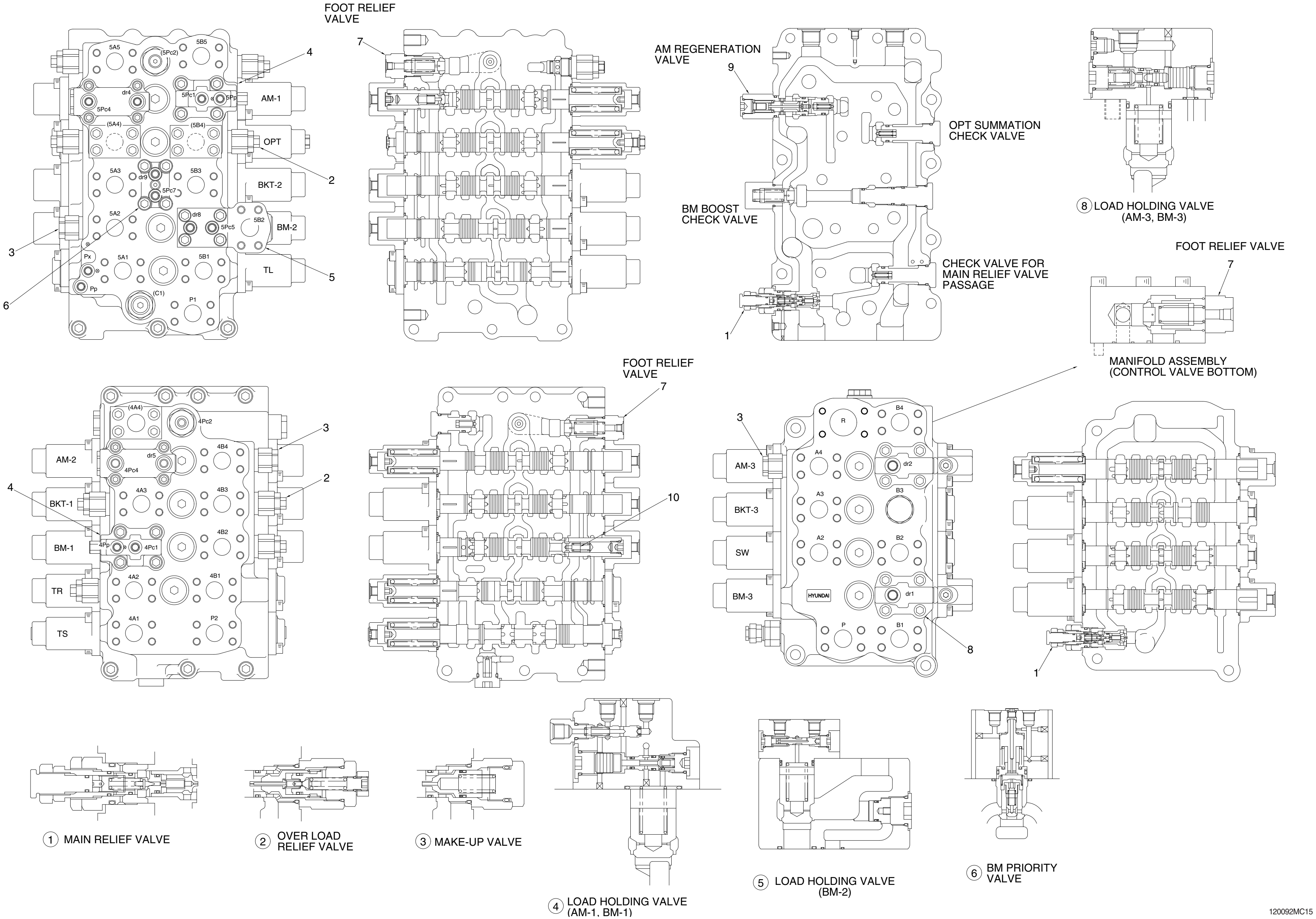


120092MC13



120092MC14

5. EACH PARTS OPERATIONAL DESCRIPTION

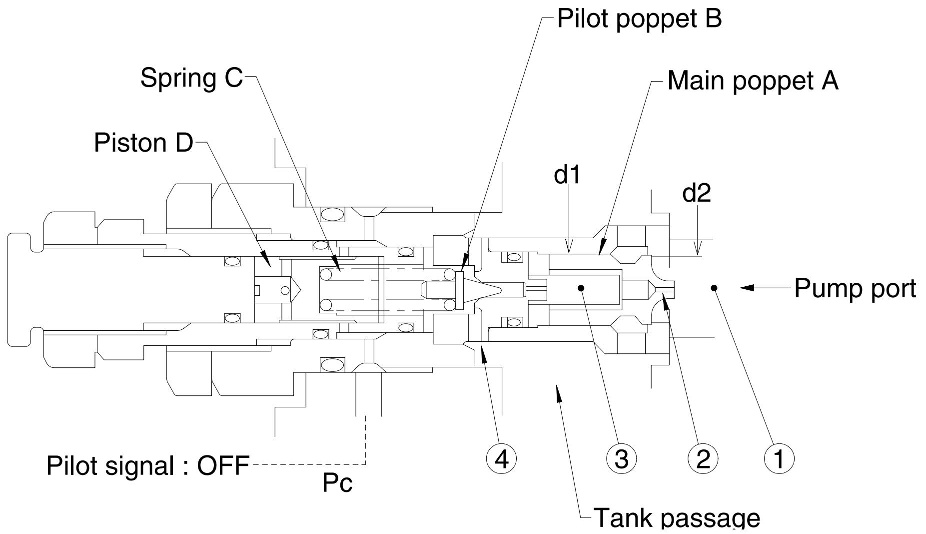


1) MAIN RELIEF VALVE

(1) Standard pressure setting (Pc pilot port : OFF)

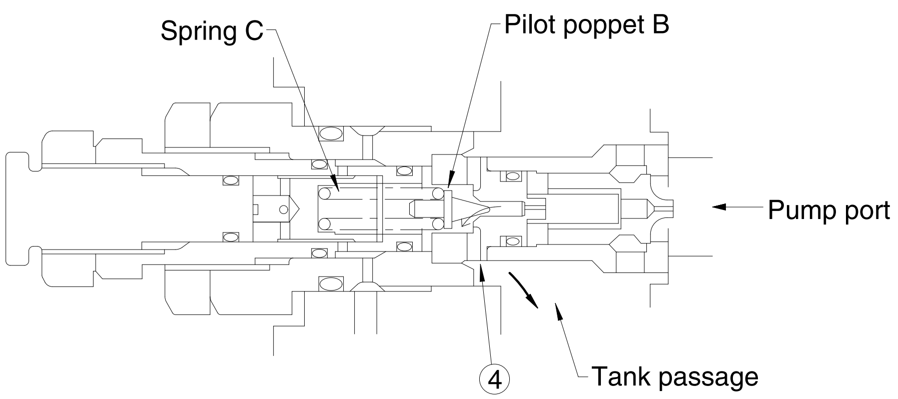
Piston "D" is positioned in left side by the spring "C".

① Oil from the pump port enters into the chamber "3" through the orifice "2" of the main poppet "A". As d1 > d2, main poppet "A" is securely seated.



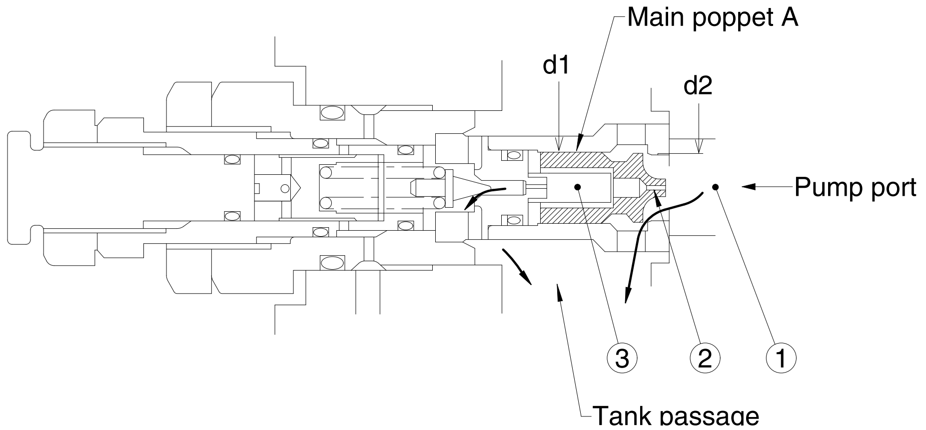
120092MC16

② When the pressure reaches the preset force of the spring "C" the pilot poppet "B" opens. Oil flows around pilot poppet "B" and flows into the tank passage through the side hole "4".



120092MC86

③ As oil flows from the pump port to the tank passage through the orifice "2" of the main poppet "A", the pressure of the chamber "3" comes to lower than that of the pump port. Then the main poppet "A" is lifted and pressured oil flows into the tank passage.

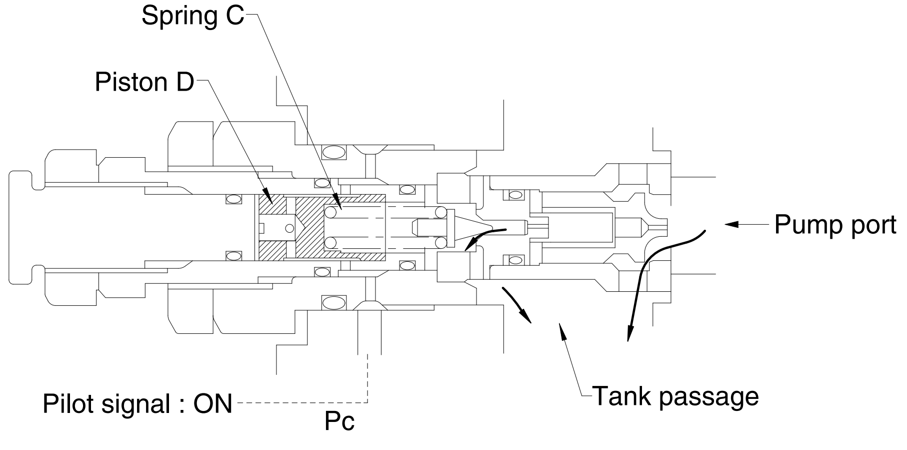


120092MC17

(2) **High pressure setting** (Pc2 pilot port : ON)

Piston "D" is positioned in right side by the pilot pressure "Pc".

The setting force of the spring "C" increases and the relief setting pressure changes to the high pressure.

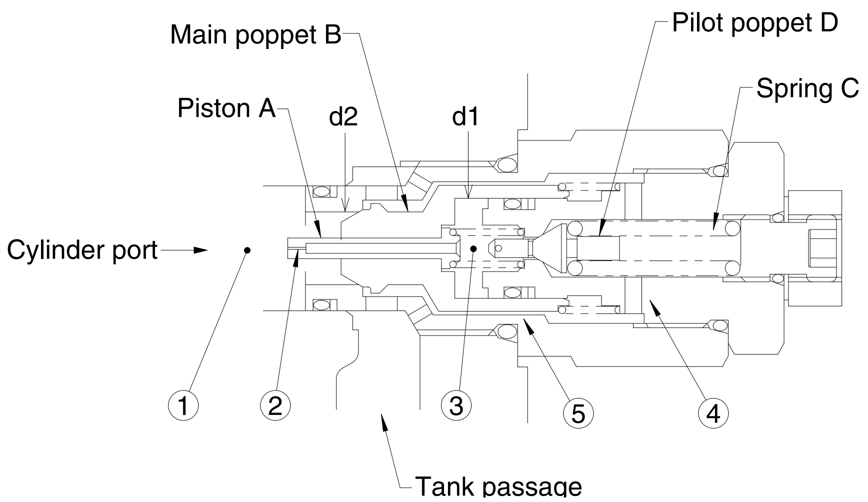


120092MC87

2) OVER LOAD RELIEF VALVE

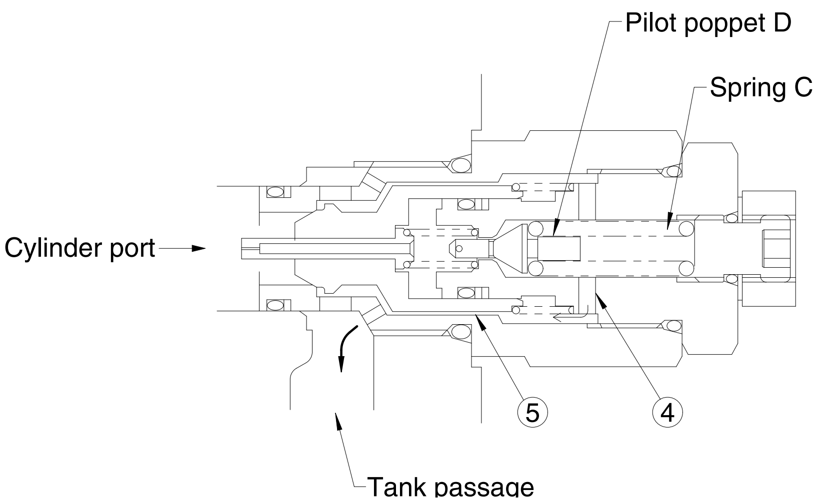
(1) Overload relief function

① Oil from the cylinder port enters into the chamber "3" through the orifice "2" of the piston "A". As d1 > d2, main poppet "B" is securely seated.



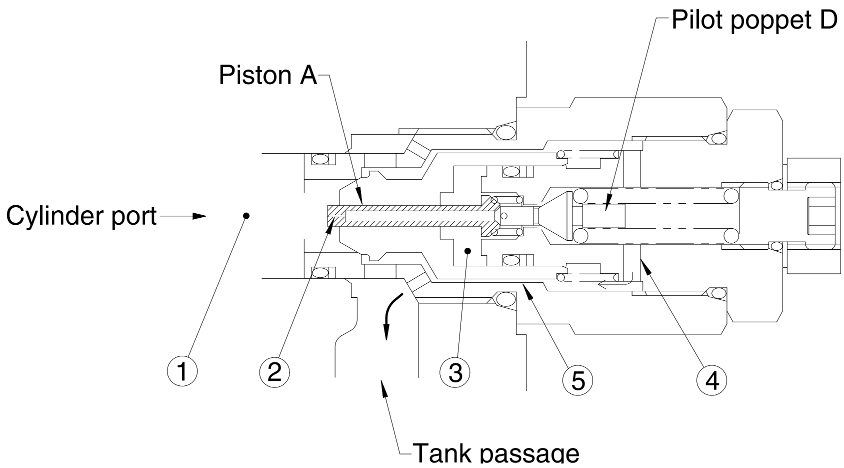
120092MC18

② When the pressure reaches the preset force of the spring "C" the pilot poppet "D" opens. Oil flows around pilot poppet "D" and flows into the tank passage through the side hole "4" and the passage "5".



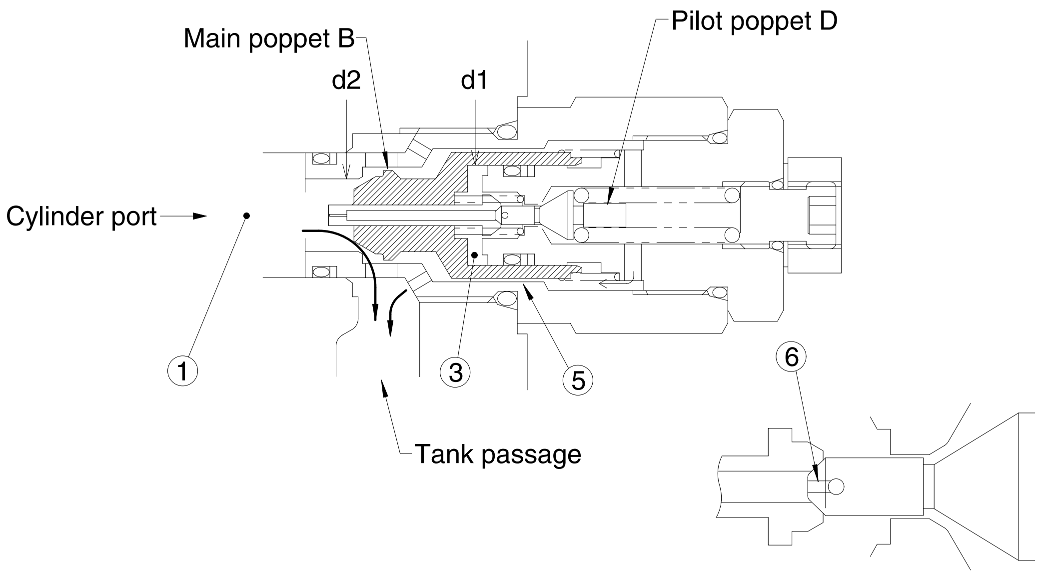
120092MC88

③ As oil flows from the cylinder port to the tank passage through the orifice "2" of the piston "A", the pressure of the chamber "3" comes to lower than that of the cylinder port. Then the piston "A" is lifted and seated to the pilot poppet "D".



120092MC19

④ Oil from the cylinder port flows to the tank passage through the orifice "6" of the pilot poppet "D" and the chamber "3". As the pressure of the chamber "3" comes to lower still more, the main poppet "B" is lifted and pressured oil flows into the tank passage.

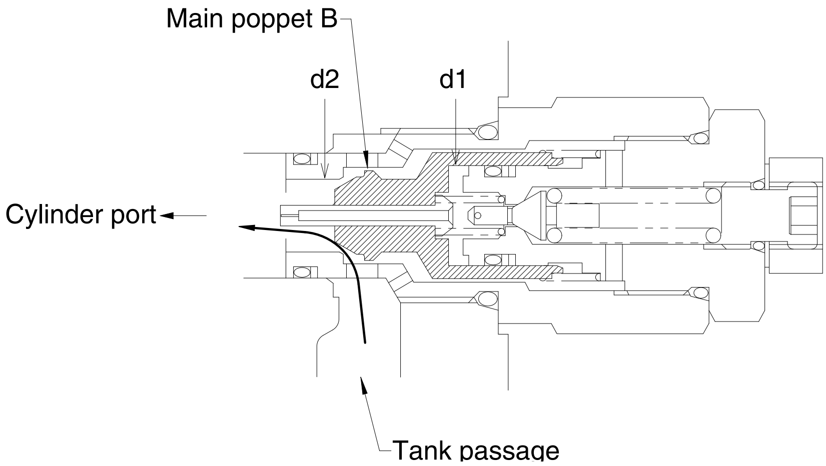


120092MC89

(2) Make-up function

① As the cylinder port pressure is normally higher than the tank passage pressure and d1 > d2, the main poppet "B" is securely seated.

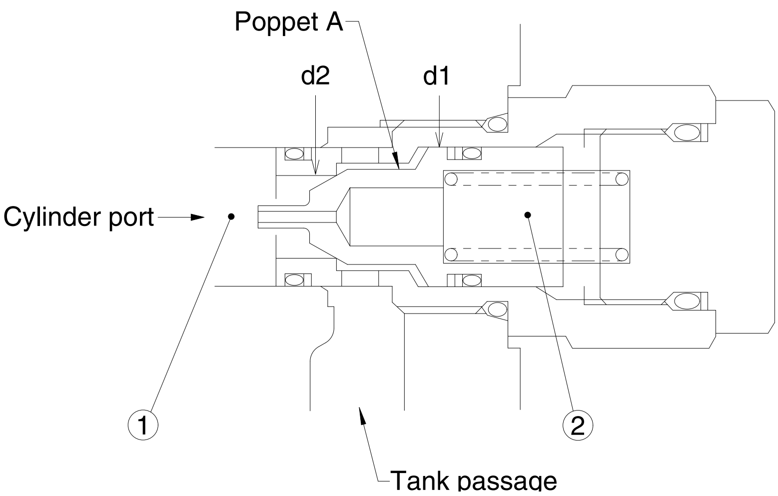
② When the cylinder port pressure comes to lower than the tank passage pressure (closer to negative pressure), the main poppet "B" opens receiving the tank passage pressure for the difference in area between "d1" and "d2". Oil flows from the tank passage flows to the cylinder port in order to prevent cavitation.



120092MC20

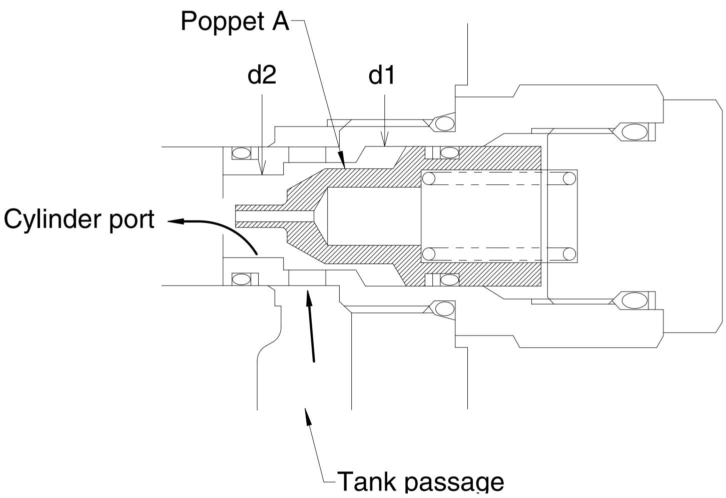
3) MAKE-UP VALVE

(1) Cylinder port pressure enters into the chamber "3" through the poppet "A.
And the main poppet "B" is securely seated, because of d1 > d2.



120092MC21

(2) When the cylinder port pressure comes to lower than the tank passage pressure (closer to negative pressure), the main poppet "B" opens receiving the tank passage pressure for the difference in area between "d1" and "d2". Oil flows from the tank passage flows to the cylinder port in order to prevent cavitation.



120092MC90

4) **LOAD HOLDING VALVE** (ARM-1, BOOM-1)

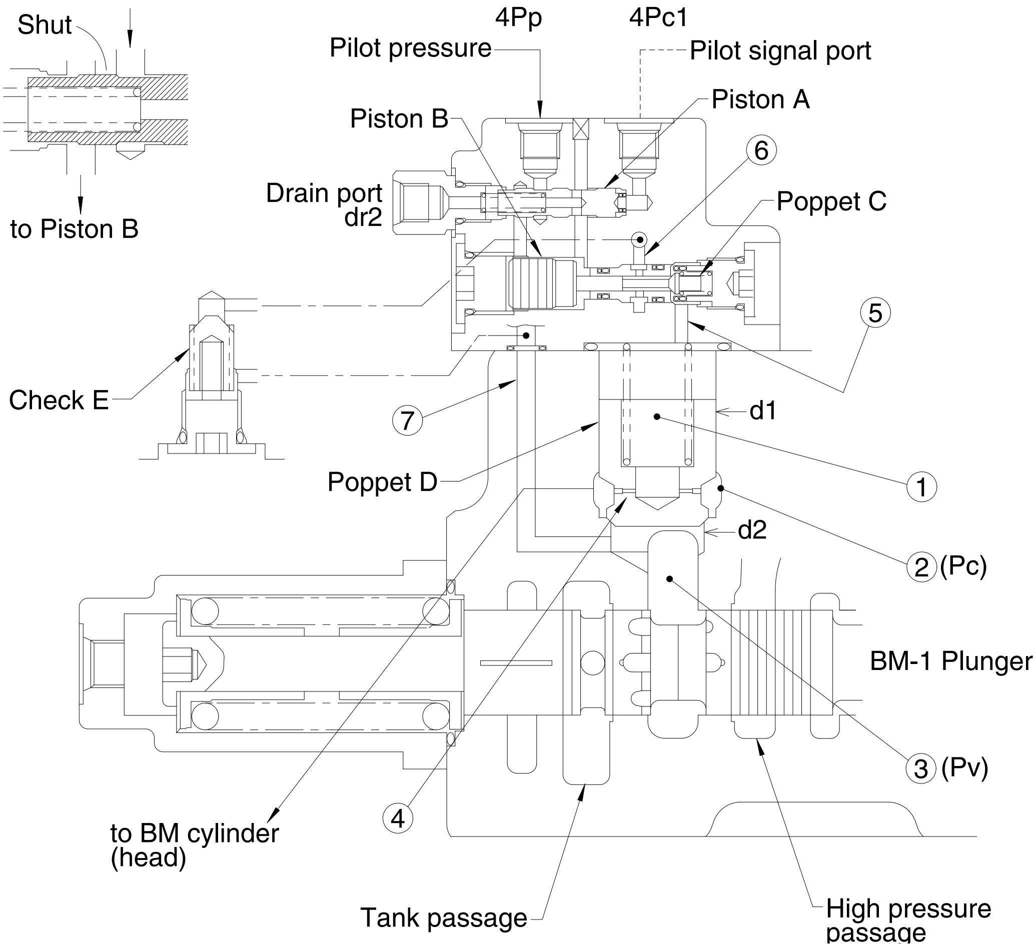
BM holding valve is explained as an example.

(1) **When the plunger is in neutral position** (4Pc1 pilot signal : OFF)

Piston "A" and piston "B" is in the status as shown, the pilot pressure (4Pp) is blocked. Therefore piston "B" and poppet "C" is in this status as shown, the passage "5" and "6" shut off by the poppet "C", and the passage "7" shut off by the check "E".

And, the pressure of chamber "1" is same to the pressure of "Pc", as it is connected with the passage "2" through the orifice "4".

Since d1 > d2, the poppet "C" is seated and the passage "2" and "3" are completely blocked.



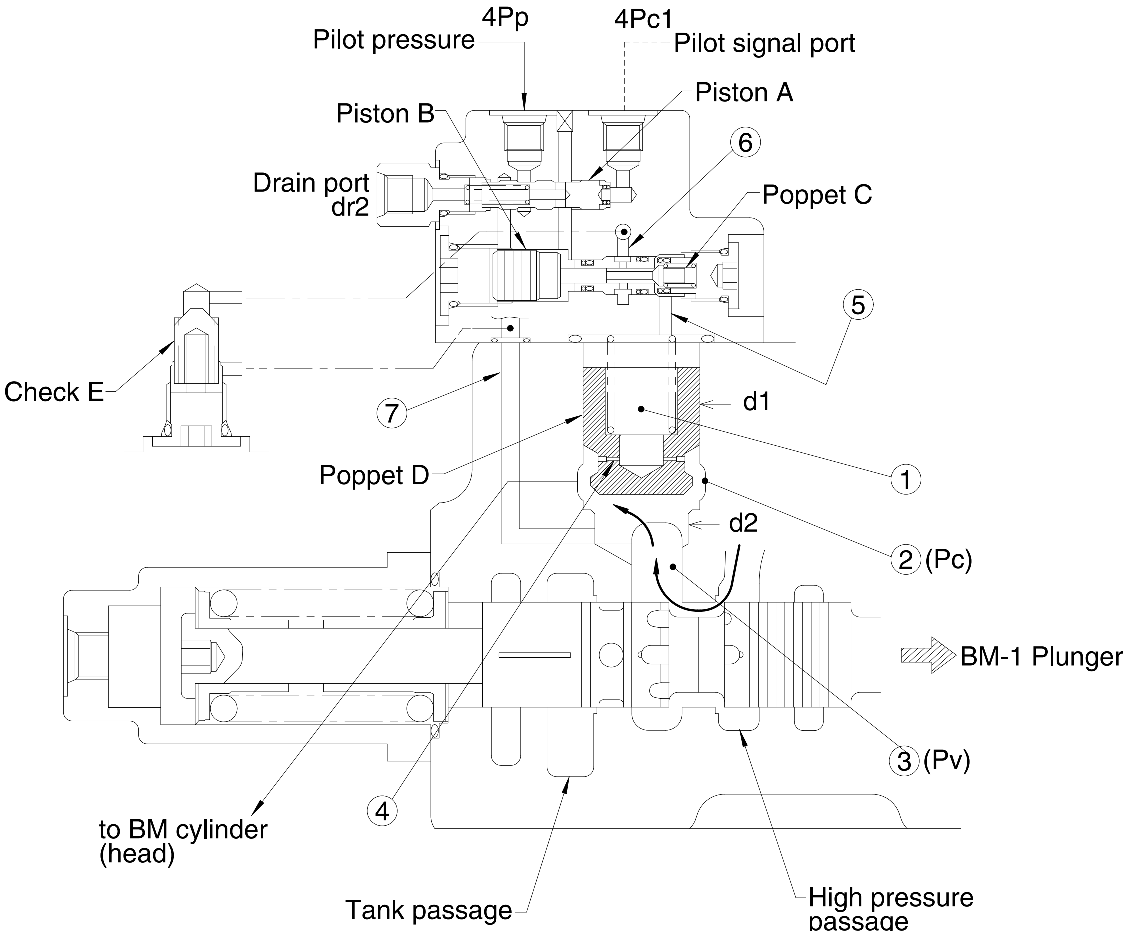
120092MC22

(2) When the plunger is operated

① **Boom-up operation** (Pv > Pc and pilot signal 4Pc1 : OFF)

The pressure of the chamber "1" is same to the pressure of "BM" cylinder (head), (equals to "Pc"), as it is connected with the core "2" through the orifice "4".

The poppet "D" is pushed up and oil from the high pressure passage flows into the "BM" cylinder port.



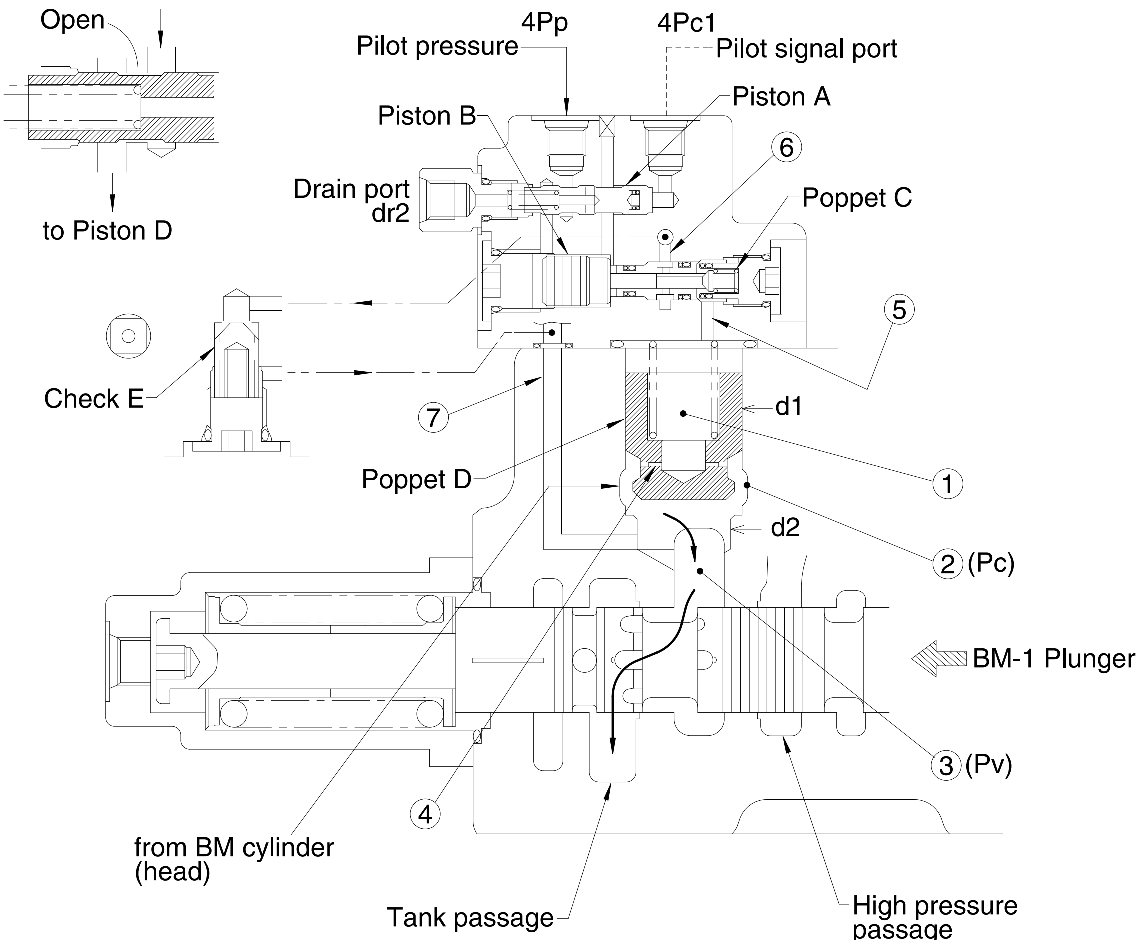
120092MC23

② **Boom-down operation** (Pc > Pv and pilot signal 4Pc1 : ON)

The BM-1 plunger moves the left side, the chamber "3" connected the tank passage. And the plunger pilot pressure is acts on the "4Pc1" port, the piston "A" moves the left side, and pilot pressure enter the chamber of piston "B".

The piston "B" and poppet "C" moves the right side, the passage "5", "6" and "7" that through the check "E" are connected the tank passage.

The chamber "A" pressure is falls, the pressure "Pc" acts on the area of difference between "d1" and "d2", the poppet "D" is opened by this. Therefore, the oil that returns from the BM cylinder head side is flows to the tank passage.



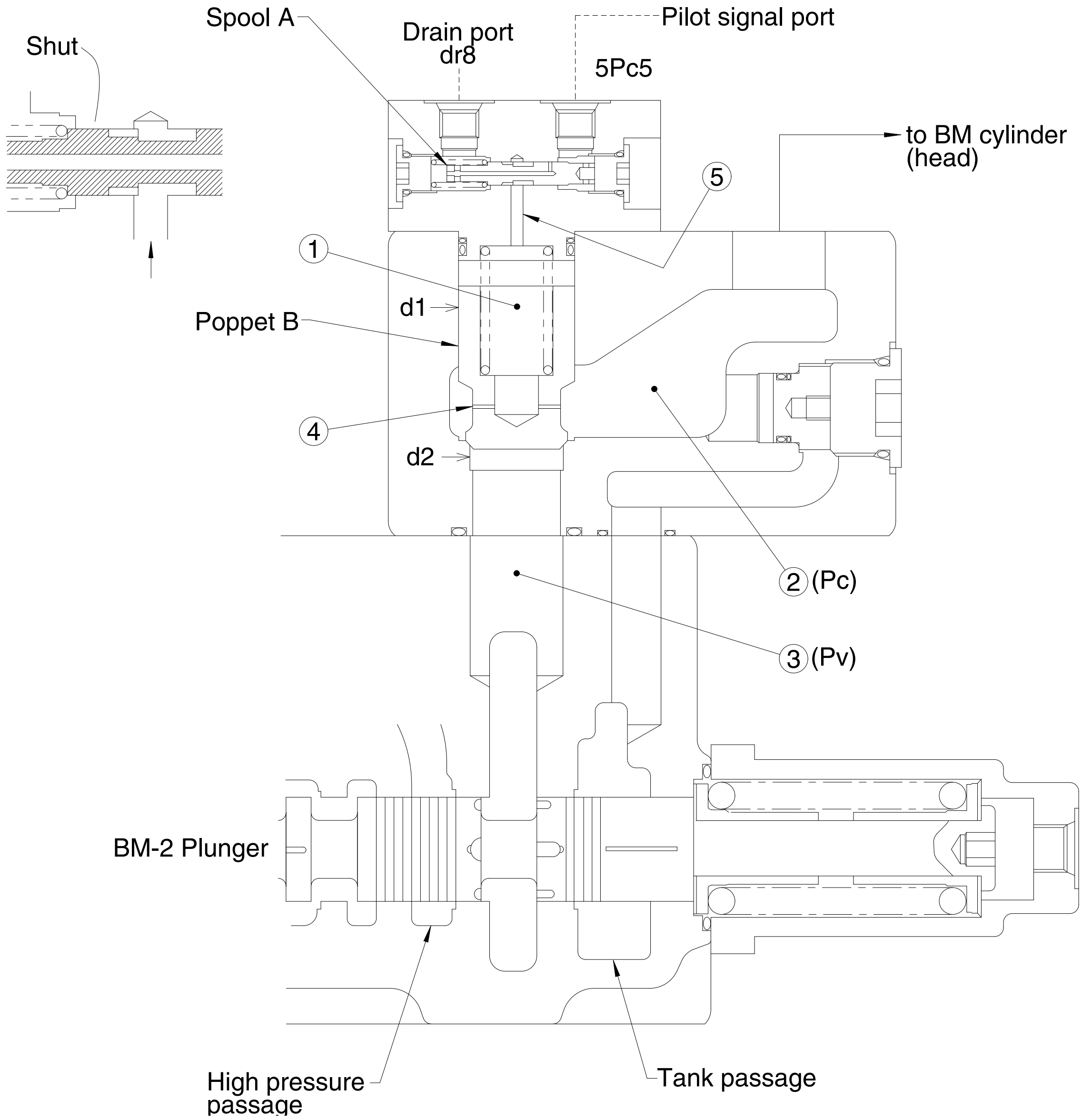
5) LOAD HOLDING VALVE (BOOM-2)

(1) When the plunger is in neutral position (5Pc5 pilot signal : OFF)

Spool "A" is in the status as shown, the passage "5" and drain port are shut off by the spool "A".

And, the pressure of chamber "1" is same to the pressure of "Pc", as it is connected with the passage "2" through the orifice "4".

Since d1 > d2, the poppet "B" is seated and the passage "2" and "3" are completely blocked.



120092MC25

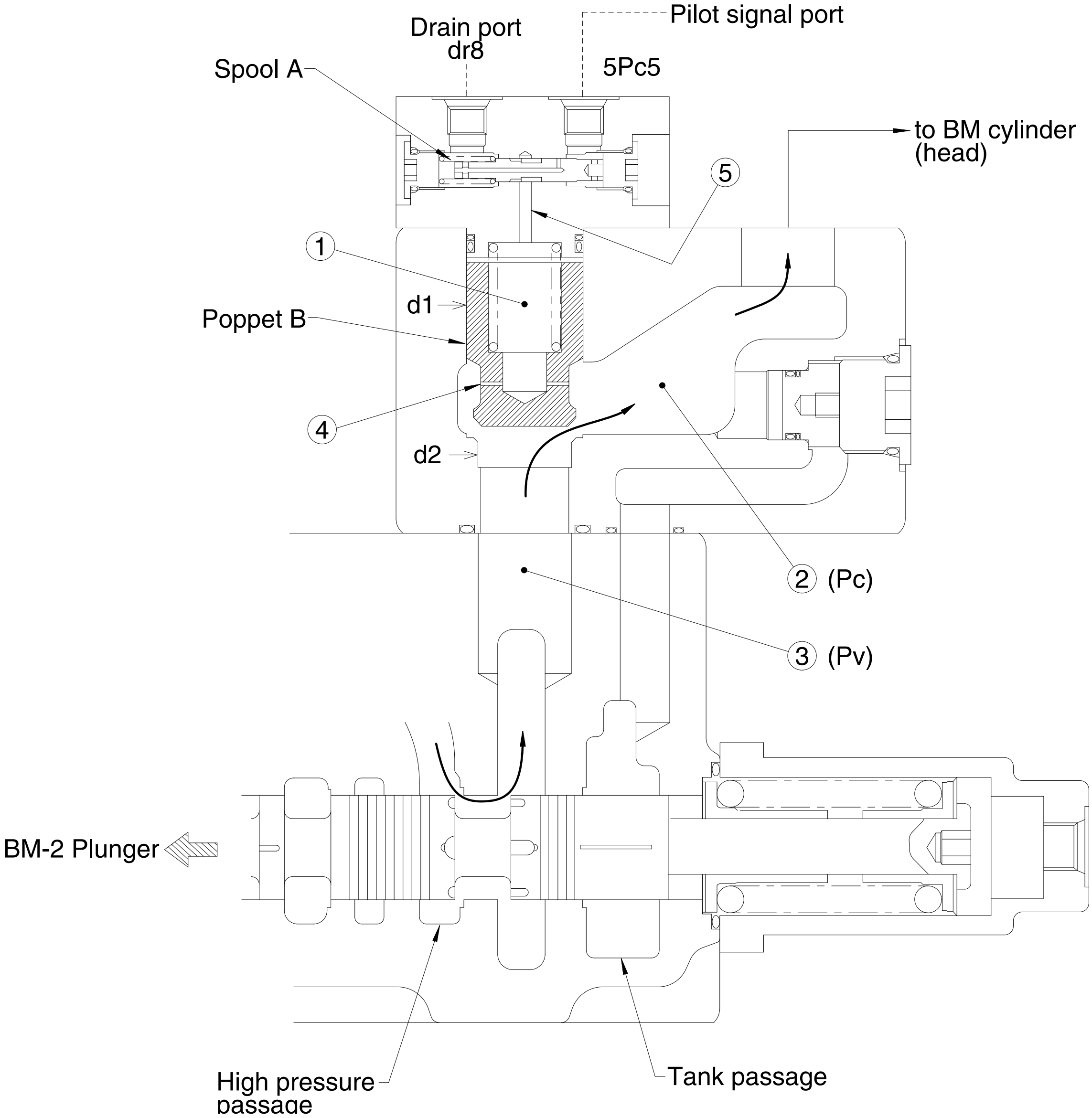
(2) When the plunger is operated

① **Boom-up operation** (Pv＞Pc and pilot signal 5Pc5 : OFF)

The BM-2 plunger moves the left side, and oil from the high pressure passage flows into the core "3".

And, the pressure of chamber "1" that through the olifice "3" is same to the pressure of "Pc".

The poppet "B" is pushed up and oil from the high pressure passage flows into the "BM" cylinder port.

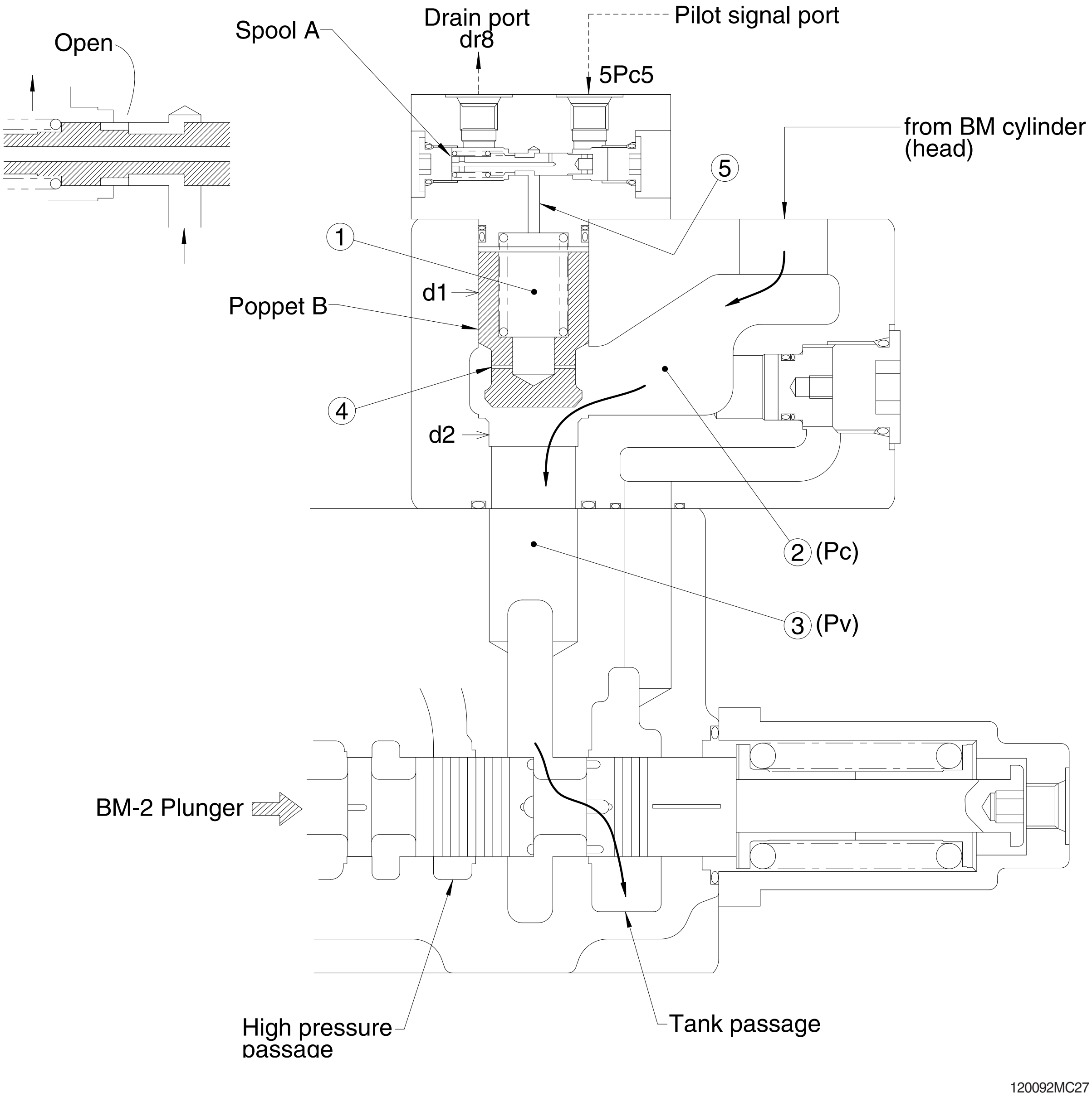


120092MC26

② **Boom-down operation** (Pc > Pv and pilot signal 5Pc5 : ON)

The BM-2 plunger moves the left side, the chamber "3" connected the tank passage. And the plunger pilot pressure is acts on the "5Pc5" port, the spool "A" moves the left side, and the passage "5" connected with the drain port.

The chamber "1" pressure is falls, the pressure "Pc" acts on the area of difference between "d1" and "d2", the poppet "B" is opened by this. Therefore, the oil that returns from the BM cylinder head side is flows to the tank passage.



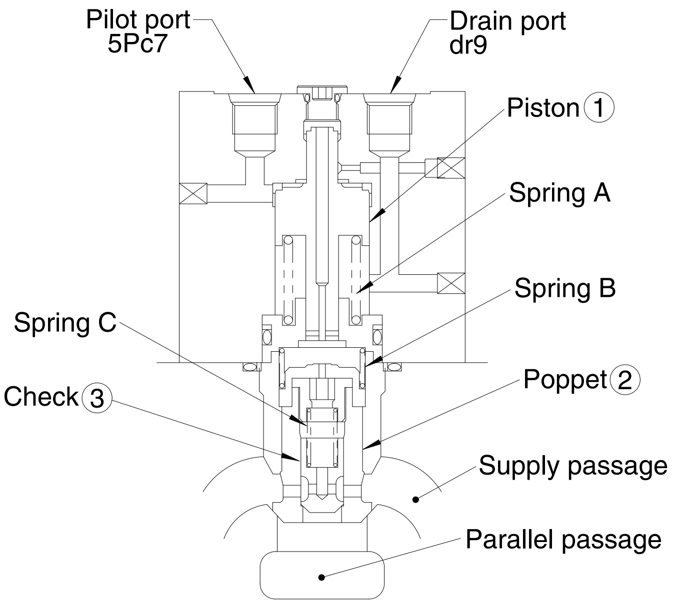
6) BOOM PRIORITY VALVE

BM priority valve (for the BKT-2 section)

(1) BKT operation (5Pc7 pilot signal : OFF)

① **When the parallel passage pressure lower than the supply passage pressure.**

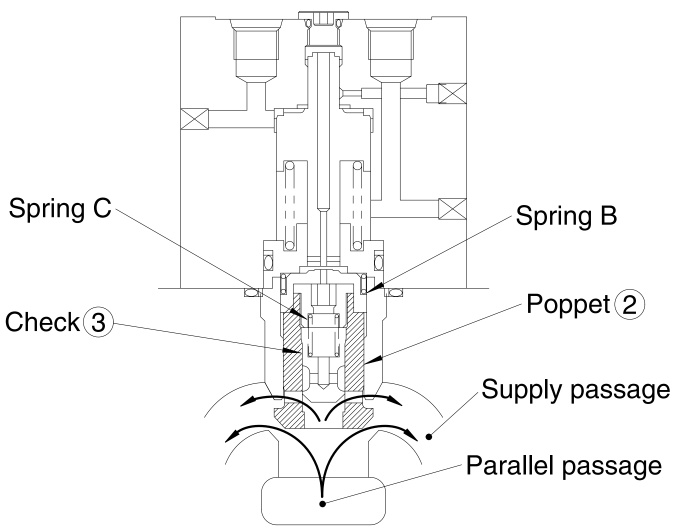
Piston "1", poppet "2" and check "B" are in the status as shown by the each springs "A", "B" and " C", and seated surely.



120092MC28

② **When the parallel passage pressure higher than the supply passage pressure.**

The oil for parallel passage that connected the pump line is supply the BKT cylinder through the supply passage, because spring force of "B" and "C" is very small, and poppet "2" and check "3" are opened.

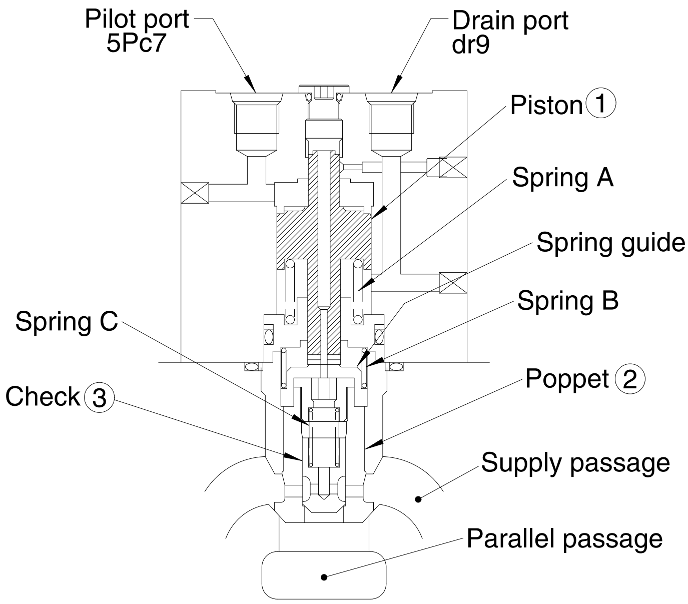


120092MC91

(2) BKT and BM up operation (5Pc7 pilot signal : ON)

① When the parallel passage pressure lower than the supply passage pressure.

BM up operation pilot pressure is acts on the pilot port "5Pc7", and its grows more than 0.1~0.15 MPa, the piston "1" moves to the position of figure, and presses poppet "2" and spring guide. Moreover, check "3" is in the status as shown and seated surely.



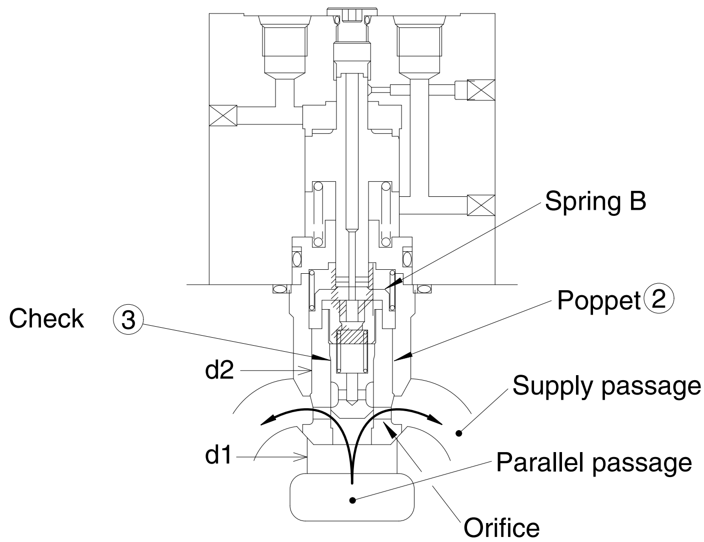
120092MC29

② When the parallel passage pressure higher than the supply passage pressure.

When the pilot pressure even a little, poppet "2" is seated, because "d1", "d2" are roughly the same.

The check "3" is opens and the oil of supply passage is flows to BKT cylinder. But this flow is controlled by the orifice of poppet "2".

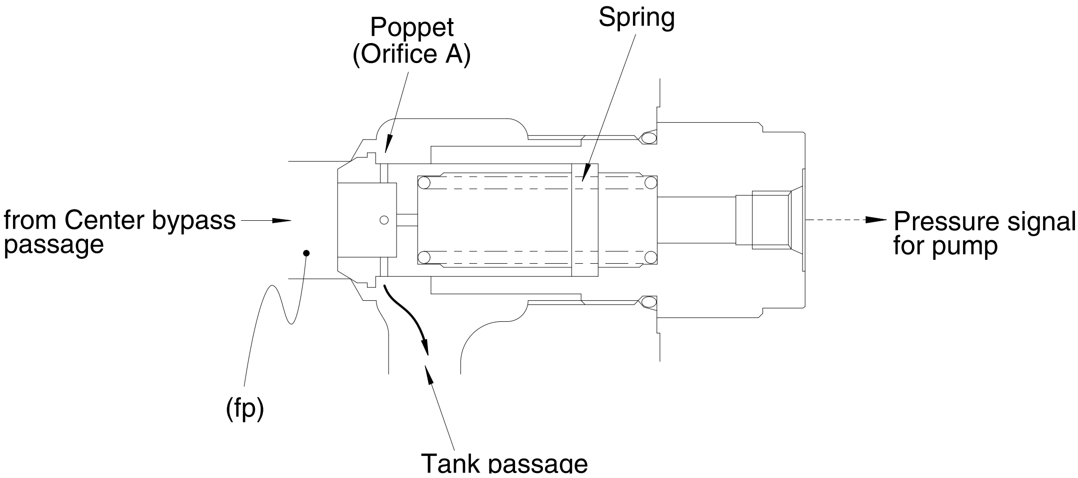
As a result, the oil that exhales the pump is supplied to the BM cylinder head side by priority.



120092MC92

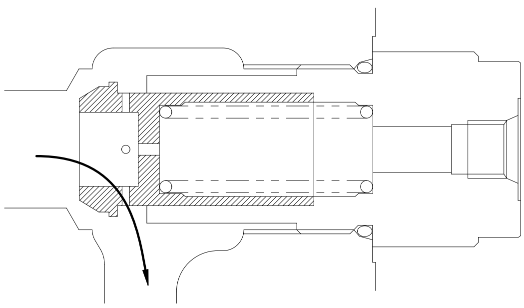
7) FOOT RELIEF VALVE

(1) The oil from center bypass passage flows tank passage through the orifice "A" of poppet. Pressure "Pf" generated when oil passes the orifice, that acts on the pump and controlled the displacement.



120092MC30

(2) For instance, the respons delay of the pump and large flow quantity flows, the pressure "Pf" grows more than the spring force that opens the poppet. And pressure oil flows to tank passage. These act like relief valve.



120092MC93

8) **LOAD HOLDING VALVE** (ARM-3, BOOM-3)

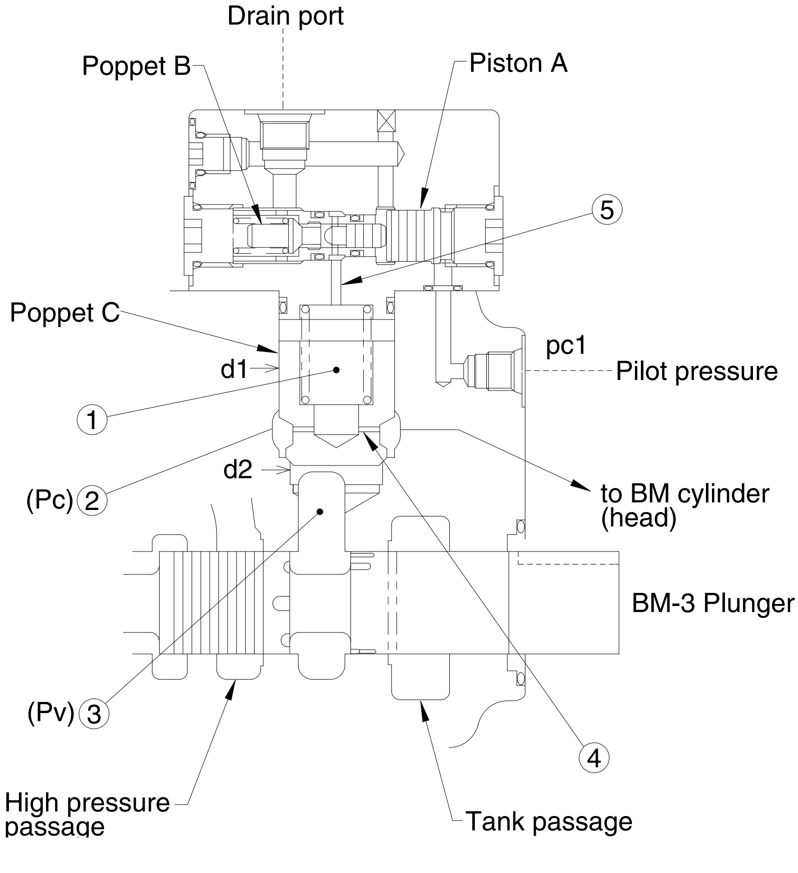
BM holding valve is explained as an example.

(1) **When the plunger is in neutral position** (Pc1 pilot signal : OFF)

Spool "A" and "B" are in the status as shown. The passage "5" and drain port are shut off by the poppet "B".

Therefore, the pressure of chamber "1" is same to "Pc", as it is connected with the core "2" through the orifice "4".

Since d1 > d2, the poppet "B" is seated and the core "2" and "3" are completely blocked.



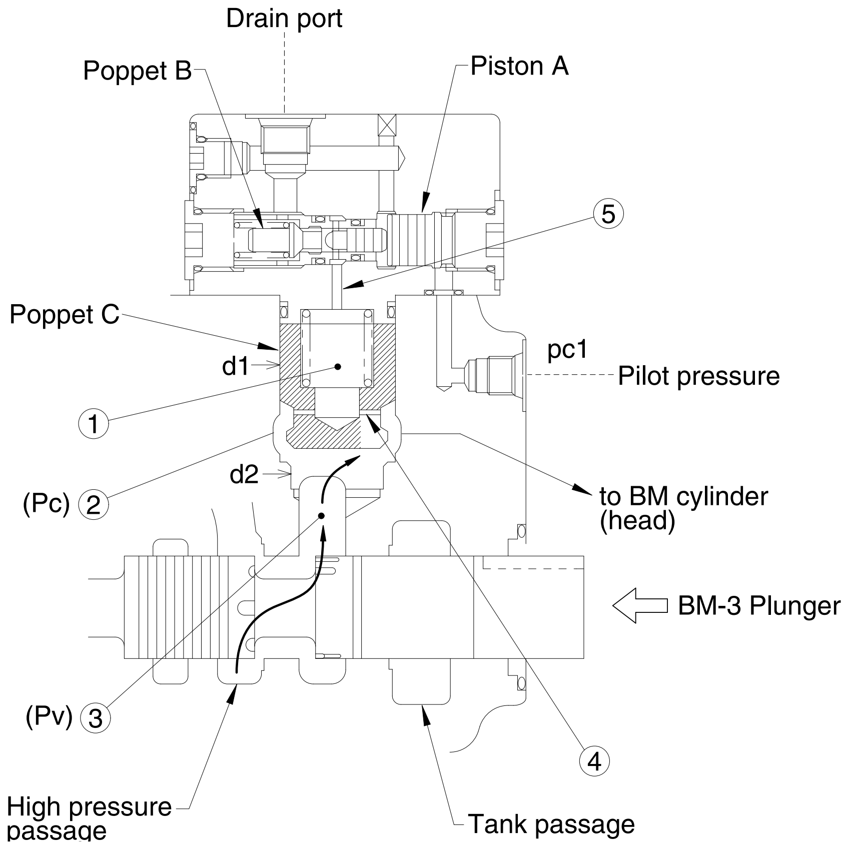
(2) When the plunger is operated

① **Boom-up operation** (Pv > Pc and pilot signal Pc1 : OFF)

The BM-3 plunger moves the left side, and oil from the high pressure passage flows into the core "3".

The pressure of the chamber "1" is same to the "Pc", as it is connected with the core "2" through the orifice "4" .

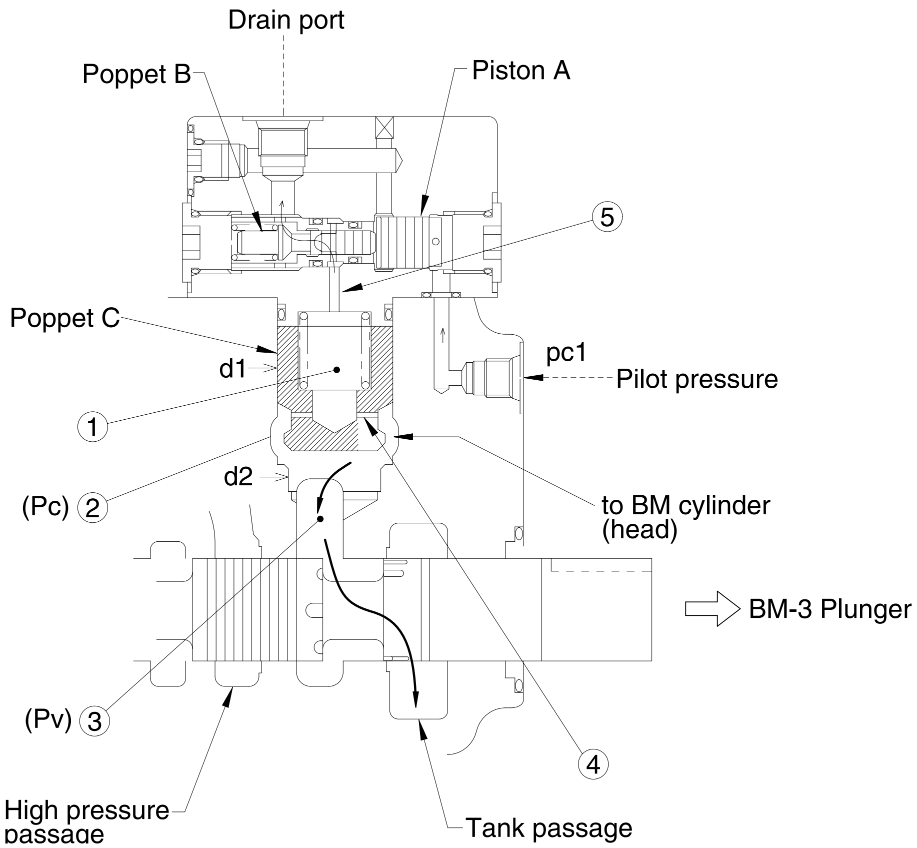
The poppet "C" is pushed up and oil from the high pressure passage flows into the cylinder port.



120092MC32

② **Boom-down operation** (Pilot signal Pc1 : ON)

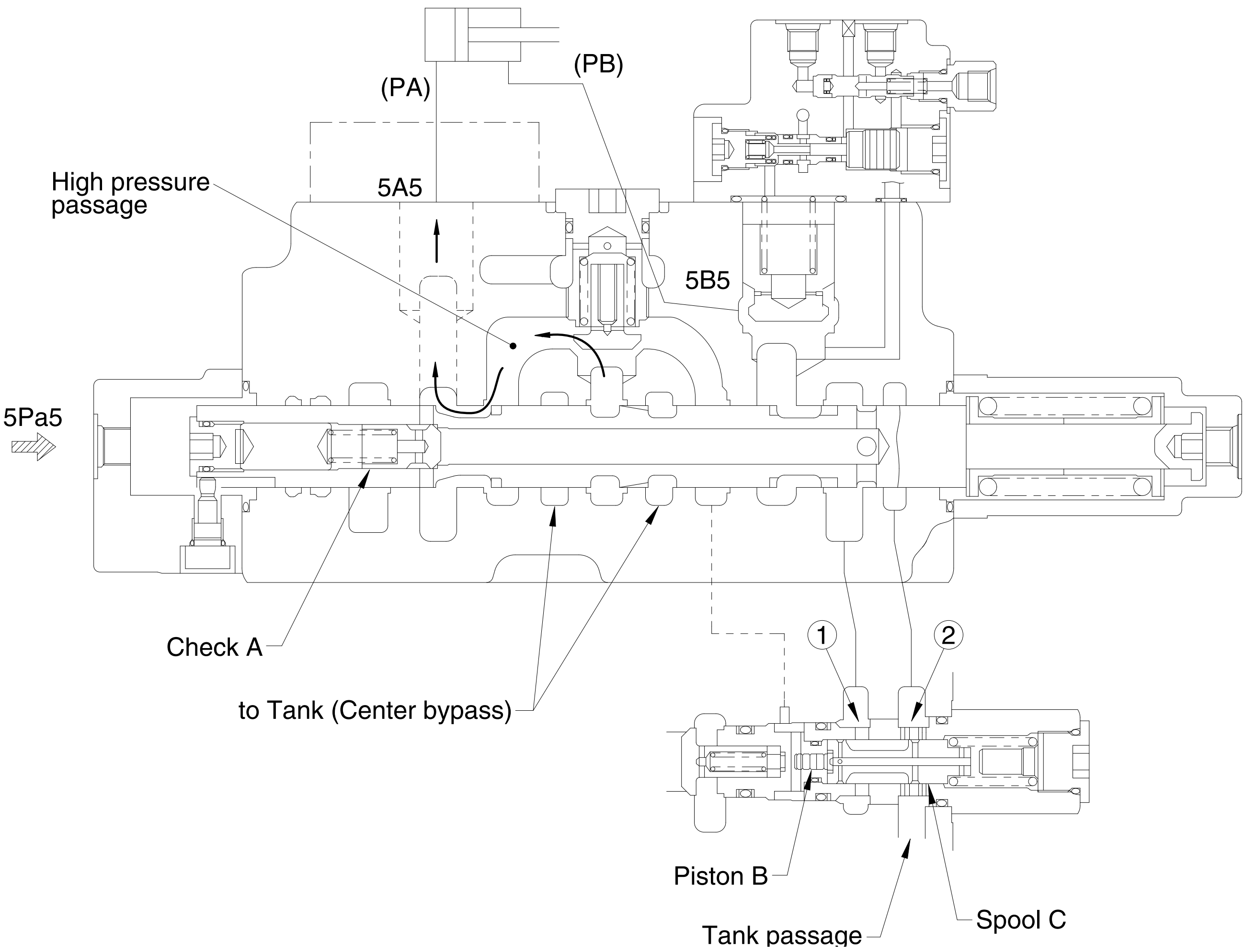
The BM-3 plunger moves the right side, and pilot pressure of "Pc1" acts on the piston chamber. Piston "A" and poppet "B" move the left side, and the passage "5" is connected to drain port. Spool "A" is switched by the pilot pressure, the passage "5" is connected to the drain port "dr6". The chamber "1" pressure is falls, the pressure "Pc" acts on the area of difference between "d1" and "d2", the poppet "C" is opened by this. Therefore, the oil that returns from the cylinder head side is flows to the tank passage.



120092MC33

9) ARM REGENERATION

(1) When AM-crowd operation, the center bypass line from the inlet port "P" to the tank passage is shut off, oil from the center bypass passage pushes up the load check valve and flows to the AM cylinder head side through the high pressure passage.

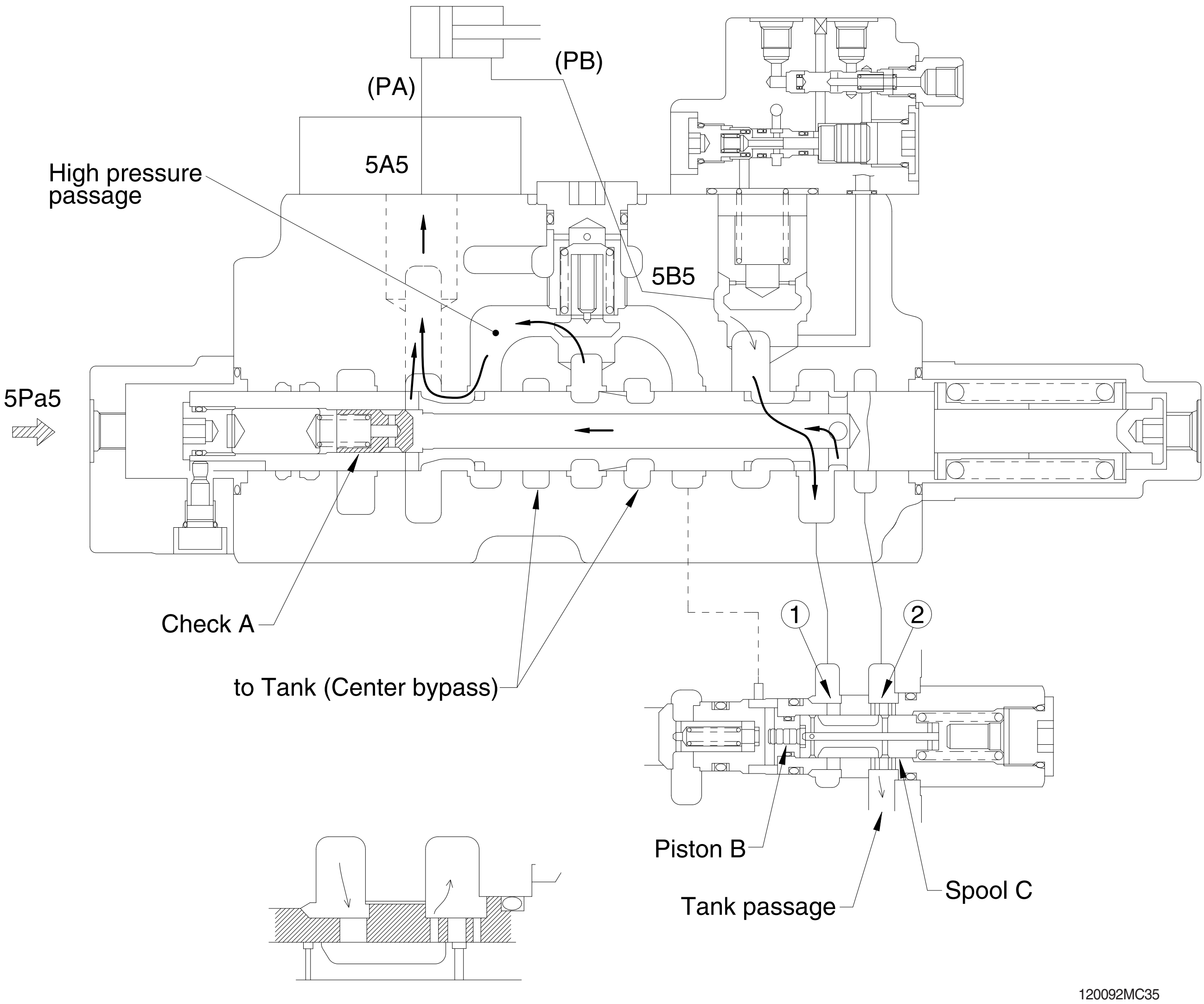


120092MC34

(2) When the rod side pressure of the "AM" cylinder is higher than head side one (PB＞PA)

Return oil from cylinder rod side flows into the tank passage through the passage "1" and "2".

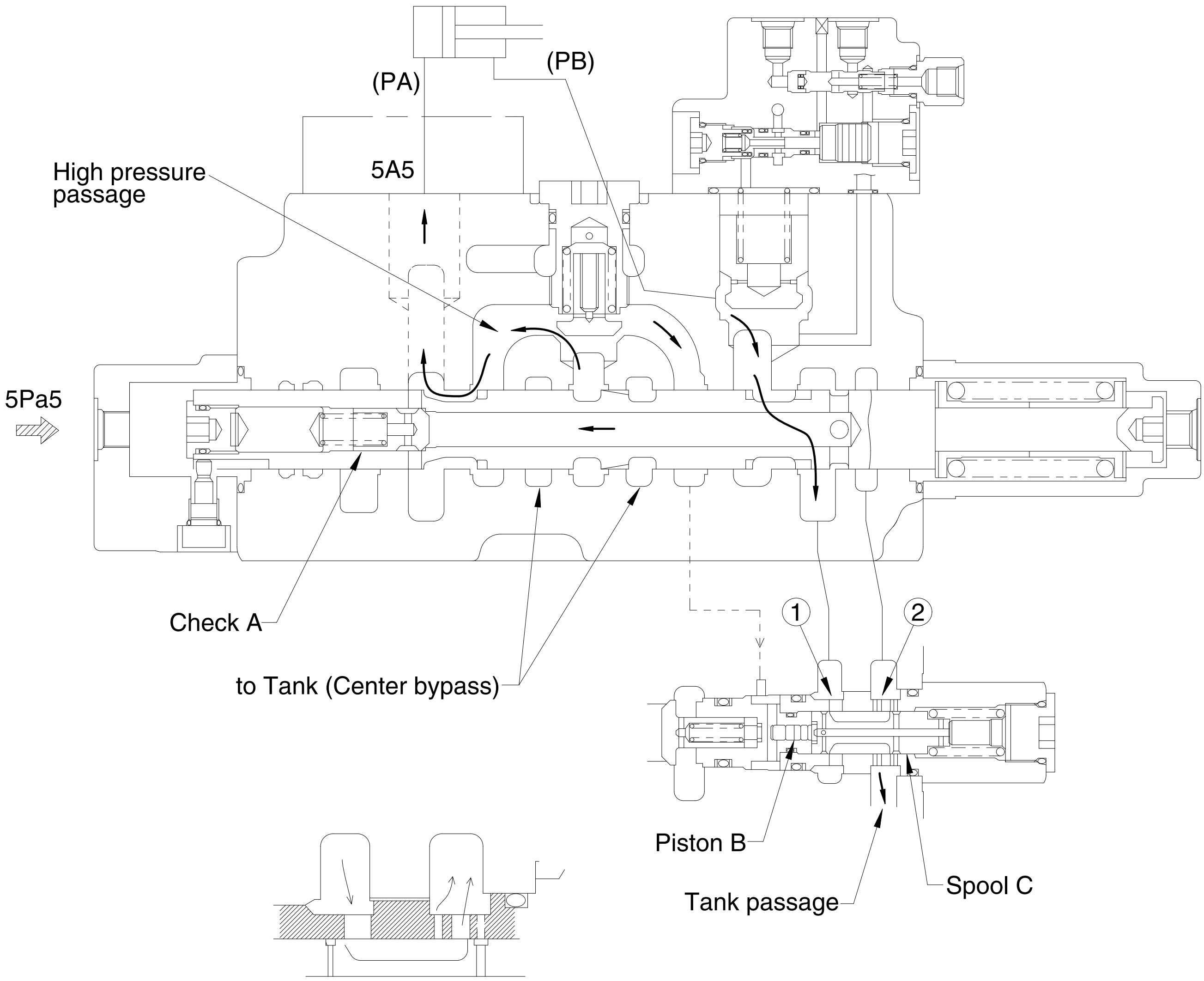
Since area is small at this time, the pressure of oil rises, check "A" opens and is regenerated to the head side.



(3) When the head side pressure of the "AM" cylinder is higher than rod side one (PA > PB)

Return oil from cylinder head side acts on check "A" and shut the passage. And it's flows acts on the piston "B", that's moves spool "C" to the right side and the passage "2" is expanded.

Return oil from cylinder rod side flows to tank passage through the passage "1" and "2".



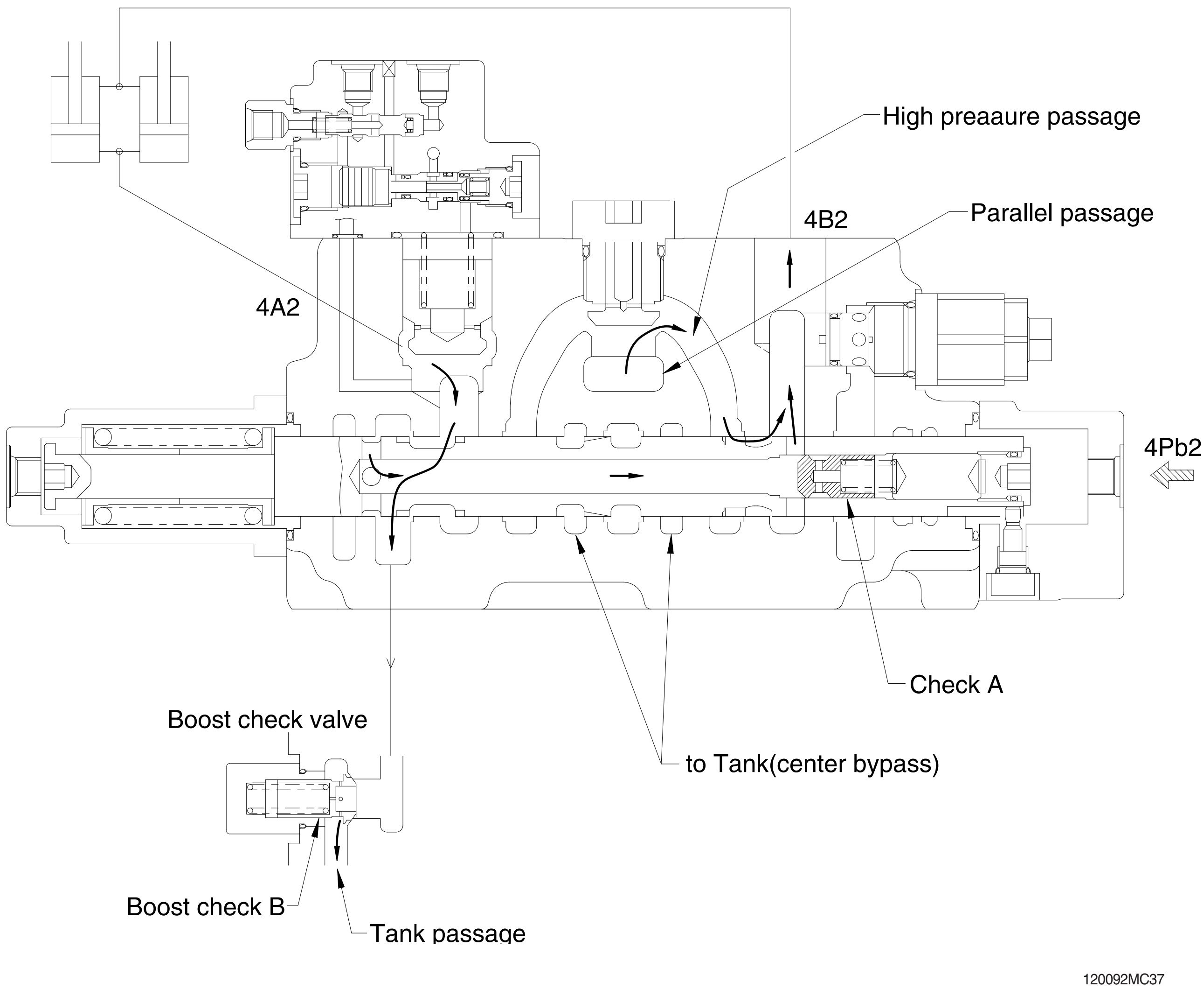
120092MC36

10) BOOM REGENERATION

When BM-down operation, the center bypass line from the inlet port "P" to the tank passage is shut off, the oil pushes up the load check valve and flows to BM cylinder rod side through the high pressure passage.

Return oil by the side of the BM cylinder head flows on a tank passage through the orifice of boost check "B".

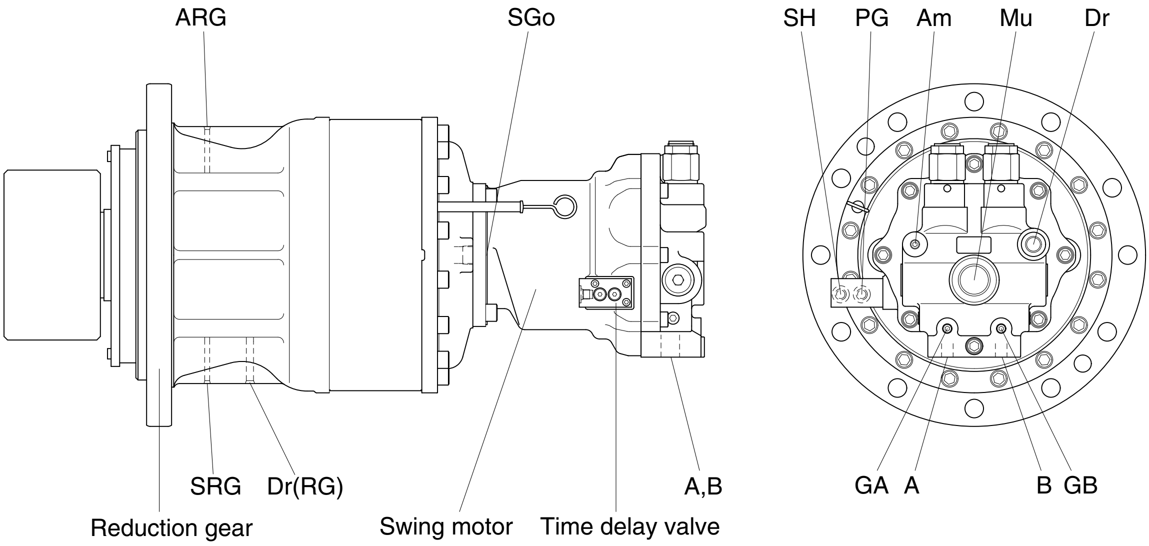
The pressure of return oil rises, check "A" opens and oil is regenerated to the rod side.



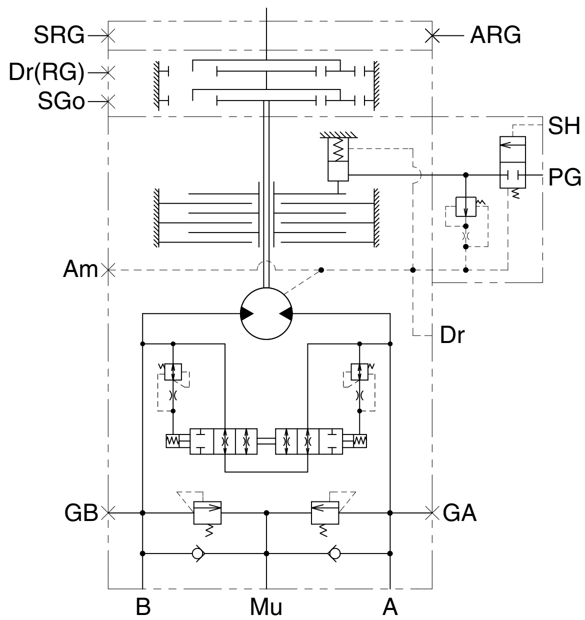
GROUP 3 SWING DEVICE

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.



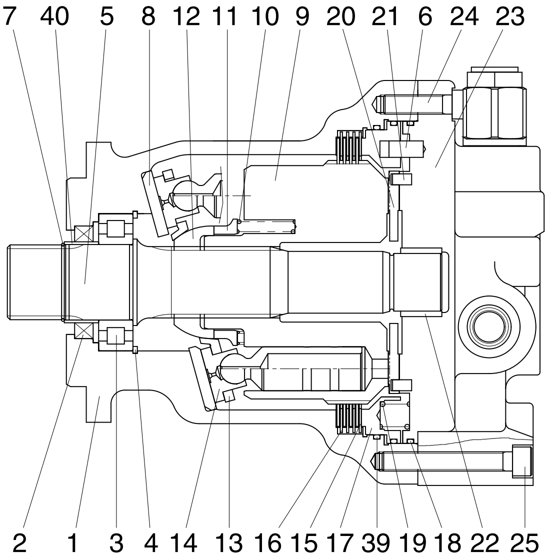
120092SM01

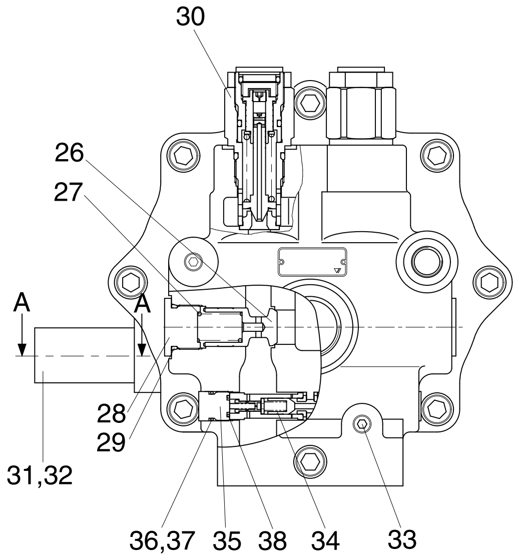


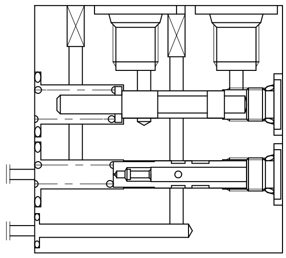
Hydraulic circuit

Port	Port name	Port size
A, B	Main port	SAE 1"
Dr	Drain port	PF 1/2
Mu	Make up port	PF 1 1/4
PG	Brake release stand by port	PF 1/4
SH	Brake release pilot port	PF 1/4
Am	Motor air bleed port	PF 1/4
GA,GB	Gauge port	PF 1/4
SGo	Reduction gear oil fill port	PT 3/4
SRG	Reduction gear grease fill port	PT 1/8
ARG	Reduction gear air vent port	PT 1/8
Dr(RG)	Reduction gear drain port	PT 1/2

1) SWING MOTOR





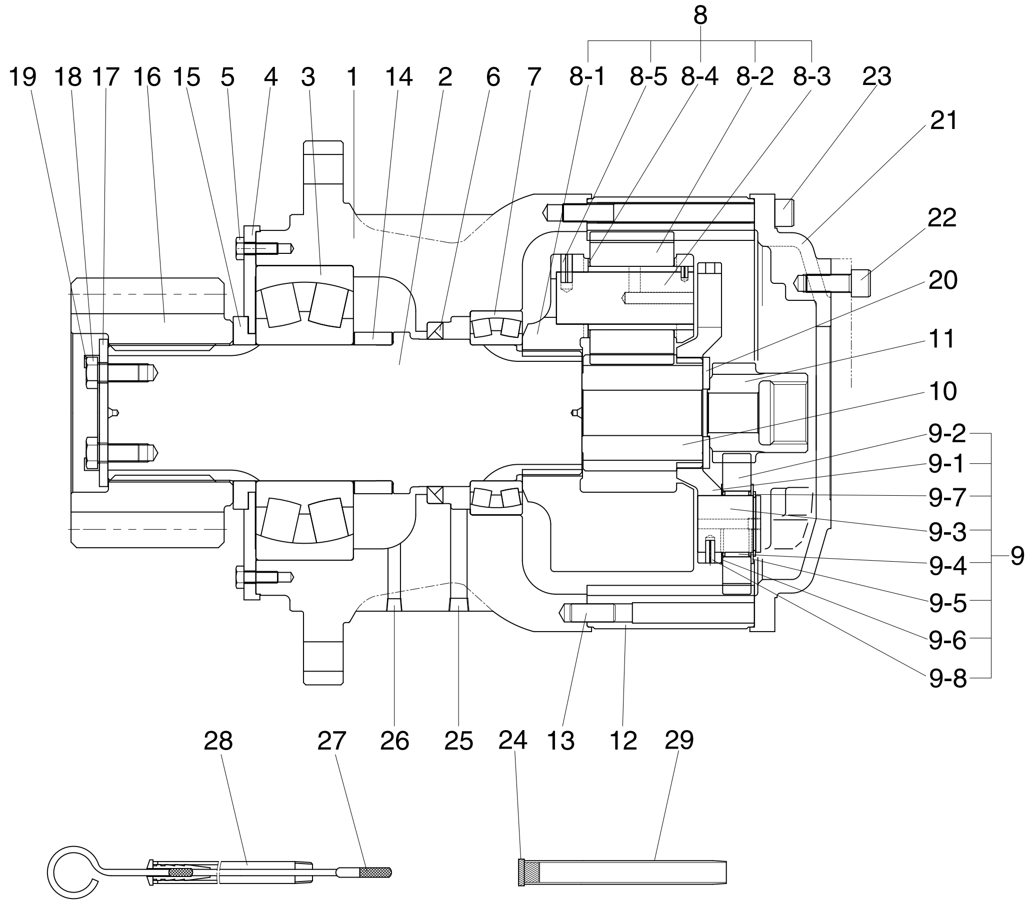


SECTION A-A

120092SM02

1 Body
2 Oil seal
3 Roller bearing
4 Snap ring
5 Shaft
6 Pin
7 Stop ring
8 Shoe plate
9 Cylinder block
10 Spring
11 Ball guide seat
12 Ball guide
13 Set plate
14 Piston assy
15 Friction plate
16 Plate
17 Brake piston
18 O-ring
19 Spring
20 Valve plate
21 Pin
22 Needle bearing
23 Rear cover
24 Wrench bolt
25 Wrench bolt
26 Poppet
27 Spring
28 Plug
29 O-ring
30 Relief valve assy
31 Time delay valve
32 Wrench bolt
33 Plug
34 Reactionless valve assy
35 Plug
36 O-ring
37 Back up ring
38 O-ring
39 O-ring
40 Bushing

2) REDUCTION GEAR



120092SM03

1	Casing	9-1	Carrier 1	16	Pinion gear
2	Drive shaft	9-2	Planetary gear 1	17	Lock plate
3	Roller bearing	9-3	Pin 1	18	Hex bolt
4	Cover plate	9-4	Needle cage	19	Lock washer
5	Hex bolt	9-5	Side plate 2	20	Thrust ring
6	Oil seal	9-6	Side plate 1	21	Cover
7	Roller bearing	9-7	Stop ring	22	Socket bolt
8	Carrier assy 2	9-8	Spring pin	23	Socket bolt
8-1	Carrier 2	10	Sun gear 2	24	Socket plug
8-2	Planet gear 2	11	Sun gear 1	25	Plug
8-3	Pin 2	12	Ring gear	26	Plug
8-4	Washer	13	Knock pin	27	Gauge bar
8-5	Spring pin	14	Spacer ring	28	Gauge pipe
9	Carrier assy 1	15	Spacer	29	Air breather assy

2. FUNCTION

1) ROTARY PART

When high pressurized oil enters a cylinder through port(a), which is the inlet of balance plate(1), hydraulic pressure acting on the piston causes axial force F. The pressure force F works via the piston(2) upon the return plate(3) which acts upon the swash plate(4) via an hydrostatic bearing. Force F1 perpendicular to swash plate(4) and force F2 perpendicular to cylinder center.

Being transferred to the cylinder block(5) 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.

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

Where p : Effective difference of pressure (kgf/cm²)

q : Displacement (cc/rev)

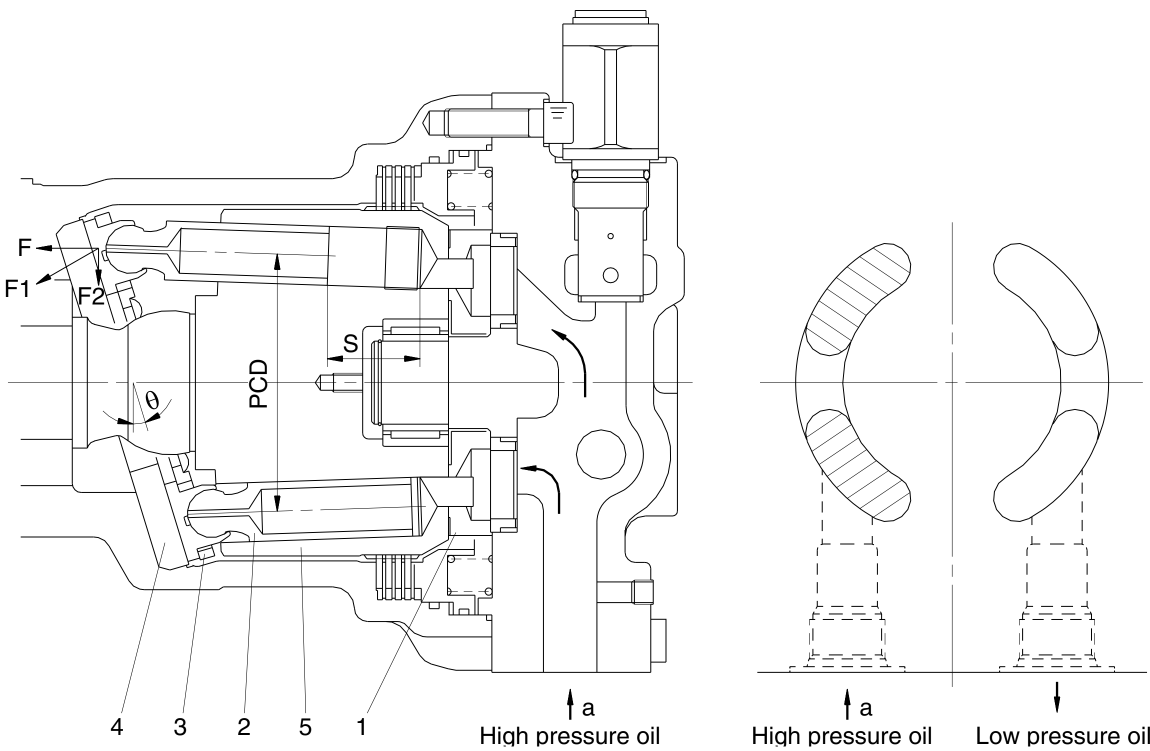
T : Output torque (kgf · cm)

Z : Piston number (9EA)

A : Piston area (cm²)

θ : Tilting angle of swash plate (degree)

S : Piston stroke (cm)



36072SM04

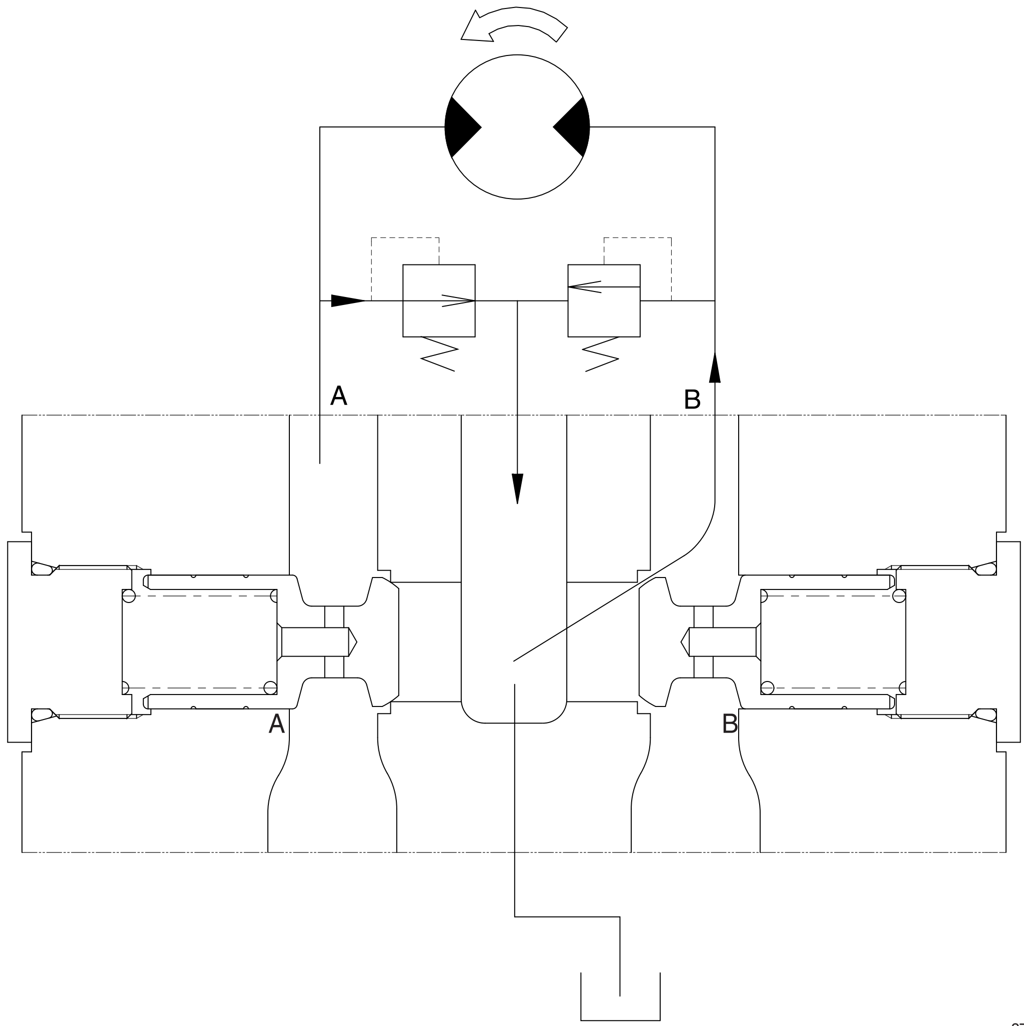
2) MAKE UP VALVE

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.



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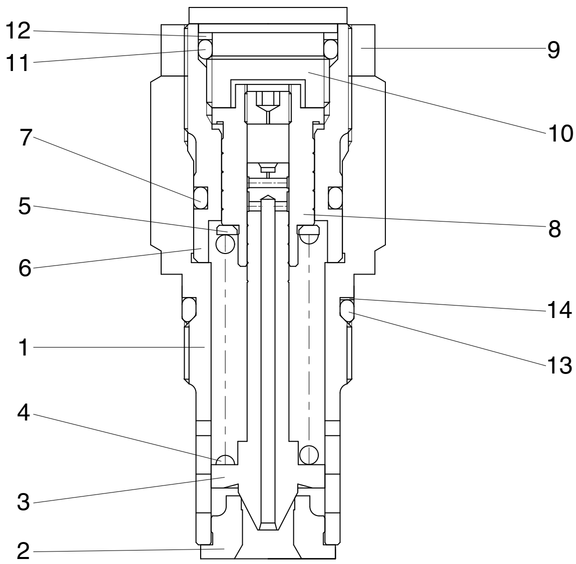
3) RELIEF VALVE



1 Body
2 Poppet seat
3 Poppet
4 Spring
5 Spring seat
6 Stopper
7 O-ring
8 Shockless valve
9 Nut
10 Plug
11 O-ring
12 Back up ring
13 O-ring
14 Back up ring

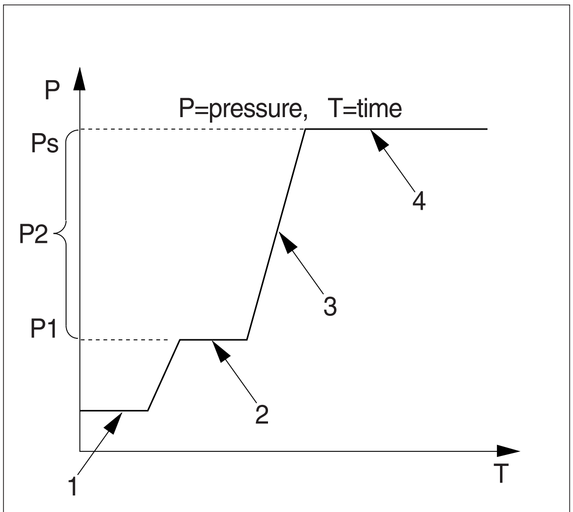
37007A2SM03

(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.

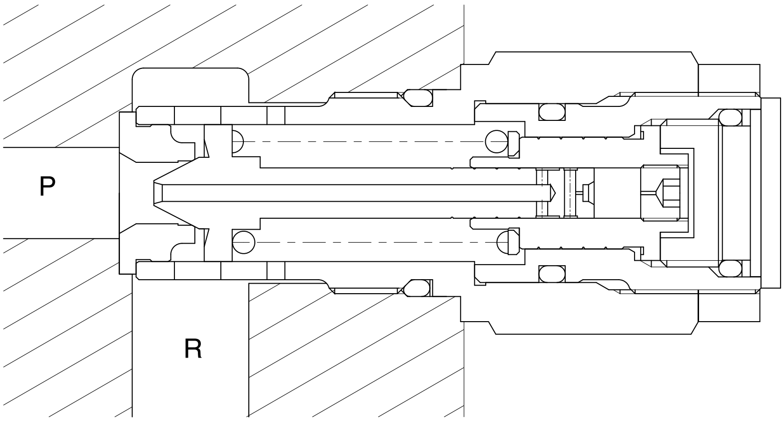
(2) Function of relief valve

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.



2-54(2) 210-7

① Ports (P,R) at tank pressure.

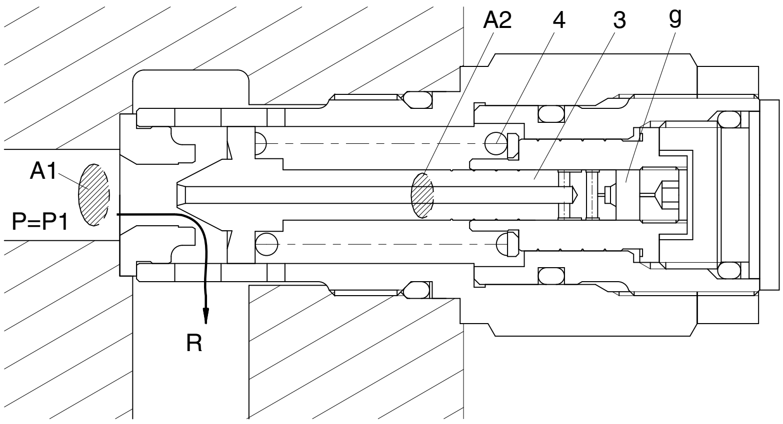


37007A2SM04

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

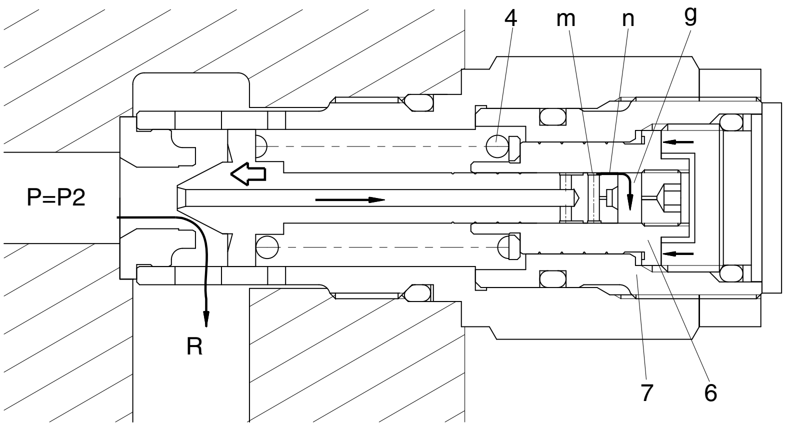
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



37007A2SM05

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

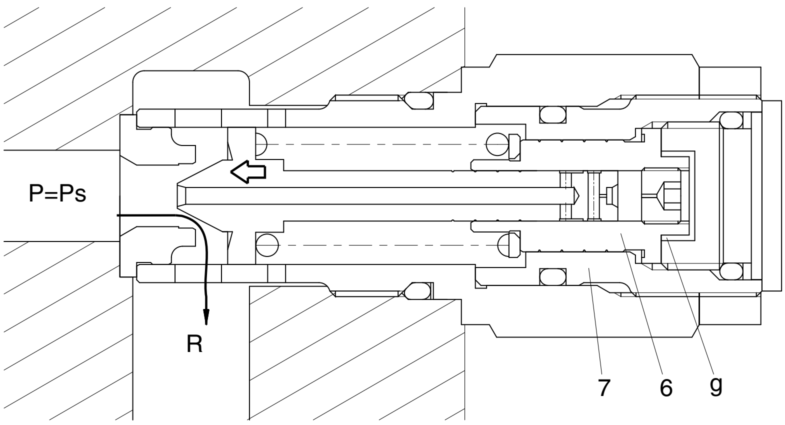


37007A2SM06

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

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

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



37007A2SM07

4) PARKING BRAKE

(1) PARKING BRAKE ON

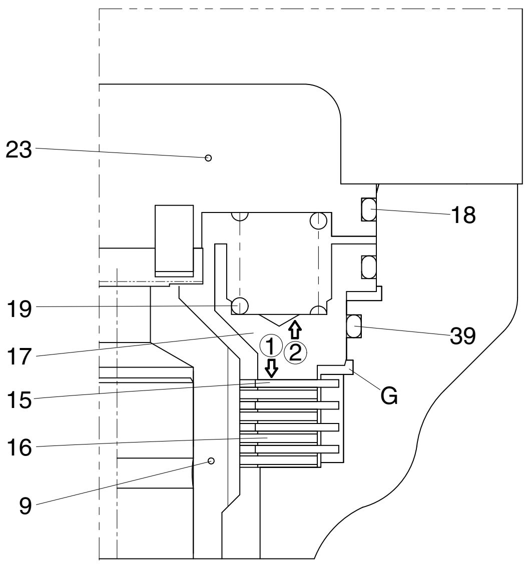
When the swing motor stops the parking brake is normally kept being fixed by mechanical force. When the brake release pressure is blocked, brake piston (17) is pushed by spring (19) force according to the arrow direction ①.

Consequently, pressure plate (16) which is fixed to cylinder block (9) and friction plate (15) which is assembled to casing (23) are pressed. And then swing motor stops.

(2) PARKING BRAKE OFF

When the brake releases pressure-supply, the oil flows into room (G). Oil pressure is pressing the spring (19) force, and then brake piston (17) is pushed according to the arrow direction ②.

The pressure of pressure plate (16) and friction plate (15) is released. Following this procedure the cylinder block (9) is rotating.

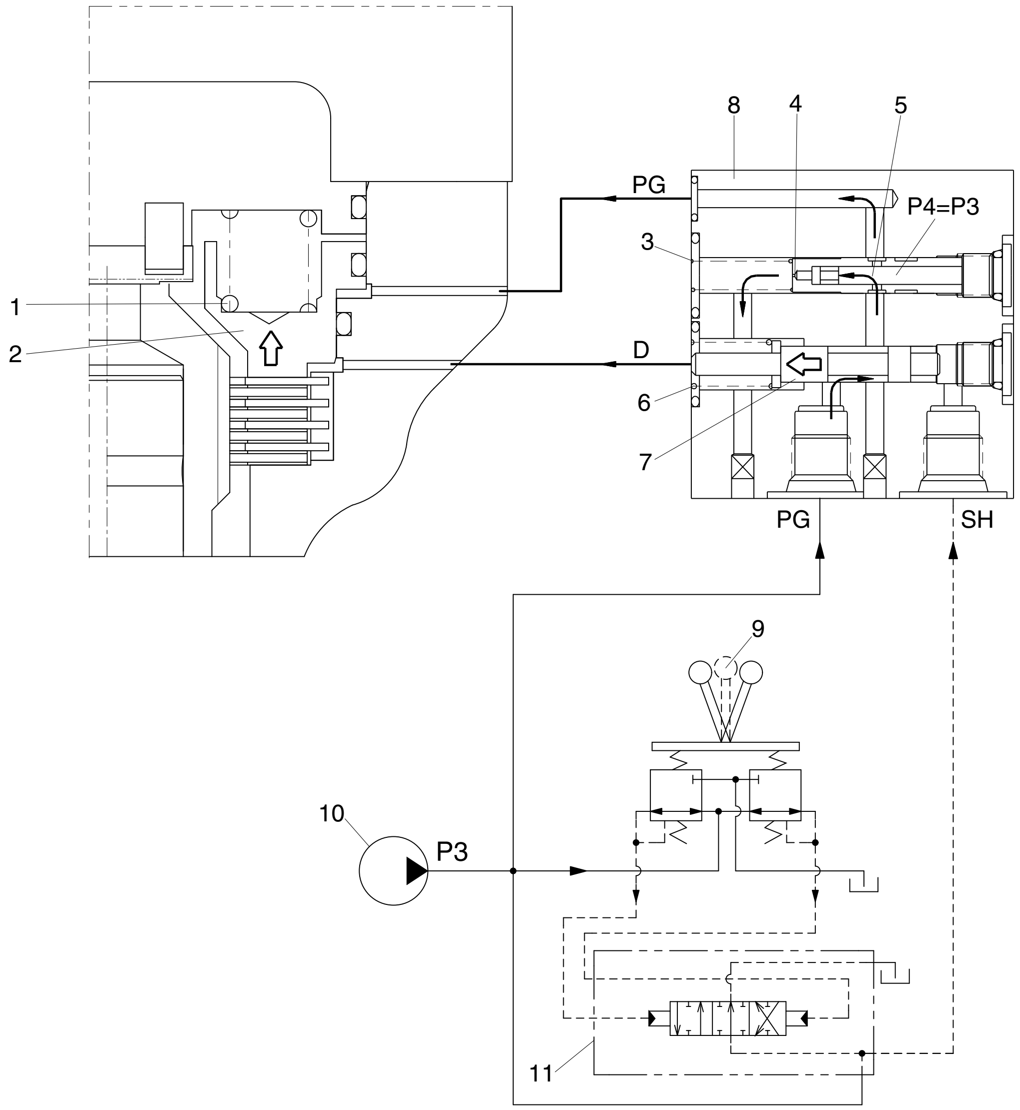


120092SM04

9	Cylinder block
15	Friction plate
16	Pressure plate
17	Brake piston
18	O-ring
19	Spring
23	Casing
39	O-ring

5) TIME DELAY VALVE

When the swing motor stops, time delay valve delays the parking brake function for a while.
For the parking brake works all of a sudden it may break the swing motor parts. When the swing control lever (9) sets up to the swing position, the pilot oil goes to the swing control valve (11) and to SH of the time delay valve (8) through the MCV.
The oil pressure moves to the piston (2) to the upward against the force of the spring (1).
Thus the brake force is released.



120092SM05

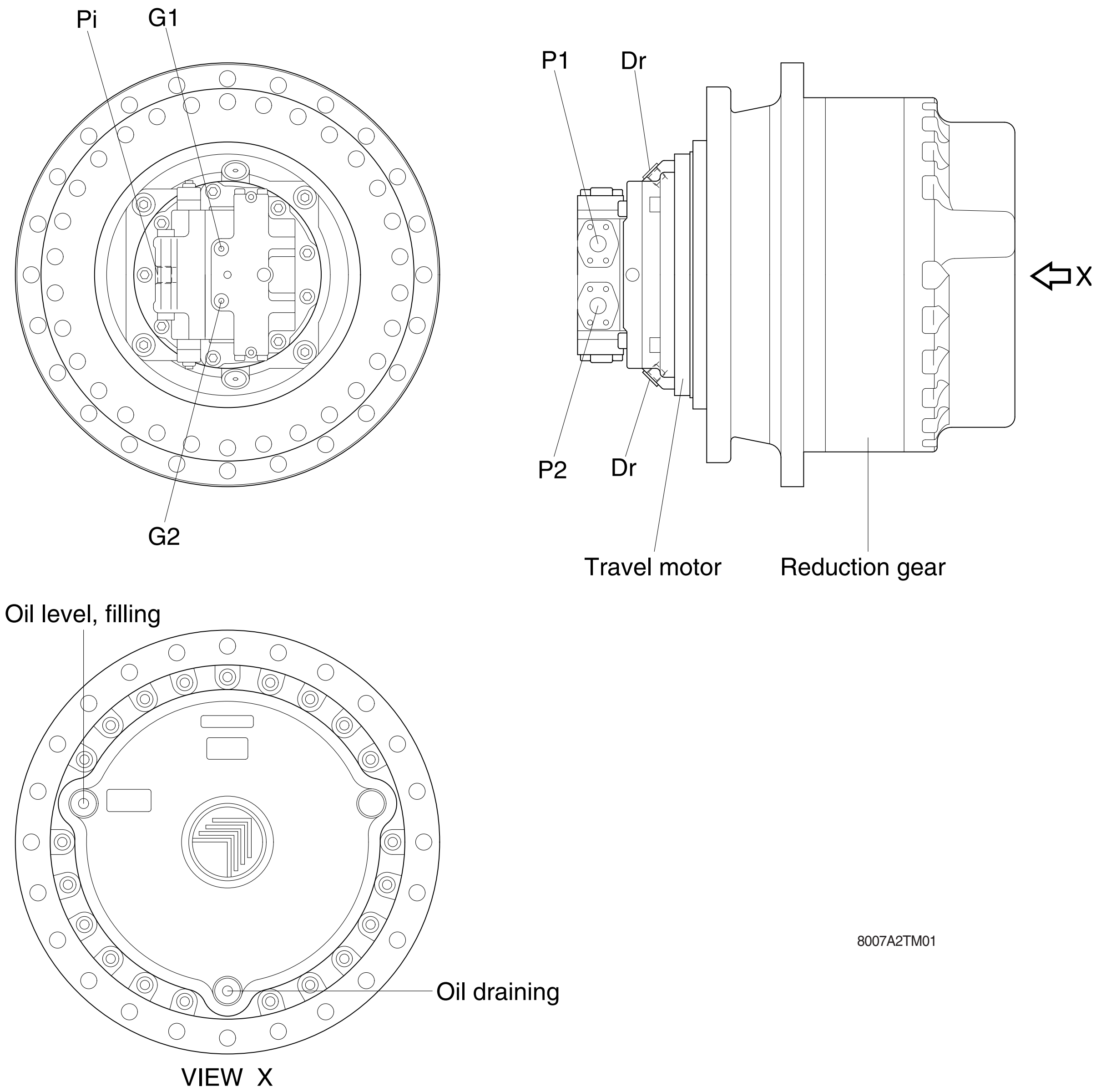
1 Spring	7 Spool
2 Piston	8 Time delay valve
3 Spring	9 Swing control lever
4 Orifice	10 Pilot pump
5 Poppet	11 Main control valve
6 Spring	

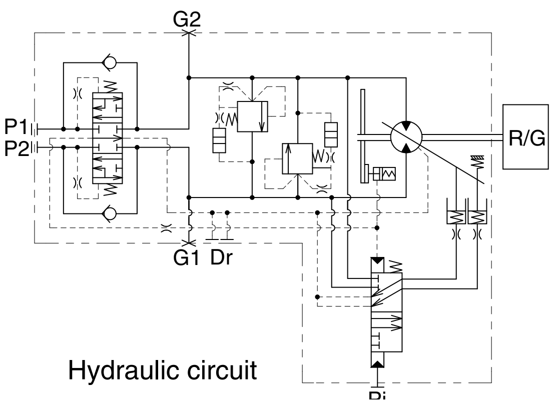
GROUP 4 TRAVEL DEVICE

1. CONSTRUCTION

Travel device consists travel motor and gear box.

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

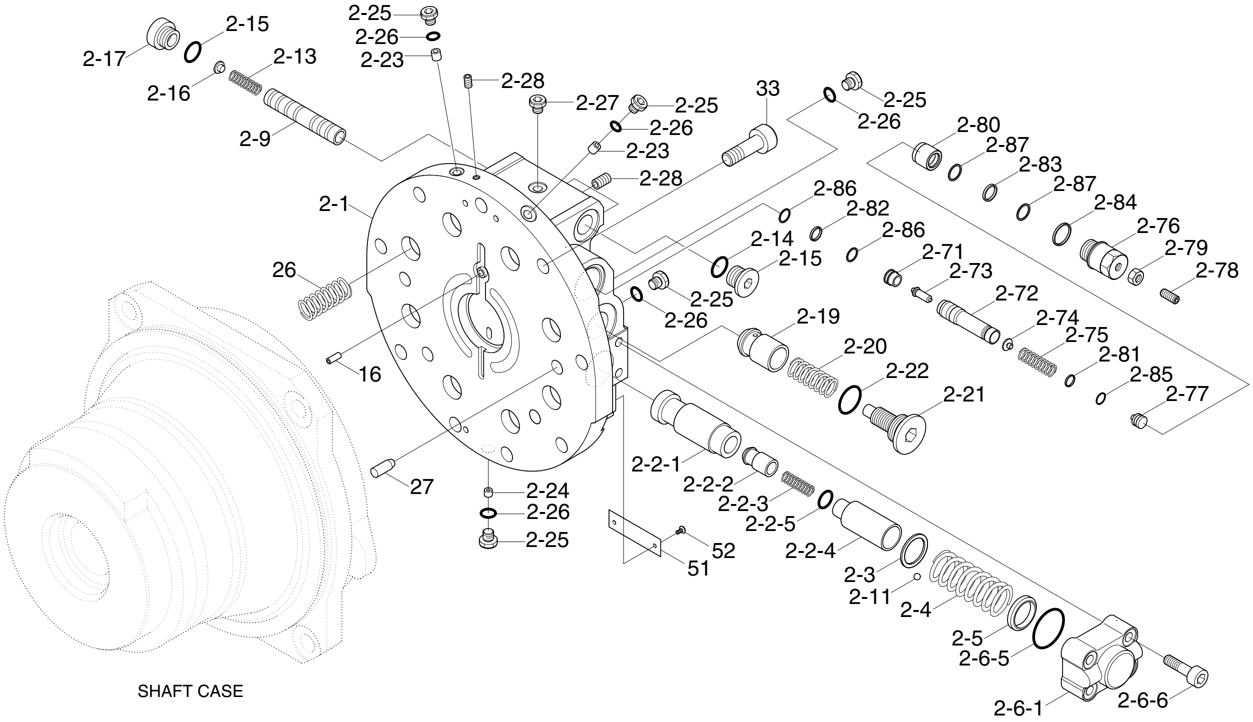




Hydraulic circuit

Port	Port name	Port size
P1	Main port	SAE 1"
P2	Main port	SAE 1"
G1, G2	Gauge port	PF 1/4
Dr	Drain port	PF 3/4
Pi	2 speed control port	PF 1/4

1) TRAVEL MOTOR

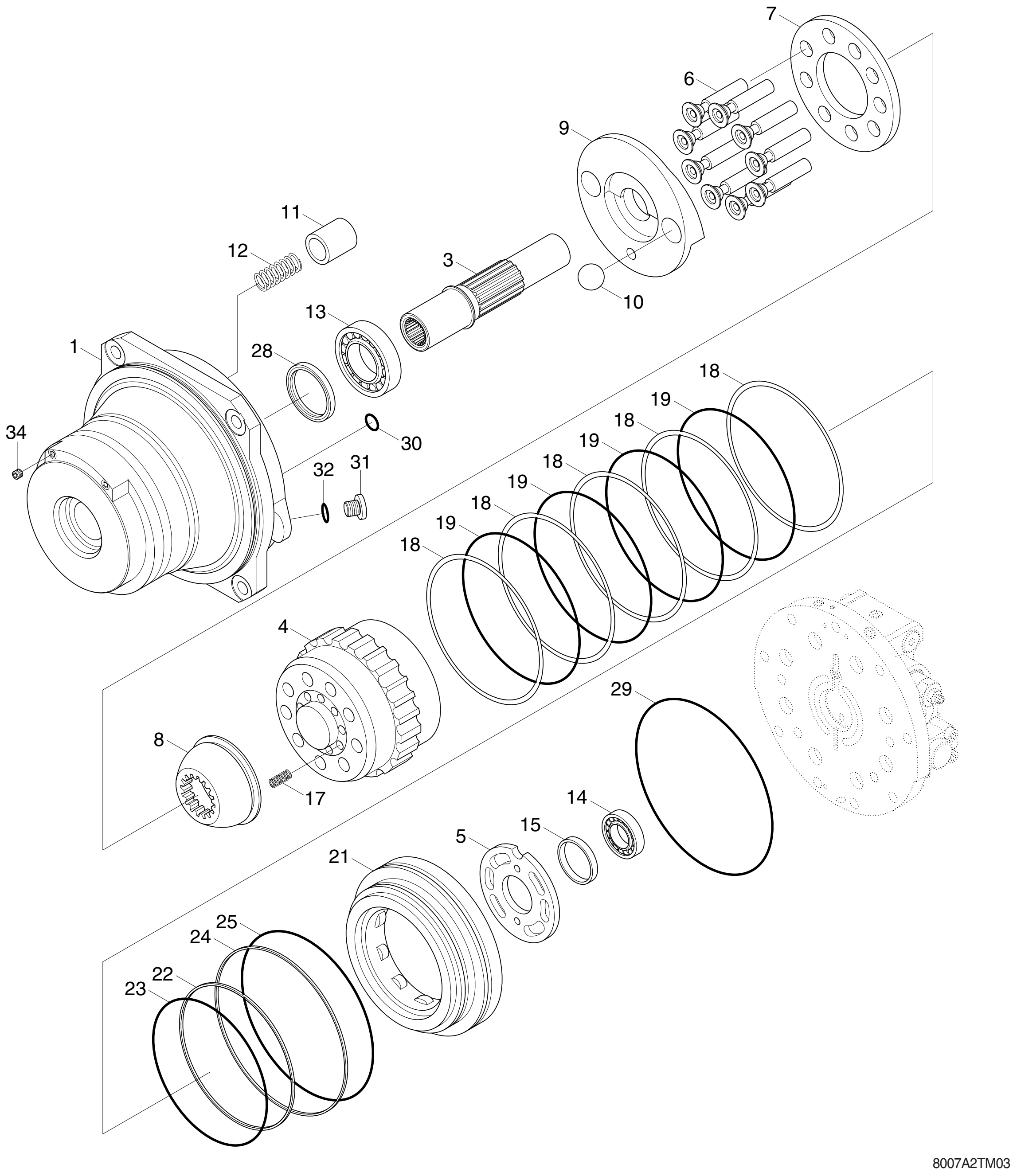


8007A2TM02

2-1	Base plate	2-7-5	Spring	2-15	O-ring
2-2	Spool assy	2-7-6	Plug	2-16	Spring guide
2-2-1	Spool	2-7-7	Spring guide	2-17	Plug
2-2-2	Check valve	2-7-8	Set screw	2-19	Check valve
2-2-3	Spring	2-7-9	Nut	2-20	Spring
2-2-4	Plug	2-80	Free piston	2-21	Plug
2-2-5	O-ring	2-81	O-ring	2-22	O-ring
2-3	Spring seat	2-82	O-ring	2-23	Orifice
2-4	Spring	2-83	O-ring	2-24	Orifice
2-5	Spring seat	2-84	O-ring	2-25	Plug
2-6	Cap assy	2-85	Back up ring	2-26	O-ring
2-6-1	Cap	2-86	Back up ring	2-27	Shipping plug
2-6-5	O-ring	2-87	Back up ring	2-28	Plug
2-6-6	Bolt	2-9	Valve assy	16	Pin
2-7	Relief valve assy	2-9-1	Spool	26	Spring
2-7-1	Poppet seat	2-9-2	Spool-C	27	Pin
2-7-2	Relief housing	2-11	Orifice	33	Socket bolt
2-7-3	Poppet	2-13	Spring	51	Name plate
2-7-4	Spring seat	2-14	Plug	52	Drive screw

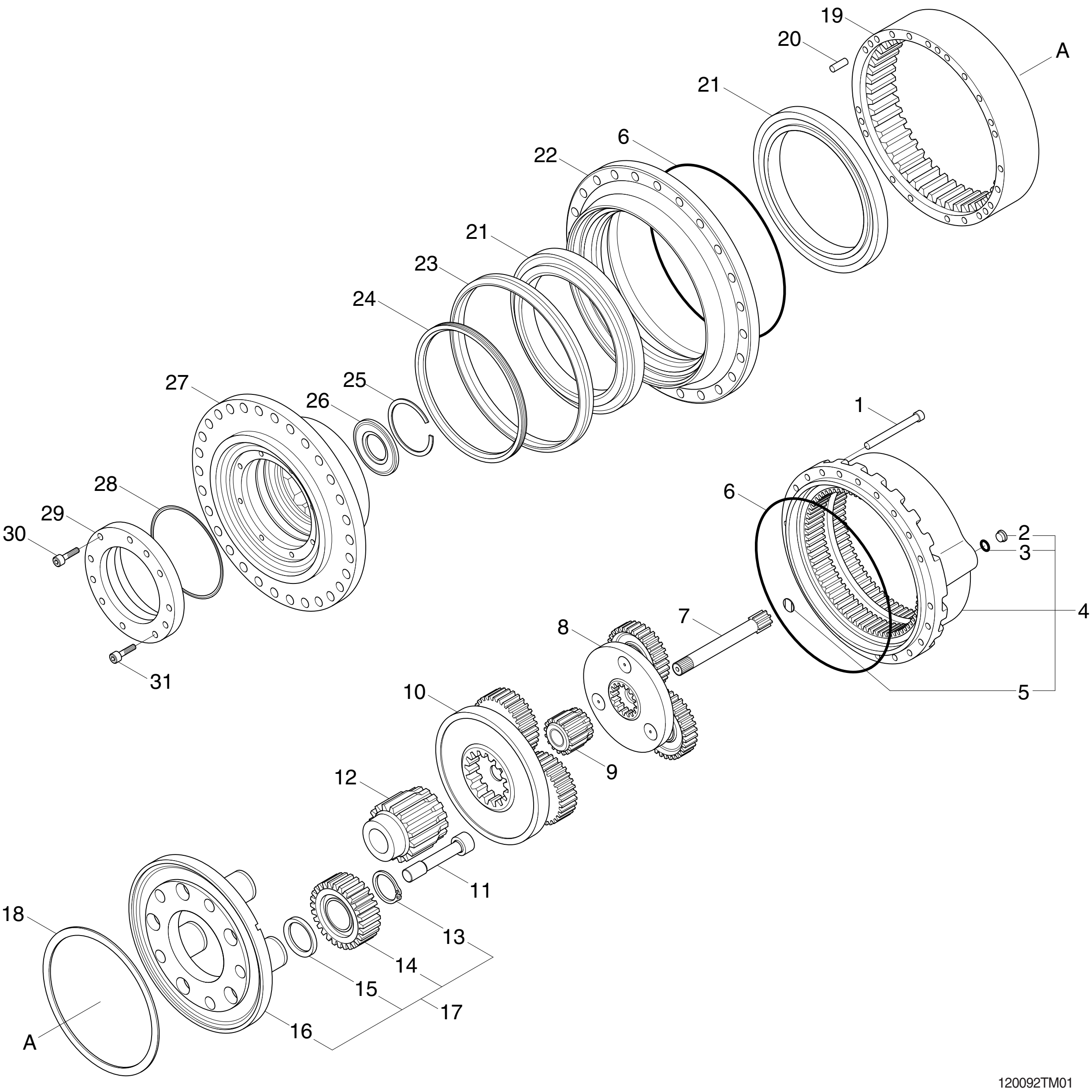
TRAVEL MOTOR (2/2)

· Control part



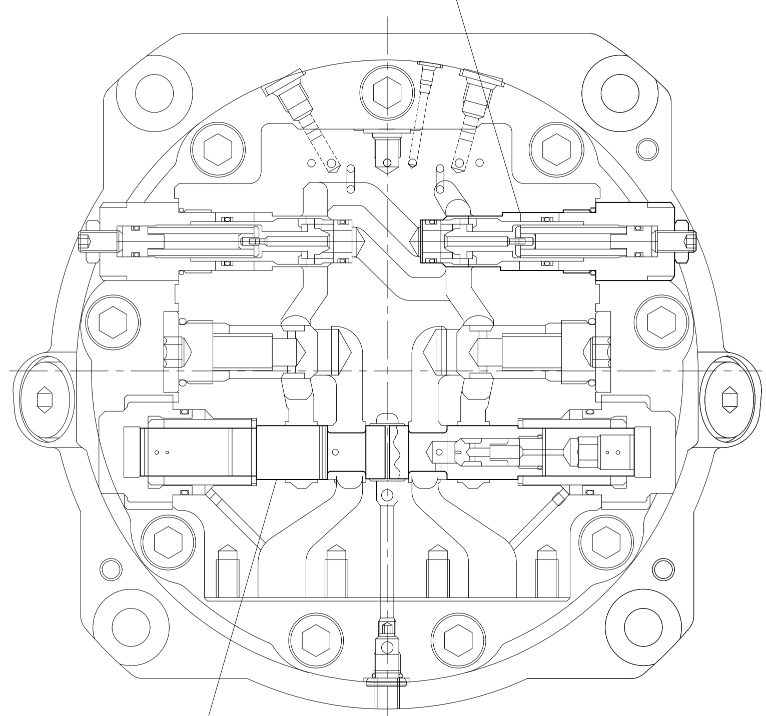
1	Case	12	Spring	24	O-ring
3	Shaft	13	Roller bearing	25	Back up ring
4	Cylinder block	14	Roller bearing	28	Oil seal
5	Valve plate	15	Collar	29	O-ring
6	Piston assy	17	Spring	30	O-ring
7	Retainer plate	18	Friction plate	31	Plug
8	Plate holder	19	Disc plate	32	O-ring
9	Swash plate	21	Brake piston	34	Plug
10	Steel ball	22	O-ring		
11	Piston assy	23	Back up ring		

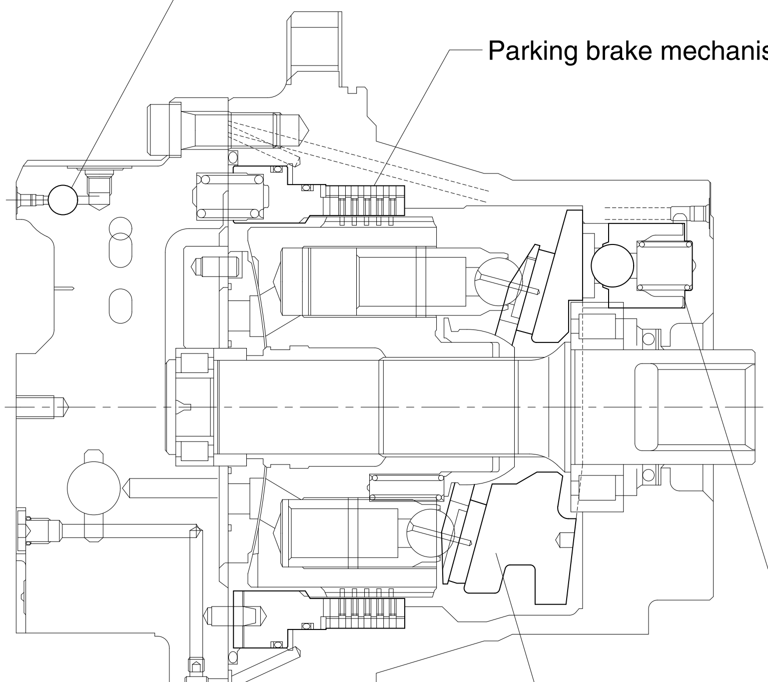
2) REDUCTION GEAR



1	Screw	12	Sun gear	22	Gear box housing
2	Oil breather plug	13	Circlip	23	Life time seal
3	Washer	14	Planetary assy	24	Spacer
4	Cover assy	15	Spacer	25	Circlip
5	Pad	16	Planetary carrier	26	Discs retainer
6	O-ring	17	Gear assy (3rd)	27	Hub
7	Sun gear	18	Spacer	28	O-ring
8	Gear assy (1st)	19	Toothed ring	29	Motor adaptor
9	Sun gear	20	Pin	30	Screw
10	Gear assy (2nd)	21	Bearing	31	Screw
11	Screw				

3) BASIC STRUCTURE

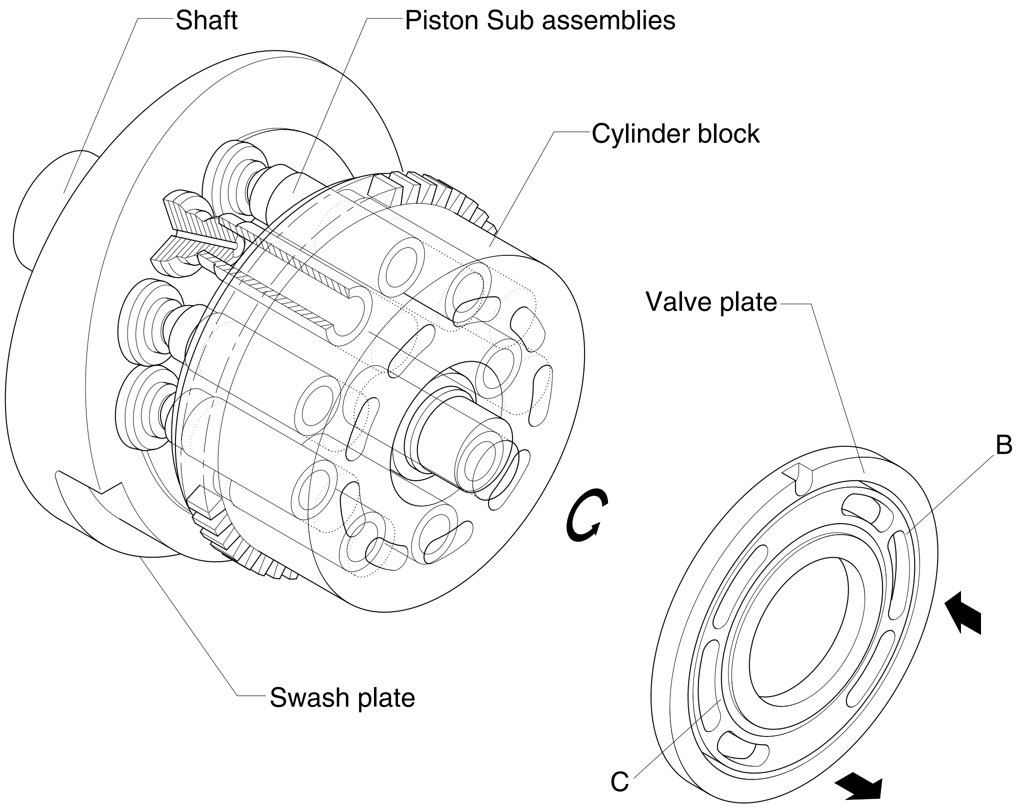




8007A2TM05

2. FUNCTION

1) HYDRAULIC MOTOR

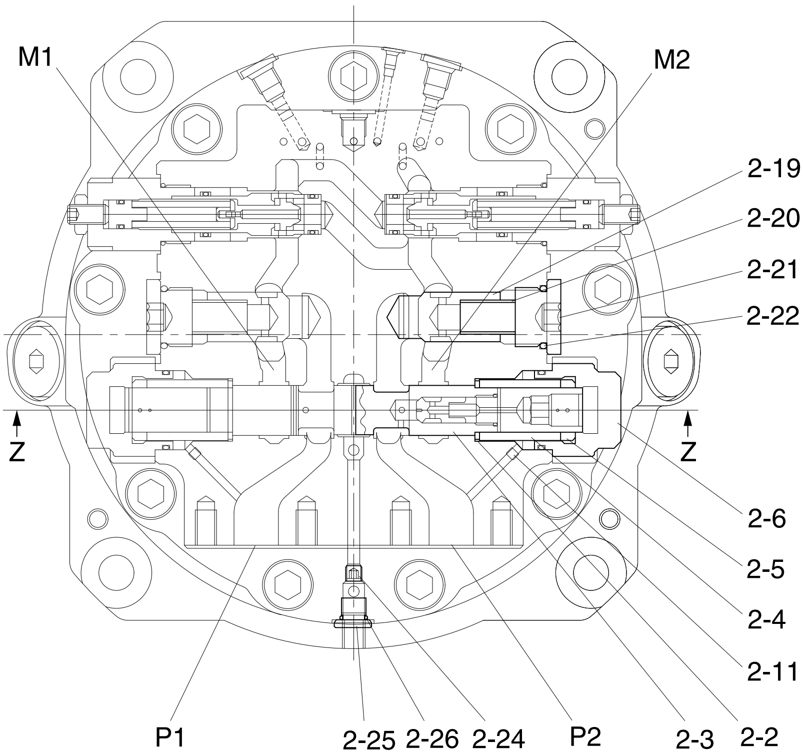


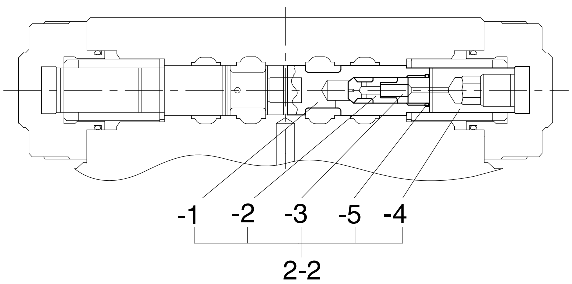
8007A2TM06

Nine piston sub assemblies are assembled in cylinder block. The end face of cylinder block is in contact with valve plate having two half moon shaped ports, B and C (high and low pressure ports).

When supplying pressure fluid (pressure P) to B port, swash plate is pushed by the force of piston sub assemblies having $F = P \cdot A$ (A: Piston pressure area). Piston sub assemblies receive the reaction force against it, and produce the reaction force (Ft) in rotating direction. The total force of high-pressure side piston sub assemblies in rotating direction produces a rotating force in the cylinder block, and the torque is transmitted to shaft through the spline resulting in the rotation of the shaft.

2) COUNTER BALANCE VALVE

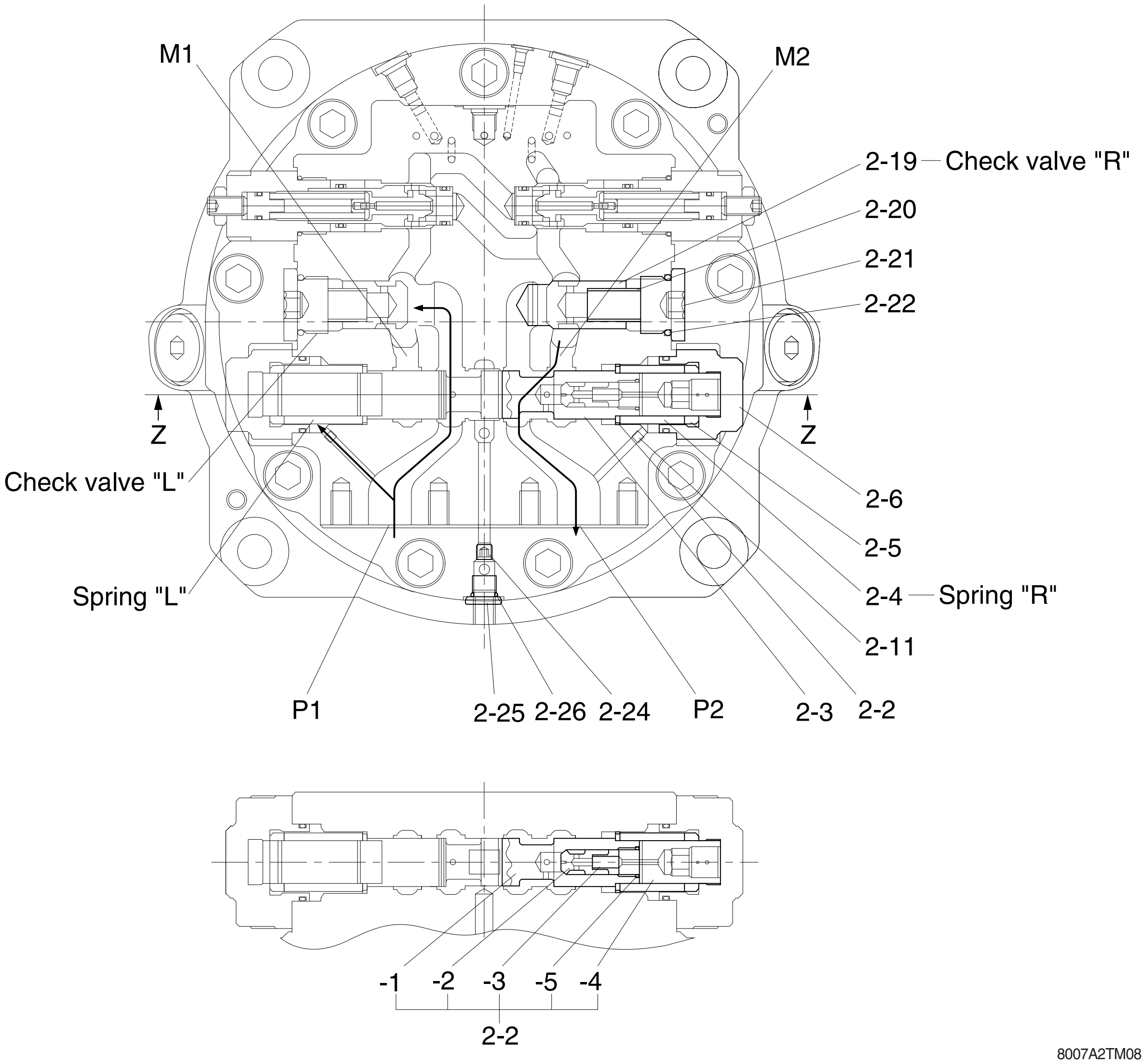




8007A2TM07

The counter balance valve is provided to stop the axial piston motor and to prevent overrun. When the control valve is set to the neutral position, there is no pressure in the ports P1 and P2, and ports M1 and M2 are blocked by spool (2-2-1) and check valve (2-19), consequently the motor does not start rotating.

(1) COUNTER BALANCE VALVE WORK



8007A2TM08

When the fluid is supplied from pump to counter balance valve port P1 through control valve, the fluid flows into piston motor through check valve "L" (2-19), and rotate the piston motor.

On the other hand, the return fluid from the piston motor flows into the counter balance valve through port M2, but the fluid is interrupted by check valve "R" (2-19), and consequently the pump delivery pressure will increase.

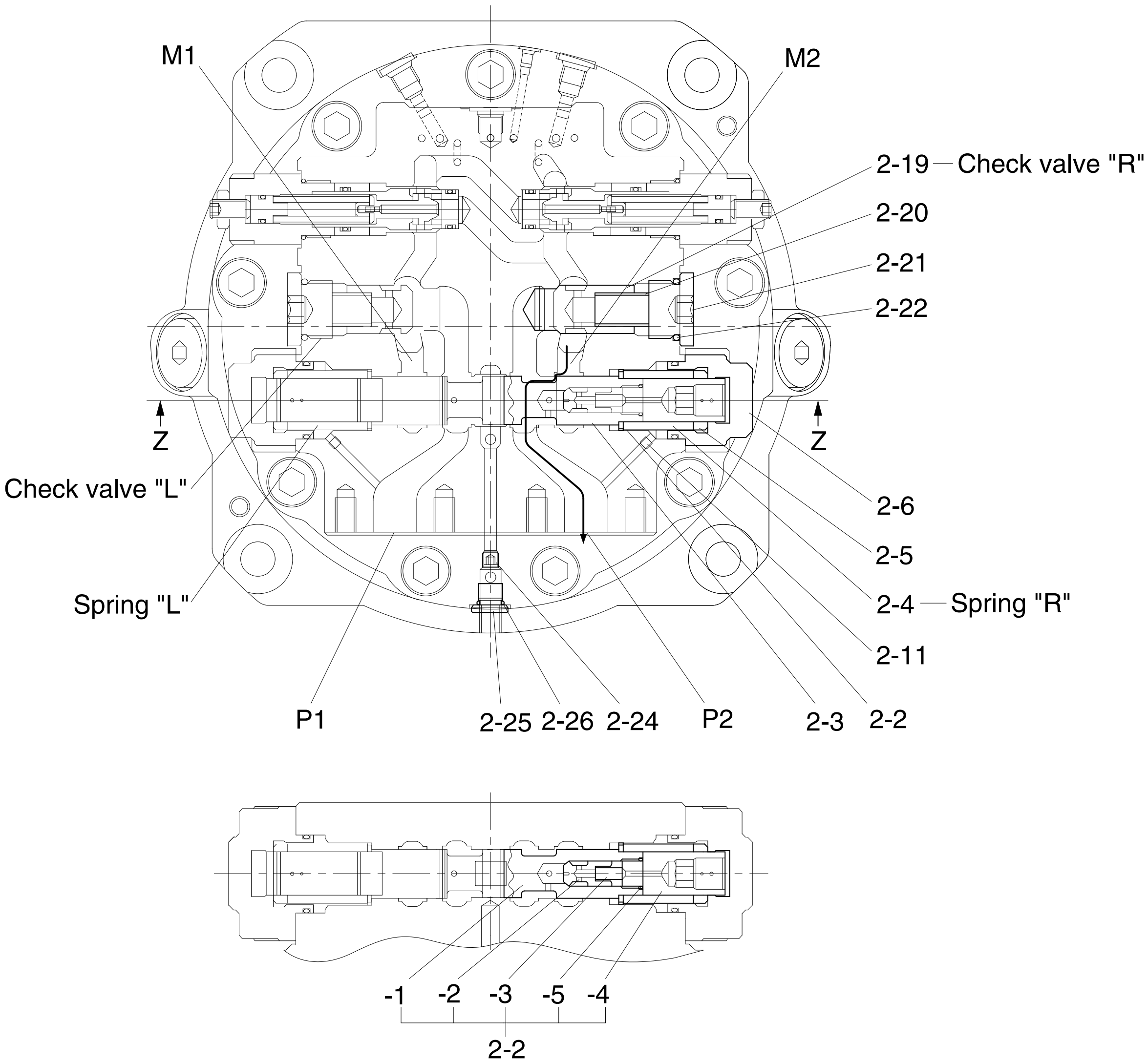
The high-pressure oil at port P1 passes through orifices "L" (2-11) pushes the end of face of spool assy (2-2) and pushes the plunger rightward against spring "R" (2-4) on the opposite side with the force proportional to the pressure.

When the hydraulic pressure rises to a certain pressure, spool assy (2-2) starts moving rightward, and the fluid in port M2 passes through the notch machined outer circular of spool assy (2-2) and flows into the port P2, producing a back pressure on the port M2, finally returning into the tank through a control valve.

And when the pump delivery pressure rises, the throttling aperture of the notch in spool assy (2-2) becomes larger, and consequently the backpressure of the port M2 becomes lower.

This way, the throttling aperture of the notch in spool assy (2-2) automatically adjusts the area of a return side passage in order to rotate the piston motor with the appropriate speed for Port P1 side flow rate (inlet flow).

(2) BRAKE WORK



8007A2TM09

Then, when the control valve returns to the neutral position, the pressurized oil from the pump is shut off and the pressures of the ports P1 and P2 become equal. Spool assy (2-2) tries to be returned to neutral position by force of spring "R" (2-4).

When spool assy (2-2) moves, the throttle opening of plunger becomes small.

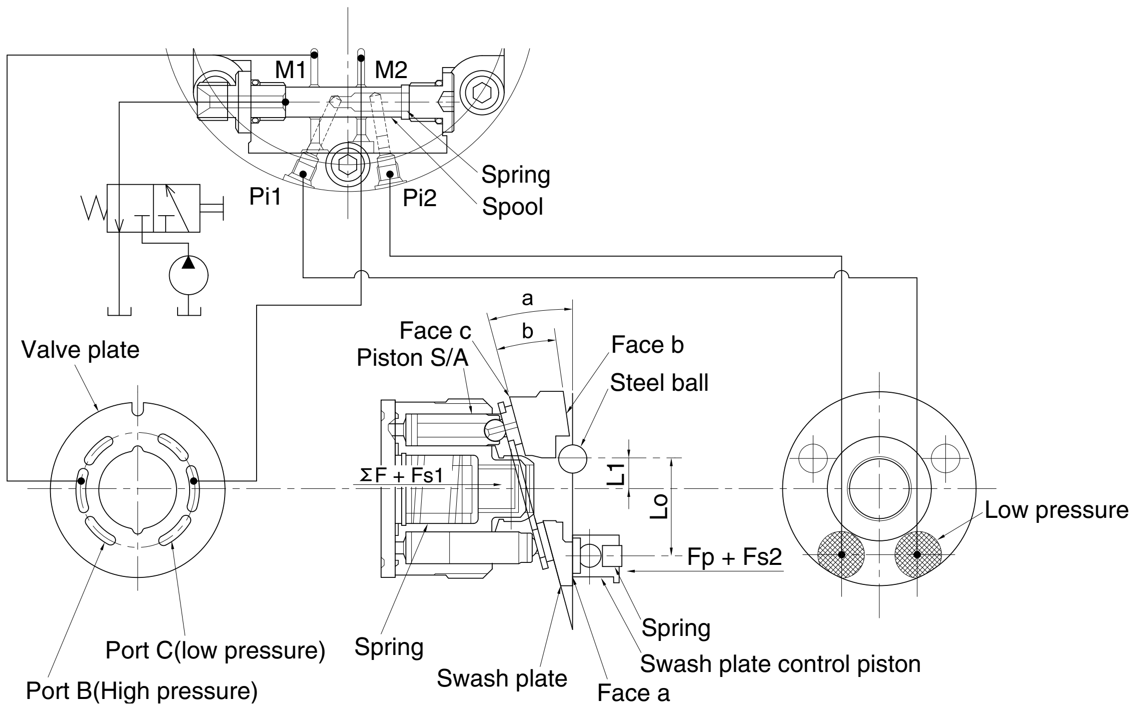
Piston motor tries to rotate with inertia energy (pumping action of motor) and the pressure rises on port M2.

With the movement of spool assy (2-2), the oil of spring "L" room flows out through orifices "L" (2-11) and controls the speed of spool assy (2-2).

By this movement, the shock pressure due to the inertia energy on the port M2 is absorbed, simultaneously preventing the cavitation on the port M1.

3) TWO SPEED CHANGE MECHANISM

(1) When running at 1st speed (low speed)



8007A2TM10

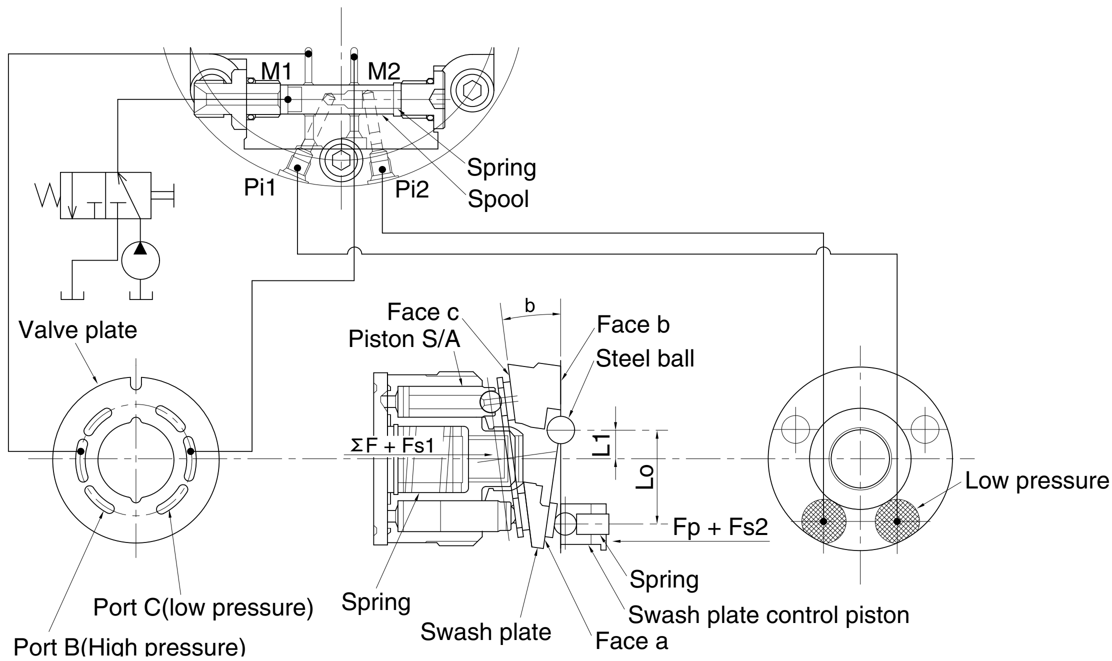
Swash plate has three faces, from "a" to "c", as shown in the figure, and installed in the flange holder with two steel balls in the condition where it can be tilted.

When the control valve is set to the 1st speed position, spool is placed in the position shown in upper figure by the force of spring, and the passage of swash plate control piston passes across the Pi1 and Pi2 port positions and led to the tank port. Therefore, the force pushing up the swash plate does not act on swash plate control piston.

$Fp=(Ap \times P)=0$

Fp : Swash plate control piston thrust
Ap : Swash plate control piston pressure receiving area
P : Pressure

(2) **When running at 2nd speed** (high speed)



8007A2TM11

When control valve is set to the 2nd speed position, the pressure oil delivered by the pump is led to spool, and spool is switched to the position shown in the figure.

And the pressurized oil flows into each ports Pi1 and Pi2 through ports M1 and M2 and the motor driving pressure (P1: high pressure and P2: low pressure) is led to each swash plate control piston. Therefore the force pushing up the swash plate acts on swash plate control piston.

$Fp1=Ap \times P1 \qquad Fp2=Ap \times P2$

When steel ball is placed on the tilting center, the balance of moment acting on swash plate is in the condition of $(\Sigma F+Fs1) \times L1<(Fp+Fs2) \times Lo$ depending on the total ΣF of driving force of piston S/A.

The face "b" of swash plate stabilizes and the swash plate angle becomes "β" angle, consequently the motor speed is the 2nd speed (high speed).

While the engine is stopped, spool is returned to the 1st speed position by the force of spring since pressurized oil does not flow. When steel ball is placed on the tilting center, the balance of moment acting on swash plate is in the condition of $Fs \times L1>Fp \times Lo$, the face "a" of swash plate stabilizes and the swash plate angle becomes "α" angle, consequently the motor speed at starting is always the 1st speed.

4) AUTO TWO SPEED CHANGE MECHANISM

Auto two-speed control mechanism consists of two spools and spring. This valve automatically changes motor displacement in portion to motor pressure. This valve works while the pilot port "Ps" is pressurized.

(1) Motor pressure is low.

The motor displacement is small (high speed displacement) as shown figure.

When the two-speed spool is on the right position. Motor pressure Pm1 and Pm2 are connected to each side of chamber of two speed piston. So swash plate is moved to high-speed position by two-speed piston and motor displacement is kept on high-speed position.

Pilot pressure is applied on the area "Ap" when Ps port is pressurized. Then the pressure of Ps pushes the spool to the right direction on figure. At the same time,

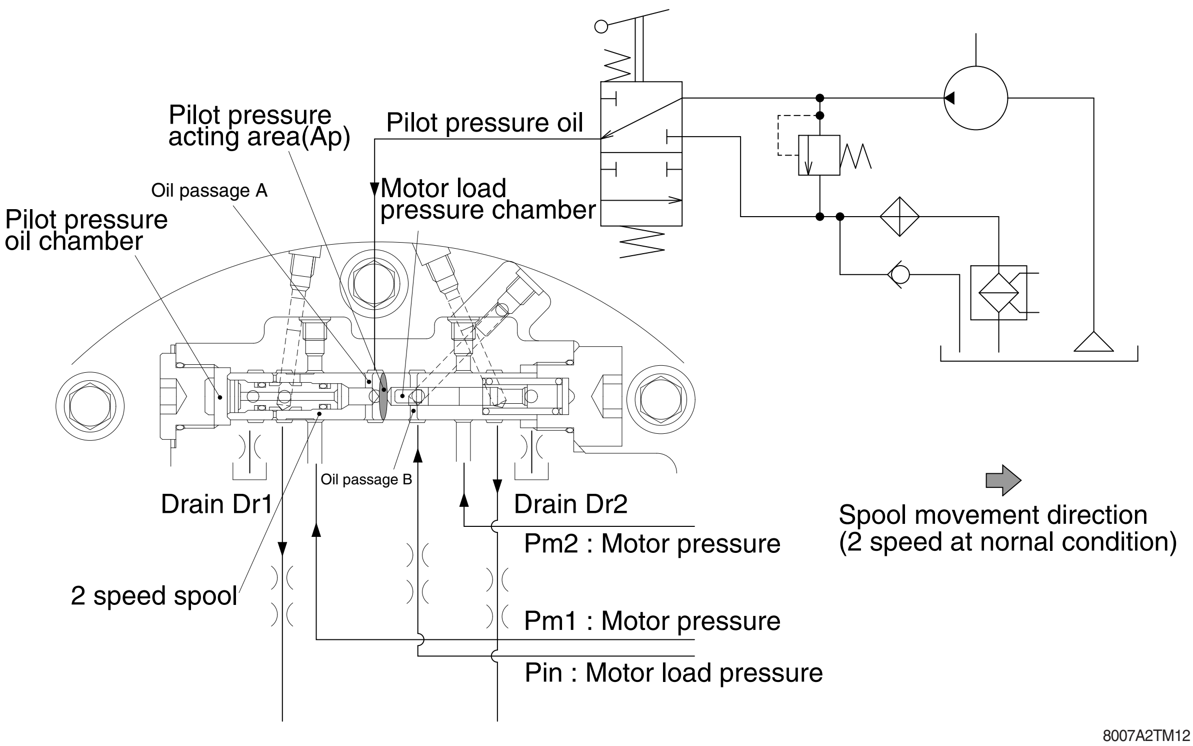
Motor inlet pressure is applied on the area "Am". So, the spool is also applied to the left direction by Am pressure. According to above, if the motor pressure is lower and keeps the following condition, the spool stays on the right position.

$$Ps \times Ap \rangle\ Am \times Pin + Kx$$

Kx : Spring force

Ap : Swash plate control piston pressure receiving area

Ps : Pilot pressure



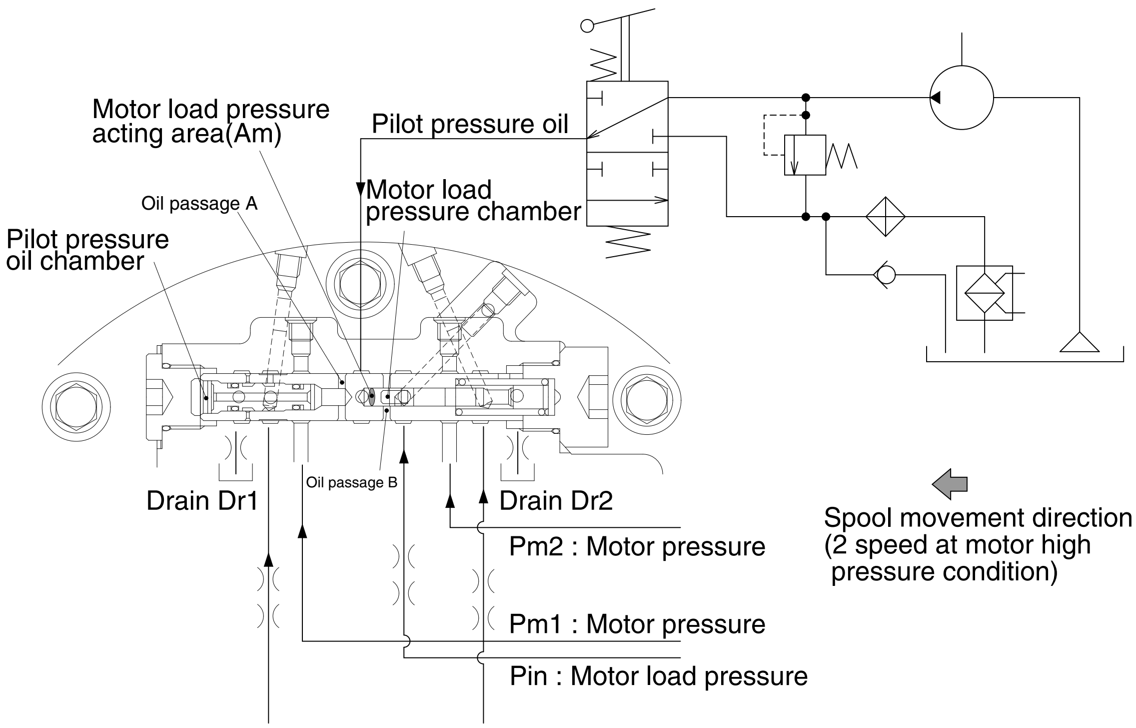
(2) Motor pressure is high.

The motor displacement is large (low speed displacement) as shown figure.

The two-speed spool is on the left position if Pin pressure is high. Then, Pm1 and Pm2 are shuttled by the spool.

If the motor pressure is higher and keeps the following condition, the spool stays on the left position.

$$Ps \times Ap < Am \times Pin + Kx$$



8007A2TM13

5) RELIEF VALVE

The relief valves determine the drive force and the brake force for hydraulic excavator travel and are installed in the main port M1 and M2 lines.

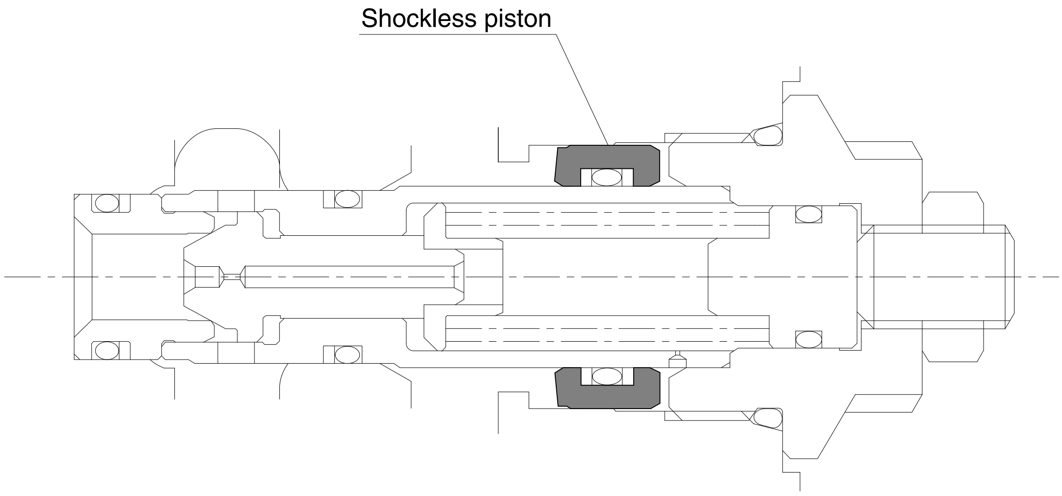
A shock less function is also incorporated to reduce shock produced at the start of both acceleration and deceleration.

(1) The construction of the relief valve.

① A direct-acting differential area type relief valve

② A shockless piston

The installation of a shockless type relief valve helps reduce.



8007A2TM16

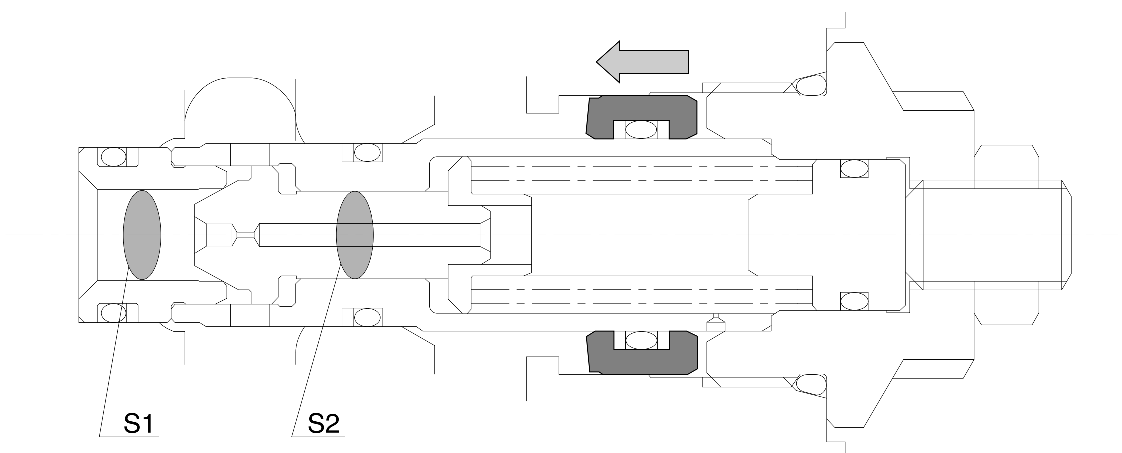
(2) The relief valve operates in two stages as follows.

① First stage

At the start of operation, the shockless piston moves to maintain the spring chamber at a low pressure. Thus, the pressure receiving area of the poppet becomes the poppet seat area (S1), a considerably larger area than the pressure receiving area (S1- S2) at the specified relief setting.

For this reason, the relief operating pressure is kept at a low pressure until the shockless piston completes its movement.

The low pressure holding time depends on the poppet orifice diameter, the free piston pressure receiving area and the free piston stroke.

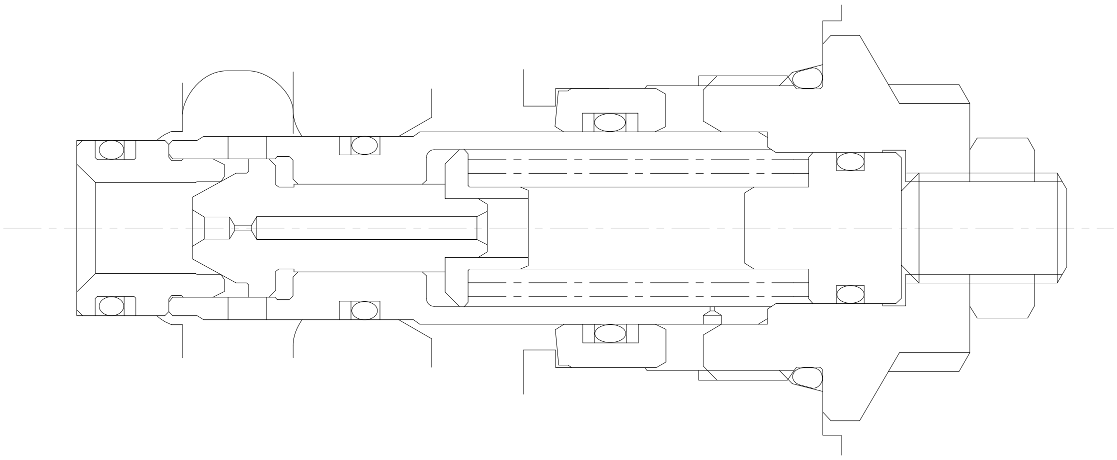


8007A2TM15

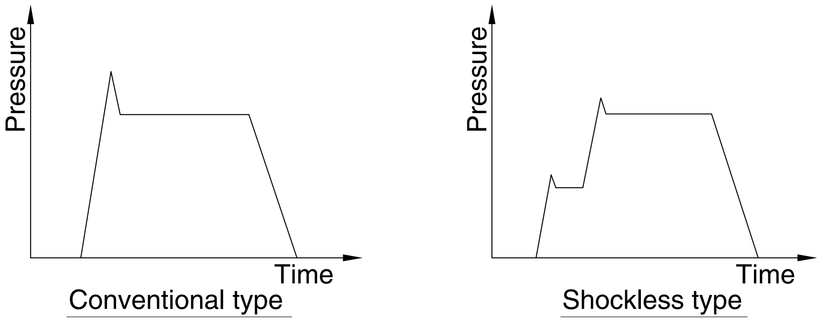
② Second stage

When the shockless piston completes its movement, the pressure inside the spring chamber increases to make the pressures before and after the poppet equal.

Then the relief valve operates at the specified set pressure.

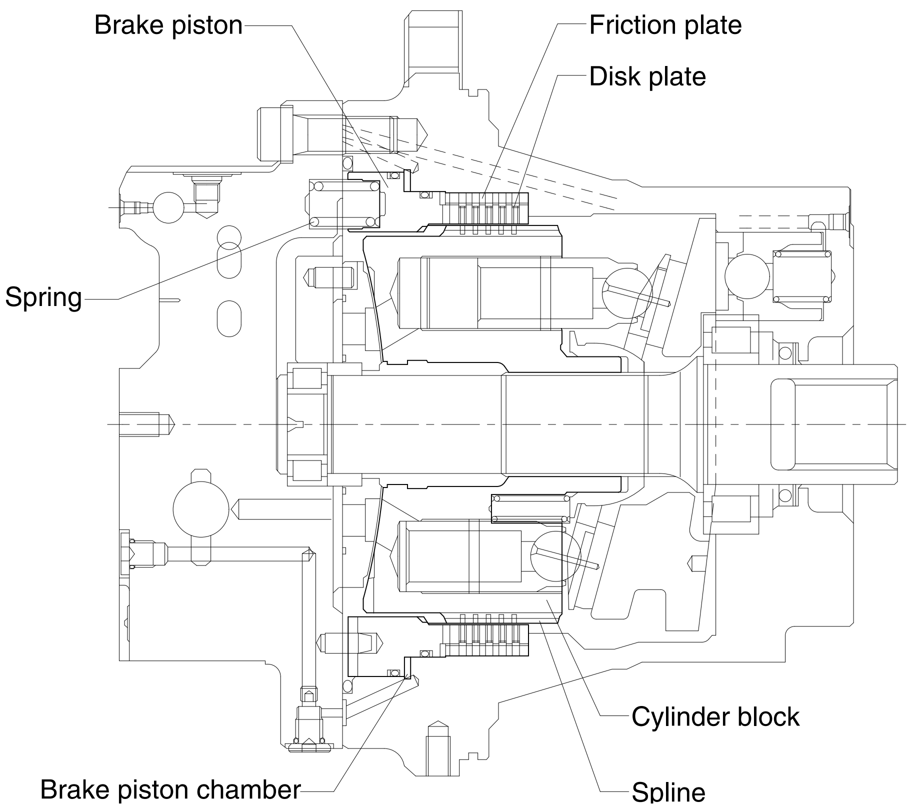


8007A2TM14



8007A2TM17

6) PARKING BRAKE

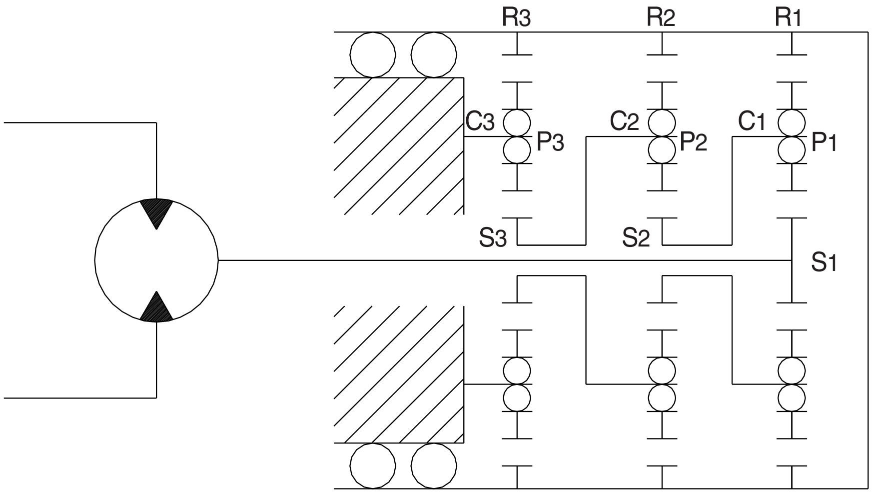


8007A2TM18A

The parking brake is a kind of negative brake which consist of disk, brake piston, friction plate and spring.
The cylinder block and disk are combined with a spline, and friction material is bonded on both sides of disk.
The disk generates frictional force between the case, the friction plate and the brake piston by the force of spring and restricts the rotating force of the motor, achieving the best performance of the parking brake.
When the pressurized oil flows into the motor, the plunger moves and the parking brake release port is opened.
After the oil flows into brake piston chamber, the thrust "F" is generated, corresponding to the pressure receiving surface of brake piston and the thrust "F" becomes larger than the force of spring "f", consequently the brake piston moves toward right.
Then, the disk rotates freely between the flange holder and brake piston, and parking brake is released.
When the motor is stopped, the plunger returns to the neutral position and the parking brake release port is closed. Consequently the pressurized oil in brake piston chamber flows into motor case, the parking brake acts by the force of spring.

7) REDUCTION GEAR

The reduction gear is composed of a three-stage planetary gear mechanism shown in the following figure. Since the sun gear is designed to have a floating mechanism, errors of the gears and carrier pin hole pitches will not affect the gears' lives heavily.



R290TM08(1)

The input rotation of the hydraulic motor is transmitted to No. 1 sun gear (S1) and this drives No. 1 planetary gears (P1). This No. 1 planetary gears (P1) drive No.1 ring gear (R1) with the same force as the meshing tangential force with No. 1 sun gear (S1), and also No. 1 carrier (C1) with the same force as the meshing reaction force. In other words, No. 1 planetary gears (P1) revolve rotating.
This rotation of No. 1 carrier (C1) becomes the output of the 1st stage, and is transmitted directly to No. 2 sun gear (S2).
(No. 1 carrier is spline-coupled with No. 2 sun gear.) Similarly the revolution of No. 2 planetary gear (P2) are transmitted via No.2 carrier (C2) to No. 3 sun gear (S3). Since No. 3 carrier (C3) supporting No. 3 planetary gears (P3) are fixed, No. 3 planetary gears (P3) do not revolve, but rotates to drive No. 3 ring gears (R3).
Therefore, the rotating case is driven by the overall driving torque of numbers.
1,2 and 3 ring gears. This reduction ratio is expressed as shown below:

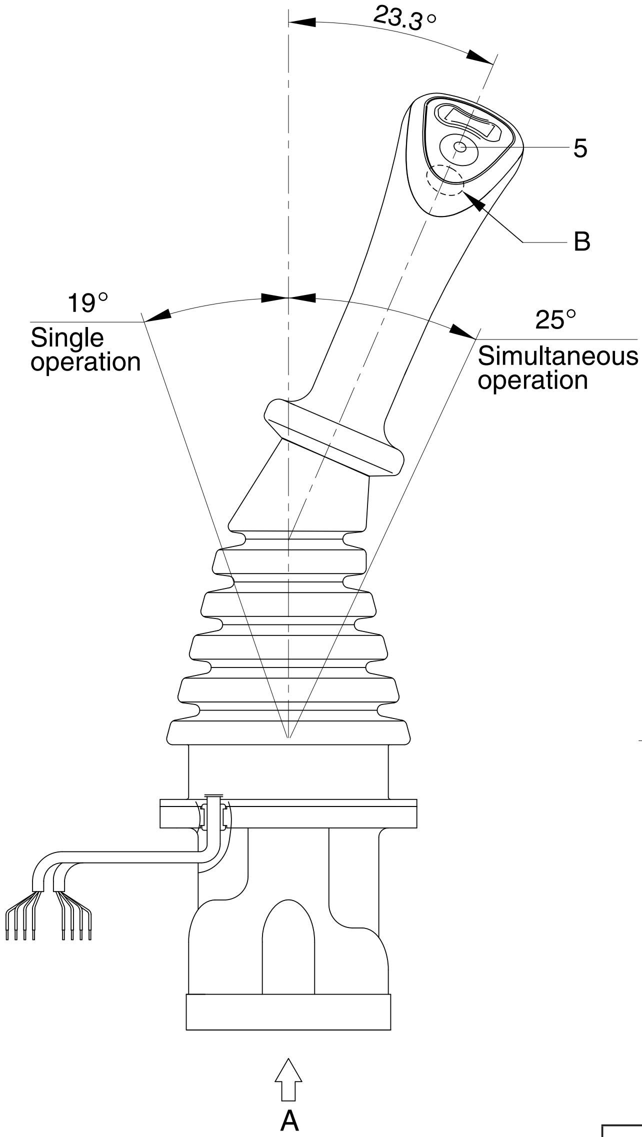
$$i = \frac{(Z_{S1} + Z_{r1})(Z_{S2} + Z_{r2})(Z_{S3} + Z_{r3})}{Z_{S1} \cdot Z_{S2} \cdot Z_{S3}} - 1$$

Where Z : Number of teeth of each gear
The direction of rotation is reverse to that of the input shaft.

GROUP 5 RCV LEVER

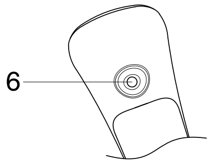
1. STRUCTURE

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

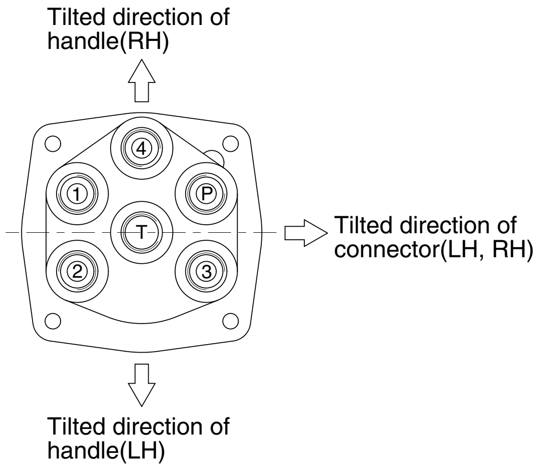


Switches

No.	LH	RH
5	One touch decel	Horn
6	Power boost	Breaker

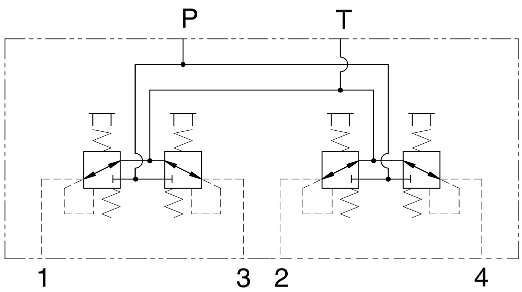


DETAIL B



VIEW A

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	



Hydraulic circuit

21092RL01

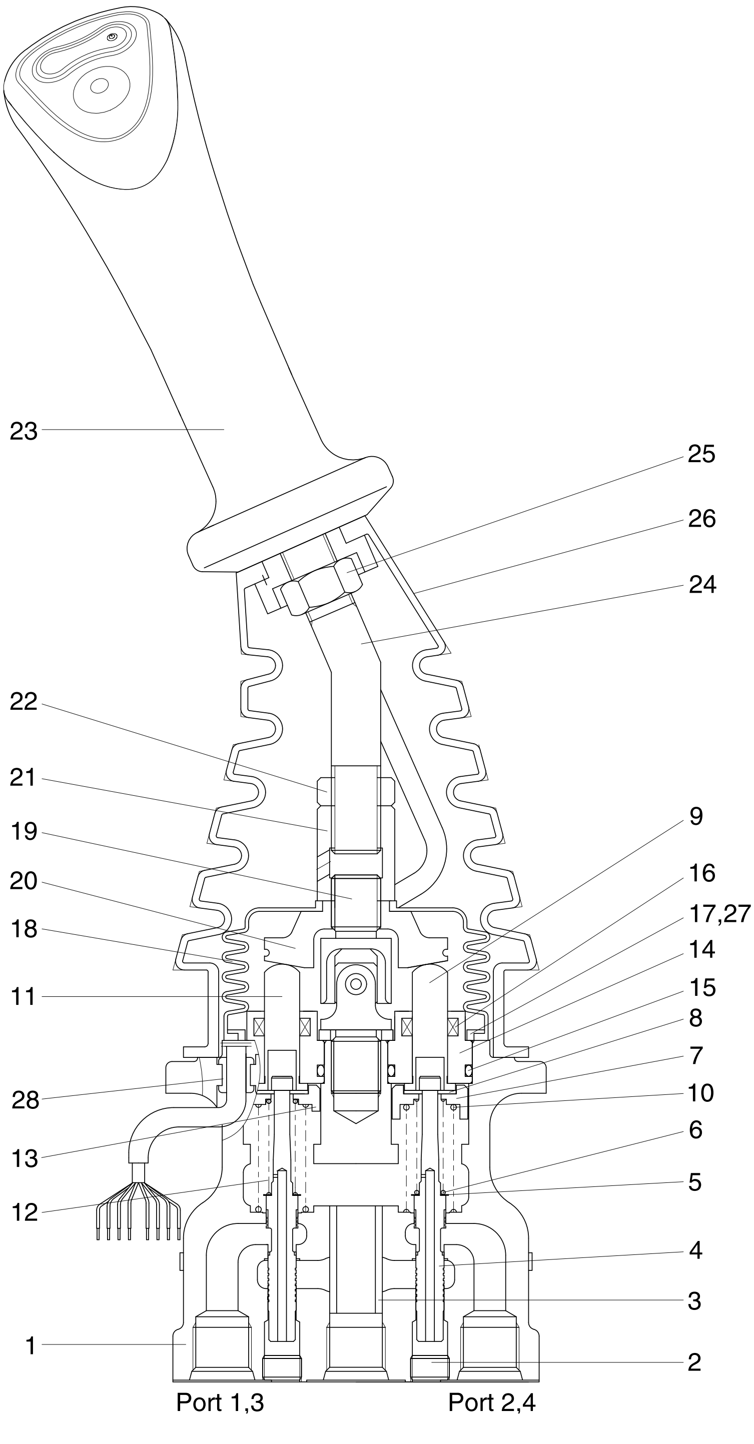
CROSS SECTION

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 (4), spring (6) for setting secondary pressure, return spring (10), stopper (8), spring seat (7, 13) and shim (5). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 20.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (9, 11) 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.

CROSS SECTION



32092RL01

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

2. 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 (4) 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 (6) works on this spool to determine the output pressure.

The change the deflection of this spring, the push rod (9,11) is inserted and can slide in the plug (14).

For the purpose of changing the displacement of the push rod through the swash plate (20) and adjusting nut (21) are provided the handle (23) that can be tilted in any direction around the fulcrum of the universal joint (19) center.

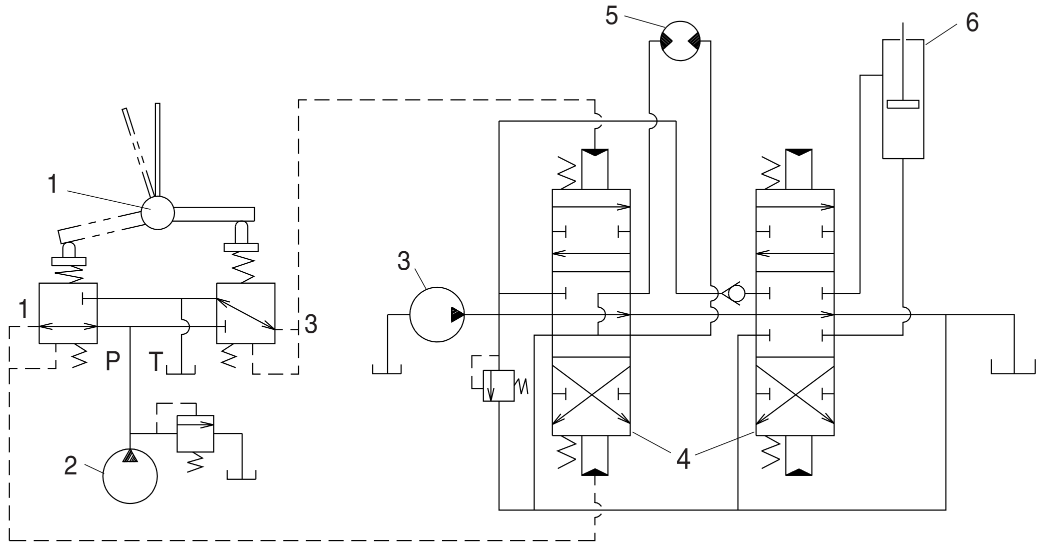
The spring (10) works on the case (1) and spring seat (7, 13) and tries to return the push rod (9,11) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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.

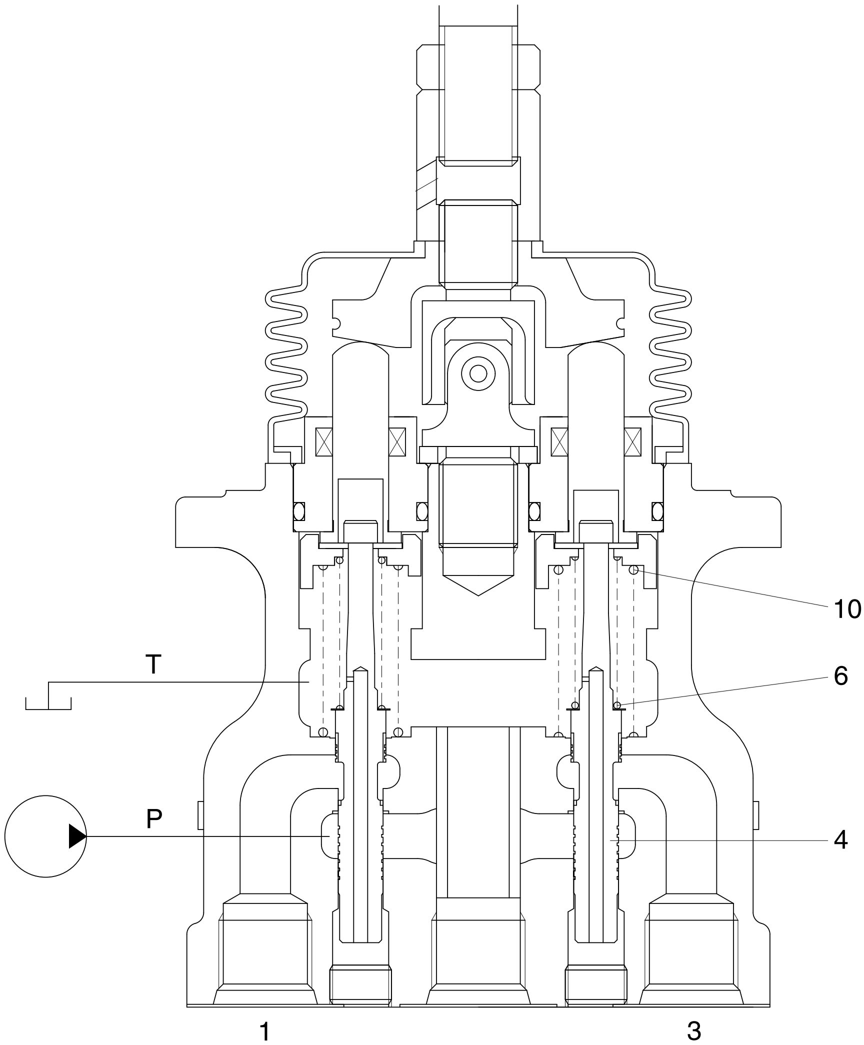
The diagram shown below is the typical application example of the pilot valve.



2-70

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

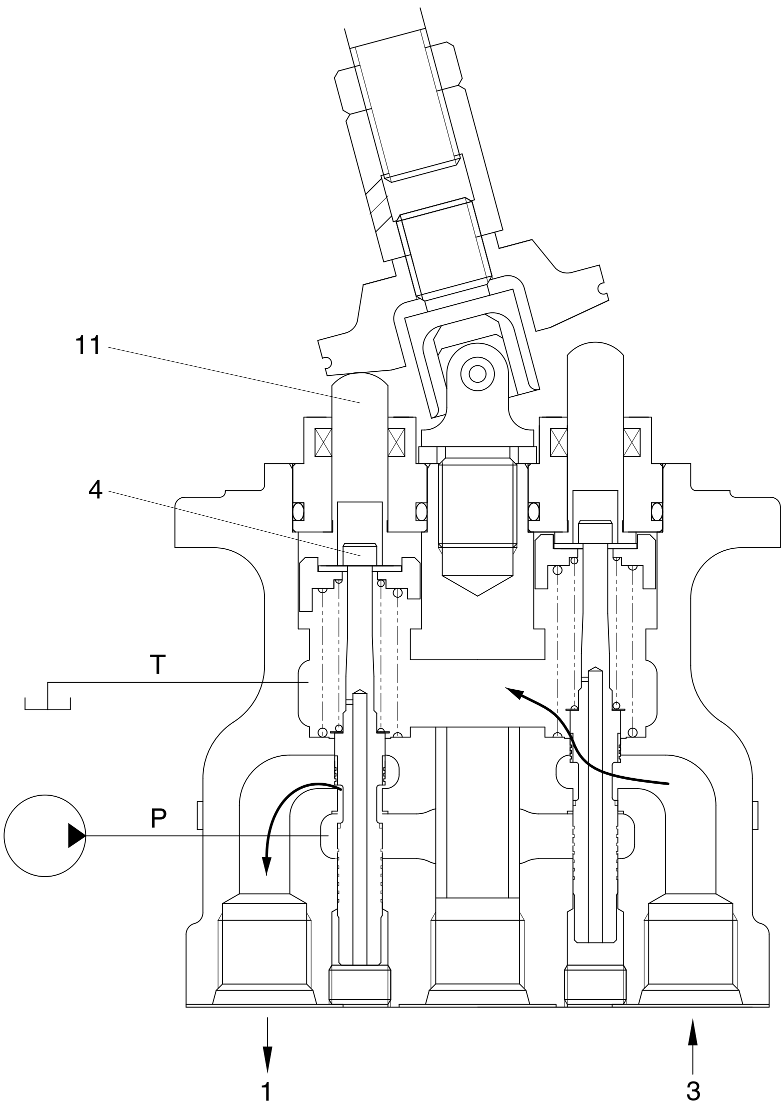
(1) Case where handle is in neutral position



21092RL03

The force of the spring (6) that determines the output pressure of the pilot valve is not applied to the spool (4). Therefore, the spool is pushed up by the spring (10) to the position of port (1, 3) in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

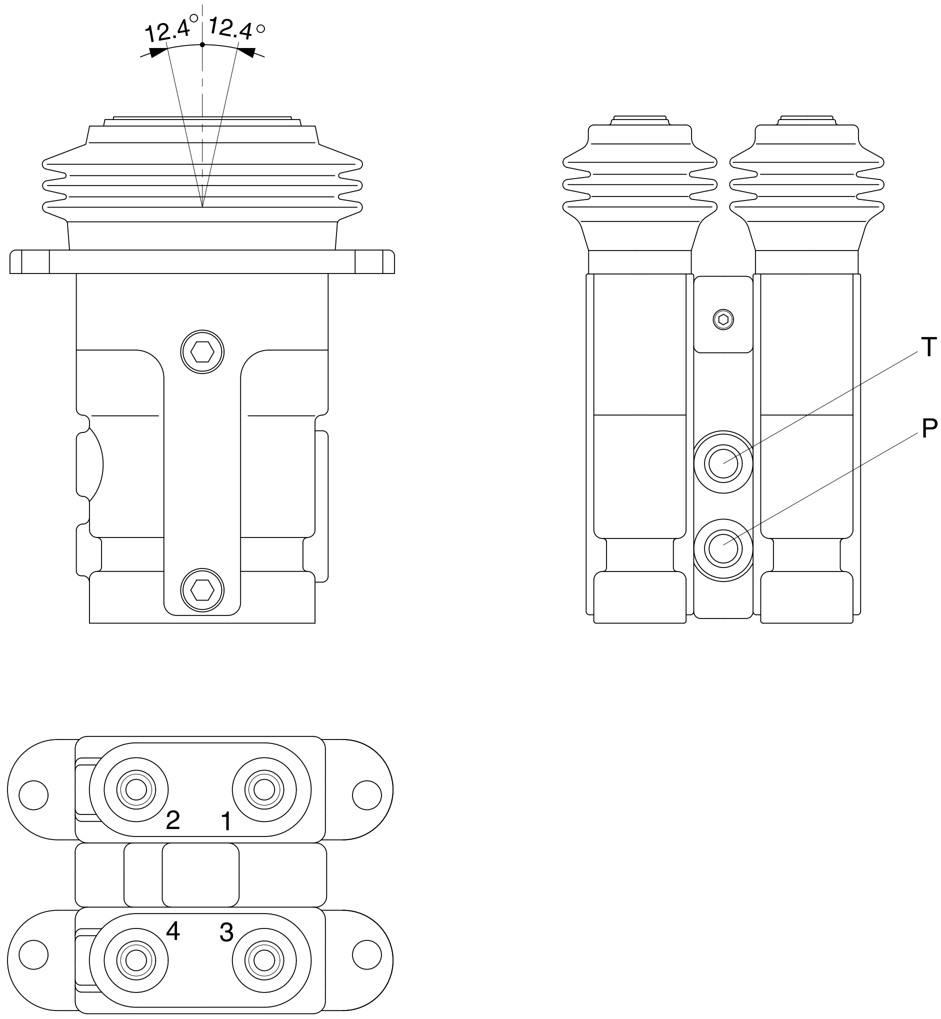
(2) Case where handle is tilted

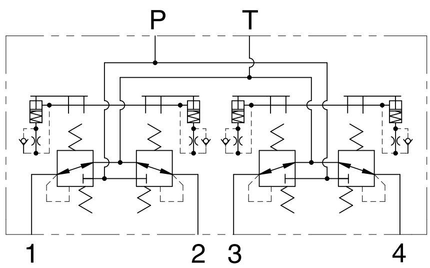


When the push rod (11) is stroked, the spool (4) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the 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.

1. STRUCTURE

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





Hydraulic circuit

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

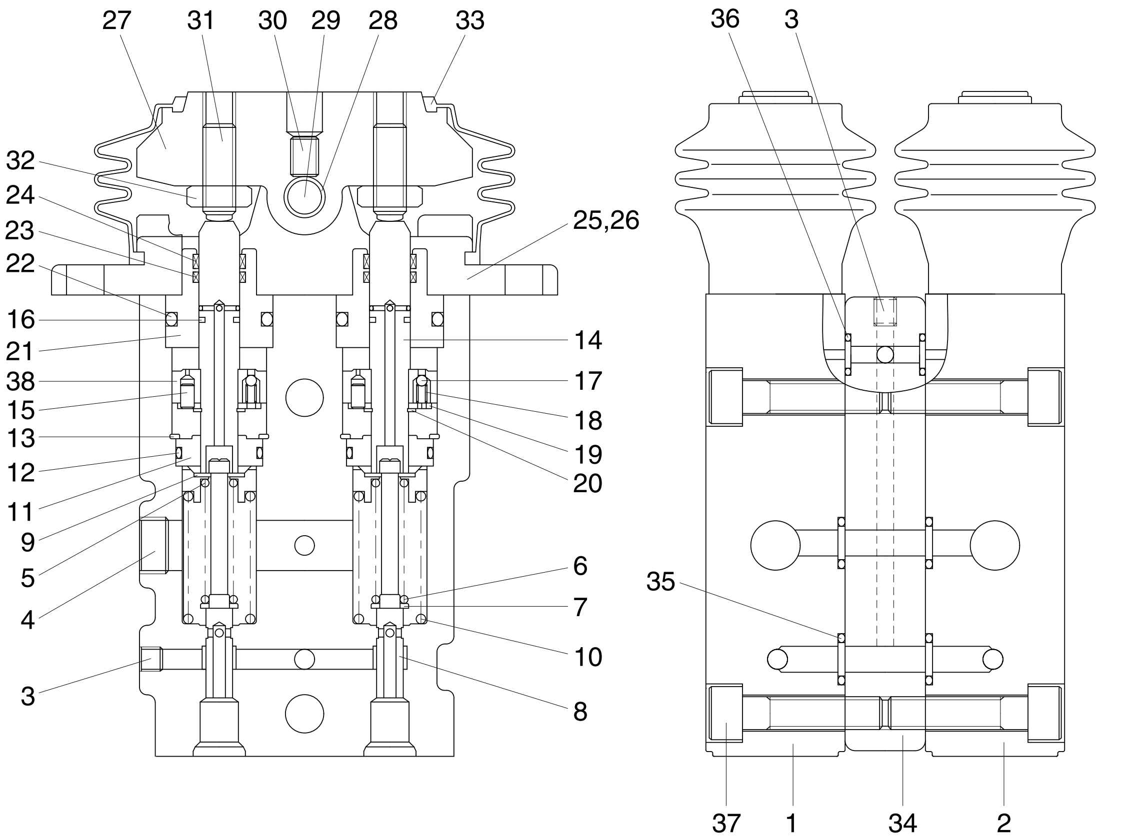
21092RP01

CROSS SECTION

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

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

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



21092RP02

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

2. FUNCTION

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

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

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

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

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

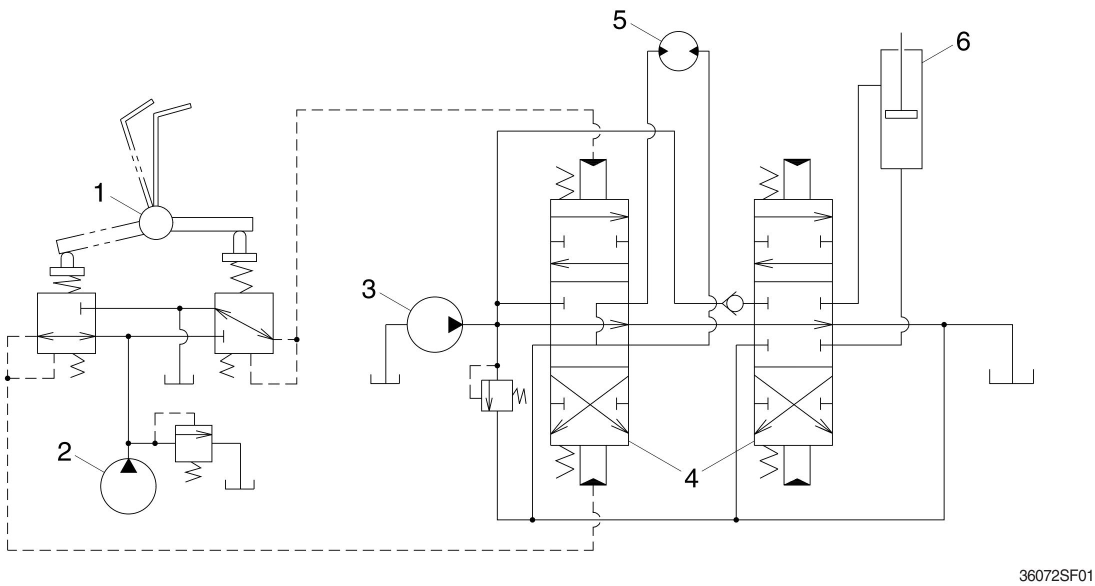
The spring (10) works on the casing (1) and spring seat (7) and tries to return the push rod (14) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

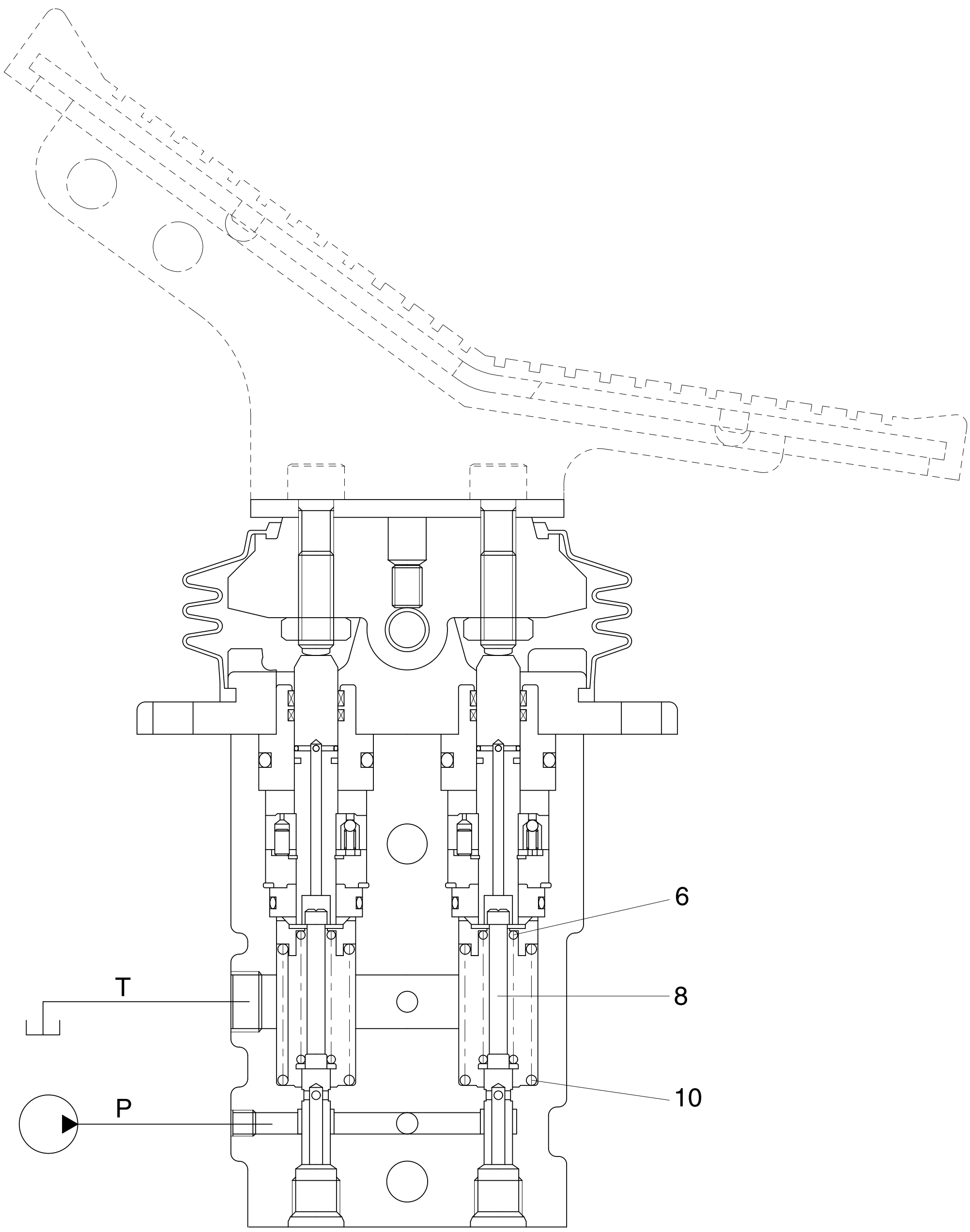
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below ant the attached operation explanation drawing.

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



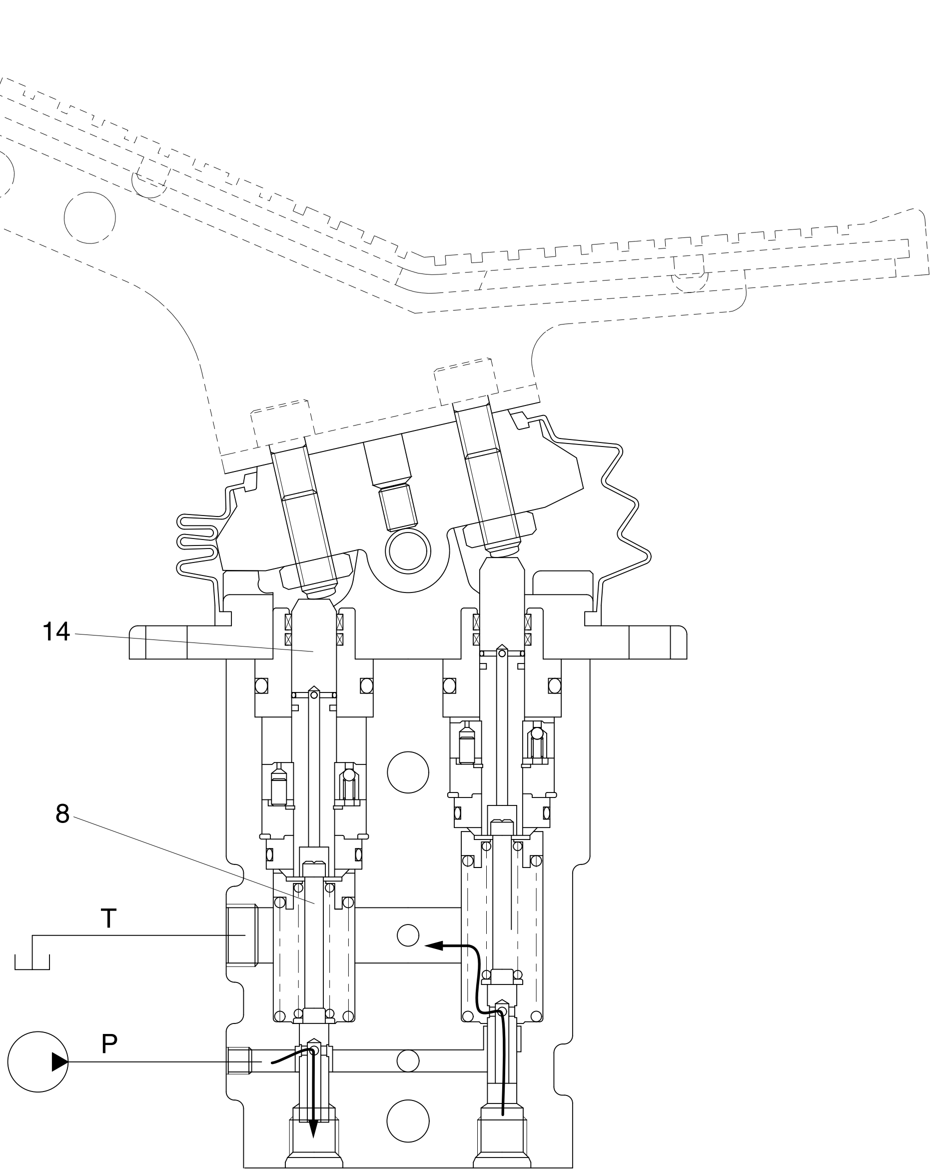
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where pedal is in neutral position



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

(2) Case where pedal is tilted



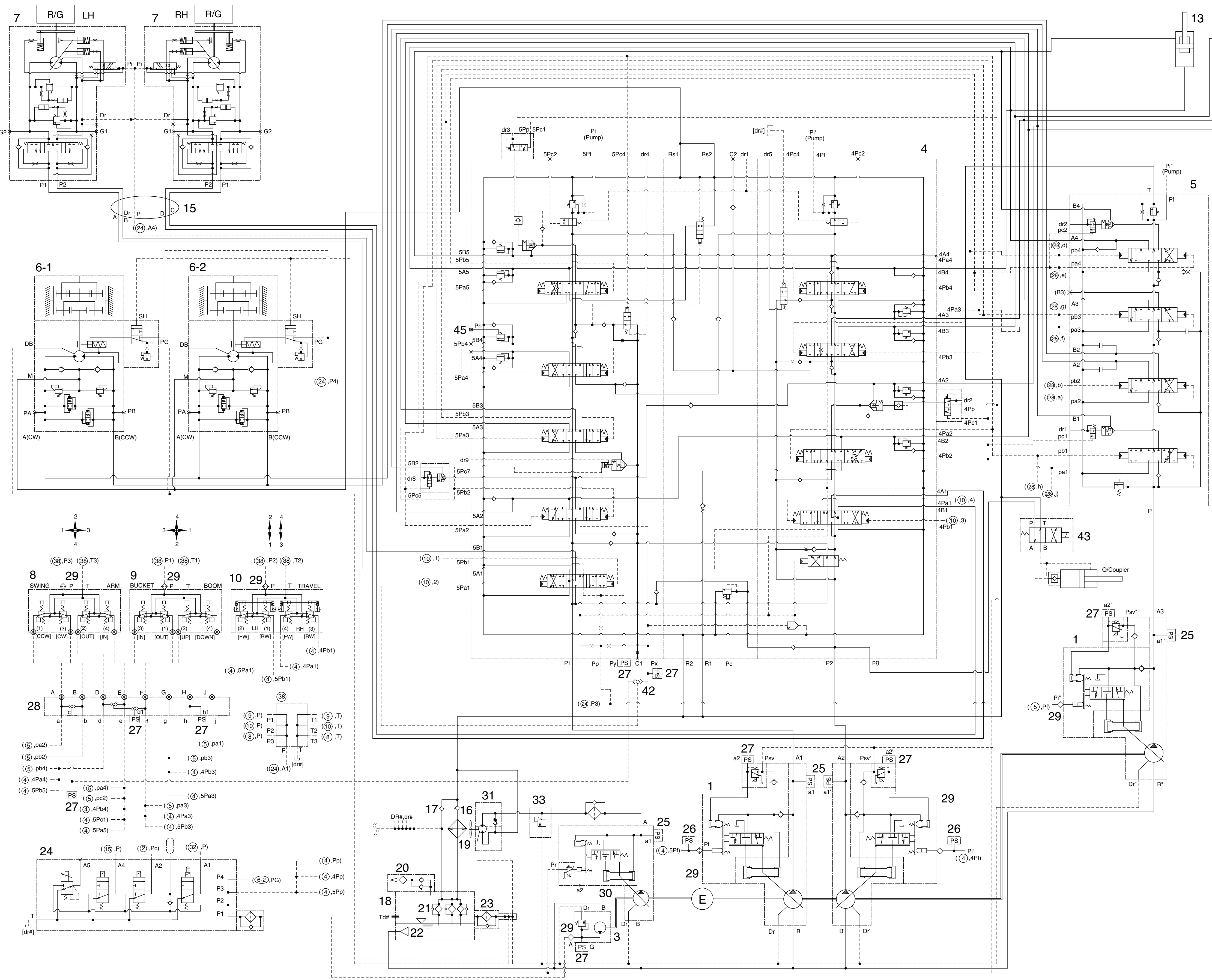
21092RP04

When the push rod (14) is stroked, the spool (8) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, the hydraulic pressure force balances with the spring force. If the pressure at port 1 increases higher than the set pressure, port P is disconnected from port 1 and port T is connected with port 1. If it decreases lower than the set pressure, port P is connected with port 1 and port T is disconnected from port 1.
In this manner the secondary pressure is kept at the constant value.
Besides, in some type, when the handle is tilted more than a certain angle, the upper end of the spool contacts with inside bottom of the push rod and the output pressure is left to be connected with port P.

SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

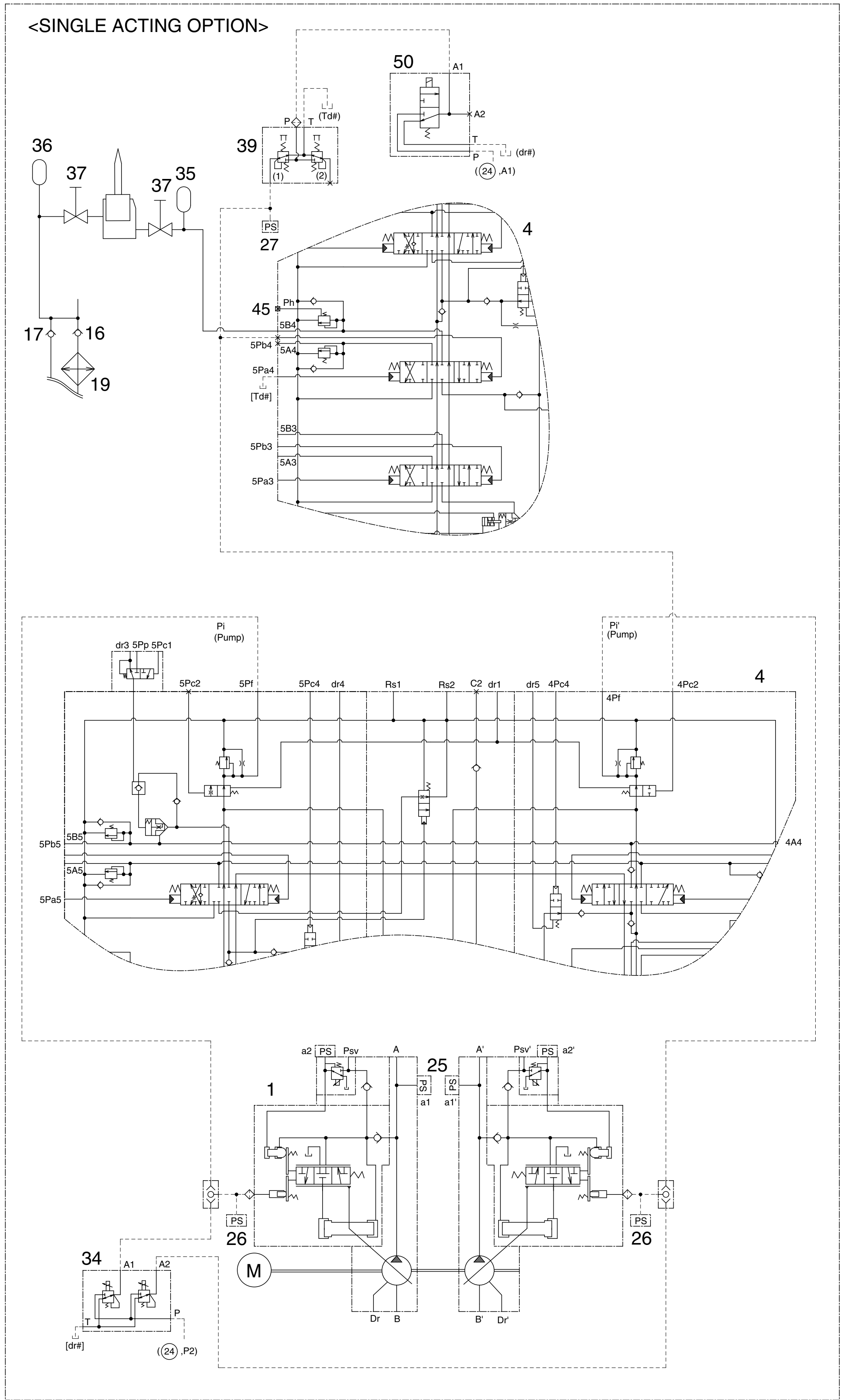
1. HYDRAULIC CIRCUIT (1/2)

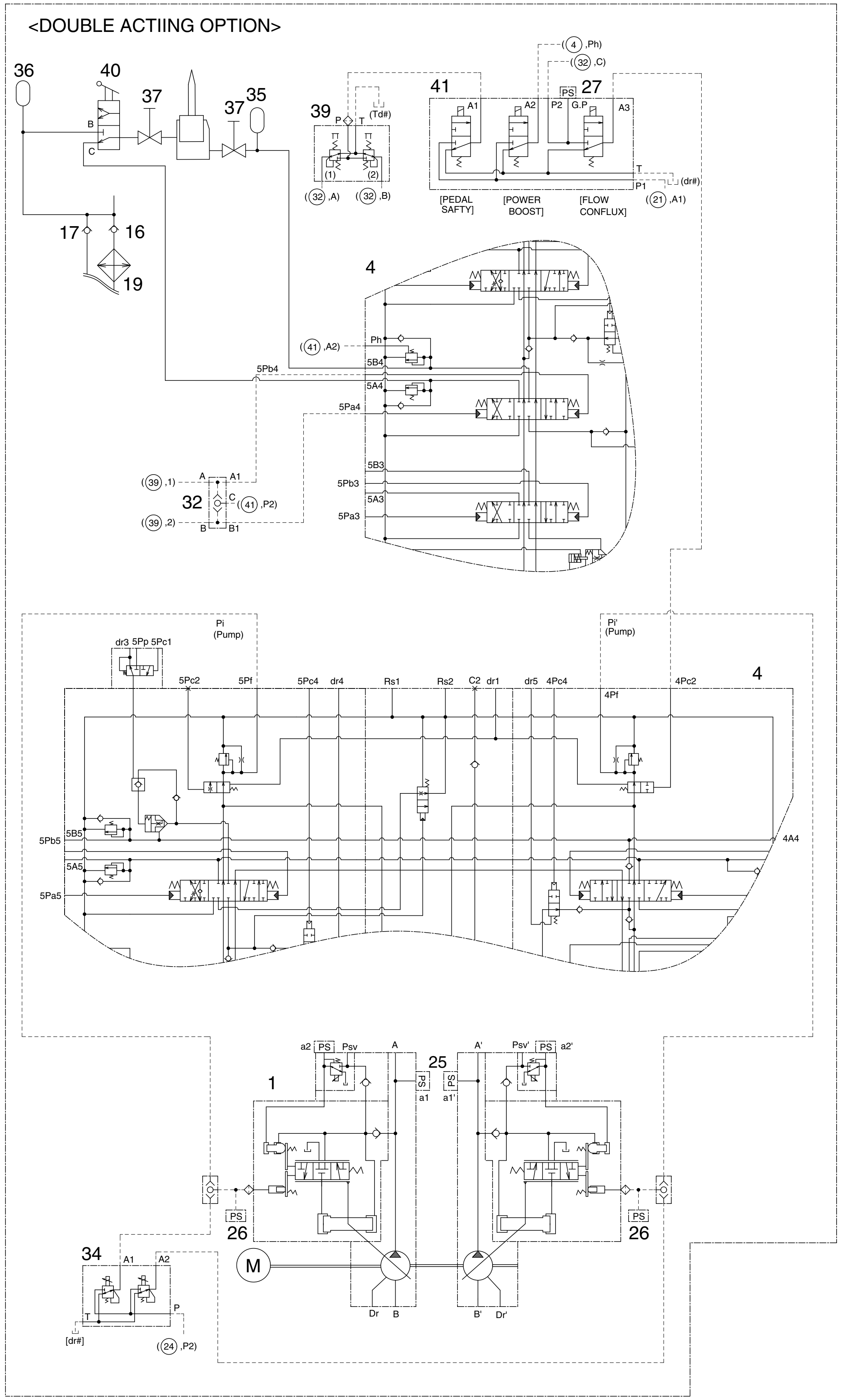


1	Pump (nega)
3	Gear pump
4	Main control valve
5	Main control valve
6-1	Swing unit
6-2	Swing unit
7	Travel unit
8	RCV lever (LH)
9	RCV lever (RH)
10	RCV pedal
11	Boom cylinder (LH)
12	Boom cylinder (RH)
13	Arm cylinder
14	Bucket cylinder
15	Turning joint
16	Check valve
17	Check valve
18	Hydraulic tank assy
19	Oil cooler
20	Air breather
21	Return element
22	Strainer assy
23	Drain fllter
24	4-cartridge valve
	Pilot filer
	Accumulator
25	Pressure sensor
26	Pressure sensor
27	Pressure sensor
28	Shuttle block
29	Last guard filter
30	Remote fan pump
	Remote fan filter
31	Remote fan motor
33	Relief valve
43	Solenoid valve
44	Pattern change valve
45	Plug

30QE-74000-07 1OF2

2. HYDRAULIC CIRCUIT (2/2)





1	Main pump
16	Check valve
17	Check valve
19	Oil cooler
25	Pressure sensor
27	Pressure sensor
32	Shuttle valve
34	2-EPPR valve
35	Accumulator
36	Accumulator
37	Stop valve
39	Option 2 way pedal
40	3 way joint
41	Solenoid valve
50	Solenoid valve

30QE-74000-07 2OF2

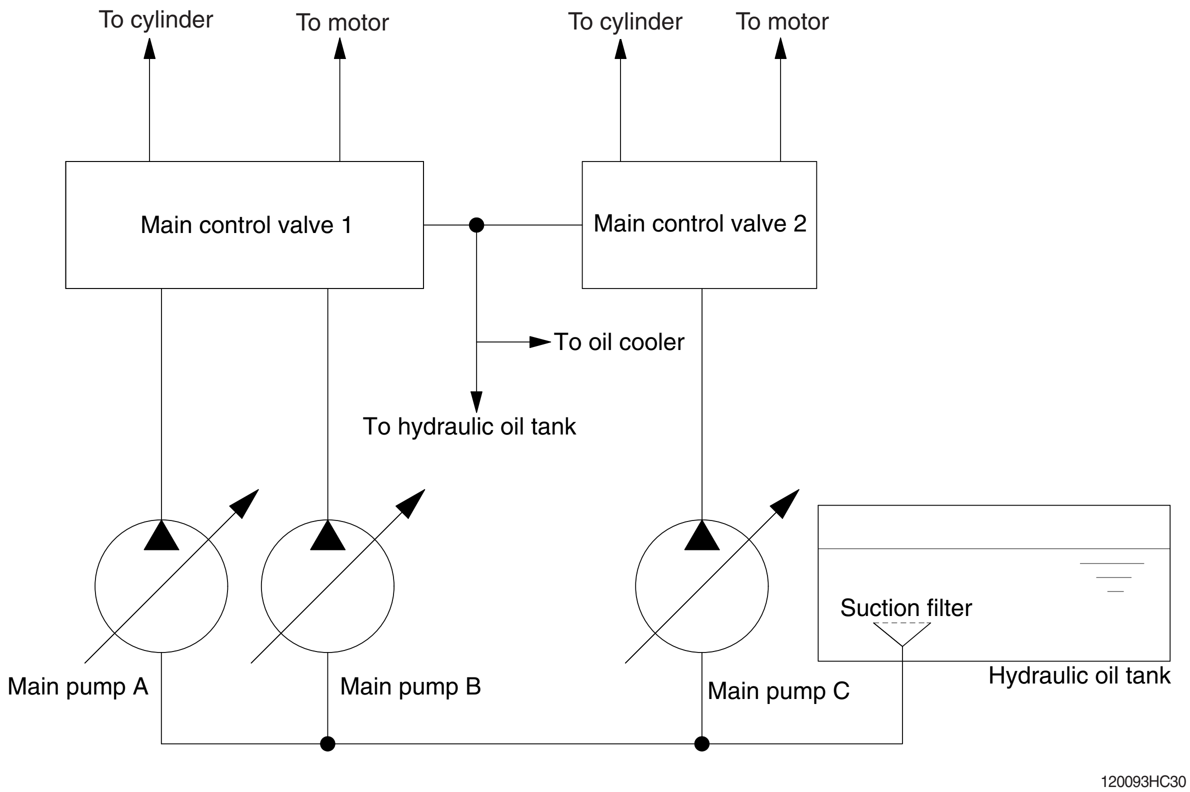
GROUP 2 MAIN CIRCUIT

The main hydraulic circuit consists of suction circuit, delivery circuit, return circuit and drain circuit.

The hydraulic system consists of three main pumps, two control valves, two swing motors, four cylinders and two travel motors.

The swash plate type variable displacement axial piston pump is used as the main pump and is driven by the engine at ratio 1.0 of engine speed.

1. SUCTION AND DELIVERY CIRCUIT



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.

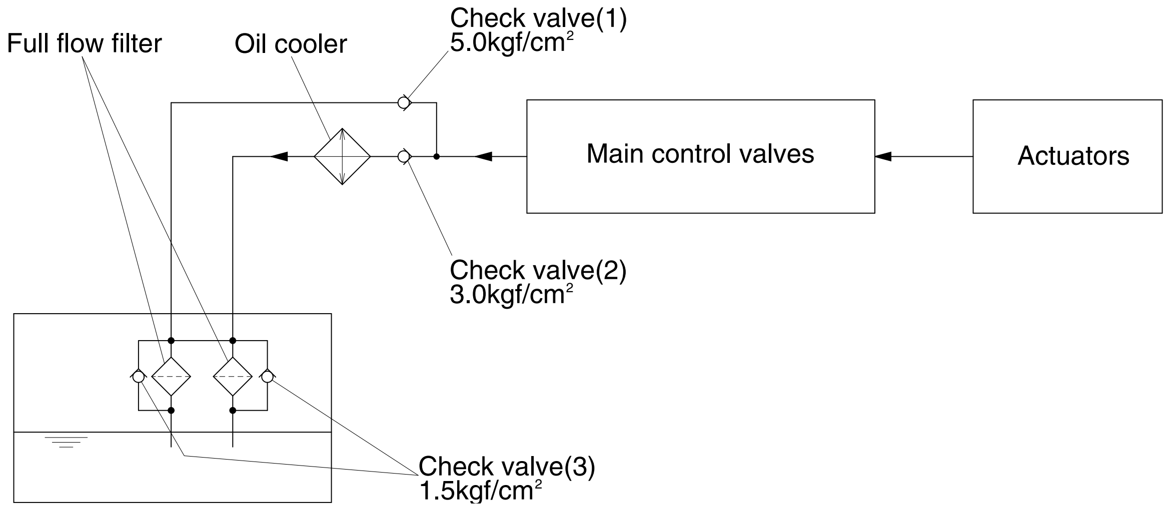
The oil discharged from the main pump flows to the actuators through the control valves.

The control valves control the hydraulic functions.

The return oil from the actuators flows to the hydraulic tank through the control valves and the oil cooler.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. RETURN CIRCUIT



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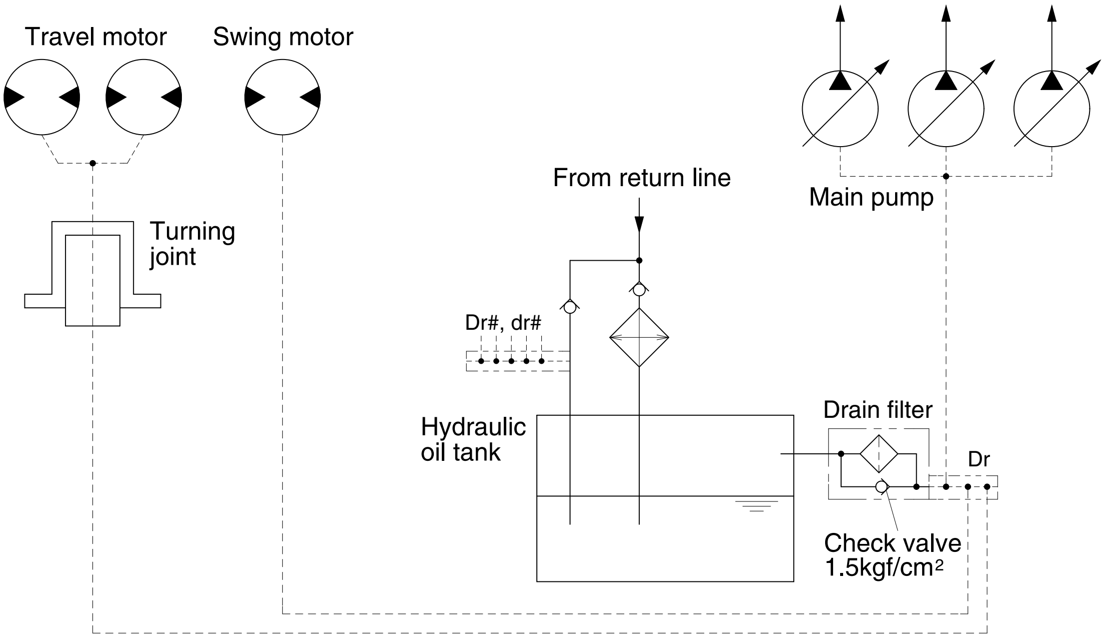
All oil from each actuator returns to the hydraulic tank through the control valves.
The bypass check valves are provided in the return circuit.
The setting pressure of bypass check valves are 1.5 kgf/cm² (21psi) and 5.0 kgf/cm² (71psi).
Usually, oil returns to the hydraulic tank from the left side of control valves 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 5.0 kgf/cm² (71psi), 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 control valves is combined and filtered by the return filter. A bypass relief valve is provided in the full-flow filter.
When the filter element is clogged, the bypass relief valve opens at 1.5 kgf/cm² (21psi) differential pressure.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. DRAIN CIRCUIT



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

1) TRAVEL MOTOR DRAIN CIRCUIT

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

2) SWING MOTOR DRAIN CIRCUIT

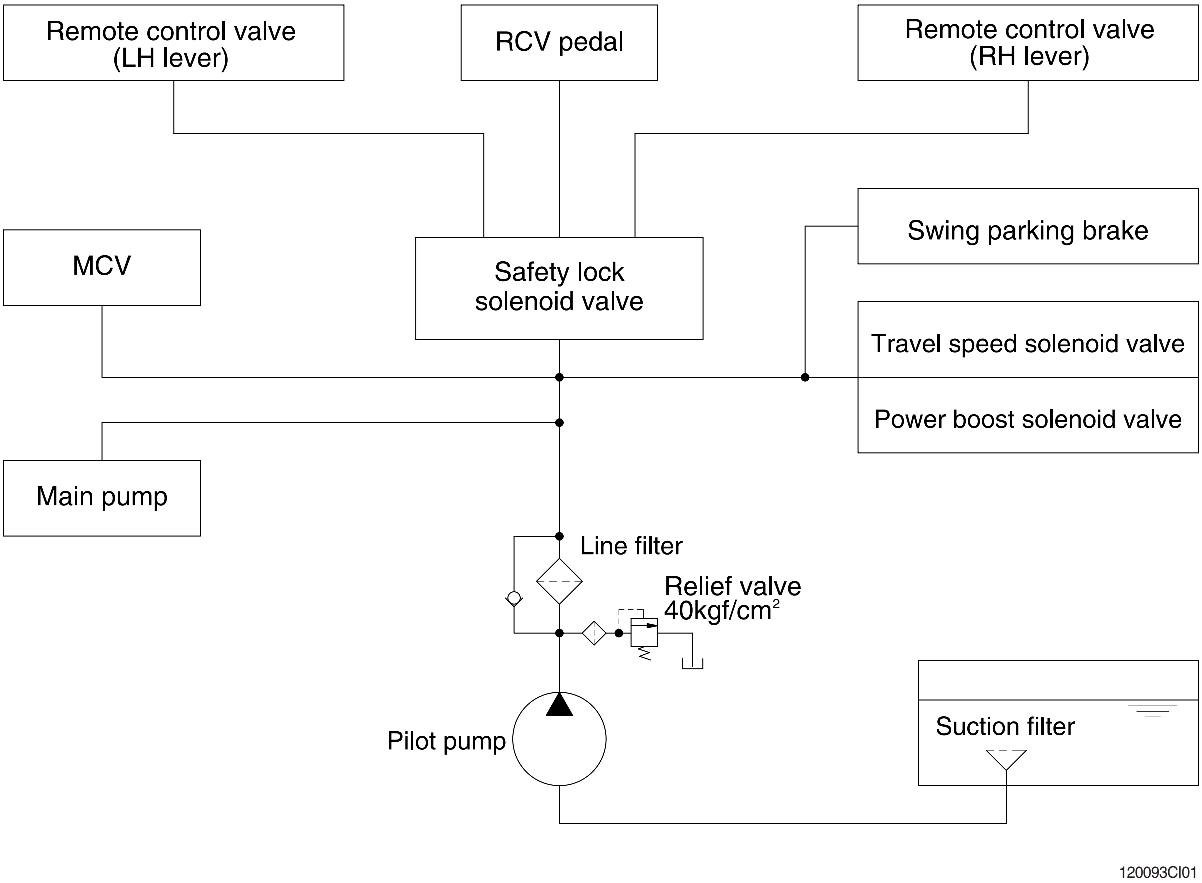
Oil leaking from the swing motors come out and return to the hydraulic tank passing through a drain filter.

3) MAIN PUMP DRAIN CIRCUIT

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

GROUP 3 PILOT CIRCUIT



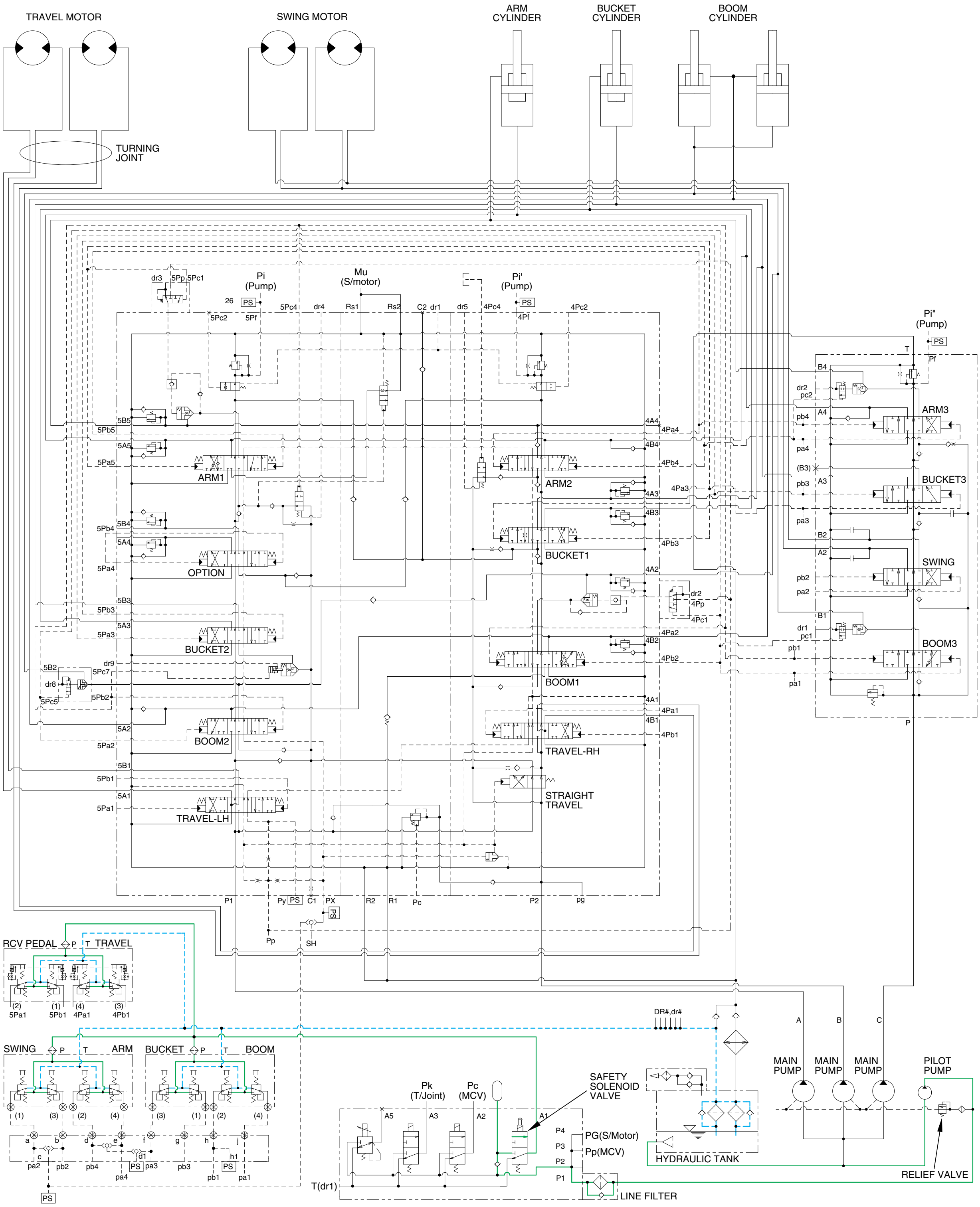
The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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.

※ The circuit diagram may differ from the equipment, so please check before a repair.

1. SUCTION, DELIVERY AND RETURN CIRCUIT



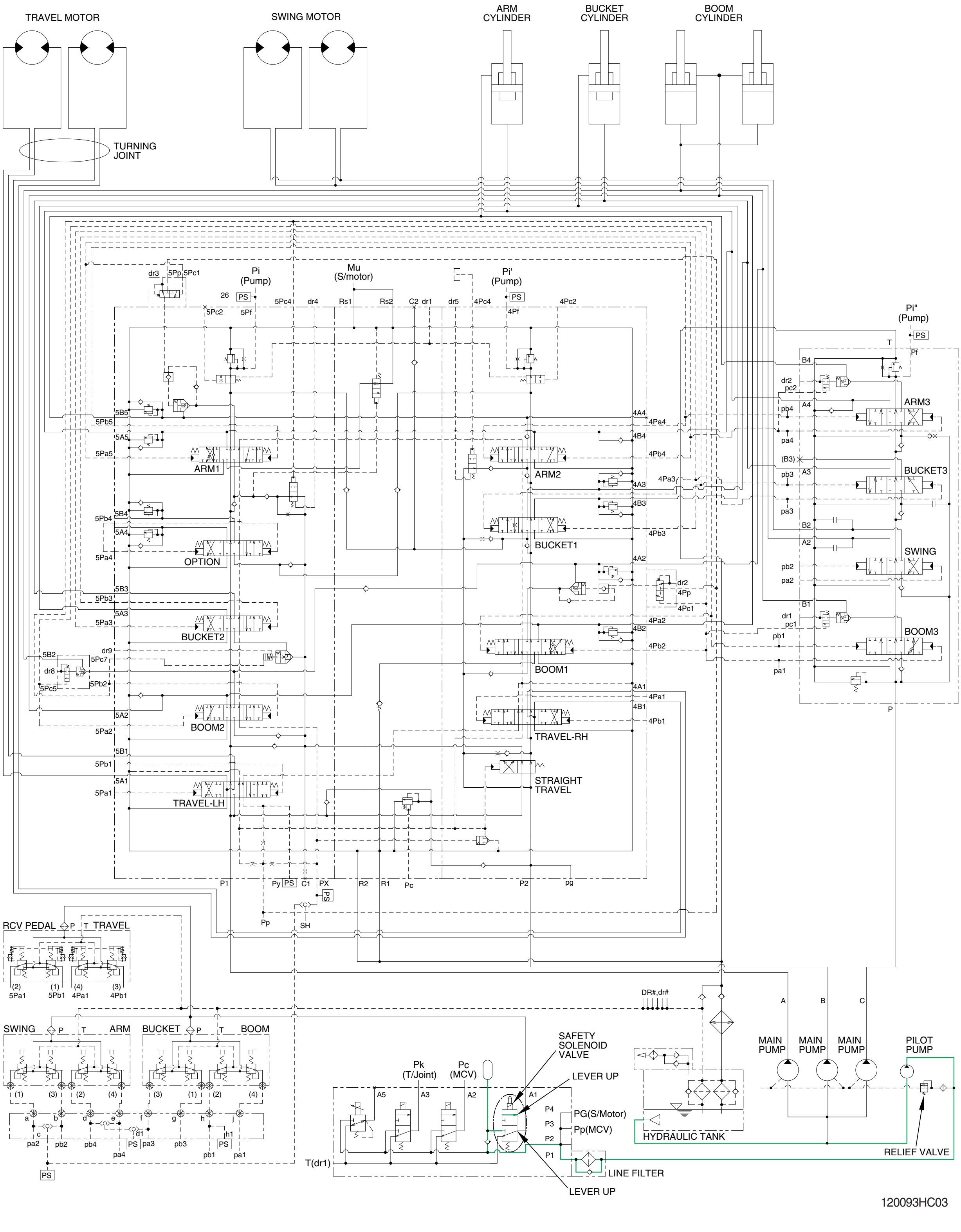
The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. SAFETY SOLENOID VALVE (SAFETY LEVER)

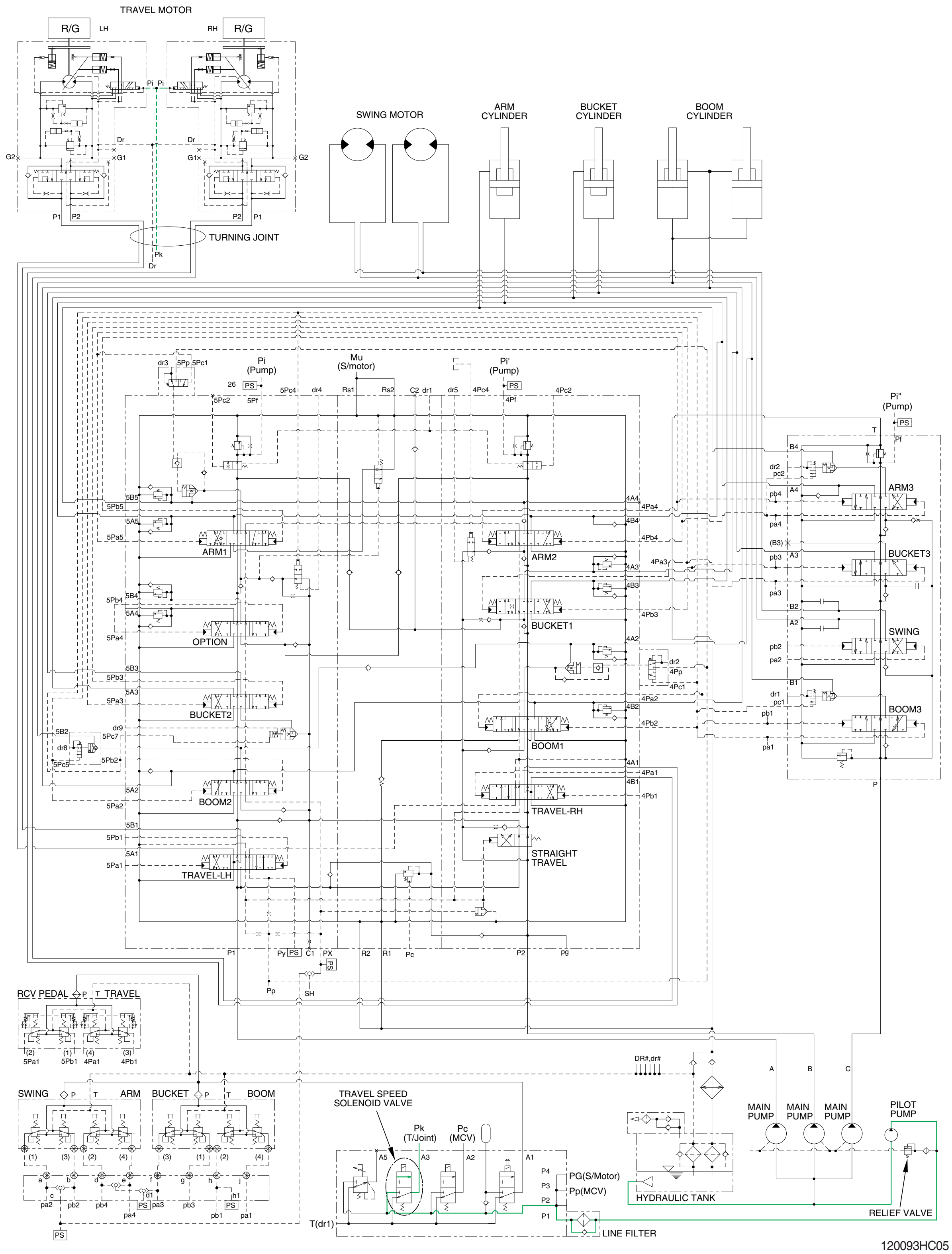


When the lever of the safety solenoid valve is moved downward, oil flows into the remote control valve through solenoid valve and line filter.

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.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. TRAVEL SPEED CONTROL SYSTEM



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

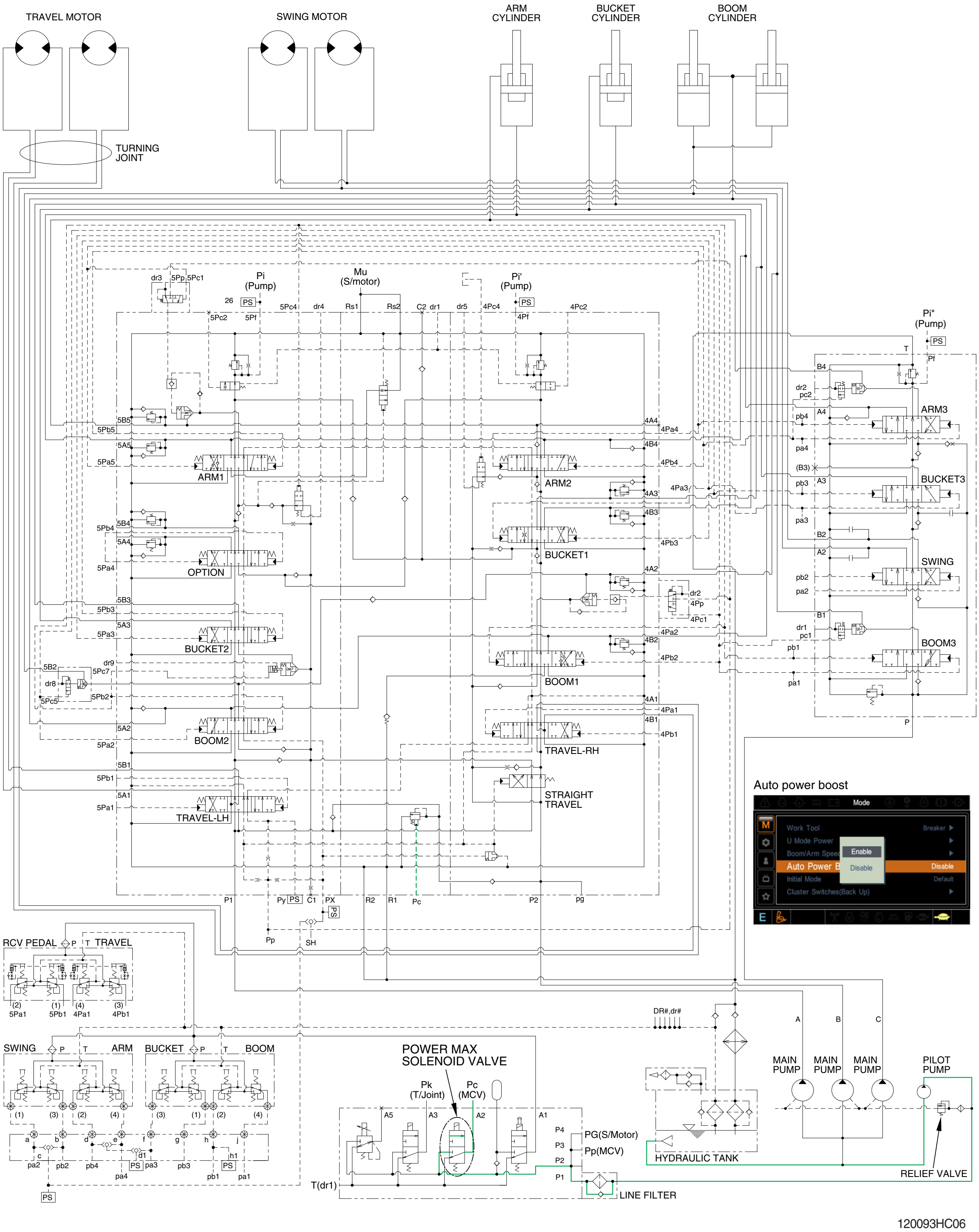
As a result, the control piston is pushed by the main oil flow, thus the displacement is minimized.

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

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

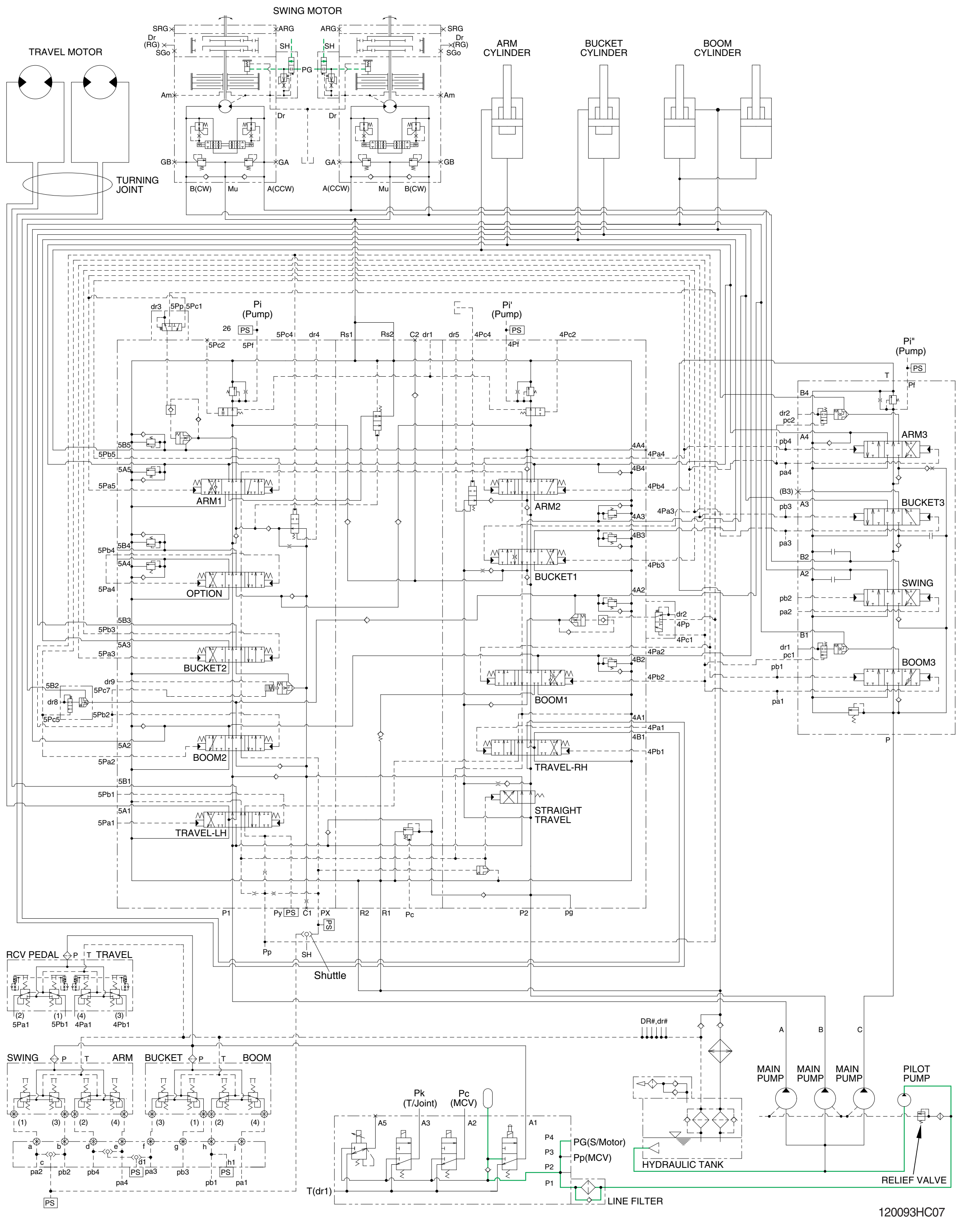
4. MAIN RELIEF PRESSURE CHANGE CIRCUIT



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 flow into Pc port of the main relief valve of main control valve; Then the setting pressure of the main control valve is raises from 320 kgf/cm^2 to 350 kgf/cm^2 for increasing the digging power. And even when press continuously, it is canceled after 8 seconds.

※ The circuit diagram may differ from the equipment, so please check before a repair.

5. SWING PARKING BRAKE RELEASE

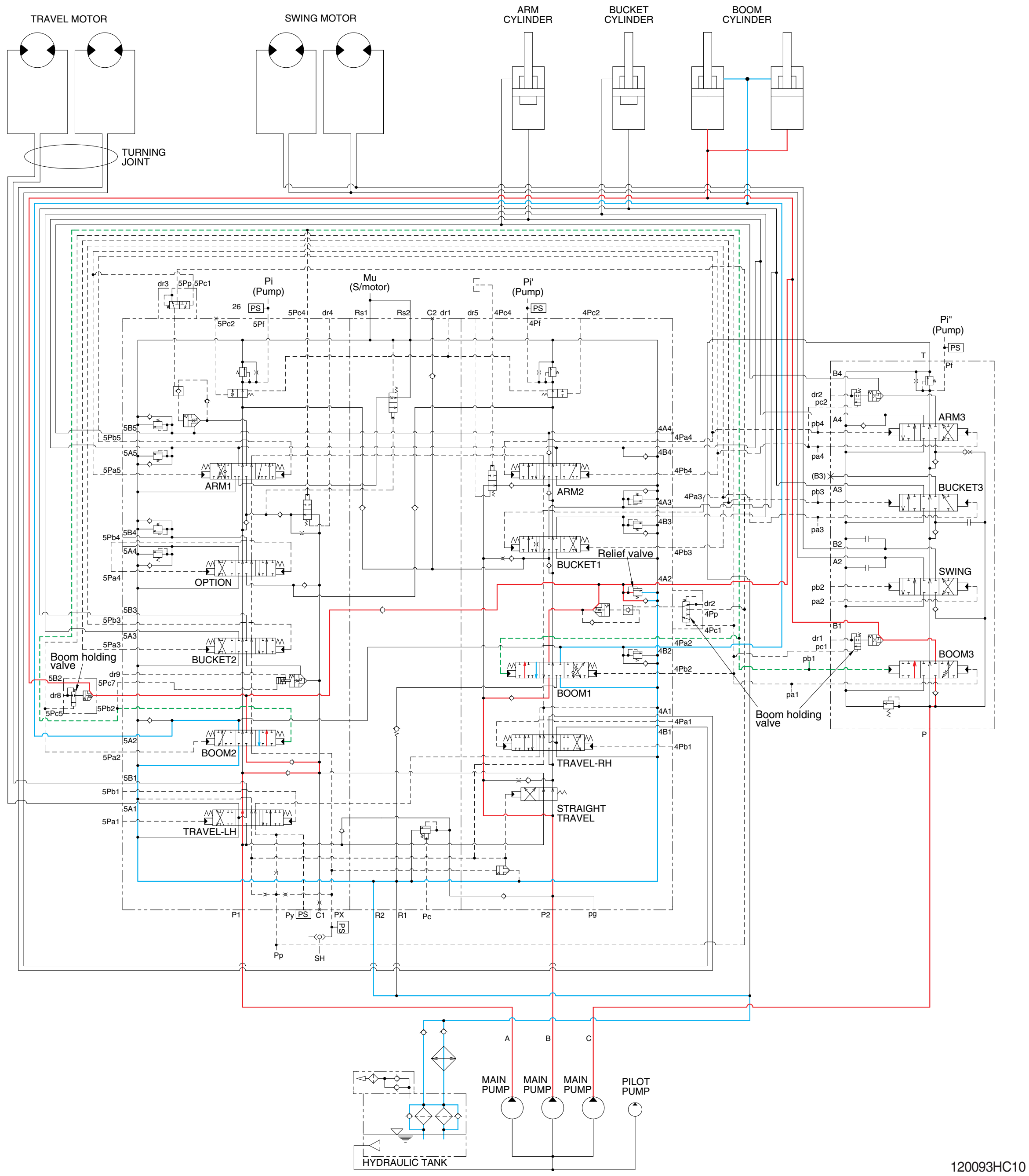


When one of the RCV levers is tilted, the pilot oil flows into SH port through the shuttle.
This pressure moves spool so, discharged oil from pilot valve flows to swing motor PG port.
This pressure is applied to swing motor disc, thus the brake is released.
When all of the RCV lever are set in the neutral position, oil in the swing motor disc cylinder is drained, thus the brake is applied.

※ The circuit diagram may differ from the equipment, so please check before a repair.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



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 A, B and C 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.

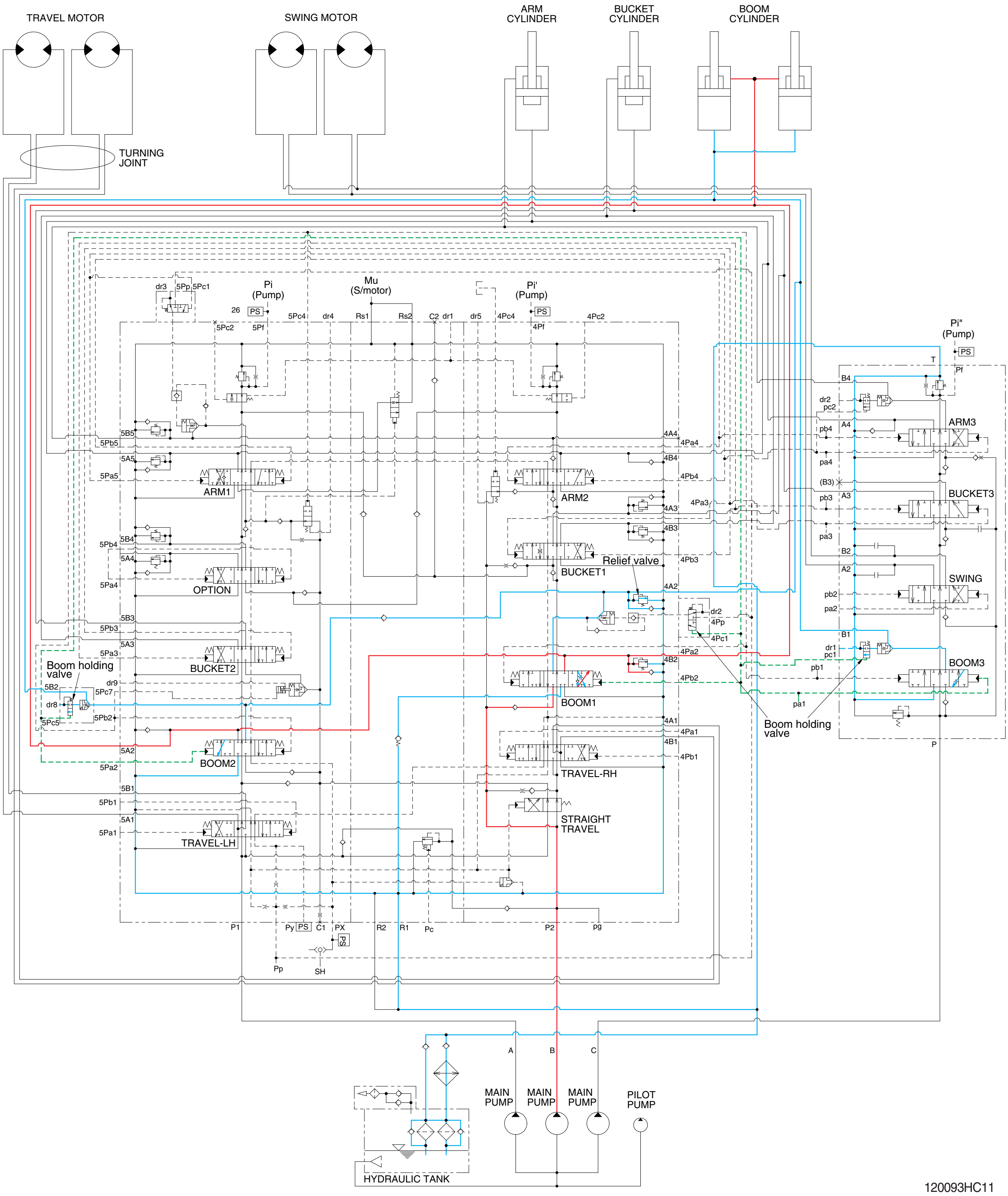
The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve.

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.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. BOOM DOWN OPERATION



When the RH control lever is pushed forward, the boom 1 spools in the main control valve are moved to the down position by the pilot oil pressure from the remote control valve.

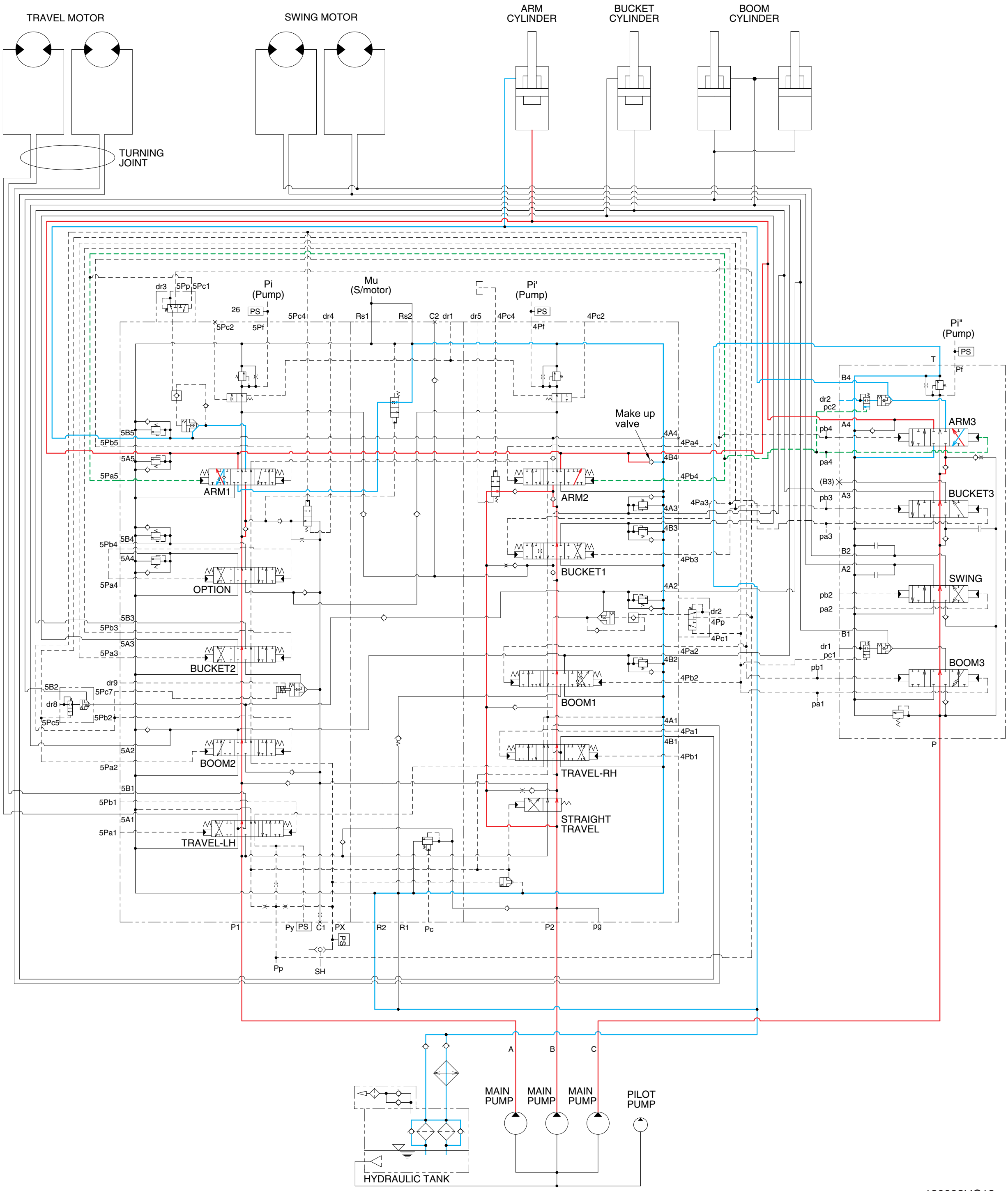
The oil from the B pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom spools in the main control valves.

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

This prevents cylinder cavitation by the negative pressure when the B 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.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. ARM IN OPERATION

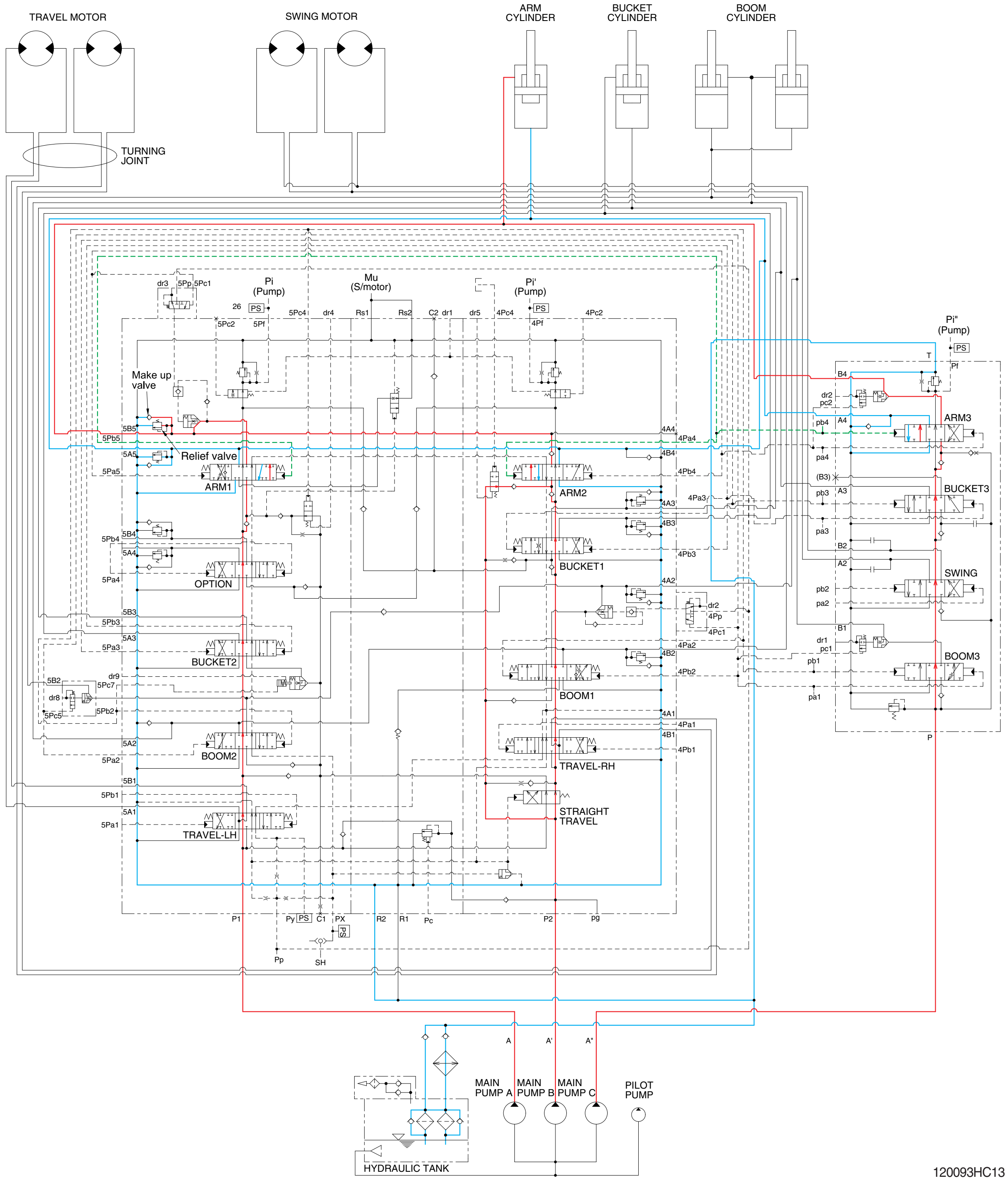


120093HC12

When the LH control lever is pulled back, the arm spools in the main control valve are moved the to roll in position by the pilot oil pressure from the remote control valve.
The oil from the A, B and C pump flows into the main control valve and then goes to the large chamber of arm cylinder.
At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm spool in the main control valve. When this happens, the arm rolls in.
The excessive pressure in the arm cylinder head side is prevented by relief valve.
The cavitation which will happen to the head side of the arm cylinder is also prevented by the make-up valve in the main control valve.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4. ARM OUT OPERATION



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 A, B and C 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 spools in the main control valve. When this happens, the arm rolls out.

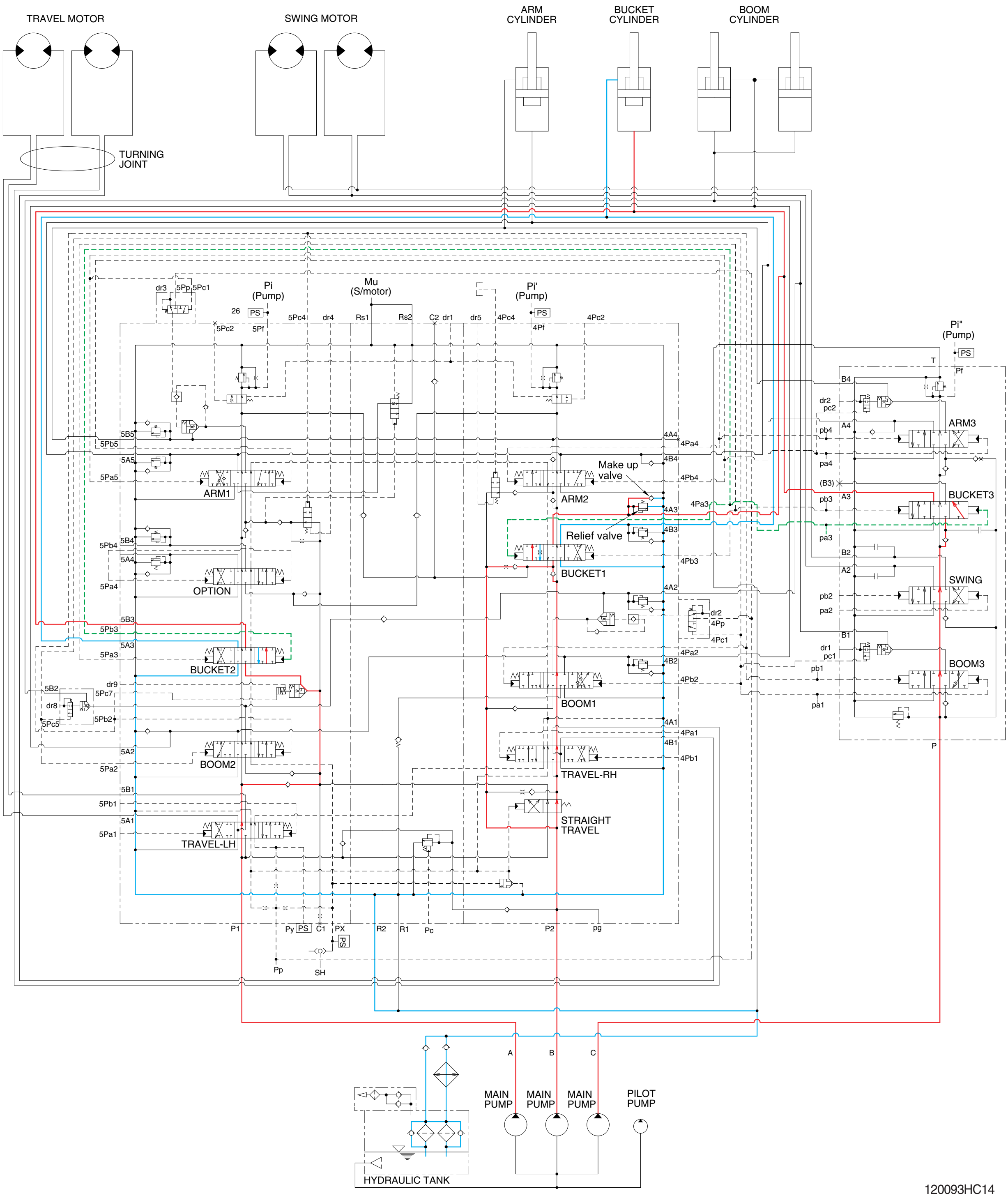
The excessive pressure in the arm cylinder rod side is prevented by relief valve.

When the arm is roll out and the control lever is returned to neutral position, the circuit for the holding pressure at the rod side of the arm cylinder is closed by the arm holding valve.

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

5. BUCKET IN OPERATION



120093HC14

When the RH control lever is pulled left, the bucket 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 A, B and C pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

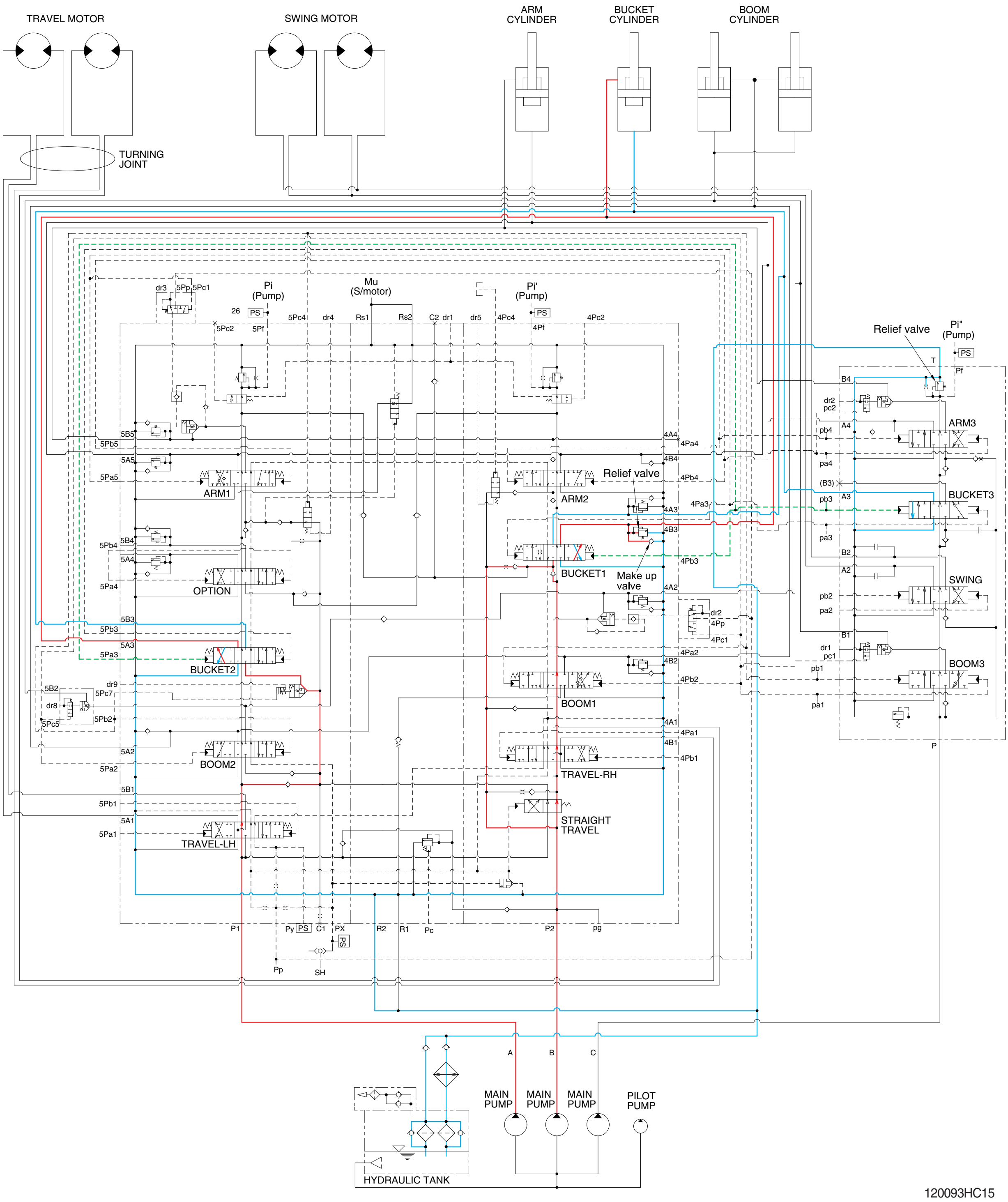
At the same time, the oil from the small chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spools in the main control valve. When this happens, the bucket rolls in.

The excessive pressure in the bucket cylinder head side is prevented by relief valve.

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

6. BUCKET OUT OPERATION



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

The oil from the A and B pumps flow into the main control valve and then goes to the small chamber of bucket cylinder.

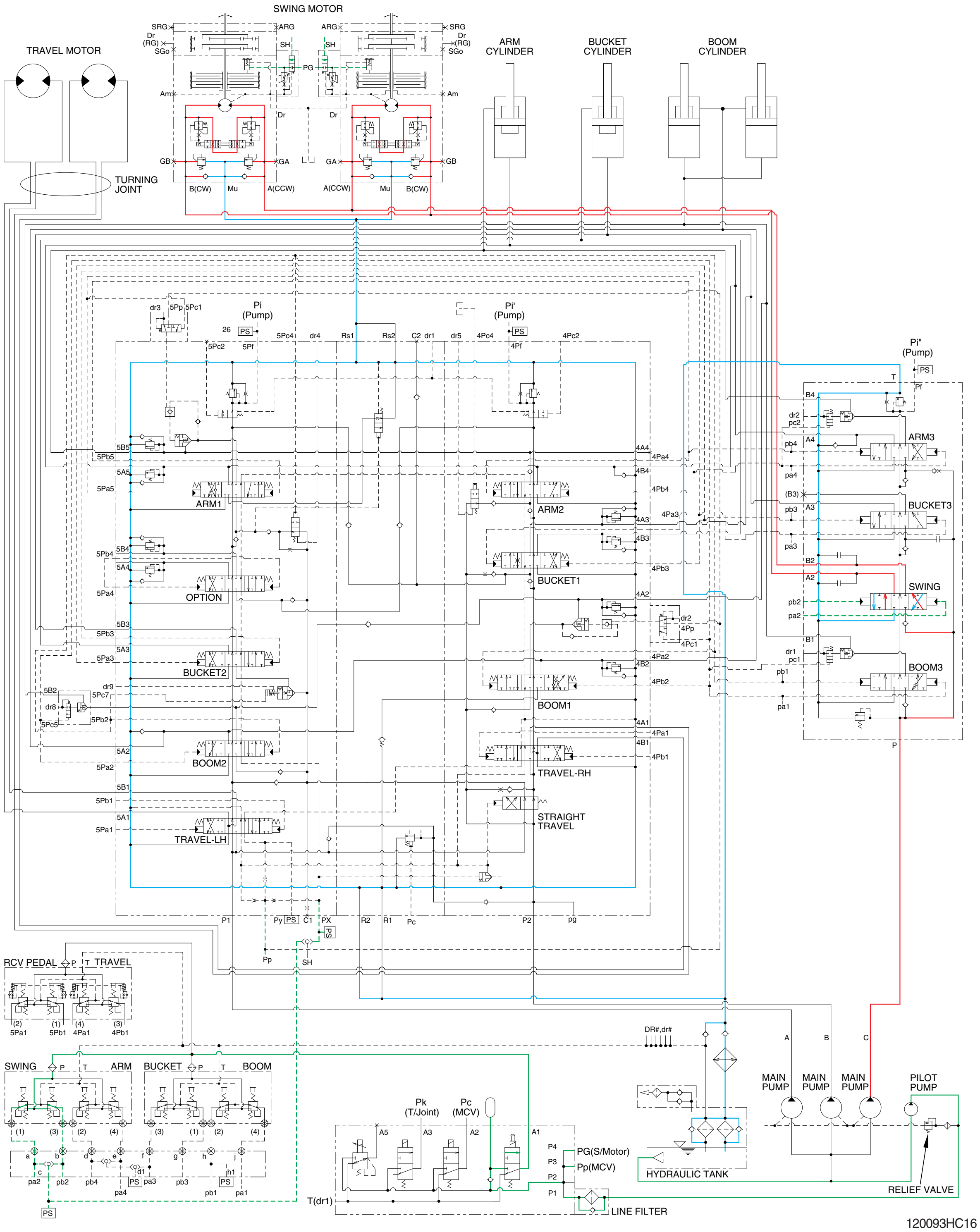
At the same time, the oil from the large chamber of bucket cylinder returns to the hydraulic oil tank through the bucket spools in the main control valve. When this happens, the bucket rolls out.

The excessive pressure in the bucket cylinder rod side is prevented by relief valve.

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

7. SWING OPERATION



120093HC16

When the LH control lever is pushed left or right, the swing spool in the main control valve 2 is moved to the left or right swing position by the pilot oil pressure from the remote control valve.

The oil from the C pump flows into the main control valve 2 and then goes to the swing motor.

At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve.

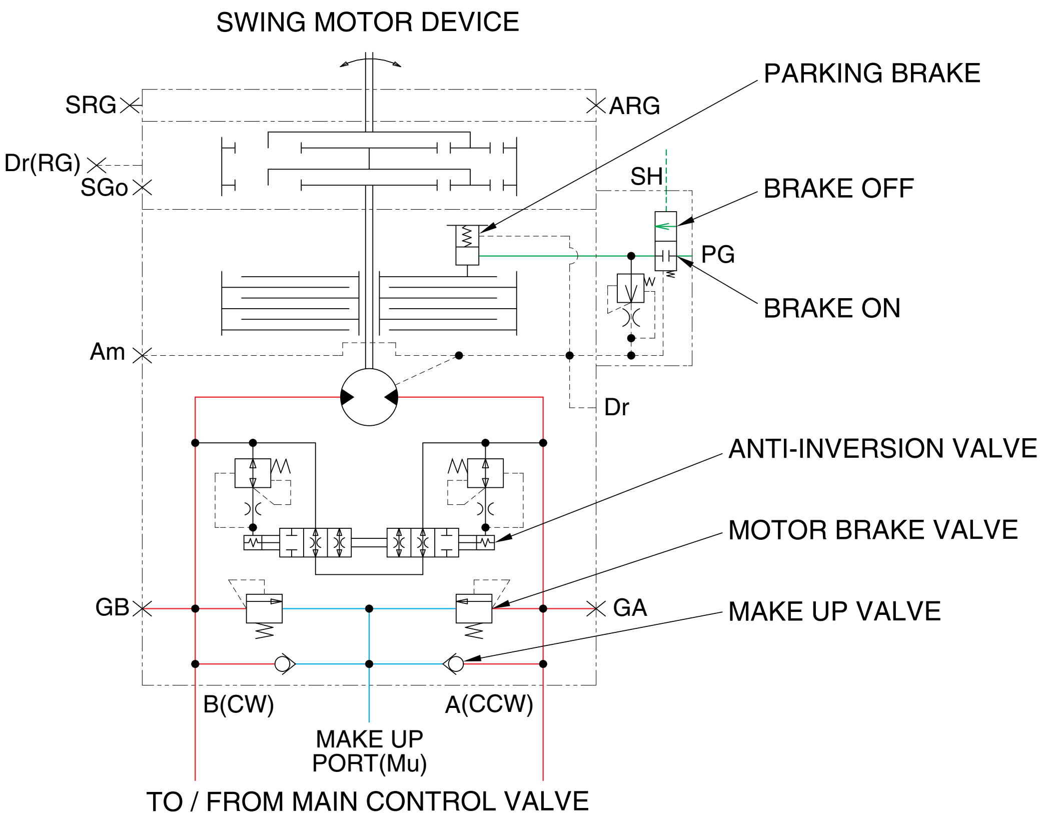
When this happens, the upper structure swings to the left or right.

The swing parking brake, make up valve and the motor brake valve are provided in the swing motor.

The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

※ The circuit diagram may differ from the equipment, so please check before a repair.

SWING CIRCUIT OPERATION



120093HC17

1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

3) PARKING BRAKE

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

PARKING BRAKE "OFF" OPERATION

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

PARKING BRAKE "ON" OPERATION

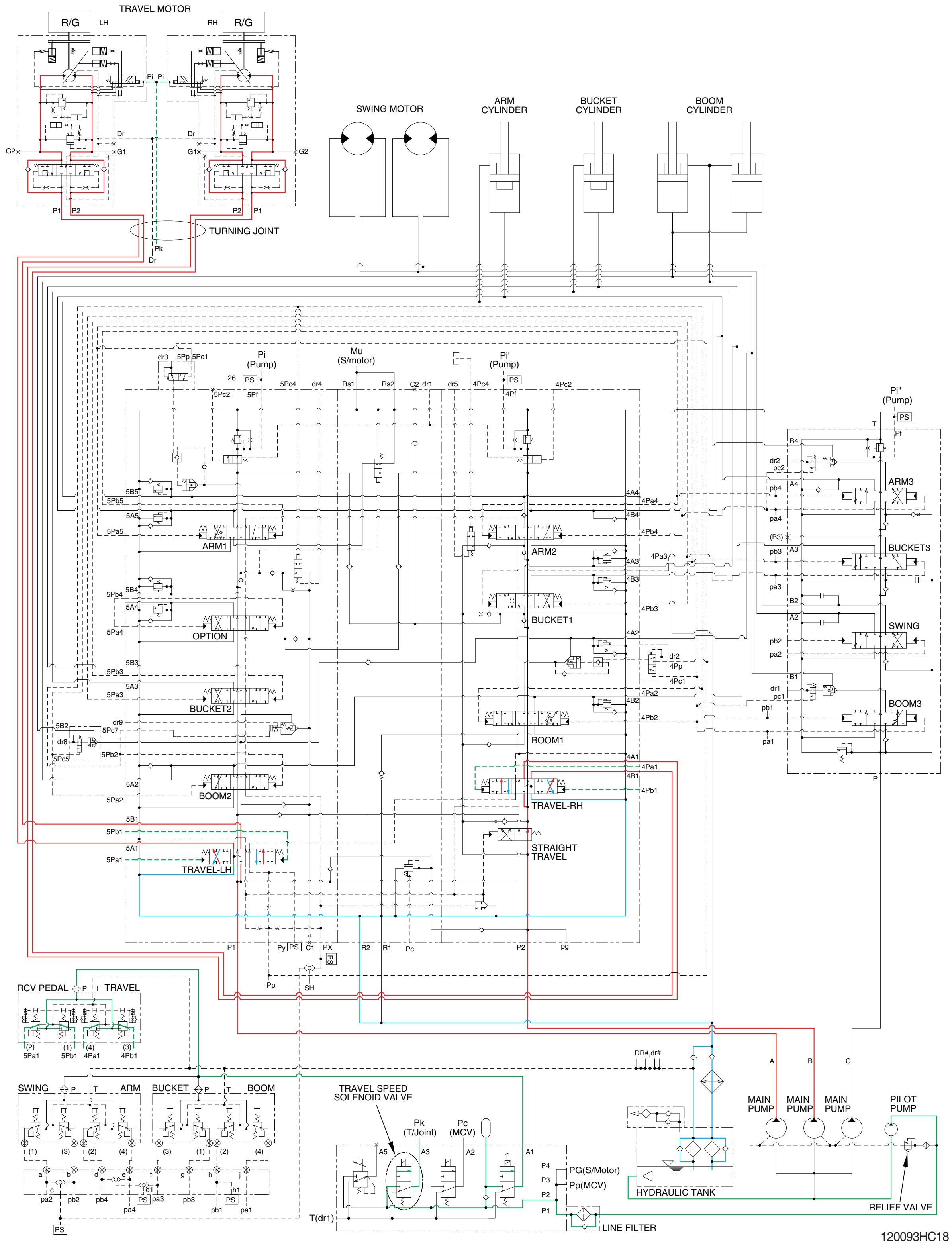
When all of the RCV lever placed in the neutral position, the pressure of the pilot oil passage down. Then the brake release valve returned to the neutral position and the oil is returned from the brake piston to the tank. And the brake is set to 'ON".

4) ANTI-INVERSION VALVE

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

8. TRAVEL FORWARD AND REVERSE OPERATION



120093HC18

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

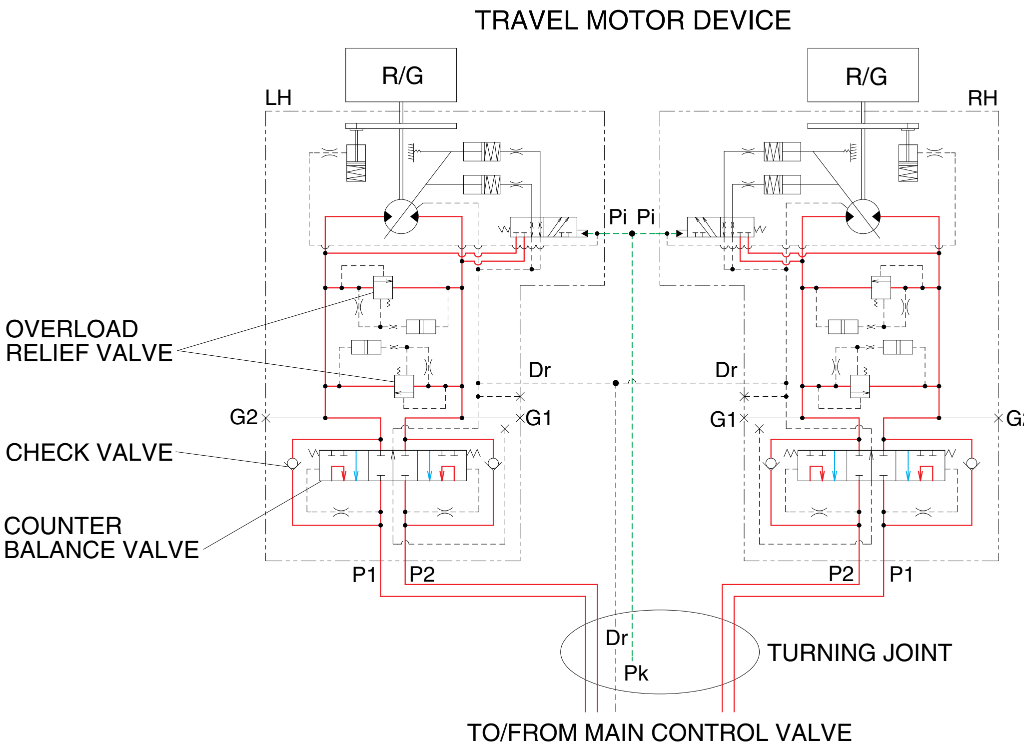
The oil from the A and B pump flows into the main control valve and then goes to the each travel motor through the turning joint.

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

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

TRAVEL CIRCUIT OPERATION



120093HC19

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

1) CHECK VALVE
   Stopping the motor, this valve sucks the oil from lower pressure passage for prevention the negative pressure and the cavitation of the motor.

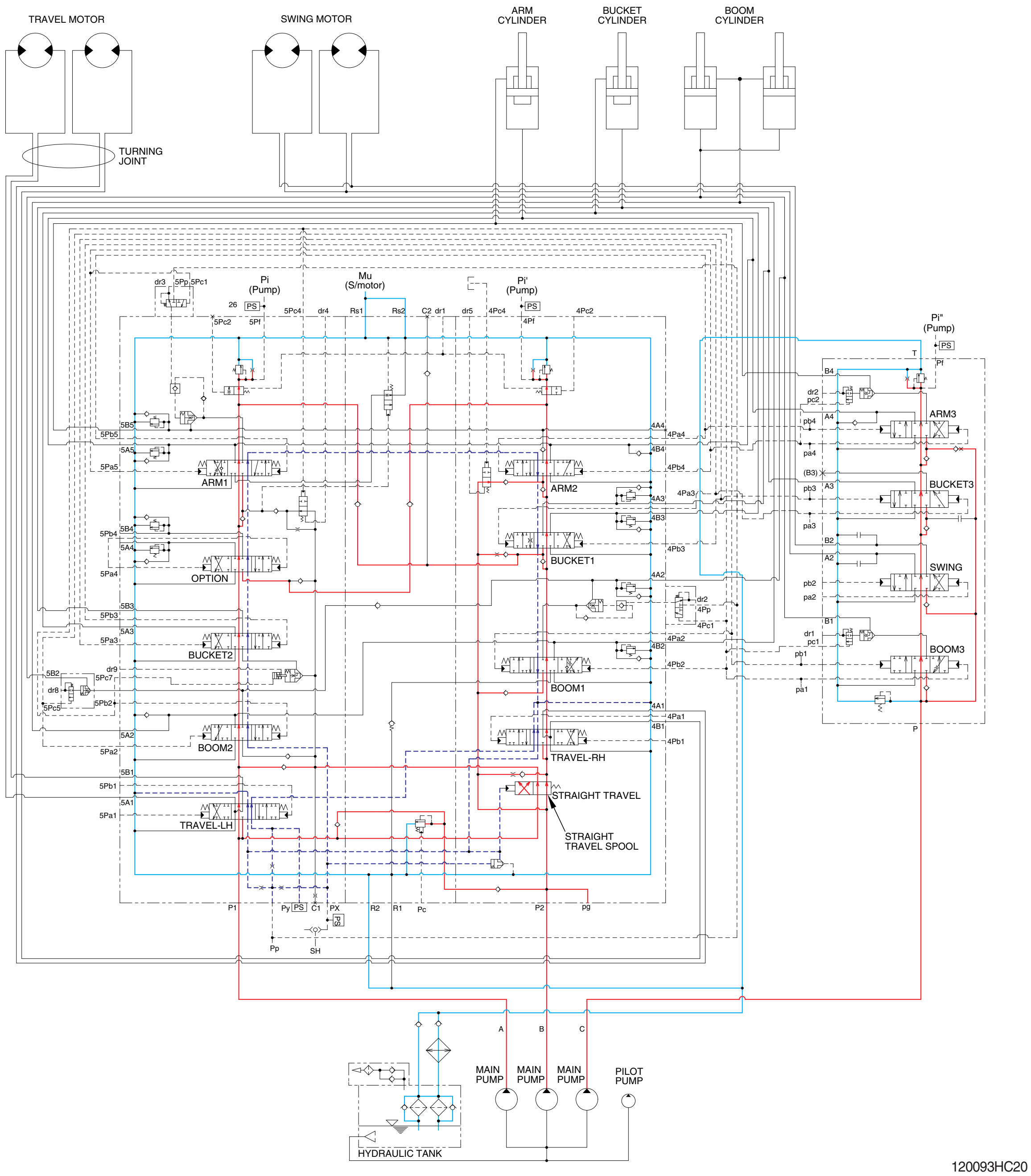
2) COUNTER BALANCE VALVE
   When stopping the motor of slope descending, this valve to prevent the motor over run.

3) OVERLOAD RELIEF VALVE
   Relief valve limit the circuit pressure below 345 kgf/cm^2 to prevent high pressure generated at a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

※ The circuit diagram may differ from the equipment, so please check before a repair.

GROUP 5 COMBINED OPERATION

1. OUTLINE



120093HC20

The oil from the A, B and C 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

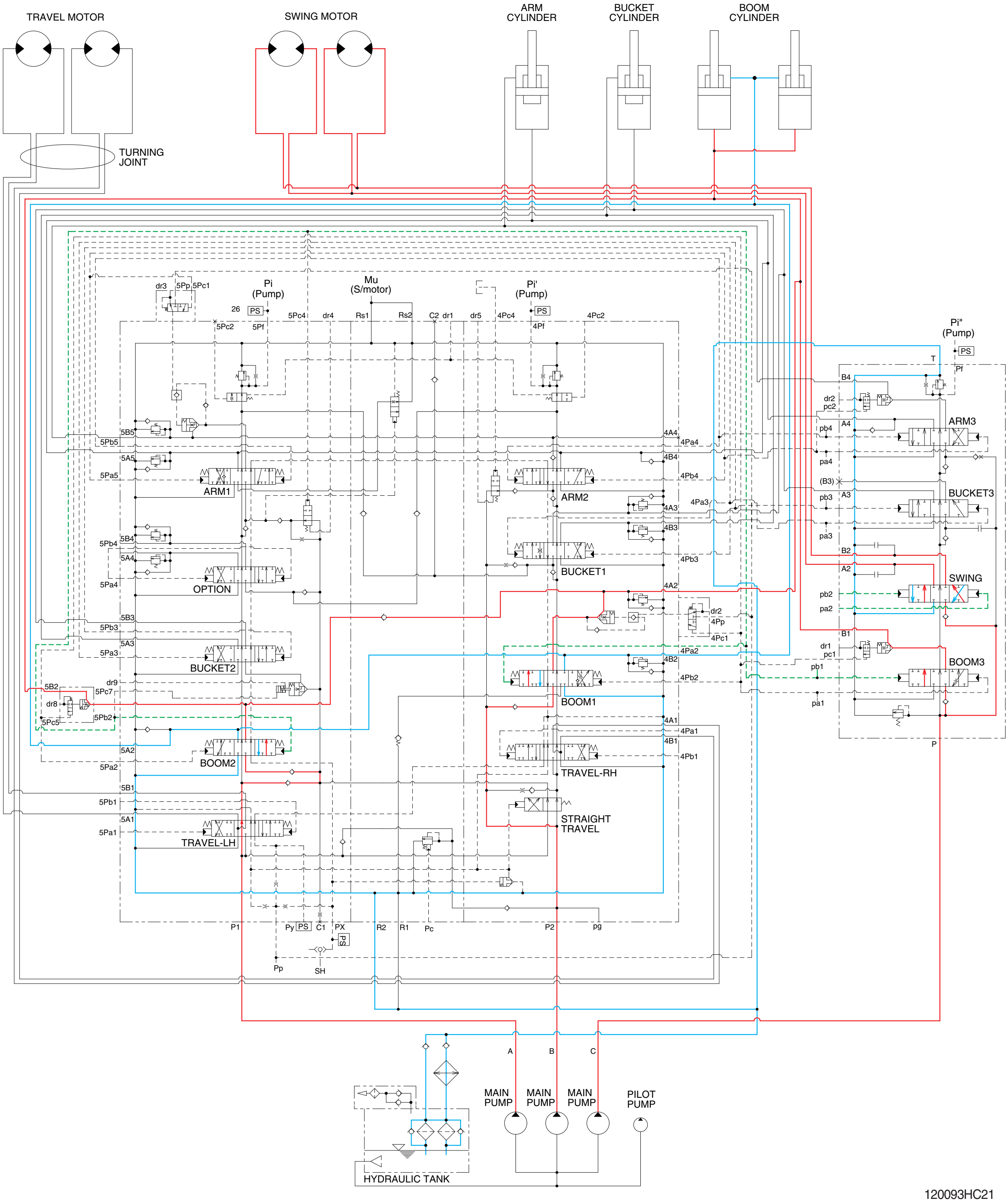
This straight travel spool is provided in the main control valve.

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.

※ The circuit diagram may differ from the equipment, so please check before a repair.

2. COMBINED SWING AND BOOM UP OPERATION



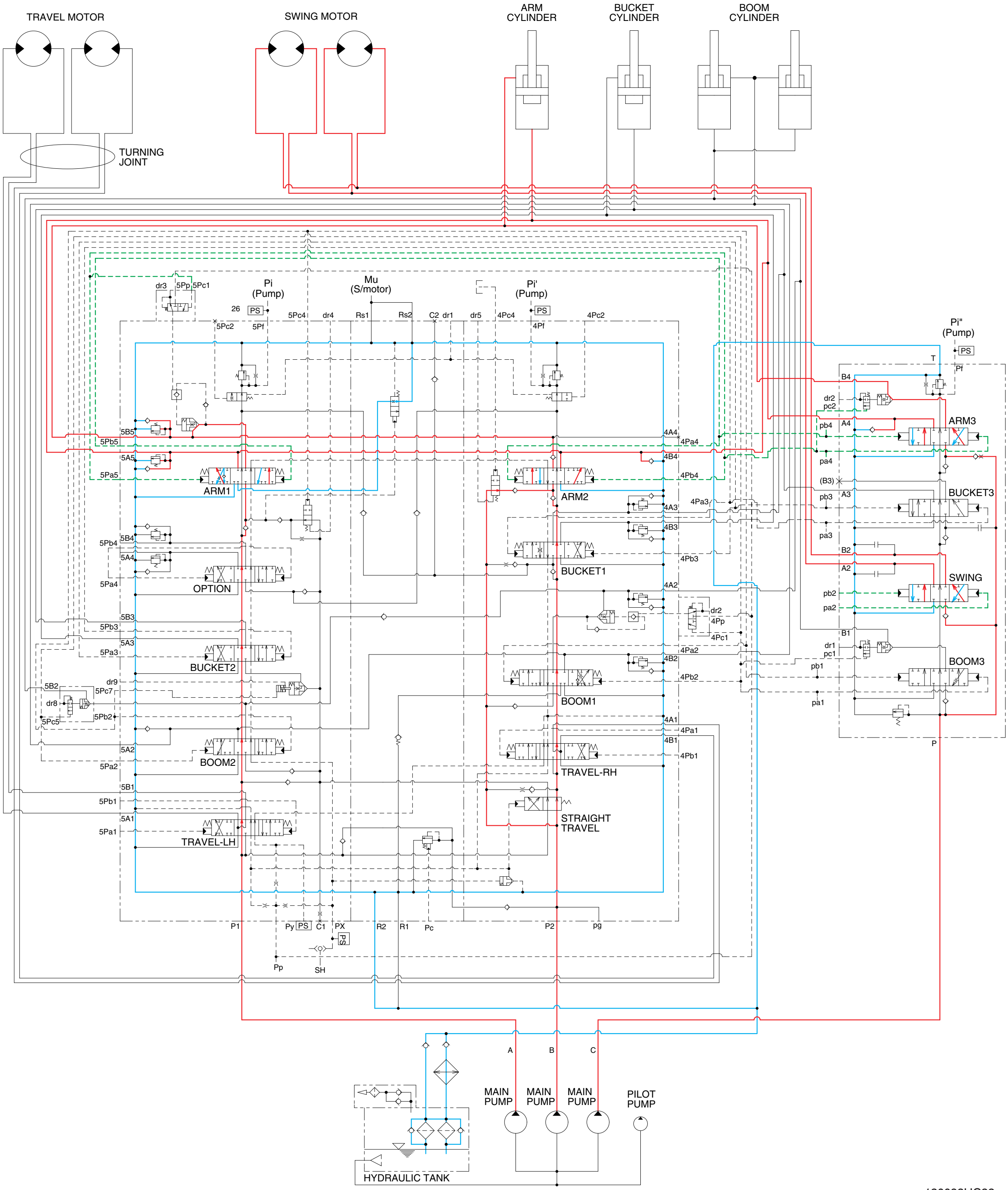
When the swing and boom up functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the C pump flows into the swing motor through swing spool and the boom cylinder through boom 3 spool.

The oil from the A and B pump flows into the boom cylinders through the boom 1 and 2 spools in the control valve. The upper structure swings and the boom are operated.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3. COMBINED SWING AND ARM OPERATION



120093HC22

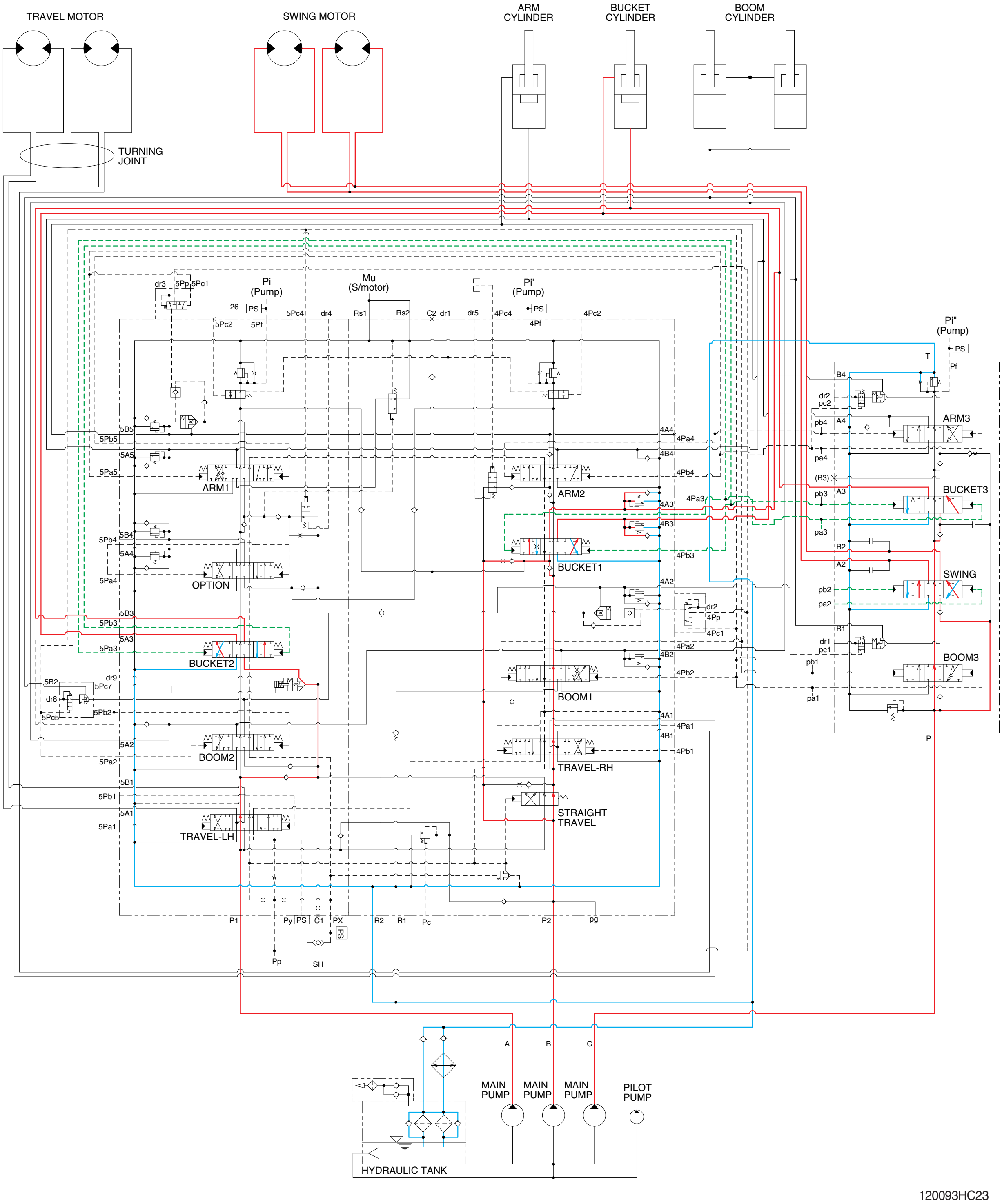
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the C pump flows into the swing motor through swing spool and the arm cylinder through arm 3 spool.

The oil from the A and B pump flows into the arm cylinder through the arm 1 and 2 spools of the control valve. The upper structure swings and the arm is operated.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4. COMBINED SWING AND BUCKET OPERATION



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

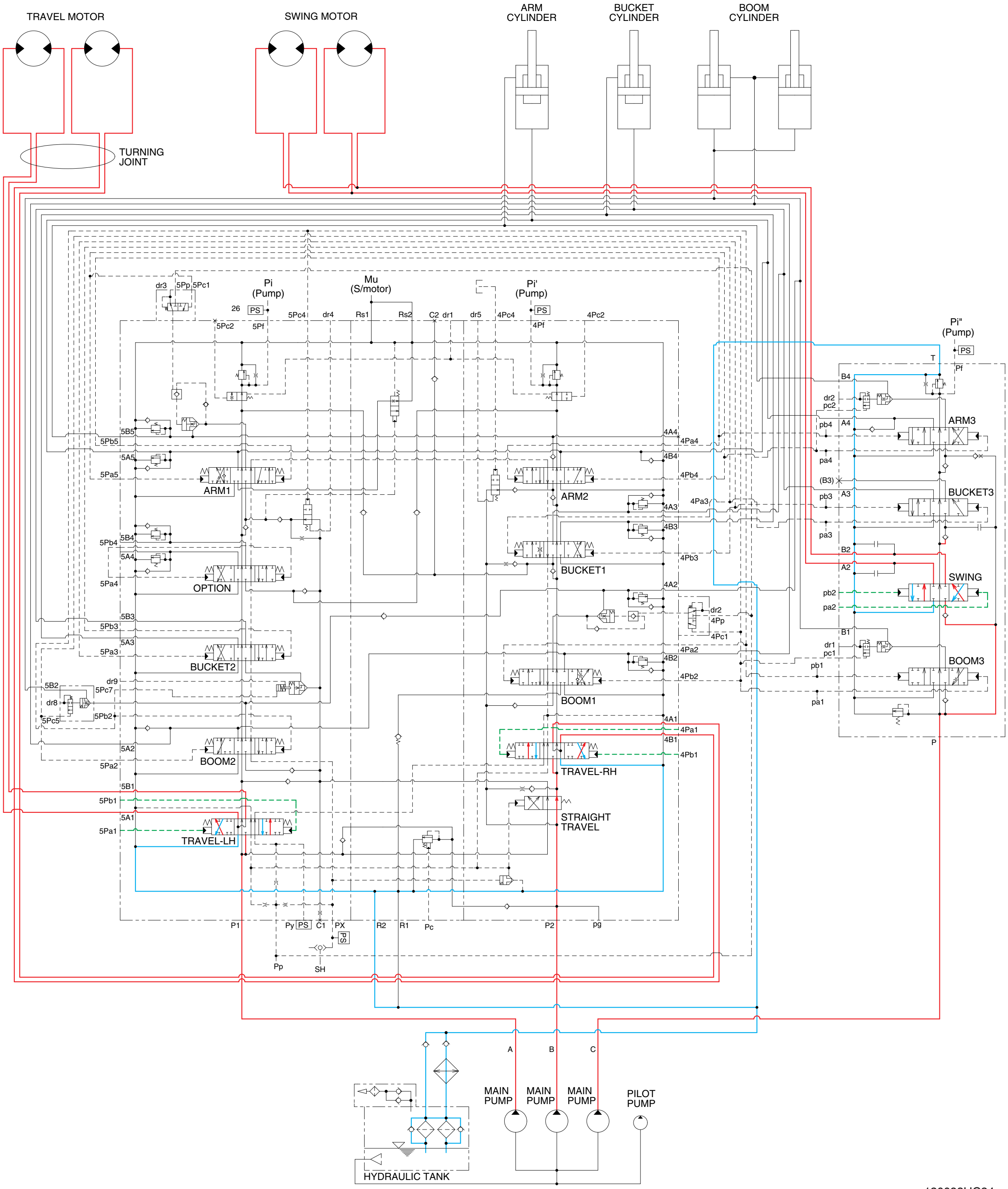
The oil from the C pump flows into the swing motors through the swing spool in the control valve 2.

The oil from the A and B pump flows into the bucket cylinder through the bucket spools in the control valve 1.

The upper structure swings and the bucket is operated.

※ The circuit diagram may differ from the equipment, so please check before a repair.

5. COMBINED SWING AND TRAVEL OPERATION



120093HC24

When the swing and travel functions are operated, simultaneously the swing spool and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and straight travel spool remained its position because the pilot oil pressure from the pilot pump is not applied to the straight travel spool.

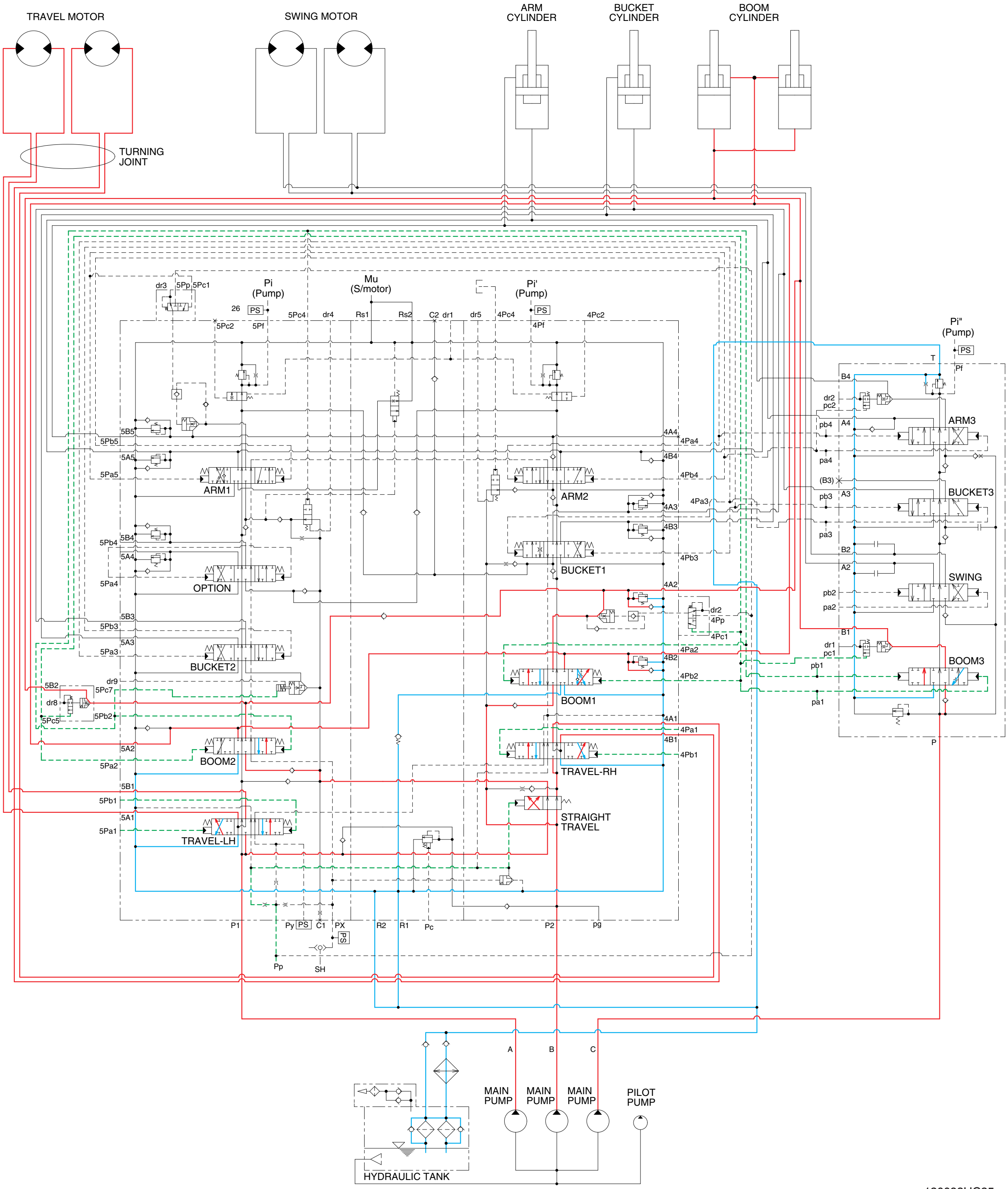
The oil from the A pump flows into the LH travel motor through the LH travel spool of the left control valve and the oil from the B pump flows into the RH travel motor through the RH travel spool of the right control valve.

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

The upper structure swings and the machine travels.

※ The circuit diagram may differ from the equipment, so please check before a repair.

6. COMBINED BOOM AND TRAVEL OPERATION



120093HC25

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

The oil from the A pump flows into the travel motors through the LH travel spool of the left control valve and the RH travel spool of the right control valve via the straight travel spool.

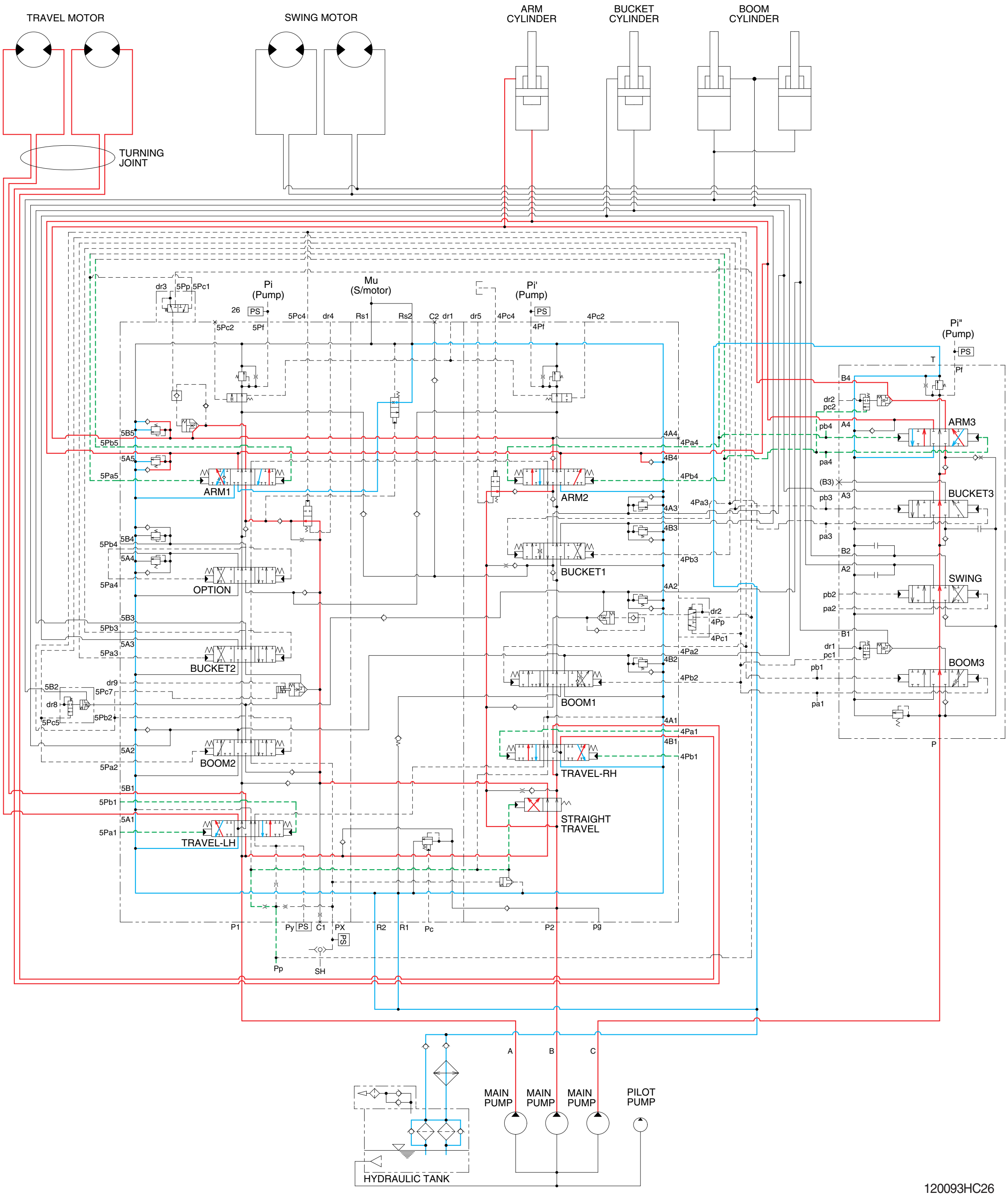
The oil from the B pump flows into the boom cylinders through the boom 1 and boom 2 spools via the parallel passage and the straight travel spool.

Also, the oil from the C pump flows into the boom cylinders through the boom 3 spool spool via confluence oil passage in case boom up operation.

The boom is operated and the machine travels straight.

※ The circuit diagram may differ from the equipment, so please check before a repair.

7. COMBINED ARM AND TRAVEL OPERATION



120093HC26

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

The oil from the A pump flows into the travel motors through the LH travel spool of the left control valve and the RH travel spool of the right control valve via the straight travel spool.

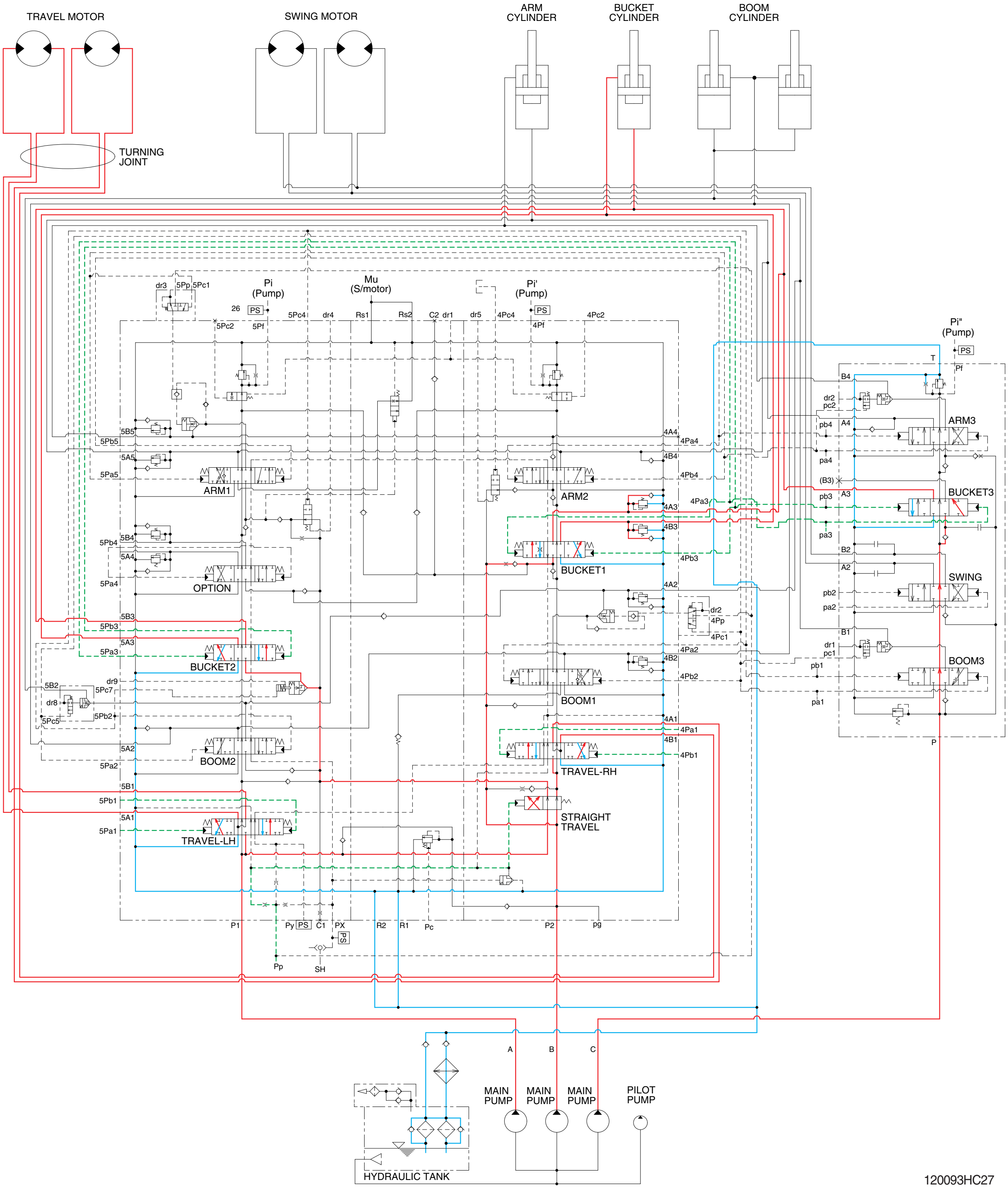
The oil from the B pump flows into the arm cylinders through the arm 2 and arm 1 spools via the parallel passage and the straight travel spool.

Also, the oil from the C pump flows into the arm cylinders through the arm 3 spool via confluence oil passage.

The arm is operated and the machine travels straight.

※ The circuit diagram may differ from the equipment, so please check before a repair.

8. COMBINED BUCKET AND TRAVEL OPERATION



120093HC27

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

The oil from the B pump flows into the bucket cylinders through the bucket 1 and bucket 2 spools via the parallel passage and the straight travel spool.

Also, the oil from the C pump flows into the bucket cylinder through the bucket 3 spool via the confluence oil passage in case the bucket in operation.

The bucket is operated and the machine travels straight.

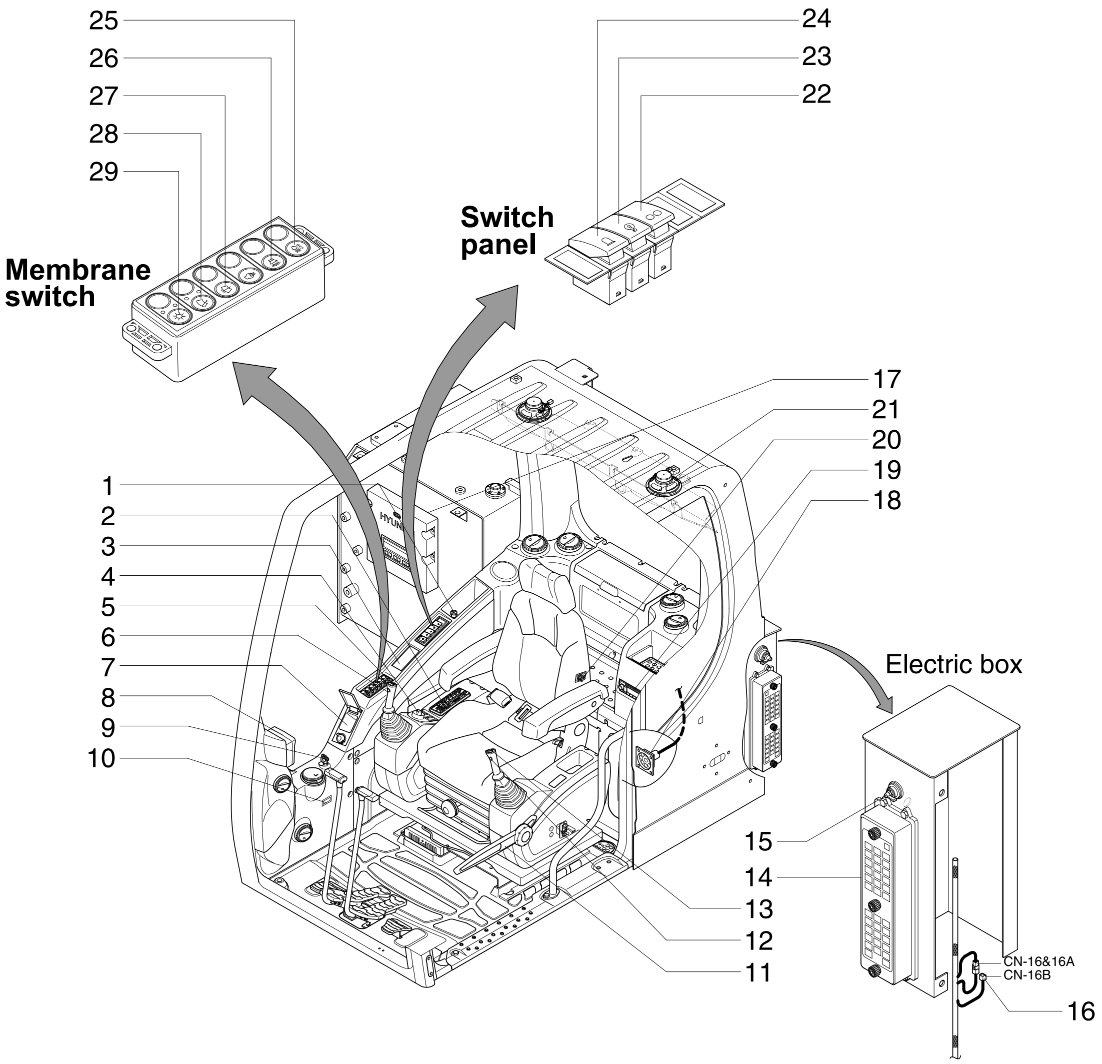
※ The circuit diagram may differ from the equipment, so please check before a repair.

SECTION 4 ELECTRICAL SYSTEM

SECTION 4 ELECTRICAL SYSTEM

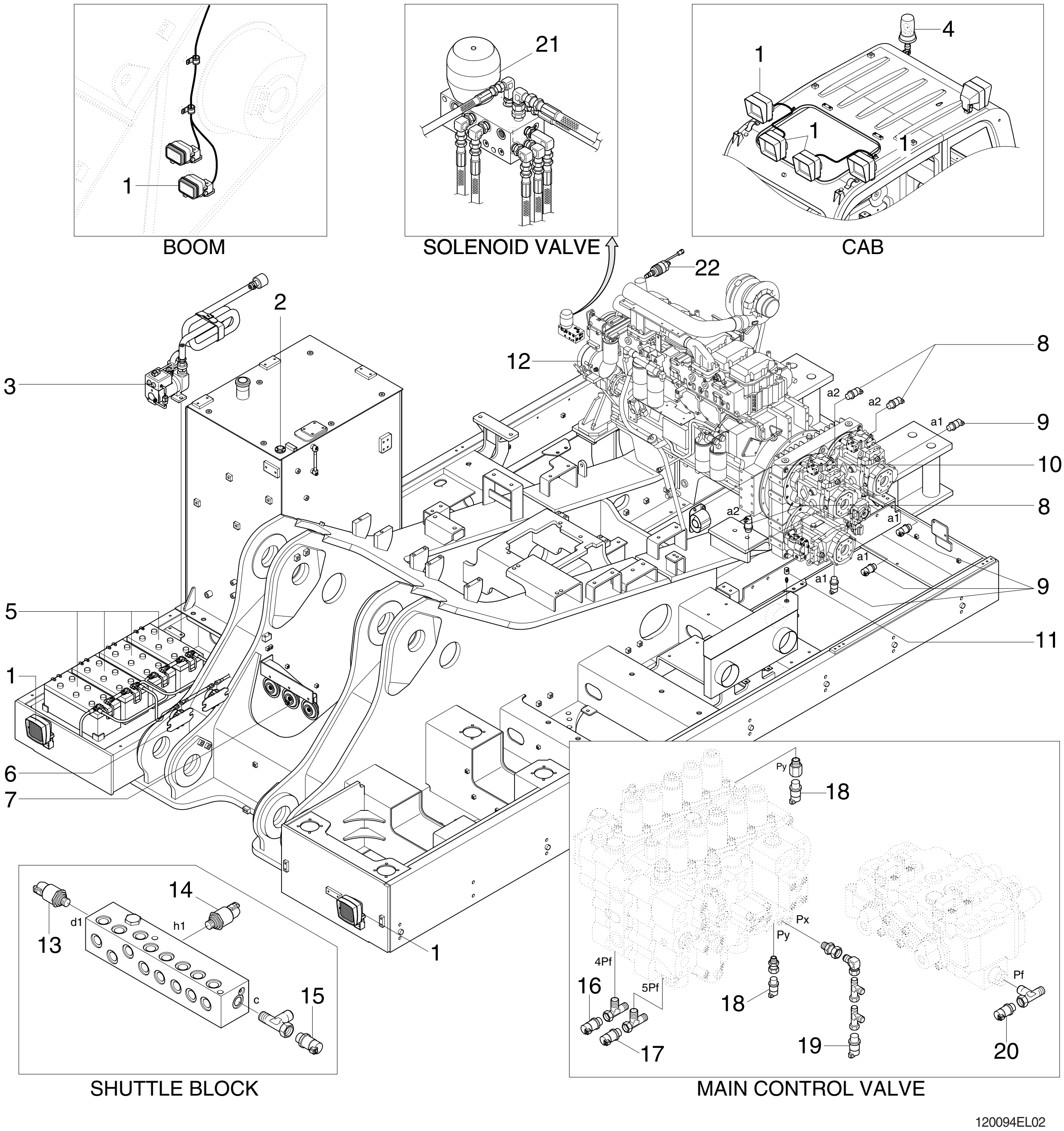
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1	Cigar light	11	Safety lever	21	Speaker
2	Aircon & heater switch panel	12	Power max switch	22	Central grease lubrication switch
3	Remote controller	13	One touch decel switch	23	Overload switch
4	Accel dial switch	14	Fuse box	24	Beacon switch
5	Horn switch	15	Master switch	25	Cab light switch
6	Breaker operation sw (null)	16	Emergency engine connector	26	Travel alarm switch
7	Handsfree	17	MCU	27	Washer switch
8	Cluster	18	RS232 & J1939 service socket	28	Wiper switch
9	Starting switch	19	Radio & USB player	29	Main light switch
10	Service meter	20	Heated seat switch		

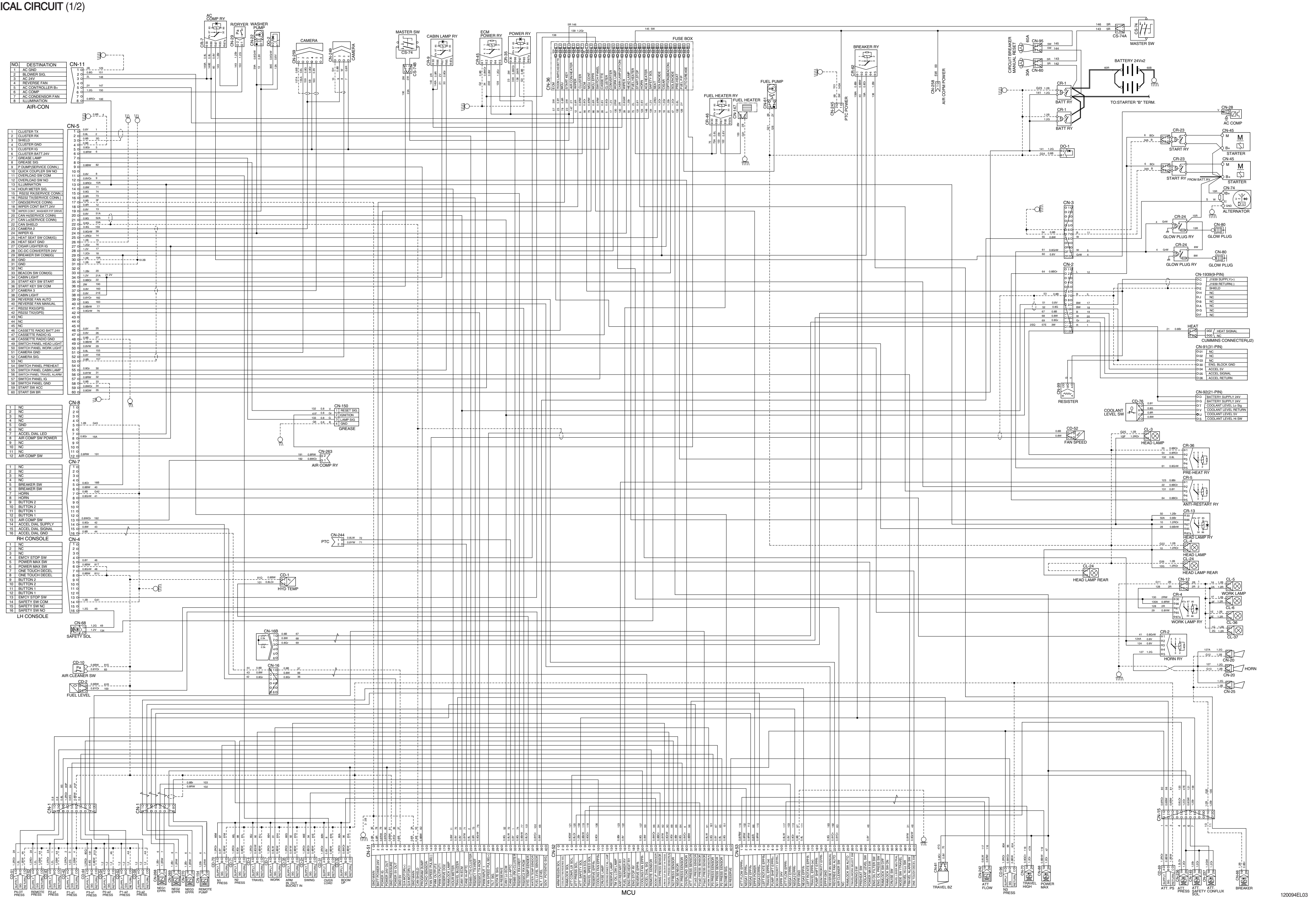
2. LOCATION 2



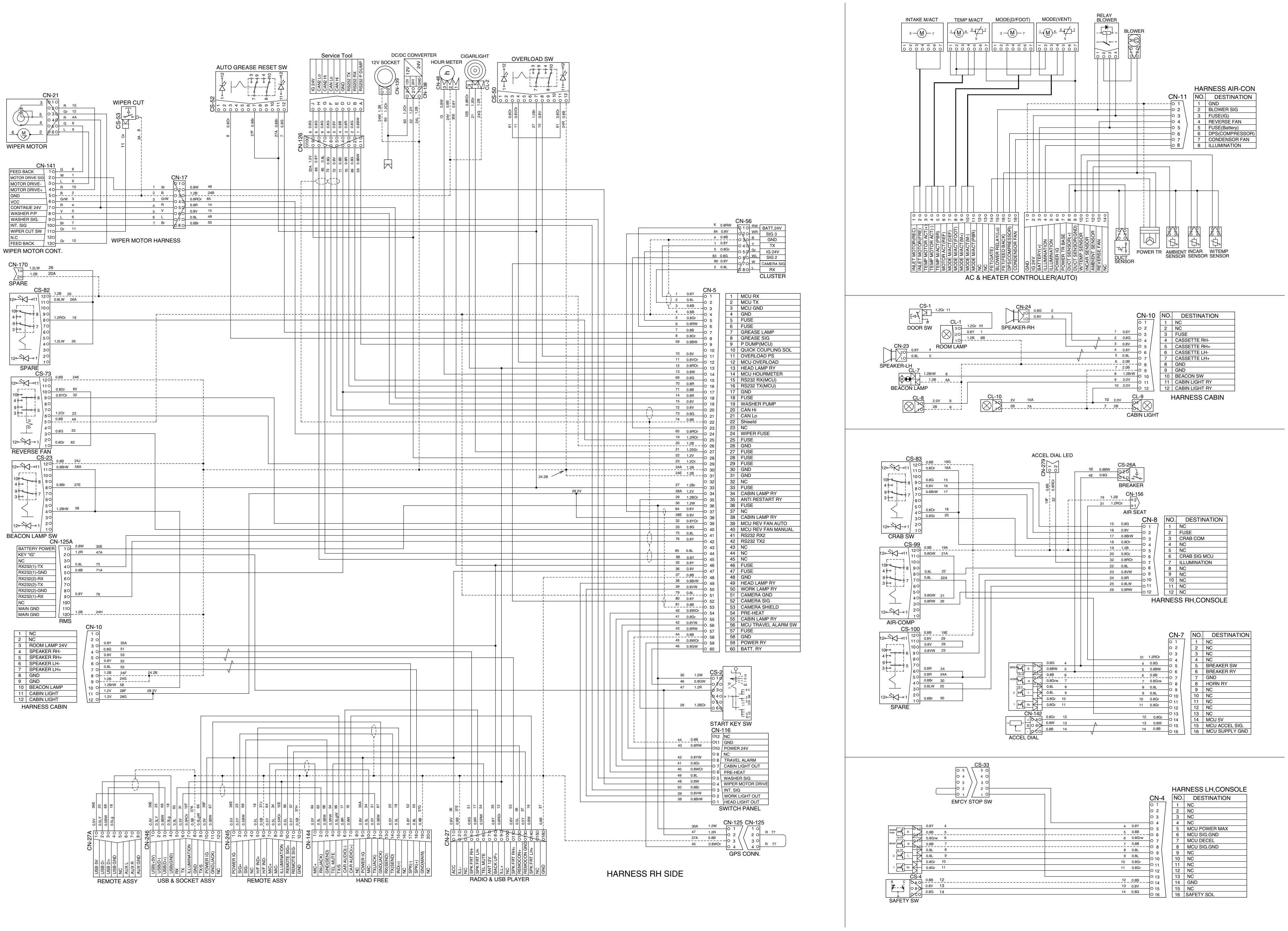
1	Lamp	9	EPPR pressure sensor	16	Nega control 1 pressure sensor
2	Fuel sender	10	Travel alarm buzzer	17	Nega control 2 pressure sensor
3	Fuel filler pump	11	Air cleaner switch	18	Attach pressure sensor
4	Beacon lamp	12	Alternator	19	Travel pressure sensor
5	Battery	13	Arm / bucket in pressure sensor	20	Nega control pressure sensor
6	Battery relay	14	Boom up pressure sensor	21	Solenoid valve
7	Horn	15	Swing pressure sensor	22	Pump EPPR valve
8	P1, P2 pressure sensor				

GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/2)



· **ELECTRICAL CIRCUIT** (2/2)



120094EL04

MEMORANDUM

1. POWER CIRCUIT

The negative terminal of battery is grounded to the machine chassis through master switch.
When the start switch is in the OFF position, the current flows from the positive battery terminal as shown below.

1) OPERATING FLOW

Battery → Battery relay → Circuit breaker [CN-60] → Master switch [CS-74A]

- → Fuse box [No.1] → I/conn [CN-2 (14)] → Engine ECM [CN -92]
- → Fuse box [No.2] → I/conn [CN-5 (46)]
  - → I/conn [CN -10 (3)] → Room lamp [CL-1 (2)]
    - → Door switch [CS-1]
  - → Radio & USB player [CN-27 (8)]
  - → Hour meter [CN-48 (1)]
- → Fuse box [No.3] → MCU [CN-51 (2)]
- → Fuse box [No.4]
  - → Master switch [CS-74B] → I/conn [CN-5 (36)]
    - → Start switch [CS-2 (1)]
    - → RMS controller [CN-125A(1)]
    - → GPS connection [CN-125 (1)]
  - → Power relay [CR-35 (30)]
  - → ECM power relay [CR-45 (3)]
- → Fuse box [No.5] → I/conn [CN-11 (5)]
  - → AC & Heater controller (3)
  - → Blower relay (3)
- → Fuse box [No.6] → I/conn [CN - 5 (18)] → I/conn [CN -17 (5)]
  - → Wiper motor controller [CN-141 (7)]
  - → Wiper motor [CN-21 (4)]
- → Fuse box [No.7] → I/conn [CN - 5 (6)] → Cluster [CN -56 (1)]

※ I/conn : Intermediate connector

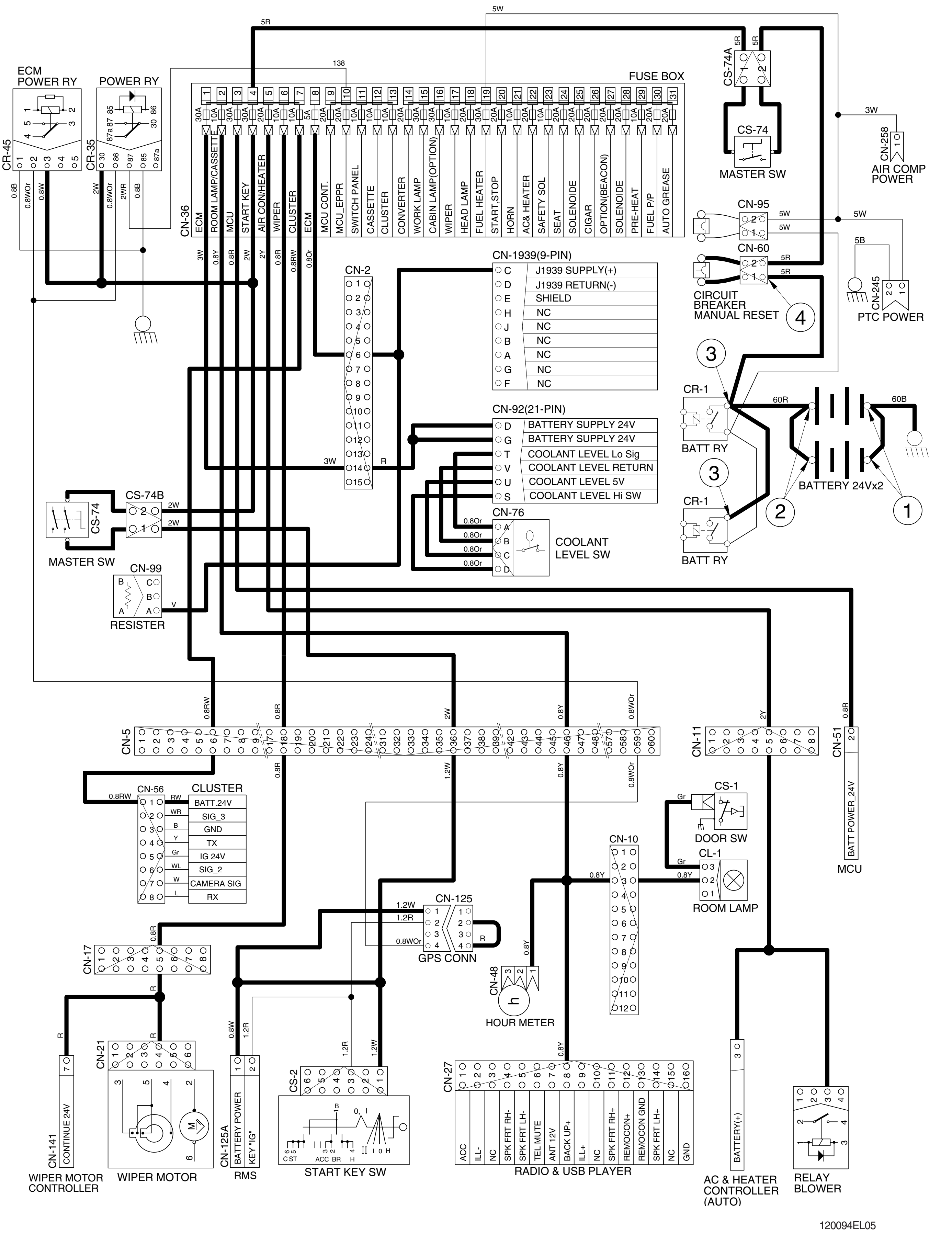
2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	OFF	① - GND (battery)	10~12.5V
		② - GND (battery)	20~25V
		③ - GND (battery relay)	20~25V
		④ - GND (circuit breaker)	20~25V

※ GND : Ground

※ The circuit diagram may differ from the equipment, so please check before a repair.

POWER CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Battery relay [CR-1] → Circuit breaker [CN-60] → Master switch [CS-74A] → Fuse box [No.4] → Master switch [CS-74B] → I/conn [CN-5(36)] → Start switch [CS-2(1)]

(1) When start key switch is in ON position

→ Start switch ON [CS-2 (2)] → I/conn [CN-5 (60)] → Battery relay [CR-1]
→ Battery relay operating (all power is supplied with the electric component)
→ Start switch ON [CS-2 (3)] → GPS conn [CN-125 (2) → (4)] → I/conn [CN-5 (59)]
→ Power relay [CR-35 (86) → (87)] → Fuse box [No.10]
→ ECM power relay [CR-45 (2) → (5)] → I/conn [CN-4 (4)] →
Emergency stop switch [CS-33 (2) → (1)] → I/conn [CN-4 (13)] → Fuse box [No.8]

(2) When start key switch is in START position

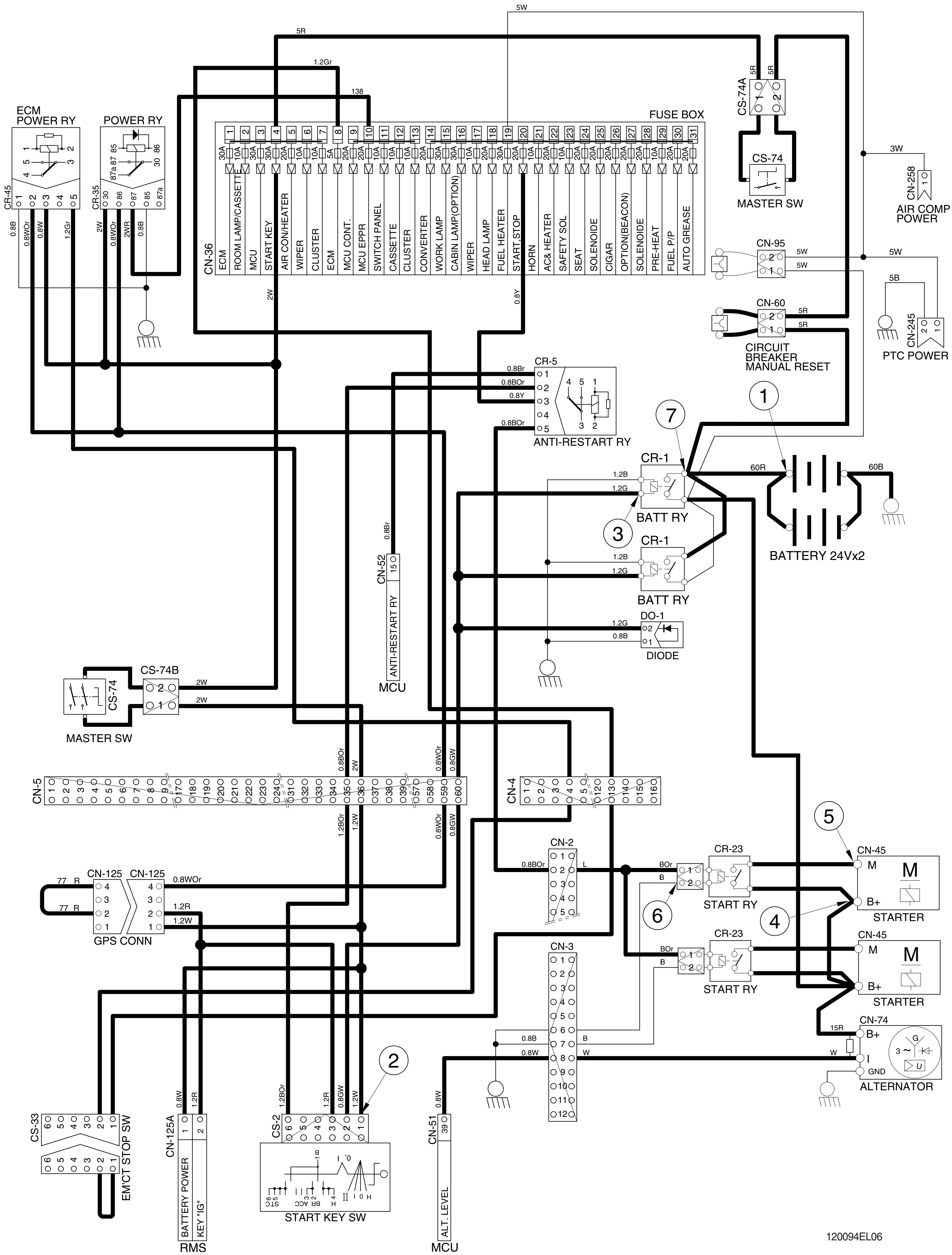
Start switch START [CS-2 (6)] → I/conn [CN-5 (35)] → Anti-restart relay [CR-5 (2) → (5)] → I/conn [CN-2 (2)] → Start relay [CR-23]

2) CHECK POINT

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

※ The circuit diagram may differ from the equipment, so please check before a repair.

STARTING CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

Alternator "I" terminal → I/conn [CN-3 (10)] → MCU alternator level [CN-51 (39)]
→ Cluster charging warning lamp(Via serial interface)

(2) Charging flow

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

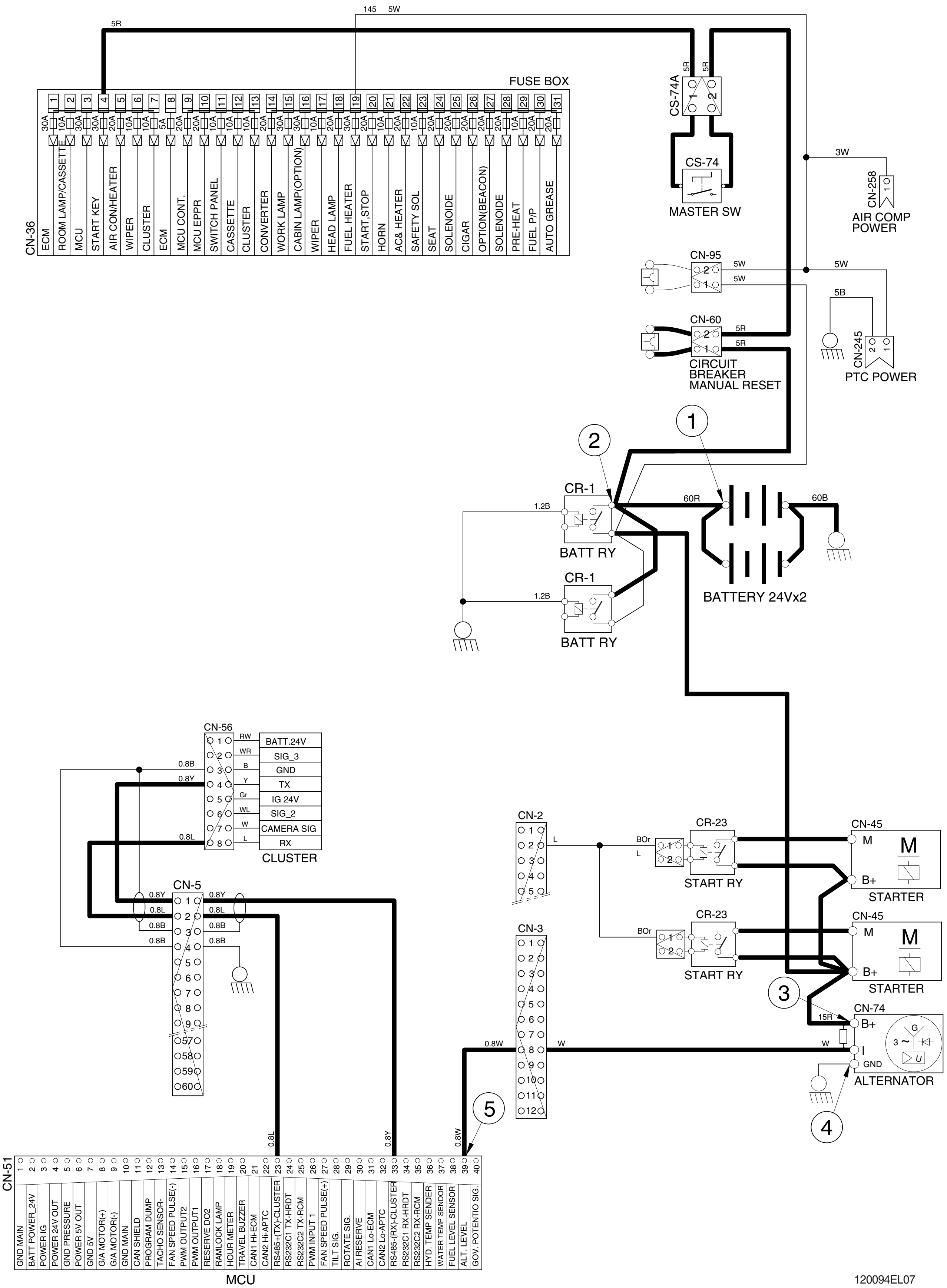
2) CHECK POINT

Engine	Start switch	Check point	Voltage
RUN	ON	① - GND (battery voltage) ② - GND (battery relay) ③ - GND (alternator B^+ terminal) ④ - GND (alternator I terminal) ⑤ - GND (MCU)	20~25V

※ GND : Ground

※ The circuit diagram may differ from the equipment, so please check before a repair.

CHARGING CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

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

(1) Head light switch ON

Head light switch ON [CN-116 (1)] → I/conn [CN-5 (49)] → Head light relay [CR-13 (85) → (87)]
- → Head light ON [CL-3 (2), CL-4 (2), CL-23 (2), CL-24 (2)]
- → I/conn [CN-11 (8)] → AC & Heater controller illumination ON [4]
- → I/conn [CN-5 (13)]
  - → Remote controller illumination ON [CN-245 (9)]
  - → Cigar light [CL-2]
  - → USB & Socket illumination ON [CN-246 (7)]
  - → Radio & USB player illumination ON [CN-27 (9)]
- → I/conn [CN-8 (7)] → Accel dial LED [CN-279]

(2) Work light switch ON

Work light switch ON [CN-116 (2)] → I/conn [CN-5 (50)] → Work light relay [CR-4 (85) → (87)]
→ I/conn [CN-12 (2)] → Work light ON [CL-5 (2), CL-6 (2), CL-36 (2), CL-37 (2)]

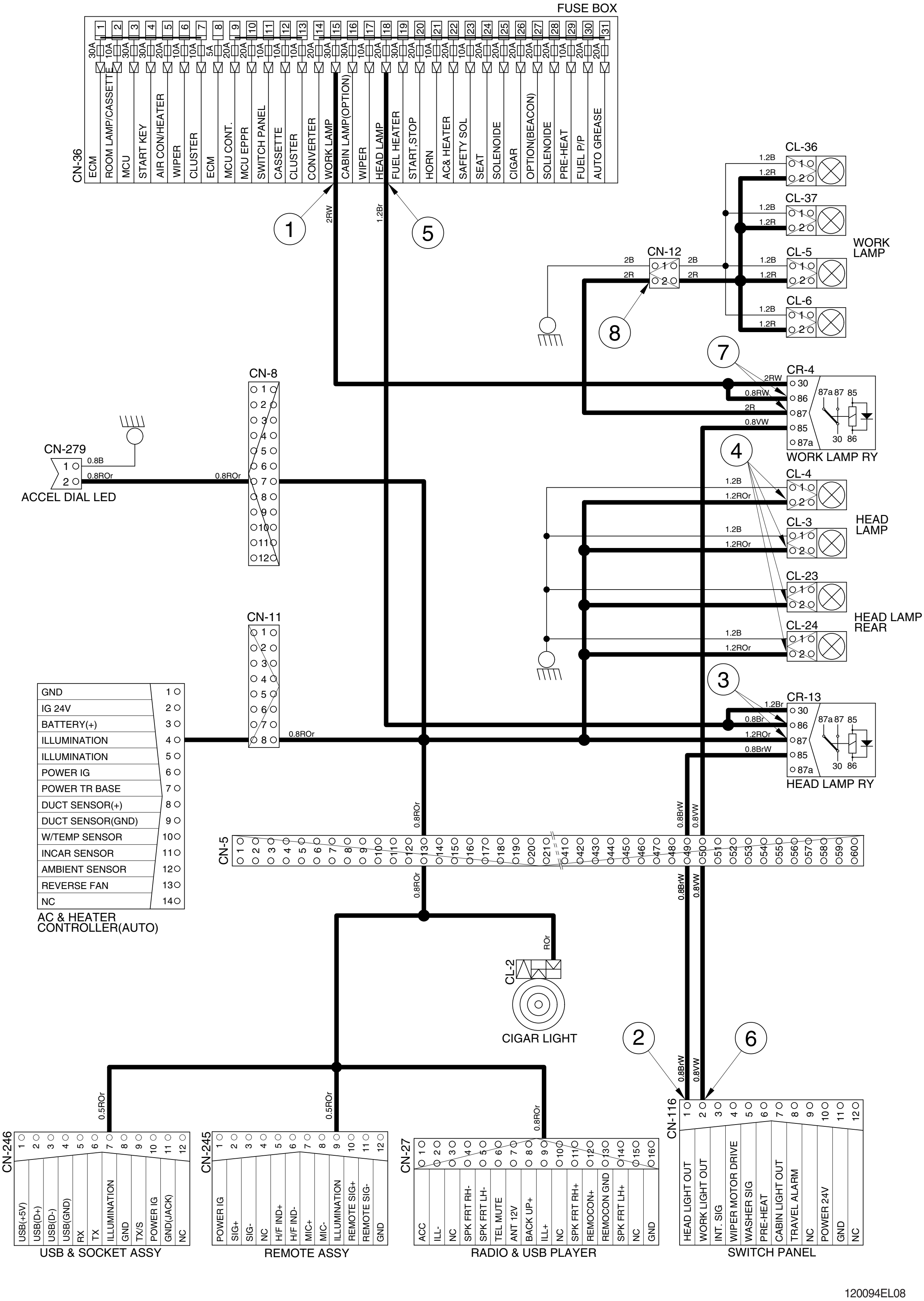
2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power output) ③ - GND (head light relay) ④ - GND (head light) ⑤ - GND (fuse box) ⑥ - GND (switch power output) ⑦ - GND (work light relay) ⑧ - GND (work light)	20~25V

※ GND : Ground

※ The circuit diagram may differ from the equipment, so please check before a repair.

HEAD AND WORK LIGHT CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.27) → I/conn [CN-5 (33)] → Beacon lamp switch [CN-23 (8)]

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

(1) Beacon lamp switch ON

Beacon lamp switch ON [CS-23 (4)] → Switch indicator lamp ON [CS-23 (11)]
→ I/conn [CN-10 (10)] → Beacon lamp ON [CL-7]

(2) Cab light switch ON

Cab light switch ON [CN-116 (7)] → I/conn [CN-5 (55)] → Cab lamp relay [CR-9 (85) → (87)]
→ I/conn [CN-5 (34, 38)] → I/conn [CN-10 (11)] → Cab light ON [CL-8 (2)]
→ I/conn [CN-10 (12)] → Cab light ON [CL-9 (2), CL-10 (2)]

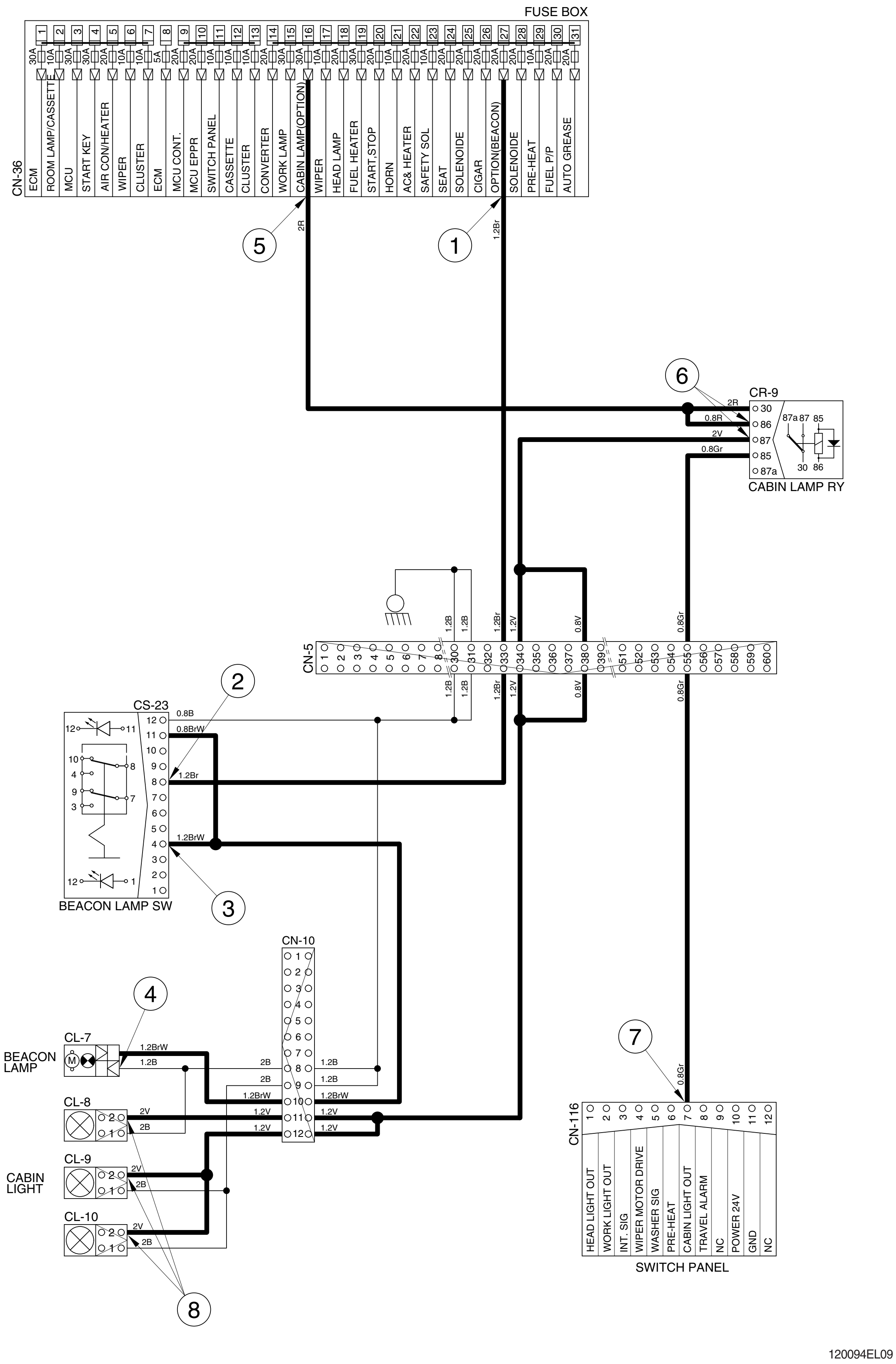
2) CHECK POINT

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) ⑤ - GND (fuse box) ⑥ - GND (cabin light relay) ⑦ - GND (switch power output) ⑧ - GND (cab light)	20~25V

※ GND : Ground

※ The circuit diagram may differ from the equipment, so please check before a repair.

BEACON LAMP AND CAB LIGHT CIRCUIT



※ The circuit diagram may differ from the equipment, so please check before a repair.

6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.11) → I/conn [CN-5 (57)] → Switch panel [CN-116 (10)]

Fuse box (No.6) → I/conn [CN-5 (18)] → I/conn [CN-17 (5)] → Wiper motor controller [CN-141(7)]
→ Wiper motor [CN-21(4)]

Fuse box (No.17) → I/conn [CN-5 (24)] → 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 (3)] → I/conn [CN-17 (8)] → Wiper motor controller [CN-141 (10) → (3)]
→ Wiper motor intermittently operating [CN-21 (6)]

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

Wiper switch ON [CN-116(4)] → 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 (5)] → I/conn [CN-17 (7)] → Wiper motor controller [CN-141 (9) → (8)]
→ I/conn [CN-17 (6)] → I/conn [CN-5 (19)] → Washer pump [CN-22 (1)] → Washer operating
Wiper switch ON [CN-116 (4)] → 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

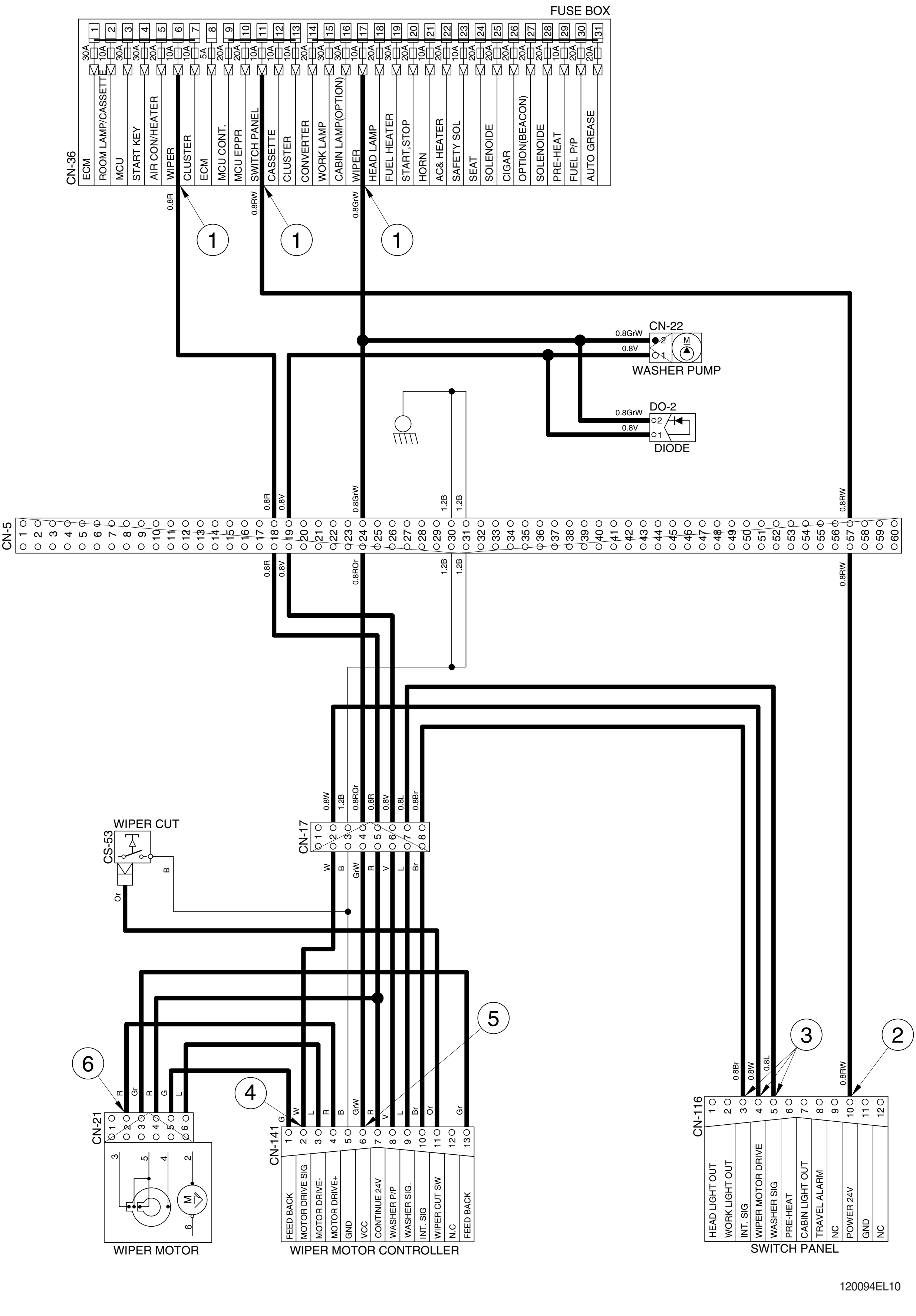
2) CHECK POINT

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)	24V
		⑥ - GND (wiper motor)	0 or 24V

※ GND : Ground

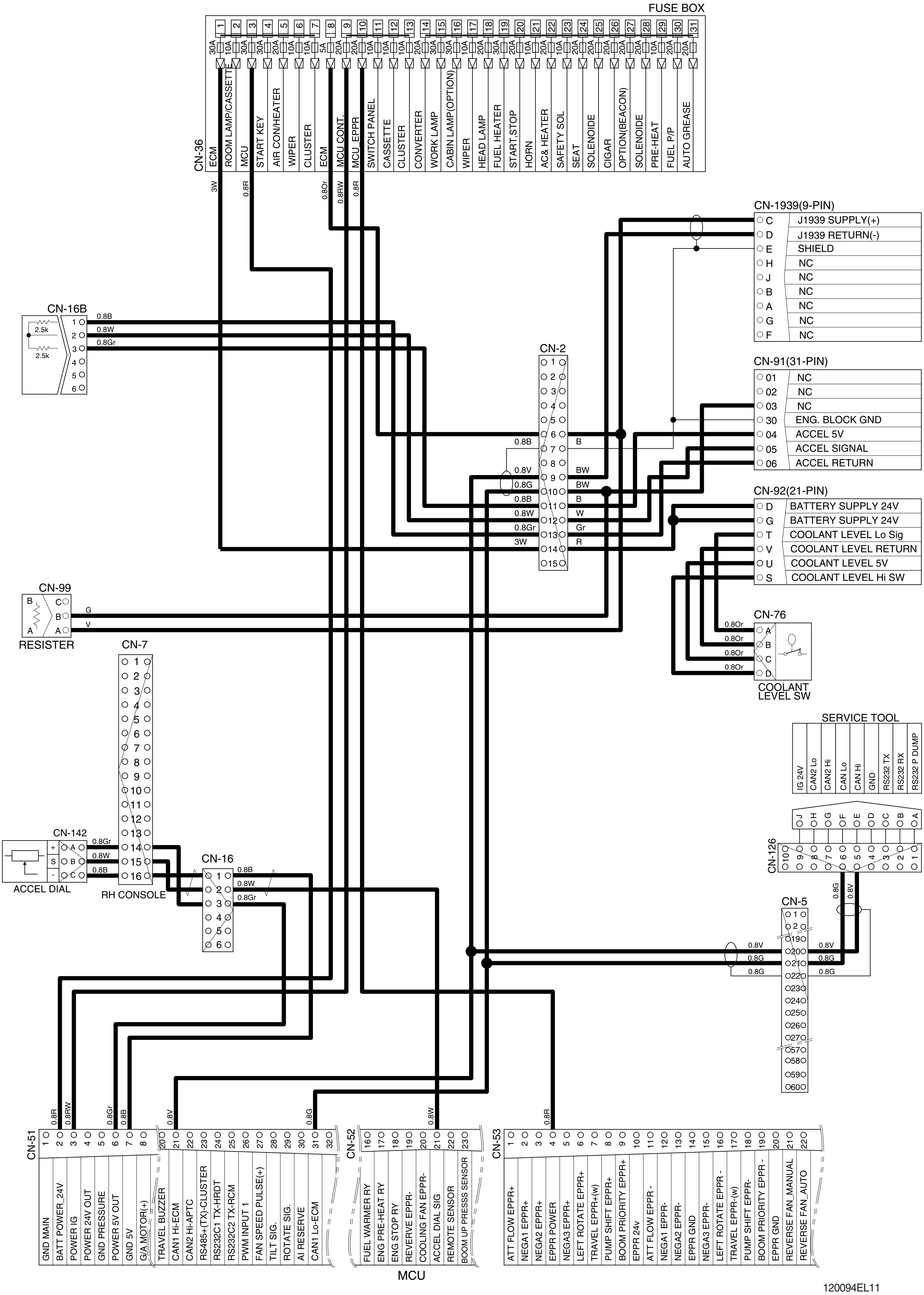
※ The circuit diagram may differ from the equipment, so please check before a repair.

WIPER AND WASHER CIRCUIT



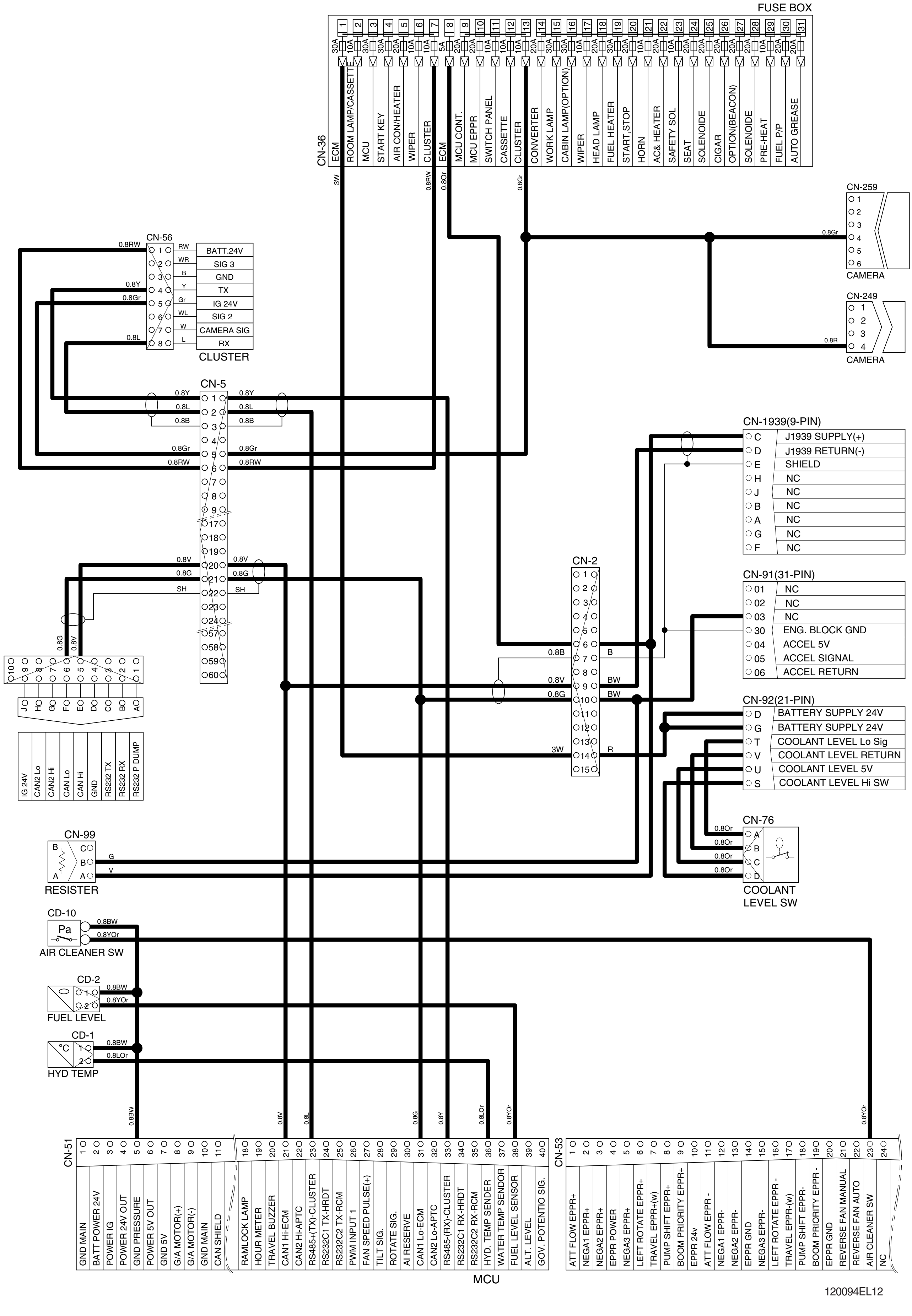
※ The circuit diagram may differ from the equipment, so please check before a repair.

CONTROLLER CIRCUIT



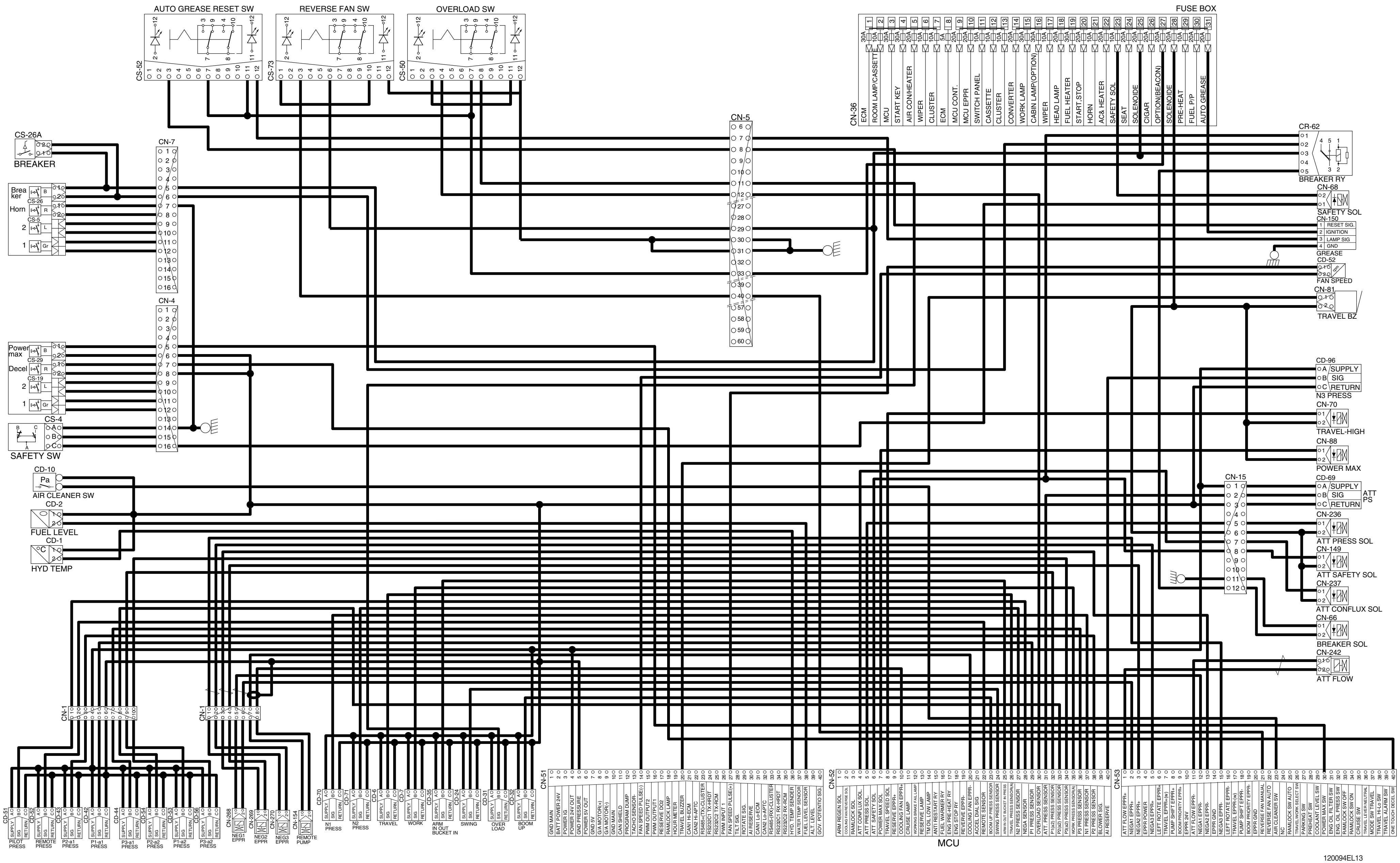
※ The circuit diagram may differ from the equipment, so please check before a repair.

MONITORING CIRCUIT



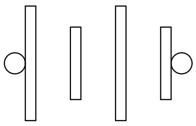
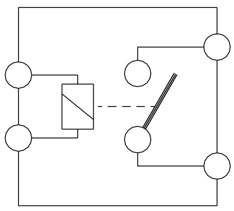
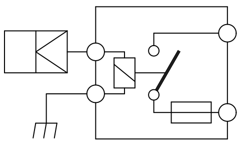
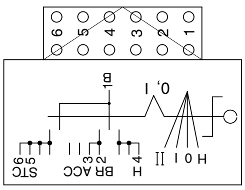
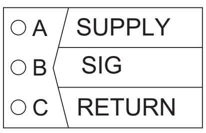
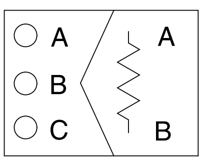
※ The circuit diagram may differ from the equipment, so please check before a repair.

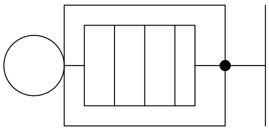
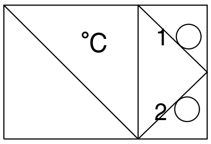
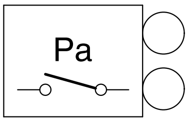
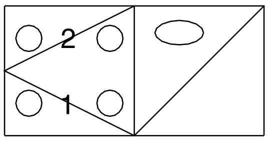
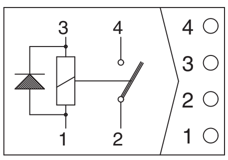
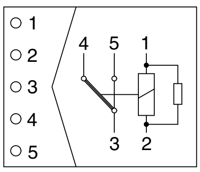
ELECTRIC CIRCUIT FOR HYDRAULIC

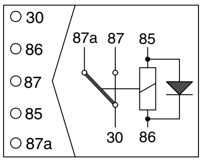
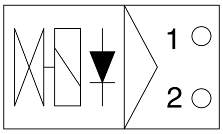
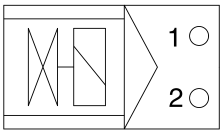
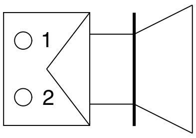
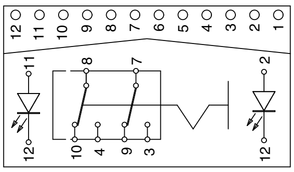
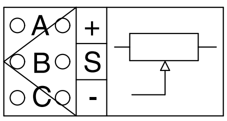


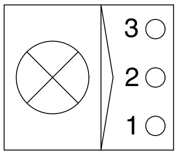
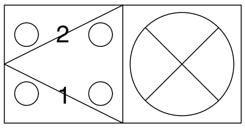
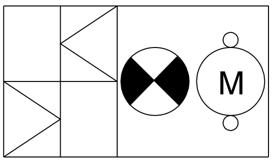
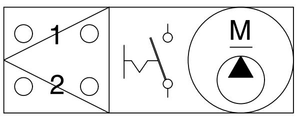
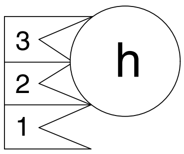
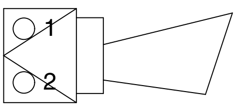
※ The circuit diagram may differ from the equipment, so please check before a repair.

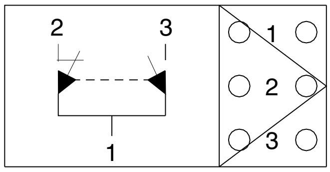
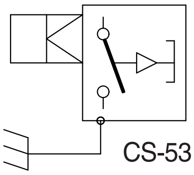
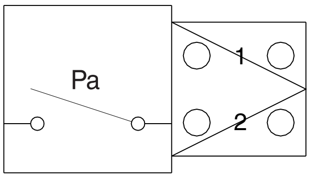
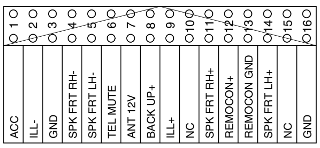
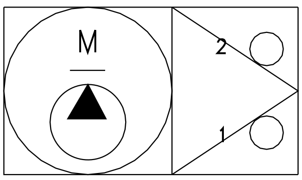
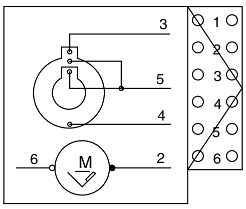
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

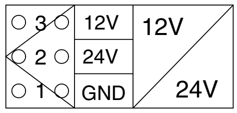
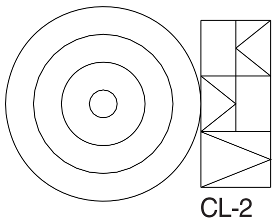
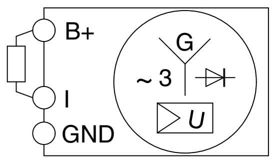
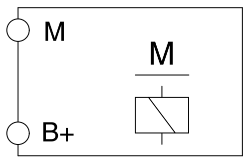
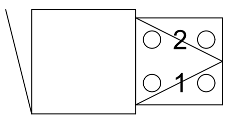
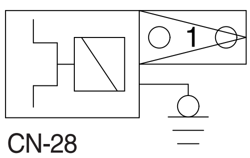
Part name	Symbol	Specifications	Check
Battery		12V × 200Ah (4EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A (continuity) 1000A (30seconds)	※ Check coil resistance(M4 to M4) Normal : About 50 Ω ※ Check contact Normal : ∞ Ω
Glow plug relay	 CR-24	24V 200A	※ Check contact Normal : 0.942 Ω (For terminal 1-GND)
Start key	 CS-2	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-5)
Pressure sensor	 CD-6 CD-7 CD-24 CD-31 CD-32 CD-35 CD-42 CD-43 CD-44 CD-51 CD-52 CD-53 CD-54 CD-56 CD-69 CD-70 CD-71 CD-96	8~30V	※ Check contact Normal : 0.1 Ω
Resistor	 CN-99	4W	※ Check resistance A-B : 120 Ω

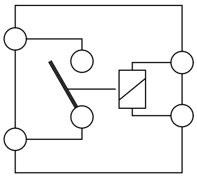
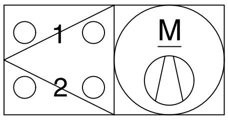
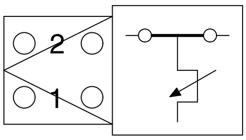
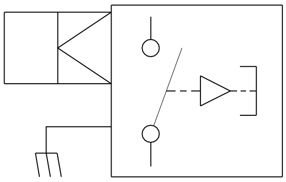
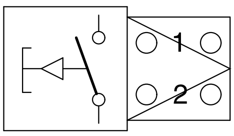
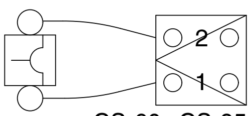
Part name	Symbol	Specifications	Check
Glow plug	 CN-80	24V 200A	※ Check resistance 0.25~0.12 Ω
Temperature sensor (hydraulic)	 CD-1	-	※ Check resistance 50˚C : 804 Ω 80˚C : 310 Ω 100˚C : 180 Ω
Air cleaner pressure switch	 CD-10	(N.O TYPE)	※ Check contact High level : ∞ Ω Low level : 0 Ω
Fuel sender	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

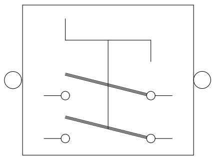
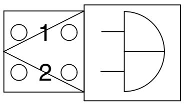
Part name	Symbol	Specifications	Check
Relay	 CR-4 CR-7 CR-9 CR-13 CR-35 CR-46	24V 16A	※ Check resistance Normal : About 160 Ω (for terminal 85-86) 0 Ω (for terminal 30-87a) ∞ Ω (for terminal 30-87)
Solenoid valve	 CN-66 CN-68 CN-70 CN-88 CN-140 CN-149 CN-236 CN-237	24V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
EPPR valve	 CN-133 CN-154 CN-242 CN-268 CN-269 CN-270	700mA	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Speaker	 CN-23(LH) CN-24(RH)	20W	※ Check resistance Normal : A few Ω
Switch (locking type)	 CS-23 CS-50 CS-52 CS-67 CS-73 CS-82 CS-83 CS-99 CS-100	24V 8A	※ Check contact Normal ON : 0 Ω (for terminal 3-7, 4-8) ∞ Ω (for terminal 7-9, 8-10) OFF : ∞ Ω (for terminal 3-7, 4-8) 0 Ω (for terminal 7-9, 8-10)
Accel dial	 CN-142	-	※ Check resist Normal : About 5k Ω (for terminal A-C) ※ Check voltage Normal : About 5V (for terminal A-C) : 2~4.5V (for terminal C-B)

Part name	Symbol	Specifications	Check
Room lamp	 CL-1	24V 10W	※ Check disconnection Normal : 1.0 Ω ON : 0 Ω (For terminal 1-2) ∞ Ω (For terminal 1-3) OFF : ∞ Ω (For terminal 1-2) 0 Ω (For terminal 1-3)
Head lamp, Work lamp, Cab lamp	 CL-3 CL-4 CL-5 CL-6 CL-8 CL-9 CL-10 CL-24 CL-36 CL-37	24V 65W (H3 Type)	※ Check disconnection Normal : 1.2 Ω
Beacon lamp	 CL-7	21V 70W (H1 Type)	※Check disconnection Normal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 l /min	※Check resistance Normal : 1.0 Ω
Hour meter	 CN-48	16~32V	※Check operation Supply power(24V) to terminal No.2 and connect terminal No.1 and ground
Horn	 CN-20 CN-25	DC22~28V 2A	※Check operation Supply power(24V) to each terminal and connect ground.

Part name	Symbol	Specifications	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※Check contact Normal : 0 Ω (for terminal 1-2) ∞ Ω (for terminal 1-3) Operating : ∞ Ω (for terminal 1-2) 0 Ω (for terminal 1-3)
Wiper cut switch	 CS-53	24V (N.O TYPE)	※Check contact Normal : 0 Ω (one pin to ground)
Receiver dryer	 CN-29	24V 2.5A	※Check contact Normal : ∞ Ω
Radio & USB player	 CN-27	24V 2A	※Check voltage 20~25V (for terminal 1-3, 3-8)
Washer pump	 CN-22	24V 3.8A	※Check contact Normal : 10.7 Ω (for terminal 1-2)
Wiper motor	 CN-21	24V 2A	※Check disconnection Normal : 7 Ω (for terminal 2-6)

Part name	Symbol	Specifications	Check
DC/DC Converter	 CN-138	12V 3A	24V (1-2) 12V (1-3)
Cigar lighter	 CL-2	24V 5A 1.4W	※Check coil resistance Normal : About 1M Ω ※Check contact Normal : ∞ Ω Operating time : 5~15sec
Alternator	 CN-74	Delco Remy 24V 55A	※Check contact Normal : 0 Ω (for terminal B^+-I) Normal : 24~27.5V
Starter	 CN-45	Denso 24V 4.5kW	※Check contact Normal : 0.1 Ω
Travel alarm	 CN-81	24V 0.5A	※Check contact Normal : 5.2 Ω
Aircon compressor	 CN-28	24V 79W	※Check contact Normal : 13.4 Ω

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

Part name	Symbol	Specifications	Check
Master switch	 CS-74A, CS-74B	6-36V	※Check disconnection Normal : 0.1 Ω
Travel alarm	 CN-113	24V 200mA 107 ± 4dB	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	8	I/conn (Frame harness-Pump PS harness)	S816-008002	S816-108002
CN-1	AMP	10	I/conn (Frame harness-Pump PS harness)	S816-010002	S816-110002
CN-2	AMP	15	I/conn (Frame harness-Engine harness)	2-85262-1	S816-112002
CN-3	AMP	12	I/conn (Frame harness-Engine harness)	S816-012002	368301-1
CN-4	AMP	16	I/conn (Console harness LH-Frame harness)	368047-1	36850-1
CN-5	DEUTSCH	60	I/conn (Side harness RH-Frame harness)	DRB16-60SAE-L018	DRB12-60PAE-L018
CN-7	AMP	16	I/conn (Console harness RH-Frame harness)	368047-1	36850-1
CN-8	AMP	12	I/conn (Console harness RH-Frame harness)	S816-012002	S816-112002
CN-10	DEUTSCH	12	I/conn (Cab harness-Side harness RH)	DT06-12S-EP06	DT04-12P-BE02
CN-11	DEUTSCH	8	I/conn (Frame harness-Aircon harness)	DT06-8S-EP06	-
CN-12	DEUTSCH	2	I/conn (Frame harness-Boom wire harness)	DT06-2S-EP06	DT04-2P-E004
CN-16	AMP	6	Emergency engine start & speed control	S816-006002	S816-106002
CN-17	AMP	8	I/conn (Wiper harness-Side harness RH)	S816-008002	S816-108202
CN-20	MOLEX	2	Horn	35825-0211	-
CN-21	AMP	6	Wiper motor	S810-006202	-
CN-22	KET	2	Washer tank	MG640795	-
CN-23	KET	2	Speaker-LH	MG610070	-
CN-24	KET	2	Speaker-RH	MG610070	-
CN-25	MOLEX	2	Horn	35825-0211	-
CN-27	KUM	16	Radio & USB player	PK145-16017	-
CN-28	KUM	1	Aircon compressor	NMWP01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	AMP	12	Fuse box	21Q7-10910	-
CN-45	RING-TERM	-	Starter motor B^+	S820-308000	-
CN-48	AMP	1	Hour meter	2-520193-2	-
CN-51	DEUTSCH	40	MCU	DRC26-40SA	-
CN-52	DEUTSCH	40	MCU	DRC26-40SB	-
CN-53	DEUTSCH	40	MCU	DRC26-40SC	-
CN-56	DEUTSCH	8	Cluster	-	S816-108002
CN-60	YAZAKI	2	Fusible link	21N4-01320	7122-4125-50
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-EP06	DT-04-2P-E005
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-EP06	-
CN-70	DEUTSCH	2	Travel high solenoid	DT06-2S-EP06	-

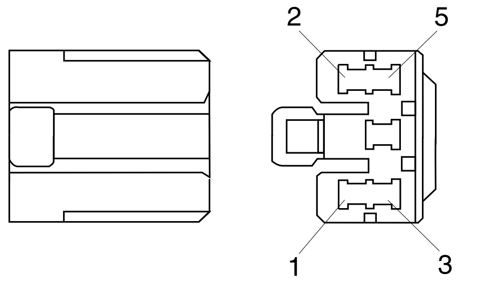
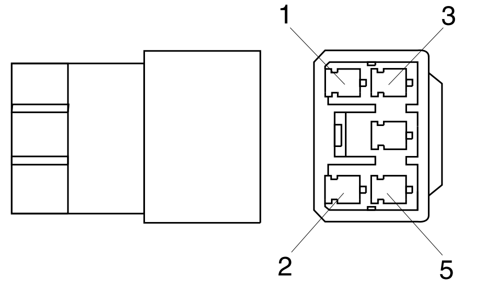
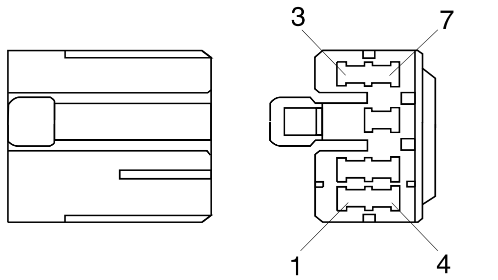
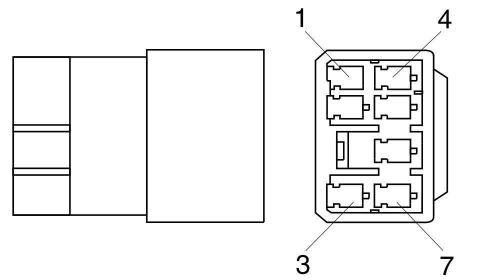
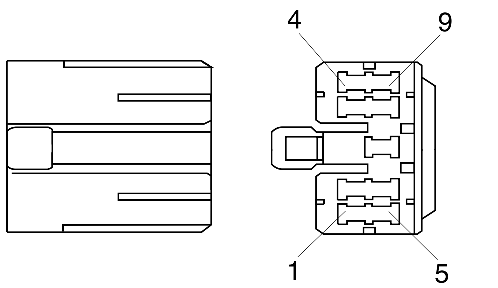
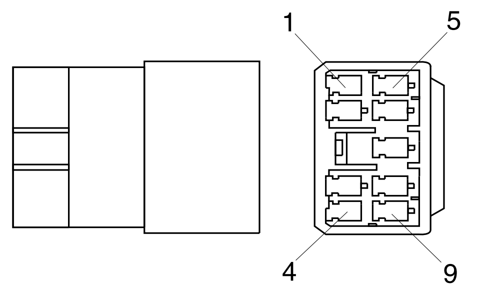
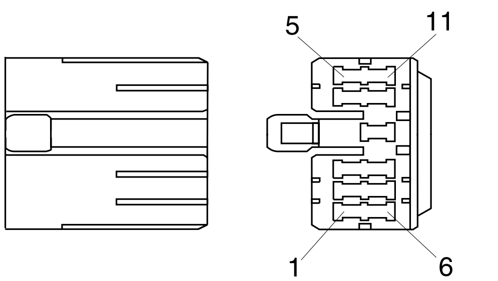
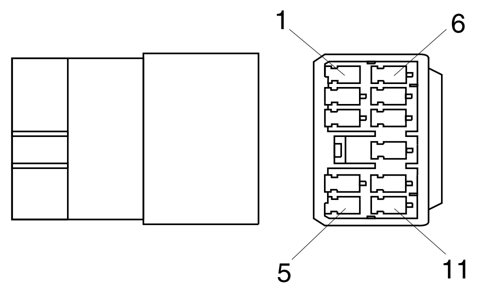
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-74	RING-TERM	-	Alternator "I" terminal	ST710384-2	-
CN-80	RING-TERM	-	Glow plug	S820-306000	-
CN-81	DEUTSCH	2	Travel buzzer solenoid	DT06-2S-EP06	-
CN-88	DEUTSCH	2	Power max solenoid	DT06-2S-EP06	-
CN-91	DEUTSCH	31	ECM	HD36-24-31SN	-
CN-92	DEUTSCH	21	ECM	HD36-24-21SN	-
CN-95	KET	2	Fusible link	21N4-01311	S813-130201
CN-113	KET	2	Travel alarm	MG651205-5	-
CN-116	AMP	12	Switch panel	176116	-
CN-125	Econoseal J	4	GPS connector	S816-004002	S816-104002
CN-126	AMP	10	Service tool	S816-010002	S816-110002
CN-133	DEUTSCH	2	Boom priority solenoid	DT06-2S-EP06	-
CN-138	FASTEN	3	DC/DC Converter	S810-003202	-
CN-139	FASTEN	2	12V socket	172434-2	-
CN-141	AMP	13	Wiper motor controller	172498-1	DT04-3P-EP10
CN-144	KET	20	Handsfree	MG610240	-
CN-147	PACKARD	2	Fuel-heater	4661958	-
CN-149	DEUTSCH	2	Attach safety solenoid	DT06-2S-EP06	-
CN-150	AMP	4	Auto grease	S816-004002	-
CN-154	AMP	2	Remote fan EPPR	S816-002002	-
CN-156	DEUTSCH	2	Air seat	DT06-2S-EP06	DT04-2P-E005
CN-170	AMP	2	Heated seat	S816-002002	S816-102002
CN-173	DEUTSCH	3	Resistor	DT06-3S-EP06	DT04-3P-EP10
CN-236	DEUTSCH	2	Attach pressure solenoid	DT06-2S-EP06	-
CN-237	DEUTSCH	2	Attach conflux solenoid	DT06-2S-EP06	-
CN-242	DEUTSCH	2	Attach flow solenoid	DT06-2S-EP06	DT04-2P-E005
CN-244	AMP	2	CAN 2	S816-002002	S816-102002
CN-245	AMP	12	PTC power	S813-030201	-
CN-246	KET	12	USB & Socket assy	174045-2	-
CN-249	DEUTSCH	4	Rear view camera	DT06-4S-EP06	DT04-4P-E005
CN-258	KET	1	Air compressor power	MG640944-5	MG650943-5
CN-259	DEUTSCH	6	Camera	DT06-6S-EP06	DT04-6P-E005
CN-263	DEUTSCH	2	Air compressor relay	DT06-2S-EP06	DT04-2P-E005
CN-268	AMP	2	Pump A EPPR	S816-002002	-
CN-270	AMP	2	Pump B & C EPPR	S816-002002	-
CN-279	AMP	2	Accel dial LED	S816-002002	-

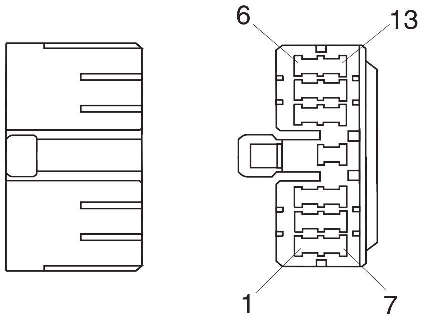
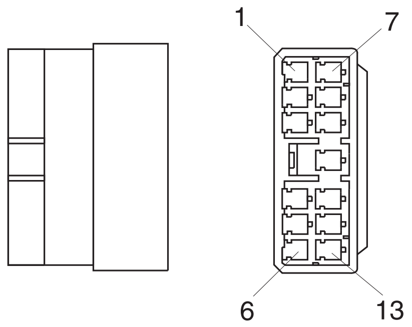
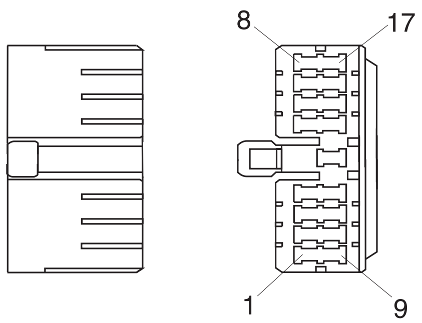
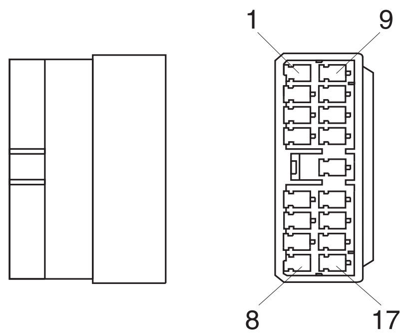
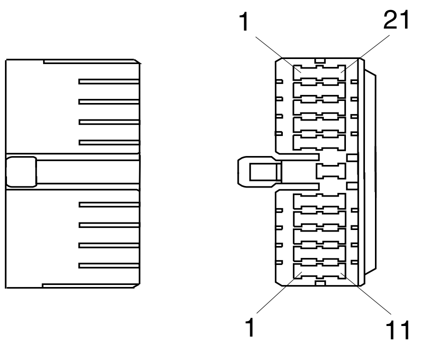
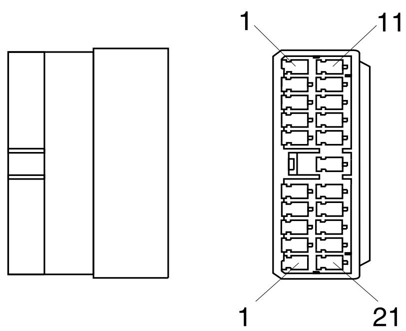
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Relay					
CR-1	RING-TERM	-	Battery relay	ST710285-2	-
CR-2	-	5	Horn relay	-	-
CR-4	-	5	Working lamp relay	-	-
CR-5	-	5	Anti restart relay	-	-
CR-7	-	5	Aircon compressor relay	-	-
CR-9	-	5	Head lamp relay	-	-
CR-13	-	5	Cabin lamp relay	-	-
CR-23	DEUTSCH	2	Start relay	DT06-2S-EP06	-
CR-24	RING TERM	-	Preheat relay	ST710384-2	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Preheat relay	-	-
CR-45	-	5	ECM power relay	-	-
CR-46	-	5	Fuel warmer relay	-	-
CR-62	-	5	Breaker relay	-	-
· Switch					
CS-1	SHUR	1	Door switch	S822-014002	S822-114002
CS-2	AMP	6	Start key switch	S814-006100	-
CS-4	DEUTSCH	3	Safety switch	DT06-3S-EP06	-
CS-5	DEUTSCH	2	Horn switch	-	DT04-2P-E005
CS-19	DEUTSCH	2	One touch decel switch	-	DT04-2P-E005
CS-23	SWF	12	Beacon lamp switch	SWF589790	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-EP06	-
CS-26A	AMP	2	Breaker pedal switch	S816-002002	S816-102002
CS-29	DEUTSCH	2	Power max switch	DT06-2S-EP06	-
CS-50	SWF	12	Overload switch	SWF589790	-
CS-52	SWF	10	Econo switch	SWF 593757	-
CS-53	AMP	1	Wiper cut switch	S822-014002	-
CS-67	SWF	12	Quick clamp switch	SWF 589790	-
CS-73	SWF	12	Reverse fan switch	SWF 589790	-
CS-74A	AMP	2	Master switch	S813-030201	-
CS-74B	DEUTSCH	2	Master switch	DT06-2S-EP06	-
CS-82	SWF	12	Spare switch	SWF 589790	-
CS-83	SWF	12	Spare switch	SWF 589790	-
CS-99	SWF	12	Spare switch	SWF 589790	-
CS-100	SWF	12	Spare switch	SWF 589790	-
CS-142	DEUTSCH	3	Accel dial switch	DT06-3S-EP06	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
· Light					
CL-1	KET	3	Room lamp	MG651032	-
CL-2	AMP	1	Cigar light	S822-014002	S822-114002
CL-3	DEUTSCH	2	Head lamp-LH	DT06-2S-EP06	-
CL-4	DEUTSCH	2	Head lamp-RH	DT06-2S-EP06	DT04-2P-E005
CL-5	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P
CL-6	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014002	S822-114002
CL-8	DEUTSCH	2	Cab lamp-LH	DT06-2S-EP06	DT04-2P
CL-9	DEUTSCH	2	Cab lamp-RH	DT06-2S-EP06	DT04-2P
CL-10	DEUTSCH	2	Cab lamp-RH	DT06-2S-EP06	DT04-2P
CL-24	DEUTSCH	2	Rear work lamp	DT06-2S-EP06	DT04-2P-E005
CL-36	DEUTSCH	2	Work lamp-LH	DT06-2S-EP06	DT04-2P
CL-37	DEUTSCH	2	Work lamp-RH	DT06-2S-EP06	DT04-2P
· Sensor, sendor					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-EP06	-
CD-6	DEUTSCH	3	Travel pressure switch	DT06-3S-EP06	-
CD-7	DEUTSCH	3	Working pressure switch	DT06-3S-EP06	-
CD-10	RING TERM	-	Air cleaner switch	ST730135-3	S820-104002
CD-24	DEUTSCH	3	Swing sensor	DT06-3S-EP06	-
CD-31	DEUTSCH	3	Overload sensor	DT06-3S-EP06	DT04-3P-E005
CD-32	DEUTSCH	3	Boom up sensor	DT06-3S-EP06	-
CD-35	DEUTSCH	3	Arm & bucket in sensor	DT06-3S-EP06	-
CD-42	DEUTSCH	3	Pump A pressure 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump B pressure 1	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump C pressure 1	DT06-3S-EP06	-
CD-51	AMP	2	Pilot pressure sensor	S816-002002	-
CD-52	AMP	2	Fan speed sensor	174352-2	-
CD-53	DEUTSCH	3	Pump A pressure 2	DT06-3S-EP06	-
CD-54	DEUTSCH	3	Pump B pressure 2	DT06-3S-EP06	-
CD-56	DEUTSCH	3	Pump C pressure 2	DT06-3S-EP06	-
CD-70	DEUTSCH	3	N1 pressure sensor	DT06-3S-EP06	-
CD-71	DEUTSCH	3	N2 pressure sensor	DT06-3S-EP06	-
CD-76	AMP	4	Coolant level switch	12065298	-
CD-96	DEUTSCH	3	N3 pressure sensor	DT06-3S-EP06	-

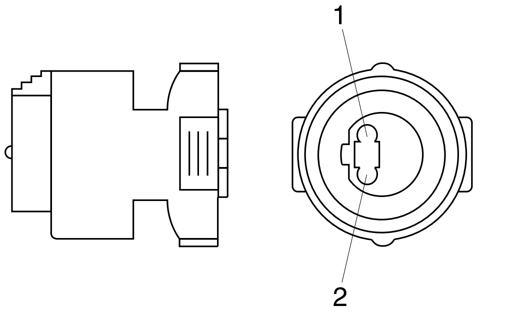
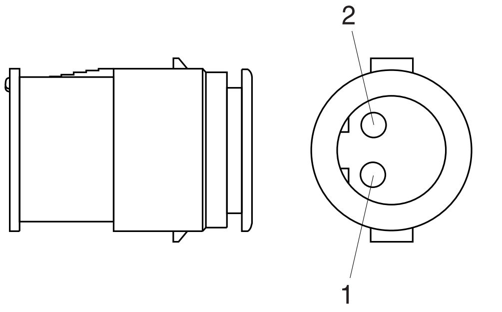
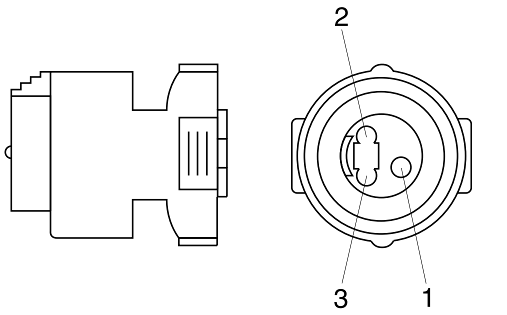
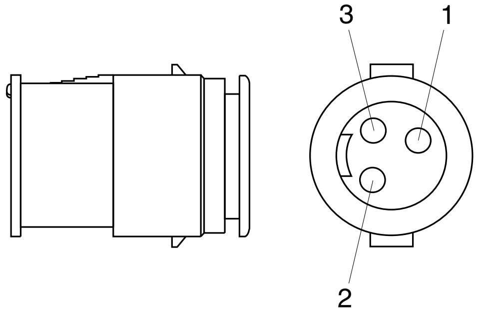
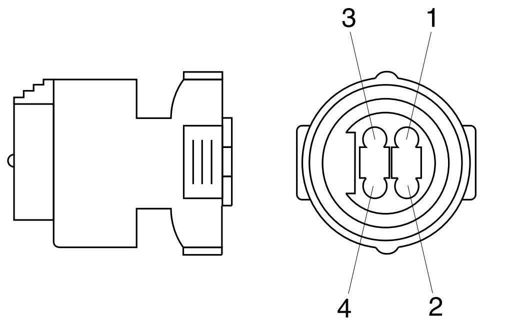
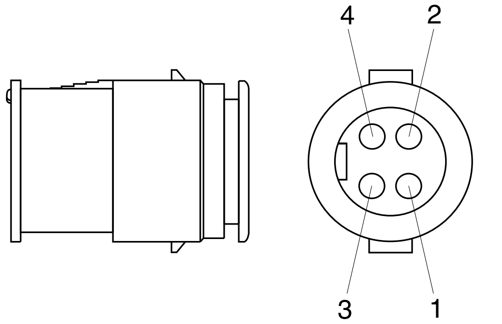
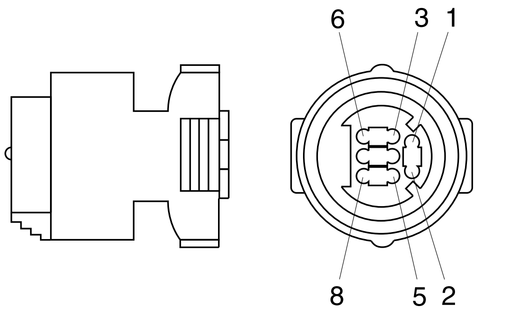
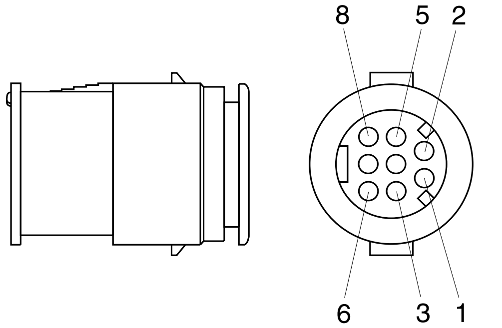
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

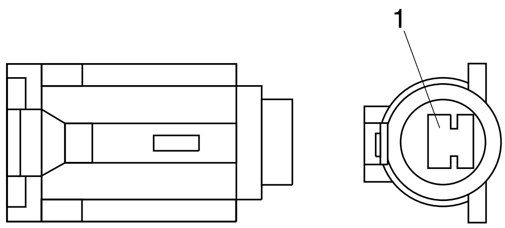
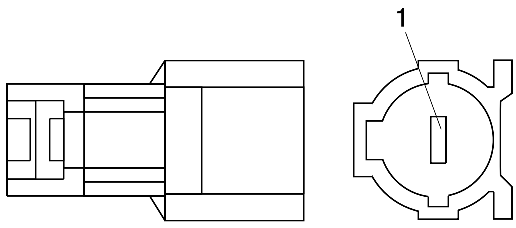
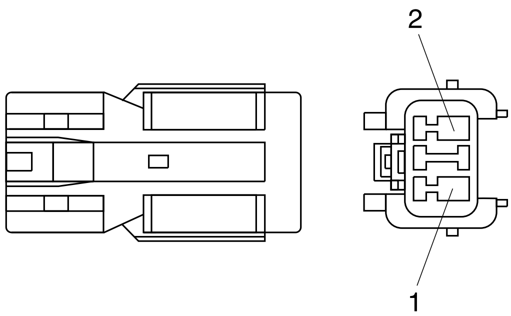
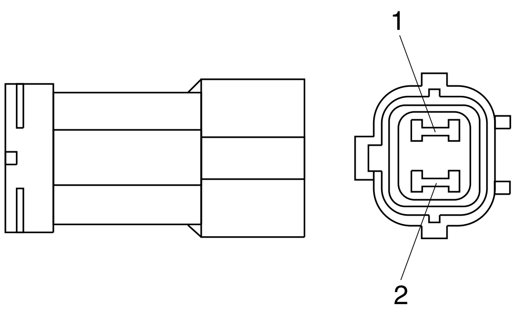
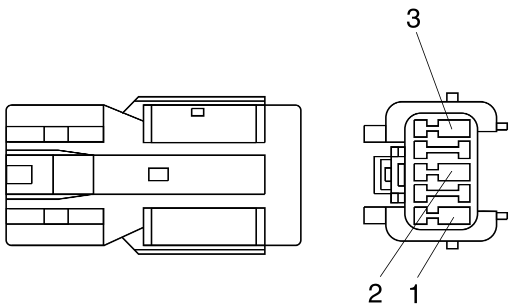
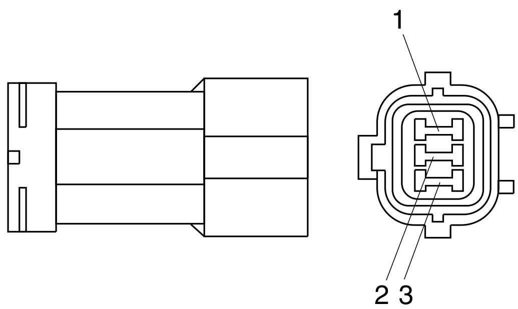
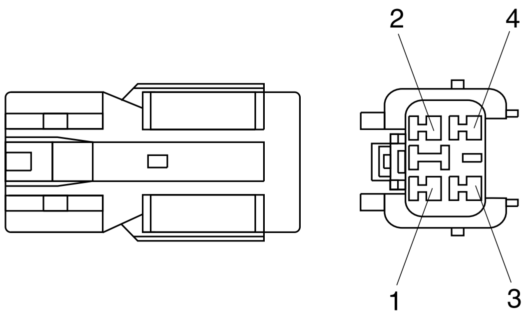
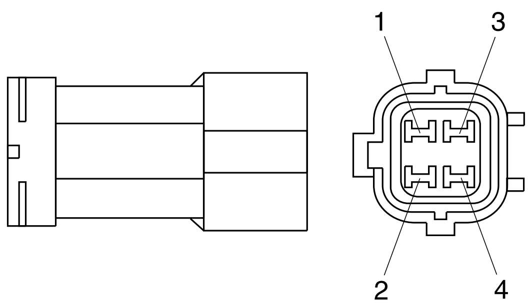
No. of pin	Receptacle connector (female)	Plug connector (male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

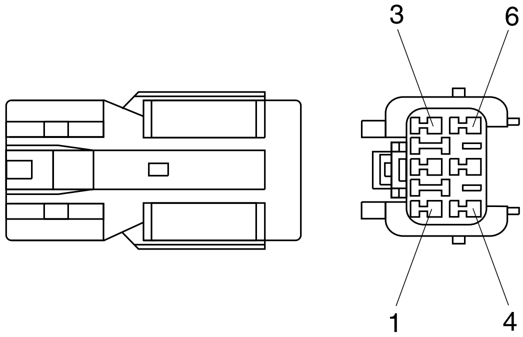
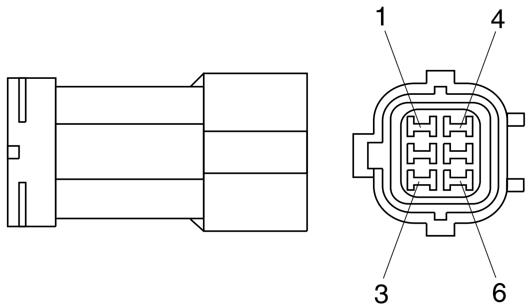
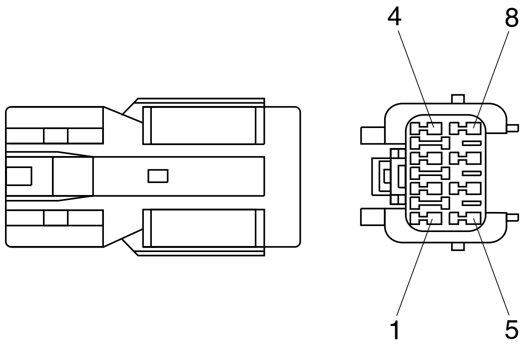
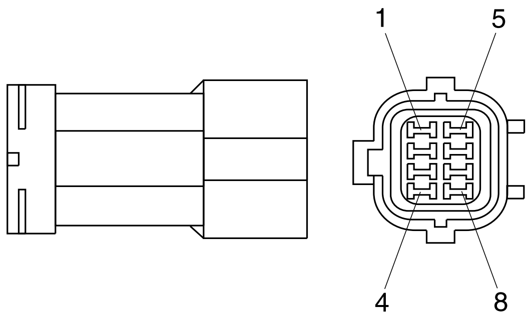
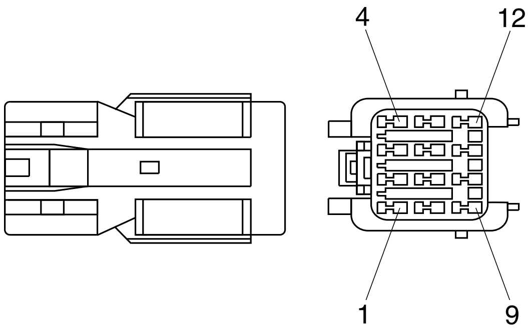
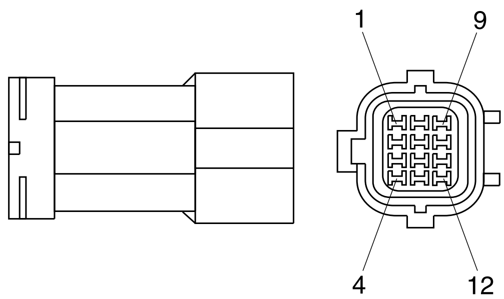
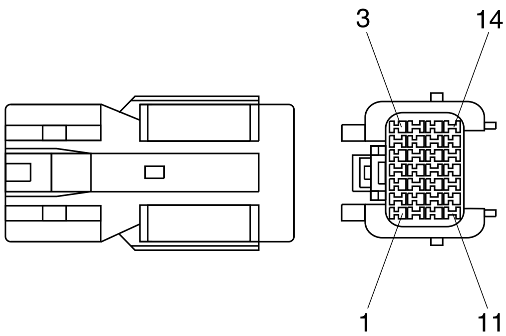
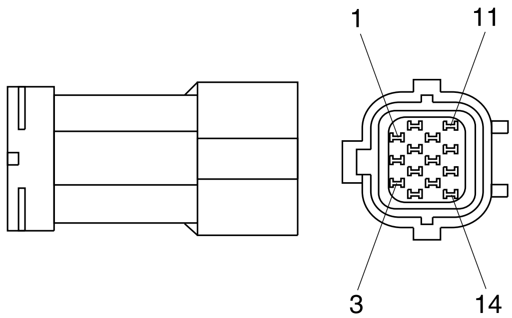
No. of pin	Receptacle connector (female)	Plug connector (male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

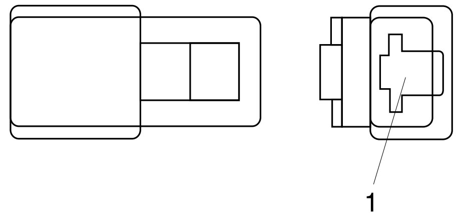
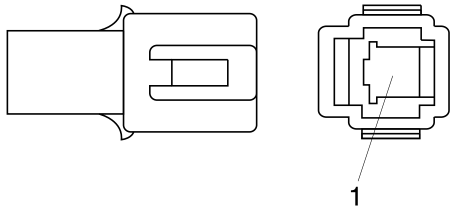
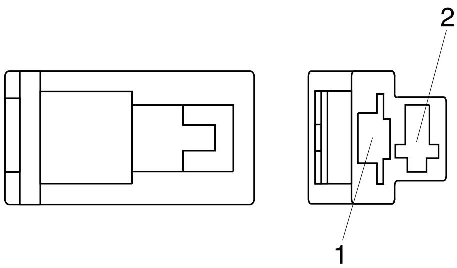
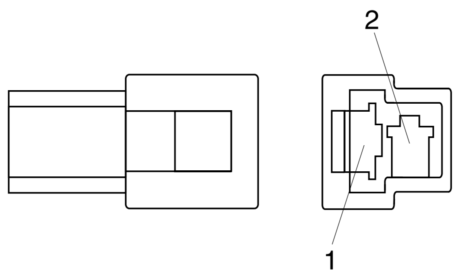
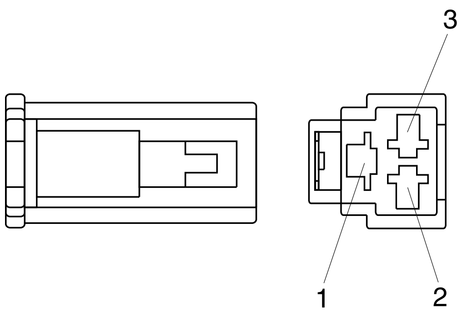
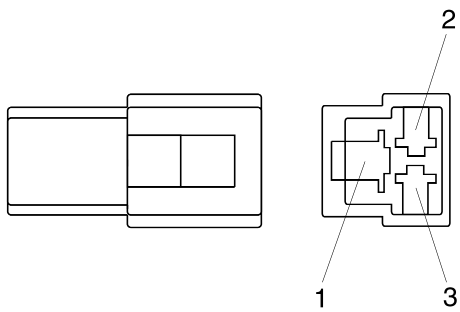
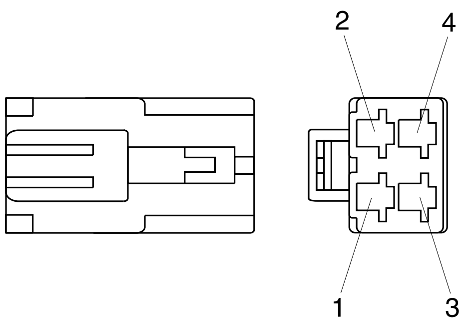
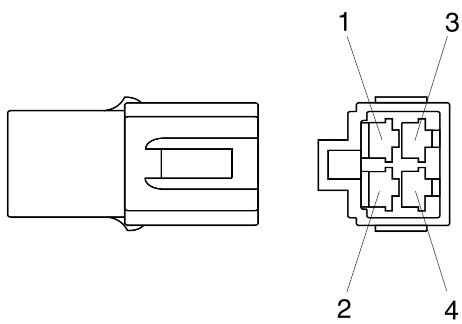
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

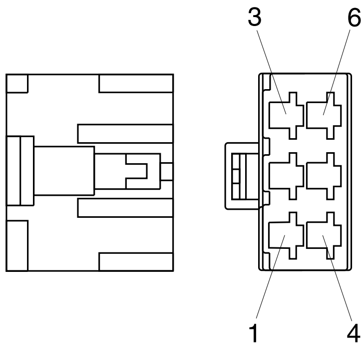
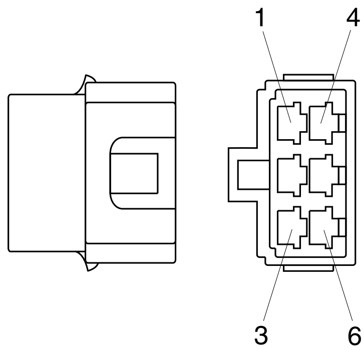
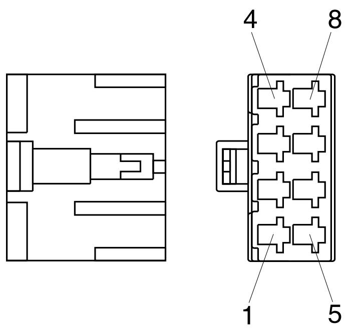
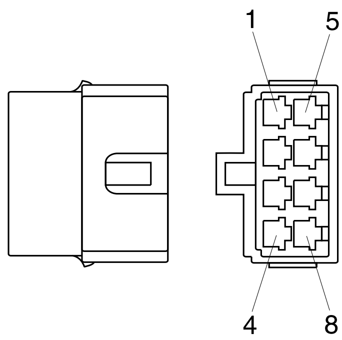
3) SWP TYPE CONNECTOR

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

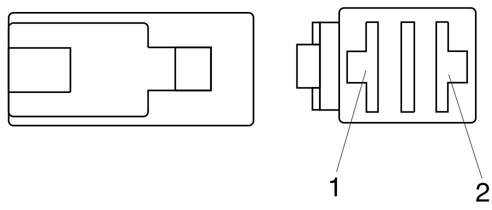
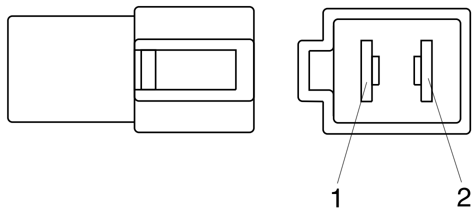
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

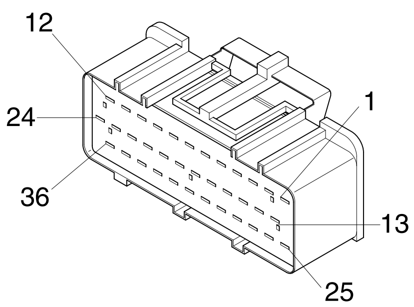
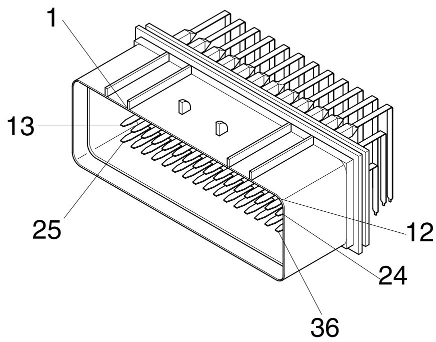
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

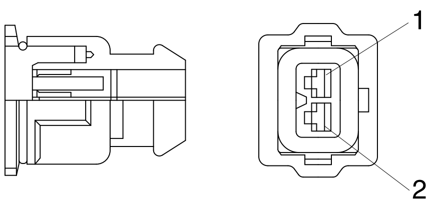
5) 375 FASTEN TYPE CONNECTOR

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

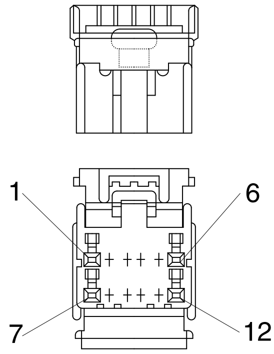
6) AMP ECONOSEAL CONNECTOR

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

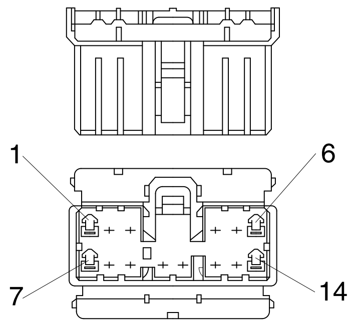
7) AMP TIMER CONNECTOR

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

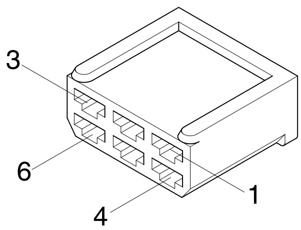
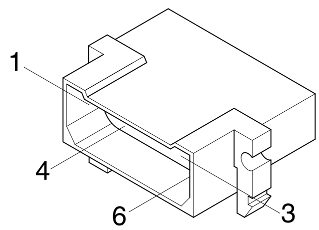
8) AMP 040 MULTILOCK CONNECTOR

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

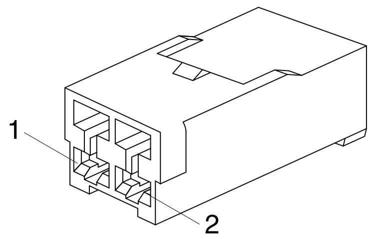
9) AMP 070 MULTILOCK CONNECTOR

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

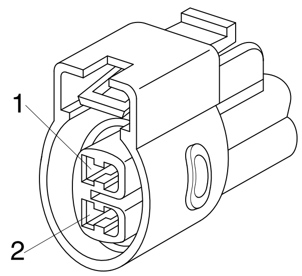
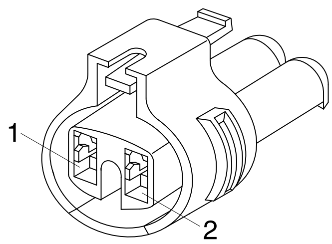
10) AMP FASTIN - FASTON CONNECTOR

No. of pin	Receptacle connector (female)	Plug connector (male)
6	 925276-0	 480003-9

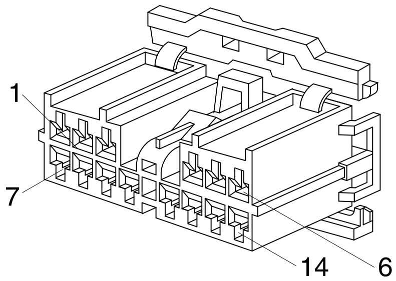
11) KET 090 CONNECTOR

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

12) KET 090 WP CONNECTORS

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

13) KET SDL CONNECTOR

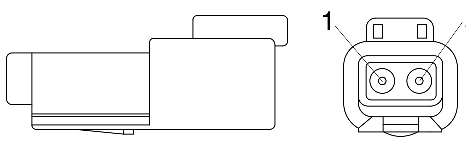
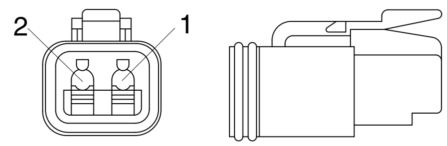
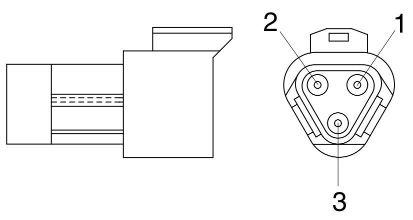
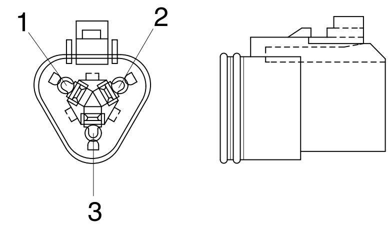
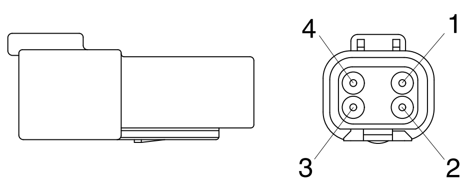
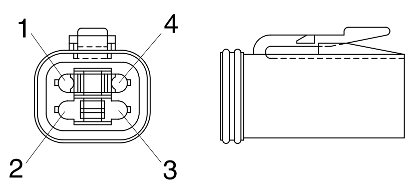
No. of pin	Receptacle connector (female)	Plug connector (male)
14	 MG610406	

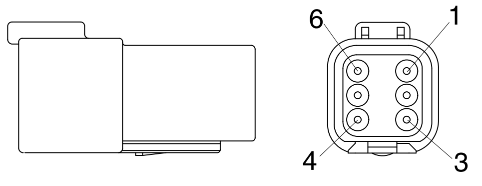
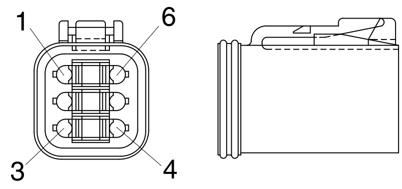
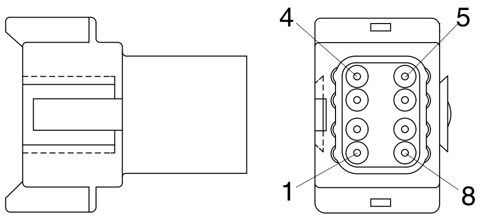
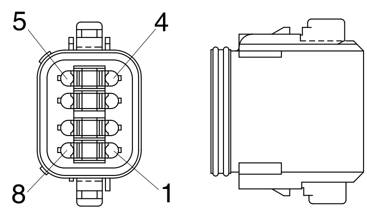
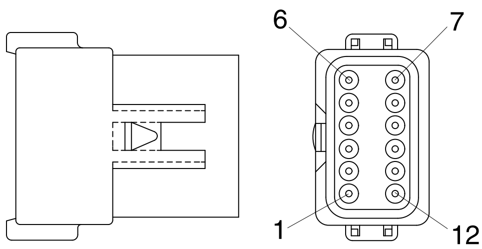
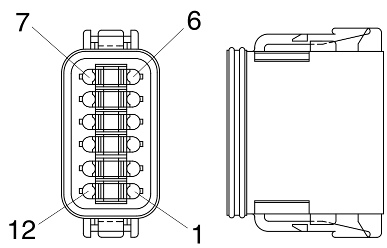
14) DEUTSCH DT CONNECTORS

DT 06 - 3S - ★★★★

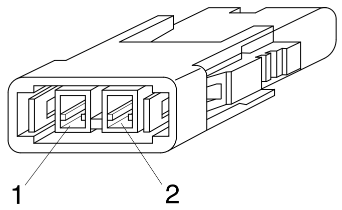
- ★★★★ : Modifications (see below)
- 3S : Number of contacts (P : Pin, S : Socket)
- 06 : 04 : Receptacle, 06 : Plug
- DT : Deutsch connectors

※ Modification
E003 : Standard end cap - gray
E004 : Color of connector to be black
E005 : Combination - E004 & E003
EP04 : End cap
EP06 : Combination P012 & EP04
P012 : Front seal enhancement - connectors color to black for 2, 3, 4 & 6pin

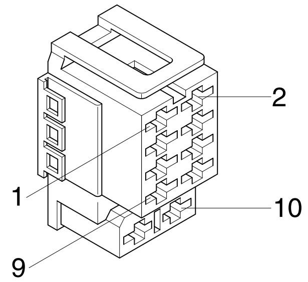
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

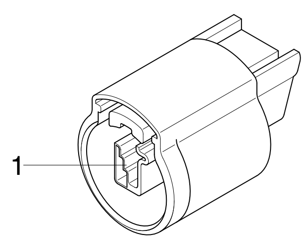
15) MOLEX 2CKTS CONNECTOR

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

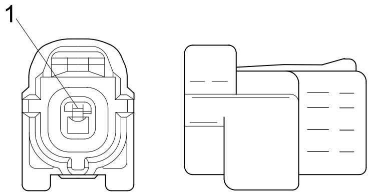
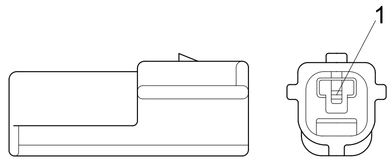
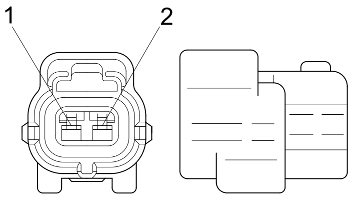
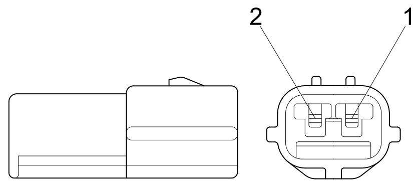
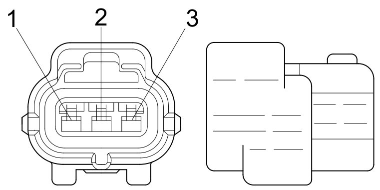
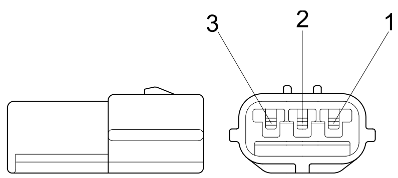
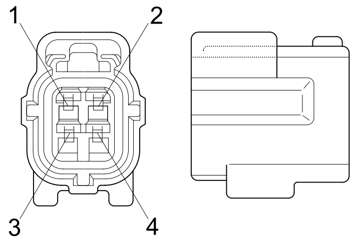
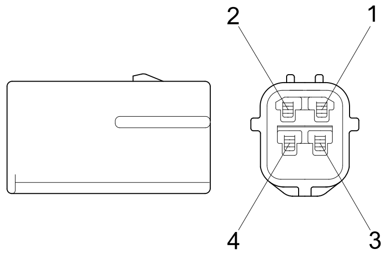
16) ITT SWF CONNECTOR

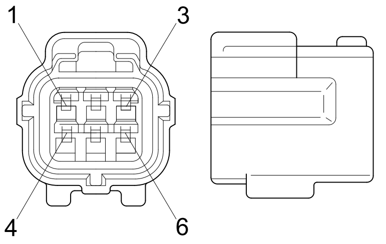
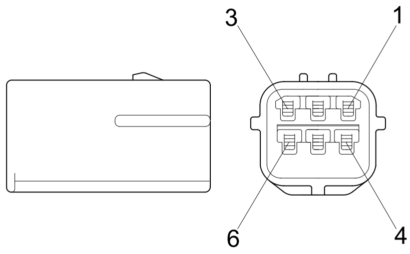
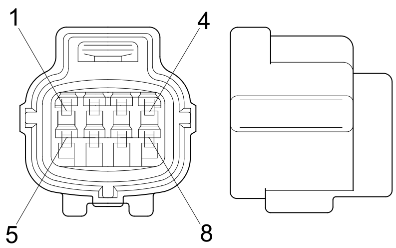
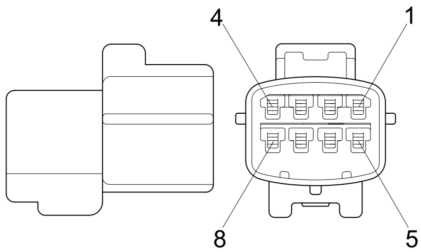
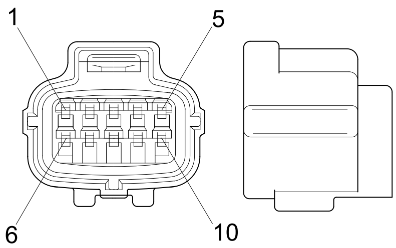
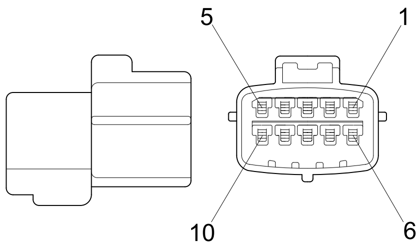
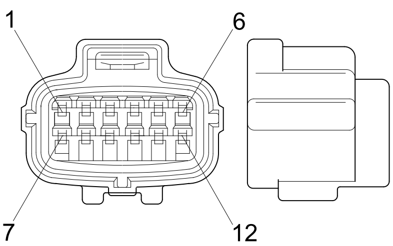
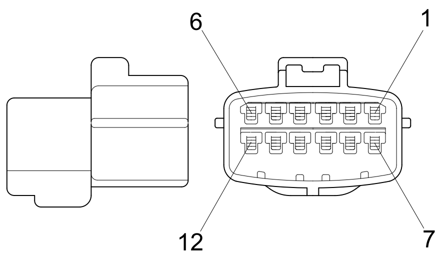
No. of pin	Receptacle connector (female)	Plug connector (male)
10	 SWF593757	

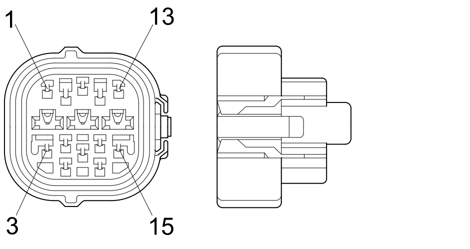
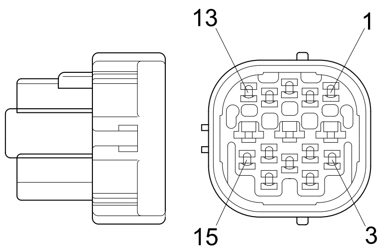
17) MWP NMWP CONNECTOR

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

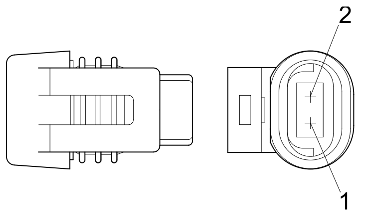
18) ECONOSEAL J TYPE CONNECTORS

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

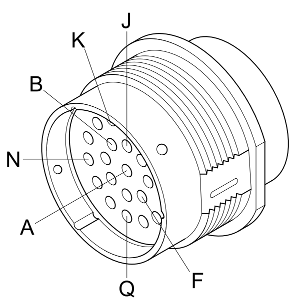
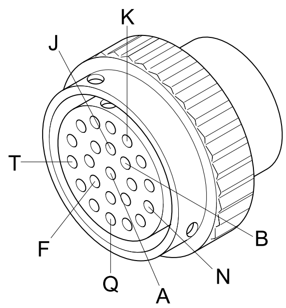
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

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

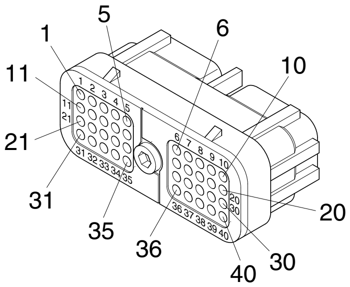
19) METRI-PACK TYPE CONNECTOR

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

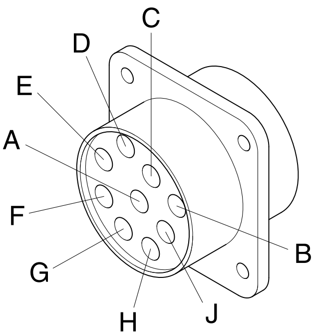
20) DEUTSCH HD30 CONNECTOR

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

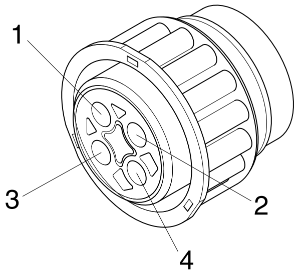
21) DEUTSCH MCU CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
40	 DRC26-40SA/B/C	

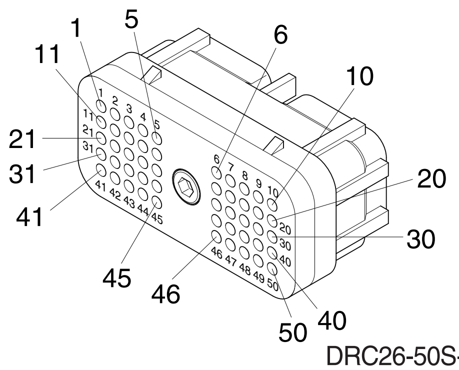
22) DEUTSCH SERVICE TOOL CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
9	 HD10-9-96P	

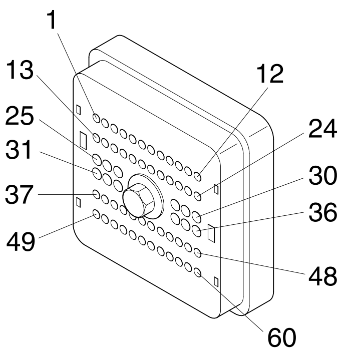
23) AMP FUEL WARMER CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
4	 2-967325-3	

24) DEUTSCH ENGINE ECM CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
50	 DRC26-50S-04	

25) DEUTSCH INTERMEDIATE CONNECTOR

No. of pin	Receptacle connector (Female)	Plug connector (Male)
60	 DRB16-60SAE-L018	

SECTION 5 MECHATRONICS SYSTEM

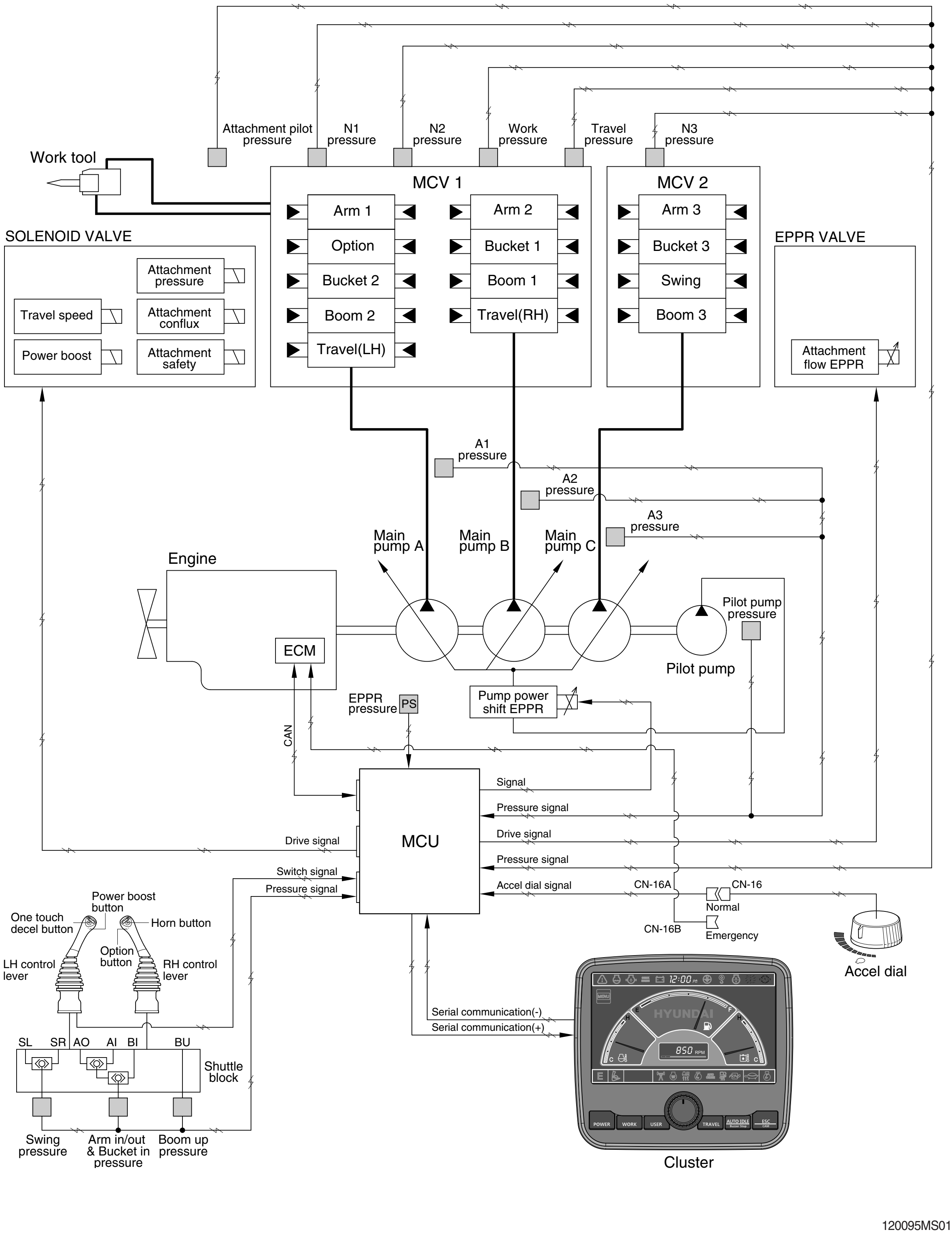
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

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

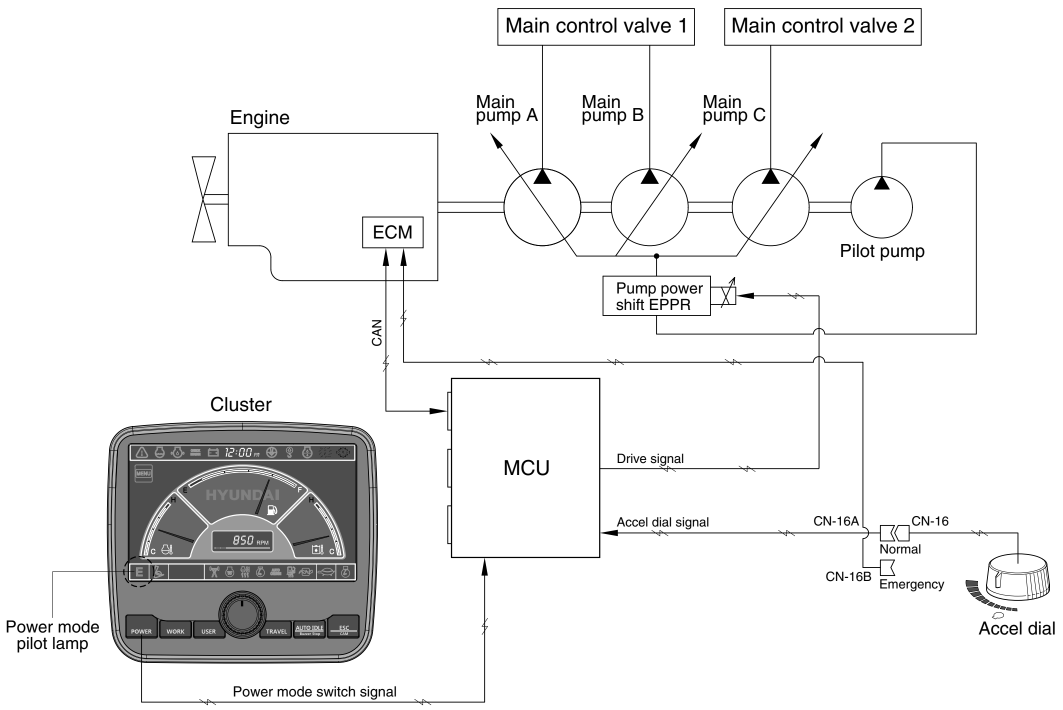
- ADVANCED CAPO SYSTEM
  - Mode selection system
    - Power mode selection (P, S, E)
    - Work mode selection
    - User mode system (U)
  - Auto deceleration system
  - Power boost system
  - Travel speed control system
  - Automatic warming up system
  - Overheat prevention system
  - Variable power control system
  - Attachment flow control system
  - Anti-restart system
  - Self-diagnostic system
    - MCU & cluster protection
    - Open-short diagnosis & error code display
    - Machine error & ECM fault code display
  - Machine monitoring system
    - Machine condition monitoring
    - Electric signal monitoring
  - One touch deceleration system

SYSTEM DIAGRAM



GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



120095MS02

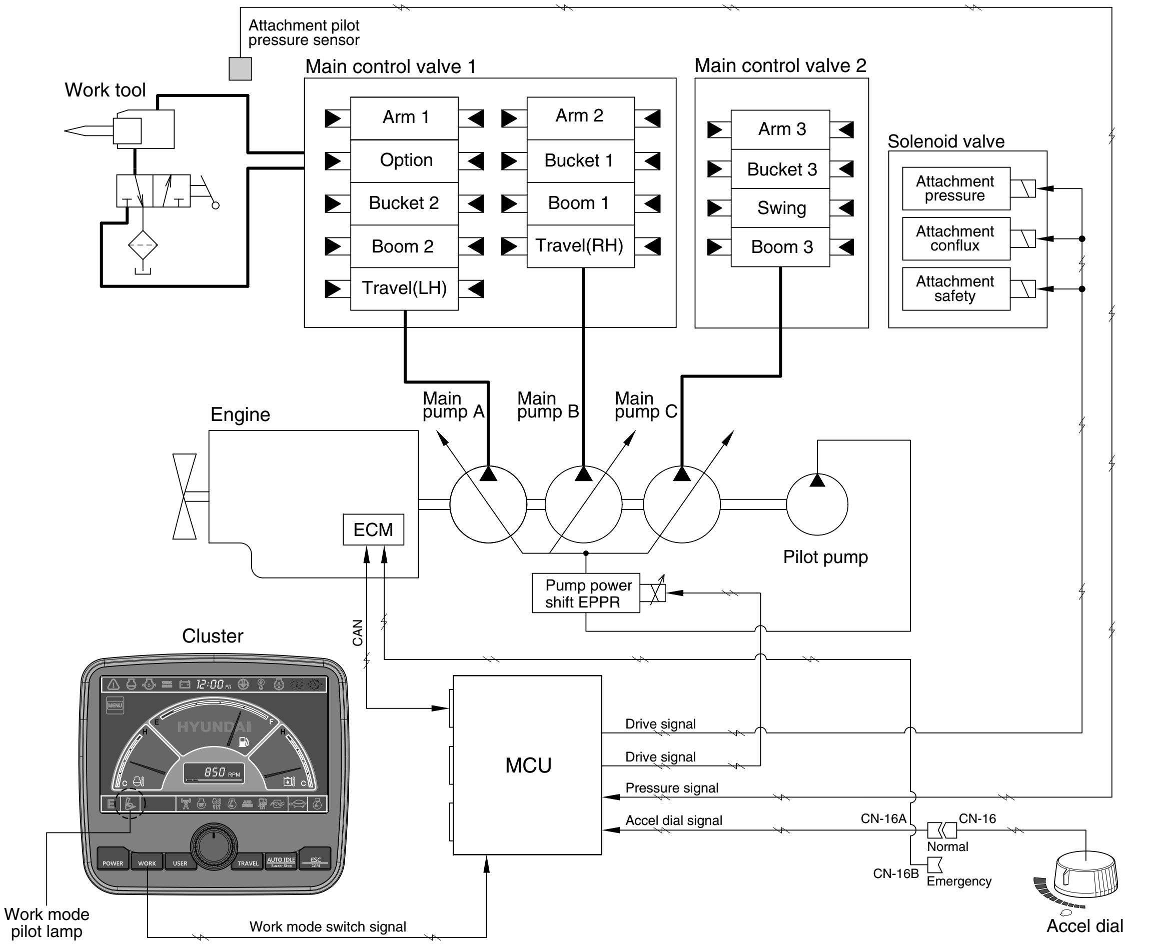
Mode selection system (micro computer based electro-hydraulic pump and engine mutual control system) optimizes the engine and pump performance.
The combination of 3 power modes (P, S, E) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Power mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
P	Heavy duty power	1800±50	1750±50	1850±50	1800±50	330±30	10	160±30	0
S	Standard power	1700±50	1650±50	1750±50	1700±50	330±30	10±3	280±30	7
E	Economy operation	1600±50	1650±50	1650±50	1700±50	400±30	15±3	360±30	12
AUTO DECEL	Engine deceleration	1100±100	-	1100±100	-	700±30	38±3	700±30	38±3
One touch decel	Engine quick deceleration	900±100	-	900±100	-	700±30	38±3	700±30	38±3
KEY START	Key switch start position	900±100	-	900±100	-	700±30	38±3	700±30	38±3

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

2. WORK MODE SELECTION SYSTEM

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



120095MS03

1) GENERAL WORK MODE (bucket)

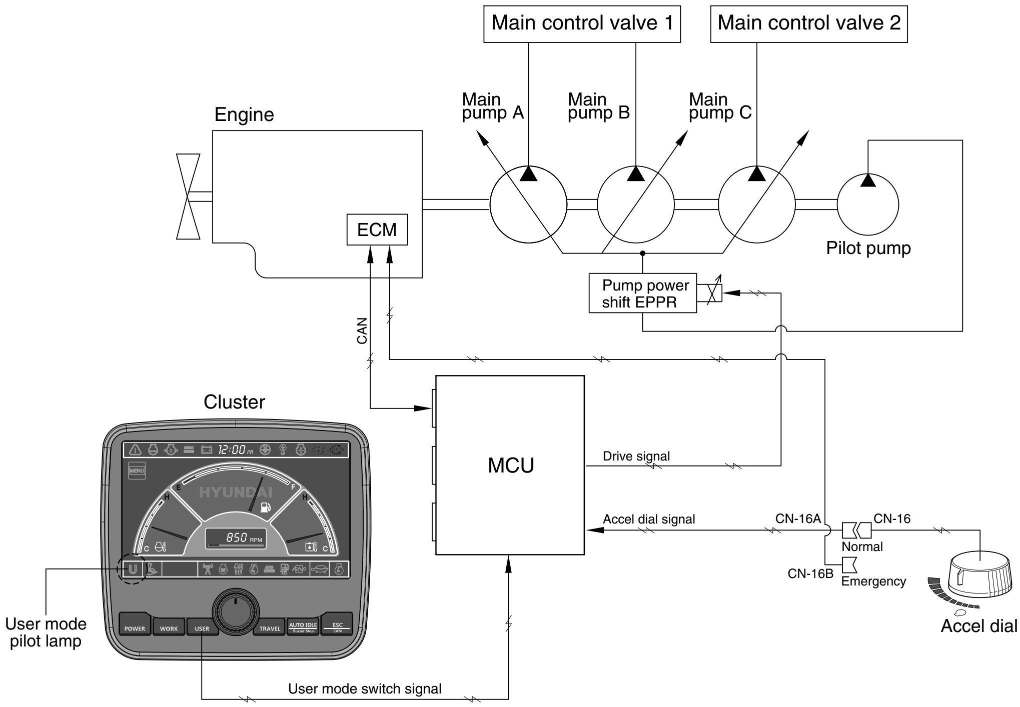
This mode is used to general digging work.

2) ATT WORK MODE (breaker, crusher)

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

Description	General mode	Work tool	
	Bucket	Breaker	Crusher
Attachment safety solenoid	OFF	ON	ON
Attachment pressure solenoid	OFF	OFF	ON
Attachment conflux solenoid	OFF	OFF	ON/OFF
Attachment flow EPPR current	100 mA	100~700 mA	100~700 mA

3. USER MODE SELECTION SYSTEM



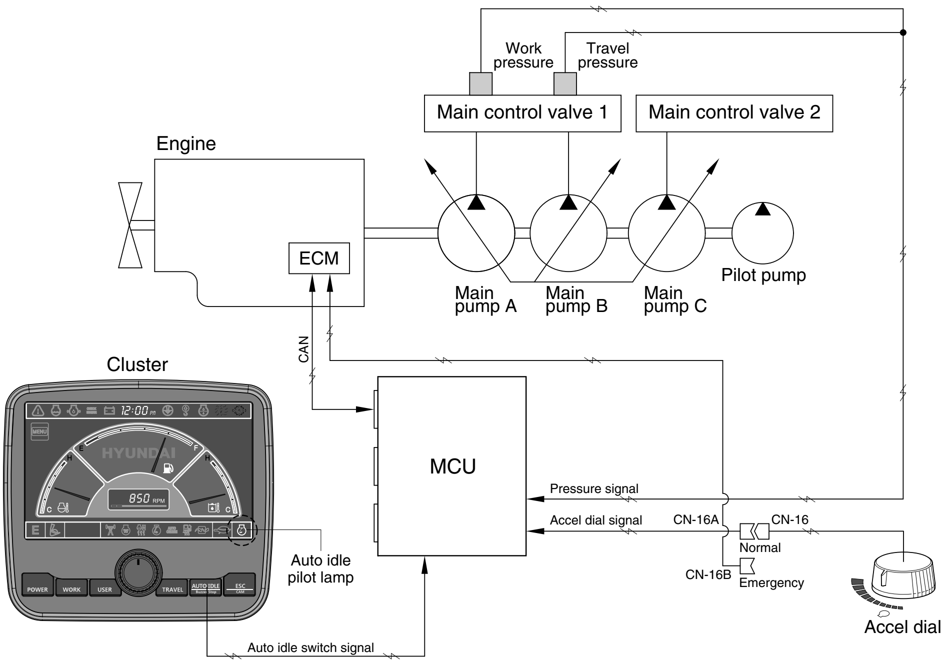
120095MS04

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

2) LCD segment vs parameter setting

Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	800	0
2	1400	850	3
3	1500	900 (low idle)	6
4	1550	950	9
5	1600	1000	12
6	1650	1050	16
7	1700	1100 (decel rpm)	20
8	1750	1150	26
9	1800	1200	32
10	1850	1250	38

GROUP 3 AUTOMATIC DECELERATION SYSTEM

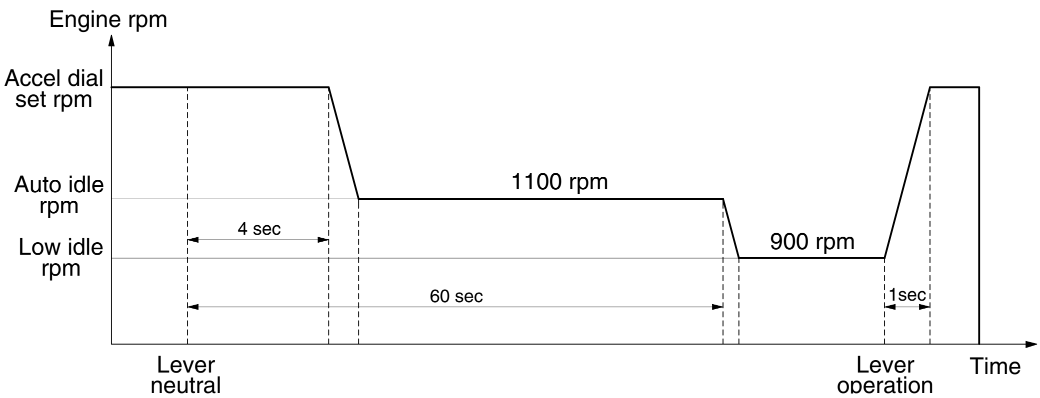


120095MS05

1. WHEN AUTO IDLE PILOT LAMP ON

When all of the work equipment control levers including swing and travel levers are at neutral for 4 seconds, MCU sends throttle command to ECM to reduce the engine speed to 1100 rpm. If the control levers are at neutral for 1 minute, MCU reduces the engine speed to 900 rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

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



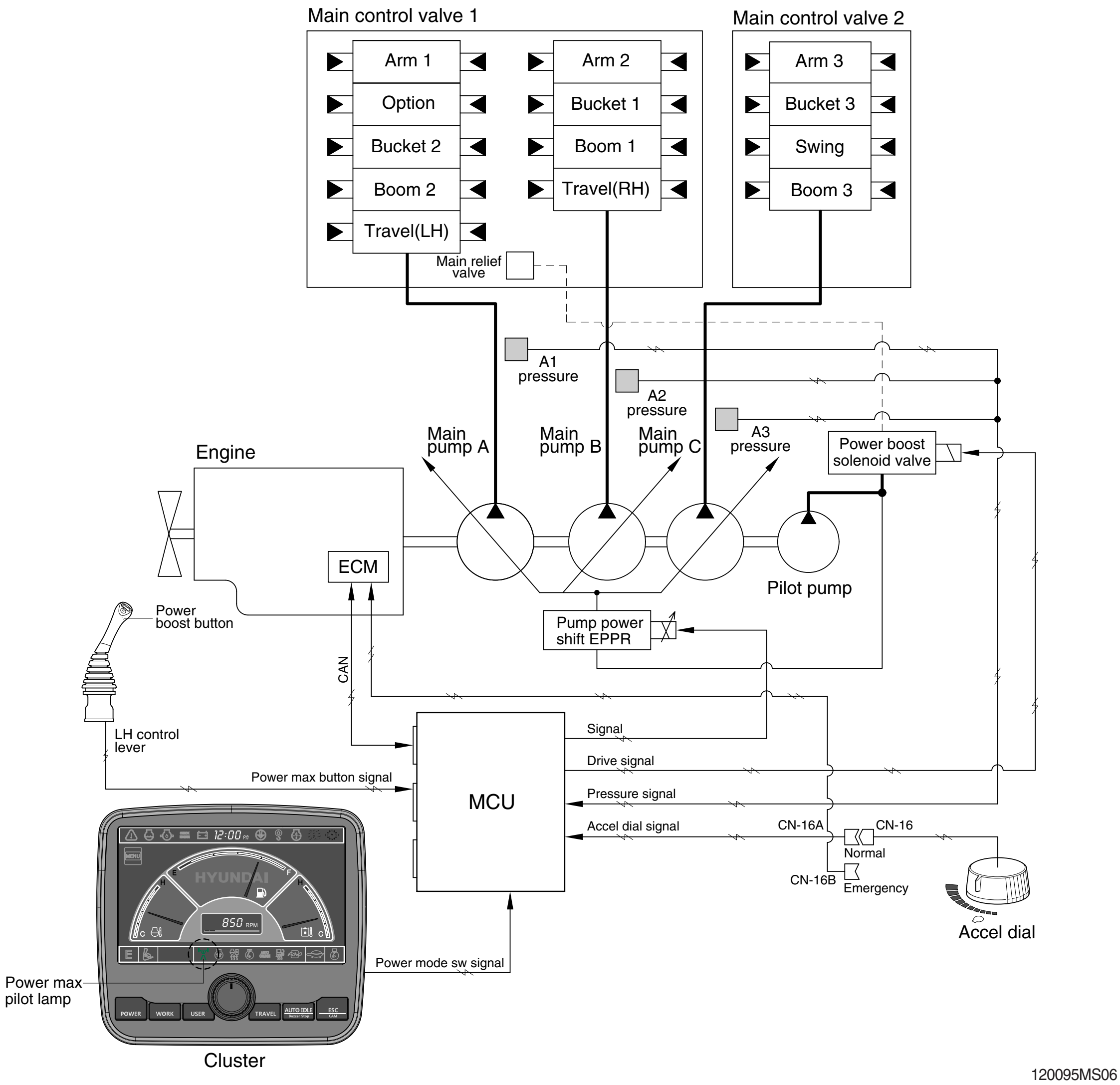
120095MS07

2. WHEN AUTO IDLE PILOT LAMP OFF

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

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

GROUP 4 POWER BOOST SYSTEM



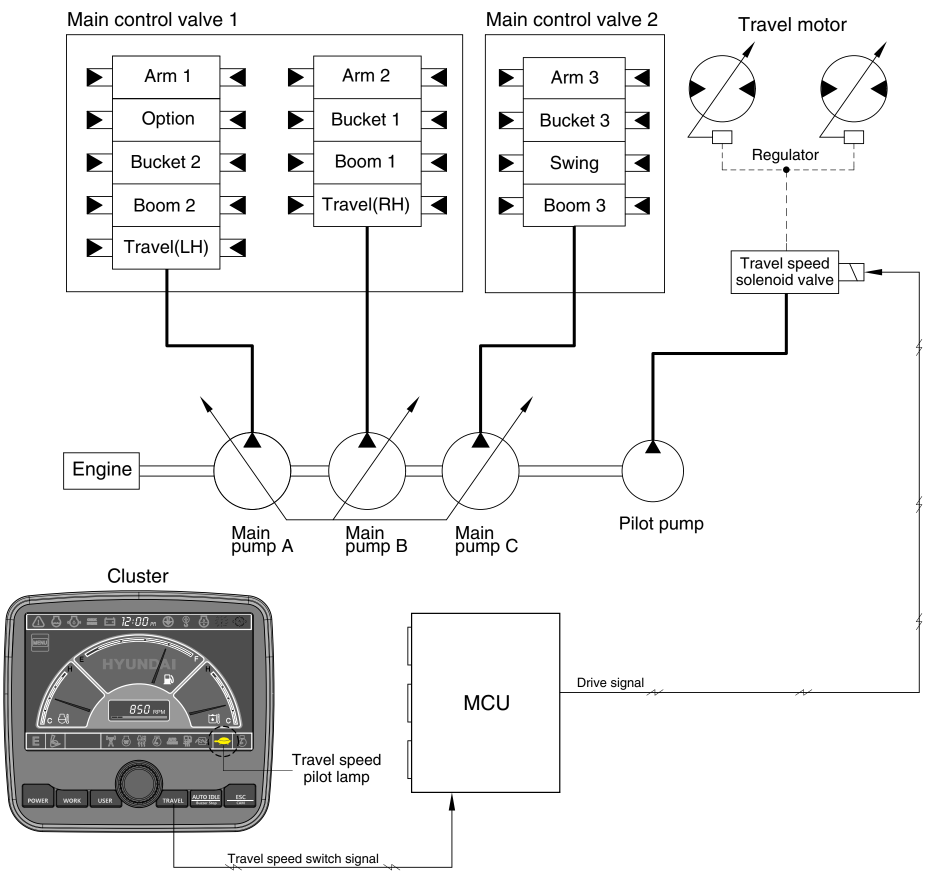
· When the power boost switch on the left control lever knob is pushed ON, the power mode is set P mode and maximum digging power is increased by 10 %.

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

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

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

GROUP 5 TRAVEL SPEED CONTROL SYSTEM



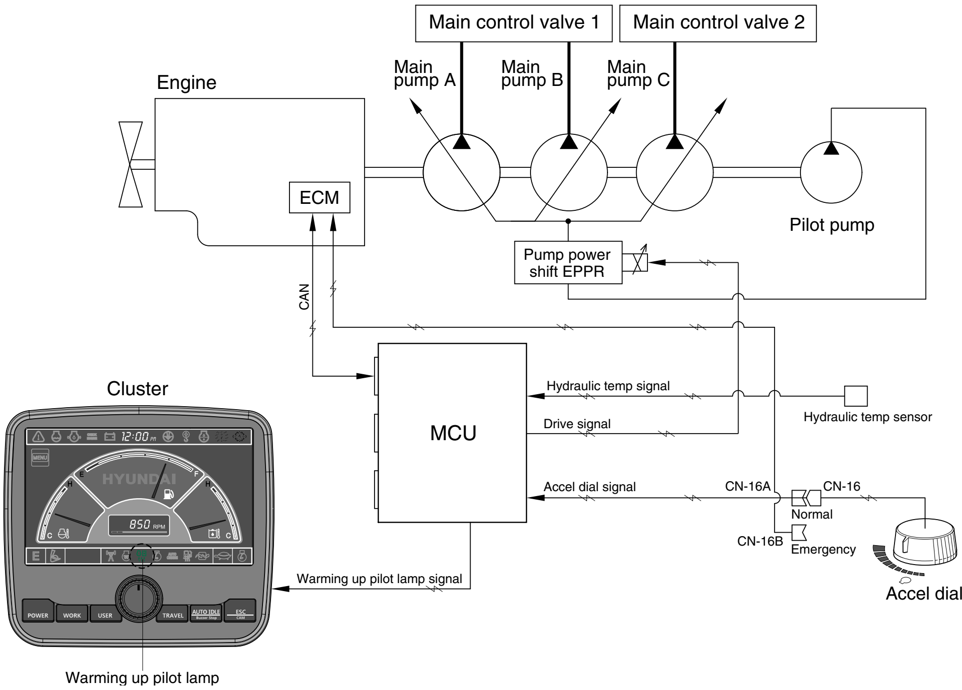
120095MS08

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

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

※ Default : Turtle (Low)

GROUP 6 AUTOMATIC WARMING UP SYSTEM



120095MS09

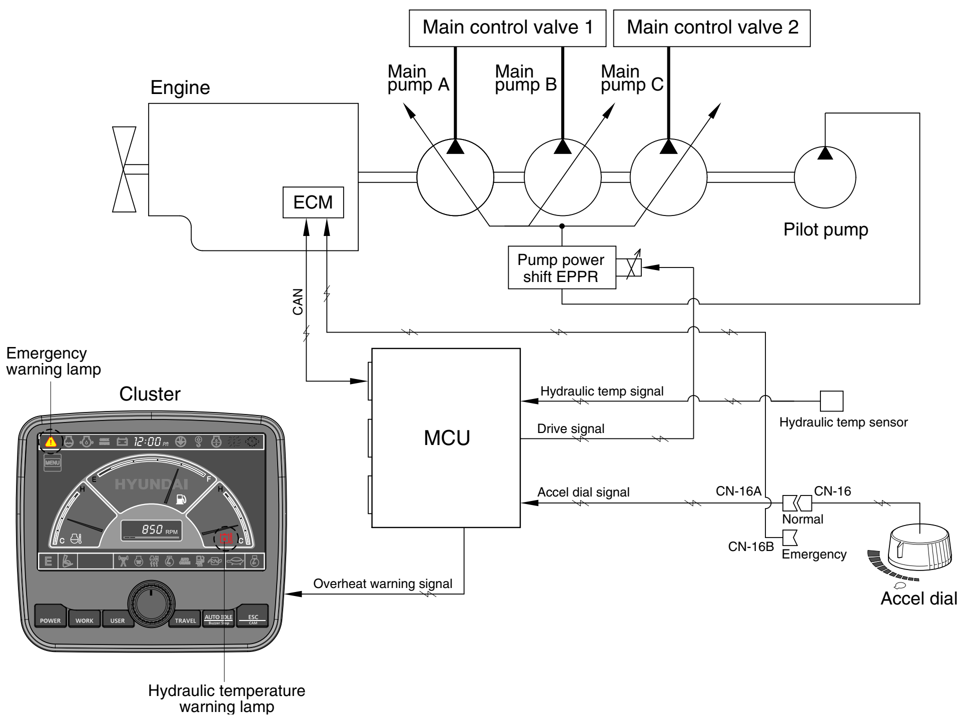
1. The MCU receives the engine coolant temperature from the ECM, and if the coolant temperature is below 30˚C, it increases the engine speed from key start rpm to 1200rpm. At this time the mode does not change. If the coolant temperature sensor has fault, the hydraulic oil temperature signal is substituted.

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

3. LOGIC TABLE

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

GROUP 7 ENGINE OVERHEAT PREVENTION SYSTEM



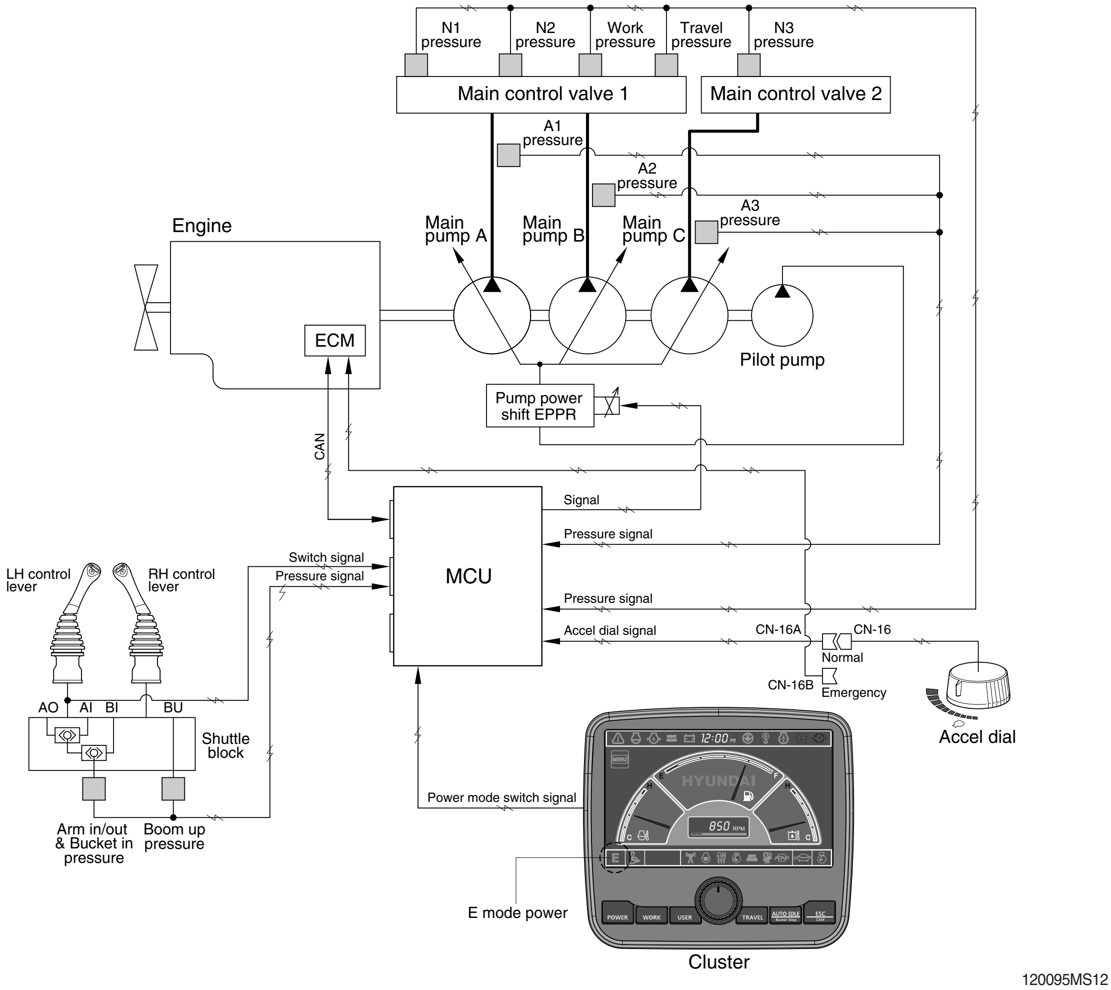
120095MS11

1. The engine coolant temperature or the hydraulic oil temperature is overheated over 100˚C, the warning lamp is ON and the pump input torque or the engine speed is reduced as below logic table.

2. LOGIC TABLE

Description		Condition	Function
First step warning	Activated	- Coolant temperature : Above 103˚C	- Warning lamp : ON , buzzer : OFF - Pump input torque is reduced.
		- Hydraulic oil temperature : Above 100˚C	- Warning lamp & buzzer : ON - Pump input torque is reduced.
	Canceled	- Coolant temperature : Less than 100˚C - Hydraulic oil temperature : Less than 95˚C	- Return to pre-set the pump absorption torque.
Second step warning	Activated	- Coolant or hydraulic oil temperature : Above 105˚C	- Emergency warning lamp pops up on the center of LCD and the buzzer sounds. - Engine speed is reduced after 10 seconds.
	Canceled	- Coolant temperature : Less than 103˚C - Hydraulic oil temperature : Less than 100˚C	- Return to pre-set the engine speed. - Hold pump absorption torque on the first step warning.

GROUP 8 VARIABLE POWER CONTROL SYSTEM

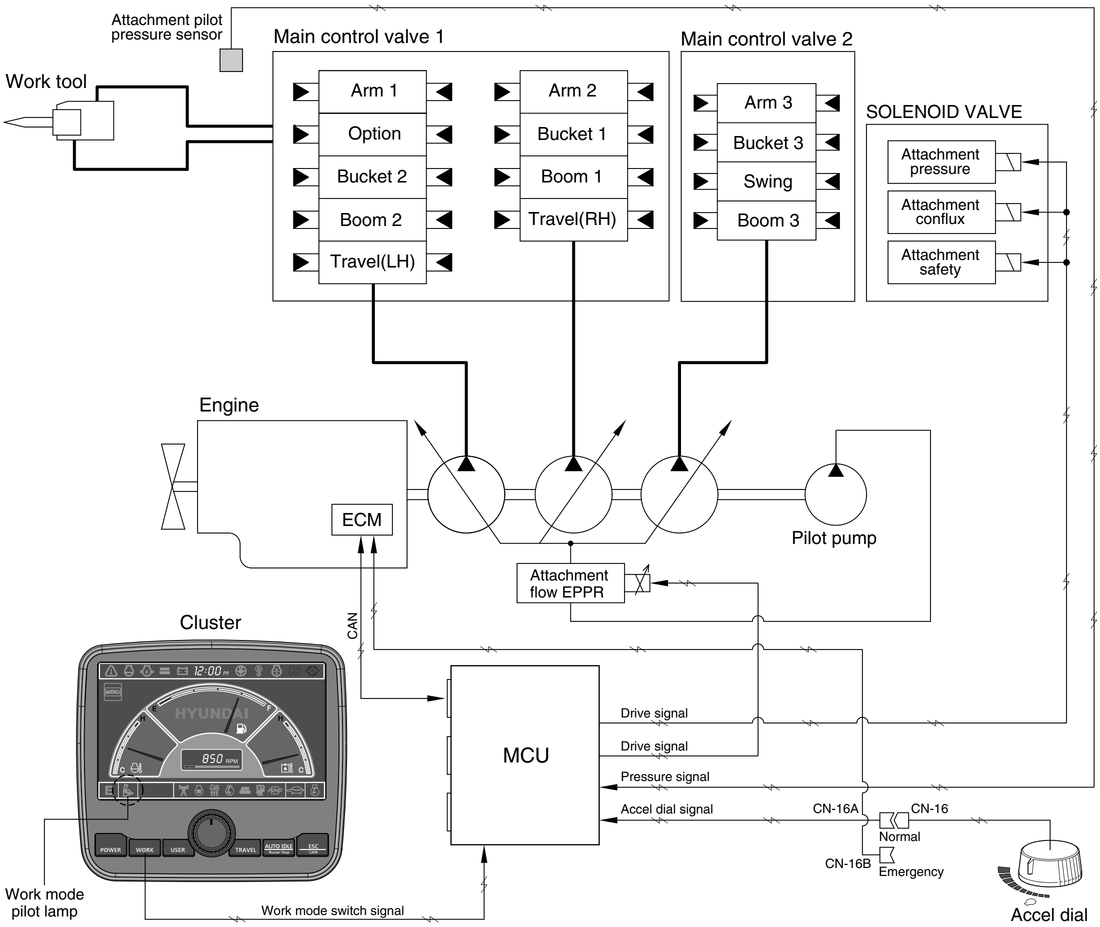


· The variable power control system controls the engine and pump mutual power according to RCV lever stroke and pump load.
It makes fuel saving and smooth control at precise work.

Description	Working condition
Power mode	E
Work mode	General (bucket)
Pressure sensor	Normal

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

GROUP 9 ATTACHMENT FLOW CONTROL SYSTEM



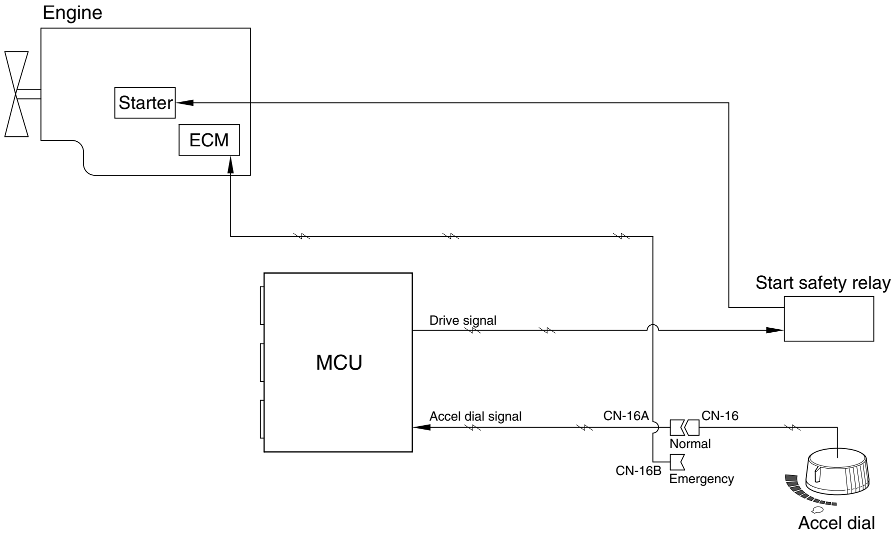
120095MS13

· The system is used to control the pump delivery flow according to set of the work tool on the cluster by the attachment flow EPPR valve.

Description	Work tool	
	Breaker	Crusher
Flow level	Max 7 step, reduced 10 lpm each step	Max 4 step, reduced 20 lpm each step
Attach safety solenoid	ON	ON
Attach pressure solenoid	OFF	ON
Attach conflux solenoid	OFF	ON/OFF

※ **Refer to the page 5-42 for the attachment kinds and max flow.**

GROUP 10 ANTI-RESTART SYSTEM



120095MS14

1. ANTI-RESTART FUNCTION

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

2. When a replacement or taking-off of the MCU is needed, connect CN-16 and CN-16B to ensure the engine start without the MCU.

GROUP 11 SELF-DIAGNOSTIC SYSTEM

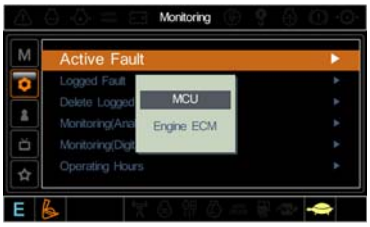
1. OUTLINE

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

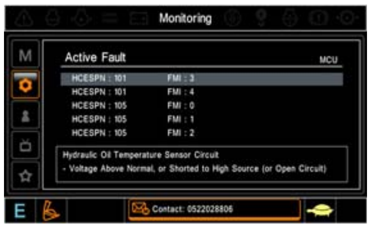
2. MONITORING

1) Active fault

21093CD66



21093CD66A

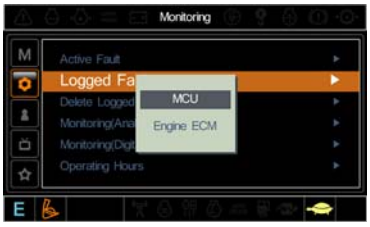


21093CD66B

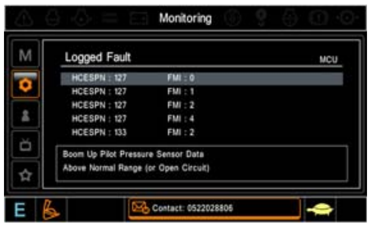
· The active faults of the MCU or engine ECM can be checked by this menu.

2) Logged fault

21093CD66C



21093CD66D



21093CD66E

· The logged faults of the MCU or engine ECM can be checked by this menu.

3) Delete fault

21093CD66F

21093CD66G

21093CD66H

· The logged faults of the MCU or engine ECM can be deleted by this menu.

3. MACHINE ERROR CODES TABLE

Error code HCESPN	Error code FMI	Description
101	3	Hydraulic oil temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Hydraulic oil temperature circuit - Voltage below normal, or shorted to low source.
105	0	Working pressure sensor data above normal range.
	1	Working pressure sensor data below normal range.
	2	Working pressure sensor data error.
	4	Working pressure sensor circuit - Voltage below normal, or shorted to Low source.
108	0	Travel oil pressure sensor data above normal range.
	1	Travel oil pressure sensor data below normal range.
	2	Travel oil pressure sensor data error.
	4	Travel oil pressure sensor circuit - Voltage below normal, or shorted to low source.
120	0	Main pump 1 (P1) pressure sensor data above normal range.
	1	Main pump 1 (P1) pressure sensor data below normal range.
	2	Main pump 1 (P1) pressure sensor data error.
	4	Main pump 1 (P1) pressure sensor circuit - Voltage below normal, or shorted to low source.
121	0	Main pump 2 (P2) pressure sensor data above normal range.
	1	Main pump 2 (P2) pressure sensor data below normal range.
	2	Main pump 2 (P2) pressure sensor data error.
	4	Main pump 2 (P2) pressure sensor circuit - Voltage below normal, or shorted to low source.
122	0	Overhead pressure sensor data above normal range.
	1	Overhead pressure sensor data below normal range.
	2	Overhead pressure sensor data error.
	4	Overhead pressure sensor circuit - Voltage below normal, or shorted to low source.
123	0	Negative 1 pressure sensor data above normal range.
	1	Negative 1 pressure sensor data below normal range.
	2	Negative 1 pressure sensor data error.
	4	Negative 1 pressure sensor circuit - Voltage below normal, or shorted to low source.
124	0	Negative 2 Pressure sensor data above normal range.
	1	Negative 2 Pressure sensor data below normal range.
	2	Negative 2 Pressure sensor data error.
	4	Negative 2 Pressure sensor circuit - Voltage below normal, or shorted to low source.
125	0	Pilot pump (P3) pressure sensor data above normal range.
	1	Pilot pump (P3) pressure sensor data below normal range.
	2	Pilot pump (P3) pressure sensor data error.
	4	Pilot pump (P3) pressure sensor circuit - Voltage below normal, or shorted to low source.
127	0	Boom up pilot pressure sensor data above normal range.
	1	Boom up pilot pressure sensor data below normal range.
	2	Boom up pilot pressure sensor data error.
	4	Boom up pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
133	0	Arm in/out & bucket in pilot pressure sensor data above normal range.
	1	Arm in/out & bucket in pilot pressure sensor data below normal range.
	2	Arm in/out & bucket in pilot pressure sensor data error.
	4	Arm in/out & bucket in pilot pressure sensor circuit - Voltage below normal, or shorted to low source.

※ **Some error codes are not applied to this machine.**

Error code		Description
HCESPN	FMI	
135	0	Swing pilot pressure sensor data above normal range.
	1	Swing pilot pressure sensor data below normal range.
	2	Swing pilot pressure sensor data error.
	4	Swing pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
138	0	Attachment pilot pressure sensor data above normal range.
	1	Attachment pilot pressure sensor data below normal range.
	2	Attachment pilot pressure sensor data error.
	4	Attachment pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
140	5	Pump EPPR valve circuit - Current below normal, or open circuit.
	6	Pump EPPR valve circuit - Current above normal.
141	5	Boom priority EPPR valve circuit - Current below normal, or open circuit.
	6	Boom priority EPPR valve circuit - Current above normal.
143	5	Travel EPPR valve circuit - Current below normal, or open circuit.
	6	Travel EPPR valve circuit - Current above normal.
144	5	Attachment flow EPPR valve circuit - Current below normal, or open circuit.
	6	Attachment flow EPPR valve circuit - Current above normal.
145	5	Remote cooling fan EPPR valve circuit - Current below normal, or open circuit.
	6	Remote cooling fan EPPR valve circuit - Current above normal.
150	5	Left rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Left rotate EPPR valve circuit - Current above normal.
151	5	Right rotate EPPR valve circuit - Current below normal, or open circuit.
	6	Right rotate EPPR valve circuit - Current above normal.
152	5	Left tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Left tilt EPPR valve circuit - Current above normal.
153	5	Right tilt EPPR valve circuit - Current below normal, or open circuit.
	6	Right tilt EPPR valve circuit - Current above normal.
166	5	Power max solenoid circuit - Current below normal, or open circuit.
	6	Power max solenoid circuit - Current above normal.
167	5	Travel speed solenoid circuit - Current below normal, or open circuit.
	6	Travel speed solenoid circuit - Current above normal.
168	5	Attachment pressure solenoid circuit - Current below normal, or open circuit.
	6	Attachment pressure solenoid circuit - Current above normal.
169	5	Attachment conflux solenoid circuit - Current below normal, or open circuit.
	6	Attachment conflux solenoid circuit - Current above normal.
170	5	Arm regeneration solenoid circuit - Current below normal, or open circuit.
	6	Arm regeneration solenoid circuit - Current above normal.
171	5	Attachment safety solenoid circuit - Current below normal, or open circuit.
	6	Attachment safety solenoid circuit - Current above normal.
181	5	Remote cooling fan reverse solenoid circuit - Current below normal, or open circuit.
	6	Remote cooling fan reverse solenoid circuit - Current above normal.
301	5	Fuel level sensor circuit - Voltage above normal, or shorted to high source.
	6	Fuel level sensor circuit - Voltage below normal, or shorted to low source.
304	3	Engine coolant temperature sensor circuit - Voltage above normal, or shorted to high source.
	4	Engine coolant temperature sensor circuit - Voltage below normal, or shorted to low source.
310	8	Engine speed signal error - Abnormal frequency or pulse width.
322	3	Engine preheat relay circuit - Voltage above normal, or shorted to high source.
	4	Engine preheat relay circuit - Voltage below normal, or shorted to low source.
325	3	Fuel warmer relay circuit - Voltage above normal, or shorted to high source.
	4	Fuel warmer relay circuit - Voltage below normal, or shorted to low source.

※ Some error codes are not applied to this machine.

Error code		Description
HCESPN	FMI	
340	3	Potentiometer (G/A) circuit - Voltage above normal, or shorted to high source.
	4	Potentiometer (G/A) circuit - Voltage below normal, or shorted to low source.
341	5	Governor actuator circuit - Current below normal, or open circuit.
	6	Governor actuator circuit - Current above normal.
501	0	Transmission oil pressure sensor data above normal range.
	1	Transmission oil pressure sensor data below normal range.
	2	Transmission oil pressure sensor data error.
	4	Transmission oil pressure sensor circuit - Voltage below normal, or shorted to low source.
503	0	Brake pressure sensor data above normal range.
	1	Brake pressure sensor data below normal range.
	2	Brake pressure sensor data error.
	4	Brake pressure sensor circuit - Voltage below normal, or shorted to low source.
505	0	Working brake pressure sensor data above normal range.
	1	Working brake pressure sensor data below normal range.
	2	Working brake pressure sensor data error.
	4	Working brake pressure sensor circuit - Voltage below normal, or shorted to low source.
506	3	Working brake lamp circuit - Voltage above normal, or shorted to high source.
	4	Working brake lamp circuit - Voltage below normal, or shorted to low source.
520	3	Ram lock lamp circuit - Voltage above normal, or shorted to high source.
	4	Ram lock lamp circuit - Voltage below normal, or shorted to low source.
525	5	Ram lock solenoid circuit - Current below normal, or open circuit.
	6	Ram lock solenoid circuit - Current above normal.
530	0	Travel F pilot pressure sensor data above normal range.
	1	Travel F pilot pressure sensor data below normal range.
	2	Travel F pilot pressure sensor data error.
	4	Travel F pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
531	0	Travel R pilot pressure sensor data above normal range.
	1	Travel R pilot pressure sensor data below normal range.
	2	Travel R pilot pressure sensor data error.
	4	Travel R pilot pressure sensor circuit - Voltage below normal, or shorted to low source.
701	3	Hourmeter circuit - Voltage above normal, or shorted to high source.
	4	Hourmeter circuit - Voltage below normal, or shorted to low source.
705	0	MCU input voltage high.
	1	MCU input voltage low.
707	1	Alternator node I voltage low.
714	3	Acc. dial circuit - Voltage above normal, or shorted to high source.
	4	Acc. dial circuit - Voltage below normal, or shorted to low source.
715	3	Rotate signal input circuit - Voltage above normal, or shorted to high source.
	4	Rotate signal input circuit - Voltage below normal, or shorted to low source.
716	3	Tilt signal input circuit - Voltage above normal, or shorted to high source.
	4	Tilt signal input circuit - Voltage below normal, or shorted to low source.
722	3	Travel alarm (buzzer) circuit - Voltage above normal, or shorted to high source.
	4	Travel alarm (buzzer) circuit - Voltage below normal, or shorted to low source.
830	12	MCU internal memory error.
840	2	Cluster communication data error.
841	2	ECM communication data error.
843	2	Option #1 (CAN 2) communication data error.
850	2	RCM communication data error.

※ Some error codes are not applied to this machine.

4. ENGINE FAULT CODE

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
111 629 12	Error internal to the ECM related to memory hardware failures or internal processor communication failures.	Mission-disabling failure. Engine **not** allowed to start.
112 635 7	The error between estimated timing fueling and desired timing fueling is outside acceptable limits.	Depending on the calibration, the engine will shut down or speed-derate or no action by the ECM is taken.
113 635 3	Timing actuator circuit is open, or supply pin 1 is shorted to ground, or return pin 20 is shorted to battery voltage.	No action by the ECM is taken. Actuator is closed or partially closed. Engine exhausts white smoke and loses power. Fault code 112 can possibly be logged.
115 190 2	No engine speed signal detected at pins 27, 28, 37 and 38 of the engine harness.	Engine is shut down and can **not** be run.
116 156 3	More than 4.78 VDC detected at timing pressure sensor signal pin 33 of the engine harness.	Depending on the calibration, the engine will shut down or speed-derate, or no action by the ECM is taken.
117 156 4	Less than 0.15 VDC detected at timing pressure sensor signal pin 33 of the engine harness.	Depending on the calibration, the engine will shut down or speed-derate, or no action by the ECM is taken.
118 135 3	More than 4.78 VDC detected at fuel pump pressure sensor signal pin 32 of the engine harness.	No action by the ECM is taken.
119 135 4	Less than 0.30 VDC detected at fuel pump pressure sensor signal pin 32 of the engine harness.	No action by the ECM is taken.
121 190 10	No engine speed signal detected at one pair of pins, either pin 27, 28, 37 or 38 of the engine harness.	No action by the ECM is taken.
122 102 3	More than 4.72 VDC detected at the intake manifold air pressure sensor signal pin 35 of the engine harness.	Engine power derate to no-air setting.
123 102 4	Less than 0.33 VDC detected at the intake manifold air pressure sensor signal pin 35 of the engine harness.	Engine power derate to no-air setting.
131 091 3	More than 4.20 VDC detected at the accelerator pedal or lever position signal pin 29 of the OEM interface harness.	Calibration dependent power and speed derate.
132 091 4	Less than 0.13 VDC detected at the accelerator pedal or lever position signal pin 29 of the OEM interface harness ECM connector.	Calibration dependent power and speed derate.
133 029 3	More than 4.82 VDC detected at the remote throttle position signal pin 30 of the OEM interface harness.	Calibration dependent power and speed derate.
134 029 4	Less than 0.12 VDC detected at the remote accelerator pedal or lever position signal pin 30 of the OEM interface harness.	Calibration dependent power and speed derate.
135 100 3	More than 4.88 VDC detected at the engine oil pressure sensor signal pin 24 of the engine harness.	No engine protection for oil pressure. Centinel system is disabled.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
141 100 4	Less than 0.31 VDC detected at the engine oil pressure sensor signal pin 24 of the engine harness.	No engine protection for oil pressure. Centinel system is disabled.
143 100 1	Low oil pressure has been detected. Voltage signal at oil pressure signal pin 24 of the engine harness indicates oil pressure lower than 103 kPa (15 psi) at 600 rpm, 131 kPa (19 psi) at 800 rpm, 165 kPa (24 psi) at 1500 rpm, and 207 kPa (30 psi) above 2100 rpm.	Calibration dependent progressive power derate and engine shutdown with increasing time after alert. Centinel™ system is disabled.
144 110 3	More than 4.95 VDC detected at the coolant temperature signal pin 22 of the engine harness.	Possible white smoke. No engine protection for coolant temperature. Centinel™ system is disabled.
145 110 4	Less than 0.21 VDC detected at the coolant temperature signal pin 22 of the engine harness.	Possible white smoke. No engine protection for coolant temperature. Centinel™ system is disabled.
147 091 8	A frequency of less than 100Hz has been detected at the frequency accelerator signal pin 17 of the OEM interface harness.	Calibration dependent power and speed derate.
148 091 8	A frequency of more than 1500Hz has been detected at the frequency accelerator signal pin 17 of the OEM interface harness.	Calibration dependent power and speed derate.
151 110 0	High coolant temperature has been detected. Voltage signal at coolant temperature signal pin 22 indicates the coolant temperature is above 100˚C (212˚F).	Calibration dependent progressive power and speed derate and engine shutdown as temperature increases over thresholds. Centinel™ system is disabled.
153 105 3	More than 4.88 VDC detected at the intake manifold temperature sensor signal pin 23 of the engine harness ECM connector.	No engine protection for the intake manifold air temperature.
154 105 4	Less than 0.08 VDC detected at the intake manifold air temperature signal pin 23 of the engine harness.	No engine protection for the intake manifold air temperature.
155 105 0	High intake air manifold temperature has been detected. Voltage signal at intake manifold air temperature signal pin 23 indicates intake manifold air temperature above 104˚C (219˚F).	Calibration dependent progressive power and speed derate and engine shutdown as the temperature increases over thresholds.
219 1380 1	Low oil level detected in the remote oil reservoir used in the Centinel™ system.	Centinel™ system is disabled.
221 108 3	More than 4.78 VDC detected at the ambient air pressure sensor signal pin 34 of the engine harness.	Derate in power output of the engine.
222 108 4	Less than 0.20 VDC detected at the ambient air pressure sensor signal pin 34 of the engine harness.	Derate in power output of the engine.
223 1265 4	The Centinel™ burn valve solenoid circuit is open or shorted. Less than 18.0 VDC detected at the Centinel™ burn valve solenoid supply pin 8 of the OEM interface harness or resistance of the solenoid has dropped below 80 ohms.	ECM turns off the burn valve supply voltage and the Centinel™ system is disabled.
225 1266 4	The centinel™ make-up valve solenoid circuit is open or shorted. Less than 18.0 VDC detected at Centinel™ make-up valve solenoid supply pin 2 of the engine harness or resistance of the solenoid has dropped below 80 ohms.	ECM turns off the Centinel™ make-up valve supply voltage and the Centinel™ system is disabled.

111Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
231 109 3	More than 4.72 VDC detected at the coolant pressure sensor signal pin 16 of the engine harness.	No engine protection for coolant pressure.
232 109 4	Less than 0.33 VDC detected at the coolant pressure sensor signal pin 16 of the engine harness.	No engine protection for coolant pressure.
233 109 1	Low coolant pressure has been detected. Voltage signal at coolant pressure signal pin 16 of the engine harness indicates coolant pressure lower than 28 kPa (4 psi) at 800 rpm, 41 kPa (6 psi) at 1300 rpm, 76 kPa (11 psi) at 1800 rpm, 96 kPa (14 psi) at 2000 rpm and 103 kPa (15 psi) above 2100 rpm.	Calibration dependent progressive power and speed derate and engine shutdown with increasing time after alert.
234 190 0	Engine speed signal on pin 27 and pin 28 and/or pin 37 and pin 38 of the engine harness indicates an engine speed greater than the safe operation rpm limit. The limit is 2450 rpm for the QSK19 and 2190 rpm for the QSK60.	Fuel shutoff valve deenergizes (valve closes). The valve reenergizes (fuel shut off valve opens) when engine speed falls below its upper rpm threshold.
235 111 1	Low coolant level has been detected. Voltage signal on the coolant level signal pin 23 of the OEM harness indicates low radiator coolant level on the vehicle	Calibration dependent progressive power and speed derate and engine shutdown with increasing time after alert.
237 644 2	Duty cycle of input throttle signal pin 17 of the OEM interface harness is less than 3 percent or more than 97 percent.	The primary engine and secondary engines are shut down with increasing time after alert if hard coupled. **Only** the secondary engines are shut down with increasing time after alert if soft coupled.
252 098 2	Oil level sensor error.	No engine protection for low oil level. CentinelTM system is disabled.
253 098 1	Low coolant level has been detected. Voltage signal on the oil level signal pin 12 of the engine harness indicates low oil level in the engine.	Calibration dependent progressive power derate and engine shutdown with increasing time after alert.
254 632 4	The fuel shutoff valve solenoid dircuit is open or shorted. Less than 6.0 VDC detected at fuel shutoff valve solenoid supply pin 30 of the engine harness or resistance of the solenoid has dropped below 20 ohms.	ECM turns off fuel shutoff valve supply voltage. The engine dies.
259 632 7	Fuel shutoff valve is open and will **not** close.	No action by the ECM is taken.
261 174 0	High fuel temperature has been detected. Voltage signal at fuel temperature signal pin 26 of engine harness indicates fuel temperature above 71˚C (160˚F).	Calibration dependent progressive power and speed derate and engine shutdown withe increasing time after alert.
263 174 3	More than 4.95 VDC detected at the fuel temperature signal pin 26 of the engine harness.	No engine protection for fuel temperature.
265 174 4	Less than 0.21 VDC detected at the fuel temperature signal pin 26 of the engine harness.	No engine protection for fuel temperature.
292 1083 14	OEM temperature out-of-range has been detected. Voltage signal at OEM temperature signal pin 27 indicates OEM temperature beyond the OEM specified threshold.	Calibration dependent progressive power and speed derate and engine shutdown with increasing time after alert.

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
293 1083 3	VDC detected at the OEM temperature sensor signal pin 27 of the OEM interface harness indicates the sensor has failed high.	No engine protection for OEM temperature.
294 1083 4	VDC detected at the OEM temperature sensor signal pin 27 of the OEM interface harness indicates the sensor has failed low.	No engine protection for OEM temperature.
296 1084 14	OEM pressure out-of-range has been detected. Voltage signal at OEM pressure signal pin 27 indicates OEM pressure beyond OEM specified threshold.	OEM and calibration dependent progressive power and speed derate and engine shutdown with increasing time after alert.
297 1084 3	VDC detected at the OEM pressure sensor signal pin 15 of the OEM interface harness indicates the sensor has failed high.	No engine protection for OEM pressure.
298 1084 4	VDC detected at the OEM pressure sensor signal pin 15 of the OEM interface harness indicates the sensor has failed low.	No engine protection for OEM pressure.
299 - -	The engine was shutdown by device other than the key switch before proper engine cooldown, resulting in a load factor above the maximum shutdown threshold. Fault Code 299 will be logged if the engine is shut down while hot by the engine protection feature or other OEM devices.	No action taken by the ECM.
316 931 3	Fuel pump actuator circuit is open, or supply pin 11 is shorted to battery voltage or ground, or return pin 40 is shorted to battery voltage or ground in the engine harness.	No action by the ECM is taken. Actuator is open or close, or or partially closed.
318 931 7	The error between estimated fuel pump pressure and desired fuel pump pressure is outside acceptable limits.	No action by the ECM is taken.
343 629 12	Microprocessor communication error internal to the ECM.	Variable; performance will or will not be affected.
346 630 12	ECM powerdown internal data store error.	Powerdown data are lost. Powerdown data include maintenance monitoring, present ECM and engine dalta times, and past fault dat.
349 191 0	A frequency of greater than a calibrated threshold has been detected at frequency accelerator signal pin 17 of the OEM interface harness.	Calibration dependent power and speed derate.
384 626 11	The ether injection solenoid circuit is open or shorted at pin 2 of the engine harness.	Ether injection feature is disabled.
415 100 1	Very low oil pressure has been detected. Voltage signal at oil pressure signal pin 24 of the engine harness indicates oil pressure lower than 83 kPa (12 psi) at 600 rpm, 110 kPa (16 psi) at 800 rpm, and 138 kPa (20 psi) at 1500 rpm and 172 kPa (25 psi) above 2100 rpm.	Calibration dependent progressive power and speed derate and engine shutdown with increasing time after alert.
422 111 2	Voltage detected simultaneously on both the coolant level high and low signal pins 14 and 23 of the OEM interface harness, or no voltage detected on either pin.	No engine protection for coolant level

※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
423 156 2	More than 1.83 VDC detected at the timing temperature signal pin 33 of the engine harness at engine key on.	Calibration dependent power and speed derate.
426 - -	ECM can **not** transmit on J1939 datalink.	No action is taken by ECM.
427 - -	ECM can not transmit on J1939 datalink at acceptable rate.	No action is taken by ECM.
431 091 2	Voltage detected simultaneously on both the idle validation off idle and idle signal pins 12 and 13 of the OEM harness, or no voltage detected on either pin.	None on performance.
432 091 13	Voltage detected at the idle validation on idle signal pins 13 of the OEM harness when voltage at accelerator position signal pin 29 of the OEM harness indicates pedal is **not** at idle or voltage detected at idle validation off-idle signal pin 12 of the OEM harness when voltage at accelerator position signal pin 29 of the OEM harness indicates pedal is at rest.	Engine will default to 0 percent accelerator.
441 168 1	Less tnan 12.0 VDC battery voltage detected at the ECM.	ECM voltage supply approaching a level at which unpredictable operation will occur.
442 168 0	More tnan 38.0 VDC battery voltage detected at the ECM.	ECM damage will occur.
451 157 3	More than 4.78 VDC detected at the rail pressure sensor signal pin 31 of the engine harness.	Depending on the calibration, the engine will shut down or power derate, or no action is taken by the ECM.
452 157 4	Less than 0.15 VDC detected at the rail pressure sensor signal pin 31 of the engine harness.	Depending on the calibration, the engine will shut down or power derate, or no action is taken by the ECM.
455 633 3	Rail actuator circuit is open, or supply pin 3 is shorted to battery voltage or ground, or return pin 10 is shorted to battery voltage or ground in the engine harness.	No action by the ECM is taken. Actuator is closed, or partially closed. Engine will **not** run, or urns at one speed. Fault code 514 can be logged.
467 635 2	The timing current offset, used to adjust timing flow, has reached the maximum or minimum threshold.	No action taken by the ECM.
468 633 2	The rail current offset, used to adjust fueling flow, has reached the maximum or minimum threshold.	No action taken by the ECM.
471 098 1	Very low oil level is detected. Voltage signal on the oil level signal pin 12 of the engine harness indicates very low oil level in the engine.	Calibration dependent progressive power derate and engine shutdown with increasing time after alert. Centinel™ feature is disabled.
487 - -	The ether bottle for the ether injection system is empty.	The ether injection system is disabled.
489 191 1	Auxiliary speed frequency on input pin 17 indicates the frequency is below a calibration dependent threshold.	Engine will go to idle.

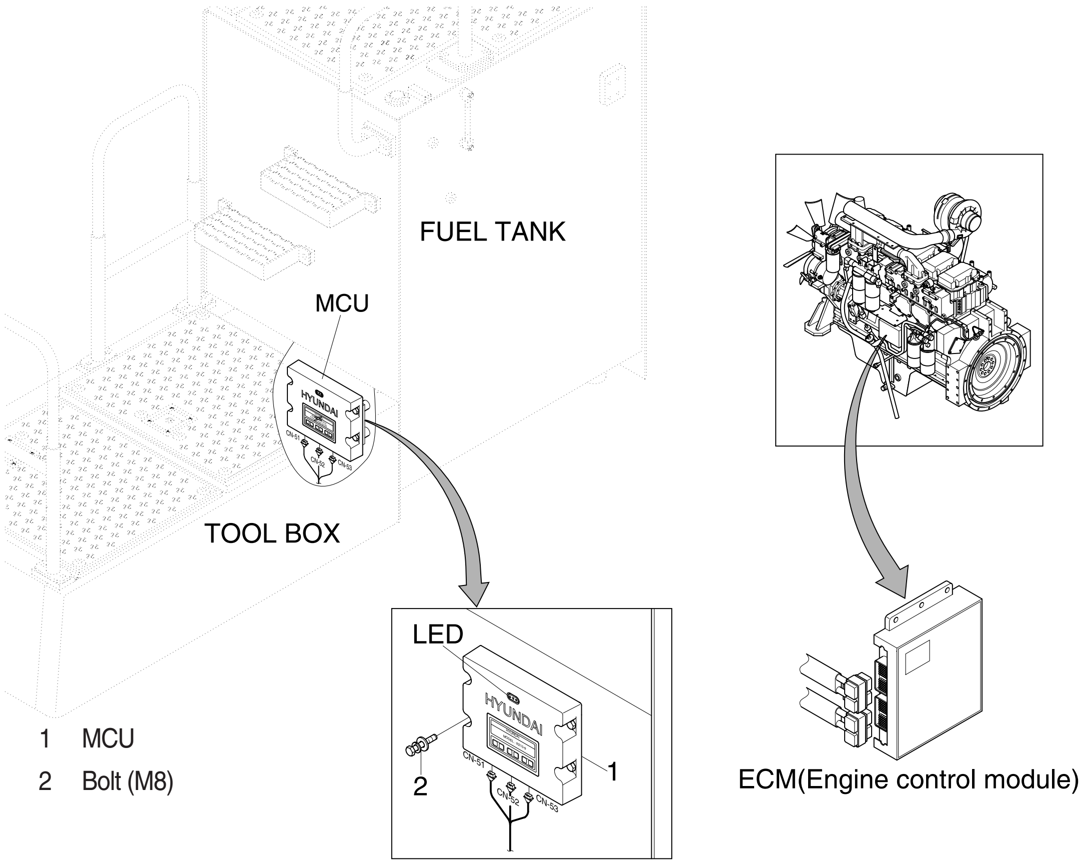
※ Some fault codes are not applied to this machine.

Fault code J1939 SPN J1939 FMI	Reason	Effect (only when fault code is active)
497 1377 2	Multiunit synchronous on/off switch and multiunit synchronous complimentary on/off switch have different values at the ECM.	Multiunit synchronous feature is disabled.
498 - -	Engine oil level #1 sensor circuit-shorted high.	No engine protection for low oil level. Centinel system is disabled.
499 - -	Engine oil level #1 sensor signal-shorted high.	No engine protection for oil level. Centinel system is disabled.
514 633 7	The error between the estimated rail fueling and the desired rail fueling is outside the acceptable limits.	Calibration-dependent engine shutdown or power derate or no action by the ECM is taken. Engine will overspeed, or run at one speed, or **not** run.
527 702 3	The dual output A signal pin 1 of the OEM interface harness indicates an open or short circuit.	OEM dependent.
529 703 3	The dual output B signal pin 9 of the OEM interface harness indicates an open or short circuit.	OEM dependent.
551 091 4	No voltage detected simultaneously on both the idle validation off-idle and idle signal pins 12 and 13 of the OEM interface harness.	Engine will default to 0-percent accelerator.
553 157 0	Rail pressure exceeds a normal limit.	Fuel shutoff valve de-energized (valve closes). The valve reenergizes (valve opens) when rail pressure falls below acceptable limit for present engine speed.
554 157 2	More than 0.67 VDC detected at the rail pressure signal pin 31 of the engine harness at engine key-on.	Calibration dependent engine derate.
555 1264 0	High blowby pressure has been detected. Voltage signal at blowby pressure signal pin 25 indicates blowby pressure above 368 mm H_2O (14.5 in H_2O).	Calibration dependent. Progressive power and speed derate and engine shutdown as pressure increases over thresholds.
611 - -	Engine shut down with the keywswitch before proper engine cooldown.	No action is taken by ECM. Load factor above the maximum shutdown threshold. Fault code will be logged.
649 - -	The maintenance interval has been reached.	No action is taken by ECM.
719 1264 3	More than 4.94 VDC detected at the blowby pressure sensor signal pin 25 of the engine harness.	No engine protection for blowby pressure.
729 1264 4	Less than 0.29 VDC detected at the blowby pressure sensor signal pin 25 of the engine harness.	No engine protection for blowby pressure.
753 723 2	The engine speed signals detected on pins 27, 28, 37 and 38 of the ECM do **not** match.	No action by the ECM is taken.
777 - -	The turbocharger inlet air temperature has exceeded the standard ambient air temperature limit.	The engine will go into a derate mode until the turbocharger inlet air temperature drops to a normal level.

※ Some fault codes are not applied to this machine.

GROUP 12 ENGINE CONTROL SYSTEM

1. MCU and Engine ECM (Electronic Control Module)



2. MCU ASSEMBLY

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

2) Three LED lamps on the MCU display as below.

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

G : green, R : red, Y : yellow

GROUP 13 EPPR VALVE

1. PUMP EPPR VALVE

1) COMPOSITION

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

(1) Electro magnet valve

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

(2) Spool valve

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

(3) Pressure and electric current value for each mode

Mode		Pressure		Electric current (mA)	Engine rpm (at accel dial 10)
		kgf/cm^2	psi		
Standard (Stage : 1.0)	P	10 ± 3	142 ± 40	330 ± 30	1800 ± 50
	S	10 ± 3	142 ± 40	330 ± 30	1700 ± 50
	E	15 ± 3	213 ± 40	400 ± 30	1600 ± 50
Option (Stage : 2.0)	P	0 ± 3	0 ± 40	160 ± 30	1850 ± 50
	S	7 ± 3	100 ± 40	280 ± 30	1700 ± 50
	E	12 ± 3	171 ± 40	360 ± 30	1700 ± 50

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

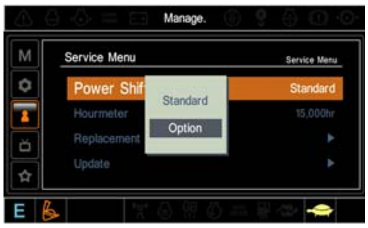
You can switch the EPPR valve pressure set by selecting the stage (1.0↔2.0).

- Management
  · Service menu

21093CD67M

Enter the password 21093CD67N

21093CD67P

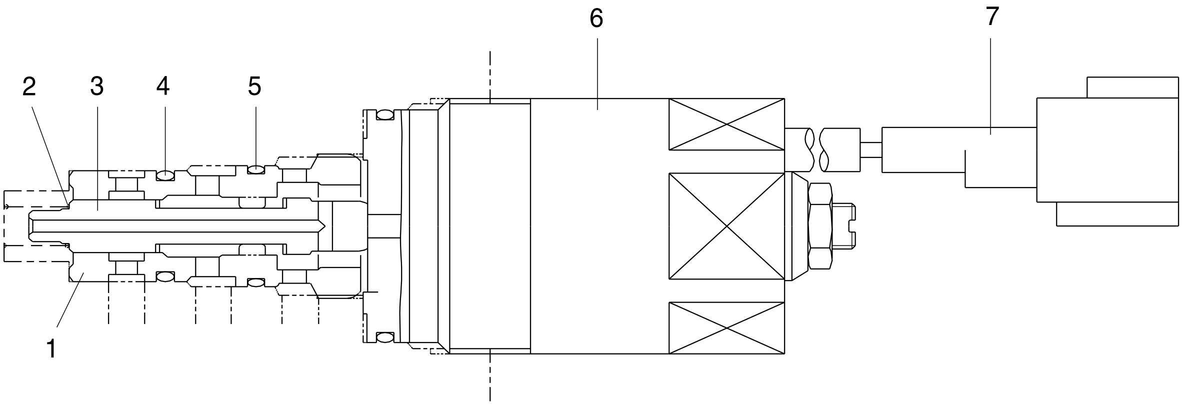


21093CD67ZZ

· Power shift (standard/option) : Power shift pressure can be set by option menu.

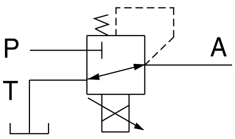
3) OPERATING PRINCIPLE (pump EPPR valve)

(1) Structure



5-22(1)

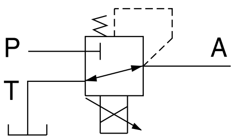
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

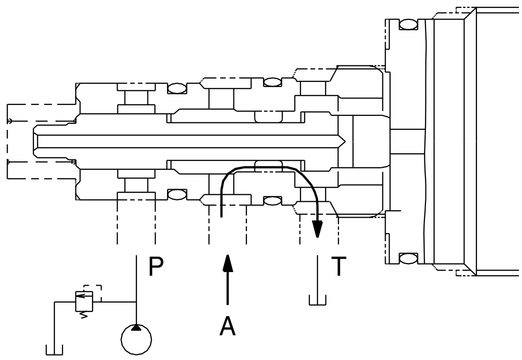


P Pilot oil supply line (pilot pressure)
T Return to tank
A Secondary pressure to flow regulator at main pump

(2) Neutral

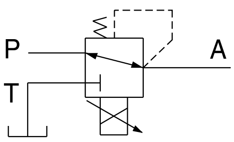
Pressure line is blocked and A oil returns to tank.

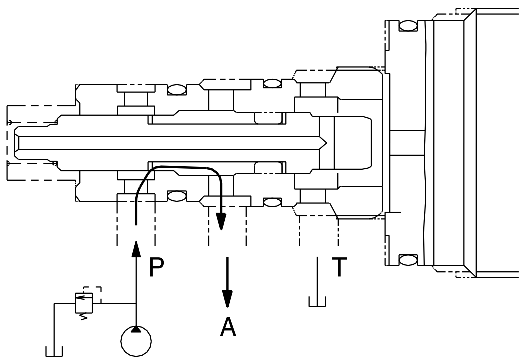




(3) Operating

Secondary pressure enters into A.

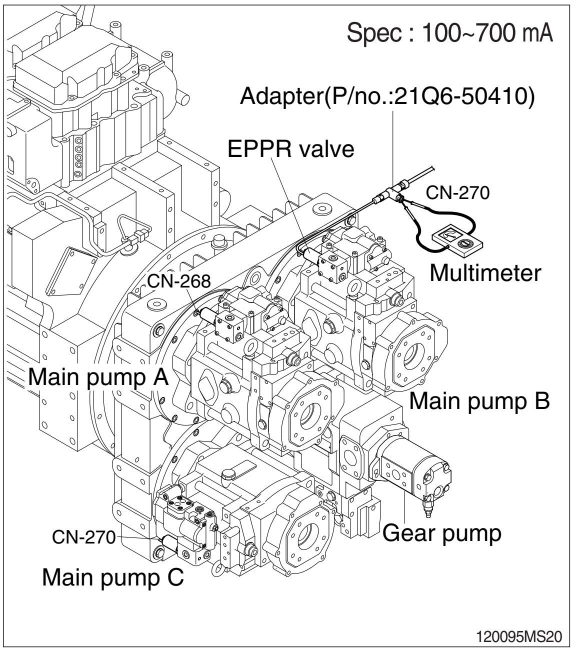




5-22(2)

4) EPPR VALVE CHECK PROCEDURE

(1) Check electric current value at EPPR valve



① Disconnect connector CN-268, CN-270 from EPPR valve.

② Insert the adapter to CN-268, CN-270 and install multimeter as figure.

③ Start engine.

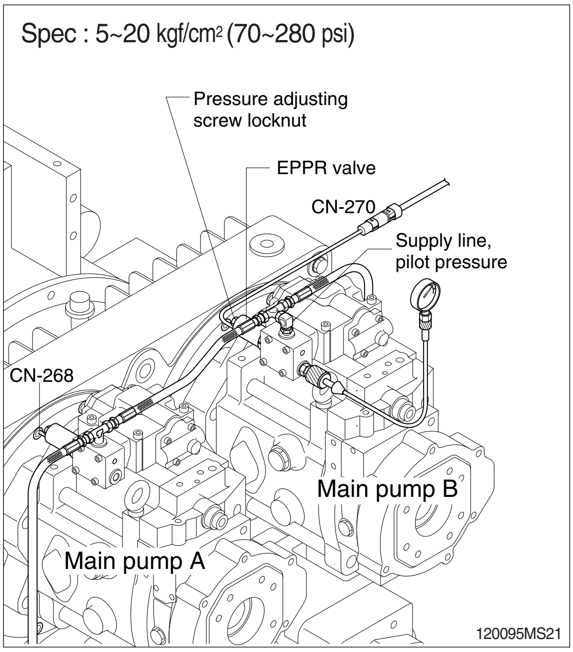
④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm display show approx 1700±50 rpm check electric current at bucket circuit relief position.

⑦ Check electric current at bucket circuit relief position.

(2) Check pressure at EPPR valve



① Remove plug and connect pressure gauge as figure.

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

② Start engine.

③ Set S-mode and cancel auto decel mode.

④ Position the accel dial at 10.

⑤ If tachometer show approx 1700±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

GROUP 14 MONITORING SYSTEM

1. OUTLINE

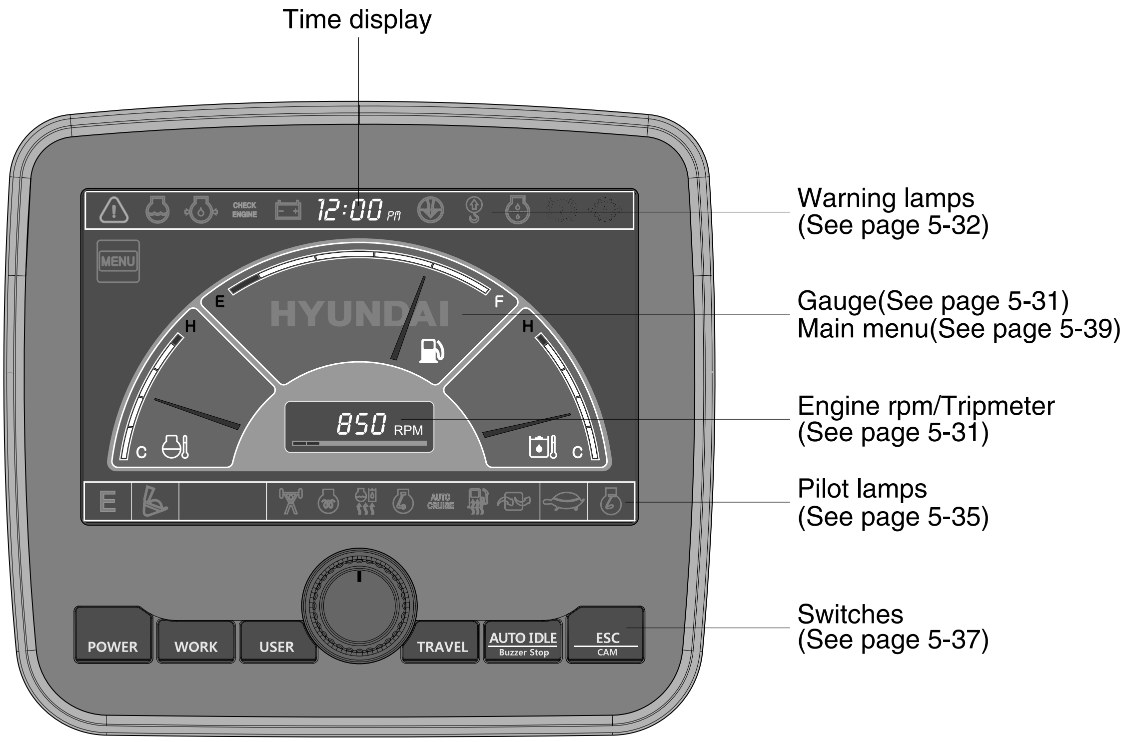
Monitoring system consists of the monitor part and switch part.

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



120095MS25

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

a. Buzzer sounding for 4 seconds with HYUNDAI logo on cluster.

※ If the ESL mode is set to the enable, enter the password to start engine.

② After initialization of cluster, the operating screen is displayed on the LCD.
Also, self diagnostic function is carried out.

a. Engine rpm display : 0 rpm

b. Engine coolant temperature gauge : White range

c. Hydraulic oil temperature gauge : White range

d. Fuel level gauge : White range

③ Indicating lamp state

a. Power mode pilot lamp : E mode or U mode

b. Work mode pilot lamp : General operation mode (bucket)

c. Travel speed pilot lamp : Low (turtle)

(2) Start of engine

① Check machine condition

a. RPM display 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 : E mode or U mode

e. Travel speed pilot lamp : Low (turtle)

② When warming up operation

a. Warming up pilot lamp : ON

b. After engine started, engine speed increases to 1200 rpm.

※ Others same as above.

③ When abnormal condition

a. The warning lamp lights up and the buzzer sounds.

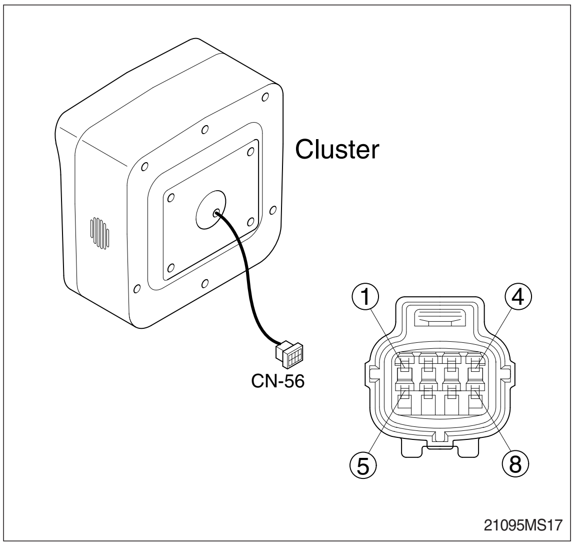
b. If BUZZER STOP switch is pressed, buzzer sound is canceled but the lamp warning lights up until normal condition.

※ The pop-up warning lamp moves to the original position and blink when the select switch is pushed. Also the buzzer stops.

3. CLUSTER CONNECTOR

No.	Name	Signal
1	Battery 24V	20~32V
2	Signal 3	NTSC
3	GND	-
4	Serial + (TX)	0~5V
5	Power IG (24V)	20~32V
6	Signal 2	NTSC
7	Camera signal	NTSC
8	Serial - (RX)	0~5V

※ NTSC : the united states National Television Systems Committee



2) GAUGE

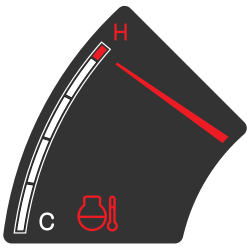
(1) Operation screen

21093CD07A

1 Engine coolant temperature gauge
2 Hydraulic oil temperature gauge
3 Fuel level gauge
4 RPM / Tripmeter display

※ Operation screen type can be set by the screen type menu of the display.
Refer to page 5-49 for details.

(2) Engine coolant temperature gauge



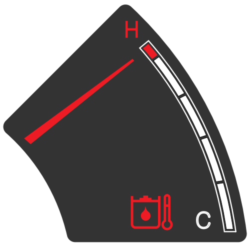
21093CD07G

① This gauge indicates the temperature of coolant.
- White range : 40-107˚C (104-225˚F)
- Red range : Above 107˚C (225˚F)

② If the indicator is in the red range or lamp blinks in red, turn OFF the engine and check the engine cooling system.

※ If the gauge indicates the red range or lamp 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.

(3) Hydraulic oil temperature gauge



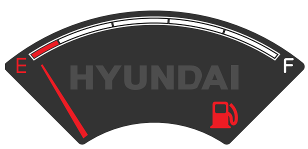
21093CD07E

① This gauge indicates the temperature of hydraulic oil.
- White range : 40-105˚C(104-221˚F)
- Red range : Above 105˚C(221˚F)

② If the indicator is in the red range or lamp blinks is red, reduce the load on the system. If the gauge stays in the red range, stop the machine and check the cause of the problem.

※ If the gauge indicates the red range or lamp 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.

(4) Fuel level gauge



21093CD07F

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

② Fill the fuel when the red range, or lamp blinks in red.

※ If the gauge indicates the red range or lamp 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.

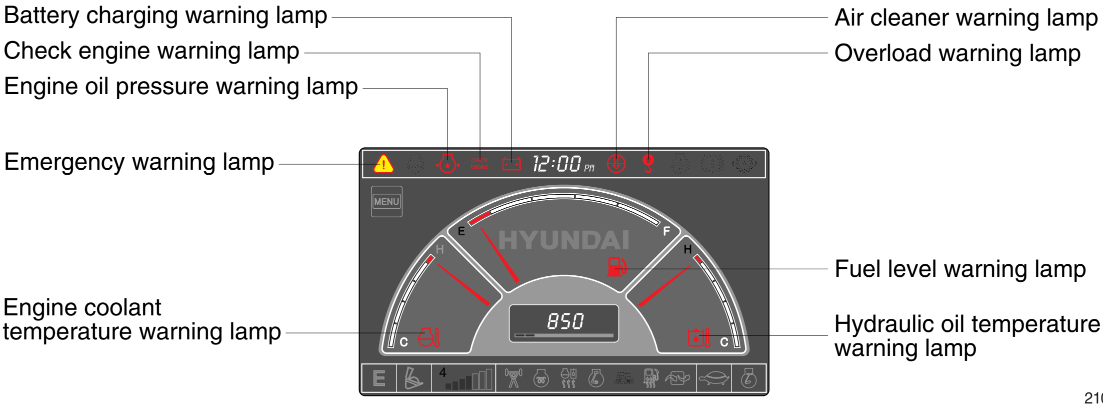
(5) RPM / Tripmeter display

21093CD02D

① This displays the engine speed or the tripmeter.

※ Refer to page 5-49 for details.

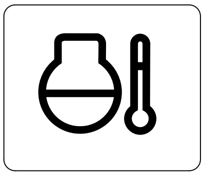
3) WARNING LAMPS



21093CD08D

※ Each warning lamp on the top of the LCD pops up on the center of LCD and the buzzer sounds when the each warning is happened. The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. And the buzzer stops.
Refer to page 5-38 for the select switch.

(1) Engine coolant temperature



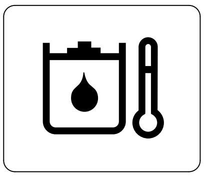
21093CD08A

① Engine coolant temperature warning is indicated two steps.
- 103˚C over : The lamp blinks and the buzzer sounds.
- 107˚C over : The lamp pops up on the center of LCD and the buzzer sounds.

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.

③ Check the cooling system when the lamp keeps ON.

(2) Hydraulic oil temperature



21093CD08C

① Hydraulic oil temperature warning is indicated two steps.
- 100˚C over : The lamp blinks and the buzzer sounds.
- 105˚C over : The lamp pops up on the center of LCD and the buzzer sounds.

② The pop-up lamp moves to the original position and blinks when the select switch is pushed. Also, the buzzer stops and lamp keeps blink.

③ Check the hydraulic oil level and hydraulic oil cooling system.

(3) Fuel level

21093CD08B

① This warning lamp blinks and the buzzer sounds when the level of fuel is below 131 ℓ (34.6 U.S. gal).

② Fill the fuel immediately when the lamp blinks.

(4) Emergency warning lamp

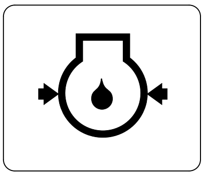
21093CD30

① This lamp pops up and the buzzer sounds when each of the below warnings is happened.
- Engine coolant overheating (over 107˚C)
- Hydraulic oil overheating (over 105˚C)
- Pump EPPR circuit abnormal or open
- Attachment flow EPPR circuit abnormal or open
- MCU input voltage abnormal
- Accel dial circuit abnormal or open
- Cluster communication data error
- Engine ECM communication data error

※ **The pop-up warning lamp moves to the original position and blinks when the select switch is pushed. Also the buzzer stops. This is same as following warning lamps.**

② When this warning lamp blinks, machine must be checked and serviced immediately.

(5) Engine oil pressure warning lamp

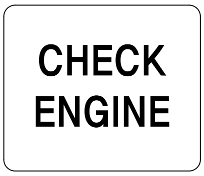


21093CD32

① This lamp blinks when the engine oil pressure is low.

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

(6) Check engine warning lamp



21093CD33

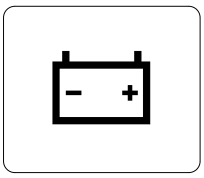
① This lamp blinks when the communication between MCU and engine ECM on the engine is abnormal, or if the cluster received any fault code from engine ECM.

② Check the communication line between them.
If the communication line is OK, then check the fault codes on the cluster.

29093CD03

③ This lamp blinks when "Engine check water in fuel" is displayed in the message box then check water separator.

(7) Battery charging warning lamp

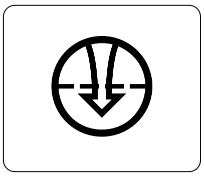


21093CD34

① This lamp blinks when the battery charging voltage is low.

② Check the battery charging circuit when this lamp blinks.

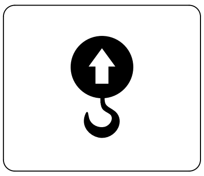
(8) Air cleaner warning lamp



21093CD35

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

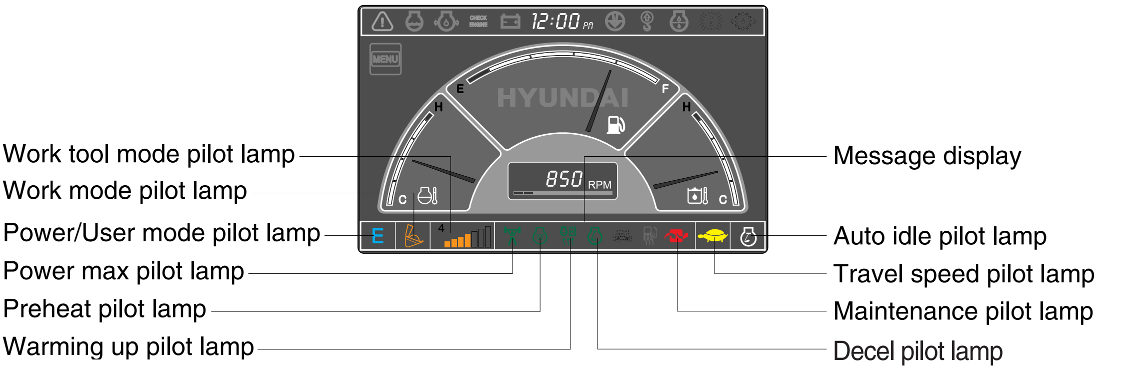
(9) Overload warning lamp (opt)



21093CD36

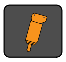
① When the machine is overload, the overload warning lamp blinks during the overload switch is ON. (if equipped)
② Reduce the machine load.

4) PILOT LAMPS

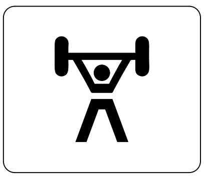


120093CD05

(1) Mode pilot lamps

No	Mode	Pilot lamp	Selected mode
1	Power mode	P	Heavy duty power work mode
		S	Standard power mode
		E	Economy power mode
2	User mode	U	User preferable power mode
3	Work mode		General operation mode
			Breaker operation mode
			Crusher operation mode
4	Travel mode		Low speed traveling
			High speed traveling
5	Auto idle mode		Auto idle
6	Work tool mode		Oil flow level of breaker or crusher mode
7	Message display		"Setting is completed" display after selection

(2) Power max pilot lamp



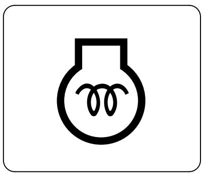
21093CD38

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

② The power max function is operated maximum 8 seconds.

※ Refer to the operator's manual page 3-26 for power max function.

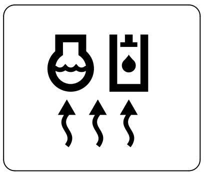
(3) Preheat pilot lamp



21093CD39

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

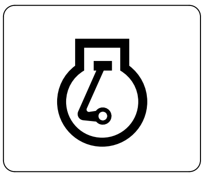
(4) Warming up pilot lamp



21093CD40

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

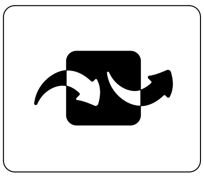
(5) Decel pilot lamp



21093CD41

① Operating one touch decel switch on the RCV lever makes the lamp ON.
② Also, the lamp will be ON and engine speed will be lowered automatically to save fuel consumption when all levers and pedals are at neutral position, and the auto idle function is selected.
※ One touch decel is not available when the auto idle pilot lamp is turned ON.
※ Refer to the operator's manual page 3-26.

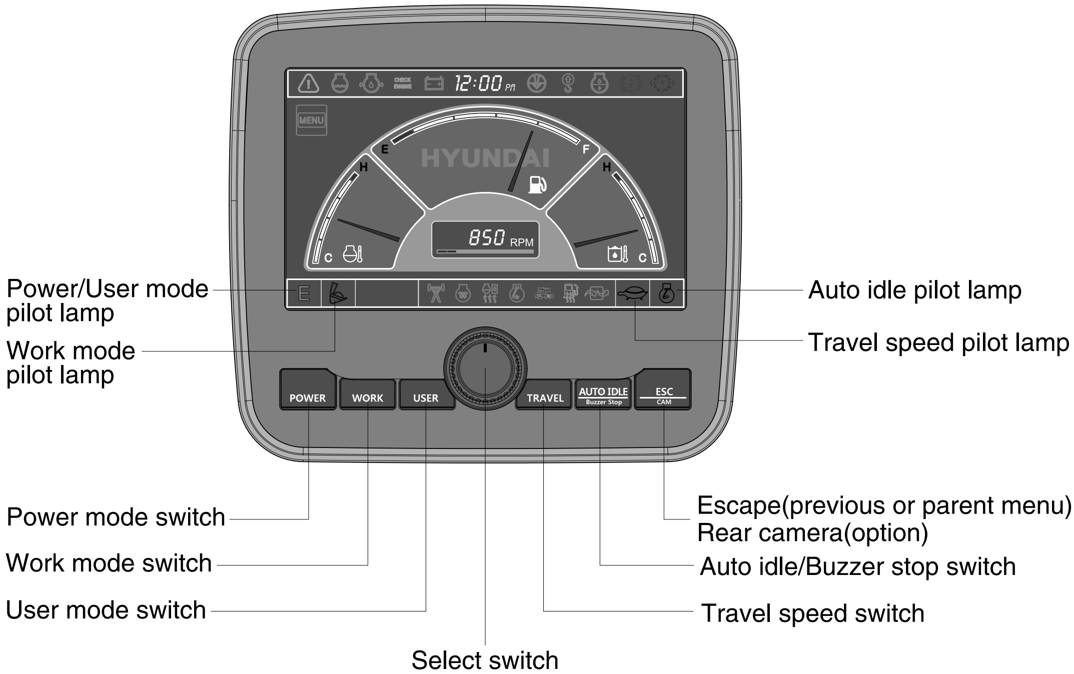
(6) Maintenance pilot lamp



21093CD44

① This lamp will be ON when the consuming parts are needed to change or replace. It means that the change or replacement interval of the consuming parts remains below 30 hours.
② Check the message in maintenance information of main menu. Also, this lamp lights ON for 3 minutes when the start switch is ON position.

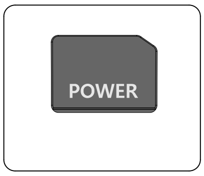
5) SWITCHES



21093CD45

※ When the switches are selected, the pilot lamps are displayed on the LCD. Refer to the page 5-35 for details.

(1) Power mode switch

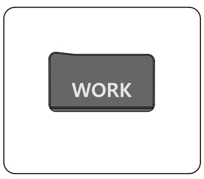


21093CD45A

① This switch is to select the machine power mode and selected power mode pilot lamp is displayed on the pilot lamp position.
- P : Heavy duty power work.
- S : Standard power work.
- E : Economy power work.

② The pilot lamp changes E → S → P → E in order.

(2) Work mode switch

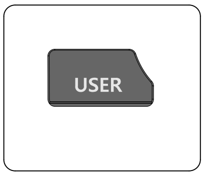


21093CD45C

① This switch is to select the machine work mode, which shifts from general operation mode to optional attachment operation mode.
- : General operation mode
- : Breaker operation mode (if equipped)
- : Crusher operation mode (if equipped)
- Not installed : Breaker or crusher is not installed.

※ Refer to the operator's manual page 4-6 for details.

(3) User mode switch

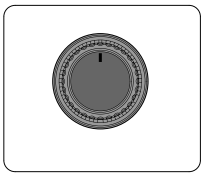


21093CD45D

① This switch is used to memorize the current machine operating status in the MCU and activate the memorized user mode.
- · Memory : Push more than 2 seconds.
- · Action : Push within 2 seconds.
- · Cancel : Push this switch once more within 2 seconds.

② Refer to the page 5-40 for another set of user mode.

(4) Select switch



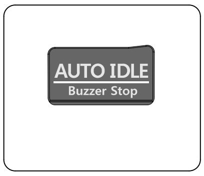
21093CD45E

① This switch is used to select or change the menu and input value.

② Knob push
- · Long (over 2 sec) : Return to the operation screen
- · Medium (0.5~2 sec) : Return to the previous screen
- · Short (below 0.5 sec) : Select menu

③ Knob rotation
This knob changes menu and input value.
- · Right turning : Down direction / Increase input value
- · Left turning : Up direction / Decreased input value

(5) Auto idle/ buzzer stop switch

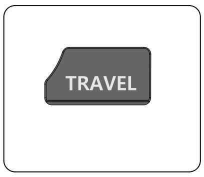


21093CD45F

① This switch is used to activate or cancel the auto idle function.
- · Pilot lamp ON : Auto idle function is activated.
- · Pilot lamp OFF : Auto idle function is cancelled.

② The buzzer sounds when the machine has a problem.
In this case, push this switch and buzzer stops, but the warning lamp blinks until the problem is cleared.

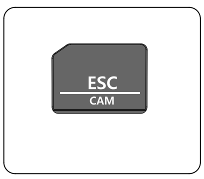
(6) Travel speed control switch



21093CD45G

① This switch is used to select the travel speed alternatively.
- · : High speed
- · : Low speed

(7) Escape/Camera switch



21093CD45H

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

② In the operation screen, pushing this switch will display the view of the camera on the machine (if equipped).
Please refer to page 5-50 for the camera.

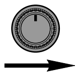
③ If the camera is not installed, this switch is used only ESC function.

6) MAIN MENU

21093CD64

21093CD64A

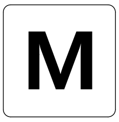
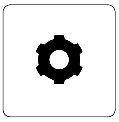
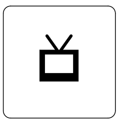
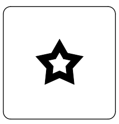
Press



21093CD64B

※ Please refer to select switch, page 5-38 for selection and change of menu and input value.

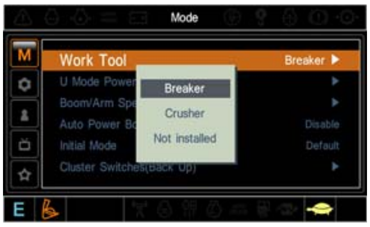
(1) Structure

No	Main menu	Sub menu	Description
1	 Mode 21093CD64D	Work tool U mode power Boom/Arm speed Auto power boost Initial mode Cluster switch (back up)	Breaker, Crusher, Not installed User mode only Boom speed, Arm speed Enable, Disable Default, U mode Switch function
2	 Monitoring 21093CD64E	Active fault Logged fault Delete logged fault Monitoring (analog) Monitoring (digital) Operating hours	MCU, Engine ECM MCU, Engine ECM All logged fault delete, Initialization canceled Machine information Switch status, Output status Operating hours for each mode
3	 Management 21093CD64F	Maintenance information Machine security Machine Information A/S phone number Service menu	Replacement, Change interval oils and filters ESL mode setting, Password change Cluster, MCU, Engine, Machine A/S phone number, A/S phone number change Power shift, Hourmeter, Replacement history, Update
4	 Display 21093CD64G	Display item Clock Brightness Unit Language Screen type	Engine speed, Tripmeter A, Tripmeter B, Tripmeter C Clock Manual, Auto Temperature, Pressure, Flow, Date format Korean, English, Chinese A type, B type
5	 Utilities 21093CD64H	Tripmeter DMB Entertainment Camera setting Message box	3 kinds (A, B, C) DMB select, DAB select, Channel scan, Exit Play MP4, codec. Basic direction, Display switching, Full screen Record for fault, attachment etc.

(2) Mode setup

① Work tool

21093CD65



21093CD65A

A

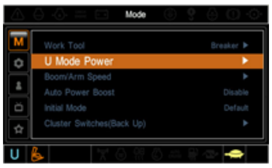
21093CD65B

B

- A : Select one installed optional attachment.
- B : Max flow - Set the maximum flow for the attachment.
  Flow level - Reduce the operating flow from maximum flow.
  Breaker - Max 7 steps, Reduced 10 lpm each step.
  Crusher - Max 4 steps, Reduced 20 lpm each step.

※ The flow level is displayed with the work mode pilot lamp.

② U mode power



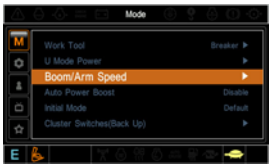
21093CD65D

21093CD65E

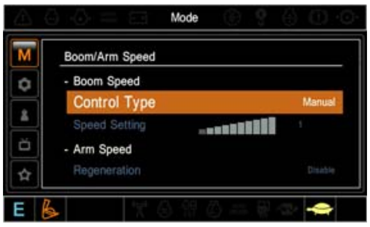
Step (▮)	Engine speed (rpm)	Idle speed (rpm)	Power shift (bar)
1	1300	800	0
2	1400	850	3
3	1500	One touch decel low idle (900)	6
4	1550	950	9
5	1600	1000	12
6	1650	1050	16
7	1700	Auto decel rpm (1100)	20
8	1750	1150	26
9	1800	1200	32
10	1850	1250	38

- Engine high idle rpm, auto idle rpm and pump torque (power shift) can be modulated and memorized separately in U-mode.
- U-mode can be activated by user mode switch.

③ Boom/Arm speed



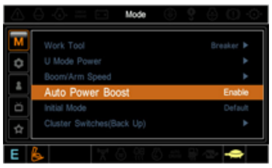
21093CD65F



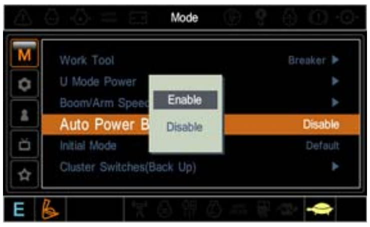
21093CD65G

- Boom speed
  - Control type
    Manual - Boom up speed is fixed as set steps.
    Auto - Boom up speed is automatically adjusted as working conditions by the MCU.
  - Speed setting - Boom up speed is increased as much as activated steps.
- Arm speed
  - Regeneration - Arm regeneration function can be activated or cancelled.
    Enable - Arm in speed is up.
    Disable - Fine operation.

④ Auto power boost



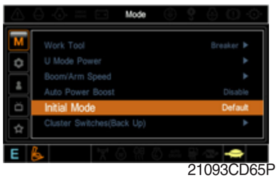
21093CD65L



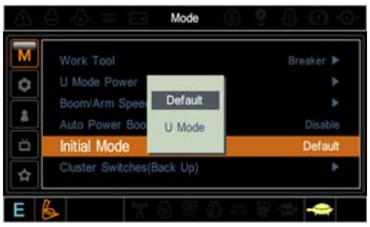
21093CD65M

- The power boost function can be activated or cancelled.
- Enable - The digging power is automatically increased as working conditions by the MCU.
  It is operated max 8 seconds.
- Disable - Not operated.

⑤ Initial mode



21093CD65P



21093CD65Q

- Default - The initial power mode is set E mode when the engine is started.
- U mode - The initial power mode is set U mode when the engine is started.

⑥ Cluster switch (back up)

21093CD65S

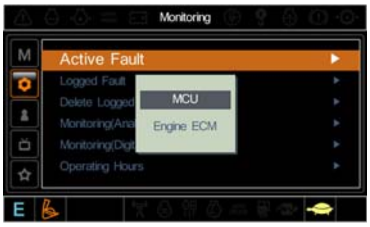
21093CD65T

- The cluster switch can be selected and changed by this menu when the switches are abnormal on the cluster.
- In order to exit "Cluster switch" mode, please put the cursor on the ESC/CAM switch by turning the select switch and push the select switch.
- In "Cluster switch", other switches except "Select switch" do not work.

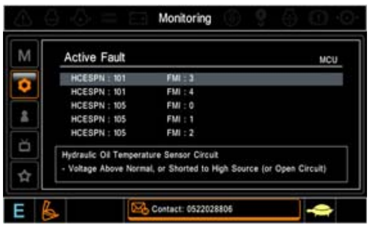
(3) Monitoring

① Active fault

21093CD66



21093CD66A

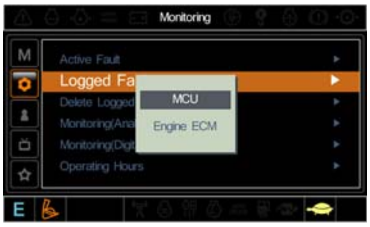


21093CD66B

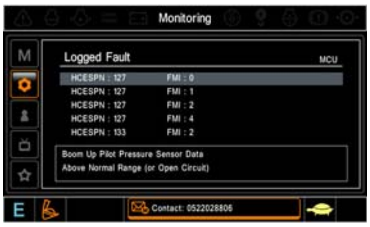
· The active faults of the MCU or engine ECM can be checked by this menu.

② Logged fault

21093CD66C



21093CD66D



21093CD66E

· The logged faults of the MCU or engine ECM can be checked by this menu.

③ Delete logged fault

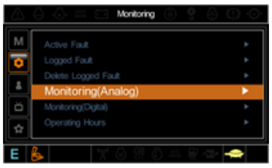
21093CD66F

21093CD66G

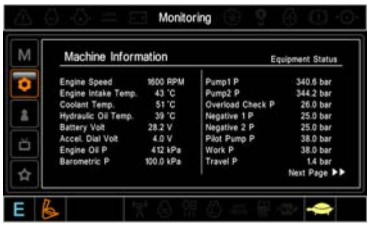
21093CD66H

· The logged faults of the MCU or engine ECM can be deleted by this menu.

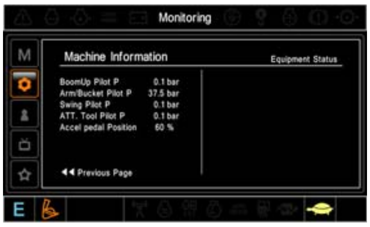
④ Monitoring (analog)



21093CD66J



21093CD66K

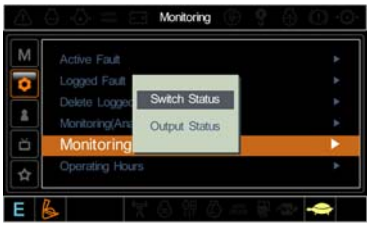


21093CD66L

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

⑤ Monitoring (digital)

21093CD66M



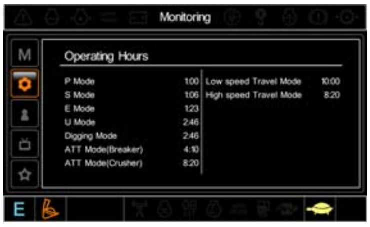
21093CD66N

21093CD66P

· The switch status or output status can be confirmed by this menu.
· The activated switch or output pilot lamps are light ON.

⑥ Operating hours

21093CD66Q



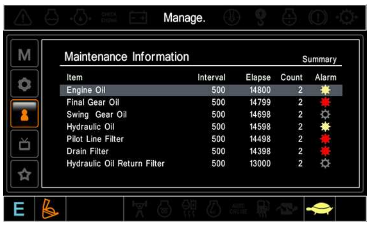
21093CD66R

· The operating hour of each mode can be confirmed by this menu.

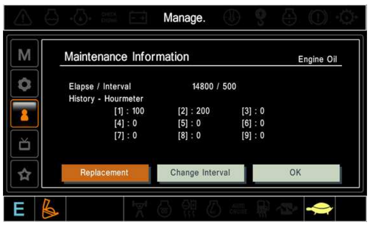
(4) Management

① Maintenance information

21093CD67



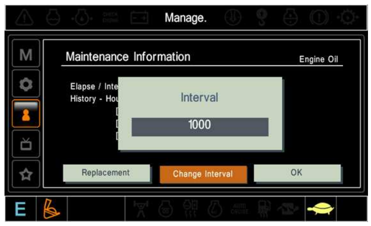
21093CD67A



21093CD67Q

21093CD67R

21093CD67S



21093CD67T

· Alarm( ): Gray - Normal
Yellow - First warning
Red - Second warning

· Replacement : The elapsed time will be reset to zero (0).

· Change interval : The change or replace interval can be changed in the unit of 50 hours.

· OK : Return to the item list screen.

· Change or replace interval

No	Item	Interval
1	Engine oil	500
2	Final gear oil	1000
3	Swing gear oil	1000
4	Hydraulic oil	5000
5	Pilot line filter	1000
6	Drain filter	1000
7	Hydraulic oil return filter	1000
8	Engine oil filter	500
9	Fuel filter	500
10	Hydraulic tank breather	250
11	Air cleaner (inner)	500
12	Radiator coolant	2000
13	Swing gear pinion grease	1000

② Machine security

21093CD67C

21093CD67D

21093CD67E

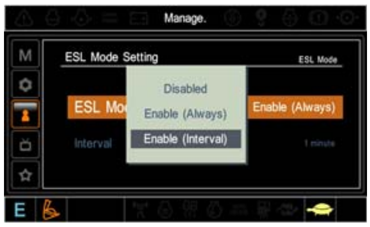
· ESL mode

- ESL : Engine Starting Limit
- ESL mode is designed to be a theft deterrent or will prevent the unauthorized operation of the machine.
- If the ESL mode was selected Enable, the password will be required when the start switch is turned ON.
- Disable : Not used ESL function

  Enable (always) : The password is required whenever the operator start engine.

  Enable (interval) : The password is required when the operator start engine first. But the operator can restart the engine within the interval time without in putting the password. The interval time can be set maximum 4 hours.

21093CD67EE



21093CD67H

21093CD67U

Enter the current password 21093CD67V

· Password change

- The password is 5~10 digits.

Enter the new password 21093CD67VV

21093CD67X

The new password is stored in the MCU.

21093CD67XX

Enter the new password again

③ Machine Information

21093CD67F

21093CD67G

・ This can confirm the identification of the cluster, MCU, engine and machine.

④ A/S phone number

21093CD67J

21093CD67K

21093CD67L

21093CD67Z

21093CD67Y

⑤ Service menu

21093CD67M

Enter the password

21093CD67N

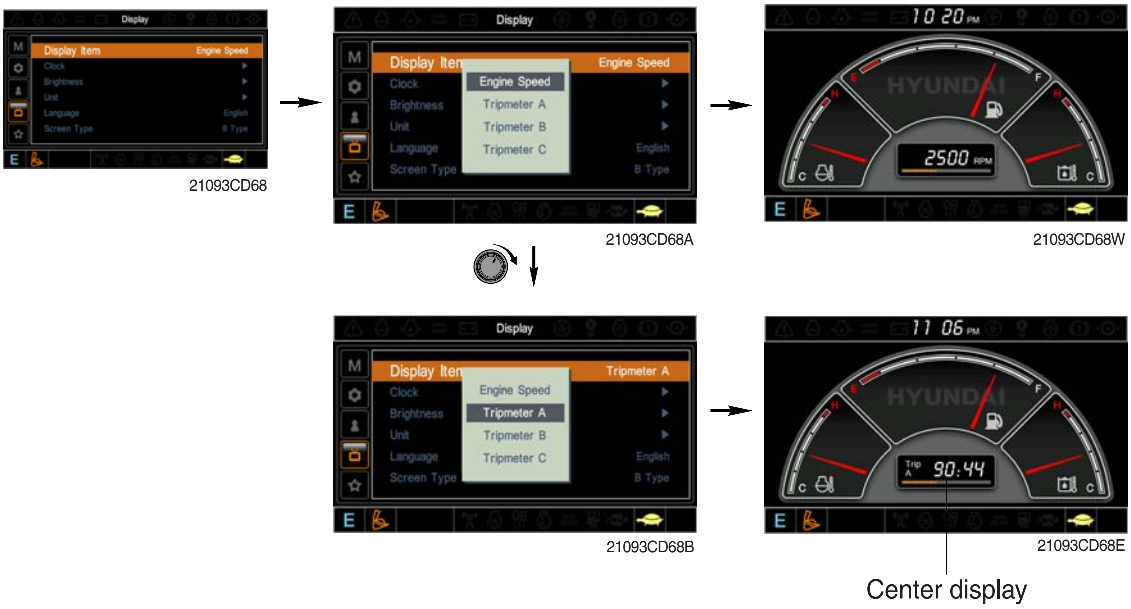
21093CD67P

21093CD67ZZ

・ Power shift (standard/option) : Power shift pressure can be set by option menu.
・ Hourmeter : Operating hours since the machine line out can be checked by this menu.
・ Replacement history : Replacement history of the MCU and cluster can be checked by this menu.
・ Update : Firm ware can be upgraded by this menu. (the USB port is located under the cluster)

(5) Display

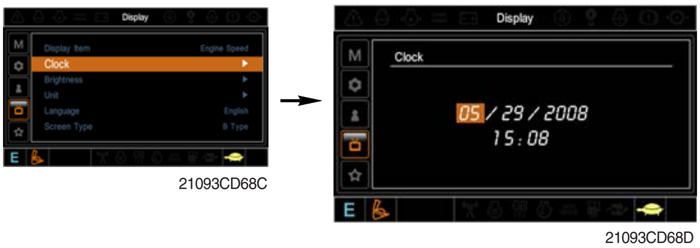
① Display item



· The center display type of the LCD can be selected by this menu.

· The engine speed or each of the tripmeter (A,B,C) is displayed on the center display.

② Clock

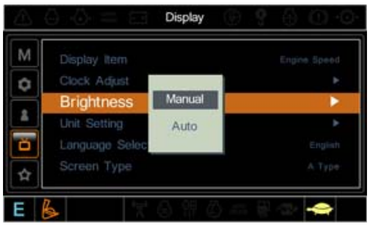


· The first line's three spots "**/**/****" represent Month/Day/Year each.

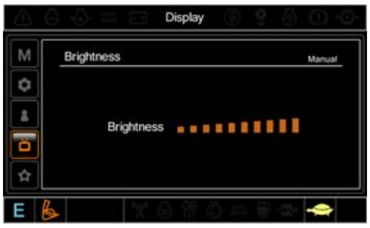
· The second line shows the current time. (0:00~23:59)

③ Brightness

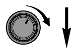

21093CD68F

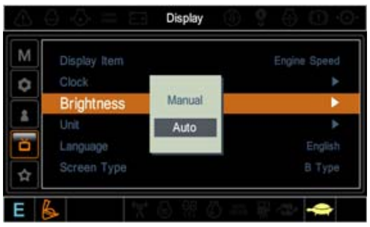


Manual (1st~10th step) 21093CD68G



21093CD68H





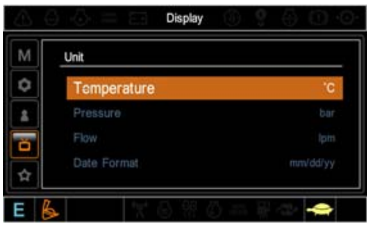
Auto (day/night) 21093CD68J

21093CD68K

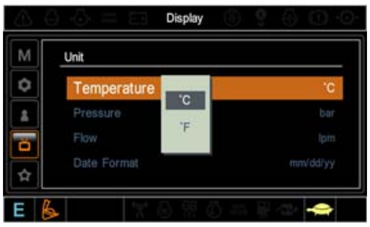
※ If "Auto" is chosen, brightness for day and night can be differently set up. Also by using the bar in lower side, users can define which time interval belongs to day and night.
(in bar figure, gray area represents night time while white shows day time)

④ Unit


21093CD68L



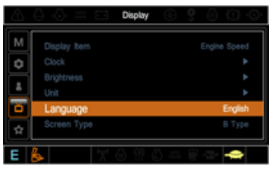
21093CD68M



21093CD68N

- Temperature : ˚C ↔ ˚F
- Pressure : bar ↔ MPa ↔ kgf/cm^2
- Flow : lpm ↔ gpm
- Date format : yy/mm/dd ↔ mm/dd/yy ↔ dd-Mar-yy

⑤ Language

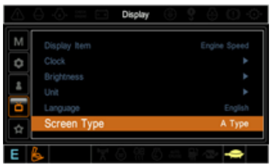

21093CD68R

21093CD68S

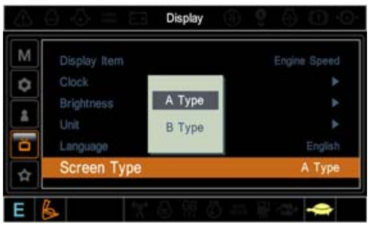
21093CD68T

- User can select preferable language and all displays are changed the selected language.

⑥ Screen type

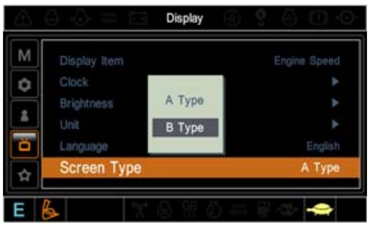


21093CD68U



A Type 21093CD68V

Standard 21093CD68W



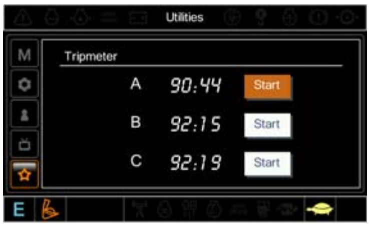
B Type 21093CD68X

Option 21093CD68Y

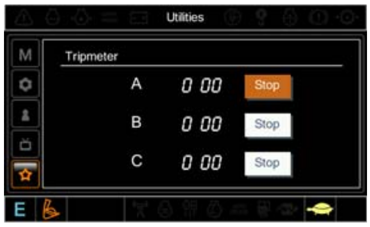
(6) Utilities

① Tripmeter

21093CD69



21093CD69A

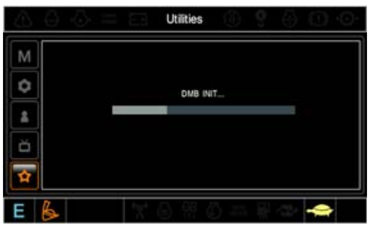


21093CD69B

- Maximum 3 kinds of tripmeters can be used at the same time.
- Each tripmeter can be turned on by choosing "Start" while it also can be turned off by choosing "Stop".
- If the tripmeter icon is activated in the operation screen, it can be controlled directly there.

② DMB

21093CD69C



21093CD69D

21093CD69E

- DMB select : TV channel can be selected by this menu.
- DAB select : Audio channel can be selected by this menu.
- Channel scan : This menu can be used other region for TV/Audio.
- Exit : Exit DMB menu

③ Entertainment

· Play MP4 or codec file of external hard disk through USB port.
· The USB port is located under the cluster.

21093CD69F

21093CD69G

④ Camera setting

21093CD69J

21093CD69K

21093CD69L

· Three cameras can be installed on the machine.
· The display order can be set by this menu.

21093CD69M

21093CD69N

· If the camera was not equipped, this menu is not useful.
· In the operation screen, if the ESC/CAM switch is pushed, the first ordered display camera will be viewed.
· Turning the select switch in clockwise direction, the next ordered will be shown and in counter-clockwise direction, the previously ordered will be shown.
· Push the select switch, the displayed screen will be enlargement.

⑤ Message box

· The history of the machine operating status can be checked by this menu.

21093CD69Q

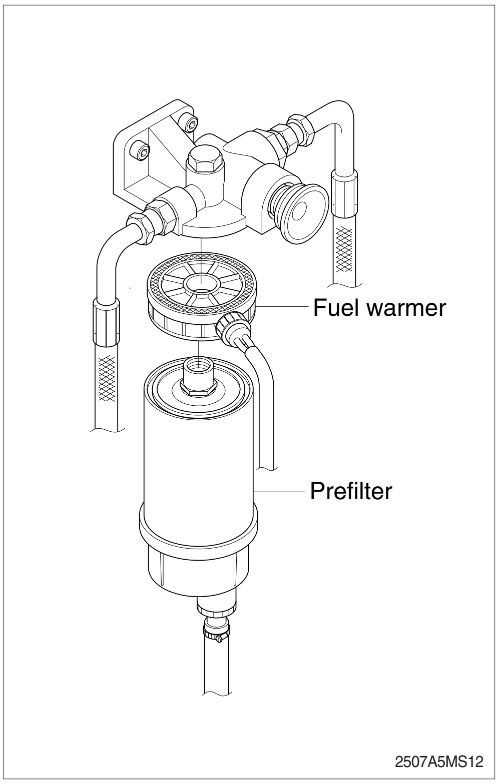
21093CD69R

1. SPECIFICATION

1) Operating voltage : 24±4 V
2) Power : 350±50 W
3) Current : 15 A

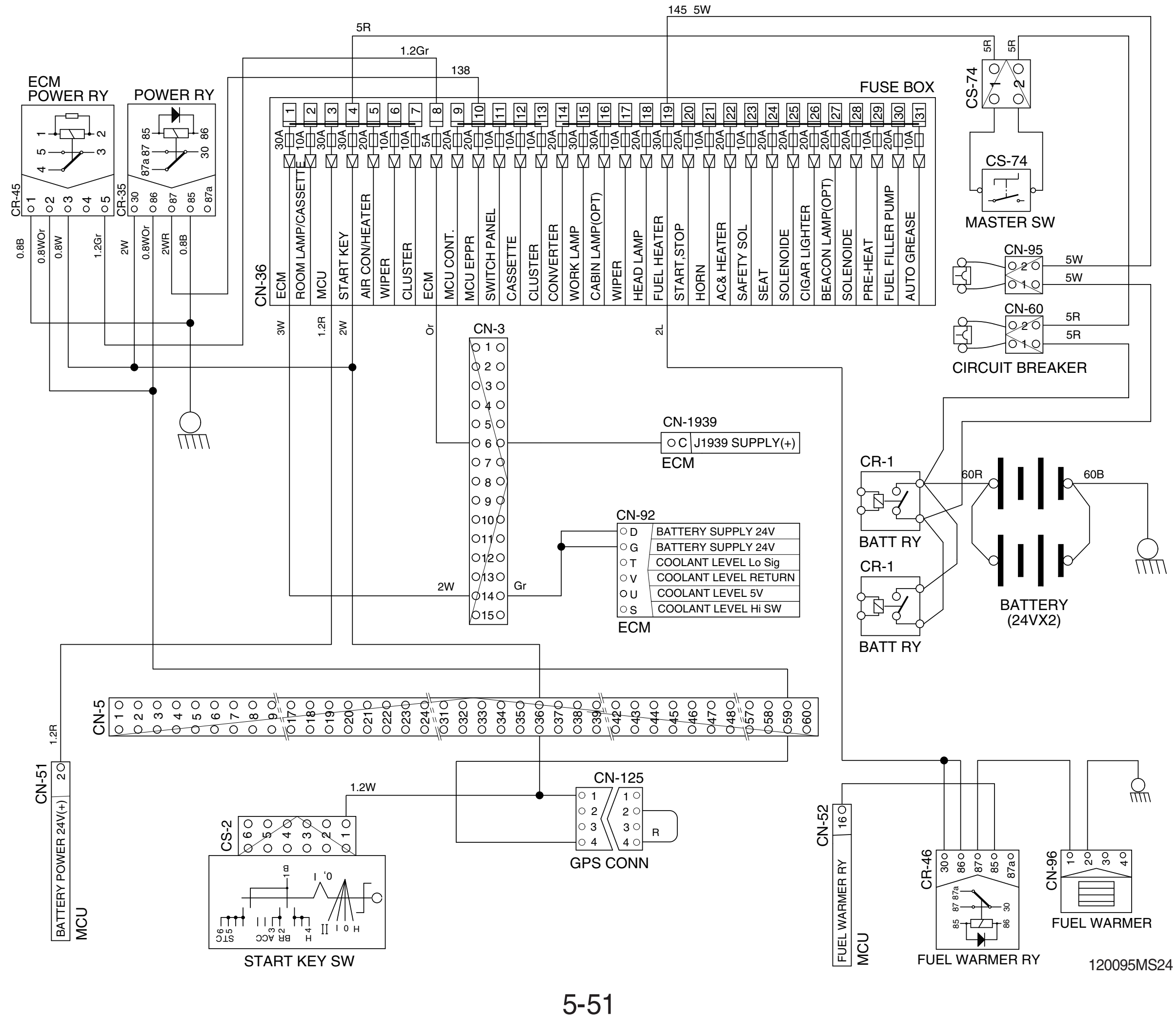
2. OPERATION

1) The current of fuel warmer system is automatically controlled without thermostat according to fuel temperature.
2) At the first state, the 15 A current flows to the fuel warmer and engine may be started in 5~6 minutes.
※ More time may take according to ambient temperature.
3) If the fuel starts to flow, ceramic-disk in the fuel warmer heater senses the fuel temperature to reduce the current as low as 1.5 A.
So, fuel is protected from overheating by this mechanism.



2507A5MS12

3. ELECTRIC CIRCUIT



120095MS24

SECTION 6 TROUBLESHOOTING

SECTION 6 TROUBLESHOOTING

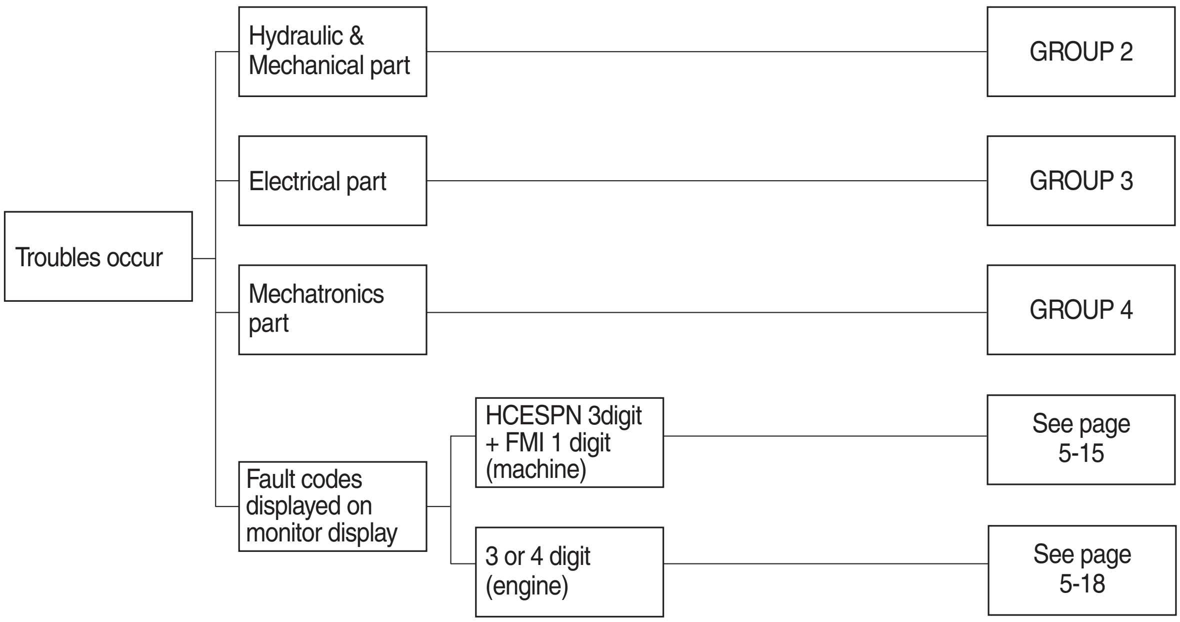
GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

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

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

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

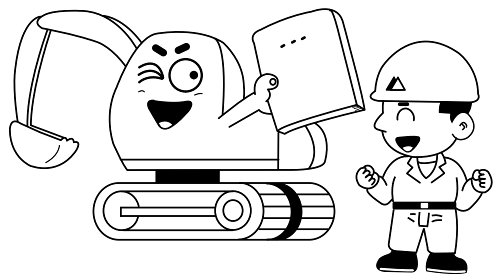


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

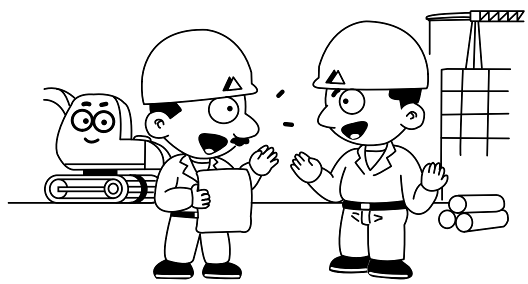


13031SH02

STEP 2. Ask the operator

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

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

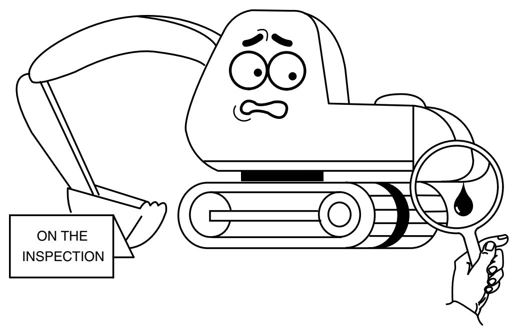


13031SH03

STEP 3. Inspect the machine

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

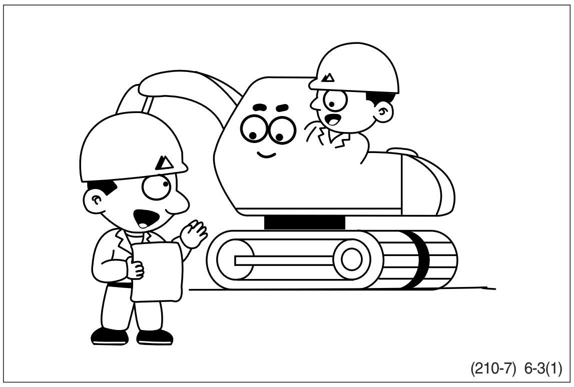
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

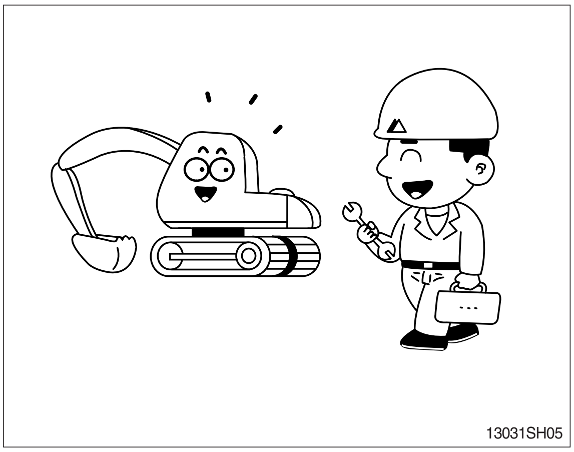
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(210-7) 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.

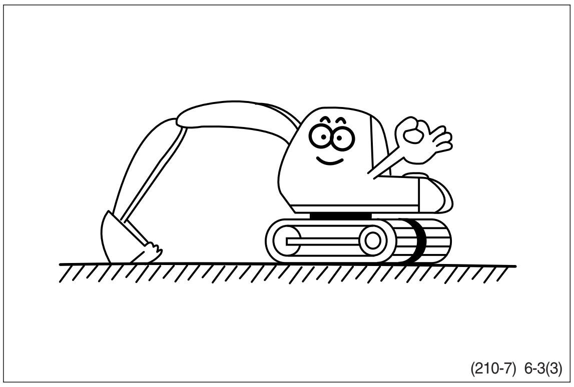


13031SH05

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.



(210-7) 6-3(3)

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

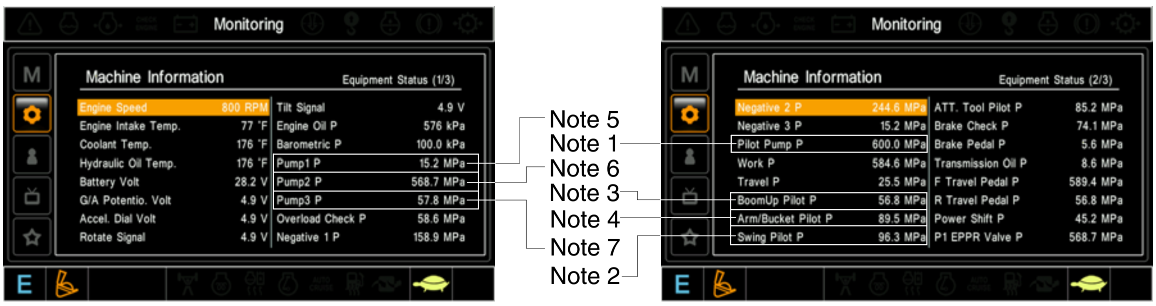
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

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

2) MACHINE STATUS MONITORING ON THE CLUSTER

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



Analog 1 Analog 2

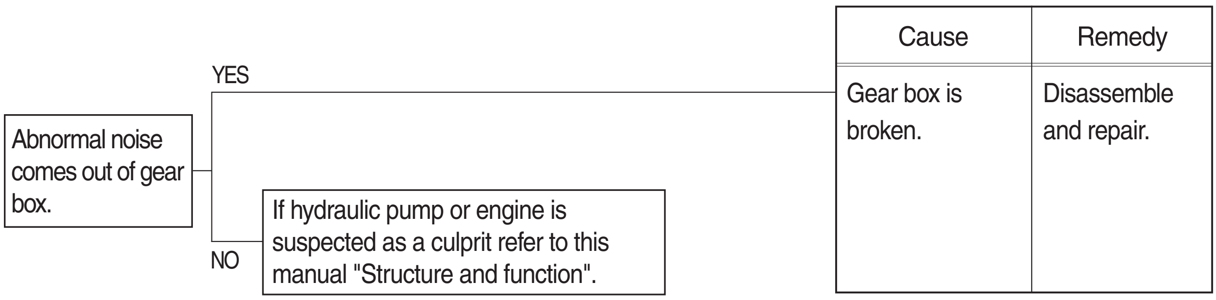
120096HS01

(2) Specification

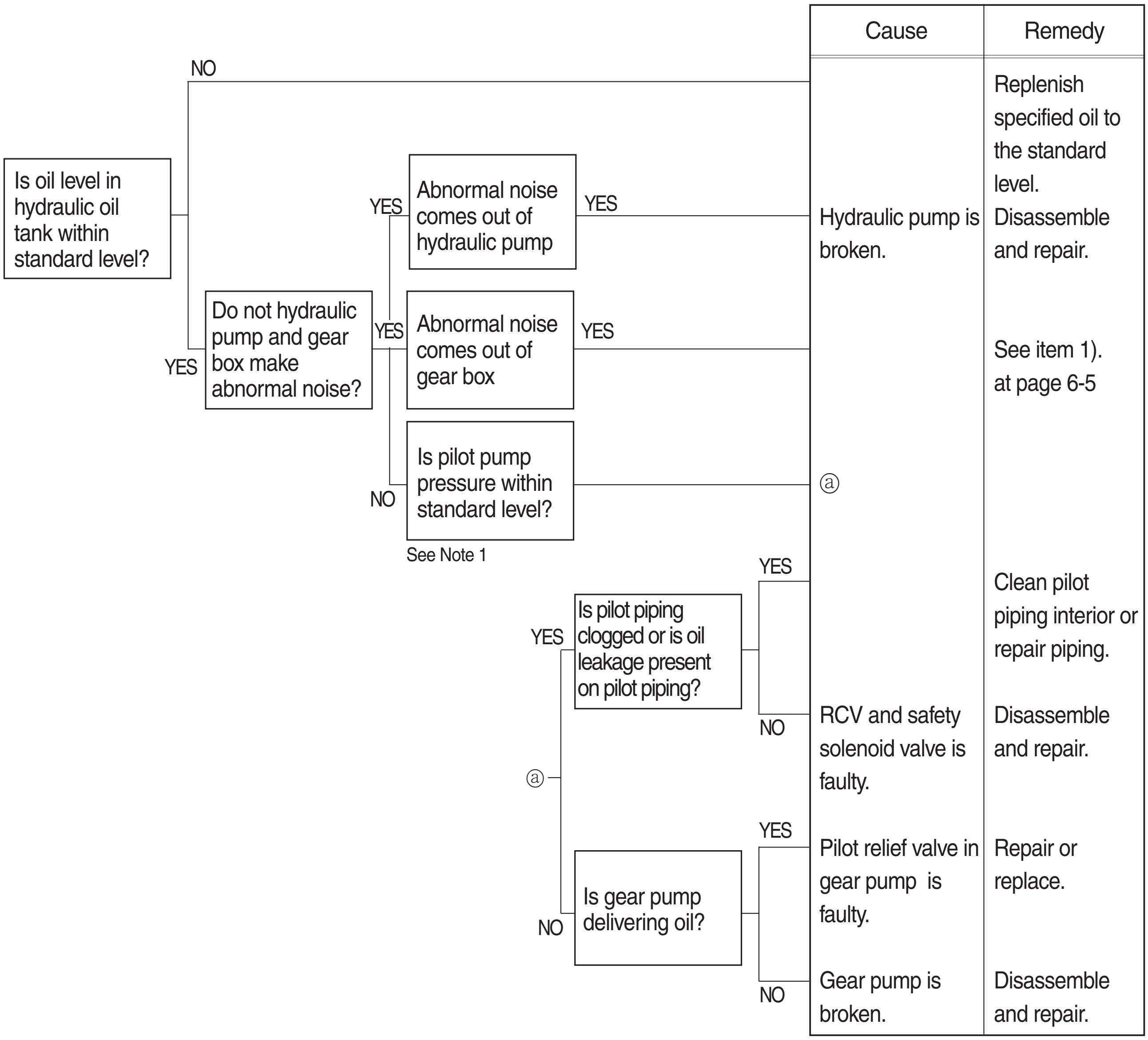
No.	Description	Specification
Note 1	Pilot pump pressure	40^{+2}_{0} bar
Note 2	Swing pilot pressure	0~40 bar
Note 3	Boom up pilot pressure	0~40 bar
Note 4	Arm/bucket pilot pressure	0~40 bar
Note 5	A pump pressure	343 bar
Note 6	B pump pressure	343 bar
Note 7	C pump control pressure	343 bar

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF GEAR BOX

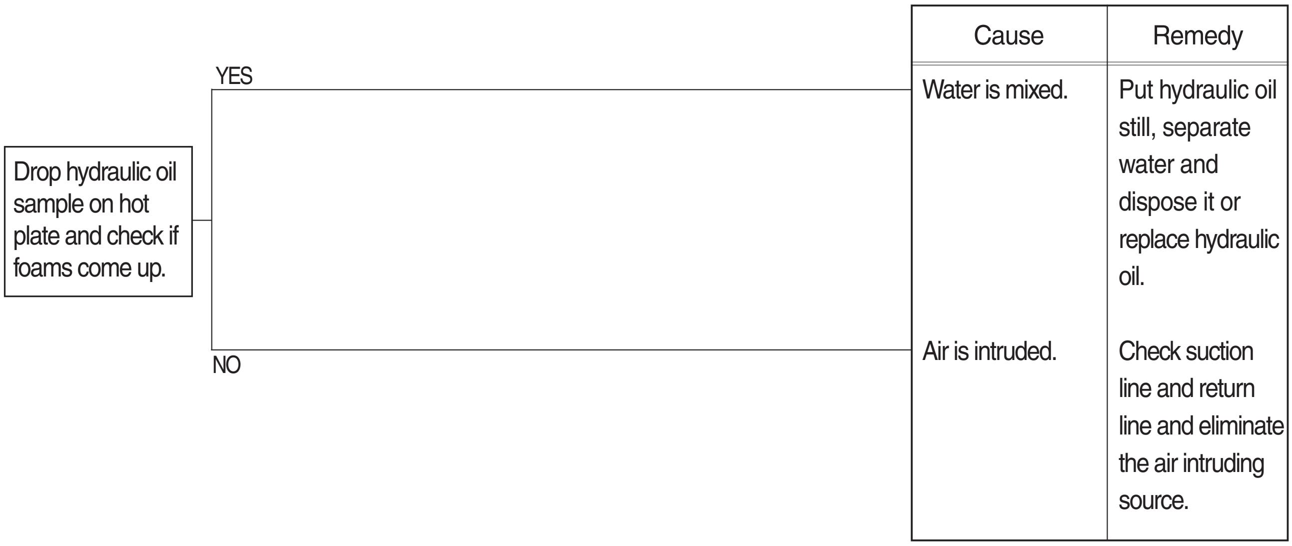


2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

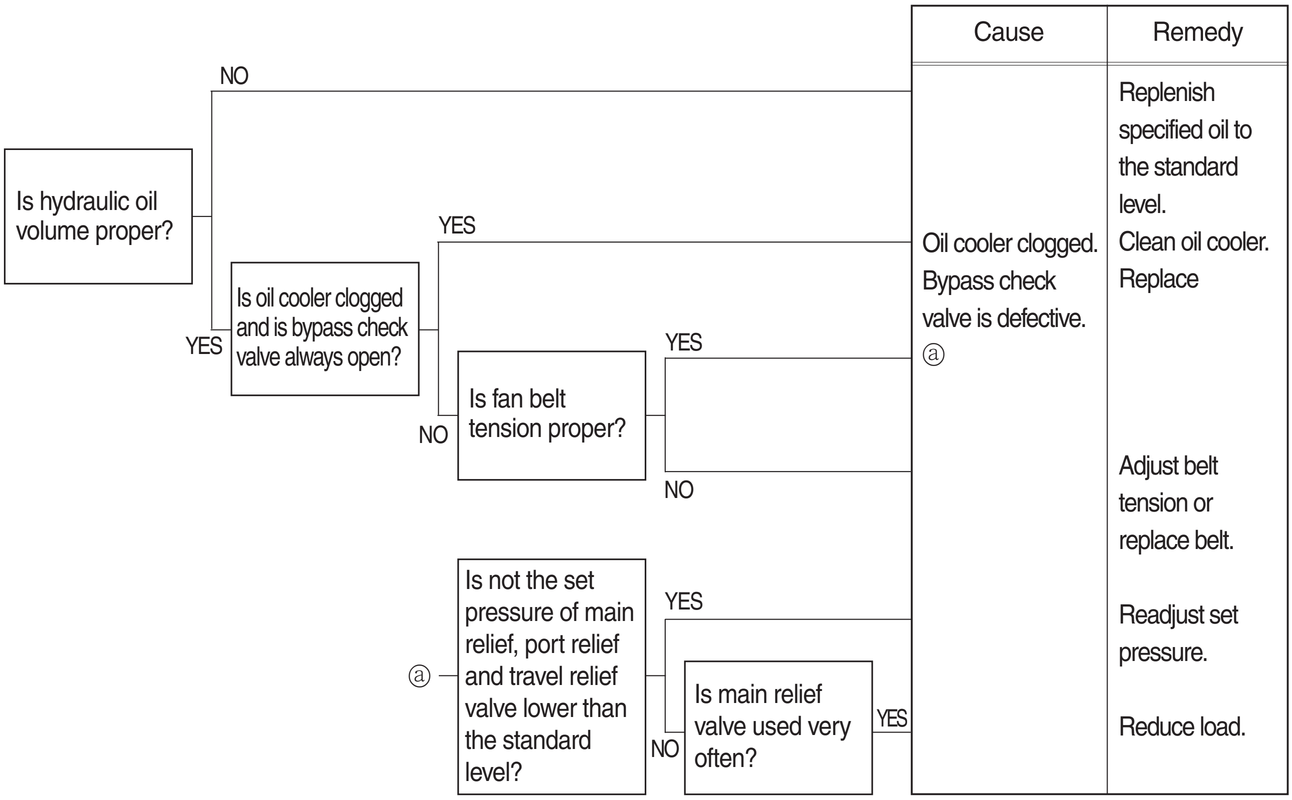


3. HYDRAULIC SYSTEM

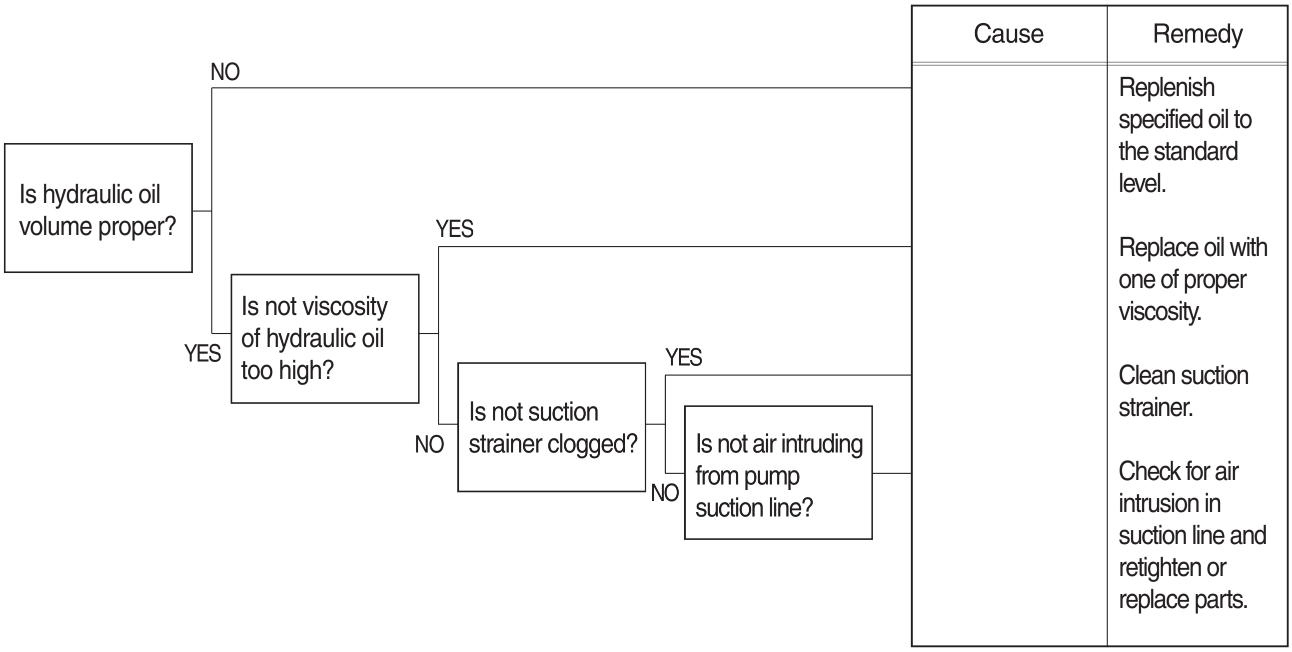
1) HYDRAULIC OIL IS CLOUDY



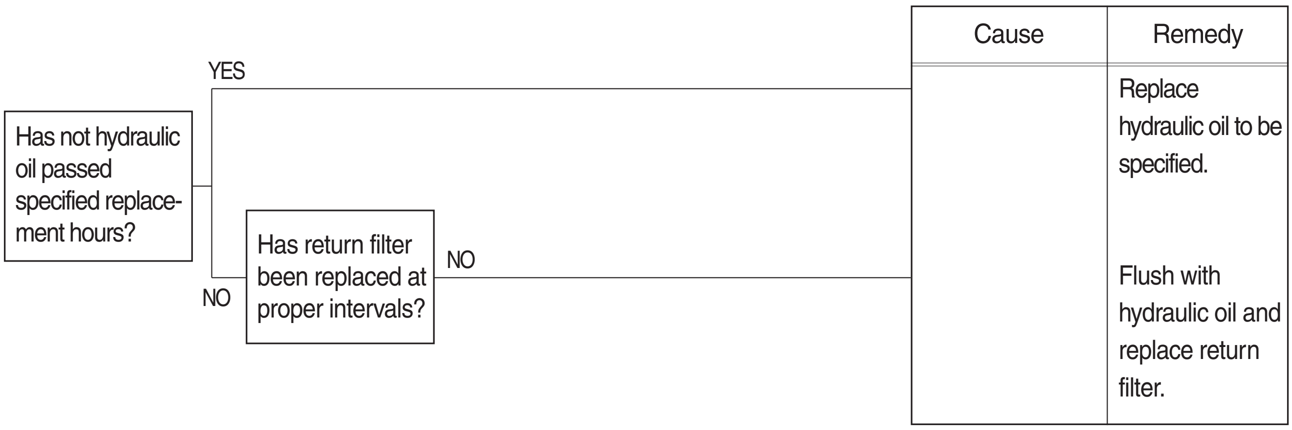
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

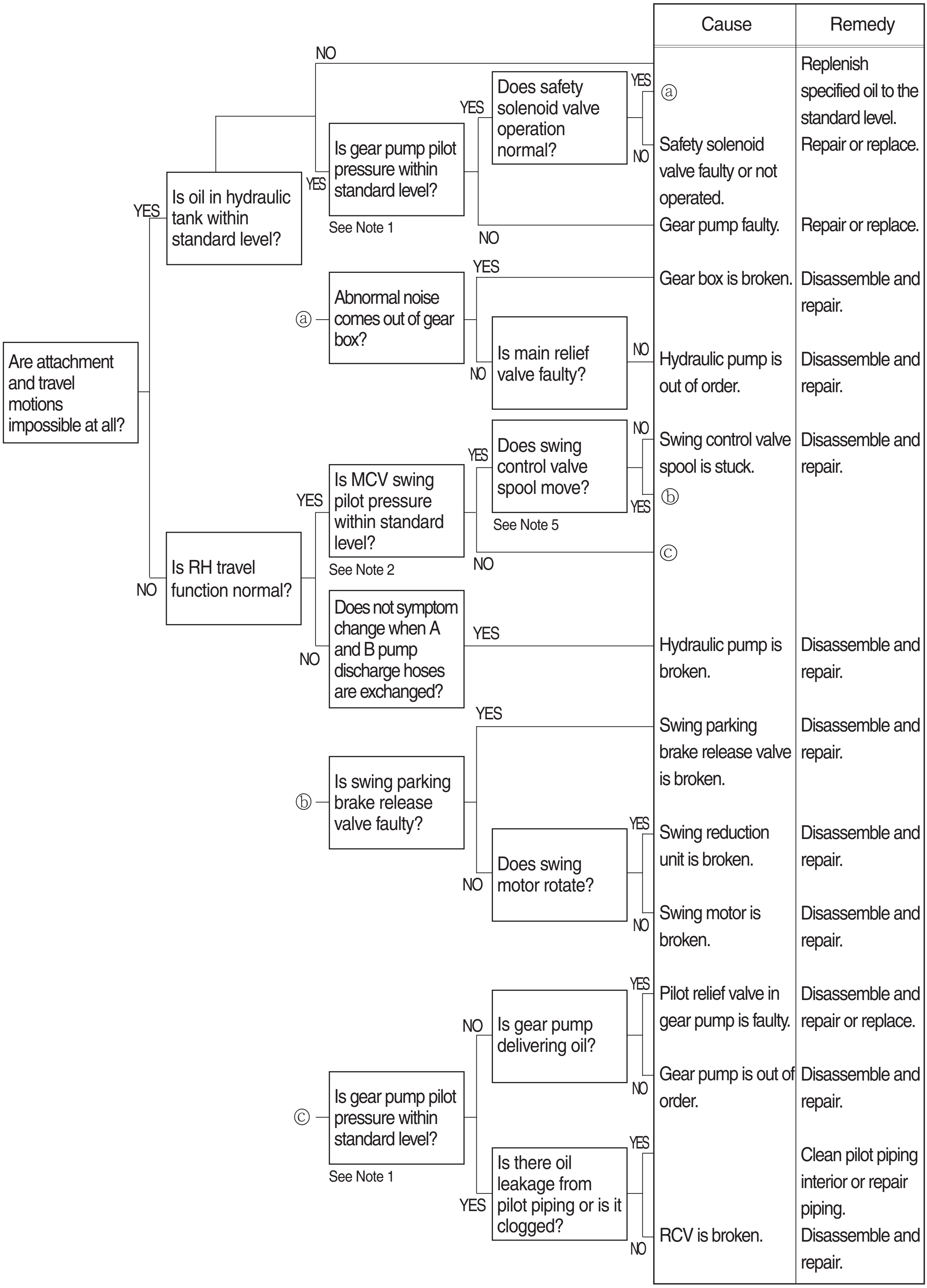


4) HYDRAULIC OIL IS CONTAMINATED

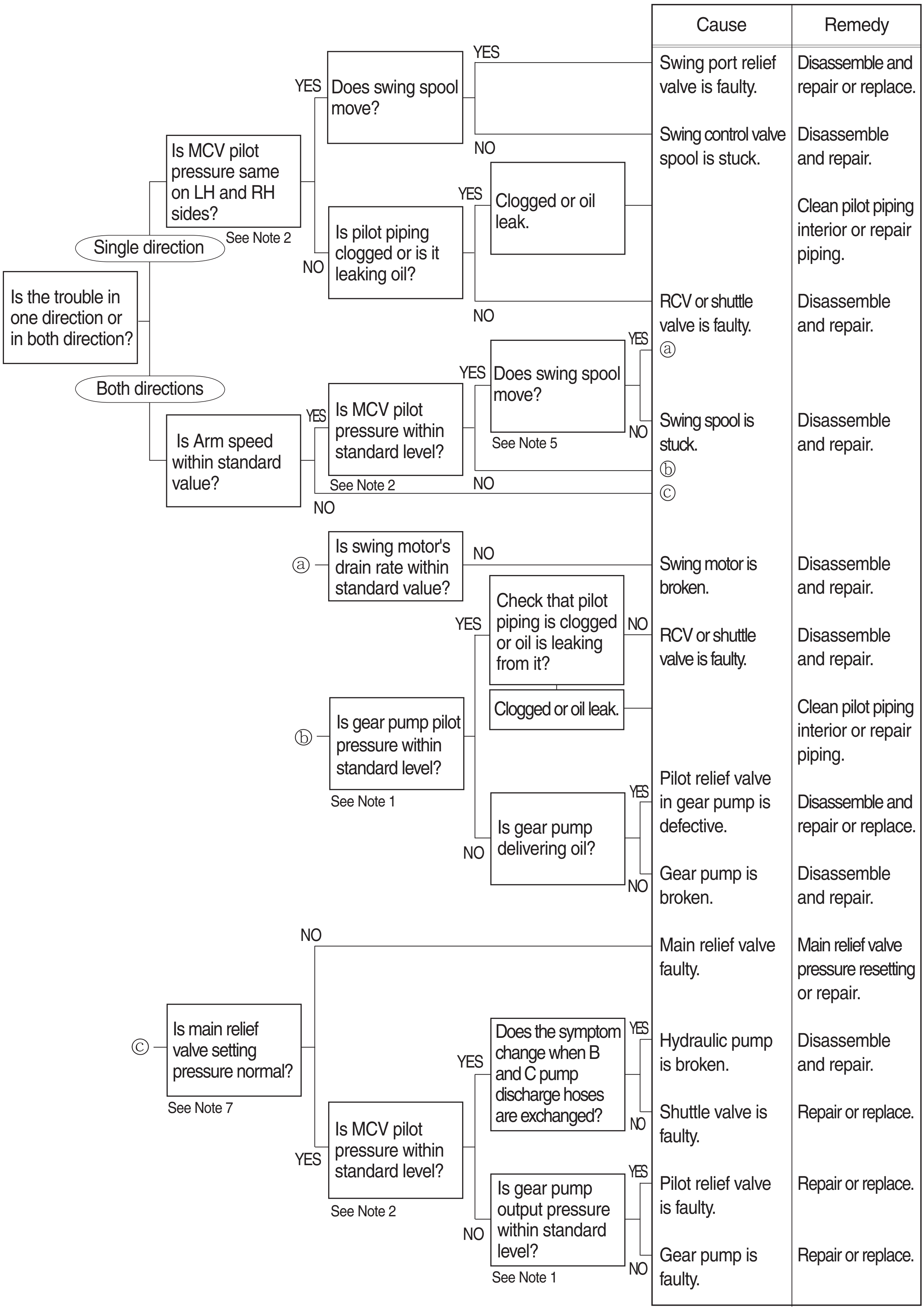


4. SWING SYSTEM

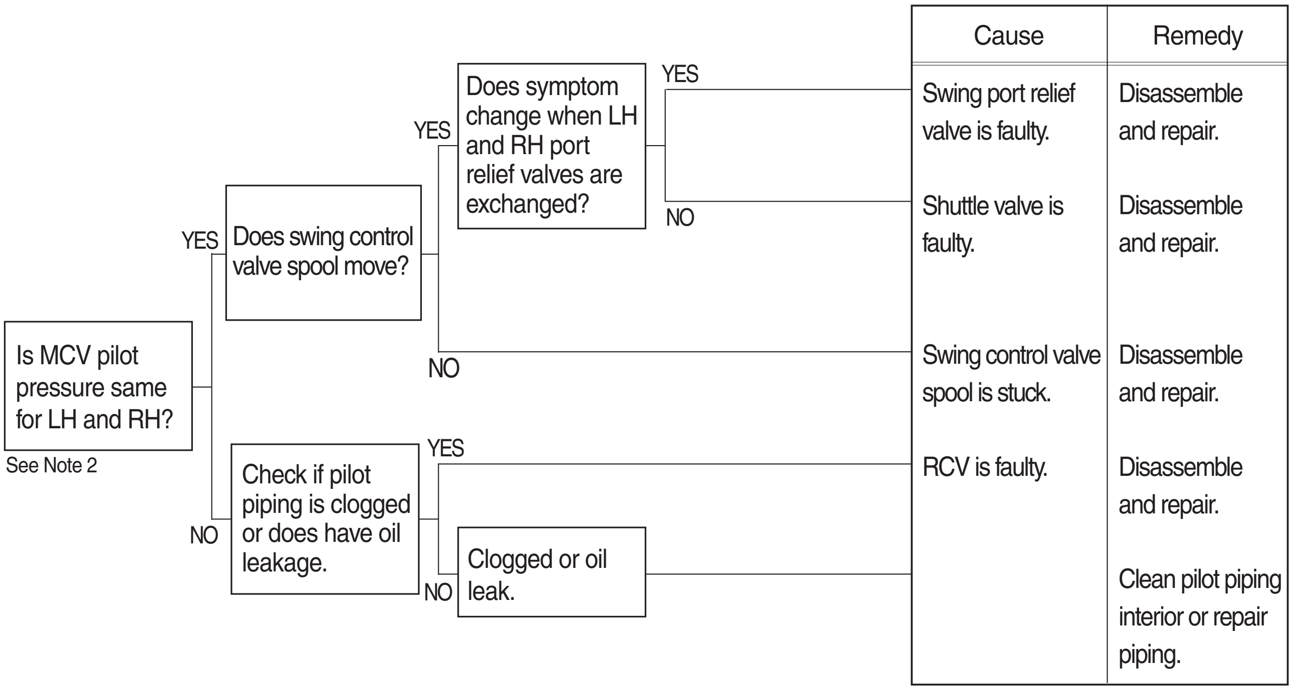
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



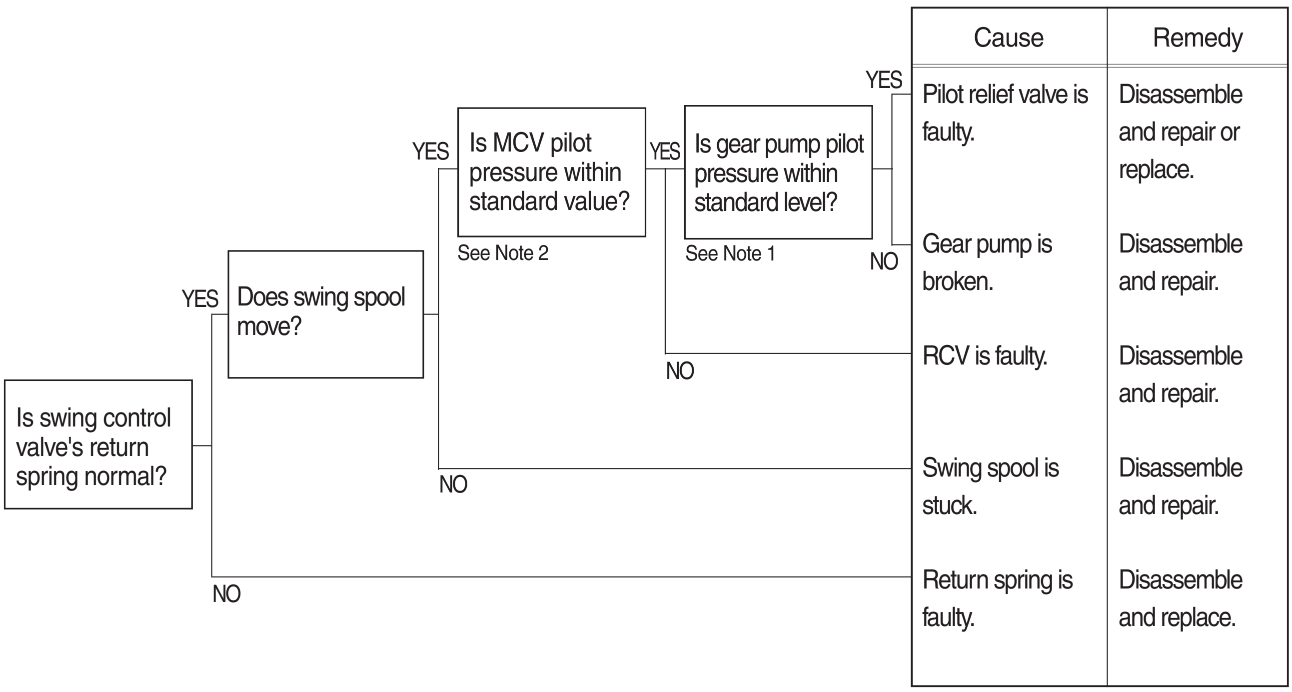
2) SWING SPEED IS LOW



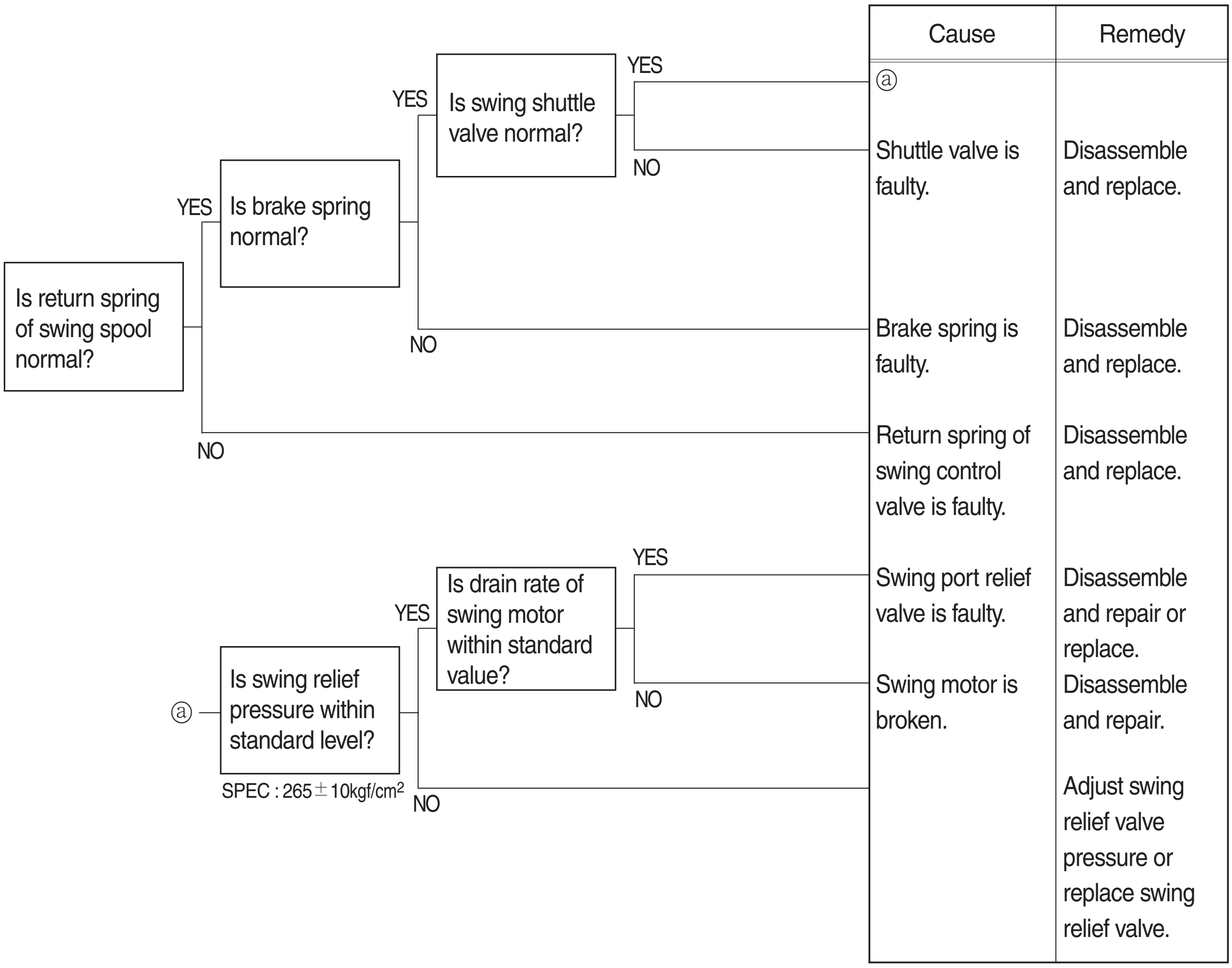
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

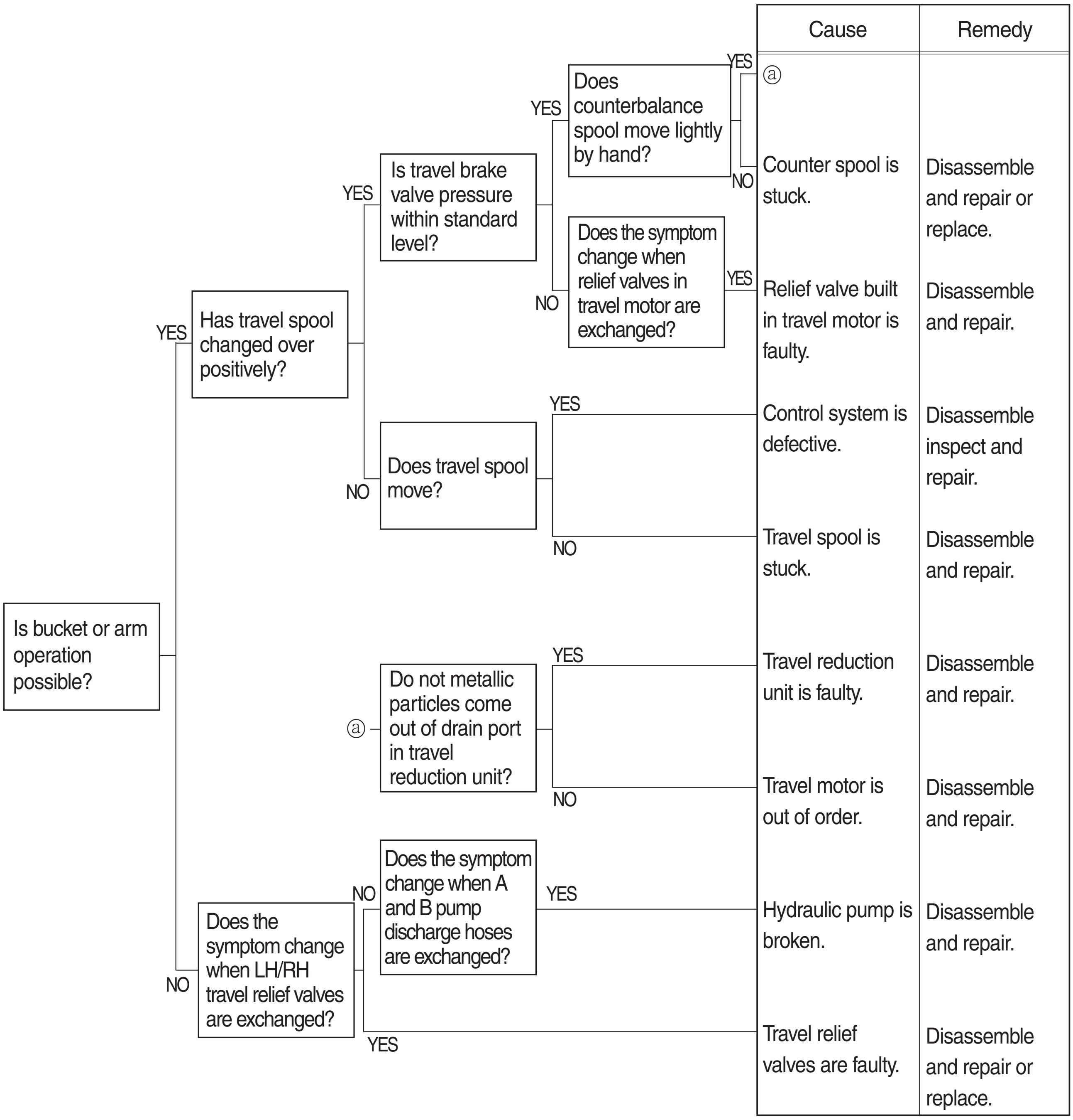


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

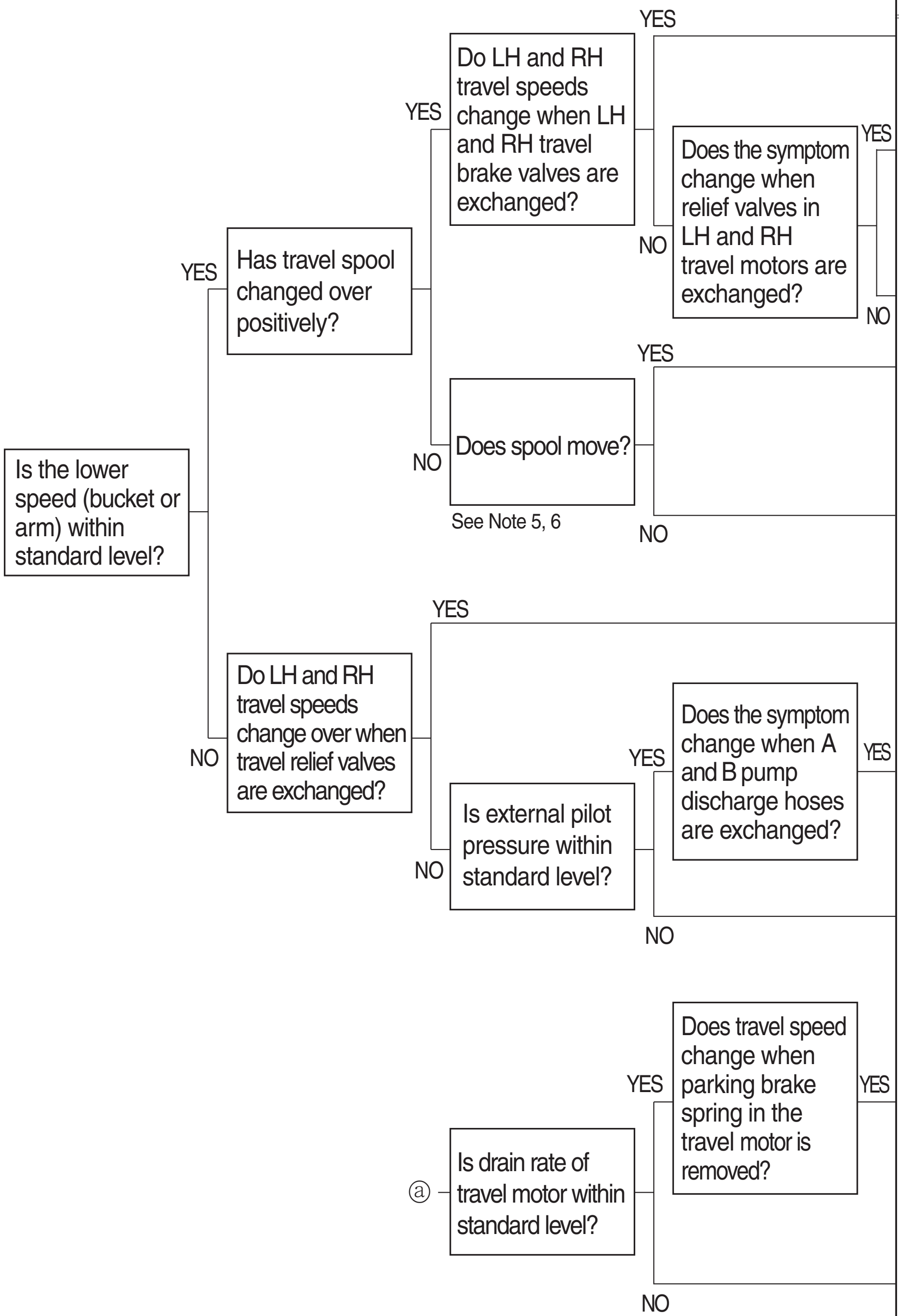


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



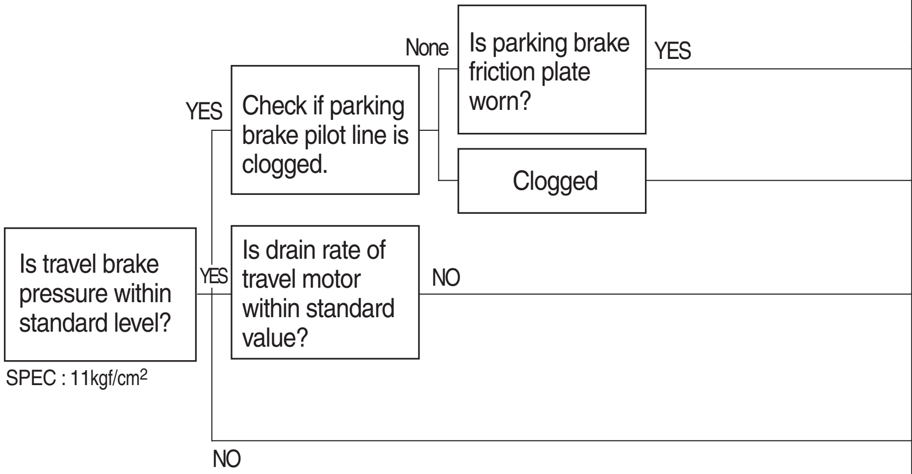
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



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.

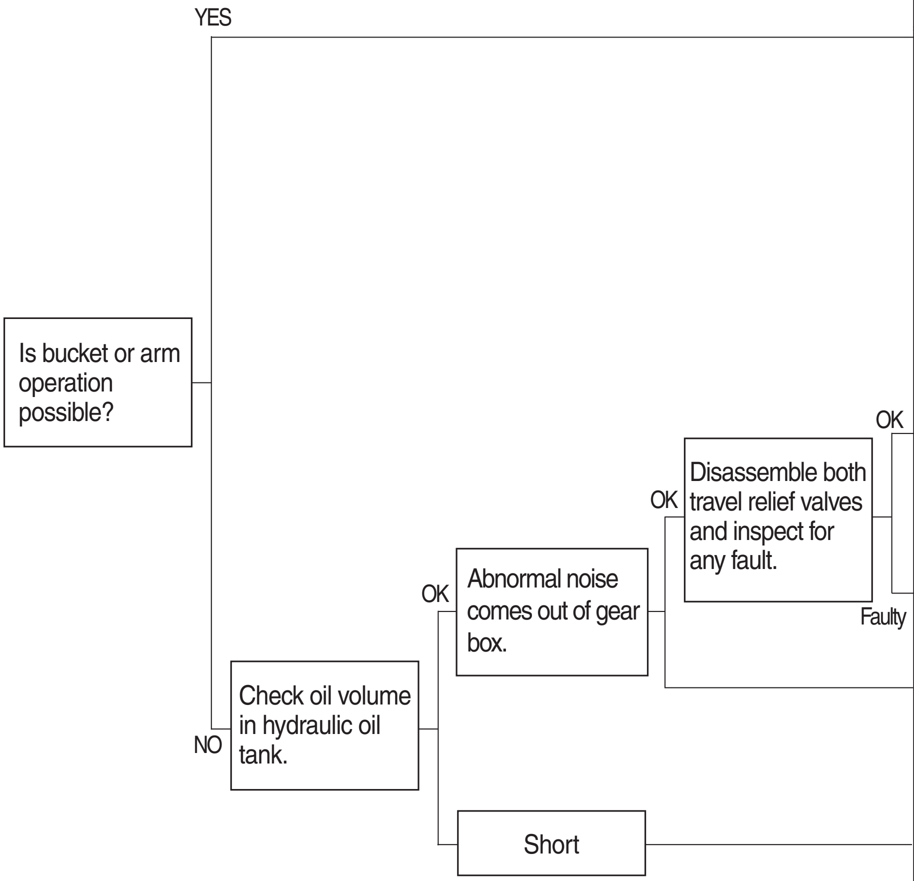
3) MACHINE DOES NOT STOP ON A SLOPE

Machine is pulled forward as sprocket rotates during digging operation.



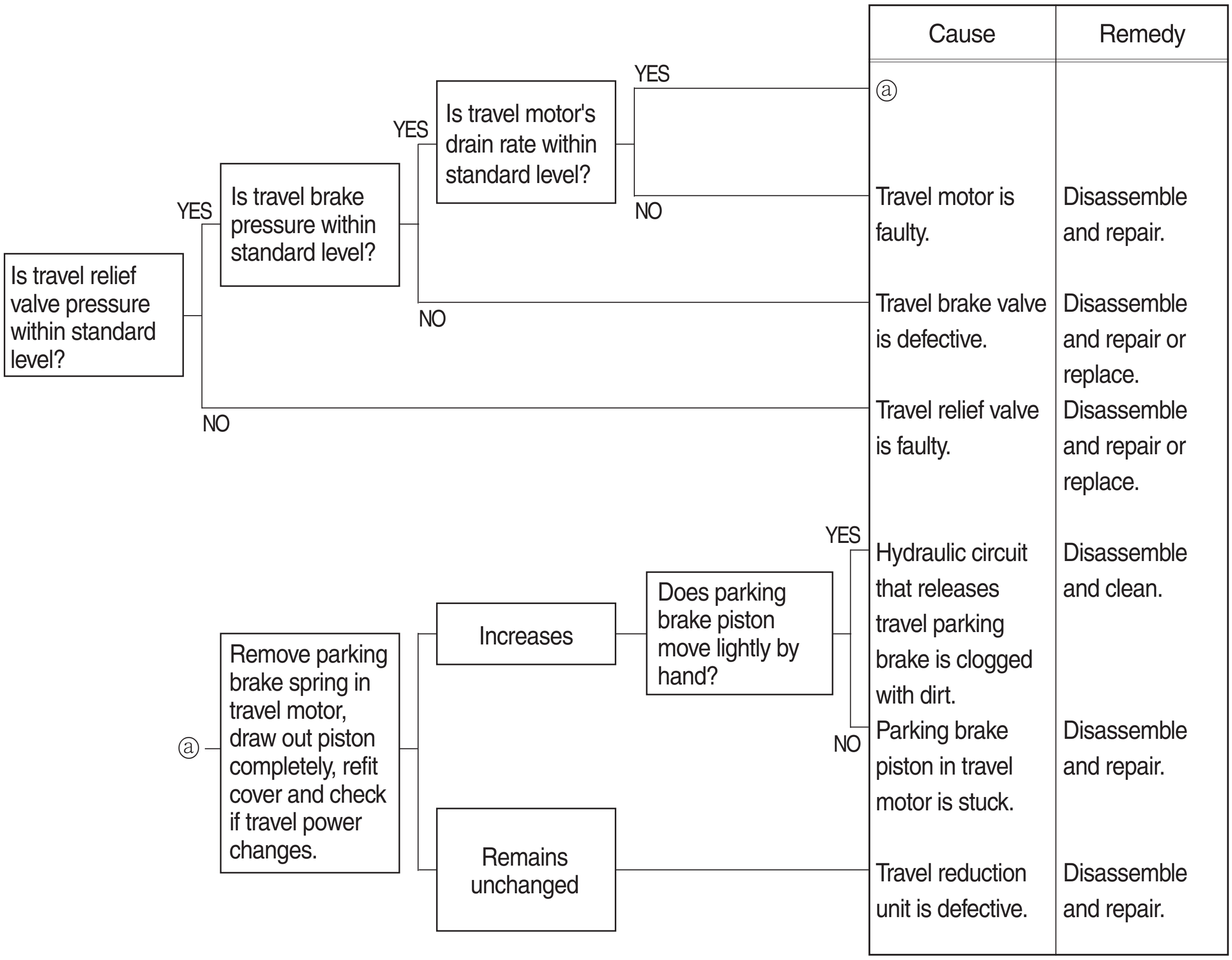
Cause	Remedy
Friction plate is faulty.	Disassemble and repair.
	Disassemble and clean pilot piping.
Travel motor is defective.	Disassemble and repair.
Brake valve is faulty.	Disassemble and repair or replace.

4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE



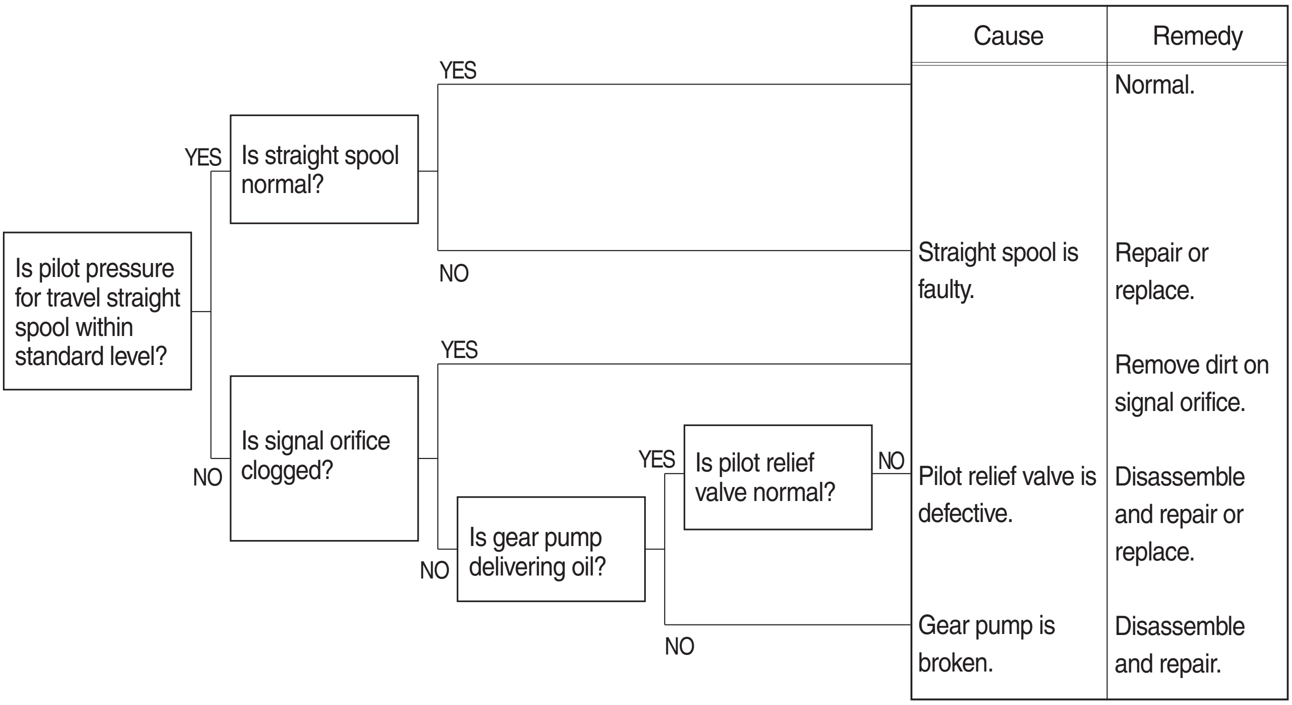
Cause	Remedy
	Inspect according to the procedure "Travel does not function at all on one side." However, a case where both LH and RH travel motions are disabled is extremely seldom statistically.
Hydraulic pump is faulty.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble and repair or replace.
Gear box is broken.	Disassemble and repair.
	Replenish hydraulic oil.

5) TRAVEL ACTION IS POWERLESS (travel only)



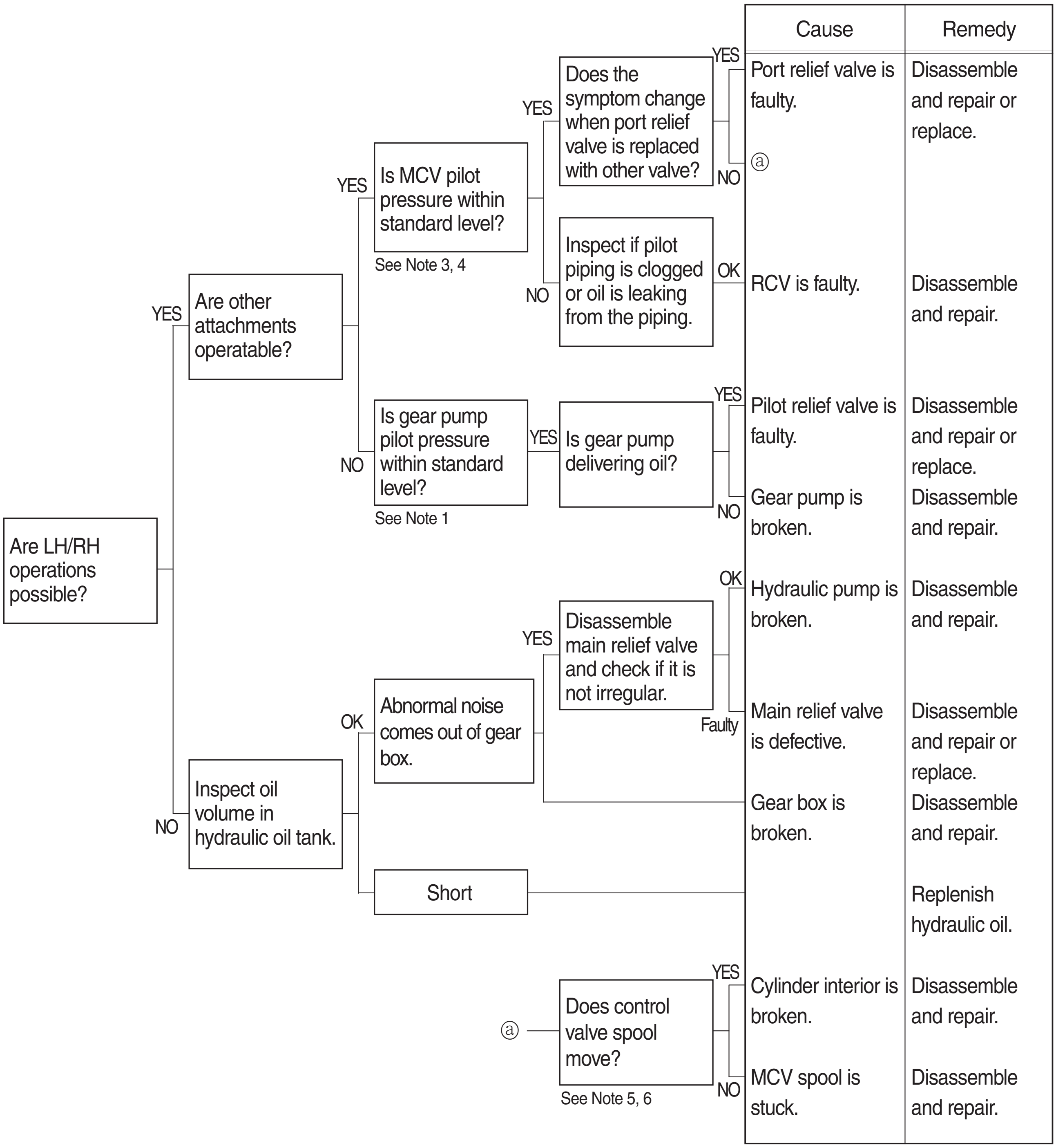
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

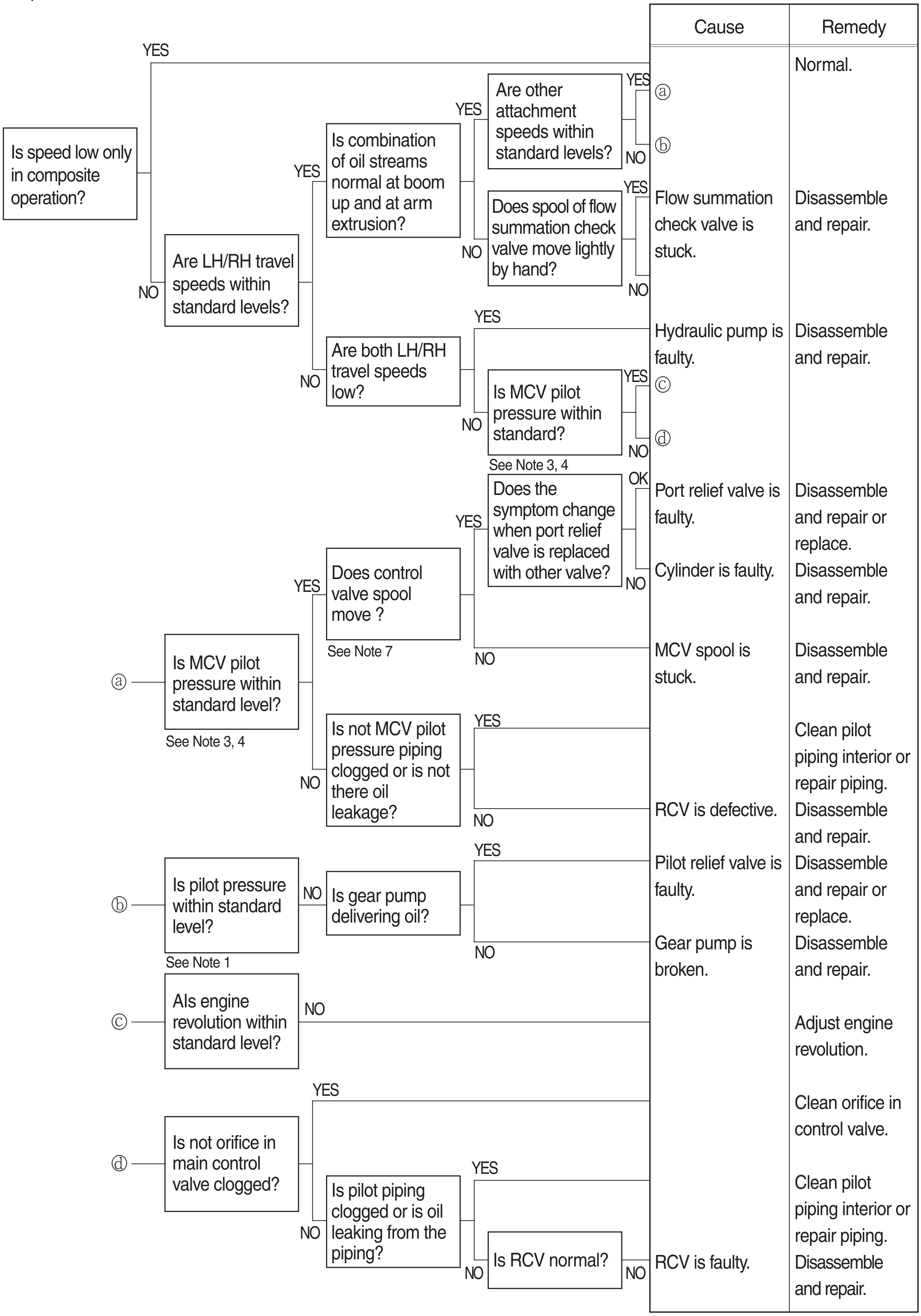


6. ATTACHMENT SYSTEM

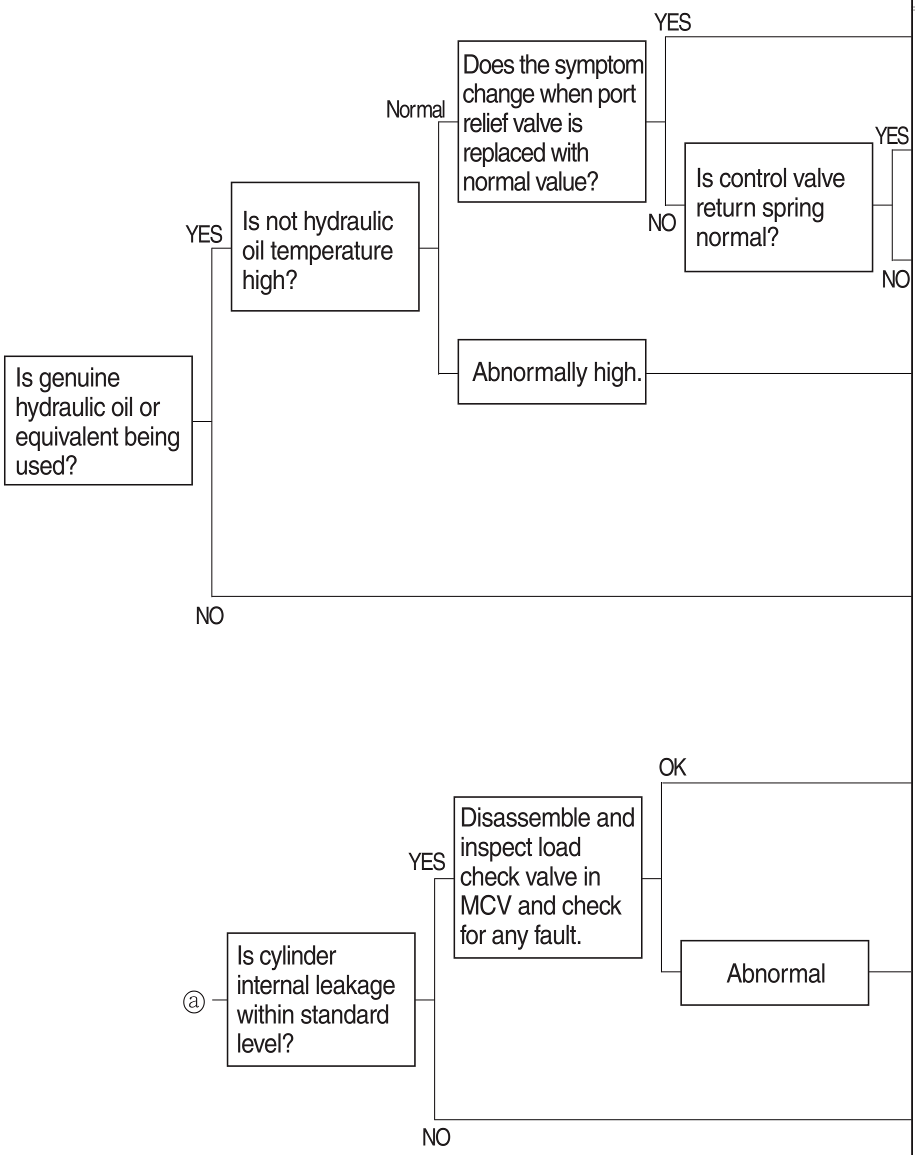
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

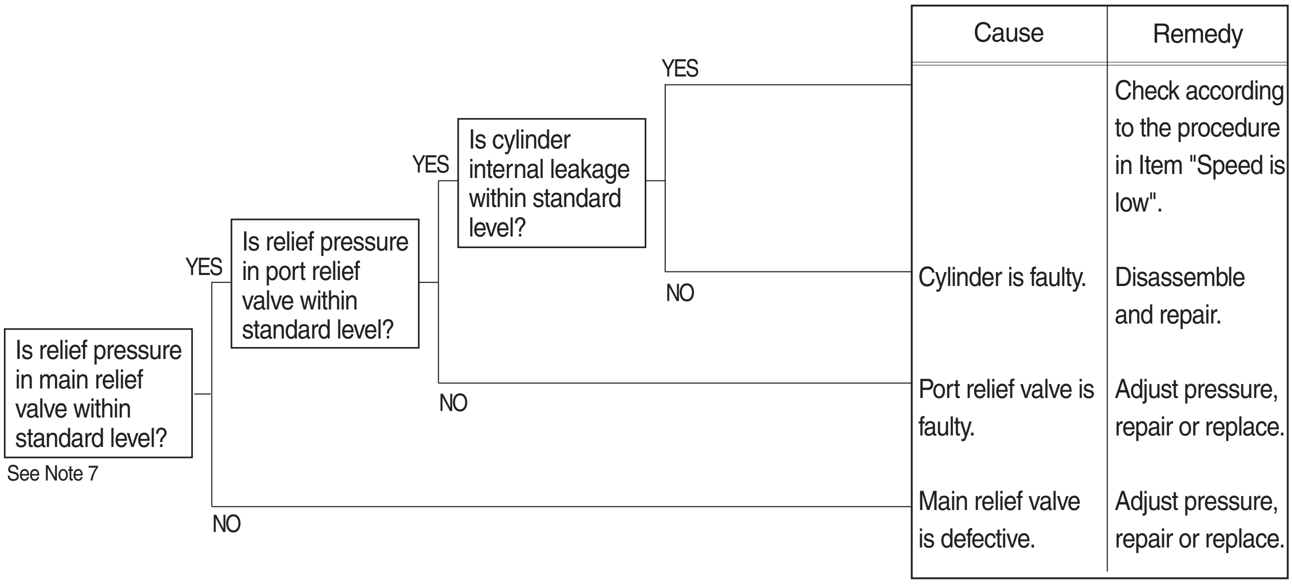


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

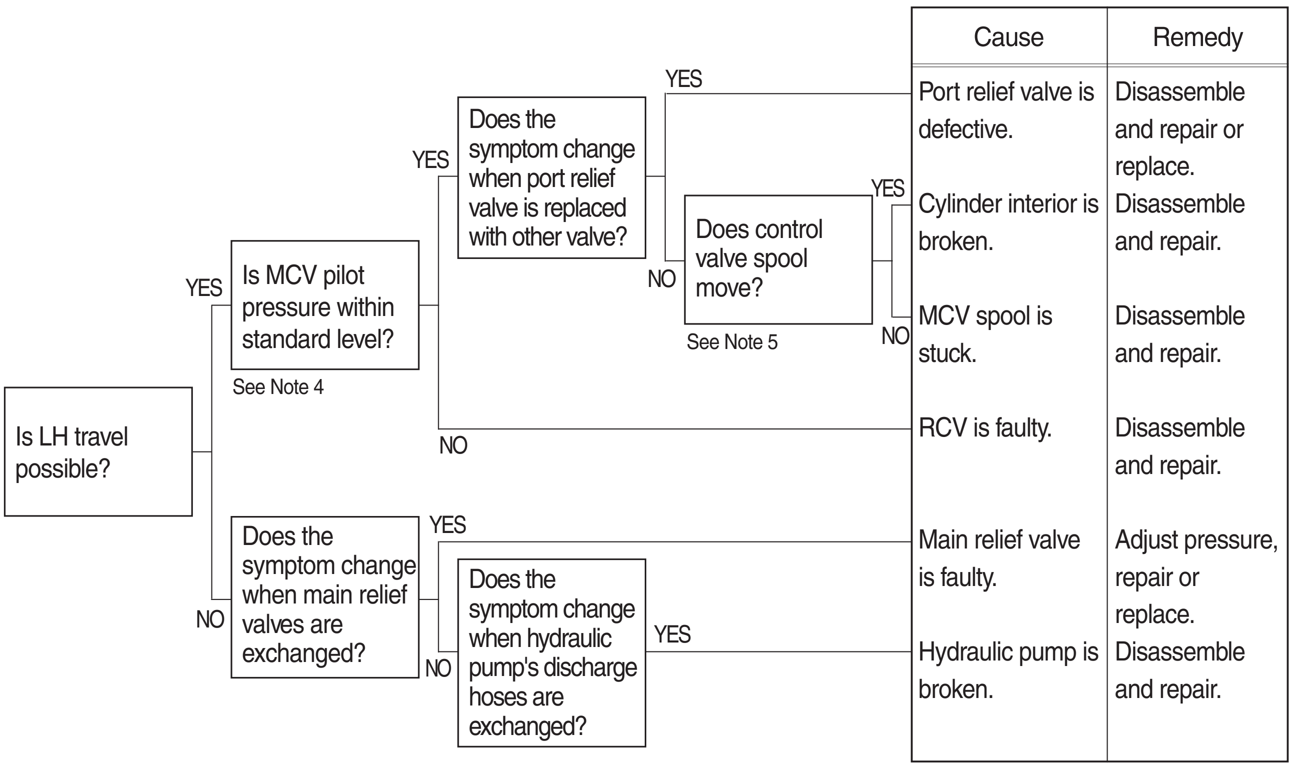


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



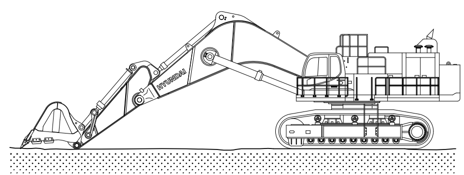
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

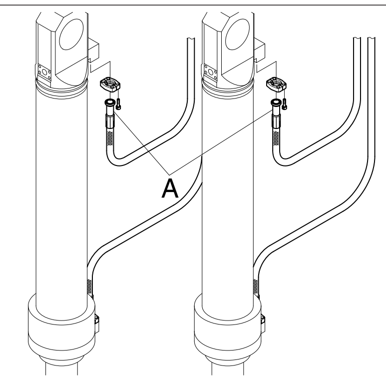
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



120096ES02A

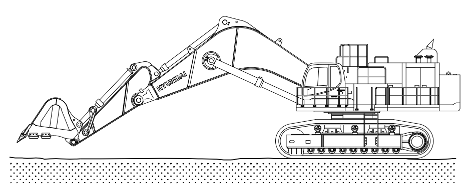
2. Disconnect hose (A) from tube side of boom cylinder and drain oil from cylinders and hose. (put cups on piping and hose ends)



120096ES04

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

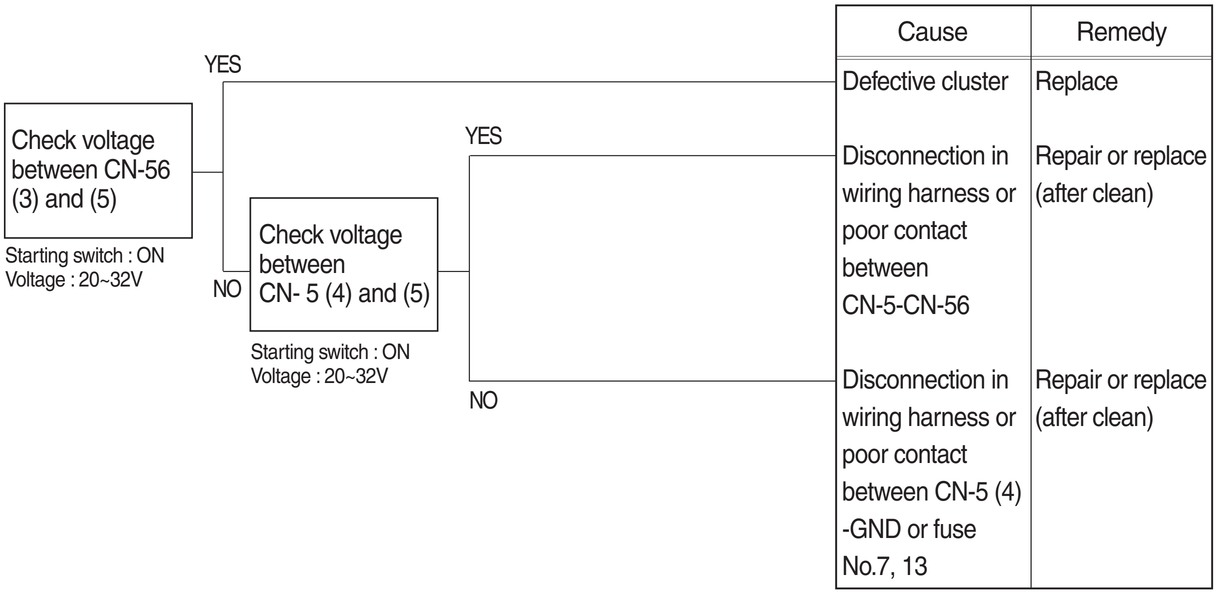
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



120096ES01A

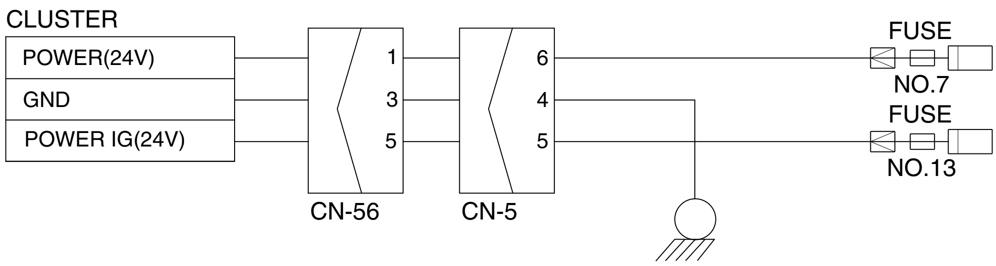
1. WHEN STARTING SWITCH IS TURNED ON, MONITOR PANEL DISPLAY DOES NOT APPEAR

· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.7, 13.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Check voltage

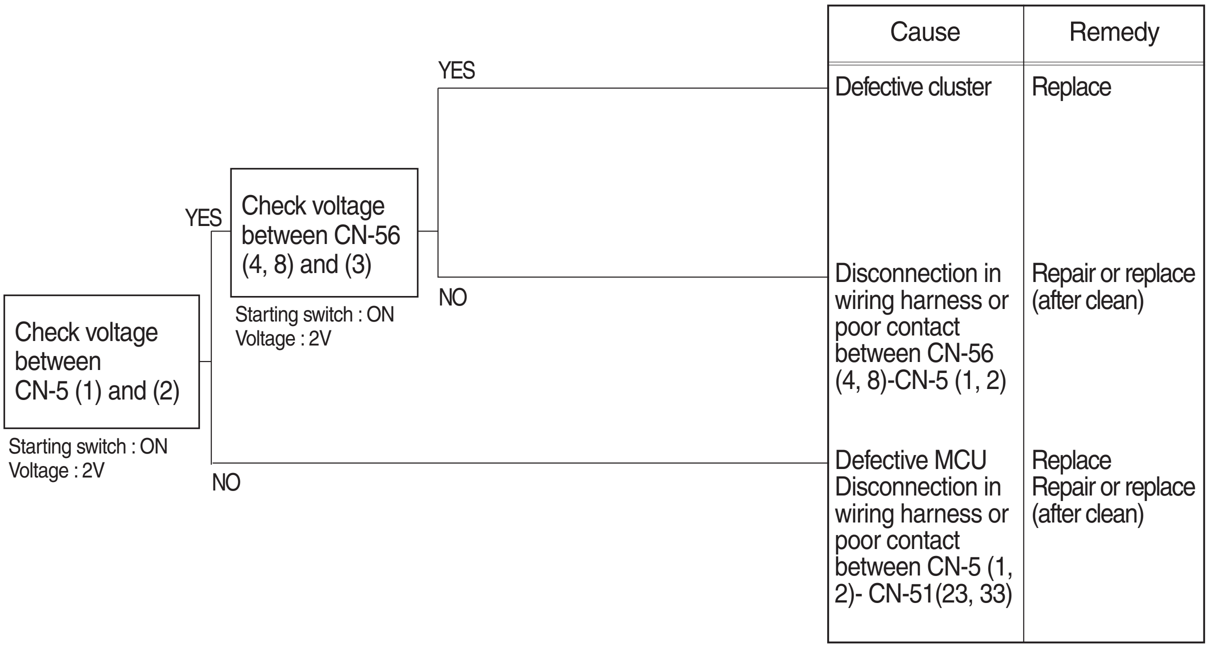
YES	20~32V
NO	0V



21096ES01

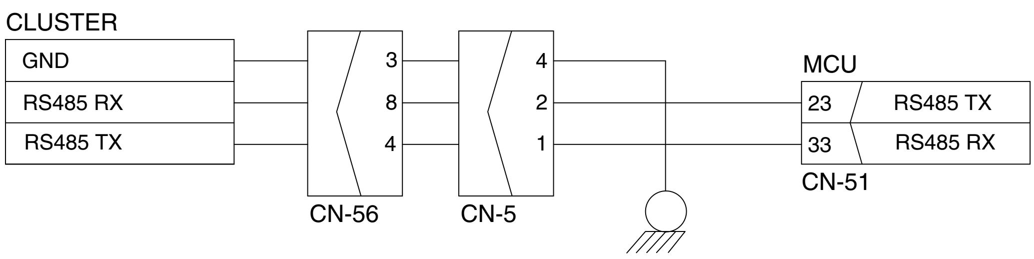
2. COMMUNICATION ERROR FLASHES ON THE CLUSTER (HCESPN 840, FMI 2)

- 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

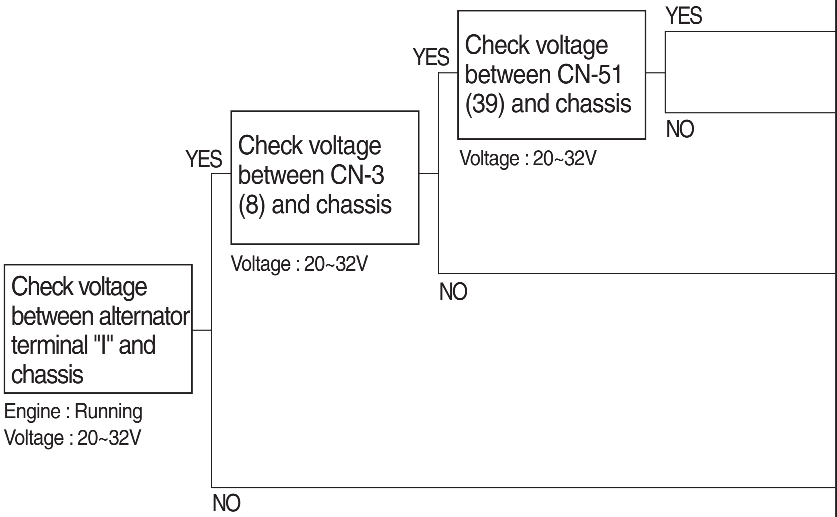
YES	2V
NO	0V



21096ES02

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

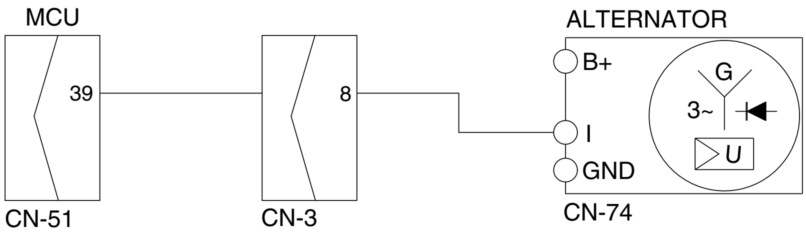
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective MCU	Replace
Disconnection in wiring harness or poor contact between CN-51 (39)-CN-3 (8)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-3 (8) alternator terminal "I"	Repair or replace (after clean)
Defective alternator	Replace

Check voltage

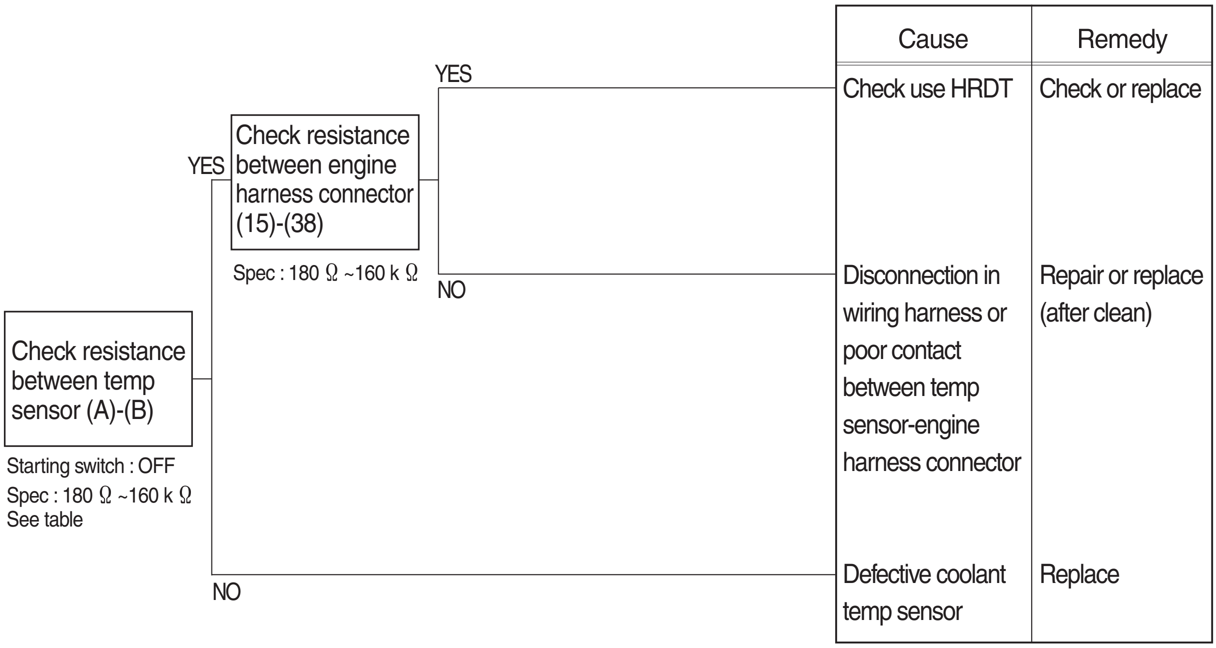
YES	20~32V
NO	0V

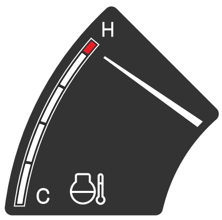


120096ES03

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

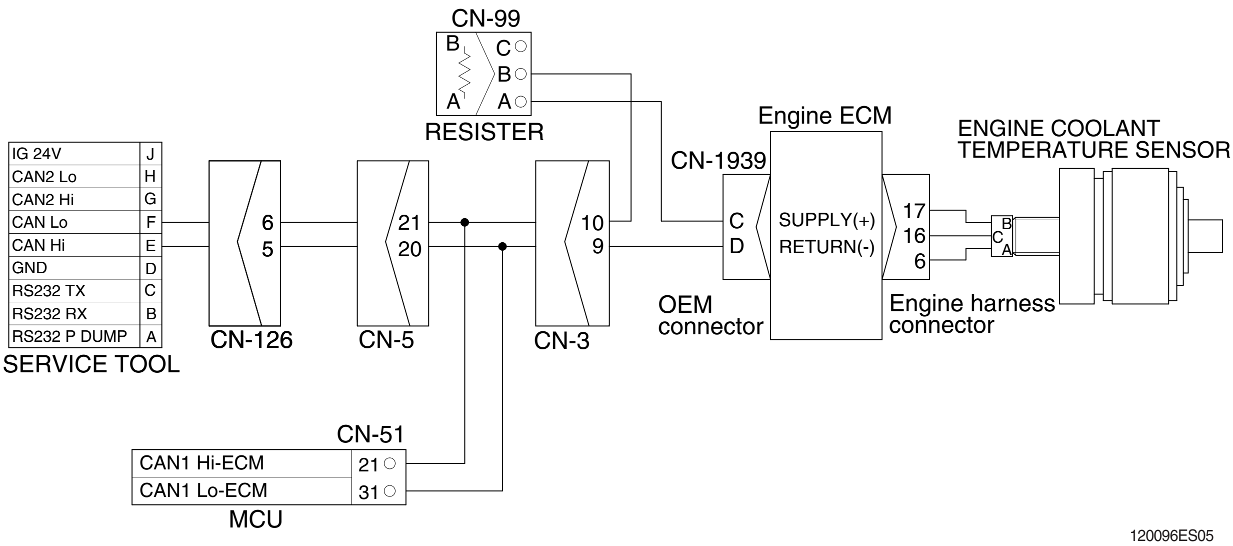
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.





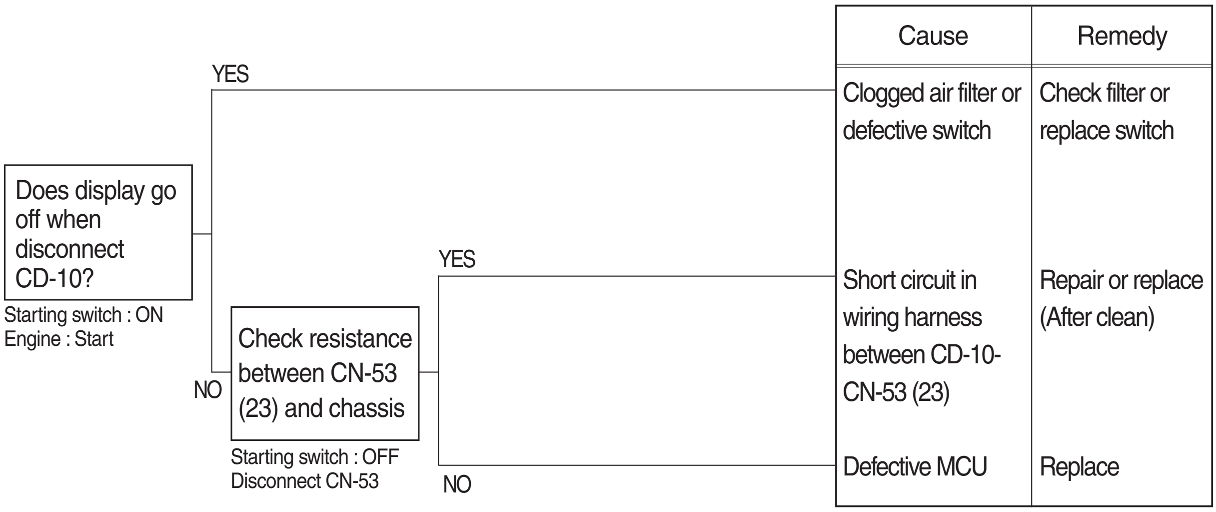
Check Table

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



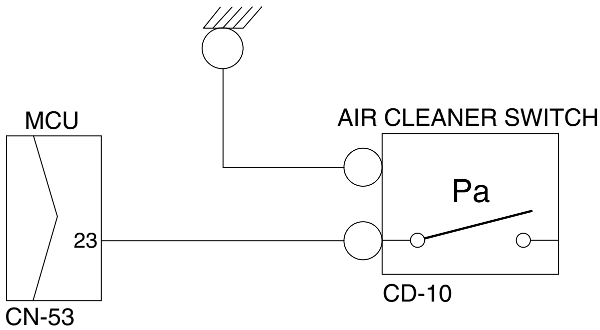
5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (engine is started)

· 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

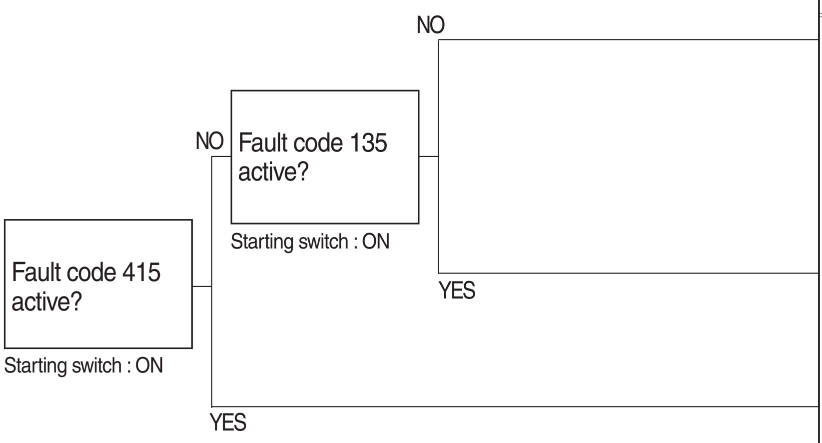
YES	MAX 1Ω
NO	MIN 1MΩ



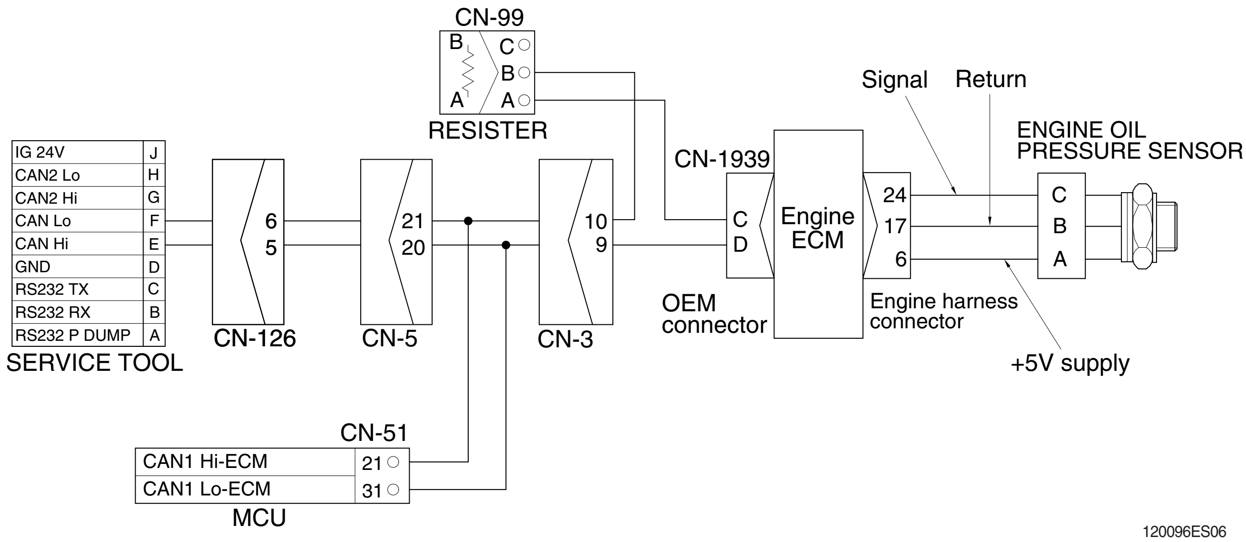
21096ES05

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.



Cause	Remedy
Defective circuit, sensor or ECM.	Contact Cummins.
Voltage above normal or shorted to high source	Refer to engine fault code 135
Voltage above normal or shorted to high source	Refer to engine fault code 415



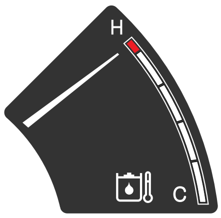
7. WHEN HYDRAULIC OIL TEMPERATURE WARNING LAMP LIGHTS UP (engine is started)

· 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.

Does display go off when disconnect CD-1?
Starting switch : ON
Engine : Start

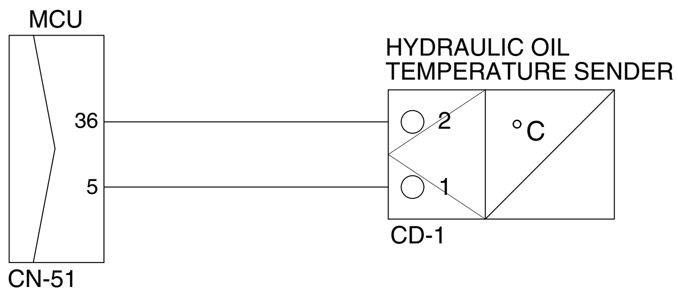
- YES → Resistance between CD-1 (1, 2) is in range of 164~151 Ω ?
  Starting switch : ON
  Disconnect CD-1
  - YES → High temperature
  - NO → Defective temp sensor
- NO → Resistance between CN-51 (36, 5) is 0~1 Ω ?
  Starting switch : OFF
  Disconnect CN-51
  - YES → Short circuit between temp sensor and MCU
  - NO → Defective controller

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



Check Table

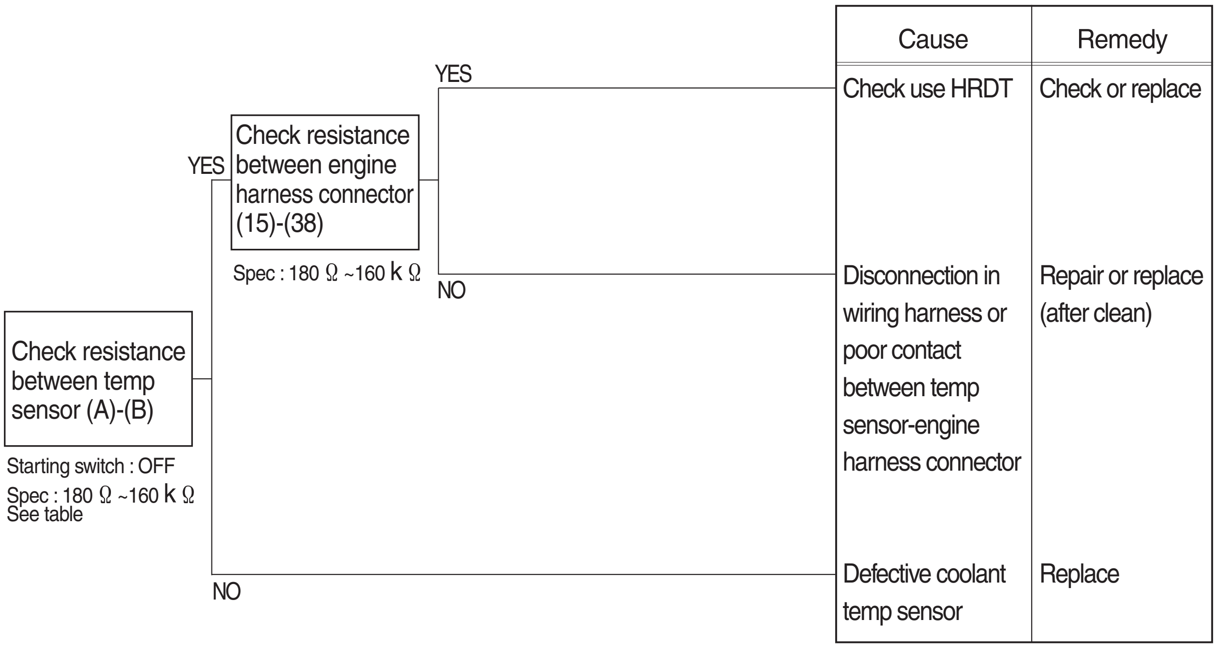
Temperature (˚C)	~ -30	~ -10	~ 0	~ 40	~ 70	~ 80	~ 90	~ 100	105~
Resistance (kΩ)	22.22 ~31.78	8.16 ~10.74	5.18 ~ 6.6	1.06 ~1.28	0.39 ~0.476	0.322 ~0.298	0.243 ~0.219	0.185 ~0.167	0.164 0.151

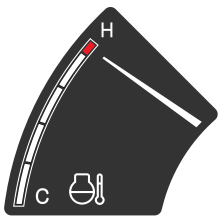


21096ES07

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE (HCESPN 304, FMI 3 or 4)

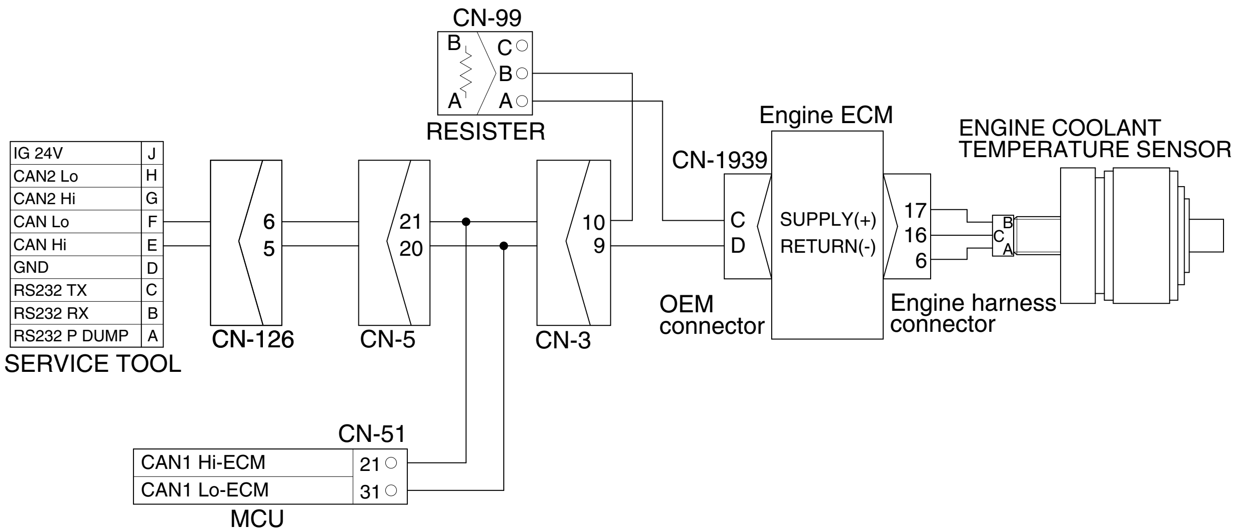
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

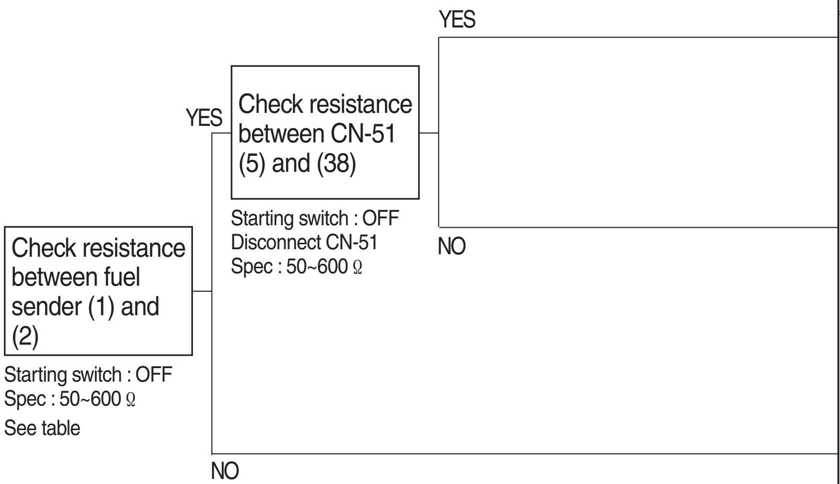
Temperature (˚C)	0	25	50	80	95
Resistance (k Ω)	30~37	9.3~10.7	3.2~3.8	1.0~1.3	0.7~0.8



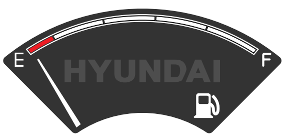
120096ES05

9. WHEN FUEL GAUGE DOES NOT OPERATE(HCESPN 301, FMI 3 or 4)

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

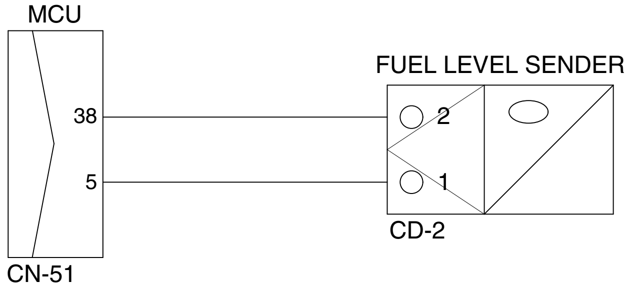


Cause	Remedy
Defective MCU or cluster	Replace
Disconnection in wiring harness or poor contact between fuel sender-MCU	Repair or replace
Defective fuel sender	Replace



Check Table

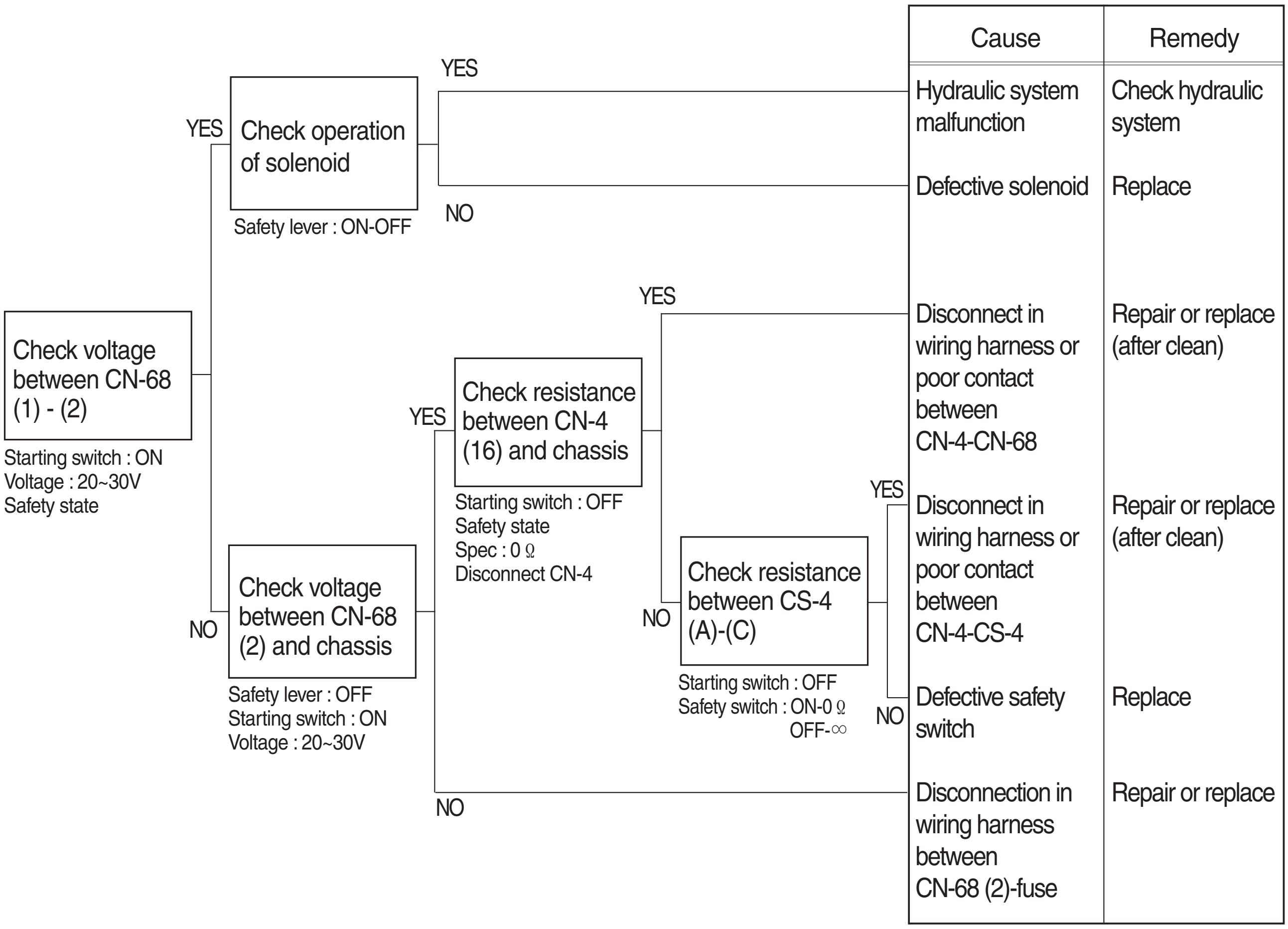
Range	Resistance (Ω)	Range	Resistance (Ω)
Full	50	5/12	400
11/12	100	4/12	450
10/12	150	3/12	500
9/12	200	2/12	550
8/12	250	1/12	600
7/12	300	Empty warning	700
6/12	350	-	-

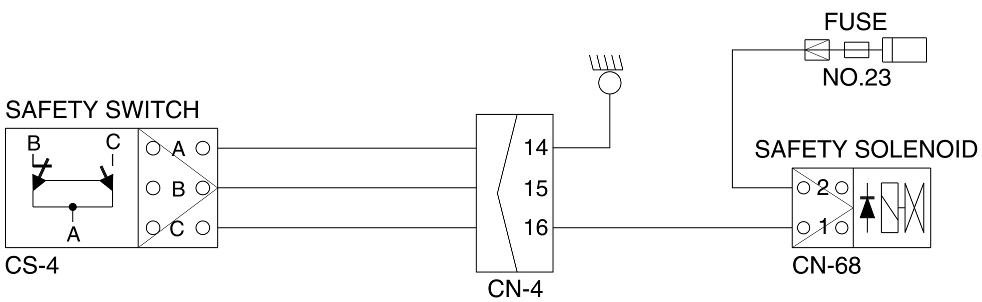


21096ES09

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.23.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

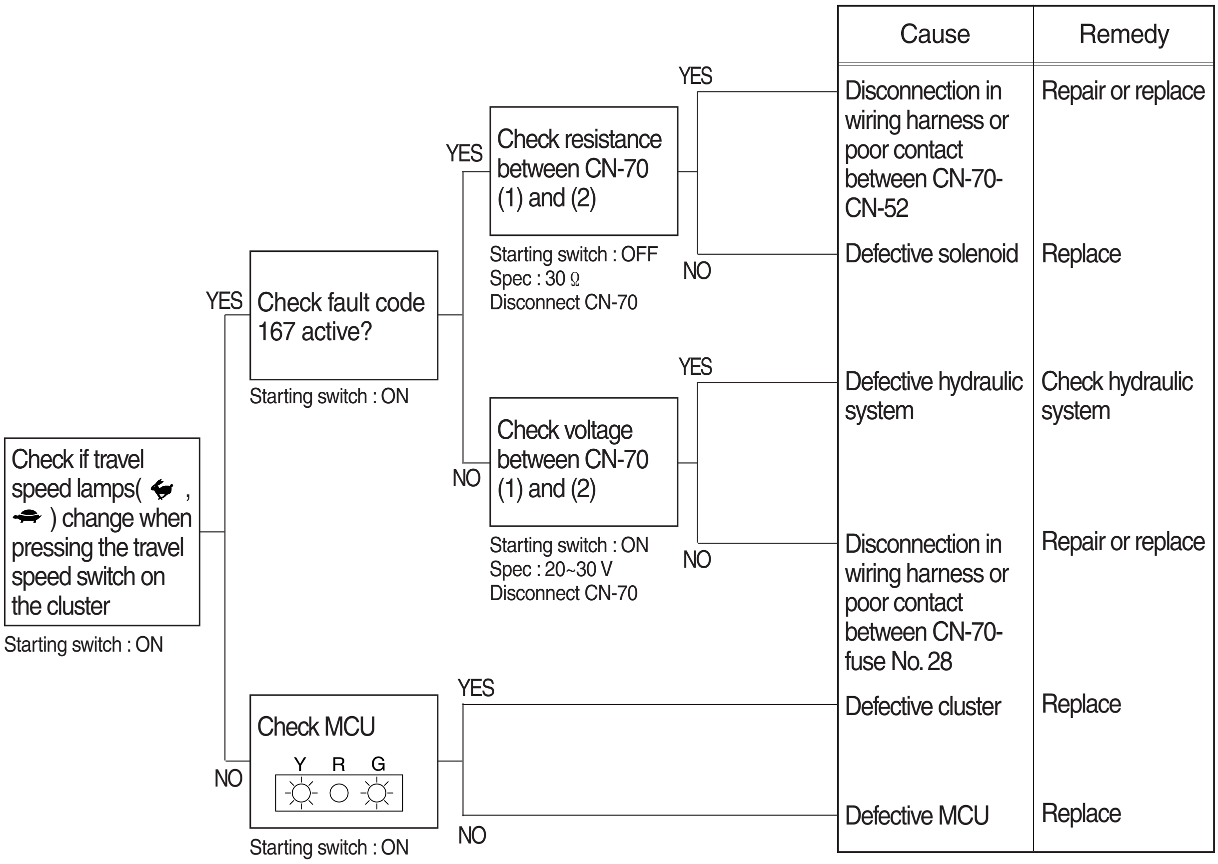


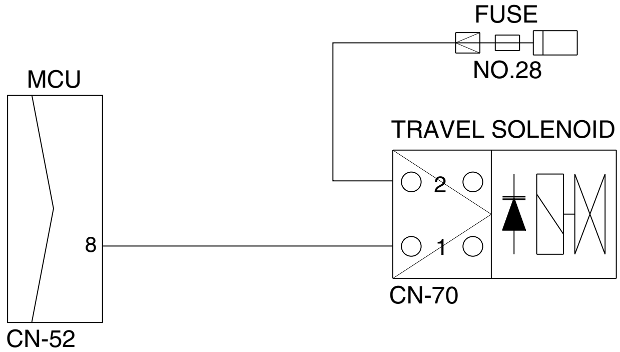


21096ES10

11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE (HCESPN 167, FMI 5 or 6)

- 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.28 .
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





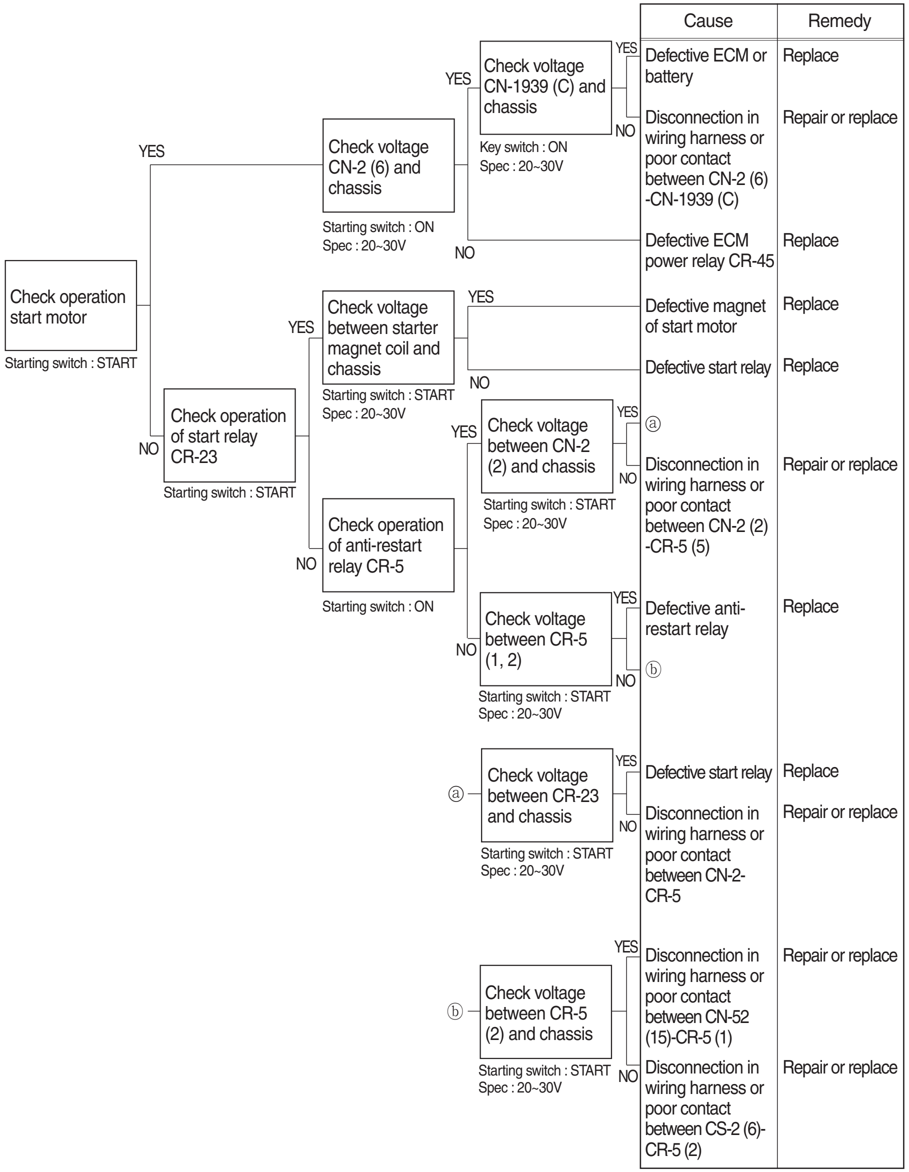
21096ES11

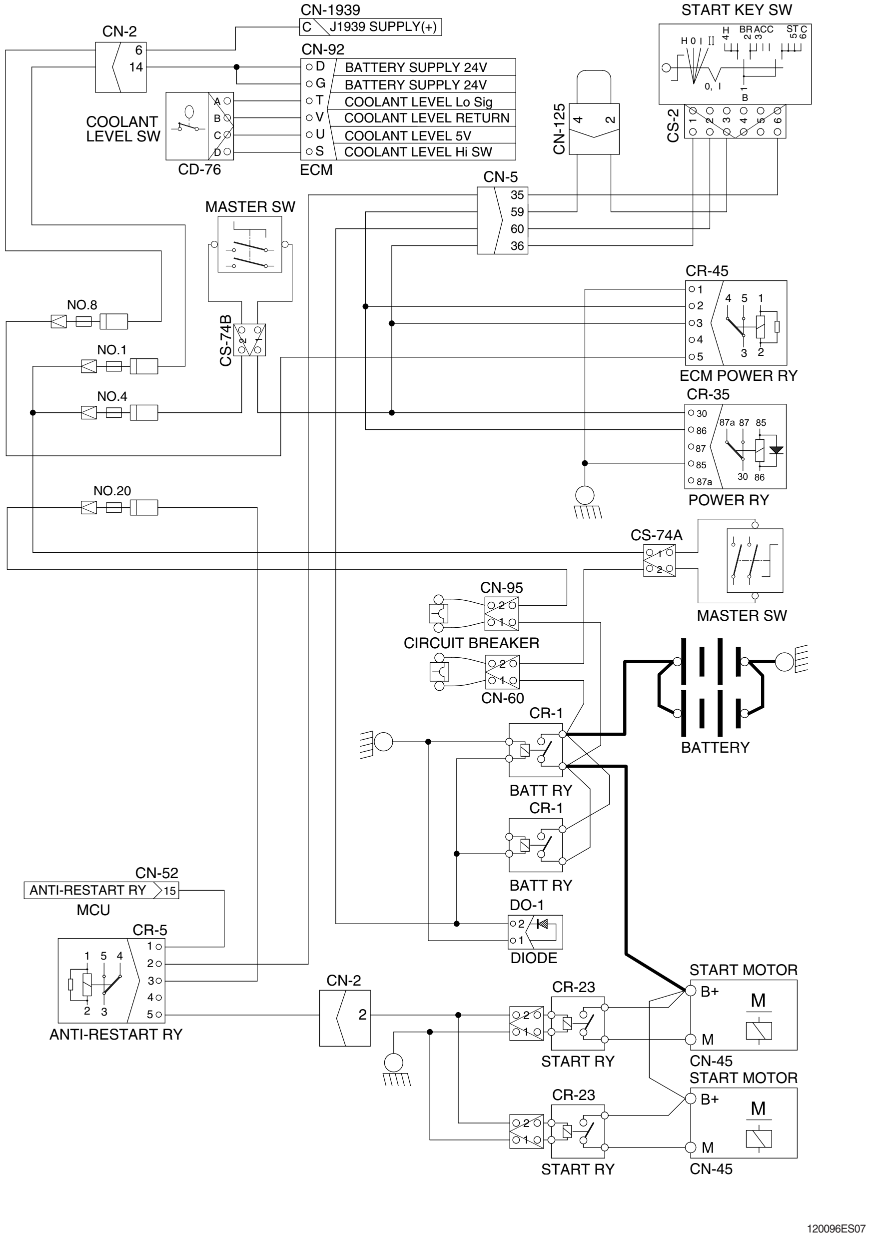
12. WHEN ENGINE DOES NOT START (- + lights up condition)

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

· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 1, 4, 8, 20.

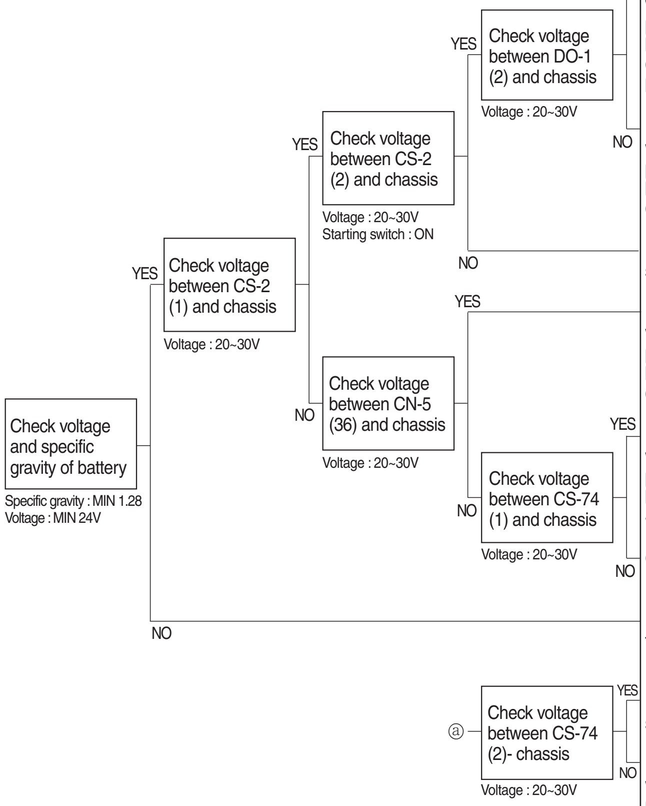
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



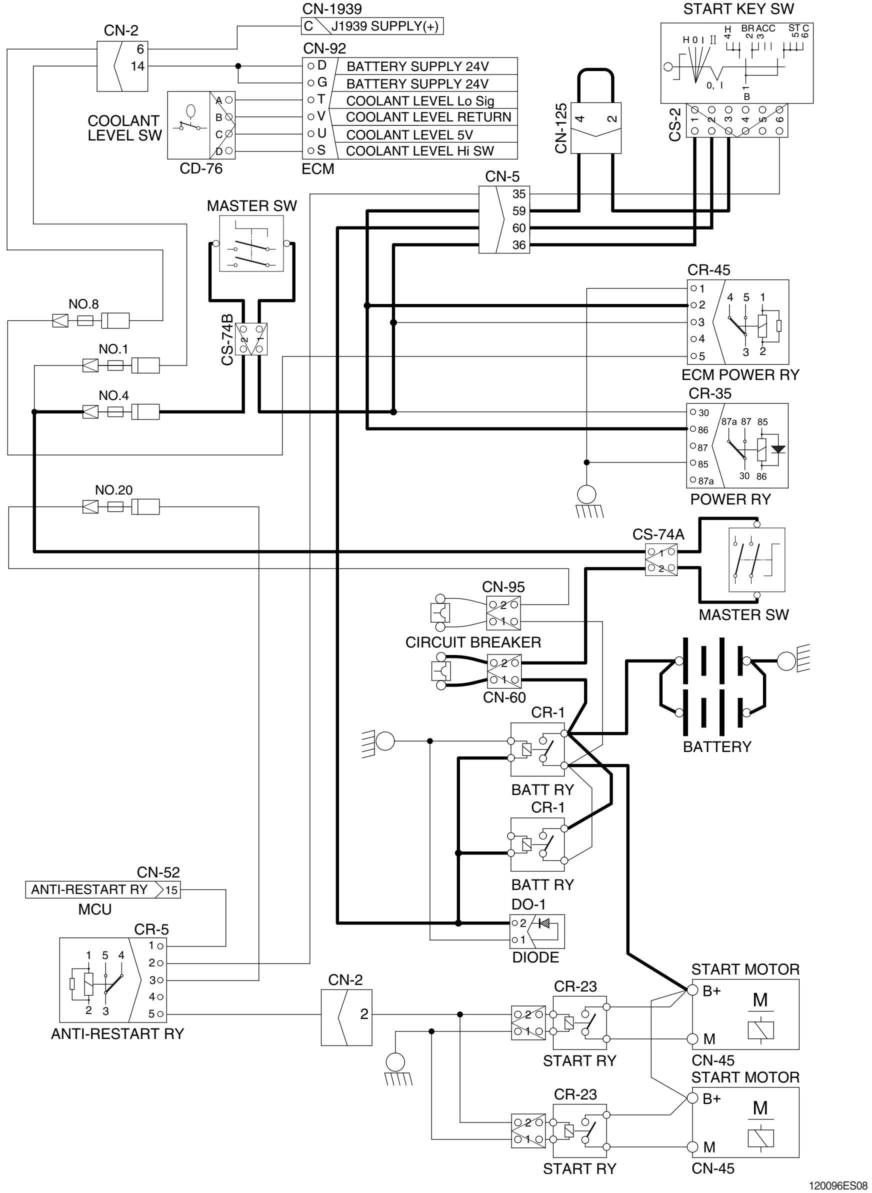


13. WHEN STARTING SWITCH ON DOES NOT OPERATE

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

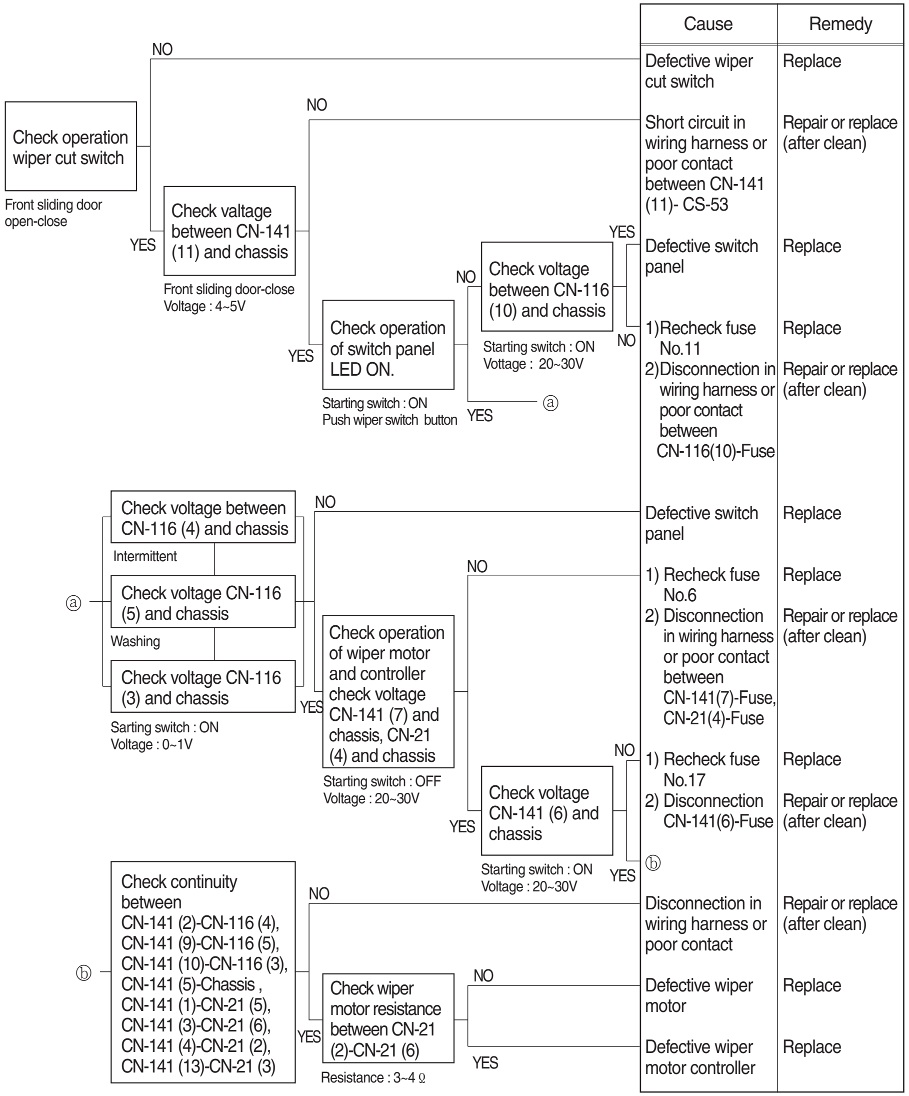


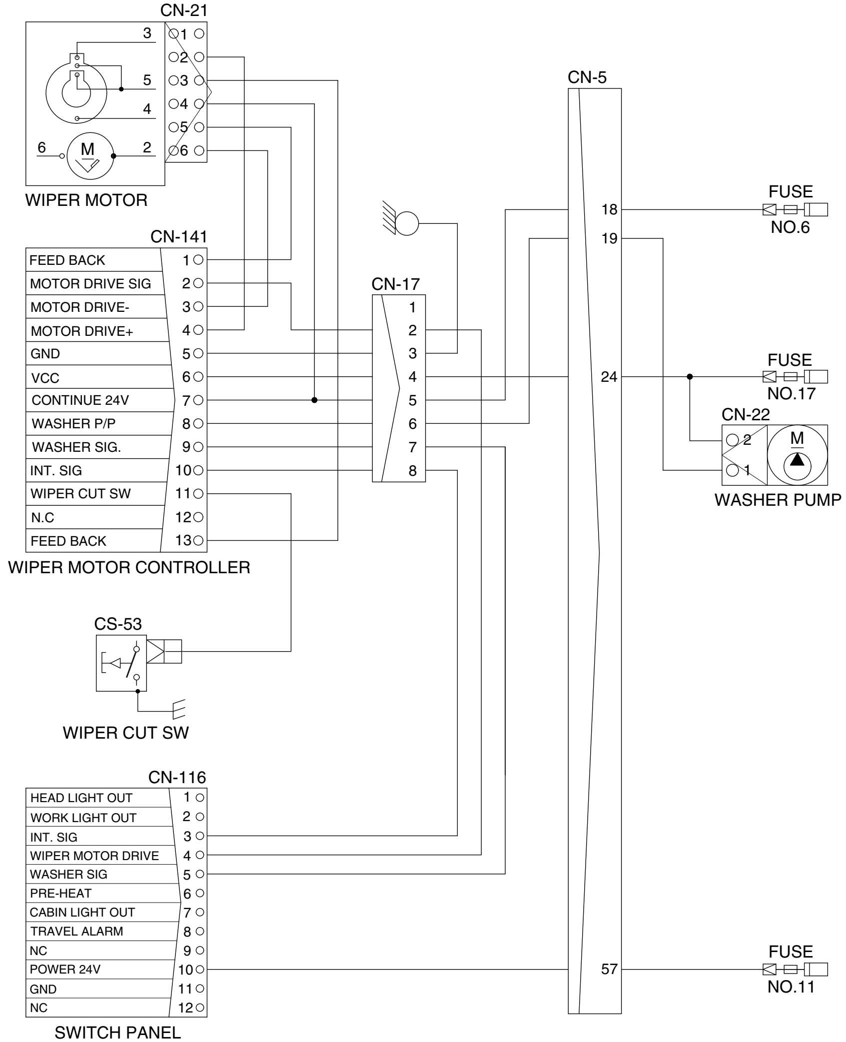
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-1 (2)-CR-1 or defective battery relay	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-5(60)- DO-1 (2)	Repair or replace (after clean)
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-5 (36)	Replace
Disconnection in wiring harness or poor contact between CS-74 (1) -CN-5 (36)	Charge or replace (after clean)
ⓐ	
Battery capacity too low	Charge or replace (after clean)
Defective master switch	Replace
Disconnection in wiring harness or poor contact between CS-74 (2) -CR-1	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. 6, 11 and 17 is not blown out.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





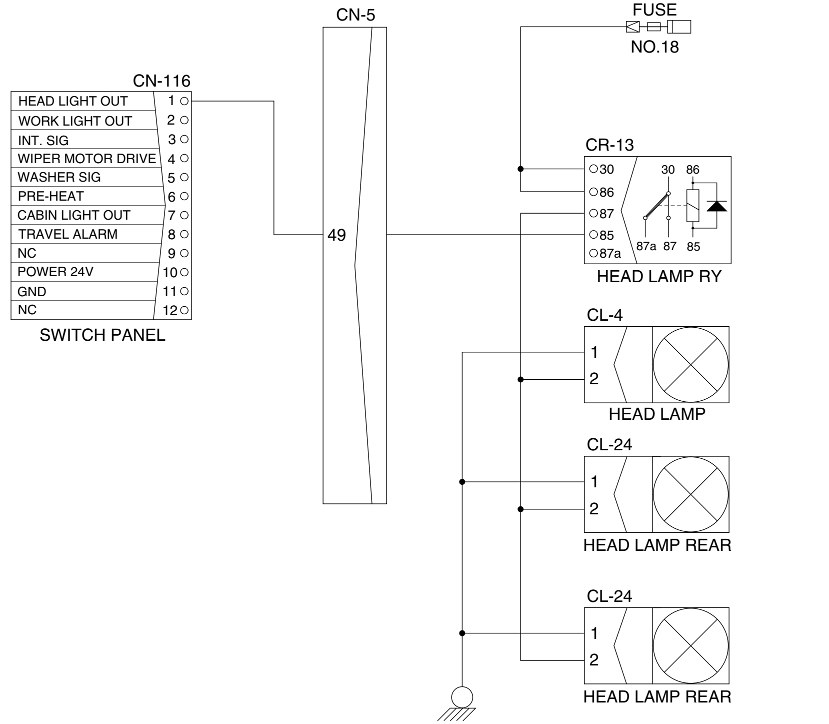
21096ES14

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.18.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

- Check voltage between CR-13 (30) and chassis, CR-13 (86) and chassis
  Starting switch : ON
  Voltage : 20~30V
  - YES: Check voltage between CR-13 (87) and chassis
    Starting switch : ON
    Head lamp switch : ON
    Voltage : 20~30V
    - YES: Check voltage between CL-4 (2) and chassis
      Voltage : 20~30V
      - YES: Defective bulb
      - NO: Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (2)
    - NO: Check voltage between CN-116 (1) and chassis
      Starting switch : ON
      Head lamp switch : ON
      Voltage : 20~30V
      - YES: Defective switch panel
      - NO: Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)
  - NO: Disconnection in wiring harness or poor contact between CR-13 (30) and chassis or CR-13 (86) - chassis

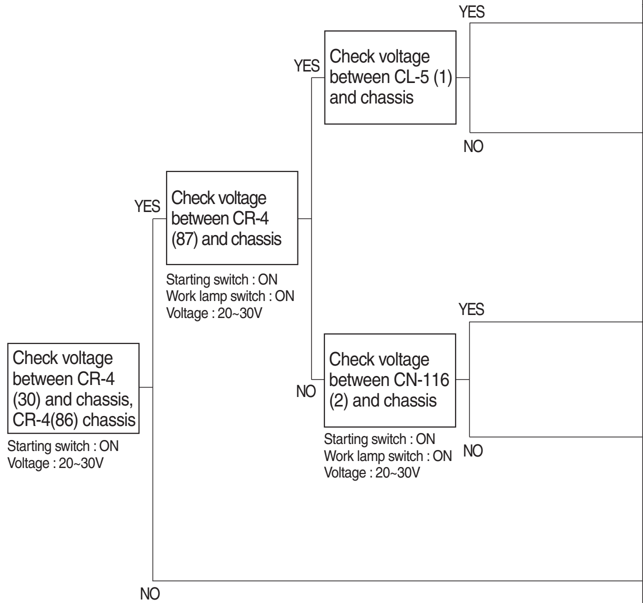
Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-13 (87)-CL-4 (2)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CN-116 (1)-CR-13 (87)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-13 (30) and chassis or CR-13 (86) - chassis	Repair or replace (after clean)
Recheck fuse No. 18	Replace



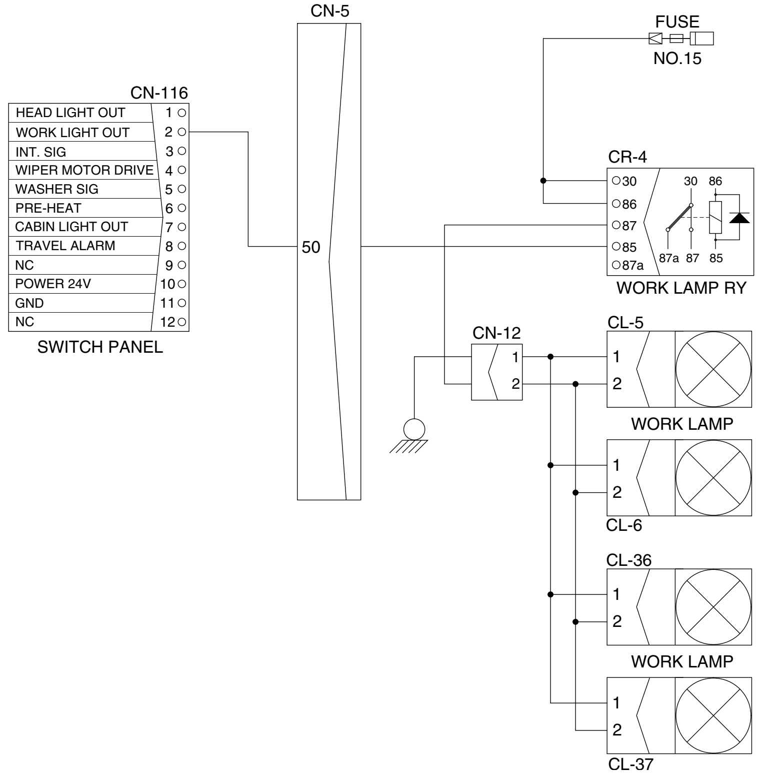
120096ES09

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

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



Cause	Remedy
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CL-5 (2)	Repair or replace (after clean)
Defective switch panel	Replace
Disconnection in wiring harness or poor contact between CR-4 (87)-CN-116 (2)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CR-4 (30) and chassis or CR-4 (86) and chassis	Repair or replace (after clean)
Recheck fuse No.15	Replace



38096ES01

GROUP 4 MECHATRONICS SYSTEM

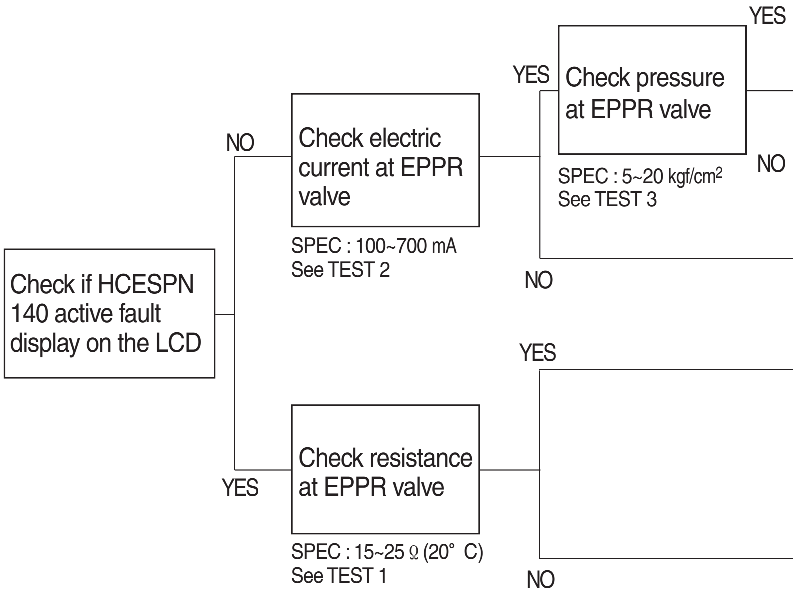
1. ALL ACTUATORS SPEED ARE SLOW

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

※ Spec : P-mode 1800 ± 50 rpm S -mode 1700 ± 50 rpm E-mode 1600 ± 50 rpm

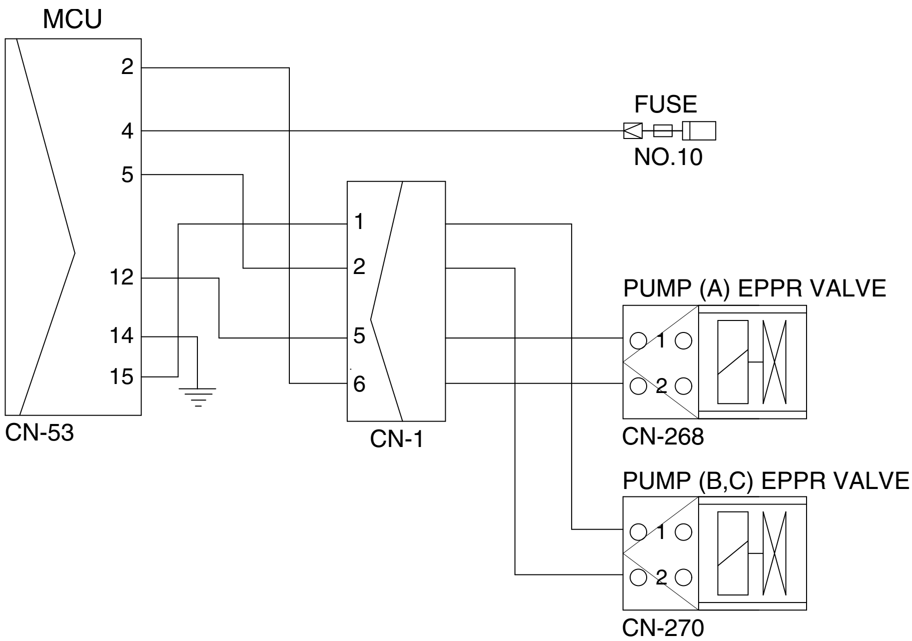
※ Before carrying out below procedure, check all the related connectors are properly inserted and fault code on the cluster.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective hydraulic system	
Defective EPPR valve	Replace
Defective MCU	Replace
Short circuit or poor connection between CN-53 -CN-268, CN-270	Check & repair wire harness or between CN-53 -CN-268, CN-270
Defective EPPR valve	Replace

Wiring diagram



120096MS01

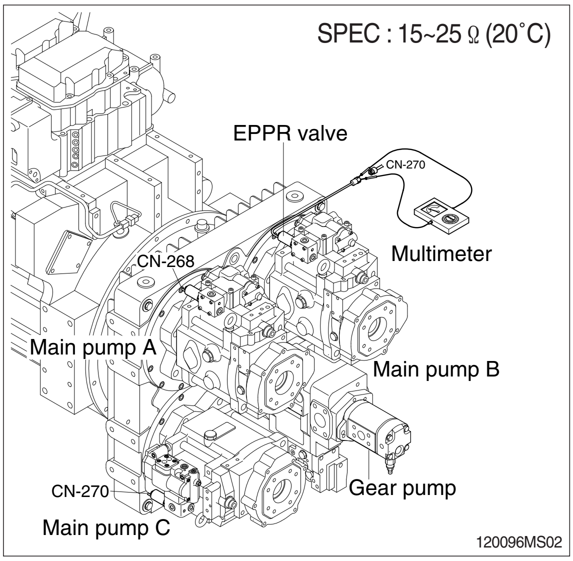
2) TEST PROCEDURE

(1) Test 1 : Check resistance at connector CN-270.

① Starting key OFF.

② Disconnect connector CN-270 from EPPR valve at main hydraulic pump.

③ Check resistance between 2 lines as figure.



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

① Disconnect connector CN-270 from EPPR valve.

② Insert the adapter to CN-270 and install multimeter as figure.

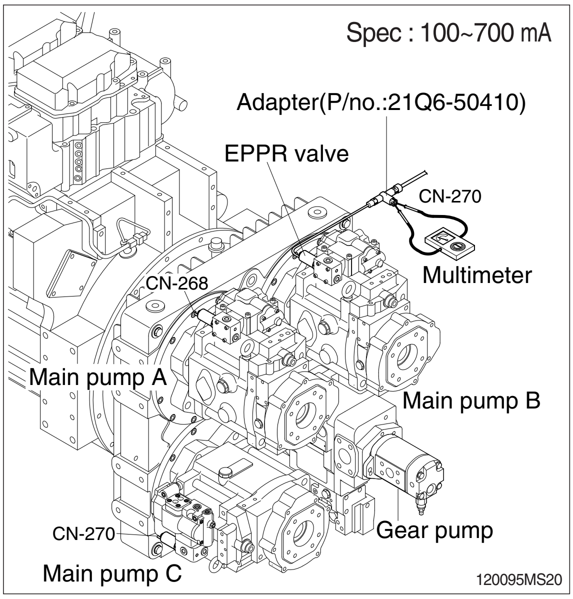
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the accel dial at 10.

⑥ If rpm show approx 1800±50 rpm disconnect one wire harness from EPPR valve.

⑦ Check electric current at bucket circuit relief position.



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

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

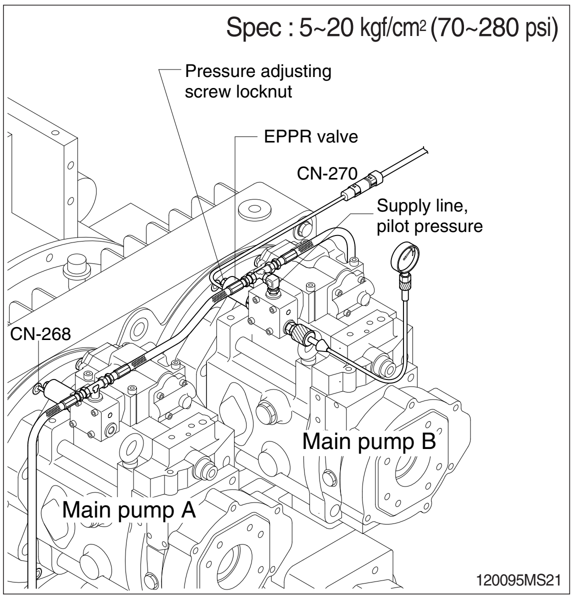
③ Set S-mode and cancel auto decel mode.

④ Position the accel dial at 10.

⑤ If rpm show approx 1800±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.

⑥ If pressure is not correct, adjust it.

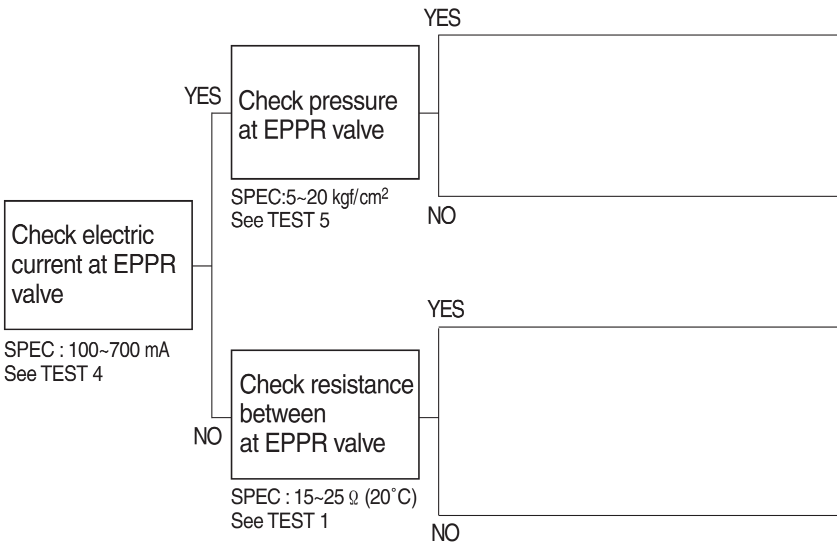
⑦ After adjust, test the machine.



2. ENGINE STALL

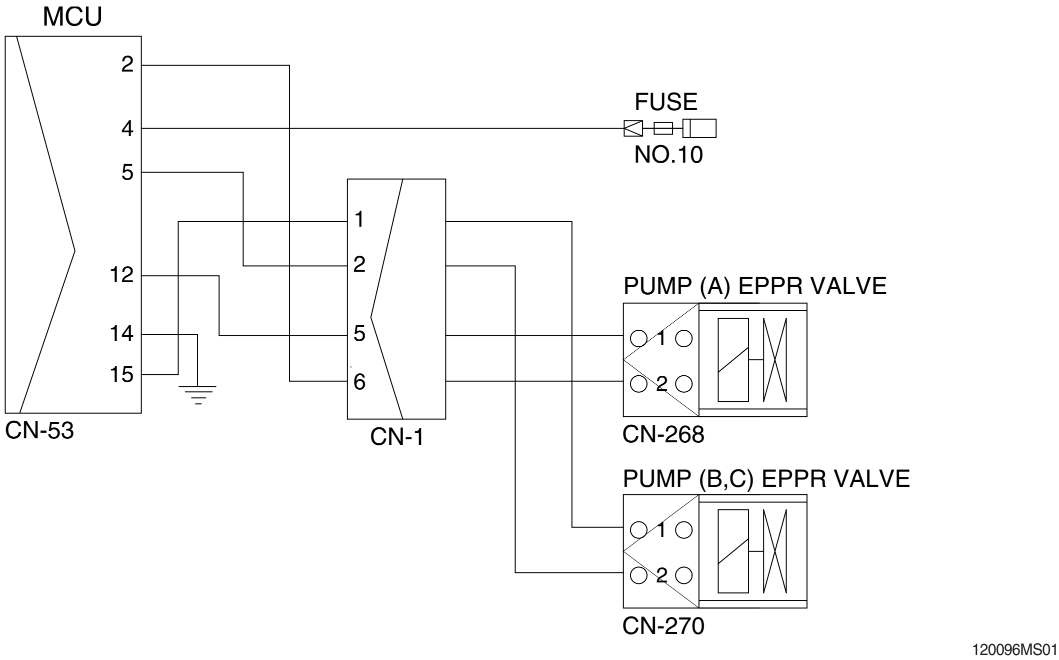
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Not enough engine power	Check engine fault Contact cummins
Defective EPPR valve	Replace
Short circuit or poor connection between CN-53 - CN-268, CN-270	Check and repair wire harness
Defective EPPR valve	Replace

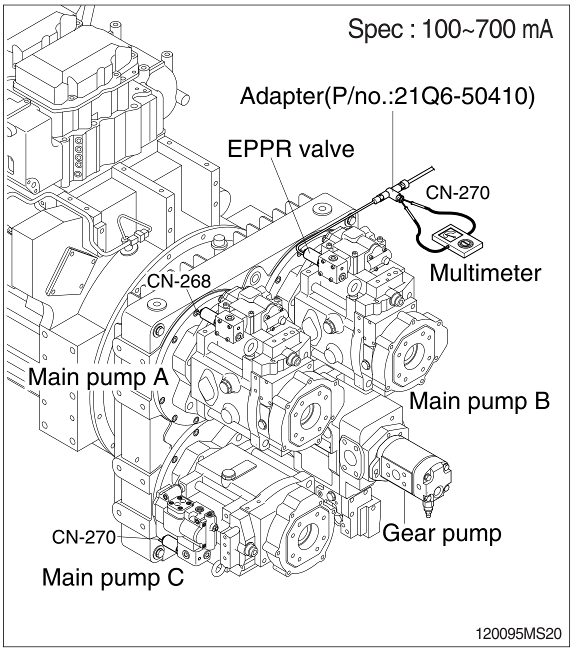
Wiring diagram



2) TEST PROCEDURE

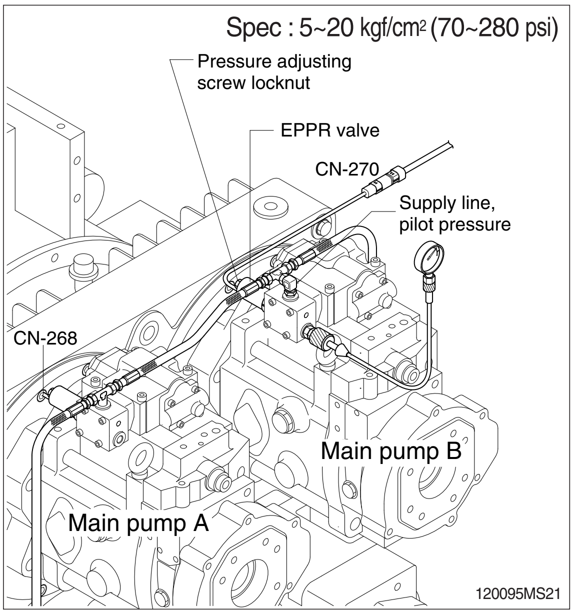
(1) Test 4 : Check electric current at EPPR valve.

① Disconnect connector CN-75 from EPPR valve.
② Insert the adapter to CN-75 and install multimeter as figure.
③ Start engine.
④ Set S-mode and cancel auto decel mode.
⑤ Position the accel dial at 10.
⑥ If rpm show approx 1750±50 rpm disconnect one wire harness from EPPR valve.
⑦ Check electric current at bucket circuit relief position.



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

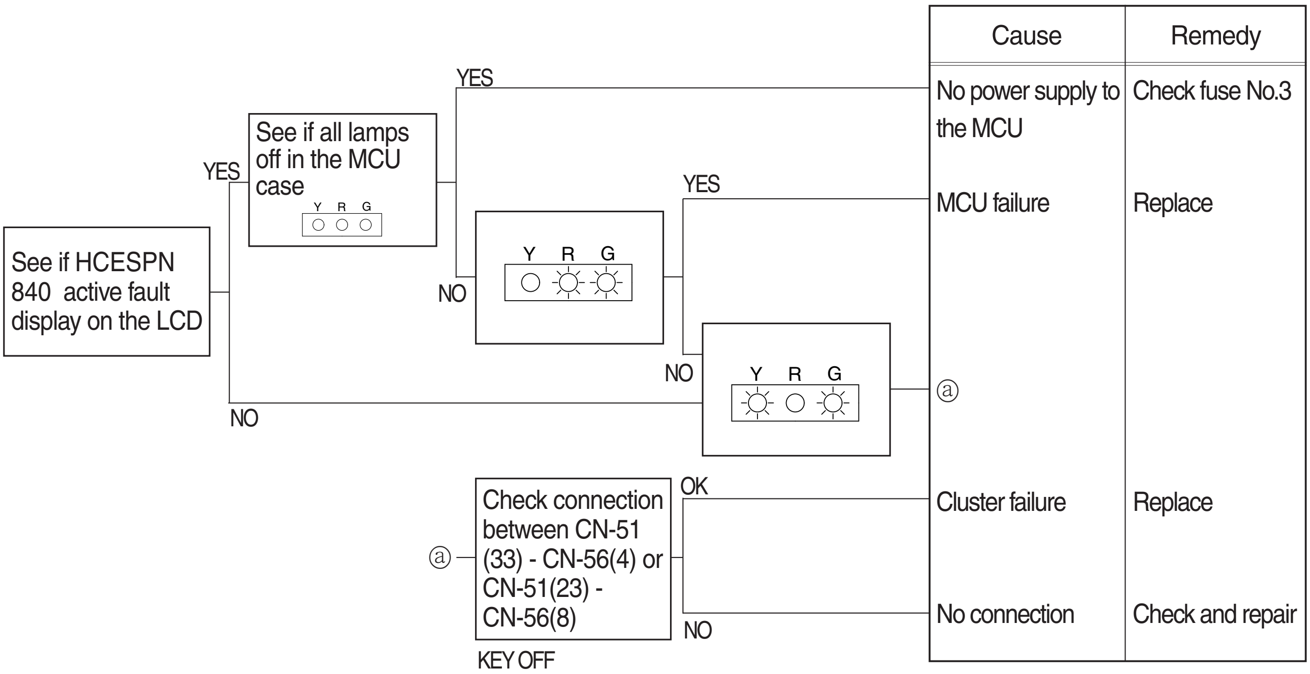
① Remove plug and connect pressure gauge as figure.
 · Gauge capacity : 0 to 50 kgf/cm^2 (0 to 725 psi)
② Start engine.
③ Set S-mode and cancel auto decel mode.
④ Position the accel dial at 10.
⑤ If rpm show approx 1750±50 rpm check pressure at relief position of bucket circuit by operating bucket control lever.
⑥ If pressure is not correct, adjust it.
⑦ After adjust, test the machine.



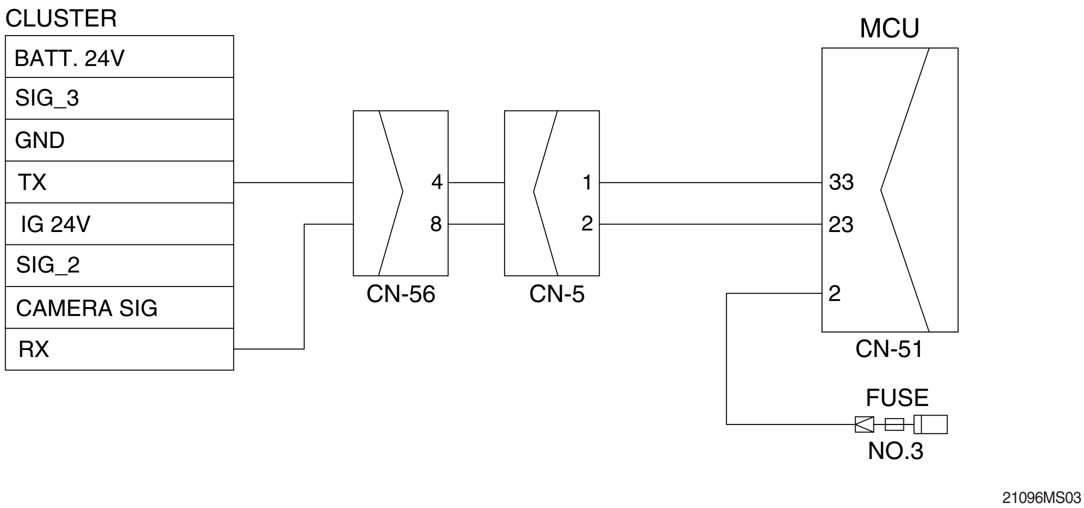
3. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



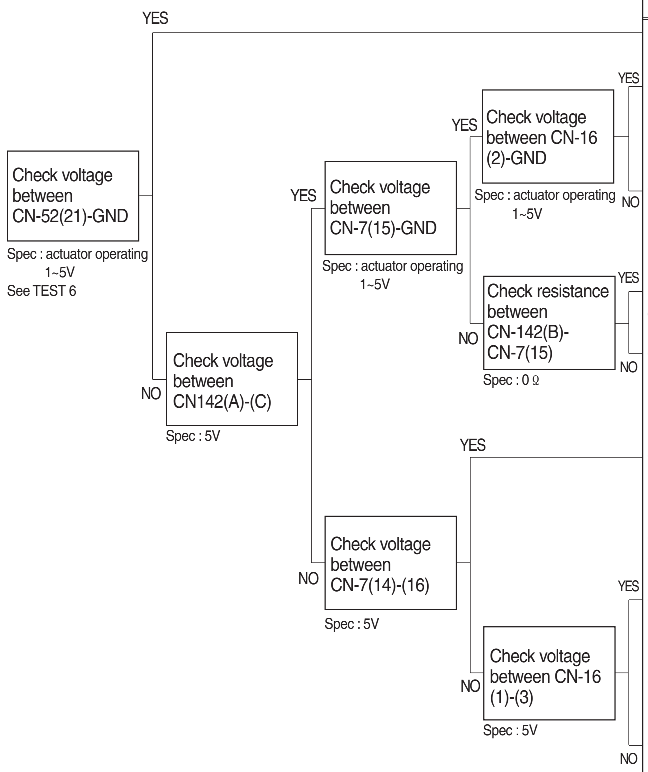
Wiring diagram



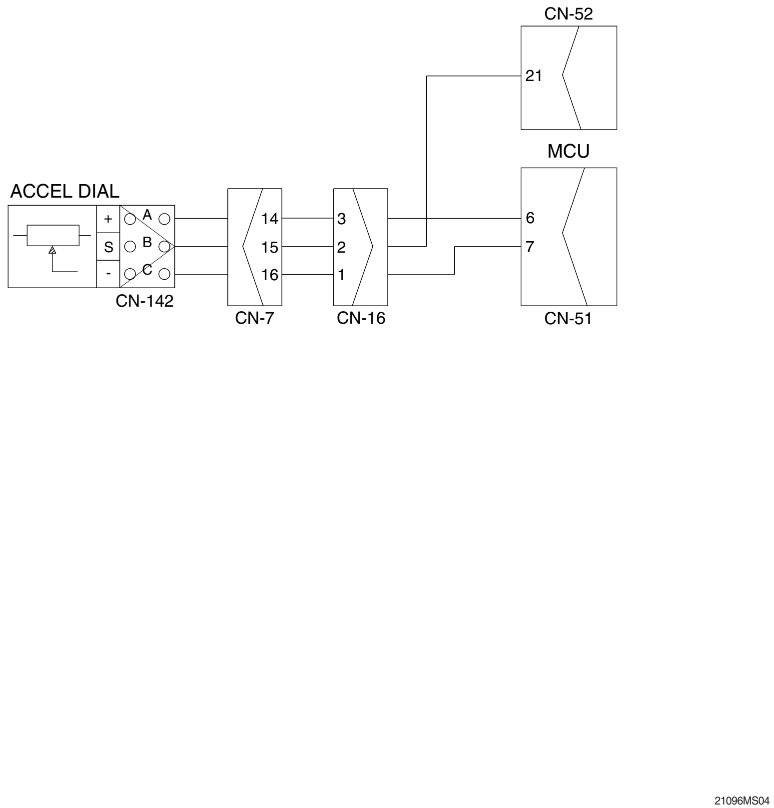
4. MALFUNCTION OF ACCEL DIAL

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

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Open circuit or poor connection between CN-16 (2) -CN-52 (21)	Replace or repair
Open circuit or poor connection between CN-7 (15) -CN-16 (2)	Replace or repair
Defective accel dial	Replace
Open circuit or poor connection between CN-142 (B) -CN-7 (15)	Replace or repair
Open circuit or poor connection between CN-142 (A) -CN-7 (14) or CN-142 (C)- CN-7 (16)	Replace or repair
Open circuit or poor connection between CN-7 (14) -CN-16 (3) or CN-7 (16)- CN-16 (1)	Replace or repair
Open circuit or poor connection between CN-16 (3) -CN-51 (6) or CN-16 (1)- CN-51 (7)	Replace or repair



2) TEST PROCEDURE

(1) Test 6 : Check voltage at CN-52 (21) and ground.

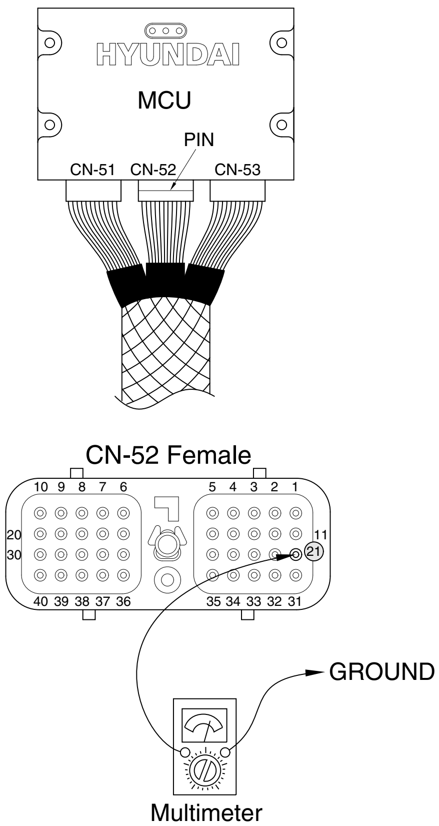
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (21) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



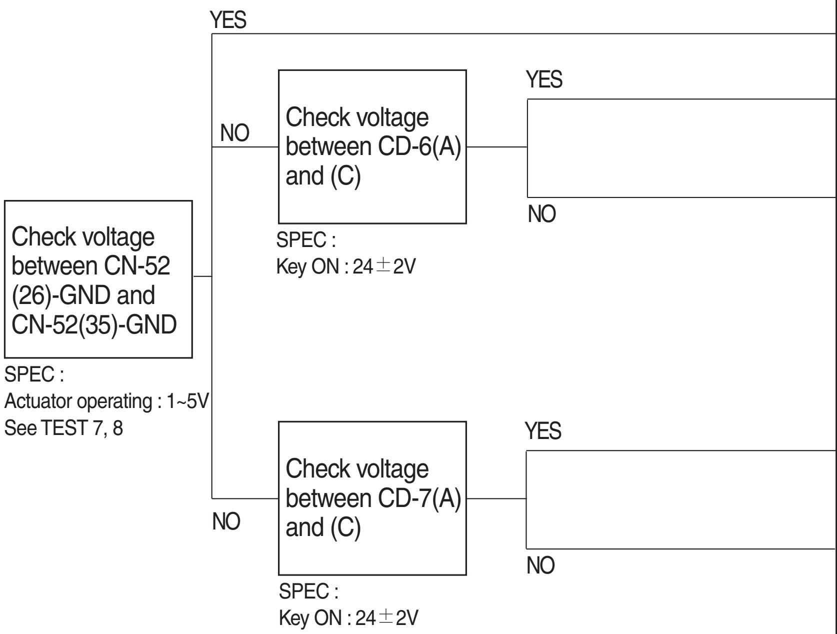
21096MS04A

5. AUTO DECEL SYSTEM DOES NOT WORK

· Fault code : HCESPN 105, FMI 0~4 (work pressure sensor)
HCESPN 108, FMI 0~4 (travel oil pressure sensor)

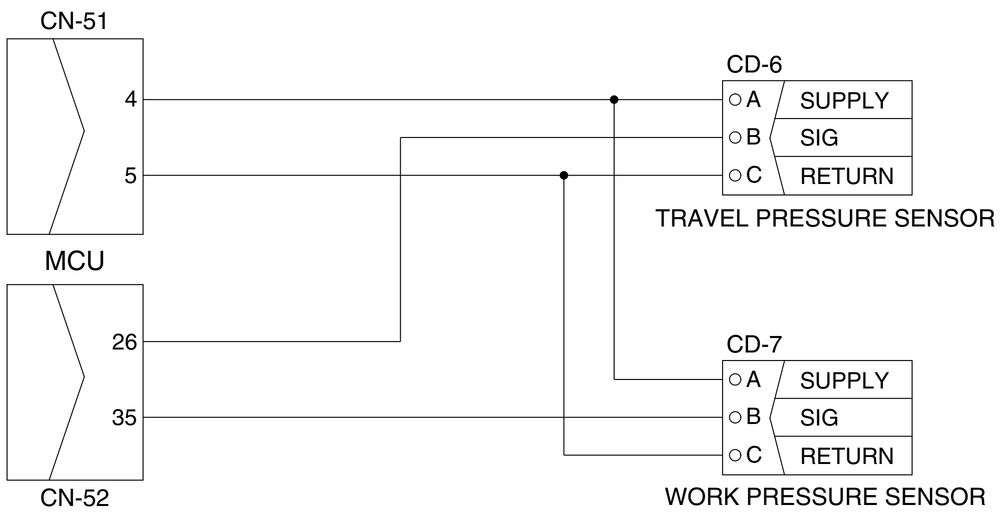
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Defective travel pressure switch	Replace
Short circuit or poor connection between CN-51(4)-CD-6(A) and / or CN-51(5)-CD-6(C) (fault code 108 displayed)	Replace or repair
Defective work pressure sensor	Replace
Short circuit or poor connection between CN-51(4)-CD-7(A) and / or CN-51(5)-CD-7(C) (fault code 105 displayed)	Replace or repair

Wiring diagram



21096MS05

2) TEST PROCEDURE

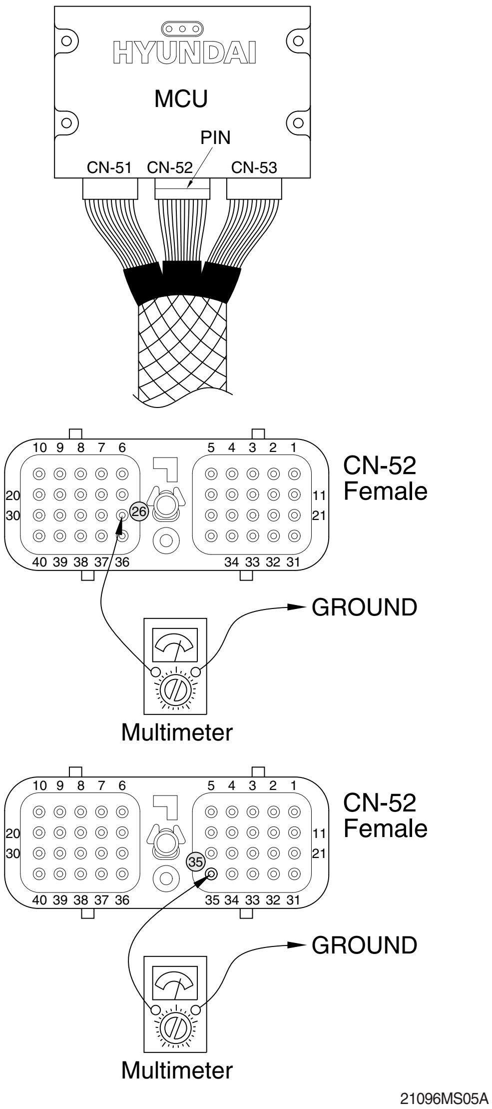
(1) Test 7 : Check voltage at CN-52 (26) and ground.

① Prepare 1 piece of thin sharp pin, steel or copper.
② Insert prepared pin to rear side of \connectors : One pin to (26) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

(2) Test 8 : Check voltage at CN-52 (35)and ground.

① Prepare 1 piece of thin sharp pin, steel or copper
② Insert prepared pin to rear side of connectors : One pin to (35) of CN-52.
③ Starting key ON.
④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V

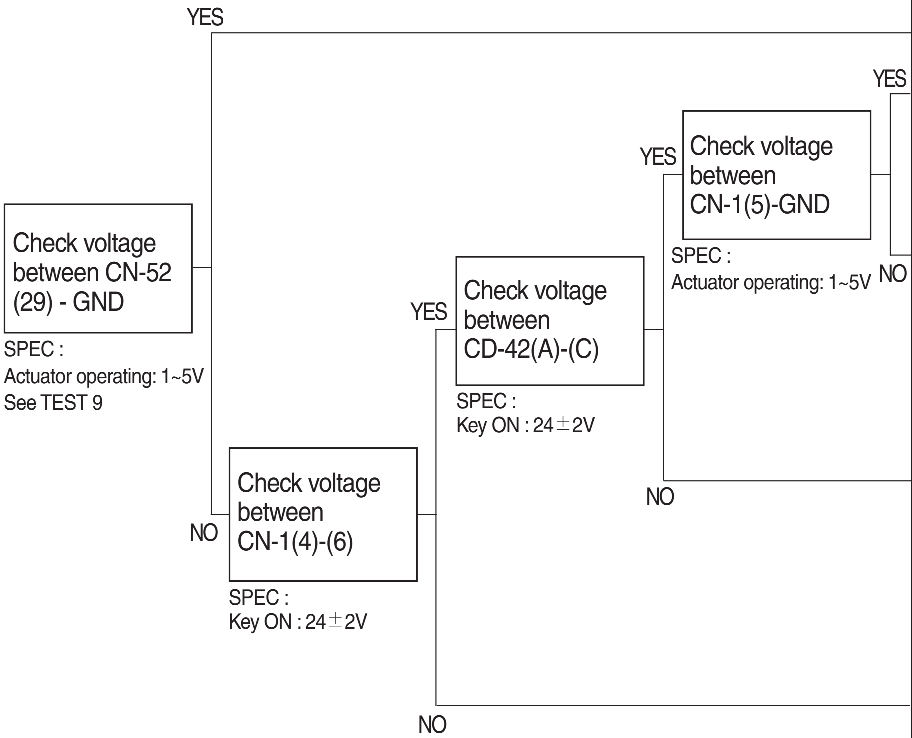


6. MALFUNCTION OF PUMP 1 PRESSURE SENSOR

· Fault code : HCESPN 120, FMI 0~4

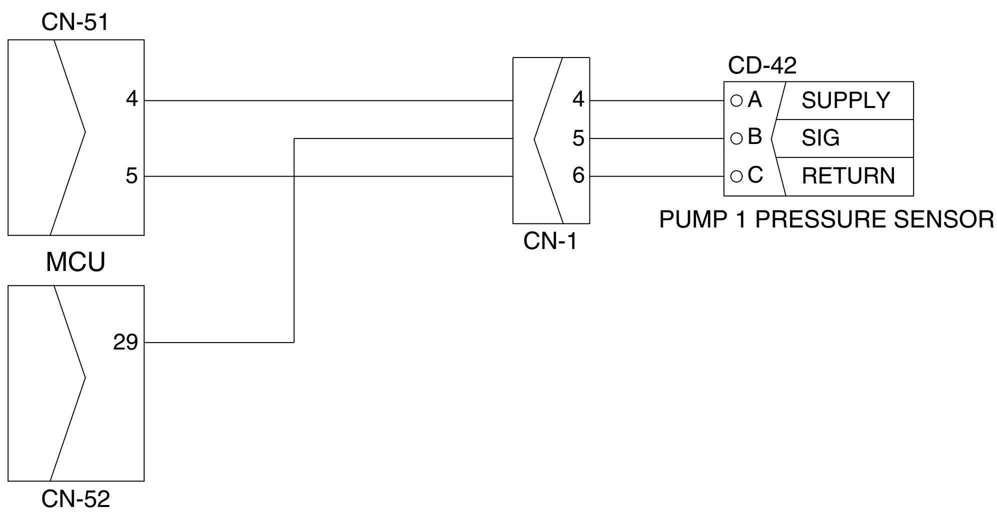
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(29)-CN-1(5)	Replace or repair
Detective P1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(5)-CD-42(B)	Replace or repair
Short circuit or poor connection between CD-42(A)-CN-1(4) or CD-42(C)-CN-1(6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(4) or CN-1 (6) - CN-51(5)	Replace or repair

Wiring diagram



120096MS03

2) TEST PROCEDURE

(1) Test 9 : Check voltage at CN-52 (29) and ground.

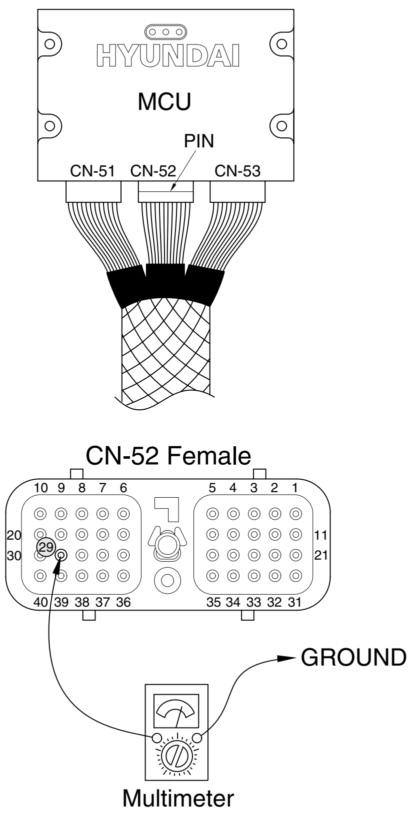
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (29) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



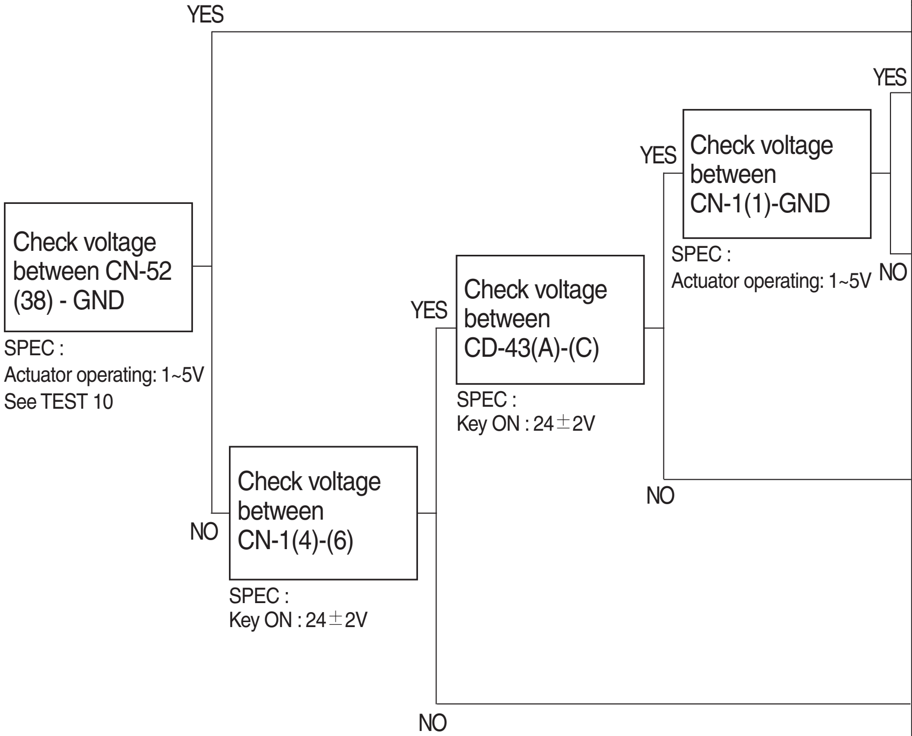
21096MS06A

7. MALFUNCTION OF PUMP 2 PRESSURE SENSOR

· Fault code : HCESPN 121, FMI 0~4

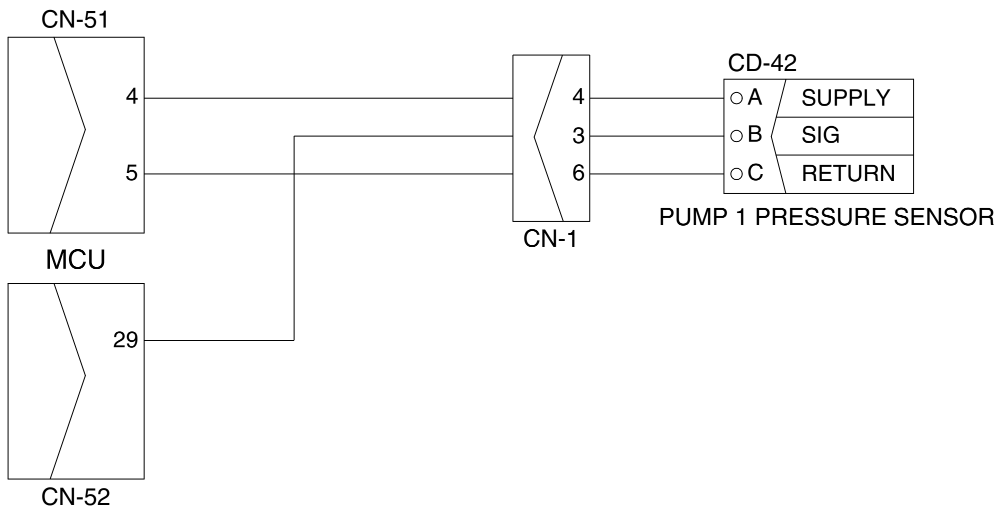
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(38)-CN-1(3)	Replace or repair
Detective P2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(3)-CD-43(B)	Replace or repair
Short circuit or poor connection between CD-43(A)-CN-1(4) or CD-43(C)-CN-1(6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(4) or CN-1 (6) - CN-51(5)	Replace or repair

Wiring diagram



120096MS04

2) TEST PROCEDURE

(1) Test 10 : Check voltage at CN-52(38) and ground.

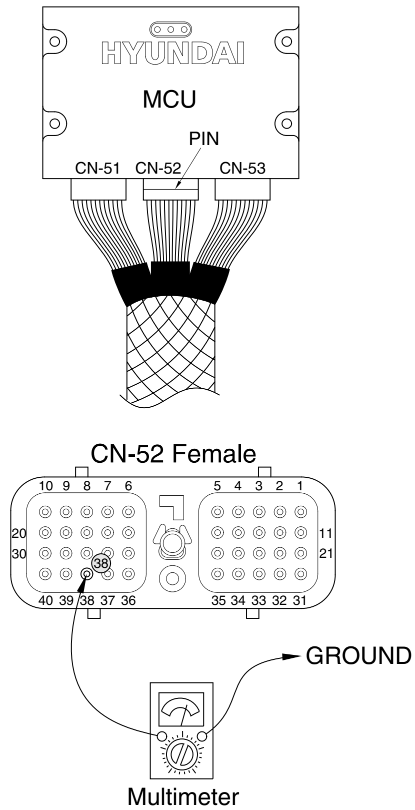
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (38) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



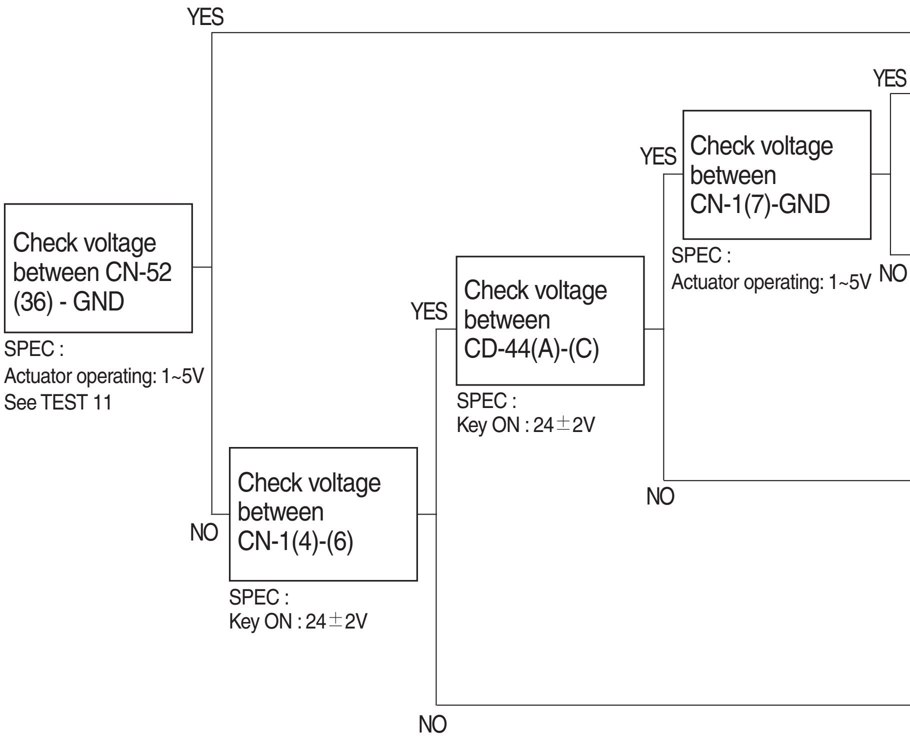
21096MS07A

8. MALFUNCTION OF PUMP 3 PRESSURE SENSOR

· Fault code : HCESPN 125, FMI 0~4

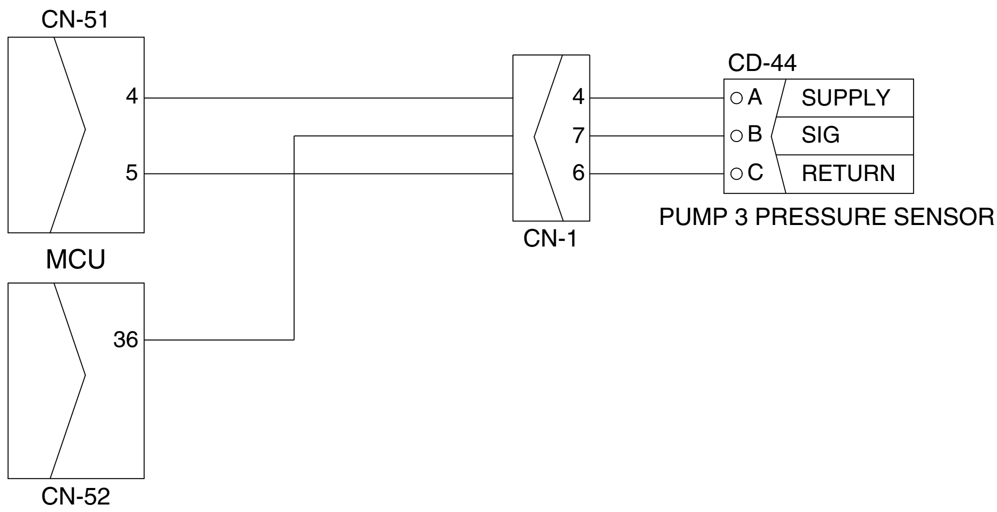
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Short circuit or poor connection between CN-52-(36)-CN-1(7)	Replace or repair
Detective P3 pressure sensor	Replace or repair
Short circuit or poor connection between CN-1(7)-CD-44(B)	Replace or repair
Short circuit or poor connection between CD-44(A)-CN-1(4) or CD-44(C)-CN-1(6)	Replace or repair
Short circuit or poor connection between CN-1(4)-CN-51(4) or CN-1 (6) - CN-51(5)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 11 : Check voltage at CN-52(36) and ground.

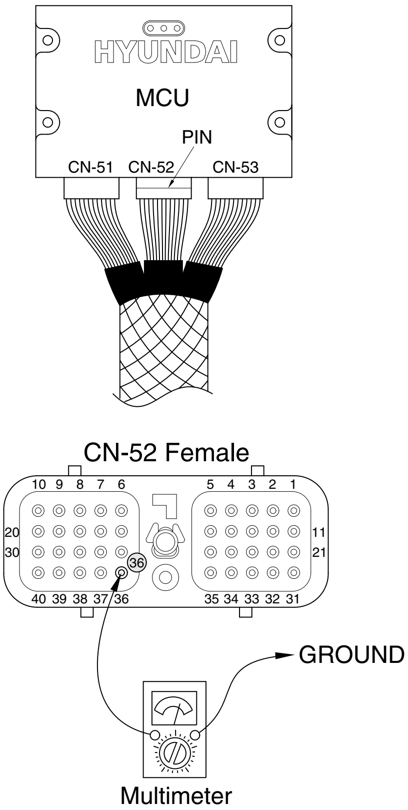
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (36) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



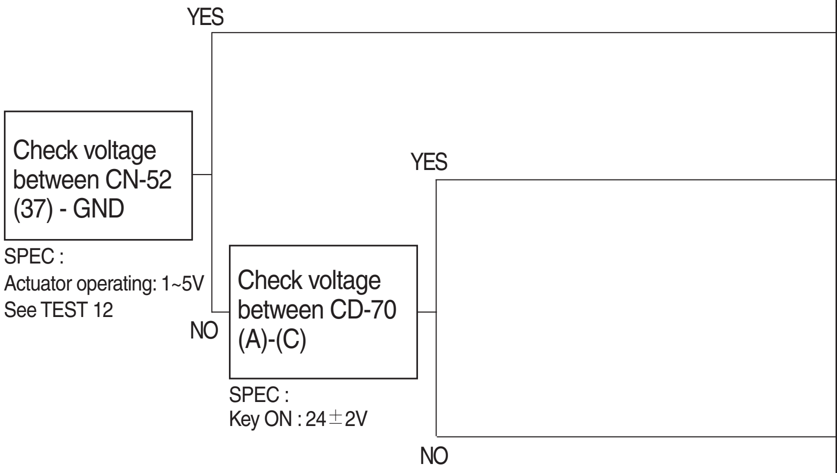
21096MS08A

9. MALFUNCTION OF NEGATIVE 1 PRESSURE SENSOR

· Fault code : HCESPN 123, FMI 0~4

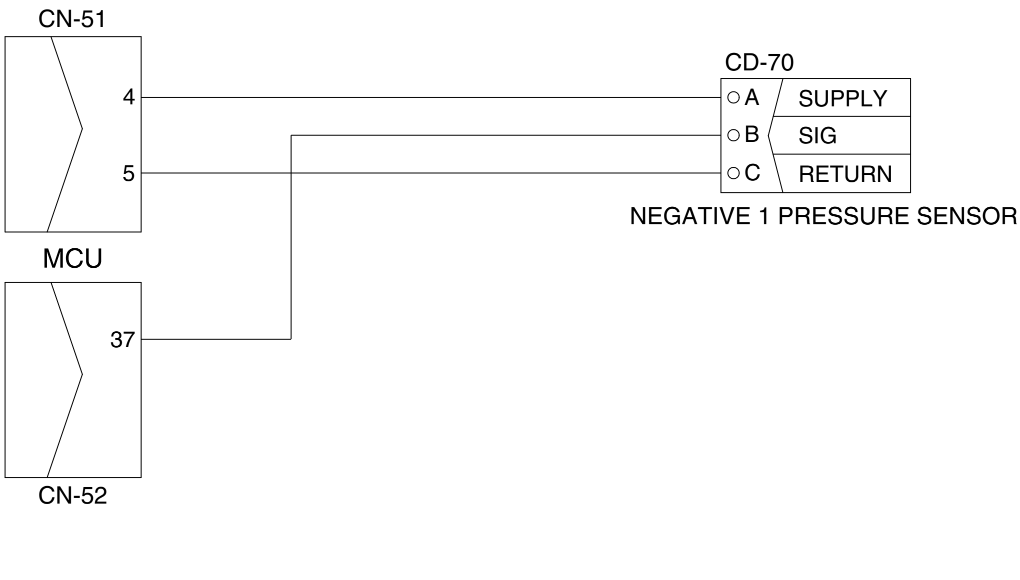
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective N1 pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (37)-CD-70 (B)	Replace or repair
Short circuit or poor connection between CD-70 (A)-CN-51(4) or CD-70(C)- CN-51 (5)	Replace or repair

Wiring diagram



2) TEST PROCEDURE

(1) Test 12 : Check voltage at CN-52(37) and ground.

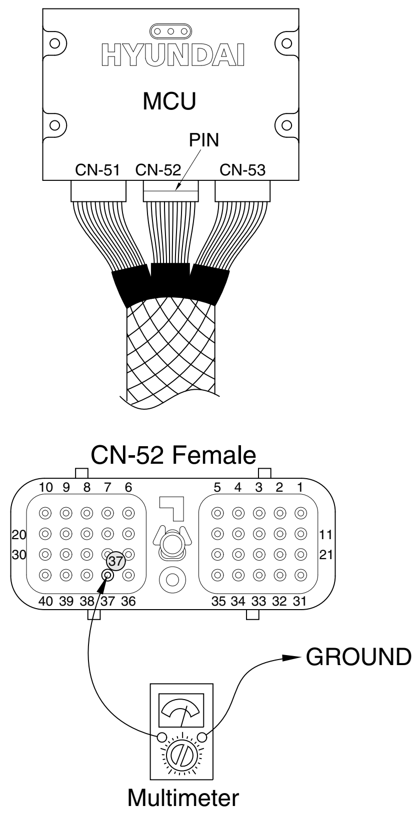
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (37) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



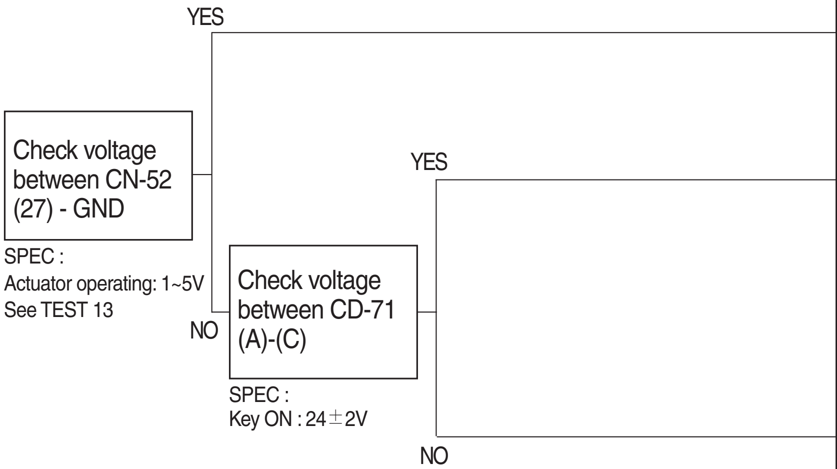
21096MS09A

10. MALFUNCTION OF NEGATIVE 2 PRESSURE SENSOR

· Fault code : HCESPN 124, FMI 0~4

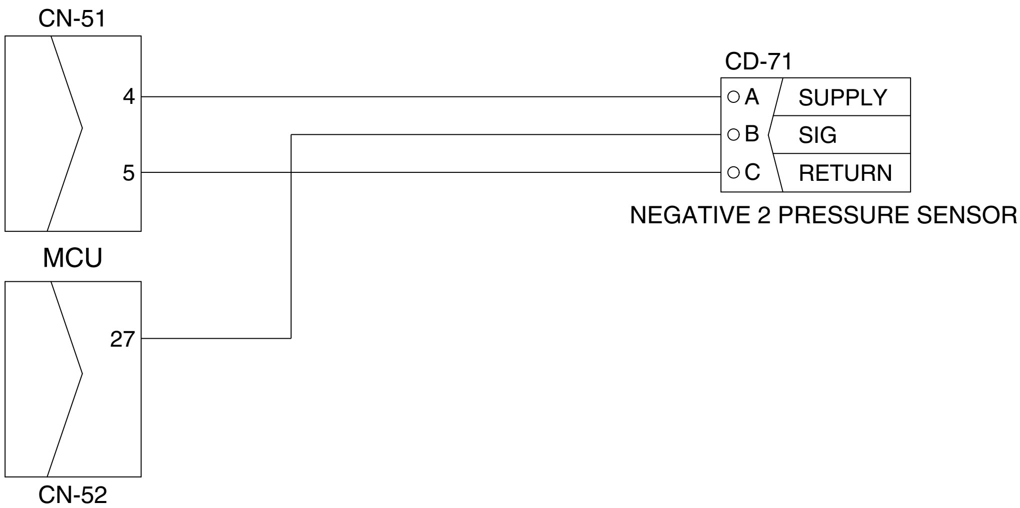
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective N2 pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (27)-CD-71 (B)	Replace or repair
Short circuit or poor connection between CD-71 (A)-CN-51(4) or CD-71(C)- CN-51 (5)	Replace or repair

Wiring diagram



21096MS10

2) TEST PROCEDURE

(1) Test 13 : Check voltage at CN-52(27) and ground.

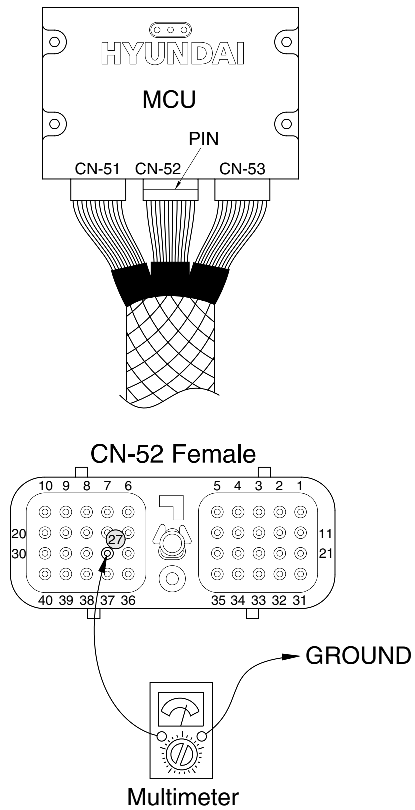
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (27) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



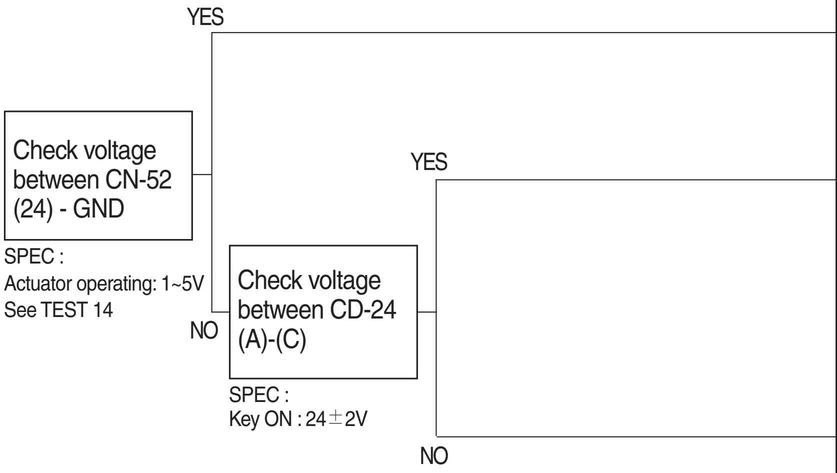
21096MS10A

11. MALFUNCTION OF SWING PRESSURE SENSOR

· Fault code : HCESPN 135, FMI 0~4

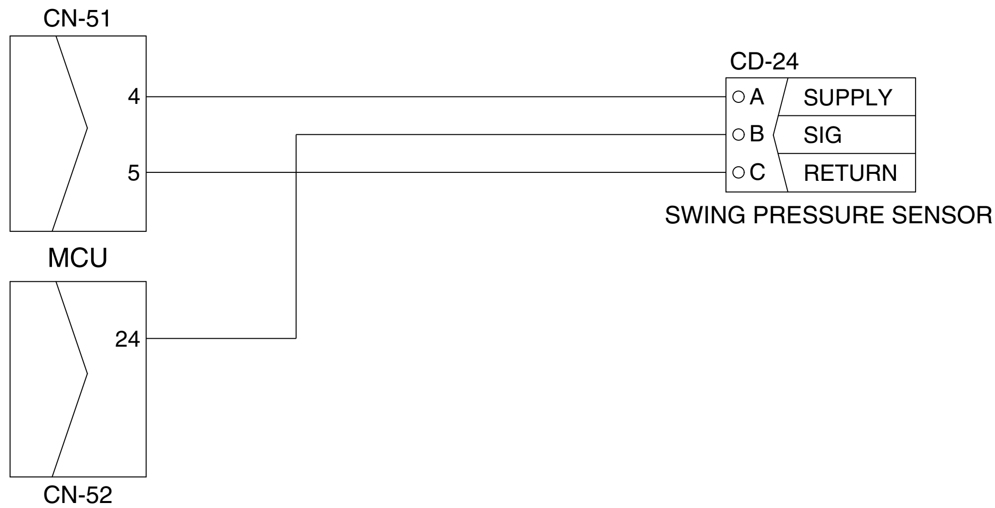
※ Before carrying out below procedure, check all the related connectors are properly inserted.

1) INSPECTION PROCEDURE



Cause	Remedy
Defective MCU	Replace
Detective swing pressure sensor	Replace or repair
Short circuit or poor connection between CN-52 (24)-CD-24 (B)	Replace or repair
Short circuit or poor connection between CD-24 (A)-CN-51(4) or CD-24(C)- CN-51 (5)	Replace or repair

Wiring diagram



21096MS11

2) TEST PROCEDURE

(1) Test 14 : Check voltage at CN-52(24) and ground.

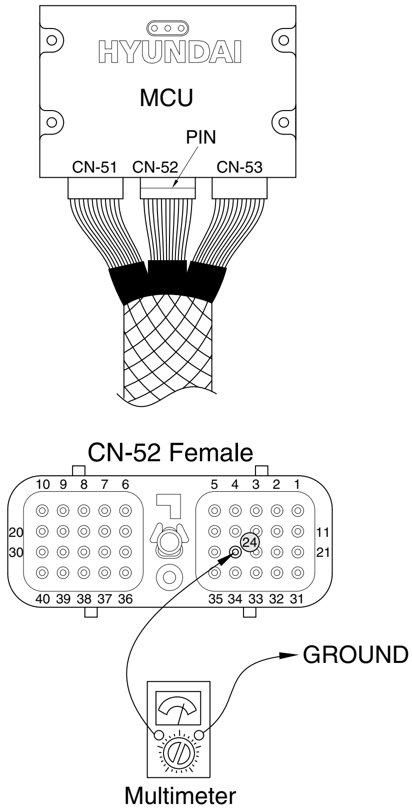
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (24) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



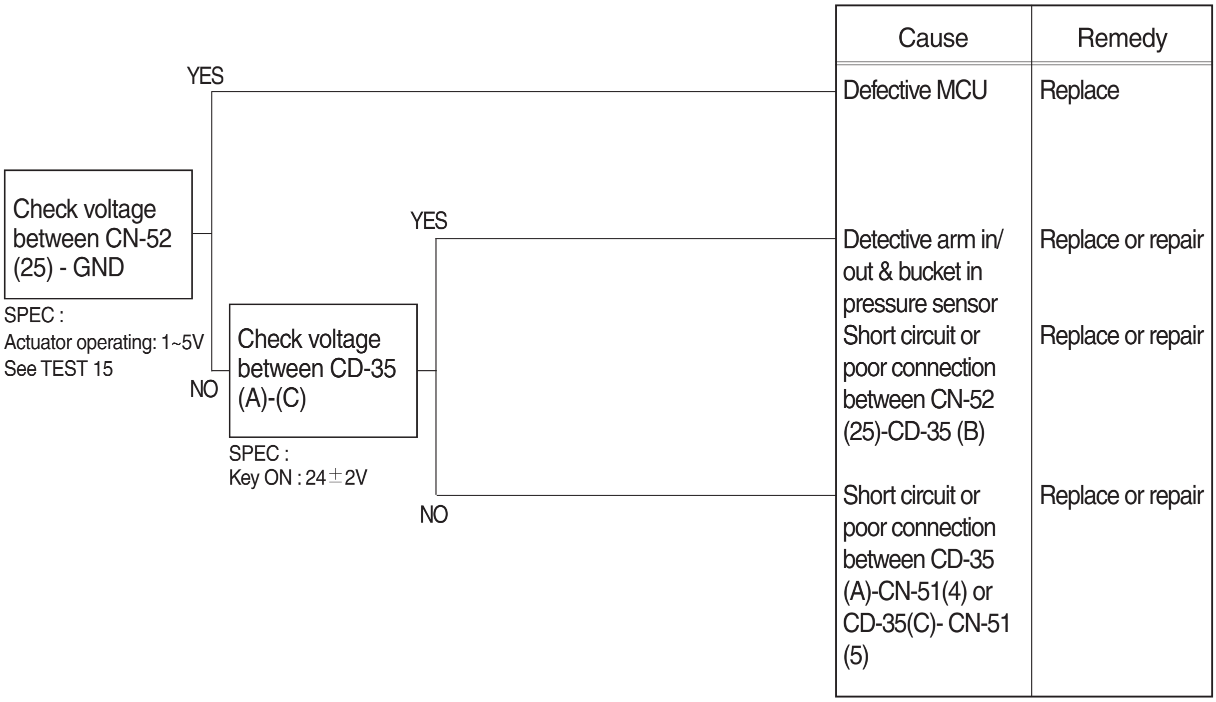
21096MS11A

12. MALFUNCTION OF ARM IN/OUT & BUCKET IN PRESSURE SENSOR

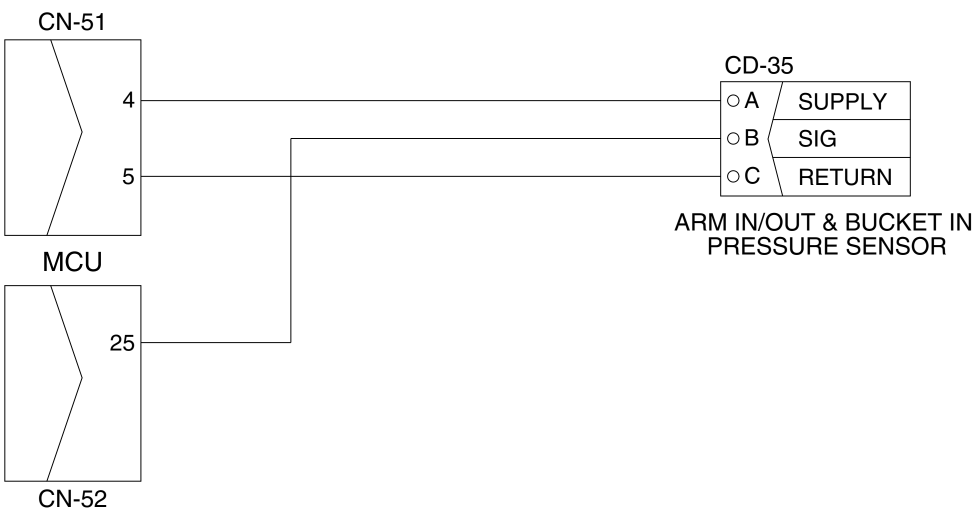
· Fault code : HCESPN 133, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



21096MS12

2) TEST PROCEDURE

(1) Test 15 : Check voltage at CN-52(25) and ground.

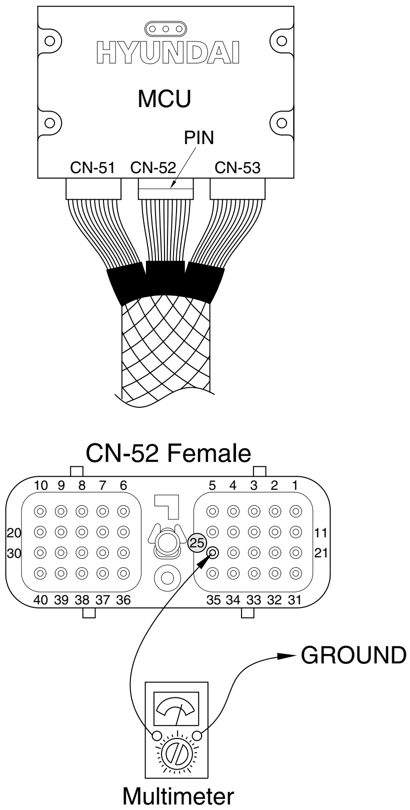
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (25) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



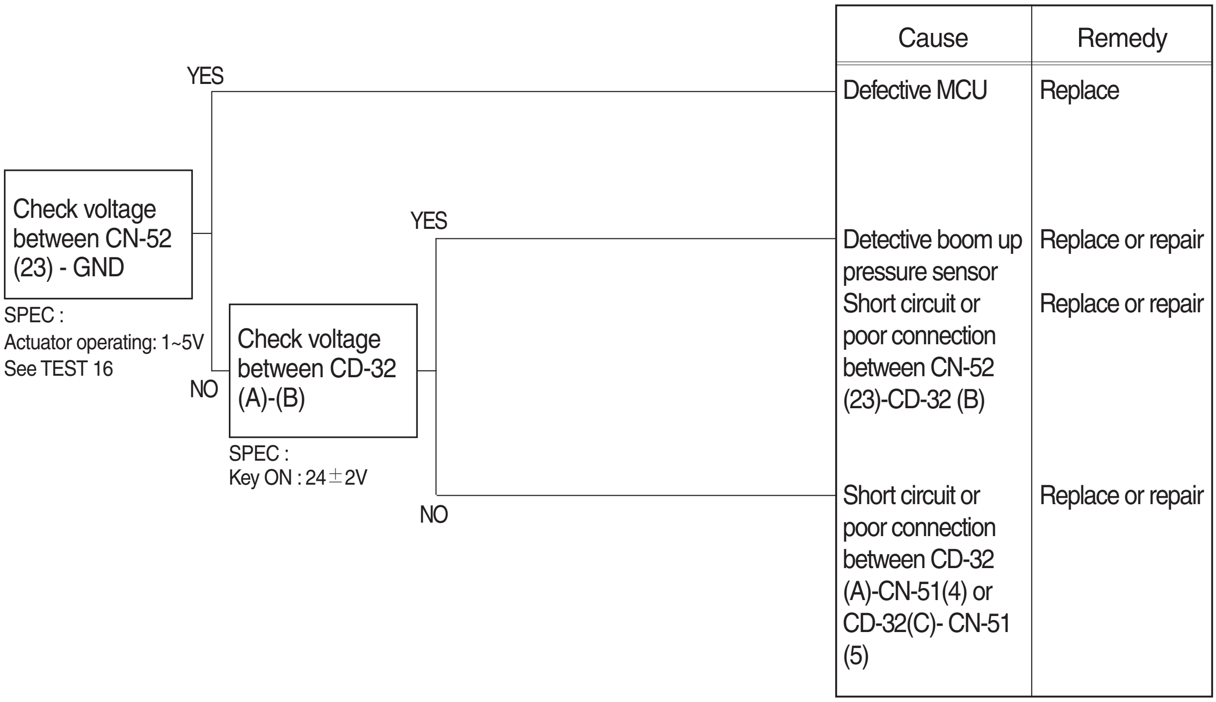
21096MS12A

13. MALFUNCTION OF BOOM UP PRESSURE SENSOR

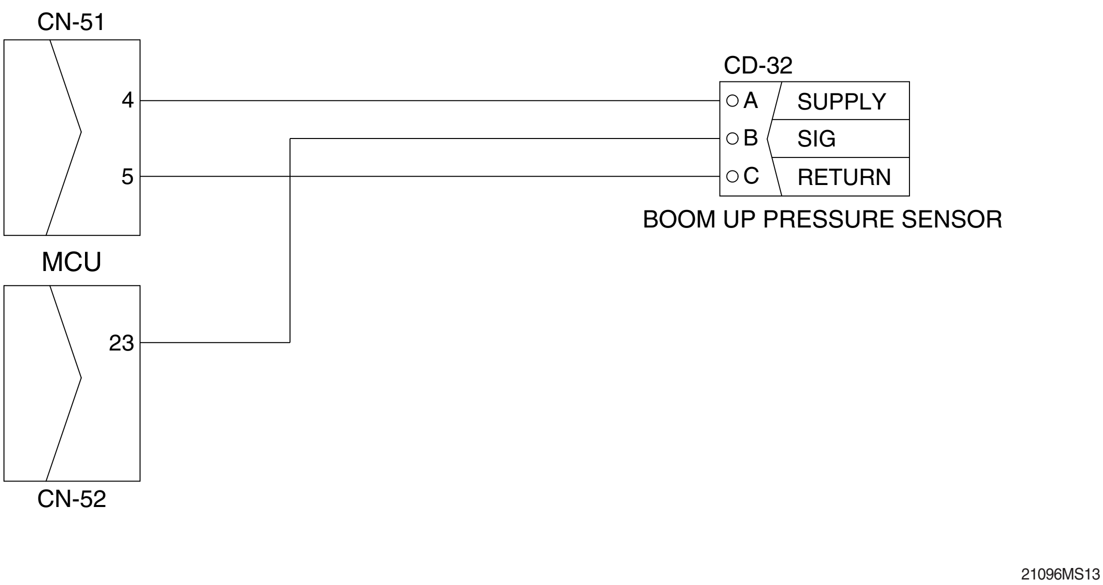
· Fault code : HCESPN 127, FMI 0~4

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

(1) Test 16 : Check voltage at CN-52(23) and ground.

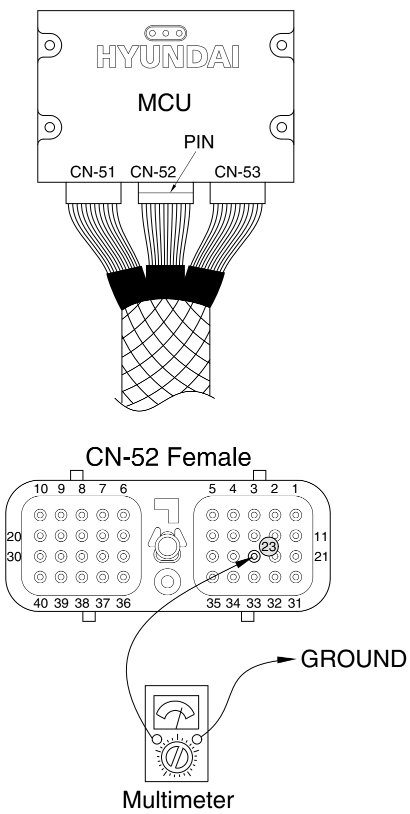
① Prepare 1 piece of thin sharp pin, steel or copper.

② Insert prepared pin to rear side of connectors : One pin to (23) of CN-52.

③ Starting key ON.

④ Check voltage as figure.

SPEC : Actuator operating : 1~5 V



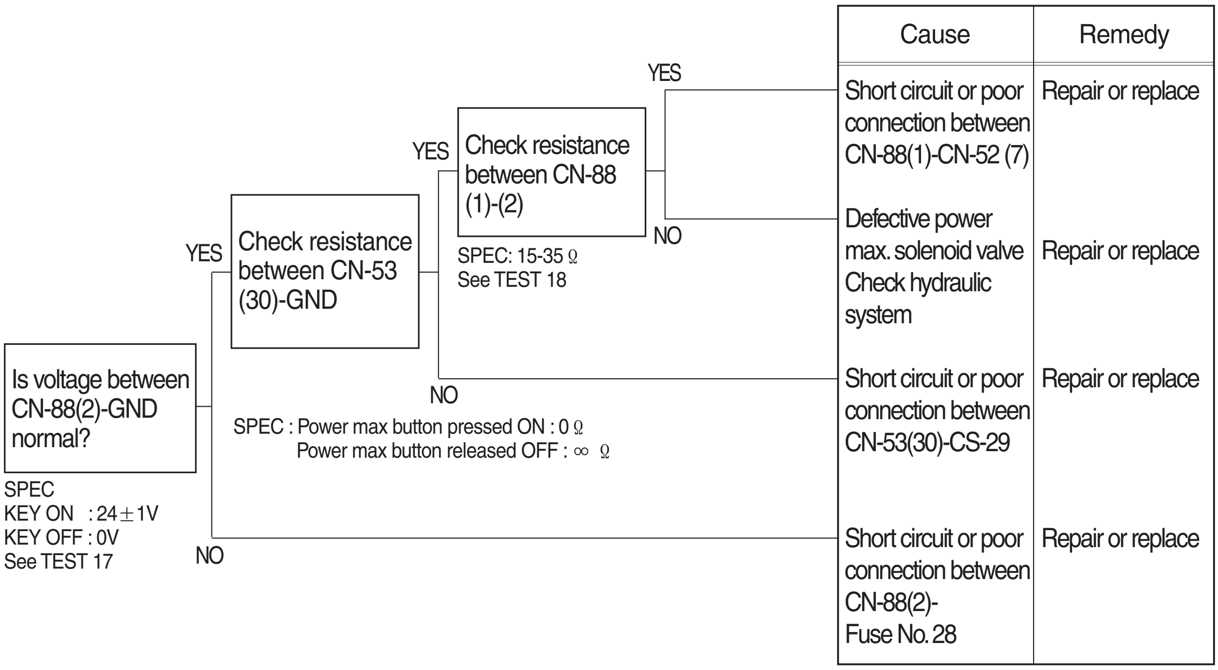
21096MS13A

14. MALFUNCTION OF POWER MAX

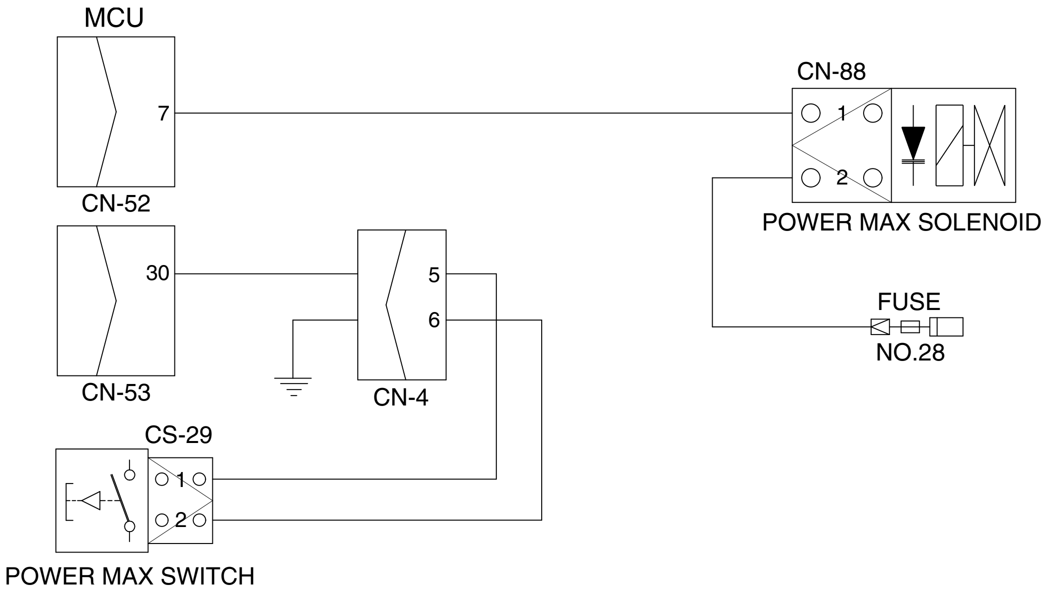
· Fault code : HCESPN 166, FMI 4 or 6

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

1) INSPECTION PROCEDURE



Wiring diagram

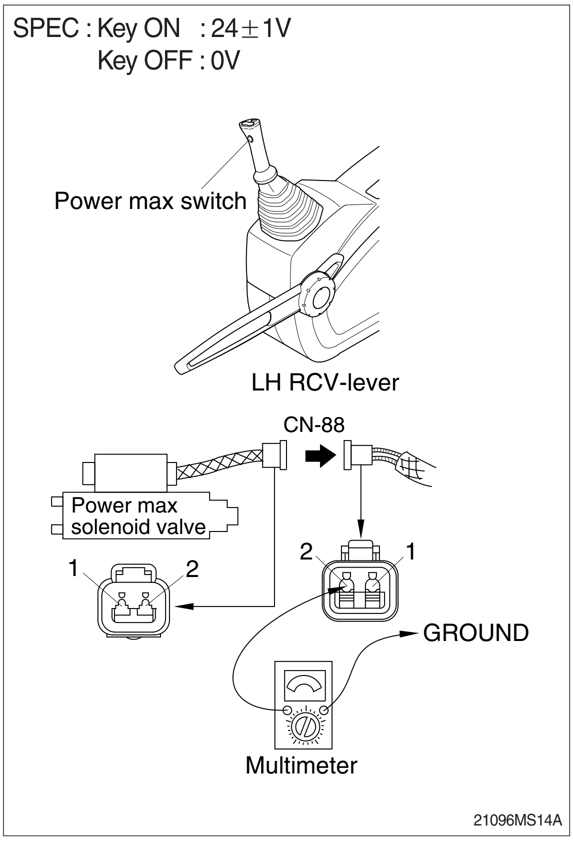


21096MS14

2) TEST PROCEDURE

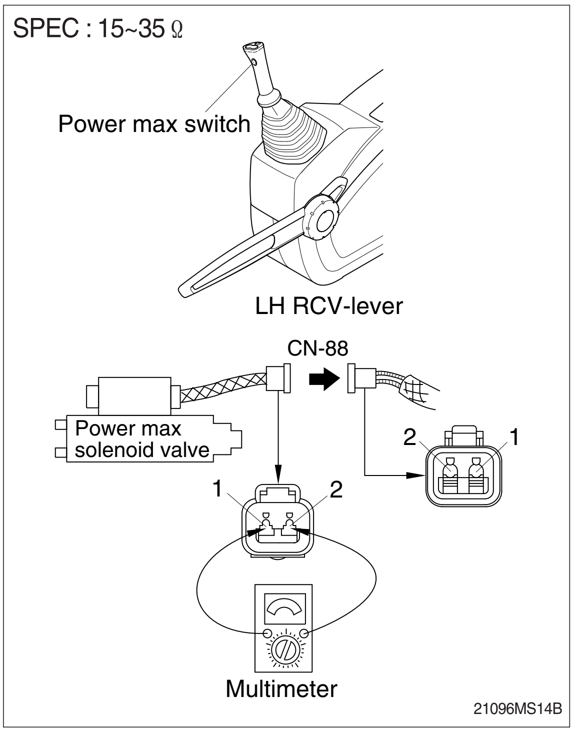
(1) Test 17: Check voltage between connector CN-88(2) - GND.

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



(2) Test 18: Check resistance of the solenoid valve between CN-88(1)-(2).

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



SECTION 7 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

1. PURPOSE

Performance tests are used to check:

1) OPERATIONAL PERFORMANCE OF A NEW MACHINE

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

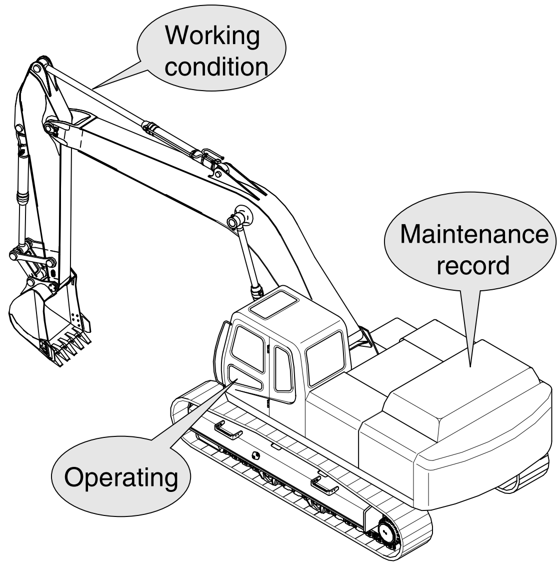
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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

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

3) OPERATIONAL PERFORMANCE OF A REPAIRED MACHINE

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

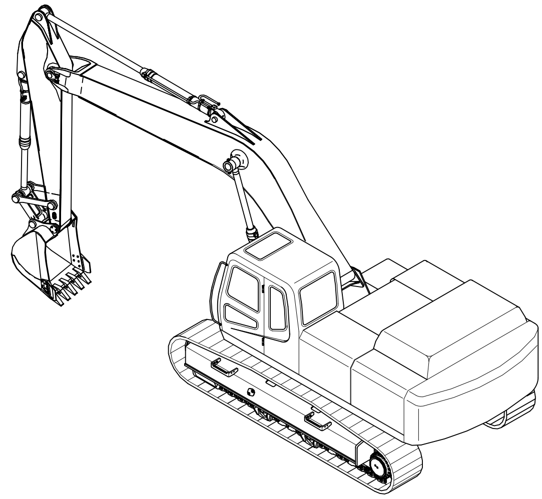


21077MS01

2. TERMINOLOGY

1) STANDARD

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

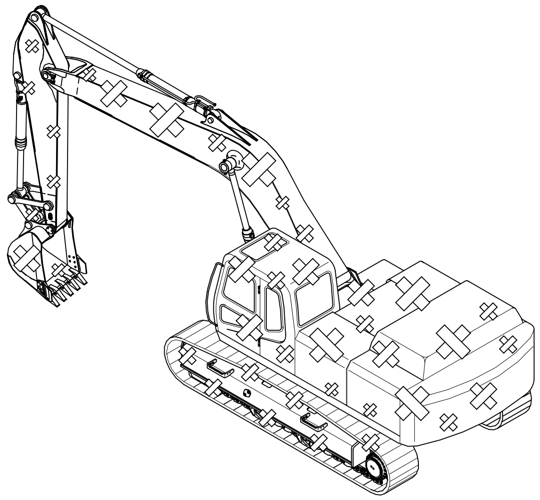


21077MS02

2) SERVICE LIMIT

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

Necessary parts and components must be replaced.



21077MS03

3. OPERATION FOR PERFORMANCE TESTS

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

(1) The machine

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

(2) Test area

① Select a hard, flat surface.

② Secure enough space to allow the machine to run straight more than 20 m, 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.

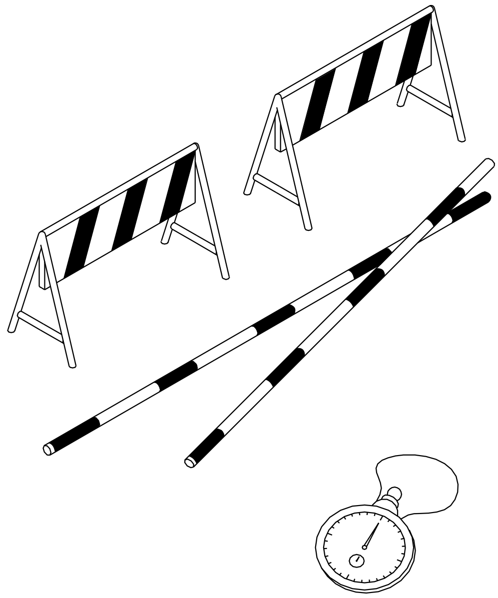
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(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 Select the P-mode switch.

④ Measure the engine RPM.

(3) Measurement

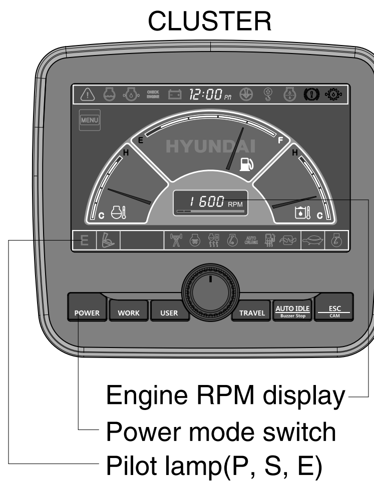
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

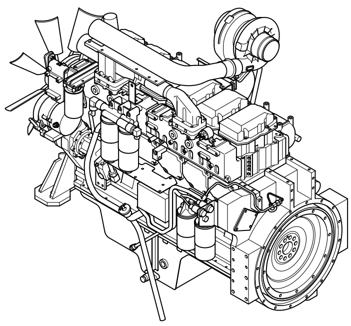
② Measure and record the engine speed at each mode (P, S, E).

③ Select the P-mode.

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

⑤ Measure and record the auto deceleration speed.





120097MS01

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
R1250-9	Start idle	900±100	
	P mode	1800±50	
	S mode	1700±50	
	E mode	1600±50	
	Auto decel	1100±100	
	One touch decel	900±100	

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

3) TRAVEL SPEED

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

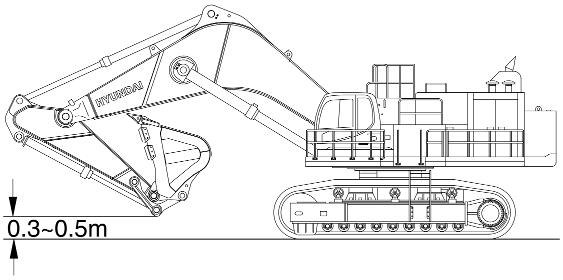
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Prepare a flat and solid test track 20m in length, with extra length of 3 to 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.



120097MS02A

(3) Measurement

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

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

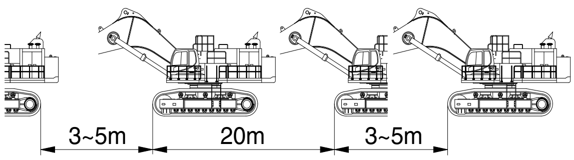
· Power mode switch : P mode

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

④ Measure the time required to travel 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.



120097MS03A

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
R1250-9	1 Speed	31.2±2.0	39.1	
	2 Speed	21.2±1.0	28.0	

4) TRACK REVOLUTION SPEED

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

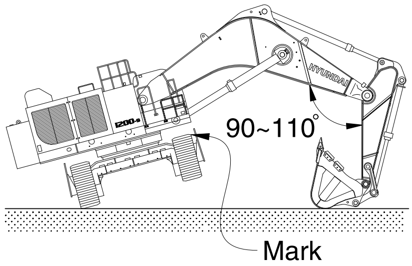
(2) Preparation

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.



120097MS04

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed
· Power mode switch : P 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
R1250-9	1 Speed	63.5±2.0	79.4
	2 Speed	43.0±1.0	55.4

5) TRAVEL DEVIATION

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

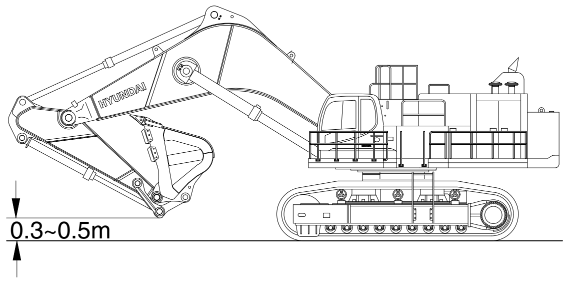
(2) Preparation

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.



120097MS02A

(3) Measurement

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

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

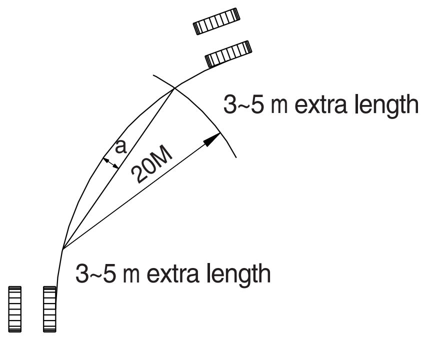
· Power mode switch : P mode

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

④ Measure the distance between a straight 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 / 20 m

Model	Standard	Maximum allowable	Remarks
R1250-9	200 below	250	

6) SWING SPEED

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

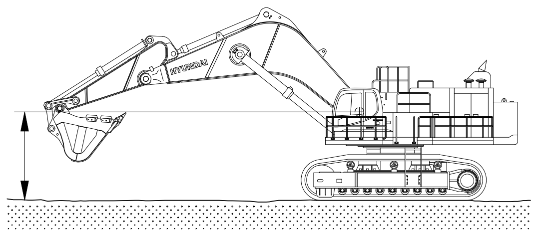
(2) Preparation

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

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

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

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



120097MS05A

(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Operate swing control lever fully.

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

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

(4) Evaluation

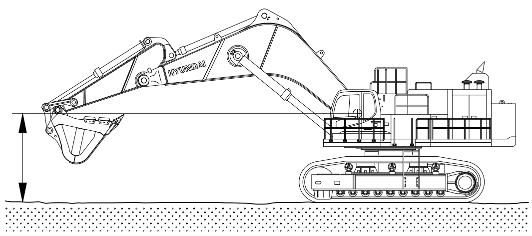
The time required for 3 swings should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
R1250-9	P mode	31.8±2.0	40.1

7) SWING FUNCTION DRIFT CHECK

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


120097MS05A

(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 P mode.

② Select the following switch positions.

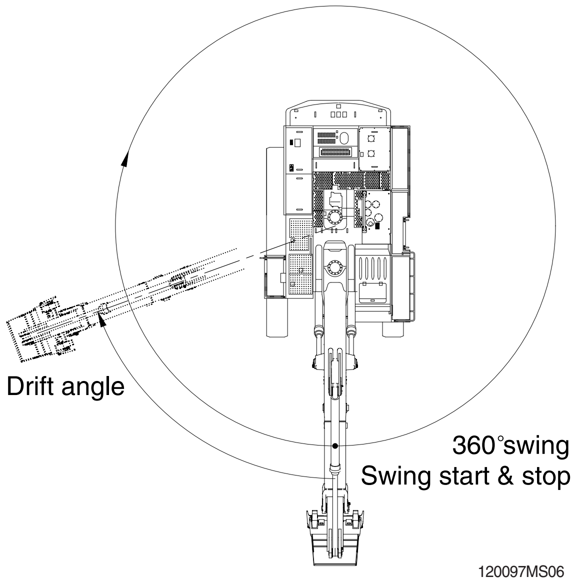
· Power mode switch : P mode

③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360˚.

④ Measure the distance between the two marks.

⑤ Align the marks again, swing 360˚, then test the opposite direction.

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



120097MS06

(4) Evaluation

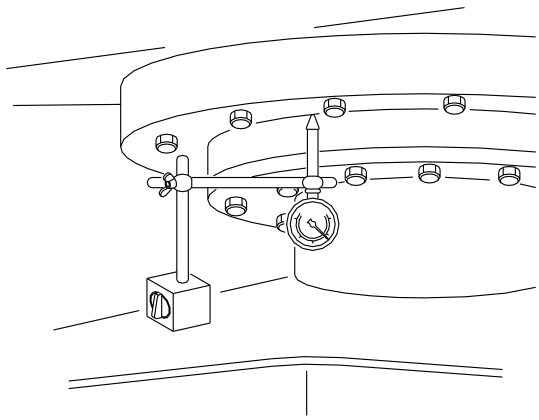
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
R1250-9	P mode	90 below	112.5	

8) SWING BEARING PLAY

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



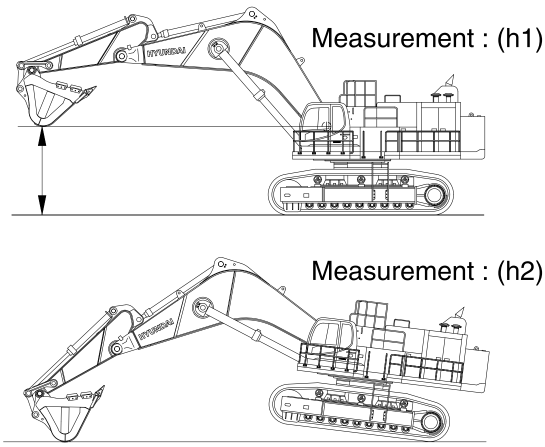
7-10(1)

(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



120097MS07A

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R1250-9	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.

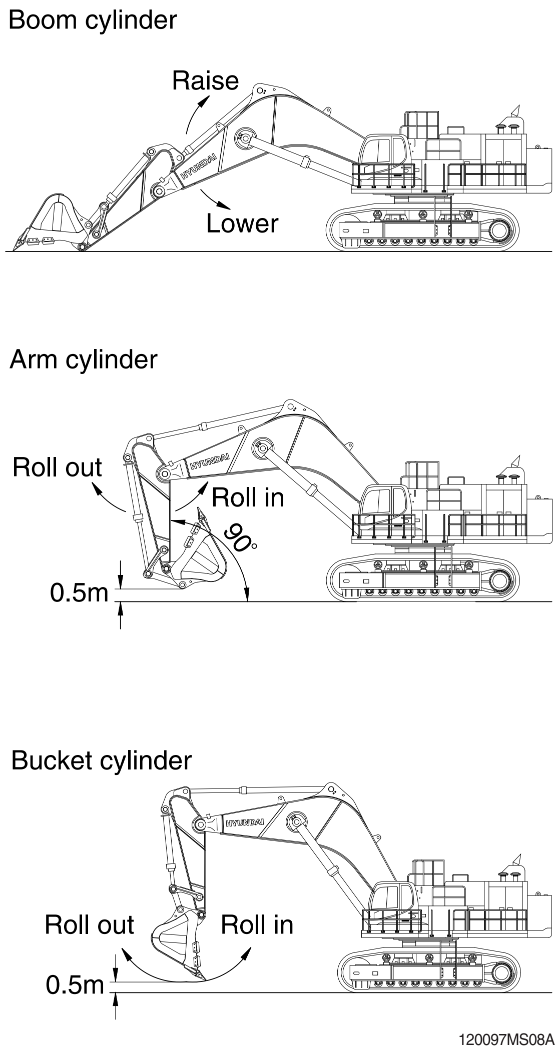
(2) Preparation

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



(3) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② To measure cylinder cycle times.

- Boom cylinders.
  Measure the time it takes to raise the boom, and the time it takes to lower the boom. To do so, position the boom at one stroke end then move the control lever to the other stroke end as quickly as possible.
- Arm cylinder.
  Measure the time it takes to roll in the arm, and the time it takes to roll out the arm. To do so, position the bucket at one stroke end, then move the control lever to the other stroke end as quickly as possible.

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

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds

Model	Function	Standard	Maximum allowable	Remarks
R1250-9	Boom raise	6.3±0.4	7.5	
	Boom lower	3.9±0.4	4.6	
	Arm in	4.3±0.4	5.2	
	Arm out	4.0±0.3	4.8	
	Bucket load	3.9±0.4	4.7	
	Bucket dump	3.3±0.3	3.9	

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.

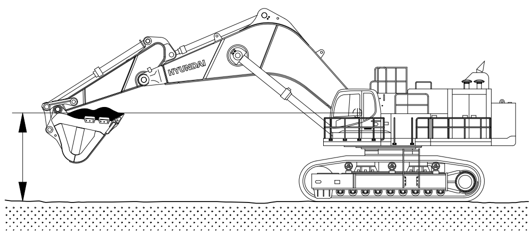
· $W = M^3 \times 1.5$
Where :
M^3 = Bucket heaped capacity (m^3)
1.5 = Soil specific gravity

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 30 mm 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.



120097MS09A

(3) Measurement

① Stop the engine.

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

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

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

Unit : mm / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
R1250-9	Boom cylinder	10 below	15	
	Arm cylinder	10 below	15	
	Bucket cylinder	40 below	50	

11) CONTROL LEVER OPERATING FORCE

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

(2) Preparation

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

(3) Measurement

① Start the engine.
② Select the following switch positions.
· Power mode switch : P mode
③ Operate each boom, arm, bucket and swing lever at full stroke and measure the maximum operating force for each.
④ Lower the bucket to the ground to raise one track off the ground. Operate the travel lever at full stroke and measure the maximum operating force required.
When finished, lower the track and then jack-up the other track.
⑤ Repeat steps ③ and ④ three times and calculate the average values.

(4) Evaluation

The measured operating force should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
R1250-9	Boom lever	1.6 or below	2.0	
	Arm lever	1.6 or below	2.0	
	Bucket lever	1.3 or below	1.7	
	Swing lever	1.3 or below	1.7	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

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

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

(2) Preparation

Keep the hydraulic oil temperature at $50 \pm 5^\circ C$.

(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
R1250-9	Boom lever	101±10	125	
	Arm lever	101±10	125	
	Bucket lever	90±10	115	
	Swing lever	90±10	115	
	Travel lever	142±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

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

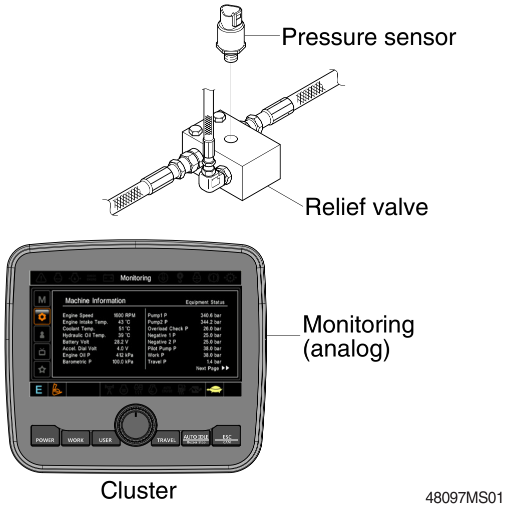
(2) Measurement

① Select the following switch positions.

· Power mode switch : E mode

· Auto decel switch : OFF

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



(3) Evaluation

The average measured pressure should meet the following specifications:

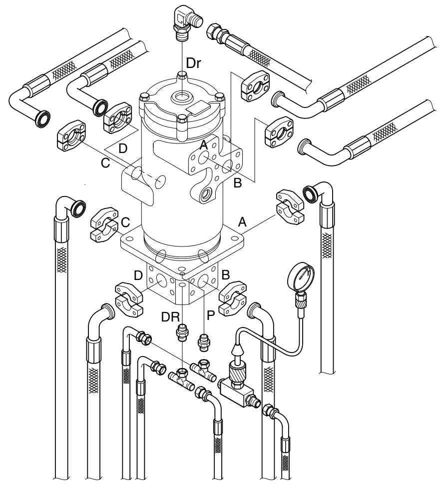
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R1250-9	P mode	40+2	-	

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 $50\pm5^{\circ}C$.



120097MS10

(2) Measurement

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

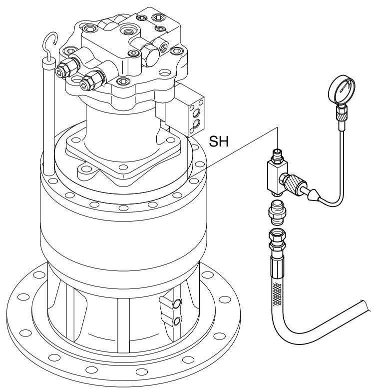
Unit : kgf/cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
R1250-9	1 Speed	0	-	
	2 Speed	40 ± 5	-	

15) SWING PARKING BRAKE RELEASING PRESSURE

(1) Preparation

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



120097MS11

(2) Measurement

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

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

Model	Description	Standard	Allowable limits	Remarks
R1250-9	Brake disengaged	40	31~49	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY PRESSURE

(1) Preparation

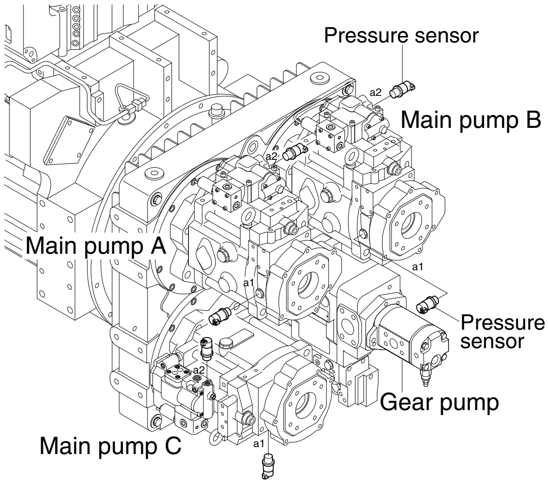
① Keep the hydraulic oil temperature at 50±5˚C.

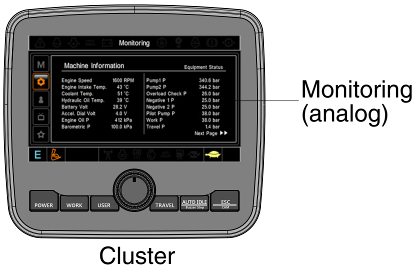
(2) Measurement

① Select the following switch positions.

· Power mode switch : P mode

② Measure the main pump delivery pressure by the monitoring menu of the cluster.





120097MS12

(3) Evaluation

The average measured pressure should meet the following specifications.

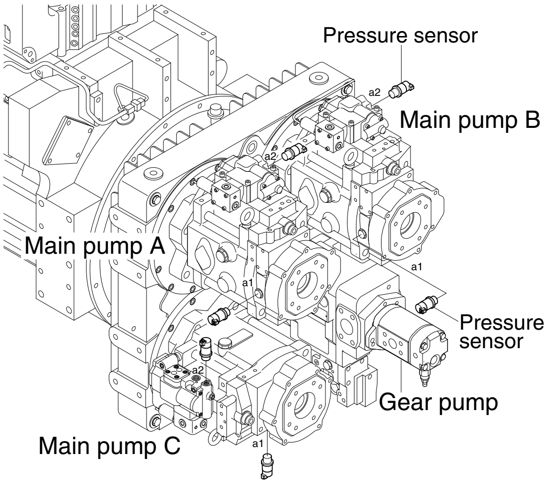
Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R1250-9	High ilde	40±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

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



(2) Measurement

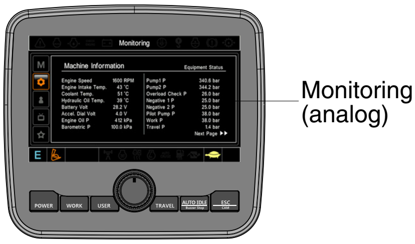
① Select the following switch positions.

· Power mode switch : P mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.



Cluster

120097MS12

(3) Evaluation

The average measured pressure should be within the following specifications.

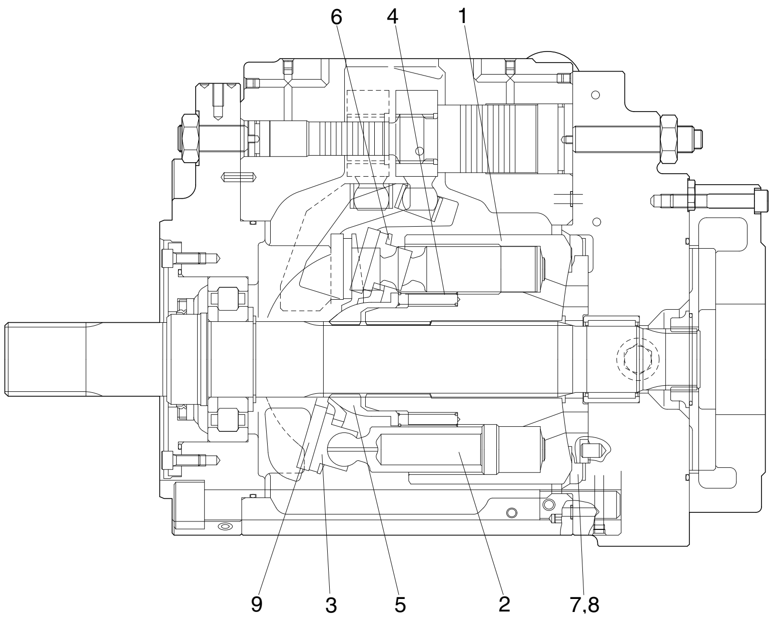
Unit : kgf / cm^2

Model	Function to be tested	Standard	Allowable allowable
R1250-9	Boom, Arm, Bucket	360±10	-
	Travel	345±10	-
	Swing	300±10	-
	Main relief	320 (350)±10	-

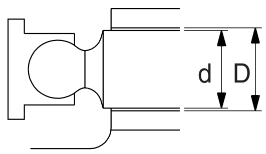
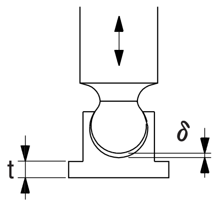
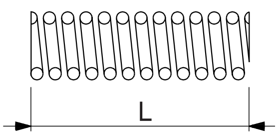
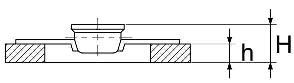
( ) : Power boost

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



120097MS21

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston(1) & cylinder bore(2) (D-d)		0.047	0.094	Replace piston or cylinder.
Play between piston(1) & shoe caulking section(3) (δ)		0-0.1	0.35	Replace assembly of piston & shoe.
Thickness of shoe (t)		6.5	6.3	
Free height of cylinder spring(4) (L)		49.5	4.8	Replace cylinder spring.
Combined height of set plate(5) & spherical bushing(6) (H-h)		33.0	32.0	Replace retainer or set plate.
Surface roughness for valve plate (sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder(2) (sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (corrected value)	0.4z or lower		

2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Sealing section of port where O-ring contacts. - Sealing 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 into casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch (especially on seals-contacting section). · Replacement when its sliding section has scratch. · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
Poppet	· Damage of poppet or spring. · Insert poppet into casing and function it.	· Correction or replacement when sealing is incomplete. · Normal when it can function lightly without being caught.
Around spring	· Rusting, corrosion, deformation or breaking of spring, spring seat, plug or cover.	· Replacement for significant damage.
Around seal for spool	· External oil leakage. · Rusting, corrosion or deformation of seal plate.	· Correction or replacement. · Correction or replacement.
Main relief valve, port relief valve & negative control relief valve	· External rusting or damage. · Contacting face of valve seat. · Contacting face of poppet. · Abnormal spring. · O-rings, back up rings and seals.	· Replacement. · Replacement when damaged. · Replacement when damaged. · Replacement. · 100% replacement in general.

3. SWING DEVICE

Part name	Inspection item	Remedy
Balance plate	· Worn less than 0.03 mm · Worn more than 0.03 mm · Sliding surface has a seizure (even though small)	· Lapping · Replace · Replace
Shoe of piston assembly	· Sliding surface has a damage. · Sliding surface depression ( ) dimension less than 0.45 mm or has a large damage.	· Lapping · Replace parts or motor
Piston of piston assembly	· Sliding surface has a seizure (even though small).	· Replace motor
Taper roller bearing Needle bearing Roller bearing	· In case 3000hour operation. · Rolling surface has a damage.	· Replace · Replace

4. TRAVEL MOTOR

Wash all parts disassembly in treated oil and dry in the compressed air.
Perform maintenance including replacement or corrections in accordance with the following criterion.

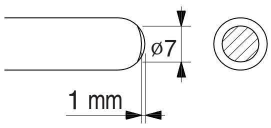
No.	Parts Name	Appearance	Allowance	Replacement parts
6	Piston sub assembly	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness : 0.8a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Cylinder block kit / Perform lapping (#1000). Replace if flaws cannot be completely removed.
		When remarkable flaws or high surface roughness are found on surface of piston.	Roughness : 1.2a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	
		When clearance between piston sub assembly and cylinder block bore is great.	Clearance : 0.060 mm	Cylinder block kit
		When looseness in shoe ball parts is great.	Looseness : 0.4 mm	
4	Cylinder Block	When remarkable flaws or high surface roughness are found on the surface with the valve plate.	Roughness : 0.8a	Cylinder block kit / Perform lapping(#1000). Replace if flaws cannot be completely removed.
		When wear inside bore is great.	Roughly : 1.6a	Cylinder block kit
		When clearance between piston sub assembly and cylinder block bore is great.	Looseness : 0.4 mm	
		When abnormal wear and breakage develop on mating teeth.		
5	Valve plate	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness : 0.8 a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	Cylinder block kit
7 8	Retainer plate Retainer holder	When remarkable flaws or high surface roughness are found on each sliding surface.	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	7 Retainer plate 8 Retainer holder

No.	Parts Name	Appearance	Allowance	Replacement parts
9	Swash plate	When remarkable flaws or high surface roughness are found on sliding surface with shoe.	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Swash plate / Perform lapping (#1000). Replace if flaws cannot be completely removed.
		When remarkable flaws or high surface oughness are found on sliding surface with steel ball.	Roughness : 1.6 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Swash plate
		When remarkable flaws or seizure are found on contact surface with steel balls.	Sphere depth : 19.06 mm	
3	Shaft	When remarkable flaws or high surface roughness are found on sliding surface of oil seal.	Roughness : 1.6 a There should be no seizure andremarkable flaws (over 0.02 mm in thickness).	Shaft
		When abnormal wear and breakage develop on mating teeth.		
21	Brake piston	When remarkable flaws or high surface roughness are found in each sliding surface	Height : 50.5 mm Roughness : 3.2 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Brake piston Friction plate
19	Disk plate	When remarkable flaws or abrasion are found on disks(friction material)	Thickness : 3.2 mm	Disk plate
13 14	Roller Bearing Roller Bearing	When flaking and abrasion develop on rolling surface.		Roller Bearing
		When indentation is found on rolling surface		
		When abnormality is found in rotation (abnormal noise, irregular rotation)		

No.	Parts Name	Appearance	Allowance	Replacement parts
11	Piston sub assembly	When remarkable flaws or high surface roughness are found on sliding surface with swash plate.	Roughness : 1.6 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Case kit / Perform lapping (#1000). Replace if flaws cannot be completely removed.
		When remarkable flaws or high surface roughness are found on surface with case.	Roughness : 1.2a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Case kit
		When clearance between piston sub assembly and case bore is great.	Clearance : 0.030 mm	
		When looseness in shoe ball parts is great.	Looseness : 0.7 mm	
2-2	Spool Assy	When remarkable flaws or high surface roughness are found on each sliding surface	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Base plate sub assembly
		When clearance between piston sub assembly and case bore is great.	Clearance : 0.050 mm	
2-1	Base plate	When remarkable flaws or high surface roughness are found on each sliding surface with spool assy.	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Base plate sub assembly
		When clearance between spool assy and base plate bore is great.	Clearance : 0.050 mm	
		When remarkable flaws or high surface roughness are found on each sliding surface with valve assy.	Roughness : 0.8 a There should be no seizure and remarkable flaws(over 0.02 mm in thickness).	
		When clearance between valve assy and base plate bore is great.	Clearance : 0.040 mm	
		When remarkable flaws or high surface roughness are found on each sliding surface with spool assy.	There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	

No.	Parts Name	Appearance	Allowance	Replacement parts
9	Valve assy	When remarkable flaws or high surface roughness are found on each sliding surface with spool assy.	Roughness : 0.8 a There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Base plate sub assembly
		When clearance between valve assy and base plate bore is great.	Clearance : 0.040 mm	
2-7-10	Free piston	When remarkable flaws or high surface roughness are found on each sliding surface with base plate.	There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	Relief valve assy
2-7-2	Housing	When remarkable flaws or high surface roughness are found on each sliding surface with free piston.	There should be no seizure and remarkable flaws (over 0.02 mm in thickness).	

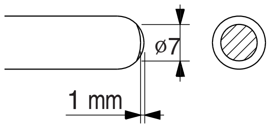
5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000 cc/m at neutral handle position, or more than 2000 cc/m during operation.	Conditions : Primary pressure : 30 kgf/cm^2 Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μ m, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2 mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

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

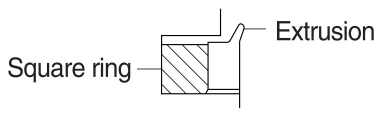
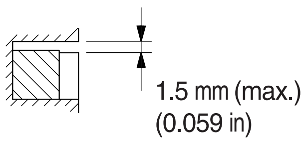
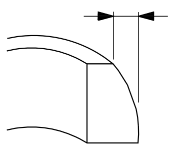
2. When loosening the hexagon socket head cap screw (125), replace the seal washers (121) without fail.

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 : 30 kgf/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 1 mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 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 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring. 	Replace
	-	· Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring. 	Replace
	-	· Worn more than 0.5 mm (0.02 in)~1.5 mm (MAX.) (0.059 in) 	Replace

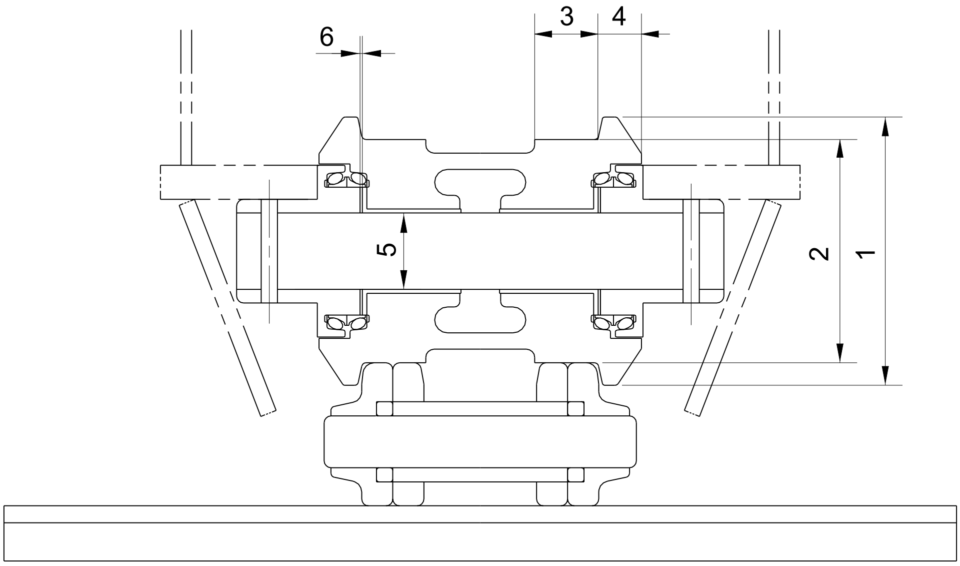
8. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal.	· Replace or replate
		· Rust is not present on plating.	· Replace or replate
		· Scratches are not present.	· Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
	· Bushing at mounting part	· Wear of I.D.	· Replace
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER

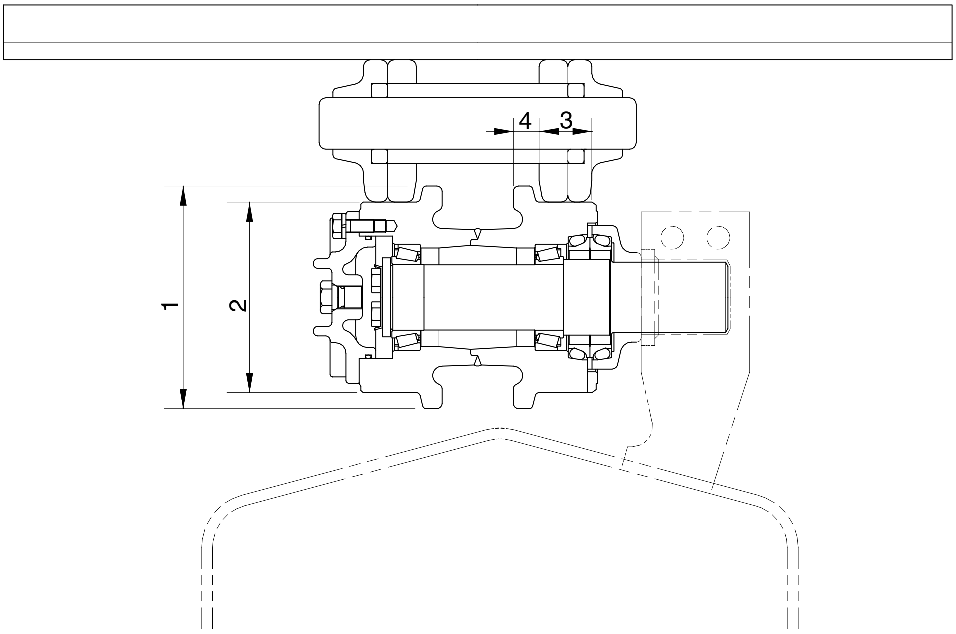


32077MS01

Unit : ㎜

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		ø 340		-		
2	Outside diameter of tread	ø 280		ø 264		
3	Width of tread	78.5		86.5		
4	Width of flange	38		-		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 122 $^{-0.25}_{-0.35}$	ø 122 $^{+0.15}_{+0.03}$	0.28 to 0.5	2.0	
6	Side clearance of roller (Both side)	Standard clearance		Clearance limit		Replace
		0.4~1.6		2.5		

2) CARRIER ROLLER

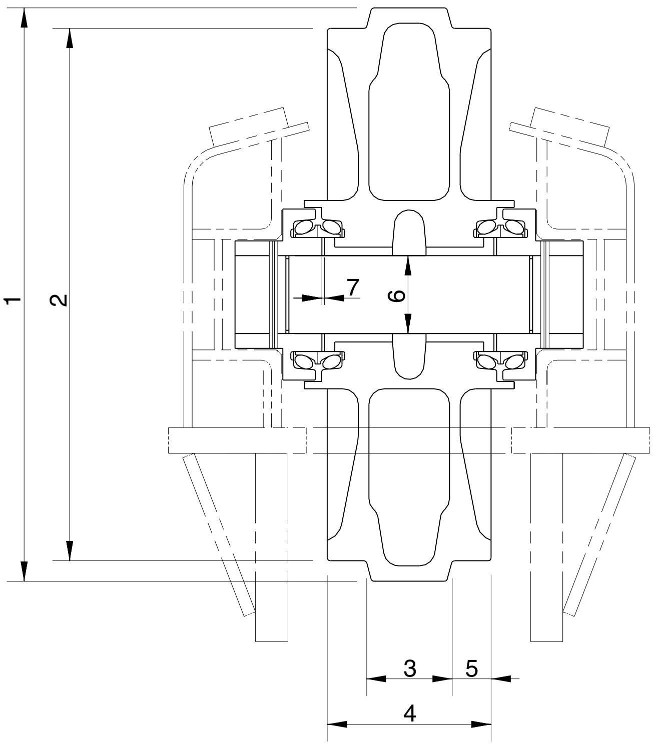


120097MS22

Unit : ㎜

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Outside diameter of flange	ø 224	-	Rebuild or replace
2	Outside diameter of tread	ø 190	ø 180	
3	Width of tread	60	65	
4	Width of flange	21	-	

3) IDLER

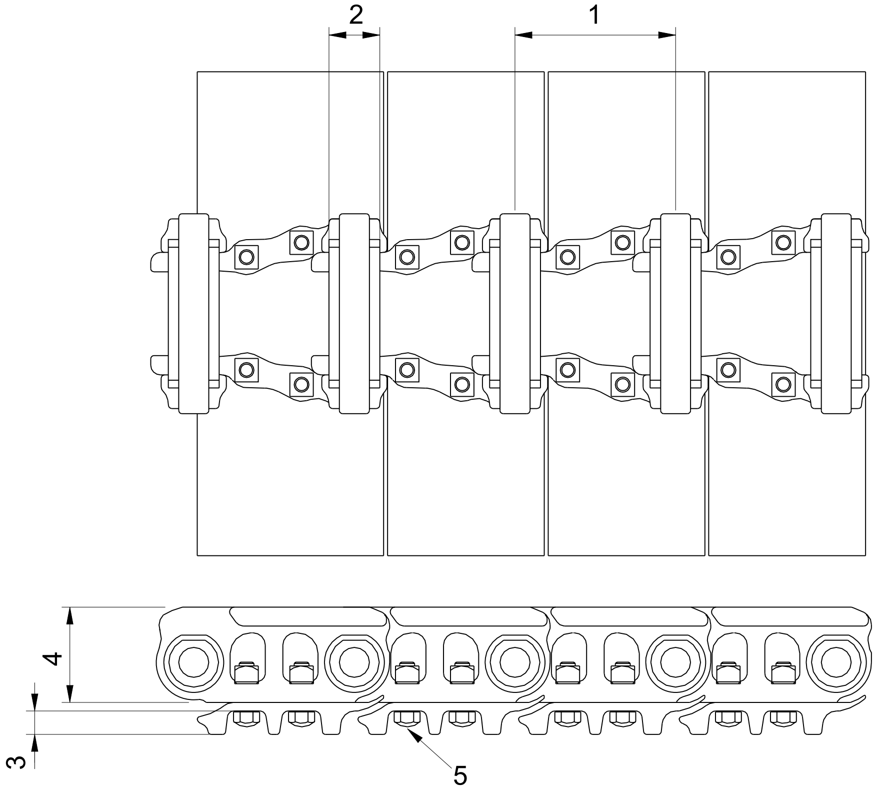


8007A7MS05

Unit : ㎜

No.	Check item	Criteria				Remedy
1	Outside diameter of protrusion	Standard size		Repair limit		Rebuild or replace
		ø 962		-		
2	Outside diameter of tread	ø 920		ø 906		
3	Width of protrusion	136		-		
4	Total width	290		-		
5	Width of tread	77		84		
6	Clearance between shaft and support	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		ø 125 $^{0}_{-0.03}$	ø 125 $^{+0.4}_{+0.35}$	0.35 to 0.43	2.0	
7	Side clearance of idler (Both side)	Standard clearance		Clearance limit		Replace
		0.4 to 1.4		2.0		

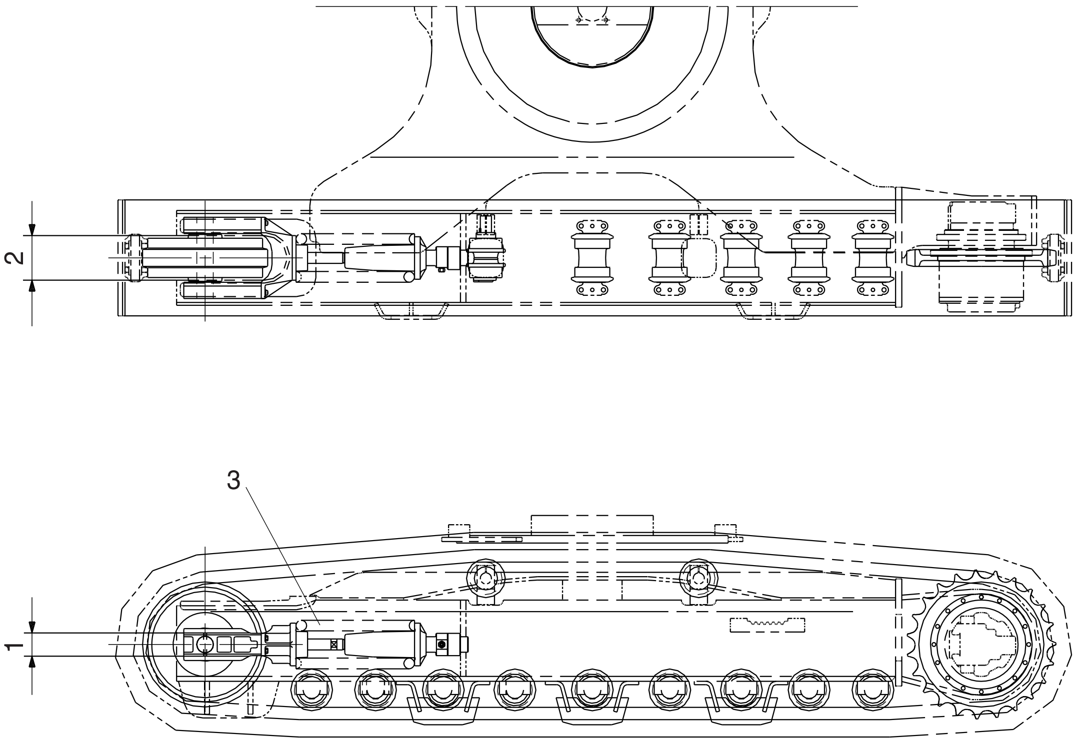
4) TRACK



Unit : ㎜

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		260.35	265.75	
2	Outside diameter of bushing	ø 90	ø 78	Rebuild or replace
3	Height of grouser	52	28	
4	Height of link	155	141	
5	Tightening torque	Initial tightening torque : 220.4 ~ 259.3 kgf · m		Retighten

5) TRACK FRAME AND RECOIL SPRING

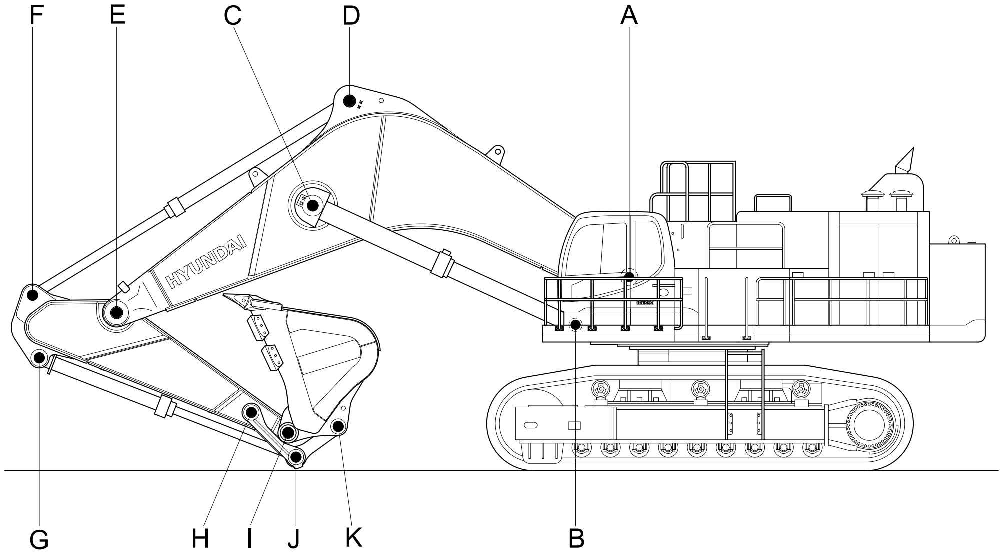


21073MS05

Unit : ㎜

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide		Standard size	Tolerance	Repair limit		Rebuild or replace
		Track frame	198	+2 0	202		
		Idler support	195	0 - 1.5	191		
2	Horizontal width of idler guide	Track frame	393	+2 0	397		
		Idler support	391	-	388		
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		ø 351 × 1508	1280	58,957 kg	-	47,170 kg	

2. WORK EQUIPMENT



Unit : mm

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	160	159	158.5	160.5	161.5	Replace
B	Boom Cylinder Head	160	159	158.5	160.5	161.5	
C	Boom Cylinder Rod	160	159	158.5	160.5	161.5	
D	Arm Cylinder Head	170	169	168.5	170.5	171.5	
E	Boom Front	170	169	168.5	170.5	171.5	
F	Arm Cylinder Rod	170	169	168.5	170.5	171.5	
G	Bucket Cylinder Head	150	149	148.5	150.5	151.5	
H	Arm Link	130	129	128.5	130.5	131.5	
I	Bucket and Arm Link	160	159	158.5	160.5	161.5	
J	Bucket Cylinder Rod	160	159	158.5	160.5	161.5	
K	Bucket Link	140	139	138.5	140.5	141.5	

SECTION 8 DISASSEMBLY AND ASSEMBLY

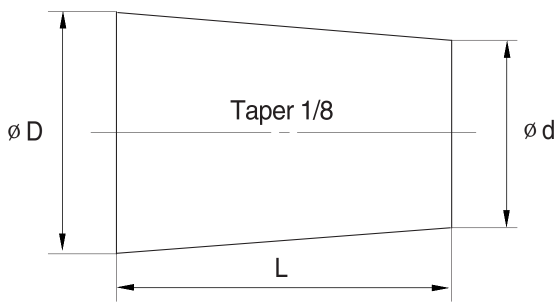
SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

(2) Operate the control lever and actuate the hydraulic cylinder 4-5 times, stopping 100 mm 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 (FR)	M22 × 2.5	70 ± 7.0	506 ± 51.3
2		Engine mounting bolt, nut (RR)	M24 × 3.0	100 ± 10	723 ± 72.3
3		Gear box mounting bolt	M12 × 1.75	12.3 ± 1.0	89 ± 7.2
4		Radiator mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 63
5		Oil cooler mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 63
6		Coupling mounting socket bolt	M10 × 1.5	27.0 ± 3.0	195 ± 21.7
7		Fan pump mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
8	Hydraulic system	Main pump mounting socket bolt	M20 × 2.5	57.9 ± 8.7	419 ± 63
9		Main control valve 1 mounting bolt	M20 × 2.5	42.6 ± 4.2	308 ± 30.3
10		Main control valve 2 mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
11		Fuel tank mounting bolt	M20 × 2.5	58 ± 6.0	420 ± 43.4
12		Hydraulic oil tank mounting bolt	M20 × 2.5	58 ± 6.0	420 ± 43.4
13		Turning joint mounting bolt, nut	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
14	Power train system	Swing motor mounting bolt	M24 × 3.0	100 ± 15	723 ± 108
15		Swing bearing upper part mounting bolt	M30 × 3.5	199 ± 10	1439 ± 72.3
16		Swing bearing lower part mounting bolt	M30 × 3.5	199 ± 10	1439 ± 72.3
17		Travel motor mounting bolt	M30 × 3.5	150 ± 10	1085 ± 72.3
18		Sprocket mounting bolt	M30 × 3.5	199 ± 10	1439 ± 72.3
19	Under carriage	Carrier roller mounting bolt, nut	M20 × 2.5	57.9 ± 8.7	419 ± 63
20		Track roller mounting bolt	M27 × 3.0	140 ± 7.0	1013 ± 50.6
21		Track tension cylinder mounting bolt	M24 × 3.0	100 ± 10	723 ± 72.3
22		Track shoe mounting bolt, nut	M24 × 1.5	240 ± 2.0	1736 ± 145
23		Track guard mounting bolt	M27 × 3.0	140 ± 7.0	1013 ± 50.6
24	Others	Counterweight mounting bolt	M42 × 3.0	390 ± 40	2821 ± 289
25		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
26		Operator's seat mounting bolt	M 8 × 1.25	4.05 ± 0.8	29.3 ± 5.8

※ For tightening torque of engine and hydraulic components, see engine maintenance guide and service manual.

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.73 ~ 4.12	19.7 ~ 29.8
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 79.5	9.8 ~ 15.8	71 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 167
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 343
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	350 ~ 457	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.5	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1655
M36 × 4.0	174 ~ 236	1261 ~ 1703	250 ~ 310	1808 ~ 2242

(2) Fine thread

Bolt size	8T		10T	
	kg · m	lb · ft	kg · m	lb · ft
M 8 × 1.0	2.17 ~ 3.37	15.7 ~ 24.3	3.04 ~ 4.44	22.0 ~ 32.0
M10 × 1.25	4.46 ~ 6.66	32.3 ~ 48.2	5.93 ~ 8.93	42.9 ~ 64.6
M12 × 1.25	7.78 ~ 11.58	76.3 ~ 83.7	10.6 ~ 16.0	76.6 ~ 115
M14 × 1.5	13.3 ~ 18.1	96.2 ~ 130	17.9 ~ 24.1	130 ~ 174
M16 × 1.5	19.9 ~ 26.9	144 ~ 194	26.6 ~ 36.0	193 ~ 260
M18 × 1.5	28.6 ~ 43.6	207 ~ 315	38.4 ~ 52.0	278 ~ 376
M20 × 1.5	40.0 ~ 54.0	289 ~ 390	53.4 ~ 72.2	386 ~ 522
M22 × 1.5	52.7 ~ 71.3	381 ~ 515	70.7 ~ 95.7	512 ~ 692
M24 × 2.0	67.9 ~ 91.9	491 ~ 664	90.9 ~ 123	658 ~ 890
M30 × 2.0	137 ~ 185	990 ~ 1338	182 ~ 248	1314 ~ 1795
M36 × 3.0	192 ~ 260	1389 ~ 1879	262 ~ 354	1893 ~ 2561

2) PIPE AND HOSE (FLARE TYPE)

Thread size (PF)	Width across flat (mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

3) PIPE AND HOSE (ORFS TYPE)

Thread size (UNF)	Width across flat (mm)	kgf·m	lbf·ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130.2
1-7/16-12	41	21	151.9
1-11/16-12	50	35	253.2

4) FITTING

Thread size	Width across flat(mm)	kgf·m	lbf·ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130.2
1"	41	21	151.9
1-1/4"	50	35	253.2

GROUP 3 PUMP DEVICE

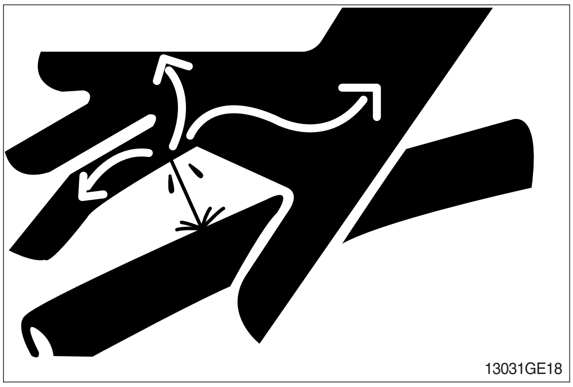
1. REMOVAL AND INSTALL

1) REMOVAL

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

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

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



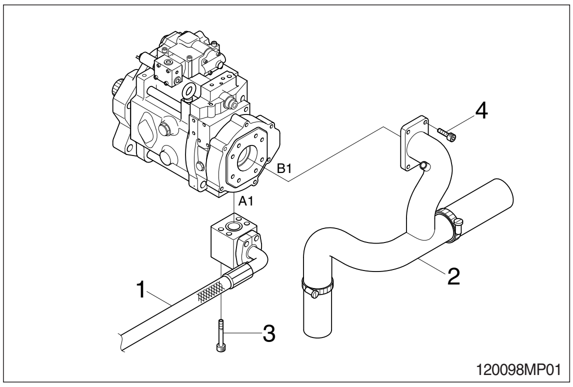
13031GE18

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

· Hydraulic tank quantity : 670 ℓ

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

(5) Remove socket bolts (1) and disconnect hose (3).



120098MP01

(6) Disconnect pilot line hoses (5, 6, 7, 8).

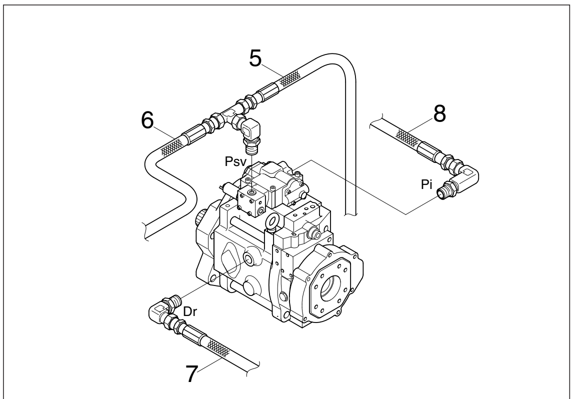
(7) Remove bolts (4) and disconnect pump suction tube (2).

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

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

· Weight : 160 kg × 3 (360 lb × 3)

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



120098MP02

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.

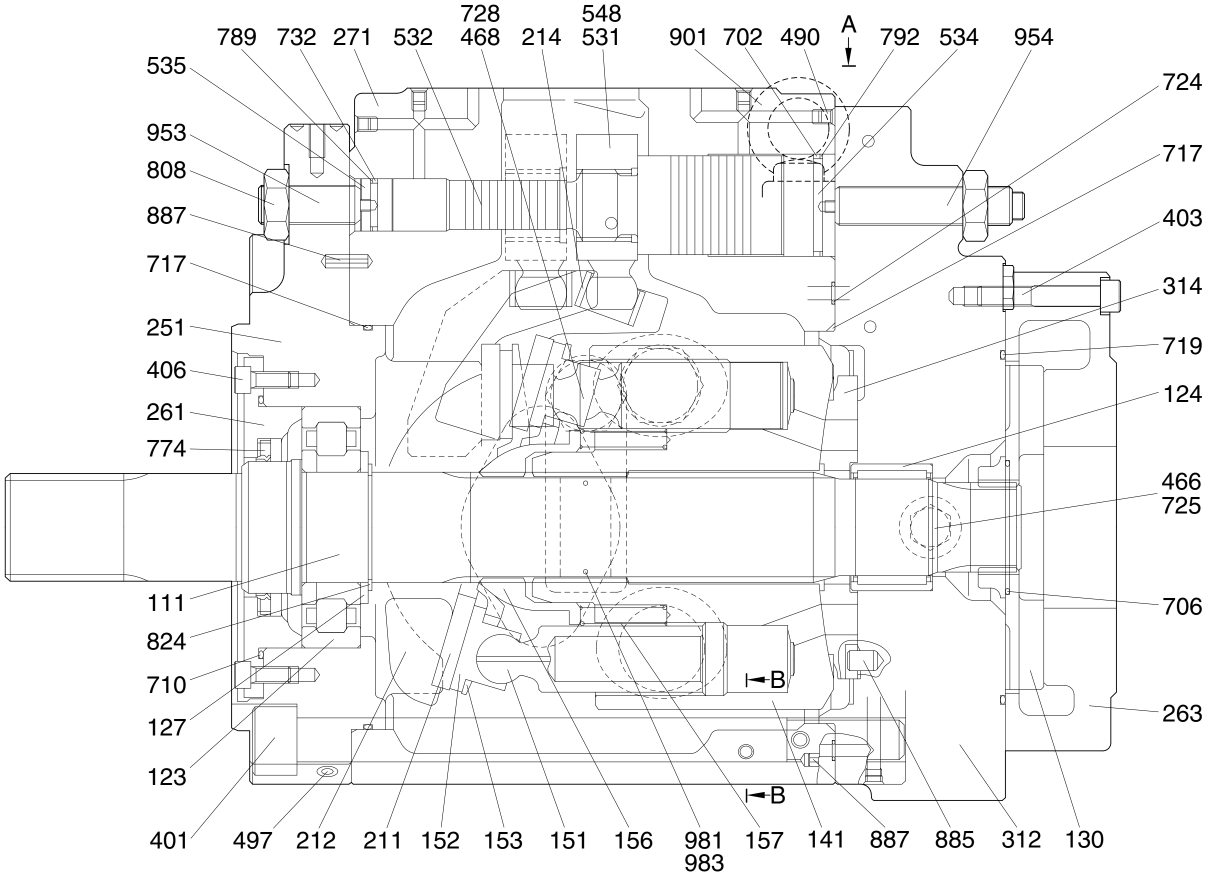
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA)
② Tighten plug lightly
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

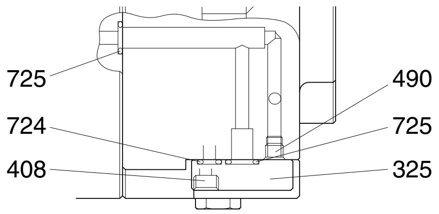
(7) Start the engine, run at low idling (3~5 minutes) to circulate the oil through the system.

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

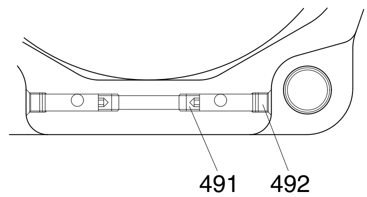
2. MAIN PUMP (1/2)

1) STRUCTURE





VIEW A



SECTION B -B

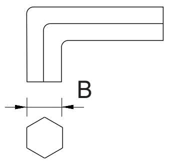
120092MP02

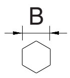
111	Drive shaft	261	Front cover	492	Plug	728	O-ring
113	Roller bearing	263	Booster cover	497	Plug	732	O-ring
114	Needle bearing	271	Pump casing	531	Tilting pin	774	Oil seal
123	Spacer	312	Valve cover	532	Servo piston	789	Back up ring
130	Booster	314	Valve plate (F)	534	Stopper (L)	792	Back up ring
141	Cylinder block	325	Cover	535	Stopper (S)	808	Nut
151	Piston	401	Screw	548	Feed back pin	824	Snap ring
152	Shoe	403	Hexagon screw	702	O-ring	885	Pin
153	Set plate	406	Hexagon screw	706	O-ring	887	Spring pin
156	Bushing	408	Screw	710	O-ring	901	Eye bolt
157	Cylinder spring	466	Plug	717	O-ring	953	Set screw
211	Shoe plate	468	Plug	719	O-ring	954	Set screw
212	Swash plate	490	Plug	724	O-ring	981	Name plate
214	Steel bearing	491	Restrictor	725	O-ring	983	Pin
251	Support						

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

Tool name & size	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	4	M 5	BP-1/16	-	M 8
	5	M 6	BP1/ 8	-	M10
	6	M 8	BP-1/4	PO-1/4	M12, M14
	8	M10	BP-3/8	PO-3/8	M16, M18
	10	M12	BP-1/2	PO-1/2	M20
	17	M20, M22	BP-1	PO-1	-
	22	M30	-	-	-

Tool name & size	B	Hexagon head bolt	Hexagon head bolt	VP plug (PF thread)
Double ring spanner, socket wrench, double (single) open end spanner 	-	Hexagon head bolt	Hexagon head bolt	VP plug (PF thread)
	19	M12	M12	VP-1/4
	30	M20	M20	-
	36	-	-	VP-3/4
	46	M30	-	-

Tool name & size	Part name
Adjustable angle wrench	Medium size 1 set, Small size 1 set
Screw driver	Flat-blade screw driver, Medium size, 2 sets
Hammer	Plastic hammer, 1 set
Pliers	For snap ring, TSR-160
Steel bar	Steel bar of key material approx. 10×8×200
Torque wrench	Capable of tightening with the specified torques

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
	M22	45.0	325	0.67	17
PT plug (material : S45C) ※ Wind a seal tape 1.5 to 2 turns round the plug	PT 1/16	1.1	8.0	0.16	4
	PT 1/ 8	1.2	8.7	0.20	5
	PT 1/ 4	2.2	16	0.24	6
VP plug (material : SS400)	PF 1/ 4	3.7	26.8	0.75	19
	PF 3/ 8	7.5	54.2	0.87	22
	PF 1/ 2	11.2	81.0	1.06	27
	PF 3/ 4	17.3	125.0	1.42	36
ROH plug ※ PF 3/8 or less : S45C More than PF 1/2 : SCM435	PF 1/ 4	3.7	26.8	0.75	19
	PF 3/ 8	7.5	54.2	0.87	22
	PF 1/ 2	11.2	81.0	1.06	27
	PF 3/ 4	17.3	125.0	1.42	36

3) DISASSEMBLY

(1) Select place suitable to disassembling.

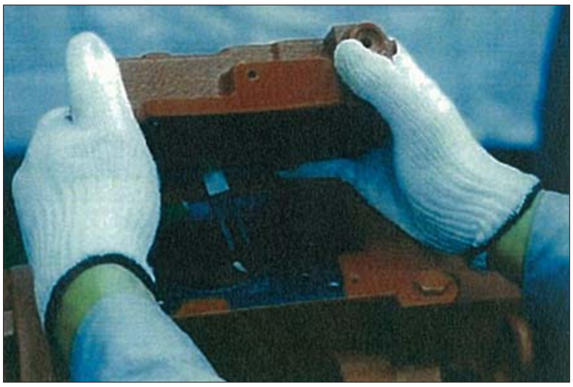
※ **Select clean place.**

※ **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 drain oil from pump casing (271).

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



120098MP04

(5) Remove hexagon socket head bolts (403) which tighten booster cover (263), valve cover (L, 312) and remove booster (130).

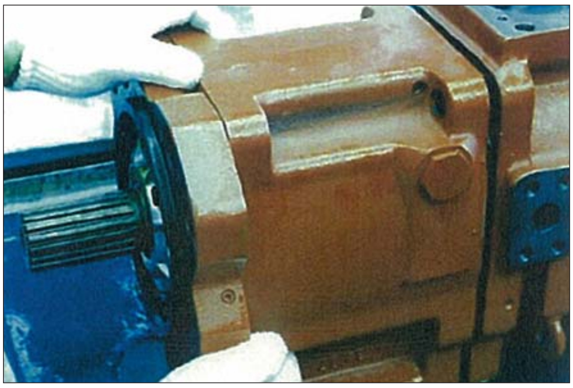
(6) Loosen hexagon socket head bolts (401) which tighten swash plate support (251), pump casing (271) and valve cover (L, 312).

※ **Do not remove hexagon socket head bolts (401).**

(7) Place pump horizontally on workbench with its regulator-fitting surface down, and remove hexagon socket bolts (401).

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

(8) Separate pump casing (271) from valve cover (L) (312).



120098MP05

(9) Pull out cylinder block (141), piston subassembly (011), set plate (153), spherical bush (158) and cylinder springs (157) simultaneously from pump casing (271) straightly over drive shaft (111).

※ **Take care not to damage silding surfaces of cylinder block (141), spherical bush (156), shoes (152), swash plate (212), etc.**

※ **Take care not to damage drive shaft (111).**

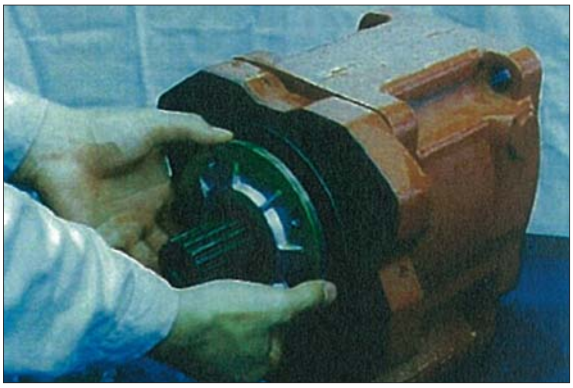
120098MP06

(10) Remove hexagon socket head bolts (406) and then remove front cover (261).

※ **Front cover can be easily removed by screwing M8 bolts into threads on the front cover.**

※ **Since oil seal is fitted on front cover (261), take care not to damage it at removing the cover.**

※ **Remove dust of the input spline part and prevent it from adhering to oil seal.**

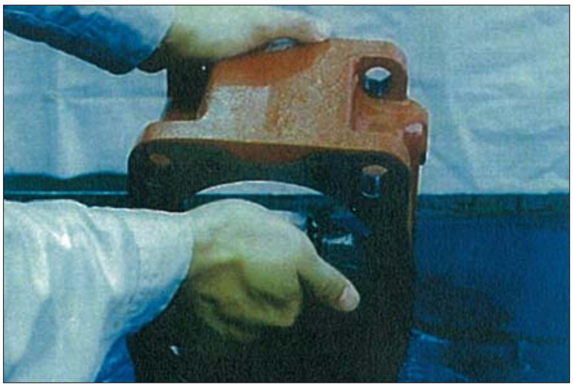


120098MP07

(11) Tap the mounting flange portion of the swash plate support (251) lightly from the pump casing side, and separate the swash plate support and the pump casing.

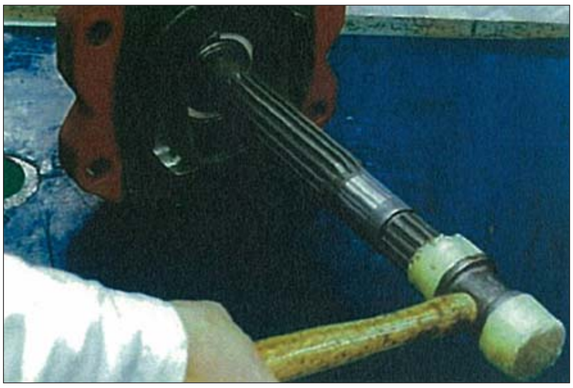
120098MP08

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



120098MP09

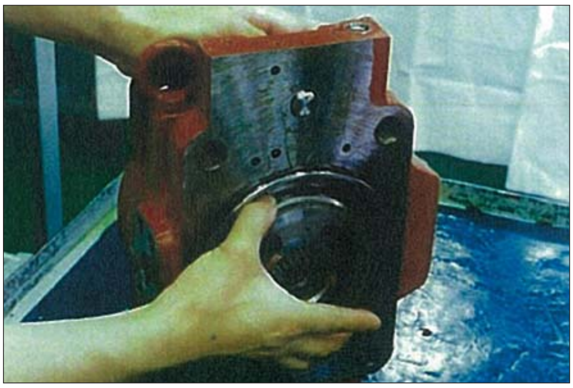
(13) Tapping shaft end of drive shaft (111) lightly with plastic hammer, remove it from the swash plate support (251).



120098MP10

(14) Remove valve plates (314) from valve cover (L, 312).

※ These may be removed in work 8.



120098MP11

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

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

※ Since adhesive (No. 1305N of threebond make) is applied to fitting areas of tilting pin (531) and servo piston (532), take care not to damage servo piston (532).

※ Do not remove needle bearing (124) unless it is considered to be out of its life span.

※ Do not loosen hexagon nuts of valve cover (312) and swash plate support (251).
If loosened, flow setting will be changed.

(16) This is the end of disassembling procedures.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-10, 11.

(2) Attach the swash plate support (251) by tapping it lightly with plastic hammer to the pump casing (271).

※ In case the servo piston, tilting pin, stopper (L), and stopper (S) have been removed, attach them to the pump casing in advance.

※ In the tightening work of the servo piston and the tilting pin, use the tool not to damage the head of the tilting pin and the feed back pin. Besides, apply adhesive (No. 1305N of threebond make) to the thread portion.

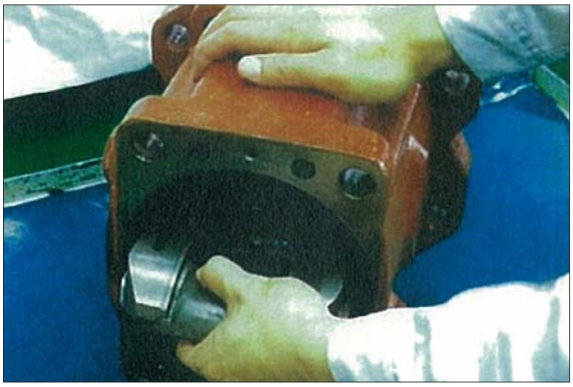
120098MP12

(3) Attach the shoe plate (211) to the swash plate (212). Place the pump casing with its regulator-mounting face directed downward, attach the tilting bush of the swash plate to the tilting pin (531), and properly attach the swash plate and shoe plate ot the swash plate support (251).

※ Confirm with fingers of both hands that swash plate can be moved smoothly.

※ Apply grease to sliding sections of swash plate (212) and swash plate support (251), and drive shaft (111) can be fitted easily.

※ Take care not to damage shoe plate (211) surface.



120098MP13

(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 (111) with hammer or so on.

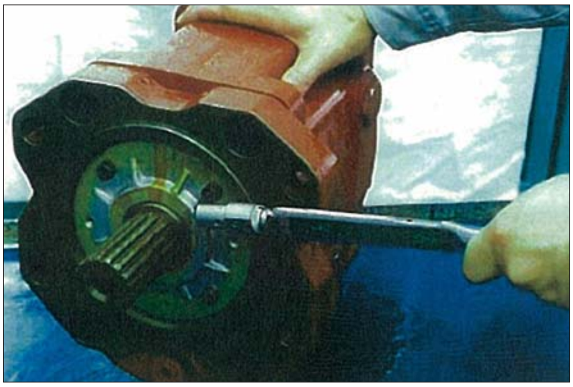
※ Tapping outer race of bearing lightly with plastic hammer, etc. Fit them fully, using steel care not to damage it.

120098MP14

(5) Assemble front cover (F, 261) to swash plate support (251) and fix it with hexagon socket head bolts (406).

※ Apply grease lightly to oil seal in front cover (261).

※ Assemble front cover with great care not to damage the oil seal.

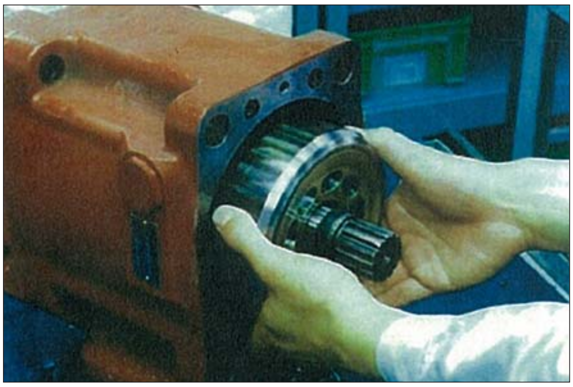


120098MP15

(6) Insert the piston cylinder subassembly〔cylinder block (141), piston subassembly (011), set plate (153), spherical bushing (156) and cylinder spring (157)〕into pump casing (271) with phasing splines on cylinder, spherical bush (156) and drive shaft (111).

※ Take care not to damage drive shaft (111).

※ Confirm that swash plate has not come off.



120098MP16

(7) Fit valve plate (L, 314) to valve cover (L, 312), locating pin (885) into pin hole.

※ Take care not to mistake suction / delivery directions of valve plate (314).

120098MP17

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

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

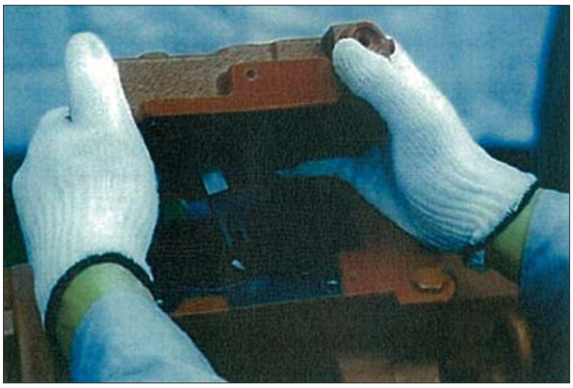
※ Take care not to damage needle bearing (124).

120098MP18

(9) Assemble booster (130) to drive shaft (111) and fit booster cover (263) with hexagon socket head bolts (403).

※ Take care not to mistake direction of booster.

(10) Putting feedback lever of regulator into feedback pin (548) of tilting pin (531), fit regulator with hexagon socket head bolts.

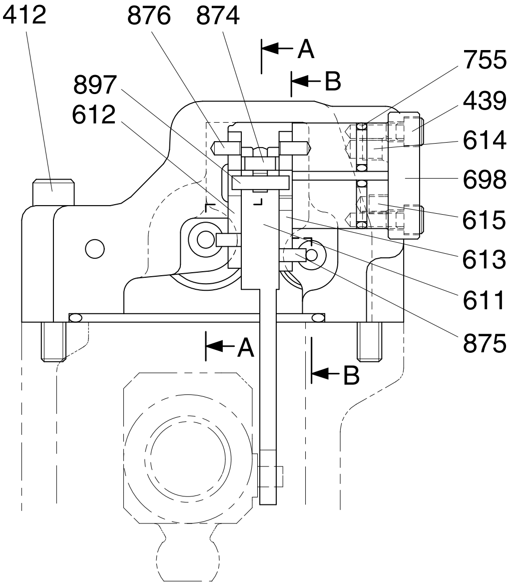


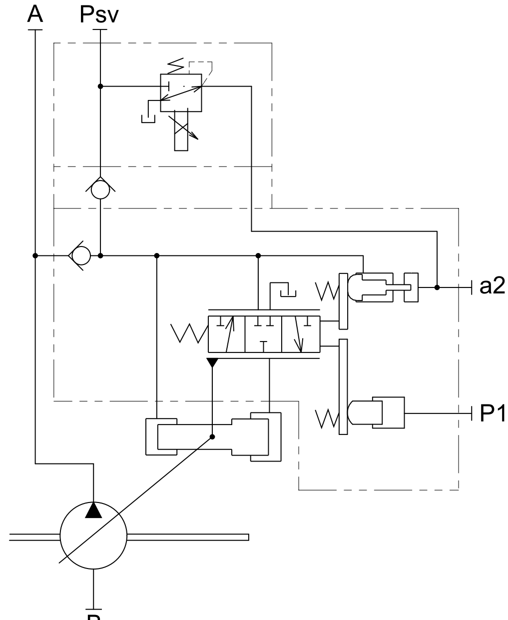
120098MP19

(11) Fit drain port plug (468) to pump casing (271).

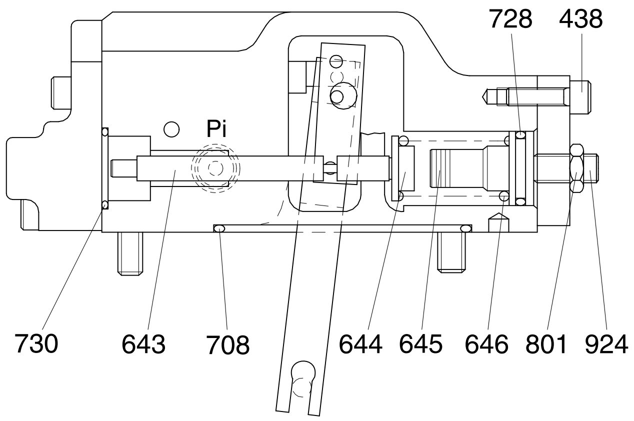
This is the end of reassembling procedure.

5) REGULATOR (1/2)

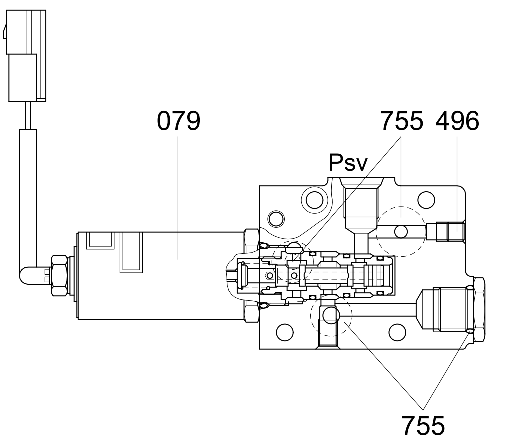




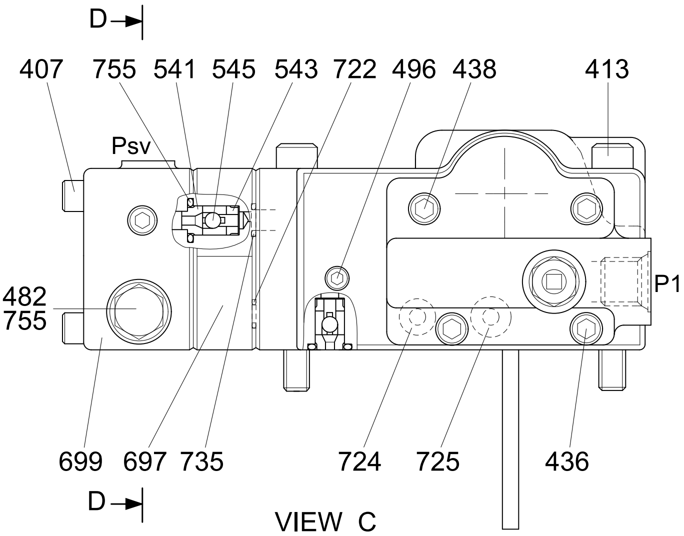
Hydraulic circuit



SECTION B-B



SECTION D-D

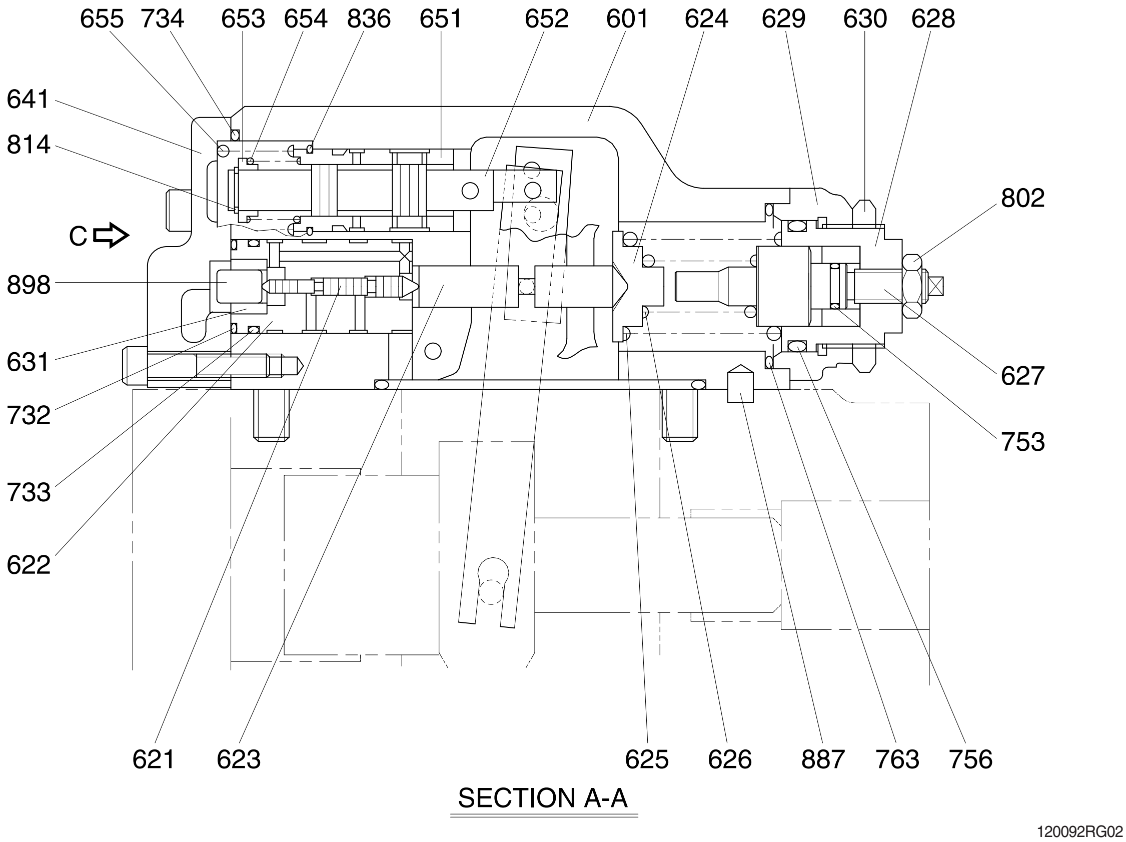


VIEW C

Port	Port name	Port size
P1	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 13
a2	Sensor port	PF 1/4 - 13

120092RG01

REGULATOR(2/2)

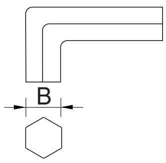
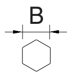


079	EPPR valve	626	Inner spring	725	O-ring
407	Hexagon socket screw	627	Adjust stem (C)	728	O-ring
412	Hexagon socket screw	628	Adjust screw (C)	730	O-ring
413	Hexagon socket screw	629	Cover (C)	732	O-ring
436	Hexagon socket screw	630	Lock nut	733	O-ring
438	Hexagon socket screw	631	Sleeve	734	O-ring
439	Hexagon socket screw	641	Pilot cover	735	O-ring
466	Plug	643	Pilot piston	753	O-ring
496	Plug	644	Spring seat (Q)	755	O-ring
541	Seat	645	Adjust stem (Q)	756	O-ring
543	Stopper	646	Pilot spring	763	O-ring
545	Steel ball	651	Sleeve	801	Nut
601	Casing	652	Spool	802	Nut
611	Feed back lever	653	Spring seat	814	Snap ring
612	Lever (1)	654	Return spring	836	Snap ring
613	Lever (2)	655	Set spring	874	Pin
614	Center plug	697	Plate	875	Pin
615	Adjust plug	698	Cover	876	Pin
621	Compensator piston	699	Casing	887	Pin
622	Piston case	708	O-ring	897	Pin
623	Compensator rod	722	O-ring	898	Pin
624	Spring seat (C)	724	O-ring	924	Set screw
625	Valve casing				

6) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

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

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plut (Materal : S45C) ※ Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plut (Materal : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

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

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

(1) Choose a place for disassembly.

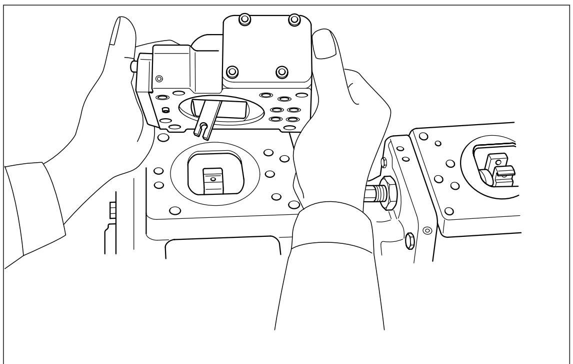
※ Choose a clean place.

※ Spread rubber sheet, cloth, or so on 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.



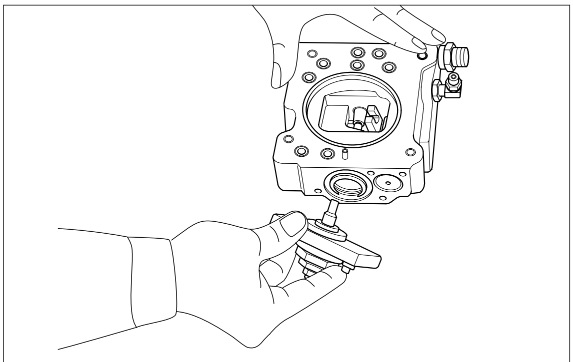
REG01 (210-7)

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

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

Do not loosen these screws and nuts.

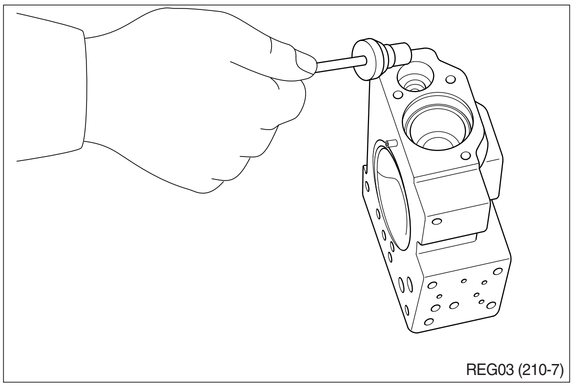
If they are loosened, adjusted pressure-flow setting will vary.



REG02 (210-7)

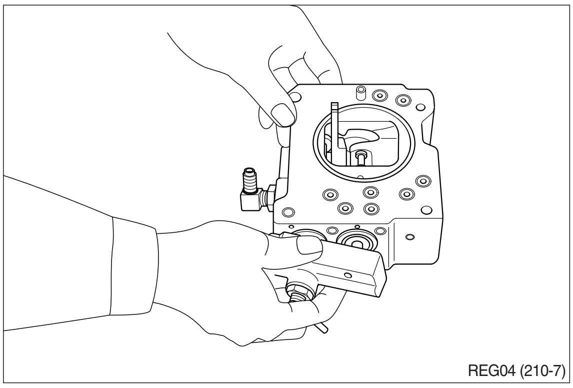
(5) After removing cover (C, 629) subassembly, take out outer spring (625), inner spring (626) and spring seat (C, 624) from compensating section.
Then draw out adjusting ring (Q, 645), pilot spring (646) and spring seat (644) from pilot section.

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



REG03 (210-7)

(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.

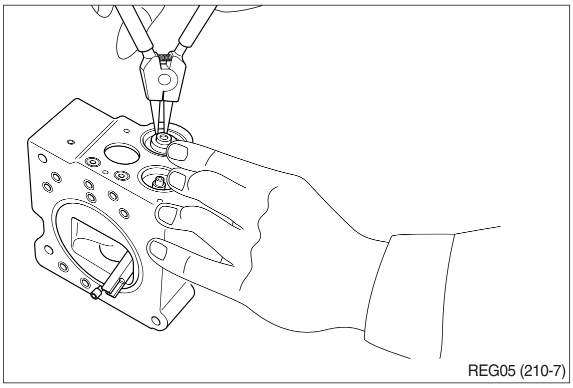


REG04 (210-7)

(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).

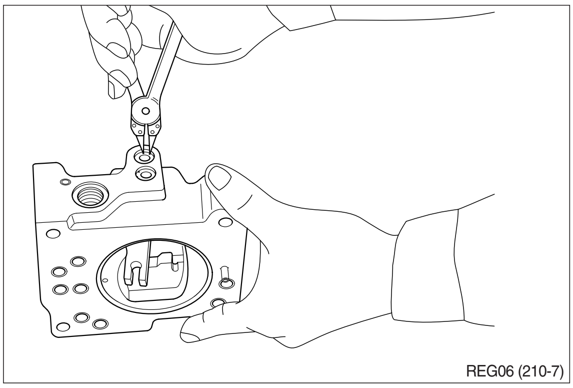
※ When removing snap ring (814), return spring (654) may pop out.
Take care not to lose it.



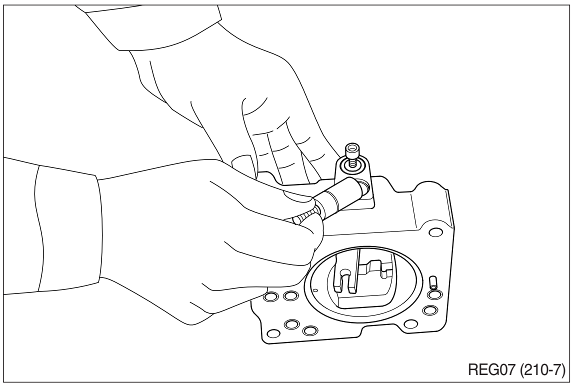
REG05 (210-7)

(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.



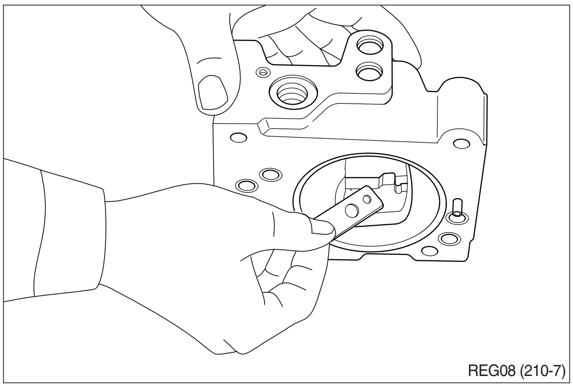
REG06 (210-7)



REG07 (210-7)

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

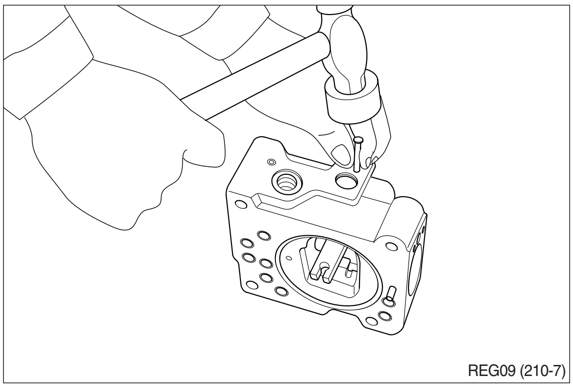
※ **Work will be promoted by using pincers or so on.**



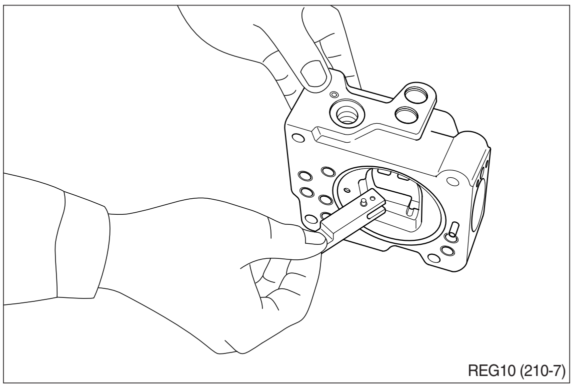
REG08 (210-7)

(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).



REG09 (210-7)



REG10 (210-7)

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

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

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

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

This completes disassembly.

4) ASSEMBLY

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

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand.

③ 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.

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.

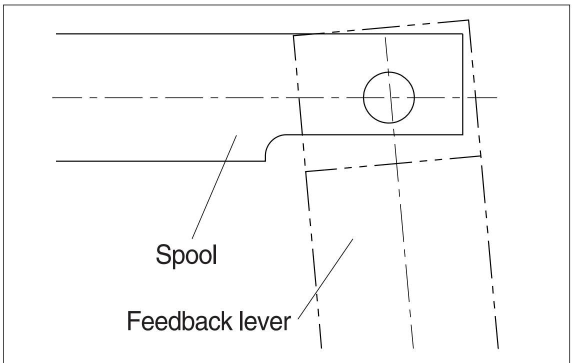
(2) Put compensating rod (623) into compensating hole of casing (601).

(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.

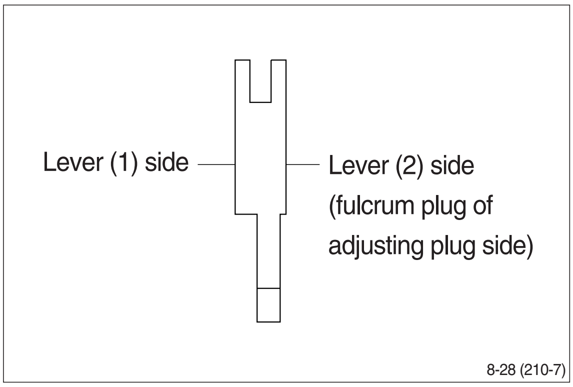
※ **Confirm that spool and sleeve slide smoothly in casing without binding.**

※ **Pay attention to orientation of spool.**



8-27 (210-7)

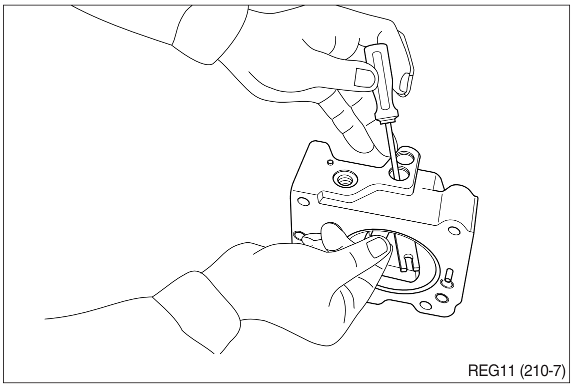
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



8-28 (210-7)

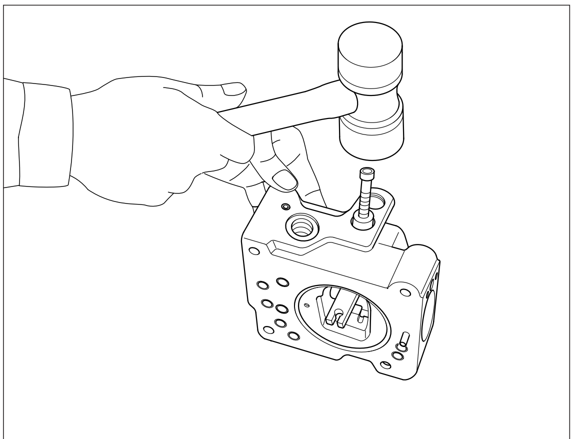
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

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

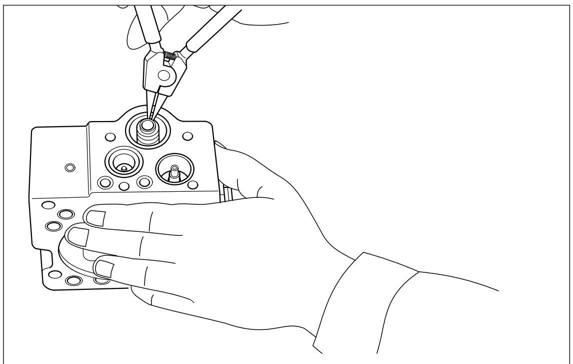

REG11 (210-7)

(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).

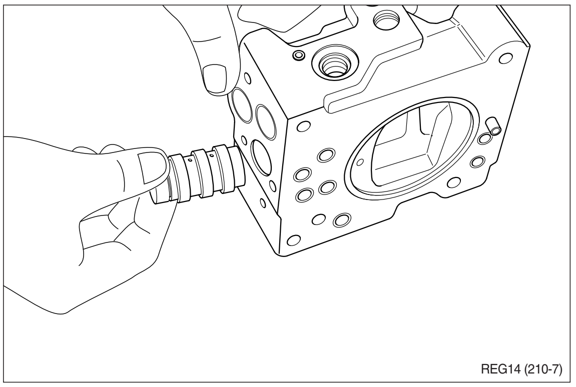
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


REG12 (210-7)

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


REG13 (210-7)

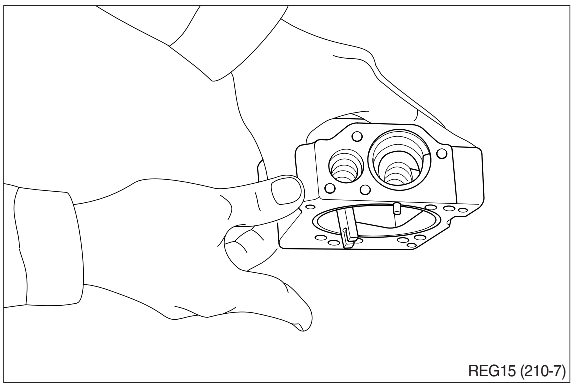
(11) Fit set spring (655) to spool hole and put compensating piston (621) and piston case (622) into compensating hole.
Fit pilot cover (641) and tighten it with hexagonal socket head screws (436, 438).



REG14 (210-7)

(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.

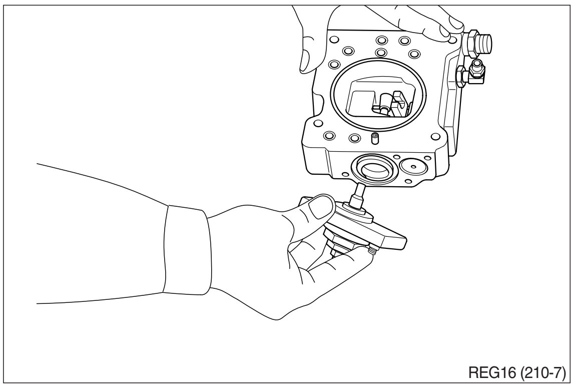
※ **When fitting spring seat, take care not to mistake direction of spring seat.**



REG15 (210-7)

(13) Install cover (C, 629) fitted with adjusting screws (628, 925), adjusting ring (C, 627), lock nut (630), hexagon nut (802) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.



REG16 (210-7)

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL

1) REMOVAL

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

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

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

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

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

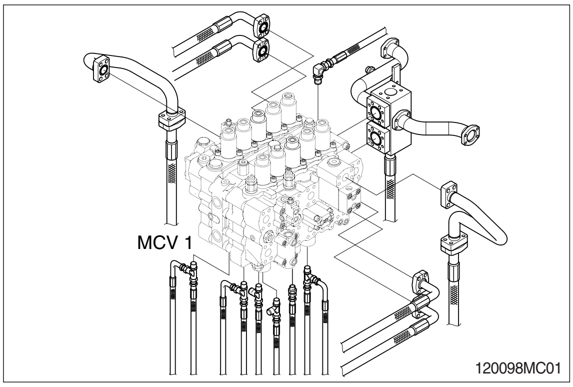

13031GE18

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

(5) Remove bolts and disconnect pipe.

(6) Disconnect pilot line hoses.

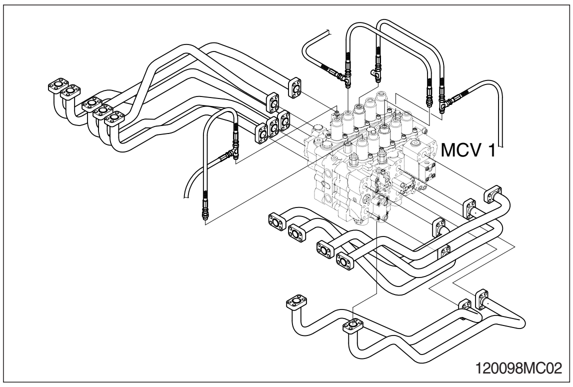
(7) Disconnect pilot piping.



120098MC01

(8) Sling the control valve assembly and remove the control valve mounting bolt.
- · MCV 1 weight : 450 kg (990 lb)
- · MCV 2 weight : 160 kg (350 lb)

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



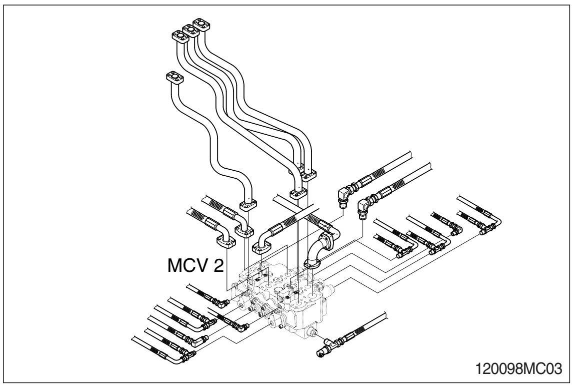
120098MC02

2) INSTALL

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

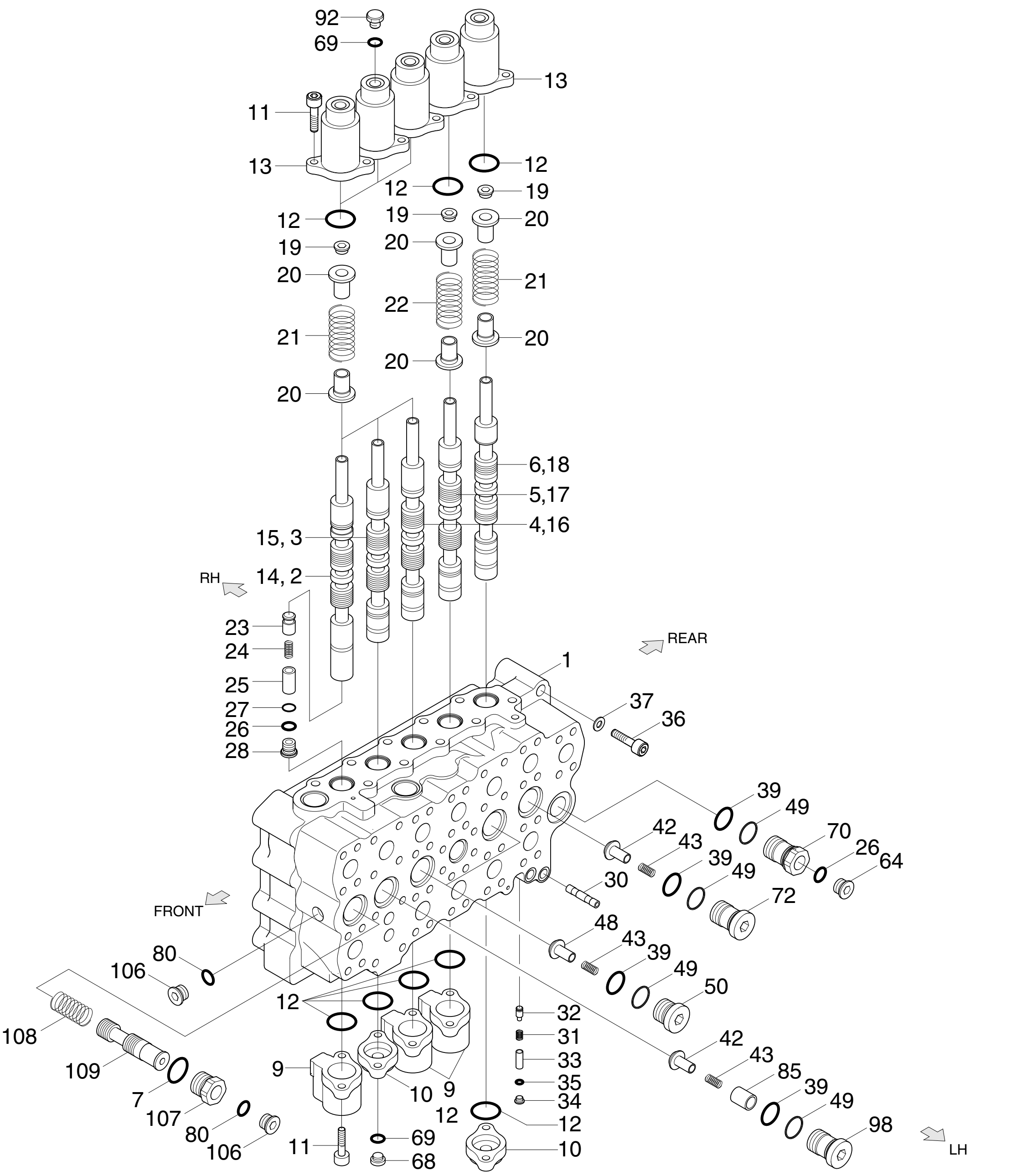
(2) Bleed the air from below items.
① Cylinder (boom, arm, bucket)
② Swing motor
③ Travel motor
※ **See each item removal and install.**

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



120098MC03

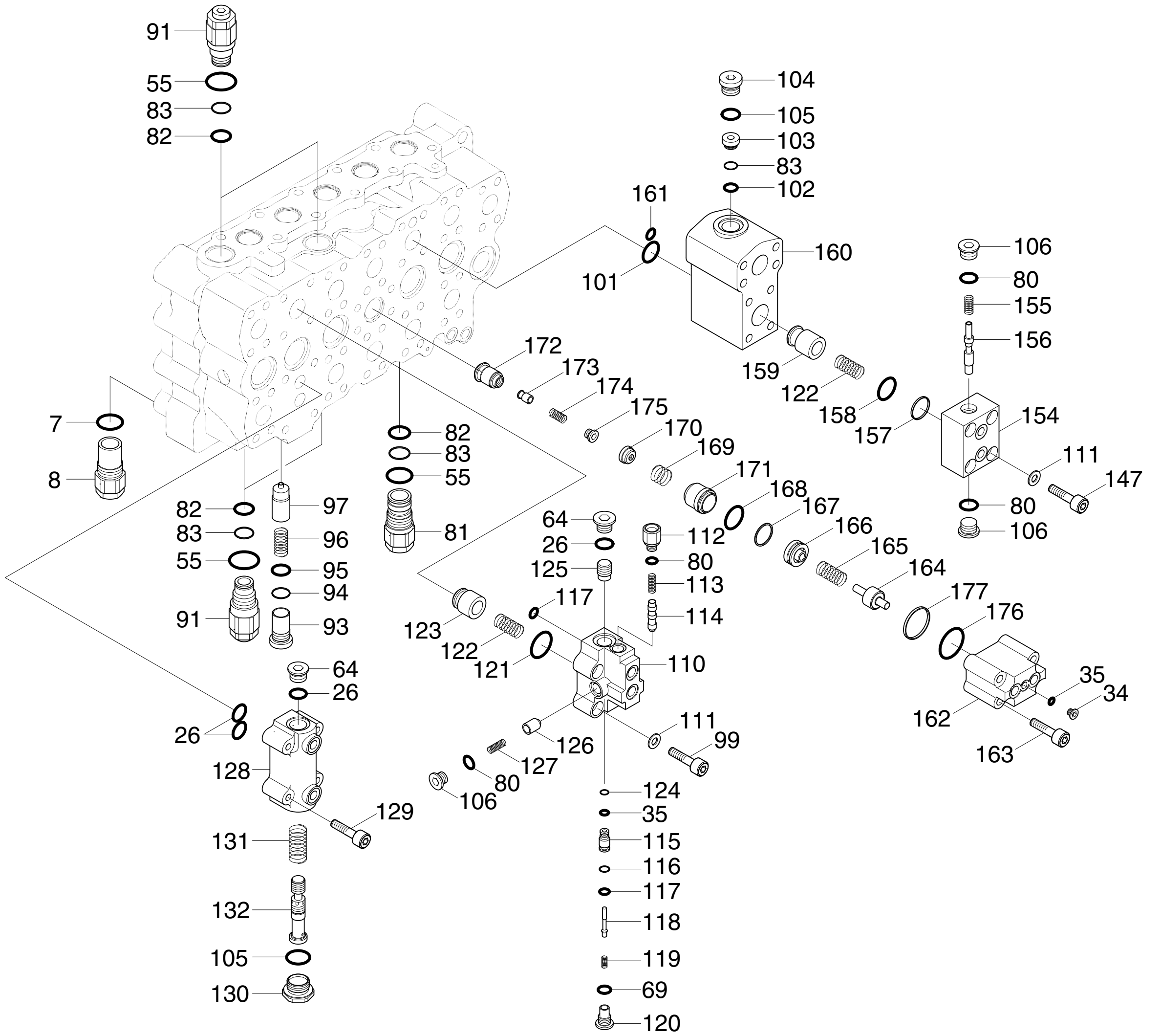
2. STRUCTURE (MCV 1, 1/5)



120098MC04

1	Housing	16	Plunger	31	Spring	68	Cap
2	Plunger assy	17	Plunger	32	Check	69	O-ring
3	Plunger assy	18	Plunger	33	Spacer	70	Cap
4	Plunger assy	19	Cap	34	Cap	72	Cap
5	Plunger assy	20	Spring guide	35	O-ring	80	O-ring
6	Plunger assy	21	Spring	36	Socket bolt	85	Cap
7	O-ring	22	Spring	37	Washer	92	Plug
9	Cover	23	Check	39	O-ring	98	Cap
10	Cover	24	Spring	42	Check	106	Cap
11	Socket bolt	25	Spacer	43	Spring	107	Cap
12	O-ring	26	O-ring	48	Check	108	Spring
13	Cover	27	Back up ring	49	Back up ring	109	Spool
14	Plunger	28	Cap	50	Cap		
15	Plunger	30	Orifice	64	Cap		

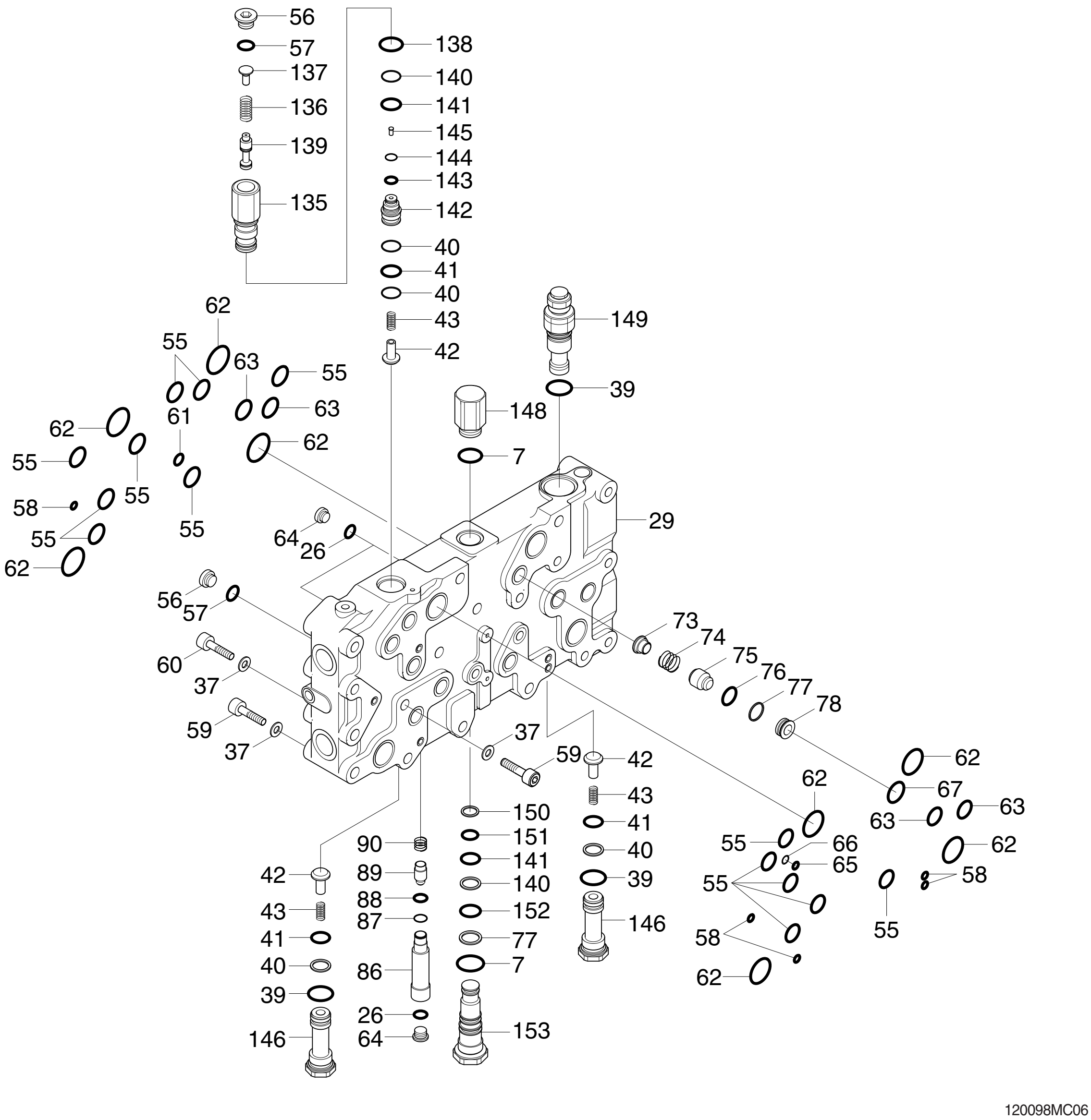
STRUCTURE (MCV1, 2/5)



120098MC05

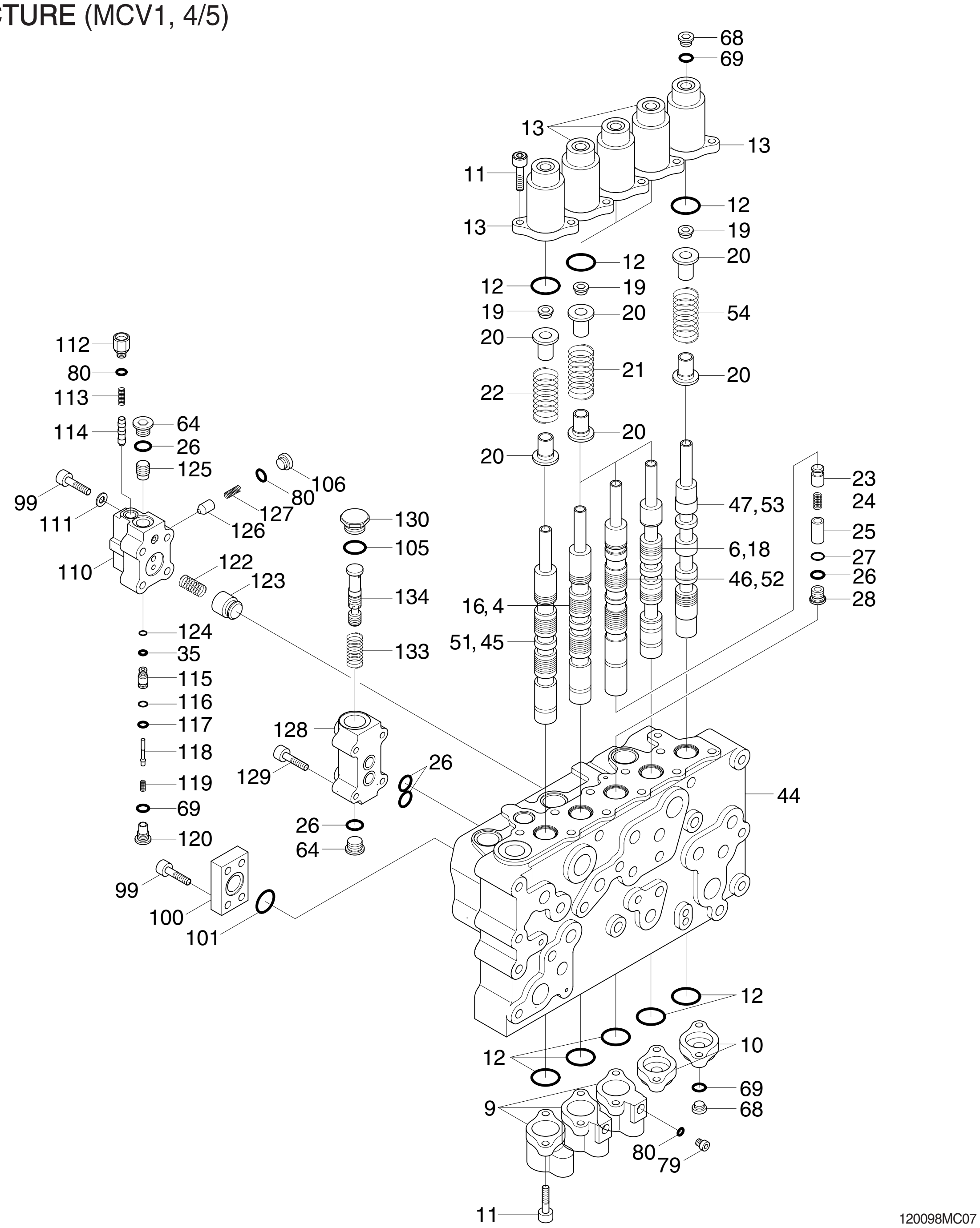
7	O-ring	101	O-ring	122	Spring	160	Mainfold
8	Foot relief valve assy	102	O-ring	123	Poppet	161	O-ring
26	O-ring	103	Plug	124	Back up ring	162	Cover
34	Cap	104	Cap	125	Piston	163	Socket bolt
35	O-ring	105	O-ring	126	Check	164	Pisotn
55	O-ring	106	Cap	127	Spring	165	Spring
64	Cap	110	Cover assy	128	Cover	166	Plate
69	O-ring	111	Lock washer	129	Socket bolt	167	Back up ring
80	O-ring	112	Cap	130	Cap	168	O-ring
81	Make up assy	113	Spring	131	Spring	169	Spring
82	O-ring	114	Piston	132	Spool	170	Spring guide
83	Back up ring	115	Sleeve	147	Socket bolt	171	Sleeve
91	Overload relief valve	116	Back up ring	154	Cover	172	Poppet
93	Cap	117	O-ring	155	Spring	173	Check
94	Back up ring	118	Poppet	156	Spool	174	Spring
95	O-ring	119	Spring	157	Back up ring	175	Cap
96	Spring	120	Cap	158	O-ring	176	O-ring
97	Check	121	O-ring	159	Poppet	177	Back up ring
99	Socket bolt						

STRUCTURE (MCV1, 3/5)



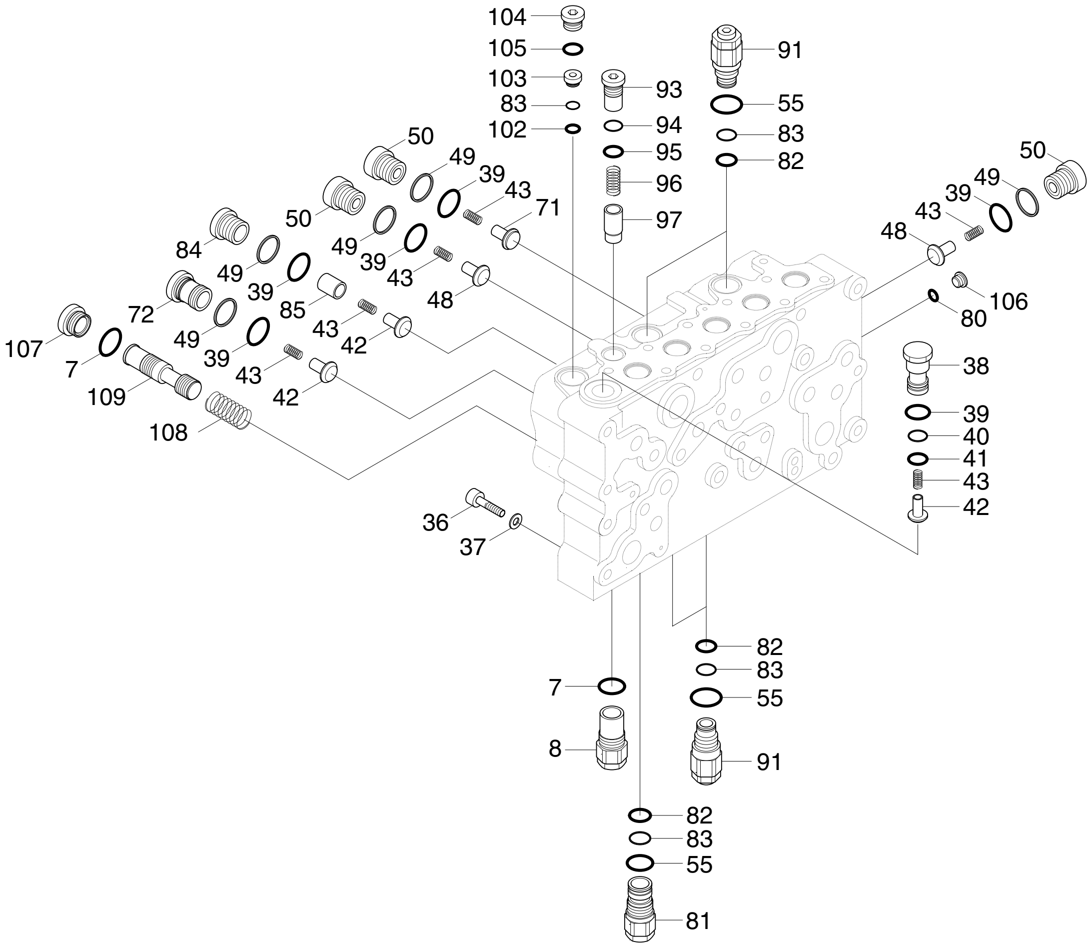
7 O-ring
26 O-ring
29 Manifold
37 Washer
39 O-ring
40 Back up ring
41 O-ring
42 Check
43 Spring
55 O-ring
56 Cap
57 O-ring
58 O-ring
59 Socket bolt
60 Socket bolt
61 O-ring
62 O-ring
63 O-ring
64 Cap
65 O-ring
66 Back up ring
67 O-ring
73 Spring guide
74 Spring
75 Check
76 O-ring
77 Back up ring
78 Seat
86 Cap
87 Back up ring
88 O-ring
89 Check
90 Spring
135 Sleeve
136 Spring
137 Spring
138 O-ring
139 Spool
140 Back up ring
141 O-ring
142 Sleeve
143 O-ring
144 Back up ring
145 Pisotn
146 Cap
148 Boost check valve
149 Main relief valve assy
150 Back up ring
151 O-ring
152 O-ring
153 Cap

STRUCTURE (MCV1, 4/5)



4	Plunger assy	25	Spacer	69	O-ring	117	O-ring
6	Plunger assy	26	O-ring	79	Plug	118	Poppet
9	Cover	27	Back up ring	80	O-ring	119	Spring
10	Cover	28	Cap	99	Socket bolt	120	Cap
11	Socket bolt	35	O-ring	100	Flange	122	Spring
12	O-ring	44	Housing	101	O-ring	123	Poppet
13	Cover	45	Plunger assy	105	O-ring	124	Back up ring
16	Plunger	46	Plunger assy	106	Cap	125	Piston
18	Plunger	47	Plunger assy	110	Cover assy	126	Check
19	Plunger cap	51	Plunger	111	Lock washer	127	Spring
20	Spring guide	52	Plunger	112	Cap	128	Cover
21	Spring	53	Plunger	113	Spring	129	Socket bolt
22	Spring	54	Spring	114	Piston	130	Cap
23	Check	64	Cap	115	Sleeve	133	Spring
24	Spring	68	Cap	116	Back up ring	134	Spool

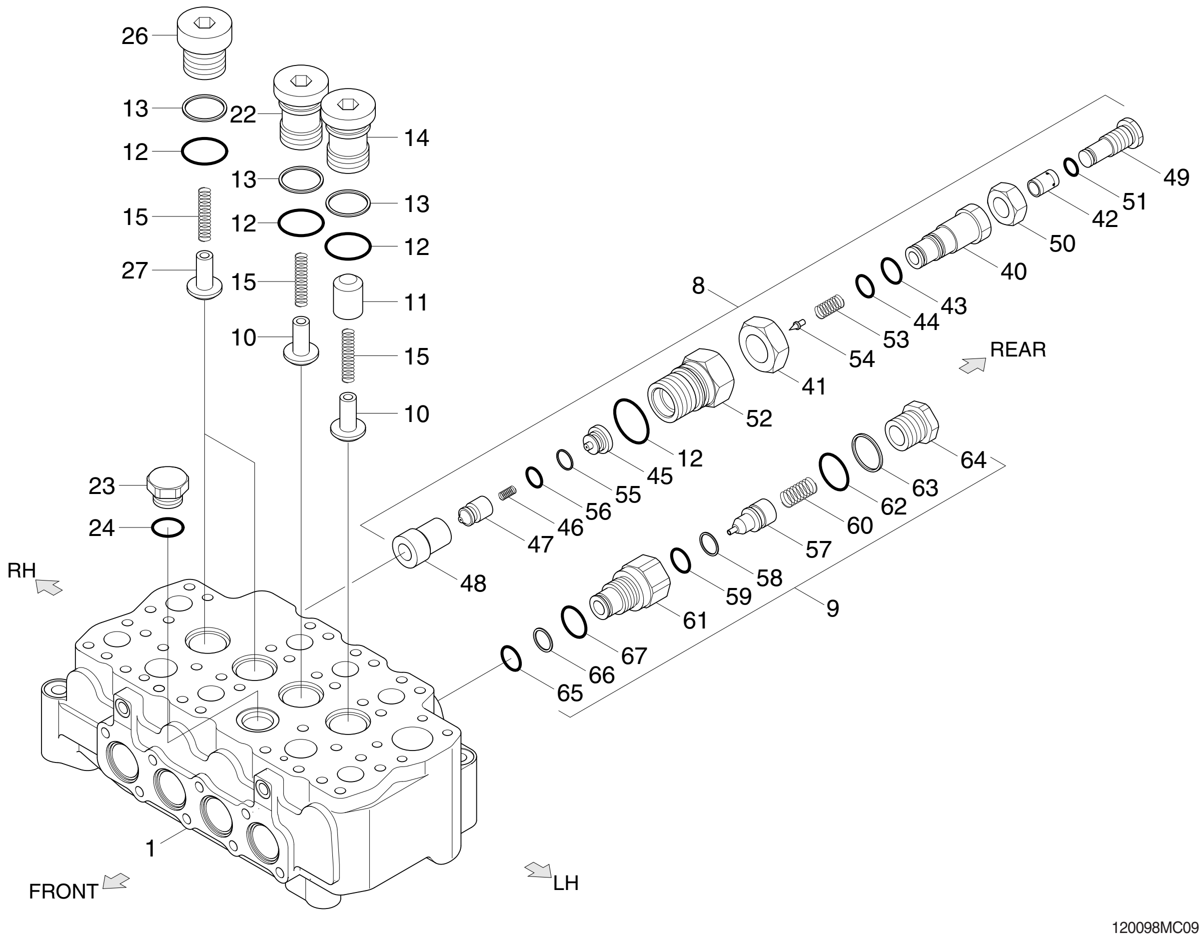
STRUCTURE (MCV1, 5/5)



120098MC08

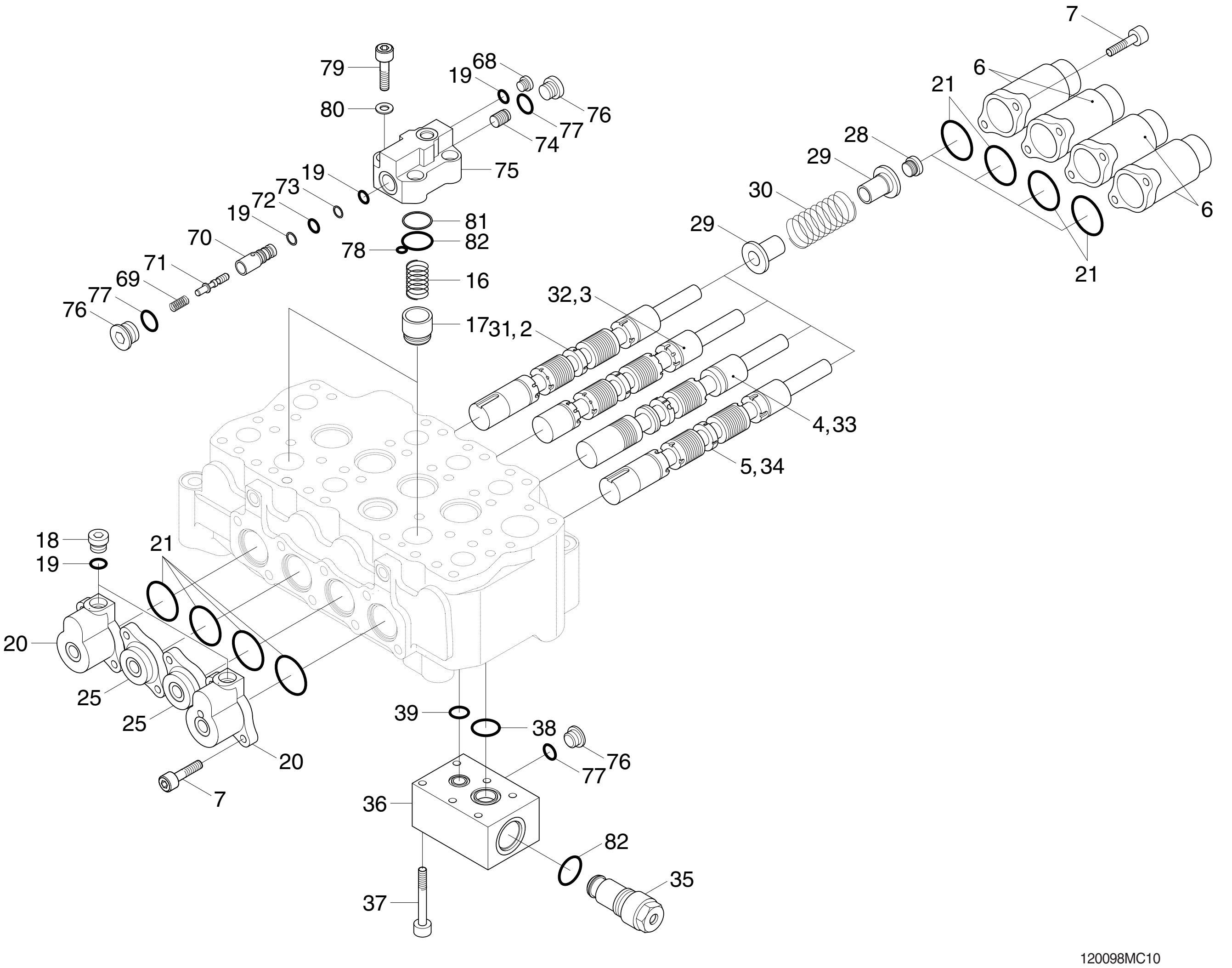
7	O-ring	50	Cap	94	Back up ring
8	Foot relief valve assy	55	O-ring	95	O-ring
36	Socket bolt	71	Check	96	Spring
37	Washer	72	Cap	97	Check
38	Cap	80	O-ring	102	O-ring
39	O-ring	81	Make up assy	103	Plug
40	Back up ring	82	O-ring	104	Cap
41	O-ring	83	Back up ring	105	O-ring
42	Check	84	Cap	106	Cap
43	Spring	85	Check	107	Cap
48	Check	91	Overload relief valve	108	Spring
49	Back up ring	93	Cap	109	Spool

STRUCTURE (MCV2, 1/2)



1	Housing	40	Sleeve	54	Pilot poppet
8	Main relief valve assy	41	Hex nut	55	Back up ring
9	Make up assy	42	Piston	56	O-ring
10	Check	43	O-ring	57	Poppet
11	Check	44	O-ring	58	Back up ring
12	O-ring	45	Pilot sheet	59	O-ring
13	Back up ring	46	Spring	60	Spring
14	Cap	47	Poppet	61	Relief sleeve
15	Spring	48	Sleeve	62	O-ring
22	Cap	49	Adjust screw	63	Back up ring
23	Cap	50	Hex nut	64	Cap
24	O-ring	51	O-ring	65	O-ring
26	Cap	52	Cap	66	Back up ring
27	Check	53	Spring	67	O-ring

STRUCTURE (MCV2, 2/2)



2	Plunger assy	29	Spring guide	70	Sleeve
3	Plunger assy	30	Spring	71	Poppet
4	Plunger assy	31	Plunger	72	O-ring
5	Plunger assy	32	Plunger	73	Back up ring
6	Cover	33	Plunger	74	Piston
7	Socket bolt	34	Plunger	75	Cover
16	Spring	35	Foot relief valve assy	76	Cap
17	Poppet	36	Manifold	77	O-ring
18	Plug	37	Socket bolt	78	O-ring
19	O-ring	38	O-ring	79	Socket bolt
20	Cover	39	O-ring	80	Lock washer
21	O-ring	68	Cap	81	Back up ring
25	Cover	69	Spring	82	O-ring
28	Cap				

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) Hydraulic machinery precisely. Please make disassembly and assembly have a small gap at a place without the dust.

(2) When remove it from an actual machine, wash a plumbing part and a plug, and dust and water do not enter.

(3) Examine a structure figure before work, and prepare a part depending on a purpose. In addition, prepare by a parts list beforehand because there is a part of the need to change in sub-assembly.

(4) Disassembly

① Handle the components carefully not to drop them or bump them with each other as they are mode with precision.
② Do not force the work by hitting or twisting as burred or damaged component may not be assembled or result in oil leakage or low performance.
③ When disassembled, tag the components for identification so that they can be reassembled correctly.
④ Once disassembled, O-ring and back-up rings are usually not to be used again. (Remove them using a wire with its end made like a shoehorn. Be careful not to damage the slot)
⑤ If the components are left disassembled or half-disassembled, they may get rust from moisture or dust. If the work has to be interrupted, take care to prevent rust and dust.

(5) Assembly

① Take the same precautions as for disassembly.
② When assembling the components, remove any metal chips or foreign objects and check them for any burrs or dents. Remove nurrs and dents with oil-stone, if any.
③ O-rings and back-up rings are to be replaced with new ones, as a rule.
④ When installing O-ring and back-up rings, be careful not to damage them. (Apply a little amount of grease for smoothness)
⑤ Tighten the bolts and caps with specified torque.

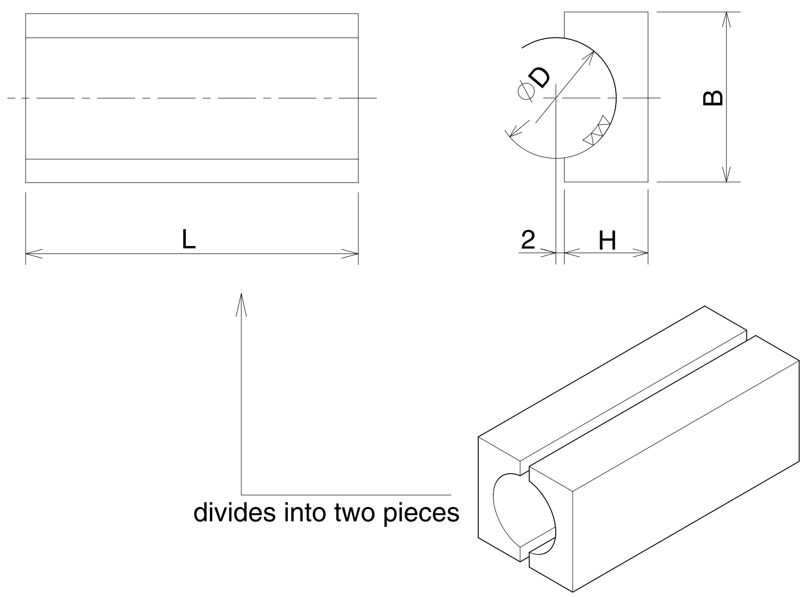
2) TOOLS

(1) Before disassembling the control valve, prepare the following tools beforehand.

① Holder

Item	ø D	L	B	H
Main plunger	36	90	50	25
Priority valve poppet assy	25	30	35	20

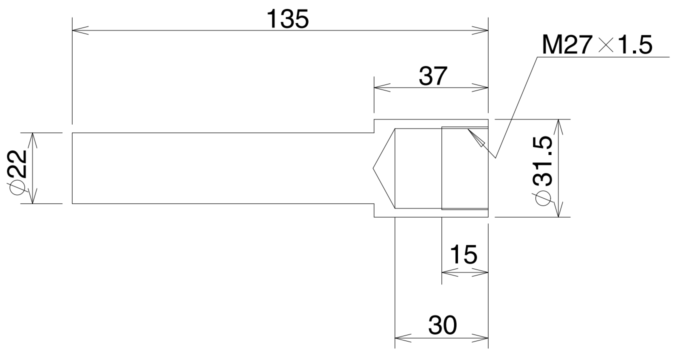
※ Material : Brass



120098MC11

② Arm regeneration valves sleeve pull out device

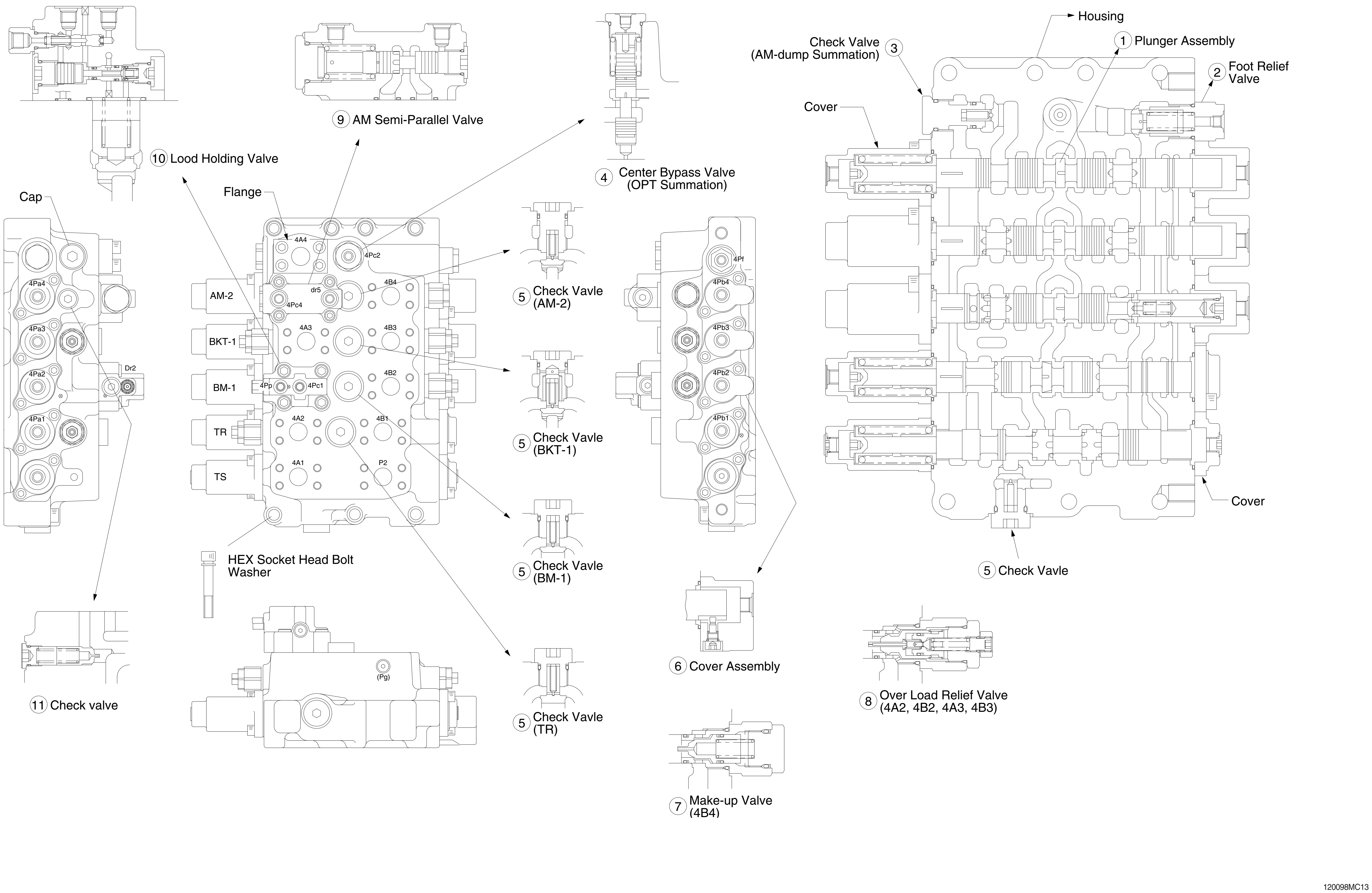
※ Material : Steel



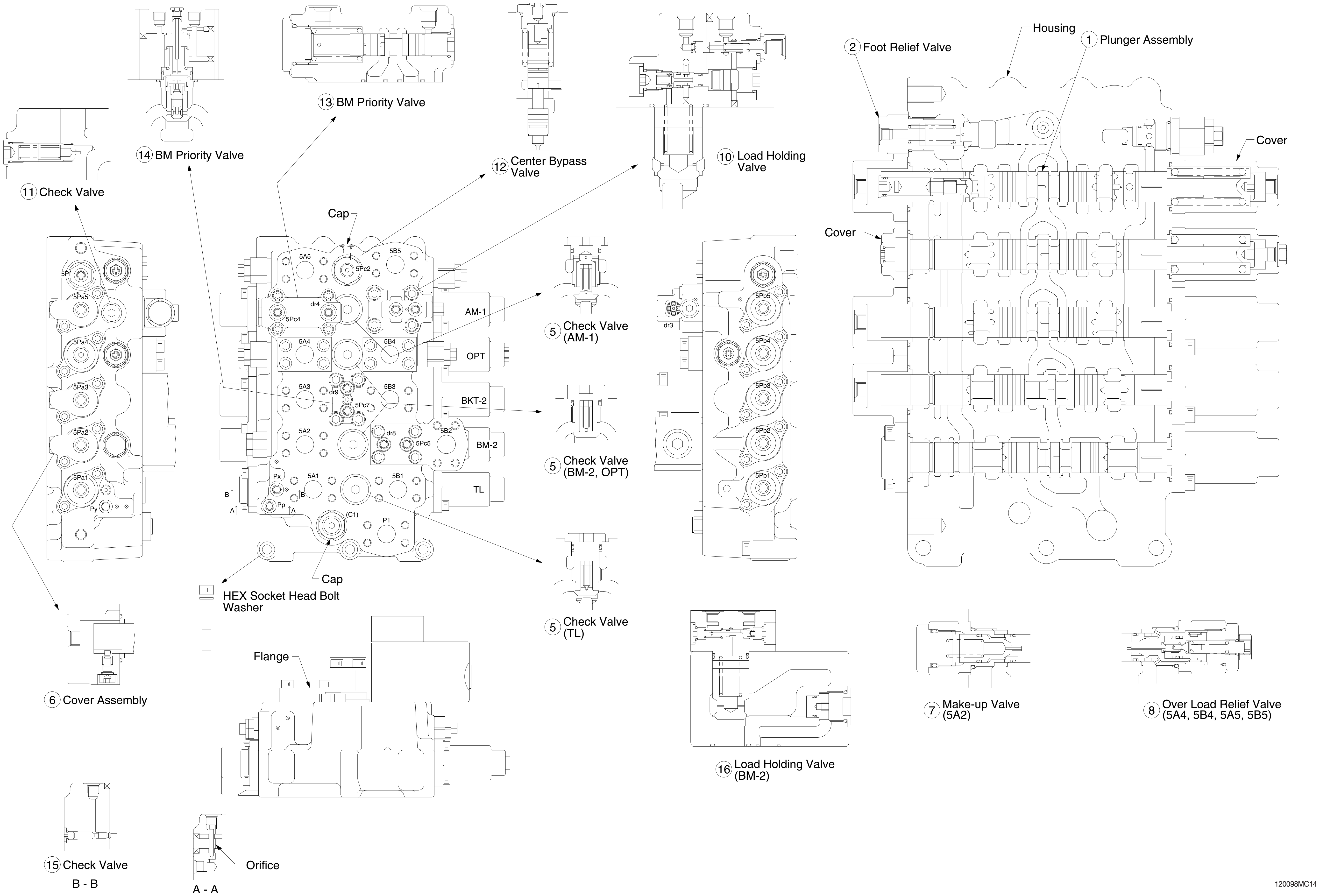
120098MC12

3) MOUNTING AND DISMOUNTING VALVES

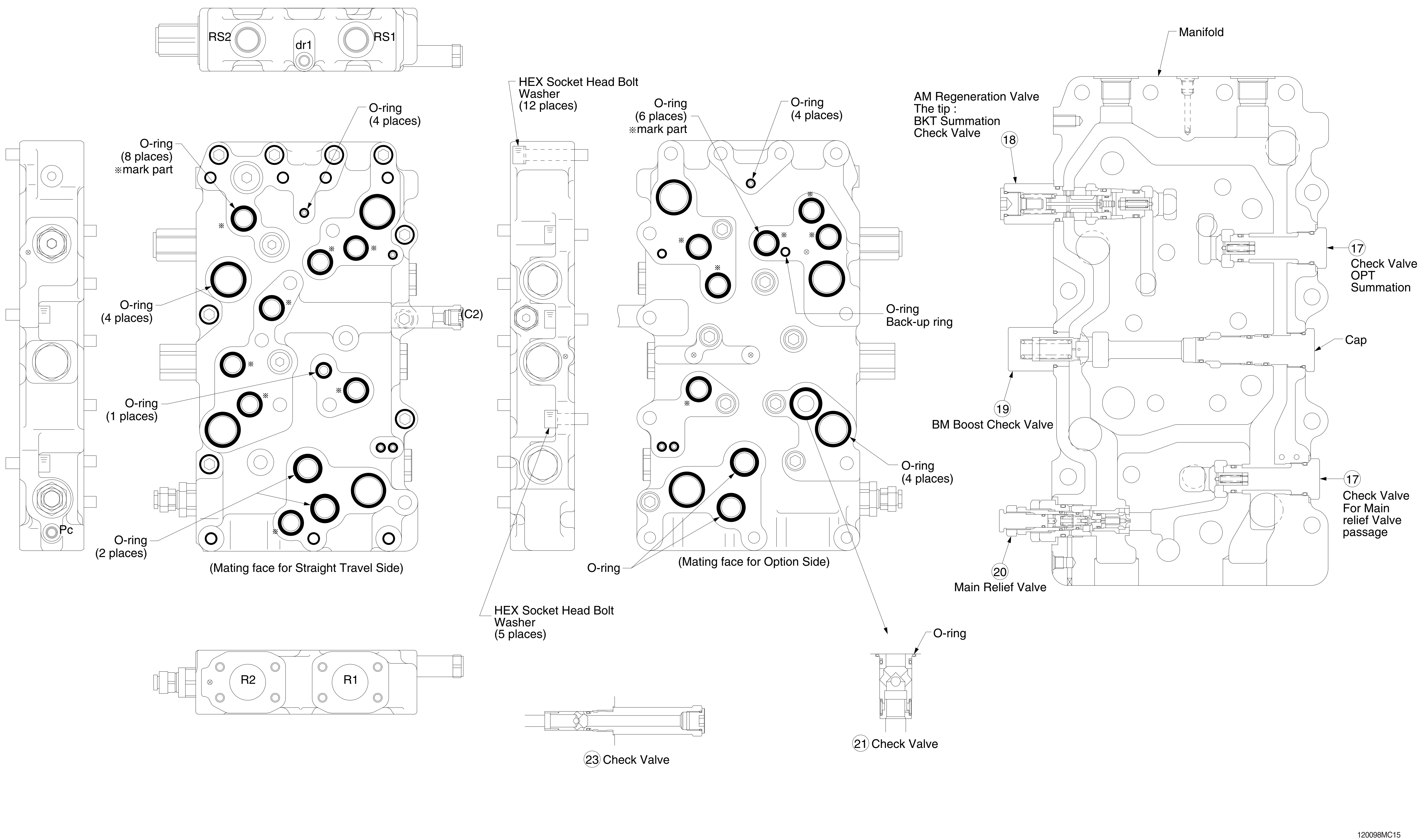
· Straight travel side valve (MCV 1)



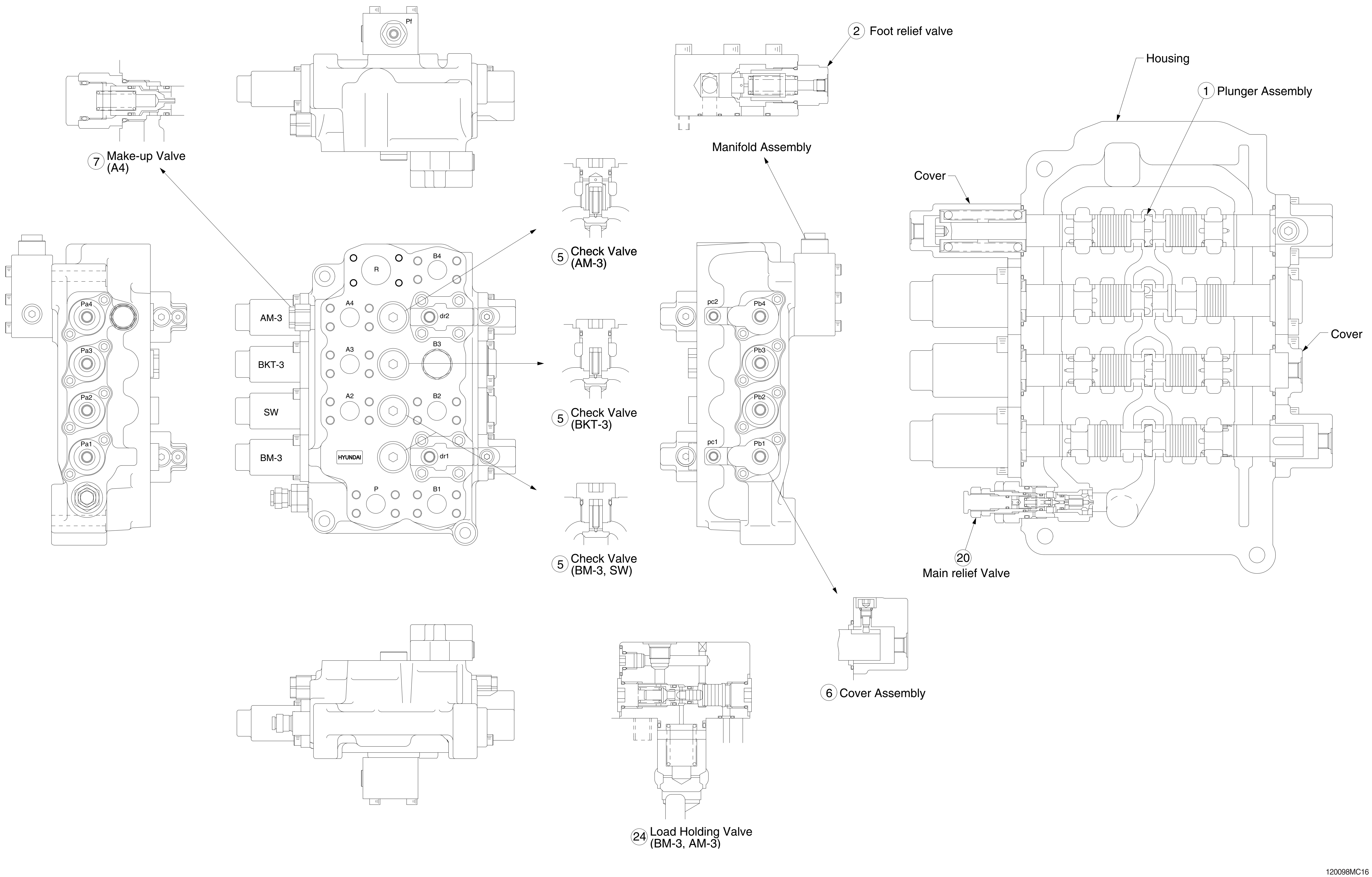
· **Option side valve** (MCV 1)



· Manifold assembly (MCV 1)



· Swing side valve (MCV 2)



(1) Main plunger

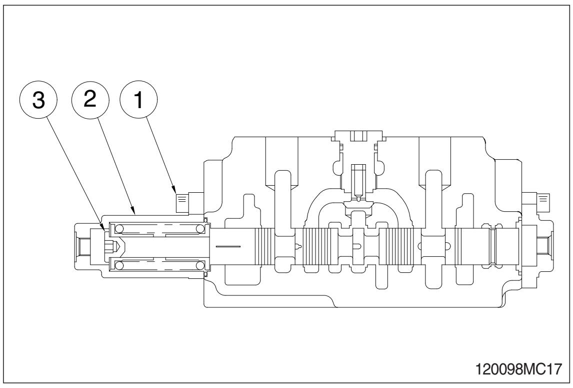
※ Reassembly in the reverse order to disassembly.

※ Attach an identification tag immediately after disassembly.

① Remove hexagon socket bolts (1) then remove cover (2).

※ Hexagon socket bolt
Width across flat : 10 mm
Tightening torque : 10 kgf · m (72.3 lbf · ft)

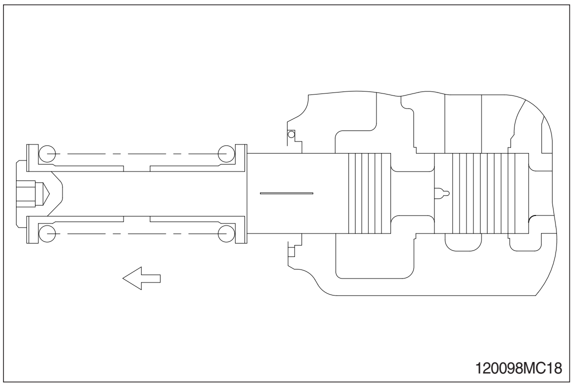
※ When reassembly
Install cover (2) after making sure that O-ring is placed on the edge of the valve hole.



② Pull out plunger sub-assembly.

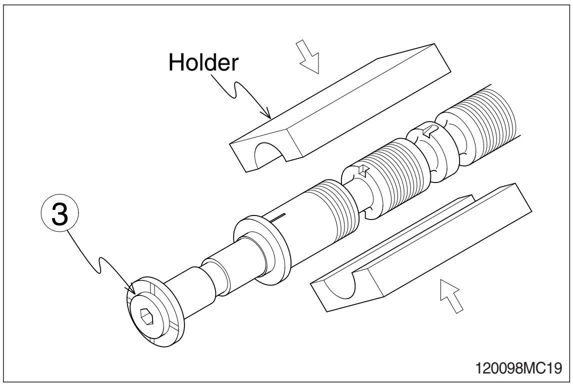
※ Do not pull out the plunger all at once.
Pull slowly while confirming the fitness with the housing hole.

※ When reassembly
AM, BM, and BKT match the key groove of the cover.



③ Place the plunger between holders and loosen the plunger cap (3) by using vise.
· Plunger cap
Width across flat : 10 mm
Tightening torque : 10 kgf · m
(72.3 lbf · ft)

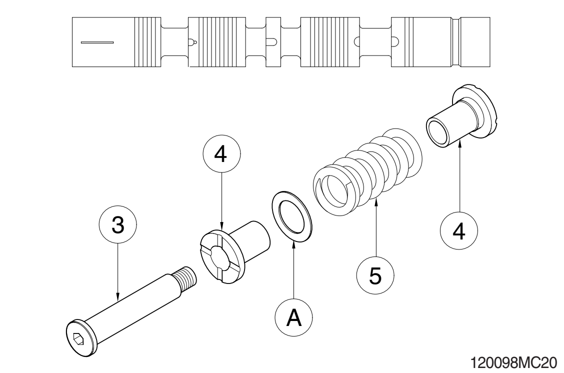
※ Put the plunger between the holders and clamp them by a vise after degreasing the plunger and holders as a special tool.



④ Remove the plunger cap (3), spring guide (4), spring (5).

※ Spring is different according to the plunger.

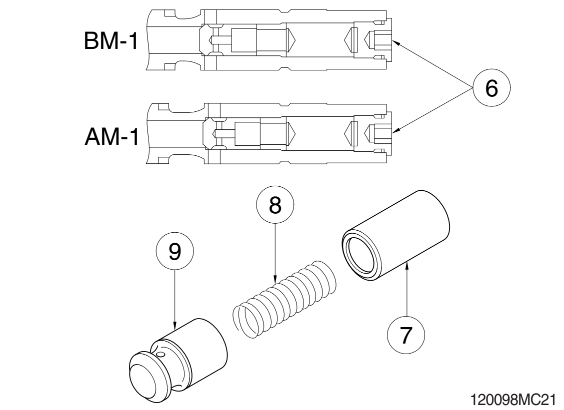
※ AM-2 plunger only.
The spacer (A) is built in.



120098MC20

⑤ BM-1, AM-1 plunger only.
Remove cap (6), spacer (7), spring (8), and check (9).

· Cap
Width across flat : 10 mm
Tightening torque : 8.2 kgf · m
(59.3 lbf · ft)



120098MC21

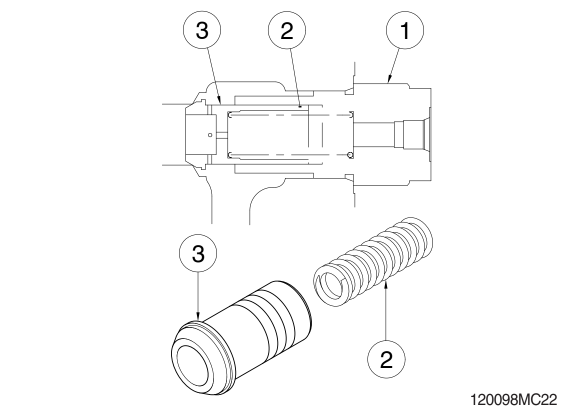
(2) Foot relief valve

※ Reassembly in the reverse order to disassembly.

※ Attach an identification tag immediately after disassembly.

① Remove cap (1) and pull out spring (2) and poppet (3).

· Cap
Width across flat : 36 mm
Tightening torque : 25.5 kgf · m
(184 lbf · ft)



120098MC22

(3) Check valve (Arm dump summation)

※ **Reassembly in the reverse order to disassembly.**

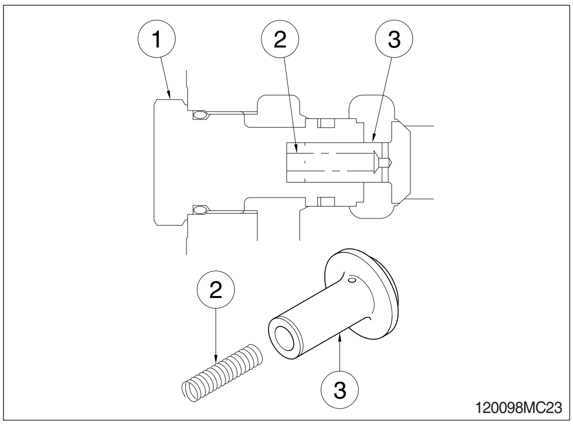
※ **Attach an identification tag immediately after disassembly.**

① Remove cap (1) and pull out spring (2) and check (3).

· Cap

Width across flat : 41 mm

Tightening torque : 18.4 kgf · m (133 lbf · ft)



(4) Center bypass valve (Opt summation)

※ Reassembly in the reverse order to disassembly.

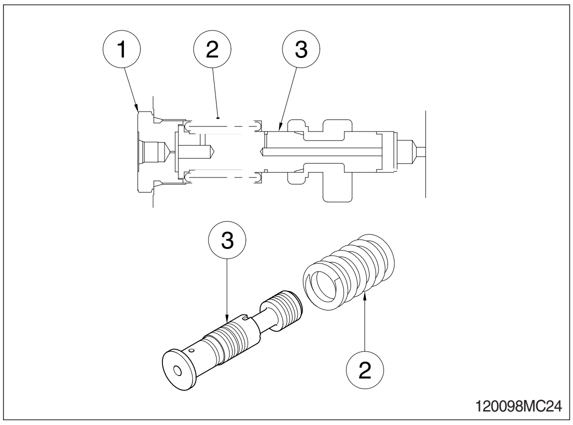
※ Attach an identification tag immediately after disassembly.

① Remove cap (1) and pull out spool (3) and spring (2).

· Cap

Width across flat : 46 mm

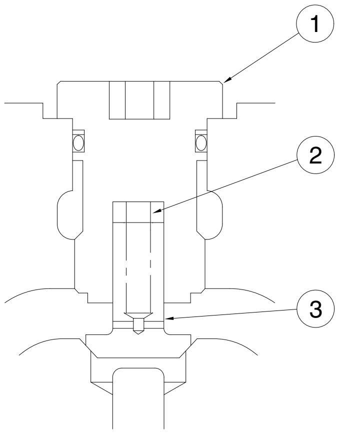
Tightening torque : 25.5 kgf · m (184 lbf · ft)



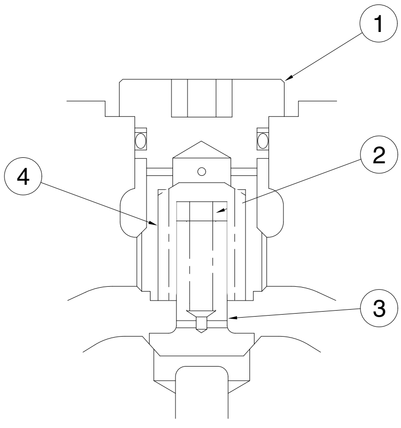
(5) Check valve

※ Reassembly in the reverse order to disassembly.

※ Attach an identification tag immediately after disassembly.

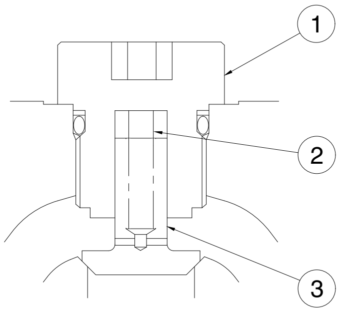


AM-2L, TL, BKT-3



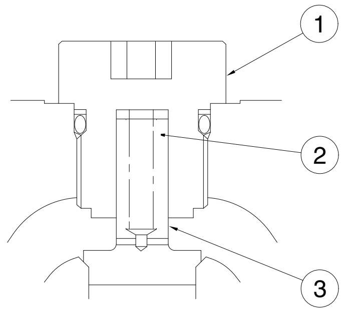
BKT-1, AM-1, AM-3

CAP : The squeezing diameter is different



BM-1, BM-2, BM-3

SW, OPT, OTHER



(TR) CHECK : Outer orifice

120098MC25

· It explains with BKT-1.

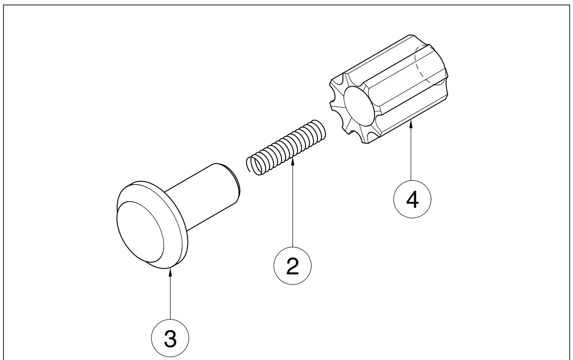
① Remove cap (1) and pull out check (4), spring (2) and check (3).

· Cap

Width across flat : 14 mm

Tightening torque : 35.7 kgf · m

(258 lbf · ft)



120098MC26

(6) Cover assy

※ Reassembly in the reverse order to disassembly.

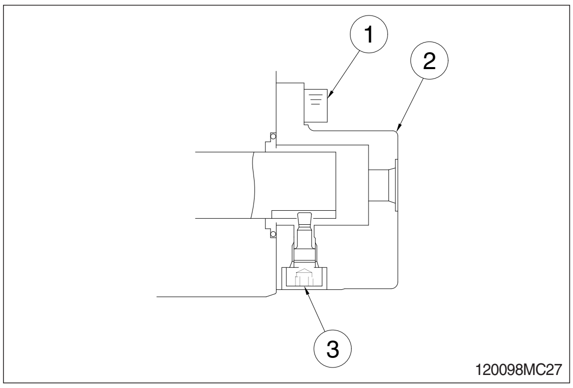
※ Attach an identification tag immediately after disassembly.

① Remove hexagon socket bolts (1) then remove cover assy (2).

※ Hexagon socket bolt
Width across flat : 10 mm
Tightening torque : 10 kgf · m (72.3 lbf · ft)

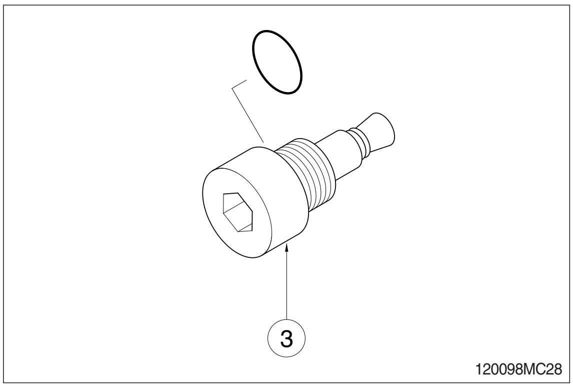
※ When reassembly
Install cover (2) after making sure that O-ring is placed on the edge of the valve hole.

The direction of the installation of the cover is noted.



② Remove plug (3).

· Plug
Width across flat : 8 mm
Tightening torque : 8.2 kgf · m (59.3 lbf · ft)



(7) Make up valve

※ Reassembly in the reverse order to disassembly.

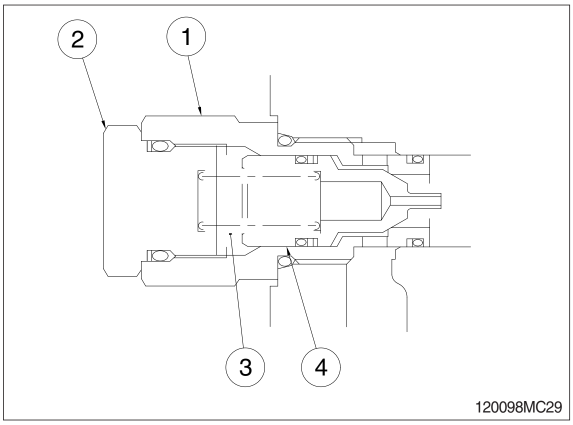
※ Attach an identification tag immediately after disassembly.

① Loosen sleeve (1) and remove make-up valve.

· Sleeve

Width across flat : 41 mm

Tightening torque : 10 kgf · m (72.3 lbf · ft)



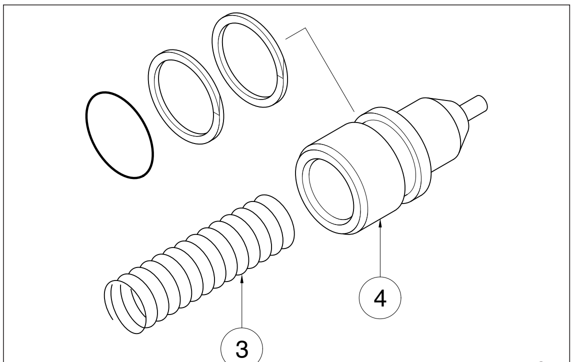
120098MC29

② Remove cap (2) and pull out spring (3) and poppet (4).

· Cap

Width across flat : 36 mm

Tightening torque : 10 kgf · m (72.3 lbf · ft)



120098MC30

(8) Overload relief valve

※ Reassembly in the reverse order to disassembly.

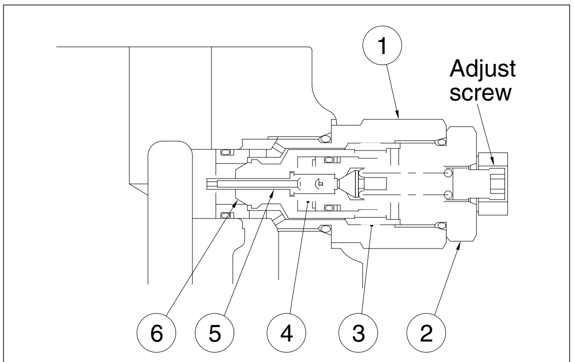
※ Attach an identification tag immediately after disassembly.

① Loosen sleeve (1) and remove relief valve.

· Sleeve

Width across flat : 41 mm

Tightening torque : 10 kgf · m (72.3 lbf · ft)



120098MC31

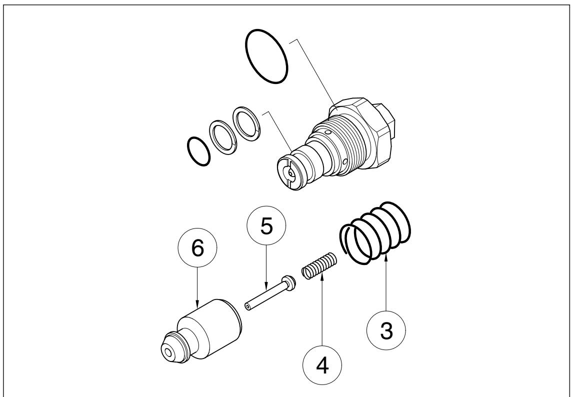
② Loosen and remove relief seat (2) sub-assembly and remove spring (3), (4), piston (5) and main poppet (6).

· Relief sleeve

Width across flat : 36 mm

Tightening torque : 10 kgf · m (72.3 lbf · ft)

※ Do not disassemble adjusting screw. It's impossible to readjust setting pressure exactly on the machine.



120098MC32

(9) Arm semi para valve

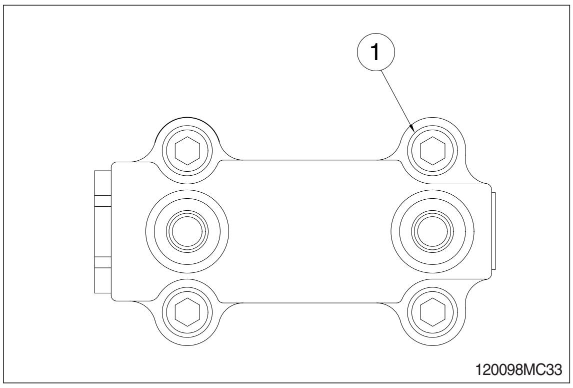
※ Reassembly in the reverse order to disassembly.

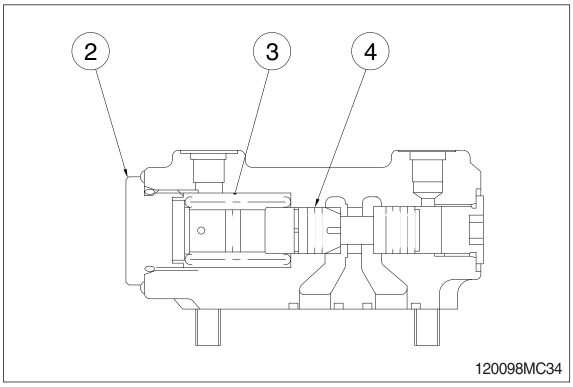
※ Attach an identification tag immediately after disassembly.

① Loosen hexagon socket bolts (1) and remove cover assembly.

· Hexagon socket bolt
  Width across flat : 8 mm
  Tightening torque : 6.12 kgf · m
  (44.3 lbf · ft)

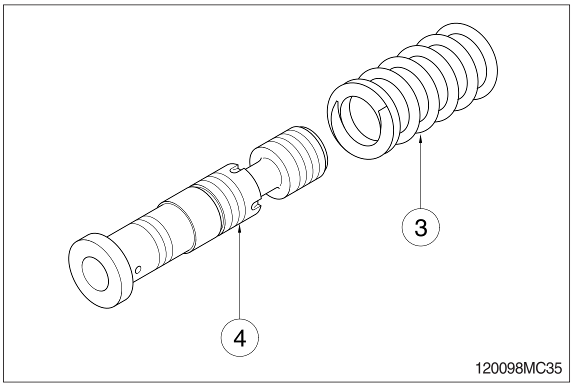
※ When reassembly
Install cover assy after making sure that O-ring is placed on the edge of the cover hole.





② Remove cap (2) and pull out spool (4) and spring (3).

· Cap
  Width across flat : 41 mm
  Tightening torque : 10 kgf · m
  (72.3 lbf · ft)



(10) **Holding valve** (Arm 1, Boom 1)

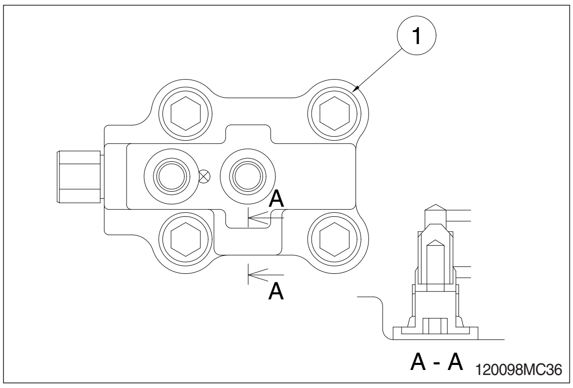
※ **Reassembly in the reverse order to disassembly.**

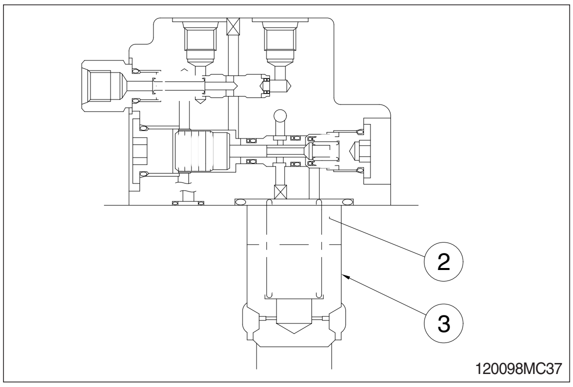
※ **Attach an identification tag immediately after disassembly.**

① Loosen hexagon socket bolts (1) and remove cover assembly.

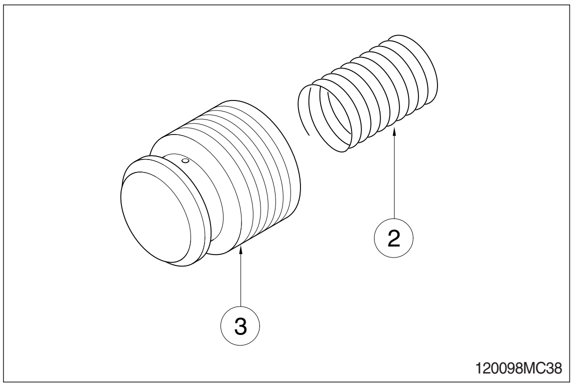
· Hexagon socket bolt
Width across flat : 12 mm
Tightening torque : 18.4 kgf · m
(133 lbf · ft)

※ **When reassembly**
Install cover assy after making sure that O-ring is placed on the edge of the cover hole.





② Remove spring (2) and poppet (3).



③ Cover assembly

a. Remove cap (4) and pull out spring (5), and piston (6).

· Cap

Width across flat : 19 mm

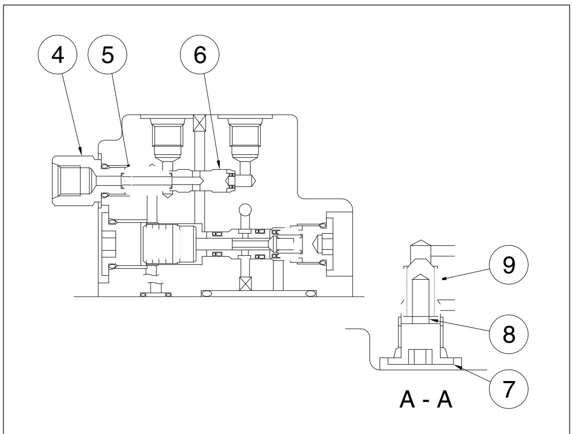
Tightening torque : 3.1 kgf · m (22.4 lbf · ft)

b. Remove cap (7) and pull out spring (8), and check (9).

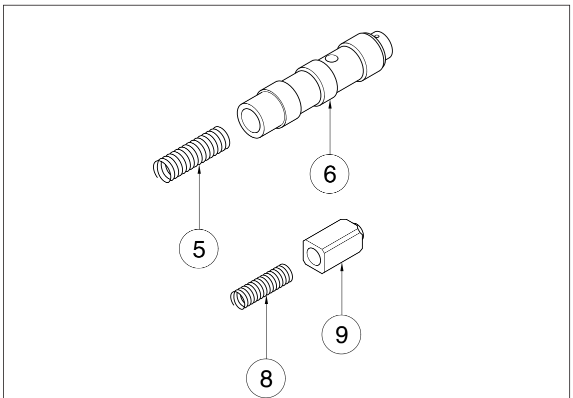
· Cap

Width across flat : 6 mm

Tightening torque : 3.1 kgf · m (22.4 lbf · ft)



120098MC39



120098MC40

c. Remove cap (10) and piston (11).

· Cap

Width across flat : 10 mm

Tightening torque : 6.1 kgf · m (44.1 lbf · ft)

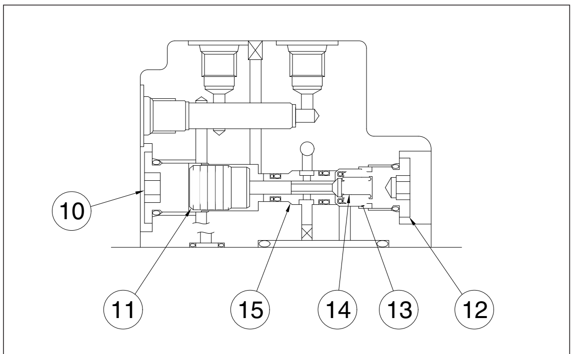
d. Remove cap (12) and pull out spring (13), and poppet (14).

· Cap

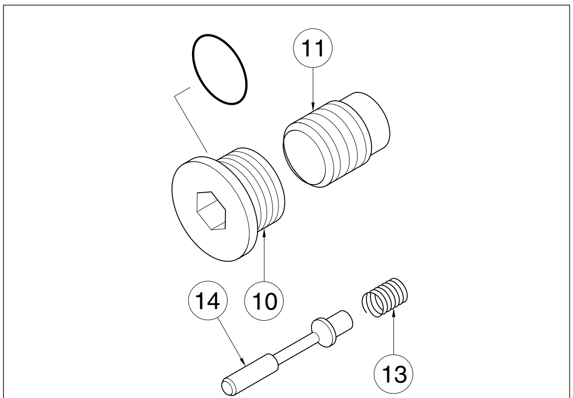
Width across flat : 8 mm

Tightening torque : 5.1 kgf · m (36.9 lbf · ft)

※ There is a case where the poppet cannot be taken by the seat edge.

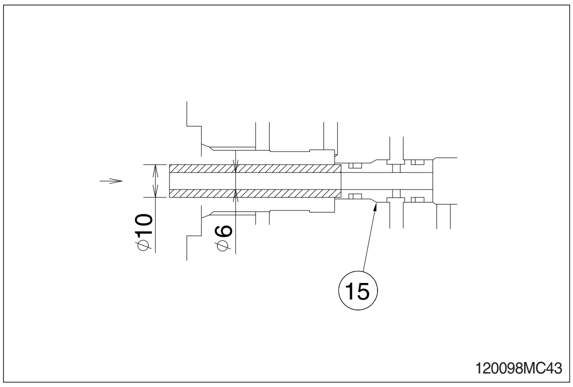


120098MC41



120098MC42

e. It begins to beat the sleeve with the pipe lightly.



(11) Check valve (Arm semi para, Boom priority)

※ Reassembly in the reverse order to disassembly.

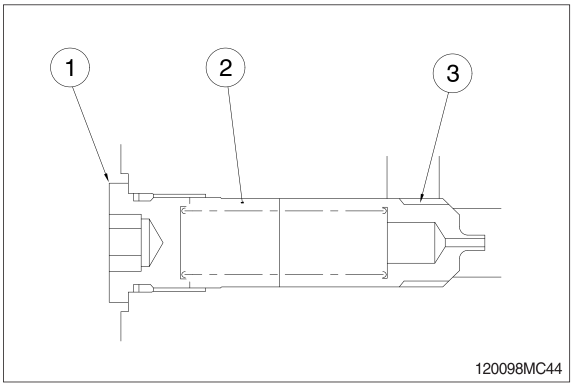
※ Attach an identification tag immediately after disassembly.

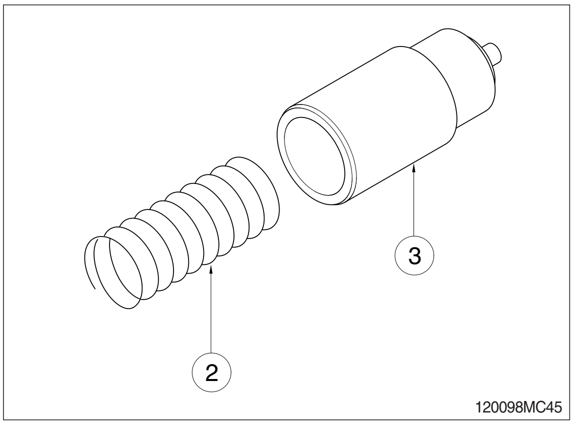
① Remove cap (1) and pull out spring (2), and check (3).

· Cap

Width across flat : 12 mm

Tightening torque : 15.3 kgf · m (111 lbf · ft)

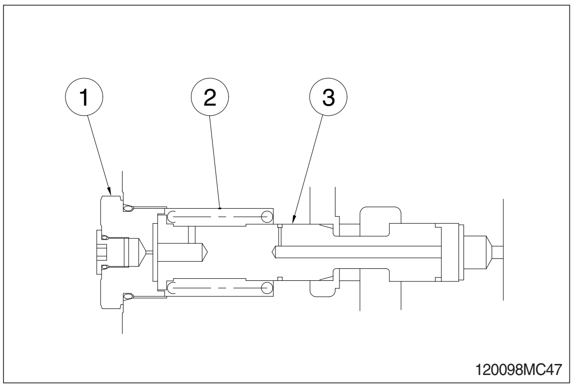


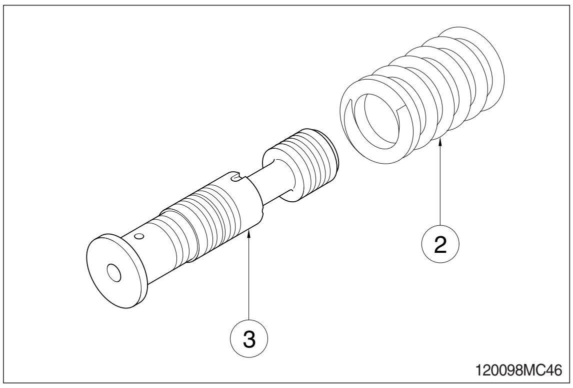


(12) Center bypass valve

※ **Reassembly in the reverse order to disassembly.**
※ **Attach an identification tag immediately after disassembly.**

① Remove cap (1) and pull out spool (3), and spring (2).
 · Cap
 Width across flat : 46 mm
 Tightening torque : 25.5 kgf · m
 (184.4 lbf · ft)



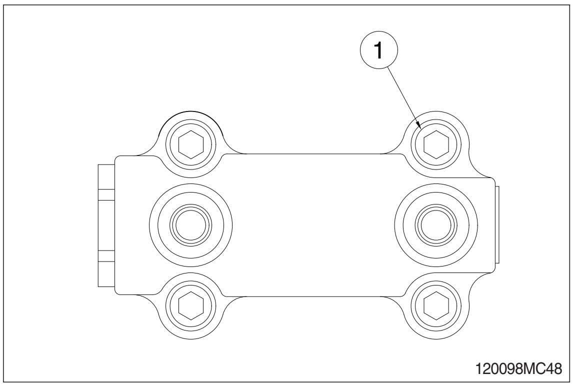


(13) Boom priority valve 1

※ **Reassembly in the reverse order to disassembly.**
※ **Attach an identification tag immediately after disassembly.**

① Loosen hexagon socket bolts (1) and remove cover assembly.
 · Hexagon socket bolt
 Width across flat : 8 mm
 Tightening torque : 6.1 kgf · m
 (44.1 lbf · ft)

※ **When reassembly**
Install cover assy after making sure that O-ring is placed on the edge of the cover hole.



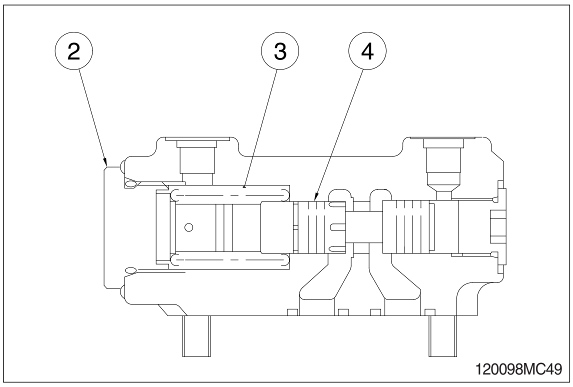
② Remove cap (2) and pull out spool (4), and spring (3).

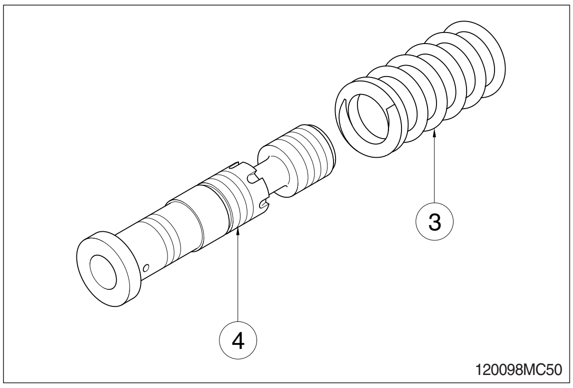
· Cap

Width across flat : 41 mm

Tightening torque : 10 kgf · m

(72.3 lbf · ft)





(14) Boom priority valve 2

※ Reassembly in the reverse order to disassembly.

※ Attach an identification tag immediately after disassembly.

① Loosen hexagon socket bolts (1) and remove cover assembly (2).

· Hexagon socket bolt

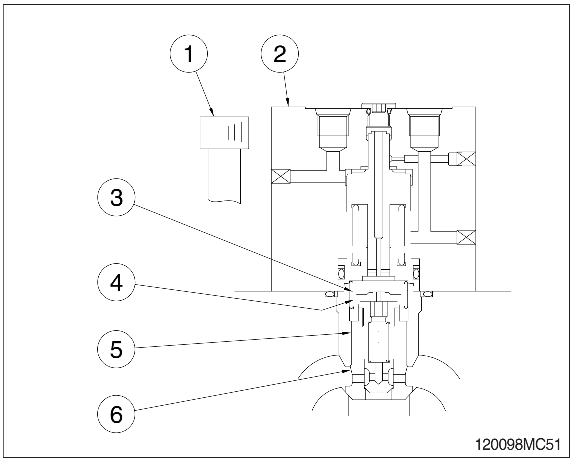
Width across flat : 12 mm

Tightening torque : 18.4 kgf · m

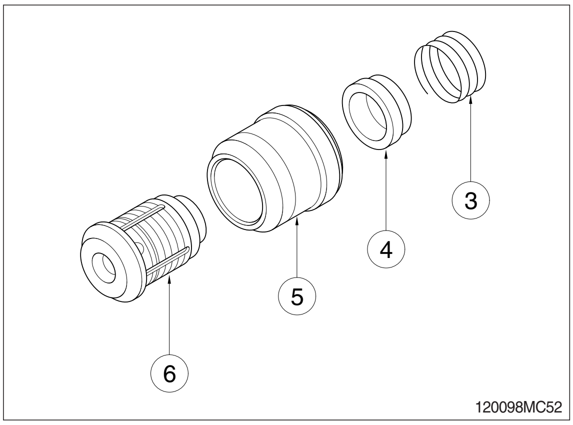
(133 lbf · ft)

※ When reassembly

Install cover assy (2) after making sure that O-ring and back-up ring is placed on the edge of the valve hole.



② Remove spring (3), spring guide (4), sleeve (5) and poppet sub-assembly (6).



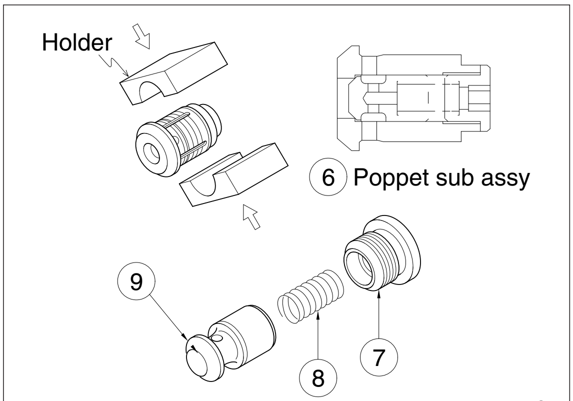
120098MC52

③ Place the poppet between holders and loosen the cap (7) by using vise.

Remove cap (7), spring (8) and check (9).

· Cap
  Width across flat : 6 mm
  Tightening torque : 3.6 kgf · m
  (26 lbf · ft)

※ **Put the poppet between the holders and clamp them by a vise after degreasing the poppet and holders as a special tool.**

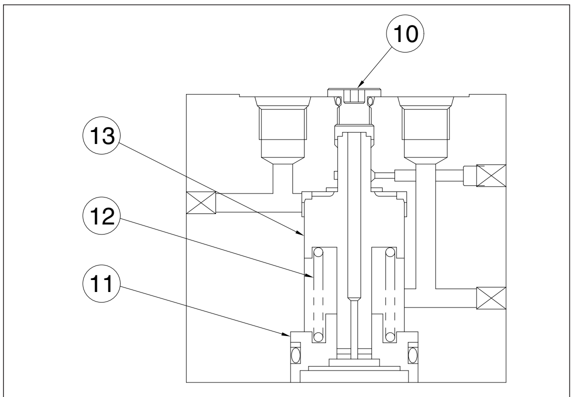


120098MC53

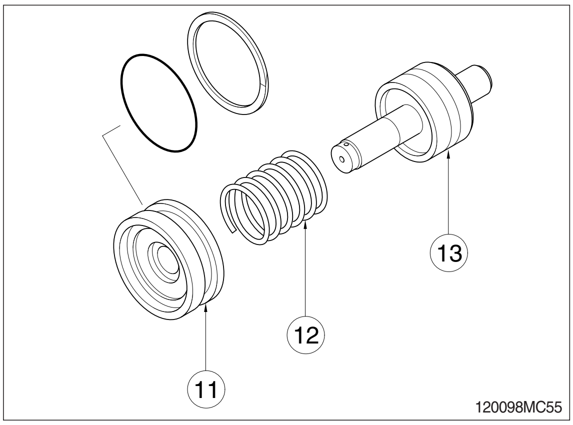
④ Cap (10) removed and a plate (11) is extracted by the press.
Remove spring (12) and piston (13).

· Cap
  Width across flat : 5 mm
  Tightening torque : 21 kgf · m
  (14.5 lbf · ft)

※ **It takes care that to not fly, when a plate (11) with spring anti-power separates.**



120098MC54



120098MC55

(15) **Check valve** (Travel straight)

※ **Reassembly in the reverse order to disassembly.**

※ **Attach an identification tag immediately after disassembly.**

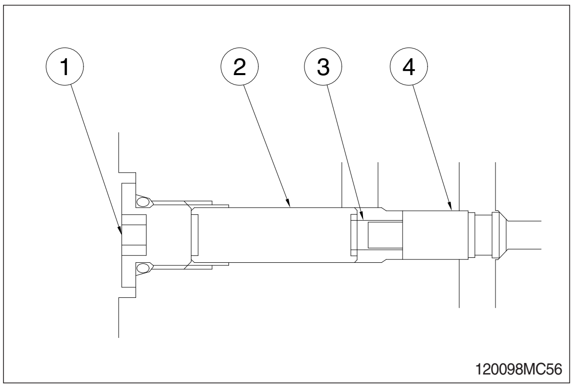
① Remove cap (1) and and pull out spacer (2), spring (3) and check (4).

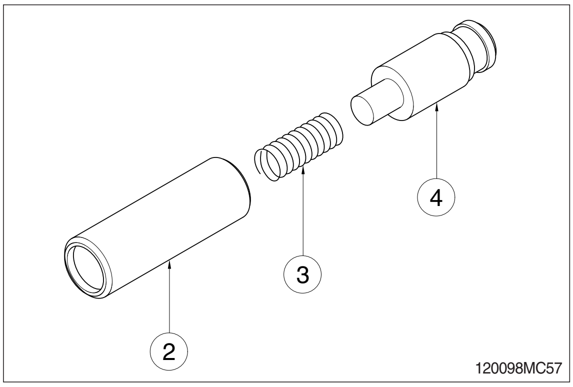
· Cap

Width across flat : 5 mm

Tightening torque : 21 kgf · m

(14.5 lbf · ft)





(16) **Load holding valve** (Boom 2)

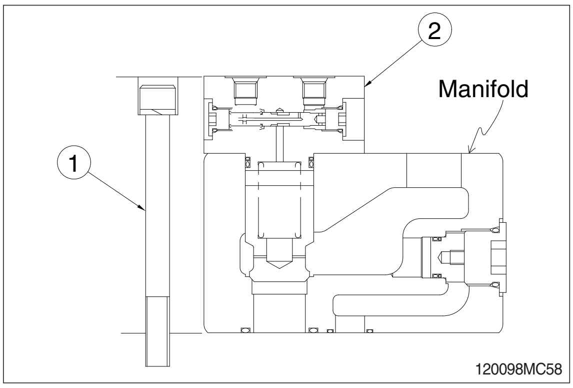
※ **Reassembly in the reverse order to disassembly.**

※ **Attach an identification tag immediately after disassembly.**

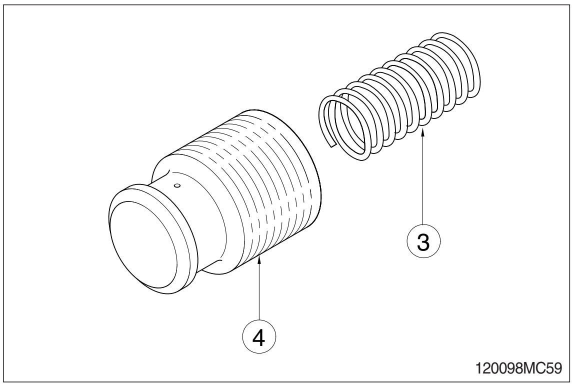
① Loosen hexagon socket bolts (1) and remove cover assembly.

· Hexagon socket bolt
Width across flat : 12 mm
Tightening torque : 18.6 kgf · m
(134.5 lbf · ft)

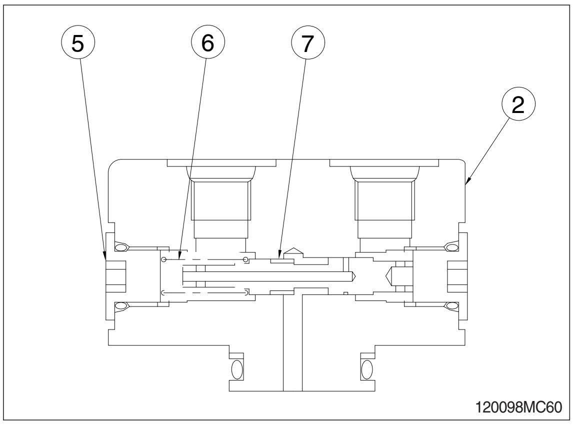
※ **When reassembly**
Install cover assy after making sure that O-ring is placed on the edge of the cover hole.

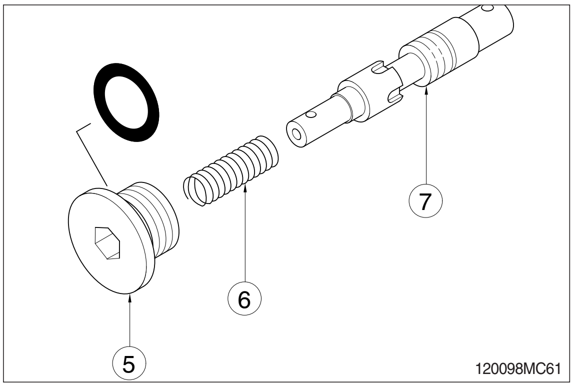


② Remove spring (3) and poppet (4).



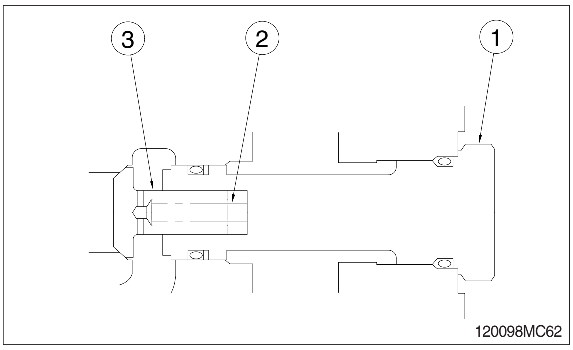
③ Cover assembly
Remove cap (5) and pull out spring (6), and spool (7).
· Cap
Width across flat : 6 mm
Tightening torque : 3.1 kgf · m
(22.4 lbf · ft)

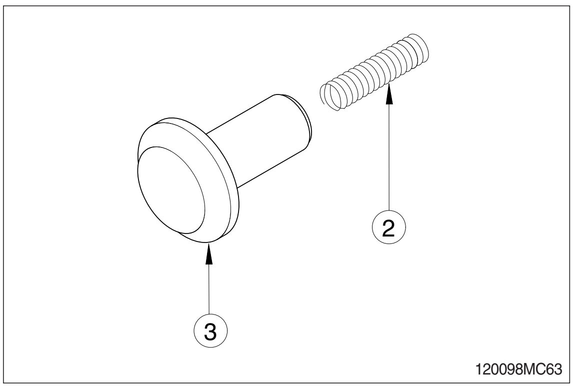




(17) **Check valve** (Opt summation, main relief valve passage)
※ **Reassembly in the reverse order to disassembly.**
※ **Attach an identification tag immediately after disassembly.**

① Remove cap (1) and pull out spool (2) and check (3).
· Cap
Width across flat : 41 mm
Tightening torque : 18.4 kgf · m
(133 lbf · ft)





(18) Arm regeneration valve

※ Reassembly in the reverse order to disassembly.

※ Attach an identification tag immediately after disassembly.

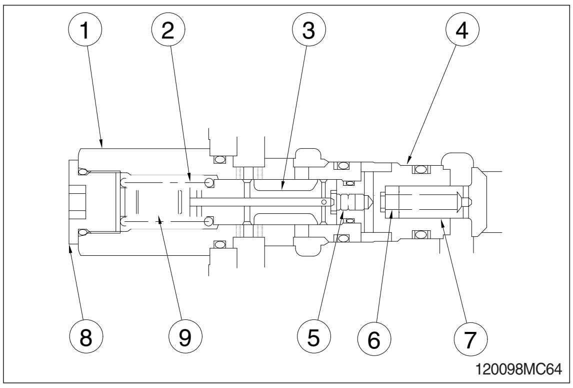
① Remove cap (1) and pull out spring (2) and spool (3).

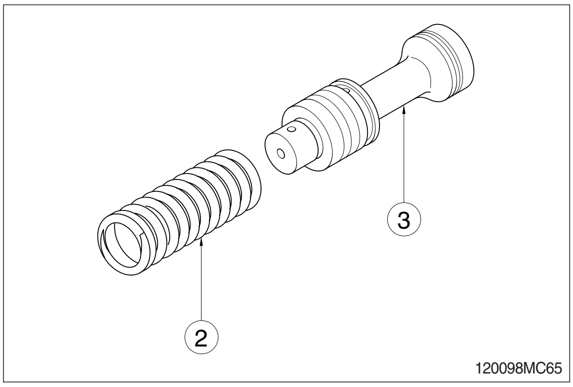
· Cap

Width across flat : 41 mm

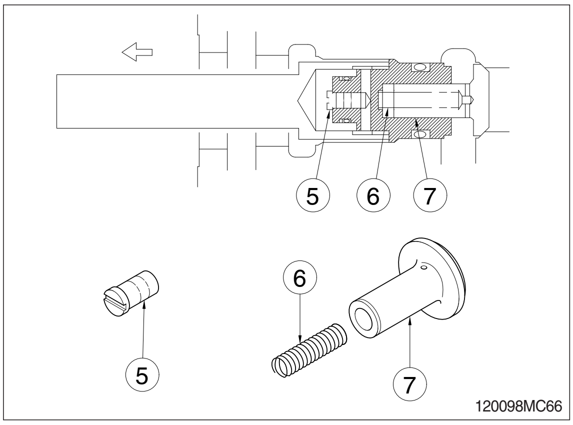
Tightening torque : 18.4 kgf · m

(133 lbf · ft)





② Sleeve (4) is pull out with a special tool. Remove piston (5), spring (6) and check (7).



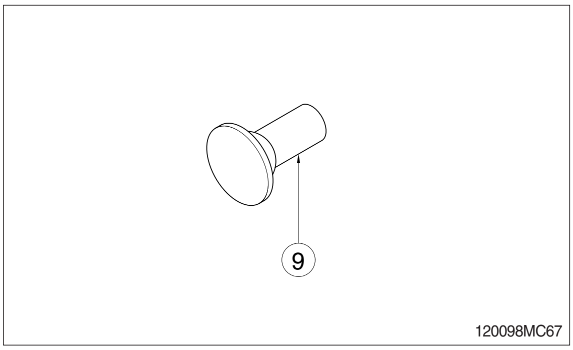
③ Remove cap (8) and pull out spring guide (9).

· Cap

Width across flat : 12 mm

Tightening torque : 10 kgf · m

(72.3 lbf · ft)



(19) Boom boost check valve

※ Reassembly in the reverse order to disassembly.

※ Attach an identification tag immediately after disassembly.

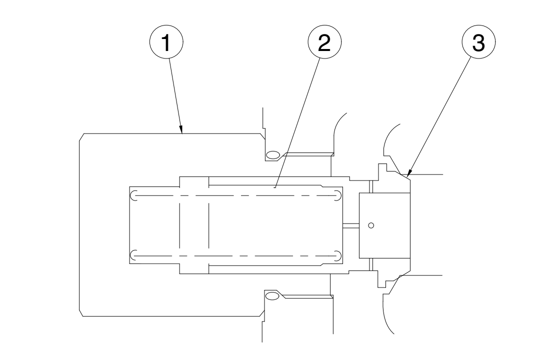
① Remove cap (1) and pull out spring (2) and poppet (3).

· Cap

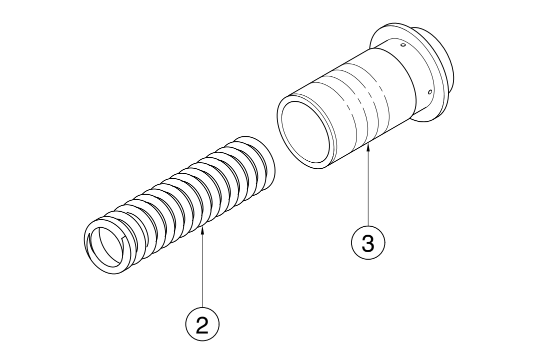
Width across flat : 46 mm

Tightening torque : 18.4 kgf · m

(133 lbf · ft)



120098MC68

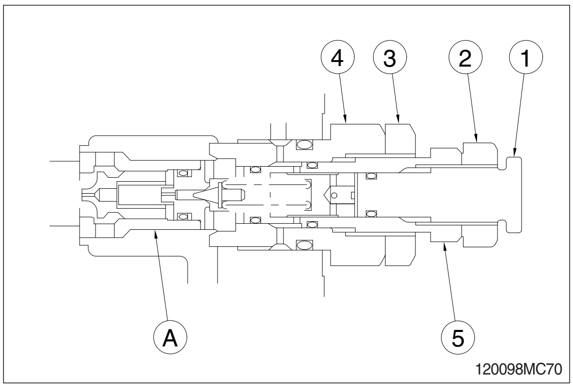


120098MC69

(20) Main relief valve

· **Disassembly**

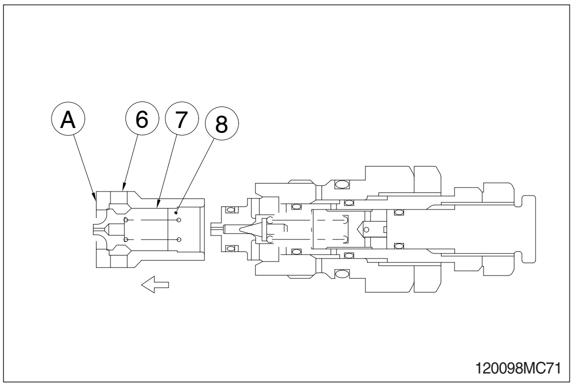
① Loosen nut (2) while holding adjusting screw (1).
② Loosen nut (3) while holding cap (4).
③ Remove main relief valve from valve body.

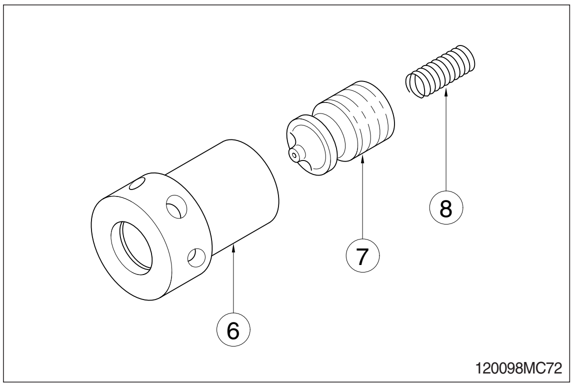


④ Pull out main poppet sub assy (A) and remove main poppet (7) and spring (8) from sleeve (6).

Width across flat

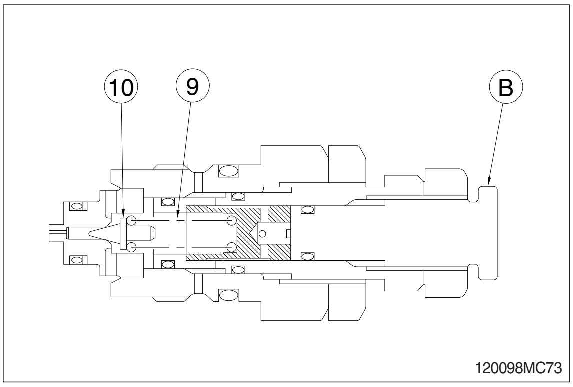
1 Adjust screw : 22 mm
2 Hexagon nut : 30 mm
3 Hexagon nut : 41 mm
4 Cap : 41 mm
5 Sleeve : 27 mm

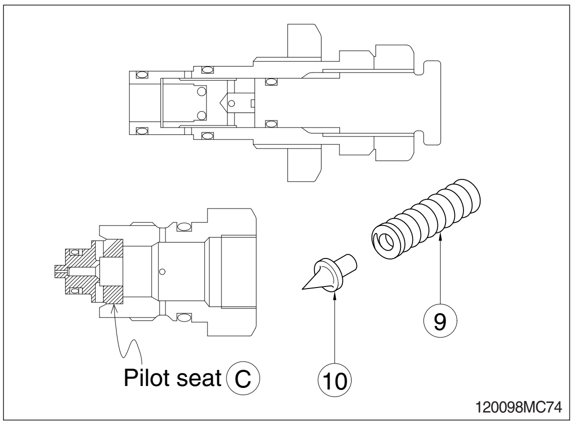




⑤ Remove adjusting sub-assy (B) then remove spring (9) and pilot poppet (10).

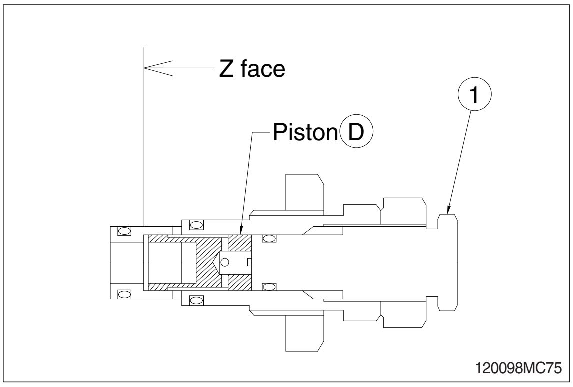
※ Do not disassembly pilot seat (C). (Press fitting)



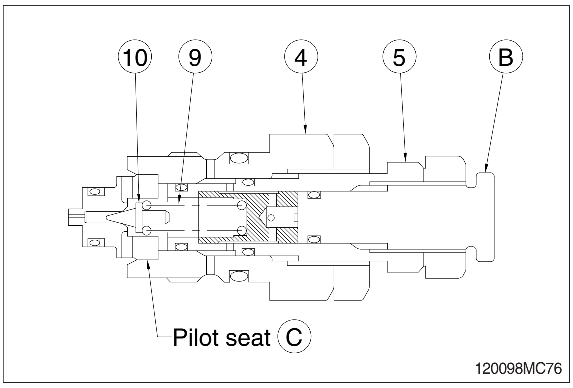


· Reassembly

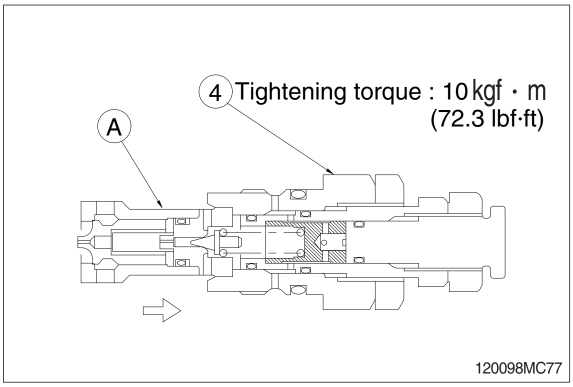
① Screw low pressure adjusting screw (1) until piston (D) touches "Z" face, in this position, relief setting pressure is high level.



② Install pilot poppet (10), spring (9) and adjusting screw sub-assy (B).
Set adjusting screw sub-assy (B) temporarily in the position that pilot poppet (10) contacts to pilot seat (C). Then pressure adjusting spring (9) begins to be effective.



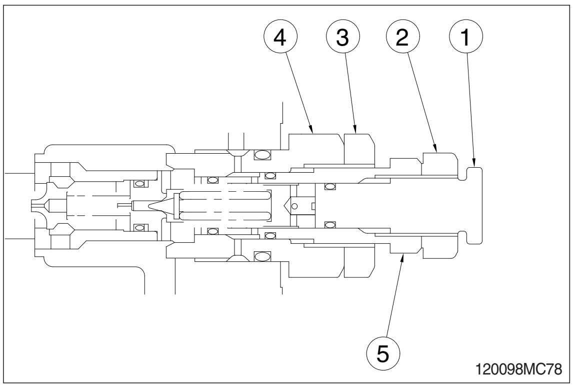
③ Assemble main poppet sub-assy (A), and install the main relief valve which is set temporarily in main body.
Tighten cap (4) with a torque wrench.



· Resetting relief pressure

① High pressure
Set the prescribed pressure correctly adjusting sleeve (5), while reading the pressure gauge. Tighten lock nut (3) with torque wrench holding sleeve (5).

※ One quarter turn of sleeve (5) equals about 4.5 MPa.



② Low pressure
Set the prescribed pressure correctly adjusting screw (1), while reading the pressure gauge. Tighten lock nut (2) with torque wrench holding adjusting screw (1).

※ One quarter turn of adjusting screw (1) equals about 4.5 MPa.

Tightening torque
1 Adjust screw : -
2 Hexagon nut : 6.1 kgf · m (44.1 lbf · ft)
3 Hexagon nut : 10 kgf · m (72.3 lbf · ft)
4 Cap : 10 kgf · m (72.3 lbf · ft)
5 Sleeve : -

(21) **Check valve** (Boom up summation)

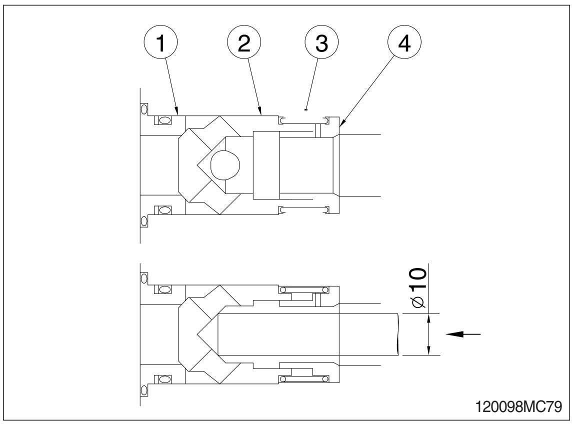
※ **Reassembly in the reverse order to disassembly.**

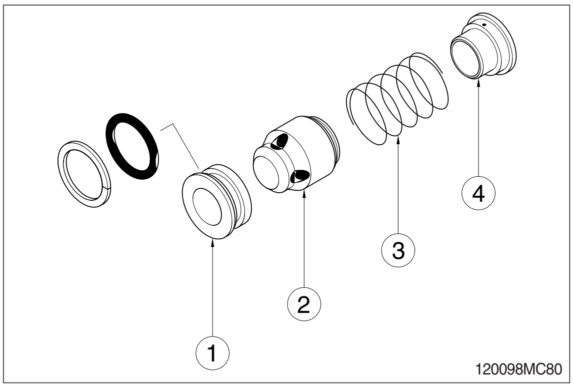
※ **Attach an identification tag immediately after disassembly.**

※ **There is a necessity for separating housing and manifold. (refer to page 8-66)**

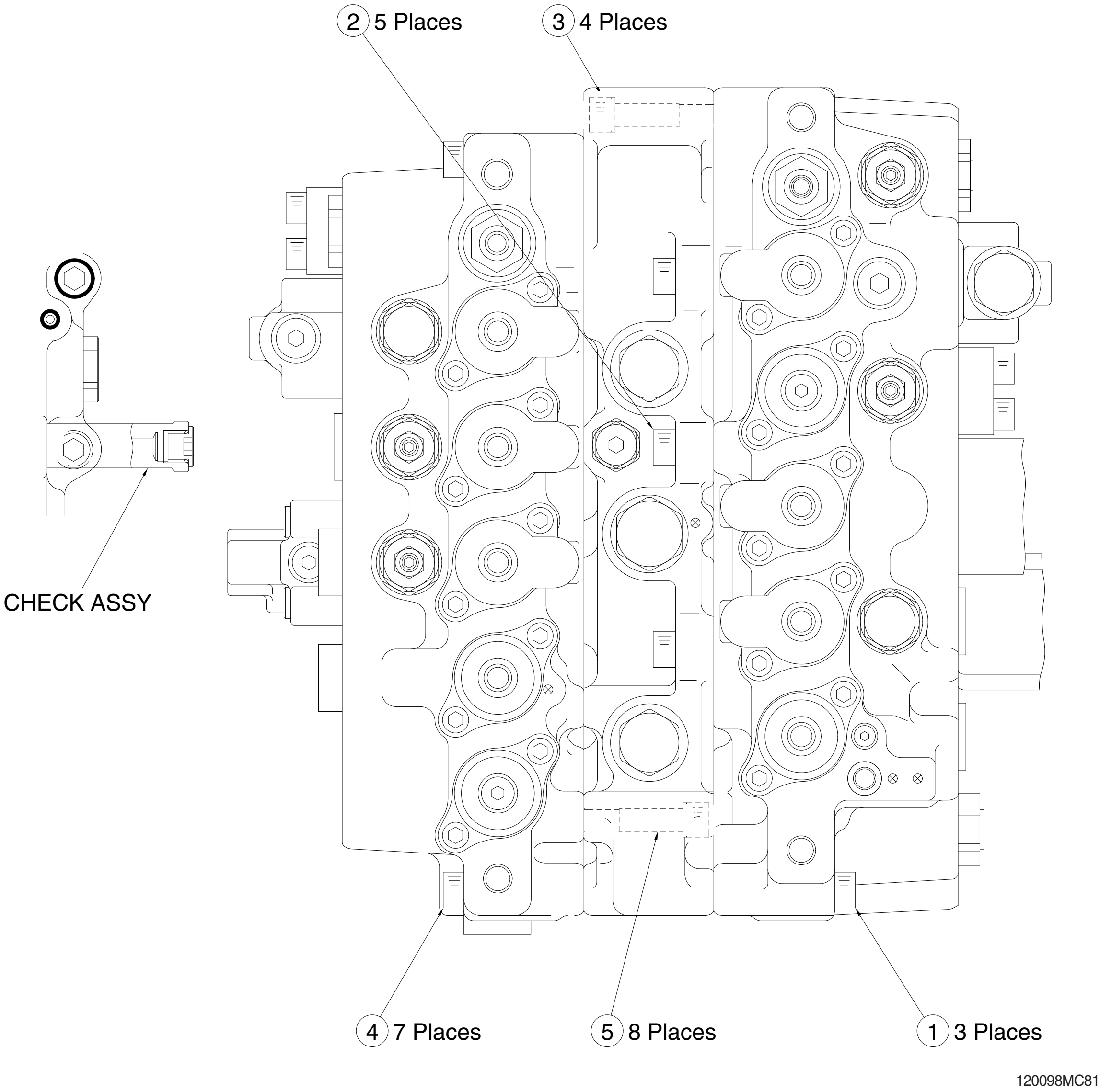
① It begins to beat the check with the pipe lightly.

Remove seat (1), check (2), spring (3) and spring guide (4).





(22) Separation/union of valve



① Separation

1-1. Loosen hexagon socket bolts (1), (2), (3) and remove OPT side valve.

1-2. Loosen hexagon socket bolts (4), (5) and remove TS side valve.

· Hexagon socket bolt

Width across flat : 14mm

※ Remove check assemble of the manifold earlier. (refer to page 8-67)

② Union

2-1. Installation respect is made smooth.

2-2. United at TS side valve earlier.

2-3. United at OPT side valve.

· Hexagon socket bolt

Tightening torque : 25.5 kgf · m (184.4 lbf · ft)

※ Install valve assy after making sure that O-ring is placed on the edge of the manifold hole.

(23) **Check valve** (Boom summation)

※ **Reassembly in the reverse order to disassembly.**

※ **Attach an identification tag immediately after disassembly.**

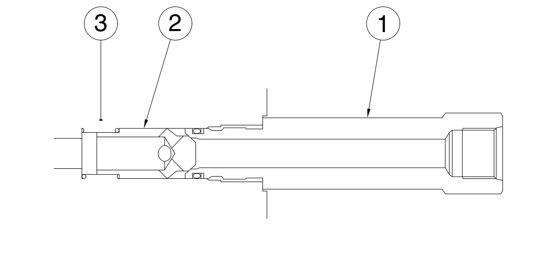
① Remove cap (1) and pull out check (2) and spring (3).

· Cap

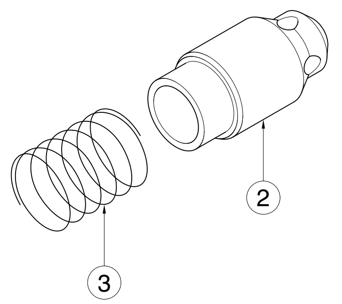
Width across flat : 32 mm

Tightening torque : 10 kgf · m

(72.3 lbf · ft)



120098MC82



120098MC83

(24) **Load holding valve** (Arm 3, Boom 3)

※ **Reassembly in the reverse order to disassembly.**

※ **Attach an identification tag immediately after disassembly.**

① Loosen hexagon socket bolts (1) and remove cover assembly (2).

· Hexagon socket bolt

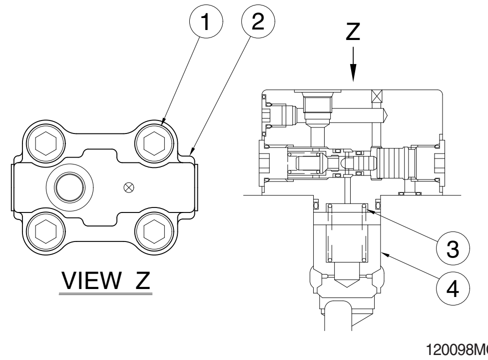
Width across flat : 12 mm

Tightening torque : 18.4 kgf · m

(133 lbf · ft)

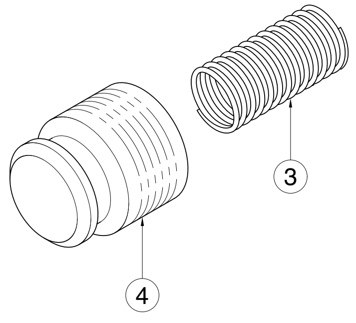
※ **When reassembly**

Install cover assy after making sure that O-ring is placed on the edge of the cover hole.



120098MC84

② Remove spring (3) and poppet (4).



120098MC85

③ Cover assembly

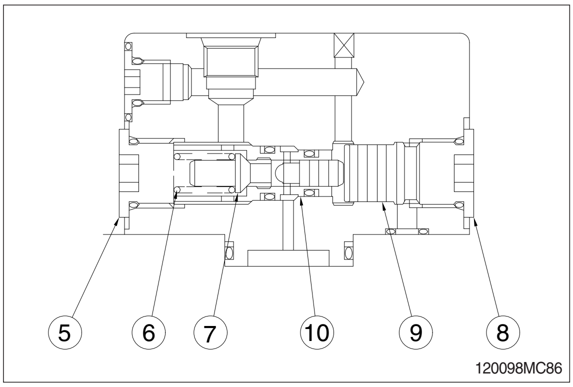
a. Remove cap (5) and pull out spring (6), and poppet (7).

· Cap

Width across flat : 10 mm

Tightening torque : 5.1 kgf · m (36.9 lbf · ft)

※ **There is a case where the poppet cannot be taken by the seat edge.**



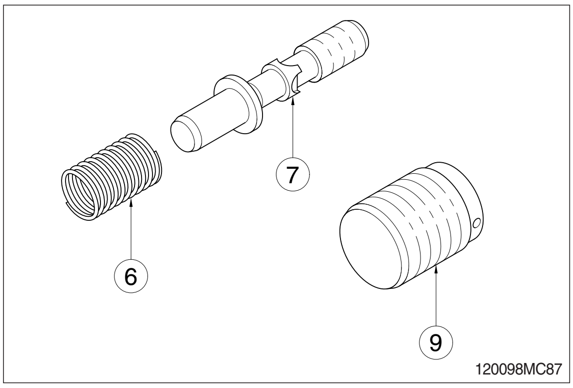
120098MC86

b. Remove cap (8) and piston (9).

· Cap

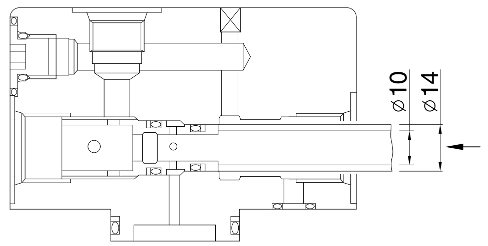
Width across flat : 10 mm

Tightening torque : 5.1 kgf · m (36.9 lbf · ft)



120098MC87

c. It begins to beat the sleeve with the pipe lightly.



120098MC88

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.**

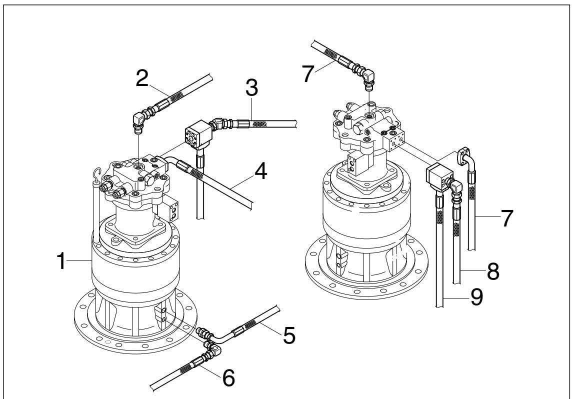
※ **When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.**

13031GE18

(3) Disconnect pilot line hoses (2, 3, 4, 5, 6, 7, 8, 9, 10, 11, 12, 13, 14, 15, 16).

(4) Sling the swing motor assembly (1) and remove the swing motor mounting bolts (17).

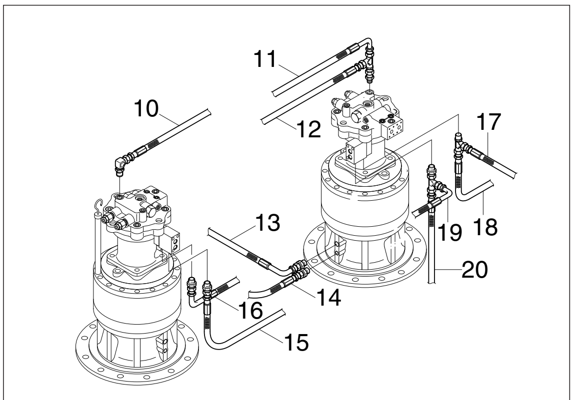
- · Motor device weight : 90 kg (200 lb)
- · Tightening torque : 25±2.5 kgf · m (180±18 lbf · ft)



120098SM01

(5) Remove the swing motor assembly.

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



120098SM02

2) INSTALL

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

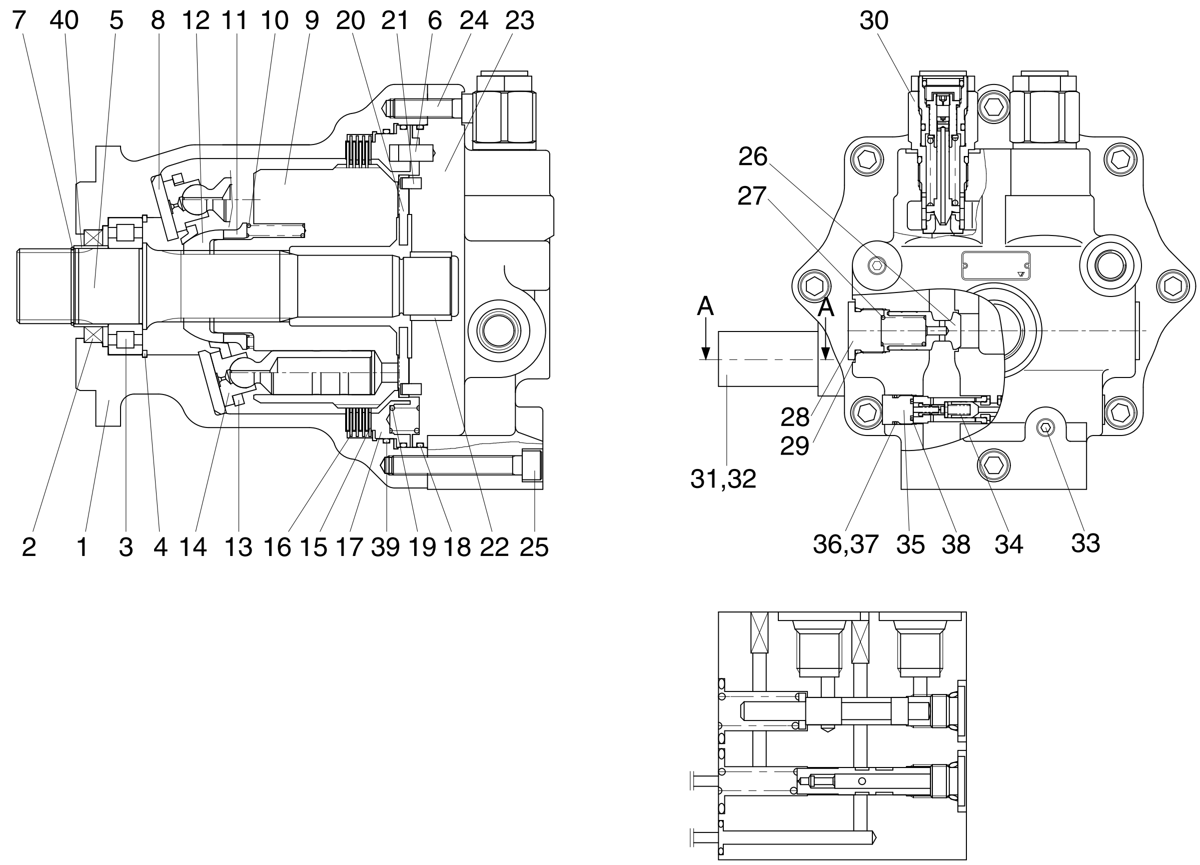
(2) Bleed the air from the swing motor.

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



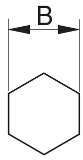
SECTION A-A

120092SM02

1	Body
2	Oil seal
3	Roller bearing
4	Snap ring
5	Shaft
6	Pin
7	Stop ring
8	Shoe plate
9	Cylinder block
10	Spring
11	Ball guide seat
12	Ball guide
13	Set plate
14	Piston assy
15	Friction plate
16	Plate
17	Brake piston
18	O-ring
19	Spring
20	Valve plate
21	Pin
22	Needle bearing
23	Rear cover
24	Wrench bolt
25	Wrench bolt
26	Poppet
27	Spring
28	Plug
29	O-ring
30	Relief valve assy
31	Time delay valve
32	Wrench bolt
33	Plug
34	Reactionless valve assy
35	Plug
36	O-ring
37	Back up ring
38	O-ring
39	O-ring
40	Bushing

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	5	
	6	
	12	
	17	
Socket for socket wrench, spanner	36	
Torque wrench	Capable of tightening with the specified torques	
Snap ring plier (for holes, axis)	Snap ring (4)	
Solder hammer	Needle bearing (22), pin (6, 21)	
Oil seal inserting jig	Oil seal (2)	
Induction heating apparatus for bearing	Roller bearing (3)	

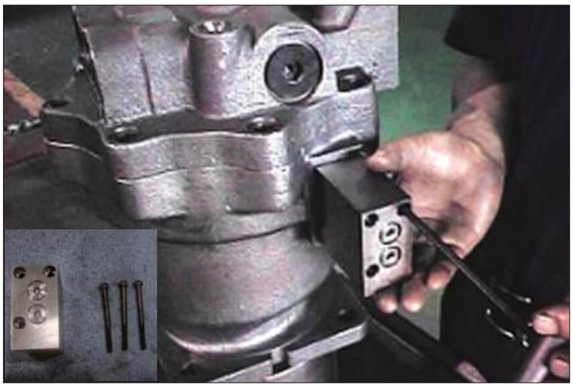
(2) Tightening torque

Part name	Item	Size	Torque		Wrench size	
			kgf · m	lbf · ft	in	mm
Wrench bolt	24	M14	20.9	151.2	0.47	12
Wrench bolt	25	M14	20.9	151.2	0.47	12
Relief valve	30	M33	18.0	130.2	1.42	36
Wrench bolt	32	PF 1/4	6.9	49.9	0.20	5
Plug	33	PF 1/4	20.9	151.2	0.24	6

3) DISASSEMBLING

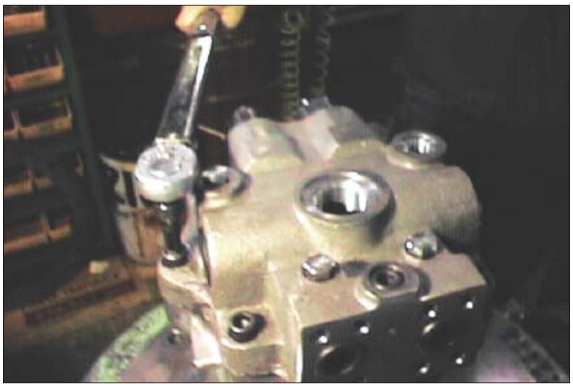
(1) Disassemble the sub of a Turning axis

① Unloosing wrench bolt (32) and disassemble time delay valve assy (31) from rear cover (23).



3607A8SM01/01A

② Hang rear cover (23) on hoist, unloose wrench bolt (24, 25) and disassemble from body (1).

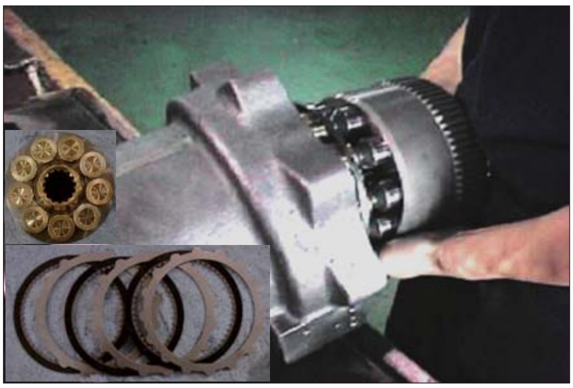


3607A8SM02

③ Using a jig, disassemble break piston (17) from body (1).

3607A8SM03

④ Disassemble respectively cylinder block assy, friction plate (15), plate (16) from body (1).



3607A8SM04

⑤ Disassemble shoe plate (8) from body (1).

3607A8SM05

⑥ Using a plier jig, disassemble snap ring (4) and shaft assy (5).

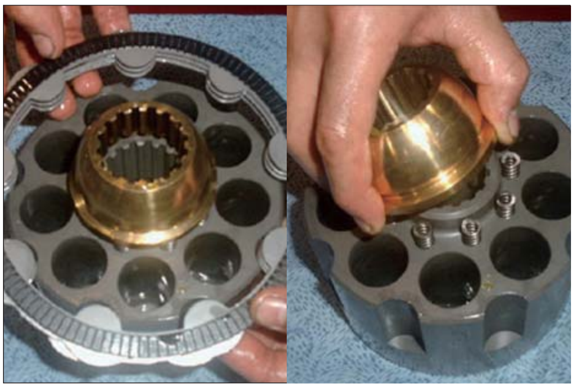
3607A8SM06/06A

(2) Disassemble cylinder block assy sub

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

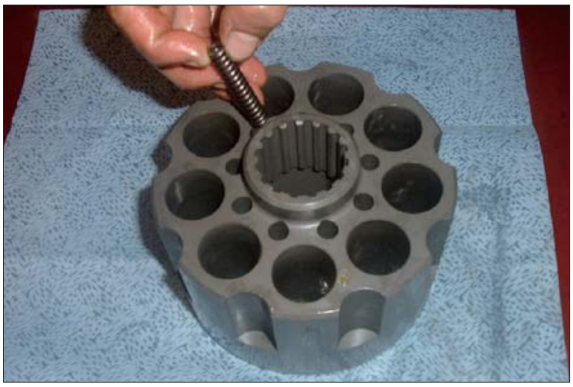
3607A8SM07

② Disassemble ball guide (12), friction plate (15), plate (16) and ball guide seat (11) from cylinder block (9).



3607A8SM08A/08B

③ Disassemble spring(10) from cylinder block(9).



3607A8SM09

(3) Disassemble rear cover assy sub

① Disassemble pin(6, 21) and valve plate (20) from rear cover(23).

3607A8SM10/10A

② Using a torque wrench, disassemble relief valve assy(30) 2 set from rear cover(23).

3607A8SM11/11A

③ Disassemble make up check valve assy with a torque wrench from rear cover(23).

3607A8SM12/12A

4) ASSEMBLING

(1) Assemble the sub of a turning axles

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

· Roller bearing ×1EA

3607A8SM21

② After assembling and compressing preheated roller bearing (3), stop ring (7) into shaft (5).

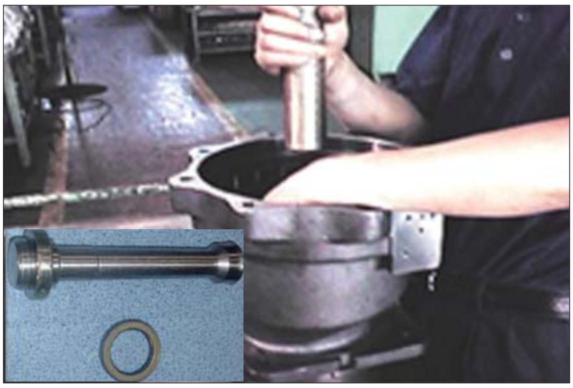
· Stop ring ×1EA

· Shaft ×1EA

3607A8SM22/22A

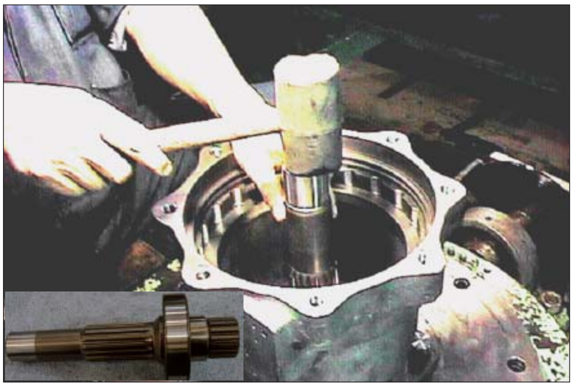
③ Using a compressing tool and steel stick, assemble oil seal (2) into body (1).

· Oil seal ×1EA



3607A8SM23/23A

④ Insert above shaft sub into body (1) and assemble it with a hammer.



3607A8SM24

⑤ Fix snap ring (4) to shaft with a plier jig.
  · Snap ring ×1EA

3607A8SM06

⑥ Spread grease on shoe plate (8) and assemble on the body.
  · Shoe plate ×1EA

3607A8SM05

(2) Assemble the sub of cylinder block assy

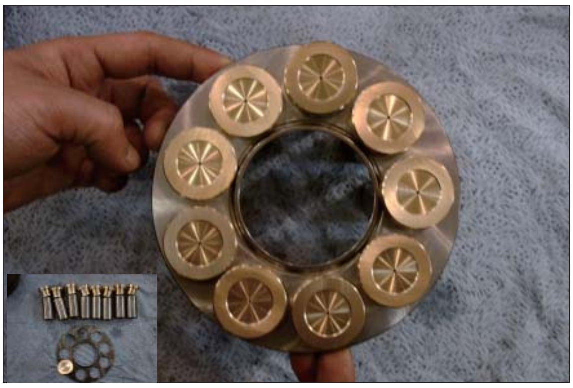
① Assemble spring (10) 9 set into cylinder block (9).
  · Spring ×9EA

3607A8SM25

② Assemble ball guide (12) and ball guide seat (11) into cylinder block (9).
  · Ball guide ×1EA

3607A8SM26

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



3607A8SM27

④ Assemble above item ② and ③.

3607A8SM28

⑤ Assemble cylinder block assy into body (1).

3607A8SM04

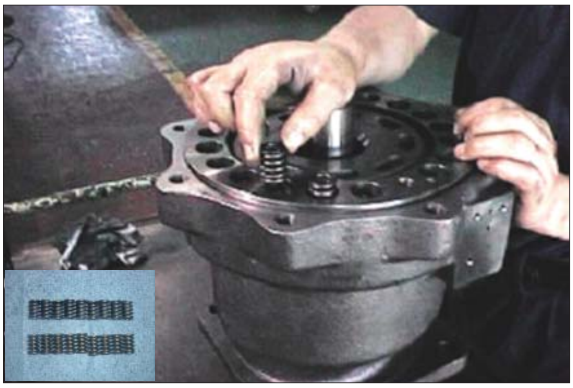
⑥ Assemble 4 set of lining plate (16), friction plate (15) respectively into body.
- Lining plate × 4EA
- Friction plate × 4EA

3607A8SM29

⑦ Assemble O-ring (18) into break piston (17).
 · O-ring × 2EA

3607A8SM30

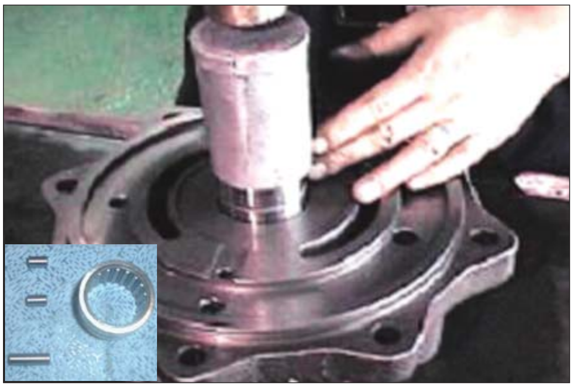
⑧ Insert break piston assy into body (1) and assemble spring (19) into break piston (17).
 · Spring × 19EA



3607A8SM31/31A

(3) Assemble the sub of rear cover assy sub

① After assembling needle bearing (22) into rear cover (23), with a hammer assemble pin (6, 21).



3607A8SM32/32A

② Assemble respectively make up check valve assy spring (27), poppet (26), plug (28) into rear cover (23) after then screw it torque wrench.
 · Make up check sub × 2set
 · Spring × 2EA
 · Check × 3EA

3607A8SM33/12A

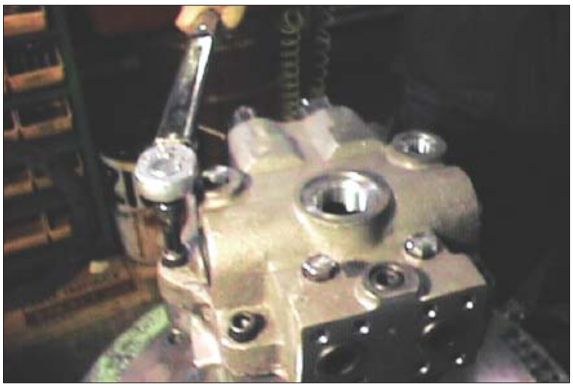
③ Assemble relief valve assy (30) 2set into rear cover (23) with a torque wrench.

3607A8SM34/11A

④ Spreading grease on valve plate (20), assemble into rear cover (23).
· Valve plate × 1EA

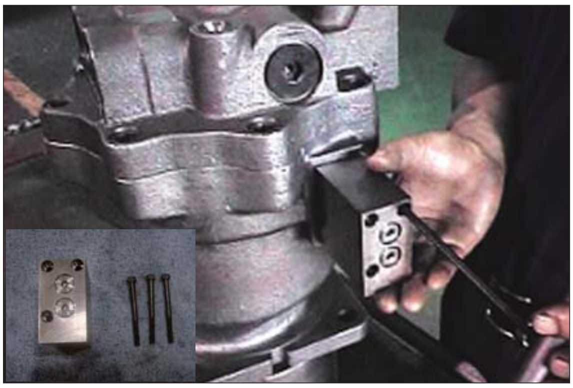
3607A8SM10/10A

⑤ Lift up rear cover assy on body (1) by a crane and assemble it with a wrench bolt (24, 25).



3607A8SM02

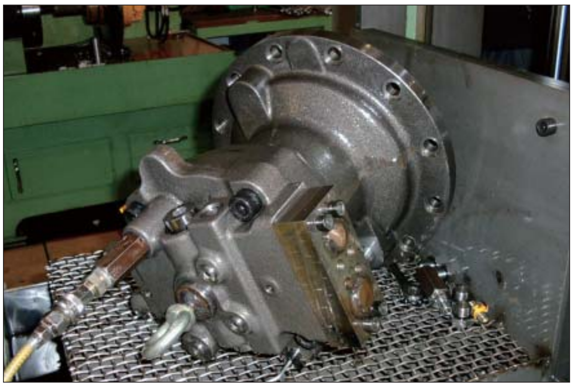
⑥ Assemble time delay valve assy (31) into rear cover (23) with a wrench bolt (32).



3607A8SM01/01A

(4) Air pressing test

Be sure of leakage, after press air into assembled motor.



14078SM232

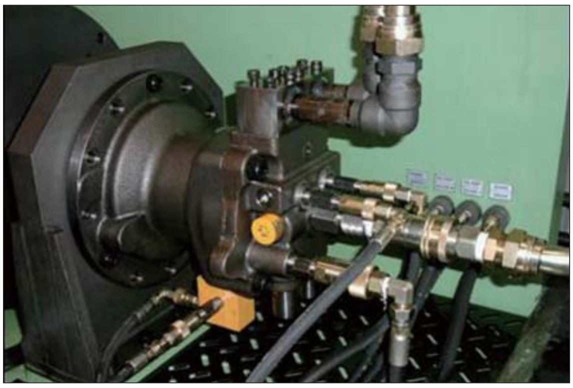
(5) Leakage check

After cleaning motor by color check No.1, paint No.3 and be sure of leakage.

14078SM233/233A

(6) Mount test bench

Mounting motor test bench, test the availability of each part.



220078SM14

3. REMOVAL AND INSTALL OF REDUCTION GEAR

1) REMOVAL

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

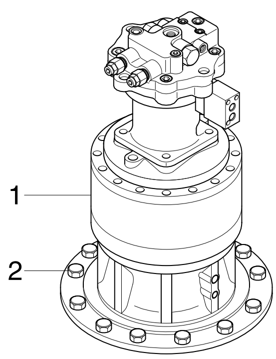
(2) Sling reduction gear assembly (1) and remove mounting bolts (2).

(3) Remove the reduction gear assembly.
· Reduction gear device weight : 270 kg (600 lb)

13031GE18

2) INSTALL

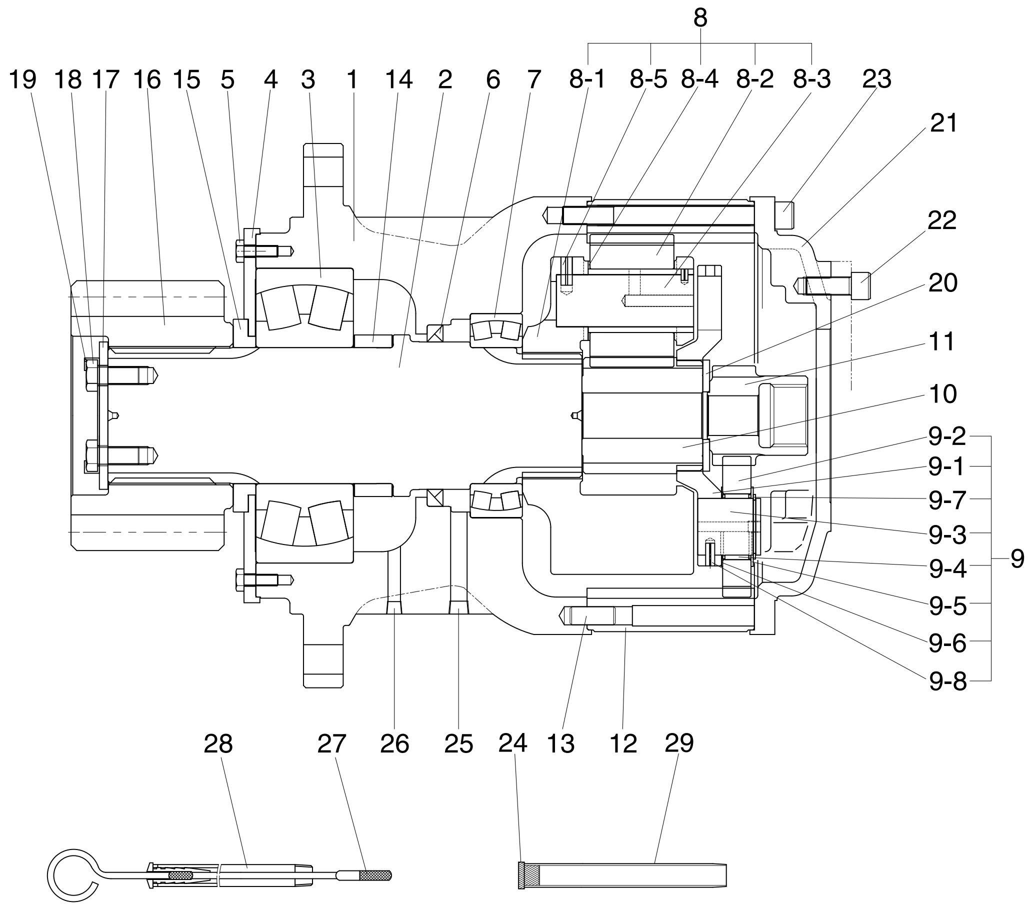
(1) Carry out installation in the reverse order to removal.
· Tightening torque : 100±15kgf · m (723±109lbf · ft)



8007A8SM03

4. REDUCTION GEAR

1) STRUCTURE



120092SM03

1	Casing	9-1	Carrier 1	16	Pinion gear
2	Drive shaft	9-2	Planetary gear 1	17	Lock plate
3	Roller bearing	9-3	Pin 1	18	Hex bolt
4	Cover plate	9-4	Needle cage	19	Lock washer
5	Hex bolt	9-5	Side plate 2	20	Thrust ring
6	Oil seal	9-6	Side plate 1	21	Cover
7	Roller bearing	9-7	Stop ring	22	Socket bolt
8	Carrier assy 2	9-8	Spring pin	23	Socket bolt
8-1	Carrier 2	10	Sun gear 2	24	Socket plug
8-2	Planet gear 2	11	Sun gear 1	25	Plug
8-3	Pin 2	12	Ring gear	26	Plug
8-4	Washer	13	Knock pin	27	Gauge bar
8-5	Spring pin	14	Spacer ring	28	Gauge pipe
9	Carrier assy 1	15	Spacer	29	Air breather assy

2) DISASSEMBLY

(1) Removal of cover

※ Loosen the socket bolt (23) with 16mm hexagonal socket and remove the cover (21).

(2) Removal of sun gear 1 and thrust ring assembly

Remove carrier 1 (9), install eye bolt to tap hole (M10) and remove carrier 1 assembly itself.

3607A8SR03

(3) Removal of sun gear 2

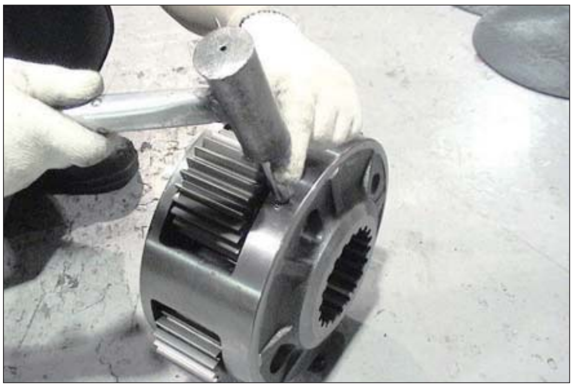
Remove sun gear 2 (10), install eye bolt to tap (M10) of carrier 2 (8) and remove carrier 2 assembly itself.

3607A8SR04

(4) Disassembly of 2nd carrier assembly

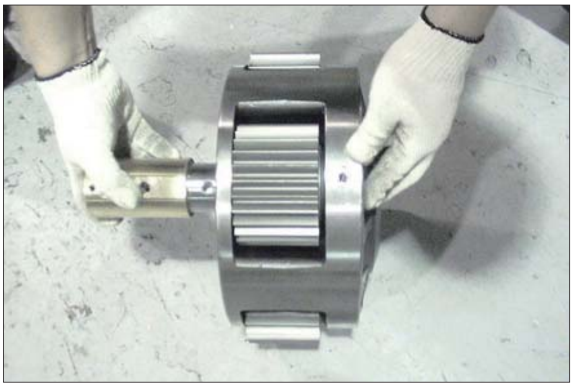
① Insert spring pin (8-5) into pin assy 2 (8-3) by hammering.

※ Do not reuse spring pin after removal.



3607A8SR05

② Remove pin assy 2 (8-3) from carrier 2 (8-1), planetary gear 2 (8-2) and thrust washer (8-4) with hands.



3607A8SR06

(5) Removal of ring gear

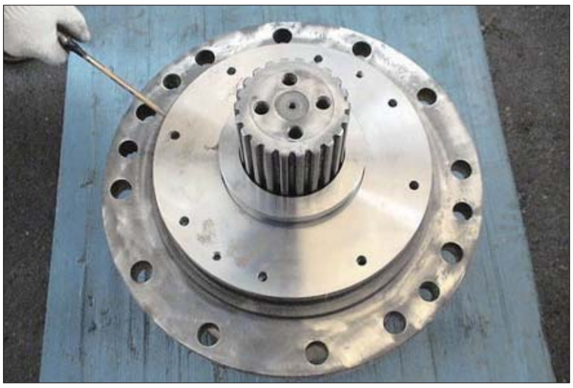
Remove ring gear (12) from casing (1).

※ Fluid packing is applied on contacting face of ring gear and gear casing. Therefore, remove ring gear from casing by minus screw driver.

3607A8SR07

(6) Removal of drive shaft (2) assembly

① Spread off the corners of spacer (15), cover plate (4) and hex bolt (5) with a tool.



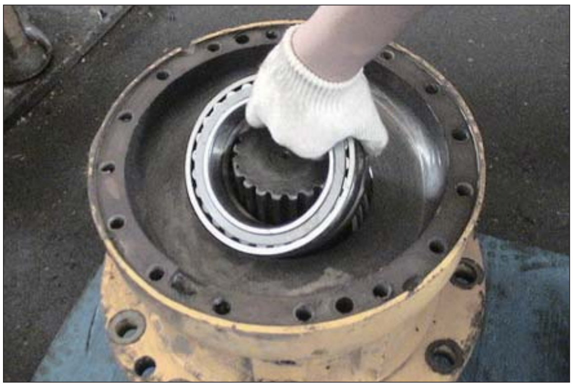
3607A8SR08

② Install hydraulic press at the end face of shaft, and remove drive shaft (2), spacer ring (14), and roller bearing (3) as assembly.

※ Do not reuse oil seal after removal.

3607A8SR09

③ Remove roller bearing (7) from gear casing (1).



3607A8SR10

④ Remove oil seal (6) from gear casing (1).

3607A8SR11

(7) Disassembly of shaft assembly

Insert motor side of shaft (2) into steel tube (inner dia : ø 145 mm) and push the end of output shaft side with hydraulic press and then remove roller bearing (3), and spacer ring (14) as assembly from drive shaft (2).

3607A8SR12

3) ASSEMBLY

(1) Assembly of drive shaft assembly

① After assembly drive shaft (2), heat roller bearing (3) up to 50°C plus surrounding temperature and assemble it to shaft with hydraulic press and then assemble spacer ring (14) in this order.

※ **Pay attention to the assembling direction of cover plate (4).**

3607A8SR13

(2) Installation of oil seal

Remove oil from assembled face of oil seal of gear casing (1) and oil seal (6).
Apply fluid packing (three bond of white color) on outer face of oil seal and assemble at pressing jig of gear casing.
After inserting with press, lubricate oil seal with grease.

3607A8SR14

(3) Assembly of drive shaft assembly

① Be careful lest oil seal lip damage by spline of drive shaft (2).
Assemble drive shaft assembly by using seal guide.

② Put drive shaft of gear casing (1) upward.
Assemble drive shaft assembly to gear casing by tightening eye bolt into tap hole (M16) of output side of drive shaft (2).

※ **Place support (approx 150 mm) below of gear case (1) for seal protector contact with work table.**

3607A8SR15

(4) Install of roller bearing

Put gear casing under output shaft and heat roller bearing (7) up to 50°C plus surrounding temperature and then assemble it to the shaft.

3607A8SR16

(5) Assembly of ring gear

① Remove oil from mating faces between gear casing (1) and ring gear (12), and knock pin (13). Assemble collar of gear casing and apply fluid packing (three bond of grey color).

3607A8SR17

② Assemble ring gear (12).

36078SR18

(6) Assembly of carrier 2 assembly

① Assemble planetary gear 2 (8-2) to carrier 2 (8-1) with thrust washer (8-4) and insert pin assy 2 (8-3).

※ Lubricate gear oil to inside of gear and outside of shaft.

3607A8SR19

② Insert spring pin (8-5) by hammering.

※ Insert as the clearance between spring pins toward planetary gear 2 (8-2).

3607A8SR20

(7) Assembly of carrier 2 assembly and sun gear 2

① Mount eye bolt into tap hole (M10) of carrier 2 (8) and lift carrier assembly and then insert carrier assembly being engaged with internal teeth of ring gear (12). Rotate carrier assembly lightly so that splines of drive shaft (2) are engaged.

3607A8SR21

② Insert sun gear 2 (10) to planetary gear 2 (8-2).

3607A8SR22

(8) Assembly of sun gear 1, carrier 1 assembly

① Mount eye bolt into tap hole (M10) of lift carrier assembly and then insert carrier assembly being engaged with internal teeth of ring gear (12).

Rotate holder assembly lightly so that sun gear 2 (10) is engaged with teeth of carrier 1 (9-1).

3607A8SR23

② Insert sun gear 1 (11) to planetary gear 1 (9-2).


3607A8SR24

(9) Check rotation of sun gear by turning plunge part of gear casing with hands.

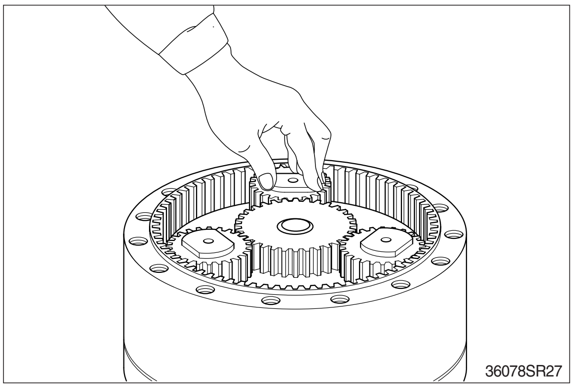
(10) Assembly of cover

Remove oil from mating faces between ring gear (12) and cover (21) and apply fluid packing.

Assemble cover (21) and tighten socket bolt (23) with 16mm hexagonal socket.

Tightening torque : 25±2.5 kgf · m
(180±18 lbf · ft)

This completes assembly


36078SR27

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 : 935 kg(2060 lb)

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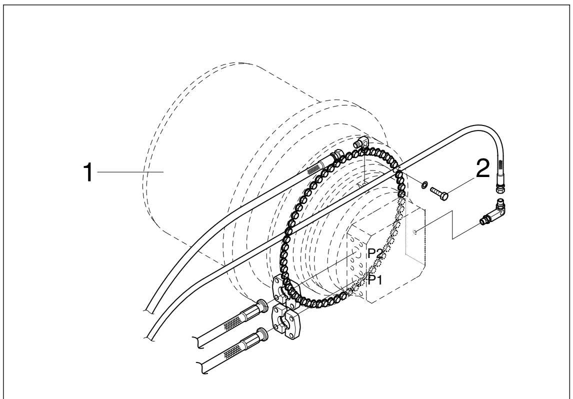

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2) INSTALL

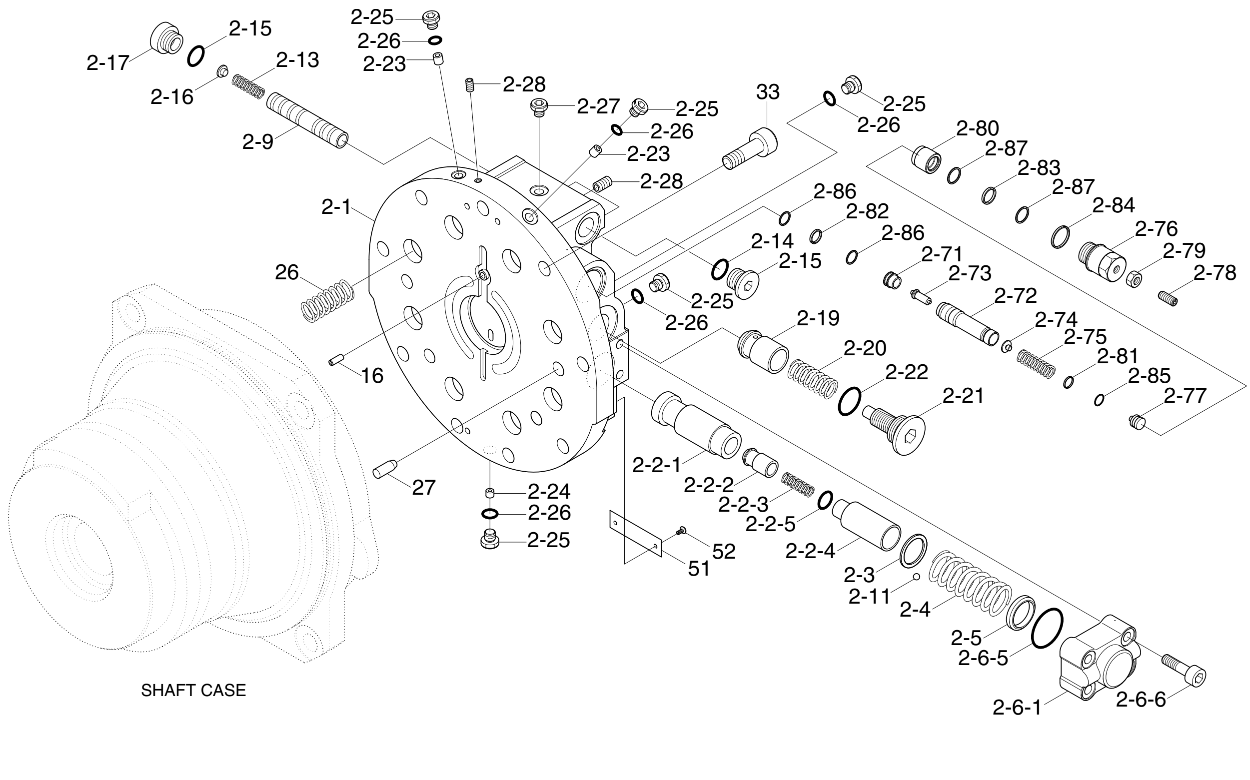
(1) Carry out installation in the reverse order to removal.

(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 (1/2)

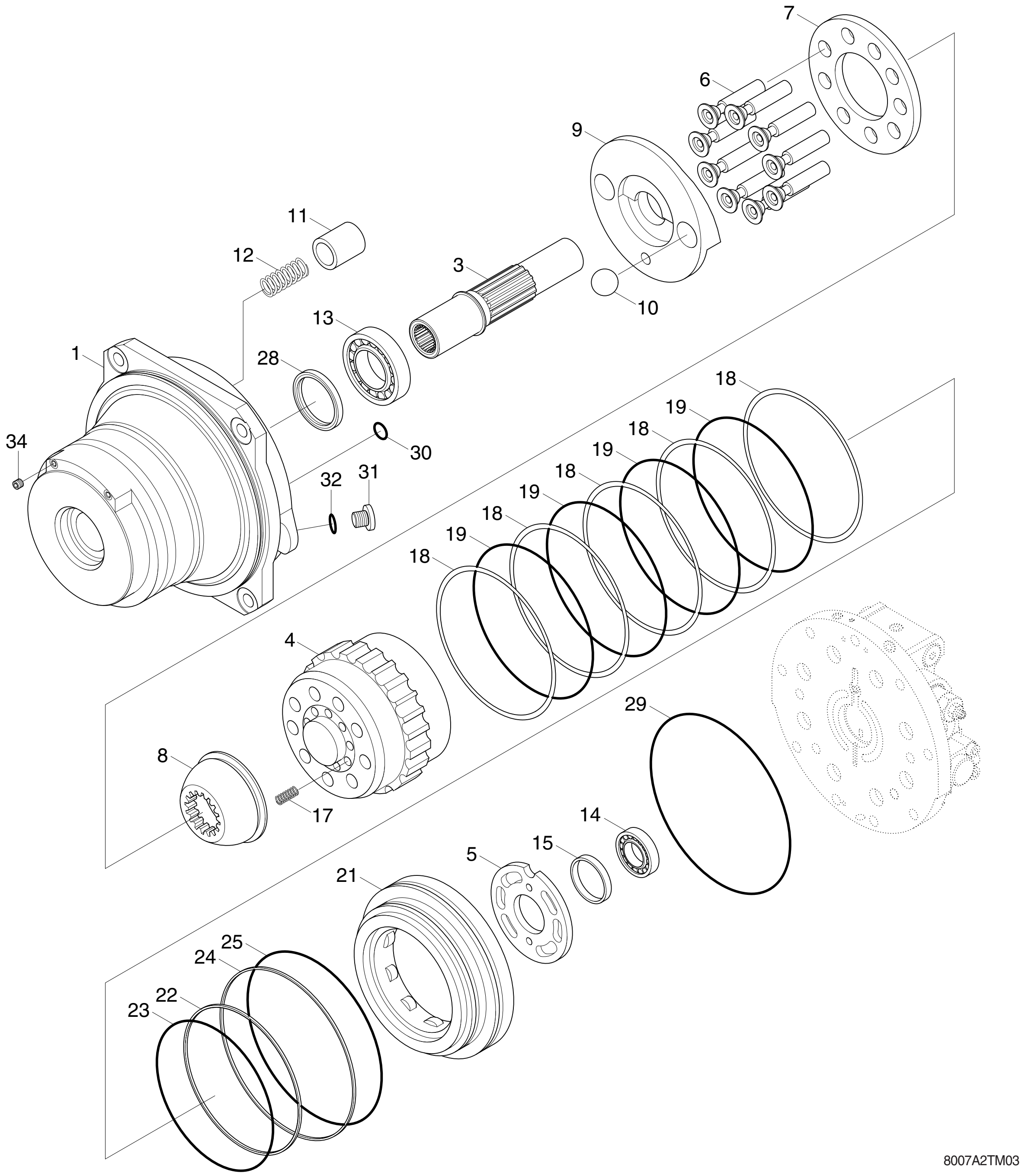
1) STRUCTURE



2-1	Base plate
2-2	Spool assy
2-2-1	Spool
2-2-2	Check valve
2-2-3	Spring
2-2-4	Plug
2-2-5	O-ring
2-3	Spring seat
2-4	Spring
2-5	Spring seat
2-6	Cap assy
2-6-1	Cap
2-6-5	O-ring
2-6-6	Bolt
2-7	Relief valve assy
2-7-1	Poppet seat
2-7-2	Relief housing
2-7-3	Poppet
2-7-4	Spring seat
2-7-5	Spring
2-7-6	Plug
2-7-7	Spring guide
2-7-8	Set screw
2-7-9	Nut
2-80	Free piston
2-81	O-ring
2-82	O-ring
2-83	O-ring
2-84	O-ring
2-85	Back up ring
2-86	Back up ring
2-87	Back up ring
2-9	Valve assy
2-9-1	Spool
2-9-2	Spool-C
2-11	Orifice
2-13	Spring
2-14	Plug
2-15	O-ring
2-16	Spring guide
2-17	Plug
2-19	Check valve
2-20	Spring
2-21	Plug
2-22	O-ring
2-23	Orifice
2-24	Orifice
2-25	Plug
2-26	O-ring
2-27	Shipping plug
2-28	Plug
16	Pin
26	Spring
27	Pin
33	Socket bolt
51	Name plate
52	Drive screw

TRAVEL MOTOR (2/2)

· Control part



1	Case	12	Spring	24	O-ring
3	Shaft	13	Roller bearing	25	Back up ring
4	Cylinder block	14	Roller bearing	28	Oil seal
5	Valve plate	15	Collar	29	O-ring
6	Piston assy	17	Spring	30	O-ring
7	Retainer plate	18	Friction plate	31	Plug
8	Plate holder	19	Disc plate	32	O-ring
9	Swash plate	21	Brake piston	34	Plug
10	Steel ball	22	O-ring		
11	Piston assy	23	Back up ring		

2) MAINTENANCE INSTRUCTION

(1) Tools for disassembly and reassembly

No.	Tool name	Specification	Applicable Components or Parts
1	Torque wrench	60 kgf · m (434 lbf · ft)	Orifice (2-11)
2		900 kgf · m (6510 lbf · ft)	Plug (2-2-4, 2-25), Nut (2-7-9), Orifice (2-23)
3		1800 kgf · m (13019 lbf · ft)	Bolt (2-6-6), Plug (2-14, 2-17)
4		5600 kgf · m (40505 lbf · ft)	Valve assy (2-7), Plug (2-21), Socket bolt (33)
5	Ratchet steering wheel for socket wrench		
6	Hexagonal bit for torque wrench	Hex. 2.5	Orifice (2-11)
7		Hex. 4	Orifice (2-23, 2-24)
8		Hex. 5	
9		Hex. 6	Set screw (2-7-8), Plug (2-25)
10		Hex. 10	Bolt (2-6-6), Plug (2-14, 2-17)
11		Hex. 12	Plug (31)
12		Hex. 14	Plug (2-2-4, 2-21), Socket bolt (33)
13	Socket	Hex. 21	
14		Hex. 36	Relief valve assy (2-7)
15	Hexagon socket screw key	Hex. 2.5	Orifice (2-11)
16		Hex. 4	Orifice (2-23, 2-24)
17		Hex. 5	
18		Hex. 6	Set screw (2-7-8), Plug (2-25)
19		Hex. 10	Bolt (2-6-6), Plug (2-14, 2-17)
20		Hex. 12	Plug (31)
21		Hex. 14	Plug (2-2-4, 2-21), Socket bolt (33)
22	Spanner	Hex. 19	Nut (2-7-9)
23		Hex. 21	
24		Hex. 36	Relief valve assy (2-7)
25	Minus driver	6×100	Base plate assy (2), Valve plate (5)
26	Plastic hammer	#3	
27	Punch	About 10 mm	
28	Hand Press	200 kgf or more	
29	Crane	For 400 kg	
30	Eyebolt	M12	Case (1), Base plate assy (2), Base plate (2-1)
31	Chain string (wire)		

3) DISASSEMBLY

(1) General precautions

① Before disassembling the motor, check the items to be inspected and, for remedy against trouble, closely examine the nature of the trouble, so that the motor can be disassembled effectively.

② To disassemble the motor, use the disassembling procedures described in section 2) and select a clean place.

③ Place a rubber or vinyl sheet or other such protective materials on your working bench to protect the surface of the motor to be serviced.

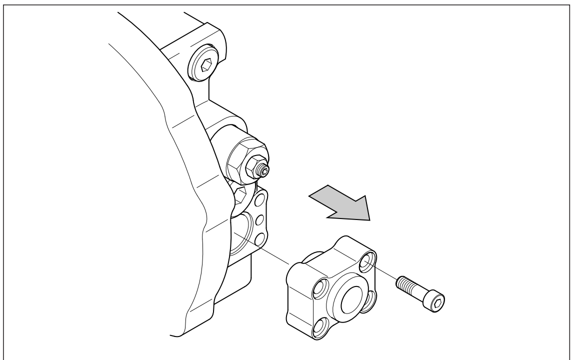
④ During disassembly, give a match mark to the mating surfaces of each part.

⑤ Arrange removed parts in order so that they will not become damaged or missing during disassembly.

⑥ Once seals have been disassembled, they should be replaced even if damage is not observed. Have replacement seals ready on hand before starting your disassembling job.

(2) DISASSEMBLY TRAVEL MOTOR

① Remove cap (2-6) and take out spring (37), spring seat (36).



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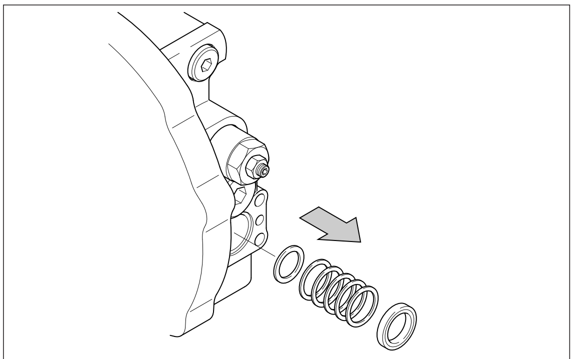

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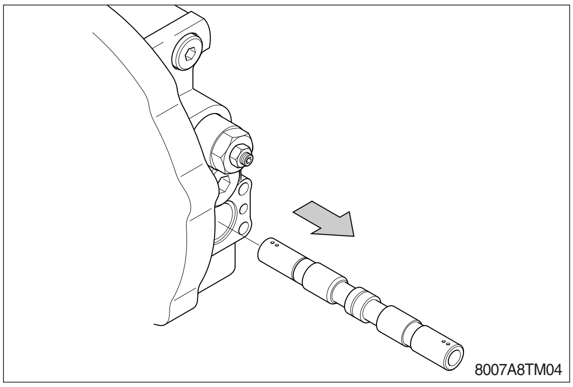
② Remove spool assy (2-2) turning slowly. Be careful not to damage around the spool assy.

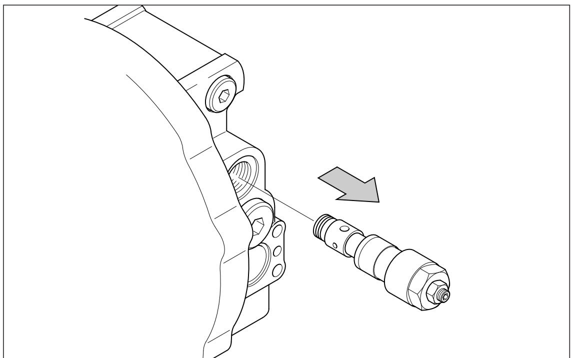


8007A8TM04

③ Loosen the plug (2-7-6) to remove the relief valve assembly (2-7).

※ Do not move the setscrew, nut. Otherwise, the set pressure will change.

※ Do not disassemble the relief valve assembly because it is a functional comonent.



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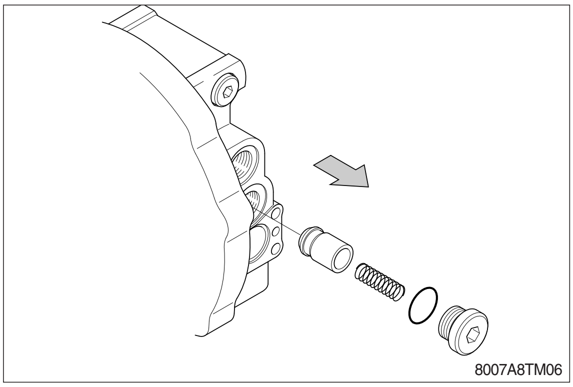
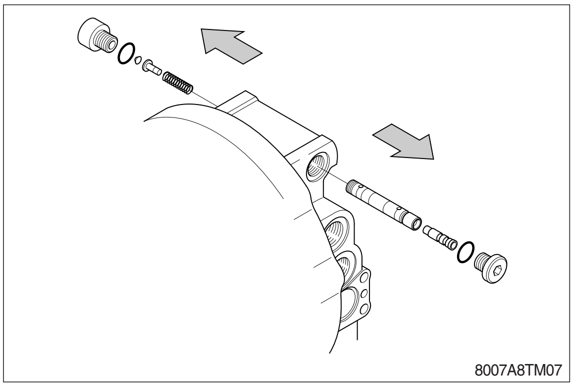
④ Remove plug (2-21), spring (2-20) and check valve (2-19).



⑤ Remove Plugs (2-14, 2-17) remove spring (2-13) and spool assy (2-9).



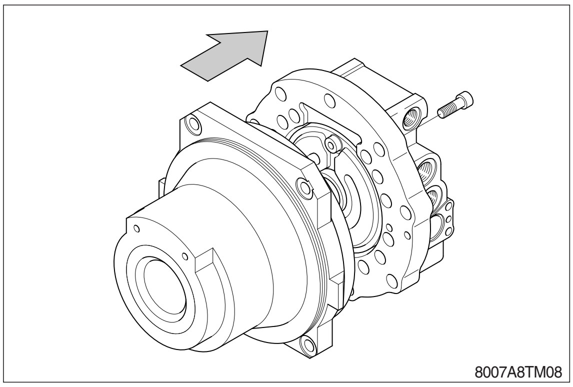
⑥ Remove socket head bolt (33).

- Points

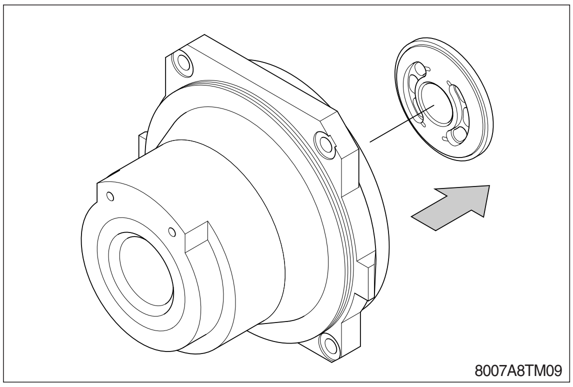
  To disassemble the motor easily, socket head bolt (33) should be loosened evenly because base plate (1-2-1) lift up by the reactive force of springs (26).

- Remove base plate (1-2-1).

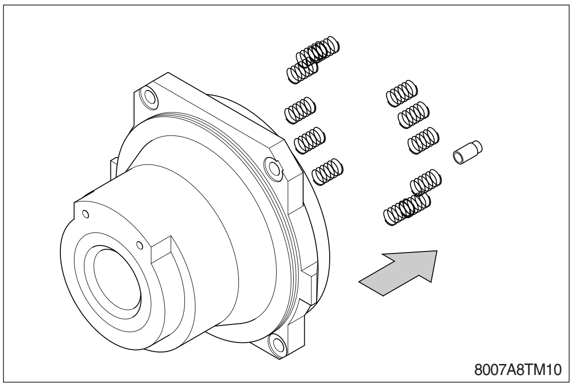
  Then, pay attention so that cylinder block does not come out. When it is difficult to remove, strike it by use of plastic hammer. If it is more difficult to remove, remove it by lightly prying with screwdriver.



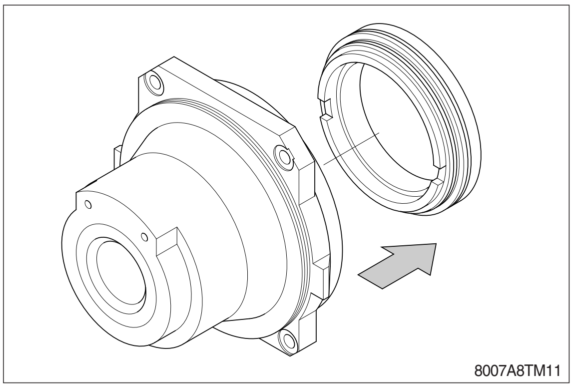
⑦ Remove valve plate (5) from base plate (1-2-1).



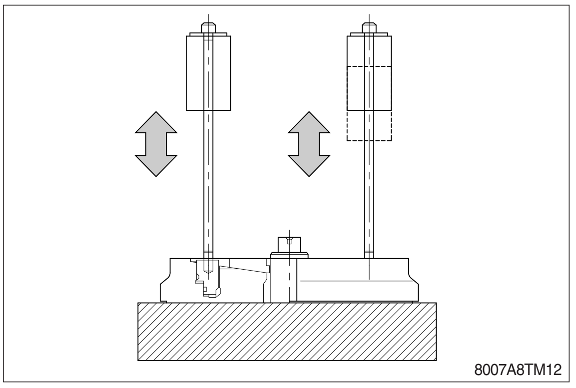
⑧ Remove O-rings (29)(30), pins (27) and springs (26).



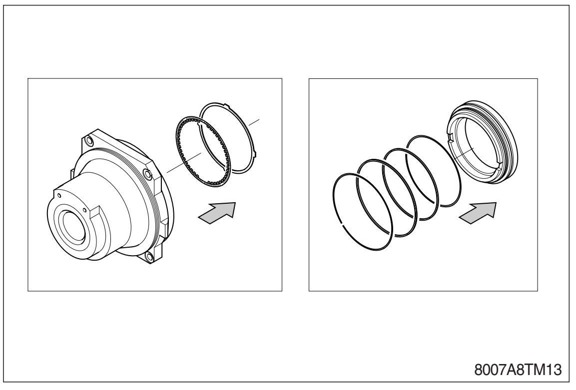
⑨ Remove brake piston (21).
Blow compressed air into parking brake-releasing port on case (1).



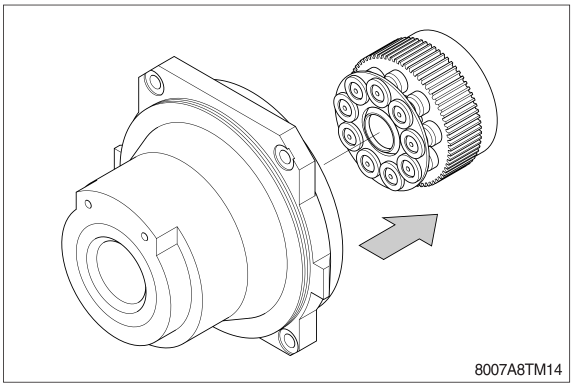
※ Before work, put rag on all surface of brake piston because brake piston fly out and oil flies off while at work.



※ After removing brake piston, remove disk (19), friction plate (18)(20). And then, removing O-rings (22)(24) and back up rings (23)(25).

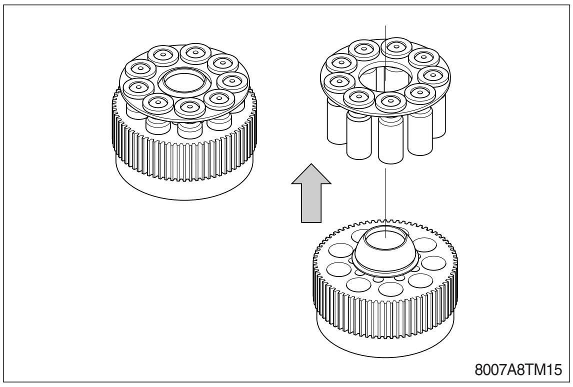


⑩ Remove cylinder block assy.

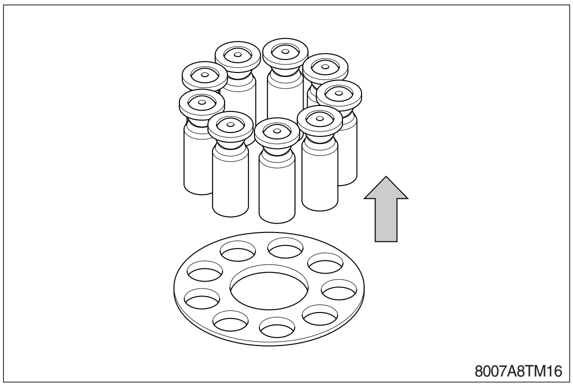


⑪ Disassemble cylinder block assy.

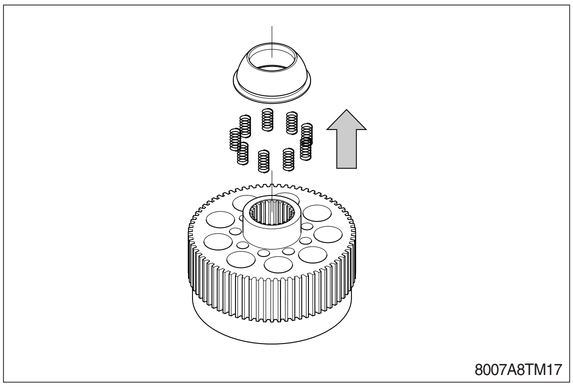
a: Remove piston assy (6) and retainer plate (7) from cylinder block (4).



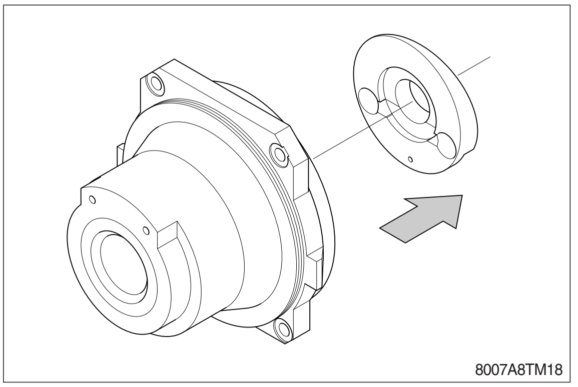
b: Remove piston assy (6) from retainer plate (7).



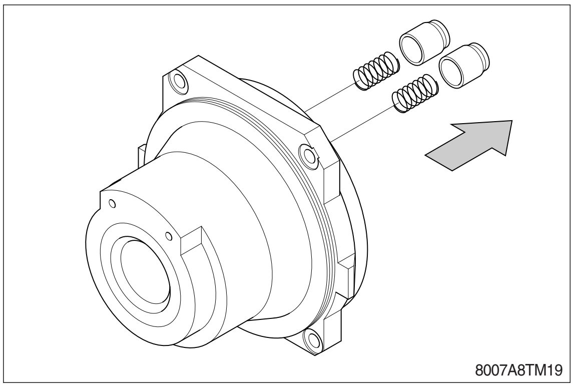
c: Remove retainer holder (8) from cylinder block (4).
And then, remove springs (17) from cylinder block (4).

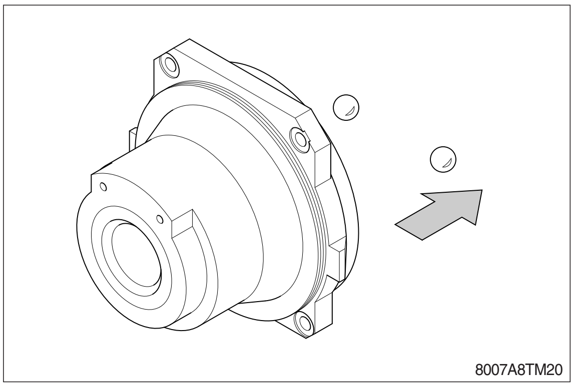


⑫ Remove swash plate (9).

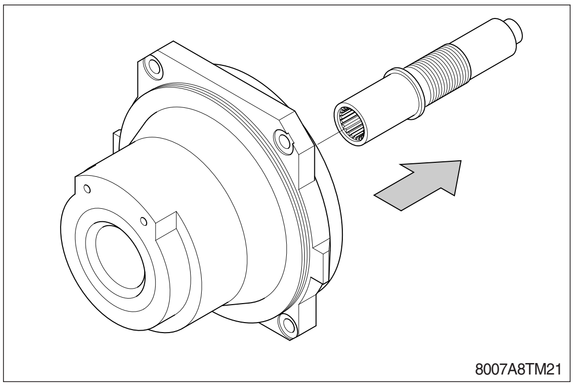


⑬ Remove piston assy (11) and spring (12).
And then remove steel ball (10).





⑭ Remove shaft (3).

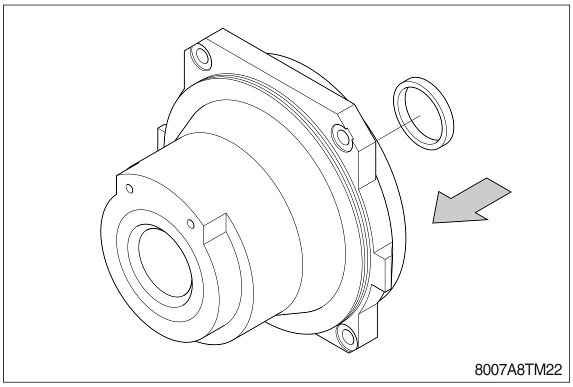


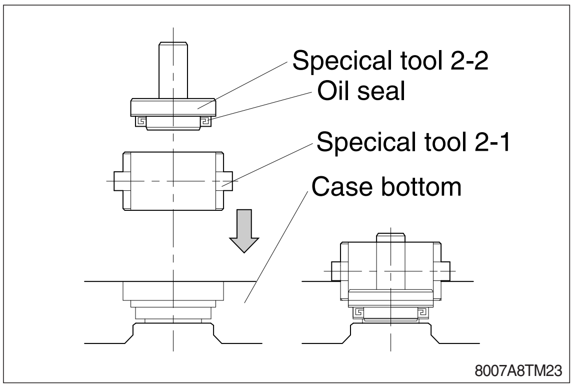
4) REASSEMBLY

(1) General precautions

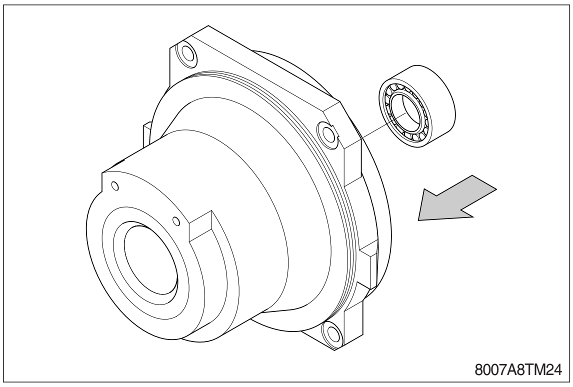
① Reassemble in a work area that is clean and free from dust and grit.
② Handle parts with bare hands to keep them free of linty contaminates.
③ Repair or replace the damaged parts.
Each parts must be free of burrs its corners.
④ Do not reuse O-rings, oil seal and floating seal that were removed in disassembly.
Provide the new parts.
⑤ Wash all parts thoroughly in a suitable solvent.
Dry thoroughly with compressed air.
Do not use the cloths.
⑥ When reassembling oil motor components of motor, be sure to coat the sliding parts of the motor and valve with fresh hydraulic oil. (NAS class 9 or above)
⑦ Use a torque wrench to tighten bolts and plugs, to the torque specified as follows.

① Apply grease to oil seal (28) and press fit it in case (1).



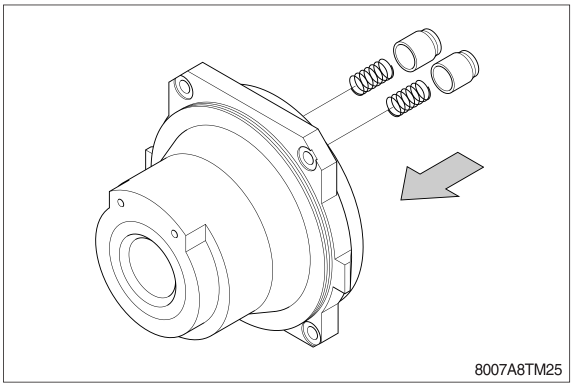


② Press fit the outer race of roller bearing (13) in case (1).

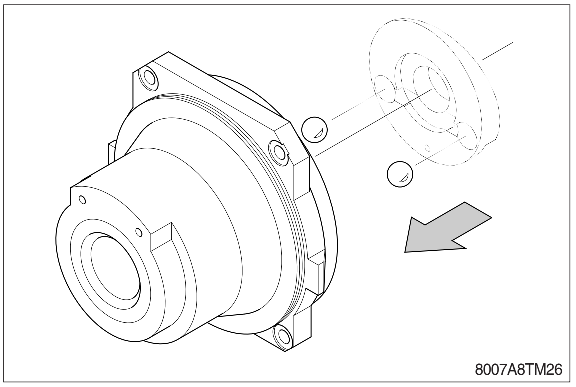


③ Install springs (12) and piston assy (11) on case (1).

※ **Apply hydraulic oil to the sliding surface of the piston assy.**



④ Install steel ball (10).
※ **Apply hydraulic oil to the surface of the steel ball.**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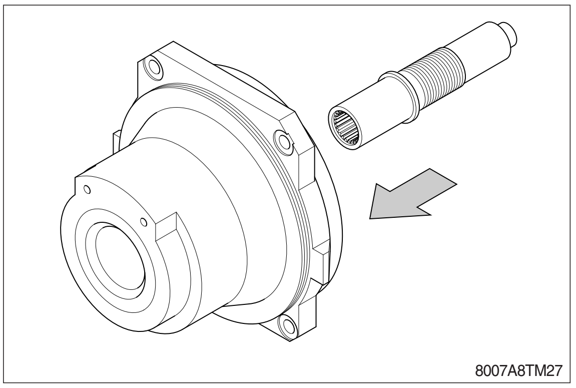
⑤ Press fit Inner race of roller bearing (13) on shaft (3).
And then, install shaft sub assy on case (1).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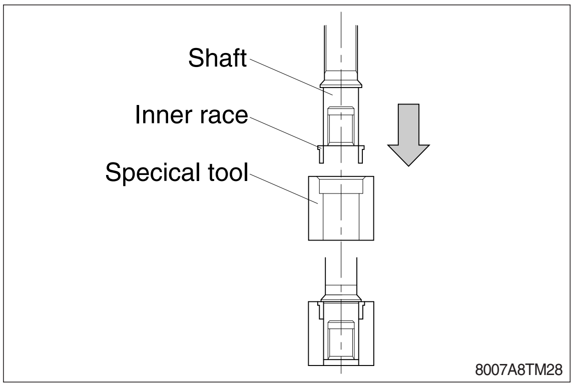

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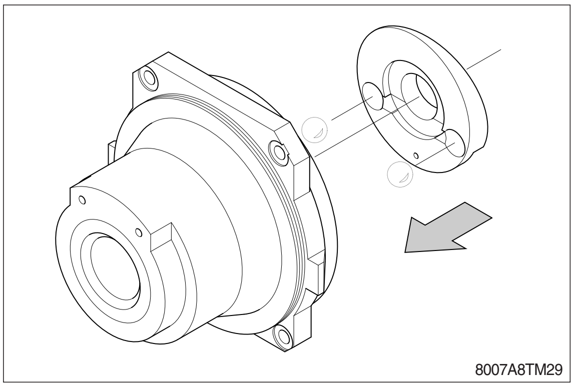
⑥ Install Swash plate (9).
※ **Apply hydraulic oil to the surface of the steel ball.**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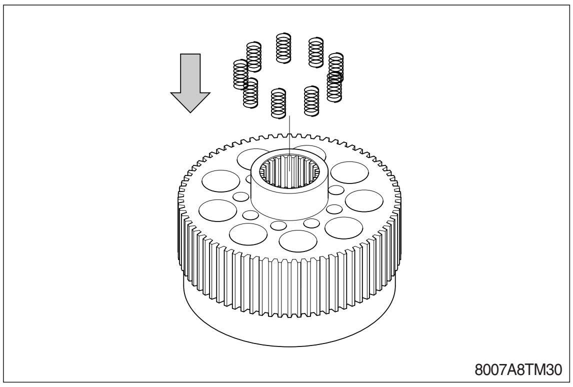
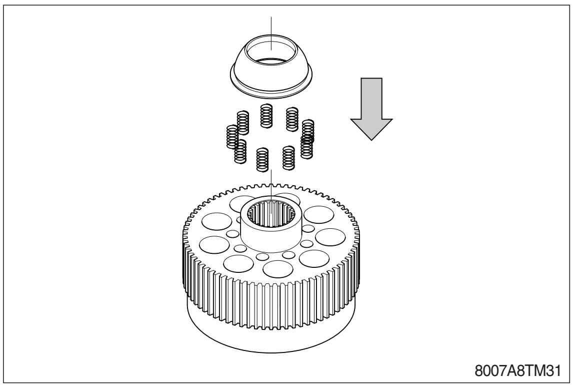
⑦ Install 9 springs (17) on cylinder block (4).

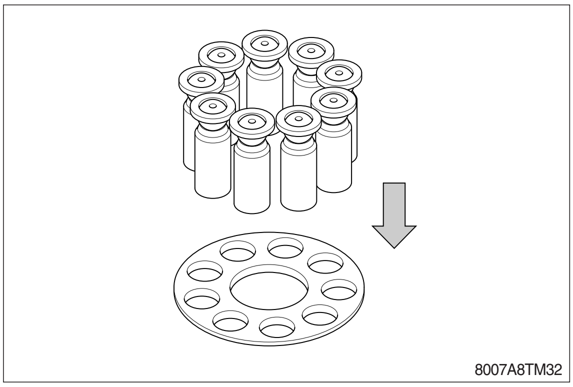


⑧ Install retainer holder (8) on cylinder block (4).



⑨ Install 9 piston assy (6) in each holes of retainer plate (7).

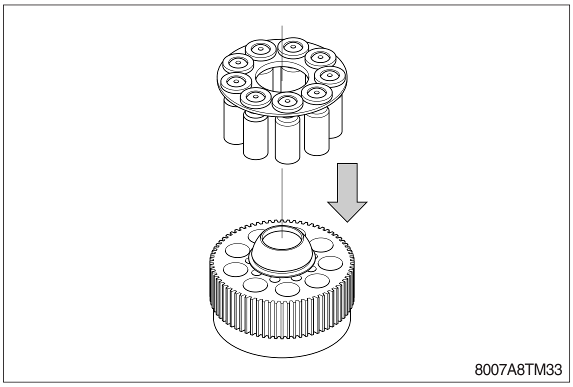
※ **Be care for the direction of the retainer plate.**



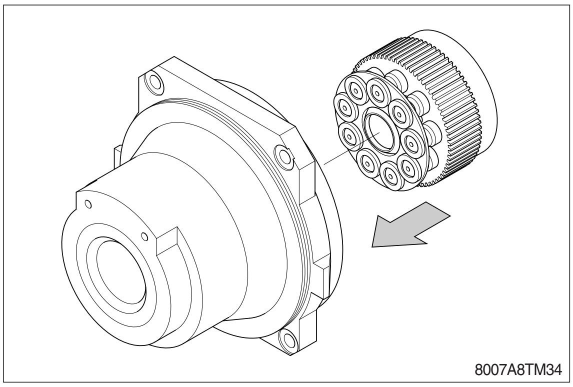
⑩ Install piston assy (6) and retainer plate (7) in cylinder block (4).

※ **Apply hydraulic oil in 9 holes of cylinder block.**

Apply hydraulic oil on the surface of retainer holder (8) and retainer plate (7).



⑪ Install cylinder block assy.
※ Apply hydraulic oil on the surface of piston assemblies (6) and swash plate (9).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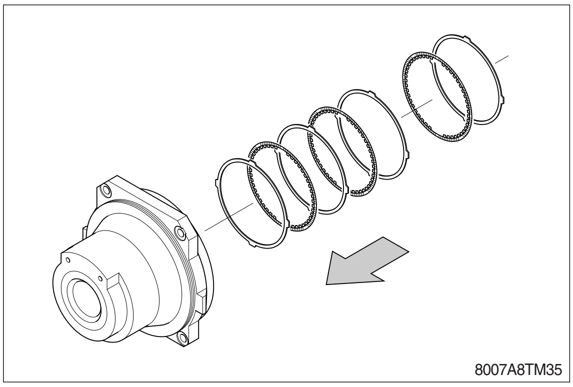
⑫ Install friction plates (18) and disk plates (19).
a: Apply enough hydraulic oil to disk plate.
b: The circular arc part of the friction plate is set to the cutting lack part of the case.
c: There is a part where teeth are lacked in the spline of disk plate.
When assembling the disk plates, match the position of these each parts.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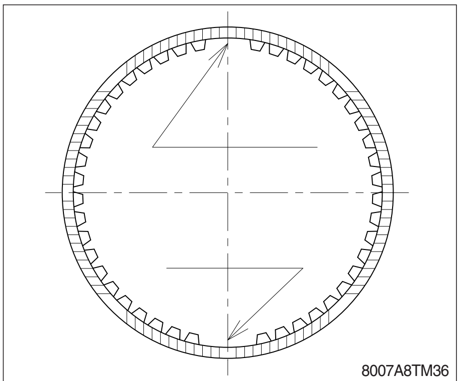
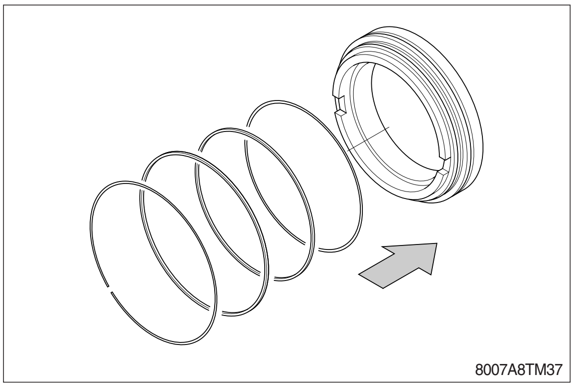
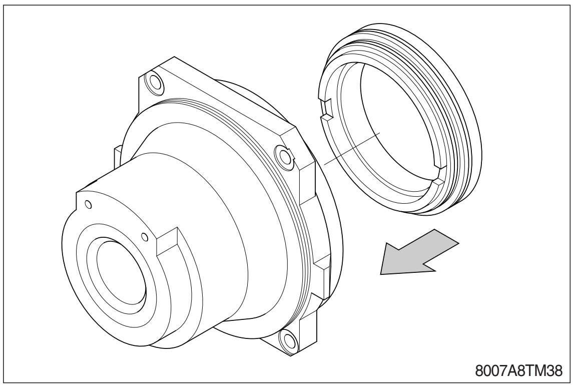

8007A8TM36

d: Refer to the sectional drawing for the combination of assembling friction plate and disk plate.

⑬ Apply grease to O-rings (22)(24), backup ring (23)(25), and install them to brake piston (21).
And install brake piston (21) to case (1) to align pins (27) installed on base plate in No.** with holes on brake piston (21).
When install it, beat on evenly outside of brake piston by using of plastic hammer.
a: Each backup rings should be set out side position.
b: Be careful of installing direction of brake piston.
c: Apply grease to outside of brake piston and inside of case (1).


8007A8TM37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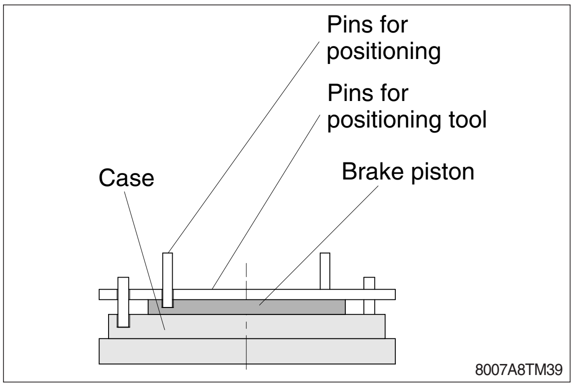
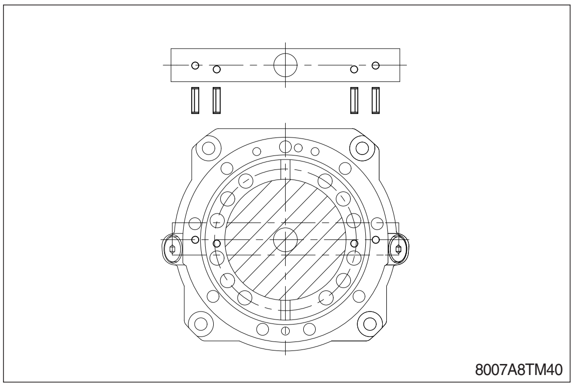
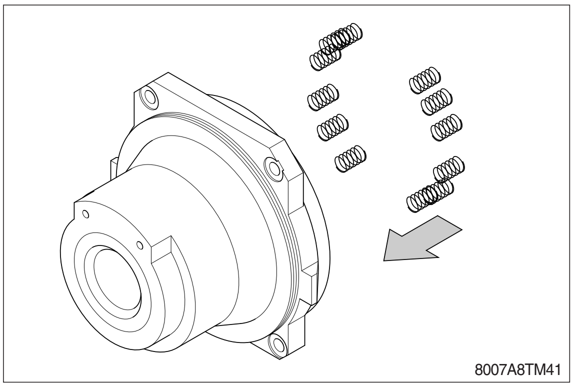


8007A8TM39

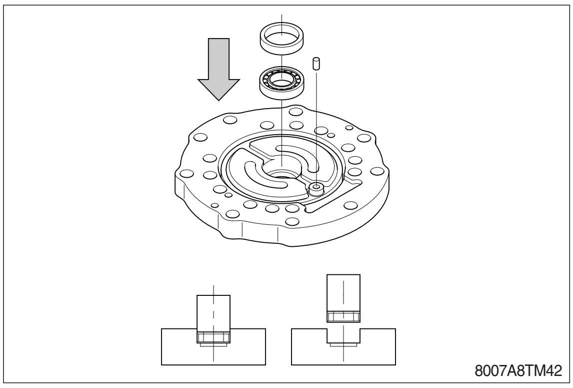

8007A8TM40

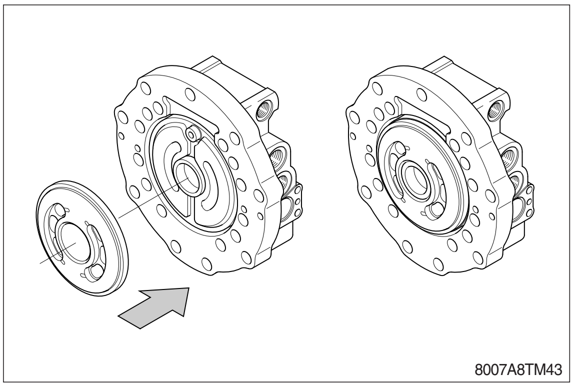
⑭ Install springs (26) in the holes of brake piston (21).



⑮ Press fit roller bearing (14) on base plate (2-1).
Install pins (16) and color (15) on base plate (2-1).

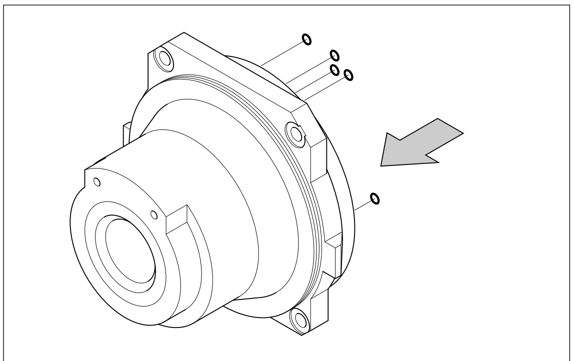
※ Apply grease to the surface of valve plate (25) and base plate (2-1).

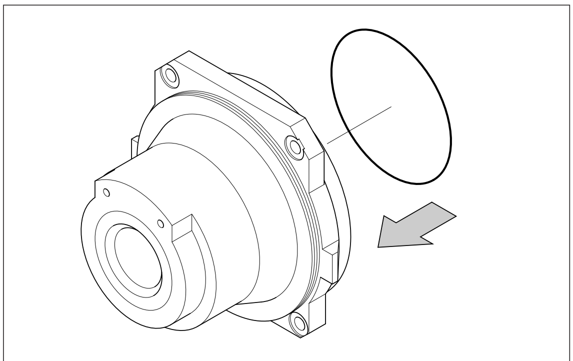


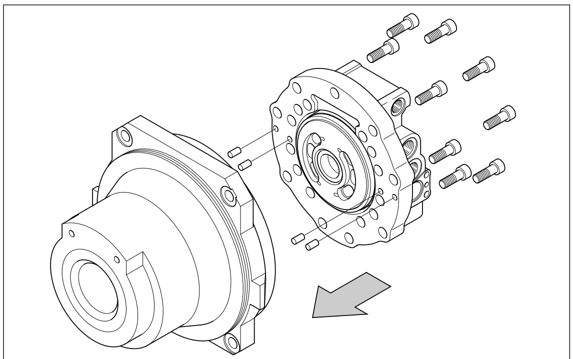


⑯ Install O-rings (29)(30) on case (1).
Install pins (27) on base plate (2-1).
Install base plate (2-1) and socket head bolt (9).

a: Apply grease to O-ring (25).
b: Do not apply grease to O-ring (30).
c: Be care for direction of pin (27).
d: Apply hydraulic oil to the surface between cylinder block (4) and valve Plate (5).
e: Be care for pilot line of base plate and case (1).
f: Tighten the bolts evenly, as base plate is pushed by spring.

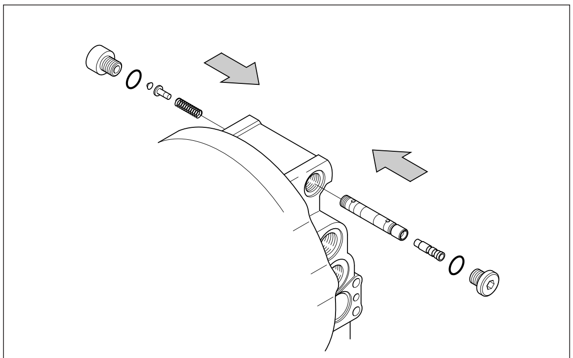

8007A8TM44


8007A8TM45


8007A8TM46

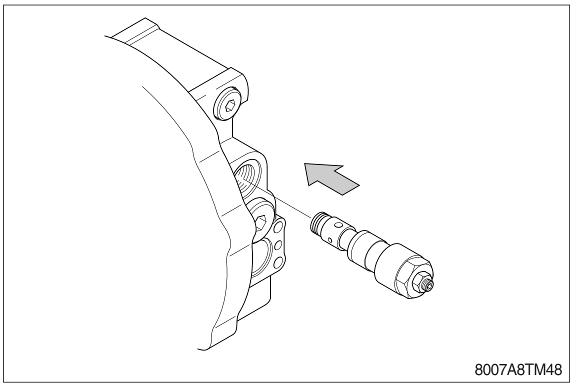
⑰ Place spring (2-13) on valve assy (2-9), and then install valve assy on base plate (2-1).
Tighten plug (2-14) with O-ring (2-15).
Place spring guide (2-16) and washer (2-18), and then tighten plug (2-17) with O-ring (2-15).

※ **Apply hydraulic oil to valve assy before installation.**
Apply slight grease to O-rings (2-15).


8007A8TM47

⑱ Tighten relief valve assemblies (2-7).

※ Apply slight grease to O-rings (2-7-12) and backup rings (2-7-16).

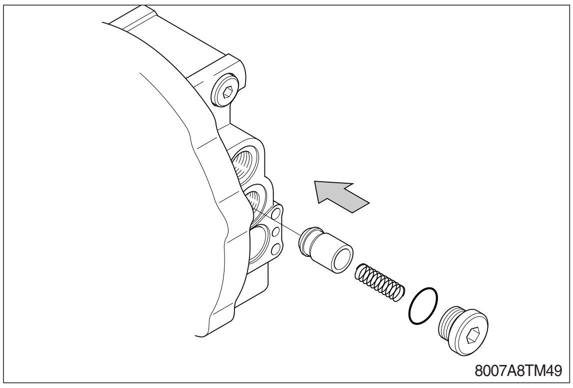


8007A8TM48

⑲ Place check valve (2-19) and springs (2-20).

Tighten plug (2-21) with O-ring (2-22).

※ Apply slight grease to the O-rings.

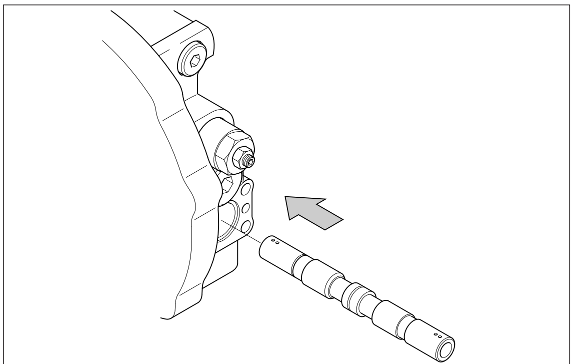


8007A8TM49

⑳ Install spool assy (2-2) on base plate (2-1).

Install it while turning to prevent it from sticking.

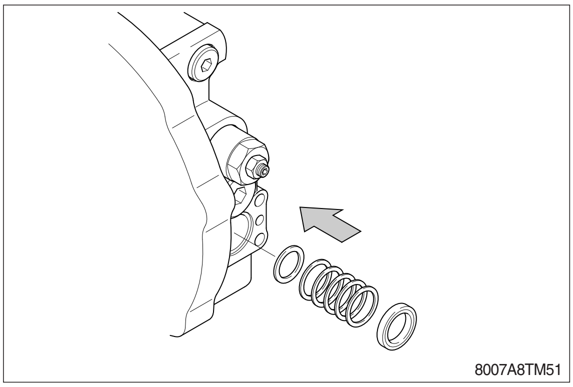
※ Apply hydraulic oil to spool assy before installation.



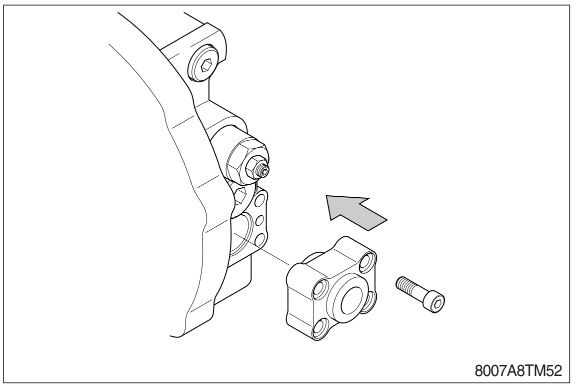
8007A8TM50

㉑ Place spring seats (2-3) and springs (2-4).
Install O-rings (2-10) on base plate (2-1).
Install O-rings (2-6-5) on cap assy (2-6).
Place spring seats (2-5) on cap assy (2-6), and then install them on base plate (2-1).

※ Tighten socket head bolts (2-6-6).
Apply grease to O-rings (2-6-5).



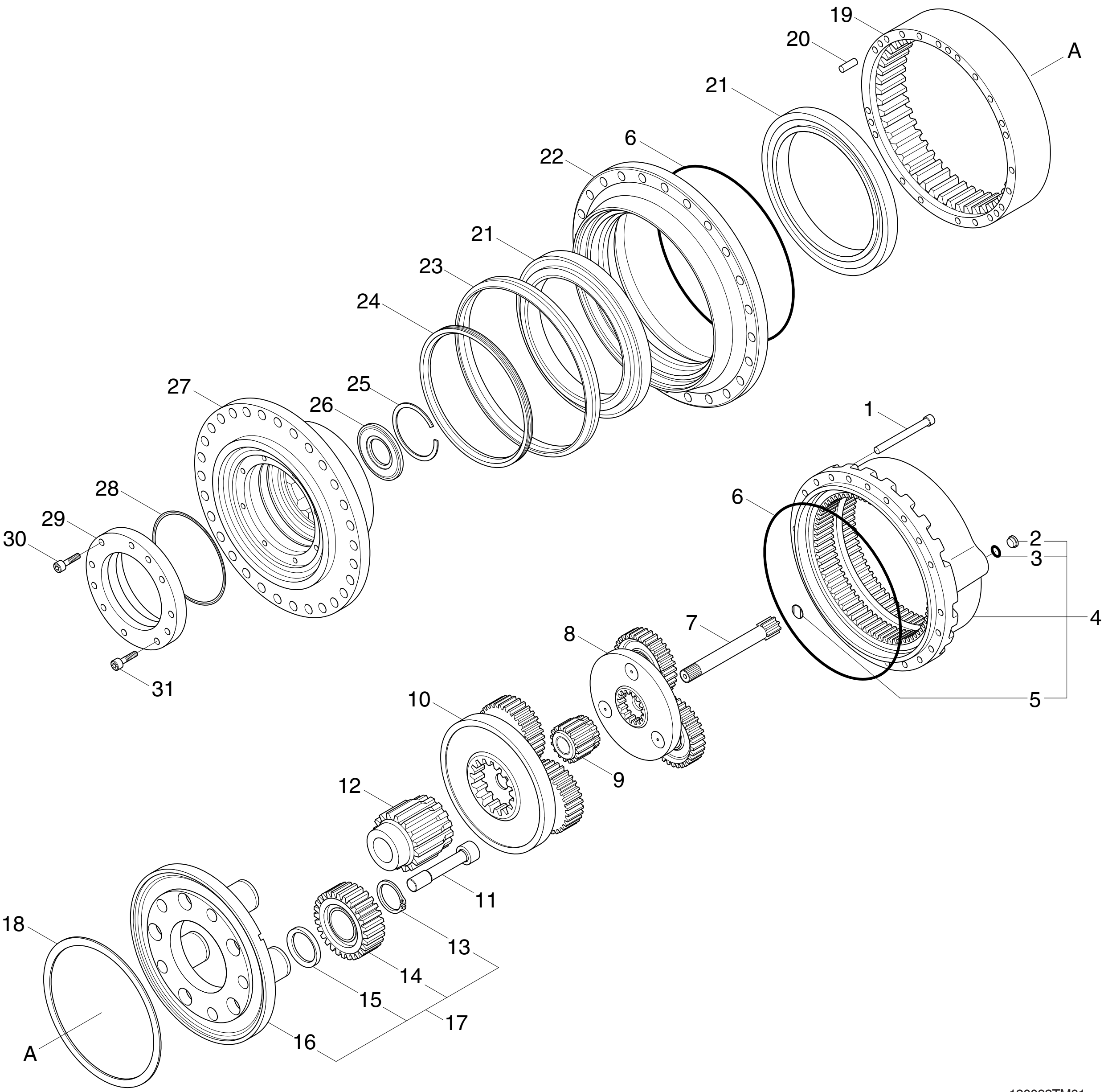
8007A8TM51



8007A8TM52

3. REDUCTION GEAR

1) STRUCTURE



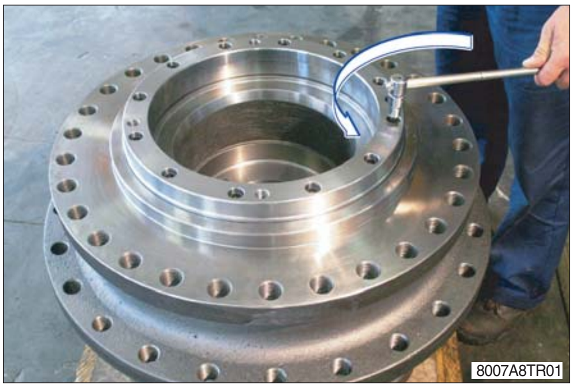
1	Screw	12	Sun gear	22	Gear box housing
2	Oil breather plug	13	Circlip	23	Life time seal
3	Washer	14	Planetary assy	24	Spacer
4	Cover assy	15	Spacer	25	Circlip
5	Pad	16	Planetary carrier	26	Discs retainer
6	O-ring	17	Gear assy (3rd)	27	Hub
7	Sun gear	18	Spacer	28	O-ring
8	Gear assy (1st)	19	Toothed ring	29	Motor adaptor
9	Sun gear	20	Pin	30	Screw
10	Gear assy (2nd)	21	Bearing	31	Screw
11	Screw				

2) DISASSEMBLING

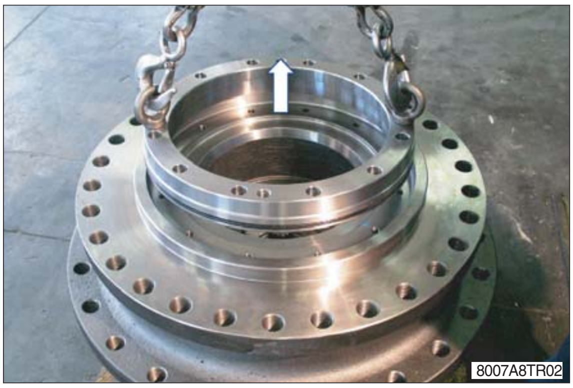
Initial inspection of the gears and the travel motor, can be made without disassembling the track and the gearmotor from the machine.

Prior to disassembling make sure that the oil is discharged, unscrew and remove the 4 screws (31), and remove the travel motor and the O-ring seal.

(1) Unscrew the 12 socket head screws (30) and remove the motor flange from the adapter flange (29).

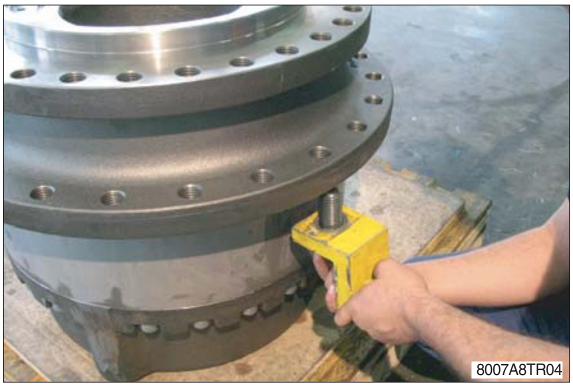


(2) By using a tackle remove the motor adapter flange (29).



(3) Remove the O-ring (28) from its seat in the motor adapter flange (29).

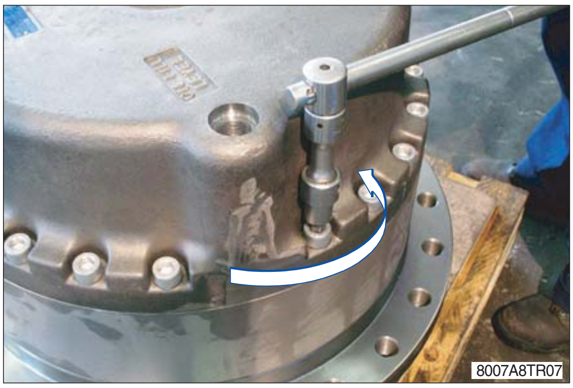
(4) Assemble the equipment on the gearbox housing (22).



(5) By using a tackle and the equipment turn the gearbox upside down.

(6) Unscrew the 2 plugs (2) and the 2 washers (3) from the end cover (4).

(7) Unscrew the 21 socket head screws (1) from the end cover (4).



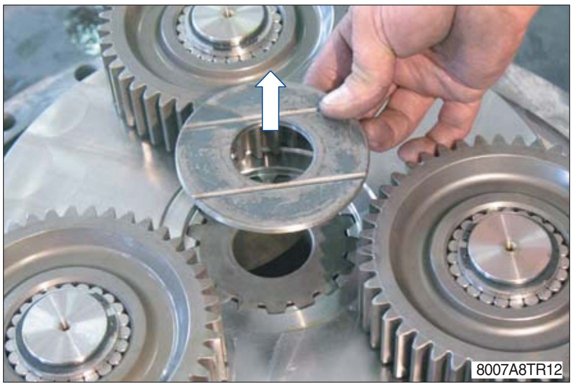
(8) By using a tackle and the equipment remove the end cover (4).

(9) Remove the O-ring (6) from its seat in the end cover (4).

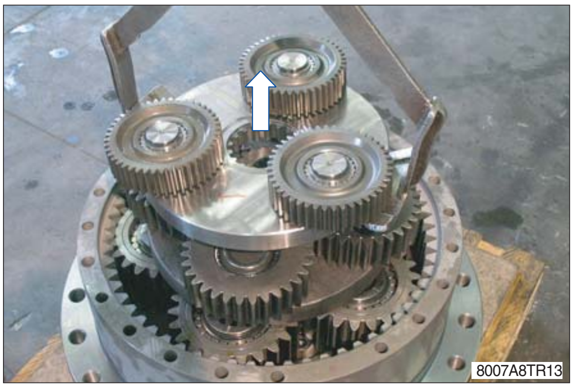
(10) Screw a socket head screw in the threaded hole of the pad (7) in order to remove it from the end cover (4).

(11) Remove the 1st stage sun gear (7).

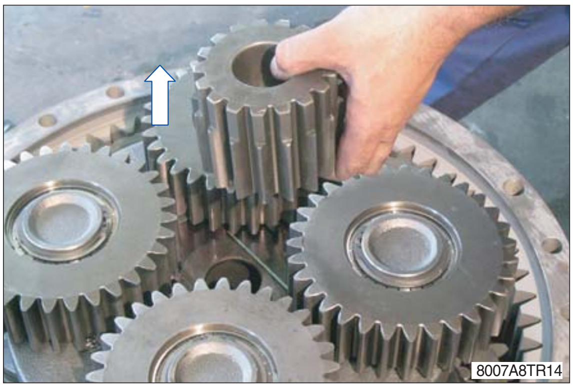
(12) Remove the centering ring.



(13) By using a tackle and the equipment remove the 1st reduction assembly (8).

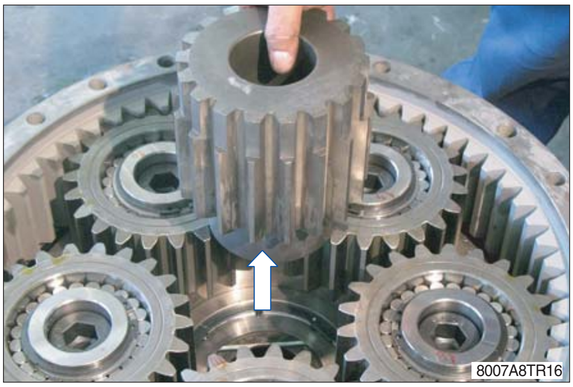


(14) Remove the 2nd stage sun gear (9).



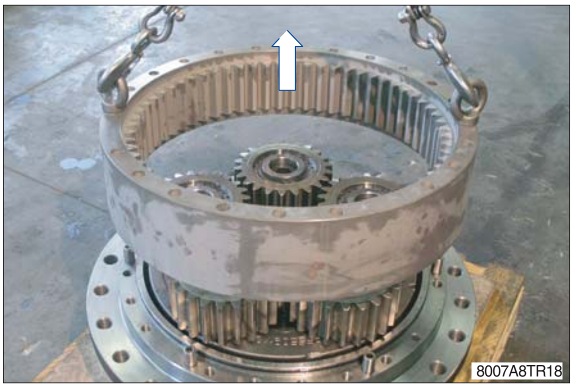
(15) By using a tackle and the equipment remove the 2nd reduction assembly (10).

(16) Remove the 3rd stage sun gear (12).

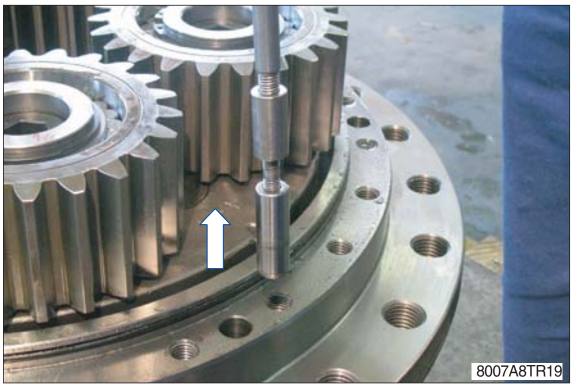


(17) By using a crowbar lift the toothed ring (19) from the gearbox housing (22).

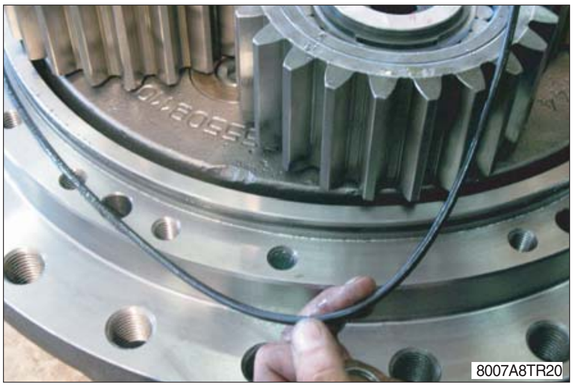
(18) Tighten 2 eyebolts on the toothed ring (19) and by using a tackle remove it from the gearbox housing (22).



(19) By using the puller remove the 6 pins (20) from the gearbox housing (22).

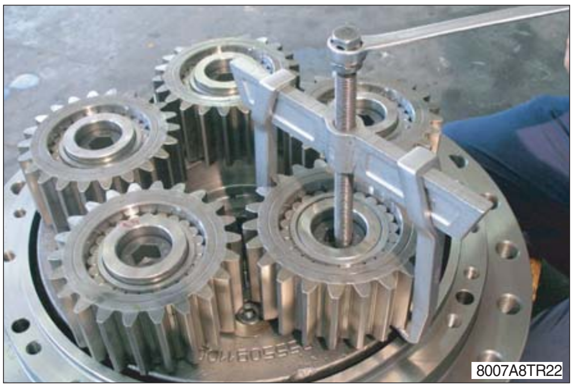


(20) Remove the O-ring (6) from its seat in the gearbox housing (22).



(21) By using pliers remove the circlips (13) from their seats placed in the planetary carrier's pins (16).

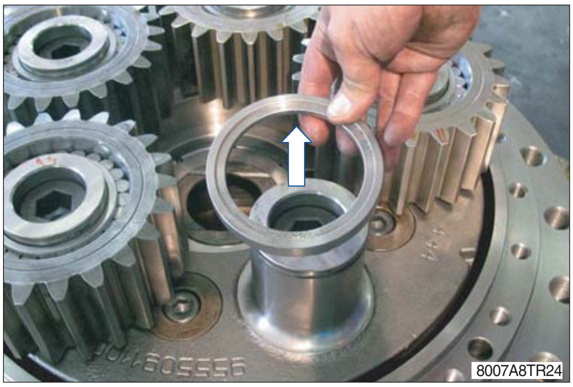
(22) By using a puller remove the planet assemblies of the 3rd reduction (14).



(23) Remove the planet assemblies of the 3rd reduction (14).

(24) Remove the spacer (15) from their seats placed in the planetary carrier's pins (16).

※ **In order to proceed with the gearbox disassembly, it is now necessary to remove it from the machine and bring it to a properly equipped workshop.**



(25) By using a tackle palce the screwer on the planetary carrier's pins (16).

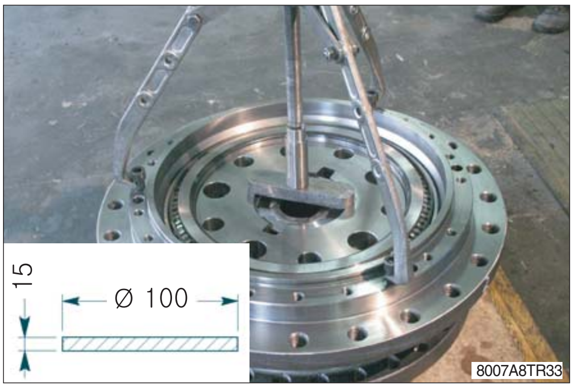
(26) By using the screwer tighten the 5 socket head screws (11) from the planetary carrier (16).

(27) Take out the nos. 5 socket head screws (11).

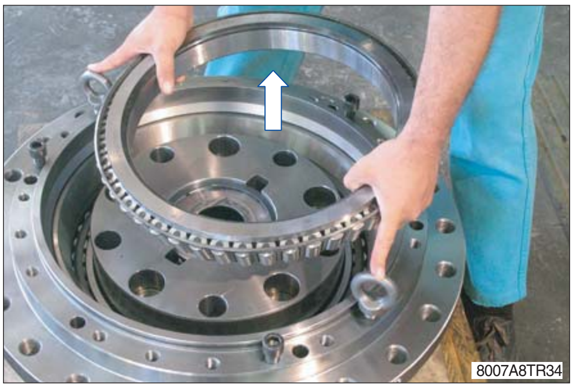
(28) By using a tackle remove the planetary carrier (16) from the gearbox housing (22).

(29) By using a screwdriver, remove the spacer (18) from the planetary carrier (16).

(30) By using a puller and a metal stopper remove the flanged hub (27) from the gearbox housing (22).

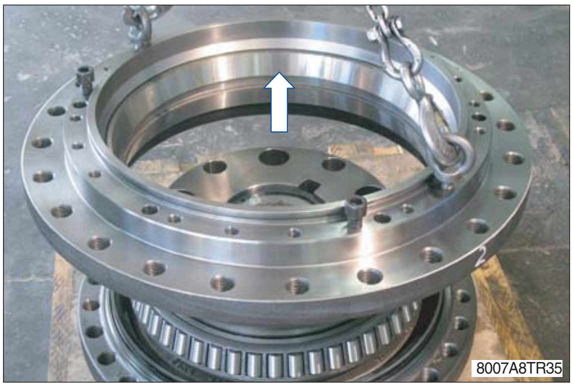


(31) Remove the bearing inner ring (21) from its seat in the gearbox housing (22).



(32) Tighten 2 eyebolts on the gearbox housing (22) and by using a tackle remove it from the flanged hub (27).

※ In case of oil leakages, it might be necessary to check and eventually replace the lifetime seal (23), which means both the steel rings and the O-ring seals.



8007A8TR35

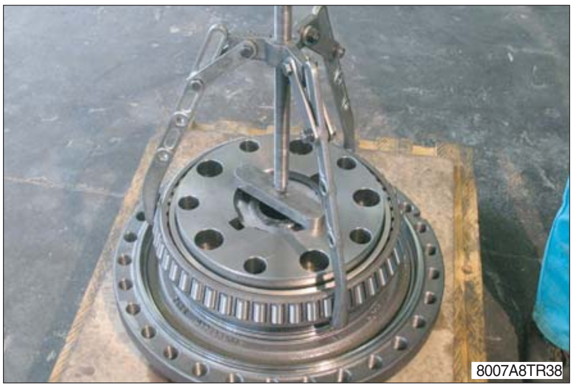
(33) Remove the half-seal (23) from the flanged hub (27).

8007A8TR36

(34) Remove the half-seal (23) from the gearbox housing (22).

8007A8TR37

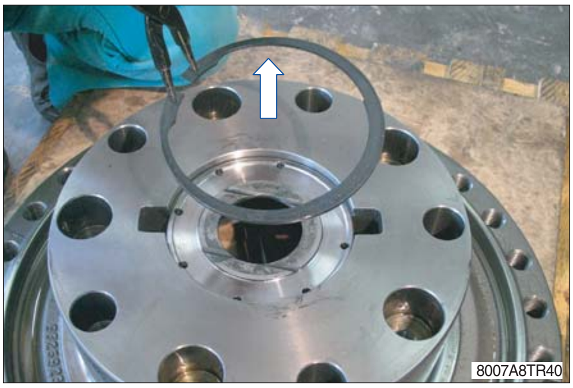
(35) By using a puller remove the bearing inner ring (21), from the flanged hub (27).



8007A8TR38

(36) Remove the spacer (24) from its seat in the flanged hub (27).

(37) By using pliers remove the circlip (25) from its seat in the flanged hub (27).



(38) By using a punch remove the discs retainer (26) from the flanged hub (27).

(39) By using a rubber hammer and a punch remove the bearing outer rings (21) from the gearbox housing (22).

※ **The gearbox disassembly ends with the above operation. All the parts are now available for the necessary inspections.**

1) REASSEMBLY

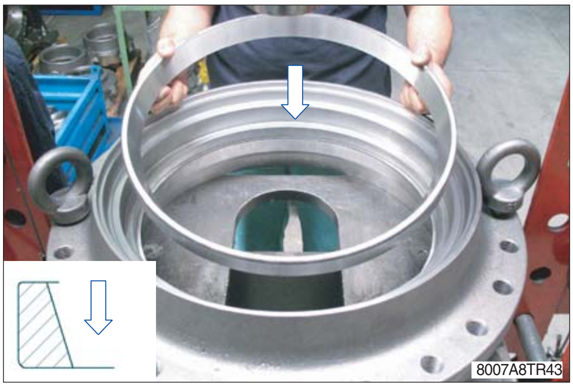
※ The pieces that are subject to general wear and tear are the following :

- Gears
- Bearings
- All the seals

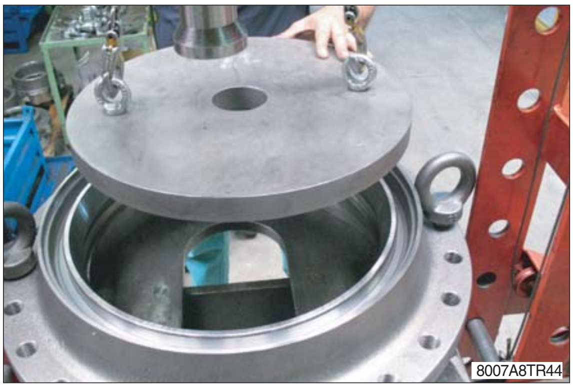
※ Replace the used or irregular parts respecting the following steps:

- Accurately remove dirt, and in particular properly clean the seals, bearings and locking rings seating.
- Lubricate the parts before connecting them.
- In the case of damaged gears, for example a planetary, do not proceed to replace the individual gear but the entire reduction assembly.
- When reconnecting a part always replace all the seals involved. Add some grease on the seats and on the new seals to make easier the reassembly.

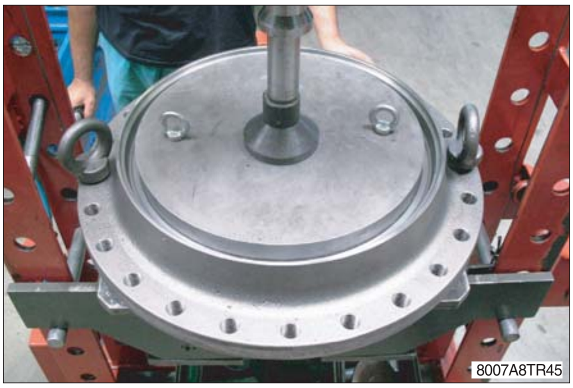
(1) Assemble the bearing inner ring (21) in the gearbox housing (22).



(2) Place the equipment on the bearing outer ring (21).



(3) By using a press and the stopper push the bearing outer ring (21) against the gear-box housing shoulder (22).



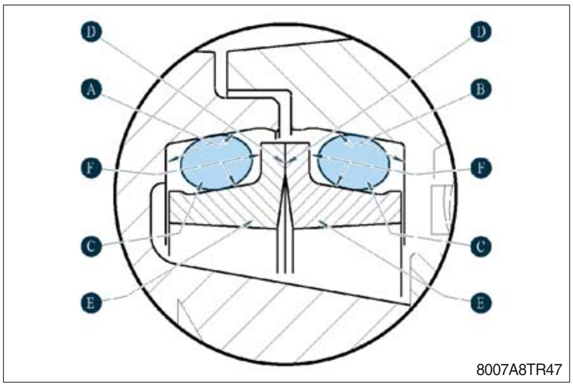
(4) Insert the spacer (24) on the flanged hub (27).

※ **Make ready of the lifetime seal :**

① Carefully clean the **seats (A and B)** using, if necessary, metallic brushes or solvent (surfaces in contact with or (c) must be perfectly clean and dry).

② Make sure that **sealing surfaces (D)** of **metal rings (E)** are free from scratches, dinges or foreign substances; metallic ring surfaces must be perfectly clean and dry. We suggest to dip the metallic rings in volatile solvent or industrial degreasing alcohol.

③ Carefully clean the **lapped surface (D)** of **metal rings (E)** and remove dust or fingerprints. Then lubrificate them with a thin oil film, taking care not to oil the other components.



8007A8TR47

(5) Assemble the half seal (23) on the tool.


8007A8TR48

(6) Assemble the 1st half seal (23) in the flanged hub (27).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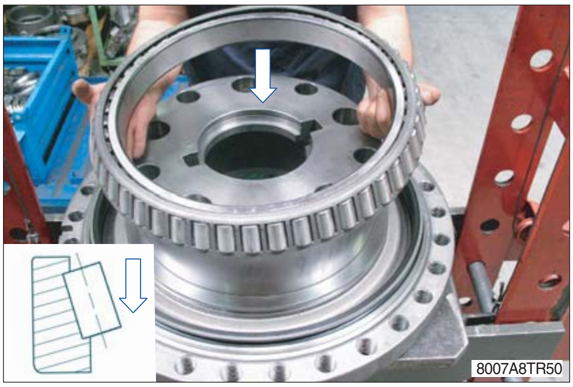
(7) Assemble the bearing inner ring (21) in the flanged hub (27).

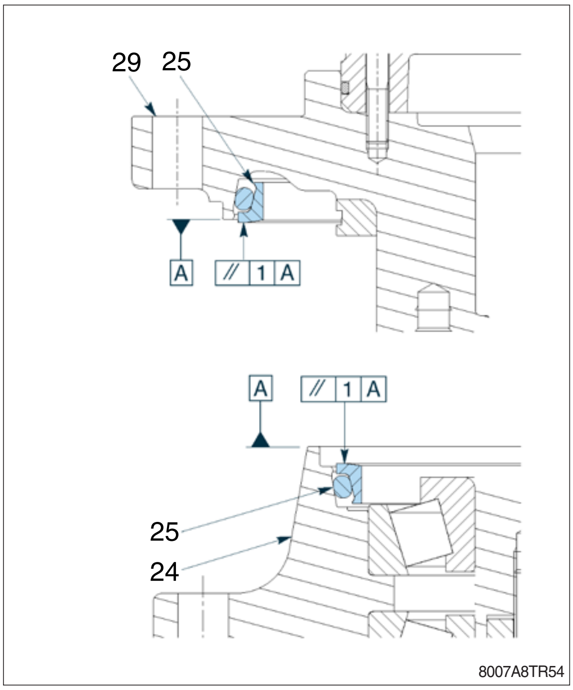


(8) Place the equipment on the bearing inner ring (21).

(9) By using a press and the stopper push the bearing inner ring (21) against the flanged hub shoulder (27).

(10) Insert the 1st reduction assembly(8).

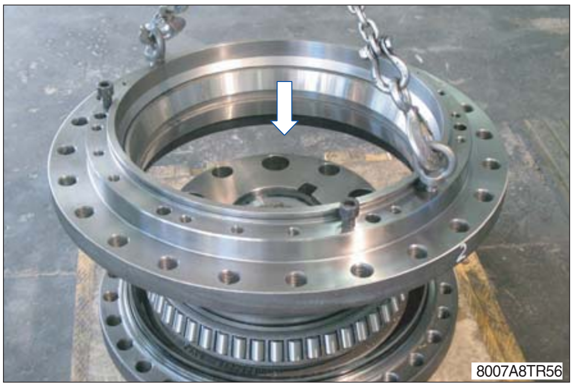
※ Correct lifetime seal assembly check (23).



(11) Clean carefully the seal faces (23).

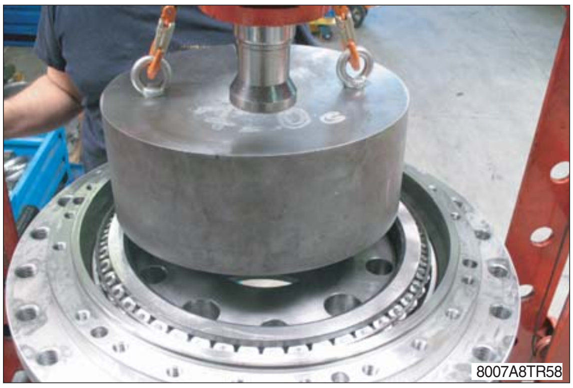
※ Apply a thin oil film on the entire metallic face of one or both seals. Oil must not contact surfaces other than the sealing faces.

(12) By using a tackle place the gearbox housing (22) on the flanged hub (27).



(13) Assemble the bearing inner ring (21) on the flanged hub (27).

(14) Place the equipment on the bearing inner ring (21).



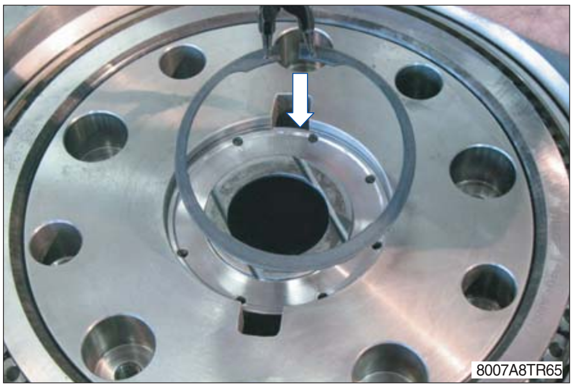
(15) By using a press and the stopper push the bearing inner ring (21) against the shoulder of the flanged hub (27) until assembling of the unit is complete.

(16) By using a tackle remove the gearbox by the press.

(17) Place the discs retainer (26).

(18) By using a rubber hammer push the discs retainer (26) against the shoulder until assembly is complete.

(19) By using pliers assemble the circlip (13) into its seat on the flanged hub (27).



※ **In case of bearings (21), gearbox housing (22) or flanged hub (27) replacing, follow the steps here below before proceeding with reassembling.**

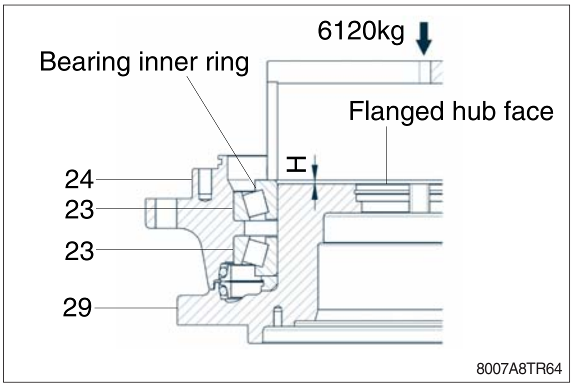
① Position the stopper on bearing (21).

② By using a press apply a load of 6120 kg (13500 lb) on the stopper.

③ Measure the control value "H"

④ Reduce the thickness "S" of the spacer (18) flattening the bearing areas at the following value;
S = 10 - H - 0.1

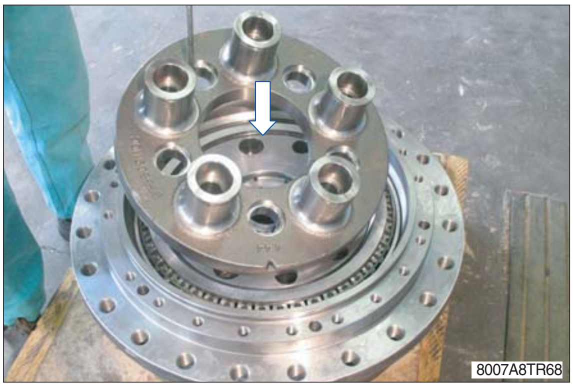
⑤ Assemble the planet carrier (16) to the flanged hub (27) and by a dynamometric wrench find the necessary torque for the gearbox housing rotation (22).
8.2~12.2 kgf · m (59.3~88.2 lbf · ft)



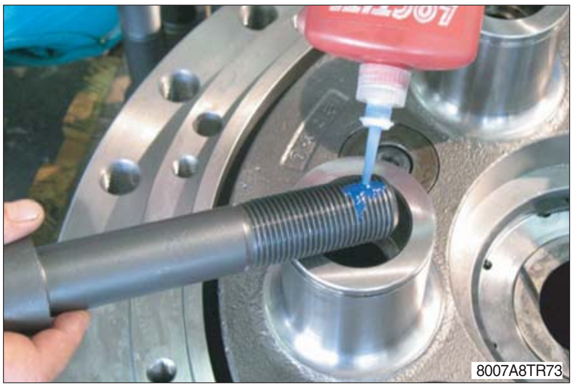
(20) Assemble the spacer (18) on the planetary carrier (16).

(21) By using a rubber hammer push the spacer (18) against the shoulder until assembly is complete.

(22) By using a tackle place the planetary carrier (16) on the flanged hub (27).



(23) Apply LOCTITE type 243 on the 5 socket head screws (11).



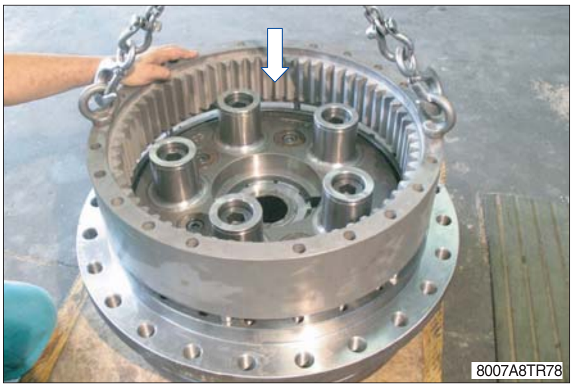
(24) By using a tackle place the screwer on the planetary carrier's pins (16).

(25) By using the screwer tighten the socket head screws (11), by a torque wrench with an input multiplier torque of 6.7 kgf · m (48.5 lbf · ft) corresponding to an output multiplier torque of 342 kgf · m (2474 lbf · ft)

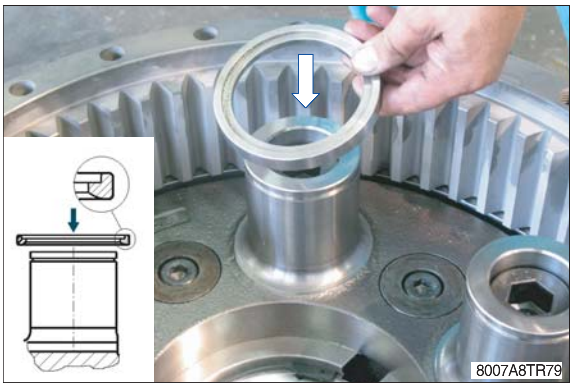
(26) Assemble the O-ring (6) into its seat in the gearbox housing (22).

(27) By using a rubber hammer push the 6 pins (20) against the shoulder until assembly is complete.

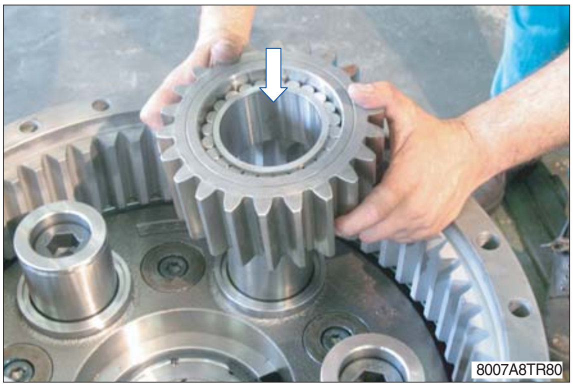
(28) By using a tackle assemble the toothed ring and, by using a rubber hammer, push it against the shoulder until assembly is complete.



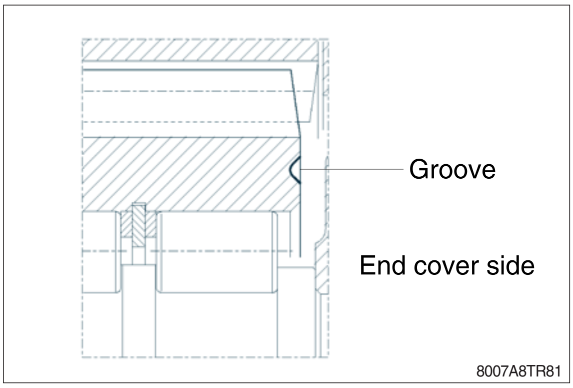
(29) Assemble correctly the spacers (15) on the pins of the planetary carrier (16).



(30) Place the reduction planet assemblies of the 3rd reduction (14) on the pins of the planetary carrier (16).

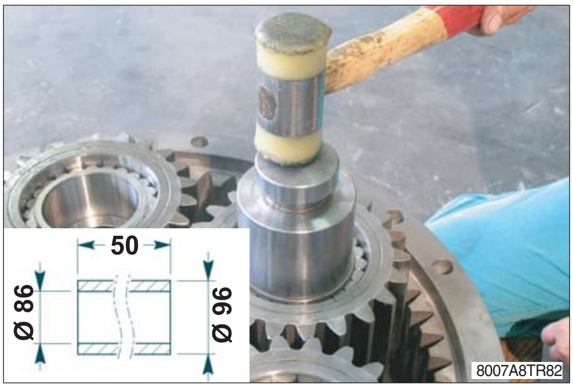

8007A8TR80

※ Place correctly the reduction planet assemblies checking that the groove is towards the end cover.



8007A8TR81

(31) By using a stopper and a rubber hammer push the planet assemblies of the 3rd reduction (14) against the shoulder until assembly is complete.



8007A8TR82

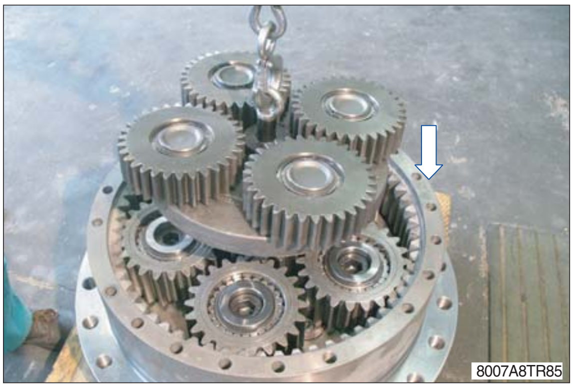
(32) By using pliers, assemble the circlips (13) in the planetary carrier pin seats (16).


8007A8TR83

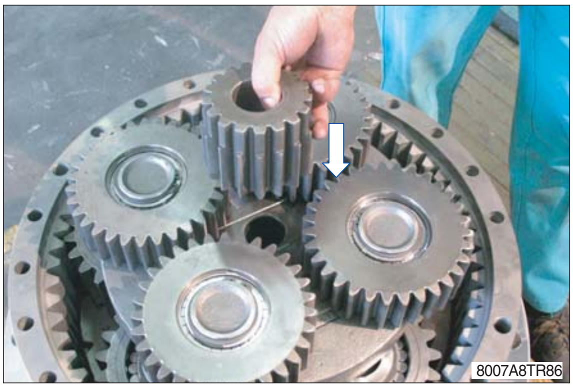
(33) Insert the 3rd stage sun gear (12).


8007A8TR84

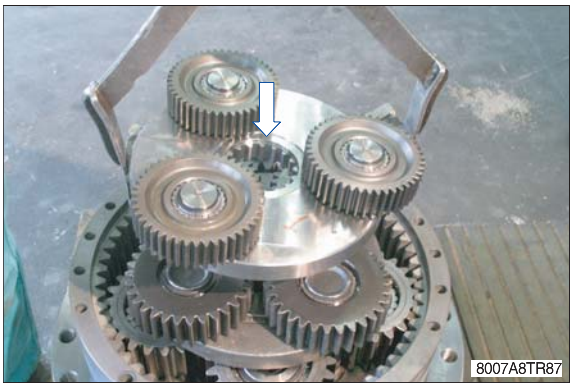
(34) By using a tackle and the equipment ass-
mble the 2nd reduction assembly (10).


8007A8TR85

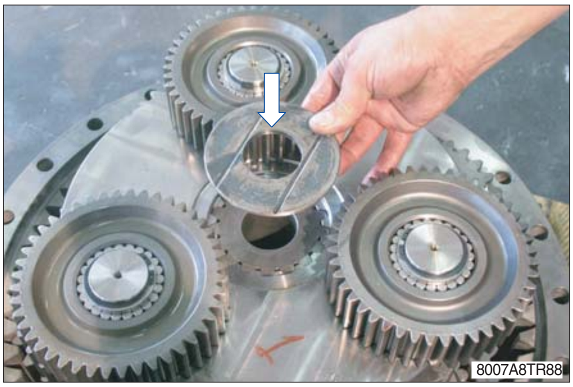
(35) Insert the 2nd stage sun gear (9).


8007A8TR86

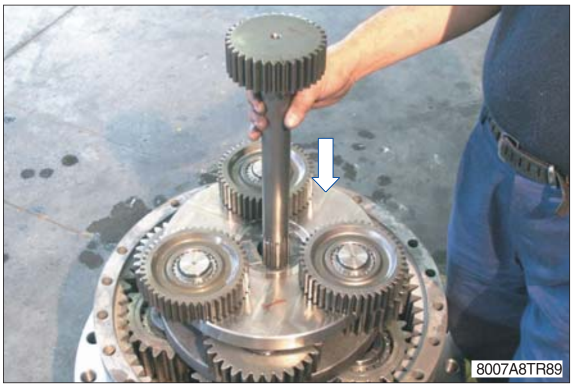
(36) By using a tackle and the equipment ass-
mble the 1st reduction assembly (8).


8007A8TR87

(37) Assemble the centering ring.



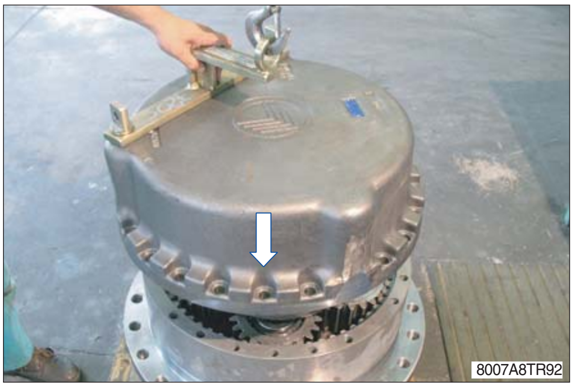
(38) Insert the 1st stage sun gear (7).



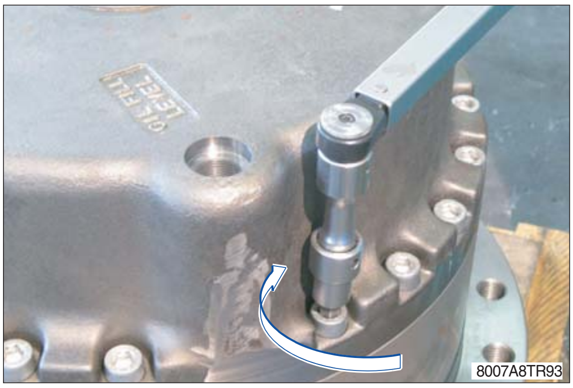
(39) By using a punch and a rubber hammer press the pad (5) against the shoulder of the end cover (4).

(40) Assemble the O-ring (6) into its seat in the end cover (4).

(41) By using a tackle and the equipment place the end cover (4) on the toothed ring (19).



(42) Tighten the 21 socket head screws (1) by a torque wrench at 48.9 kgf · m (354 lbf · ft) torque.



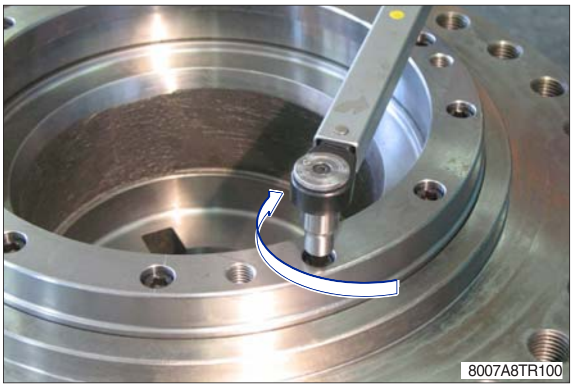
(43) Insert the washers (3) and the plugs (2) into the oil draing-filling holes of the end cover (4). Tighten the plugs by a torque wrench at 7.1±1.0 kgf · m (51.4±7.2 lbf · ft) torque.

(44) By using a tackle and the equipment turn the gearbox upside down.

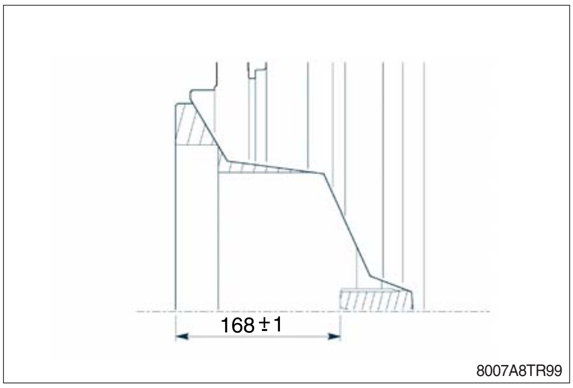
(45) Assemble the O-ring (28) into its seat in the motor adapter flange (29).

(46) Position the motor adapter flange (29) on the gearbox.

(47) Tighten the 12 socket head screws (30) by a torque wrench torque.



※ Before assembling the hydraulic motor, verify by a depth slide gauge the correct assembly of the unit checking the axial distance as shown in the scheme.



GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

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

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

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

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

13031GE18

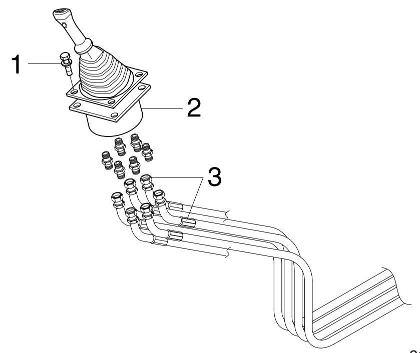
(4) Loosen the socket bolt (1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses (3).

(7) Remove the pilot valve assembly (2).

※ **When removing the pilot valve assembly, check that all the hoses have been disconnected.**



21098RL01

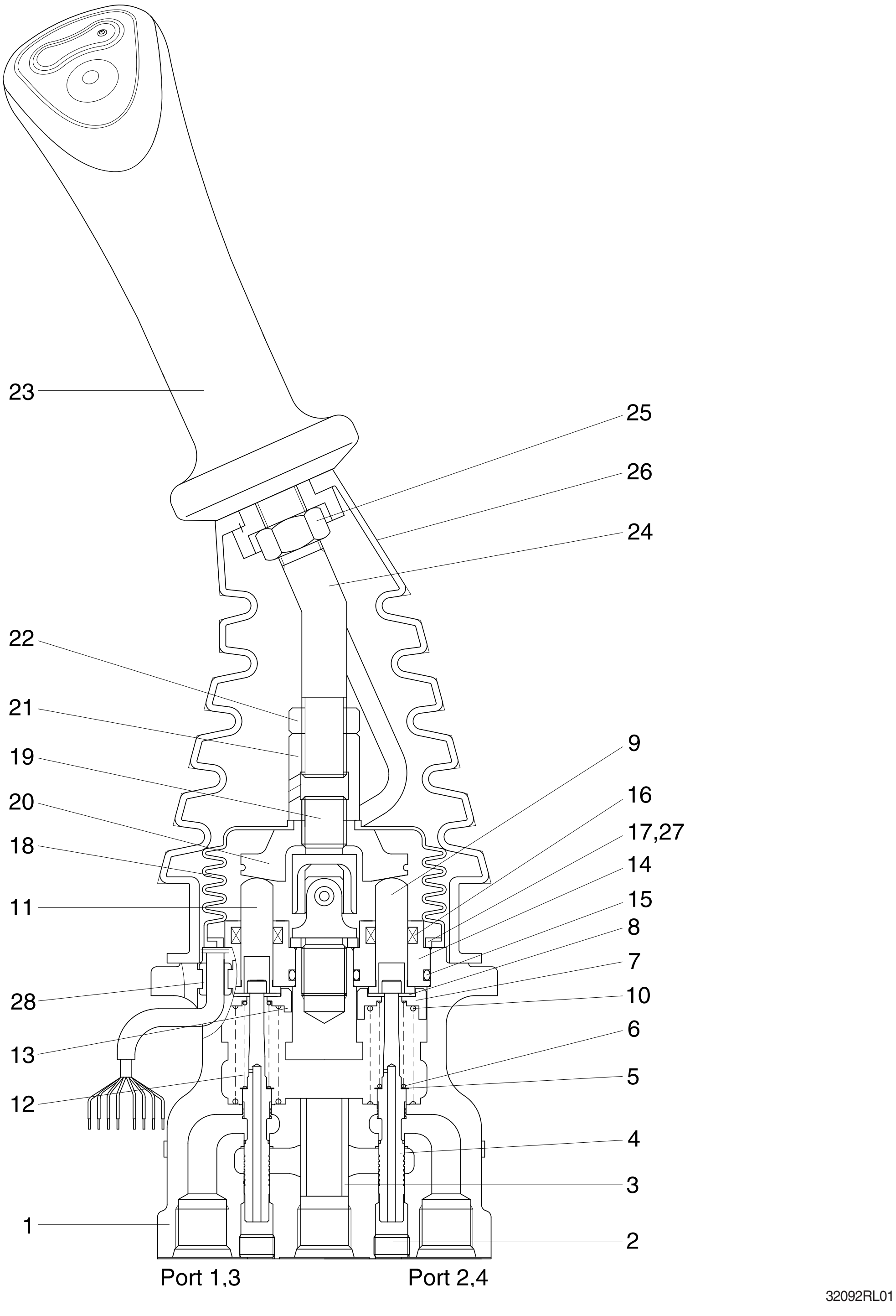
2) INSTALL

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

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

2. DISASSEMBLY AND ASSEMBLY

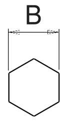
1) STRUCTURE



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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	6	
Spanne	22	
	27	
(+) Driver	Length 150	
(-) Driver	Width 4~5	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name	Item	Size	Torque	
			kgf · m	lbf · ft
Plug	2	PT 1/8	3.0	21.7
Joint	19	M14	3.5	25.3
Swash plate	20	M14	5.0±0.35	36.2±2.5
Adjusting nut	21	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

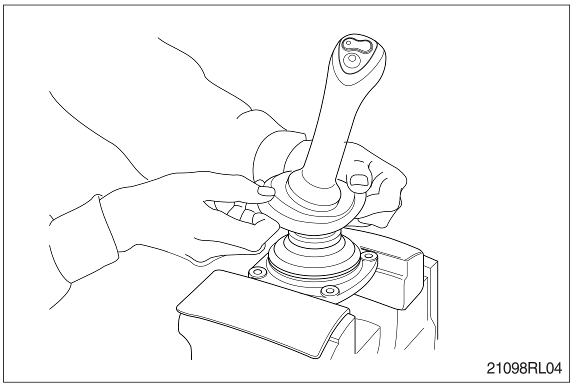
3) DISASSEMBLY

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

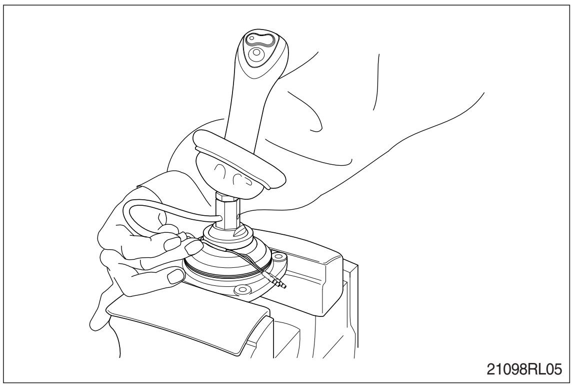
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (26) from case (1) and take it out upwards.



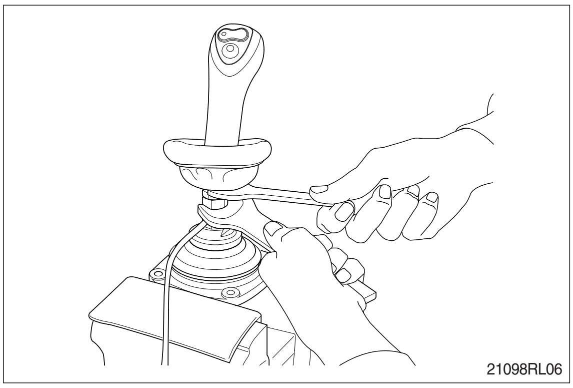
21098RL04

※ For valve with switch, remove cord also through hole of casing.



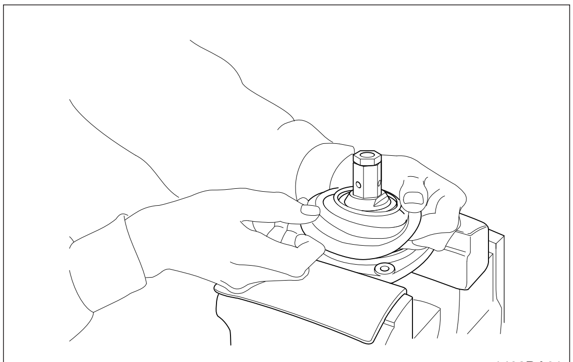
21098RL05

(4) Loosen lock nut (22) and adjusting nut (21) with spanners on them respectively, and take out handle section as one body.



21098RL06

(5) Remove the boot (18).



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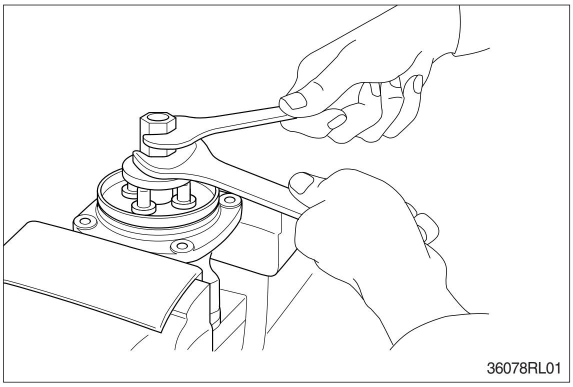
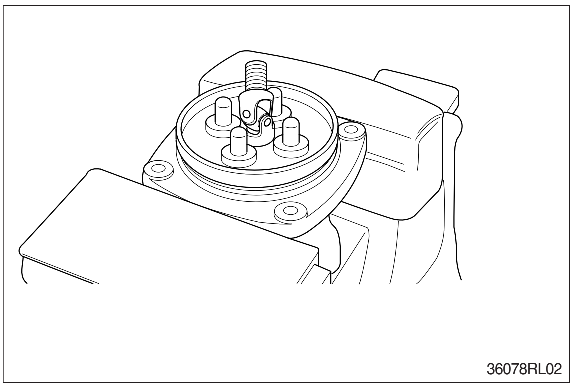
(6) Loosen adjusting nut (21) and swash plate (20) with spanners on them respectively, and remove them.



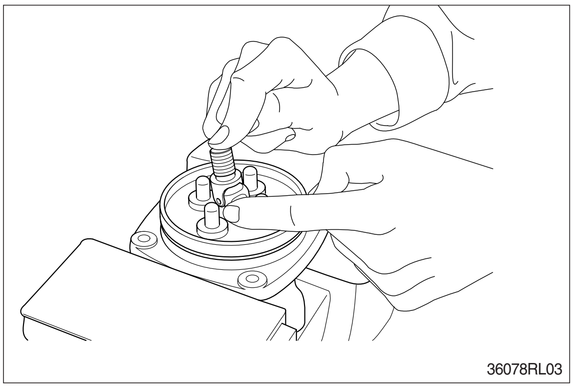
36078RL01



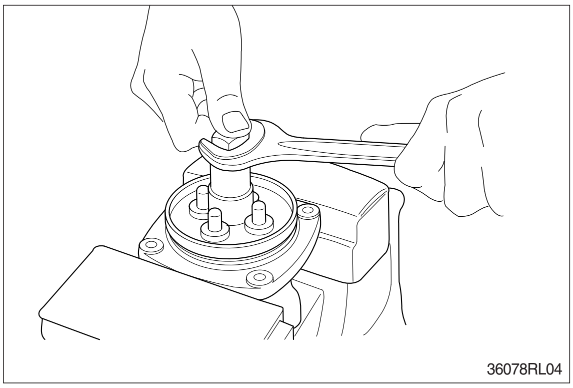
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ **When return spring (10) is strong in force, plate (17), plug (14) and push rod (11) will come up on loosening joint.**
Pay attention to this.

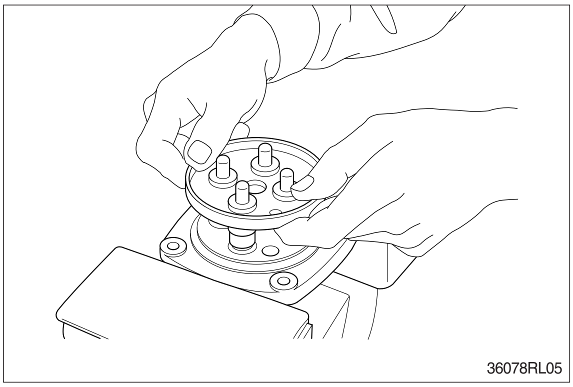


36078RL03



36078RL04

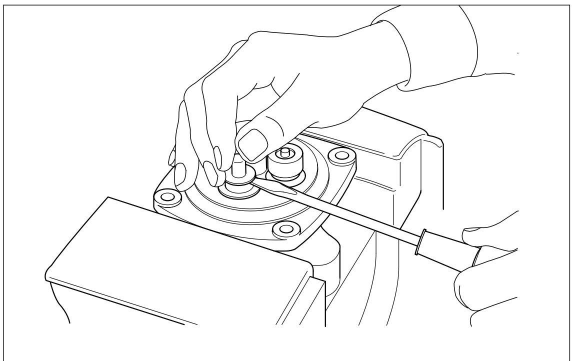
(8) Remove plate (17).


36078RL05

(9) When return spring (10) is weak in force, plug (14) stays in casing because of sliding resistance of O-ring.

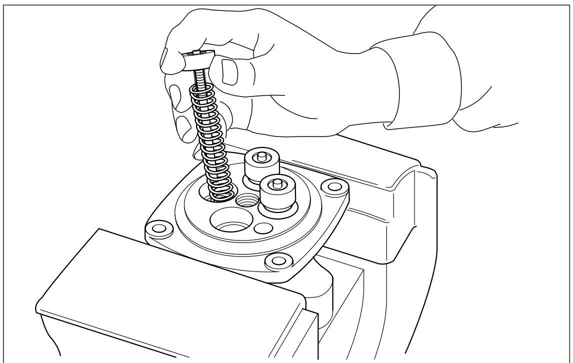
※ **Take it out with minus screwdriver.**
Take it out, utilizing external periphery groove of plug and paying attention not to damage it by partial loading.

※ **During taking out, plug may jump up due to return spring (10) force.**
Pay attention to this.

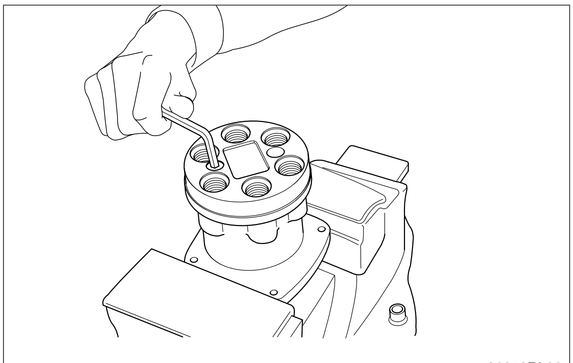

36078RL06

(10) Remove reducing valve subassembly and return spring (10) out of casing.

※ **Record relative position of reducing valve subassembly and return springs.**


36078RL07

(11) Loosen hexagon socket head plug(2) with hexagon socket screw key.

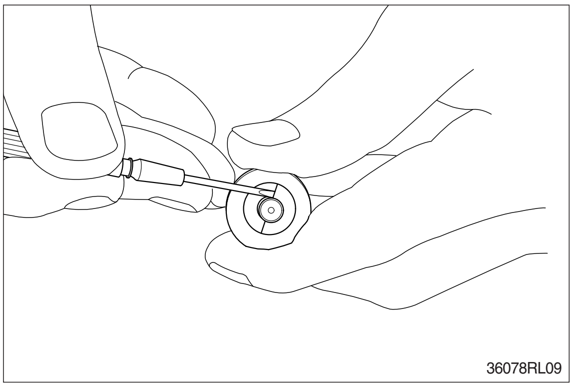

36078RL08

(12) For disassembling reducing valve section, stand it vertically with spool (4) bottom placed on flat workbench. Push down spring seat (7) and remove two pieces of semicircular stopper (8) with tip of small minus screwdriver.

※ Pay attention not to damage spool surface.

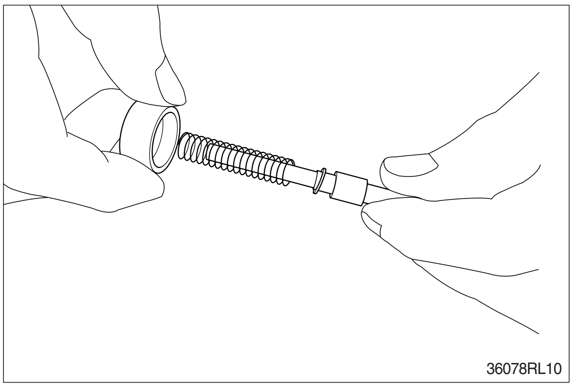
※ Record original position of spring seat (7).

※ Do not push down spring seat more than 6mm.

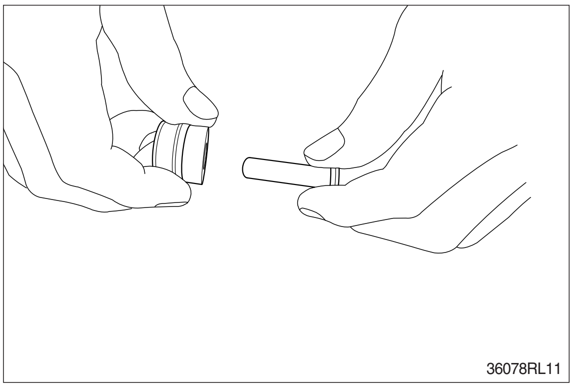


(13) Separate spool (4), spring seat (7), spring (6) and shim (5) individually.

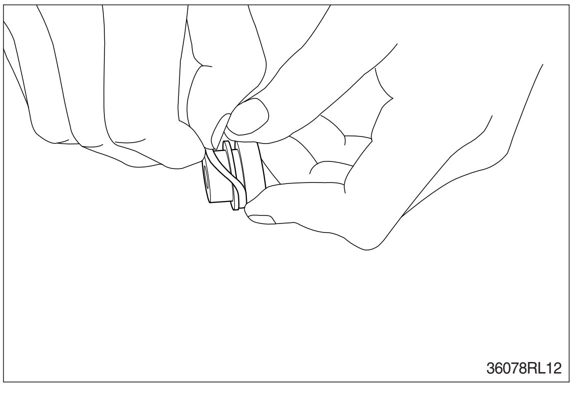
※ **Until being assembled, they should be handled as one subassembly group.**

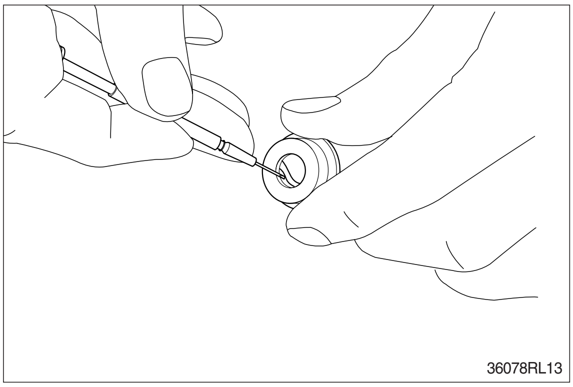


(14) Take push rod (11) out of plug (14).



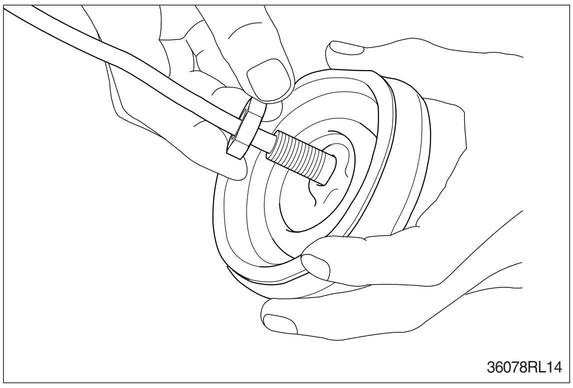
(15) Remove O-ring (15) and seal (16) from plug (14).
Use small minus screwdriver or so on to remove this seal.



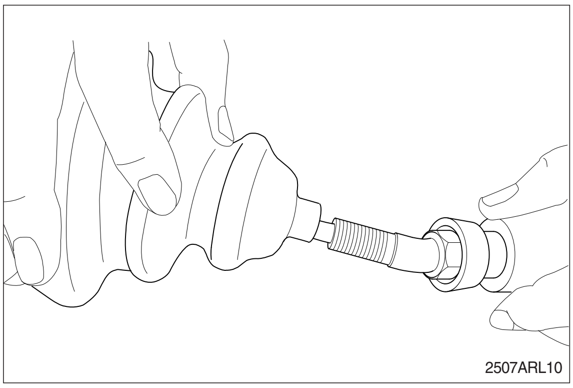


36078RL13

(16) Remove lock nut (22) and then boot (26).



36078RL14



2507ARL10

(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

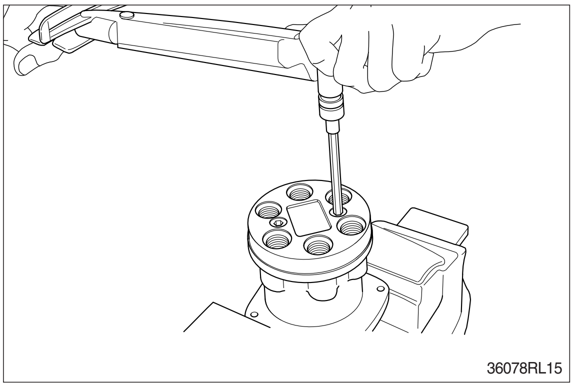
Apply rust-preventives to all parts.

※ If left as they after being cleaned, they will be rusted and will not display their functions fully after being reassembled.

4) ASSEMBLY

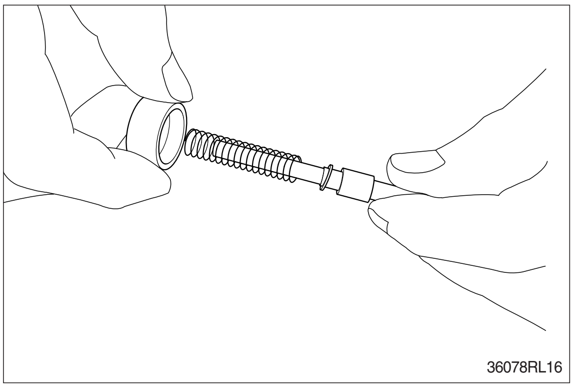
(1) Tighten hexagon socket head plug (2) to the specified torque.

※ Tighten two bolts alternately and slowly.



36078RL15

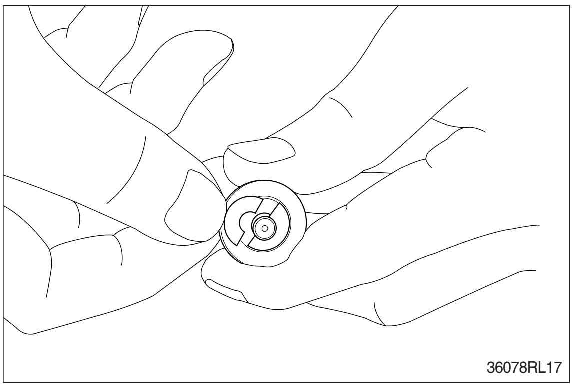
(2) Put shim (5), springs (6) and spring seat (7) onto spool (4) in this order.



36078RL16

(3) Stand spool vertically with its bottom placed on flat workbench, and with spring seat pushed down, put two pieces of semicircular stopper (8) on spring seat without piling them on.

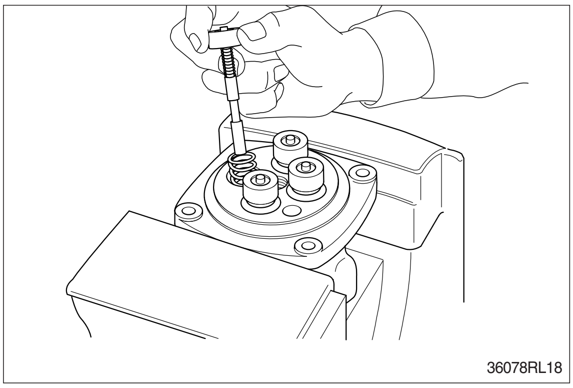
※ Assemble stopper (8) so that its sharp edge side will be caught by head of spool. Do not push down spring seat more than 6mm.



36078RL17

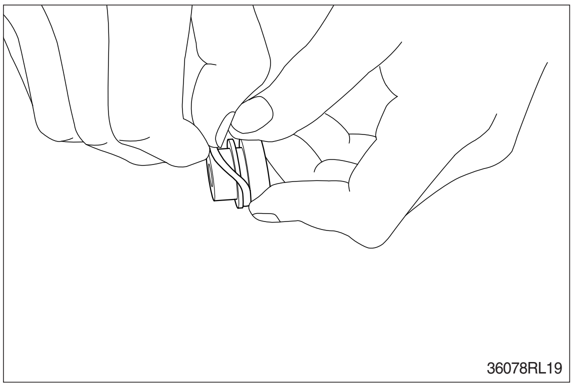
(4) Assemble spring (10) into casing (1). Assemble reducing valve subassembly into casing.

※ Assemble them to their original positions.



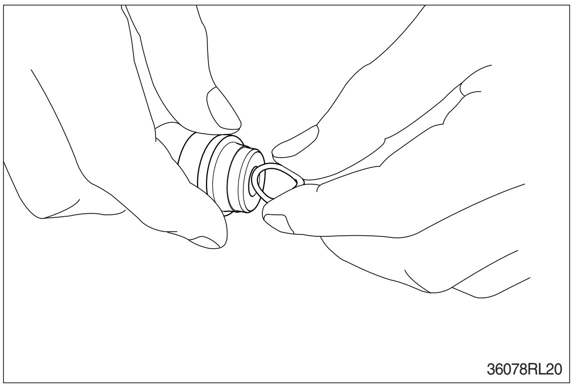
36078RL18

(5) Assemble O-ring (15) onto plug (14).



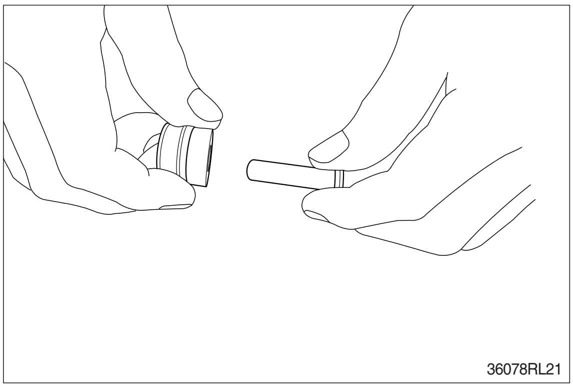
(6) Assemble seal (16) to plug (14).

※ Assemble seal in such lip direction as shown below.



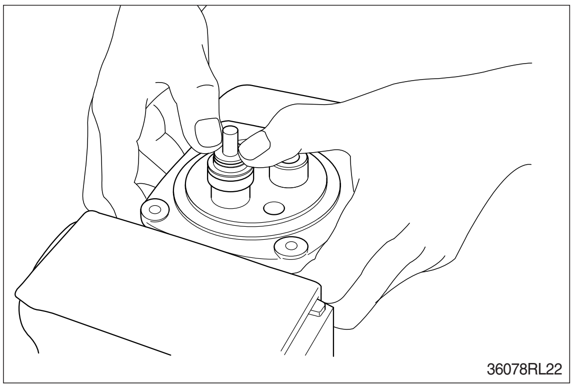
(7) Assemble push rod (11) to plug (14).

※ Apply working oil on push-rod surface.

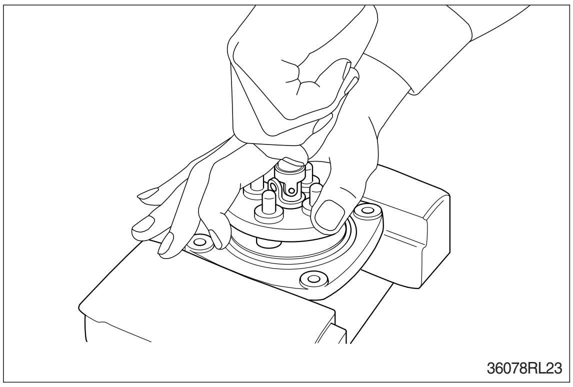


(8) Assemble plug subassembly to casing.

※ When return spring is weak in force, sub-assembly stops due to resistance of O-ring.



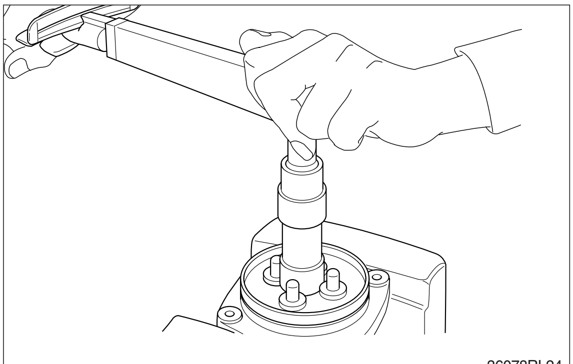
(9) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (17), and tighten joint (19) temporarily.



36078RL23

(10) Fit plate (17).

(11) Tighten joint (19) with the specified torque to casing, utilizing jig.

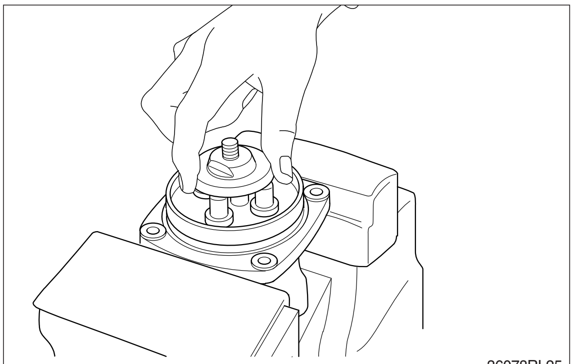


36078RL24

(12) Assemble swash plate (20) to joint (19).

※ Screw it to position that it contacts with 4 push rods evenly.

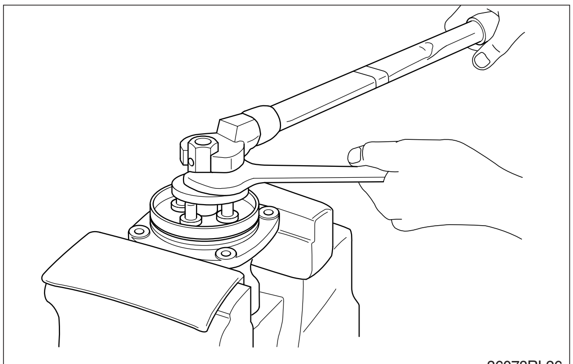
※ Do not screw it over.



36078RL25

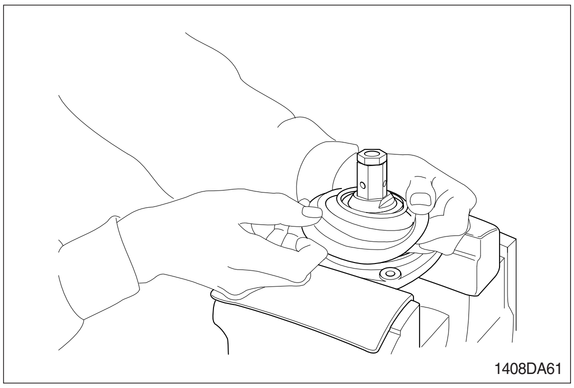
(13) Assemble adjusting nut (21), apply spanner to width across flat of plate (20) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.



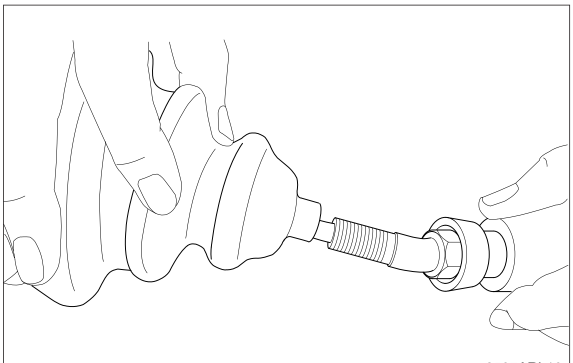
36078RL26

(14) Fit boot (18) to plate.

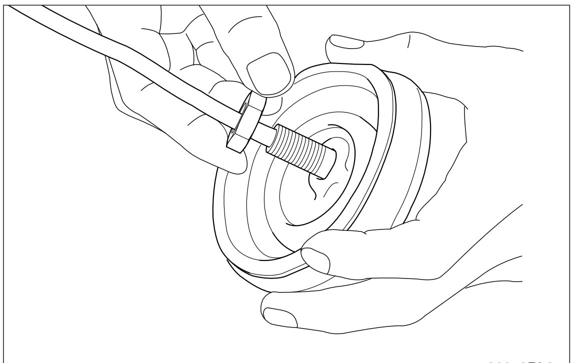


1408DA61

(15) Fit boot (26) and lock nut (22), and handle subassembly is assembled completely.

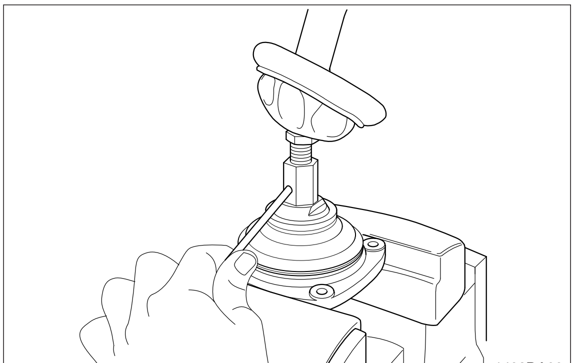


2507ARL10



36078RL27

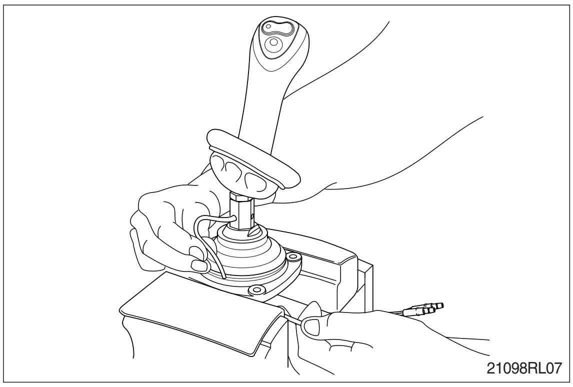
(16) Pull out cord and tube through adjusting nut hole provided in direction 60° to 120° from casing hole.



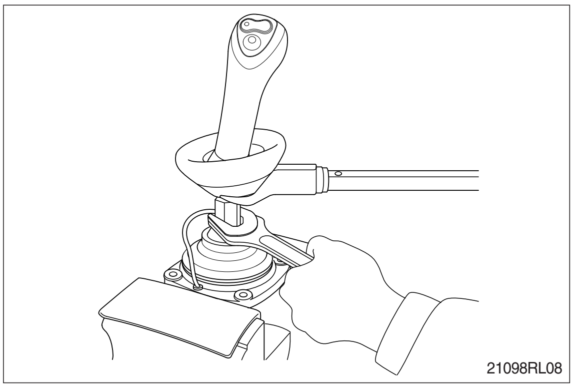
1408DA66

(17) Assemble bushing (27) to plate and pass cord and tube through it.

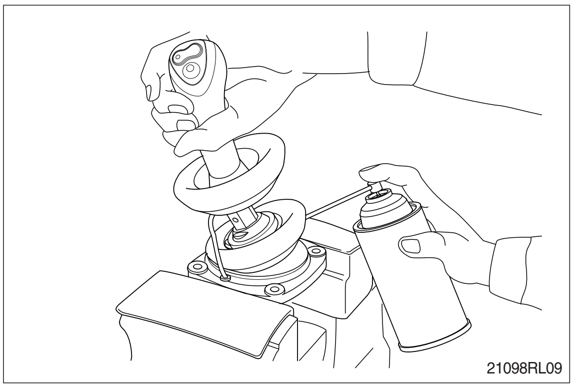
※ Provide margin necessary to operation.


21098RL07

(18) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

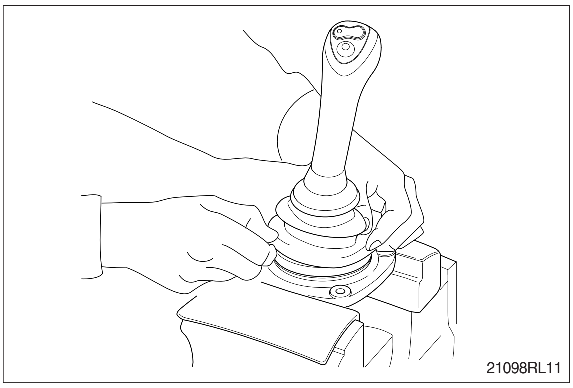

21098RL08

(19) Apply grease to rotating section of joint and contacting faces of disk and push rod.


21098RL09

(20) Assemble lower end of bellows to casing.

(21) Inject volatile rust-preventives through all ports and then put blind plugs in ports.


21098RL11

GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL


13031GE18

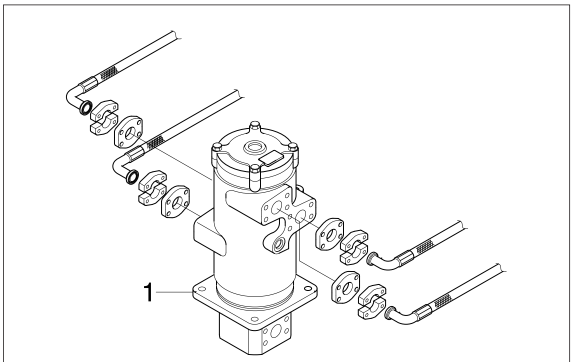
(1) Lower the work equipment to the ground and stop the engine.

(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.**



8007A8TJ02

(4) Disconnect all hoses .

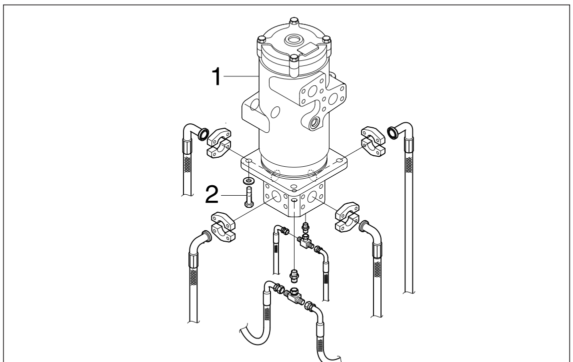
(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

- Weight : 75 kg (165 lb)
- Tightening torque : 29.7±45 kgf · m (215±32.5 lbf · ft)

(6) Remove the turning joint assembly.

※ **When removing the turning joint, check that all the hoses have been disconnected.**

2) INSTALL



8007A8TJ01

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

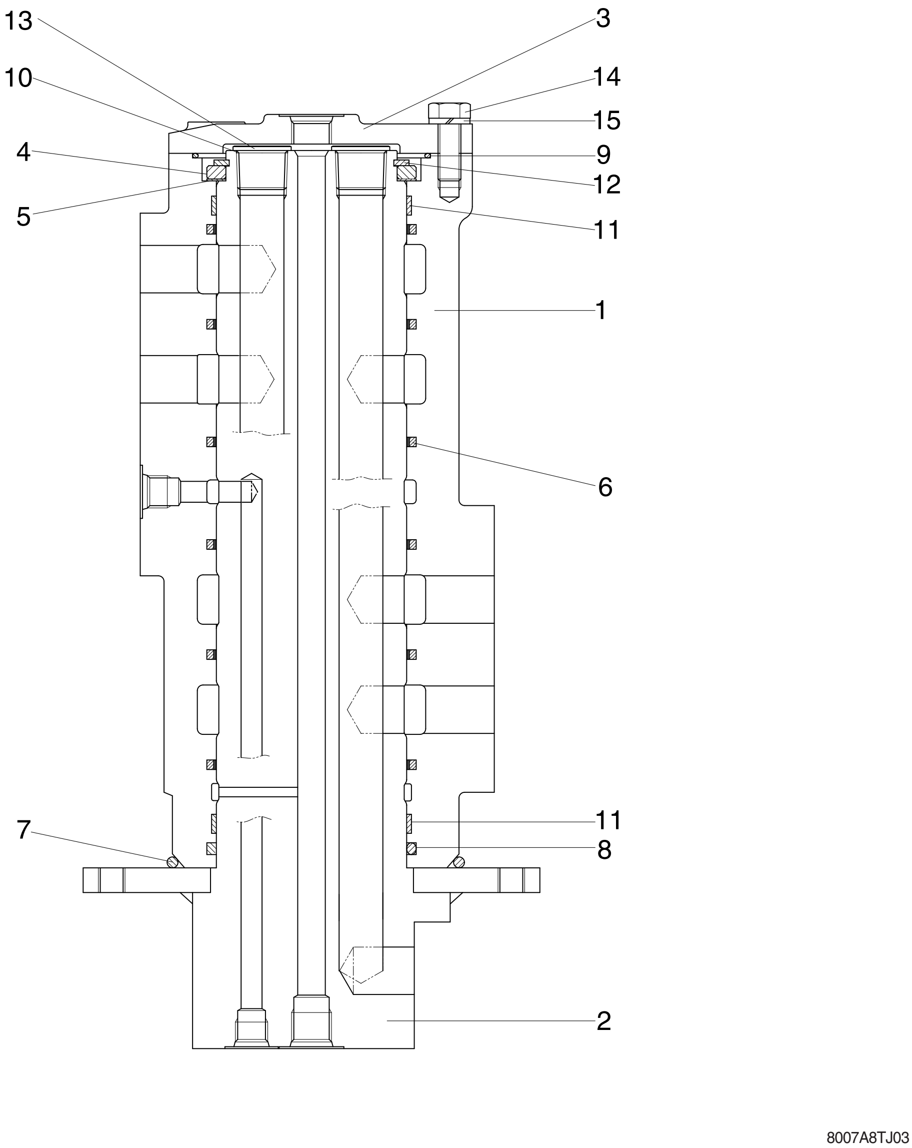
※ **Take care of turning joint direction.**

※ **Assemble hoses to their original positions.**

※ **Confirm the hydraulic oil level and check the hydraulic oil leak or not.**

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

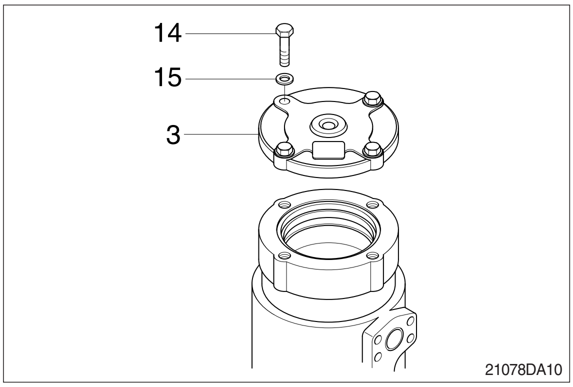


1	Hub	6	Slipper seal	11	Wear ring
2	Shaft assembly	7	O-ring	12	Retaining ring
3	Cover	8	O-ring	13	Socket plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

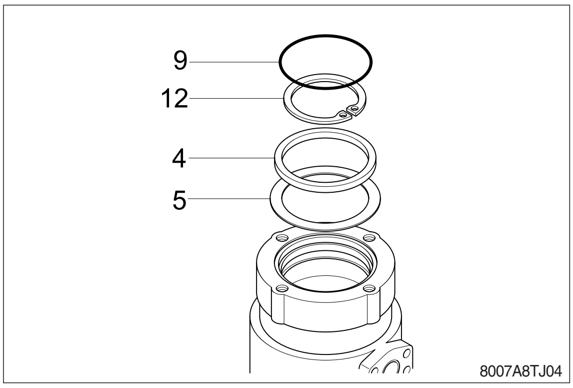
※ **Before the disassembly, clean the turning joint.**

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove O-ring (9).

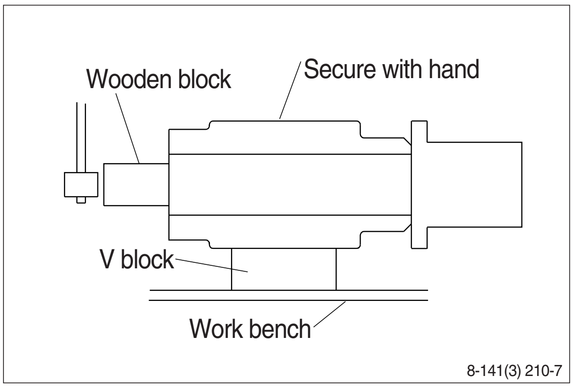
(3) Remove retainer ring (12), spacer (4) and shim (5).



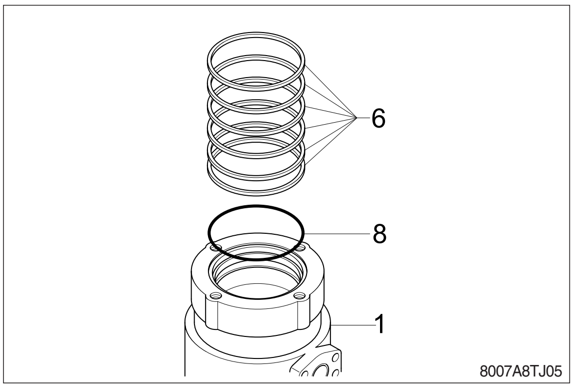
(4) Place body (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ **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 (6) and O-ring (8), from body (1).

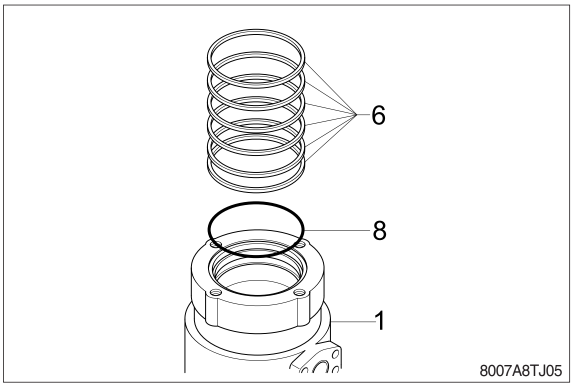


3) ASSEMBLY

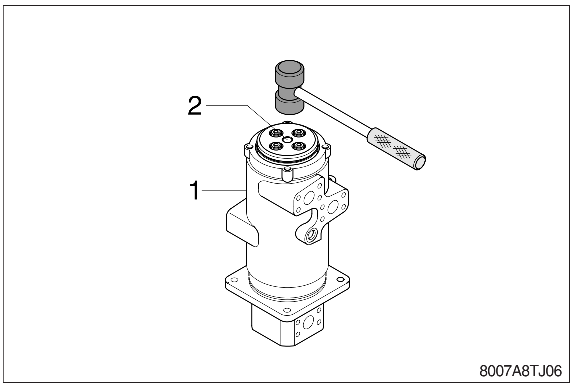
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix six slipper seal (6) and O-ring (8), to body (1).

(2) Fit O-ring (7) to shaft(2).

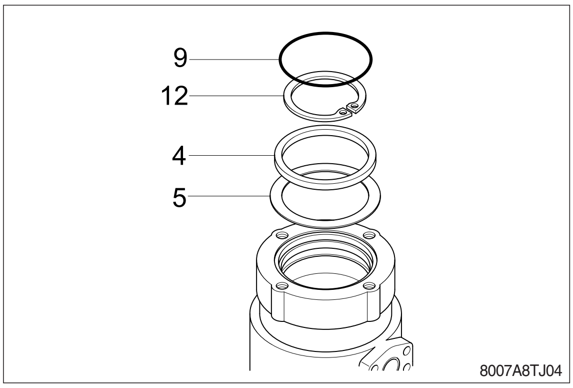


(3) Set shaft (2) on block, tap body (1) with a plastic hammer to install.

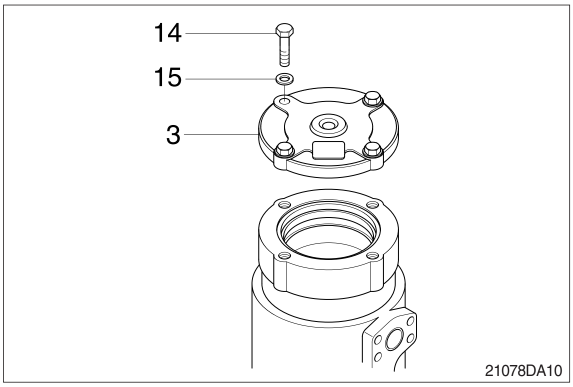


(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

(5) Fit O-ring (9) to body (1).



(7) Install cover (3) to body (1) and tighten bolts (14).
 · Torque : 10~12.5 kgf · 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.

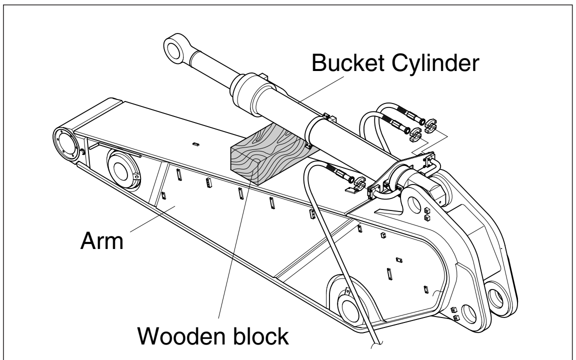
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ 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 disconnecing them, to prevent dirt or dust from entering.


13031GE18

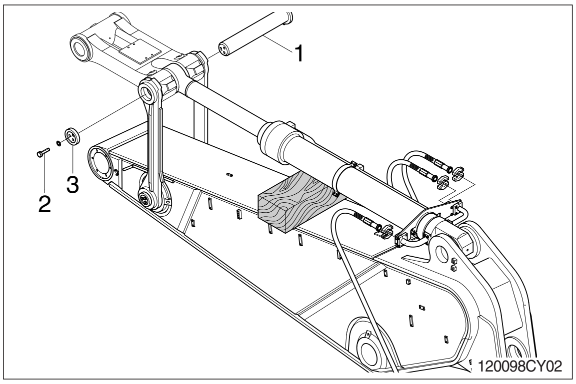
① Set block between bucket cylinder and arm.



120098CY01

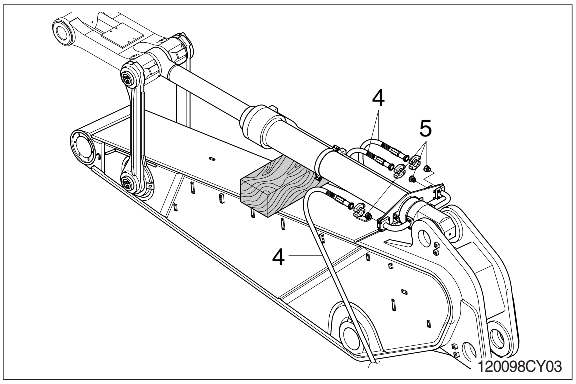
② Remove bolt (2), stopper (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



120098CY02

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

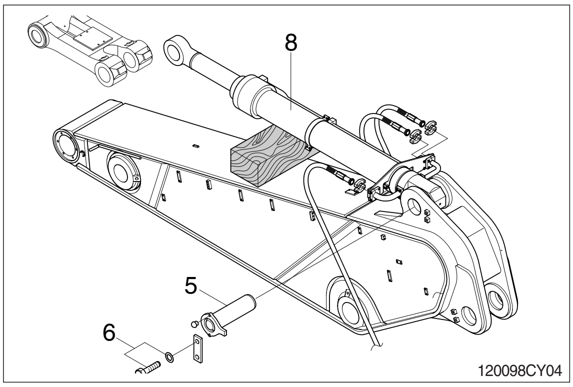


120098CY03

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 1050 ㎏ (2310 ㏶)



(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

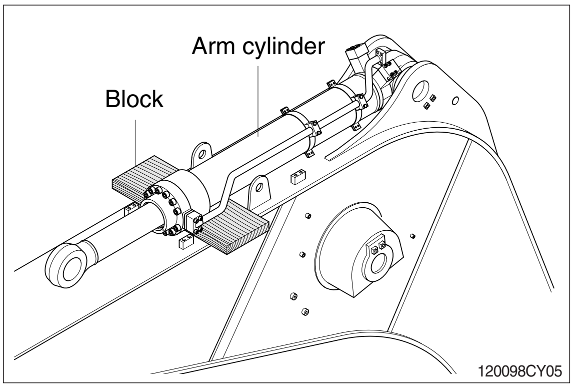
※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

※ 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.

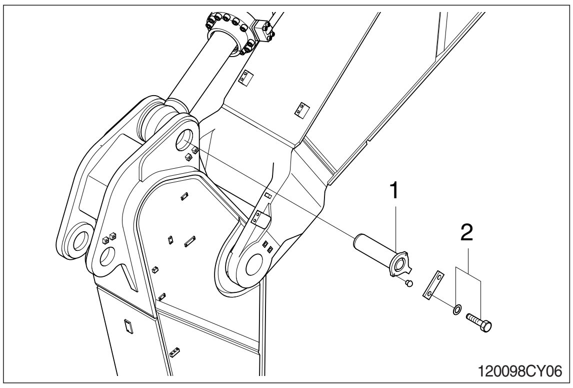
※ Escaping fluid under pressure can penetrate the skin causing serious injury. Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

① Set block between arm cylinder and boom.



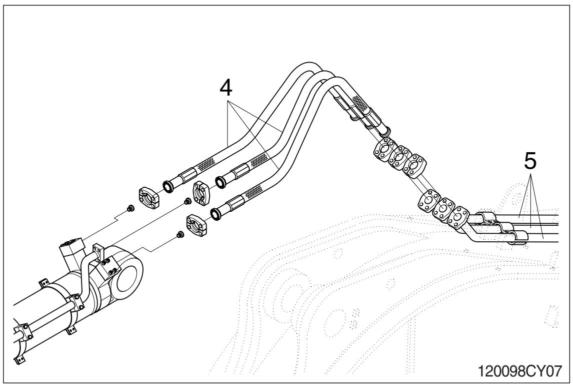
② Remove bolt (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

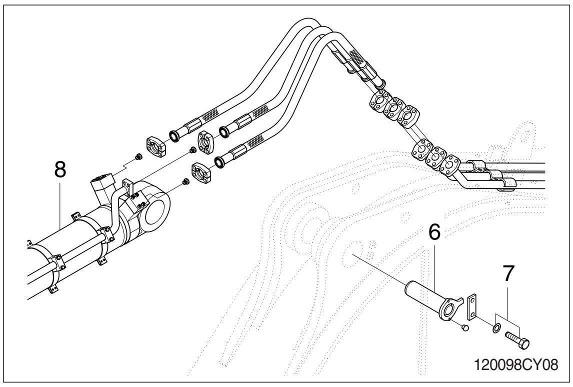
④ Disconnect greasing pipings (5).



⑤ Sling arm assembly (8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 1510 kg (3330 lb)



(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.

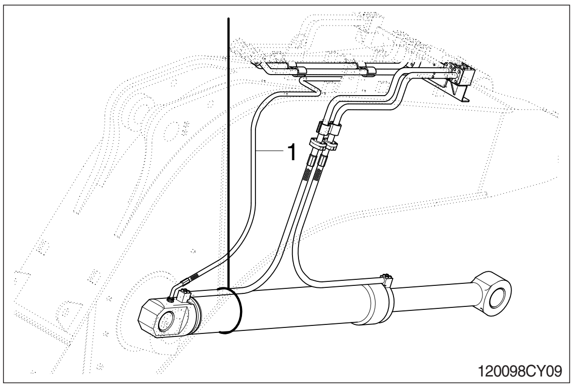
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

⚠ **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.

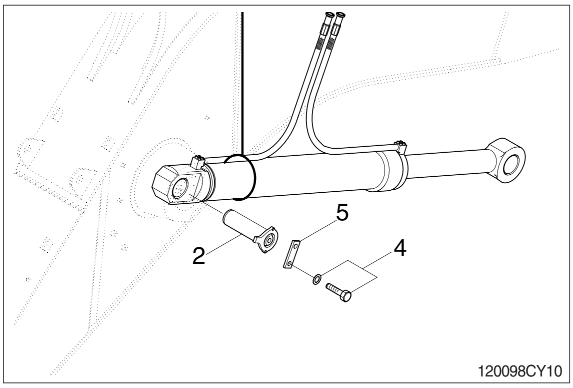
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

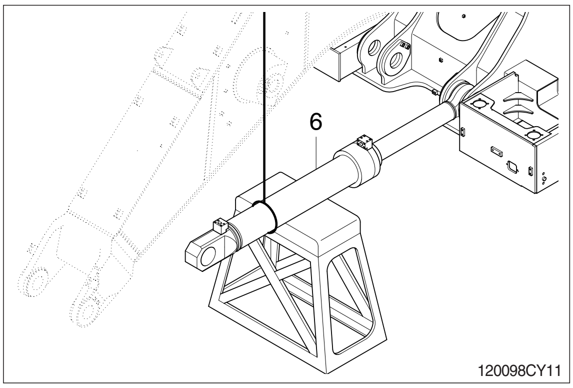


③ Remove bolt (4), pin plate (5) and pull out pin (2).

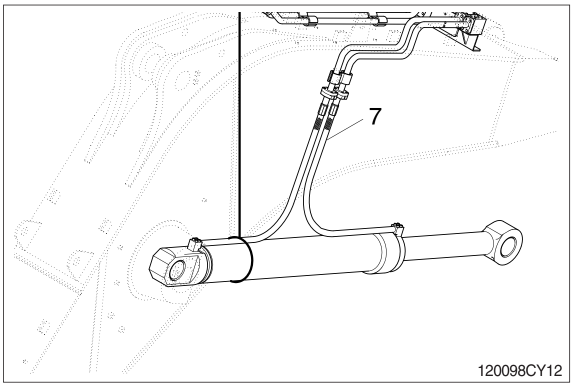
※ **Tie the rod with wire to prevent it from coming out.**



④ Lower the boom cylinder assembly (6) on a stand.



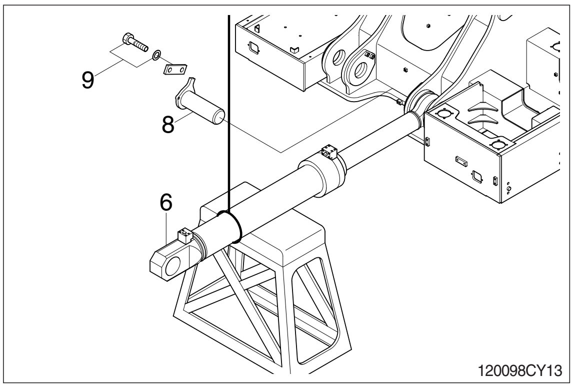
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 1190 ㎏ (2620 ℔)



(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.

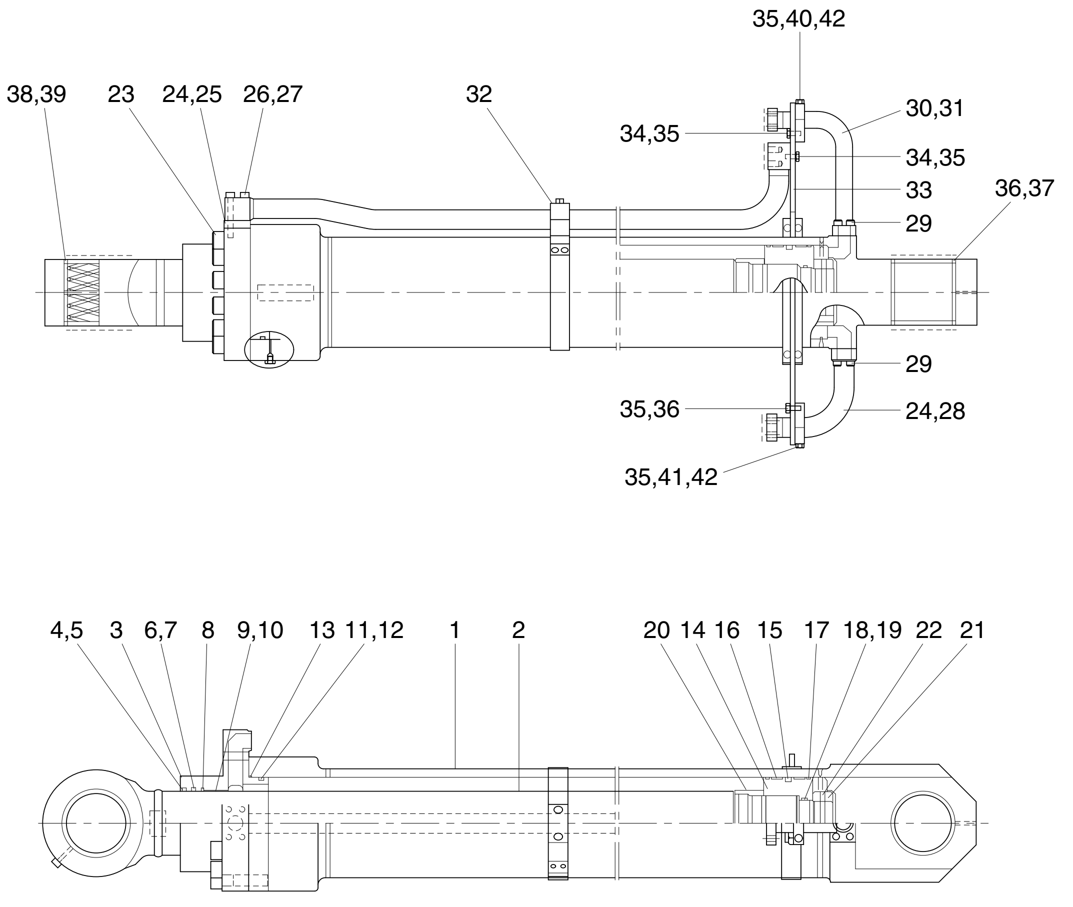
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

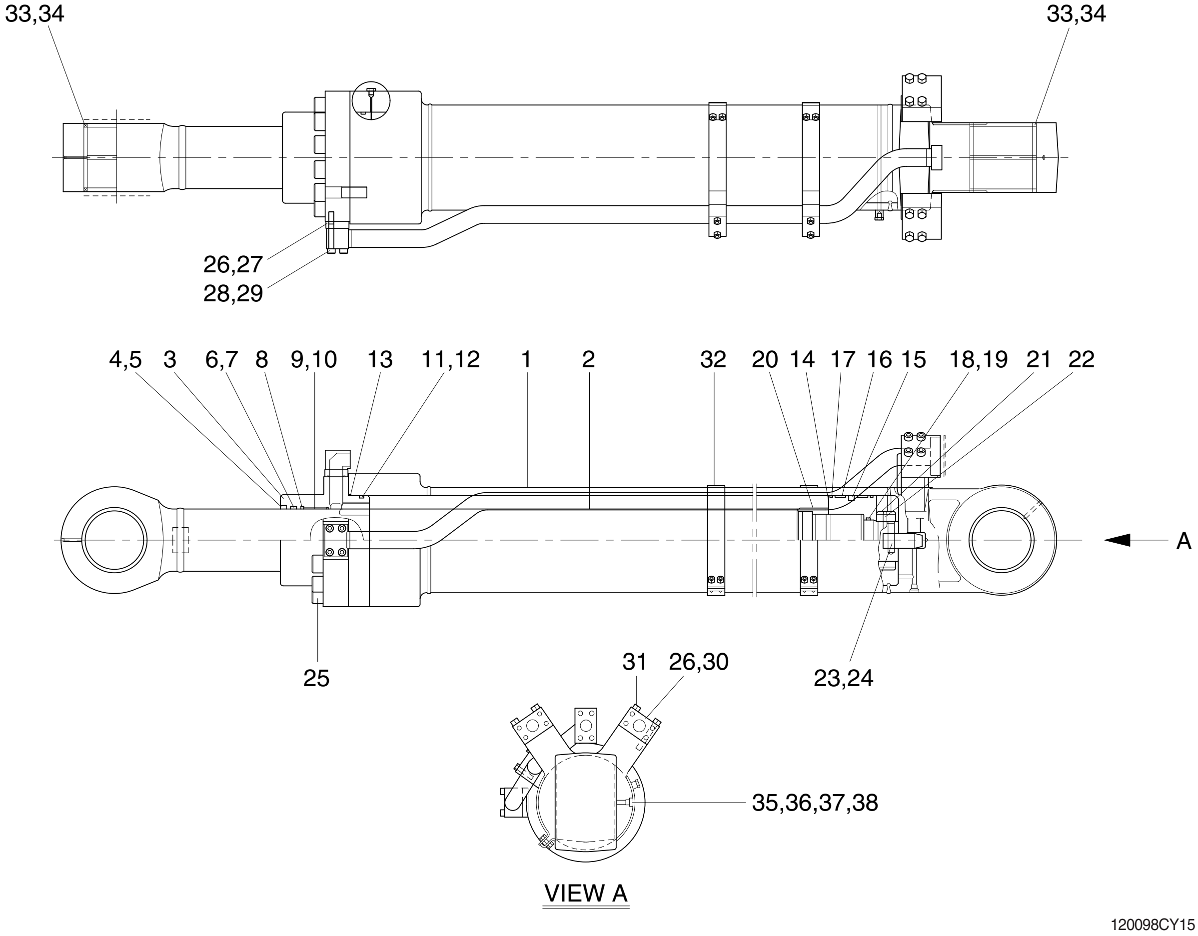
(1) Bucket cylinder



120098CY14

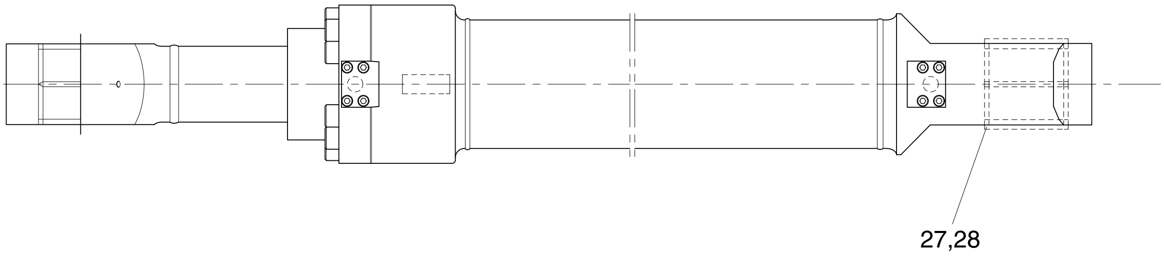
1	Tube assembly	15	Piston seal	29	Hexagon socket head bolt
2	Rod assembly	16	Wear ring	30	O-ring
3	Gland	17	Dust ring	31	Pipe assembly
4	Dust wiper	18	O-ring	32	Band assembly
5	Retain ring	19	Back up ring	33	Band assembly
6	Rod seal	20	Cushion ring	34	Hexagon socket head bolt
7	Back up ring	21	Piston nut	35	Plain washer
8	Buffer ring	22	Set screw	36	Oilless bearing
9	Dry bearing	23	Hexagon socket head bolt	37	Dust seal
10	Retain ring	24	O-ring	38	Pin bushing
11	O-ring	25	Flange	39	Dust seal
12	Back up ring	26	Pipe assembly	40	Clamp assembly
13	O-ring	27	Hexagon socket head bolt	41	Clamp assembly
14	Piston	28	Pipe assembly	42	Hexagon socket head bolt

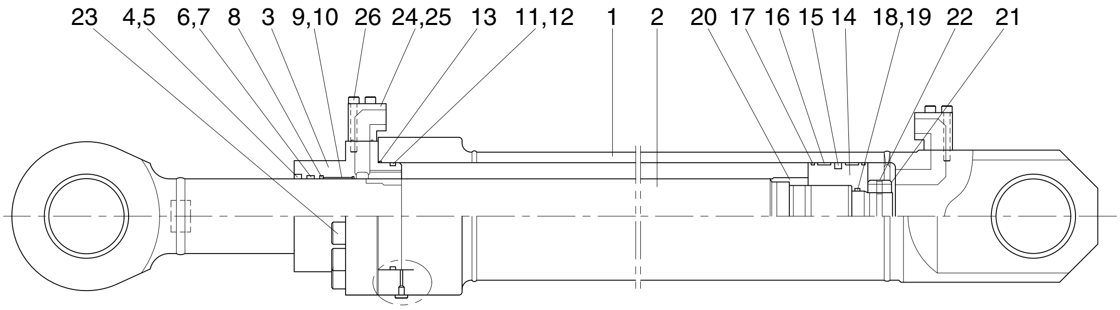
(2) Arm cylinder



1	Tube assembly	14	Piston	27	Flange
2	Rod assembly	15	Piston seal	28	Pipe assembly
3	Gland	16	Wear ring	29	Hexagon socket head bolt
4	Dust wiper	17	Dust ring	30	Block
5	Retain ring	18	O-ring	31	Hexagon socket head bolt
6	Rod seal	19	Back up ring	32	Band assembly
7	Back up ring	20	Cushion ring	33	Oilless bushing
8	Buffer ring	21	Piston pin	34	Dust seal
9	Dry bearing	22	Set screw	35	Check valve
10	Retain ring	23	Cushion spear	36	Spring
11	O-ring	24	Parallel pin	37	O-ring
12	Back up ring	25	Hexagon socket head bolt	38	Socket plug
13	O-ring	26	O-ring		

(3) Boom cylinder



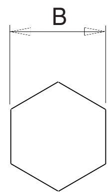


120098CY16

1	Tube assembly	11	O-ring	21	Piston nut
2	Rod assembly	12	Back up ring	22	Set screw
3	Gland	13	O-ring	23	Hexagon socket head bolt
4	Dust wiper	14	Piston	24	O-ring
5	Retain ring	15	Piston seat	25	Flange
6	Rod seal	16	Wear ring	26	Hexagon socket head bolt
7	Back up ring	17	Dust ring	27	Oilless bushing
8	Buffer ring	18	O-ring	28	Dust seal
9	Dry bearing	19	Back up ring		
10	Retain ring	20	Cushion ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Allen wrench	10	
	14	
	16	
	30	
	33	
(-) 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
Piston	Bucket cylinder	14	-	210±21	1520±152
	Boom cylinder	14	-	250±25	1810±181
	Arm cylinder	14	-	200±20	1447±145
Piston lock nut	Bucket cylinder	20	-	280±28	2025±203
	Boom cylinder	20	-	290±29	2100±210
	Arm cylinder	20	-	260±26	1881±188
Socket head bolt	Bucket cylinder	23	M30	157±16	1136±116
		27	M14	15±1.5	108±10.8
	Boom cylinder	25	M33	215±21.5	1555±156
		31	M16	23±2.3	166±16.6
	Arm cylinder	23	M30	157±16	1136±116
		26	M14	15±1.5	108±10.8

3) DISASSEMBLY

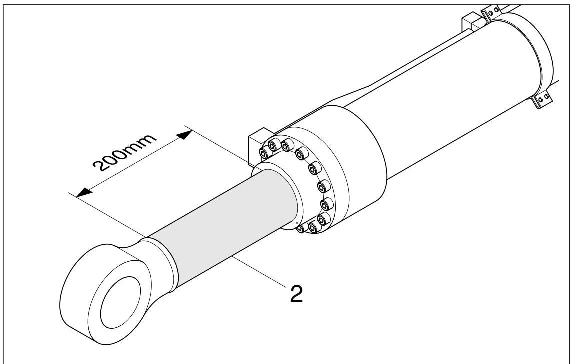
(1) Remove cylinder head and piston rod

※ 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.

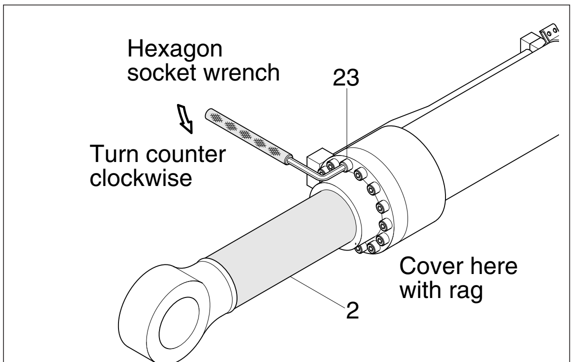
② Pull out rod assembly (2) about 200 mm (7.1in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



120098DA01

③ Loosen and remove socket bolts (23) of the gland in sequence.

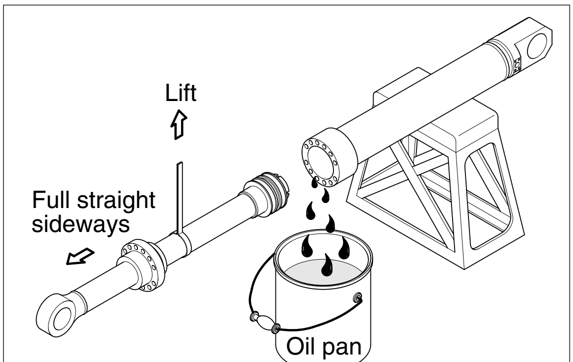
※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



120098DA02

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.

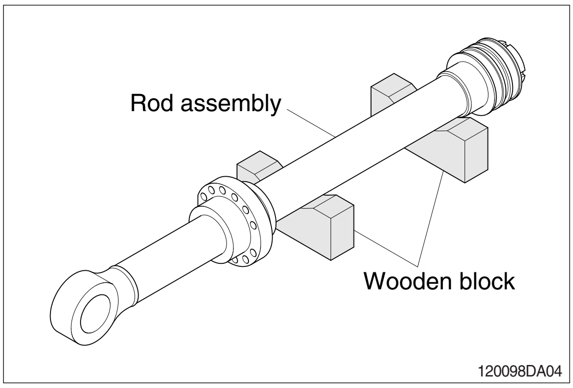


120098DA03

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.

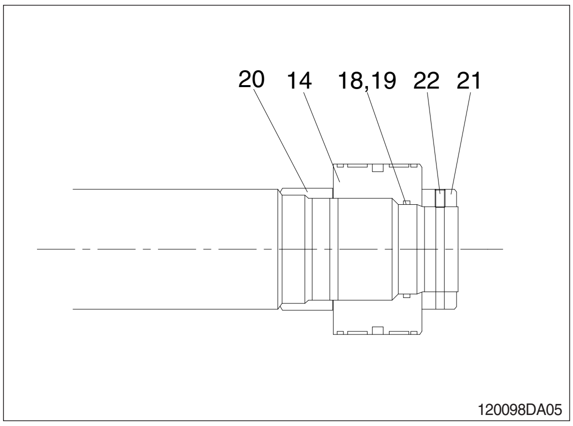


(3) Remove piston and cylinder head

① Loosen socket set screw (22) and remove piston nut (21).

※ Since piston nut (21) is tightened to a high torque use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove piston nut (21).

② Remove piston assembly (14), back up ring (19), and O-ring (18).

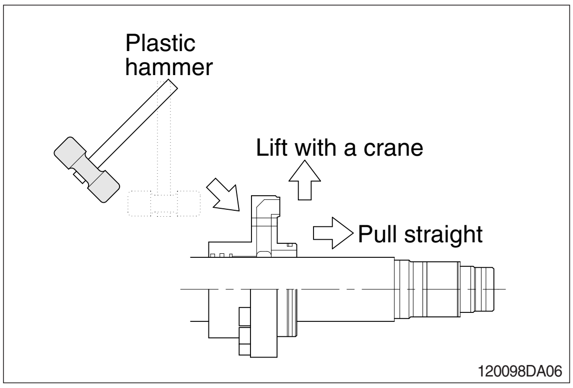


③ Remove the cylinder head assembly from rod assembly (2).

※ 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 dry bearing (9) and packing (4, 5, 6, 7, 8, 10) by the threads of rod assembly (2).

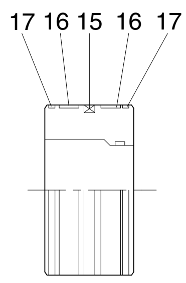


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



120098DA07

(4) Disassemble cylinder head assembly

① Remove back up ring (12) and O-ring (11).

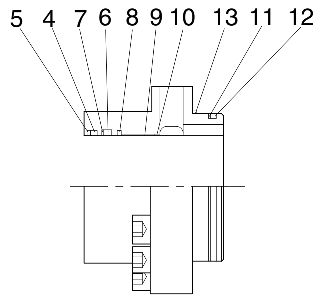
② Remove snap ring (5), dust wiper (4).

③ Remove back up ring (7), rod seal (6) and buffer ring (8) and snap ring (10).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove dry bearing (9).



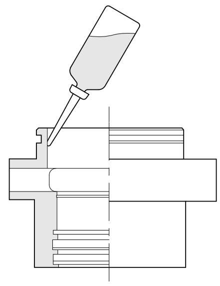
120098DA08

3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

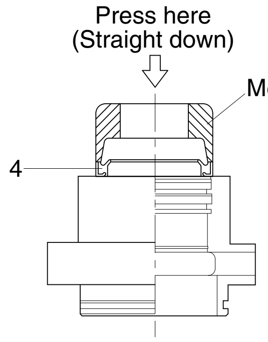
① Coat the inner face of gland (3) with hydraulic oil.



120098DA09

② Coat dust wiper (4) with grease and fit dust wiper (4) 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 (5) to the stop face.

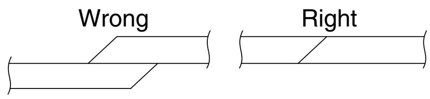


120098DA10

④ Fit back up ring (7), rod seal (6), buffer ring (8) and snap ring (5) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

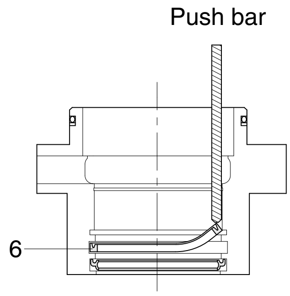
※ Insert the backup ring until one side of it is inserted into groove.



120098DA11

※ 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.

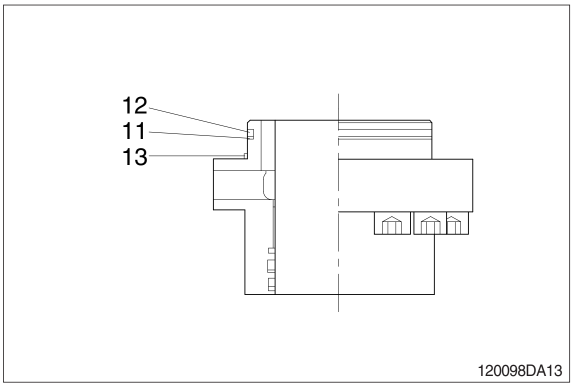


120098DA12

⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

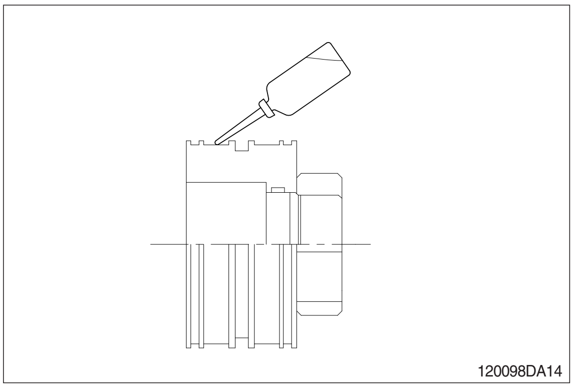
⑥ Fit O-ring (11, 13) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

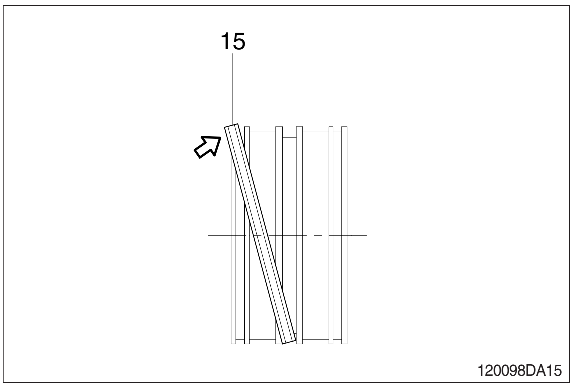
① Coat the outer face of piston (14) with hydraulic oil.



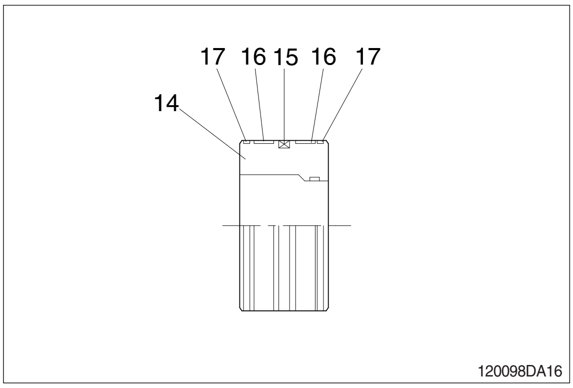
② Fit piston seal (15) to piston.

※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.

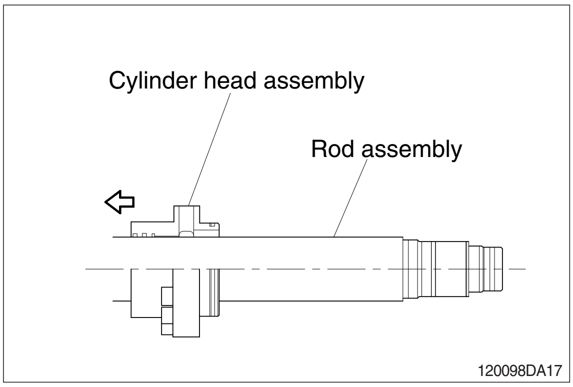


③ Fit wear ring (16) and dust ring (17) to piston (14).

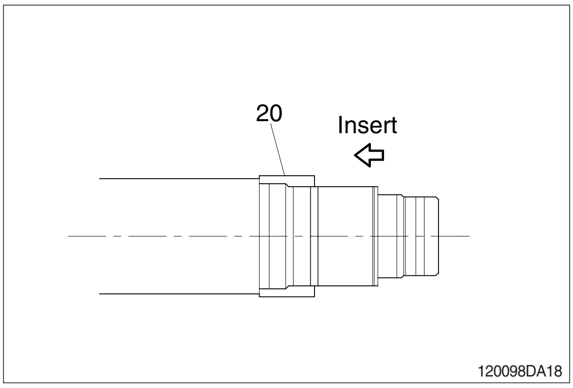


(3) Install piston and cylinder head

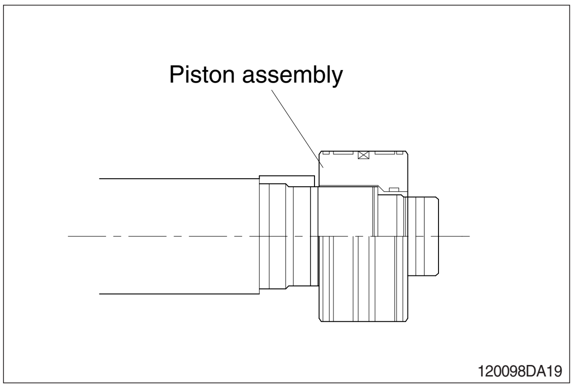
① Fix the rod assembly to the work bench.
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.
③ Insert cylinder head assembly to rod assembly.



④ Insert cushion ring (20) to rod assembly.
※ Note that cushion ring (20) has a direction in which it should be fitted.

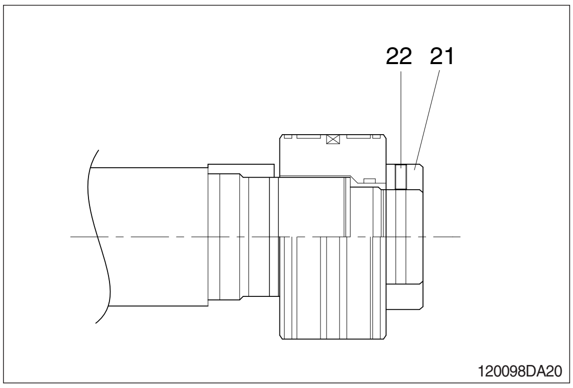


⑤ Fit piston assembly to rod assembly.
· Tightening torque : 210±21 kgf · m (1520±152 lbf · ft)



⑥ Fit piston nut (21) and tighten the set screw (22).
· Tightening torque :

Item		kgf · m	lbf · ft
Bucket	21	280±28	2025±203
	22	3.2±0.3	23.1±2.2
Boom	21	260±26	1881±188
	22	3.0±0.3	21.7±3.6
Arm	21	290±29	2100±210
	22	3.0±0.3	21.7±3.6



(3) Overall assemble

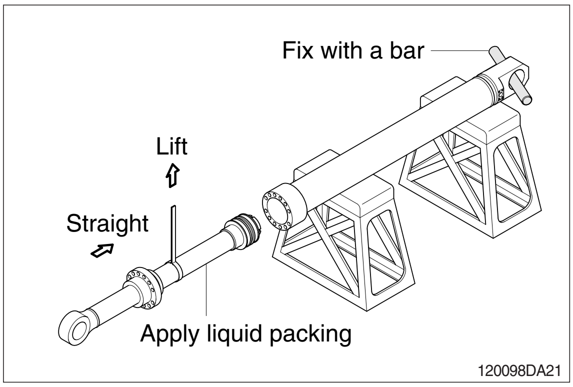
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

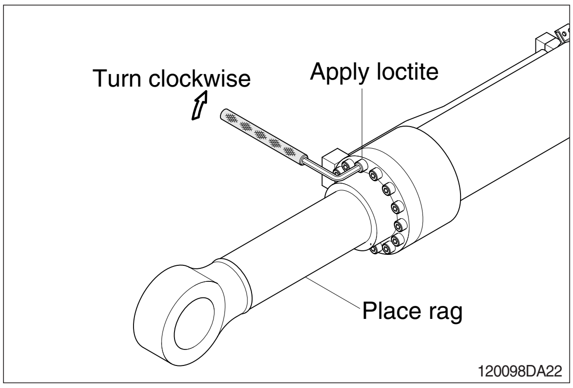
※ Be careful not to damage piston seal by thread of tube assembly.

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.



120098DA21



120098DA22

GROUP 10 UNDERCARRIAGE

1. TRACK LINK

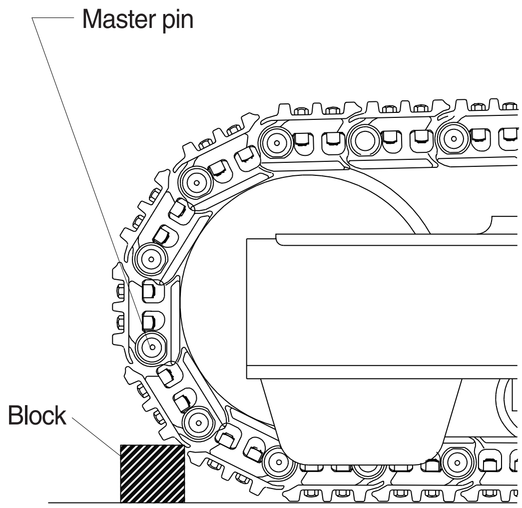
1) REMOVAL

(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.

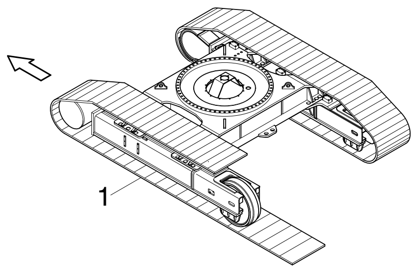


45078UC11

(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.**

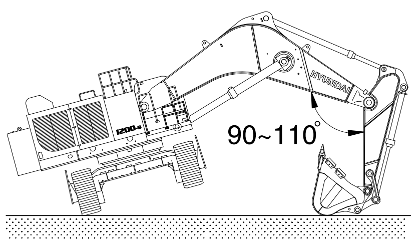


120098UC01

2) INSTALL

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

※ **Adjust the tension of the track link.**

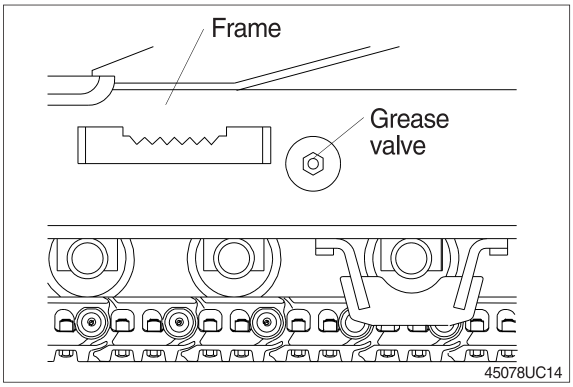


120094OP09

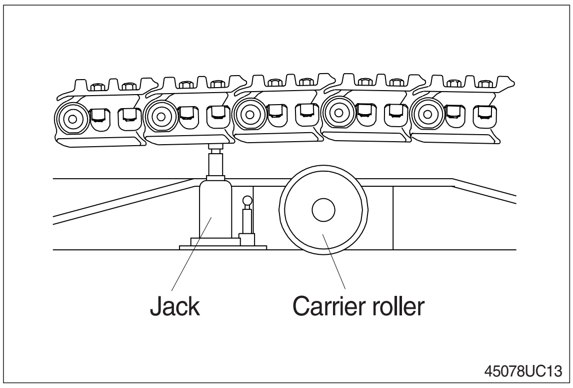
2. CARRIER ROLLER

1) REMOVAL

(1) Loosen tension of the track link.



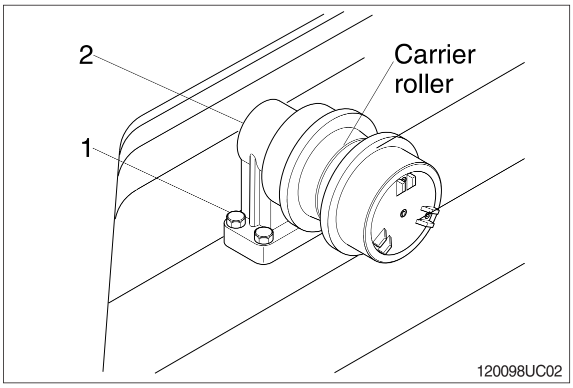
(2) Jack up the track link height enough to permit carrier roller removal.



(3) Loosen the lock nut (1).

(4) Remove carrier roller assembly (2).

· Weight : 70 kg (150 lb)



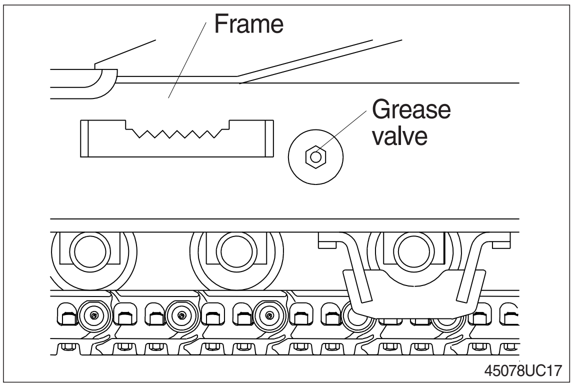
2) INSTALL

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

3. TRACK ROLLER

1) REMOVAL

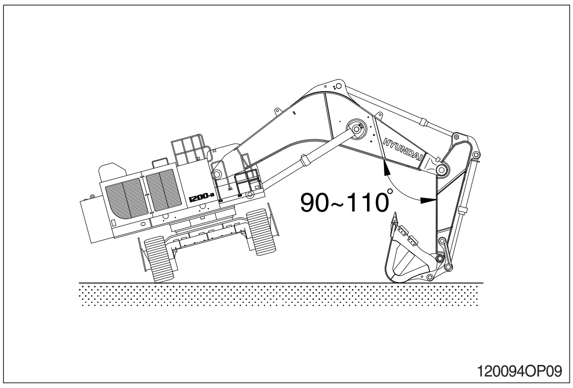
(1) Loosen tension of the track link.



45078UC17

(2) Using the work equipment, push up track frame on side which is to be removed.

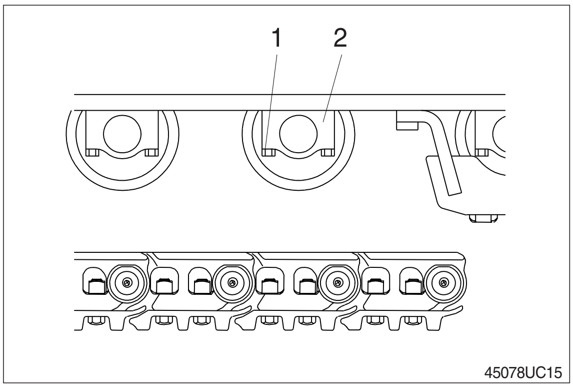
※ **After jack up the machine, set a block under the unit.**



120094OP09

(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 210 kg (460 lb)



45078UC15

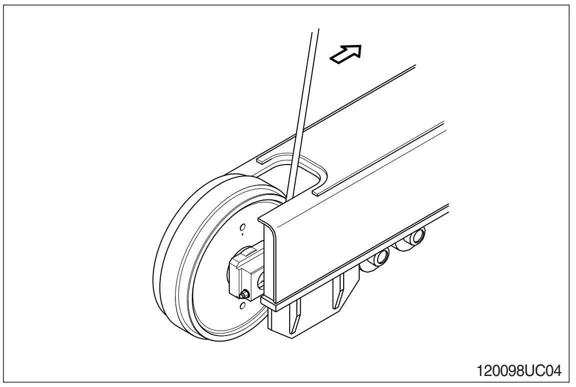
2) INSTALL

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

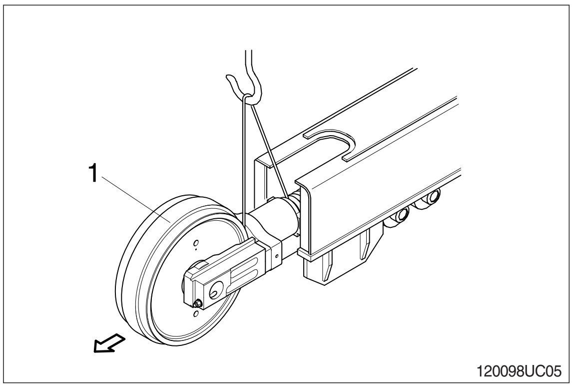
4. IDLER AND RECOIL SPRING

1) REMOVAL

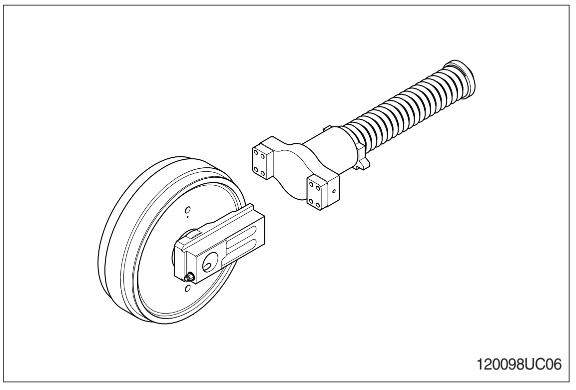
(1) Remove the track link.
For detail, see removal of track link.



(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
  · Weight : 1880 ㎏ (4140 ℔)



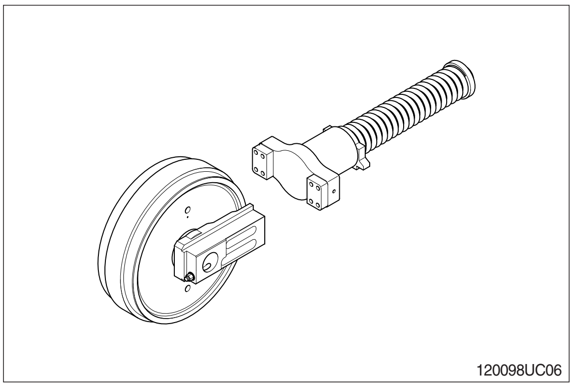
(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.



2) INSTALL

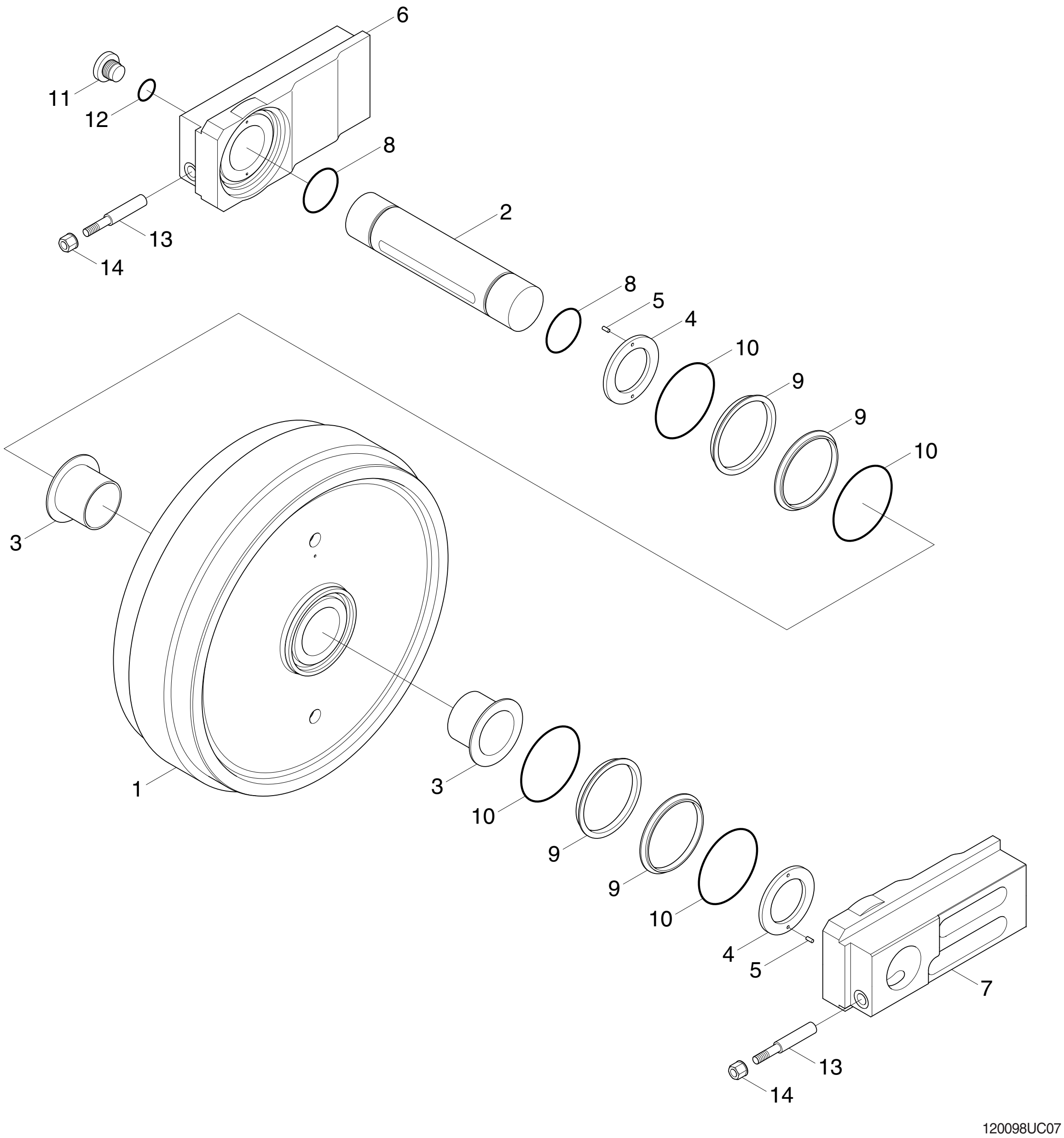
(1) Carry out installation in the reverse order to removal.

※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



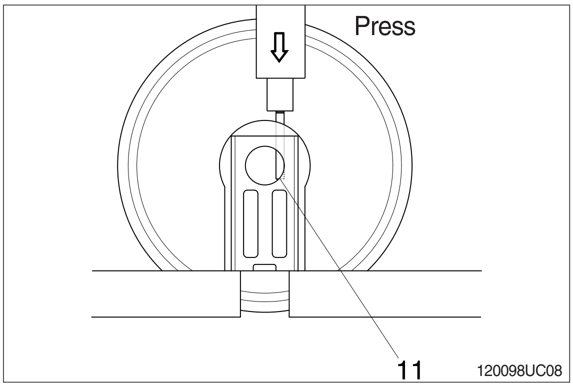
1	Idler	6	Bracket	11	Plug
2	Shaft	7	Bracket	12	O-ring
3	Bushing	8	O-ring	13	Taper pin
4	Spacer	9	Seal	14	Nut
5	Pin	10	O-ring		

(2) Disassembly

① Remove plug and drain oil.

② Remove nut (14).

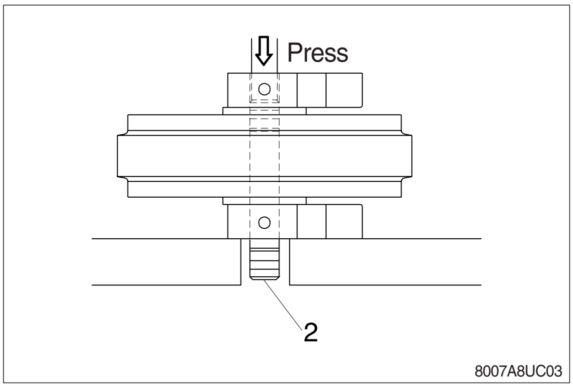
③ Draw out the spring pin (13), using a press.



④ Pull out the shaft (2) with a press.

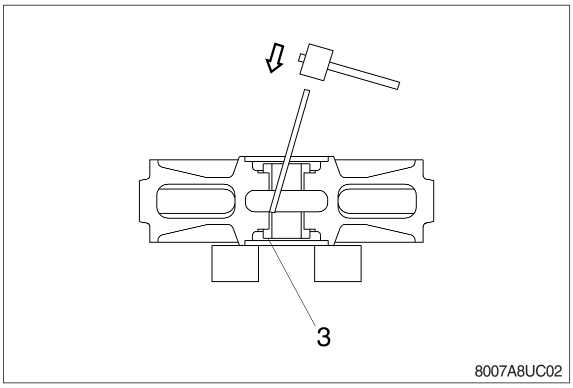
⑤ Remove seal (9) from idle (1) and bracket (6, 7).

⑥ Remove O-ring (10) from shaft.



⑦ Remove the bushing (3) from idler, using a special tool.

※ Only remove bushing if replacement is necessity.

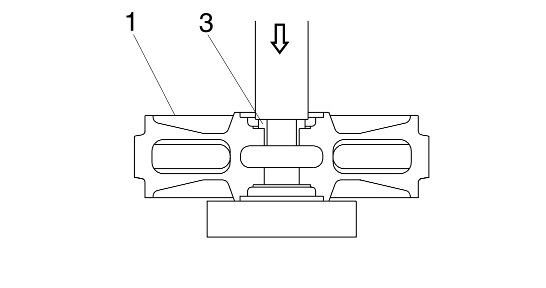


(3) Assembly

※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

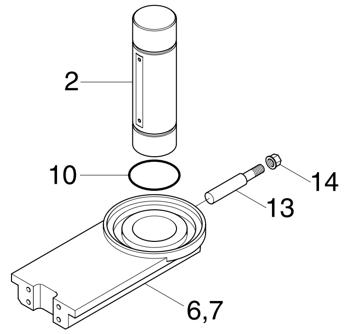
① Cool up bushing (3) fully by some dry ice and press it into idle (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.



8007A8UC05

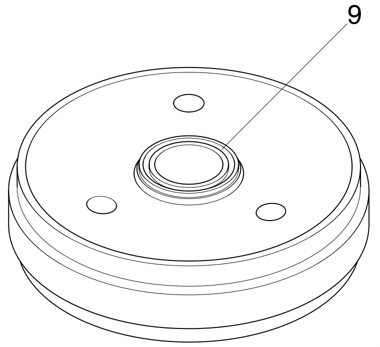
② Coat O-ring (10) with grease thinly, and install it to shaft (2).

③ Insert shaft (2) into bracket (6, 7) and drive in the taper pin (13) and nut (14).



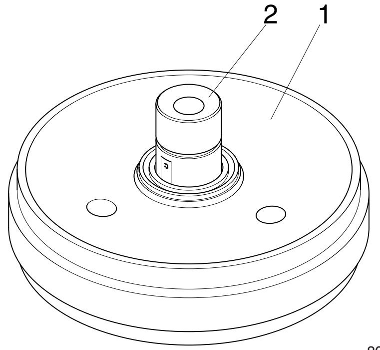
120098UC09

④ Install seal (9) to idler (1) and bracket (6, 7).



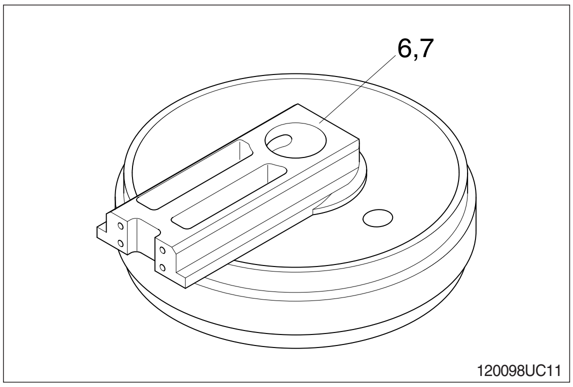
120098UC10

⑤ Install shaft (2) to idler (1).

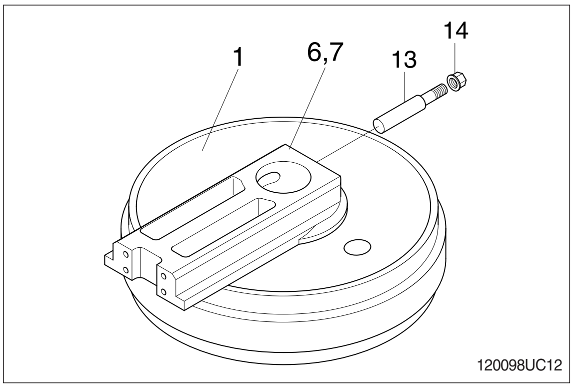


8007A8UC08A

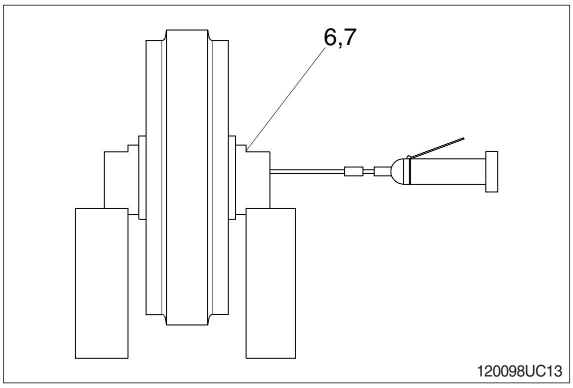
⑥ Install bracket (6, 7) attached with seal (9).



⑦ Knock in the taper pin (13) with a hammer and tighten nut (14).

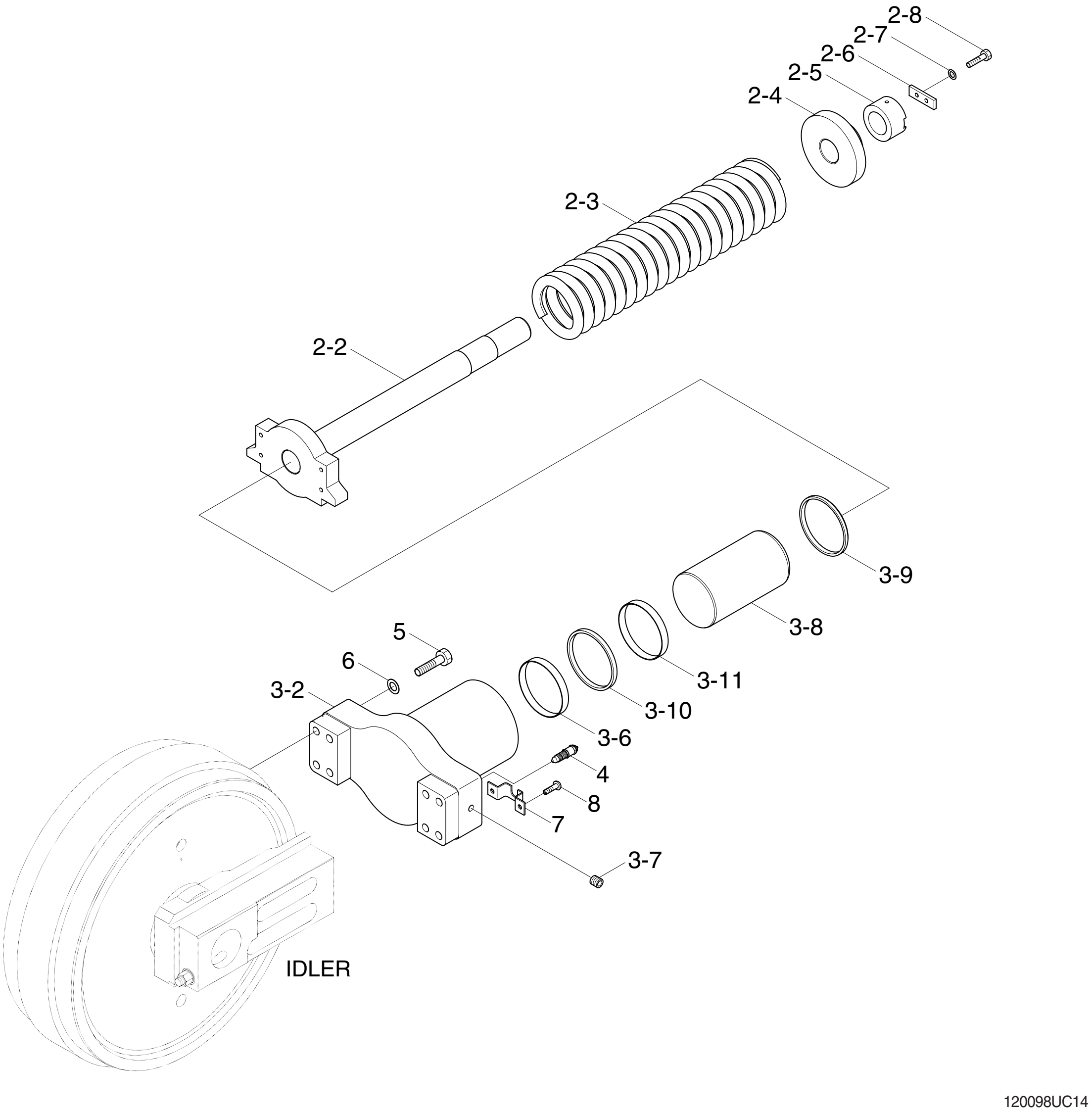


⑧ Lay bracket (6, 7) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



2	Tension cylinder assy	2-8	Bolt	3-10	U/Packing seal
2-2	Main rod	3	Tension body assy	3-11	Guide ring
2-3	Spring	3-2	Cylinder wa	4	Grease valve
2-4	Rear flange	3-6	Guide ring	5	Hex bolt
2-5	Locking ring	3-7	Plug	6	Hardened washer
2-6	Plate	3-8	Piston	7	Plate
2-7	Washer	3-9	Wiper ring	8	Socket bolt

(2) Disassembly

① Apply pressure on spring (2-3) with a press.

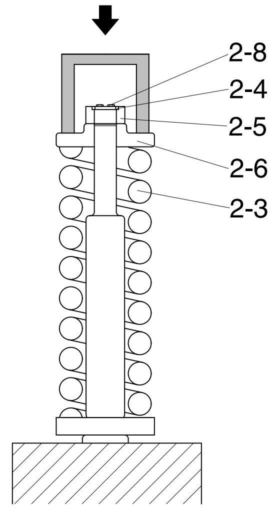
※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

· Spring set load : 58957 kg (129980 lb)

② Remove bolt (2-8), safety plate (2-6) and locking ring (2-5).

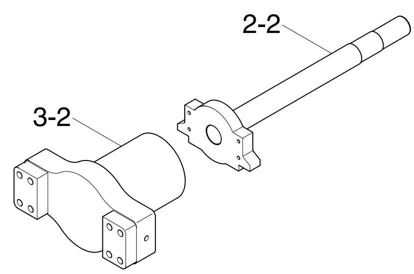
③ Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

④ Lighten the press load slowly and remove bracket (2-4) and spring (2-3).



120098UC15

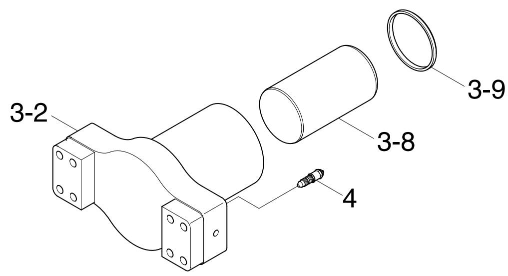
⑤ Remove rod (2-2) cylinder (3-2).



120098UC16

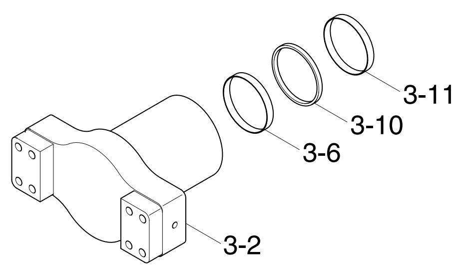
⑥ Remove grease valve (4) from cylinder (3-2).

⑦ Remove wiper ring (3-9) and piston (3-8) from cylinder (3-2).



120098UC17

⑧ Remove guide ring (3-11) packing seal (3-10) and guide ring (3-6).



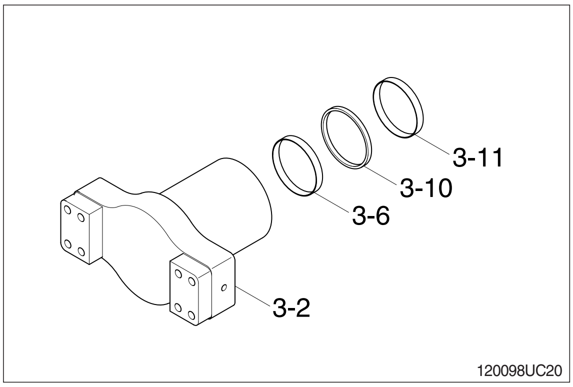
120098UC20

(3) Assembly

① Install guide ring (3-6), packing seal (3-10), guide ring (3-11).

※ **When installing packing seal (3-10) take full care so as not to damage the lip.**

② Install piston (3-8) and wiper ring (3-9).

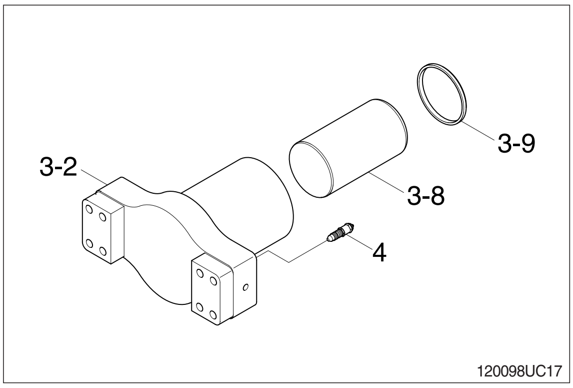


③ Pour grease into cylinder (3-2), then push in piston (3-8) by hand.
After take grease out of grease valve mounting hole, let air out.

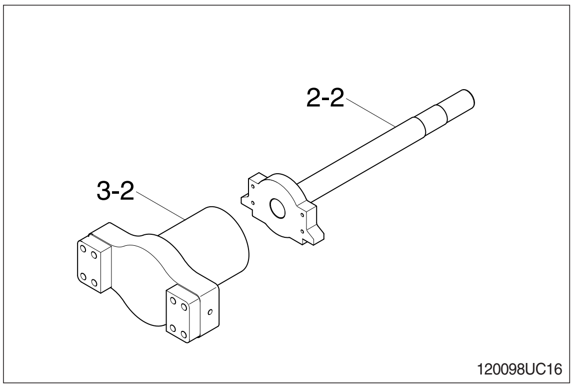
※ **If air letting is not sufficient, it may be difficult to adjust the tension of crawler.**

④ Fit grease valve (4) to cylinder (3-2).

· Tightening torque : 6.0±1.0 kgf · m (43.4±7.2lbf · ft)



⑤ Install rod (2-2) and cylinder (3-2).

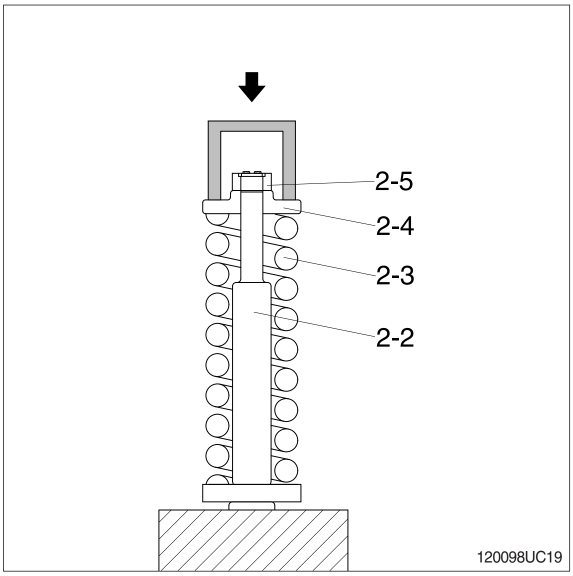


⑥ Install spring (2-3) and rear flange (2-4) to rod (2-2).

⑦ Apply pressure to spring (2-3) with a press and tighten locking ring (2-5).

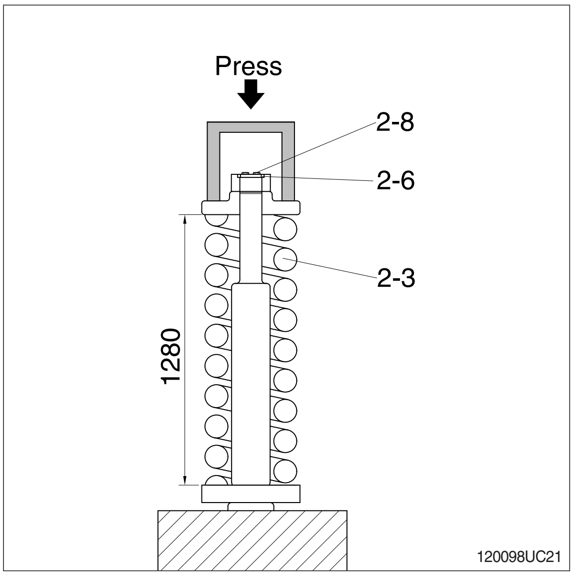
※ Apply sealant before assembling.

※ During the operation, pay attention specially to prevent the press from slipping out.



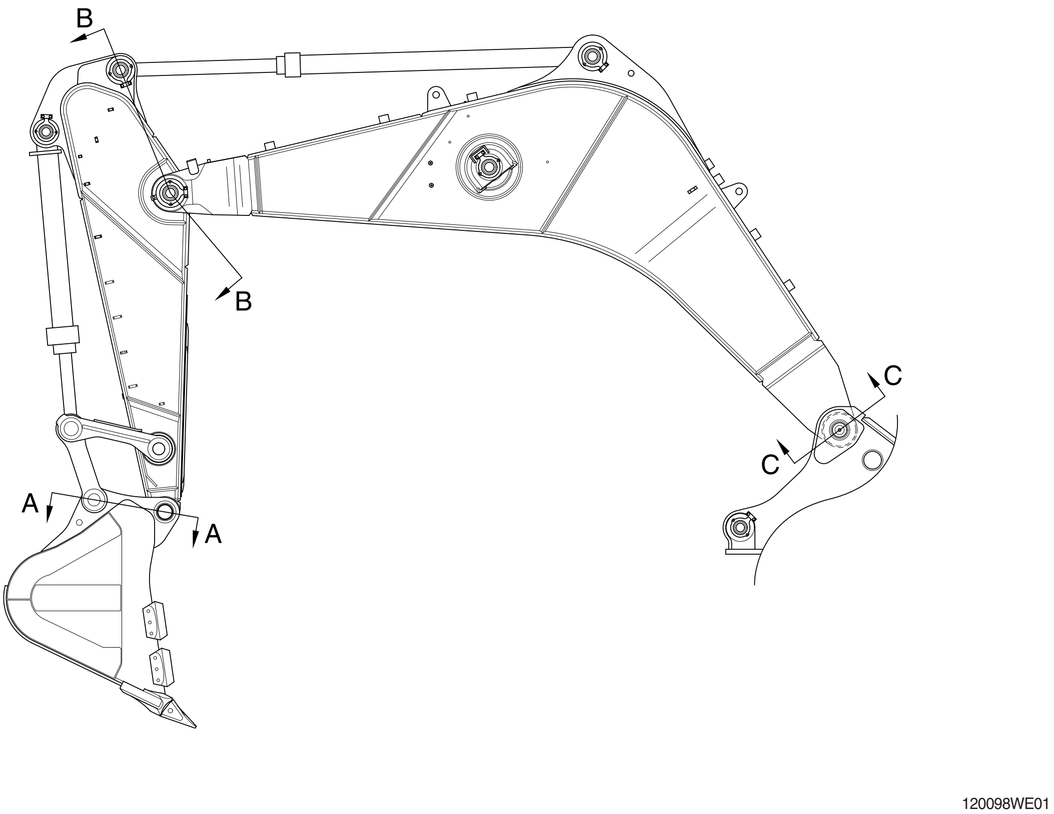
⑧ Lighten the press load and confirm the set length of spring (2-3).

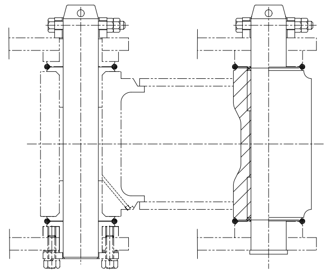
⑨ After the setting of spring (2-3), install safety plate (2-6) and bolt (2-8).



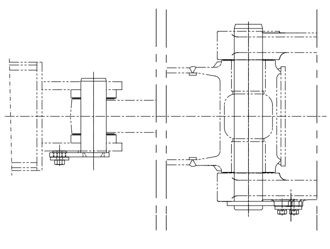
GROUP 11 WORK EQUIPMENT

1. STRUCTURE

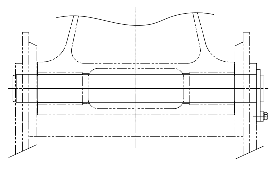




SECTION A



SECTION B



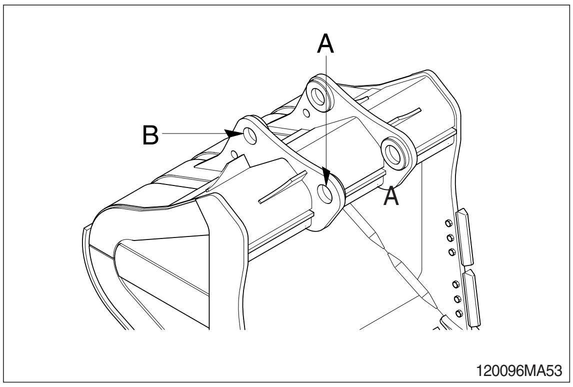
SECTION C

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

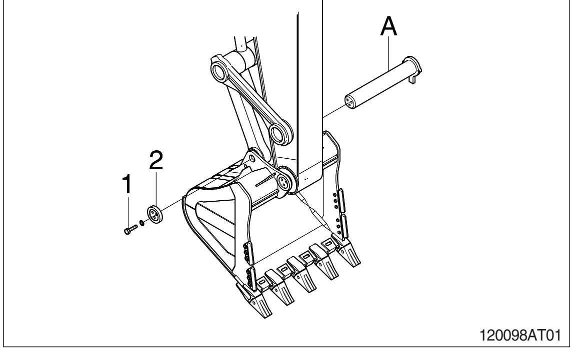
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



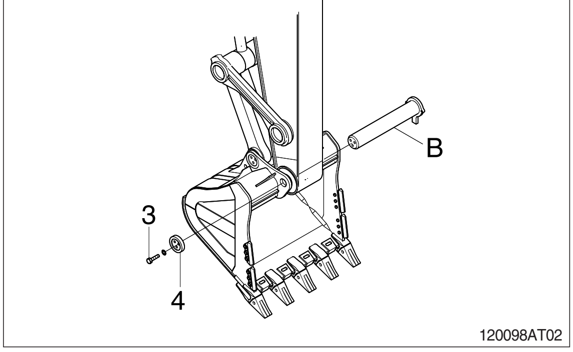
120096MA53

② Remove stopper bolts (1), stopper (2) and draw out the pin (A).



120098AT01

③ Remove stopper bolts (3), stopper (4) and draw out the pin (B).



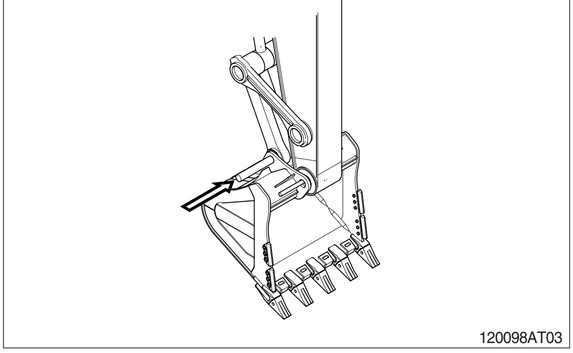
120098AT02

(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.**



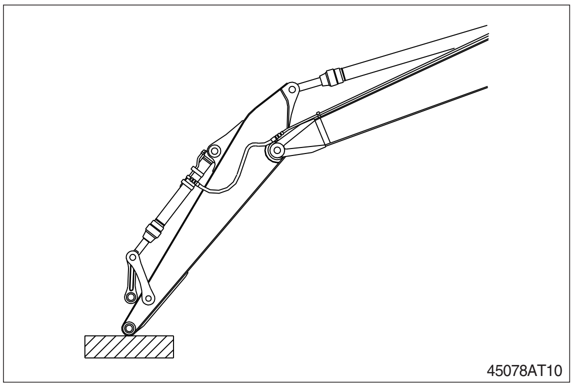
120098AT03

2) ARM ASSEMBLY

(1) Removal

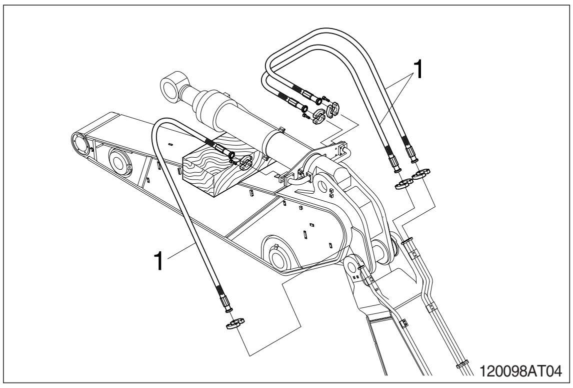
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

▲ Escaping fluid under pressure can panetrated 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.

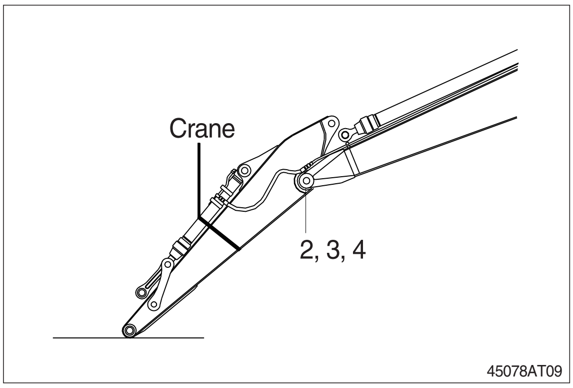
※ Tie the rod with wire to prevent it from coming out.

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 : 6500 kg (14330 lb)

※ When lifting the arm assembly, always lift the center of gravity.



(2) Install

① Carry out installation in the reverse order to removal.

▲ When lifting the arm assembly, always lift the center of gravity.

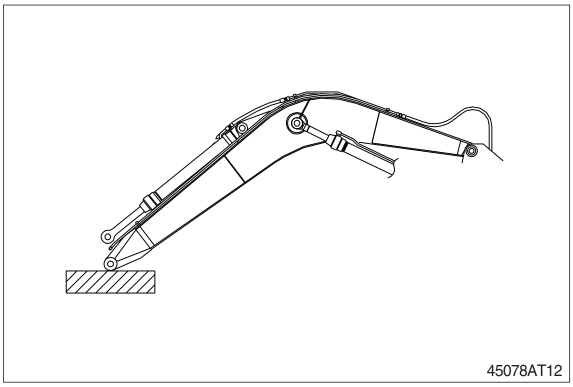
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.

② For details, see removal of arm and bucket assembly.
Remove boom cylinder assembly from boom.
For details, see removal of boom cylinder assembly.



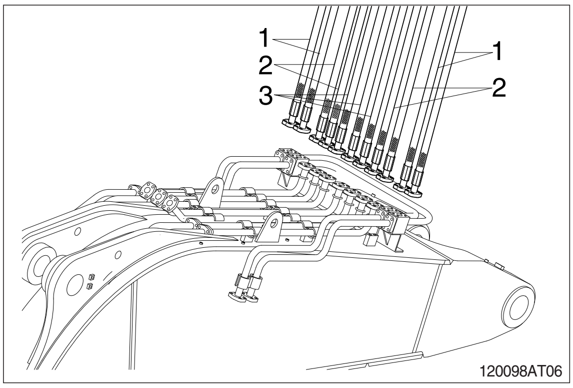
45078AT12

③ Disconnect head lamp wiring.

④ Disconnect boom cylinder hose (1), bucket cylinder hose (2) and arm cylinder hose (3).

※ **When the hose are disconnected, oil may spurt out.**

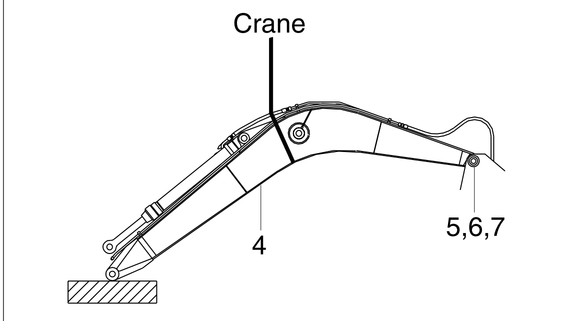
⑤ Sling boom assembly (4).



120098AT06

⑥ Remove bolt (5), plate (6) and pull out the pin (7) then remove boom assembly.
· Weight : 12300 ㎏ (27120 ℔)

※ **When lifting the boom assembly always lift the center of gravity.**



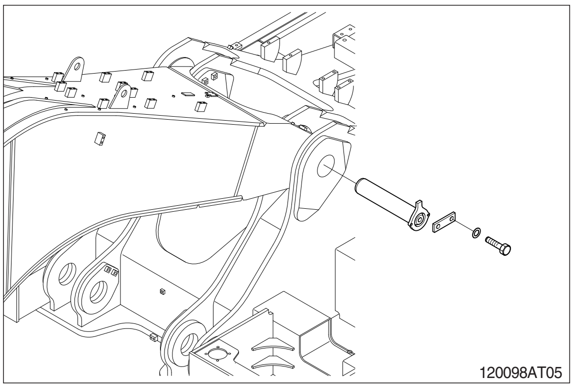
120098AT07

(2) Install

① Carry out installation in the reverse order to removal.

⚠ When lifting the boom assembly, always lift the center of gravity.

※ Bleed the air from the cylinder.



120098AT05

SECTION 9 COMPONENT MOUNTING TORQUE

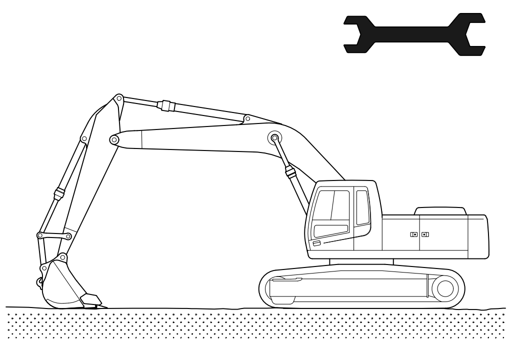
SECTION 9 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine Hyundai spare parts.
   We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases Hyundai cannot assume liability for any damage.

※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.

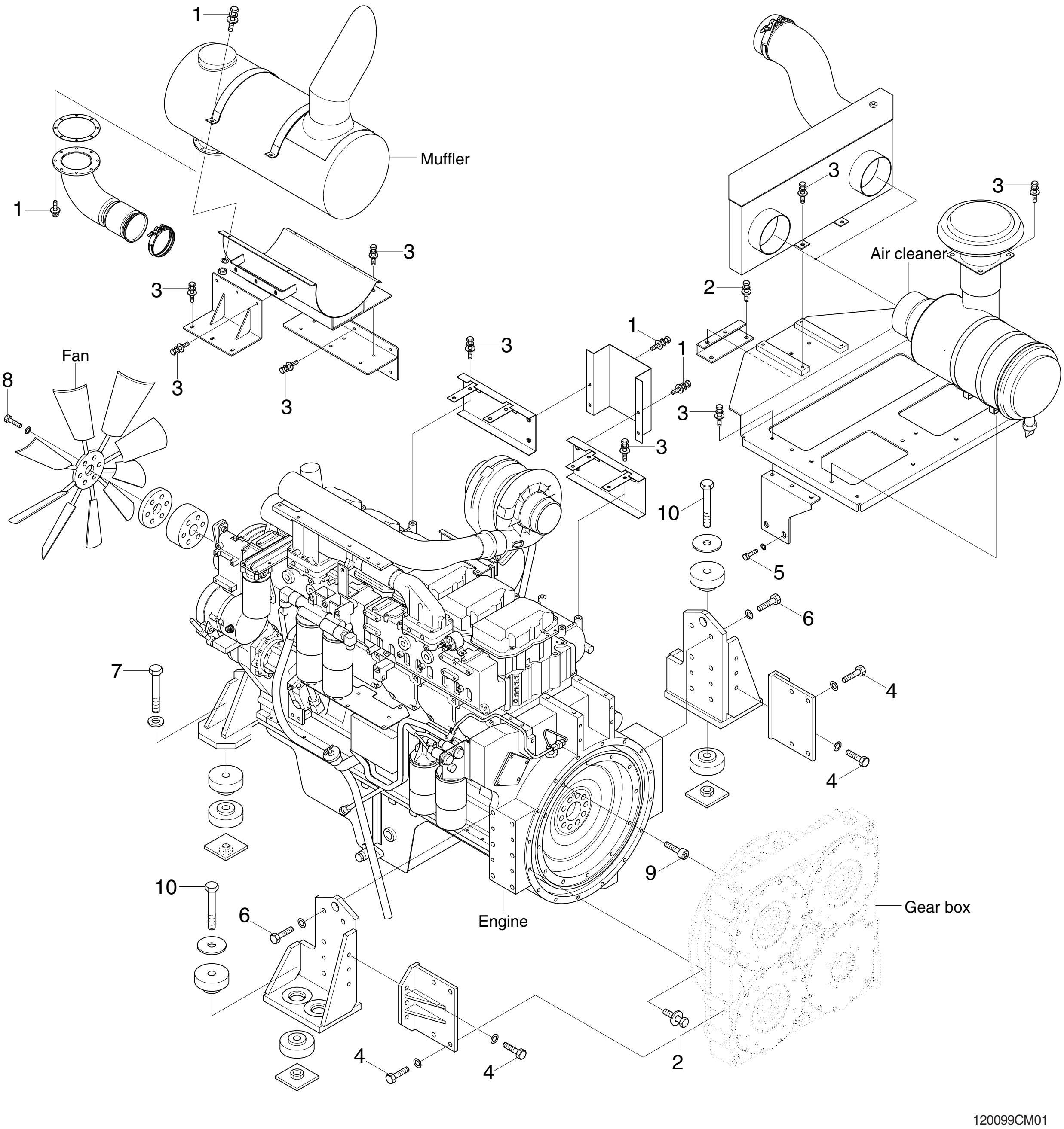
※ Before installation, clean all the compone-nts with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



29079CM00

GROUP 2 ENGINE SYSTEM

ENGINE AND ACCESSORIES MOUNTING

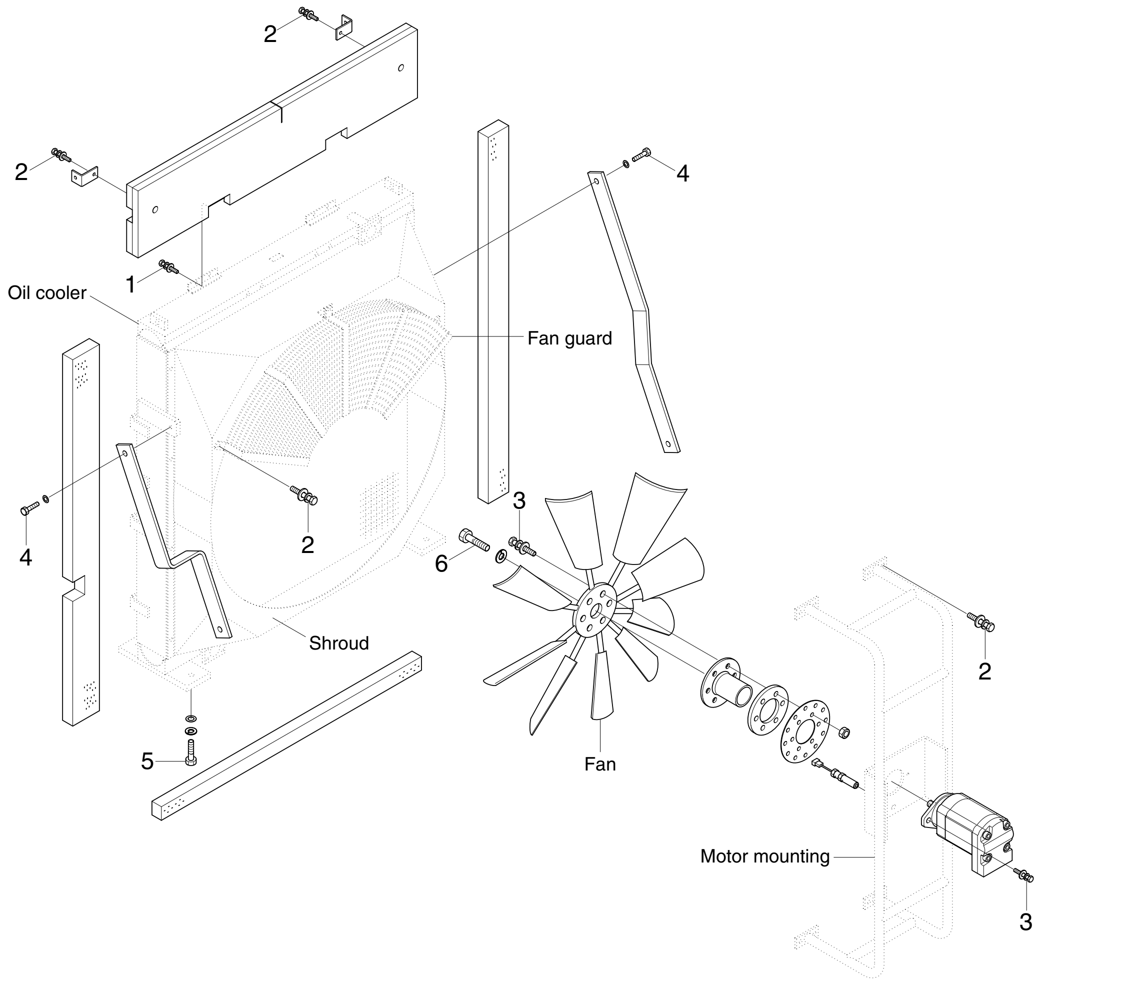


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.9±1.4	49.9±10.1
2	M12×1.75	12.3±1.0	89±7.2
3	M12×1.75	12.3±2.4	88.9±17.3
4	M16×2.0	29.7±3.0	215±21.7
5	M16×2.0	29.7±5.0	215±36.1

Item	Size	kgf · m	lbf · ft
6	M18×2.5	41.3±4.0	299±29
7	M22×2.5	70±7.0	506±50.6
8	1/2-13UNC	13.4±1.0	97±7.2
9	5/8-11UNC	27±3.0	195±21.7
10	M24×3.0	100±10	723±7.2

OIL COOLER AND FAN DRIVE MOUNTING



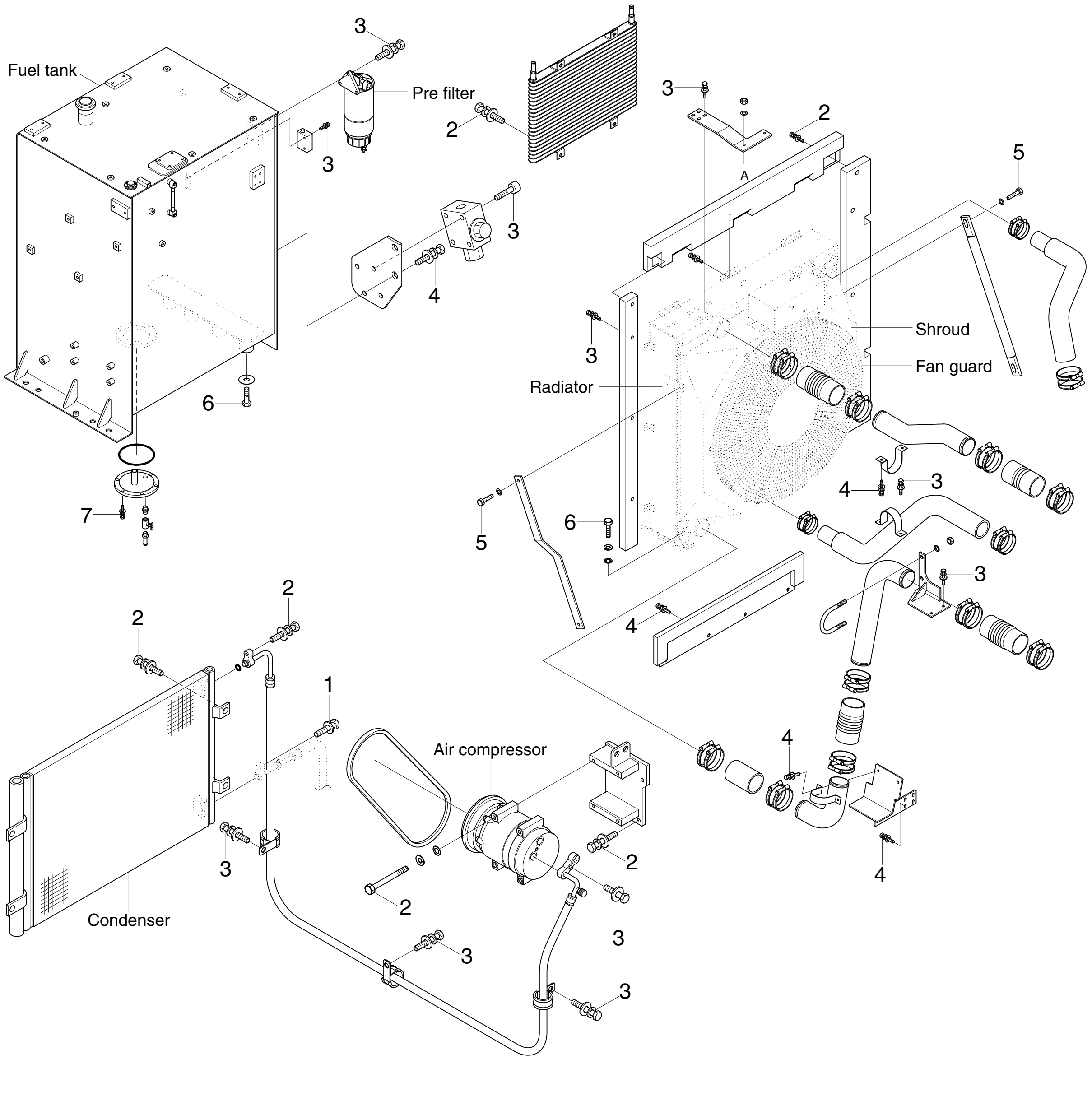
120099CM02

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1
3	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
4	M14×2.0	14.4±2.2	104±16
5	M20×2.5	57.9±8.7	419±62.9
6	5/16-18UNC	3.4±0.4	24.6±2.9

COOLING SYSTEM AND FUEL TANK MOUNTING



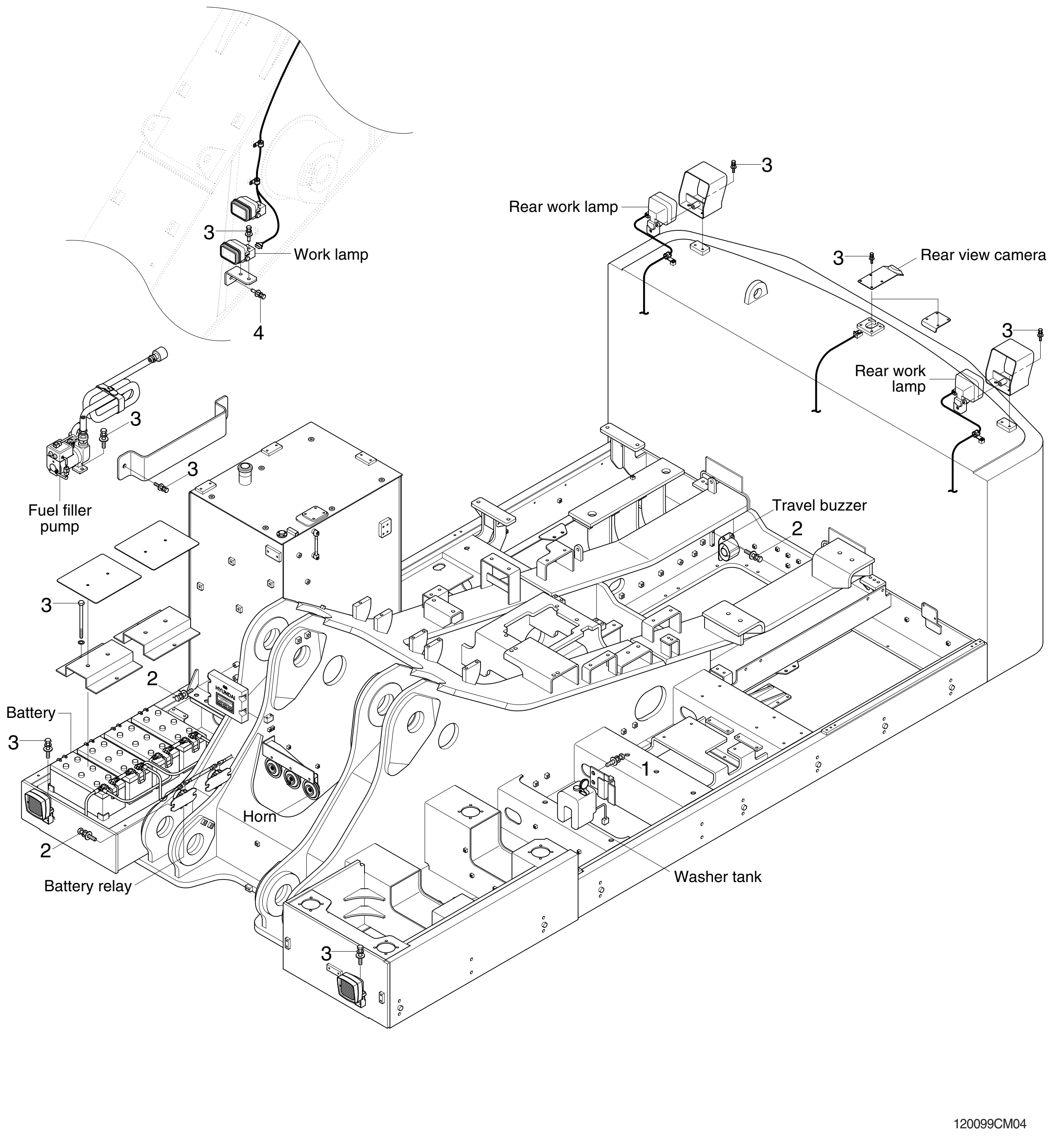
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M6 × 1.0	1.05 ± 0.2	7.6 ± 1.45
2	M8 × 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	M14 × 2.0	14.4 ± 2.2	104 ± 16
6	M20 × 2.5	45 ± 5.1	325 ± 37
7	-	2.3 ± 0.6	16.6 ± 4.3

GROUP 3 ELECTRIC SYSTEM

ELECTRIC COMPONENTS MOUNTING 1

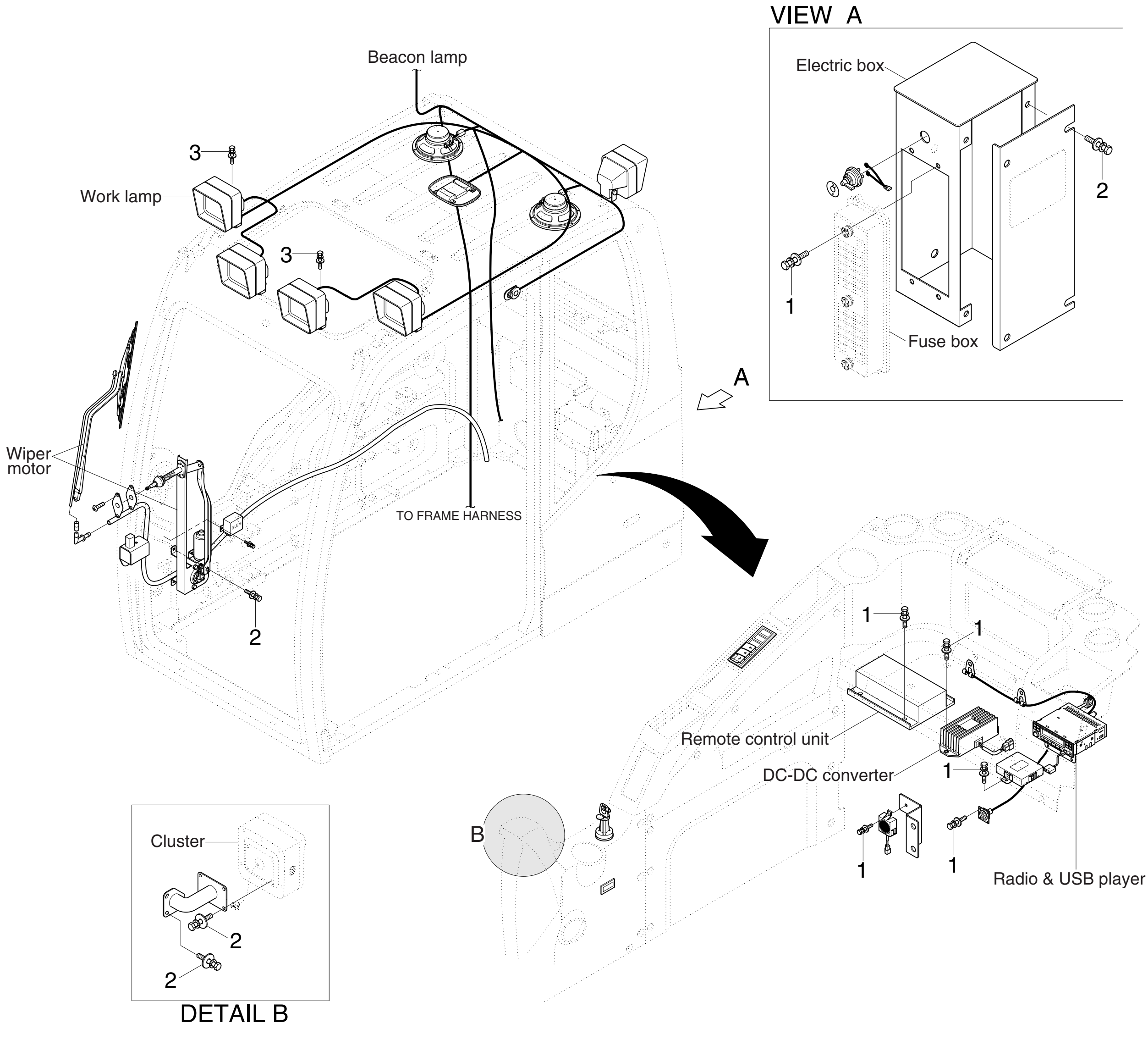


· Tightening torque

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



120099CM05

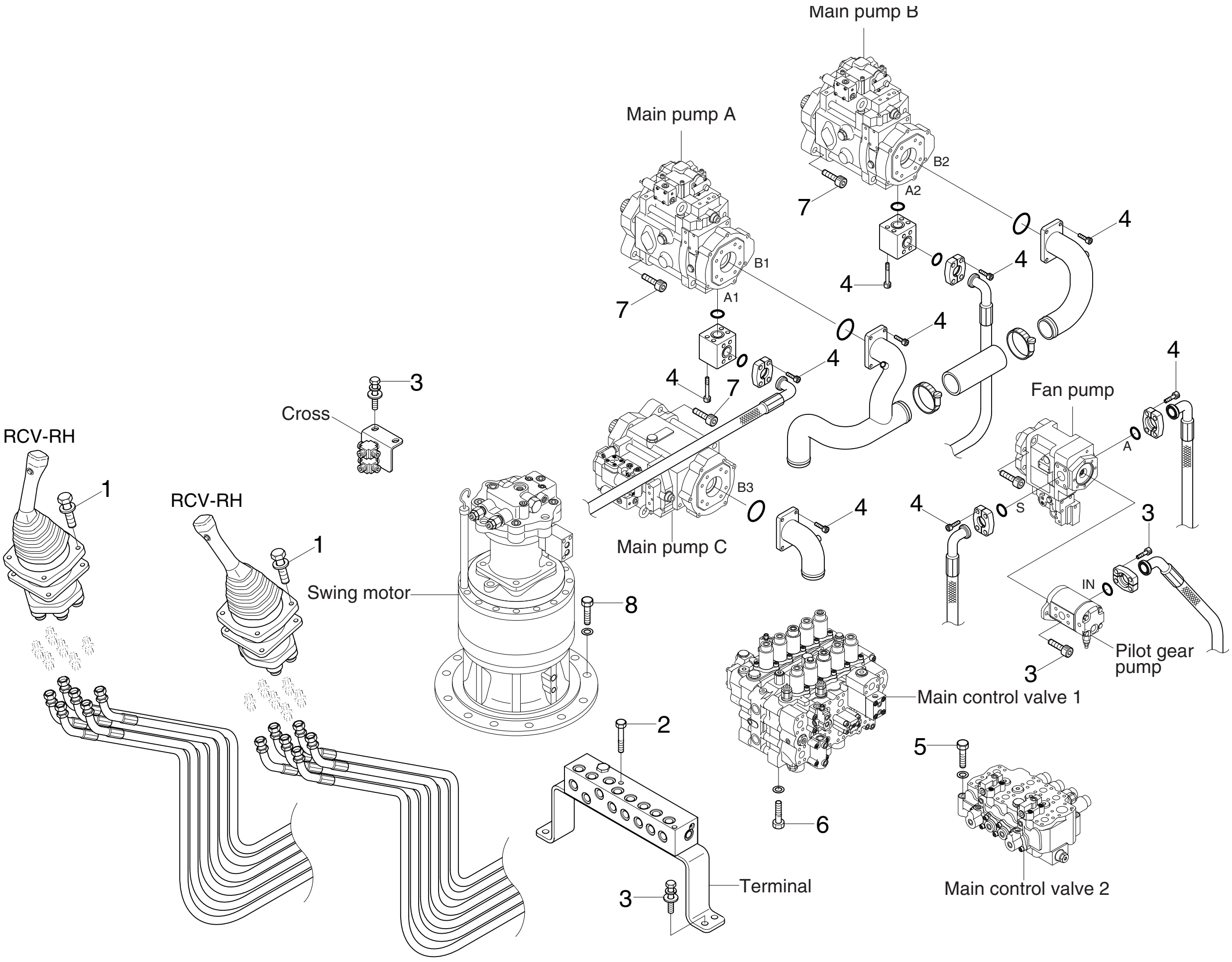
· Tightening torque

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



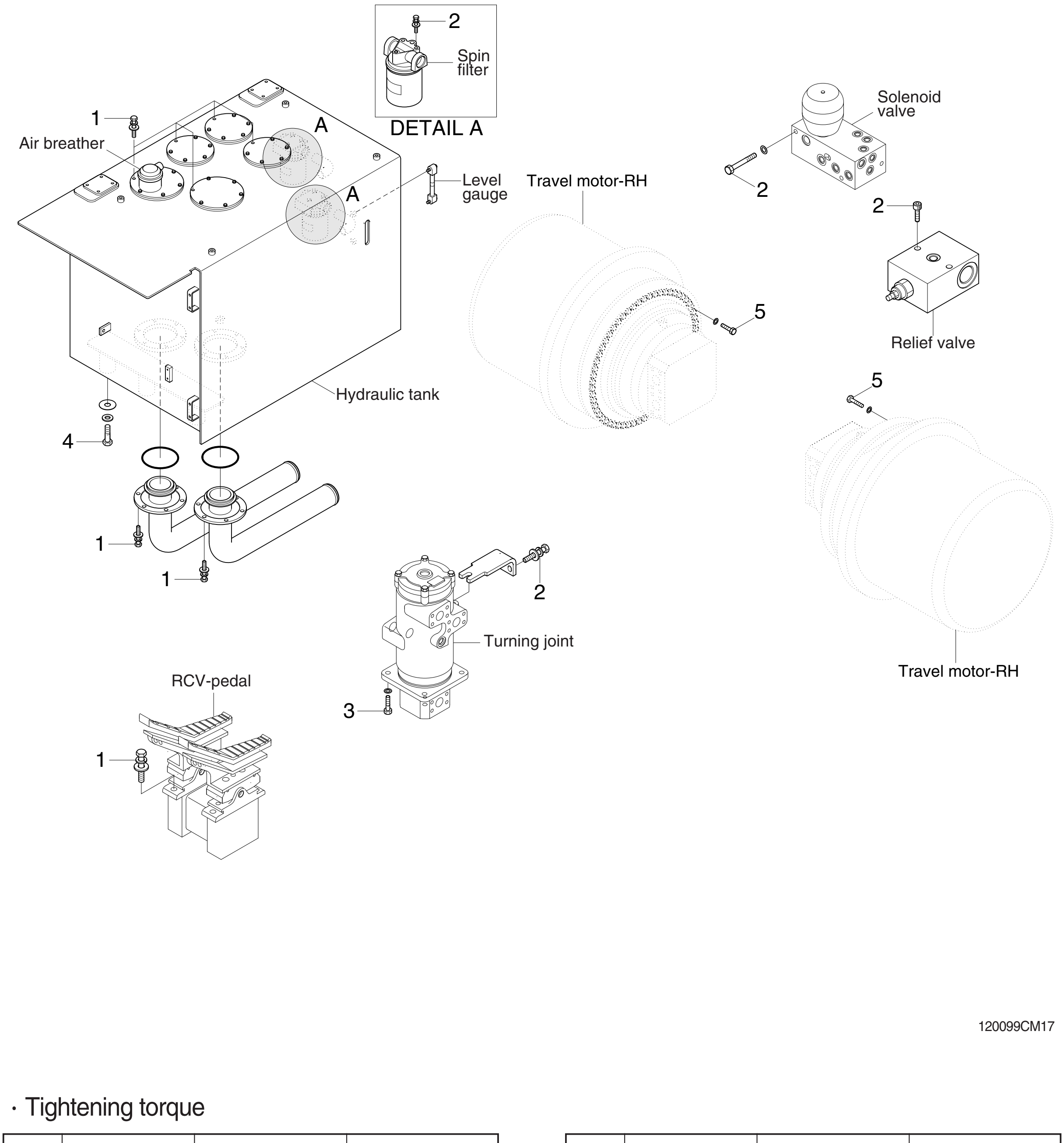
120099CM06

· 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	12.3±1.3	88.2±9.4

Item	Size	kgf · m	lbf · ft
5	M16×2.0	29.7±4.4	215±31.8
6	M20×2.5	42.6±4.2	308±30.3
7	M20×2.5	57.9±8.7	419±62.9
8	M24×3.0	100±15	723±108

HYDRAULIC COMPONENTS MOUNTING 2

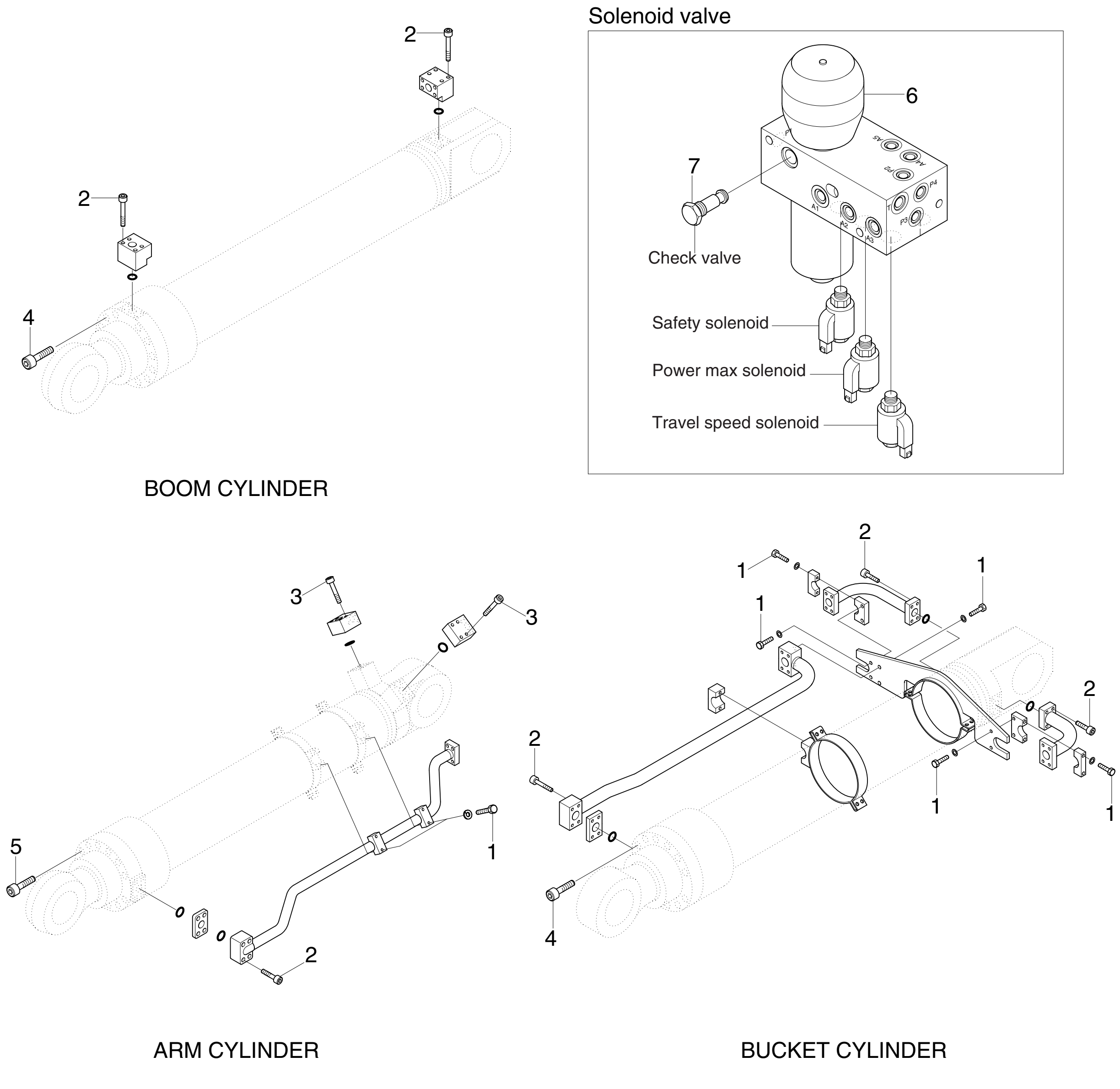


· Tightening torque

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	M16×2.0	29.7±4.5	215±32.5

Item	Size	kgf · m	lbf · ft
4	M20×2.5	57.9±8.7	419±62.9
5	M30×3.5	150±10	1085±72.3

HYDRAULIC COMPONENTS MOUNTING 3



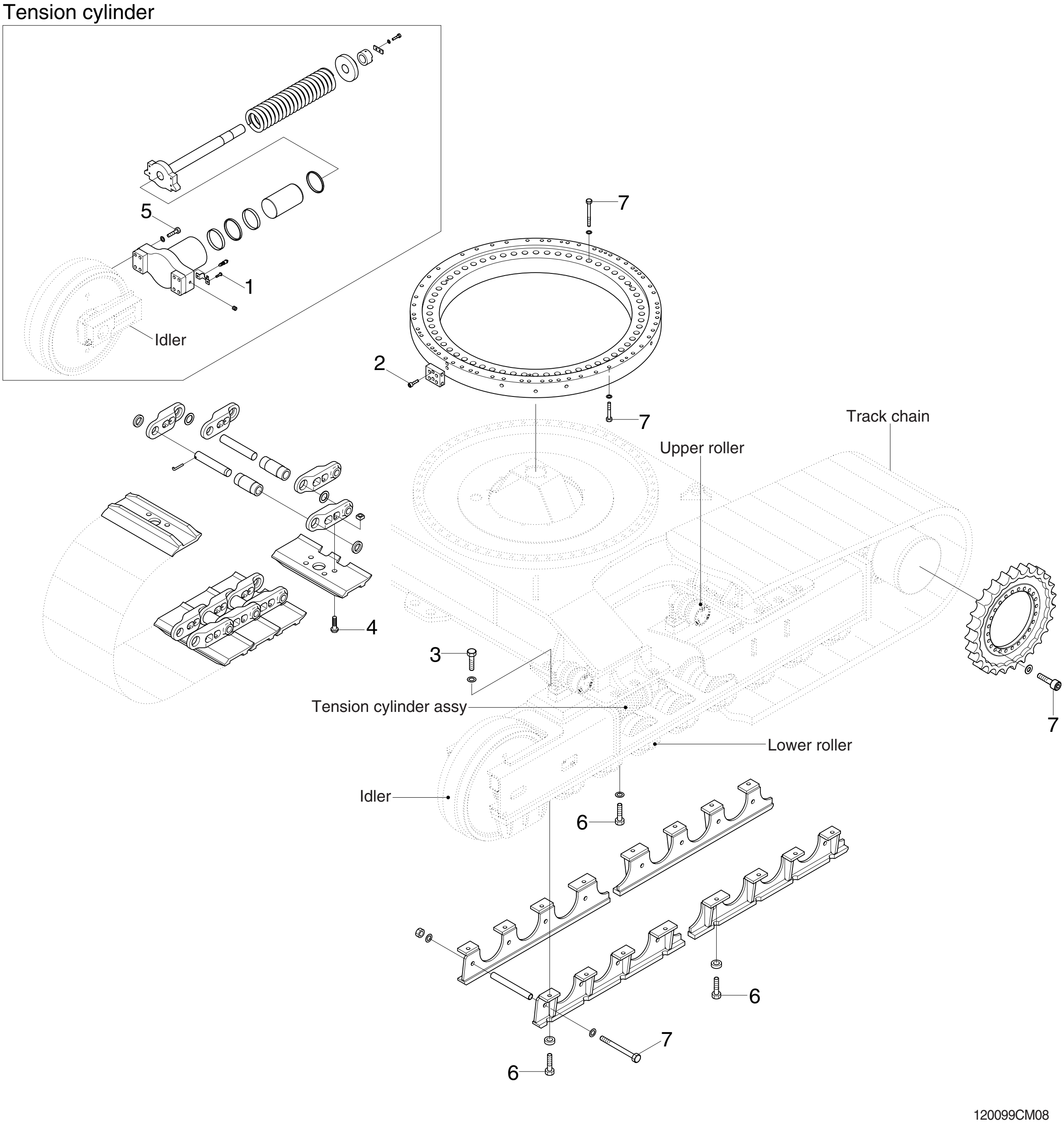
120099CM07

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M12×1.75	9.4±1.0	68.0±7.2
2	M14×2.0	15±1.5	109±10.8
3	M16×2.0	23±2.3	166±16.6
4	M30×3.5	157±16	1136±116

Item	Size	kgf · m	lbf · ft
5	M33×3.5	215±21.5	1555±156
6	M22×2.5	4.1	29.6
7	M27×3.0	5.1	36.9

GROUP 5 UNDERCARRIAGE

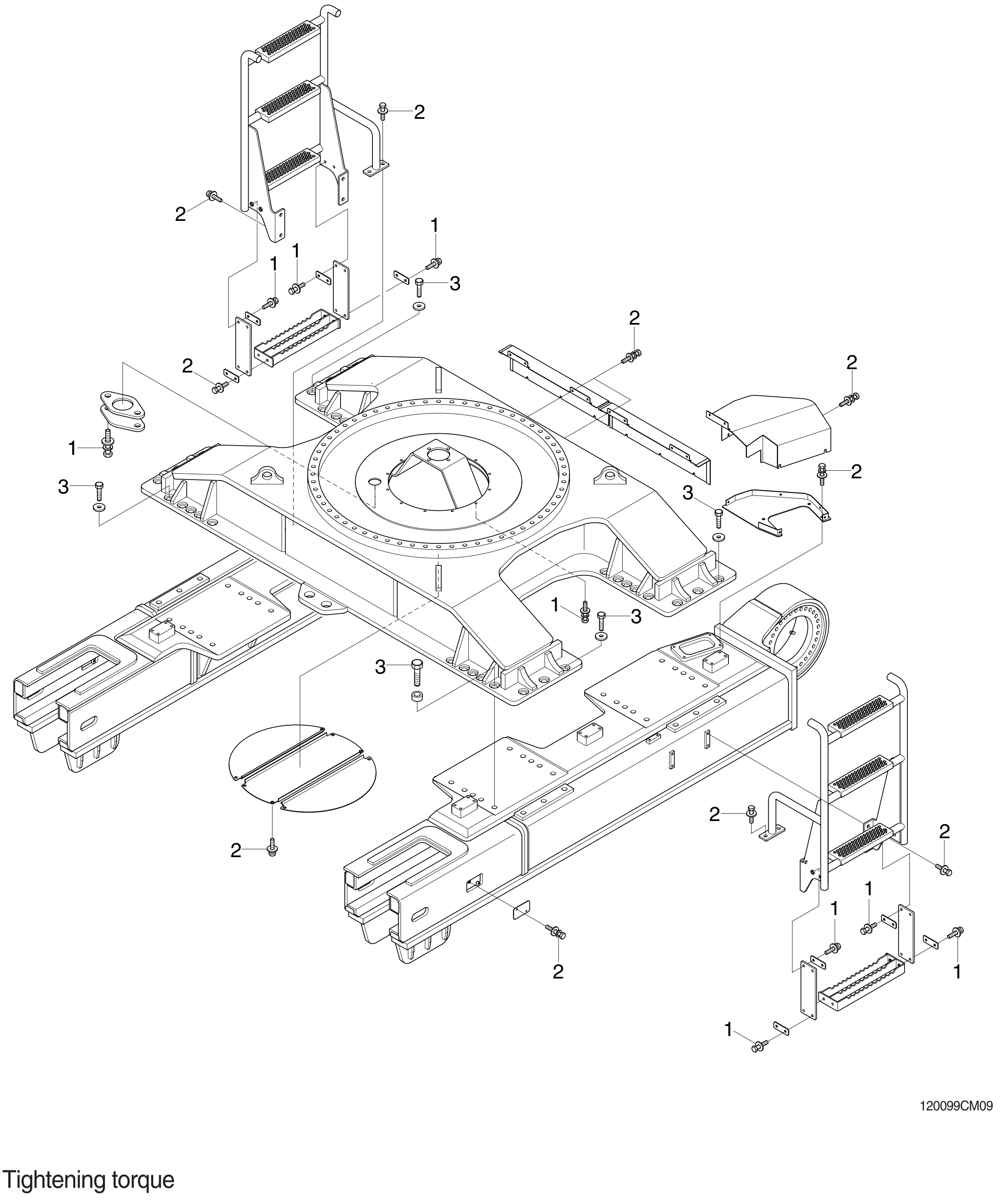


· Tightening torque

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	M20×2.5	57.9±8.7	419±63
4	M24×1.5	240±2.0	1736±50.6

Item	Size	kgf · m	lbf · ft
5	M24×3.0	100±10	723±72.3
6	M27×3.0	140±7.0	1013±50.6
7	M30×3.5	199±10	1439±72.3

COVER AND FOOT BOARD MOUNTING

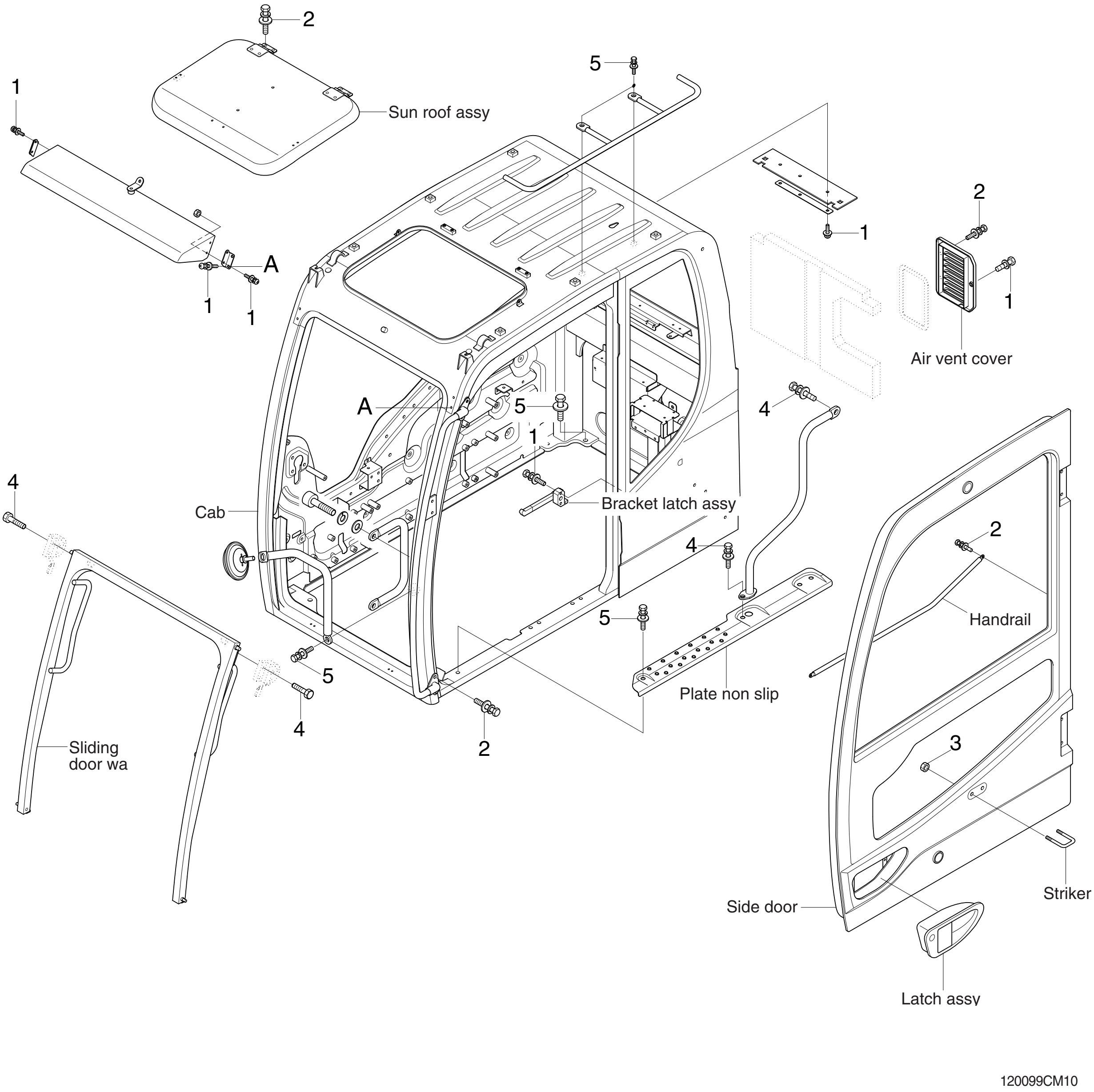


· Tightening torque

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	M42×4.5	483±48	3494±347

GROUP 6 STRUCTURE

CAB AND ACCESSORIES MOUNTING

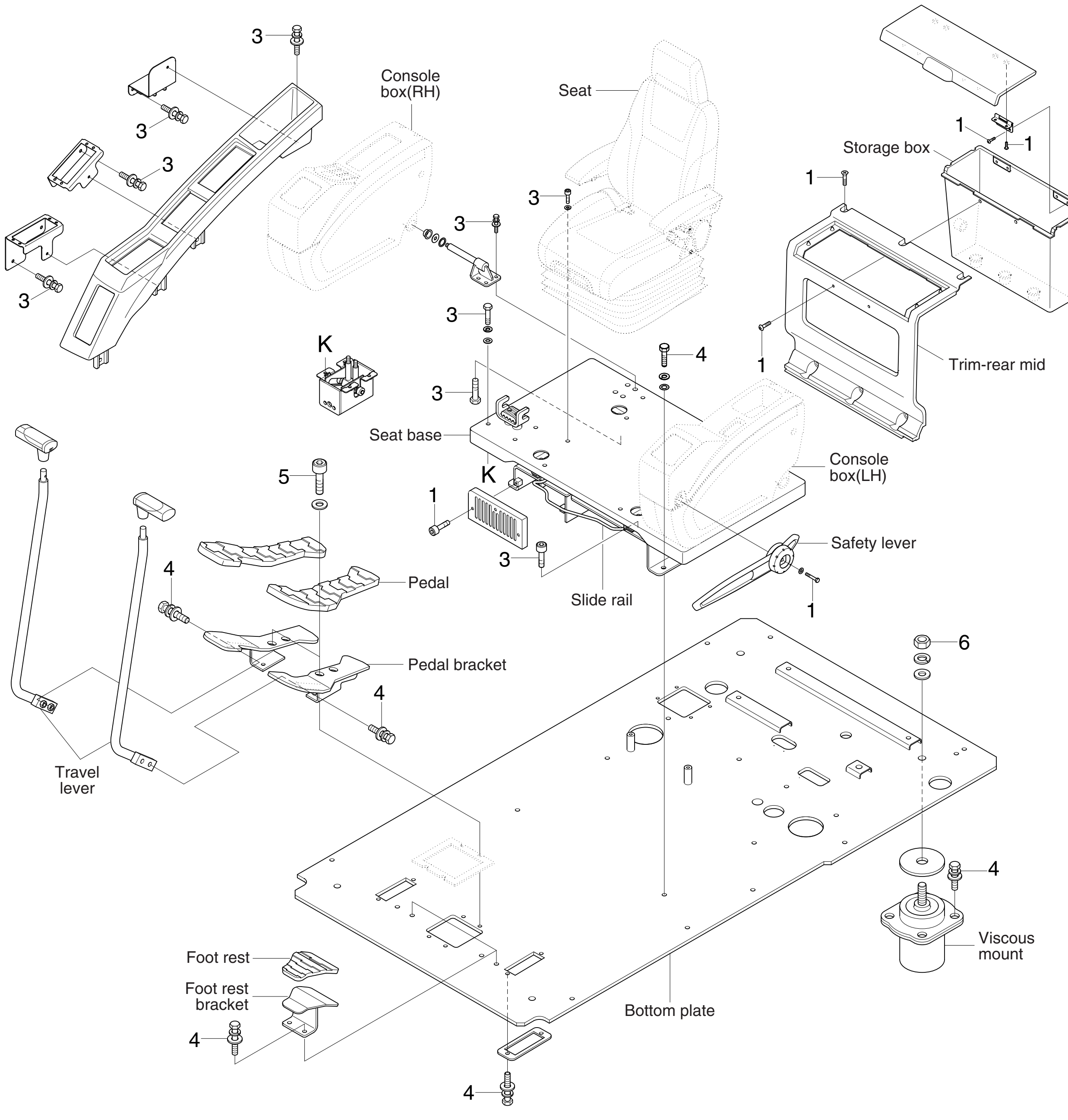


· Tightening torque

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

CAB INTERIOR MOUNTING

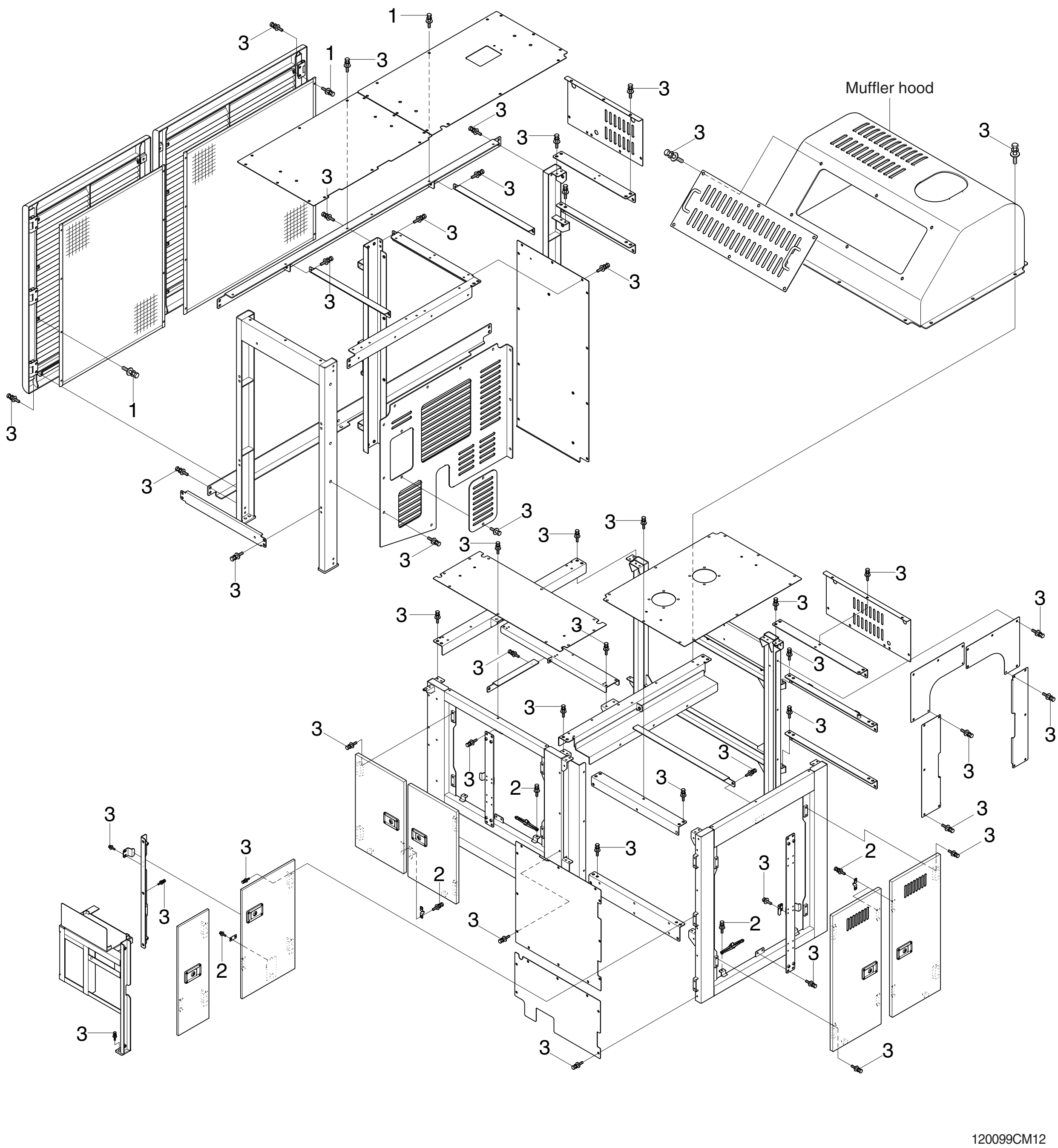


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	0.49±0.1	3.5±0.7
2	M 8×1.25	4.05±0.8	29.3±5.8
3	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
4	M10×1.5	6.9±1.4	49.9±10.1
5	M10×1.5	8.27±1.7	59.8±12.3
6	M16×2.0	29.7±4.5	215±32.5

COWLING MOUNTING

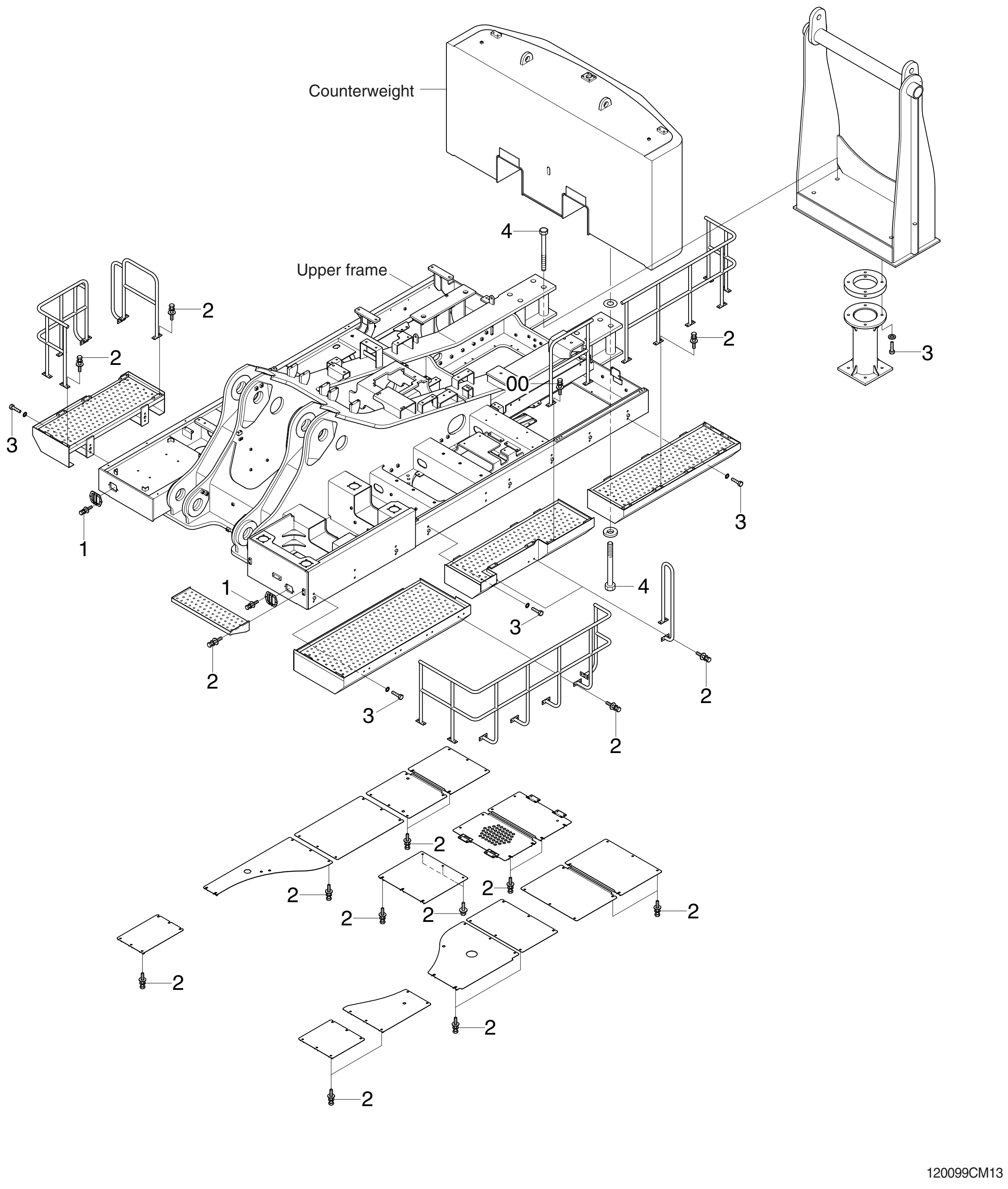


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7

COUNTERWEIGHT AND COVERS MOUNTING

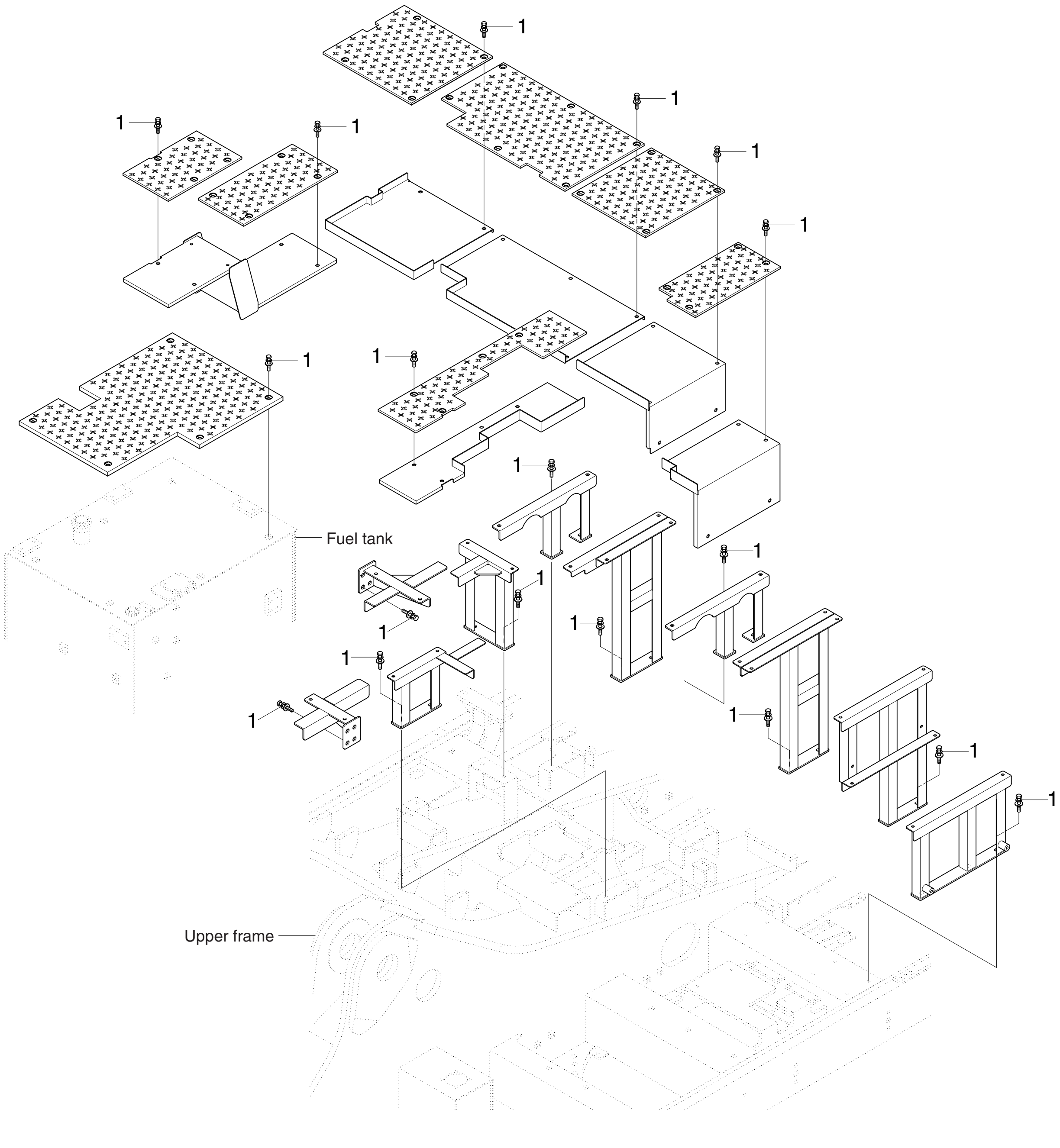


· Tightening torque

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	M16×2.0	29.7±4.5	215±32.5
4	M42×3.0	390±40	2821±289

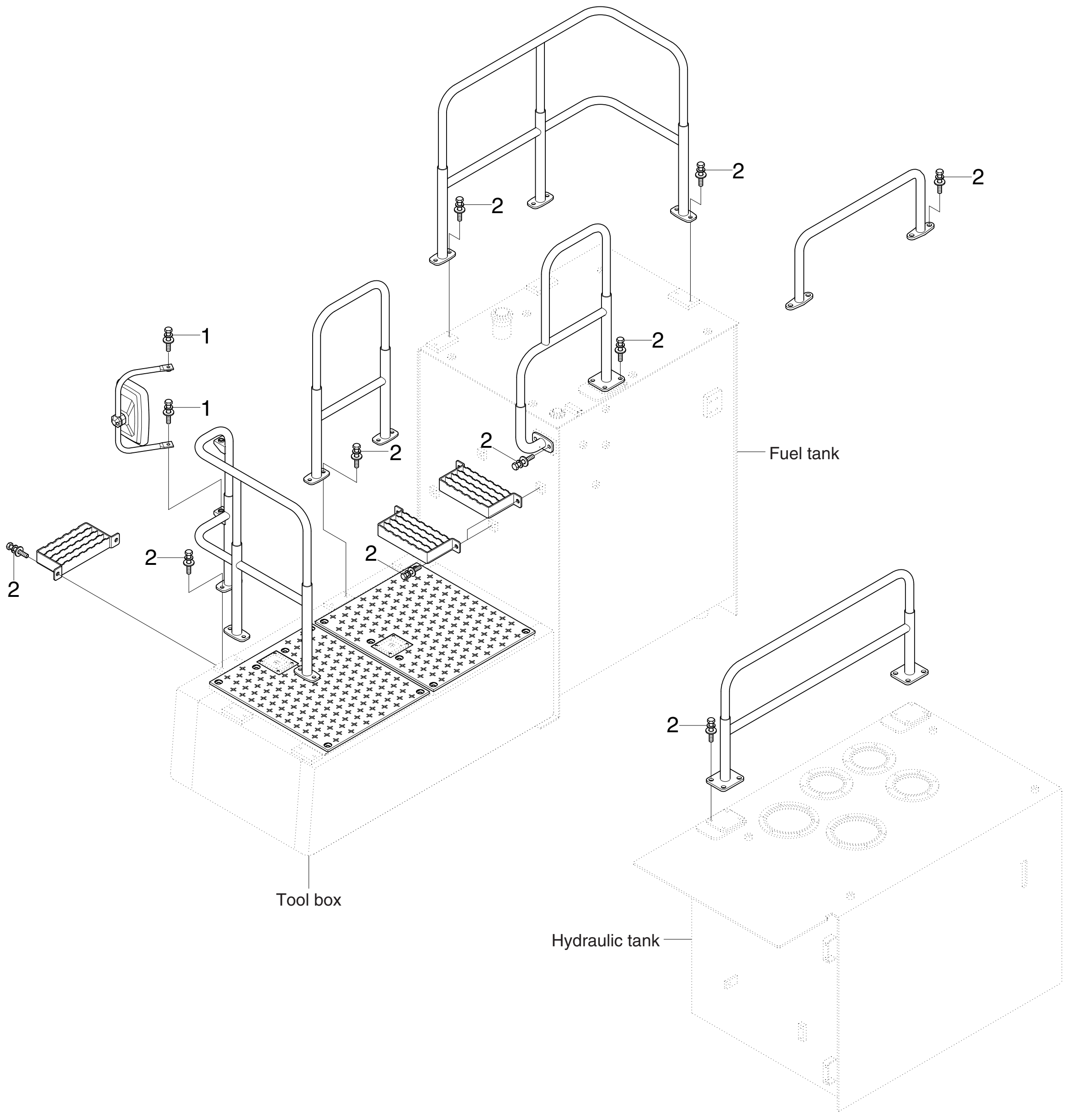
FLATFORM MOUNTING



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M12×1.75	12.8±3.0	92.6±21.7

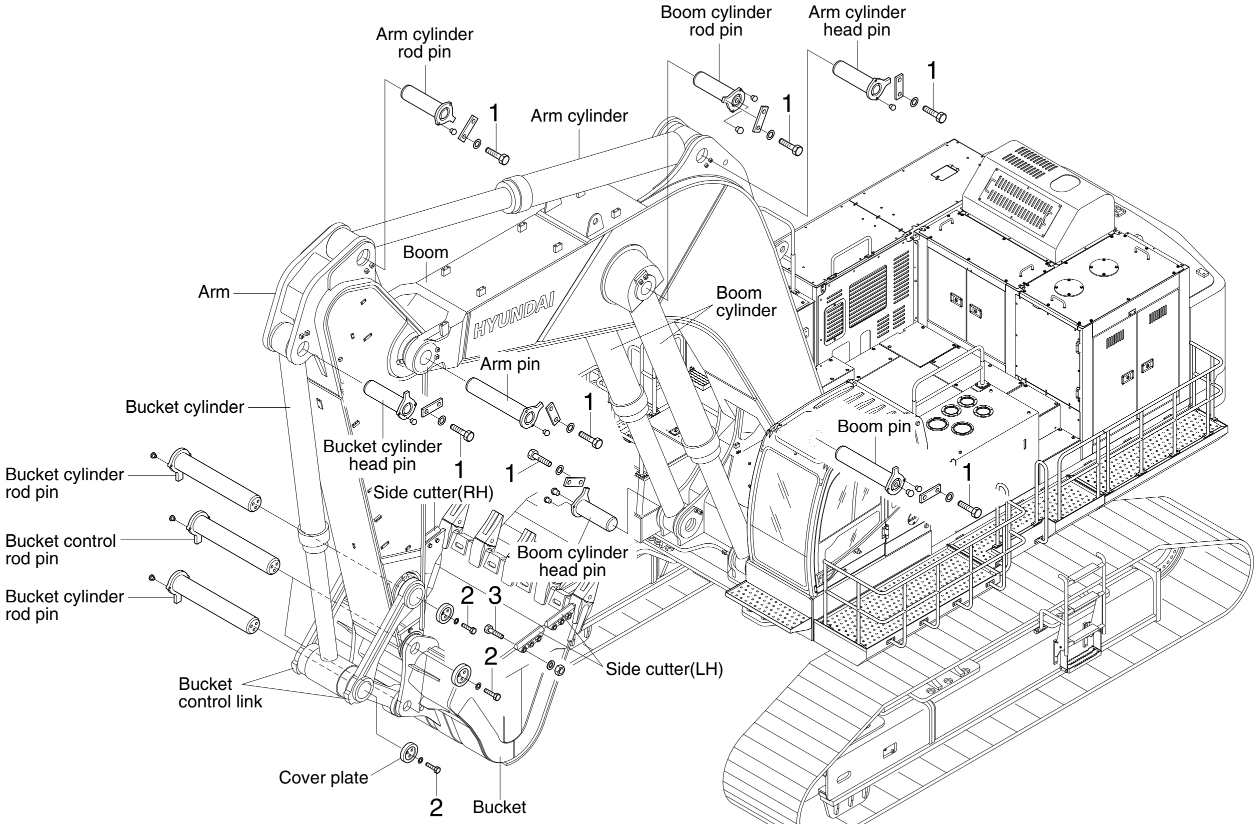
HANDRAIL AND TOOL BOX MOUNTING



· 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

GROUP 7 WORK EQUIPMENT



120099CM16

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M16×2.0	29.7±4.5	215±32.5
2	M24×3.0	100±15	723±108

Item	Size	kgf · m	lbf · ft
3	M30×3.5	199±30	1439±217
-	-	-	-