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1. STRUCTURE

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

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

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

SECTION 1 GENERAL

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

SECTION 2 STRUCTURE AND FUNCTION

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

SECTION 3 HYDRAULIC SYSTEM

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

SECTION 4 ELECTRICAL SYSTEM

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

SECTION 5 TROUBLESHOOTING

This section explains the troubleshooting charts correlating problems to causes.

SECTION 6 MAINTENANCE STANDARD

This section gives the judgement standards when inspecting disassembled parts.

SECTION 7 DISASSEMBLY AND ASSEMBLY

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

SECTION 8 COMPONENT MOUNTING TORQUE

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

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

2. HOW TO READ THE SERVICE MANUAL

Distribution and updating

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

Filing method

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

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

Revised edition mark (①②③…)

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

Revisions

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

Symbols

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

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

3. CONVERSION TABLE

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

Example

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

2. Convert 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 55 mm.
   (2) Carry out the same procedure as above to convert 55 mm to 2.165 inches.
   (3) The original value (550 mm) was divided by 10, so multiply 2.165 inches by 10 (Move the decimal point one place to the right) to return to the original value.
   This gives 550 mm = 21.65 inches.

Millimeters to inches

ⓑ

1 mm = 0.03937 in

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

Millimeters to inches

1 mm = 0.03937 in

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

Kilogram to Pound

1 kg = 2.2046 lb

	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

1 kgf · m = 7.233 lbf · ft

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

kgf/cm² to lbf/in²

1 kgf / cm² = 14.2233 lbf / in²

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

TEMPERATURE

Fahrenheit-Centigrade Conversion.

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

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

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

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

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

SECTION 1 GENERAL

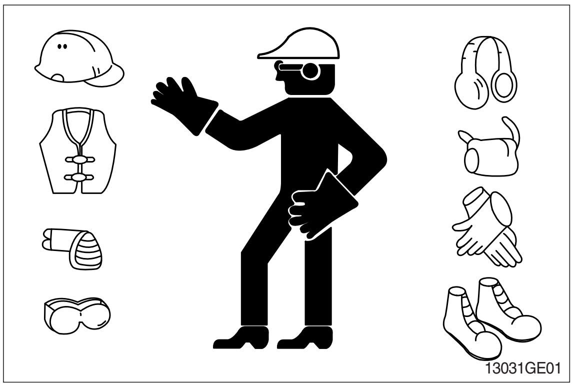
GROUP 1 SAFETY

FOLLOW SAFE PROCEDURE

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

WEAR PROTECTIVE CLOTHING

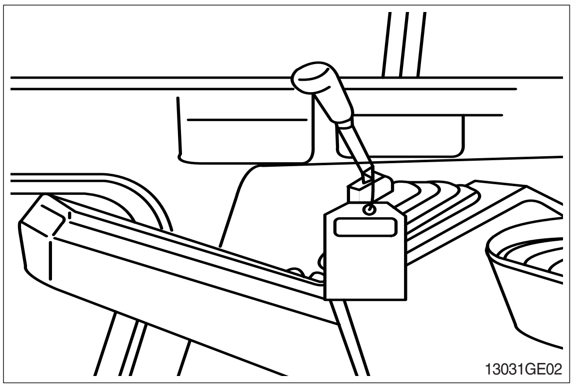
Wear close fitting clothing and safety equipment appropriate to the job.



13031GE01

WARN OTHERS OF SERVICE WORK

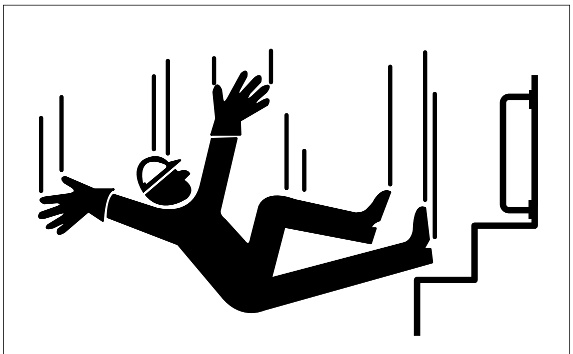
Unexpected machine movement can cause serious injury.
Before performing any work on the excavator, attach a 「**Do Not Operate**」 tag on the right side control lever.



13031GE02

USE HANDHOLDS AND STEPS

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



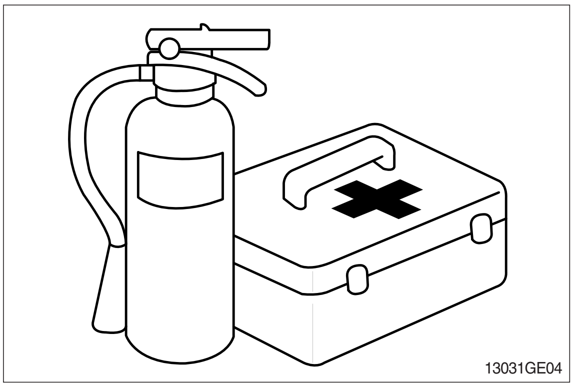
13031GE03

PREPARE FOR EMERGENCIES

Be prepared if a fire starts.

Keep a first aid kit and fire extinguisher handy.

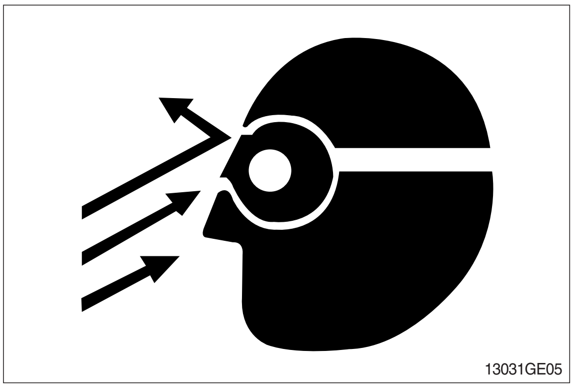
Keep emergency numbers for doctors, ambulance service, hospital, and fire department near your telephone.



13031GE04

PROTECT AGAINST FLYING DEBRIS

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

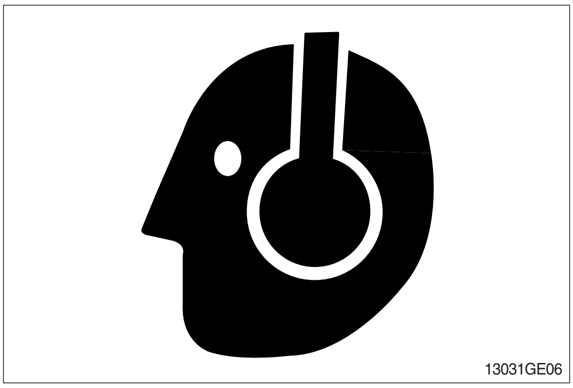


13031GE05

PROTECT AGAINST NOISE

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

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

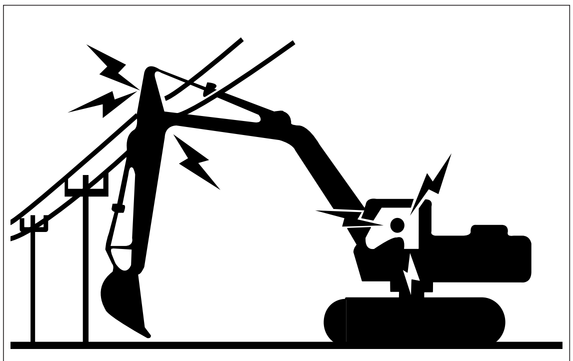


13031GE06

AVOID POWER LINES

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

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

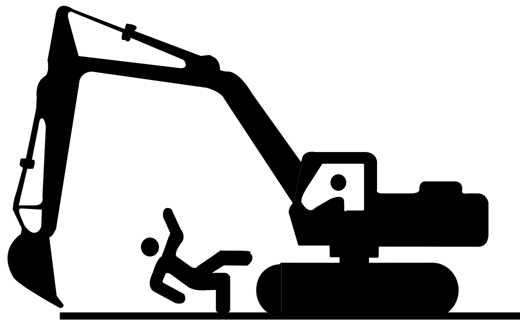


13031GE07

KEEP RIDERS OFF EXCAVATOR

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

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



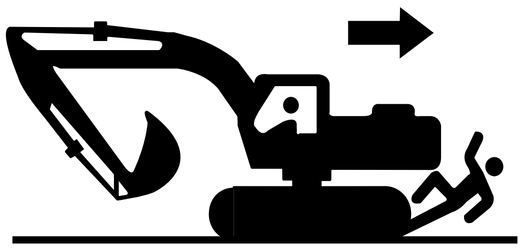
13031GE08

MOVE AND OPERATE MACHINE SAFELY

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

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

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

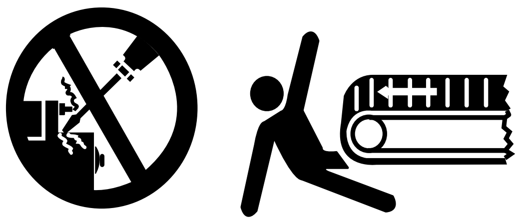


13031GE09

OPERATE ONLY FORM OPERATOR'S SEAT

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

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



13031GE26

PARK MACHINE SAFELY

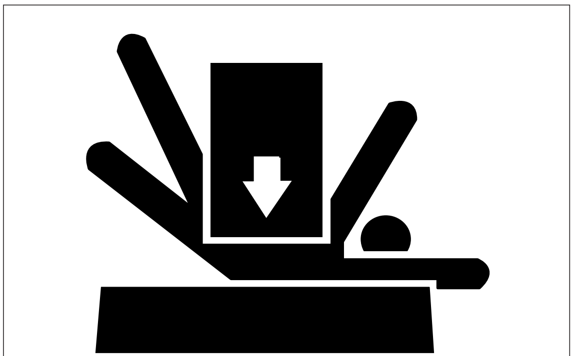
Before working on the machine:

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

SUPPORT MACHINE PROPERLY

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

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

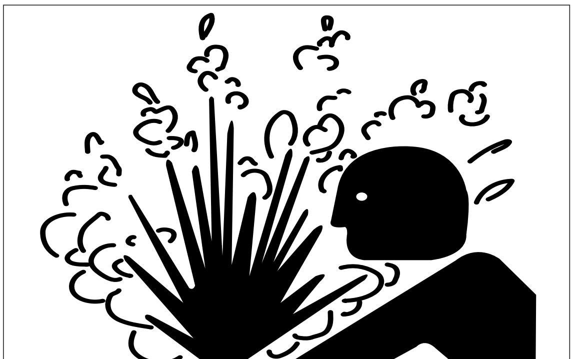


13031GE10

SERVICE COOLING SYSTEM SAFELY

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

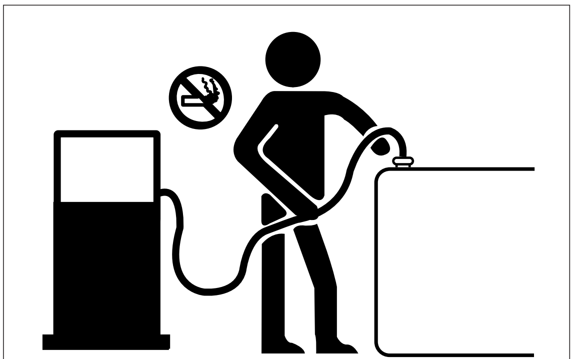
Shut off engine. Only remove filler cap when cool enough to touch with bare hands.



13031GE11

HANDLE FLUIDS SAFELY-AVOID FIRES

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



13031GE12

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

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

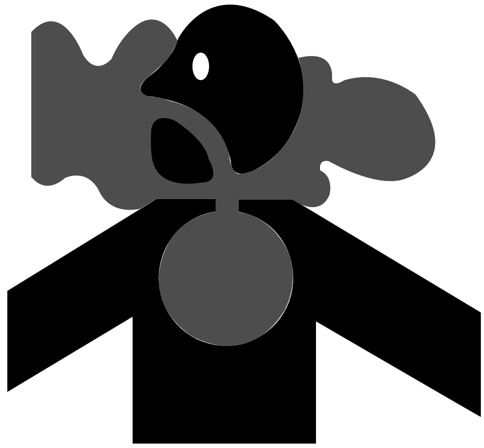
Do not store oily rags; They can ignite and burn spontaneously.

13031GE13

BEWARE OF EXHAUST FUMES

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

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



13031GE14

REMOVE PAINT BEFORE WELDING OR HEATING

Avoid potentially toxic fumes and dust.

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

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

Remove paint before welding or heating:

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

ILLUMINATE WORK AREA SAFELY

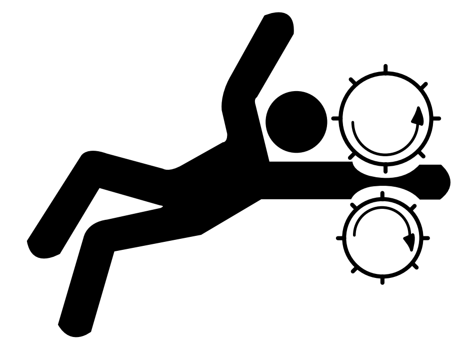
Illuminate your work area adequately but safely. Use a portable safety light for working inside or under the machine. Make sure the bulb is enclosed by a wire cage. The hot filament of an accidentally broken bulb can ignite spilled fuel or oil.

13031GE15

SERVICE MACHINE SAFELY

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

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

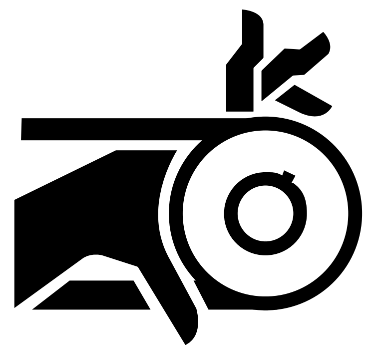


13031GE16

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

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



13031GE17

AVOID HIGH PRESSURE FLUIDS

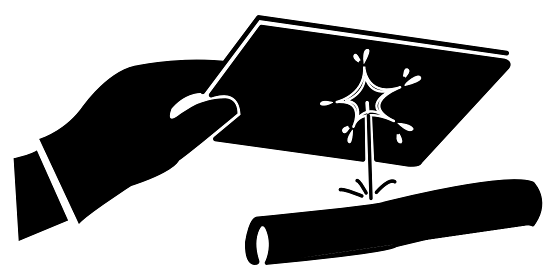
Escaping fluid under pressure can penetrate the skin causing serious injury.

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

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

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

13031GE18



13031GE19

AVOID HEATING NEAR PRESSURIZED FLUID LINES

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:

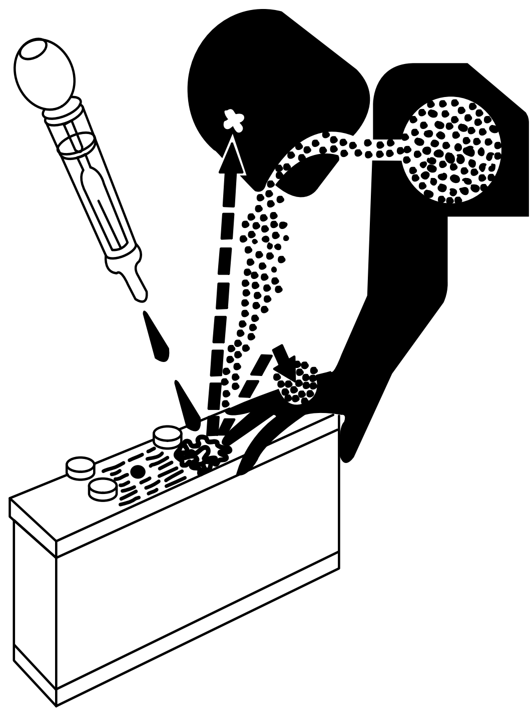
1. Filling batteries in a well-ventilated area.
2. Wearing eye protection and rubber gloves.
3. Avoiding breathing fumes when electrolyte is added.
4. Avoiding spilling of dripping electrolyte.
5. Use proper jump start procedure.

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

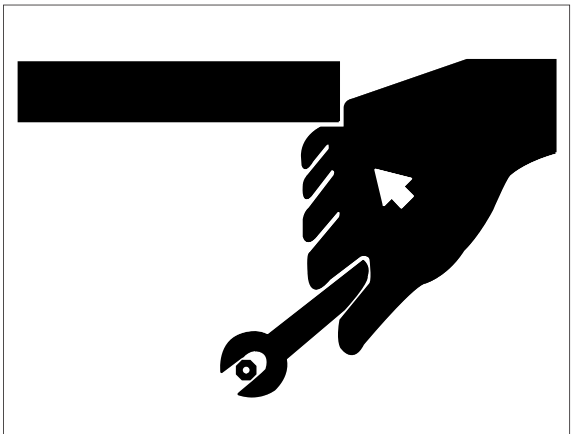
USE TOOLS PROPERLY

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.)



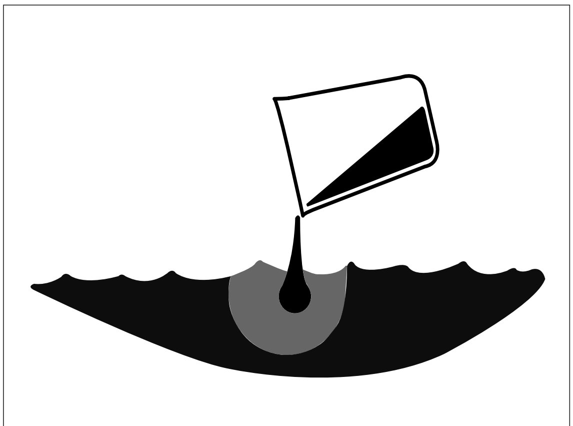
13031GE23

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.

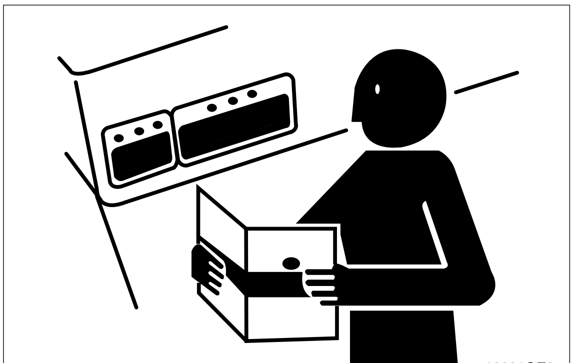
DO NOT pour oil into the ground, down a drain, or into a stream, pond, or lake. Observe relevant environmental protection regulations when disposing of oil, fuel, coolant, brake fluid, filters, batteries, and other harmful waste.



13031GE24

REPLACE SAFETY SIGNS

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

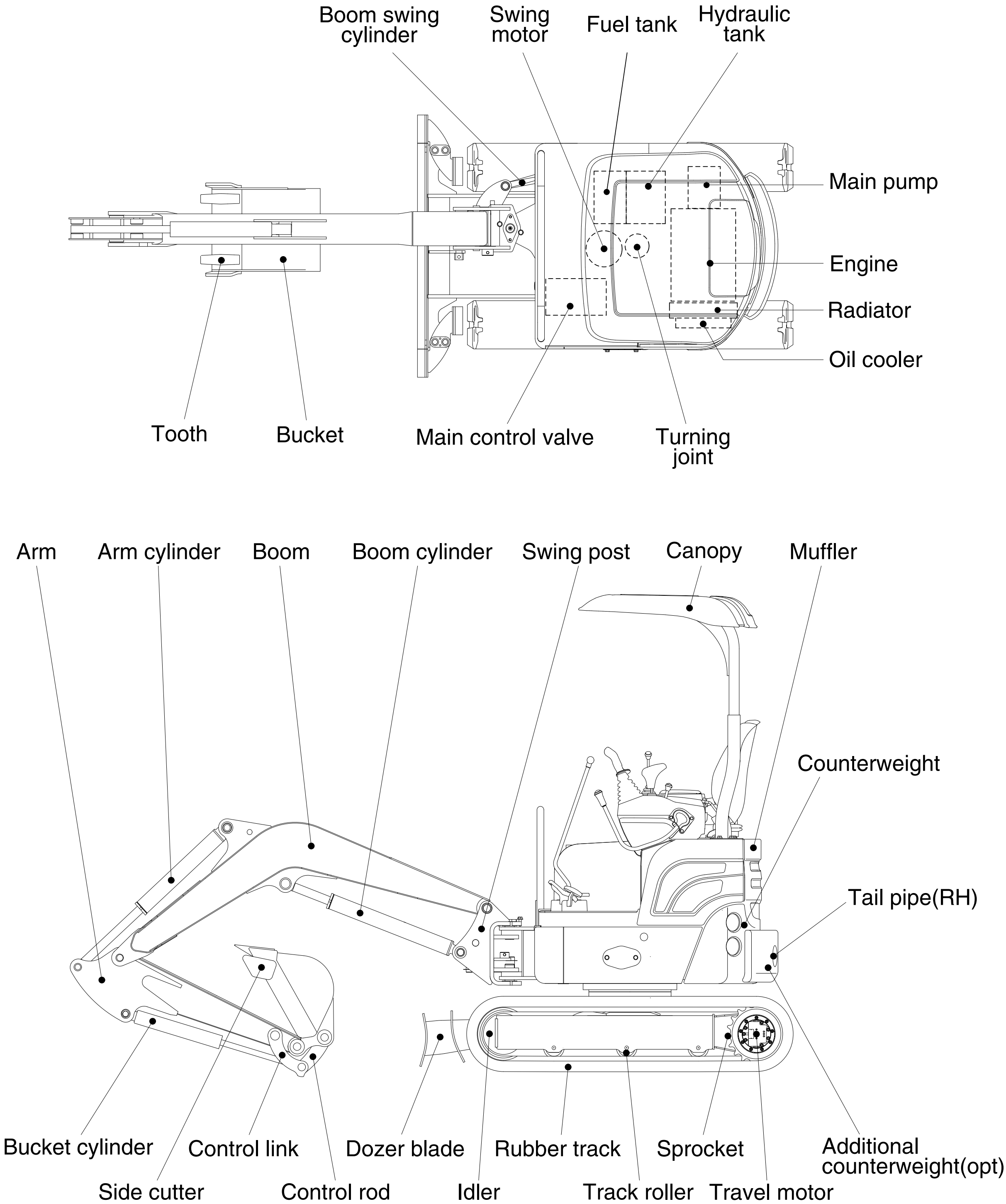


13031GE25

LIVE WITH SAFETY

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

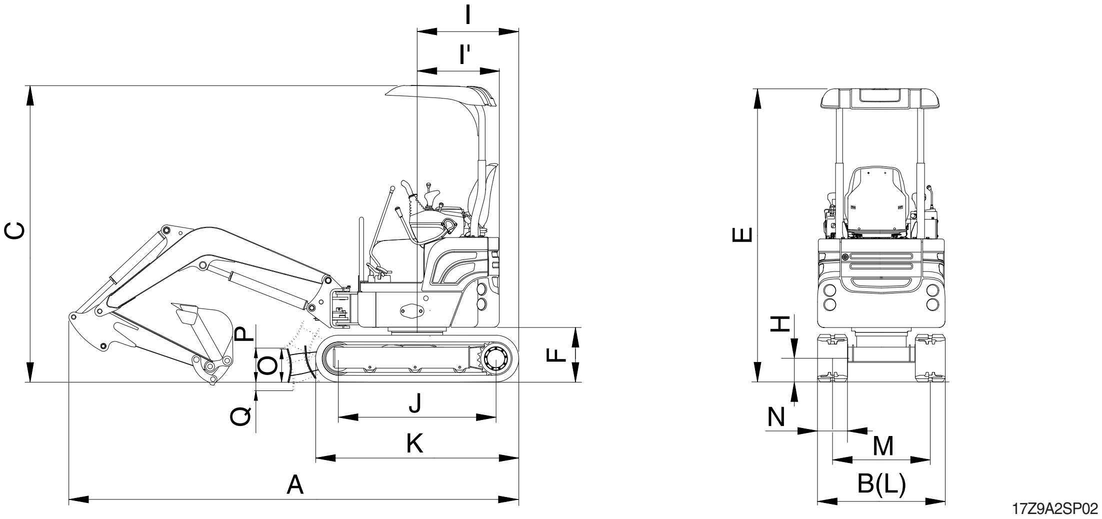
1. MAJOR COMPONENT



17Z9A2SP01

2. SPECIFICATIONS

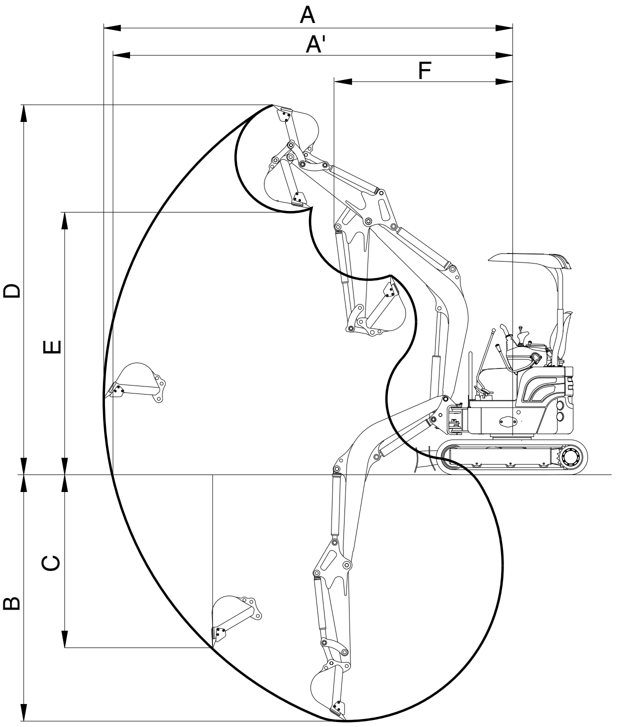
1) 1.80 m (5' 11") MONO BOOM, 0.96 m (3' 2") ARM, WITH BOOM SWING POST



Description		Unit	Specification
Operating weight (canopy)		kg (lb)	1700 (3750)
Bucket capacity (SAE heaped), standard		m^3 (yd^3)	0.04 (0.05)
Overall length	A	mm (ft-in)	3500 (11' 6")
Overall width, with 230 mm shoe (extension crawler)	B		990~1300 (3' 3" ~ 4' 3")
Overall height	C		2320 (7' 7")
Overall height of canopy	E		2320 (7' 7")
Ground clearance of counterweight	F		440 (1' 5")
Minimum ground clearance	H		170 (6. 7")
Rear-end distance	I		645 (2' 1")
Rear-end swing radius	I'		645 (2' 1")
Distance between tumblers	J		1230 (4' 0")
Undercarriage length	K		1590 (5' 3")
Undercarriage width (extension crawler)	L		990~1300 (3' 3" ~ 4' 3")
Track gauge (extension crawler)	M		760~1070 (2' 6" ~ 3' 6")
Track shoe width, standard	N		230 (9")
Height of blade	O		250 (9.8")
Ground clearance of blade up	P		285 (11.2")
Depth of blade down	Q		225 (8.9")
Travel speed (low/high)		km/hr (mph)	2.2/4.1 (1.4/2.5)
Swing speed		rpm	9.5
Gradeability		Degree (%)	30 (58)
Ground pressure 230 mm rubber shoe (canopy)		kgf/cm^2 (psi)	0.25 (3.98)
Max traction force		kg (lb)	1420 (3130)

3. WORKING RANGE

1) 1.80 m (5' 11") MONO BOOM WITH BOOM SWING POST



Description		0.96 m (3' 2") Arm
Max digging reach	A	3900 mm (12' 10")
Max digging reach on ground	A'	3800 mm (12' 6")
Max digging depth	B	2200 mm (7' 3")
Max vertical wall digging depth	C	1320 mm (4' 4")
Max digging height	D	3580 mm (11' 9")
Max dumping height	E	2570 mm (8' 5")
Min swing radius	F	1570 mm (5' 2")
Boom swing radius (left/right)		70°/54°
Bucket digging force	SAE	13.7 kN
		1400 kgf
		2960 lbf
	ISO	15.5 kN
		1580 kgf
		3490 lbf
Arm crowd force	SAE	8.3 kN
		850 kgf
		1880 lbf
	ISO	8.5 kN
		870 kgf
		1920 lbf

4. WEIGHT

Item	kg	lb
Upperstructure assembly	923	2030
Main frame weld assembly	160	353
Engine assembly	75	165
Main pump assembly	13	29
Main control valve assembly	14	31
Swing motor assembly	15	33
Hydraulic oil tank assembly	17	37
Fuel tank assembly	5	11
Boom swing post	35	80
Counterweight	188	414
Canopy assembly	40	88
Front guard	8	18
Lower chassis assembly	550	1210
Track frame weld assembly	185	408
Swing bearing	20	44
Travel motor assembly	18	40
Turning joint	14	31
Track recoil spring	11	24
Idler	15	33
Track roller	5	11
Sprocket	4	9
Rubber track (230 mm)	59	130
Dozer blade assembly	70	154
Front attachment assembly (1.8 m boom, 0.96 m arm, 0.04 m^3 SAE heaped bucket)	227	500
1.8 m boom assembly	70	154
0.96 m arm assembly	35	77
0.04 m^3 SAE heaped bucket	40	90
Boom cylinder assembly	17	37
Arm cylinder assembly	15	33
Bucket cylinder assembly	11	24
Bucket control link assembly	10	22
Dozer cylinder assembly	8	18
Boom swing cylinder assembly	10	22
Extension cylinder assembly	8	18

5. LIFTING CAPACITIES

1) 1.8 m (5' 11") boom, 0.96 m (3' 2") arm equipped with 0.04 m^3 (SAE heaped) bucket and 230 mm (9") rubber track, the dozer blade up, track extended with 188 kg (414 lb) counterweight.

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

Load point height		Load radius						At max. reach		
		2.0 m (7.0 ft)		2.5 m (8.0 ft)		3.0 m (10.0 ft)		Capacity		Reach
										m (ft)
3.0 m (10.0 ft)	kg lb							280 620	*290 *640	2.63 (8.6)
2.5 m (8.0 ft)	kg lb			310 680	*310 *680			200 440	210 460	3.13 (10.3)
2.0 m (7.0 ft)	kg lb			300 660	310 680	210 460	220 490	170 370	180 400	3.43 (11.3)
1.5 m (5.0 ft)	kg lb	430 950	440 970	290 640	300 660	210 460	220 490	150 330	160 350	3.60 (11.8)
1.0 m (3.0 ft)	kg lb	400 880	410 900	270 600	290 640	200 440	210 460	140 310	150 330	3.67 (12.0)
0.5 m (2.0 ft)	kg lb	370 820	390 860	260 570	270 600	190 420	200 440	140 310	150 330	3.64 (11.9)
Ground Line	kg lb	360 790	370 820	250 550	270 600	190 420	200 440	150 330	160 350	3.51 (11.5)
-0.5 m (-2.0 ft)	kg lb	360 790	370 820	250 550	260 570	190 420	200 440	170 370	180 400	3.27 (10.7)
-1.0 m (-3.0 ft)	kg lb	360 790	380 840	250 550	270 600			210 460	220 490	2.87 (9.4)
-1.5 m (-5.0 ft)	kg lb	380 840	390 860							

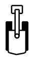
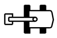
Note 1. Lifting capacity are based on SAE J1097 and ISO 10567.
2. Lifting capacity of the ROBEX series does not exceed 75% of tipping load with the machine on firm, level ground or 87% of full hydraulic capacity.
3. The load point is a hook located on the back of the bucket.
4. *indicates load limited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

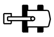
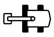
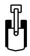
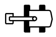
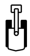
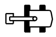
※ Lifting capacities are based upon a standard machine conditions.
Lifting capacities will vary with different work tools, ground conditions and attachments.
The difference between the weight of a work tool attachment must be subtracted.
Consult your Hyundai dealer regarding the lifting capacities for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

※ Please be aware of the local regulations and instructions for lifting operations.

⚠ 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.

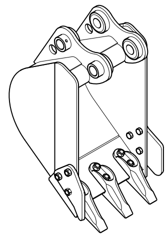
2) 1.8 m (5' 11") boom, 0.96 m (3' 2") arm equipped with 0.04 m^3 (SAE heaped) bucket and 230 mm (9") rubber track, the dozer blade down, track extended with 188 kg (414 lb) counterweight.

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

Load point height		Load radius						At max. reach		
		2.0 m (7.0 ft)		2.5 m (8.0 ft)		3.0 m (10.0 ft)		Capacity		Reach
										m (ft)
3.0 m	kg							*290	*290	2.63
(10.0 ft)	lb							*640	*640	(8.6)
2.5 m	kg			*310	*310			*290	220	3.13
(8.0 ft)	lb			*680	*680			*640	490	(10.3)
2.0 m	kg			*320	*320	*320	230	*300	180	3.43
(7.0 ft)	lb			*710	*710	*710	510	*660	400	(11.3)
1.5 m	kg	*450	*450	*380	310	*340	230	*300	160	3.60
(5.0 ft)	lb	*990	*990	*840	680	*750	510	*660	350	(11.8)
1.0 m	kg	*620	430	*450	300	*380	220	*310	150	3.67
(3.0 ft)	lb	*1370	950	*990	660	*840	490	*680	330	(12.0)
0.5 m	kg	*740	400	*520	280	*410	210	*320	150	3.64
(2.0 ft)	lb	*1630	880	*1150	620	*900	460	*710	330	(11.9)
Ground	kg	*790	390	*550	270	*420	210	*330	160	3.51
Line	lb	*1740	860	*1210	600	*930	460	*730	350	(11.5)
-0.5 m	kg	*760	390	*540	270	*400	210	*330	180	3.27
(-2.0 ft)	lb	*1680	860	*1190	600	*880	460	*730	400	(10.7)
-1.0 m	kg	*660	390	*470	270			*320	230	2.87
(-3.0 ft)	lb	*1460	860	*1040	600			*710	510	(9.4)
-1.5 m	kg	*450	400							
(-5.0 ft)	lb	*990	880							

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

6. BUCKET SELECTION GUIDE



0.04 m^3 SAE
heaped bucket

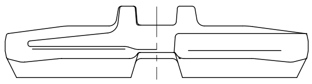
Capacity		Width		Weight	Recommendation
					1.8 m (5' 11") boom
SAE heaped	CECE heaped	Without side cutter	With side cutter		0.96 m (3' 2") arm
0.04 m^3 (0.05 yd^3)	0.03 m^3 (0.04 yd^3)	365 mm (14.4")	410 mm (16.1")	40 kg (88 lb)	Applicable for materials with density of 1600 kgf/m^3 (2700 lb/yd^3) or less

7. UNDERCARRIAGE

(1) TRACKS

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

(2) TYPES OF SHOES

Model	Shapes		Rubber track
			
R17Z-9A	Shoe width	mm (in)	230 (9")
	Operating weight	kg (lb)	1700 (3750)
	Ground pressure	kgf/cm^2 (psi)	0.28 (3.98)
	Overall width	mm (ft-in)	1300 (4' 3")

(3) NUMBER OF ROLLERS AND SHOES ON EACH SIDE

Item	Quantity
Track rollers	3 EA

8. SPECIFICATIONS FOR MAJOR COMPONENTS

1) ENGINE

Item	Specification
Model	Kubota D902
Type	4-cycle vertical overhead valve, diesel fuel
Cooling method	Water cooling
Number of cylinders and arrangement	3 cylinders, in-line
Firing order	1-2-3
Combustion chamber type	Swirl chamber type
Cylinder bore × stroke	72 × 73.6 mm (2.83" × 2.90")
Piston displacement	898 cc (54.8 cu in)
Compression ratio	24 : 1
Rated gross horse power (SAE J1995)	16.2 Hp at 2400 rpm (12.1 kW at 2400 rpm)
Maximum torque at 1900 rpm	5.6 kgf · m (36 lbf · ft)
Engine oil quantity	3.7 ℓ (1.0 U.S. gal)
Dry weight	75 kg (165 lb)
High idling speed	2600 + 30 rpm
Low idling speed	1450 ± 25 rpm
Rated fuel consumption	208 g/Hp · hr at 2300 rpm (279 g/kW · hr at 2300 rpm)
Starting motor	12V-1.2 kW
Alternator	12V-40 A
Battery	1 × 12 V × 45 Ah

2) MAIN PUMP (P1, P2+P3)

Item	Specification
Type	Variable displacement tandem axis piston pumps + gear pump
Capacity	2 × 7.5 + 4.5 cc/rev
Rated oil flow	2 × 18.8 + 11.3 ℓ/min (2 × 5 + 3 U.S. gpm / 2 × 4.1 + 2.5 U.K. gpm)
Rated speed	2500 rpm

3) PILOT PUMP (P4)

Item	Specification
Type	Fixed displacement gear pump single stage
Capacity	2.7 cc/rev
Rated oil flow	6.8 ℓ/min (1.8 U.S. gpm / 1.5 U.K. gpm)

4) MAIN CONTROL VALVE

Item	Specification
Type	Sectional, 9 spools (12 blocks)
Operating method	Hydraulic pilot system
Main relief valve pressure (P1, P2 / P3)	210 kgf/cm^2 (2990 psi) / 200 kgf/cm^2 (2840 psi)
Overload relief valve pressure	230 kgf/cm^2 (3270 psi)

5) SWING MOTOR

Item	Specification
Type	Fixed displacement orbit motor
Capacity	19.5 cc/rev
Relief pressure	135 kgf/cm^2 (1920 psi)

6) TRAVEL MOTOR

Item	Specification
Type	Variable displacement axial piston motor
Relief pressure	210 kgf/cm^2 (2990 psi)
Reduction gear type	2-stage planetary

7) CYLINDER

Item		Specification
Boom cylinder	Bore dia × Rod dia × Stroke	ø 60 × ø 40 × 440 mm
	Cushion	Extend only
Arm cylinder	Bore dia × Rod dia × Stroke	ø 60 × ø 40 × 353 mm
	Cushion	Extend and retract
Bucket cylinder	Bore dia × Rod dia × Stroke	ø 55 × ø 35 × 320 mm
	Cushion	-
Boom swing cylinder	Bore dia × Rod dia × Stroke	ø 55 × ø 30 × 355 mm
	Cushion	-
Dozer cylinder	Bore dia × Rod dia × Stroke	ø 65 × ø 30 × 115 mm
	Cushion	-
Extension cylinder	Bore dia × Rod dia × Stroke	ø 55 × ø 30 × 310 mm
	Cushion	-

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

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

8) BUCKET

Item	Capacity		Tooth quantity	Width	
	SAE heaped	CECE heaped		Without side cutter	With side cutter
Standard	0.04 m^3 (0.05 yd^3)	0.03 m^3 (0.04 yd^3)	3	365 mm (14.4")	410 mm (16.1")

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	3.7 (1.0)	★SAE 5W-40 SAE 30 SAE 10W SAE 10W-30 SAE 15W-40
Final drive	Gear oil	0.33×2 (0.99×2)	★SAE 75W-90 SAE 85W-140
Hydraulic tank	Hydraulic oil	Tank: 13 (3.4) System: 23 (6.1)	★ISO VG 15 ISO VG 46, HBHO VG 46★3 ISO VG 68
Fuel tank	Diesel fuel★1	20 (5.3)	★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★2	3.5 (0.9)	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
UTTO : Universal Tractor Transmission Oil

★ : Cold region
Russia, CIS, Mongolia
★1 : Ultra low sulfur diesel
- sulfur content ≤ 15 ppm
★2 : Soft water
City water or distilled water
★3 : Hyundai Bio Hydraulic Oil
- For more information, contact HYUNDAI dealers.

※ 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.

※ Do not use any engine oil other than that specified above, as it may clog the diesel particulate filter(DPF).

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

SECTION 2 STRUCTURE AND FUNCTION

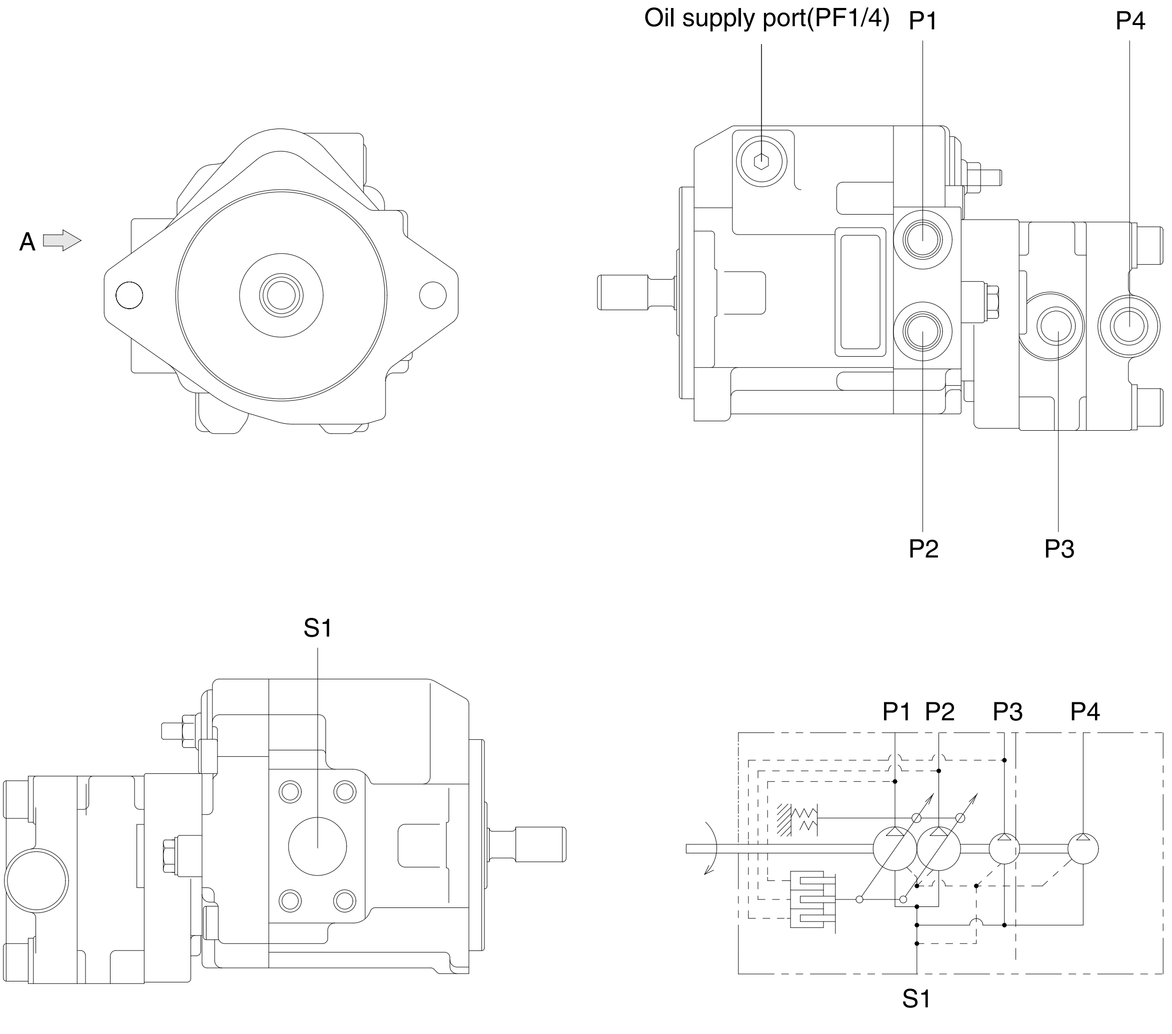
GROUP 1 HYDRAULIC PUMP

1. GENERAL

This is a variable displacement double-piston pump for discharge with equal displacements from one cylinder block. This pump is so compact as to appear a single pump though this is actually a double pump.

Because this pump has one swash plate, the tilting angle is the same for two pumps. Tilting of the pump changes in response to the total pressure of P1 + P2. Namely, the output is controlled to the constant value so that the relationship between the discharge pressure and flow rate Q becomes constant, (P1 + P2) * Q =Constant.

The third pump and pilot pump can be connected to the same shaft via a coupling.



VIEW A

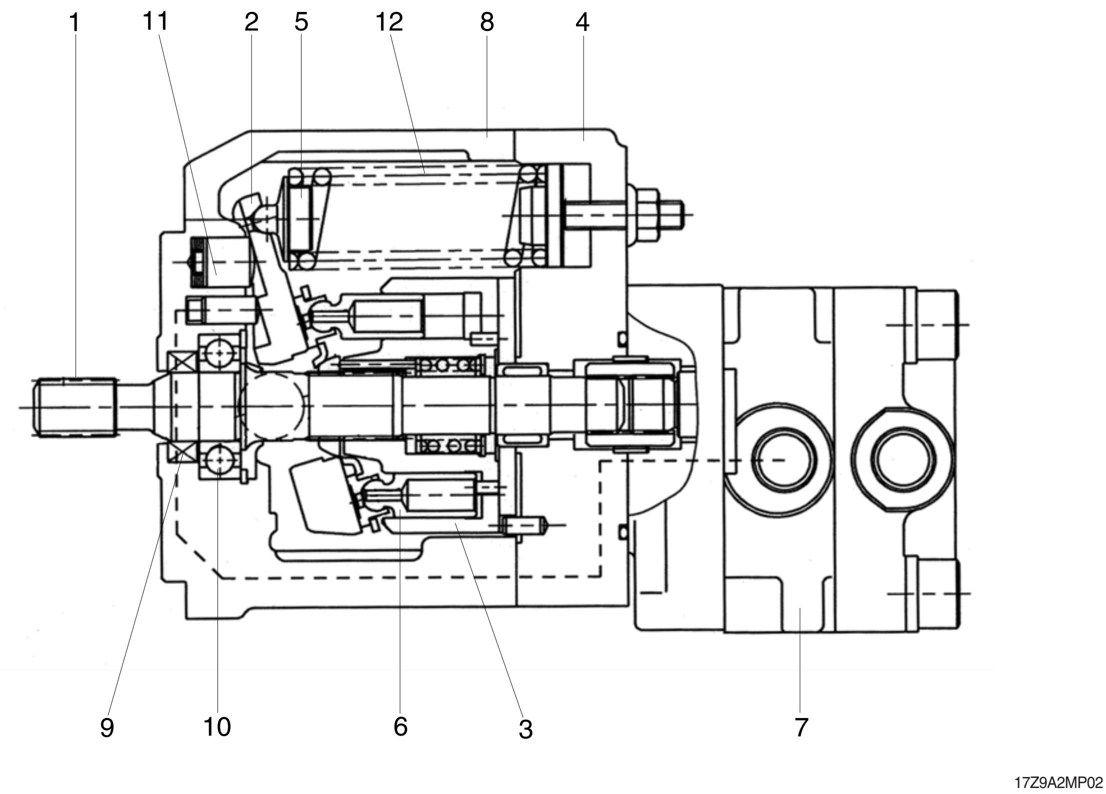
Hydraulic circuit

17Z9A2MP01

Description of the ports

Port	Port name	Port size
S1	Suction port	SAE 1
A1, A2, A3, A4	Discharge port	PF 3/8

2. MAJOR COMPONENTS AND FUNCTIONS



1	Drive shaft assembly	7	Gear pump
2	Swash plate assembly	8	Body
3	Cylinder barrel	9	Oil seal
4	Port plate assembly	10	Bearing
5	Spring holder assembly	11	Stopper pin assembly
6	Piston	12	Spring

This is a variable displacement double-piston pump for discharge with two equal displacements from one cylinder block. Because this is one cylinder barrel, there is only one suction port.

The oil is divided into two equal flows by the control plate in the cover and directed to two discharge ports provided in the cover.

The discharge pressure directed to the piston tilts the hanger by overcoming the spring force.

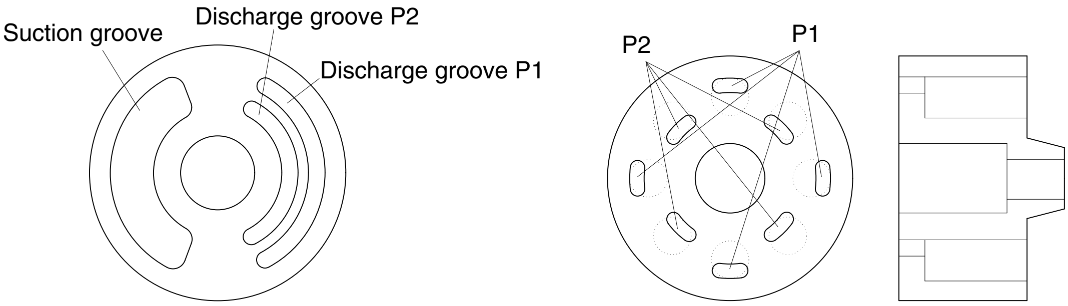
Since the piston stroke changes according to the tilting angle of the hanger, the flow can be changed.

The simultaneous tilting angle constant-output control method is employed.

The pilot pump can be connected to the same shaft via a coupling.

1) PRINCIPLE OF OPERATION

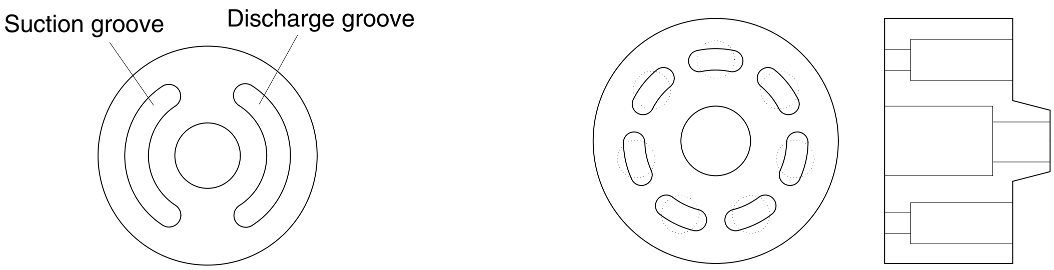
(1) Function of pump



Valve plate

Cylinder barrel

Figure 1 Working principle of PVD pump



Valve plate

Cylinder barrel

Figure 2 Working principle of Conventional type

R17Z9A2MP05

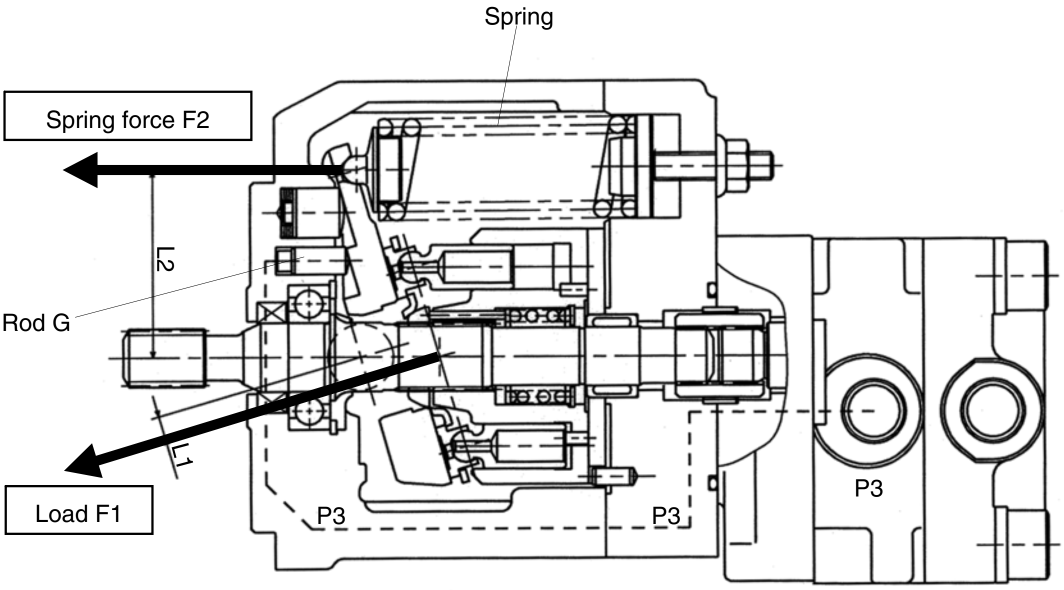
This pump adopts a new method using even numbered pistons to make functions of two same volume pumps available in one casing of a swash plate type variable volume piston pump.

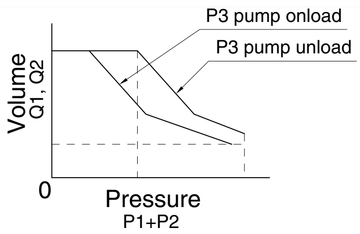
Conventional valve plate has one suction groove and one discharge groove respectively as shown in figure 2. But this method adopts one common suction groove and two discharge grooves on the outer side (P1) and the inner side (P2) as shown in figure 1, the piston room in the cylinder barrel opens to either the outer side (P1) or the inner side (P2) discharge groove of the valve plate alternately, and the discharges are performed independently on the inner side and the outer side.

Since this model has even numbered pistons, same No of pistons open to the outer side and the inner side of the valve plate. All pistons are of same swash plate, so the discharges from the outer side (P1) and the inner side (P2) are equal.

Also, since only one swash plate is used, the discharges from P1 and P2 ports changes equally when the swash plate angle of rake changes in variable controls. So, there is no difference between the two discharges.

2) CONTROL FUNCTIONS





P-Q characteristic

17Z9A2MP04

(1) Constant horse power variable structure

The pump output flow rate is variable depending on an angle of the swash plate which is controlled according to the pump output pressure. This control enables the pump consumption horse power to be sustained at the maximum. The tilt point of the swash plate is the balls located behind the swash plate. The load F1 from the pistons is in the direction shown in the illustration and generates a clockwise moment against the swash plate. Against this force the spring (force F2) is located in the opposite direction to keep the horse power constant and set at the appointed load. As the pressure increases, the above clockwise moment increases, and when it overcomes the counter-clockwise moment created by the spring force, the spring is sagged and the swash plate angle gets smaller. Then the output flow rate is reduced to keep the horse power constant.

This prevents engine stall and the engine horse power can be utilized at the maximum.

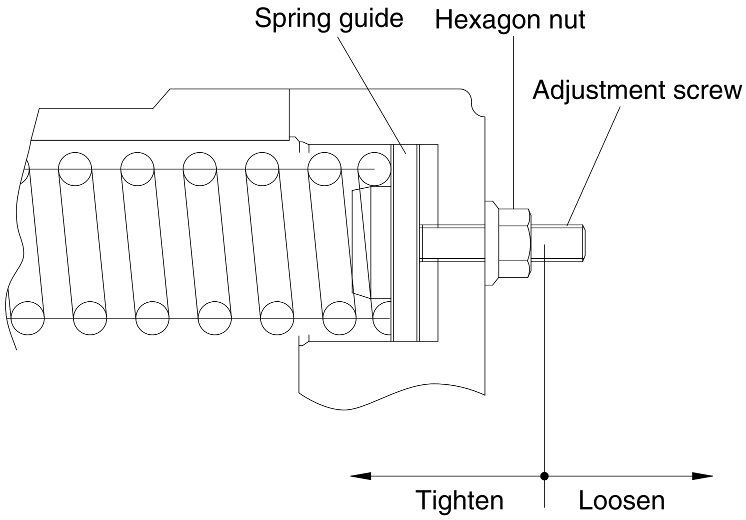
(2) Power shift mode (Reduced horse power control by P3 pressure)

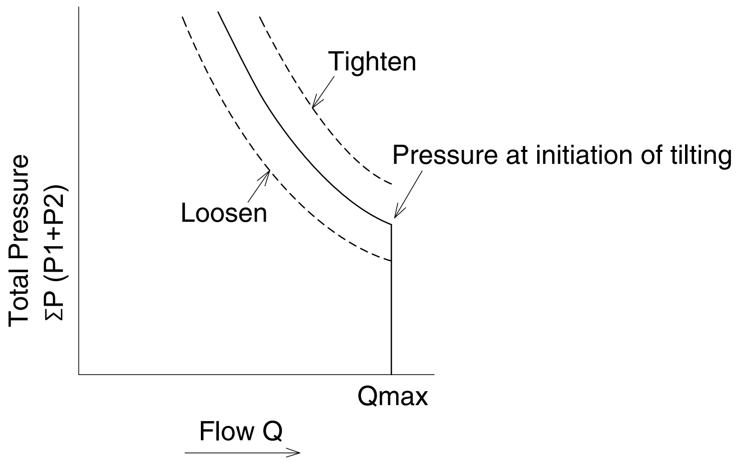
This control keeps the maximum value of the pump consumption horse power including the third pump (gear pump) constant. When the P3 (gear pump) pressure acts on the rod G, a clockwise moment proportion to the pressure acts on the swash plate and the P-Q characteristic shifts so that the total pump consumption horse power including the gear pump horse power is kept constant.

3) CONTROL / ADJUSTMENT PROCEDURE

(1) Loosen the hexagonal nut.

(2) Tighten or loosen the adjusting screw to set the power shifting line.





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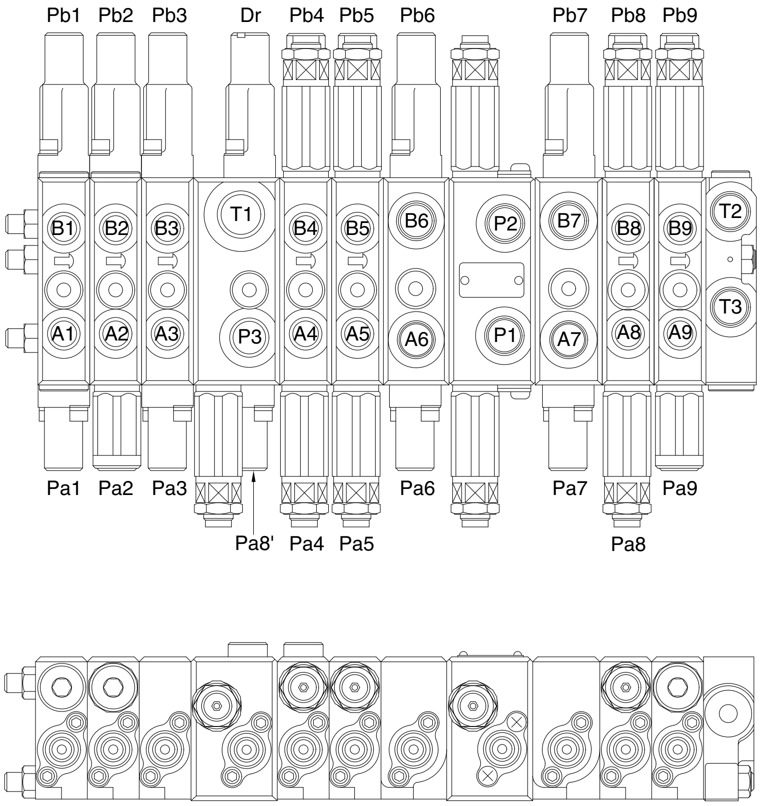
GROUP 2 MAIN CONTROL VALVE

1. OUTLINE

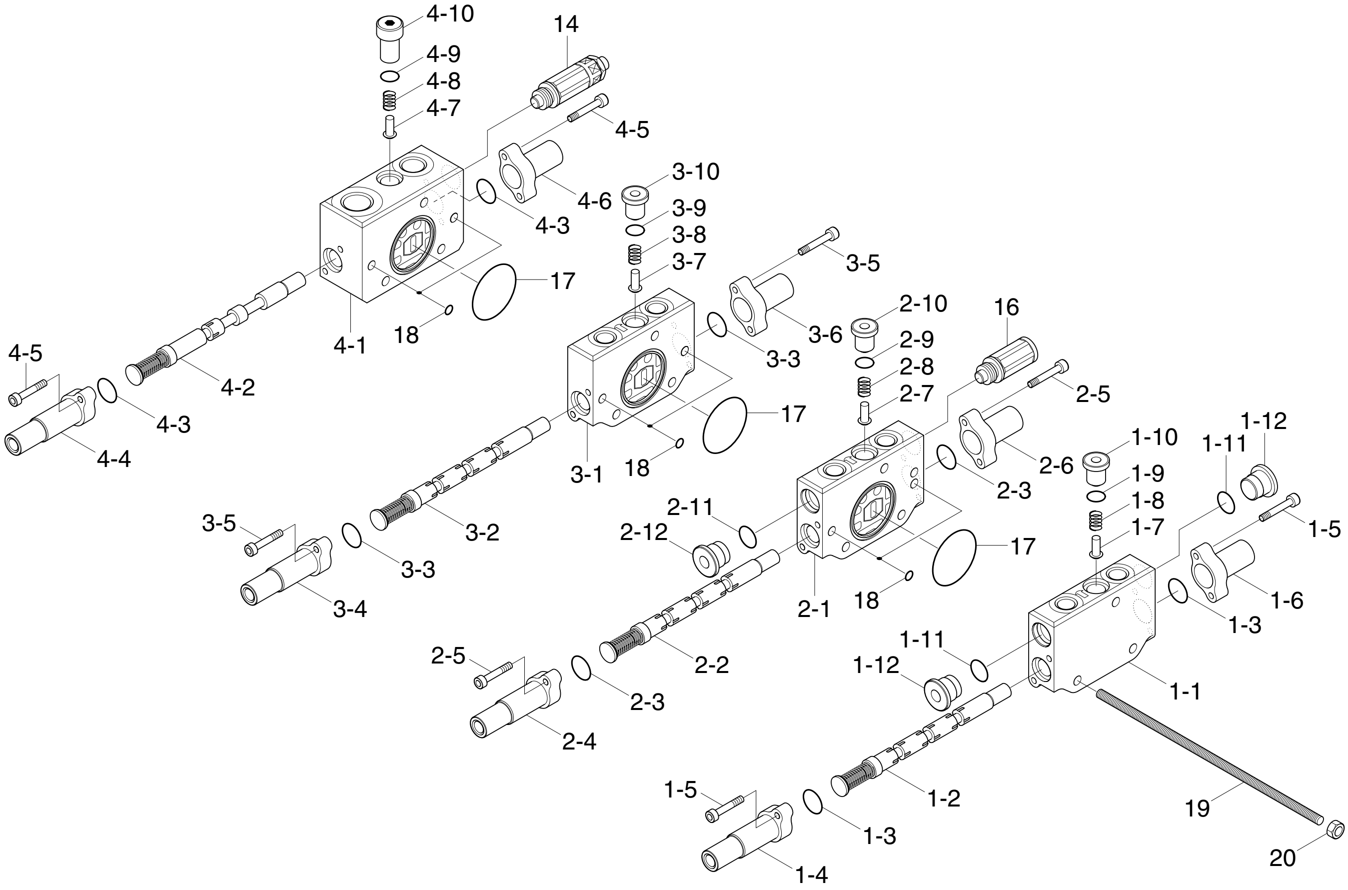


17Z9A2MC01

Mark	Port name	Port size	Tightening torque
T1	Tank return port	PF 1/2	6~7 kgf · m
A6	Travel [RH/RR] port	PF 3/8	4.0~5.0 kgf · m
B6	Travel [RH/FW] port		
A7	Travel [LH/RR] port		
B7	Travel [LH/FW] port		
P1	P1 (A1) pump port		
P2	P2 (A2) pump port		
P3	P3 (A3) pump port		
T2	Tank return port		
T3	Tank return port		
A1	Dozer	PF 1/4	2.5~3.0 kgf · m
B1	Dozer		
A2	Boom swing (RH) port		
B2	Boom swing (LH) port		
A3	Swing (LH) port		
B3	Swing (RH) port		
A4	Option port		
B4	Option port		
A5	Arm out port		
B5	Arm in port		
A8	Boom up port		

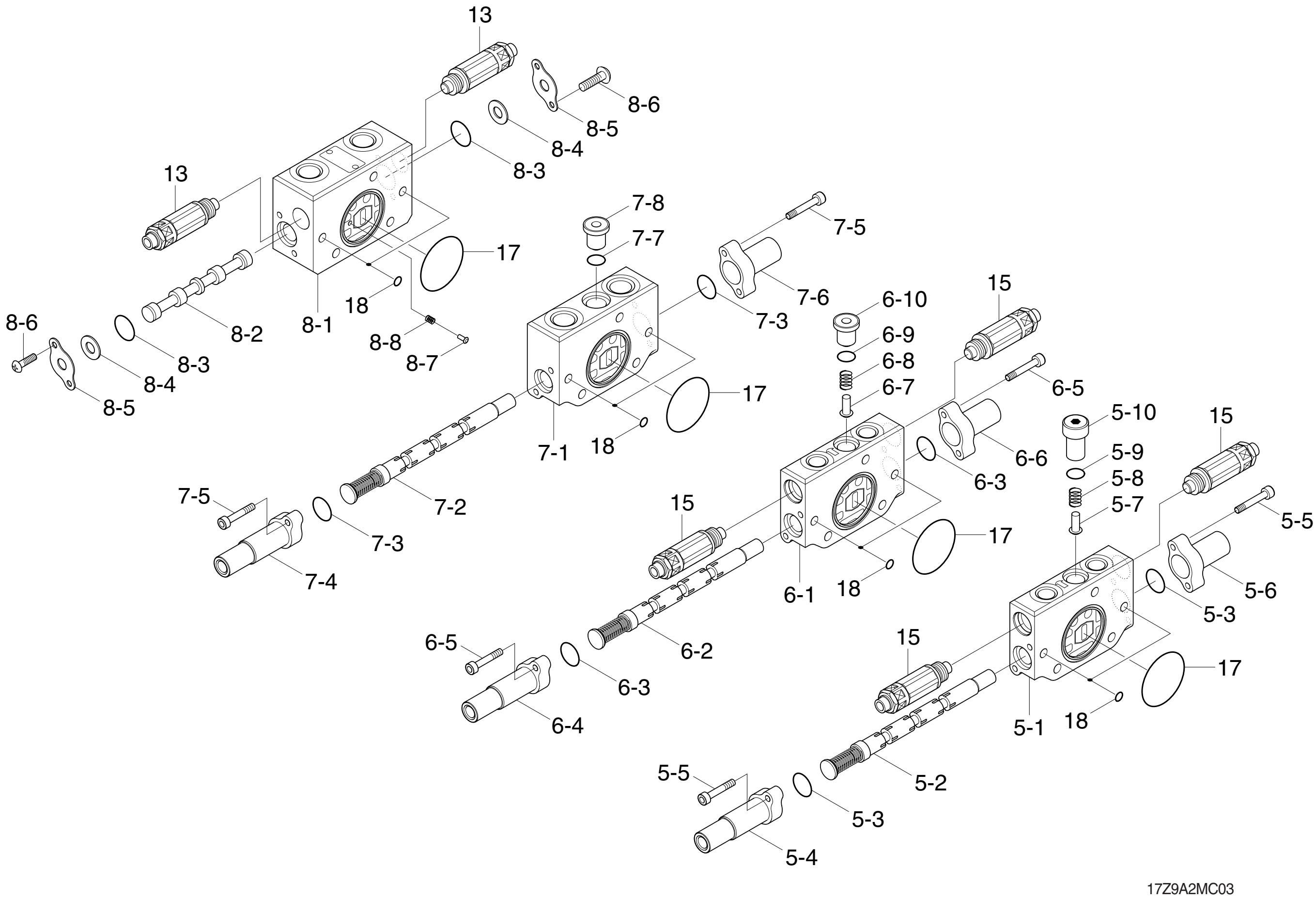
Mark	Port name	Port size	Tightening torque
B8	Boom down port	PF 1/4	2.5~3.0 kgf · m
A9	Bucket out port		
B9	Bucket in port		
Pa1	Dozer down pilot port	PF 1/8	1.0~1.5 kgf · m
Pb1	Dozer up pilot port		
Pa2	Boom swing (RH) pilot port		
Pb2	Boom swing (LH) pilot port		
Pa3	Swing (RH) pilot port		
Pb3	Swing (LH) pilot port		
Pa5	Arm out pilot port		
Pb5	Arm in pilot port		
Pa6	Travel [RH/RR] pilot port		
Pb6	Travel [RH/FW] pilot port		
Pa7	Travel [LH/RR] pilot port		
Pb7	Travel [LH/FW] pilot port		
Pa8	Boom up pilot port		
Pb8	Boom down pilot port		
Pa9	Bucket out pilot port		
Pb9	Bucket in pilot port		
Pa8'	Boom connecting pilot port		
Dr	Travel drain port		

2. STRUCTURE (1/3)



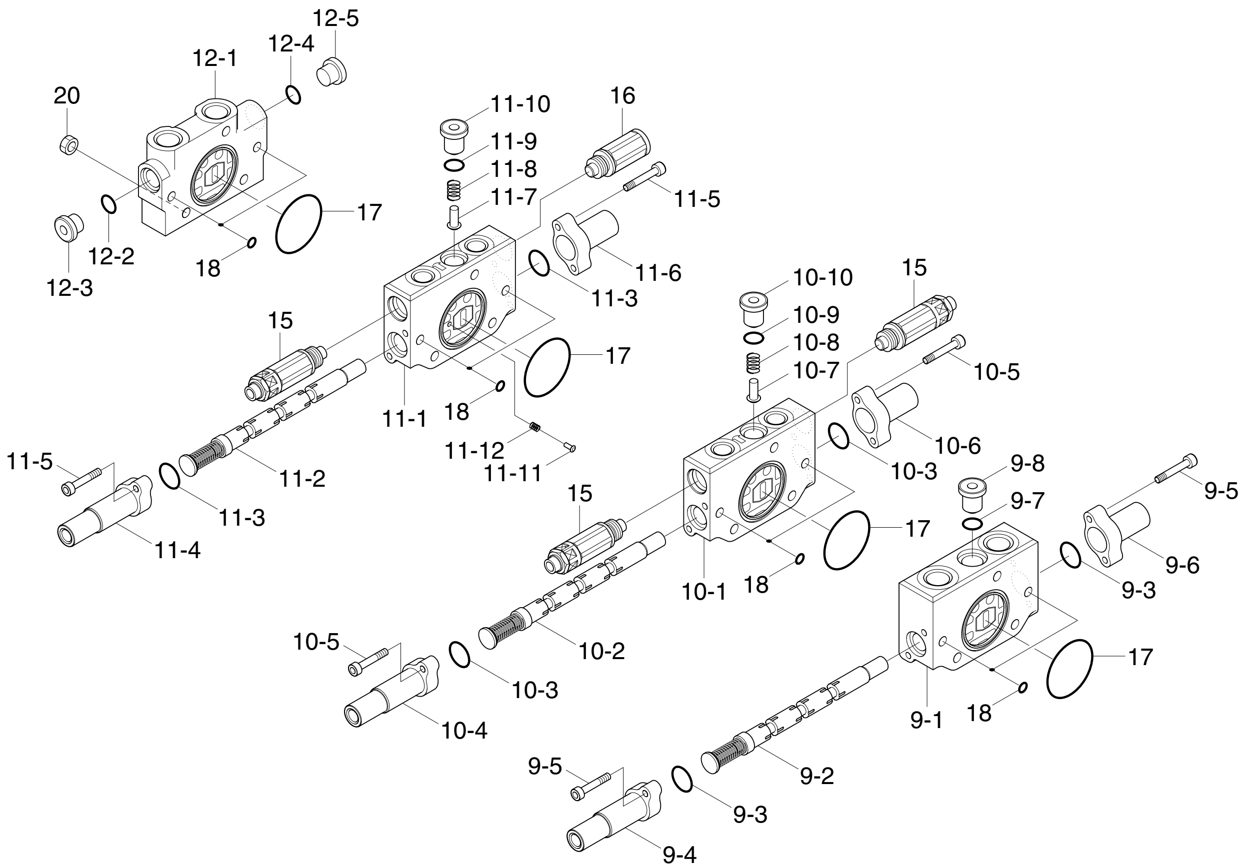
1	Dozer work body	2-5	Bolt	3-10	Plug
1-1	Work body	2-6	Pilot cover	4	Connecting body
1-2	Spool assy	2-7	Poppet	4-1	Work body
1-3	O-ring	2-8	Spring	4-2	Spool assy
1-4	Pilot cover	2-9	O-ring	4-3	O-ring
1-5	Bolt	2-10	Plug	4-4	Pilot cover
1-6	Pilot cover	2-11	O-ring	4-5	Bolt
1-7	Poppet	2-12	Plug	4-6	Pilot cover
1-8	Spring	3	Swing work body	4-7	Poppet
1-9	O-ring	3-1	Work body	4-8	Spring
1-10	Plug	3-2	Spool assy	4-9	O-ring
1-11	O-ring	3-3	O-ring	4-10	Plug
1-12	Plug	3-4	Cover	14	Relief valve
2	Boom swing work body	3-5	Bolt	16	Anticavitation valve
2-1	Work body	3-6	Pilot cover	17	O-ring
2-2	Spool assy	3-7	Poppet	18	O-ring
2-3	O-ring	3-8	Spring	19	Tie bolt
2-4	Pilot cover	3-9	O-ring	20	Hex nut

STRUCTURE (2/3)



5	PTO work body	6-4	Pilot cover	7-8	Plug
5-1	Work body	6-5	Bolt	8	Inlet work body
5-2	Spool assy	6-6	Pilot cover	8-1	Work body
5-3	O-ring	6-7	Poppet	8-2	Spool assy
5-4	Pilot cover	6-8	Poppet	8-3	O-ring
5-5	Bolt	6-9	O-ring	8-4	Plate
5-6	Pilot cover	6-10	Plug	8-5	Plate
5-7	Poppet	7	Travel work body	8-6	Screw
5-8	Spring	7-1	Work body	8-7	Poppet
5-9	O-ring	7-2	Spool assy	8-8	Spring
5-10	Plug	7-3	O-ring	13	Relief valve
6	Arm work body	7-4	Pilot cover	15	Overload relief valve
6-1	Work body	7-5	Bolt	17	O-ring
6-2	Spool assy	7-6	Pilot cover	18	O-ring
6-3	O-ring	7-7	O-ring		

STRUCTURE (3/3)



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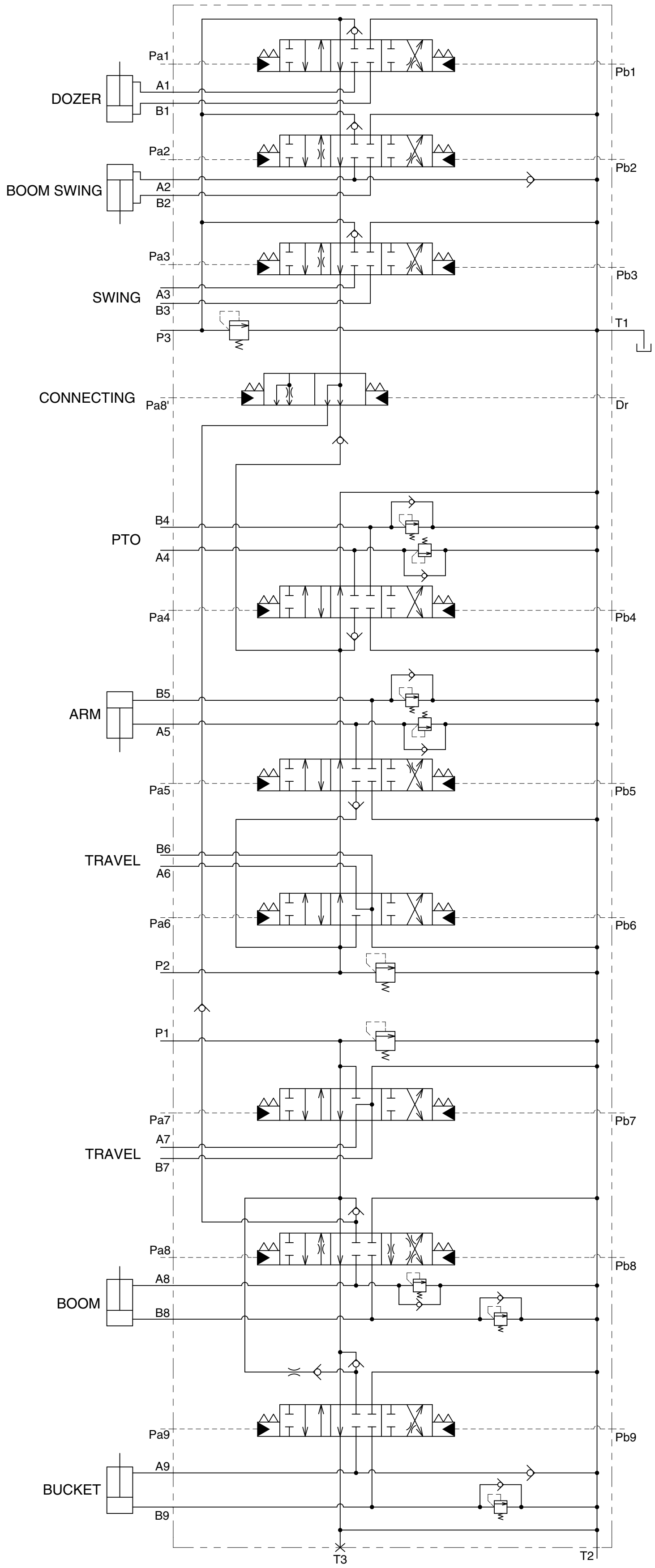
9	Travel work body
9-1	Work body
9-2	Spool assy
9-3	O-ring
9-4	Pilot cover
9-5	Bolt
9-6	Pilot cover
9-7	O-ring
9-8	Plug
10	Boom work body
10-1	Work body
10-2	Spool assy
10-3	O-ring
10-4	Pilot cover
10-5	Bolt
10-6	Pilot cover
10-7	Poppet
10-8	Spring
10-9	O-ring
10-10	Plug
11	Bucket work body
11-1	Work body
11-2	Spool assy
11-3	O-ring
11-4	Pilot cover
11-5	Bolt
11-6	Pilot cover
11-7	Poppet
11-8	Spring
11-9	O-ring
11-10	Plug
11-11	Poppet
11-12	Spring
12	Outlet work body
12-1	Work body
12-2	O-ring
12-3	Plug
12-4	O-ring
12-5	Plug
15	Overload relief valve
16	Anticavitation valve
17	O-ring
18	O-ring
20	Hex nut

3. HYDRAULIC CIRCUIT



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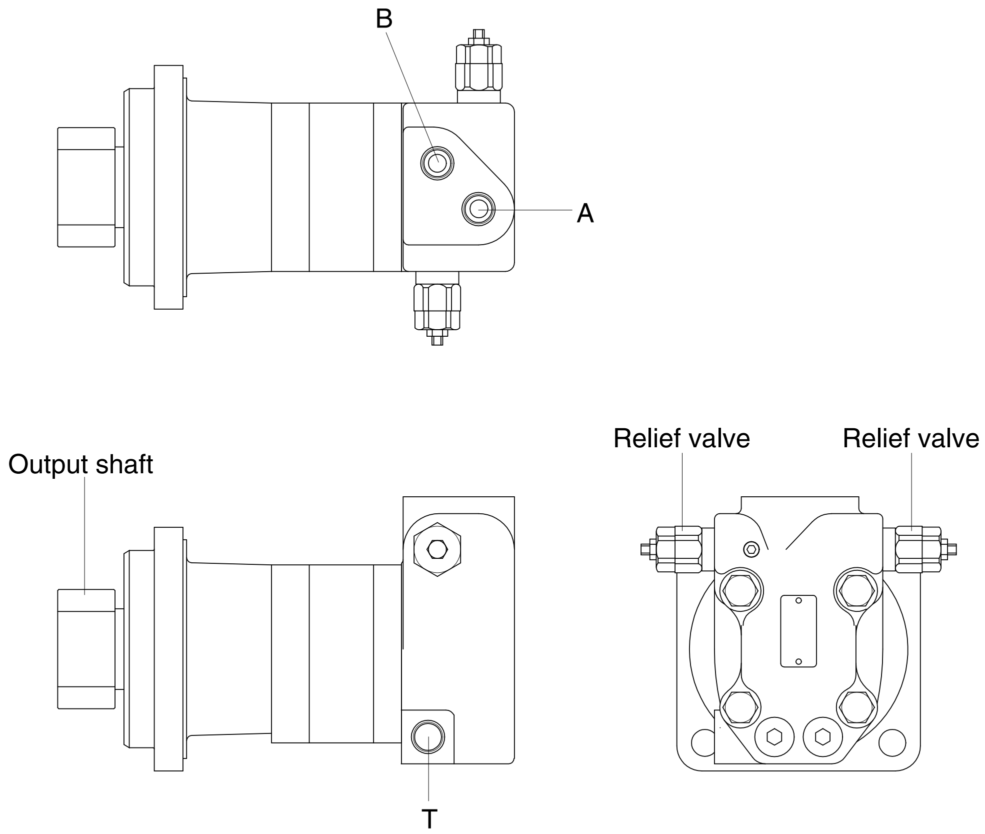
GROUP 3 SWING DEVICE

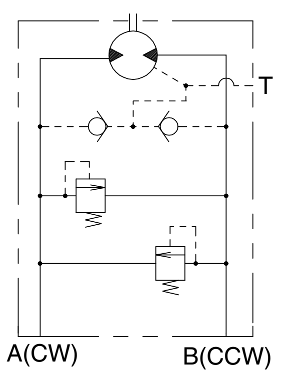
1. STRUCTURE

Swing device consists swing motor and swing reduction gear.

1) SWING MOTOR

Swing motor include mechanical relief valve, make up valve and check valve.





HYDRAULIC CIRCUIT

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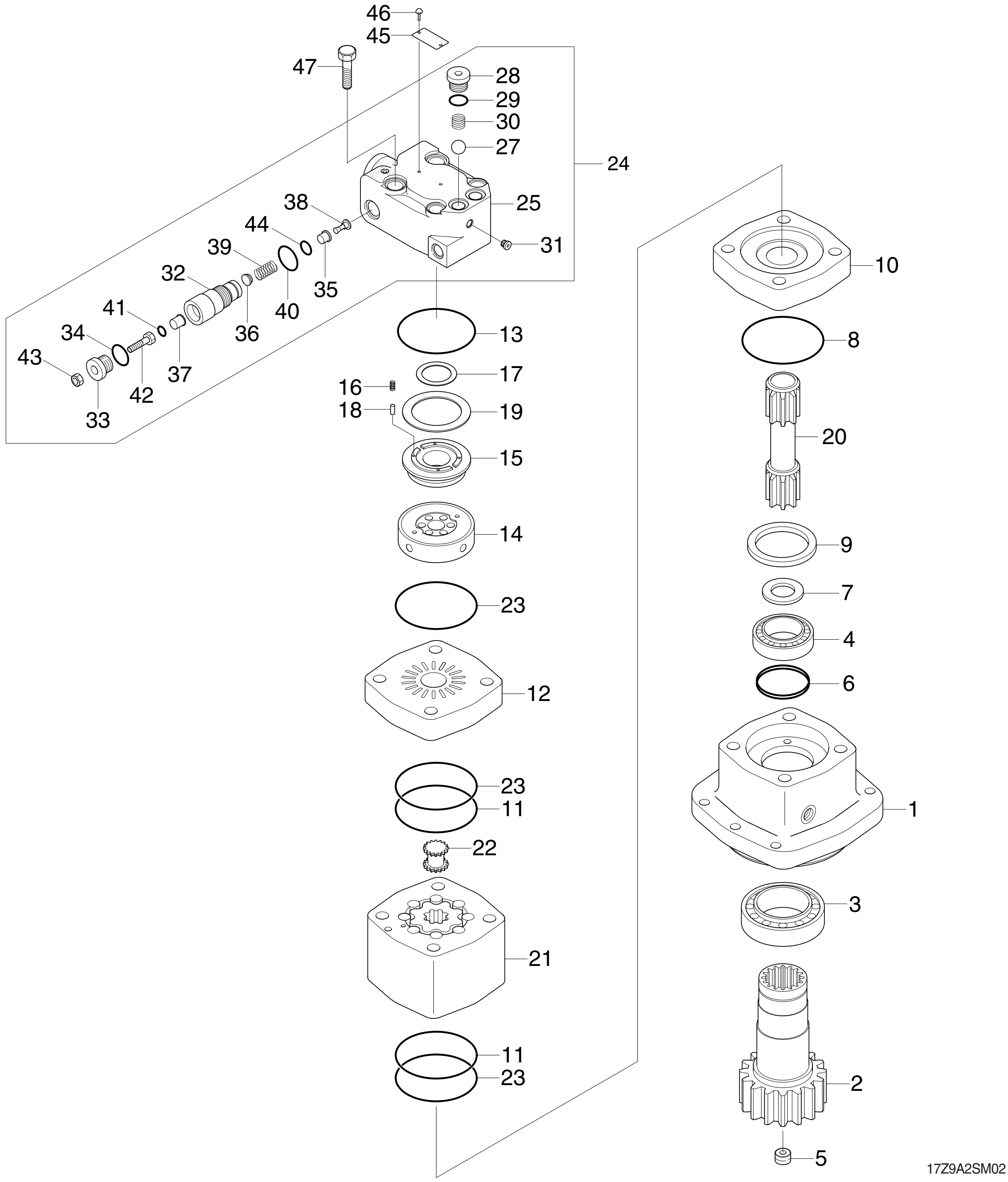
Port	Port name	Port size
A	Main port	PF 3/8
B	Main port	PF 3/8
T	Drain port	PF 3/8

2) COMPONENTS

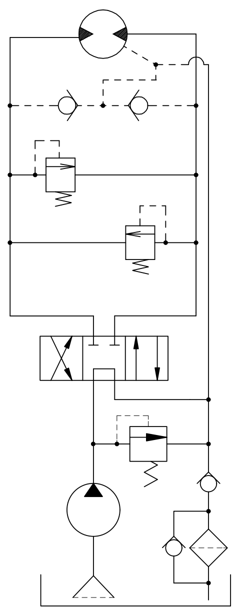


1	Bearing housing	13	O-ring	25	Valve housing	37	Spring push
2	Pinion gear	14	Valve	26	Relief cartridge	38	Orifice plate
3	Ball bearing	15	Balancing ring	27	Steel ball	39	Spring
4	Ball bearing	16	Spring	28	Plug	40	O-ring
5	Plug	17	Inner face seal	29	O-ring	41	O-ring
6	X-ring	18	Pin	30	Spring	42	Hexagon socket set screw
7	Retaining ring	19	Outer face seal	31	Plug	43	Hexagon nut
8	O-ring	20	Drive	32	Cartridge	44	O-ring
9	Shaft face seal	21	Gerotor	33	Screw guide	45	Name plate
10	Wear plate	22	Valve drive	34	O-ring	46	Rivet
11	O-ring	23	O-ring	35	Needle valve	47	Hexagon bolt
12	Valve plate	24	Valve housing assy	36	Spring seat		

2. OPERATION

1) PREVENTION OF CAVITATION

When a load with great inertia is stopped suddenly or a motor is turned by an external load, cavitation may be generated. In order to prevent cavitation, sufficient boost pressure must be applied to the suction side of the hydraulic motor. The boost pressure changes according to the motor speed and the viscosity of hydraulic oil, so apply pressure exceeding the specified boost pressure.



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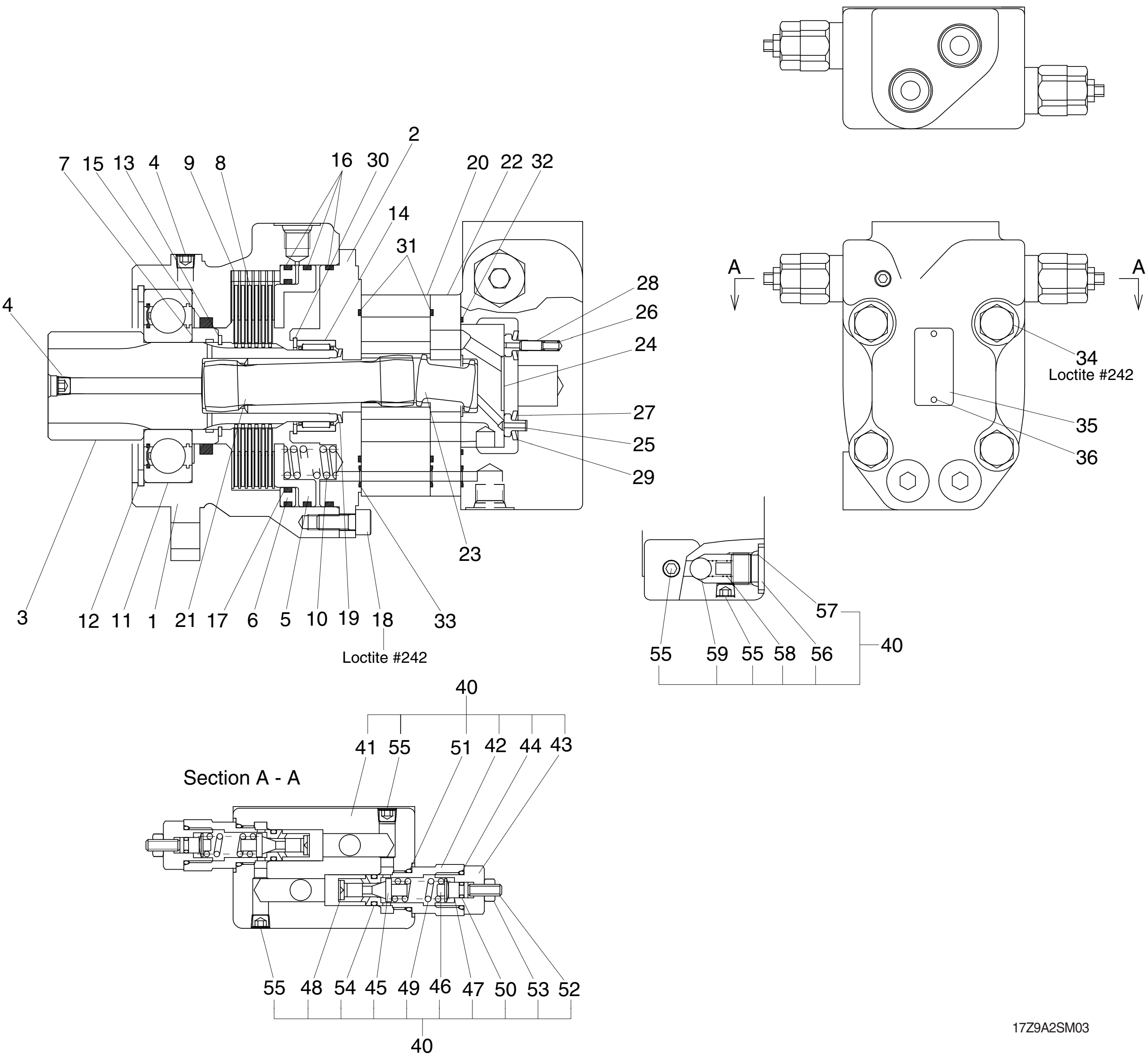
2. SWING MOTOR WITH PARKING BRAKE

1) STRUCTURE



1	Bearing housing	15	X-ring	29	Outer face seal	46,47	Spring seat
2	Flange mounting	16,17	O-ring	30	Snap ring	48	Orifice plug
3	Pinion gear	18	Cap screw	31,32	O-ring	49	Spring
4	Plug	19	Shaft face seal	33	O-ring	50	O-ring
5	Piston	20	Geroler	34	Bolt	51	O-ring
6	Ring	21	Drive	35	Name plate	52	Hexagon screw
7	Collar	22	Valve plate	36	Rivet	53	Hexagon nut
8	Friction disk	23	Valve drive	40	Valve housing assy	54	O-ring
9	Center plate	24	Valve	41	Valve housing	55	Plug
10	Spring	25	Balancing ring	42	Cartridge	56	Plug
11	Front bearing	26	Spring	43	Screw guide	57	O-ring
12,13	Snap ring	27	Inner face seal	44	O-ring	58	Spring
14	Rear bearing	28	Pin	45	Needle valve	59	Ball

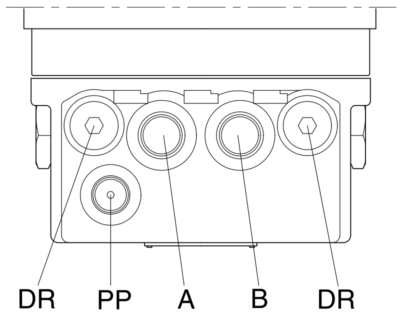
GROUP 4 TRAVEL DEVICE

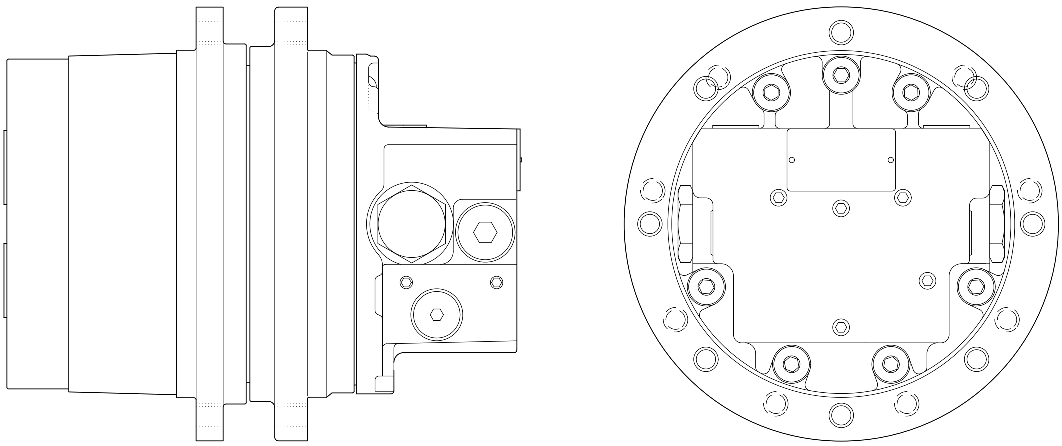
1. CONSTRUCTION

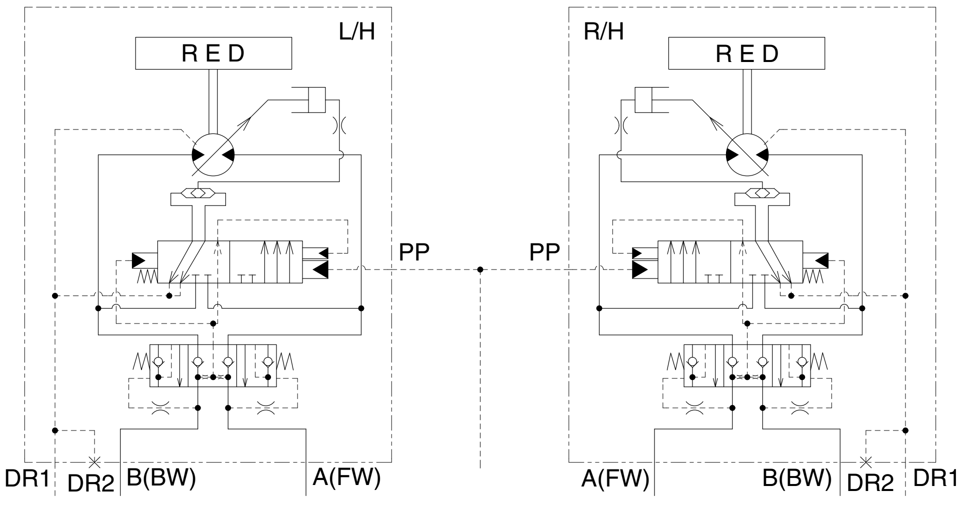
Travel device consists travel motor and gear box.

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

Port	Port name	Port size
A	Main port	PF 3/8
B	Main port	PF 3/8
DR1, DR2	Drain port	PF 1/4
PP	2 speed control port	PF 1/4



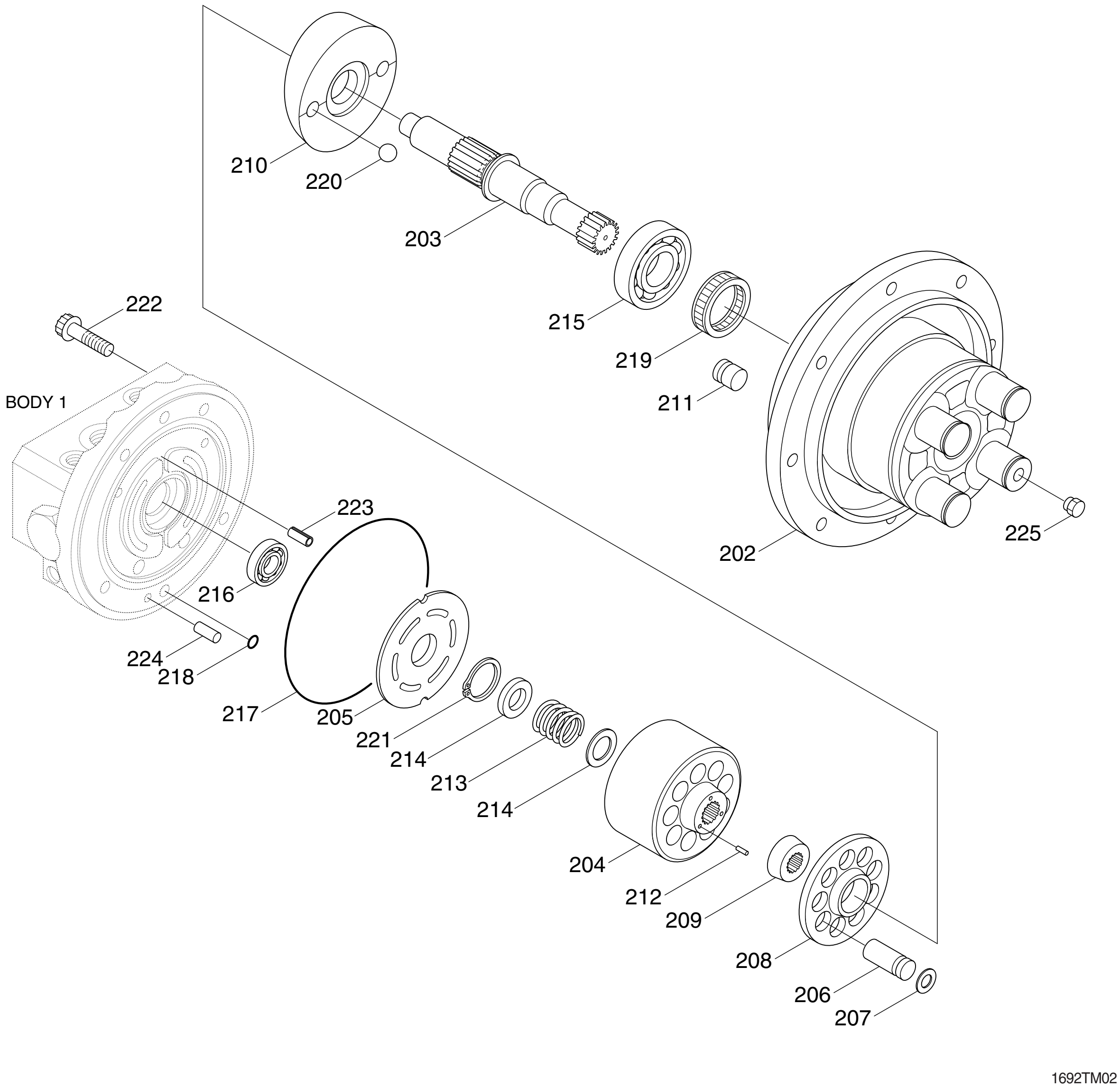




HYDRAULIC CIRCUIT

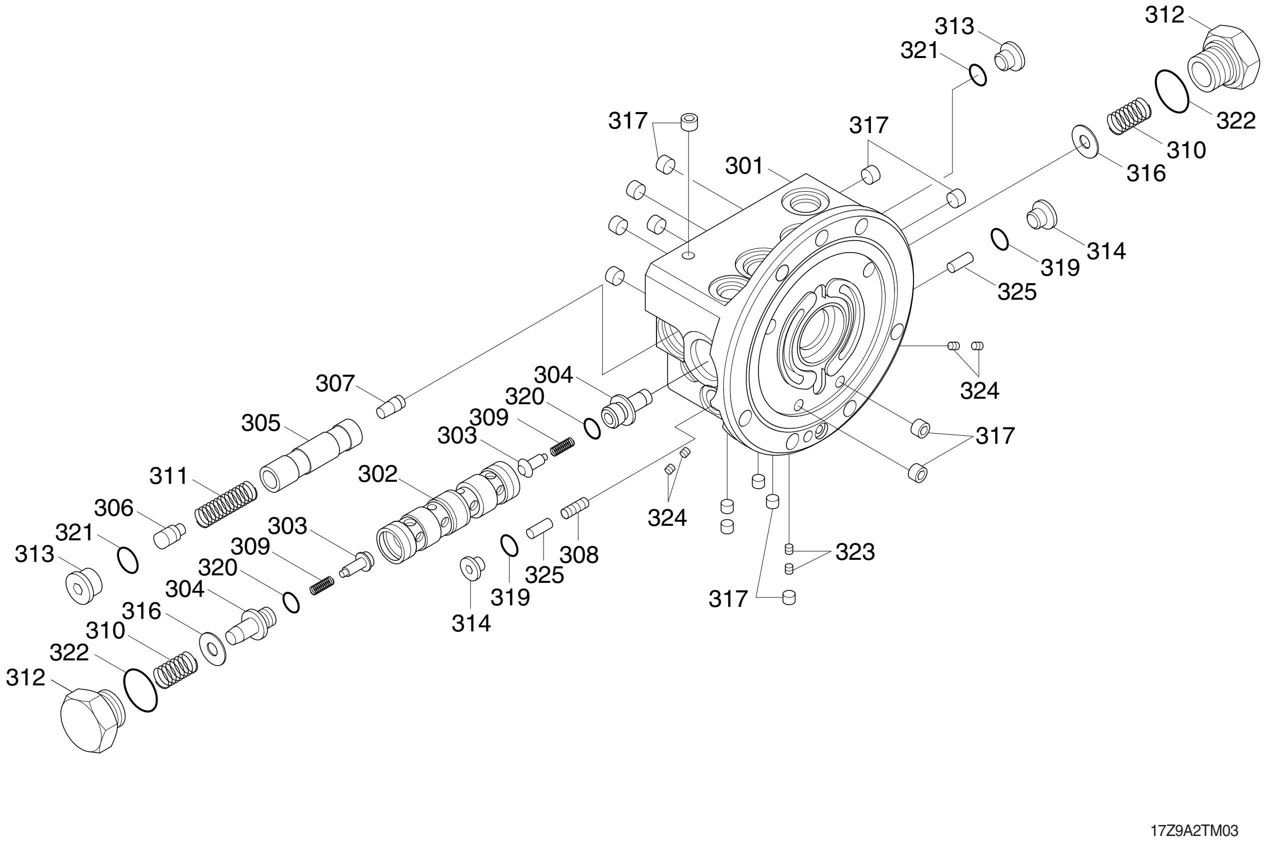
17Z9A2TM01

2) STRUCTURE (1/3)



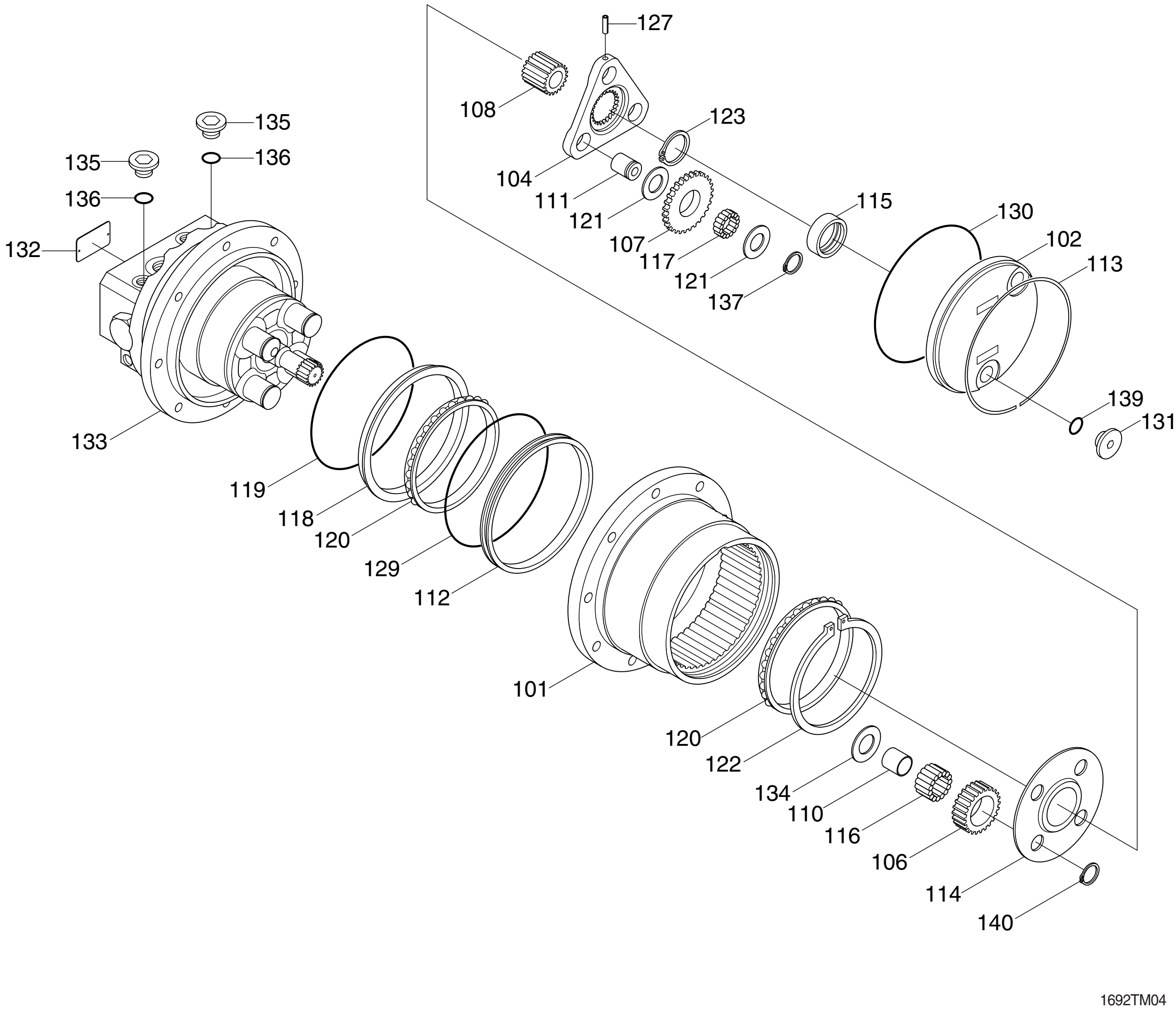
202	Body 2	210	Swash plate	218	O-ring
203	Shaft	211	Control piston	219	Oil seal
204	Cylinder barrel	212	Pin	220	Ball
205	Valve plate	213	Spring C	221	Snap ring
206	Piston	214	Retainer	222	Screw
207	Shoe	215	Bearing	223	Spring pin
208	Shoe holder	216	Bearing	224	Pin
209	Barrel holder	217	O-ring	225	Plug

STRUCTURE (2/3)



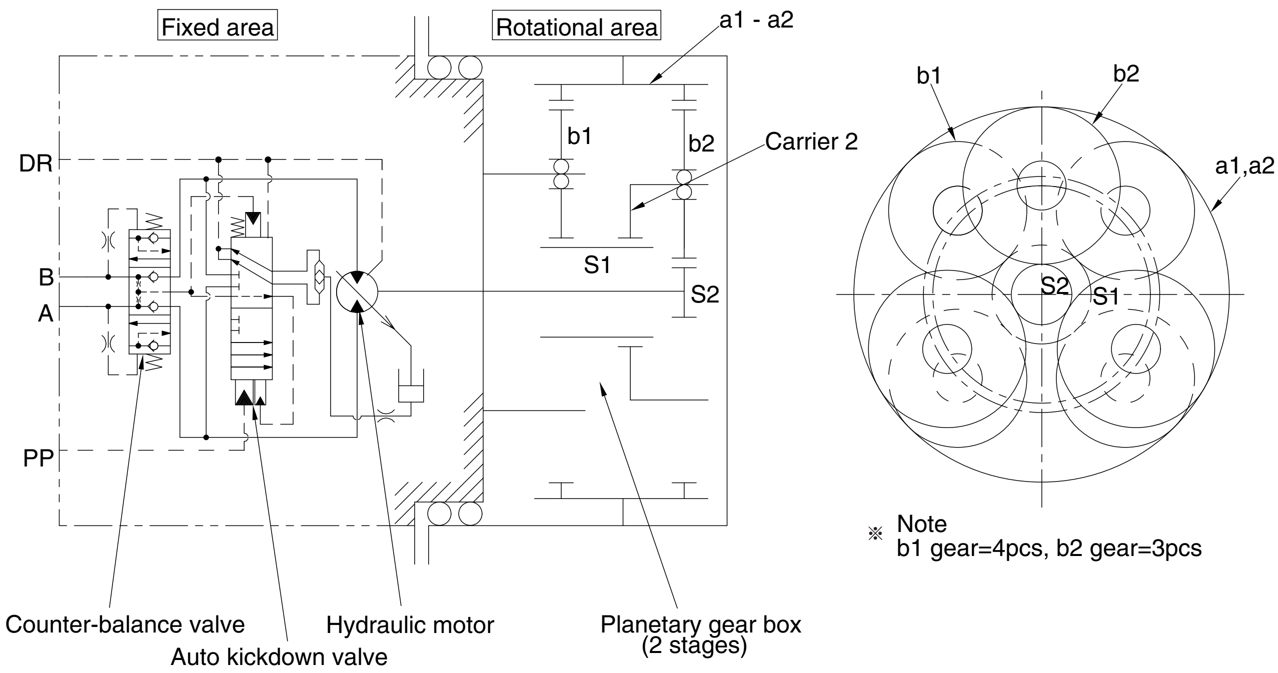
301	Body 1	309	Spring V1	319	O-ring
302	Spool	310	Spring V2	320	O-ring
303	Check valve	311	Spring V3	321	O-ring
304	Spring guide	312	Plug	322	O-ring
305	Spool	313	Plug	323	Choke
306	Spool B	314	Ring	324	Choke
307	Spool C	316	Plug	325	Pin
308	Shuttle spool	317	Plug		

STRUCTURE (3/3)



101	Body	113	Snap ring	121	Thrust washer	134	Thrust washer
102	Cover	114	Thrust plate	122	Snap ring	135	Plug
104	Carrier 2	115	Slide ring	123	Snap ring	136	O-ring
106	Gear B1	116	Needle	127	Spring pin	137	Snap ring
107	Gear B2	117	Needle	129	O-ring	139	O-ring
108	Gear S1	118	Floating seat (Incl 119)	130	O-ring	140	Snap ring
110	Ring			131	Plug		
111	Pin B2	119	O-ring	132	Name plate		
112	Seal ring	120	Bearing	133	Hydraulic motor		

2. DRAWING OF OPERATIONAL PRINCIPLE



17Z9A2TM05

3. OPERATION

Travel motor consists of a hydraulic motor "Fixed parts" and a planetary gear speed reducer "Rotating parts".

1) REDUCTION GEAR SECTION

(1) Function

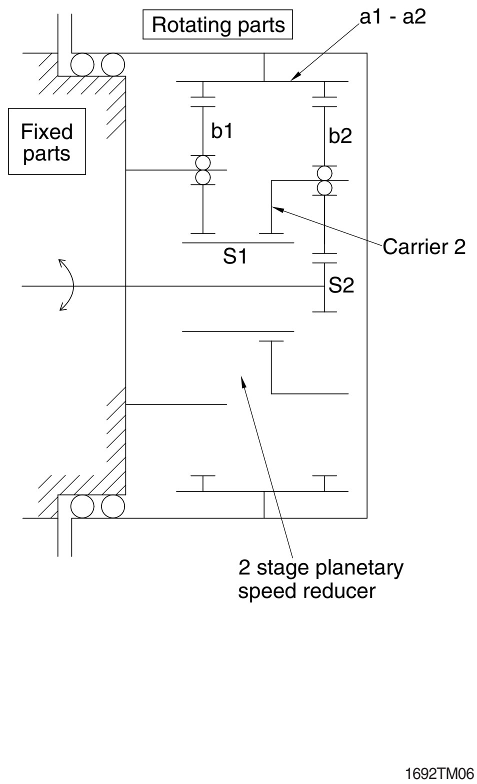
The speed reducer of travel motor is a simple planetary gear type with two stages. The high output speed of the hydraulic motor is reduced to low speed with high torque.

(2) Operation

The S2 gear is attached to the hydraulic motor shaft and the S2 output speed is reduced between the gears (s2, b2, a2) as a first stage speed reducer.

The reduced output speed of this first stage is reduced again between the gears (s1, b1, a1) which are connected to the carrier 2 with the spline.

This reduced output speed of the second stage is transmitted to the body case "rotating parts" through the inner gears (a1, a2) and drives the machine.



The gear ratio of 2 stage simple planetary speed reducer is calculated using the following formula.

$$R = \frac{Zs1}{Zs1+Za1} \times \frac{Zs2}{Zs2+Za2}$$

※ Z_{**} : Number of teeth

With the travel motor, the body case rotating, so the gear ratio is ;

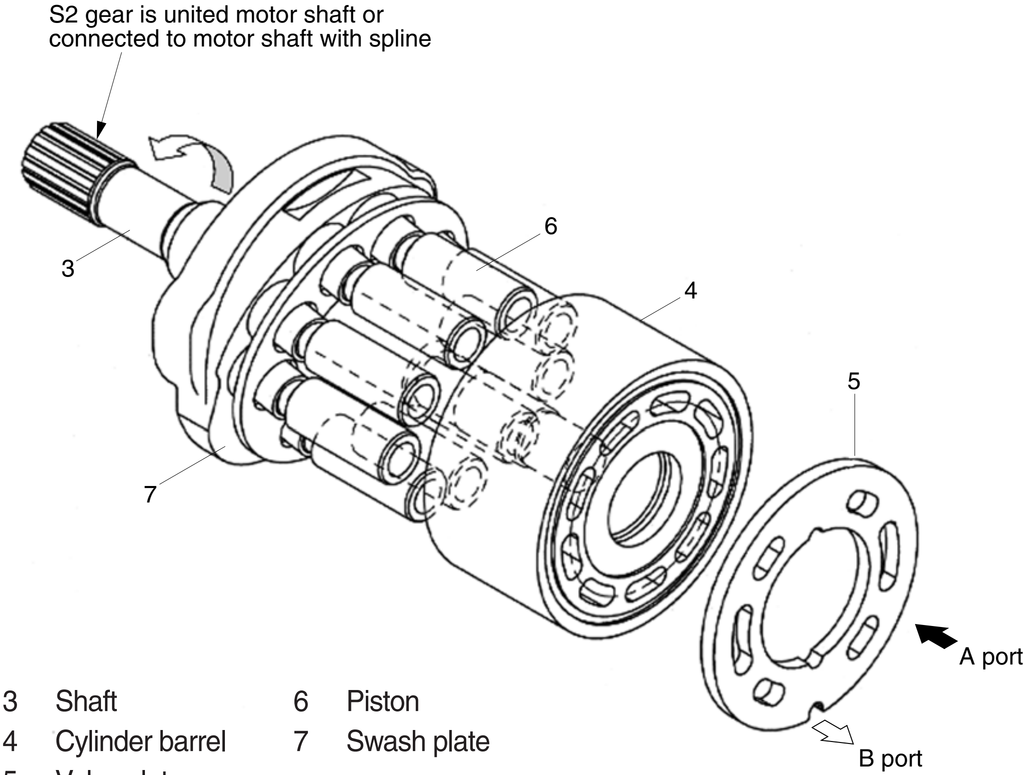
$$R' = \frac{1}{1-1/R}$$

2) HYDRAULIC MOTOR SECTION

(1) Function

This hydraulic motor is an axial piston type, and changes the hydraulic energy supplied from the pump to the rotary motion.

(2) Structure



3	Shaft	6	Piston
4	Cylinder barrel	7	Swash plate
5	Valve plate		

17Z9A2TM06

Through a hydraulic valve, the pressurized oil is supplied to the valve plate (5).
When the pressurized oil is supplied to the A port, this pressurized oil pushes the piston (6) in the clylinder barrel (4). This pushing force is changed to the rotational power by the swash plate (7) and transmitted to the shaft (3) which is connected to the cylinder barrel (4) with the spline. The return flow from the cylinder port is going out through the B port of the valve plate (5). To reverse rotation, pressurized oil is supplied to the B port and returning oil exits through the A port.

(3) 2 speed motor operation

The swash plate, which has surface Ⅰ and Ⅱ in the opposite side to the shoe sliding surface, is supported by the 2 balls which are fixed to the body 2.

Since the balls are located in the eccentric position, in the low speed range, the surface Ⅰ is faced to the body 2 by the oil pressure in the piston and the spring force in the cylinder barrel.

The swash plate angle is α (max capacity).

When the pressurized oil is supplied to the (PP) port, the two-speed spool moves to the high position.

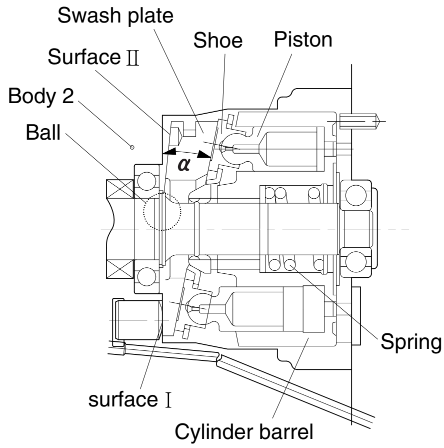
And the pressurized oil of inlet is led to the control chamber through the two-speed spool.

The control piston moves forward until the surface Ⅱ of the swash plate is in contact with the body 2, and the swash plate angle becomes β .

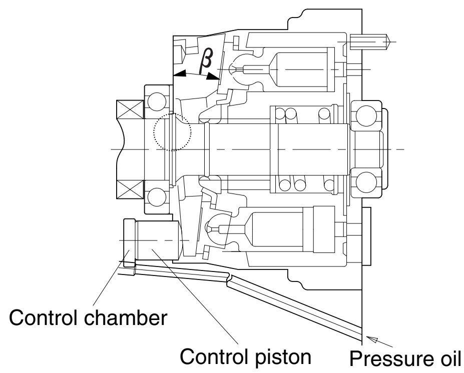
The capacity of the hydraulic motor is made small.

The pressurized oil of the (PP) port is shut off (or the engine is stopped), the two-speed spool moves to the low position.

And the control chamber is led to the tank port through the two-speed spool and the swash plate position comes to the low speed by the spring force.



Low speed



High speed

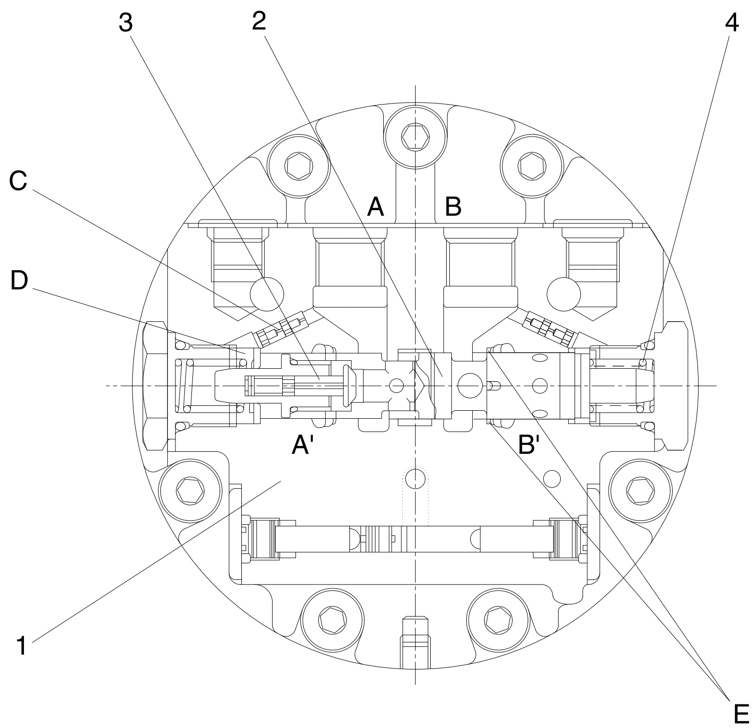
17Z9A2TM07

3) HYDRAULIC VALVE SECTION

(1) Counter-balance valve

When the pressurized oil is supplied from the A port, the pressurized oil opens the check valve (3) and flows into the hydraulic motor inlet A' port. At the same time, the pressurized oil goes through the orifice C into the chamber D, pushes the spring (4) and moves the spool (2) to right. Then the returned oil from the hydraulic motor flows into the B port, goes through area E and drives the hydraulic motor. When the pressurized oil is supplied from the B port, the hydraulic motor rotates in reverse.

Even the pressurized oil of the A port is shut off, the hydraulic motor tries to rotate by inertia force. When the pressurized oil from the A port is shut off, the spool (2) tries to return to left by the spring (4) force. At this time, the oil in the chamber D tries to go out to the A port through the orifice C, but due to the throttle effect of orifice C, the spool (2) speed is reduced. With the orifice and notches on the spool, the returned oil is controlled gradually and the hydraulic motor stops smoothly.



17Z9A2TM08

(2) Auto kick down valve

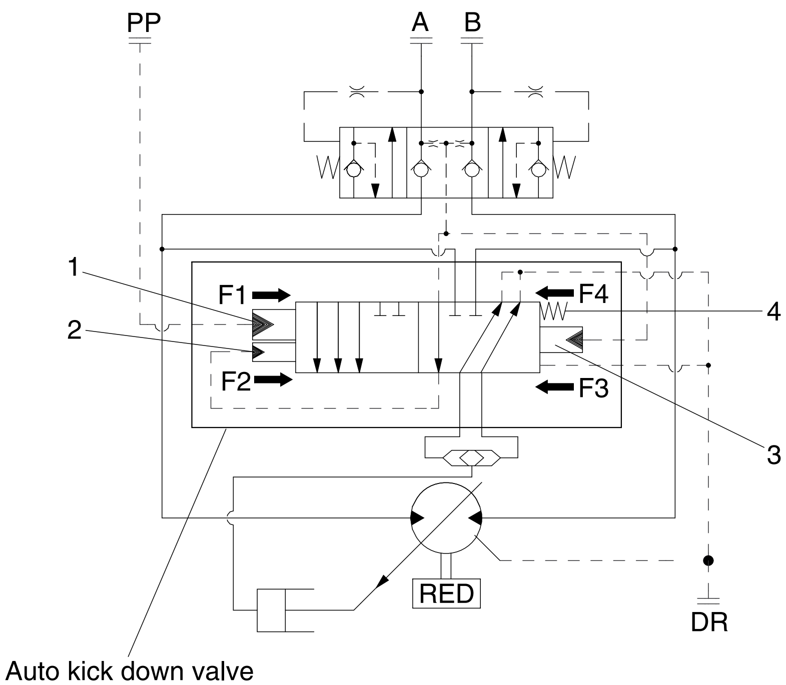
When the travel speed control switch for Hi speed mode is turned on, the pilot pressure for Hi speed mode comes from PP port to the hydraulic pilot (1), then the force F1 occurs. The auto kick down valve moves to the right direction because the F1 is larger than F4, which is by spring (4). Then the speed of track motor is changed to the Hi speed mode.

On the other hand, the operating pressure comes from A or B port to the hydraulic pilot (2) and (3), then the force F2 and F3 occur. The F3 is larger than F2 because the area of (3) is wider than the area of (2). Therefore, if the operating pressure increases, the difference between F2 and F3 also increases.

When the operating pressure is larger than the setting pressure of Hi speed to Lo speed, the right direction resultant of F1 and F2 is smaller than the left direction resultant of F3 and F4.

Therefore the auto kick down valve moves to the left direction, then the speed of track motor is changed to the Lo speed mode. When the operating pressure is smaller than the setting pressure of Lo speed to Hi speed, the right direction resultant of F1 and F2 is larger than the left direction resultant of F3 and F4.

Therefore the auto kick down valve moves to the right direction, then the speed of track motor is changed to the Hi speed mode.

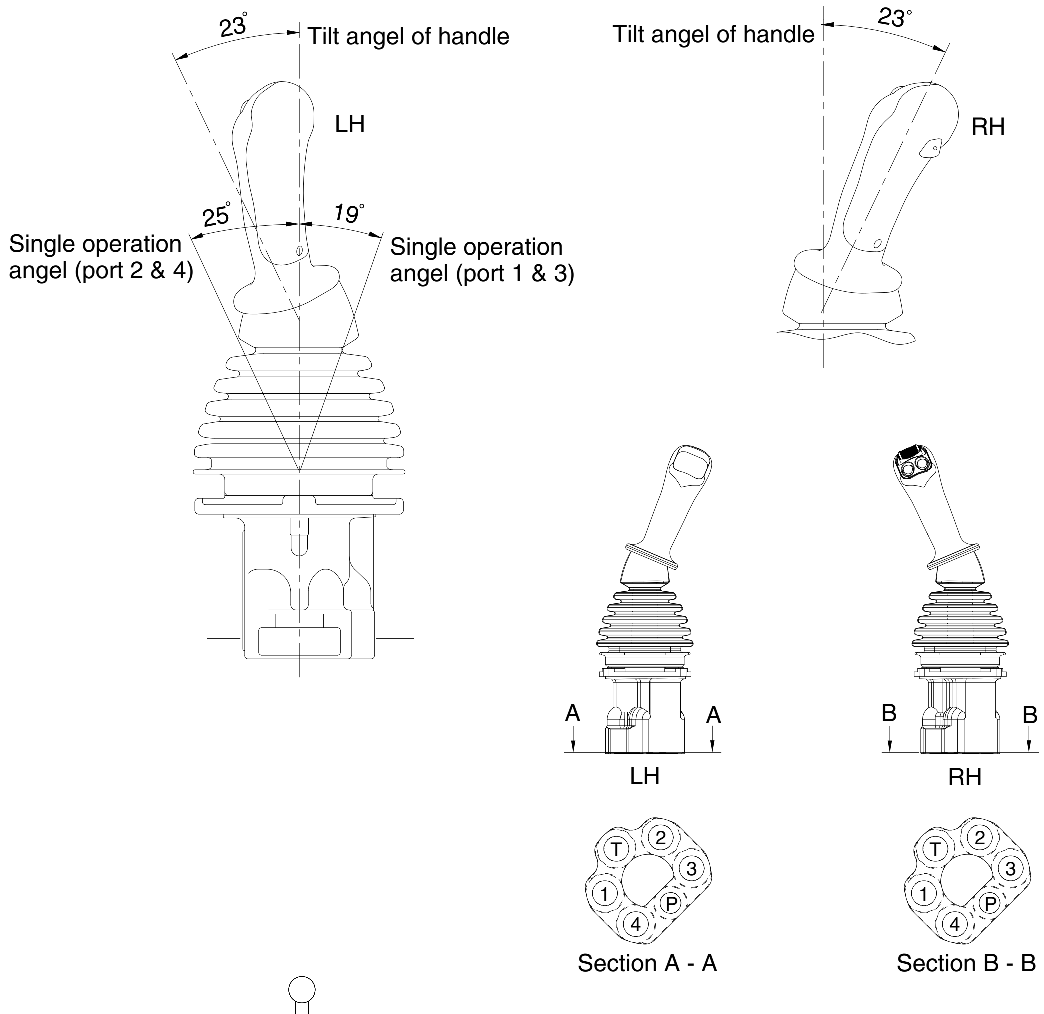


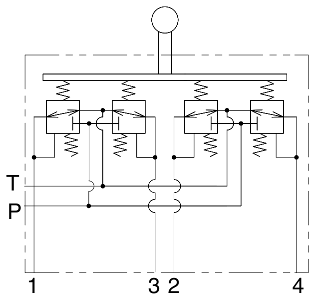
17Z9A2TM10

GROUP 5 RCV LEVER

1. STRUCTURE

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

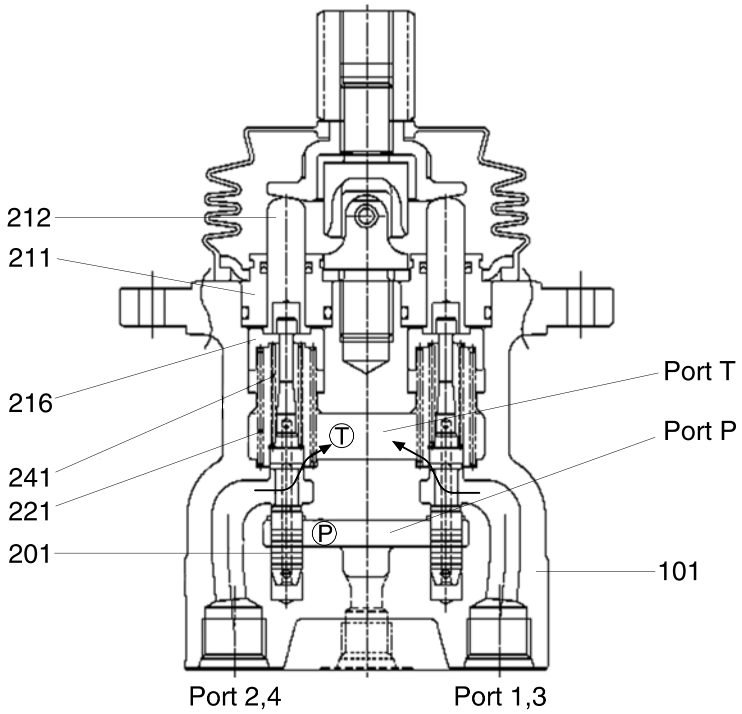




Hydraulic circuit

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

CROSS SECTION



17Z9A2RL02

101	Casing	216	Spring seat
201	Spool	221	Return spring
211	Plug	241	Secondary pressure setting spring
212	Push rod		

The structure of the remote control valve is as shown in the assembly. There is a vertical axial hole in the casing and the reduction valves are inserted into this.

The secondary pressure setting spring (241) is set such that the secondary pressure is calculated as 5.1~10.2 kgf/cm^2. Spool (201) is pushed onto the push rod (212) by return spring (221).
Tilting the control handle pushes down push rod (212), the spring seat (216) also moves down and the setting of the secondary pressure setting spring (241) is changed.
Port P, oil inlet (primary pressure) and port T outlet (tank) are in the casing (101).

2. PERFORMANCE

1) BASIC PERFORMANCE

The remote control valve controls the stroke and direction of the control valve spools. This is achieved by the output pressure of the remote control valve acting on the tip of the control valve spool.

To achieve satisfactory performance, the remote control valve comprises the following elements :

(1) An inlet port (P) for oil fed from the hydraulic pump.

(2) Multiple output ports (1, 2, 3 and 4) to allow pressure from the inlet port to act on the spool tips of the control valve.

(3) A tank port (T) to control the output pressure.

(4) A spool to connect the output port to the inlet port or tank port.

(5) A mechanical assembly, which contains a spring which acts on the spool and controls the output pressure.

2) PERFORMANCE OF THE MAIN PARTS

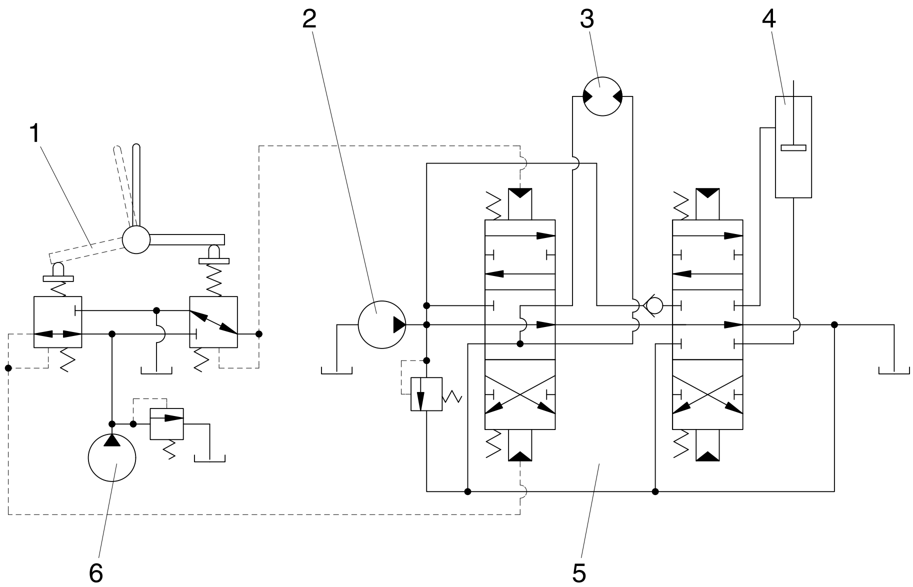
The spool (201) operates to take the supply oil pressure from the hydraulic pump. This switches the oil channel so that the port P oil pressure is directed to the output ports 1, 2, 3, 4 or to port T.
The secondary pressure setting spring (241) determines the output pressure that acts on the spool (201).

The push-rod (212), which changes the strain of the secondary pressure setting spring (241), is inserted so that it can move smoothly into the plug (211).

The return spring (221) acts to return the push-rod (212) towards zero displacement without reference to the output pressure acting on the spring seat (216) and casing (101). This acts to ensure the return to neutral of the spool (201) and also acts as a resistance spring to provide the operator with an appropriate operating "feel".

3) OPERATION

The operation of the remote control valve is described in the hydraulic circuit plan and operation explanatory figures (see figures RL04, 05 and 06). The below figure shows a typical example of the use of the remote control valve.



17Z9A2RL03

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

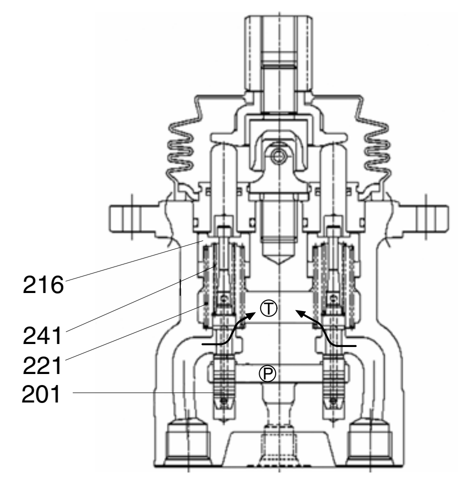
(1) Control handle neutral

The force of the secondary pressure setting spring (241) (which determines the output pressure of the pilot valve) does not act on the spool (201).

Spool (201) is pressed upward by the return spring (221) and spring seat (216) .

Output ports (2, 4) and port T are open.

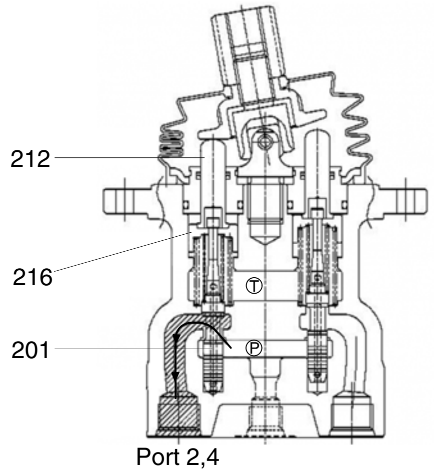
The output pressure is the same as the tank pressure.



17Z9A2RL04

(2) Control handle tilted

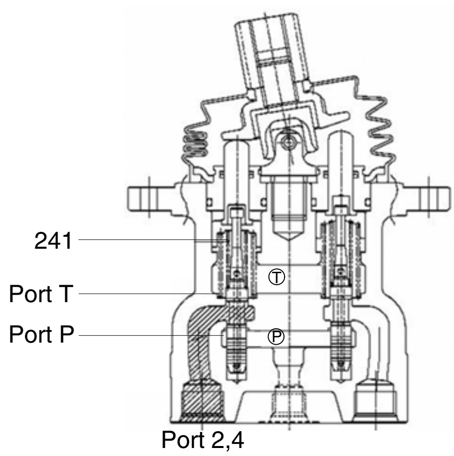
The push-rod moves, (spring seat (216)), spool (201) moves downward, port P and ports (2, 4) are open and the oil fed from the pilot pump flows to ports (2, 4) and generates pressure.



17Z9A2RL05

(3) Control handle held

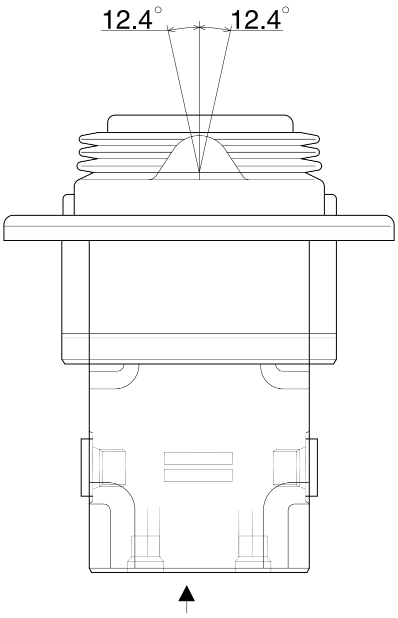
The pressure of ports (2, 4) rises to become equal to the spring (241) force; the oil pressure and spring pressures become balanced. If the pressure of ports (2, 4) exceeds the set pressure, ports (2, 4) and port P close, ports (2, 4) and port T open. If the pressure of ports (2, 4) falls below the set pressure, ports (2, 4) and port P open and ports (2, 4) and port T close. The secondary pressure is kept constant.

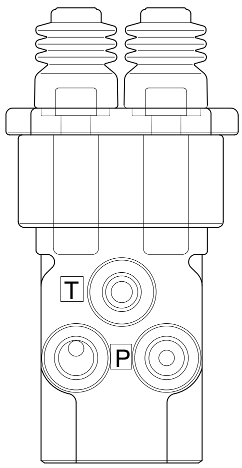


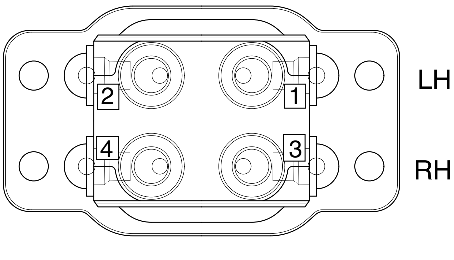
17Z9A2RL06

1. STRUCTURE

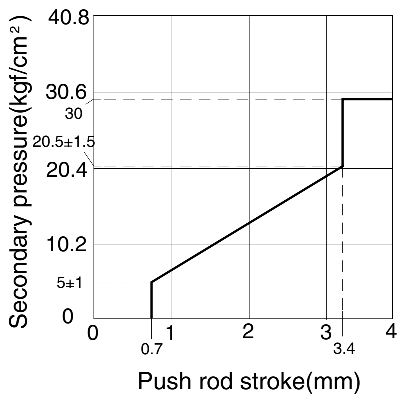
The casing has the oil inlet port P (primary pressure), and the oil outlet port T (tank). In addition the secondary pressure is taken out through ports 1, 2, 3 and 4 provided at the bottom face.



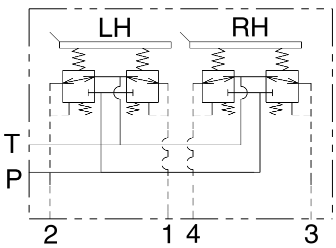




VIEW "A"



R35Z72RCP01



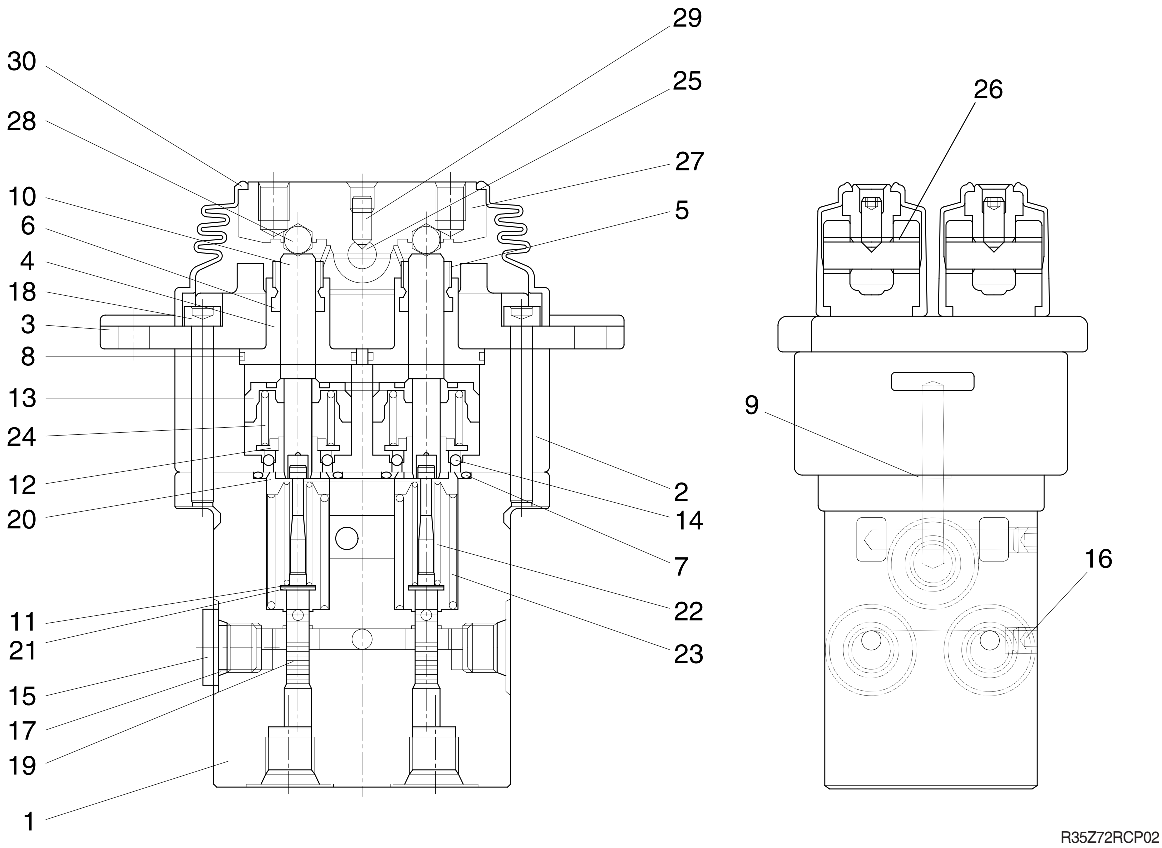
Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Travel (LH, Backward)	
2	Travel (LH, Forward)	
3	Travel (RH, Backward)	
4	Travel (RH, Forward)	

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 (19), spring (22) for setting secondary pressure, return spring (23), spring seat (20) and washer (21). The spring for setting the secondary pressure has been generally so preset that the secondary pressure is 5 to 19 kgf/cm^2 (depending on the type). The spool is pushed against the push rod (10) by the return spring.

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



1	Casing (1)	11	Shim	21	Washer
2	Casing (2)	12	Spring seat	22	Spring
3	Cover	13	Piston	23	Spring
4	Plug	14	Steel ball	24	Spring
5	Grease cap	15	Plug	25	Cam shaft
6	Packing	16	Plug	26	Bushing
7	O-ring	17	O-ring	27	Cam
8	O-ring	18	Hex soc head screw	28	Steel ball
9	O-ring	19	Spool	29	Set screw
10	Push rod	20	Spring seat	30	Bellows

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

The change the deflection of this spring, the push rod (10) is inserted and can slide in the plug (4).

For the purpose of changing th displacement of the push rod through the cam (27) and steel ball (28) are provided the pedal that can be tilted in any direction around the fulcrum of the cam (27) center.

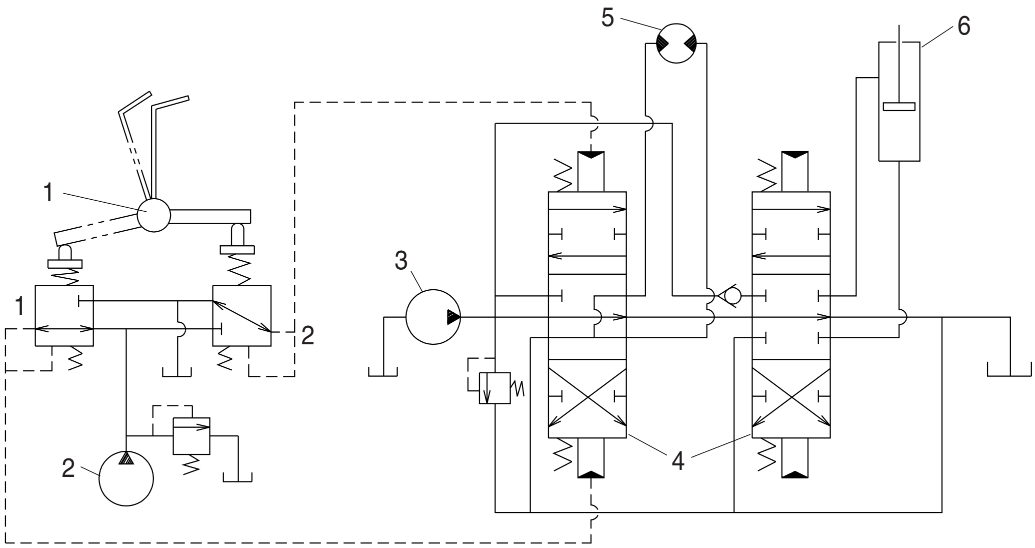
The spring (23) works on the casing (1) and washer (21) and tries to return the push rod (10) to the zero-displacement position irrespective of the output pressure, securing its resetting to the center position.

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

3) OPERATION

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

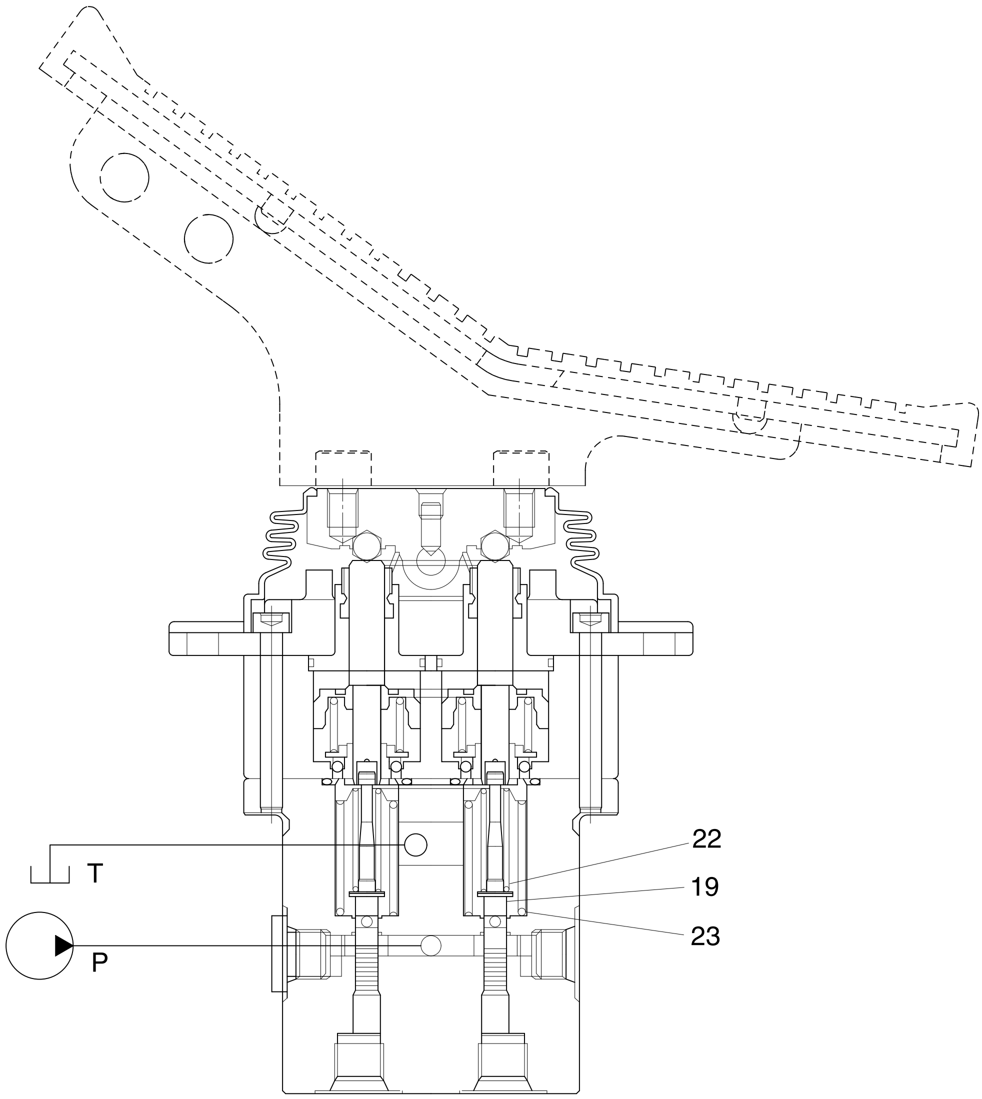
The diagram shown below is the typical application example of the pilot valve.



140LC-7 기타2-76

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

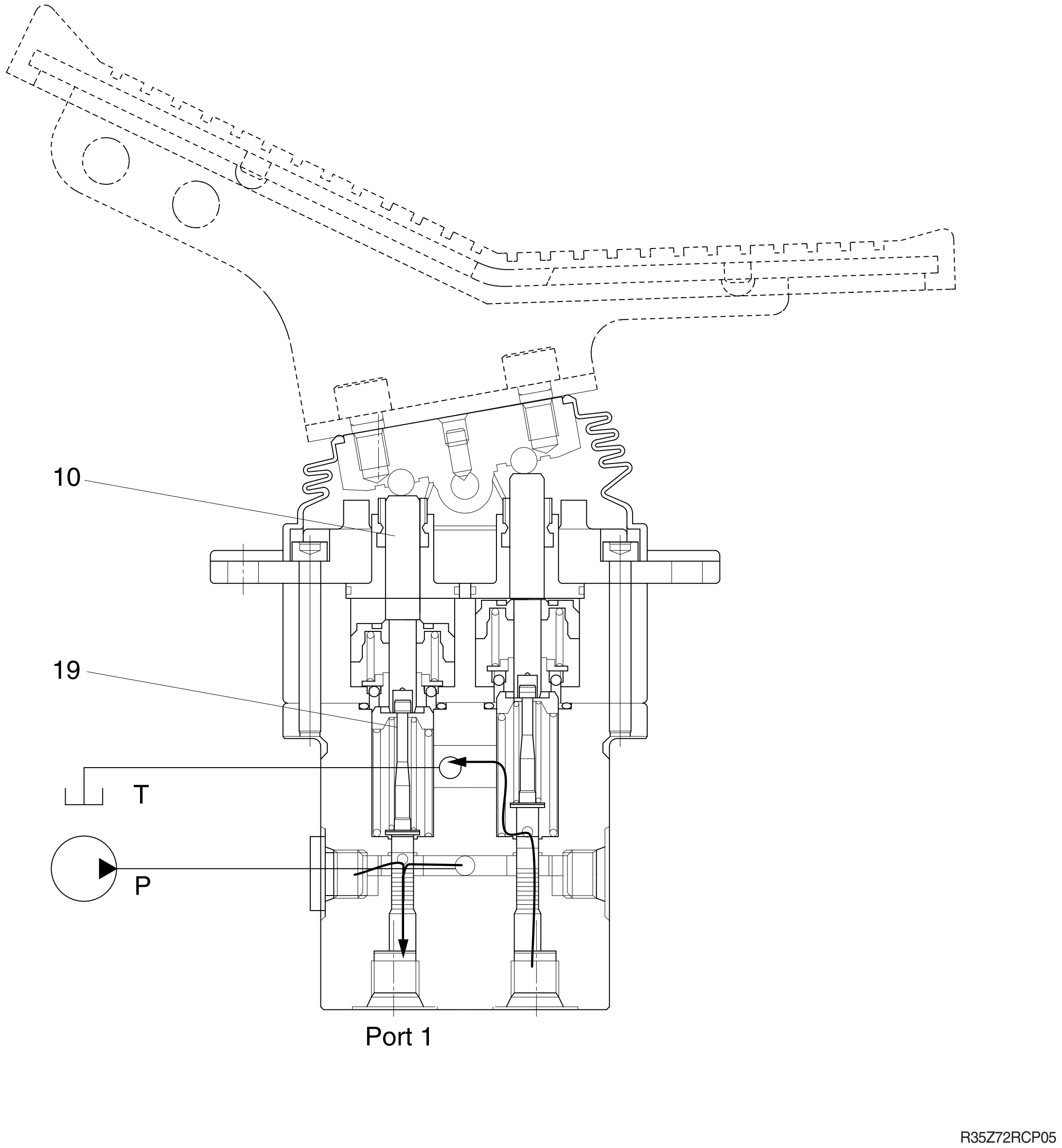
(1) Case where pedal is in neutral position



R35Z72RCP04

The force of the spring (22) that determines the output pressure of the pilot valve is not applied to the spool (19). Therefore, the spool is pushed up by the spring (23) to the position of port 2 in the operation explanation drawing. Then, since the output port is connected to tank port T only, the output port pressure becomes equal to tank pressure.

(2) Case where pedal is tilted



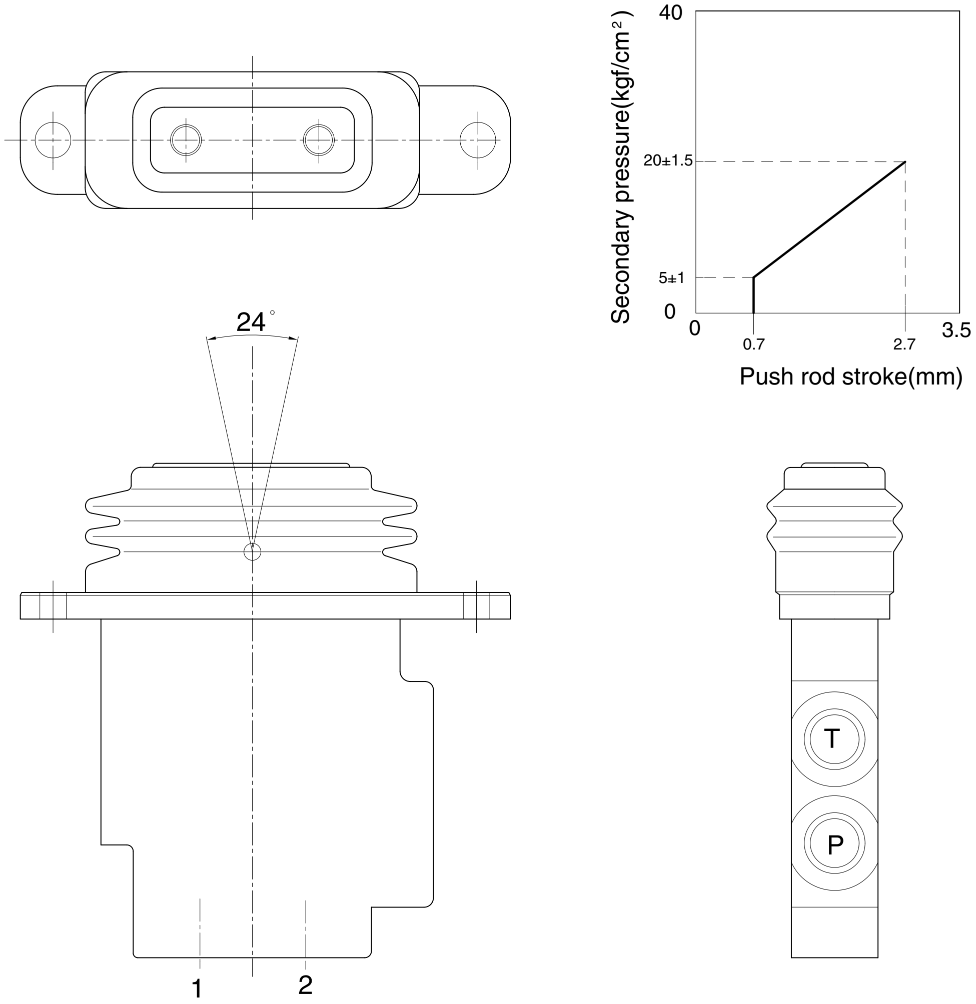
When the push rod (10) is stroked, the spool (19) moves downwards.
Then port P is connected with port 1, and the oil supplied from the pilot pump flows through port 1 to generate the pressure.
When the pressure at port 1 increases to the value corresponding to the spring force set by tilting the handle, 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.

3. BOOM SWING PEDAL

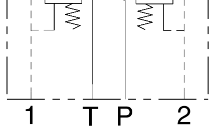
1) STRUCTURE

The casing has the oil inlet P (primary pressure) and the oil return port (tank).

In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.



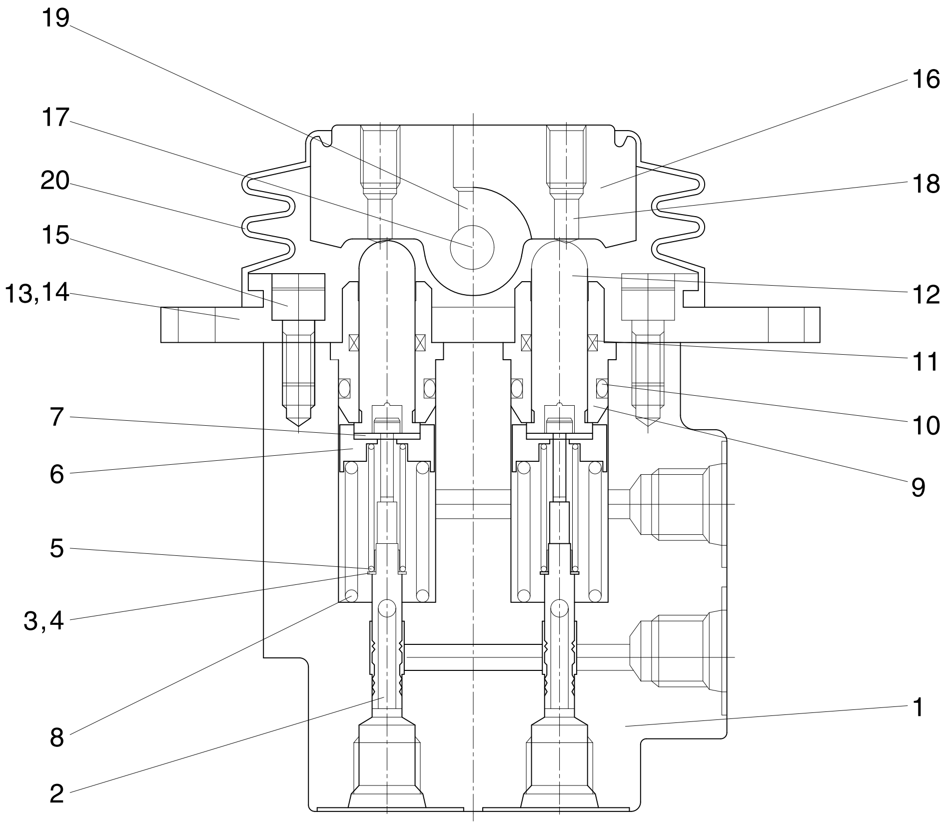
R35Z72RSP01



Hydraulic circuit

Port	Port name	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	
1	Boom swing (LH)	
2	Boom swing (RH)	

2) COMPONENT



R35Z72RSP02

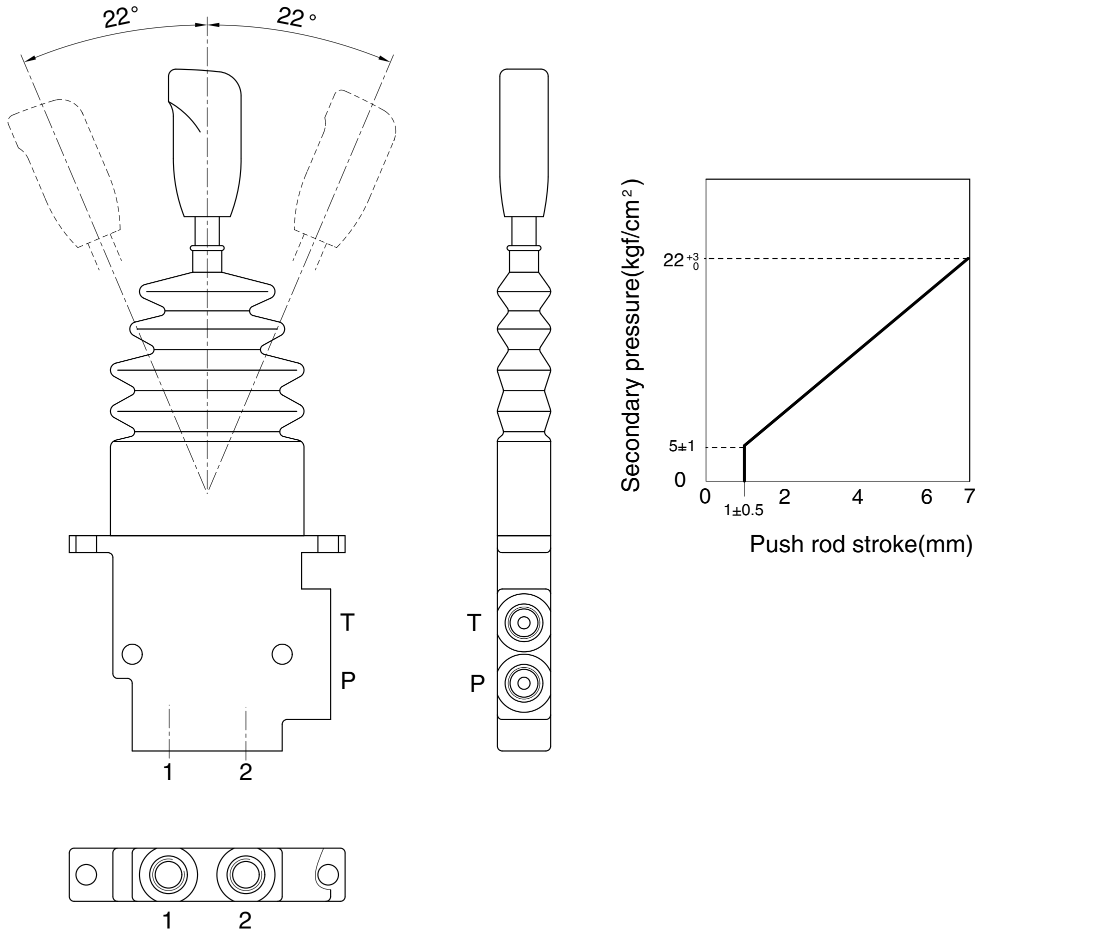
1	Body	8	Stopper	15	DU bush
2	Plug	9	Spring	16	Wrench bolt
3	O-ring	10	Plug	17	Cam
4	Spool	11	O-ring	18	Pin
5	Spring seat	12	Rod seal	19	Adjust screw
6	Spring	13	Push rod	20	Socket bolt
7	Spring seat	14	Cover	21	Bellows

4. DOZER LEVER

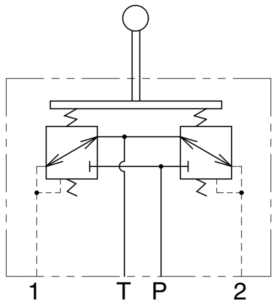
1) STRUCTURE

The casing has the oil inlet P (primary pressure) and the oil return port (tank).

In addition the secondary pressure is taken out through port 1 and port 2 provided at the housing bottom face.



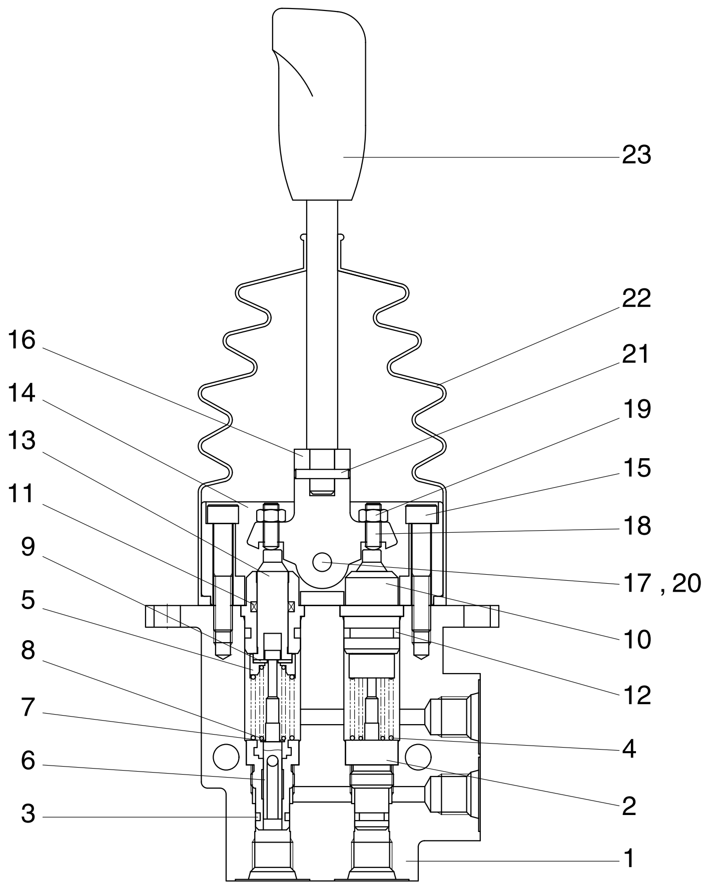
R35Z72DL01



Hydraulic circuit

Port	Port	Port size
P	Pilot oil inlet port	PF 1/4
T	Pilot oil return port	PF 1/4
1	Dozer blade up port	PF 1/4
2	Dozer blade down port	PF 1/4

2) COMPONENT

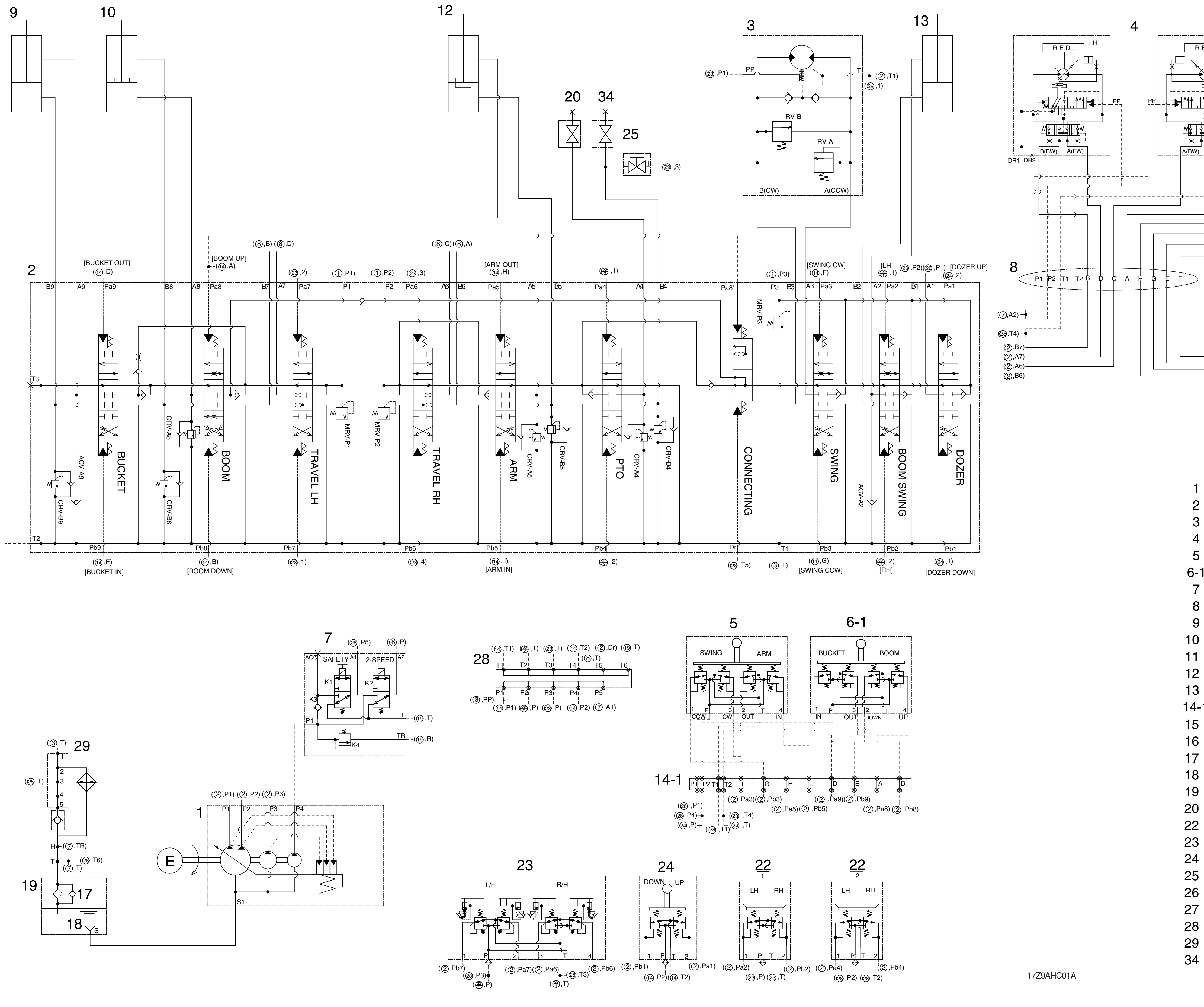


R35Z72DL02

1	Body	9	Stopper	17	Pin
2	Plug	10	Plug	18	Socket bolt
3	O-ring	11	Rod seal	19	Nut
4	Spring	12	O-ring	20	Snap ring
5	Spring seat	13	Push rod	21	Spring pin
6	Spool	14	Cover	22	Bellows
7	Spring seat	15	Wrench bolt	23	Lever
8	Spring	16	Guide		

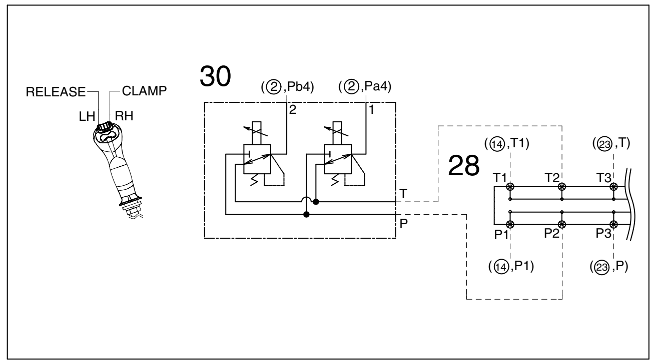
SECTION 3 HYDRAULIC SYSTEM

GROUP 1 HYDRAULIC CIRCUIT

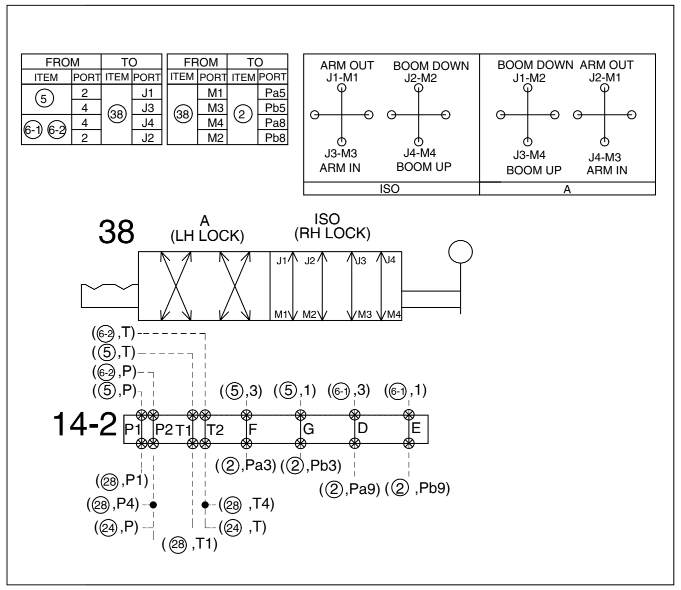


1 MAIN PUMP
2 MAIN CONTROL VALVE
3 SWING MOTOR
4 TRAVEL MOTOR
5 RCV LEVER-LH
6-1 RCV LEVER-RH
7 SOLENOID VALVE
8 TURNING JOINT
9 BUCKET CYLINDER
10 BOOM CYLINDER
11 DOZER CYLINDER
12 ARM CYLINDER
13 BOOM SWING CYLINDER
14-1 TREMINAL
15 OIL COOLER
16 RETURN CHECK VALVE
17 RETURN FILTER
18 SUCTION STRAINER
19 HYDRAULIC TANK
20 STOP VALVE-LH
22 RCV REDAL-PTO
23 RCV PEDAL-TRAVEL
24 RCV-DOZER
25 SELECTOR VALVE
26 PILOT SELECTOR VALVE
27 FRAME EXTENSION CYLINDER
28 BLOCK
29 RETURN PIPE
34 STOP VALVE-RH

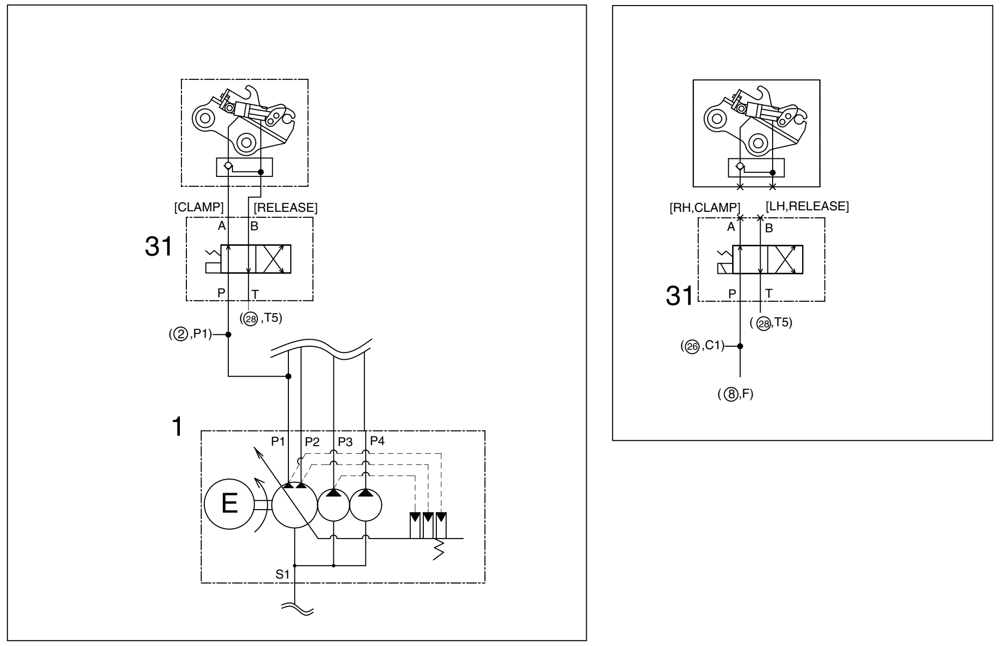
2-WAY PROPORTIONAL RCV



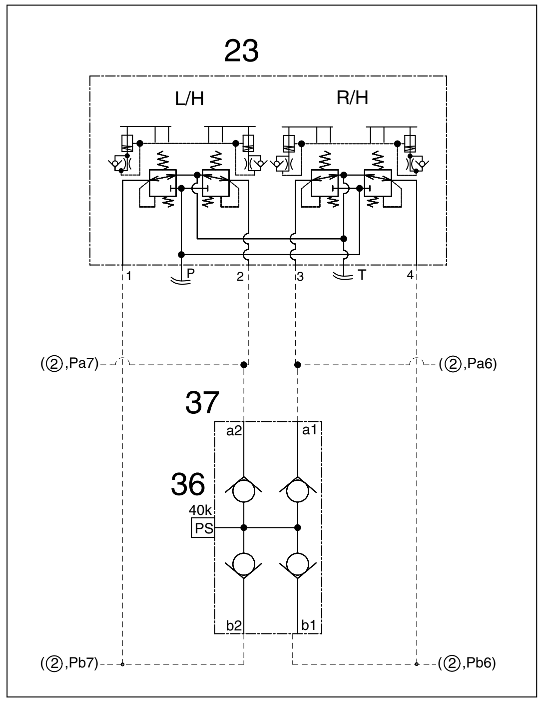
LEVER PATTERN



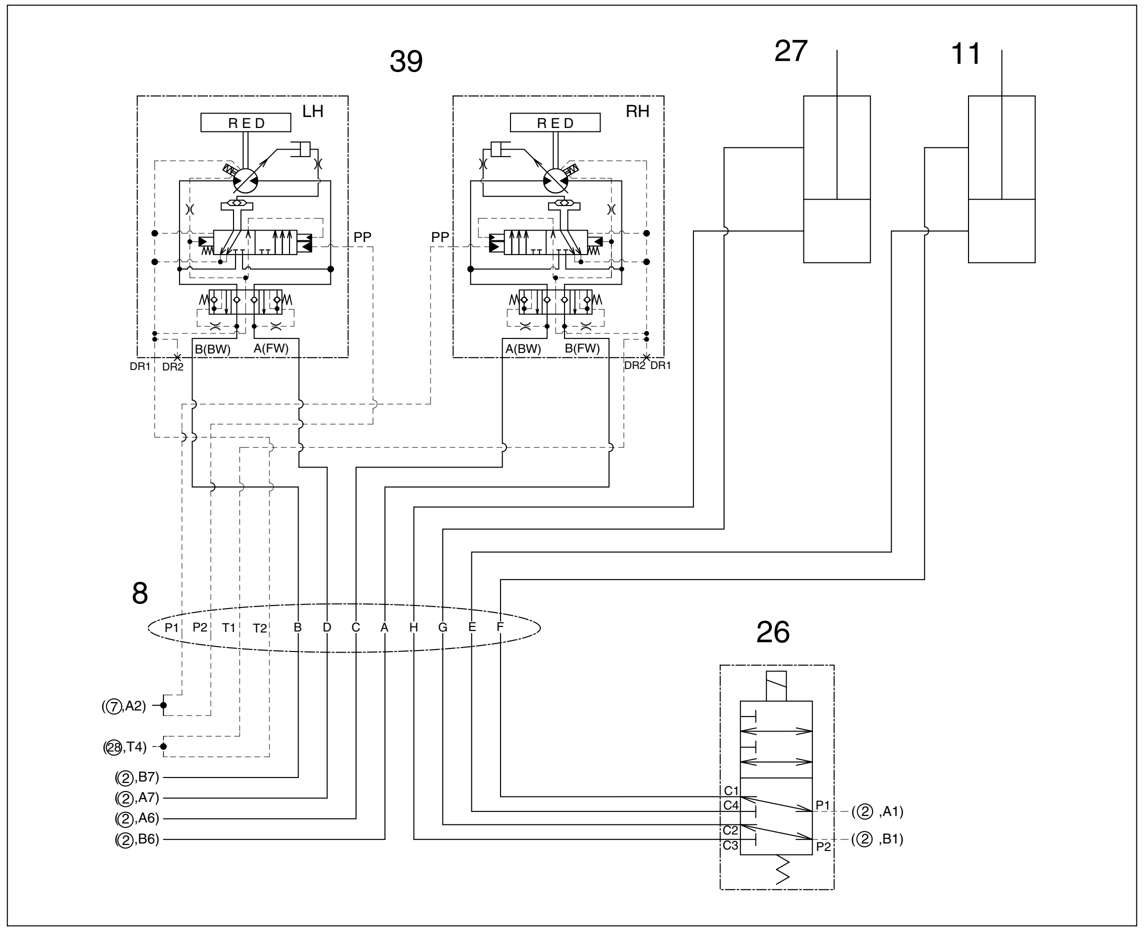
QUICK COUPLER



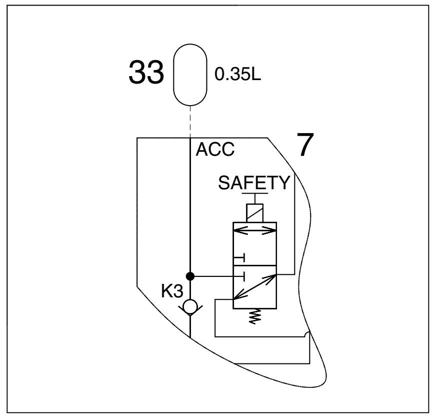
TRAVEL ALARM



TRAVEL MOTOR WITH PARKING BRAKE



ACCUMULATOR



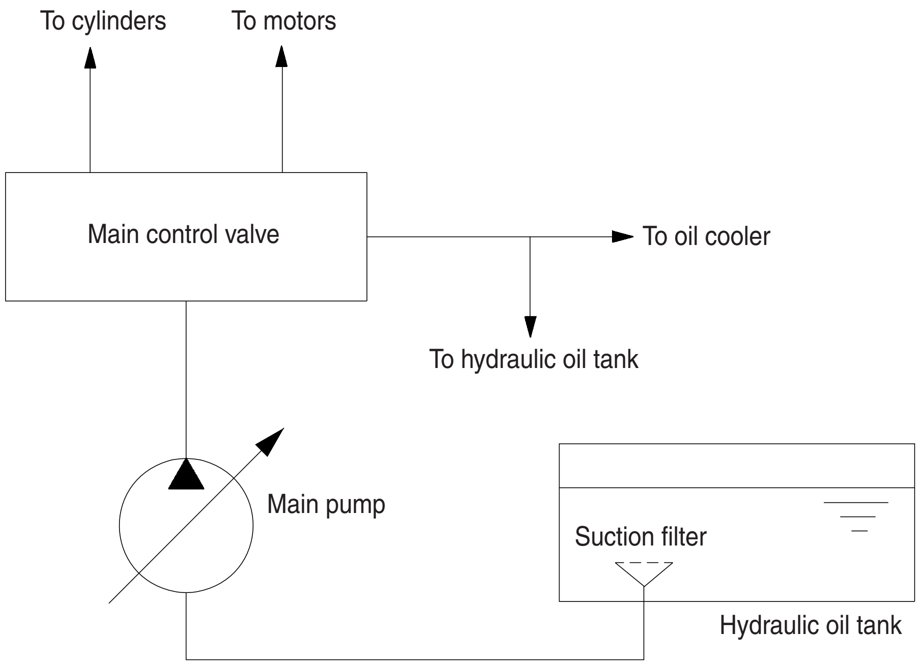
1 MAIN PUMP
5 RCV LEVER-LH
6-2 RCV(PROPORTIONAL)-RH
11 DOZER CYLINDER
14-2 TERMINAL
23 RCV PEDAL-TR
26 PILOT SELECTOR VALVE
27 FRAME EXTENSION CYLINDER
28 BLOCK
30 2-EPPR VALVE
31 SOLENOID VAVLE
33 ACCUMULATOR
36 SWITCH-PRESSURE
37 SHUTTLE VALVE
38 SELECTOR VALVE
39 TRAVEL MOTOR

17Z9AHC01B

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.

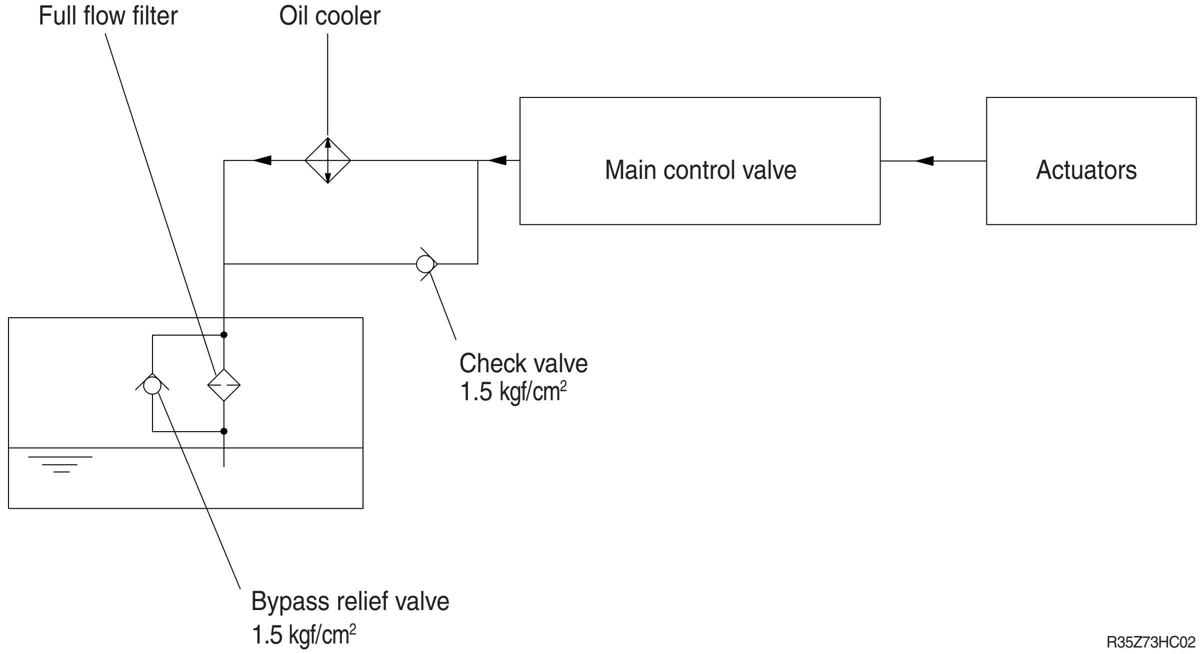
1. SUCTION AND DELIVERY CIRCUIT



3-02 (140-7 TIER)

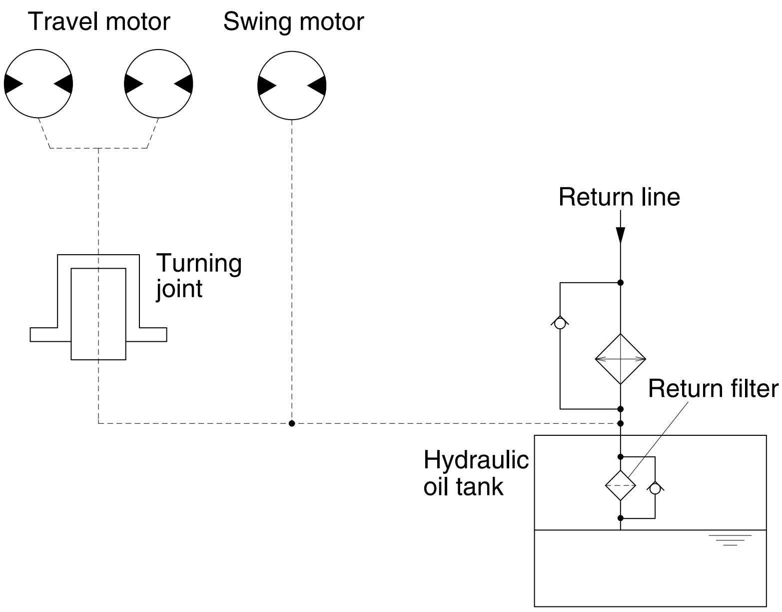
The pumps receive oil from the hydraulic tank through a suction filter. The discharged oil from the pump flows into the control valve and goes out the tank ports.
The oil discharged from the main pump flows to the actuators through the control valve.
The control valve controls the hydraulic functions.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

2. RETURN CIRCUIT



All oil returned from each actuator returns to the hydraulic tank through the control valve.
The bypass check valves are provided in the return circuit.
The setting pressure of bypass check valves are 1.5 kgf/cm^2 (21 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 1.5 kgf/cm^2 (21 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.
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



R35Z73HC43

Besides internal leaks from the motors and main pump, the oil for lubrication circulates.

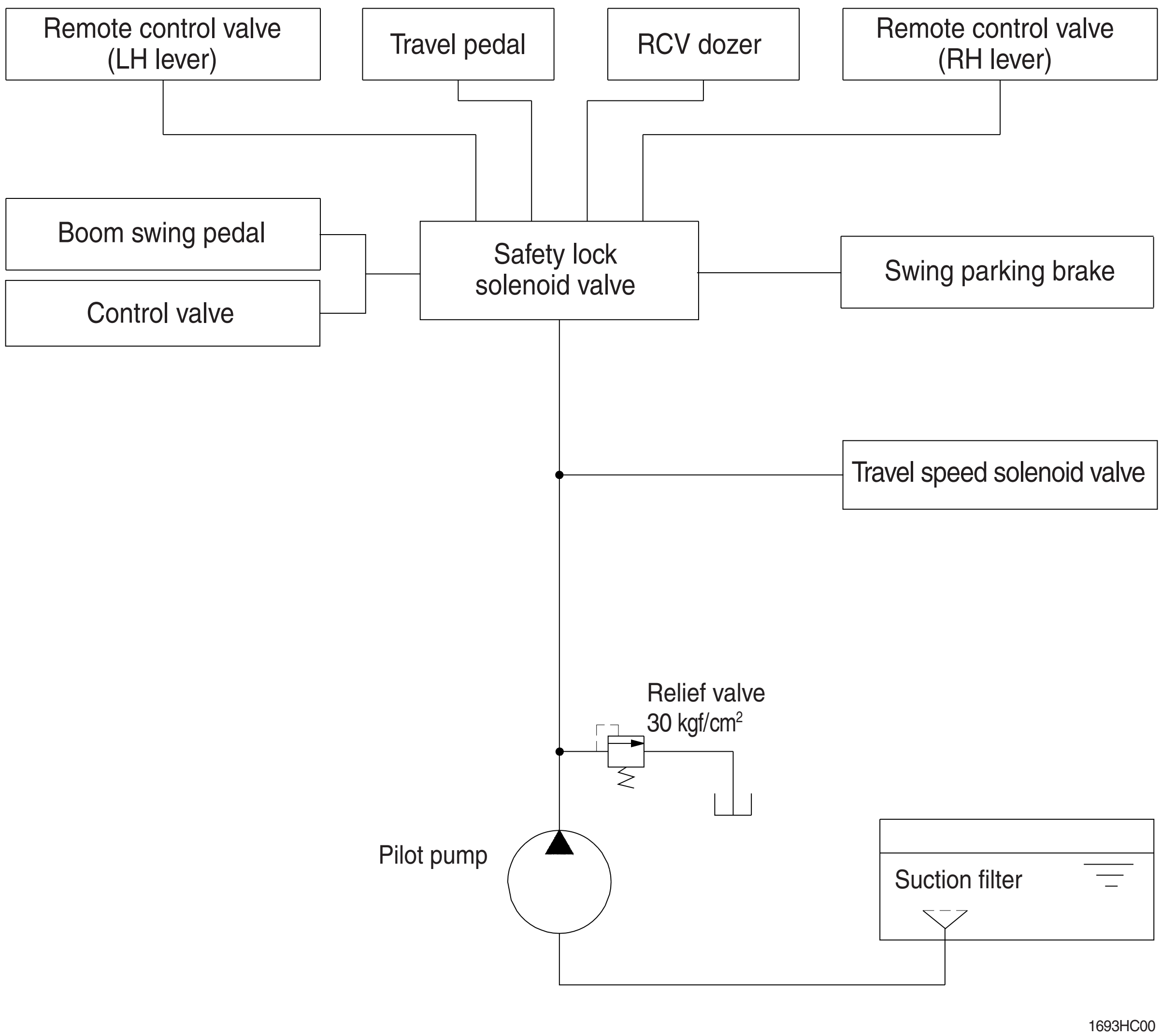
1) TRAVEL MOTOR DRAIN CIRCUIT

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 a return filter with oil drained from the travel circuit .

GROUP 3 PILOT CIRCUIT

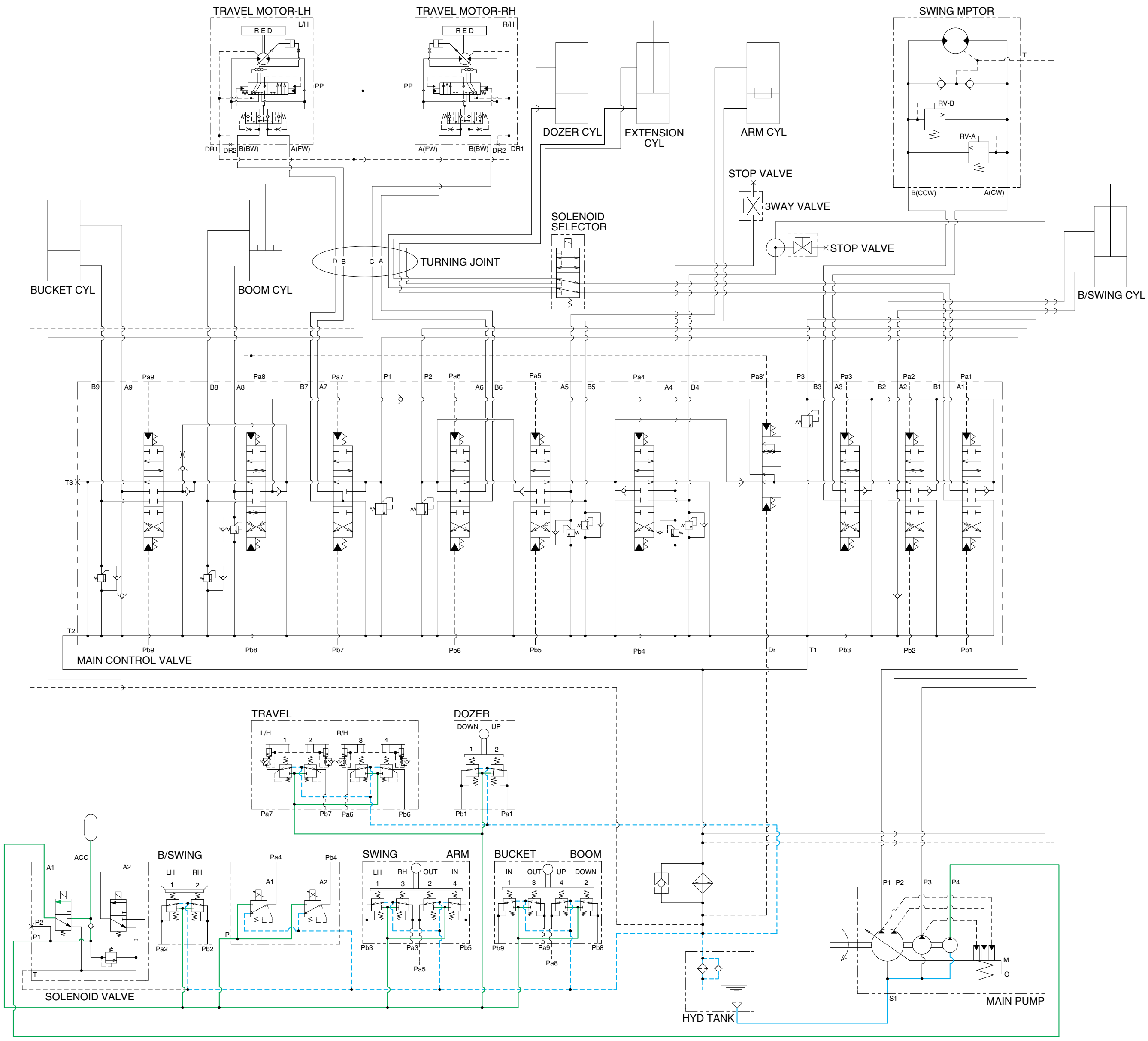


The pilot circuit consists of suction circuit, delivery circuit and return circuit.

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

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

1. SUCTION, DELIVERY AND RETURN CIRCUIT



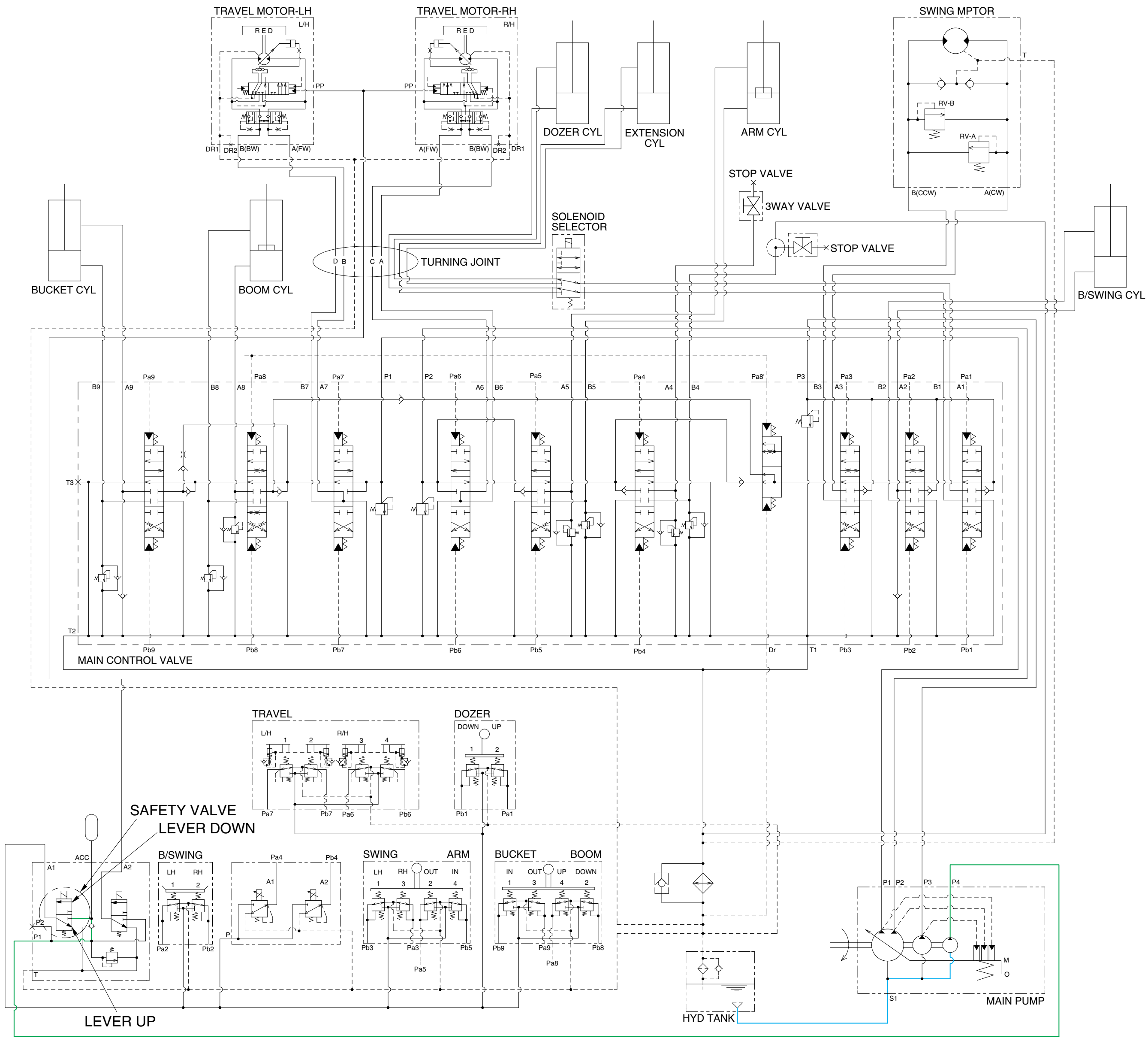
17Z9A3HC03

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

The oil filtered by line filter flows remote control valve, MCV and swing port through safety solenoid valve.

The return oil flow into the hydraulic tank.

2. SAFETY VALVE (SAFETY LEVER)

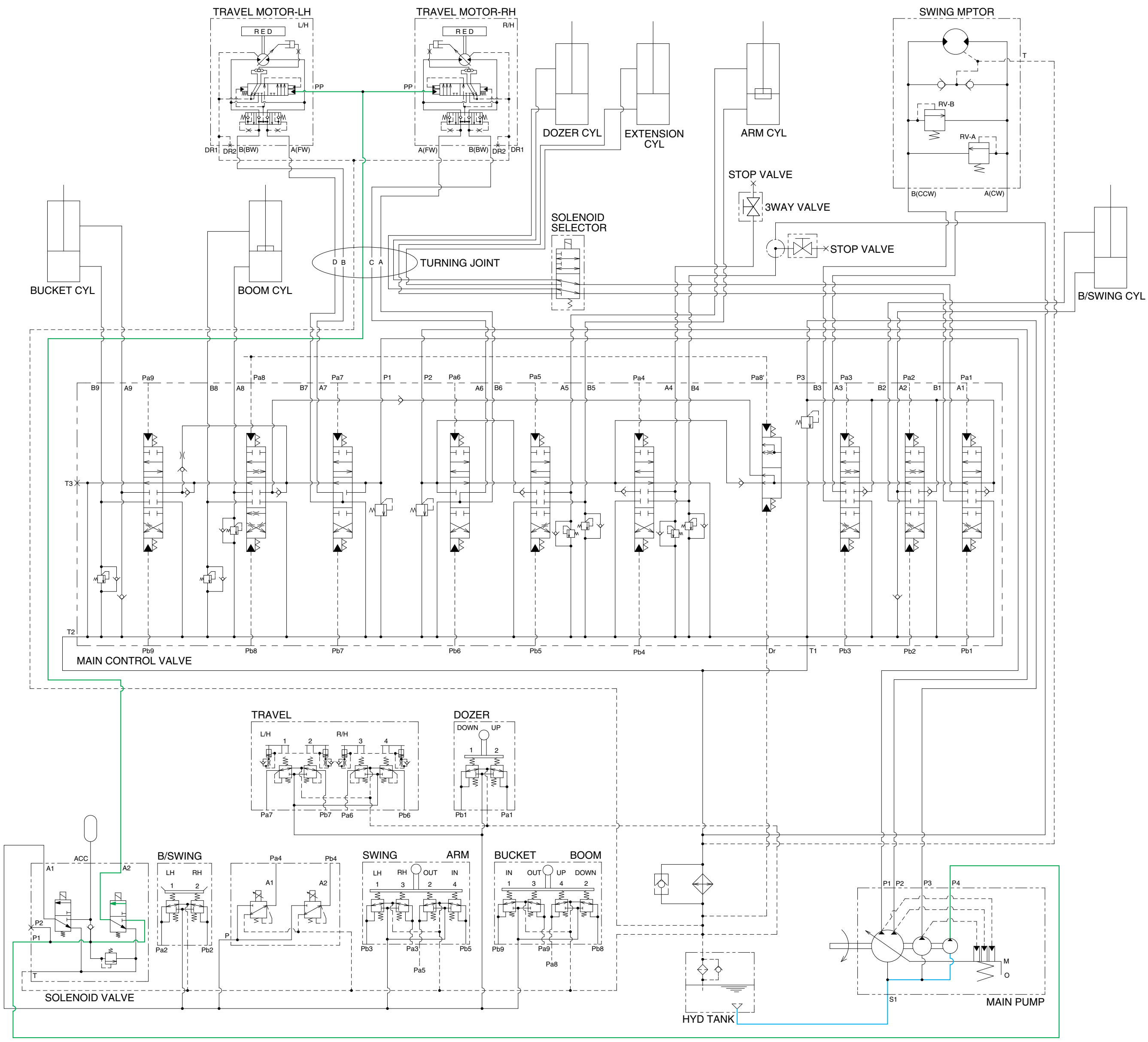


17Z9A3HC04

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

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.

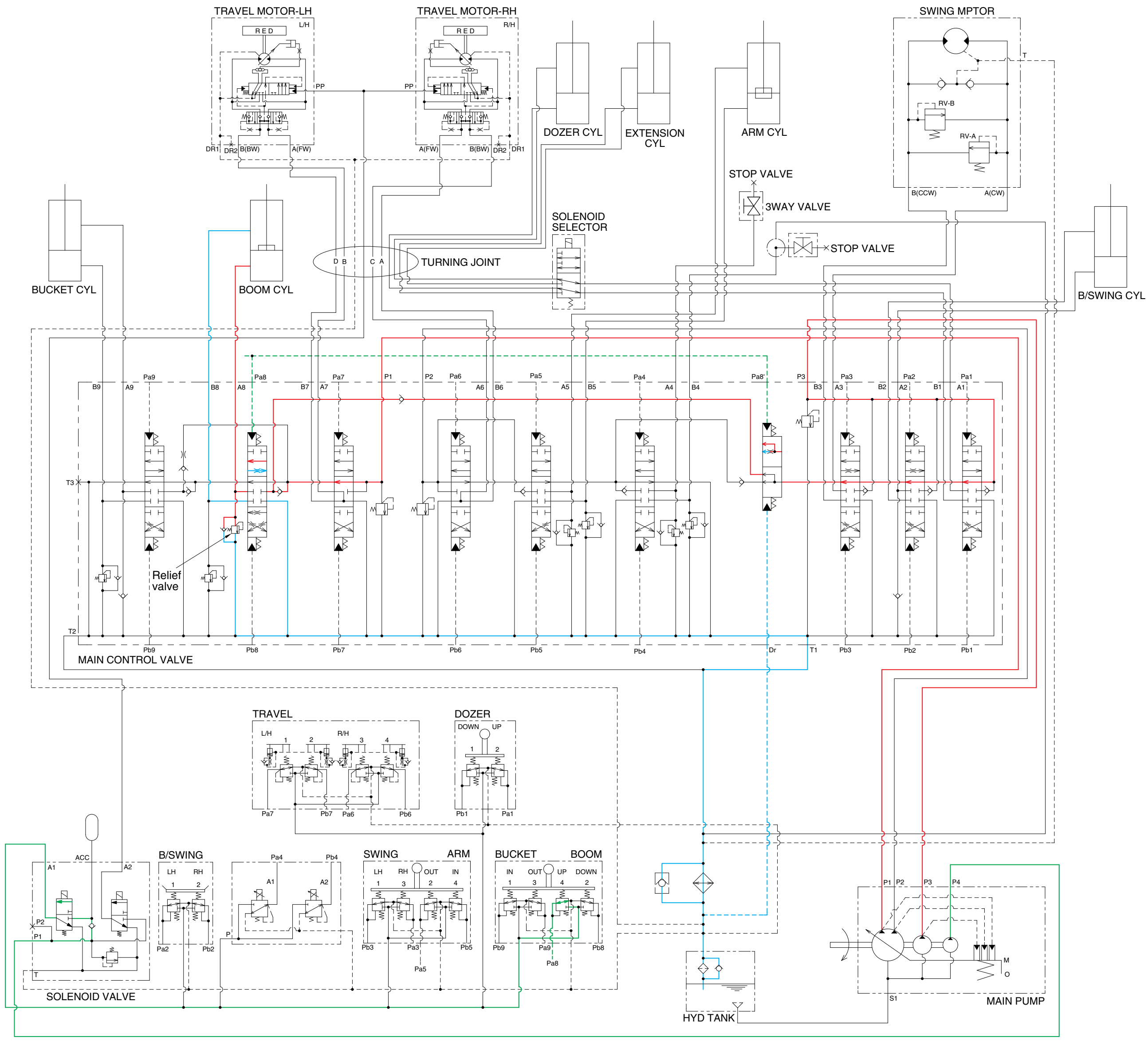
3. TRAVEL SPEED CONTROL SYSTEM



17Z9A3HC05

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 PP 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 PP port returns to the hydraulic tank.
As a result, the control piston is returned by the main oil flow, thus the displacement is maximized.

1. BOOM UP OPERATION

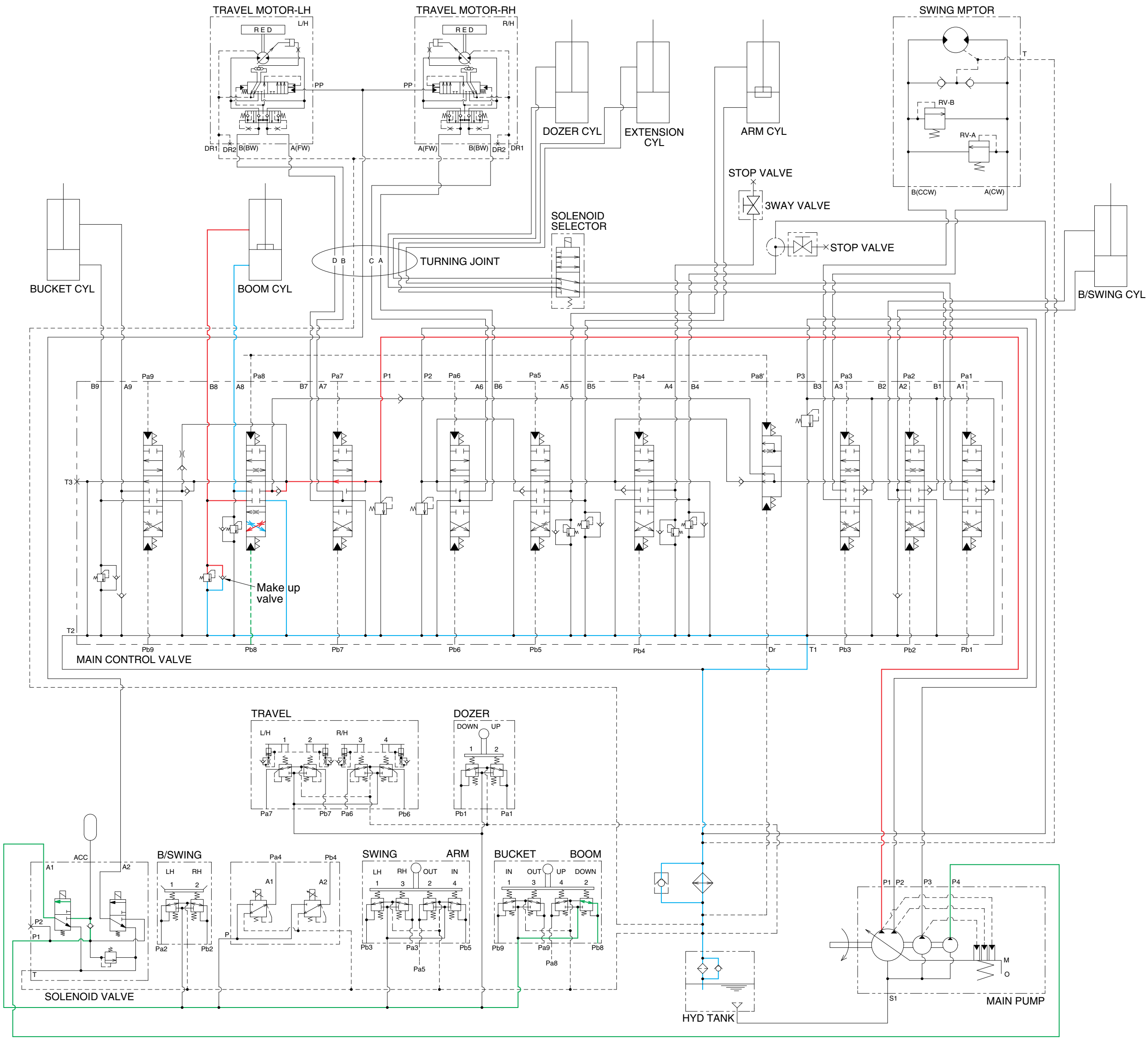


17Z9A3HC10

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 P1 and P3 pump flows into the main control valve and then goes to the large chamber of boom cylinders. At the same time, the oil from the small chamber of boom cylinders returns to the hydraulic oil tank through the boom spool in the main control valve. When this happens, the boom goes up. The excessive pressure in the boom cylinder bottom end circuit is prevented by relief valve.

2. BOOM DOWN OPERATION



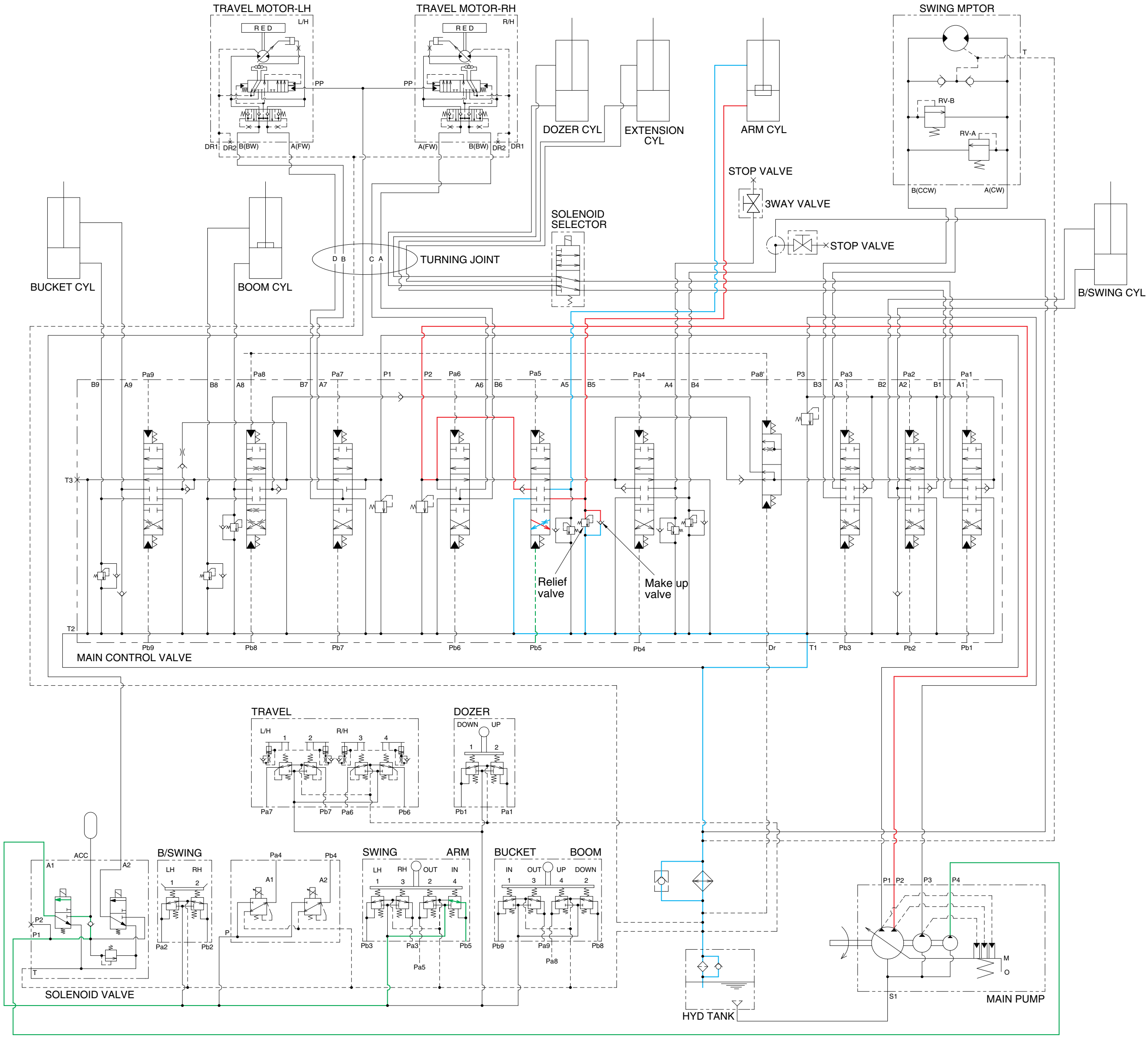
17Z9A3HC11

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

The oil from the P1 pump flows into the main control valve and then goes to the small chamber of boom cylinders. At the same time, the oil from the large chamber of boom cylinders returns to the hydraulic tank through the boom spool in the main control valve.

The cavitation in the boom cylinder rod end circuit is prevented by the make-up valve.

3. ARM ROLL IN OPERATION



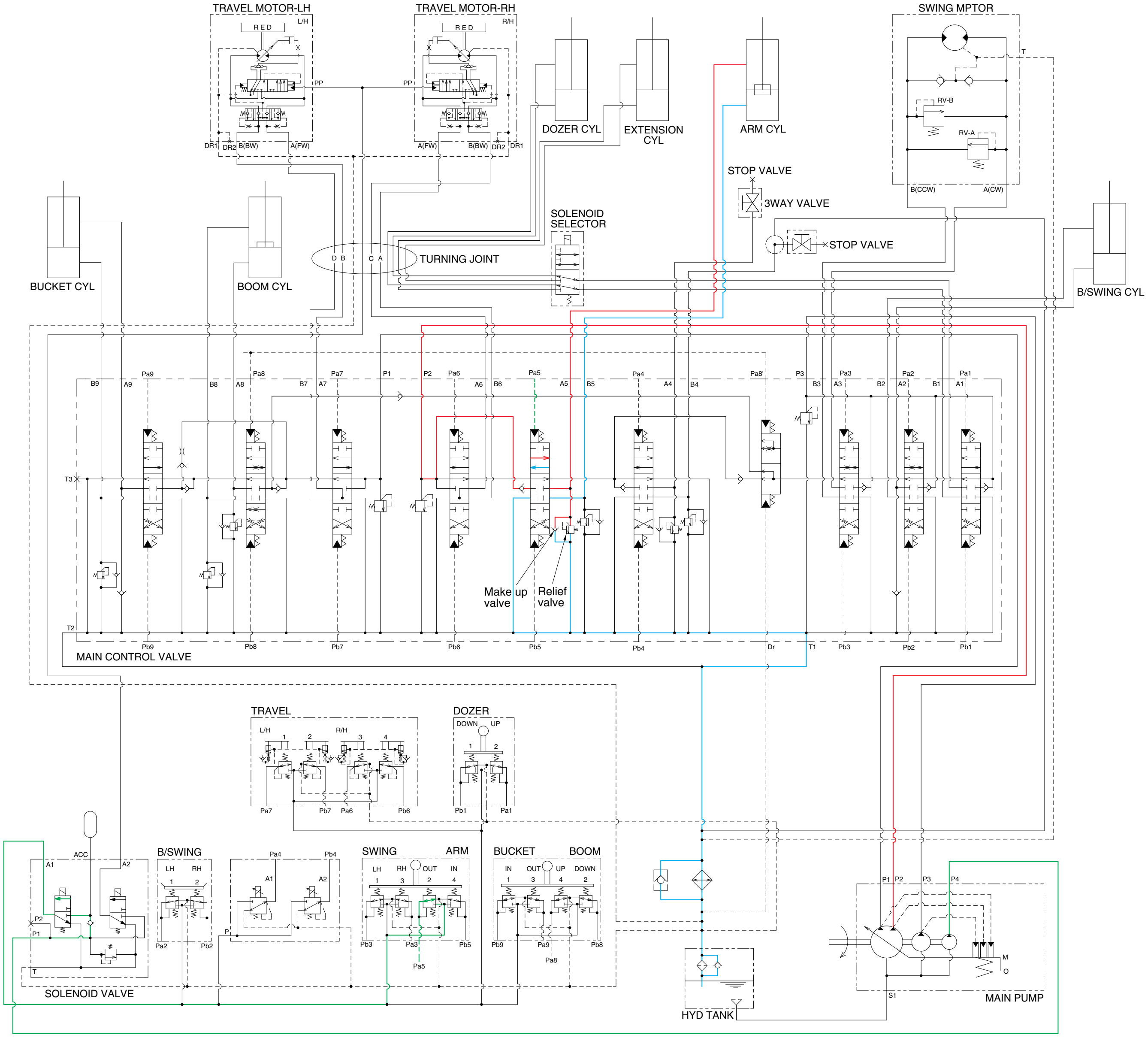
When the left control lever is pulled back, the arm spools in the main control valve are moved the to roll in position by the pilot oil pressure from the remote control valve.

The oil from the P2 pump flows into the main control valve and then goes to the large chamber of arm cylinder.

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

The cavitation and excessive pressure in the bottom of the arm cylinder is also prevented by the make-up valve and the relief valve in the main control valve.

4. ARM ROLL OUT OPERATION



17Z9A3HC13

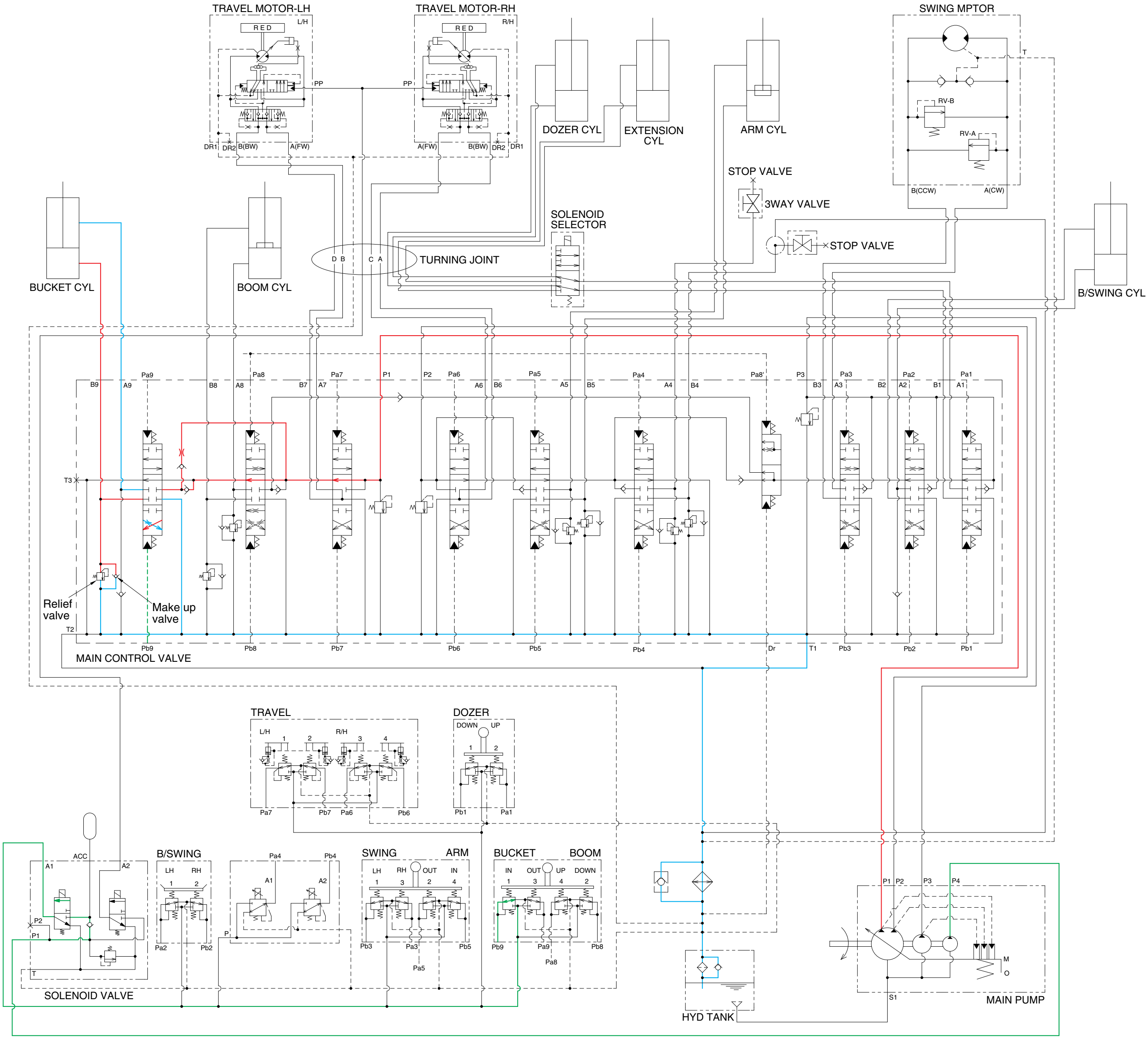
When the left control lever is pushed forward, the arm spool in the main control valve are moved to the roll out position by the pilot oil pressure from the remote control valve.

The oil from the P2 pump flows into the main control valve and then goes to the small chamber of arm cylinder.

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

The cavitation and excessive pressure in the rod of the arm cylinder is also prevented by the make-up valve and relief valve in the main control valve.

5. BUCKET ROLL IN OPERATION



17Z9A3HC14

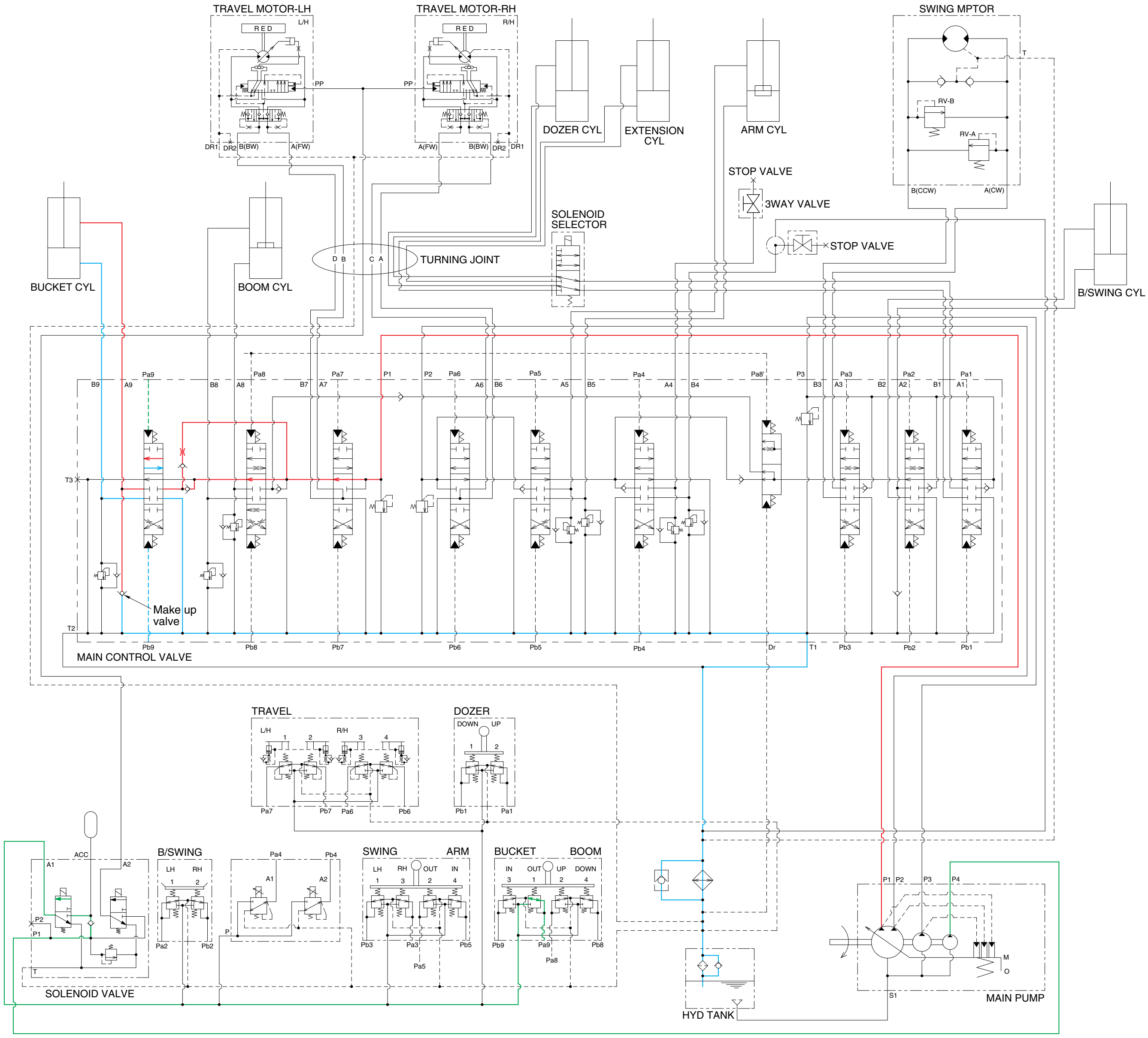
When the right control lever is pulled left, the bucket spool in the main control valve is moved to the roll in position by the pilot oil pressure from the remote control valve.

The oil from the P1 pump flows into the main control valve and then goes to the large chamber of bucket cylinder.

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

The cavitation and excessive pressure in the bottom of the bucket cylinder is also prevented by the make-up valve and relief valve in the main control valve.

6. BUCKET ROLL OUT OPERATION



17Z9A3HC15

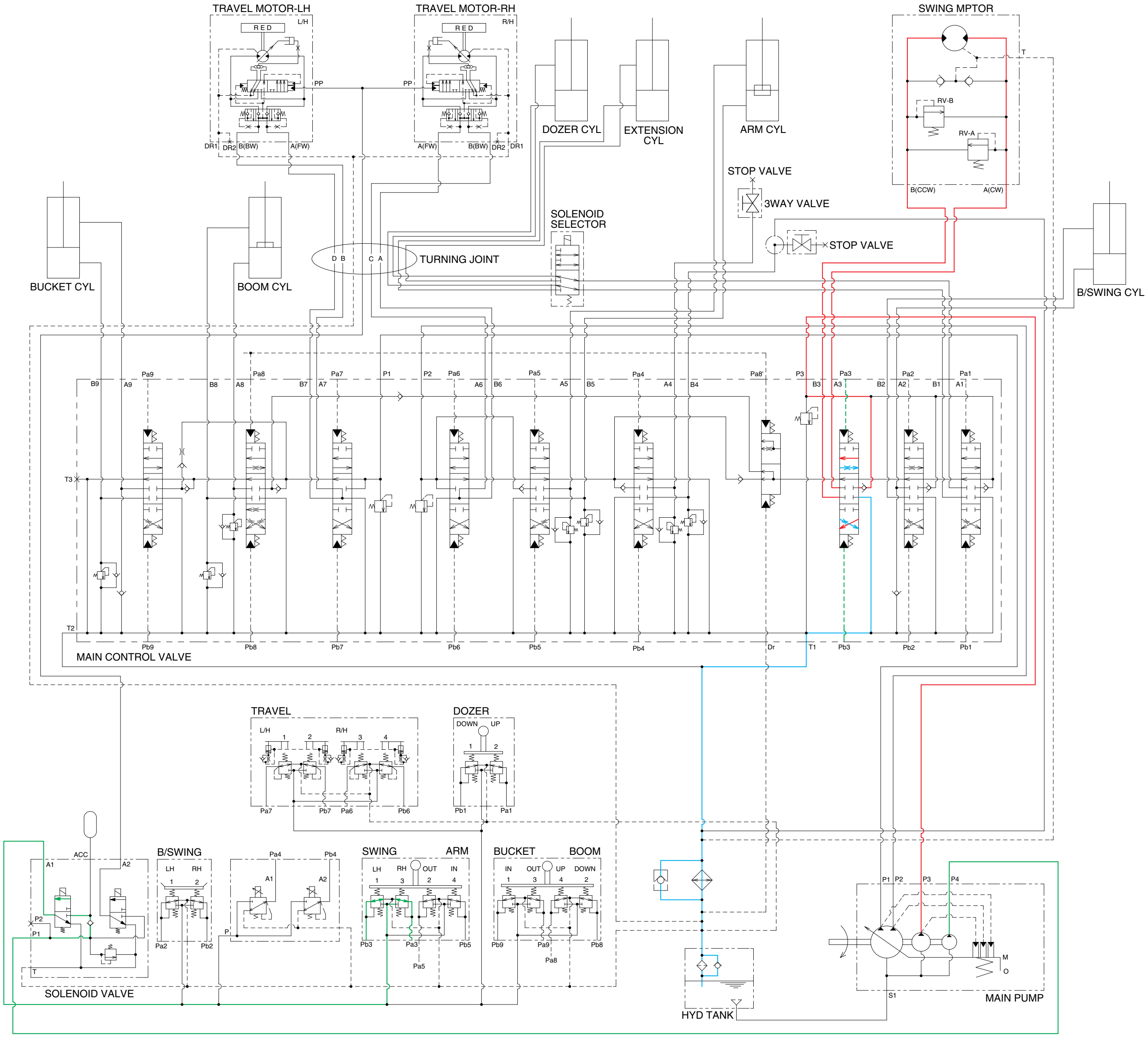
When the right control lever is pushed right, the bucket spool in the main control valve is moved to the roll out position by the pilot oil pressure from the remote control valve.

The oil from the P1 pump flows into the main control valve and then goes to the small chamber of bucket cylinder.

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

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

7. SWING OPERATION



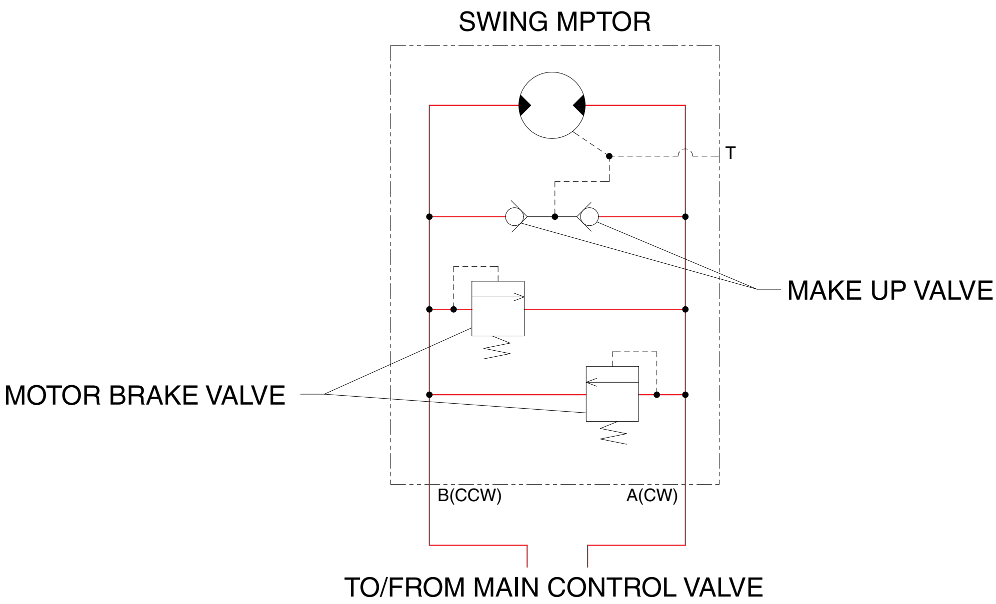
17Z9A3HC16

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

The oil from the P3 pump flows into the main control valve and then goes to the swing motor.

At the same time, the return oil from the swing motor returns to the hydraulic oil tank through the swing spool in the main control valve. When this happens, the superstructure swings to the left or right. The make up valve and the overload relief valve are provided in the swing motors. The cavitation which will happen to the swing motor is also prevented by the make up valve in the swing motor itself.

SWING CIRCUIT OPERATION



17Z9A3HC20

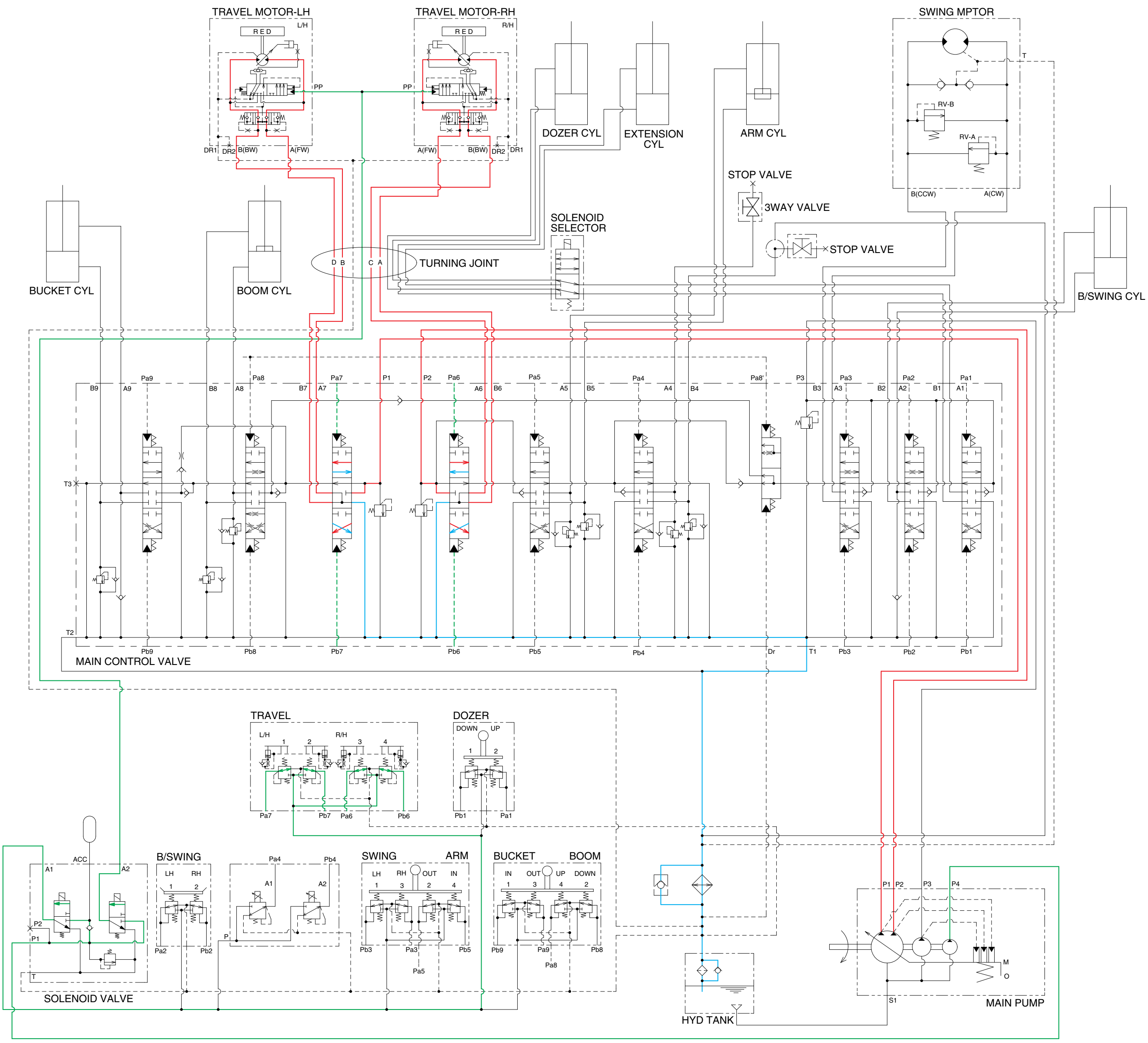
1) MOTOR BRAKE VALVE

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

2) MAKE UP VALVE

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

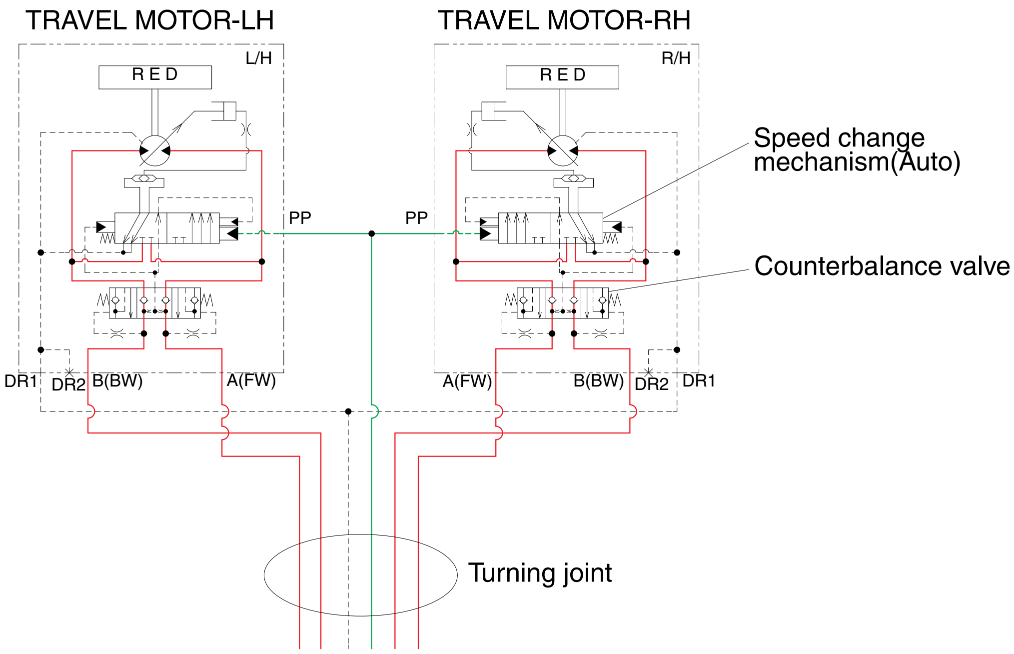
8. TRAVEL FORWARD AND REVERSE OPERATION



17Z9A3HC17

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 pilot pressure oil. The oil from the both pumps flows into the main control valve and then goes to the both travel motors through the turning joint. The return oil from both travel motors returns to the hydraulic oil tank through the turning joint and the travel spools in the main control valve. When this happens, the machine moves to the forward or reverse.

TRAVEL CIRCUIT OPERATION



17Z9A3HC21

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

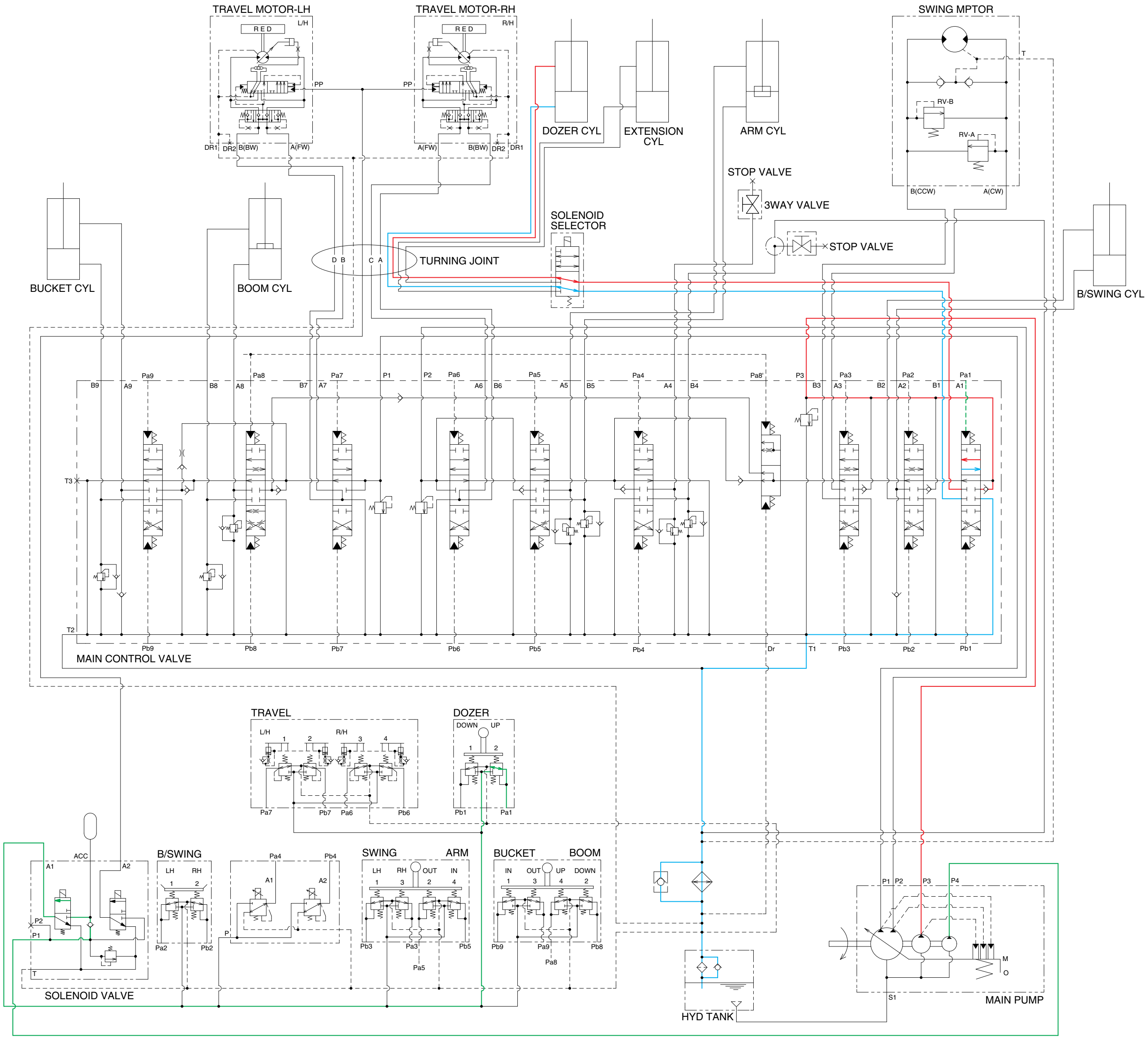
1) COUNTERBALANCE VALVE

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

2) SPEED CHANGE MECHANISM (auto)

Auto two speed control mechanism consists of two spools and spring. This valve automatically changes motor displacement in portion to motor pressure.

9. DOZER UP OPERATION



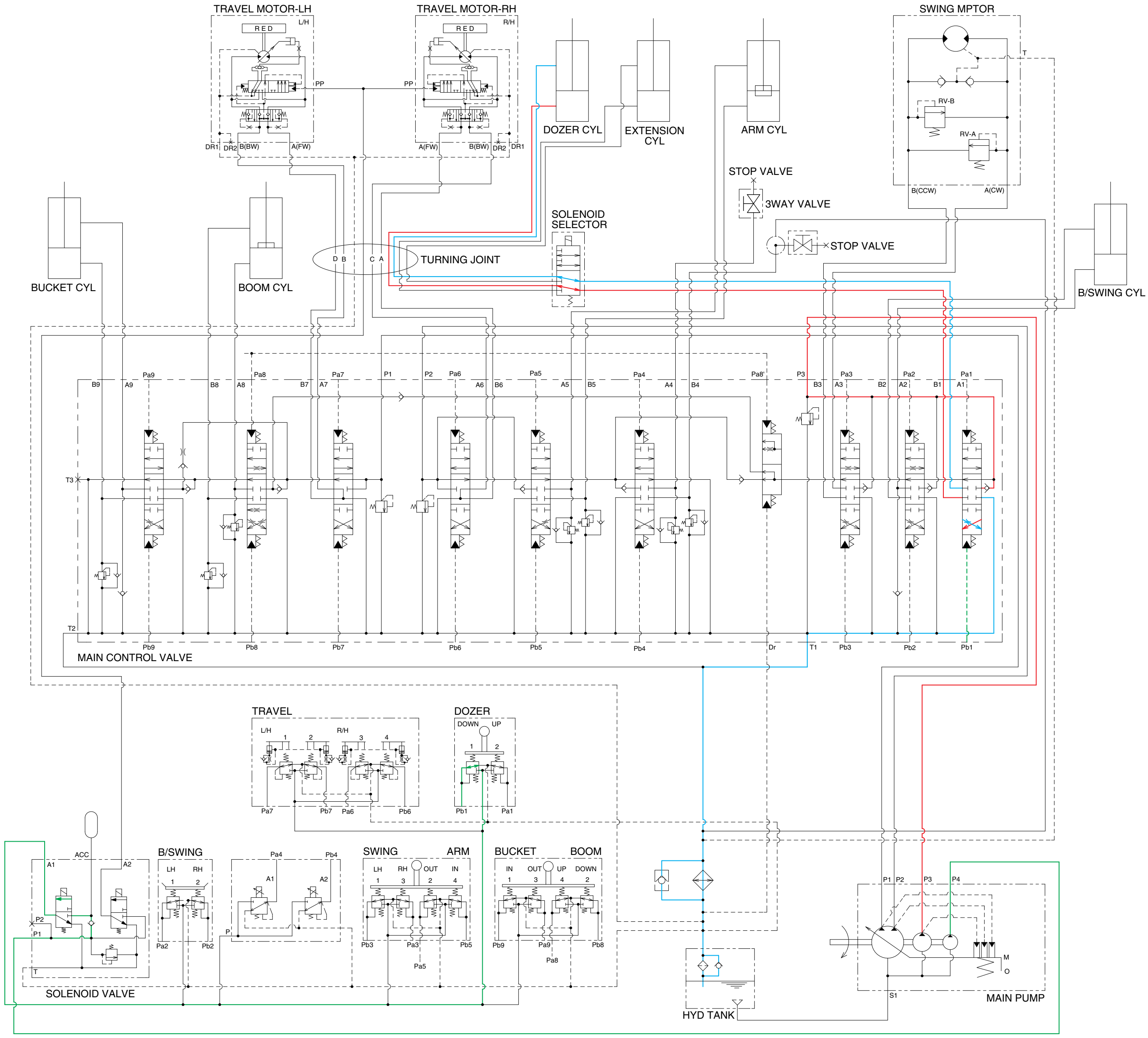
17Z9A3HC18

When the dozer control lever is pulled back, the dozer spool in the main control valve is moved to the dozer up position by the pilot oil pressure from the remote control valve.

The oil from the P3 pump flows into the main control valve and then goes to the small chamber of dozer cylinders.

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

10. DOZER DOWN OPERATION



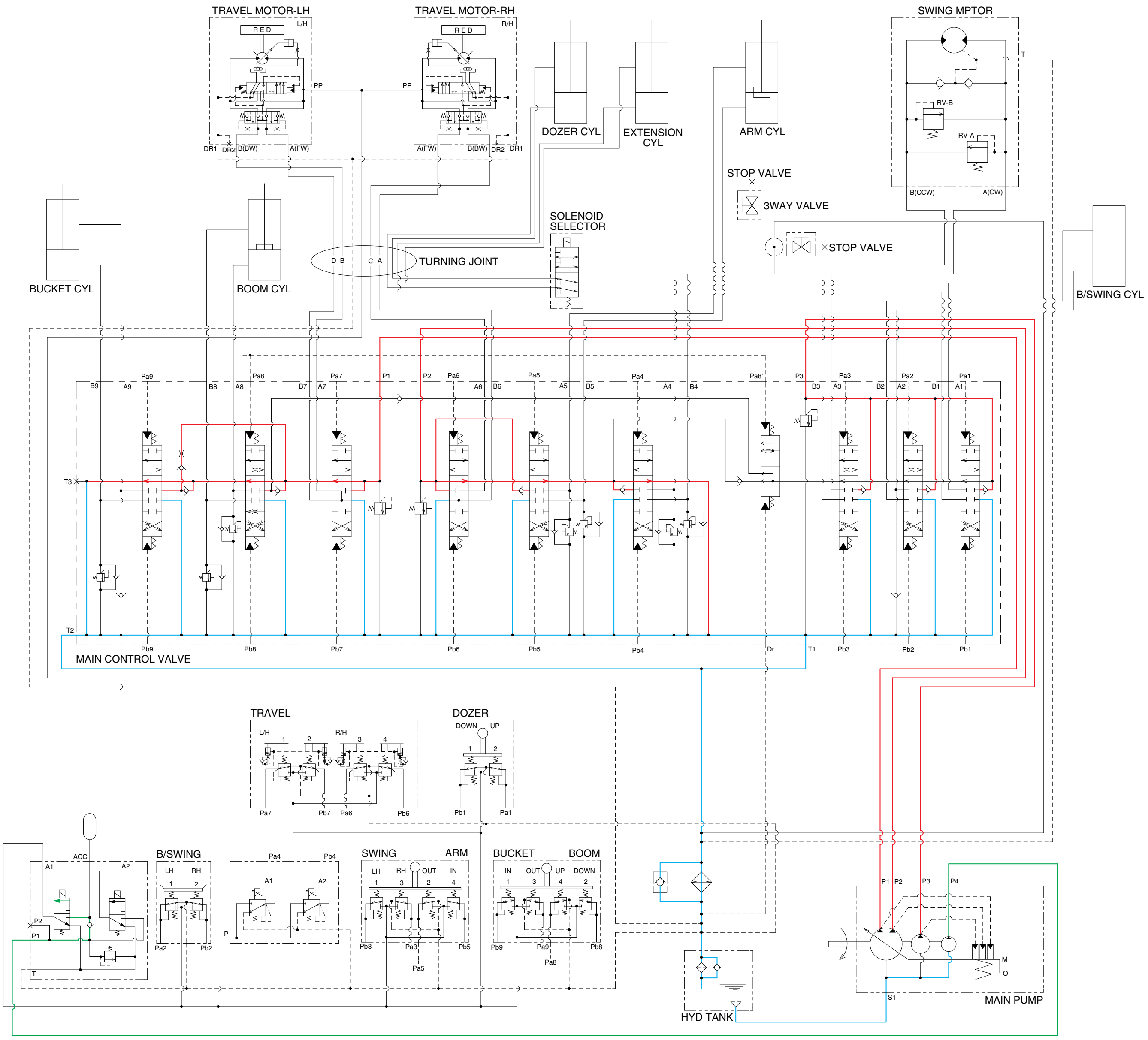
17Z9A3HC19

When the dozer control lever is pushed forward, the dozer spool in the main control valve is moved to the dozer down position by the pilot oil pressure from the remote control valve.

The oil from the P3 pump flows into the main control valve and then goes to the large chamber of dozer cylinders.

At the same time, the oil from the small chamber of dozer cylinders returns to the hydraulic oil tank through the dozer spool in the main control valve. When this happens, the dozer blade is down.

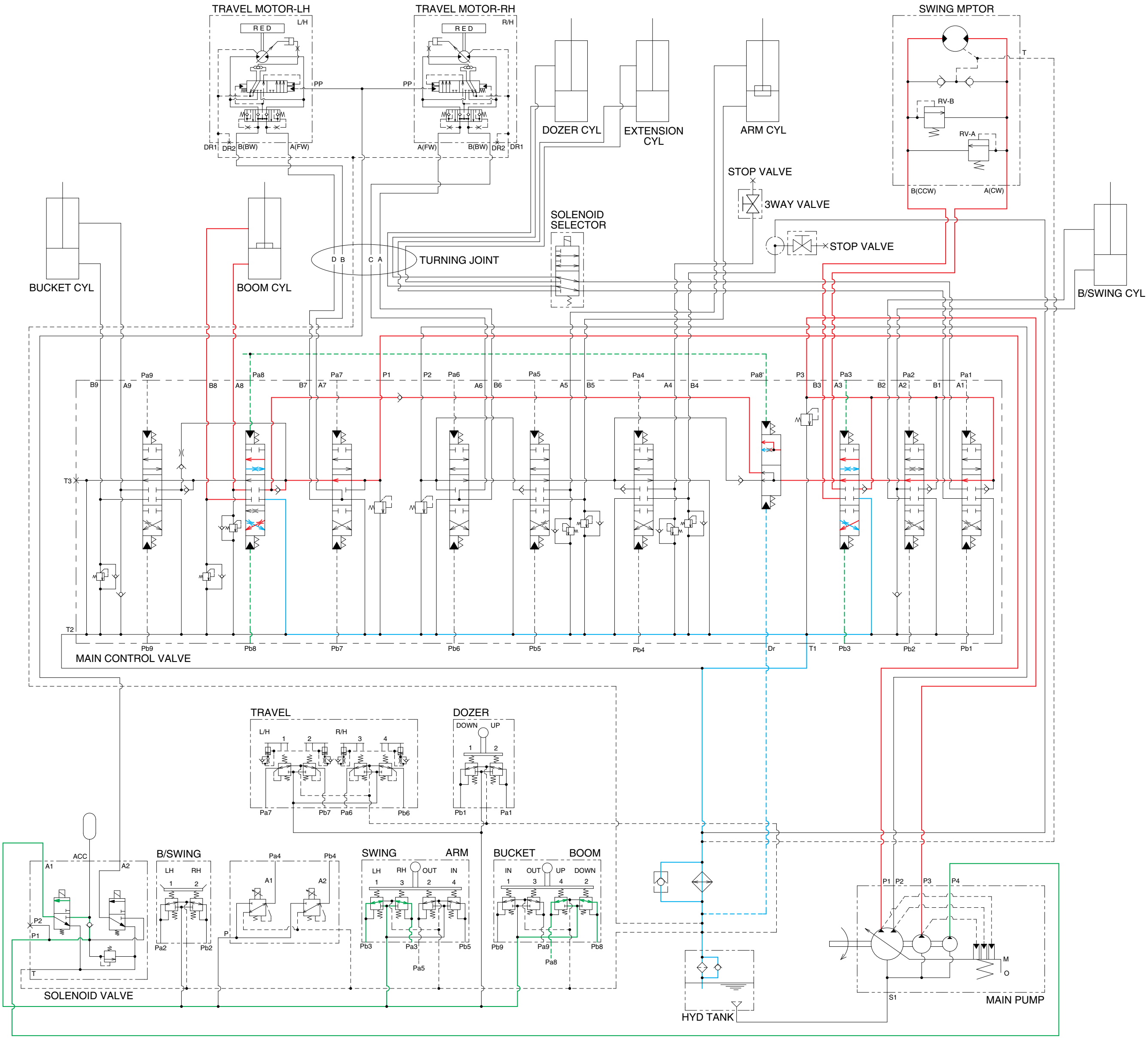
1. OUTLINE



17Z9A3HC30

The oil from the P1, P2, P3 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.

2. COMBINED SWING AND BOOM OPERATION



17Z9A3HC31

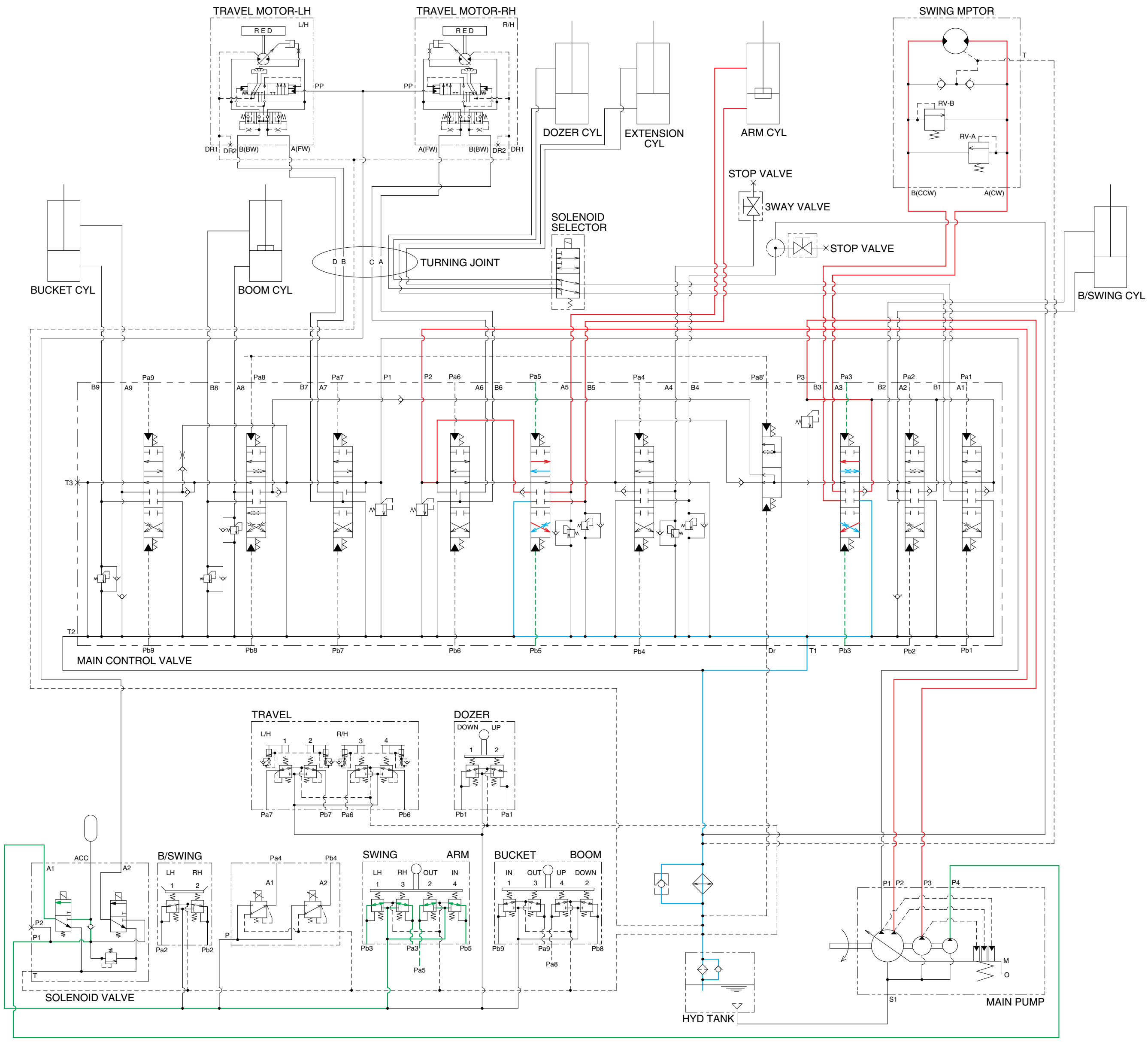
When the swing and boom functions are operated, simultaneously the selector spool, swing spool and boom spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the P1 pump and solenoid from the P3 pump flows into the boom cylinder through boom.

The oil from the P3 pump flows into the swing motor through the swing spool.

The superstructure swings and the boom is operated.

3. COMBINED SWING AND ARM OPERATION



17Z9A3HC32

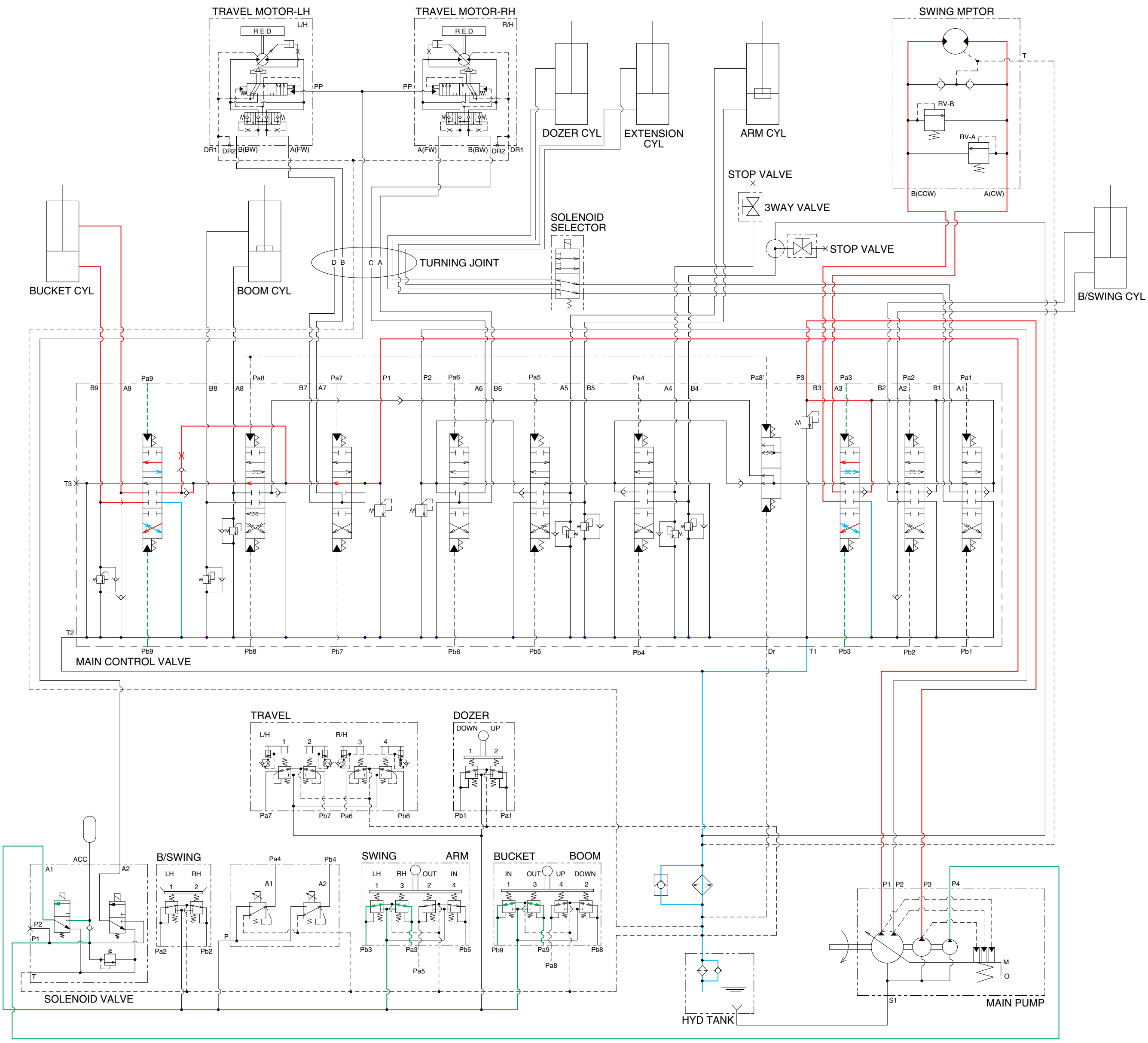
When the swing and arm functions are operated, simultaneously the swing spool and arm spools in the main control valve are moved to the functional position by the pilot oil pressure from the remote control valve.

The oil from the P3 pump flows into the swing motor through swing spool.

The oil from the P2 pump flows into the arm cylinder through the arm.

The superstructure swings and the arm is operated.

4. COMBINED SWING AND BUCKET OPERATION



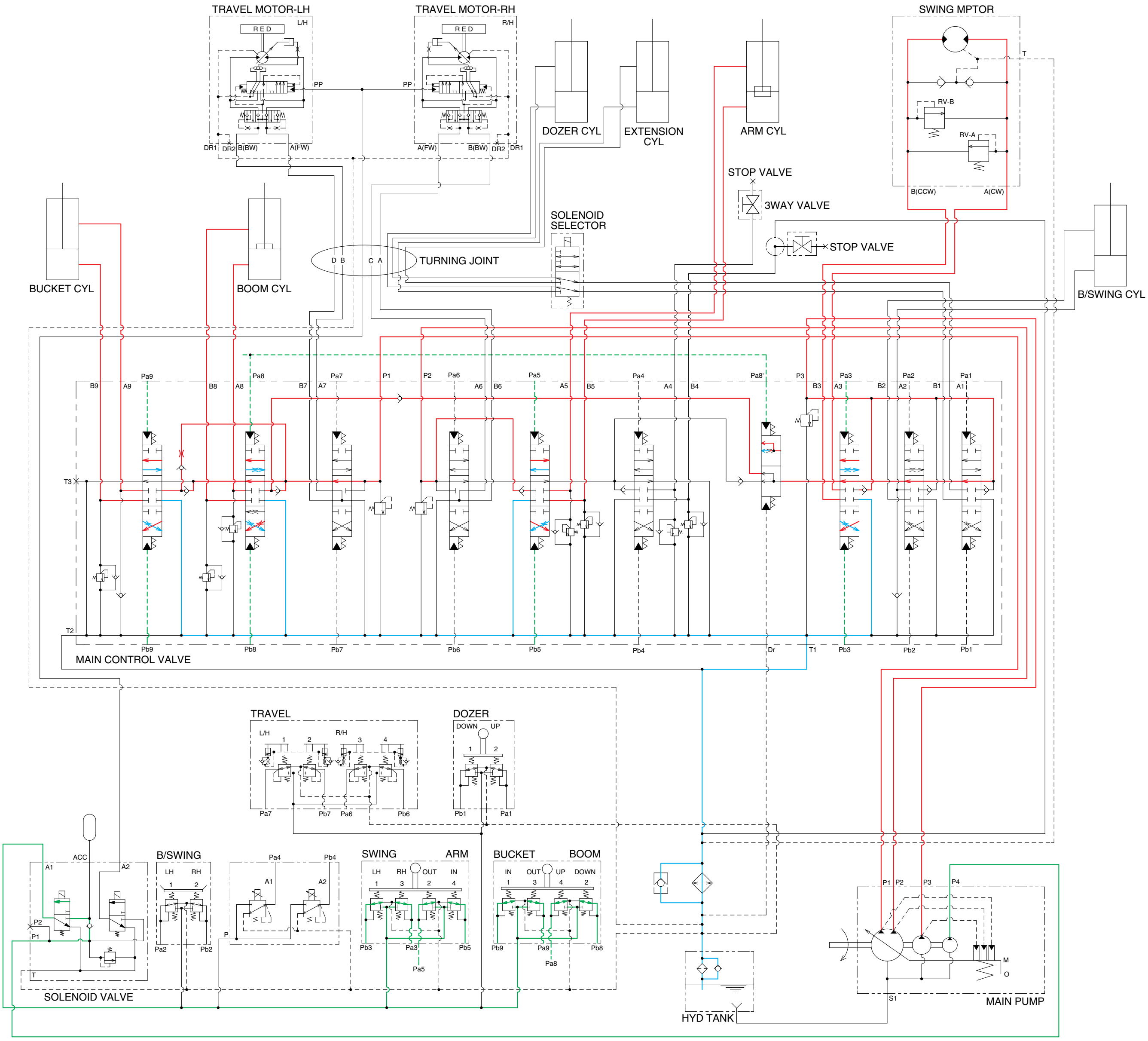
17Z9A3HC33

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 P3 pump flows into the swing motor through the swing spool.

The oil from the P1 pump flows into the bucket cylinder through the bucket spool.

5. COMBINED SWING, BOOM, ARM AND BUCKET OPERATION



17Z9A3HC34

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

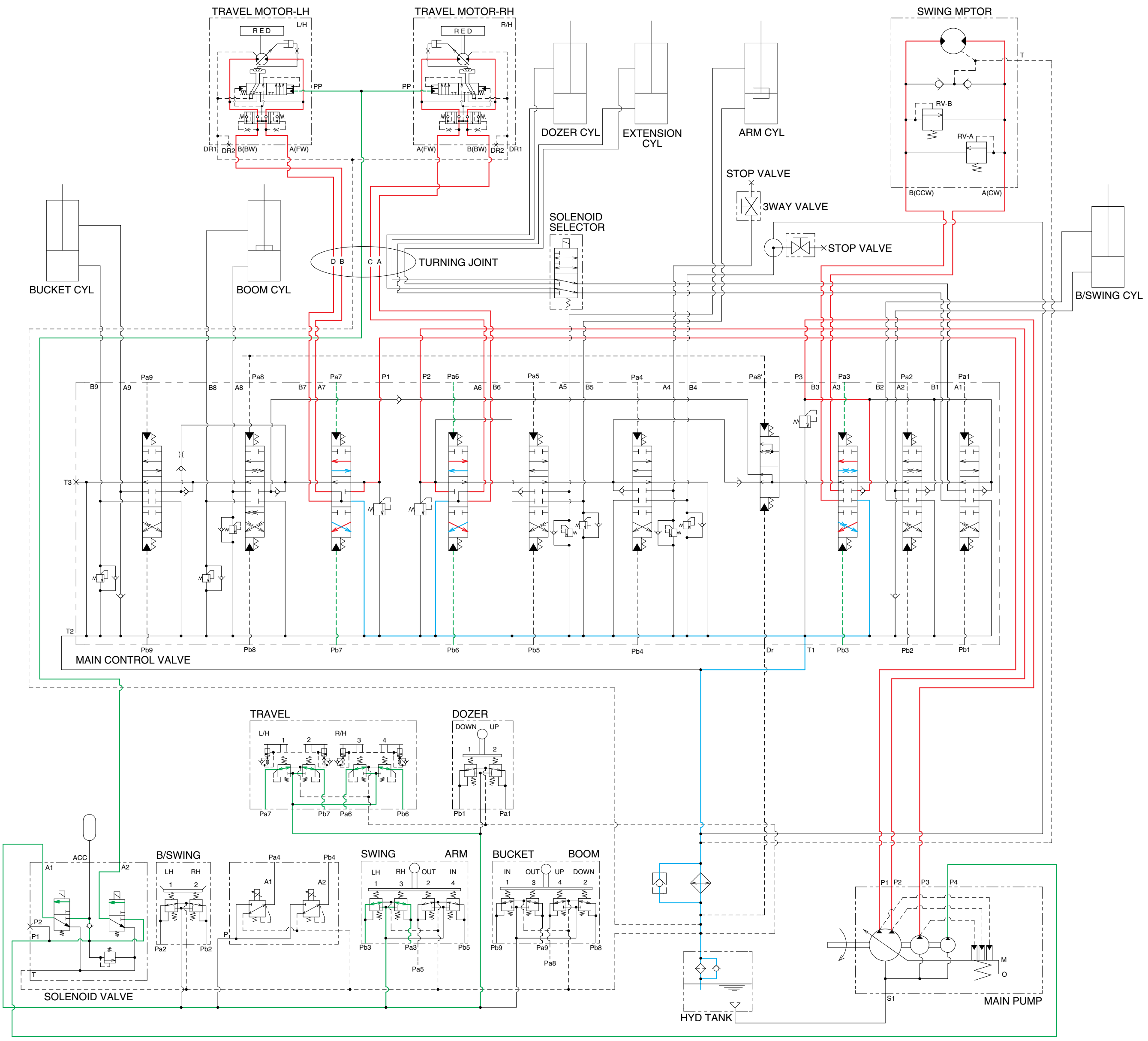
The oil from the P2 pump flows into the arm cylinder through, arm spool.

The oil from the P1 pump flows into the boom cylinders and bucket cylinder through the boom spool, bucket spool.

The oil from the P3 pump flows into the swing motor through the swing spool.

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

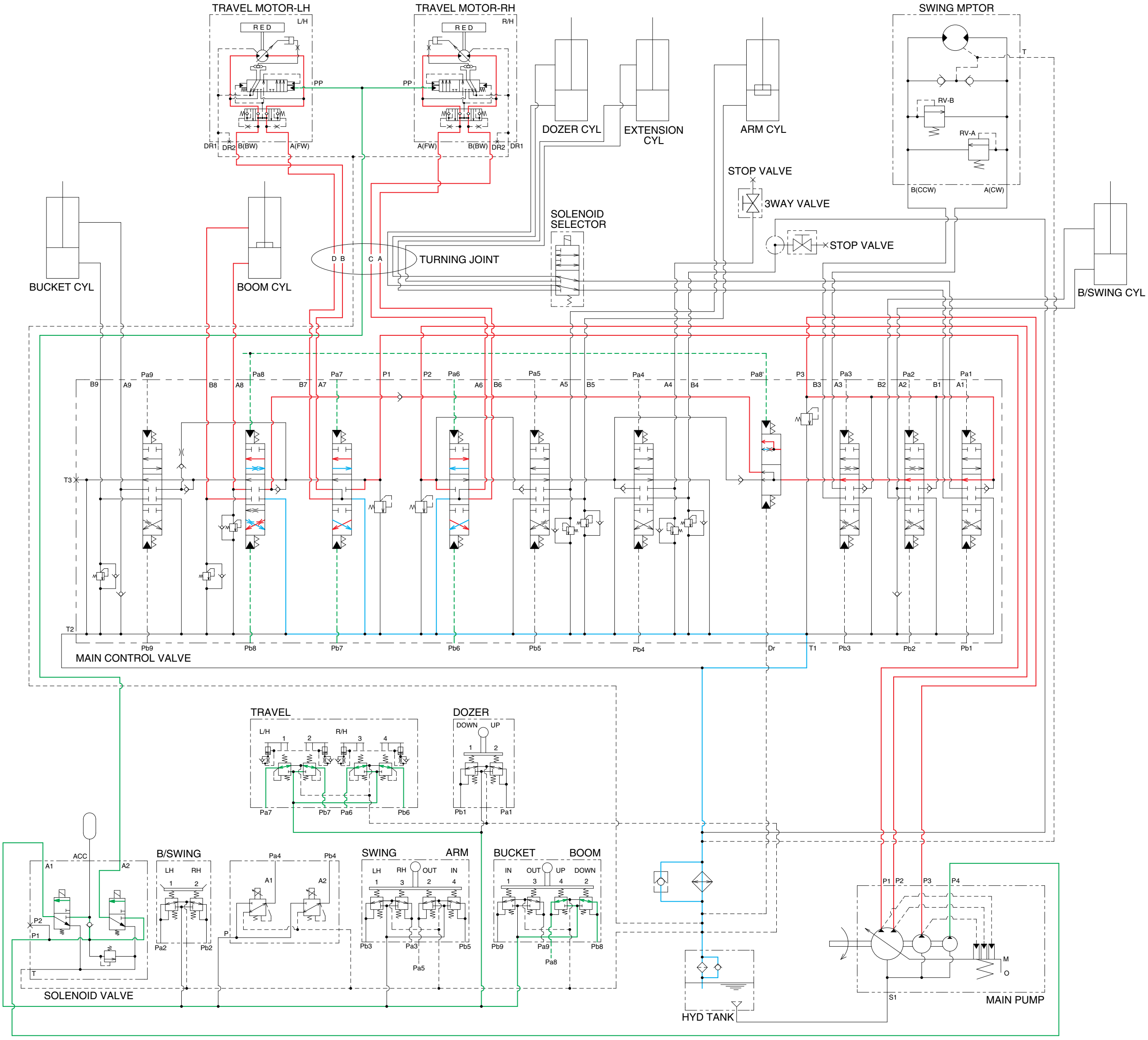
6. COMBINED SWING AND TRAVEL OPERATION



17Z9A3HC35

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 the travel levers.
The oil from the P3 pump flows into the swing motor through the swing spool.
The oil from the P1 pump flows into the travel motor through the LH travel spool.
The oil from the P2 pump flows into the travel motor through the RH travel spool.
The superstructure swings and the machine travels straight.

7. COMBINED BOOM AND TRAVEL OPERATION



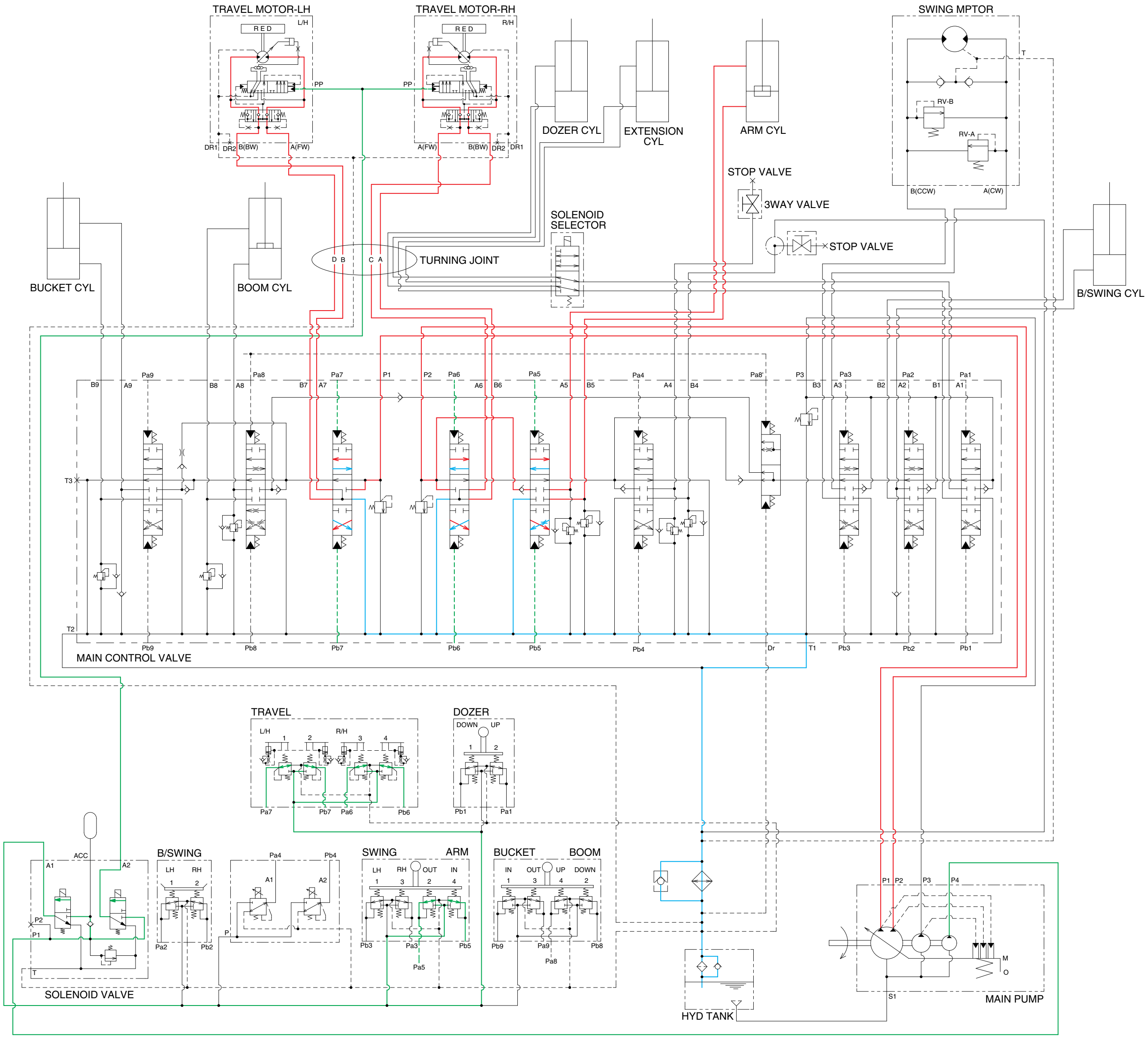
17Z9A3HC36

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.

The oil from the P1 and P2 pumps flows into the travel motors through travel LH and travel RH spools.

The oil from the P3 pump flows into the boom cylinders through boom spool via the travel selector spool. The boom is operated and the machine travels straight.

8. COMBINED ARM AND TRAVEL OPERATION



17Z9A3HC37

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.

The oil from the P1 and P2 pumps flows into the travel motors through travel spools.

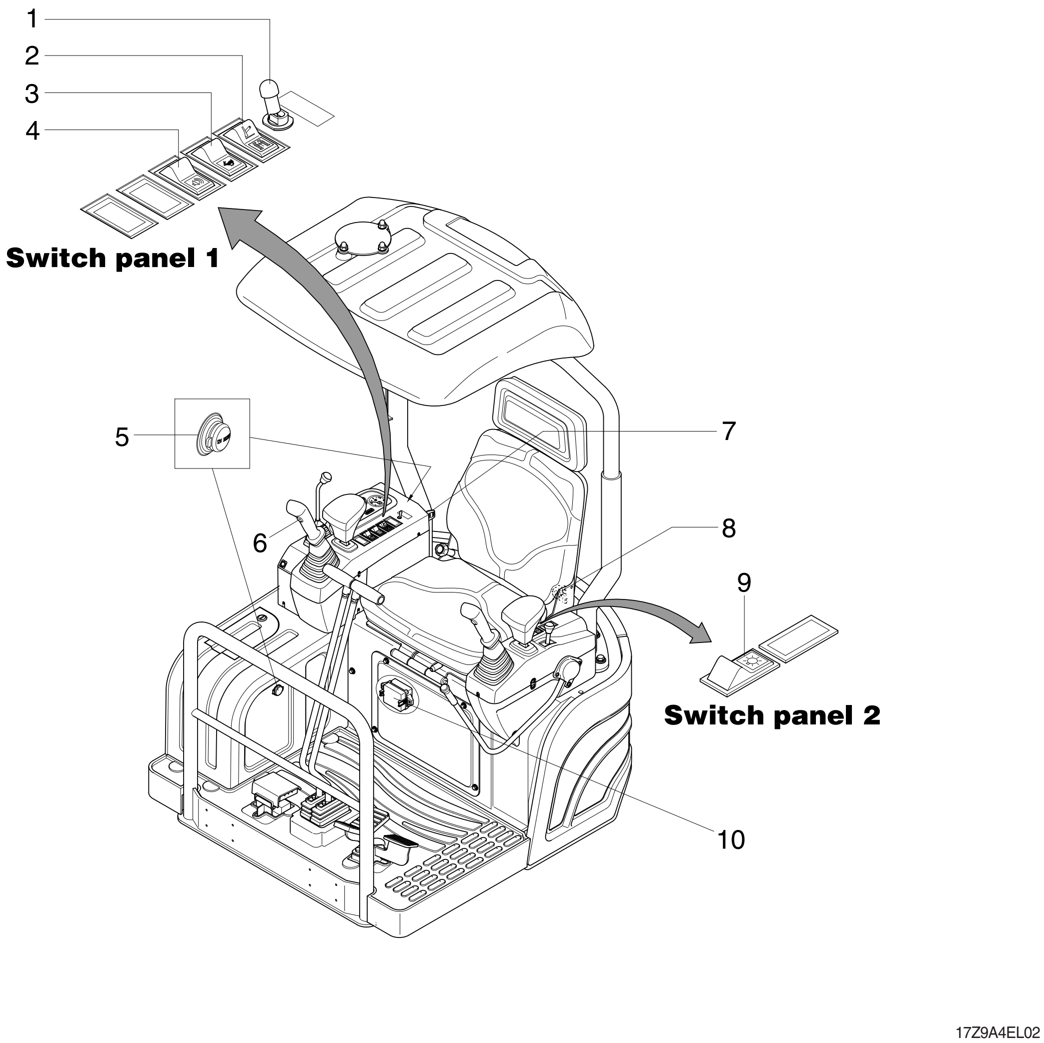
The oil from the P2 pump flows into the arm cylinder through arm spool via the travel selector spool.

The arm is operated and the machine travels.

SECTION 4 ELECTRICAL SYSTEM

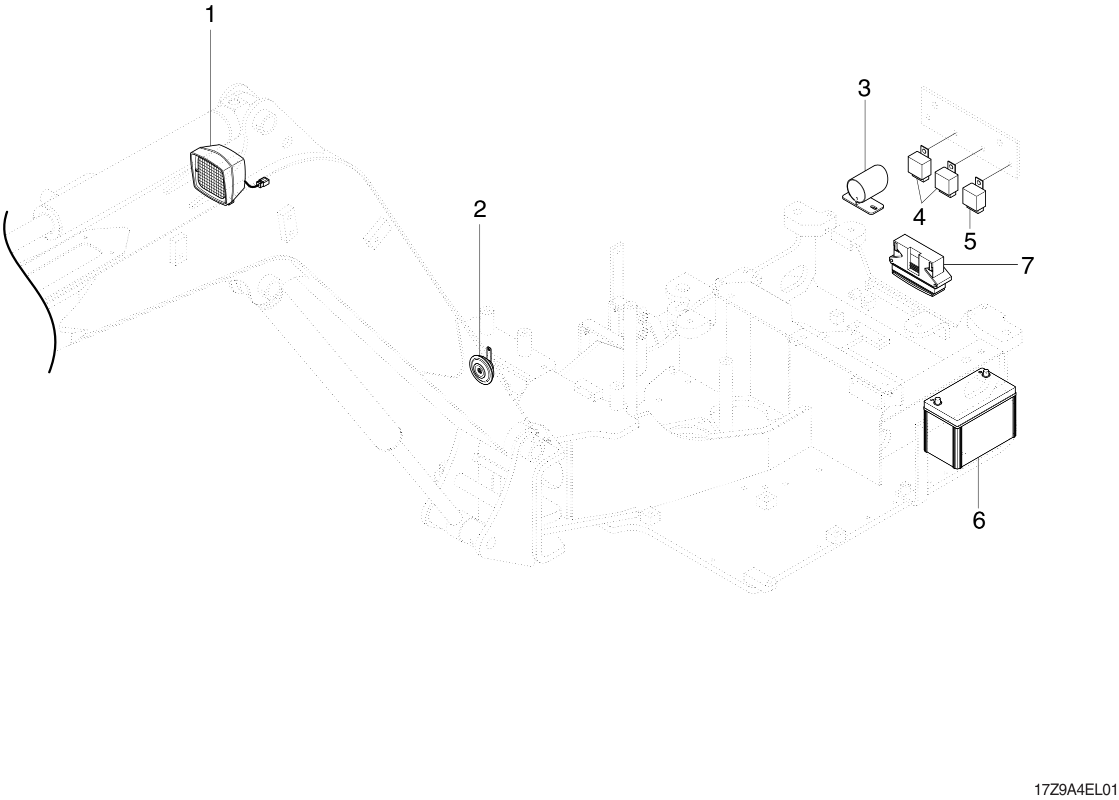
GROUP 1 COMPONENT LOCATION

1. LOCATION 1



1	Quick clamp toggle switch	6	Horn switch
2	Select switch	7	Start switch
3	Travel speed control switch	8	Emergency engine stop switch
4	Travel alarm switch	9	Main light switch
5	12V socket	10	Fuse box

2. LOCATION 2



1	Work lamp	4	Power relay	7	Controller
2	Horn	5	Relay		
3	Travel alarm buzzer	6	Battery		

GROUP 2 MONITORING SYSTEM

1. OUTLINE

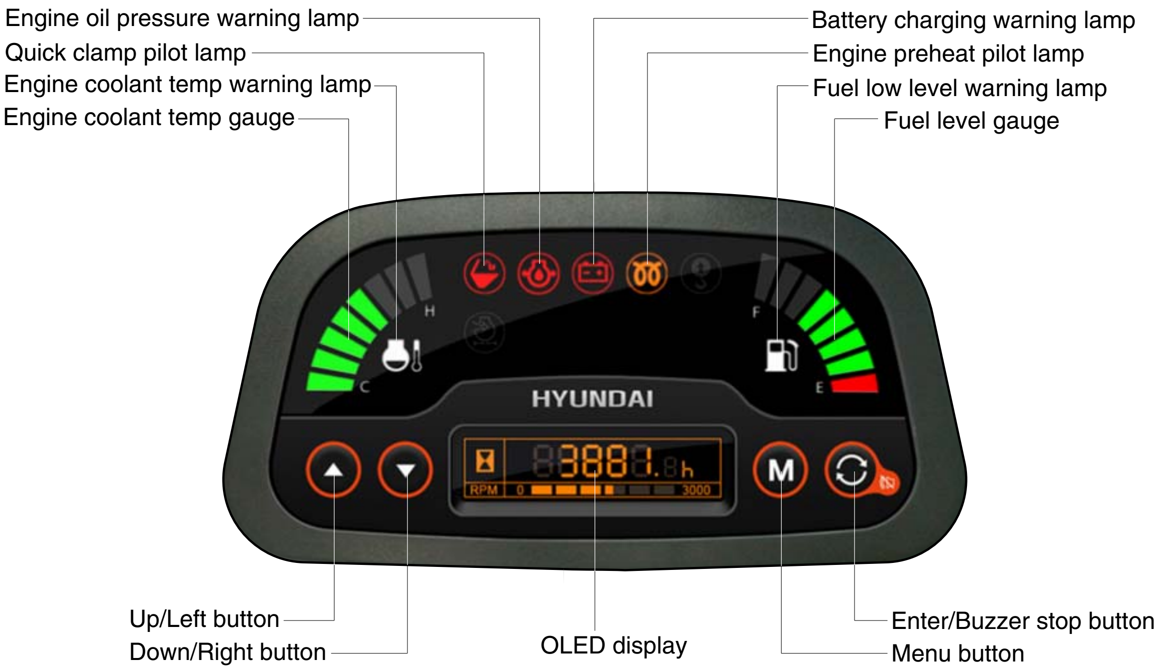
Monitoring system consists of the monitor part and switch part.

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



17Z9A3CD03

2) GAUGES AND DISPLAYS

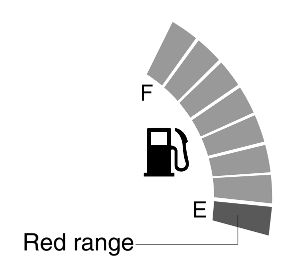
(1) Service meter

17Z9A3CD20

① This meter shows the total operation hours of the machine.

② Always ensure the operating condition of the meter during the machine operation.
Inspect and service the machine based on hours as indicated in chapter 6, maintenance.

(2) Fuel gauge



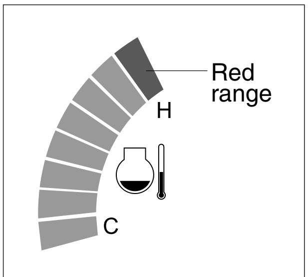
17Z9A3CD21

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

② Fill the fuel when the red range or warning lamp ON.

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

(3) Engine coolant temperature gauge



17Z9A3CD22

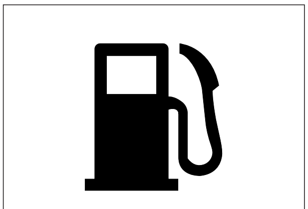
① This indicates the temperature of coolant.
· Red range : Above 115°C (239°F)

② When the red range pointed or warning lamp ON, engine do not abruptly stop but run it at medium speed to allow it to cool gradually, then stop it.
Check the radiator and engine.

※ If the engine is stopped without cooled down running, the temperature of engine parts will rise suddenly, this could cause severe engine trouble.

3) WARNING AND PILOT LAMPS

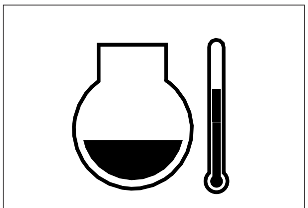
(1) Fuel low level warning lamp



R5573CD10

① This lamp blinks and buzzer sounds when the level of fuel is below 5.0 ℓ (1.3 U.S. gal).
② Fill the fuel immediately when the lamp blinks.

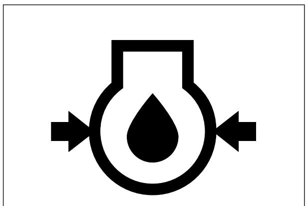
(2) Engine coolant temperature warning lamp



R25Z9A3CD08

① This lamp blinks and buzzer sounds when the temperature of coolant is over the normal temperature 115˚C (239˚F) .
② Check the cooling system when the lamp blinks.

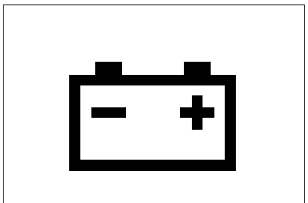
(3) Engine oil pressure warning lamp



R5573CD13

① This lamp blinks and 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.

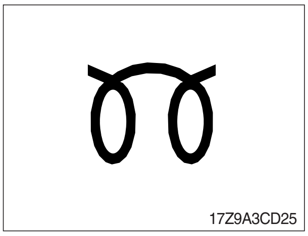
(4) Battery charging warning lamp



R5573CD16

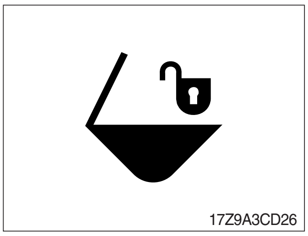
① This lamp blinks and buzzer sounds when the starting switch is ON, it is turned OFF after starting the engine.
② Check the battery charging circuit when this lamp blinks during engine operation.

(5) Engine preheat pilot lamp



① When the start switch turn to HEAT position, pilot lamp comes ON.
② Refer to the page 4-4 for details.

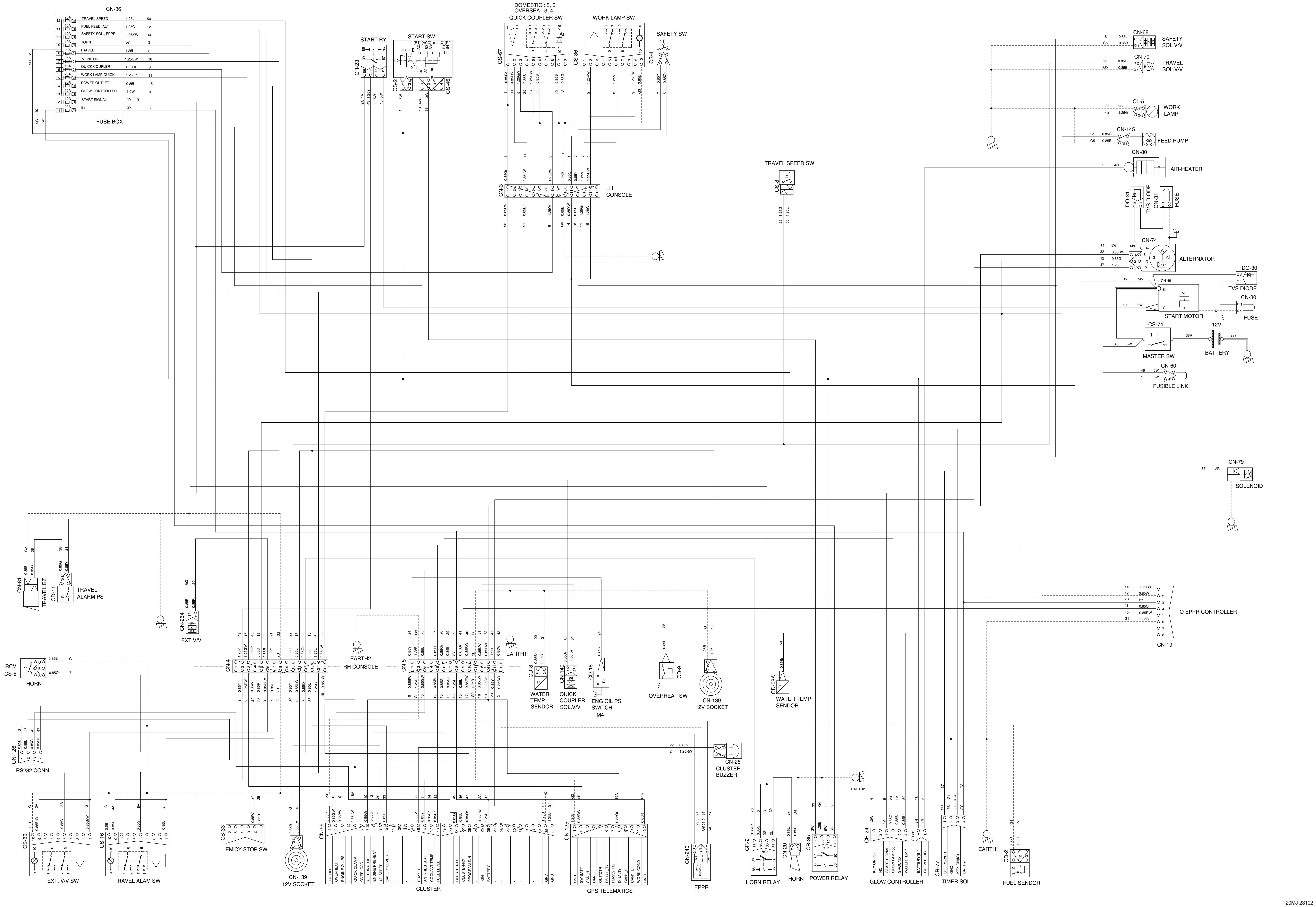
(6) Quick clamp lock pilot lamp



① When the quick clamp switch turned ON, this lamp turn ON and the buzzer sounds.
② This lamp turned OFF and the buzzer stop when the quick clamp switch turned OFF.

GROUP 3 ELECTRICAL CIRCUIT

· ELECTRICAL CIRCUIT (CANOPY TYPE)



MEMORANDUM

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 → Fusible link (CN-60) → Start switch [CS-2 (1)]
→ Fuse box [No.1] →
→ I/conn [CN-5 (8)] → Cluster [CN-56 (26)]
→ Timer solenoid [CN-77 (4)]

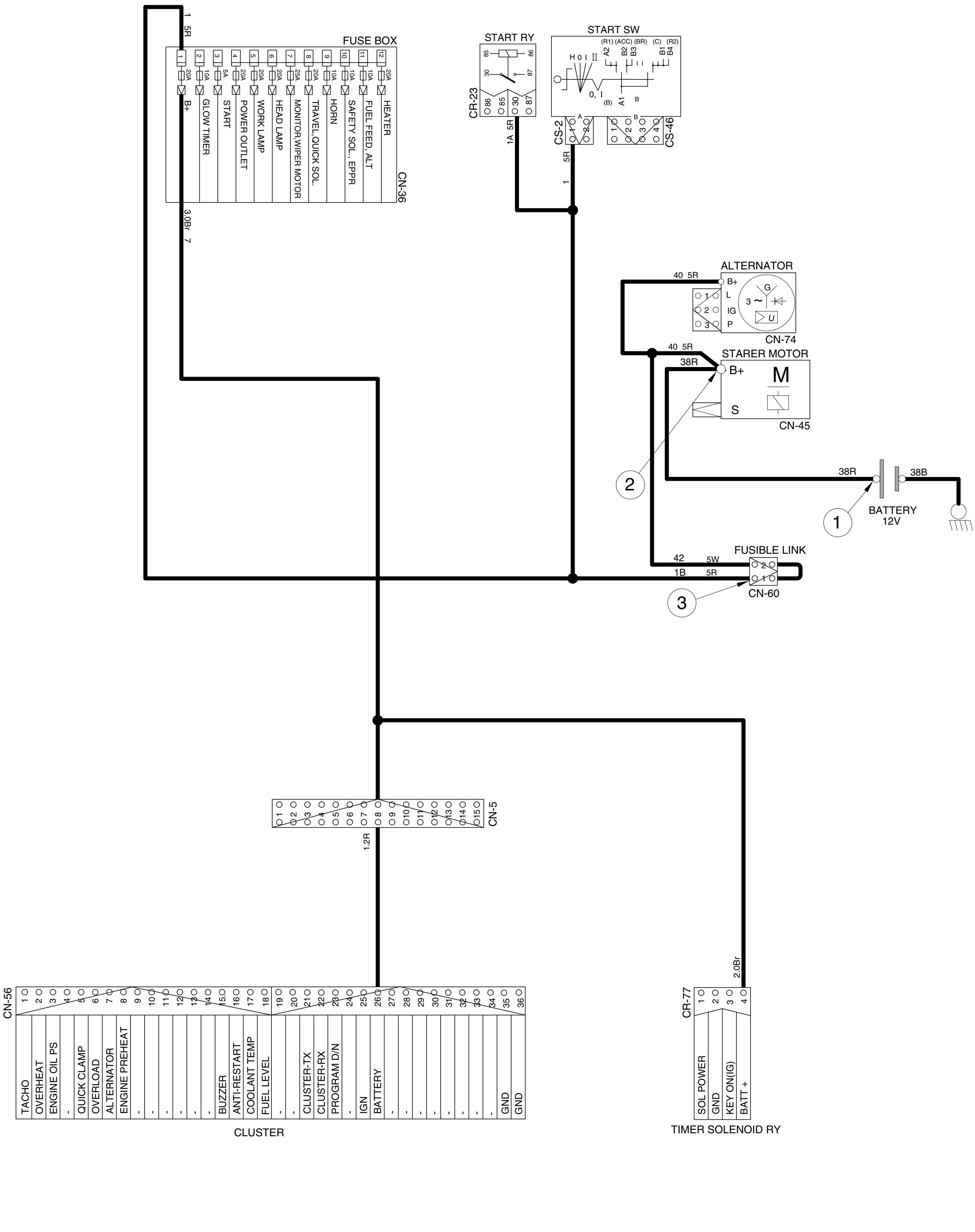
※ I/conn : Intermediate connector

2) CHECK POINT

Engine	Start switch	Check point	Voltage
OFF	OFF	① - GND (Battery) ② - GND (Master switch) ③ - GND (Fusible link)	10~12.5 V

※ GND : Ground

POWER CIRCUIT



2. STARTING CIRCUIT

1) OPERATING FLOW

Battery(+) terminal → Fusible link [CN-60]

- → Start switch [CS-2 (1)]
- → Fuse box No.1
- → Power relay [CR-35 (30)]
- → Start relay [CR-23 (30)]

※ **Start switch : HEAT**

Start switch [CS-2 (2)] → Preheater [CN-80]
→ Fuse box [CN-36 (2)] → Glow timer [CR-24 (4)]

※ **Start switch : ON**

Start switch [CS-46 (2)] → Power relay [CR-35 (30) → (87)]
→ Fuse box [all power is supplied with electric component)

※ **Start switch : START**

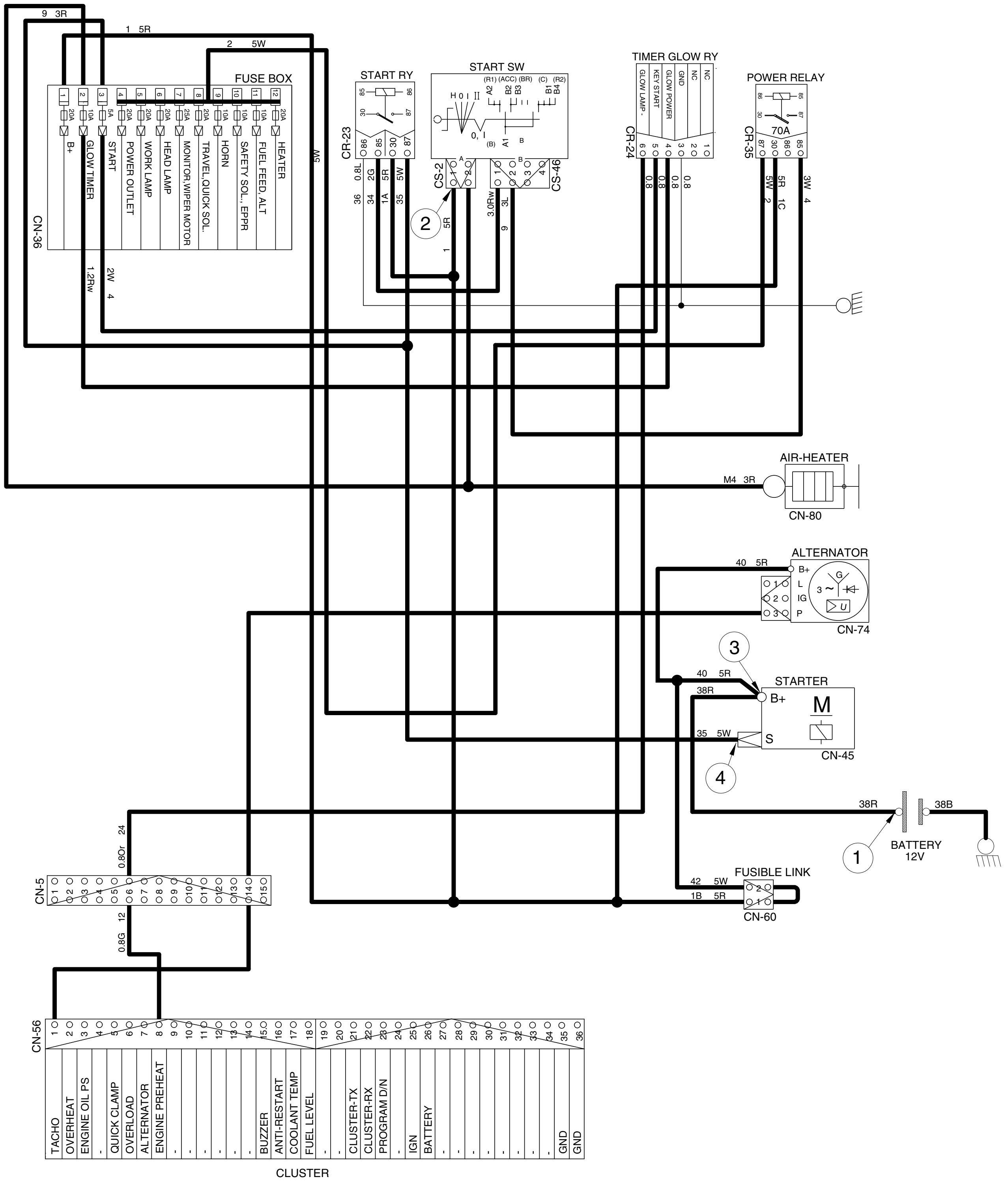
Start switch START [CS-46 (1)] → Start relay [CR-23 (30) → (87)] → Starter [CN-45 (S)] →
Start motor operating

2) CHECK POINT

Engine	Start switch	Check point	Voltage
Operating	Start	① - GND (Battery) ② - GND (Start key) ③ - GND (Starter B^+) ④ - GND (Starter S)	10~12.5 V

※ GND : Ground

STARTING CIRCUIT



17Z9A4EL05

3. CHARGING CIRCUIT

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

Charging current generated by operating alternator flows into the battery.

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

1) OPERATING FLOW

(1) Warning flow

Alternator "L" terminal → I/conn [CN-5 (13)] → Cluster [CN-56 (7)] → Cluster warning lamp ON

(2) Charging flow

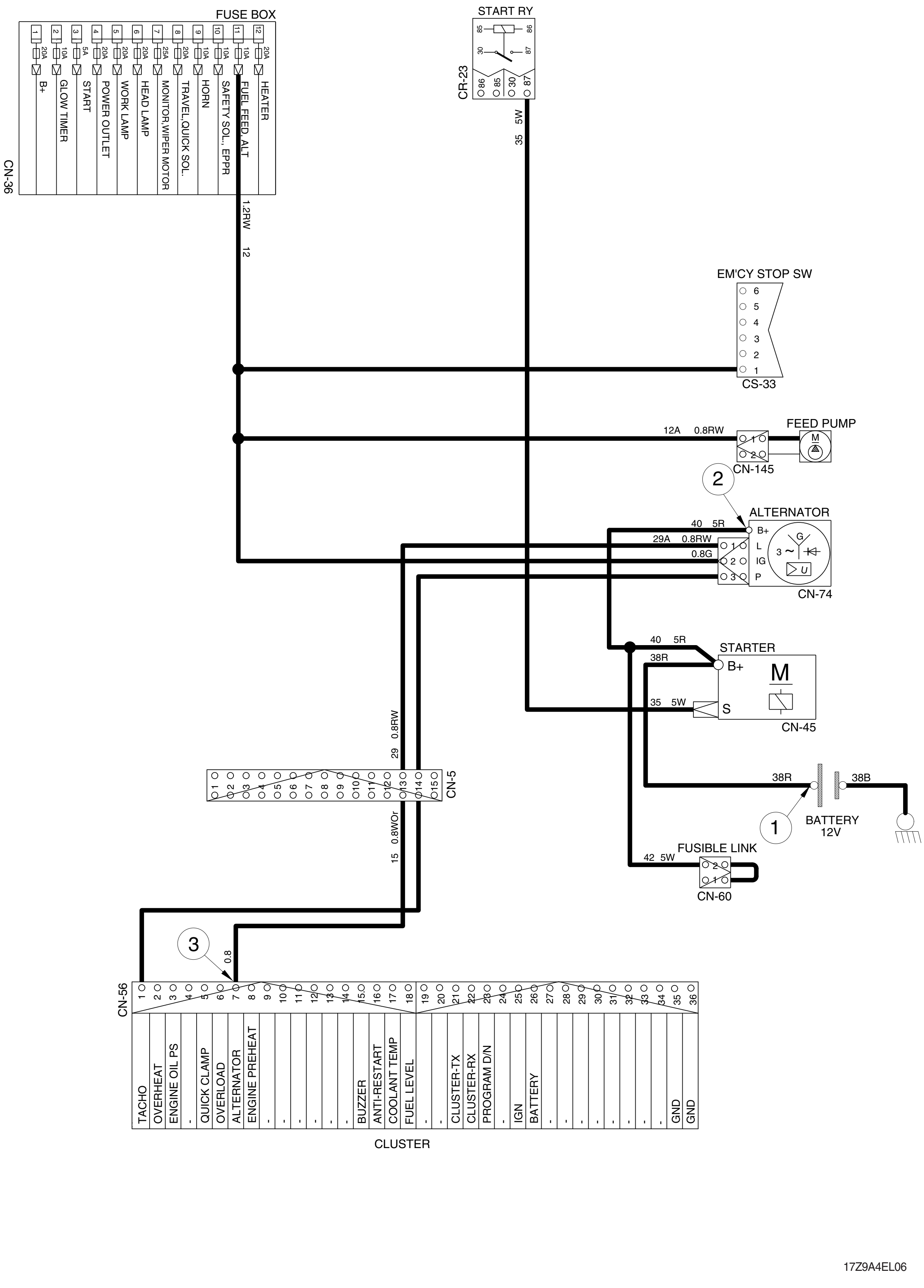
Alternator "B^+" terminal → Battery(+) terminal

2) CHECK POINT

Engine	Start switch	Check point	Voltage
ON	ON	① - GND (Battery voltage) ② - GND (Alternator B^+ terminal) ③ - GND (Cluster)	10~12.5 V

※ GND : Ground

CHARGING CIRCUIT



4. WORK LIGHT CIRCUIT

1) OPERATING FLOW

Fuse box (No.6) → I/conn [CN-3 (8)] → Light switch [CS-21 (1)]
Fuse box (No.5) → I/conn [CN-3 (13)] → Light switch [CS-21 (4)]

(1) Main light switch ON : 1st step

Main light switch ON [CS-21 (5)] → Main light switch illumination ON [CS-21 (9)]

(2) Main light switch ON : 2nd step

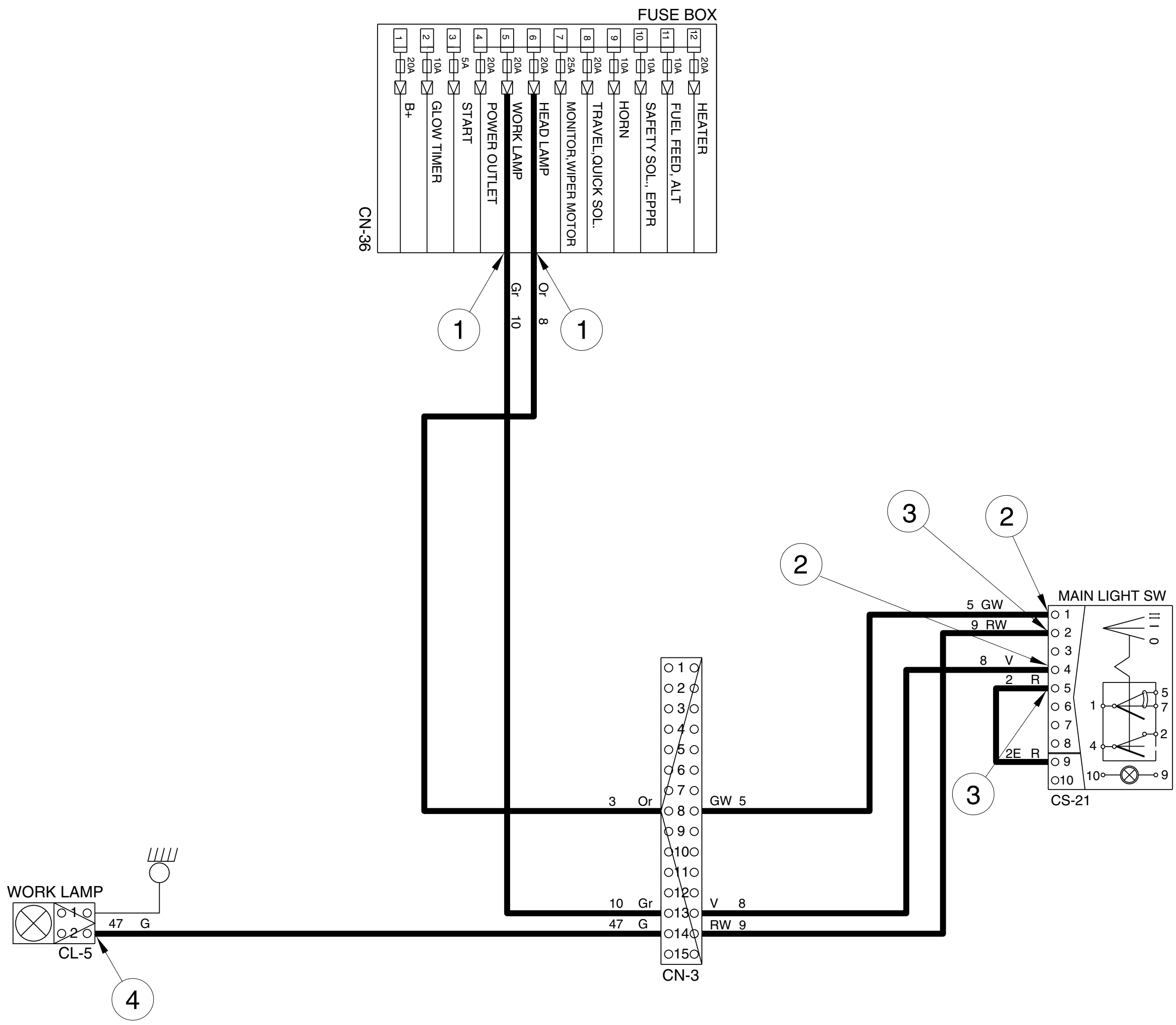
Main light switch ON [CS-21 (2)] → I/conn [CN-3 (14)] → Work light ON [CL-5 (2)]

2) CHECK POINT

Engine	Start switch	Check point	Voltage
STOP	ON	① - GND (Fuse box) ② - GND (Switch power input) ③ - GND (Switch power output) ④ - GND (Work light)	10~12.5 V

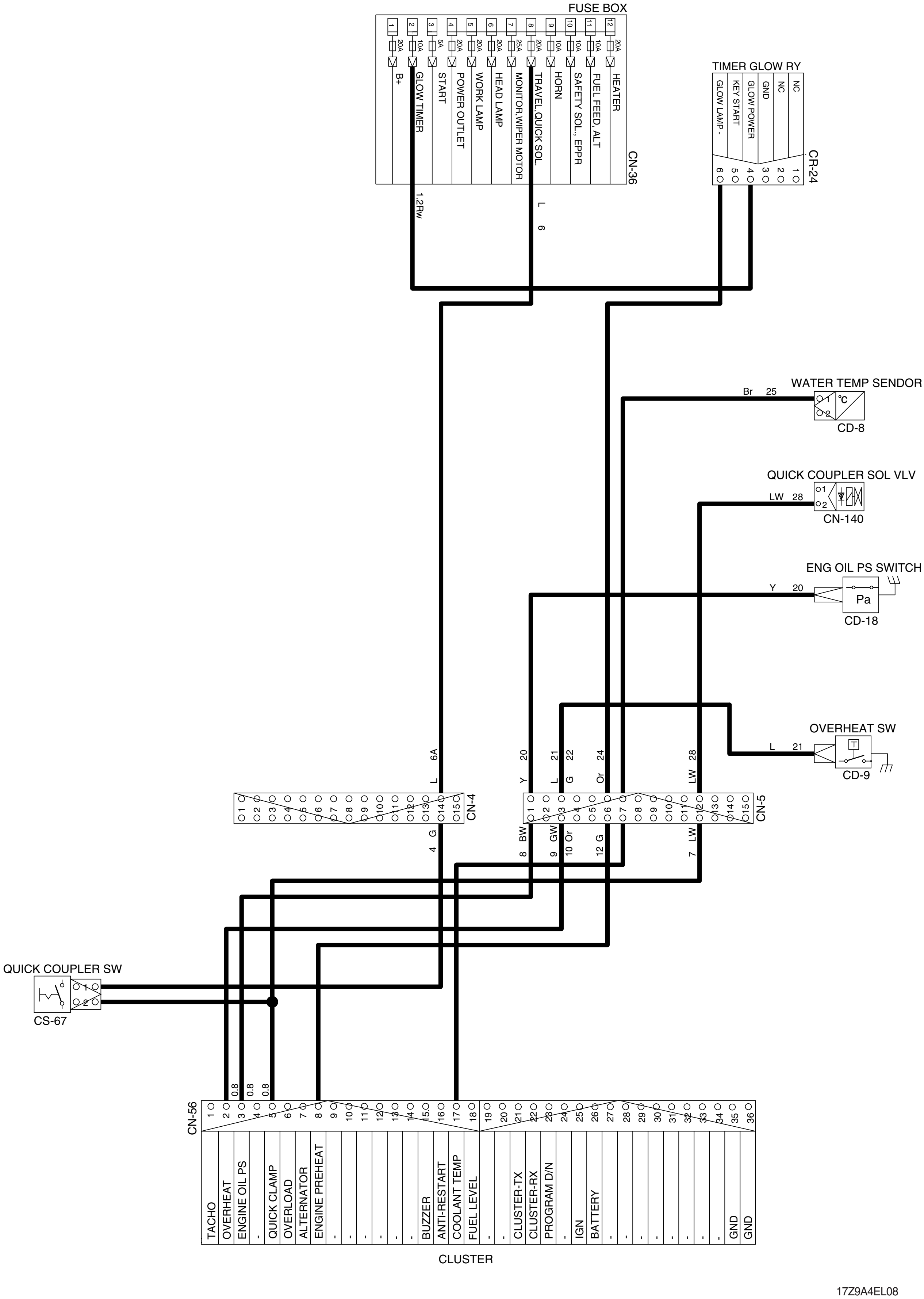
※ GND : Ground

WORK LAMP CIRCUIT

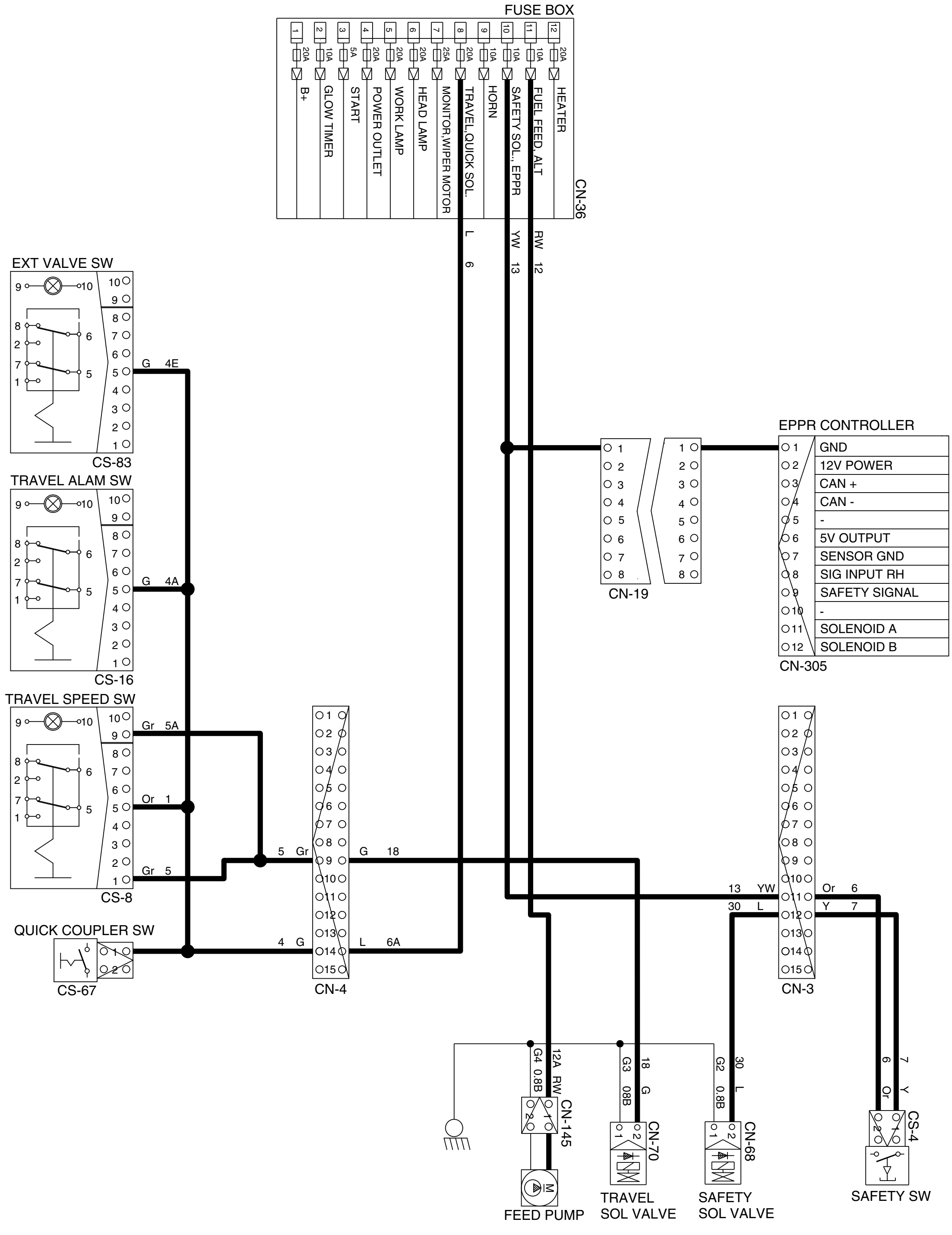


17Z9A4EL07

MONITORING CIRCUIT

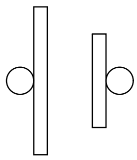
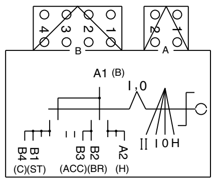
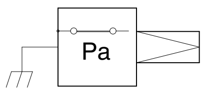
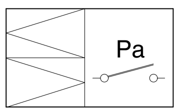
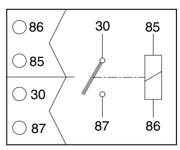
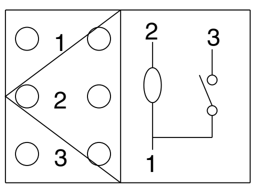


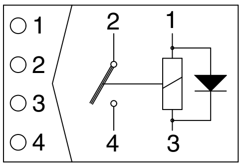
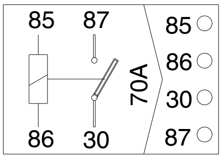
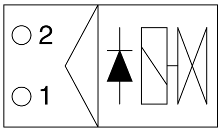
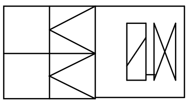
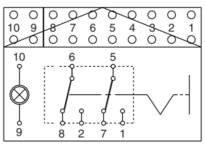
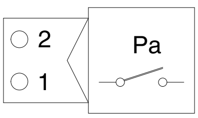
ELECTRIC CIRCUIT FOR HYDRAULIC

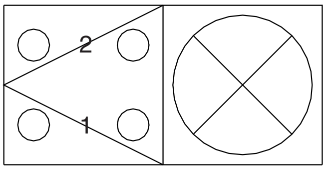
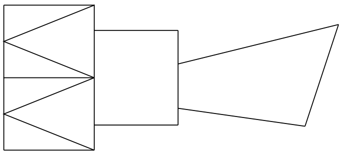
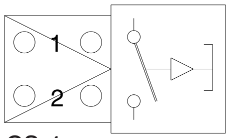
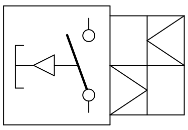
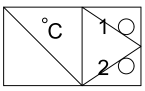
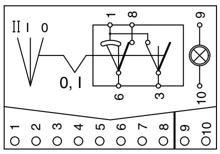


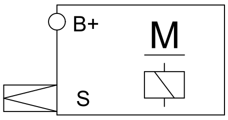
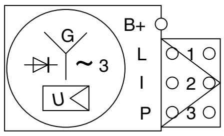
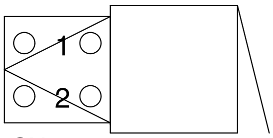
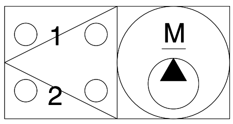
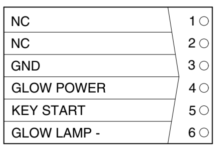
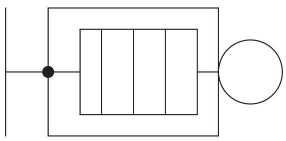
17Z9A4EL09

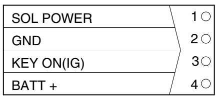
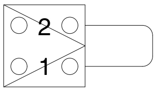
GROUP 4 ELECTRICAL COMPONENT SPECIFICATION

Part name	Symbol	Specification	Check
Battery		12V × 45Ah	※ Check specific gravity 1.280 over : Over charged 1.280 ~ 1.250 : Normal 1.250 below : Recharging
Start key	 CS-2 CS-46	12V	※ Check contact OFF : ∞ Ω (for each terminal) ON : 0 Ω (for terminal 1-3 and 1-2) START : 0 Ω (for terminal 1-5)
Pressure switch (for engine oil)	 CD-18	0.5 kgf/cm^2 (N.C TYPE)	※ Check resistance Normal : 0 Ω (CLOSE)
Air cleaner pressure switch	 CD-10	Pressure: 635 mmH_2O (N.O TYPE)	※ Check contact Normal : ∞ Ω
Start relay	 CR-23	12V 60A	※ Rated coil current 1.2±0.3A
Fuel sender	 CD-2	-	※ Check resistance Full : 30 Ω Low : 100 Ω Empty warning : 200 Ω

Part name	Symbol	Specification	Check
Horn relay	 CR-2	12V 20A	※ Check resistance Normal : About 200 Ω (for terminal 1-3) : 0 Ω (for terminal 2-4)
Power relay	 CR-35	12V 70A	※ Rated coil current 1.2±0.3 A
Solenoid valve	 CN-70 CN-68 CN-140 CN-238 CN-239 CN-264	12V 1A	※ Check resistance Normal : 15~25 Ω (for terminal 1-2)
Solenoid valve (engine stop)	 CN-79	12V	※Coil resistance : 1.8 Ω
Switch (looking type)	 CS-8 CS-16 CS-83	12V 16A	※ Check contact Normal OFF - ∞ Ω (for terminal 1-5,2-6) - 0 Ω (for terminal 5-7,6-8)
Pressure switch	 CD-11	10bar (N.C type)	※ Check contact Normal : 0.1 Ω

Part name	Symbol	Specification	Check
Lamp	 CL-5	12V 55W (H3 TYPE)	※ Check disconnection Normal : 1.2 Ω
Horn	 CN-20	12V 6A	132±5 dB
Safety switch	 CS-4	Micro 12V 15A	※ Check contact Normal : 0 Ω Operating : ∞ Ω
Horn switch	 CS-5	12V 10A	※ Check contact Normal : 0 Ω
Water temp sender	 CD-8	-	※ Check contact 50°C : 0.748~0.904 Ω 67°C : 0.538~0.650 Ω 102°C : 0.185~0.167 Ω 110°C : 0.143~0.130 Ω 135°C : 0.076~0.100 Ω
Light switch	 CS-21	12V 16A	※Check contact Normal : ∞ Ω

Part name	Symbol	Specification	Check
Starter	 CN-45	12V	※ Check contact Normal : 0.1 Ω
Alternator	 CN-74	12V 40A	※ Check contact Normal : 0 Ω (For terminal B^+-1) Normal : 10 ~ 12.5V
Travel alarm	 CN-81	12V	-
Fuel feed pump	 CN-145	12V	-
Glow timer	 CR-24	12V	-
Air-heater	 CN-80	12V 42A 500W	-

Part name	Symbol	Specification	Check
Control time relay	 CR-77	12V	-
Fusible link	 CN-60	27A	※Check coil resistance Normal : 3.26m Ω /m

GROUP 5 CONNECTORS

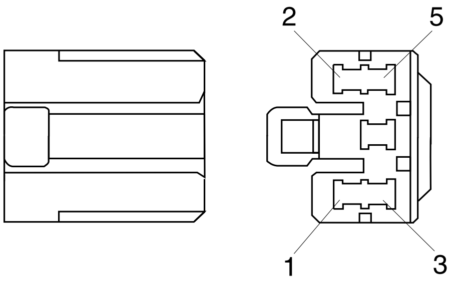
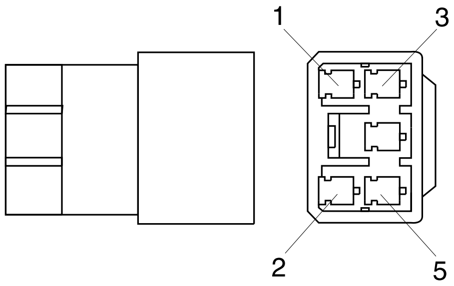
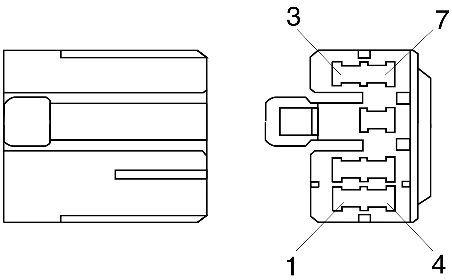
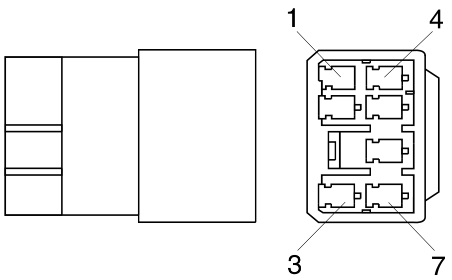
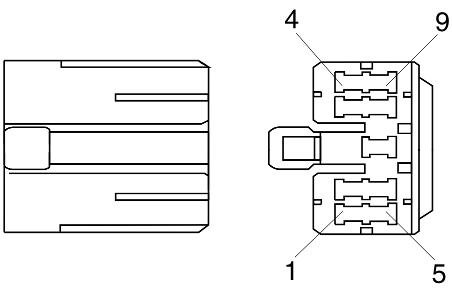
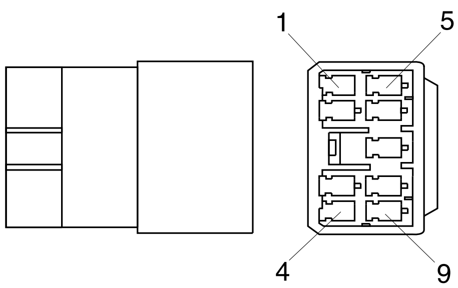
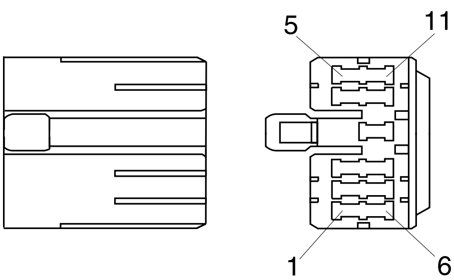
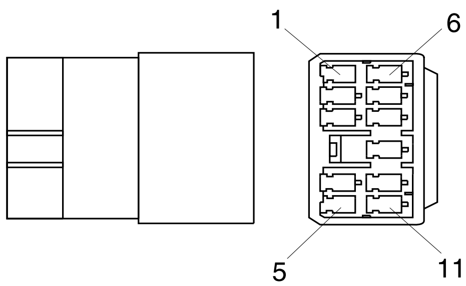
1. CONNECTOR DESTINATION

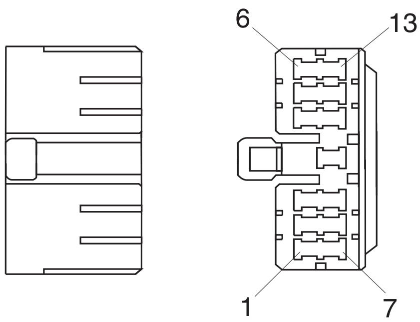
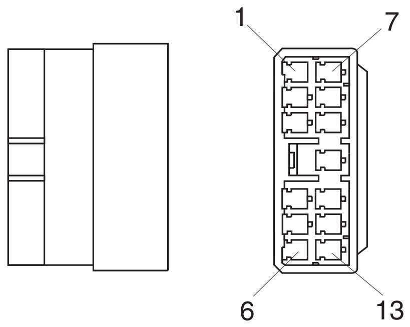
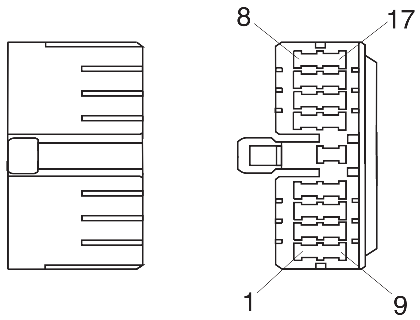
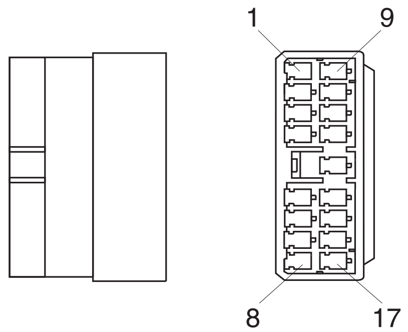
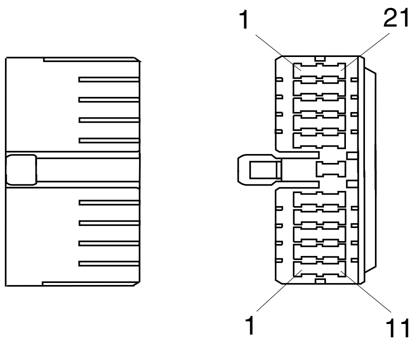
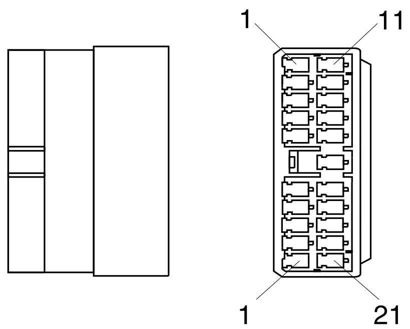
Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
CN-3	AMP	15	I/conn (main harness-LH console harness)	2-85262-1	368301-1
CN-4	AMP	15	I/conn (main harness-RH console harness)	2-85262-1	368301-1
CN-5	AMP	15	I/conn (RH console harness-main harness)	2-85262-1	368301-1
CN-20	DEUTSCH	2	Horn	DT06-2S-P012	-
CN-36	-	-	Fuse box body	F12890010	-
CN-45	RING TERM	1	Starter	ST710258-2	-
	YAZAKI	1	Starter	7123-2115	-
CN-56	AMP	20	Cluster	175967-2	-
	AMP	16		175966-2	-
CN-60	AMP	2	Fusible link	-	S831-130200
CN-68	DEUTSCH	2	Safety solenoid	DT06-2S-P012	-
CN-70	DEUTSCH	2	Travel Hi-Lo solenoid	DT06-2S-P012	-
CN-74	SUMITOMO	3	Alternator	6189-0442	-
	RING TERM	1		S820-306002	-
CN-80	-	1	Pre heater	7323-3010	-
CN-81	SWP	1	Travel buzzer	S822-014000	S822-114000
CN-140	DEUTSCH	2	Quick clamp	DT06-2S-P012	DT04-2P-E004
CN-145	YAZAKI	2	Fuel feed pump	7122-2820	-
CN-264	DEUTSCH	1	Extension valve	DT06-2S-P012	-
LAMP					
CL-2	AMP	3	Power outlet	174200-1	-
CL-5	DEUTSCH	2	Work lamp	DT06-2S-P012	DT04-2P-E004
RELAY					
CR-2	AMP	4	Horn relay	S810-004202	-
CR-23	KET	4	Start relay	612017-5	-
CR-24	YAZAKI	6	Glow timer relay	7123-2262	-
CR-35	KET	4	Power relay	MG612017-5	-
CR-77	YAZAKI	4	Timer solenoid relay	7123-2446	-
CR-79	YAZAKI	1	Engine stop solenoid relay	7122-2215	-
SENSOR					
CD-2	AMP	3	Fuel sender	S816-003002	S816-102002
CD-8	AMP	2	Water temp sender	85202-1	-
CD-9	AMP	1	Overheat switch	172320-2	-
CD-11	KET	2	Travel pressure switch	MG640795	-
CD-18	RING TERM	1	Engine oil pressure	GP110021	-

Connector number	Type	No. of pin	Destination	Connector part No.	
				Female	Male
SWITCH					
CS-2	KET	4	Start switch	MG651926	-
CS-4	AMP	2	Safety switch	-	S814-102001
CS-5	-	1	Horn switch	S822-014000	-
	-	1		-	S822-114000
CS-8	SWF	10	Travel speed switch	583757	-
CS-16	SWF	10	Travel alarm switch	583757	-
CS-21	SWF	10	Light switch	593757	-
CS-24	SUMITOMO	8	EPPR switch	6195-0051	-
CS-46	-	2	Start switch	S813-030201	-
CS-67	AMP	2	Quick clamp switch	174352-2	-
CS-83	SWF	10	Extension valve switch	583757	-

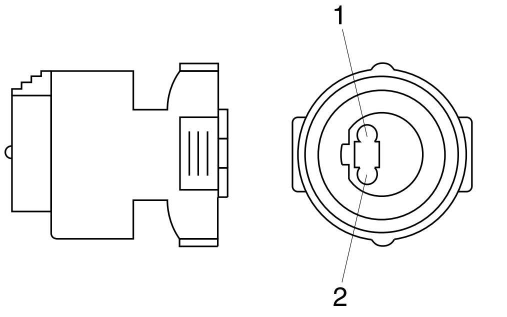
2. CONNECTION TABLE FOR CONNECTORS

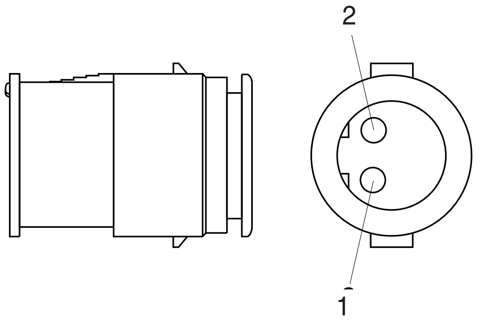
1) PA TYPE CONNECTOR

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

<table>
<tr><th>No. of pin</th><th>Receptacle connector (female)</th><th>Plug connector (male)</th></tr>
<tr><td>2</td><td>

S816-002001</td><td>

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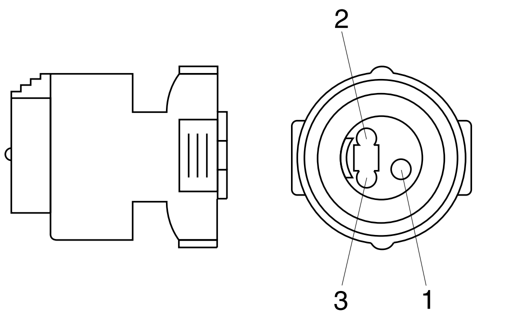
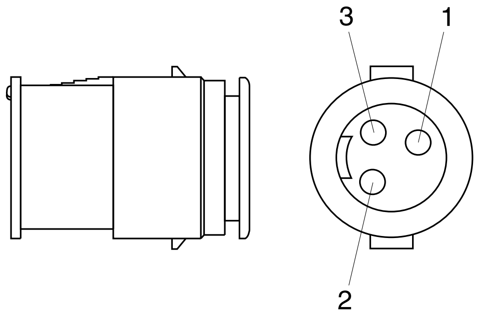
<tr><td>3</td><td>

S816-003001</td><td>

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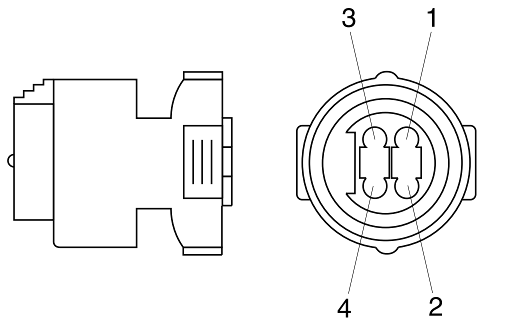
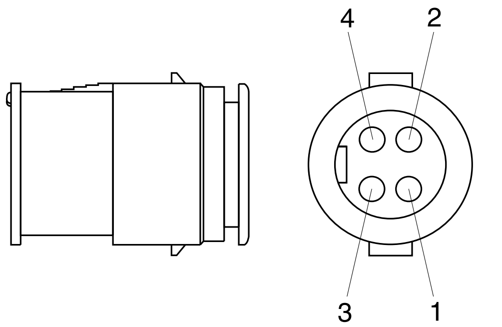
<tr><td>4</td><td>

S816-004001</td><td>

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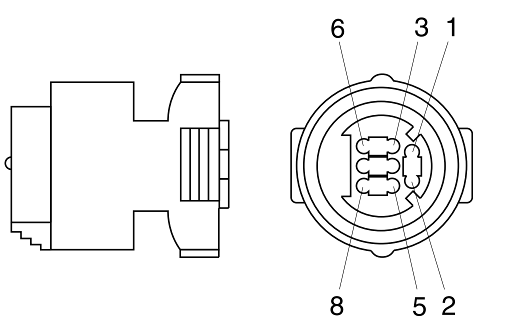
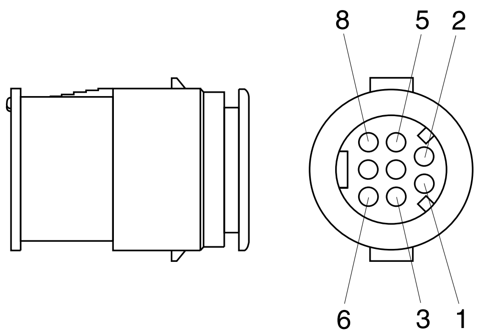
<tr><td>8</td><td>

S816-008001</td><td>

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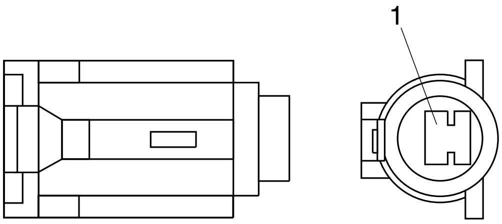
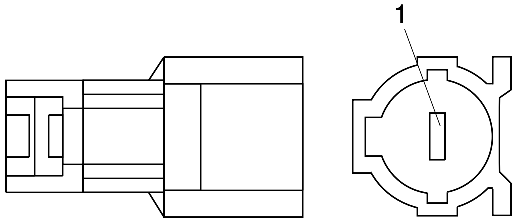
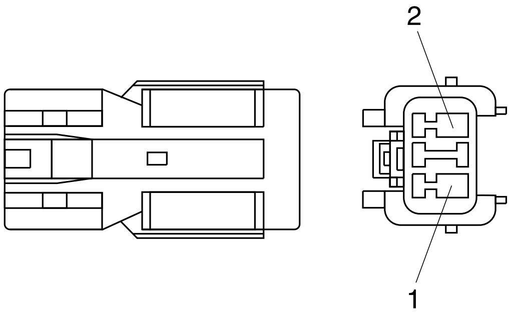
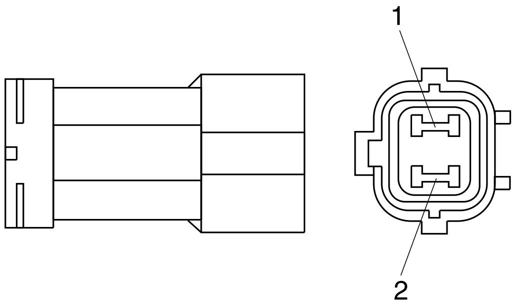
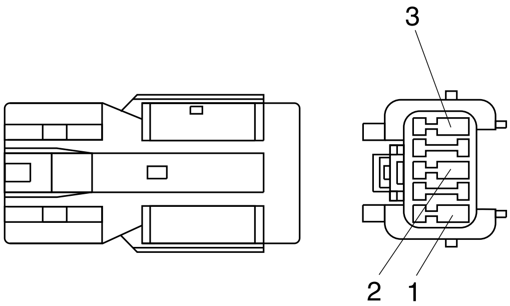
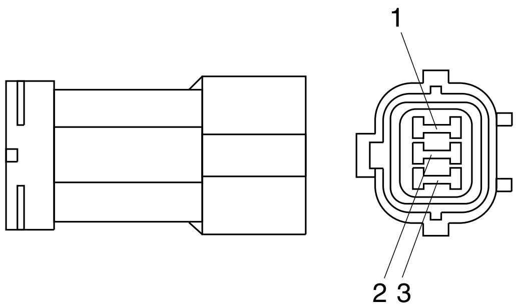
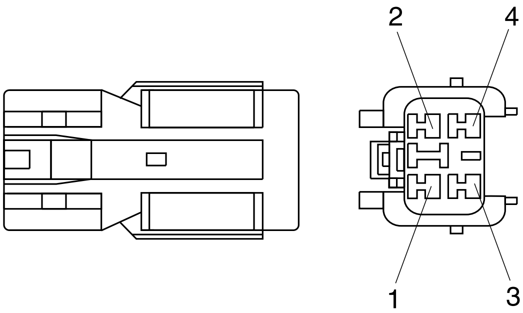
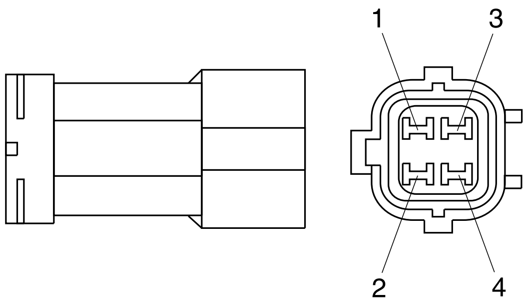
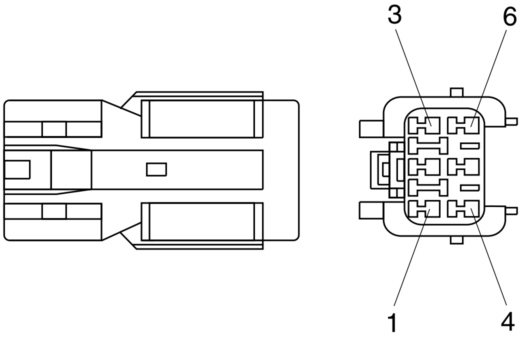
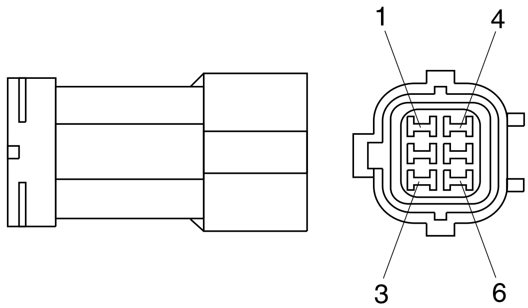
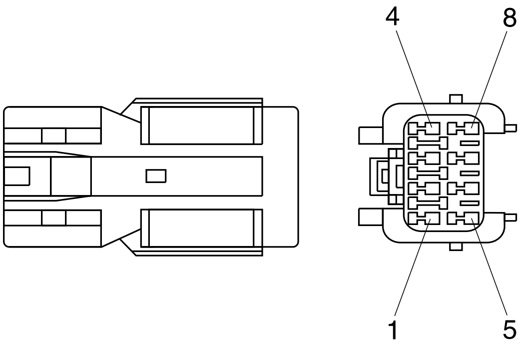
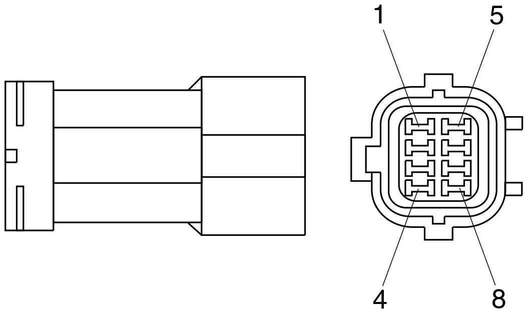
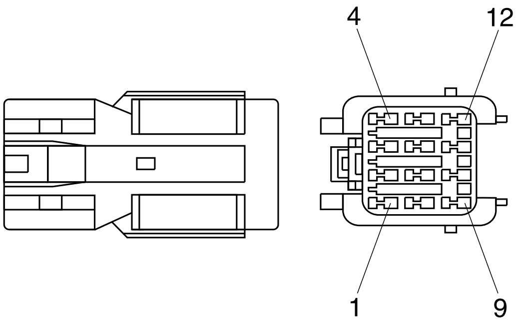
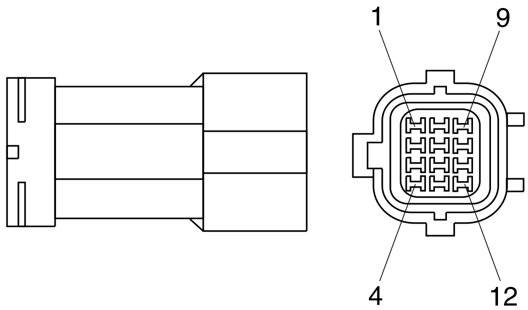
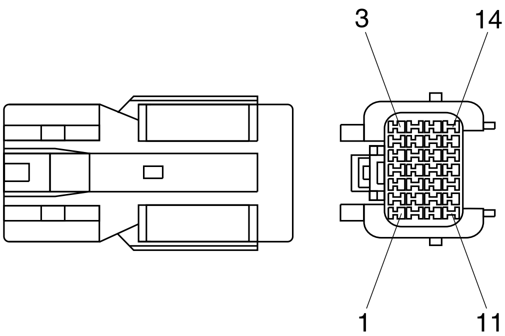
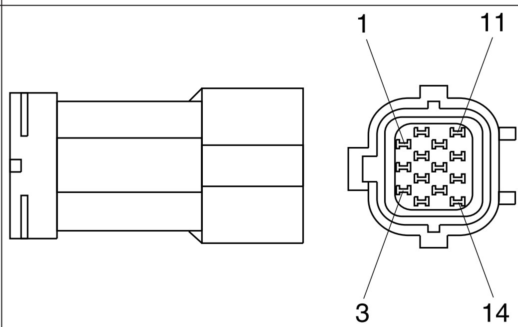
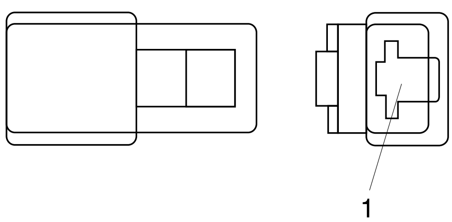
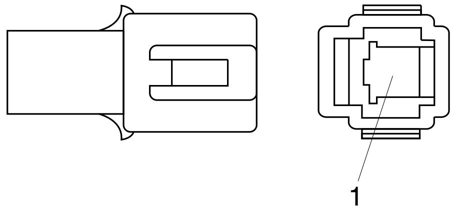
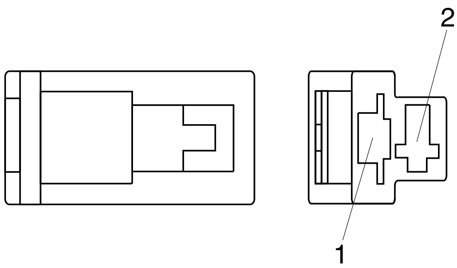
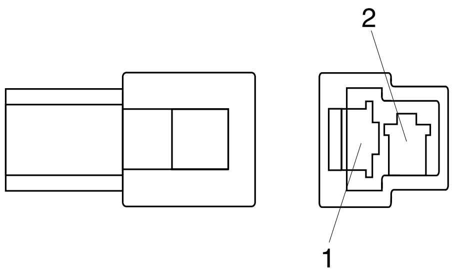
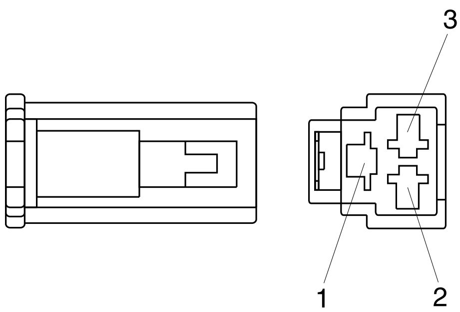
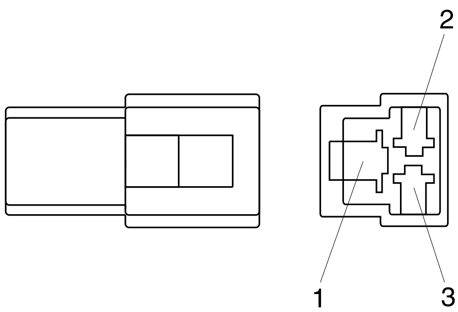
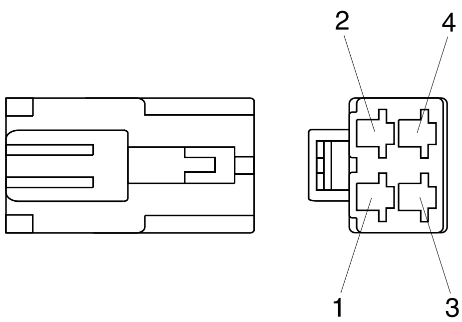
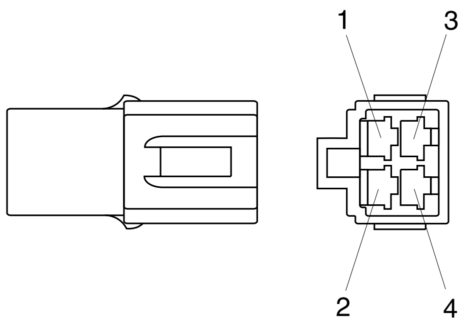
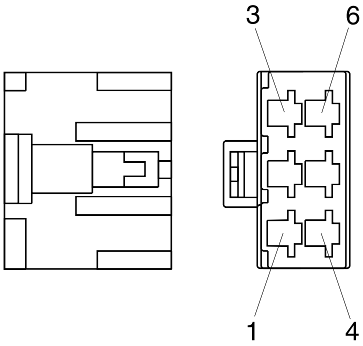
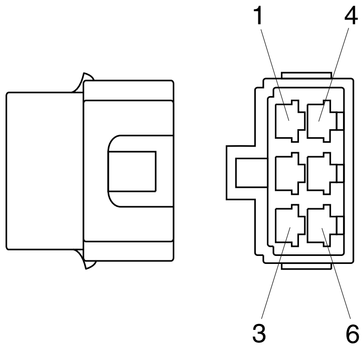
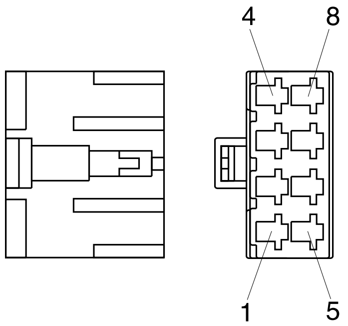
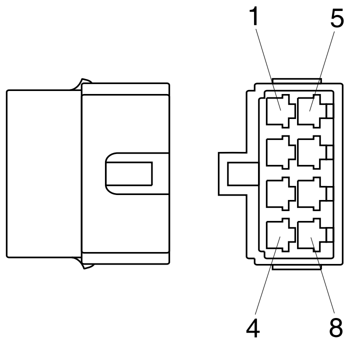
3) SWP TYPE CONNECTOR

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

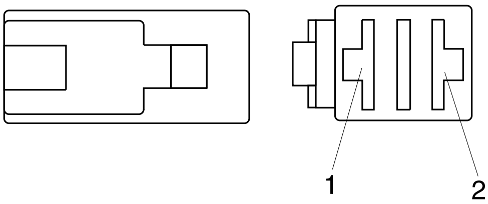
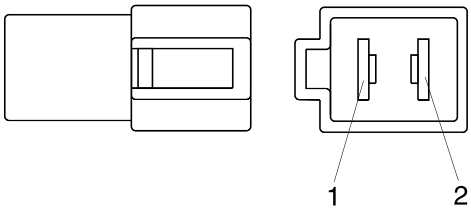
No. of pin	Receptacle connector (female)	Plug connector (male)
6	 S814-006000	 S814-106000
8	 S814-008000	 S814-108000
12	 S814-012000	 S814-112000
14	 S814-014000	 S814-114000

4) CN TYPE CONNECTOR

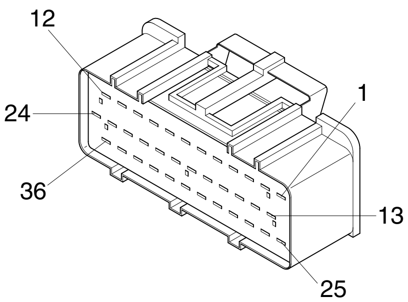
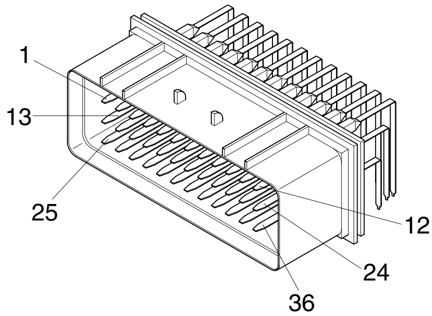
No. of pin	Receptacle connector (female)	Plug connector (male)
1	 S810-001202	 S810-101202
2	 S810-002202	 S810-102202
3	 S810-003202	 S810-103202
4	 S810-004202	 S810-104202

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

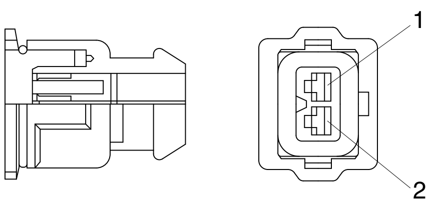
5) 375 FASTEN TYPE CONNECTOR

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

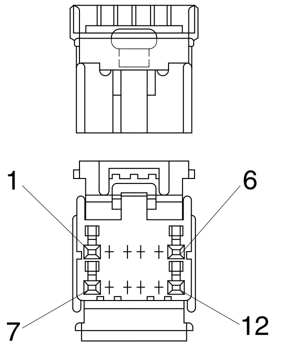
6) AMP ECONOSEAL CONNECTOR

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

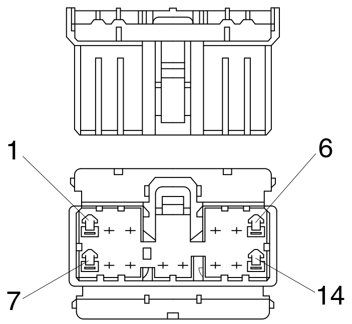
7) AMP TIMER CONNECTOR

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

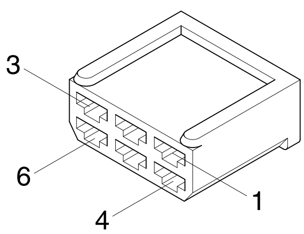
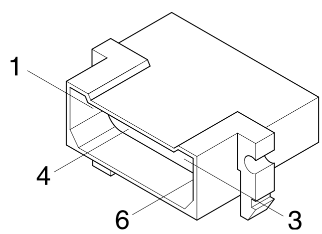
8) AMP 040 MULTILOCK CONNECTOR

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

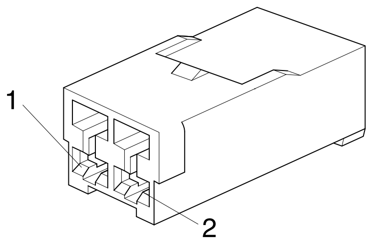
9) AMP 070 MULTILOCK CONNECTOR

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

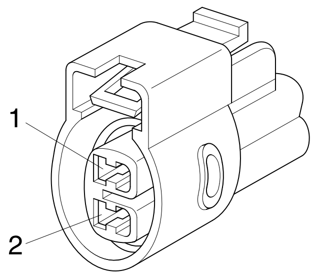
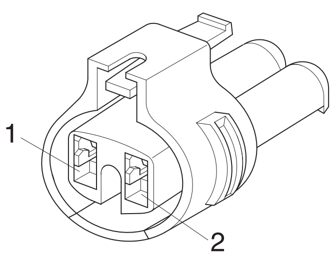
10) AMP FASTIN - FASTON CONNECTOR

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

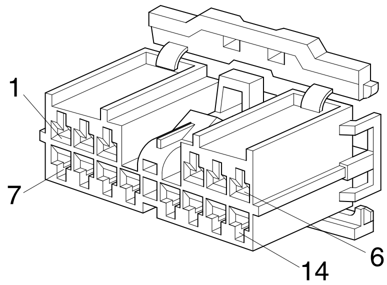
11) KET 090 CONNECTOR

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	

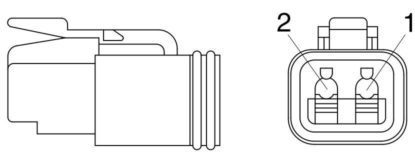
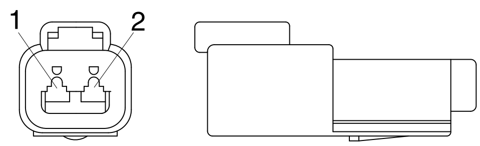
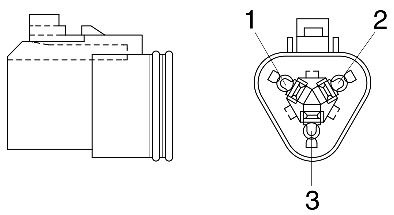
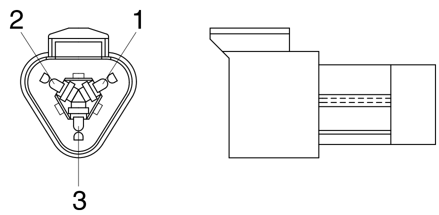
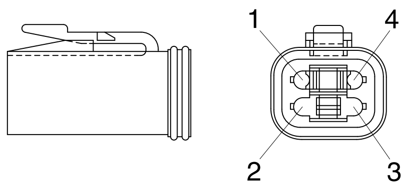
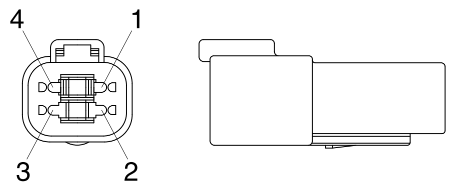
14) DEUTSCH DT CONNECTORS

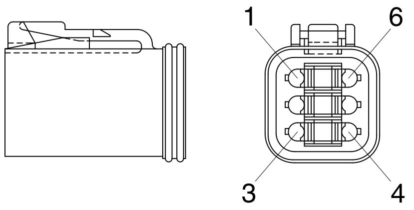
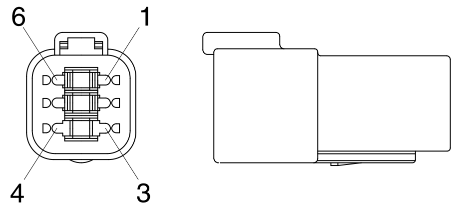
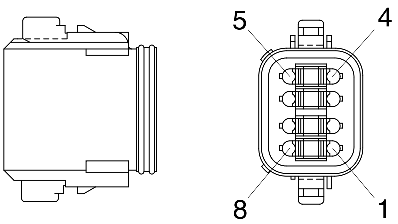
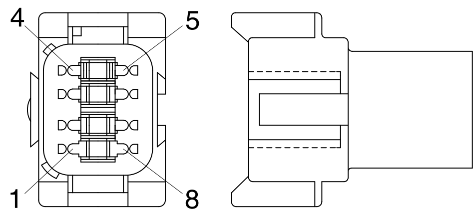
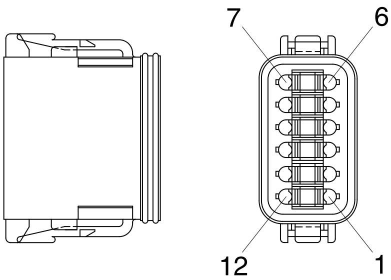
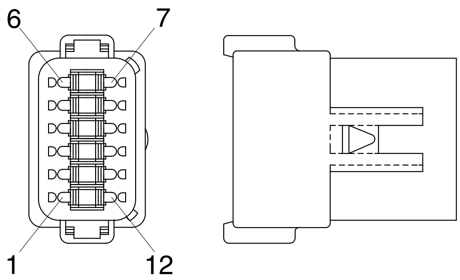
DT 06 - 3S - ★★★★

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

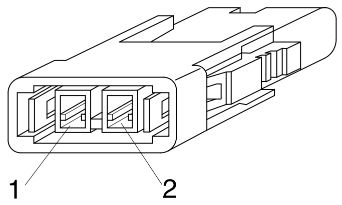
※ Modification

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

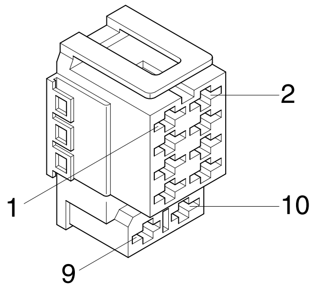
No. of pin	Receptacle connector (female)	Plug connector (male)
2	 DT06-2S	 DT04-2P
3	 DT06-3S	 DT04-3P
4	 DT06-4S	 DT04-4P

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

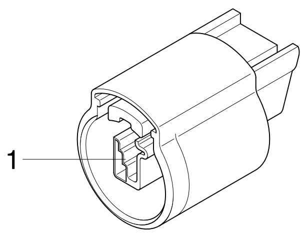
15) MOLEX 2CKTS CONNECTOR

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

16) ITT SWF CONNECTOR

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

17) MWP NMWP CONNECTOR

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

SECTION 5 TROUBLESHOOTING

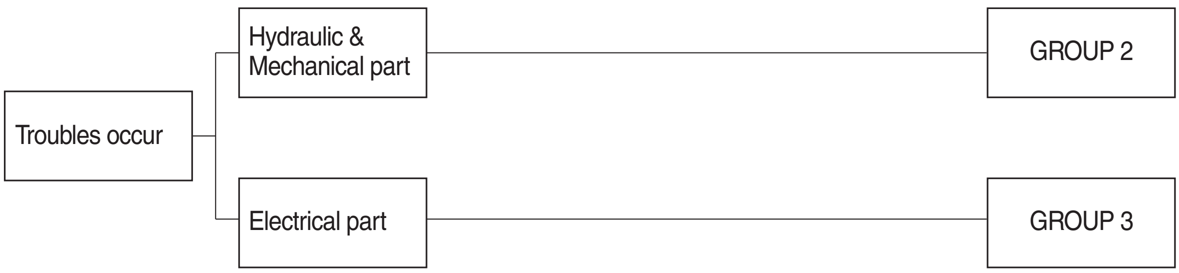
GROUP 1 BEFORE TROUBLESHOOTING

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 and Electrical system.

At each system part, an operator can check the machine according to the troubleshooting process diagram.

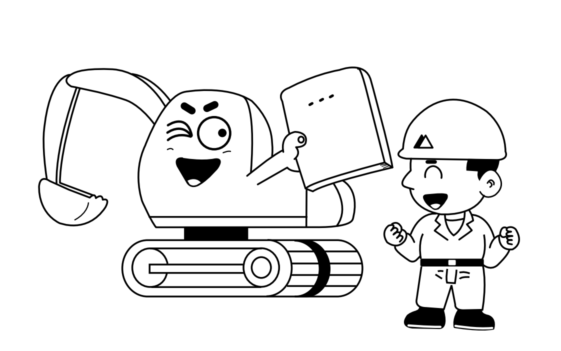


2. DIAGNOSING PROCEDURE

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.

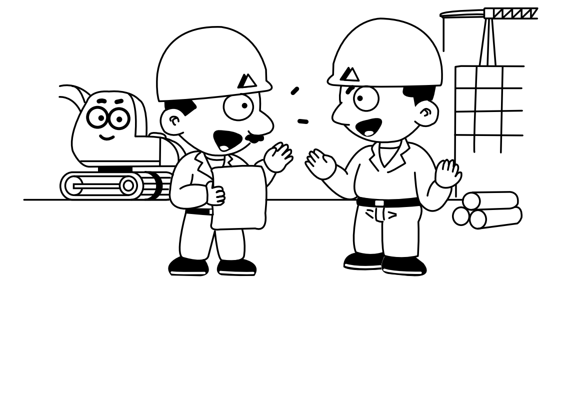


13031SH02

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.

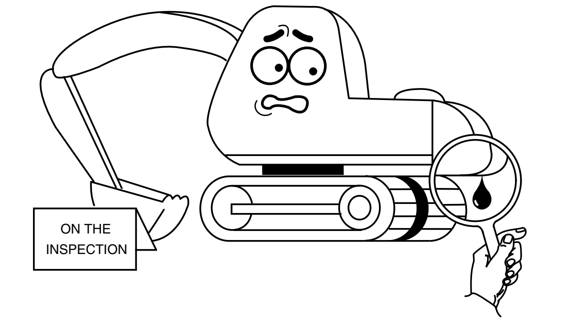


13031SH03

STEP 3. Inspect the machine

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

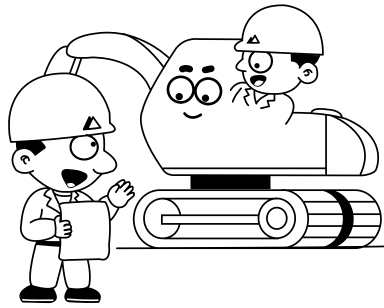
And also check the electrical system including batteries, as the troubles in the electrical system such as low battery voltage, loose connections and blown out fuses will result in malfunction of the controllers causing total operational failures of the machine.



6-2(3) 140-7

STEP 4. Inspect the trouble actually on the machine

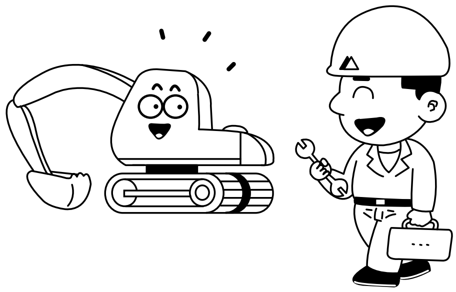
In case that some trouble cannot be confirmed, obtain the details of the malfunction from the operator.
Also, check if there are any in complete connections of the wire harnesses are or not.



6-3(1) 140-7

STEP 5. Perform troubleshooting

According to where the trouble parts are located, hydraulic & mechanical system part or electrical system part or mechatronics system part, perform troubleshooting the machine refer to the each system part's troubleshooting process diagram.

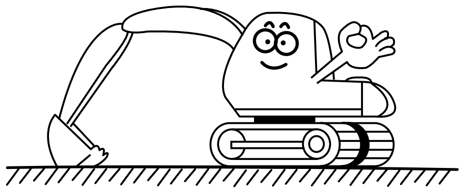


13031SH05

STEP 6. Trace a cause

Before reaching a conclusion, check the most suspectible causes again. Try to trace what the real cause of the trouble is.

Make a plan of the appropriate repairing procedure to avoid consequential malfunctions.



6-3(3) 140-7

GROUP 2 HYDRAULIC AND MECHANICAL SYSTEM

1. INTRODUCTION

1) MACHINE IN GENERAL

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

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

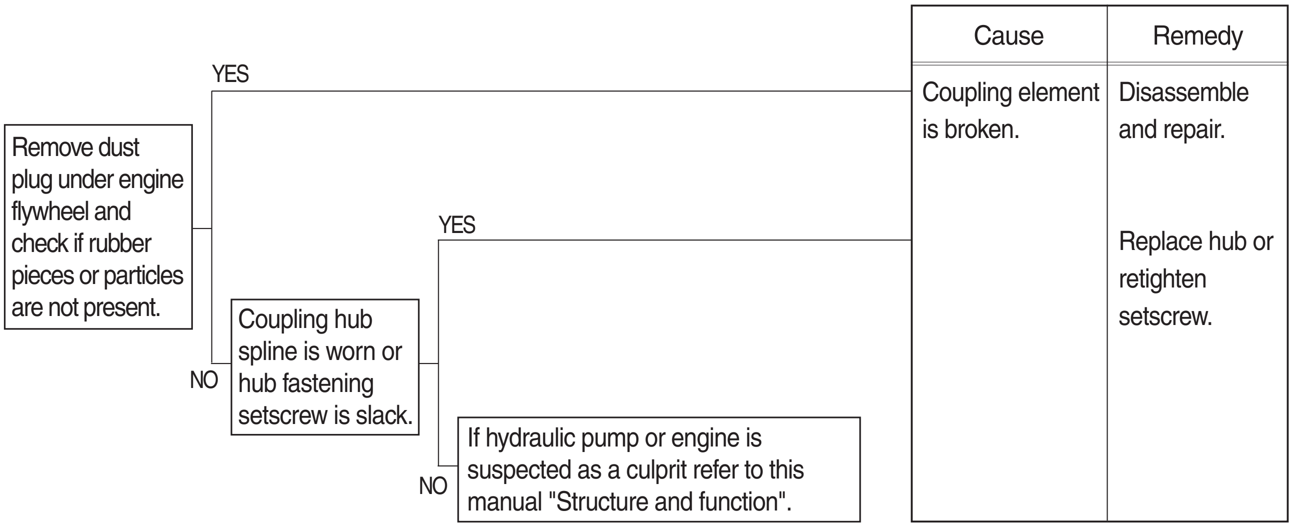
(3) When carrying out troubleshooting, do not hurry to disassemble the components.
It will become impossible to find the cause of the problem.

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

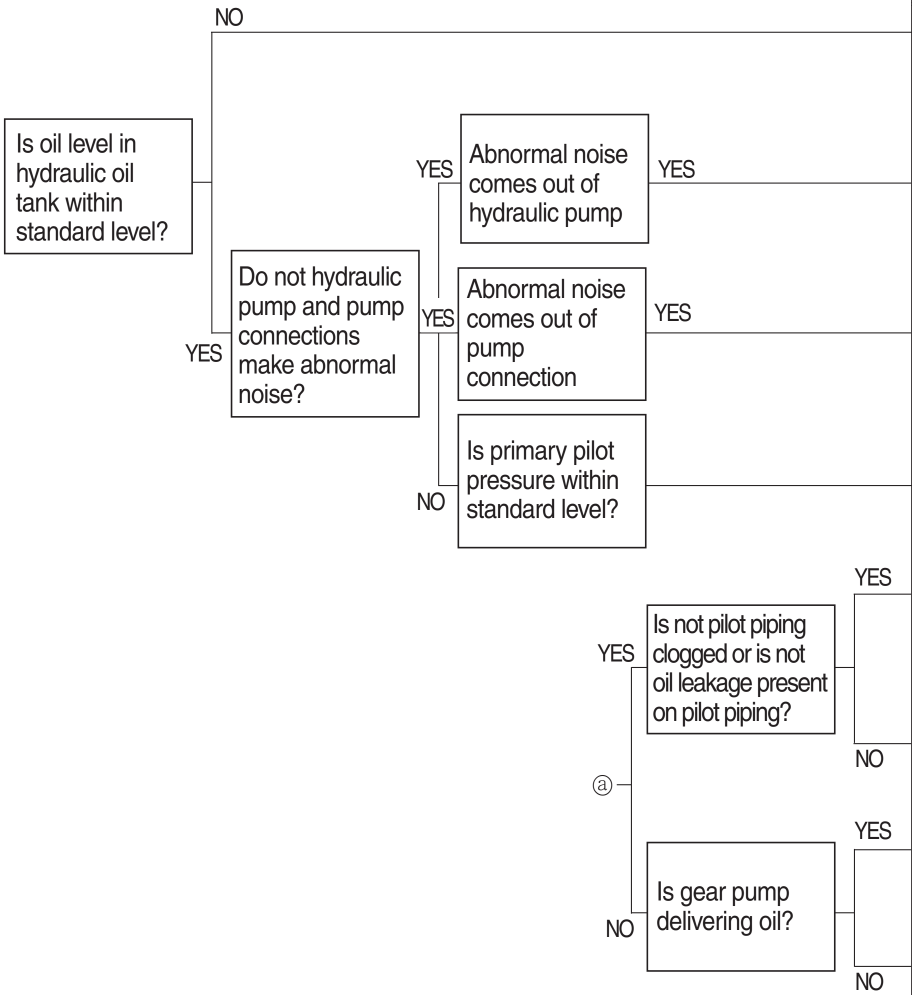
(5) Check before troubleshooting.
① Check oil and fuel level.
② Check for any external leakage of oil from components.
③ Check for loose or damage of wiring and connections.

2. DRIVE SYSTEM

1) UNUSUAL NOISE COMES OUT OF PUMP CONNECTION



2) ENGINE STARTS BUT MACHINE DOES NOT OPERATE AT ALL

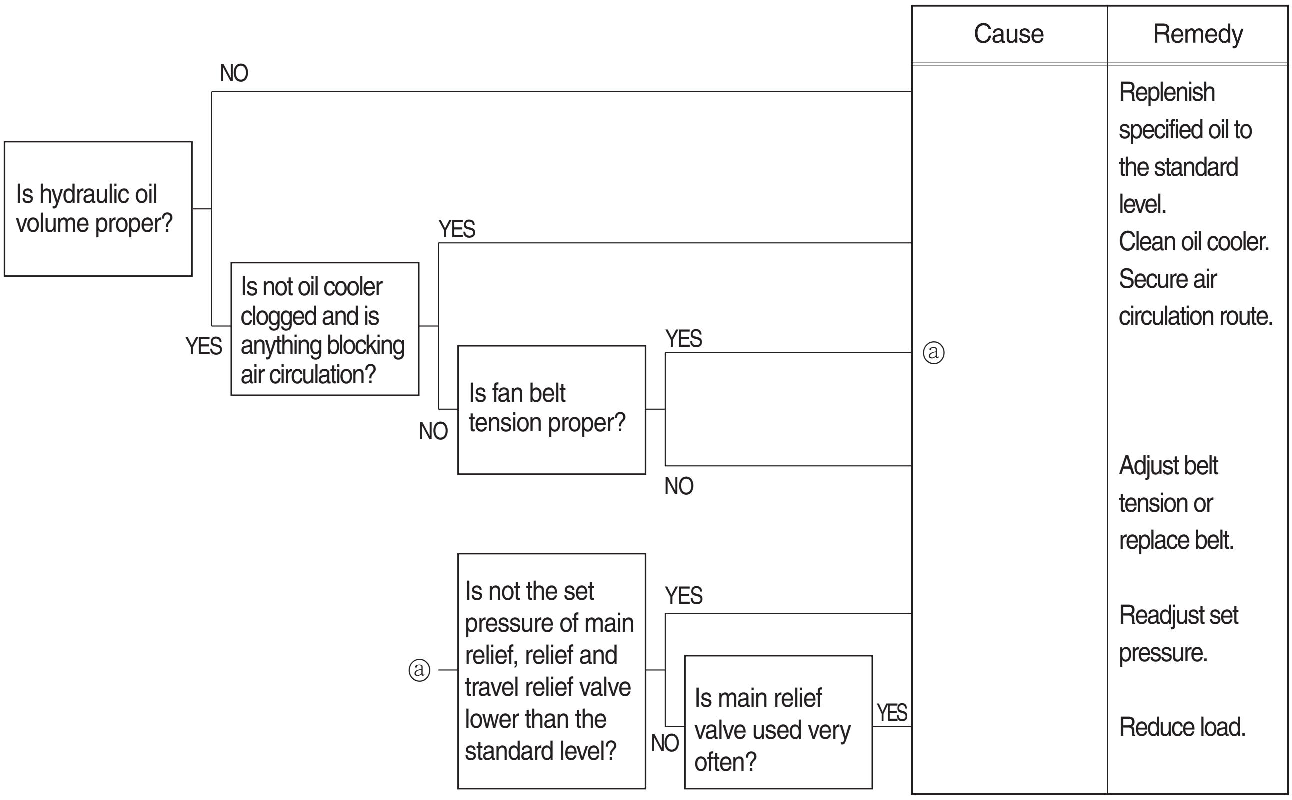


Cause	Remedy
	Replenish specified oil to the standard level.
Hydraulic pump is broken.	Disassemble and repair.
	See item 1). at page 5-5
ⓐ	
	Clean pilot piping interior or repair piping.
Pilot valve is faulty.	Disassemble and repair.
Pilot relief valve is faulty.	Repair or replace.
Gear pump is broken.	Disassemble and repair.

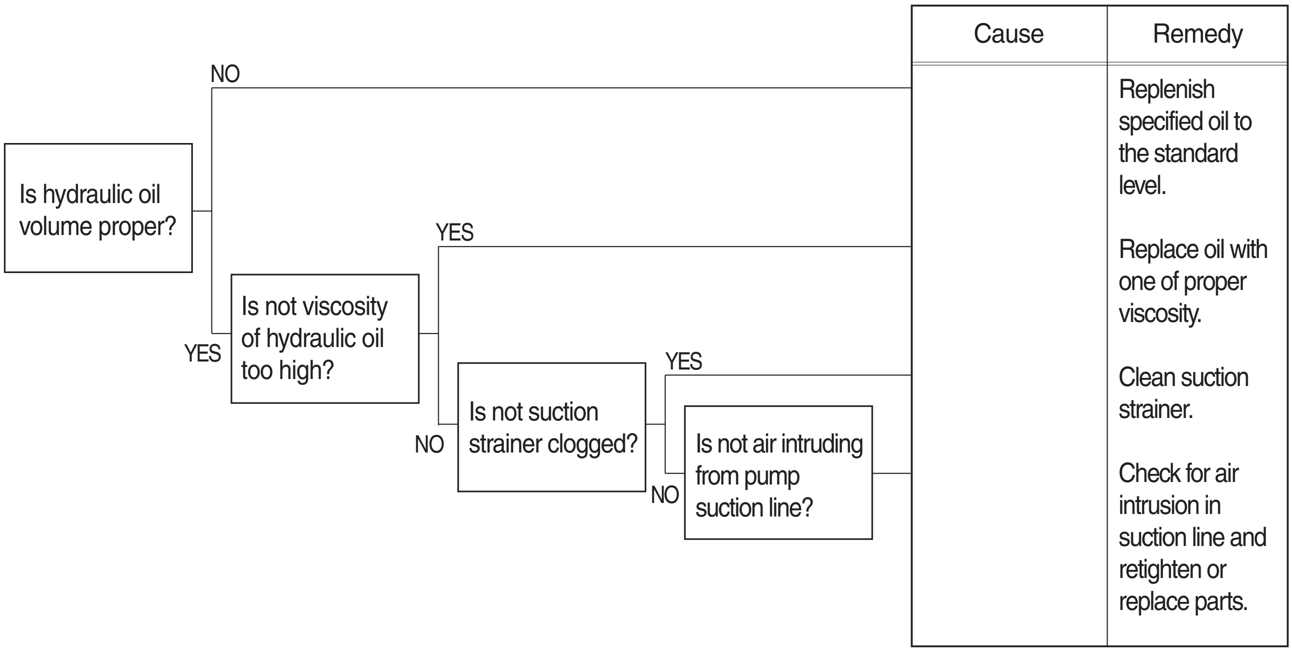
3. HYDRAULIC SYSTEM

1) HYDRAULIC OIL IS CLOUDY

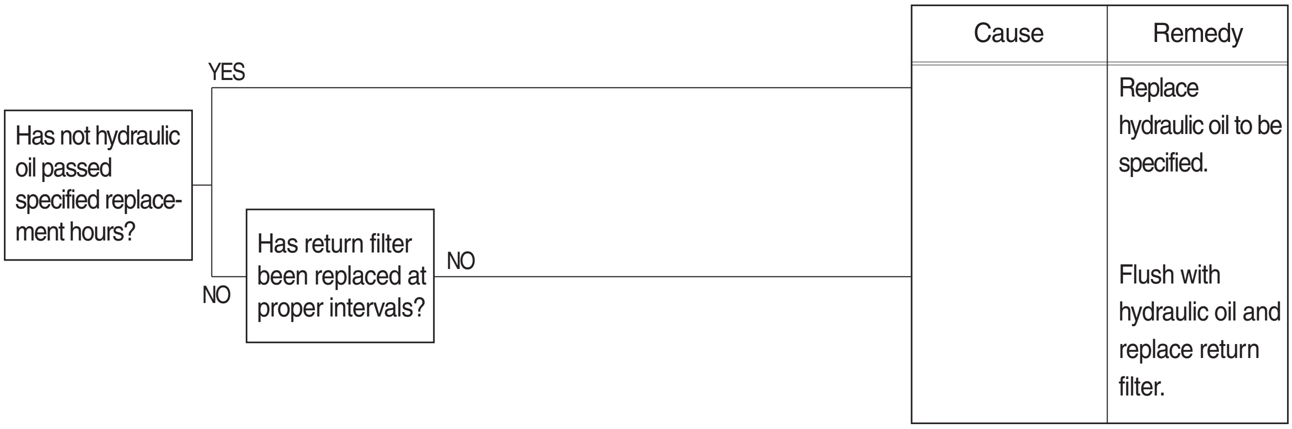
2) HYDRAULIC OIL TEMPERATURE HAS RISEN ABNORMALLY



3) CAVITATION OCCURS WITH PUMP

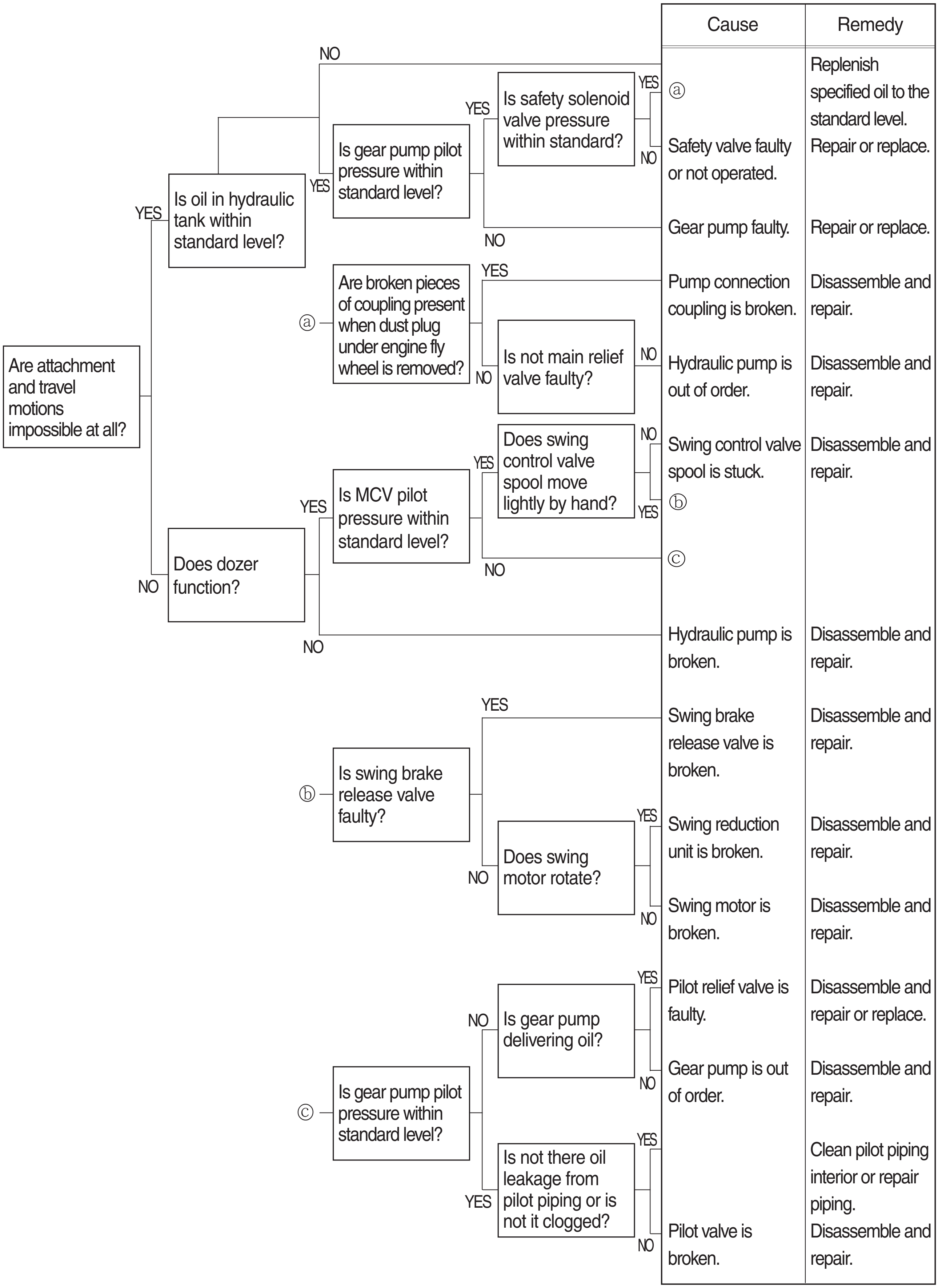


4) HYDRAULIC OIL IS CONTAMINATED

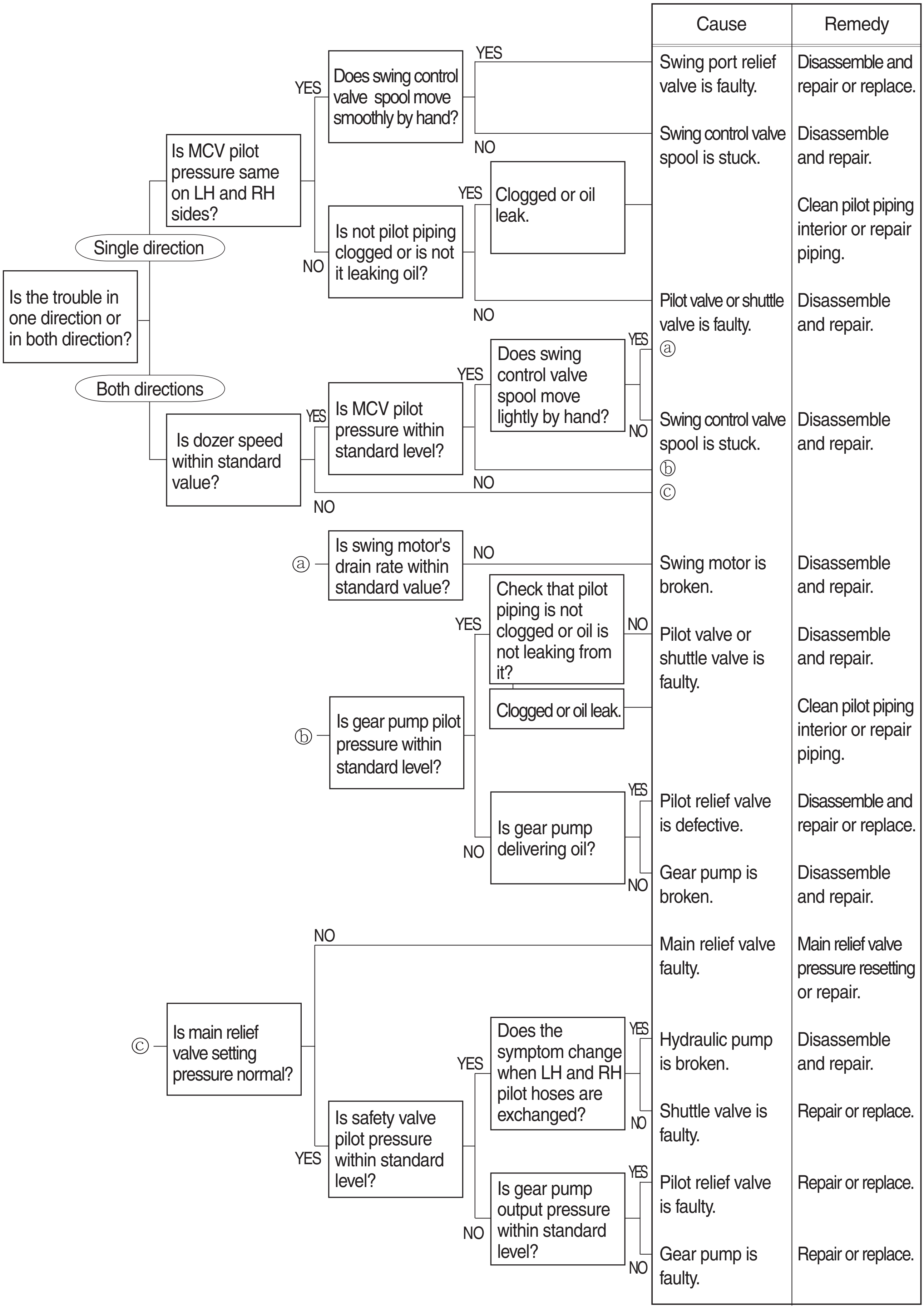


4. SWING SYSTEM

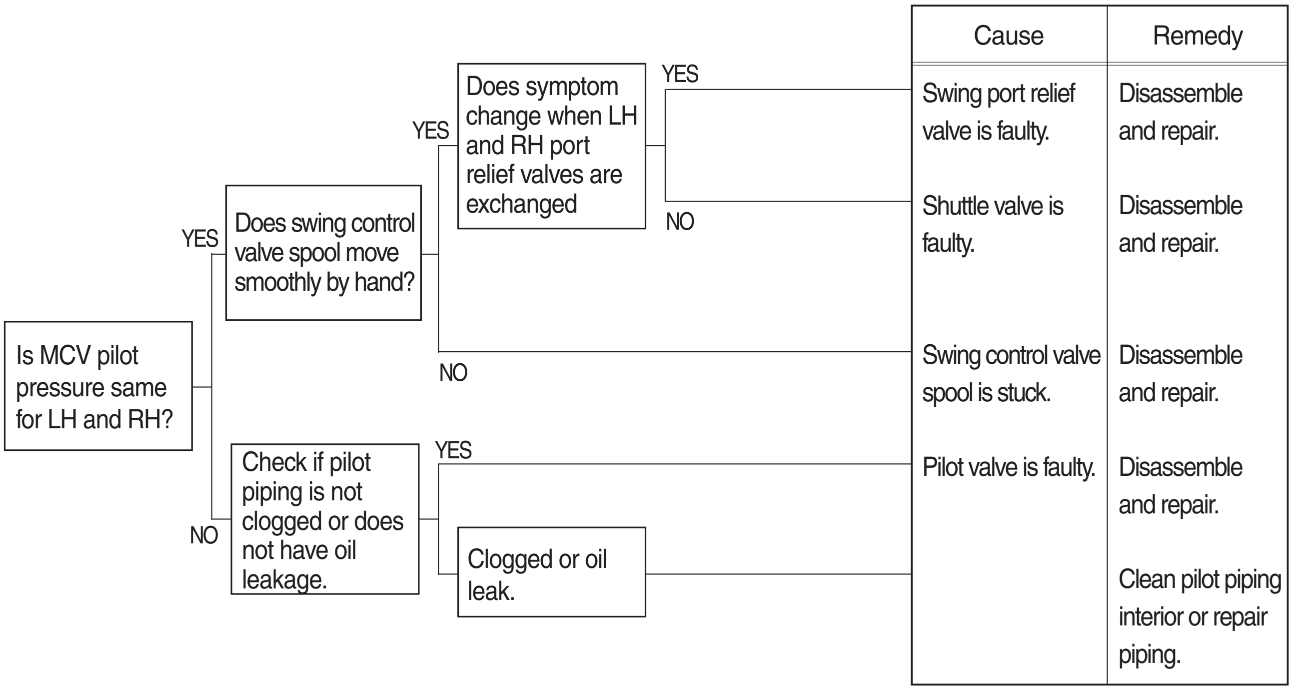
1) BOTH LH AND RH SWING ACTIONS ARE IMPOSSIBLE



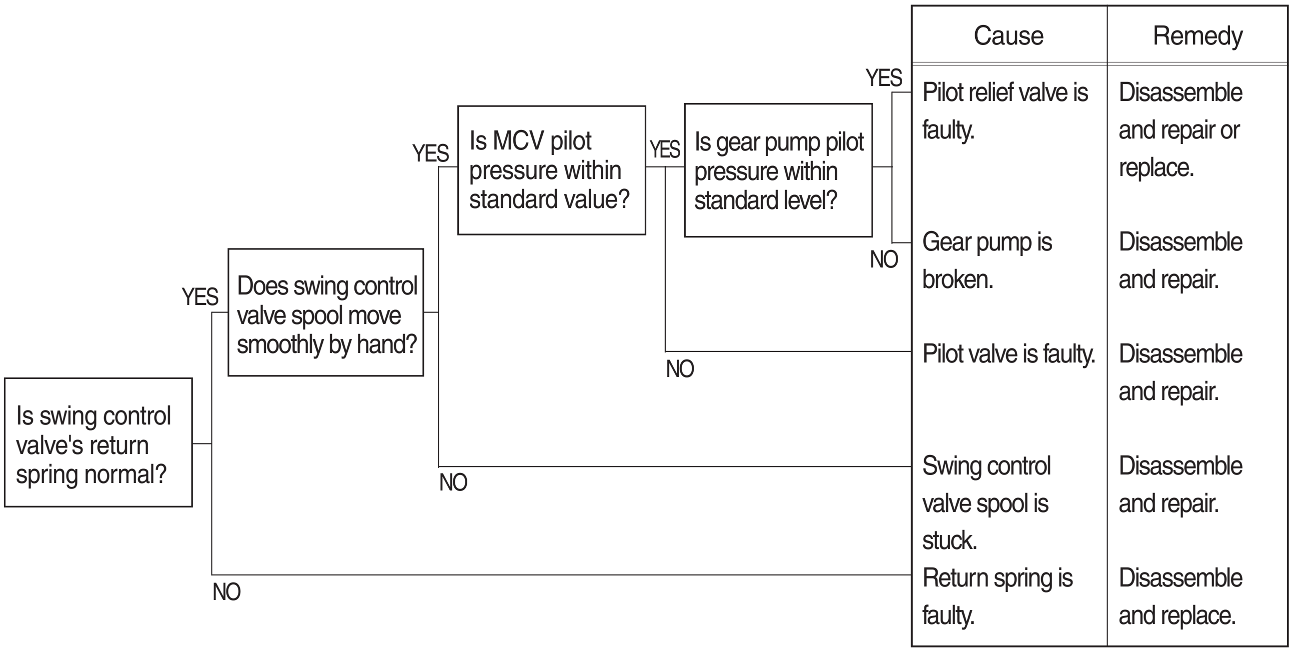
2) SWING SPEED IS LOW



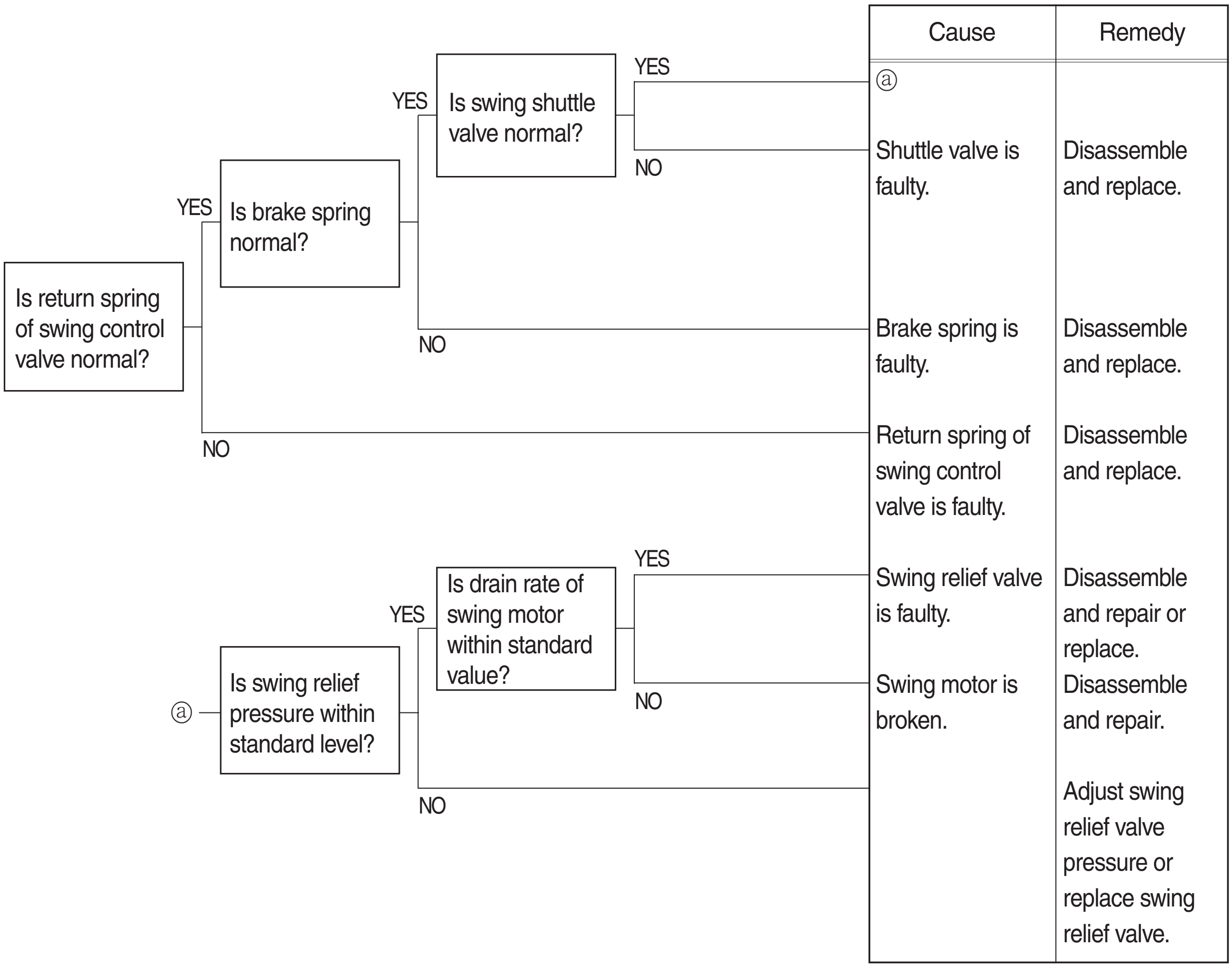
3) SWING MOTION IS IMPOSSIBLE IN ONE DIRECTION



4) MACHINE SWINGS BUT DOES NOT STOP

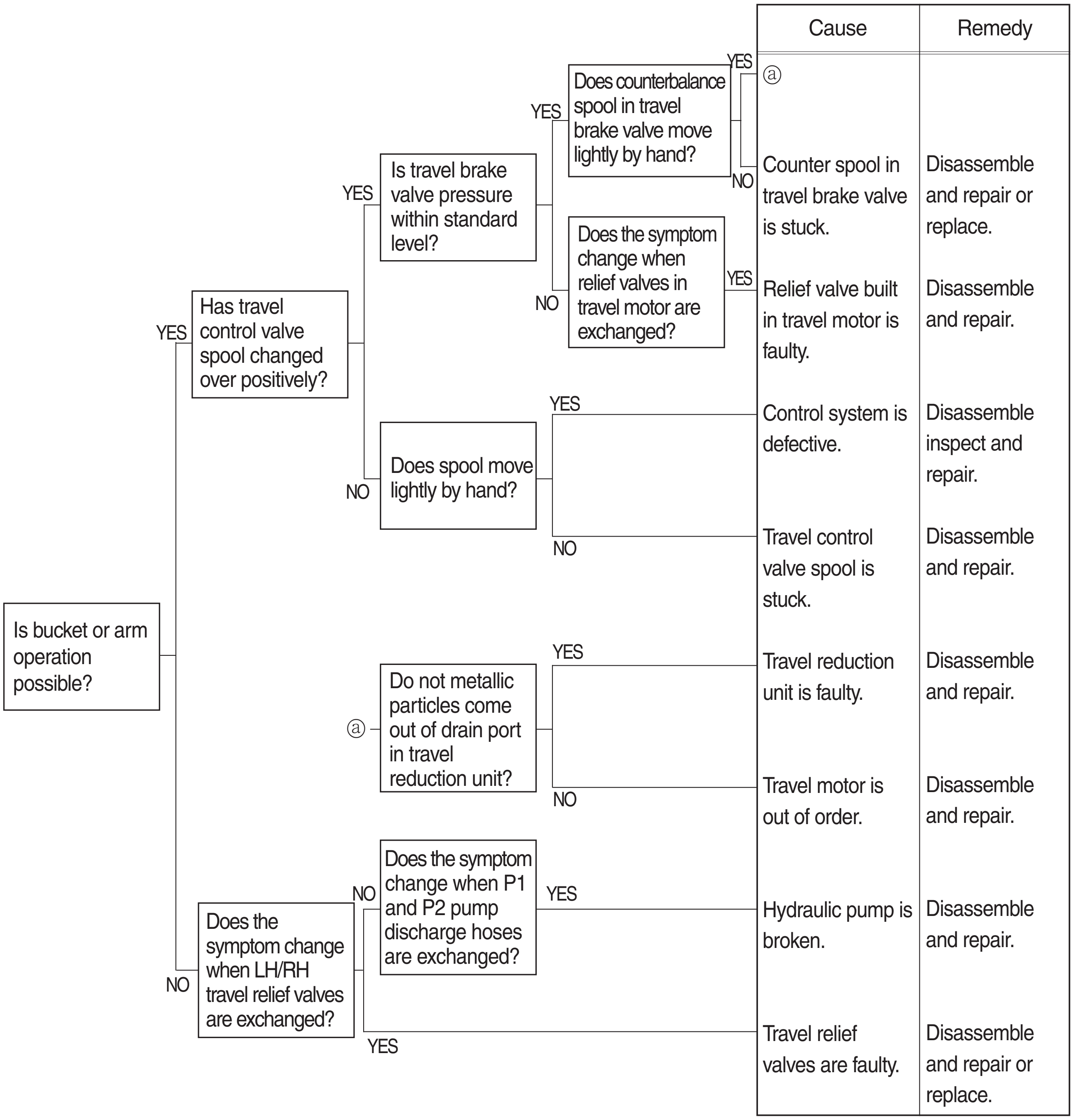


5) THE SWING UNIT DRIFTS WHEN THE MACHINE IS AT REST ON A SLOPE

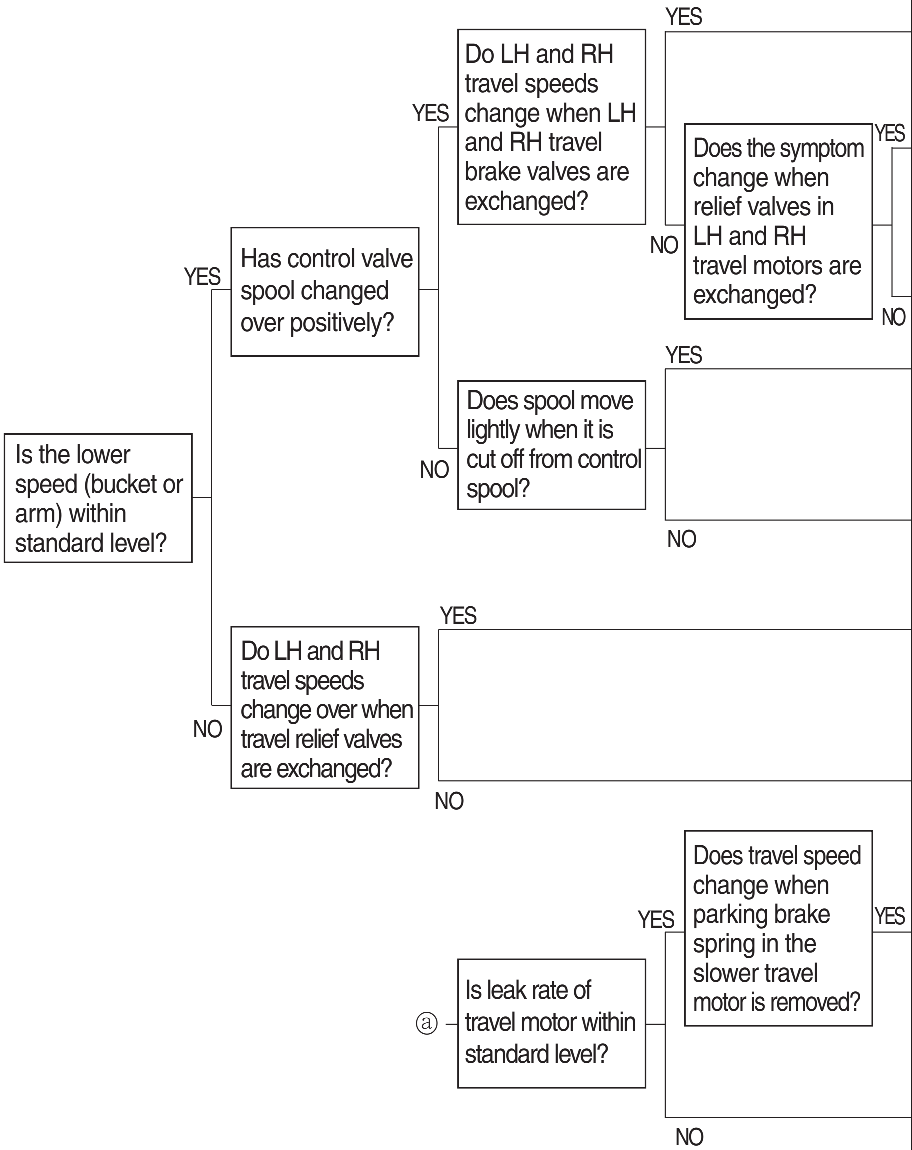


5. TRAVEL SYSTEM

1) TRAVEL DOES NOT FUNCTION AT ALL ON ONE SIDE



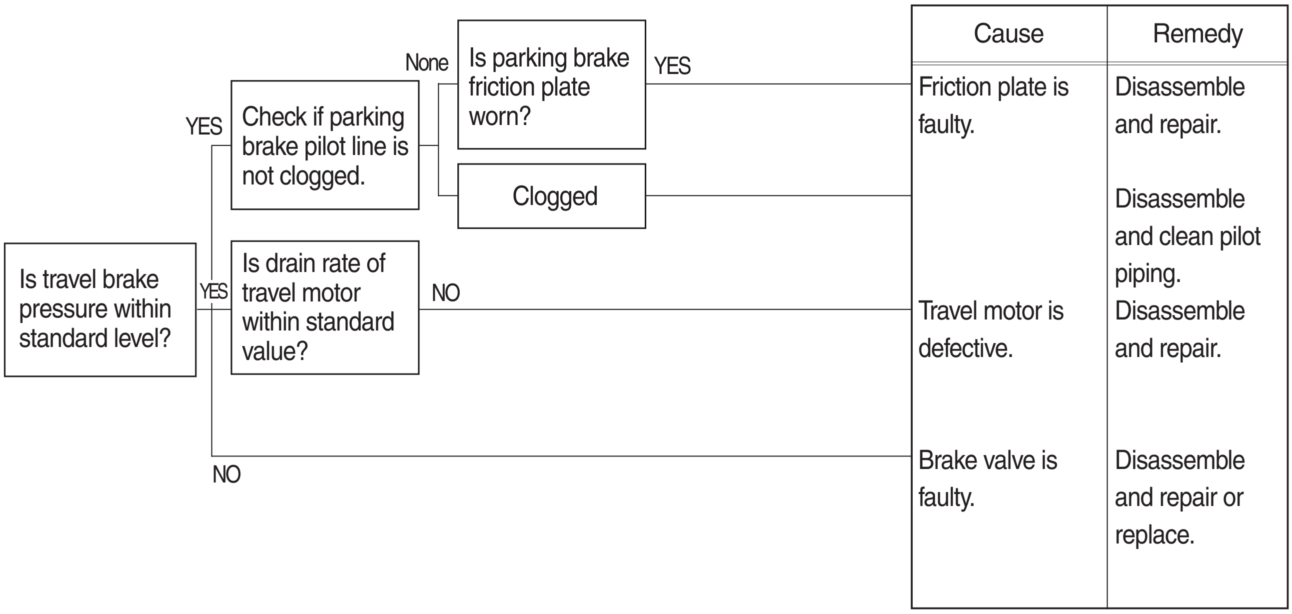
2) SPEED ON ONE SIDE FALLS AND THE MACHINE CURVES



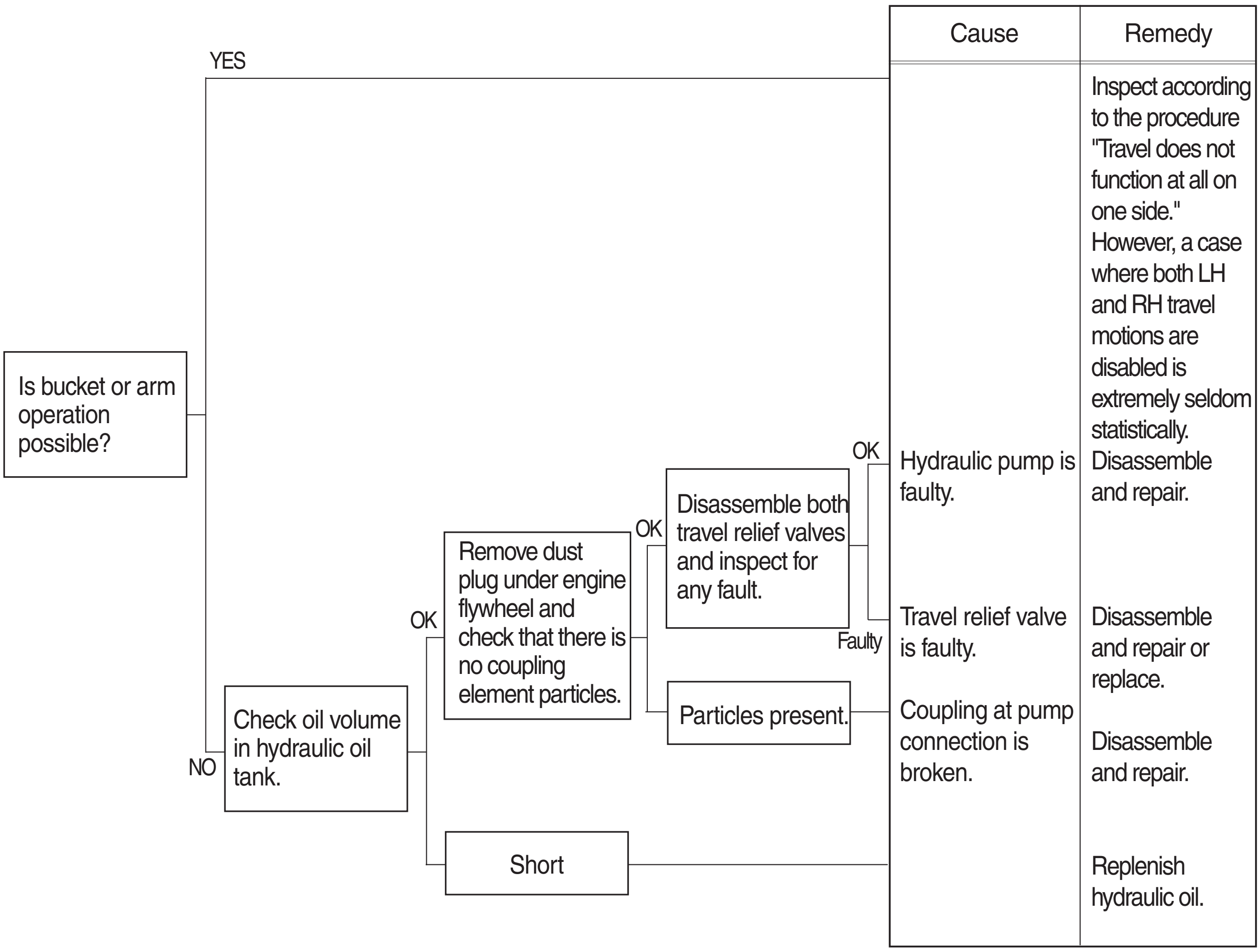
Cause	Remedy
Brake valve is defective.	Disassemble and repair or replace.
Relief valve built in travel motor is faulty.	Disassemble and repair.
Control system is faulty .	Disassemble, inspect and repair.
Control valve spool is stuck.	Disassemble and repair.
Travel relief valve is faulty.	Disassemble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

3) MACHINE DOES NOT STOP ON A SLOPE

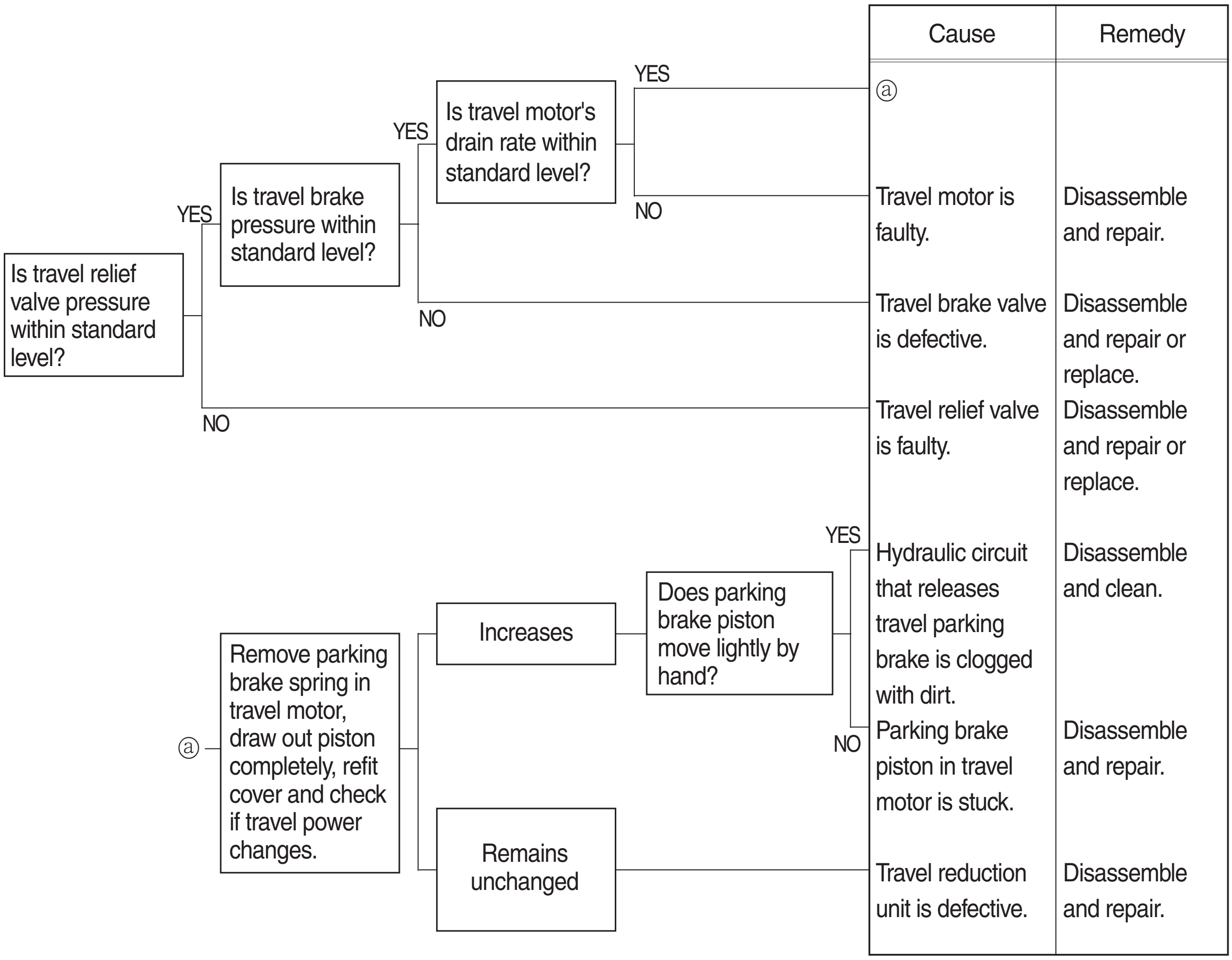
Machine is pulled forward as sprocket rotates during digging operation.



4) LH AND RH TRAVEL MOTIONS ARE IMPOSSIBLE

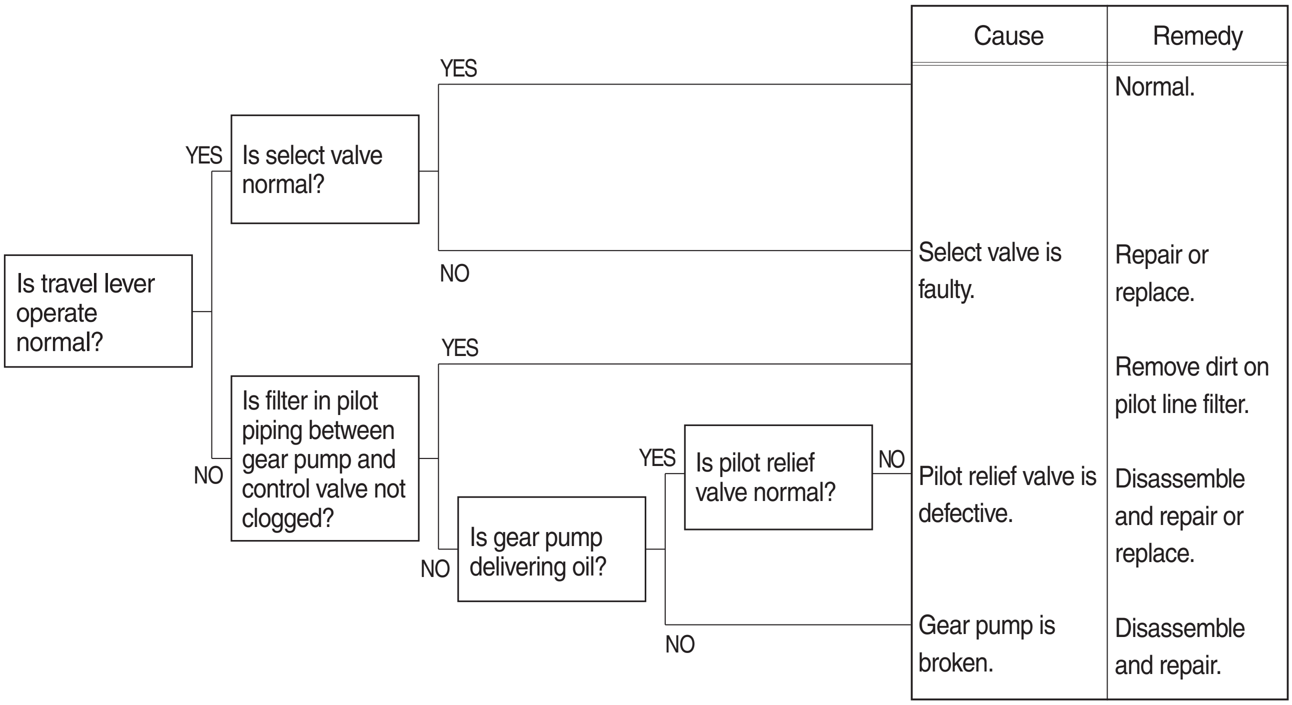


5) TRAVEL ACTION IS POWERLESS (travel only)



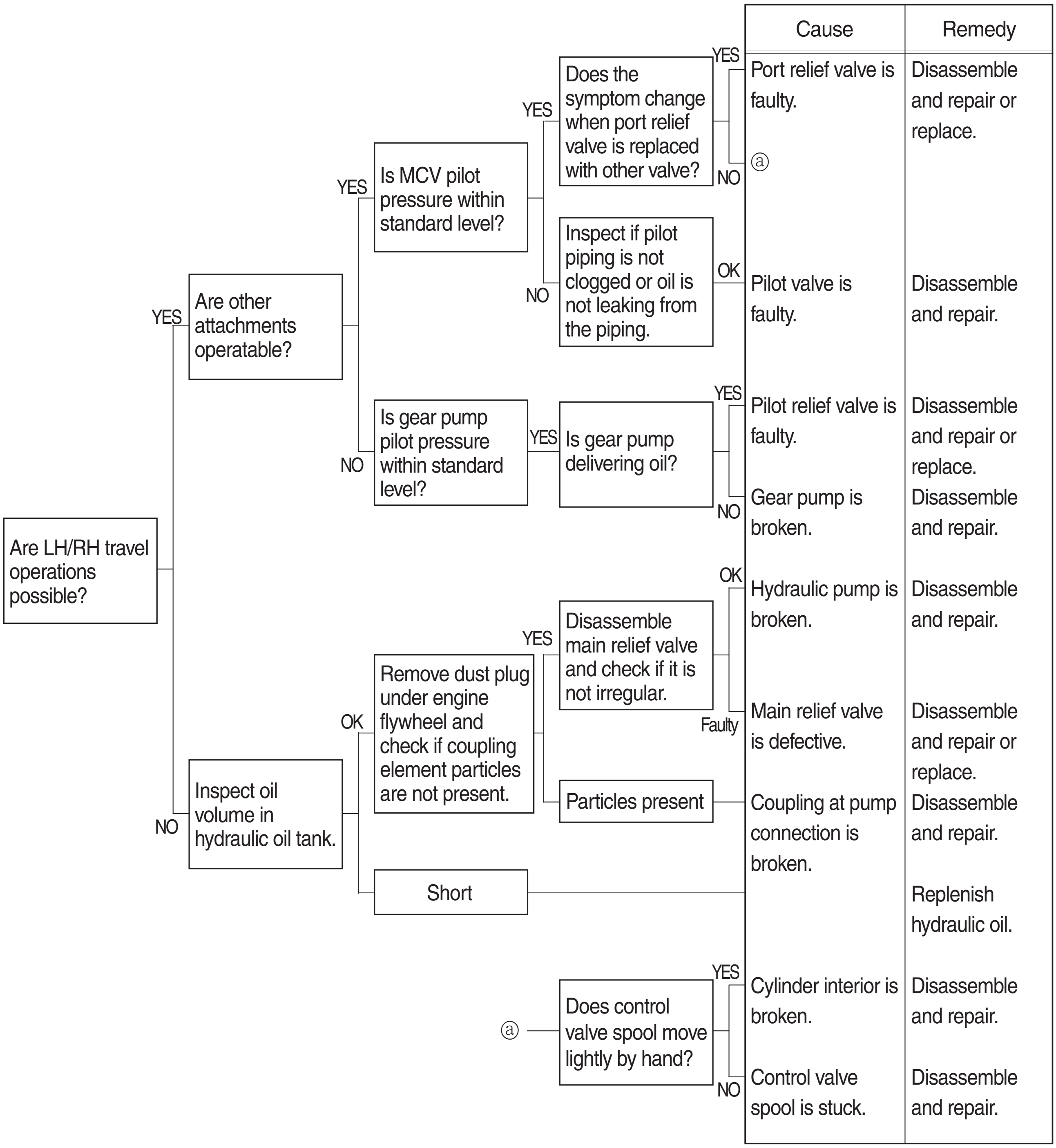
6) MACHINE RUNS RECKLESSLY ON A SLOPE

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

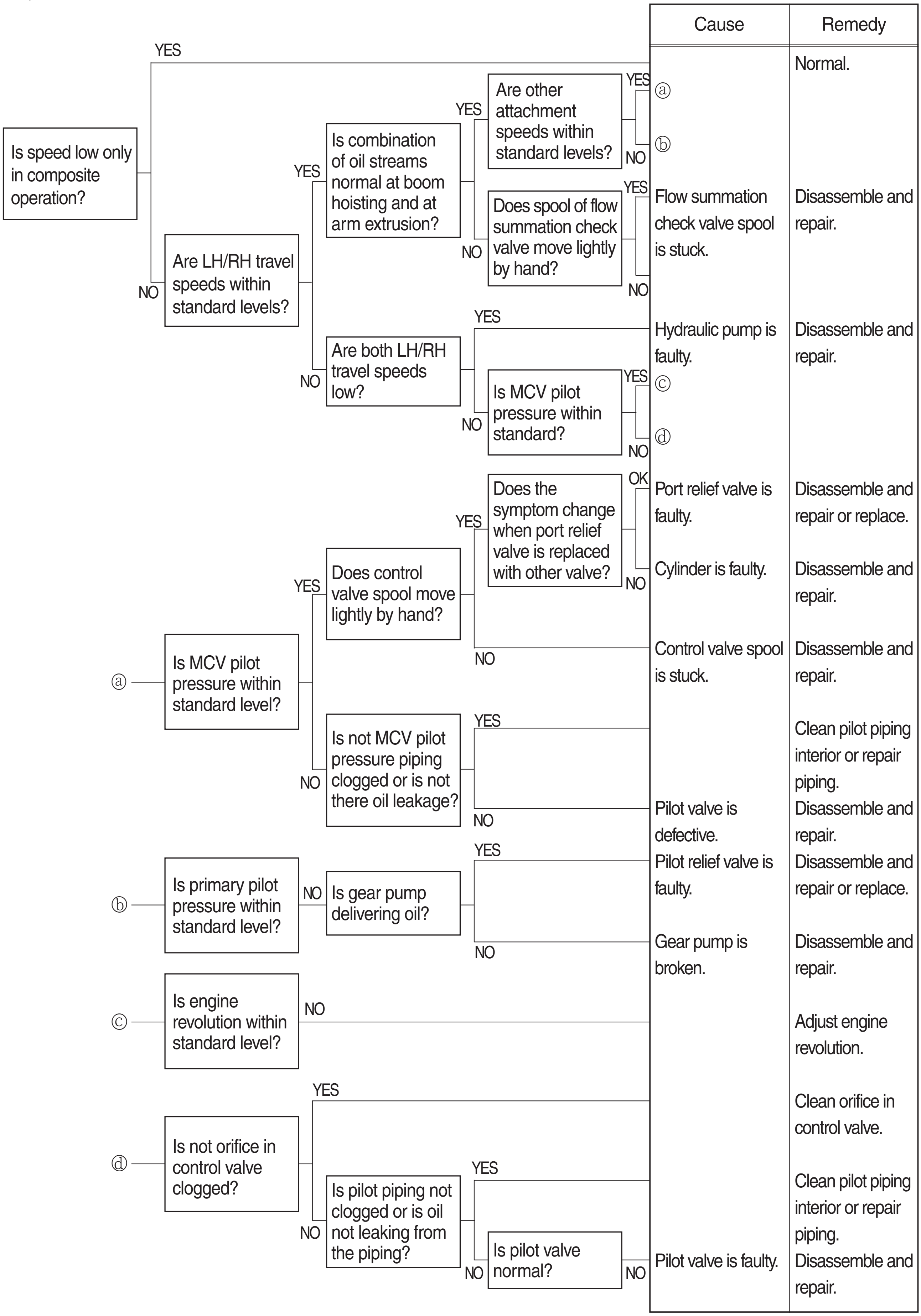


6. ATTACHMENT SYSTEM

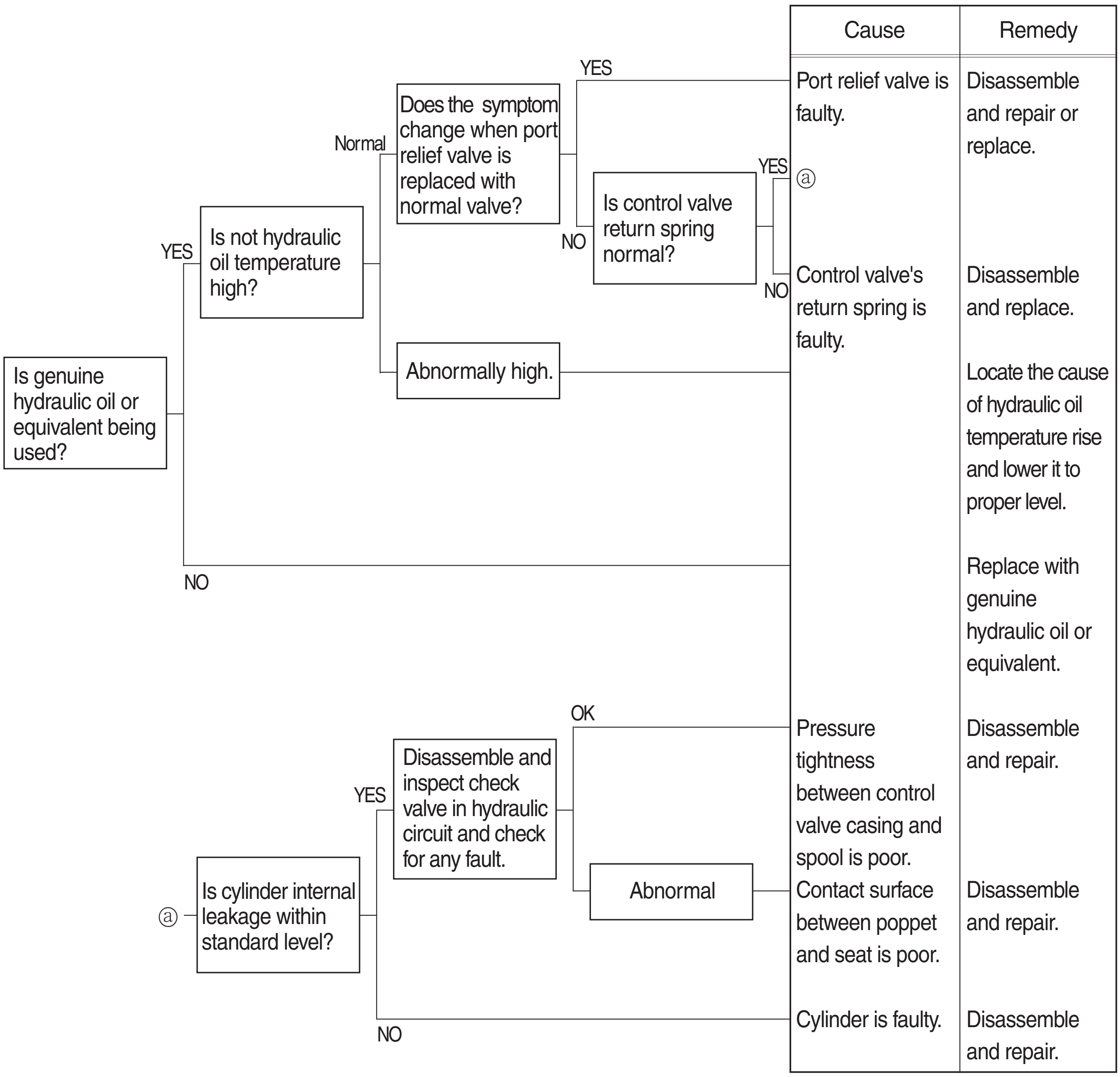
1) BOOM OR ARM ACTION IS IMPOSSIBLE AT ALL



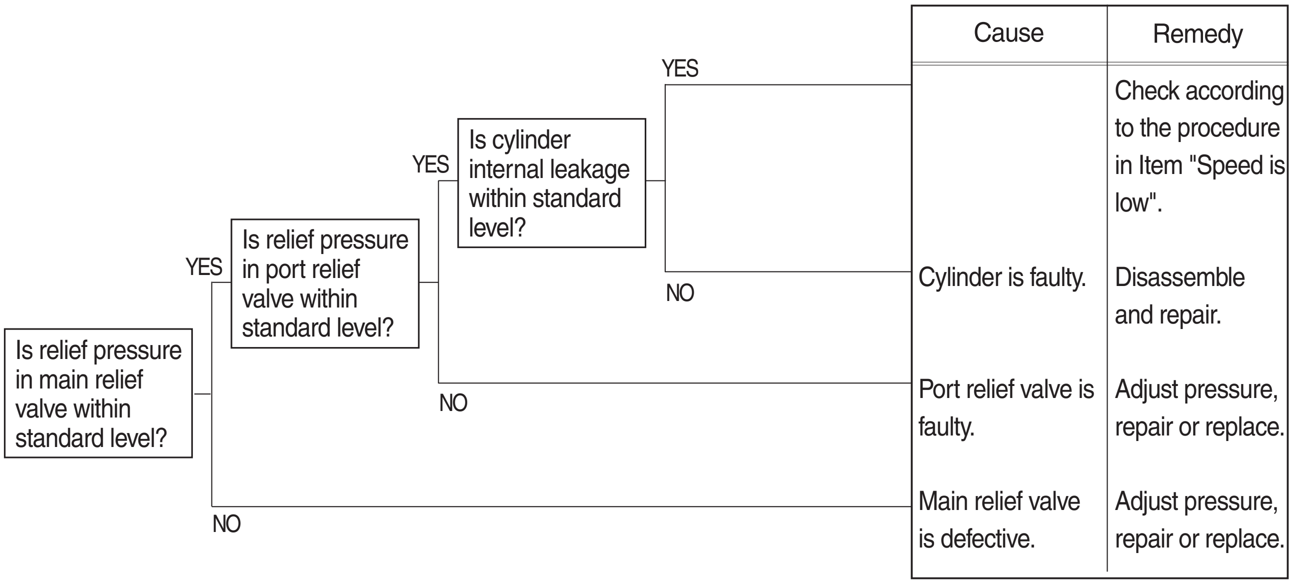
2) BOOM, ARM OR BUCKET SPEED IS LOW



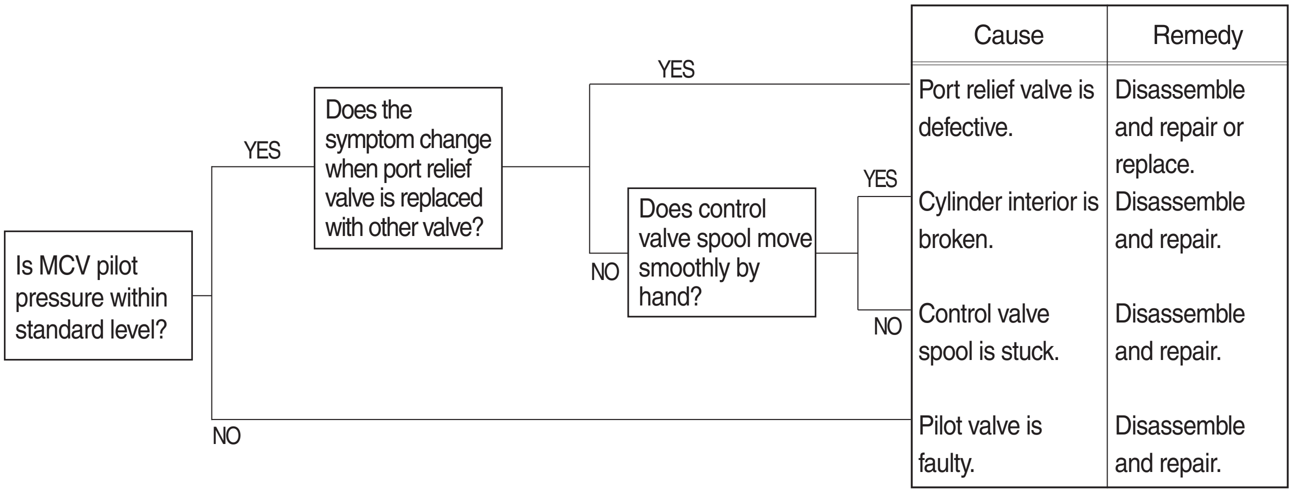
3) BOOM, ARM OR BUCKET CYLINDER EXTENDS OR CONTRACTS ITSELF AND ATTACHMENT FALLS



4) BOOM, ARM OR BUCKET POWER IS WEAK



5) ONLY BUCKET OPERATION IS TOTALLY IMPOSSIBLE



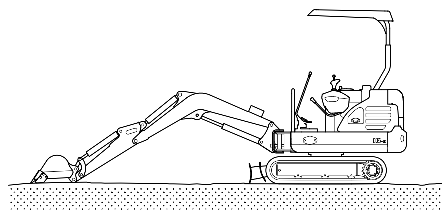
6) BOOM MAKES A SQUEAKING NOISE WHEN BOOM IS OPERATED

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.

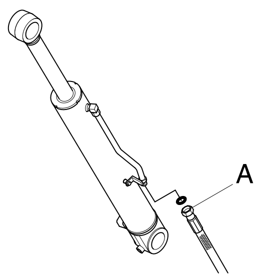
※ HOW TO CHECK INTERNAL BOOM CYLINDER LEAKAGE

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



1696MA01

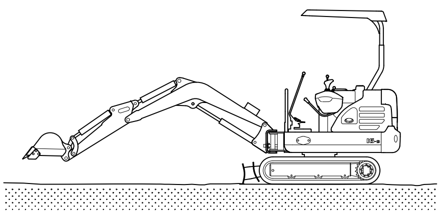
2. Disconnect hose (A) from rod side of boom cylinder and drain oil from cylinders and hose. (Put cups on piping and hose ends)



R5575BY02

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

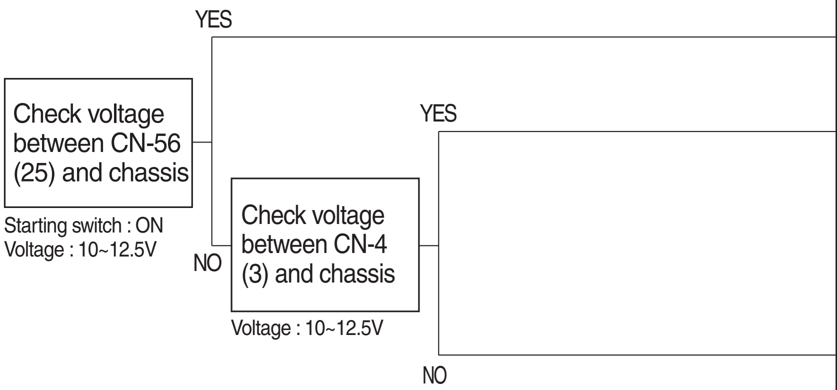
   If oil leaks from piping side and boom cylinder rod is retracted there is an internal leak in the cylinder.
   If no oil leaks from piping side and boom cylinder rod is retracted, there is an internal leak in the control valve.



1695TS01

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

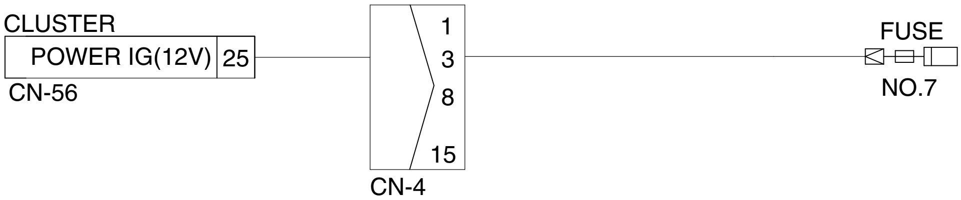
· Before disconnecting the connector, always turn the starting switch OFF.
· Before carrying out below procedure, check all the related connectors are properly inserted and short of fuse No. 7.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.



Cause	Remedy
Defective cluster	Replace
Disconnection in wiring harness or poor contact between CN-56 (25) and CN-4(3)	Repair or replace (after clean)
Disconnection in wiring harness or poor contact between CN-4(3) and fuse No.7	Repair or replace (after clean)

Check voltage

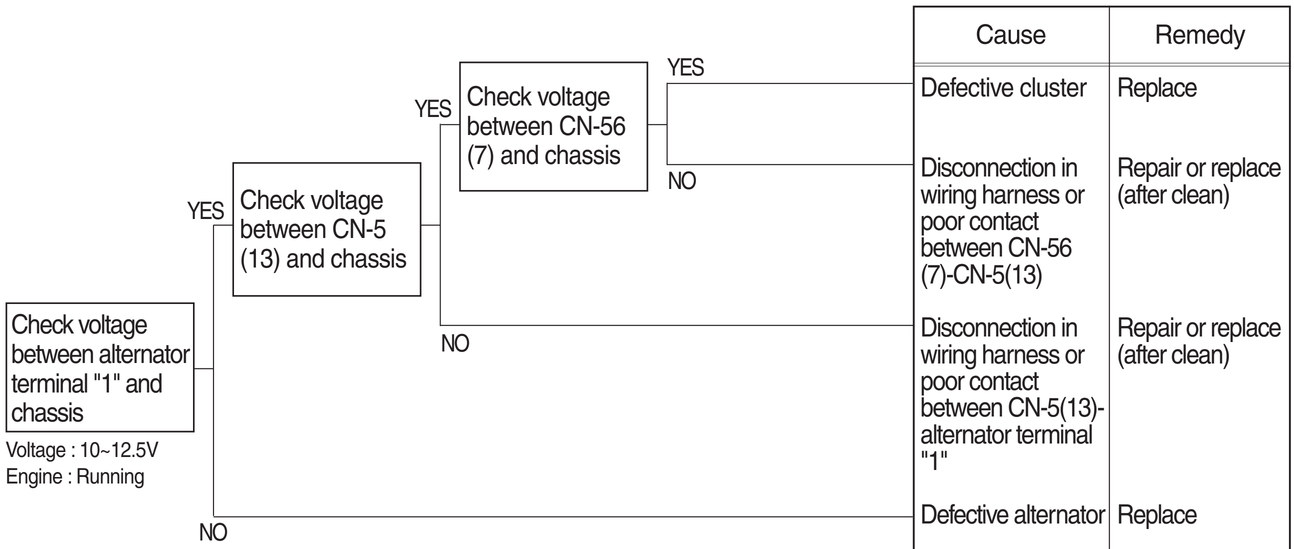
YES	10 ~ 12.5V
NO	0V



17Z9A5TS02

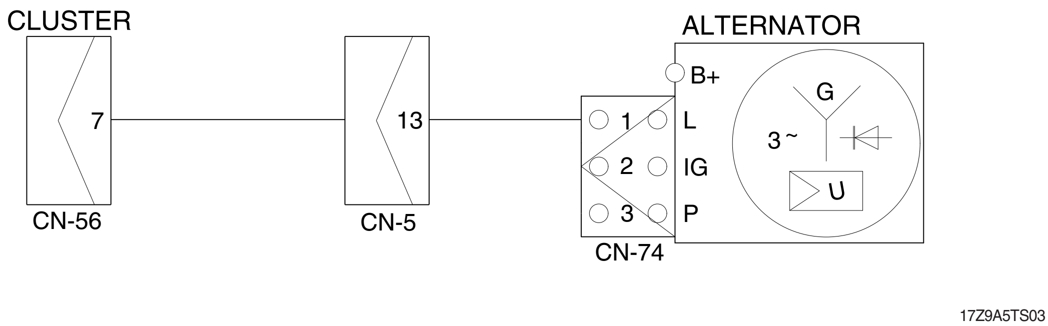
2. BATTERY CHARGING WARNING LAMP LIGHTS UP (starting switch : ON)

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



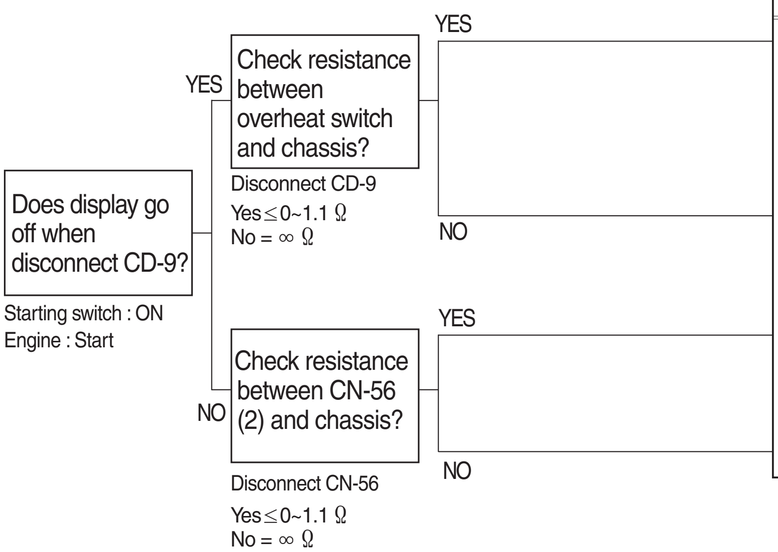
Check voltage

YES	10 ~ 12.5V
NO	0V



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

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

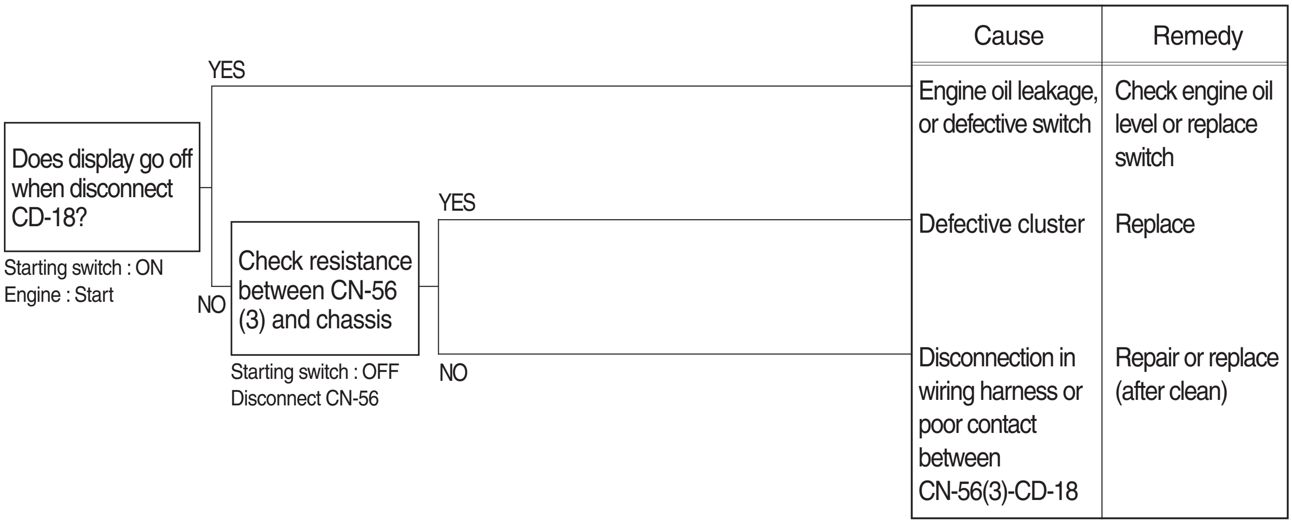


Cause	Remedy
Coolant overheat (115°C ±2°C)	Check engine cooling system or replace temp switch
Defective overheat switch	Repair or replace the detector
Short circuit in wiring harness	Repair or replace (after clean)
Defective cluster	Replace

17Z9A5TS04

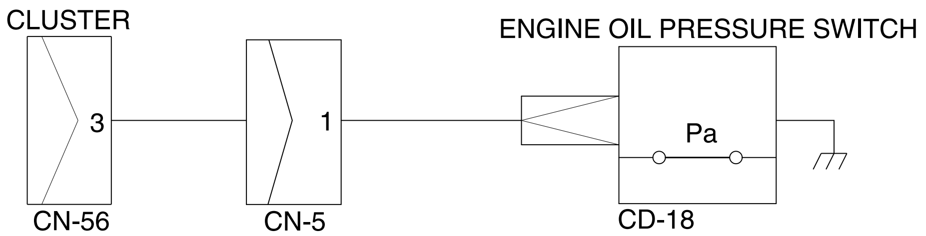
4. WHEN ENGINE OIL PRESSURE WARNING LAMP LIGHTS UP (Engine is started)

· 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

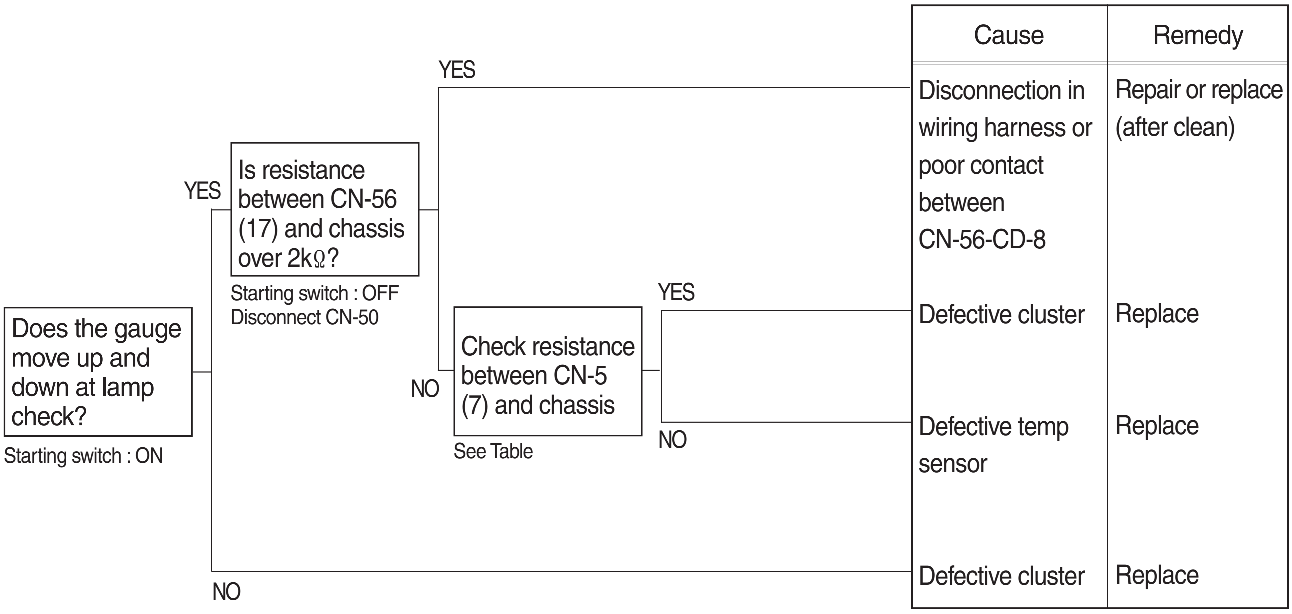
YES	MAX 1Ω
NO	MIN 1MΩ

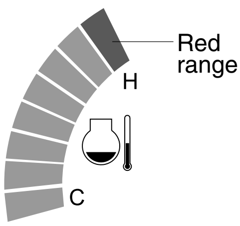


1695TS06

5. WHEN COOLANT TEMPERATURE GAUGE DOES NOT OPERATE

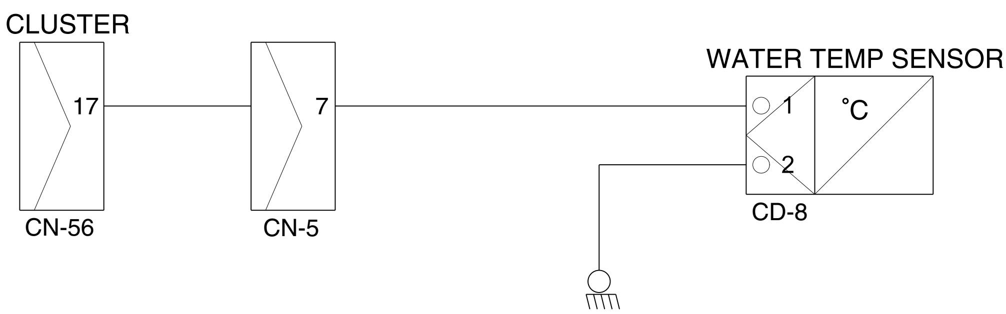
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

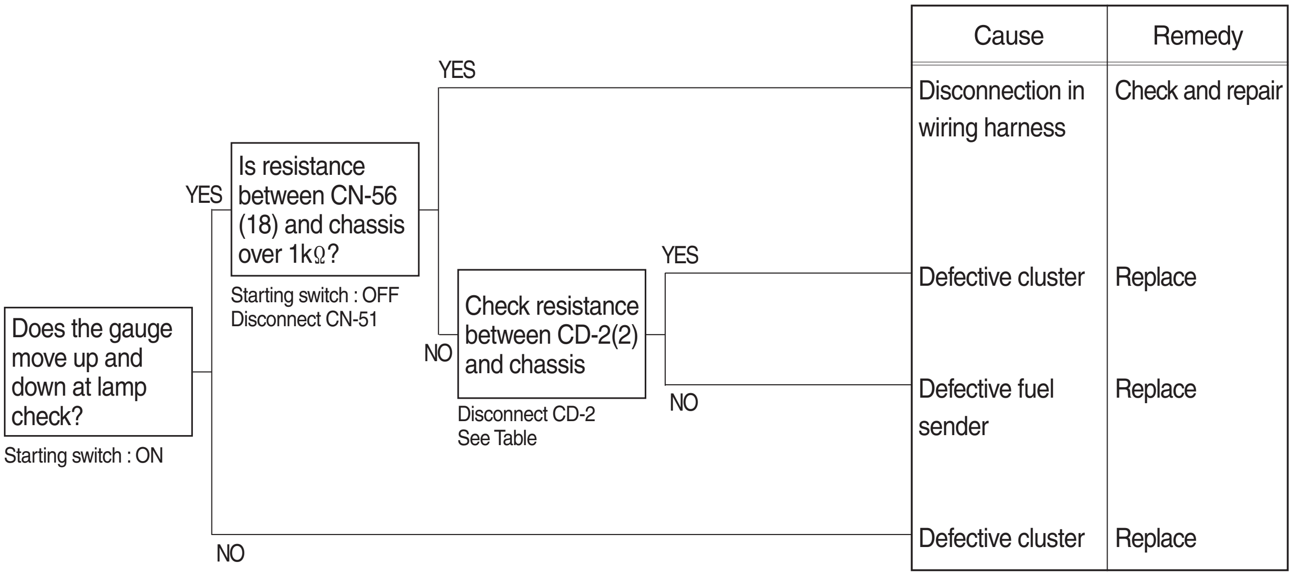
Item \ Temperature	50˚C	80˚C	100˚C	115˚C (red range)
Unit resistance (Ω)	350	118	63.5	36.2

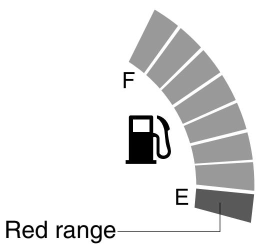


17Z9A5TS07

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

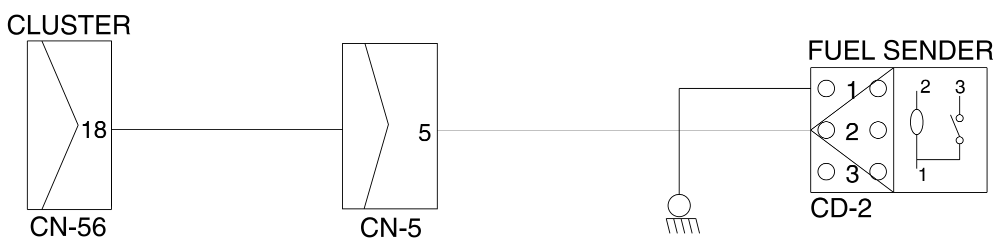
- Before disconnecting the connector, always turn the starting switch OFF.
- Before carrying out below procedure, check all the related connectors are properly inserted.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.





Check Table

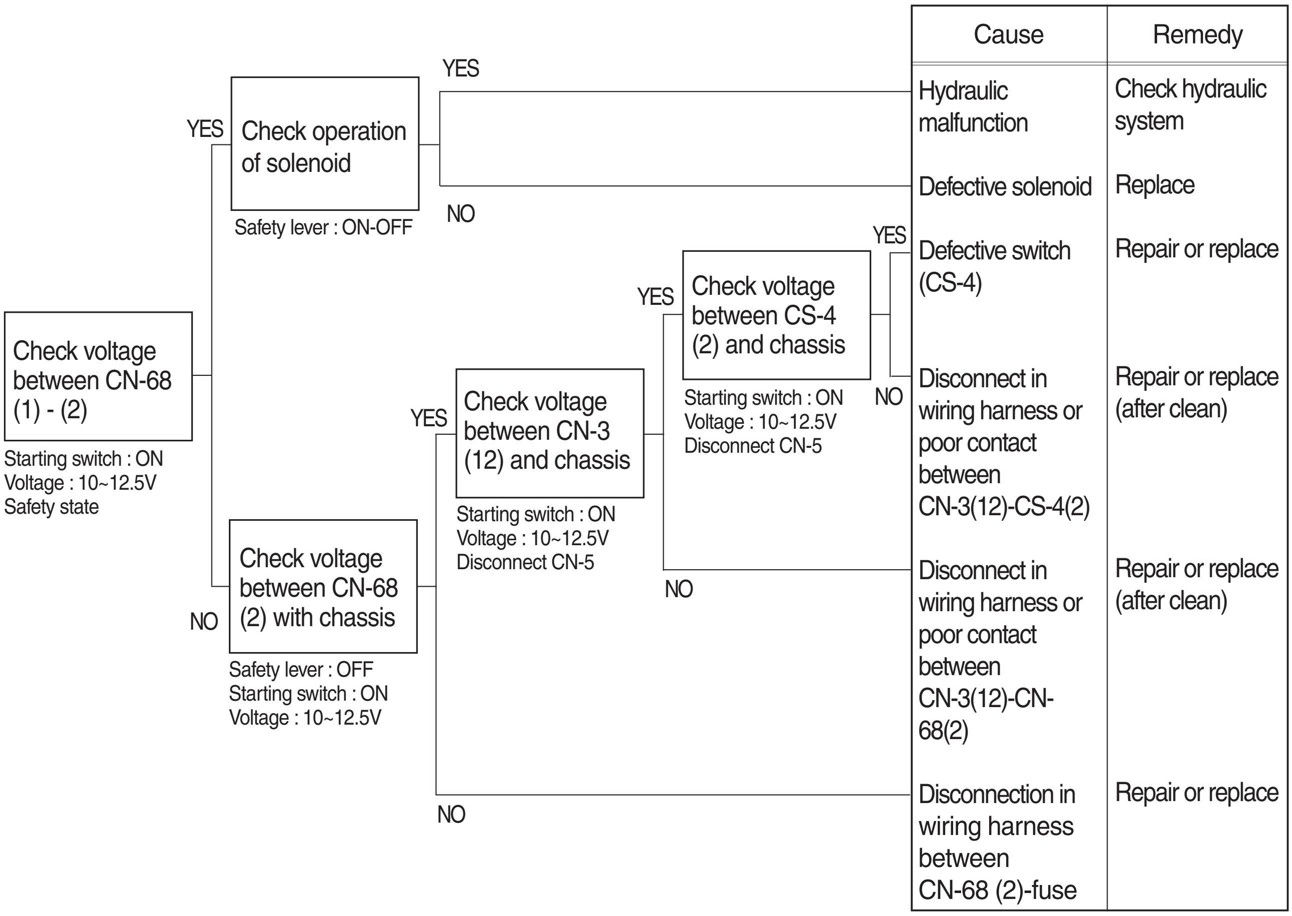
Item \ Temperature	Empty	1/2	Full
Unit resistance (Ω)	90	38	10

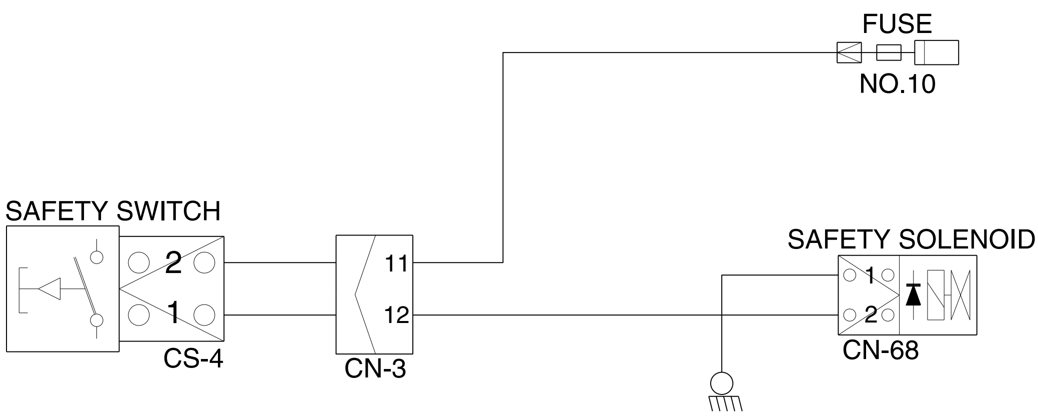


17Z9A5TS08

7. 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.10.
- After checking, insert the disconnected connectors again immediately unless otherwise specified.

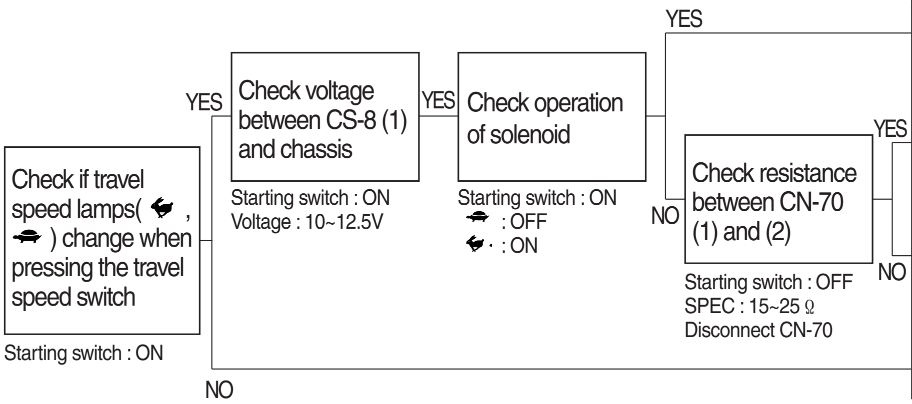




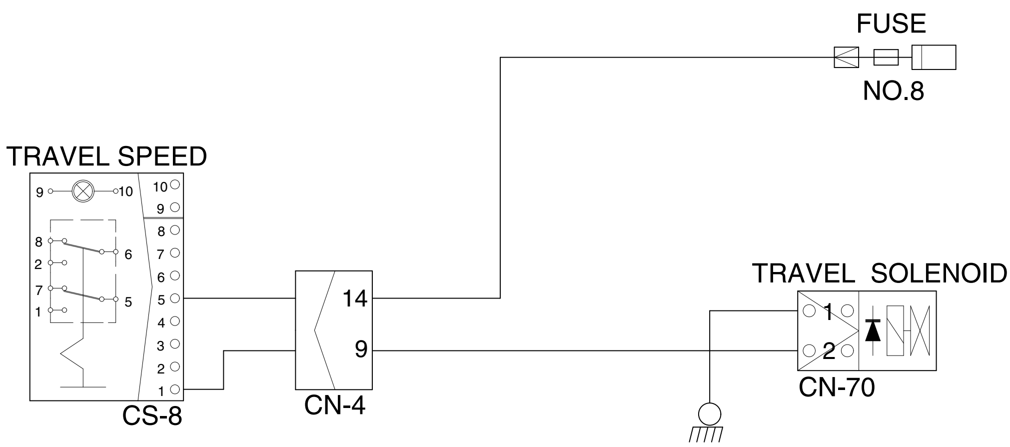
17Z9A5TS20

8. WHEN TRAVEL SPEED 1, 2 DOES NOT OPERATE

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



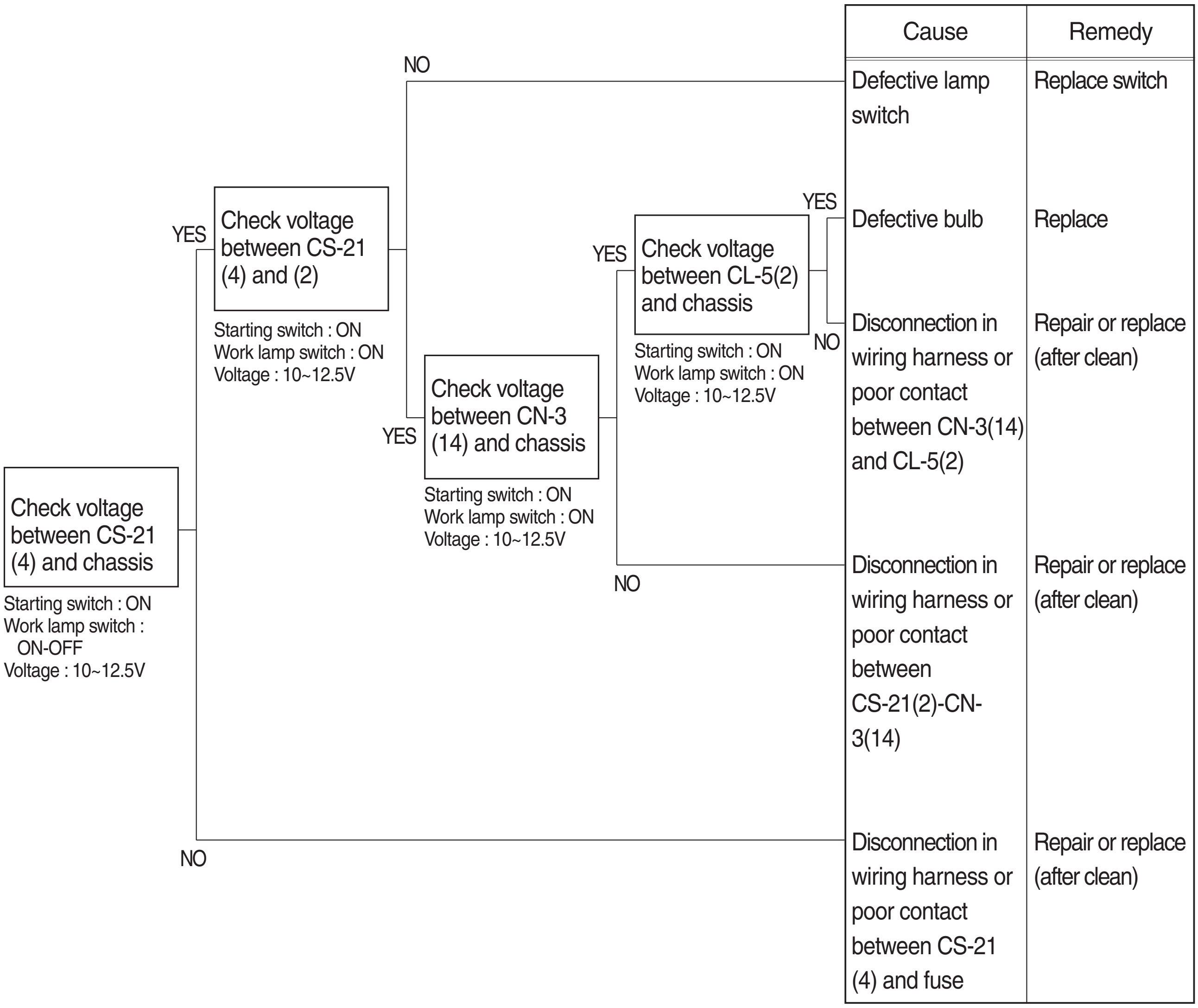
Cause	Remedy
Defective hydraulic system	Check hydraulic system
Defective cluster	Replace
Defective solenoid	Replace
Defective switch	Replace

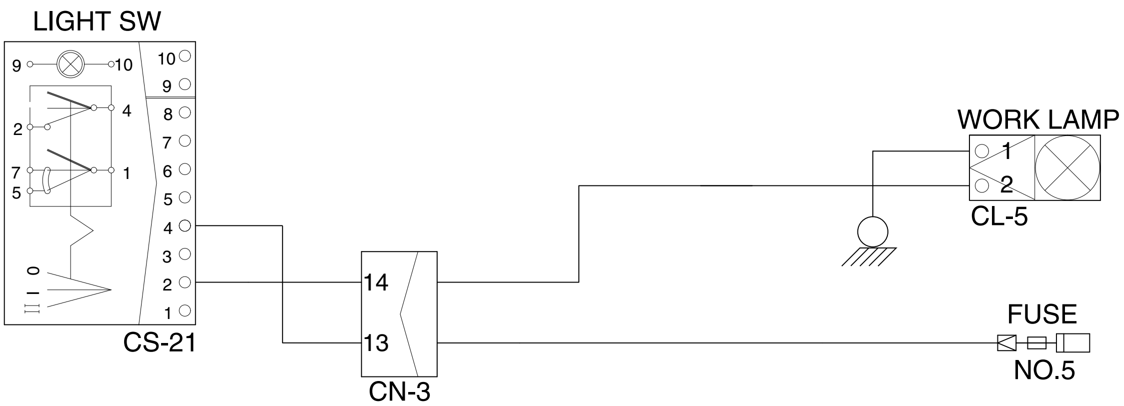


17Z9A5TS21

9. 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.5.
· After checking, insert the disconnected connectors again immediately unless otherwise specified.

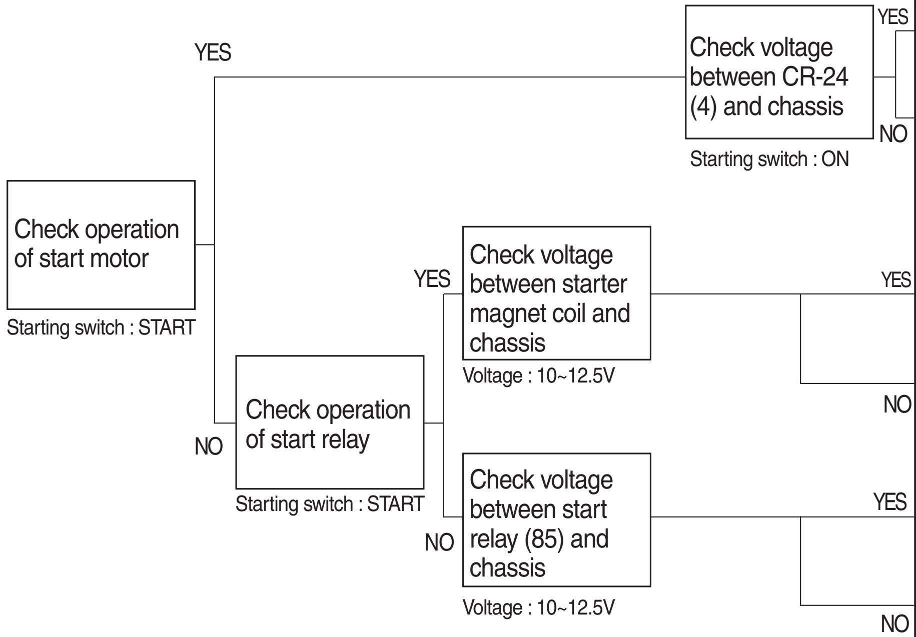




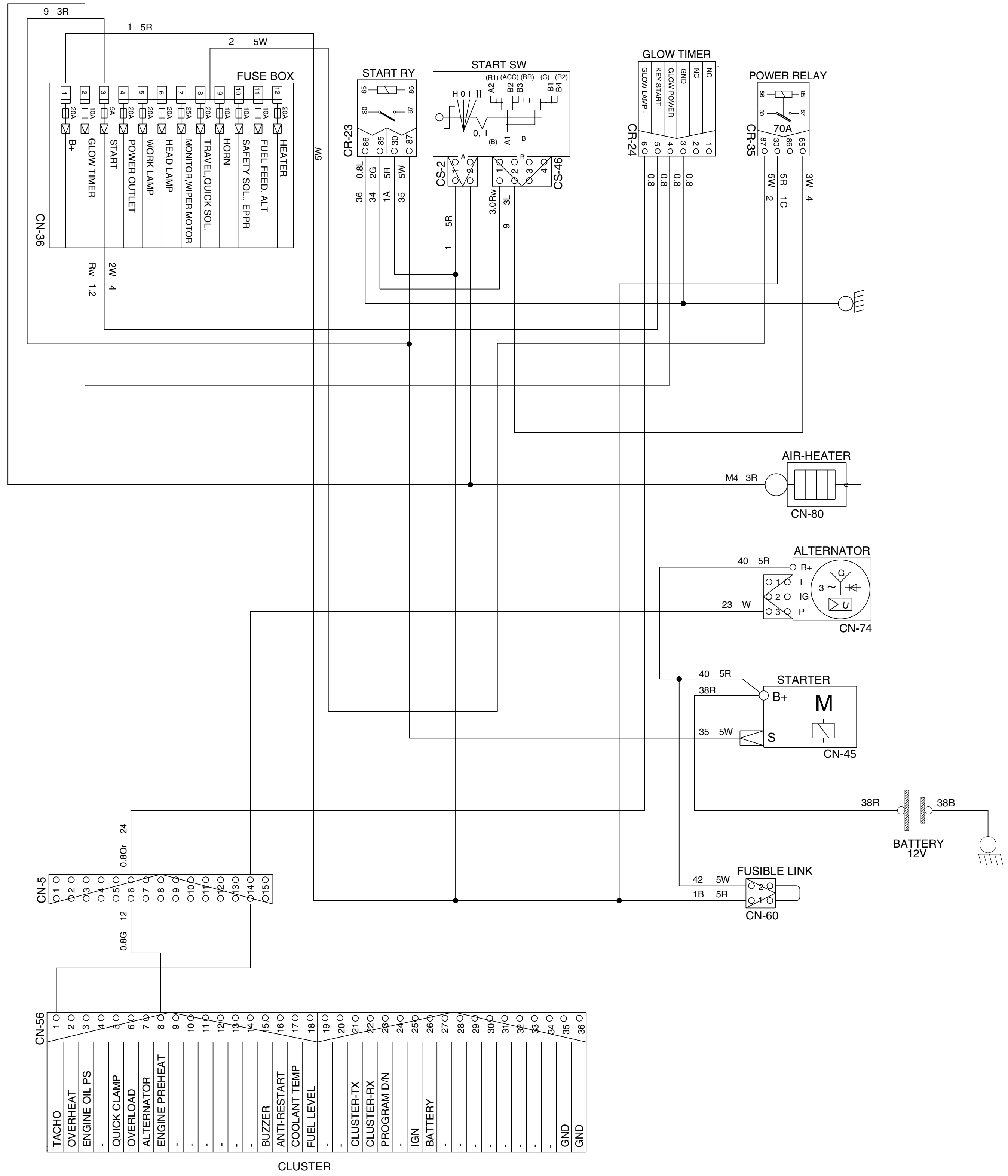
17Z9A5TS12

10. WHEN ENGINE DOES NOT START

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



Cause	Remedy
Defective timer	Repair or replace Timer
Disconnection in wiring harness or poor contact between CR-24 (4) and fuse box	Repair or replace fuel cut off relay or repair or replace (after clean)
Defective magnet of start motor	Repair or replace start motor
Defective start relay	Repair or replace start relay
Defective start relay	Repair or replace start relay
Disconnection in wiring harness or poor contact between CR-23 (85)and CS-46 (1)	Repair or replace (after clean)



17Z9A5TS19

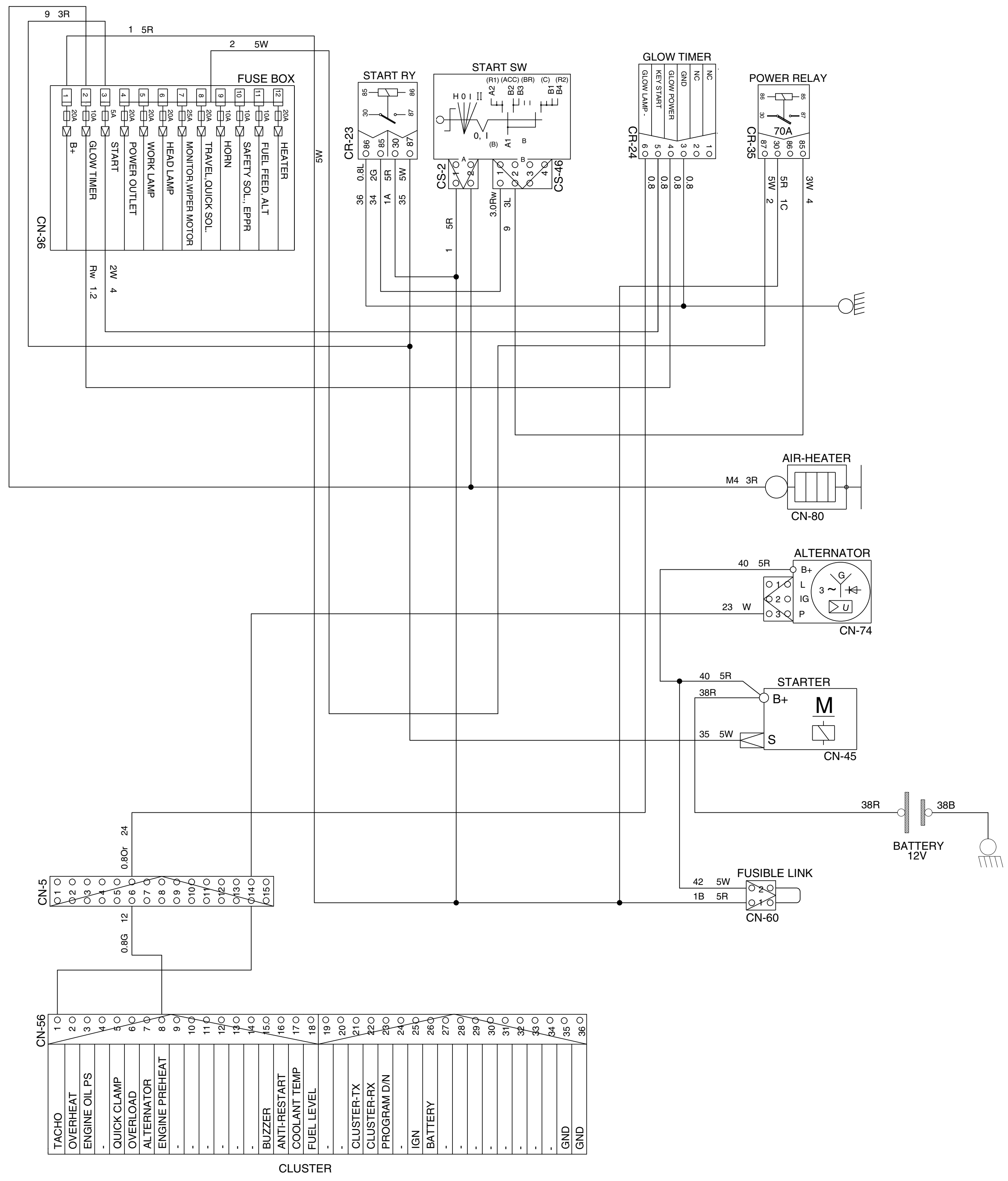
11. WHEN STARTING SWITCH ON DOES NOT OPERATE

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

Check voltage and specific gravity of battery
Specific gravity : MIN 1.28
Voltage : MIN 12V

- YES → Check voltage between CS-2 (1) and chassis
  Voltage : 10~12.5V
  - YES → Defective start switch
  - NO → Disconnection in wiring harness or poor contact between CS-2 (1)-Starter
- NO → Battery capacity too low

Cause	Remedy
Defective start switch	Replace
Disconnection in wiring harness or poor contact between CS-2 (1)-Starter	Replace
Battery capacity too low	Charge or replace (after clean)



17Z9A5TS19

SECTION 6 MAINTENANCE STANDARD

GROUP 1 OPERATIONAL PERFORMANCE TEST

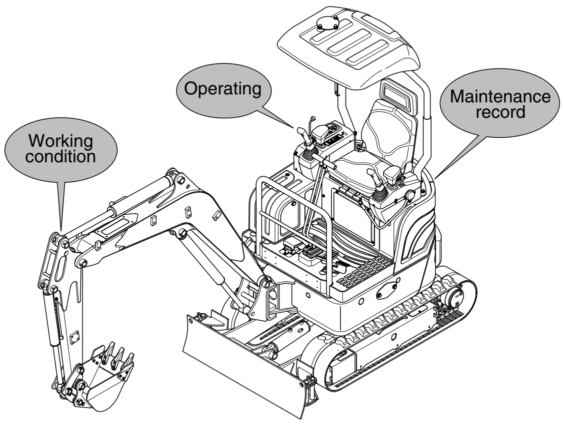
1. PURPOSE

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.

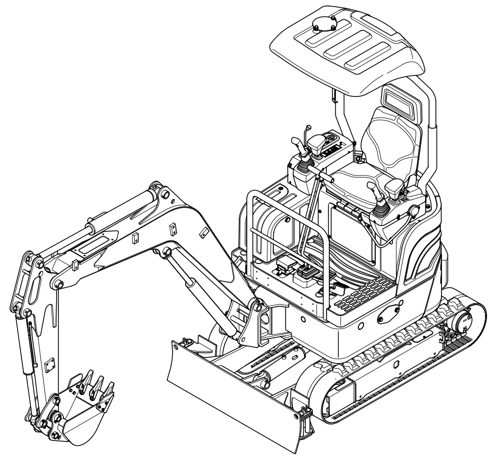


17Z9A6MS01

2. TERMINOLOGY

1) STANDARD

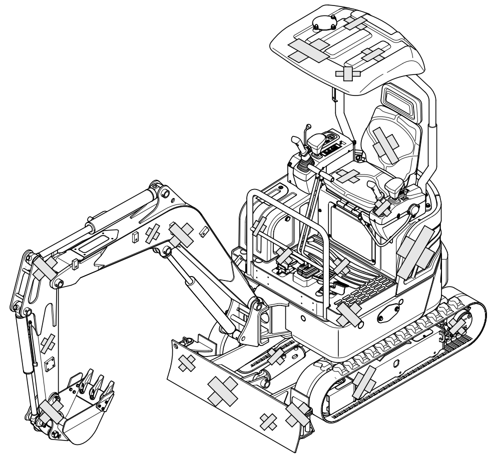
Specifications applied to the brand-new machine, components and parts.



17Z9A6MS02

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.



17Z9A6MS03

3. OPERATION FOR PERFORMANCE TESTS

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

(1) The machine

Repair any defects and damage found, such as oil or water leaks, loose bolts, cracks and so on, before starting to test.

(2) Test area

① Select a hard, flat surface.

② Secure enough space to allow the machine to run straight more than 20m, and to make a full swing with the front attachment extended.

③ If required, rope off the test area and provide signboards to keep unauthorized personnel away.

(3) Precautions

① Before starting to test, agree upon the signals to be employed for communication among coworkers. Once the test is started, be sure to communicate with each other using these signals, and to follow them without fail.

② Operate the machine carefully and always give first priority to safety.

③ While testing, always take care to avoid accidents due to landslides or contact with high voltage power lines. Always confirm that there is sufficient space for full swings.

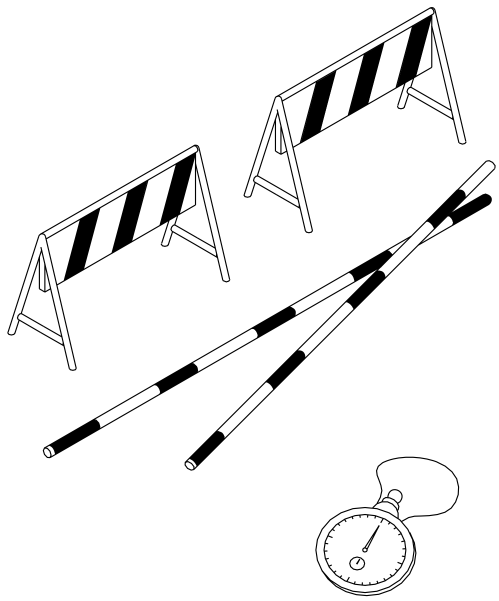
④ Avoid polluting the machine and the ground with leaking oil. Use oil pans to catch escaping oil. Pay special attention to this when removing hydraulic pipings.

(4) Make precise measurements

① Accurately calibrate test instruments in advance to obtain correct data.

② Carry out tests under the exact test conditions prescribed for each test item.

③ Repeat the same test and confirm that the test data obtained can be procured repeatedly. Use mean values of measurements if necessary.



7-3 (140-7)

2) ENGINE SPEED

(1) Measure the engine speed at the maximum RPM.

※ The engine speed must meet standard RPM; if not, all other operational performance data will be unreliable. It is essential to perform this test first.

(2) Preparation and measurement

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 lever at the maximum stroke.

③ Measure the engine RPM.

(3) Evaluation

The measured speeds should meet the following specifications.

Unit : rpm

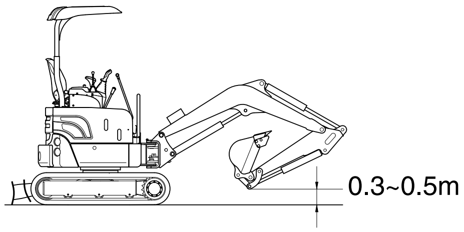
Model	Engine speed	Standard	Remarks
R17Z-9A	Low idle	1450±100	
	High idle	2600±50	

3) TRAVEL SPEED

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

(2) Preparation

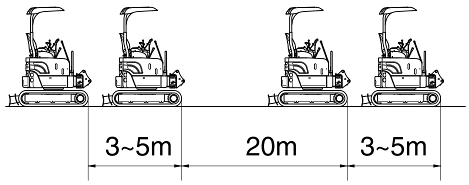
① Adjust the tension of both tracks to be equal.
② Prepare a flat and solid test track 20m in length, with extra length of 3 to 5m on both ends for machine acceleration and deceleration.
③ Hold the bucket 0.3 to 0.5m above the ground with the arm and bucket rolled in.
④ Keep the hydraulic oil temperature at 50±5°C.



17Z9A6MS04

(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.
③ Start traveling the machine in the acceleration zone with the travel levers at full stroke.
④ Measure the time required to travel 20m.
⑤ After measuring the forward travel speed, turn the upperstructure 180° and measure the reverse travel speed.
⑥ Repeat steps ④ and ⑤ three times in each direction and calculate the average values.



17Z9A6MS05

(4) Evaluation

The average measured time should meet the following specifications.

Unit : Seconds / 20m

Model	Travel speed	Standard	Maximum allowable	Remarks
R17Z-9A	1 Speed	31.3±2.0	39.1	
	2 Speed	17.1±1.0	21.4	

4) TRACK REVOLUTION SPEED

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

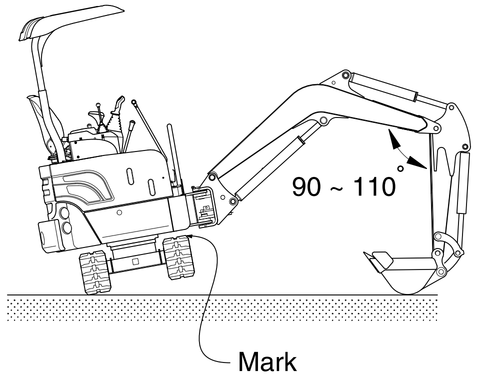
(2) Preparation

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.



17Z9A6MS06

(3) Measurement

① Select the following switch positions.

・ Travel mode switch : 1 or 2 speed

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
R17Z-9A	1 Speed	15.8±2.0	19.75
	2 Speed	8.6±2.0	10.75

5) TRAVEL DEVIATION

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

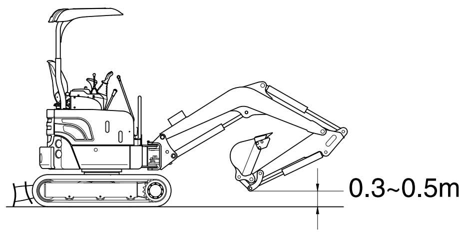
(2) Preparation

① Adjust the tension of both tracks to be equal.

② Provide a flat, solid test yard 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.



17Z9A6MS07

(3) Measurement

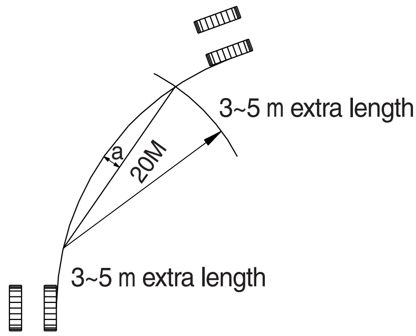
① Measure the amount of mistracking at high and low travel speeds.

② Start traveling the machine in the acceleration zone with the travel levers at full stroke.

③ Measure the distance between a straight 20m line and the track made by the machine. (Dimension a)

④ After measuring the tracking in forward travel, turn the upperstructure 180°and measure that in reverse travel.

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



7-7(2) 140-7

(4) Evaluation

Mistrack should be within the following specifications.

Unit : mm / 20 m

Model	Standard	Maximum allowable	Remarks
R17Z-9A	200 below	240	

6) SWING SPEED

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

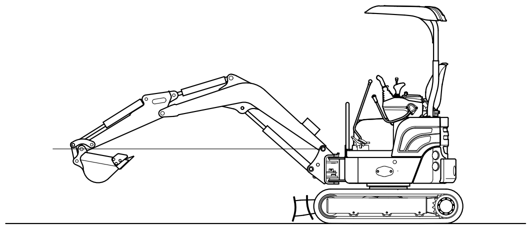
(2) Preparation

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.



17Z9A6MS08

(3) Measurement

① Operate swing control lever fully.

② Swing 1 turn and measure time taken to swing next 2 revolutions.

③ Repeat steps ① and ② three time and calculate the average values.

(4) Evaluation

The time required for 2 swings should meet the following specifications.

Unit : Seconds / 2 revolutions

Model	Standard	Maximum allowable	Remarks
R17Z-9A	12.9±1.0	16.1	

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.

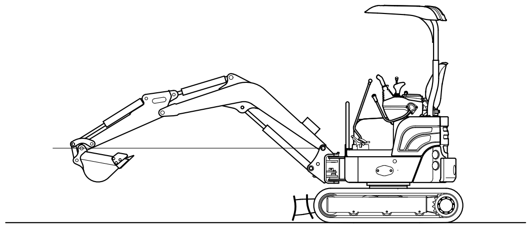
② Place the machine on flat, solid ground with ample space for swinging. Do not conduct this test on slopes.

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.



17Z9A6MS09

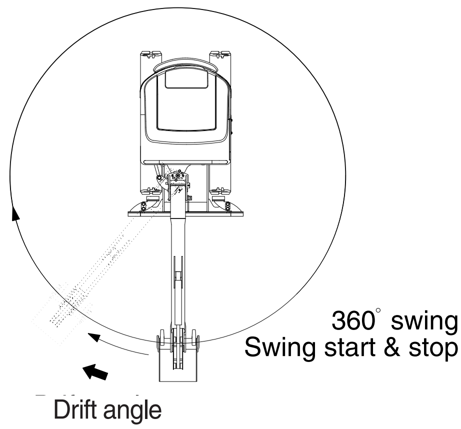
(3) Measurement

① 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°

② Measure the distance between the two marks.

③ Align the marks again, swing 360° , then test the opposite direction.

④ Repeat steps ② and ③ three times each and calculate the average values.



17Z9A6MS10

(4) Evaluation

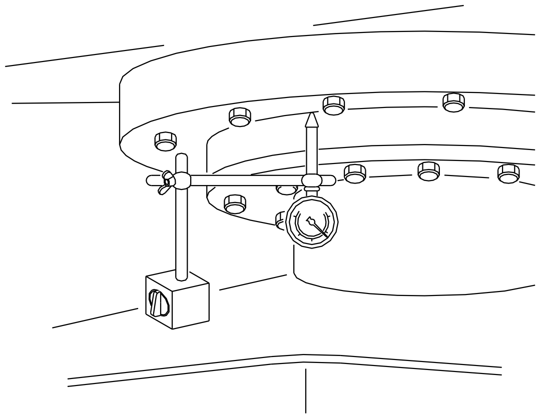
The measured drift angle should be within the following specifications.

Unit : Degree

Model	Standard	Maximum allowable	Remarks
R17Z-9A	40 below	50	

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.

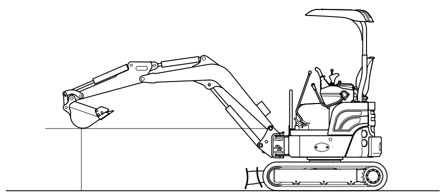
(3) Measurement

① With the arm rolled out and bucket rolled in, hold the bottom face of the bucket to the same height of the boom foot pin.
Record the dial gauge reading (h1).

② Lower the bucket to the ground and use it to raise the front idler 50 ㎝.
Record the dial gauge reading (h2).

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

Measurement : h1



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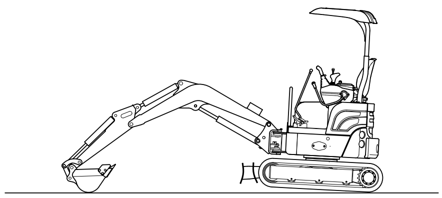
Measurement : h2



17Z9A6MS11

(4) Evaluation

The measured drift should be within the following specifications.

Unit : mm

Model	Standard	Maximum allowable	Remarks
R17Z-9A	0.5 ~ 1.2	2.4	

9) HYDRAULIC CYLINDER CYCLE TIME

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

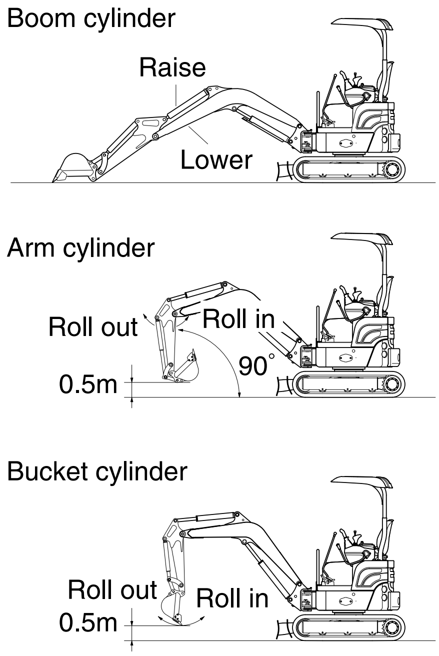
(2) Preparation

① To measure the cycle time of the boom cylinders:
With the arm rolled out and the empty bucket rolled out, lower the bucket to the ground, as shown.

② To measure the cycle time of the arm cylinder.
With the empty bucket rolled in, position the arm so that it is vertical to the ground. Lower the boom until the bucket is 0.5m above the ground.

③ To measure the cycle time of the bucket cylinder.
The empty bucket should be positioned at midstroke between roll-in and roll-out, so that the sideplate edges are vertical to the ground.

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



17Z9A6MS12

(3) Measurement

① 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
R17Z-9A	Boom raise	2.3±0.4	2.9	
	Boom lower	1.9±0.4	2.5	
	Arm in	3.2±0.4	3.8	
	Arm out	2.0±0.4	2.6	
	Bucket load	2.5±0.4	3.2	
	Bucket dump	1.8±0.4	2.4	
	Boom swing (LH)	4.5±0.4	5.6	
	Boom swing (RH)	3.6±0.4	4.4	
	Dozer up (raise)	1.8±0.3	2.1	
	Dozer down (lower)	2.1±0.3	2.4	

10) DIG FUNCTION DRIFT CHECK

(1) Measure dig function drift, which can be caused by oil leakage in the control valve and boom, standard arm, and standard bucket cylinders, with the loaded bucket. When testing the dig function drift just after cylinder replacement, slowly operate each cylinder to its stroke end to purge air.

(2) Preparation

① Load bucket fully. Instead of loading the bucket, weight (W) of the following specification can be used.

· $W = M^3 \times 1.5$

Where :

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

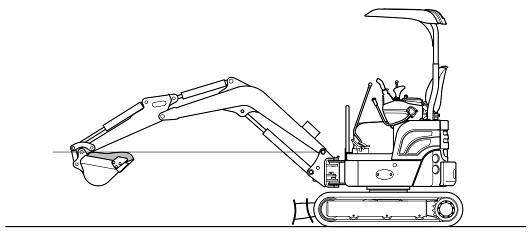
1.5= Soil specific gravity

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

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

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

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



17Z9A6MS13

(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 / 5 min

Model	Drift to be measured	Standard	Maximum allowable	Remarks
R17Z-9A	Boom cylinder	10 below	20	
	Arm cylinder	20 below	30	
	Bucket cylinder	20 below	30	

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

③ 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.

④ Repeat steps ② and ③ 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
R17Z-9A	Boom lever	1.4 or below	1.9	
	Arm lever	1.4 or below	1.9	
	Bucket lever	1.4 or below	1.9	
	Swing lever	1.4 or below	1.9	
	Travel lever	2.0 or below	2.5	

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.

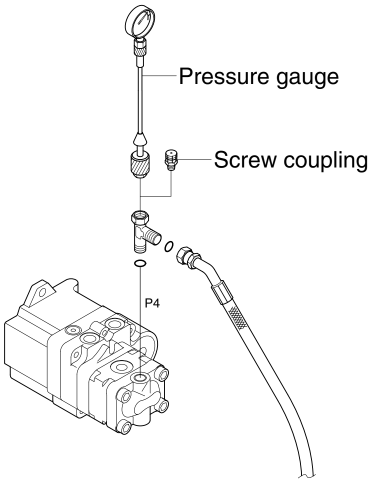
(4) Evaluation

The measured drift should be within the following specifications.

Unit : kgf

Model	Kind of lever	Standard	Maximum allowable	Remarks
R17Z-9A	Boom lever	87±10	109	
	Arm lever	87±10	109	
	Bucket lever	87±10	109	
	Swing lever	87±10	109	
	Travel lever	86±10	105	

13) PILOT PRIMARY PRESSURE



1696MS14

(1) Preparation

① Stop the engine.
② Loosen the cap of screw coupling at the fitting near pilot pump and connect pressure gauge.
③ Start the engine and check for oil leakage from the port.
④ Keep the hydraulic oil temperature at 50±5˚C.

(2) Measurement

① Measure the primary pilot pressure.

(3) Evaluation

The average measured pressure should meet the following specifications:

Unit : kgf / cm^2

Model	Standard	Remarks
R17Z-9A	36±5	

14) FOR TRAVEL SPEED SELECTING PRESSURE

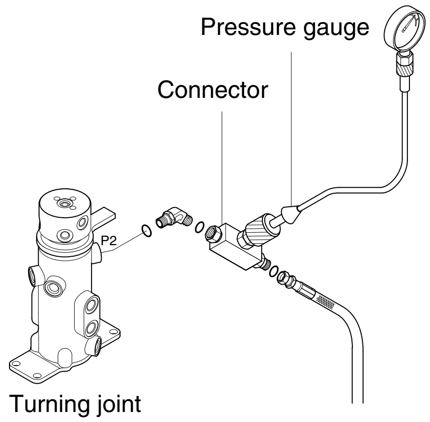
(1) Preparation

① Stop the engine.

② To measure the speed selecting pressure: Install a connector and pressure gauge assembly to turning joint P2 port as shown.

③ Start the engine and check for on leakage from the adapter.

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



R27Z96MC18

(2) Measurement

① Select the following switch positions.
Travel mode switch : 1 speed
2 speed

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
R17Z-9A	1 Speed	0	-	
	2 Speed	30±5	-	

15) MAIN PUMP DELIVERY PRESSURE

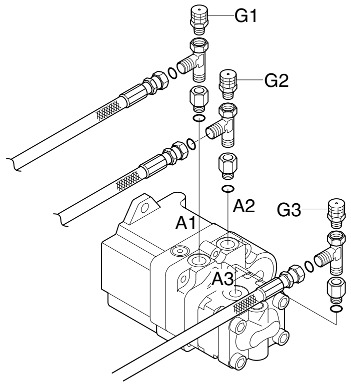
(1) Preparation

① Stop the engine.

② To measure the main pump pressure. Loosen the cap of screw coupling and connect pressure gauge to the main pump gauge port(G1, G2, G3) as shown.

③ Start the engine and check for oil leakage from the port.

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



1696MS15

(2) Measurement

① Measure the main pump delivery pressure at high idle.

(3) Evaluation

The average measured pressure should meet the following specifications.

Unit : kgf / cm^2

Model	Engine speed	Standard	Allowable limits	Remarks
R17Z-9A	High idle	20±5	-	

16) SYSTEM PRESSURE REGULATOR RELIEF SETTING

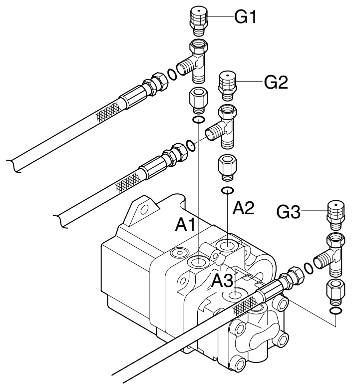
(1) Preparation

① Stop the engine.

② To measure the system relief pressure. Loosen the cap of screw coupling and connect pressure gauge to the main pump gauge port(G1, G2, G3) as shown.

③ Start the engine and check for oil leakage from the port.

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



1696MS15

(2) Measurement

① Slowly operate each control lever of boom, arm and bucket functions at full stroke over relief and measure the pressure.

② In the swing function, place bucket against an immovable object and measure the relief pressure.

③ 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
R17Z-9A	Boom, Arm, Bucket	210±10
	Travel	210±10
	Swing	200±10

GROUP 2 MAJOR COMPONENT

1. MAIN PUMP

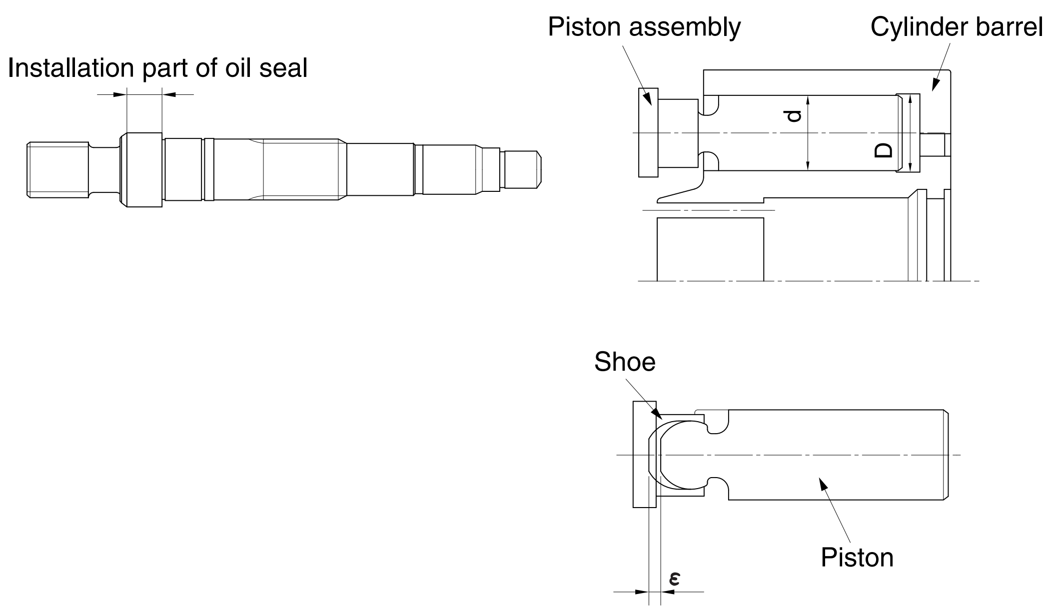
Before inspection, wash the parts well and dry them completely.

Inspect the principal parts with care and replace them with new parts when any abnormal wear exceeding the allowable limit or damage considered harmful is found.

Replace the seal also when any remarkable deformation and damage are found.

1) INSPECTION POINTS WHEN DISASSEMBLED

Part	Extent of the damage	Inspection standard	Action
Shaft	Excessive wear on the seal surface.	Worn depth : 0.025 mm or more	Replace the shaft.
Valve plate	Excessive wear or damages on the sliding surface.	Worn depth : 0.020 mm or more	Replace the cylinder barrel kit.
Cylinder barrel	Excessive wear or damages on the sliding surface.	Worn depth : 0.020 mm or more	Replace the cylinder barrel kit.
	Clearance between the pistons (D-d)	0.030 mm or more	Replace the cylinder barrel kit.
Piston and shoe	Wear of joint section	Check play (ε) between the shoe and the piston ε : 0.2 mm or more by hand operation.	Replace the cylinder barrel kit.
Seals (O-rings, gasket, etc.)	Damage, excessive rust	-	Replace each part.



17Z9A6MC01

2) TROUBLESHOOTING AND COUNTERMEASURE

No.	Trouble	Possible cause	Countermeasure
1	Overload to engine	· Speed is higher than standard · Setting pressure is higher than specifications · Damage of internal parts of pump	· Readjust it as standard · Readjust it as spec · Repair or replace
2	Low pump flow or low pressure	· Speed down of engine · Wrong coupling · Damage of internal parts of pump	· Readjust of engine speed · Repair or replace · Repair or replace
3	Abnormal noise or abnormal vibration (cavitations)	· The level of oil in the tank is low · Air in the oil · Water in the oil · Clog of suction filter · High suction pressure · Damage of piston shoe · Installation condition is no good · Wrong coupling	· Replenish a tank with oil · Check piping Bleed the air in the hydraulic circuit · Replace oil · Clean or replace · Correction · Replace · Correction · Replace
4	Oil leakage	· Damage of O-ring or packing · Loosened plug · Leaking from oil seal	· Replace · Tight up · Replace Replace of oil seal

2. MAIN CONTROL VALVE

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

3. SWING MOTOR

Condition	Cause	Correction
Motor will not turn	· No oil · Pump broken · Relief valve stuck open or set too low	· Fill reservoir to proper oil level. · Replace pump. · Clean and free relief valve spool and adjust to proper setting.
Slow operation	· Low oil viscosity · Worn pump · Extremely high fluid temperatures · Relief setting too low	· Use proper viscosity oil. · Repair or replace pump. · Increase reservoir size or add oil cooler. · Set relief valve for proper pressure.
Erratic motor operation	· Relief setting too low · Air sucked in inlet side of pump	· Set relief valve for proper pressure. · Tighten pipe fitting on pump inlet side.
Motor turns in wrong direction	· Wrong piping · The valve timing is incorrect due to a disassembling error.	· Reverse the piping · Disassemble and reassemble the unit and correct valve timing.
Fluid leakage	· Loose bolts or plugs. · Scratched or abraded O-ring · Scratched or abraded X-ring	· Tighten bolts and plugs by the correct torque. · Replace the O-ring with a new one. · Replace the X-ring with a new one. Lower the drain pressure until it is within the allowable range.
Abnormal sound	· Air is remaining in the circuit and motor. · Pump cavitation.	· Bleed air completely. · Remove substance clogging the suction filter. Enlarge the diameter of the suction pipe of the pump. Raise the boost pump pressure.

※ In case of, caused from life, torque or revolution declined or increase of noise, repair the motor or replace for new one.

4. TRAVEL MOTOR

1) MAINTENANCE STANDARD FOR TRAVEL MOTOR

Travel motors basically don't require maintenance except changing the reducer lubricant. Don't disassemble the motor unless there are problem with it. Refer to the following standards for parts (kits) replacement.

(1) Reducer

No.	Part name	Point to be checked	Standard	Action
1	Body (internal gear)	Engaging tooth surface with B1 and B2 gears	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
2	Carrier 2	Spline tooth surface	No abnormal damage, wear	Replace whole carrier 2 kit
		Loose of B2 pins	No loose by hand	
3	B1 gears	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
		Needle rolling contact surface	No flaking and pitching	
4	B2 gears	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace whole carrier 2 kit
		Needle rolling contact surface	No flaking and pitching	
5	S1 gear	Tooth surface	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace whole carrier 2 kit
6	S2 gear	Engaging tooth surface with B2 gears	No pitching with 5% or greater (ratio of engaging area to tooth surface) No abnormal damage	Replace
		Spline tooth surface	No abnormal damage, wear	
7	B2 pins	Needle rolling contact surface	No flaking and pitching	Replace whole carrier 2 kit
8	Floating seals	Seat surface	No abnormal damage, wear	Replace
		O-ring surface	No damage, deformation, and hardening	
9	Angular ball bearings	Rolling contact surface	No abnormal damage, flaking	Replace
10	Needles	Rolling contact surface	No flaking and pitching	Replace whole carrier 2 kit
11	O-rings	Surface, hardness	No damage, deformation, and hardening	Replace

(2) Hydraulic valve and motor

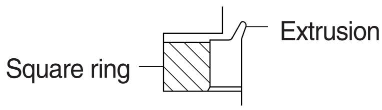
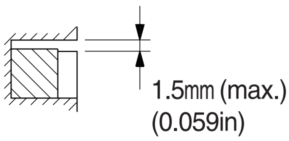
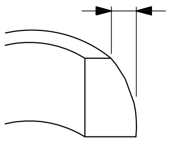
No.	Part name	Point to be checked	Standard	Action
12	Body 1	Spool sliding contact surface	No abnormal damage, wear	Relpace whole body 1 kit
13	Counter valve spool Two-speed spool Shuttle spool	Body 1 sliding contact surface	No abnormal damage, wear	Relpace whole body 1 kit
14	Body 2	Spline tooth surface	No abnormal damage, wear	Replace whole body 2 kit
		Control piston sliding contact surface	No abnormal damage, wear Clearance between piston and body 2 is 0.023 mm or smaller	
		Swash plate installaion surface	No abnormal damage, wear	
		Ball sliding contact surface	No abnormal damage, wear	
15	Shaft	Spline tooth surface	No abnormal damage, wear	Replace shaft kit
		Oil seal sliding contact surface	No abnormal damage, wear (0.025 mm or greater)	
16	Cylinder barrel	Piston sliding contact surface	No abnormal damage, wear Clearance between piston and cylinder barrel is 0.030 mm or smaller	Replace cylinder barrel kit
		Valve place sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
17	Valve plate	Cylinder barrel sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
18	Pistons Shoes	Cylinder barrel sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Replace cylinder barrel kit
		Swash plate sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace cylicder barrel kit
		Loose of shoe calking part	Loose is smaller than 0.3 mm	Replace cylinder barrel kit
19	Shoe holder	Barrel holder sliding contact surface	No abnormal damage, wear	Replace cylinder barrel kit
20	Barrel holder	Spline tooth surface	No abnormal damage, wear	Replace cylinder barrel kit
		Shoe holder sliding contact surface	No abnormal damage, wear	
21	Swash plate	Shoe sliding contact surface	No abnormal damage, wear (0.020 mm or greater)	Lap or replace
		Ball sliding contact surface	No abnormal damage, wear	Replace
22	Control piston	Body 2 sliding contact surface	Clearance between piston and body 2 is 0.023 mm or smaller	Replace body 2 kit
23	Oil seal	Lip surface	No abnormal damage, wear and deformation	Replace
24	Ball bearing	Rolling contact surface	No abnormal damage, flaking	Replace
25	Springs	Surface	No crack	Replace
26	O-rings	Surface and hardness	No damage, deformation, and hardening	Replace

2) FAILURE DIAGNOSIS OF TRAVEL MOTOR

Failure detail	Major causes	Countermeasure
Doesn't start	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal working pressure is supplied to the motor inlet port.
	Defect in reducer - Damage of inner parts	 Replace the damaged part (kit).
	Defect in hydraulic motor - Oil leakage due to abnormal wear of the sliding parts - Damage of inner parts	 Replace the worn part (kit). Replace the damaged part (kit).
	Defect in hydraulic valve - Spool doesn't move Foreign object is caught in the spool sliding part. Choke is clogged	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object.
Doesn't stop or stop slowly	Defect in hydraulic valve - Spool doesn't return Foreign object is caught in the spool sliding part. Choke is clogged. Spring is damaged. - Check valve doesn't close due to foreign object being caught on the seat.	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object. Replace the body 1 kit. Remove the foreign object. In case of much leakage, replace the body 1 kit.
Rotating speed is slow	Prescribed flow rate is not supplied to the motor due to operating defect in the pump.	Inspect and repair or replace the pump.
	Volumetric efficiency declines due to defect in the motor. - Abnormal wear of sliding parts	 Replace the worn part (kit).
	Volumetric efficiency declines due to defect in the hydraulic valve. - Abnormal wear of main spool and two speed spool sliding part	 Replace body 1 kit.

Failure detail	Major causes	Countermeasure
Doesn't change to two speed	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal pressure is supplied to the pilot port.
	Defect in the hydraulic valve - Two speed spool doesn't move due to foreign object being caught in the spool sliding part. - Choke in the two speed pilot line is clogged.	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Remove the foreign object.
	Defect in the hydraulic motor - Control piston doesn't move. Foreign object is caught in the piston sliding part. Oil leakage due to abnormal wear of the sliding part. Oil leakage due to damage of O-ring located between body 1 and body 2.	 Remove the foreign object. In case of much leakage, replace the body 2 kit. Replace the worn part (kit). Replace the O-ring.
Doesn't change to one speed	Operating defect in hydraulic equipment except travel motors	Inspect and repair or replace each equipment. Check that normal pressure is supplied to the pilot port.
	Defect in the hydraulic valve - Two speed spool doesn't move. Foreign object is caught in the spool sliding part. Damage of spring - Choke in the two speed pilot line is clogged.	 Remove the foreign object. In case of much leakage, replace the body 1 kit. Replace the body 1 kit. Remove the foreign object.
Tracking deviation	Same as No.3, 4 and 5	-
Oil leakage	Oil leakage due to damage of O-rings. - Damage of O-ring located in the reducer cover. - Damage of O-rings located between body 1 and body 2.	 Replace the O-ring. Replace the O-ring.
	Oil leakage from the floating seals - Abnormal wear of the seat surface or damage of the O-ring. - Pressure in the reducer casing rises due to damage of the oil seal.	 Replace the floating seal. Replace the oil seal.

5. TURNING JOINT

Parts Name		Check Points	Measures
Body, Stem	Sliding surface with sealing sections.	Plating worn or peeled due to seizure or contamination.	Replace
	Sliding surface between body and stem other than sealing section.	· Worn abnormality or damaged more than 0.1 mm (0.0039 in) in depth due to seizure contamination.	Replace
		· Damaged more than 0.1 mm (0.0039 in) in depth.	Smooth with oilstone.
	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Smooth
Cover	Sliding surface with thrust plate.	· Worn more than 0.5 mm (0.02 in) or abnormality.	Replace
		· Worn less than 0.5 mm (0.02 in).	Smooth
		· Damage due to seizure or contamination remediable within wear limit (0.5 mm) (0.02 in).	Replace
Seal set	-	· Extruded excessively from seal groove square ring. 	Replace
	-	· Slipper ring 1.5 mm (0.059 in) narrower than seal groove, or narrower than back ring. 	Replace
	-	· Worn more than 0.5 mm (0.02 in) ~ 1.5 mm (MAX.) (0.059 in) 	Replace

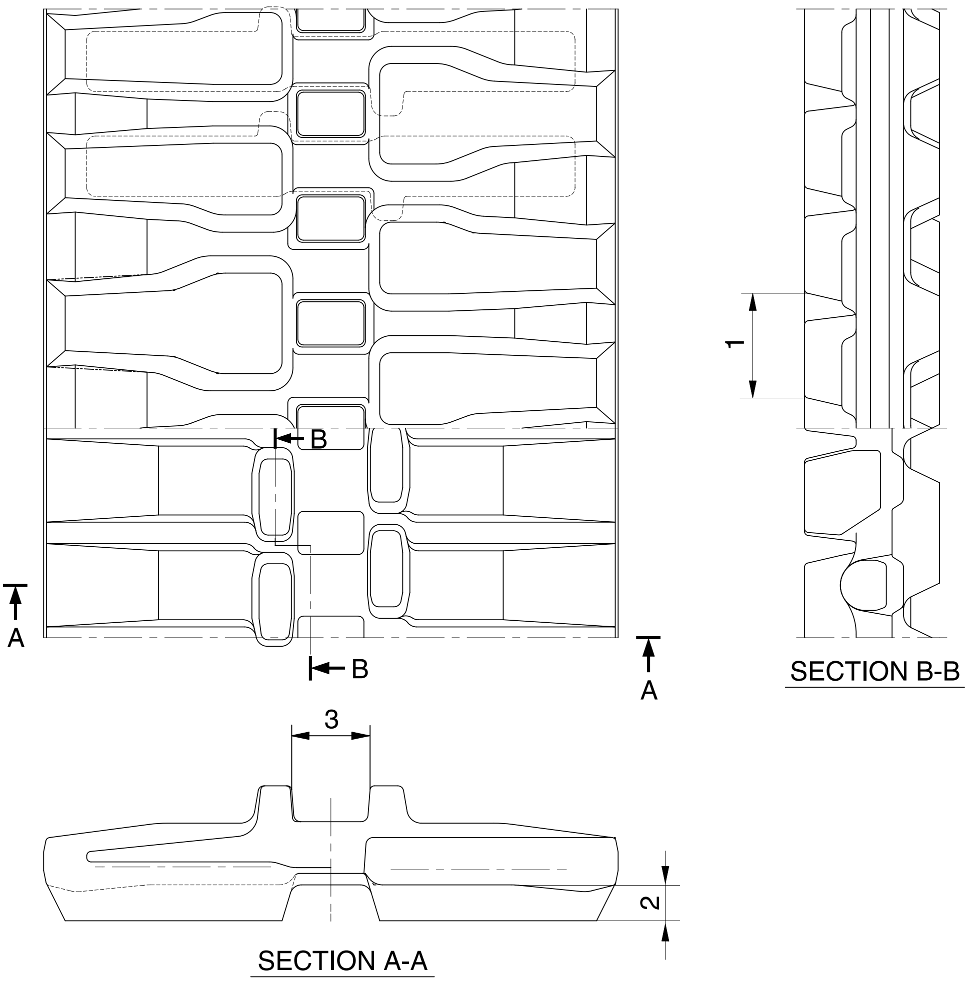
6. CYLINDER

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 SHOE

1) RUBBER SHOE SPEC

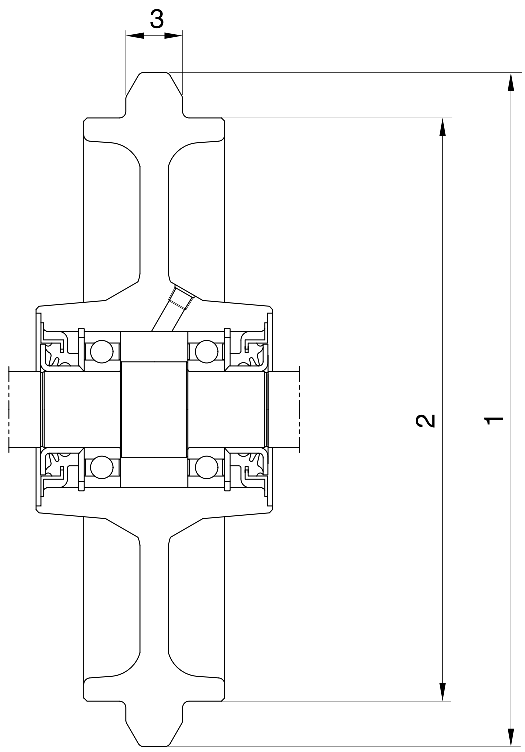


R5576MC17

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Link pitch	48	50	Replace
2	Height of grouser	20	5	
3	Width of link	34	44	

2. IDLER

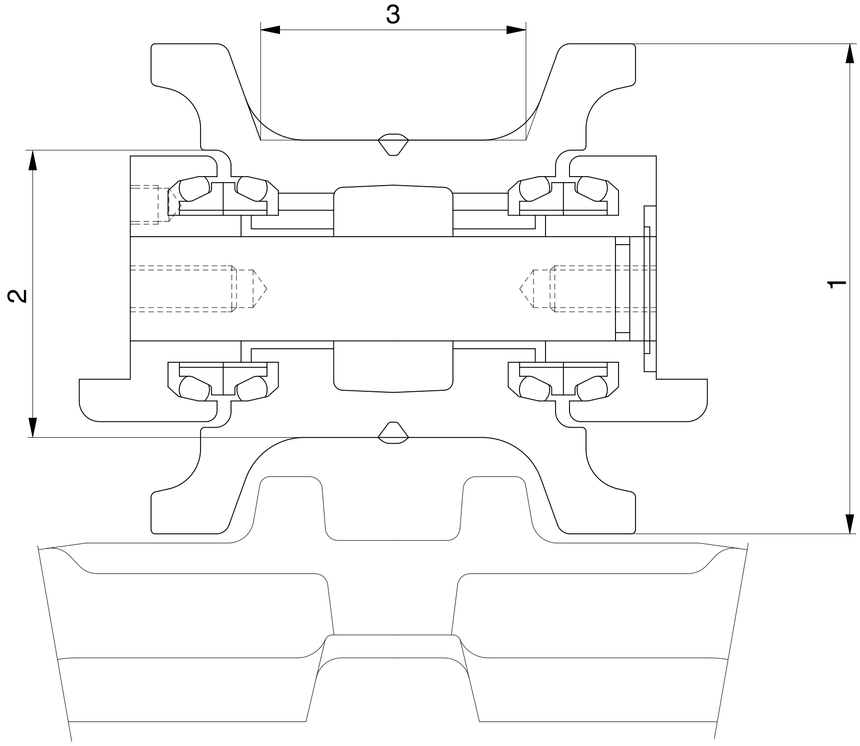


R27Z96MC23

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Rubber	249	-	Rebuild or replace
2	Outside diameter of thread	Rubber	216	210	
3	Width of flange		25	19	

3. TRACK ROLLER

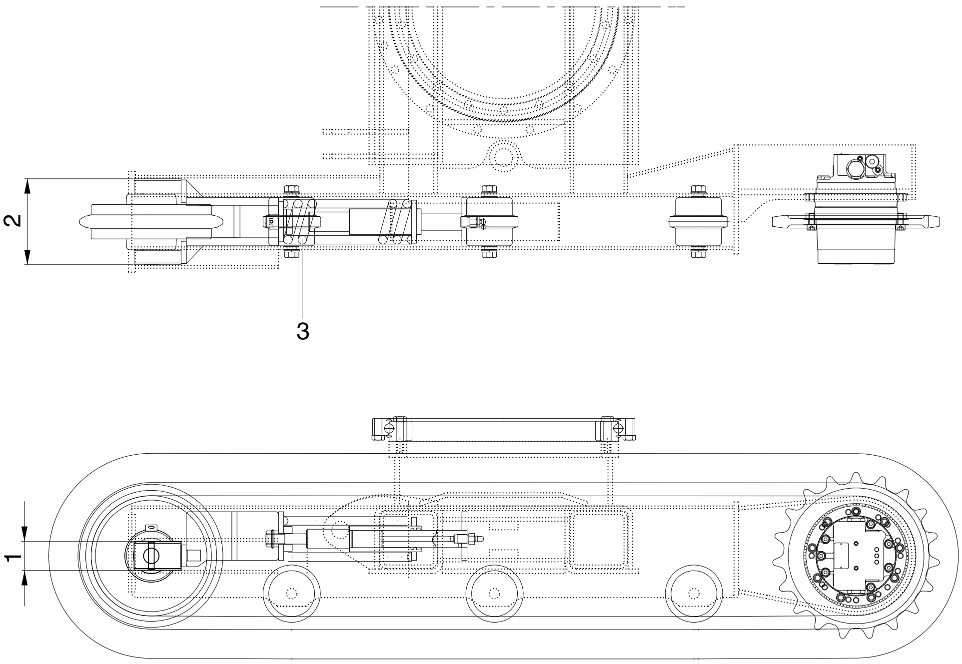


17Z9A6MC13

Unit : mm

No	Check item		Criteria		Remedy
			Standard size	Repair limit	
1	Outside diameter of flange	Rubber	118	112	Rebuild or replace
2	Outside diameter of thread	Rubber	72	-	
3	Width of flange		64	70	

4. TENSION CYLINDER



17Z9A6MC16

Unit : mm

<table>
<tr><th rowspan="2">No</th><th rowspan="2">Check item</th><th colspan="5">Criteria</th><th rowspan="2">Remedy</th></tr>
<tr><th></th><th colspan="2">Standard size</th><th colspan="2">Repair limit</th></tr>
<tr><td rowspan="2">1</td><td rowspan="2">Vertical width of idler guide</td><td>Track frame</td><td colspan="2">51</td><td colspan="2">53</td><td>Rebuild</td></tr>
<tr><td>Idler support</td><td colspan="2">49</td><td colspan="2">47</td><td>Rebuild or replace</td></tr>
<tr><td rowspan="2">2</td><td rowspan="2">Horizontal width of idler guide</td><td>Track frame</td><td colspan="2">151</td><td colspan="2">155</td><td>Rebuild</td></tr>
<tr><td>Idler guide</td><td colspan="2">149</td><td colspan="2">145</td><td>Rebuild or replace</td></tr>
<tr><td rowspan="3">3</td><td rowspan="3">Recoil spring</td><td colspan="3">Standard size</td><td colspan="2">Repair limit</td><td rowspan="3">Replace</td></tr>
<tr><td>Free length</td><td>Installed length</td><td>Installed load</td><td>Free length</td><td>Installed load</td></tr>
<tr><td>261</td><td>188</td><td>1785 kg</td><td>-</td><td>1540 kg</td></tr>
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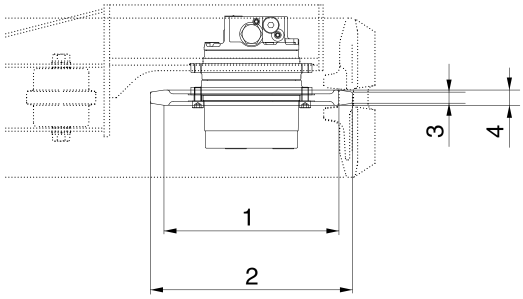
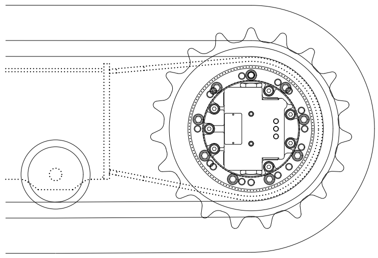
5. SPROCKET



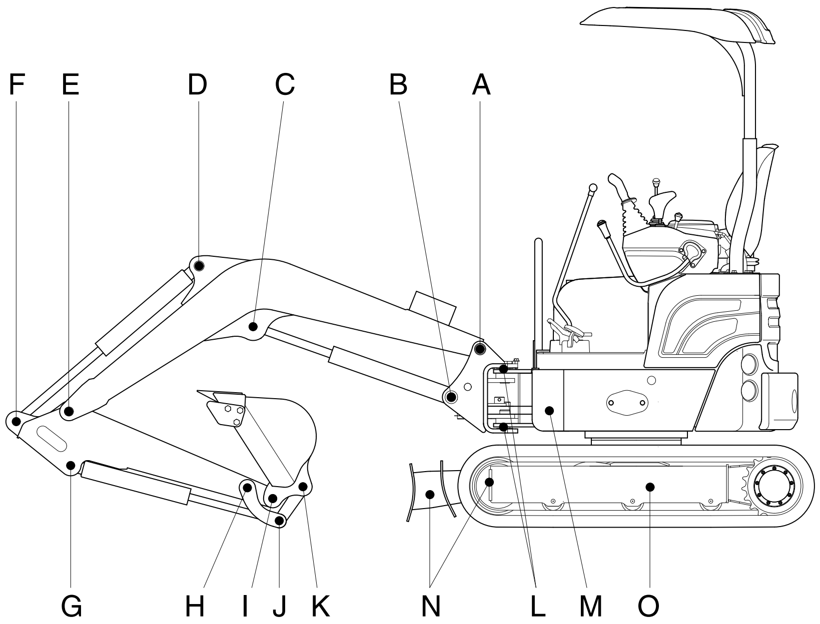


17Z9A6MC22

Unit : mm

No	Check item	Criteria		Remedy
		Standard size	Repair limit	
1	Wear out of sprocket tooth lower side diameter	253	247	Rebuild or Replace
2	Wear out of sprocket tooth upper side diameter	292	-	
3	Wear out of sprocket tooth upper side width	16	-	
4	Wear out of sprocket tooth lower side width	22	16	

6. WORK EQUIPMENT



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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	35	34	33.5	35.5	36	Replace
B	Boom cylinder head	30	29	28.5	30.5	31	〃
C	Boom cylinder rod	30	29	28.5	30.5	31	〃
D	Arm cylinder head	30	29	28.5	30.5	31	〃
E	Boom front	30	29	28.5	30.5	31	〃
F	Arm cylinder rod	30	29	28.5	30.5	31	〃
G	Bucket cylinder head	30	29	28.5	30.5	31	〃
H	Arm link	30	29	28.5	30.5	31	〃
I	Bucket and arm link	30	29	28.5	30.5	31	〃
J	Bucket cylinder rod	30	29	28.5	30.5	31	〃
K	Bucket link	30	29	28.5	30.5	31	〃
L	Boom swing post	45	44	43.5	45.5	46	〃
M	Boom swing cylinder	30	29	28.5	30.5	31	〃
N	Blade cylinder	30	29	28.5	30.5	31	〃
O	Blade and frame link	30	29	28.5	30.5	31	〃

SECTION 7 DISASSEMBLY AND ASSEMBLY

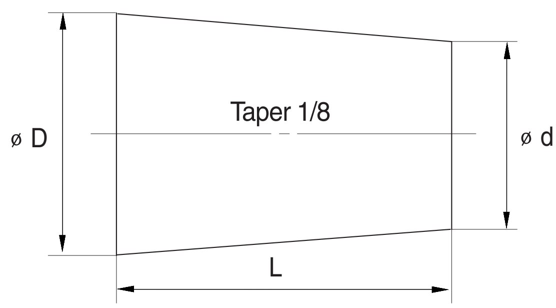
SECTION 7 DISASSEMBLY AND ASSEMBLY

GROUP 1 PRECAUTIONS

1. REMOVAL WORK

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

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



2. INSTALL WORK

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

2) Install the hoses without twisting or interference.

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

4) Bend the cotter pin or lock plate securely.

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

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

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

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

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

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

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

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

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

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

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

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

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

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

※ If the hydraulic cylinder has been replaced, carry out this procedure before assembling the rod to
※ the work equipment.
Carry out the same operation on machines that have been in storage for a long time after completion of repairs.

3. COMPLETING WORK

1) If the coolant has been drained, tighten the drain valve, and add water to the specified level. Run the engine to circulate the water through the system. Then check the water level again.

2) If the hydraulic equipment has been removed and installed again, add engine oil to the specified level. Run the engine to circulate the oil through the system. Then check the oil level again.

3) If the piping or hydraulic equipment, such as hydraulic cylinders, pumps, or motors, have been removed for repair, always bleed the air from the system after reassembling the parts.

4) Add the specified amount of grease (Molybdenum disulphide 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)	M10 × 1.25	7.4±1.5	53.5±11.0
2		Engine mounting bolt (bracket-frame)	M12 × 1.75	12.3±1.5	89±11.0
3		Radiator mounting bolt, nut	M12 × 1.75	12.8±3.0	92.6±21.7
4		Coupling mounting bolt	M10 × 1.5	5.15±0.25	37.2±1.8
5	Hydraulic system	Main pump mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
6		Main control valve mounting bolt	M 8 × 1.25	3.4±0.7	24.6±5.1
7		RCV lever mounting bolt	M 6 × 1.0	1.44±0.3	10.4±2.2
8		Fuel tank mounting bolt	M10 × 1.5	6.9±1.4	50±10.1
9		Hydraulic oil tank mounting bolt	M10 × 1.5	6.9±1.4	50±10.1
10		Turning joint mounting bolt, nut	M10 × 1.5	6.9±1.4	50±10.1
11	Power train system	Swing motor mounting bolt	M14 × 2.0	21	152
12		Swing bearing upper mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
13		Swing bearing lower mounting bolt	M12 × 1.75	12.8±3.0	92.6±21.7
14		Travel motor mounting bolt	M10 × 1.5	6.9±1.4	50±10.1
15		Sprocket mounting bolt	M10 × 1.5	6.9±0.7	50±5.1
16	Under carriage	Track roller mounting bolt	M12 × 1.75	12.3±1.2	89±8.7
17	Others	Counterweight mounting bolt	M20 × 2.5	57.9±8.7	432±62.9
18		Additional counterweight mounting bolt	M24 × 3.0	100±15	723±108
19		Canopy mounting bolt, nut	M12 × 1.75	12.8±3.0	92.6±21.7
20		Operator's seat mounting bolt	M 8 × 1.25	3.4±0.7	24.6±5.1

2. TORQUE CHART

Use following table for unspecified torque.

1) BOLT AND NUT

(1) Coarse thread

Bolt size	8T		10T	
	kgf · m	lbf · ft	kgf · m	lbf · ft
M 6 × 1.0	0.85 ~ 1.25	6.15 ~ 9.04	1.14 ~ 1.74	8.2 ~ 12.6
M 8 × 1.25	2.0 ~ 3.0	14.5 ~ 21.7	2.7 ~ 4.1	19.5 ~ 29.7
M10 × 1.5	4.0 ~ 6.0	28.9 ~ 43.4	5.5 ~ 8.3	39.8 ~ 60
M12 × 1.75	7.4 ~ 11.2	53.5 ~ 81.0	9.8 ~ 15.8	70.9 ~ 114
M14 × 2.0	12.2 ~ 16.6	88.2 ~ 120	16.7 ~ 22.5	121 ~ 163
M16 × 2.0	18.6 ~ 25.2	135 ~ 182	25.2 ~ 34.2	182 ~ 247
M18 × 2.5	25.8 ~ 35.0	187 ~ 253	35.1 ~ 47.5	254 ~ 344
M20 × 2.5	36.2 ~ 49.0	262 ~ 354	49.2 ~ 66.6	356 ~ 482
M22 × 2.5	48.3 ~ 63.3	349 ~ 458	65.8 ~ 98.0	476 ~ 709
M24 × 3.0	62.5 ~ 84.5	452 ~ 611	85.0 ~ 115	615 ~ 832
M30 × 3.0	124 ~ 168	898 ~ 1214	169 ~ 229	1223 ~ 1656
M36 × 4.0	174 ~ 236	1261 ~ 1704	250 ~ 310	1808 ~ 2242

(2) Fine thread

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

2) PIPE AND HOSE (FLARE type)

Thread size (PF)	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

3) PIPE AND HOSE (ORFS type)

Thread size (UNF)	Width across flat (mm)	kgf · m	lbf · ft
9/16-18	19	4	28.9
11/16-16	22	5	36.2
13/16-16	27	9.5	68.7
1-3/16-12	36	18	130
1-7/16-12	41	21	152
1-11/16-12	50	35	253

4) FITTING

Thread size	Width across flat (mm)	kgf · m	lbf · ft
1/4"	19	4	28.9
3/8"	22	5	36.2
1/2"	27	9.5	68.7
3/4"	36	18	130
1"	41	21	152
1-1/4"	50	35	253

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) Loosen the drain plug under the hydraulic tank and drain the oil from the hydraulic tank.
  · Hydraulic tank quantity : 13 l (3.4 U.S.gal)

(5) Disconnect hoses (44) and remove connectors (24).

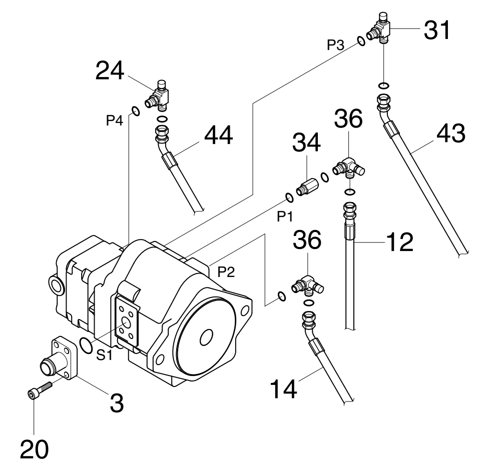
(6) Disconnect pilot line hoses (12, 14, 43) and remove connectors (31, 34, 36).

(7) Remove socket bolts (20) and disconnect pump suction tube (3).

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

(8) Sling the pump assembly and remove the pump mounting bolts.
  · Weight : 13 kg (29 lb)

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



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2) INSTALL

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

(2) Remove the suction strainer and clean it.

(3) Replace return filter with new one.

(4) Remove breather and clean it.

(5) After adding oil to the hydraulic tank to the specified level.

(6) Bleed the air from the hydraulic pump.

① Remove the air vent plug (1EA).

② Tighten plug lightly.

③ Start the engine, run at low idling, and check oil come out from plug.

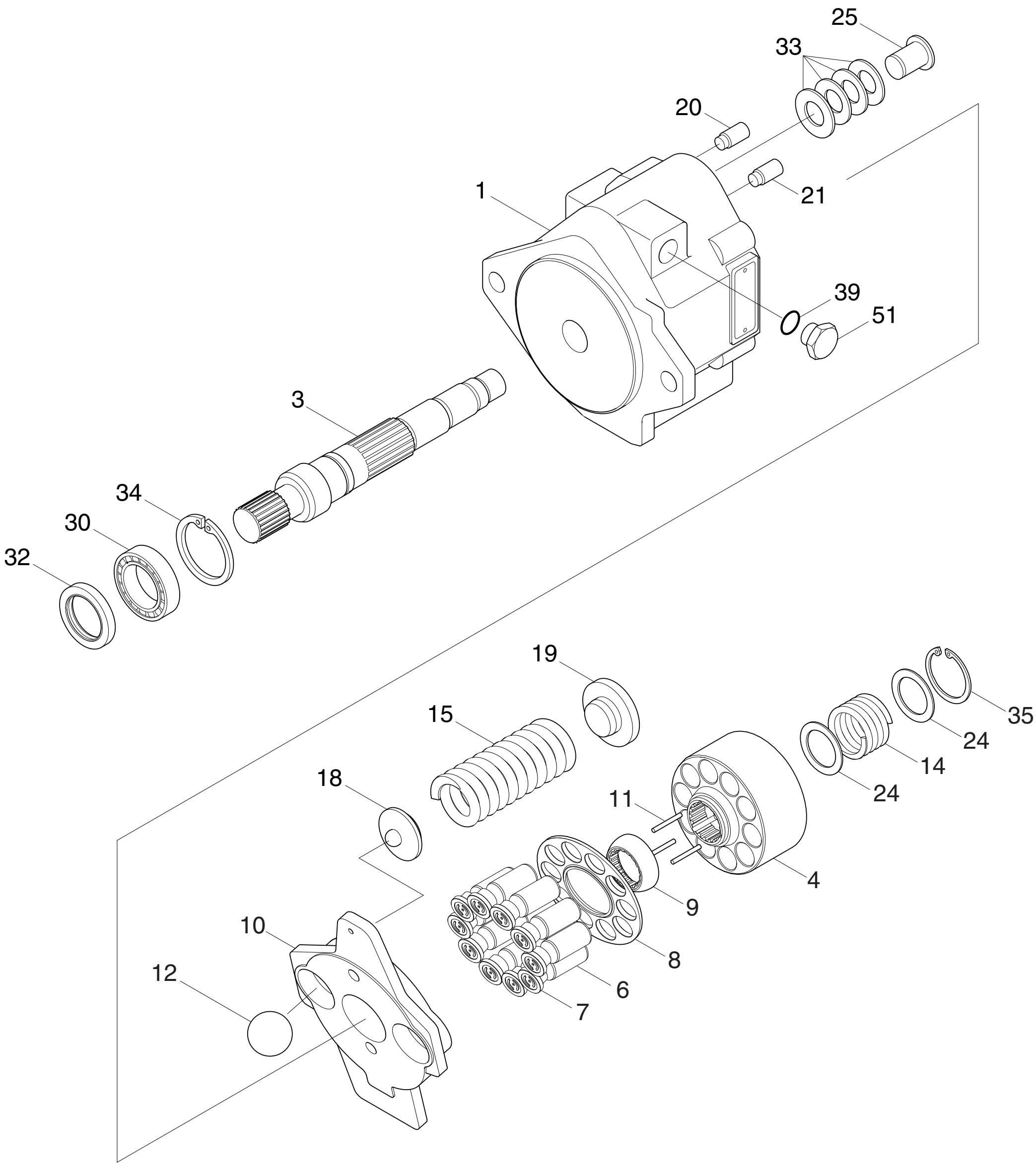
④ Tighten plug.

(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) STRUCTURE (1/2)



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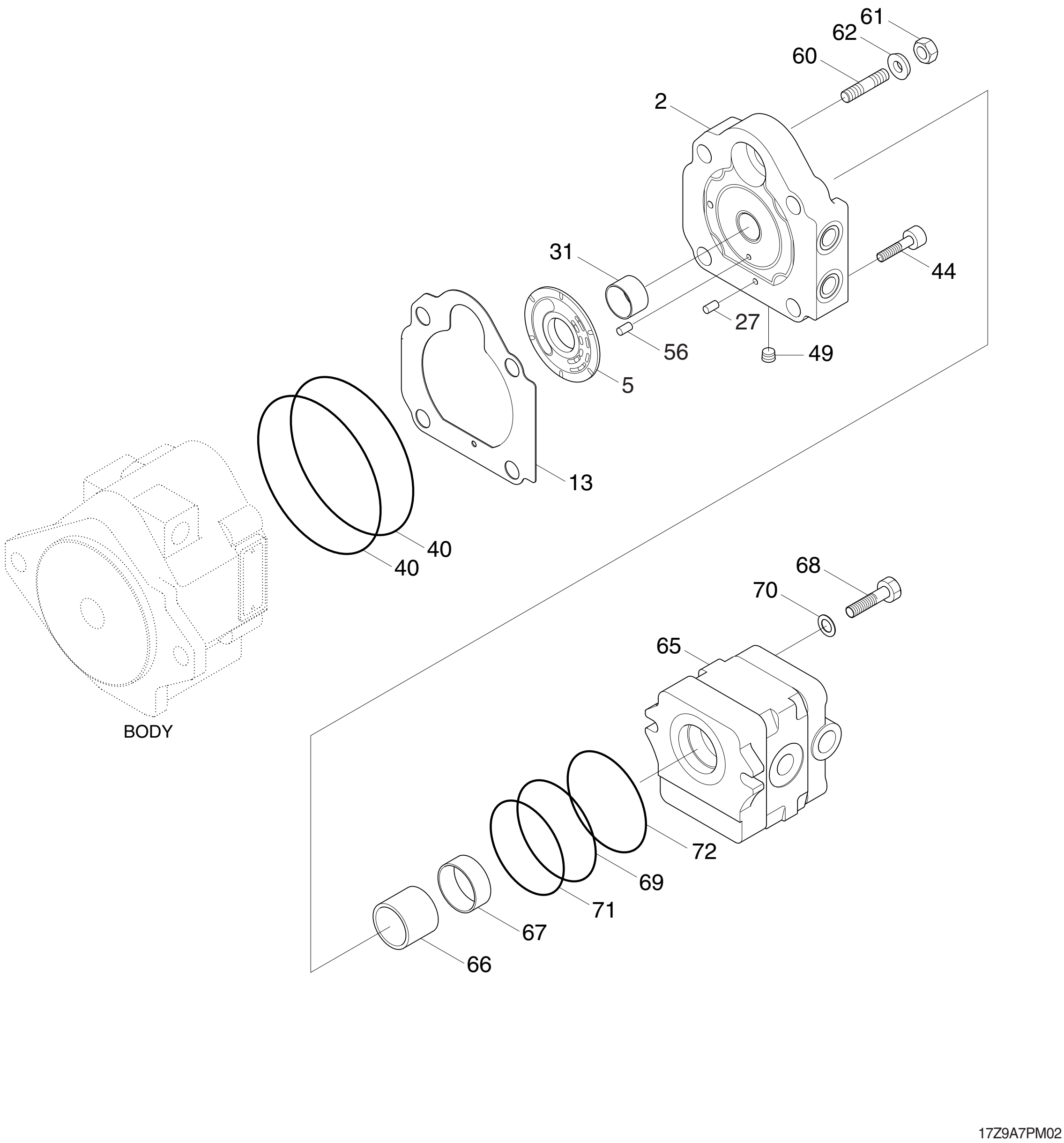
1	Body S	12	Ball	30	Ball bearing
3	Shaft	14	Spring C	32	Oil seal
4	Cylinder barrel	15	Spring T	33	Dish spring
6	Piston	18	Spring holder	34	Snap ring
7	Shoe	19	Spring guide	35	Snap ring
8	Shoe holder	20	Pin	36	Snap ring
9	Barrel holder	21	Rod G	39	O-ring
10	Swash plate	24	Retainer	51	Plug
11	Needle	25	Stopper pin A		

STRUCTURE (2/2)



2	Body H	49	Plug	67	Collar
5	Valve plate	56	Spring pin	68	Screw
13	Packing	60	Screw	69	O-ring
27	Pin	61	Nut	70	Washer
31	Needle bearing	62	Seal washer	71	O-ring
40	O-ring	65	Gear pump	72	O-ring
44	Screw	66	Coupling		

3. ASSEMBLE AND DISASSEMBLE

1) General precautions

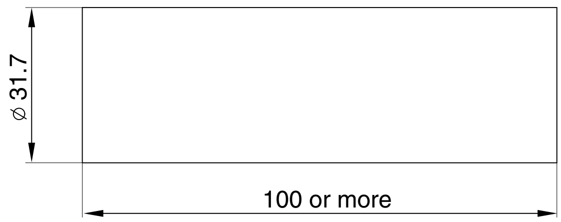
(1) Before disassembling, it is important to have fully understood the internal structure of the pump.

※ The gasket (13), oil seal (32) and O-rings will be probably damaged when you disassemble it, so be sure to have prepared spares.

(2) After having drained oil inside the pump, wash the pump and put it on a working bench covered with clean paper, cloth, or rubber mat for disassembling and assembling. Then, disassemble and assemble the pump slowly and carefully with necessary tools. Use care not to scratch even slightly, and take proper measures to prevent foreign matters from entering the assembly.

2) Tools

Tool name	Size	Quantity
Hexagon wrench	8 mm	1 each
Circlip player	For hole	1
Spanner wrench	13 mm	1
Torque wrench	45N (JIS B 4650) 90N (JIS B 4650)	1 1
Resin hammer	-	1
Special tooling for oil seal	See below	1
Seal kit	-	1 set
Grease	-	Small amount



Special tooling for oil seal

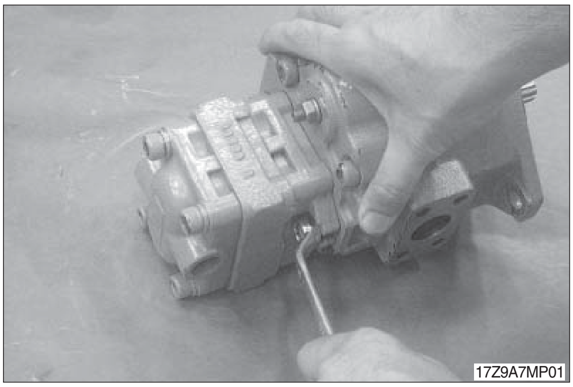
17Z9A7MP98

3) DISASSEMBLING

(1) Disassembling of gear pump

Remove two screws (68) with spanner wrench 13 mm, and after that remove two washer (70), gear pump (65), collar (67) and coupling (66).

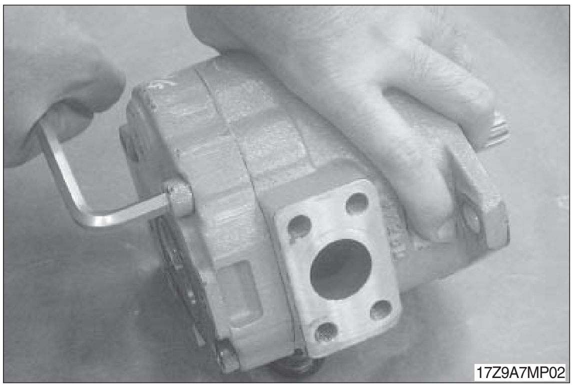
※ Coupling (66) and collar (67) may be attached with gear pump kit (65).



17Z9A7MP01

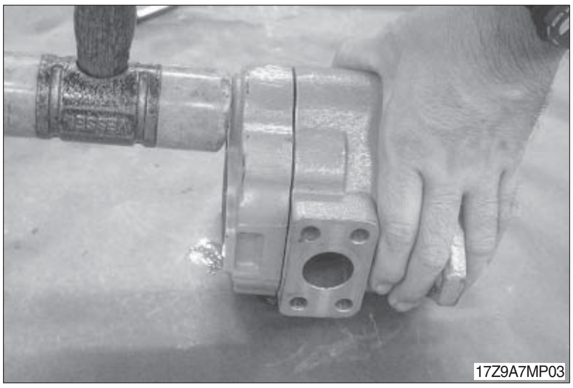
(2) Separation of body S and body H

Remove five screws (44) with hexagon wrench 8 mm.



17Z9A7MP02

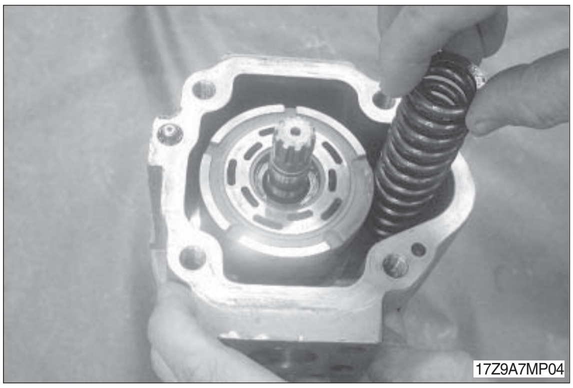
※ If you tap the part of inserted spring of body H with hummer softly, it is easy for separation.



17Z9A7MP03

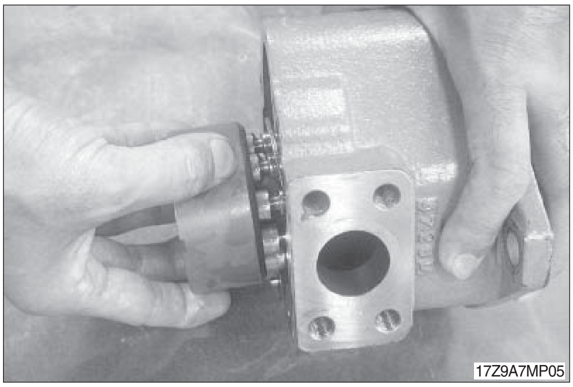
(3) Disassembling of body S kit

① Remove spring T (15) from body S kit, then take off spring holder (18).



17Z9A7MP04

② Remove cylinder barrel kit.



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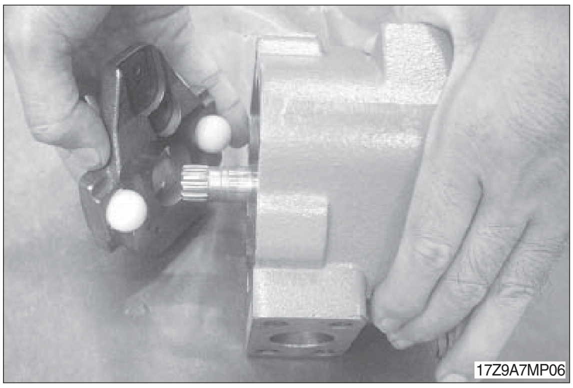
③ Remove swash plate (10) and two balls (12).



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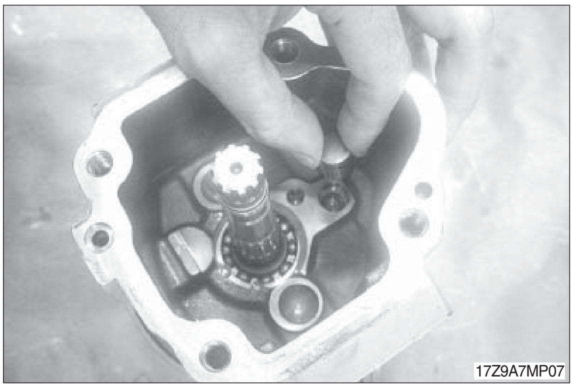
④ Remove stopper pin A (25), dish washers (33), rod G (21).



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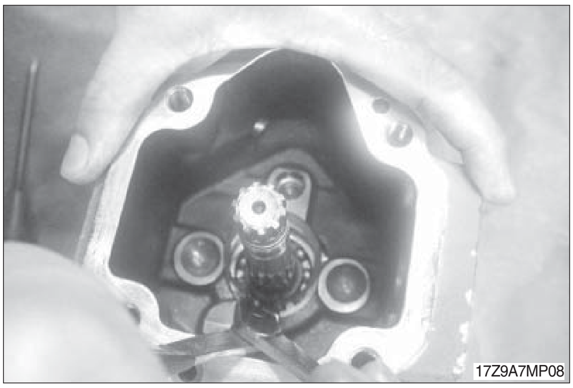
⑤ Remove snap ring (34) from body S (1).



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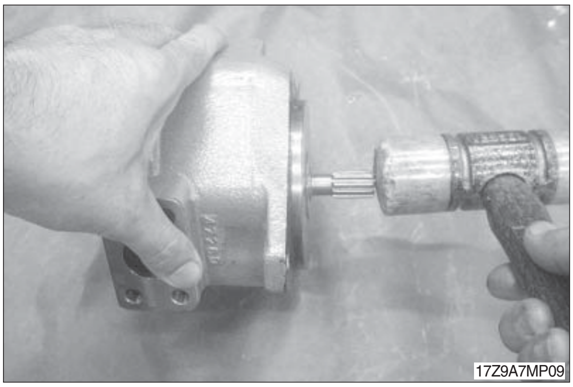
⑥ Tap the end of shaft (3) with hammer, then shaft with bearing (30) come off.



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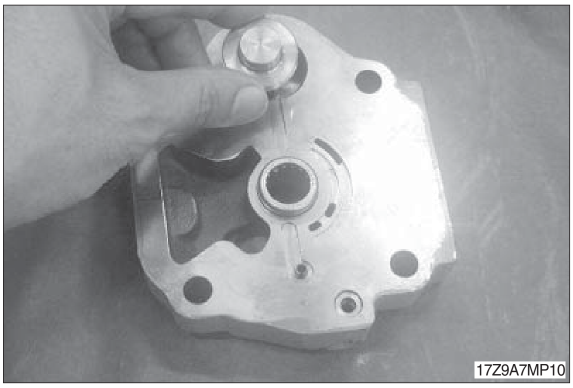
(4) Disassembling of body H kit

Remove spring guide (19) from body H.



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4) ASSEMBLING

(1) Precautions during assembling

Reverse the above procedures for assembling.

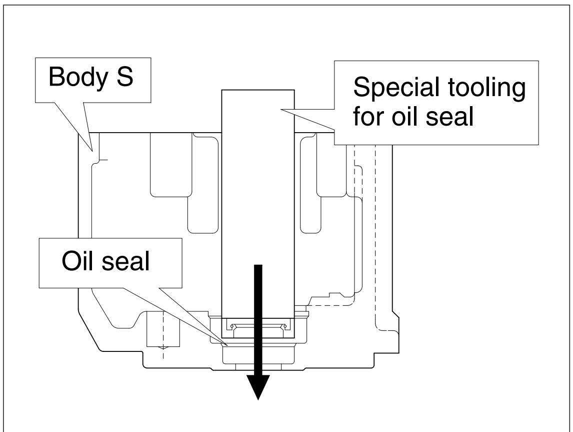
When assembling, be very careful to wash parts in clean oil, to prevent dusts and water from adhering to parts entering assemblies and not to scratch on the sliding surfaces of all parts.

※ Apply small quantity of grease to the periphery of O-rings to be set in socket and spigot joints to prevent the O-rings from being damaged.

(2) Assembling of body S kit

① Press-fit oil seal into body S (1).

※ Use new oil seal for assembling. Before assembling, apply a small quantity of grease to the periphery of oil seal lip and tap it together with the following special tooling with hammer.



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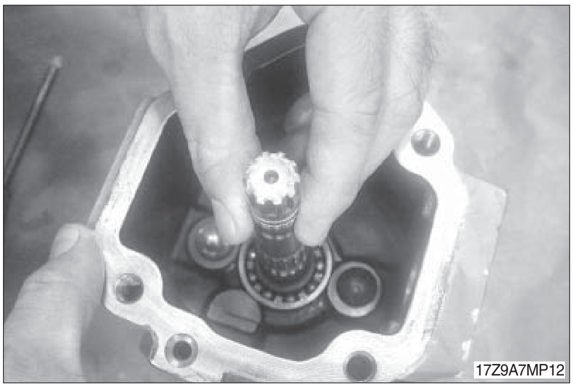
② Set shaft (3) with bearing (30) and snap ring (34) in this order into body S (1).

※ Pay attention not to damage the oil seal when assembling the shaft.



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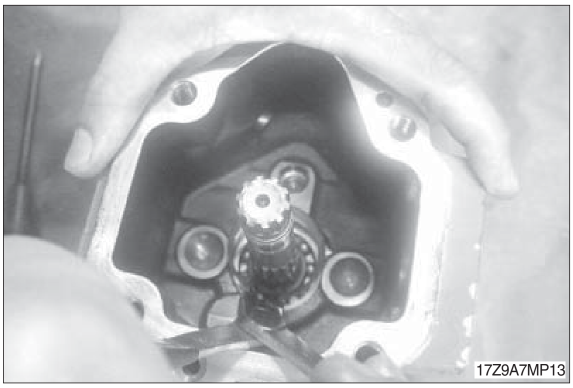

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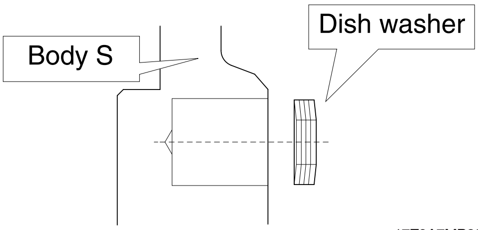
③ Set four dish springs (33), then set stopper pin A (25) and stopper pin B (26) into body S (1).

※ Pay attention to direction of the dish washer.



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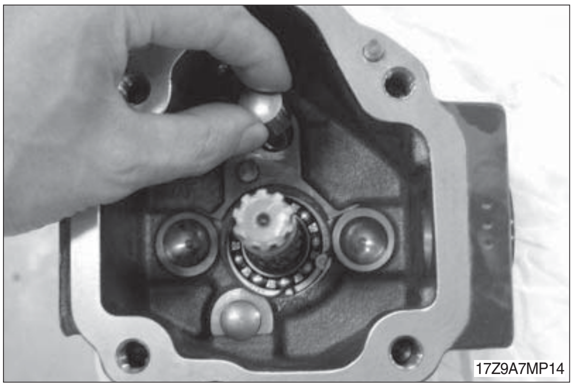
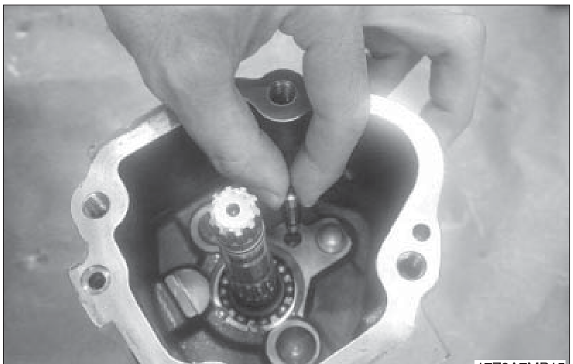


17Z9A7MP14

④ Set rod G (21) into body S (1).



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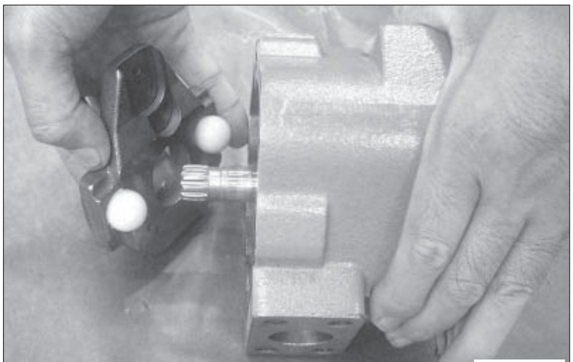
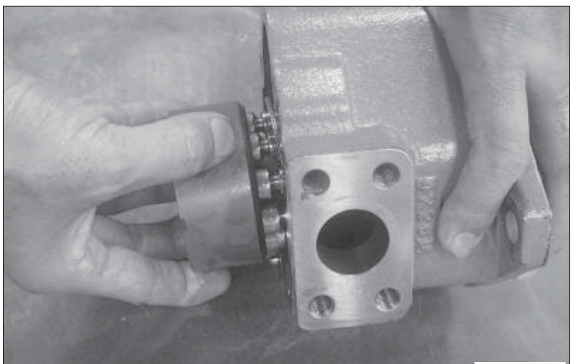
⑤ Put two balls (12) in the hole of swash plate (10) and install it in body S.

※ Apply grease on the balls if they drop out.



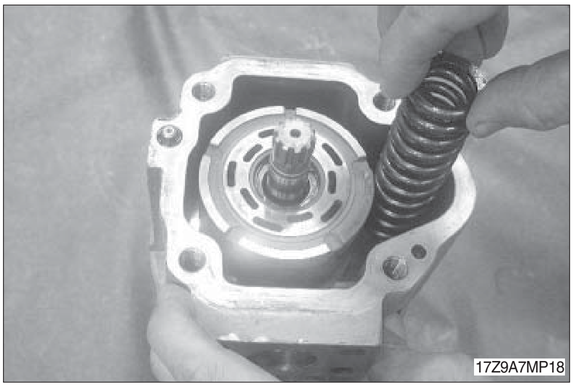
17Z9A7MP16

⑥ Assemble cylinder barrel kit into the body S (1).



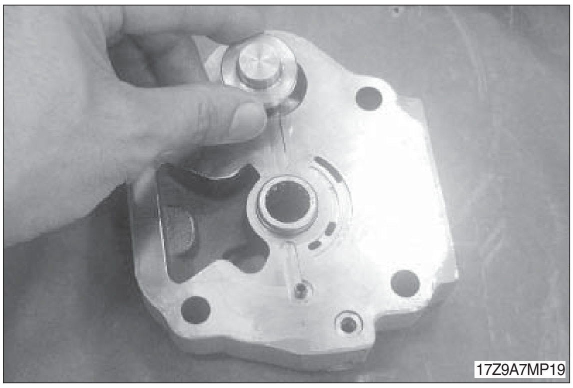
17Z9A7MP17

⑦ Set spring T (15) to spring holder (18), then set them together into the body S (1).



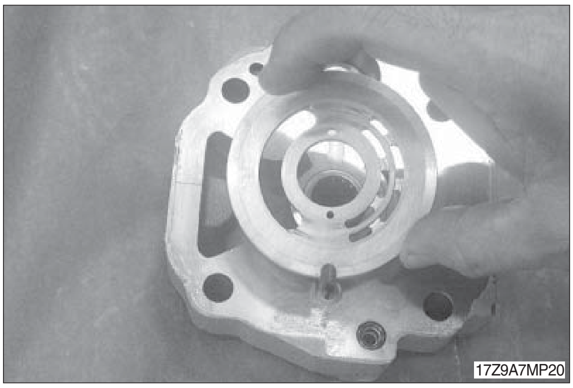
(3) Assembling of body H kit

① Set spring guide (19) in body H (2).



② Place valve plate (5) slowly on body H (2) by positioning it with spring pin (56).

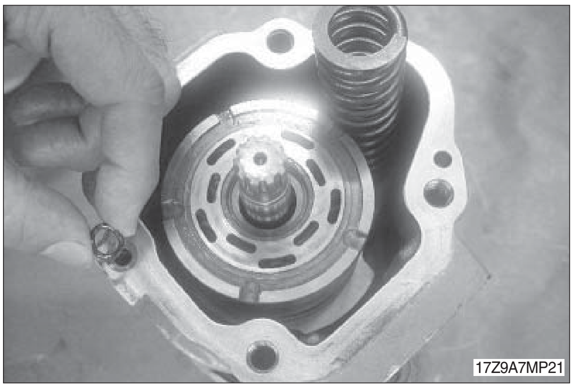
※ V notch copper alloy side of valve plate slides with cylinder barrel (4) and be careful not to set the valve plate to a wrong direction.



(4) Assembling of body S kit with body H kit

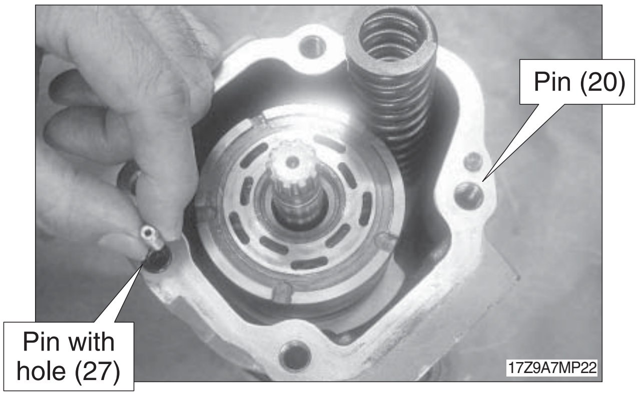
① Place O-ring (40) on body S.

※ Use new O-ring for assembling.



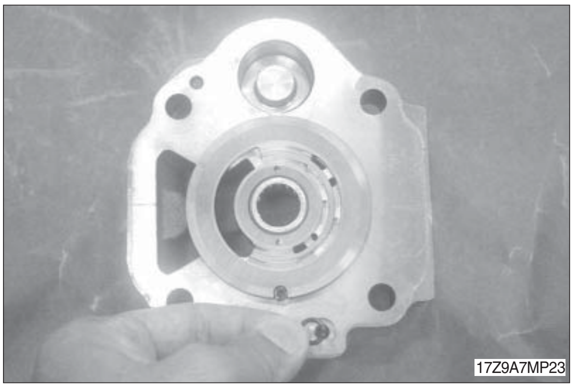
② Set pin (20) and pin (27) on body S.

※ Pay attention to the position of each pin. Pin (27) has a hole.



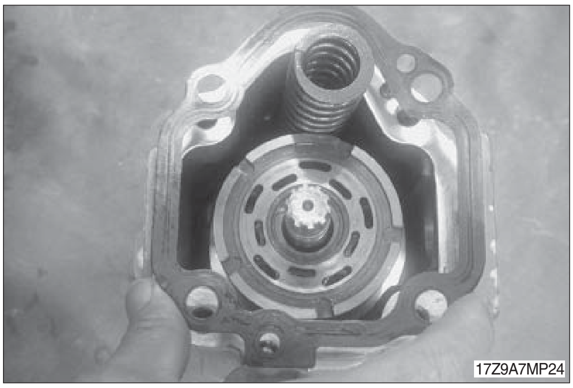
③ Place O-ring (40) on body S.

Use new O-ring for assembling.



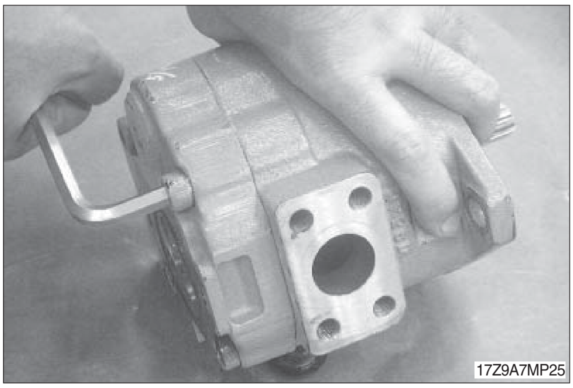
④ Place packing (13), position it with locating pin (20) on body S.

Use new gasket for assembling.



⑤ Set two screws (M10×65) into the upper side two screw holes, and tighten them until the distance between body S and body H comes to 5 to 10 mm.
Then set three screws (44, M10×40) into the lower side two screw holes, after that, replace the upper side two screws (M10×65) to the regular size screws (44, M10×40) and fix them.

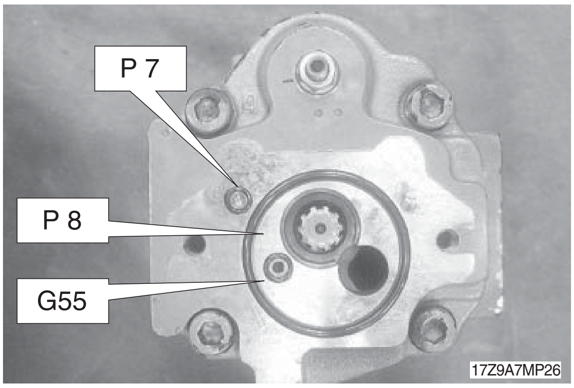
· Tightening torque : 5.2~6.6 kgf · m (37.6~47.7 lbf · ft)



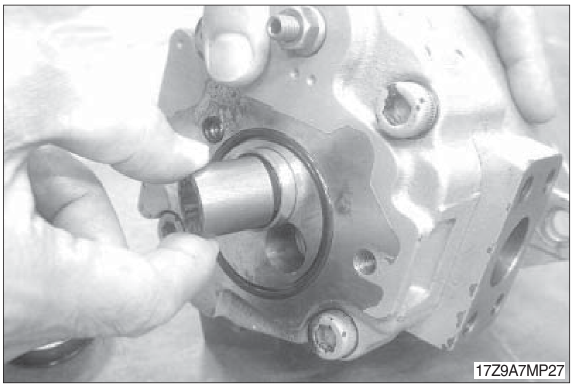
(5) Installation of gear pump kit

① Place O-ring (69, 71, 72) on the installation side of body H.

※ Use new O-ring for assembling.

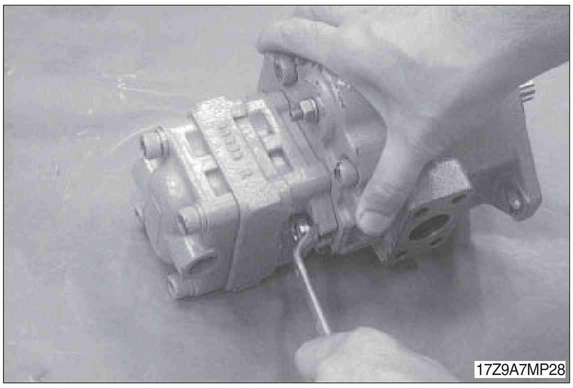


② Set collar (67), coupling (66).



③ Install gear pump kit (65) and fix it by two screws (68, M8×25) and washers (70) with spanner wrench 13 mm.

· Tightening torque : 2.0~2.4 kgf · m (14.5~17.4 lbf · ft)



(6) Inspection of assembling

After completed the assembling of pump, make sure that pump shaft rotates smoothly by hand.

GROUP 4 MAIN CONTROL VALVE

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

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

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

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

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

(4) Disconnect hydraulic hose.

(5) Disconnect pilot line hoses.

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

· Weight : 14 kg (31 lb)

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

2) INSTALL

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

(2) Bleed the air from below items.

① Cylinder (boom, arm, bucket)

② Swing motor

③ Travel motor

※ See each item removal and install.

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

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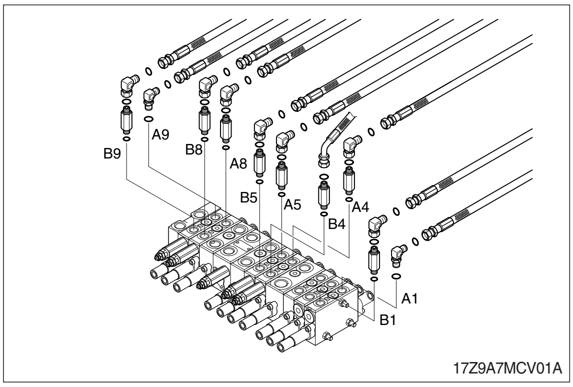

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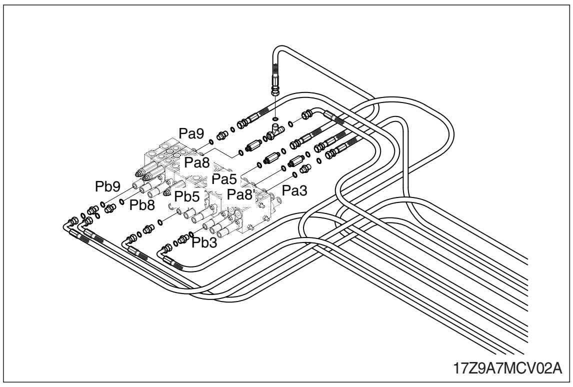

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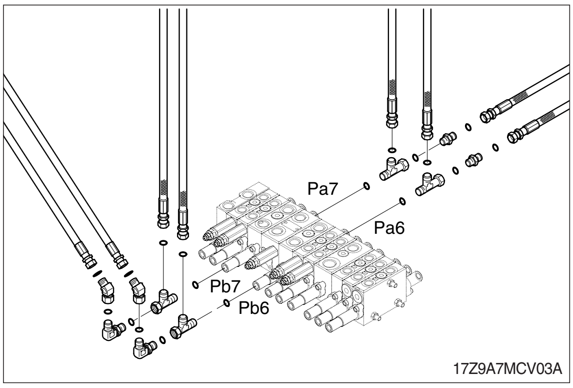

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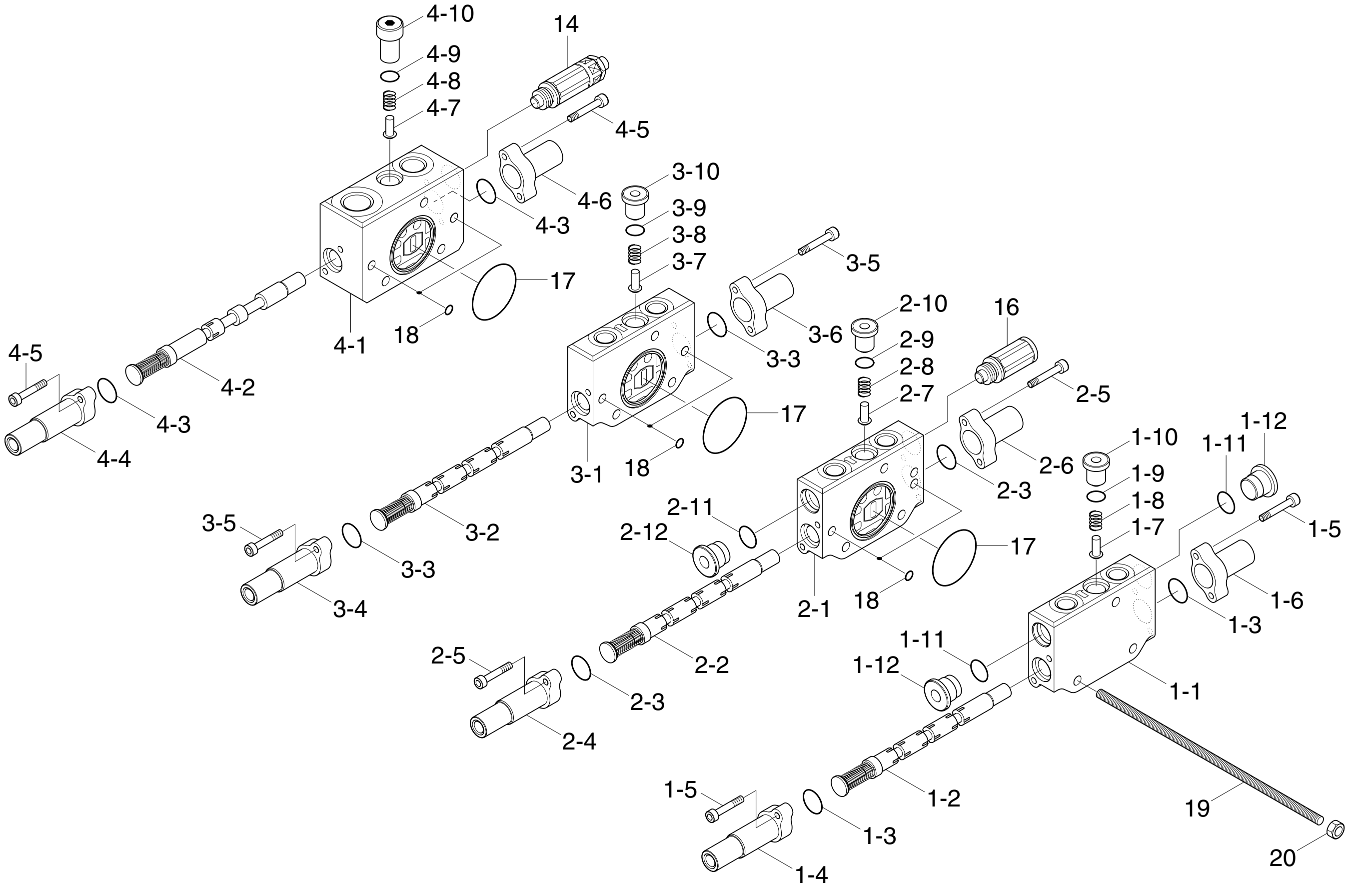
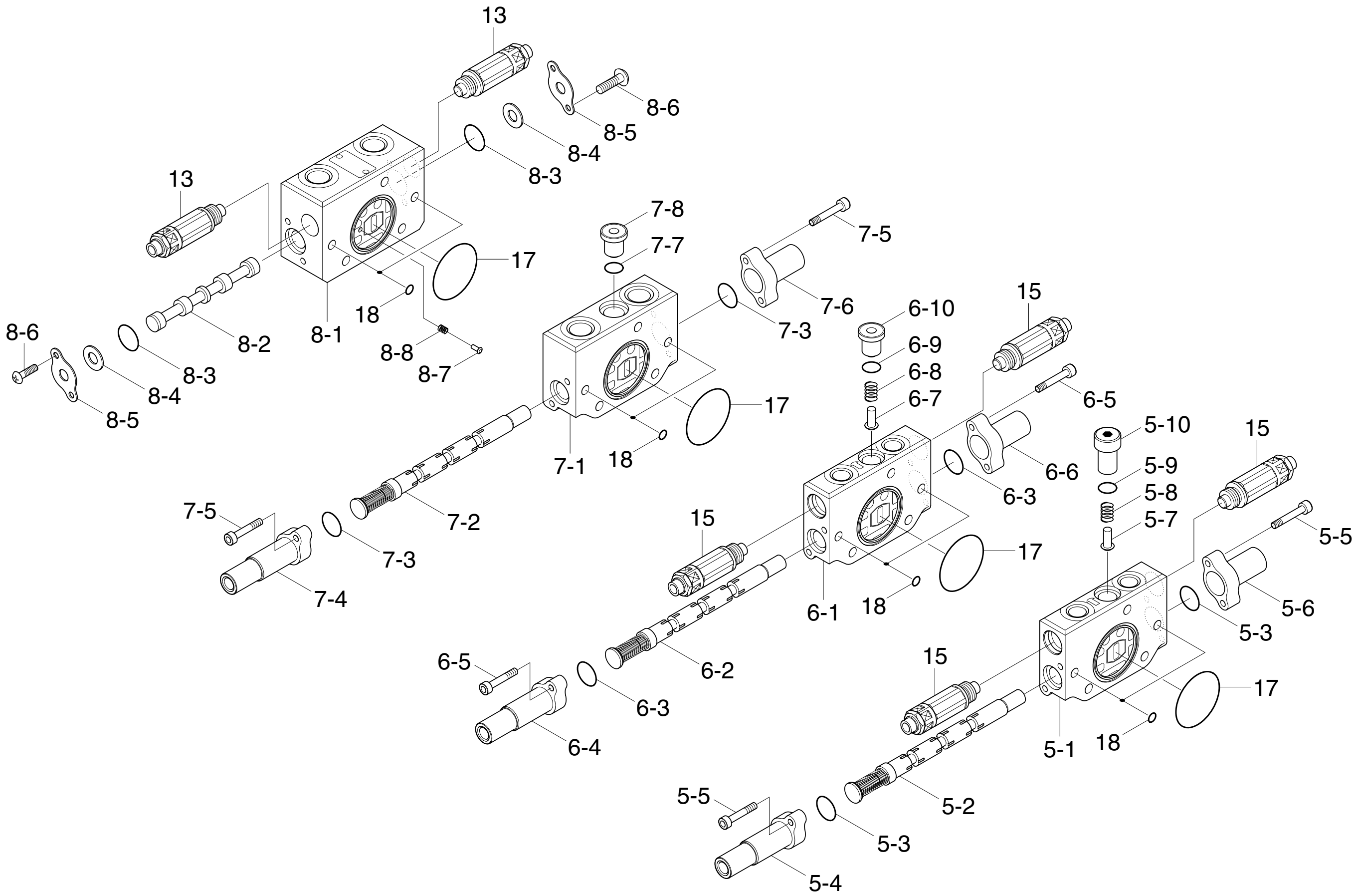
2. STRUCTURE (1/3)



17Z9A2MC02

1	Dozer work body	2-5	Bolt	3-10	Plug
1-1	Work body	2-6	Pilot cover	4	Connecting body
1-2	Spool assy	2-7	Poppet	4-1	Work body
1-3	O-ring	2-8	Spring	4-2	Spool assy
1-4	Pilot cover	2-9	O-ring	4-3	O-ring
1-5	Bolt	2-10	Plug	4-4	Pilot cover
1-6	Pilot cover	2-11	O-ring	4-5	Bolt
1-7	Poppet	2-12	Plug	4-6	Pilot cover
1-8	Spring	3	Swing work body	4-7	Poppet
1-9	O-ring	3-1	Work body	4-8	Spring
1-10	Plug	3-2	Spool assy	4-9	O-ring
1-11	O-ring	3-3	O-ring	4-10	Plug
1-12	Plug	3-4	Cover	14	Relief valve
2	Boom swing work body	3-5	Bolt	16	Anticavitation valve
2-1	Work body	3-6	Pilot cover	17	O-ring
2-2	Spool assy	3-7	Poppet	18	O-ring
2-3	O-ring	3-8	Spring	19	Tie bolt
2-4	Pilot cover	3-9	O-ring	20	Hex nut

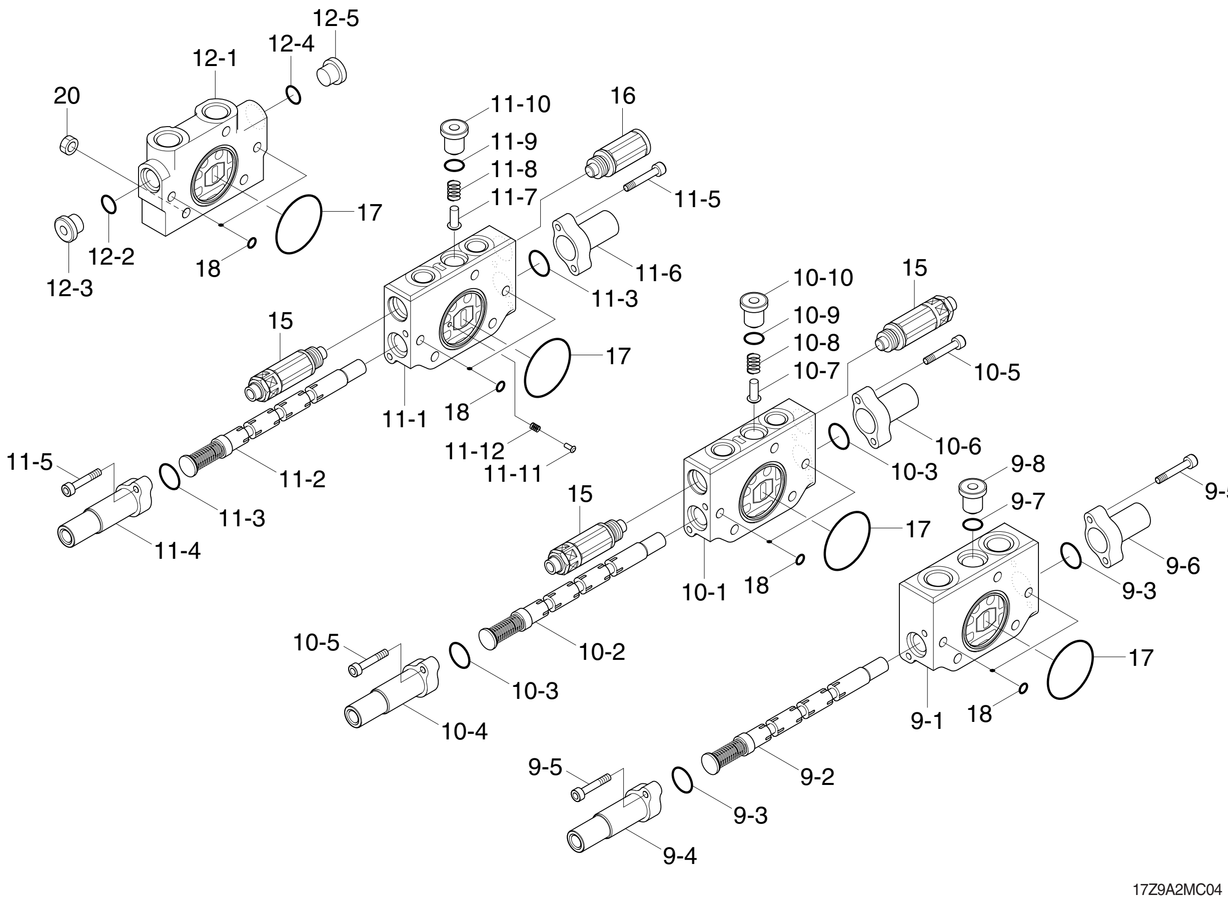
STRUCTURE (2/3)



17Z9A2MC03

5	PTO work body	6-4	Pilot cover	7-8	Plug
5-1	Work body	6-5	Bolt	8	Inlet work body
5-2	Spool assy	6-6	Pilot cover	8-1	Work body
5-3	O-ring	6-7	Poppet	8-2	Spool assy
5-4	Pilot cover	6-8	Poppet	8-3	O-ring
5-5	Bolt	6-9	O-ring	8-4	Plate
5-6	Pilot cover	6-10	Plug	8-5	Plate
5-7	Poppet	7	Travel work body	8-6	Screw
5-8	Spring	7-1	Work body	8-7	Poppet
5-9	O-ring	7-2	Spool assy	8-8	Spring
5-10	Plug	7-3	O-ring	13	Relief valve
6	Arm work body	7-4	Pilot cover	15	Overload relief valve
6-1	Work body	7-5	Bolt	17	O-ring
6-2	Spool assy	7-6	Pilot cover	18	O-ring
6-3	O-ring	7-7	O-ring		

STRUCTURE (3/3)



9	Travel work body	10-5	Bolt	11-8	Spring
9-1	Work body	10-6	Pilot cover	11-9	O-ring
9-2	Spool assy	10-7	Poppet	12	Outlet work body
9-3	O-ring	10-8	Spring	12-1	Work body
9-4	Pilot cover	10-9	O-ring	12-2	O-ring
9-5	Bolt	10-10	Plug	12-3	Plug
9-6	Pilot cover	11	Bucket work body	12-4	O-ring
9-7	O-ring	11-1	Work body	12-5	Plug
9-8	Plug	11-2	Spool assy	15	Overload relief valve
10	Boom work body	11-3	O-ring	16	Anticavitation valve
10-1	Work body	11-4	Pilot cover	17	O-ring
10-2	Spool assy	11-5	Bolt	18	O-ring
10-3	O-ring	11-6	Pilot cover	20	Hex nut
10-4	Pilot cover	11-7	Poppet		

3. DISASSEMBLY

1) PRECAUTIONS FOR DISASSEMBLY

(1) Since hydraulic devices are all machined precisely with clearances being very little, carry out the disassembly and assembly work at a clean place and make sure to prevent the device from being entered with dust, sand, and the like.

(2) Before disassembly work, prepare necessary material such as the structural drawing for control valve to fully understand the structure and others.

(3) When removing the control valve from the machine, put a dustproof cap on each port and then clean the outside of assembly after checking the installation of caps.
Furthermore, prepare a suitable workbench with clean paper or rubber mat on it for the work.

(4) Since there is a possibility of rust when the disassembled parts are left, apply anti-corrosive oil to the parts and seal them.

(5) Hold the control valve body when carrying or moving. Especially, do not hold the exposed spool after removing a pilot cover from the control valve.

(6) Do not hit the control valve even if it does not move smoothly.

(7) It is recommend carrying out various tests (relief valve setting, leak test, internal pressure loss check, etc.) after the disassembly and assembly of the control valve, which requires a hydraulic test device.
Accordingly, when the disassembly might be possible technically but the test and/or adjustment might be impossible, do not carry out the work.

※ Before removing the pipes, attach suitable indications on them to be able to locate their positions later. If there is a mistake in piping between the ports, unintentional movement could result in an accident.
※ Falling or hitting the control valve could bend the spool, which could result in an accident.
※ If foreign matter enters each port, there could be a control valve malfunction, resulting in an accident.
※ Since the load side port could hold an empty weight or enclosed pressure, release the inside pressure before loosening the piping.
There could be a fall of attachments or a jet of high-temperature hydraulic fluid.
※ The control valve becomes high temperature after operating the machine; after checking that the temperature becomes low, start the work.
※ The control valve has complicated connections and seals through the internal passages, which means that there could be enclosed pressure, resulting in an oil jet after disassembly.
※ Ware safety goggles during disassembly work because there could be a blow off of parts if they are caught.

2) NECESSARY TOOLS AND OTHERS

(1) Before disassembling the control valve, prepare the following tools.
The tools below are used to disassemble this control valve only; tools for disassembling the port fittings are not included.

Name	Quantity	Application
Hexagon spanner	Each 1	4, 6 and 8 mm
Spanner	Each 1	13, 19 and 22 mm
Socket wrench	Each 1	13, 19 and 22 mm
Torque wrench	1	0.2~2.0 kgf・m (1.4~14.5 lbf・ft)
Torque wrench	1	2.0~10.0 kgf・m (14.5~72.3 lbf・ft)
Magnet	1	-
Pliers	1	-
Screwdriver for cross	1	-
Tweezers	1	-

(2) Prepare clean wash oil, hydraulic fluid, grease, tag paper, marker pen, and others before work.

3) DISASSEMBLY OF EACH PART

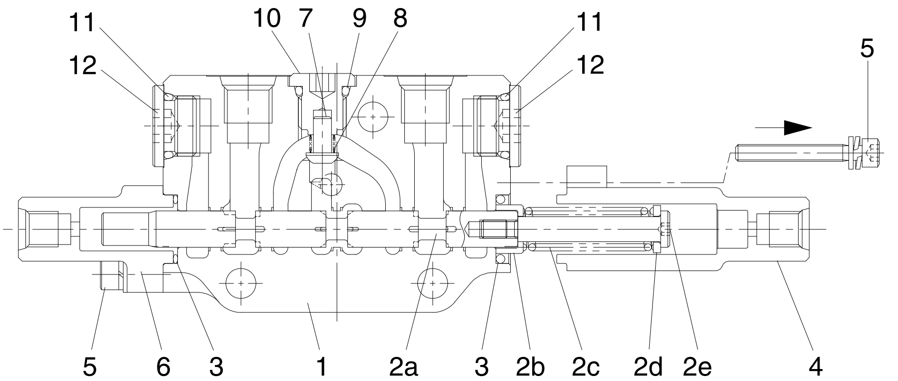
Before disassembly work, check that there is no dust on the outside of the control valve and then place it on a workbench with actuator ports facing upward.

(1) Spool draw-out procedures

Except P1, P2 inlet component

Taking the dozer spool as an example, the draw-out procedures are as follows.

① Remove 2 hexagonal socket head bolt with washer (5) with 4 mm hexagonal wrench.
② Remove pilot cover (4).
③ With a spring in the dozer spool exposed, pull out spool assy from the control valve slowly and horizontally (parallel to spool sleeve) by holding spring.
④ The other spools can also be pulled out in the same manner.
At this time, check O-ring (3) is on the bottom of body side flange.



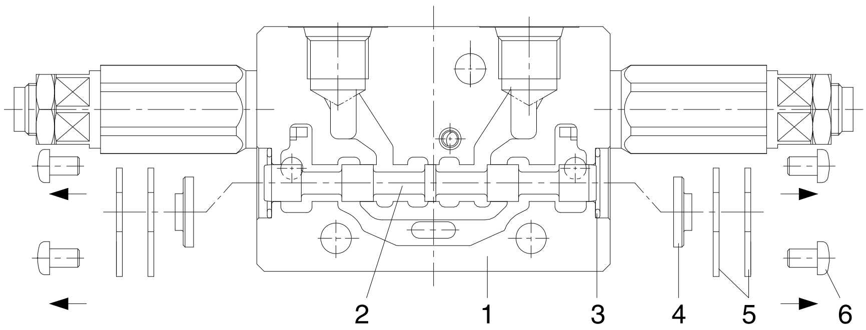
17Z9A7MCV01

1	Work body	2e	Spool end	8	Check valve spring
2	Dozer spool assy	3	O-ring	9	O-ring
2a	Dozer spool	4	Pilot cover	10	Check valve plug
2b	Spring seat	5	Hex socket head with washer	11	O-ring
2c	Spring	6	Pilot cover	12	Plug
2d	Spring seat	7	Check valve poppet		

P1, P2 inlet component

The draw-out procedures for P1, P2 inlet component spool are as follows.

① Loosen and remove 2-M5 cross recessed head screws (6) by using screwdriver for cross.
② Remove 2-seat plates (5), and pull a seat plate (4) out by using tweezers.
③ A reverse-side also similarly pull out 2-seat plates (5) and a seat plate (4).
④ With a spool (2) exposed, pull out a spool by magnet.



17Z9A7MCV02

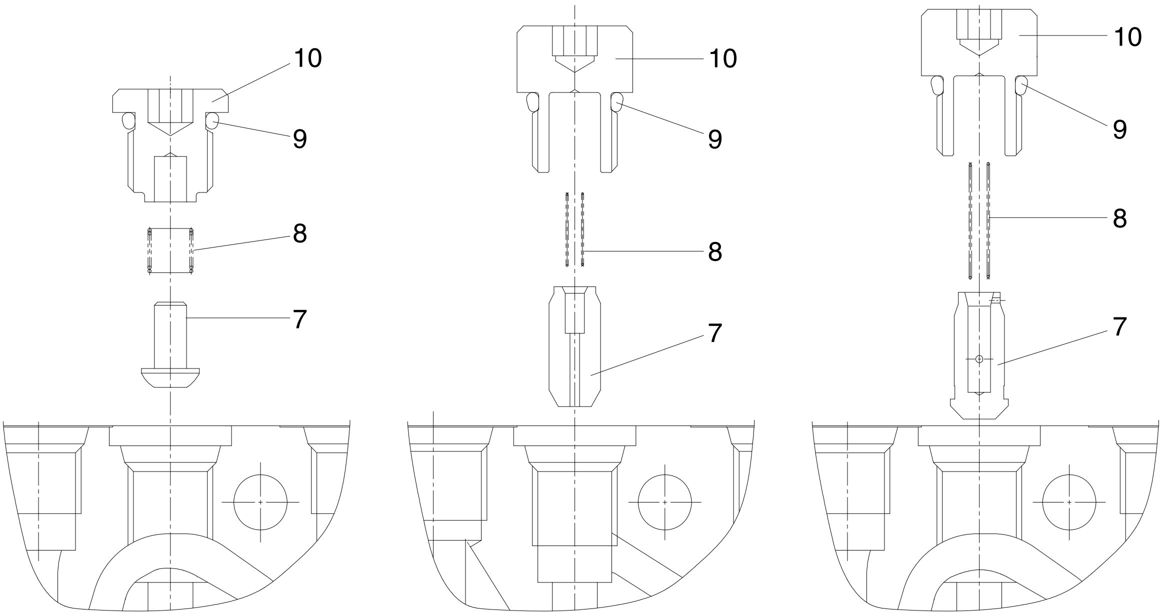
(2) Check valve disassembly procedures

① Hold the control valve body at workbench or hold it by two or more people.

② Loosen and remove check valve plug (10) at the center of the control valve upper surface with 6 ㎜ hexagonal wrench.
When it is hard to loosen the plug because O-ring (9) bites the screw, do not loosen forcibly; refasten it once and then try to loosen again.

③ From the hole where check valve plug has been removed, remove check valve spring (8) and check valve (7) with tweezers or magnet.

④ Connecting component and PTO component are different in shape; however, they can be disassembled in the same manner.
- For travel component pull out only check valve plug (8, see page 7-22) in the same procedures since there is no check valve.



Standard type　　Connecting component　　PTO component

17Z9A7MCV03

(3) Accessory valve disassembly procedures

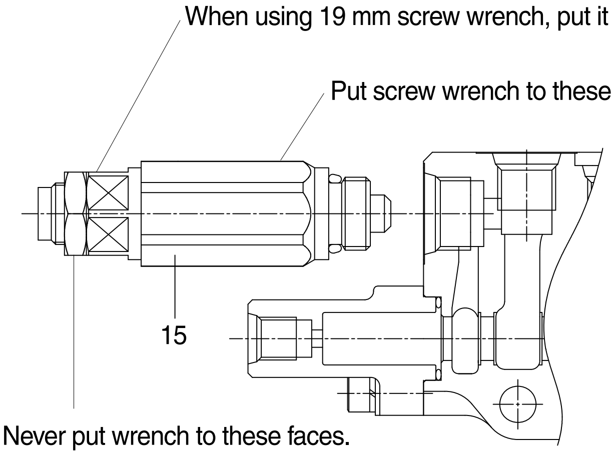
※ Accessory valves are the most important parts for performance and safety; in particular, the relief valve is very difficult to readjust the setting so that replace the accessory valve as assy if any malfunction occurs.

Main relief valve and overload relief valve

Taking overload relief valve in the arm section as an example, the removal procedures are as follows.

① Loosen and remove overload relief valve (15) by using 22 ㎜ screw wrench or socket wrench.
② Put screw wrench (or socket wrench) to 22 ㎜ hexagonal part of pressure regulating body.
③ If there is no 22 ㎜ screw wrench (or socket wrench), it is also possible to loosen and remove by putting 19 ㎜ screw wrench to the hexagonal part as shown in the figure.
④ The main relief valve for P1, P2 and P3 are slightly different in shape; however, they can be disassembled in the same manner.

※ If using 19 ㎜ screw wrench to remove, never put it to the lock nut part.
If not, only lock nut is loosened to change the relief valve setting, which could result in the degradation in performance or damage.

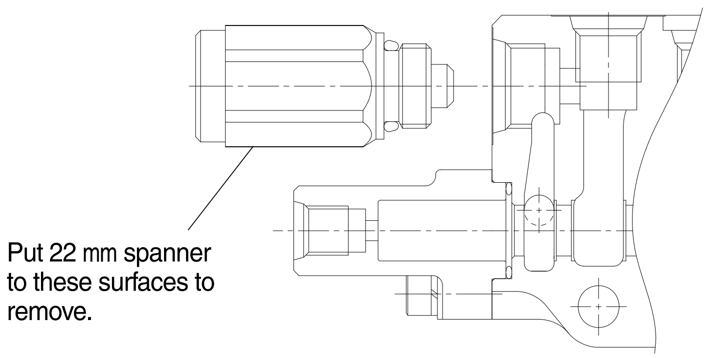


17Z9A7MCV04

Anticavitation valve

As well as overload relief valve, loosen and remove anticavitation valve by using 22 ㎜ spanner or socket wrench.

※ Removing anticavitation valve causes the seat to be exposed.
Flaws on the seat causes internal leakage, which makes the holding performance of actuator worse. When storing it, be careful not to damage the seat.



17Z9A7MCV05

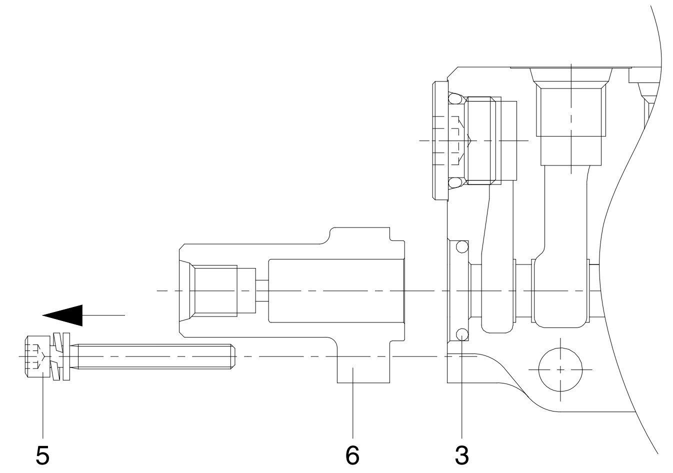
(4) The other parts disassembly procedures

Remove the other parts that have not been removed at the work (1) through (3) as shown below.

Pilot cover

① Remove 2 hexagonal socket head bolt with washer (5) with 4 mm hexagonal wrench.

② Remove pilot cover (6).
Check O-ring (3) is on the bottom of body-side flange.

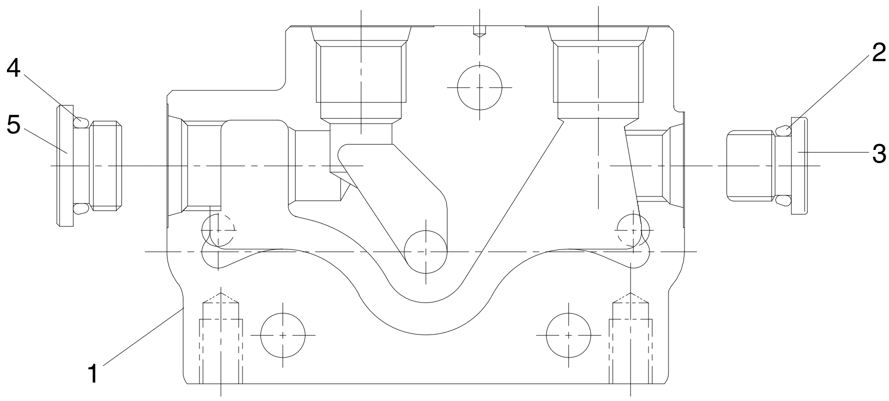


17Z9A7MCV06

The plug (PF3/8, PF1/4) of outlet component

① Loosen plug (3) by using 6 ㎜ hexagonal wrench to remove it from outlet body (1).

② Loosen plug (5) by using 8 ㎜ hexagonal wrench to remove it from outlet body (1).

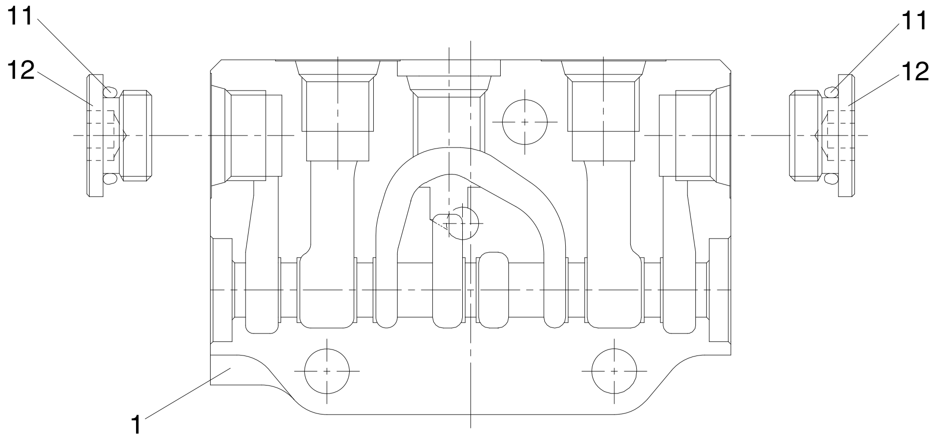


17Z9A7MCV07

The plug (PF3/8) of boom swing and dozer component

① Using dozer component as an example, the disassembly procedures are as follows.

② Remove plug (12) from the body (1) by using 8 mm hexagonal wrench to loosen.

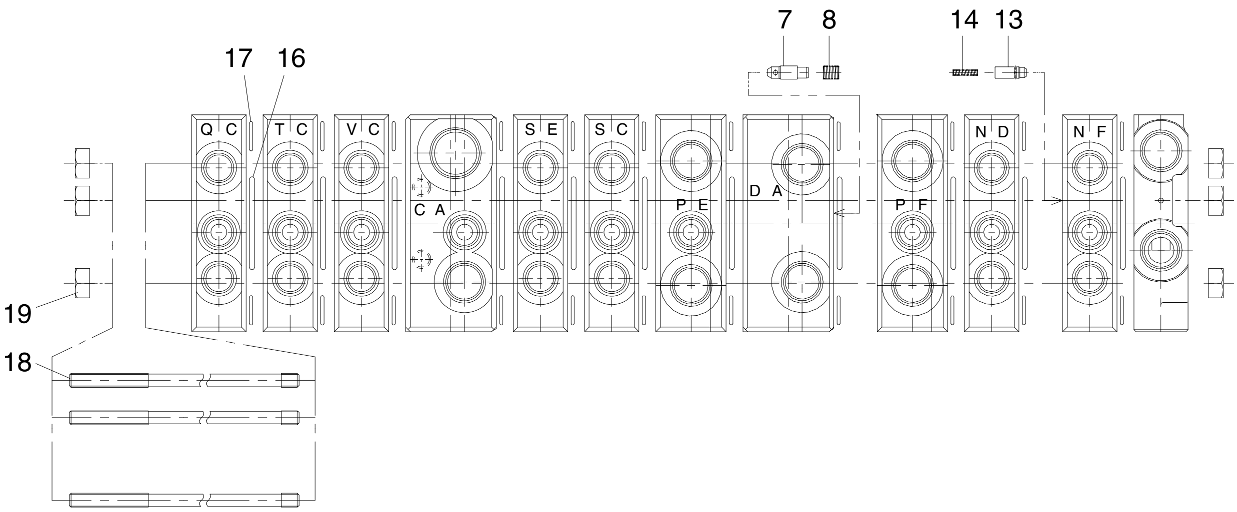


17Z9A7MCV08

(5) Component body disassembly procedures

① Loosen and remove 3-M8 nuts (19) from both end faces of control valve, which are for assembling component body, by using 13 mm spanner or socket wrench.

② When pulling out 3-M8 tie bolts (18) from the side faces, each component body can be in individual condition. At this time, be careful not to drop or lose O-rings (16,17), poppet check valve(7,13) and spring check valve (8,14) mounted on mating surfaces of each component body.



17Z9A7MCV09

QC	Dozer	SE	PTO	PF	Travel
TC	Boom swing	SC	Arm	ND	Boom
VC	Swing	PE	Travel	NF	Bucket
CA	Connecting	DA	Inlet P1 and P2	BH	Outlet

(6) Precautions after disassembly

※ For the parts already removed in the work, store and/or transport them with attention on flaws and dirt.

※ When carrying out another work, storage, or transportation with the parts removed condition, apply caps or plastic tape to the holes from which the parts have been taken out, protecting the holes from being entered with dust or the like.

4. ASSEMBLY

1) PRECAUTIONS FOR ASSEMBLY

The disassembly and assembly of our products are to be carried out at our factory in principle.
If there is a necessity of them unavoidably, observe the following precautions and carry out the work at a factory where there are engineers with sufficient technique for hydraulic devices.

(1) Be careful that the unevenness of fastening torque and the contamination of dust during assembly work could result in malfunction.
In addition, observe fastening torque values specified in the specifications and drawings.

(2) During assembly work, compare valves with the specifications and drawings and check the number of parts whether there is any improper assembly and/or the omission of parts.

(3) For the parts to be used in assembly, dip in fluid oil as need arises to reassemble after washing well in washing oil and being dried.

(4) After cleaning and degreasing the surface sufficiently, apply loctite to 2 threads of the screw from the tip (Too much loctite could result in malfunction after squeezing out).

(5) For the part to be attached or assembled with two or more bolts and nuts, fastening them evenly and alternately for several times, not once with the specified torque.
The unevenness of fastening torque could result in the leakage of hydraulic fluid to the outside and/or malfunctions.

2) PRECAUTIONS FOR ASSEMBLING SEAL PARTS

(1) All seals are to be renewed at assembly.

(2) Check seals for defects in molding and flaws in handling.
Do not use the seal with defect and/or flaw.

(3) The seals used on sliding surfaces and the places to be installed with seals are to be applied with grease or hydraulic fluid for sufficient lubrication where not specially noted.

(4) Do not make seals longer up to permanent deformation.

(5) O-ring is not to be twisted during assembly.
Kinked O-ring could cause oil leakage after installation because kinks are hard to restored.

3) NECESSARY TOOLS AND OTHERS

Before assembling the control valve, prepare the following tools.
The tools below are used to assemble this control valve only; tools for assembling the port fittings are not included.

Name	Quantity	Application
Hexagon spanner	Each 1	4, 6 and 8 mm
Spanner	Each 1	13, 19 and 22 mm
Socket wrench	Each 1	13, 19 and 22 mm
Torque wrench	1	0.2~2.0 kgf・m (1.4~14.5 lbf・ft)
Torque wrench	1	2.0~10.0 kgf・m (14.5~72.3 lbf・ft)
Magnet	1	-
Pliers	1	-
Screwdriver for cross	1	-
Tweezers	1	-

Prepare clean wash oil, hydraulic fluid, grease, tag paper, marker pen, and others before work.

4) ASSEMBLING WORK

For the fastening torque values for screws, see the page 2-6.

(1) Assembling body work

① Place component bodies with each mating surface facing up in the order of assembling.
Then, mount O-rings on mating surfaces of each component body.
However, do not apply hydraulic oil or grease to these O-rings.
(There is a possibility of mistaking them for oil leakage when oozing out from mating surfaces)
The next page shows the order of assembling component bodies and O-rings mounted on mating surfaces.

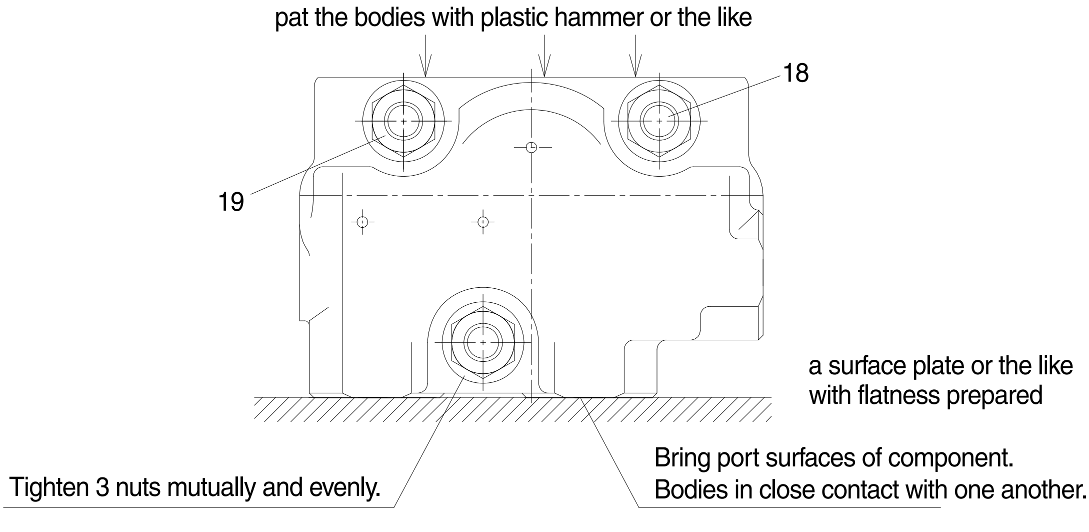
② On a surface plate or the like with flatness prepared, place each component body with actuator port surface facing down in the same order with the above ①.
At this time, insert it from the mating face in order of poppet check valve (7) and spring check valve (8) in P1, P2 inlet component body symbol "DA". And insert it also in the bucket component body symbol "NB" similarly in order of poppet check valve (13) and spring check valve (14).

※ Then, check the mating surfaces in each component body for dust or the like and check whether O-rings shown in the delivery specifications are surely put in each groove for O-ring.

※ Kinked O-rings could cause the leakage of hydraulic fluid to the outside due to the malfunction of sealing performance.
If O-rings are not installed surely in O-ring grooves, there would be the nip of O-ring, resulting in the leakage of hydraulic fluid to the outside when assembling the bodies.

③ Put 3-M8 tie bolts (18) through each component body from the side, and screw M8 nuts (19) on both ends lightly.
At this time, pat the bodies with plastic hammer or the like to align the port surface of each component body.
Then, tighten one-side nuts with the opposite side nuts fixed by 13 mm spanner.
Tighten 3-nuts equally and mutually, not all at once with specified torque.
Be careful that applying not specified torque causes the deformation of body or oil leakage.

· Nut tightening torque : 1.4~1.5 kgf · m (10.1~10.8 lbf · ft)



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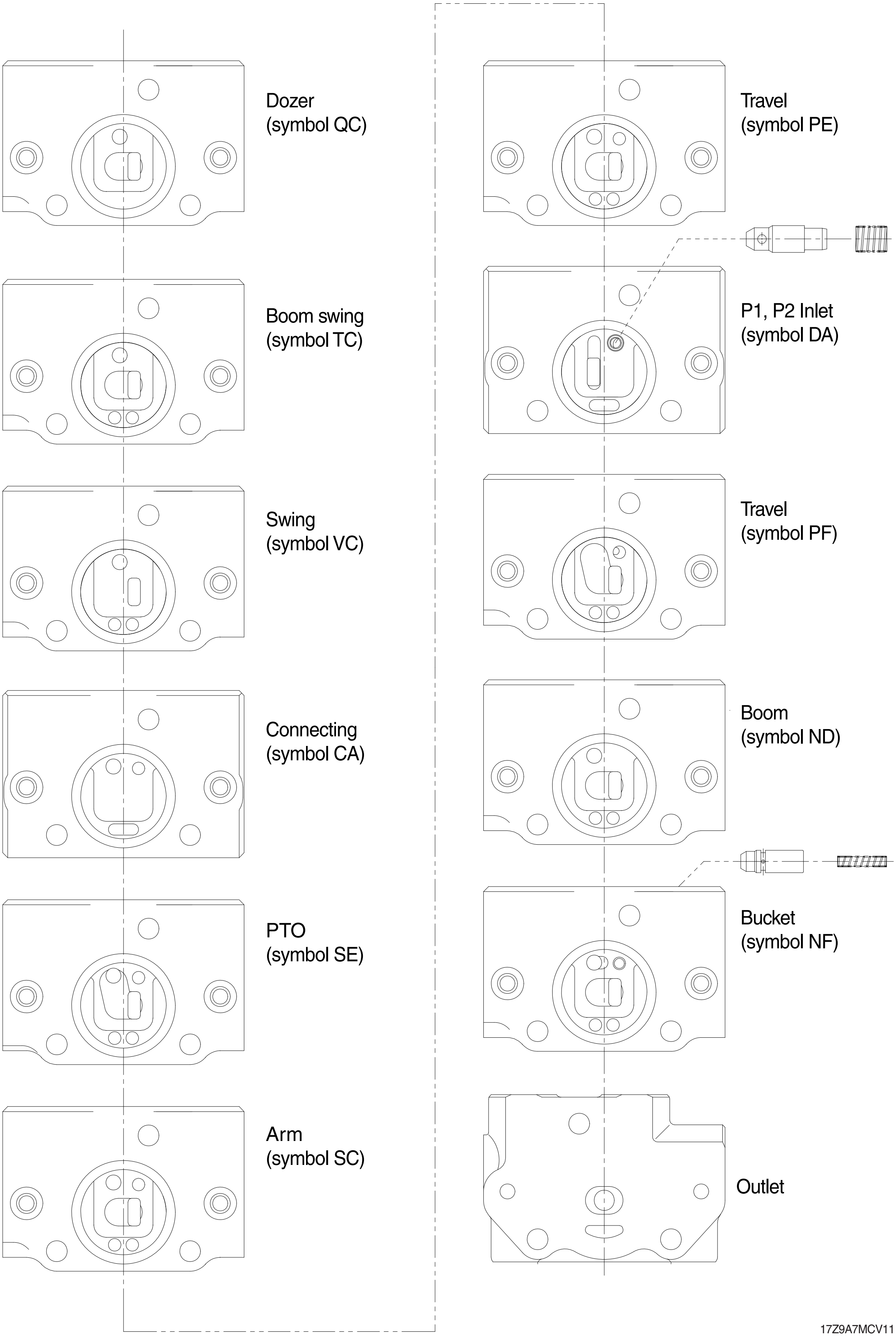
Array of body

※ Do not apply hydraulic oil or grease to O-rings.

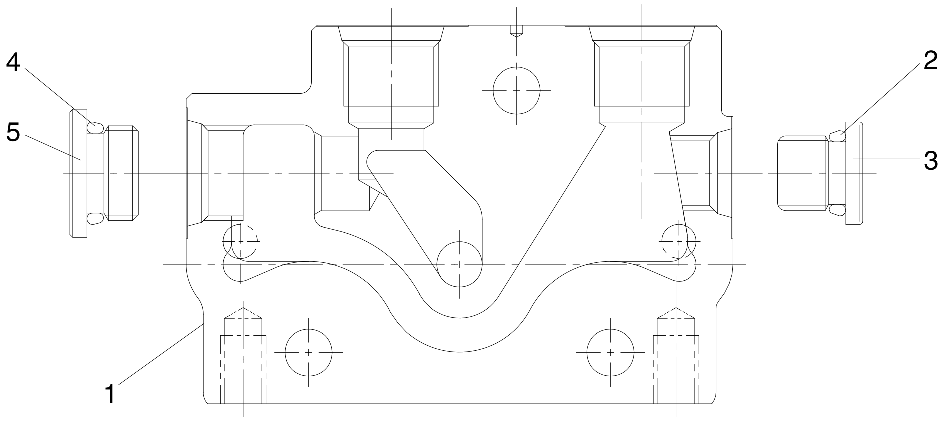


(2) The other parts assembly procedures

① The plug (PF3/8, PF1/4) of outlet component

After checking that plug (3) is mounted with O-ring (2), screw the plug into outlet body (1) loosely and then tighten it with specified torque by using 6 mm hexagonal wrench.

And after checking that plug (5) is mounted with O-ring (4), screw the plug into outlet body (1) loosely and then tighten it with specified torque by using 8 mm hexagonal wrench.



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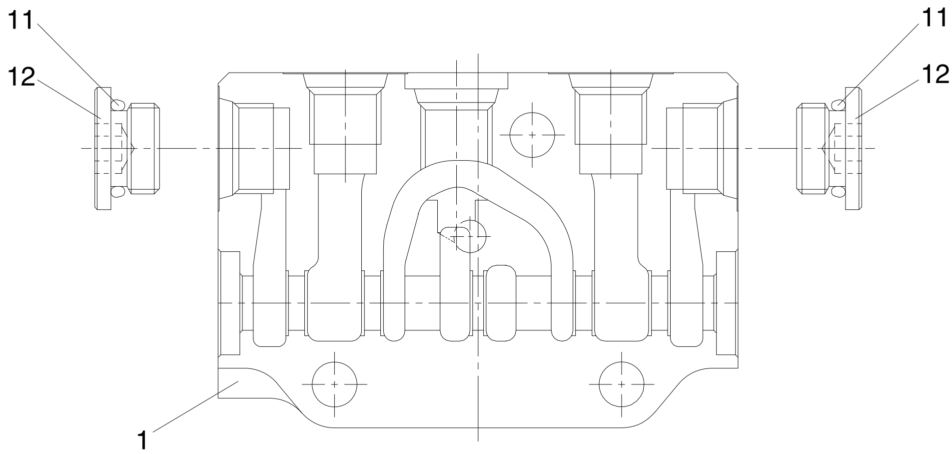
② The plug (PF3/8) of boom swing and dozer component

After checking that plug (12) is mounted with O-ring (11), screw the plug into component body (1) loosely and then tighten it with specified torque by using 8 mm hexagonal wrench.



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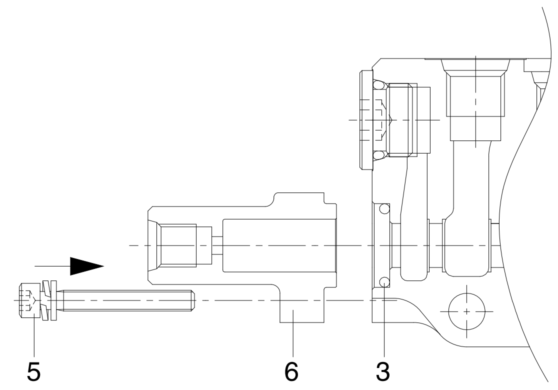
③ Pilot cover

- Install O-ring (3) securely on the flange bottom of the body.
- Insert pilot cover (6) into the flange of the body.
- Tighten bolt with washers (5) with specified torque by using 4 mm hexagonal wrench.



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(3) Accessory valve disassembly procedures

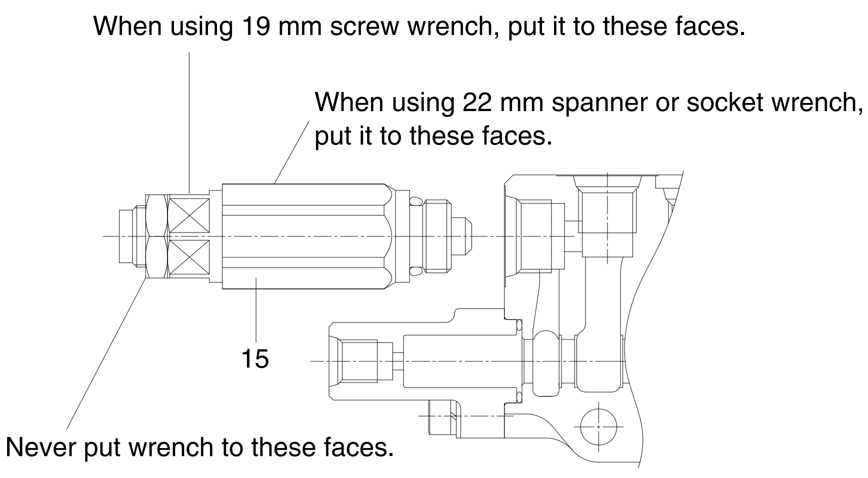
① Main relief valve and overload relief valve

Tighten main relief valve and overload relief valve by using 22 mm spanner or socket wrench.

- Put spanner (socket wrench) to 22 mm hexagonal part of pressure regulating body.
- If there is no 22 mm spanner (socket wrench), it is also possible to loosen and remove by putting 19 mm spanner to the hexagonal part as shown in the figure.

※ If using 19 mm screw wrench to remove, never put it to the lock nut part.
If not, only lock nut is loosened to change the relief valve setting, which could result in the degradation in performance or damage.

※ Before installing accessory valves (main relief valve, overload relief valve), check that there is no flaw or dust on the seat.
The presence of flaw or dust on the seat can cause internal leakage, resulting in the holding failure of actuator.



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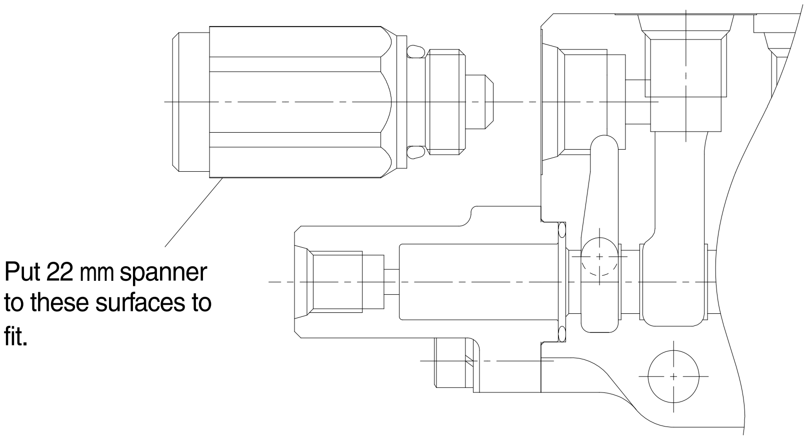
② Anticavitation valve

As well as overload relief valve, fit anticavitation valve by using 22 ㎜ spanner or socket wrench.

※ Before installing accessory valves (anticavitation valve), check that there is no flaw or dust on the seat.

The presence of flaw or dust on the seat can cause internal leakage, resulting in the holding failure of actuator.



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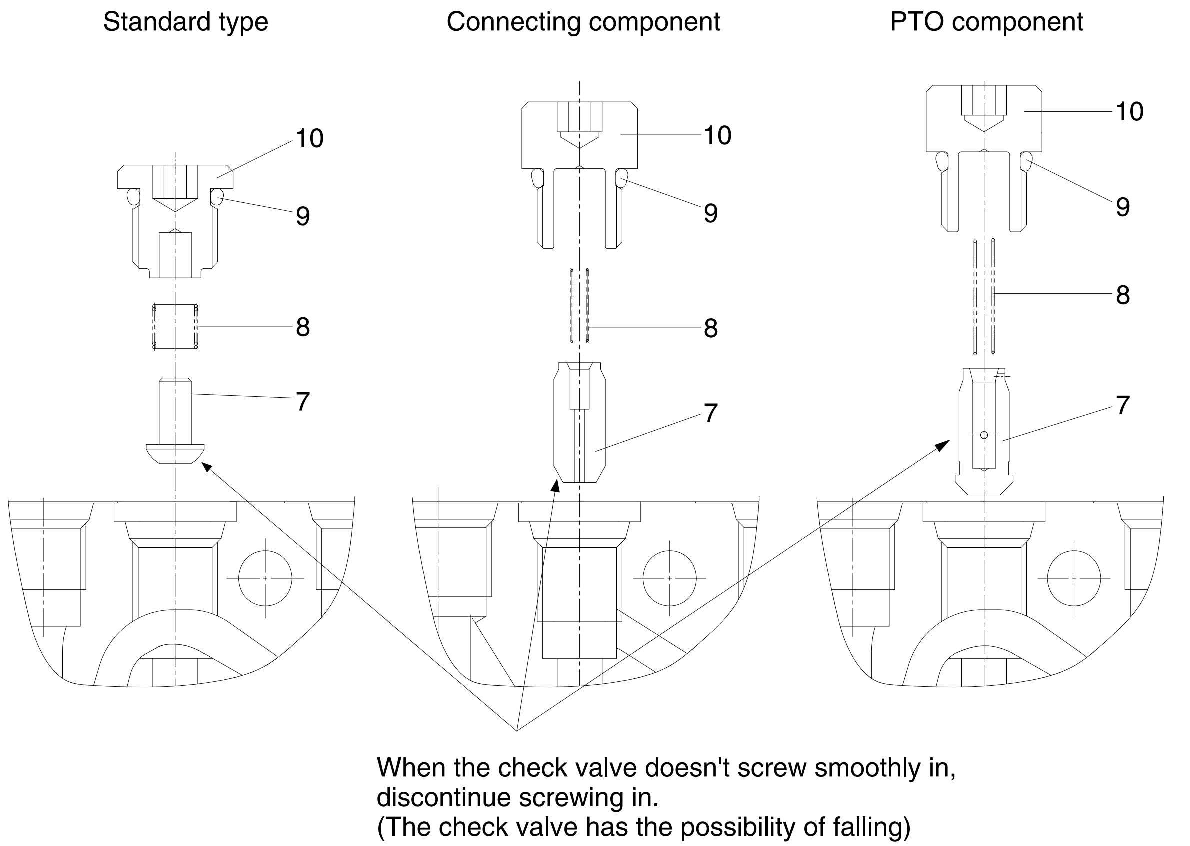
(4) Check valve assembly procedures

① Hold the control valve body at workbench or hold it by two or more people.

② Insert check valve (7) with its bevel facing down vertically into the upper center of control valve's body (1). Then, insert check valve spring (8) into the body of check valve (7).
Be careful that inclined check valve (7) cannot be inserted into the hole of check valve plug (10).
(It is necessary to check that check valve is almost at the center.)

③ After checking that check valve plug (10) is surely mounted with O-ring (9), screw it in and tighten with specified torque by using 6 ㎜ hexagonal wrench.

④ Connecting component and PTO component are different in shape; however, they can be assembled in the same manner.
Meanwhile, since track component does not have check valve nor check valve spring-check valve, the working in ② can be omitted and plug(8, see page 7 -22) is to be tightened as well.



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(5) Spool installing procedures

Except P1, P2 inlet component

Taking the dozer spool as an example, the installing procedures are as follows.

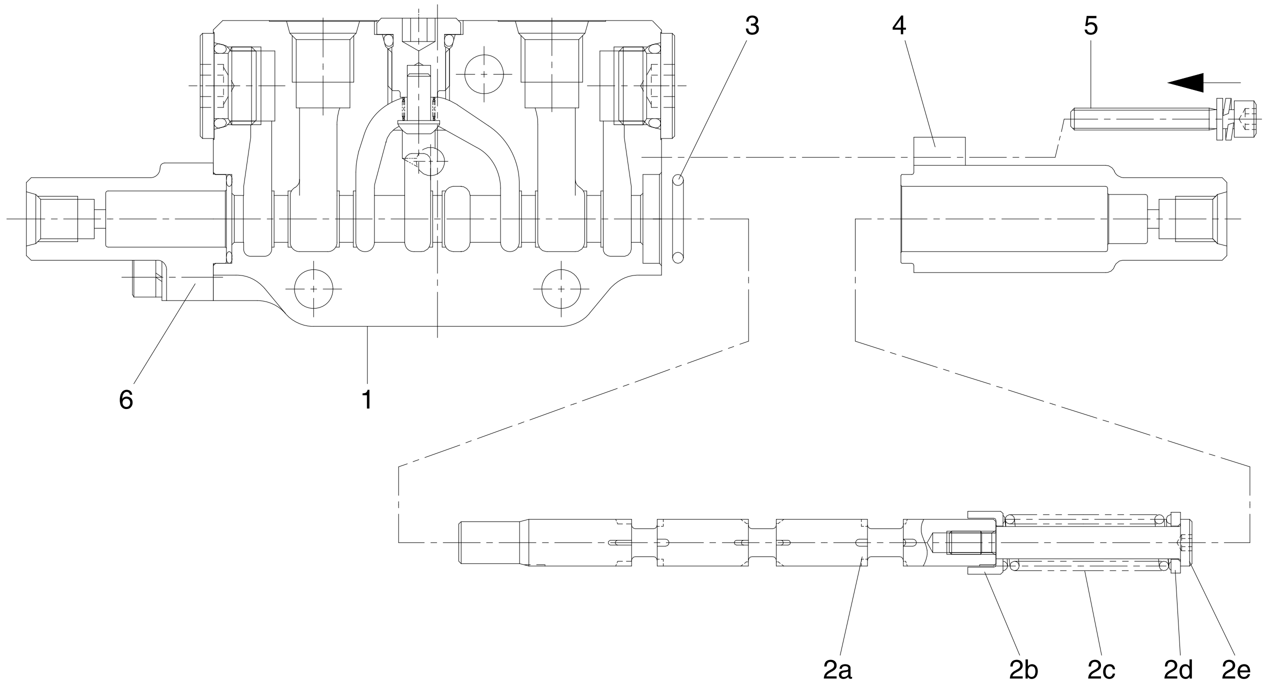
① After checking whether there is no dust or the like in the spool sleeves of the body and/or spool assy and O-ring (3) is securely installed with that the flange bottom of the body, insert the dozer spool assy into spool sleeve of the body with attention on the position and direction.
- Then, apply little hydraulic fluid to spool before the insertion.

※ Carefully insert spool assy into the spool sleeve horizontally.
If it is hard to insert, forcible insertion could cause impressions on spool sleeves and/or spools, resulting in malfunction.

※ If you feel any feeling of wrongness such as catches or strong resistance, pull it out once to check whether there is the adhesion of dust or the development of flaw or burr.
If there are flaws or burrs, there could be malfunction so that replace body and spool in set.
- When there is no feeling of wrongness, check for any heavy movement or a feeling of catches.

② With pilot cover (4) being pressed in a direction from the spring side of spool assy to the flange of body, tighten bolt with washers (5) with specified torque by using 4 ㎜ hexagonal wrench.

③ The other spools can be assembled in the same manner.



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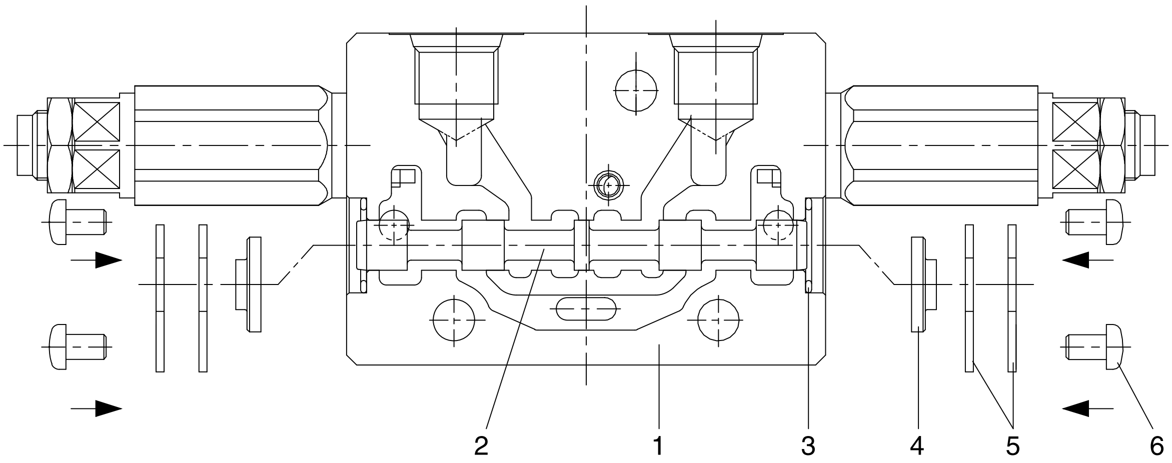
P1, P2 Inlet component

The fitting procedures for P1, P2 inlet component spools are as follows.

① After checking whether there is dust or the like in the spool hole of spool and/or body and that the flange bottom of the body is securely installed with O-ring (3), insert the spool into spool hole of the body with attention on the position and direction.
- The insertion direction in the spool can be inserted according to any direction because there is no right and left specification.
- Apply little hydraulic fluid to spools before the insertion.

② A seat plate (4) and two seat plates (5) are installed, and tighten 2-M5 cross recessed head screws (6) with the specified torque by using screwdriver for cross.

③ Tighten a reverse-side with the specified torque similarly.



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5. PROBLEM CAUSES AND MEASURES

Since the cause of trouble occurred in hydraulic devices might be a complexity of various factors, first check whether the trouble occurs in any control valve, the other hydraulic device, or the circuit if you find any abnormality.

It is necessary to measure the pressure, flow rate, and so on of each important point.

Before disassembling even a part, follow to the above-mentioned disassembly and assembly procedures. The followings show typical trouble examples in control valves.

Phenomenon	Possible cause	Remedy
Spool's sliding movement is not smooth.	· Storage of foreign matter. · Oil-film shortage between spool and body due to abnormal rise of oil temperature. · Friction of spool. · Insufficient lubrication due to oil deterioration. · Set or breakage of return spring. · Bend of spool. · Distortion of valve due to fitting surface failure. · Abnormal tightening of fitting surface. · Failure in link fitting.	· Disassemble, check, correct, or replace it. · Decrease oil temperature or change hydraulic oil. · Replace spool. · Change hydraulic oil and carry out flashing of circuit. · Replace spring. · Replace spool. · Loosen fitting bolts, carry out check and correction. · Retighten them with specified torque. · Inspect and correct link fitting.
Oil leakage from spool seals.	· Damaged or cut O-rings. · Dent or score on sliding part of spool seal. · Paint adhered on sliding part of spool seal.	· Replace O-rings. · Correct or replace spool. · Remove paint with thinner or the like.
Attachment does not operate, moves slow, or outputs less power.	· Storage of foreign matter on the seat of relief valve or overload relief valve. · Loosened adjusting screw in relief valve or overload relief valve. · Storage of foreign matter on the seat of anticavitation valve.	· Disassemble, check, and replace it. If the seat contacting with overload relief valve's body is damaged, replace body also. · Readjust with specified torque. · Disassemble, check, and replace it. If the seat contacting with overload relief valve's body is damaged, replace body also.
Even when spool position is neutral, cylinder sinks under its own weight.	· Damaged body or spool. · Storage of foreign matter between body and spool, or stick. · Set or breakage of check valve spring or return spring. · Storage of foreign matter on the seat of overload relief valve. · Loosened adjusting screw in overload relief valve. · Storage of foreign matter on the seat of anticavitation valve.	· Replace body and/or spool. · Disassemble, check, correct, or replace it. When there is a stick, replace body and spool as a set. · Replace spring. · Disassemble, check, and replace it. If the seat contacting with overload relief valve's body is damaged, replace body also. · Readjust it with specified torque. · Disassemble, check, and replace it. If the seat contacting with anticavitation valve's body is damaged, replace body also.
When operating it upward, cylinder falls conversely.	· Storage of foreign matter between load check valve and component body's seat. · Stick of check valve. · Set or breakage of check valve spring.	· After disassembling and cleaning, replace body if damage is serious. · Replace check valve and check valve plug as a set. · Replace spring.

1. REMOVAL AND INSTALL OF MOTOR

1) REMOVAL

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

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

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

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

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

(4) Disconnect hose assembly (8, 10, 11, 13).

(5) Sling the swing motor assembly and remove the swing motor mounting bolts (18).

※ Motor device weight : 15 kg (33 lb)

(6) Remove the swing motor assembly.

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

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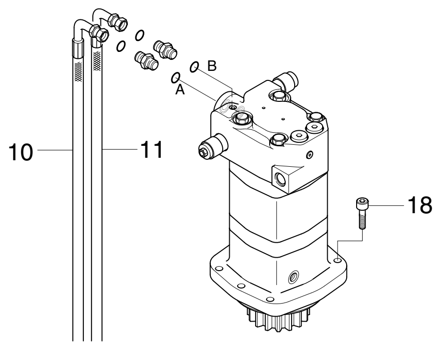

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2) INSTALL

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

(2) Bleed the air from the swing motor.

① Remove the air vent plug.

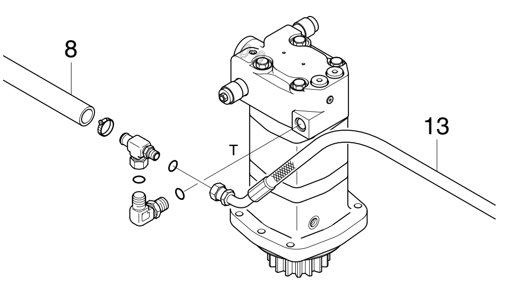
② Pour in hydraulic oil until it overflows from the port.

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.



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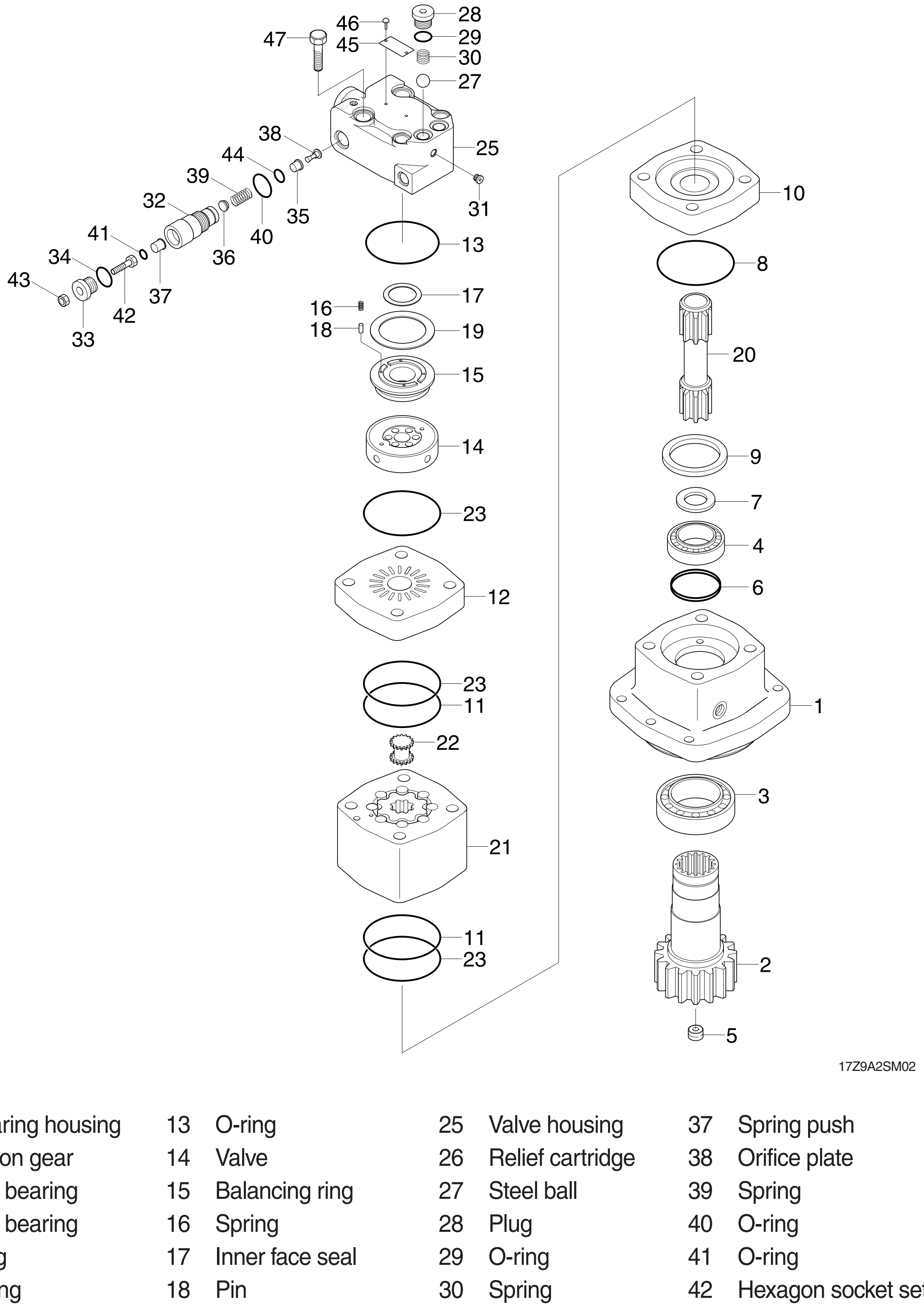
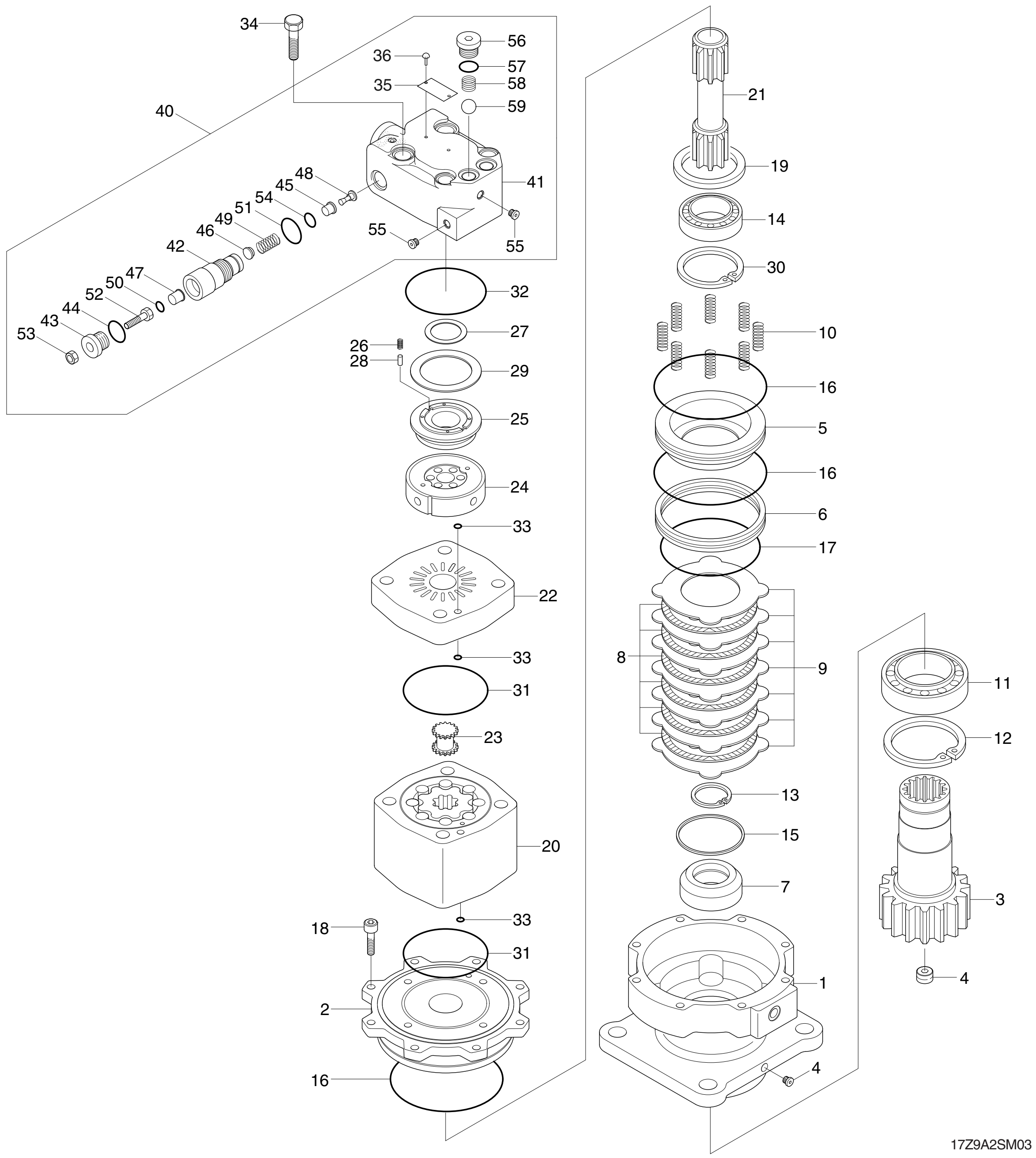
2. COMPONENTS (WITHOUT PARKING BRAKE)



1	Bearing housing	13	O-ring	25	Valve housing	37	Spring push
2	Pinion gear	14	Valve	26	Relief cartridge	38	Orifice plate
3	Ball bearing	15	Balancing ring	27	Steel ball	39	Spring
4	Ball bearing	16	Spring	28	Plug	40	O-ring
5	Plug	17	Inner face seal	29	O-ring	41	O-ring
6	X-ring	18	Pin	30	Spring	42	Hexagon socket set screw
7	Retaining ring	19	Outer face seal	31	Plug	43	Hexagon nut
8	O-ring	20	Drive	32	Cartridge	44	O-ring
9	Shaft face seal	21	Gerotor	33	Screw guide	45	Name plate
10	Wear plate	22	Valve drive	34	O-ring	46	Rivet
11	O-ring	23	O-ring	35	Needle valve	47	Hexagon bolt
12	Valve plate	24	Valve housing assy	36	Spring seat		

COMPONENTS (WITHOUT PARKING BRAKE)



1	Bearing housing	15	X-ring	29	Outer face seal	46,47	Spring seat
2	Flange mounting	16,17	O-ring	30	Snap ring	48	Orifice plug
3	Pinion gear	18	Cap screw	31,32	O-ring	49	Spring
4	Plug	19	Shaft face seal	33	O-ring	50	O-ring
5	Piston	20	Geroler	34	Bolt	51	O-ring
6	Ring	21	Drive	35	Name plate	52	Hexagon screw
7	Collar	22	Valve plate	36	Rivet	53	Hexagon nut
8	Friction disk	23	Valve drive	40	Valve housing assy	54	O-ring
9	Center plate	24	Valve	41	Valve housing	55	Plug
10	Spring	25	Balancing ring	42	Cartridge	56	Plug
11	Front bearing	26	Spring	43	Screw guide	57	O-ring
12,13	Snap ring	27	Inner face seal	44	O-ring	58	Spring
14	Rear bearing	28	Pin	45	Needle valve	59	Ball

3. DISASSEMBLY (WITHOUT PARKING BRAKE)

1) GENERAL PRECAUTIONS

(1) Cleanliness is extremely important when repairing a hydraulic motor.

(2) Work in a clean area.

(3) Before disconnecting the lines, clean the port area of the motor thoroughly.

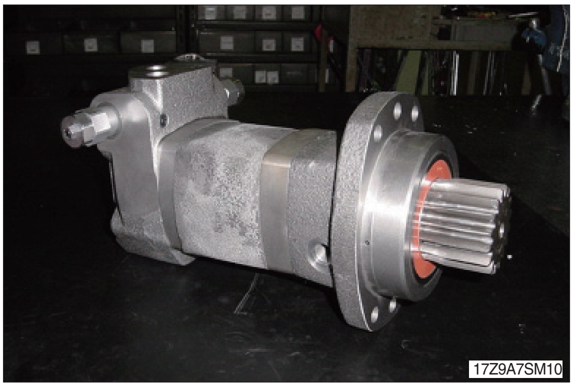
(4) Use a wire brush to remove foreign material and debris from around the exterior joints of the motor.

※ Don't disassembly the following parts if not necessary.
- Pinion gear and valve housing assembly

2) TOOLS

Tool name	Information
Torque wrench	Capacity 1.0~10 kgf · m (7.2~72 lbf · ft)
Socket	9/16" (or 14 mm)
Hexagon socket	5 mm, 8 mm
Snap ring pliers	-
Screwdriver	-
Plastic hammer	-
Press machine	-

3) Place the motor in a vise with the valve housing part up.
Clamp across the mounting flange of the motor.



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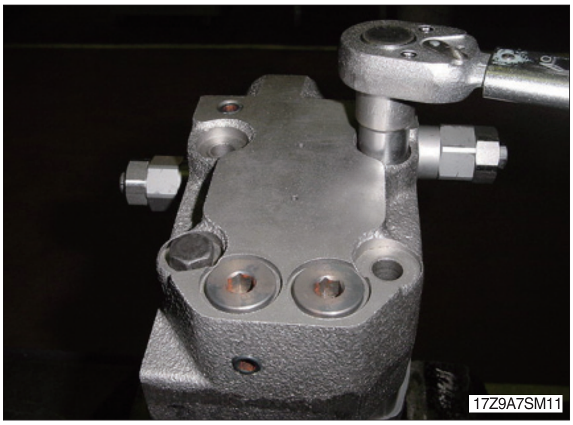
4) Remove four hexagon bolts (45) from the motor.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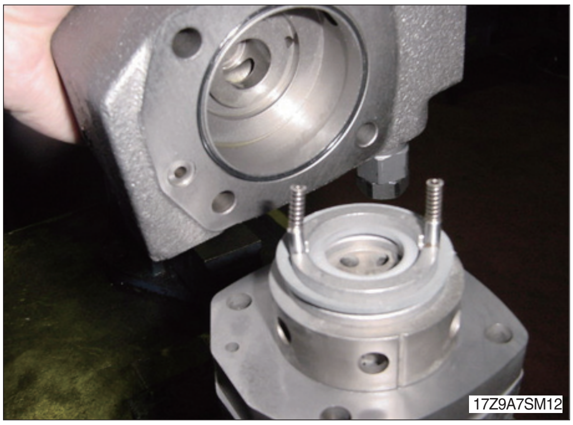
5) Remove the valve housing assembly (23), spring (15) and pin (17).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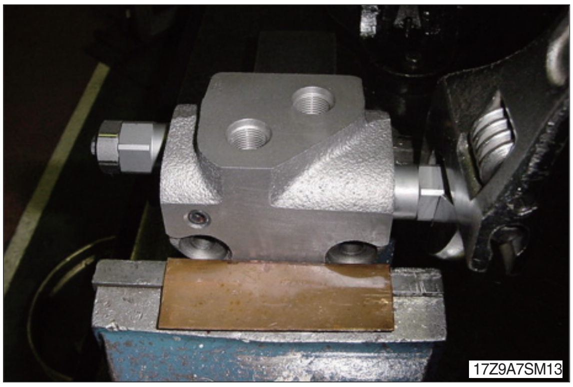
6) Don’t disassembly relief cartridge (25) if not necessary.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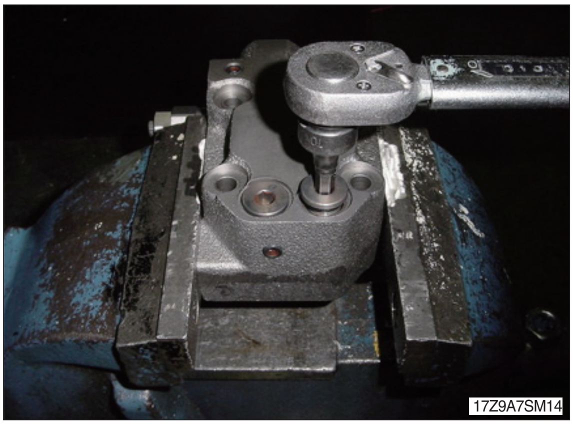
7) Don’t disassembly check plug (27) if not necessary.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8) Balancing ring assembly, and valve (13) will remain on the valve plate (11).
   Remove the balancing ring (14) and valve (13).

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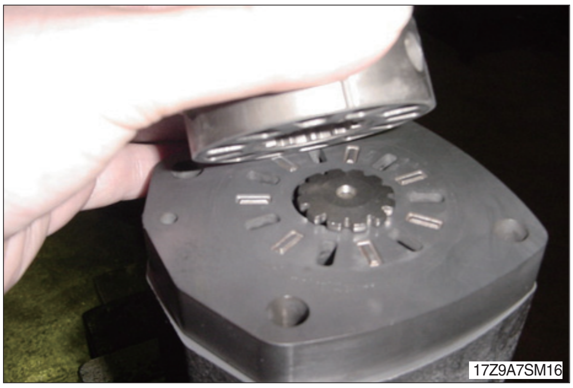

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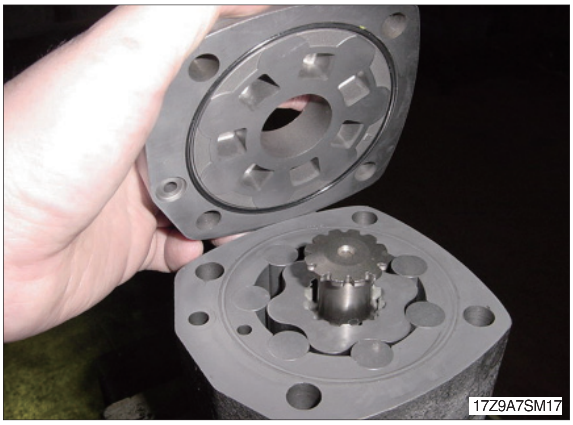
9) Remove the valve plate (11) and valve drive (21).



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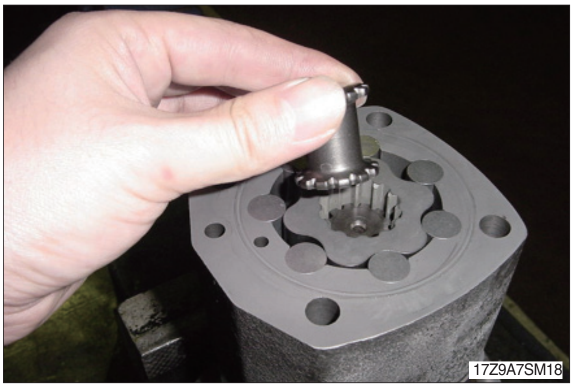

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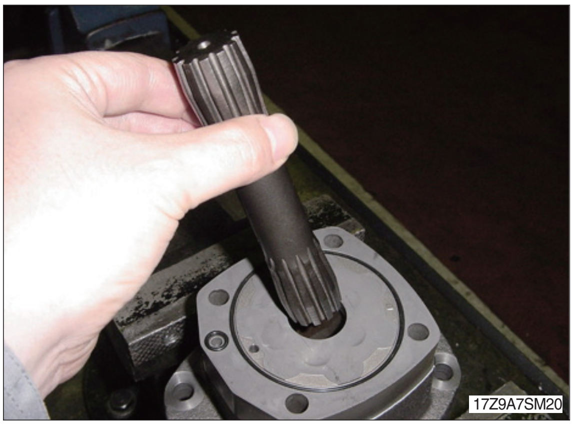
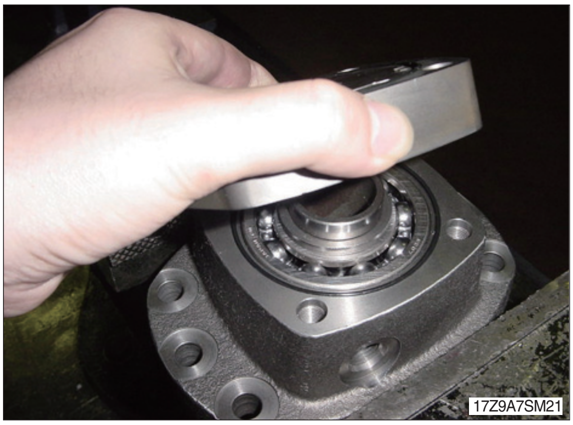
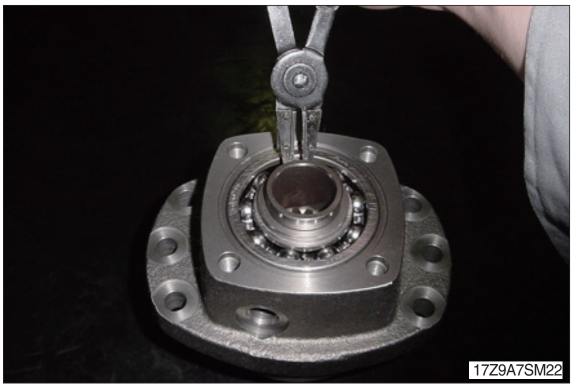
10) Remove the gerotor (20) and drive (19).



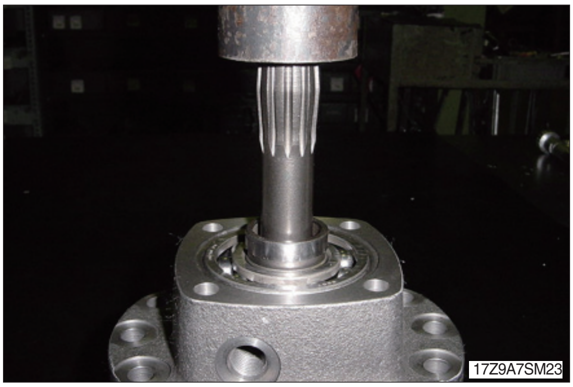
11) Remove the wear plate (10).



12) Don't disassembly pinion gear assembly if not necessary.
Remove the retaining ring (7).

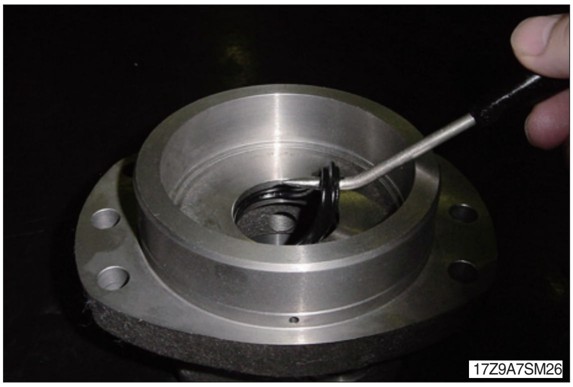


13) Remove the pinion gear shaft (2) by press machine.



14) Remove two ball bearings (3, 4).

15) Remove the X-ring (6).



4. ASSEMBLY (WITHOUT PARKING BRAKE)

1) GENERAL PRECAUTION

(1) Check all mating surfaces.

(2) Replace any parts that have scratches or burrs that could cause leakage.

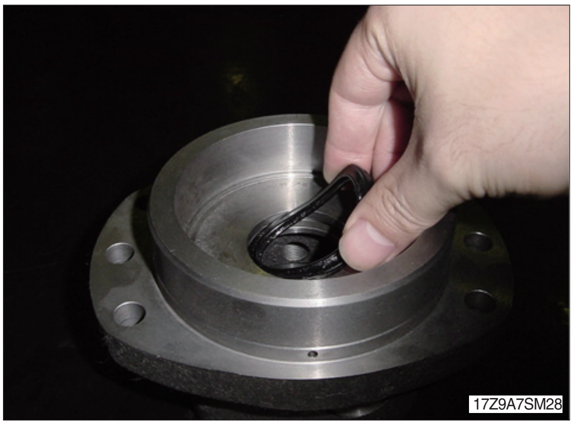
(3) Clean all metal parts in clean solvent. Blow-dry with air.

(4) Do not wipe dry with paper towel because lint or other matter can get in the hydraulic system and cause damage.

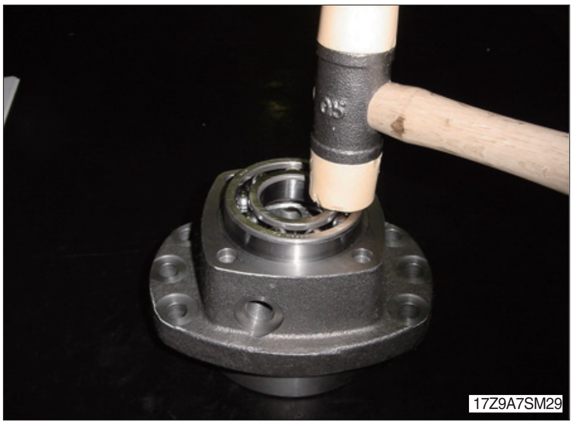
(5) Do not file or grind motor parts.

2) Please replace all old seals with new seals and lubricant all seals (prior to installation) with petroleum such as vaseline.

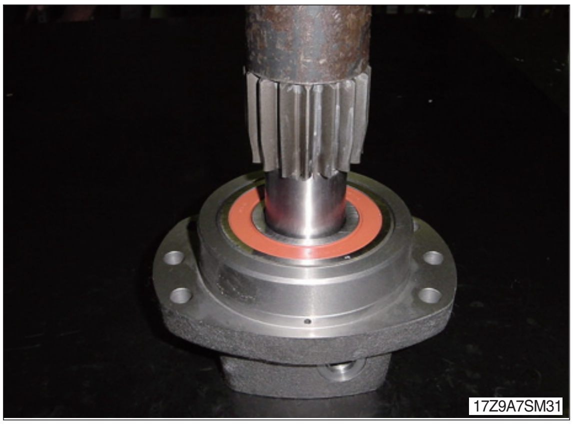
3) Install the X-ring (6) in the bearing housing (1).



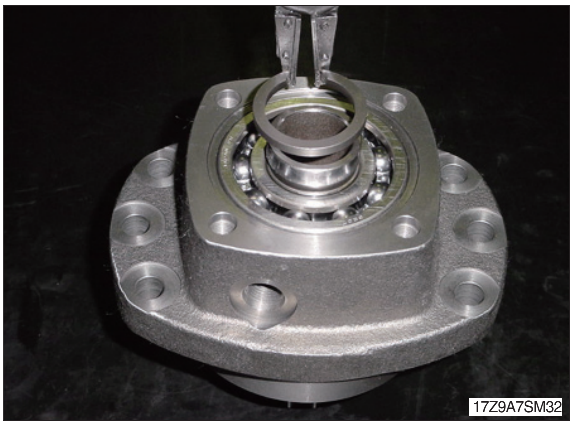
4) Install two bearings (3, 4) in the bearing housing (1).



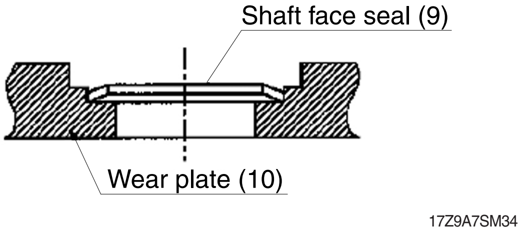
5) Install the pinion gear shaft (2) in the bearing housing (1) by press machine.

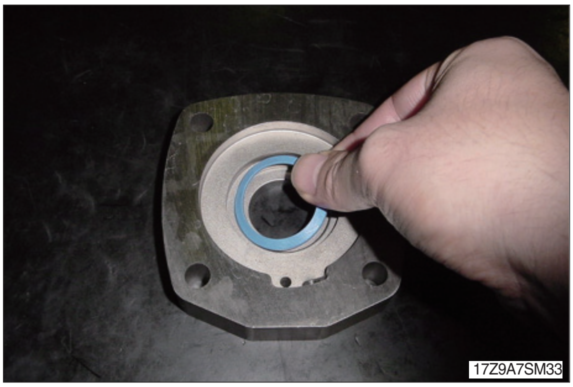


6) Install the retaining ring (7).

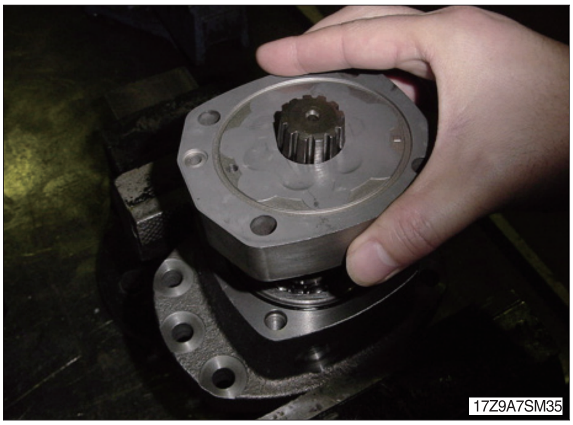


7) Install the shaft face seal (9) in the wear plate (10).

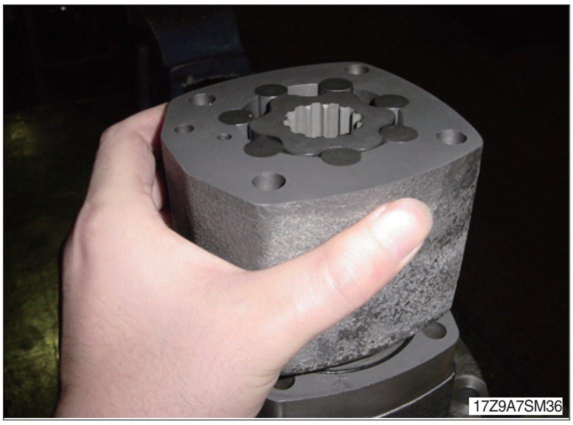




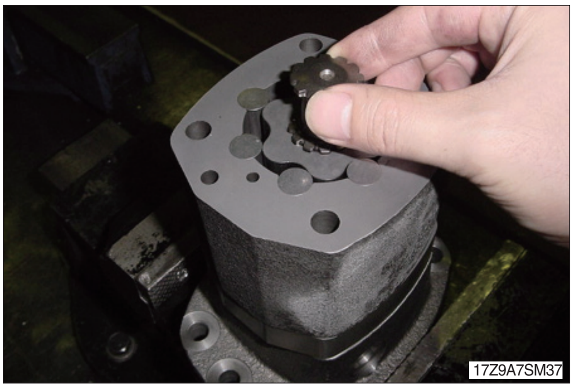
8) Install the O-ring (8) in the bearing housing (1).
Install the drive (19).
Install two O-rings (8, 22) in the wear plate (10).



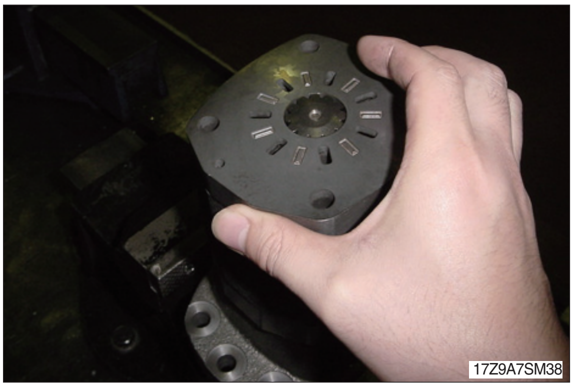
9) Install the gerotor (20).
Align the outline shape the gerotor with the wear plate.



10) Install the valve drive (21).



11) Install the O-ring (8) in the valve plate (11).
Install the valve plate.
Align outline shape the valve plate with the gerotor.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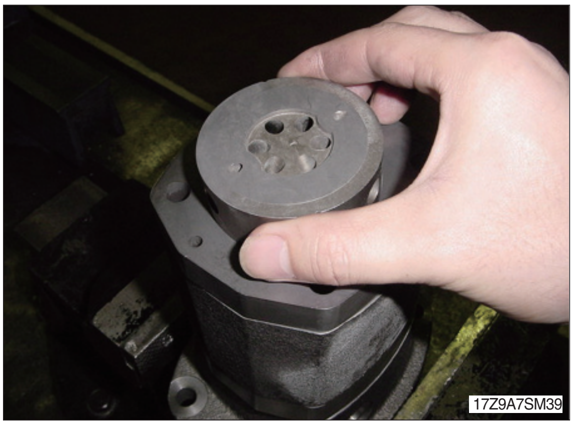
12) Timing procedure

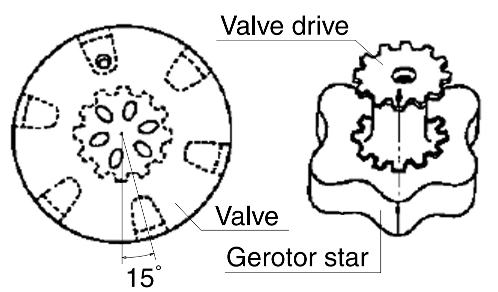
※ Install the valve drive and valve as shown in figure.

Install the valve (13).


17Z9A7SM39

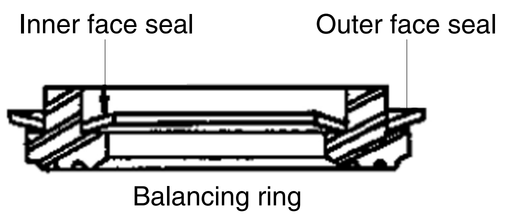
13) Locate the spline tooth of the valve drive and external tooth of gerotor and mark it on the spline tooth of valve drive.
Install the valve, locate to 15° right side (rotate the valve 15° ccw) side hole of the valve and marking spline tooth of valve drive.

※ If you mistake the valve timing, motor turns in the opposite direction. Please be careful.



17Z9A7SM40

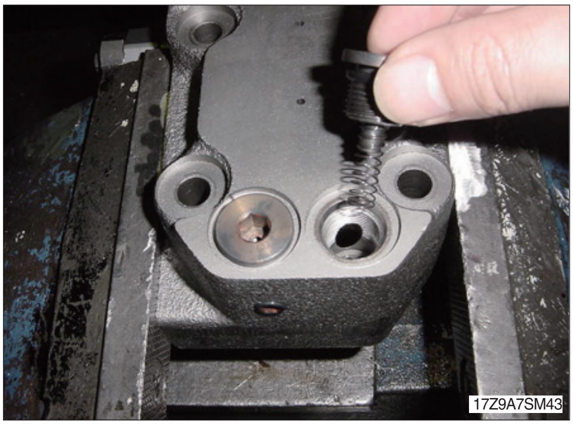
14) Install the inner face seal (16) and outer face seal (18) on the balancing ring.



17Z9A7SM41

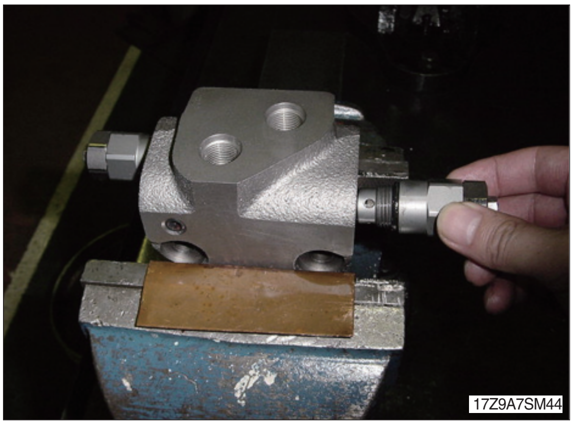

17Z9A7SM42

15) Install the steel ball (26), check plug (27) and spring (29) in the valve housing (24).



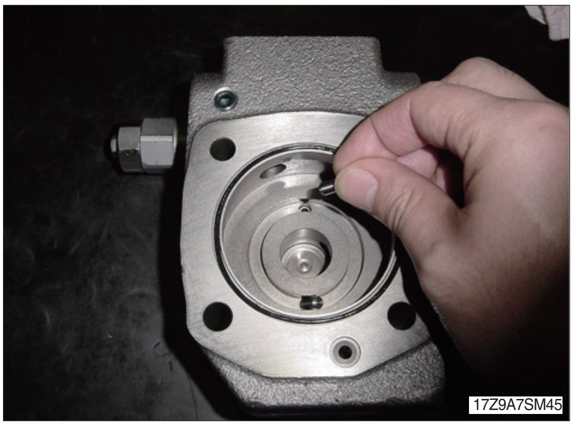
17Z9A7SM43

16) Install the relief cartridge (25) in the valve housing (24).



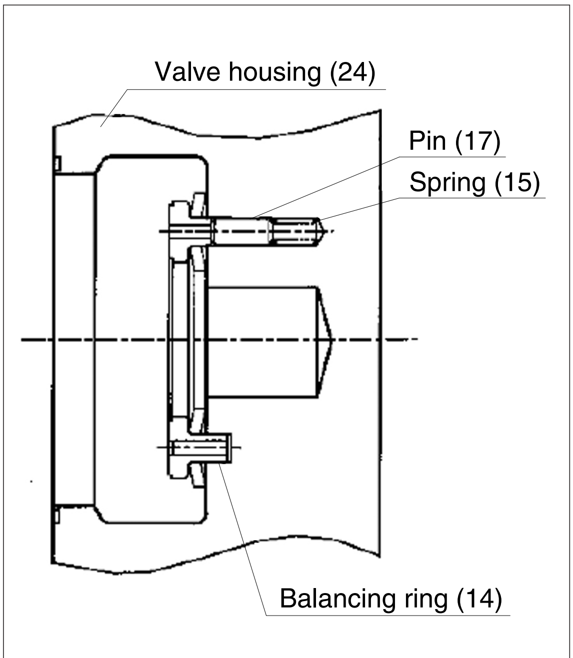
17Z9A7SM44

17) Install two springs (15) in the hole located in the bore of the valve housing (24).
Install two pins (17) in the same holes.



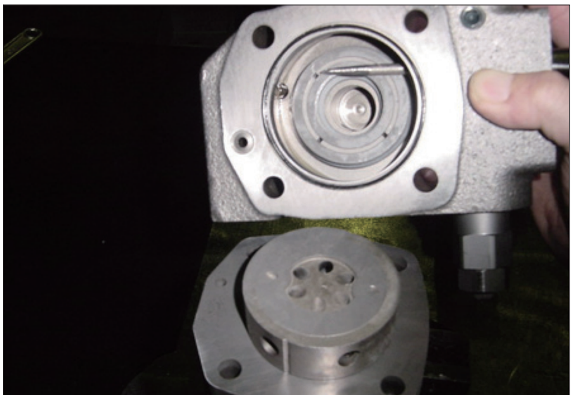
17Z9A7SM45

18) Align the pin grooves in the balancing plate with the pins in the bore of the valve housing.
Install the balancing ring (14) in the valve housing (24).

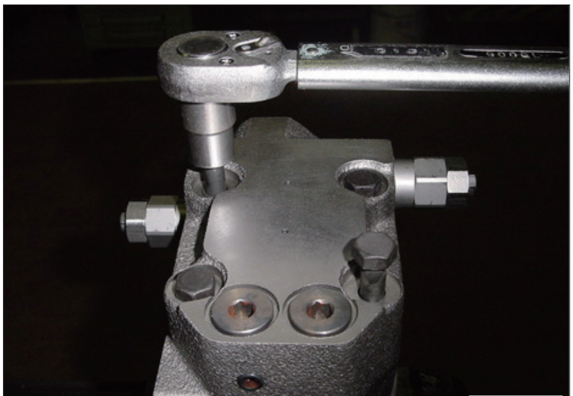


17Z9A7SM46

19) Install the O-ring (12) in the valve housing assembly (23).
Install the valve housing assembly.
Insert a screwdriver through port of valve housing to apply pressure to the side of balancing plate assembly. Hold plate in position unit you install housing.


17Z9A7SM47

20) Install 4 hexagon bolts (45).
Torque all 4 bolts alternately to 5.2 kgf · m (37.6 lbf · ft).


17Z9A7SM48

5. DISASSEMBLY (WITH PARKING BRAKE)

1) GENERAL PRECAUTIONS

(1) Cleanliness is extremely important when repairing a hydraulic motor.

(2) Work in a clean area.

(3) Before disconnecting the lines, clean the port area of the motor thoroughly.

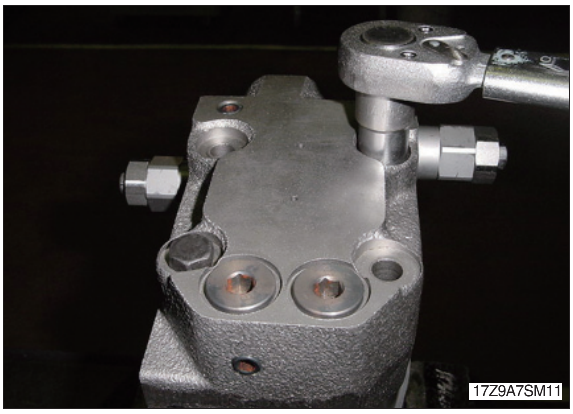
(4) Use a wire brush to remove foreign material and debris from around the exterior joints of the motor.

※ Don't disassembly the following parts if not necessary.
- Pinion gear and valve housing assembly

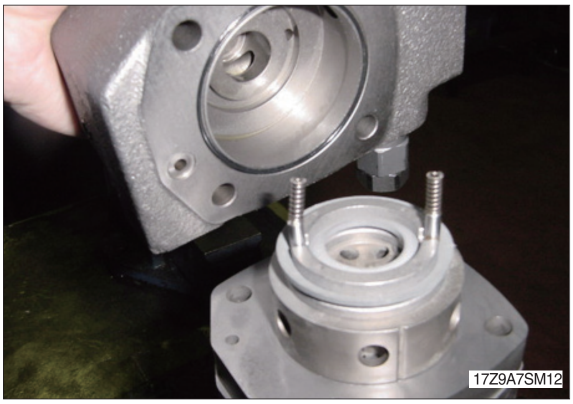
2) TOOLS

Tool name	Information
Torque wrench	Capacity 1.0~10 kgf · m (7.2~72 lbf · ft)
Socket	9/16" (or 14 mm)
Hexagon socket	5 mm, 8 mm
Snap ring pliers	-
Screwdriver	-
Plastic hammer	-
Press machine	-

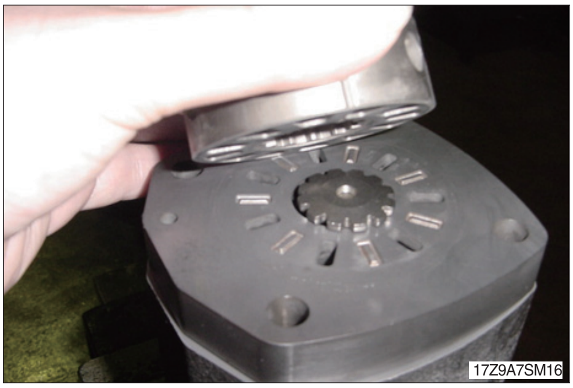
3) Remove 4 hexagon bolts from the motor.



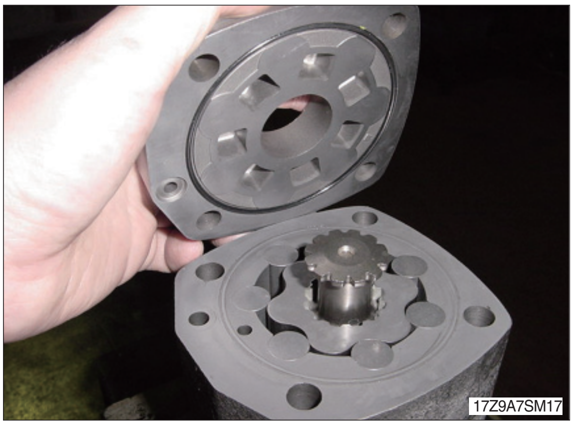
4) Remove the valve housing assembly.
If done carefully the spring, pin, balancing plate assembly, and valve will remain on the valve plate.

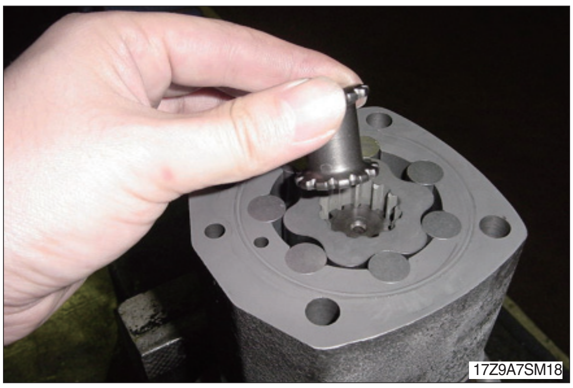


5) Remove the balancing plate and valve.



6) Remove the valve plate and valve drive.



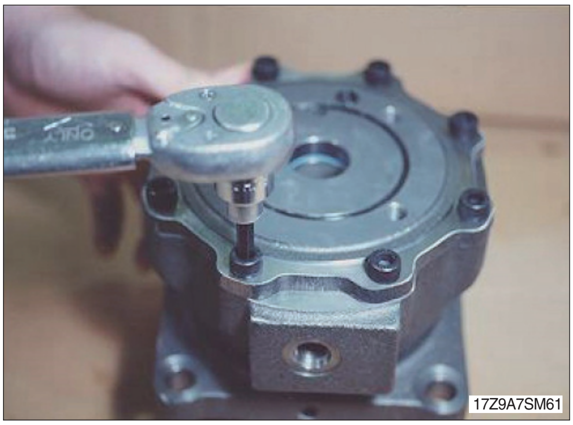


7) Remove the geroler and drive.

17Z9A7SM60

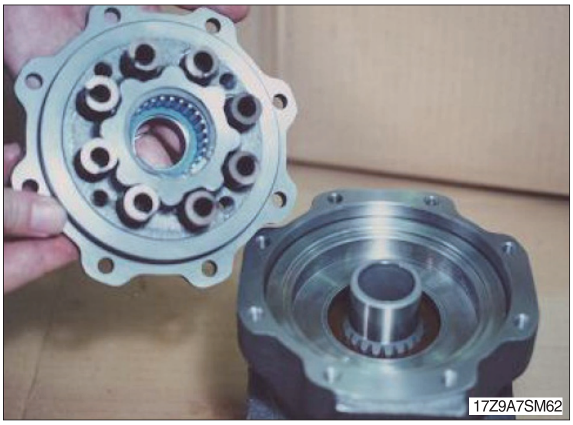
8) Disassembly of brake assembly.
Remove the screw.

※ Don't disassembly the following parts if not necessary.



17Z9A7SM61

9) Remove the flange mounting and spring.

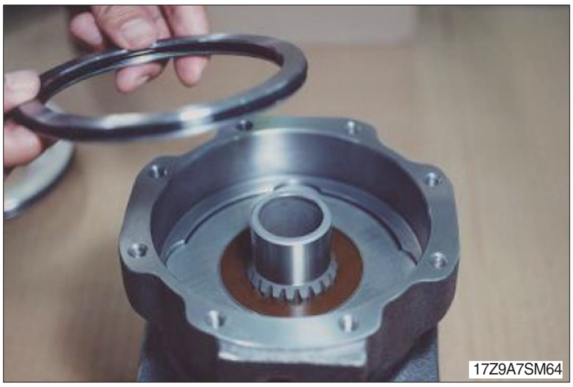


17Z9A7SM62

10) Remove the piston.

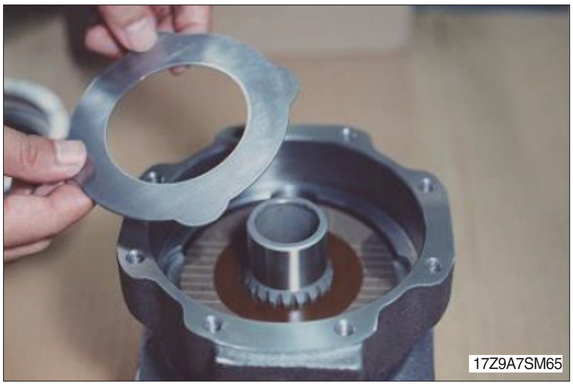
17Z9A7SM63

11) Remove the ring.

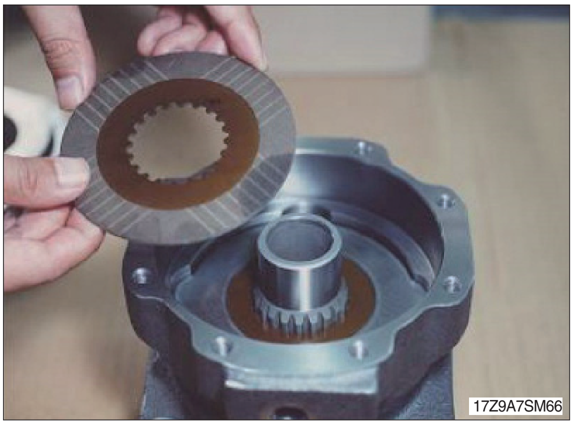


17Z9A7SM64

12) Remove the center plate and friction plate.



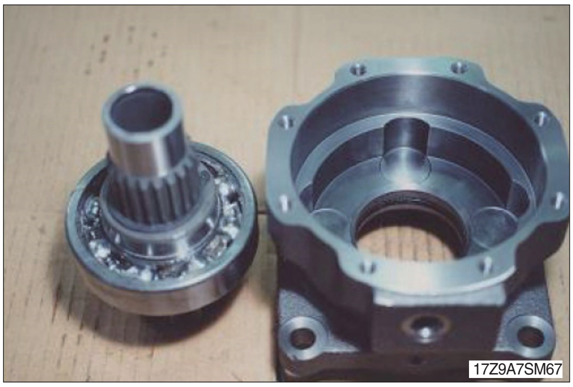
17Z9A7SM65



17Z9A7SM66

13) Remove the pinion gear assembly with press machine.
Remove the X-ring.

※ Don't disassembly the following parts if not necessary.



17Z9A7SM67

6. ASSEMBLY (WITH PARKING BRAKE)

1) GENERAL PRECAUTION

(1) Check all mating surfaces.

(2) Replace any parts that have scratches or burrs that could cause leakage.

(3) Clean all metal parts in clean solvent. Blow dry with air.

(4) Do not wipe dry with paper towel because lint or other matter can get in the hydraulic system and cause damage.

(5) Do not file or grind motor parts.

※ Please replace all old seals with new seals and lubricant all seals (prior to installation) with petroleum such as vaseline.

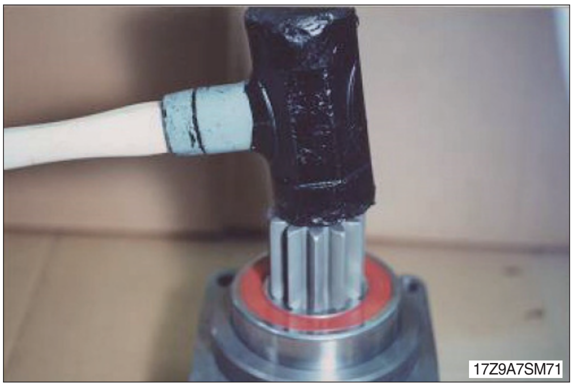
2) Install the bearing, collar and snap ring to the pinion shaft.


17Z9A7SM68

3) Install the X-ring.

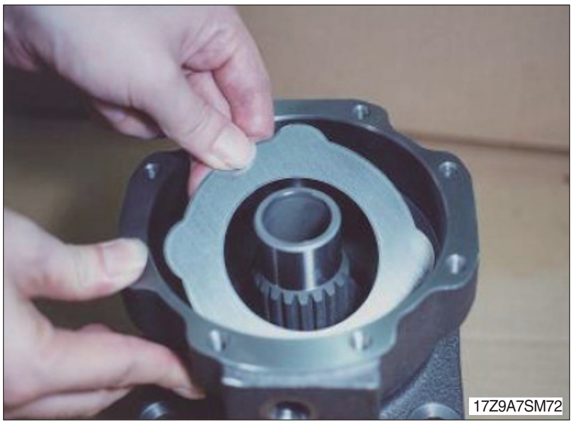
17Z9A7SM70

4) Install the pinion gear assembly in the bearing housing.

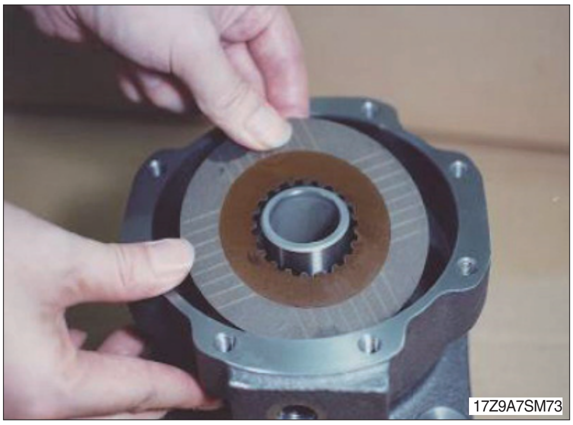


17Z9A7SM71

5) Install the center plate and fricrion plate.

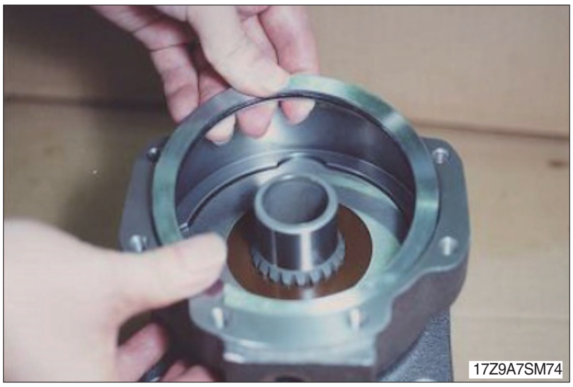


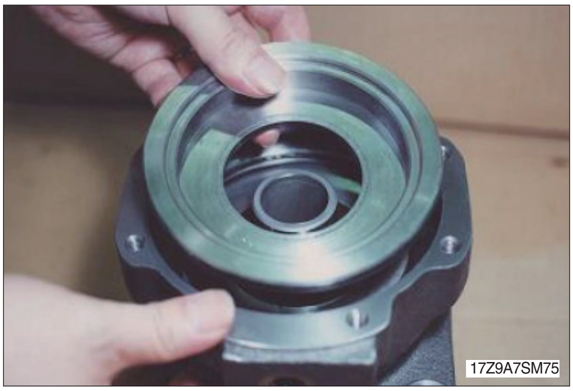
17Z9A7SM72



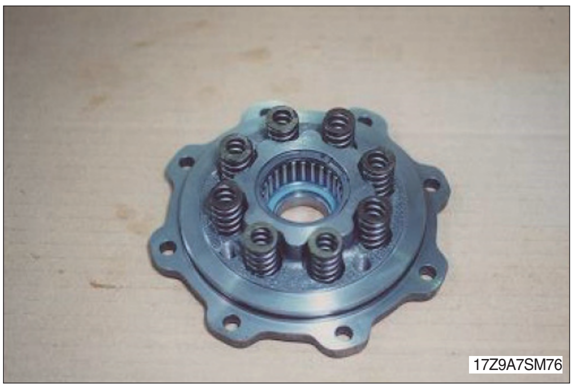
17Z9A7SM73

6) Install the ring with O-ring and piston with O-ring in the bearing housing.

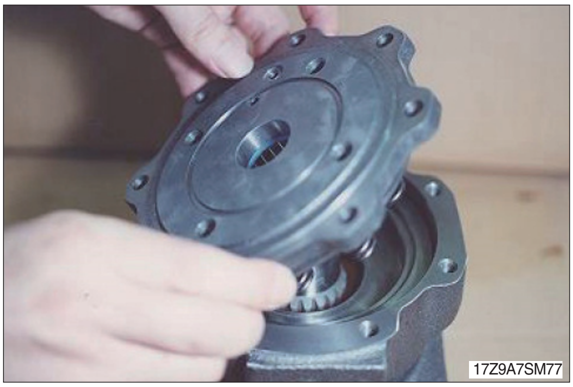


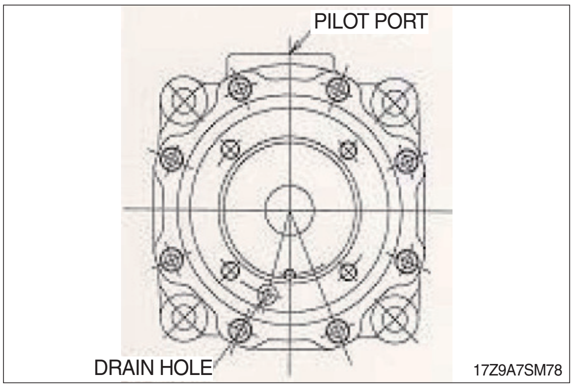


7) Install the shaft face seal. Bearing and snap ring in the flange mounting.
Install the spring with enough grease for fall prevention.



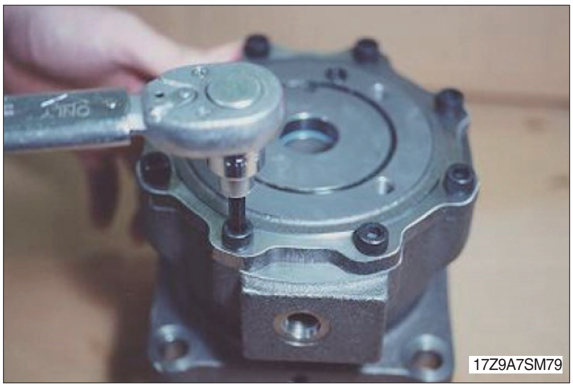
8) Install the flange mounting.
See below illustration relationship pilot port to drain hole.


17Z9A7SM77

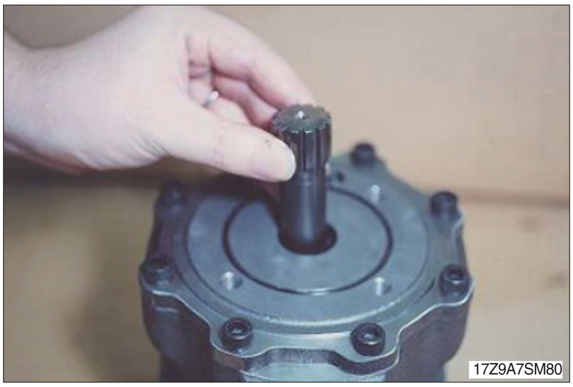


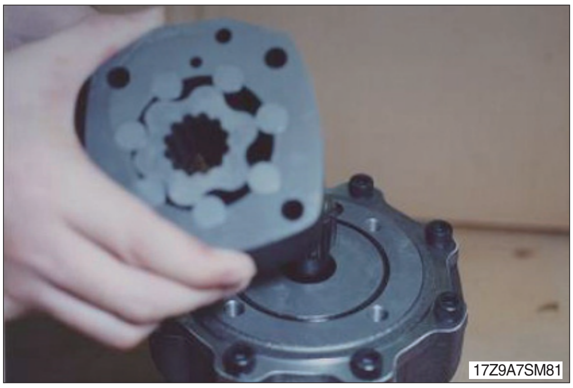
17Z9A7SM78

9) Tightening torque ; 3.47kgf · m (25.1 lbf · ft)

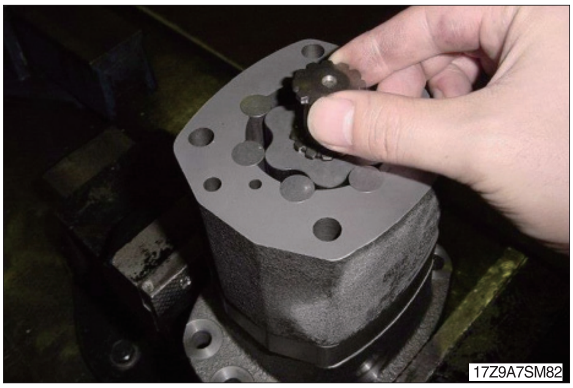

17Z9A7SM79

10) Install the drive and geroler.
Align the case drain hole in the geroler with the case drain hole in the flange mounting.



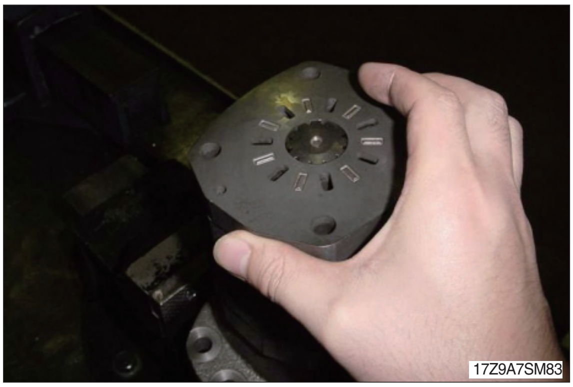


11) Install the valve drive.



12) Install the valve plate.

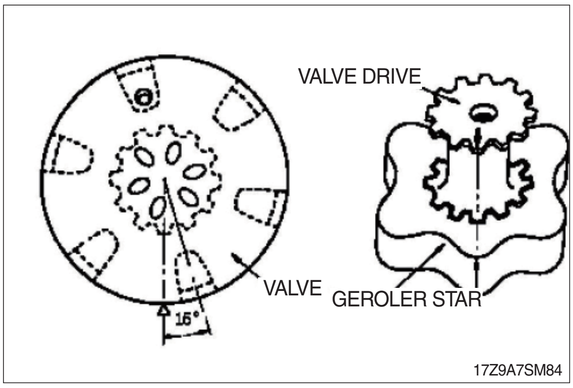
Align the case drain hole in the valve plate with the case drain hole in the geroler.



17Z9A7SM83

13) Timing procedure.

※ Install the valve drive and valve as shown in figure.



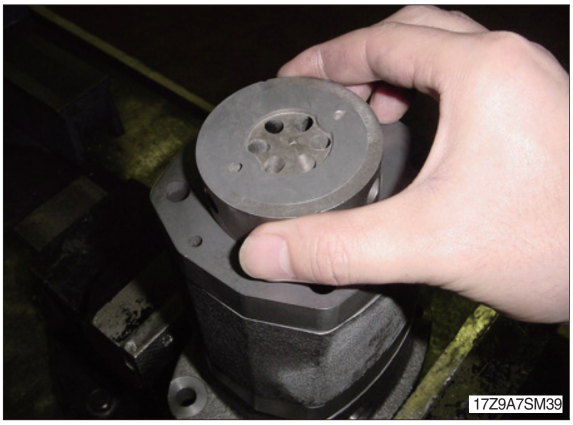
17Z9A7SM84

14) Install the valve.

Locate the spline tooth of the valve drive and external tooth of geroler and mark it on the spline tooth of valve drive.

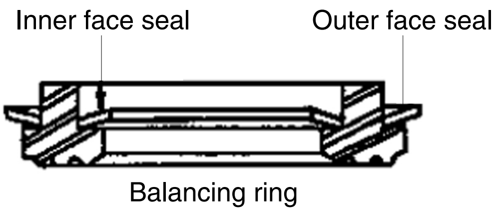
Install the valve, locate to 15° right side (rotate the valve 15° ccw) side hole of the valve and marking spline tooth of valve drive.

※ If you mistake the valve timing, motor turns in the opposite direction. Please be careful.



17Z9A7SM39

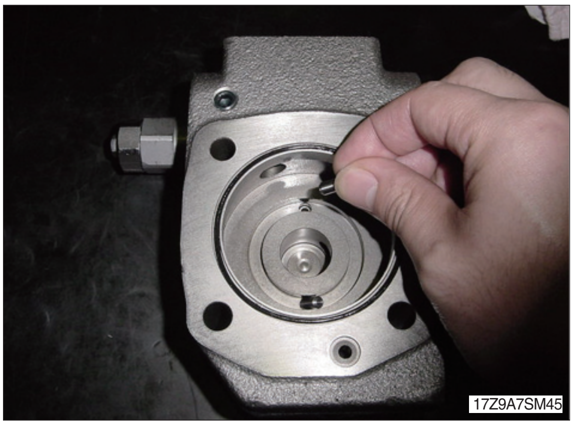
15) Install the inner face seal and outer face seal on the balancing plate.



17Z9A7SM41

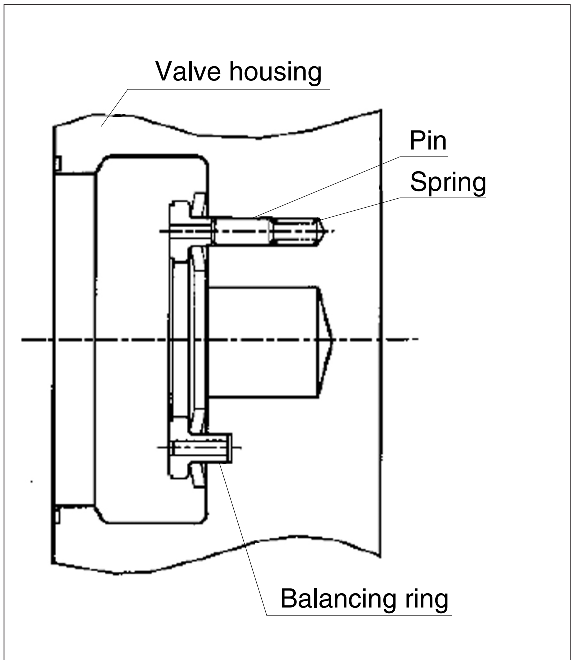
17Z9A7SM42

16) Install spring (in the hole located in the bore of the valve housing).
Install pin in the same holes.



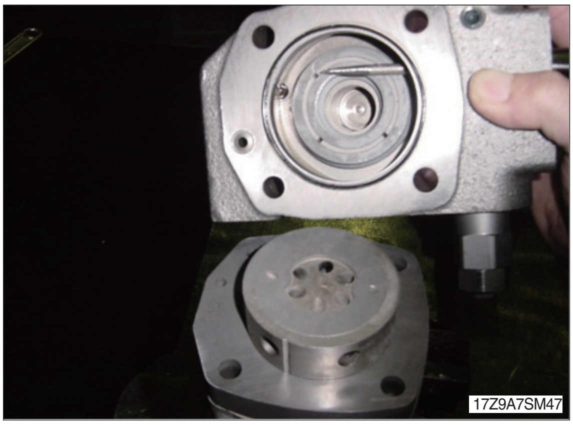
17Z9A7SM45

17) Align the pin grooves in the balancing plate with the pins in the bore of the valve housing. Install the balancing plate in the valve housing.

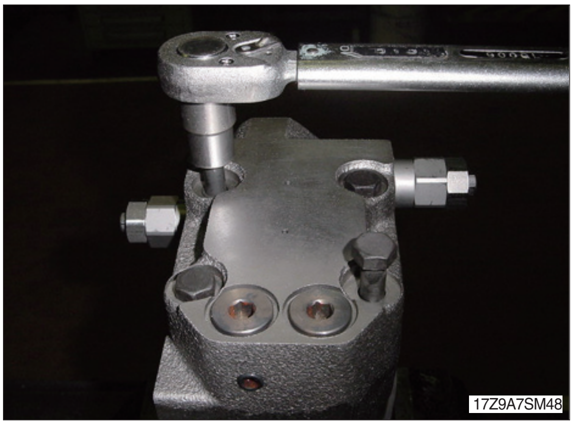


17Z9A7SM46

18) Install the valve housing assembly.
Insert a screw driver through port of valve housing to apply pressure to the side of balancing plate assembly.
Hold plate in position unit you install housing.


17Z9A7SM47

19) Install 4 hexagon bolts.
Torque all 4 bolts alternately to 5.2 kgf · m (37.6 lbf · ft).


17Z9A7SM48

GROUP 6 TRAVEL DEVICE

1. REMOVAL AND INSTALL

1) REMOVAL

(1) Swing the work equipment 90° and lower it completely to the ground.

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

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

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

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

13031GE18

(4) Remove the track shoe assembly.
For details, see removal of track shoe assembly.

(5) Remove the cover.

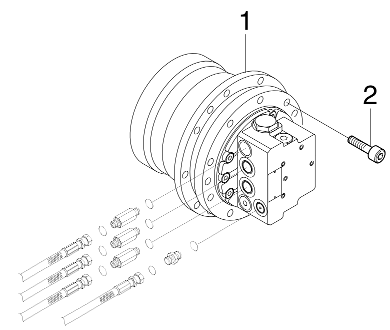
(6) Remove the hose.

※ Fit blind plugs to the disconnected hoses.

(7) Remove the bolts and the sprocket.

(8) Sling travel device assembly (1).

(9) Remove the mounting bolts (2), then remove the travel device assembly.
- Weight : 18 kg (40 lb)



17Z9A7TM01

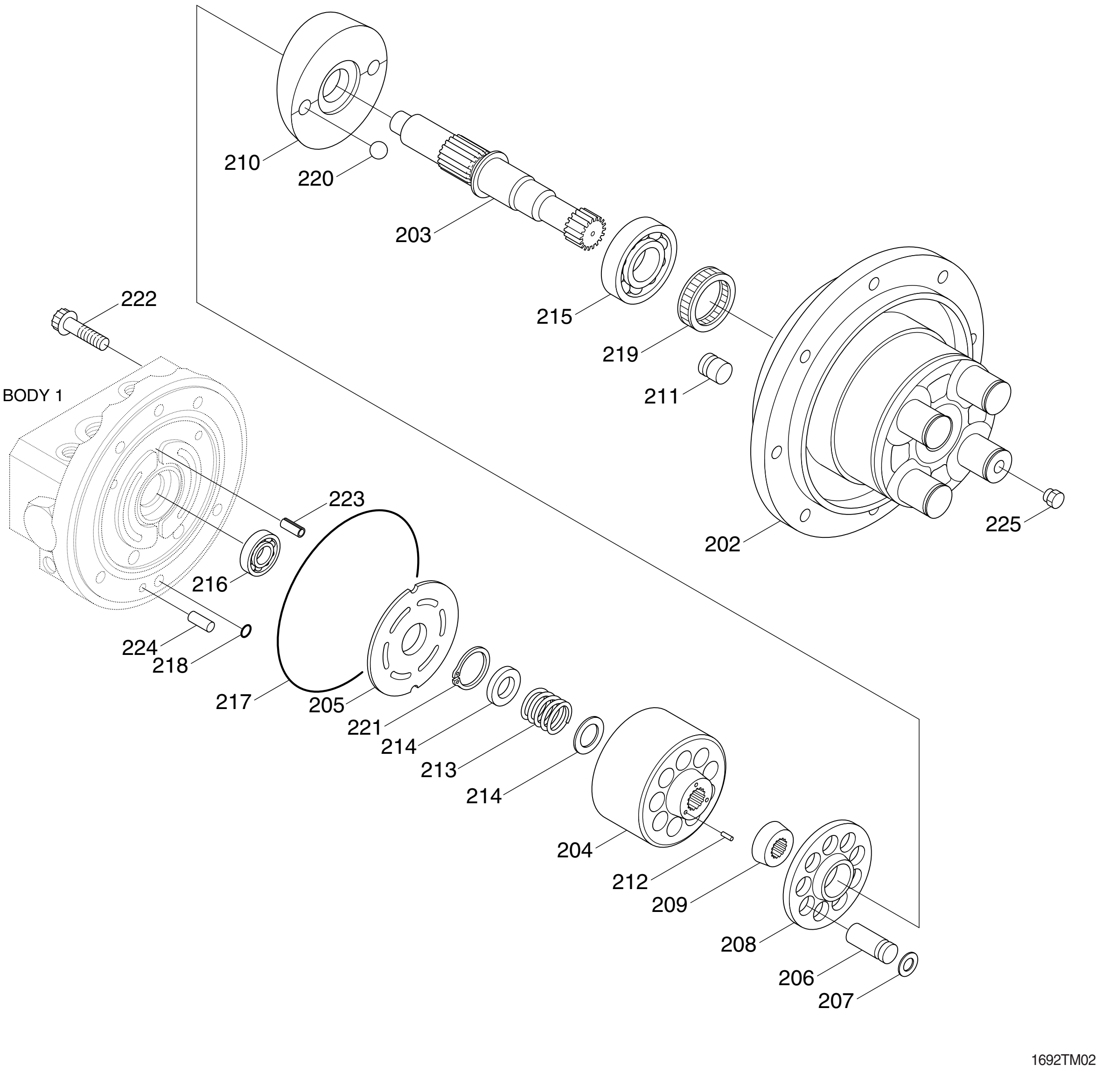
2) INSTALL

(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.

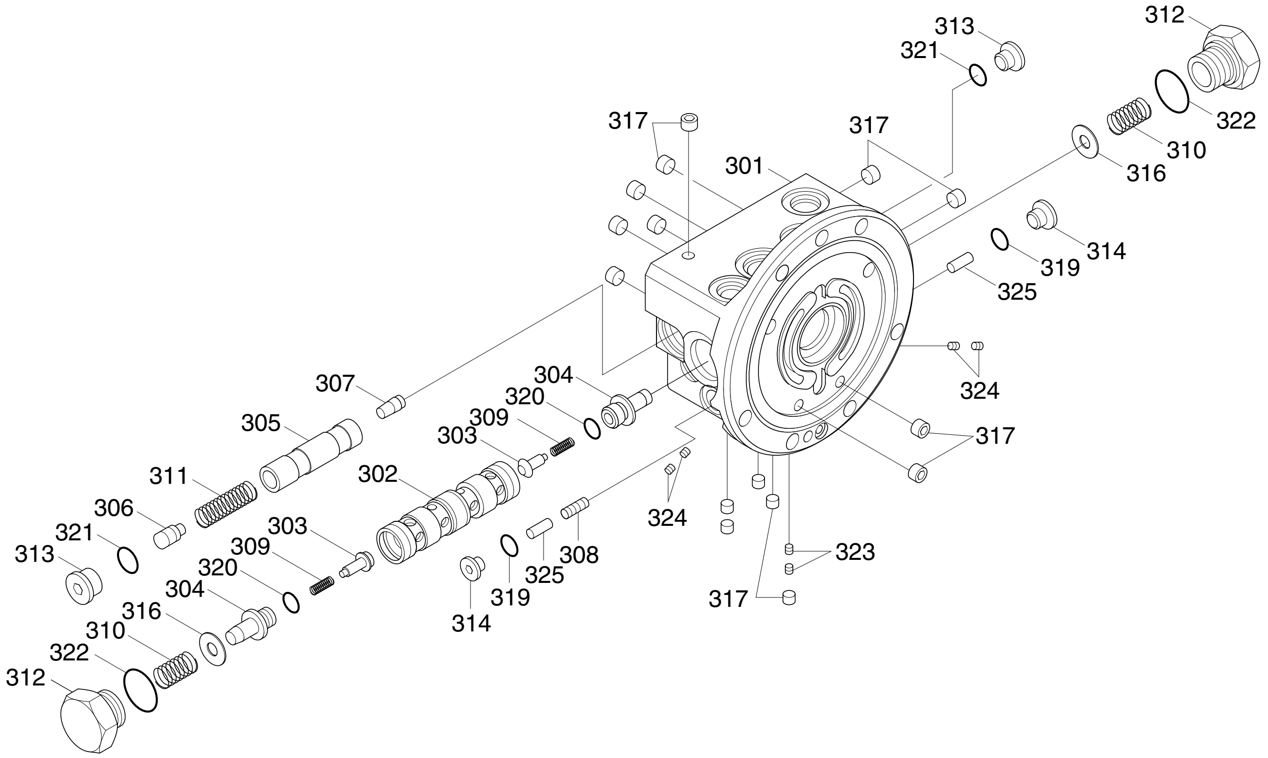
(3) Confirm the hydraulic oil level and check the hydraulic oil leak or not.

2) STRUCTURE (1/3)



202	Body 2	210	Swash plate	218	O-ring
203	Shaft	211	Control piston	219	Oil seal
204	Cylinder barrel	212	Pin	220	Ball
205	Valve plate	213	Spring C	221	Snap ring
206	Piston	214	Retainer	222	Screw
207	Shoe	215	Bearing	223	Spring pin
208	Shoe holder	216	Bearing	224	Pin
209	Barrel holder	217	O-ring	225	Plug

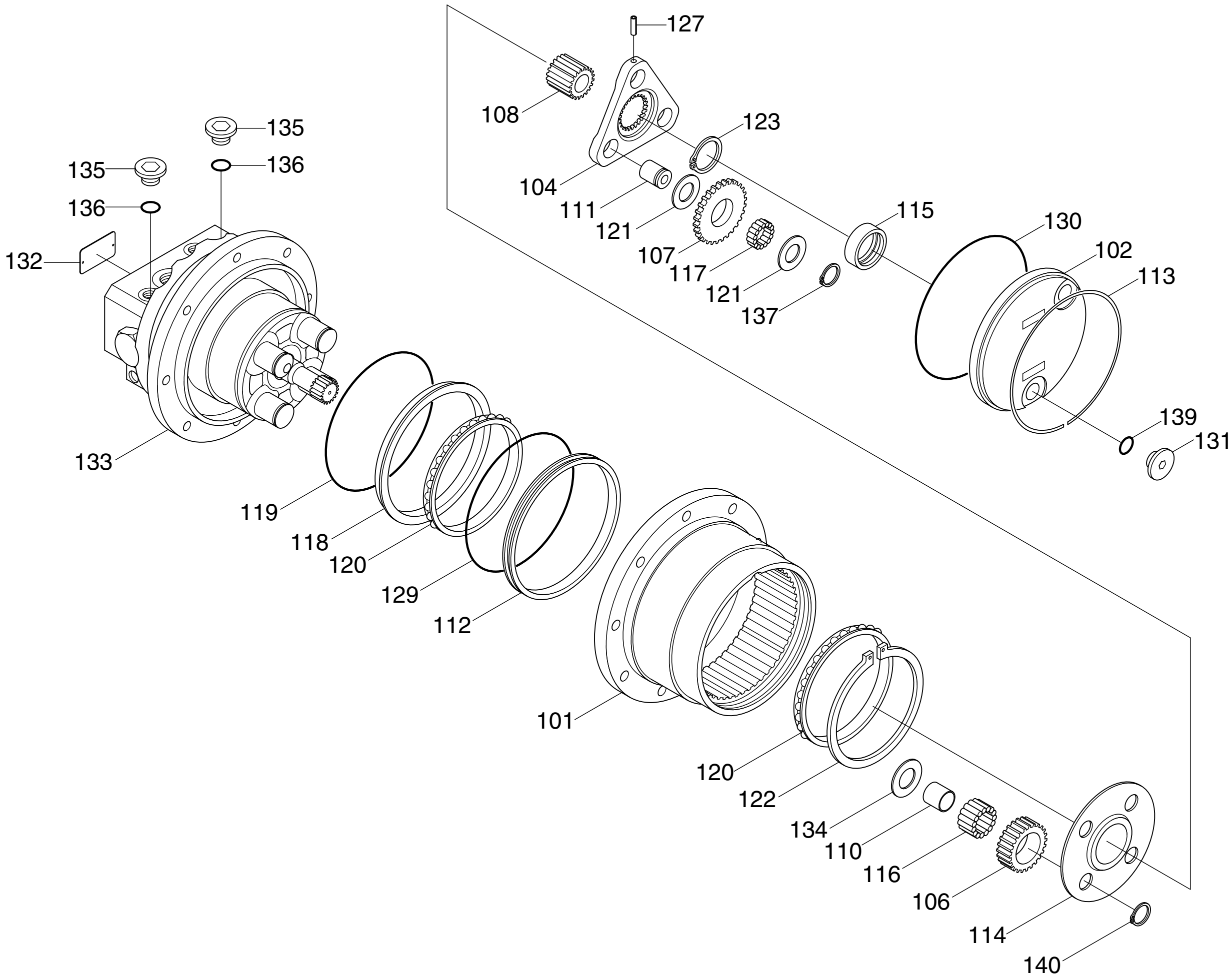
STRUCTURE (2/3)



17Z9A2TM03

301	Body 1	309	Spring V1	319	O-ring
302	Spool	310	Spring V2	320	O-ring
303	Check valve	311	Spring V3	321	O-ring
304	Spring guide	312	Plug	322	O-ring
305	Spool	313	Plug	323	Choke
306	Spool-B	314	Ring	324	Choke
307	Spool-C	316	Plug	325	Pin
308	Shuttle spool	317	Plug		

STRUCTURE (3/3)



101	Body	113	Snap ring	121	Thrust washer	134	Thrust washer
102	Cover	114	Thrust plate	122	Snap ring	135	Plug
104	Carrier 2	115	Slide ring	123	Snap ring	136	O-ring
106	Gear B1	116	Needle	127	Spring pin	137	Snap ring
107	Gear B2	117	Needle	129	O-ring	139	O-ring
108	Gear S1	118	Floating seat (Incl 119)	130	O-ring	140	Snap ring
110	Ring			131	Plug		
111	Pin B2	119	O-ring	132	Name plate		
112	Seal ring	120	Bearing	133	Hydraulic motor		

3) MAINTENANCE INSTRUCTION

(1) Necessary tool to assemble

Tool name	Information
Torque wrench	12 N, 90 N and 180 N
Hexagon socket	Hexagon size : 5 mm, 6 mm and 8 mm
Socket wrenches	Hexagon size : 27 mm
Hexagon socket wrenches	Hexagon size : 5 mm, 6 mm and 8 mm
Screwdriver	Width : 6~10 mm
Snap ring pliers	ø 24 mm for hole ø 15 mm, ø 18 mm, ø 26 mm, ø 90 mm for shaft
Plastic hammer	-
Others	Grease, Oil, Sand paper and C-clamps

2. DISASSEMBLY

1) GENERAL PRECAUTIONS

(1) Work at the clean area, and pay attention to clean each part from rubbish, peace of paint and prepare the clean case for disassembled parts.

(2) Remove the rubbish from the outside of the track motor before disassembling, and remove of paint by wiring brush.

(3) Put a mark on each part before disassembling for keeping the correct position at assembling.

(4) Handle disassembled parts with special care.

(5) Clean each part with cleaning solvents.

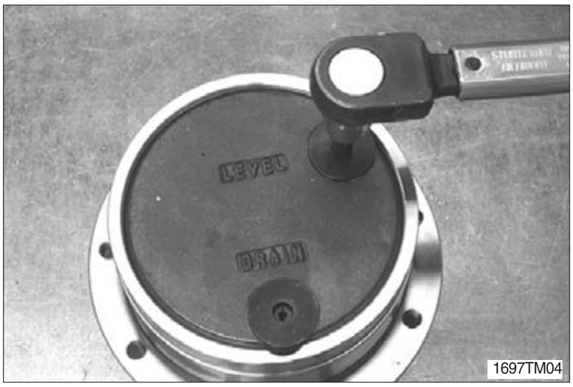
(6) Check disassembled parts with no damage, and removes any burrs.

(7) Use the new seal parts and snap rings.

(8) The press-fitting parts (for example, bearing and pin) can not be disassembled.

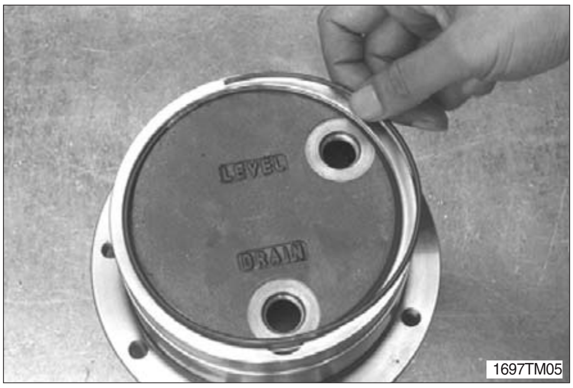
2) REDUCTION GEAR SECTION

(1) Remove the two plugs (PF3/8).
· Hexagon size : 8 mm
※ Remove the plug of "LEVEL" side first.



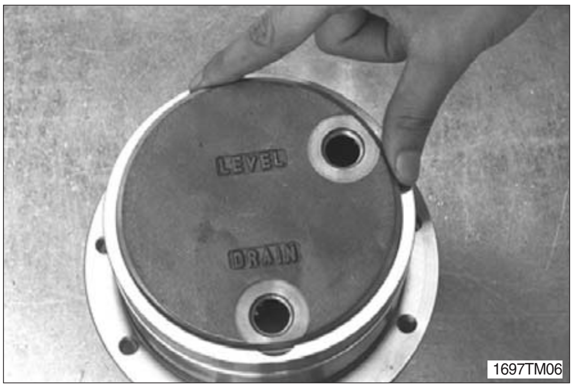
1697TM04

(2) Remove the snap ring.
※ Put the screwdriver into the notch of the body, and then pull the snap ring.



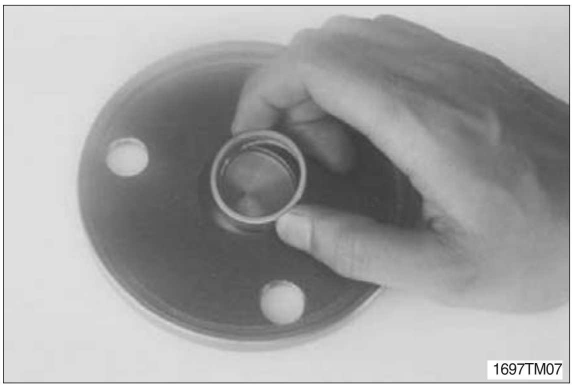
1697TM05

(3) Remove the cover.

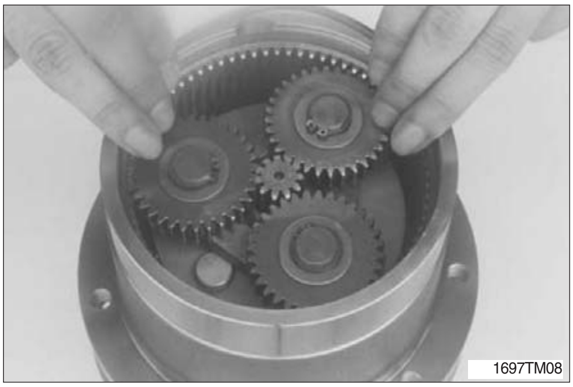


1697TM06

(4) Remove the slide ring from the cover.


1697TM07

(5) Remove the O-ring from the body.



1697TM08

(6) Remove the carrier 2 kit from the body.

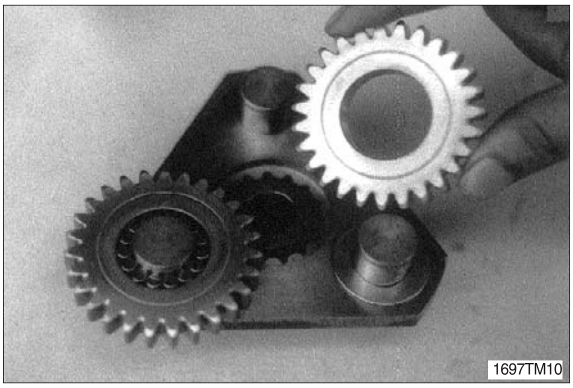
1697TM09

(7) Remove the three snap rings, three thrust washers, three b2 gears, thirty-nine needles and three thrust washers.

※ The thrust washers on both sides of the b2 gears are the same.

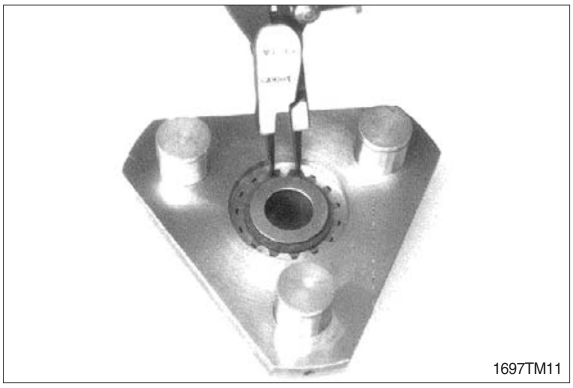
※ The b2 pins and spring pins are not able to disassemble, because they are press-fitted.

※ The needles are easily dispersed, pay attention not to lose.



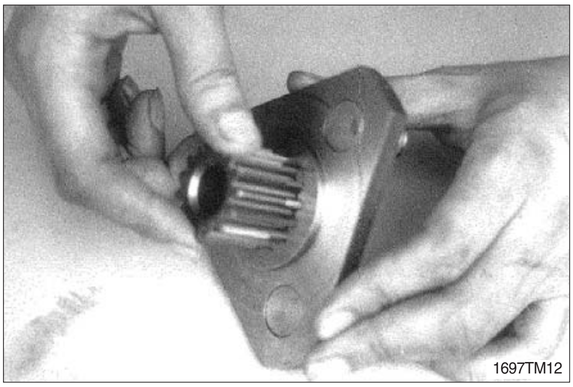
1697TM10

(8) Remove the snap ring from the carrier 2.

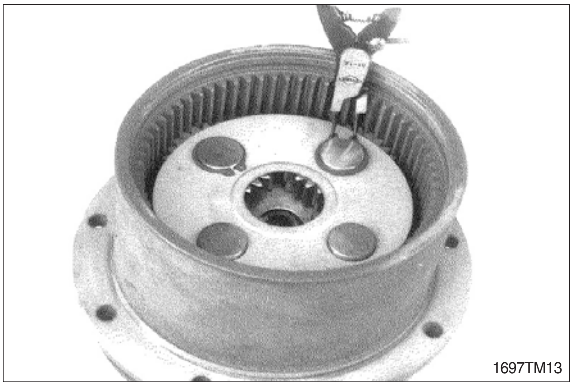


1697TM11

(9) Remove the s1 gear from the carrier 2.

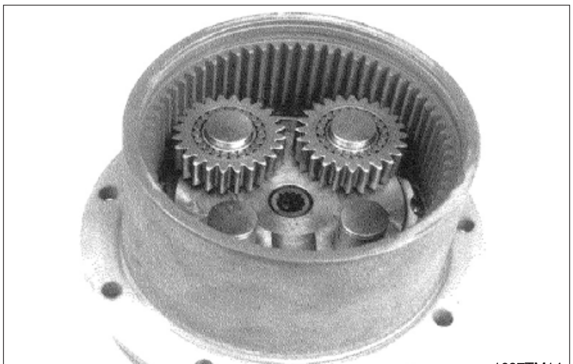

1697TM12

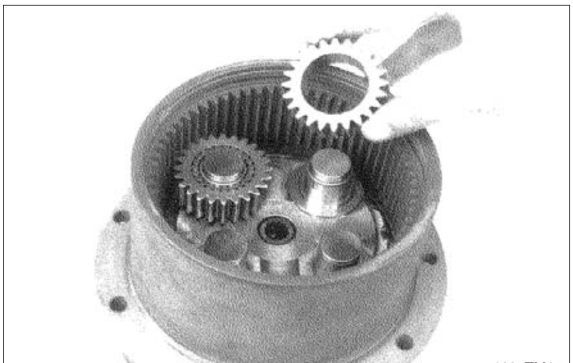
(10) Remove the four snap rings and the four thrust plates.


1697TM13

(11) Remove the four b1 gears, ninety-six needles, four thrust washers and four rings.

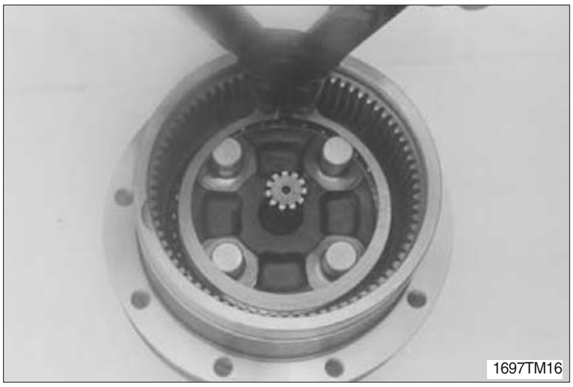
※ The needles are easily dispersed, pay attention not to lose.


1697TM14

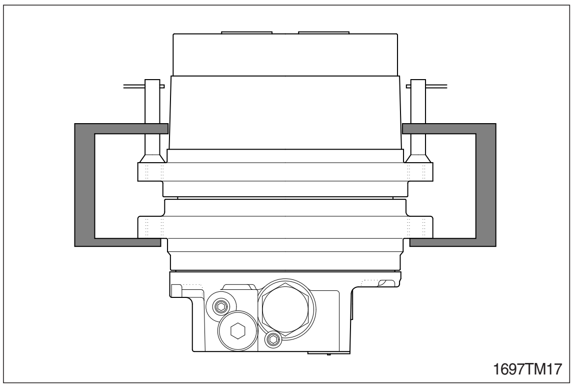

1697TM15

(12) Remove the snap ring.

※ Tighten the speed reducer flange and the motor flange with C-clamps or a hydraulic press (see the illustration) to make it easy.

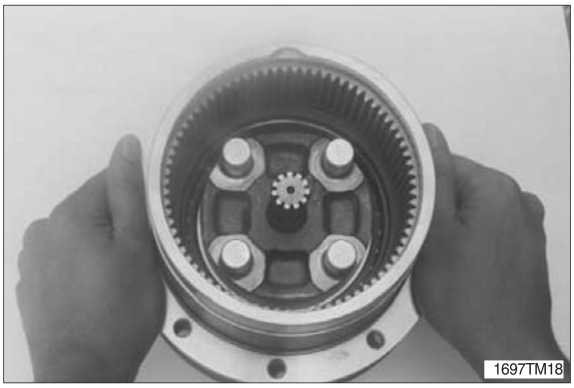


1697TM16



1697TM17

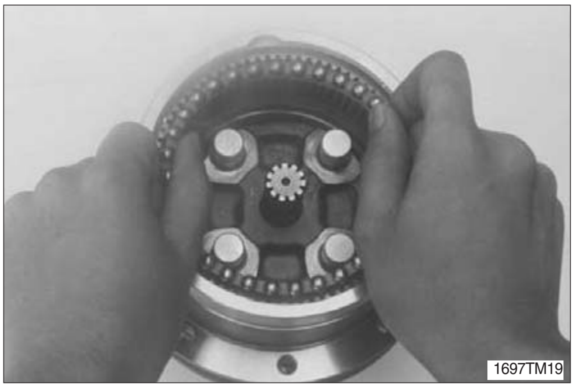
(13) Remove the speed reducer with the iron balls with retainer and the internal ring of bearing.



1697TM18

(14) Remove the iron balls with retainer from the speed reducer.

※ Pay attention not to lose the balls from retainer.

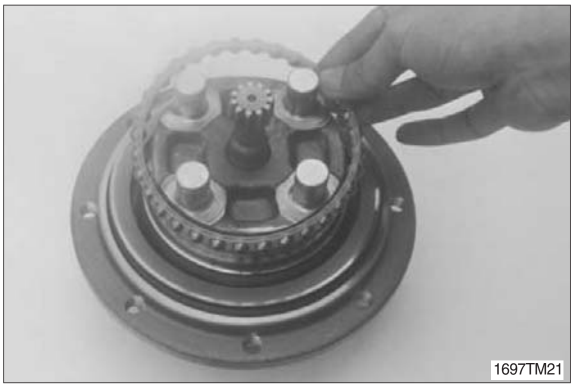


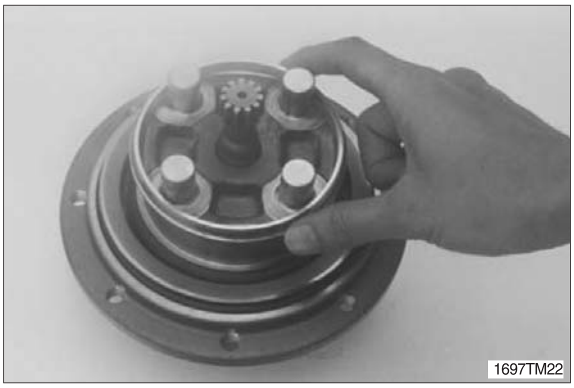
1697TM19

(15) Remove the seal ring from the speed reducer.

(16) Remove the iron balls with retainer and the internal ring of bearing from the hydraulic motor.

※ Pay attention not to lose the balls from retainer.





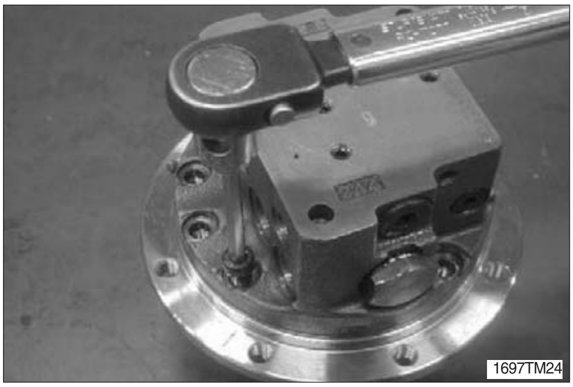
(17) Remove the floating seat with O-ring from the hydraulic motor.

3) HYDRAULIC MOTOR SECTION

(1) Remove the seven hexagon socket head cap bolts.

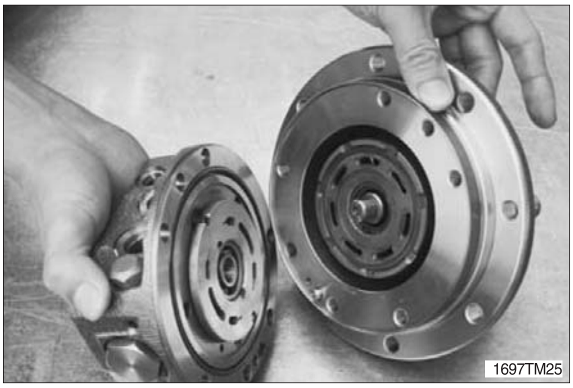
· Hexagon size : 6 mm

※ If you fix the motor with a vice, protect it with aluminum plates or equivalent.

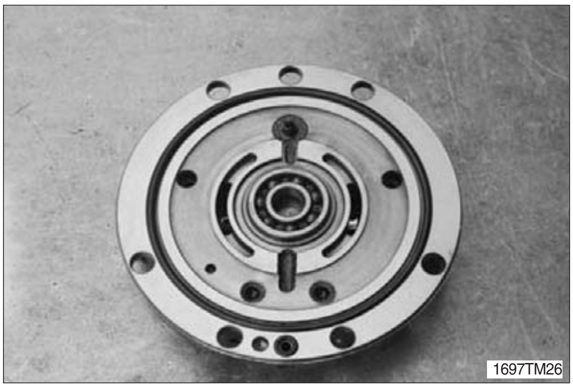

1697TM24

(2) Remove the body 1 from the body 2.

※ Pay attention not to come off and damage the valve plate.

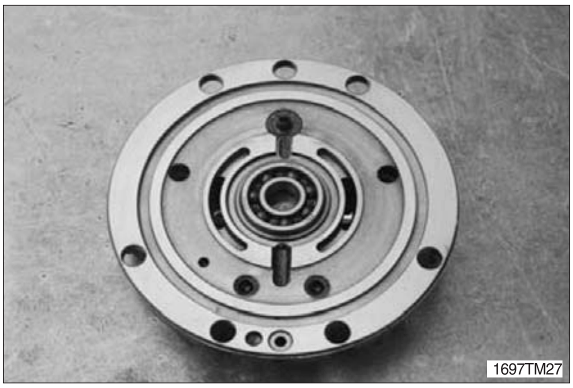

1697TM25

(3) Remove the valve plate.


1697TM26

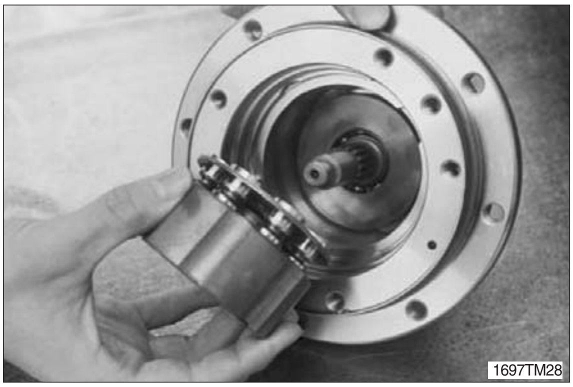
(4) Remove the two O-rings from the body 1.

※ The bearing and spring pins are not able to disassemble, because they are press-fitted.

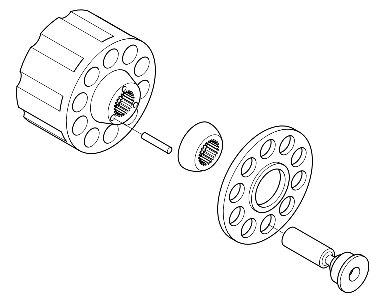

1697TM27

(5) Remove the cylinder barrel assembly from the body 2.

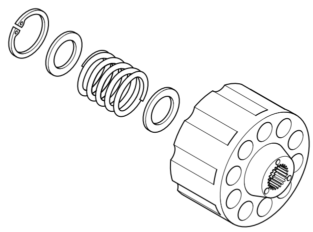
※ The small parts are easily dispersed, pay attention not to miss.


1697TM28

(6) Remove the seven piston-shoe assemblies, shoe holder, barrel holder, three pins.

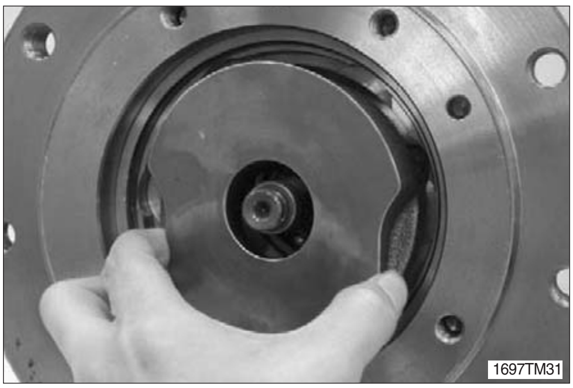

1697TM29

(7) Remove the snap ring, retainer, spring-C and retainer.


R27Z97TM28


1697TM30

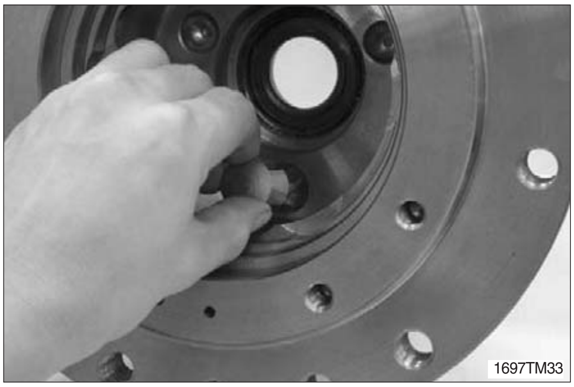
(8) Remove the swash plate and two balls from the body 2.


1697TM31

(9) Remove the shaft from the body 2.

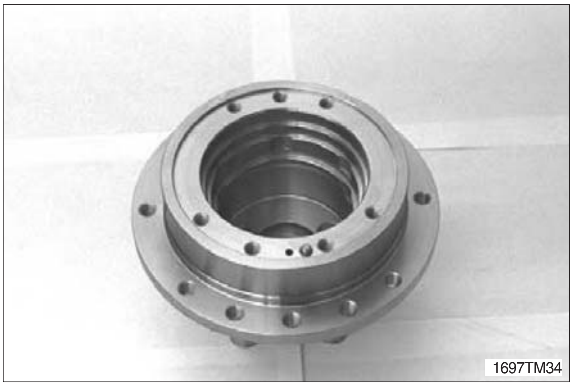
※ The bearing is not able to disassemble, because they are press-fitted.

(10) Remove the control piston from the body 2.



(11) Remove the oil seal from the body 2.

(12) Remove the pin from the body 2.



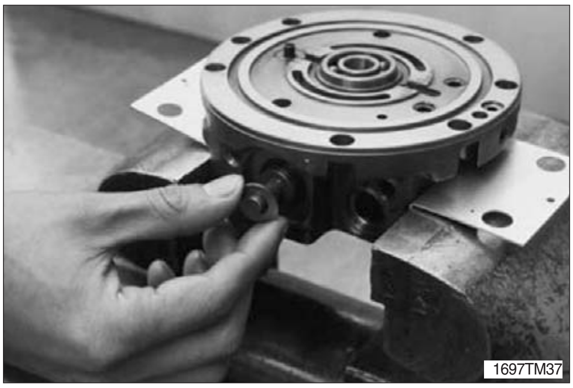
(13) Remove the two plugs with O-rings from the body 1.

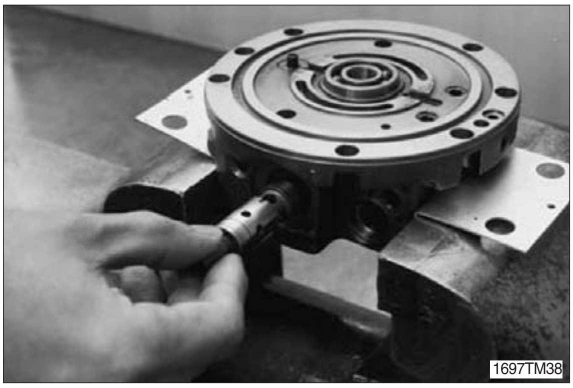
· Hexagon size : 27 mm

(14) Remove the two spring V2, two rings and spool assembly.

※ The spool assembly is not able to disassemble.

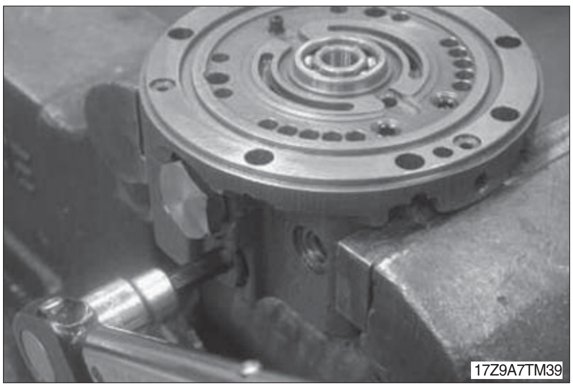

1697TM36


1697TM37


1697TM38

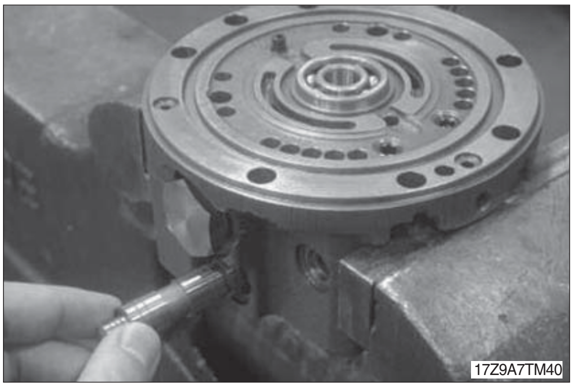
(15) Remove the two plugs with O-rings from the body 1.

· Hexagon size : 8 mm


17Z9A7TM39

(16) Remove the spring V3, two speed spool, spool B and spool C.

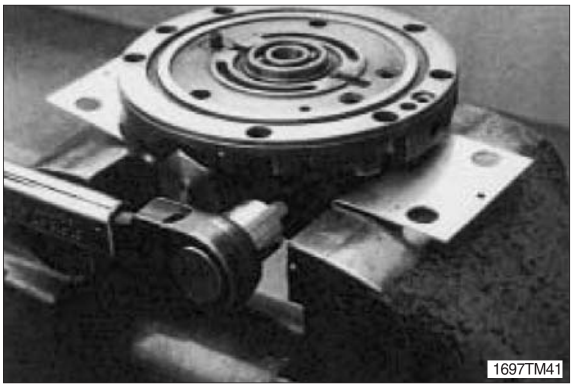
※ The small parts are easily dispersed, pay attention not to miss.


17Z9A7TM40


17Z9A7TM41

(17) Remove the two plugs with O-ring from the body 1.

· Hexagon size : 5 mm


1697TM41

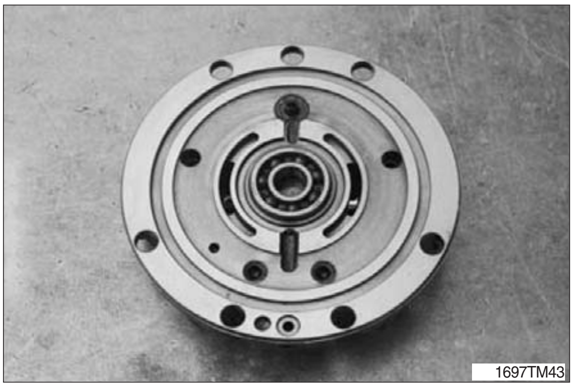
(18) Remove the two needles and shuttle spool.


1697TM42

3. ASSEMBLY

1) HYDRAULIC MOTOR SECTION

(1) Press-fit the bearing and the spring pin into the body 1.



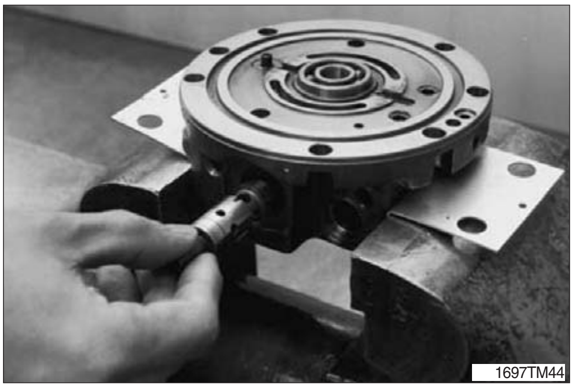
1697TM43

(2) Insert the spool assembly, two rings (1pc/side) and two springs (1pc/side) in that order into the body 1, and then screw the two plugs (1pc/side) with two O-rings (1pc/side).

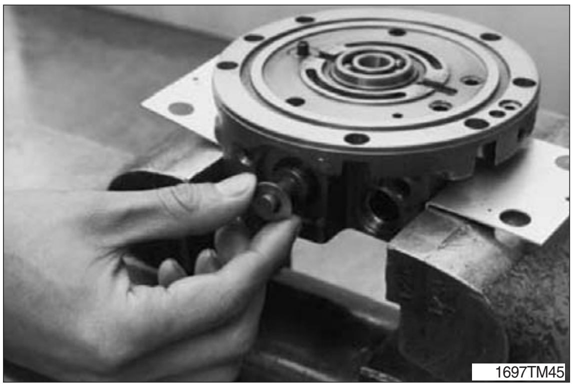
※ The spool assembly is not able to disassemble.

· Plugs tightening torque (both sides) : 13~17 kgf · m (94~123 lbf · ft)

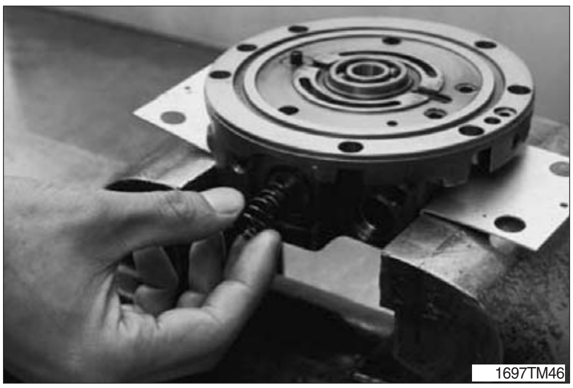
· Hexagon size : 27 mm



1697TM44



1697TM45



1697TM46

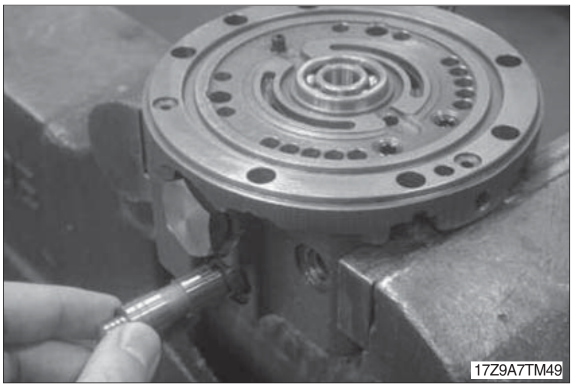

1697TM47

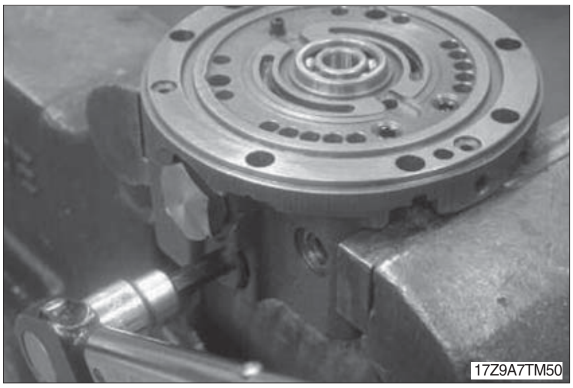
(3) Insert the spring V3, spool B and spool C into two speed spool. Insert its assembly into the body 1. Screw the two plugs (1pc/side) with two O-rings (1pc/side).

· Plugs tightening torque :
4.69~5.2 kgf · m (33.9~37.6 lbf · ft)
· Hexagon size : 8 mm

※ Pay attention to the direction of the spool. (See drawings for the direction, page 7-58~60).


17Z9A7TM48

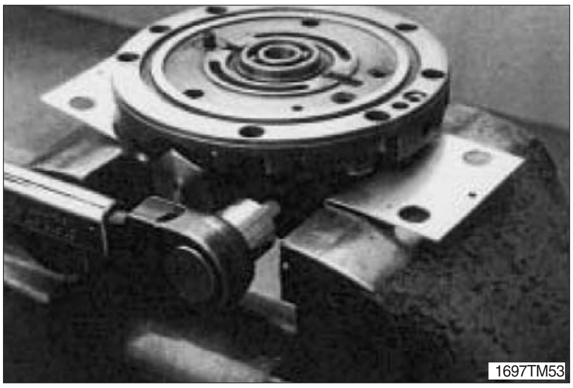

17Z9A7TM49


17Z9A7TM50

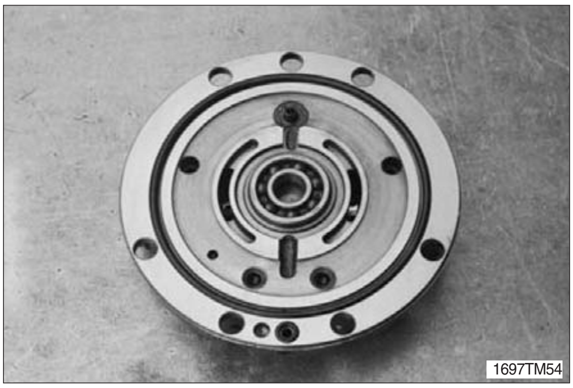
(4) Insert the shuttle spool and two needles (1pc/side) into the body 1, and then screw them in with the two plugs with O-rings (1pc/side).

· Plugs tightening torque :
 1.2~1.8 kgf · m
 (8.7~13.0 lbf · ft, both sides)

· Hexagon size : 5 mm



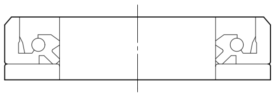
(5) Place two O-rings onto the body 1.



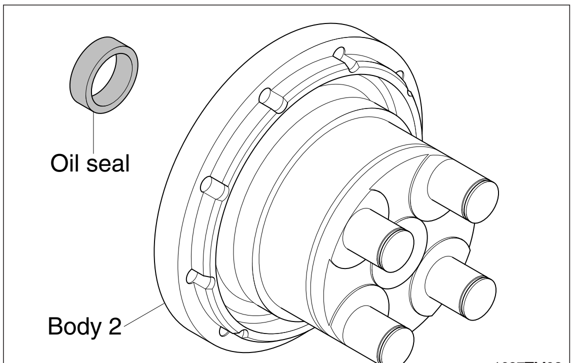
(6) Press-fit the oil seal into the body 2.

※ Apply grease to the periphery of the oil seal.

※ Pay attention to the direction of the oil seal, and do not slant it.



R27Z97TM52



1697TM03

(7) Place the pin into the body 2.

1697TM55

(8) Press-fit the bearing with the shaft.

1697TM56

(9) Insert the control piston into the body 2.

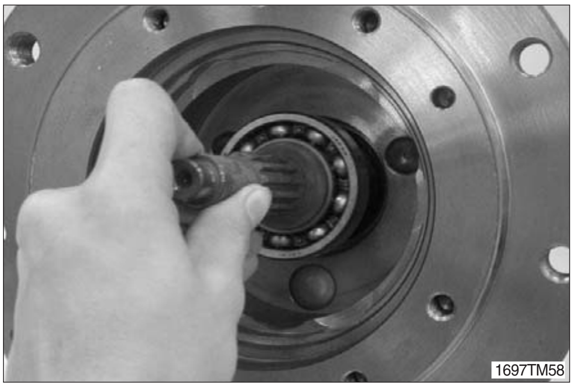
※ Pay attention to the direction of the control piston.

※ Assemble the control piston, which shoe surface should be upper side (see drawings for the direction, page 7-58~60).

1697TM57

(10) Place the shaft into the body 2.

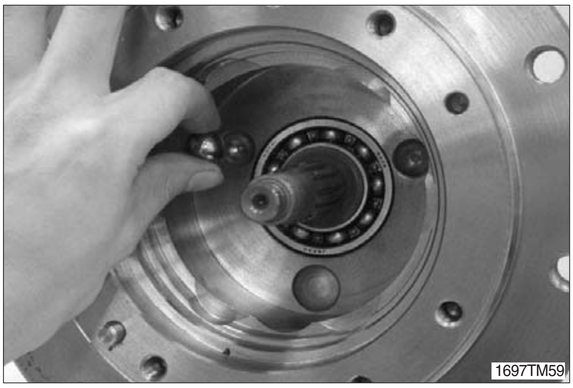
※ Pay attention not to damage the oil seal with the shaft.
A oil which damaged should be replaced.

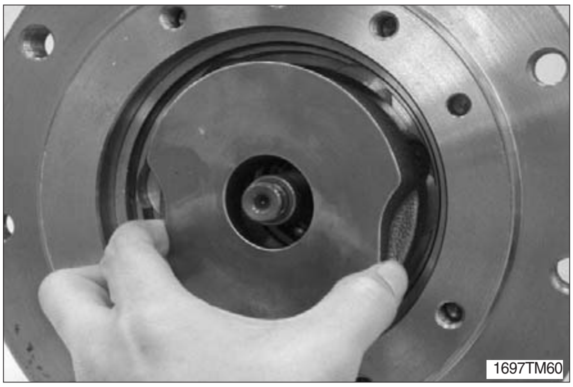

1697TM58

(11) Place the two balls and the swash plate onto the body 2.

※ Apply oil to the working face of the swash plate.

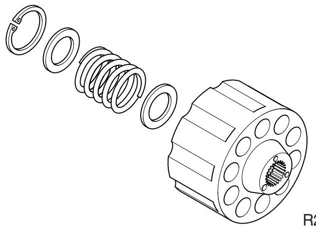
※ In case the swash plate drops out, apply grease to the back of it.


1697TM59


1697TM60

(12) Place the retainer, spring C and retainer in that order into the cylinder barrel, and then secure them with the snap ring.

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.


R27Z97TM60


1697TM61

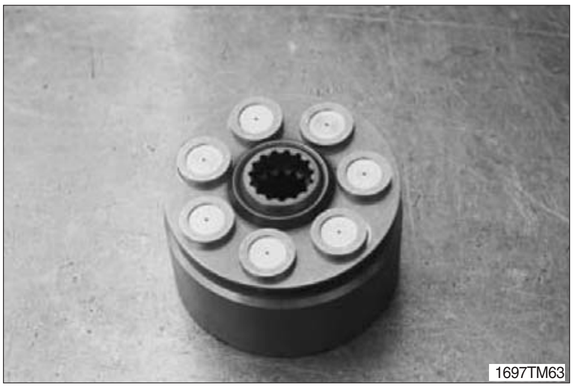
(13) Place the piston-shoe assemblies into the shoe holder.

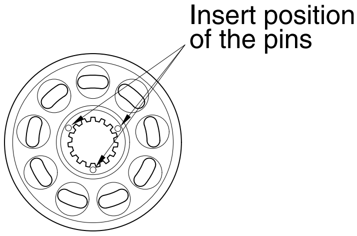

1697TM62

(14) Place the three pins, barrel holder and piston-shoe assemblies in that order into the cylinder barrel.

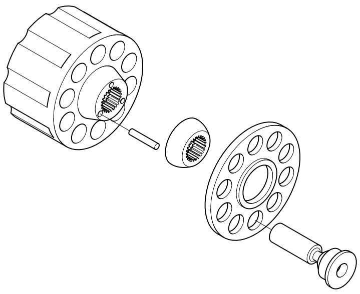
※ Apply oil to the inside of the cylinders, then lower the pistons into the cylinder barrel.

※ Pay attention to the order of pins, barrel holder and piston-shoe assemblies. (See drawing for the order, page 7-58~60)


1697TM63

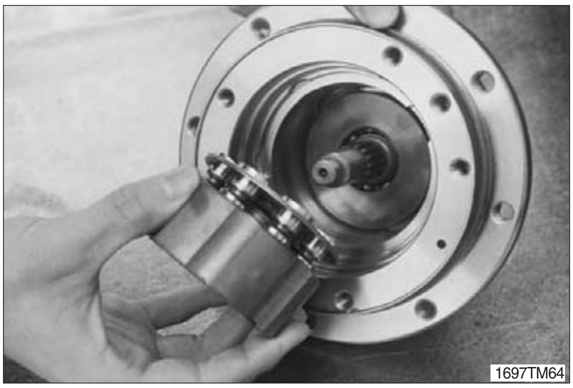


1697TM93


1697TM29

(15) Insert the cylinder barrel assembly into the body 2 so that the shoes contact the swash plate.

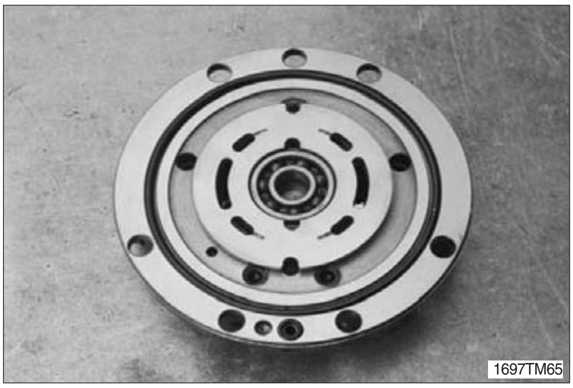
※ The small parts are easily dispersed, pay attention not to lose.


1697TM64

(16) Fill the body 2 with 0.1ℓ hydraulic oil for lubrication.

(17) Place the valve plate onto the body 1.

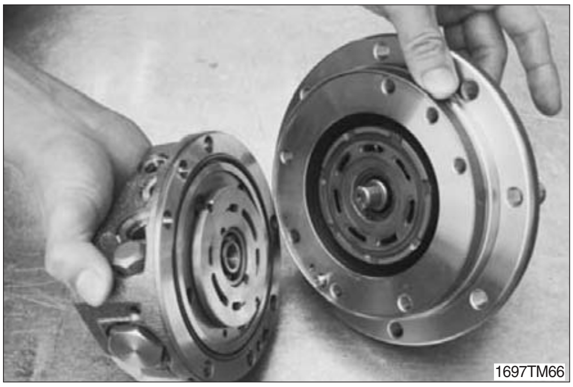
※ The copper face of the valve plate should be uppermost.
※ Apply oil to the copper face of the valve plate.
※ In case the valve plate drops out, apply grease to the steel face of it.



1697TM65

(18) Join the body 1 to the body 2.

※ The small parts are easily dispersed, pay attention not to miss.

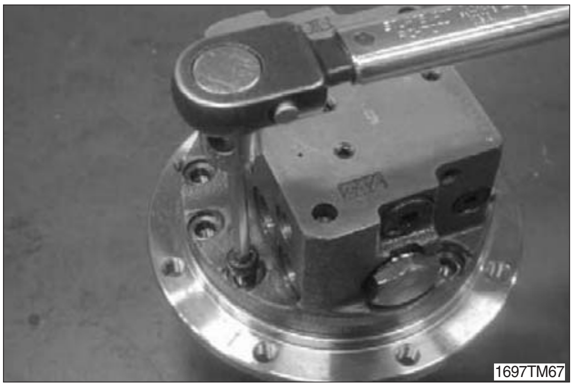


1697TM66

(19) Bolt them with seven hexagon socket head cap bolts.

· Bolt tightening torque : 2.9~3.1 kgf · m (21.0~22.4 lbf · ft)
· Hexagon size : 6 mm

※ If you fix the motor with a vice, protect it with aluminum plates or equivalent.



1697TM67

2) REDUCTION GEAR SECTION

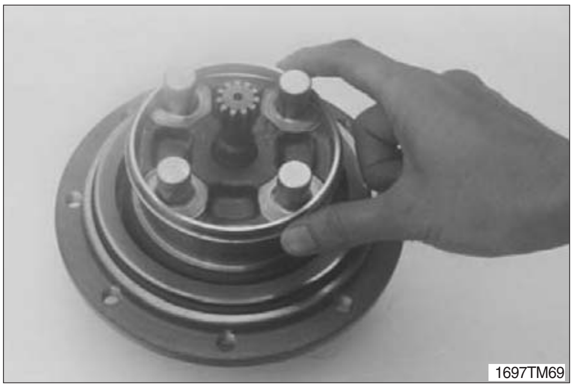
(1) Place the floating seal with O-ring into the hydraulic motor.

1697TM68

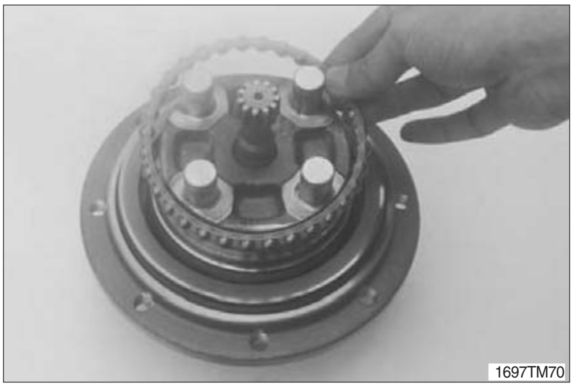
(2) Place inner ring, retainer with balls of the bearing in that order, onto the hydraulic motor.

※ Pay attention to the direction of the inner ring and the retainer.
(See drawings for the direction, page 7-58~60)

※ Pay attention not to disassemble the balls from the retainer.



1697TM69



1697TM70

(3) Put the seal ring with O-ring onto the body.

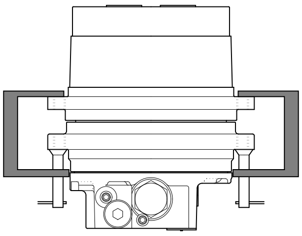
※ Apply grease to the O-ring to make it easy, and then wipe grease from the seal surface.

1697TM71

(4) Join the body to the motor.

※ Wipe grease from the seal surface.

※ Tighten the speed reducer flange and the motor flange with C-cramps or a hydraulic press.

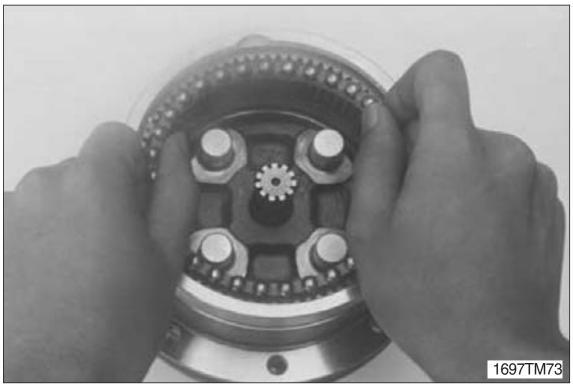


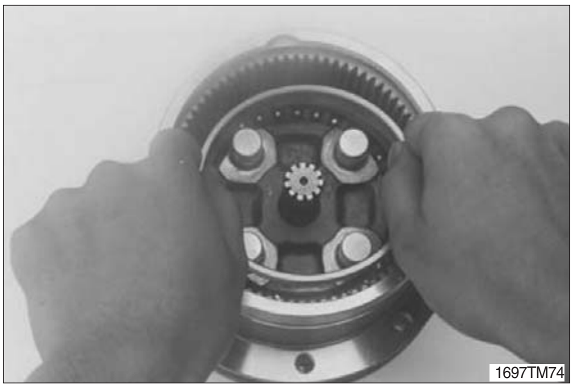
1697TM95

(5) Place retainer with balls, inner ring of the bearing in that order onto the hydraulic motor.

※ Pay attention to the direction of the inner ring and the retainer.

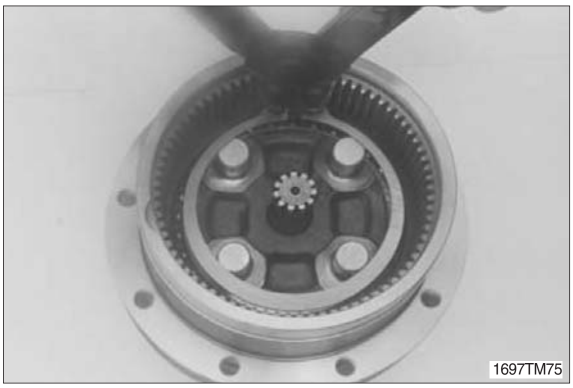
※ Pay attention not to disassemble the balls from retainer.
(See drawing for the direction.)





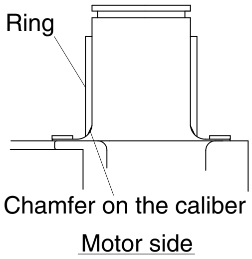
(6) Fix the bearing with the snap ring.

※ The pre-load for the bearings is adjusted by thickness of the snap ring.



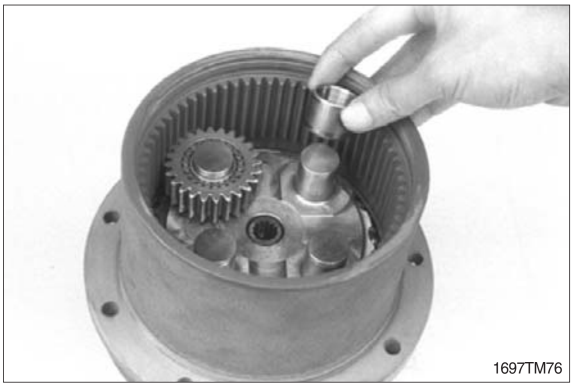
(7) Place the four rings (1pc/1pin), four thrust washers (1pc/1pin), four b1 gears (1pc/1pin) and ninety-six needles (24pcs/1pin) in that order onto the body 2.

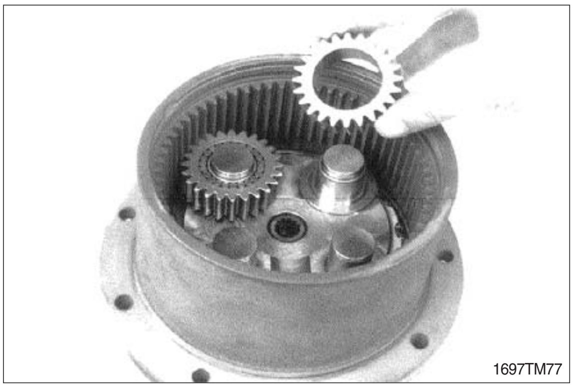
※ Pay attention to the direction of the ring. The chamfer on the caliber of the ring direction is motor side.



1697TM94

※ The needles are easily dispersed, pay attention not to lose.


1697TM76


1697TM77

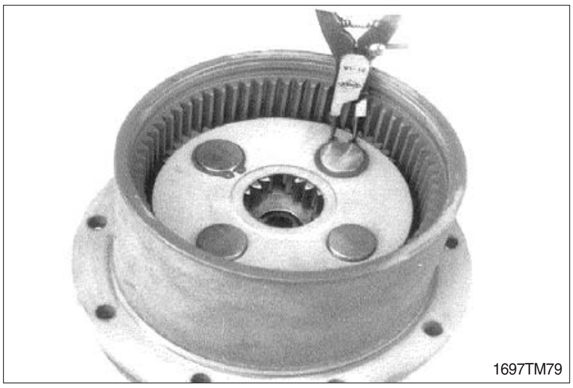

1697TM78

(8) Place thrust plate onto the gears and secure it with four snap rings.

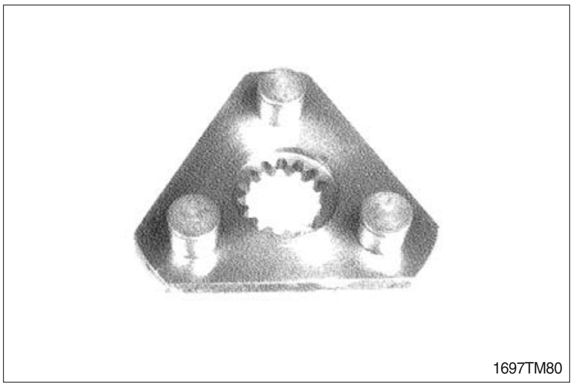
※ Pay attention to the direction of the thrust plate. The convex side should be uppermost. (see drawings for the direction, page 7-58~60).

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.

※ Pay attention not to open the snap ring too much. A snap ring which loses tension should be replaced.


1697TM79

(9) Press-fit the three b2 pins and three spring pins (1pc/pin) into the carrier 2.

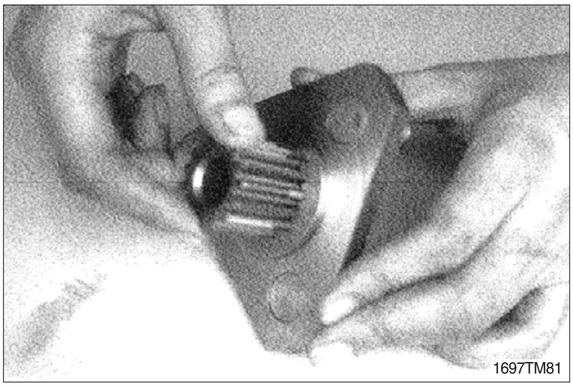


1697TM80

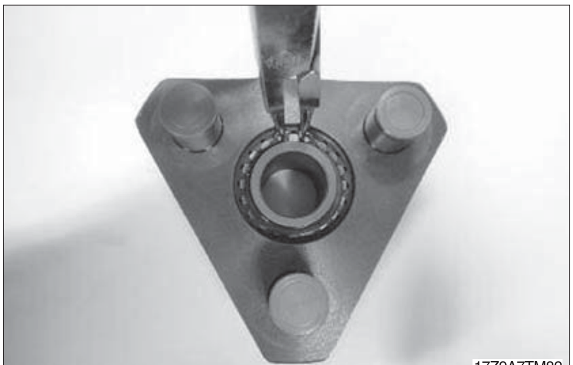
(10) Put the S1 gear to the carrier 2, and then secure them with the snap ring.

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.

※ Pay attention not to open the snap ring too much. A snap ring which loses tension should be replaced.



1697TM81

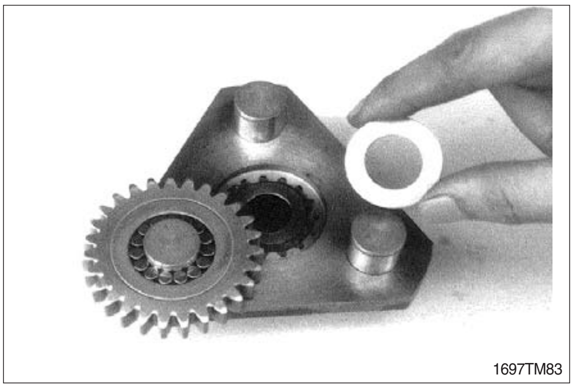


17Z9A7TM82

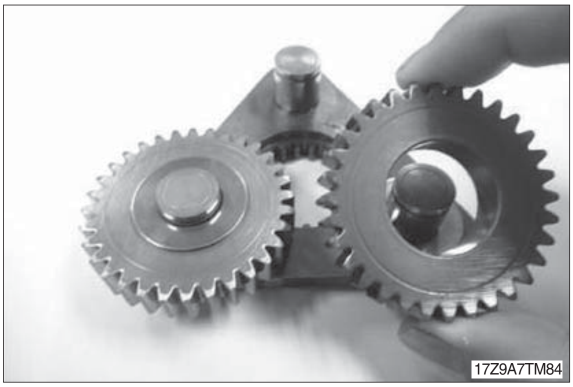
(11) Place the three thrust washers (1pc/1pin), three b2 gears (1pc/1pin), thirty-nine needles (13pcs/1pin) and the three thrust washers (1pc/1pin), in that order the carrier 2 and secure them with the three snap rings.

※ Pay attention to the direction of the snap ring. The edge side should be uppermost.

※ Pay attention not to open the snap ring too much. A snap ring which loses tension should be replaced.



1697TM83



17Z9A7TM84

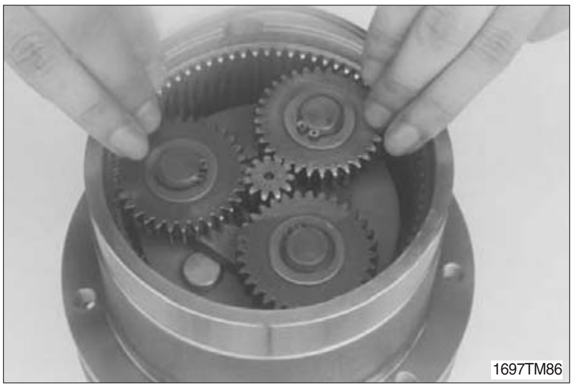
(12) Place the carrier 2 assembly into the body.

1697TM85

(13) Place the O-ring to the body.

※ Apply grease to the O-ring.

※ Pay attention not the rubbish in the O-ring groove.



1697TM86

(14) Place the slide ring onto the cover.

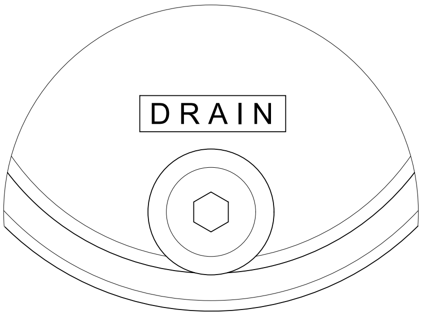
※ Apply grease to the slide ring to prevent it dropping out.

1697TM87

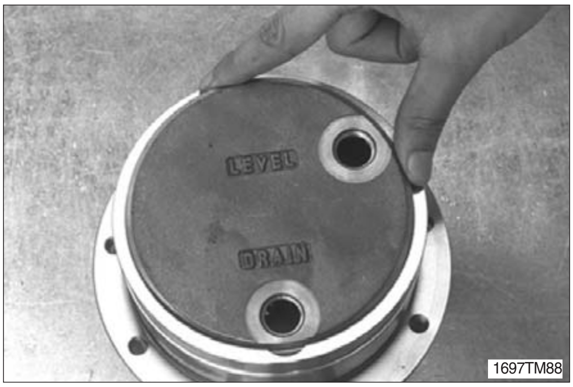
(15) Fill 0.33 ℓ gear oil in the body and insert cover.

※ Pay attention not to damage the O-ring.

※ The "DRAIN" side tapped hole should be aligned with notches of the body.



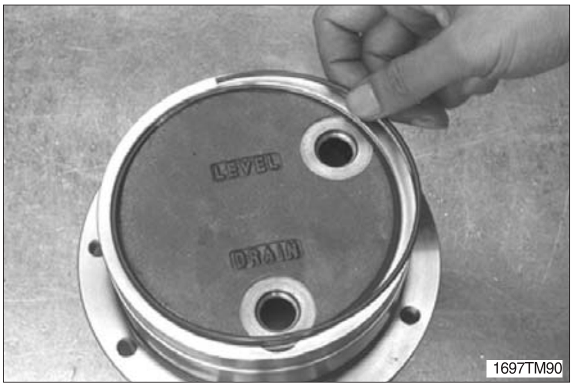
1697TM89



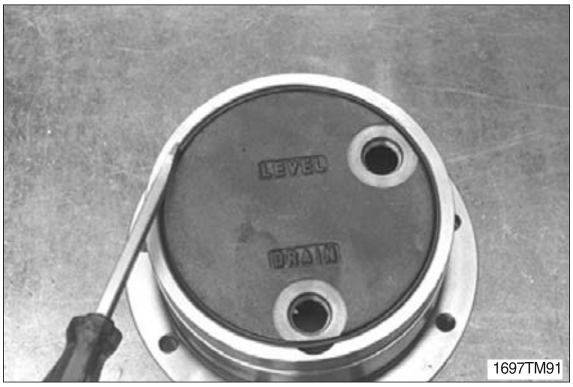
1697TM88

(16) Put the snap ring into the groove of the body to secure the cover.

※ Put the flat blade-flared tip screwdriver to the end of the snap ring, and tap it in the direction of the circumference.



1697TM90



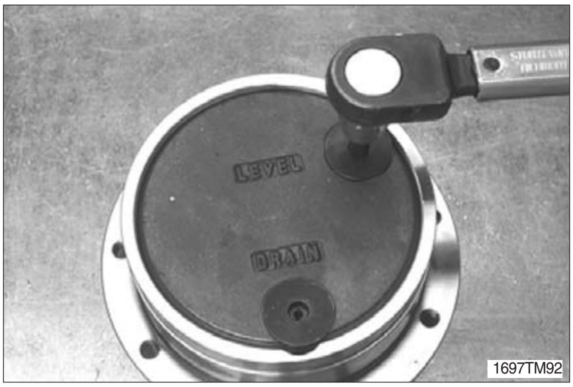
1697TM91

(17) Screw the two plugs (size : PF3/8) with O-rings (1pc/plug) to the cover.

· Plug tightening torque (PF3/8) :
4.69~5.2 kgf · m (33.9~37.6 lbf · ft)

· Hexagon size : 8 mm (PF3/8)

※ Screw the plug of "DRAIN" side first.



GROUP 7 RCV LEVER

1. REMOVAL AND INSTALL

1) REMOVAL

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

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

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

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

13031GE18

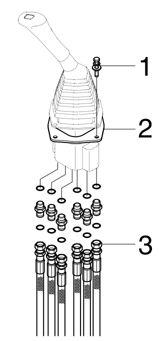
(4) Loosen the socket bolt(1).

(5) Remove the cover of the console box.

(6) Disconnect pilot line hoses(3).

(7) Remove the pilot valve assembly(2).

※ When removing the pilot valve assembly, check that all the hoses have been disconnected.



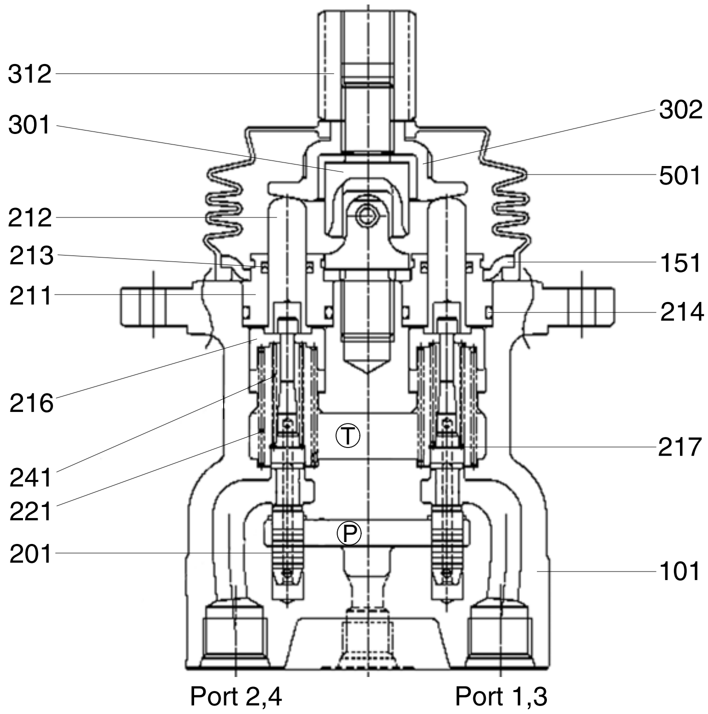
17Z9A8DA06

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. STRUCTURE



17Z9A7RCV50

101	Casing	213	Seal	241	Spring
151	Plate	214	O-ring	301	Joint
201	Spool	216	Spring seat	302	Disc
211	Plug	217	Washer	312	Nut
212	Push rod	221	Spring	501	Bellows

3. DISASSEMBLY AND ASSEMBLY

1) Rinse the pilot valve in paraffin.

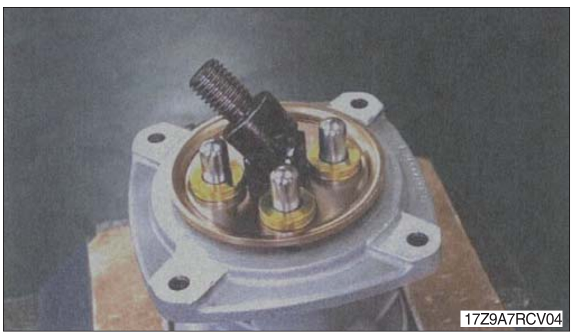
※ Place blind plug in all ports.

2) Secure the pilot valve in a vice using a copper or aluminium faced jaws.

3) Detach the bellows (501) (If outer bellows is attached, then this bellows may not be attached).

※ Take care not to damage the bellows (501).

4) Use a spanner applied to both the adjustment nut (312) and disc (302) and loosen and then remove them.



⚠ Items under tension. The return spring (221), plate (151) and push-rod (212) will rise as joint (301) is loosened. Make sure the items do not fly out and damage personnel in the vicinity.

5) Using the jig, turn the joint (301) counter-clockwise to loosen it.
   The right illustration shows the jig attached.

17Z9A7RCV05

17Z9A7RCV06

6) Remove the plate (151).
   - When the return spring (221) is strong

17Z9A7RCV07

   - When the return spring (221) is weak

17Z9A7RCV08

⚠ Items under tension. The return spring (221) tension will be released when plug (211) is removed. Make sure the item does not fly out and damage personnel in the vicinity.

7) When the return spring (221) is weak, the plug (211) is held in the casing (101) by the friction of the O-ring. Remove this using a screwdriver.

※ Use the groove around the plug and take care to apply force evenly to avoid damage.

8) Remove the push-rod (212), plug (211), reduction valve assembly and return spring (221) from the casing (101).

※ The location in relationship with the casing aperture.

※ The surface of the spool (201) and the spring seat (216) can be damaged by mis-handling. Take care not to damage the surface of the spool during removal and do not push the spring seat down more than 6 mm.

9) The reduction valve is disassembled by pressing down the spring seat (216) and flexing the secondary pressure spring (241), sliding the spring seat (216) sideways and removing it from the spool (201) via the larger aperture.

※ Take care not to damage the surface of the spool (201).

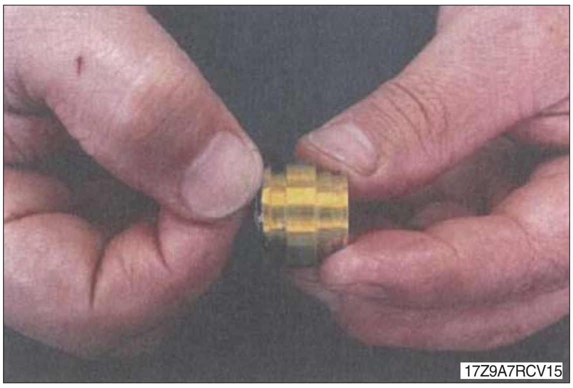
10) Take the spool (201), spring seat (216), secondary pressure spring (241) and washer #2 (217) apart.

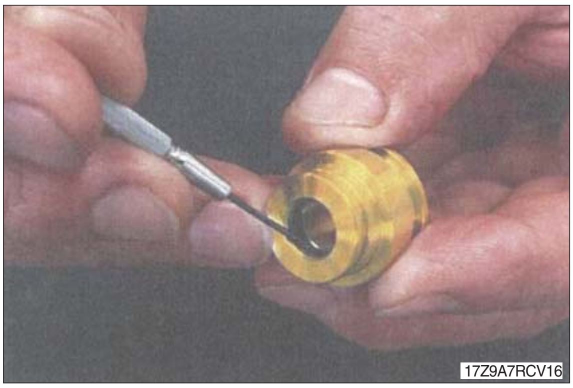
※ Take care not to damage the surface of the spool (201).

※ Keep these parts together until reassembly.

11) Extract the push-rod (212) from the plug (211).

12) Detach the O-ring (214) and seal (213) from the plug (211). Detach the seal (213) using a small screwdriver.





13) CLEANING OF PARTS

(1) Wash the parts by placing in an initial bath containing paraffin oil (or similar cleaning fluid).

※ To reduce the risk of damage if dirty parts are initially washed in oil. To remove the dirt and oil, soak thoroughly so that dirt and oil float to the surface.

※ Dirty paraffin could result in damage to the parts, and deterioration in performance after reassembly. Ensure the contamination of the paraffin is thoroughly monitored and controlled.

(2) Place the parts in a finish wash container, rotate this slowly until even the inner areas of the parts are clean. (Finish wash)
Wipe of the paraffin oil on the parts using clean cloth.

※ If compressed air is used for drying, dust and moisture in the compressed air may damage the parts and make corrosion more likely.

15) PREVENTION OF CORROSION OF PARTS

Coat the parts with the anti-corrosion preparation.

※ If the parts are left to stand for some time after cleaning, they may start to corrode and the performance after reassembly will be impaired.

4. ASSEMBLY

※ The surface of the spool (201) and the spring seat (216) can be damaged by mis-handling. Take care not to damage the surface of the spool during assembly and do not push the spring seat down more that 6 mm.

1) Insert, in this order, the washer #2 (217), secondary spring (241) and spring seat (216) onto the spool (201).

17Z9A7RCV17

2) Press down the spring seat (216) to flex the secondary pressure spring (241) while sliding the spring sideways through the larger aperture to attach it to the spool (201).
   Fit the return spring (221) into the casing (101).

※ Do not press the spring seat down more than 6mm.

17Z9A7RCV18

3) Fit the reduction valve assembly into the casing (101).

※ Fit in the locations noted in step 8 of the disassembly procedure.

17Z9A7RCV19

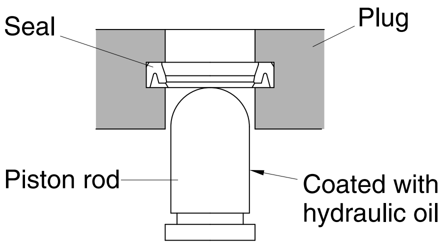
4) Fit the O-ring (214) into the plug (221).

5) Fit the seal (213) into the plug (211).

※ Fit the lip of the seal (213) as shown right.

6) Fit the push-rod (212) into the plug (211).

※ Apply hydraulic oil to the surface of the push rod.



Push rod, plug & seals

17Z9A7RCV32

⚠ Items under tension. The plug assembly and plate (151) have to be assembled against spring tension. Make sure the item does not fly out and damage personnel in the vicinity.

※ The surface of the spool (201) and aperture (101) can be damaged by mis-handling. Take care not to damage the surface of either during assembly.

7) Fit the plug assembly into the casing (101). When the return spring (221) is weak, it is held in place by the friction of the O-ring (214).
   When the return spring (221) is strong, use the plate (151) to insert all four simultaneously and temporarily secure them with the joint (301).

8) Attach the plate (151).

9) Tighten the joint (301) to the casing (101) to the specified torque using the special jig.

※ The right figure shows the jig attacched. Screw down to a position where the four push rods (212) are in contact equally.

※ Excessive tightening or wrong positioning of the disc can cause the valve to malfunction.

10) Attach the disc (302) onto the joint (301).

17Z9A7RCV28

11) Install the adjustment nut (312), tighten up the discs (302) with a spanner on both and tighten the adjustment nut to the specified torque.

※ Do not allow the position of the disc (302) to shift during tightening.

17Z9A7RCV29

12) Apply grease to the rotating part of the joint (301) and end of the push-rod (212).

17Z9A7RCV30

13) Attach the bellows (501).
If outer bellows is attached, then this bellows may not be attached.

※ Take care not to tear the bellows.

14) Fit the handle assembly into the valve.

15) Spray anti-corrosion preparation into each port and insert blind plugs.

17Z9A7RCV29

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.

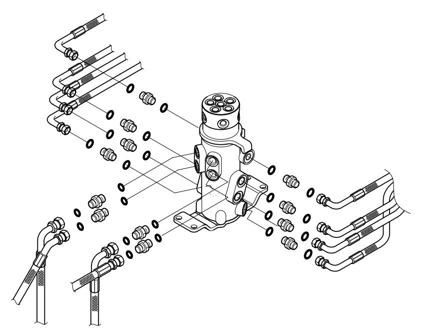

13031GE18

(4) Disconnect all hoses.

(5) Sling the turning joint assembly (1) and remove the mounting bolt (2).

· Weight : 14 kg (31 lb)

· Tightening torque : 6.9± 1.4 kgf · m
(49.9± 10.1 lbf · ft)


17Z9A7TJ01

(6) Remove the turning joint assembly.

※ When removing the turning joint, check that all the hoses have been disconnected.

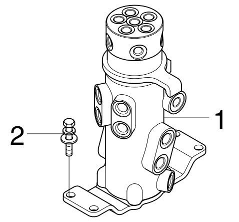
2) INSTALL

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

※ Take care of turning joint direction.

※ Assemble hoses to their original positions.

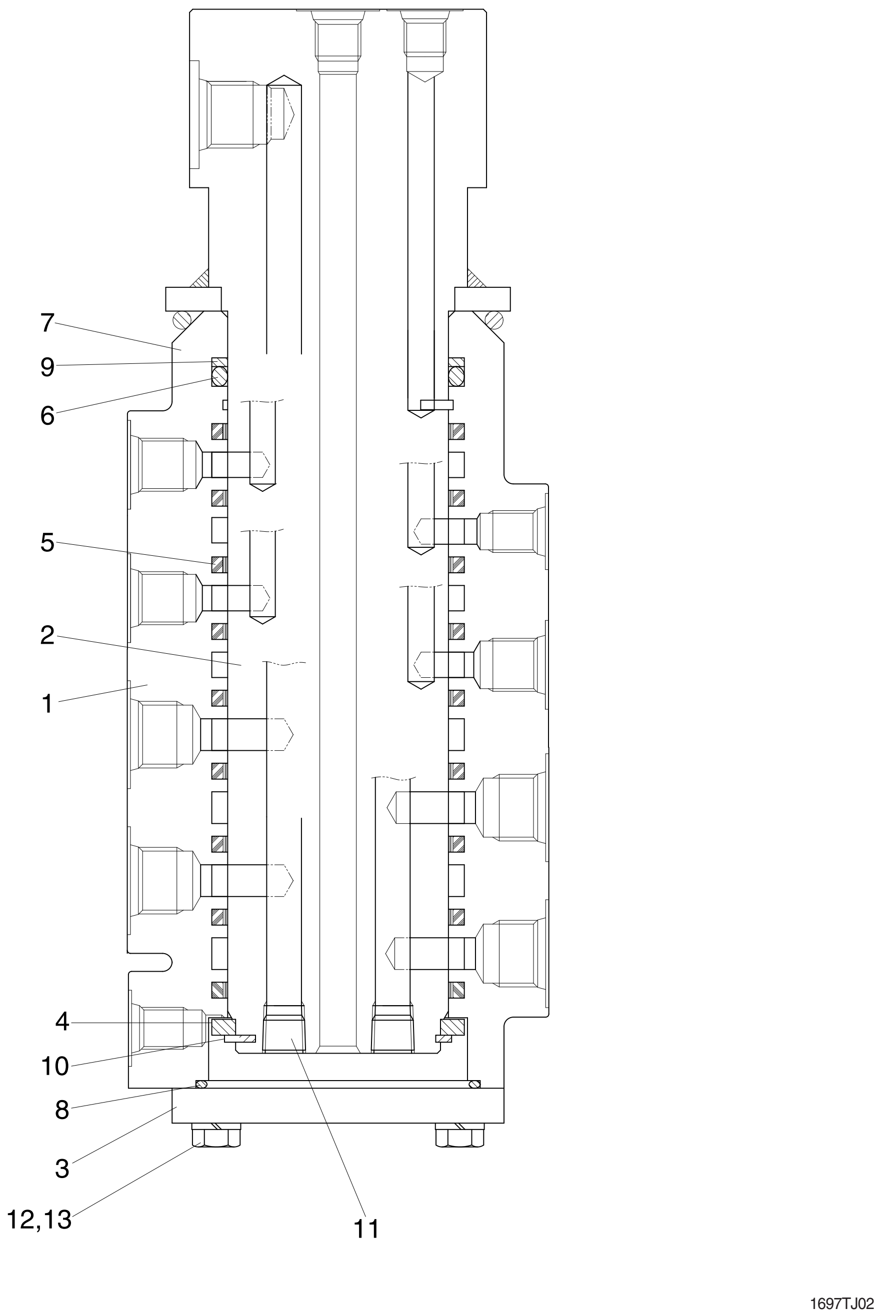
※ Confirm the hydraulic oil level and check the hydraulic oil leak or not.



17Z9A7TJ02

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

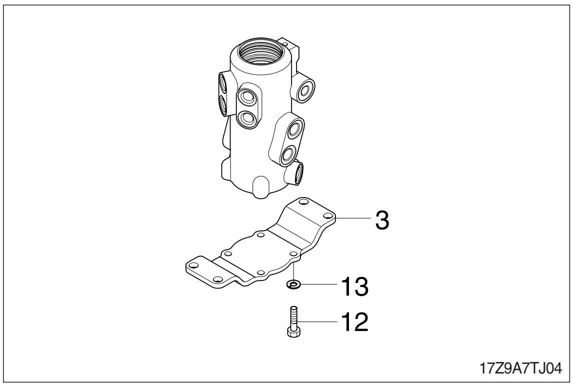


1	Hub	6	O-ring	11	Plug
2	Shaft	7	O-ring	12	Hexagon bolt
3	Cover	8	O-ring	13	Spring washer
4	Spacer	9	Back-up ring		
5	Slipper seal	10	Retainer ring		

2) DISASSEMBLY

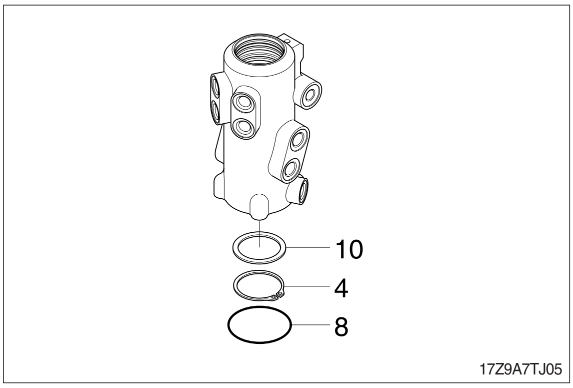
※ Before the disassembly, clean the turning joint.

(1) Remove bolts (12), washer (13) and cover (3).



(2) Remove O-ring (8).

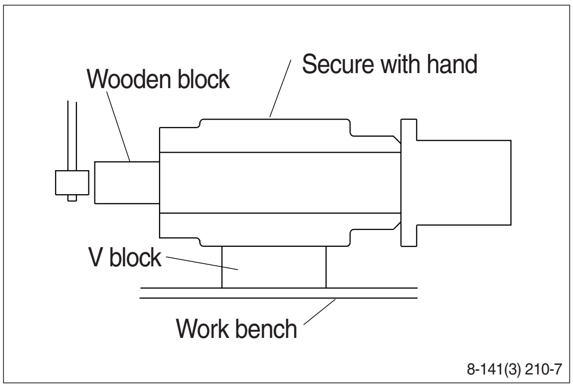
(3) Remove retainer ring (10) and spacer (4).



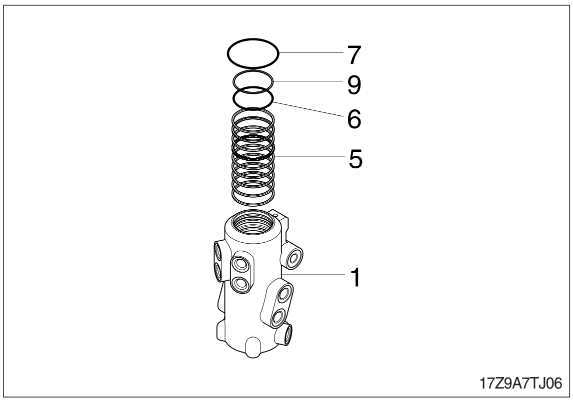
(4) Place hub (1) on a V-block and by using a wood buffer at the shaft end, hit out shaft (2) to about 1/2 from the body with a hammer.

※ 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).



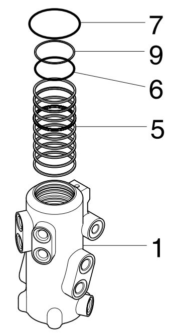
(5) Remove nine slipper seals (5), O-ring (7), back-up ring (9), and O-ring (6) from hub (1).



3) ASSEMBLY

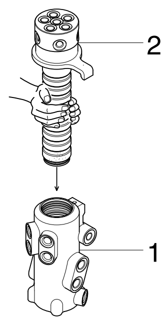
※ Clean all parts.
※ As a general rule, replace oil seals and O-ring.
※ Coat the sliding surfaces of all parts with engine oil or grease before installing.

(1) Fix nine slipper seal (5) and O-ring (7), back-up ring (9) and O-ring (6) to hub (1).



17Z9A7TJ06

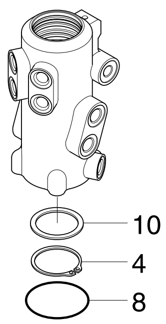
(2) Set hub (1) on block, install shaft (2) into hub (1) by hand.



17Z9A7TJ07

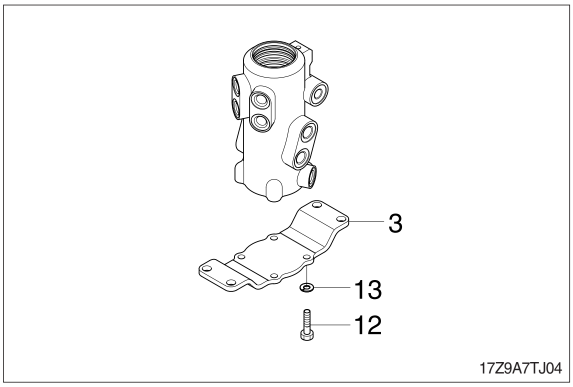
(3) Fit spacer (4) and retainer ring (10) to shaft (2).

(4) Fit O-ring (8) to hub (1).



17Z9A7TJ05

(5) Install cover (3) to hub, tighten bolts (12) with washer (13).



GROUP 9 BOOM, ARM AND BUCKET CYLINDERS

1. REMOVAL AND INSTALL

1) BUCKET CYLINDER

(1) Removal

※ Expand the arm and bucket fully, lower the work equipment to the ground and stop the engine.

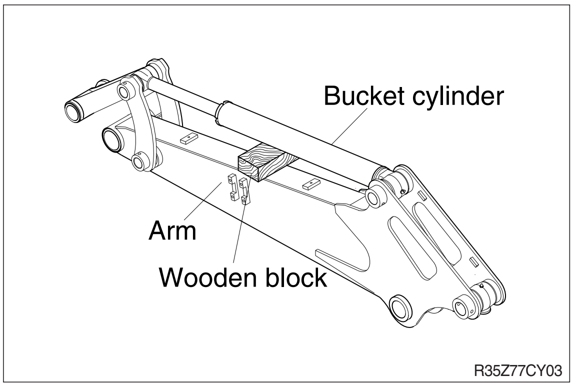
※ Operate the control levers and pedals several times to release the remaining pressure in the hydraulic piping.

13031GE18

⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank. Escaping fluid under pressure can penetrate the skin causing serious injury.

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

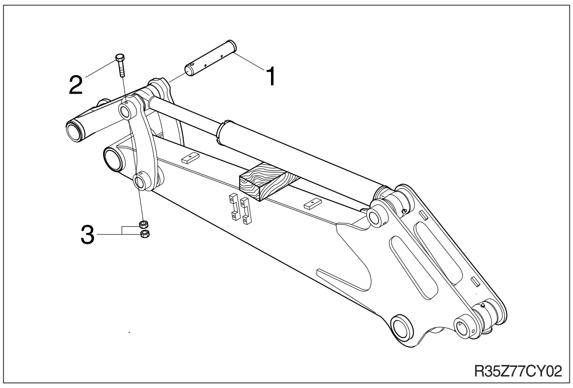
① Set block between bucket cylinder and arm.



R35Z77CY03

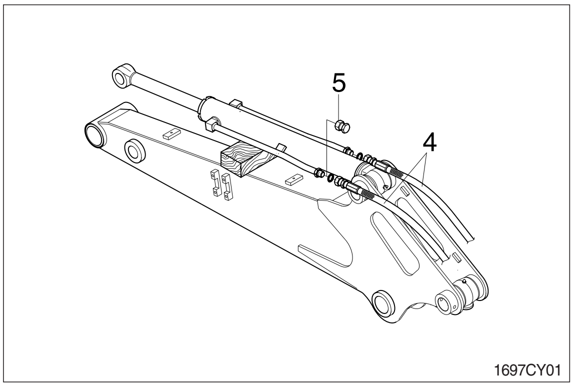
② Remove bolt (2), nut (3) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



R35Z77CY02

③ Disconnect bucket cylinder hoses (4) and put plugs (5) on cylinder pipe.

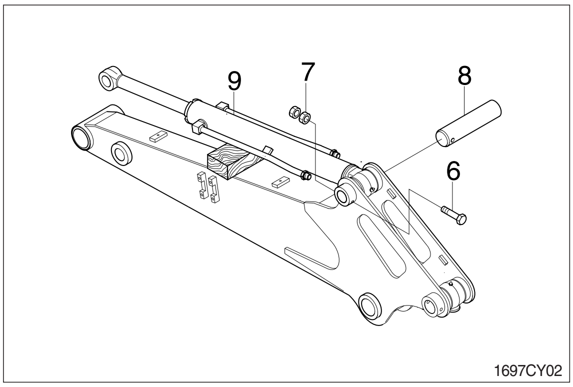


1697CY01

④ Sling bucket cylinder assembly (9) and remove bolt (6) and nut (7) then pull out pin (8).

⑤ Remove bucket cylinder assembly (9).

· Weight : 11 ㎏ (24 ℔)



(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.

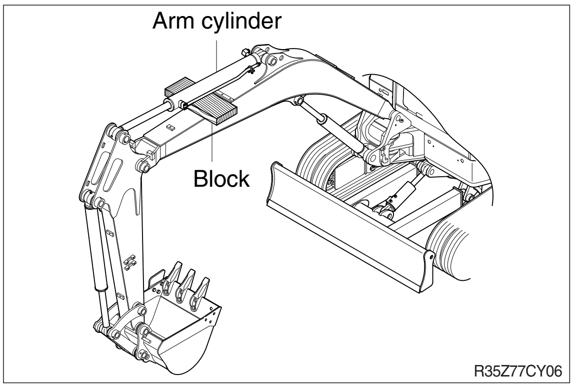
13031GE18

⚠ **Loosen the breather slowly to release the pressure inside the hydraulic tank.**

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

※ Fit blind plugs in the hoses after disconnecting them, to prevent dirt or dust from entering.

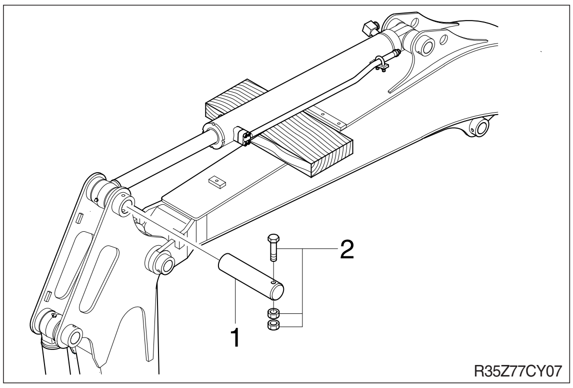
① Set block between arm cylinder and boom.



R35Z77CY06

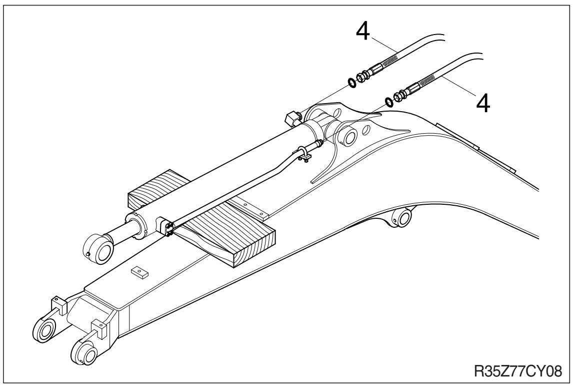
② Remove bolt and nut (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



R35Z77CY07

③ Disconnect arm cylinder hoses (4) and put plugs on cylinder pipe.

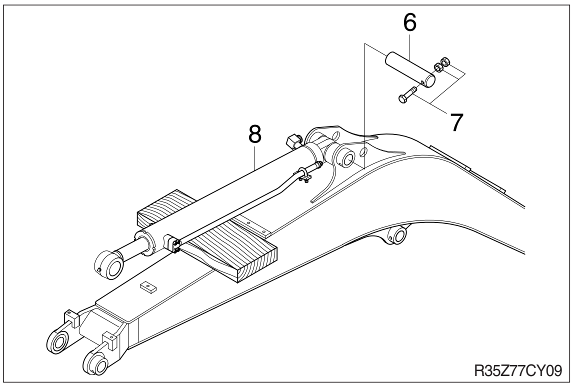


R35Z77CY08

⑤ Sling arm assembly (8) and remove bolt and nut (7) then pull out pin (6).

⑥ Remove arm cylinder assembly (8).

· Weight : 15 ㎏ (33 ㏓)



R35Z77CY09

(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.

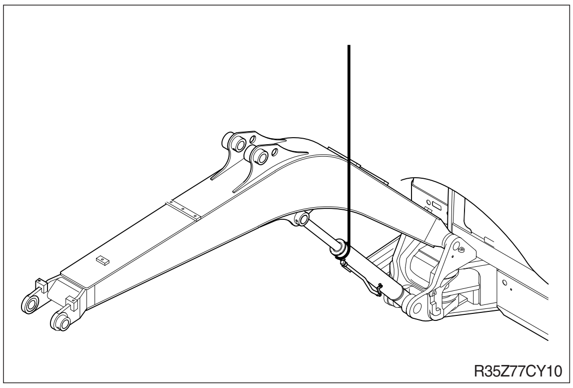
⚠ Loosen the breather slowly to release the pressure inside the hydraulic tank.

⚠ 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 Sling boom cylinder assembly.

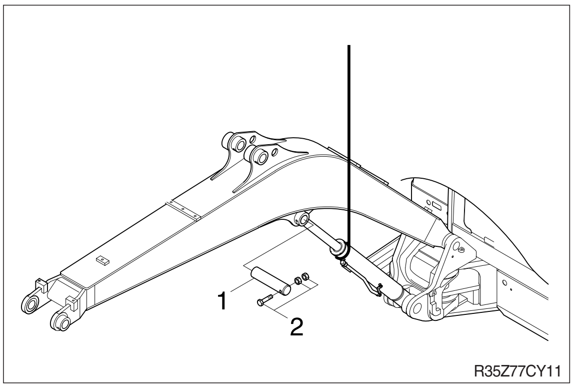
13031GE18



R35Z77CY10

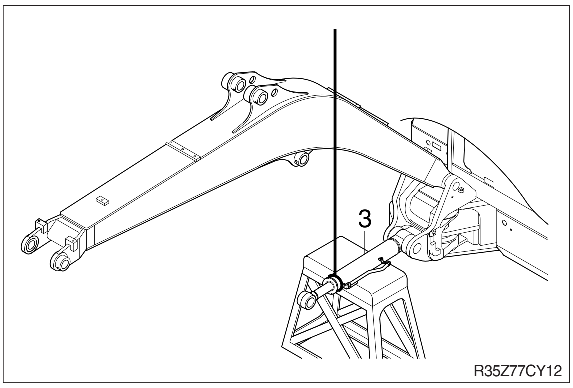
③ Remove bolt and nut (2) and pull out pin (1).

※ Tie the rod with wire to prevent it from coming out.



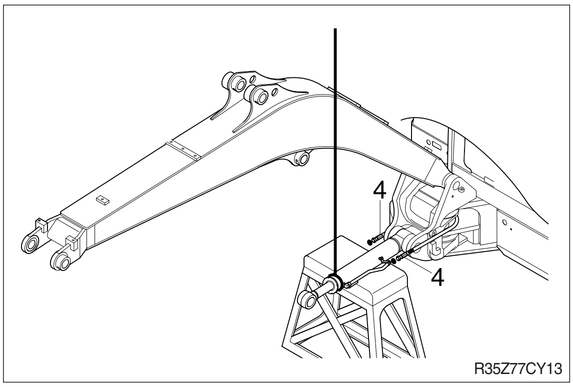
R35Z77CY11

④ Lower the boom cylinder assembly (3) on a stand.



R35Z77CY12

⑤ Disconnect boom cylinder hoses(4) and put plugs on cylinder pipe.

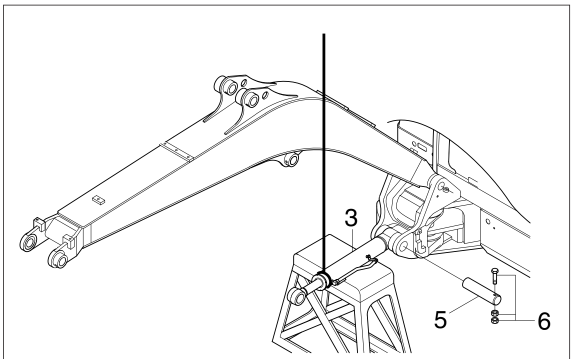


R35Z77CY13

⑥ Remove bolt (6) and pull out pin (5).

⑦ Remove boom cylinder assembly (3).

· Weight : 17 ㎏ (37 ℔)



R35Z77CY14

(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.

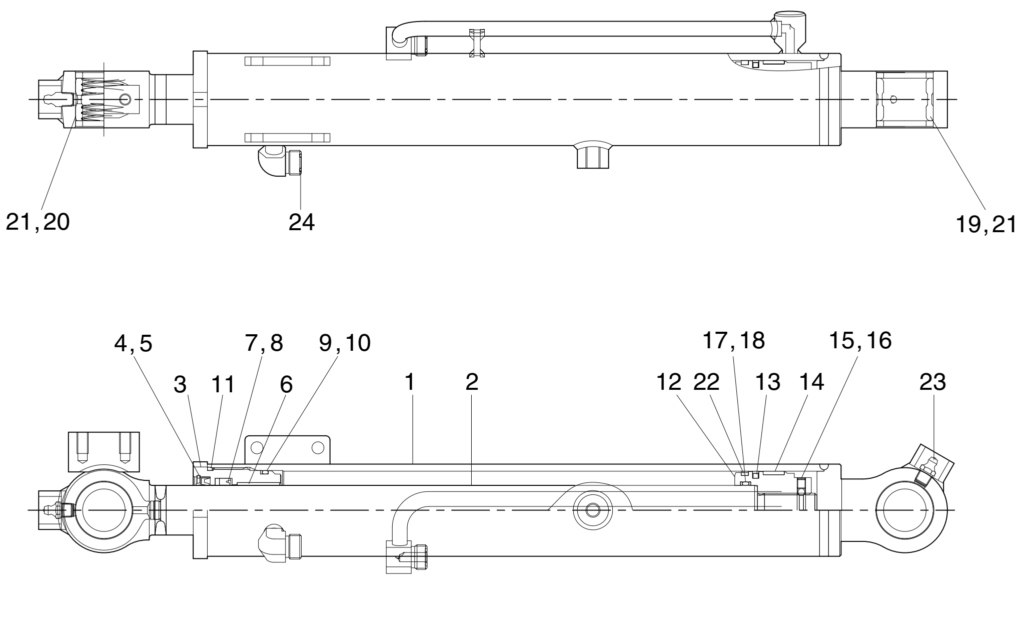
※ Bleed the air from the boom cylinder.

※ Conformed the hydraulic oil level and check the hydraulic oil leak or not.

2. DISASSEMBLY AND ASSEMBLY

1) STRUCTURE

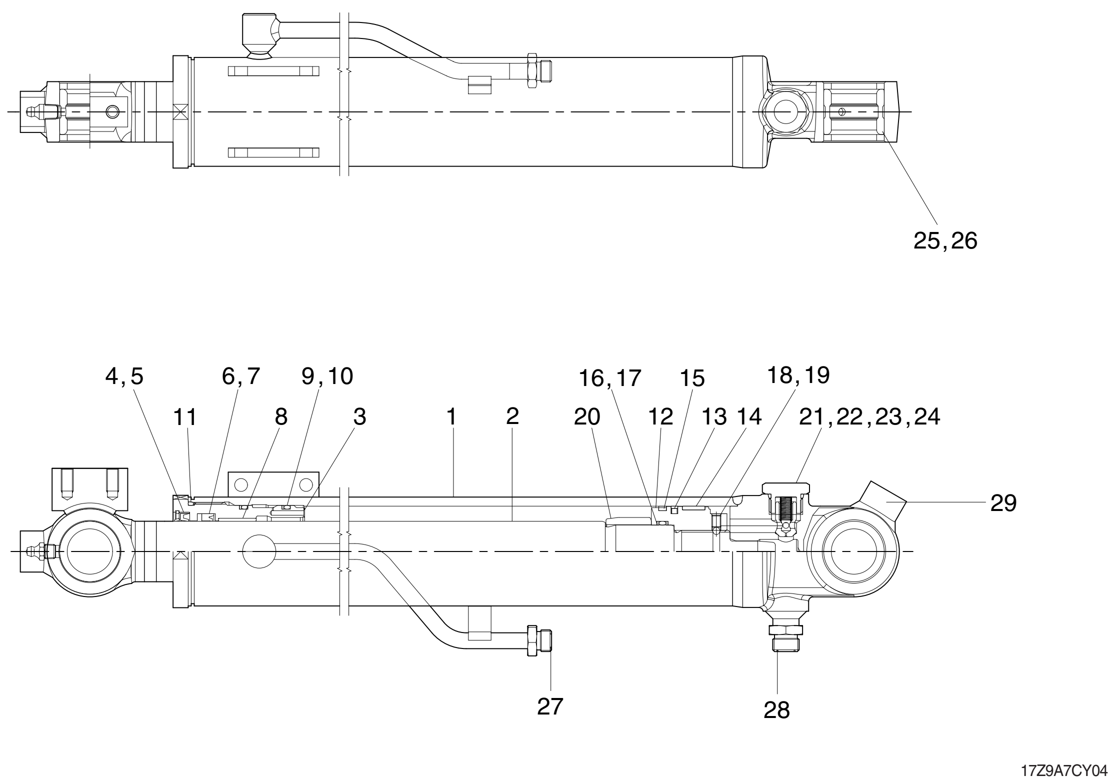
(1) Bucket cylinder



17Z9A7CY03

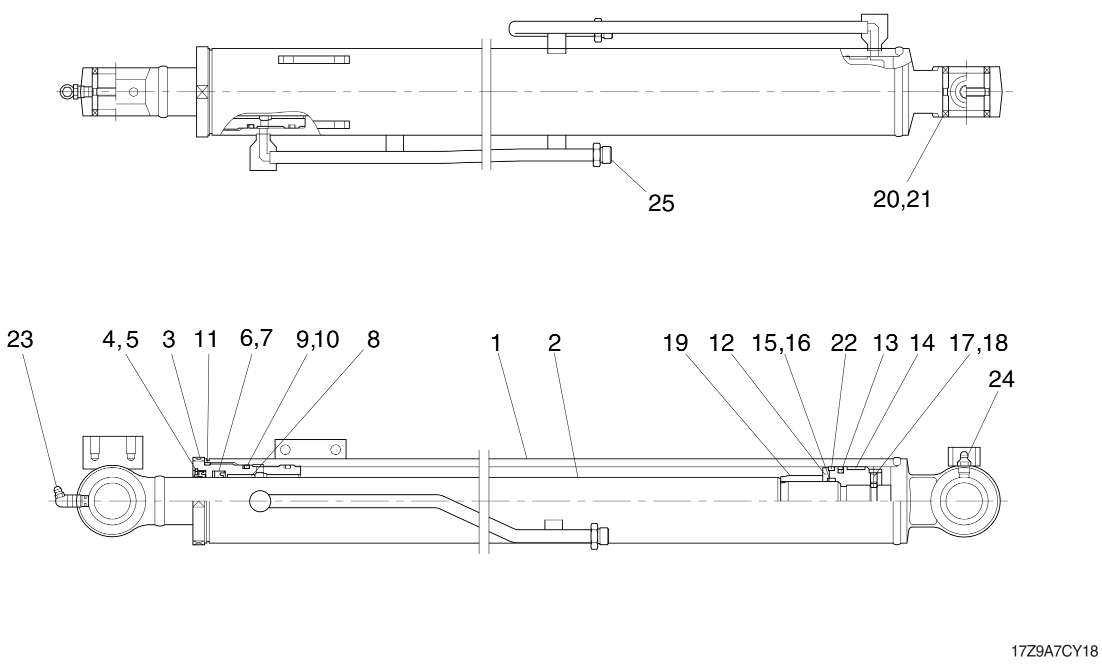
1	Tube assembly	9	O-ring	17	O-ring
2	Rod assembly	10	Back-up ring	18	Back up ring
3	Gland	11	O-ring	19	Pin bushing
4	Dust wiper	12	Piston	20	Pin bushing
5	Retaining ring	13	Piston seal	21	Dust seal
6	Bushing	14	Wear ring	22	Dust ring
7	Rod seal	15	Set screw	23	Grease nipple
8	Back-up ring	16	Steel ball	24	O-ring

(2) Arm cylinder



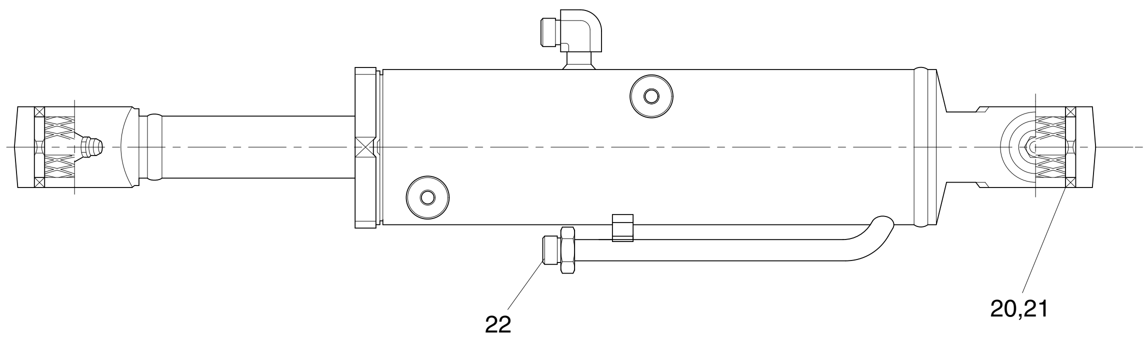
1	Tube assembly	11	O-ring	21	Check valve
2	Rod assembly	12	Piston	22	Spring
3	Gland	13	Piston seal	23	Plug
4	Dust wiper	14	Wear ring	24	O-ring
5	Retaining ring	15	Dust ring	25	Pin bushing
6	Rod seal	16	O-ring	26	Dust seal
7	Back-up ring	17	Back up ring	27	O-ring
8	Bushing	18	Steel ball	28	O-ring
9	O-ring	19	Set screw	29	Grease nipple
10	Back-up ring	20	Cushion ring		

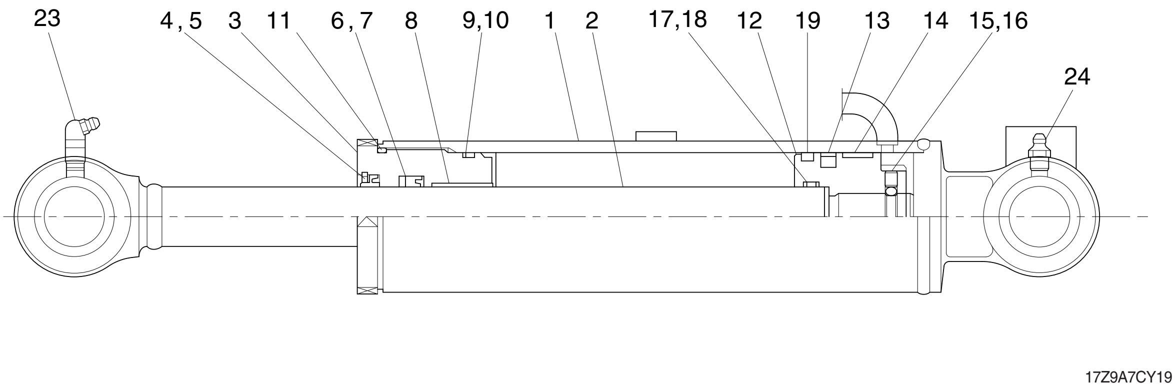
(3) Boom cylinder



1	Tube assembly	10	Back-up ring	19	Cushion ring
2	Rod assembly	11	O-ring	20	Pin bushing
3	Gland	12	Piston	21	Dust seal
4	Dust wiper	13	Piston seal	22	Dust ring
5	Retaining ring	14	Wear ring	23	Grease nipple
6	Rod seal	15	O-ring	24	Grease nipple
7	Back-up ring	16	Back up ring	25	O-ring
8	Bushing	17	Set screw		
9	O-ring	18	Steel ball		

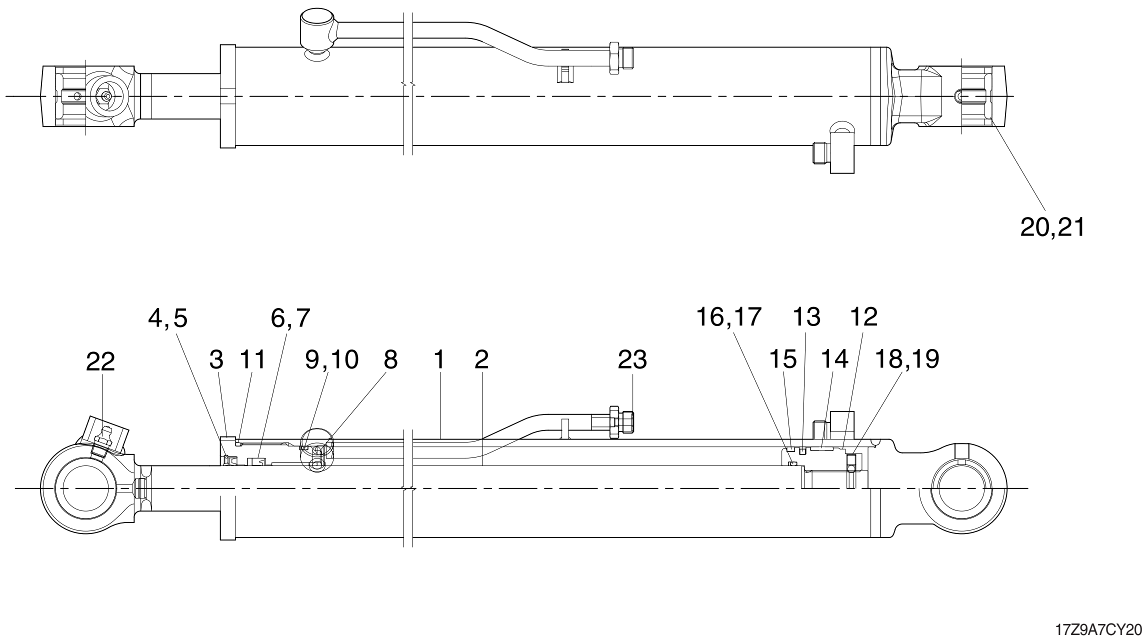
(4) Dozer cylinder





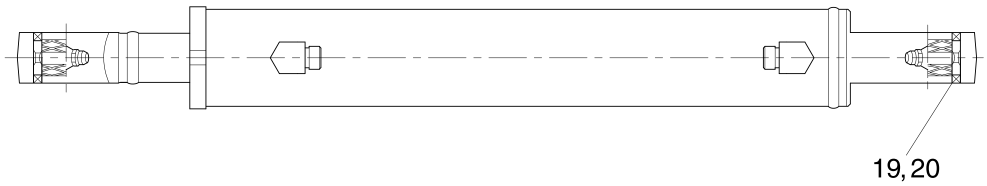
1	Tube assembly	9	O-ring	17	O-ring
2	Rod assembly	10	Back-up ring	18	Back-up ring
3	Gland	11	O-ring	19	Dust ring
4	Dust wiper	12	Piston	20	Bushing
5	Retaining ring	13	Piston seal	21	Dust seal
6	Rod seal	14	Wear ring	22	O-ring
7	Back-up ring	15	Set screw	23	Grease nipple
8	DU bushing	16	Steel ball	24	Grease nipple

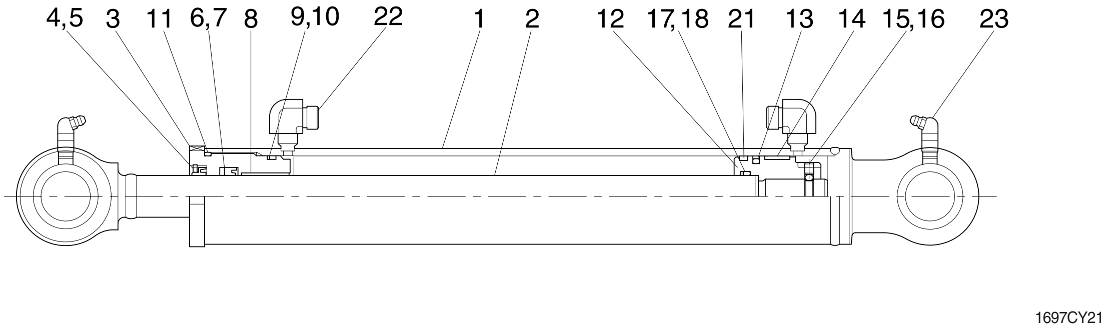
(5) Boom swing cylinder



1	Tube assembly	9	O-ring	17	Back up ring
2	Rod assembly	10	Back-up ring	18	Set screw
3	Gland	11	O-ring	19	Steel ball
4	Dust wiper	12	Piston	20	Pin bushing
5	Retaining ring	13	Piston seal	21	Dust seal
6	Rod seal	14	Wear ring	22	Grease nipple
7	Back-up ring	15	Dust ring	23	O-ring
8	DU bushing	16	O-ring		

(6) Extension cylinder

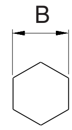




1	Tube assembly	9	O-ring	17	O-ring
2	Rod assembly	10	Back-up ring	18	Back-up ring
3	Gland	11	O-ring	19	Pin bushing
4	Dust wiper	12	Piston	20	Dust seal
5	Retaining ring	13	Piston seal	21	Dust ring
6	Rod seal	14	Wear ring	22	O-ring
7	Back-up ring	15	Set screw	23	Grease nipple
8	DU bushing	16	Steel ball		

2) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Allen wrench	8	
	3	
Spanner	M22	
Hook spanner	Suitable size (80~120 mm)	
(-) 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
Gland	Boom cylinder	3	M65	52±5.0	376±36.2
	Arm cylinder	3	M65	52±5.0	376±36.2
	Bucket cylinder	3	M60	48±5.0	347±36.2
	Dozer cylinder	3	M70	56±5.0	405±36.2
	Boom swing cylinder	3	M60	48±4.8	347±34.7
	Extension cylinder	3	M60	48±4.8	347±34.7
Piston	Boom cylinder	12	M28	70±7.0	506±50.6
	Arm cylinder	12	M28	70±7.0	506±50.6
	Bucket cylinder	12	M24	60±6.0	434±43.4
	Dozer cylinder	12	M24	60±6.0	434±43.4
	Boom swing cylinder	12	M24	60±6.0	434±43.4
	Extension cylinder	12	M24	60±6.0	434±43.4
Set screw	Boom cylinder	17	M6	2±0.2	14.5±1.45
	Arm cylinder	19	M6	2±0.2	14.5±1.45
	Bucket cylinder	15	M6	2±0.2	14.5±1.45
	Dozer cylinder	15	M6	2±0.2	14.5±1.45
	Boom swing cylinder	18	M6	2±0.2	14.5±1.45
	Extension cylinder	15	M6	2±0.2	14.5±1.45

3) DISASSEMBLY

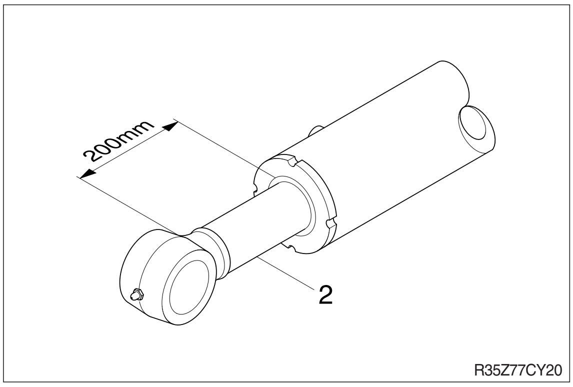
※ Procedures are based on the boom cylinder.

(1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

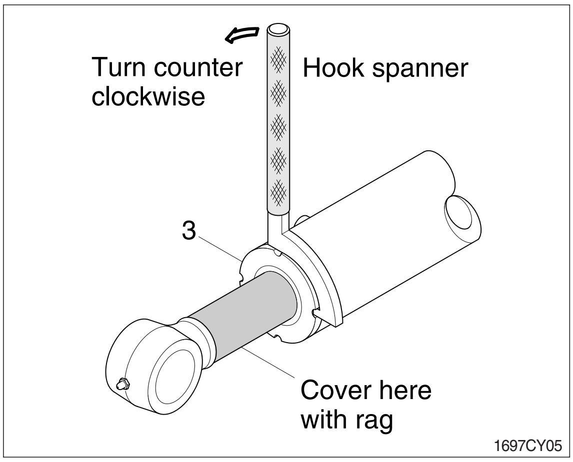
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out rod assembly (2) about 200 ㎜ (7.1 in). Because the rod assembly is rather heavy, finish extending it with air pressure after the oil draining operation.



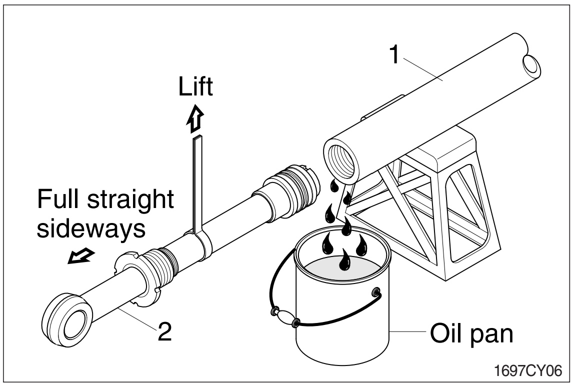
③ Loosen and remove the gland (3) by hook spanner.

※ Cover the extracted rod assembly (2) with rag to prevent it from being accidentally damaged during operation.



④ Draw out cylinder head and rod assembly together from tube assembly (1).

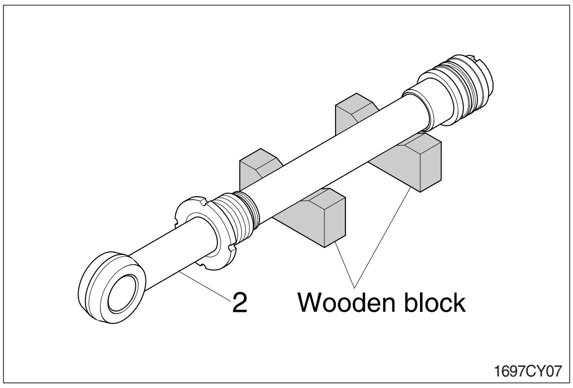
※ Since the rod assembly is heavy in this case, lift the tip of the rod assembly (2) with a crane or some means and draw it out. However, when rod assembly (2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



Note that the plated surface of rod assembly (2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

⑤ Place the removed rod assembly (2) on a wooden V-block that is set level.

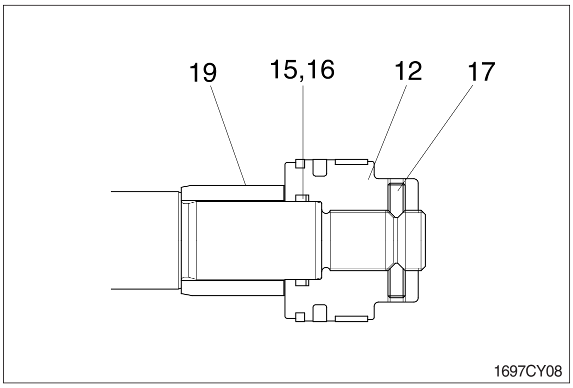
※ Cover a V-block with soft rag.



(2) Remove piston and gland

① Remove set screw (17).

② Remove piston assembly (12), back up ring (16), O-ring (15) and cushion ring (19).

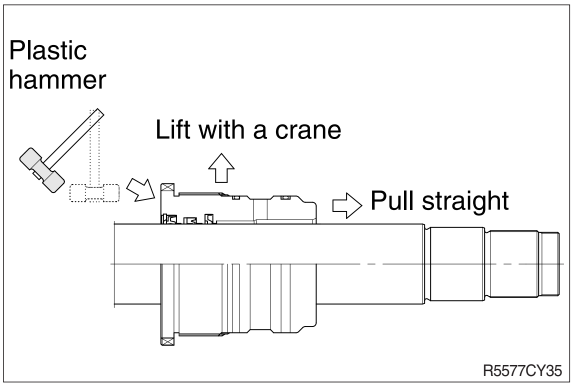


④ Remove the gland assembly from rod assembly (2).

※ If it is too heavy to move, move it by striking the flanged part of gland with a plastic hammer.

※ Pull it straight with gland assembly lifted with a crane.

Exercise care so as not to damage the lip of packing (7, 8, 9, 10, 11) by the threads of rod assembly (2).

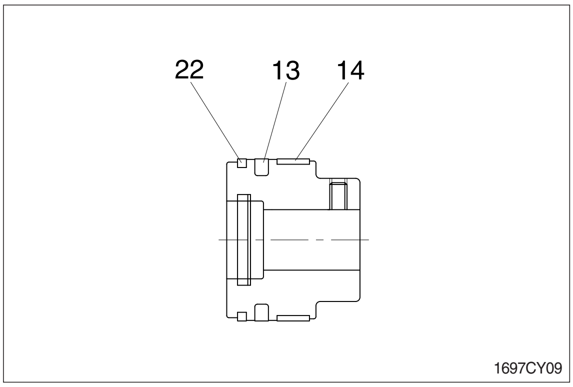


(3) Disassemble the piston assembly

① Remove wear ring (14).

② Remove dust ring (22) and piston seal (13).

※ Exercise care in this operation not to damage the grooves.



(4) Disassemble gland assembly

① Remove back-up ring (10) and O-ring (9).

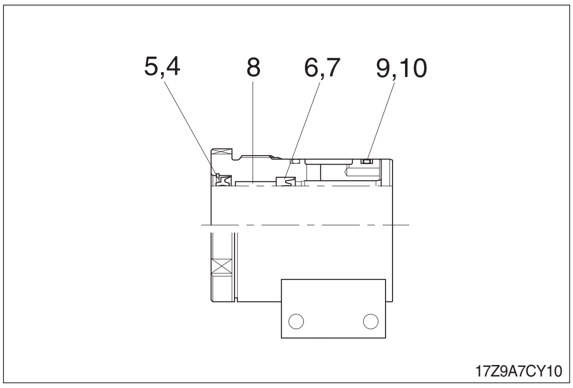
② Remove retaining ring (5), dust wiper (4).

③ Remove back up ring (7), rod seal (6).

④ Remove the dry bushing (8).

※ Exercise care in this operation not to damage the grooves.

※ Do not remove seal and ring, if does not damaged.

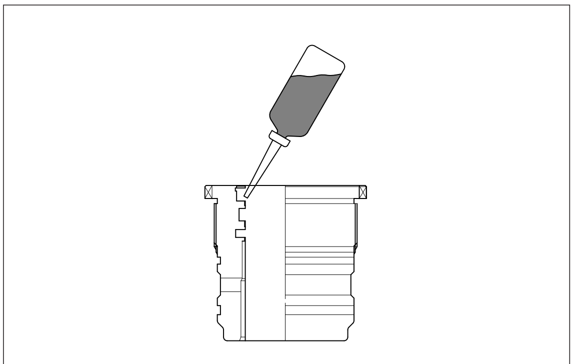


4) ASSEMBLY

(1) Assemble cylinder head assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

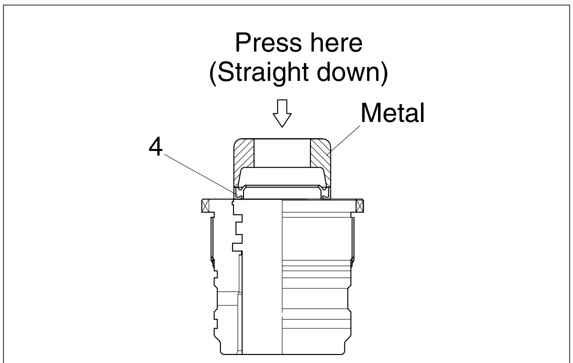
① Coat the inner face of gland (3) with hydraulic oil.



R5577CY38

② Coat dust wiper (4) with grease and fit dust wiper (4) to the bottom of the hole of dust seal.
At this time, press a pad metal to the metal ring of dust seal.

③ Fit retain ring (5) to the stop face.

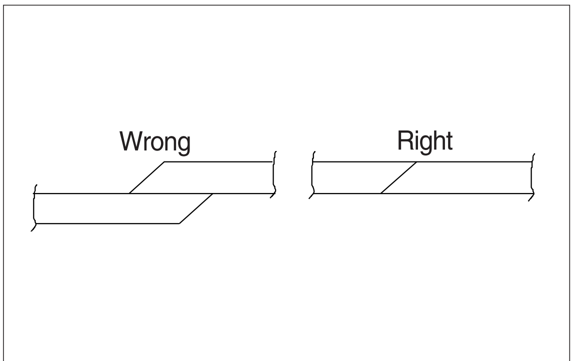


1697CY11

④ Fit back up ring (7), rod seal (6) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

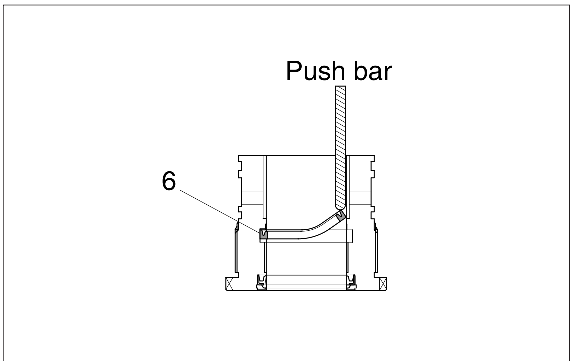
※ Insert the backup ring until one side of it is inserted into groove.



8-157(3) 210-7

※ 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.

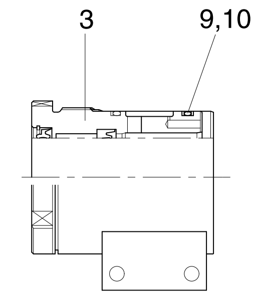


17Z9A7CY35

⑤ Fit back up ring (10) to gland (3).

※ Put the backup ring in the warm water of 30~50°C .

⑥ Fit O-ring (9) to gland (3).

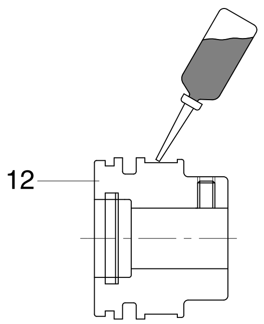


1697CY12

(2) Assemble piston assembly

※ Check for scratches or rough surfaces. If found smooth with an oil stone.

① Coat the outer face of piston (12) with hydraulic oil.

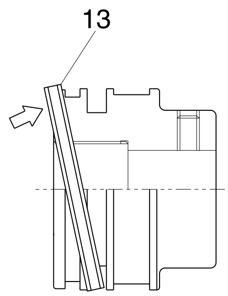


1697CY13

② Fit piston seal (13) to piston.

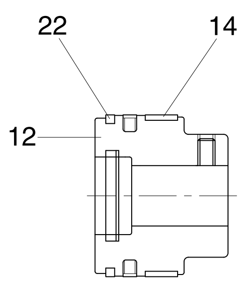
※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.

※ After assembling the piston seal, press its outer diameter to fit in.



1697CY14

③ Fit wear ring (14) and dust ring (22) to piston (12).



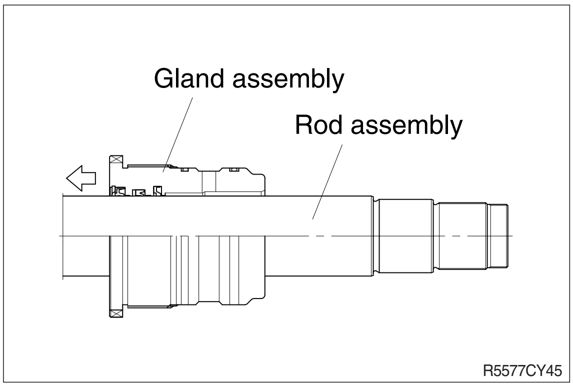
1697CY15

(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 gland.

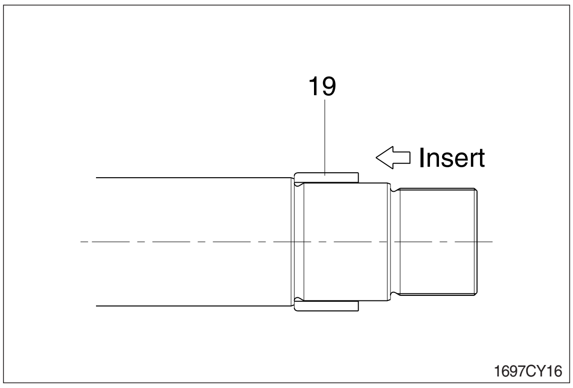
③ Insert gland assembly to rod assembly.



R5577CY45

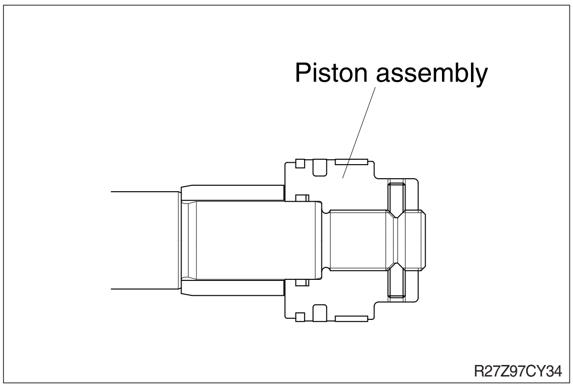
④ Insert cushion ring (19) to rod assembly.

※ Note that cushion ring (19) has a direction in which it should be fitted.



1697CY16

⑤ Fit piston assembly to rod assembly.

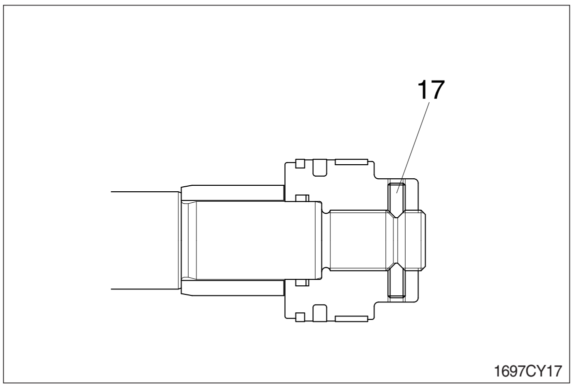


R27Z97CY34

⑥ Fit set screw (17).

· Tightening torque :

2 ± 0.2 kgf · m (14.5 ± 1.45 lbf · ft)



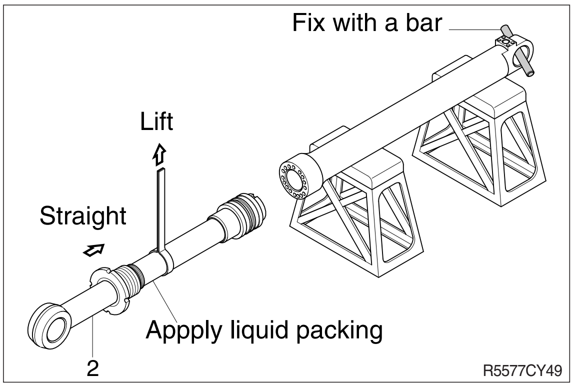
1697CY17

(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.

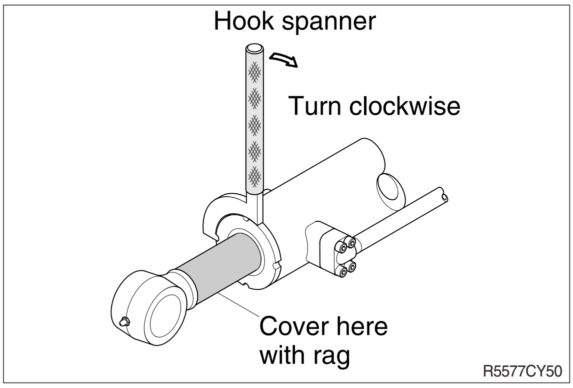
② Insert the rod assembly in to the tube assembly, while lifting and moving the rod assembly (2) with a crane.

※ Be careful not to damage piston seal (13) by thread of tube assembly (1).



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.



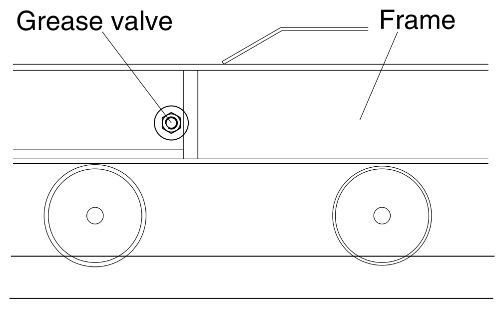
GROUP 10 UNDERCARRIAGE

1. RUBBER TRACK

1) REMOVAL

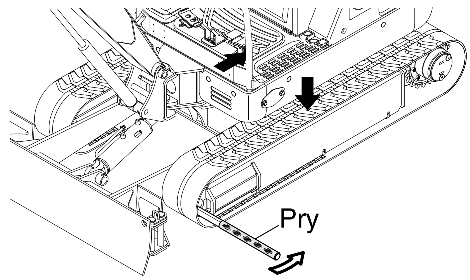
(1) Loosen tension of the rubber track.

※ If track tension is not relieved when the grease valve is loosened, move the machine backwards and forwards.



1697UC01

(2) Remove the rubber track from lower frame using pry.

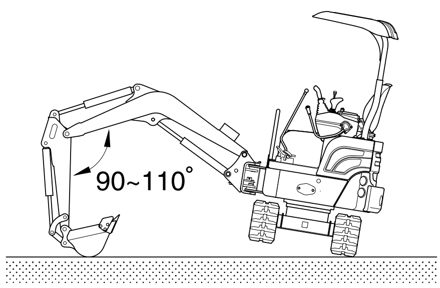


1697UC02

2) INSTALL

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

※ Adjust the tension of the rubber track.

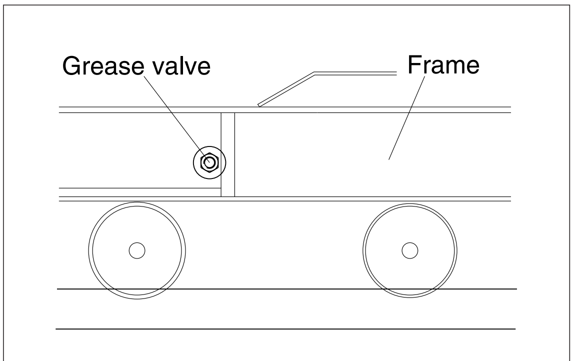


17Z9A7UC03

2. TRACK ROLLER

1) REMOVAL

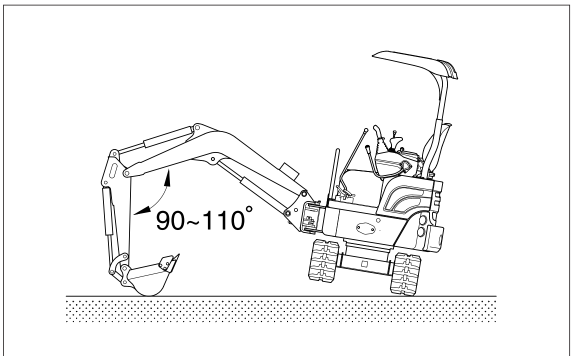
(1) Loosen tension of the rubber track.



1697UC01

(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.

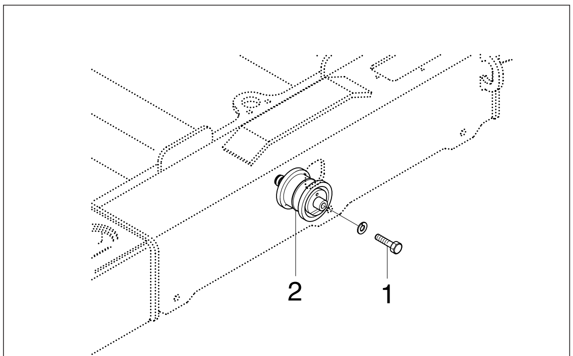


17Z9A7UC03

(3) Remove the mounting bolt (1) and draw out the track roller (2).

· Weight : 3 kg (7 lb)

· Tightening torque : 12.3±1.2 kgf · m (89±8.7 lbf · ft)



17Z9A7UC04

2) INSTALL

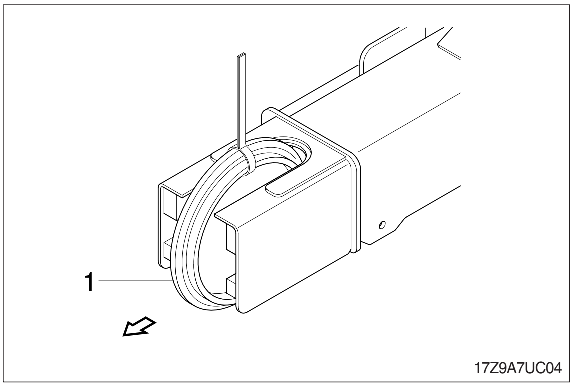
(1) Carry out installation in the reverse order to removal.

3. IDLER AND RECOIL SPRING

1) REMOVAL

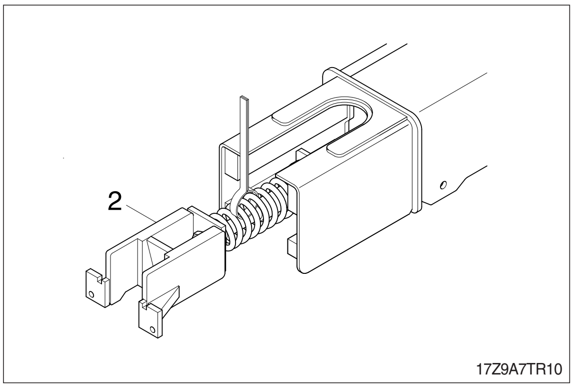
(1) Remove the track link.
For detail, see removal of track link.

(2) Sling the idler (1) and pull out idler and recoil spring assembly from track frame, using a pry.
- Weight : 15 kg (33 lb)



17Z9A7UC04

(3) Pull out yoke and spring weld assembly from track frame, using a pry.
- Weight : 11 kg (24 lb)

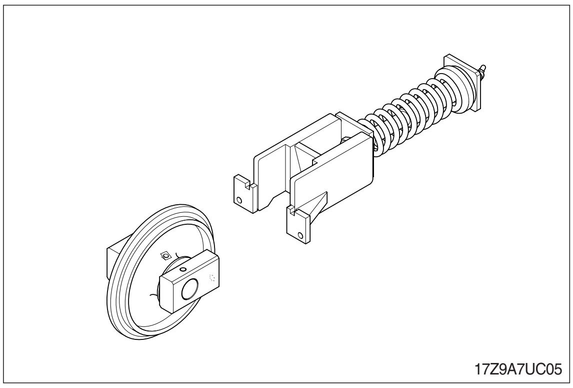


17Z9A7TR10

2) INSTALL

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

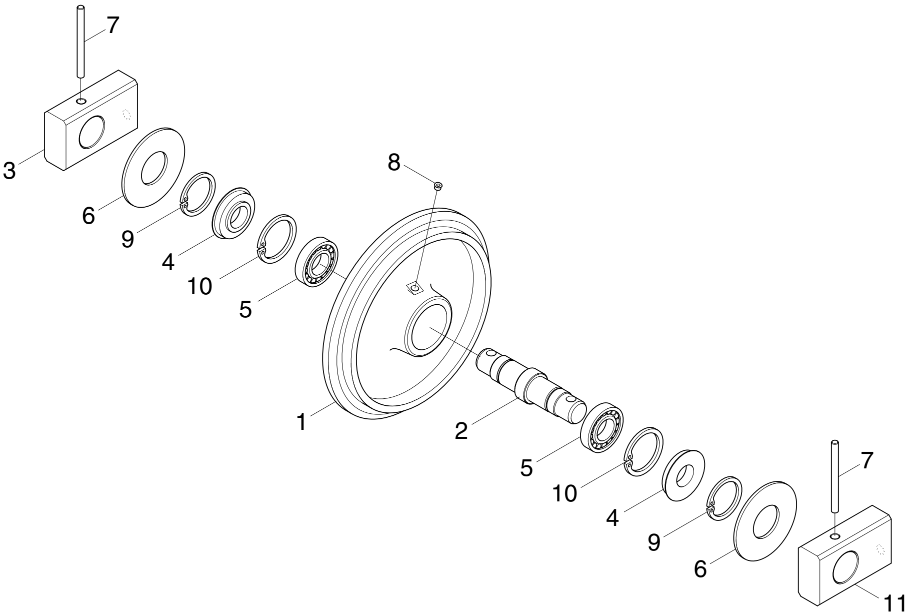
※ Make sure that the boss on the end face of the recoil cylinder rod is in the hole of the track frame.



17Z9A7UC05

3) DISASSEMBLY AND ASSEMBLY OF IDLER

(1) Structure



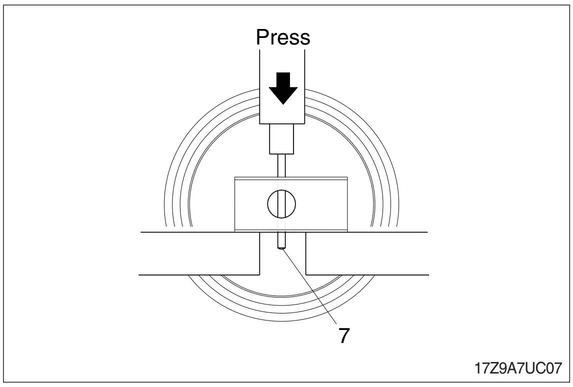
17Z9A7UC06

1	Shell	5	Ball bearing	9	Snap ring
2	Shaft	6	Plate	10	Snap ring
3	Collar-LH	7	Spring pin	11	Collar-RH
4	Oil seal	8	Plug		

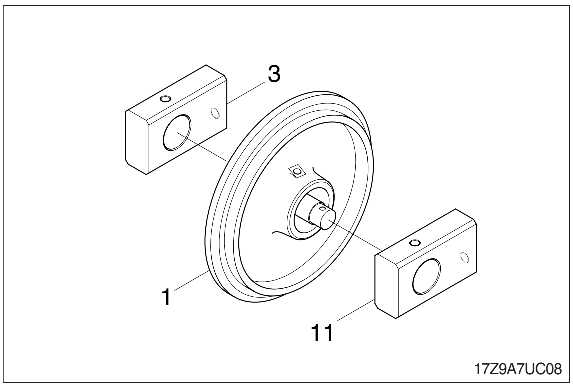
(2) Disassembly

① Remove plug and drain oil.

② Draw out the spring pin (7), using a press.



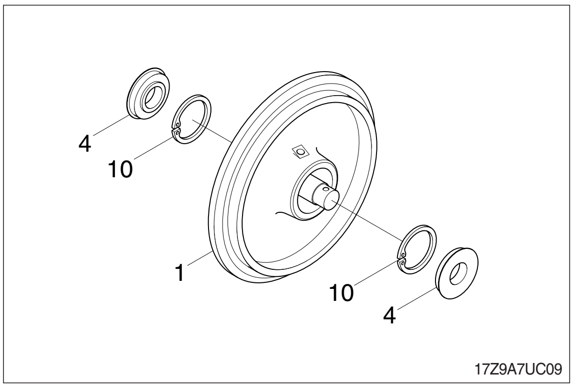
③ Remove collar (3, 11) from shaft.



④ Remove seal assembly (4) from shell (1) by pry.

※ Do not reuse seal assembly after removal.

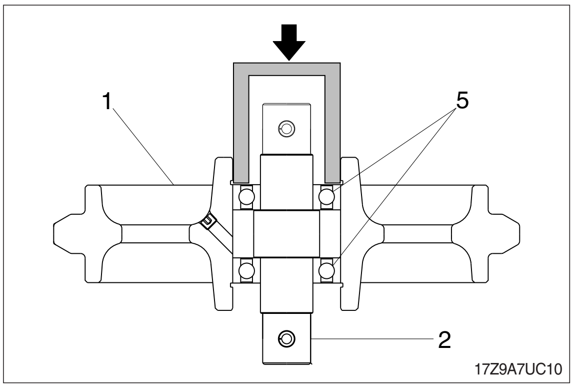
⑤ Remove snap ring (10) from shell (1)



⑥ Draw out the ball bearing (5) with shaft (2) using press.

⑦ Remove the ball bearing (5) from shaft, using a special tool.

※ Only remove ball bearing if replacement is necessity.

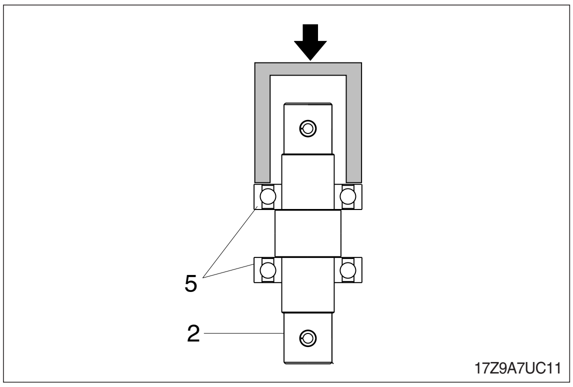


(3) Assembly

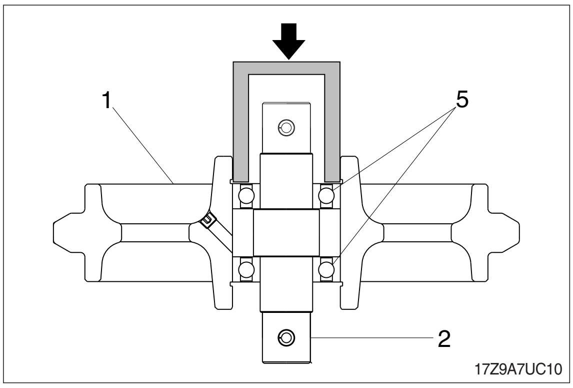
※ Before assembly, clean the parts.

※ Coat the sliding surfaces of all parts with oil.

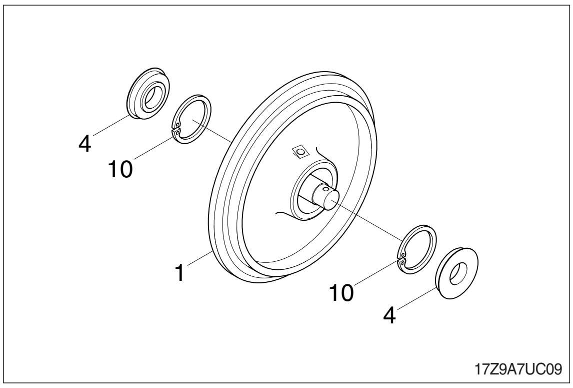
① Do not press it at the normal temperature, assemble ball bearing (5) to shaft (2) by press.



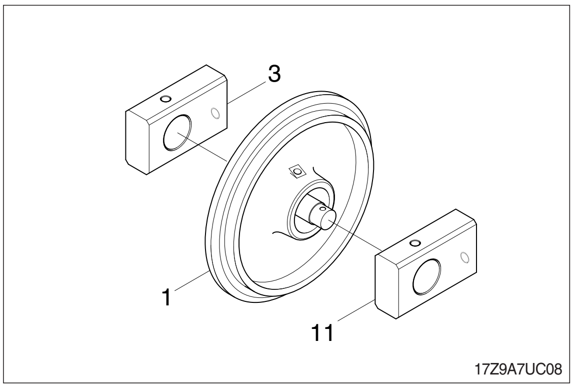
② Insert shaft (2) with ball bearing (5) assembly to shell (1).



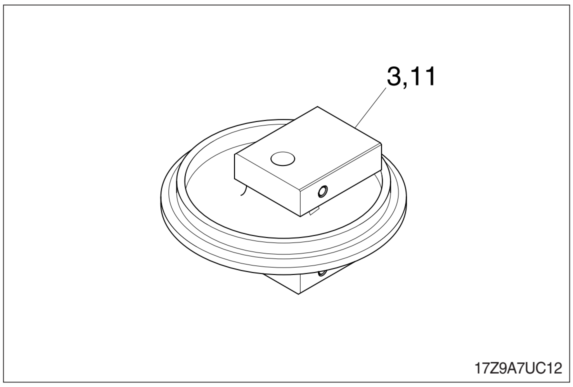
③ Assembly snap ring (10) and seal assembly (4).



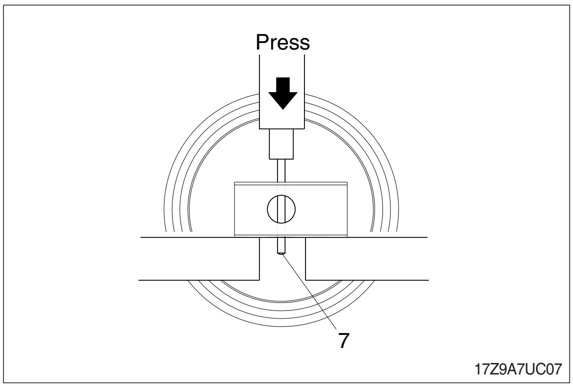
④ Assemble collar (3, 11) to shell (1).



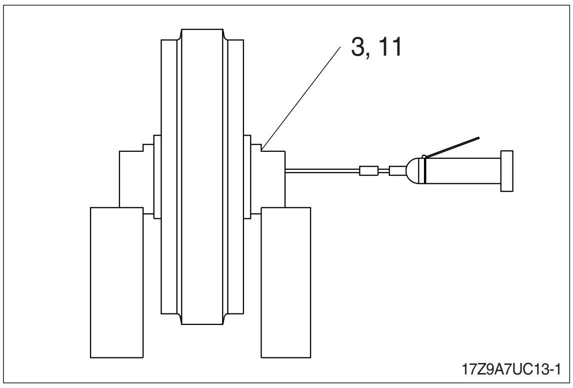
⑤ Install collar (3, 11) attached with seal (4).



⑥ Knock in the spring pin (7) with a hammer.

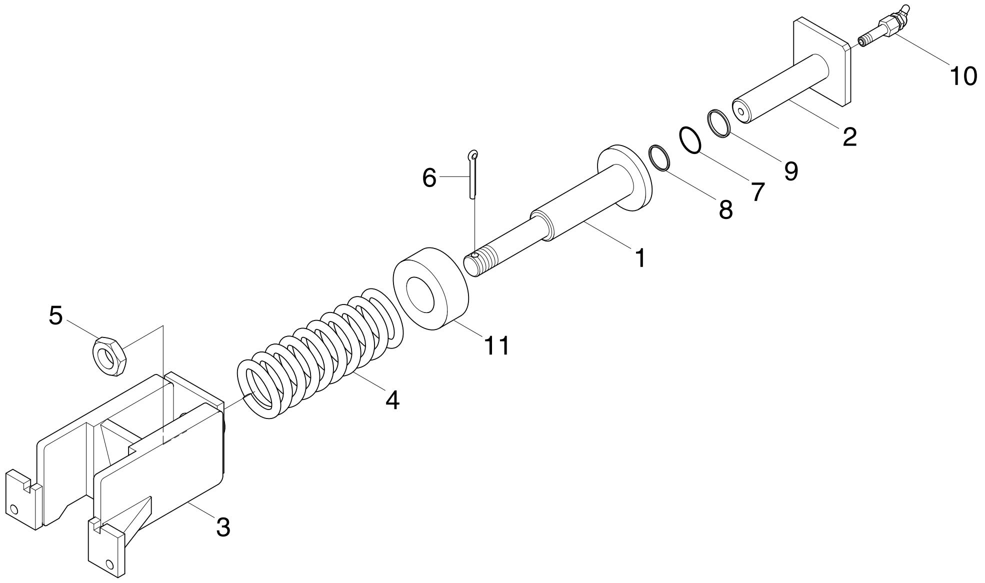


⑦ Lay collar (3, 11) on its side.
Supply engine oil to the specified level, and tighten plug.



4) DISASSEMBLY AND ASSEMBLY OF RECOIL SPRING

(1) Structure



1	Cylinder	5	Castle nut	9	Packing
2	Piston rod	6	Split pin	10	Valve assy
3	Bracket	7	O-ring	11	Spacer
4	Spring	8	Back-up ring		

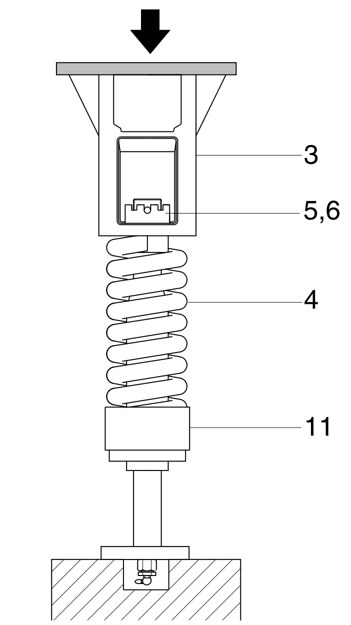
(2) Disassembly

① Apply pressure on bracket (3) with a press.
The spring is under a large installed load. This is dangerous, so be sure to set properly.
· Spring set load : 1785 ㎏ (3940 ℔)

※ Remove split pin (6) and nut (5).

② Take enough notice so that the press which pushes down the spring, should not be slipped out in its operation.

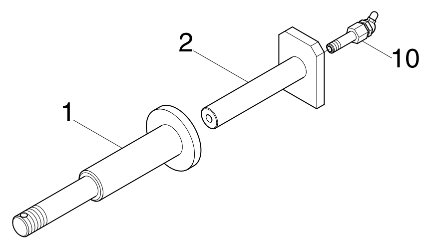
③ Lighten the press load slowly and remove bracket (6) and spring (4).



17Z9A7UC17

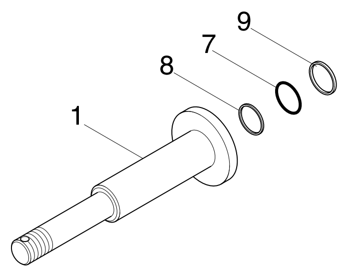
⑤ Remove piston rod (2) from cylinder (1).

⑥ Remove grease valve (10) from piston rod (1).



1697UC14

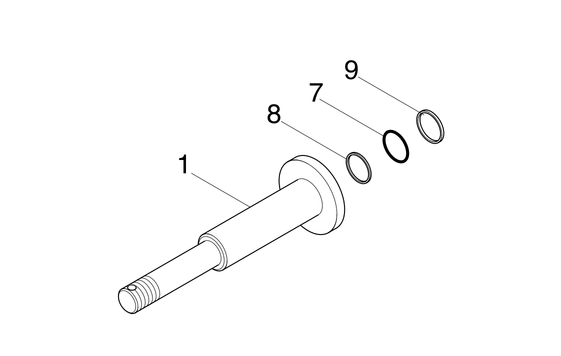
⑦ Remove packing (9), back-up ring (8) and O-ring (7) from cylinder (1).



1697UC15

(3) Assembly

① Install O-ring (7), back-up ring (8), and packing (9) cylinder (1).



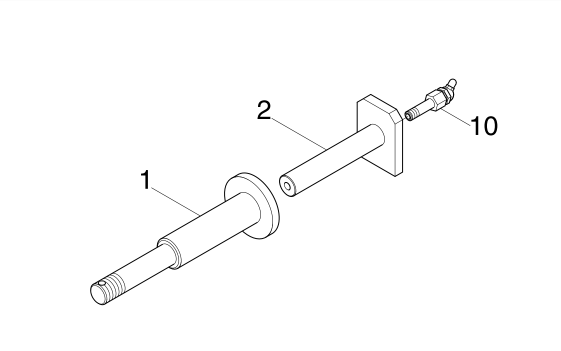
1697UC15

② Pour grease into cylinder (1), then push in piston rod (2) 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.

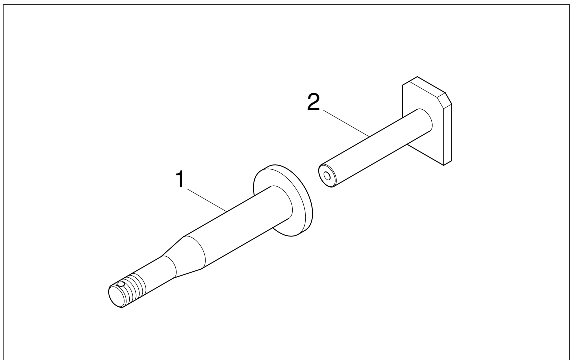
③ Fit grease valve (10) to piston rod (2).

· Tightening torque : 10±0.5 kgf · m (72.4±3. 6 lbf · ft)



1697UC14

④ Install piston rod (2) to cylinder (1).



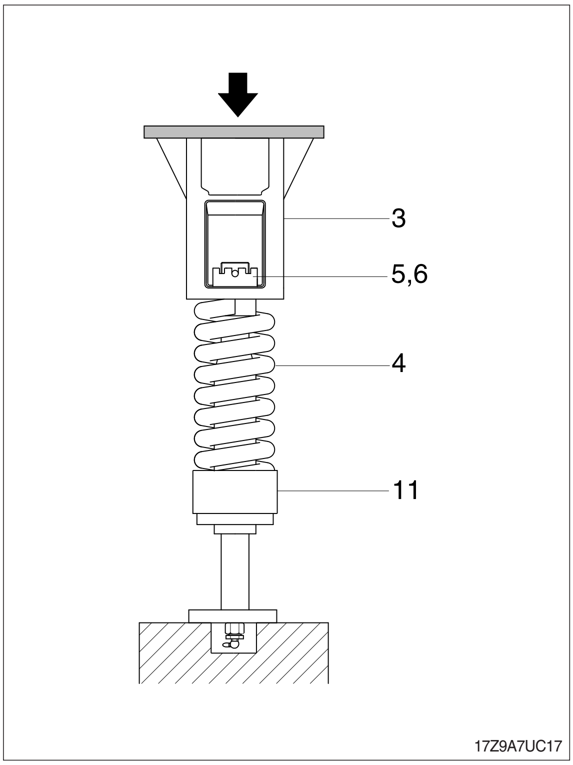
1697UC16

⑤ Install spring (4) and spacer (11) to cylinder (1).

⑥ Apply pressure to bracket (3) with a press and tighten nut (5).

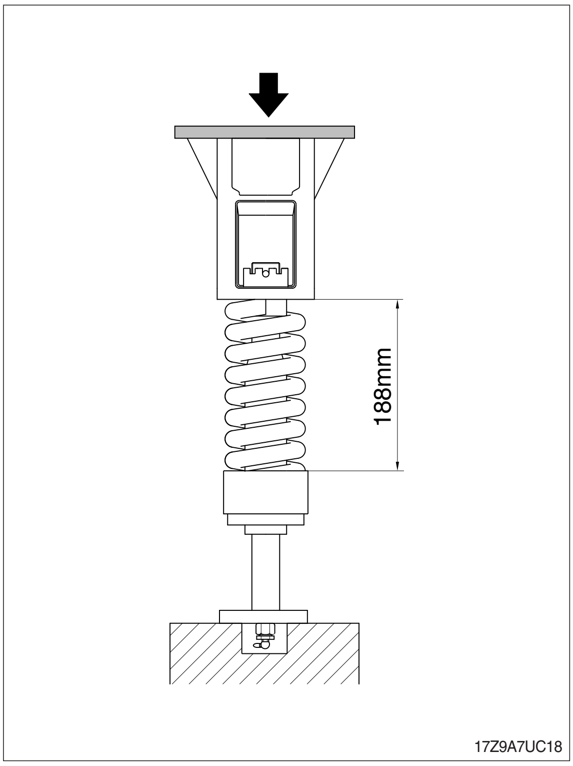
※ During the operation, pay attention specially to prevent the press from slipping out.

⑦ Tighten nut (5) and insert split pin (6).



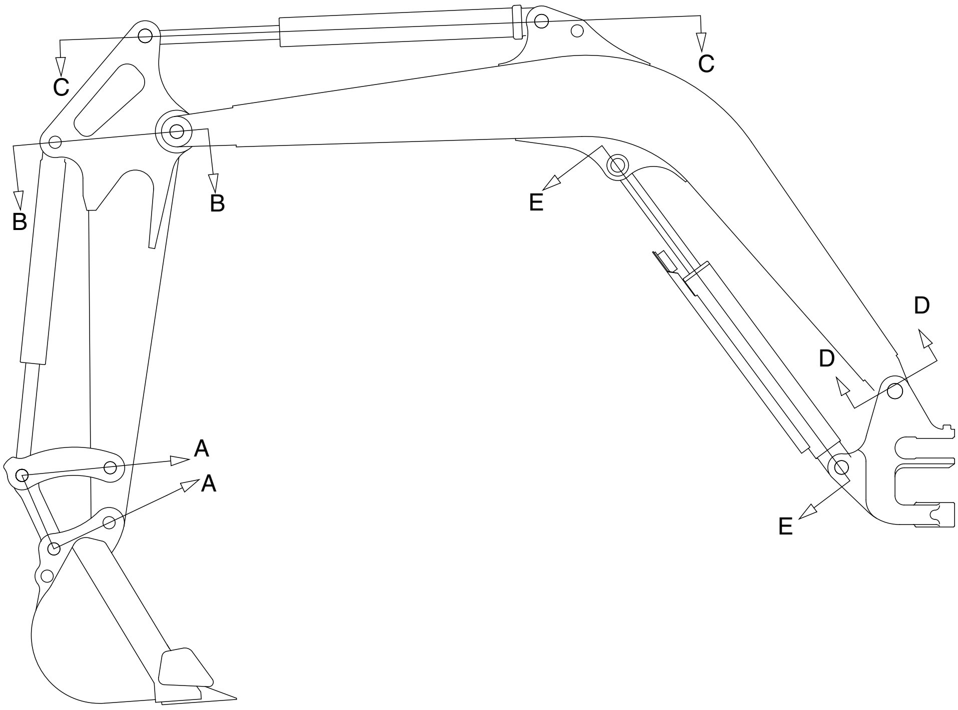
⑧ Lighten the press load and confirm the set length of spring (4).

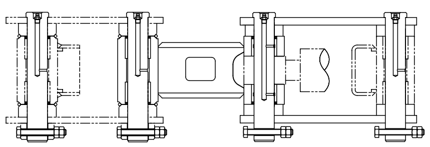
· Spring length : 188 mm (7.4")



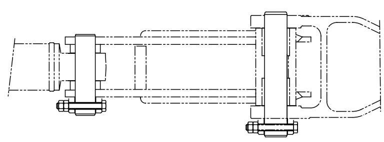
GROUP 11 WORK EQUIPMENT

1. STRUCTURE

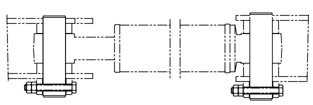




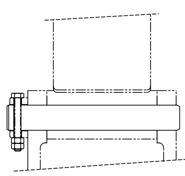
SECTION A-A



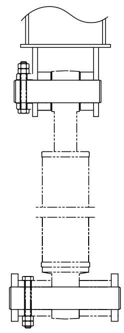
SECTION B-B



SECTION C-C



SECTION D-D



SECTION E-E

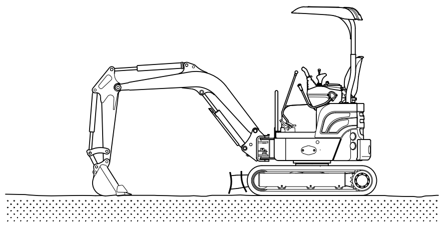
1697AT01

2. REMOVAL AND INSTALL

1) BUCKET ASSEMBLY

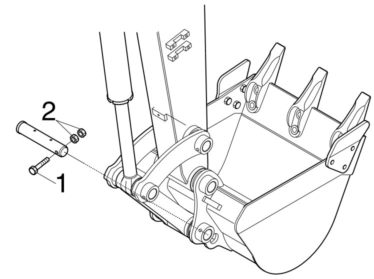
(1) Removal

① Lower the work equipment completely to ground with back of bucket facing down.



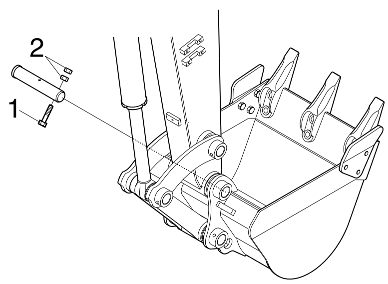
17Z9A7AT01

② Remove nut (1), bolt (2) and draw out the pin (4).



1697AT02

③ Remove nut (1), bolt (2) and draw out the pin (3) then remove the bucket assembly.
  · Weight : 40 ㎏ (90 ℔)



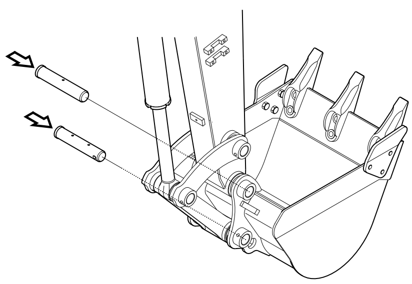
1697AT03

(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 operator's manual.



1697AT04

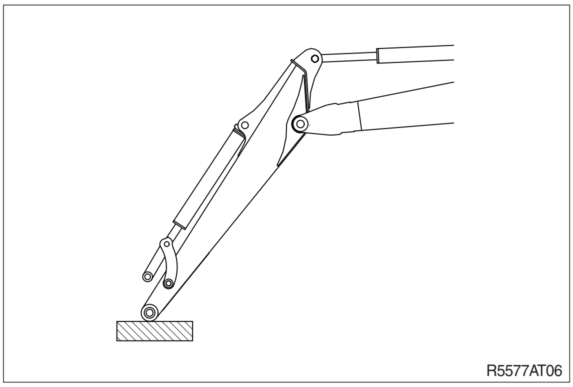
2) ARM ASSEMBLY

(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.

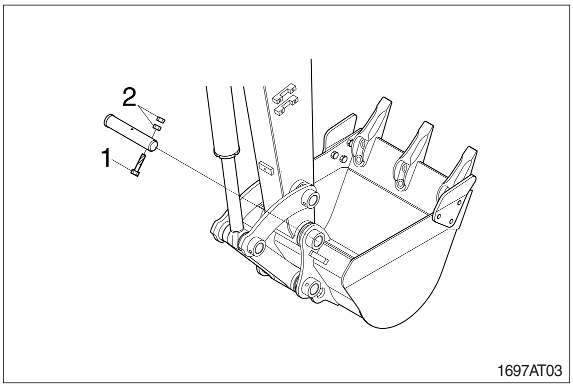


② Disconnect bucket cylinder hose (4).

⚠ **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.

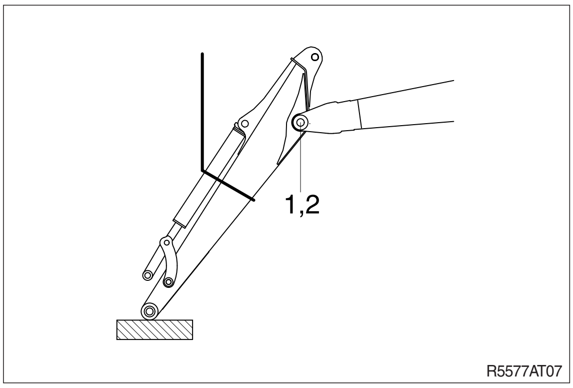


④ For details, see removal of arm cylinder assembly.
Place a wooden block under the cylinder and bring the cylinder down to it.

⑤ Remove bolt (1) and pull out the pin (2) then remove the arm assembly.

・Weight : 35 ㎏ (77 ℔)

※ When lifting the arm assembly, always lift the center of gravity.



(2) Install

① Carry out installation in the reverse order to removal.

⚠ **When lifting the arm assembly, always lift the center of gravity.**

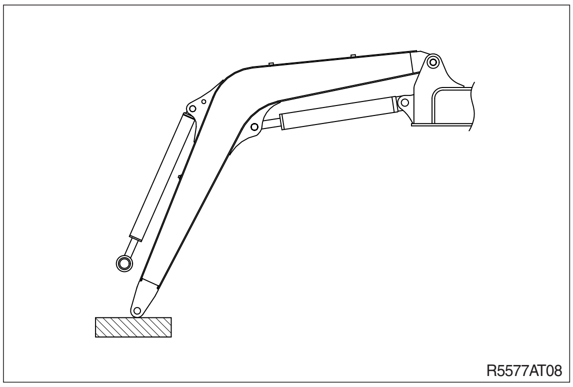
※ Bleed the air from the cylinder.

3) BOOM CYLINDER

(1) Removal

① Remove arm and bucket assembly.
For details, see removal of arm and bucket assembly.

② Remove boom cylinder assembly from boom.
For details, see removal of arm cylinder assembly.



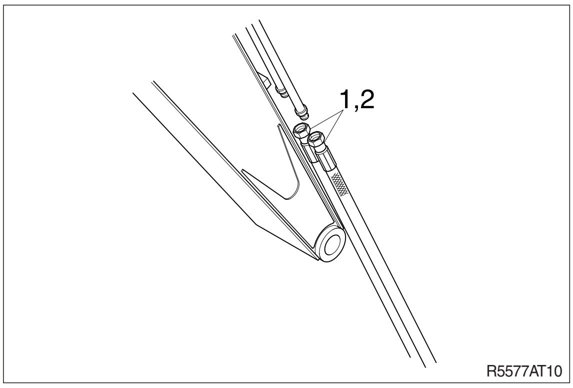
R5577AT08

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.

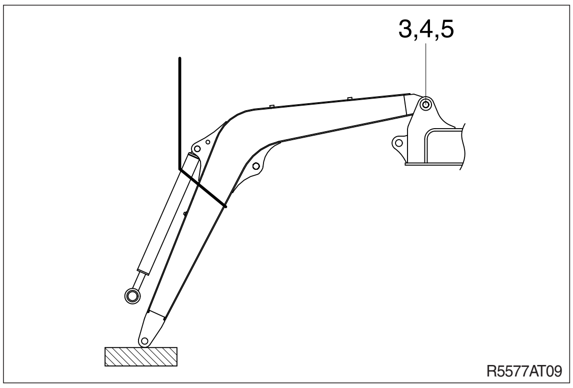
⑤ Sling boom assembly (3).



R5577AT10

⑥ Remove bolt (3), nut (4) and pull out the pin (5) then remove boom assembly.
· Weight : 70 ㎏ (154 ℔)

※ When lifting the boom assembly always lift the center of gravity.



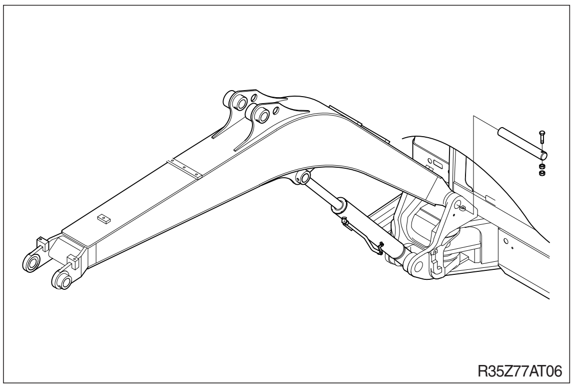
R5577AT09

(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.



R35Z77AT06

SECTION 8 COMPONENT MOUNTING TORQUE

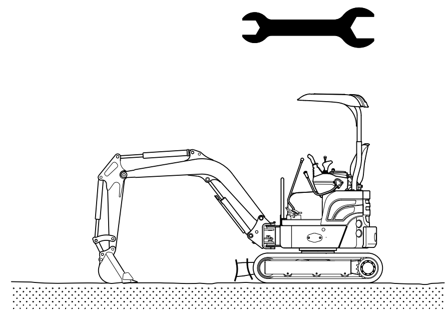
SECTION 8 COMPONENT MOUNTING TORQUE

GROUP 1 INTRODUCTION GUIDE

1. This section shows bolt specifications and standard torque values needed when mounting components to the machine.
2. Use genuine Hyundai spare parts.
   We expressly point out that Hyundai will not accept any responsibility for defects resulted from non-genuine parts.
   In such cases Hyundai cannot assume liability for any damage.

※ Only metric fasteners can be used and incorrect fasteners may result in machine damage or malfunction.

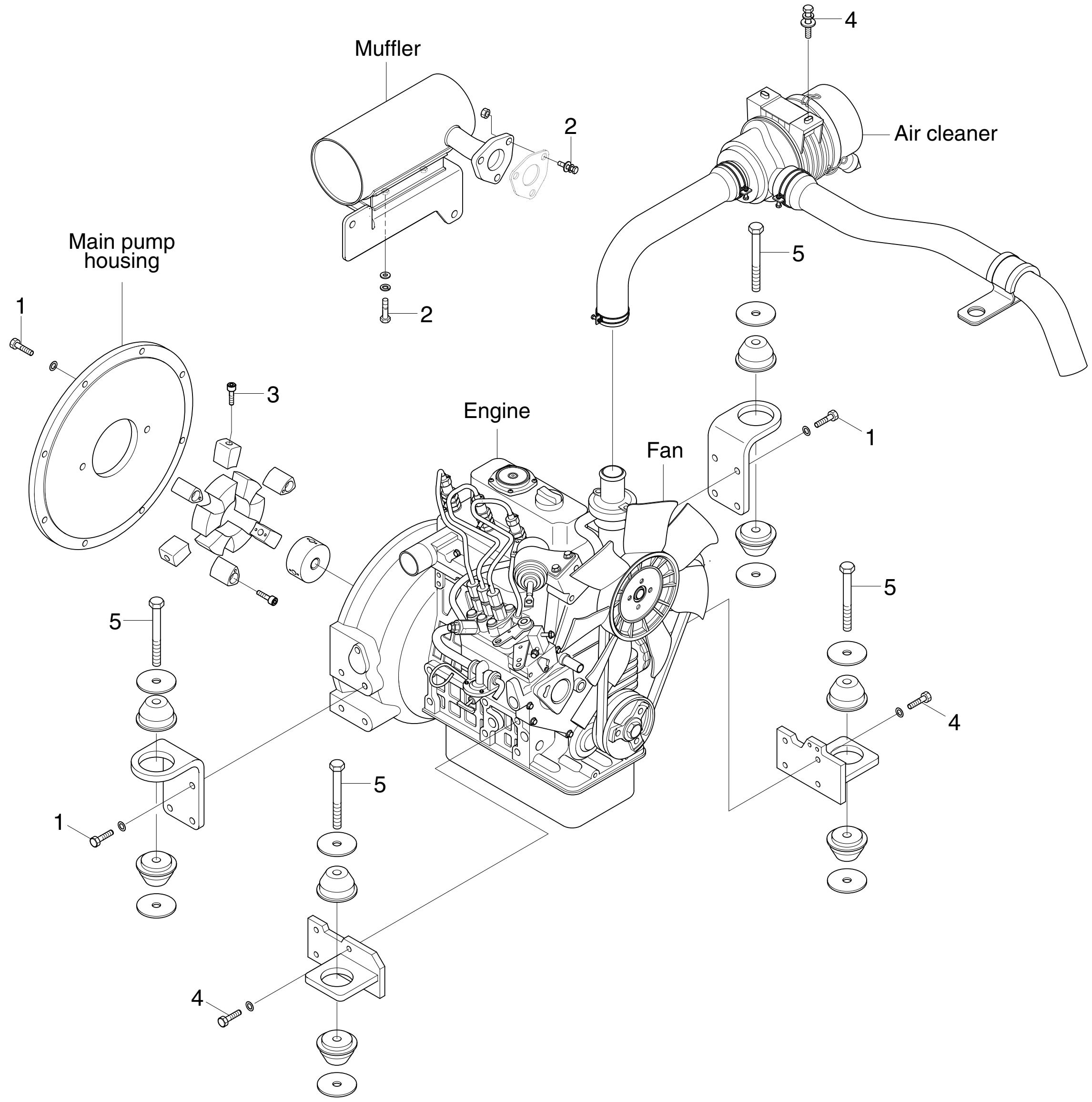
※ Before installation, clean all the components with a non-corrosive cleaner. Bolts and threads must not be worn or damaged.



17Z9A8CM30

GROUP 2 ENGINE SYSTEM

1. ENGINE AND ACCESSORIES MOUNTING



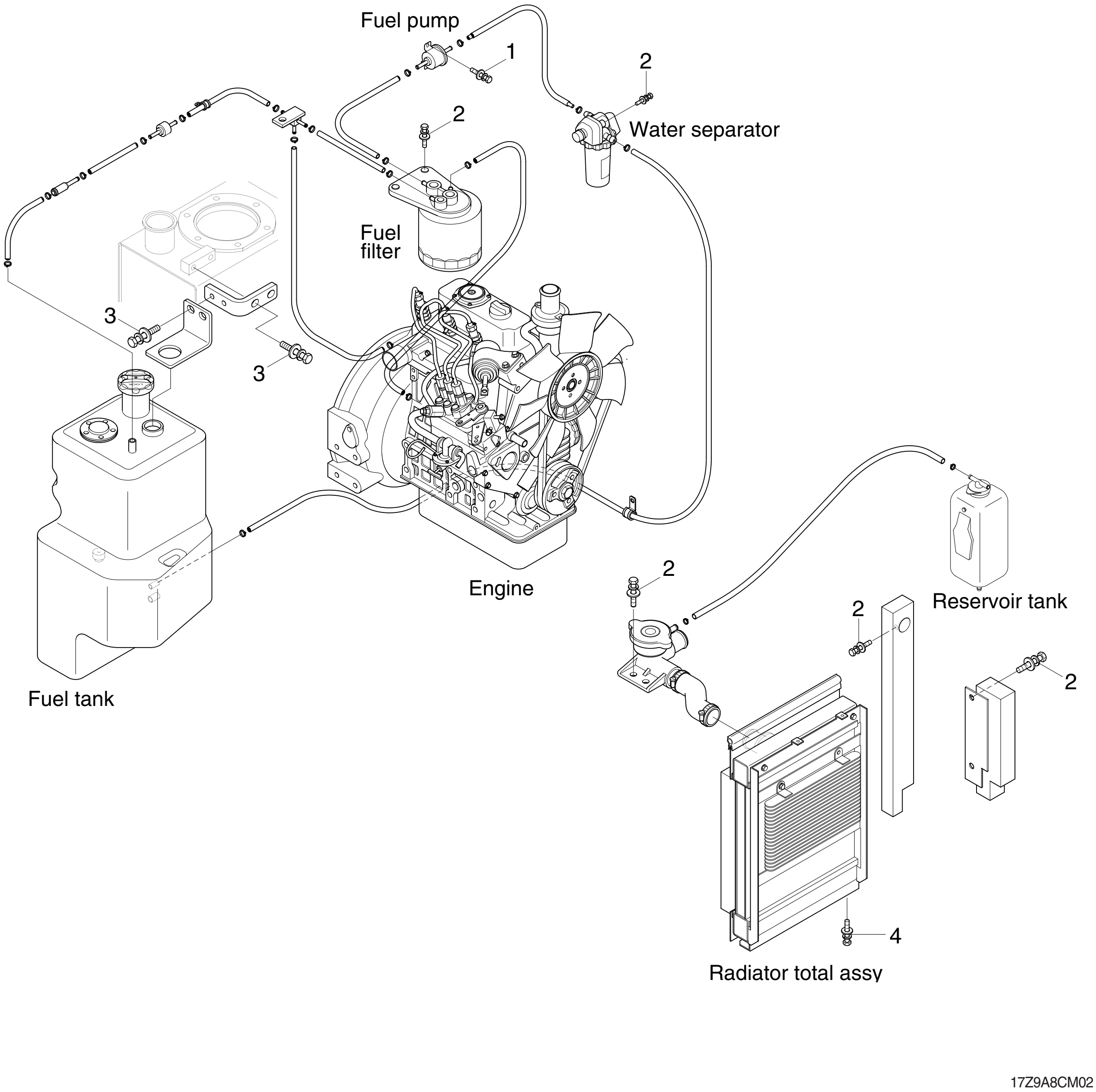
17Z9A8CM01

· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	5.2±0.3	37.6±2.2

Item	Size	kgf · m	lbf · ft
4	M10×1.25	7.4±1.5	53.5±11.0
5	M12×1.75	12.3±1.5	88.9±11.0

2. COOLING SYSTEM AND FUEL TANK MOUNTING



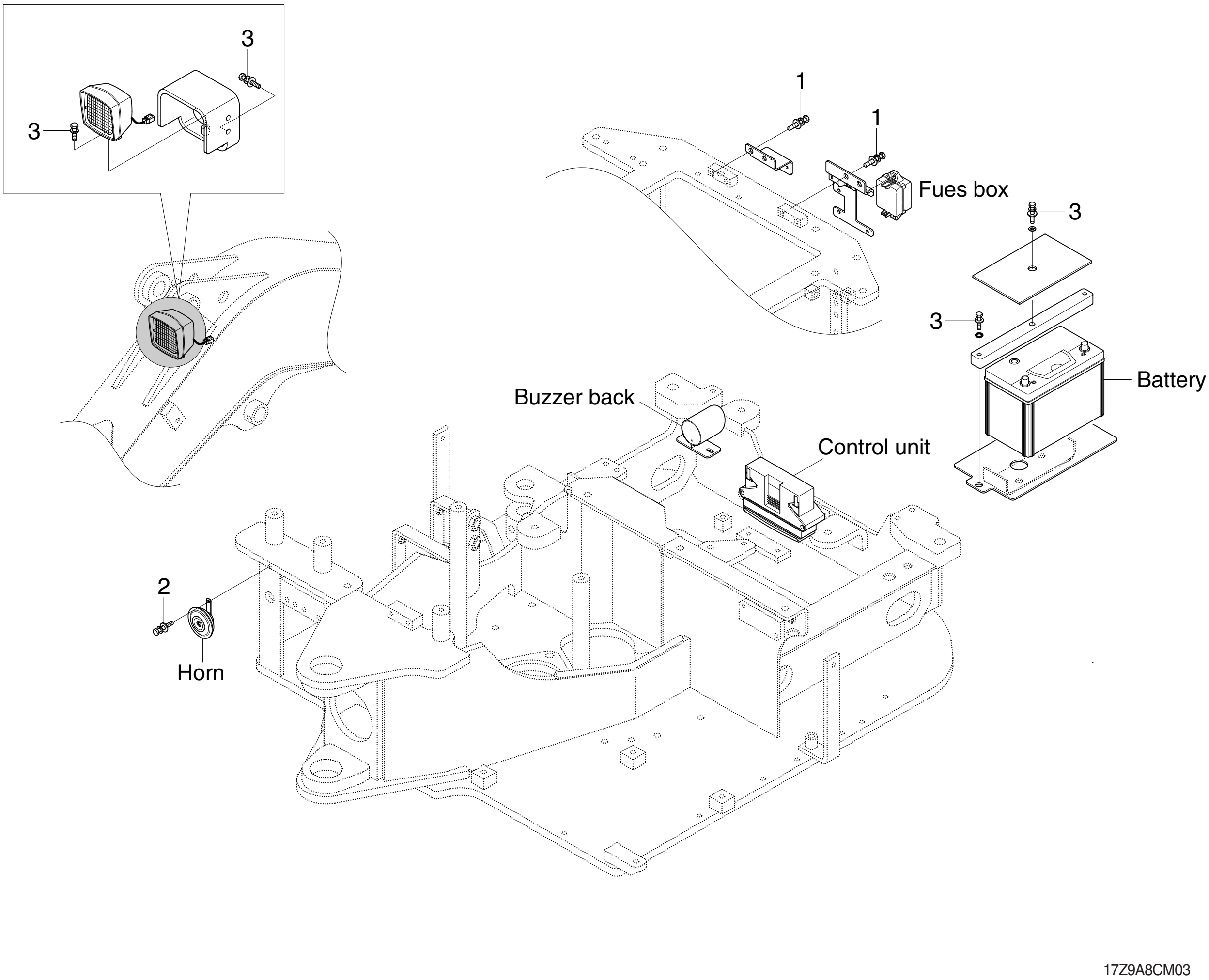
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M 10×1.5	6.9±1.4	49.9±10.1
4	M 12×1.75	12.8±3.0	92.6±21.7

GROUP 3 ELECTRIC SYSTEM

1. ELECTRIC COMPONENTS MOUNTING



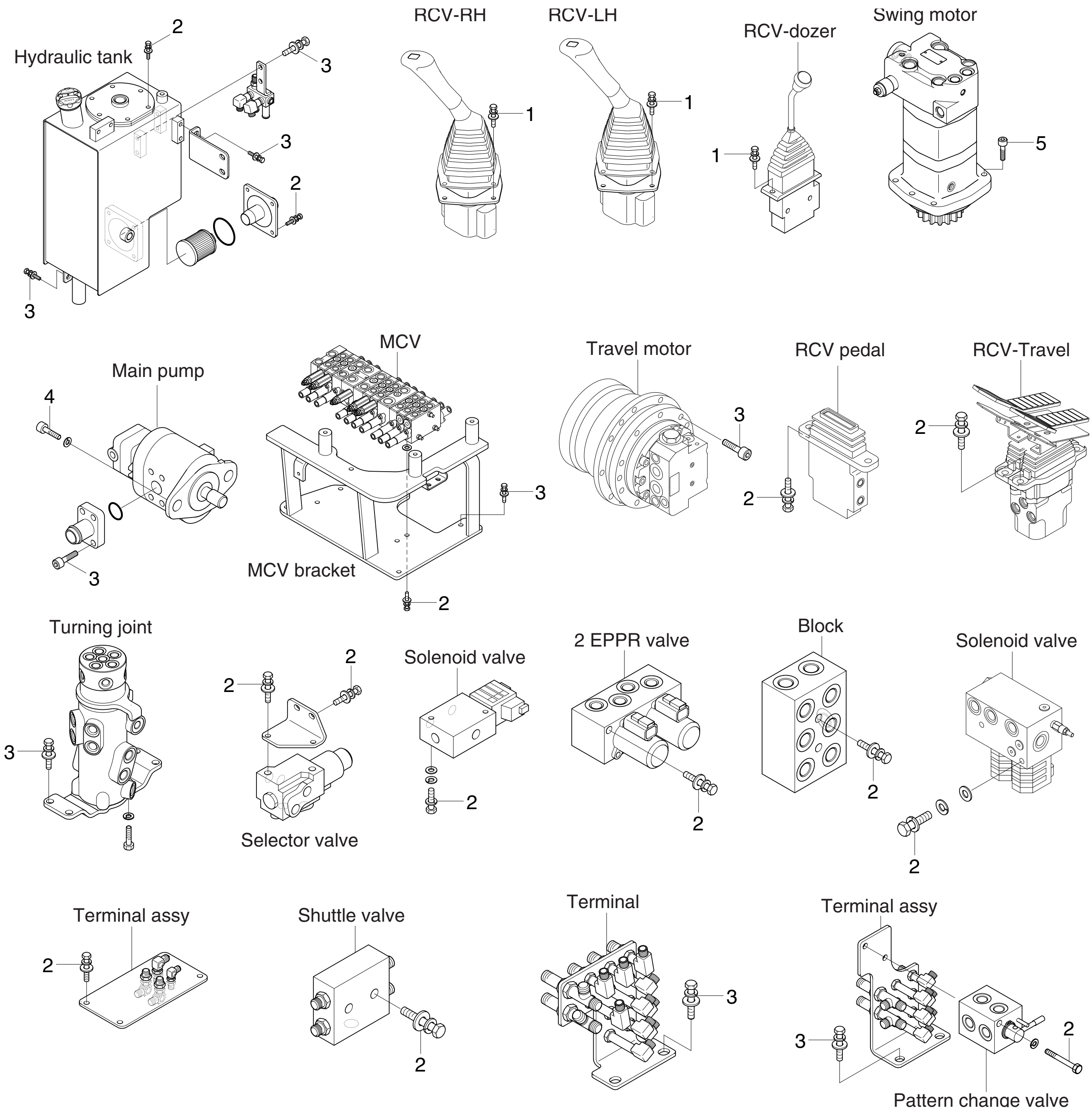
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6

Item	Size	kgf · m	lbf · ft
3	M10×1.5	6.9±1.4	49.9±10.1

GROUP 4 HYDRAULIC SYSTEM

1. HYDRAULIC COMPONENTS MOUNTING 1



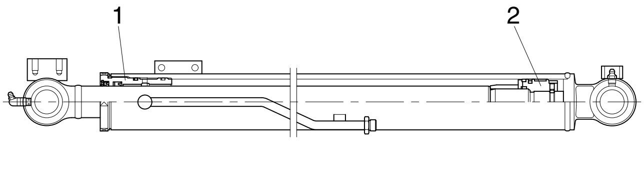
17Z9A8CM05

· Tightening torque

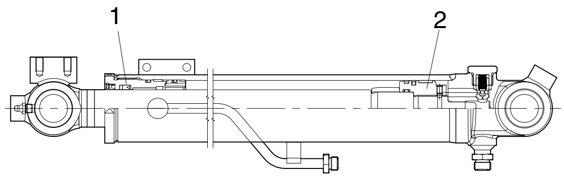
Item	Size	kgf · m	lbf · ft
1	M 6×1.0	1.05±0.2	7.6±1.45
2	M 8×1.25	2.5±0.5	18.1±3.6
3	M10×1.5	6.9±1.4	49.9±10.1

Item	Size	kgf · m	lbf · ft
4	M12×1.75	12.8±3.0	93±22.0
5	M14×2.0	21	152

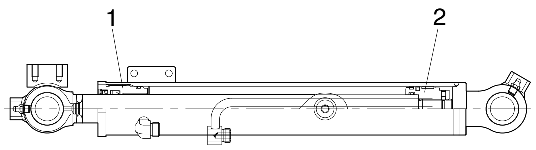
2. HYDRAULIC COMPONENTS MOUNTING 2



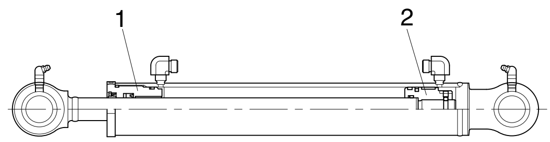
Boom cylinder



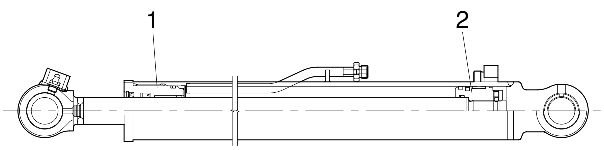
Arm cylinder



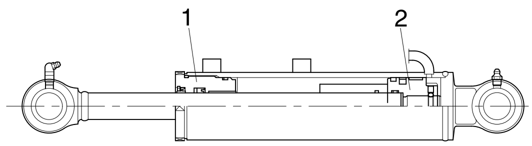
Bucket cylinder



Extension cylinder



Boom swing cylinder



Blade cylinder

17Z9A8CM07

· Tightening torque

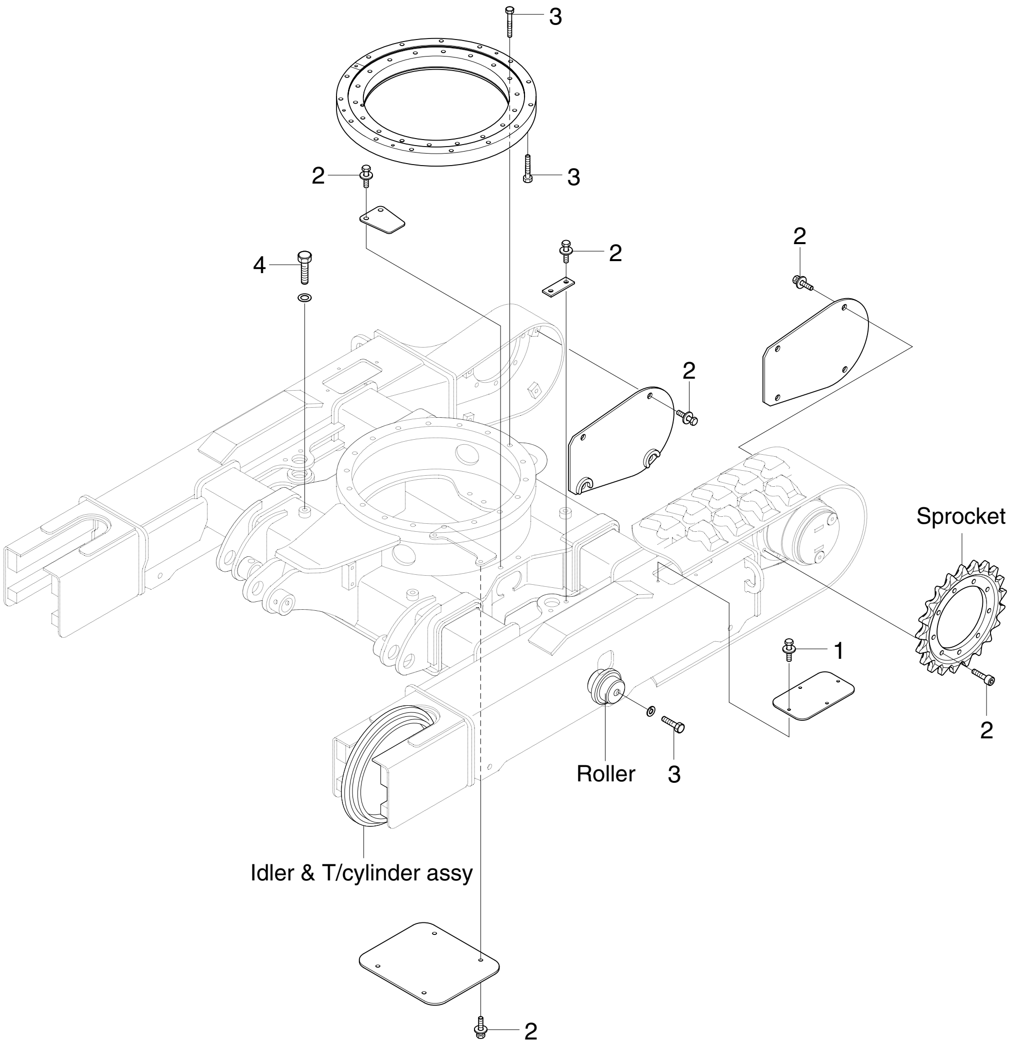
1) Gland

Item	Size	kgf · m	lbf · ft
Boom cylinder	M65	52±5.0	376±36.2
Arm cylinder	M65	52±5.0	376±36.2
Bucket cylinder	M60	48±5.0	347±36.2
Dozer cylinder	M70	56±5.0	405±36.2
Boom swing cylinder	M60	48±4.8	347±34.7
Extension cylinder	M60	48±4.8	347±34.7

2) Piston

Item	Size	kgf · m	lbf · ft
Boom cylinder	M28	70±7.0	506±50.6
Arm cylinder	M28	70±7.0	506±50.6
Bucket cylinder	M24	60±6.0	434±43.4
Dozer cylinder	M24	60±6.0	434±43.4
Boom swing cylinder	M24	60±6.0	434±43.4
Extension cylinder	M24	60±6.0	434±43.4

GROUP 5 UNDERCARRIAGE



17Z9A8CM08

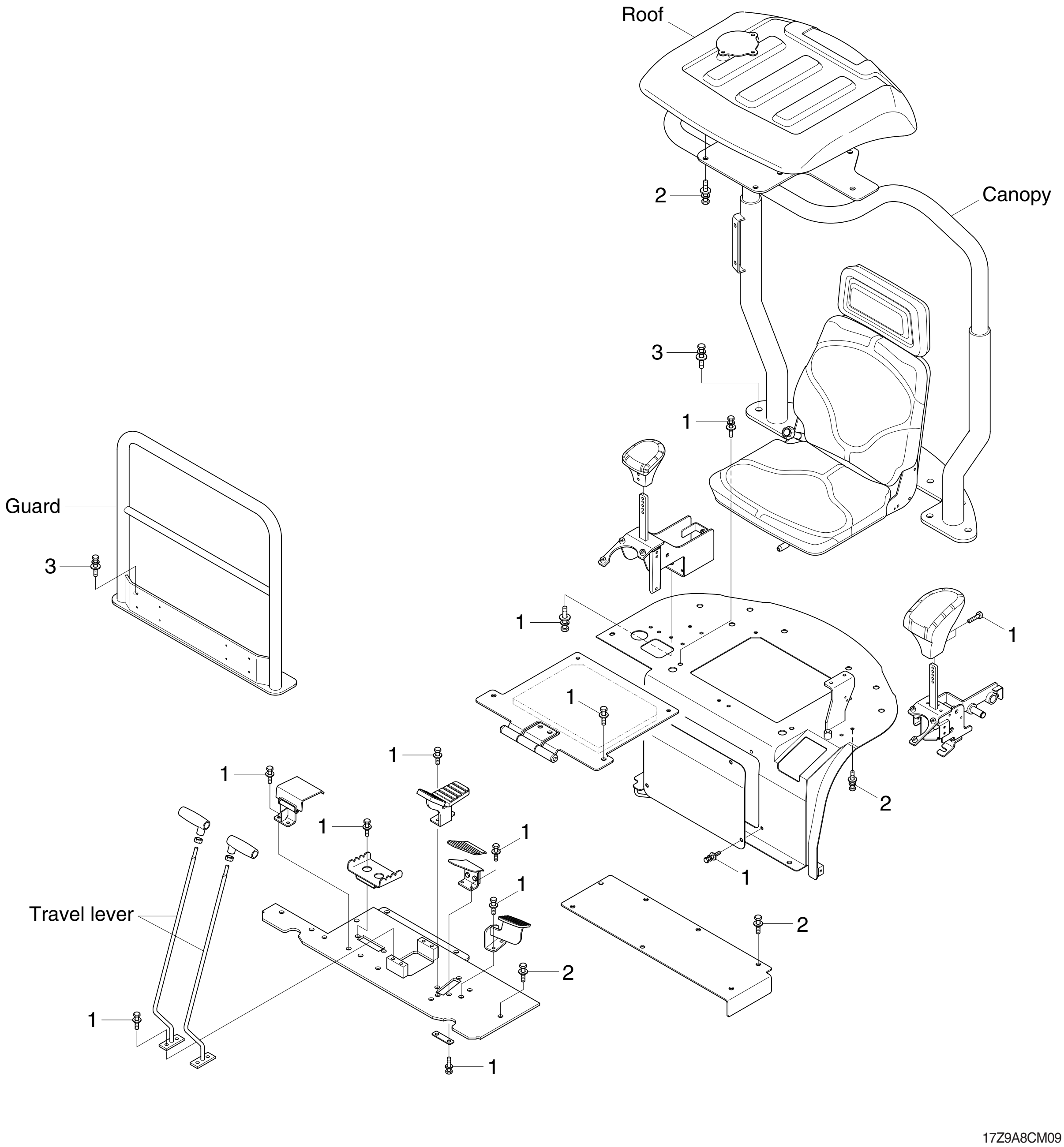
· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M6 × 1.0	1.05 ± 0.2	7.6 ± 1.45
2	M10 × 1.5	6.9 ± 1.4	49.9 ± 10.1

Item	Size	kgf · m	lbf · ft
3	M12 × 1.75	12.8 ± 3.0	93 ± 22.0
4	M20 × 2.5	57.9 ± 8.7	419 ± 62.9

GROUP 6 STRUCTURE

1. CANOPY AND ACCESSORIES MOUNTING

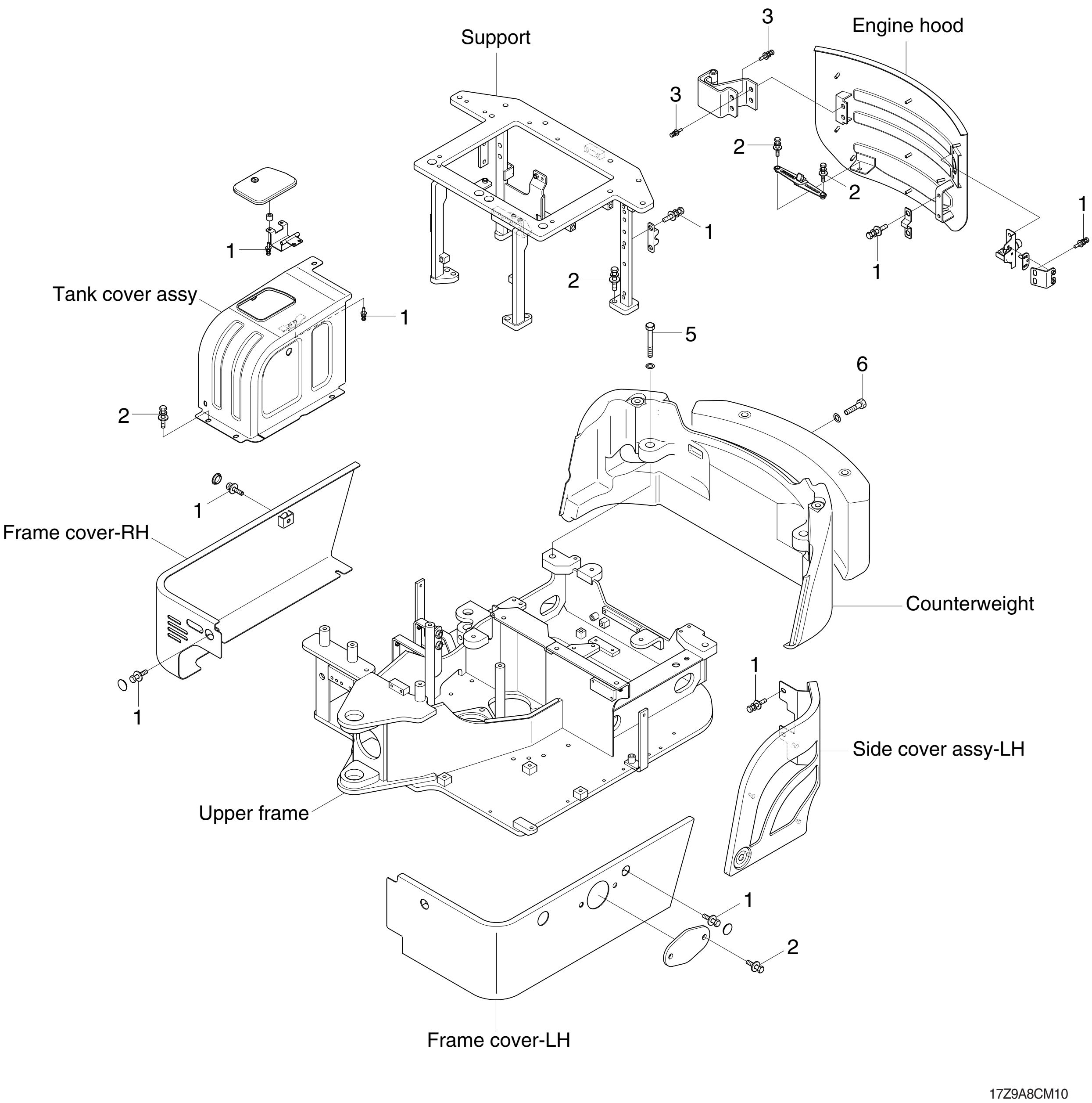


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.9±1.4	50±10

Item	Size	kgf · m	lbf · ft
3	M12×1.75	12.8±3.0	92.6±21.7

2. COWLING MOUNTING

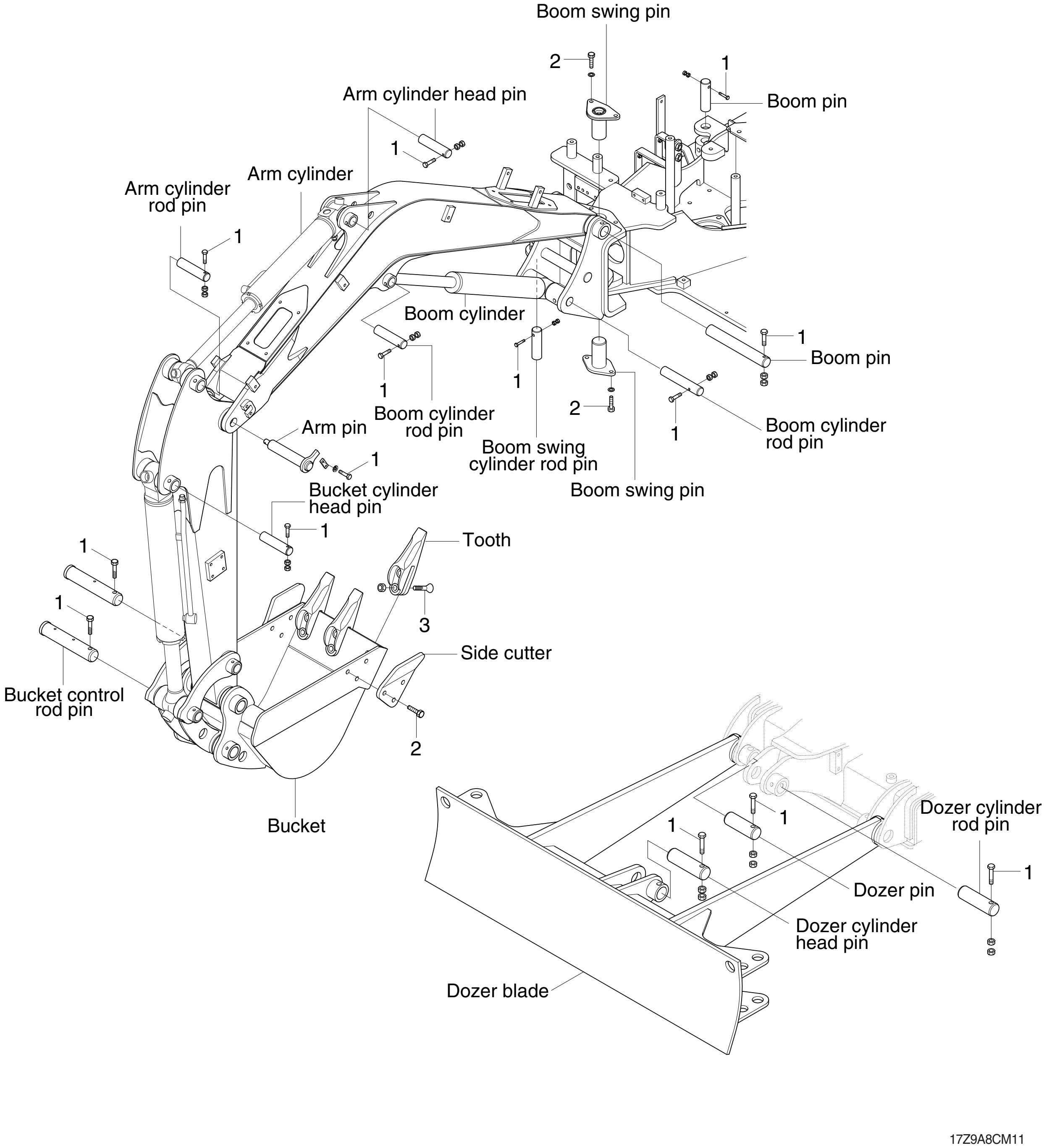


· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M 8×1.25	2.5±0.5	18.1±3.6
2	M10×1.5	6.0±1.4	43.4±10.1
3	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
4	M16×2.0	29.7±4.5	215±32.5
5	M20×2.5	57.9±8.7	432±62.9
6	M24×3.0	100±15	723±108

GROUP 7 WORK EQUIPMENT



· Tightening torque

Item	Size	kgf · m	lbf · ft
1	M10×1.5	6.0±1.4	43.4±10.1
2	M12×1.75	12.8±3.0	92.6±21.7

Item	Size	kgf · m	lbf · ft
3	M16×1.5	31.3±4.7	226±34