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SECTION 6 TROUBLESHOOTING

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SECTION 8 DISASSEMBLY AND ASSEMBLY

1. STRUCTURE

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

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

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

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

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

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 MECHATRONICS SYSTEM

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

SECTION 6 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 7 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 8 DISASSEMBLY AND ASSEMBLY

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

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

   10 - 4
   10 - 4 - 1 ┐
   10 - 4 - 2 ┘ Added pages
   10 - 5

Revised edition mark(①②③···)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

Method of using the Conversion Table

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

Example

1. Method of using the Conversion Table to convert from millimeters to inches
   Convert 55mm into inches.
   (1) Locate the number 50in the vertical column at the left side, take this as ⓐ, then draw a horizontal line from ⓐ.
   (2) Locate the number 5in the row across the top, take this as ⓑ, then draw a perpendicular line down from ⓑ.
   (3) Take the point where the two lines cross as ⓒ. This point ⓒ gives the value when converting from millimeters to inches. Therefore, 55mm = 2.165 inches.

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

Millimeters to inches ⓑ

1mm = 0.03937 in

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

Millimeters to inches

1mm = 0.03937in

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

Kilogram to Pound

1kg = 2.2046lb

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

Liter to U.S. Gallon

1 ℓ = 0.2642 U.S.Gal

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

Liter to U.K. Gallon

1 ℓ = 0.21997 U.K.Gal

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

kgf · m to lbf · ft

1kgf · m = 7.233lbf · ft

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

kgf/cm^2 to lbf/in^2

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

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

A simple way to convert a fahrenheit temperature reading into a centigrade temperature reading or vice verse is to enter the accompanying table in the center or boldface column of figures.

These figures refer to the temperature in either Fahrenheit or Centigrade degrees.

If it is desired to convert from Fahrenheit to Centigrade degrees, consider the center column as a table of Fahrenheit temperatures and read the corresponding Centigrade temperature in the column at the left.

If it is desired to convert from Centigrade to Fahrenheit degrees, consider the center column as a table of Centigrade values, and read the corresponding Fahrenheit temperature on the right.

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

SECTION 1 GENERAL

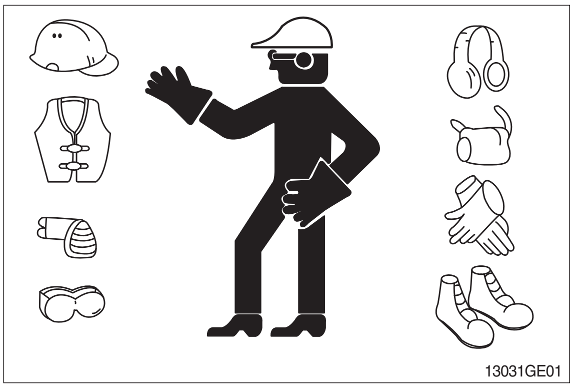
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

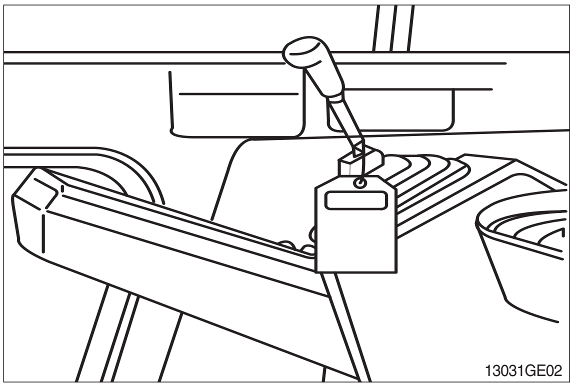
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

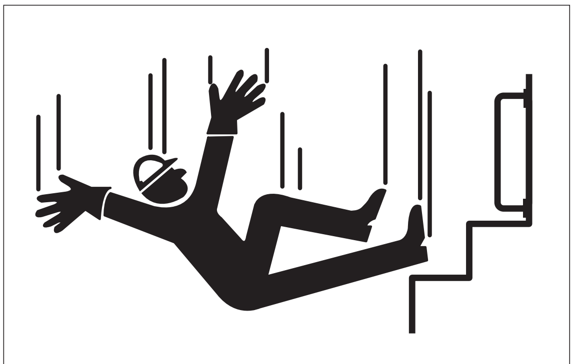
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a「**Do Not Operate**」tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



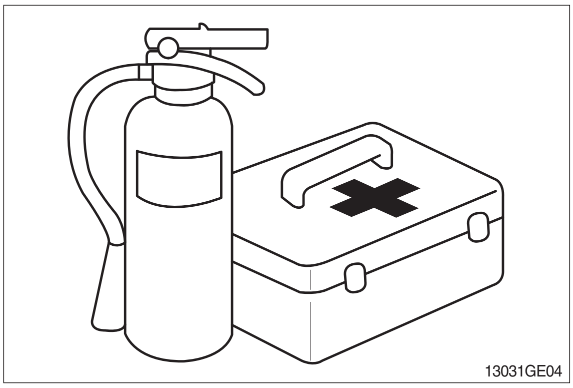
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

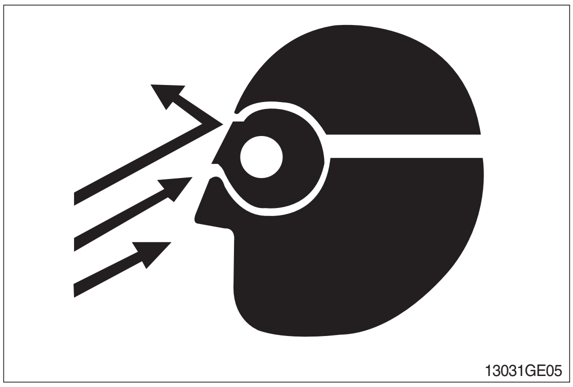
Keep a first aid kit and fire extinguisher handy.

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



PROTECT AGAINST FLYING DEBRIS

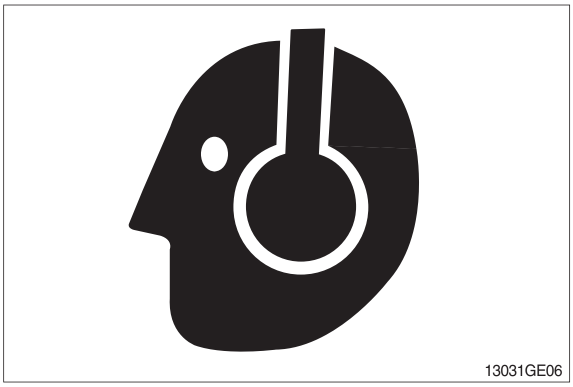
Guard against injury from flying pieces of metal or debris; Wear goggles or safety glasses.



PROTECT AGAINST NOISE

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

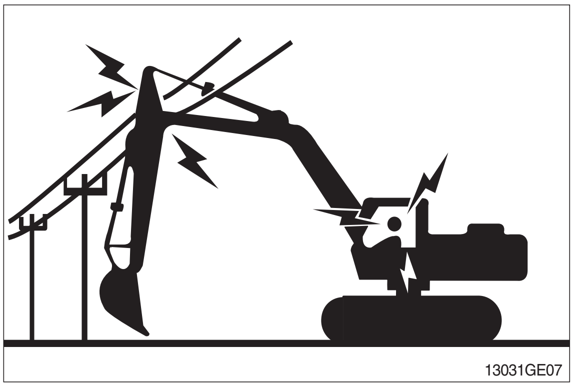
Wear a suitable hearing protective device such as earmuffs or earplugs to protect against objectionable or uncomfortable loud noises.



AVOID POWER LINES

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

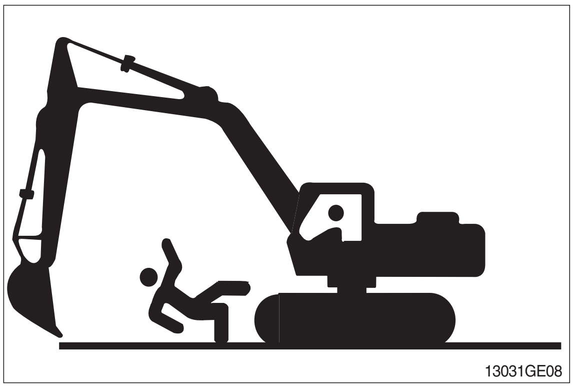
Never move any part of the machine or load closer to electric line than 3m(10ft) plus twice the line insulator length.



KEEP RIDERS OFF EXCAVATOR

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

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



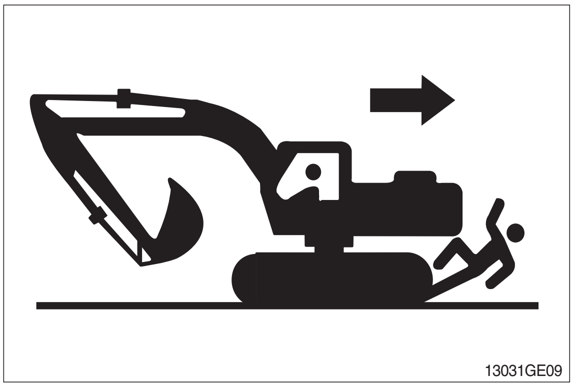
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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



13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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

13031GE26

PARK MACHINE SAFELY

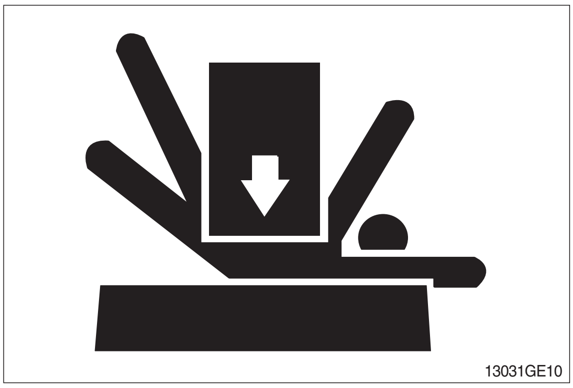
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

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



13031GE10

SERVICE COOLING SYSTEM SAFELY

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

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

13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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

13031GE12

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

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

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

13031GE13

BEWARE OF EXHAUST FUMES

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

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

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

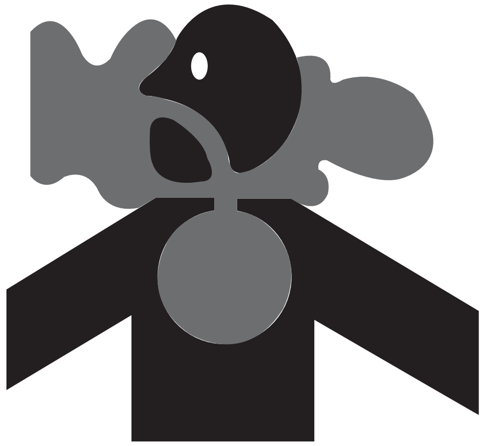
Hazardous fumes can be generated when paint is heated by welding, soldering, or using a torch.

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.



13031GE14

ILLUMINATE WORK AREA SAFELY

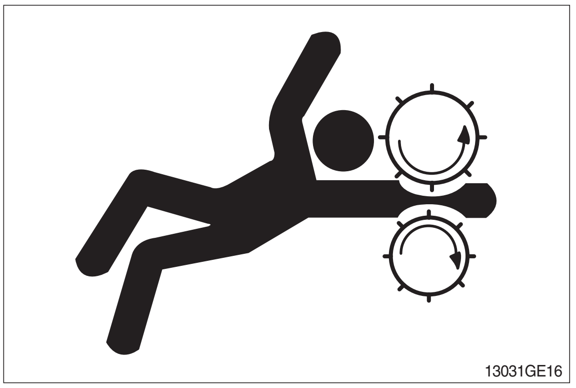
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

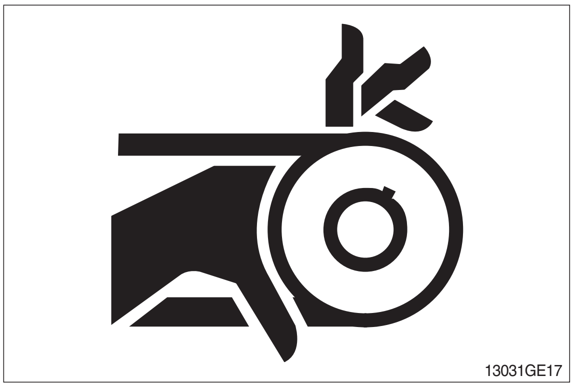


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

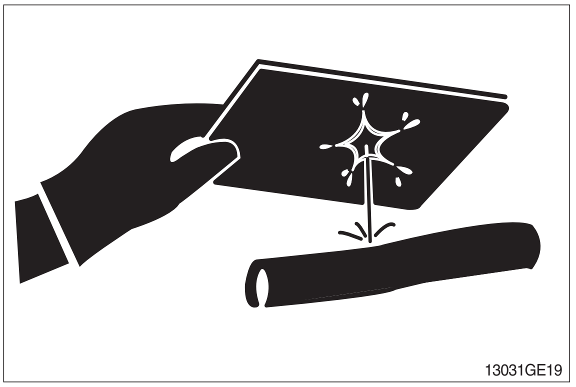
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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

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

13031GE20

PREVENT BATTERY EXPLOSIONS

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

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

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

13031GE21

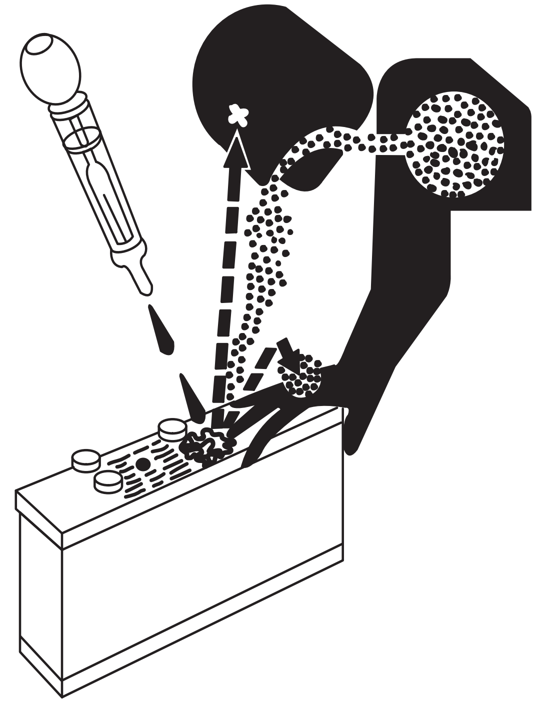
PREVENT ACID BURNS

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

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

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

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


13031GE22

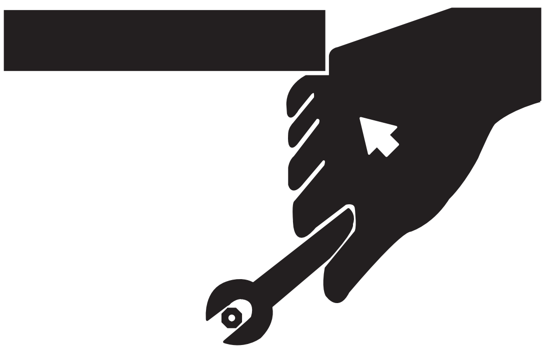
USE TOOLS PROPERLY

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

Use power tools only to loosen threaded tools and fasteners.

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

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

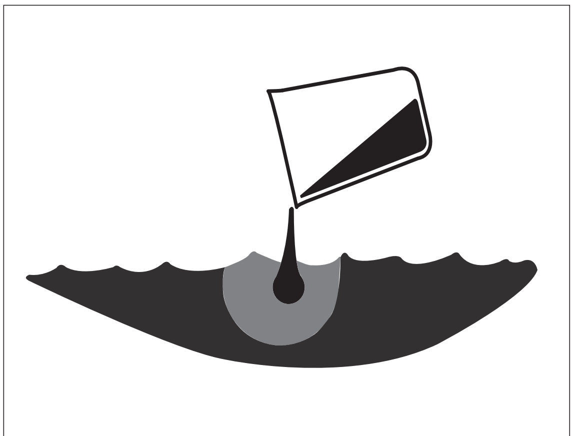

13031GE23

DISPOSE OF FLUIDS PROPERLY

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

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

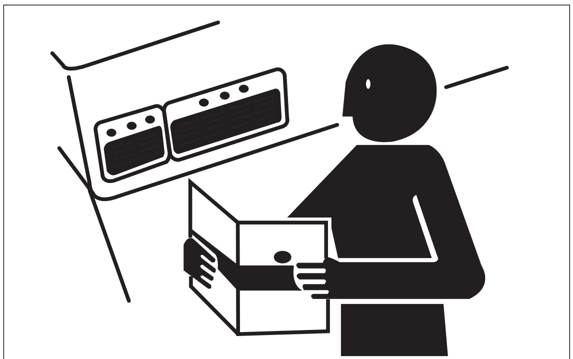
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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



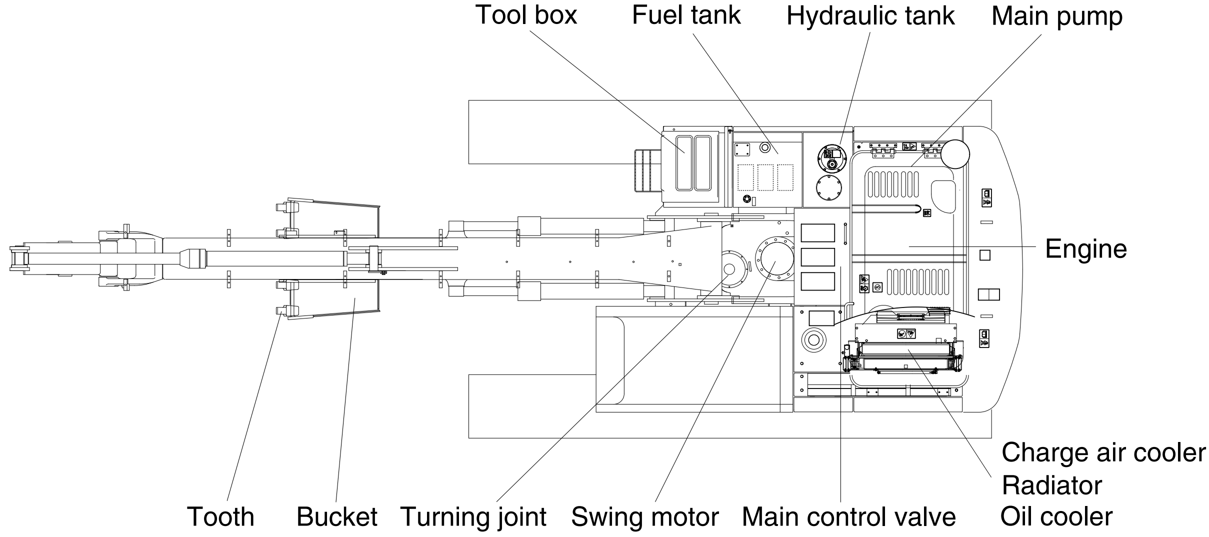
13031GE25

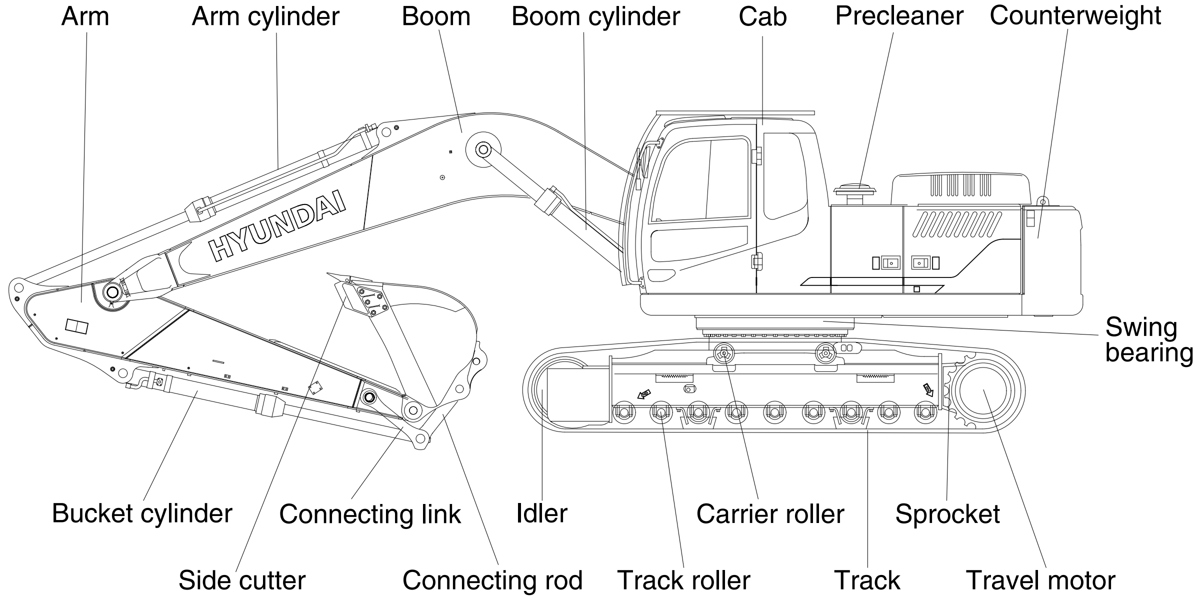
LIVE WITH SAFETY

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

GROUP 2 SPECIFICATIONS

1. MAJOR COMPONENT

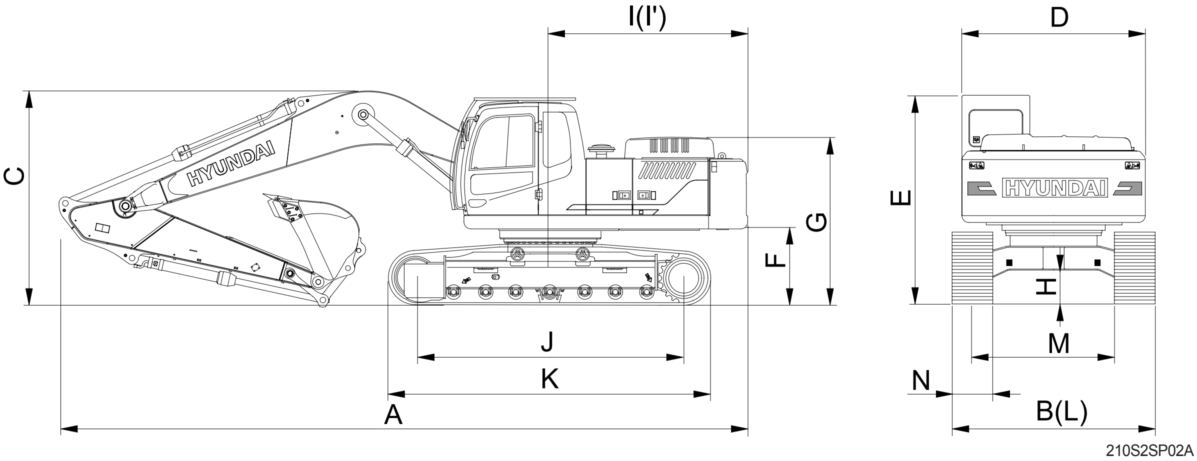




210S2SP01A

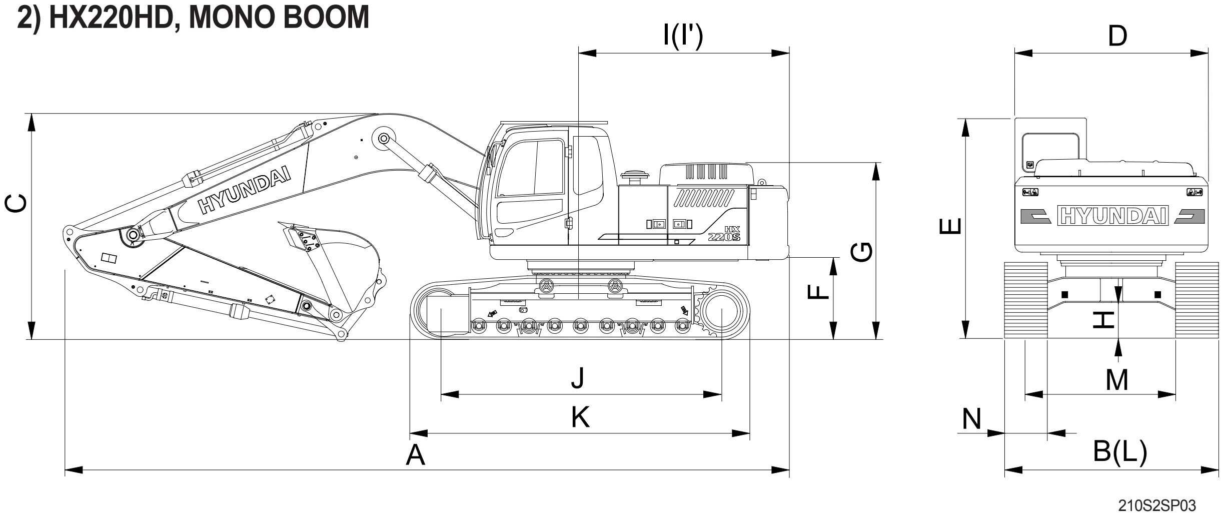
2. SPECIFICATIONS

1) HX210HD MONO BOOM



Description		Unit		Specification		
		m (ft-in)	Boom	5.68 (18' 8")		
			Arm	2.92 (9' 7")	2.00 (6' 7")	2.40 (7' 10")
		mm (in)	Shoe	600 (24)		
Operating weight		kg (lb)		20990 (46270)	20790 (45830)	20860 (45990)
Bucket capacity (SAE heaped), standard		m³ (yd³)		0.92 (1.20)	0.92 (1.20)	0.92 (1.20)
Overall length	A	mm (ft-in)		9530 (31' 3")	9650 (31' 8")	9570 (31' 5")
Overall width	B			2800 (9' 2")	2800 (9' 2")	2800 (9' 2")
Overall height of boom	C			3030 (9' 11")	3200 (10' 6")	3110 (10' 2")
Superstructure width	D			2700 (8' 10")	2700 (8' 10")	2700 (8' 10")
Overall height of cab	E			3000 (9' 10")	3000 (9' 10")	3000 (9' 10")
Ground clearance of counterweight	F			1060 (3' 6")	1060 (3' 6")	1060 (3' 6")
Overall height of engine hood	G			2380 (7' 10")	2380 (7' 10")	2380 (7' 10")
Overall height of handrail	G'			2970 (9' 9")	2970 (9' 9")	2970 (9' 9")
Minimum ground clearance	H			470 (1' 7")	470 (1' 7")	470 (1' 7")
Rear-end distance	I			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")
Rear-end swing radius	I'			2845 (9' 4")	2845 (9' 4")	2845 (9' 4")
Distance between tumblers	J			3360 (11' 0")	3360 (11' 0")	3360 (11' 0")
Undercarriage length	K			4170 (13' 8")	4170 (13' 8")	4170 (13' 8")
Undercarriage width	L			2800 (9' 2")	2800 (9' 2")	2800 (9' 2")
Track gauge	M			2200 (7' 3")	2200 (7' 3")	2200 (7' 3")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.5/5.7	3.5/5.7	3.5/5.7
Swing speed		rpm		12.2	12.2	12.2
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm² (psi)		0.48 (6.86)	0.48 (6.80)	0.48 (6.82)
Max traction force		kg (lb)		21100 (46517)	21100 (46517)	21100 (46517)

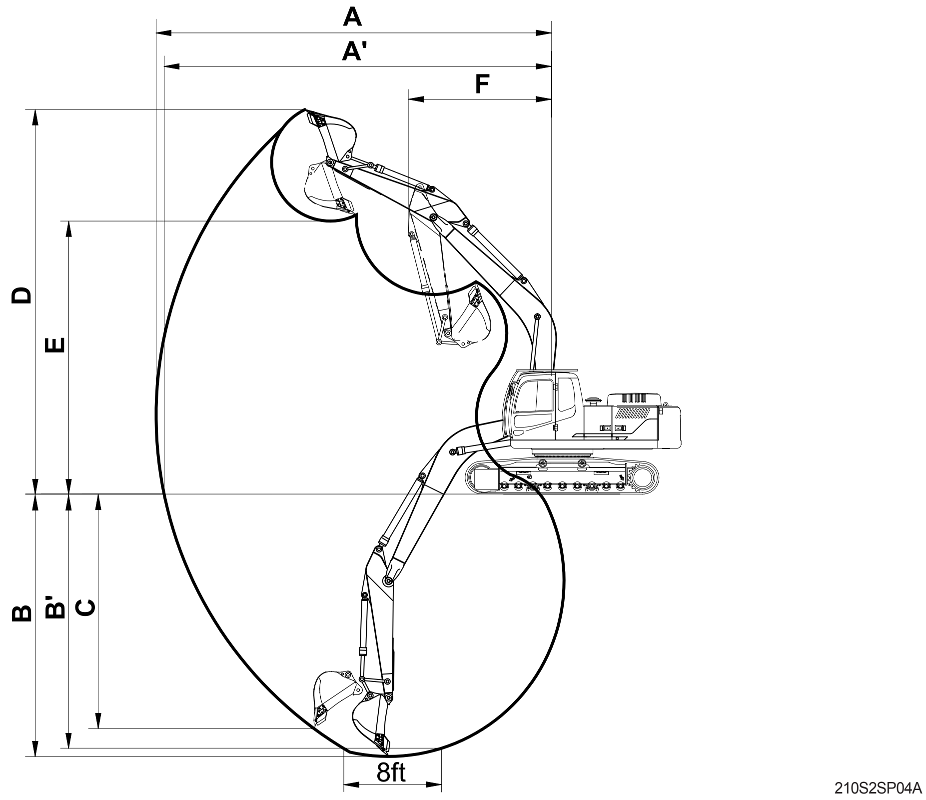
2) HX220HD, MONO BOOM



Description		Unit		Specification		
		m (ft-in)	Boom	5.68 (20' 6")		
			Arm	2.92 (9' 7")	2.00 (6' 7")	2.40 (7' 10")
		mm (in)	Shoe	600 (24)		
Operating weight		kg (lb)		21420(47220)	21220 (46780)	21280 (46910)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)		0.92 (1.20)	0.92 (1.20)	0.92 (1.20)
Overall length	A	mm (ft-in)		9530 (31' 3")	9650 (31' 8")	9570 (31' 5")
Overall width	B			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Overall height of boom	C			3030 (9' 11")	3200 (10' 6")	3110 (10' 2")
Superstructure width	D			2700 (8' 10")	2700 (8' 10")	2700 (8' 10")
Overall height of cab	E			3000 (9' 10")	3000 (9' 10")	3000 (9' 10")
Ground clearance of counterweight	F			1060 (3' 6")	1060 (3' 6")	1060 (3' 6")
Overall height of engine hood	G			2380 (7' 10")	2380 (7' 10")	2380 (7' 10")
Overall height of handrail	G'			2970 (9' 9")	2970 (9' 9")	2970 (9' 9")
Minimum ground clearance	H			470 (1' 7")	470 (1' 7")	470 (1' 7")
Rear-end distance	I			2770 (9' 1")	2770 (9' 1")	2770 (9' 1")
Rear-end swing radius	I'			2845 (9' 4")	2845 (9' 4")	2845 (9' 4")
Distance between tumblers	J			3650 (12' 0")	3650 (12' 0")	3650 (12' 0")
Undercarriage length	K			4440 (14' 7")	4440 (14' 7")	4440 (14' 7")
Undercarriage width	L			2990 (9' 10")	2990 (9' 10")	2990 (9' 10")
Track gauge	M			2390 (7' 10")	2390 (7' 10")	2390 (7' 10")
Track shoe width, standard	N			600 (2' 0")	600 (2' 0")	600 (2' 0")
Travel speed (low/high)		km/hr (mph)		3.5/5.7	3.5/5.7	3.5/5.7
Swing speed		rpm		12.2	12.2	12.2
Gradeability		Degree (%)		35 (70)	35 (70)	35 (70)
Ground pressure		kgf/cm^2 (psi)		0.45 (6.50)	0.45 (6.45)	0.45 (6.46)
Max traction force		kg (lb)		21100 (46517)	21100 (46517)	21100 (46517)

3. WORKING RANGE AND DIGGING FORCE

1) HX210HD, MONO BOOM
HX220HD,MONO BOOM



Description	m (ft-in)	Boom	5.68 (18' 8")		
		Arm	2.92 (9' 7")	2.00 (6' 7")	2.40 (7' 10")
Max digging reach	mm (ft-in)	A	9,980 (32' 9")	9,140 (30' 0")	9,500 (31' 2")
Max digging reach on ground		A'	9,820 (32' 3")	8,960 (29' 5")	9,330 (30' 7")
Max digging depth		B	6,730 (22' 1")	5,820 (19' 1")	6,220 (20' 5")
Max digging depth (8 ft level)		B'	6,560 (21' 6")	5,580 (18' 4")	6,010 (19' 9")
Max vertical wall digging depth		C	6,280 (20' 7")	5,280 (17' 4")	5,720 (18' 9")
Max digging height		D	9,600 (31' 6")	9,140 (30' 0")	9,340 (30' 8")
Max dumping height		E	6,780 (22' 3")	6,330 (20' 9")	6,520 (21' 5")
Min swing radius		F	3,670 (12' 0")	3,750 (12' 4")	3,740 (12' 3")
Bucket digging force	kN	SAE	133.4	133.4	133.4
	kgf		13600	13600	13600
	lbf		29980	29980	29980
	kN	ISO	152.0	152.0	152.0
	kgf		15500	15500	15500
	lbf		34170	34170	34170
Arm digging force	kN	SAE	102.0	144.2	119.6
	kgf		10400	14700	12200
	lbf		22930	32410	26900
	kN	ISO	106.9	151.0	125.5
	kgf		10900	15400	12800
	lbf		24030	33950	28220

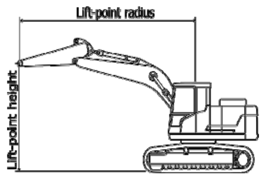
4. WEIGHT

Item	HX210HD		HX220HD	
	kg	lb	kg	lb
Upperstructure assembly	8950	19730	←	
Main frame weld assembly	2600	5730	←	
Engine assembly	437	963	←	
Main pump assembly	120	265	←	
Main control valve assembly	200	440	←	
Swing motor assembly	190	420	←	
Hydraulic oil tank assembly	240	530	←	
Fuel tank assembly	195	430	←	
Counterweight	3600	7940	←	
Cab assembly	310	680	←	
Lower chassis assembly	8060	17770	8700	19180
Track frame weld assembly	2545	5611	2720	6000
Swing bearing	290	639	←	
Travel motor assembly	305	670	←	
Turning joint	55	120	←	
Track recoil spring	140	309	←	
Idler	151	333	←	
Carrier roller	21	46	←	
Track roller	48	106	←	
Track-chain assembly (600 mm standard triple grouser shoe)	1353	2983	1356	2989
Front attachment assembly (5.68 m boom, 2.92 m arm, 0.87 m^3 SAE heaped bucket)	4030	8880	←	
5.68 m boom assembly	1640	3620	←	
2.92 m arm assembly	750	1650	←	
0.92 m^3 SAE heaped bucket	765	1690	←	
Boom cylinder assembly	180	400	←	
Arm cylinder assembly	290	640	←	
Bucket cylinder assembly	175	390	←	
Bucket control link assembly	170	370	←	

5. LIFTING CAPACITIES

Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa. [m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger [F]	Outtriger [R]	Cabin type
HX210HD	OPT	MONO	GP	5680	GP	2000	GP	0.92	NO	NO	3600	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius								At max. reach		
		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
		Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	Over-front	Over-side or 360 degree	m(ft)
7.5m 24.6ft	kg lb									*5700 *12570	*5700 *12570	5.00 (16.4)
6.0m 19.7ft	kg lb					*5440 *11990	4320 9520			*5500 *12130	3910 8620	6.35 (20.8)
4.5m 14.8ft	kg lb			*6870 *15150	6500 14330	*5780 *12740	4190 9240			4890 10780	3160 6970	7.14 (23.4)
3.0m 9.8ft	kg lb			*8650 *19070	5950 13120	6250 13780	3970 8750	4430 9770	2840 6260	4390 9680	2810 6190	7.55 (24.8)
1.5m 4.9ft	kg lb					6020 13270	3770 8310	4350 9590	2760 6080	4230 9330	2690 5930	7.64 (25.1)
0.0m 0.0ft	kg lb			9160 20190	5420 11950	5890 12990	3650 8050			4360 9610	2760 6080	7.43 (24.4)
-1.5m -4.9ft	kg lb			9180 20240	5430 11970	5880 12960	3640 8020			4870 10740	3060 6750	6.88 (22.6)
-3.0m -9.8ft	kg lb	*12330 *27180	10710 23610	*9100 *20060	5570 12280					6170 13600	3860 8510	5.90 (19.4)
-4.5m -14.8ft	kg lb											

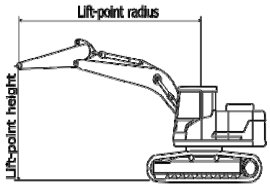
Note 1. Lifting capacity are based on ISO 10567.
2. Lifting capacity of the HX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited 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 your Hyundai dealer regarding the lifting capacities for specific work tools and attachments.

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

Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa. [m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger [F]	Outtriger [R]	Cabin type
HX220HD	OPT	MONO	GP	5680	GP	2000	GP	0.92	NO	NO	3600	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius 3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		At max. reach Capacity		Reach
		Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	Over-front	Over-side	m(ft)
7.5m	kg									*5700	*5700	5.00
24.6ft	lb									*12570	*12570	(16.4)
6.0m	kg					*5440	4810			*5500	4360	6.35
19.7ft	lb					*11990	10600			*12130	9610	(20.8)
4.5m	kg			*6870	*6870	*5780	4680			5510	3540	7.14
14.8ft	lb			*15150	*15150	*12740	10320			12150	7800	(23.4)
3.0m	kg			*8650	6710	*6510	4450	5000	3190	4950	3160	7.55
9.8ft	lb			*19070	14790	*14350	9810	11020	7030	10910	6970	(24.8)
1.5m	kg					6850	4250	4920	3110	4780	3030	7.64
4.9ft	lb					15100	9370	10850	6860	10540	6680	(25.1)
0.0m	kg			*10480	6160	6710	4130			4940	3110	7.43
0.0ft	lb			*23100	13580	14790	9110			10890	6860	(24.4)
-1.5m	kg			*10180	6180	6700	4120			5520	3450	6.88
-4.9ft	lb			*22440	13620	14770	9080			12170	7610	(22.6)
-3.0m	kg	*12330	*12330	*9100	6320					*6650	4340	5.91
-9.8ft	lb	*27180	*27180	*20060	13930					*14660	9570	(19.4)
-4.5m	kg											
-14.8ft	lb											

Note 1. Lifting capacity are based on ISO 10567.
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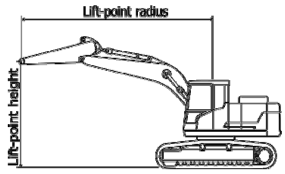
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

※ 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 your Hyundai dealer regarding the lifting capacities for specific work tools and attachments.

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

Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger [F]	Outtriger [R]	Cabin type
HX210HD	OPT	MONO	GP	5680	GP	2000	GP	0.92	NO	NO	4200	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius								At max. reach		
		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
												m(ft)
7.5m 24.6ft	kg lb									*5700 *12570	*5700 *12570	5.00 (16.4)
6.0m 19.7ft	kg lb					*5440 *11990	4660 10270			*5500 *12130	4220 9300	6.35 (20.8)
4.5m 14.8ft	kg lb			*6870 *15150	*6870 *15150	*5780 *12740	4530 9990			5220 11510	3430 7560	7.14 (23.4)
3.0m 9.8ft	kg lb			*8650 *19070	6430 14180	*6510 *14350	4310 9500	4750 10470	3100 6830	4700 10360	3060 6750	7.55 (24.8)
1.5m 4.9ft	kg lb					6450 14220	4100 9040	4660 10270	3020 6660	4540 10010	2940 6480	7.64 (25.1)
0.0m 0.0ft	kg lb			9810 21630	5900 13010	6320 13930	3990 8800			4680 10320	3010 6640	7.43 (24.4)
-1.5m -4.9ft	kg lb			9830 21670	5920 13050	6300 13890	3970 8750			5220 11510	3340 7360	6.88 (22.6)
-3.0m -9.8ft	kg lb	*12330 *27180	11600 25570	*9100 *20060	6060 13360					6600 14550	4200 9260	5.90 (19.4)
-4.5m -14.8ft	kg lb											

Note 1. Lifting capacity are based on ISO 10567.
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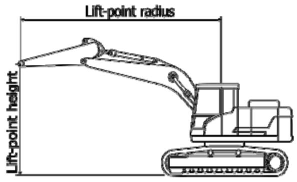
⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa. [m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger [F]	Outtriger [R]	Cabin type
HX220HD	OPT	MONO	GP	5680	GP	2000	GP	0.92	NO	NO	4200	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius								At max. reach		
		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
												m(ft)
7.5m	kg									*5700	*5700	5.00
24.6ft	lb									*12570	*12570	(16.4)
6.0m	kg					*5440	5160			*5500	4680	6.35
19.7ft	lb					*11990	11380			*12130	10320	(20.8)
4.5m	kg			*6870	*6870	*5780	5030			*5540	3820	7.14
14.8ft	lb			*15150	*15150	*12740	11090			*12210	8420	(23.4)
3.0m	kg			*8650	7220	*6510	4800	5340	3450	5280	3420	7.55
9.8ft	lb			*19070	15920	*14350	10580	11770	7610	11640	7540	(24.8)
1.5m	kg					*7230	4600	5250	3370	5110	3290	7.64
4.9ft	lb					*15940	10140	11570	7430	11270	7250	(25.1)
0.0m	kg			*10480	6680	7170	4480			5270	3370	7.43
0.0ft	lb			*23100	14730	15810	9880			11620	7430	(24.4)
-1.5m	kg			*10180	6690	7150	4460			5890	3750	6.88
-4.9ft	lb			*22440	14750	15760	9830			12990	8270	(22.6)
-3.0m	kg	*12330	*12330	*9100	6840					*6650	4700	5.91
-9.8ft	lb	*27180	*27180	*20060	15080					*14660	10360	(19.4)
-4.5m	kg											
-14.8ft	lb											

Note 1. Lifting capacity are based on ISO 10567.
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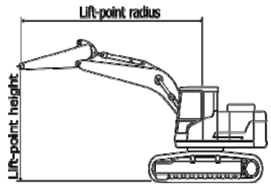
⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessary for non-standard configurations.

Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger[F]	Outtriger[R]	Cabin type
HX210HD	OPT	MONO	GP	5680	GP	2400	GP	0.92	NO	NO	3600	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius								At max. reach		
		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
												m(ft)
7.5m	kg									*5080	4910	5.58
24.6ft	lb									*11200	10820	(18.3)
6.0m	kg					*4980	4380			*4620	3490	6.82
19.7ft	lb					*10980	9660			*10190	7690	(22.4)
4.5m	kg			*6320	*6320	*5430	4230	4520	2920	4470	2880	7.55
14.8ft	lb			*13930	*13930	*11970	9330	9960	6440	9850	6350	(24.8)
3.0m	kg			*8110	6050	*6200	3990	4440	2840	4050	2590	7.94
9.8ft	lb			*17880	13340	*13670	8800	9790	6260	8930	5710	(26.1)
1.5m	kg			9370	5590	6030	3770	4330	2740	3910	2480	8.03
4.9ft	lb			20660	12320	13290	8310	9550	6040	8620	5470	(26.3)
0.0m	kg			9130	5390	5870	3630	4260	2680	4010	2530	7.83
0.0ft	lb			20130	11880	12940	8000	9390	5910	8840	5580	(25.7)
-1.5m	kg	*10830	10320	9110	5370	5820	3590			4420	2770	7.31
-4.9ft	lb	*23880	22750	20080	11840	12830	7910			9740	6110	(24.0)
-3.0m	kg	*13210	10520	9230	5470	5910	3670			5410	3390	6.40
-9.8ft	lb	*29120	23190	20350	12060	13030	8090			11930	7470	(21.0)
-4.5m	kg			*7130	5770					*6300	5160	4.89
-14.8ft	lb			*15720	12720					*13890	11380	(16.0)

Note
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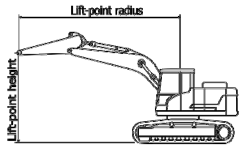
Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa. [m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger[F]	Outtriger[R]	Cabin type
HX220HD	OPT	MONO	GP	5680	GP	2400	GP	0.92	NO	NO	3600	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius								At max. reach		
		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
												m(ft)
7.5m	kg									*5080	*5080	5.58
24.6ft	lb									*11200	*11200	(18.3)
6.0m	kg					*4980	4870			*4620	3900	6.81
19.7ft	lb					*10980	10740			*10190	8600	(22.4)
4.5m	kg			*6320	*6320	*5430	4710	*4990	3270	*4490	3230	7.55
14.8ft	lb			*13930	*13930	*11970	10380	*11000	7210	*9900	7120	(24.8)
3.0m	kg			*8110	6810	*6200	4480	5010	3190	4570	2910	7.94
9.8ft	lb			*17880	15010	*13670	9880	11050	7030	10080	6420	(26.1)
1.5m	kg			*9660	6340	6860	4250	4900	3090	4420	2790	8.03
4.9ft	lb			*21300	13980	15120	9370	10800	6810	9740	6150	(26.3)
0.0m	kg			*10360	6140	6690	4100	4820	3020	4540	2850	7.83
0.0ft	lb			*22840	13540	14750	9040	10630	6660	10010	6280	(25.7)
-1.5m	kg	*10820	*10820	*10290	6110	6640	4060			5010	3130	7.31
-4.9ft	lb	*23850	*23850	*22690	13470	14640	8950			11050	6900	(24.0)
-3.0m	kg	*13210	12210	*9460	6220	6740	4140			6140	3820	6.41
-9.8ft	lb	*29120	26920	*20860	13710	14860	9130			13540	8420	(21.0)
-4.5m	kg			*7130	6530					*6300	5820	4.89
-14.8ft	lb			*15720	14400					*13890	12830	(16.0)

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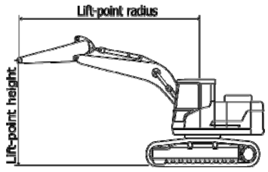
Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger[F]	Outtriger[R]	Cabin type
HX210HD	OPT	MONO	GP	5680	GP	2400	GP	0.92	NO	NO	4200	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius								At max. reach		
		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
												m(ft)
7.5m	kg									*5080	*5080	5.58
24.6ft	lb									*11200	*11200	(18.3)
6.0m	kg					*4980	4710			*4620	3780	6.82
19.7ft	lb					*10980	10380			*10190	8330	(22.4)
4.5m	kg			*6320	*6320	*5430	4560	4840	3180	*4490	3130	7.55
14.8ft	lb			*13930	*13930	*11970	10050	10670	7010	*9900	6900	(24.8)
3.0m	kg			*8110	6530	*6200	4330	4750	3100	4340	2820	7.94
9.8ft	lb			*17880	14400	*13670	9550	10470	6830	9570	6220	(26.1)
1.5m	kg			*9670	6070	6450	4100	4640	3000	4200	2710	8.03
4.9ft	lb			*21320	13380	14220	9040	10230	6610	9260	5970	(26.3)
0.0m	kg			9780	5870	6290	3960	4570	2930	4310	2770	7.83
0.0ft	lb			21560	12940	13870	8730	10080	6460	9500	6110	(25.7)
-1.5m	kg	*10830	*10830	9760	5850	6240	3920			4740	3030	7.31
-4.9ft	lb	*23880	*23880	21520	12900	13760	8640			10450	6680	(24.0)
-3.0m	kg	*13210	11400	*9460	5950	6330	4000			5800	3690	6.40
-9.8ft	lb	*29120	25130	*20860	13120	13960	8820			12790	8140	(21.0)
-4.5m	kg			*7130	6250					*6300	5590	4.89
-14.8ft	lb			*15720	13780					*13890	12320	(16.0)

Note 1. Lifting capacity are based on ISO 10567.
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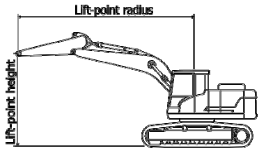
Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa. [m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger [F]	Outtriger [R]	Cabin type
HX220HD	OPT	MONO	GP	5680	GP	2400	GP	0.92	NO	NO	4200	600	NONE	NONE	CABIN



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

Lift-point height (m/ft)		Lift-point radius 3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		At max. reach Capacity		Reach
		over-front	over-side	over-front	over-side	over-front	over-side	over-front	over-side	over-front	over-side	m(ft)
7.5m	kg									*5080	*5080	5.58
24.6ft	lb									*11200	*11200	(18.3)
6.0m	kg					*4980	*4980			*4620	4190	6.81
19.7ft	lb					*10980	*10980			*10190	9240	(22.4)
4.5m	kg			*6320	*6320	*5430	5060	*4990	3540	*4490	3490	7.55
14.8ft	lb			*13930	*13930	*11970	11160	*11000	7800	*9900	7690	(24.8)
3.0m	kg			*8110	7330	*6200	4820	5340	3460	*4580	3150	7.94
9.8ft	lb			*17880	16160	*13670	10630	11770	7630	*10100	6940	(26.1)
1.5m	kg			*9660	6860	*7000	4600	5230	3350	4730	3040	8.03
4.9ft	lb			*21300	15120	*15430	10140	11530	7390	10430	6700	(26.3)
0.0m	kg			*10360	6650	7140	4450	5160	3290	4860	3100	7.83
0.0ft	lb			*22840	14660	15740	9810	11380	7250	10710	6830	(25.7)
-1.5m	kg	*10820	*10820	*10290	6620	7090	4410			5350	3400	7.31
-4.9ft	lb	*23850	*23850	*22690	14590	15630	9720			11790	7500	(24.0)
-3.0m	kg	*13210	13160	*9460	6730	*6940	4490			*6280	4140	6.41
-9.8ft	lb	*29120	29010	*20860	14840	*15300	9900			*13850	9130	(21.0)
-4.5m	kg			*7130	7040					*6300	6270	4.89
-14.8ft	lb			*15720	15520					*13890	13820	(16.0)

Note 1. Lifting capacity are based on ISO 10567.
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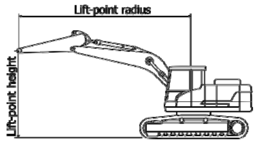
Model	Type	Boom	Boom type	Length[mm]	Arm type	Length [mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger [F]	Outtriger[R]	Cabin type
HX210HD	OPT	MONO	GP	5680	GP	2920	GP	0.92	NO	NO	3600	600	NONE	NONE	CABIN

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



Lift-point height (m/ft)		Lift-point radius 1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		At max. reach Capacity		Reach
														m(ft)
7.5m	kg							*4440	4430			*3360	*3360	6.26
24.6ft	lb							*9790	9770			*7410	*7410	(20.5)
6.0m	kg							*4410	*4410			*3090	3050	7.38
19.7ft	lb							*9720	*9720			*6810	6720	(24.2)
4.5m	kg							*4920	4260	4540	2930	*3010	2560	8.07
14.8ft	lb							*10850	9390	10010	6460	*6640	5640	(26.5)
3.0m	kg					*7340	6150	*5740	4000	4420	2820	*3060	2310	8.43
9.8ft	lb					*16180	13560	*12650	8820	9740	6220	*6750	5090	(27.7)
1.5m	kg					*9060	5610	6010	3740	4290	2700	*3240	2210	8.51
4.9ft	lb					*19970	12370	13250	8250	9460	5950	*7140	4870	(27.9)
0.0m	kg			*5920	*5920	9070	5320	5810	3560	4180	2600	*3580	2240	8.32
0.0ft	lb			*13050	*13050	20000	11730	12810	7850	9220	5730	*7890	4940	(27.3)
-1.5m	kg	*6490	*6490	*10390	10020	8970	5240	5720	3480	4150	2570	3910	2430	7.84
-4.9ft	lb	*14310	*14310	*22910	22090	19780	11550	12610	7670	9150	5670	8620	5360	(25.7)
-3.0m	kg	*11110	*11110	*14070	10210	9050	5300	5760	3520			4640	2880	7.00
-9.8ft	lb	*24490	*24490	*31020	22510	19950	11680	12700	7760			10230	6350	(23.0)
-4.5m	kg			*11520	10600	*8120	5520					*6030	4030	5.65
-14.8ft	lb			*25400	23370	*17900	12170					*13290	8880	(18.5)

Note 1. Lifting capacity are based on ISO 10567.
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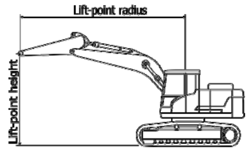
3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

※ 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 your Hyundai dealer regarding the lifting capacities for specific work tools and attachments.

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

Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger [F]	Outtriger[R]	Cabin type
HX220HD	OPT	MONO	GP	5680	GP	2920	GP	0.92	NO	NO	3600	600	NONE	NONE	CABIN



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

Lift-point height (m/ft)		Lift-point radius										At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
														m(ft)
7.5m	kg							*4440	*4440			*3360	*3360	6.26
24.6ft	lb							*9790	*9790			*7410	*7410	(20.5)
6.0m	kg							*4410	*4410			*3090	*3090	7.38
19.7ft	lb							*9720	*9720			*6810	*6810	(24.2)
4.5m	kg							*4920	4750	*4660	3280	*3010	2870	8.07
14.8ft	lb							*10850	10470	*10270	7230	*6640	6330	(26.5)
3.0m	kg					*7340	6920	*5740	4480	5000	3170	*3060	2600	8.43
9.8ft	lb					*16180	15260	*12650	9880	11020	6990	*6750	5730	(27.7)
1.5m	kg					*9060	6370	*6610	4220	4860	3040	*3240	2500	8.51
4.9ft	lb					*19970	14040	*14570	9300	10710	6700	*7140	5510	(27.9)
0.0m	kg			*5910	*5910	*10050	6070	6630	4040	4750	2950	*3580	2540	8.32
0.0ft	lb			*13030	*13030	*22160	13380	14620	8910	10470	6500	*7890	5600	(27.3)
-1.5m	kg	*6490	*6490	*10380	*10380	*10260	5980	6540	3960	4720	2920	*4190	2750	7.84
-4.9ft	lb	*14310	*14310	*22880	*22880	*22620	13180	14420	8730	10410	6440	*9240	6060	(25.7)
-3.0m	kg	*11110	*11110	*14070	11880	*9740	6050	6580	3990			5270	3260	7.00
-9.8ft	lb	*24490	*24490	*31020	26190	*21470	13340	14510	8800			11620	7190	(23.0)
-4.5m	kg			*11530	*11530	*8130	6270					*6030	4560	5.66
-14.8ft	lb			*25420	*25420	*17920	13820					*13290	10050	(18.6)

Note 1. Lifting capacity are based on ISO 10567.
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3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
4. *Indicates load limited by hydraulic capacity.

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Lifting capacities will vary with different work tools, ground conditions and attachments.
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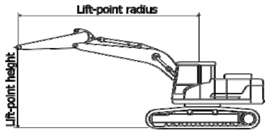
⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Boom type	Length[mm]	Arm type	Length [mm]	BK type	Capa.[m^3]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger[F]	Outtriger[R]	Cabin type
HX210HD	OPT	MONO	GP	5680	GP	2920	GP	0.92	NO	NO	4200	600	NONE	NONE	CABIN



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

Lift-point height (m/ft)		Lift-point radius 1.5m (4.9ft) Over-front	1.5m (4.9ft) Over-side	3.0m (9.8ft) Over-front	3.0m (9.8ft) Over-side	4.5m (14.8ft) Over-front	4.5m (14.8ft) Over-side	6.0m (19.7ft) Over-front	6.0m (19.7ft) Over-side	7.5m (24.6ft) Over-front	7.5m (24.6ft) Over-side	At max. reach Capacity Over-front	Capacity Over-side	Reach m(ft)
7.5m	kg							*4440	*4440			*3360	*3360	6.26
24.6ft	lb							*9790	*9790			*7410	*7410	(20.5)
6.0m	kg							*4410	*4410			*3090	*3090	7.38
19.7ft	lb							*9720	*9720			*6810	*6810	(24.2)
4.5m	kg							*4920	4590	*4660	3180	*3010	2790	8.07
14.8ft	lb							*10850	10120	*10270	7010	*6640	6150	(26.5)
3.0m	kg					*7340	6630	*5740	4330	4740	3070	*3060	2530	8.43
9.8ft	lb					*16180	14620	*12650	9550	10450	6770	*6750	5580	(27.7)
1.5m	kg					*9060	6090	6430	4080	4600	2950	*3240	2430	8.51
4.9ft	lb					*19970	13430	14180	8990	10140	6500	*7140	5360	(27.9)
0.0m	kg			*5920	*5920	9720	5800	6230	3890	4500	2850	*3580	2460	8.32
0.0ft	lb			*13050	*13050	21430	12790	13730	8580	9920	6280	*7890	5420	(27.3)
-1.5m	kg	*6490	*6490	*10390	*10390	9620	5720	6140	3820	4460	2820	*4190	2670	7.84
-4.9ft	lb	*14310	*14310	*22910	*22910	21210	12610	13540	8420	9830	6220	*9240	5890	(25.7)
-3.0m	kg	*11110	*11110	*14070	11090	9690	5780	6180	3850			4980	3160	7.00
-9.8ft	lb	*24490	*24490	*31020	24450	21360	12740	13620	8490			10980	6970	(23.0)
-4.5m	kg			*11520	11480	*8120	6000					*6030	4390	5.65
-14.8ft	lb			*25400	25310	*17900	13230					*13290	9680	(18.5)

Note 1. Lifting capacity are based on ISO 10567.
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3. The Lift-point is bucket pivot mounting pin on the arm (without bucket mass).
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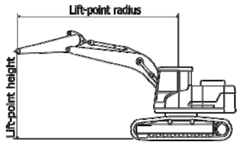
⚠ Failure to comply to the rated load can cause possible personal injury or property damage.
Make adjustments to the rated load as necessory for non-standard configurations.

Model	Type	Boom	Boom type	Length [mm]	Arm type	Length [mm]	BK type	Capa.[m³]	QC	Swing Post	CWT[kg]	Shoe (wheel) [mm]	Outtriger[F]	Outtriger [R]	Cabin type
HX220HD	OPT	MONO	GP	5680	GP	2920	GP	0.92	NO	NO	4200	600	NONE	NONE	CABIN



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

Lift-point height (m/ft)		Lift-point radius										At max. reach		
		1.5m (4.9ft)		3.0m (9.8ft)		4.5m (14.8ft)		6.0m (19.7ft)		7.5m (24.6ft)		Capacity		Reach
														m(ft)
7.5m	kg							*4440	*4440			*3360	*3360	6.26
24.6ft	lb							*9790	*9790			*7410	*7410	(20.5)
6.0m	kg							*4410	*4410			*3090	*3090	7.38
19.7ft	lb							*9720	*9720			*6810	*6810	(24.2)
4.5m	kg							*4920	*4920	*4660	3550	*3010	*3010	8.07
14.8ft	lb							*10850	*10850	*10270	7830	*6640	*6640	(26.5)
3.0m	kg					*7340	*7340	*5740	4830	*5020	3430	*3060	2830	8.43
9.8ft	lb					*16180	*16180	*12650	10650	*11070	7560	*6750	6240	(27.7)
1.5m	kg					*9060	6880	*6610	4570	5190	3310	*3240	2730	8.51
4.9ft	lb					*19970	15170	*14570	10080	11440	7300	*7140	6020	(27.9)
0.0m	kg			*5910	*5910	*10050	6580	7080	4390	5080	3210	*3580	2770	8.32
0.0ft	lb			*13030	*13030	*22160	14510	15610	9680	11200	7080	*7890	6110	(27.3)
-1.5m	kg	*6490	*6490	*10380	*10380	*10260	6490	6990	4310	5050	3180	*4190	3000	7.84
-4.9ft	lb	*14310	*14310	*22880	*22880	*22620	14310	15410	9500	11130	7010	*9240	6610	(25.7)
-3.0m	kg	*11110	*11110	*14070	12840	*9740	6560	7030	4340			*5400	3550	7.00
-9.8ft	lb	*24490	*24490	*31020	28310	*21470	14460	15500	9570			*11900	7830	(23.0)
-4.5m	kg			*11530	*11530	*8130	6780					*6030	4930	5.66
-14.8ft	lb			*25420	*25420	*17920	14950					*13290	10870	(18.6)

Note 1. Lifting capacity are based on ISO 10567.
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Make adjustments to the rated load as necessory for non-standard configurations.

6. BUCKET SELECTION GUIDE

1)HX210HD/ HX220HD COUNTERWEIGHT:

All Buckets are welded with high-strength steel.

0.92 (1.20)

1.20 (1.57)

◉ 0.87 (1.14)
◉ 1.20 (1.57)

SAE Heaped m3 (yd3)

Capacity m3(yd2)			Width mm(in)	Weight Kg (lb)	Tooth EA	Recommendation mm (ft-in)					
						5.680					
						3.6 ton CWT			4.2 ton CWT		
Type	SAE Heaped	CECE Heaped				2000 (6'7") Arm	2400 (7'10") Arm	2920 (9'7") Arm	2000 (6'7") Arm	2400 (7'10") Arm	2920 (9'7") Arm
HX210HD	0.92 (1.20)	0.80 (1.05)	1,080 (42.5")	765 (1,690)	5	●	◐		●	●	◐
	1.20 (1.57)	1.00(1.31)	1,330 (52.4")	810 (1,790)	5	■	▲	▲	◐	■	▲
	◉ 0.87 (1.14)	0.75 (0.98)	1,140 (44.9")	900 (1,980)	5	●	◐	■	●	●	◐
	◉1.20 (1.57)	1.00 (1.31)	1,410 (55.5")	1,030 (2,270)	5	■	▲	X	■	■	▲
HX220HD	0.92 (1.20)	0.80 (1.05)	1,080 (42.5")	765 (1,690)	5	●	●	◐	●	●	●
	1.20 (1.57)	1.00 (1.31)	1,330 (52.4")	810 (1,790)	5	◐	■	▲	◐	◐	■
	◉ 0.87 (1.14)	0.75 (0.98)	1,140 (44.9")	900 (1,980)	5	●	●	◐	●	●	●
	◉ 1.20 (1.57)	1.00 (1.31)	1,410 (55.5")	1,030 (2,270)	5	■	■	▲	◐	■	■

◉ Rock- Heavy duty bucket

●	Applicable for materials with density of 2100 kg/m³ (3500 lb/yd³) or less
◐	Applicable for materials with density of 1800 kg/m³ (3000 lb/yd³) or less
■	Applicable for materials with density of 1500 kg/m³ (2500 lb/yd³) or less
▲	Applicable for materials with density of 1200 kg/m³ (2000 lb/yd³) or less
X	Not recommended

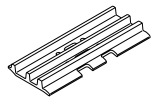
※ These recommendations are for general conditions and average use.
Work tools and ground conditions have effects on machine performance.
Select an optimum combination according to the working conditions and the type of work that is being done.
Consult your Hyundai dealer for information on selecting 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		Triple grouser			
						
HX210HD	Shoe width	mm (in)	600 (24)	-	-	800 (32)
	Operating weight	kg (lb)	20990 (46270)	-	-	21540 (47490)
	Ground pressure	kgf/cm² (psi)	0.48 (6.86)	-	-	0.42 (6.03)
	Overall width	mm (ft-in)	2800 (9' 2")	-	-	3000 (9' 10")
HX220HD	Shoe width	mm (in)	600 (24)	-	-	800 (32)
	Operating weight	kg (lb)	21420 (47220)	-	-	22200 (48940)
	Ground pressure	kgf/cm² (psi)	0.45 (6.50)	-	-	0.35 (5.06)
	Overall width	mm (ft-in)	2990 (9' 10")	-	-	3190 (10' 6")

3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item		Quantity
Carrier rollers		2 EA
Track rollers	HX210HD	7 EA
	HX220HD	9 EA
Track shoes	HX210HD	46 EA
	HX220HD	49 EA

4) SELECTION OF TRACK SHOE

Suitable track shoes should be selected according to operating conditions.

Method of selecting shoes

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

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

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

※ Table 1

Track shoe	Specification	Category
600 mm triple grouser	Standard	A
800 mm triple grouser	Option	C

※ Table 2

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

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	HYUNDAI 6BTAA-5.9 (HM5.9)
Type	4-cycle, turbocharged, charge air cooled, mechanical controlled diesel engine
Cooling method	Water cooled
Number of cylinders and arrangement	6 cylinders, in-line
Firing order	1-5-3-6-2-4
Combustion chamber type	Direct injection type
Cylinder bore×stroke	102×120 mm (4.02 "×4.72 ")
Piston displacement	5900 cc (360 cu in)
Compression ratio	17.3 : 1
Rated gross horse power (SAE J1995)	148 Hp at 2000rpm (110 kW at 2000 rpm)
Rated net horse power (SAE J1349)	145 Hp at 2000 rpm (108 kW at 2000 rpm)
Maximum torque at 1300 rpm	64 kgf · m (463 lbf · ft)
Engine oil quantity	14 ℓ (3.8 U.S. gal) : -#1161 20 ℓ (5.3 U.S. gal) : #1162-
Dry weight	437 kg (963 lb)
High idling speed	2250 + 50 rpm
Low idling speed	800 ± 100 rpm
Rated fuel consumption	95 g/Hp · hr at 1200 rpm
Starting motor	Lucas 24V
Alternator	Lucas 24V-75A
Battery	2×12V×100Ah

2) MAIN PUMP

Item	Specification
Type	Variable displacement tandem axis piston pumps
Capacity	2×117 cc/rev
Maximum pressure	350 kgf/cm^2 (4978 psi)
Rated oil flow	2×234 ℓ/min (61.8 U.S. gpm/ 51.4 U.K. gpm)
Rated speed	2000 rpm

3) GEAR PUMP

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	15 cc/rev
Maximum pressure	40 kgf/cm^2 (568 psi)
Rated oil flow	30.0 ℓ/min (7.9 U.S. gpm/6.7 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	9 spools mono-block
Operating method	Hydraulic pilot system
Main relief valve pressure	350 kgf/cm^2 (4978 psi)
Overload relief valve pressure	400 kgf/cm^2 (5689 psi)

5) SWING MOTOR

Item	Specification
Type	Two fixed displacement axial piston motor
Capacity	142.8 cc/rev
Relief pressure	265 kgf/cm^2 (3894 psi)
Braking system	Automatic, spring applied hydraulic released
Braking torque	63.3 kgf/cm^2 (470.8 lbf · ft)
Brake release pressure	20.9~35.5 kgf/cm^2 (297~505 psi)
Reduction gear type	2 - stage planetary
Swing speed	12.2rpm

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	350 kgf/cm^2 (4978 psi)
Reduction gear type	2-stage planetary
Braking system	Automatic, spring applied hydraulic released
Brake release pressure	13 kgf/cm^2 (182 psi)
Braking torque	65.1 kgf · m (470 lbf · ft)

7) REMOTE CONTROL VALVE

Item		Specification
Type		Pressure reducing type
Operating pressure	Minimum	6.5 kgf/cm^2 (92 psi)
	Maximum	26 kgf/cm^2 (370 psi)
Single operation stroke	Lever	61 mm (2.4 in)
	Pedal	123 mm (4.84 in)

8) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	Ø120 × Ø85 × 1290 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	Ø140 × Ø100 × 1510 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	Ø120 × Ø85 × 1055 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.

9) SHOE

Item		Width	Ground pressure	Link quantity	Overall width
HX210HD	Standard	600 mm (24")	0.48 kgf/cm^2 (6.86 psi)	46	2800 mm (9' 2")
	Option	800 mm (32")	0.42 kgf/cm^2 (6.03 psi)	46	3000 mm (9' 10")
HX220HD	Standard	600 mm (24")	0.45 kgf/cm^2 (6.50 psi)	49	2990 mm (9' 10")
	Option	800 mm (32")	0.35 kgf/cm^2 (5.06 psi)	49	3190 mm (10' 6")

10) BUCKET

Item		Capacity		Tooth quantity	Width	
		SAE heaped	CECE heaped		Without side cutter	With side cutter
HX210HD HX220HD	STD	0.92 m^3 (1.20 yd^3)	0.80 m^3 (1.05 yd^3)	5	1080 mm (42.5")	1250 mm (49.2")
	OPT	1.20 m^3 (1.57 yd^3)	1.00 m^3 (1.31 yd^3)	5	1330 mm (52.4")	1500 mm (59.1")
		◆0.87 m^3 (1.14 yd^3)	0.75 m^3 (0.98 yd^3)	5	1140 mm (44.9")	–
		◆1.20 m^3 (1.14 yd^3)	1.00 m^3 (1.31 yd^3)	5	1410 mm (55.5")	–

◆ : Heavy duty bucket

9. RECOMMENDED OILS

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

We recommend that you use only HYUNDAI genuine lubricating oils and grease officially approved by HYUNDAI.

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 ★2		★SAE 0W-40 ★SAE 0W-30 SAE 5W-30 SAE 10W-30 SAE 15W-40
Swing drive	Gear oil	6.2 (1.6)	★SAE 75W-90
Final drive	Gear oil	4.5×2 (1.2×2)	SAE 80W-90
Hydraulic tank	Hydraulic oil	Tank : 160 (42.3) System : 275 (72.6)	★ISO VG 15 ISO VG 32 ISO VG 46 ISO VG 68
Fuel tank	Diesel fuel	340 (89.8)	★ASTM D975 NO.1 ASTM D975 NO.2
Fitting (grease nipple)	Grease	As required	★NLGI NO.1 NLGI NO.2
Radiator (reservoir tank)	Mixture of antifreeze and soft water★1	31 (8.2)	Ethylene glycol base permanent type (50 : 50) ★Ethylene glycol base permanent type (60 : 40)

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

★ : Cold region
Russia, CIS, Mongolia
★1 : Soft water
City water or distilled water
★2 : Meets or exceeds
API CI-4 grade

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

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

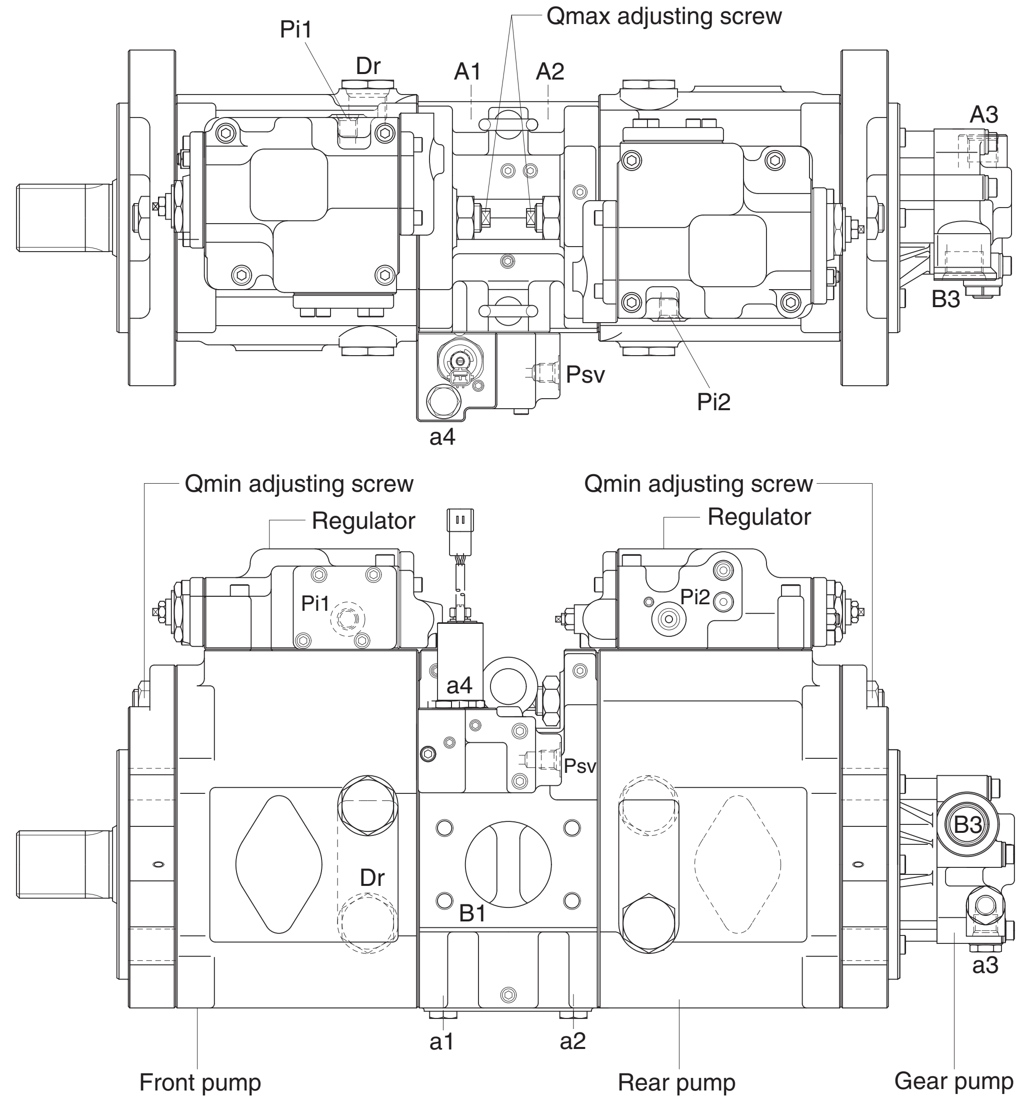
※ For HYUNDAI genuine lubricating oils and grease for use in regions with extremely low temperatures, please contact HYUNDAI dealers.

SECTION 2 STRUCTURE AND FUNCTION

GROUP 1 PUMP DEVICE

1. STRUCTURE

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



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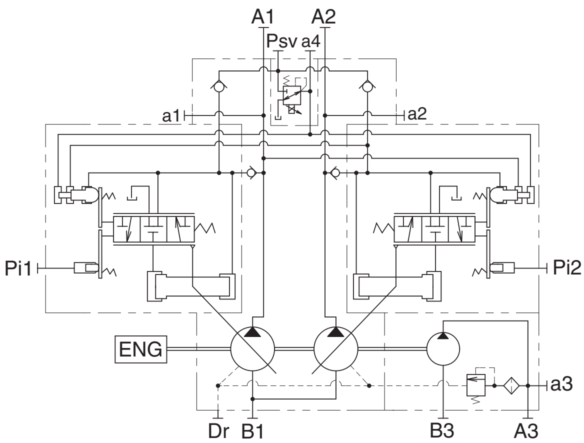
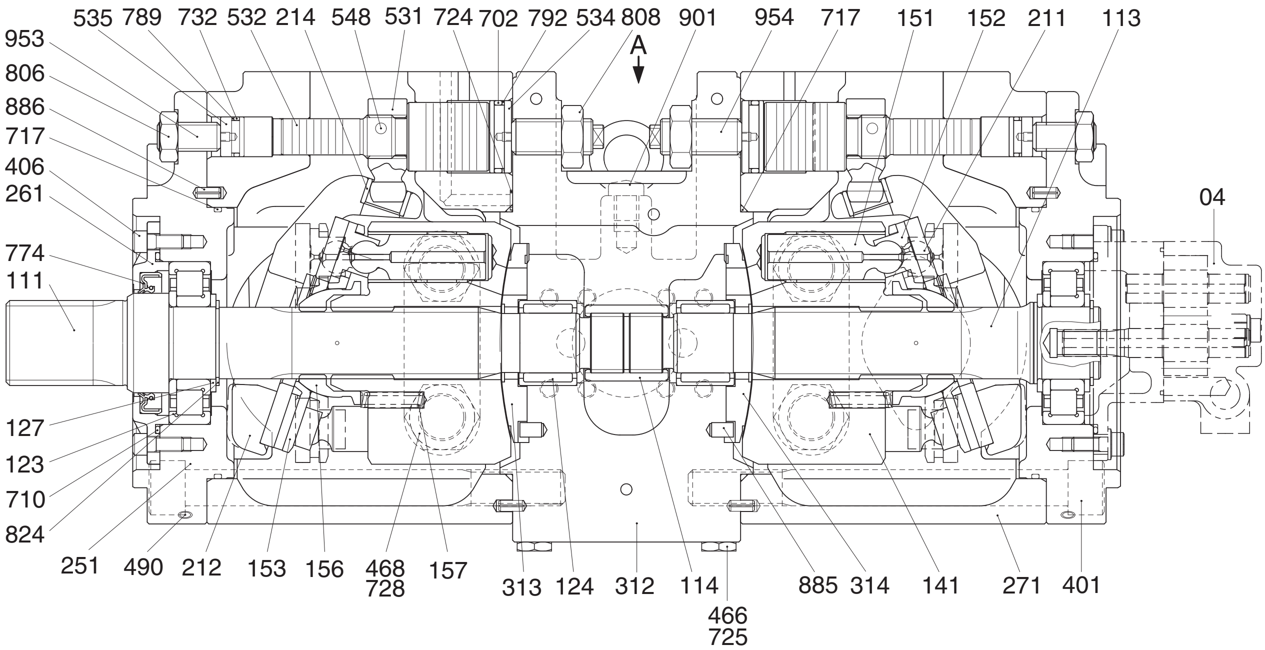


Hydraulic circuit

Port	Port name	Port size
A1,2	Delivery port	SAE6000psi 3/4"
B1	Suction port	SAE2500psi 2 1/2"
Dr	Drain port	PF 3/4 - 20
Pi1,i2	Pilot port	PF 1/4 - 15
Psv	Servo assist port	PF 1/4 - 15
a1,2,4	Gauge port	PF 1/4 - 15
a3	Gauge port	PF 1/4-14
A3	Gear pump delivery port	PF 1/2 - 19
B3	Gear pump suction port	PF 3/4 - 20.5

1) MAIN PUMP (1/2)

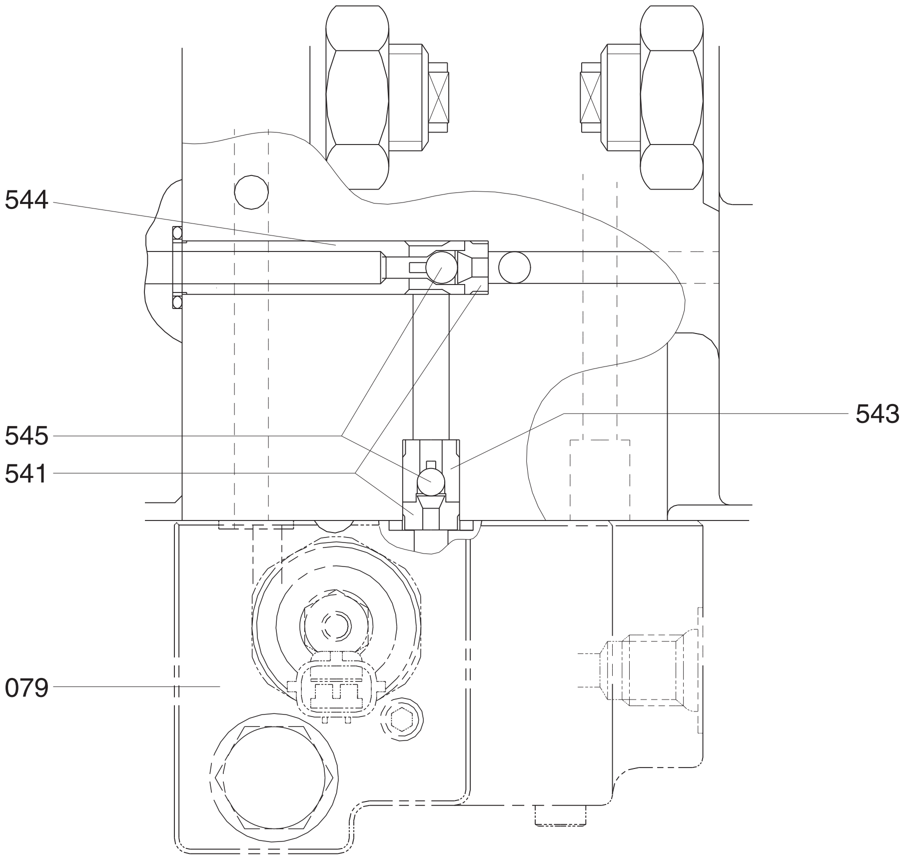
The main pump consists of two piston pumps (front & rear) and valve block.



2209S2MP02

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

MAIN PUMP (2/2)

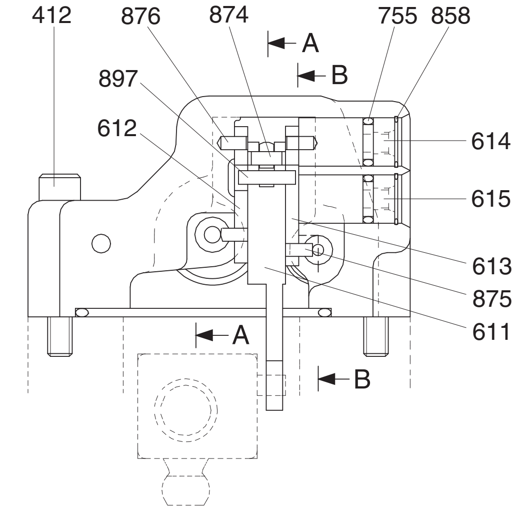


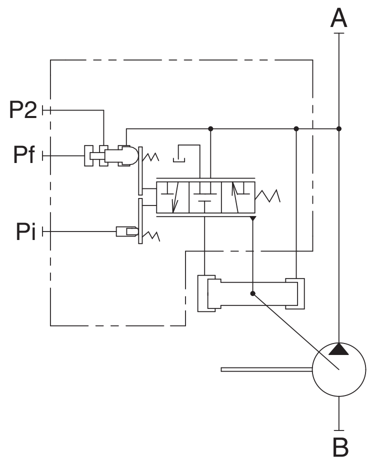
VIEW A

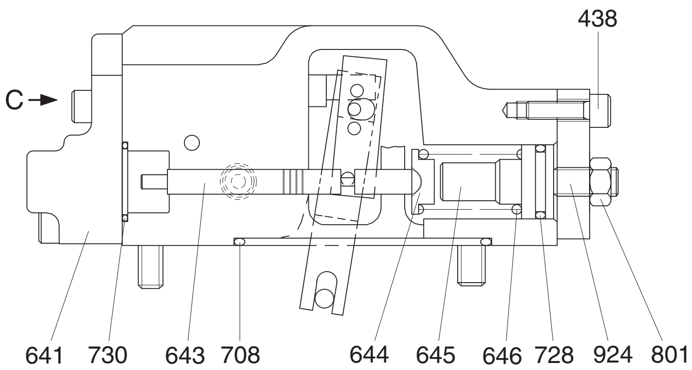
21092MP08

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

2) REGULATOR (1/2)

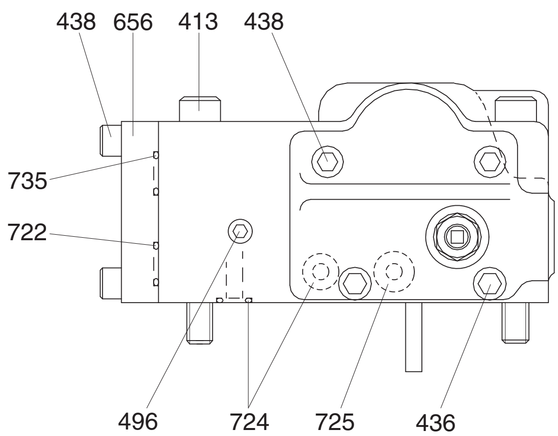






SECTION B-B

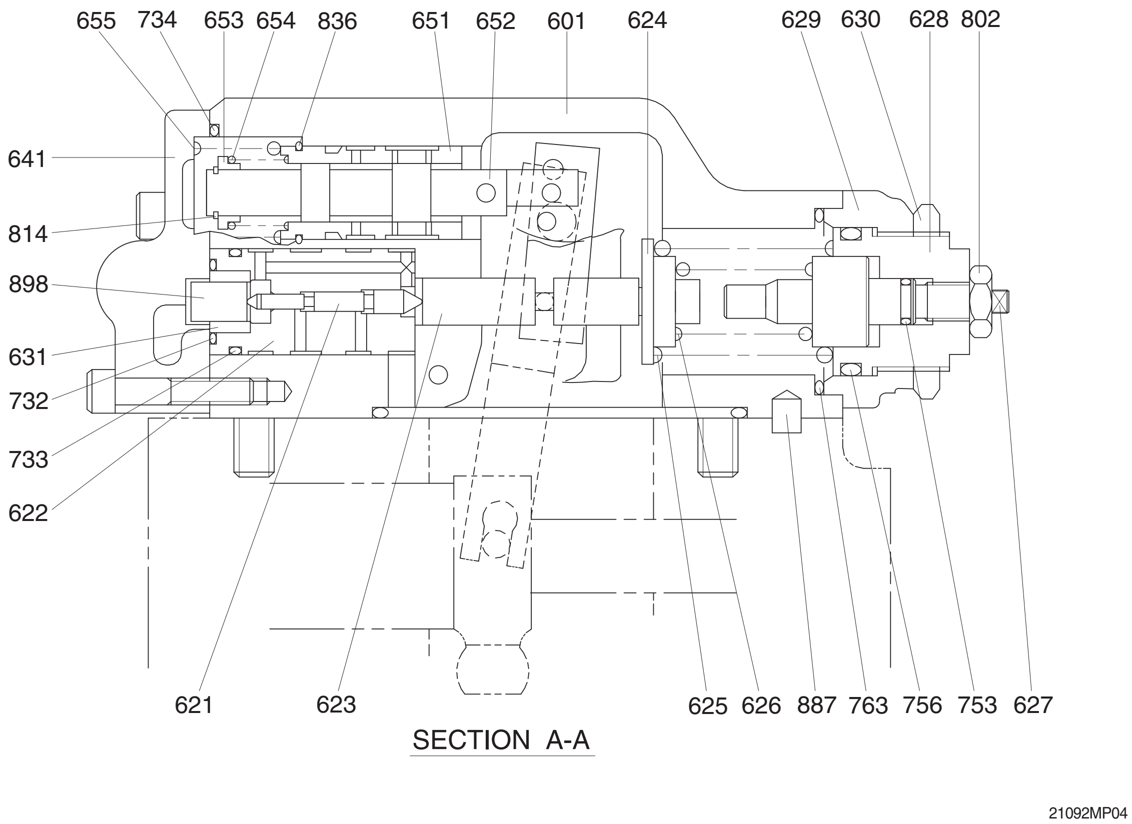
2209S2MP03



VIEW C

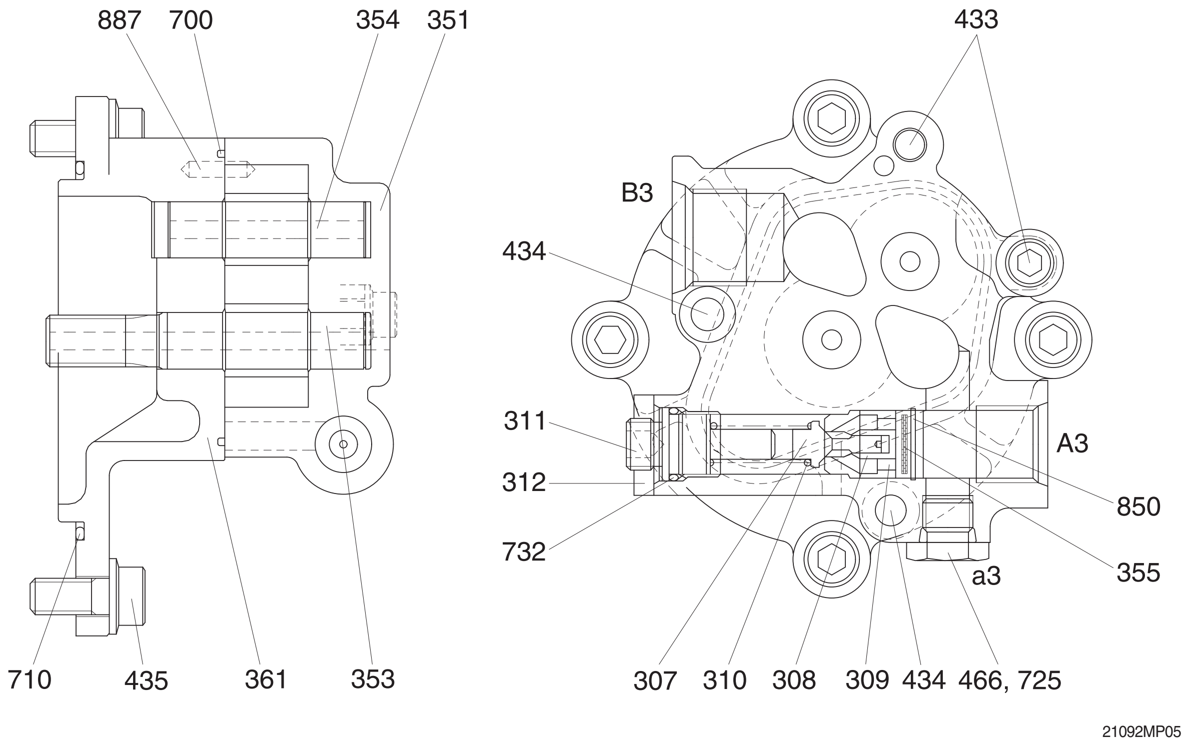
Port	Port name	Port size
A	Delivery port	3/4"
B	Suction port	2 1/2"
Pi	Pilot port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

REGULATOR (2/2)



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

3) GEAR PUMP



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

2. FUNCTION

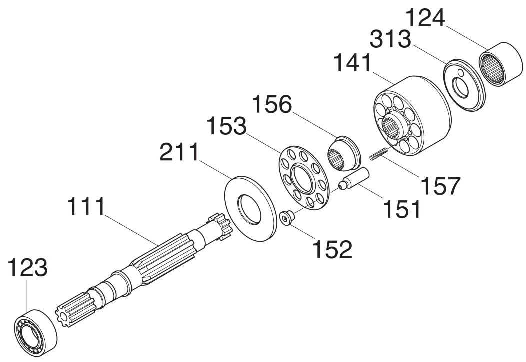
1) MAIN PUMP

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

(1) Rotary group

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

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



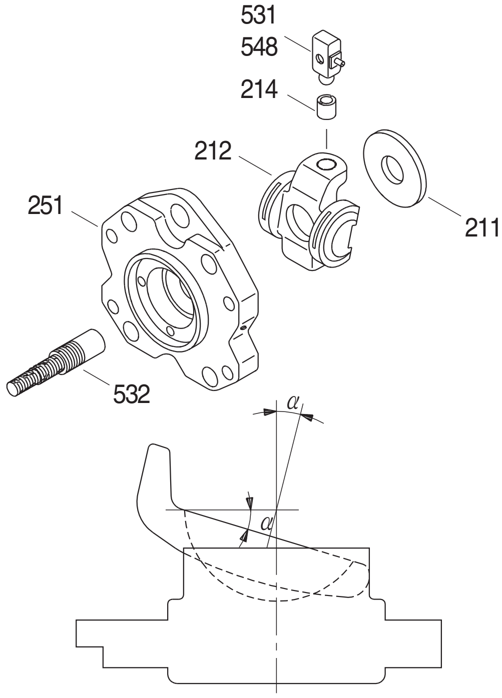
2209S2MP06

(2) Swash plate group

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

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

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



2-7

(3) Valve block group

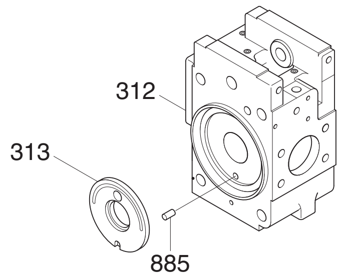
The valve block group consists of valve block (312), valve plate (313) and valve plate pin(885).

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

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

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

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



21092MP07

2) REGULATOR

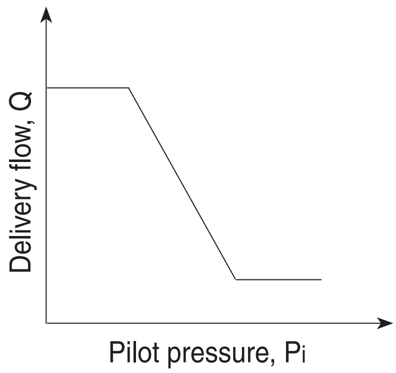
Regulator consists of the negative flow control, total horse power control and power shift control function.

(1) Negative flow control

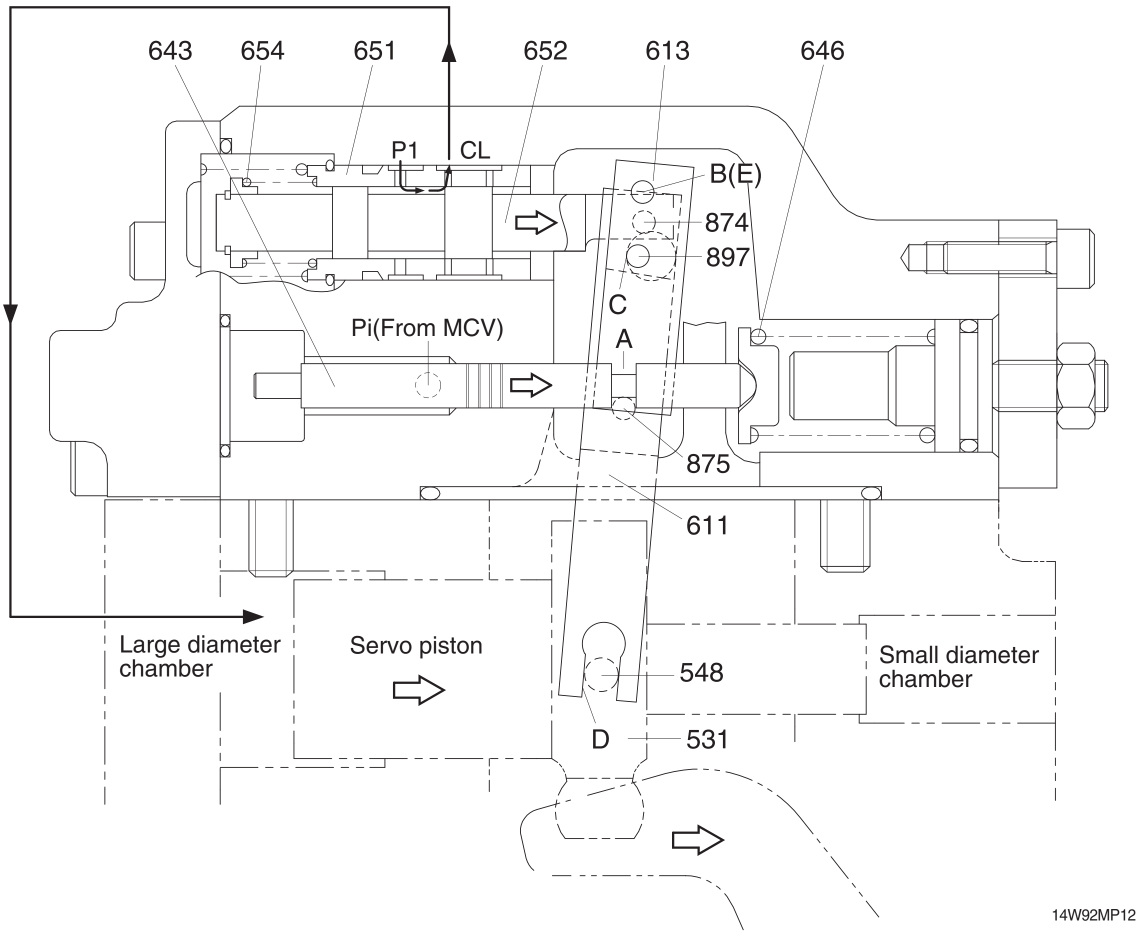
By changing the pilot pressure Pi, the pump tilting angle (delivery flow) is regulated arbitrarily, as shown in the figure.

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

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

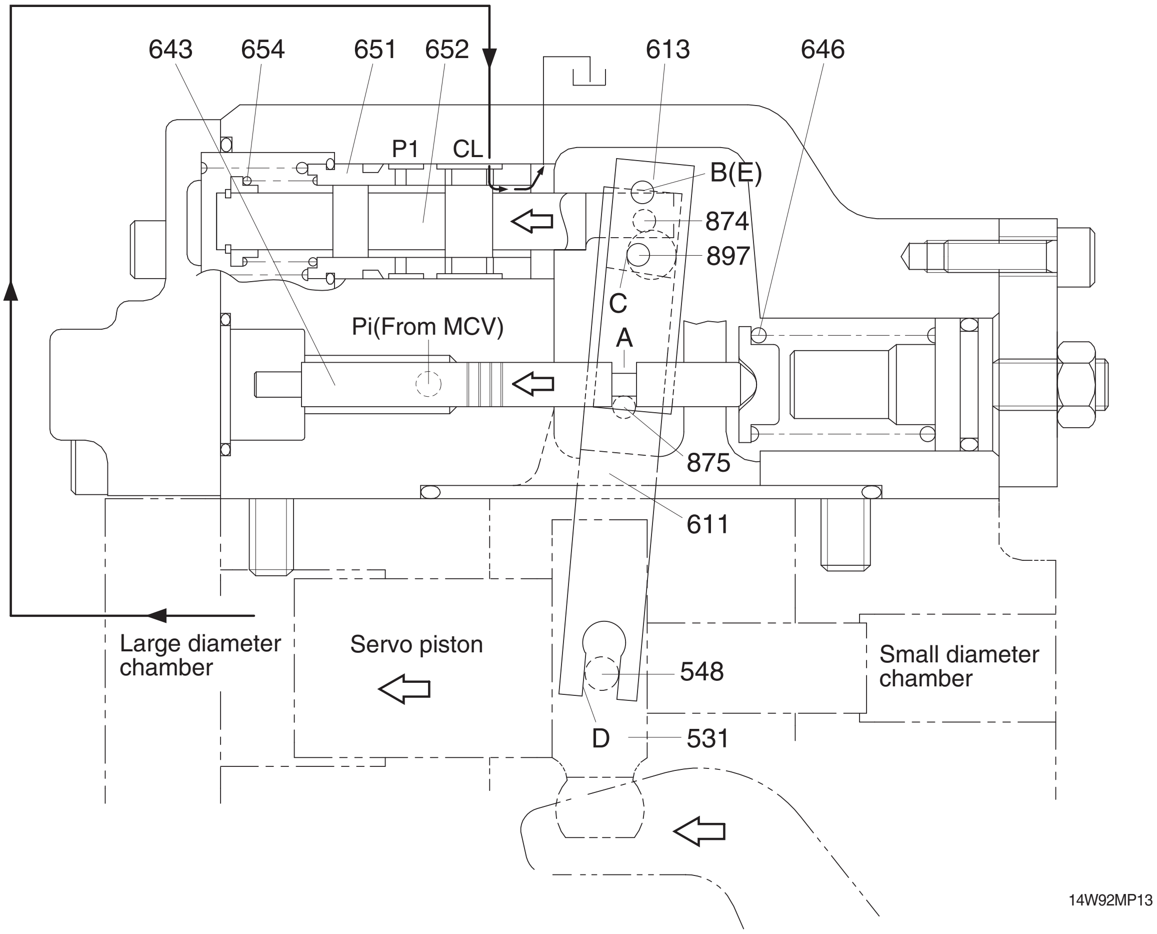


① Flow reducing function



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

② Flow increasing function



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

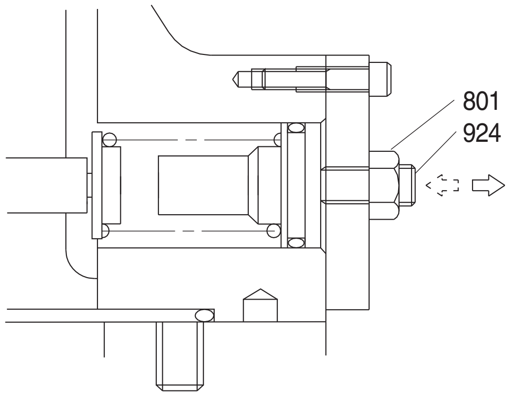
As the servo piston moves, point D also moves to the left, the feedback lever rotates around the fulcrum of point C, and the spool moves to the right till the opening between the spool and sleeve is closed.

③ Adjustment of flow control characteristic

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

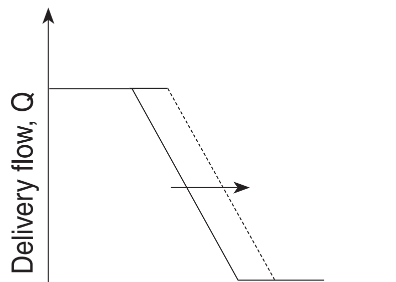
Adjust it by loosening the hexagon nut (801) and by tightening (or loosening) the hexagonal socket head screw (924).

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

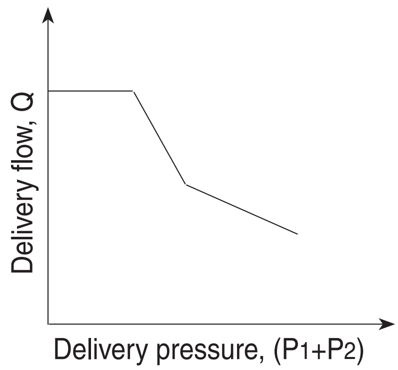


※ Adjusting value

Speed	Adjustment of flow control characteristic		
	Tightening amount of adjusting screw(924)	Flow control starting pressure change amount	Flow change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(ℓ/min)
1900	+1/4	+1.5	+14.8



(2) Total horsepower control

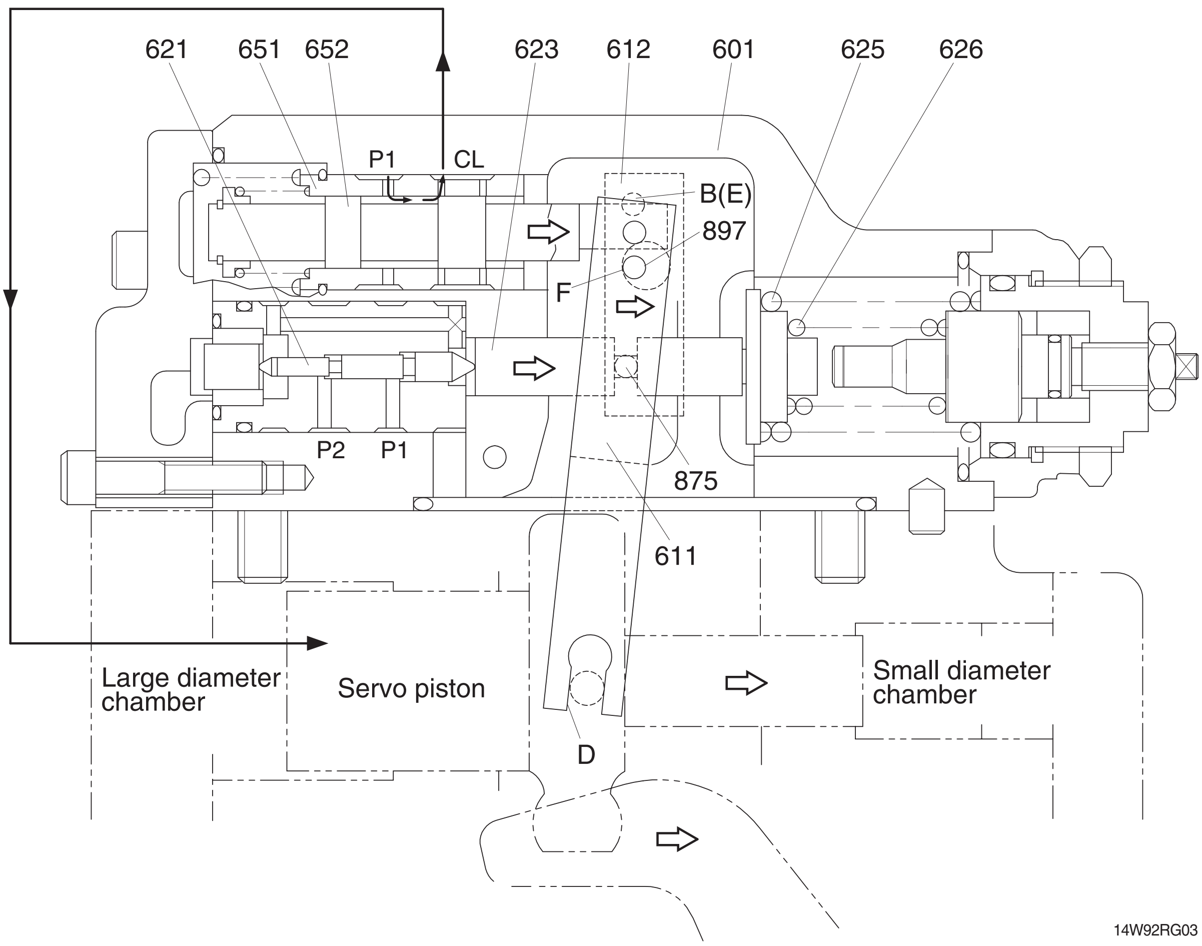


The regulator decreases the pump tilting angle (delivery flow) automatically to limit the input torque within a certain value with a rise in the delivery pressure P1 of the self pump and the delivery pressure P2 of the companion pump.
(The input horsepower is constant when the speed is constant.)
Since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

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

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

① Overload preventive function



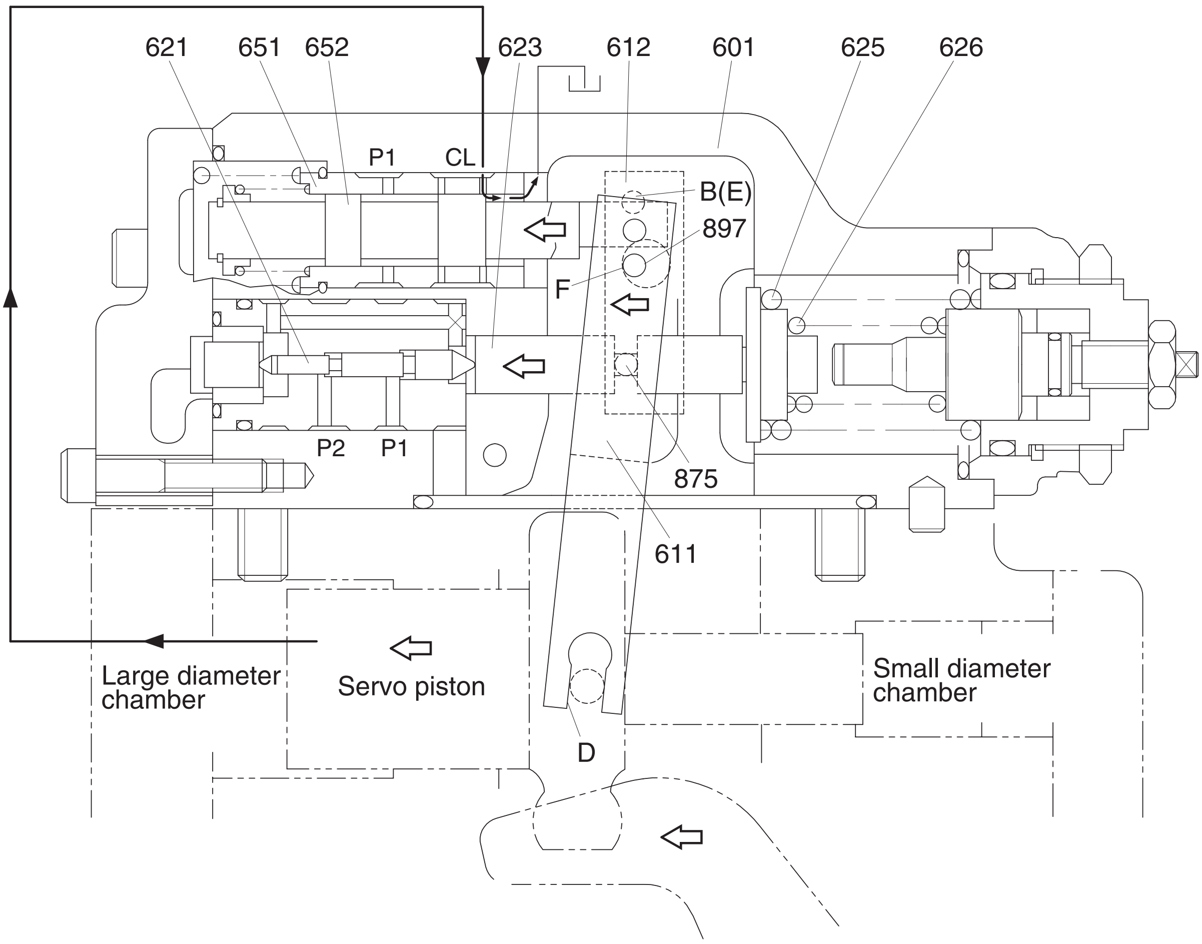
When the self pump delivery pressure P1 or the companion pump delivery pressure P2 rises, it acts on the stepped part of the compensating piston (621). It presses the compensating rod (623) to the right till the force of the outer spring (625) and inner spring (626) balances with the hydraulic force.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

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

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

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

② Flow reset function



14W92RG04

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.

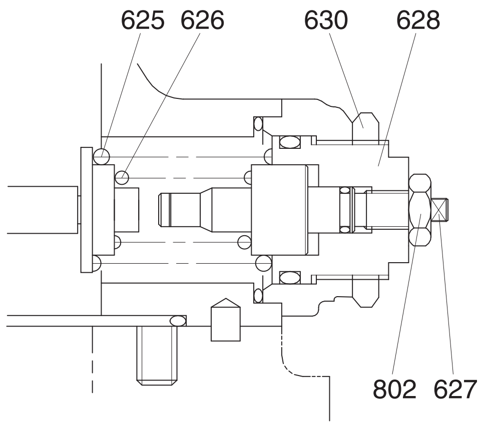
③ Low tilting angle (low flow) command preferential function

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

a. Adjustment of outer spring

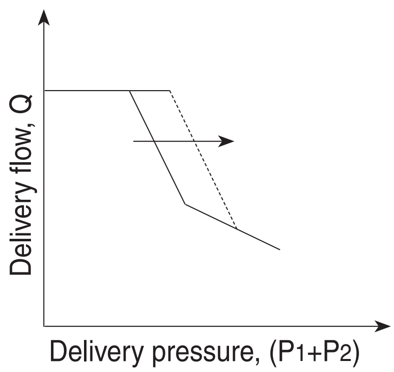
Adjust it by loosening the hexagon nut (630) and by tightening (or loosening) the adjusting screw C (628). Tightening the screw shifts the control chart to the right and increases the input horsepower as shown in the figure. Since turning the adjusting screw C by N turns changes the setting of the inner spring (626), return the adjusting stem C (627) by N×A turns at first.(A=1.78)



2107A2MP07

※ Adjusting value

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting screw(628)	Compensating control starting pressure change amount	Input torque change amount
(min^{-1})	(Turn)	(kgf/cm^2)	(kgf · m)
1900	+1/4	+16.5	+4.0



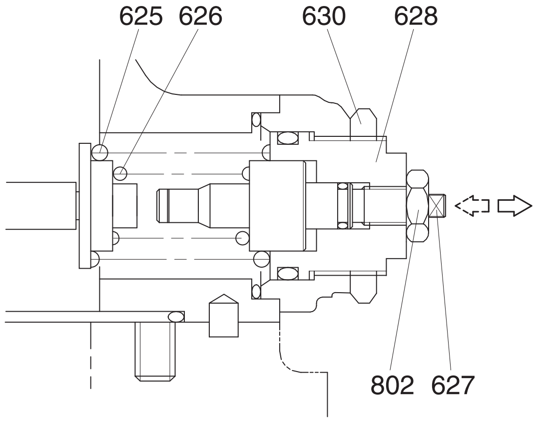
b. **Adjustment of inner spring**

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

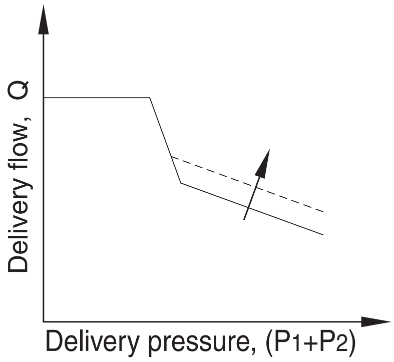
Tightening the screw increases the flow and then the input horsepower as shown in the figure.

※ Adjusting valve

Speed	Adjustment of input horsepower		
	Tightening amount of adjusting stem (C) (627)	Flow change amount	Input torque change amount
(min^{-1})	(Turn)	(ℓ/min)	(kgf·m)
1900	+1/4	+11.3	+4.7



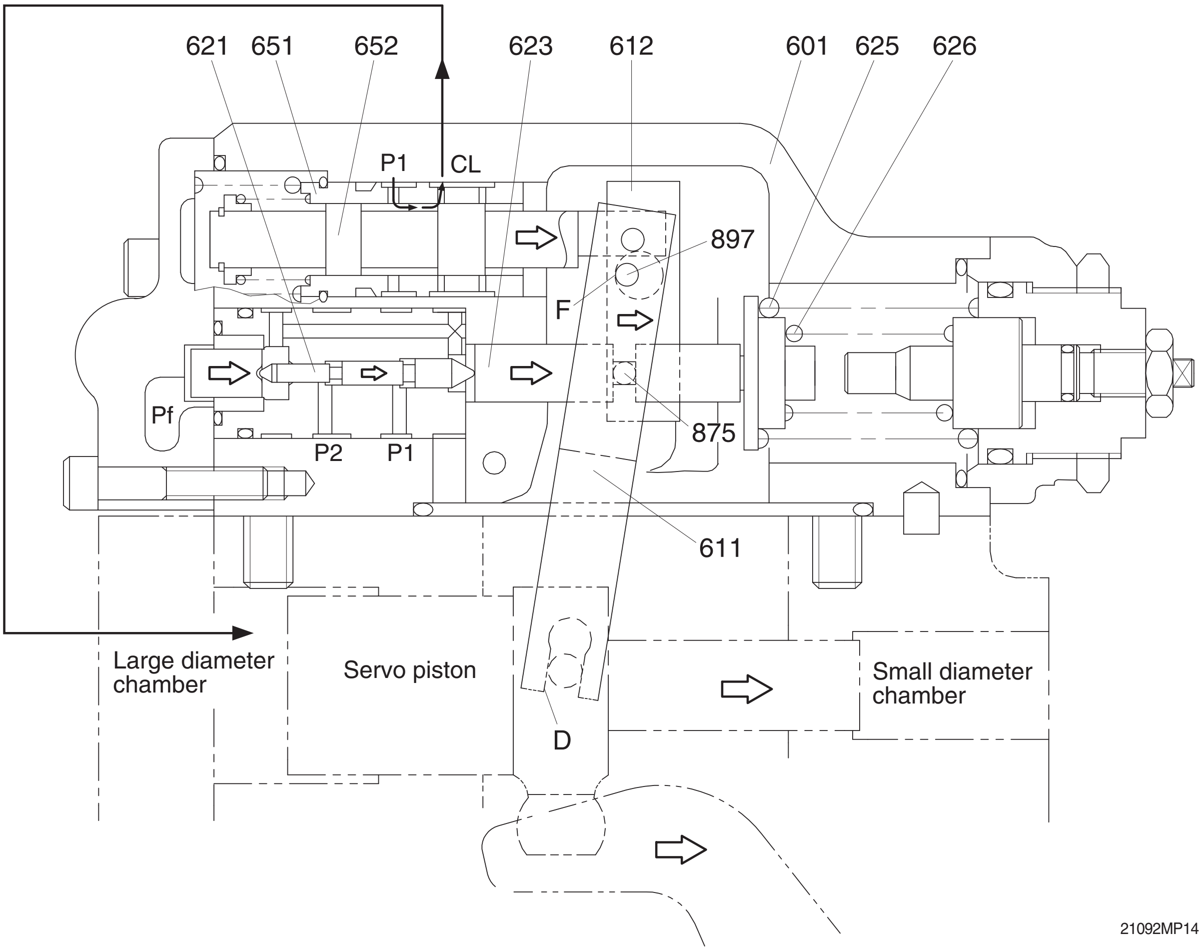
2107A2MP08



21092MP18

(3) Variable horsepower control

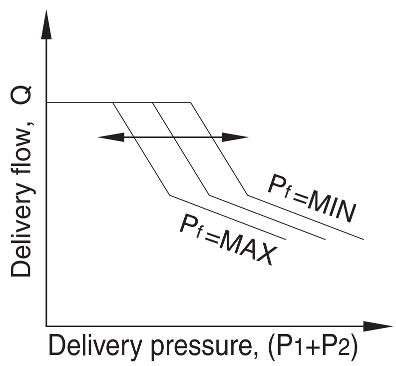
Variable horsepower control can be obtained by supplying pilot pressure.



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.

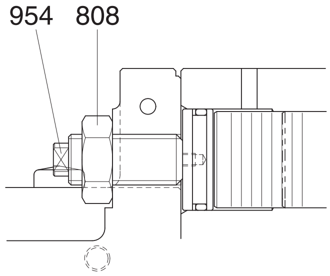
(4) Adjustment of maximum and minimum flows

The regulator can adjust the maximum and minimum flows with the adjusting screws.

① Adjustment of maximum flow

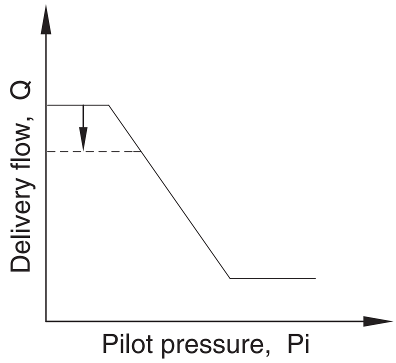
Adjust it by loosening the hexagon nut (808) and by tightening (or loosening) the set screw (954).

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



21092MP23

Speed	Adjustment of max flow	
	Tightening amount of adjusting screw (954)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1900	+1/4	-5.5

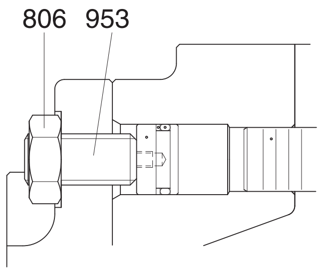


21092MP21

② Adjustment of minimum flow

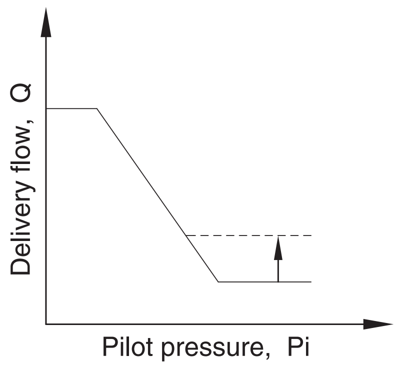
Adjust it by loosening the hexagon nut (806) and by tightening (or loosening) the hexagonal socket head set screw (953). Similarly to the adjustment of the maximum flow, other characteristics are not changed.

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



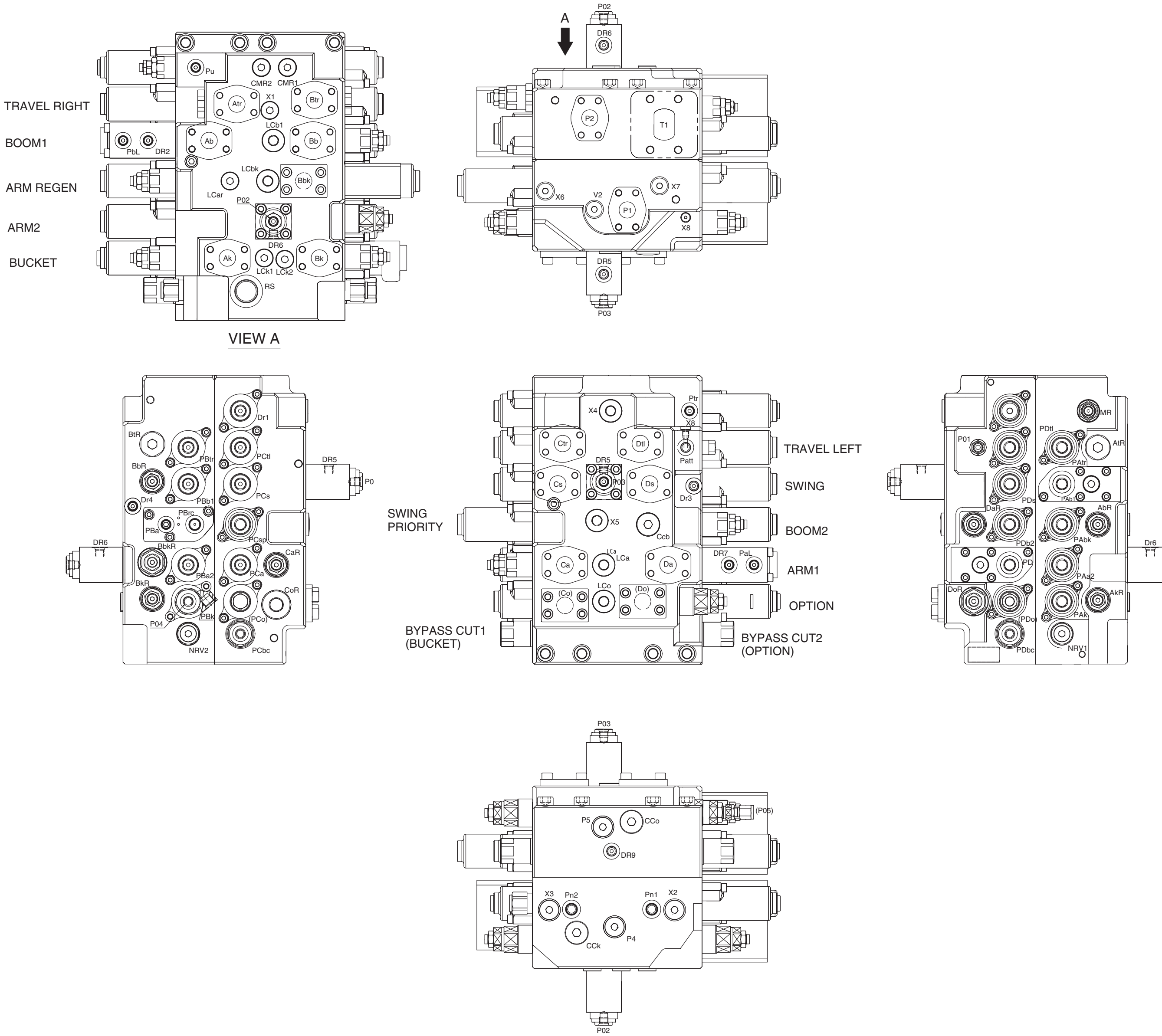
21092MP24

Speed	Adjustment of min flow	
	Tightening amount of adjusting screw (953)	Flow change amount
(min^{-1})	(Turn)	(ℓ/min)
1900	+1/4	+4.4



21092MP22

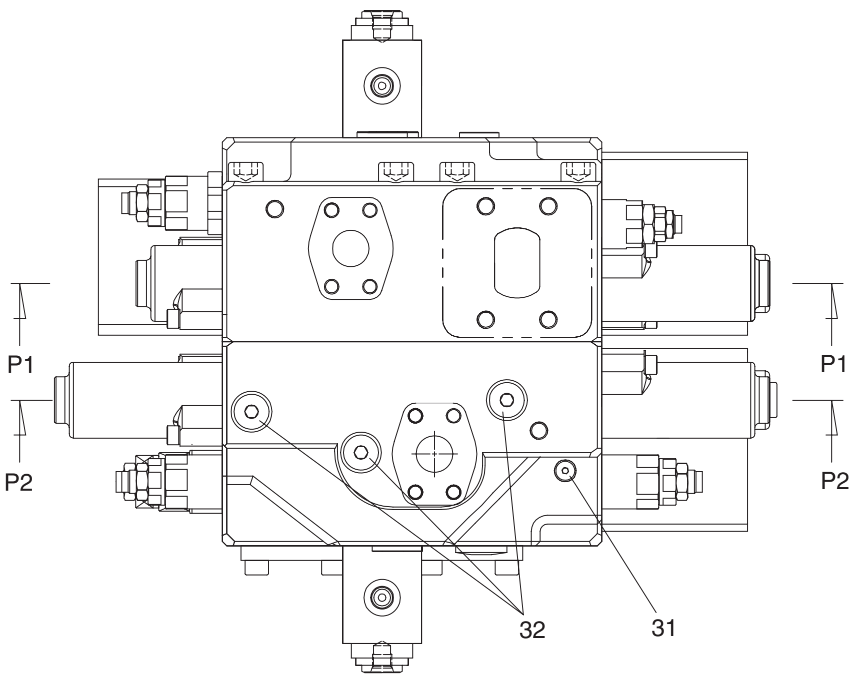
1. STRUCTURE (1/8)



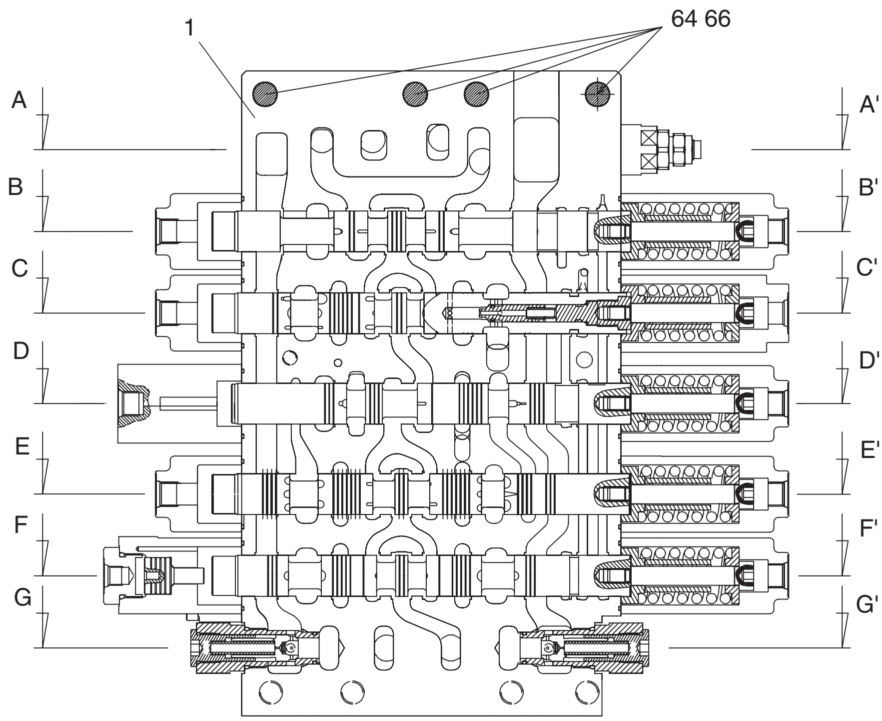
220S2MC01

Mark	Port name	Port size	Tightening torque
Rs	Make up for swing motor	PF1	20~25 kgf · m (145~180 lbf · ft)
Patt	Auto idle signal-attachment	PF1/4	3.5~4.0 kgf · m (25.3~28.9 lbf · ft)
PbL	Lock valve pilot port (boom)		
PCbc	Bucket in confluence pilot port		
PDbc	Option confluence pilot port		
P01	Pilot signal port		
P02	Pilot signal port		
P03	Swing logic pilot port		
P04	Bucket parallel orifice pilot port		
P05	Option B confluence pilot port		
P06	Option B 2 stage relief valve pilot port		
PaL	Lock valve pilot port (arm)		
Ptr	Auto idle signal-travel		
Pu	Power boost		
DR1	Drain port		
DR2	Drain port		
DR3	Drain port		
DR4	Drain port		
DR5	Drain port		
DR7	Drain port		
DR9	Drain port		
(P4)	-	PF1/2	10~12 kgf · m (72.3~86.8 lbf · ft)
(P5)	-		
PAtr	Travel pilot port-RH (FW)	PF3/8	7~8 kgf · m (50.6~57.8 lbf · ft)
PBtr	Travel pilot port-RH (BW)		
PCtl	Travel pilot port-LH (BW)		
PDtl	Travel pilot port-LH (FW)		
PAb1	Boom up pilot port		
PDb2	Boom up confluence pilot port		
PBb1	Boom down pilot port		
PCS	Swing pilot port (LH)		
PDS	Swing pilot port (RH)		
PBa	Arm in regen-cut signal selector port		
PBa2	Arm in confluence pilot port		
PCsp	Swing priority pilot port		
PAbk	Option A pilot port (breaker)		
PBrc	Arm in regeneration cut port		
PCa	Arm in pilot port		
PDa	Arm out pilot port		
PAa2	Arm out confluence pilot port		
PAk	Bucket in pilot port		
PBk	Bucket out pilot port		
(PCo)	Option B pilot port		
(PDo)	Option B pilot port		
Pn1	Negative control signal port (A2 port side)		
Pn2	Negative control signal port (A1 port side)		
V2	Carry-over port		
Atr	Travel motor port-LH (FW)	M10	5.0~6.5 kgf · m (36.2~47.0 lbf · ft)
Btr	Travel motor port-LH (BW)		
Ctl	Travel motor port-RH (BW)		
Dtl	Travel motor port-RH (FW)		
Ab	Boom up port		
Bb	Boom down port		
Cs	Swing motor port (LH)		
Ds	Swing motor port (RH)		
Abk	Option A port (breaker)		
Ca	Arm in port		
Da	Arm out port		
Ak	Bucket in port		
Bk	Bucket out port		
(Co)	Option B port		
(Do)	Option B port		
P1	Pump port (A2 side)		
P2	Pump port (A1 side)		
T1	Return port	M12	8.0~11.0 kgf · m (57.9~79.6 lbf · ft)

STRUCTURE (2/8)



TOP VIEW

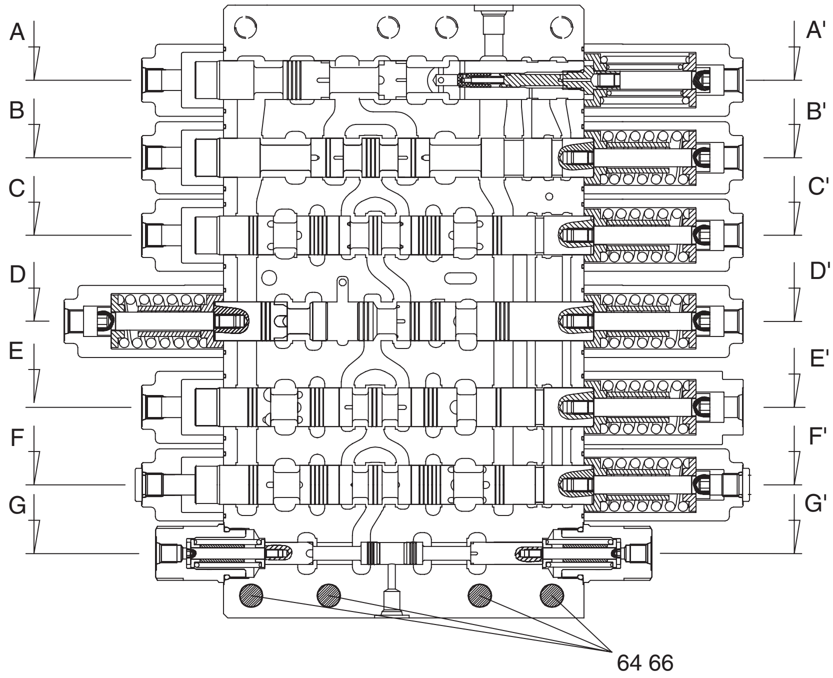


P1 BLOCK SPOOL SECTION

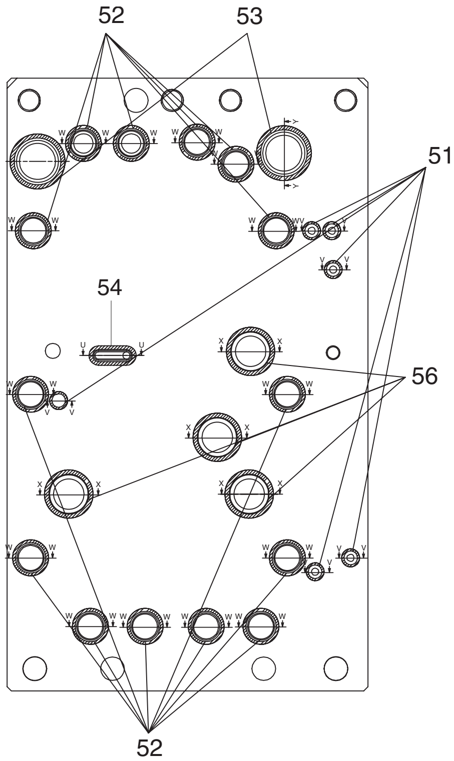
220S2MC02

1	Housing P1
31	Plug
32	Plug
64	Hex socket head bolt
66	Spring washer

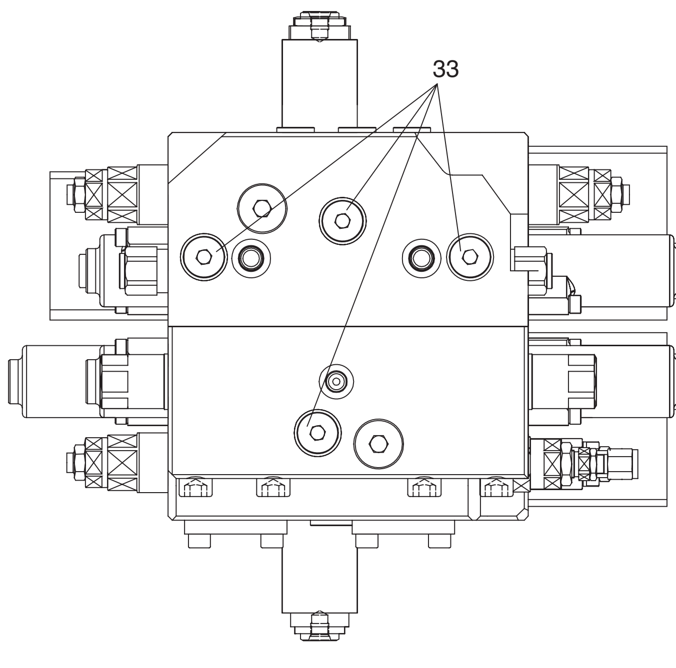
STRUCTURE (3/8)



P2 BLOCK SPOOL SECTION



CONTACT FACE

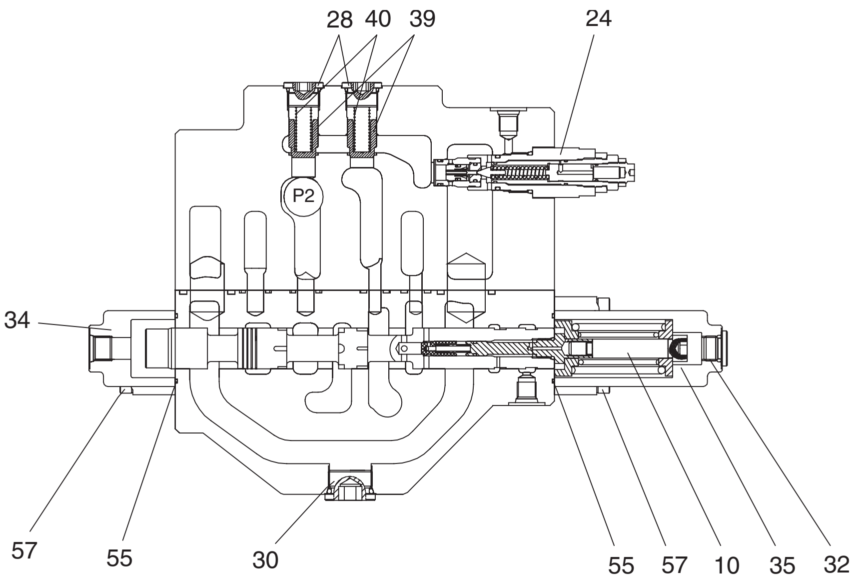


BOTTOM VIEW

220S2MC03

2	Housing 2
33	Plug
51	O-ring
52	O-ring
53	O-ring
54	O-ring
56	O-ring
64	Hex socket head bolt
66	Spring washer

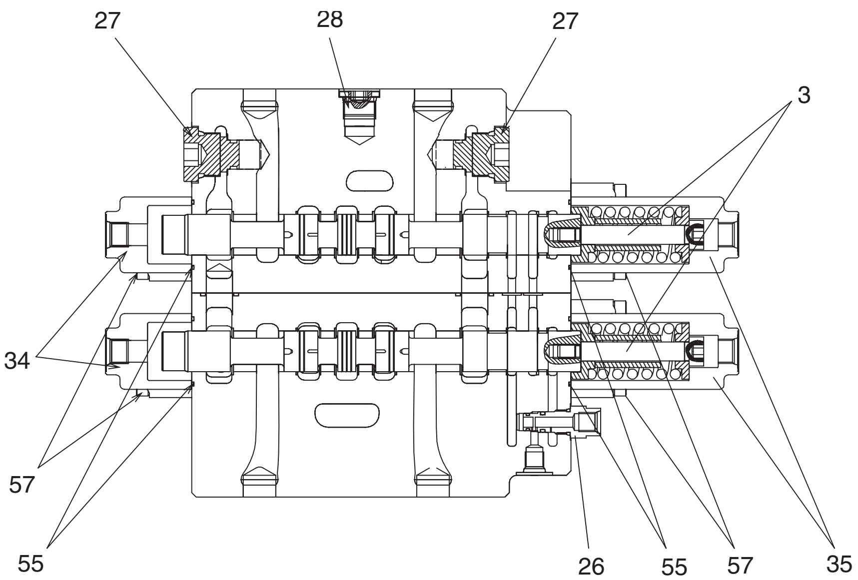
STRUCTURE (4/8)



A-A' (STRAIGHT TRAVEL AND SUPPLY)

220S2MC04

10 Travel straight spool kit
24 Main relief valve
28 Plug
30 Plug
32 Plug
34 Pilot cover A
35 Pilot cover B
39 Check valve poppet 2
40 Check valve spring 2
55 O-ring
57 Hex socket head bolt

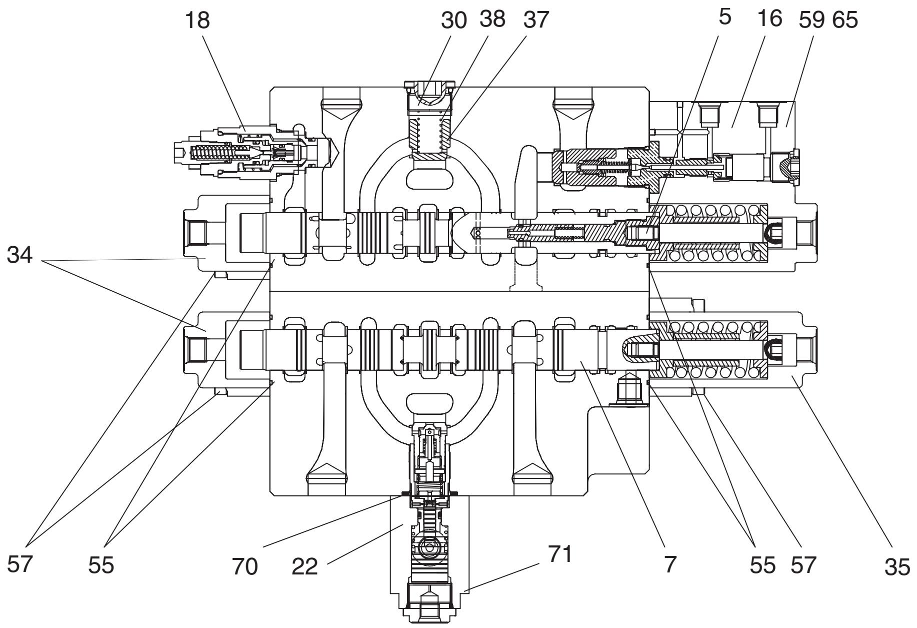


B-B' (TRAVEL RIGHT AND LEFT)

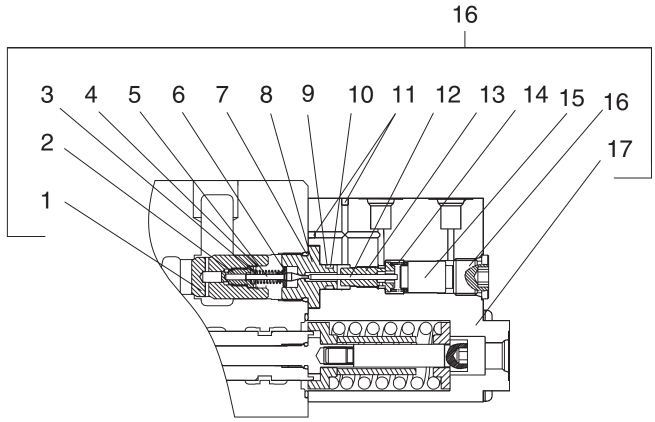
220S2MC05

3 Travel spool kit
26 Orifice signal plug
27 ORV plug
28 Plug
34 Pilot cover A
35 Pilot cover B
55 O-ring
57 Hex socket head bolt

STRUCTURE (5/8)



C-C' (SWING AND BOOM1)

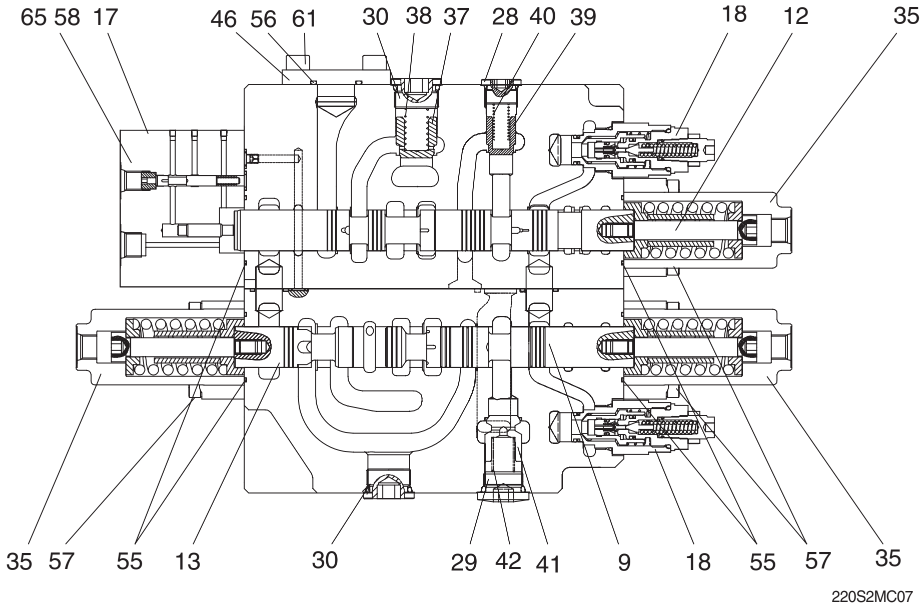


HOLDING VALVE

220S2MC06

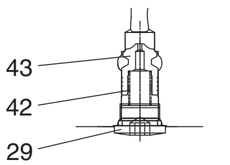
5	Boom 1 spool kit	16-9	Back up ring	30	Plug
7	Swing spool kit	16-10	O-ring	34	Pilot cover A
16	Holding valve assy	16-11	Plug	35	Pilot cover B
16-1	Main poppet	16-12	Pilot piston	37	Check valve poppet 1
16-2	Restrictor	16-13	Piston guide	38	Check valve spring 1
16-3	Pilot spring	16-14	Spring	55	O-ring
16-4	C-ring	16-15	Main piston	57	Hex socket head bolt
16-5	Pilot poppet	16-16	Plug	58	Hex socket head bolt
16-6	Poppet guide	16-17	Block	65	Spring washer
16-7	O-ring	18	Overload relief valve	70	O-ring
16-8	Poppet seat	22	Swing logic valve	71	Hex socket head bolt

STRUCTURE (6/8)

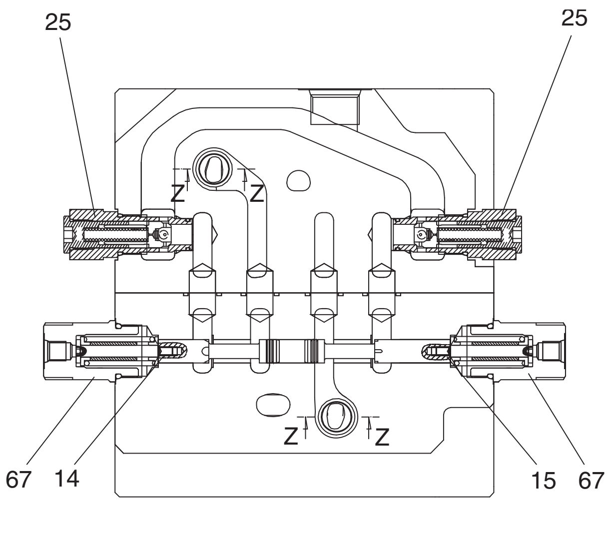


D-D' (SWING PRI, BOOM 2 & ARM REGEN)

9	Boom 2 spool kit
12	Arm regen spool kit
13	Swing priority spool kit
17	Regen valve
18	Overload relief valve
28	Plug
29	Plug
30	Plug
35	Pilot cover B
37	Check valve poppet 1
38	Check valve spring 1
39	Check valve poppet 2
40	Check valve spring 2
41	Check valve poppet 3
42	Check valve spring 3
46	Flange
50	Gasket 3
55	O-ring
56	O-ring
57	Hex socket head bolt
58	Hex socket head bolt
61	Hex socket head bolt
65	Spring washer



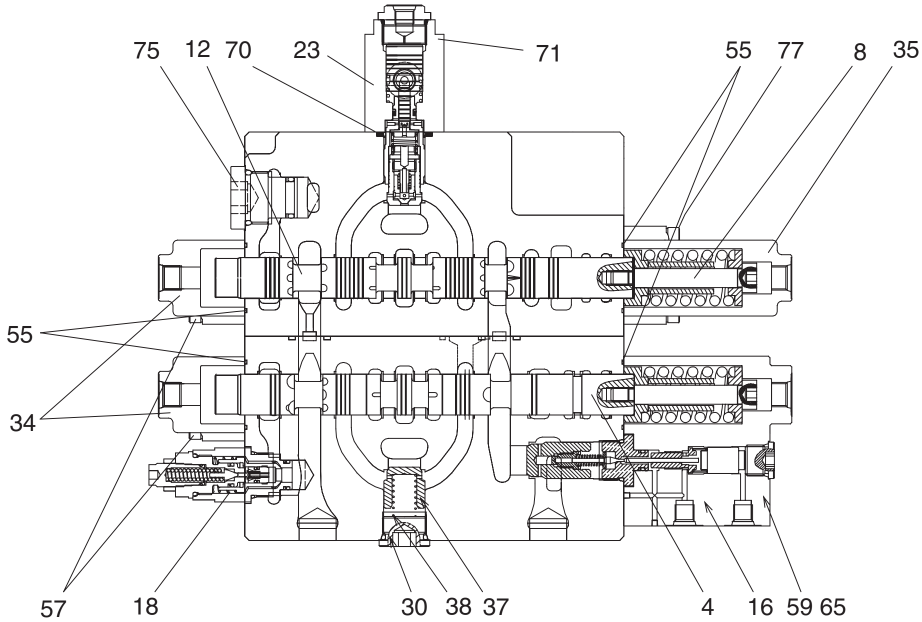
SECTION Z-Z



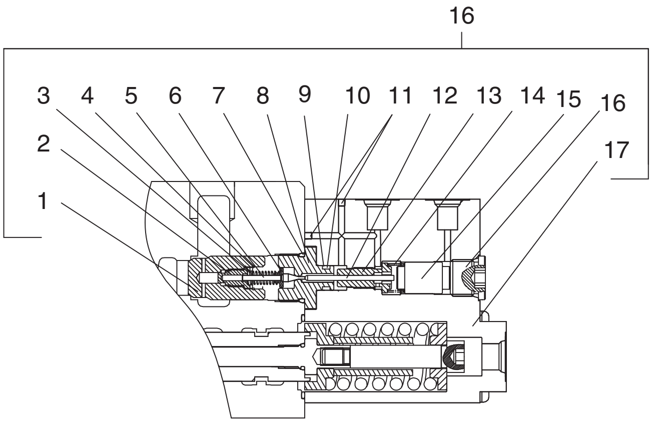
G-G' (BYPASS CUT & NEGATIVE CONTROL)

14	Bypass cut 1 spool kit (bucket)
15	Bypass cut 1 spool kit (option)
25	Negacon valve
29	Plug
42	Check valve spring 3
43	Check valve poppet 4
67	BC plug

STRUCTURE (7/8)



E-E' (ARM 1 & ARM 2)

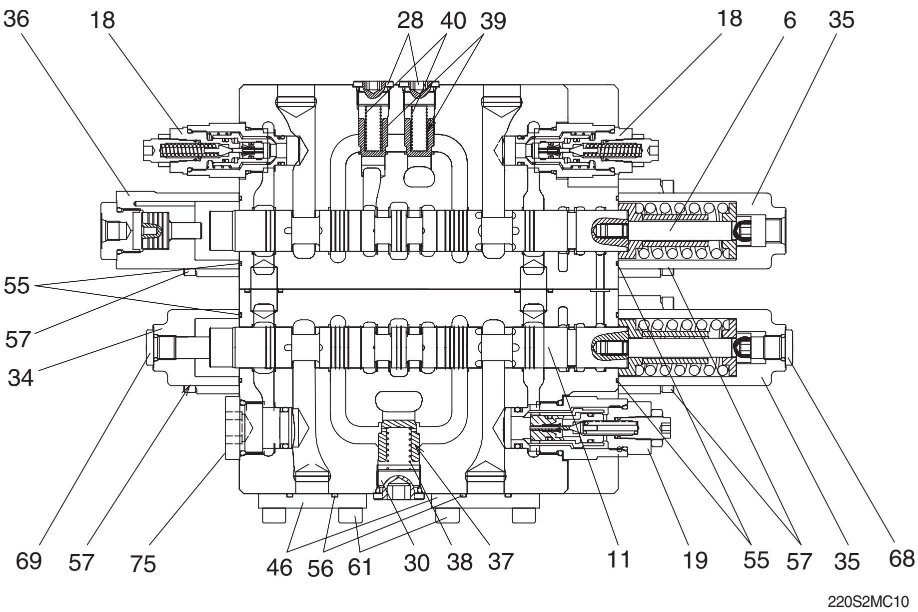


HOLDING VALVE

220S2MC09

4	Arm 1 spool kit	16-9	Back up ring	34	Pilot cover A
8	Arm 2 spool kit	16-10	O-ring	35	Pilot cover B
12	Arm regen spool kit	16-11	Plug	37	Check valve poppet 1
16	Holding valve assy	16-12	Pilot piston	38	Check valve spring 1
16-1	Main poppet	16-13	Piston guide	55	O-ring
16-2	Restrictor	16-14	Spring	57	Hex socket head bolt
16-3	Pilot spring	16-15	Main piston	58	Hex socket head bolt
16-4	C-ring	16-16	Plug	65	Spring washer
16-5	Pilot poppet	16-17	Block	70	O-ring
16-6	Poppet guide	18	Overload relief valve	71	Hex socket head bolt
16-7	O-ring	22	Swing logic valve	75	Plug
16-8	Poppet seat	30	Plug		

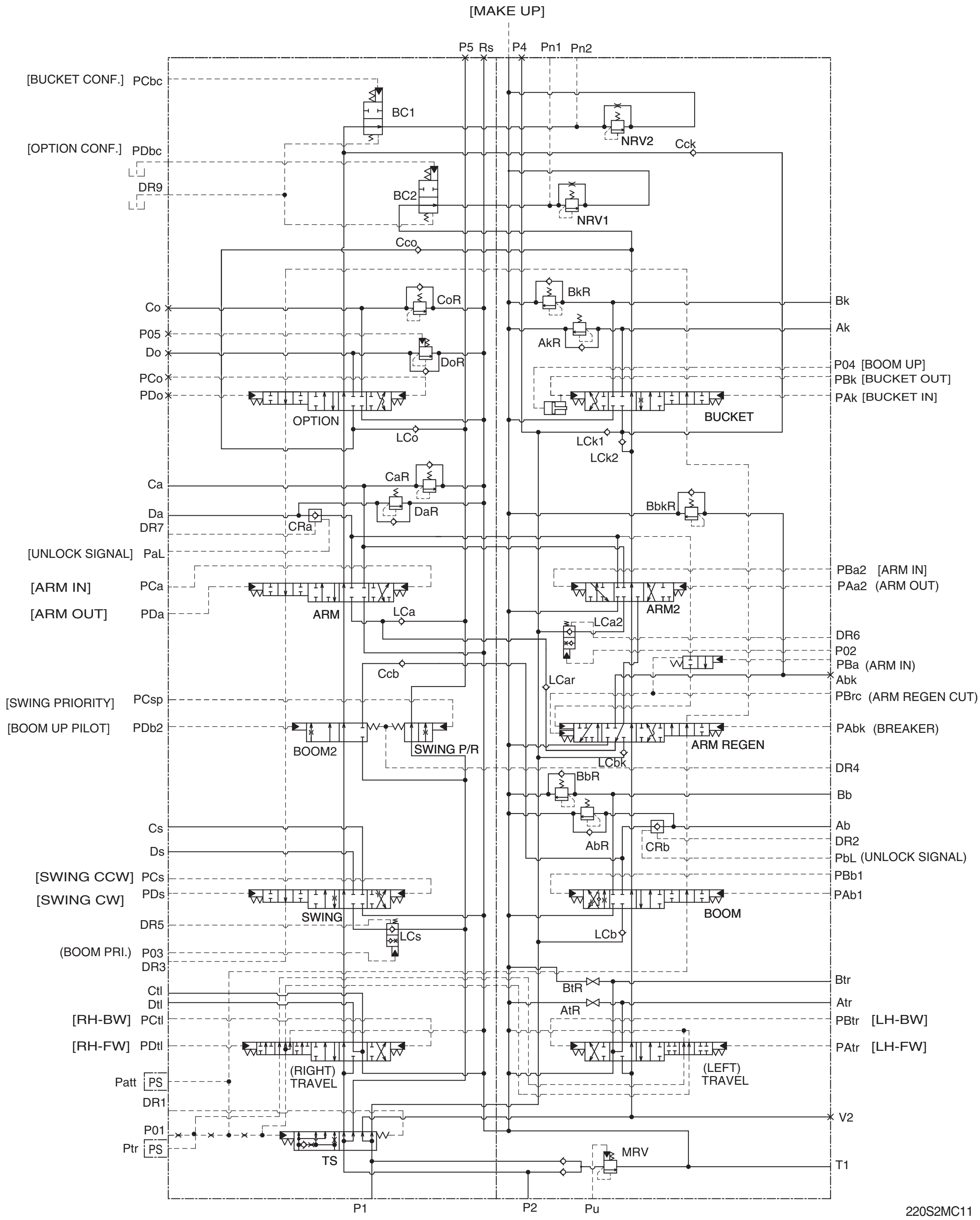
STRUCTURE (8/8)



F-F' (OPTION & BUCKET)

6	Bucket spool kit
11	Option spool kit
18	Overload relief valve
20	Overload relief valve
21	Overload relief valve
28	Plug
30	Plug
34	Pilot cover A
35	Pilot cover B
36	Pilot cover (stroke limit)
37	Check valve poppet 1
38	Check valve spring 1
39	Check valve poppet 2
40	Check valve spring 2
46	Flange
50	Gasket 3
55	O-ring
56	O-ring
57	Hex socket head bolt
61	Hex socket head bolt
68	Plug kit 1
69	Plug kit 2

2. HYDRAULIC CIRCUIT



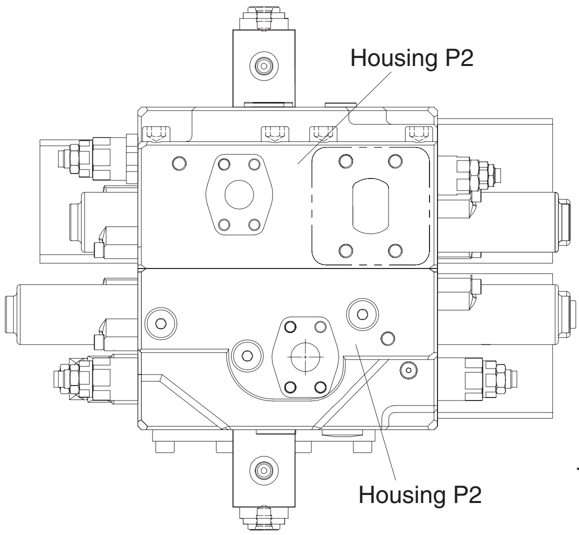
3. FUNCTION

1) CONTROL IN NEUTRAL POSITION

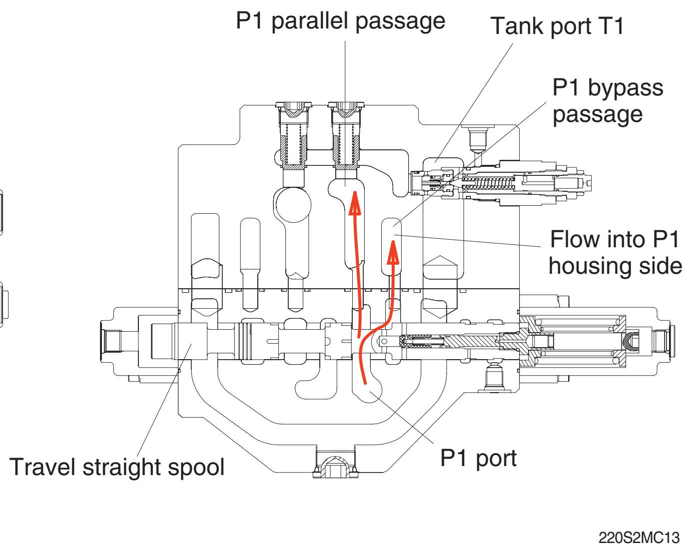
(1) P1 housing side

The pressurized oil discharged from hydraulic pump flows into the main control valve through the inlet port P1 and pass the land of the straight travel spool into the P1 bypass passage and P1 parallel passage.

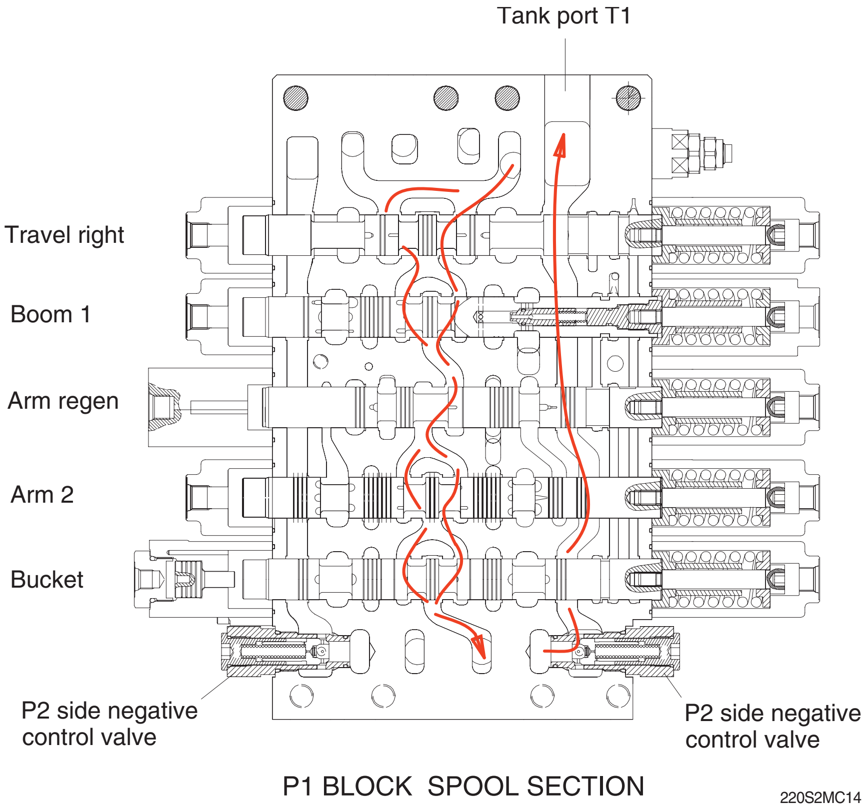
When the straight travel spool is neutral, the P1 side bypass passage is not cut-off and the pressurized oil is directed to the tank port T1 through the bypass passage of spools (travel right -> boom 1 -> arm regeneration -> arm 2 -> bucket), the negative control valve of P1 and tank passage.



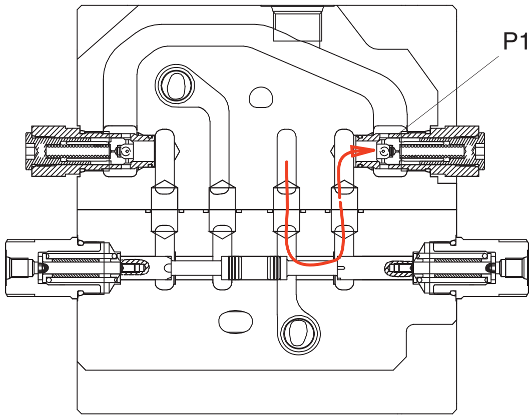
TOP VIEW



A-A' (STRAIGHT TRAVEL AND SUPPLY)



P1 BLOCK SPOOL SECTION



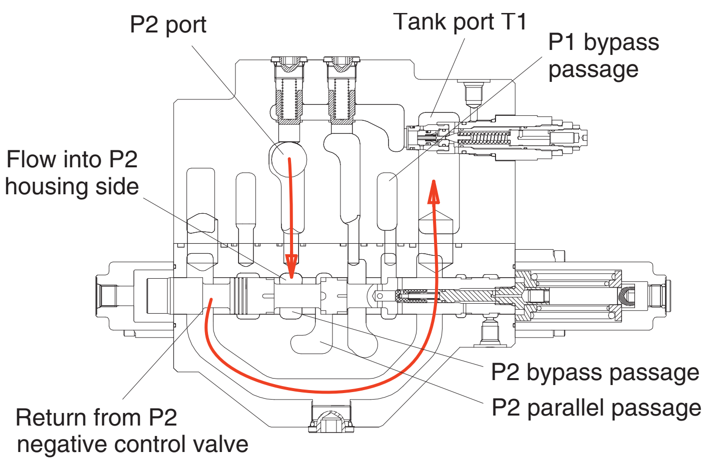
G-G' (BYPASS CUT & NEGATIVE CONTROL)

220S2MC15

(2) P2 housing side

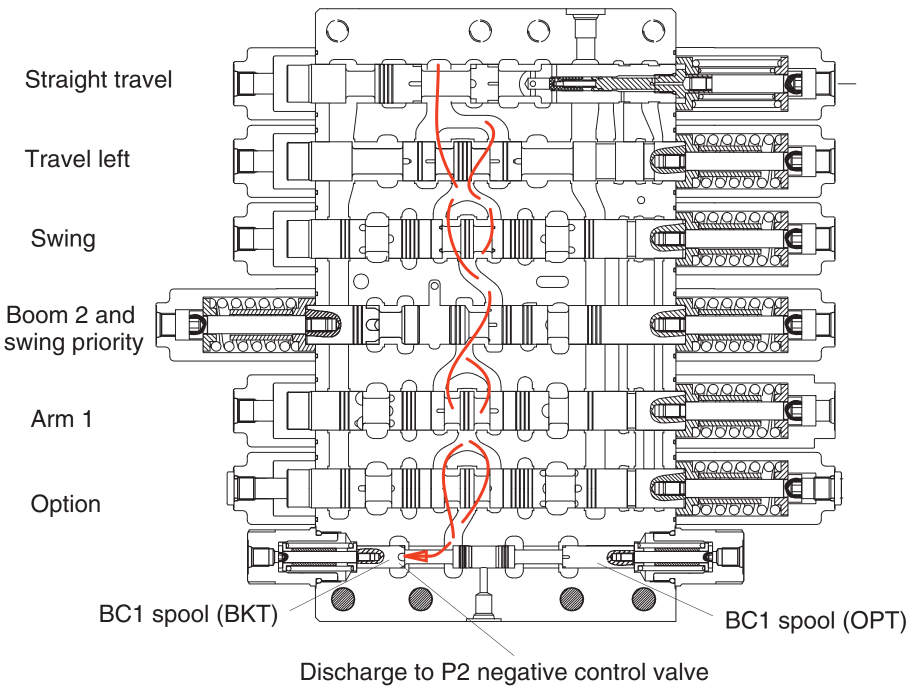
The pressurized oil discharged from hydraulic pump flows into the main control valve through the inlet port P2 and pass the land of the straight travel spool into the P2 bypass passage and P2 parallel passage.

When the straight travel spool is neutral, the P2 side bypass passage is not cut-off and the pressurized oil is directed to the tank port T1 through the bypass passage of spools (travel left -> swing -> boom 2 and swing priority -> arm 1 -> option), the negative control valve of P2 and tank passage.



A-A' (STRAIGHT TRAVEL AND SUPPLY)

220S2MC16



P2 BLOCK SPOOL SECTION

220S2MC17

2) TRAVEL OPERATION

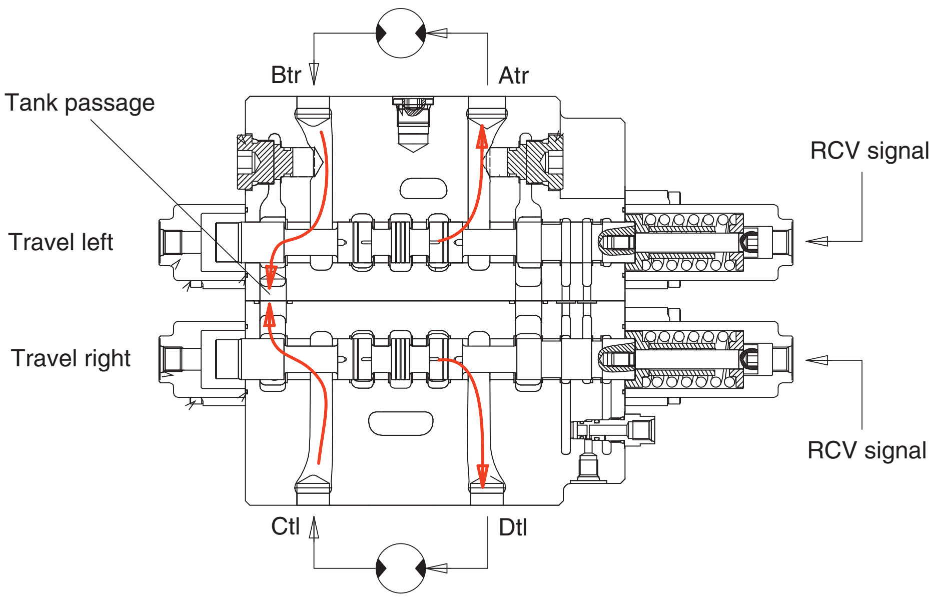
(1) Travel forward operation

During the travel forward operation, the pilot secondary pressure from the remote control valve is supplied to the spring side of pilot port and it shifts travel spools to the left direction.

The pressurized oil from the pump flows into the bypass passage of the travel spools through the land of the straight travel spool.

When the travel spools is shifted and the bypass passage is shut-off. The pressurized oil flowed into bypass passage is supplied to the travel motors through opened port Atr and Dtl.

On the other hand, the return oil from the travel motors flows into main control valve inside through the port Btr and Ctl and return to the tank passage.



B-B' (TRAVEL RIGHT AND LEFT)

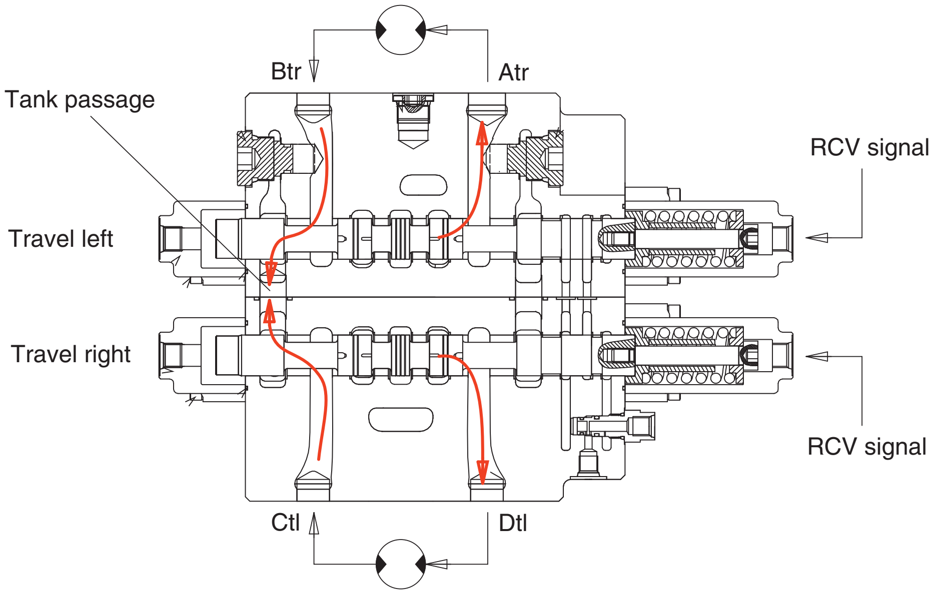
(2) Travel backward operation

During the travel backward operation, the pilot secondary pressure from the remote control valve is supplied to the against pilot port of the spring side and it shifts travel spools to the right direction.

The pressurized oil from the pump flows into the bypass passage of the travel spools through the land of the straight travel spool.

When the travel spools are shifted and the bypass passage is shut-off. The pressurized oil flowed into bypass passage is supplied to the travel motors through opened port Btr and Ctl.

On the other hand, the return oil from the travel motors flows into main control valve inside through the port Atr and Dtl and return to the tank passage.



B-B' (TRAVEL RIGHT AND LEFT)

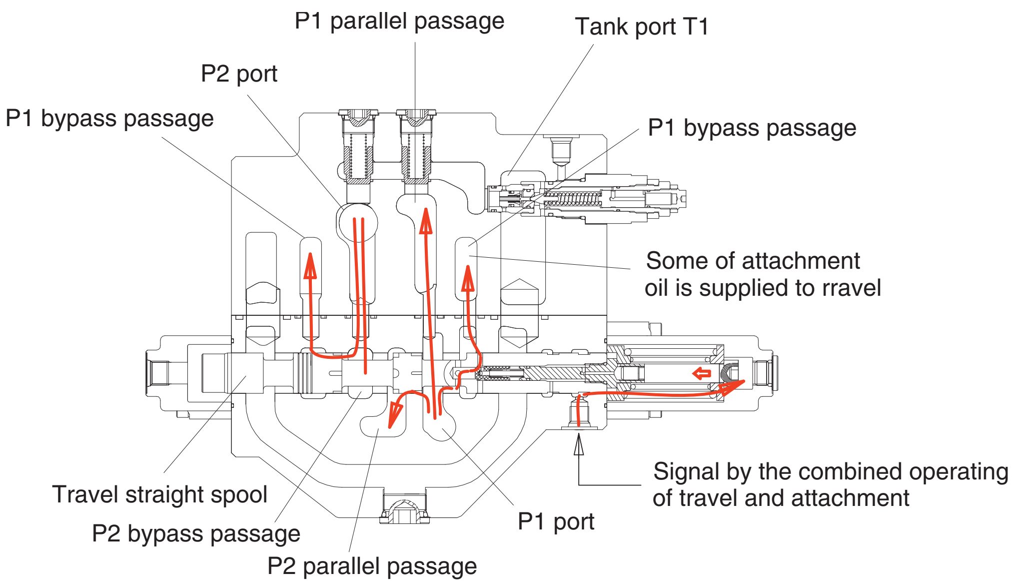
220S2MC19

(3) Travel straight function

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

In normal conditions, travel straight spool keeps neutral conditions, the pressurized oil of the P1 and P2 pumps is supplied to each passage independently.

When the attachment spool is operated under the travel operation of both sides, the pilot pressure is supplied to the spring side port of the travel straight spool and then the travel straight spool is shifted to the left direction.



A-A' (STRAIGHT TRAVEL AND SUPPLY)

After changeover of the travel straight spool, the pressurized oil discharged from the P1 pump is connected with P2 port oil and is supplied to the attachment line through both parallel passage of the P1 and P2.

Also, some of the pressurized oil open the check valve of the spool inside through side of the travel straight spool and is connected with the bypass passage of the P2 side.

On the other hand, the pressurized oil discharged from the P2 pump is connected with P1 port oil and is supplied to the travel line through both parallel passage of the P1 and P2.

Accordingly the attachment spool is operated under the travel operation of both sides, the pressurized oil discharged from P2 pump is mainly supplied to left and right travel line and the pressurized oil discharged from P1 pump is mainly supplied to attachment line.

As a result, simultaneous operation of both travel spools and attachment is not influenced to the travel operation of the both sides and the machine keeps straight travel.

3) BOOM OPERATION

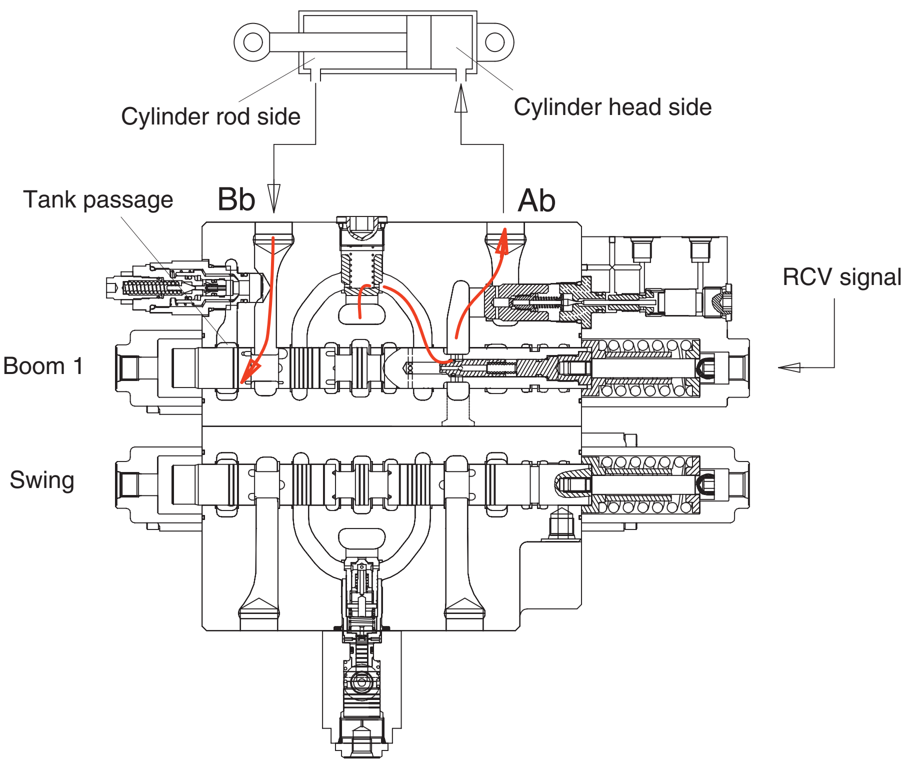
(1) Boom up operation

During the boom up operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the boom 1 spool to the left direction. The P1 bypass passage is shut off by the movement of the boom 1 spool and the pressurized oil from P2 port is entered P1 parallel passage and then passes through the load check valve, bridge passage and boom holding valve then flows into the head side of the boom cylinder via Ab port. (In this case, the boom holding valve is free flow condition)

At the same time, the pilot secondary pressure from RCV is supplied to the port of the spring side of boom 2 and shifts the boom 2 spool. The bypass passage is shut off by the movement of the boom 2 spool and the pressurized oil from P2 port entered boom summation passage via the P2 parallel passage, notch of the boom 2 spool, the check valve.

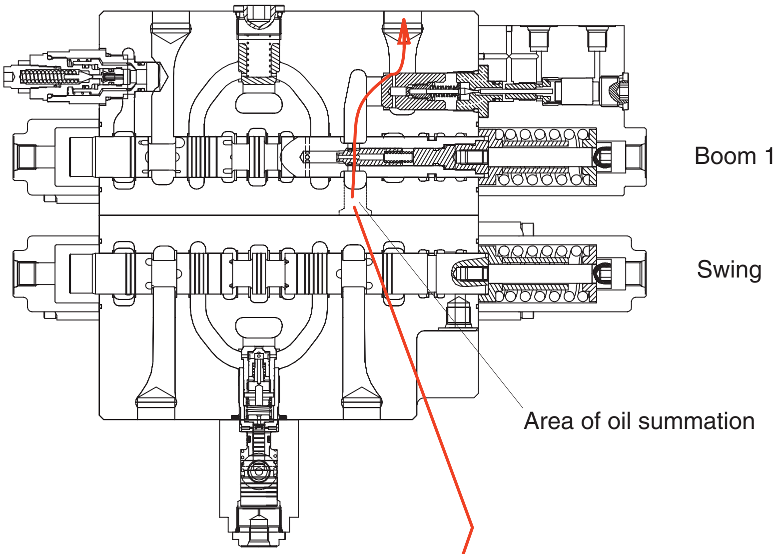
The oil from boom 2 spool combined with the boom 1 spool oil and is supplied Ab port.

At the same time, the return oil from rod side of the boom cylinders flows the boom 1 spool through the Bb port and return to the hydraulic oil tank through the tank passage.

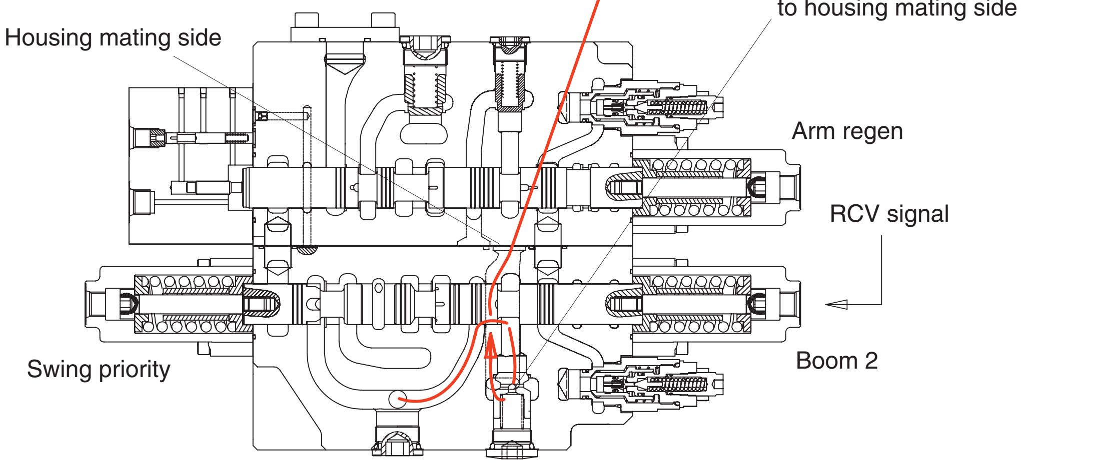


C-C' (SWING AND BOOM1)

220S2MC21



C-C' (SWING AND BOOM1)



D-D' (SWING PRI, BOOM 2 & ARM REGEN)

220S2MC22

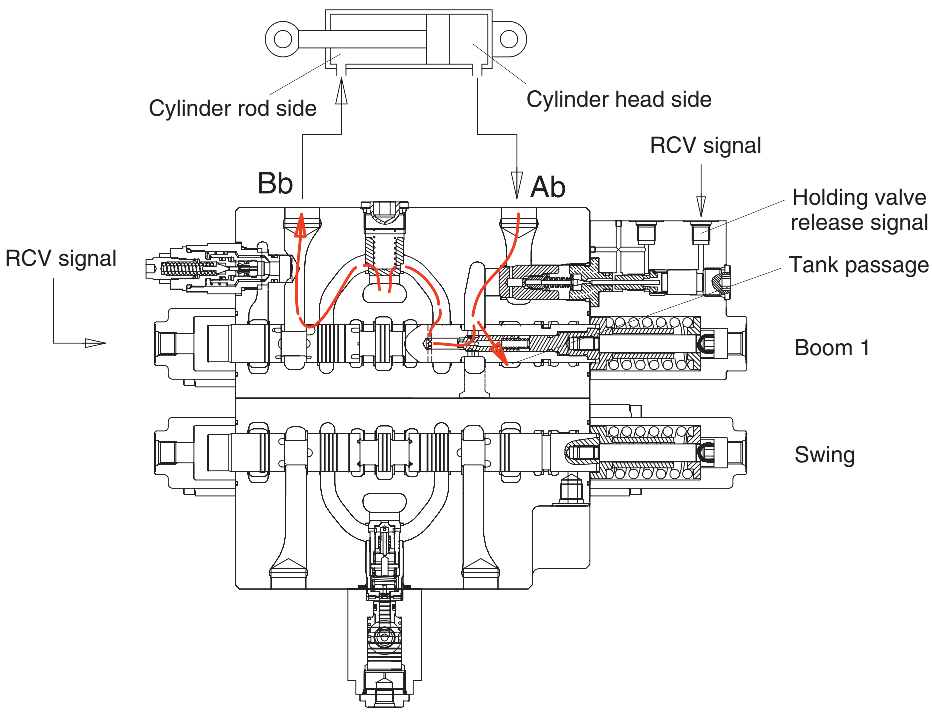
(2) Boom down operation

During the boom down operation, the pilot secondary pressure from the RCV is supplied to the against port of the spring side and shifts the boom 1 spool to the right direction. The P1 bypass passage is shut off by the movement of the boom 1 spool and the pressurized oil from P1 port is entered P1 parallel passage and then passes through the load check valve and bridge passage then flows into the rod side of the boom cylinder via Bb port.

At the same time, the return oil from head side of the boom cylinders flows the boom 1 spool through the Ab port and the boom holding valve and return to the hydraulic oil tank through the tank passage.

At this time, some of the return oil from the boom head side passes to the connected passage of the boom 1 spool inside and flows into the P1 parallel passage. (Boom spool inside regeneration function). At this time, the boom holding valve is open status and the operation principles are described following page.

During the boom down operation, the flow is not combined.



C-C' (SWING AND BOOM1)

4) HOLDING VALVE OPERATION

(1) Holding operation

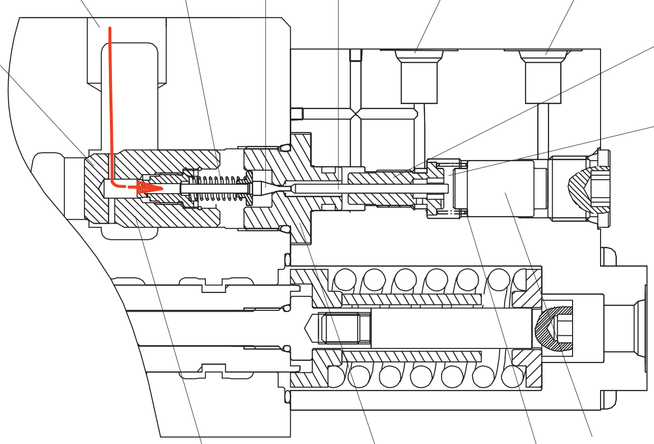
At neutral condition, the pilot piston chamber is connected to drain port through the pilot port.

And the main piston is seated by the spring B.

Also, the pressurized oil from the actuator entered to inside of the holding valve through the periphery hole of the main poppet, crevice of the main poppet and the restrictor and the periphery hole of the restrictor.

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

So the pressurized oil from the holding side of the actuator is not escaped and the actuator is not moved.



HOLDING VALVE BLOCK SECTION

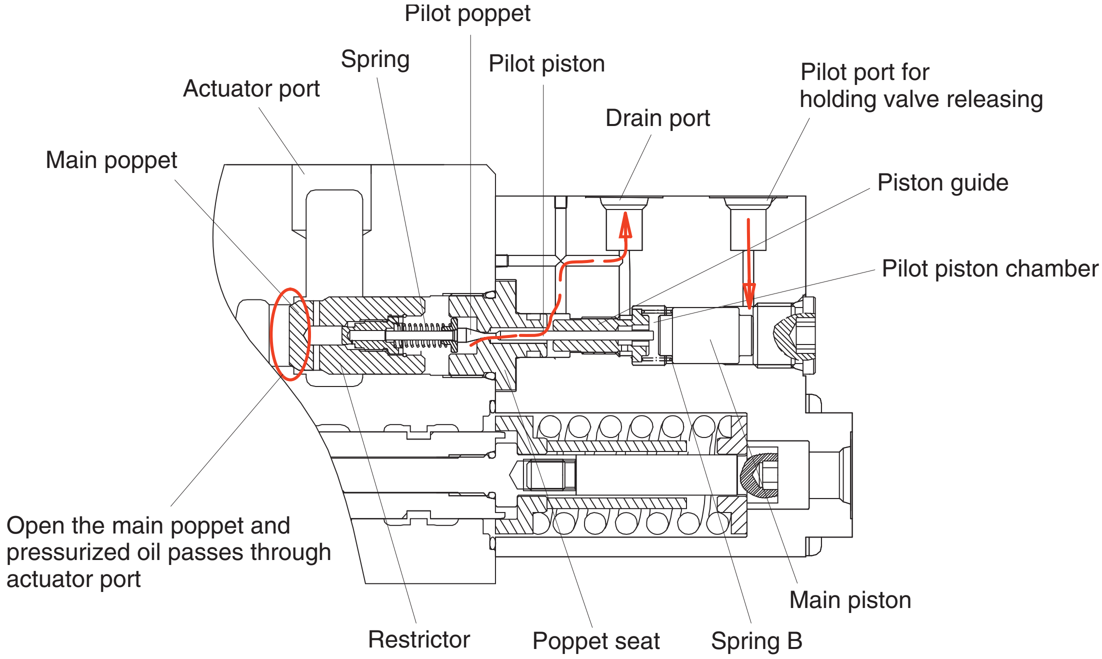
220S2MC24

(2) Releasing holding operation

The pilot pressure is supplied to the pilot port for releasing holding valve and shifts the main piston to the left direction against the spring B and shifts the pilot poppet to the left direction through the pilot piston and open the passage for the drain.

At same time, the return oil from actuator returns to the drain port through the periphery hole of main poppet, crevice of the main poppet and the restrictor, the periphery hole of the restrictor, inside of holding valve, crevice of the pilot poppet and the drain passage of the holding valve.

After above operation, pressure of inside of holding valve is decreased and the main poppet is opened by the return oil of the actuator and the return oil from actuator returns to the tank passage through the notch of spool.



HOLDING VALVE BLOCK SECTION

220S2MC25

5) BUCKET OPERATION

(1) Bucket in operation

① Bucket operation only

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

The P1 bypass passage is shut off by the movement of the bucket spool and the pressurized oil from P1 port entered P1 parallel passage and is directed to the Ak port through the check valve 2.

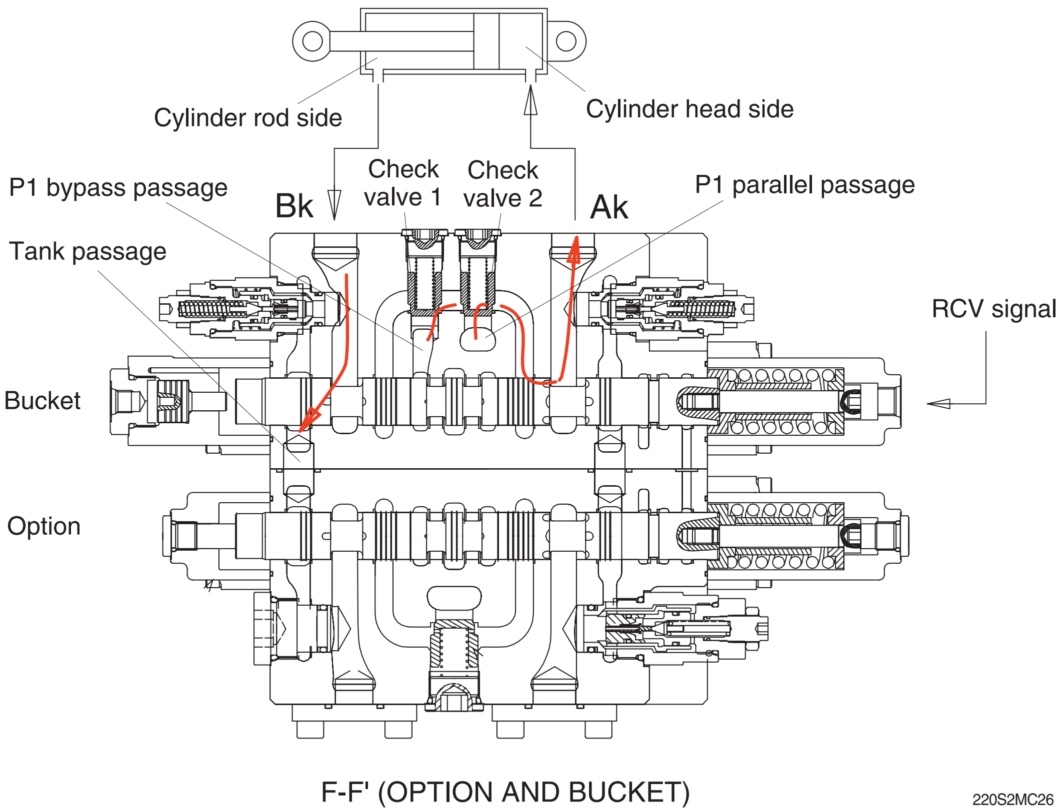
At the same time, the pressurized oil from P1 bypass passage is directed to the AK port through the check valve 1.

The return oil from the rod side of the bucket cylinder (Bk port) returns to the hydraulic oil tank through the tank passage.

② Combined operation

When combined operation of the bucket and other actuators, mostly same as above operation but the fluid from P1 bypass passage is empty by the upstream operation such as the arm or boom operation.

So only the fluid from P1 parallel passage is supplied to the Ak port.



F-F' (OPTION AND BUCKET)

(2) Bucket slow operation (incase bucket in)

This function is used to speed up of the boom or arm by reducing the bucket speed when the bucket operation with boom or arm operation simultaneously.

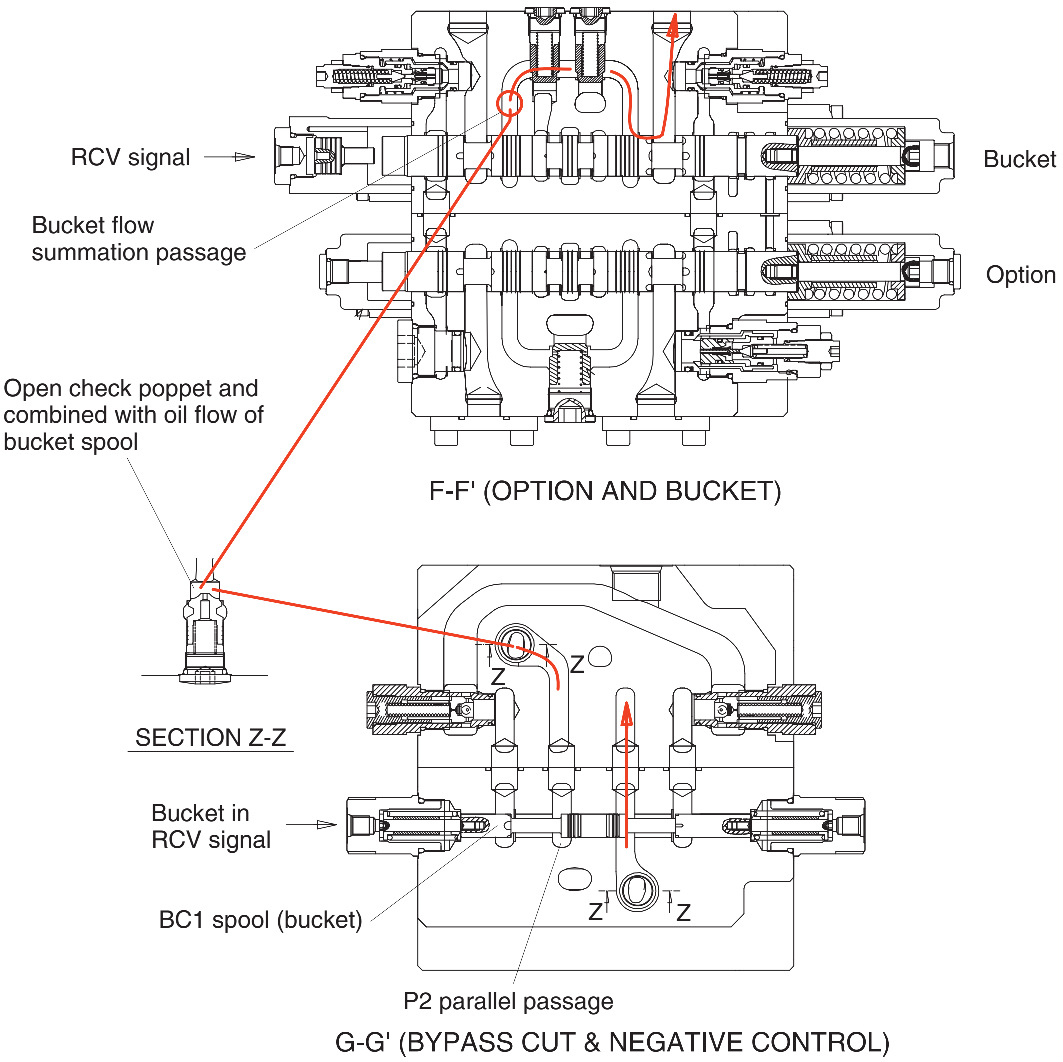
The bucket slow pilot pressure is supplied the pilot port of the BC1 spool and the piston is shifted to the right and then the bucket spool stroke is limited and the oil passage from P1 to the bucket cylinder is reduced and the oil flow of the bucket spool is reduced.

Bucket flow summation function, bypass cut-off 1 spool

During the bucket in operation, the pilot secondary pressure from the RCV is supplied to port of the spring side and shifts the BC1 (bucket) spool to the right direction.

The P2 parallel passage is shut off by the movement of the BC1 spool and the pressurized oil from P2 port opens the check poppet and combined with the flow of the bucket spool.

(Only bucket in operation)



FLOW SUMMATION BY THE SHIFTING OF THE BC1 SPOOL

220S2MC27

(3) Bucket out operation

① Bucket operation only

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

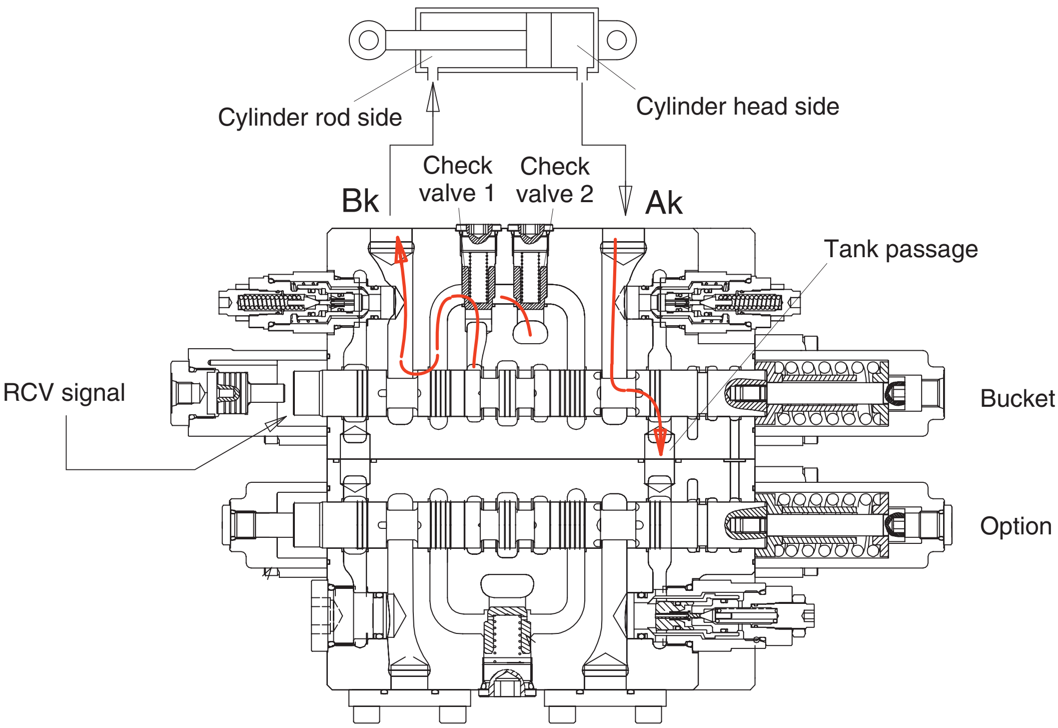
The P1 bypass passage is shut off by the movement of the bucket spool and the pressurized oil from P1 port entered P1 parallel passage and is directed to the Bk port through the check valve 2.

At the same time, the pressurized oil from P1 bypass passage is directed to the Bk port through the check valve 1.

The return oil from the head side of the bucket cylinder (Ak port) returns to the hydraulic oil tank through the tank passage.

② Combined operation

When combined operation of the bucket and other actuators, exactly same as above operation.



F-F' (OPTION AND BUCKET)

220S2MC28

6) SWING OPERATION

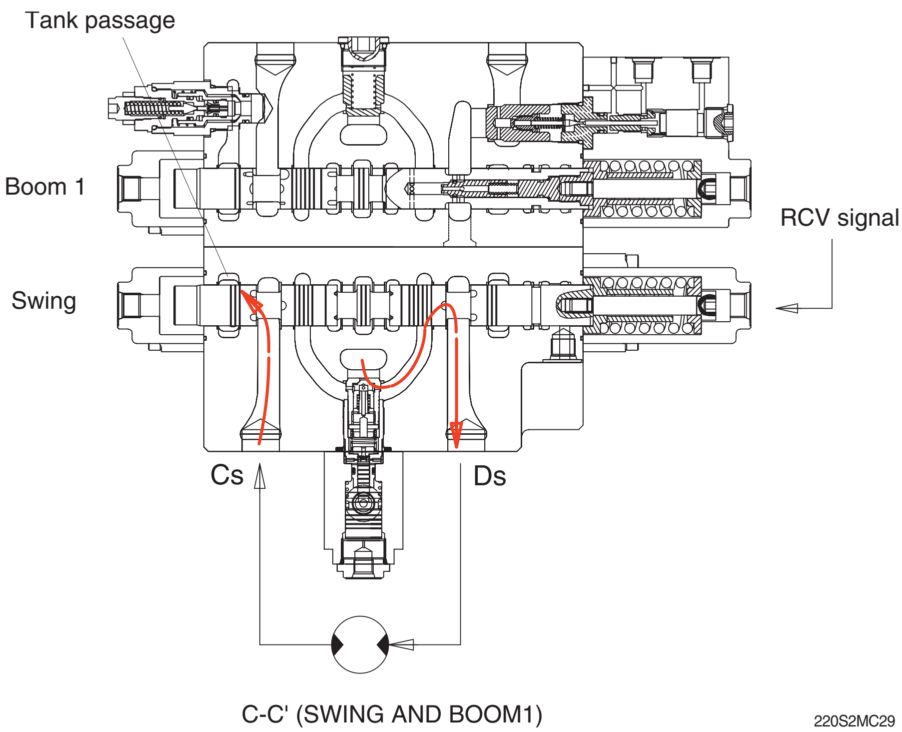
(1) Swing left and right operation

During the swing left operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the swing spool in left direction. The P2 bypass passage is shut off by the movement of the swing spool and the pressurized oil from P2 port flows into the P2 parallel passage and open the load check valve and is supplied to swing motor through the Ds port.

As the result, the return oil from the swing motor flows into the main control inside through Cs port and returns to the hydraulic oil tank through the swing spool and the tank passage.

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

Accordingly, the pressurized oil from P2 parallel passage flows into swing motor through the Cs port and returns to the hydraulic oil tank through the Ds port and the tank passage.



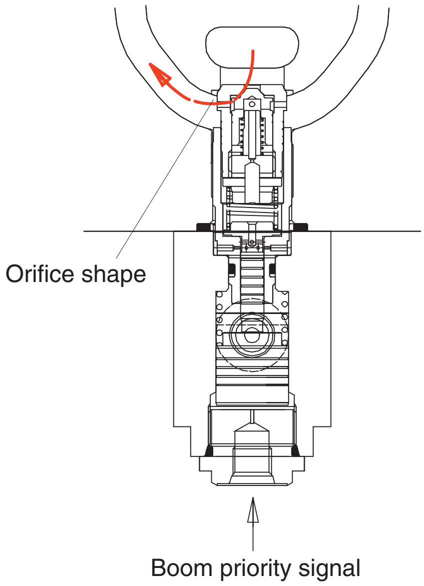
C-C' (SWING AND BOOM1)

(2) Boom priority function

This function is used to speed up of the boom by reducing the swing speed when the swing operation with boom operation simultaneously.

The boom priority signal is supplied the pilot port and the poppet of the swing logic valve is closed and then the pressurized oil from P2 port is reduced by the oil leaking through the orifice.

As a result, the swing speed is slowed.



SWING LOGIC VALVE

220S2MC30

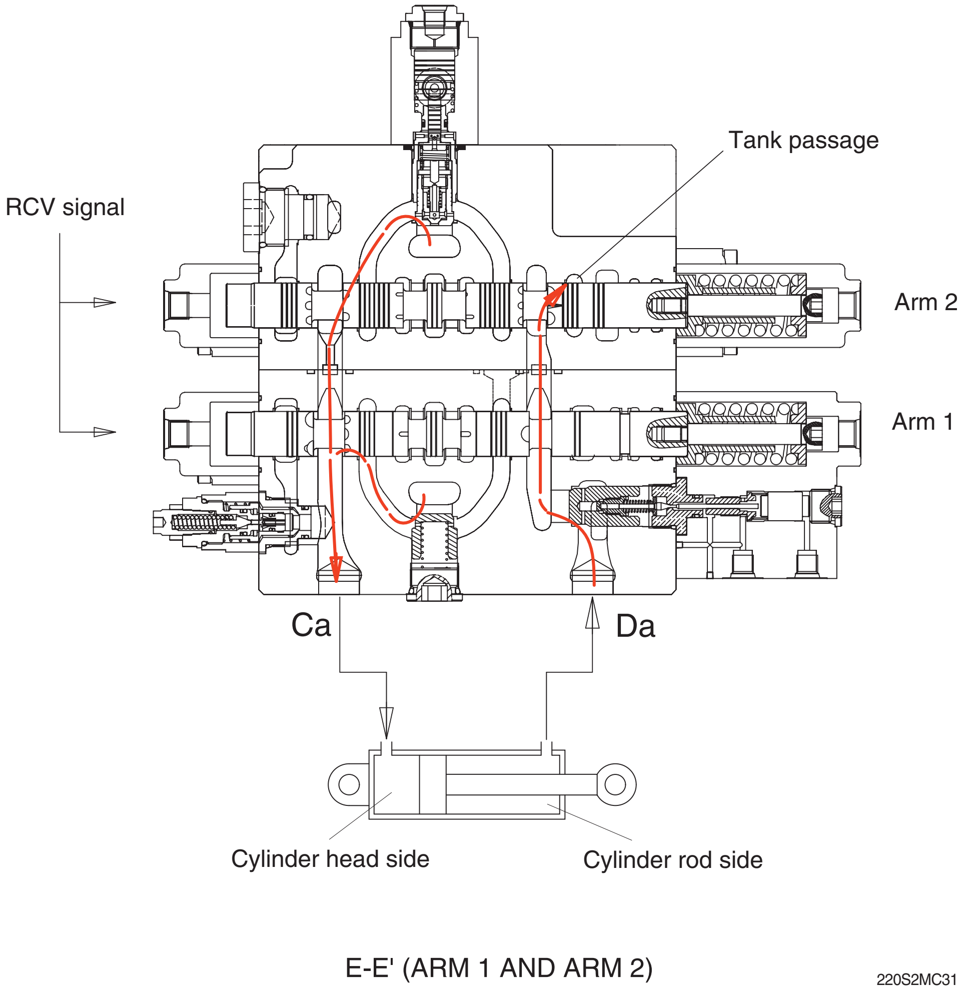
7) ARM OPERATION

(1) Arm in operation

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

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

At the same time, the pilot secondary pressure from the RCV is supplied to the port of spring opposite side and shifts the arm 2 spool in the right direction. The P2 bypass passage is shut off by the movement of the arm 2 spool and the pressurized oil from the P1 port flows into the arm summation passage through P1 parallel passage, the check valve and the notch of the arm 2 spool.



E-E' (ARM 1 AND ARM 2)

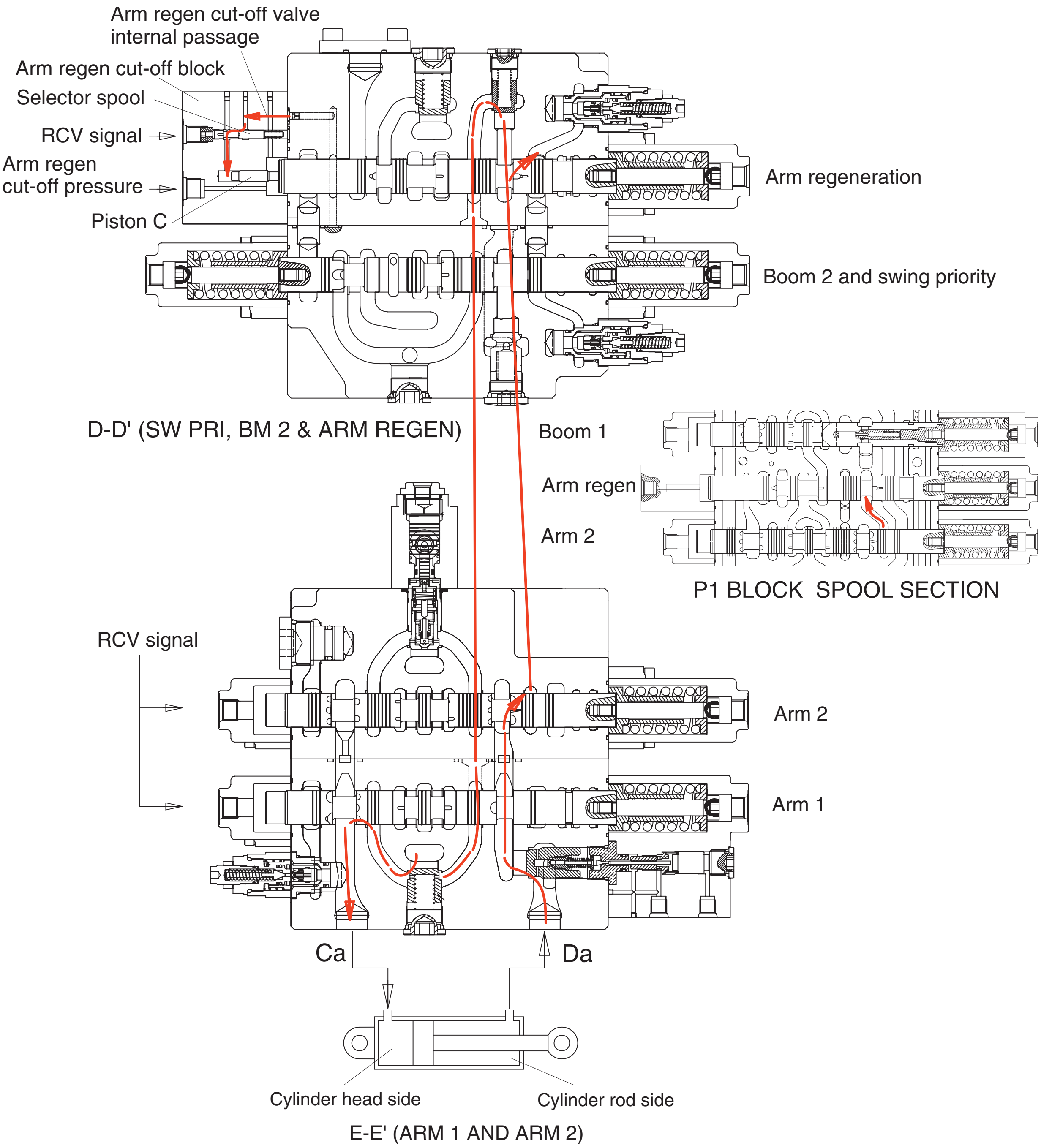
ARM REGENERATION

The return oil from the arm cylinder rod side passes the arm holding valve (open condition) through the Da port and the notch of the arm 1 and arm 2, and swing priority spool. And some of the oil return to the tank passage through the notch of the arm regeneration spool and most of the oil is supplied to the head side of the arm cylinder through internal summation passage.

This is called the arm regeneration function.

The amount of regeneration fluid is changed by movement of the arm regeneration spool. A few fluids of the oil that is supplied to the head side of the arm cylinder passes the selector spool (in this case, the selector spool is opened by the arm in pilot pressure) built in the arm regeneration block through internal passage and is pushed the piston C.
The amount of the regeneration oil from the rod side of the arm cylinder to the tank passage is increased by the movement of the piston C and the arm regeneration spool to the right direction and the arm regeneration flow is decreased as much increased oil.
The pressure of the arm cylinder head increases, then, the arm regeneration flow decreases.

Furthermore, the arm regeneration cut-off pressure is supplied to the port of the spring opposite side and the arm regeneration spool is moved to the right direction fully. The flow from the arm cylinder rod to the tank passage is maximum condition.



ARM REGENERATION PASSAGE

220S2MC32

(2) Arm out operation

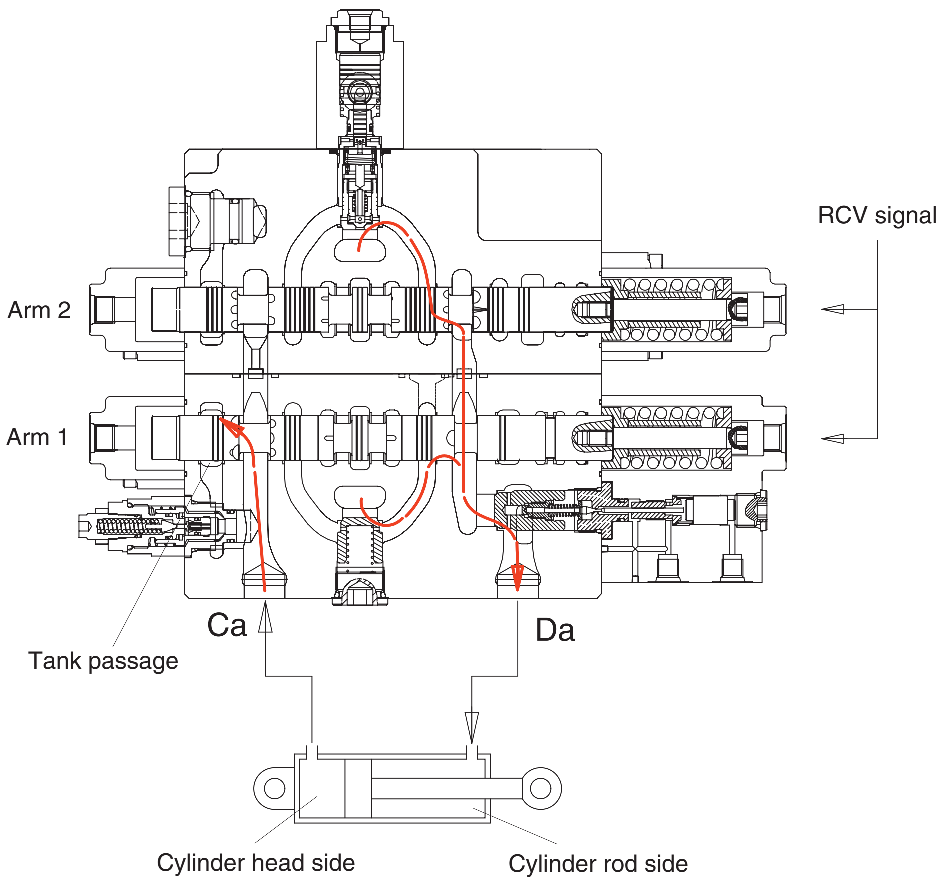
During arm out operation, the pilot secondary pressure from the RCV is supplied to the port of the spring side and shifts the arm 1 spool to the left direction.

The bypass passage is shut off by the movement of the arm 1 spool and the pressurized oil from the P2 port flows into arm 1 spool through the P2 parallel passage. Then it enters into the arm cylinder rod side through the load check, bridge passage, arm holding valve (oped status) and the port Da.

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

The bypass passage is shut off by the movement of the arm 2 spool and the pressurized oil from the P2 port through the P2 parallel passage. Then it combined with the flow of the arm 1 passage through P1 parallel passage, the check valve, bridge passage, the notch of the arm 1 and the arm holding valve (open status).

On the other hand, the return flow from the arm cylinder head side returns to the hydraulic tank through the port Ca, the notch of the arm 1 spool and tank passage.

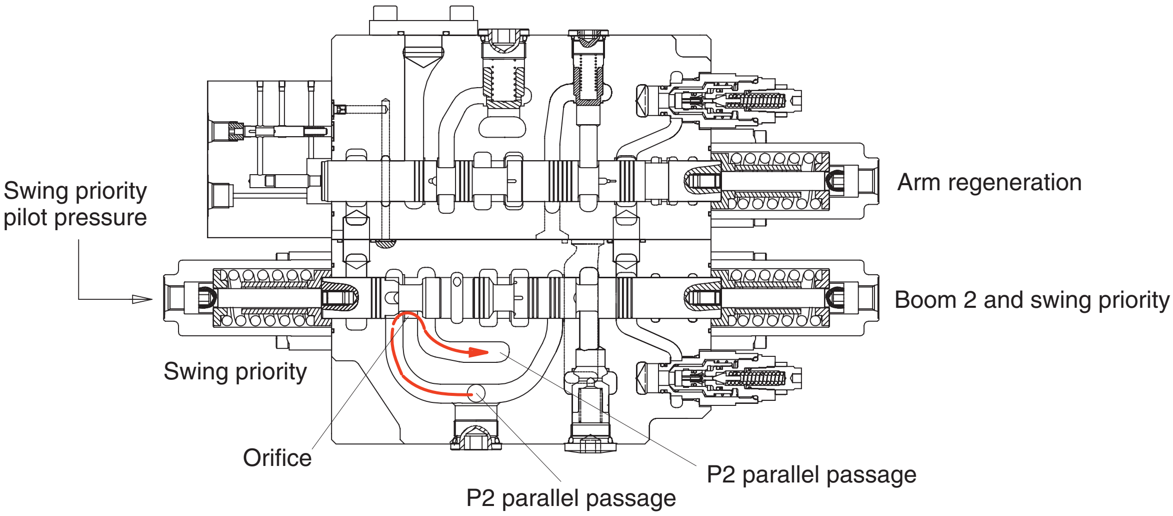


E-E' (ARM 1 AND ARM 2)

220S2MC33

8) OPERATION OF SWING PRIORITY SPOOL

During swing priority operation, the pilot secondary pressure is supplied to the port of the spring side of the swing priority spool and shift swing priority spool to the right direction.
The pressurized oil from the P2 port flows into the P2 parallel passage through the notch of the swing priority spool.
When the swing priority spool is neutral condition, the passage is same as normal condition. But due to shifting of the swing priority spool, the orifice is formed between the notch of the swing priority spool and the land of the block housing and then the fluid to the swing side more then the downstream of the swing spool such as the arm 1 and option spool.
As a result, the flow is supplied to the swing operation most preferential.



D-D' (SWING PRI, BOOM 2 & ARM REGENERATION)

220S2MC34

9) OPERATION OF OPTION SPOOL

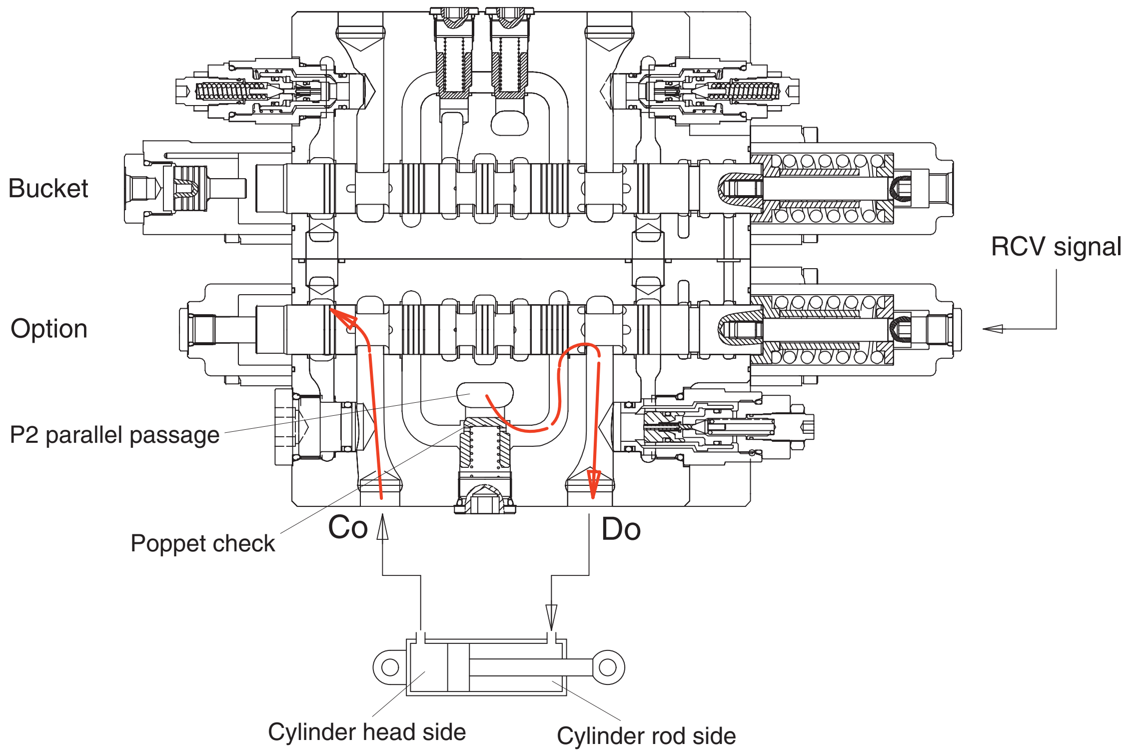
(1) 1-way operation

※ The pilot pressure is supplied to the port of the spring side and shifts spool to the left direction. The pilot secondary pressure from the RCV is supplied to the port of the spring opposite side of the option spool, the P2 bypass passage is shut off by the movement of the option spool and the pressurized oil from the P2 port flows into the actuator through the P2 parallel passage, the check valve, bridge passage and the Do port.

(2) 2-way operation

※ Shifts spool to the left and right direction.

- When the spool shifts to the left, same as 1-way operation.
- When the spool shifts to the right, the pressurized oil from the P2 port flows into the actuator through the P2 parallel passage, the check valve, bridge passage and the Co port.



F-F' (OPTION AND BUCKET)

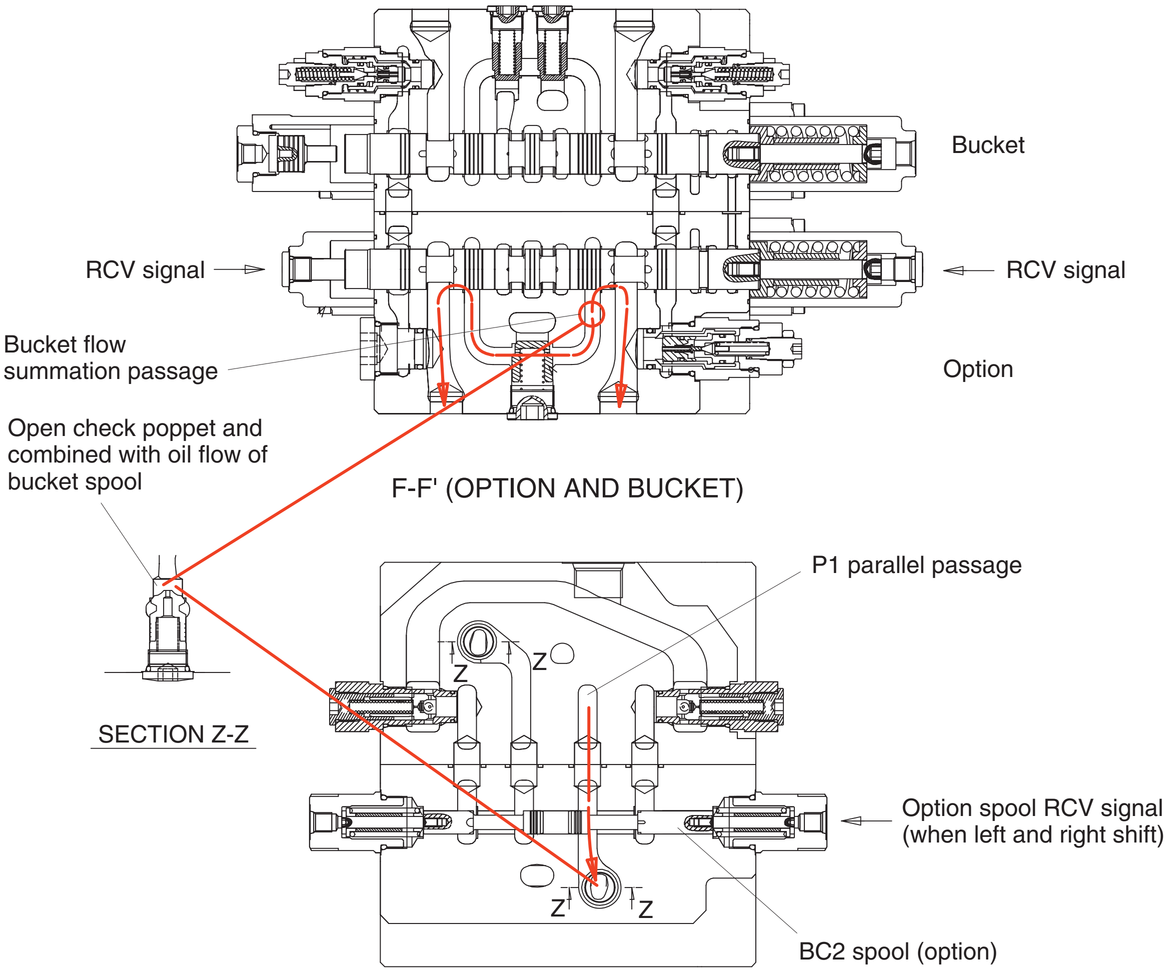
220S2MC35

Option flow summation function, bypass cut-off 2 spool

During the 2-way option operation, the pilot secondary pressure from the RCV is supplied to port of the spring side and shifts the BC2 (option) spool.

The P1 parallel passage is shut off by the movement of the BC2 spool and the pressurized oil from P1 port opens the check poppet and combined with flow of the option spool.

(Only bucket in operation)



G-G' (BYPASS CUT & NEGATIVE CONTROL)

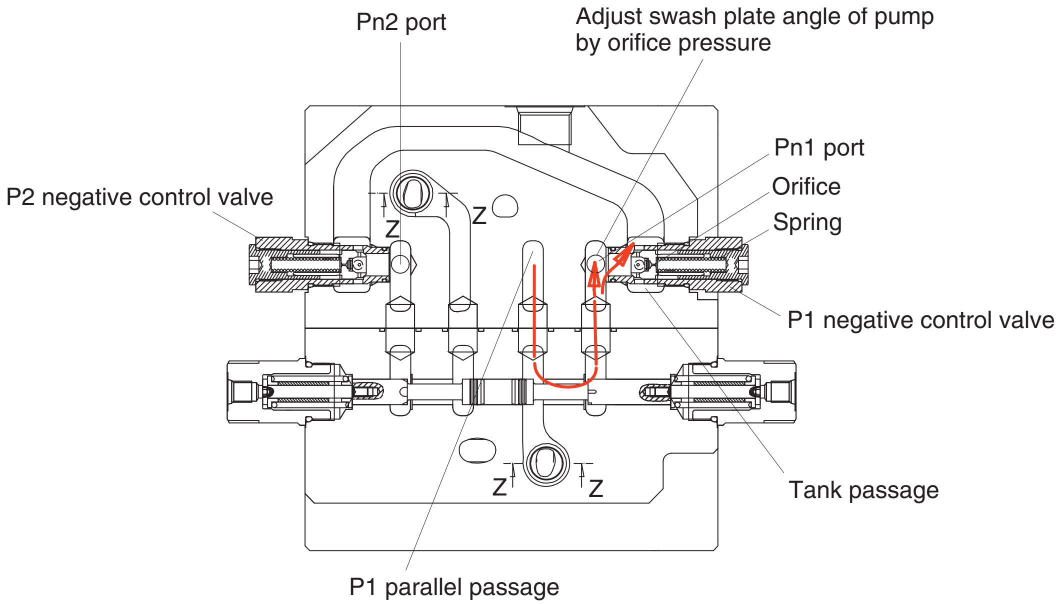
FLOW SUMMATION BY THE SHIFTING OF THE BC2 SPOOL

220S2MC36

10) OPERATION OF NEGATIVE CONTROL VALVE

When no function is being actuated on P1 side, the hydraulic fluid from the P2 port, flows into the tank passage through the P1 bypass passage and the orifice of the negative control valve.
The negative control pressure caused by this operation is transferred to the regulator of the piston pump through the Pn1 port.
This pressure controls the swash plate angle of the pump to the minimum and minimize the flow of the P1 side.
When one or more spools are shifted, the P1 bypass passage is shut-off and the flow is almost zero.
Accordingly, the negative control pressure that is supplied to the pump through Pn1 port is lowered and the swash plate angle becomes maximum and the flow of the P1 side becomes maximum.
On the other hand, the negative control pressure is increased and high than the setting pressure of the spring, the negative control valve is opened and the flow passes to the hydraulic tank and functions as a relief valve.

The operation of the negative control valve of the P2 side is same as that of the P1 side.



OPERATION OF NEGATIVE CONTROL VALVE

220S2MC37

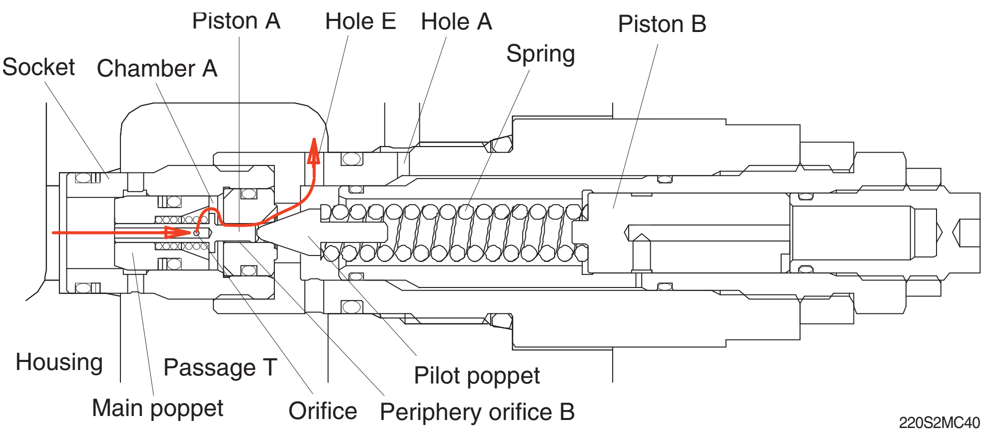
11) OPERATION OF MAIN RELIEF VALVE

(1) Neutral

The pressurized oil passes through the internal passage of the piston A, fitted in the main poppet and the orifice A and is filled up in the chamber A of the inside and seats the main poppet against socket and socket against the housing securely.

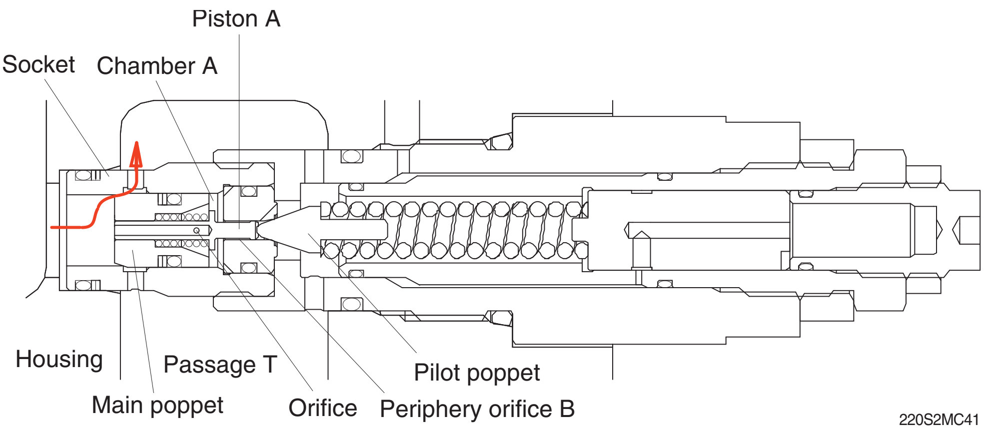
(2) When operation (relief)

① When the pressurized oil flowed in the chamber A through the orifice becomes equal to the set pressure of the spring, the hydraulic oil apply to the main poppet through the piston and pushes open the pilot poppet and flows to tank passage through the piston A internal passage, orifice A, chamber A, periphery orifice B and the hole E.



OPERATION 1 OF MAIN RELIEF VALVE

② The pressure in chamber A is lowered by moving of the pilot poppet and the main poppet is opened. As a result, the pressurized oil flows out to the tank passage through the hole of the socket side.



OPERATION 2 OF MAIN RELIEF VALVE

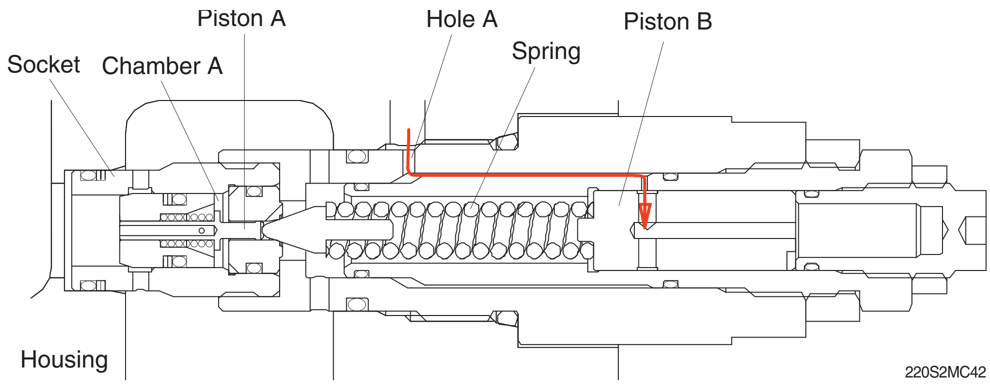
(3) When retraction (return)

On the other hand, the pressure of the pressurized oil becomes lower than set pressure of the spring, the main poppet is seated by spring force. Then the pressure of the chamber A becomes equal to the pressure of the P port and the main poppet is seated to the seat of the socket. The valve returns to the initial condition.

Power boost function

During power boost operation, the pilot pressure for the power boost enters inside of the piston B through the hole A, the crevice passage and the side hole of the piston B.

It pushes the piston to the left direction and the set pressure of the spring is increased.

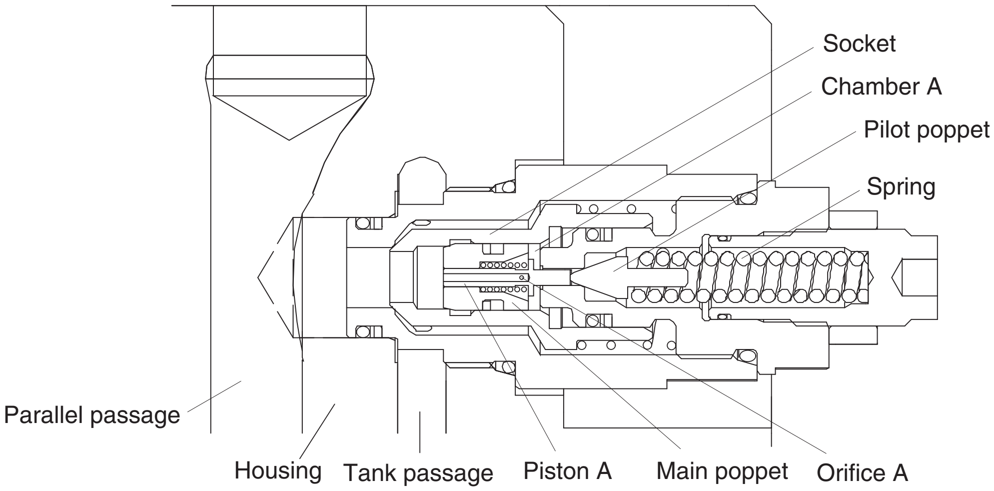


OPERATION 3 OF MAIN RELIEF VALVE

12) OPERATION OF PORT RELIEF VALVE

(1) Function as relief valve

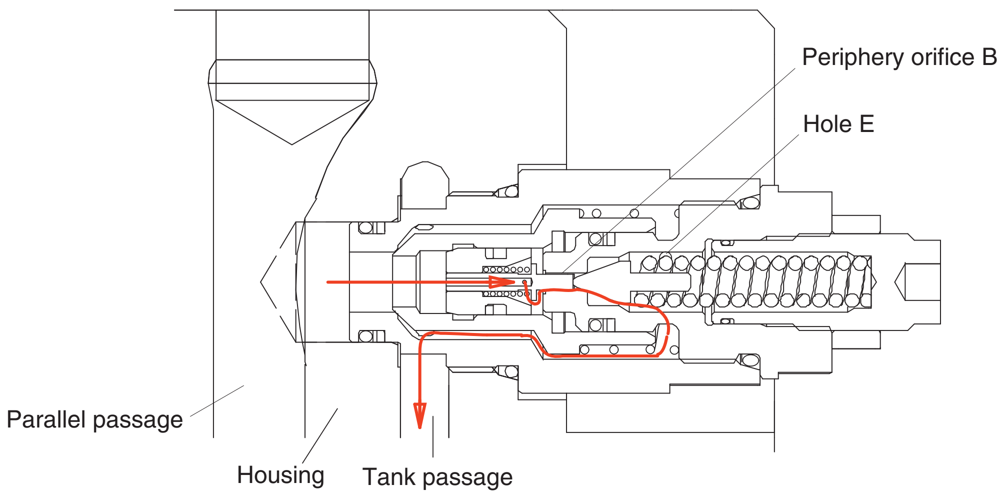
① The pressurized oil passes through the internal passage of the piston A, fitted in the main poppet and the orifice A and is filled up in the chamber A of the inside and seats the main poppet against socket and socket against the housing securely.



PORT RELIEF VALVE

220S2MC43

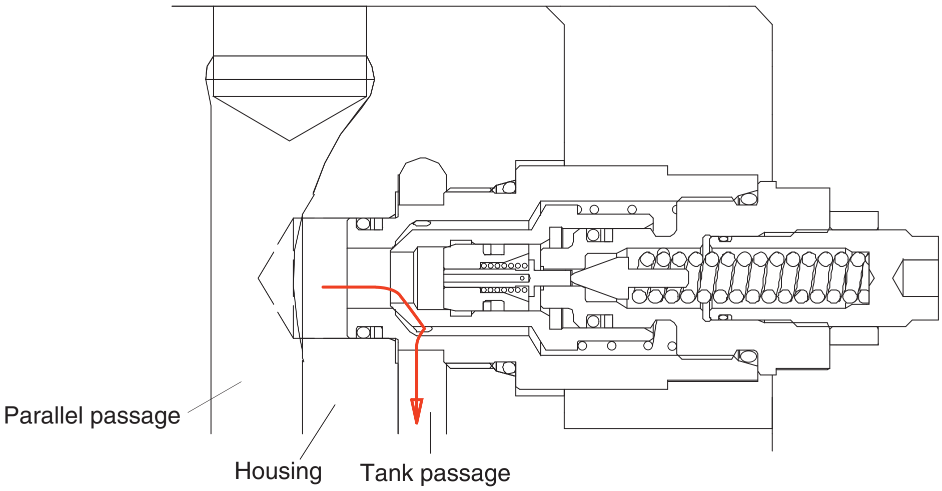
② When the pressurized oil from the actuators becomes equal to the set pressure of the spring, the hydraulic oil apply to the pilot poppet and pushes the pilot poppet to the right direction and flows to tank passage through the piston A internal passage, orifice A, chamber A, periphery orifice B and the hole E.



OPERATION 1 OF PORT RELIEF VALVE

220S2MC44

③ The pressure in chamber A is lowered by moving of the pilot poppet and the main poppet is opened. As a result, the pressurized oil from the actuator port flows out to the tank passage through the hole of the socket side.

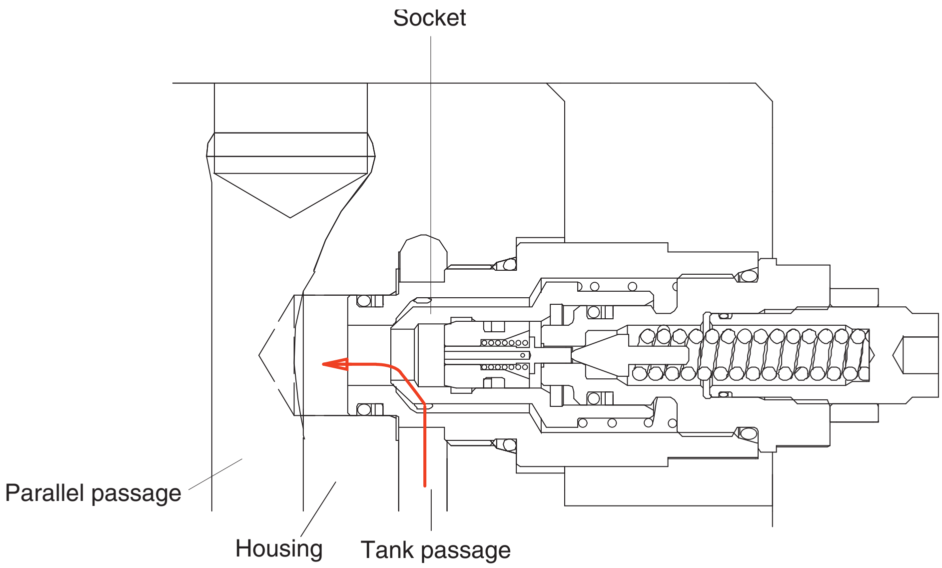


OPERATION 2 OF PORT RELIEF VALVE 220S2MC45

④ On the other hand, the pressure of the actuator becomes lower than set pressure of the spring, the pilot poppet is seated by spring force. Then the pressure of the chamber A becomes equal to the pressure of the actuator port and the main poppet is seated to the seat of the socket. The valve returns to the initial condition.

Make up function

When negative pressure exists at the actuator port, the oil is supplied through tank passage. When the pressure at tank passage becomes higher than that of at the actuator port, it pushed the socket moves in the right direction. Then, the gap between the housing and socket is opened and pressurized oil from the tank passage flows into parallel passage side.



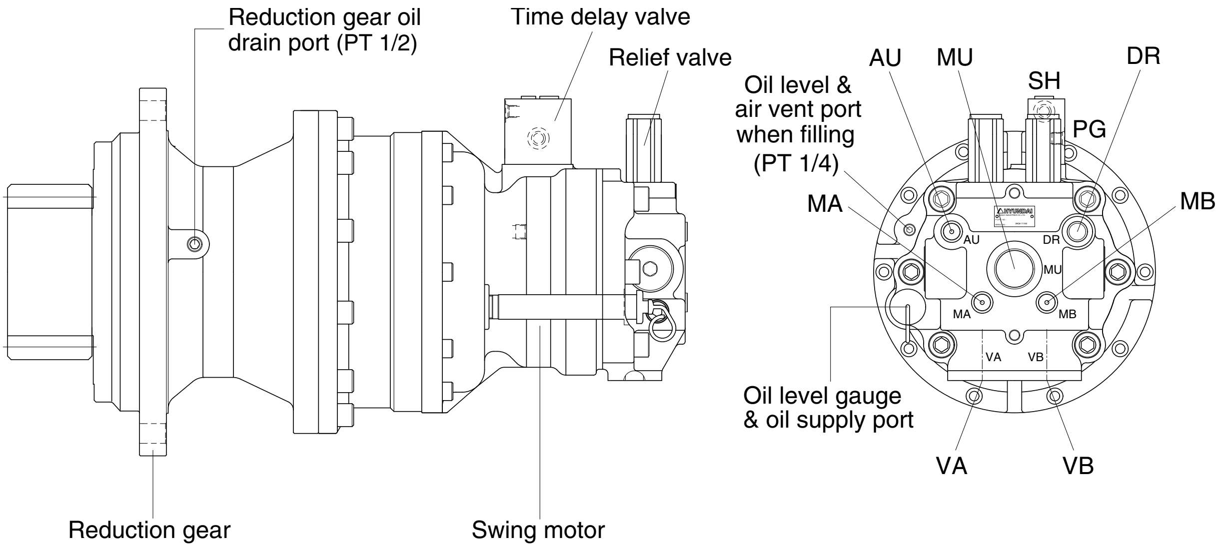
MAKE UP FUNCTION OF PORT RELIEF VALVE 220S2MC46

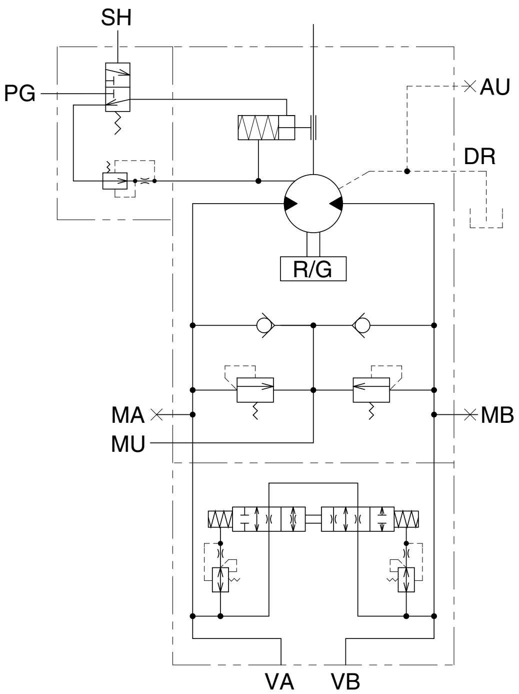
GROUP 3 SWING DEVICE (TYPE 1 & 2)

1. STRUCTURE

Swing device consists swing motor, swing reduction gear.

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



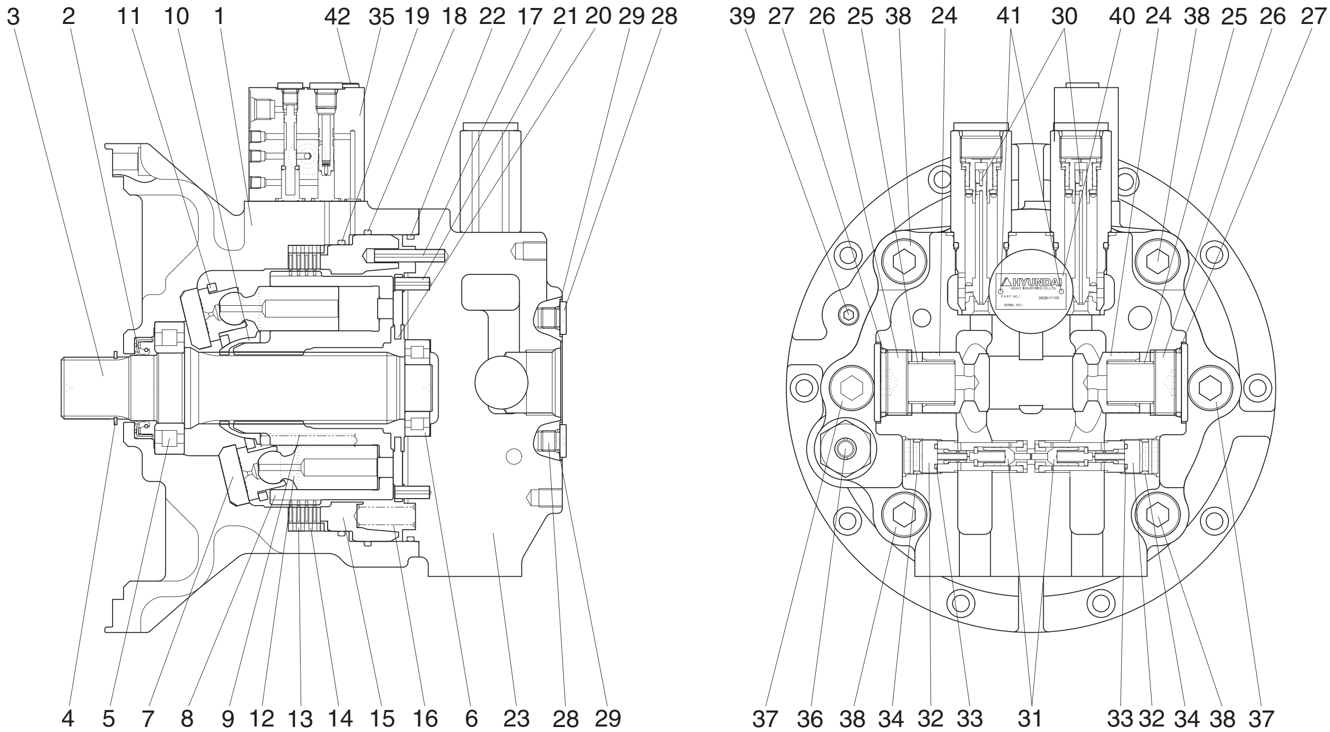


Hydraulic circuit

Port	Port name	Port size
VA	Main port	Ø20
VB	Main port	Ø20
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
MA, MB	Gauge port	PF 1/4
AU	Air vent port	PF 1/4

210S2SM21

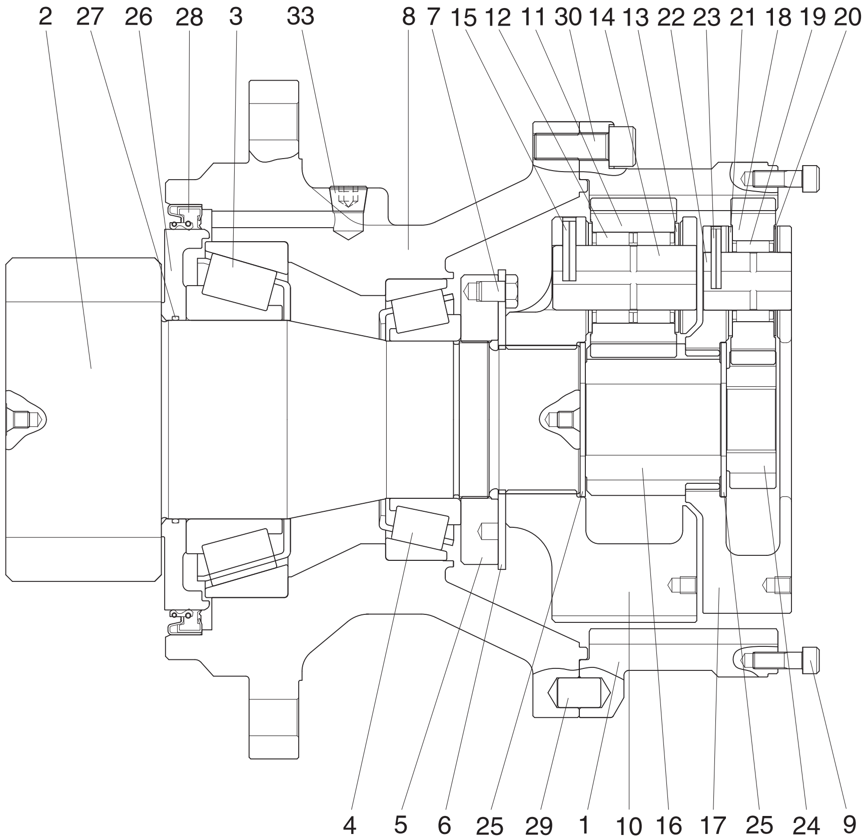
1) SWING MOTOR



210S2SM22

1	Casing	15	Parking piston	29	O-ring
2	Oil seal	16	Brake spring	30	Relief valve assy
3	Shaft	17	Spring pin	31	Reactionless valve assy
4	Snap ring	18	O-ring	32	Plug
5	Roller bearing	19	O-ring	33	O-ring
6	Needle bearing	20	Valve plate	34	O-ring
7	Swash plate	21	Spring pin	35	Time delay valve assy
8	Cylinder block	22	O-ring	36	Level gauge
9	Spring	23	Valve casing	37	Socket bolt
10	Ball guide	24	Check valve	38	Socket bolt
11	Retainer plate	25	Spring	39	Plug
12	Piston assy	26	Plug	40	Name plate
13	Friction plate	27	O-ring	41	Rivet
14	Separate plate	28	Plug	42	Socket bolt

2) REDUCTION GEAR



1	Ring gear	11	Planetary gear 2	21	Thrust washer 1-lower
2	Drive shaft	12	Needle bearing 2	22	Carrier pin 1
3	Taper bearing	13	Thrust washer 2	23	Spring pin
4	Taper bearing	14	Carrier pin 2	24	Sun gear 1
5	Ring nut	15	Spring pin	25	Thrust plate
6	Lock plate	16	Sun gear 2	26	Sleeve
7	Hexagon bolt	17	Carrier 1	27	O-ring
8	Casing	18	Planetary gear 1	29	Parallel pin
9	Socket bolt	19	Needle bearing 1	30	Socket bolt
10	Carrier 2	20	Thrust washer 1-upper	33	Plug

2. PRINCIPLE OF DRIVING

1) GENERATING THE TURNING FORCE

The high hydraulic supplied from a hydraulic pump flows into a cylinder block (8) through valve casing of motor (23), and valve plate (20).

The high hydraulic is built as flowing on one side of Y-Y line connected by the upper and lower sides of piston (12).

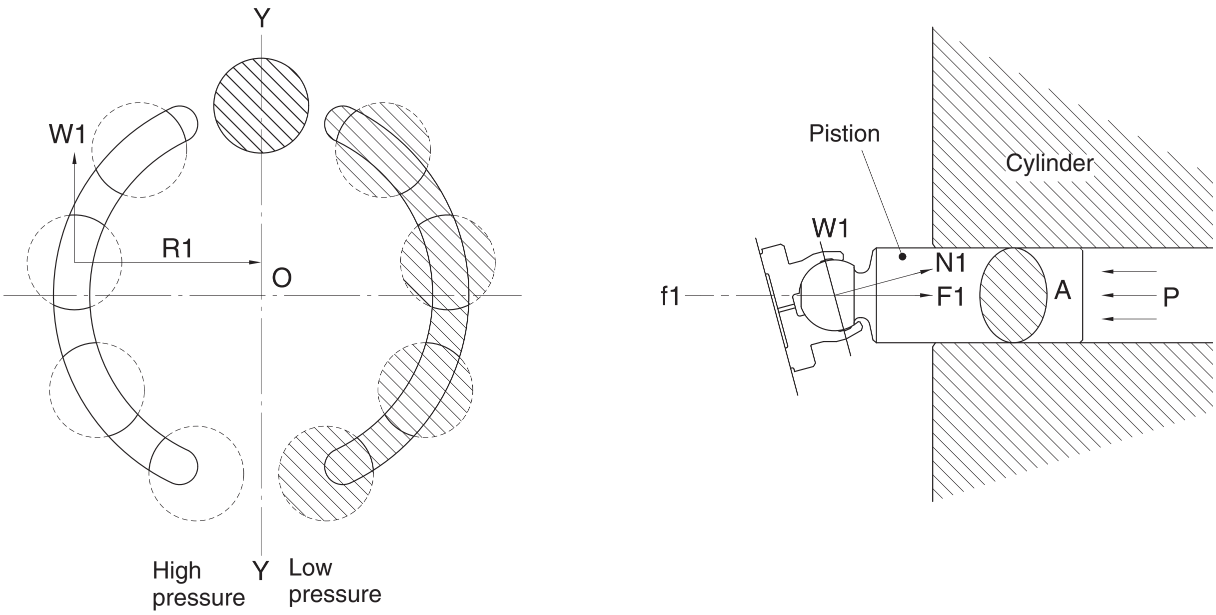
The high hydraulic can generate the force, $F1=P \times A$ (P : supplied pressure, A : water pressure area), like following pictures, working on a piston.

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

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

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

This torque transfers the turning force to a cylinder block (8) through a piston; because a cylinder is combined with a turning axis and spline, a turning axis rotates and a turning force is sent.



21078TM05

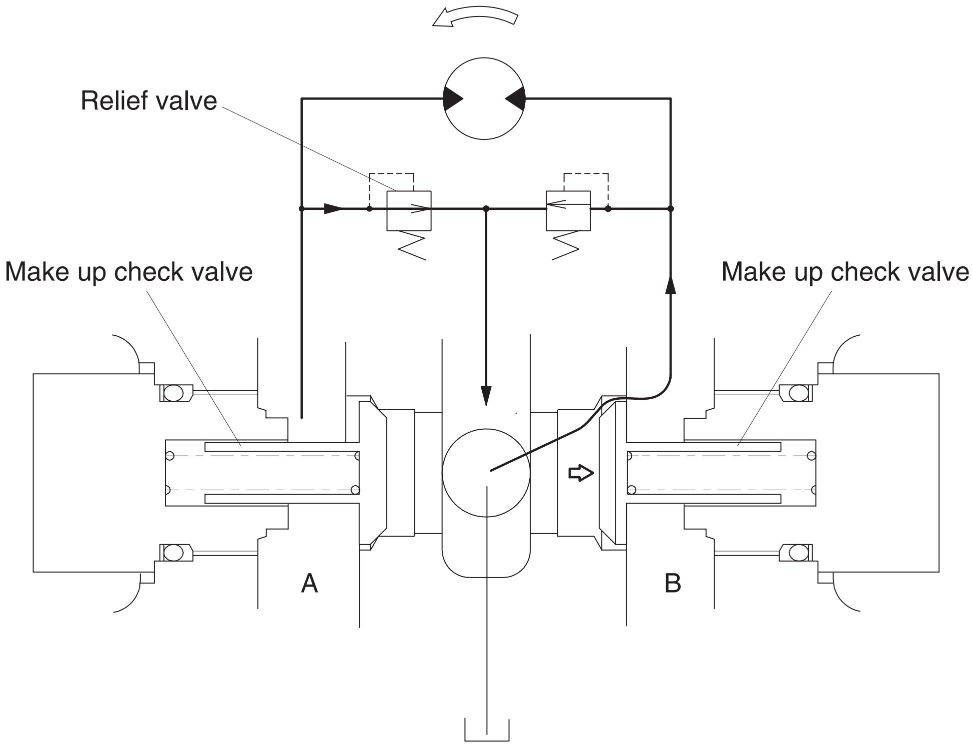
2) MAKE UP VALVE

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

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

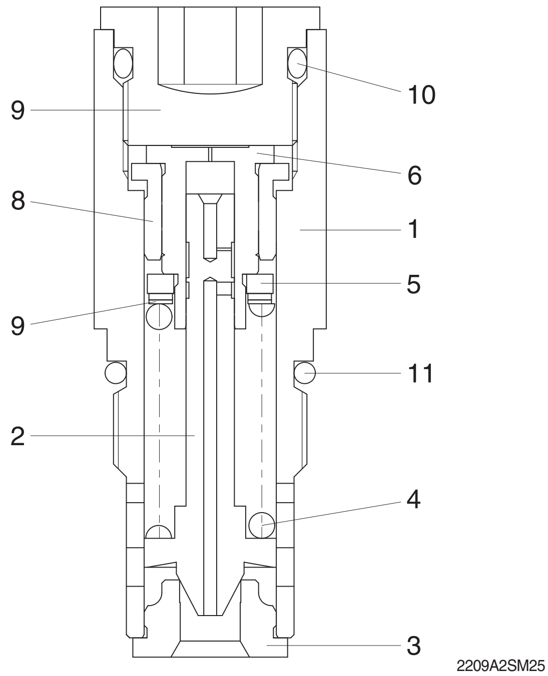
Pressurized oil into the port B, the motor rotate counterclockwise.

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



21092SM04

3) RELIEF VALVE



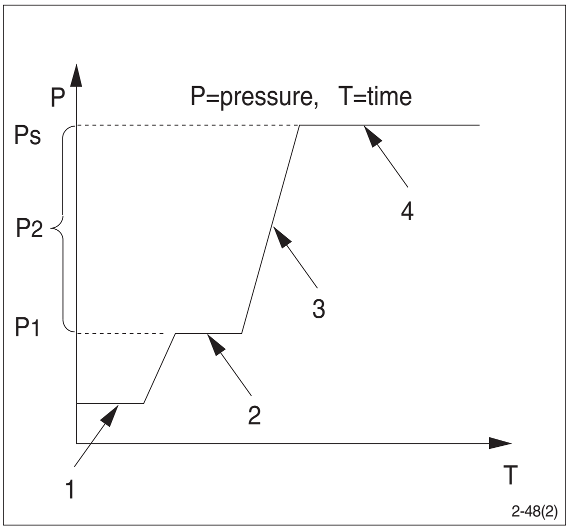
1	Sleeve
2	Poppet
3	Poppet seat
4	Spring
5	Spring seat
6	Shim
7	Piston
8	Stopper
9	Plug
10	O-ring
11	O-ring

(1) Construction of relief valve

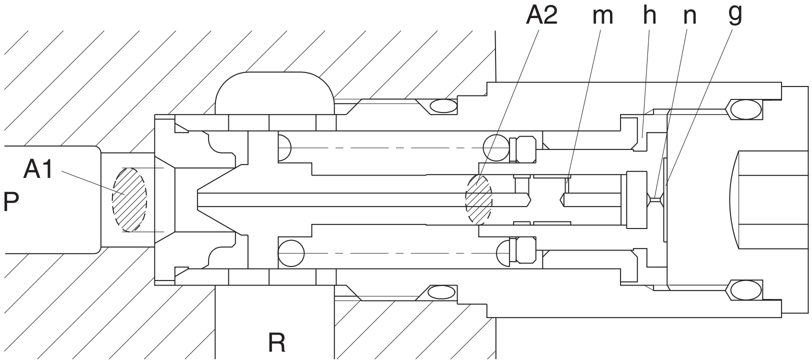
The valve casing contains two cartridge type relief valves that stop the regular and reverse rotations of the hydraulic motor. The relief valves relieve high pressure at start or at stop of swing motion and can control the relief pressure in two steps, high and low, in order to insure smooth operation.

(2) Function of relief valve

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



① Ports (P,R) at tank pressure.

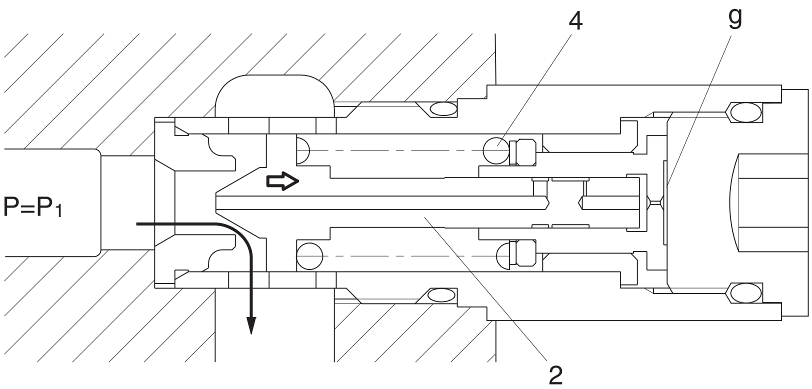


2209A2SM26

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

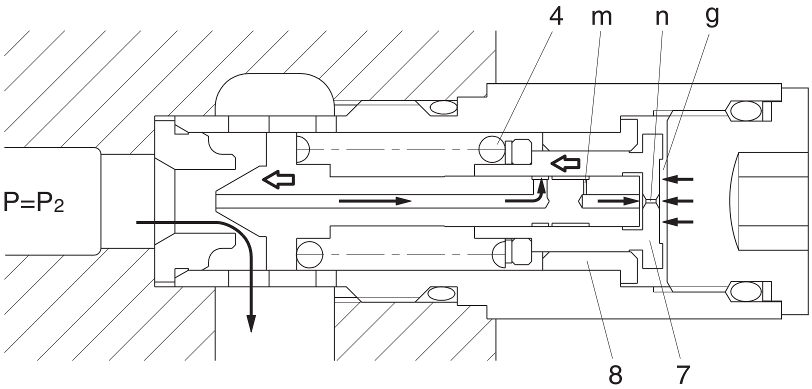
$P_1 \times A_1 = Fsp + Pg \times A_2$

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



2209A2SM27

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 (7) moves left and stop the piston (7) hits the bottom of bushing (8).

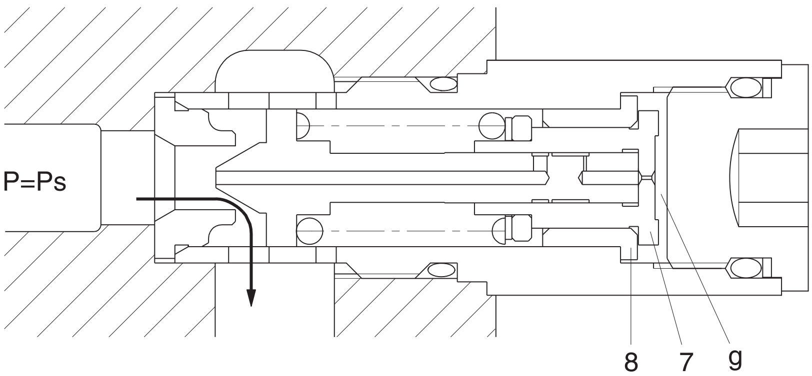


2209A2SM28

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

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

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



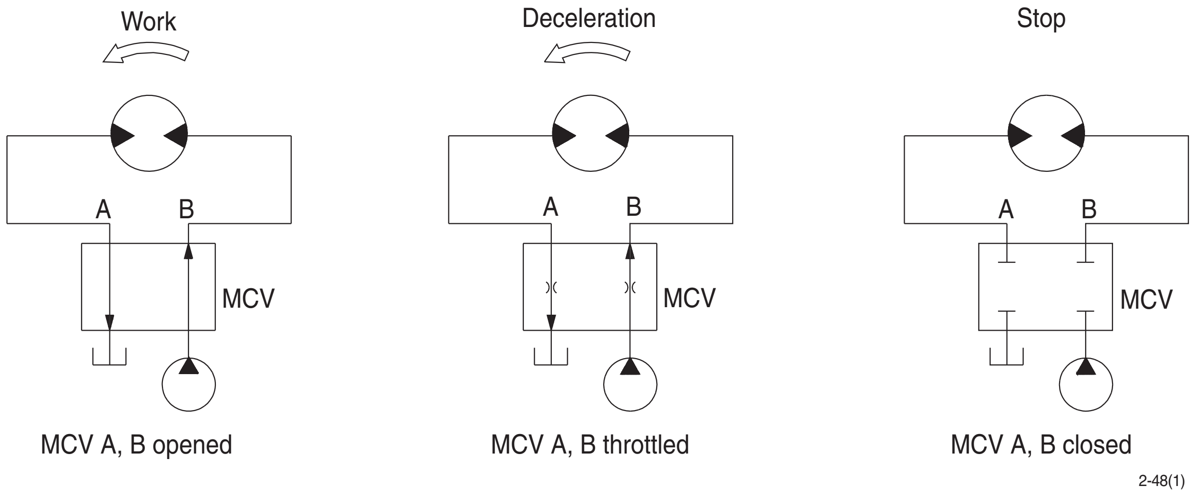
2209A2SM29

4) BRAKE SYSTEM

(1) Control valve swing brake system

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

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



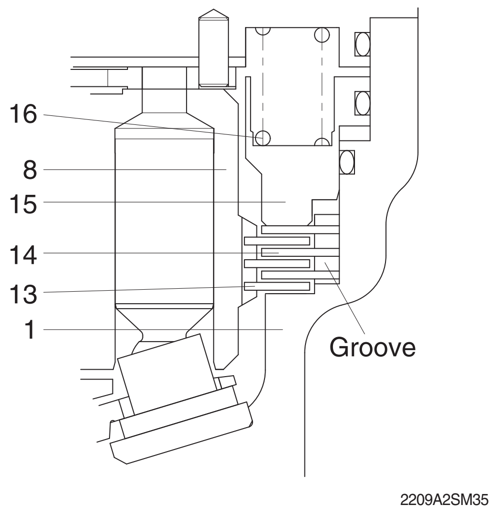
(2) Mechanical swing parking brake system

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

① Brake assembly

Circumferential rotation of separate plate (14) is constrained by the groove located at casing (1). When housing is pressed down by brake spring (16) through friction plate (13), separate plate (14) and parking piston (15), friction force occurs there.

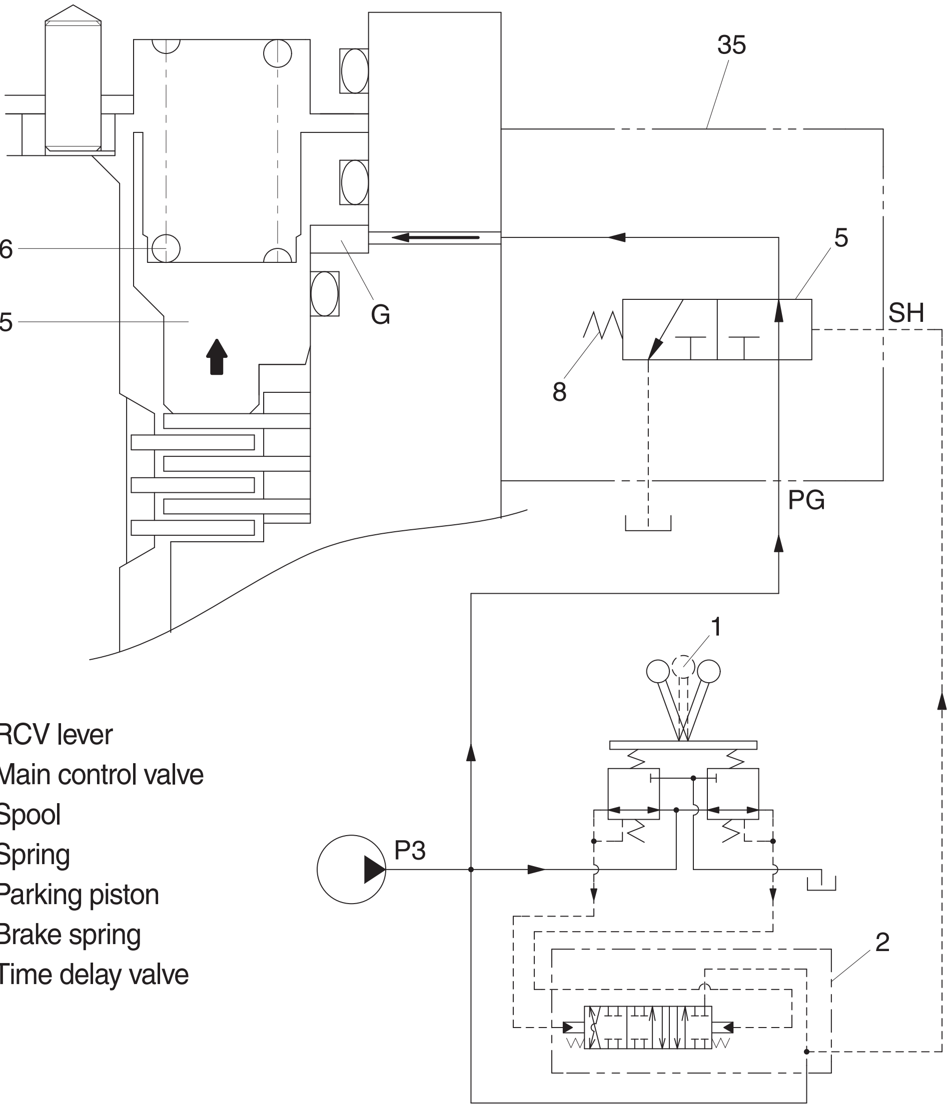
Cylinder block (8) is constrained by this friction force and brake acts, while brake releases when hydraulic force exceeds spring force.



1	Casing	14	Separate plate
8	Cylinder block	15	Parking piston
13	Friction plate	16	Brake spring

② Operating principle

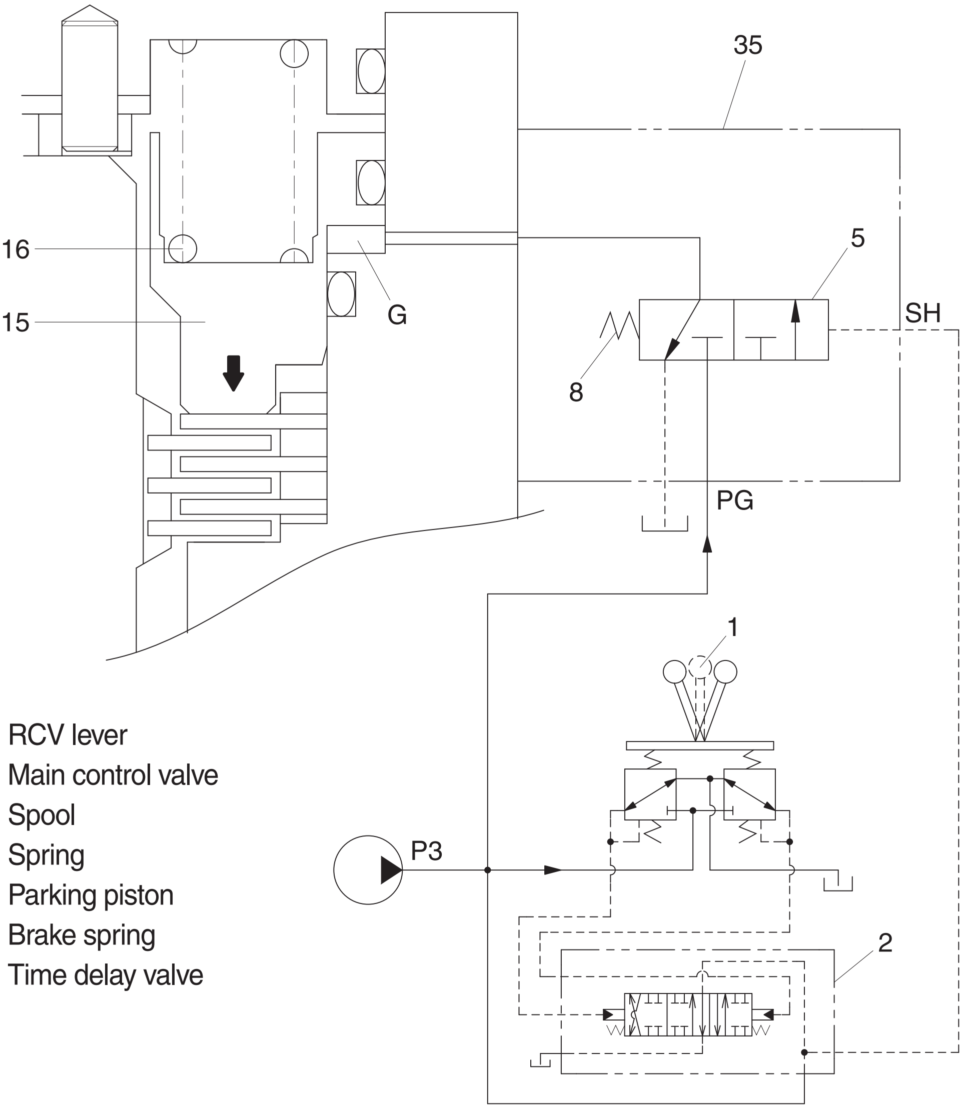
a. When one of the RCV lever (1) is set to the operation position, the each spool is shifted to left or right and the pilot oil flow is blocked. Then the pilot oil go to SH of the time delay valve (35). This pressure moves spool (5) to the leftward against the force of the spring(8), so pilot pump charged oil (P3) goes to the chamber G through port PG.
This pressure is applied to move the parking piston (15) to the upward against the force of the brake spring (16). Thus, it releases the brake force.



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

2209A2SM36

b. When all of the RCV lever (1) are set the neutral position, the spool (5) returns to right.
Then, the parking piston (15) is moved lower by spring force and the return oil from the chamber G flows back to tank port.
At this time, the brake works.



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

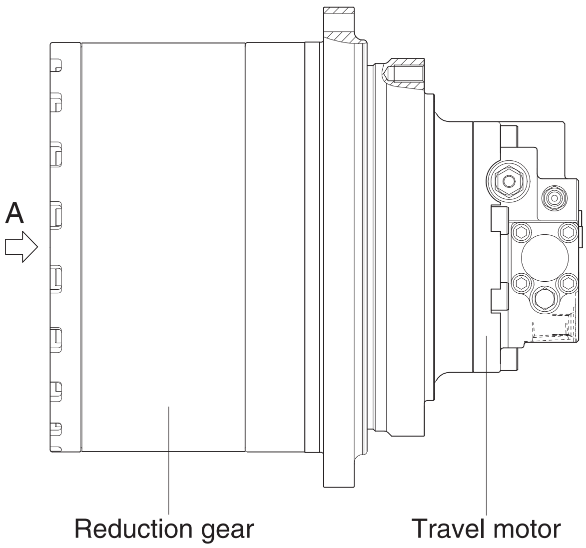
2209A2SM37

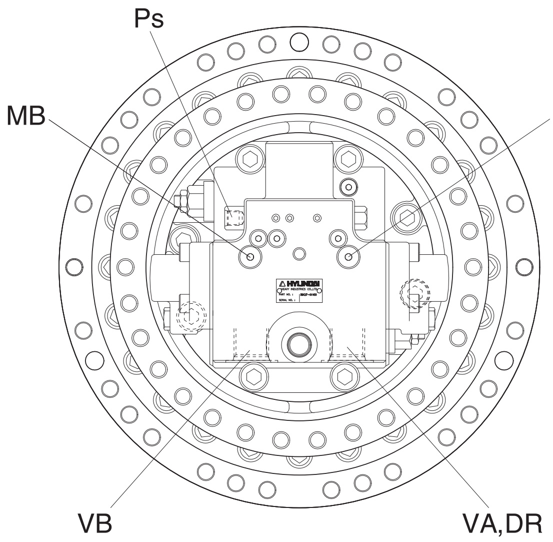
GROUP 4 TRAVEL DEVICE (TYPE 1, 2)

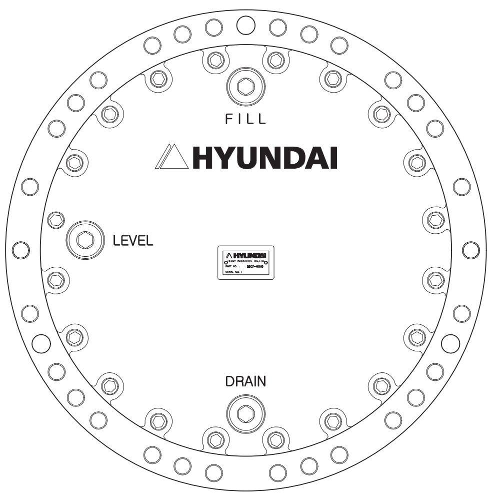
1. CONSTRUCTION

Travel device consists travel motor and gear box.

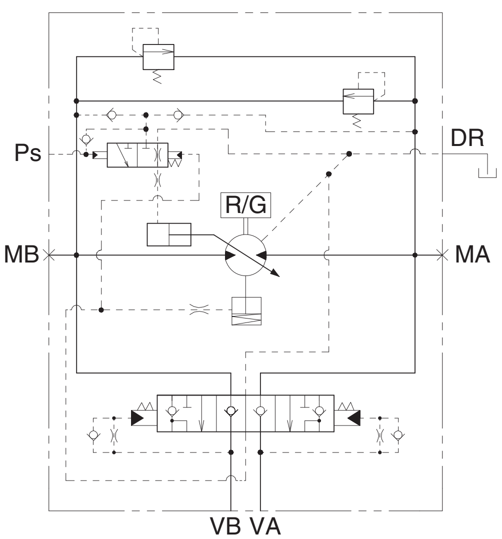
Travel motor includes brake valve, parking brake and high/low speed changeover mechanism.







VIEW A



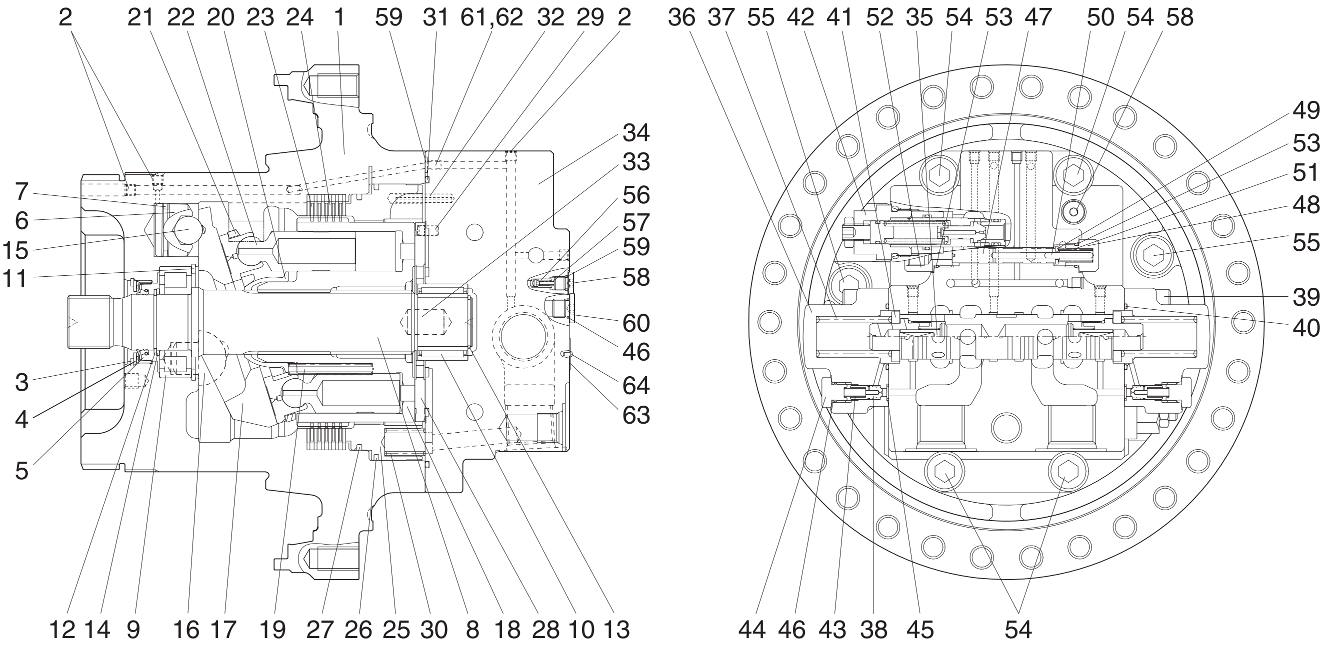
Hydraulic circuit

210S2TM20

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

2. SPECIFICATION

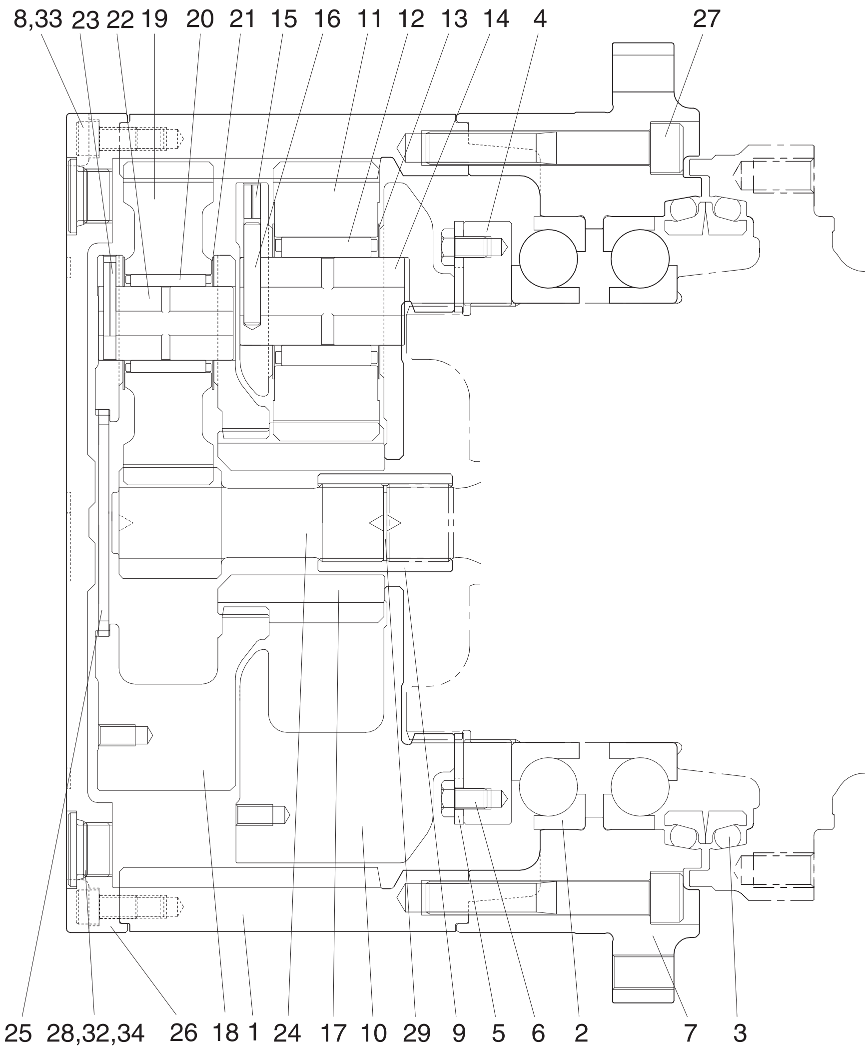
1) TRAVEL MOTOR



2209A2TM21

1	Casing	23	Friction plate	44	Plug
2	Plug	24	Separated plate	45	O-ring
3	Oil seal	25	Parking piston	46	O-ring
4	Thrust plate	26	D-ring	47	Spool
5	Snap ring	27	D-ring	48	Plug
6	Swash piston	28	Valve plate	49	Spring seat
7	Piston seal	29	Parallel pin	50	Parallel pin
8	Shaft	30	Brake spring	51	Spring
9	Cylinder roller bearing	31	O-ring	52	Connector
10	Needle bearing	32	Spring pin	53	O-ring
11	Snap ring	33	Parallel pin	54	Hexagon socket head bolt
12	Snap ring	34	Rear cover	55	Hexagon socket head bolt
13	Snap ring	35	Main spool assy	56	Check valve
14	Thrust plate	36	Spool cover	57	Spring
15	Steel ball	37	Spring	58	Plug
16	Pivot	38	Restrictor	59	O-ring
17	Swash plate	39	Hexagon socket head bolt	60	Plug
18	Cylinder block	40	O-ring	61	Restrictor
19	Spring	41	Spring seat	62	Restrictor
20	Ball guide	42	Relief valve assy	63	Name plate
21	Retainer plate	43	Spring	64	Rivet
22	Piston assy				

2) TRAVEL REDUCTION GEAR



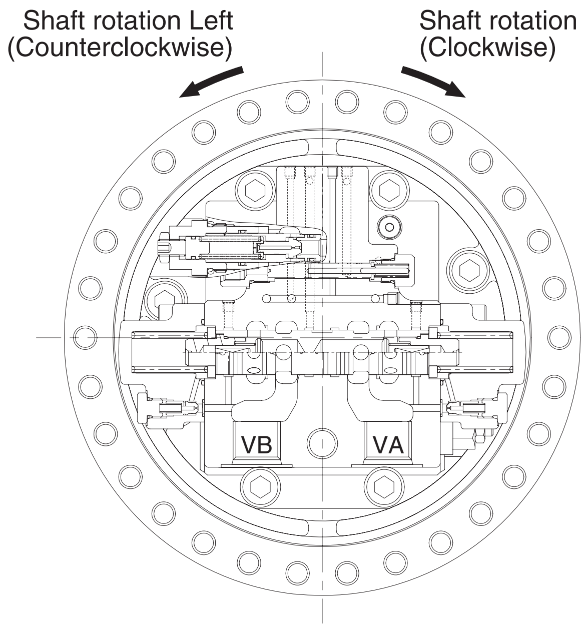
220S2TM22

1	Ring gear	13	Thrust washer 2	25	Thrust plate
2	Ball bearing	14	Carrier pin 2	26	Cover
3	Floating seal assy	15	Spring pin 2	27	Hexagon socket head bolt
4	Nut ring	16	Solid pin 2	28	Plug
5	Lock plate	17	Sun gear 2	29	Snap ring
6	Hexagon bolt	18	Carrier 1	30	Name plate
7	Housing	19	Planetary gear 1	31	Rivet
8	Hexagon socket head bolt	20	Needle bearing 1	32	O-ring
9	Coupling	21	Thrust washer 1	33	Rubber cap
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1		
12	Needle bearing 2	24	Sun gear 1		

3. OPERATION

1) MOTOR

High pressure oil delivered form hydraulic pump is led to inlet port that is provided in the brake valve portion and, through the rear cover (34) and valve plate (28), led to cylinder block (18).
The oil flow and direction of shaft rotation are indicated in table.



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

25092TM23

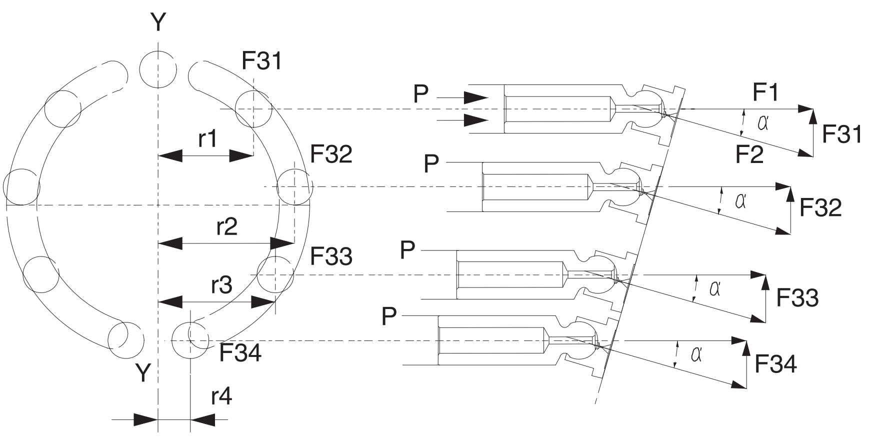
As shown in below figure, high pressure oil is supplied to the pistons which are on one side of the line Y-Y that connects upper and lower dead points and produces force F1.

F1 = P $\times$ A (P : pressure, A : area of piston section)

The swash plate (17) with inclined angle of α divides this force F1 into thrust force F2 and radial force F31-34.
This radial force is applied to axis Y-Y as turning force and generate drive torque of T.

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

This drive torque is transmitted via cylinder block (18) to driving shaft (8).

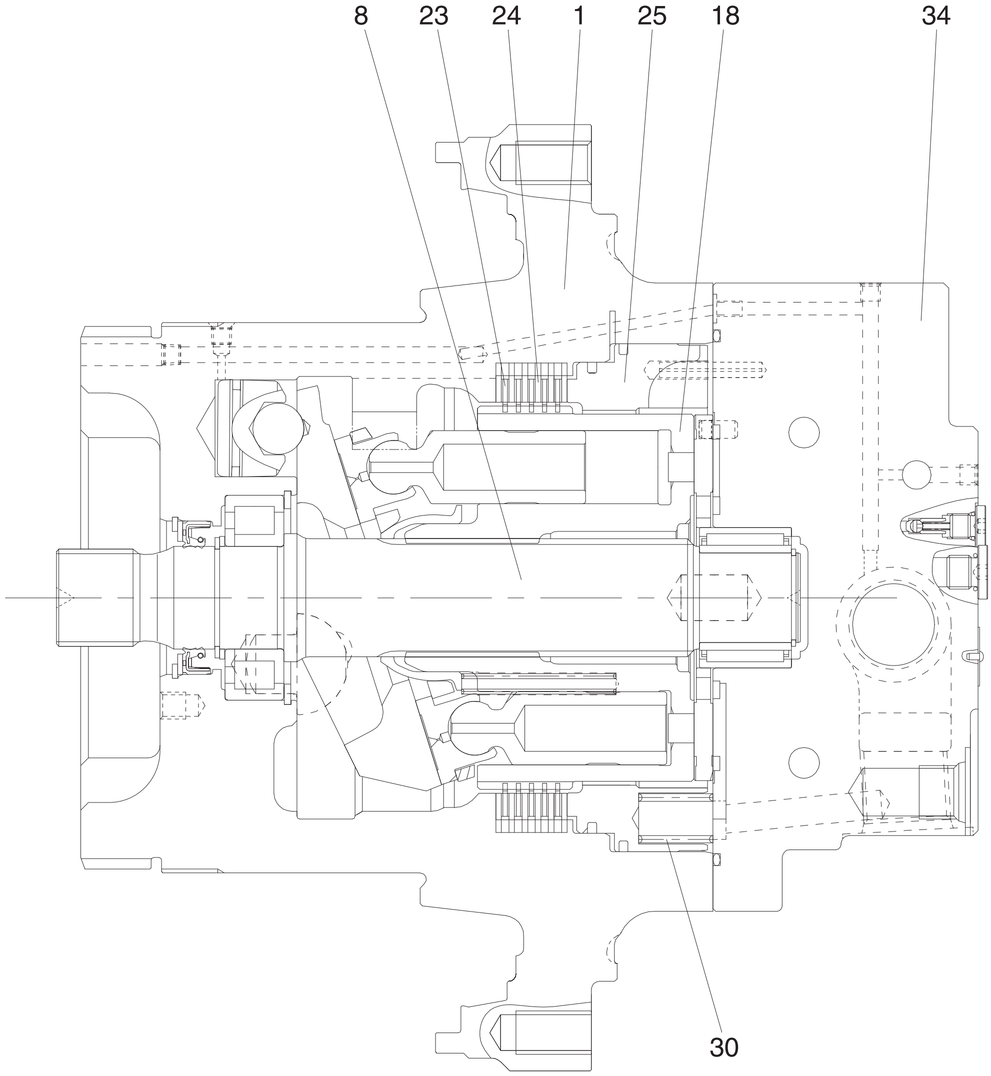


29092TM07

2) PARKING BRAKE

Parking brake is released when high pressure oil selected by the brake valve portion that is connected directly to the rear cover (34), is applied to the parking piston (25).
Otherwise the braking torque is always applied.

This braking torque is generated by the friction between the separated plates (24), inserted into the casing (1), and friction plates (23), coupled to cylinder block (18) by the outer splines.
When no pressure is activated on the parking piston (25), it is pushed by the brake springs (30) and it pushes friction plates (23) and separated plates (24) towards casing (1) and generates the friction force which brakes the rotation of cylinder block (18) and hence the shaft (8).



25092TM24

3) CAPACITY CONTROL MECHANISM

Figure typically shows the capacity control mechanism.

When high speed pilot line is charged with the pressure P_A that overcome the spring (51), the spring (51) is compressed and spool (47) shifts to the right to connect the port P and port C.

Then, the highest pressure is selected by the check valve (56) from inlet and outlet pressure of the motor and high speed pilot line pressure and pushes shifter piston (6). As a result, swash plate (17) turns around the line L which connect the two pivots (16) as shown by dotted lines. The turn stops at the stopper (1-1) of casing and swash plate (17) keeps the position.

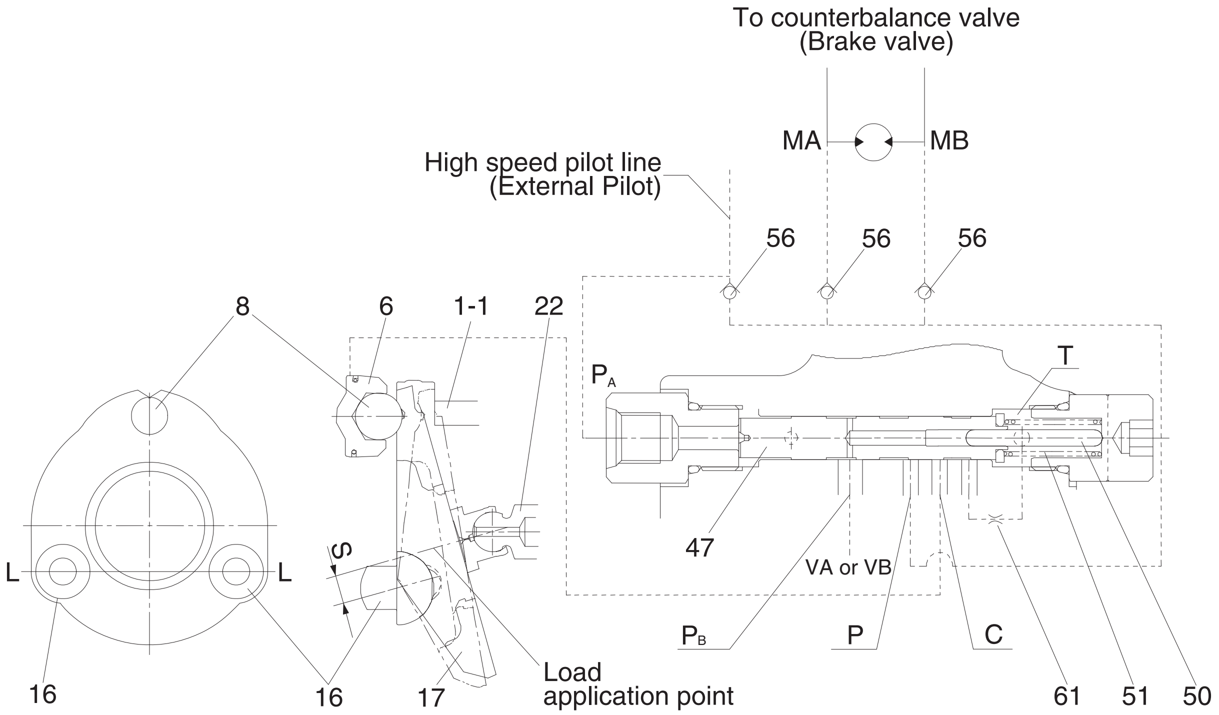
In this case, the piston stroke become shorter and motor capacity become smaller and motor rotates faster, around 1.60 times, by the same volume of oil.

When no pressure is in the high speed pilot line P_A, spool (35) is pushed back by the spring (51) and pressure that pressed the shifter piston (6) is released to the hydraulic tank through restrictor (61).

Here, nine pistons are there and they equally spaced on the swash plate (17). The force that summed up those of pistons comes to almost the center of the swash plate (17) as shown. Since the pivots (16) are off-set by S from the center, the rotating force of product S and the force moves swash plate (17) to the former position and the speed returns to low.

When the power demand exceeds the engine power, such as in steep slope climbing or turning at high speed mode, the system step down to the low speed automatically. The mechanism is that: pump pressure is led to the port P_B and this pressure activate on pin (50). When the pressure at P_B exceeds predetermined value, spool (47) returns to the left by the counter-pressure against pin (50) and the pressure on the shifter piston (6) through port C is released to the tank and the motor comes to low speed.

When P_B goes down, the spool (47) moves to the right and the speed become high.

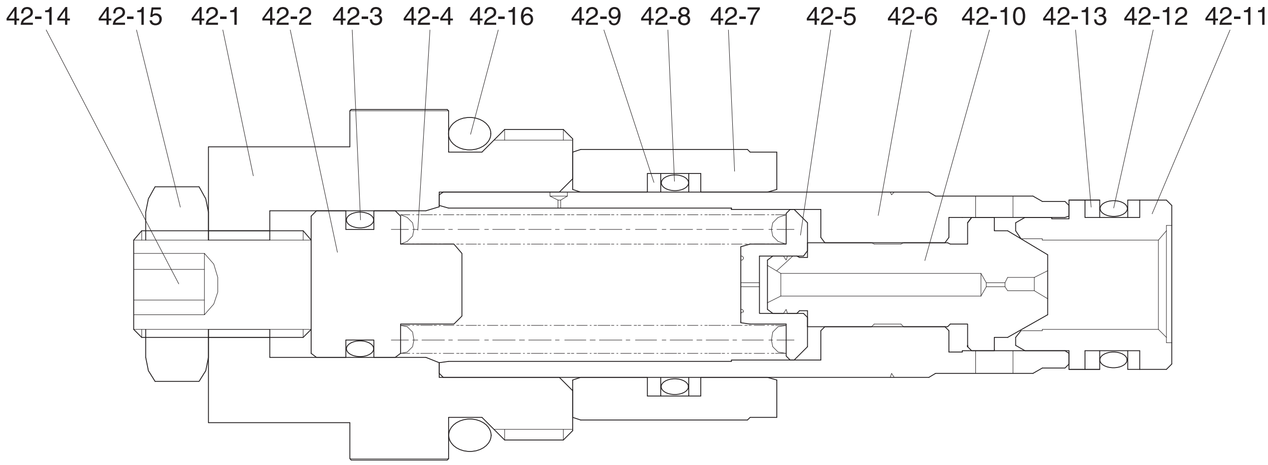


25092TM19

4) OVERLOAD RELIEF VALVE

(1) Structure

This valve is screwed in the motor rear cover (34) and consists of : plug (42-1) that is screwed and fixed in the rear cover (34), poppet (42-10) and supports the poppet seat (42-11), spring (42-4) that is operating relief valve setting pressure and supports the spring seat (42-5), that is inserted in the sleeve (42-6), screw (42-14) that is adjust the spring force, nut (42-15) that fix screw (42-14), piston (42-7) that reduce the shock.



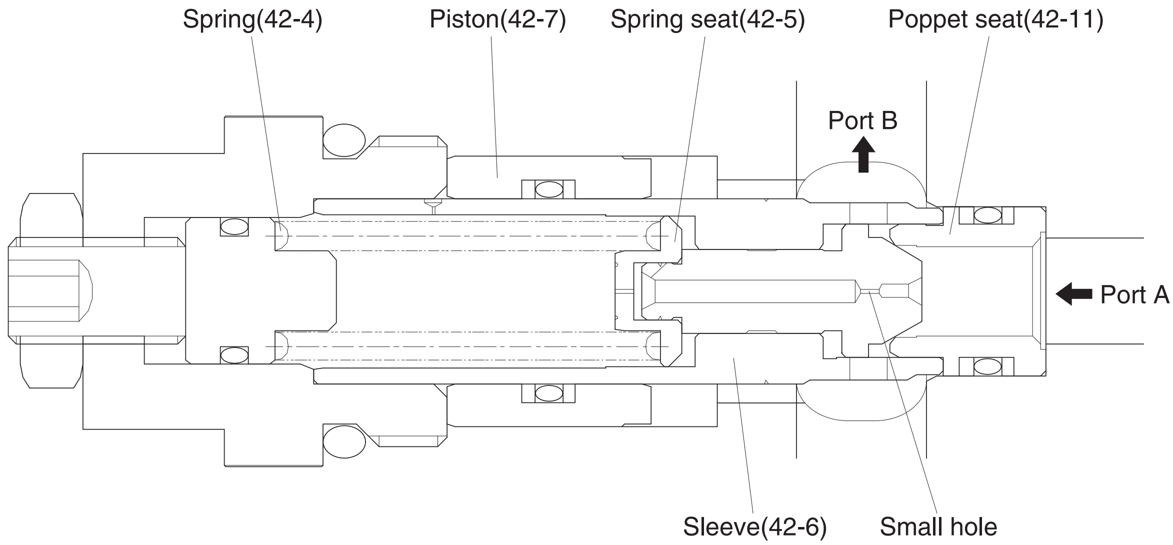
42-1 Plug	42-7 Piston	42-12 O-ring
42-2 Guide	42-8 O-ring	42-13 Back-up ring
42-3 O-ring	42-9 Back-up ring	42-14 Socket screw
42-4 Spring	42-10 Poppet	42-15 Hexagon nut
42-5 Spring seat	42-11 Poppet seat	42-16 O-ring
42-6 Sleeve		

(2) Operation

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

① When hydraulic motor starts, keep the driving pressure below predetermined value and while accelerating, bypasses surplus oil to return line.
② When stopping the motor, keep the brake pressure, that develops on the outlet side of motor, under the predetermined value to stop the inertial force.
③ To accelerate sharply while starting, and to mitigate the braking shock while stopping. For these purposes, the developed pressure is kept comparatively low for a short period, then keep the line pressure as normal value. While the pressure is low, meshing of reduction gears, crawler and sprocket etc. can be smoothly done and the shock are absorbed.

When starting, "A" port pressure of overload valve increases, this pressure is applied to the effective diameter of poppet (42-10) which seats on the poppet seat (42-11) and, at the same time, is delivered, via small hole, to the spring seat (42-5) located inside the sleeve (42-6) and the seat bore pressure increases up to "A" port pressure. The poppet (42-10) opposes to spring (42-4) by the force of the pressure exerted on the area difference between poppet seat's effective diameter and spring seat bore and keep the predetermined pressure.
When hydraulically braking, the piston (42-7) is at the left position by the driving pressure, and when "A" port pressure increases, the pressure is applied also to the piston (42-7) through the small hole in the poppet (42-10) and piston (42-7) moves rightward until it touches the stopper in rear cover. In this while, the poppet (42-10) maintains "A" port pressure at comparatively low against the spring (42-4) force and exhaust oil to "B" port side. After the piston reached to the plug, the valve acts the same as at starting.



25092TM27

5) BRAKE VALVE

(1) Structure

The brake valve portion mainly consists of the following parts:

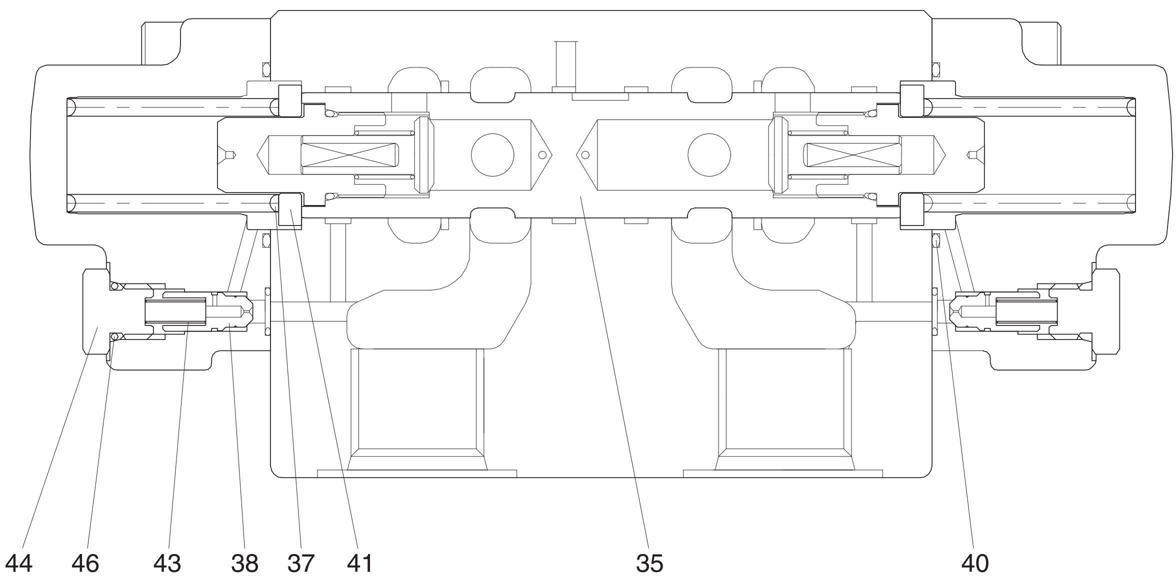
① Spool

By shifting the spool (35), the discharged oil from hydraulic motor is automatically shut off or restricted according to the condition and give the effect of holding, accelerating, stopping and counterbalance operations.

(See page 2-74, (2) Operation)

② Check valve (built in the spool)

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



25092TM28

35	Main spool	40	O-ring	44	Plug
37	Spring	41	Spring seat	46	O-ring
38	Restrictor	43	Restrictor spring		

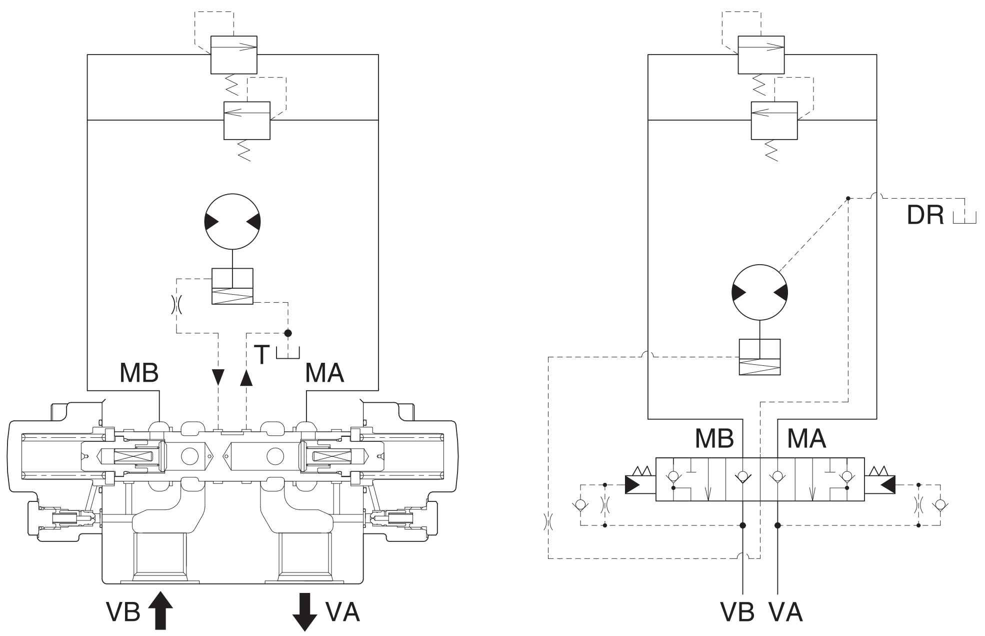
(2) Operation

① Holding operation

When the control valve is at neutral position, VA and VB ports are connected to the tank, and the spring (37) located on both spool ends holds the spool (35) at central position.
Therefore, the passages from VA to MA and VB to MB are closed, which result in closing MA and MB ports connected to hydraulic motor.

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

In case the brake should be released for some reason, pressure is built on MA or MB port. But, due to oil leakage inside hydraulic motor or so, high-pressure oil escapes from the closed circuit and motor rotates a bit. So, the cavitation tends to occur in the lower pressure side of the closed circuit. Then, the check valve, built in the spool (35), operates to avoid the cavitation and opens the passage from VA to MA or from VB to MB. Then the oil equivalent to the leakage is sucked from the tank line to the closed circuit.



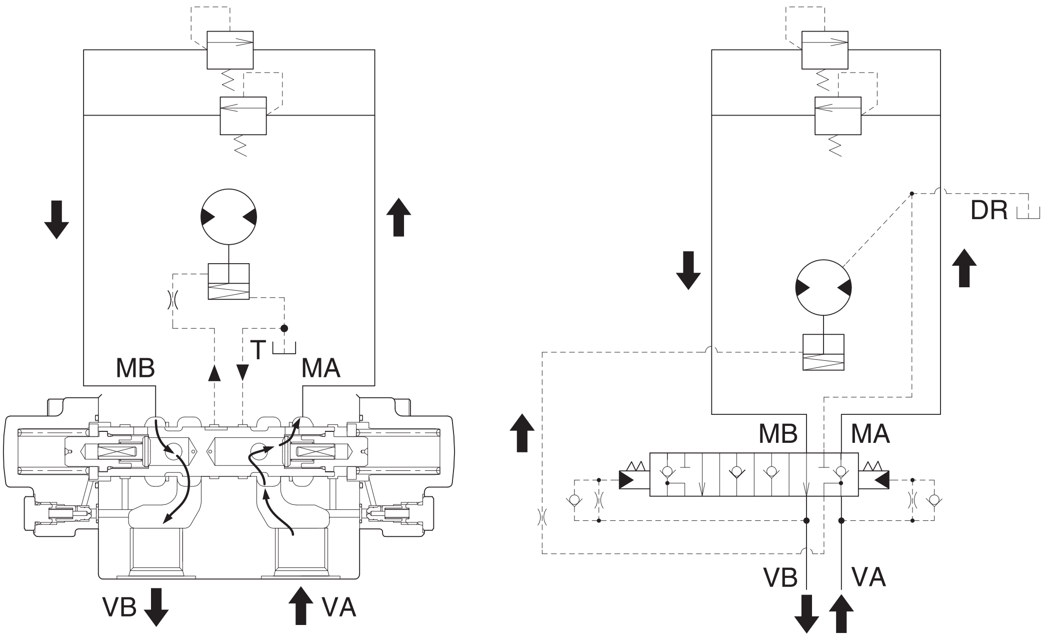
25092TM29

② Accelerating operation

When VA and VB ports are connected respectively to pump and tank by operating the control valve, hydraulic oil from pump is forwarded through VA port to push open the check valve provided inside spool (35), and oil flows to motor via MA port to rotate the motor.

Therefore, the pressure increases and negative brake is released by the pressure supplied from pump. At the same time, the pressure of pilot chamber increases to push and move the spool (35) leftwards, overcoming the spring (37) force. Thus, the return line from MB to VB opens to rotate the motor.

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



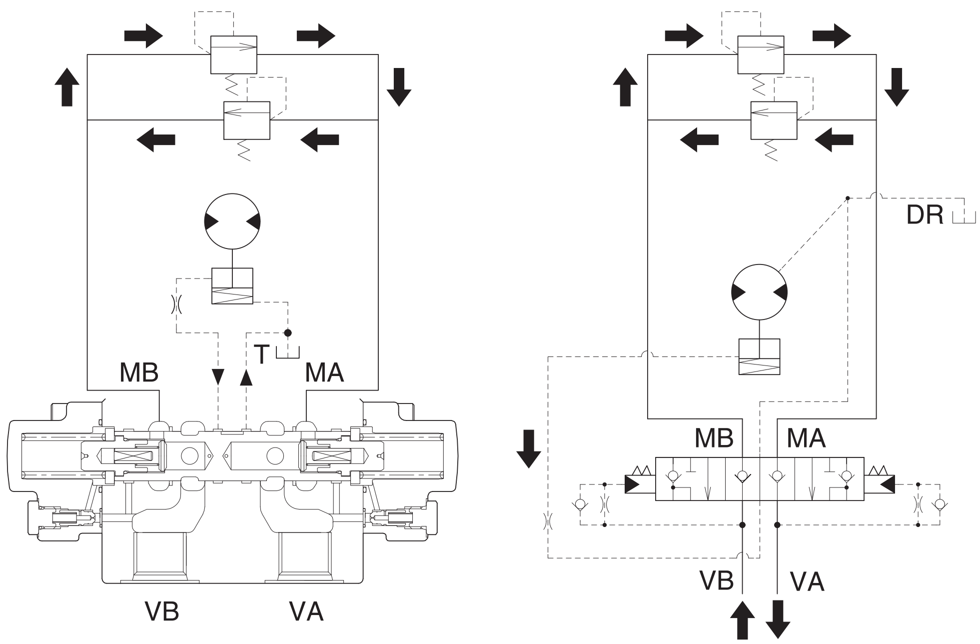
25092TM30

③ Stopping operation

Returning the control valve to neutral position while running the motor, the oil supply is cut off and VA and VB ports are connected to the tank line. Then the pressure of the pilot chamber located on both spool ends become equal, and the spool (35) returns to the neutral position by spring (37) force. Thus, the passage from MA to VA is closed.

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

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



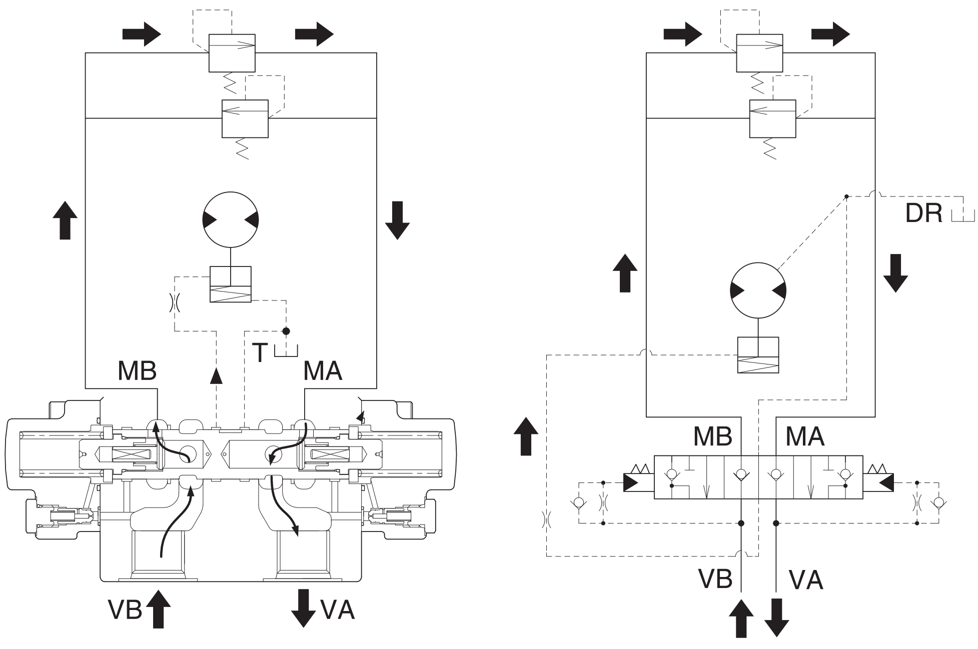
25092TM31

④ Counterbalance operation

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

In case the hydraulic oil is gradually decreased from pump to VB port, the drive shaft of hydraulic motor tends to rotate faster than that matched to the volume of oil supply.
Consequently, the pilot chamber pressure on MB to VB side decreases and the spring (37) force moves the spool (35) leftwards towards neutral position.
Therefore, the area of passage from MA to VA becomes smaller and the pressure on MA side rises due to increased resistance in the passage and the motor receives hydraulic braking effect.

If the motor rotates slower than that matched to the volume of supplied oil, the pilot chamber pressure on VB port increases, and spool (35) moves rightwards to enlarge the area of passage from MA to VA. Therefore the braking effect becomes smaller and the rotational speed of motor is controlled to correspond to the volume of supplied oil.
In order to give stable counterbalance operation, the restrictors (38) are set in the pilot chamber to damp the spool (35) movement.
The parking brake is released during pressure adjusting action of the spool (35).



25092TM32

6) REDUCTION GEAR

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

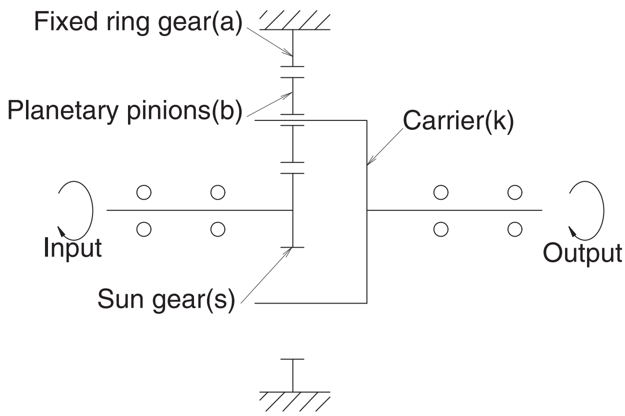
This reduction unit utilizes two stages, planetary reduction system.

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

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

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

This mechanism is called planetary gear mechanism.



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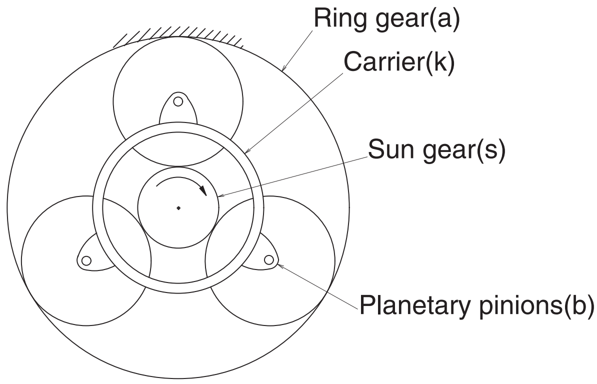
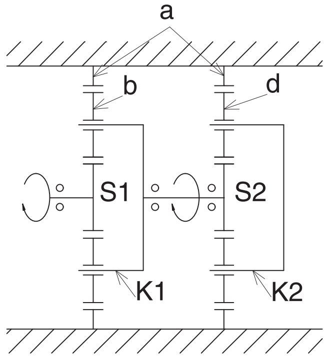


29072TM11

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

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



29072TM12

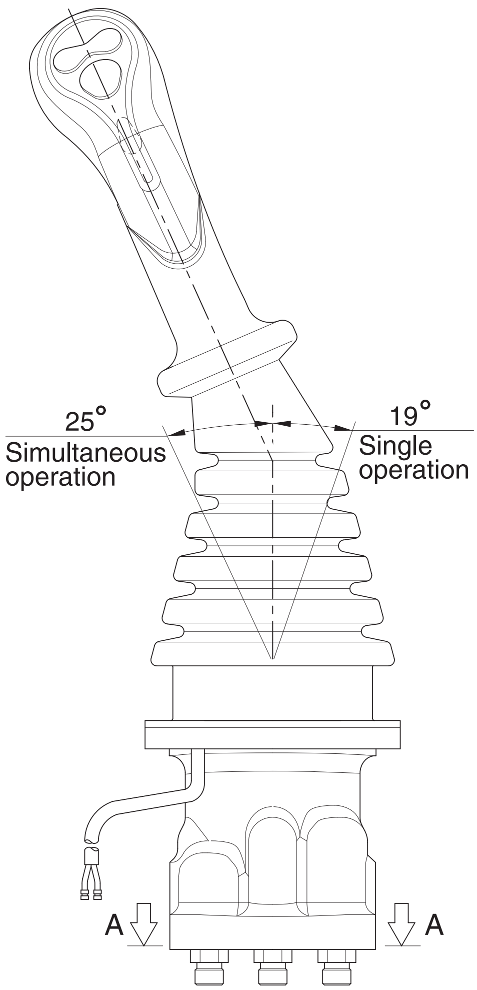
GROUP 5 RCV LEVER

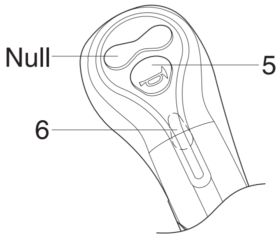
1. STRUCTURE

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

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

1) TYPE M5

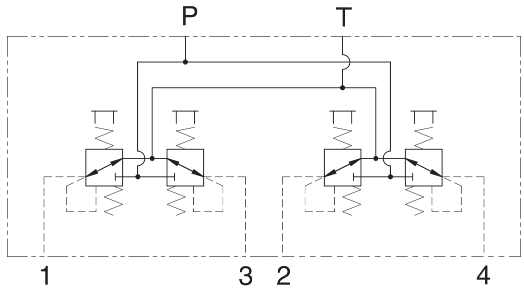




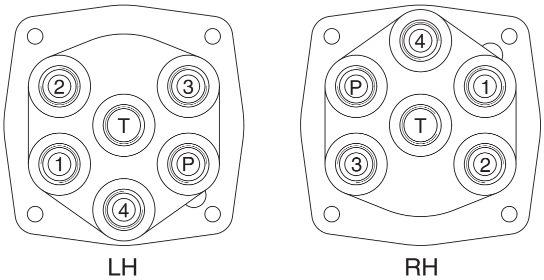
TYPE M5

Switches

Type	No.	LH	RH
M5	5	One touch decel	Horn
	6	Power boost(null)	Breaker



Hydraulic circuit



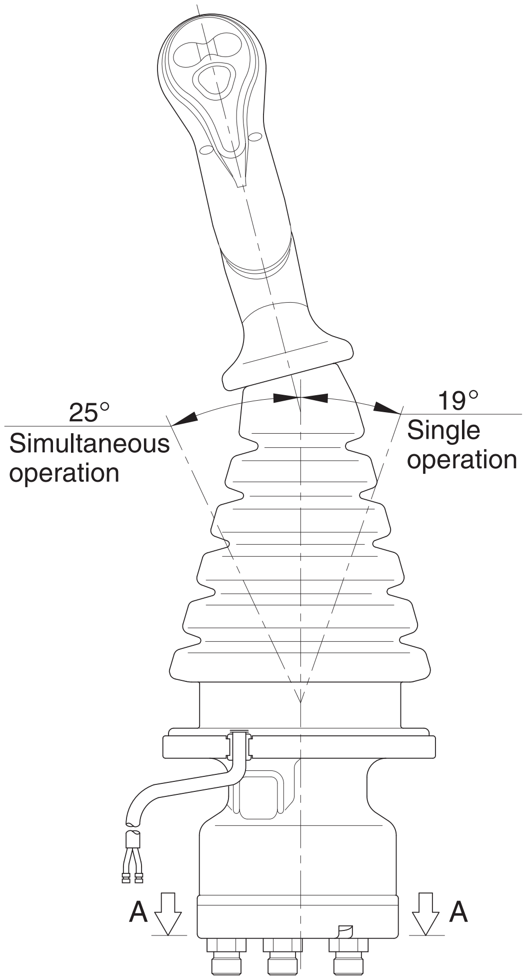
VIEW A-A

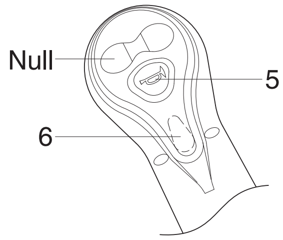
Pilot ports

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

210S2RL01

2) TYPE M2

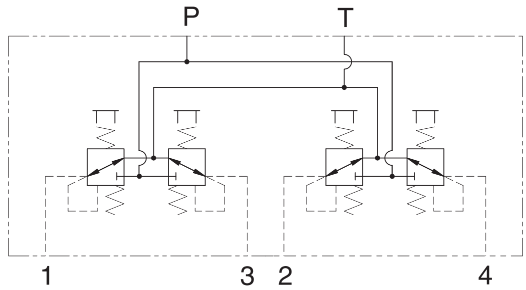




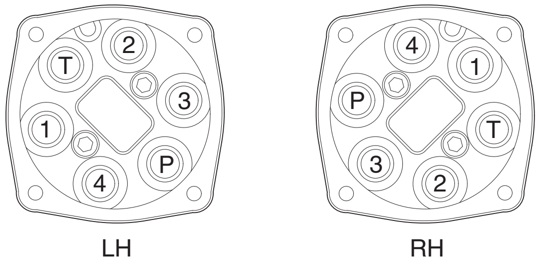
TYPE M2

Switches

Type	No.	LH	RH
M2	5	One touch decel	Horn
	6	Power boost (null)	Breaker



Hydraulic circuit



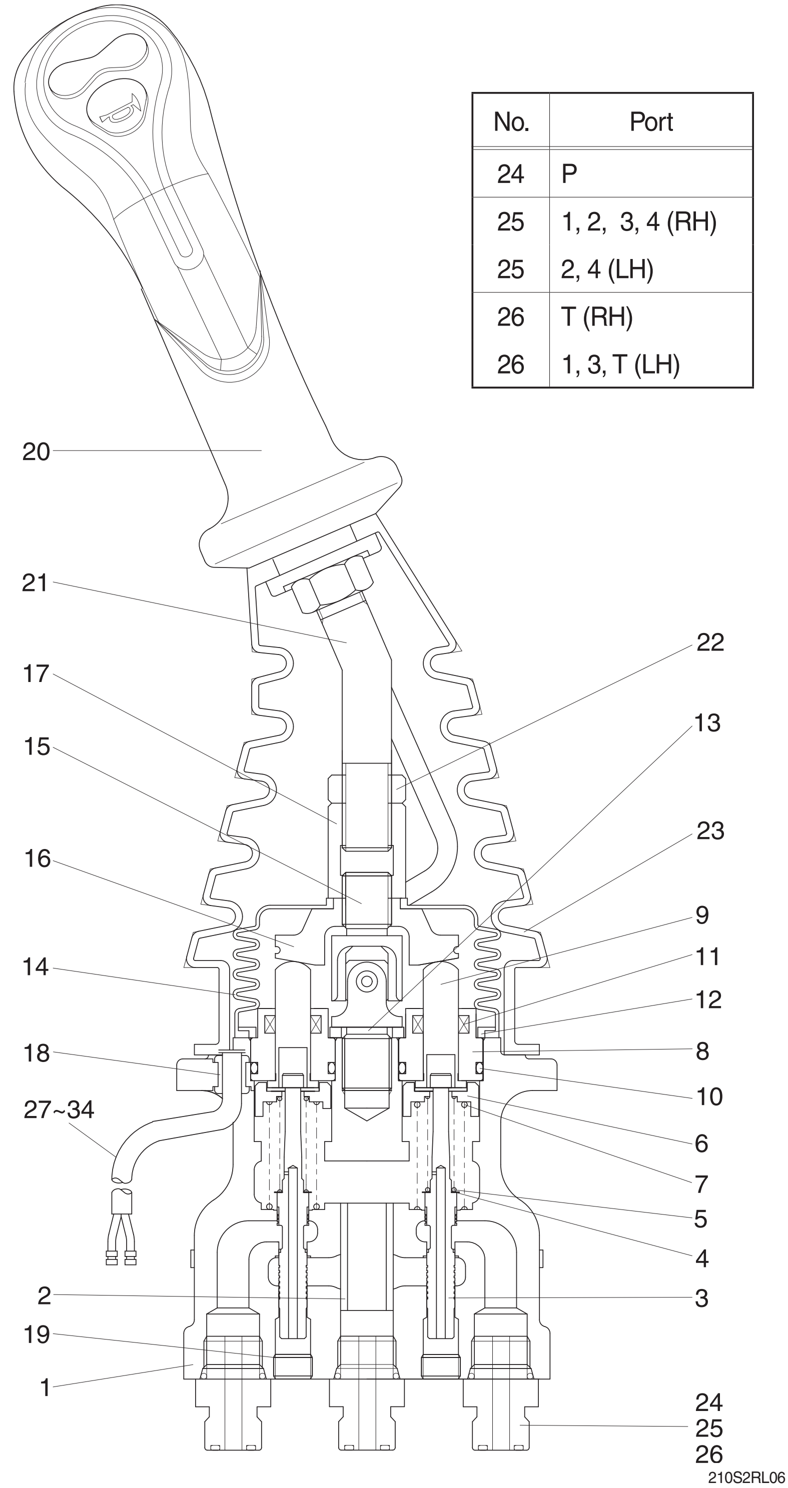
VIEW A-A

Pilot ports

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

210S2RL05

3) CROSS SECTION



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

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

Item numbers are based on the type M2.

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

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

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

2. FUNCTIONS

1) FUNDAMENTAL FUNCTIONS

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

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

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

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

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

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

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

2) FUNCTIONS OF MAJOR SECTIONS

Item numbers are based on the type M2.

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

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

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

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

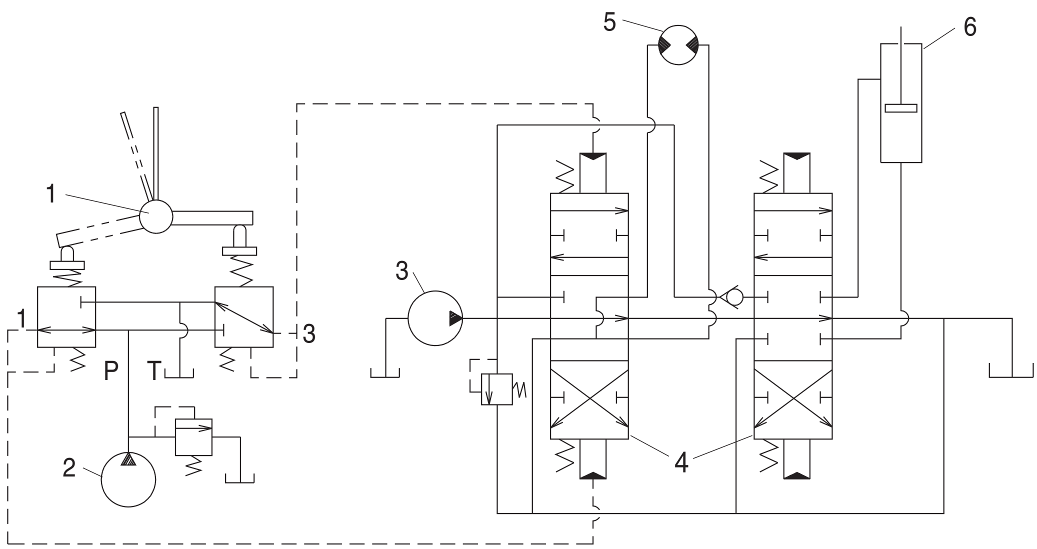
The spring (7) works on the case (1) and spring seat (6) and tries to return the push rod (9) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

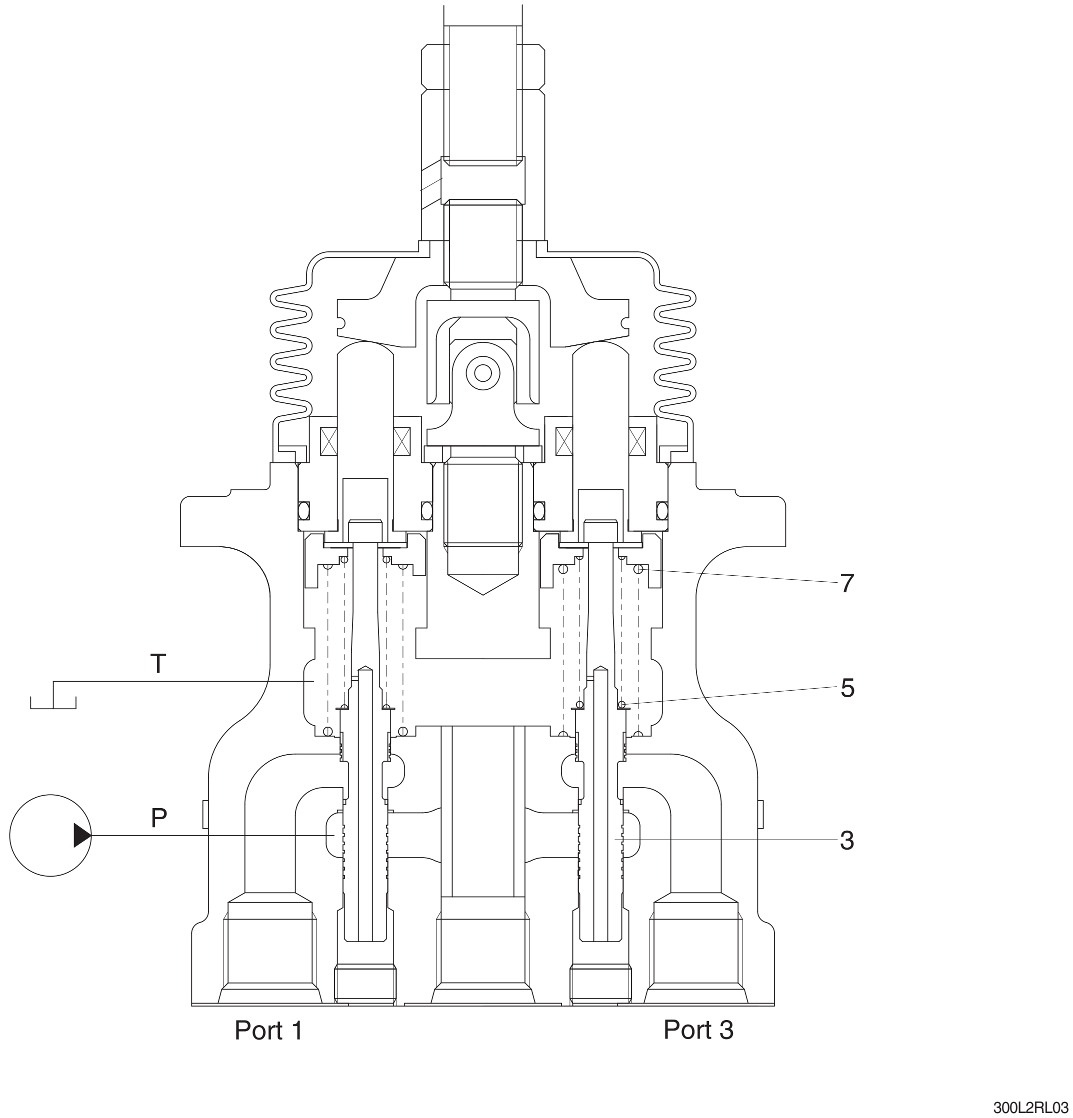
The diagram shown below is the typical application example of the pilot valve.



2-70

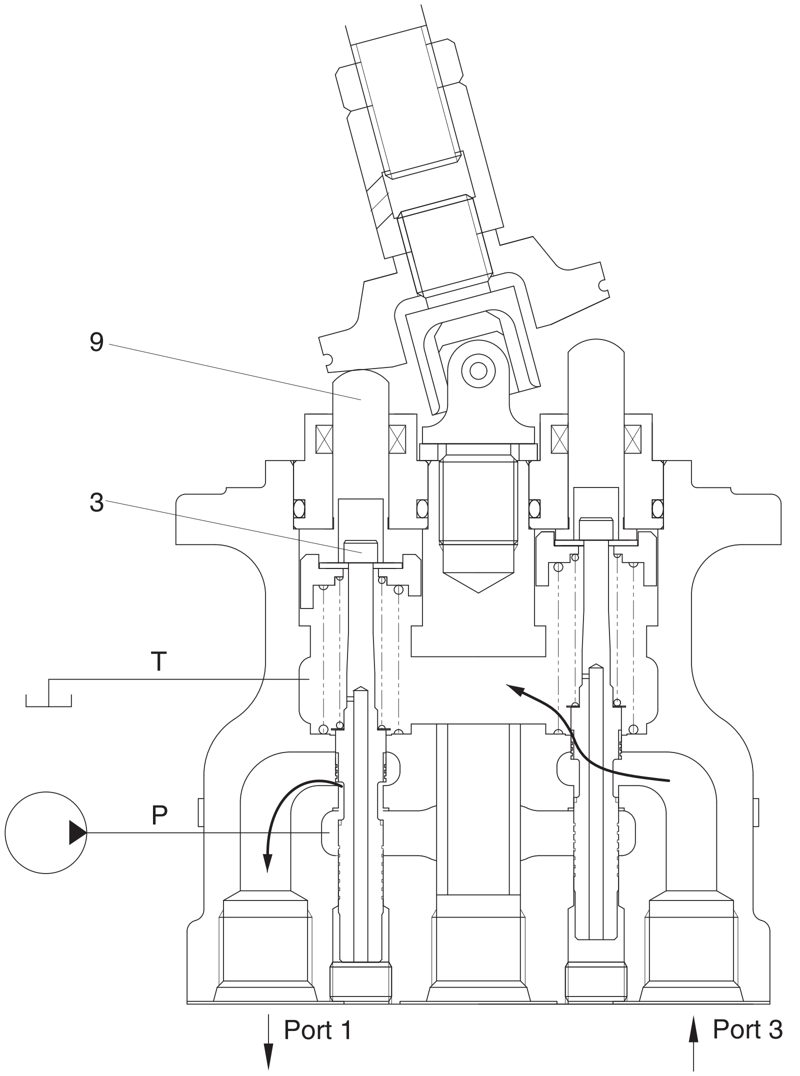
1	Pilot valve	3	Main pump	5	Hydraulic motor
2	Pilot pump	4	Main control valve	6	Hydraulic cylinder

(1) Case where handle is in neutral position



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

(2) Case where handle is tilted



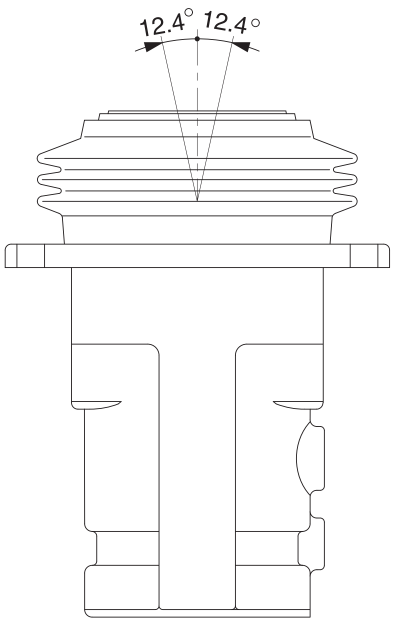
300L2RL04

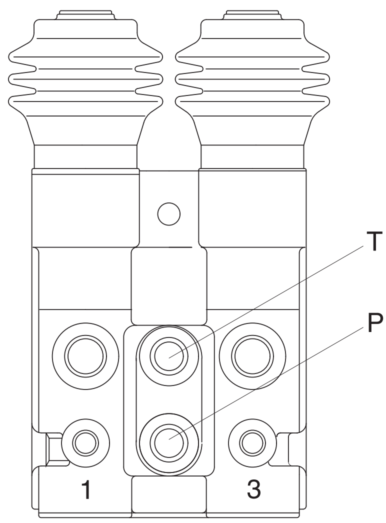
When the push rod (9) is stroked, the spool (3) moves downwards.
Then port P is connected with port (1) and the oil supplied from the pilot pump flows through port (1) to generate the pressure.
When the pressure at port (1) increases to the value corresponding to the spring force set by tilting the handle,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

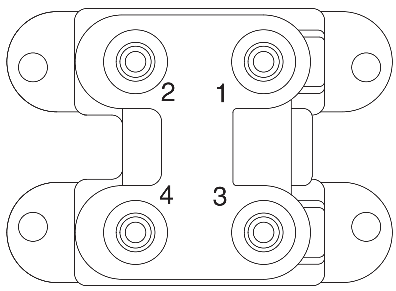
GROUP 6 RCV PEDAL

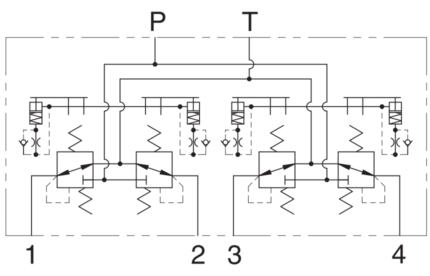
1. STRUCTURE

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









Hydraulic circuit

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

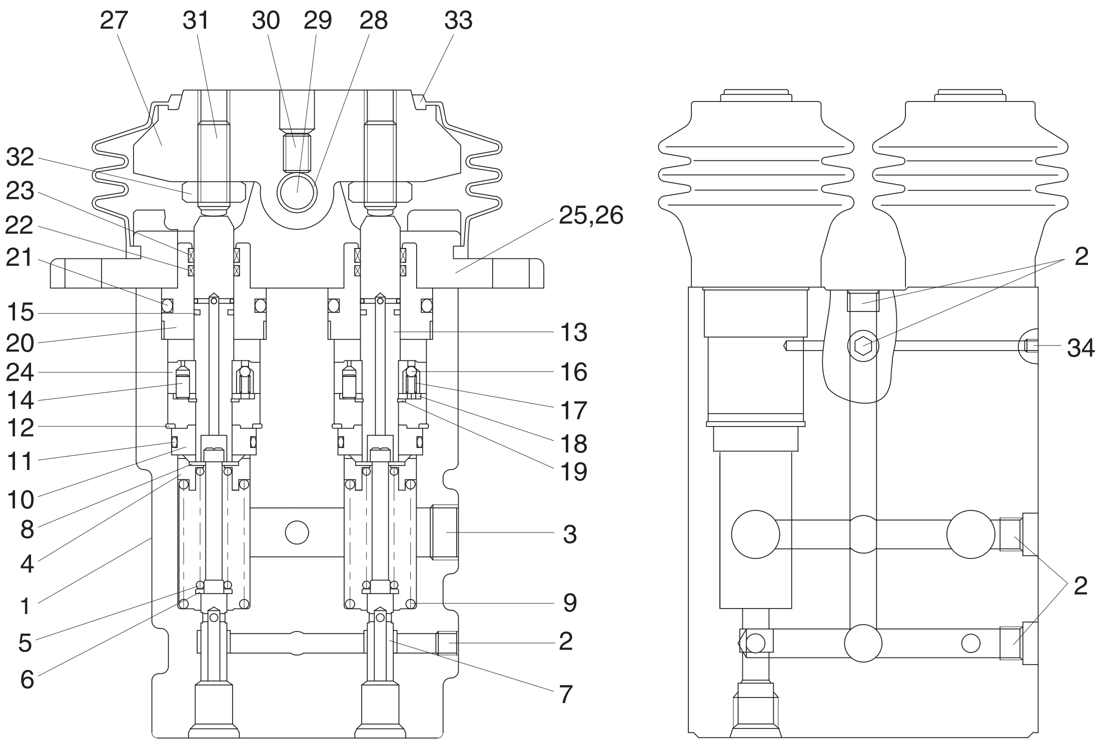
130ZF2RP01

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 (7), spring (5) for setting secondary pressure, return spring (9), stopper (8), and spring seat (6). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 6.3±1 to 24.9±1.5 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (13) 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.



130ZF2RP02

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

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 (13) is inserted and can slide in the plug (20).

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.

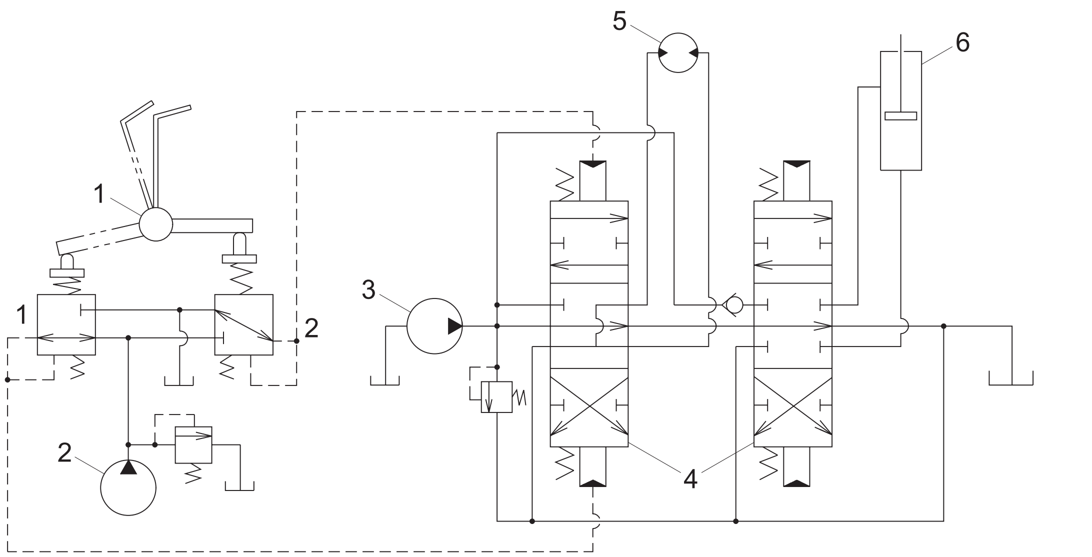
The spring (9) works on the body (1) and spring seat (6) and tries to return the push rod (13) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

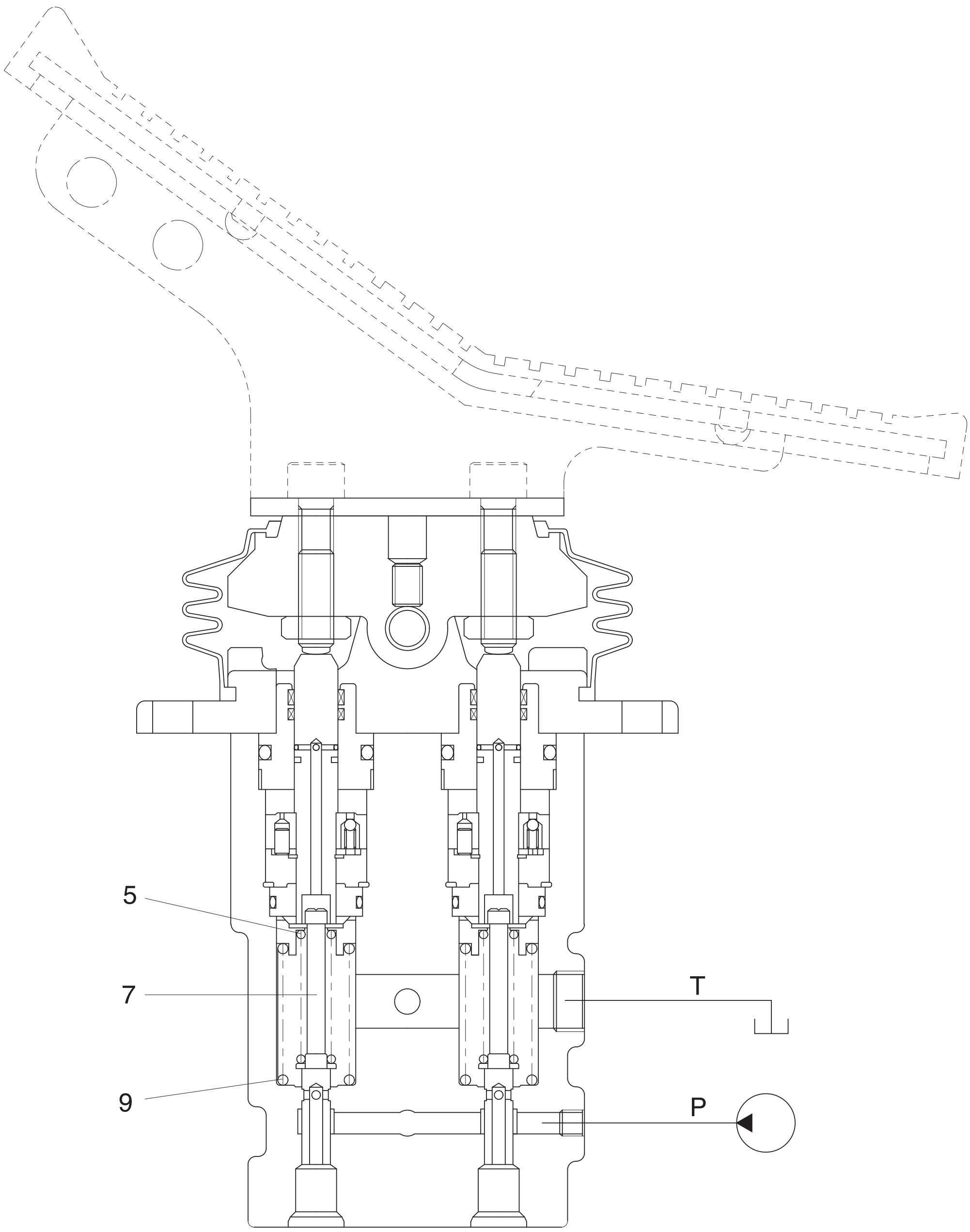
The operation of the pilot valve will be described on the basis of the hydraulic circuit diagram shown below and the attached operation explanation drawing.

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



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

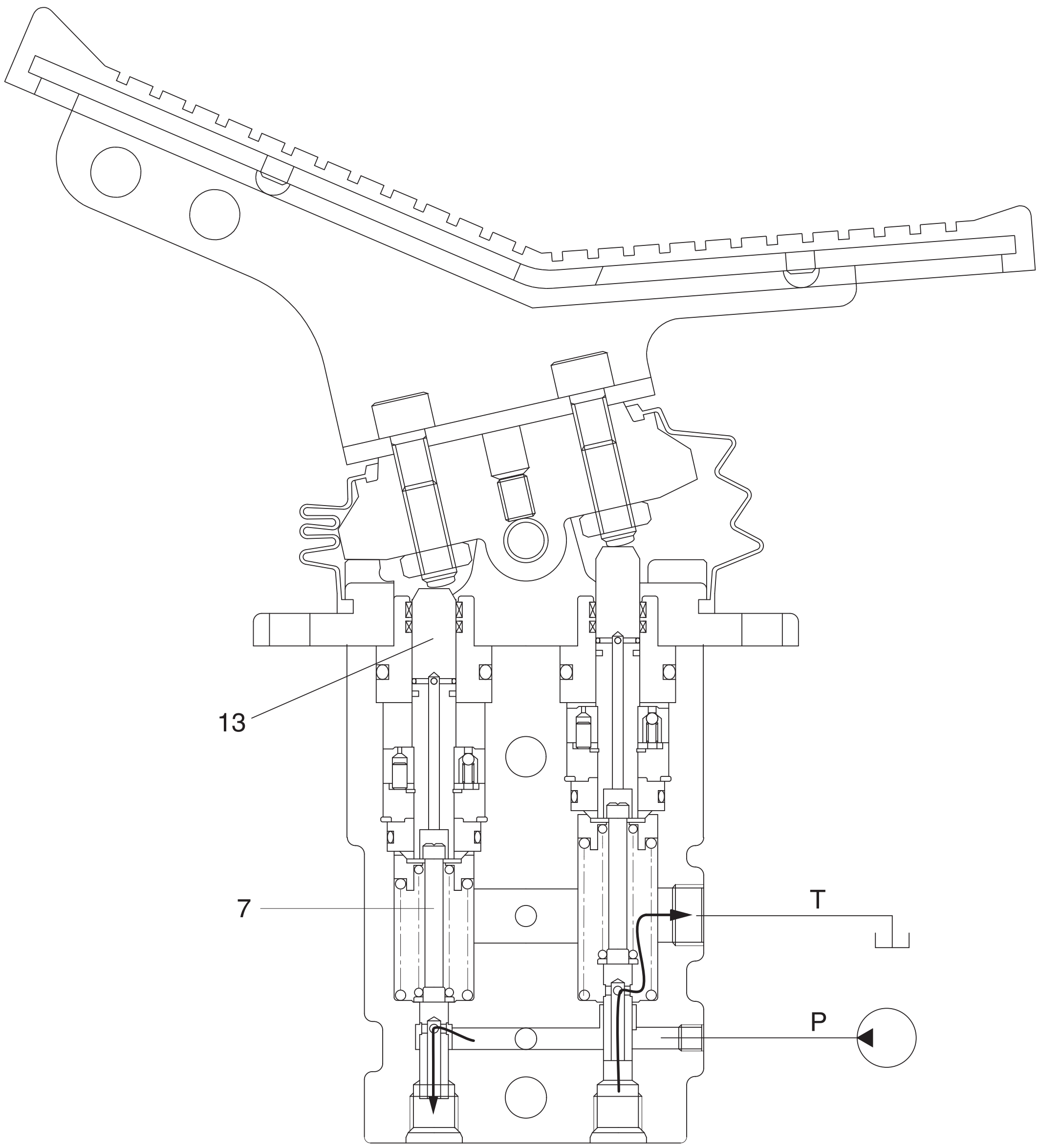
(1) Case where pedal is in neutral position



130ZF2RP03

The force of the spring (5) that determines the output pressure of the pilot valve is not applied to the spool (7). Therefore, the spool is pushed up by the spring (9) to the position of 1 and port 2. 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



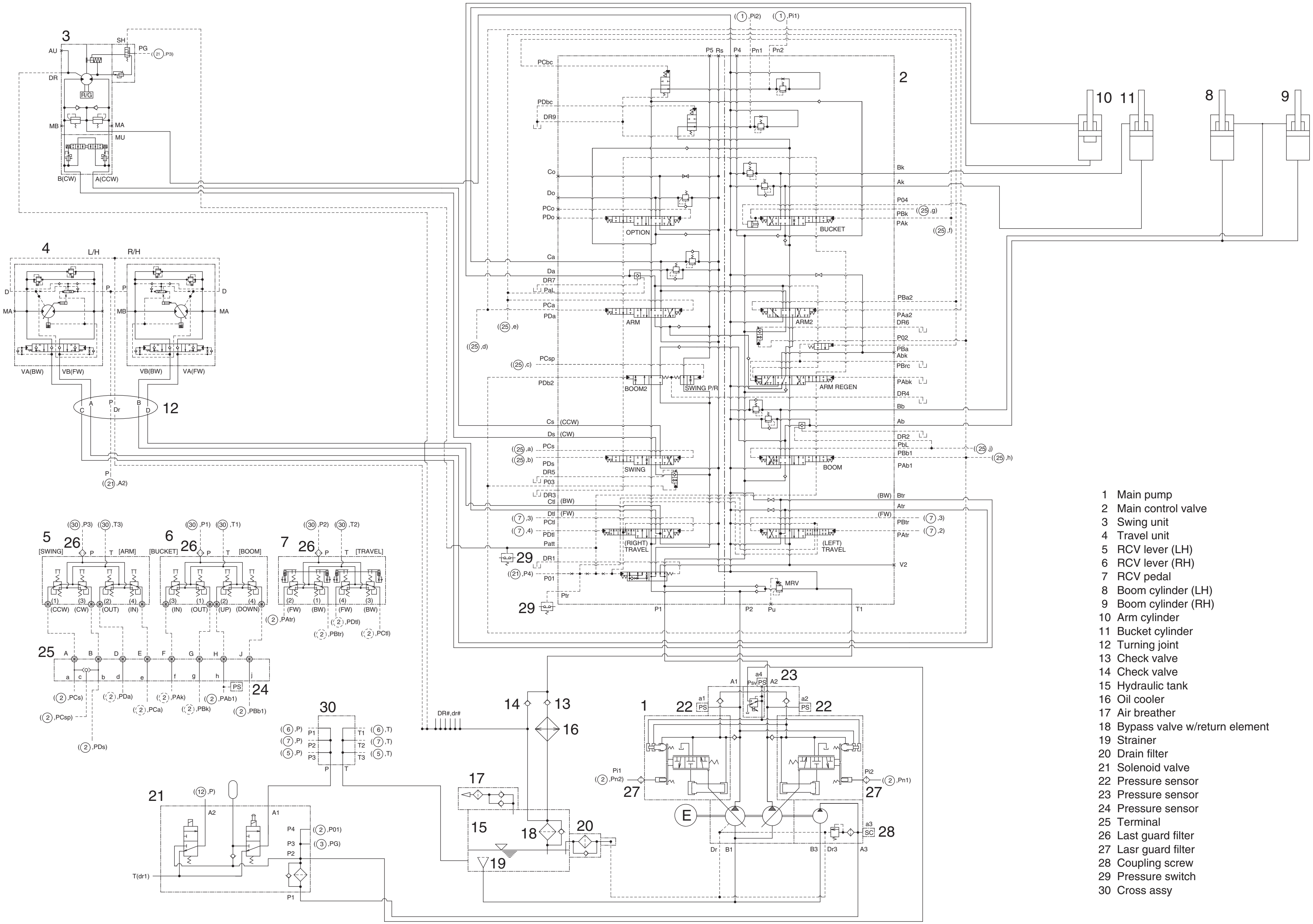
130ZF2RP04

When the push rod (13) is stroked, the spool (7) 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)

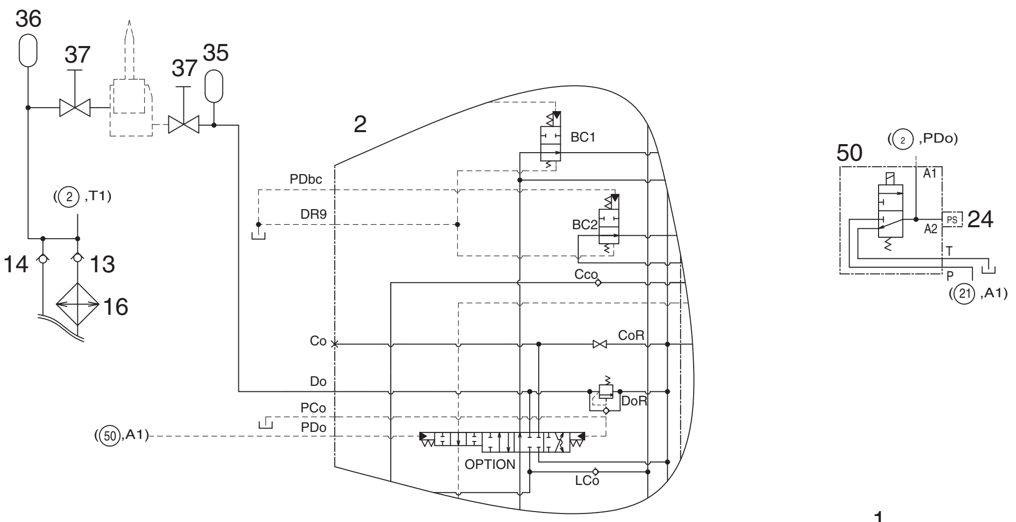


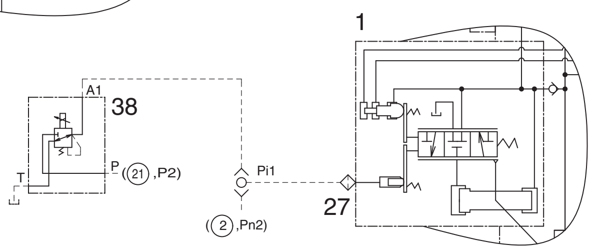
1 Main pump
2 Main control valve
3 Swing unit
4 Travel unit
5 RCV lever (LH)
6 RCV lever (RH)
7 RCV pedal
8 Boom cylinder (LH)
9 Boom cylinder (RH)
10 Arm cylinder
11 Bucket cylinder
12 Turning joint
13 Check valve
14 Check valve
15 Hydraulic tank
16 Oil cooler
17 Air breather
18 Bypass valve w/return element
19 Strainer
20 Drain filter
21 Solenoid valve
22 Pressure sensor
23 Pressure sensor
24 Pressure sensor
25 Terminal
26 Last guard filter
27 Lasr guard filter
28 Coupling screw
29 Pressure switch
30 Cross assy

30Q6-57100-00 1OF2

2. HYDRAULIC CIRCUIT (2/2)

<1-WAY OPTION>





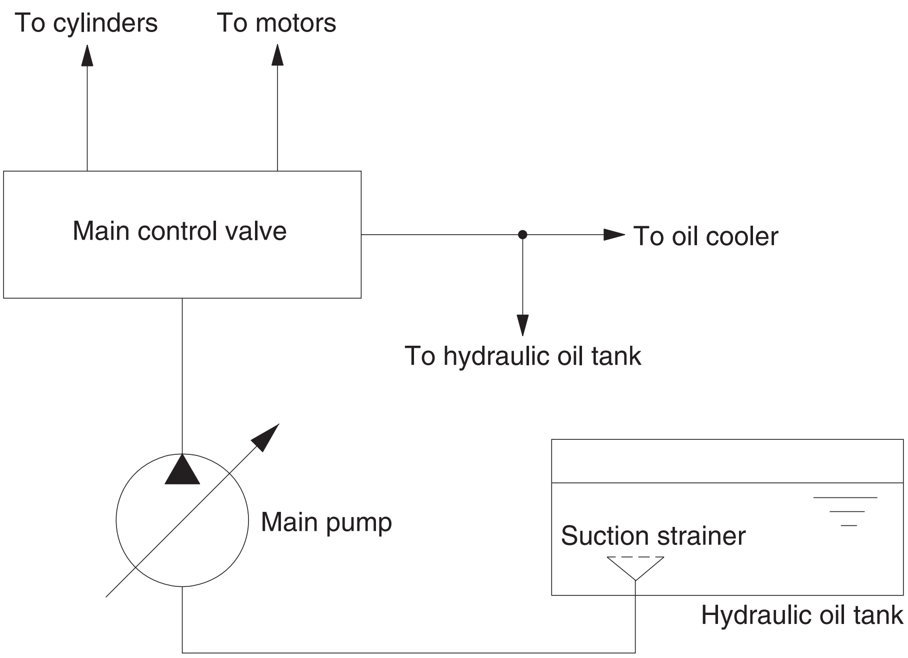
1 Main pump
2 Main control valve
13 Check valve
14 Check valve
16 Oil cooler
24 Pressure sensor (option)
35 Accumulator (option)
36 Accumulator (option)
37 Stop valve (option)
38 1-EPPR valve (option)
50 Solenoid valve (option)

30Q6-57100-00 1OF2

GROUP 2 MAIN CIRCUIT

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

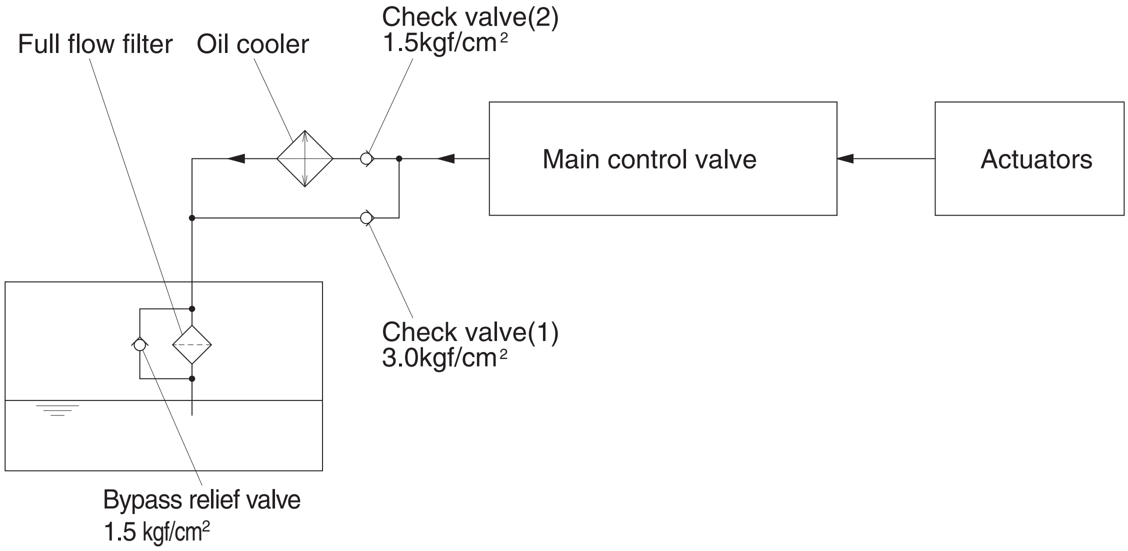
1. SUCTION AND DELIVERY CIRCUIT



140L3CI01

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

2. RETURN CIRCUIT



21073CI01

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

The bypass check valves are provided in the return circuit.

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

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

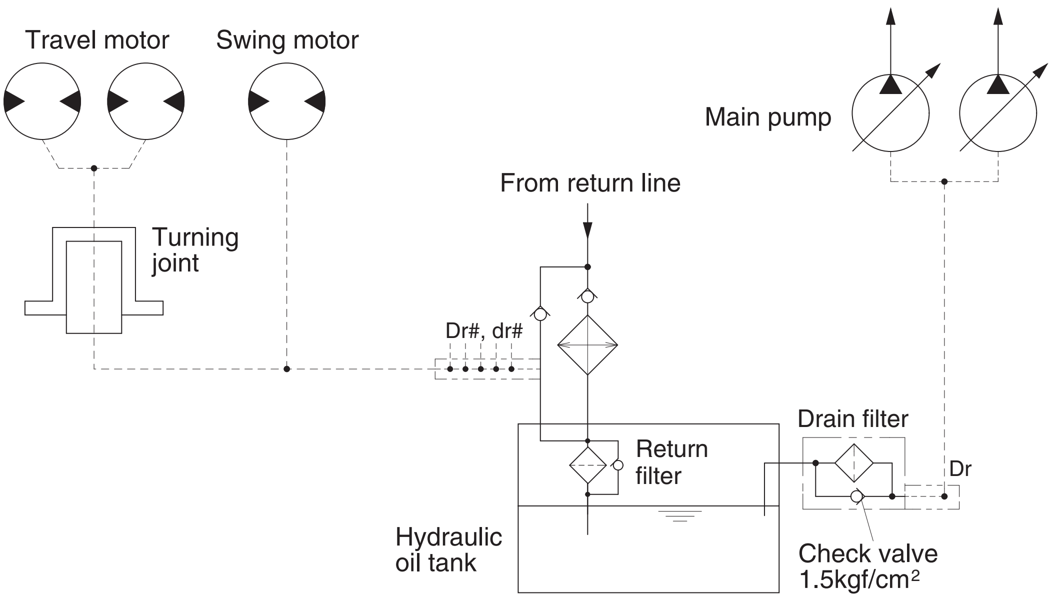
When the oil cooler is clogged, the oil returns directly to the hydraulic tank through bypass check valve (1).

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

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

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

3. DRAIN CIRCUIT



21093CI02

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

1) TRAVEL MOTOR DRAIN CIRCUIT

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

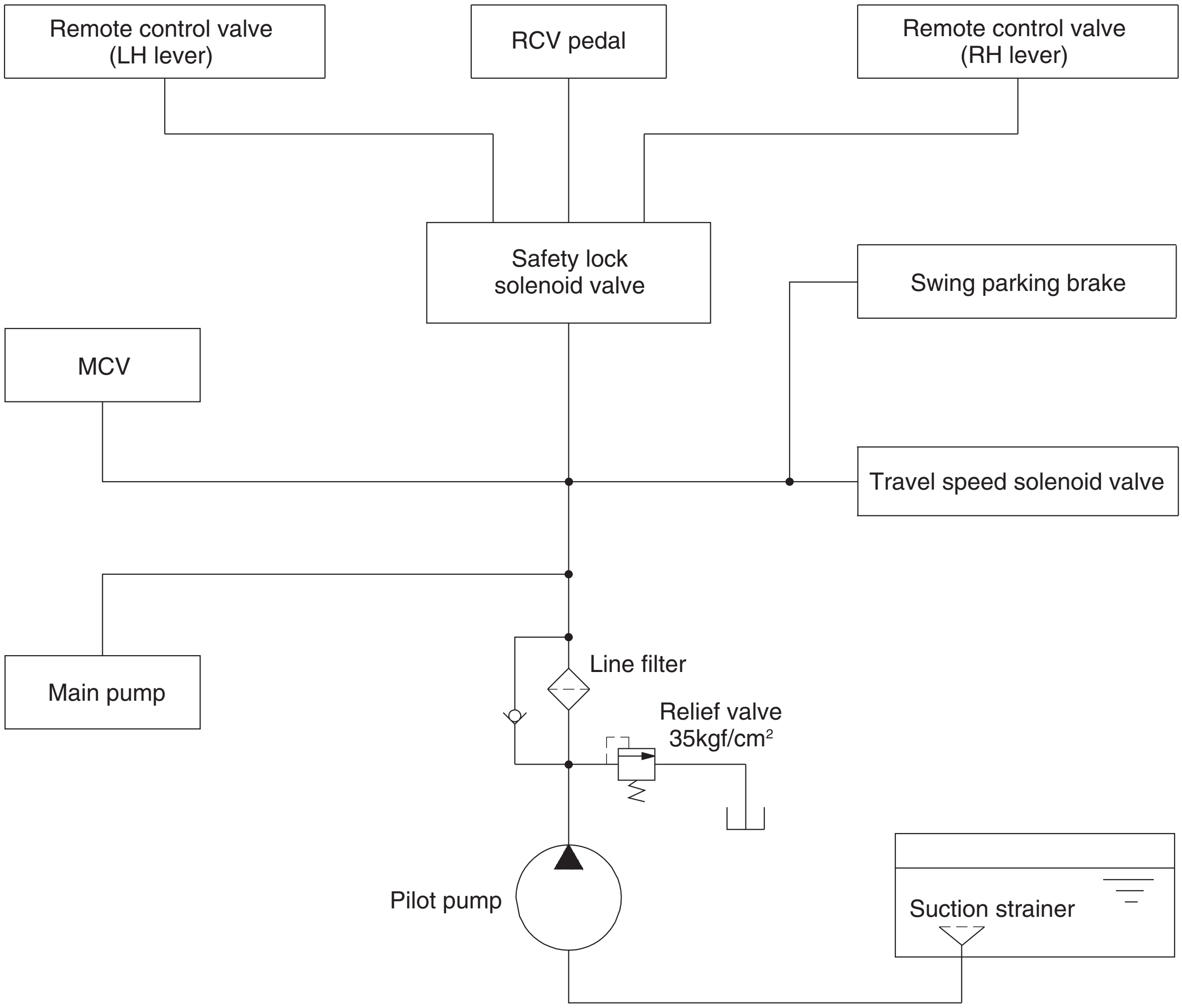
2) SWING MOTOR DRAIN CIRCUIT

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

3) MAIN PUMP DRAIN CIRCUIT

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

GROUP 3 PILOT CIRCUIT



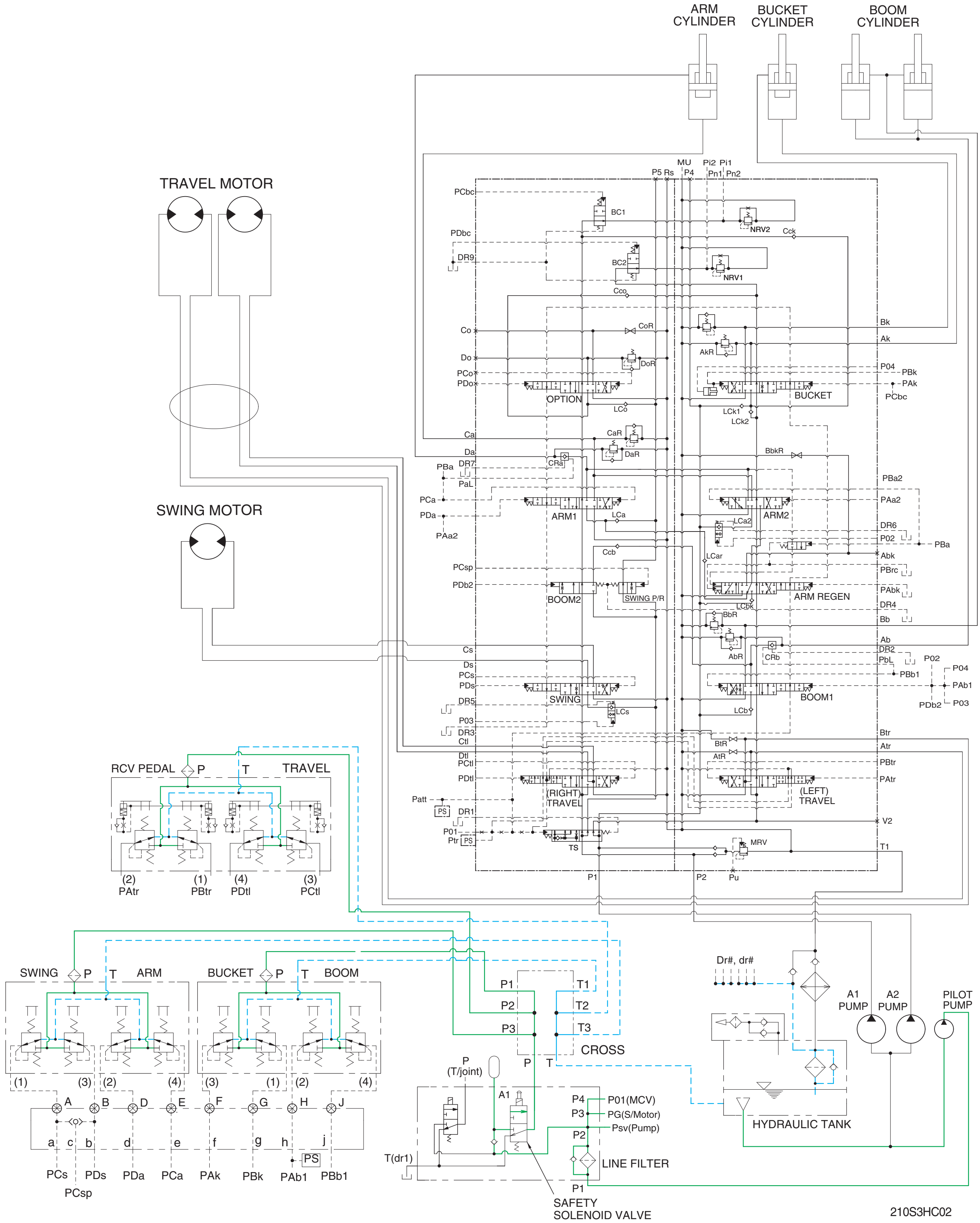
210S3CI03

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, and safety lock solenoid valve and flows to the travel speed solenoid valve, swing parking brake, main control valve and main pump.

1. SUCTION, DELIVERY AND RETURN CIRCUIT

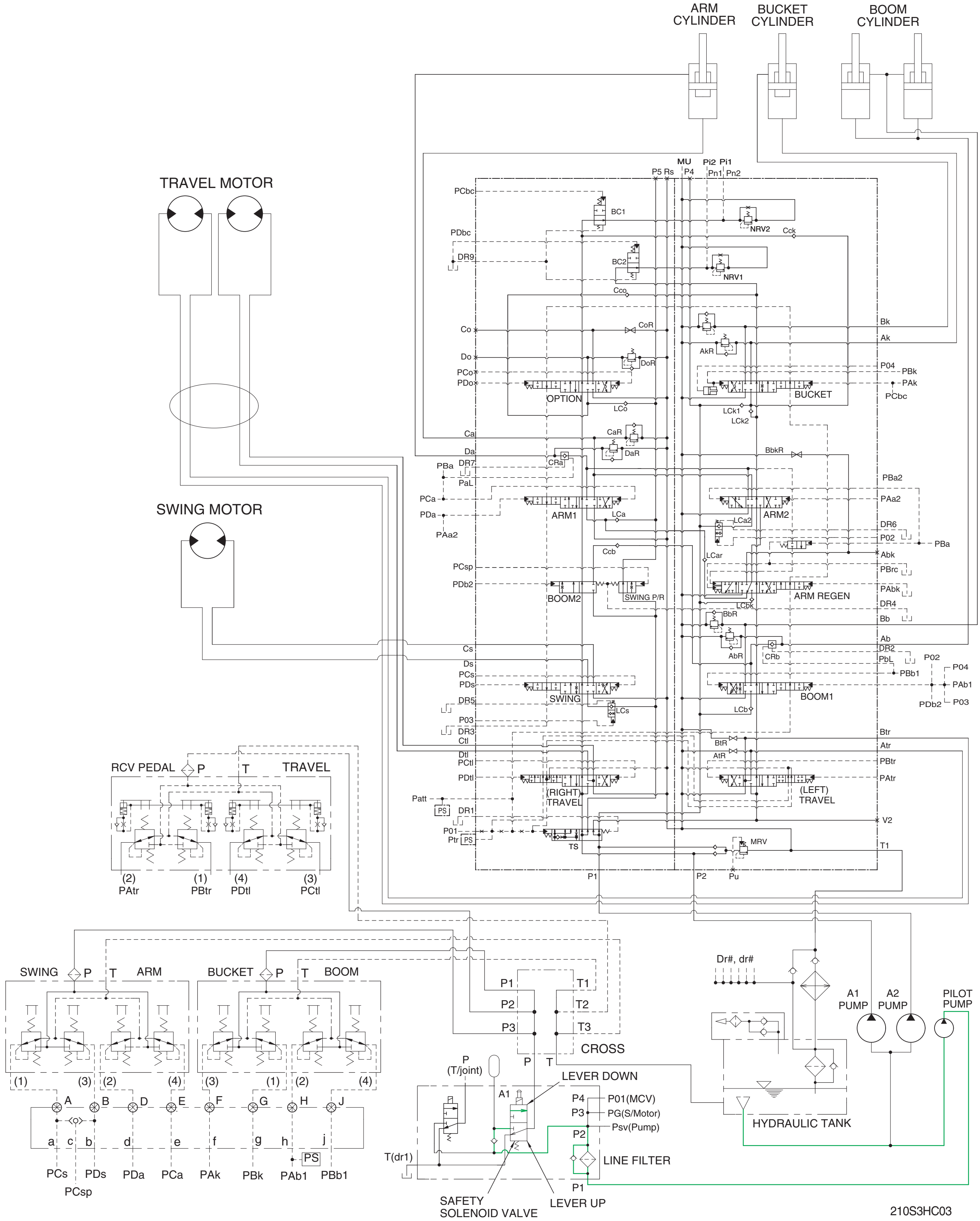


The pilot pump receive oil from the hydraulic tank. The discharged oil from the pilot pump flows to the safety solenoid valve through the line filter. The oil is filtered by the line filter. The pilot relief valve is provided in the pilot pump for limiting the pilot circuit pressure.

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

The return oil flow into the hydraulic tank.

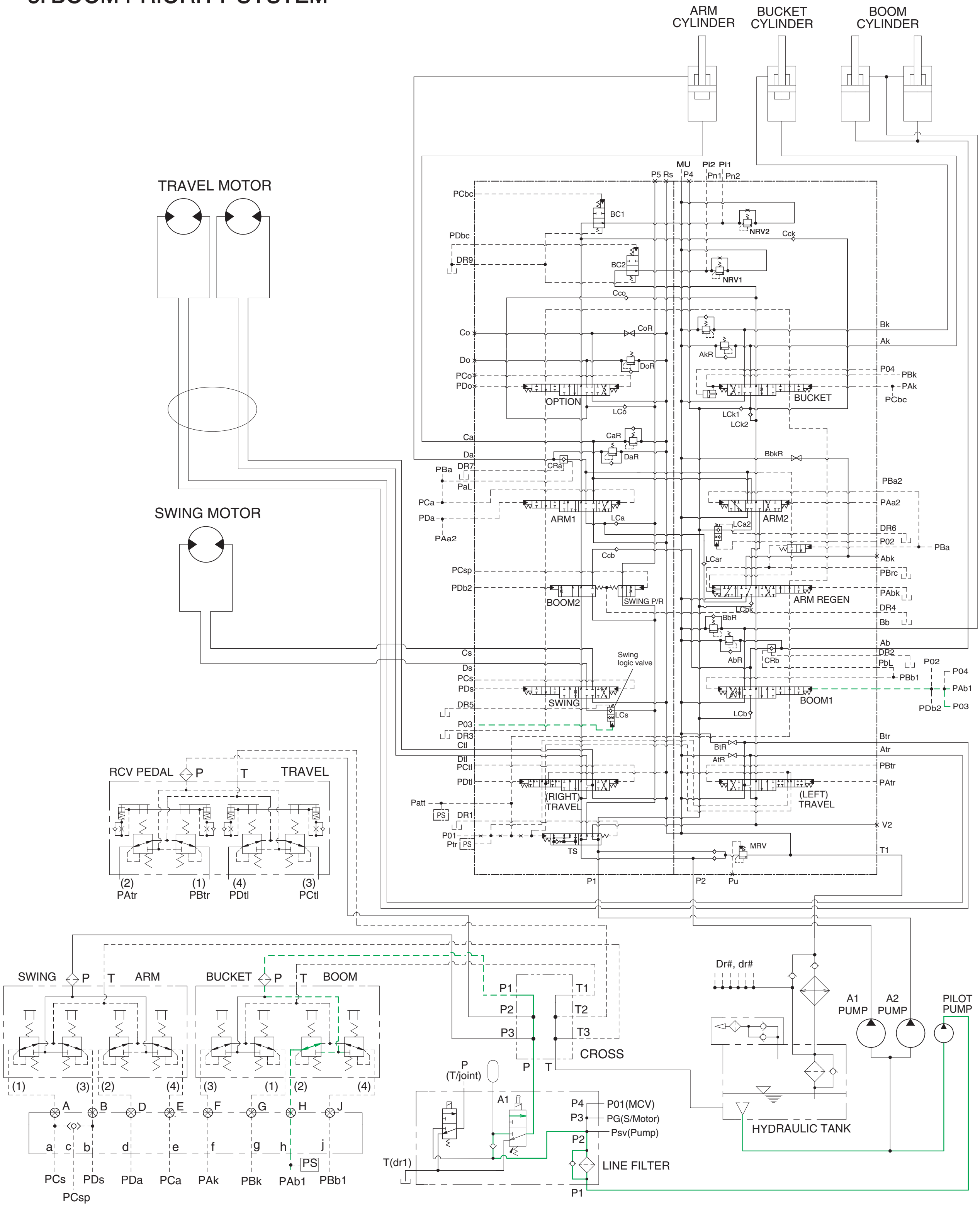
2. SAFETY VALVE (SAFETY LEVER)



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

3. BOOM PRIORITY SYSTEM



210S3HC04

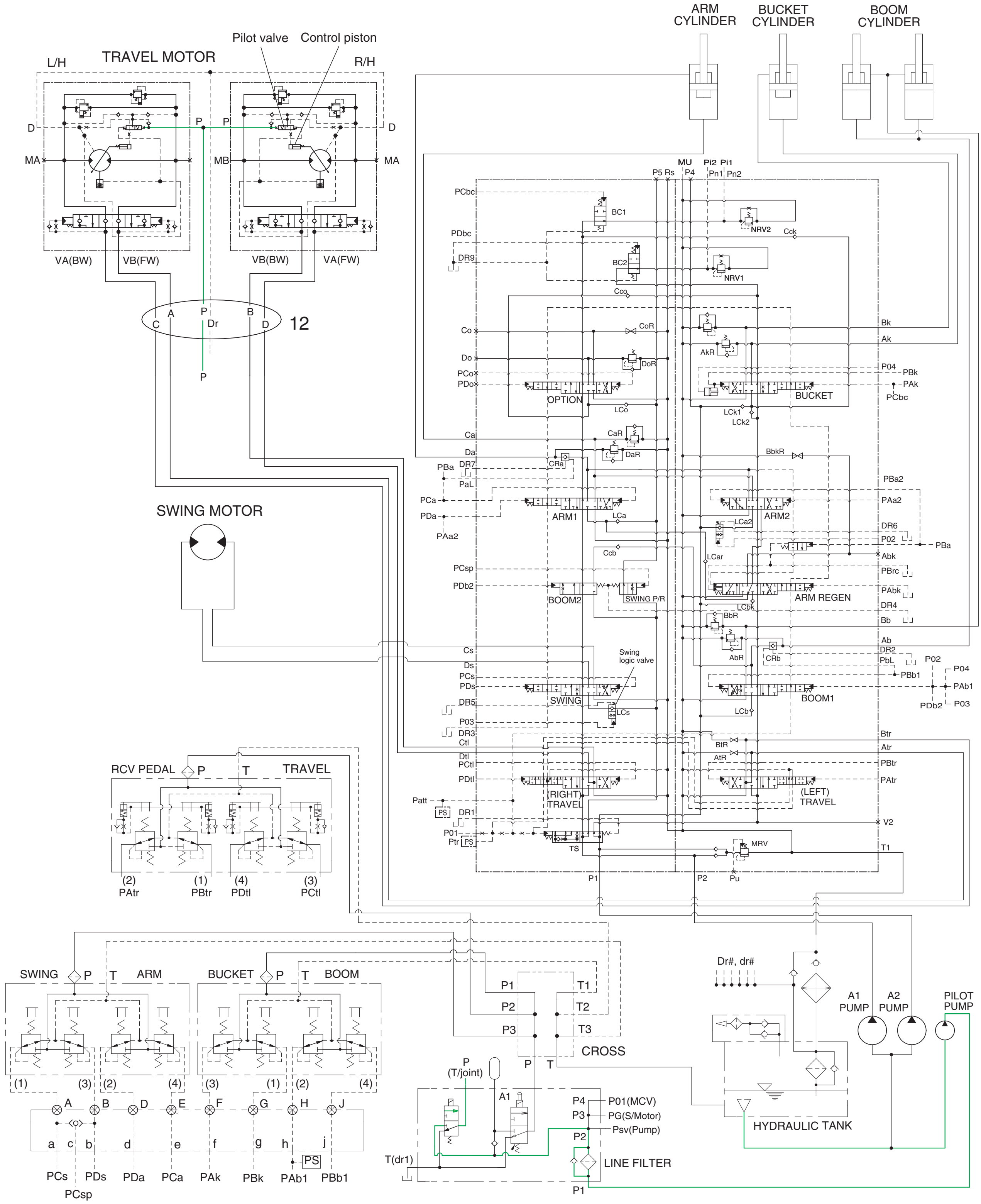
When carrying out the combined operation of swing and boom up, the boom up operating speed is lowered then normal operation.

To increase working efficieny, swing speed reducing system is used.

When the boom up control lever is operated, the pilot oil from the pilot oil pump flows into the swing logic valve in the main control valve and oil flow rate to the swing motor decreased. Then, the boom up speed is increased.

This is called the boom priority system.

4. TRAVEL SPEED CONTROL SYSTEM



210S3HC05

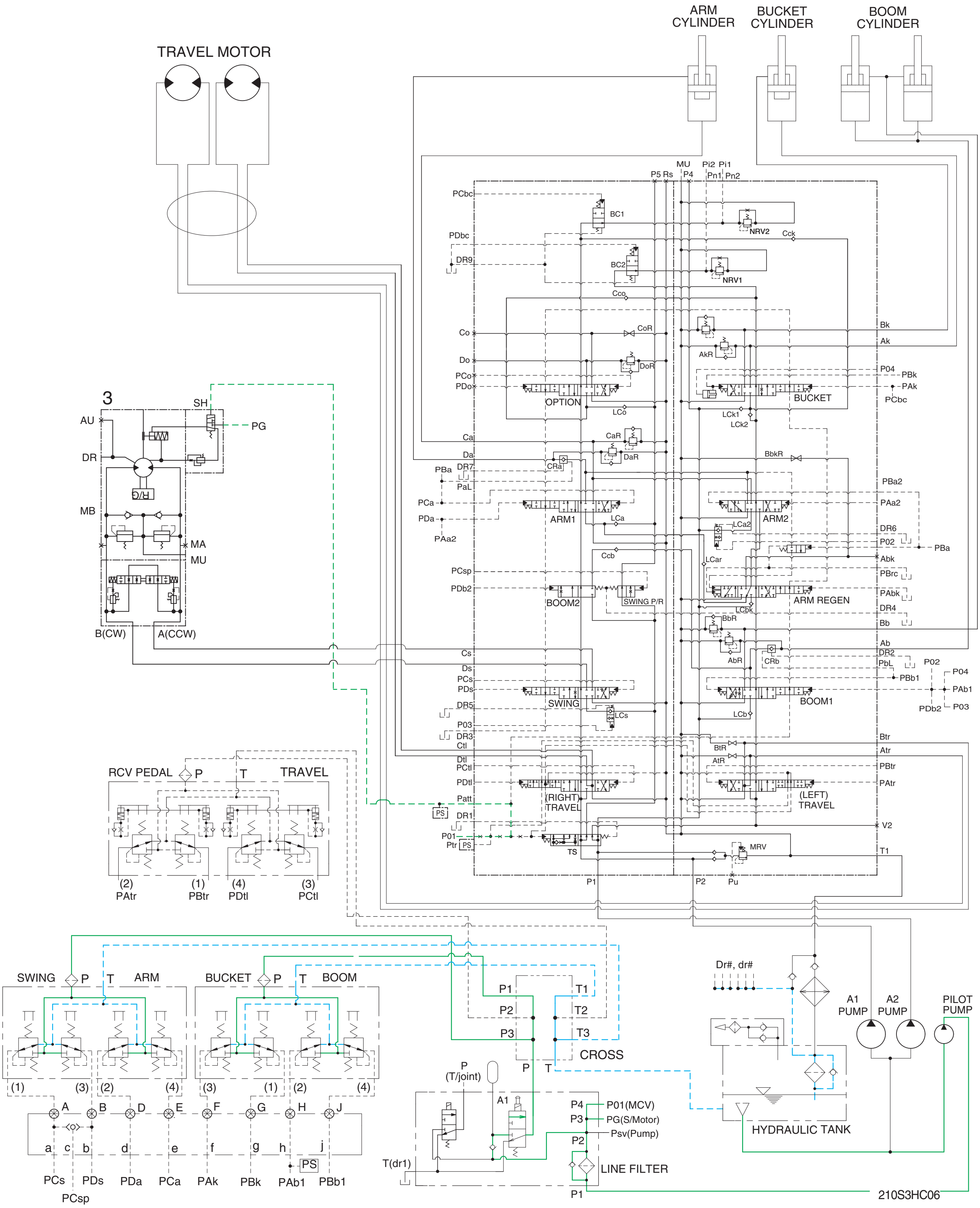
When the travel speed switch is pushed, the travel speed solenoid valve is actuated and the discharged oil from the pilot pump flows to the P port of pilot valve in the travel motors.

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

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

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

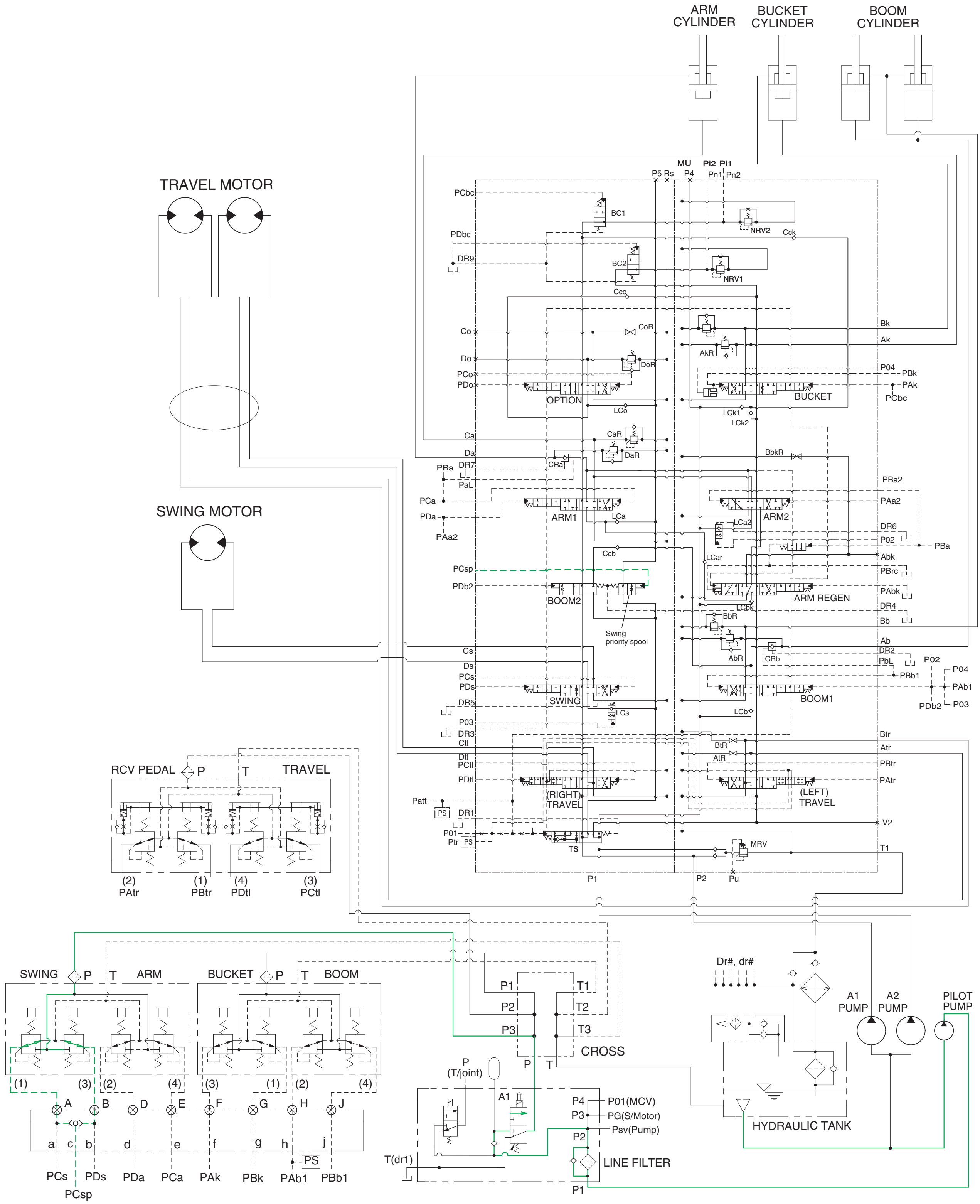
5. SWING PARKING BRAKE RELEASE



When one of the RCV lever (except travel lever) is tilted, the pilot oil flows into SH port through the main control valve, this pressure move spool so, discharged oil from pilot valve flow into PG port. This pressure is applied to swing motor disc, thus the brake is released.

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

6. SWING PRIORITY SYSTEM



210S3HC07

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

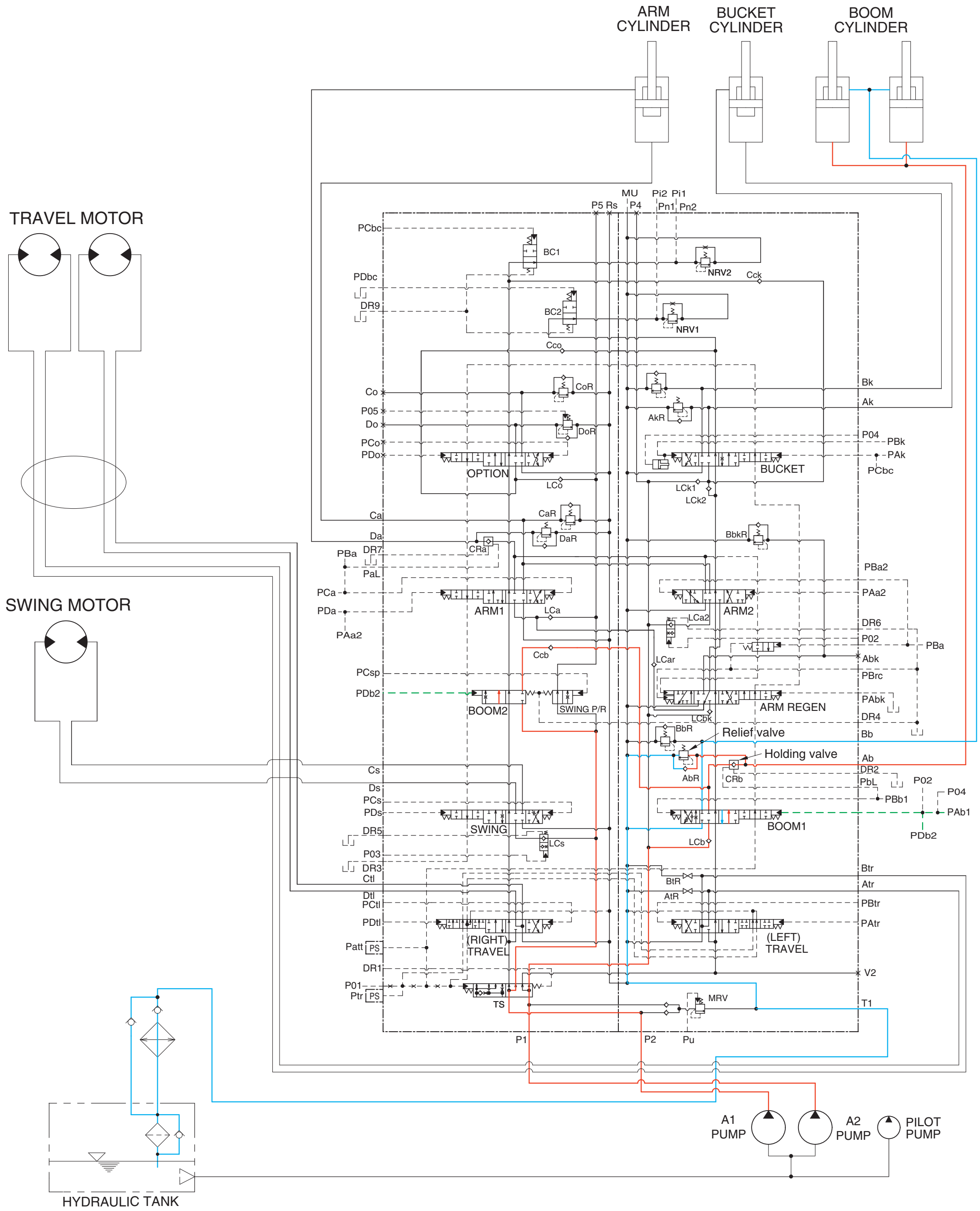
PCsp pressure from the swing shuttle block change the swing priority spool and decreases the oil flow rate to the next section to make the swing operation most preferential.

This is called the swing priority system.

For details, refer to page 2-48.

GROUP 4 SINGLE OPERATION

1. BOOM UP OPERATION



220S3HC09

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

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

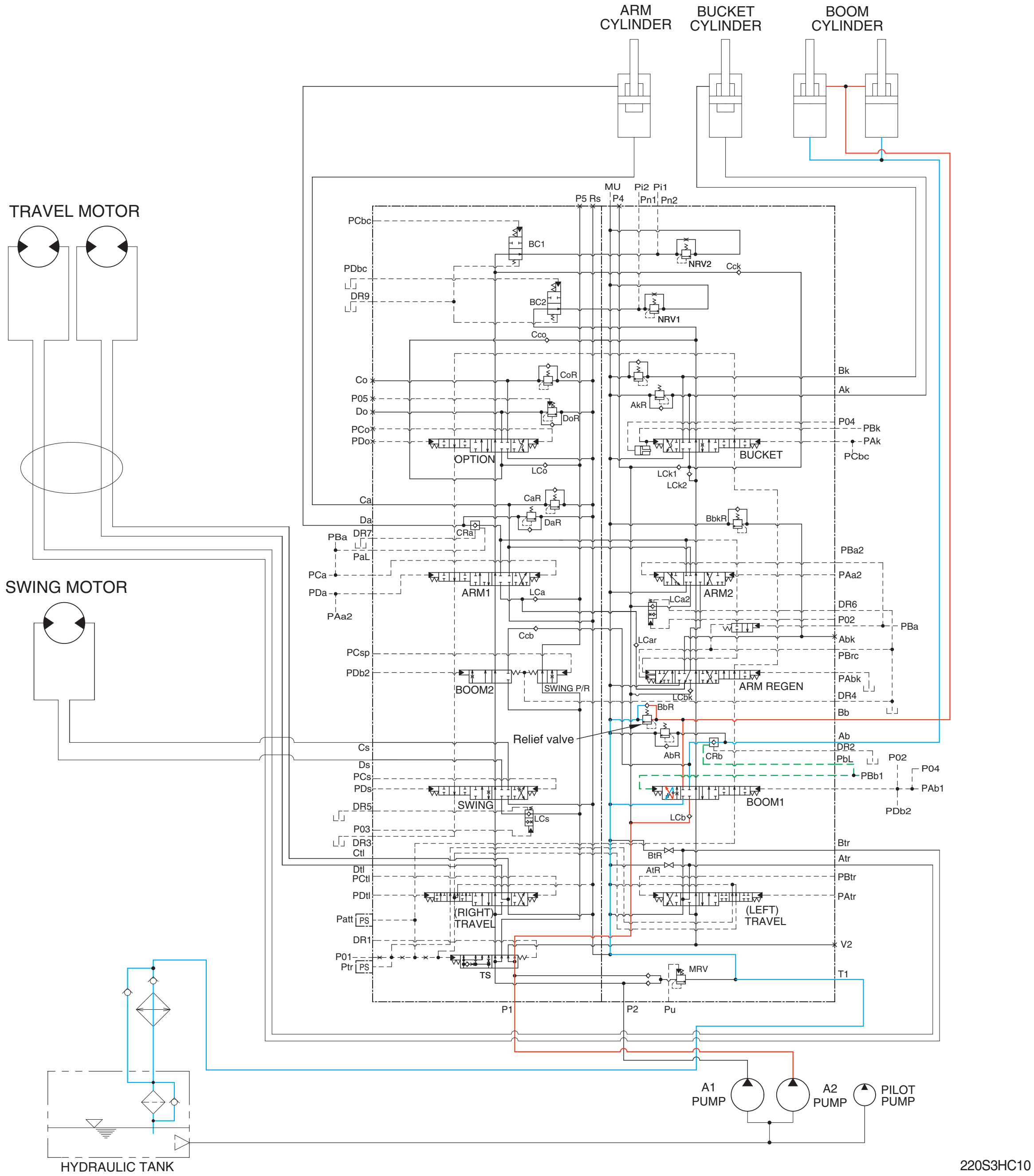
At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom1 spool in the main control valve. When this happens, the boom goes up.

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

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

This prevents the hydraulic drift of boom cylinder.

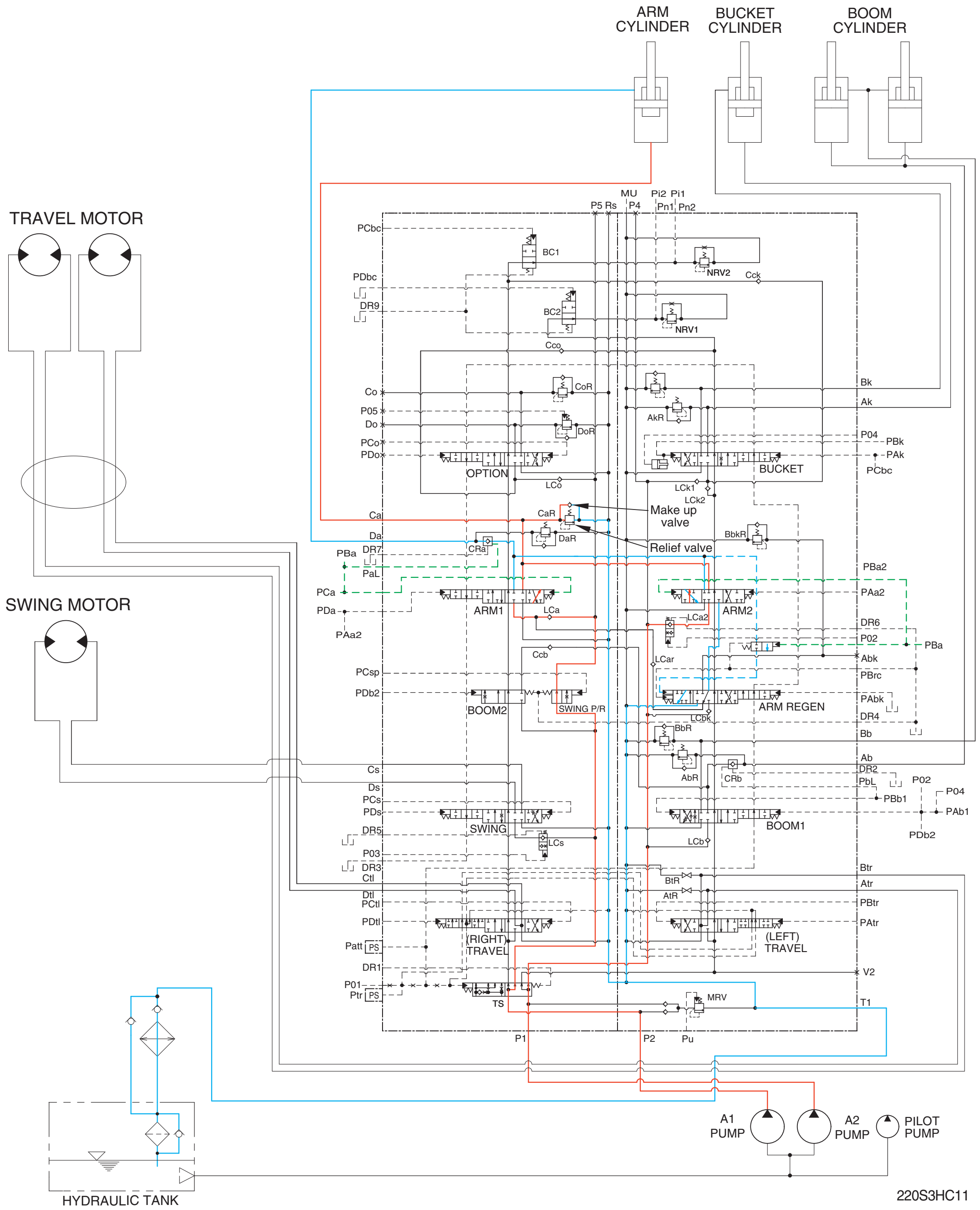
2. BOOM DOWN OPERATION



220S3HC10

When the right control lever is pushed forward, the boom 1 spool in the main control valve is moved to the down position by the pilot oil pressure from the remote control valve.
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom 1 spool in the main control valve.
When the down speed of boom is faster, the oil returned from the large chamber of boom cylinder combines with the oil from the A2 pump, and flows into the small chamber of the cylinder.
This prevents cylinder cavitation by the negative pressure when the A2 pump flow can not match the boom down speed. And the excessive pressure in the boom cylinder rod side is prevented by the relief valve.

3. ARM IN OPERATION



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

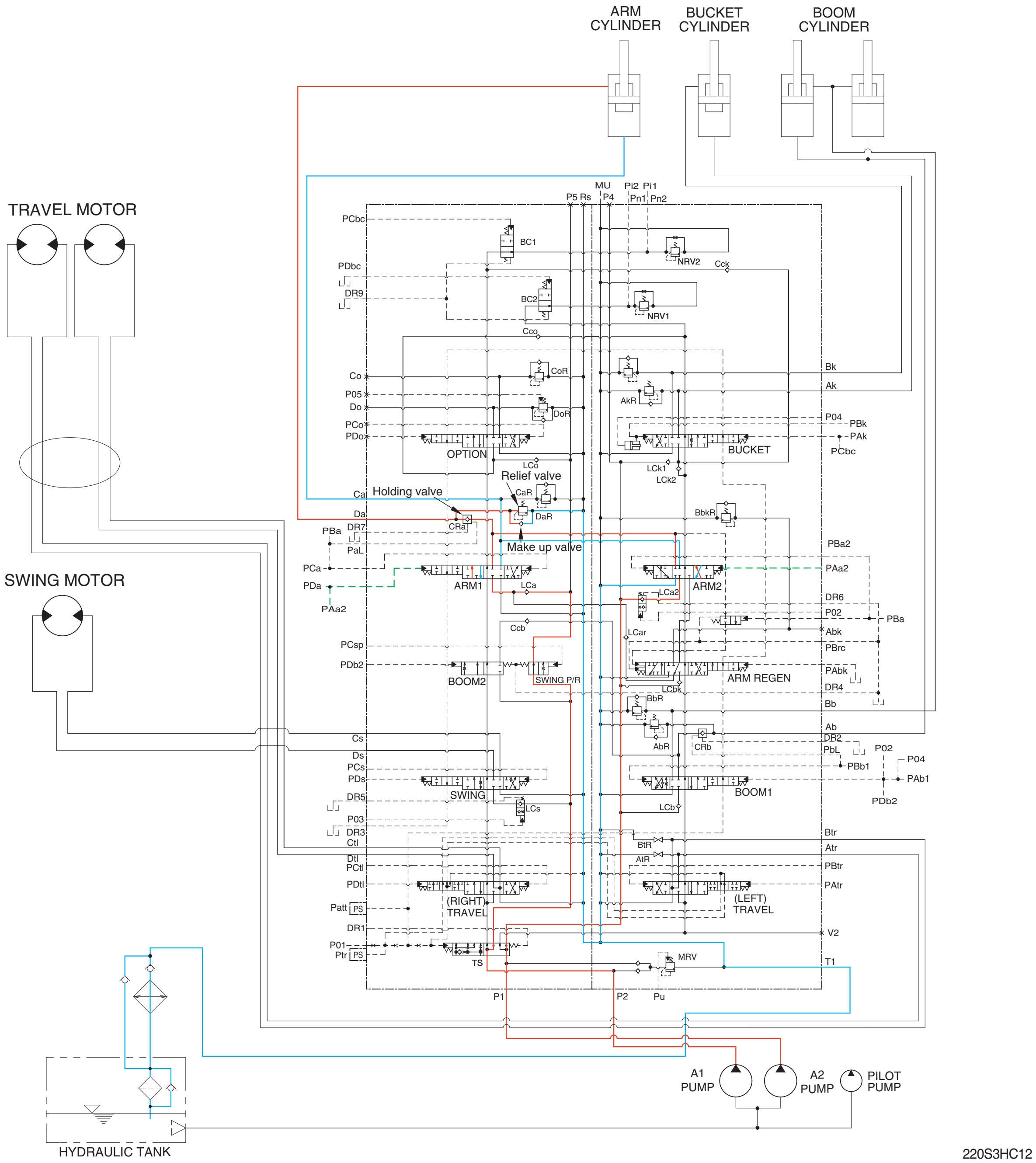
The oil from the A1 and A2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

At the same time, the oil from small chamber of arm cylinder returns to the hydraulic oil tank through the arm 2 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 makeup valve in the main control valve.

4. ARM OUT OPERATION



220S3HC12

When the left 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 A1 and A2 pump flows into the main control valve and then goes to the small chamber of arm cylinder.

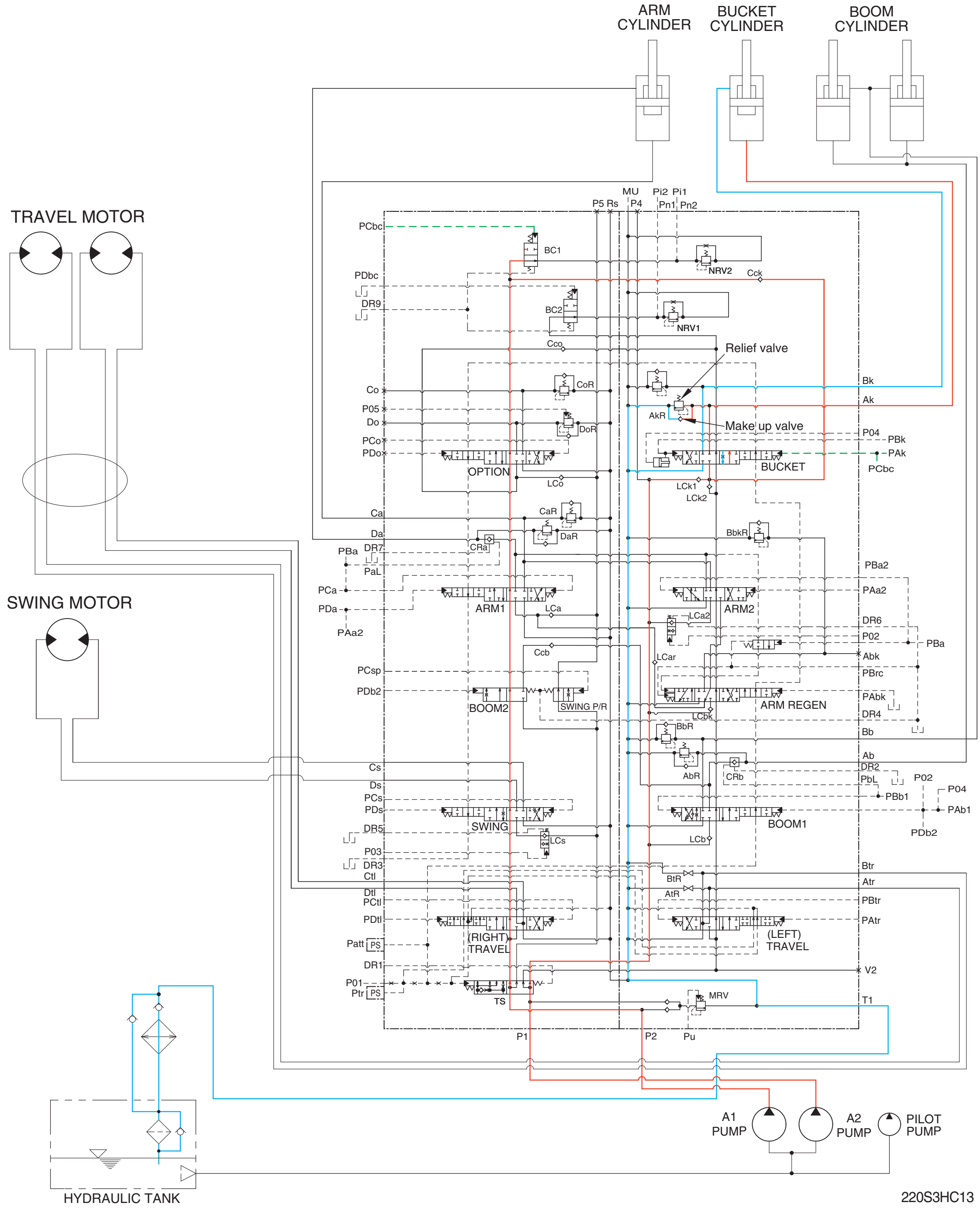
At the same time, the oil from the large chamber of arm cylinder returns to the hydraulic oil tank through the arm spools in the main control valve. When this happens, the arm rolls out.

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 makeup valve in the main control valve.

5. BUCKET IN OPERATION



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

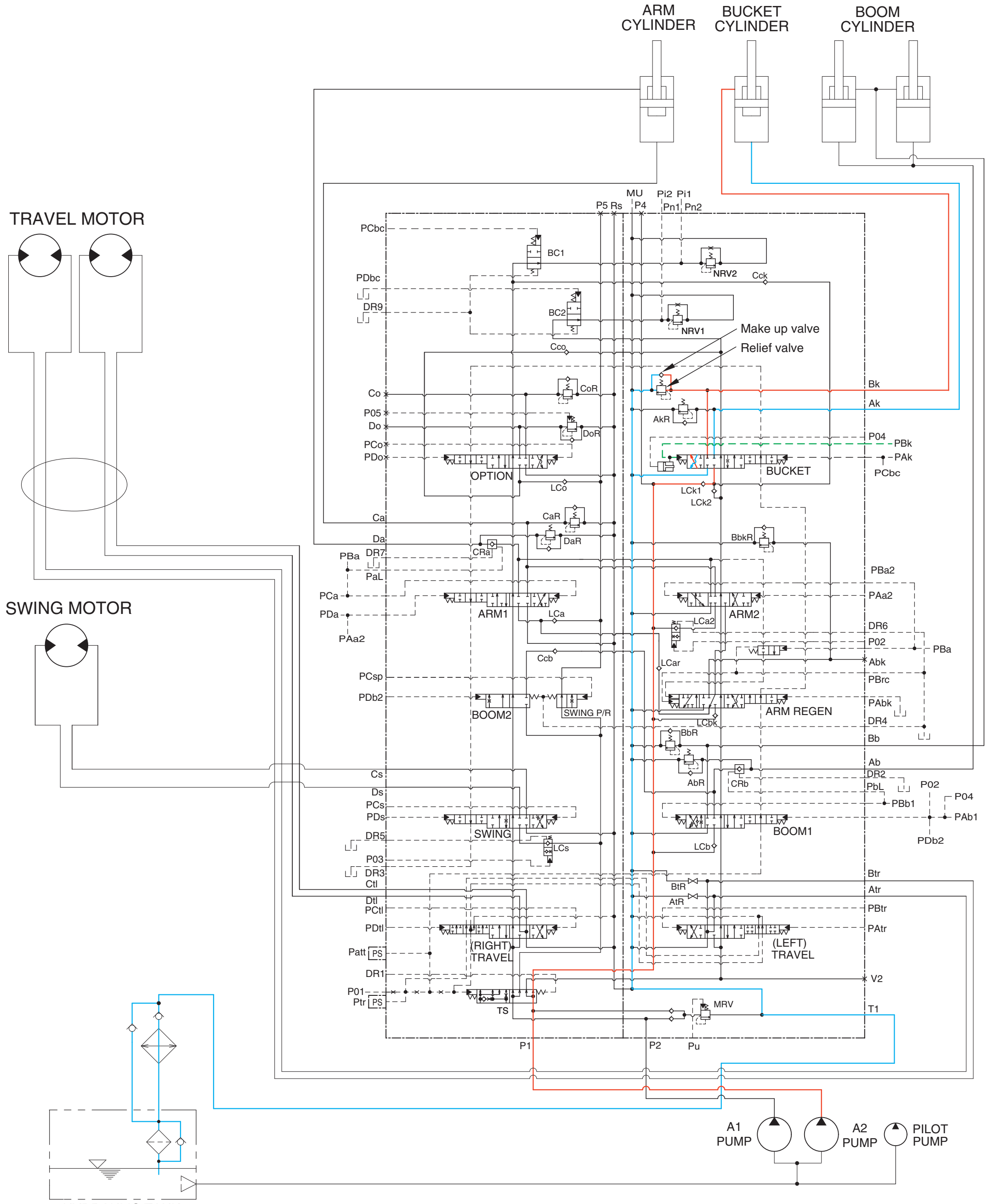
The oil from the A2 pump flows into the main control valve and then goes to the large chamber of bucket cylinder. The oil form the A1 pump flows into the large chamber of bucket cylinder through confluence oil passage in the main control valve by bypass cut pilot pressure (PCbc).

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

6. BUCKET OUT OPERATION



220S3HC14

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

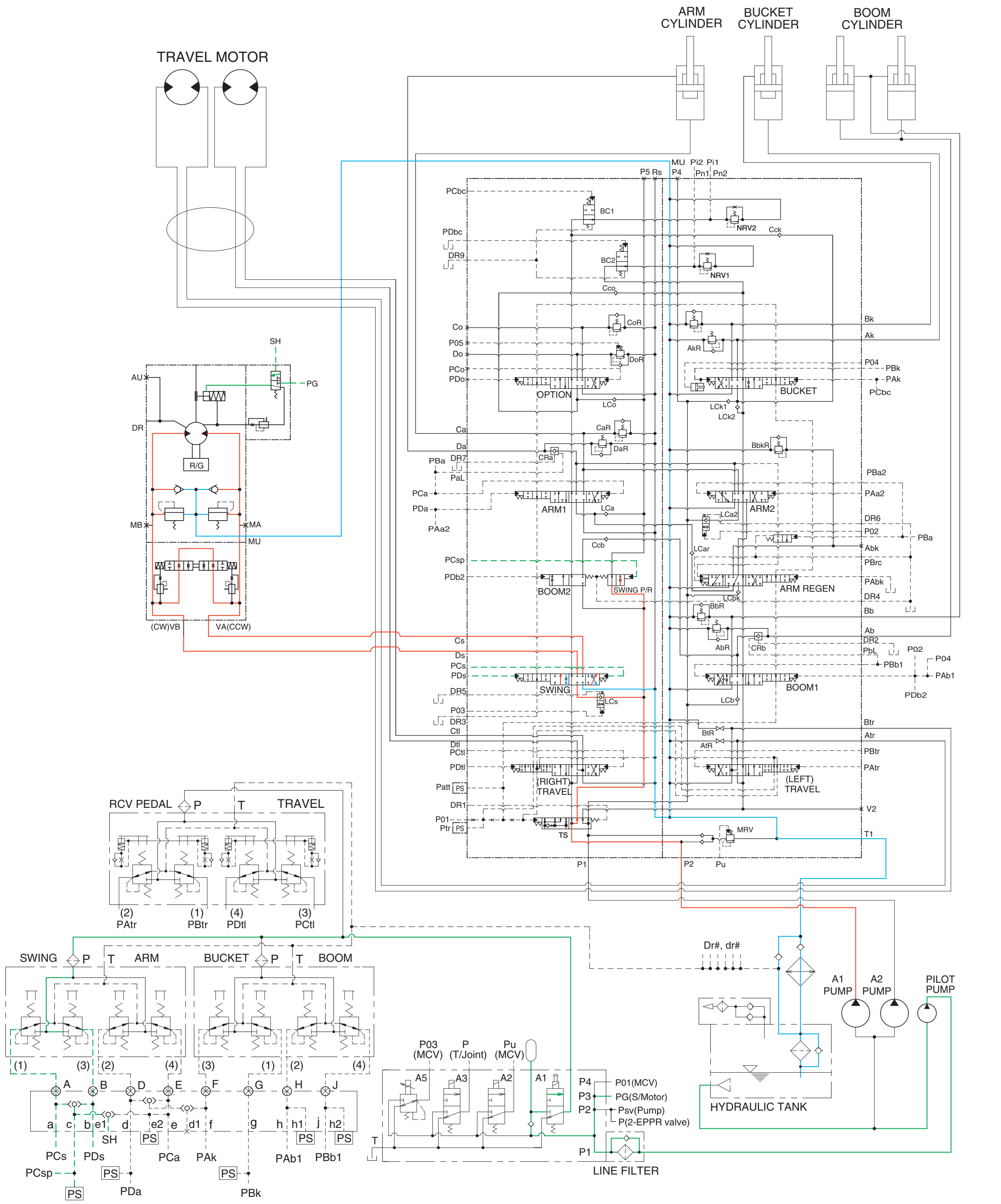
The oil from the A2 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

The 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 makeup valve in the main control valve.

7. SWING OPERATION



220S3HC15

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

Also the swing operation preference function is operated by the pilot pressure PCsp (refer to page 2-48).

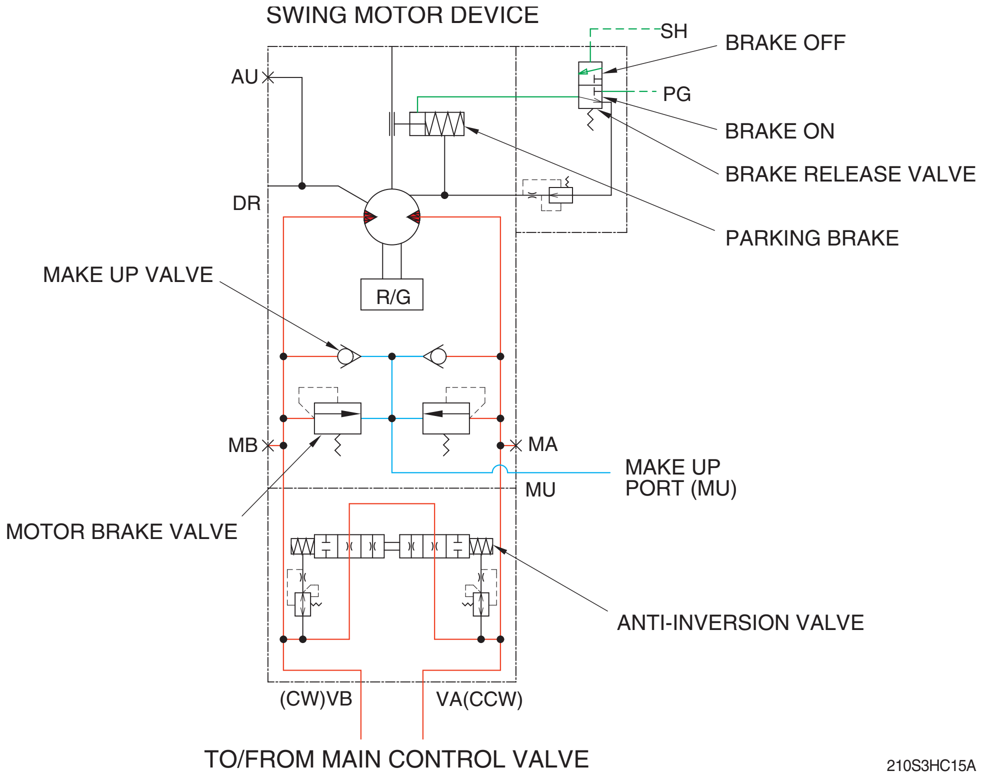
The oil from the A1 pump flows into the main control valve and then goes to the swing motor.

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

When this happens, the 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.

SWING CIRCUIT OPERATION



1) MOTOR BRAKE VALVE

Motor brake valve for the swing motor limits to cushion the starting and stopping pressure of swing operation and controls the swing motor operating pressure to 240 kgf/cm^2 (3414 psi).

2) MAKE UP VALVE

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

3) PARKING BRAKE

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

PARKING BRAKE "OFF" OPERATION

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

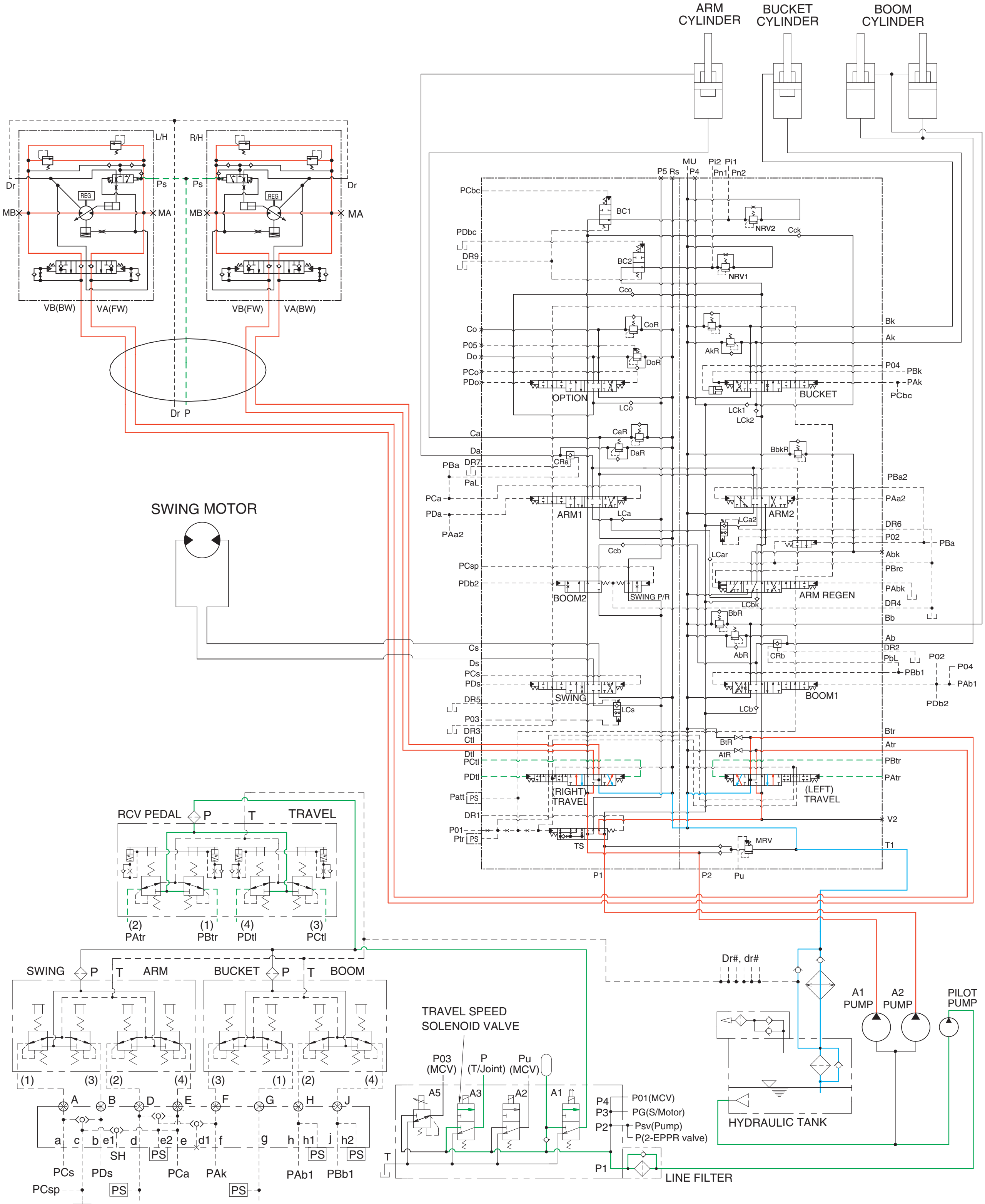
PARKING BRAKE "ON" OPERATION

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

4) ANTI-INVERSION VALVE

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

8. TRAVEL FORWARD AND REVERSE OPERATION



220S3HC16

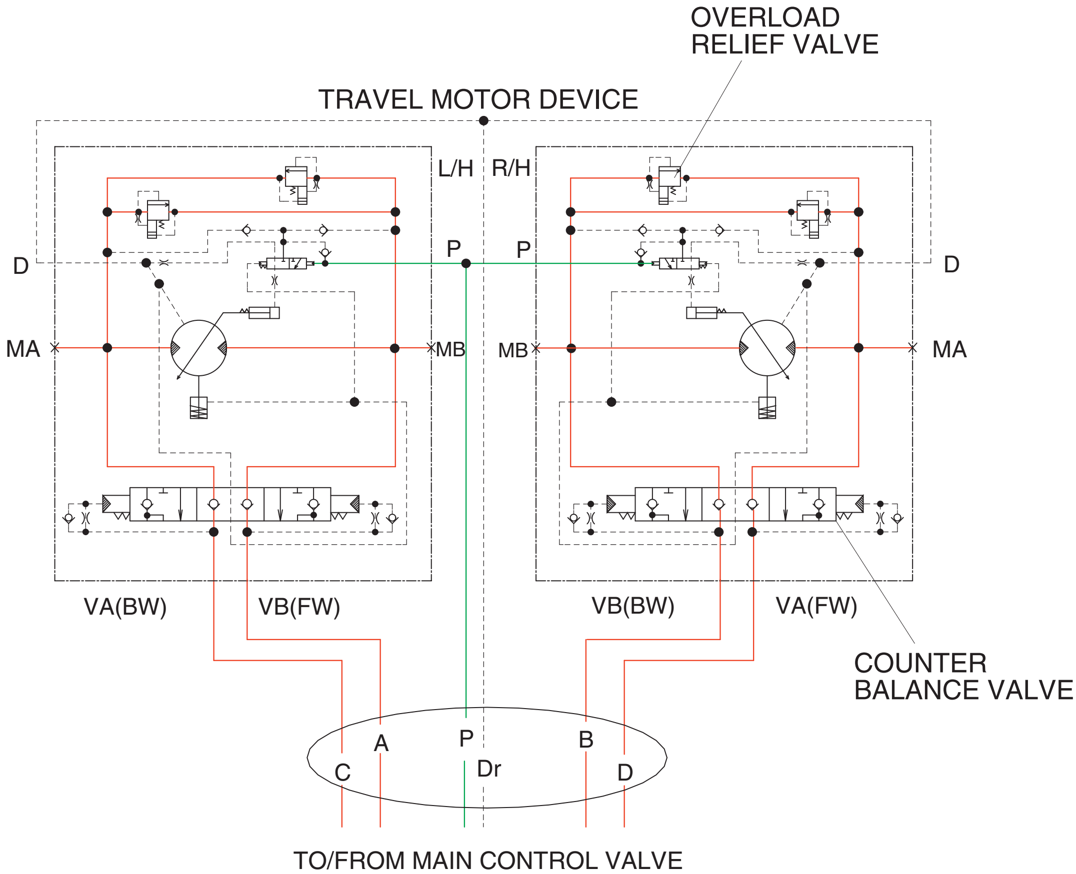
When the travel levers are pushed forward or reverse position, the travel spools in the main control valve are moved to the forward or reverse travel position by the pilot oil pressure from the remote control valve.

The oil from the each 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.

TRAVEL CIRCUIT OPERATION



210S3HC16A

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

1) COUNTER BALANCE VALVE

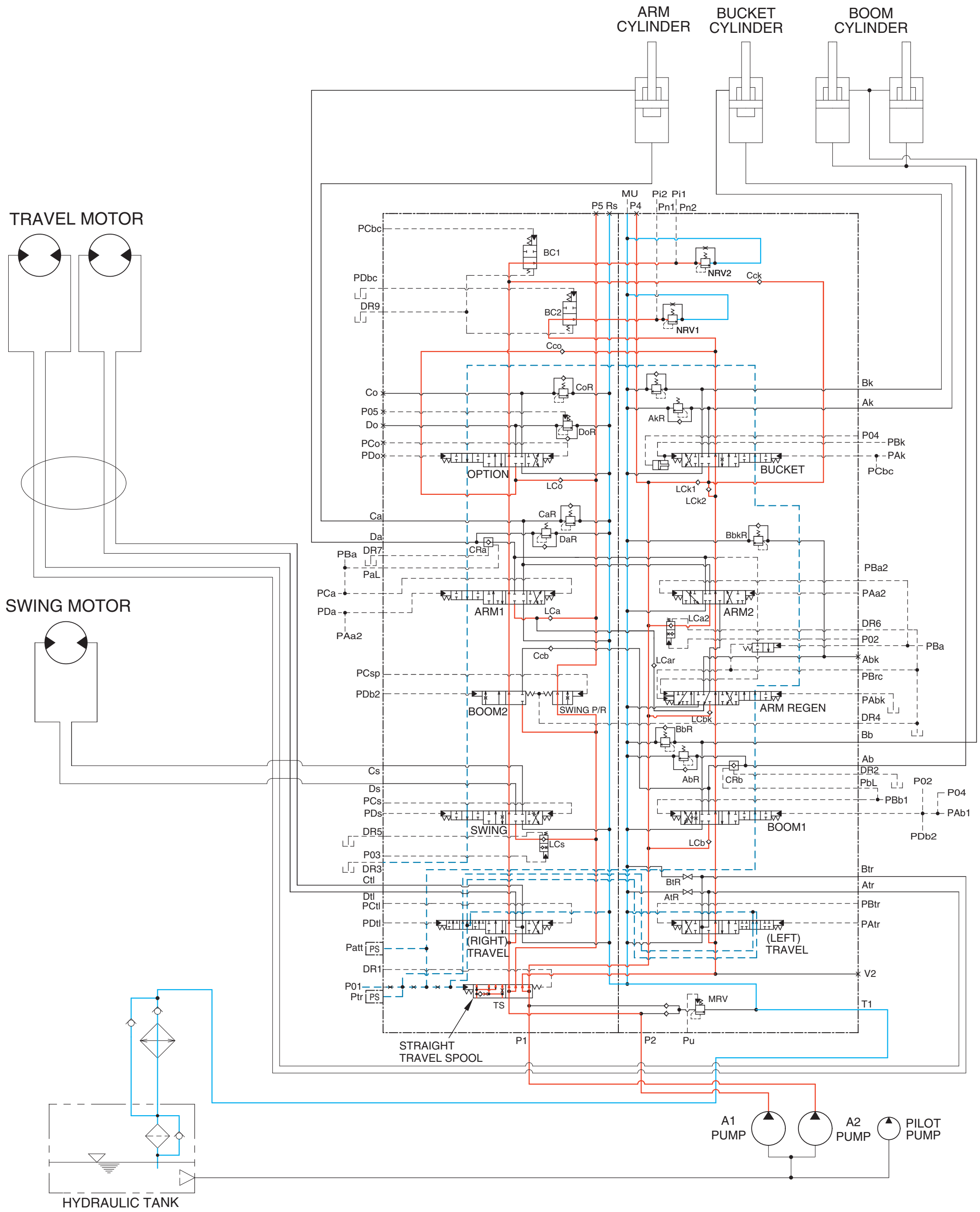
When stopping the motor of slope descending, this valve to prevent the motor over run.

2) OVERLOAD RELIEF VALVE

Relief valve limit the circuit pressure below 330 kgf/cm^2 (4695 psi) to prevent high pressure generated at a time of stopping the machine. Stopping the motor, this valve sucks the oil from lower pressure passage for preventing the negative pressure and the cavitation of the motor.

GROUP 5 COMBINED OPERATION

1. OUTLINE



220S3HC17

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

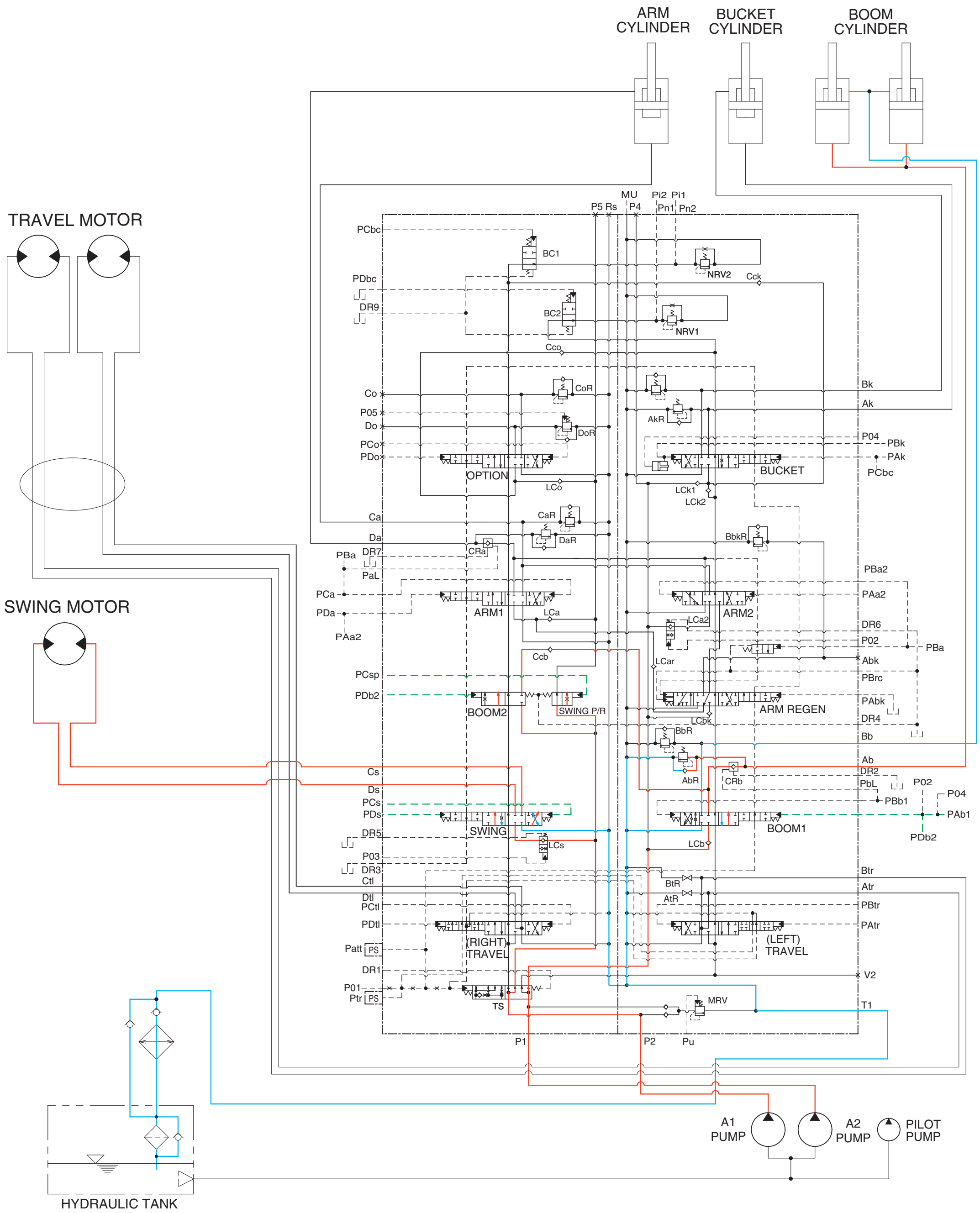
STRAIGHT TRAVEL SPOOL

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

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

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

2. COMBINED SWING AND BOOM UP OPERATION



220S3HC18

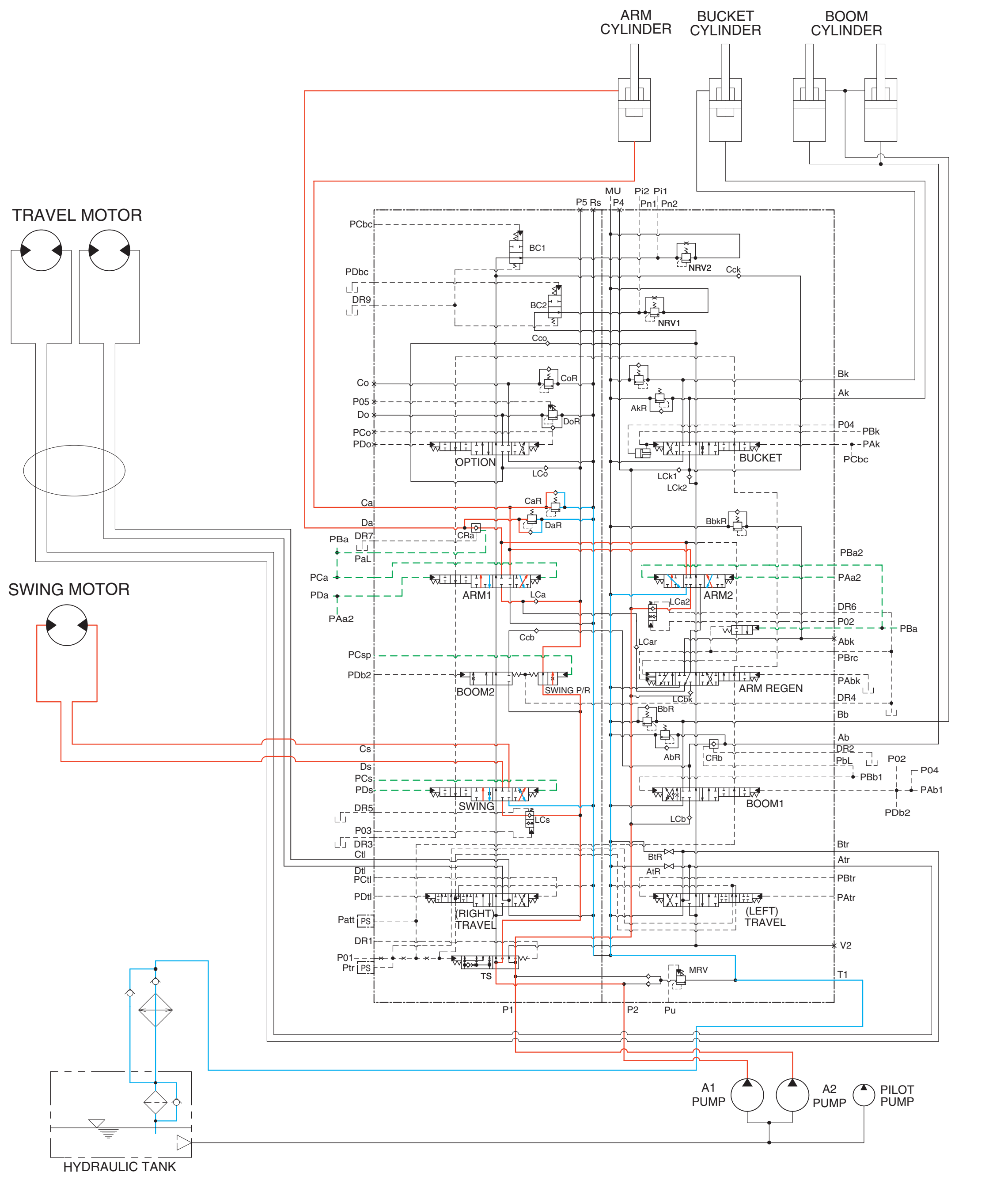
When the swing and boom up functions are operated, simultaneously the swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

The oil from the A2 pump flows into the boom cylinders through the boom 1 spool in the right control valve. The upper structure swings and the boom is operated.

Refer to page 3-9 for the boom priority system.

3. COMBINED SWING AND ARM OPERATION



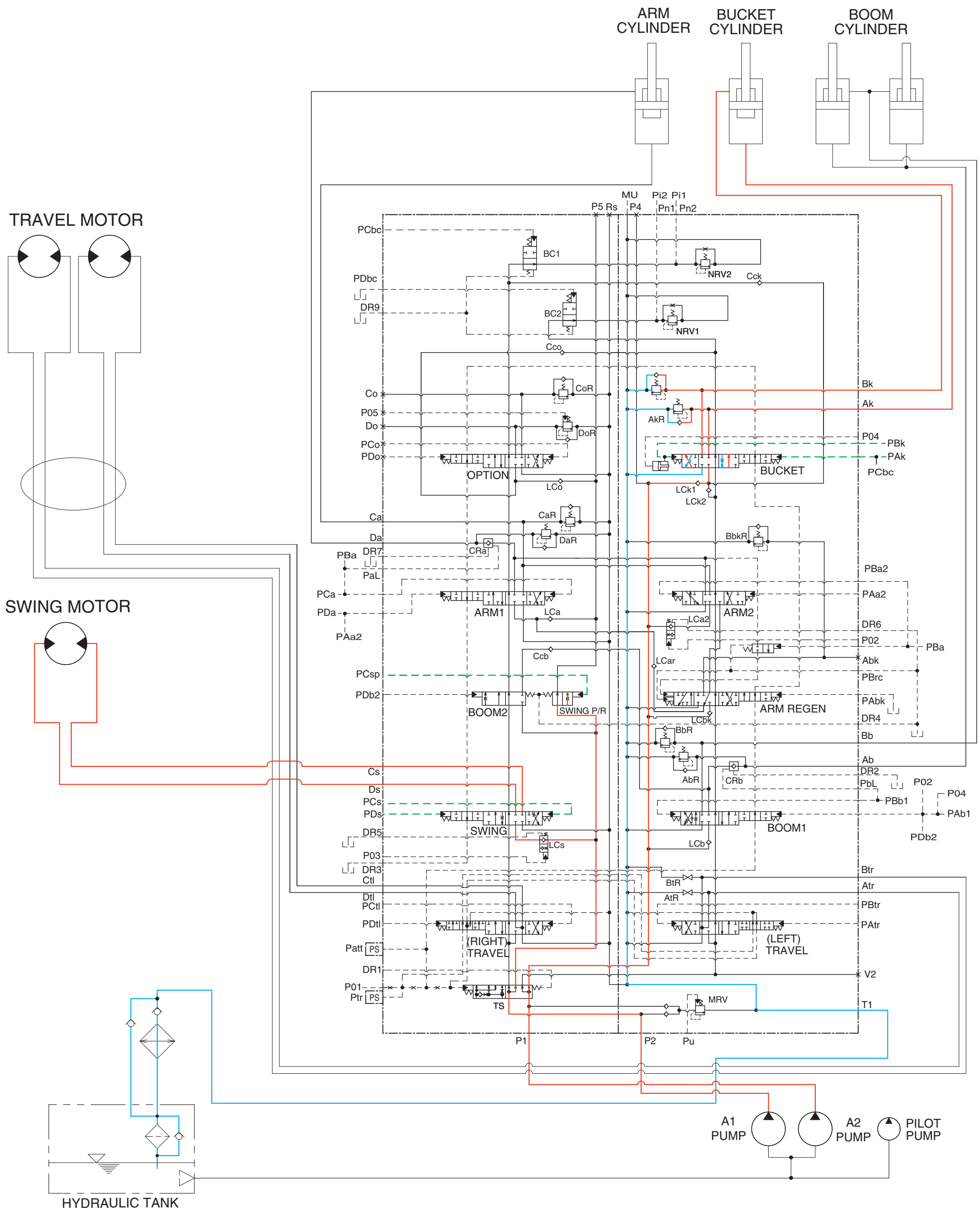
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

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

The oil from the A2 pump flows into the arm cylinder through the arm 2 spool of the right control valve. The upper structure swings and the arm is operated.

Refer to page 2-48 for the swing operation preference function.

4. COMBINED SWING AND BUCKET OPERATION



220S3HC20

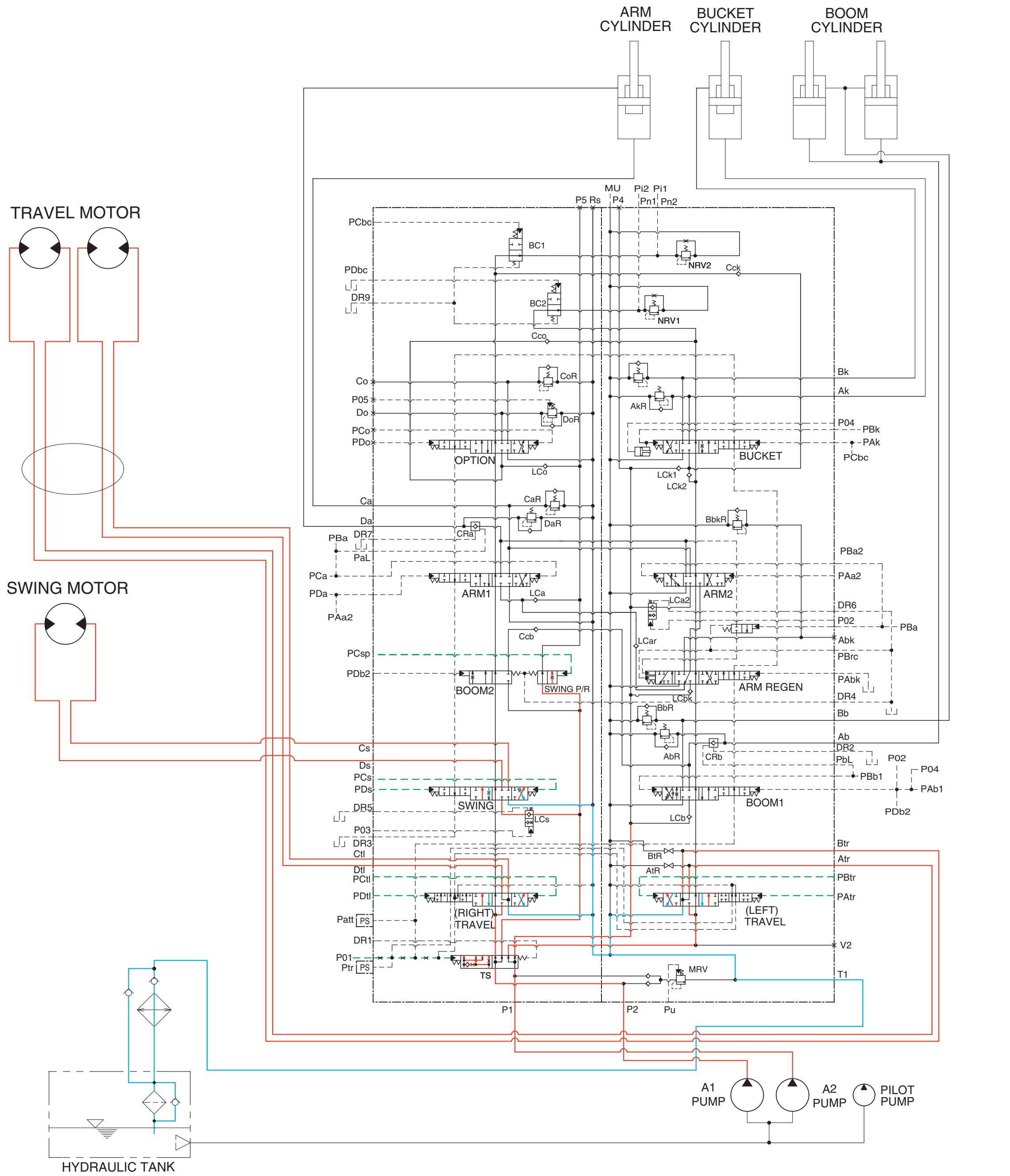
When the swing and bucket functions are operated, simultaneously the swing spool and bucket spool in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the swing motor through the swing spool in the left control valve.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool in the right control valve.

The upper structure swings and the bucket is operated.

5. COMBINED SWING AND TRAVEL OPERATION



220S3HC21

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

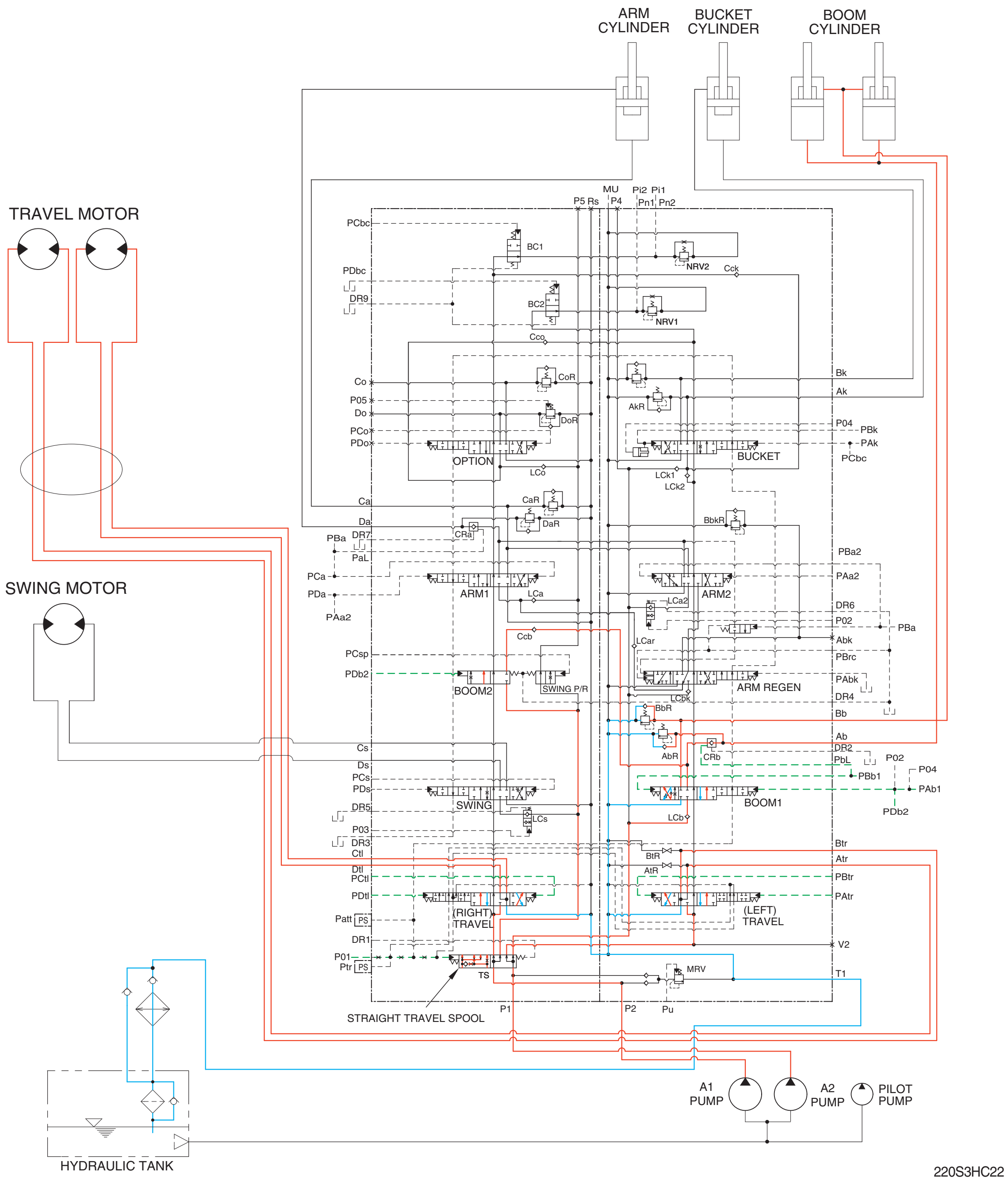
The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the swing motor through the straight travel spool.

When the pressure of the travel motors is lower than the pressure of the swing motor, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The upper structure swings and the machine travels straight.

6. COMBINED BOOM AND TRAVEL OPERATION



220S3HC22

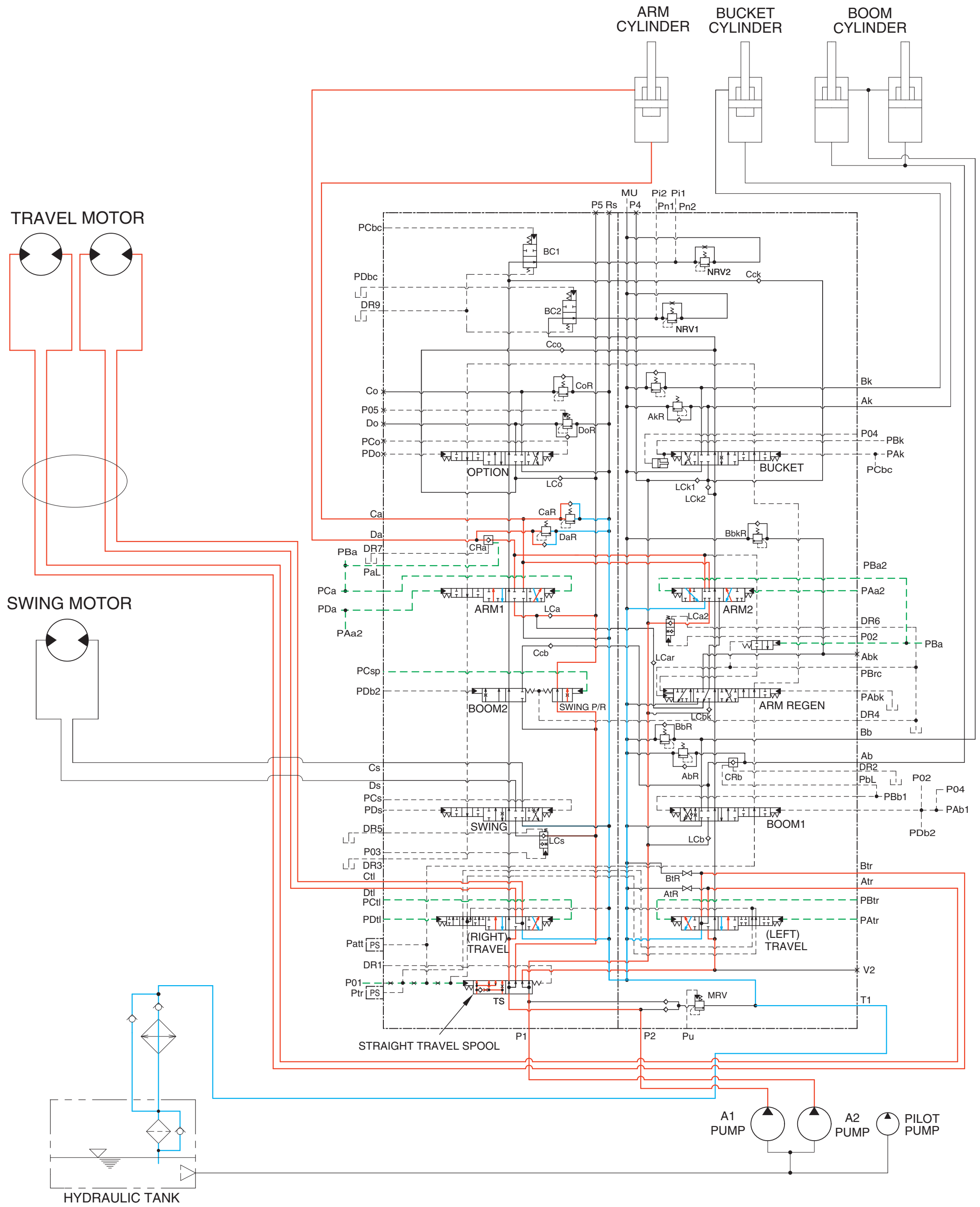
When the boom and travel functions are operated, simultaneously the boom spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot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

The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the boom cylinders through the boom 2 spool and boom 1 spool via the parallel and confluence oil passage in case boom up operation. When the pressure of the travel motors is lower than the pressure of the boom cylinders, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The boom is operated and the machine travels straight.

7. COMBINED ARM AND TRAVEL OPERATION



220S3HC23

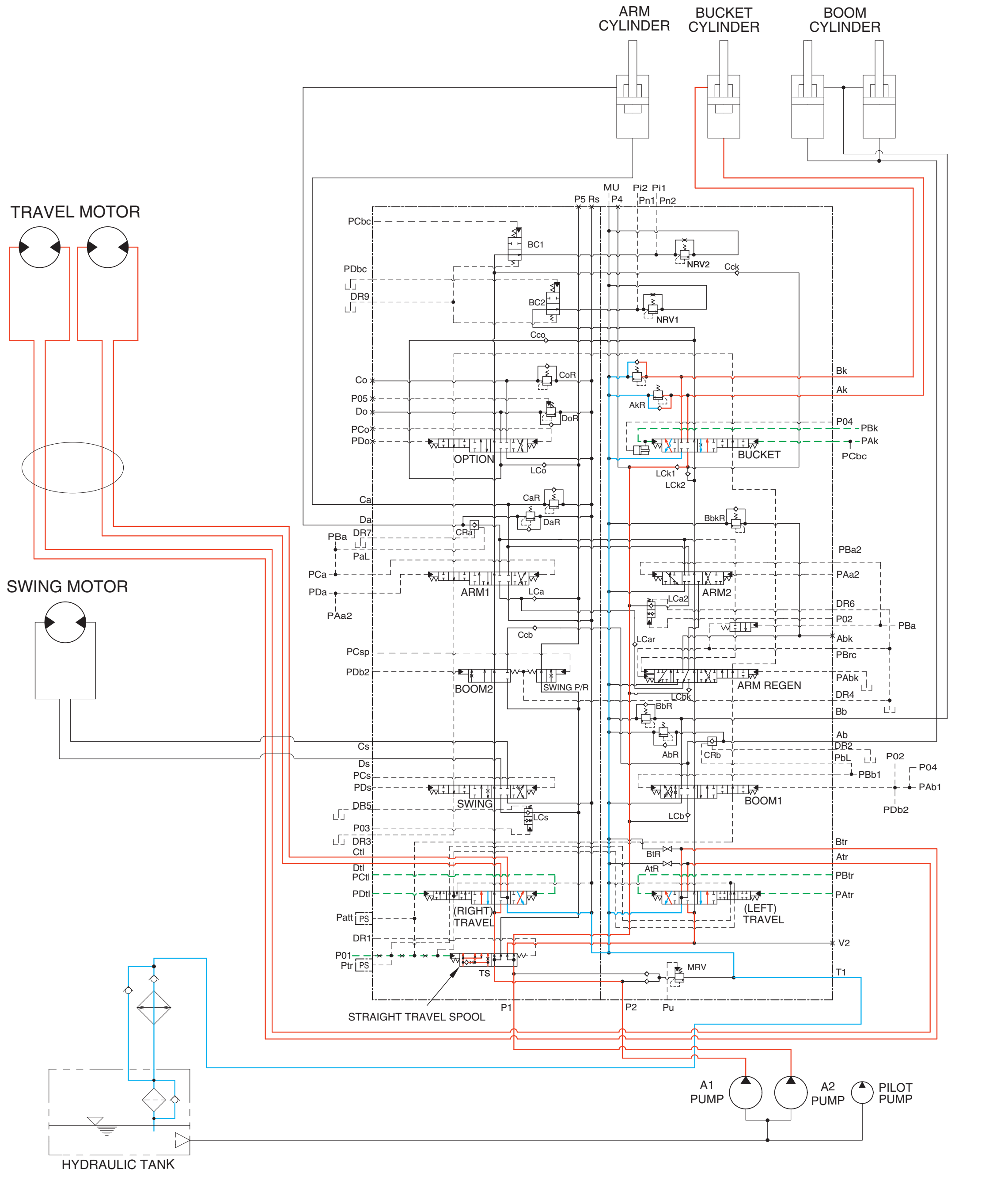
When the arm and travel functions are operated, simultaneously the arm spools and travel spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve and the straight travel spool is pushed to the right by the oil pressure from pilot pump.

The oil from the A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool.

The oil from the A2 pump flows into the arm cylinders through the arm 1 spool and arm 2 spool via the parallel and confluence oil passage. When the pressure of the travel motors is lower than the pressure of the arm cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The arm is operated and the machine travels straight.

8. COMBINED BUCKET AND TRAVEL OPERATION



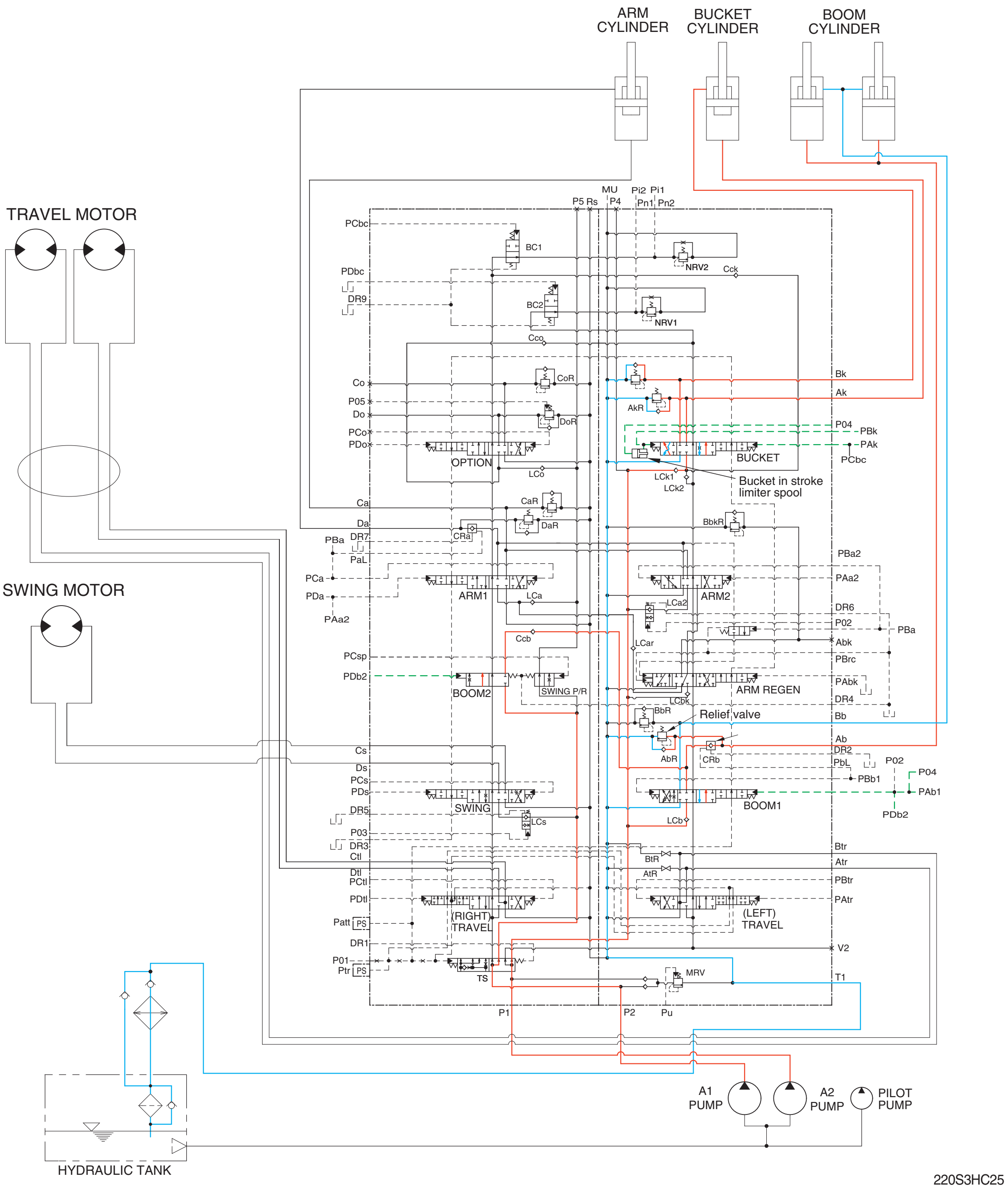
220S3HC24

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 A1 pump flows into the travel motors through the RH travel spool of the left control valve and the LH travel spool of the right control valve via the straight travel spool of the control valve.

The oil from the A2 pump flows into the bucket cylinder through the bucket spool via the confluence oil passage. When the pressure of the travel motors is lower than the pressure of the bucket cylinder, some oil from the A2 pump flows into the travel motors through the check valve and orifice in the straight travel spool. This prevents the rapid slowdown of the travel.

The bucket is operated and the machine travels straight.

9. COMBINED BOOM UP AND BUCKET OPERATION



220S3HC25

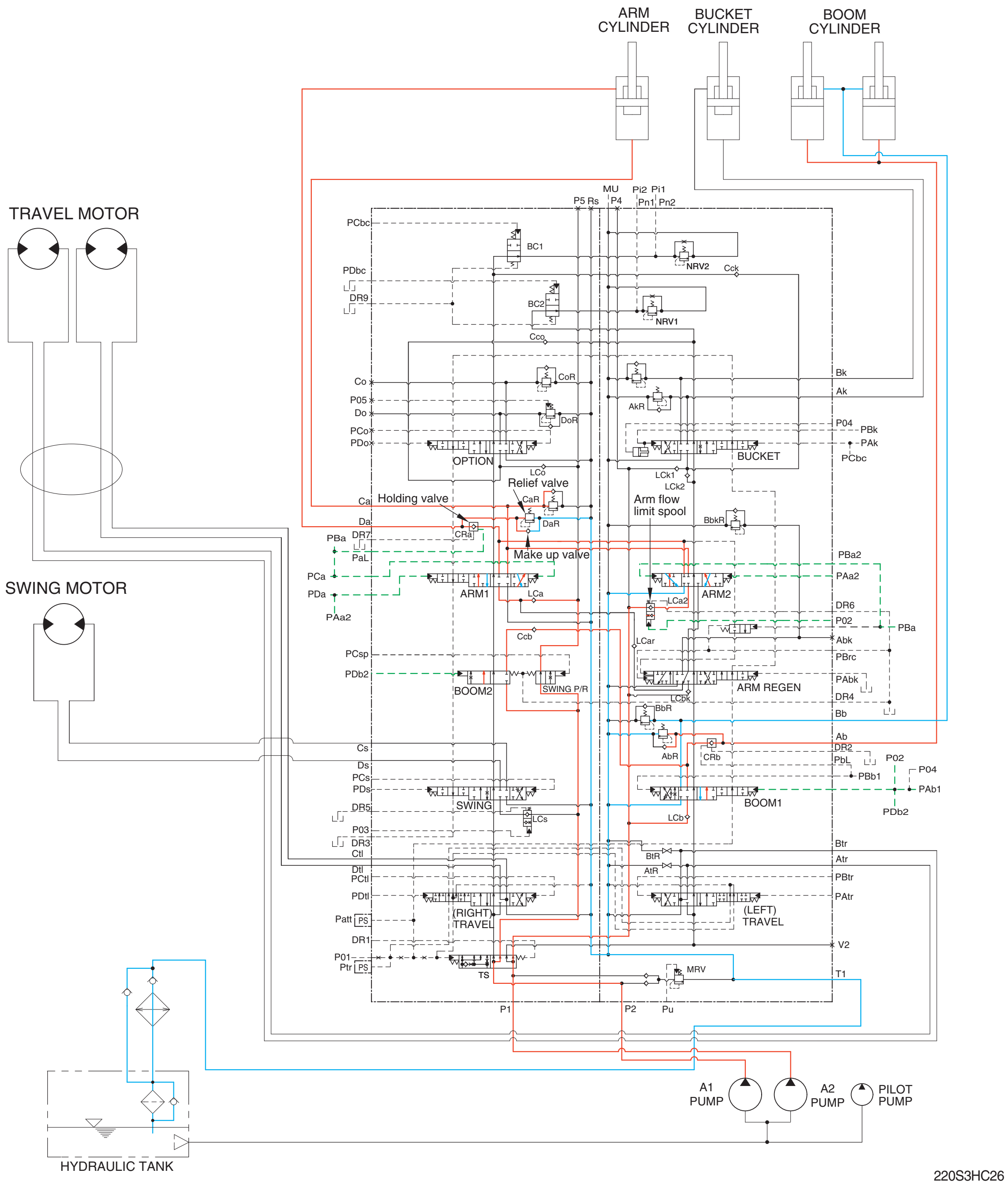
When the boom up and bucket functions are operated, simultaneously each spool in the main control valve is moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the A1 pump flows into the boom cylinders through the boom 2 spool in the left control valve. The oil from the A2 pump flows into the boom cylinders and bucket cylinder through the boom 1 spool, bucket spool and the parallel and confluence oil passage in the right control valve.

Also, when the boom up and bucket in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure P04 and then the bucket spool transfers in the half stroke not full stroke (refer to page 2-35). Therefore, the most of pressurized oil flows into boom 1 spool than the bucket spool to make the boom up operation more preferential.

The boom and bucket are operated.

10. COMBINED BOOM UP AND ARM OPERATION



220S3HC26

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

The oil from the A1 pump flows into the boom cylinders and arm cylinder through the boom 2 spool and arm 1 spool in the left control valve. The oil from the A2 pump flows into the boom cylinders and arm cylinder through the boom 1 spool, arm 2 spool and the parallel and confluence oil passage in the right control valve.

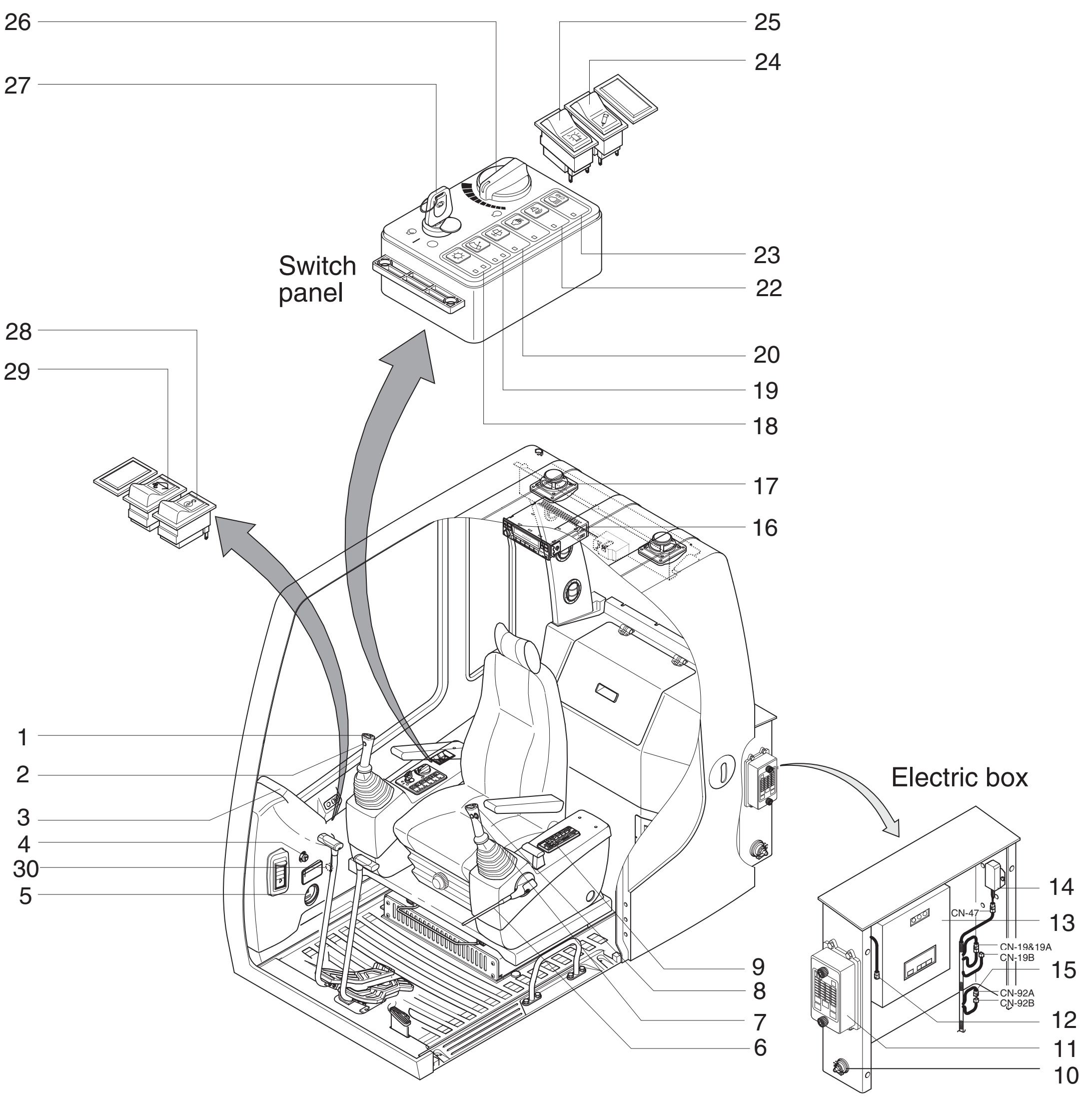
Also, when the boom up and arm in functions are operated simultaneously, the boom up operation preference function is operated by the pilot pressure P02 and then the flow into arm 2 spool is reduced by shifting of the arm in flow limit spool. Therefore, the most of pressurized oil flows into boom 1 spool than the arm 2 spool to make the boom up operation more preferential.

The boom and bucket are operated.

SECTION 4 ELECTRICAL SYSTEM

GROUP 1 COMPONENT LOCATION

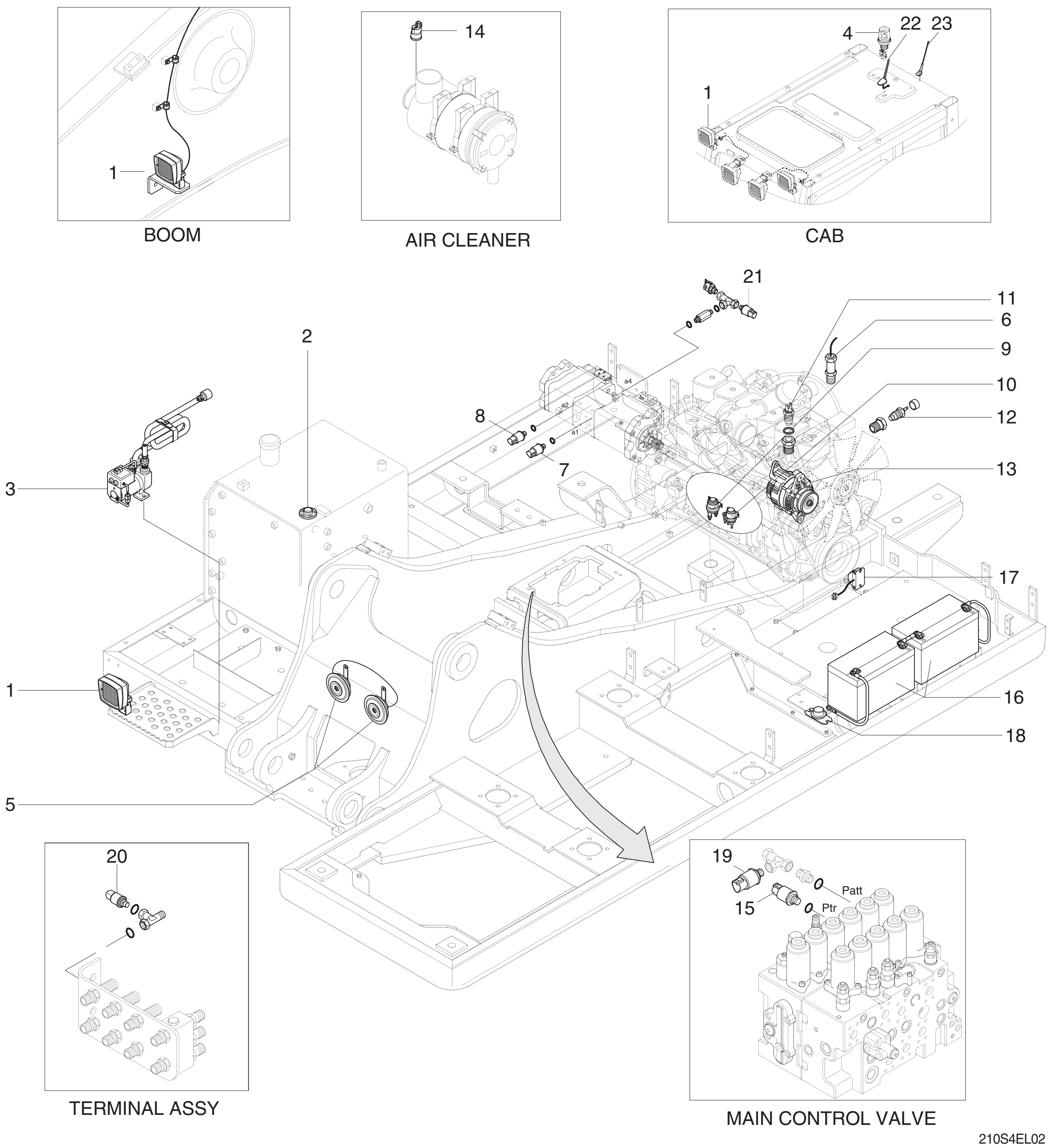
1. LOCATION 1



210S4EL01

1 Horn switch
2 Breaker operation switch
3 Cluster
4 Cigar lighter
5 Hour meter
6 Safety lever
7 Power max switch (null)
8 One touch decel switch
9 Air conditioner switch
10 Master switch
11 Fuse box
12 RS232 serial connector
13 MCU
14 Prolix resistor
15 Emergency engine starting connector
16 Radio & USB player
17 Speaker
18 Main light switch
19 Wiper switch
20 Washer switch
22 Travel alarm switch
23 Cab light switch
24 Breaker selection switch
25 Beacon switch
26 Accel dial
27 Start switch
28 Overload switch
29 Quick clamp switch
30 12V socket

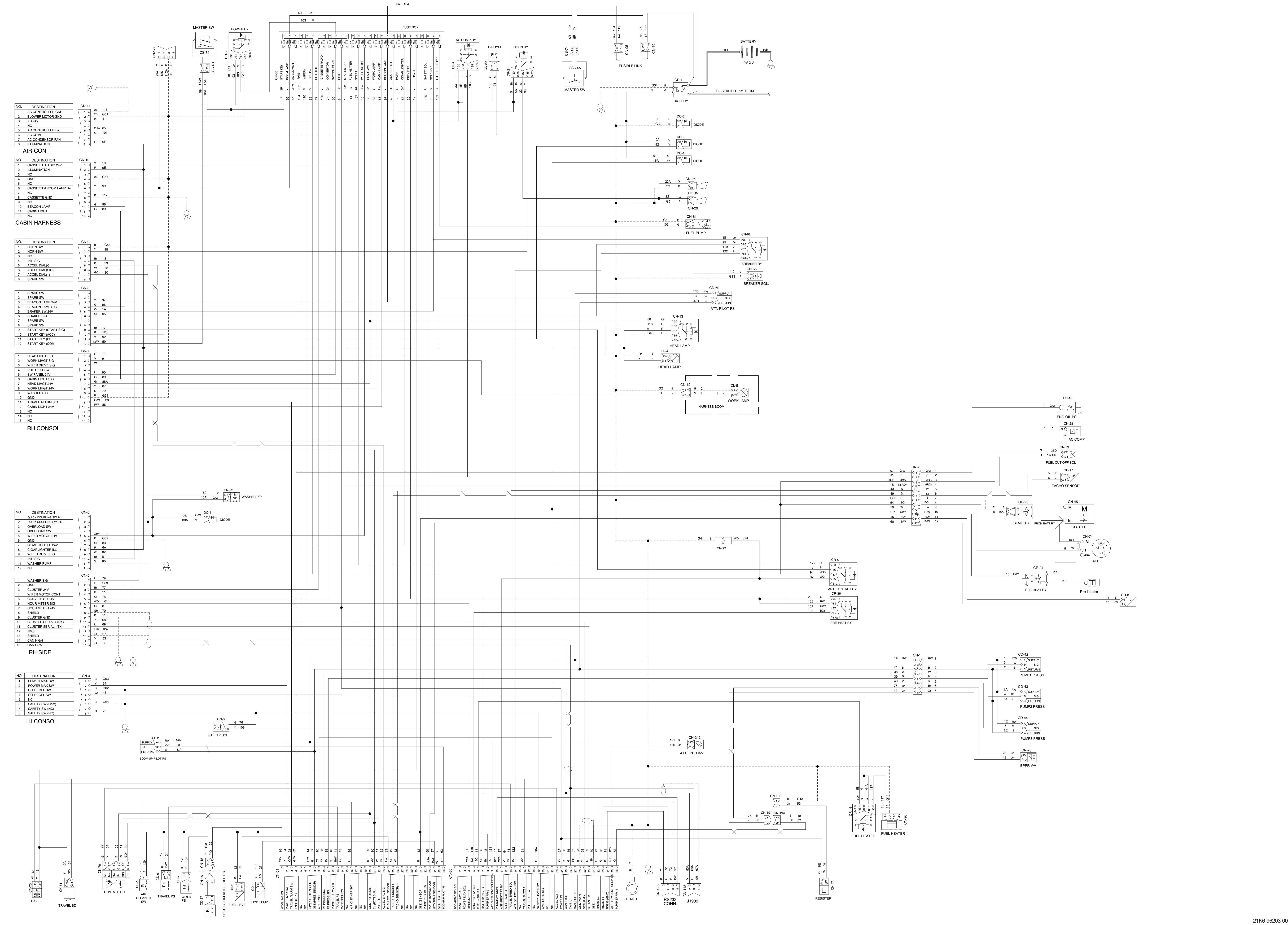
2. LOCATION 2



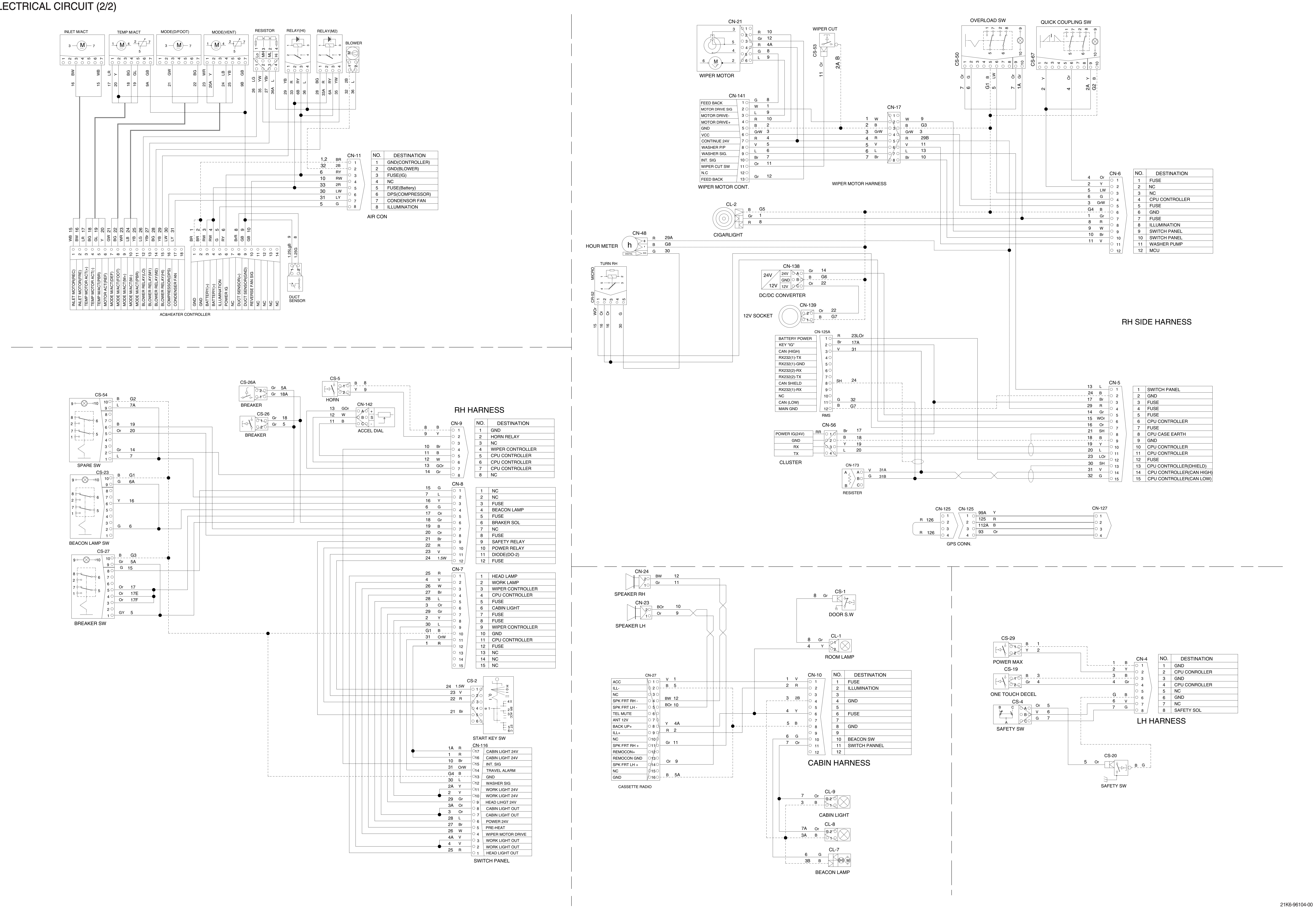
1	Lamp	9	Start relay	17	Travel alarm buzzer
2	Fuel sender	10	Heater relay	18	Battery relay
3	Fuel filler pump	11	Temp sender	19	Auto idle pressure sensor
4	Beacon lamp	12	Engine oil pressure switch	20	Boom up pressure sensor
5	Horn	13	Alternator	21	EPPR pressure switch
6	Speed sensor	14	Air cleaner switch	22	Integrated antenna
7	P1 pressure sensor	15	Travel pressure switch	23	Satellite antenna
8	P2 pressure sensor	16	Battery		

GROUP 2 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (1/2)

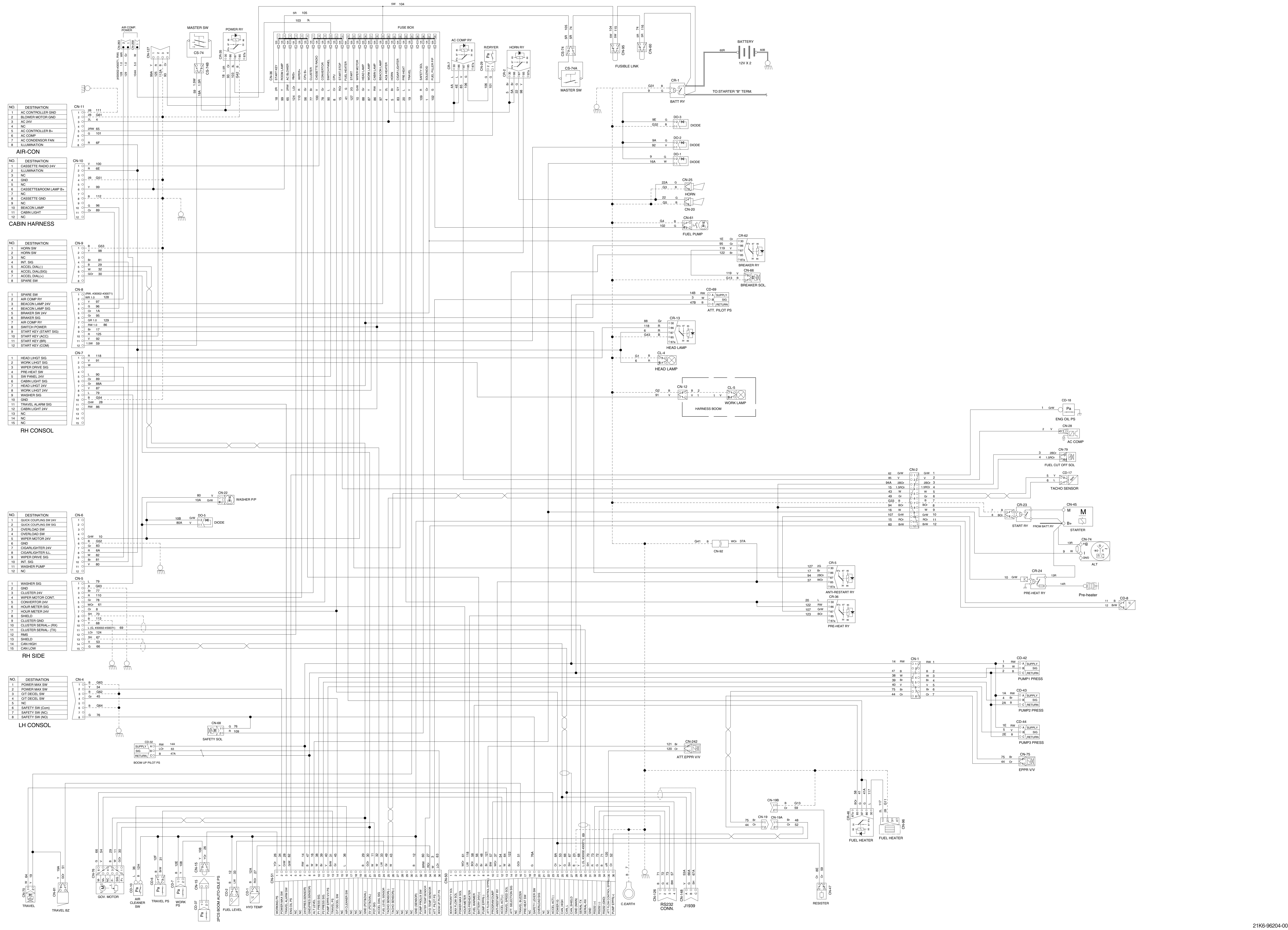


· ELECTRICAL CIRCUIT (2/2)



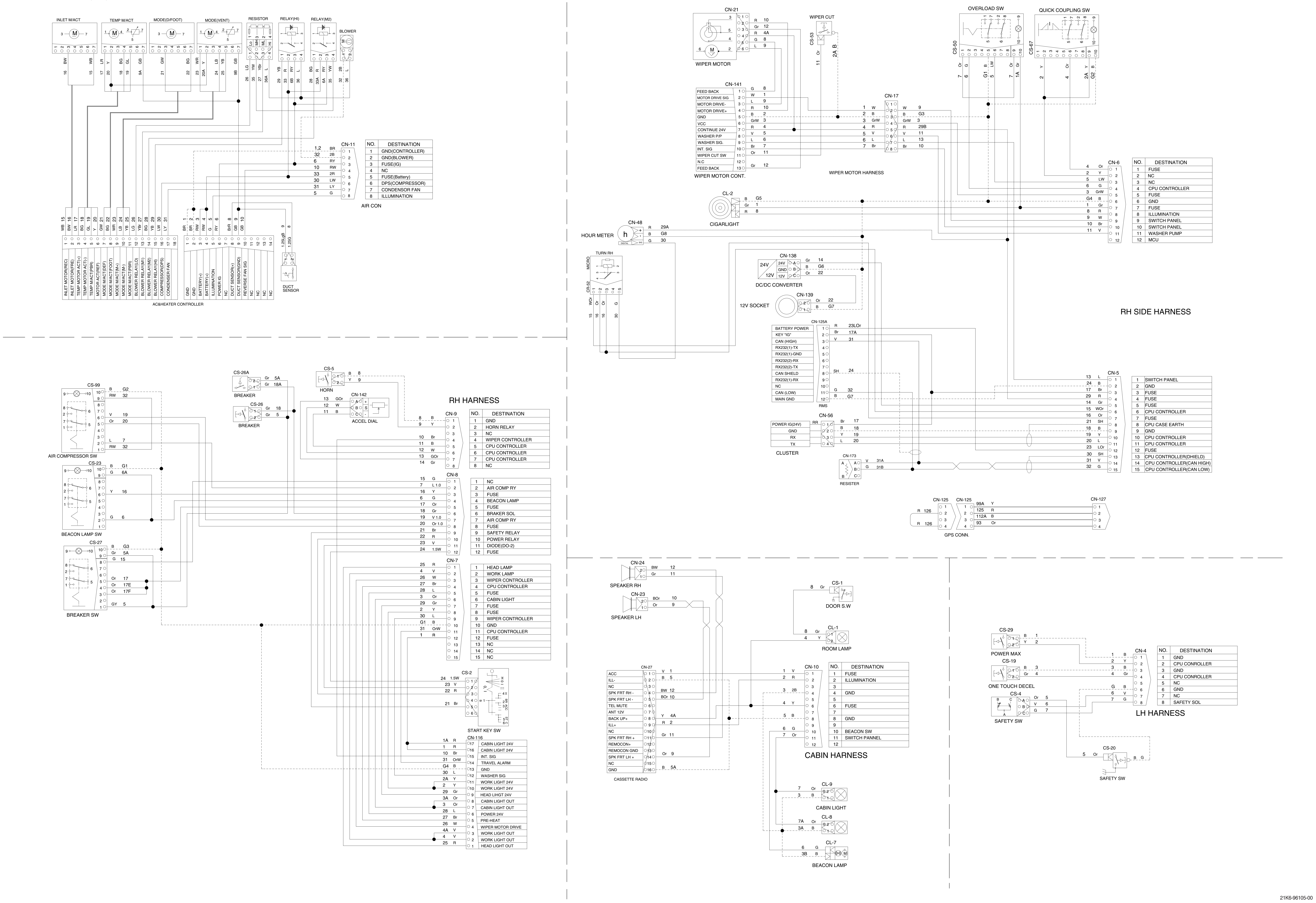
GROUP 2 ELECTRICAL CIRCUIT (MAHCINE SERIAL NO. : #30001-#60000)

· ELECTRICAL CIRCUIT (1/2)



21K6-96204-00

· ELECTRICAL CIRCUIT (2/2)



1. POWER CIRCUIT

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

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

1) OPERATING FLOW

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

- → Fuse box [No.1]
  - → Master switch [CS-74B] → I/conn [CN-8 (12)] → Start switch [CS-2 (1)]
  - → Power relay [CR-35 (30)]
- → Fuse box [No.2]
  - → I/conn [CN-10 (6)]
    - → Room lamp [CL-1 (2)] → Door switch [CS-1]
    - → Radio & USB Player [CN-27 (8)]
  - → GPS connector [CN-125 (1)]
- → Fuse box [No.3] → I/conn [CN-11 (4)]
  - → AC&Heater controller (3,4)
  - → Relay [Hi/M2 (2)]
- → Fuse box [No.5] → I/conn [CN - 5 (4)]
  - → I/conn [CN -17 (5)]
    - → Wiper motor Controller [CN-141 (7)]
    - → Wiper motor [CN-21 (4)]
  - → RMS [CN-125A (1)]
- → Fuse box [No.6] → MCU [CN-50(7)]

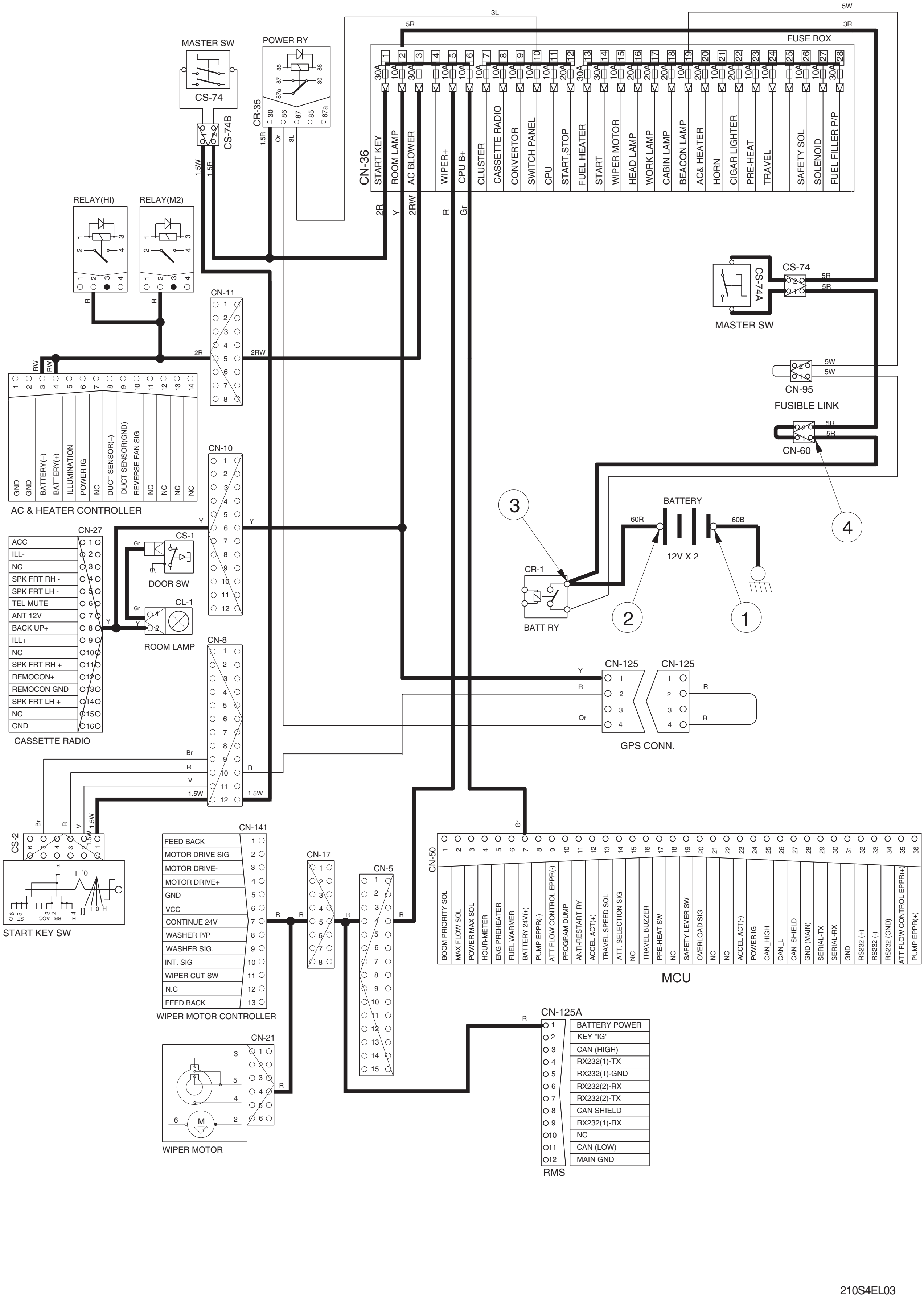
※ I/conn : Intermediate connector

2) CHECK POINT

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

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

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

(1) When start key switch is in ON position

→ Start switch ON [CS-2 (2)] → I/conn [CN-8 (11)] → Battery relay [CR-1]
→ Battery relay operating (All power is supplied with the electric component)
→ Start switch ON [CS-2 (3)] → I/conn [CN-8 (10)] → GPS connector [CN-125 (2) → (4)]
→ Power relay [CR-35 (86) → (87)] → Fuse box [No.12]
→ I/conn [CN-2 (4)] → Fuel cut-off [CN-79 (2)]

(2) When start key switch is in START position

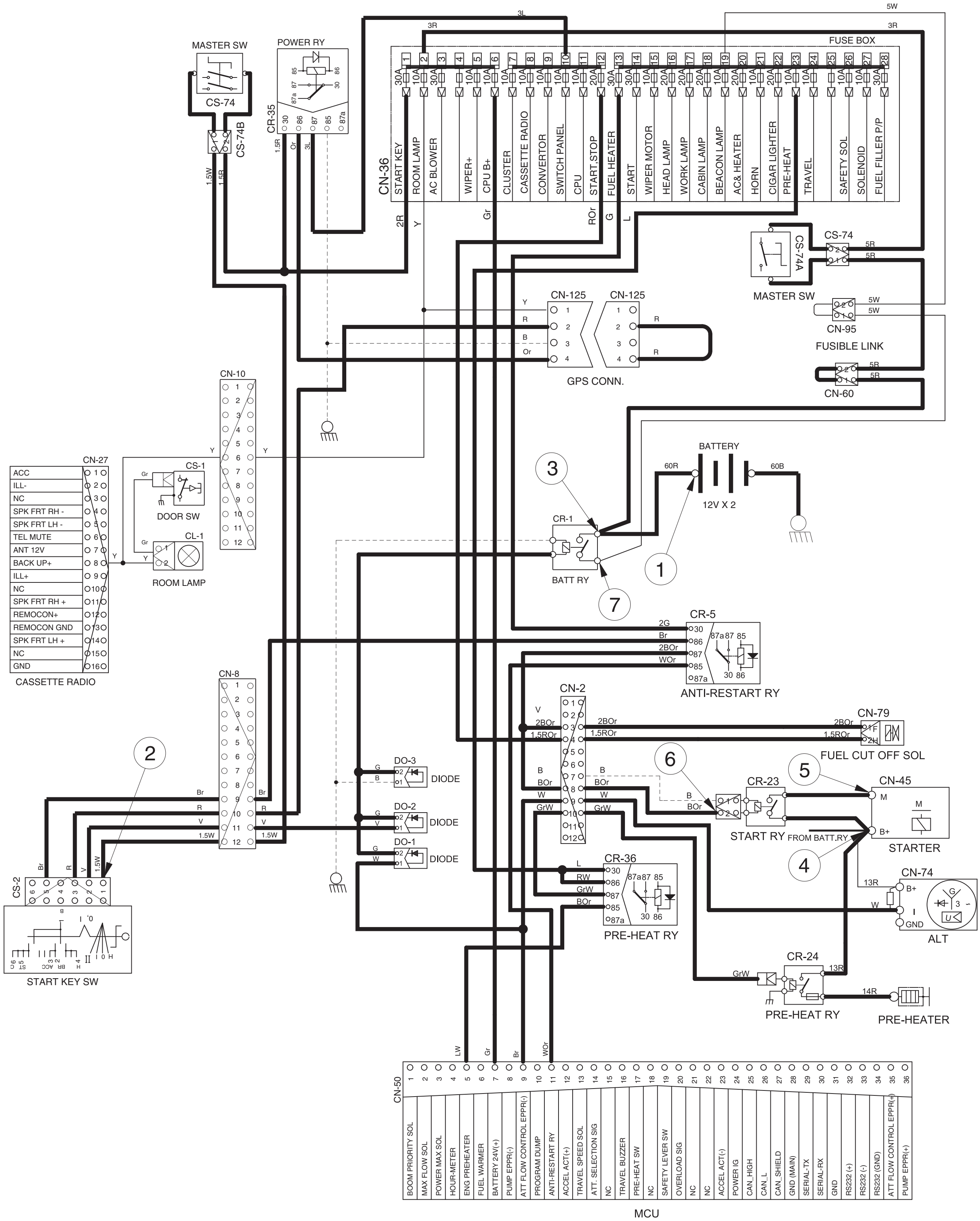
Start switch START [CS-2 (5)] → I/conn [CN-8 (9)] → Safety relay [CR-5 (86) → (87)]
→ I/conn [CN-3 (8)] → Start relay [CR-23 (2)] → Start motor operating
→ I/conn [CN-2 (3)] → Fuel cut off [CN-79 (1)]

2) CHECK POINT

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

※ GND : Ground

STARTING CIRCUIT



210S4EL04

3. CHARGING CIRCUIT

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

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

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

1) OPERATING FLOW

(1) Warning flow

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

(2) Charging flow

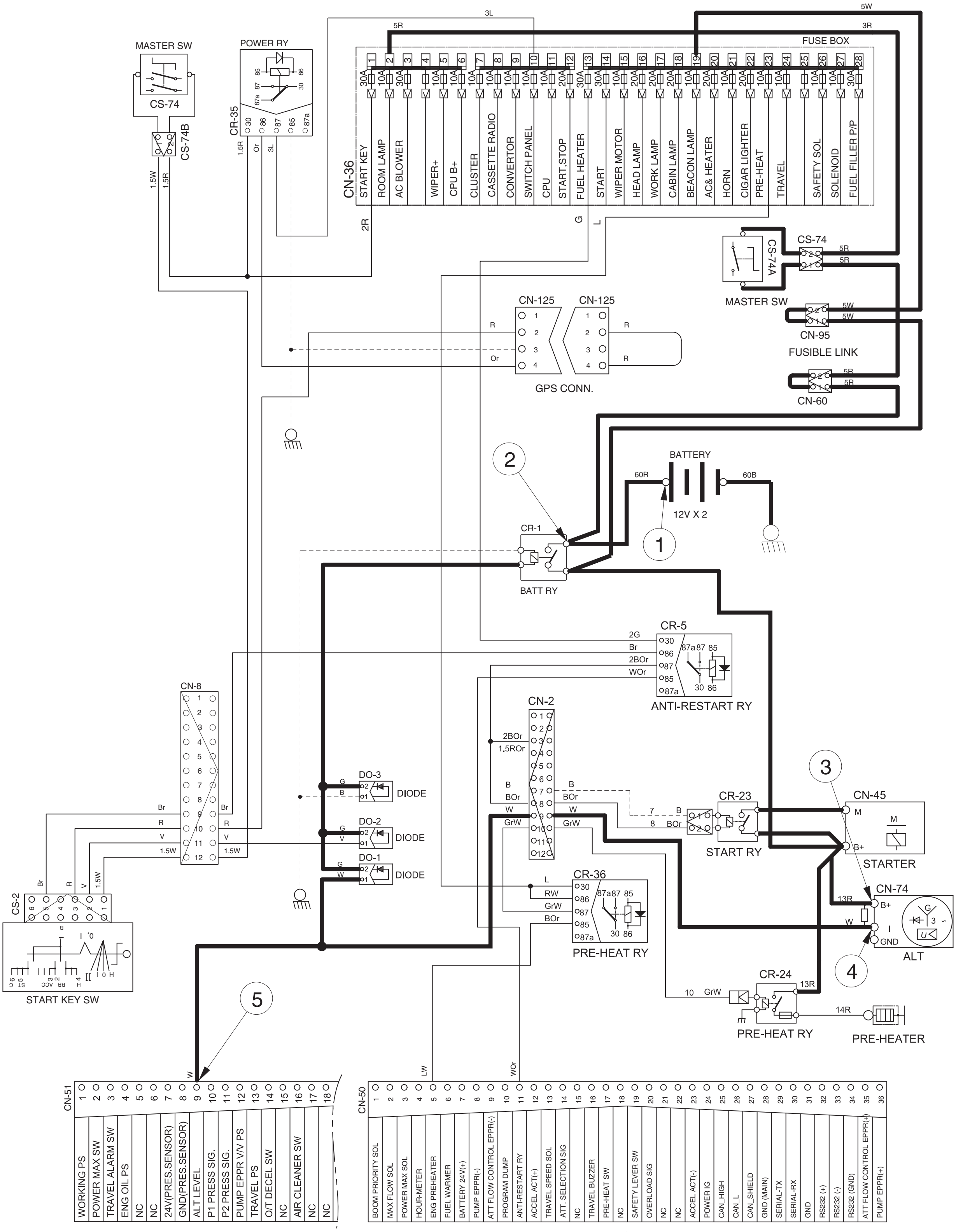
Alternator "B^+" terminal → Start motor [B^+] → Battery relay
→ Battery(+) terminal
→ Fusible link [CN-60] → Master switch [CN-74A] → Fuse box [No.1~6]
→ Fusible link [CN-95] → Fuse box [No.13~28]

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 (CPU)	20~30V

※ GND : Ground

CHARGING CIRCUIT



4. HEAD AND WORK LIGHT CIRCUIT

1) OPERATING FLOW

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

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

(1) Head light switch ON

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

→ Head light ON [CL-4 (2)] → Head lamp ON
→ I/conn [CN-10 (2)] → Radio & USB player ON [CN-27 (9)]
→ I/conn [CN-11 (8)] → AC & Heater controller illumination ON
→ I/conn [CN-6 (8)] → Cigar lighter [CL-2]

(2) Work light switch ON

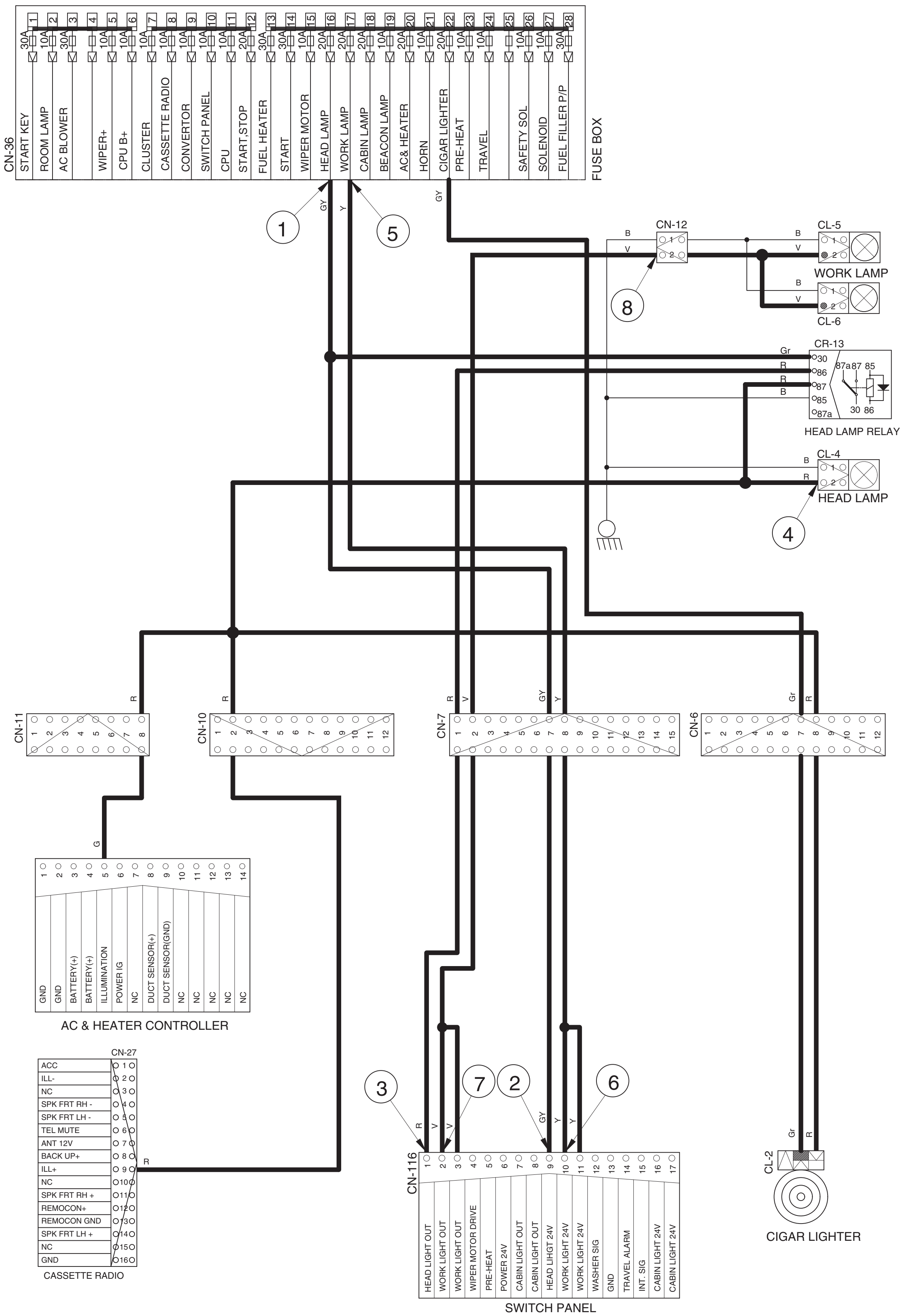
Work light switch ON [CN-116 (2,3)] → I/conn [CN-7 (2)] → I/conn [CN-12 (2)]
→ Work light ON [CL-5 (2), CL-6 (2)]

2) CHECK POINT

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

※ GND : Ground

HEAD AND WORK LIGHT CIRCUIT



210S4EL06

5. BEACON LAMP AND CAB LIGHT CIRCUIT

1) OPERATING FLOW

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

(1) Beacon lamp switch ON

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

(2) Cab light switch ON

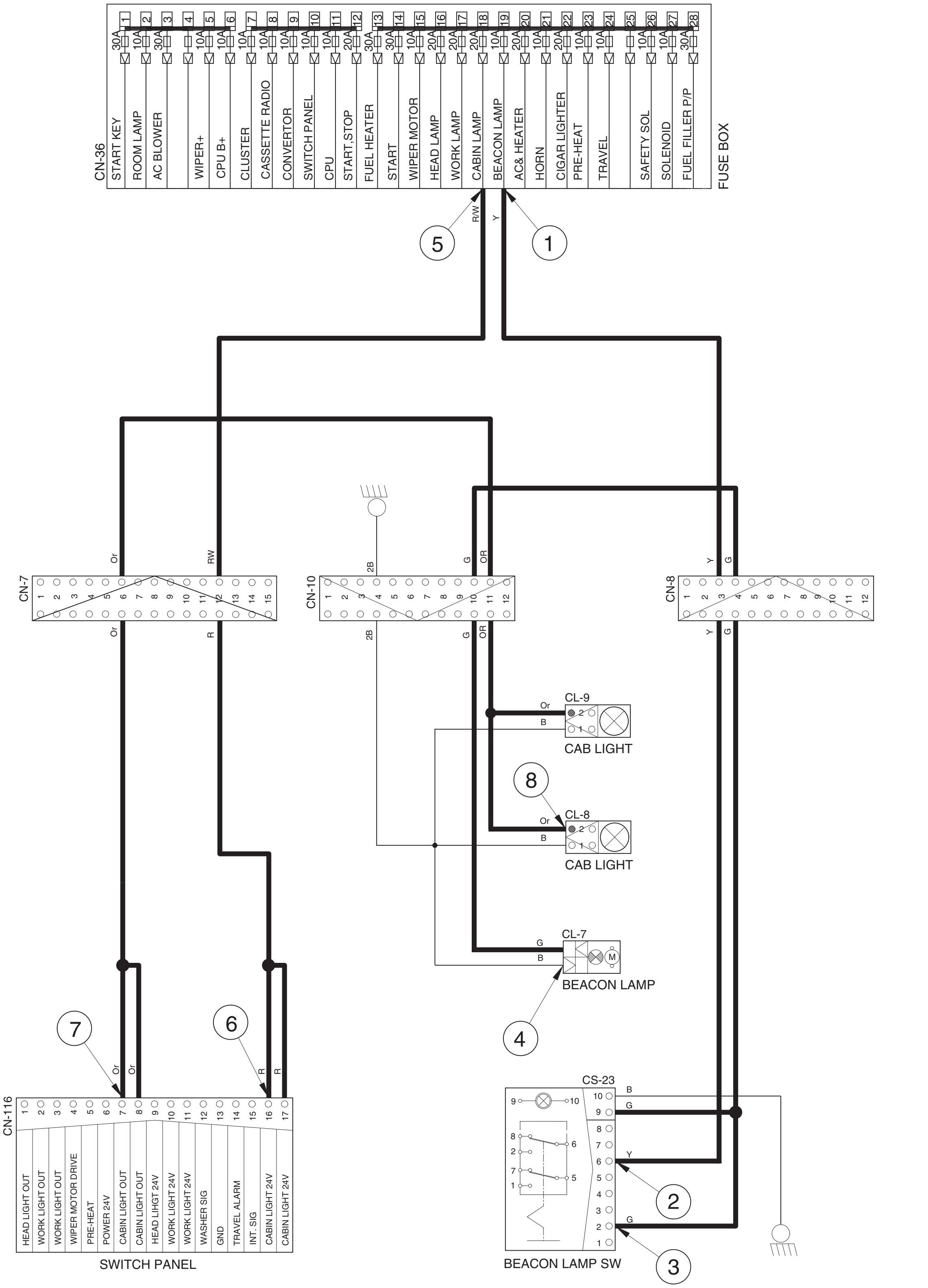
Cab light switch ON [CN-116 (7, 8)] → I/conn [CN-7 (6)] → I/conn [CN-10 (11)]
→ Cab light ON [CL-8 (2), CL-9 (2)]

2) CHECK POINT

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

※ GND : Ground

BEACON LAMP AND CAB LIGHT CIRCUIT



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6. WIPER AND WASHER CIRCUIT

1) OPERATING FLOW

(1) Key switch ON

Fuse box (No.12) → I/conn [CN-7 (5)] → Switch panel [CN-116 (6)]

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

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

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

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

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

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

(4) Washer switch ON

Washer switch ON [CN-116 (12)] → I/conn [CN-7 (9)] → I/conn [CN-5 (1)] → I/conn [CN-17 (7)]
→ Wiper motor controller [CN-141 (9) → (8)] → I/conn [CN-17 (6)] → I/conn [CN-6 (11)]
→ Washer pump [CN-22 (1)] → Washer operating
Wiper switch ON [CN-116 (4)] → I/conn [CN-7 (3)] → I/conn [CN-6 (9)] → I/conn [CN-17 (2)]
Wiper motor controller [CN-141 (2) → (4)] → Wiper motor operating [CN-21 (2)]

(5) Auto parking (when switch OFF)

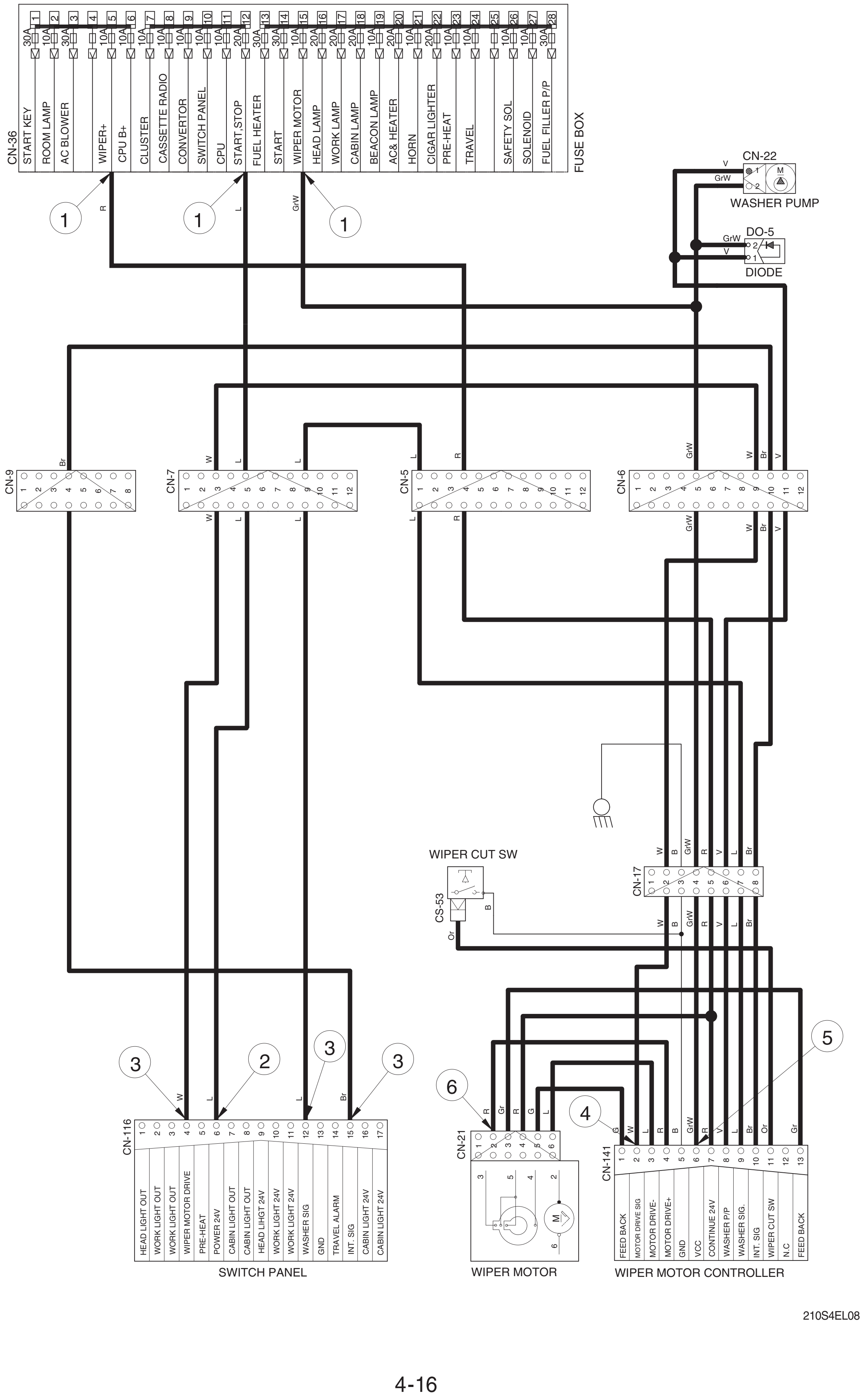
Switch OFF [CN-116 (4)] → Wiper motor parking position by wiper motor controller

2) CHECK POINT

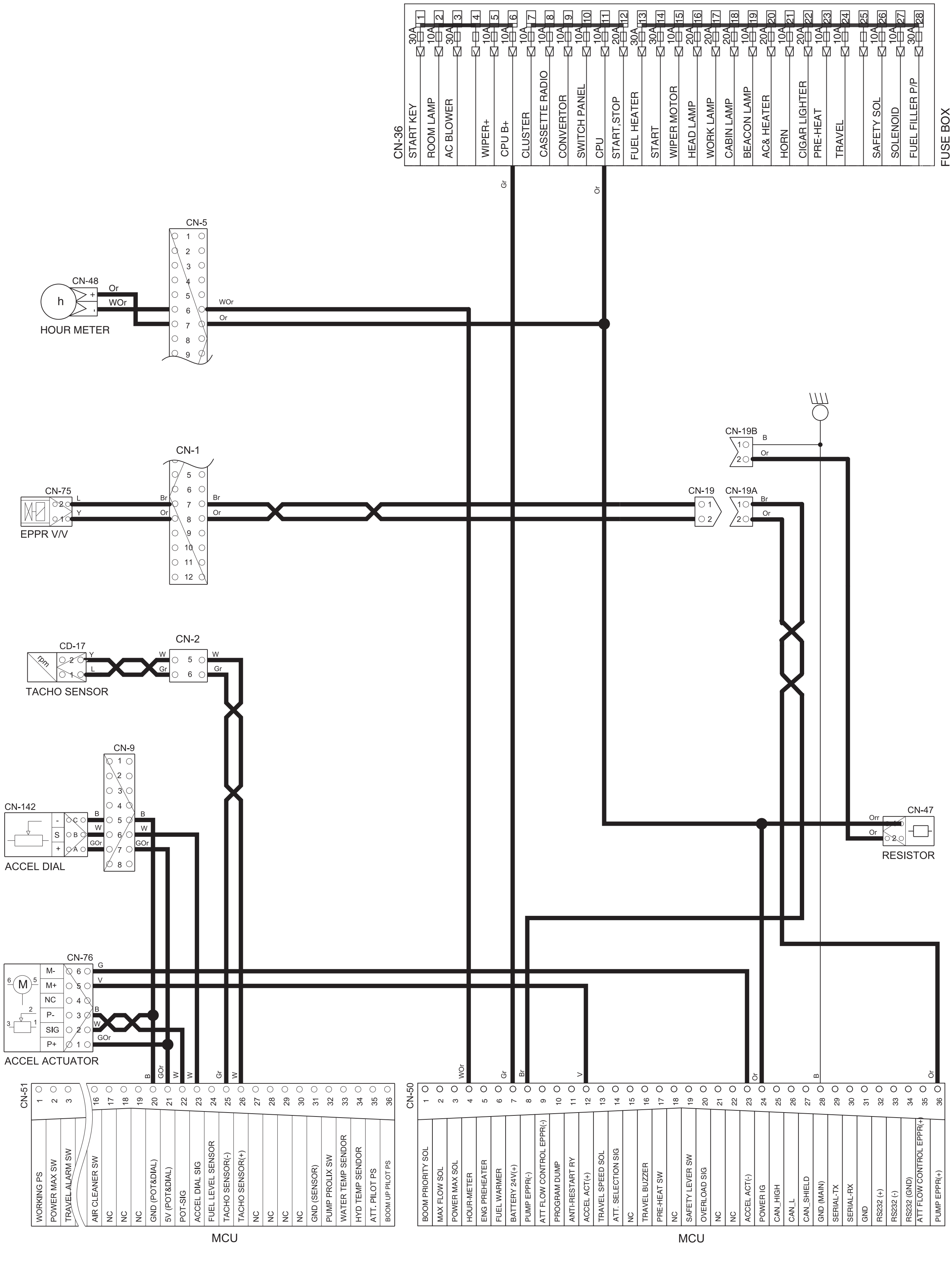
Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (fuse box) ② - GND (switch power input)	24V
		③ - GND (switch power output) ④ - GND (wiper Power input)	0 ~ 5V
		⑤ - GND (wiper power output) ⑥ - GND (wiper motor)	0 or 24V

※ GND : Ground

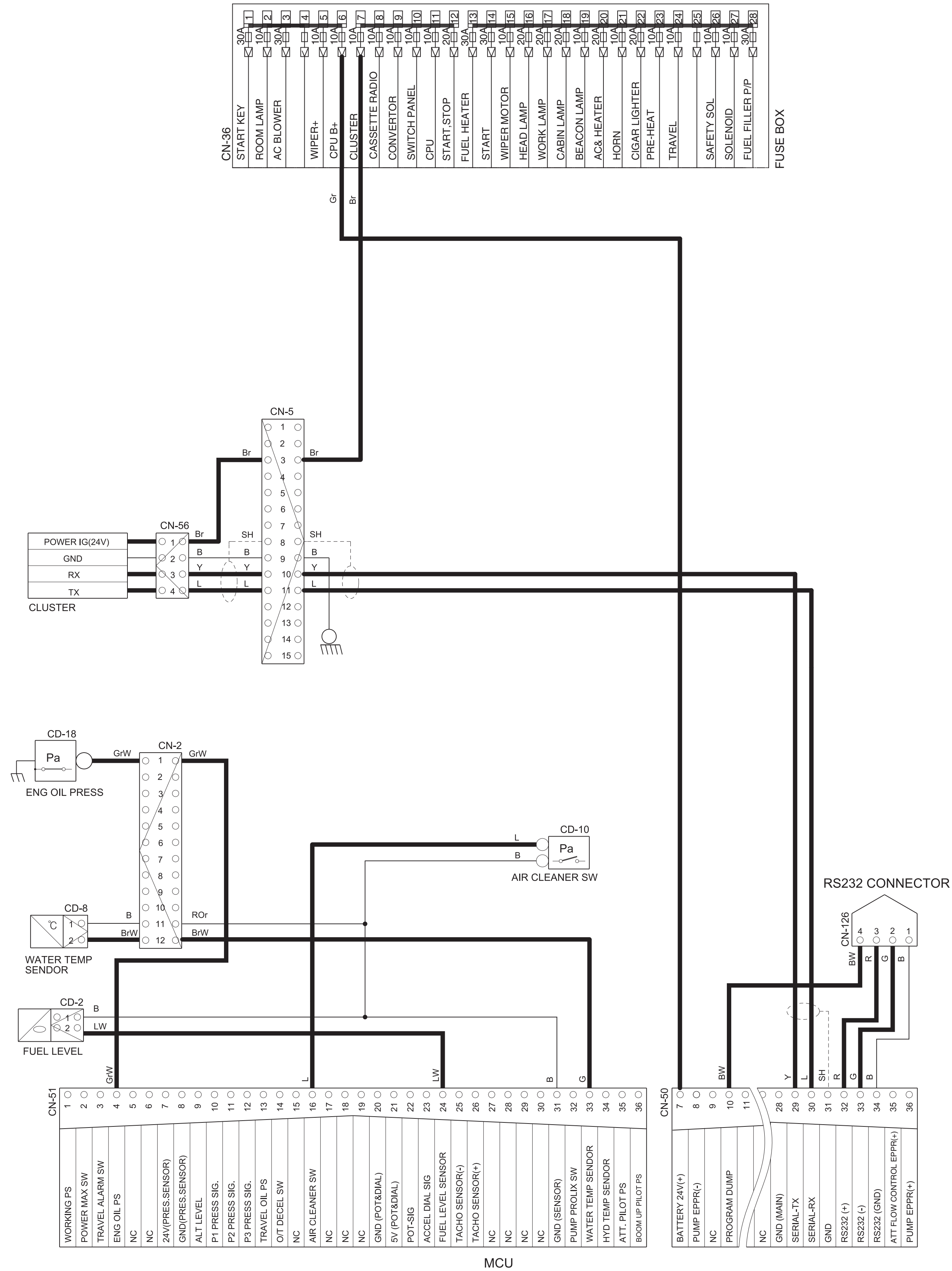
WIPER AND WASHER CIRCUIT



CONTROLLER CIRCUIT



MONTORING CIRCUIT



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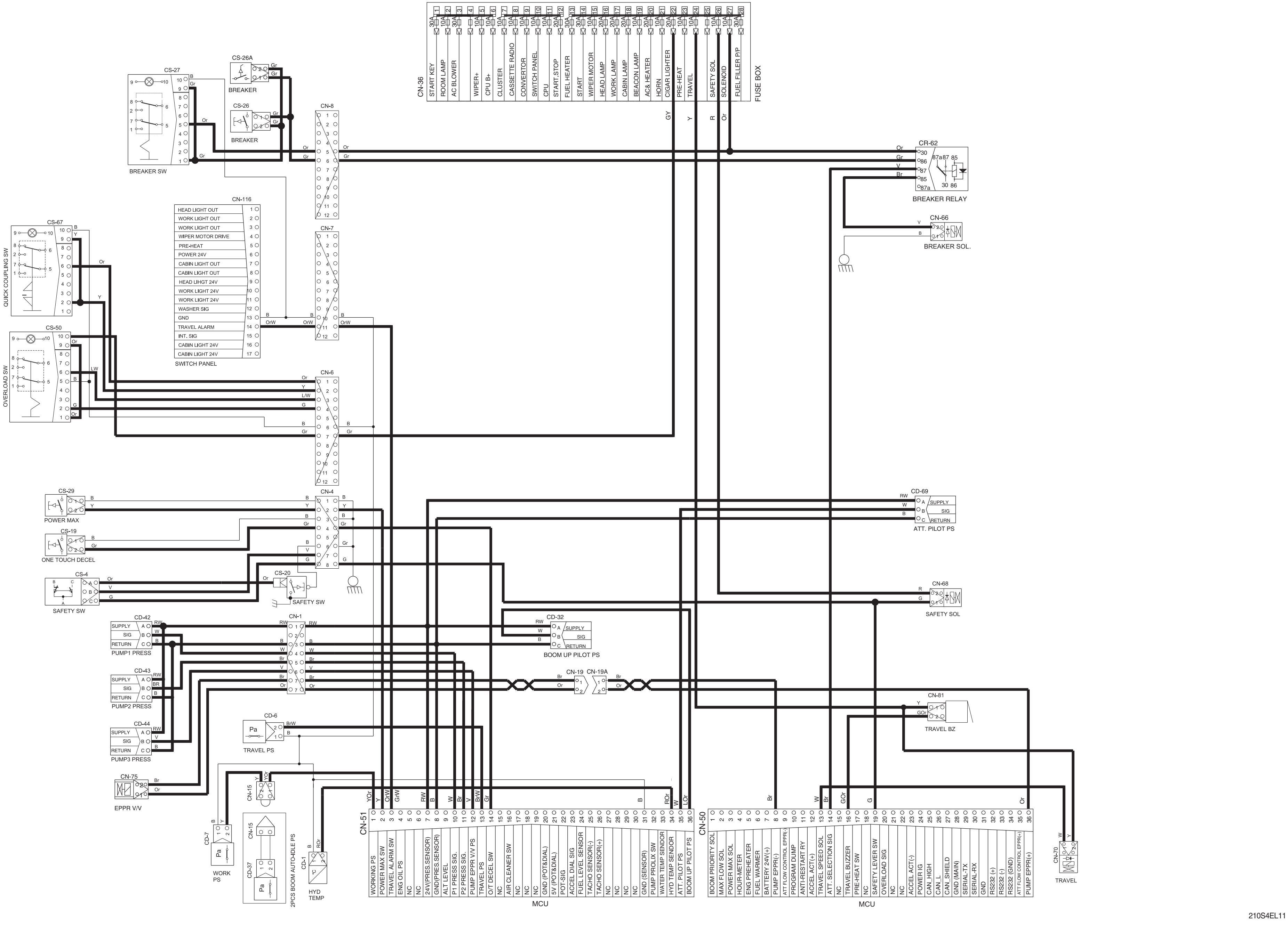
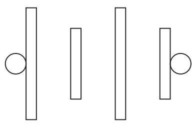
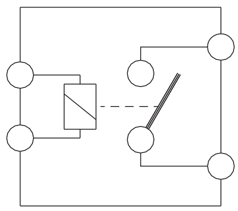
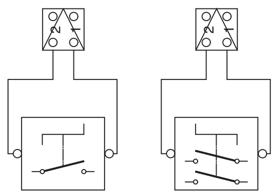
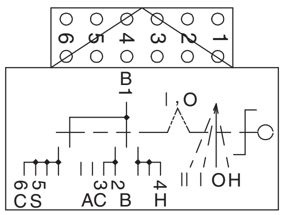
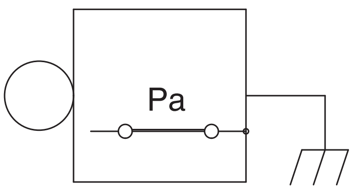
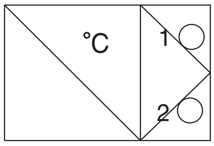
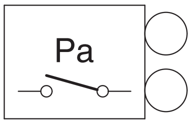
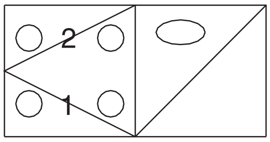
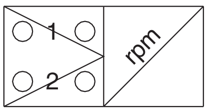
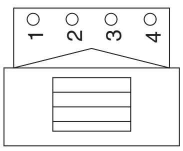
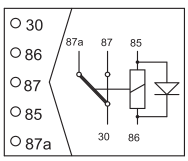
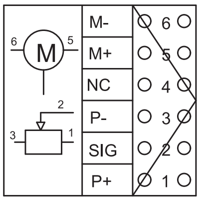
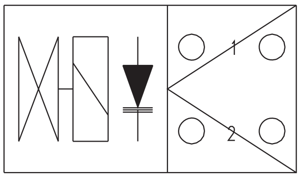
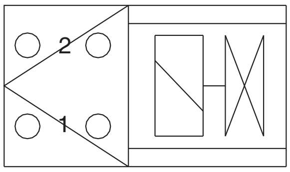
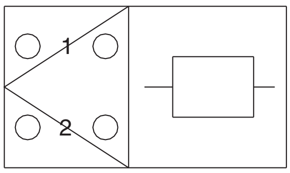
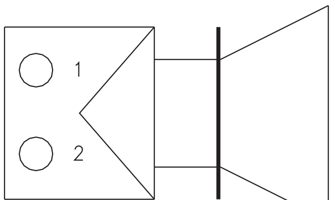
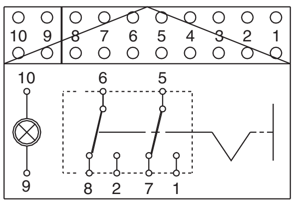
· ELECTRICAL CIRCUIT FOR HYDRAULIC

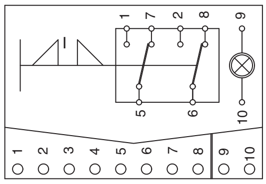
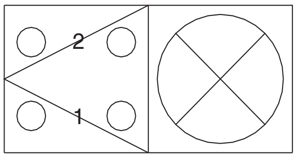
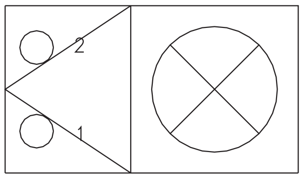
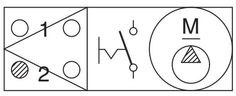
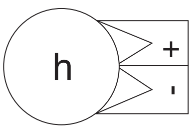
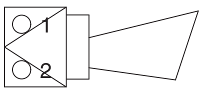


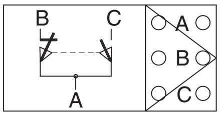
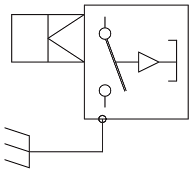
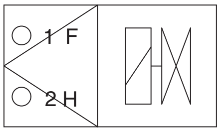
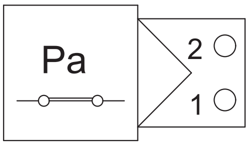
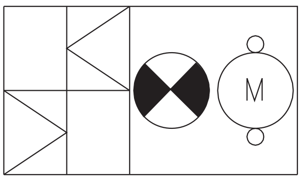
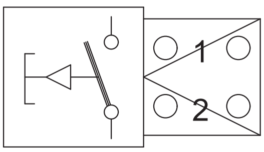
GROUP 3 ELECTRICAL COMPONENT SPECIFICATION

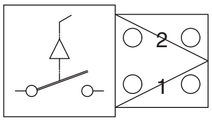
Part name	Symbol	Specification	Check
Battery		12V × 100Ah (2EA)	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Battery relay	 CR-1	Rated load : 24V 100A(continuity) 1000A(30seconds)	※ Check coil resistance (M4 to M4) Normal : About 50Ω ※ Check contact Normal : ∞Ω
Master switch	 CS-74A CS-74B	6~36V	※ Check disconnection Normal : 0.1Ω
Start switch	 CS	B-BR : 24V 1A B-ACC : 24V 10A B-ST : 24V 40A	※Check contact OFF : ∞Ω (For each terminal) ON : 0Ω (For terminal 1-3 and 1-2) START : 0Ω (For terminal 1-5)
Pressure switch (For engine oil)	 CD-18	0.5 kgf/cm^2 (N.C TYPE)	※ Check resistance Normal : 0Ω (CLOSE)

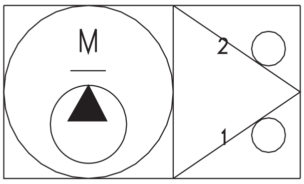
Part name	Symbol	Specification	Check
Temperature sensor (hydraulic, water)	 CD-1 CD-8	–	※ Check resistance 50 °C : 804Ω 80 °C : 310Ω 100 °C : 180Ω
Air cleaner pressure switch	 CD-10	Pressure: 635mmH₂O (N.O TYPE)	※ Check contact Normal : ∞Ω
Fuel sender	 CD-2	–	※ Check resistance Full : 50Ω 6/12 : 350Ω 11/12 : 100Ω 5/12 : 400Ω 10/12 : 150Ω 4/12 : 450Ω 9/12 : 200Ω 3/12 : 500Ω 8/12 : 250Ω 2/12 : 550Ω 7/12 : 300Ω 1/12 : 600Ω Empty warning :700Ω
Tacho sensor	 CD-17	–	※ Check resistance Normal : 300Ω (For terminal 1,2)
Fuel heater	 CN-96	-	-
Relay	 CR-2 CR-13 CR-46 CR-5 CR-35 CR-62 CR-7 CR-36	24V 16A	※ Check resistance Normal : About 160Ω (For terminal 85-86) : 0Ω (For terminal 30-87a) : ∞Ω (For terminal 30-87)

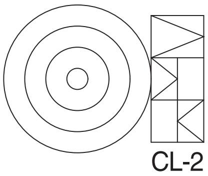
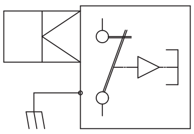
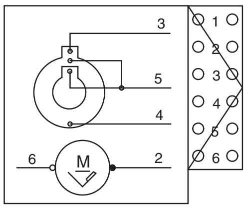
Part name	Symbol	Specification	Check
Accel actuator	 CN-76	-	※ Check resistance Normal : 1-2Ω(For terminal 5-6) 0.8-1.2kΩ (For terminal 1-3)
Solenoid valve	 CN-66 CN-68 CN-70	24V 1A	※ Check resistance Normal : 15~25Ω (For terminal 1-2)
EPPR valve	 CN-75 CN-242	700mA	※ Check resistance Normal : 18~25Ω (For terminal 1-2)
Resistor	 CN-47	50Ω 20W± 5%	※ Check resistance Normal : 50Ω
Speaker	 CN-23(LH) CN-24(RH)	4Ω 20W	※Check resistance Normal : 4Ω
Switch (Locking type)	 CS-23 CS-27 CS-50 CS-52 CS-54	24V 8A	※ Check contact Normal ON - 0Ω(For terminal 1-5,2-6) - ∞Ω(For terminal 5-7,6-8) OFF - ∞Ω(For terminal 1-5,2-6) - 0Ω(For terminal 5-7,6-8)

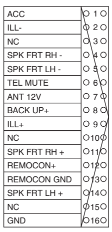
Part name	Symbol	Specification	Check
Switch (Quick clamp)	 CS-67	24V 8A	※ Check contact Normal ON - 0Ω(For terminal 1-5,2-6) - ∞Ω(For terminal 5-7,6-8) OFF - ∞Ω(For terminal 1-5,2-6) - 0Ω(For terminal 5-7,6-8)
Head lamp, Work lamp, Cab lamp	 CL-4 CL-5 CL-8 CL-9	24V 70W (H3 TYPE)	※ Check disconnection Normal : 1.2Ω
Room lamp	 CL-1	24V 10W	※ Check disconnection Nomal : A few Ω
Fuel filler pump	 CN-61	24V 10A 35 ℓ/min	※ Check resistance Normal : 1.0Ω
Hour meter	 CN-48	16V ~ 32V	※ Check operation · Supply powe(24V) to terminal No. 2 and connect terminal No. 1 and ground.
Horn	 CN-20 CN-25	DC 22.0 ~ 28.0V 2A	※ Check operation · Supply powe(24V) to each terminal and connect ground.

Part name	Symbol	Specification	Check
Safety switch	 CS-4	24V 15A (N.C TYPE)	※ Check contact Normal : 0Ω (For terminal 1-2) : ∞Ω (For terminal 1-3) Operating : ∞Ω (For terminal 1-2) : 0Ω (For terminal 1-3)
Safety switch Wiper cut sw	 CS-20 CS-53	24V (N.O TYPE)	※ Check contact Normal : ∞Ω (one pin to ground)
Fuel cut-off Solenoid	 CN-79	24V	※ Check resistance Normal : 15~25Ω
Pressure switch (Travel, Work, 2pcs boom auto idle)	 CD-6 CD-7 CD-37	10bar (N.C type)	※ Check contact Normal : 0.1Ω
Beacon lamp	 CL-7	24V 70W	※ Check disconnection Normal : 1.1Ω
Switch (Power max, One touch decel, Breaker, Horn)	 CS-5 CS-19 CS-26 CS-29	24V 6A	※Check contact Normal : ∞Ω

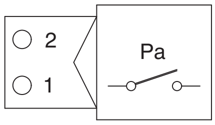
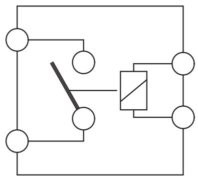
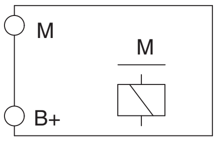
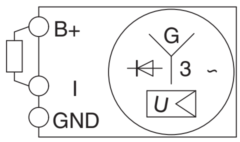
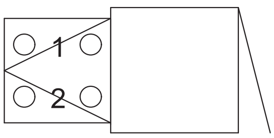
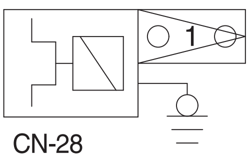
<table>
<tr><th>Part name</th><th>Symbol</th><th>Specification</th><th>Check</th></tr>
<tr><td>Switch
(Breaker)</td><td>

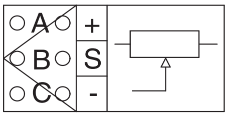
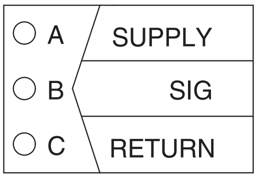
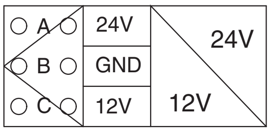
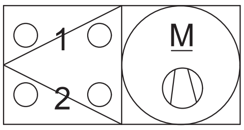
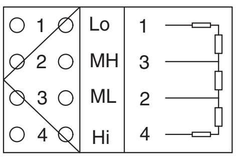
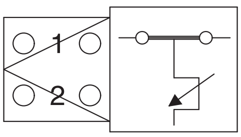
CS-26A</td><td>24V 6A</td><td>※Check contact
Normal : ∞Ω</td></tr>
<tr><td>Washer tank</td><td>

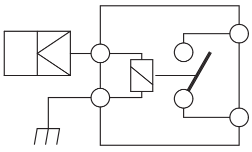
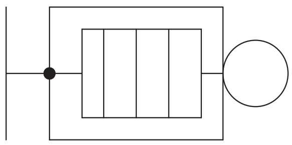
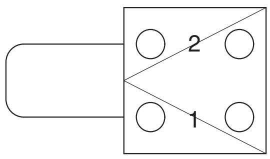
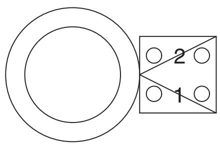
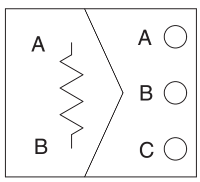
CN-22</td><td>24V 3.8A</td><td>※Check contact
Normal : 10.7Ω(For terminal 1-2)</td></tr>
<tr><td>Cigar lighter</td><td>
CL-2</td><td>24V 5A 1.4W</td><td>※Check coil resistance
Normal : About 1MΩ
※ Check contact
Normal : ∞Ω
Operating time : 5~15sec</td></tr>
<tr><td>Door switch</td><td>
CS-1</td><td>24V 2W</td><td>※Check resistance
Normal : About 5MΩ</td></tr>
<tr><td>Wiper motor</td><td>

CN-21</td><td>24V 2A</td><td>※Check contact
Normal : 7Ω(For terminal 2-6)</td></tr>
<tr><td>Radio and
USB player</td><td>

CN-27</td><td>24V 2A</td><td>※ Check voltage
20 ~ 25V
(For terminal 10-14,11-14)</td></tr>
</table>

Part name	Symbol	Specification	Check
Receiver dryer	 CN-29	24V 2.5A	※ Check contact Normal : 0Ω
Start relay	 CR-23	24V 300A	※ Check contact Normal : 0.94Ω (For terminal 1-2)
Starter	 CN-45	Lucas 24V	※ Check contact Normal : 0.1Ω
Alternator	 CN-74	Lucas 24V 75A	※ Check contact Normal : 0Ω (For terminal B+-I) Normal : 24 ~ 27.5V
Travel alarm buzzer	 CN-81	24V 0.5A	※ Check contact Normal : 5.2Ω
Aircon compressor	 CN-28	24V 79W	※ Check contact Normal : 13.4Ω

Part name	Symbol	Specification	Check
Accel dial	 CN-142	-	※ Check resistance Normal : About 5kΩ (For terminal A-C) ※ Check valtage Normal : About 5V (For terminal A-C) : 2 ~ 4.5V (For terminal C-B)
Pressure sensor	 CD-32 CD-43 CD-69 CD-42 CD-44	8~30 V	※ Check contact Normal : 0.1 Ω
DC/DC Converter	 CN-138	12V 3A	24V(A-B) 12V(B-C)
Blower motor		24V 9.5A	※ Check resistance 2.5Ω(For terminal 1-2)
Aircon resistor		-	※ Check resistance 1.12Ω(For terminal 4-2) 2.07Ω(For terminal 2-3) 3.17Ω(For terminal 3-1)
Duct sensor (Switch)		1 ℃ OFF 4 ℃ ON	※ Check resistance : 0Ω(For terminal 1-2, the atmosphere temp : over 4 ℃)

Part name	Symbol	Specification	Check
Preheater relay	 CR-24	24V 200A	※ Check contact Normal : 0.94Ω (For terminal 1-GND)
Preheater		24V 200A	※ check resistance : 0.25 ~ 0.12Ω
Fusible link	 CN-60 CN-65	60A	※Check disconnection Normal : 0Ω (Connect ring terminal and check resist between terminal 1 and 2)
Socket	 CN-139	-	-
Resistor	 CN-173	-	-

GROUP 4 CONNECTORS

1. CONNECTOR DESTINATION

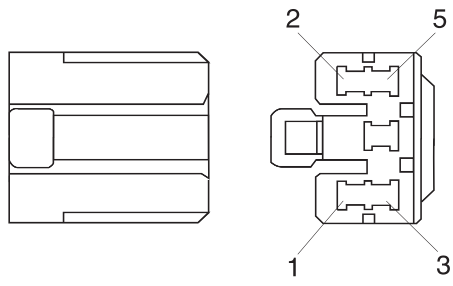
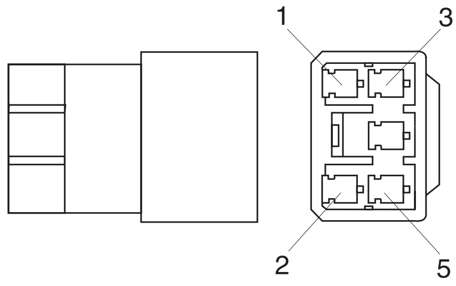
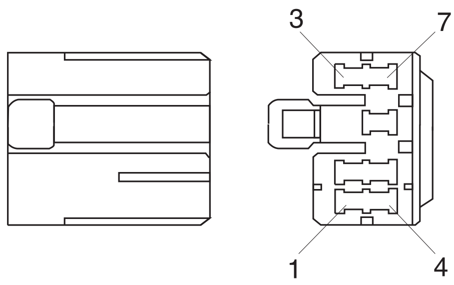
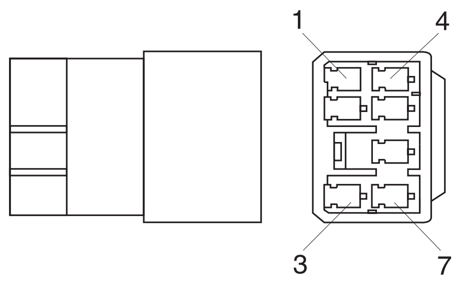
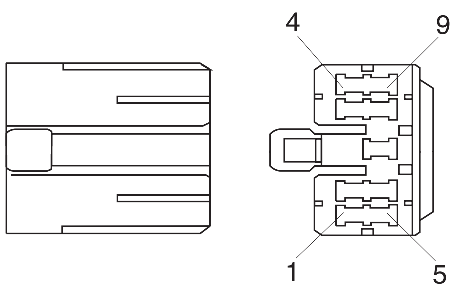
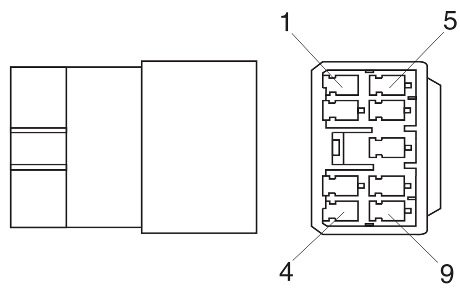
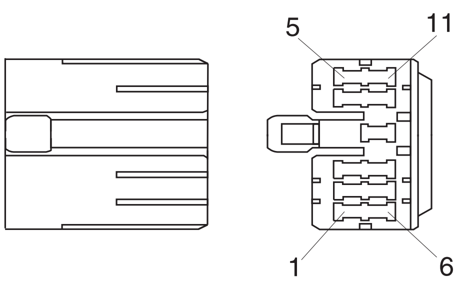
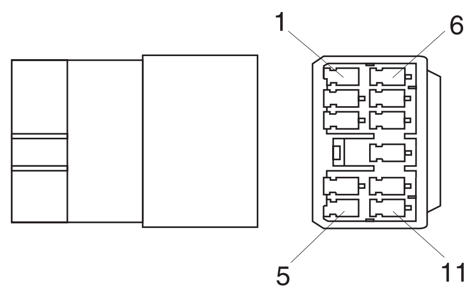
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-1	AMP	8	I/conn (Engine rear harness-Frame harness)	S816-008002	S816-108002
CN-2	AMP	12	I/conn (Engine rear harness-Frame harness)	S816-012002	S816-112002
CN-3	DEUTSCH	8	I/conn (Engine harness)	DT06-8S	DT04-8P
CN-4	DEUTSCH	8	I/conn (Cabin LH wire harness-Frame harness)	S816-008002	S816-108002
CN-5	AMP	15	I/conn (Frame harness-RH side harness)	2-85262-1	368301-1
CN-6	AMP	12	I/conn (Frame harness-RH side harness)	S816-012002	S816-112002
CN-7	AMP	15	I/conn (Frame harness-Cabin RH wire harness)	2-85262-1	368301-1
CN-8	AMP	12	I/conn (Frame harness-Cabin RH wire harness)	S816-012002	S816-112002
CN-9	AMP	8	I/conn (Frame harness-Cabin RH wire harness)	S816-008002	S816-108002
CN-10	DEUTSCH	12	I/conn (Frame haness-Cabin harness)	DT06-12S	DT06-12P
CN-11	DEUTSCH	8	Aircon harness	DT06-8S	DT04-9P-E004
CN-12	DEUTSCH	2	Work lamp harness	DT06-2S-P012	DT04-2P-E005
CN-15	DEUTSCH	2	2pcs auto idle pressure	S814-002100	21N5-30100
CN-17	DEUTSCH	8	Wiper harness	DT06-8S	DT04-8P
CN-19	-	2	Prolix resistor	-	S816-102002
CN-19A	AMP	2	Prolix resistor	S816-002002	-
CN-19B	AMP	2	Prolix resistor	S816-002002	S816-102002
CN-20	MOLEX	2	Horn	36825-0211	-
CN-21	AMP	6	Wiper motor	925276-0	-
CN-21A	AMP	6	Wiper motor	S816-006002	-
CN-22	KET	2	Washer tank	MG640605	-
CN-23	KET	2	LH speaker	MG610070	-
CN-24	KET	2	RH speaker	MG610070	-
CN-25	MOLEX	2	Horn	36825-0211	-
CN-27	-	16	Radio & USB player	PK145-16017	PK141-16017
CN-28	MWP	1	Air-con compressor	MWP-01F-B	-
CN-29	KET	2	Receiver dryer	MG640795	-
CN-36	-	-	Fuse box	21N8-20041	-
CN-45	RING TERM	-	Start motor B^+	ST710246-2	-
CN-47	AMP	2	Resistor	S810-002202	S810-102202
CN-48	-	1	Hour meter	GP890469	-
CN-50	AMP	36	MCU	3441111-1	-
CN-51	AMP	36	MCU	3441111-1	-
CN-56	DEUTSCH	4	Cluster	-	DT04-4P-E004
CN-60	YAZAKI	2	Fusible link	7123-412S-50	7122-4125-50
CN-61	DEUTSCH	2	Fuel filler pump	DT06-2S-P012	-
CN-66	DEUTSCH	2	Breaker solenoid	DT06-2S-P012	DT04-2P-E004
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-P012	-

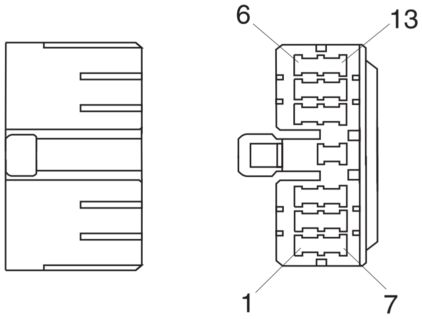
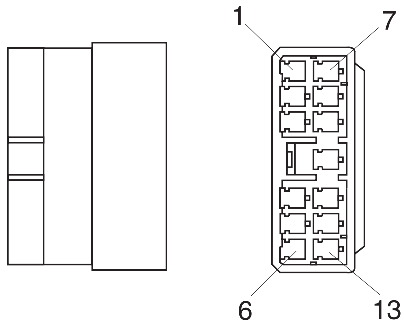
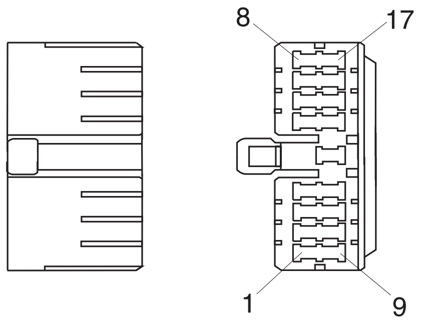
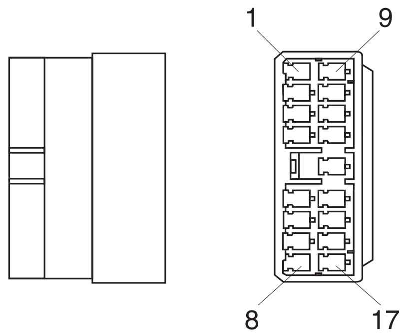
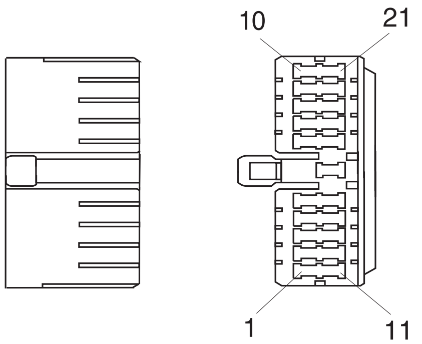
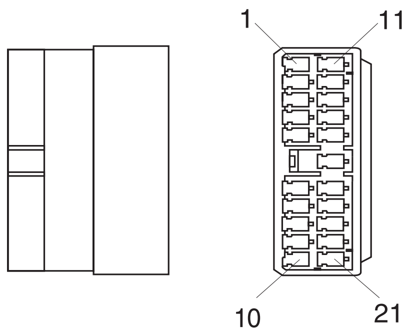
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-70	DEUTSCH	2	Travel speed solenoid	DT06-2S-P012	-
CN-74	RING-TERM	1	Alternator	S820-408000	-
	-		Alternator	174198-2	-
CN-75	Econoseal J	2	EPPR valve	S816-002002	-
CN-76	DEUTSCH	6	DC motor	DT06-6S	-
CN-78	DEUTSCH	6	Accel actuator	DT06-6S-EP06	-
CN-79	-	3	Fuel cut-off	174198-2	-
CN-81	DEUTSCH	2	Travel alarm buzzer	DT06-2S-P012	DT04-2P-E004
CN-92	AMP	1	Safety	S814-001100	S814-101100
CN-95	KET	2	Fusible link	S813-030201	S813-130200
CN-116	PA	17	Switch panel	S811-017002	-
CN-125	-	4	GPS connector	S816-004002	S816-104002
CN-125A	DEUTSCH	12	RMS	DT06-12S-EP06	DT04-12P
CN-126	DEUTSCH	4	RS232 connector	DT06-4S-P012	DT04-4P-E004
CN-138	DEUTSCH	3	DC/DC converter	DT06-3S-P012	-
CN-139	DEUTSCH	2	12V Socket	DT06-2S	DT04-2P-E004
CN-141	AMP	13	Wiper motor controller	172498-1	-
CN-142	DEUTSCH	3	Accel dial	DT06-3S	-
CN-147	-	2	Fuel heater	15300027	-
CN-148	DEUTSCH	3	J1939 connector	DT06-3S-P012	-
CN-173	DEUTSCH	3	Resistor	DT06-3S-P012	DT04-3P-EP10
CN-242	DEUTSCH	2	Attatchment EPPR	DT06-2S-P012	DT04-2P-E004
RELAY					
CR-1	RING TERM	1	Battery relay	ST710289-2	-
				ST710285-2	
CR-2	-	5	Horn relay	-	-
CR-5	-	5	Safety relay	-	-
CR-7	-	5	Ac comp relay	-	-
CR-13	-	5	Head lamp relay	SJA003526-001	2411-05100
CR-23	KET	2	Start relay	MG610320	S814-102001
CR-24	-	1	Pre-heater relay	S822-014000	-
CR-35	-	5	Power relay	-	-
CR-36	-	5	Pre-heat relay	-	-
CR-46	-	5	Fuel heater relay	SJA003526-001	2411-05100
CR-62	-	5	Breaker relay	SJA003526-001	2411-05100
SWITCH					
CS-1	SHUR	1	Door switch	S822-014004	-
CS-2	-	6	Start key switch	S814-006000	S814-106000
CS-4	DEUTSCH	3	Safety switch	DT06-3S-P012	DT04-3P
CS-5	DEUTSCH	2	Horn switch	DT06-2S	DT04-2P-E004
CS-19	DEUTSCH	2	One touch decel	DT06-2S	DT04-2P-E004

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CS-20	AMP	1	Safety switch	S822-014002	-
CS-23	SWF	10	Beacon lamp switch	SWF593757	-
CS-26	DEUTSCH	2	Breaker switch	DT06-2S-P012	DT04-2P
CS-26A	-	2	Breaker switch	S816-002002	S816-102002
CS-27	SWF	10	Breaker switch	SWF593757	-
CS-29	DEUTSCH	2	Power max switch	DT06-2S-P012	DT04-2P
CS-50	SWF	10	Overload switch	SWF593757	-
CS-52	SWF	10	Econo switch	SWF593757	-
CS-53	SHUR	1	Wiper cut switch	S822-014002	-
CS-54	SWF	10	Spare switch	SWF593757	-
CS-67	SWF	10	Quick clamp switch	SWF593757	-
CS-74A	KET	2	Master switch	MG620558	S813-130201
CS-74B	DEUTSCH	2	Master switch	DT06-2S-P012	DT04-2P-E005
CS-83	SWF	10	Beacon lamp switch	SWF 593757	-
LAMP					
CL-1	KET	2	Cabin room lamp	MG610392	-
CL-2	AMP	1	Cigar light	S822-014002	S822-114002
				S816-012002	-
CL-4	DEUTSCH	2	Head lamp	DT06-2S	DT04-2P-E004
CL-5	DEUTSCH	2	Work lamp	DT06-2S-EP06	DT04-2P
CL-7	SHUR	1	Beacon lamp	S822-014004	S822-114004
CL-8	DEUTSCH	2	Cabin light-LH	DT06-2S	DT04-2P-E005
CL-9	DEUTSCH	2	Cabin light-RH	DT06-2S	DT04-2P-E005
SENDER					
CD-1	AMP	2	Hydraulic oil temp sender	85202-1	-
CD-2	DEUTSCH	2	Fuel sender	DT06-2S-P012	-
CD-6	KET	2	Travel pressure switch	MG640795	-
CD-7	KET	2	Working pressure switch	MG640795	-
CD-8	AMP	2	Water temp sender	85202-1	-
CD-10	RING TERM	1	Air cleaner switch	ST710289-2	-
CD-17	PACKARD	2	Tacho sensor	-	S818-120221
CD-18	AMP	1	Engine oil pressure switch	174196-1	-
CD-32	DEUTSCH	3	Boom up pressure switch	DT06-3S-P012	-
CD-42	DEUTSCH	3	Pump pressure sensor 1	DT06-3S-EP06	-
CD-43	DEUTSCH	3	Pump pressure sensor 2	DT06-3S-EP06	-
CD-44	DEUTSCH	3	Pump pressure sensor 3	DT06-3S-EP06	-
CD-69	DEUTSCH	3	Attachment pilot pressure switch	DT06-3S-P012	DT04-3P-E004
DIODE					
DO-1	AMP	2	Diode	S816-002002	21EA-50550
DO-2	AMP	2	Diode	S816-002002	21EA-50550
DO-3	AMP	2	Diode	S816-002002	21EA-50550
DO-5	AMP	2	Diode	S816-002002	21EA-50550

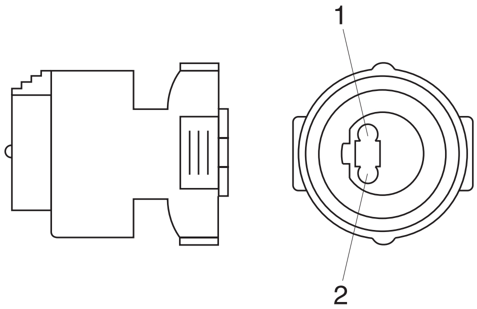
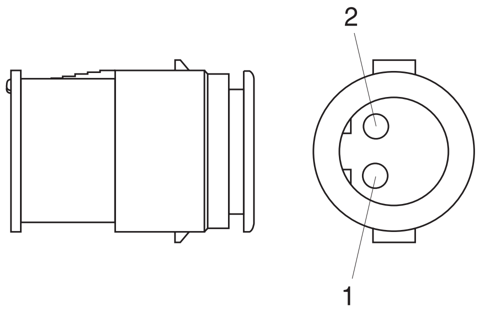
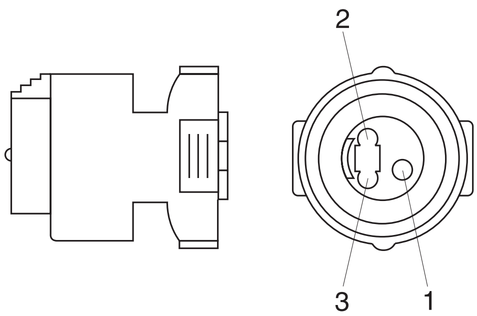
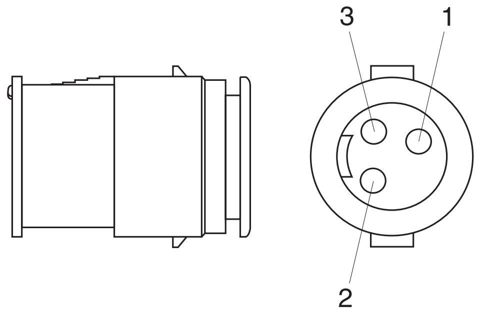
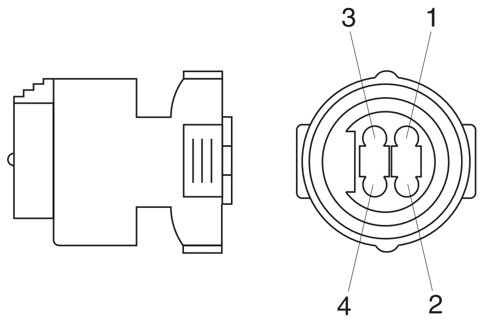
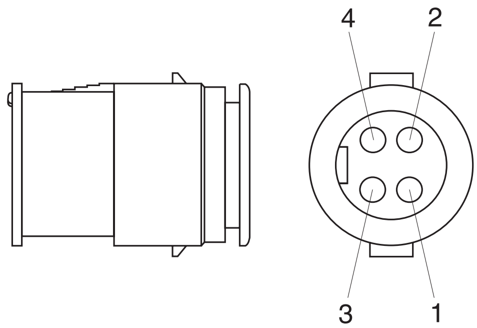
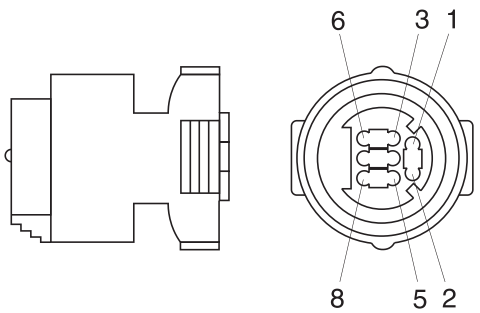
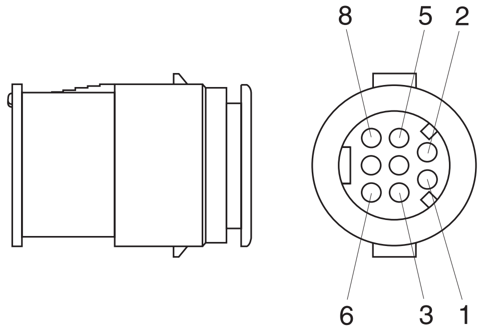
2. CONNECTION TABLE FOR CONNECTORS

1) PA TYPE CONNECTOR

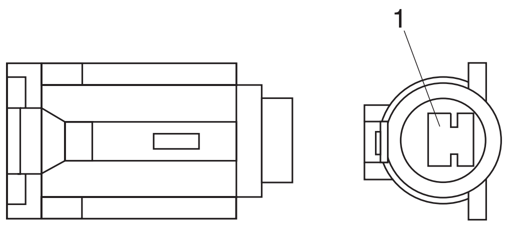
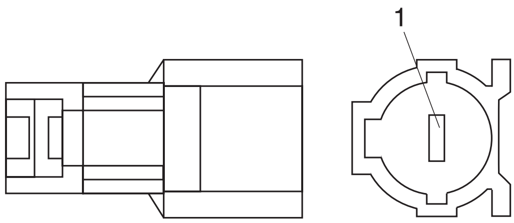
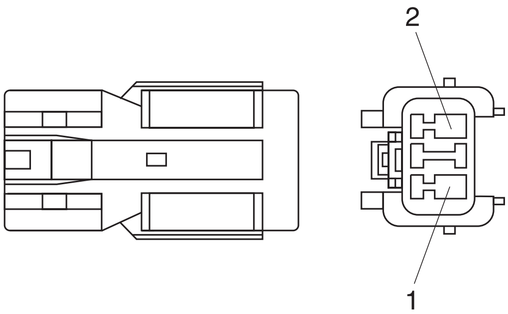
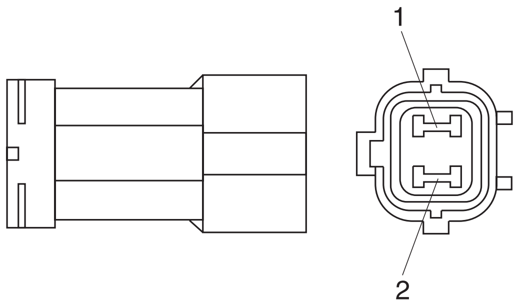
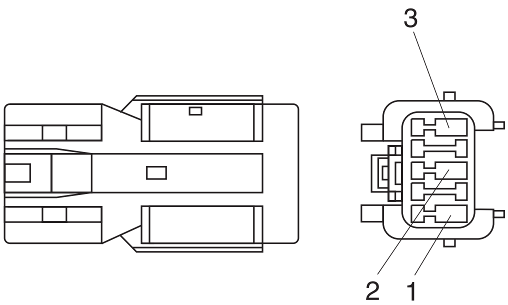
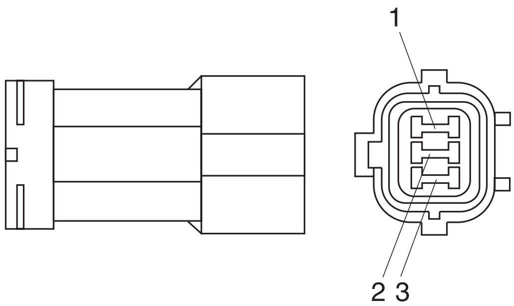
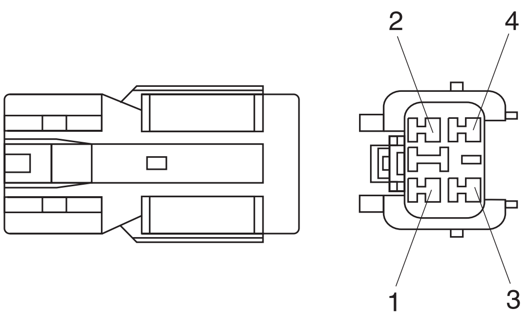
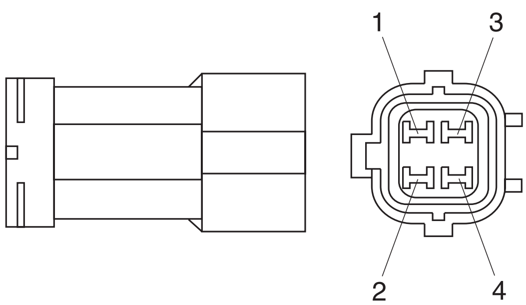
No. of pin	Receptacle connector(Female)	Plug connector(Male)
5	 S811-005002	 S811-105002
7	 S811-007002	 S811-107002
9	 S811-009002	 3S811-109002
11	 S811-011002	 S811-111002

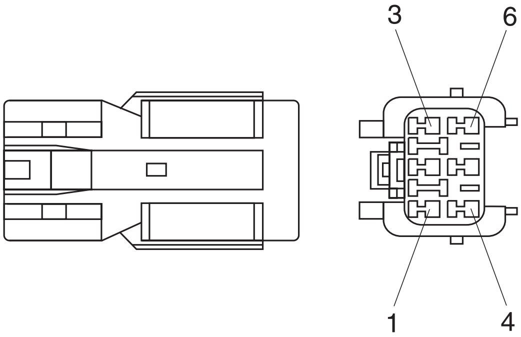
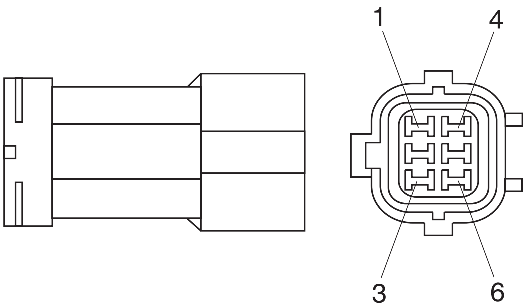
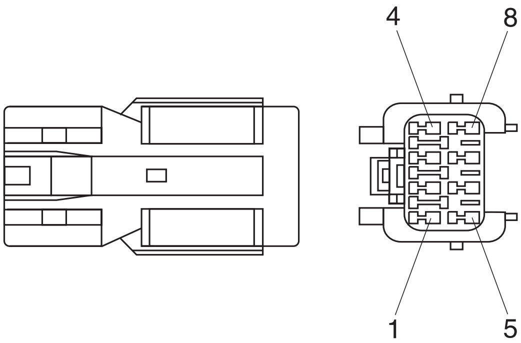
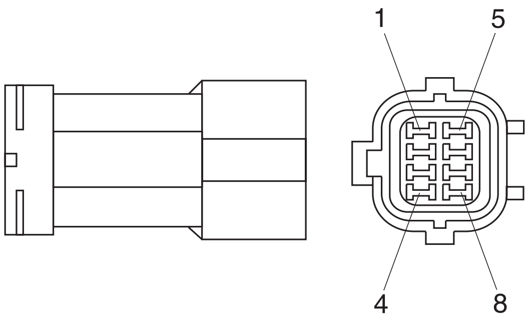
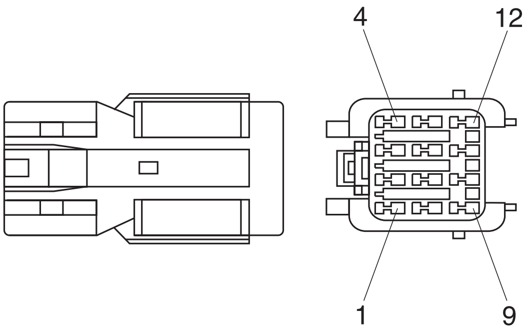
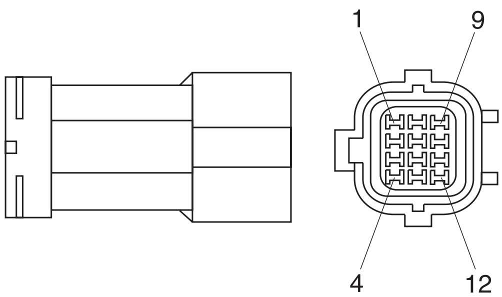
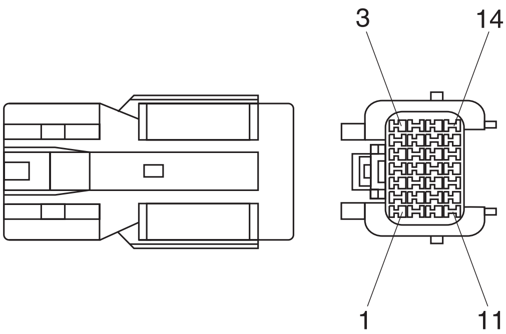
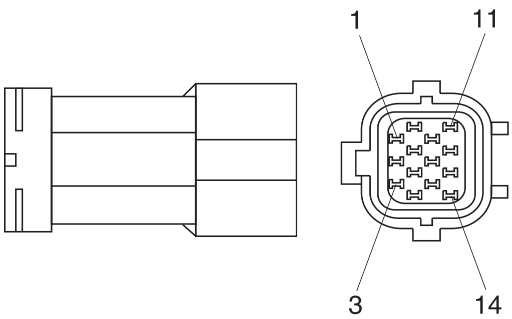
No. of pin	Receptacle connector(Female)	Plug connector(Male)
13	 S811-013002	 S811-113002
17	 S811-017002	 S811-117002
21	 S811-021002	 S811-121002

2) J TYPE CONNECTOR

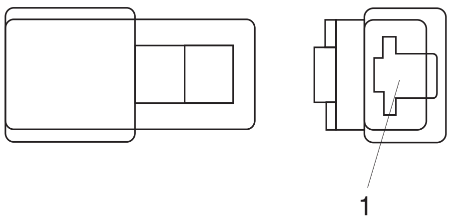
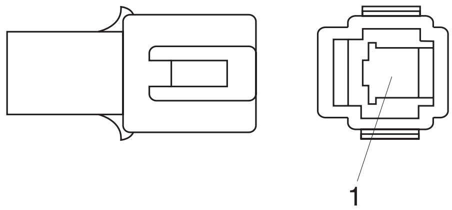
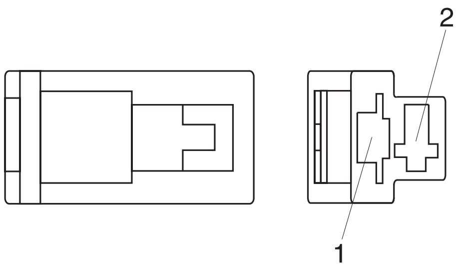
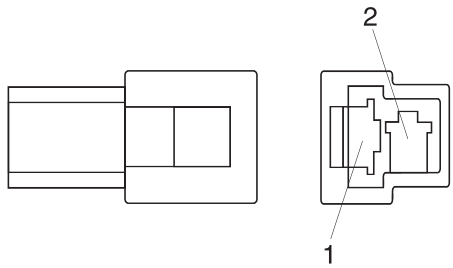
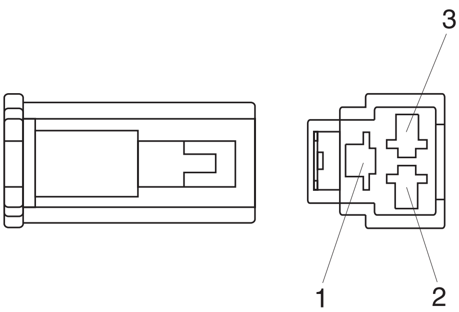
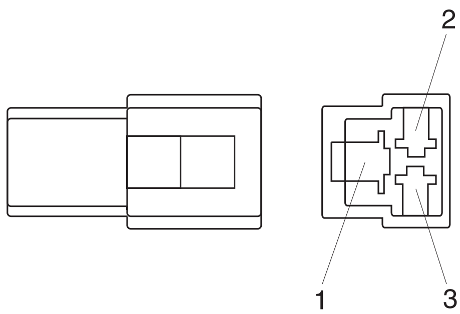
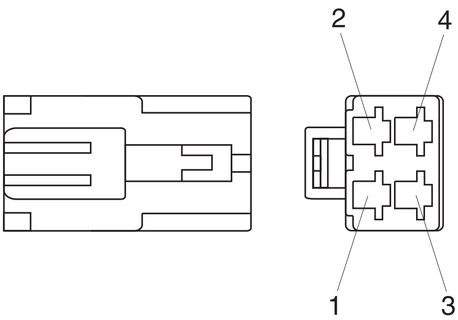
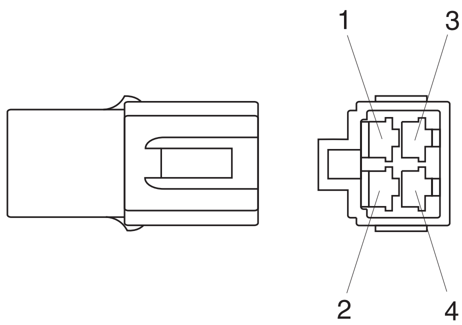
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 S816-002001	 S816-102001
3	 S816-003001	 S816-103001
4	 S816-004001	 S816-104001
8	 S816-008001	 S816-108001

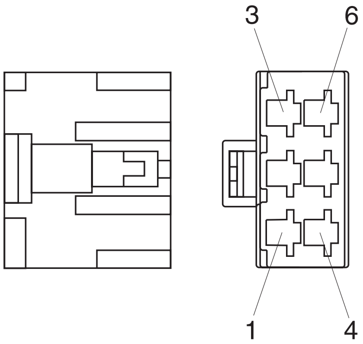
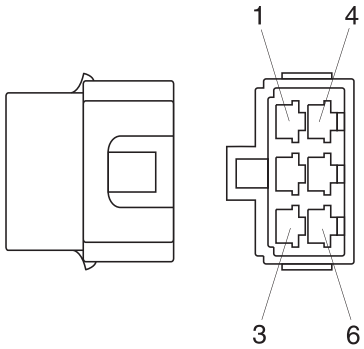
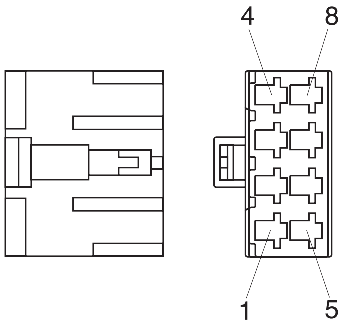
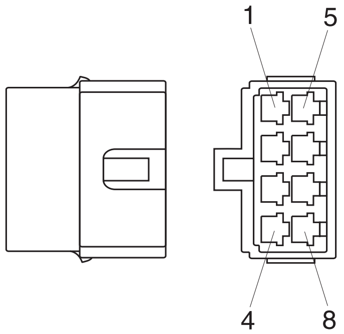
3) SWP TYPE CONNECTOR

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

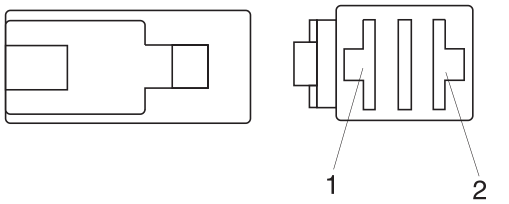
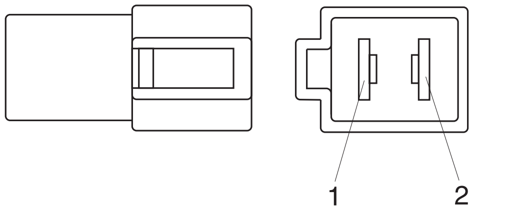
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

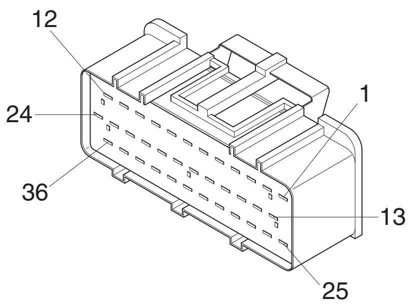
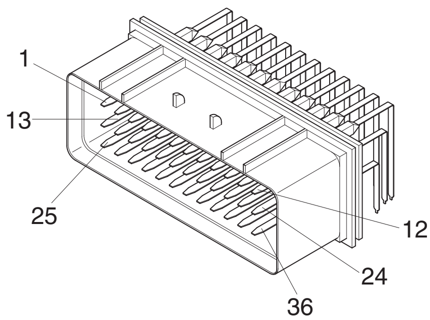
No. of pin	Receptacle connector(Female)	Plug connector(Male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

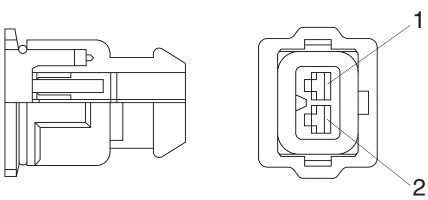
5) 375 FASTEN TYPE CONNECTOR

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

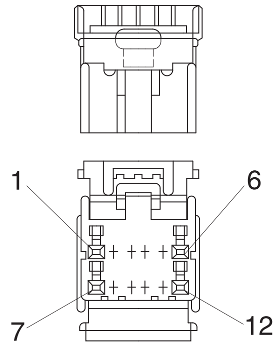
6) AMP ECONOSEAL CONNECTOR

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

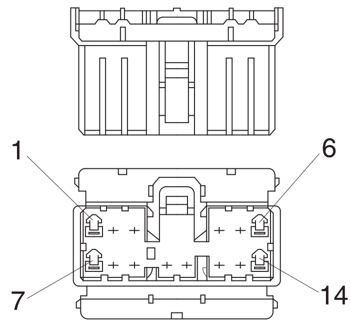
7) AMP TIMER CONNECTOR

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

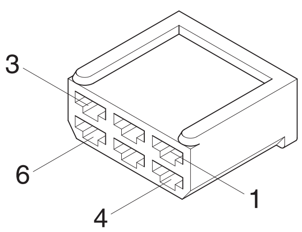
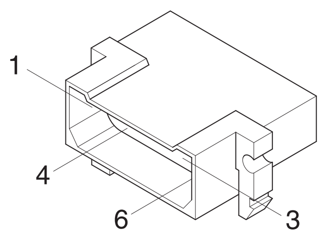
8) AMP 040 MULTILOCK CONNECTOR

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

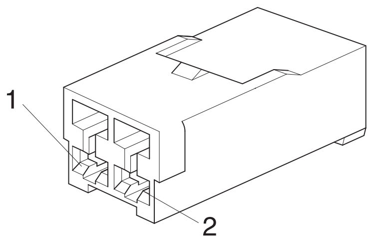
9) AMP 070 MULTILOCK CONNECTOR

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

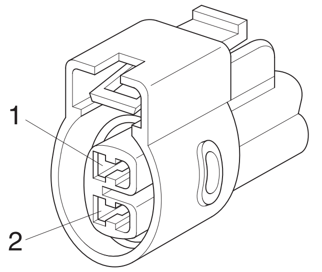
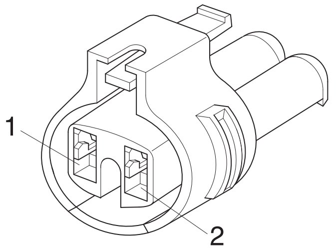
10) AMP FASTIN - FASTON CONNECTOR

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

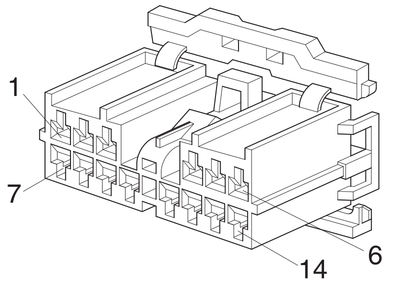
11) KET 090 CONNECTOR

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	

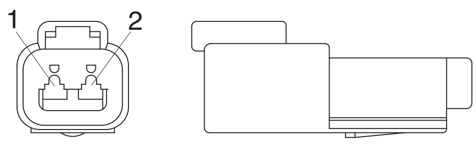
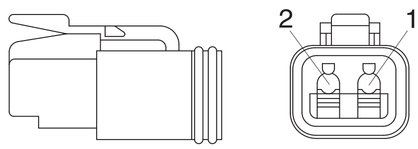
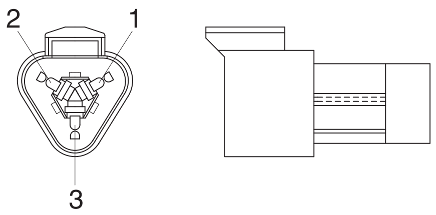
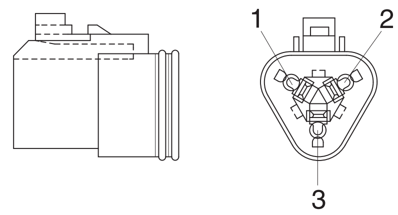
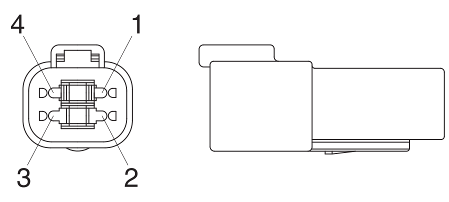
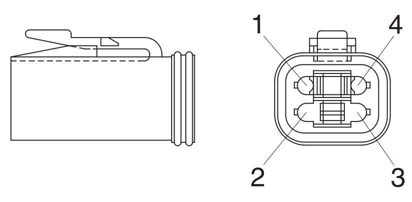
14) DEUTSCH DT CONNECTORS

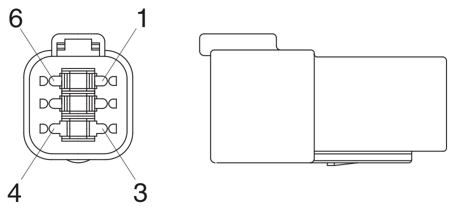
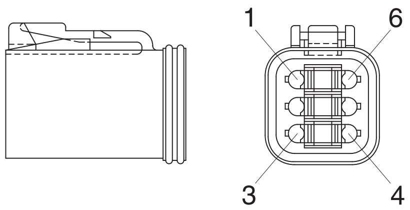
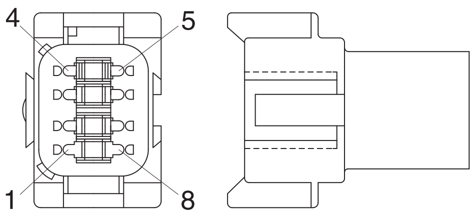
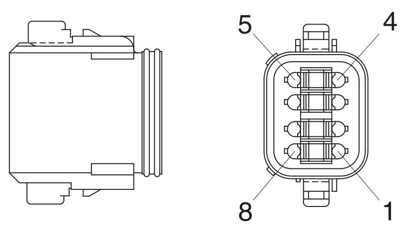
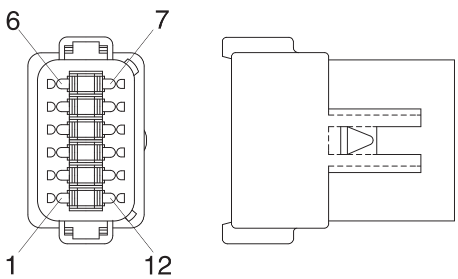
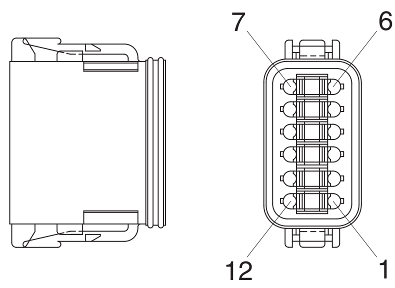
DT 06 - 3S - ★★★★

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

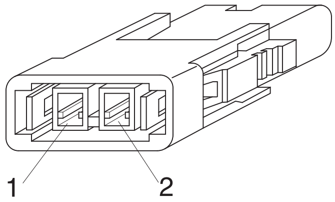
※ Modification

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

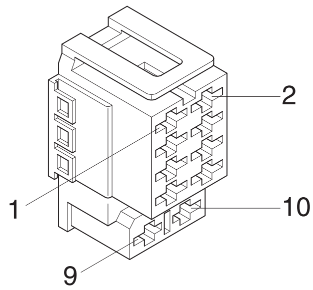
No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

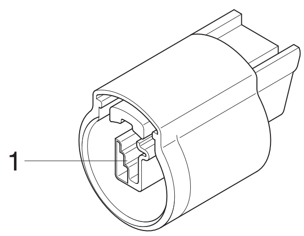
15) MOLEX 2CKTS CONNECTOR

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

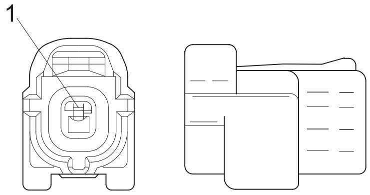
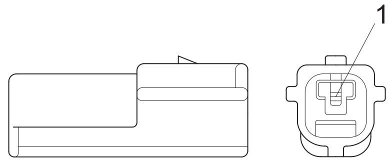
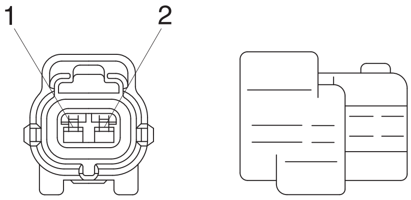
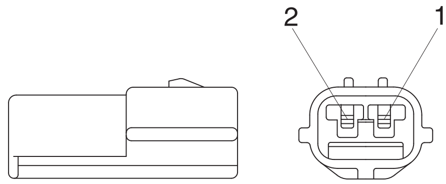
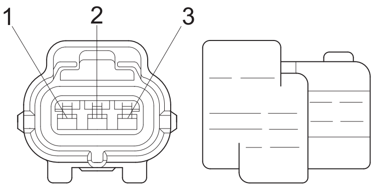
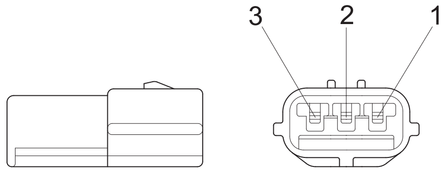
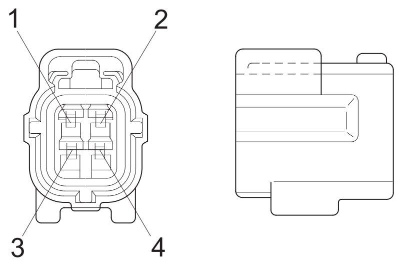
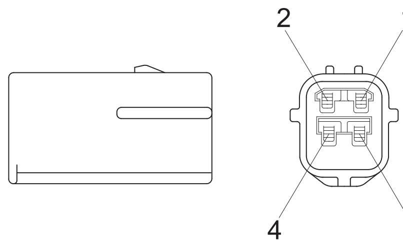
16) ITT SWF CONNECTOR

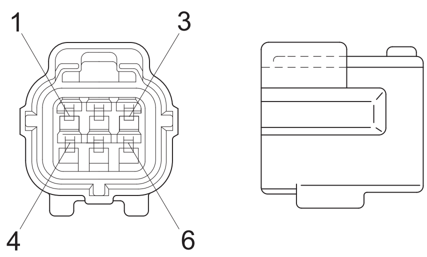
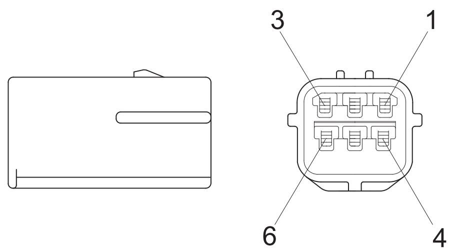
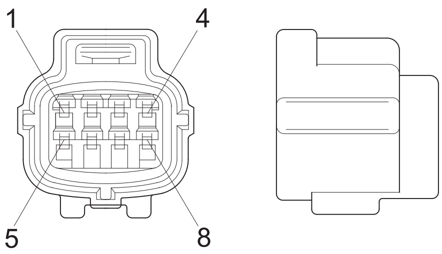
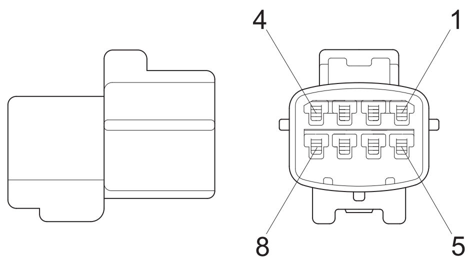
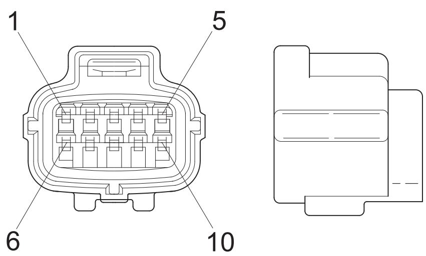
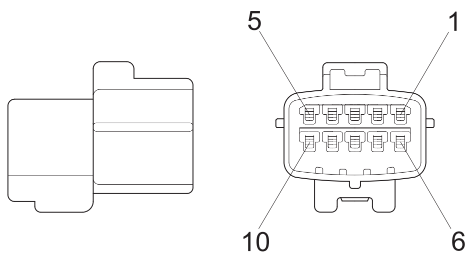
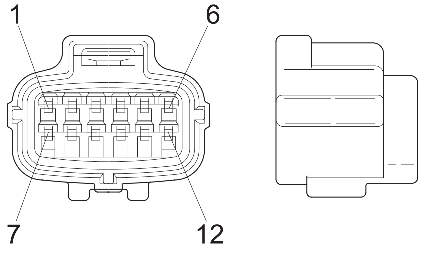
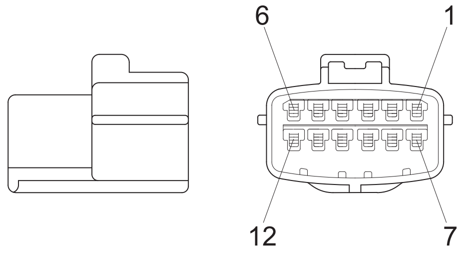
No. of pin	Receptacle connector(Female)	Plug connector(Male)
10	 SWF593757	

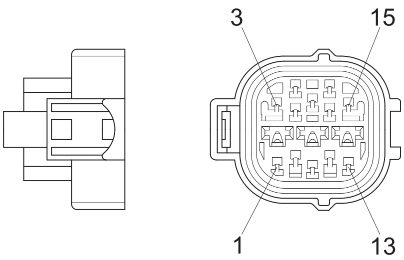
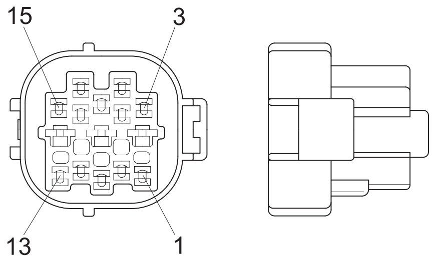
17) MWP NMWP CONNECTOR

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

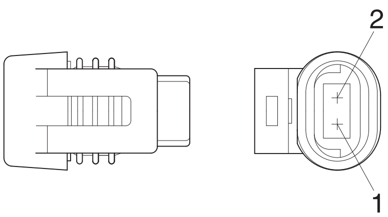
18) ECONOSEAL J TYPE CONNECTORS

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

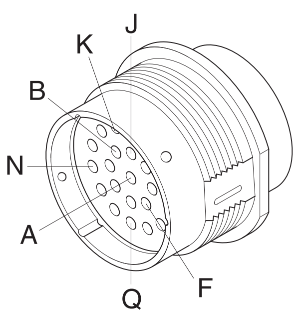
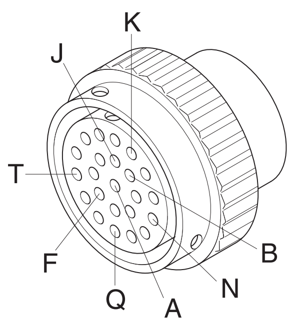
No. of pin	Receptacle connector(Female)	Plug connector(Male)
6	 S816-006002	 S816-106002
8	 S816-008002	 S816-108002
10	 S816-010002	 S816-110002
12	 S816-012002	 S816-112002

No. of pin	Receptacle connector(Female)	Plug connector(Male)
15	 368301-1	 2-85262-1

19) METRI-PACK TYPE CONNECTOR

No. of pin	Receptacle connector(Female)	Plug connector(Male)
2	 12040753	

20) DEUTSCH HD30 CONNECTOR

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

SECTION 5 MECHATRONICS SYSTEM

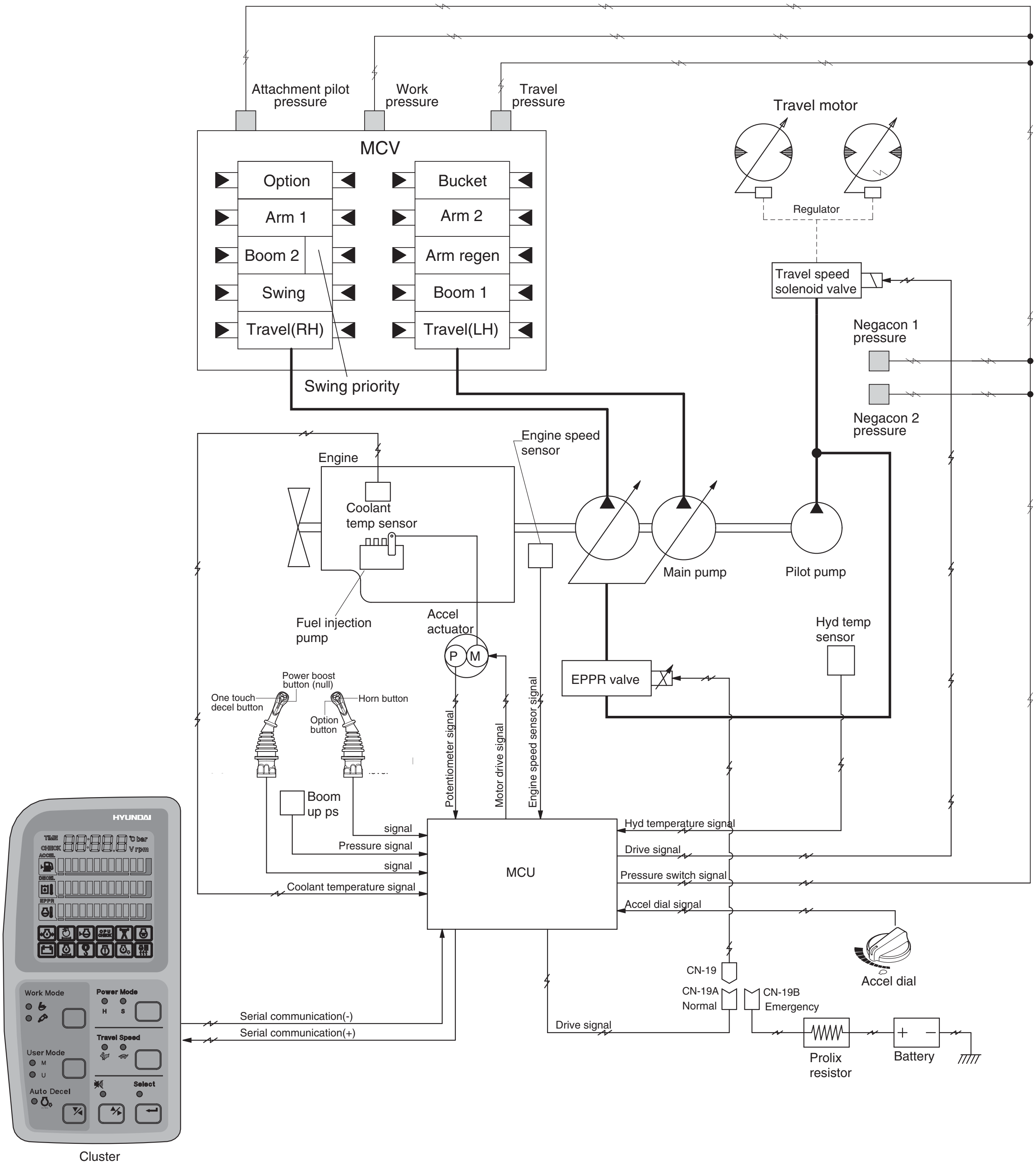
SECTION 5 MECHATRONICS SYSTEM

GROUP 1 OUTLINE

The NEW CAPO (Computer Aided Power Optimization) system controls engine and pump mutual power at an optimum and less fuel consuming state for the selected work by mode selection, auto-deceleration, power boost function, etc. It monitors machine conditions, for instance, engine speed, coolant temperature, hydraulic oil temperature, and hydraulic oil pressure, etc.
It consists for a MCU, a cluster, an accel actuator, an EPPR valve, 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.

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

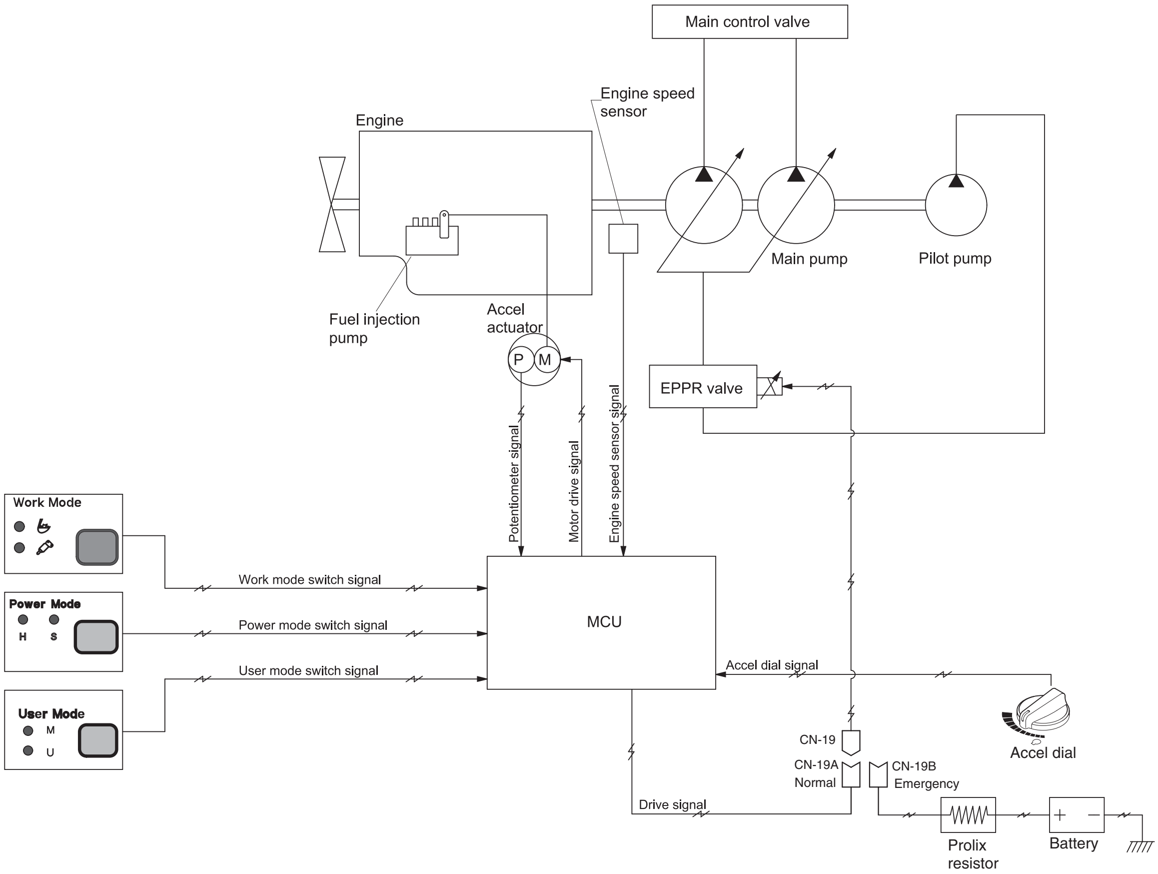
SYSTEM DIAGRAM



210S5MS01

GROUP 2 MODE SELECTION SYSTEM

1. POWER MODE SELECTION SYSTEM



210S5MS02

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

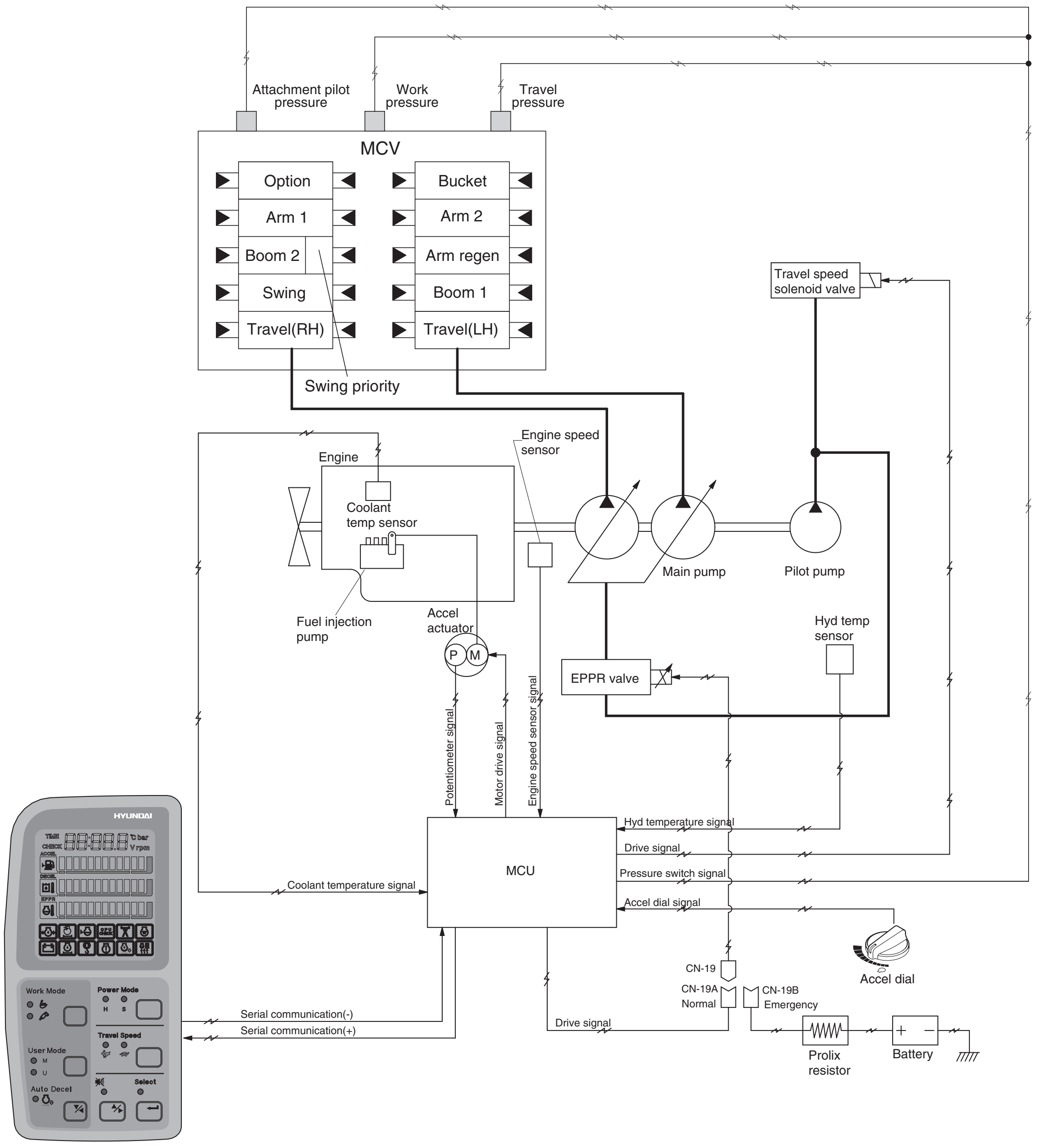
The combination of 3 power modes (M, H, S) and accel dial position (10 set) makes it possible to use the engine and pump power more effectively corresponding to the work conditions from a heavy and great power requesting work to a light and precise work.

Mode	Application	Engine rpm				Power shift by EPPR valve			
		Standard		Option		Standard		Option	
		Unload	Load	Unload	Load	Current (mA)	Pressure (kgf/cm^2)	Current (mA)	Pressure (kgf/cm^2)
M mode	Maximum power	2100±100	2000±100	2200±100	2100±100	-	12(~7)	-	12(~6)
H mode	High power	2000±100	1900±100	2050±100	1950±100	-	15(~10)	-	13(~7)
S mode	Standard power	1900±100	1800±100	1950±100	1850±100	-	15(~10)	-	13(~7)
Auto decel	Engine deceleration	1150±100	-	1150±100	-	700±30	38	700±30	38
One touch decel	Engine quick deceleration	1050±100	-	1050±100	-	700±30	38	700±30	38
Key start	Key switch start position	850±100	-	850±100	-	700±30	38	700±30	38

※(~※): Load

2. WORK MODE SELECTION SYSTEM

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



210S5MS03

1) HEAVY DUTY WORK MODE

2) BREAKER OPERATION MODE

It sets the pump flow to the optimal operation of breaker by MCU.

3. USER MODE SELECTION SYSTEM

Through 1 memory sets of M and U, an operator can change the engine and pump power and memorize it for his preference.

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

HOW TO MODULATE THE MEMORY SET

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

140W74OP03G

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

3) To change DECEL rpm, press the USER mode switch and SELECT switch once more and then DECEL blinks at 0.5 seconds interval.

- By pressing ▲or ▼ switch, ▮ will increase or decrease.

4) To change EPPR current, press the USER mode switch and SELECT switch one more and then EPPR blinks at 0.5 seconds interval.

- By pressing ▲or ▼ switch, ▮ will increase or decrease.

210S4OP08

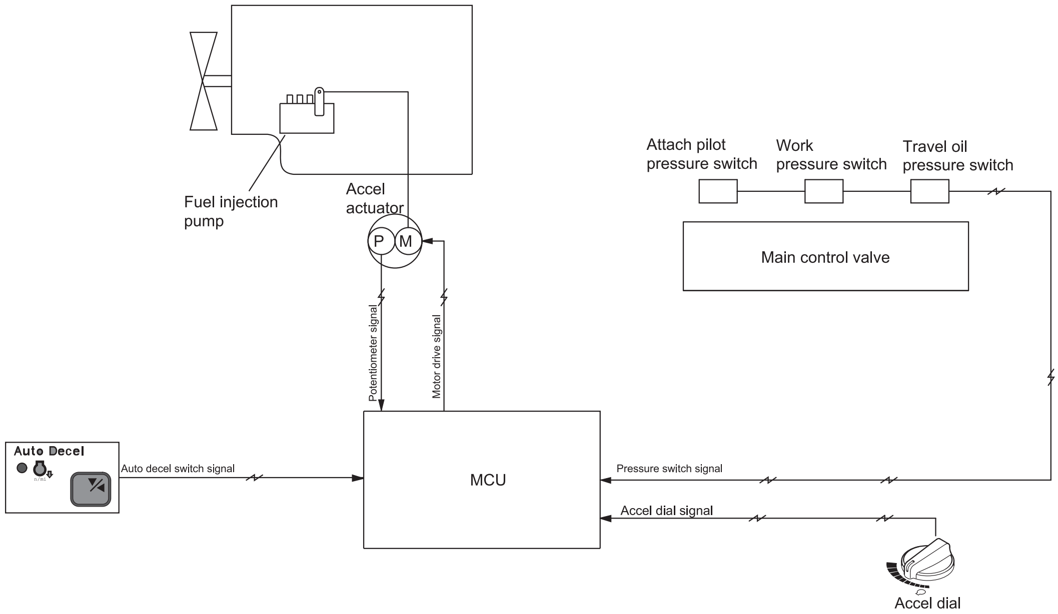
· LCD segment vs parameter setting

Segment (▮)	ACCEL (rpm)	DECEL (rpm)	EPPR (mA)
1	1300	1000 (low idle)	0
2	1400	1050	3
3	1500	1080	6
4	1600	1100	9
5	1650	1150	12
6	1700	1200	16
7	1750	1250 (auto decel)	20
8	1800	1300	26
9	1850	1350	32
10	1900	1400	38

※ : One touch decel : 1050 rpm

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

GROUP 3 AUTOMATIC DECELERATION SYSTEM

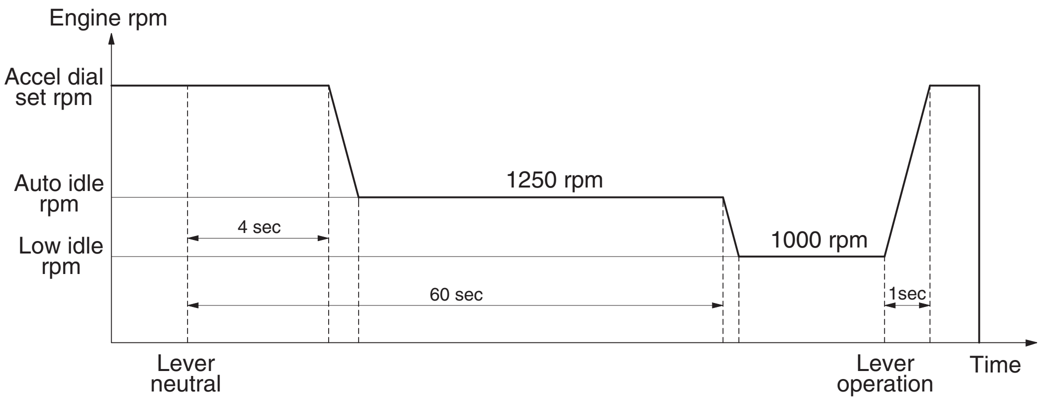


210S5MS04

1. WHEN AUTO DECEL LAMP ON

If all the work equipment control levers including swing and travel levers are at neutral for at least 4 seconds, the MCU drives the accel actuator to reduce the engine speed to 1250rpm. As the result of reducing the engine speed, fuel consumption and noise are effectively cut down during non-operation of the control levers.

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



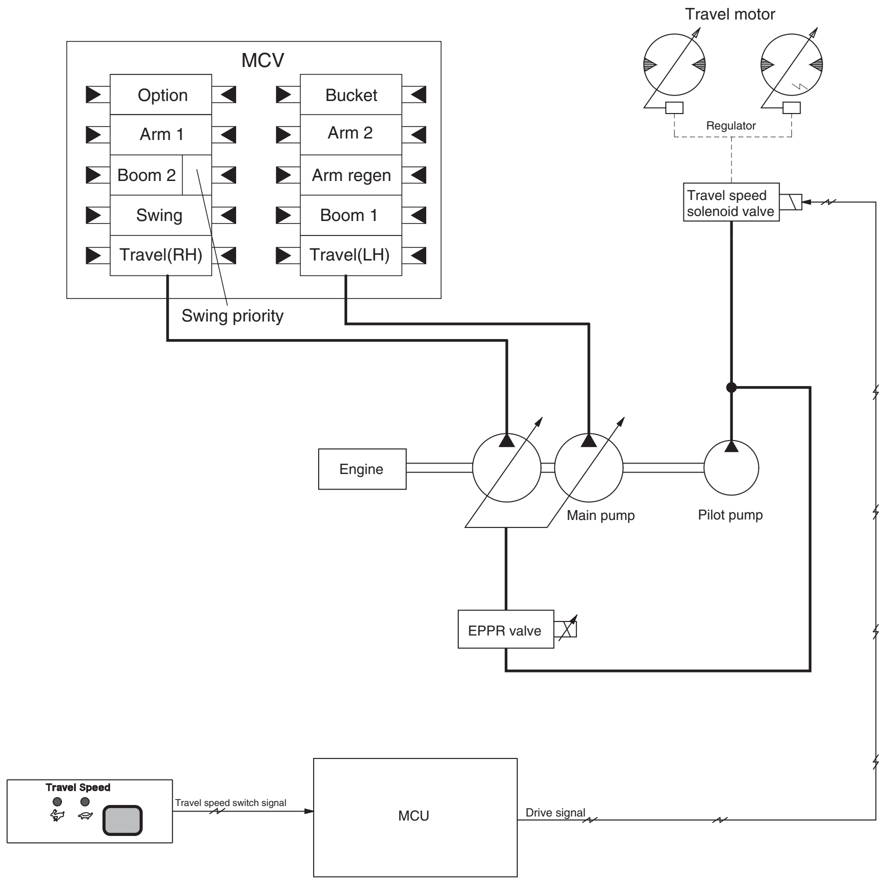
210S5MS05

2. WHEN AUTO DECEL 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.

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

GROUP 4 TRAVEL SPEED CONTROL SYSTEM



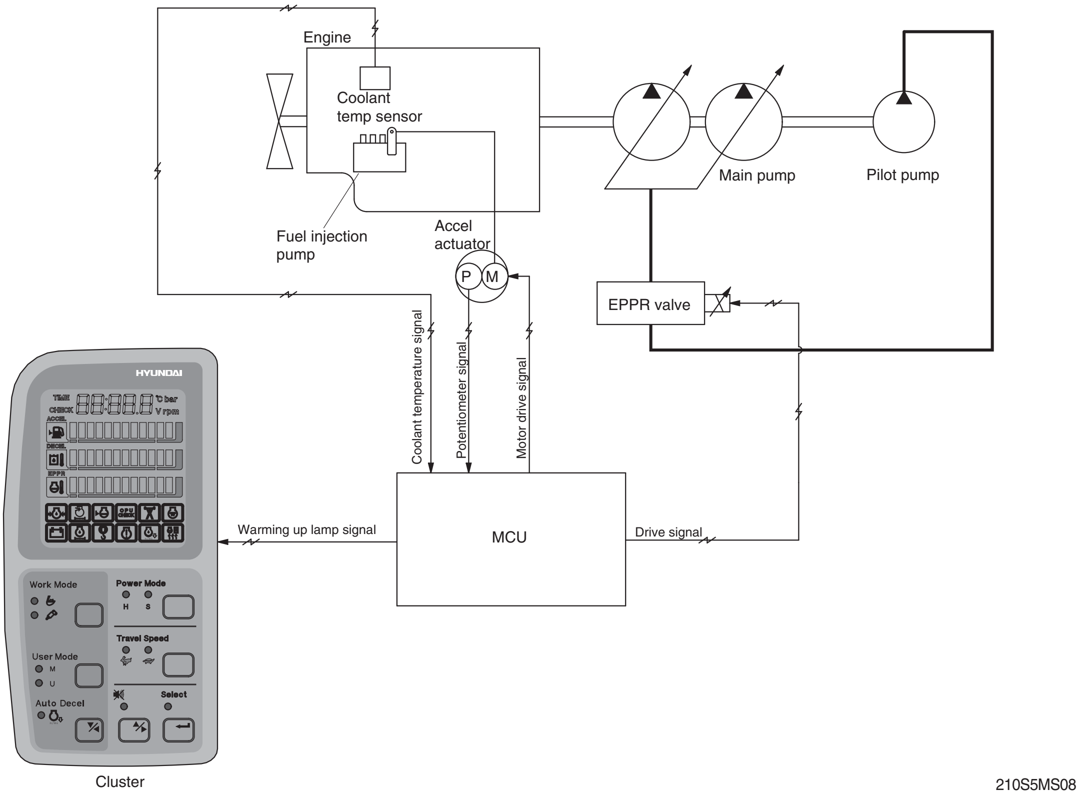
210S5MS07

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

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

※ Default : Turtle(Lo)

GROUP 5 AUTOMATIC WARMING UP FUNCTION



210S5MS08

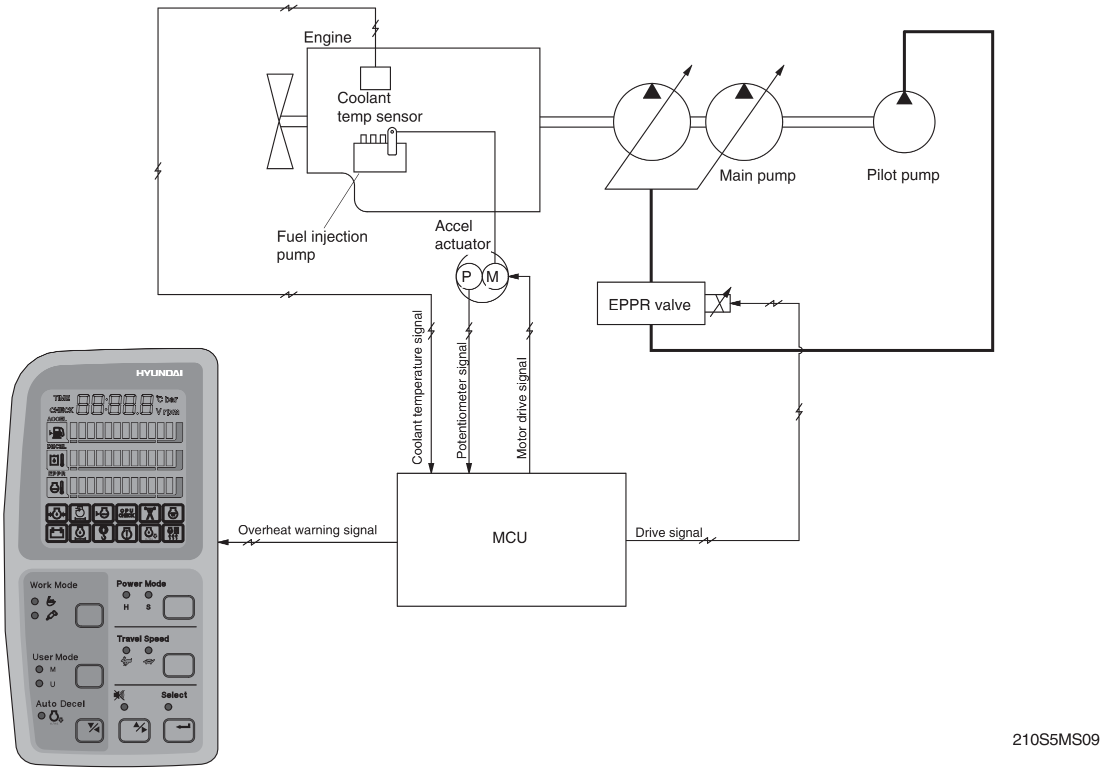
1. The MCU reads engine coolant temperature through the temperature sensor, and if the coolant temperature is less than 30 ℃, it increases the engine speed from key start rpm to 1250rpm. At this time the mode does not change.

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

3. LOGIC TABLE

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

GROUP 6 ENGINE OVERHEAT PREVENTION FUNCTION



Cluster

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

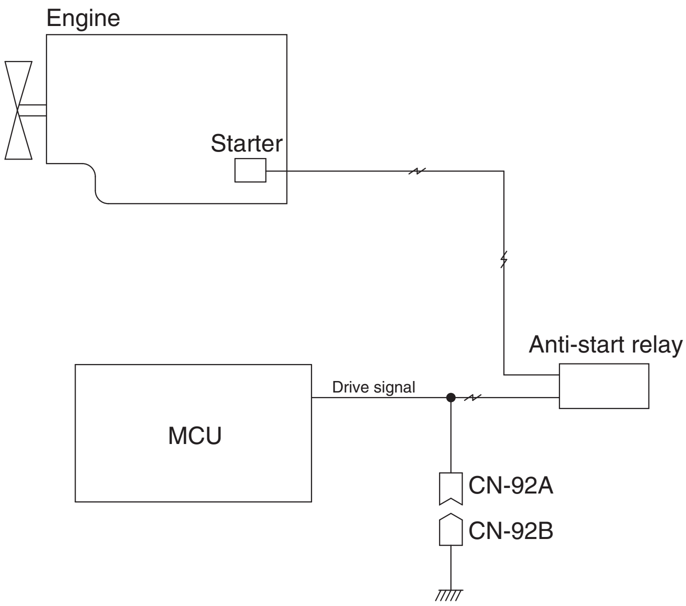
2. If the coolant temperature drops less than 100 ℃, the The MCU returns the mode to the mode set before. And if mode set is changed during the function, the The MCU cancels the function.

Even if the overheat prevention function is canceled by mode change, the overheat warning lamp turns OFF only when the coolant temperature is less than 100 ℃.

3. LOGIC TABLE

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

GROUP 7 ANTI-RESTART SYSTEM



210S5MS10

1. ANTI-RESTART FUNCTION

After 10 seconds from the engine starts to run, the MCU turns off the anti-restart relay to protect the starter from inadvertent restarting.

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

GROUP 8 SELF-DIAGNOSTIC SYSTEM

1. OUTLINE

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

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

2. CURRENT ERROR DISPLAY

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

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

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

Examples :

1) Communication Error

Co : Er & Buzzer sound

2) No problem

CHECK Er : 0 0

3) 4 Error codes(03, 06, 10, 43) display

CHECK Er : 0 3

0 3 (Start) ⇄ 0 6 ⇄ 1 0 ⇄ 4 3 → No change

(Press ▼ to move right, Press ▲ to move left)

3. RECORDED ERROR DISPLAY

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

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

TIME Er : 0 3

0 3 (Start) ⇄ 0 6 ⇄ 1 0 ⇄ 2 0 ⇄ 3 2 → No change

(Press ▼ to move right, Press ▲ to move left)

4. DELETE ALL RECORDED ERROR CODES

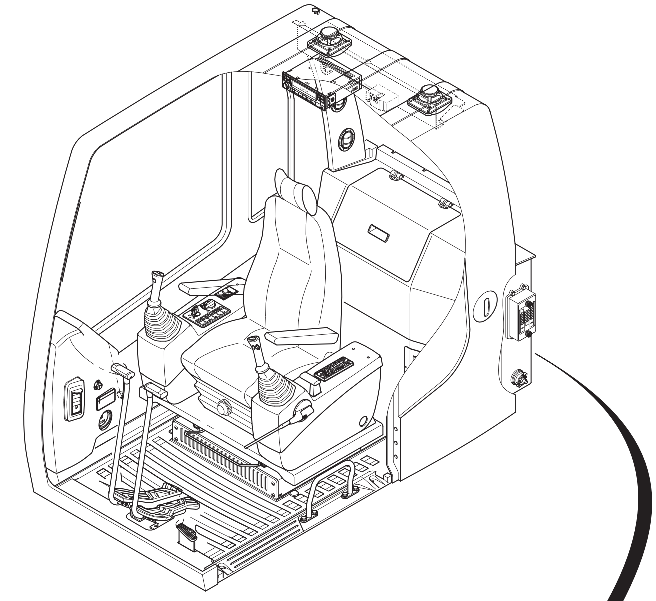
Select recorded error(TIME **Er**) display and press engine and select switch at the same time for 2 seconds or more. Cluster display changes to TIME **Er : 00**, which shows that MCU deleted all the recorded error codes in the memory.

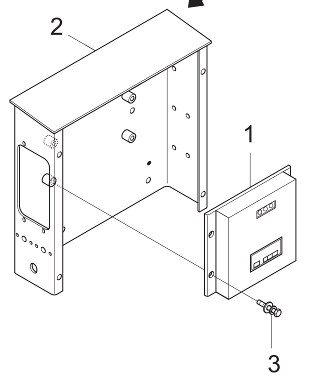
5. ERROR CODES TABLE

Fault code No.	Description
2	POTENTIOMETER is shorted to Vcc (5V) or battery +
3	Pump EPPR valve circuit is shorted
5	Travel solenoid valve circuit is shorted
10	Hour meter circuit is shorted
11	Accel dial circuit is shorted to Vcc (5V) or battery +
17	Potentiometer circuit is open or shorted to ground
18	Pump EPPR circuit is open or shorted to ground
20	Travel solenoid valve circuit is open or shorted to ground
22	Max flow co solenoid valve circuit is open or shorted to ground
25	Hour meter circuit is open or shorted to ground
26	Accel dial signal circuit is open or shorted to ground
27	P1 pressure sensor circuit is open or shorted to ground
28	P2 pressure sensor circuit is open or shorted to ground
31	Engine preheater circuit is open or shorted to ground
33	Alternator signal circuit is open or shorted to ground
34	Voltage under 18V
35	Voltage over 35V
36	Communication error
37	Engine speed sensor circuit is open or shorted to ground
40	Engine rpm discrepancy value is over ±500
41	Hydraulic oil temp sensor circuit is open or shorted to ground
42	Fuel level sensor circuit is open or shorted to ground
43	Coolant temp sensor circuit is open or shorted to ground
45	Hydraulic oil temp sensor circuit is open or shorted to battery +
46	Fuel level sensor circuit is open or shorted to battery +
47	Coolant temp sensor circuit is open or shorted to battery +
48	Boom up pressure sensor circuit is open or shorted to ground
49	Engine preheater circuit is shorted to battery +
61	Power shift pressure sensor circuit is open or shorted to battery +
99	MCU-RMCU communication error

GROUP 9 ENGINE CONTROL SYSTEM

1. MCU MOUNTING





1 MCU
2 Electric box
3 Bolt (M8)

210S5MS11

2. MCU ASSEMBLY

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

2) Disconnect 2 connectors from MCU.

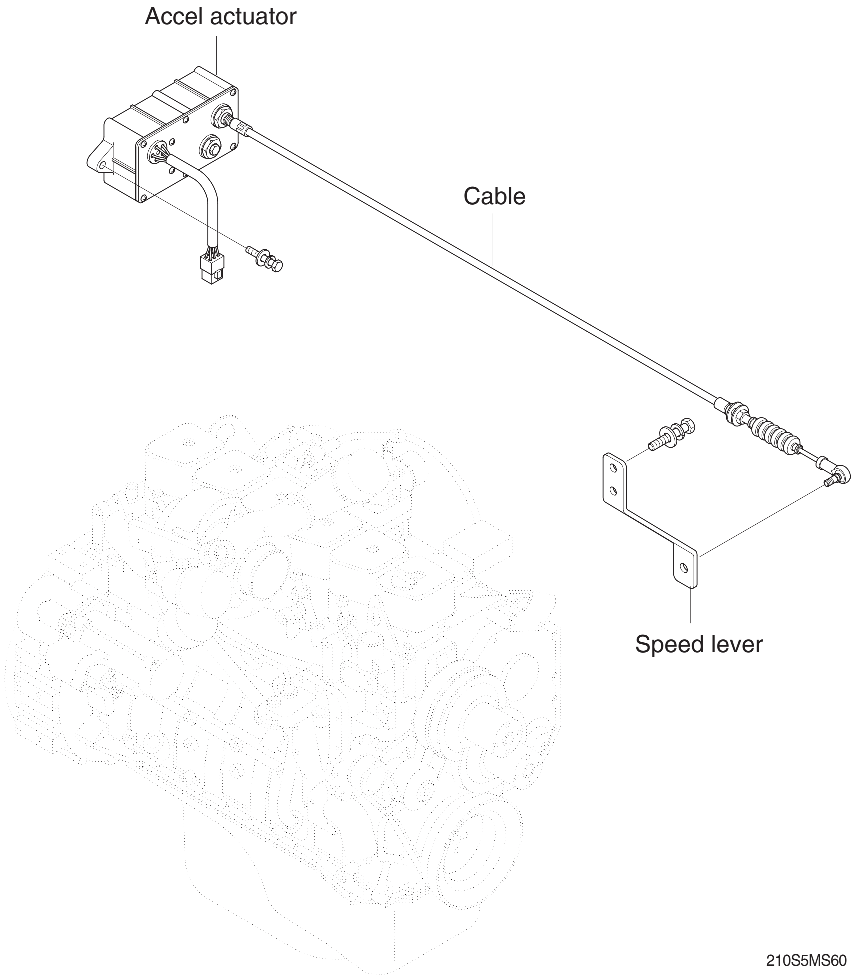
3) Remove 6 pieces of screw and open the cover of MCU.

4) Inspection : Check PCB (Printed Circuit Board)

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

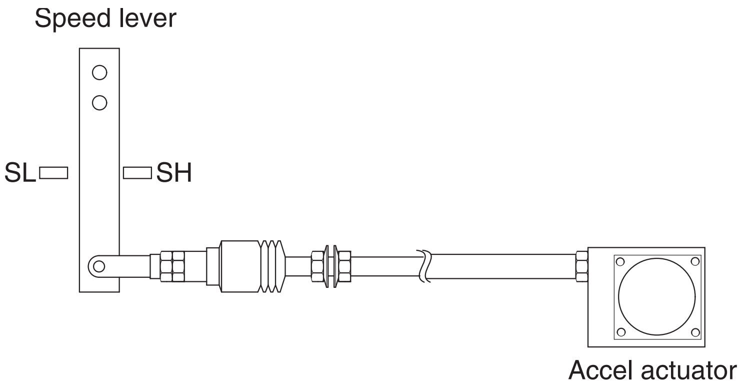
(2) If not, but CAPO system does not work please report it to Hyundai dealer or A/S department.

3. ENGINE ACCEL ACTUATOR



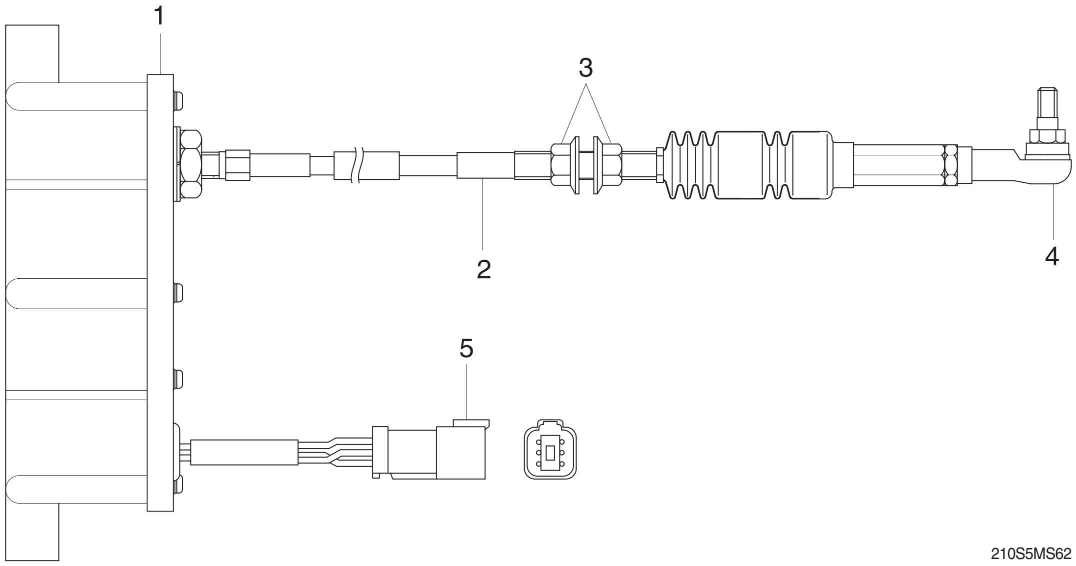
210S5MS60

1) ENGINE SPEED LEVER

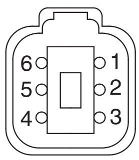


210S5MS61

2) ACCEL ACTUATOR



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

Connector		
Type		6P, female
Line color & description	1	Red, sensor (VCC)
	2	Orange, sensor (OUT)
	3	Blue, sensor (GND)
	4	Null
	5	Green, motor (+)
	6	Yellow, motor (-)
Inspection		Check resistance Spec : 10Ω(Between No.5-6) 5kΩ(Between No.1-3)

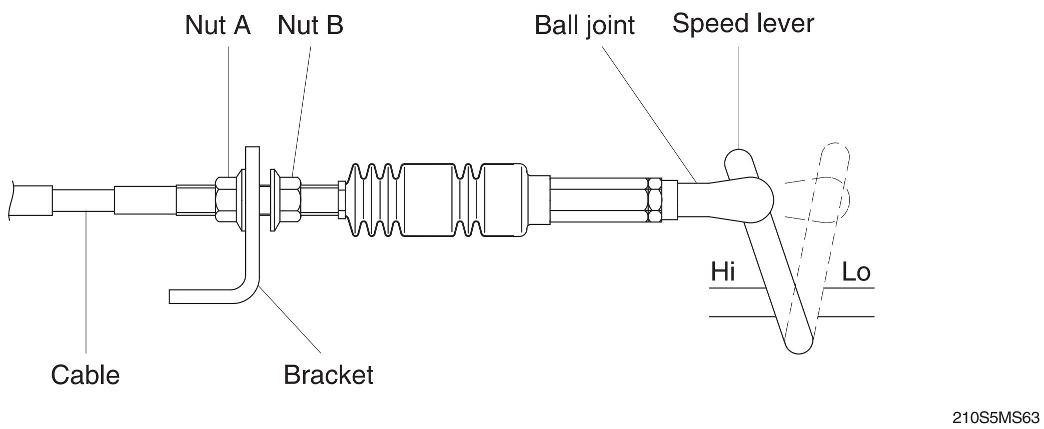
3) ACCEL ACTUATOR CABLE SETTING PROCEDURE

(1) Key OFF

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

(2) Key START

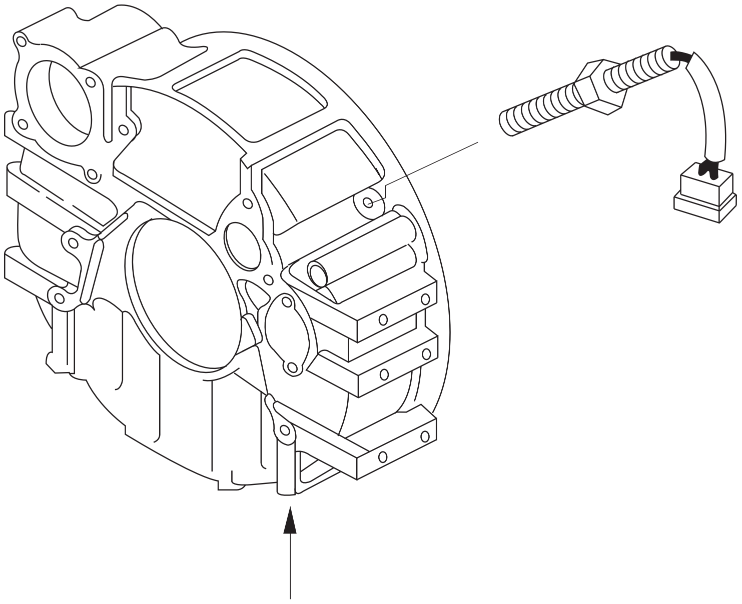
⑤ Confirm if the engine speed on cluster is same as each mode specification.
⑥ If the engine speed displayed on cluster is highter than each mode specification, then turn the nut A to counter clockwise and make the engine speed same to each mode specification.
⑦ If the engine speed displayed on cluster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

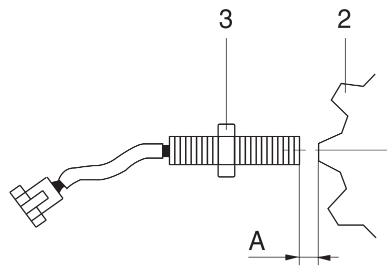


Mode	RPM
M	2100±100
H	2000±100
S	1900±100
Auto decel	1150±100
Key start	850±100

4. ENGINE SPEED SENSOR

1) STRUCTURE





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

5-20 (210-7)

2) INSTALLATION

(1) Clean contacting point of sensor.

(2) Loosen lock nut.

(3) Screw speed sensor into flywheel housing.

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

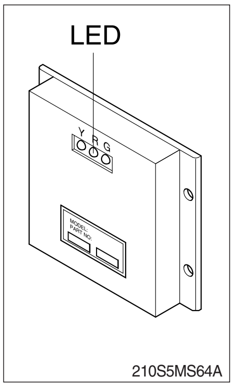
(5) Tight lock nut and connect wiring.

3) INSPECTION

(1) Check resistance
 · SPEC : 300±30 Ω

(2) Check voltage while engine run.
 · SPEC : 2~28Vac, dependent on the engine speed (rpm)

5. MCU



(1) To match the engine torque with the pump absorption 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 or ROM	· Change the MCU
G and Y are turned ON	Trouble on serial communication line	· Check if serial communication lines between MCU and cluster are disconnected
Three LED are turned OFF	Trouble on MCU power	· Check if the input power wire (24V, GND) of MCU is disconnected · Check the fuse

G : green, R : red, Y : yellow

GROUP 10 EPPR VALVE

1. COMPOSITION OF EPPR VALVE

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

1) ELECTRO MAGNET VALVE

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

2) SPOOL VALVE

Is the two way direction control valve for pilot pressure to reduce hydraulic pump flow.
When the electro magnet valve is activated, pilot pressure enters into flow regulator of hydraulic pump. So, pump flow decreases to prevent engine stall.

3) PRESSURE AND ELECTRIC CURRENT VALUE FOR EACH MODE

Mode		Pressure		Electric current (mA)	Engine rpm (At accel dial 10)
		kgf/cm^2	psi		
Standard (Ver : 1.x)	M	12 ± 3	171 ± 43	-	2100 ± 100
	H	15 ± 3	213 ± 43	-	2000 ± 100
	S	15 ± 3	213 ± 43	-	1900 ± 100
Option (Ver : 2.x)	M	12 ± 3	171 ± 43	-	2200 ± 100
	H	13 ± 3	185 ± 43	-	2050 ± 100
	S	13 ± 3	185 ± 43	-	1950 ± 100

★ Manually operated condition when the prolix resistor is connected with CN-47.

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

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

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

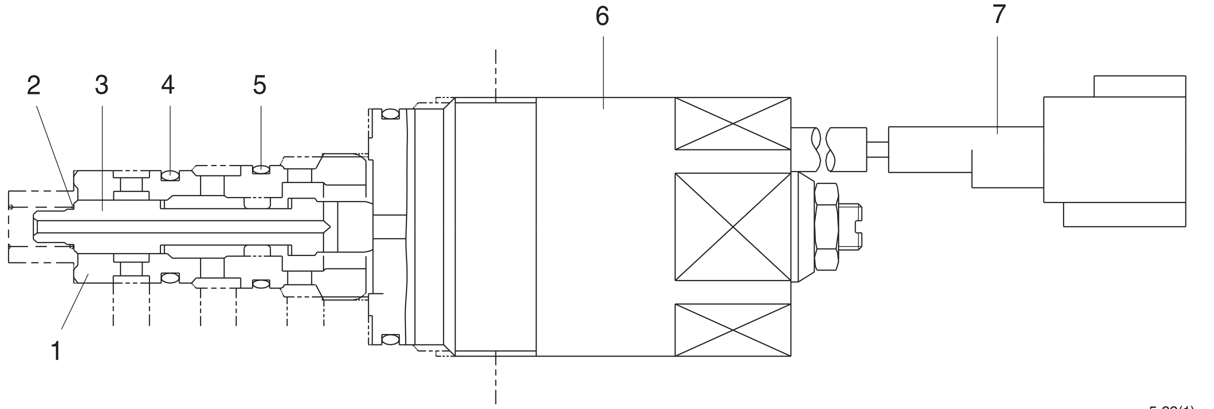
Step 2. Press the **SELECT** switch 3 times.

Step 3. While 7 segment on the cluster shows the version of the MCU program, for example **21SC1.0** press the buzzer stop switch ( ) + travel speed control switch ( ) at the same time for 2 seconds.
The display changes to **21SC1.0**, and it indicates that version 2.0 (Option) is selected.

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

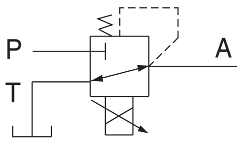
2. OPERATING PRINCIPLE

1) STRUCTURE



5-22(1)

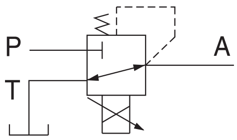
1	Sleeve	4	O-ring	6	Solenoid valve
2	Spring	5	O-ring	7	Connector
3	Spool				

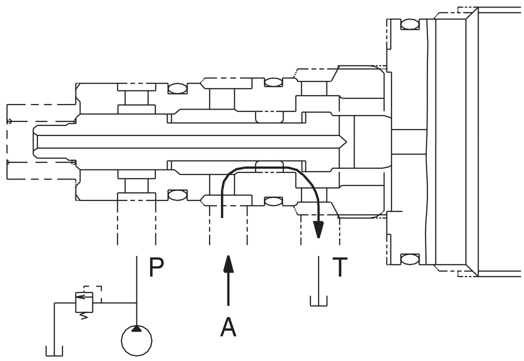


P	Pilot oil supply line(Pilot pressure)
T	Return to tank
A	Secondary pressure to flow regulator at hydraulic pump

2) AT H MODE

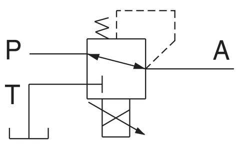
Pressure line is blocked and A oil returns to tank.

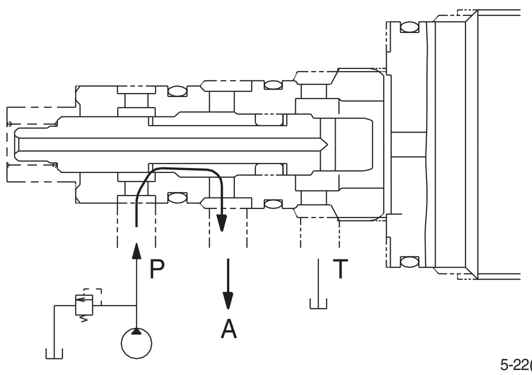




3) AT S MODE

Secondary pressure enters into A.





5-22(2)

3. EPPR VALVE CHECK PROCEDURE

1) CHECK ELECTRIC CURRENT VALUE AT EPPR VALVE

① Disconnect connector CN-75 from EPPR valve.

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

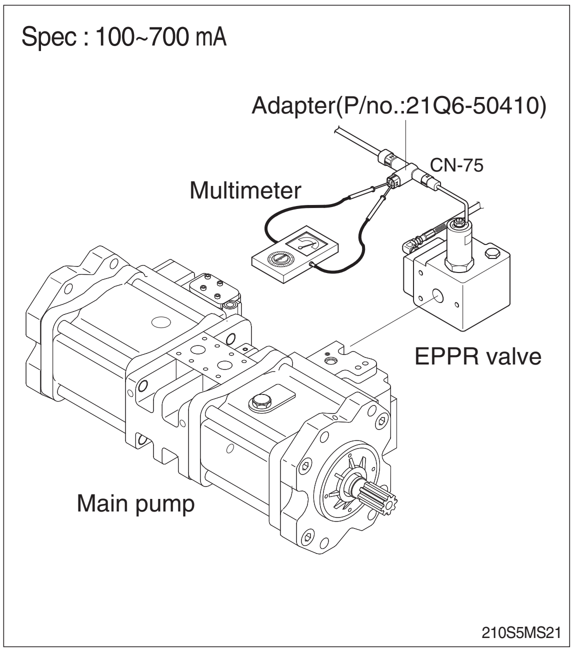
③ Start engine.

④ Set S-mode and cancel auto decel mode.

⑤ Position the multimodal dial at 10.

⑥ If engine rpm display show approx 1900±100 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.

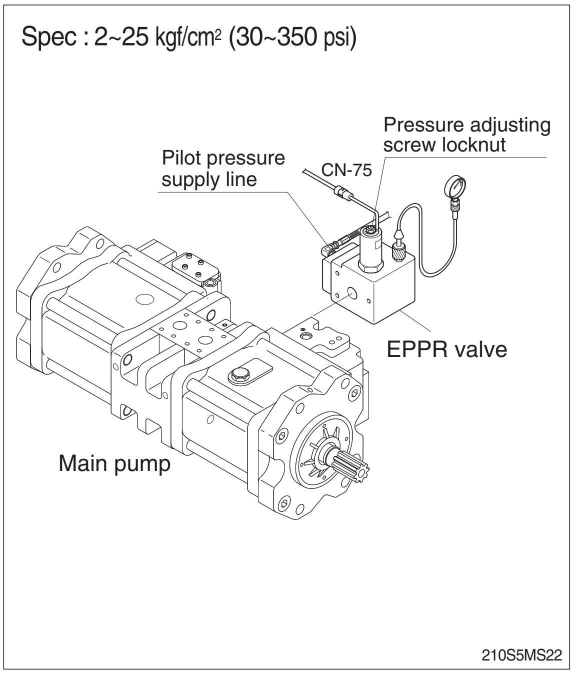
③ Set S-mode and cancel auto decel mode.

④ Position the multimodal dial at 10.

⑤ If engine rpm display show approx 1900±100 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 11 MONITORING SYSTEM

1. OUTLINE

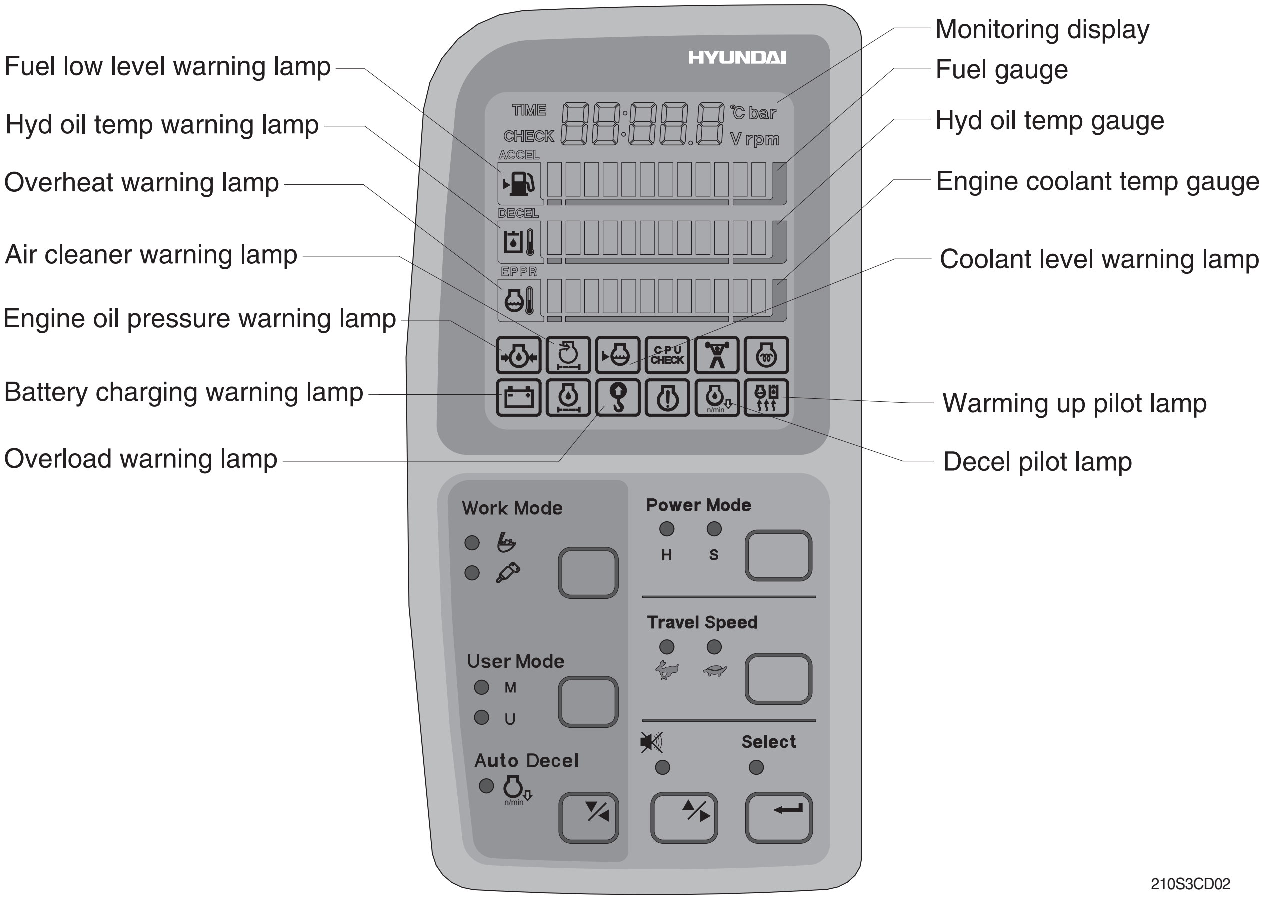
Monitoring system consists of the monitor part and switch part.

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

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

2. CLUSTER

1) MONITOR PANEL



210S3CD02

2) CLUSTER CHECK PROCEDURE

(1) Start key : ON

① Check monitor

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

② Check monitor after 4 seconds : Indicate cluster version and machine condition

a. Cluster program version : CL : 「1.0」← Indicates program version「1.0」for 2 seconds.
b. Engine rpm display : 0 rpm
c. Fuel gauge : All light up below appropriate level
d. Hydraulic temperature : All light up below appropriate level
e. Engine coolant temperature gauge : All light up below appropriate level
f. Warning lamp
※ During start switch ON the engine oil pressure lamp and battery charging lamp go on, but it is not abnormal.
※ When engine coolant temperature below 30°C , the warming up lamp lights up.

③ Indicating lamp state

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

(2) Start of engine

① Check machine condition

a. Engine 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 : Heavy duty work mode
d. Power mode selection : S mode
e. User mode selection : No LED ON, M mode or U mode
f. Auto decel LED : ON
g. Travel speed pilot lamp : Low (turttle)

② When warming up operation

a. Warming up lamp : ON
b. 10 seconds after engine started, engine speed increases to 1250 rpm
※ Others same as above ①.

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 warning lamp light up until normal condition.

2.1)Option for Dual Mode Selection :

1. It helps to increase machine implement speed

Mode	Default	Option
	RPM/EPPR	RPM/EPPR
Version	21:C3.5	21:C4.5
S	1910/15 bar	1980/13 bar
H	2050/4 bar	2080/12 bar
M	2110/13 bar	2200/11 bar

2.1.1) Process for Dual Mode Selection :

Initially the machine was set to default mode version i.e- 21:C3.5

Step 1: Press the select button on the cluster
Step 2: select setting option
Step 3: Press the select button on cluster

Image 1

Image 2

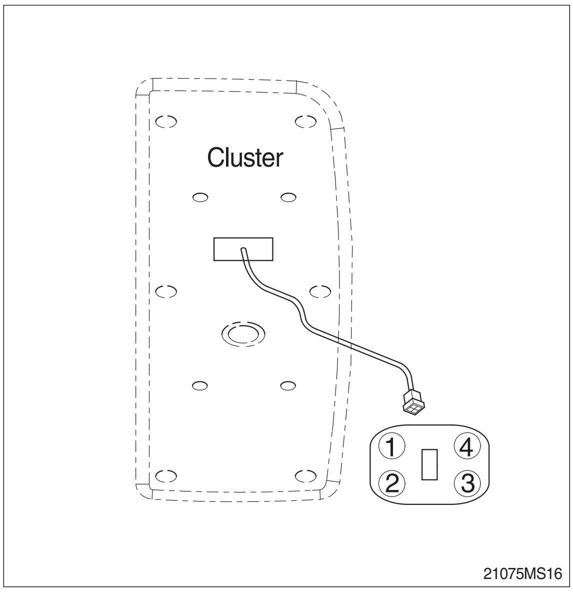
Step 4: Select Dual mode using arrows button on cluster.
Step 5: Press the select button on cluster.
Step 6: Change mode from 21:C3.5 to 21:C4.5 as shown below
Step 7: Press the select button on cluster
Step 8: Press Escape button 2 times

Image 3

Image 4

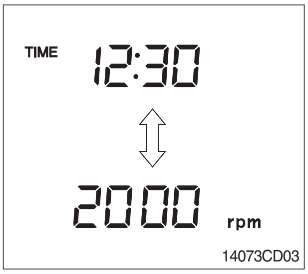
3) CLUSTER CONNECTOR

No.	Signal	Input / Output
1	Power IG (P)	Input (10~16V)
2	GND	Input (0V)
3	Serial- (RX)	Input (Vpp=12V)
4	Serial+ (TX)	Output (Vpp=12V)



4) CLUSTER FUNCTION

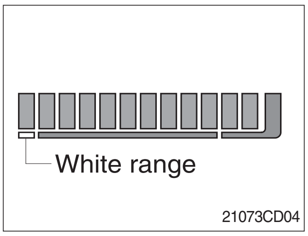
(1) Monitoring display



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

※ **Refer to the operator's manual page 4-12 for details.**

(2) Fuel gauge

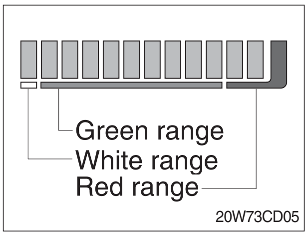


① This gauge indicates the amount of fuel in the fuel tank.

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

※ **If the gauge illuminates the white range or warning lamp blinks even though the machine is on the normal condition, check the electric device as that can be caused by the poor connection of electricity or sensor.nection of electricity or sensor.**

(3) Hydraulic oil temperature gauge



① This indicates the temperature of coolant.

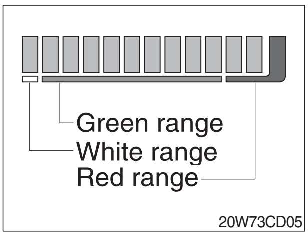
- White range : Bolow 30 ˚C (86 ˚F) below
- Green range : 30-105 ˚C (86-221 ˚F)
- Red range : 105˚C (221 ˚F) above

② The green range illuminates when operating.

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

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

(4) Engine coolant temperature gauge



① This indicates the temperature of coolant.

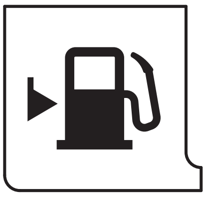
- White range : Bolow 30 ˚C (86 ˚F) below
- Green range : 30-105 ˚C (86-221 ˚F)
- Red range : 105˚C (221 ˚F) above

② The green range illuminates when operating.

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

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

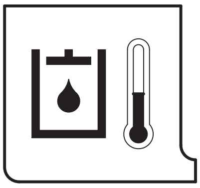
(5) Engine coolant temperature warning lamp



21073CD04A

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

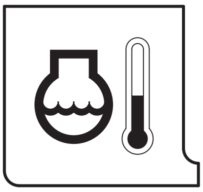
(6) Hydraulic oil temperature warning lamp



21073CD05A

① This warning lamp operates and the buzzer sounds when the temperature of hydraulic oil is over 105 ˚C (221 ˚F).
② Check the hydraulic oil level when the lamp blinks.
③ Check for debris between oil cooler and radiator.

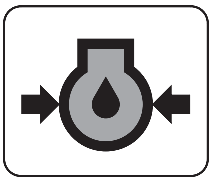
(7) Fuel level warning lamp



21073CD06A

① This lamp blinks and the buzzer sounds when the temperature of coolant is over the normal temperature 110 ˚C (230 ˚F).
② Check the cooling system when the lamp blinks.

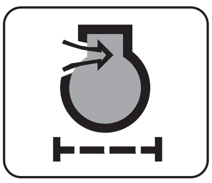
(8) Emergency warning lamp



210S3CD07

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

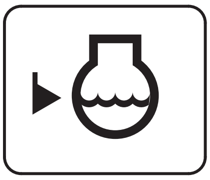
(9) Air cleaner warning lamp



210S3CD08

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

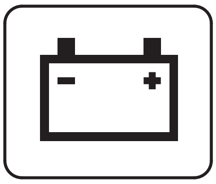
(10) COOLANT LEVEL WARNING LAMP



21073CD09

① This lamp blinks and the buzzer sounds when the coolant is below LOW in the reservoir tank of radiator.
② Check the reservoir tank when the lamp blinks.

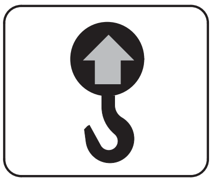
(11) BATTERY CHARGING WARNING LAMP



21073CD13

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

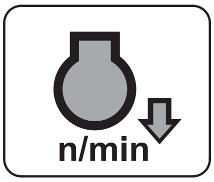
(12) OVERLOAD WARNING LAMP



210S3CD15

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

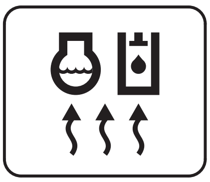
(13) DECEL PILOT LAMP



210S3CD17

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

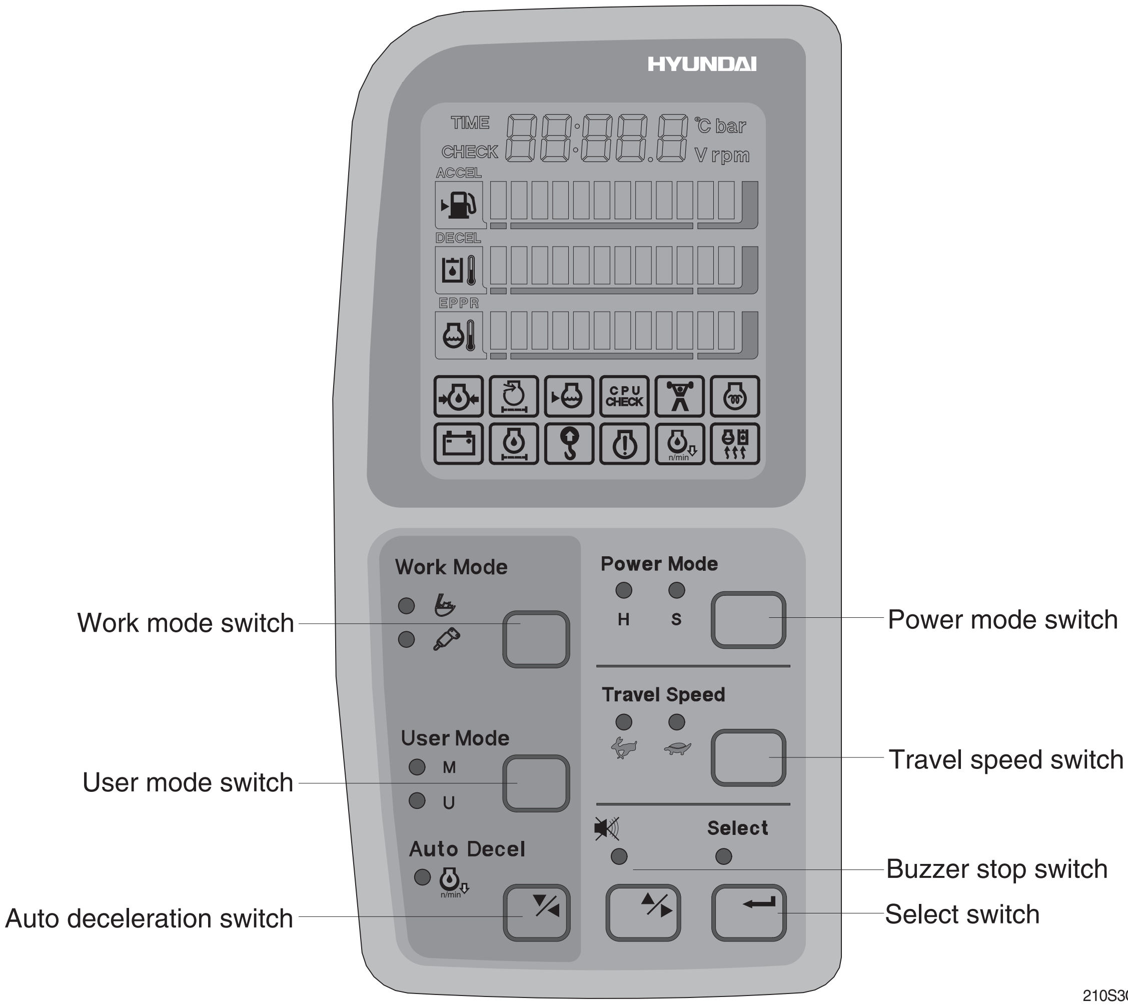
(14) WARMING UP PILOT LAMP



21073CD18

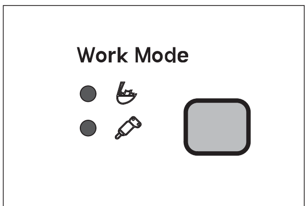
① This lamp is turned ON when the coolant temperature is below 30 ˚C (86 ˚F).
② The automatic warming up is cancelled when the engine coolant temperature is above 30 ˚C, or when 10 minutes have passed since starting.

5) SWITCH PANEL



210S3CD19

(1) Work mode switch



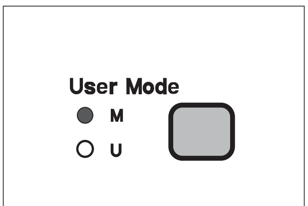
290F3CD61

① This switch is to select the machine operation mode, which shifts from general operation mode to heavy operation mode and breaker mode in a raw by pressing the switch.

- : Heavy duty work mode
- : Breaker operation mode

※ Refer to the operator's manual page 4-7 for details.

(2) User mode switch



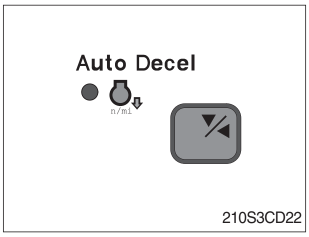
140W73CD21

① This switch is to select the maximum power or user mode.

- M : Maximum power
- U : Memorizing operators preferable power setting

※ Refer to the operator's manual page 4-7 for details.

(3) Auto deceleration switch



① This switch is used to actuate or cancel the auto deceleration function.

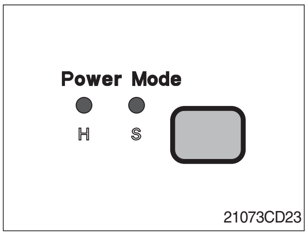
② When the switch actuated and all control levers and pedals are at neutral position, engine speed will be lowered automatically to save fuel consumption.

· Light ON : Auto deceleration function is selected.

· Light OFF : Auto deceleration function is cancelled so that the engine speed increased to previous setting value.

③ Operating the auto deceleration function makes the decel indicate lamp on the LCD panel ON.

(4) Power mode switch

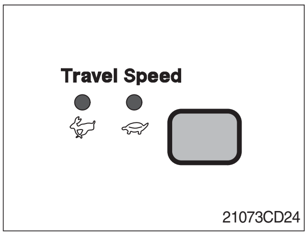


① The lamp of selected mode is turned ON by pressing the switch ( ), when selecting the power mode to use.

· H : This is used for high power work.

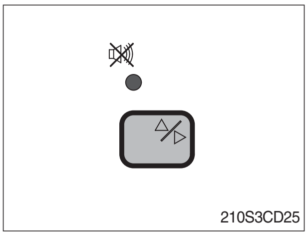
· S : This is used for standard power work.

(5) Travel speed switch



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

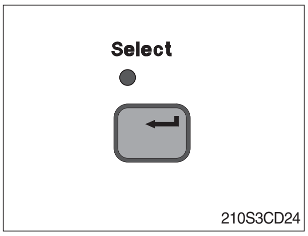
(6) Buzzer stop switch



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

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

(7) Select switch



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

※ **Refer to the operator's manual page 4-12 for details.**

② If the switch is pressed for 3 seconds in time display mode, it moves to time adjusting function, and you can adjust the time as below.

· Hour by auto decel ( )switch

· Minute by buzzer stop ( ) switch.

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

3. MONITORING DISPLAY

1) OUTLINE

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

Display group	How to select display mode: Group selection	Display mode selection		Name	Display on the cluster
Group 0 (Default)	Way 1 Key switch **ON** or **START** Way 2 Touch **AUTO DECEL** switch while pressing **BUZZER STOP** at group 1~4.	Initial		Engine rpm	950 rpm
		Touch **SELECT** 1 time		Time	TIME 12:30
		Touch **SECLET** 2 times		Power shift pressure (EPPR valve)	EP: 10 bar
		Touch **SELECT** 3 times		MCU model & version	21:C 1.2
		Touch **SELECT** 4 times	Option (Only when a pressure sensor is installed)	Front pump pressure	P1: 100 bar
		Touch **SELECT** 5 times		Rear pump pressure	P2:200 bar
		Touch **SELECT** 6 times		Pilot pressure	P3:30 bar
Group 1 (Volt, temp, EPPR press, version)	Touch **SELECT** switch **once** while pressing **BUZZER STOP**. In this group **SELECT** LED **ON**	Default		Battery voltage(V)	b:24.8 V
		Touch **SELECT** 1 time		Potentiometer voltage(V)	Po: 2.5 V
		Touch **SELECT** 2 times		Accel dial voltage(V)	dL: 3.8 V
		Touch **SELECT** 3 times		Hydraulic oil temperature(℃)	Hd: 50 ℃
		Touch **SELECT** 4 times		Coolant temperature(℃)	Ct: 85 ℃
Group 2 (Error code)	Touch **SELECT** switch **twice** while pressing **BUZZER STOP**. In this group **BUZZER STOP** LED blinks	Default		Current error	CHECK Er: 03
		Touch **SELECT** 1 time		Recorded error	TIME Er: 03
		Press down(▼) & **SELECT** at the same time		(Only key switch ON) Recorded error deletion	TIME Er: 00
Group 3 (Switch input)	Touch **SELECT** switch **3 times** while pressing **BUZZER STOP**. In this group **SELECT** LED blinks at 0.5sec interval	Default		(Only key switch ON) Pump prolix switch	PP:on or oFF
		Touch **SELECT** 1 time		Auto decel pressure switch	dP:on or oFF
		Touch **SELECT** 2 times		Power boost switch	Pb:on or oFF
		Touch **SELECT** 3 times		Travel oil pressure switch	oP:on or oFF
		Touch **SELECT** 4 times		One touch decel switch	od:on or oFF
		Touch **SELECT** 5 times		Travel alarm switch	br:on or oFF

Display group	How to select display mode		Name	Display on the cluster
	Group selection	Display mode selection		
Group 4 (Output)	Touch **SELECT** switch **4 times** while pressing **BUZZER STOP.** In this group **SELECT** LED blinks at 1sec interval	Default	Hourmeter	Ho:on or oFF
		Touch **SELECT** 1 time	Neutral relay	nr:on or oFF
		Touch **SELECT** 2 times	(Anti-restart relay) Travel speed solenoid	tS:on or oFF
		Touch **SELECT** 3 times	Power boost solenoid	PS:on or oFF
		Touch **SELECT** 4 times	(2-stage relief solenoid) Boom priority solenoid	bS:on or oFF
		Touch **SELECT** 5 times	Travel alarm	AU:on or oFF
		Touch **SELECT** 6 times	Max flow cut off solenoid	FS:on or oFF

※By touching **SELECT** switch once while pressing **BUZZER STOP**, display group shifts.

Example : Group 0 → 1 → 2 → 3 → 4 → 0

2) DESCRIPTION OF MONITORING DISPLAY

Group	Display	Name	Description
Group 0	2250 rpm	Engine speed	It displays current engine speed detected by engine speed sensor from 500 to 3000 rpm. Range : 500~3000 rpm by 10 rpm
	TIME 12 : 30	Time	It displays current time (12 is hour and 30 is minute) Range : Hour (1~12), minute (00~59)
	EP : 10bar	Power shift pressure of EPPR valve	It shows that pump power shift pressure of EPPR valve being controlled by the MCU is 10bar. Range : 00~50bar by 1bar
	21 : C1.4	Model and MCU program version	It shows that machine model(HX210HD, HX220HD) and the program version of the MCU is 1.4. Version display range : 0.0~9.9 by 0.1
	P1 : 100bar (Option)	Front pump pressure	It displays front pump pressure of 100bar which is detected by pressure sensor. Range : 000~500bar by 10bar
	P2 : 200bar (Option)	Rear pump pressure	It displays rear pump pressure of 200bar which is detected by pressure sensor. Range : 000~500bar by 10bar
	P3 : 30bar (Option)	Pilot pump pressure	It displays pilot pump pressure of 30bar which is detected by pressure sensor. Range : 00~50bar by 1bar
Group 1	b : 24.8V	Battery voltage	It shows that battery power of 24.8V is supplied into MCU. Range : 00.0~48.0V by 0.1V
	Po : 2.5V	Potentiometer voltage	It shows that potentiometer signal voltage is 2.5V. Range : 0.0~5.0V by 0.1V
	dL : 3.8V	Accel dial voltage	It shows that accel dial signal voltage is 3.8V. Range : 0.0~5.0V by 0.1V
	Hd : 50℃	Hydraulic oil temperature	It shows that hydraulic oil temperature detected by temperature sensor is 50℃. Range : 0~150 ℃ by 1℃
	Ct : 85℃	Coolant temperature	It shows that coolant oil temperature detected by temperature sensor is 50℃. Range : 0~150℃ by 1℃

Group	Display	Name	Description
Group 2	CHECK Er : 03	Current error	It shows that current error of 03(Short circuit in pump EPPR valve system) is diagnosed by self diagnosis system in the MCU. If more than 2 errors, when pressing ▼ or ▲ switch, other error codes show. Range : 00~58
	TIME Er : 03	Recorded error	It shows recorded error code of 03 which is diagnosed before. If more than 2 error codes, when pressing ▼ or ▲ switch, other error codes show. Range : 00~58
	TIME Er : 00	Recorded error deletion	It shows all recorded error codes are removed in the MCU memory.
Group 3	PP : on or oFF	Pump prolix switch	PP : on Shows that pump prolix switch is turned on (At emergency position). PP : oFF Shows that pump prolix switch is turned off(At normal position).
	dP : on or oFF	Auto decel pressure switch	dP : on Shows that auto decel pressure switch is pressed on (No operation of control lever). dP : oFF Shows that auto decel pressure switch is released off (Operation of control lever).
	Pb : on or oFF	Power boost switch	Pb : on Shows that power boost switch is pressed on (Activated). Pb : oFF Shows that power boost switch is released off (Canceled).
	oP : on or oFF	Travel oil pressure switch	oP : on Shows that travel oil pressure switch is pressed on (No operation of travel control lever). oP : oFF Shows that travel oil pressure switch is released off (Operation of travel control lever).
	od : on or oFF	One touch decel switch	od : on Shows that one touch decel switch is pressed. od : oFF Shows that one touch decel switch is released.
	br : on or oFF	Travel alarm switch	br : on Shows that travel alarm function is selected. br : oFF Shows that travel alarm function is canceled.

Group	Display	Name	Description
Group 4	Ho : on or oFF	Hourmeter	Ho : on Shows that hourmeter is activated by MCU. Ho : oFF Shows that hourmeter is turned off.
	nr : on or oFF	Neutral relay (Anti-restart relay)	nr : on Shows that neutral relay for anti-restarting function is activated(Engine start is possible). nr : oFF Shows that neutral relay is turned off to disable the engine restart.
	ts : on or oFF	Travel speed solenoid	ts : on Shows that travel speed solenoid is activated (High speed). ts : oFF Shows that travel speed solenoid is released (Low speed).
	PS : on or oFF	Power boost solenoid	PS : on Shows that power boost solenoid is activated to maximize the power(Power up). PS : oFF Shows that power boost solenoid is turned off(Cancel the power boost function).
	bs : on or oFF	Boom priority solenoid	bs : on Shows that boom priority solenoid is activated. bs : oFF Shows that boom priority solenoid is released.
	Ru : on or oFF	Travel alarm	Ru : on Shows that travel buzzer is activated. Ru :oFF Shows that travel buzzer is canceled.
	FS : on or oFF	Max flow cut off solenoid	FS : on Shows that max flow cut off solenoid is activated. FS : oFF Shows that max flow cut off solenoid is released.

SECTION 6 TROUBLESHOOTING

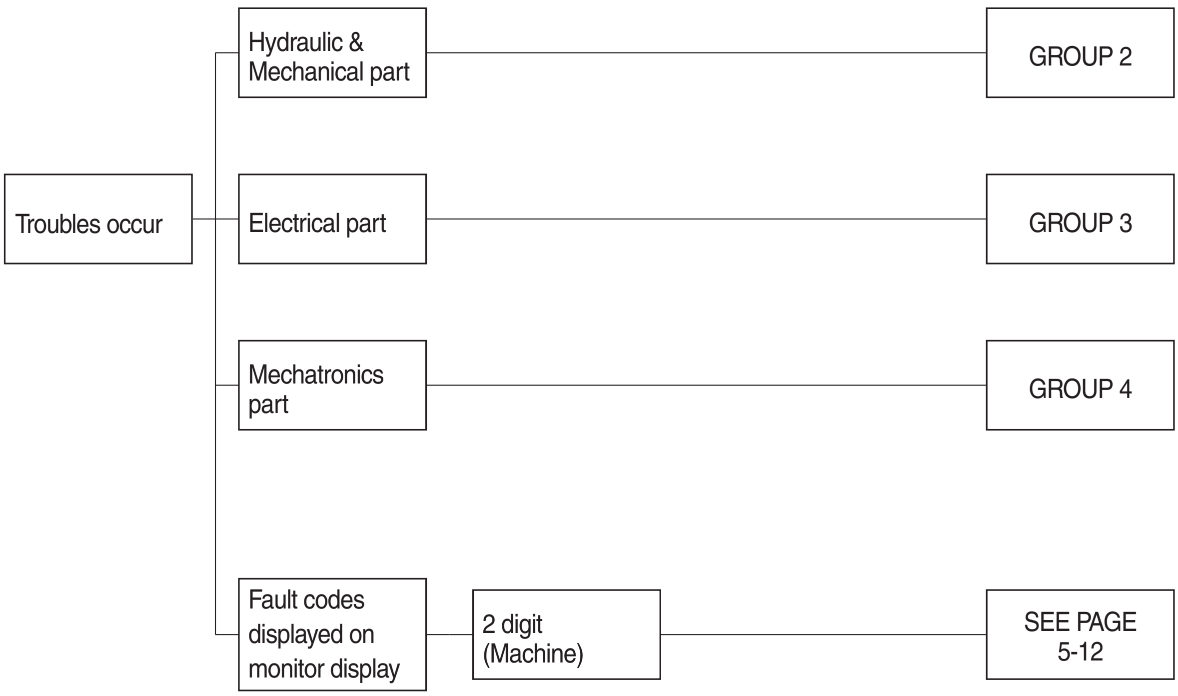
SECTION 6 TROUBLESHOOTING

GROUP 1 BEFORE TROUBLESHOOTING

1. INTRODUCTION

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

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

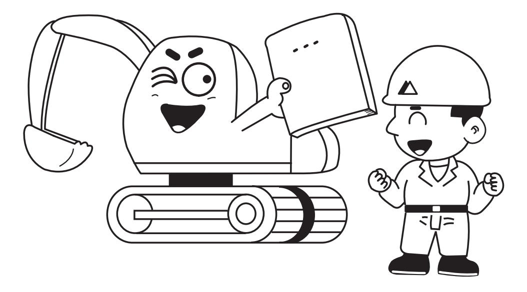


2. DIAGNOSING PROCEDURE

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

STEP 1. Study the machine system

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

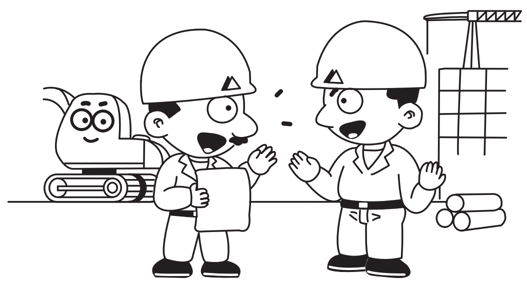


13031SH02

STEP 2. Ask the operator

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

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

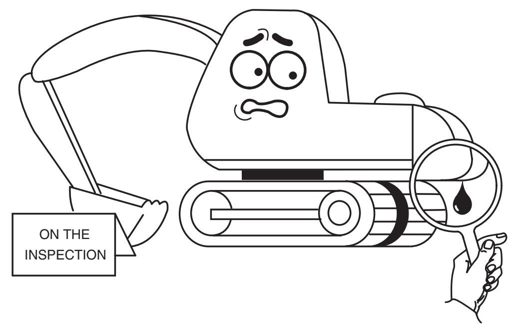


13031SH03

STEP 3. Inspect the machine

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

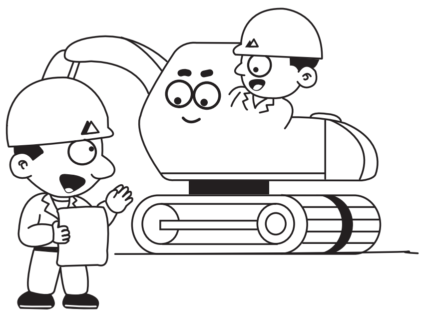
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



(210-7) 6-2(3)

STEP 4. Inspect the trouble actually on the machine

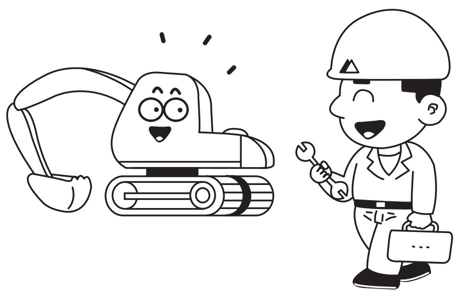
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



(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.

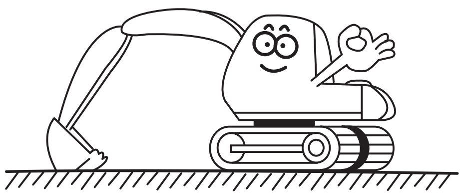


13031SH05

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.

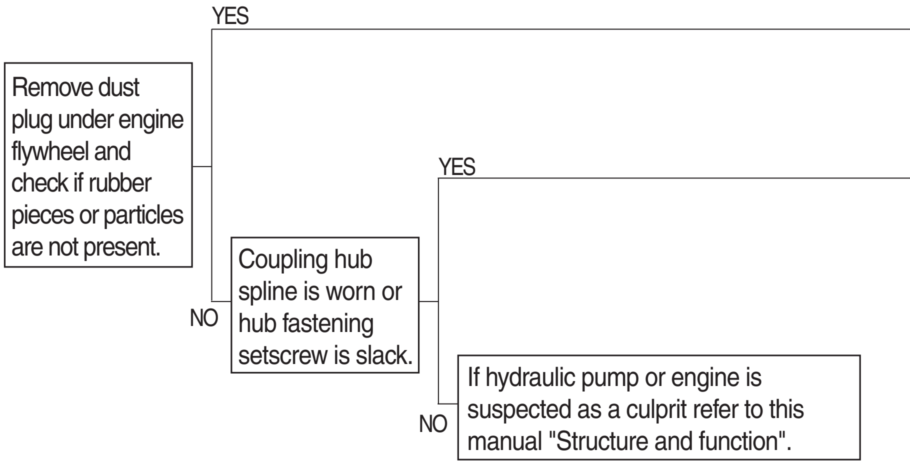
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

(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.

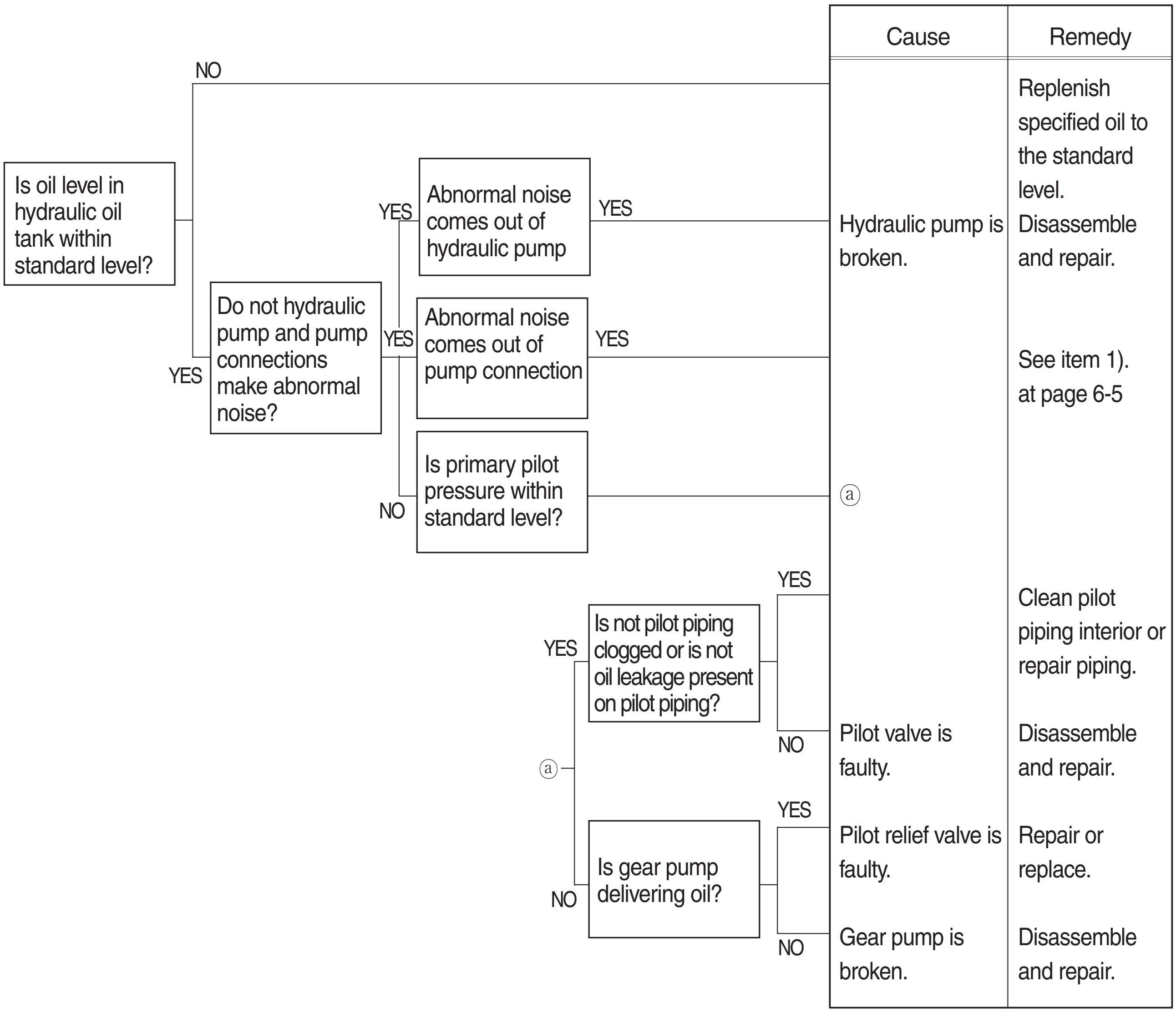
2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



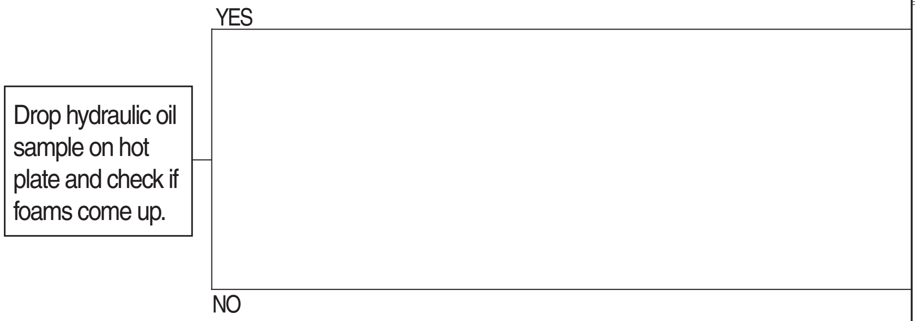
Cause	Remedy
Coupling element is broken.	Disassemble and repair.
	Replace hub or retighten setscrew.

2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL



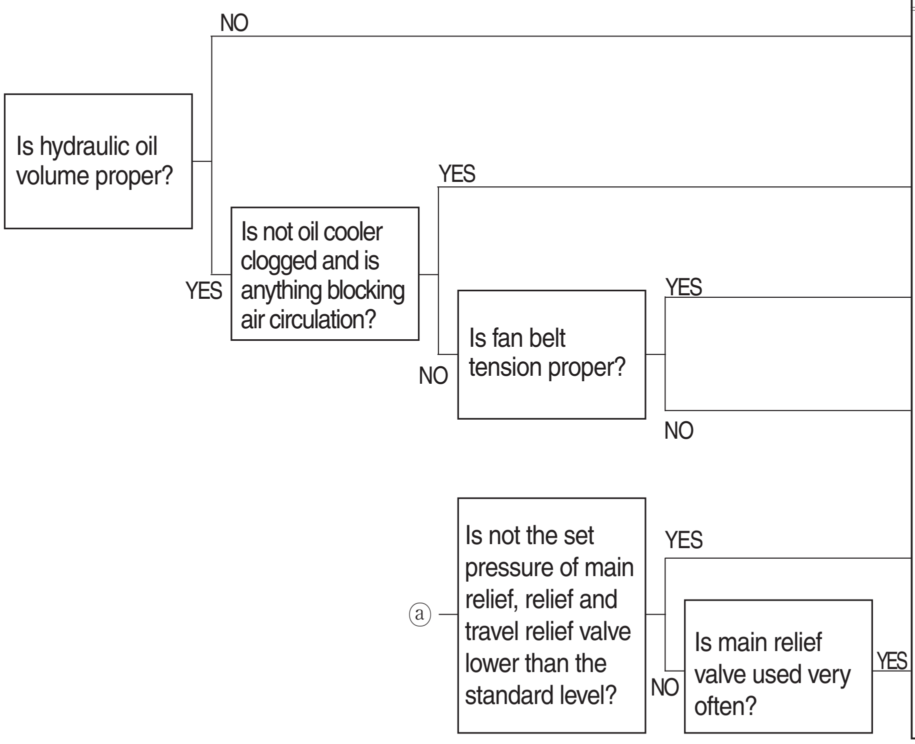
3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY



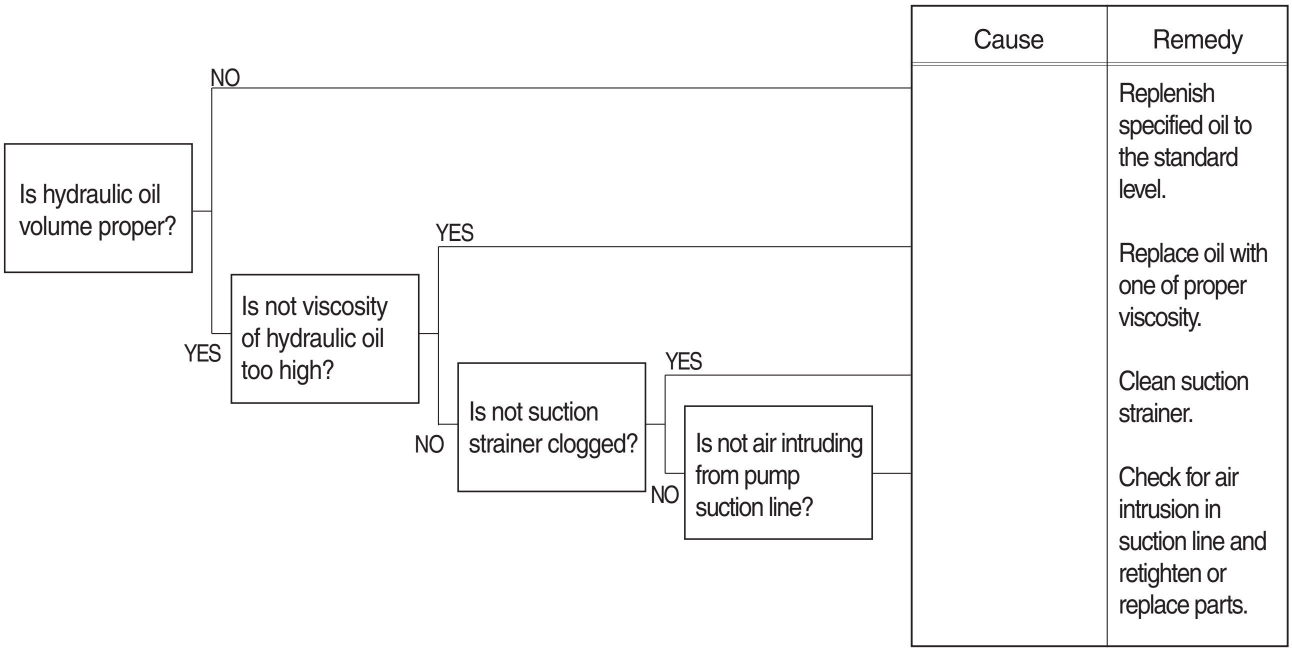
Cause	Remedy
Water is mixed.	Put hydraulic oil still, separate water and dispose it or replace hydraulic oil.
Air is intruded.	Check suction line and return line and eliminate the air intruding source.

2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY

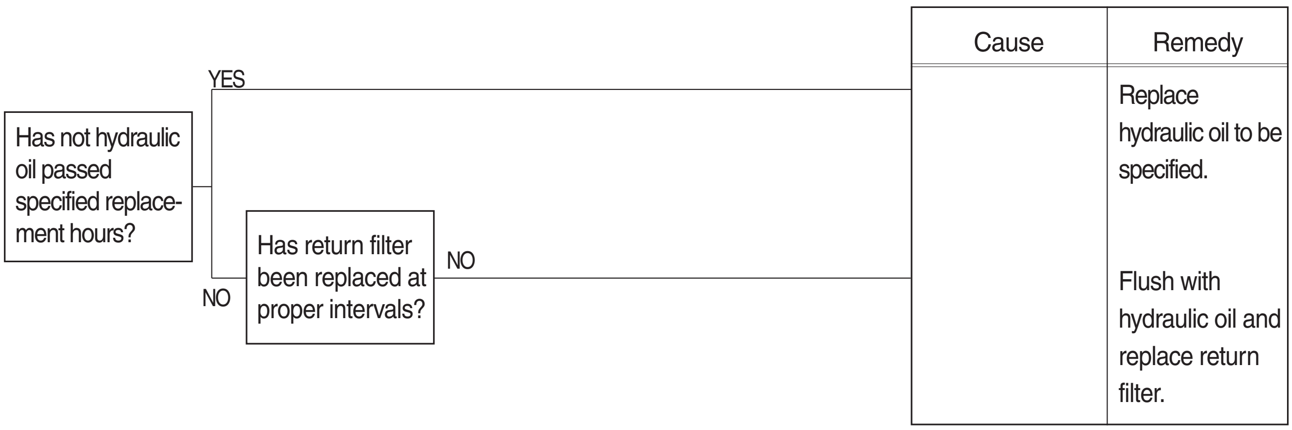


Cause	Remedy
	Replenish specified oil to the standard level.
	Clean oil cooler. Secure air circulation route.
a	
	Adjust belt tension or replace belt.
	Readjust set pressure.
	Reduce load.

3) CAVITATION OCCURS WITH PUMP

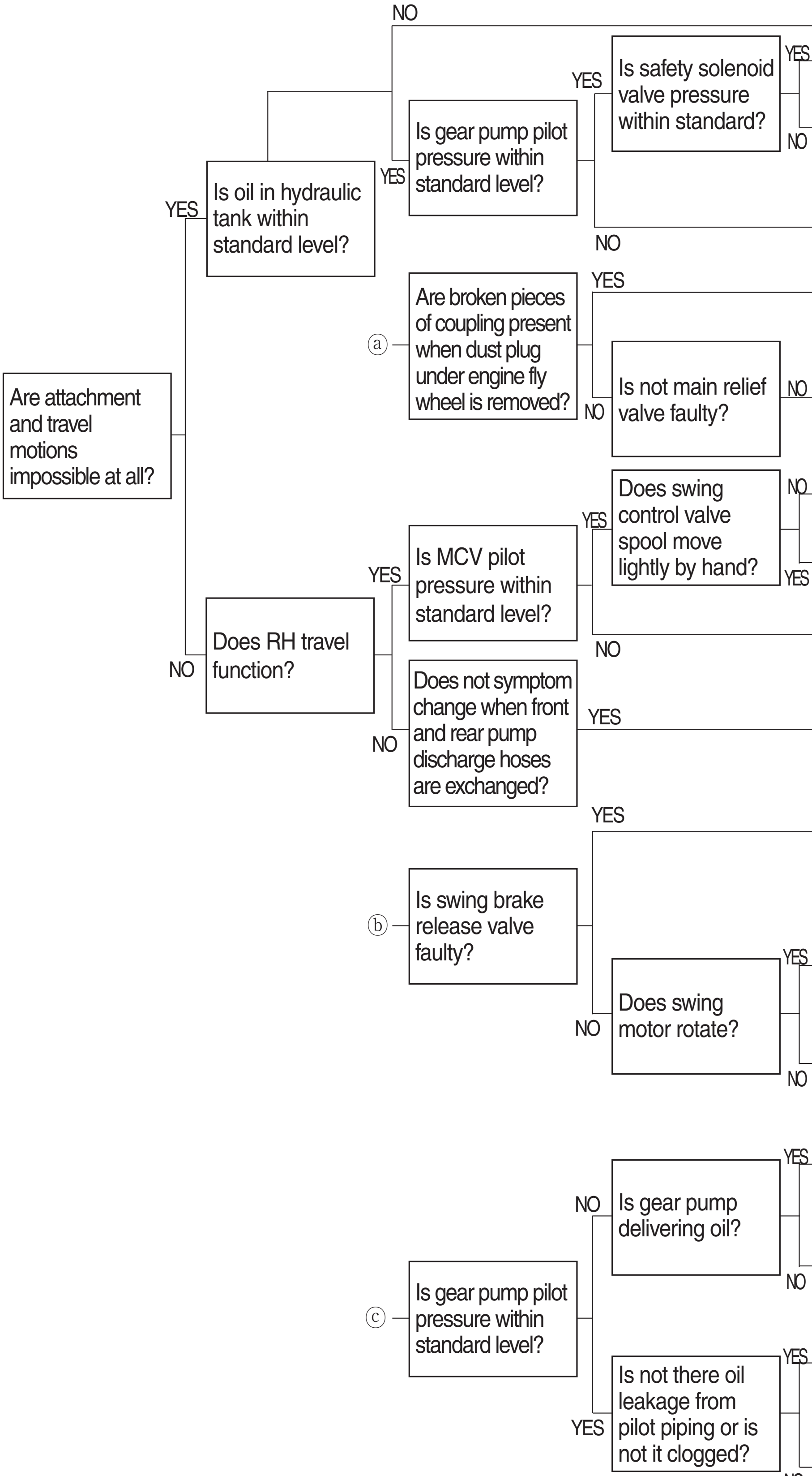


4) HYDRAULIC OIL IS CONTAMINATED



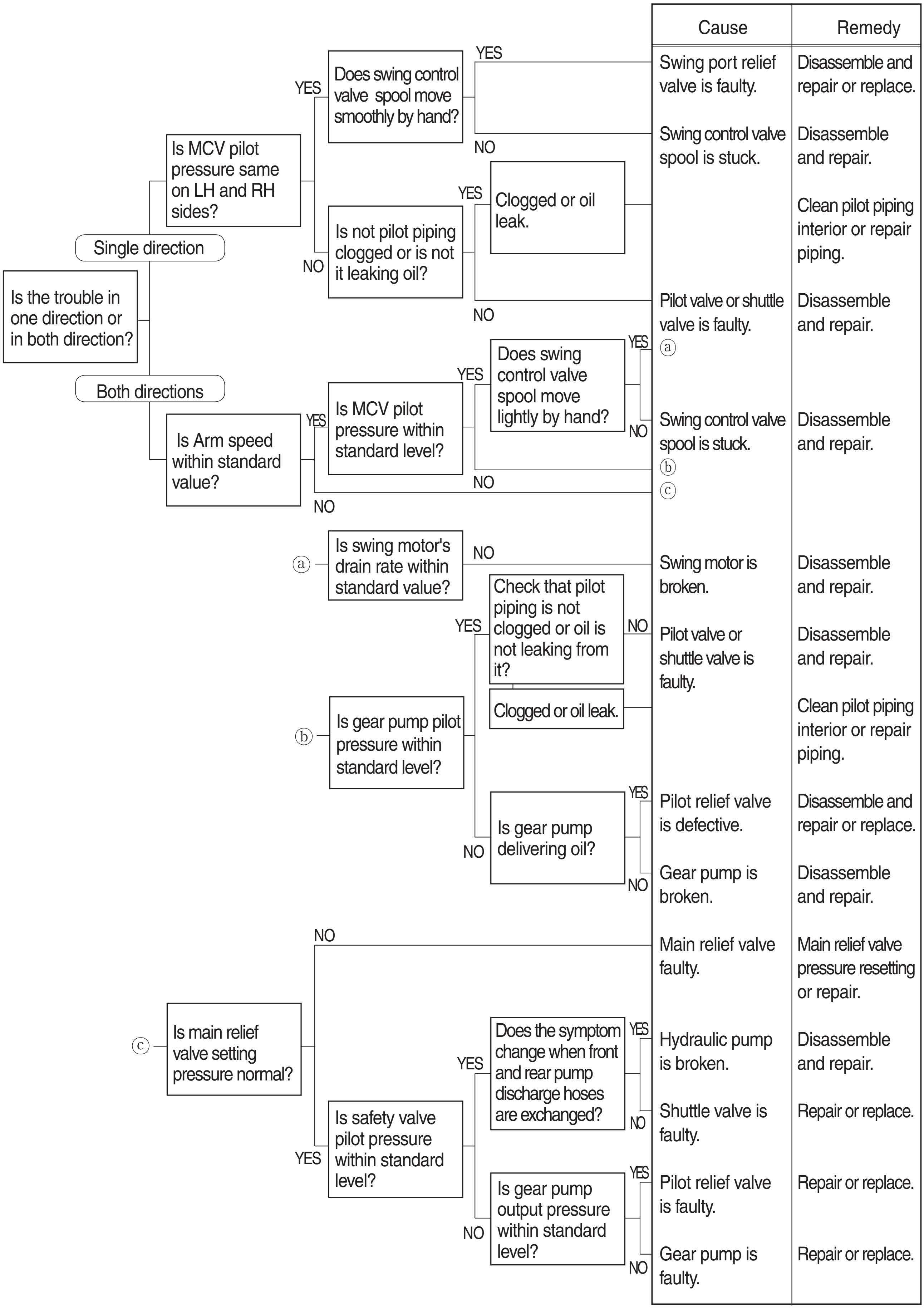
4. SWING SYSTEM

1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE

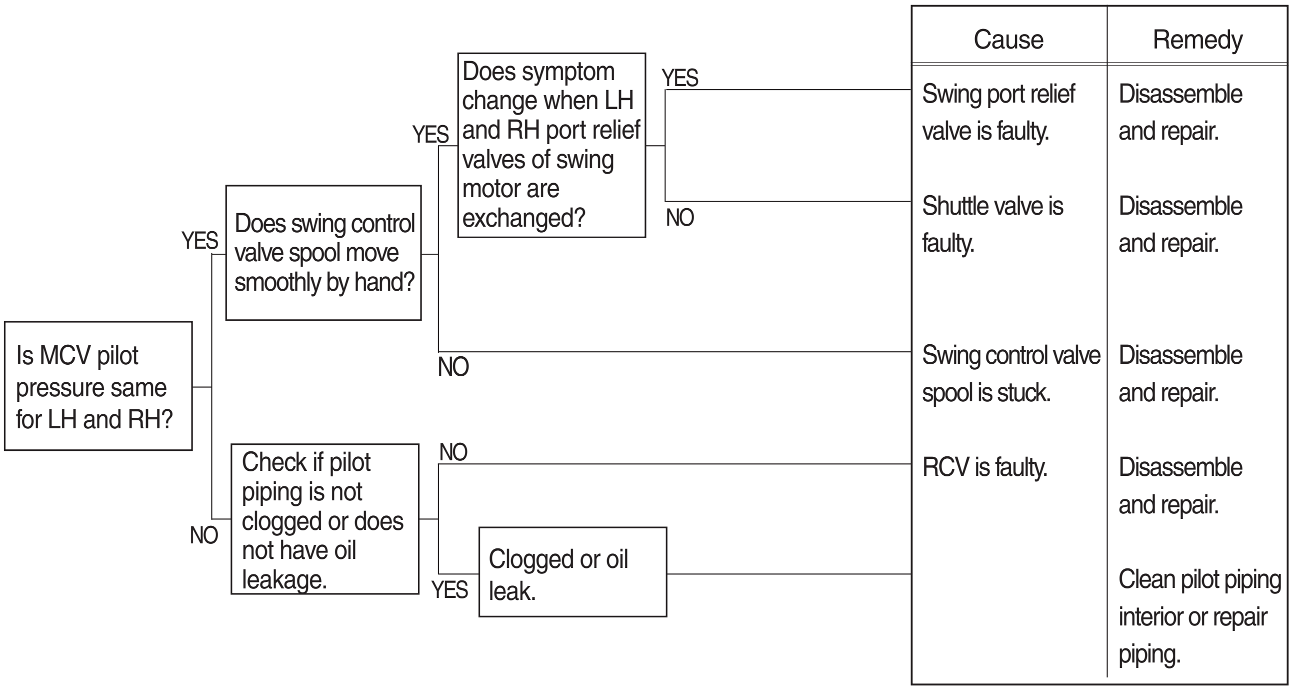


Cause	Remedy
ⓐ	Replenish specified oil to the standard level.
Safety valve faulty or not operated.	Repair or replace.
Gear pump faulty.	Repair or replace.
Pump connection coupling is broken.	Disassemble and repair.
Hydraulic pump is out of order.	Disassemble and repair.
Swing control valve spool is ⓑ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

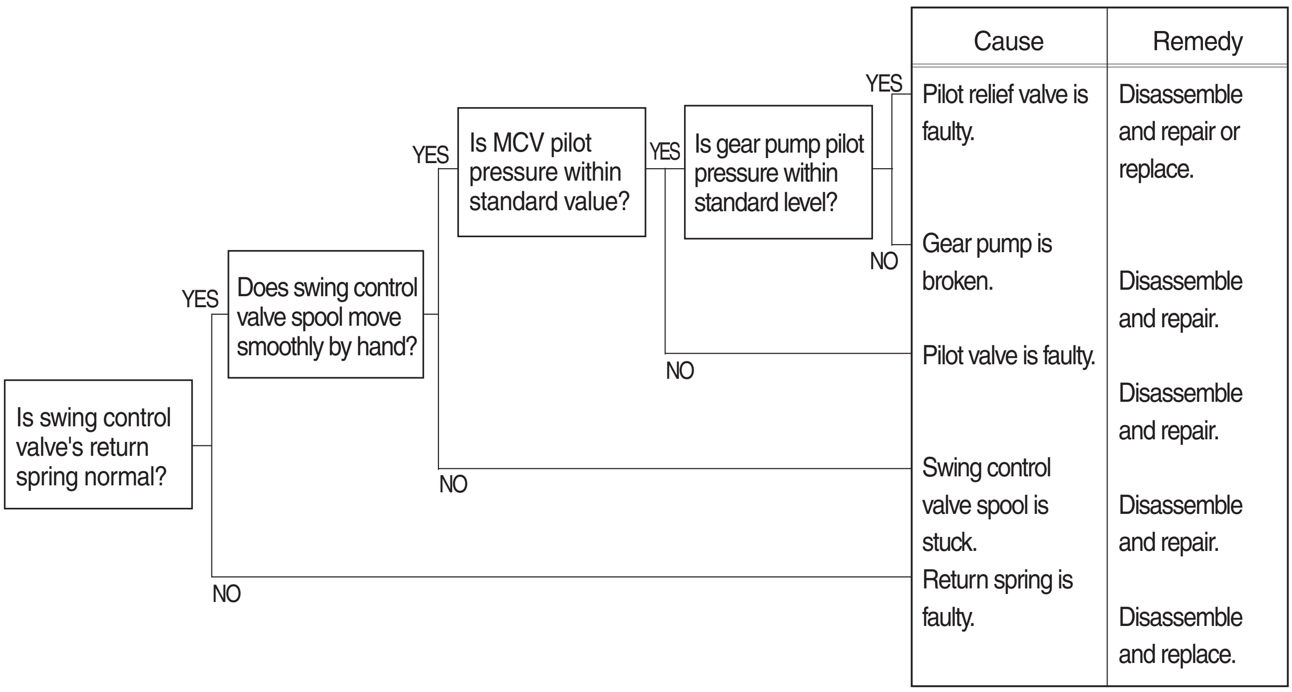
2) SWING SPEED IS LOW



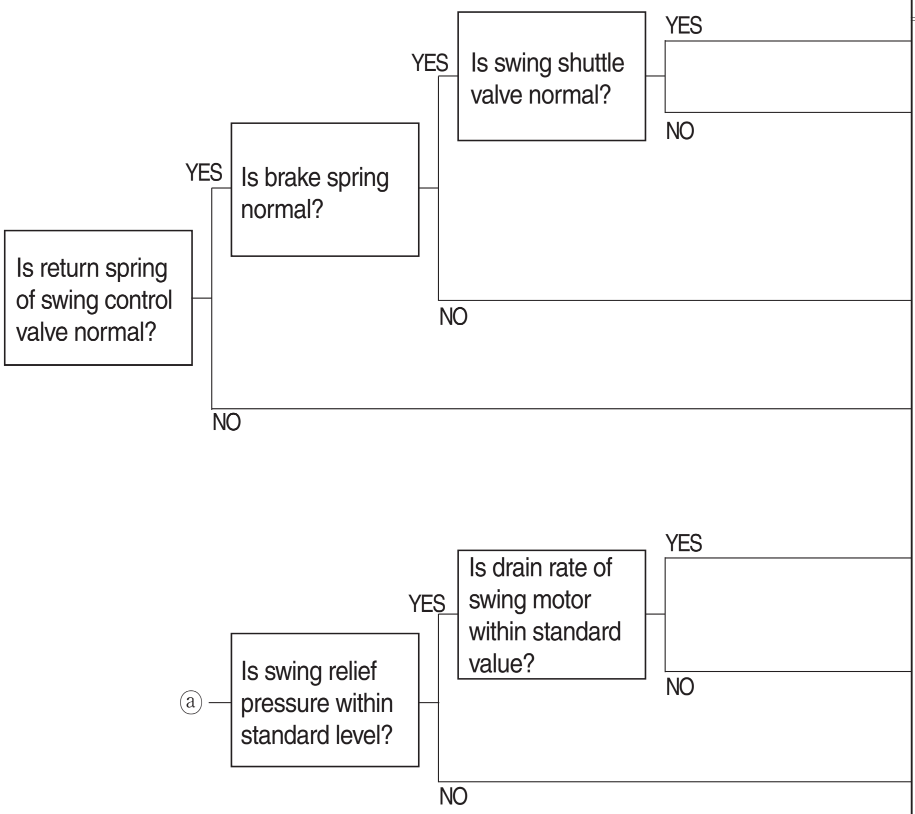
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP



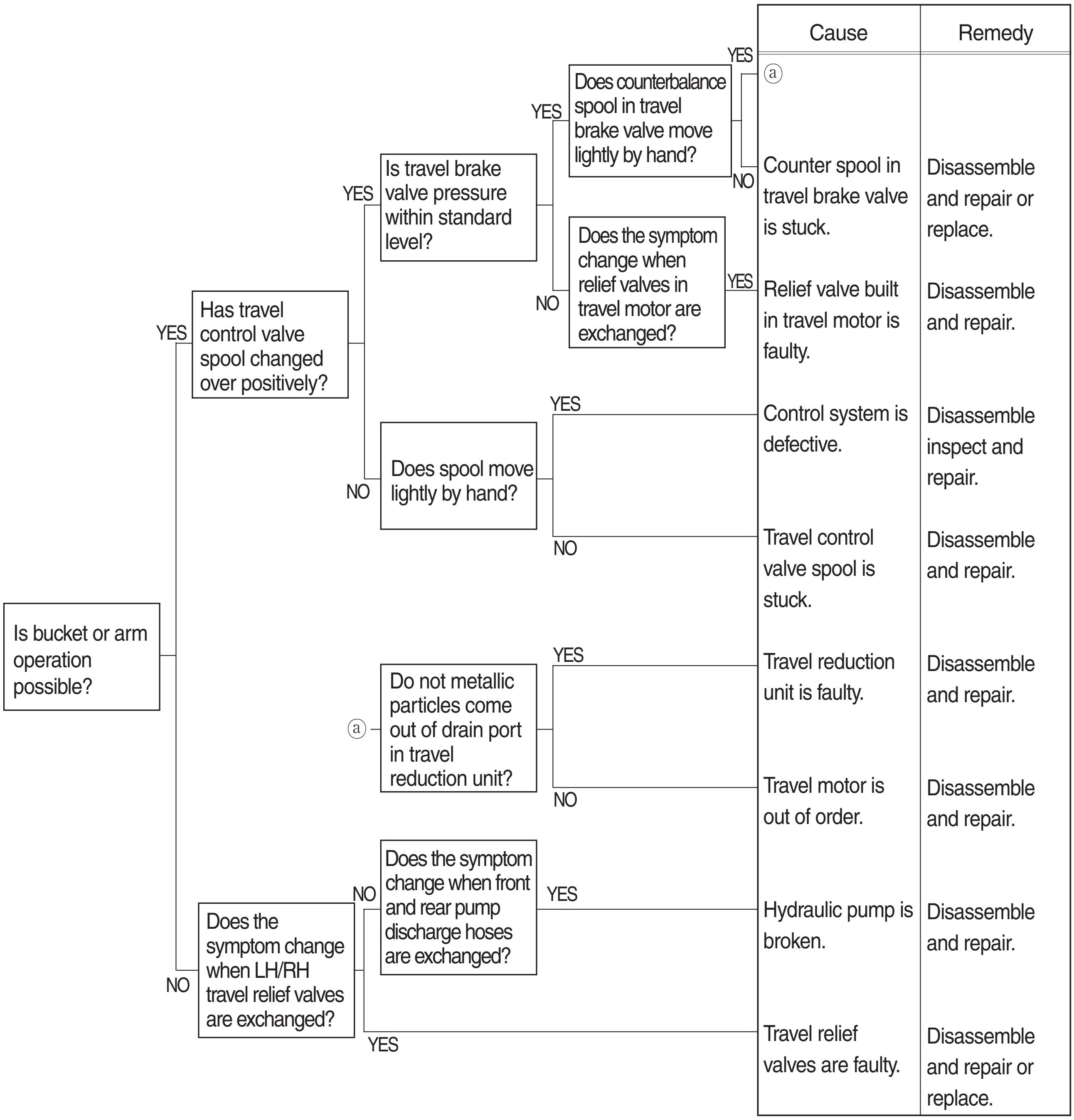
5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE



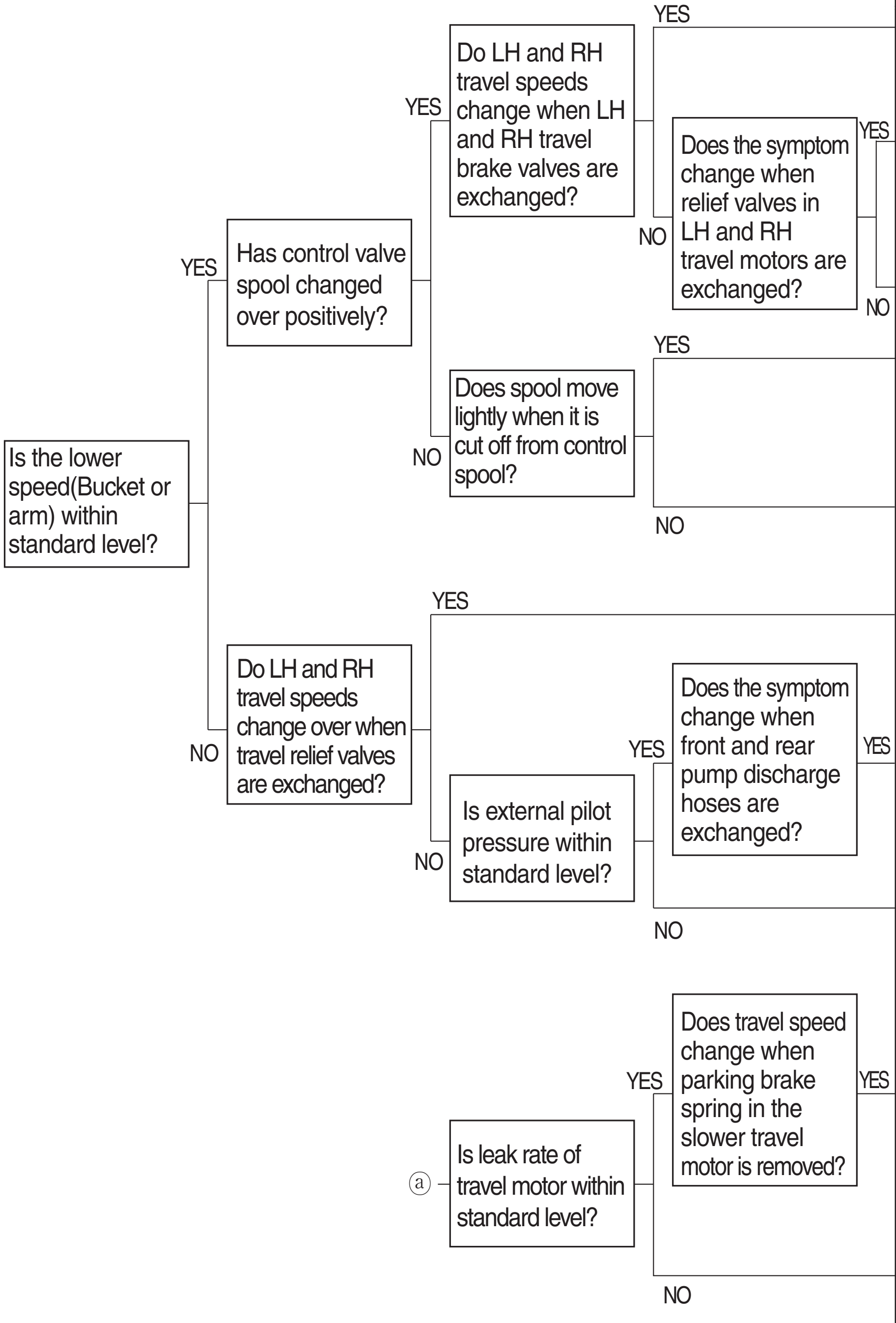
Cause	Remedy
ⓐ	
Shuttle valve is faulty.	Disassemble and replace.
Brake spring is faulty.	Disassemble and replace.
Return spring of swing control valve is faulty.	Disassemble and replace.
Swing relief valve is faulty.	Disassemble and repair or replace.
Swing motor is broken.	Disassemble and repair.
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

5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



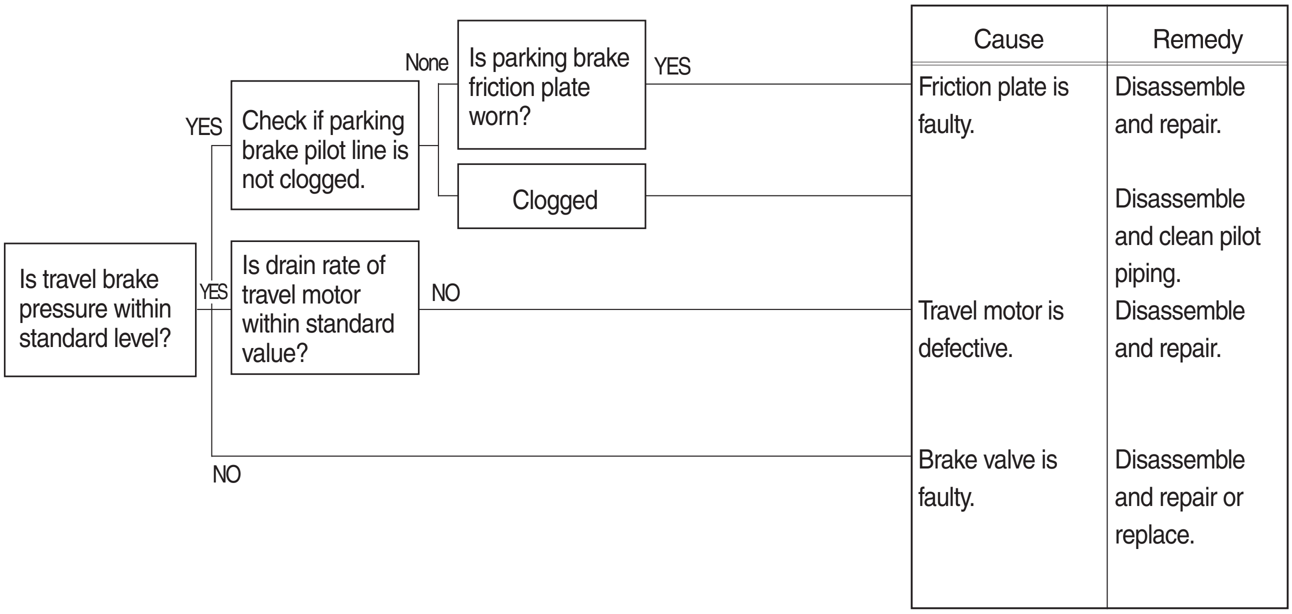
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



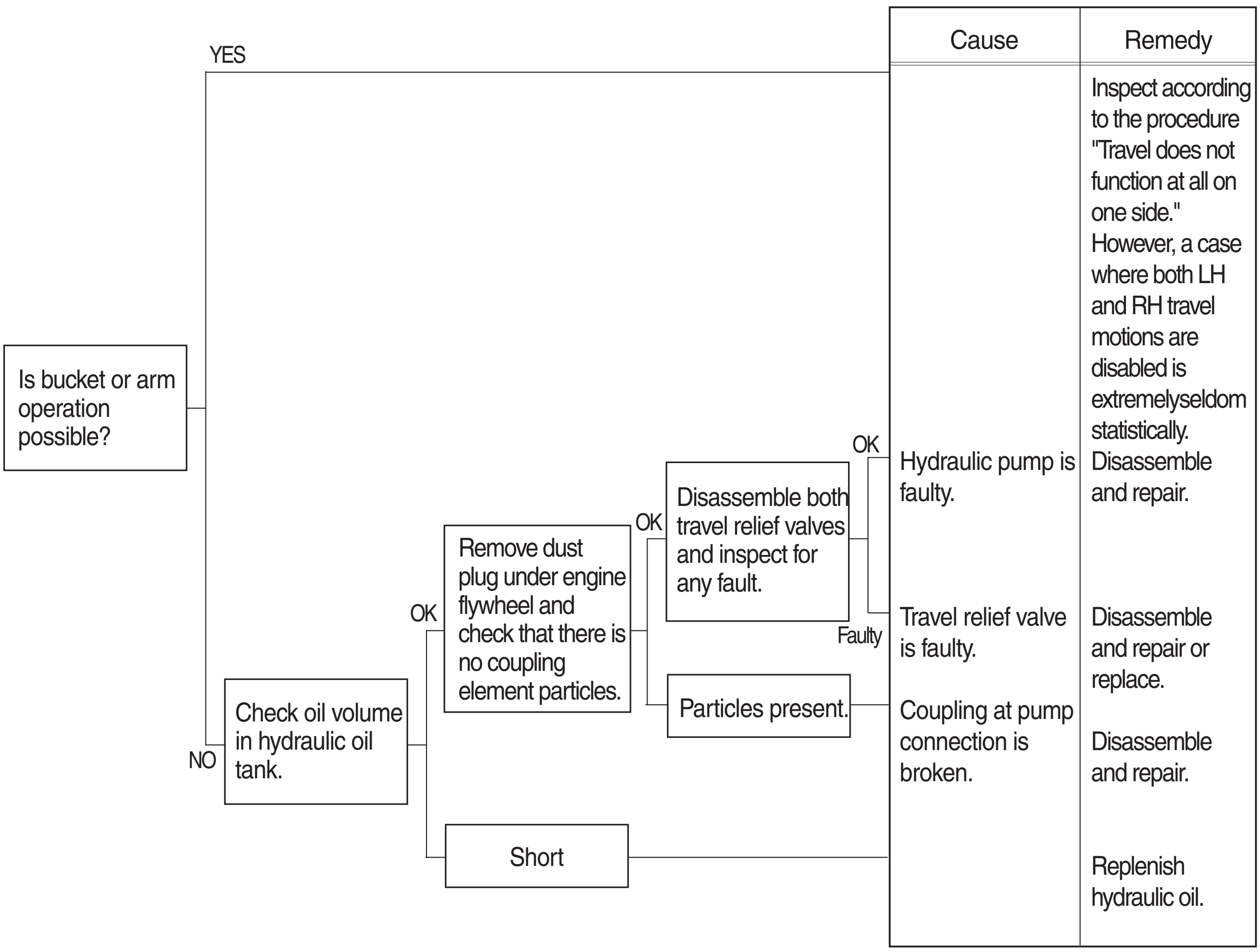
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
ⓐ	
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble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

3) MACHINE DOES NOT STOP ON A SLOPE

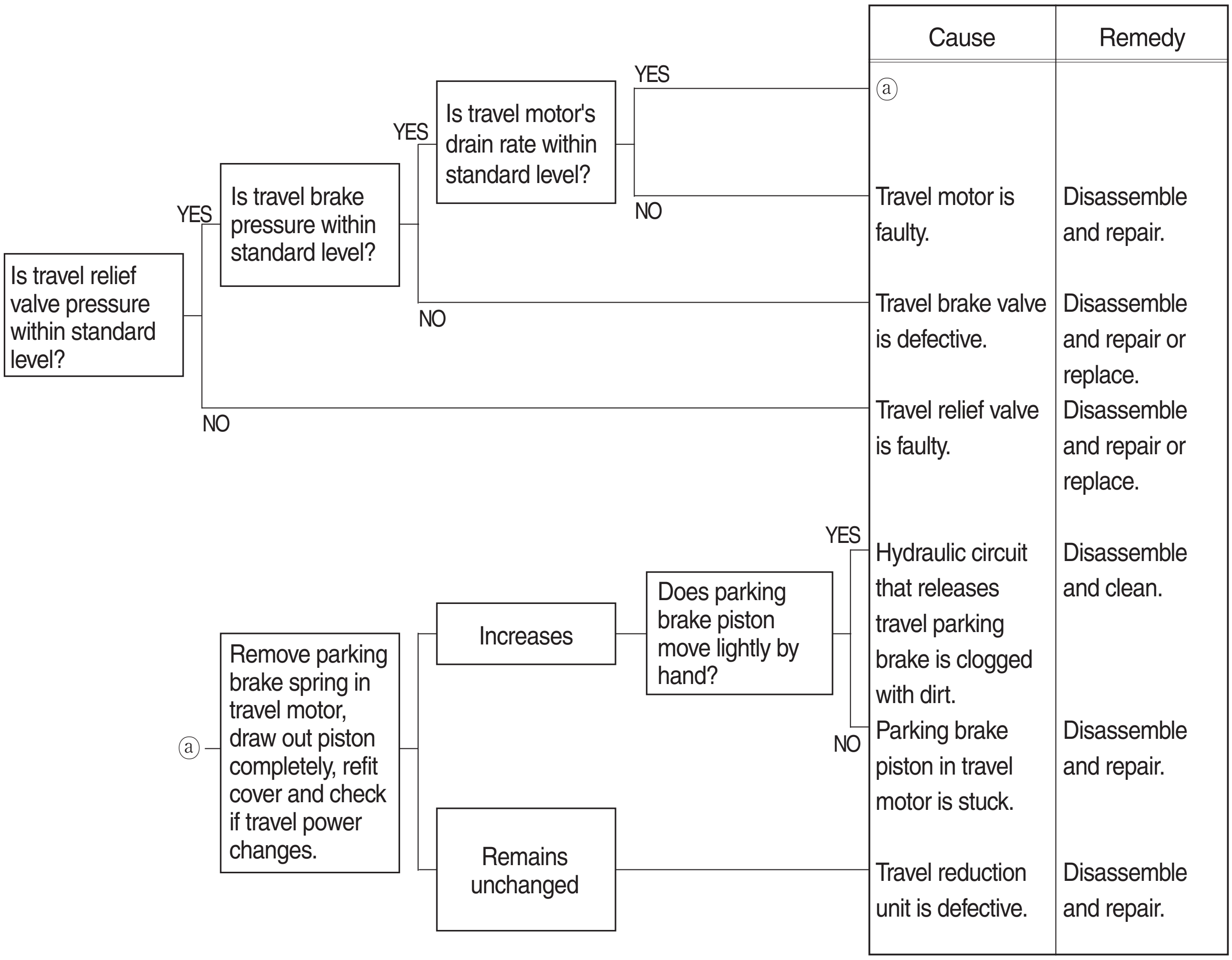
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

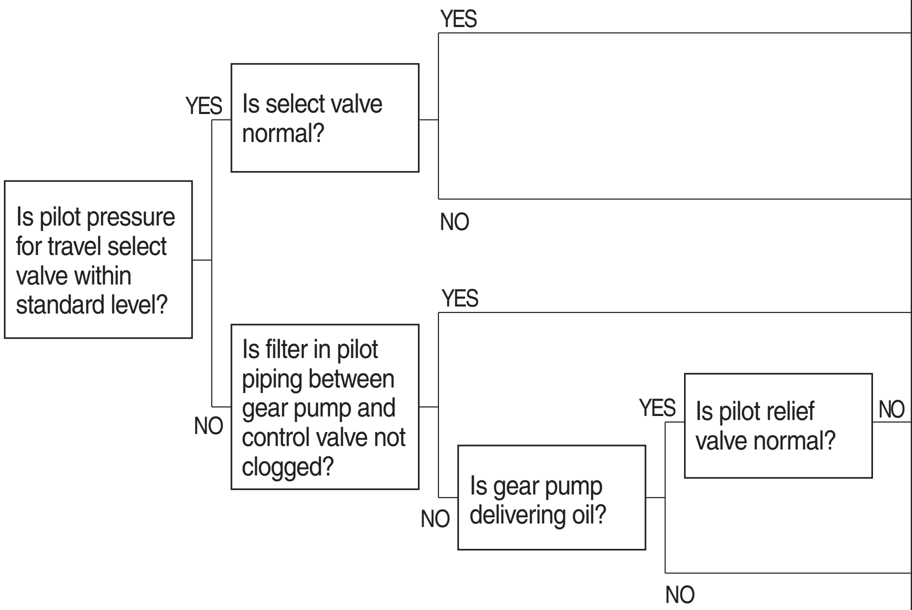


5) TRAVEL ACTION IS POWERLESS(Travel only)



6) MACHINE RUNS RECKLESSLY ON A SLOPE

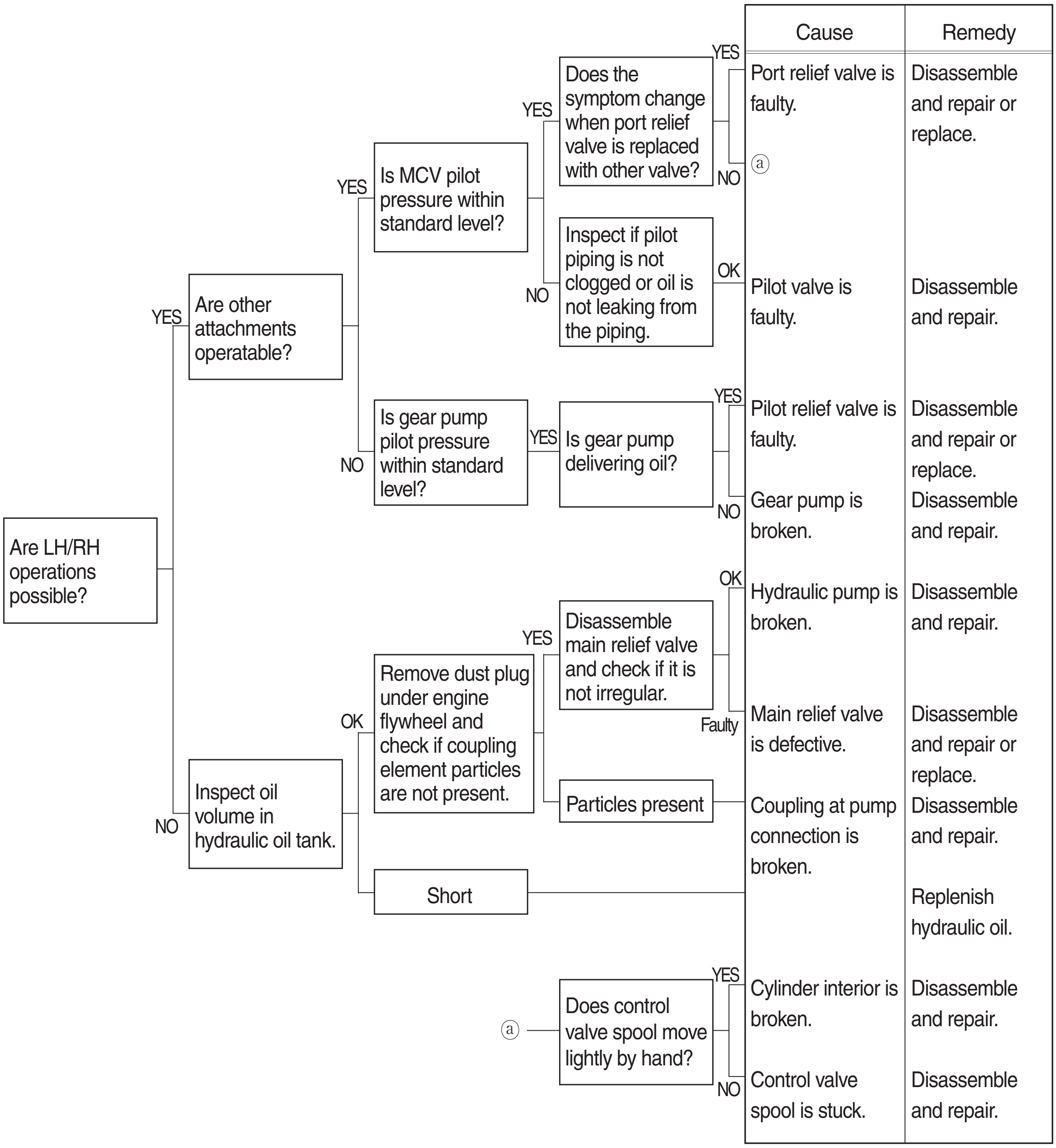
7) MACHINE MAKES A CURVED TRAVEL OR DOES NOT TRAVEL AT ALL WHEN TRAVEL AND ATTACHMENT OPERATIONS ARE EXECUTED AT THE SAME TIME



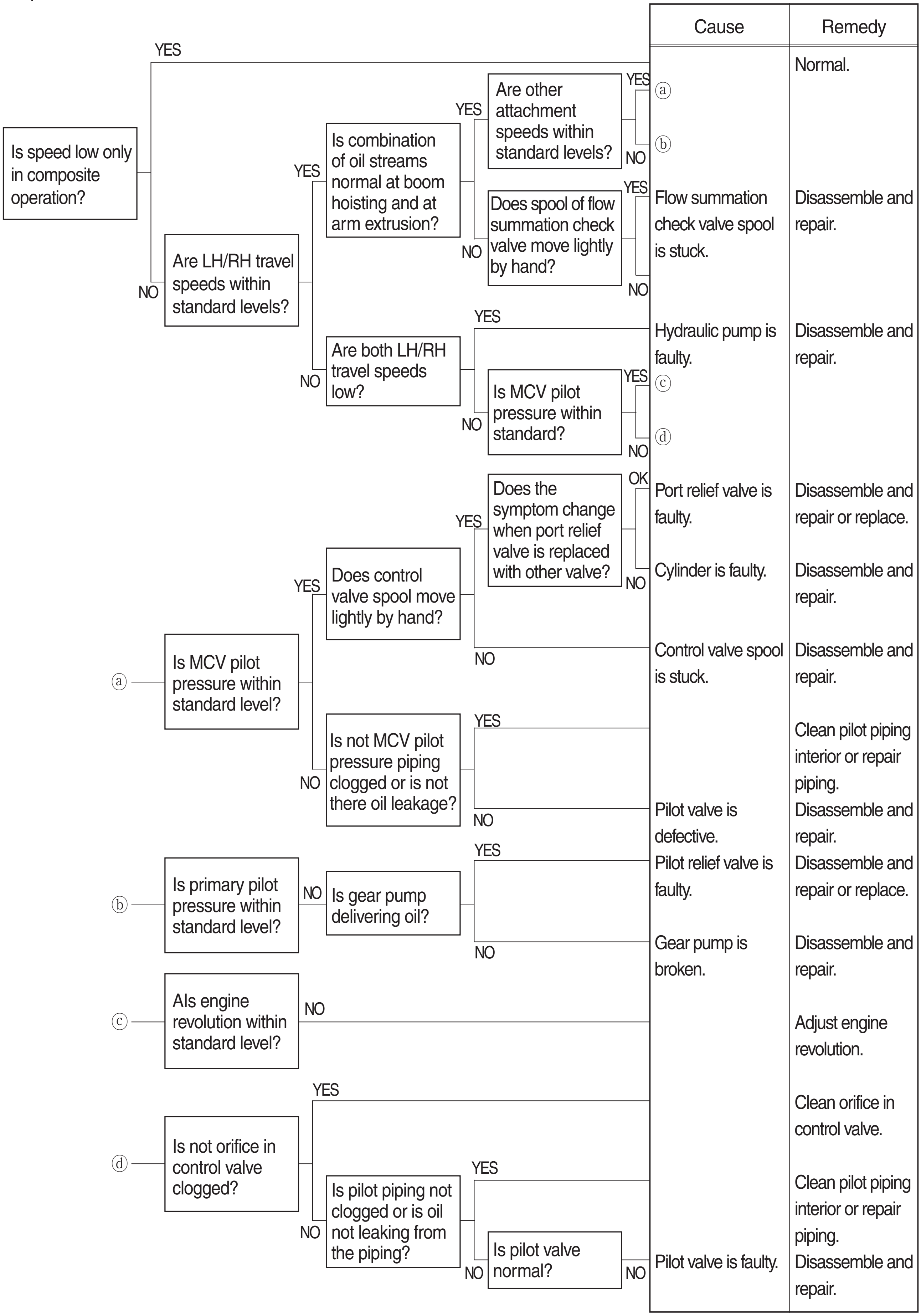
Cause	Remedy
	Normal.
Select valve is faulty.	Repair or replace.
	Remove dirt on pilot line filter.
Pilot relief valve is defective.	Disassemble and repair or replace.
Gear pump is broken.	Disassemble and repair.

6. ATTACHMENT SYSTEM

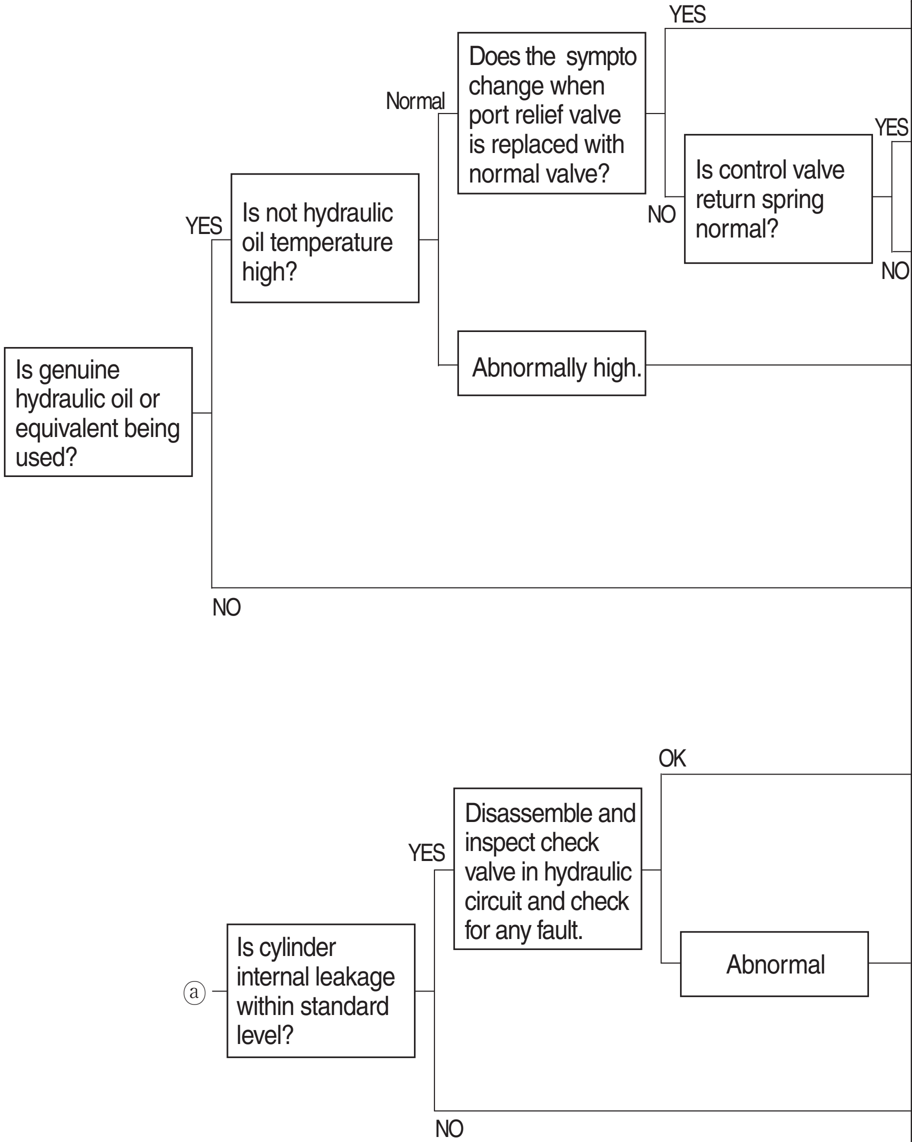
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



2) BOOM, ARM OR BUCKET SPEED IS LOW

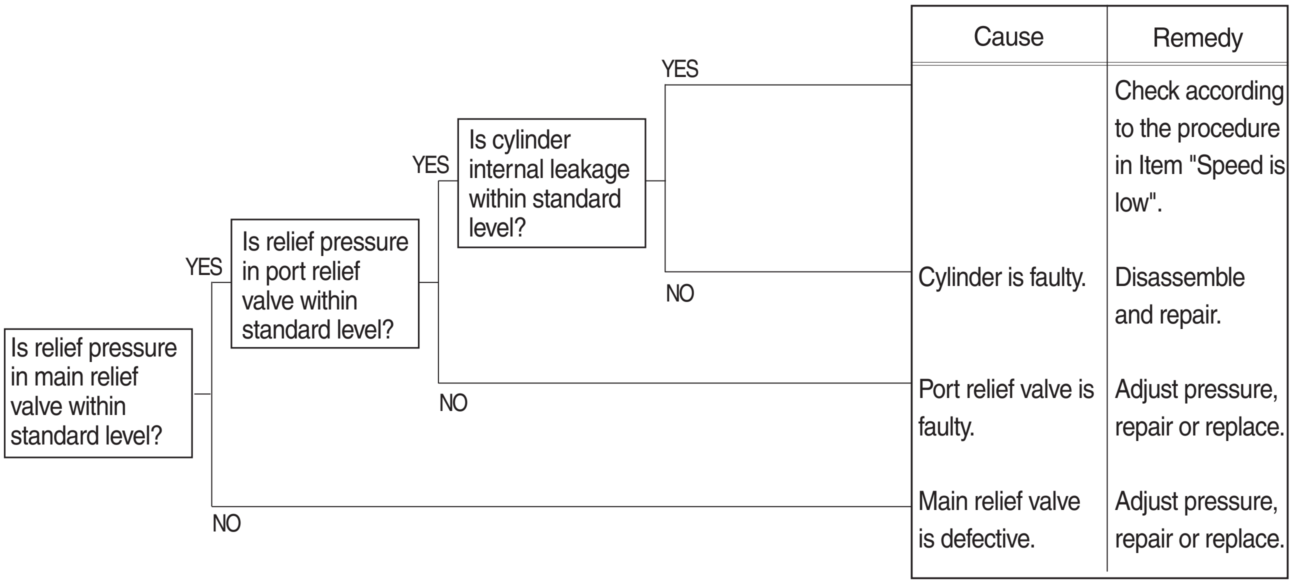


3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS

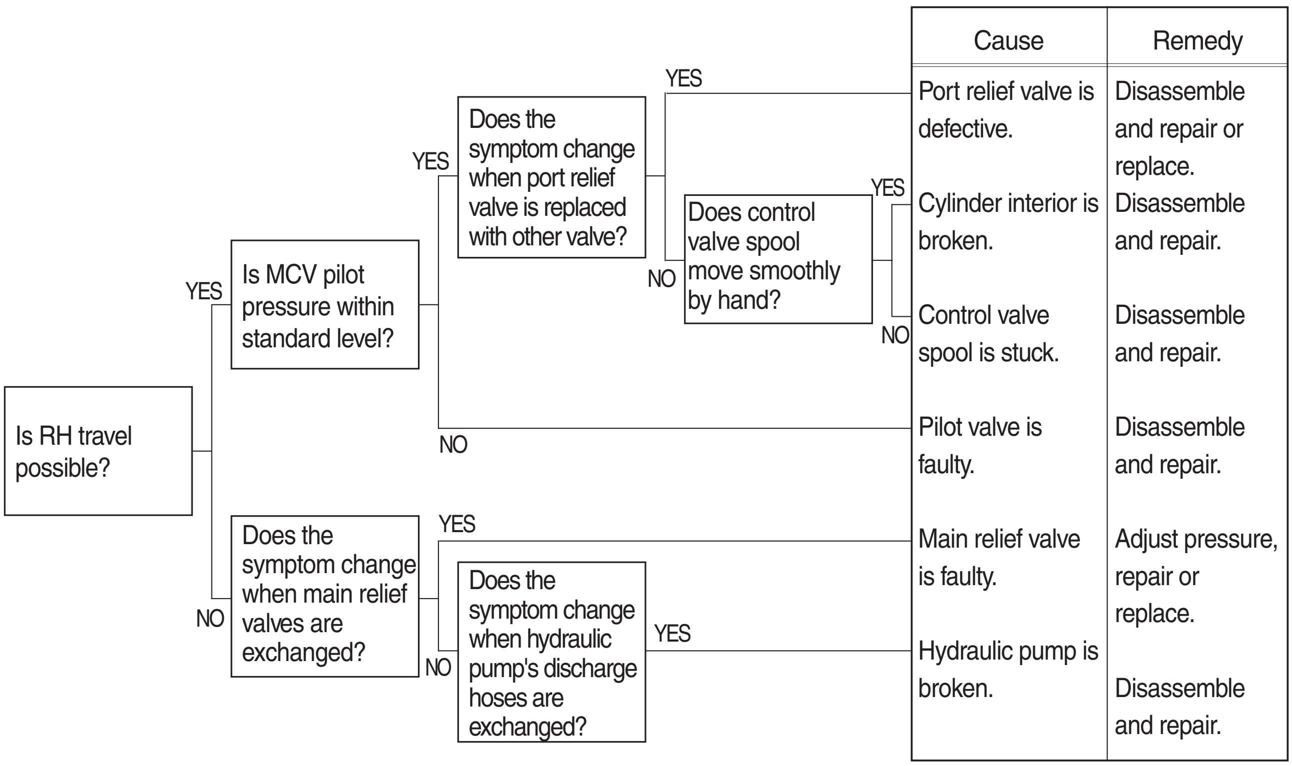


Cause	Remedy
Port relief valve is faulty.	Disassemble and repair or replace.
Control valve's return spring is faulty.	Disassemble and replace.
	Locate the cause of hydraulic oil temperature rise and lower it to proper level.
	Replace with genuine hydraulic oil or equivalent.
Pressure tightness between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

4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



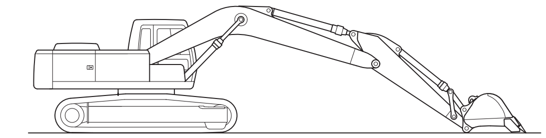
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

Is boom foot pin greased sufficiently?

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

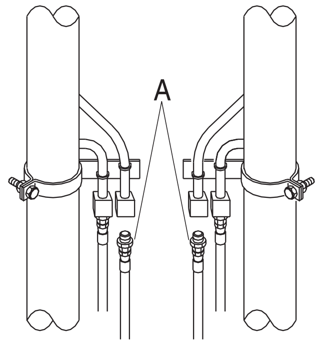
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



29076TS01

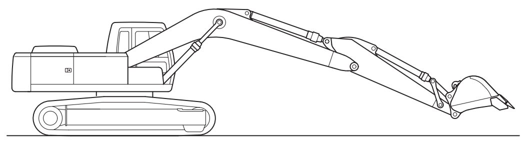
2. Disconnect hose(A) from rod side of boom cylinder and drain oil from cylinders and hose.(Put cups on piping and hose ends)



(210-7) 6-20(2)

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

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



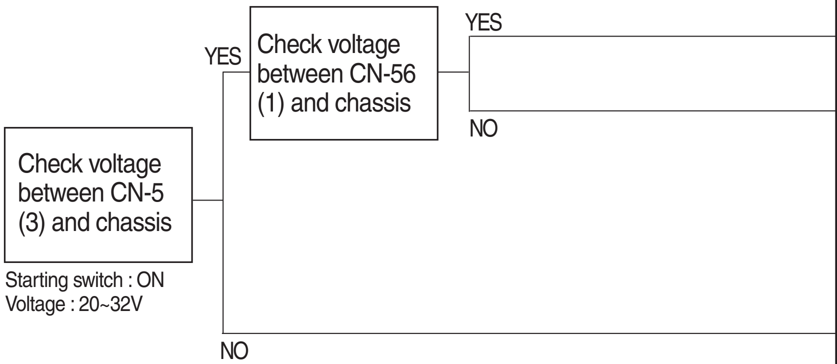
29076TS01

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

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

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

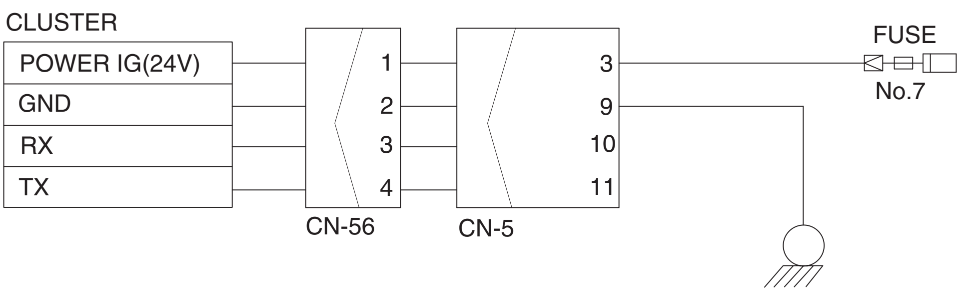
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective clucter	Replace
Disconnection in wiring harness or poor contact between CN-5 (3) -CN-56 (1)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-5 (3) and fuse No.7	Repair or replace (After clean)

Check voltage

YES	20 ~ 32V
NO	0V



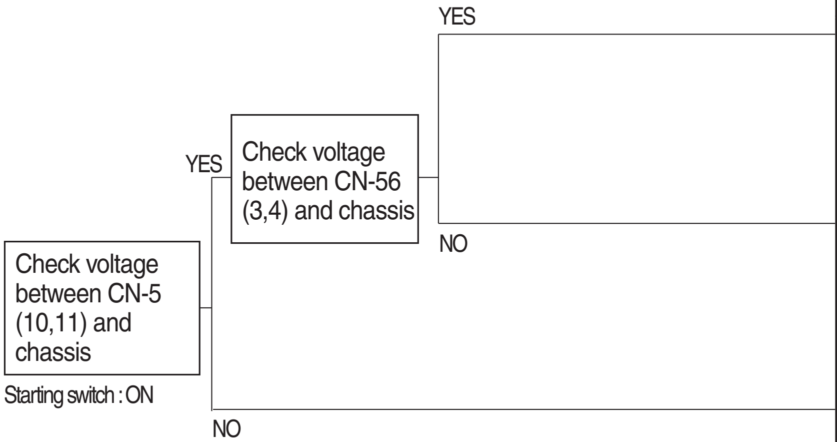
21076ES51

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

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

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

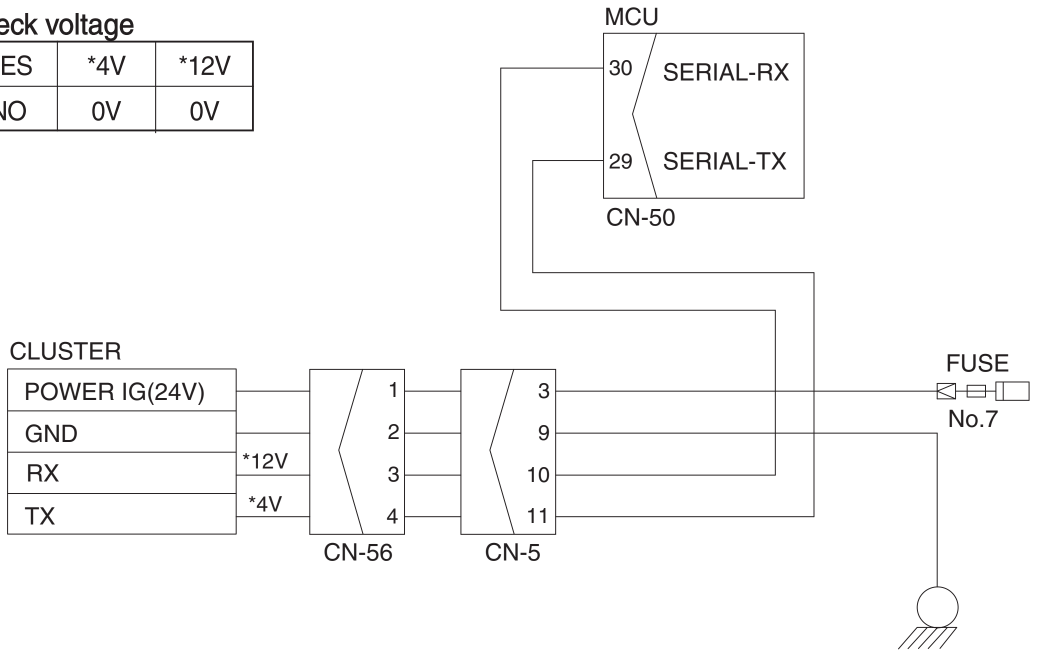
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



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

Check voltage

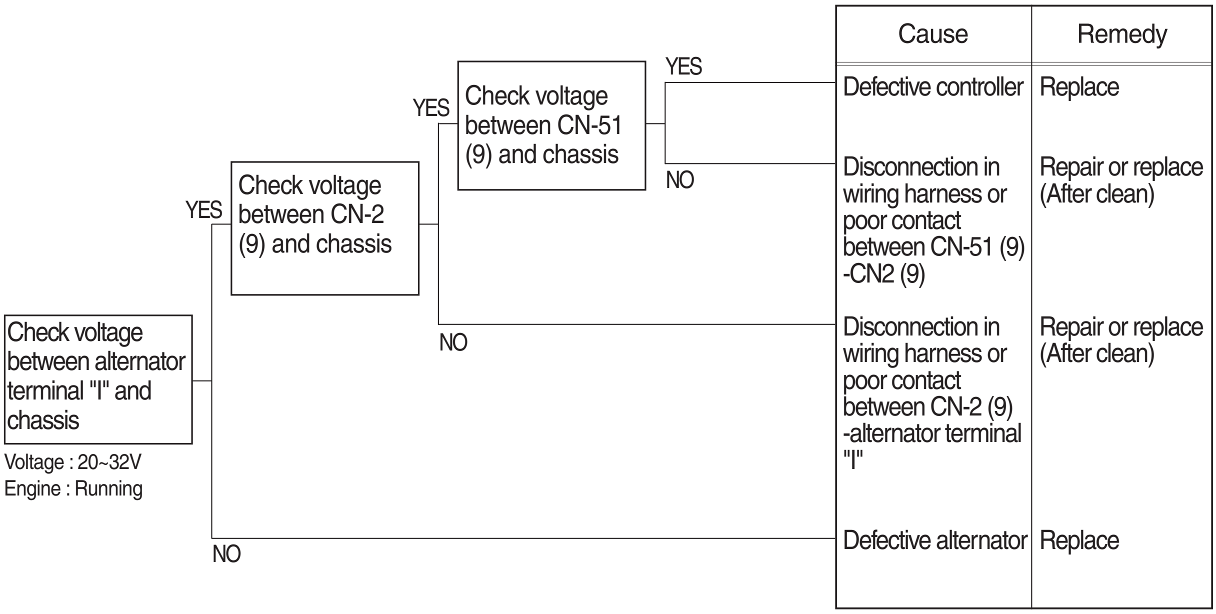
YES	*4V	*12V
NO	0V	0V

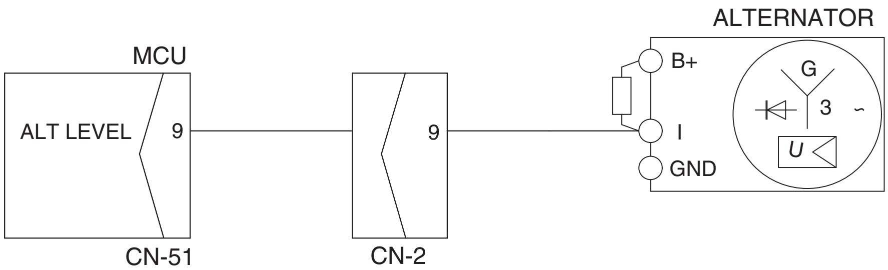


29076ES02

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

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

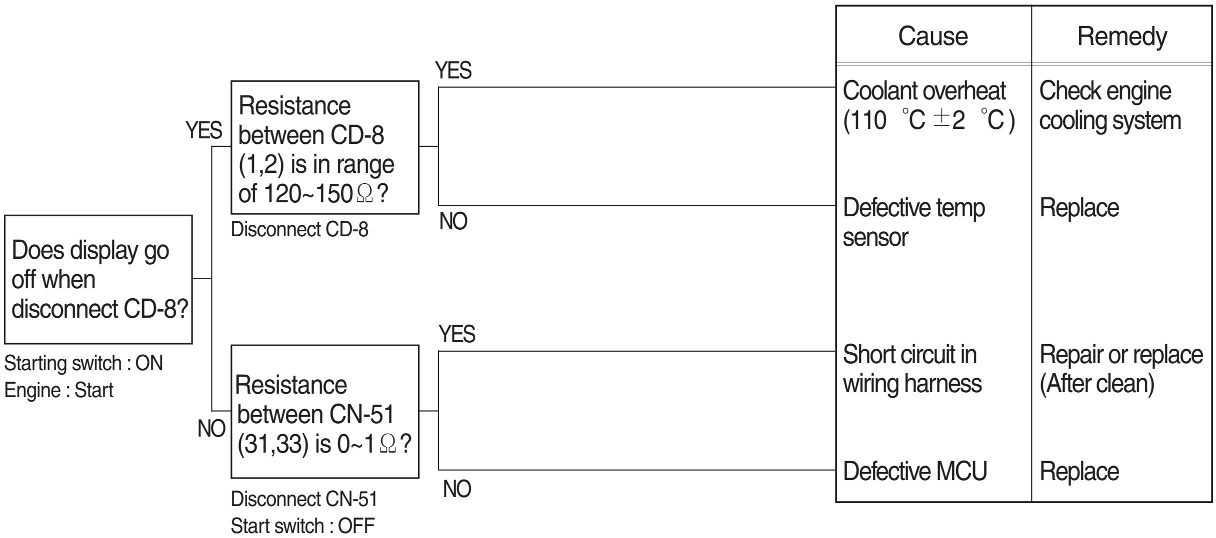


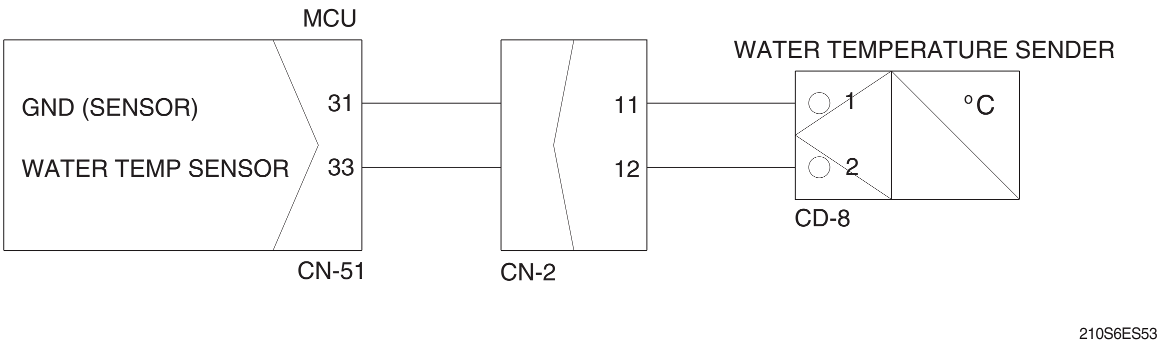


210S6ES52

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

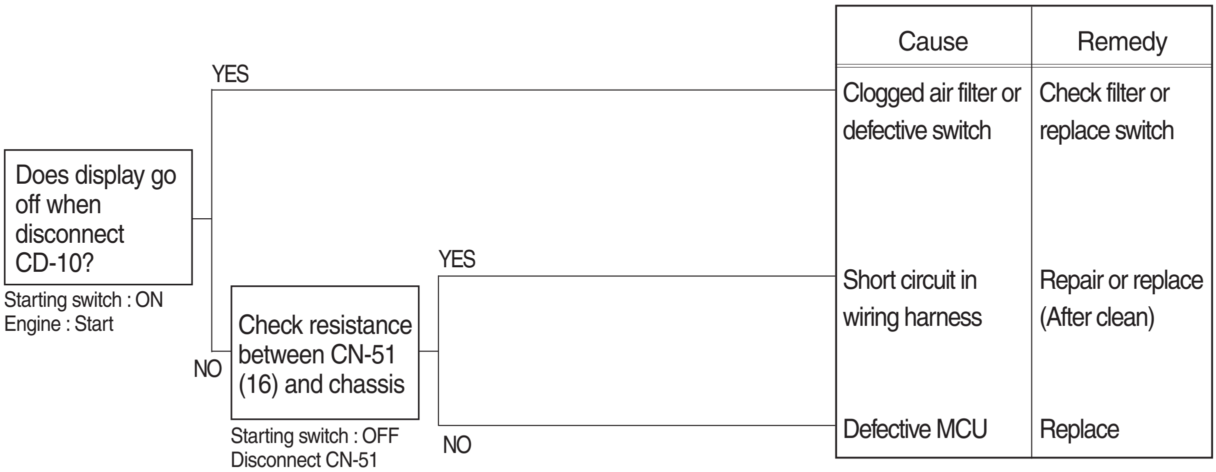
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



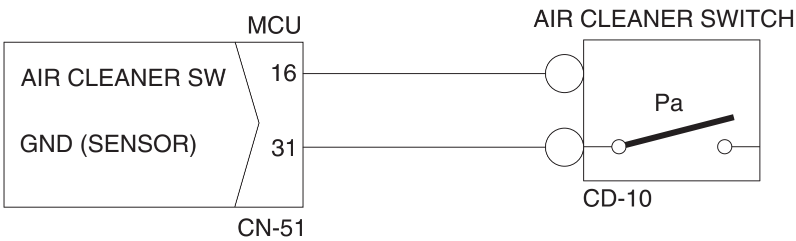


5. WHEN AIR CLEANER WARNING LAMP LIGHTS UP (Engine is started)

· 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.



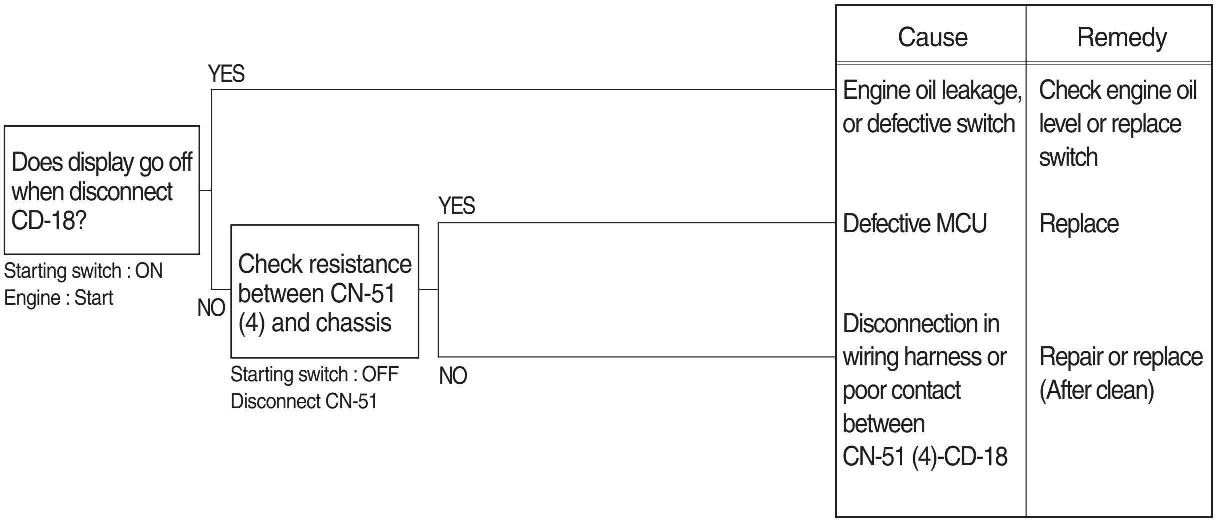
YES	MAX 1Ω
NO	MIN 1MΩ



210S6ES55

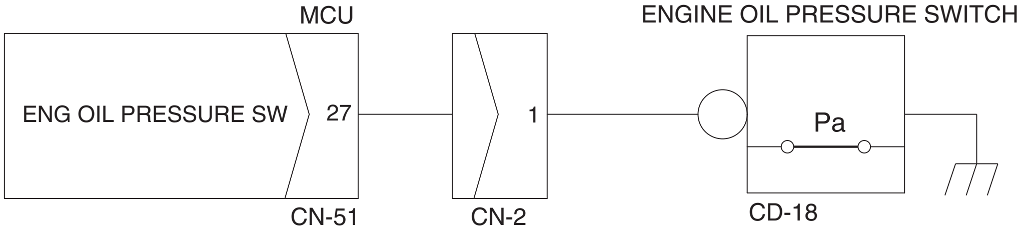
6. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP(Engine is started)

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



Check resistance

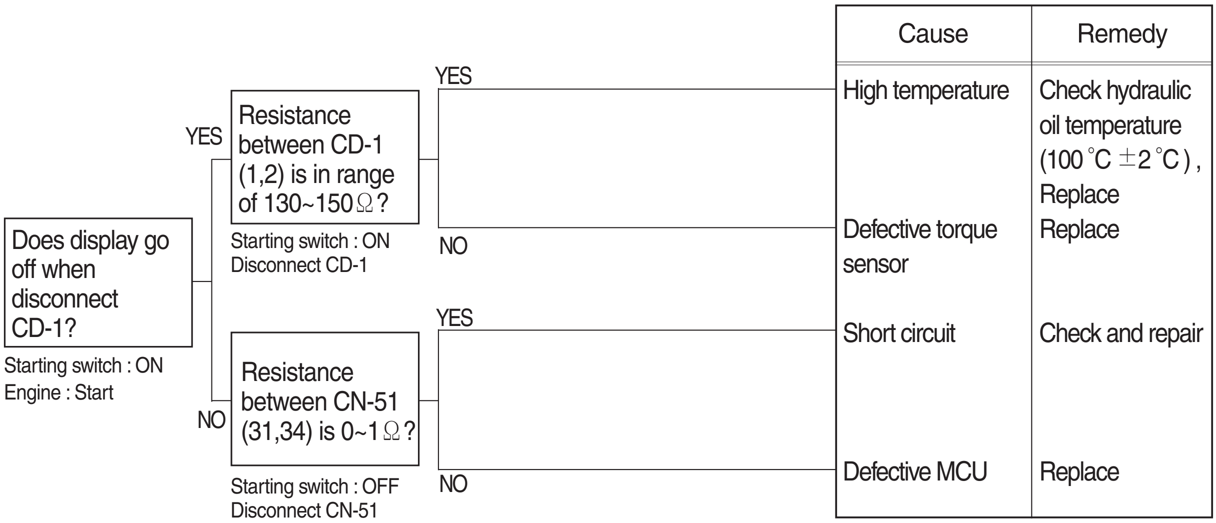
YES	MAX 1Ω
NO	MIN 1MΩ

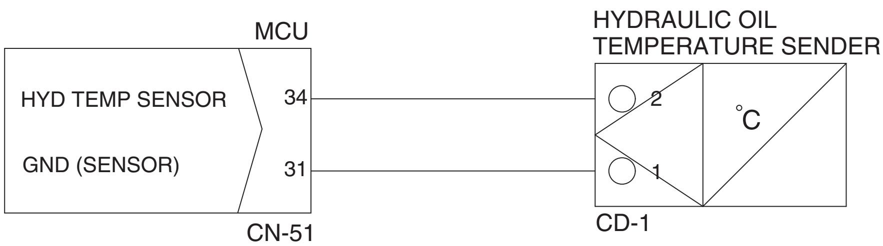


210S6ES56

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.

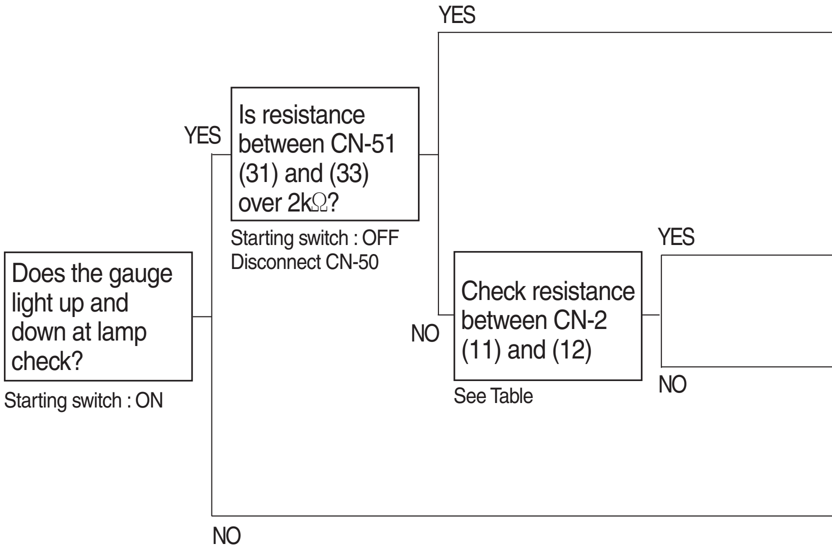




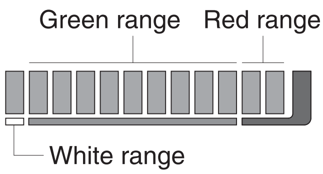
210S6ES57

8. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

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

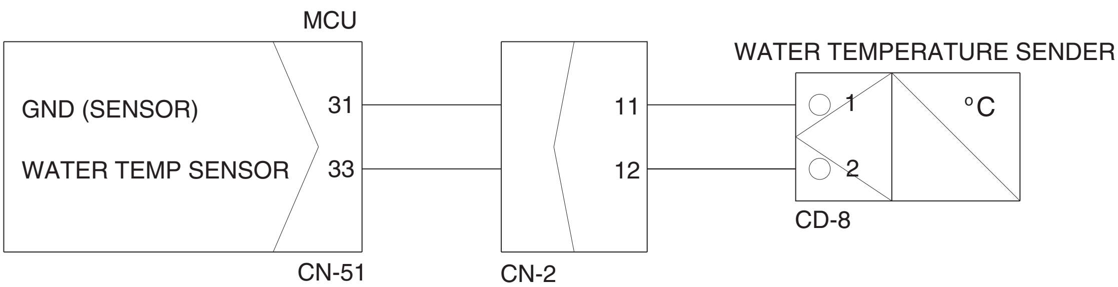


Cause	Remedy
Disconnection in wiring harness or poor contact between CN-51-CD-8	Repair or replace (After clean)
Defective MCU	Replace
Defective temp sensor	Replace
Defective cluster	Replace



Check Table

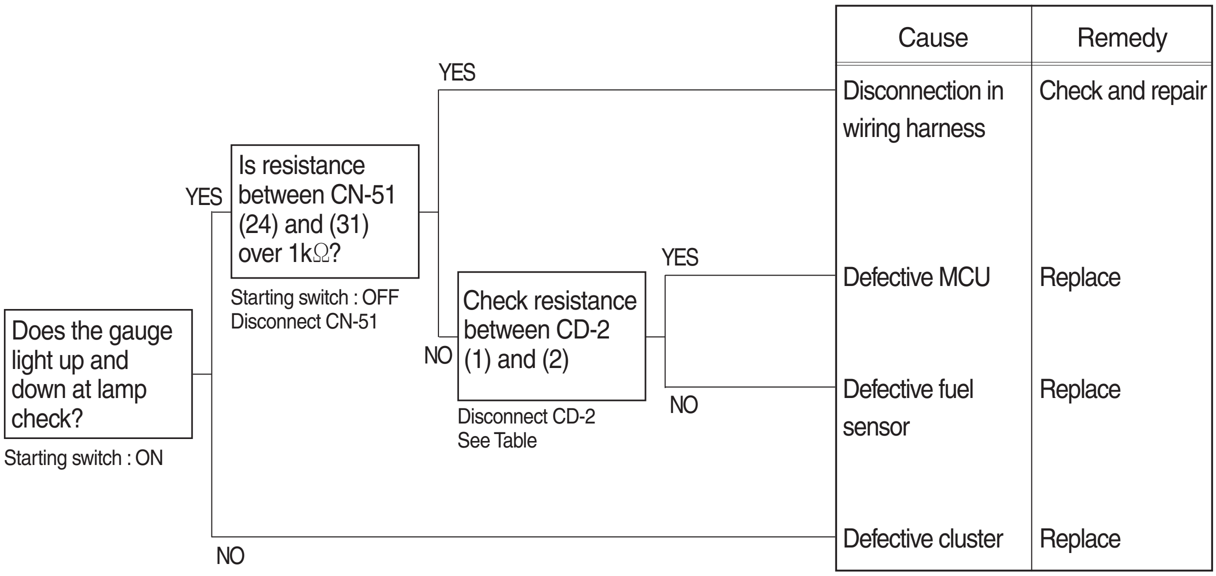
Item \ Temperature	White range (~29 ℃)	Green range (30~105 ℃)	Red range (105 ℃ ~)
Unit Resistance(Ω)	1646~	1645~158	~139
Tolerance(%)	±20	±20	±20



210S6ES53

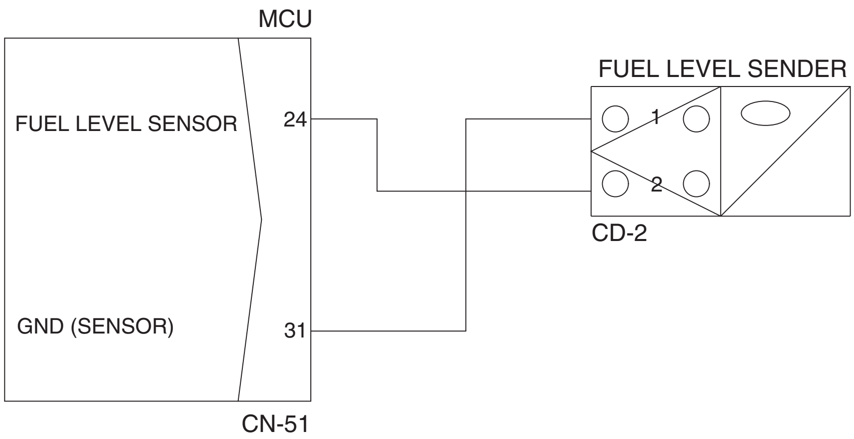
9. WHEN FUEL GAUGE DOES NOT OPERATE (Check warning lamp ON/OFF)

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



Check Table

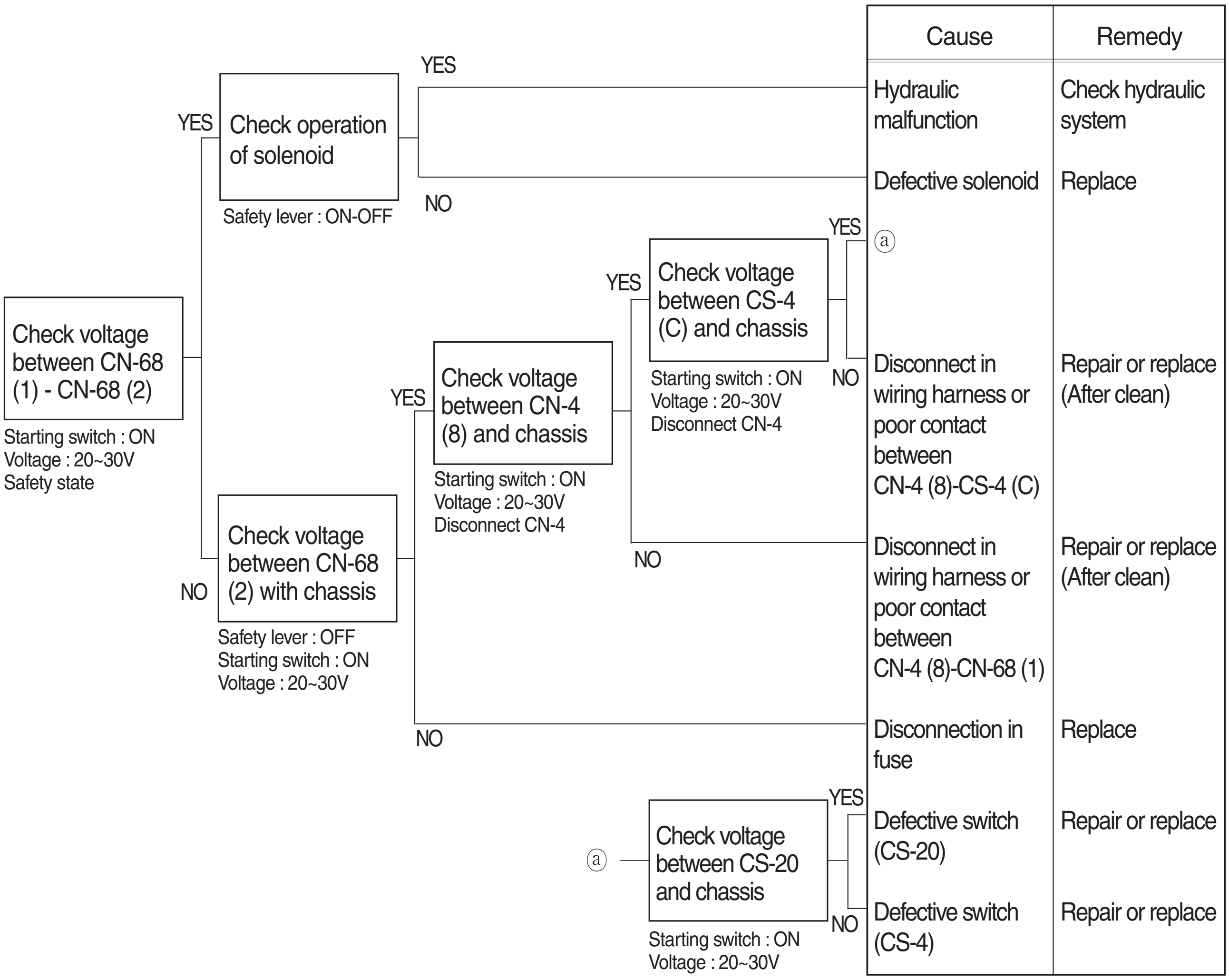
Item \ Level	White range	Green range	Red range
Unit Resistance(Ω)	700~601	600~101	~100
Tolerance(%)	±5	±5	±5

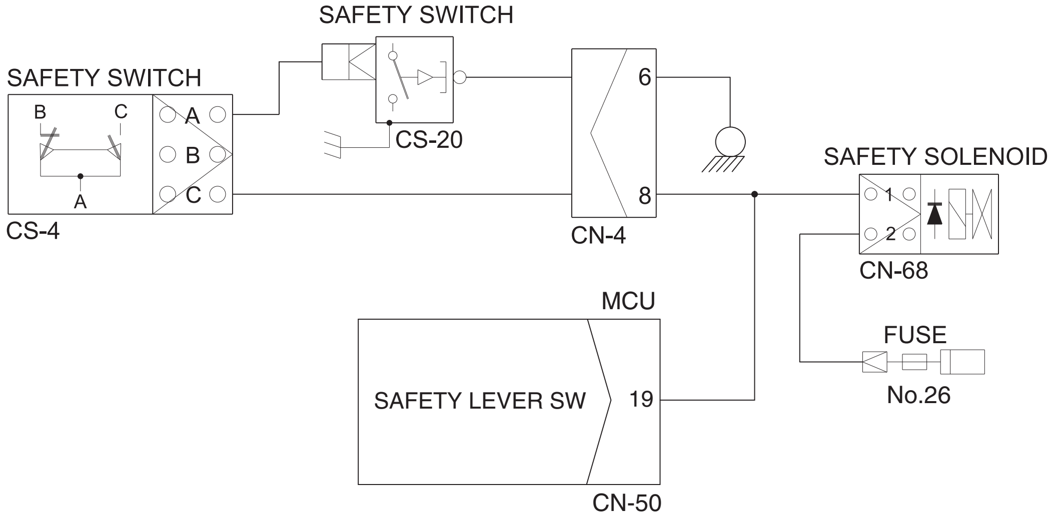


210S6ES58

10. WHEN SAFETY SOLENOID DOES NOT OPERATE

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

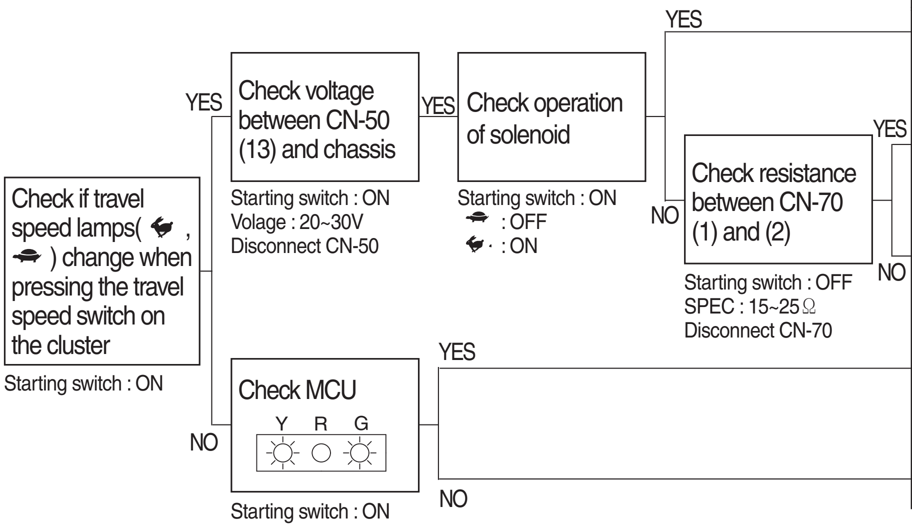




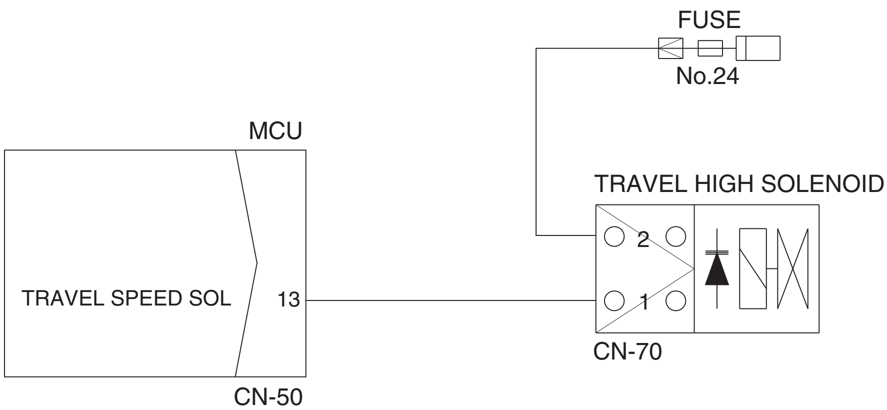
210S6ES59

11. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE

- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No.22 .
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



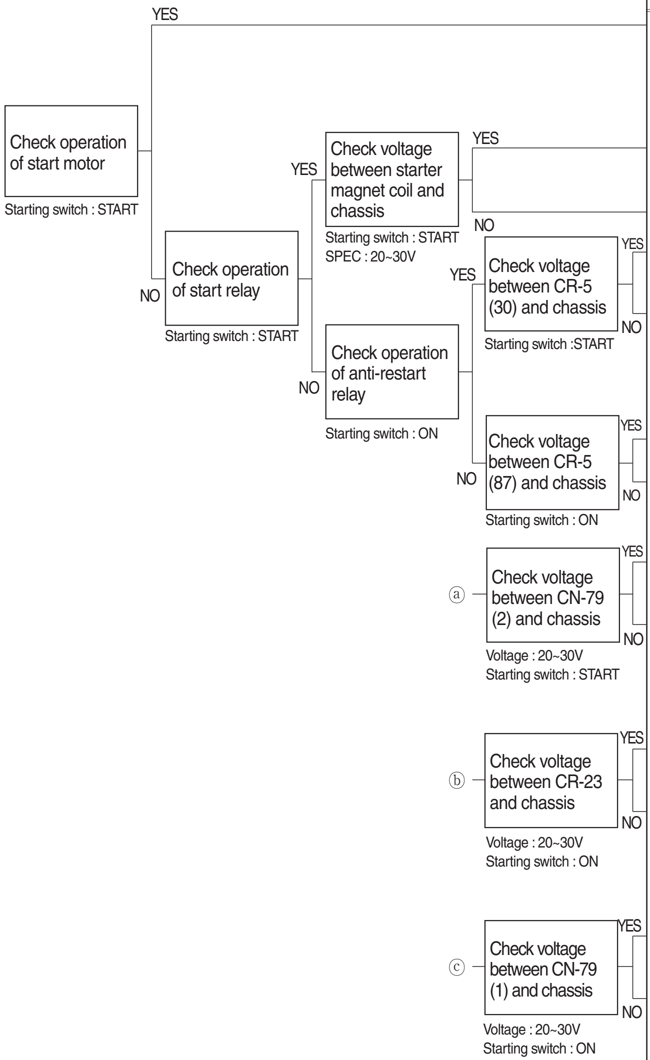
Cause	Remedy
Defective hydraulic system	Check hydraulic system
Defective MCU	Replace
Defective solenoid	Replace
Defective cluster	Replace
Defective MCU	Replace



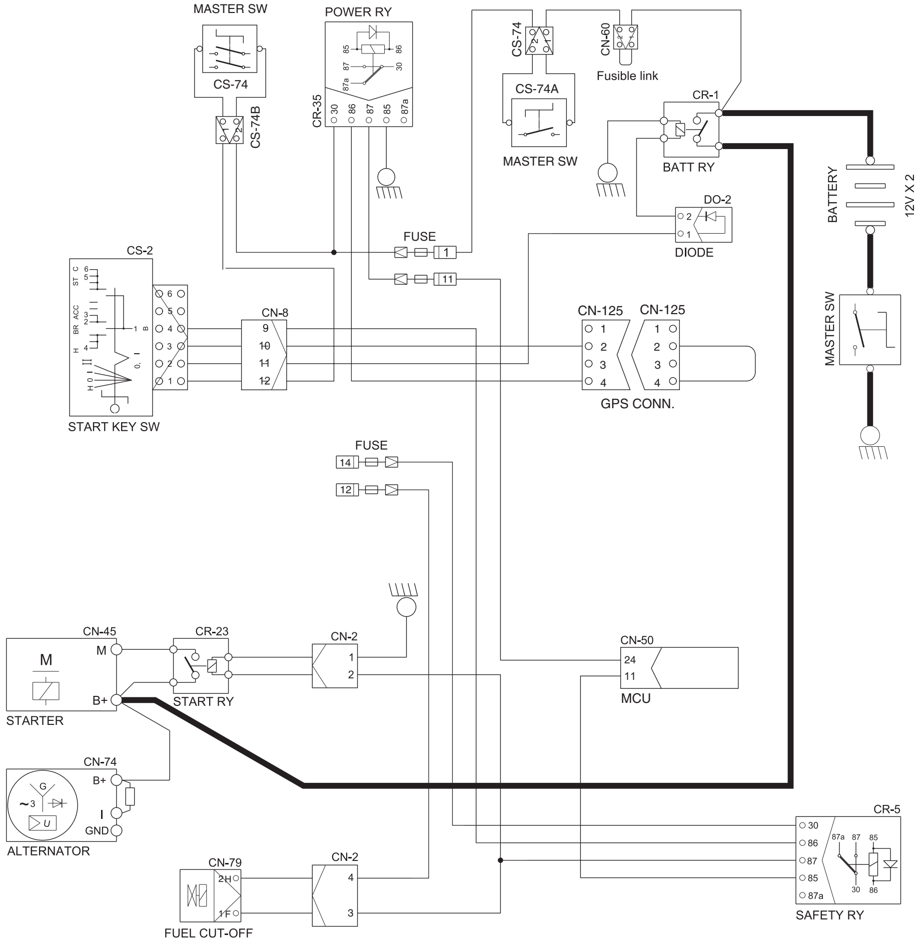
210S6ES60

12. WHEN ENGINE DOES NOT START

- Check supply of the power at engine stop solenoid while starting switch is ON.
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.



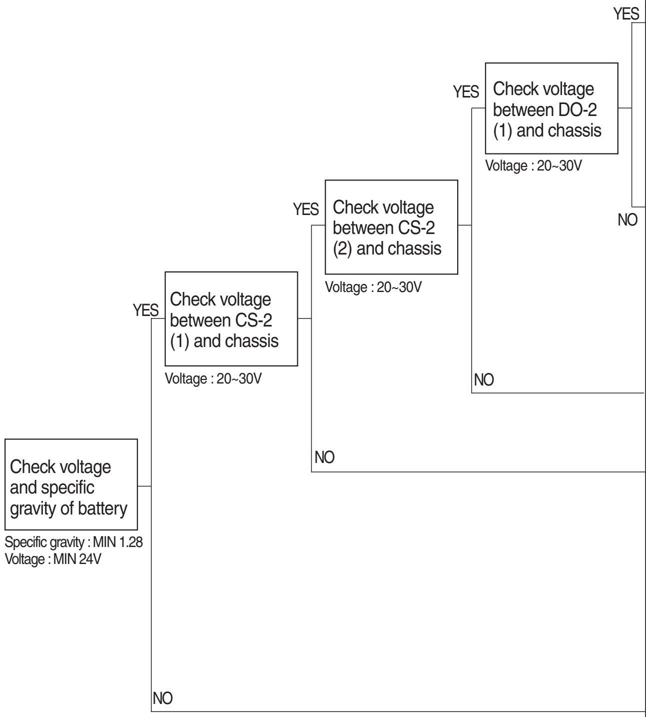
Cause	Remedy
Defective battery	Check engine system charge or replace (After checking specific gravity of battery)
Defective magnet of start motor	Replace
Defective start relay	Replace
ⓐ, ⓑ	
Disconnection in wiring harness or poor contact between CR-5 (86) and CN-8 (9)	Repair or replace (After clean)
Defective relay	Replace
ⓒ	
Defective fuel cut off solenoid	Replace
Disconnection in wiring harness or poor contact between CN-2 (4)-CN-79 (2)	Repair or replace (After clean)
Defective relay	Replace
Disconnection in wiring harness or poor contact between CR-5 (87)-CR-23	Repair or replace (After clean)
Defective fuel cut-off solenoid	Replace
Disconnection in wiring harness or poor contact between CN-2 (3) and CR-5 (87)	Repair or replace (After clean)



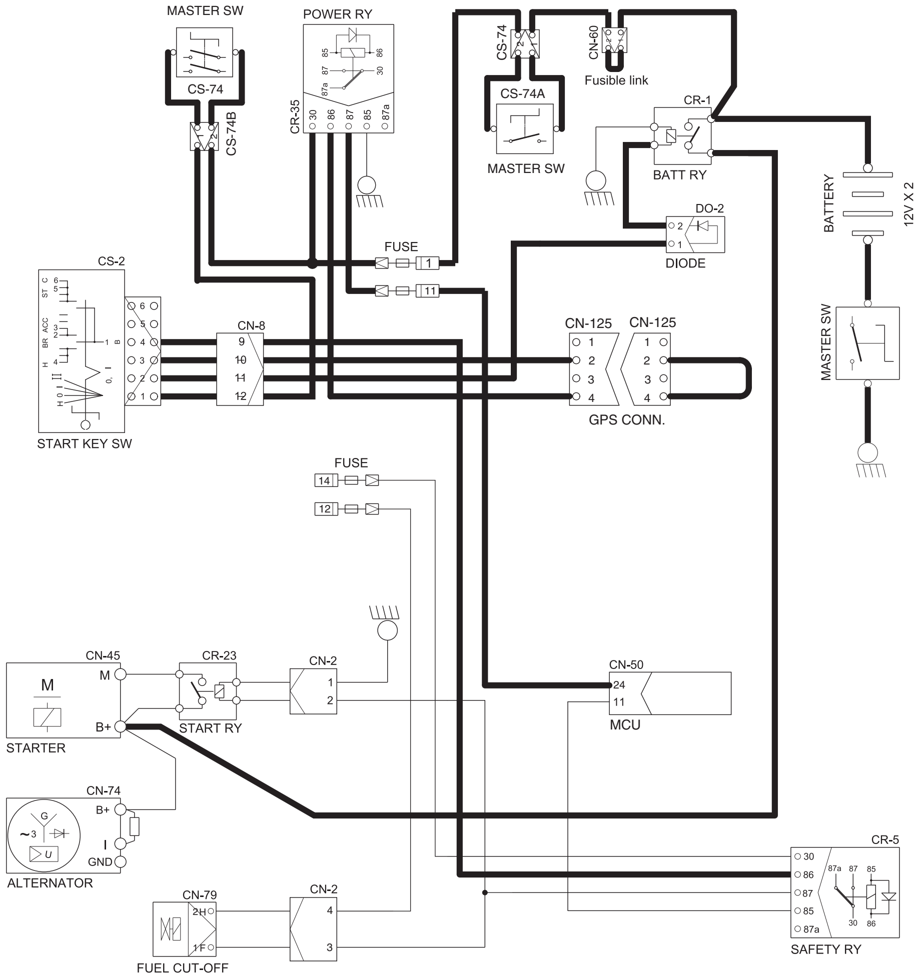
210S6ES61

13. WHEN STARTING SWITCH "ON" ELECTRIC PART DOES NOT OPERATE

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



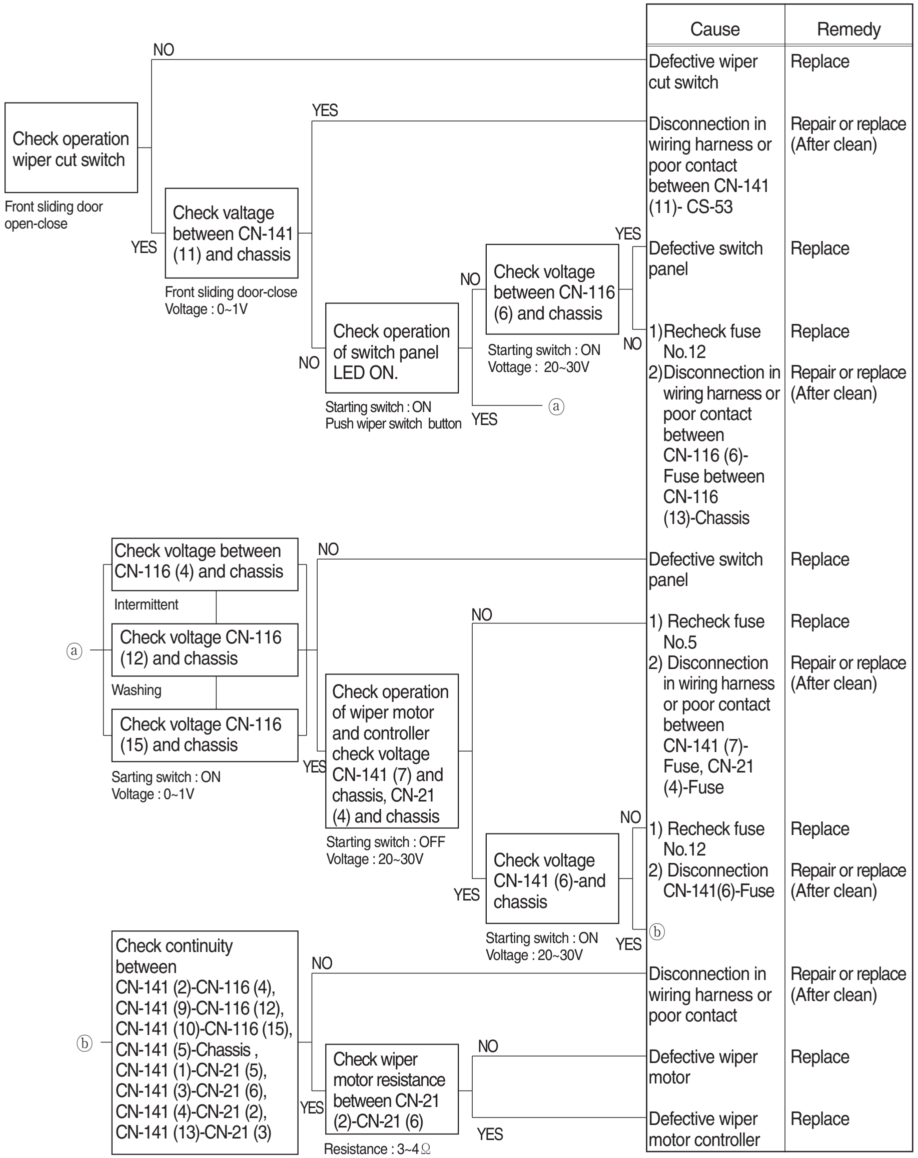
Cause	Remedy
Disconnection in wiring harness or poor contact between DO-2 (2)-CR-1 or defective battery relay	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CS-2 (2)-CN-8 (11)- DO-2 (1)	Replace
Defective start key switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-CN-8 (12)-CS-74B-Fuse No.1 -CS-74A-CN-60-CR-1-Battery	Replace
Battery capacity too low	Charge or replace (After clean)

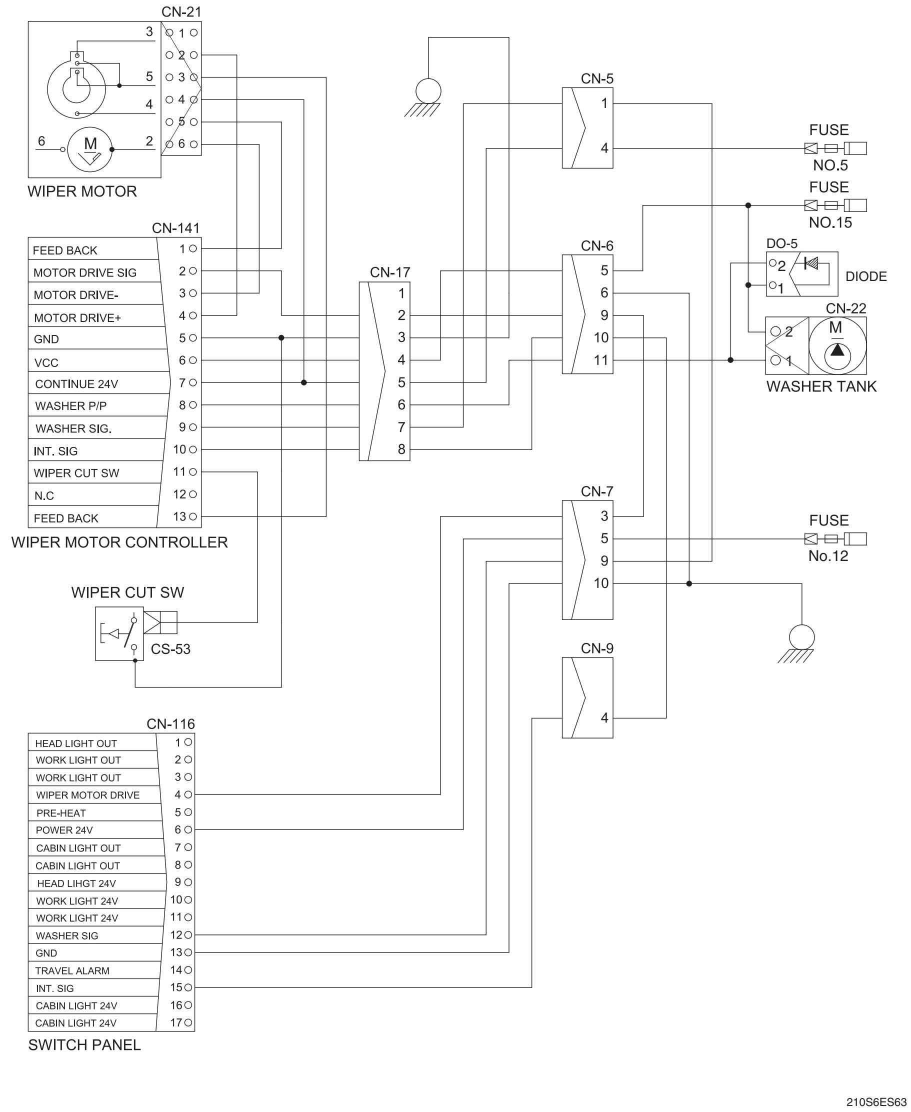


210S6ES62

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

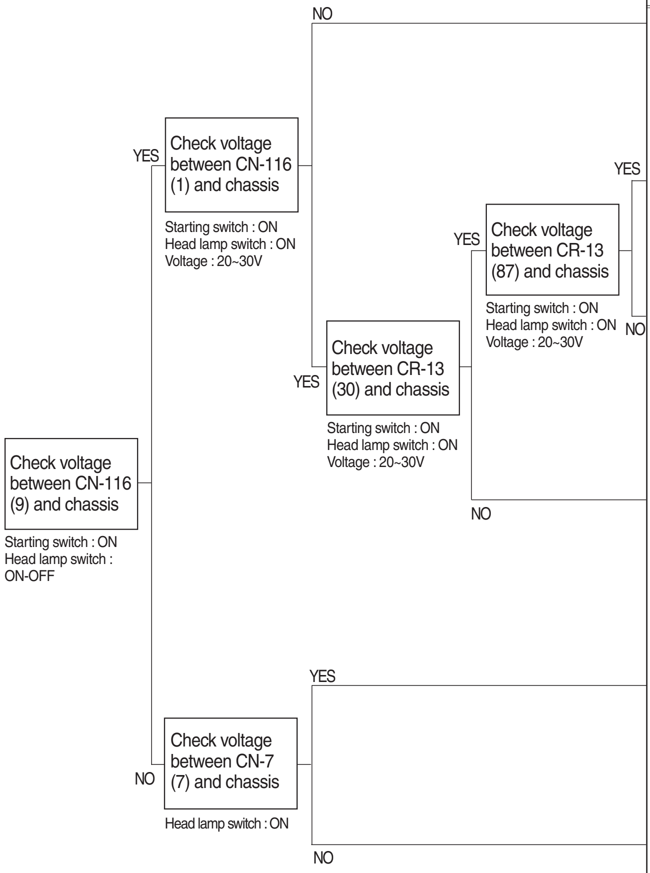
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and the fuse No.5,12 and 15 is not blown out.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



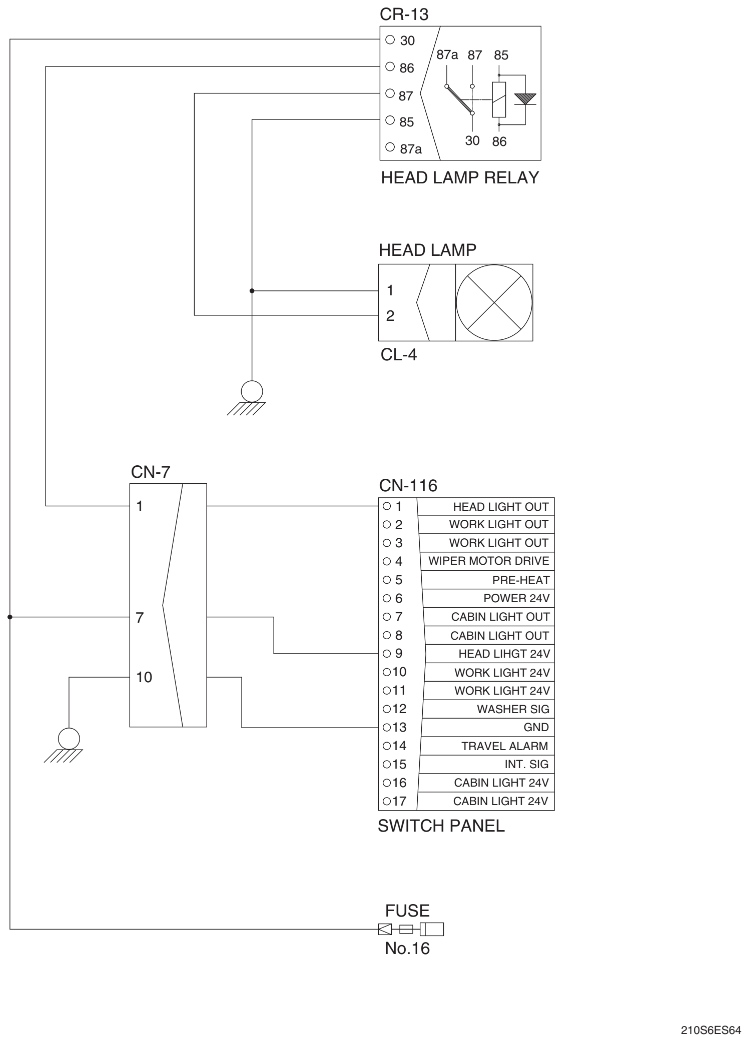


15. WHEN STARTING SWITCH IS TURNED ON, HEAD LAMP DOES NOT LIGHTS UP

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

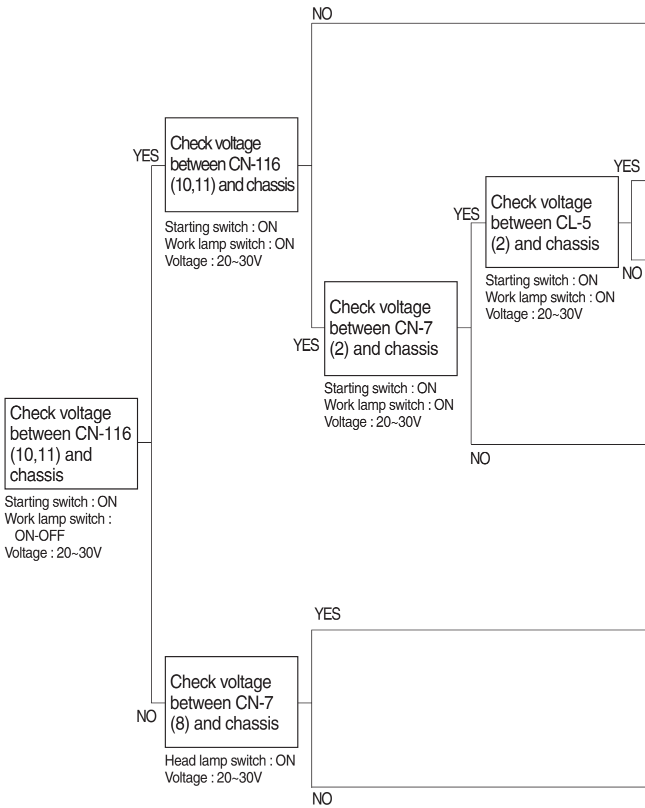


Cause	Remedy
Defective lamp switch	Replace switch
Defective bulb or Disconnection CR-13 (87)-CL-4 (2)	Replace
Disconnection in wiring harness or poor contact between CN-7 (1)-CL-13 (86) or Detective bulb	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CR-13 (30)-fuse No.16	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-116 (9)-CN-7 (7)	Repair or replace (After clean)
Recheck fuse No.16	Replace

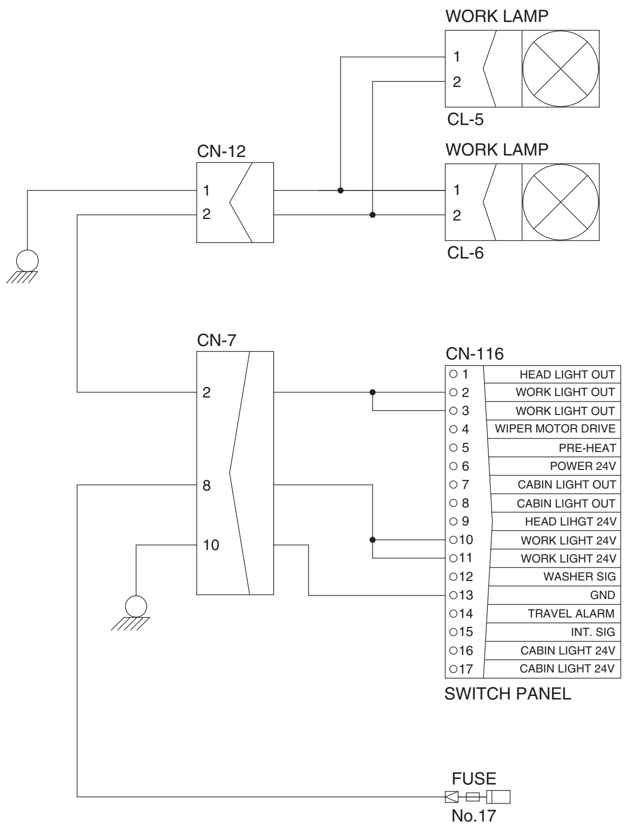


16. WHEN STARTING SWITCH IS TURNED ON, WORK LAMP DOES NOT LIGHTS UP

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



Cause	Remedy
Defective lamp switch	Replace switch
Defective bulb	Replace
Disconnection in wiring harness or poor contact between CN-7 (2) -CL-5 (2) and CL-6 (2)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-116 (2,3)-CN-7 (2)	Repair or replace (After clean)
Disconnection in wiring harness or poor contact between CN-116 (10,11)-CN-7 (8)	Repair or replace (After clean)
Recheck fuse No.17	Replace



210S6ES65

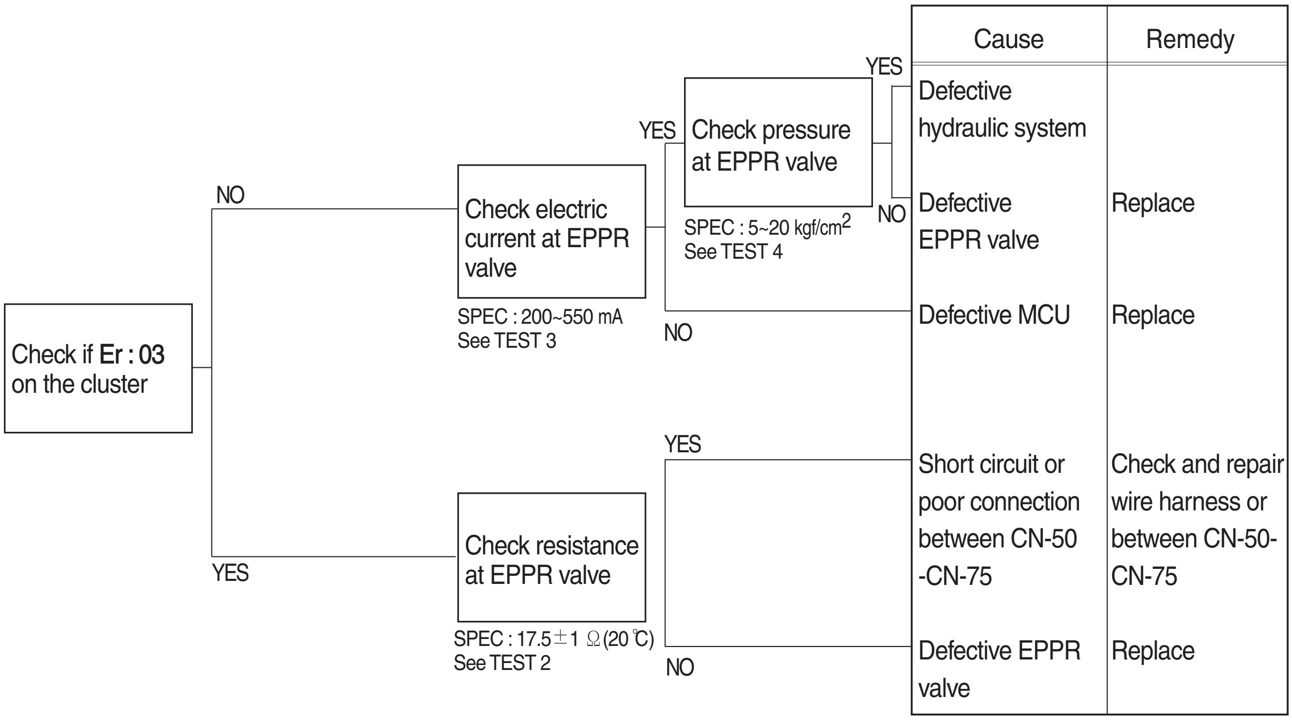
1. ALL ACTUATORS SPEED ARE SLOW

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

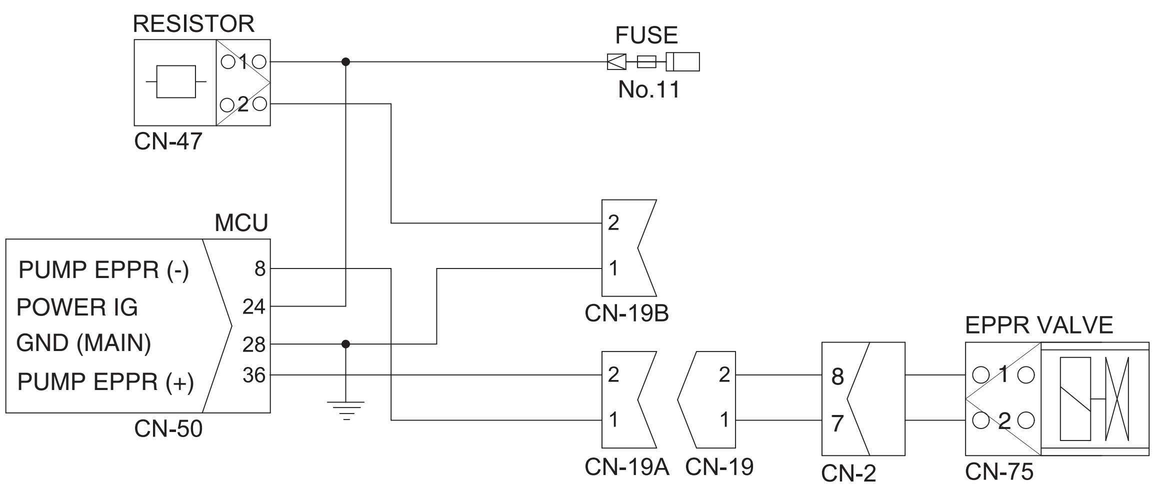
※ Spec : M-mode 2100 ± 100 rpm H-mode 2000 ± 100 rpm S-mode 1900 ± 100 rpm

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

1) INSPECTION PROCEDURE



Wiring diagram

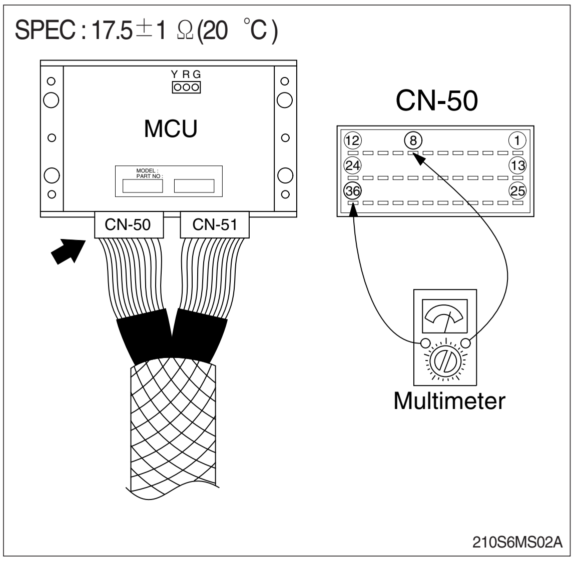


210S6MS51

2) TEST PROCEDURE

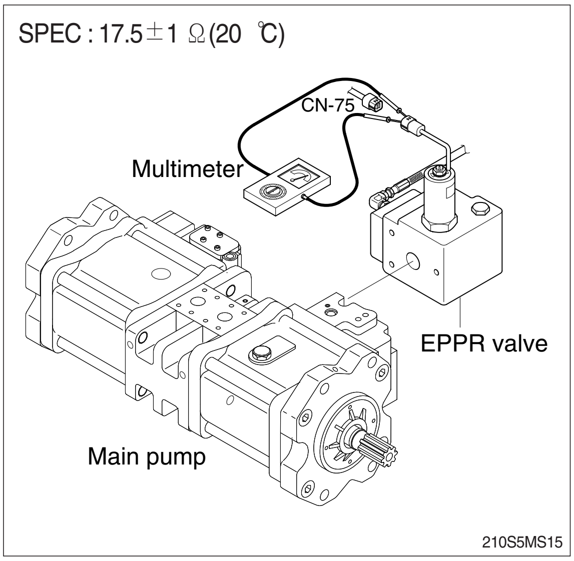
(1) Test 1 : Check resistance at connector CN-50 (8)-(36).

① Starting switch OFF.
② Disconnect connector CN-50.
③ Check resistance between pin and at connector CN-50 (8)-(36).



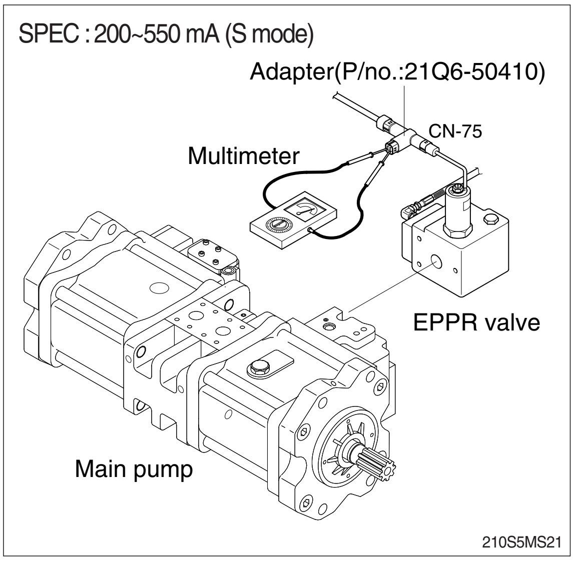
(2) Test 2 : Check resistance at connector CN-75.

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



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

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at 10 (MAX).
④ Set S-mode and cancel auto decel mode.
⑤ If engine rpm display show approx 1900 ±100rpm, check electric current.



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

① Remove plug and connect pressure gauge as figure.

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

② Start engine.

③ Set the accel dial at 10 (Max).

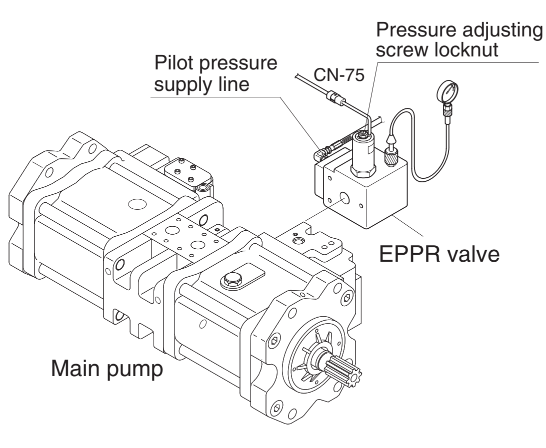
④ Set S-mode and cancel auto decel mode.

⑤ If engine rpm display show approx 1900 ±100rpm, check pressure.

⑥ If pressure is not correct, adjust it.

⑦ After adjust, test the machine.

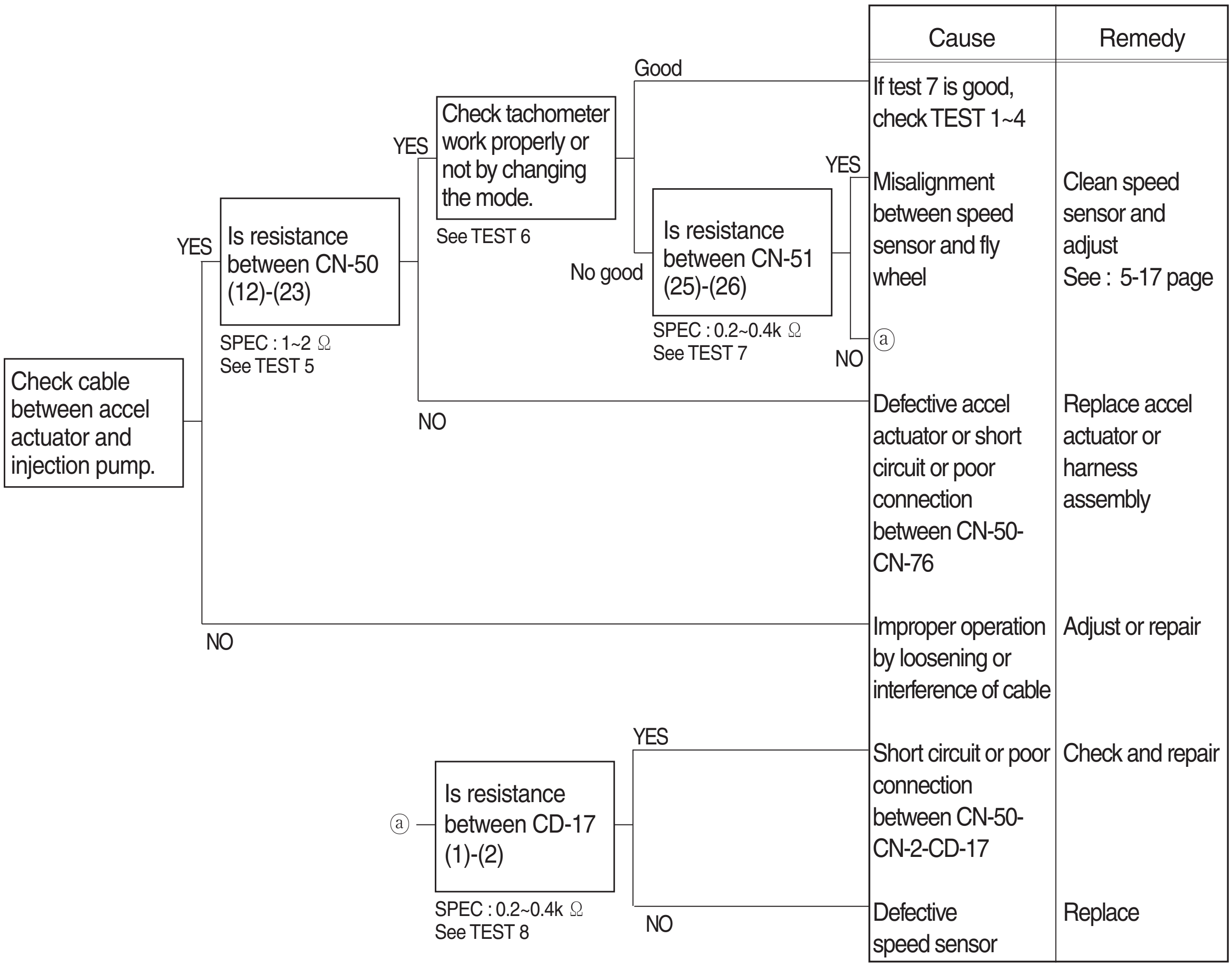
SPEC : 5~20 kgf/cm^2(70~280 psi)



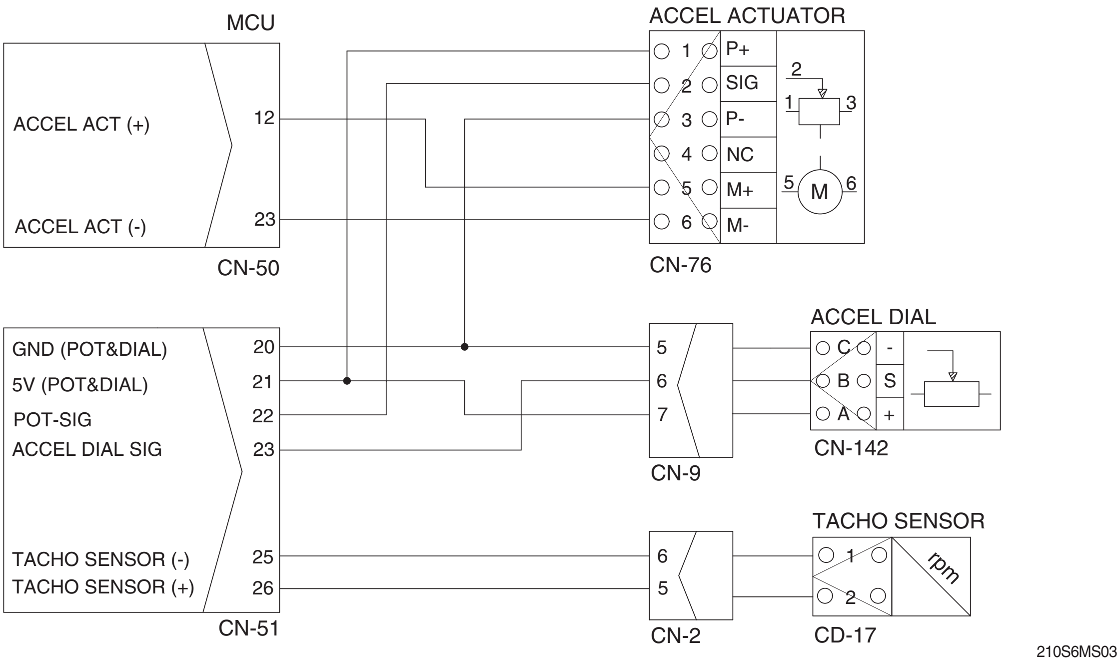
2. ENGINE SPEED IS SLOW AT ALL MODE

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

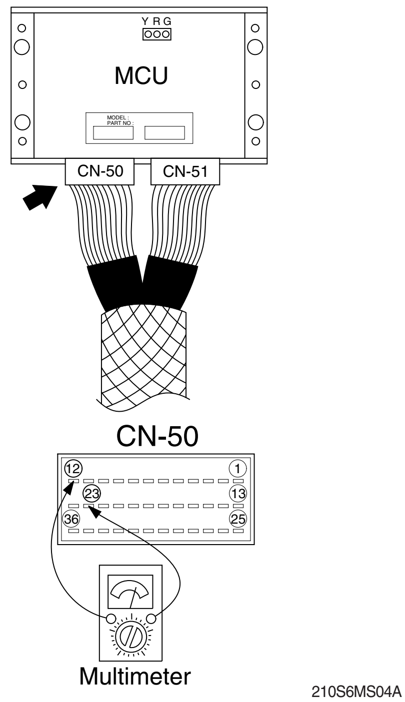
(1) **Test 5 :** Check resistance between CN-50 (12)-(23).

① Starting switch OFF.

② Disconnect connector CN-50 from MCU.

③ Check resistance as figure.

SPEC : 1~2Ω



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

① Start engine.

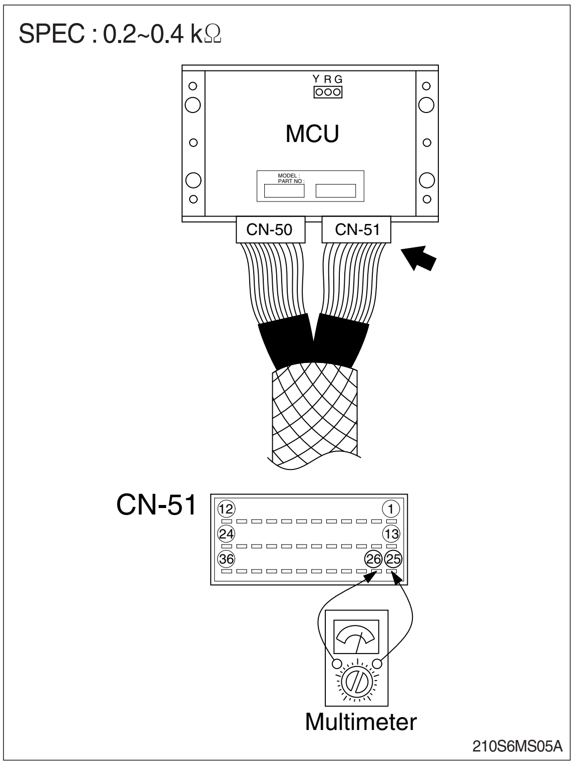
② Check engine rpm display reading.

Unit : rpm

Spec		Remark
M Mode	2100±100	Check rpm after cancel the Auto decel mode.
H Mode	2000±100	
S Mode	1900±100	

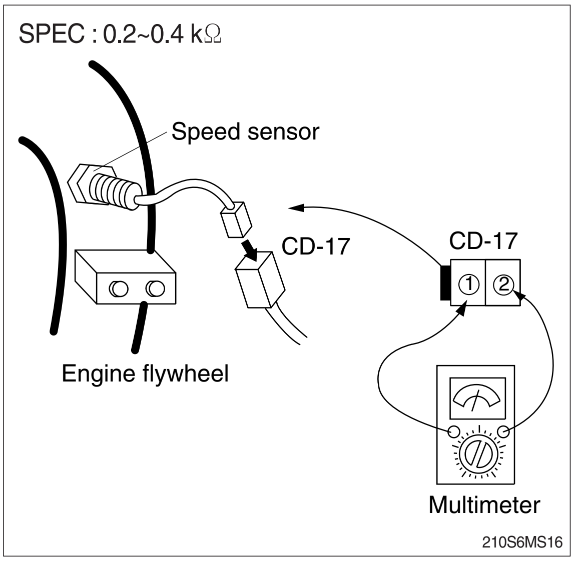
(3) **Test 7 :** Check resistance between CN-51 (25) and CN-51 (26).

① Starting switch OFF.
② Disconnect connector CN-51 from MCU.
③ Check resistance as figure.



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

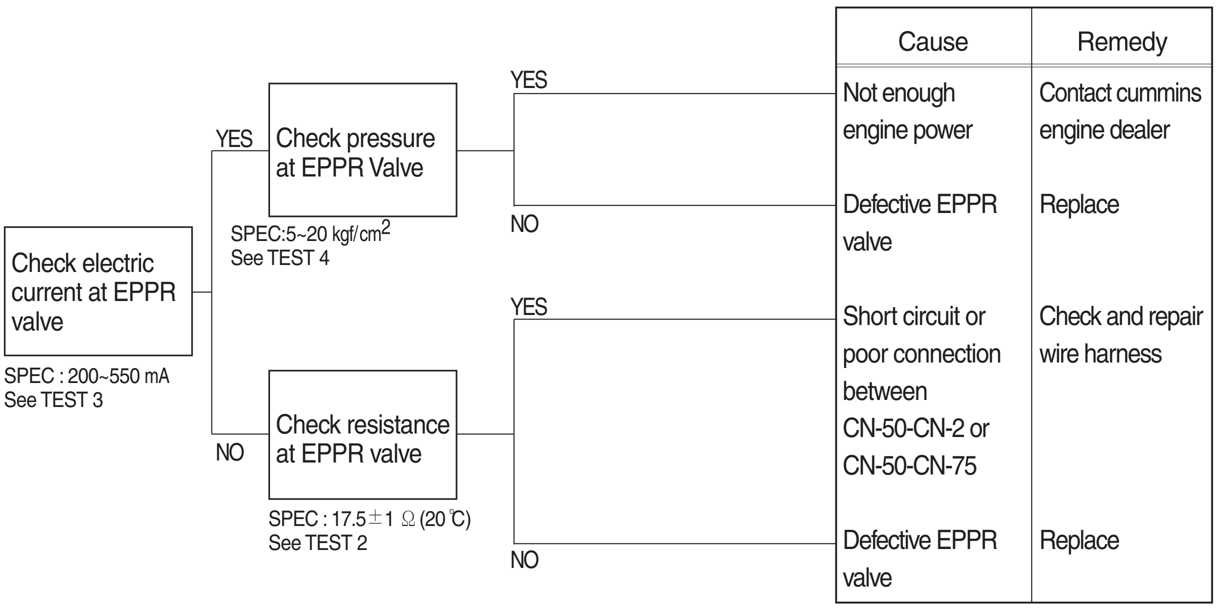
① Starting switch OFF.
② Disconnect connector CD-17 of speed sensor at engine flywheel housing.
③ Check resistance as figure.



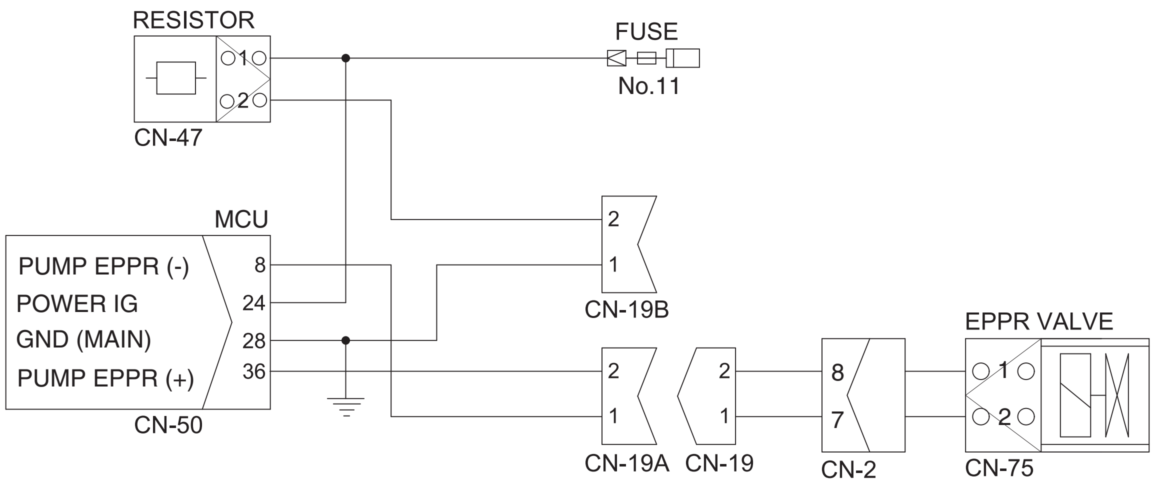
3. ENGINE STALL

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

1) INSPECTION PROCEDURE



Wiring diagram

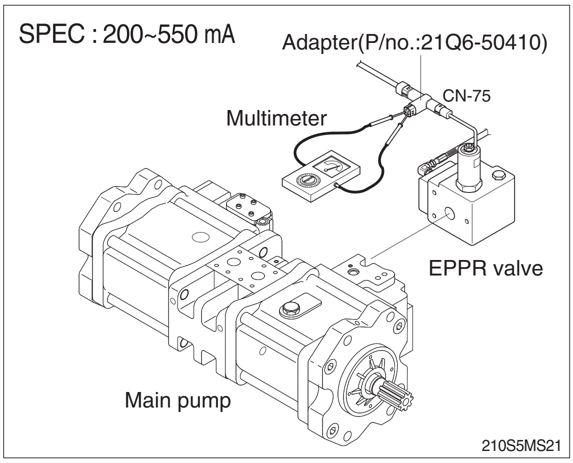


210S6MS51

2) TEST PROCEDURE

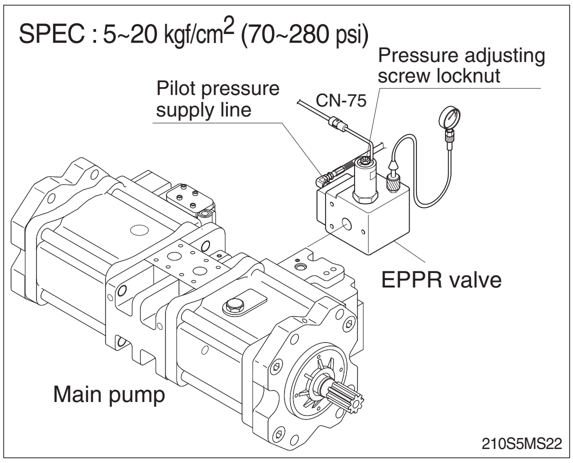
(1) Test 9 : Check electric current at EPPR valve at S-mode

① Install multimeter as figure.
② Start engine.
③ Set the accel dial at 10 (max)
④ Set S-mode with 1900±100 rpm.
⑤ Check electric current.



(2) Test 10 : Check pressure at EPPR valve at S-mode

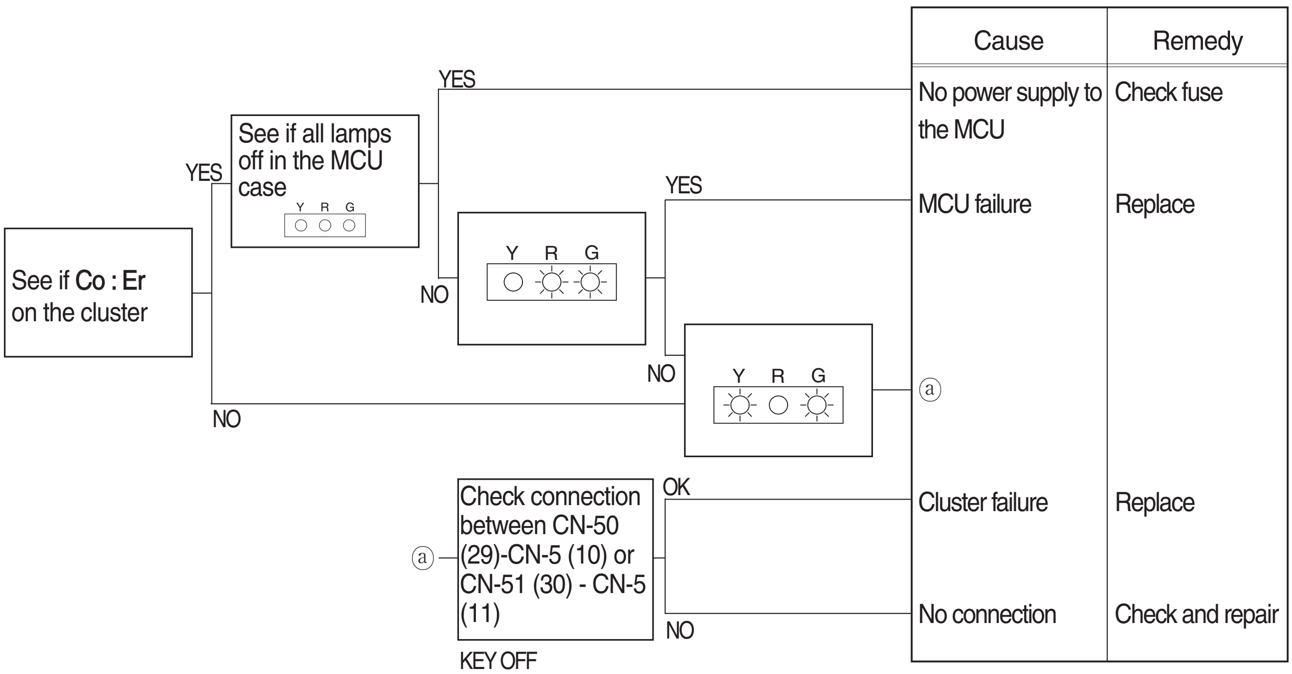
① Connect pressure gauge at EPPR valve.
② Start engine.
③ Set the accel dial at 10(max).
④ Set S-mode with 1900±100 rpm.
⑤ Operate bucket control lever completely push or pull.
⑥ Hold arm conterol lever at the end of stroke.
⑦ Check pressure at relief position.



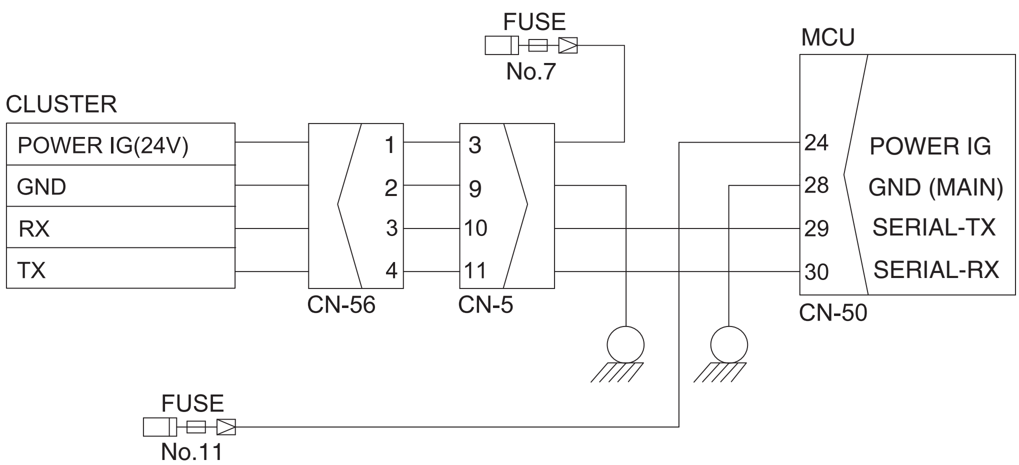
4. MALFUNCTION OF CLUSTER OR MODE SELECTION SYSTEM

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

1) INSPECTION PROCEDURE



Wiring diagram

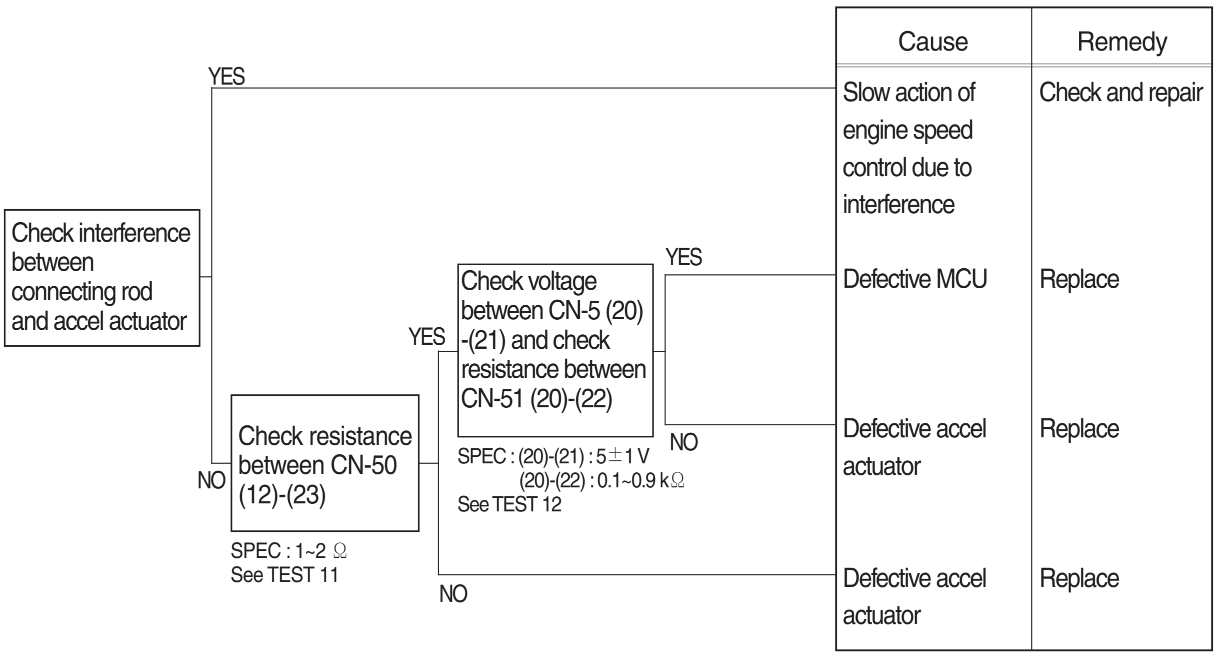


210S6MS06

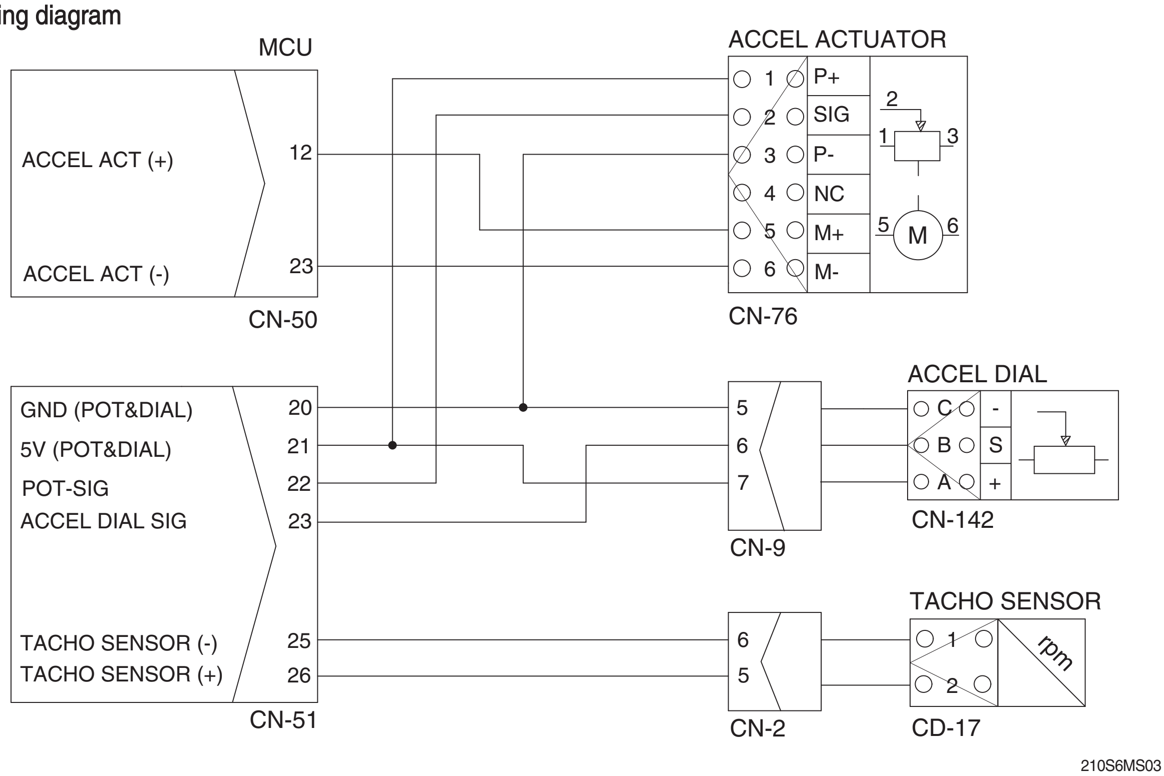
5. SLOW ACTION OF ENGINE SPEED CHANGE WHEN CHANGE THE MODE

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

1) INSPECTION PROCEDURE



Wiring diagram



2) TEST PROCEDURE

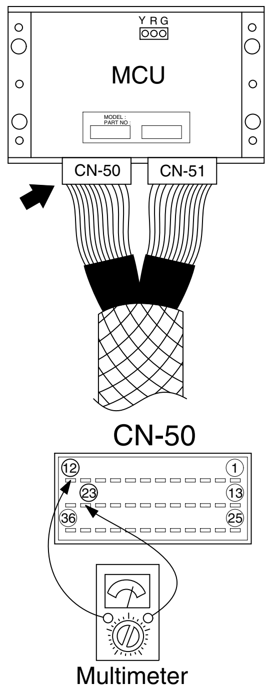
(1) Test 11 : Check resistance.

① Starting switch OFF.

② Disconnect connector CN-50 from MCU.

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

SPEC : 1~2 Ω

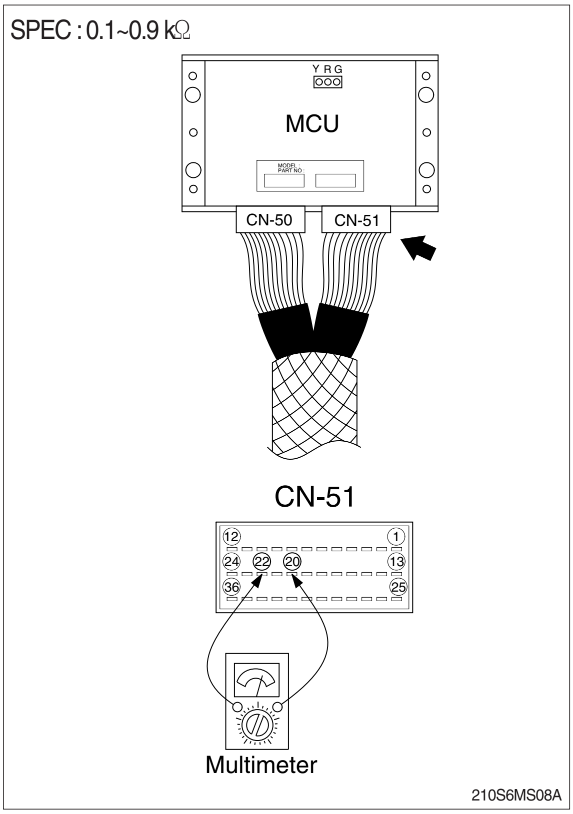


210S6MS04A

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

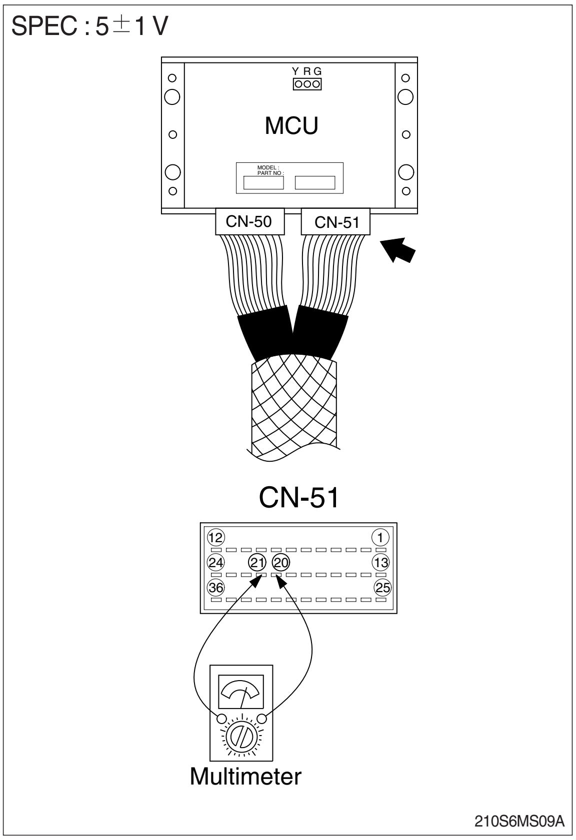
① Check resistance between CN-51 (20)-(22).

- Starting switch OFF.
- Disconnect connector CN-51 from MCU.
- Check resistance value with engine rpm display as figure.



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

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



6. AUTO DECEL SYSTEM DOES NOT WORK

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

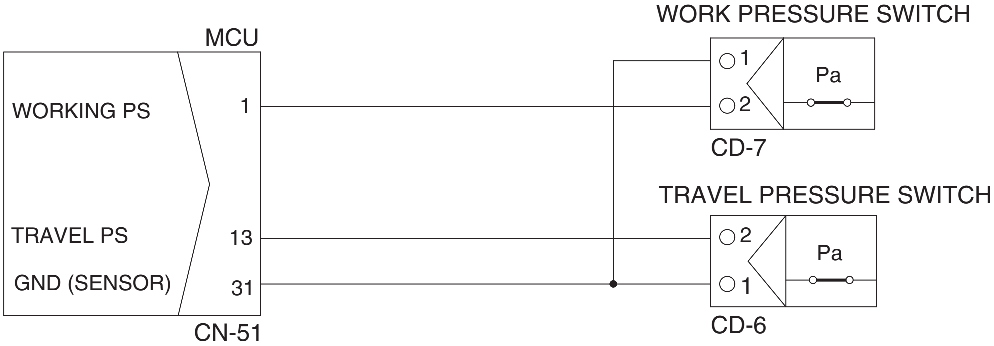
1) INSPECTION PROCEDURE

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

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

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

Wiring diagram



210S6MS10

2) TEST PROCEDURE

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

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

② Starting switch ON.

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

④ Check voltage as figure.

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

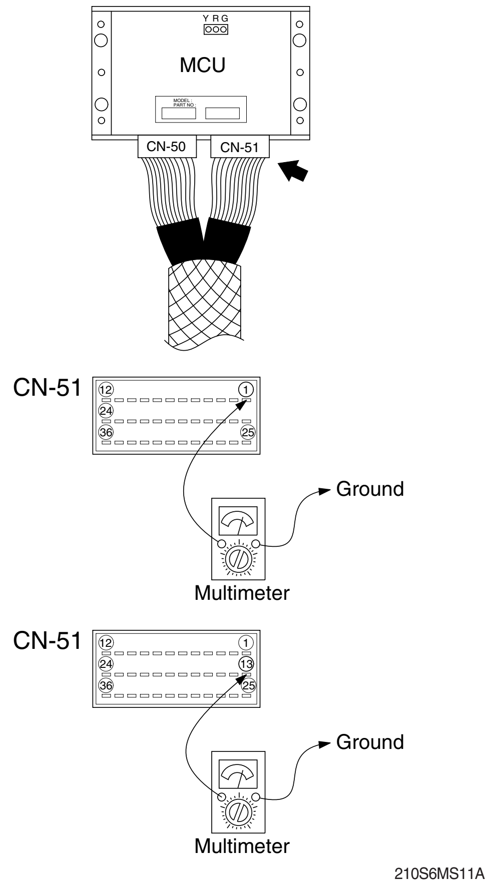
① Prepare 1 piece of thin sharp pin, steel or copper

② Starting switch ON.

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

④ Check voltage as figure.

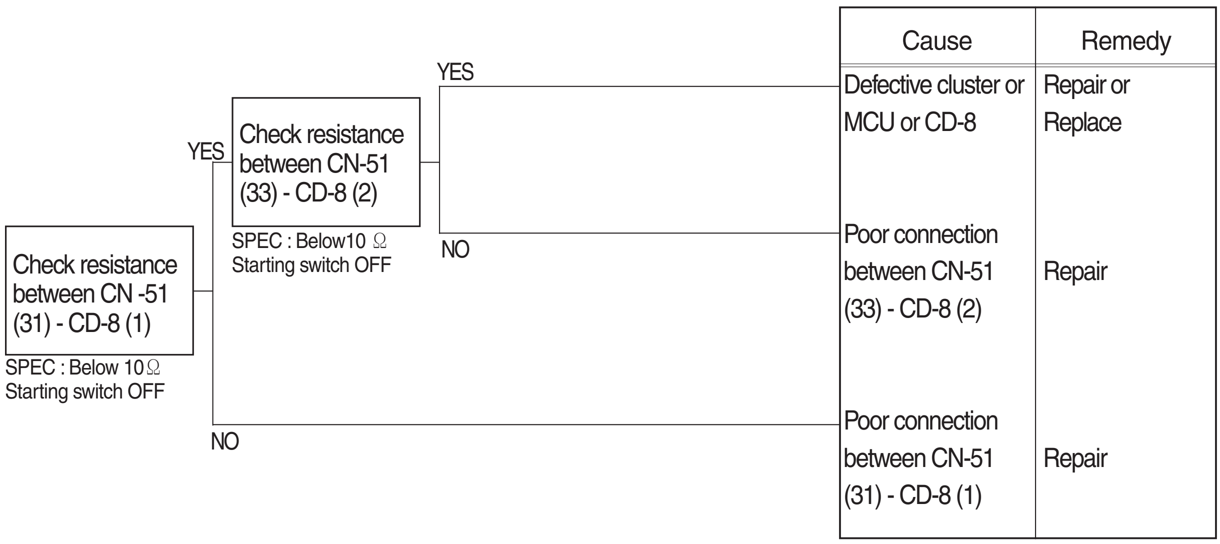
SPEC : Actuator stop : 4~5 V
Actuator operating : 0~1 V



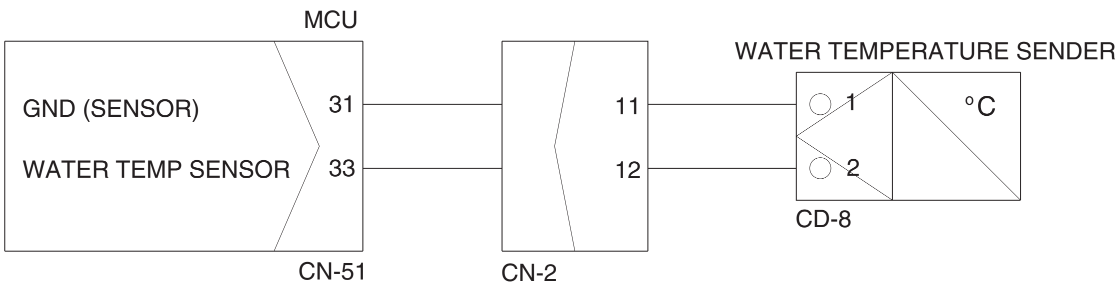
7. MALFUNCTION OF WARMING UP

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

1) INSPECTION PROCEDURE



Wiring diagram



210S6ES53

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.

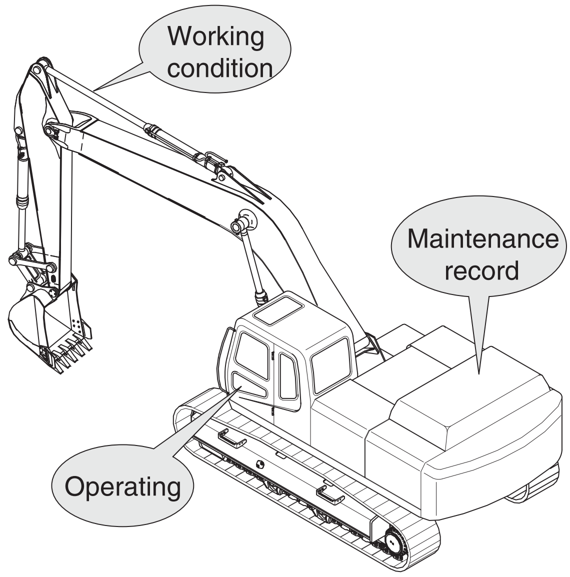
2) OPERATIONAL PERFORMANCE OF A WORKING MACHINE

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.

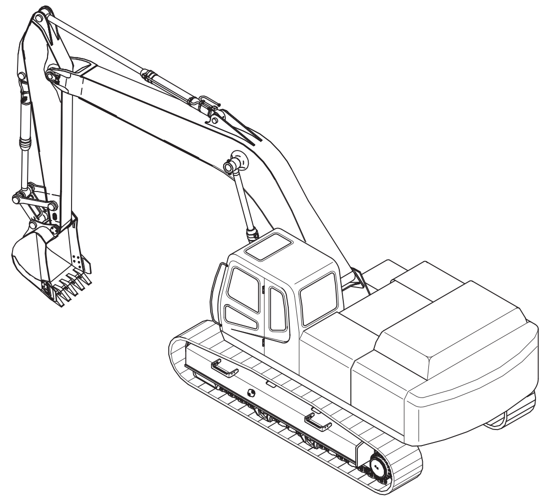


21077MS01

2. TERMINOLOGY

1) STANDARD

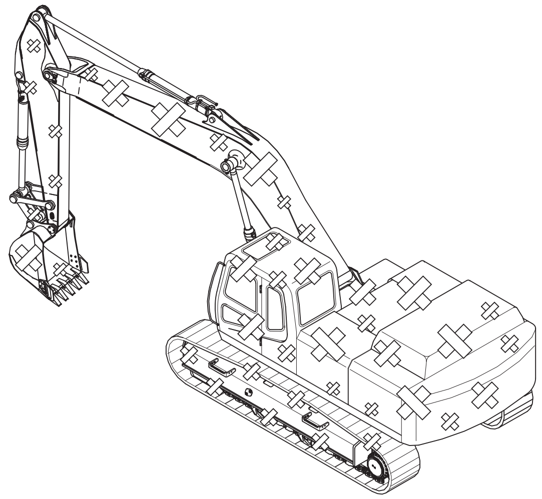
Specifications applied to the brand-new machine, components and parts.



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.

The machine

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

(2) Test area

① Select a hard, flat surface.

② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.

③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.

② Operate the machine carefully and always give first priority to safety.

③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.

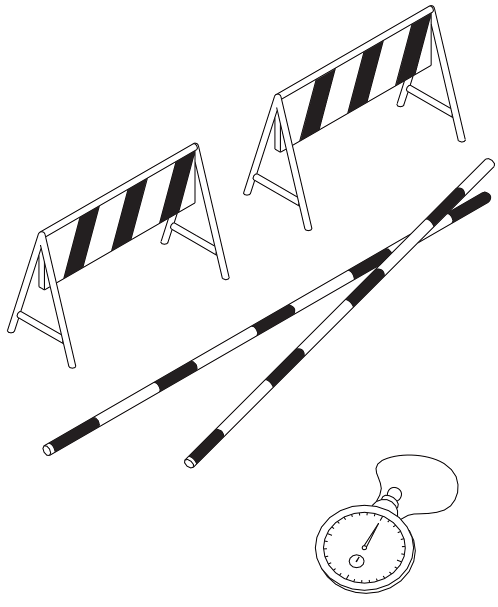
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

① Accurately calibrate test instruments in advance to obtain correct data.

② Carry out tests under the exact test conditions prescribed for each test item.

③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.



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2) ENGINE SPEED

(1) Measure the engine speed at each power mode

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

(2) Preparation

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

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

③ Measure the engine RPM.

(3) Measurement

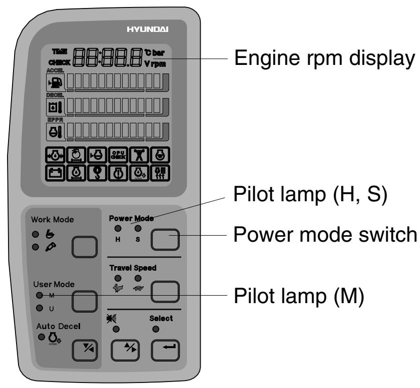
① Start the engine. The engine will run at start idle speed. Measure engine speed with a engine rpm display.

② Measure and record the engine speed at each mode.

③ Select the M-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.



Cluster

210S7MS03

(4) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

Model	Engine speed	Standard	Remarks
HX210HD HX220HD	Start idle	850±100	
	M mode	2100±100	
	H mode	2000±100	
	S mode	1900±100	
	Auto decel	1150±100	
	One touch decel	1050±100	

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

3) TRAVEL SPEED

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

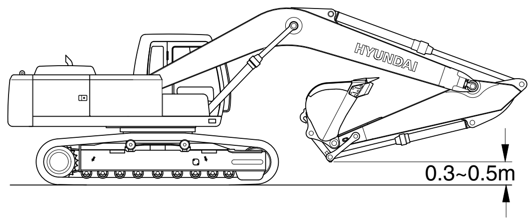
(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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



21097MS04

(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.

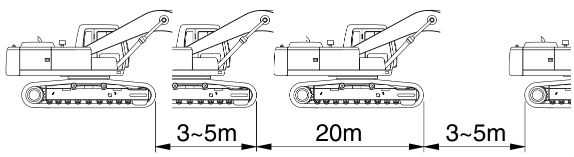
· Power mode switch : M mode

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

④ Measure the time required to travel 20 m.

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

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



21077MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20 m

Model	Travel speed	Standard	Maximum allowable	Remarks
HX210HD HX220HD	1 Speed	20.0±2.0	25.0	
	2 Speed	12.7±2.0	15.9	

4) TRACK REVOLUTION SPEED

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

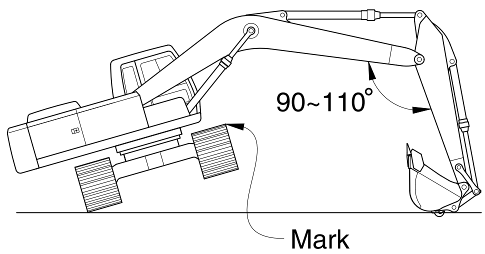
(2) Preparation

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

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

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

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



21077MS06

(3) Measurement

① Select the following switch positions.

· Travel mode switch : 1 or 2 speed
· Power mode switch : M mode
· Auto idle switch : OFF

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

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

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

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

(4) Evaluation

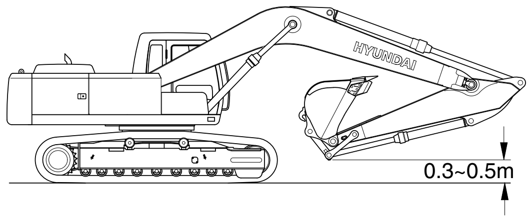
The revolution cycle time of each track should meet the following specifications.

Unit : Seconds / 3 revolutions

Model	Travel speed	Standard	Maximum allowable
HX210HD HX220HD	1 Speed	25.0±2.0	31.3
	2 Speed	16.3±2.0	20.4

5) TRAVEL DEVIATION

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



21097MS04

(2) Preparation

① Adjust the tension of both tracks to be equal.

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

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

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

(3) Measurement

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

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

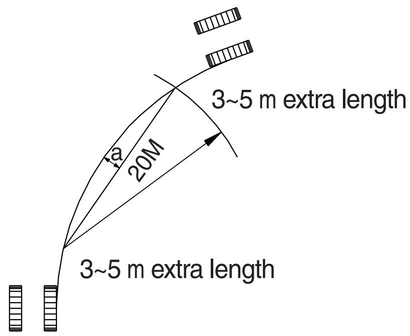
· Power mode switch : M mode

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

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

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

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



(210-7) 7-7(2)

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
HX210HD, HX220HD	200 below	240	

6) SWING SPEED

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

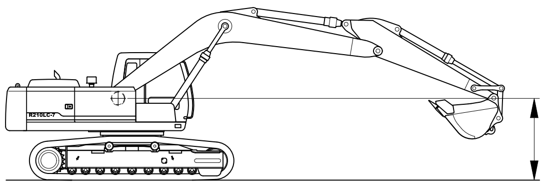
(2) Preparation

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

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

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

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



21077MS07

(3) Measurement

① Select the following switch positions.

· Power mode switch : M mode

② Operate swing control lever fully.

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

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

(4) Evaluation

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

Unit : Seconds / 3 revolutions

Model	Power mode switch	Standard	Maximum allowable
HX210HD, HX220HD	M mode	14.7±1.5	18.4

7) SWING FUNCTION DRIFT CHECK

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

(2) Preparation

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

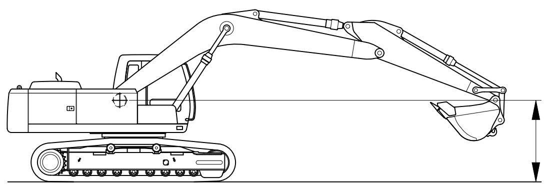
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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

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

⑤ Swing the upperstructure 360˚.

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



21097MS07

(3) Measurement

① Conduct this test in the M mode.

② Select the following switch positions.

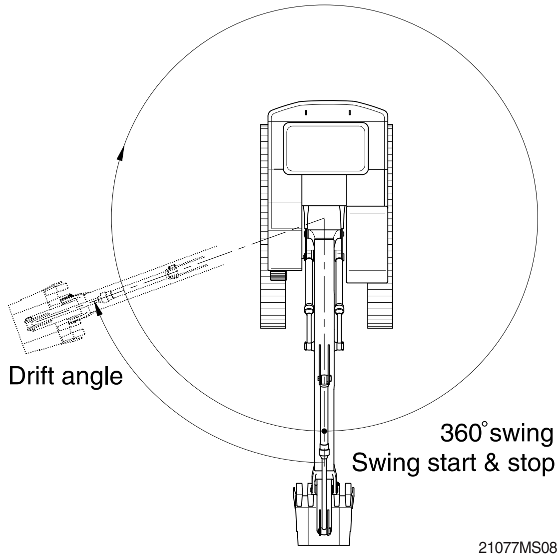
· Power mode switch : M mode

③ Operate the swing control lever fully and return it to the neutral position when the mark on the upperstructure aligns with that on track frame after swinging 360°

④ Measure the distance between the two marks.

⑤ Align the marks again, swing 360°, then test the opposite direction.

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



21077MS08

(4) Evaluation

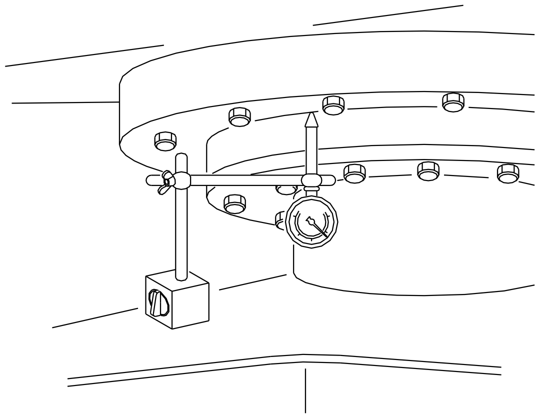
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Power mode switch	Standard	Maximum allowable	Remarks
HX210HD, HX220HD	M mode	90 below	128.7	

8) SWING BEARING PLAY

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



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(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.

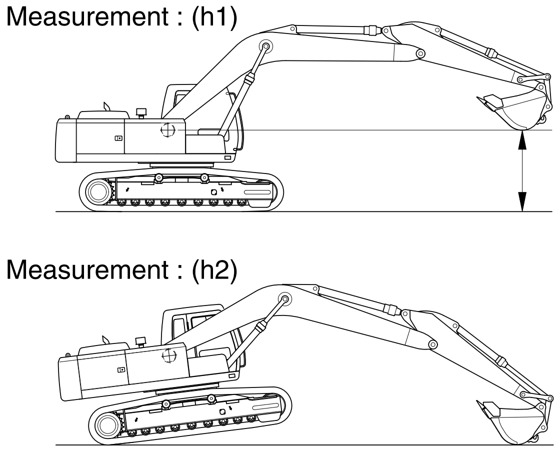
③ Install a dial gauge on the track frame as shown, using a magnetic base.

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



21077MS09

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
HX210HD, HX220HD	0.5 ~ 1.5	3.0	

9) HYDRAULIC CYLINDER CYCLE TIME

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

(2) Preparation

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

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

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

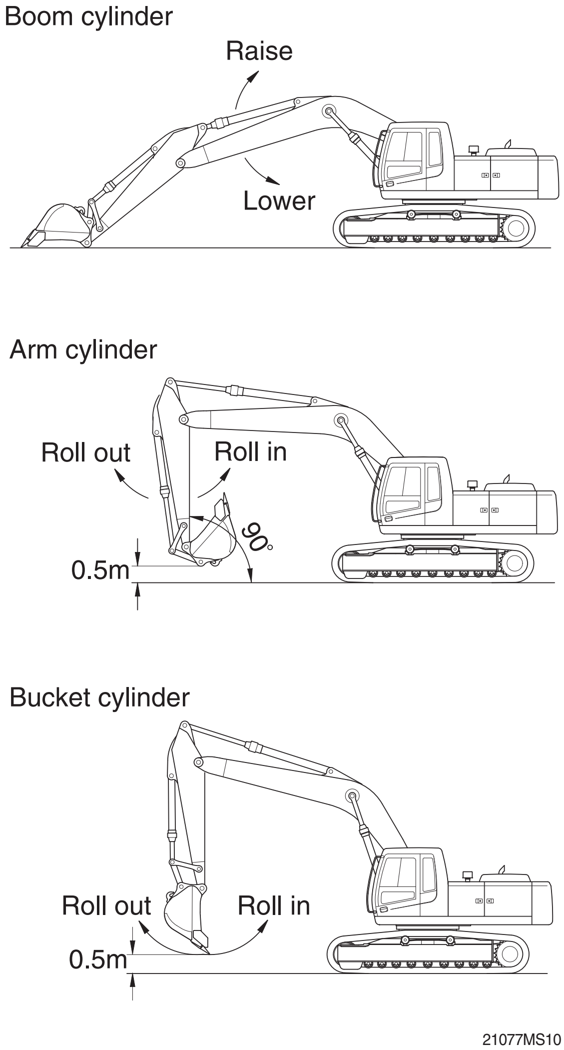
④ Keep the hydraulic oil temperature at 50±5˚C.

(3) Measurement

① Select the following switch positions.
· Power mode switch : M 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
HX210HD HX220HD	Boom raise	3.5±0.4	4.4	
	Boom lower	2.2±0.3	2.8	
	Arm in	2.5±0.3	3.1	
	Arm out	2.7±0.3	3.4	
	Bucket in	2.2±0.3	2.8	
	Bucket out	2.1±0.3	2.6	

10) DIG FUNCTION DRIFT CHECK

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

(2) Preparation

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

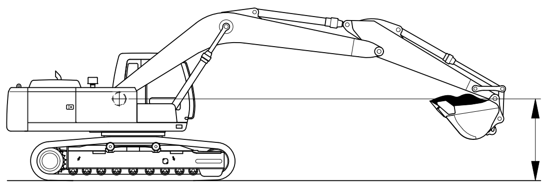
· $W = M^3 \times 1.5$
Where :
M^3 = Bucket heaped capacity (m^3)
1.5 = Soil specific gravity

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

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

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

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



21077MS11

(3) Measurement

① Stop the engine.

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

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm / 5min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
HX210HD HX220HD	Boom cylinder	10 below	20	
	Arm cylinder	10 below	20	
	Bucket cylinder	40 below	60	

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 : M 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
HX210HD HX220HD	Boom lever	1.7 or below	2.0	
	Arm lever	1.7 or below	2.0	
	Bucket lever	1.4 or below	2.0	
	Swing lever	1.4 or below	2.0	
	Travel lever	2.1 or below	3.15	

12) CONTROL LEVER STROKE

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

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

(2) Preparation

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

(3) Measurement

① Stop the engine.

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

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

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Kind of lever	Standard	Maximum allowable	Remarks
HX210HD HX220HD	Boom lever	112±10	134	
	Arm lever	112±10	134	
	Bucket lever	90±10	112	
	Swing lever	90±10	112	
	Travel lever	139±10	178	

13) PILOT PRIMARY PRESSURE

(1) Preparation

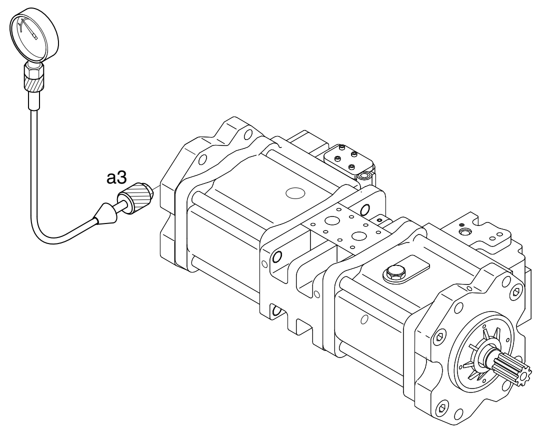
① Stop the engine.

② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.

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

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

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



210S7MS12

(2) Measurement

① Select the following switch positions.

· Power mode switch : M mode

· Auto decel switch : OFF

② Measure the primary pilot pressure in the M mode.

(3) Evaluation

The average measured pressure should be within the following specifications.

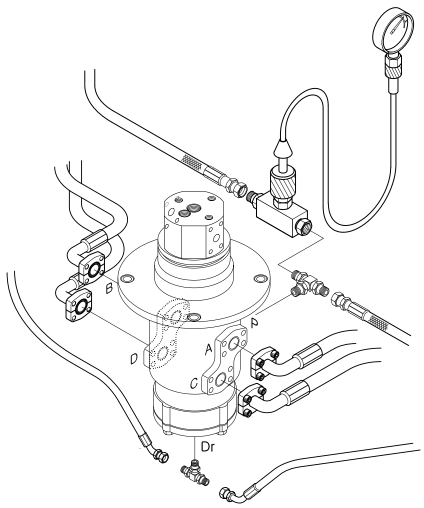
Unit : kgf / cm²

Model	Engine speed	Standard	Alowable limits	Remarks
HX210HD, HX220HD	M mode	40^{+2}_{0}	-	

14) FOR TRAVEL SPEED SELECTING PRESSURE:

(1) Preparation

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



210S7MS14

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed
· Mode selector : M 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.

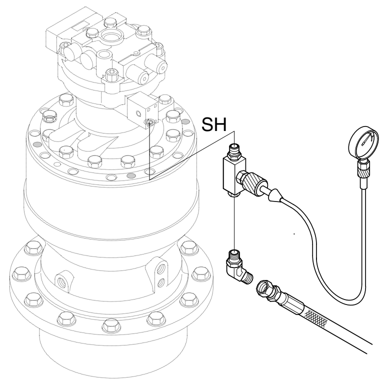
Unit : kgf / cm^2

Model	Travel speed mode	Standard	Maximum allowable	Remarks
HX210HD HX220HD	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 The pressure release L wrench to bleed air.
④ Install a connector and pressure gauge assembly to swing motor SH port, as shown.
⑤ Start the engine and check for oil leakage from the adapter.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



210S7MS15

(2) Measurement

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

(3) Evaluation

The average measured pressure should be within the following specifications.

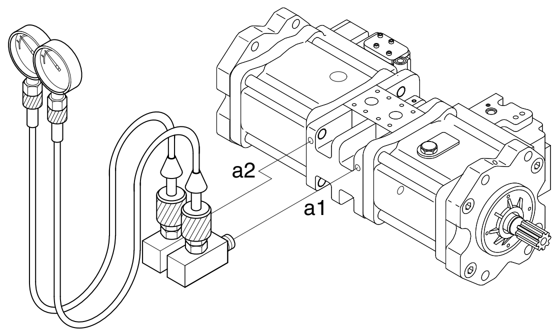
Unit : kgf / cm^2

Model	Description	Standard	Allowable limits	Remarks
HX210HD HX220HD	Brake disengaged	40	Over 9	
	Brake applied	0	-	

16) MAIN PUMP DELIVERY 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 Push the pressure release button to bleed air.
④ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.
⑤ Start the engine and check for oil leakage from the port.
⑥ Keep the hydraulic oil temperature at 50±5˚C.



210S7MS07

(2) Measurement

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

(3) Evaluation

The average measured pressure should be within the following specifications.

Unit : kgf / cm²

Model	Engine speed	Standard	Alowable limits	Remarks
HX210HD, HX220HD	High idle	40±5	-	

17) SYSTEM PRESSURE REGULATOR RELIEF SETTING

(1) Preparation

① Stop the engine.

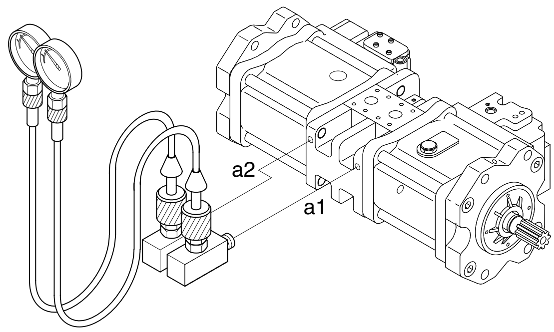
② Loosen the cap and relieve the pressure in the tank by pushing the top of the air breather.

③ Push the pressure release button to bleed air.

④ To measure the main pump pressure. Install a connector and pressure gauge assembly main pump gauge port as shown.

⑤ Start the engine and check for oil leakage from the port.

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



210S7MS07

(2) Measurement

① Select the following switch positions.

· Power mode switch : M mode

② Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

③ In the swing function, place bucket against an immovable object and measure the relief pressure.

④ In the travel function, lock undercarriage with an immovable object and measure the relief pressure.

(3) Evaluation

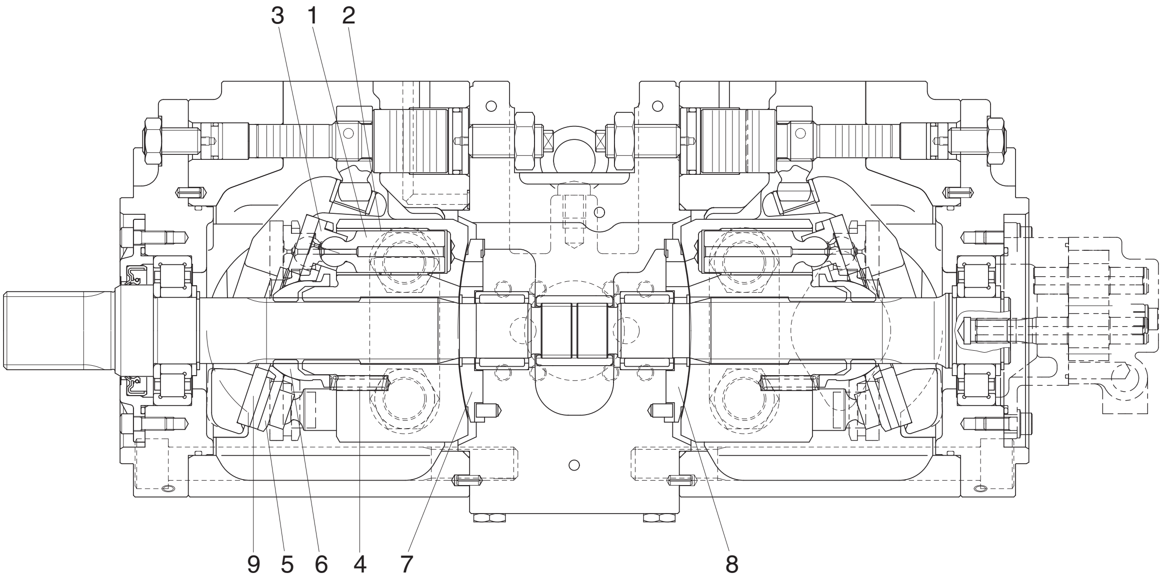
The average measured pressure should be within the following specifications.

Unit : kgf / cm^2

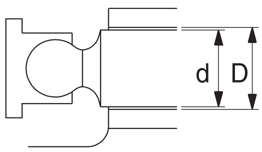
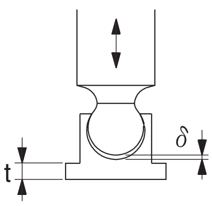
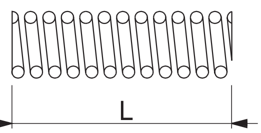
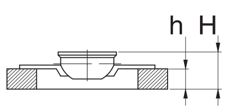
Model	Function to be tested	Standard	Remarks
HX210HD HX220HD	Boom, Arm, Bucket	350±10	-
	Travel	350±10	-
	Swing	250±10	-

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP



2209S7MP01

Part name & inspection item		Standard dimension	Recommended replacement value	Counter measures
Clearance between piston (1) & cylinder bore (2) (D-d)		0.039	0.067	Replace piston or cylinder.
Play between piston (1) & shoe caulking section (3) (δ)		0-0.1	0.3	Replace assembly of piston & shoe.
Thickness of shoe (t)		4.9	4.7	
Free height of cylinder spring (4) (L)		41.1	40.3	Replace cylinder spring.
Combined height of set plate (5) & spherical bushing (6) (H-h)		23.0	22.0	Replace retainer or set plate.
Surface roughness for valve plate(Sliding face) (7,8), swash plate (shoe plate area) (9), & cylinder (2) (Sliding face)	Surface roughness necessary to be corrected	3z		Lapping
	Standard surface roughness (Corrected value)	0.4z or lower		

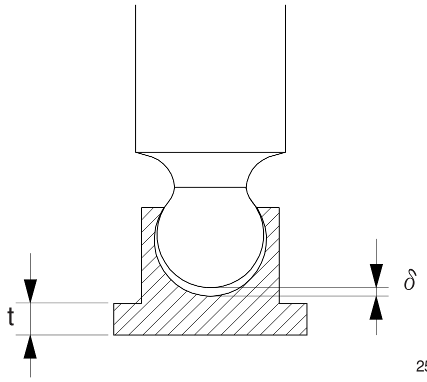
2. MAIN CONTROL VALVE

Part name	Inspection item	Criteria & measure
Casing	· Existence of scratch, rusting or corrosion.	· In case of damage in following section, replace part. - Sliding sections of casing fore and spool, especially land sections applied with holded pressure. - Seal pocket section where spool is inserted. - Seal section of port where O-ring contacts. - Seal section of each relief valve for main, travel, and port. - Other damages that may damage normal functions.
Spool	· Existence of scratch, gnawing, rusting or corrosion. · Insert spool in casing hole, rotate and reciprocate it.	· Replacement when its outside sliding section has scratch(Especially on seals-contacting section). · Correction or replacement when O-ring is damaged or when spool does not move smoothly.
	· Damage of load check valve 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.	· 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.	· Replacement. · Replacement when damaged. · Replacement when damaged.

3. SWING DEVICE (TYPE 1)

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.028	0.058	Replace piston or cylinder block
Play between piston and shoe caulking section (δ)	0	0.3	Replace assembly of piston and shoe
Thickness of shoe (t)	5.5	5.3	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H)	6.5	6.0	Replace set of retainer plate and sperical bushing
Thickness of friction plate (h)	4.0	3.6	Replace



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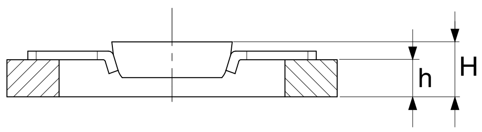


2507A7MS05

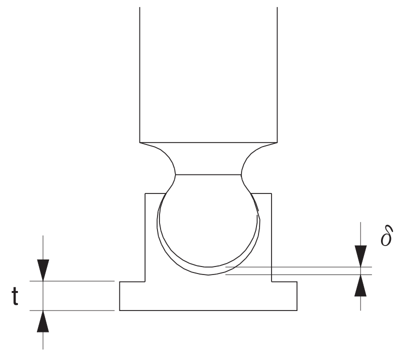
2) SLIDING PARTS

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

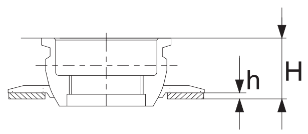
SWING DEVICE (TYPE 2)

1) WEARING PARTS

Inspection item	Standard dimension	Recommended replacement value	Counter measures
Clearance between piston and cylinder block bore	0.041	0.060	Replace piston or cylinder block
Thickness of valve plate	6	5.88	Replace
Play between piston and shoe caulking section (δ)	0.025	0.1	Replace assembly of piston and shoe
Thickness of shoe (t)	6.6	6.5	Replace assembly of piston and shoe
Combined height of retainer plate and spherical bushing (H-h)	17.6	17.3	Replace set of retainer plate and sperical bushing
Thickness of friction plate	2.94	2.7	Replace



140W77MS12



2609A7MS01

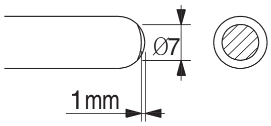
2) SLIDING PARTS

Part name	Standard roughness	Allowable roughness	Remark
Shoe	Rmax=1S (Ra=0.2a) (LAPPING)	4S (Ra=0.1a)	
Shoe plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Cylinder	Rmax=0.4S (Ra=0.1a) (LAPPING)	3S (Ra=0.8a)	
Valve plate	Rmax=0.4S (Ra=0.1a) (LAPPING)	2S (Ra=0.5a)	

4. TRAVEL MOTOR (TYPE 1, 2)

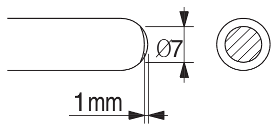
Problem		Cause	Remedy
Does not start	Pressure is not developed	· Pump failure · Control valve malfunction	· Check if action other than traveling is available. If faulty, repair. · Check if spool moves correctly. Repair if necessary.
	Pressure in developed	· Brake valve failure -Sleeve stick -Check valve stick · Motor failure -Valve seat seizure · Gear broken and fragment locked · Overloaded	· Replace brake valve · Replace -Check hydraulic oil for contamination · Replace reduction gear · Reduce load
Oil leakage	Leakage from engaging surfaces	· Scratch on engaging surfaces · Loosening by poor bolt tightening	· Correct surfaces by oilstone or sandpaper or replace · Check after retightening
	Leakage from casing	· Plug loosened · Crack formed by stone	· Retighten · Replace reduction gear
	Leakage from floating seal	· Sliding surfaces worn · Creep on O-ring	· Replace reduction gear · Replace floating seal
	Leakage from hydraulic motor	· Bolt loosened · O-ring damaged · Sealing surface scratched	· Tighten properly · Replace O-ring · Correct by oilstone or sandpaper
Coasts on slope excessively		· Poor volumetric efficiency of hydraulic motor · Increase of internal leakage of brake valve · Parking brake not actuated -Spring breakage -Wear of friction plate	· Replace hydraulic motor · Replace brake valve · Replace spring · Replace parking brake
Excessive temperature on reduction gear case		· Pitting on bearing · Lack of gear oil · Hydraulic oil introduced to gear case	· Replace reduction gear · Supply gear oil properly · Check motor and replace oil seal
Meanders	Meanders at low pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair pump · Replace motor
	Meanders at high pressure	· Delivery rate is different between right and left · Motor drain rate is different between right and left	· Repair regulator or pump · Replace motor
	Meanders at high pressure	· Relief pressure dropped at right and left brake valve · Main relief pressure dropped at right or left of control valve	· Replace brake valve · Replace main relief valve
Pump delivery is poor		· Regulator operation poor · External leakage of pump is excessive	· Repair regulator · Repair pump
External leakage of motor is excessive		-	· Replace motor

5. RCV LEVER

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage becomes more than 1000cc/m at neutral handle position, or more than 2000cc/m during operation.	Conditions : Primary pressure : 30kgf/cm^2 Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

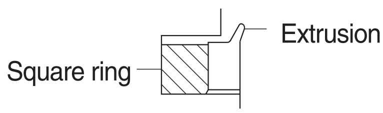
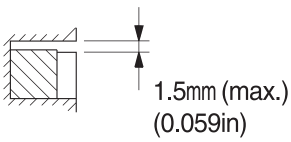
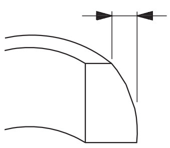
Notes
1. It is desirable to replace seal materials, such as O-rings, every disassembling. However, they may be reused, after being confirmed to be free of damage.
2. When loosening the hexagon socket head cap screw(125), replace the seal washers(121) without fail.

6. RCV PEDAL

Maintenance check item	Criteria	Remark
Leakage	The valve is to be replaced when the leakage effect to the system. For example, the primary pressure drop.	Conditions : Primary pressure : 30kgf/cm^2 Oil viscosity : 23cSt
Spool	This is to be replaced when the sliding surface has worn more than 10 μm, compared with the non-sliding surface.	The leakage at the left condition is estimated to be nearly equal to the above leakage.
Push rod	 This is to be replaced when the top end has worn more than 1mm.	
Play at operating section	The pin, shaft, and joint of the operating section are to be replaced when their plays become more than 2mm due to wears or so on.	When a play is due to looseness of a tightened section, adjust it.
Operation stability	When abnormal noises, hunting, primary pressure drop, etc. are generated during operation, and these cannot be remedied, referring to section 6. Troubleshooting, replace the related parts.	

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

7. TURNING JOINT

Part name		Maintenance standards	Remedy
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1mm (0.0039in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1mm(0.0039in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5mm(0.02in) or abnormality.	Replace
		· Worn less than 0.5mm(0.02in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5mm)(0.02in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5mm(0.02in) or abnormality.	Replace
		· Worn less than 0.5mm(0.02in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5mm)(0.02in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring.  	Replace
	-	· Slipper ring 1.5mm(0.059in) narrower than seal groove, or narrower than back ring.  	Replace
	-	· Worn more than 0.5mm(0.02in) ~ 1.5mm(MAX.) (0.059in) 	Replace

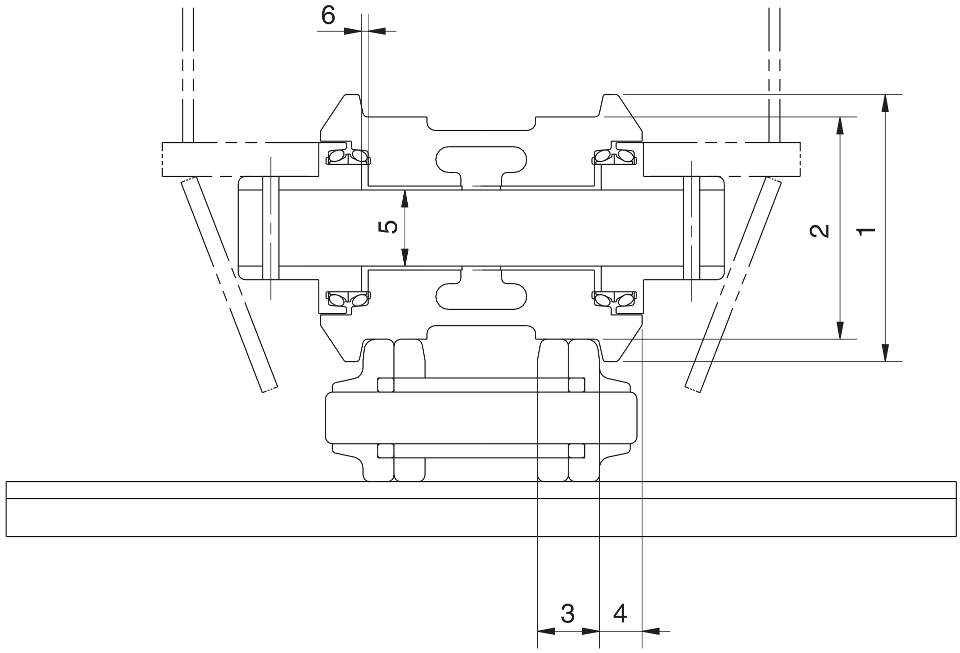
8. CYLINDER

Part name	Inspecting section	Inspection item	Remedy
Piston rod	· Neck of rod pin	· Presence of crack	· Replace
	· Weld on rod hub	· Presence of crack	· Replace
	· Stepped part to which piston is attached.	· Presence of crack	· Replace
	· Threads	· Presence of crack	· Recondition or replace
	· Plated surface	· Plating is not worn off to base metal.	· Replace or replate
		· Rust is not present on plating.	· Replace or replate
		· Scratches are not present.	· Recondition, replate or replace
	· Rod	· Wear of O.D.	· Recondition, replate or replace
	· Bushing at mounting part	· Wear of I.D.	· Replace
Cylinder tube	· Weld on bottom	· Presence of crack	· Replace
	· Weld on head	· Presence of crack	· Replace
	· Weld on hub	· Presence of crack	· Replace
	· Tube interior	· Presence of faults	· Replace if oil leak is seen
	· Bushing at mounting part	· Wear on inner surface	· Replace
Gland	· Bushing	· Flaw on inner surface	· Replace if flaw is deeper than coating

GROUP 3 TRACK AND WORK EQUIPMENT

1. TRACK

1) TRACK ROLLER

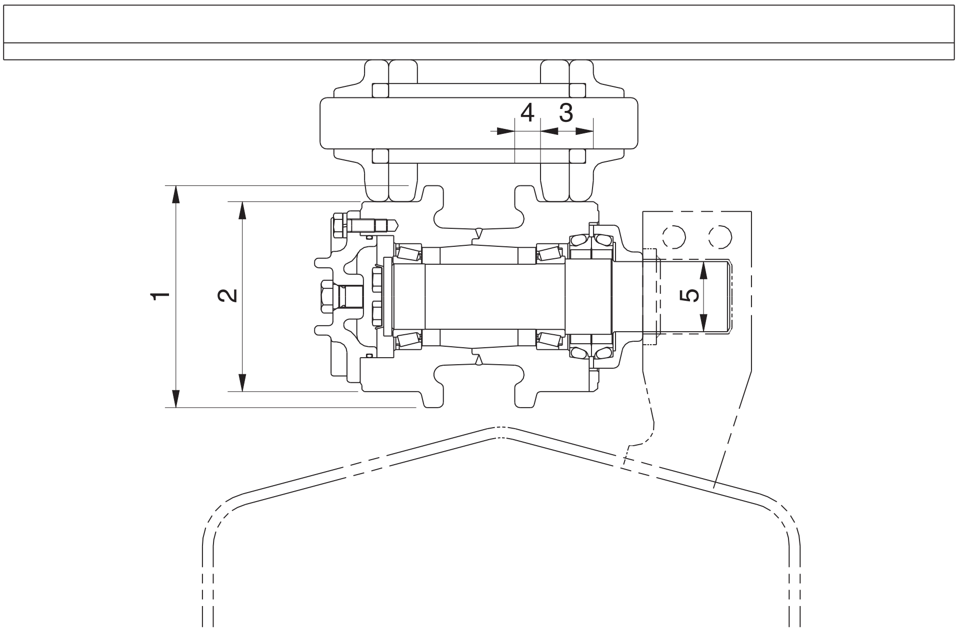


21037MS01

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of flange	Standard size		Repair limit		Rebuild or replace
		Ø190		–		
2	Outside diameter of tread	Ø160		Ø148		
3	Width of tread	44		50		
4	Width of flange	33.3		-		
5	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		Ø70 $^{-0}_{-0.03}$	Ø70.1 $^{+0.35}_{+0.30}$	0.3 to 0.38	2.0	
6	Side clearance of roller (Both side)	Standard clearance		Clearance limit		Replace
		0.2 to 1.2		2.0		

2) CARRIER ROLLER

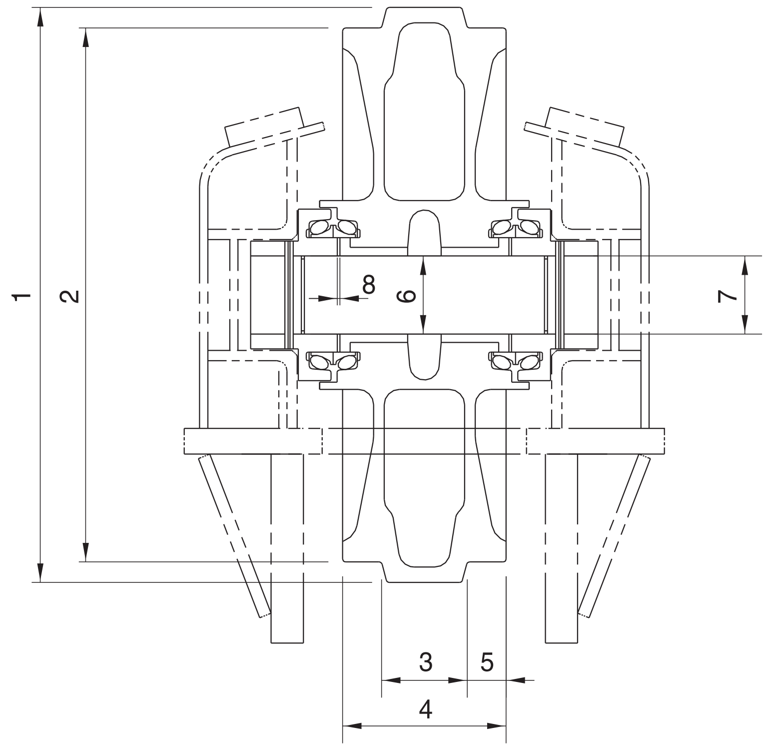


21037MS02

Unit : ㎜

<table>
<tr><th>No.</th><th>Check item</th><th colspan="4">Criteria</th><th>Remedy</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Outside diameter of flange</td><td colspan="2">Standard size</td><td colspan="2">Repair limit</td><td rowspan="5">Rebuild or replace</td></tr>
<tr><td colspan="2">Ø169</td><td colspan="2">–</td></tr>
<tr><td>2</td><td>Outside diameter of tread</td><td colspan="2">Ø144</td><td colspan="2">Ø134</td></tr>
<tr><td>3</td><td>Width of tread</td><td colspan="2">44</td><td colspan="2">49</td></tr>
<tr><td>4</td><td>Width of flange</td><td colspan="2">17</td><td colspan="2">–</td></tr>
<tr><td rowspan="3">5</td><td rowspan="3">Clearance between shaft and hole</td><td rowspan="2">Standard size</td><td>Tolerance
Shaft | Hole</td><td rowspan="2">Standard clearance</td><td rowspan="2">Clearance limit</td><td rowspan="3">Replace bushing</td></tr>
<tr><td>Shaft: -0.05 / -0.1
Hole: +0.3 / +0.1</td></tr>
<tr><td>Ø55</td><td></td><td>0.15 to 0.4</td><td>1.2</td></tr>
</table>

3) IDLER

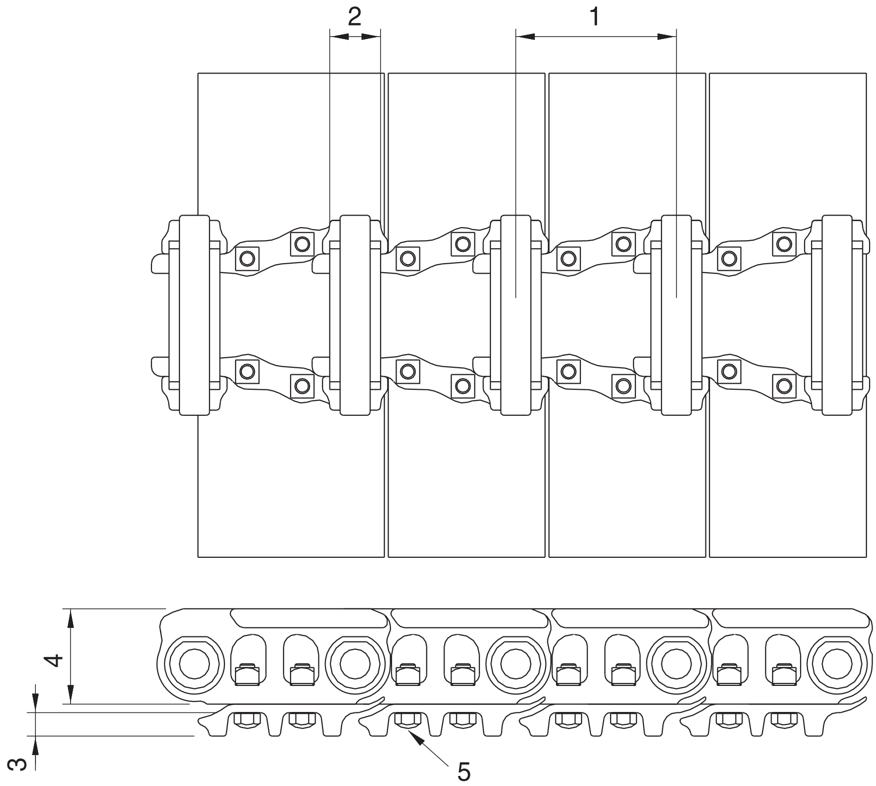


21037MS03

Unit : mm

No.	Check item	Criteria				Remedy
1	Outside diameter of protrusion	Standard size		Repair limit		Rebuild or replace
		Ø560		–		
2	Outside diameter of tread	Ø520		Ø510		
3	Width of protrusion	82		–		
4	Total width	160		–		
5	Width of tread	39		43		
6	Clearance between shaft and bushing	Standard size & tolerance		Standard clearance	Clearance limit	Replace bushing
		Shaft	Hole			
		$\varnothing 75^{\ 0}_{-0.03}$	$\varnothing 75^{+0.42}_{+0.35}$	0.35 to 0.45	2.0	
7	Clearance between shaft and support	$\varnothing 75^{\ 0}_{-0.03}$	$\varnothing 75^{+0.07}_{+0.03}$	0.03 to 0.1	1.2	Replace
8	Side clearance of idler (Both side)	Standard clearance		Clearance limit		Replace bushing
		0.25 to 1.2		2.0		

4) TRACK

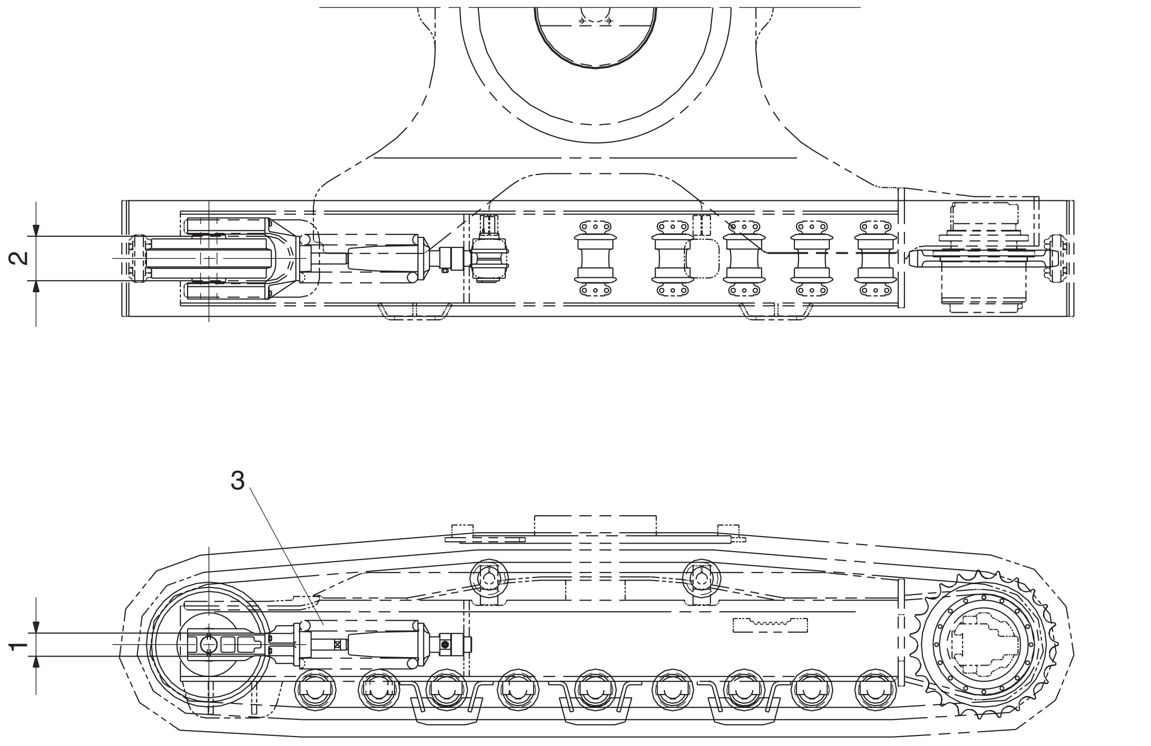


21037MS04

Unit : mm

No.	Check item	Criteria		Remedy
1	Link pitch	Standard size	Repair limit	Turn or replace
		190	194.4	
2	Outside diameter of bushing	Ø59	Ø51	Rebuild or replace
3	Height of grouser	26	16	
4	Height of link	105	97	
5	Tightening torque	Initial tightening torque : 78±8kgf · m		Retighten

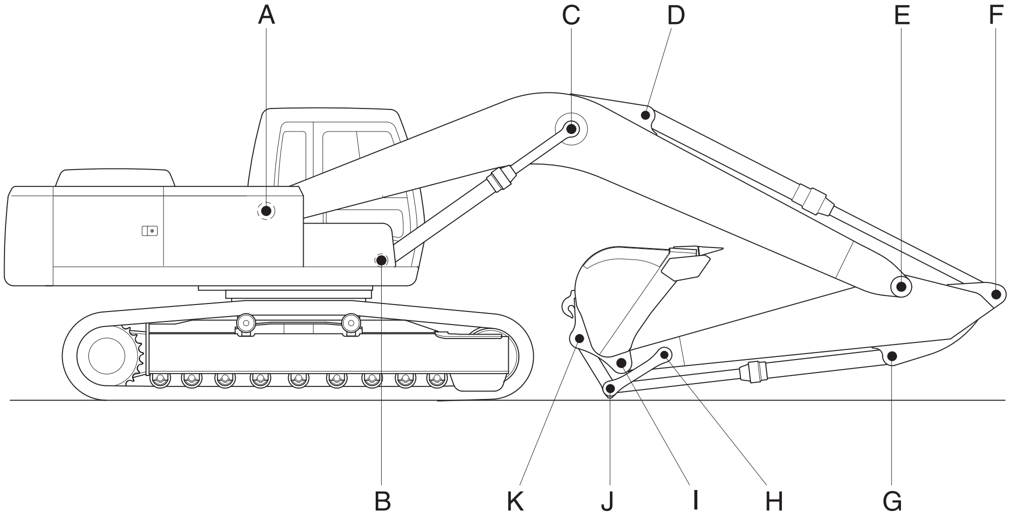
5) TRACK FRAME AND RECOIL SPRING



Unit : mm

No.	Check item	Criteria					Remedy
1	Vertical width of idler guide		Standard size	Tolerance	Repair limit		Rebuild or replace
		Track frame	113	+2 0	117		
		Idler support	110	- 0.5 - 1.0	106		
2	Horizontal width of idler guide	Track frame	272	+2 0	276		
		Idler support	270	-	267		
3	Recoil spring	Standard size			Repair limit		Replace
		Free length	Installation length	Installation load	Free length	Installation load	
		Ø235×515	431	13716kg	–	10973kg	

2. WORK EQUIPMENT



21077MS20

Unit : ㎜

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

SECTION 8 DISASSEMBLY AND ASSEMBLY

SECTION 8 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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

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

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

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

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

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

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

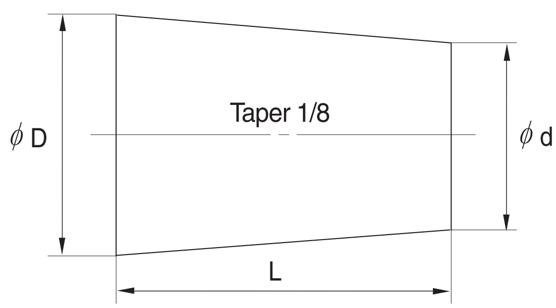
9) When using forcing screws to remove any components, tighten the forcing screws alternately.

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

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

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

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

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

3. COMPLETING WORK

1) If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.

2) If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.

4) Add the specified amount of grease(Molybdenum disulphied grease) to the work equipment related parts.

GROUP 2 TIGHTENING TORQUE

1. MAJOR COMPONENTS

No.	Descriptions		Bolt size	Torque	
				kgf · m	lbf · ft
1	Engine	Engine mounting bolt (engine-bracket)	M12 × 1.75	11.45 ± 1.0	82.8 ± 7.2
2		Engine mounting bolt (bracket-frame, FR)	M20 × 2.5	52.1 ± 5.0	377 ± 36.2
3		Engine mounting bolt (bracket-frame, RR)	M24 × 3.0	90.0 ± 9.0	651 ± 65.1
4		Radiator mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
5		Coupling mounting socket bolt	M20 × 2.5	59.7 ± 8.7	419 ± 62.9
6		Main pump housing mounting bolt	M10 × 1.5	4.8 ± 0.3	34.7 ± 2.2
7	Hydraulic system	Main pump mounting socket bolt	M20 × 2.5	42 ± 4.5	304 ± 32.5
8		Main control valve mounting nut	M12 × 1.75	12.2 ± 1.3	88.2 ± 9.4
9		Fuel tank mounting bolt	M20 × 2.5	45 ± 5.1	325 ± 36.9
10		Hydraulic oil tank mounting bolt	M20 × 2.5	45 ± 5.1	325 ± 36.9
11		Turning joint mounting bolt, nut	M12 × 1.75	12 ± 1.3	86.8 ± 9.4
12	Power train system	Swing motor mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
		Swing bearing upper part mounting bolt	M20 × 2.5	57.8 ± 6.4	418 ± 46.3
13		Swing bearing lower part mounting bolt	M20 × 2.5	57.8 ± 6.4	418 ± 46.3
14		Travel motor mounting bolt	M16 × 2.0	23 ± 2.5	166 ± 18.1
15		Sprocket mounting bolt	M16 × 2.0	26 ± 4.0	188 ± 28.9
16	Under carriage	Carrier roller mounting bolt, nut	M16 × 2.0	29.7 ± 4.4	215 ± 31.8
17		Track roller mounting bolt	M20 × 2.5	54.7 ± 5.0	396 ± 36.2
18		Track tension cylinder mounting bolt	M16 × 2.0	29.7 ± 4.5	215 ± 32.5
19		Track shoe mounting bolt, nut	M20 × 1.5	78 ± 8.0	564 ± 57.9
20		Track guard mounting bolt	M20 × 2.5	57.9 ± 8.7	419 ± 62.9
21	Others	Counter weight mounting bolt	M36 × 3.0	308 ± 46	2228 ± 333
22		Cab mounting bolt	M12 × 1.75	12.8 ± 3.0	92.6 ± 21.7
23		Operator's seat mounting bolt	M8 × 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	8.8T		10.9T		12.9T	
	kgf·m	lbf·ft	kgf·m	lbf·ft	kgf·m	lbf·ft
M 6 × 1.0	0.8 ~ 1.2	5.8 ~ 8.6	1.2 ~ 1.8	8.7 ~ 13.0	1.5 ~ 2.1	10.9 ~ 15.1
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.6	2.8 ~ 4.2	20.3 ~ 30.4	3.4 ~ 5.0	24.6 ~ 36.1
M10 × 1.5	4.0 ~ 6.0	29.0 ~ 43.3	5.6 ~ 8.4	40.5 ~ 60.8	6.8 ~ 10.0	49.2 ~ 72.3
M12 × 1.75	6.8 ~ 10.2	50.0 ~ 73.7	9.6 ~ 14.4	69.5 ~ 104	12.3 ~ 16.5	89.0 ~ 119
M14 × 2.0	10.9 ~ 16.3	78.9 ~ 117	16.3 ~ 21.9	118 ~ 158	19.5 ~ 26.3	141 ~ 190
M16 × 2.0	17.9 ~ 24.1	130 ~ 174	25.1 ~ 33.9	182 ~ 245	30.2 ~ 40.8	141 ~ 295
M18 × 2.5	24.8 ~ 33.4	180 ~ 241	34.8 ~ 47.0	252 ~ 340	41.8 ~ 56.4	302 ~ 407
M20 × 2.5	34.9 ~ 47.1	253 ~ 340	49.1 ~ 66.3	355 ~ 479	58.9 ~ 79.5	426 ~ 575
M22 × 2.5	46.8 ~ 63.2	339 ~ 457	65.8 ~ 88.8	476 ~ 642	78.9 ~ 106	570 ~ 766
M24 × 3.0	60.2 ~ 81.4	436 ~ 588	84.6 ~ 114	612 ~ 824	102 ~ 137	738 ~ 991
M30 × 3.5	120 ~ 161	868 ~ 1164	168 ~ 227	1216 ~ 1641	202 ~ 272	1461 ~ 1967

(2) Fine thread

Bolt size	8.8T		10.9T		12.9T	
	kgf · m	lbf · ft	kgf · m	lbf · ft	kgf · m	lbf · ft
M 8 × 1.0	2.1 ~ 3.1	15.2 ~ 22.4	3.0 ~ 4.4	21.7 ~ 31.8	3.6 ~ 5.4	26.1 ~ 39.0
M10 × 1.25	4.2 ~ 6.2	30.4 ~ 44.9	5.9 ~ 8.7	42.7 ~ 62.9	7.0 ~ 10.4	50.1 ~ 75.2
M12 × 1.25	7.3 ~ 10.9	52.8 ~ 78.8	10.3 ~ 15.3	74.5 ~ 110	13.1 ~ 17.7	94.8 ~ 128
M14 × 1.5	12.4 ~ 16.6	89.7 ~ 120	17.4 ~ 23.4	126 ~ 169	20.8 ~ 28.0	151 ~ 202
M16 × 1.5	18.7 ~ 25.3	136 ~ 182	26.3 ~ 35.5	191 ~ 256	31.6 ~ 42.6	229 ~ 308
M18 × 1.5	27.1 ~ 36.5	196 ~ 264	38.0 ~ 51.4	275 ~ 371	45.7 ~ 61.7	331 ~ 446
M20 × 1.5	37.7 ~ 50.9	273 ~ 368	53.1 ~ 71.7	384 ~ 518	63.6 ~ 86.0	460 ~ 622
M22 × 1.5	51.2 ~ 69.2	370 ~ 500	72.0 ~ 97.2	521 ~ 703	86.4 ~ 116	625 ~ 839
M24 × 2.0	64.1 ~ 86.5	464 ~ 625	90.1 ~ 121	652 ~ 875	108 ~ 146	782 ~ 1056
M30 × 2.0	129 ~ 174	933 ~ 1258	181 ~ 245	1310 ~ 1772	217 ~ 294	1570 ~ 2126

2) PIPE AND HOSE

Thread size(PF)	Width across flat(mm)	kgf · m	lbf · ft
1/4"	19	3	21.7
3/8"	22	4	28.9
1/2"	27	5	36.2
3/4"	36	12	86.8
1"	41	14	101

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	6	43.4
3/4"	36	13	94.0
1"	41	15	109

GROUP 3 PUMP DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

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

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

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

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

13031GE18

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

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

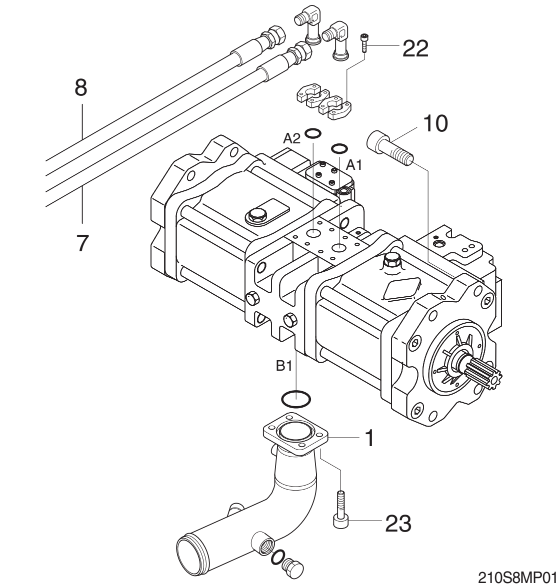
- · Hydraulic tank quantity : 165 ℓ

(6) Remove socket bolts (22) and disconnect pipe (7, 8).

(7) Disconnect pilot line hoses (2, 3, 4, 5, 6, 7).

(8) Remove socket bolts (23) and disconnect pump suction tube (1).

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

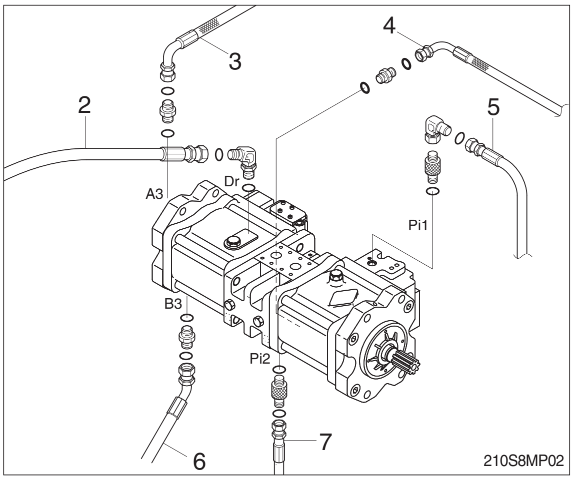


210S8MP01

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

- · Weight : 140 kg (310 lb)

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



210S8MP02

2) INSTALL

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

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

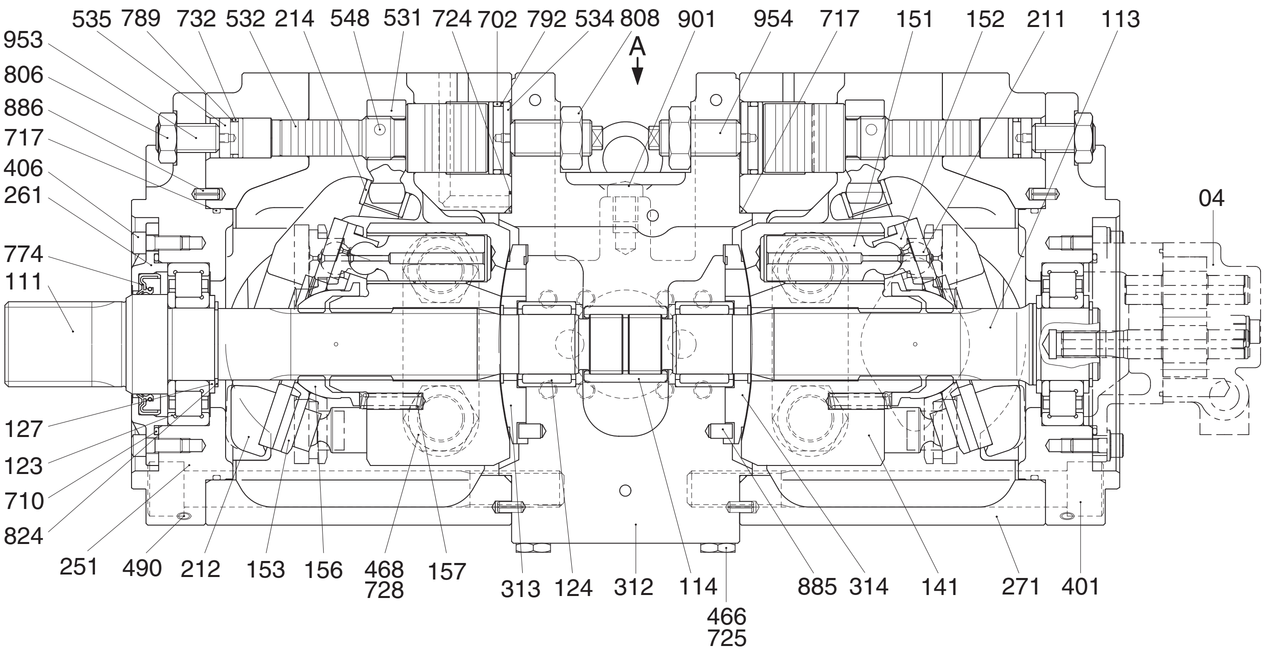
(6) Bleed the air from the hydraulic pump.
① Remove the air vent plug (2EA).
② Tighten plug lightly.
③ Start the engine, run at low idling, and check oil come out from plug.
④ Tighten plug.

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

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

2. MAIN PUMP (1/2)

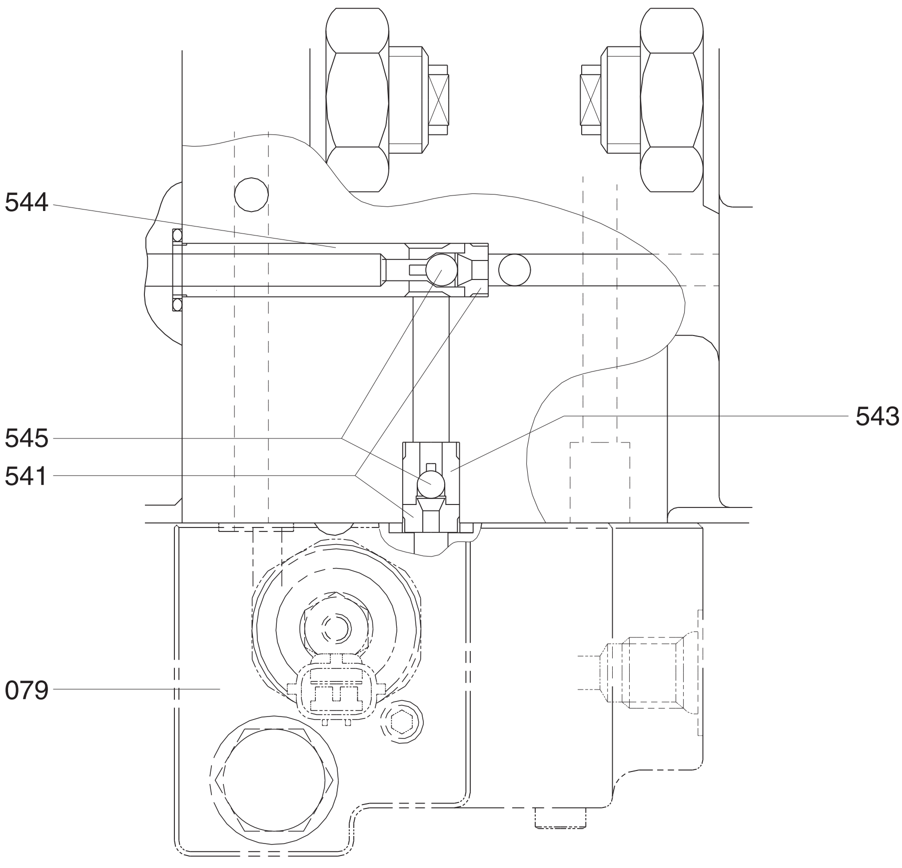
The main pump consists of two piston pumps (front & rear) and valve block.



2209S2MP02

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

MAIN PUMP (2/2)



VIEW A

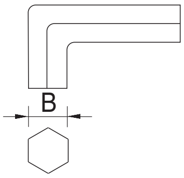
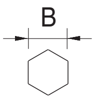
21092MP08

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

Tool name & size		Part name			
Name	B	Hexagon socket head bolt	PT plug (PT thread)	PO plug (PF thread)	Hexagon socket head setscrew
Allen wrench 	4	M 5	BP-1/16	-	M 8
	5	M 6	BP-1/8	-	M10
	6	M 8	BP-1/4	PO-1/4	M12, M14
	8	M10	BP-3/8	PO-3/8	M16, M18
	17	M20, M22	BP-1	PO-1, 1 1/4, 1 1/2	-
Double ring spanner, socket wrench, double (single) open end spanner 	-	Hexagon socket head bolt	Hexagon nut	VP plug (PF thread)	
	19	M12	M12	VP-1/4	
	24	M16	M16	-	
	27	M18	M18	VP-1/2	
	30	M20	M20	-	
	36	-	-	VP-3/4	
Adjustable angle wrench		Medium size, 1 set			
Screw driver		Minus type screw driver, Medium size, 2 sets			
Hammer		Plastic hammer, 1 set			
Pliers		For snap ring, TSR-160			
Steel bar		Steel bar of key material approx. 10×8×200			
Torque wrench		Capable of tightening with the specified torques			

(2) Tightening torque

Part name	Bolt size	Torque		Wrench size	
		kgf · m	lbf · ft	in	mm
Hexagon socket head bolt (Material : SCM435)	M 5	0.7	5.1	0.16	4
	M 6	1.2	8.7	0.20	5
	M 8	3.0	21.7	0.24	6
	M10	5.8	42.0	0.31	8
	M12	10.0	72.3	0.39	10
	M14	16.0	116	0.47	12
	M16	24.0	174	0.55	14
	M18	34.0	246	0.55	14
	M20	44.0	318	0.67	17
PT Plug (Material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (Material : S45C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

(1) Select place suitable to disassembling.

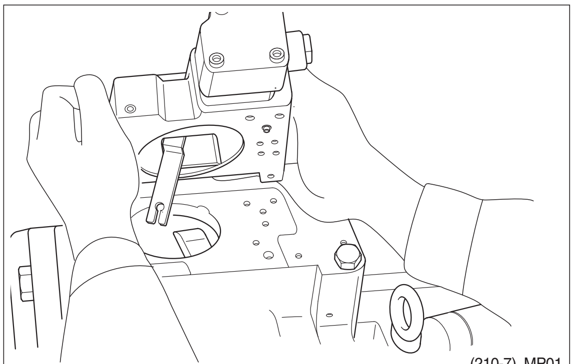
※ Select clean place.

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

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

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

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



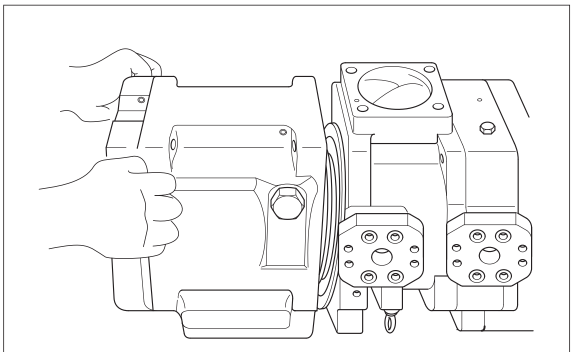
(210-7) MP01

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

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

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

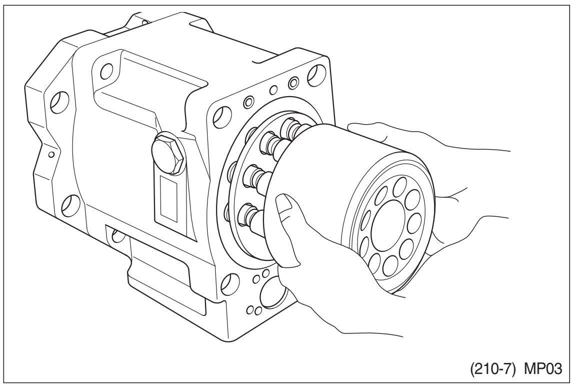
※ Before bringing this surface down, spread rubber sheet on workbench without fail to prevent this surface from being damaged.



(210-7) MP02

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

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

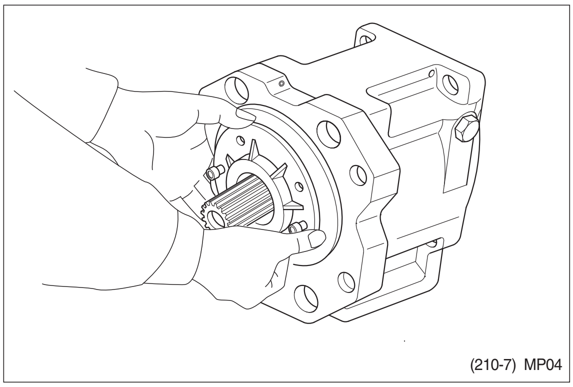


(210-7) MP03

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

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

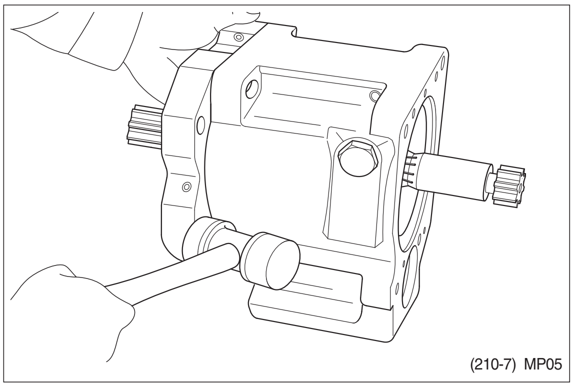
※ Since oil seal is fitted on seal cover (F), take care not to damage it in removing cover.



(210-7) MP04

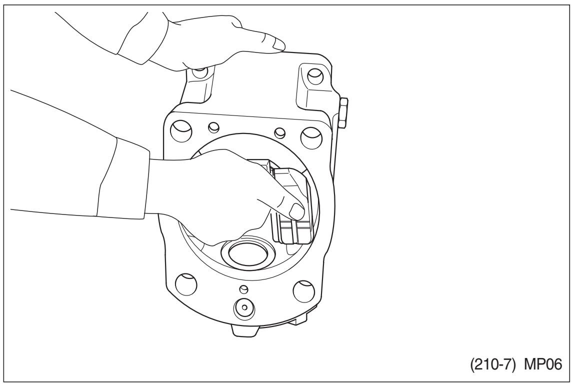
(9) Remove hexagon socket head bolts (408) and then seal cover (R, 262).
In case fitting a gear pump, first, remove gear pump.

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



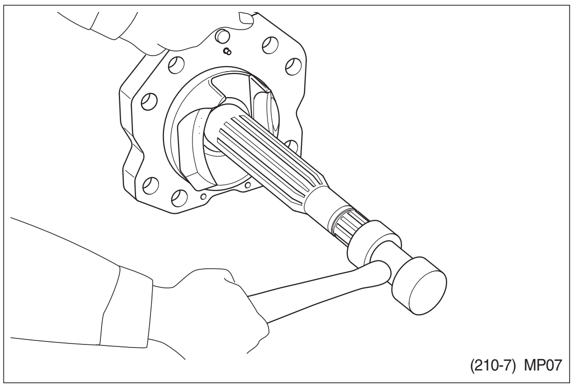
(210-7) MP05

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



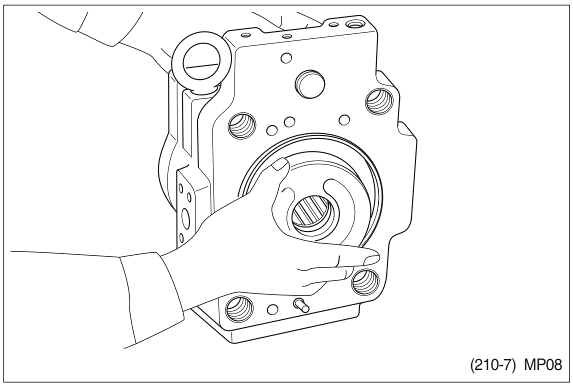
(210-7) MP06

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


(210-7) MP07

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

※ These may be removed in work (6).


(210-7) MP08

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

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

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

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

※ Do not loosen hexagon nuts of valve block and swash plate support.
If loosened, flow setting will be changed.

4) ASSEMBLY

(1) For reassembling reverse the disassembling procedures, paying attention to the following items.

① Do not fail to repair the parts damaged during disassembling, and prepare replacement parts in advance.

② Clean each part fully with cleaning oil and dry it with compressed air.

③ Do not fail to apply clean working oil to sliding sections, bearings, etc. before assembling them.

④ In principle, replace seal parts, such as O-rings, oil seals, etc.

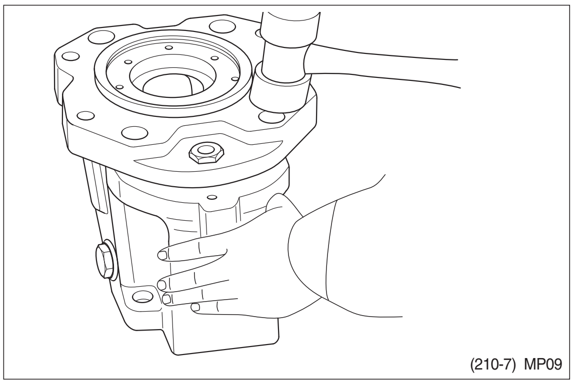
⑤ For fitting bolts, plug, etc., prepare a torque wrench or so on, and tighten them with torques shown in page 8-11, 12.

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

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

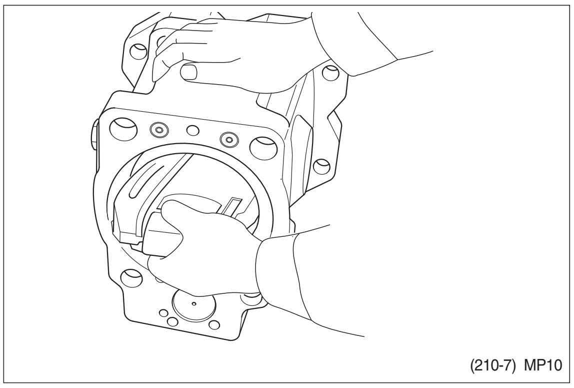
※ After servo piston, tilting pin, stopper (L) and stopper (S) are removed, fit them soon to pump casing in advance for reassembling.

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

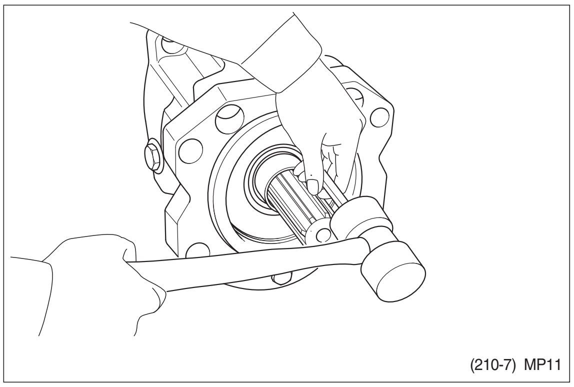


(210-7) MP09

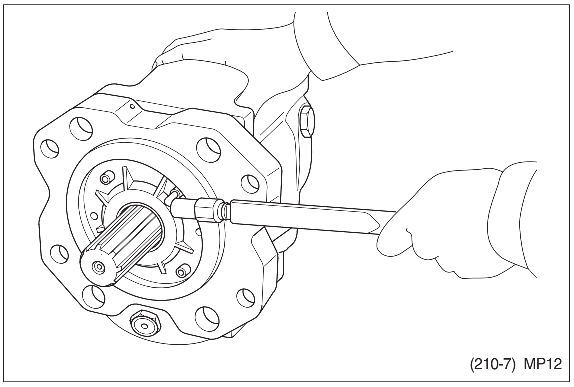
(3) Place pump casing with its regulator fitting surface down, fit tilting bush of swash plate to tilting pin (531) and fit swash plate (212) to swash plate support (251) correctly.
※ Confirm with fingers of both hands that swash plate can be removed smoothly.
※ Apply grease to sliding sections of swash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


(210-7) MP10

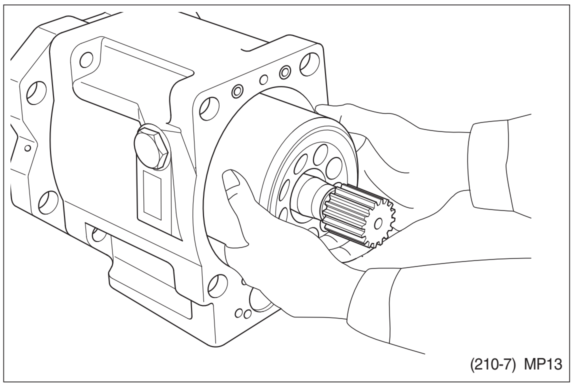
(4) To swash plate support (251), fit drive shaft (111) set with bearing (123), bearing spacer (127) and snap ring (824).
※ Do not tap drive shaft with hammer or so on.
※ Assemble them into support, tapping outer race of bearing lightly with plastic hammer.
Fit them fully, using steel bar or so on.


(210-7) MP11

(5) Assemble seal cover (F, 261) to pump casing (271) and fix it with hexagon socket head bolts (406).
※ Apply grease lightly to oil seal in seal cover (F).
※ Assemble oil seal, taking full care not to damage it.
※ For tandem type pump, fit rear cover (263) and seal cover (262) similarly.

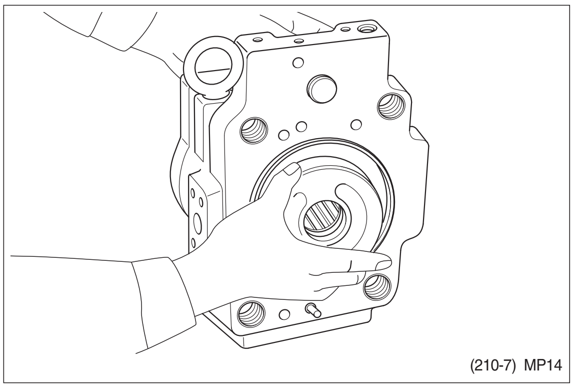

(210-7) MP12

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


(210-7) MP13

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

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



(210-7) MP14

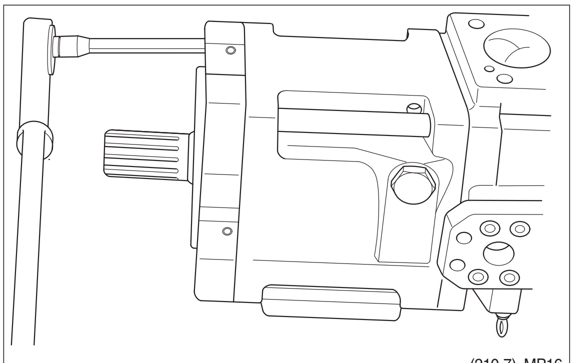
(8) Fit valve block (312) to pump casing (271) and tighten hexagon socket head bolts (401).

※ At first assemble this at rear pump side, and this work will be easy.

※ Take care not to mistake direction of valve block.

※ Clockwise rotation (Viewed from input shaft side) - Fit block with regulator up and with delivery flange left, viewed from front side.

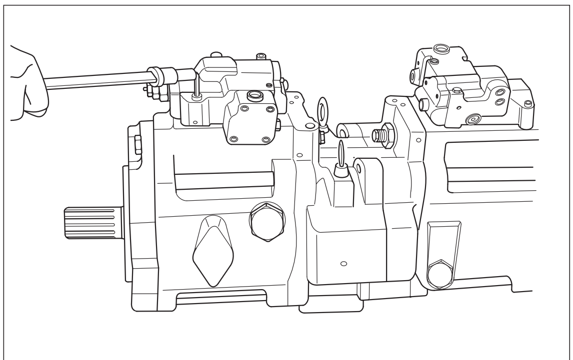
※ Counter clockwise rotation (Viewed from input shaft side) - Fit block with delivery flange right, viewed from front side.



(210-7) MP16

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

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

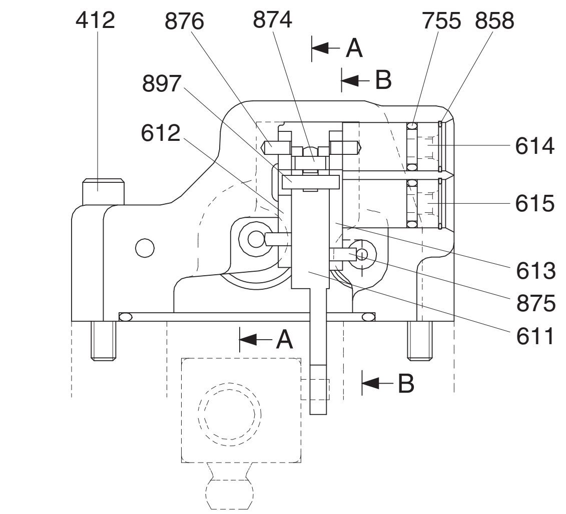


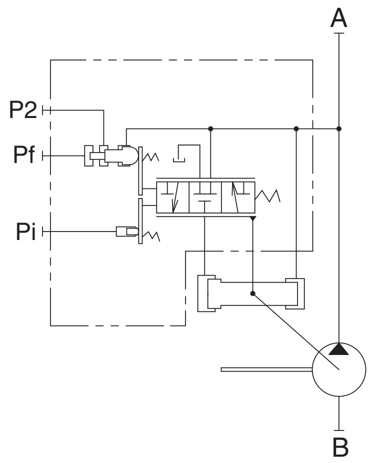
(210-7) MP17

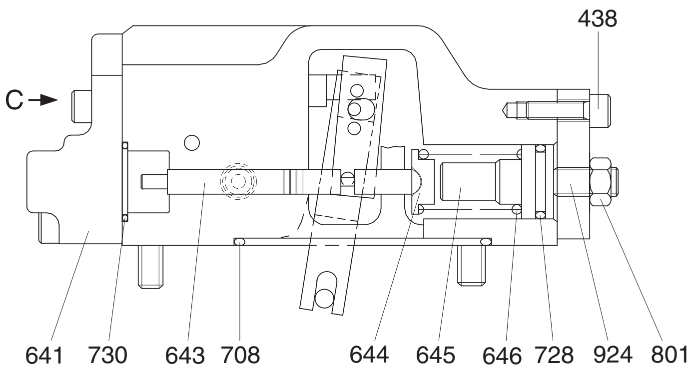
(10) Fit drain port plug (468).

This is the end of reassembling procedures.

3. REGULATOR (1/2)

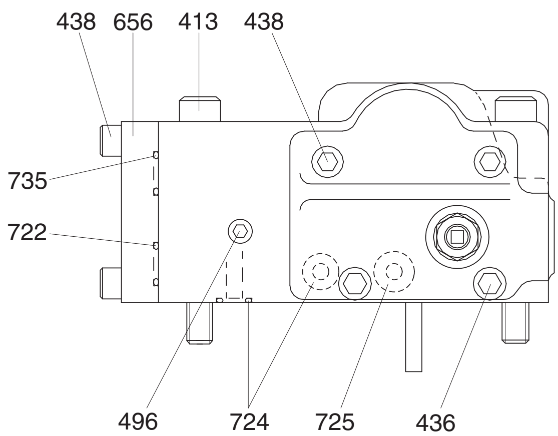






SECTION B-B

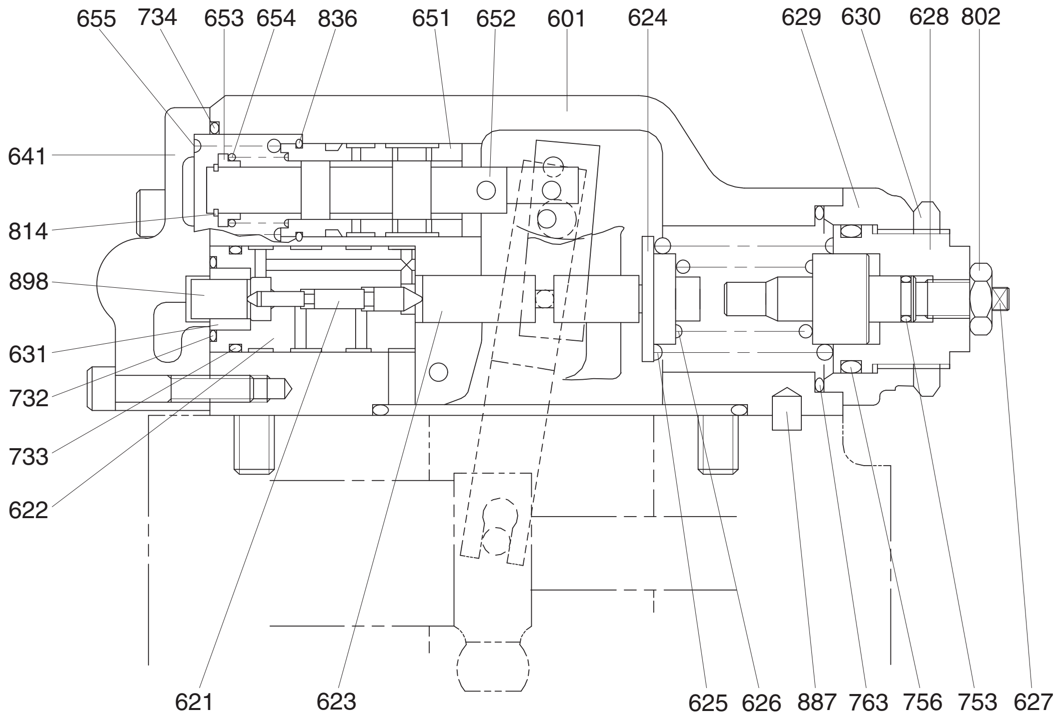
2209S2MP03



VIEW C

Port	Port name	Port size
A	Delivery port	3/4"
B	Suction port	2 1/2"
Pi	Pilot port	PF 1/4-15
Pf	Power shift port	-
P2	Companion delivery port	-

REGULATOR (2/2)



SECTION A-A

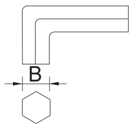
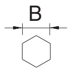
21092MP04

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

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

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

<table>
<tr><td colspan="2">Tool name & size</td><td colspan="12">Part name</td></tr>
<tr><td>Name</td><td>B</td><td colspan="3">Hexagon socket head bolt</td><td colspan="3">PT plug (PT thread)</td><td colspan="3">PO plug (PF thread)</td><td colspan="3">Hexagon socket head setscrew</td></tr>
<tr><td rowspan="3">Allen wrench
</td><td>4</td><td colspan="3">M 5</td><td colspan="3">BP-1/16</td><td colspan="3">-</td><td colspan="3">M 8</td></tr>
<tr><td>5</td><td colspan="3">M 6</td><td colspan="3">BP-1/8</td><td colspan="3">-</td><td colspan="3">M10</td></tr>
<tr><td>6</td><td colspan="3">M 8</td><td colspan="3">BP-1/4</td><td colspan="3">PO-1/4</td><td colspan="3">M12, M14</td></tr>
<tr><td rowspan="2">Double ring spanner, socket wrench, double (single) open end spanner
</td><td>-</td><td colspan="4">Hexagon head bolt</td><td colspan="4">Hexagon nut</td><td colspan="4">VP plug (PF thread)</td></tr>
<tr><td>6</td><td colspan="4">M 8</td><td colspan="4">M 8</td><td colspan="4">-</td></tr>
<tr><td colspan="2">Adjustable angle wrench</td><td colspan="12">Small size, Max 36mm</td></tr>
<tr><td colspan="2">Screw driver</td><td colspan="12">Minus type screw driver, Medium size, 2 sets</td></tr>
<tr><td colspan="2">Hammer</td><td colspan="12">Plastic hammer, 1 set</td></tr>
<tr><td colspan="2">Pliers</td><td colspan="12">For snap ring, TSR-160</td></tr>
<tr><td colspan="2">Steel bar</td><td colspan="12">4×100 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 Plug (Material : S45C) ※Wind a seal tape 1 1/2 to 2 turns round the plug	PT1/16	0.7	5.1	0.16	4
	PT 1/8	1.05	7.59	0.20	5
	PT 1/4	1.75	12.7	0.24	6
	PT 3/8	3.5	25.3	0.31	8
	PT 1/2	5.0	36.2	0.39	10
PF Plug (Material : S35C)	PF 1/4	3.0	21.7	0.24	6
	PF 1/2	10.0	72.3	0.39	10
	PF 3/4	15.0	109	0.55	14
	PF 1	19.0	137	0.67	17
	PF 1 1/4	27.0	195	0.67	17
	PF 1 1/2	28.0	203	0.67	17

3) DISASSEMBLY

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

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

(1) Choose a place for disassembly.

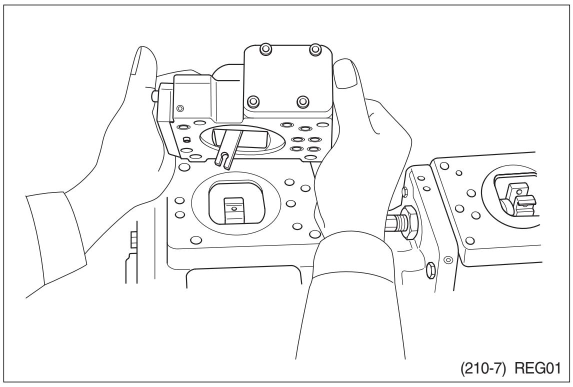
※ Choose a clean place.

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

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

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

※ Take care not to lose O-ring.



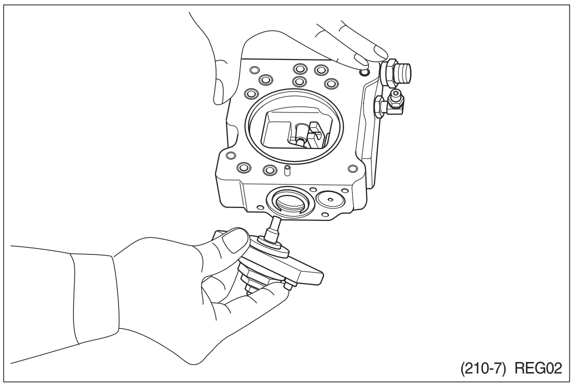
(210-7) REG01

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

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

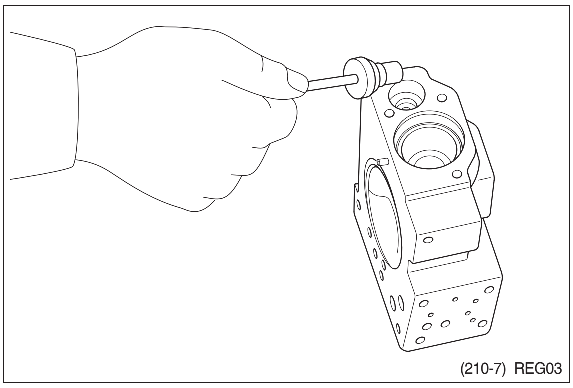
※ Do not loosen these screws and nuts.

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



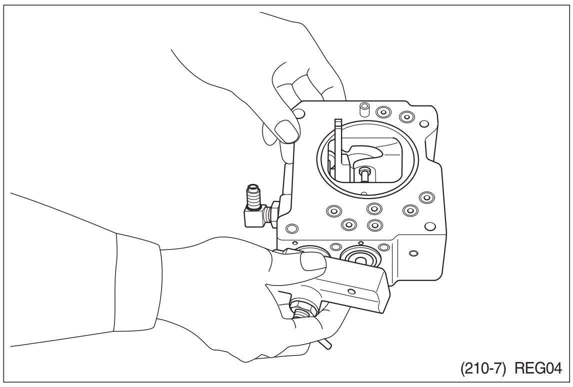
(210-7) REG02

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



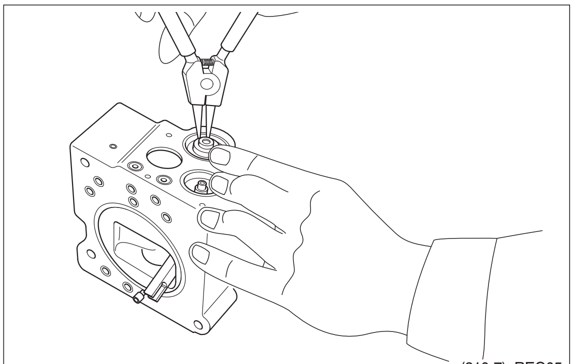
(210-7) REG03

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



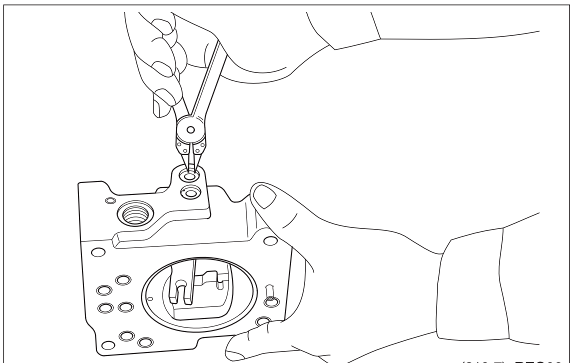
(210-7) REG04

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

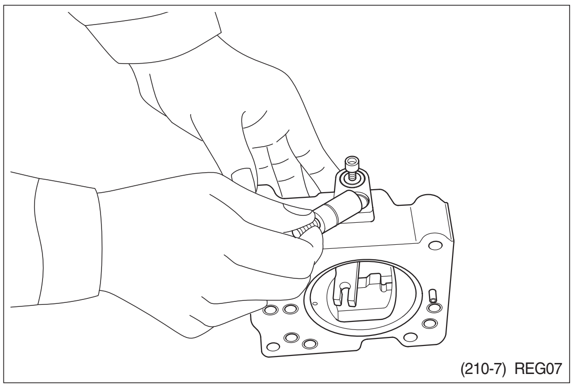


(210-7) REG05

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

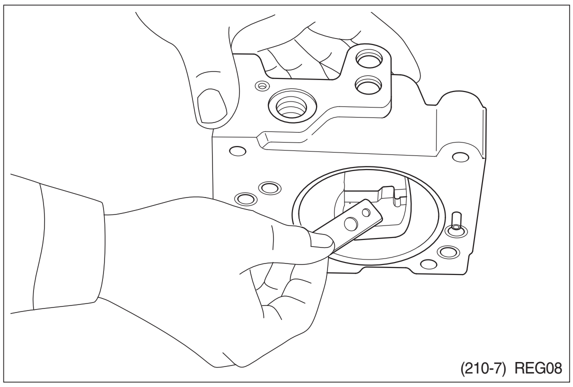


(210-7) REG06



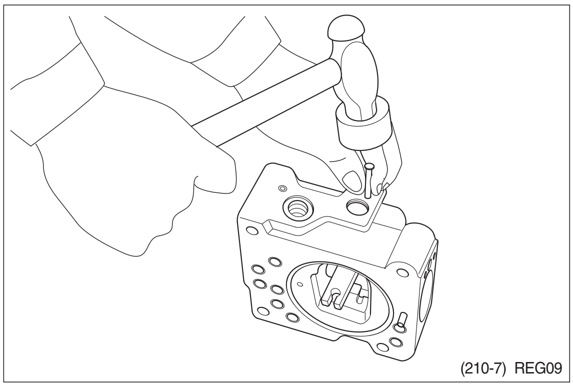
(210-7) REG07

(9) Remove lever (2, 613). Do not draw out pin (875).
※ Work will be promoted by using pincers or so on.

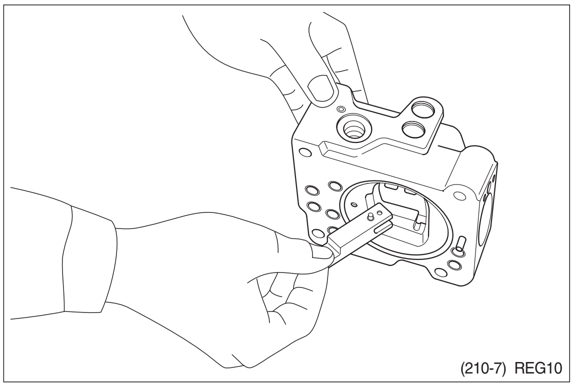


(210-7) REG08

(10) Draw out pin (874) and remove feedback lever (611).
Push out pin (874, 4 mm in dia.) from above with slender steel bar so that it may not interfere with lever (1, 612).



(210-7) REG09



(210-7) REG10

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

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

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

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

This completes disassembly.

4) ASSEMBLY

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

① Always repair parts that were scored at disassembly.

② Get replacement parts ready beforehand. Mixing of foreign matter will cause malfunction.
Therefore, wash parts well with cleaning oil, let them dry with jet air and handle them in clean place.

③ Always tighten bolts, plugs, etc. to their specified torques.

④ Do not fail to coat sliding surfaces with clean hydraulic oil before assembly.

⑤ Replace seals such as O-ring with new ones as a rule.

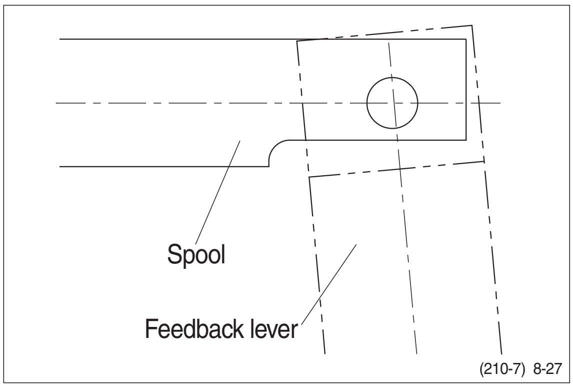
(2) Put compensating rod (623) into compensating hole of casing (601).

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

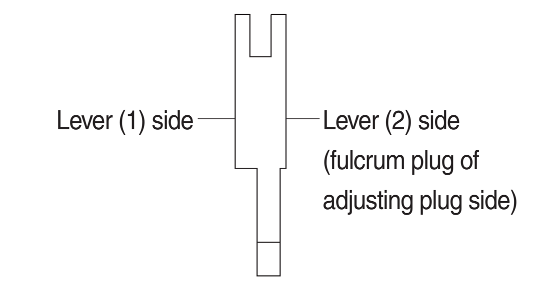
(4) Fit spool (652) and sleeve (651) into hole in spool of casing.

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

※ Pay attention to orientation of spool.



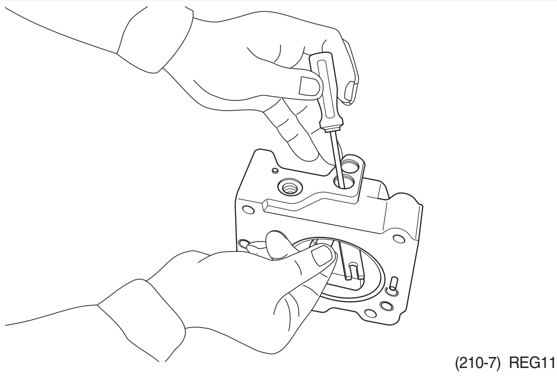
(5) Fit feedback lever (611), matching its pin hole with pin hole in spool.
Then insert pin (874).
※ Insert pin in feedback lever a little to ease operation.
※ Take care not to mistake direction of feedback lever.



(210-7) 8-28

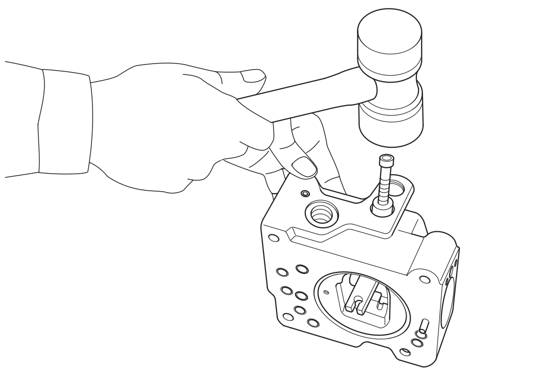
(6) Put pilot piston (643) into pilot hole of casing.
※ Confirm that pilot piston slides smoothly without binding.

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

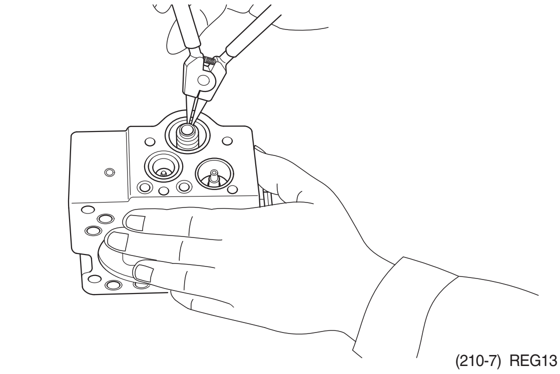

(210-7) REG11

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

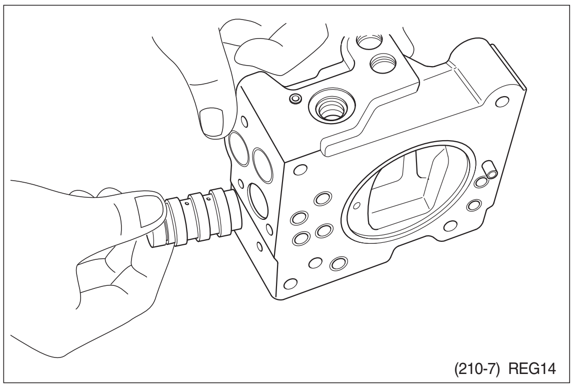
(9) Insert adjusting plug (615) and fit locking ring.
※ Take care not to mistake inserting holes for fulcrum plug and adjusting plug.
At this point in time move feedback lever to confirm that it has no large play and is free from binding.


(210-7) REG12

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

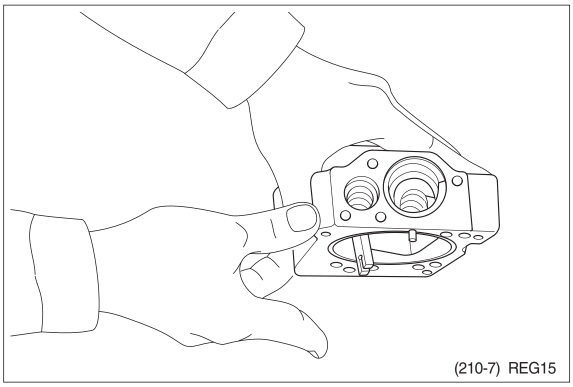

(210-7) REG13

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



(210-7) REG14

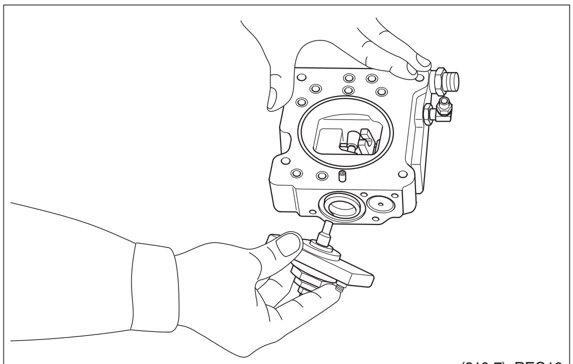
(12) Put spring seat (644), pilot spring (646) and adjusting ring (Q, 645) into pilot hole.
Then fix spring seat (624), inner spring (626) and outer spring (625) into compensating hole.
※ When fitting spring seat, take care not to mistake direction of spring seat.



(210-7) REG15

(13) Install cover (C, 629) fitted with adjusting screws (628), adjusting ring (C, 627), lock nut (630), hexagon nut (801) and adjusting screw (924).
Then tighten them with hexagonal socket head screws (438).

This completes assembly.



(210-7) REG16

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

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

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

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

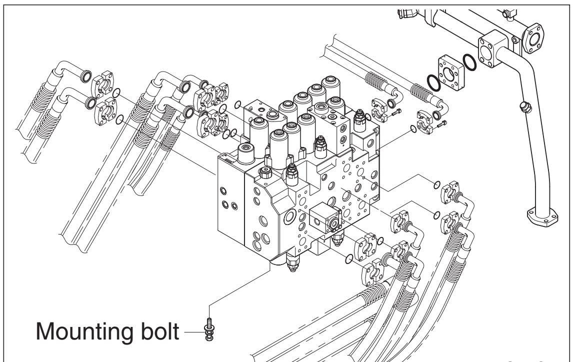
※ When pipes and hoses are disconnected, the oil inside the piping will flow out, so catch it in oil pan.

13031GE18

(4) Remove bolts and disconnect pipe.

(5) Disconnect pilot line hoses.

(6) Disconnect pilot piping.



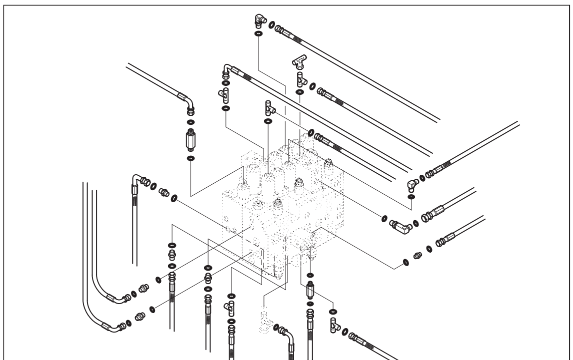
210S8MC01

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

· Weight : 220kg (485lb)

· Tightening torque : 12.3 ± 1.3 kgf · m (89.0 ± 9.4 lbf · ft)

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



210S8MC02

2) INSTALL

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

(2) Bleed the air from below items.

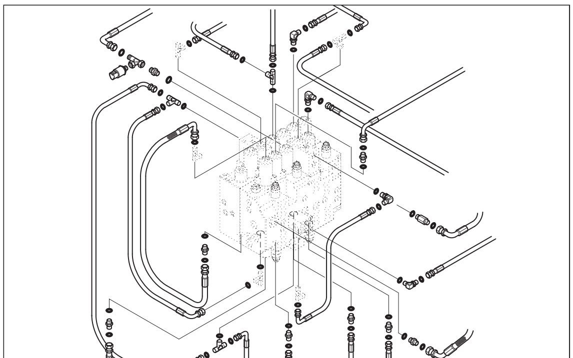
① Cylinder(Boom, arm, bucket)

② Swing motor

③ Travel motor

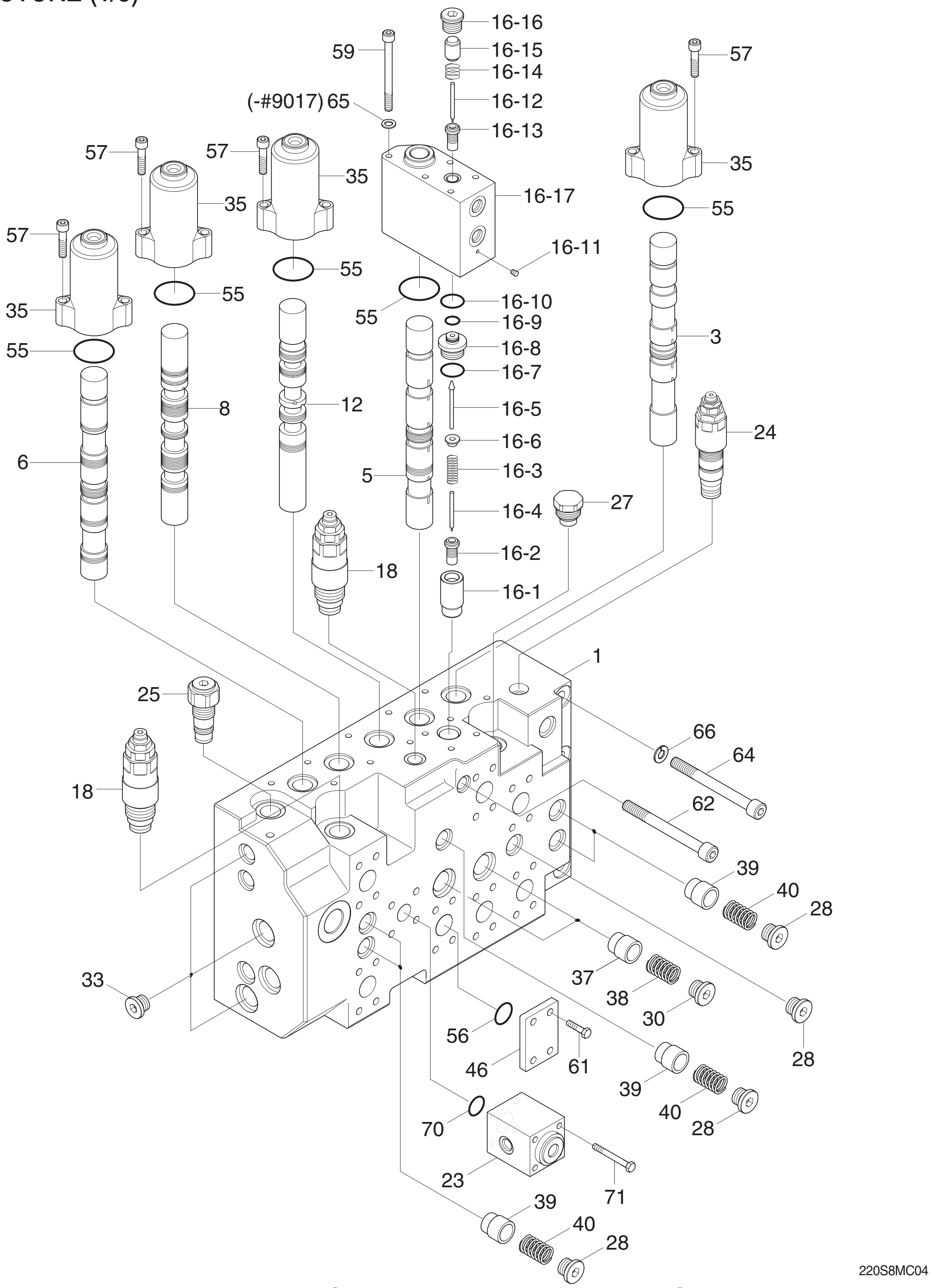
※ See each item removal and install.

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



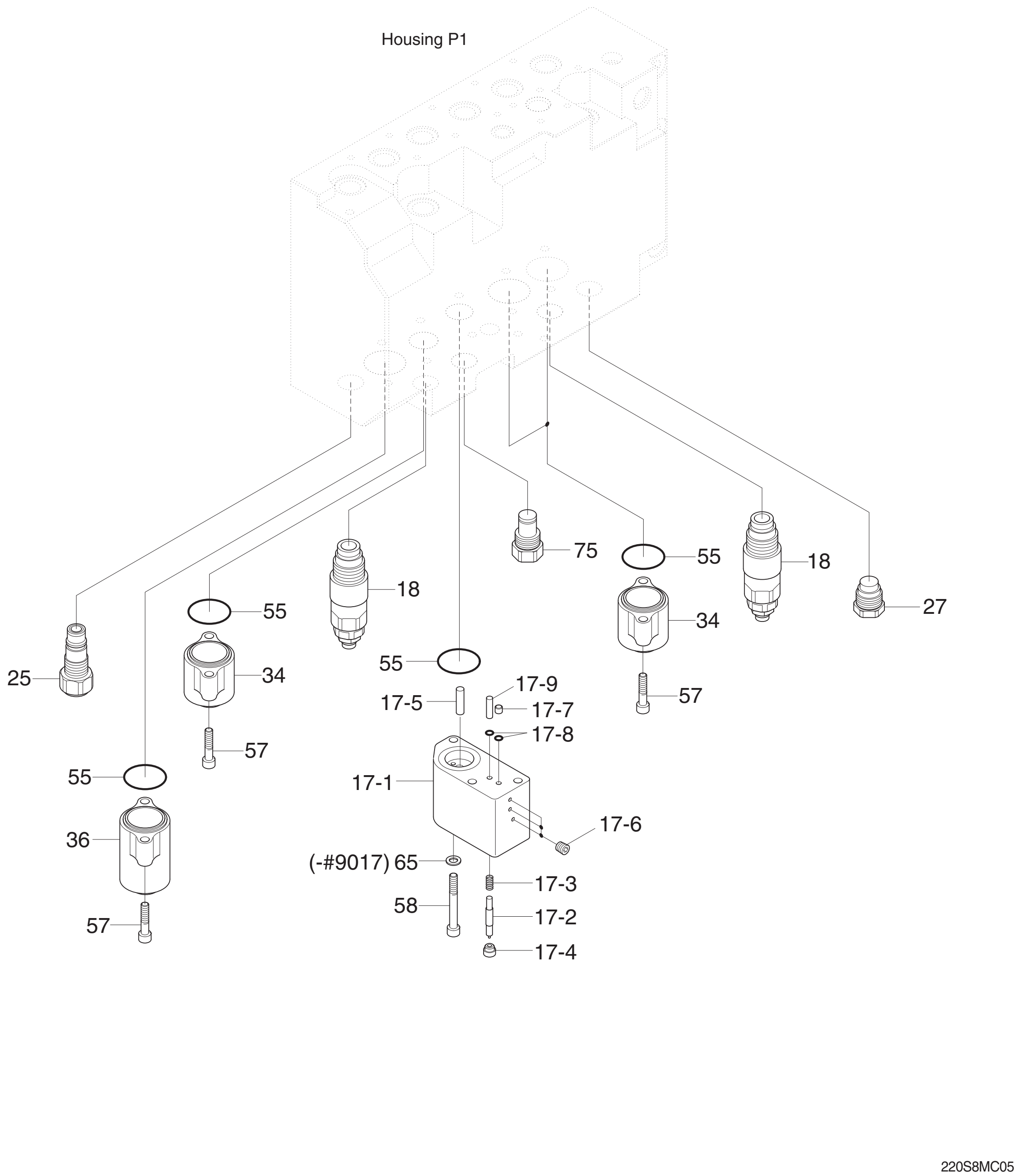
210S8MC03

2. STRUCTURE (1/5)



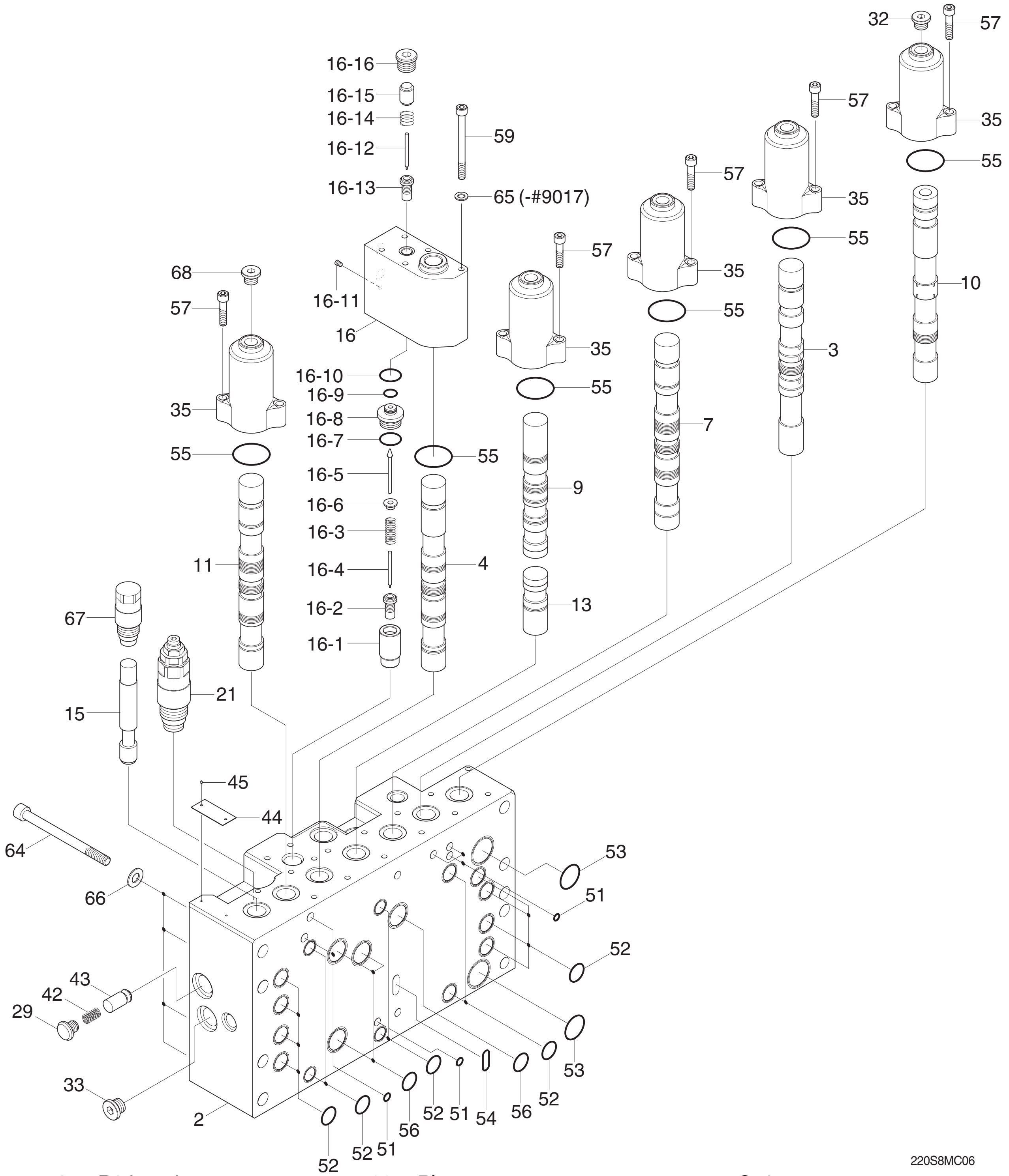
1	P1 housing	27	Overload plug	56	O-ring
3	Travel spool kit	28	Plug	57	Socket bolt
5	Boom 1 spool kit	30	Load check plug	59	Socket bolt
6	Bucket spool kit	33	Plug	61	Socket bolt
8	Arm 2 spool kit	35	Spool cap	62	Socket bolt
12	Arm regen spool kit	37	L/C poppet 1	64	Socket bolt
16	Holding valve assy	38	L/C spring 1	66	Spring washer
18	Port relief valve assy	39	L/C poppet 2	70	O-ring
23	Arm 2 logic valve assy	40	L/C spring 2	71	Socket bolt
24	Main relief valve assy	46	Port plug flange		
25	Negacon relief valve	55	O-ring		

STRUCTURE (2/5)



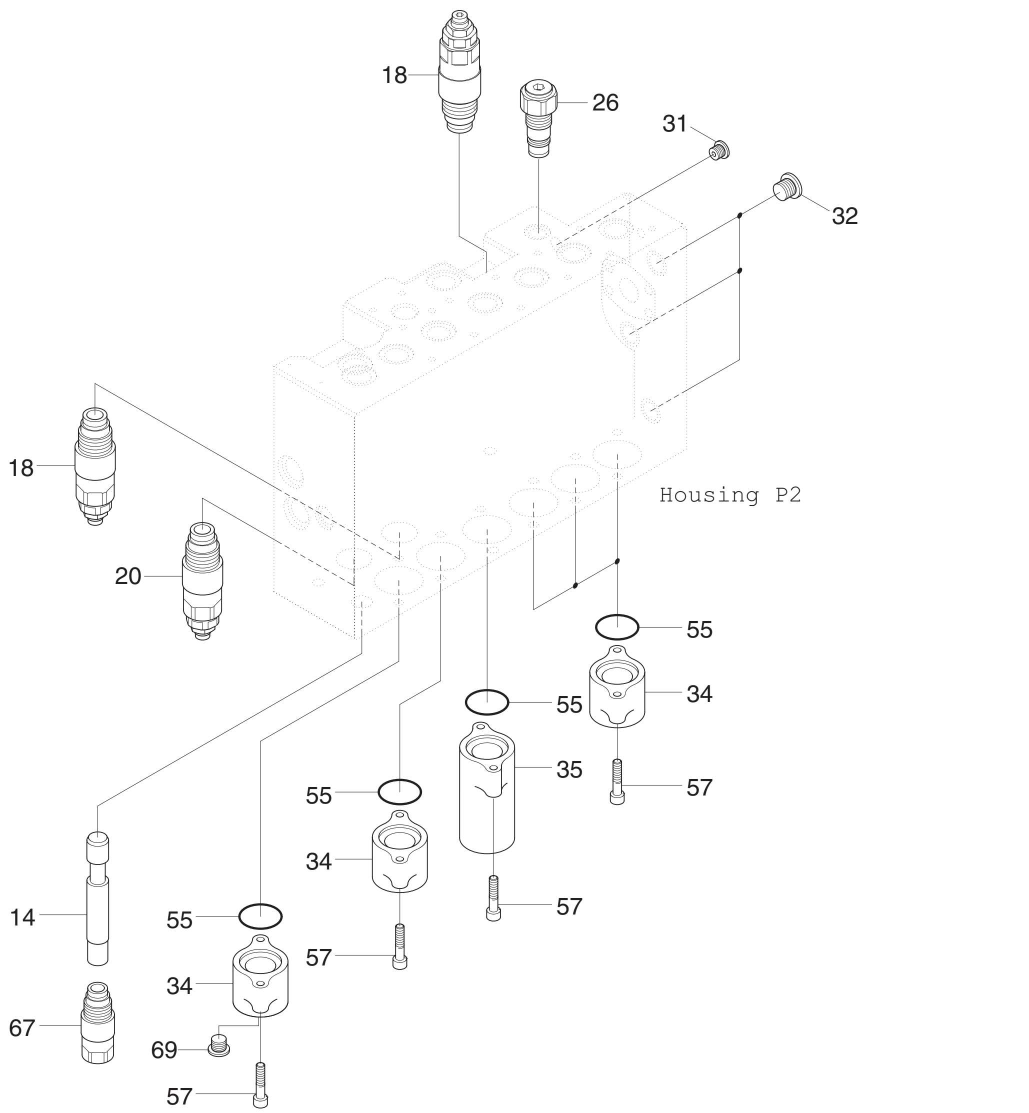
17	Regen valve assy	34	Spool cap	58	Socket bolt
18	Port relief valve assy	36	Bucket stroke limit	75	Plug assy
25	Negacon relief valve	55	O-ring		
27	Overload plug	57	Socket bolt		

STRUCTURE (3/5)



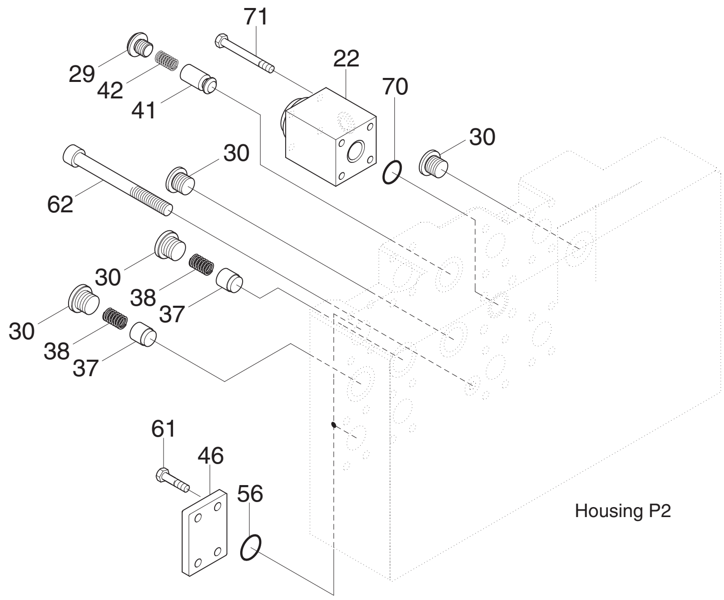
2	P2 housing	29	Plug	54	O-ring
3	Travel spool kit	32	Plug	55	O-ring
5	Arm 1 spool kit	33	Plug	56	O-ring
7	Swing spool kit	35	Cap spool	57	Socket bolt
9	Boom 2 spool kit	42	Spring	59	Socket bolt
10	Travel straight spool kit	43	Poppet	64	Socket bolt
11	Option spool kit	44	Name plate	66	Spring washer
13	Swing priority spool kit	45	Rivet	67	BC plug assy
15	BC2 spool kit	51	O-ring	68	Opt stroke limit plug kit 1
16	Holding valve assy	52	O-ring		
21	Port relief valve assy	53	O-ring		

STRUCTURE (4/5)



14	BC1 spool kit	31	Plug	55	O-ring
18	Port relief valve assy	32	Plug	57	Socket bolt
20	Port relief valve assy	34	Spool cap	67	BC plug assy
26	Orifice signal plug assy	35	Spool cap	69	Opt stroke limit plug kit 2

STRUCTURE (5/5)



220S8MC08

22	Swing logic valve assy	41	Poppet	62	Socket bolt
29	Plug	42	Spring	70	O-ring
30	Load check valve	46	Port plug flange	71	Socket bolt
37	L/C poppet 1	56	O-ring		
38	L/C spring 1	61	Socket bolt		

3. DISASSEMBLY AND ASSEMBLY

1) GENERAL PRECAUTIONS

(1) All hydraulic components are manufactured to a high precision. Consequently, before disassembling and assembling them, it is essential to select an especially clean place.
In handling a control valve, pay full attention to prevent dust, sand, etc. from entering into it.

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

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

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

2) TOOLS

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

Name of tool	Quantity	Size (mm)
Torque wrench	1	-
Extension bar	1	-
Hexagon bit socket	Each 1	6, 8, 10
Hex socket	1	36
Spanner	Each 1	32, 34, 38
Loctite #262	1	-

3) DISASSEMBLY

The figure in ( ) shown after the part name in explanation sentence shows its number in the construction figures (8-31)

(1) Place main control valve on working bench

※ Disassemble it in clean place and pay attention not to damage flange faces and plate faces.

(2) Disassembling of orifice signal plug

① Loosen and remove orifice signal plug (25).

220S8MC11

(3) Disassembling of main spool assy 1 (Pilot cover B side) (Travel R/L (3), Swing (7), Boom 2 (9), Arm regen (12), Arm 2 (8), Bucket (6), Option (11))

① Loosen the hexagon socket head bolts (45) 2EA and remove the pilot cover B (33) and O-ring (43).
[Hexagon key wrench 6 mm]

② Pull out the main spool, spring, spring seat stopper and spacer bolt in the spool assembly condition from the housing P1 & P2.

21078MC10

(4) Disassembling of main spool assy 2 (Pilot cover B side)
(Boom 1 (5), Arm 1 (4))

① Loosen the hexagon socket head bolts (47) 5EA and remove the O-ring (44) and holding valve block assy (16)
[Hexagon key wrench : 6 mm]

② Pull out the main spool, spring, spring seat stopper and spacer bolt in the spool assembly condition from the housing P1 & P2.

※ When you disassemble holding valve block assy, pay attention not to miss the pilot poppet.

220S8MC13

(5) Disassembling of bypass cut spool (=BC)
(Bucket BC (14), Option BC (15))

① Loosen bypass cut plug assy
[36mm socket wrench]

② Pull out the bypass cut spool

※ Option BC spool (14) and bucket BC spool (15) are different lengths. So when you reassemble, be careful of length. (length : option BC > bucket BC)

220S8MC14

(6) Disassembling of pilot cover (Bucket stroke limiter)

① Loosen the hexagon socket head bolts (45) 2EA.
[Hexagon key wrench 6 mm]

② Remove the pilot cover (34) and O-ring (43).

(7) Disassembling of swing priority spool & pilot cover A
(Travel R/L (3), Swing (7), Boom1 (5), Arm 1 (4), Bucket (6), Option (11), Boom2 (9), Arm 2 (8))

① Loosen the hexagon socket head bolts (45) 2EA and remove the pilot cover A (32) and O-ring (43).

② Pull out the swing priority spool (13).

③ Remove the pilot cover A (32).

21078MC15

21078MC16

(8) Disassembling of regen valve block assy

① Loosen the hexagon socket head bolts (46) 3EA.
[Hexagon key wrench 6 mm]

② Remove plug (551) or (552) and take out poppet (511) or (515, 516) and spring (521) or (523).

③ When you disassemble regen valve block assy, pay attention not to miss the piston and O-ring (43).

220S8MC17

(9) Disassembling of main relief valve

① Loosen and remove the main relief valve (23).
[Spanner 32 mm]

220S8MC18

(10) Disassembling of port relief valve (Except the option side)

① Loosen and remove the port relief valve (18).
[Spanner 34 mm]

220S8MC19

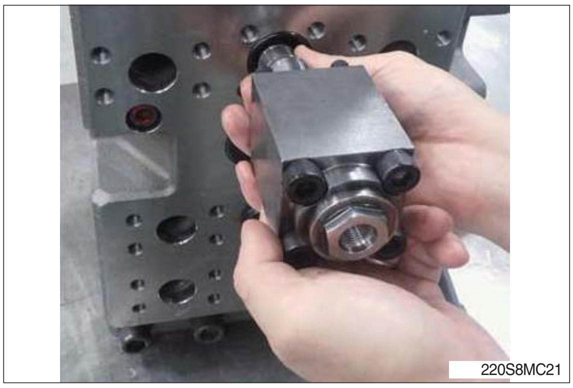
(11) Disassembling of port relief valve (Option side)
(1-stage (19), 2-stage (20))

① Loosen and remove the port relief valve.
[Spanner 38 mm]

220S8MC20

(12) Disassembling of logic valve
(Arm logic valve (22), Swing logic valve (21))

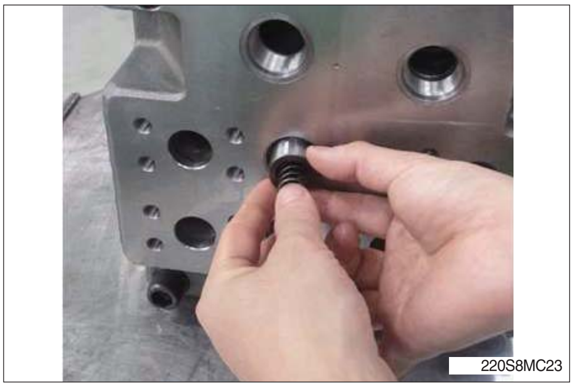
① Loosen the hexagon socket head bolts (56) 4EA and remove the logic valve.
[Hexagon key wrench 8 mm]


220S8MC21

② Remove the swing logic poppet.


220S8MC22

③ Remove the Arm logic poppet and spring by same method.


220S8MC23

(13) Disassembling of check valve (Plug (27) 2EA)

① Loosen the plug (27) and remove the poppet (37), spring (38).
[Hexagon key wrench 10 mm]

220S8MC24

220S8MC25

(14) Main spool disassembly

① Fix the spool to the dedicated jig and take it apart.
(Spacer bolt, spring, stopper, spring seat)
[Hexagon key wrench 8 mm]

220S8MC26

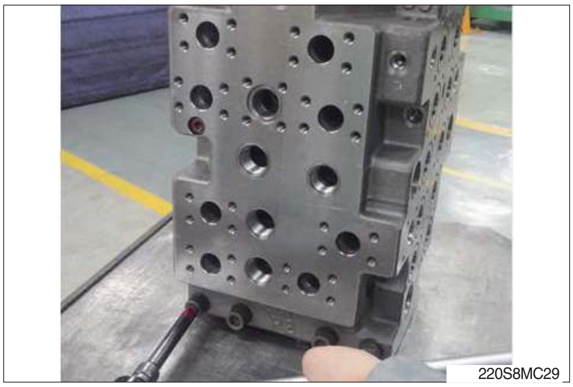
220S8MC27

(15) Disassembling of housing

① Loosen the hexagon socket head bolts (49, 50) each 2EA, 8EA

※ Except when required specially, do not disassemble housing P1&P2 for sanitation.

220S8MC28



220S8MC29

(16) Inspection after disassembly

Clean all disassembled parts with clean mineral oil fully, and dry them with compressed air. Then, place them on clean papers or cloths for inspection.

① Control valve

a. Check whole surfaces of all parts for burrs, scratches, notches and other defects.
b. Confirm that the seal groove faces of the housing and the covers are smooth and free of dust, dent, rust etc.
c. Correct dents and damages on check seat faces of housing, if any, by lapping.
※ Pay attention not to leave lapping agent in the housing.
d. Confirm that all sliding and fitting parts can be moved manually and that all grooves and paths are free from foreign matter.
e. If any spring is broken or deformed, replace it with new one.
f. When a relief valve does not function properly, repair it, following its inspection procedures.
g. Replace all the O-rings with new ones.

② Relief valve

a. Confirm that all seat faces at ends of all poppets and seats are free of defects and are uniform contact faces.
b. Confirm manually that main poppet and seat can slide lightly and smoothly.
c. Confirm that outside face of main poppet and inside face of seat are free from scratches and so on.
d. Confirm that orifices of the main poppet and seat section are not clogged with foreign matter.
e. Replace all O-rings with new ones.
f. When any light damage is found in above inspections, correct it by lapping.
g. When any abnormal part is found, replace it with a relief valve assembly.

GROUP 5 SWING DEVICE (TYPE 1 & 2)

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

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

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

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

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

13031GE18

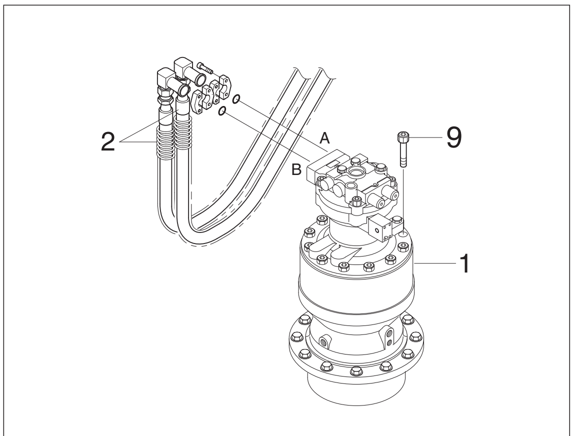
(4) Disconnect hose assembly (2).

(5) Disconnect pilot line hoses (3, 4, 5, 6, 7, 8).

(6) Sling the swing motor assembly (1) and remove the swing motor mounting socket bolts (9).

· Motor device weight : 61 kg (135 lb)

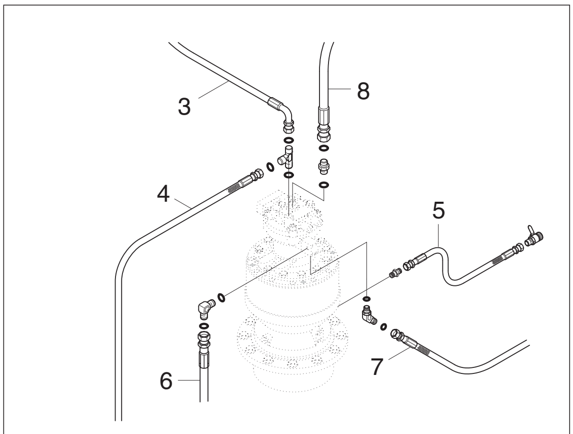
· Tightening torque : 57.9 ± 5.8 kgf·m (419 ± 42 lbf·ft)



210S8SM01

(7) Remove the swing motor assembly.

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



210S8SM02

2) INSTALL

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

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

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

③ Tighten plug lightly.

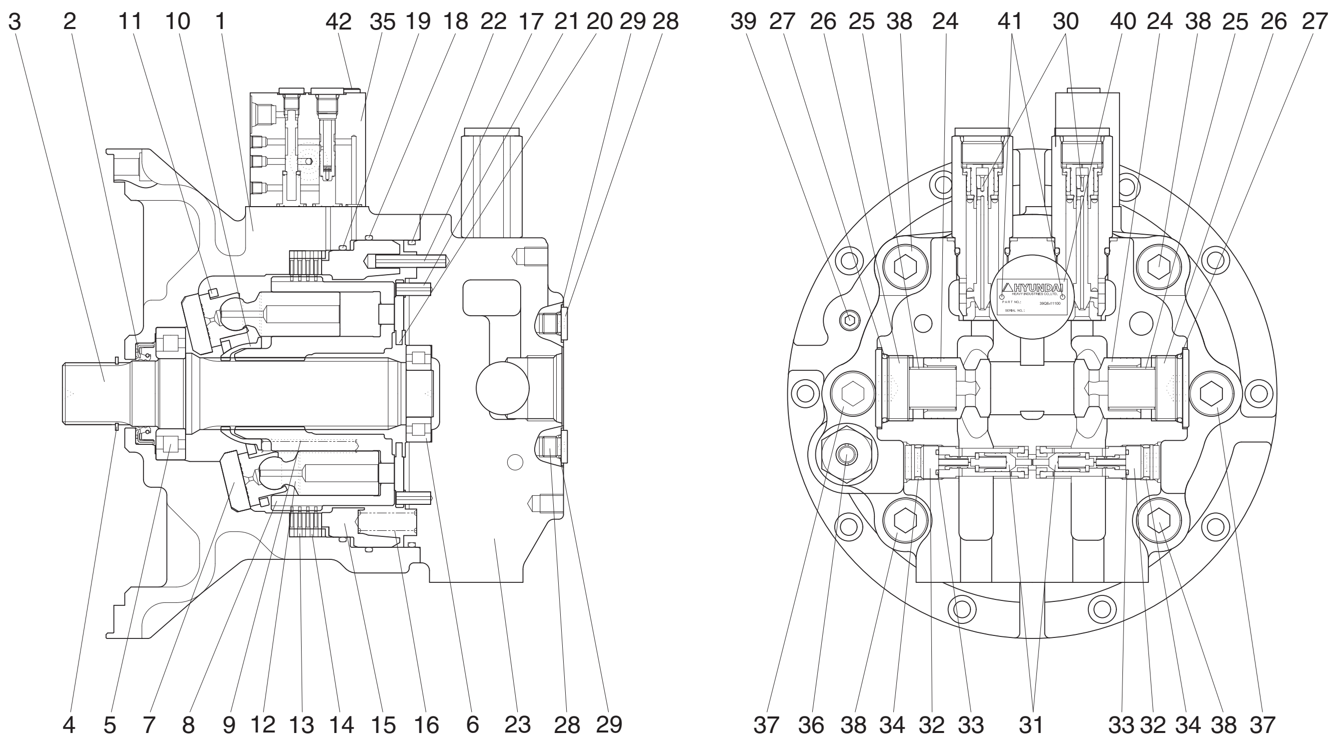
④ Start the engine, run at low idling and check oil come out from plug.

⑤ Tighten plug fully.

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

2. DISASSEMBLY AND ASSEMBLY OF SWING MOTOR

1) STRUCTURE



210S2SM22

1	Casing
2	Oil seal
3	Shaft
4	Snap ring
5	Roller bearing
6	Needle bearing
7	Swash plate
8	Cylinder block
9	Spring
10	Ball guide
11	Retainer plate
12	Piston assy
13	Friction plate
14	Separate plate
15	Parking piston
16	Brake spring
17	Spring pin
18	O-ring
19	O-ring
20	Valve plate
21	Spring pin
22	O-ring
23	Valve casing
24	Check valve
25	Spring
26	Plug
27	O-ring
28	Plug
29	O-ring
30	Relief valve assy
31	Reactionless valve assy
32	Plug
33	O-ring
34	O-ring
35	Time delay valve assy
36	Level gauge
37	Socket bolt
38	Socket bolt
39	Plug
40	Name plate
41	Rivet
42	Socket bolt

2) DISASSEMBLY

(1) Disassemble drive shaft

① Unloosing socket bolt (time delay valve, 42) and disassemble time delay valve assy (35) from casing (1).

2209A8SM51

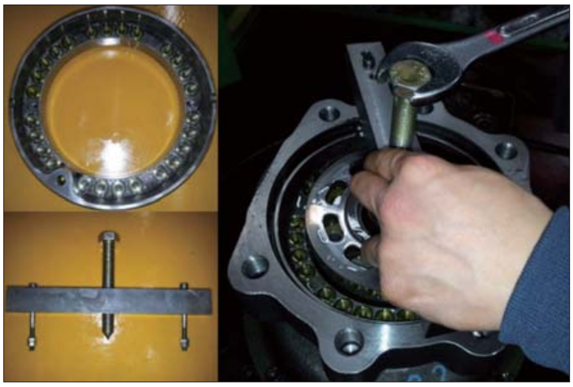
② Disassemble level gauge (36) from casing (1).

2209A8SM52

③ Hang valve casing (23) on hoist, unloose socket bolt (37, 38) and disassemble from casing (1).

2209A8SM53

④ Disassemble spring (16) and using a jig, disassemble parking piston (15) from casing (1).



2209A8SM54

⑤ Disassemble respectively cylinder block sub (8), friction plate (13), separate plate (14) from casing (1).

2209A8SM55

⑥ Disassemble swash plate (7) from casing (1).

2209A8SM56

⑦ Using a plier jig, disassemble snap ring (4) from casing (1).

2209A8SM57

⑧ Disassemble shaft assy (3), oil seal (2) and O-ring (18, 22) from casing (1).

2209A8SM58

(2) Disassemble cylinder block sub

① Disassemble piston assy (12) from cylinder block (8).

2209A8SM59

② Disassemble ball guide (10) and spring (cylinder block, 9) from cylinder block (8).

· Ball guide × 1EA
· Spring × 9EA

2209A8SM60

(3) Disassemble valve casing sub

① Disassemble spring pin (17, 21), valve plate (20), O-ring (22) from valve casing (23).

2209A8SM61

② Using a torque wrench, disassemble relief valve (30) from valve casing (23).

2209A8SM62

③ Using a torque wrench, disassemble plug (32) from valve casing (23) and disassemble O-ring (33, 34) and reactionless valve assy (31).

2209A8SM63

④ Using a torque wrench, disassemble check valve (24) from valve casing (23).

2209A8SM64

⑤ Disassemble plug (28), O-ring (29) from valve casing (23).

2209A8SM65

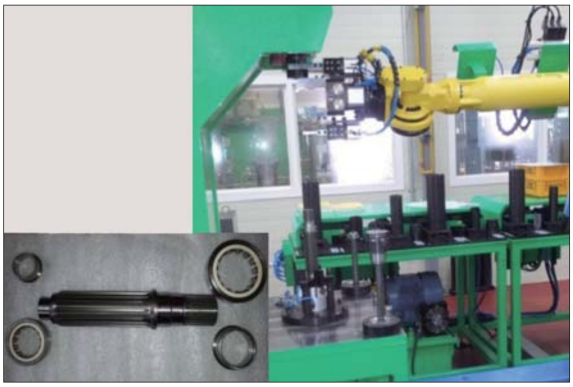
3) ASSEMBLING

(1) Assemble shaft sub

① Put roller bearing (3) on preheater and provide heat to inner race.
(Temperature in conveyor : 120°C for 3~5 minutes)

2209A8SM66

② Using a robot machine, assemble and press preheated roller bearing (3) into shaft (5).



2209A8SM67

(2) Assemble cylinder block sub

① Assemble 9 springs (cylinder block, 9) into cylinder block (8).
・Spring×9EA

2209A8SM68

② Assemble ball guide (10) into cylinder block (8).
・Ball guide×1EA

2209A8SM69

③ Assemble 9 piston assy (12) into retainer plate (11).

· Piston assy × 9EA
· Retainer plate × 1EA

2209A8SM70

④ Assemble parts of procedure ② and ③.

2209A8SM71

(3) Assemble valve casing sub

① Assemble make up check valve sub

Assemble check valve (24), O-ring (27), plug (26) in that order and then screw it torque wrench.

· Make up check valve × 2EA
· Spring × 2EA
· Plug × 2EA
· O-ring × 2EA

2209A8SM72

② Assemble reactionless valve assy

Assemble reactionless valve assy (31), plug (32), O-ring (33, 34) in that order and then screw it a torque wrench.

· Reactionless valve assy (31) × 2EA
· Plug (32) × 2EA
· O-ring (33, 34) × 2EA

2209A8SM73

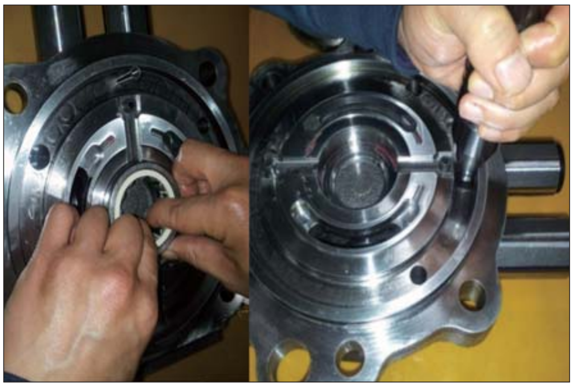
③ Using a torque wrench, assemble relief valve (30) 2 sets into valve casing (23).
  · Relief valve (30)×2EA

2209A8SM74

④ Assemble plug (28) and O-ring (27) into valve casing (23).
  · Plug (28)×3EA
  · O-ring (27)×3EA

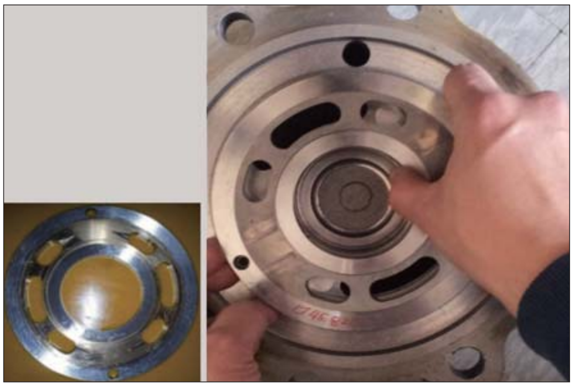
2209A8SM75

⑤ Assemble needle bearing (6) into valve casing (23) and assemble spring pin (17, 21) into valve casing (23).
  · Needle bearing (6)×1EA
  · Spring pin (17, 21)×1EA



2209A8SM76

⑥ Apply some grease valve plate (20) and assemble it into valve casing (23).



2209A8SM77

(4) Assemble drive shaft sub

① Using a jig, assemble oil sealing (2) into casing (1).

2209A8SM78

② Fit shaft sub (shaft+roller bearing) into casing (1).

2209A8SM79

③ Using a plier jig, assemble snap ring (4) to shaft (3).

· Snap ring×1EA

2209A8SM80

④ Apply some grease swash plate (7) and assemble it into casing (1).

· Swash plate×1EA

2209A8SM81

⑤ Insert O-ring (18, 19) into casing (1).
- O-ring (18)×1EA
- O-ring (19)×1EA


2209A8SM82

⑥ Assemble cylinder block (8) into casing (1).


2209A8SM83

⑦ Assemble separate plate (14) and friction plate (13) 4 sets into casing (1) and fit parking piston (15) into casing (1) by a jig or a press.
- Separate plate×4EA
- Friction plate×4EA
- Parking piston×1EA


2209A8SM84

⑧ Assemble spring (parking piston, 16) into parking piston (15).
- Spring×26EA


2209A8SM85

⑨ Lift up valve casing (23) on casing (1) by a crane and assemble it with socket bolts (37, 38).

2209A8SM86

⑩ Assemble level gauge (36) and plug (39) into casing (1).

2209A8SM87

⑪ Assemble time delay valve assy (35) into valve casing (23) with socket bolt (42).

- Time delay valve × 1EA
- Socket bolt × 3EA

2209A8SM88

⑫ **Air pressing test**

Be sure of leakage, after press air into assembled motor and put it in water for 1 minute (pressure : 2 kgf/cm^2).

2209A8SM89

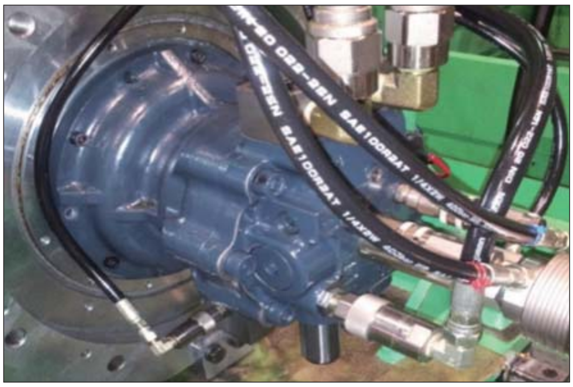
⑬ Leakage check

Place motor on a bench tester and after cleaning motor by color check No.1, paint No.3 and be sure of leakage.

2209A8SM90

⑭ Mount test bench

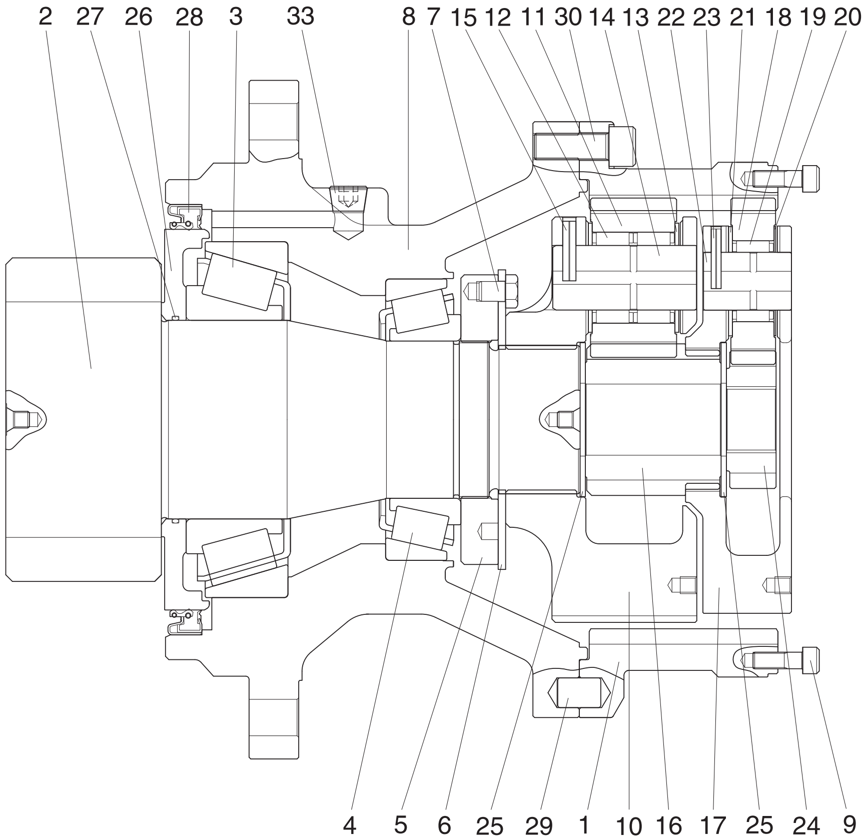
Mounting motor a test bench, test the availability of each part.



2209A8SM91

3. DISASSEMBLY AND ASSEMBLY OF REDUCTION GEAR

1) STRUCTURE



220L2SM03

1	Ring gear	11	Planetary gear 2	21	Thrust washer 1 - lower
2	Drive shaft	12	Needle bearing 2	22	Carrier pin 1
3	Taper bearing	13	Thrust washer 2	23	Spring pin
4	Taper bearing	14	Carrier pin 2	24	Sun gear 1
5	Ring nut	15	Spring pin	25	Thrust plate
6	Lock plate	16	Sun gear 2	26	Sleeve
7	Hexagon bolt	17	Carrier 1	27	O-ring
8	Casing	18	Planetary gear 1	29	Parallel pin
9	Socket bolt	19	Needle bearing 1	30	Socket bolt
10	Carrier 2	20	Thrust washer 1 - upper	33	Plug

2) DISASSEMBLY

(1) Preparation

① The reduction gear removed from machine is usually covered with mud.
Wash out side of reduction gear and dry it.
② Setting reduction gear on work stand for disassembling.
③ Mark for mating
Put marks on each mating parts when disassembling so as to reassemble correctly as before.
⚠ Take great care not to pinch your hand between parts while disassembling not let fall parts on your foot while lifting them.


2209A8SM01

(2) Disassembly

① Remove every “Socket bolt (M10)” that secure swing motor and reduction gear.
② Removing carrier sub assy & sun gear
a. Removing No.1 sun gear from No.1 carrier sub assy.
※ Be sure maintaining it vertical with ground when disassembling No.1 sun gear.


2209A8SM02

b. Removing No.1 carrier sub assy screwing I-bolt to tab hole (M10) in No.1 carrier.
Lifting it gradually maintaining it vertical with ground.
※ It’s impossible to disassemble No.1 spring pin. If No.1 spring pin has problem, change whole No.1 carrier sub assy.


2209A8SM03

c. Removing No.2 sun gear from No.2 carrier sub assy.

※ Be sure maintaining it vertical with ground when disassembling No.2 sun gear.

2209A8SM04

d. Removing No.2 carrier sub assy screwing I-bolt to tab hole (M10) in No.2 carrier. Lifting it gradually maintaining it vertical with ground.

※ It's impossible to disassemble No.2 spring pin. If No.2 spring pin has problem, change whole No.2 carrier sub assy.

2209A8SM05

③ Removing ring gear

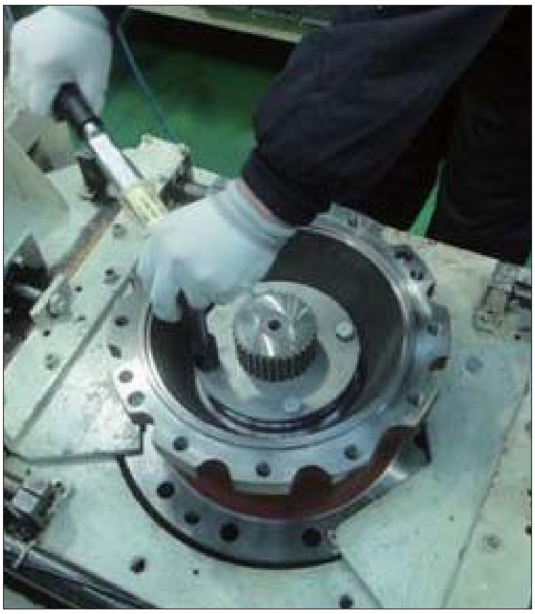
After unscrewing every socket bolt (M16), remove ring gear from casing.

※ Because of liquid gaskets between ring gear and casing, put sharp punch between ring gear and casing and tapping it to remove them.

2209A8SM06

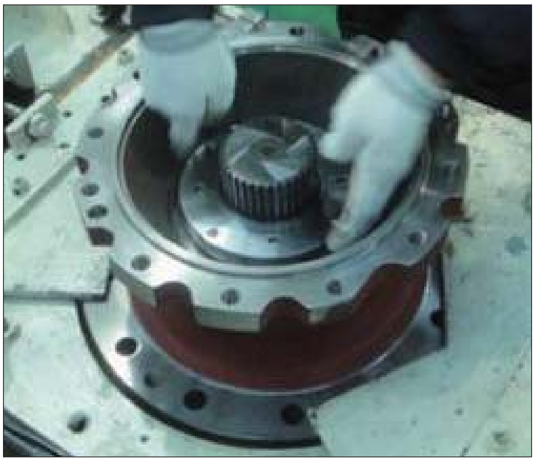
④ Removing drive shaft sub assy

a. Unscrew every hex head bolt (M12) to remove lock plate.



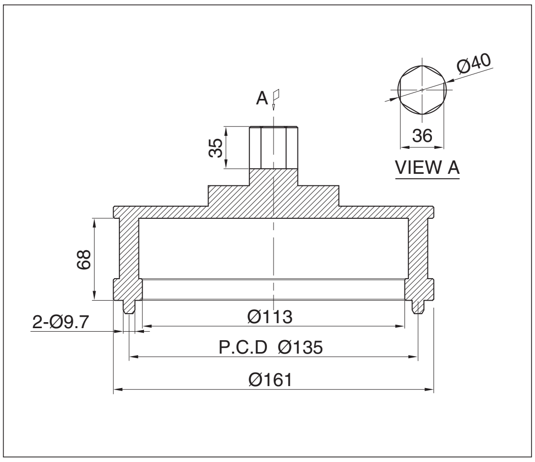
2209A8SM07

b. Rolling ring nut for removing them from drive shaft sub assy.



2209A8SM08

※ Use special tool to roll ring nut to counter clockwise.



220L8SM01

c. Remove drive shaft sub assy from casing.
※ Set a rack for flange of casing, and remove drive shaft sub assy from casing by using press.


2209A8SM09

d. Remove oil seal & taper bearing (small) from casing.
※ Do not re-use oil seal. It is impossible to dis-assemble drive shaft sub assy.


2209A8SM10


2209A8SM11

4. ASSEMBLY REDUCTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them in a cool and dry place.

(2) Loctite on surface must be removed by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite #242 applied on its threads.

(5) Apply gear oil slightly on each part before assembling.

⚠ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.
Inspection before assembling.

Thrust washer
- Check the seizure, abnormal wear or uneven wear.
- Check the unallowable wear.

Gear
- Check the pitting or seizure on tooth surface.
- Check the cracks on the root of tooth.

Bearing
- Rotate it by hands to check such noise or uneven rotation.

2) ASSEMBLING NO.1 CARRIER SUB ASSY

(1) Put thrust plate firmly in No.1 carrier.

(2) After assembling No.1 needle bearing to No.1 planetary gear, put a pair of No.1 thrust washer on both sides of bearing and install them to No.1 carrier.


2209A8SM12


2209A8SM13

(3) Make of spring pin hole No.1 pin and No.1 carrier of spring pin hole in line, press No.1 spring pin into the holes.
Make No.1 spring pin hole head for No.1 planetary gear.

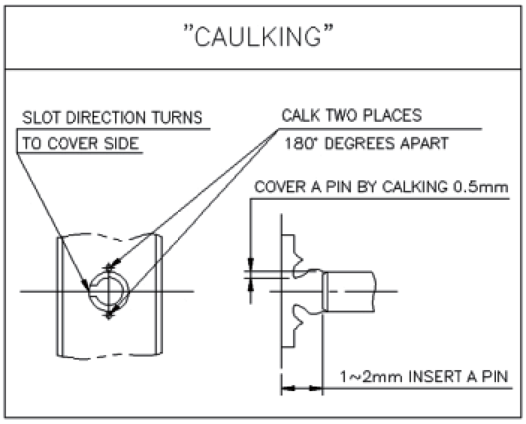
2209A8SM14

(4) Caulk carrier holes to make No.1 spring pin settle down stably.

2209A8SM15

※ Refer to "Caulking details"

Use paint marker for marking after caulking.



2209A8SM16

2) ASSEMBLING NO.2 CARRIER SUB ASSY

(1) Put thrust plate in firmly No.2 carrier.


2209A8SM17

(2) After assembling No.2 needle bearing to No.2 planetary gear, put 2 pieces of No.2 thrust washer on both sides of bearing and install them to No.2 carrier.

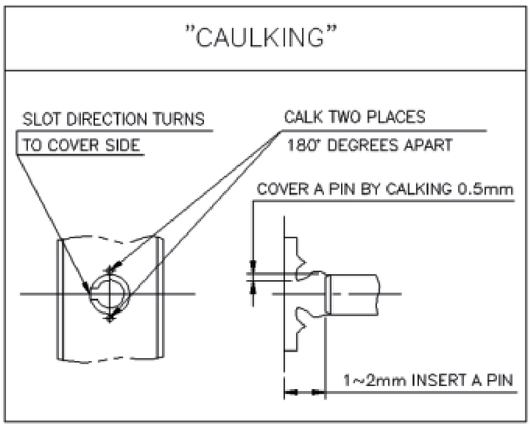

2209A8SM18

(3) Align No.2 spring pin hole and No.2 carrier spring pin hole, put No.2 spring pin into the holes.
Make No.2 spring pin cutting line face to No.2 planetary gear.


2209A8SM19

(4) Caulk carrier holes to make No.2 spring pin settle down stably.
※ Refer to “Caulking details”

Use paint marker for marking after caulking.



2209A8SM20

3) ASSEMBLING PINION GEAR SUB ASSY

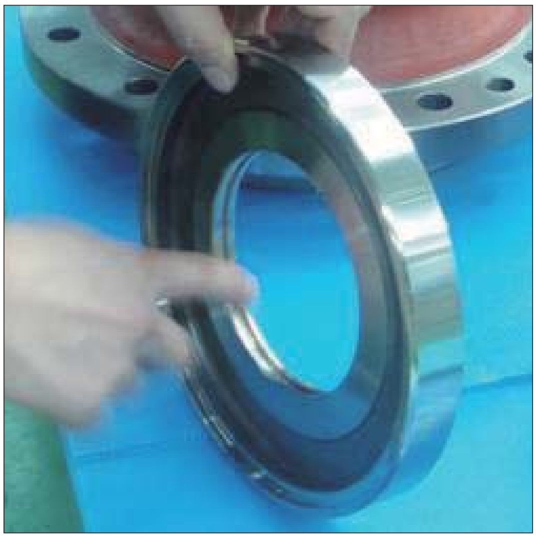
(1) Prepare drive shaft pinion gear vertical with ground.

2209A8SM21

(2) Fully apply grease (albania EP02) to O-ring groove of sleeve.

※ Be sure to maintain it vertical with ground when assembling it.

(3) Put O-ring into O-ring groove of sleeve.
Fully apply grease on O-ring.



2209A8SM22

(4) Assemble taper bearing and sleeve into drive shaft using press jig.
Use special jig for pressing. Leave no space between sleeve and taper bearing.

2209A8SM23

2209A8SM24

4) ASSEMBLING BEARING CUP & OIL SEAL (PRESSING)

(1) Put top, bottom bearing cup into casing.
Use special jig for pressing. Pay attention to foreign materials while assembling bearing cup.

※ Flip over casing to assemble oil seal.

2209A8SM25

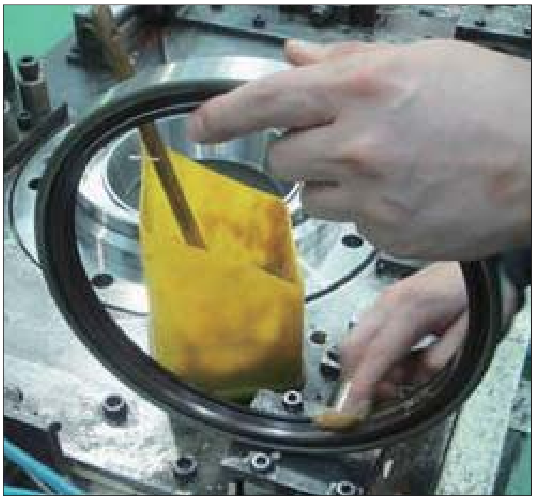
2209A8SM26

(2) Assemble oil seal to casing.
Use special jig for pressing. Pay attention to direction of dust seal and dent.

2209A8SM27

※ WHILE ASSEMBLING OIL SEAL

1. Be sure to set dust seal to gear oil.
2. Before assembling, charge enough grease in oil seal.
3. Before assembling, apply enough grease inside and outside of oil seal.



2209A8SM28

5) ASSEMBLING SHAFT SUB ASSY & RING NUT

(1) After assembling casing & drive shaft sub assy, flip it over.

2209A8SM29

(2) Put drive shaft sub assy into casing.
※ Be sure to maintain it vertical with ground when assembling it.

2209A8SM30

(3) Put taper bearing into it.
Rotate bearing by hands for checking after assembly.

2209A8SM31

(4) Put ring into drive shaft sub assy by using special jig.

The tightening torque (M95) = 3.5±0.4 kgf·m
(25.3±2.9 lbf·ft)

2209A8SM32

※ Apply enough loctite #242 before screwing bolts.

2209A8SM33

(5) Align bolt screw of ring nut with lock plate's hole.
In case of misalign between bolt screw ring nut and lock plate's hole, put lock plate as near as possible to hole of bolt screw of ring nut and make it in line by increasing tightening torque.

2209A8SM34

2209A8SM35

(6) Screw 4 bolts (M12×16) to connect ring nut and lock plate by using torque wrench.
Bolt (M12, 4EA) = 10.9T
The tightening torque = 8.8±0.9 kgf·m
(63.7±6.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.

2209A8SM36

(7) Use paint marker for checking surplus parts after assembling.

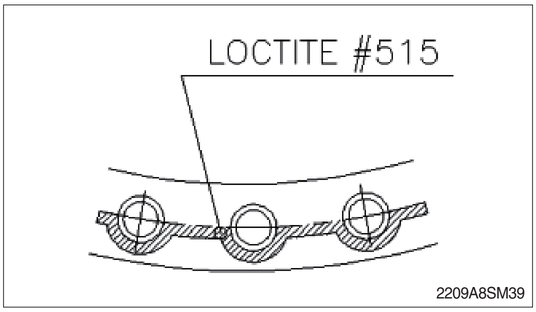
2209A8SM37

6) ASSEMBLING RING GEAR

(1) Apply loctite #515 bottom of casing sub assy contacting with ring gear without disconnection.

2209A8SM38

Refer to loctite detail.



2209A8SM39

(2) Put parallel pin into hole of casing sub assy. Mark parallel pin position using paint marker.

2209A8SM40

(3) Align ring gear with parallel pin to put them into casing sub assy.

※ Be sure to maintain them vertical with ground while using press.

2209A8SM41

(4) Screw 12 bolts (M16×45) to connect casing sub assy and ring gear (01) by using torque wrench.
Bolt (M16, 12EA) = 12.9T
The tightening torque = 27±2.7 kgf·m
(195±19.5 lbf·ft)

※ Apply enough loctite #242 before screwing bolts.

2209A8SM42

(5) Use paint marker for checking surplus parts after assembling.

2209A8SM43

2209A8SM44

7) ASSEMBLING CARRIER SUB ASSY & SUN GEAR

(1) Put No.2 carrier sub assy along spline of drive shaft spline.

- Screw M10 I-bolt to No.2 carrier sub assy.
- Lifting up No.2 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.2 carrier sub assy by hands to fit No.2 carrier sub assy into drive shaft spline.

2209A8SM45

(2) Put No.2 sun gear into No.2 carrier sub assy.

2209A8SM46

(3) Put No.1 carrier sub assy into No.2 sun gear along spline.
- Screw M10 I-bolt to No.1 carrier sub assy.
- Lifting up No.1 carrier sub assy and align planetary gear and tooth of ring gear by rotating planetary gear by hands.
- Rotate No.1 carrier sub assy by hands to fit No.1 carrier into No.2 sun gear spline.

2209A8SM47

(4) Put No.1 sun gear into No.1 carrier sub assy. Be sure to maintain it vertical with ground. And align with No.1 planetary gear spline.

(5) Rotate No.1 carrier sub assy by hands to check noise.

2209A8SM48

8) MEASURING CLEARANCE & ASSEMBLING NAME PLATE

(1) Check the clearance between ring gear and No.1 sun gear using a tool with dial gauge.

Check the clearance
Dial gauge = -0.3 ~ +2.95

2209A8SM49

GROUP 6 TRAVEL DEVICE (TYPE 1 & 2)

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

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

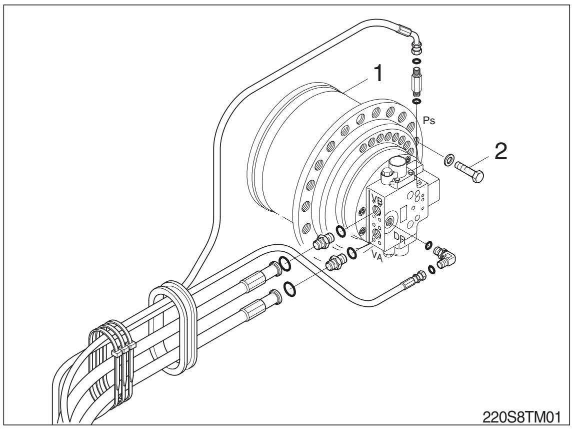
(3) Loosen the breather slowly to release the pressure inside the hydraulic tank.

13031GE18

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

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

(4) Remove the track shoe assembly.
For details, see **removal of track shoe assembly.**



220S8TM01

(5) Remove the cover.

(6) Remove the hoses.
※ 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 : 305 kg (670 lb)
· Tightening torque : 23 ± 2.5 kgf · m
(166 ± 18.1 lbf · ft)

2) INSTALL

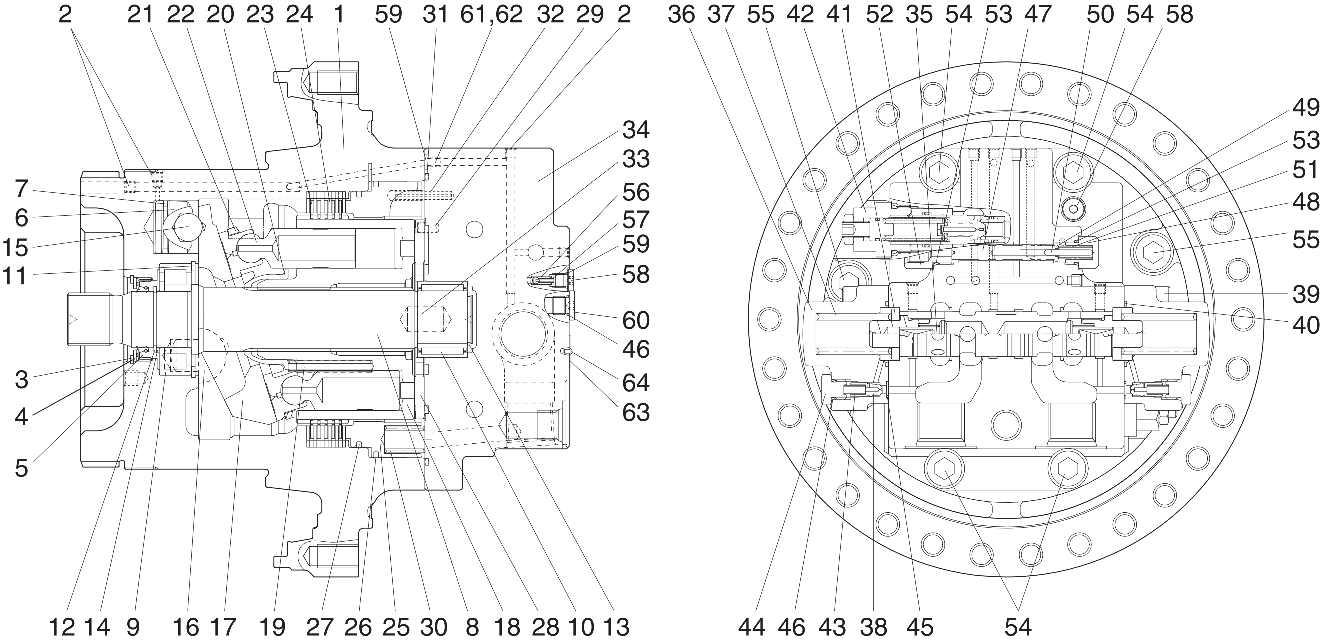
(1) Carry out installation in the reverse order to removal.

(2) Bleed the air from the travel motor.
① Remove the air vent plug.
② Pour in hydraulic oil until it overflows from the port.
③ Tighten plug lightly.
④ Start the engine, run at low idling, and check oil come out from plug.
⑤ Tighten plug fully.

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

2. TRAVEL MOTOR

1) STRUCTURE

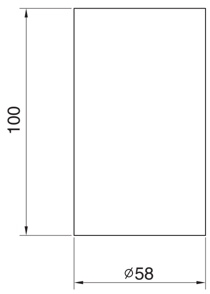
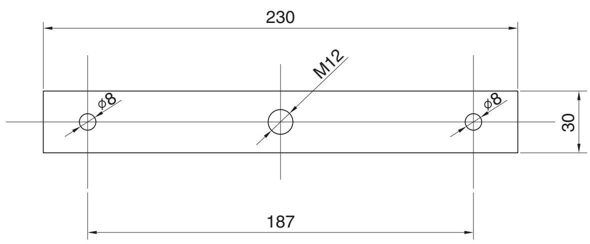
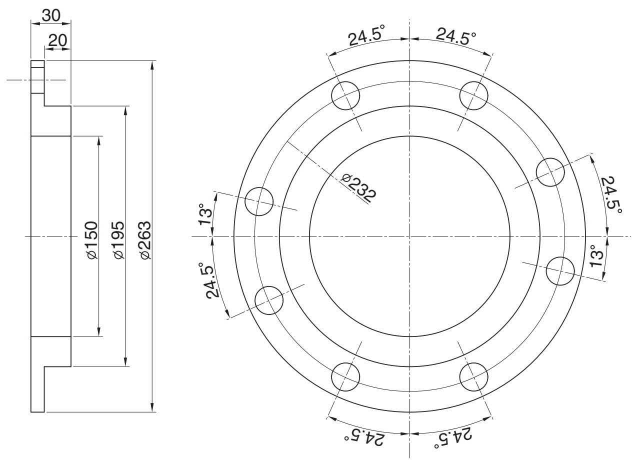


2209A2TM21

1	Casing	23	Friction plate	44	Plug
2	Plug	24	Separated plate	45	O-ring
3	Oil seal	25	Parking piston	46	O-ring
4	Thrust plate	26	D-ring	47	Spool
5	Snap ring	27	D-ring	48	Plug
6	Piston	28	Valve plate	49	Spring seat
7	Piston seal	29	Parallel pin	50	Parallel pin
8	Shaft	30	Spring	51	Spring
9	Cylinder roller bearing	31	O-ring	52	Connector
10	Needle bearing	32	Spring pin	53	O-ring
11	Snap ring	33	Parallel pin	54	Hexagon socket head bolt
12	Snap ring	34	Rear cover	55	Hexagon socket head bolt
13	Snap ring	35	Main spool assy	56	Check valve
14	Thrust plate	36	Cover	57	Spring
15	Steel ball	37	Spring	58	Plug
16	Pivot	38	Restrictor	59	O-ring
17	Swash plate	39	Hexagon socket head bolt	60	Plug
18	Cylinder block	40	O-ring	61	Restrictor
19	Spring	41	Spring seat	62	Restrictor
20	Ball guide	42	Relief valve assy	63	Name plate
21	Retainer plate	43	Spring	64	Rivet
22	Piston assy				

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark
Hexagon wrench	Width across flat 5, 6, 8, 10, 14 mm
Snap ring prier	For shaft Ø60~80 mm
Snap ring prier	For bore Ø32~58 mm
Plastic hammer	1 piece
Screw dirver	Minus (-), medium size, 2 pieces
Torque wrench	10 kgf·m (72.3 lbf·ft), 33 kgf·m (238.6 lbf·ft), 45 kgf·m (325.4 lbf·ft)
Gig for inserting oil seal	 25098TM31
Gig for inserting parking piston (M10×100 bolt 2EA, M12×100 bolt 1EA)	 25098TM32
Gig for pulling out brake piston	 25098TM33

(2) Tightening torque

Item	Name	Size	Torque	
			kgf · m	lbf · ft
2	Plug	NPTF 1/16	1.1±0.1	7.9±0.72
39	Hexagon socket head bolt	M12	1.0±1.0	72.3±7.2
42	Relief valve	1 5/16	34±3.4	246±24.6
44	Plug	PF 1/4	2.8±0.3	20.3±2.17
48	Plug	PF 3/8	5.5±0.5	39.8±3.6
52	Connector	PF 3/8	5.5±0.5	39.8±3.6
54	Hexagon socket head bolt	M18	38±3.8	275±27.5
55	Hexagon socket head bolt	M18	38±3.8	275±27.5
58	Plug	PF 1/8	1.5±0.1	10.8±0.72
60	Plug	PF 1/4	3±0.3	21.7±2.17

3. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ Combustibles such as white kerosene are used for washing parts.
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ Internal parts are coated with hydraulic fluid during disassembling and are slippery.
If a part slips out of your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Generally, hydraulic equipment is precisely manufactured and clearances between each parts are very narrow. Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather. Tools and kerosene to wash parts should also be clean and handled with great care.

(2) When motor is removed from the host machine, wash around the ports sufficiently and put the plugs so that no dust and/or water may invade. Take off these plugs just before the piping works when re-attach it to the host machine.

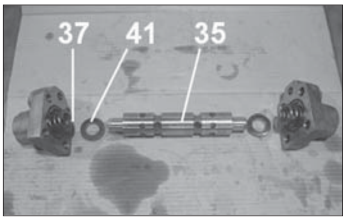
(3) Before disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

(4) The piston can be inserted to whichever cylinder block for the initial assembling.
However, their combination should not be changed if they are once used. To reuse them, put the matching mark on both pistons and cylinder block before disassembling.

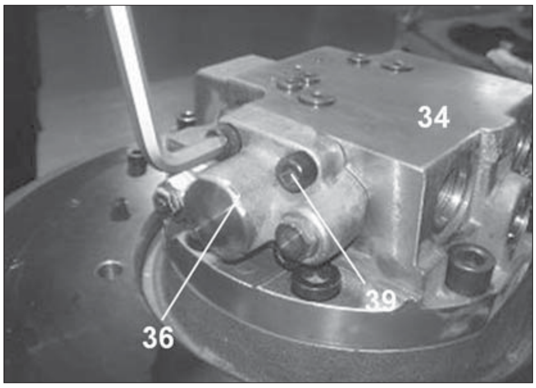
⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

2) DISASSEMBLING TRAVEL MOTOR

(1) Disassemble the wrench bolt (39) to tighten the spool cover (36) and rear cover (34) by using the L-wrench or impact wrench and then disassemble the spring (37), spring seat (41) and main spool assy (35) in order.

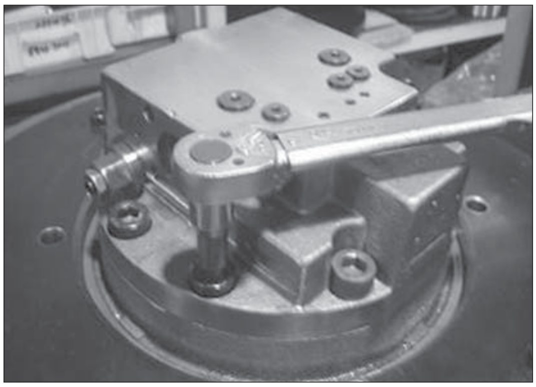


25098TM034



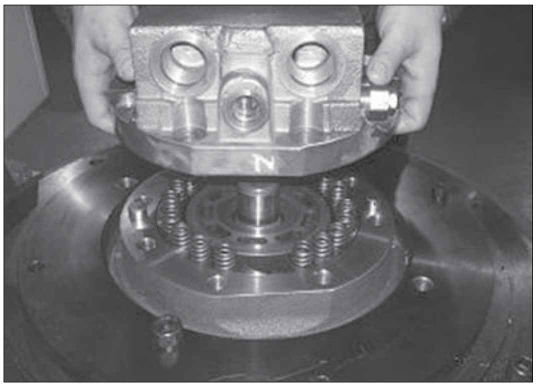
25098TM035

(2) Disassemble the wrench bolt (54, 55) to tighten the casing (1) and rear cover (34) by using the L-wrench or impact wrench.



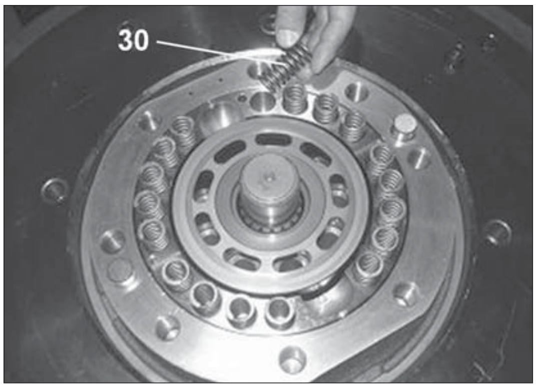
25098TM036

(3) Separate the casing (1) and rear cover (34).



25098TM037

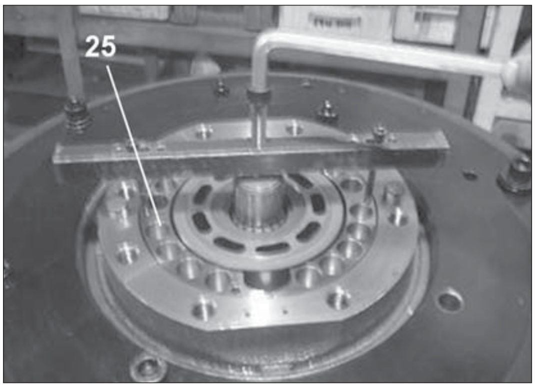
(4) Disassemble the brake spring (30, 18EA) from the piston.



25098TM118

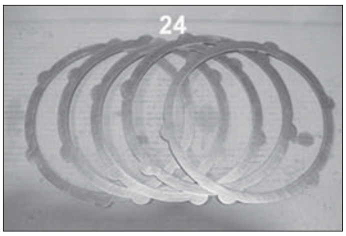
(5) Disassemble the parking piston (25) by using the jig for disassembling parking piston.

25098TM039

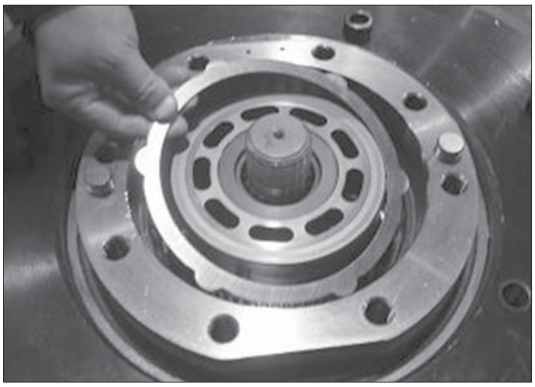


25098TM040

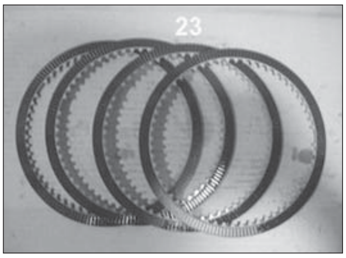
(6) Disassemble the separated plate (24, 5EA) and friction plate (23, 4EA) from the casing.



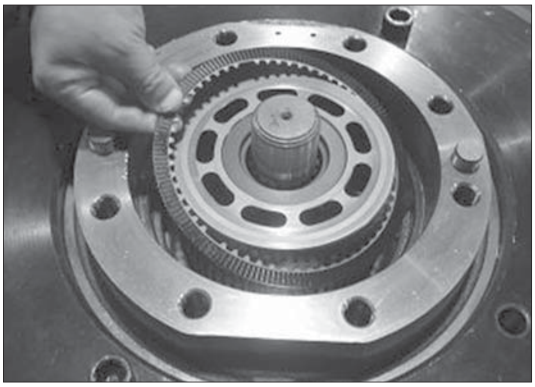
25098TM041



25098TM042

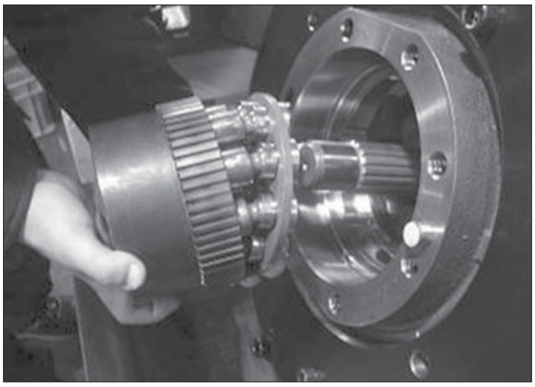


25098TM043



25098TM044

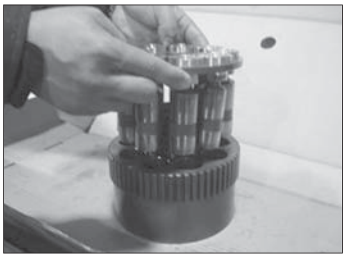
(7) Turn the casing (1) horizontal by using the assemble truck and disassemble the cylinder block kit form the casing (1).

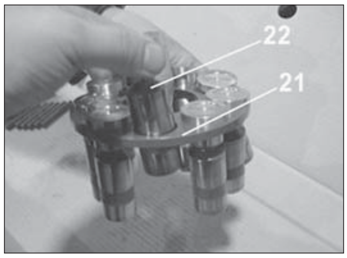


25098TM045

(8) Disassemble the cylinder block (18), retainer plate (21), piston assy (22), ball guide (20) and spring (19) from the cylinder block kit.


25098TM046


25098TM047



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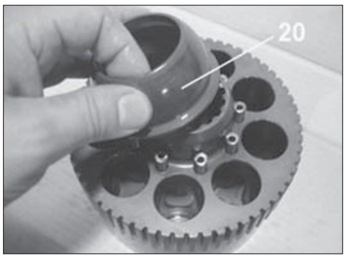
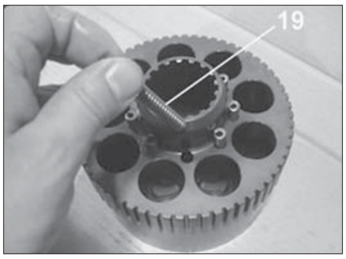


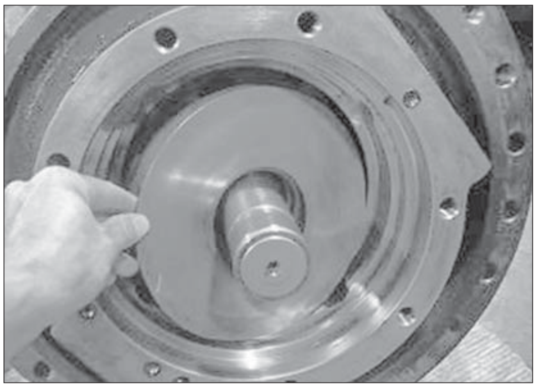
25098TM049



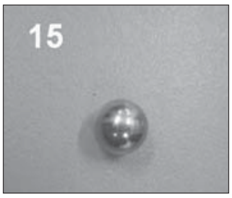
25098TM050

(9) Disassemble the swash plate (17) from the casing.

25098TM051


25098TM052

(10) Disassemble the steel ball (15) and swash piston (6) from the casing.



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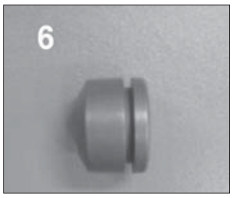
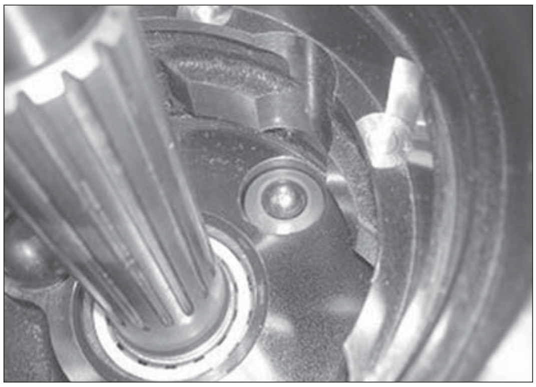
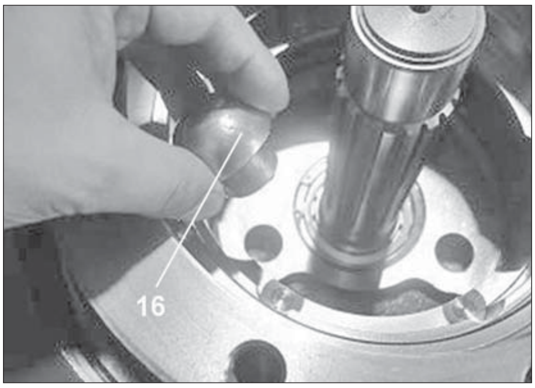


25098TM054

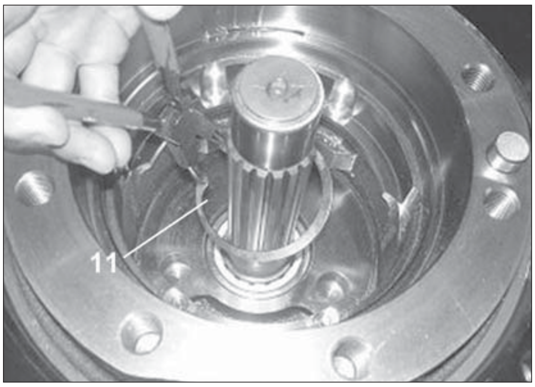

25098TM055

(11) Disassemble the pivot (16, 2EA) from the casing.



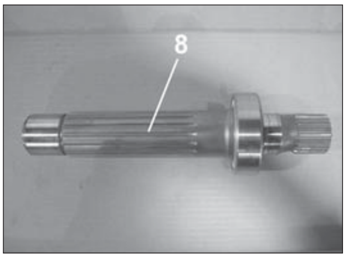
25098TM056

(12) Disassemble the snap ring (11) from the shaft (8) with the pryer for retaining ring.



25098TM057

(13) Disassemble the shaft (8) from the casing (1).



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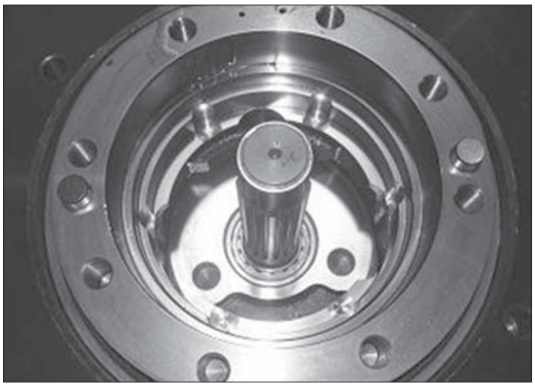
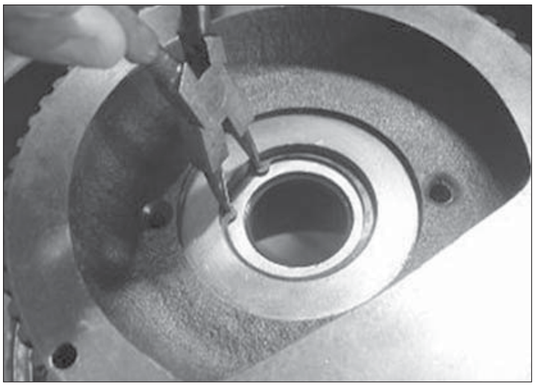
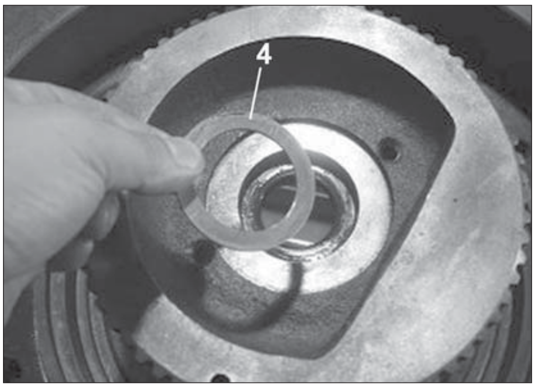

25098TM059

(14) Disassemble the snap ring (5) from the casing (1) with the pryer for retaining ring.


25098TM060

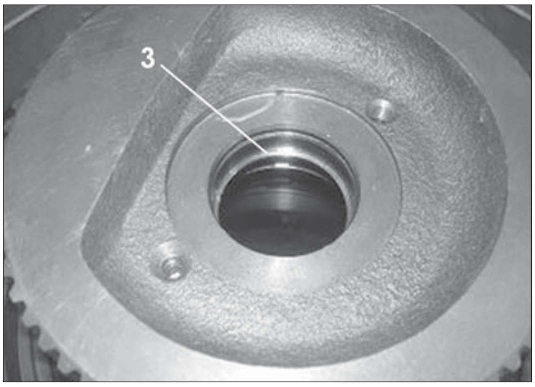
(15) Disassemble the thrust plate (4) from the casing (1).



25098TM061

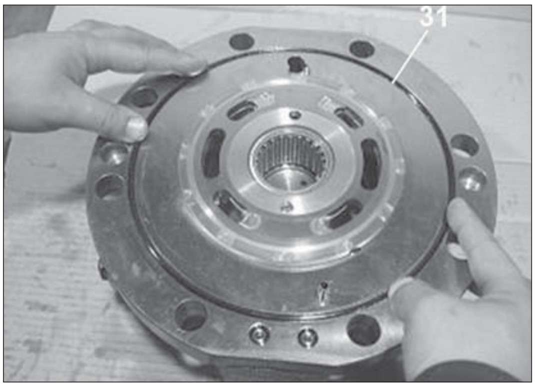
(16) Disassemble the oil seal (3) from the casing (1) with suitable tool.

25098TM062



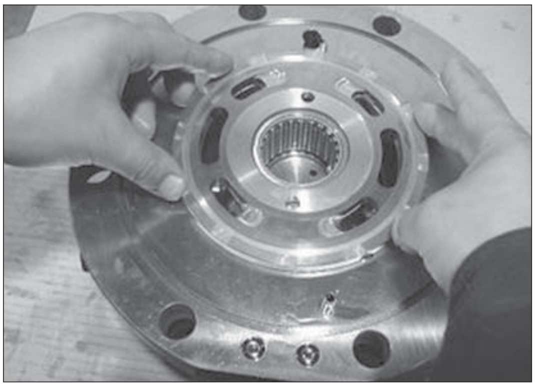
25098TM063

(17) Disassemble the O-ring (31) from the casing (1).



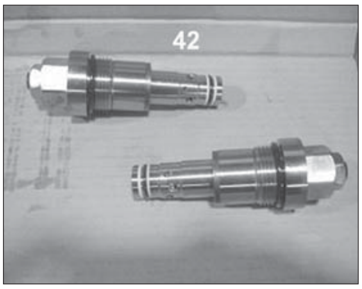
25098TM064

(18) Disassemble the valve plate (28) from the casing (1).

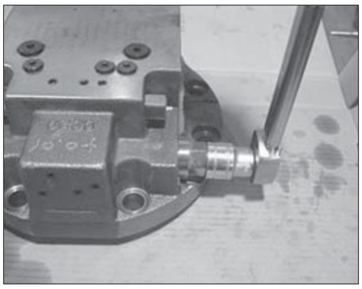


25098TM065

(19) Disassemble the relief valve (42, 2EA) from the rear cover (34) by using the torque wrench.



25098TM066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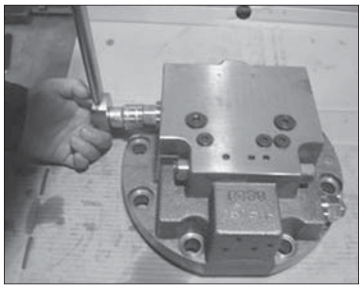
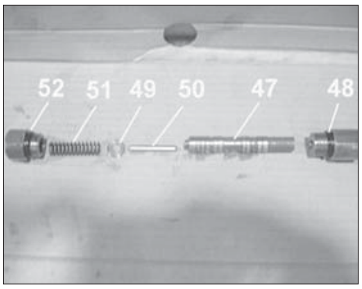
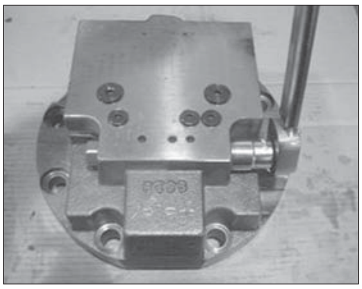
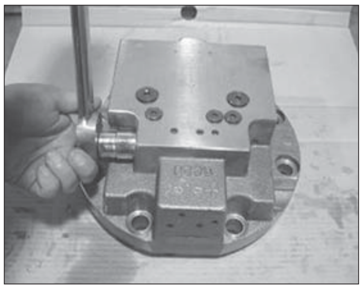

25098TM068

(20) Disassemble both side of the plug (48) and connector (52) from the rear cover (34) by using the torque wrench and then disassemble the spring (51), spring seat (49), parallel pin (50) and spool (47) in order.

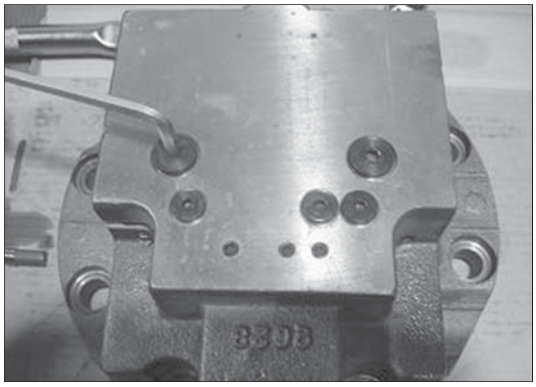


25098TM069

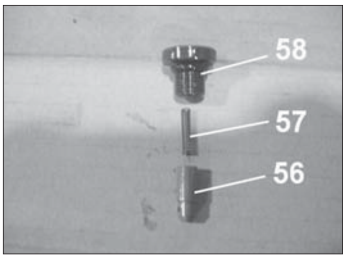

25098TM070


25098TM071

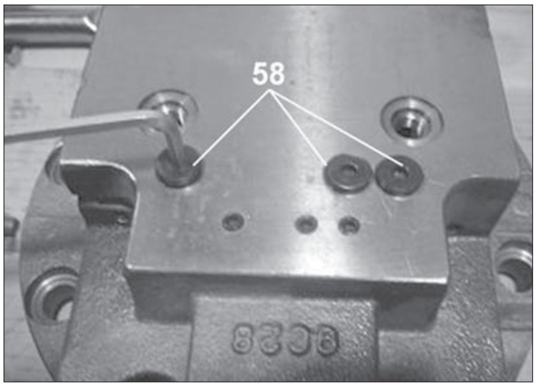
(21) Disassemble the plug (60) from the rear cover.


25098TM072

(22) Disassemble the plug (58) and then disassemble the spring (57) and check valve (56) from the rear cover in order.



25098TM073



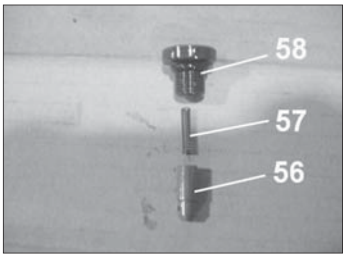
25098TM074

4. REASSEMBLING

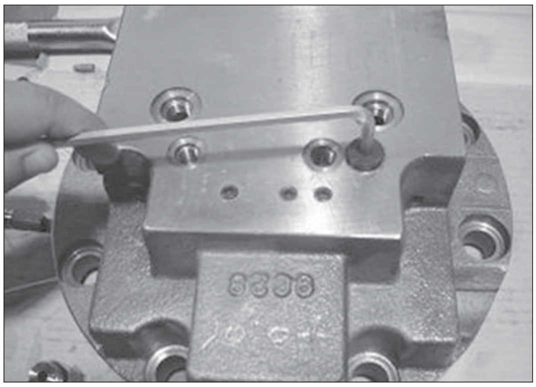
1) ASSEMBLING MOTOR

- REAR COVER ASSY

(1) Assemble the check valve (56) and the spring (57) to the rear cover and then tighten the plug (60) by using the L-wrench.

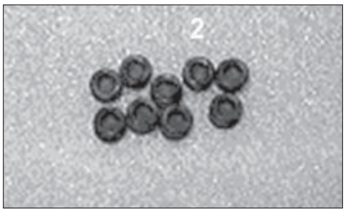


25098TM075

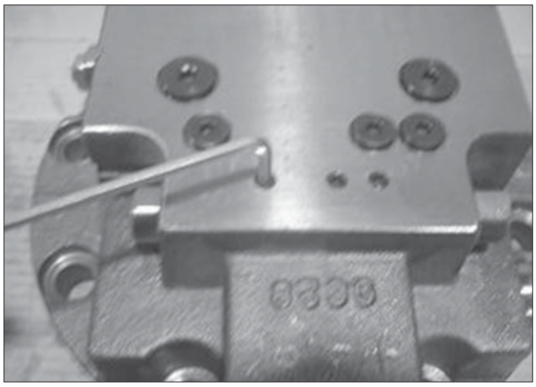


25098TM076

(2) Apply the loctite #242 on the NPTF 1/16 plug (2, 12EA) and tighten it.

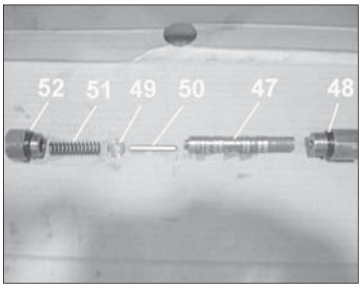


25098TM077

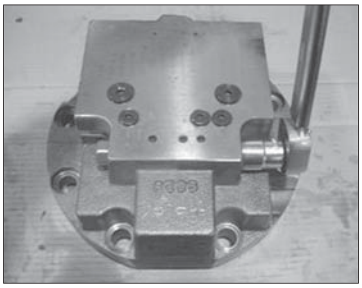


25098TM078

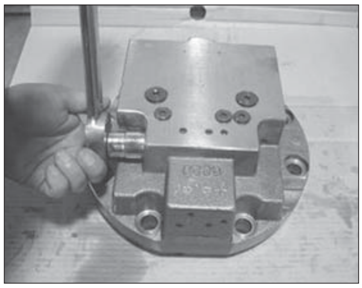
(3) Assemble the spool (47), parallel pin (50), spring seat (49) and spring (51) into the rear cover (34) and tighten both side of the plug (48) and connector (52) into the rear cover (34).



25098TM079

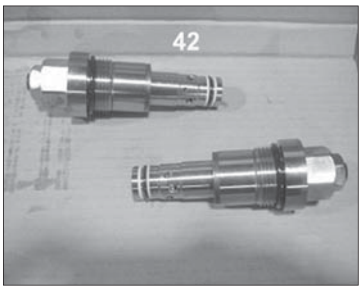


25098TM080

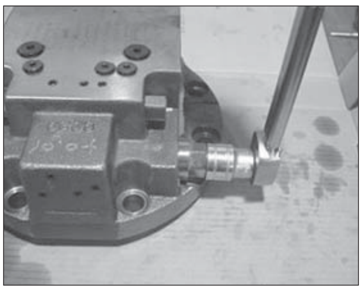


25098TM081

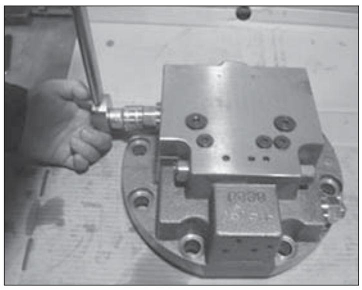
(4) Assemble the relief valve (42, 2EA) into rear cover (34).



25098TM082

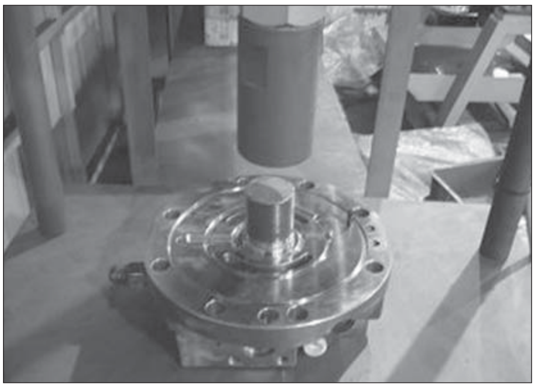


25098TM083



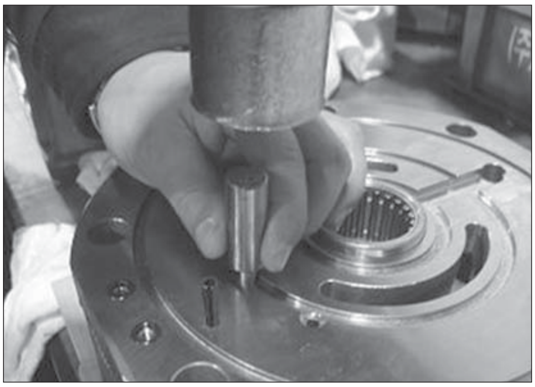
25098TM084

(5) Tight fit the needle bearing (10) into rear cover (34) by using pressing jig.



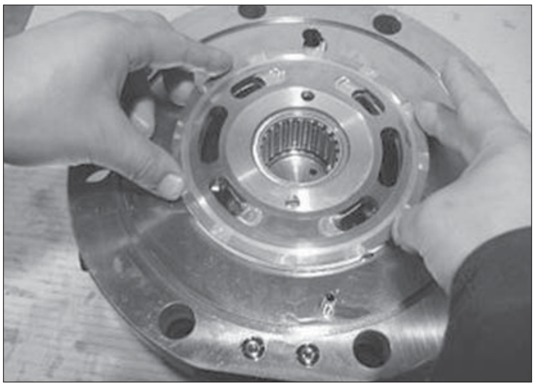
25098TM085

(6) Assemble the spring pin (32) and parallel pin (29) into rear cover (34) by using round bar or small hammer.



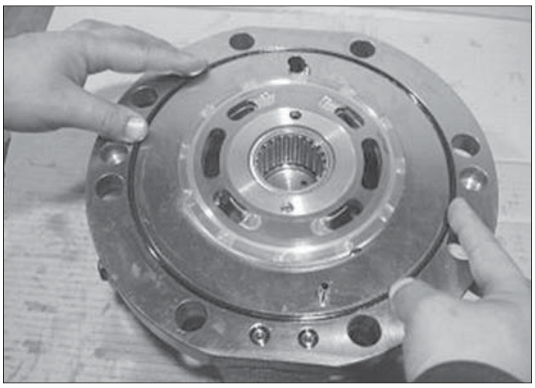
25098TM086

(7) Assemble the valve plate (28) into rear cover (34).
Before assembling, apply some grease on contact surface of the valve plate.



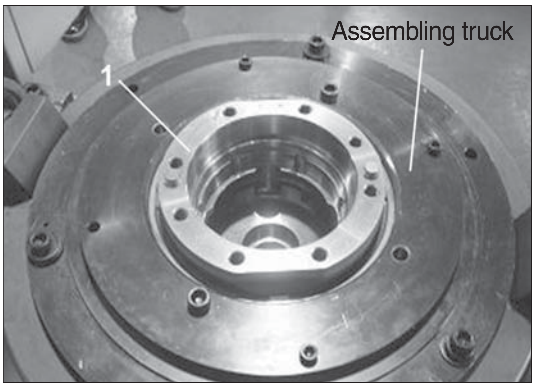
25098TM087

(8) Apply some grease on the O-ring and fit it into groove.



25098TM088

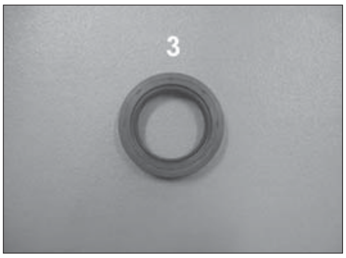
(9) Assemble the casing (1) on the assembling truck.



25098TM089

(10) Tight fit the oil seal (3) into the casing (1) by using jig.

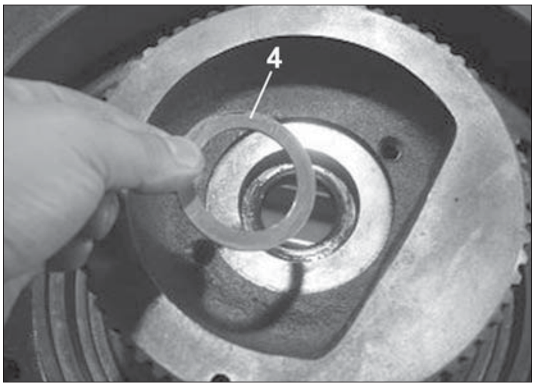
※ Be careful direction of the oil seal.



25098TM090

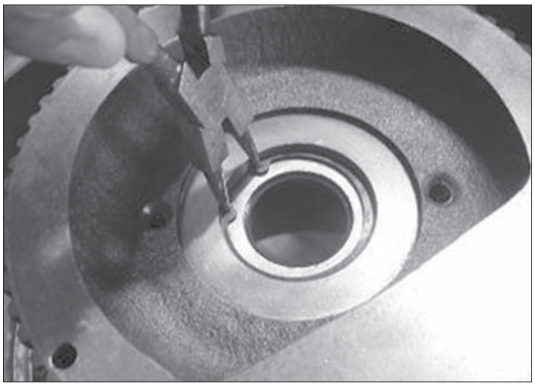

25098TM091

(11) Assemble the thrust plate (4) into the casing (1).



25098TM092

(12) Assemble the snap ring (5) into the casing (1) with the plier for retaining ring.

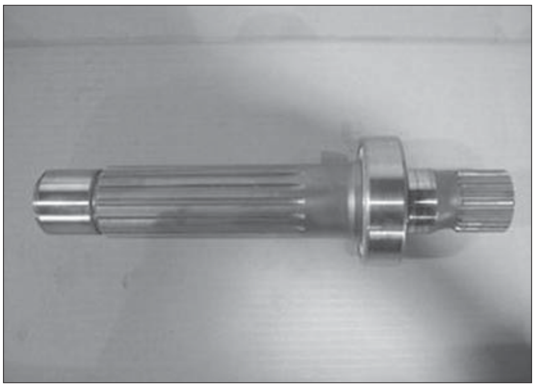

25098TM093

(13) Heat the roller bearing (9) and fit it into the shaft with shrink fitting.

a. Shrink fitting can be used induction heating system and set the temperature at 100°C.
b. Be careful not to damage the sliding surface of the oil seal of the shaft.


25098TM094

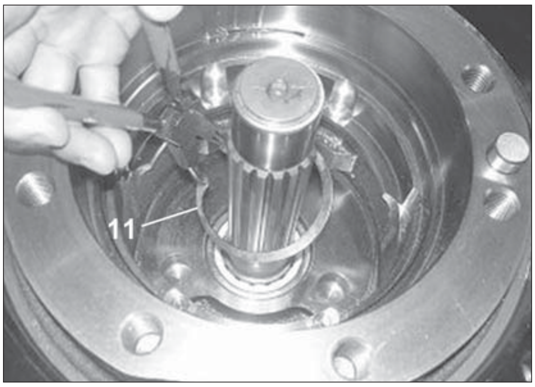

25098TM095


25098TM096

(14) Assemble the heat-fitted shaft (8) into casing (1).

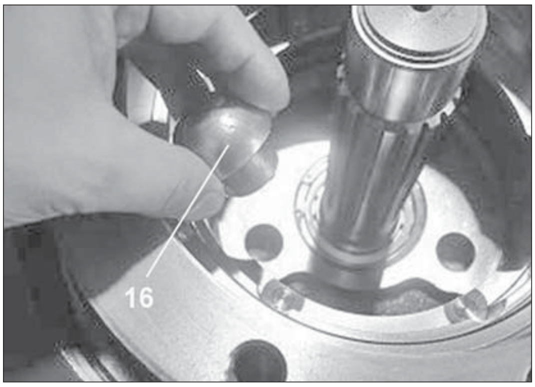

25098TM097

(15) Assemble the snap ring (11) into the casing (1) with the plier for retaining ring.



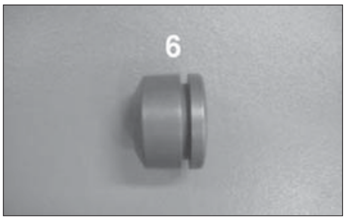
25098TM098

(16) Apply a little grease on the pivot (16, 2EA) and assemble it into the casing (1).

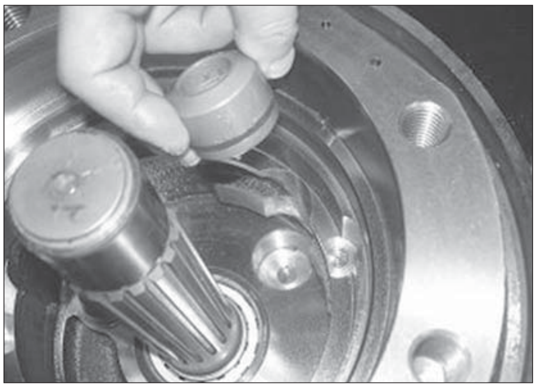


25098TM099

(17) Heat the piston seal (7) and fit it into the swash piston (6) and then tighten it a few minutes by band or tie. Loosen the band or tie and assemble it to the casing (1).

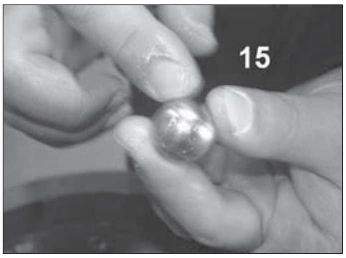


25098TM100

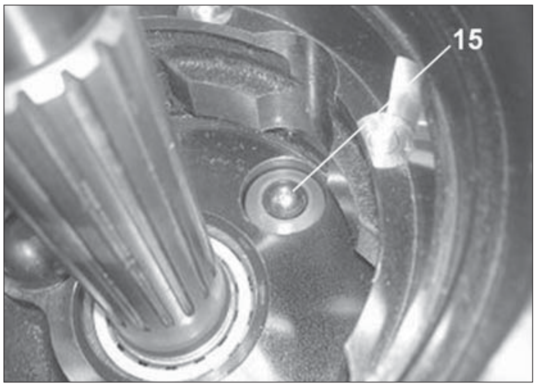


25098TM101

(18) Apply a little grease on the steel ball (15) and assemble it into the swash plate (17).



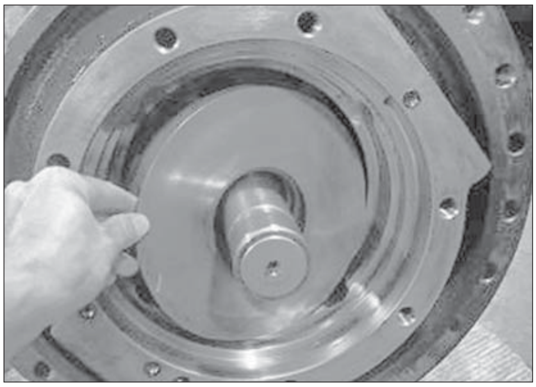
25098TM102



25098TM103

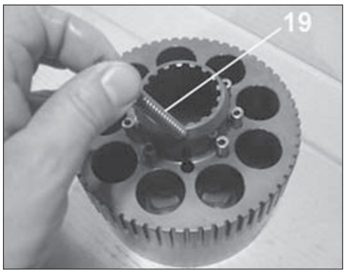
(19) Apply some grease on the steel ball hole of the swash plate (17) and assemble it casing (1).

25098TM104

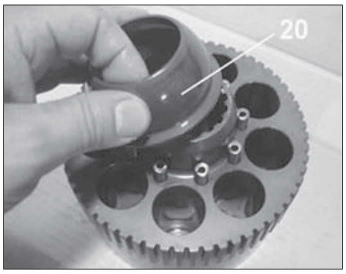


25098TM105

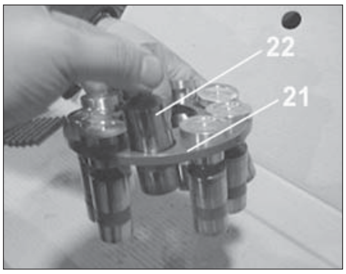
(20) Assemble the spring (19), ball guide (20), retainer plate (21) and piston assy (22) into cylinder block (18) in order.



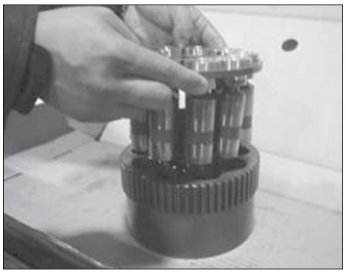
25098TM106



25098TM107



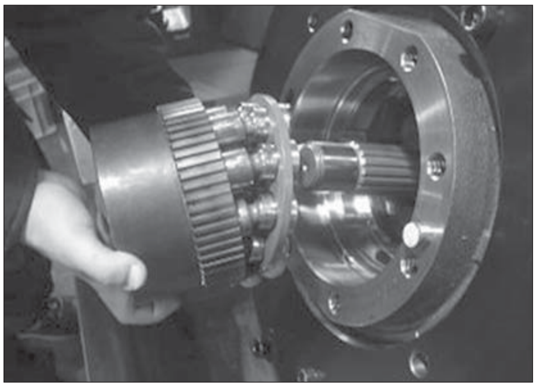
25098TM108



25098TM109

25098TM110

(21) Tilt the casing (1) sideways and assemble the cylinder block kit into the casing (1).

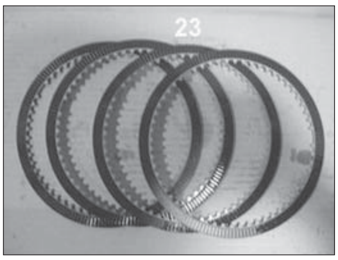


25098TM111

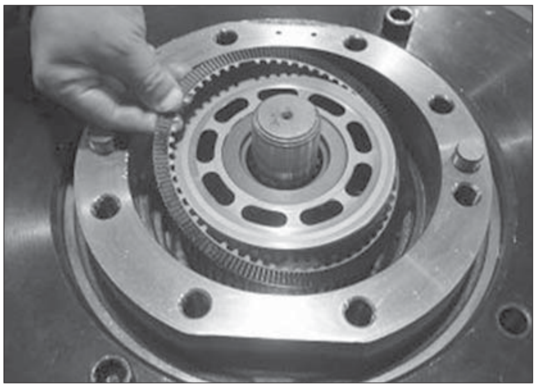
(22) Assemble the separated plate (24) and friction plate (23) into the cylinder block alternately.

Friction plate : 4EA

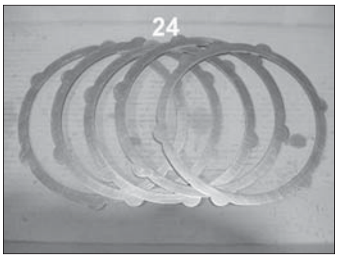
Separated plate : 5EA



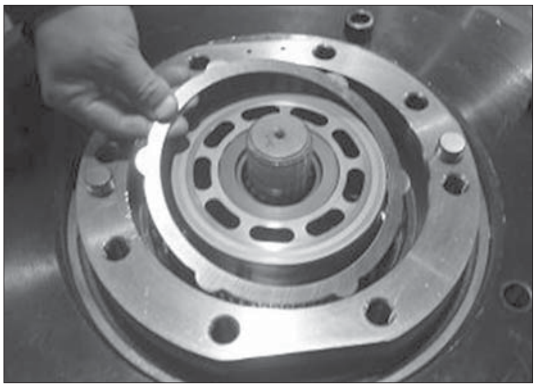
25098TM112



25098TM113

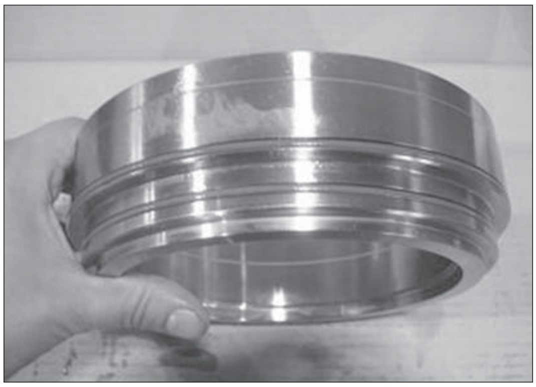


25098TM114



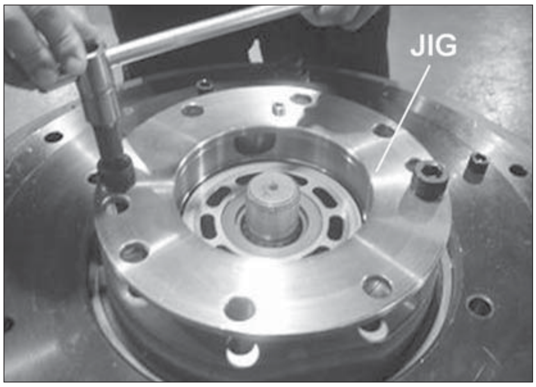
25098TM115

(23) Apply some grease on the D-ring and assemble it parking piston.



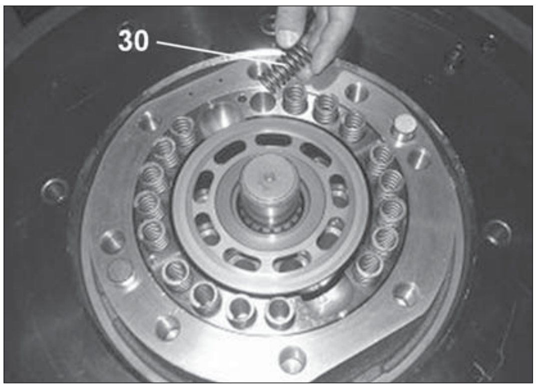
25098TM116

(24) Insert the parking piston into the casing and assemble it by using jig.



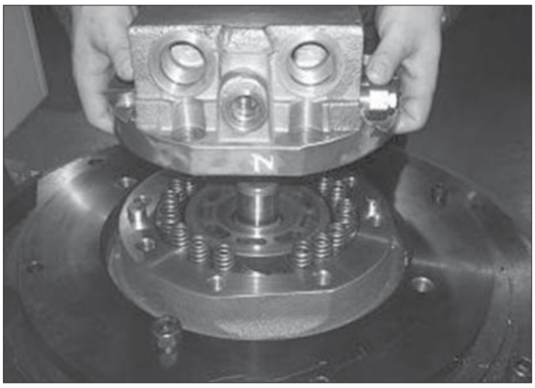
25098TM117

(25) Assemble the brake spring (30, 18EA) into the piston.



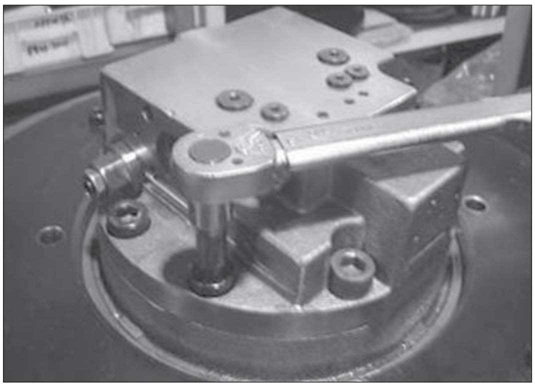
25098TM118

(26) Place the rear cover (34) on the casing (1).



25098TM119

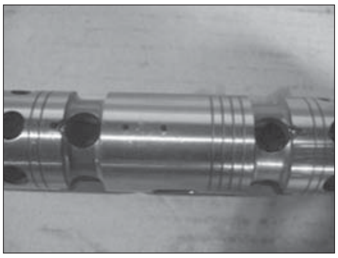
(27) Tighten the casing (1) and rear cover (34) specified torque with wrench bolt (54, 55) by using the impact wrench and torque wrench.



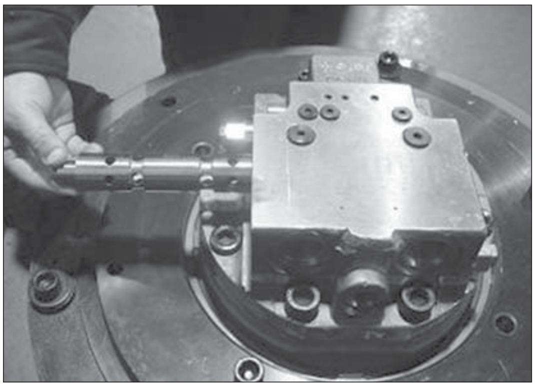
25098TM120

(28) Confirm the insert direction of the main spool assy (35) exactly and assemble it into the rear cover (34).

※ Assure that four balance hole is directed VA port.

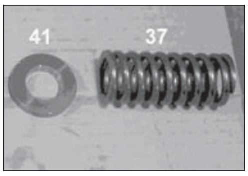


25098TM121

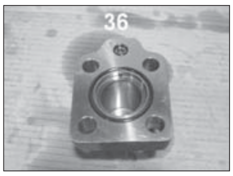


25098TM122

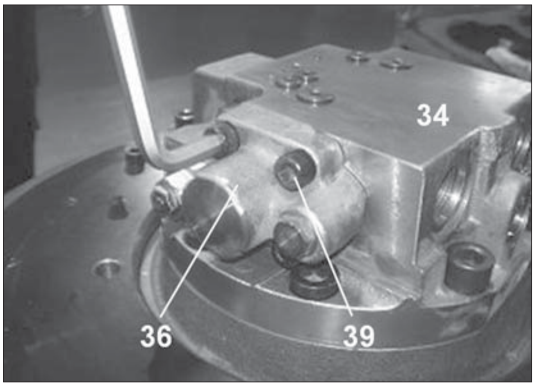
(29) Assemble the spring seat (41), spring (37) and main spool cover (36) into valve plate and tighten the wrench bolt (39, M12x35) by using L-wrench or impact wrench.



25098TM123

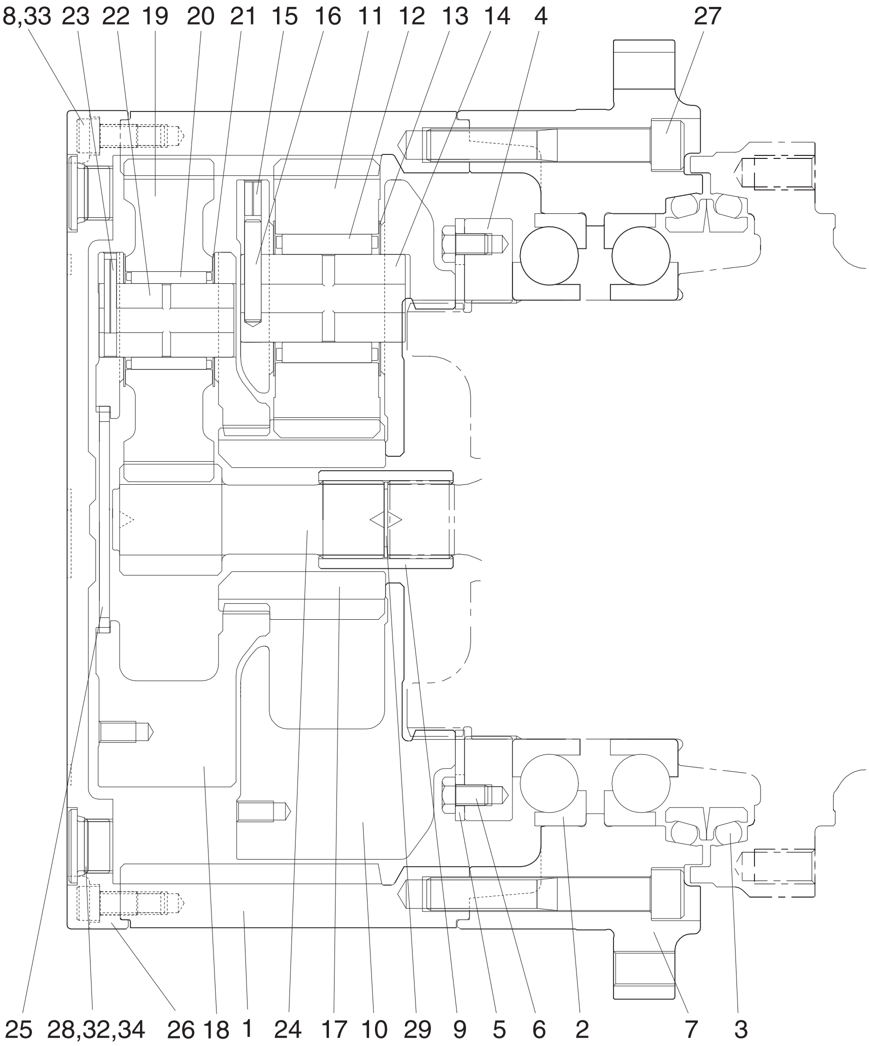


25098TM124



25098TM125

2) TRAVEL REDUCTION GEAR



1	Ring gear	13	Thrust washer 2	25	Thrust plate
2	Ball bearing	14	Carrier pin 2	26	Cover
3	Floating seal assy	15	Spring pin 2	27	Hexagon socket head bolt
4	Ring nut	16	Solid pin 2	28	Plug
5	Lock plate	17	Sun gear 2	29	Snap ring
6	Hexagon bolt	18	Carrier 1	30	Name plate
7	Housing	19	Planetary gear 1	31	Rivet
8	Hexagon socket head bolt	20	Needle bearing 1	32	O-ring
9	Coupling	21	Thrust washer 1	33	Rubber cap
10	Carrier 2	22	Carrier pin 1	34	Rubber cap
11	Planetary gear 2	23	Spring pin 1		
12	Needle bearing 2	24	Sun gear 1		

6. DISASSEMBLING

1) GENERAL INSTRUCTIONS

⚠ Combustibles such as white kerosene are used for washing parts.
These combustibles are easily ignited, and could result in fire or injury.
Be very careful when using.

⚠ Internal parts are coated with gear oil during disassembling and are slippery.
If a part slips off from your hand and fails, it could result in bodily injury or could damage the park.
Be very careful when handling.

(1) Therefore, disassembling and assembling works should be performed on the clean place where dusts hardly gather.
Tools and kerosene to wash parts should also be clean and handled with great care.

(2) Bofore disassembling, review the sectional drawing and prepare the required parts, depending on the purpose and the range of disassembling.
Seals, O-rings, etc., if once disassembled, are not reusable.
There are some parts that should be replaced as a subassembly.
Consult with the parts manual in advance.

⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.

2) DISASSEMBLING TRAVEL REDUCTION GEAR

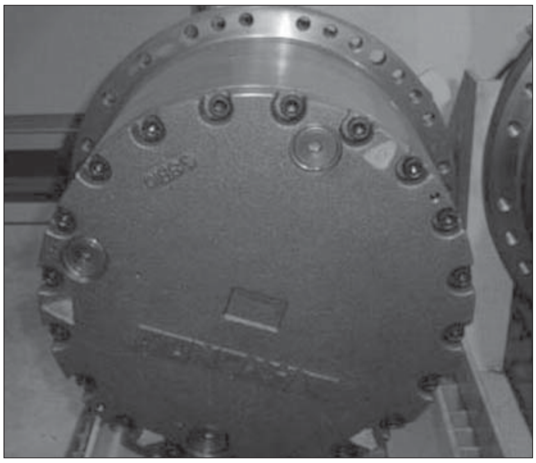
(1) Preparation for disassembling

① The reduction units removed from excavator are usually covered with mud. Wash outside of propelling unit and dry it.
② Locate reducer in order for drain port to be at the lowest level, loosen taper screw plug of drain port, and drain oil from reduction gear.

※ While oil is still hot, inside of the unit may be pressurized.

⚠ Take care of the hot oil gushing out of the unit when loosening the plug.

③ Mark for mating
Put marks on each mating parts when disassembling so as to reassemble correctly as before.

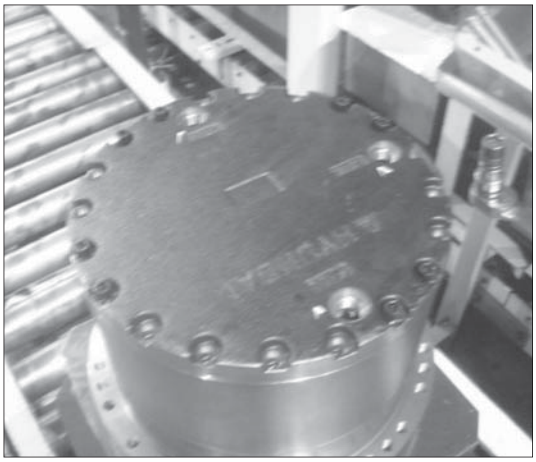


25098TM126

(2) Setting reduction unit (or whole propelling unit) on work stand for disassembling

① Remove 7/16-14UNC hexagon socket head bolts at 3 places from cover almost equally apart each other, and then install 7/16-14UNC eye bolts.

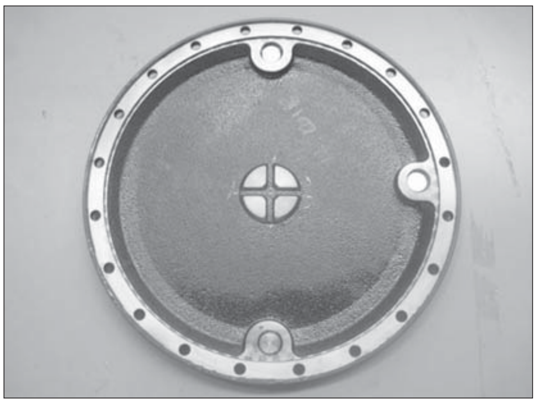
⚠ Take great care not to pinch your hand between parts while disassembling nor let fall parts on your foot while lifting them.



25098TM127

(3) Removing cover

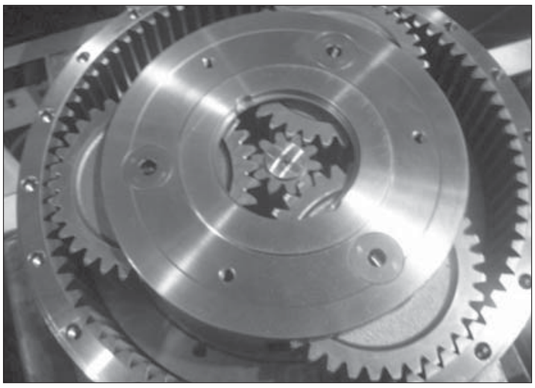
① Remove the rest of 7/16-14UNC hexagon socket head bolts that secure cover and ring gear. Loosen all the socket bolts and then, disassemble cover.
② As the cover is adhered to ring gear, disassemble ring gear and cover by lightly hammering slantwise upward using sharpen punch inserted between the cover and ring gear.



25098TM128

(4) Removing No.1 carrier sub assembly

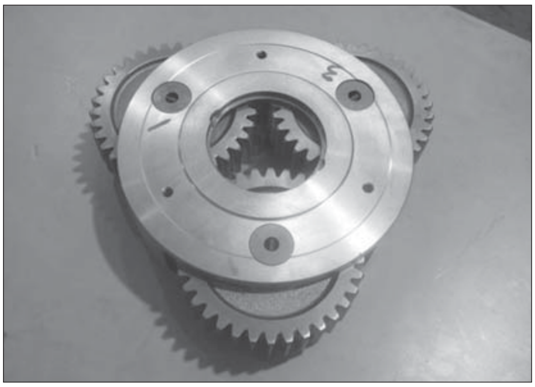
① Screw three M10 eye-bolt in No.1 carrier and lift up and remove No.1 carrier assy.



25098TM129

② Remove No.1 sun gear.

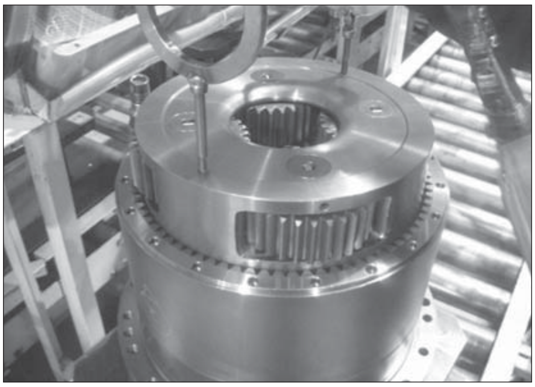
※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



25098TM130

(5) Removing No.2 carrier sub assembly

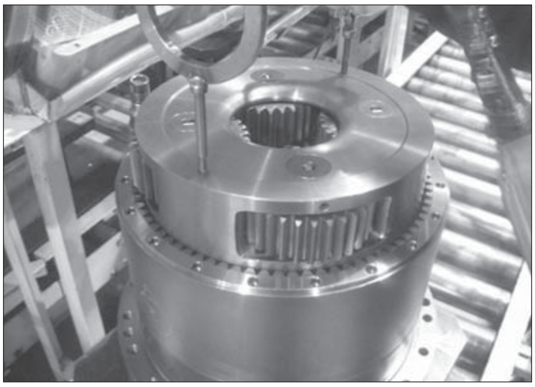
① Screw three M10 eye-bolt in No.2 carrier and lift up and remove No.2 carrier assy.



25098TM131

② Remove No.2 sun gear.

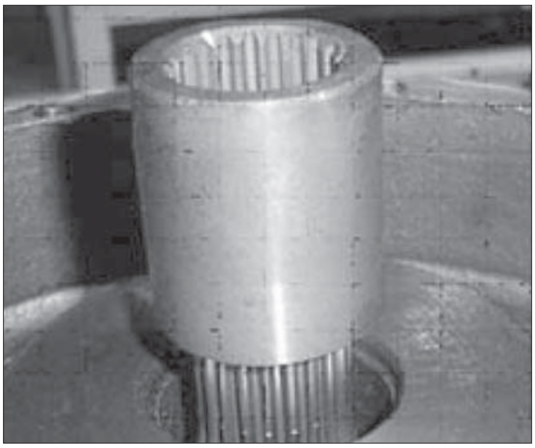
※ Be sure to maintain it vertical with the ground when disassembling No.1 sun gear.



25098TM132

(6) Removing coupling

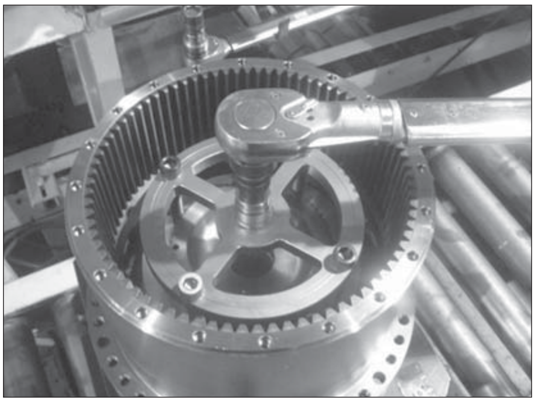
① Remove coupling.



25098TM133

(7) Removing ring nut & lock plate

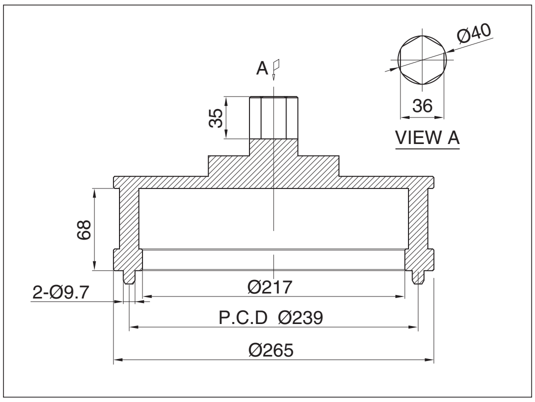
① Remove M12 hexagon head bolts that secure ring nut and lock plate.
② Remove lock plate.



25098TM134

③ Remove ring nut from motor casing.

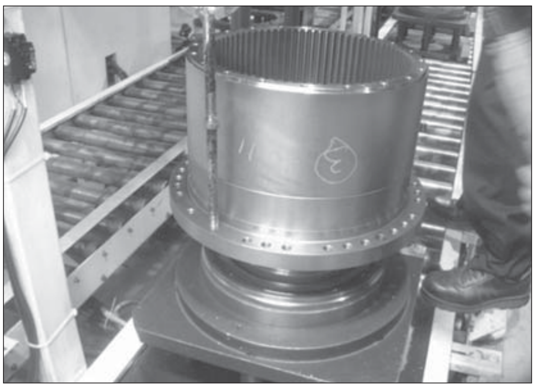
※ Remove the ring nut by using the special tool for removing the ring nut.



220L8TM01

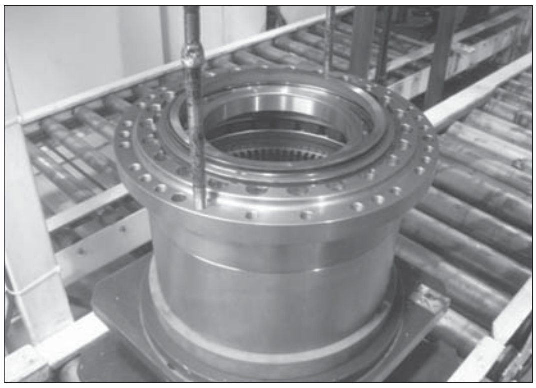
(8) Removing housing sub assembly & ring gear

① Screw 7/16-14UNC eye bolt in housing and lift up ring gear and housing assembly including anguler bearing and floating seal.



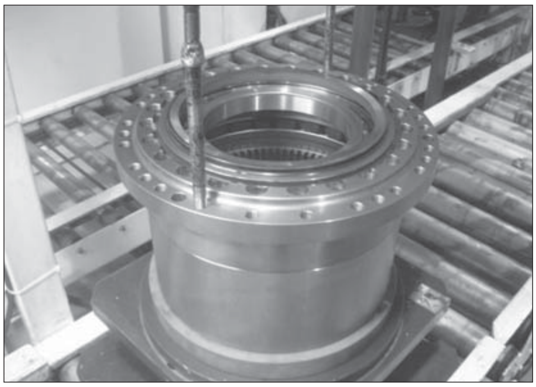
25098TM135

② Setting reduction unit on work stand for disassembling. Remove M16 hexagon socket head bolts that secure ring gear and housing assembly.



25098TM136

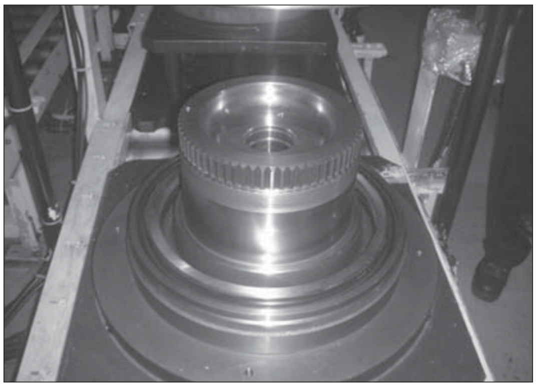
③ As the ring gear is adhered to housing assy, disassemble housing assy and ring gear by lightly hammering slantwise upward using sharpen punch inserted between the housing assy and ring gear.



25098TM137

(9) Removing floating seal

① Lift up a piece of floating seal of motor side.

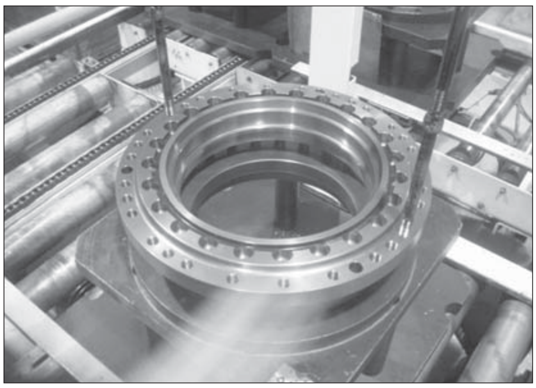


25098TM138

(10) Removing housing sub assembly

① Setting housing assembly on work stand for disassembling.
② After setting housing, lift up a piece of floating seal from housing and then remove it.

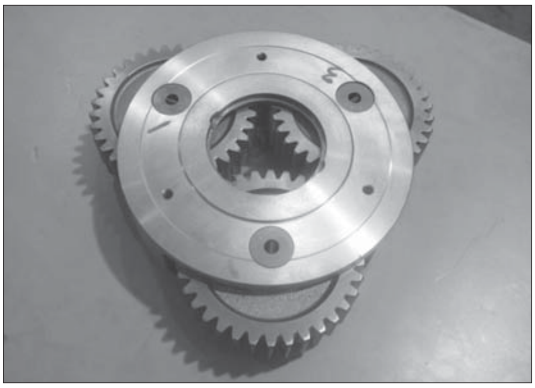
※ Don't disassemble angular bearing.



25098TM139

(11) Disassembling No.1 carrier

① Remove thrust plate.

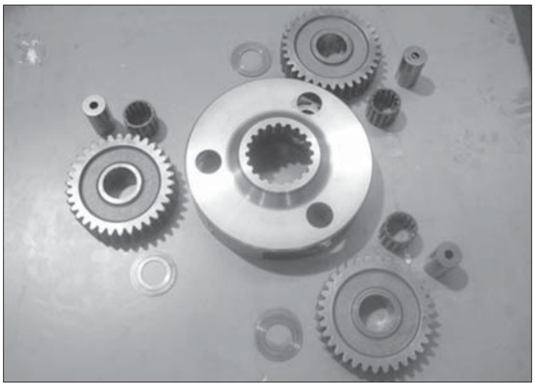


25098TM140

② Knock spring pin fully into No.1 pin.

25098TM141

③ Remove planetary, thrust washer, No.1 pin, bearing from carrier.



25098TM142

(12) Disassembling No.2 carrier

① Knock spring pin fully into No.2 pin.
② Remove No.2 solid pin.
③ Remove planetary, thrust washer, No.2 pin, bearing from carrier.

25098TM143

7. ASSEMBLY REDUCTION UNIT

1) GENERAL NOTES

(1) Clean every part by kerosene and dry them by air blow.

(2) Surfaces to be applied by loctite must be decreased by solvent.

(3) Check every part for any abnormal.

(4) Each hexagon socket head bolt should be used with loctite No.242 applied on its threads.

(5) Apply gear oil slightly on each part before assembling.

⚠ Take great care not to pinch your hand between parts or tools while assembling nor let fall parts on your foot while lifting them.
Inspection before reassembling.

Thrust washer
· Check if there are seizure, abnormal wear or uneven wear.
· Check if wear is over the allowable limit.

Gear
· Check if there are pitting or seizure on the tooth surface.
· Check if there are cracks on the root of tooth by die check.

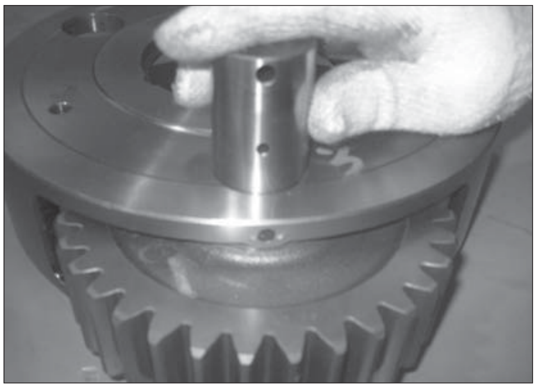
Bearing
· Rotate by hand to see if there are something unusual such as noise or uneven rotation.

Floating seal
· Check flaw or score on sliding surfaces or O-ring.

2) ASSEMBLING CARRIER 1 ASSY

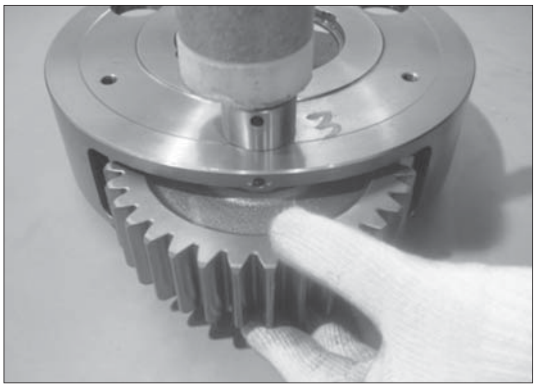
(1) Put No.1 carrier on a flat place.

(2) Install No.1 needle bearing into No.1 planetary gear, put 2EA of No.1 thrust washer on both sides of planetary gear, and then, install it into carrier.



25098TM144

(3) Install No.1 pin into No.1 carrier where the holes for No.1 pin are to be in line with those of No.1 carrier, and then, install spring pins into the holes.



25098TM145

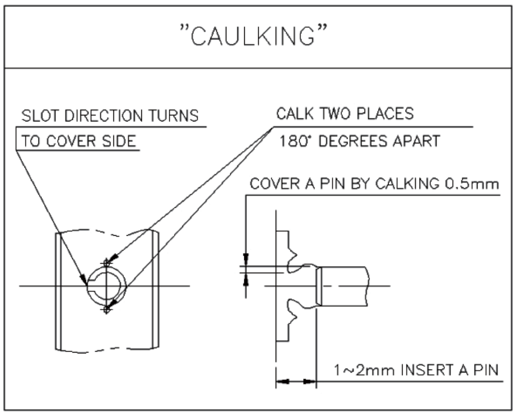
(4) Caulk carrier holes as shown on the picture.

25098TM146

3) ASSEMBLING CARRIER 2 ASSY

(1) Put No.2 carrier on a flat place.

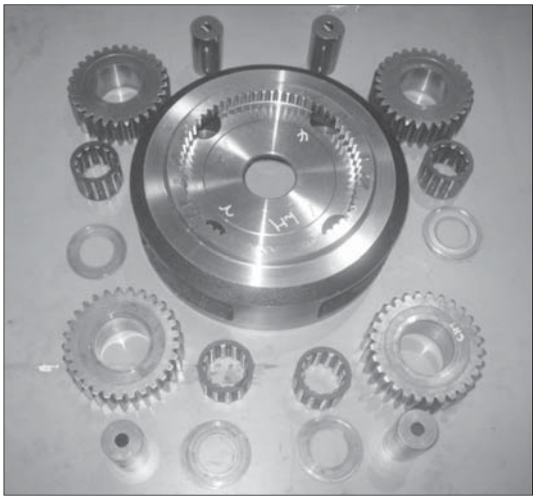
(2) Install No.2 needle bearing into No.2 planetary gear, put 2EA of No.2 thrust washer on both sides of planetary gear, and then, install it into carrier.



25098TM147

(3) After install solid pin into the holes, install No.2 pin into No.1 carrier where the holes for No.1 pin are to be in line with those of No.1 carrier, and then, install spring pins into the holes.

(4) Caulk carrier holes as shown on the picture.

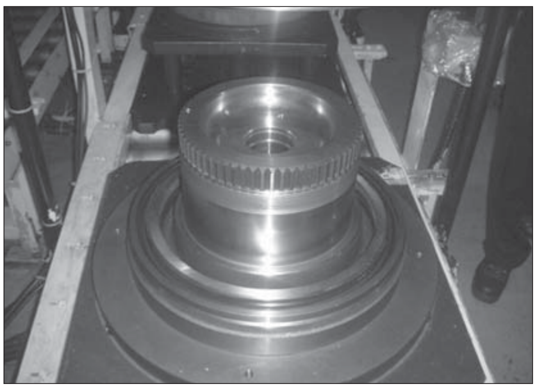


25098TM148

4) ASSEMBLING FLOATING SEAL

(1) Assemble floating seal into motor by use of pressing jig.
Grease the contact parts for floating seal which is assembled into motor.

※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.

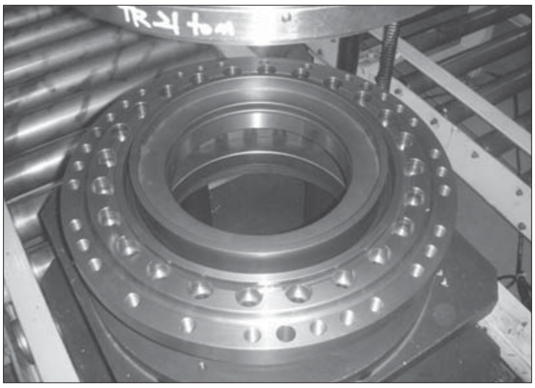


25098TM149

5) ASSEMBLING HOUSING

(1) Heat housing at 60~70˚C while clearing it out and then, assemble floating seal into housing by use of pressing jig.

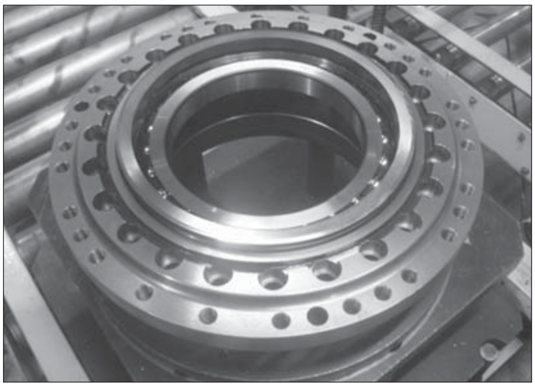
(2) Setting housing assembly on work stand for assembling.
Assemble angular bearing into housing by use of pressing jig.



25098TM150

(3) Assemble floating seal into housing by use of pressing jig.
Do not reuse the disassembling O-ring.
Grease the contact parts for floating seal which is assembled into housing.

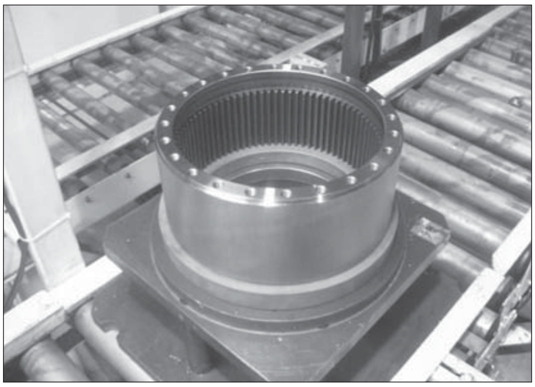
※ Be sure to maintain it vertical with the ground when assembling bearing and floating seal.



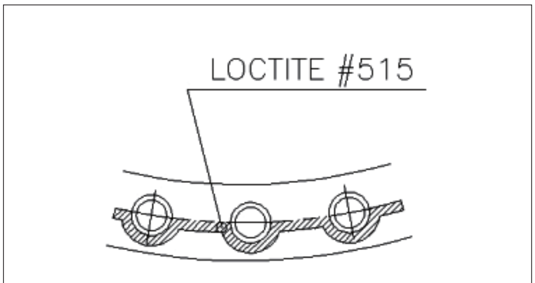
25098TM151

6) ASSEMBLING HOUSING ASSY AND RING GEAR

(1) Setting ring gear on work stand for assembling.
Apply loctite #515 on ring gear for housing without gap.



25098TM152

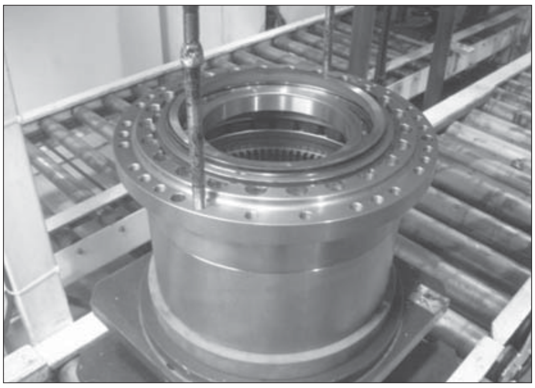


25098TM153

(2) Install M16 eye-bolt on the tap of housing.

(3) Lift housing and then, assemble into housing in order for bolt hole of ring gear and bolt hole of housing to be in line.

(4) Apply loctite #242 on M16 hexagon socket head bolt, and then, bolt.



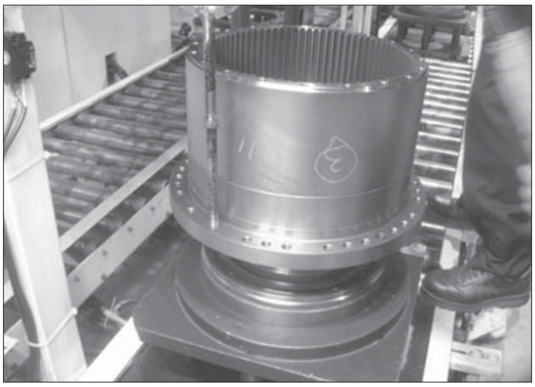
25098TM154

7) ASSEMBLING HOUSING ASSY AND MOTOR

(1) Install 7/16-14UNC eye-bolt on the tap of ring gear.

(2) Assemble housing assembly into motor by use of hoist and eye-bolt.

※ Be sure to tighten eye-bolt deep enough.



25098TM155

8) ASSEMBLING MAIN BEARING

(1) Assemble angular bearing into housing by use of pressing jig.

※ Be sure to maintain it vertical with the ground when assembling bearing.

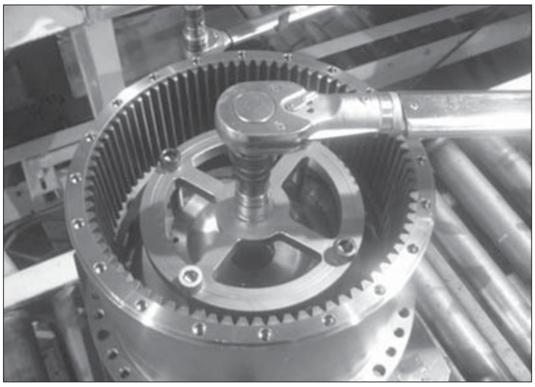
25098TM156

9) ASSEMBLING NUT RING AND LOCK PLATE

(1) Tighten nut ring to specified torque, utilizing special tool.

· Tightening torque : 60.3 kgf·m (436 lbf·ft)

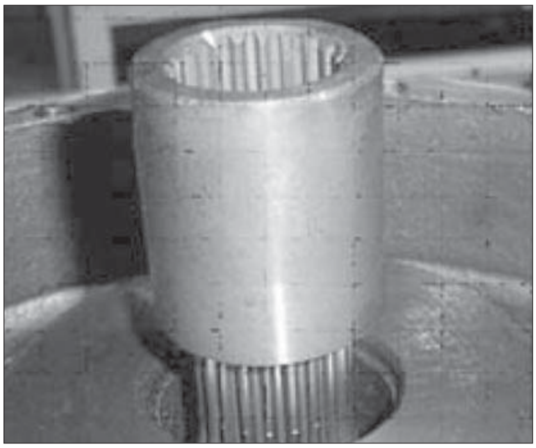
(2) After install lock plate, apply loctite #242 on M12 hexagon head bolt, and then, bolt.
Tighten M12 hexagon head bolt to specified torque, with torque wrench.



25098TM157

10) ASSEMBLING COUPLING

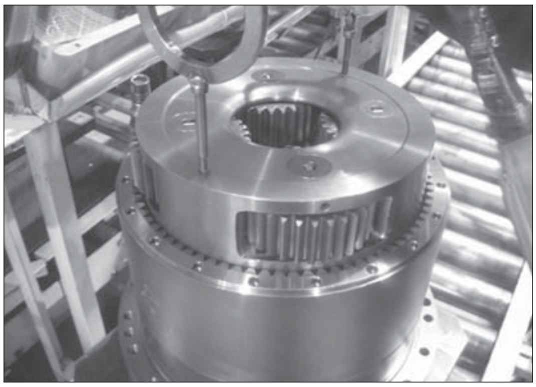
(1) Install coupling on spline of the motor.



25098TM158

11) ASSEMBLING NO.2 CARRIER SUB ASSEMBLY

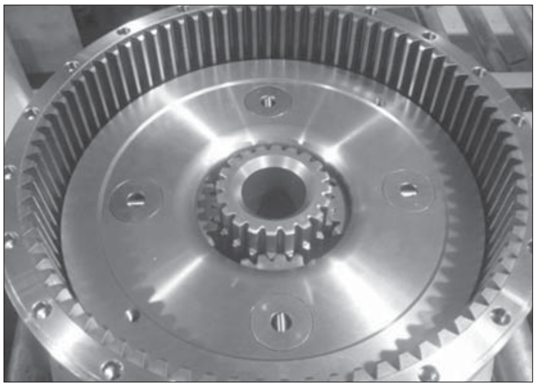
(1) Install M10 eye-bolt on No.2 carrier assembly.
(2) Lift No.2 carrier assembly and then, slowly put it down on ring gear.
(3) Rotate planetary gear by hands and install on ring gear.
(4) Rotate No.2 carrier assembly by hands and install on motor.
※ Match pin hole of No.2 carrier with main (A, B) port of motor.



25098TM159

12) ASSEMBLING NO.2 SUN GEAR

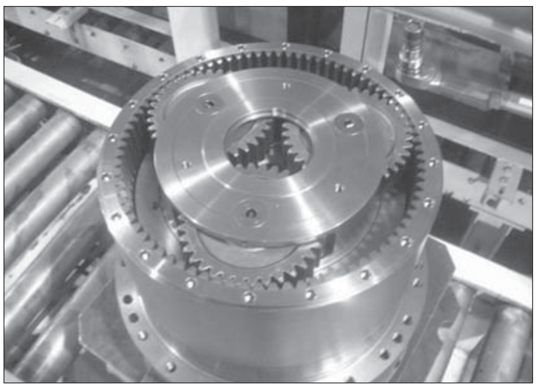
(1) Install No.2 sun gear on the No.2 planetary gear, matching teeth of them.



25098TM160

13) ASSEMBLING NO.1 CARRIER SUB ASSEMBLY

(1) Install M10 eye-bolt on No.1 carrier assembly.
(2) Lift No.1 carrier assembly and then, slowly put it down on ring gear.
(3) Rotate planetary gear by hands and install on ring gear.
(4) Rotate No.1 carrier assembly by hands and install on No.2 sun gear.



25098TM161

14) ASSEMBLING NO.1 SUN GEAR

(1) Put down No.1 sun gear on No.1 carrier, maintaining it vertical with spline of coupling.

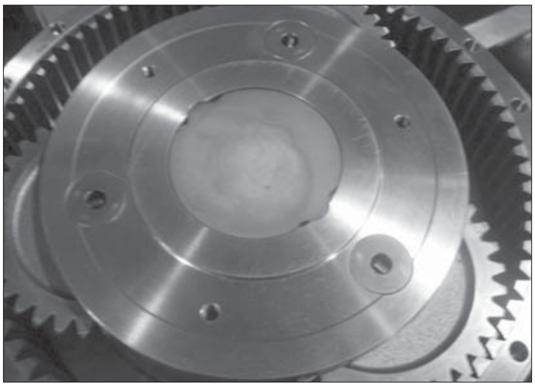
(2) Install No.1 sun gear on No.1 planetary gear, matching their teeth.

25098TM162

15) ASSEMBLING THRUST PLATE

(1) Assembly thrust plate into No.1 carrier.

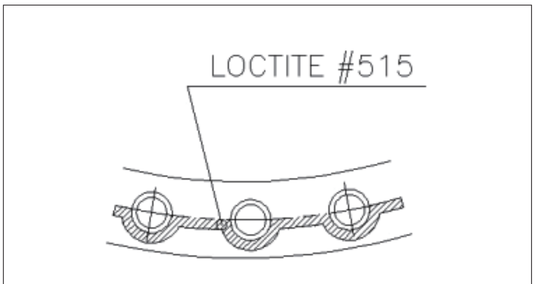
※ Edge of thrust plate direction turns to cover side.



25098TM163

16) ASSEMBLING COVER

(1) Apply loctite #515 on the ring gear for cover without gap.

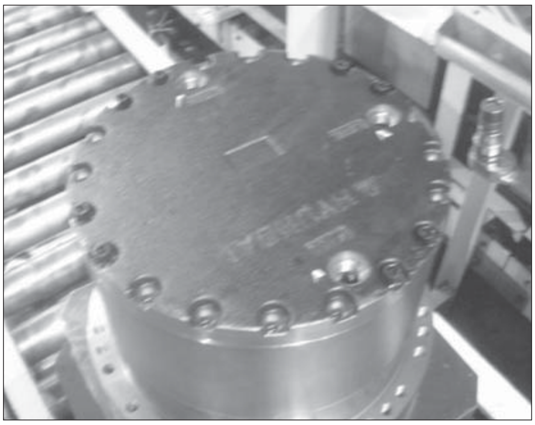


25098TM164

(2) Put cover on ring gear, apply loctite #242 on 7/16-14UNC hexagon socket head bolt, and then, bolt.
Tighten 7/16-14UNC hexagon socket head bolt to specified torque, with torque wrench.

(3) Fill gear oil (6 liter) into drain port.

(4) Apply gear oil on PF3/4 hydraulic plug and then, bolt.



25098TM165

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

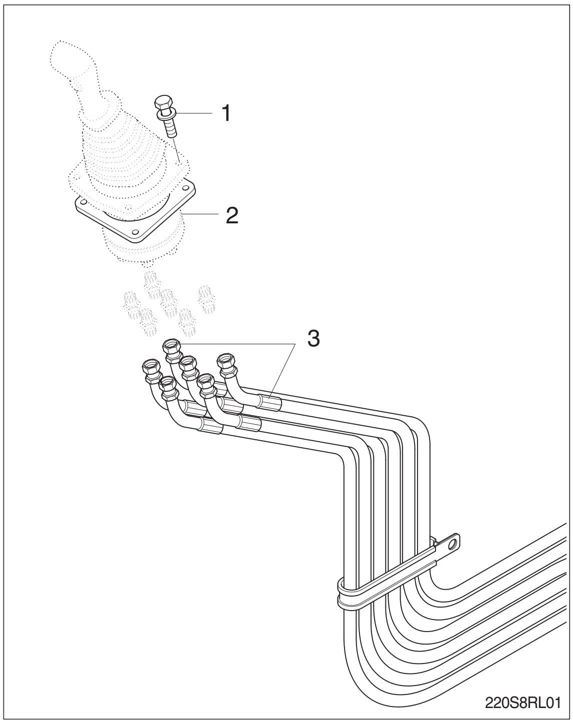
(4) Loosen the socket bolt (1).
Tightening torque : 1.05 ± 0.2 kgf · m
(7.6 ± 1.45 lbf · ft)

(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.



220S8RL01

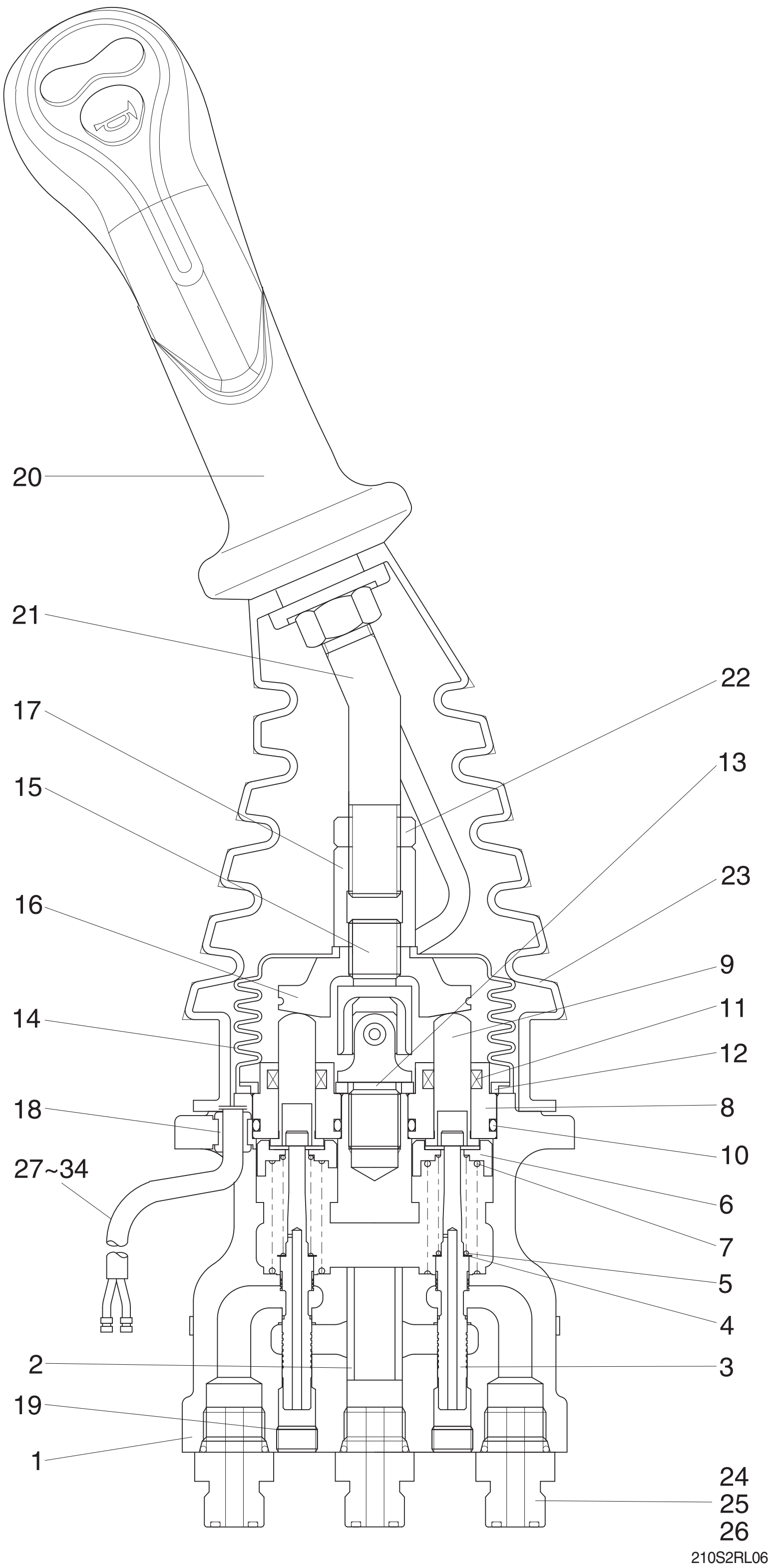
2) INSTALL

(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

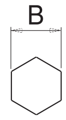
1) STRUCTURE



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

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
Joint	15	M14	3.5	25.3
Swash plate	16	M14	5.0±0.35	36.2±2.5
Adjusting nut	17	M14	5.0±0.35	36.2±2.5
Lock nut	22	M14	5.0±0.35	36.2±2.5

3) DISASSEMBLY

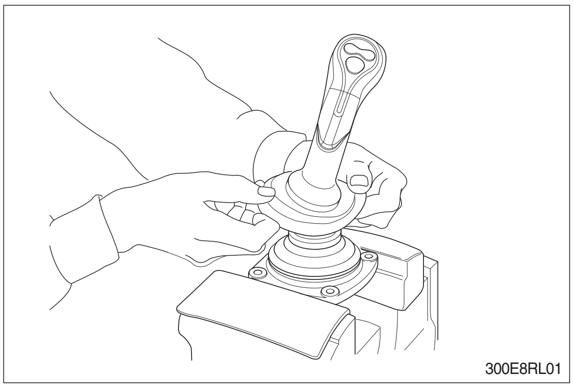
※ Procedures are based on the type M1.

(1) Clean pilot valve with kerosene.

※ Put blind plugs into all ports

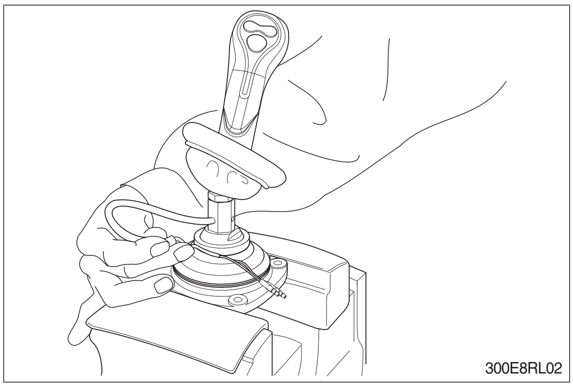
(2) Fix pilot valve in a vise with copper (or lead) sheets.

(3) Remove end of boot (23) from case (1) and take it out upwards.



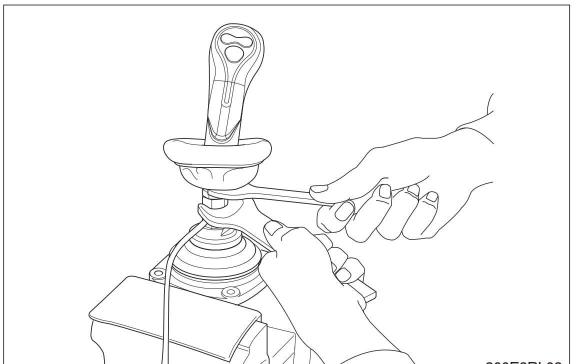
300E8RL01

※ For valve with switch, remove cord also through hole of casing.



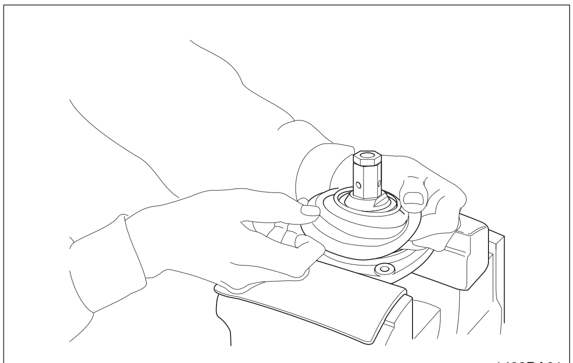
300E8RL02

(4) Loosen lock nut (22) and adjusting nut (17) with spanners on them respectively, and take out handle section as one body.



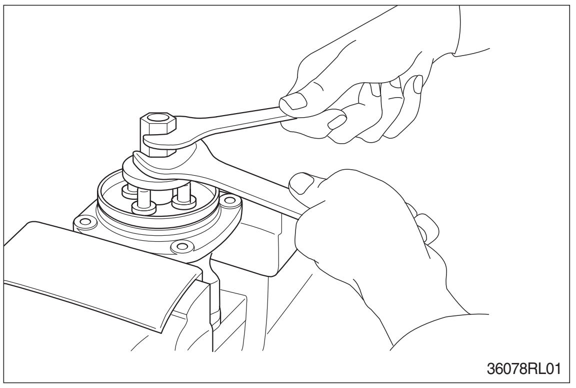
300E8RL03

(5) Remove the boot (14).

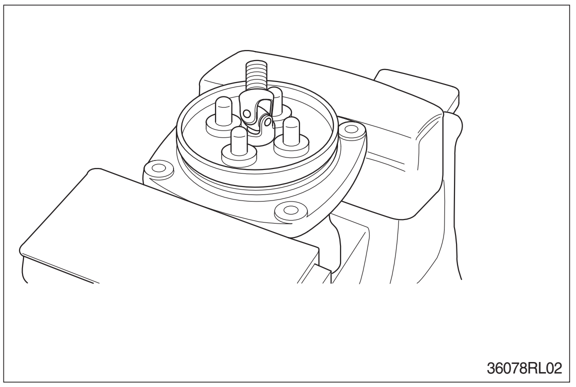


1408DA61

(6) Loosen adjusting nut (17) and swash plate (16) with spanners on them respectively, and remove them.



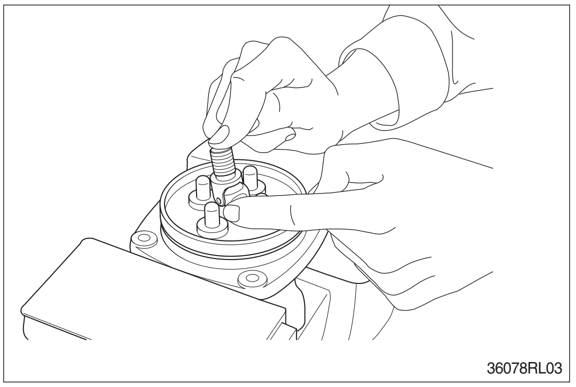
36078RL01



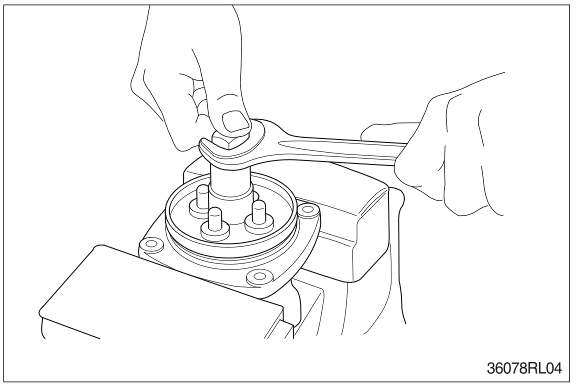
36078RL02

(7) Turn joint anticlockwise to loosen it, utilizing jig (Special tool).

※ When return spring (7) is strong in force, plate (12), plug (8) and push rod (9) will come up on loosening joint.
Pay attention to this.

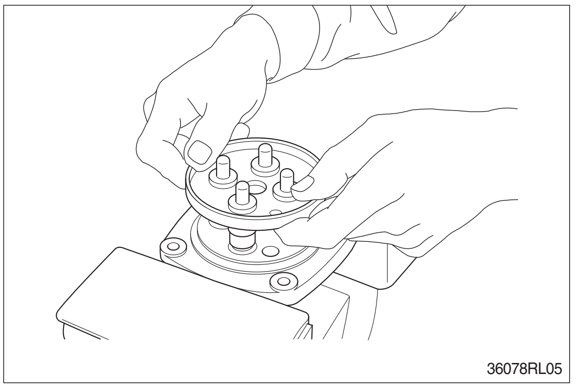


36078RL03



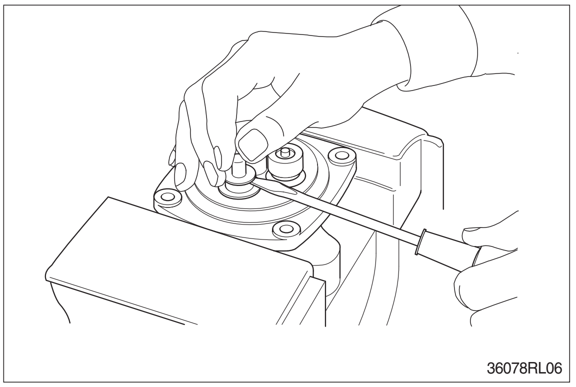
36078RL04

(8) Remove plate (12).



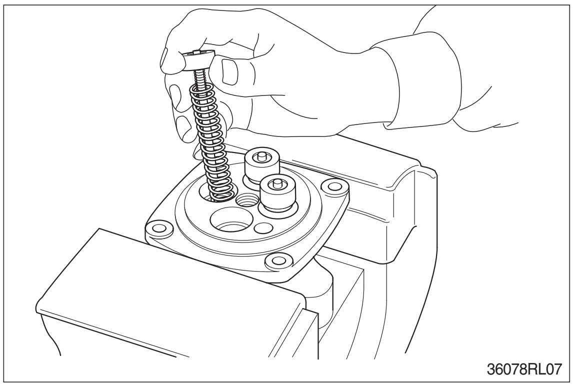
36078RL05

(9) When return spring (7) is weak in force, plug (8) 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 (7) force.
Pay attention to this.



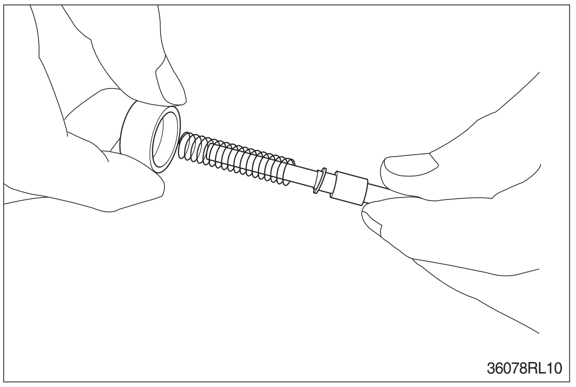
36078RL06

(10) Remove reducing valve subassembly and return spring (7) out of casing.
※ Record relative position of reducing valve subassembly and return springs.



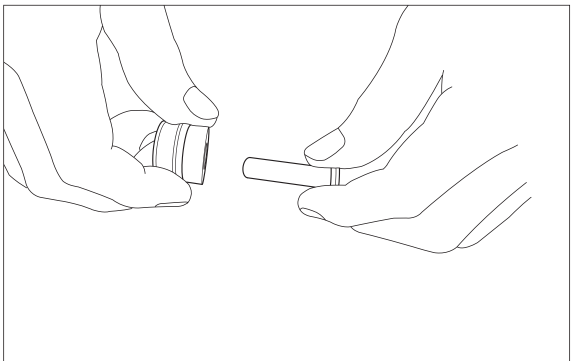
36078RL07

(11) Separate spool (3), spring seat (6), spring (5) and shim (4) individually.
※ Pay attention not to damage spool surface.
※ Record original position of spring seat (6).
※ Until being assembled, they should be handled as one subassembly group.



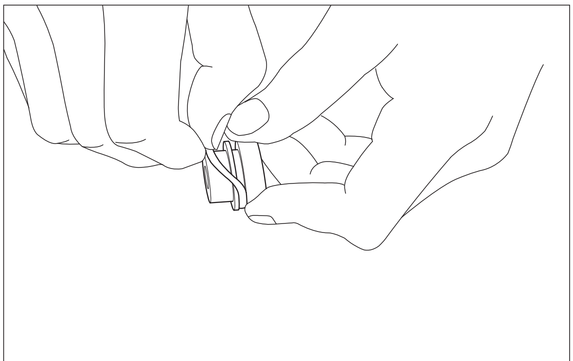
36078RL10

(12) Take push rod (9) out of plug (8).

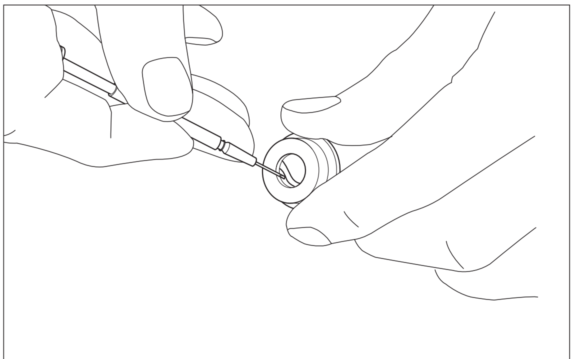


36078RL11

(13) Remove O-ring (10) and seal (11) from plug (8).
Use small minus screwdriver or so on to remove this seal.

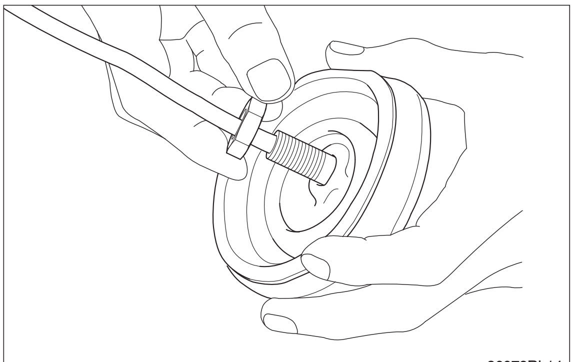


36078RL12

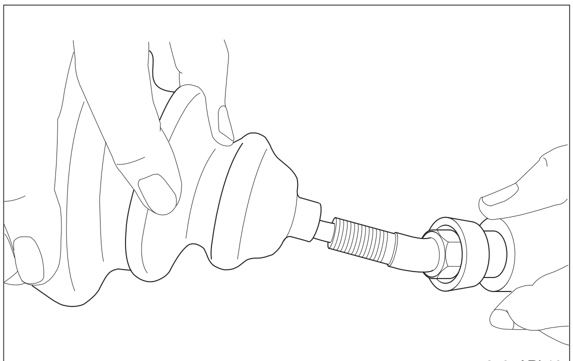


36078RL13

(14) Remove lock nut (22) and then boot (23).



36078RL14



2507ARL10

(15) 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.

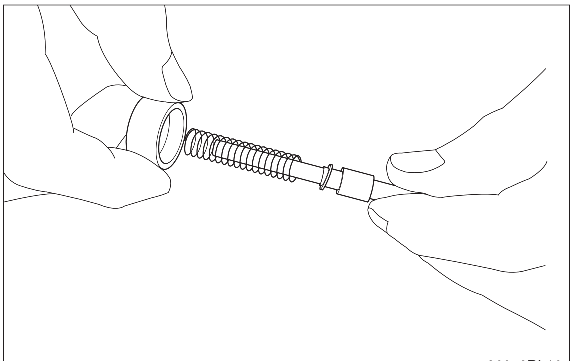
(16) Rust prevention of parts

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.

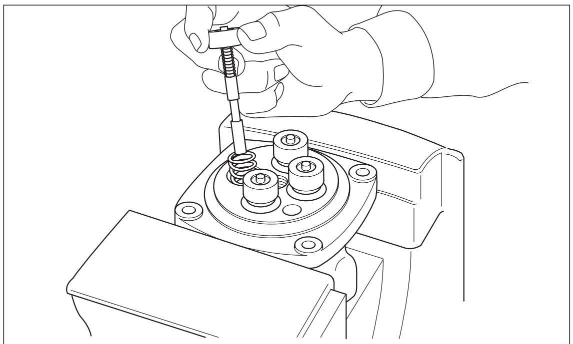
4) ASSEMBLY

(1) Put shim (4), springs (5) and spring seat (6) onto spool (3) in this order.



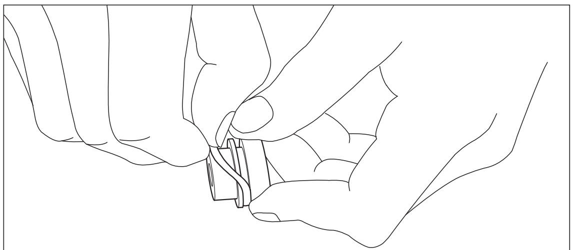
36078RL16

(2) Assemble spring (7) into casing (1).
Assemble reducing valve subassembly into casing.
※ Assemble them to their original positions.



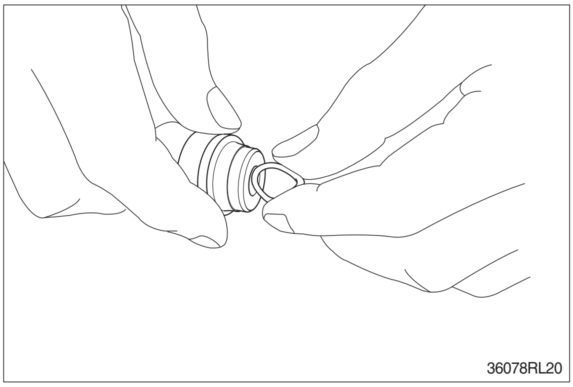
36078RL18

(3) Assemble O-ring (10) onto plug (8).



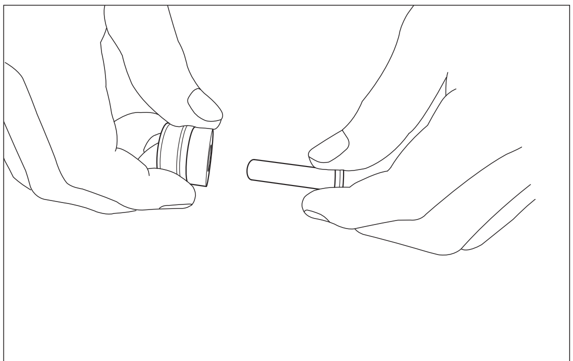
36078RL19

(4) Assemble seal (11) to plug (8).
※ Assemble seal in such lip direction as shown below.

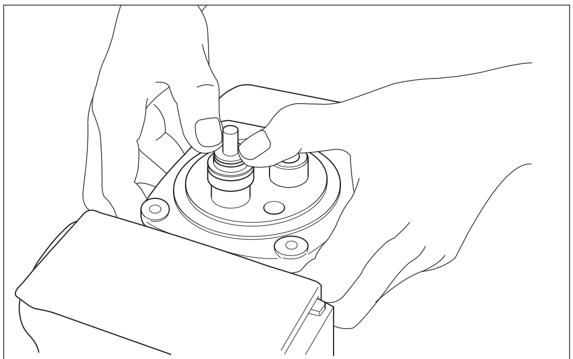


36078RL20

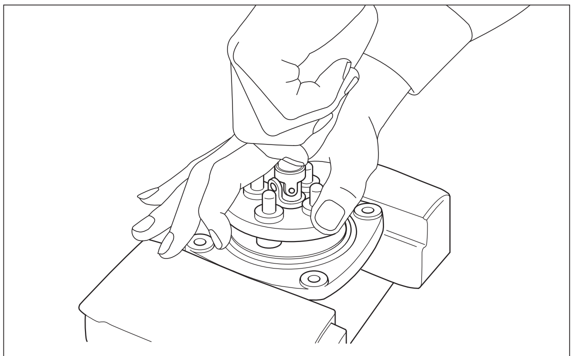
(5) Assemble push rod (9) to plug (8).
※ Apply working oil on push-rod surface.


36078RL21

(6) Assemble plug subassembly to casing.
※ When return spring is weak in force, subassembly stops due to resistance of O-ring.

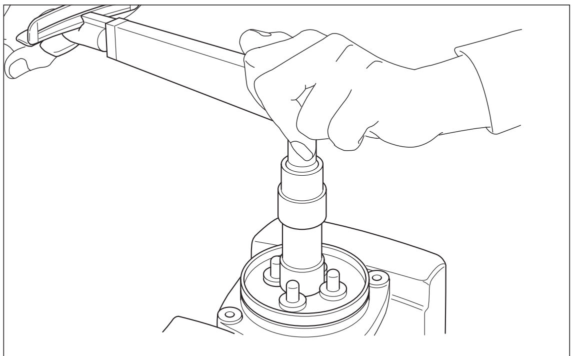

36078RL22

(7) When return spring is strong in force, assemble 4 sets at the same time, utilizing plate (12), and tighten joint (15) temporarily.


36078RL23

(8) Fit plate (12).

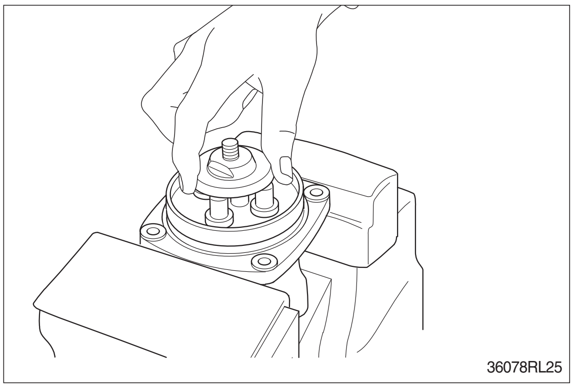
(9) Tighten joint (15) with the specified torque to casing, utilizing jig.


36078RL24

(10) Assemble swash plate (16) to joint (15).

※ Screw it to position that it contacts with 4 push rods evenly.

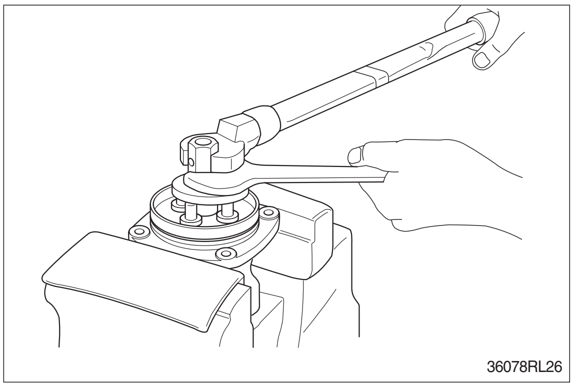
※ Do not screw it over.



36078RL25

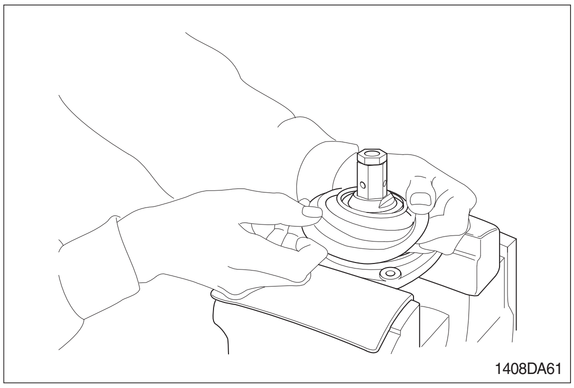
(11) Assemble adjusting nut (17), apply spanner to width across flat of plate (16) to fix it, and tighten adjusting nut to the specified torque.

※ During tightening, do not change position of disk.



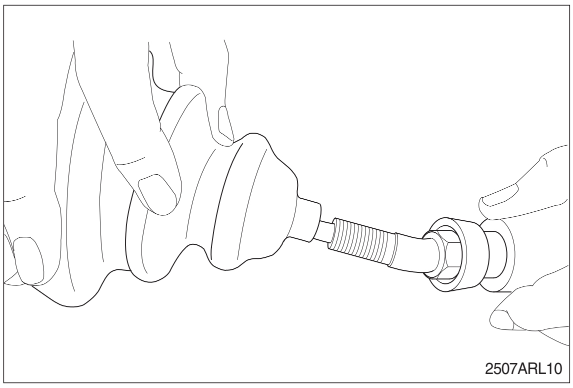
36078RL26

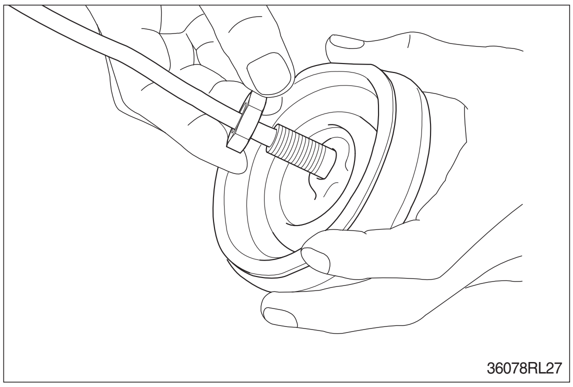
(12) Fit boot (14) to plate.



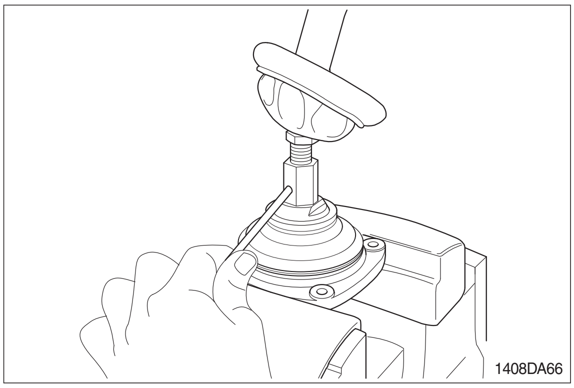
1408DA61

(13) Fit boot (23) and lock nut (22), and handle subassembly is assembled completely.



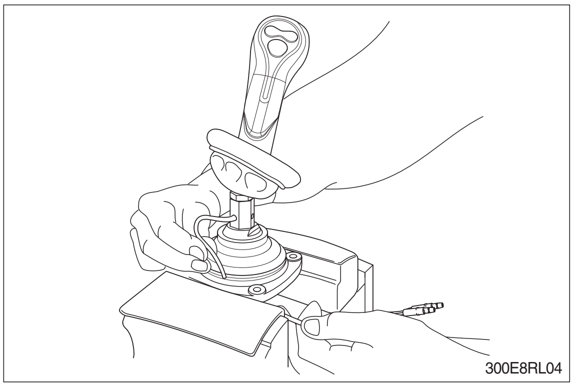


(14) Pull out cord and tube through adjusting nut hole provided in direction 60 °to 120 °from casing hole.

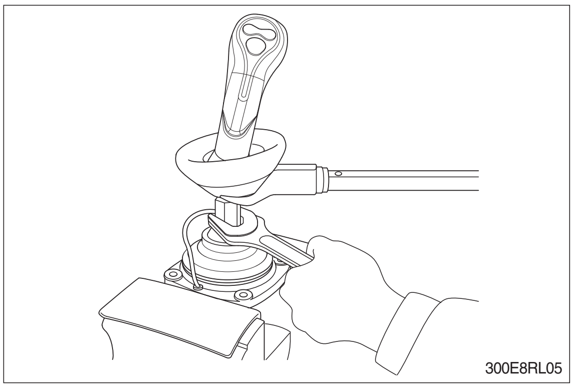


(15) Assemble bushing (18) to plate and pass cord and tube through it.

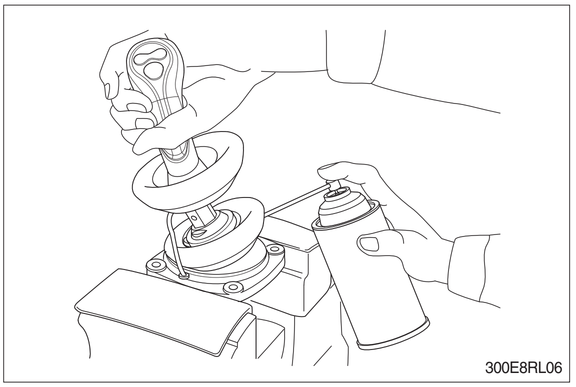
※ Provide margin necessary to operation.



(16) Determine handle direction, tighten lock nut (22) to specified torque to fix handle.

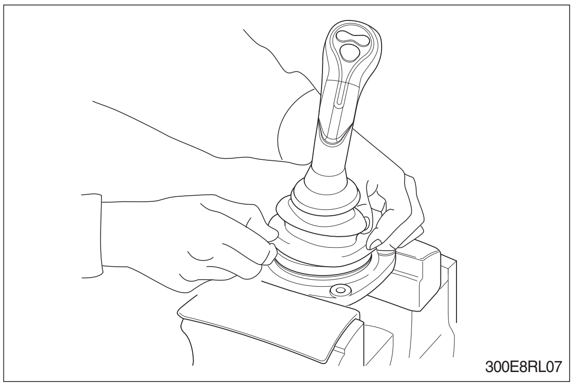


(17) Apply grease to rotating section of joint and contacting faces of disk and push rod.



(18) Assemble lower end of bellows to casing.

(19) Inject volatile rust-preventives through all ports and then put blind plugs in ports.



GROUP 8 TURNING JOINT

1. REMOVAL AND INSTALL

1) REMOVAL

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

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

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

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

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

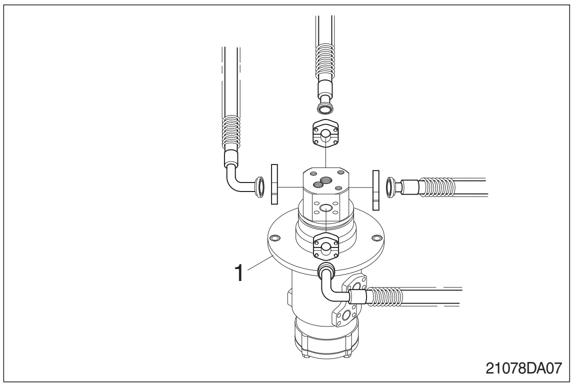

13031GE18

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight : 55 kg (120 lb)

· Tightening torque : 12.0 ± 1.3 kgf · m (86.8 ± 9.4 lbf · ft)



21078DA07

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

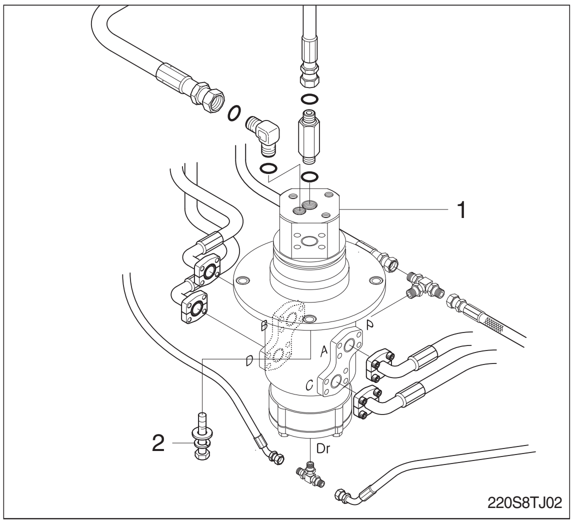
2) INSTALL

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

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

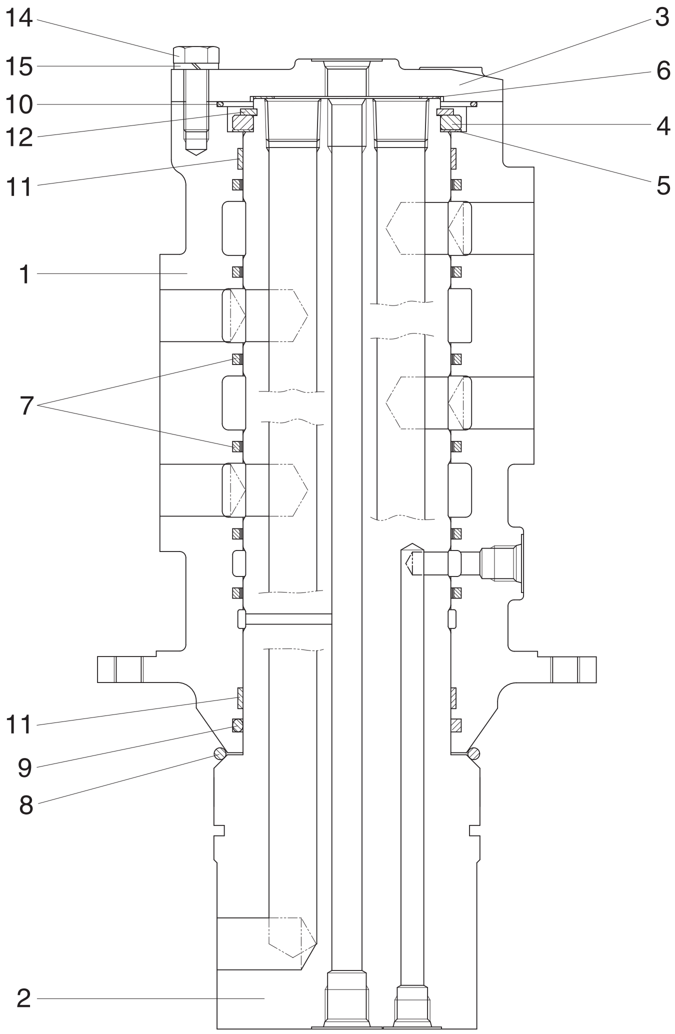
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



220S8TJ02

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE



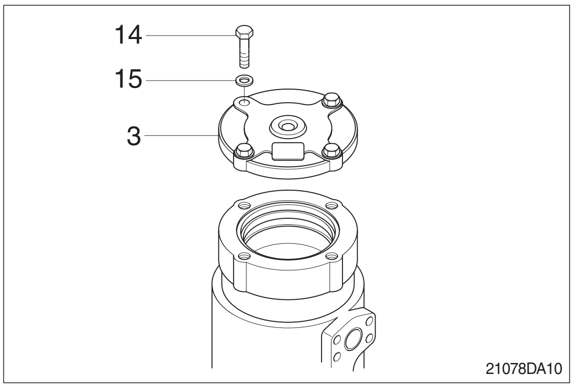
21098TJ01

1	Hub	6	Shim	11	Wear ring
2	Shaft	7	Slipper seal	12	Retainer ring
3	Cover	8	O-ring	13	Plug
4	Spacer	9	O-ring	14	Hexagon bolt
5	Shim	10	O-ring	15	Spring washer

2) DISASSEMBLY

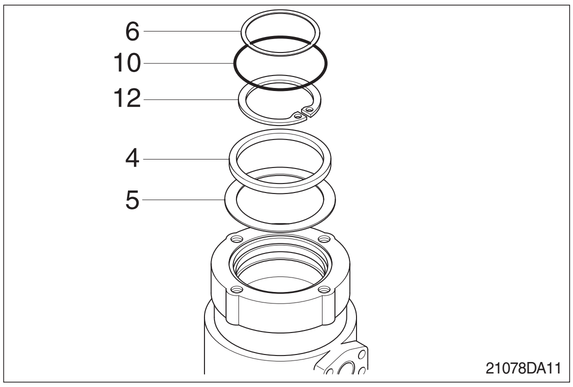
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (14), washer (15) and cover (3).



(2) Remove shim (6) and O-ring (10).

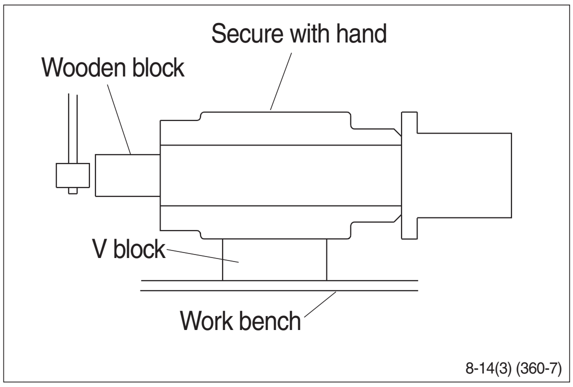
(3) Remove retainer ring (12), spacer (4) and shim (5).



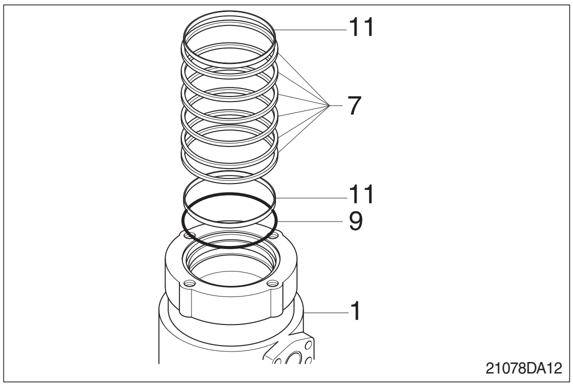
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ Take care not to damage the shaft (2) when remove hub (1) or rest it sideway.

※ Put a fitting mark on hub (1) and shaft (2).



(5) Remove six slipper seals (7) and O-ring (9), two wear ring (11) from hub (1).

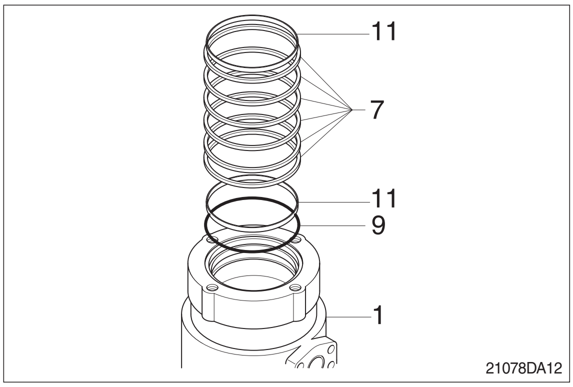


3) ASSEMBLY

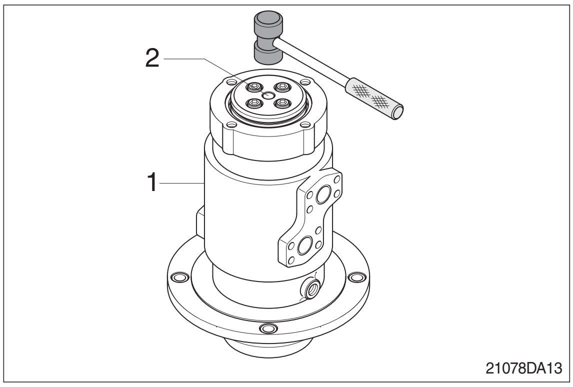
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix seven slipper seal (7) and O-ring (9), two wear ring (11) to hub (1).

(2) Fit O-ring (8) to shaft (2).



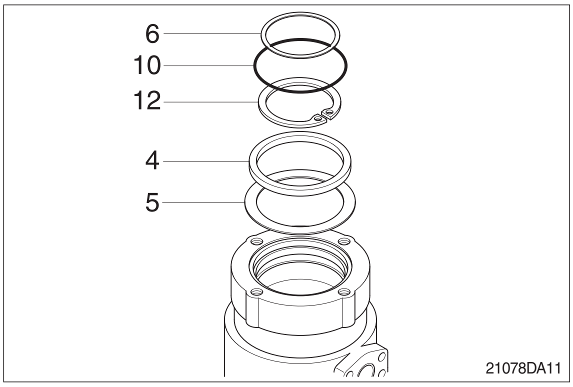
(3) Set shaft (2) on block, tap hub (1) with a plastic hammer to install.



(4) Fit shim (5), spacer (4) and retainer ring (12) to shaft (2).

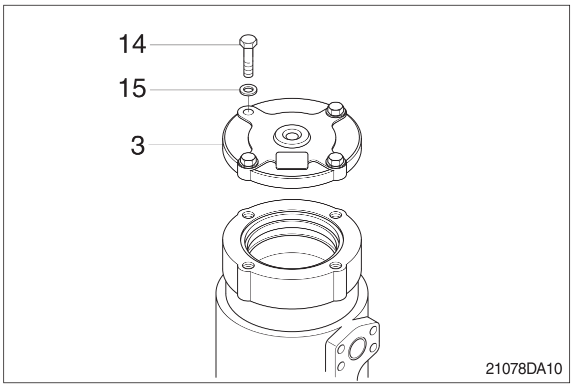
(5) Fit O-ring (10) to hub (1).

(6) Fit shim (6) to shaft (2).



(7) Install cover (3) to body (1) and tighten bolts (14).

· Torque : 10~12.5 kgf · m (72.3~90.4 lbf · ft)



GROUP 9 BOOM, ARM AND BUCKET CYLINDER

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

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

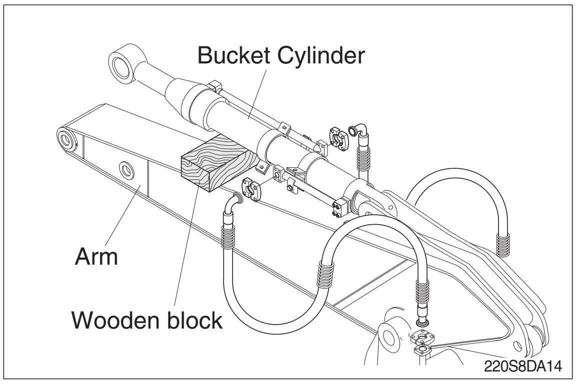
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

13031GE18

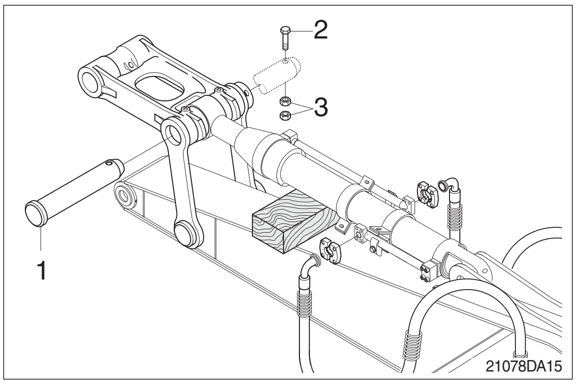
① Set block between bucket cylinder and arm.



220S8DA14

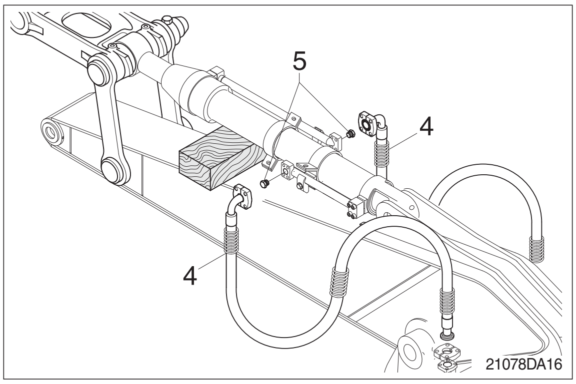
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



21078DA15

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

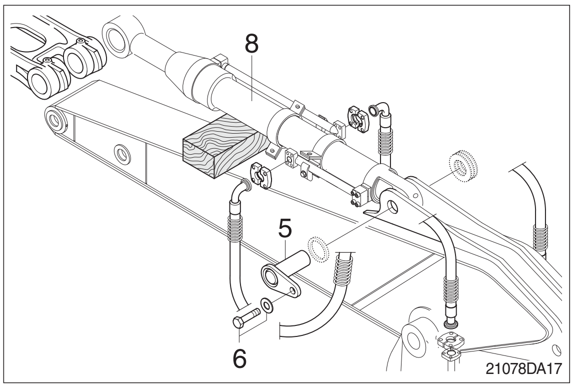


21078DA16

④ Sling bucket cylinder assembly (8) and remove bolt (6) then pull out pin (5).

⑤ Remove bucket cylinder assembly (8).

· Weight : 175 ㎏ (390 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the bucket cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) ARM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

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

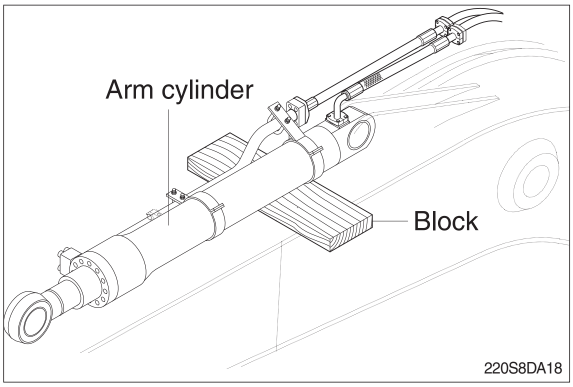
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

13031GE18

⚠ **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.

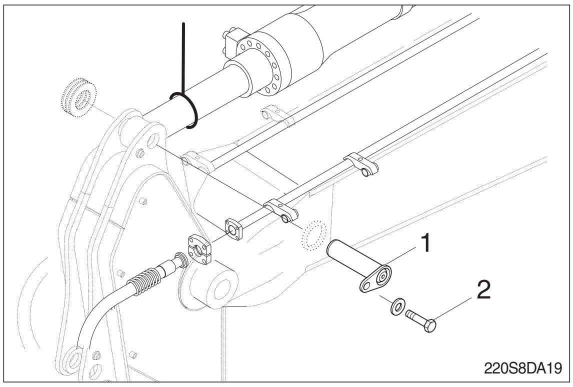
① Set block between arm cylinder and boom.



220S8DA18

② Remove bolt (2) and pull out pin (1).

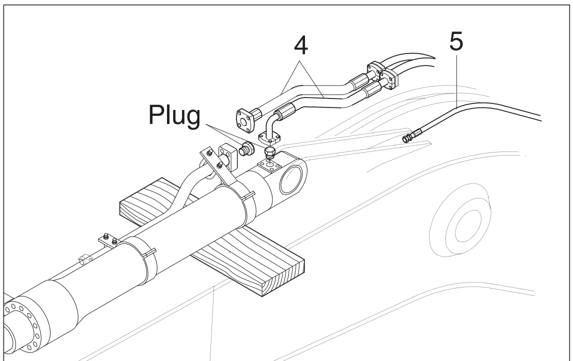
※ Tie the rod with wire to prevent it from coming out.



220S8DA19

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

④ Disconnect greasing pipings (5).

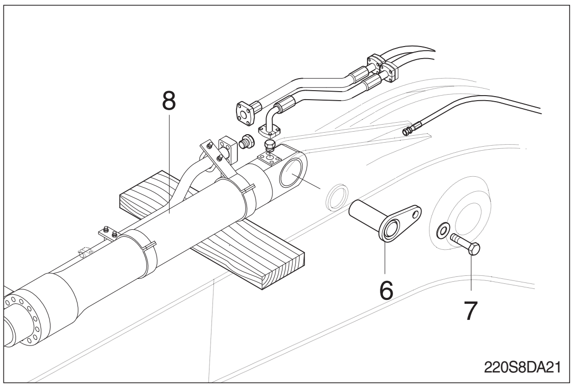


220S8DA20

⑤ Sling arm cylinder assembly(8) and remove bolt (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 290 ㎏ (640 ㏓)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Bleed the air from the arm cylinder.

※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.

3) BOOM CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

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

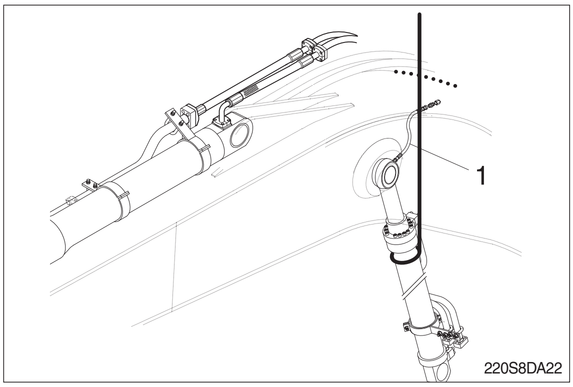
※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

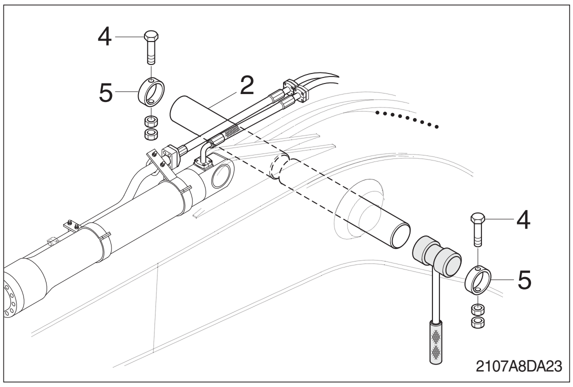
① Disconnect greasing hoses (1).

② Sling boom cylinder assembly.

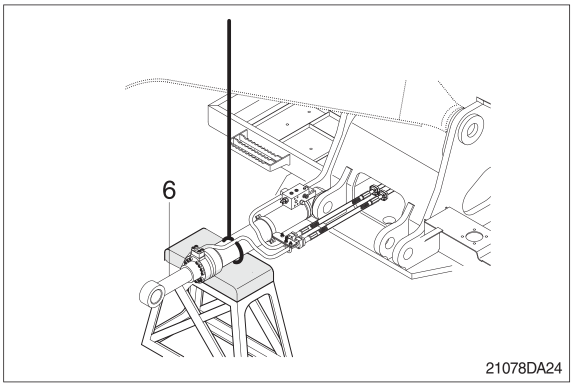


③ Remove bolt (4), stopper (5) and pull out pin (2).

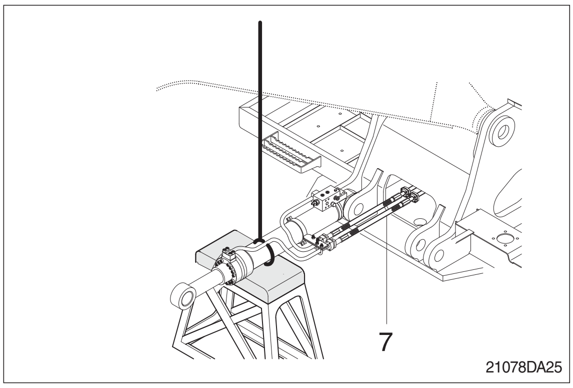
※ Tie the rod with wire to prevent it from coming out.



④ Lower the boom cylinder assembly (6) on a stand.



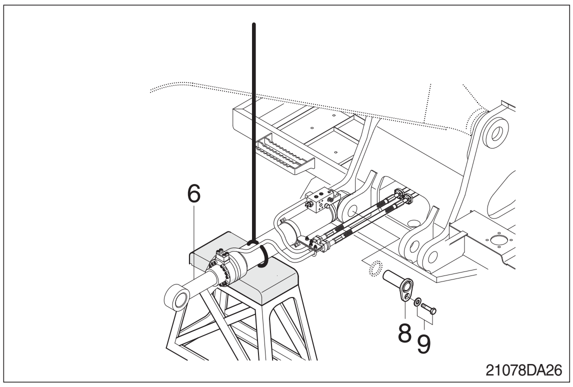
⑤ Disconnect boom cylinder hoses (7) and put plugs on cylinder pipe.



⑥ Remove bolt (9) and pull out pin (8).

⑦ Remove boom cylinder assembly (6).

· Weight : 180 ㎏ (400 ℔)



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

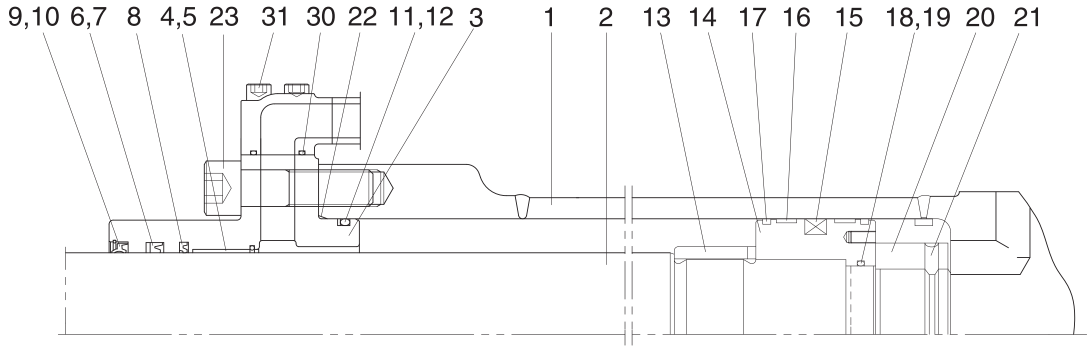
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

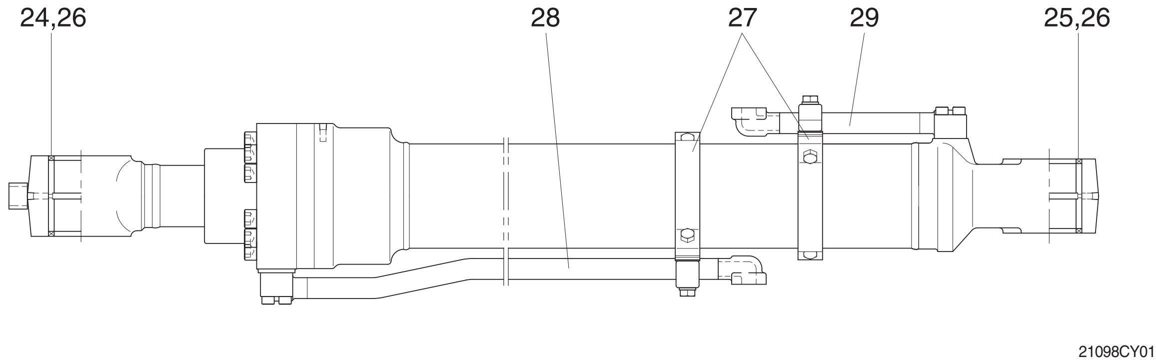
2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

(1) Bucket cylinder

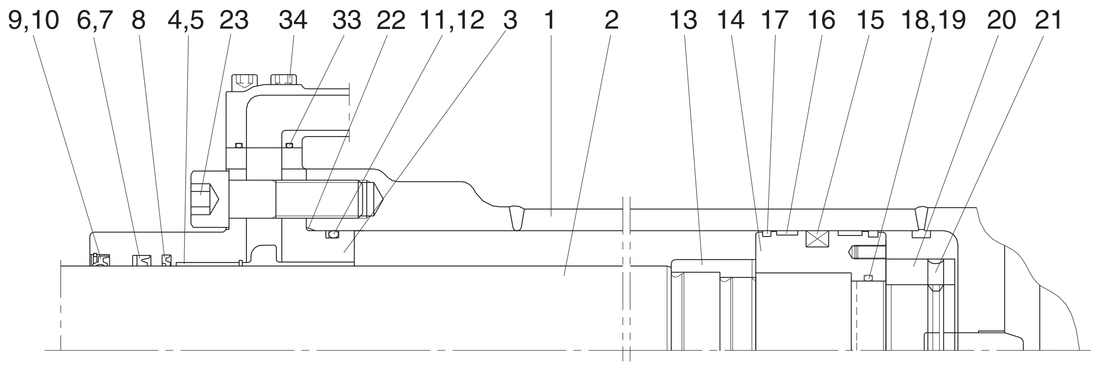


Internal detail

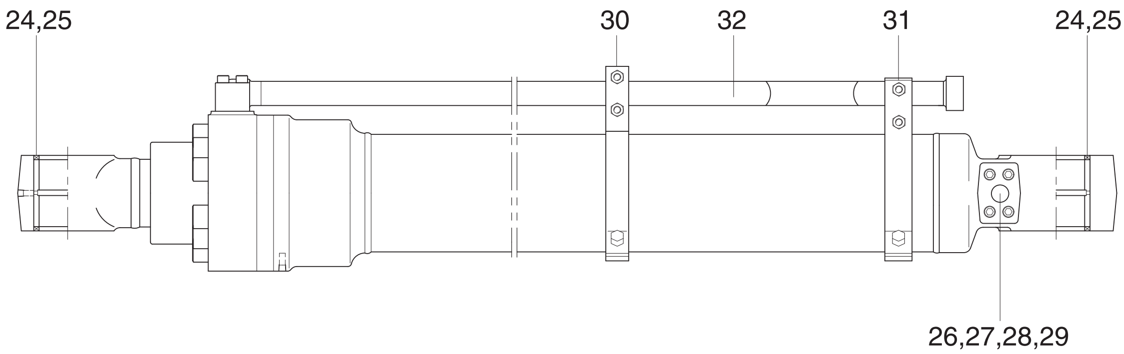


1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

(2) Arm cylinder



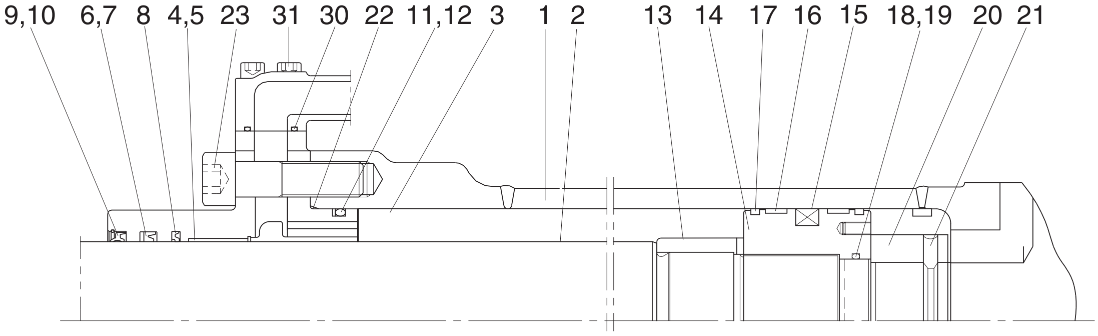
Internal detail



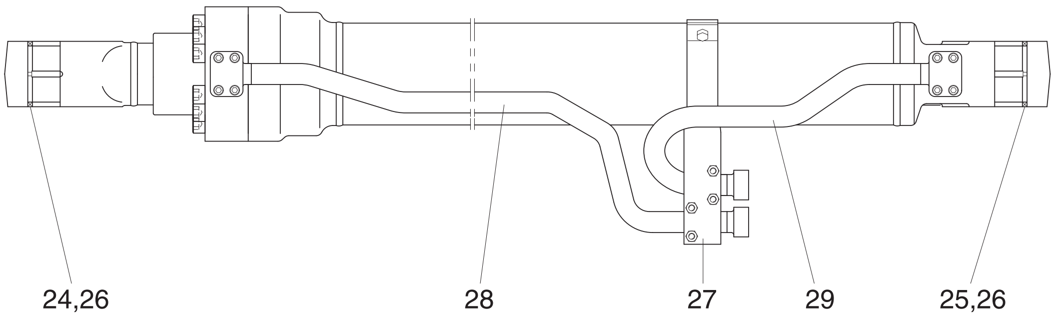
21098CY02

1	Tube assembly	13	Cushion ring	25	Dust seal
2	Rod assembly	14	Piston	26	Check valve
3	Gland	15	Piston seal	27	Coil spring
4	DD2 bushing	16	Wear ring	28	O-ring
5	Snap ring	17	Dust ring	29	Plug
6	Rod seal	18	O-ring	30	Band assembly-R
7	Back up ring	19	Back up ring	31	Band assembly-B
8	Buffer ring	20	Lock nut	32	Pipe assembly-R
9	Dust wiper	21	Hexagon socket set screw	33	O-ring
10	Snap ring	22	O-ring	34	Hexagon socket head bolt
11	O-ring	23	Hexagon socket head bolt		
12	Back up ring	24	Pin bushing		

(3) Boom cylinder



Internal detail

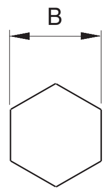


21098CY03

1	Tube assembly	12	Back up ring	23	Hexagon socket head bolt
2	Rod assembly	13	Cushion ring	24	Pin bushing
3	Gland	14	Piston	25	Pin bushing
4	DD2 bushing	15	Piston seal	26	Dust seal
5	Snap ring	16	Wear ring	27	Band assembly
6	Rod seal	17	Dust ring	28	Pipe assembly-R
7	Back up ring	18	O-ring	29	Pipe assembly-B
8	Buffer ring	19	Back up ring	30	O-ring
9	Dust wiper	20	Lock nut	31	Hexagon socket head bolt
10	Snap ring	21	Hexagon socket set screw		
11	O-ring	22	O-ring		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tools	Remark	
Allen wrench	4	
	5	
	8	
	10	
	14	
Spanner	7	
	8	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Socket head bolt	Bucket cylinder	★1 23	M16	23±2.0	166±14.5
		31	M10	5.4±0.5	39.1±3.6
	Boom cylinder	★1 23	M16	23±2.0	166±14.5
		31	M10	5.4±0.5	39.1±3.6
	Arm cylinder	★1 23	M18	32±3.0	232±21.7
		34	M12	9.4±1.0	68±7.2
Lock nut	Bucket cylinder	20	-	100±10	723±72.3
	Boom cylinder	20	-	100±10	723±72.3
	Arm cylinder	20	-	150±15	1085±108
Piston	Bucket cylinder	14	-	150±15	1085±108
	Boom cylinder	14	-	150±15	1085±108
	Arm cylinder	14	-	200±20	1447±145
Socket set screw	Bucket cylinder	21	M8	2.7±0.3	19.5±2.2
	Boom cylinder	21	M8	2.7±0.3	19.5±2.2
	Arm cylinder	21	M10	5.4±0.5	39.1±3.6

★1 : Apply loctite #243 on the thread of bolt.

3) DISASSEMBLY

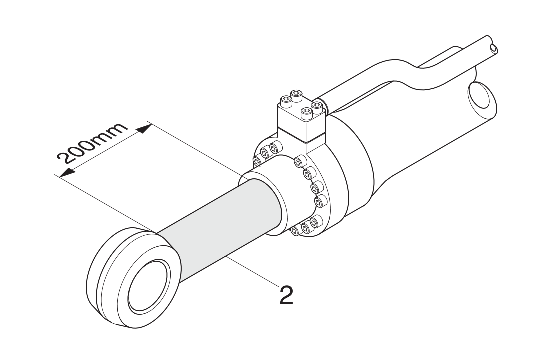
(1) Remove cylinder head and piston rod

※ 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.

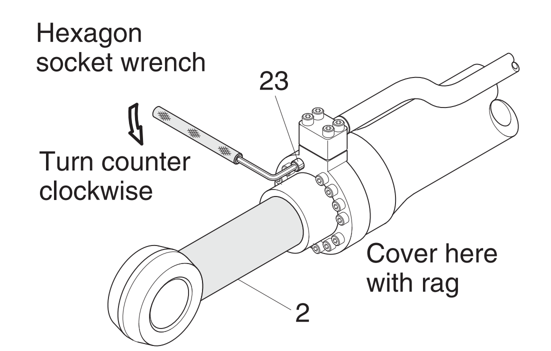
② Pull out rod assembly (2) about 200 mm (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



21078DA30

③ Loosen and remove socket bolts (23) of the gland in sequence.

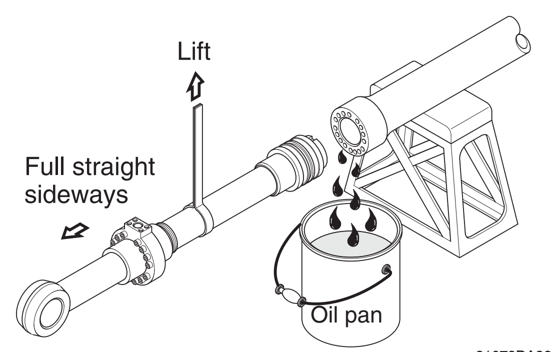
※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



21098DA31

④ Draw out cylinder head and rod assembly together from tube assembly (1).

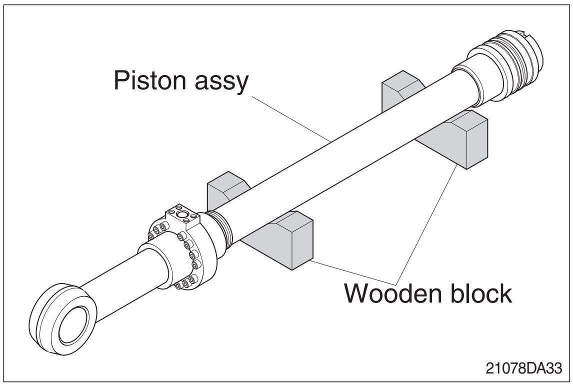
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



21078DA32

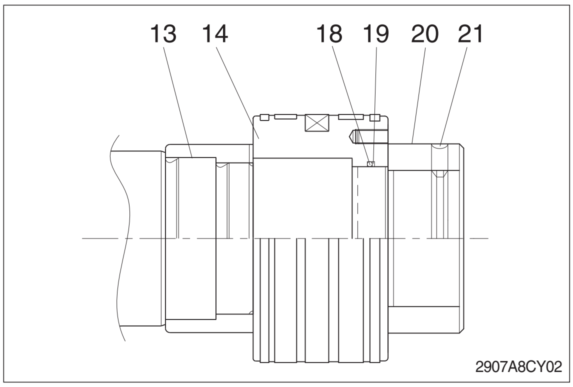
Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly on a wooden V-block that is set level.
※ Cover a V-block with soft rag.

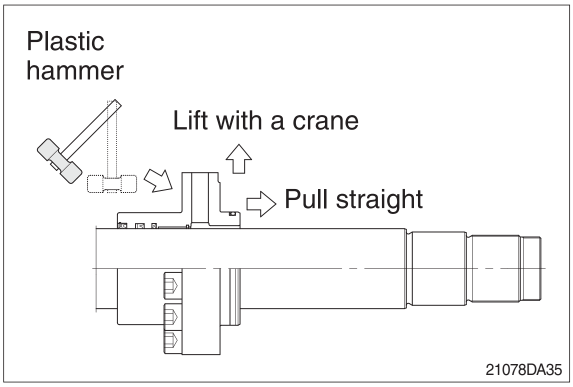


(2) Remove piston and cylinder head

① Remove set screw (21).
② Remove lock nut (20).
※ Since piston (14) and lock nut (20) are tightened to a high torque, use a hydraulic and power wrench that utilizers a hydraulic cylinder, to remove the piston (14) and lock nut (20).
③ Remove piston assembly (14), back up ring (19), and O-ring (18).
④ Remove cushion ring (13).



⑤ Remove the cylinder head assembly from rod assembly (2).
※ If it is too heavy to move, move it by striking the flanged part of cylinder head with a plastic hammer.
※ Pull it straight with cylinder head assembly lifted with a crane.
Exercise care so as not to damage the lip of rod bushing (4) and packing (5,6,7,8,9,10) by the threads of rod assembly (2).

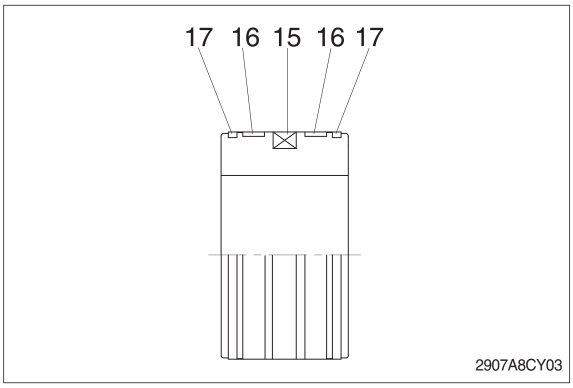


(3) Disassemble the piston assembly

① Remove wear ring (16).

② Remove dust ring (17) and piston seal (15).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble cylinder head assembly

① Remove back up ring (12), O-ring (11) and O-ring (22).

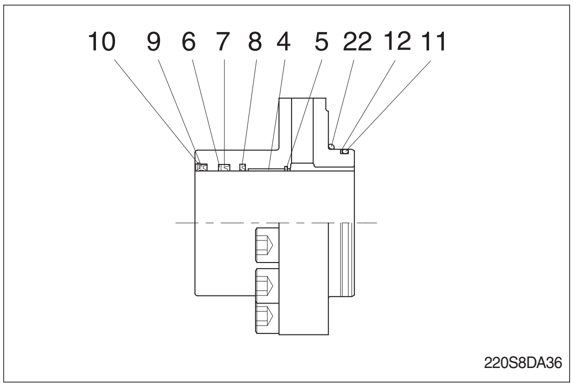
② Remove snap ring (10), dust wiper (9).

③ Remove back up ring (7), rod seal (6) and buffer ring (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

※ Do not remove bushing (4).

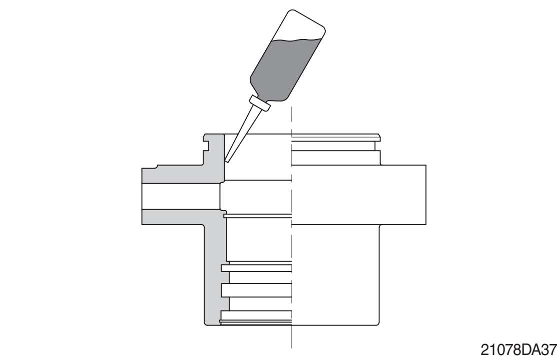


3) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

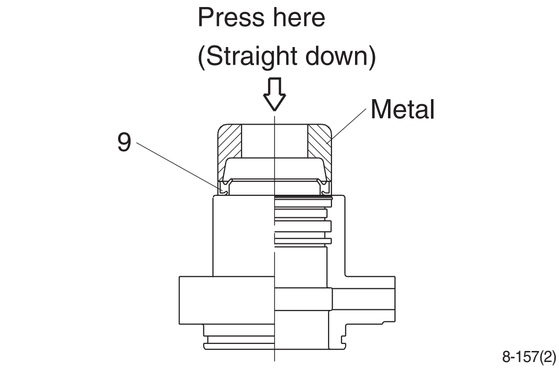
① Coat the inner face of gland (3) with hydraulic oil.



21078DA37

② Coat dust wiper (9) with grease and fit dust wiper (9) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit snap ring (10) to the stop face.

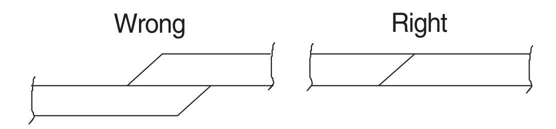


8-157(2)

④ Fit back up ring (7), rod seal (6) and buffer ring (8) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

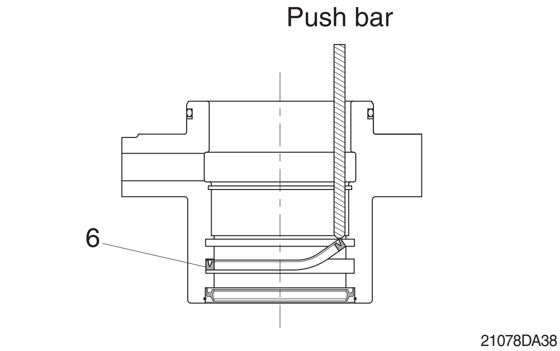
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3)

※ Rod seal (6) has its own fitting direction. Therefore, confirm it before fitting them.

※ Fitting rod seal (6) upside down may damage its lip. Therefore check the correct direction that is shown in fig.

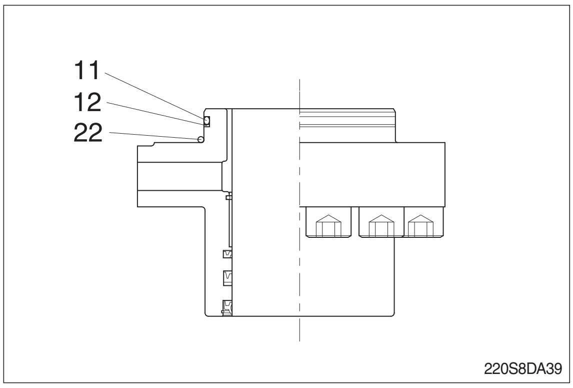


21078DA38

⑤ Fit back up ring (12) to gland (3).

※ Put the backup ring in the warm water of 30~50˚C.

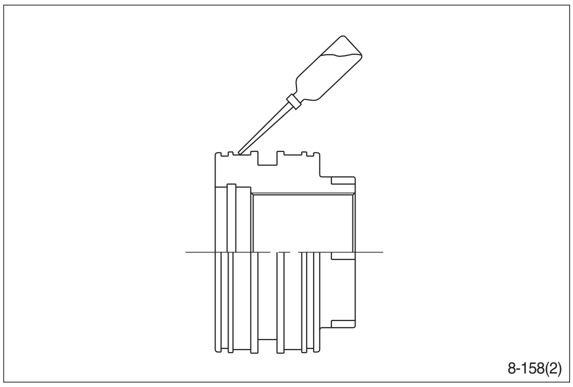
⑥ Fit O-ring (11) and O-ring (22) to gland (3).



(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

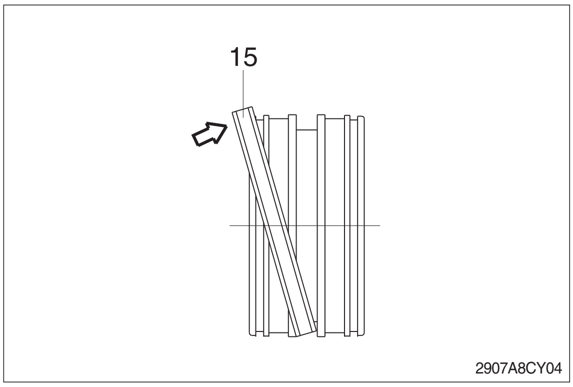
① Coat the outer face of piston (14) with hydraulic oil.



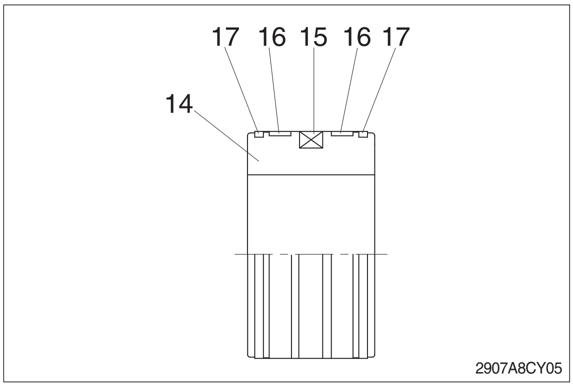
② Fit piston seal (15) to piston.

※ Put the piston seal in the warm water of 60~100˚C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



③ Fit wear ring (16) and dust ring (17) to piston (14).

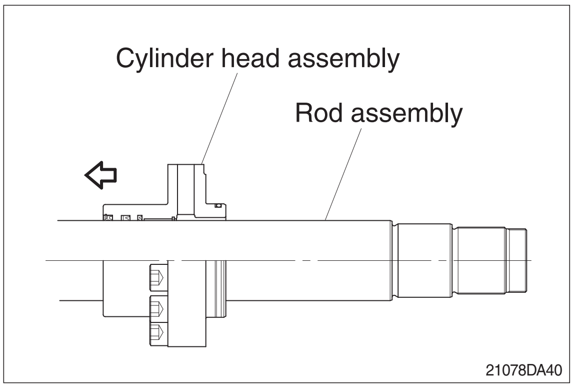


(3) Install piston and cylinder head

① Fix the rod assembly to the work bench.

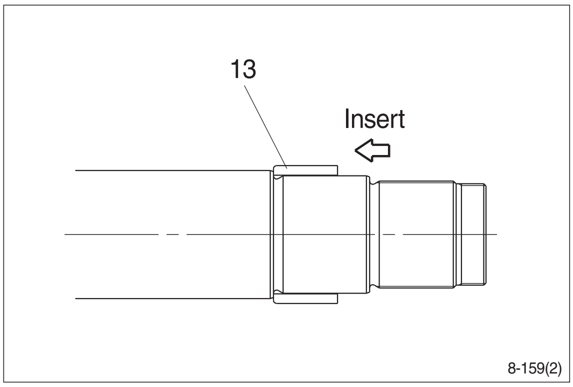
② Apply hydraulic oil to the outer surface of rod assembly (2), the inner surface of piston and cylinder head.

③ Insert cylinder head assembly to rod assembly.



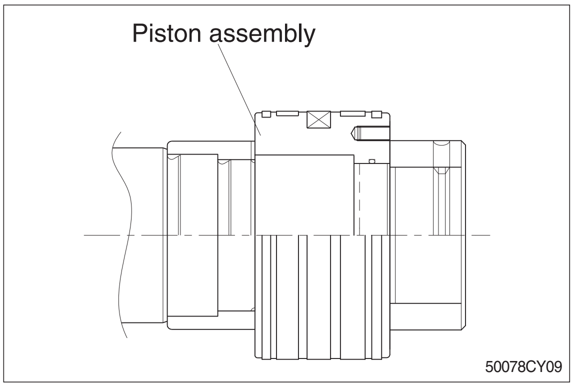
④ Insert cushion ring (13) to rod assembly.

※ Note that cushion ring (13) has a direction in which it should be fitted.



⑤ Fit piston assembly to rod assembly.

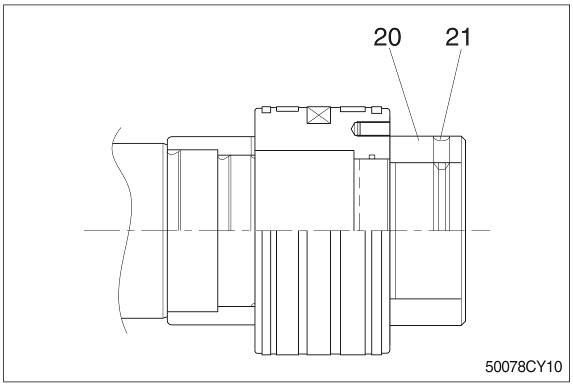
· Tightening torque : 150±15 kgf · m (1085±108 lbf · ft)



⑥ Fit lock nut (20) and tighten the screw (21).

· Tightening torque :

Item		kgf · m	lbf · ft
20	Bucket	100±10	723±72.3
	Boom	100±10	723±72.3
	Arm	150±15	1085±108
21	Bucket	2.7±0.3	19.6±2.2
	Boom	2.7±0.3	19.5±2.2
	Arm	5.4±0.5	39.1±3.6



(3) Overall assemble

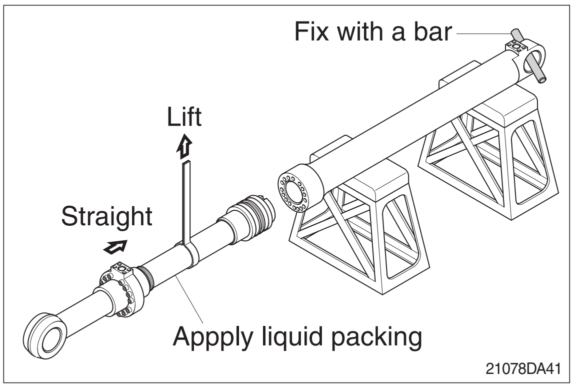
① Place a V-block on a rigid work bench. Mount the tube assembly (1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.

② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly with a crane.

※ Be careful not to damage piston seal by thread of tube assembly.

③ Match the bolt holes in the cylinder head flange to the tapped holes in the tube assembly and tighten socket bolts to a specified torque.

※ Refer to the table of tightening torque.



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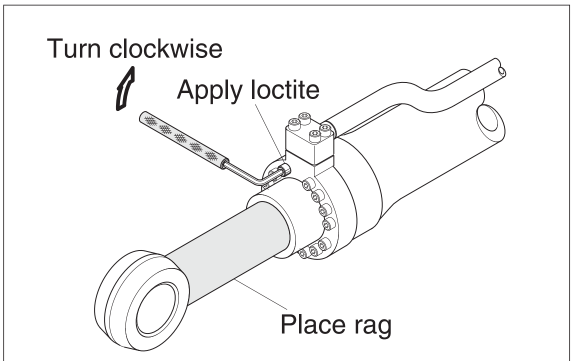
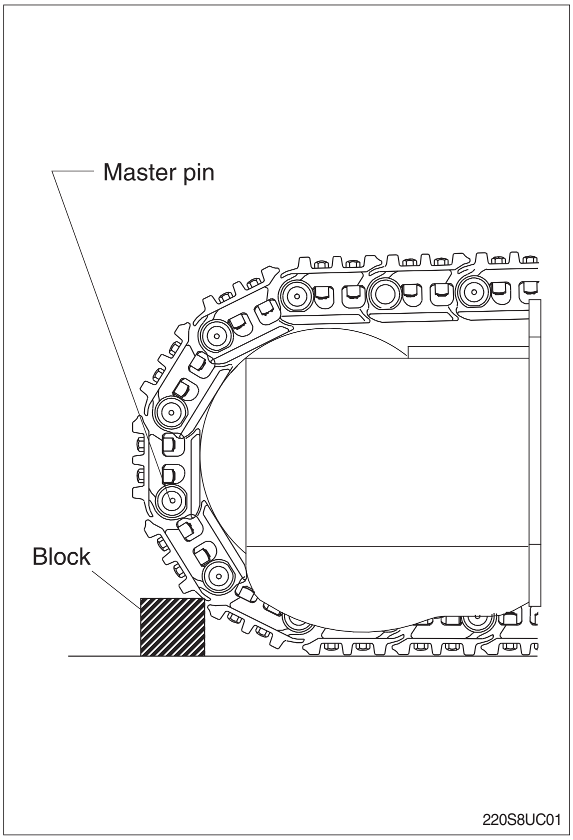


21078DA42

1. TRACK LINK

1) REMOVAL



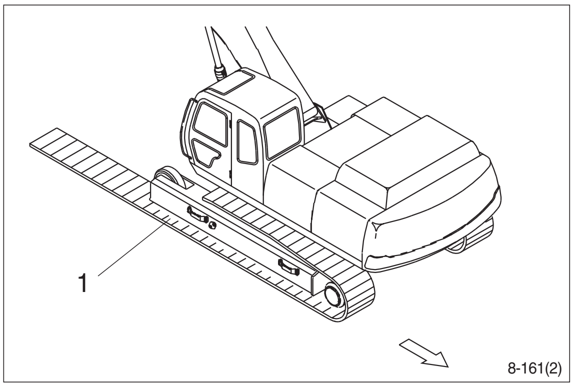
(1) Move track link until master pin is over front idler in the position put wooden block as shown.

(2) Loosen tension of the track link.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.

※ Unscrew the grease nipple after release the tension by pushing the poppet only when necessarily required.
Grease leaking hole is not existing. So, while unscrew the grease nipple, grease is not leaking until the grease nipple is completely coming out. If the tension is not released in advance, the grease nipple can be suddenly popped out by pressurized grease.

(3) Push out master pin by using a suitable tool.

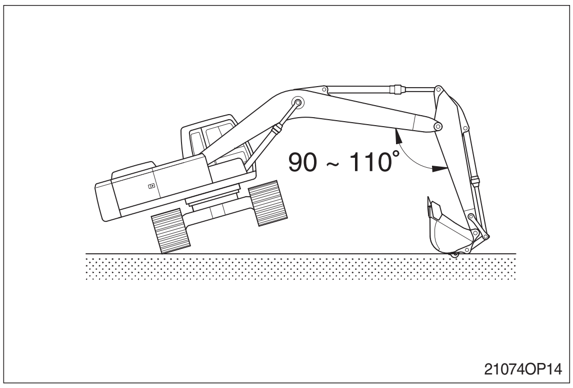


(4) Move the machine slowly in reverse, and lay out track link assembly (1).

※ Jack up the machine and put wooden block under the machine.

※ Don't get close to the sprocket side as the track shoe plate may fall down on your feet.

2) INSTALL



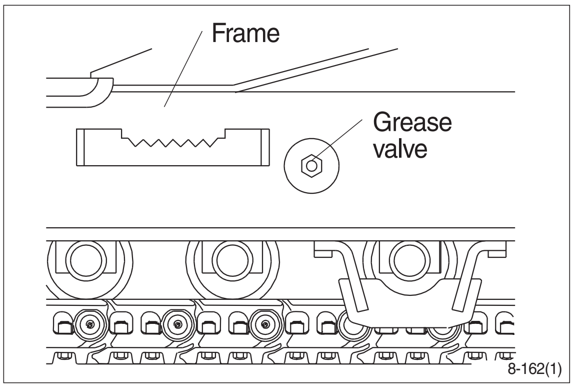
(1) Carry out installation in the reverse order to removal.

※ Adjust the tension of the track link.

2. CARRIER ROLLER

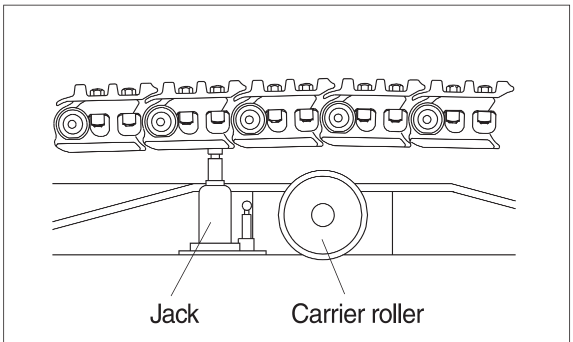
1) REMOVAL

(1) Loosen tension of the track link.



8-162(1)

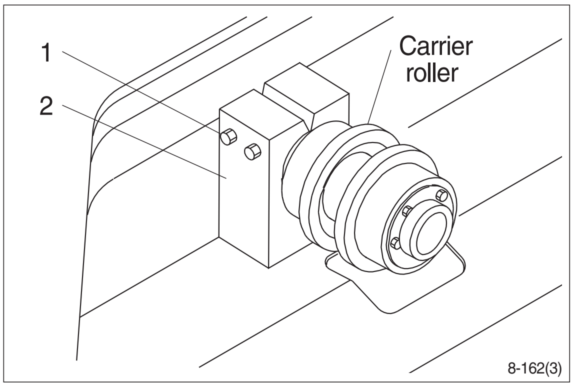
(2) Jack up the track link height enough to permit carrier roller removal.



8-162(2)

(3) Loosen the lock nut (1).

(4) Open bracket(2) with a screwdriver, push out from inside, and remove carrier roller assembly.
- · Weight : 21 ㎏ (46 ℔)
- · Tightening torque : 29.7±4.5 kgf·m (215±32.5 lbf · ft)



8-162(3)

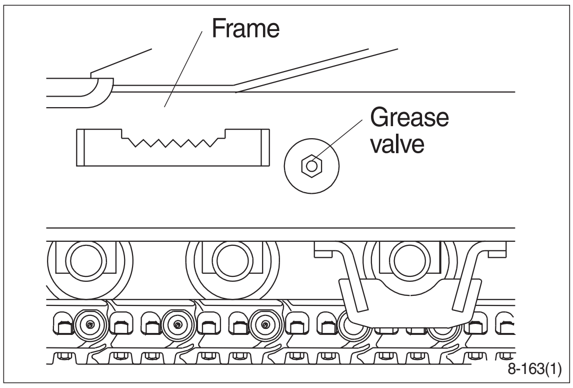
2) INSTALL

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

3. TRACK ROLLER

1) REMOVAL

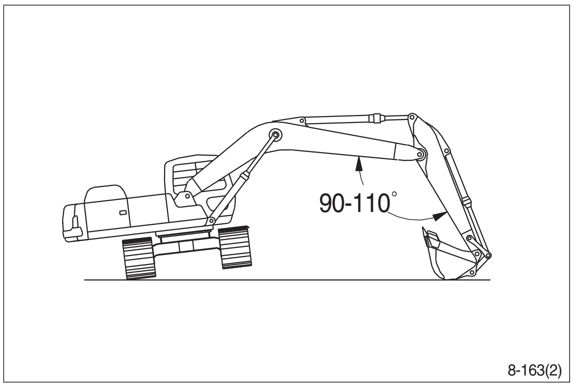
(1) Loosen tension of the track link.



8-163(1)

(2) Using the work equipment, push up track frame on side which is to be removed.

※ After jack up the machine, set a block under the unit.

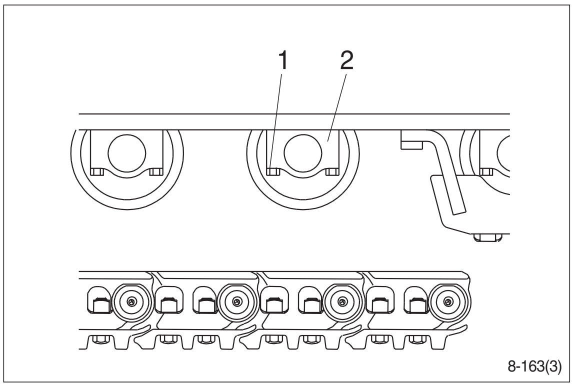


8-163(2)

(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 46 ㎏ (106 lb)

· Tightening torque : 57.9±8.7 kgf·m (419±62.9 lbf · ft)



8-163(3)

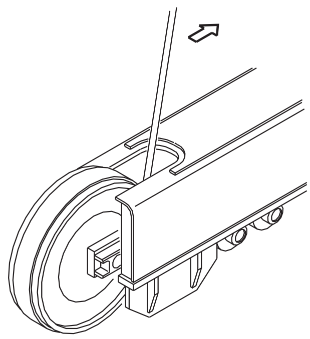
2) INSTALL

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

4. IDLER AND RECOIL SPRING

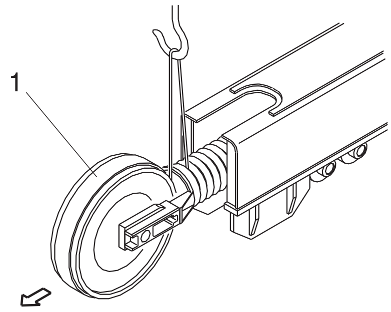
1) REMOVAL

(1) Remove the track link.
For detail, see removal of track link.



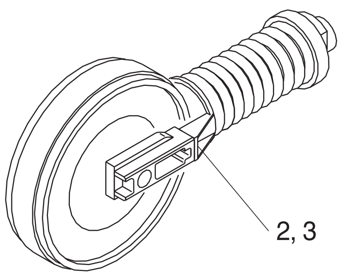
8-164(1)

(2) Sling the recoil spring (1) and pull out idler and recoil spring assembly from track frame, using a pry.
· Weight : 310 kg (680 lb)



8-164(2)

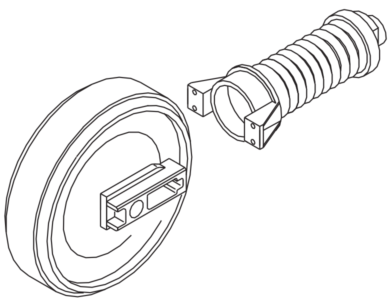
(3) Remove the bolts (2), washers (3) and separate ilder from recoil spring.
· Tightening torque : 29.7±4.5 kgf·m
(215±32.5 lbf · ft)



8-164(3)

2) INSTALL

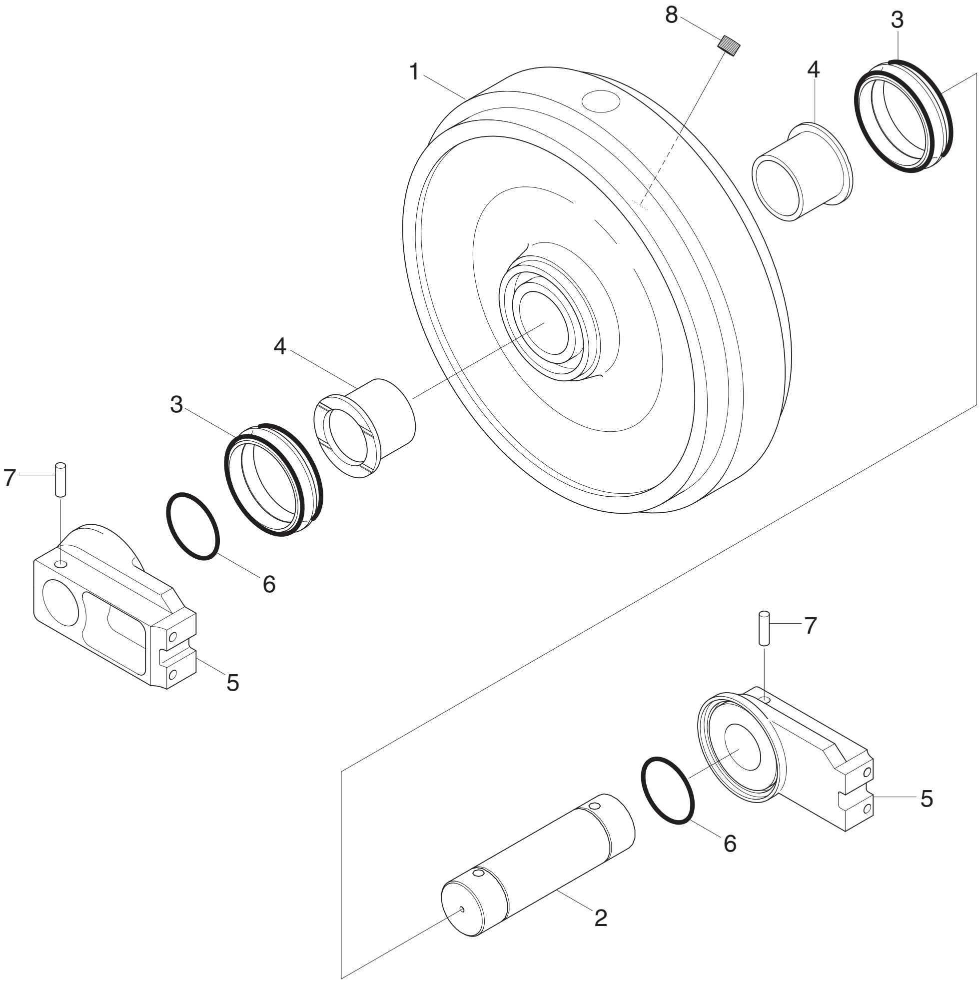
(1) Carry out installation in the reverse order to removal.
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



8-164(4)

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



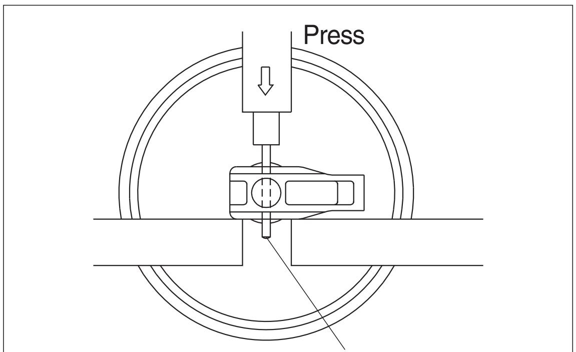
220S8DA43

1	Shell	4	Bushing	7	Spring pin
2	Shaft	5	Bracket	8	Plug
3	Seal assembly	6	O-ring		

(2) Disassembly

① Remove plug and drain oil.

② Draw out the spring pin (7), using a press.

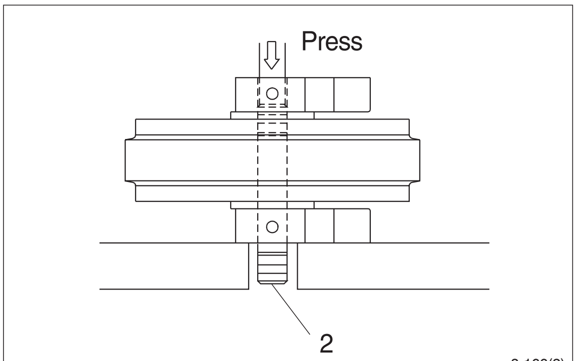


8-166(1)

③ Pull out the shaft (2) with a press.

④ Remove seal (3) from idler (1) and bracket (5).

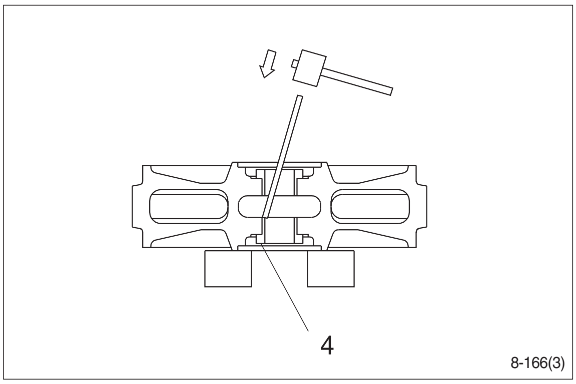
⑤ Remove O-ring (6) from shaft.



8-166(2)

⑥ Remove the bushing (4) from idler, using a special tool.

Only remove bushing if replacement is necessity.



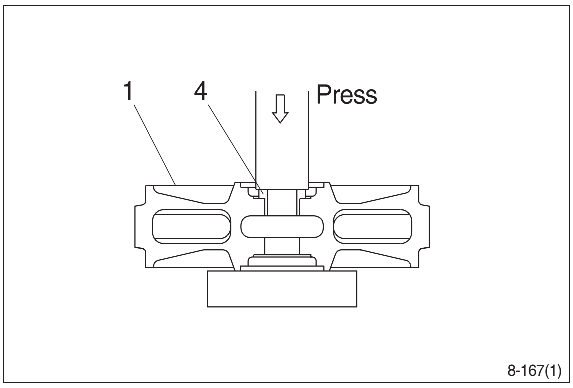
8-166(3)

(3) Assembly

※ Before assembly, clean the parts.

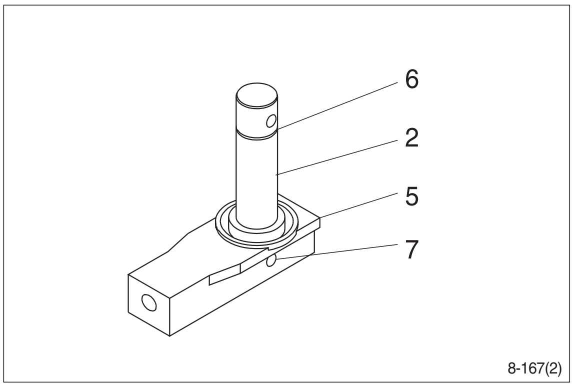
※ Coat the sliding surfaces of all parts with oil.

① Cool up bushing (4) fully by some dry ice and press it into shell (1).
Do not press it at the normal temperature, or not knock in with a hammer even after the cooling.

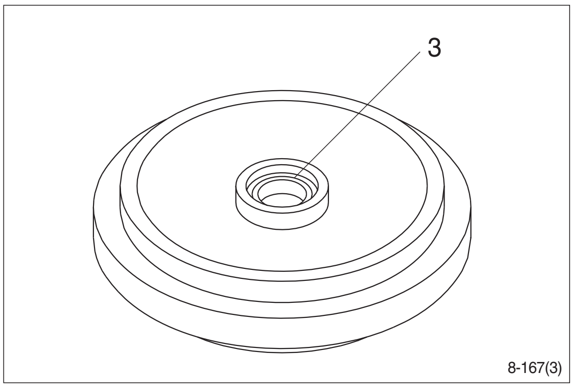


② Coat O-ring (6) with grease thinly, and install it to shaft (2).

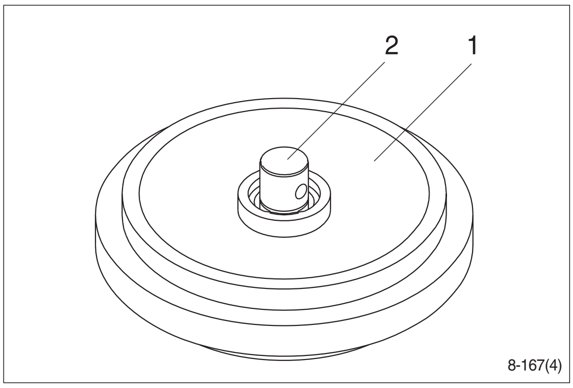
③ Insert shaft (2) into bracket (5) and drive in the spring pin (7).



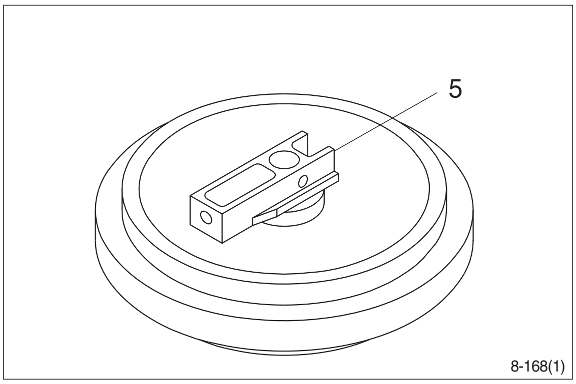
④ Install seal (3) to shell (1) and bracket (5).



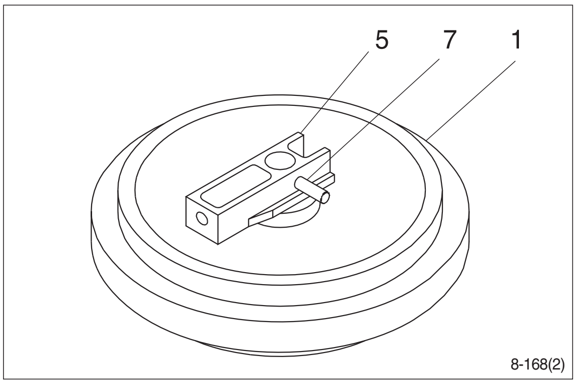
⑤ Install shaft (2) to shell (1).



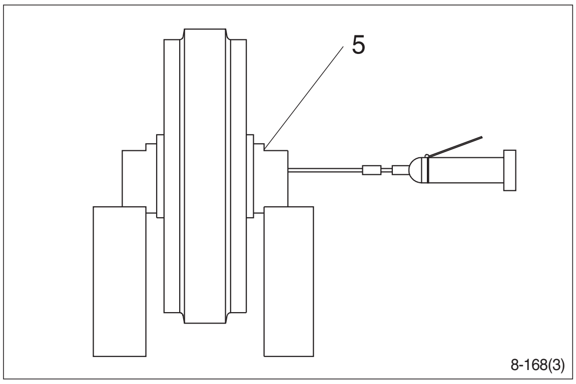
⑥ Install bracket (5) attached with seal (3).



⑦ Knock in the spring pin (7) with a hammer.

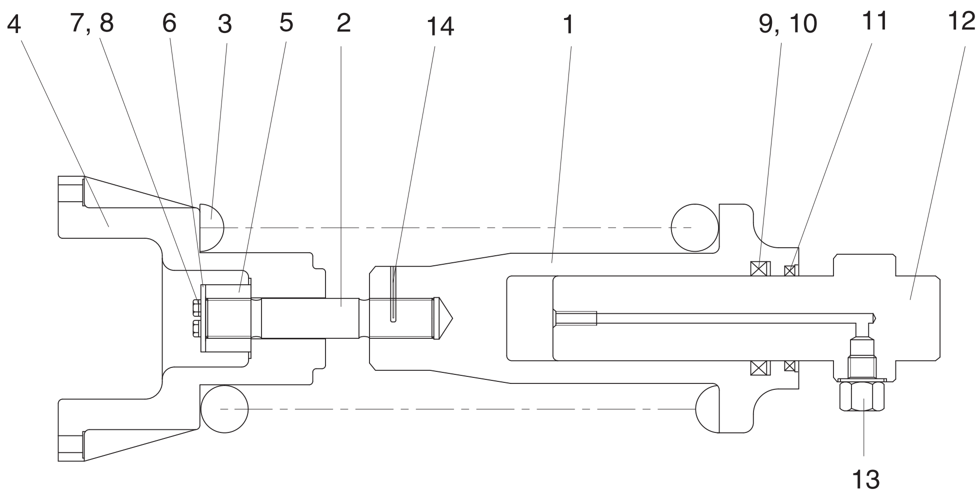


⑧ Lay bracket (5) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

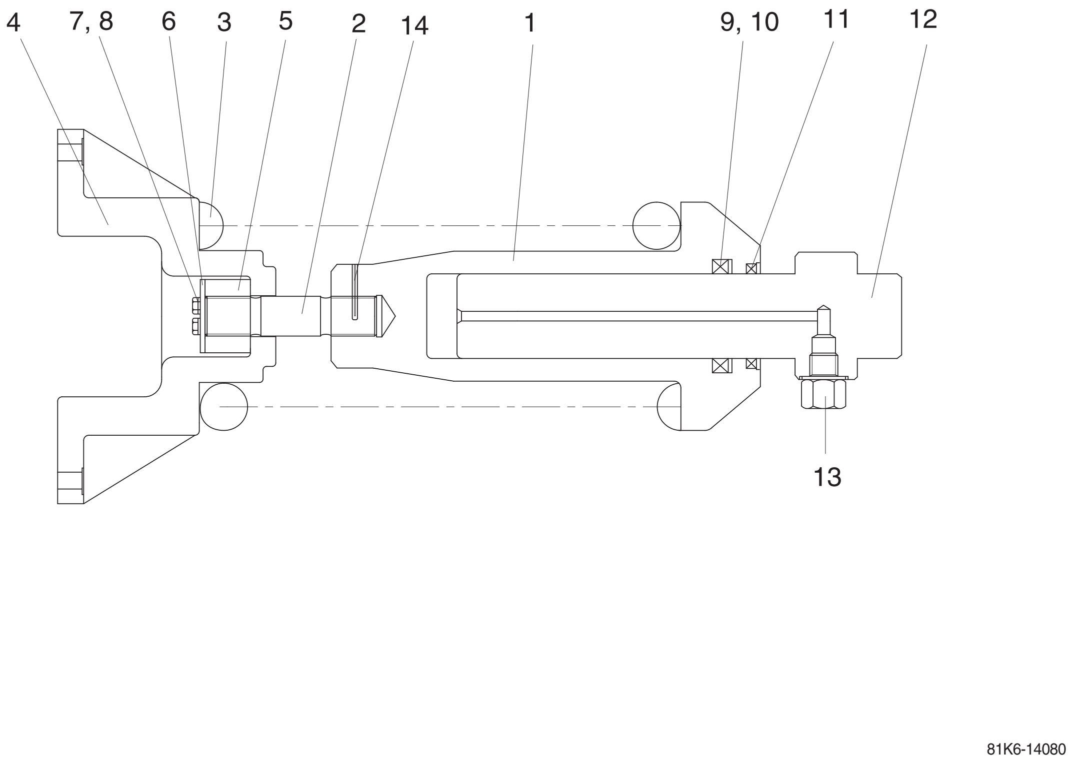
(1) Structure (standard)



220L8UC100

1	Body	6	Lock plate	11	Dust seal
2	Tie bar	7	Bolt	12	Rod
3	Spring	8	Spring washer	13	Grease valve
4	Bracket	9	Rod seal	14	Spring pin
5	Lock nut	10	Back up ring		

Structure (option)



1	Body	6	Lock nut	11	Back up ring
2	Tie bar	7	Lock plate	12	Dust seal
3	Spring	8	Hex bolt	13	Grease valve
4	Bracket	9	Spring washer	14	Spring pin
5	Rod	10	Rod packing		

(2) Disassembly

※ The illustrations are based on the standard type.

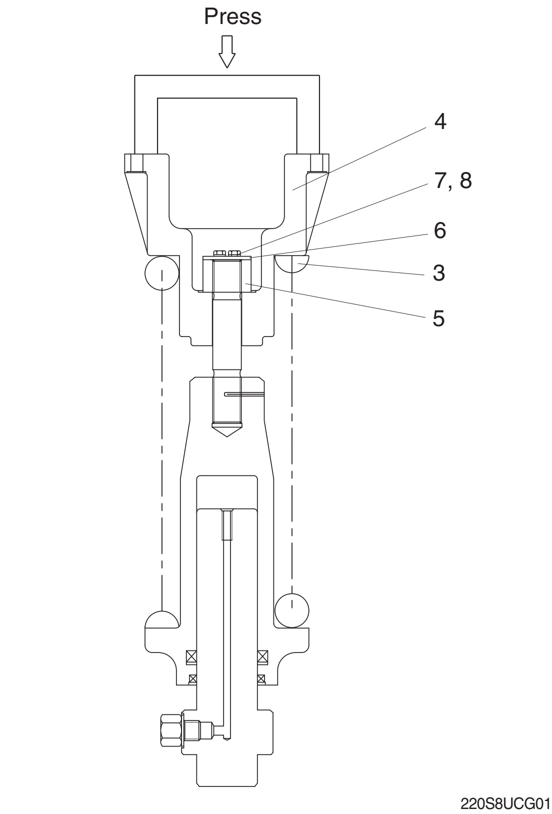
① Apply pressure on spring (3) with a press.

※ The spring is under a large installed load. This is dangerous, so be sure to set properly.

② Remove bolt (7), spring washer (8) and lock plate (6).

③ Remove lock nut (5).
Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

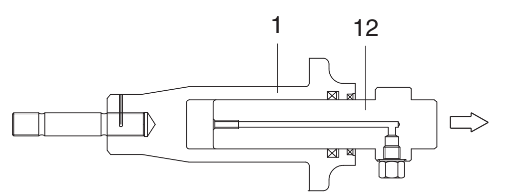
④ Lighten the press load slowly and remove bracket (4) and spring (3).



220S8UCG01

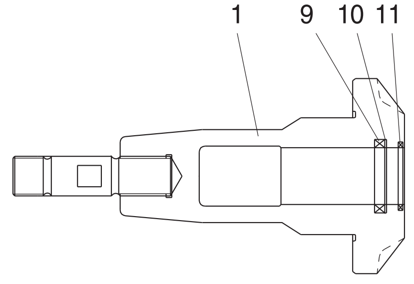
⑤ Remove rod (12) from body (1).

⑥ Remove grease valve (13) from rod (12).



220S8UCG02

⑦ Remove rod seal (9), back up ring (10) and dust seal (11).

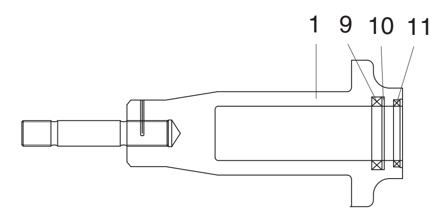


R210UCG2(3)

(3) Assembly

Install dust seal (11), back up ring (10) and rod seal (9) to body (1).

※ When installing dust seal (11) and rod seal (9), take full care so as not to damage the lip.



220S8UCG03

② Pour grease into body (1), then push in rod (12) by hand.

After take grease out of grease valve mounting hole, let air out.

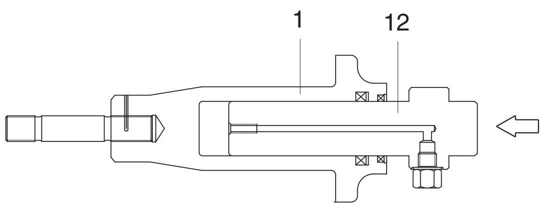
※ If air letting is not sufficient, it may be difficult to adjust the tension of crawler.

③ Fit grease valve (13) to rod (12).

· Tightening torque

Standard : 13±1.0 kgf·m (94±7.2 lbf·ft)

Option : 13±0.5 kgf·m (94±3.6 lbf·ft)



220S8UCG04

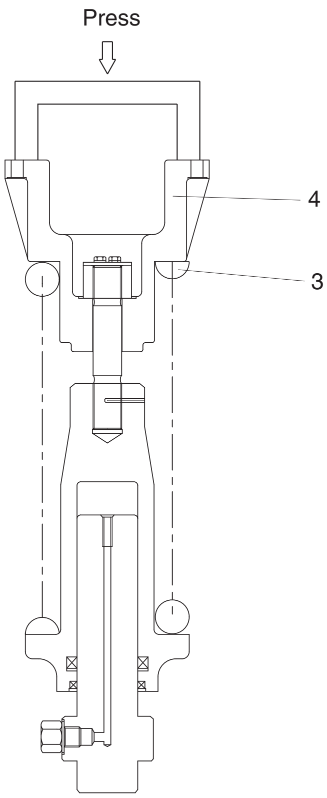
④ Install spring (3) and bracket (4) to body (1).

⑤ Apply pressure to spring (3) with a press and tighten lock nut (5).

· Spring set load : 13716 kg (30239 lb)

※ Apply sealant before assembling.

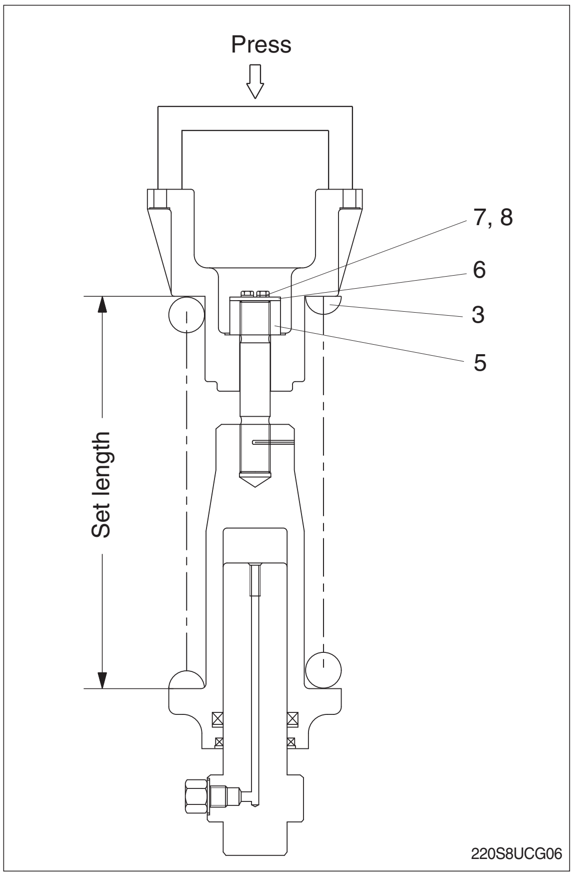
※ During the operation, pay attention specially to prevent the press from slipping out.



220S8UCG05

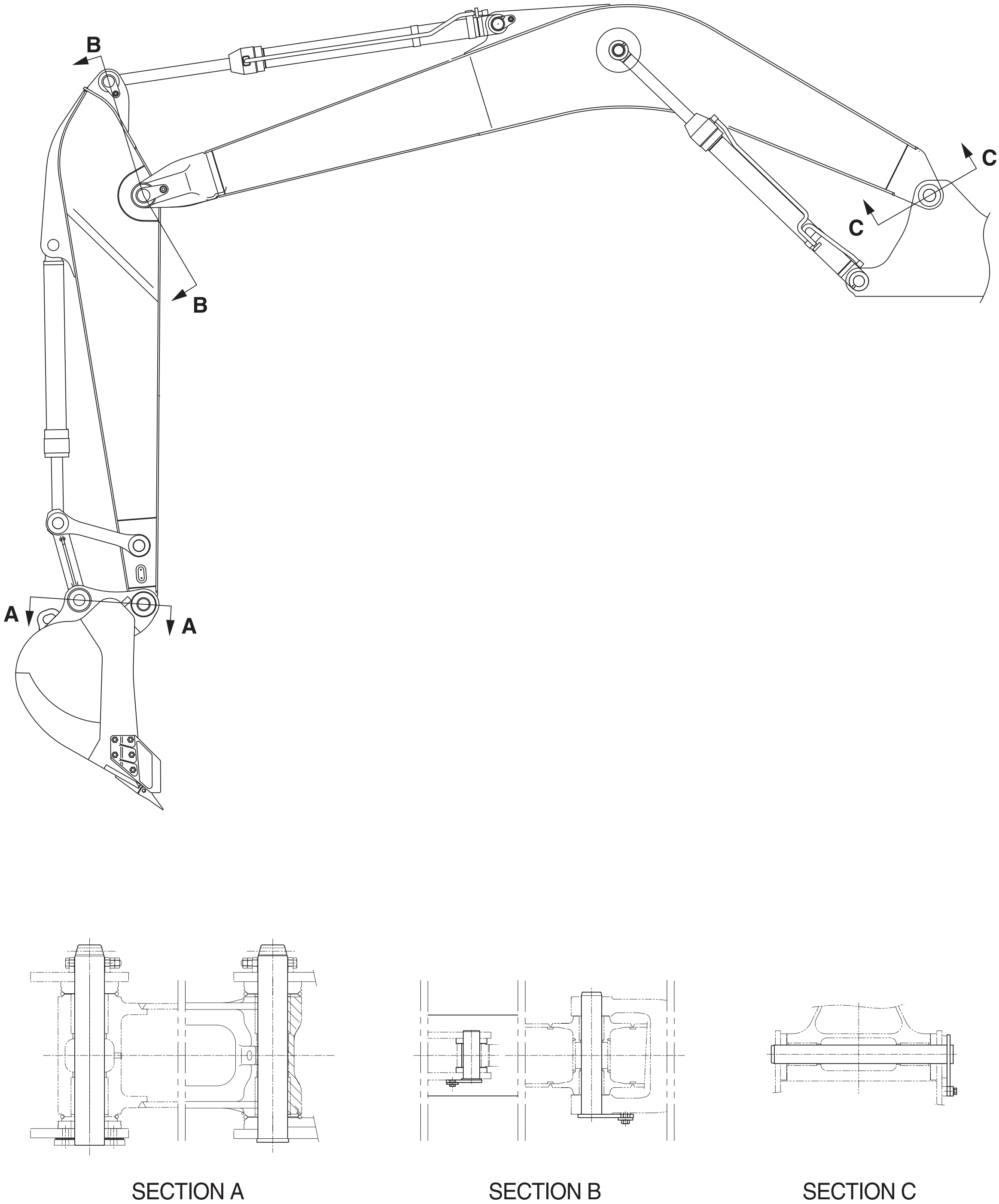
⑥ Lighten the press load and confirm the set length of spring (3).
- Set length : 431 ± 1.5 mm

⑦ After the setting of spring (3), install lock plate (6), spring washer (8) and bolt (7).
· Tightening torque :
Std : 15±0.5 kgf·m (108±3.6 lbf·ft)
Opt : 12±0.5 kgf·m (86.8±3.6 lbf·ft)



GROUP 11 WORK EQUIPMENT

1. STRUCTURE



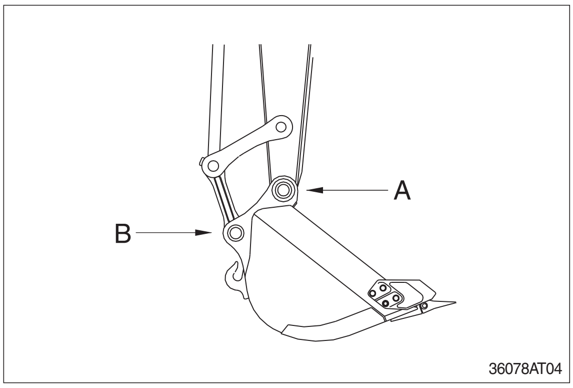
21078DA44

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

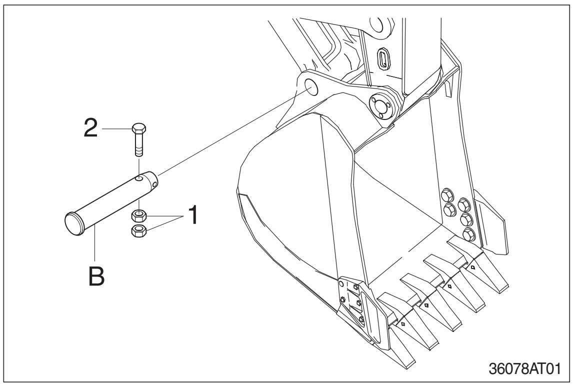
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



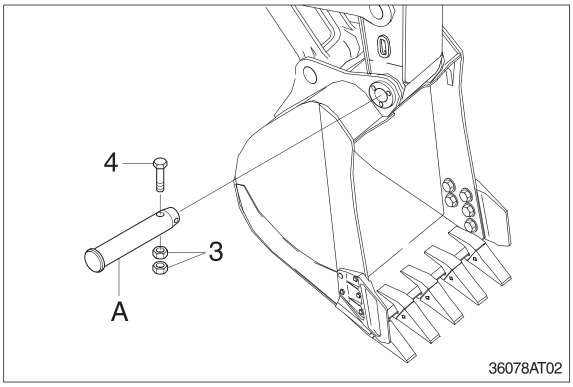
② Remove nut (1), bolt (2) and draw out the pin (A).

· Tightening torque (1) : 29.7±45 kgf · m (215± 32.5 lbf · ft)



③ Remove nut (3), bolt (4) and draw out the pin (B).

· Tightening torque (3) : 29.7±45 kgf · m (215± 32.5 lbf · ft)

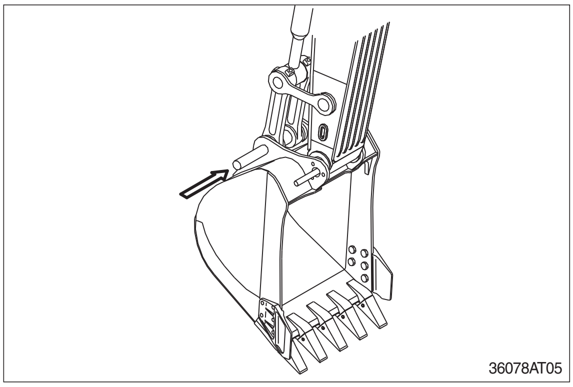


(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When aligning the mounting position of the pin, do not insert your fingers in the pin hole.**

※ Adjust the bucket clearance. For detail, see operation manual.



2) ARM ASSEMBLY

(1) Removal

※ Loosen the breather slowly to release the pressure inside the hydraulic tank.

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

① Remove bucket assembly.
For details, see removal of bucket assembly.

② Disconnect bucket cylinder hose (1).

⚠ **Fit blind plugs (5) in the piping at the chassis end securely to prevent oil from spurting out when the engine is started.**

③ Sling arm cylinder assembly, remove spring, pin stopper and pull out pin.

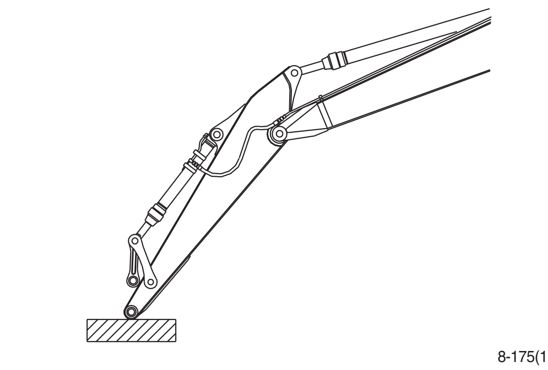
※ Tie the rod with wire to prevent it from coming out.

④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

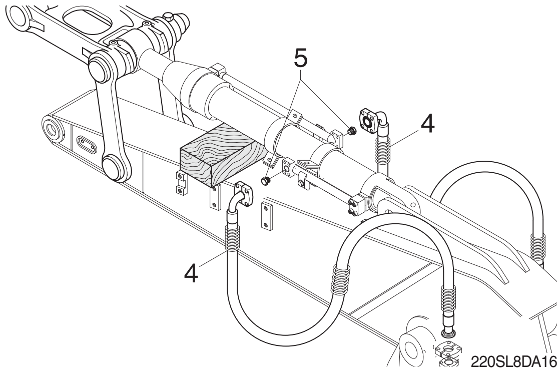
⑤ Remove bolt (2), plate (3) and pull out the pin (4) then remove the arm assembly.

· Weight : 1095 kg (2410 lb)
· Tightening torque (2) : 29.7±45 kgf·m (215± 32.5 lbf·ft)

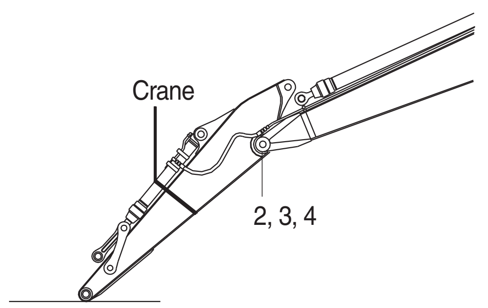
※ When lifting the arm assembly, always lift the center of gravity.



8-175(1)



220SL8DA16



8-175(3)

(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

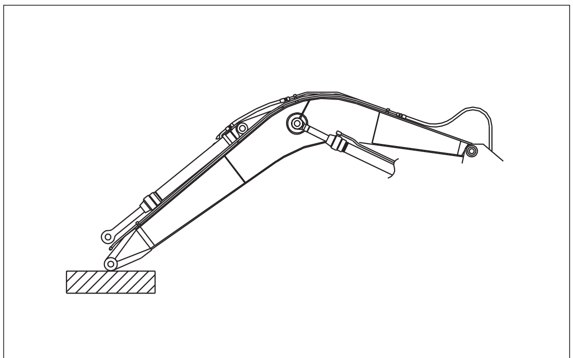
※ Bleed the air from the cylinder.

3) BOOM ASSEMBLY

(1) Removal

① Remove arm and bucket assembly.
For details, see removal of arm and bucket assembly.

② Remove boom cylinder assembly from boom.
For details, see removal of boom cylinder assembly.



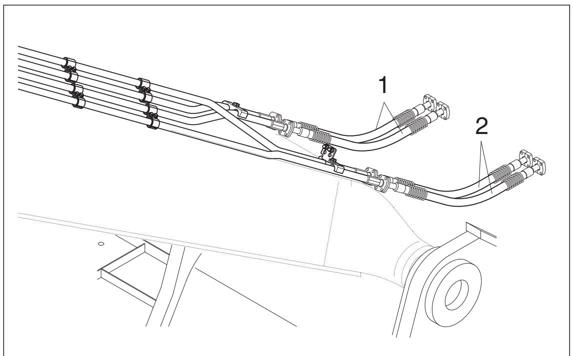
8-176(1)

③ Disconnect head lamp wiring.

④ Disconnect bucket cylinder hose (2) and arm cylinder hose (1).

※ When the hose are disconnected, oil may spurt out.

⑤ Sling boom assembly (3).



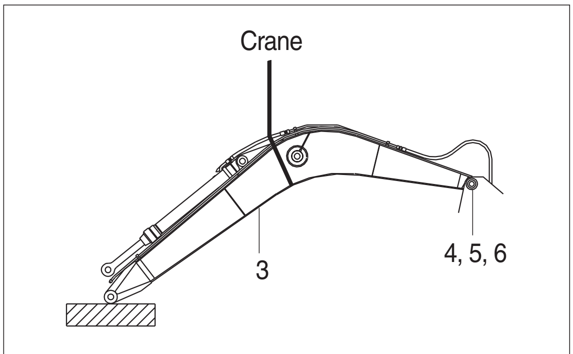
220S8DA45

⑥ Remove bolt (4), plate (5) and pull out the pin (6) then remove boom assembly.

· Weight :1950 ㎏ (4300 ㏶)

· Tightening torque (4) : 29.7±45 kgf · m
(215± 32.5 lbf · ft)

※ When lifting the boom assembly always lift the center of gravity.



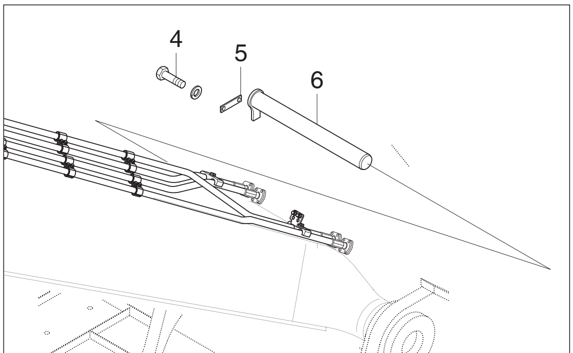
8-176(3)

(2) Install

① Carry out installation in the reverse order to removal.

▲ **When lifting the arm assembly, always lift the center of gravity.**

※ Bleed the air from the cylinder.



220S8DA46