Travel Precautions

Never turn the starting switch to the "O" (OFF) position when traveling. It is dangerous if the engine stops when the machine is traveling. It will be impossible to operate the steering.

Attachment control levers should not be operated while traveling.

Do not change selected travel mode (FAST/SLOW) while traveling.

Fold in work equipment so that the outer end of the boom is as close to the machine as possible, and is 40 - 50 cm (16 - 20 in) above ground.

Never travel over obstacles or slopes that will cause the machine to tilt severely. Travel around any slope or obstacle that causes the machine to tilt 10 degrees or more to the right or left, or 30 degrees or more from front to rear.

Do not operate the steering suddenly. The work equipment may hit the ground and cause the machine to lose its balance, and this may damage the machine or structures in the area.

When traveling on rough ground, travel at low speed, and avoid sudden changes in direction.

Always keep to the permissible water depth. Permissible water depth is to the center line of the upper track rollers.

When traveling over bridges or structures on private land, check first that the bridge or structure can withstand the weight of the machine. When traveling on public roads, check with the local authorities and follow their instructions.

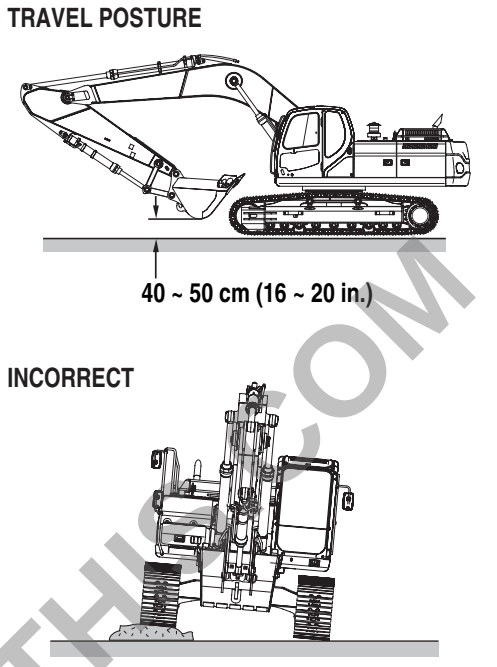


Figure 17

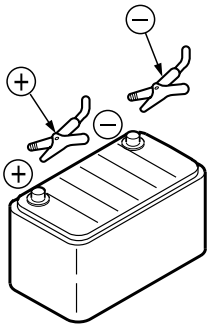
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Boost Starting or Charging Engine Batteries

If any mistake is made in the method of connecting the booster cables, it may cause an explosion or fire. Always do the following:

- Turn off all electrical equipment before connecting leads to the battery. This includes electrical switches on the battery charger or boost starting equipment.
- When boost starting from another machine or vehicle do not allow the two machines to touch. Wear safety glasses or goggles while required battery connections are made.
- 24 volt battery units consisting of two series connected twelve volt batteries have a cable connecting one positive terminal on one of the 12 volt batteries to a negative terminal on the other battery. Booster or charger cable connections must be made between the nonseries connected positive terminals and between the negative terminal of the booster battery and the metal frame of the machine being boosted or charged. Refer to the procedure and illustration in "Starting Engine With a Booster Cable" in the Operation and Maintenance Manual.
- Connect positive cable first when installing cables and disconnect the negative cable first when removing them. The final cable connection, at the metal frame of the machine being charged or boost started, should be as far away from the batteries as possible.



HAOA310L

Figure 45

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Cylinder Performance Tests

NOTE: *All tests are performed with standard boom, arm and bucket configuration. The bucket should be empty.*

Boom Cylinders Test

The starting points for the test are with the boom and arm extended away from the excavator, and the bucket curled inward. The arm cylinder should be fully retracted; boom and bucket cylinders must be extended. Test movement in both directions, several times, and average results for both Standard Mode and Power Mode.

Arm Cylinder Test

Start with the boom up and the arm cylinder fully retracted. Test movement in both directions several times, between the "crowd" and "dump" positions, and average the results of both tests, in both standard and extra-duty power modes.

Bucket Cylinder Test

Start with the boom up and the teeth of the bucket hanging vertically, 500 mm (1-1/2' - 2') above the ground. Dump and crowd the bucket several times, and average results, for both standard and extra-duty power modes.

Operation	Standard Mode	Power Mode
Boom Up	2.9 - 3.7 sec	2.5 - 3.3 sec
Boom Down	2.3 - 2.9 sec	2.2 - 2.8 sec
Arm Dump	2.3 - 2.9 sec	2.1 - 2.7 sec
Arm Crowd	3.7 - 4.5 sec	3.4 - 4.2 sec
Bucket Dump	2.0 - 2.6 sec	1.9 - 2.5 sec
Bucket Crowd	3.4 - 4.2 sec	3.1 - 3.9 sec

Hydraulic Cylinder Natural Drop Test

To check boom and arm cylinder tightness against the specified performance standard for new cylinders, put a full load of dirt in the bucket and move the attachment cylinders so that the arm cylinder is extended 20 - 50 mm (1" - 2") and boom cylinders are retracted the same amount, 20 - 50 mm (1" - 2"). The top of the bucket should be approximately 2 m (6' - 7') off the ground.

Shut down engine and measure cylinder drop after 5 minutes. Bucket cylinder should not show more than 40 mm (1.57") change, while the arm and boom cylinders should not fall more than 10 mm (0.39").

Travel Motor Jack-up Test

Test travel motor operation on each side by painting or chalking a mark on one crawler shoe, with a corresponding mark on the travel frame. Use the attachment to jack up one side of the

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TORQUE WRENCH EXTENSION TOOLS

Very large diameter, high grade fasteners (nuts, bolts, cap screws, etc.) require a great deal of turning force to achieve recommended tightening torque values.

Common problems that could occur as a result are:

- Recommended torque exceeds the measuring capacity of the torque wrench.
- Specialized sockets do not fit the adapter on the front end (nose) of the torque wrench.
- Generating adequate force on the back end (handle) of the wrench is difficult or impossible.
- Restricted access or an obstruction may make use of the torque wrench impossible.
- A unique application requires fabrication of an adapter or other special extension.

Most standard torque wrenches can be adapted to suit any one of the proceeding needs or situations, if the right extension tool is used or fabricated.

Torque Multiplication

A wrench extension tool can be used to increase the tightening force on a high capacity nut or bolt.

For example, doubling the distance between the bolt and the back (handle) end of the torque wrench doubles the tightening force on the bolt. It also halves the indicated reading on the scale or dial of the torque wrench. To accurately adjust or convert indicated scale or dial readings, use the following formula:

I = A x T / A + B where:

I = Indicated force shown on the torque wrench scale or dial.

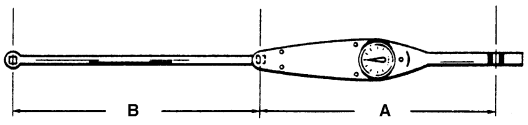
T = Tightening force applied to the nut or bolt (actual Torque).

A = Length of the torque wrench (between the center of the nut or bolt and the center of the handle).

B = Length of the extension.

As an example, if a 12" extension is added to a 12" torque wrench, and the indicated torque on the dial reads "150 ft lb," the real force applied to the bolt is 300 ft lb:

$$I = \frac{A \times T}{A + B} = \frac{12 \times 300}{12 + 12} = \frac{3600}{24} = 150$$



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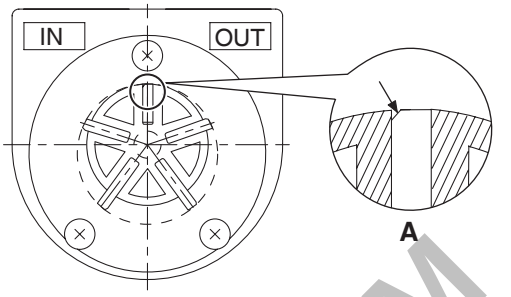
Figure 1

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Insert vane, with the circled edge of vane facing in the counterclockwise direction. (Detail A)

Insert a new O-ring during reassembly of pump cover.



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Figure 6

REPLACEMENT OF REAR COVER

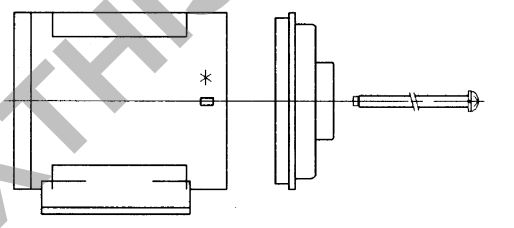
Brush assembly and a thermal limiter are installed in the rear cover. If you find any damage, replace them with new ones.

Remove the switch cover and screw (M5 x L95) from the rear cover.

Remove cover.

At reassembly of rear cover, widen the space of the brush and insert it to the armature. Then fit the hole of screw in the housing.

Be careful when installing the screw. The cover screw may be attracted by the motor magnet.



HAAG0330

Figure 7

REPLACEMENT OF ARMATURE

You can replace only the armature in case motor was damaged by a short circuit.

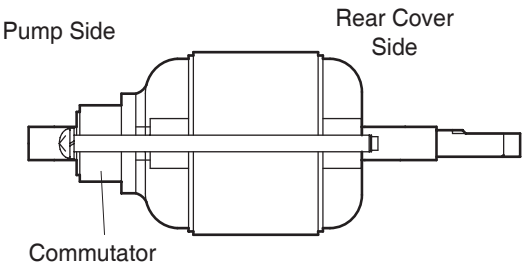
Remove the switch cover and rear cover, than remove the armature from the housing.

Remove the pump cover and remove the rotor and vane.

Insert a new armature into the housing.

Refer to “Replacement of Rear Cover” on page 1-9, for installation of the rear cover.

Fit the rotor into the shaft flute of the armature. Insert vane to the rotor being careful of the direction. Refer to “Replacement of Rotor and Vane” on page 1-8.



FG001146

Figure 8

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Assembly of No. 1 Carrier

1. Put No. 1 carrier on assembly jig as shown in Figure 29.

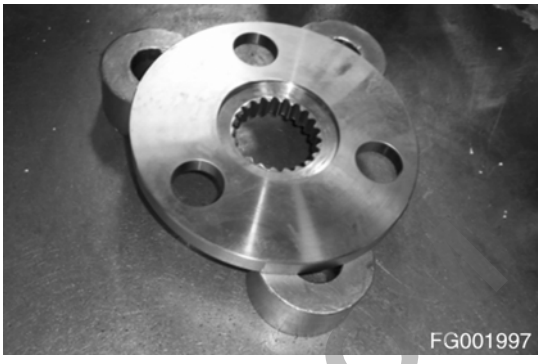


Figure 29

2. Assemble the pin ass'y 1 and the washer into planet gear 1 and arrange it on the pin hole of the carrier 1.

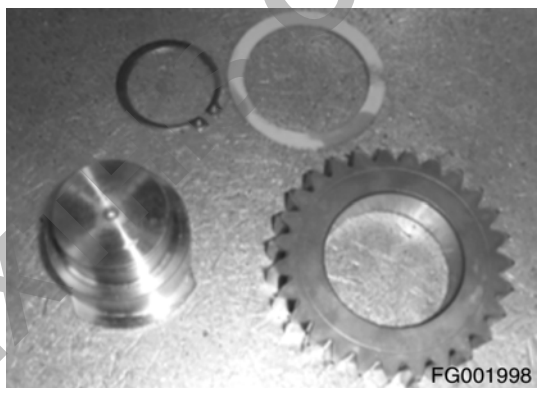


Figure 30

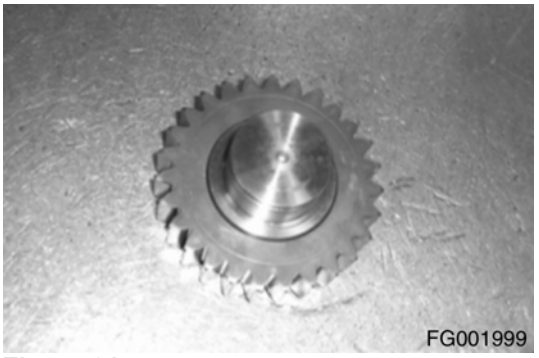


Figure 31



Figure 32

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INSTALLATION

1. Coat pinion gear with grease. Refer to operation manual for specifications.
2. Make sure a alignment pin (6, Figure 111) is installed in flange of swing reduction gearbox (5).
3. Using a suitable lifting device, sling swing motor (1, Figure 111) and position swing motor and reduction gearbox (5) as an assembly on unit.
4. Install eleven bolts and washers (4, Figure 111) to secure swing reduction gearbox (5) to frame.

   NOTE: *Apply Loctite #262 to bolt threads.*

   NOTE: *Tighten bolt to 55 kg•m (398 ft lb).*
5. Connect hose (2, Figure 111) to reduction gearbox (5).
6. Connect grease lubrication line (7, Figure 111) to reduction gearbox (5).
7. Connect hoses as tagged during removal to swing motor (1, Figure 111).
8. Fill swing reduction gearbox with oil. Refer to operation manual for specifications.

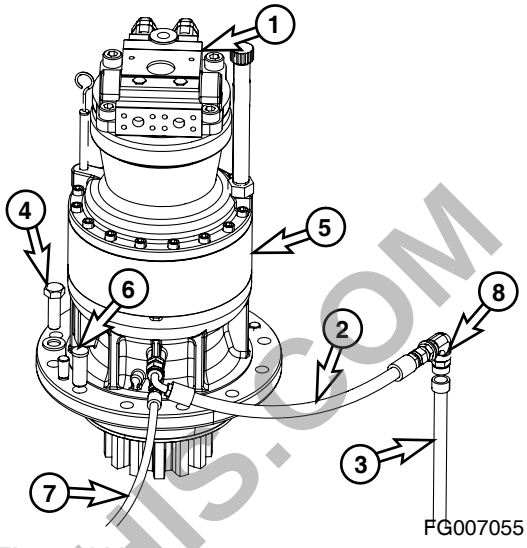


Figure 111

START-UP PROCEDURES

IMPORTANT

If air is not vented from system, it will cause damage to swing motor and bearings.

1. Disconnect drain hose and fill swing motor case with hydraulic oil.
2. Connect drain hose.
3. Start engine and set throttle at "LOW IDLE" and swing upper structure slowly two full revolutions to left and right.
4. Shut engine down and check hydraulic oil level. Fill hydraulic oil tank to "H" mark on sight gauge.
5. Check for oil leaks and clean all fill and venting locations.

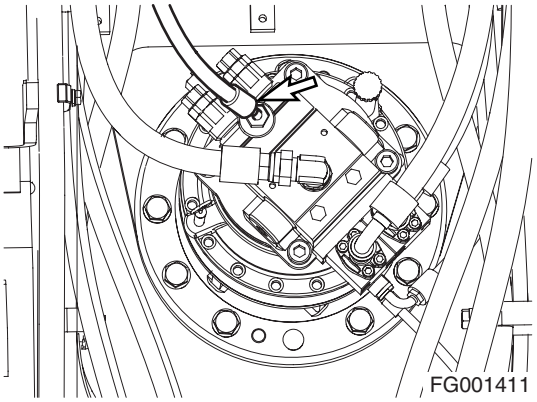
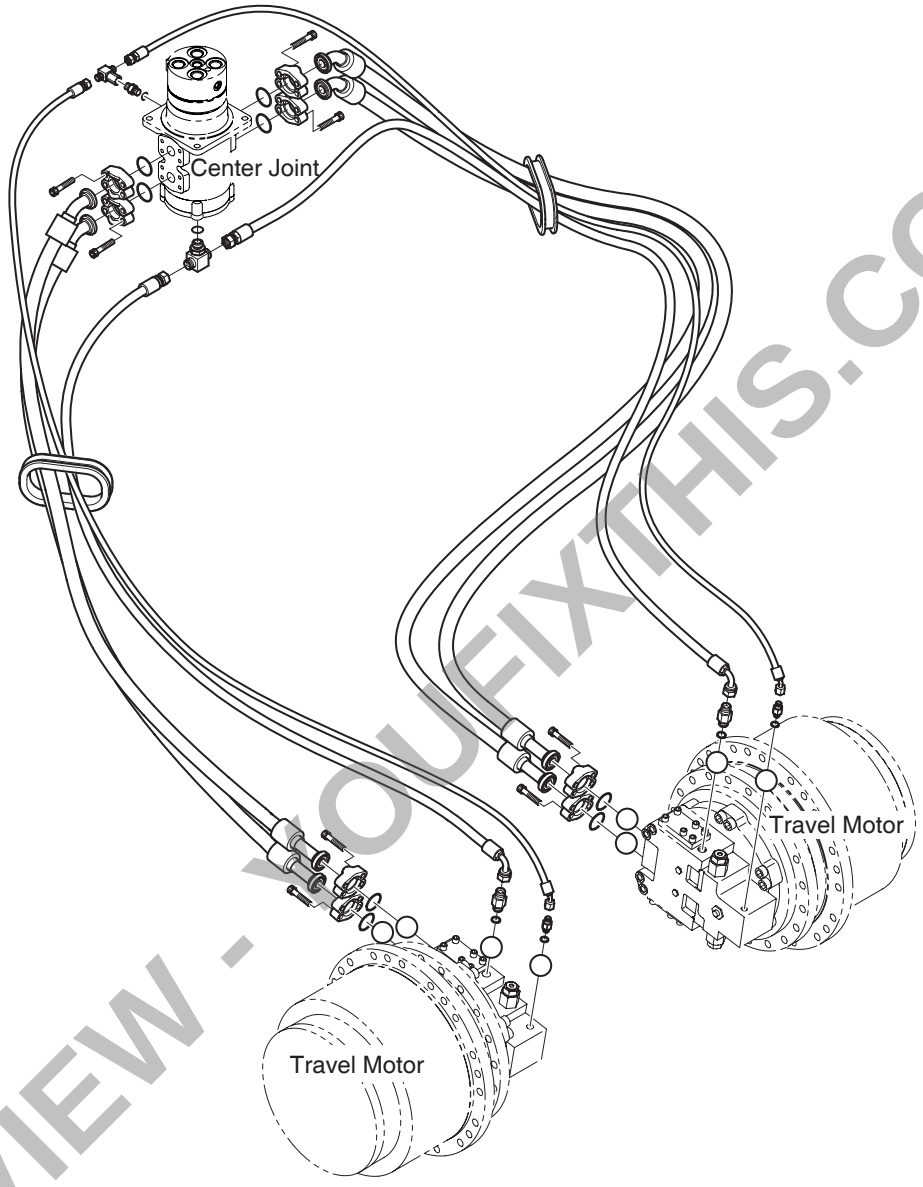


Figure 112

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HYDRAULIC SYSTEM - GENERAL NOTES



FG001322

Figure 1

The hydraulic system has several improvements over conventional hydraulic systems - including cross-sensing total horsepower control - to maximize output efficiency.

The system features an electronically controlled output optimization system, which allows the operator to choose between two, distinctly different power modes: high-output/rapid cycling maximum speed power mode, and a standard power mode for most types of general operation.

Electronic management of hydraulic control valves assists in optimizing the application speed and overall operator control of hydraulic actuators and functions.

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power mode selector at Power Mode and the work mode selector at digging mode:

- Unloaded maximum engine speed baseline test (all controls in neutral).
- Front pump test – operate "travel right" lever. Record values at all specified pressures.
- Rear pump test – operate "travel left" lever. Record values at all specified pressures.

Record the values for each of the three tests (neutral, travel right and travel left) at the following pump pressure levels, with travel speed control set at "high speed."

Engine RPM	Pressure	Flow
	100 kg/cm^2 (1,422 psi)	
	135 kg/cm^2 (1,930 psi)	
	180 kg/cm^2 (2,560 psi)	
	240 kg/cm^2 (3,413 psi)	
	320 kg/cm^2 (4,550 psi)*	
	*See below note.	

Compare recorded values with output shown in the P-Q curve in the specifications section of this book.

If test results do not measure up to specified values, pump output tests can be repeated using different control levers. Recheck front pump operation while stroking the bucket cylinder out lever, and the rear pump by actuating the swing control lever.

NOTE: *When testing bucket and swing functions, read maximum flow tests at 330 kg/cm^2 (4,785 psi), not 350 kg/cm^2 (5075 psi).*

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DISASSEMBLY

Refer to the assembly drawing of the swivel joint for component references (Figure 1).

IMPORTANT

Do not unbolt the center joint from the lower car body until an adequate number of piping block-off plates are available, for disconnected piping lines. Be sure that system pressure has been vented - including the hydraulic accumulator and tank reserve pressure - before disassembly is started.

1. Clean off the exterior of the swivel joint after it has been removed.
2. Scribe or otherwise mark a line across the cover and the body of the center joint, to allow reassembly in the same configuration.
3. Unbolt the four 12 mm fasteners holding the cover. Use a vise or V-block to hold the assembly in place.
4. Remove the cover, withdraw the O-ring and remove the retaining ring holding the thrust plate, taking care to support the spindle assembly, so that it will not separate and fall out when retaining ring is removed.
5. If the spindle assembly doesn't separate easily when the thrust plate and retaining ring are removed, use a wooden block and hammer to drive it out of the housing.
6. O-rings and seals should be replaced whenever the assembly is being overhauled or rebuilt. For repair procedures or emergency tear down, use a thin but rounded tip, smoothedge scraper or spatula to remove O-rings or seals, to avoid causing damage to those that must be reused.

   NOTE: *The "backup ring" shown in the assembly drawing (above the swivel joint spindle lower seals) should not be overlooked. It is tucked behind the top slip ring, doubled up inside the same groove in the body of the spindle.*

7. Before reassembling the center swivel, visually inspect ball bearing surfaces for visible signs of wear, damage or discoloration and replace any worn component.

   Check clearance between the spindle and thrust plate. Replace any component that shows more than 0.5 mm (0.020") of visible wear.

   Clearance between the spindle and body of the center swivel must be tight. Replace or repair either component if there is more than 0.1 mm (0.0039") of measurable wear.

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Reference Number	Description
101	V/V Casing
102	Plug
103	Spring
104	Plunger
105	S/R Valve Assembly
106	O-ring
107	Relief valve
108	Ball Bearing
109	Socket Bolt
110	VP Plug
111	O-ring
112	O-ring
113	Pin Spring
201	Drive Shaft
202	Swash Plate
203	Shoe
204	Piston
205	Cylinder Block
206	Thrust Ball
207	Retainer Plate
208	Collar

Reference Number	Description
209	Roller
210	Washer
211	Spring
212	Ring Snap
213	Valve Plate
301	Casing
302	Oil Seal
303	Ball Bearing
304	Parallel Pin
305	Separation Plate
306	Friction Plate
307	O-ring
308	O-ring
309	Brake Piston
310	Brake Spring
311	PT Plug
312	PT Plug
400	Hex Bolt
401	Name Plate
402	Rivet Screw

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3. (This procedure is necessary when the ball bearing was separated from the driving shaft.)

   Install the ball bearing (303) in the driving shaft (201) by shrinkage fitting.



Figure 29

4. Insert the driving shaft (101) with the ball bearing (303) in the casing (301) with its output shaft facing upward and use a hammer to tap the surface of the ball bearing into the casing. At this point, apply grease to the lip of the oil seal light and then insert it carefully that it may not be damaged.

   (Wrap a tape around the spline of the driving shaft to prevent the damage of the spline due to the lip. Tap the surface of the external circumference evenly until it reaches the end completely.)

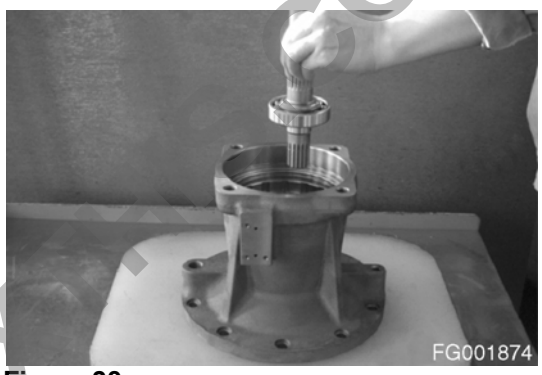


Figure 30

5. (This procedure is necessary when the parallel pin was removed from the casing.)

   Insert the parallel pin (304) in the casing(301).

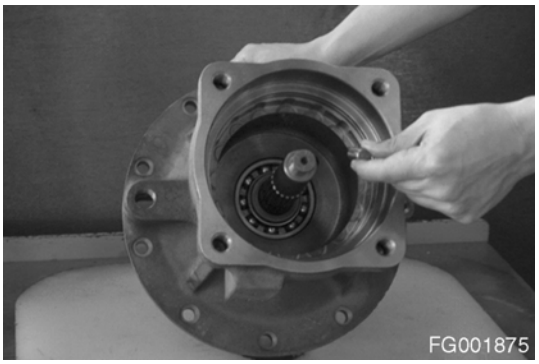


Figure 31

6. Assemble the swash plate (202) in the casing (301). (It is easy to assembly when the casing is put horizontally.)

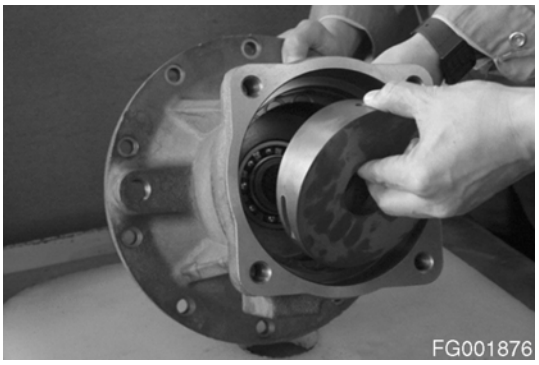


Figure 32

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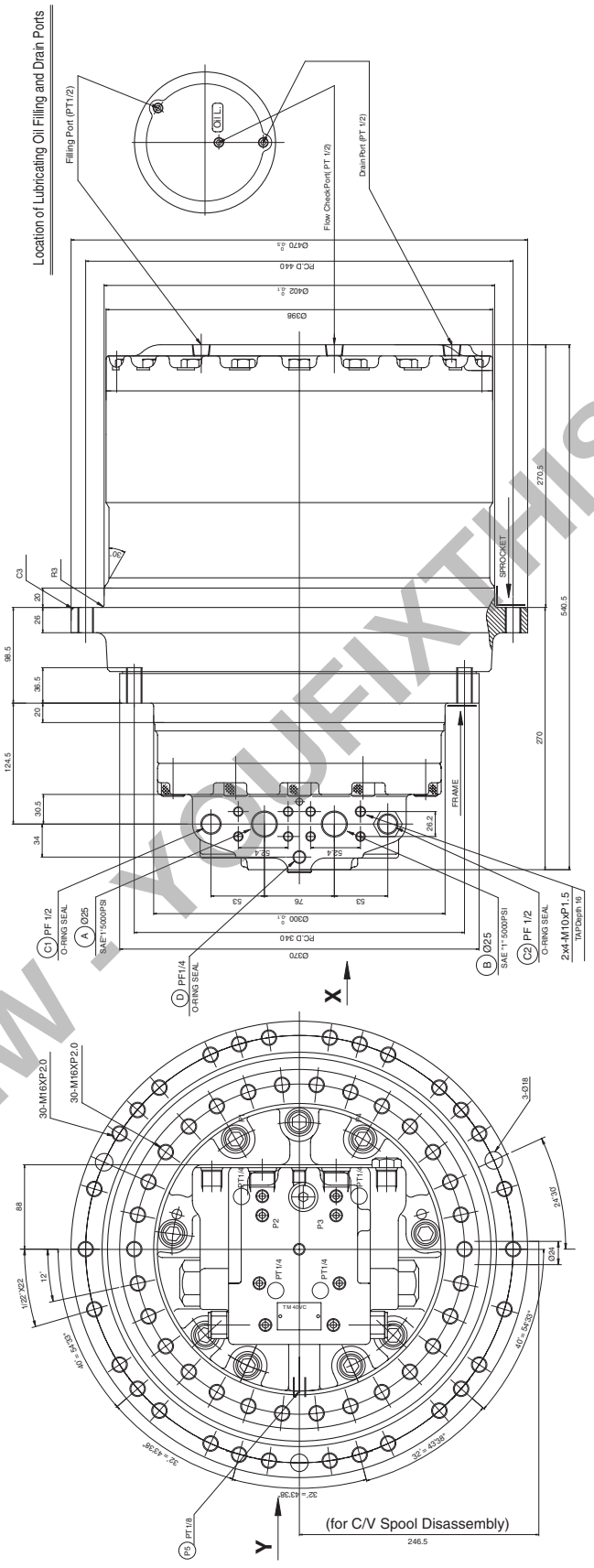


Figure 14

FG007068

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3. Parts in Spindle (2)

   A. Turn spindle (2) until it is at an 180 degree.

   B. Remove oil seal (132) from spindle (2). (To do so, use hammer to strike driver against the circumference of oil seal.)

   NOTE: *Remove oil seal (132) only when it has to be replaced. Do not reuse removed oil seal.*

   – θ driver and hammer

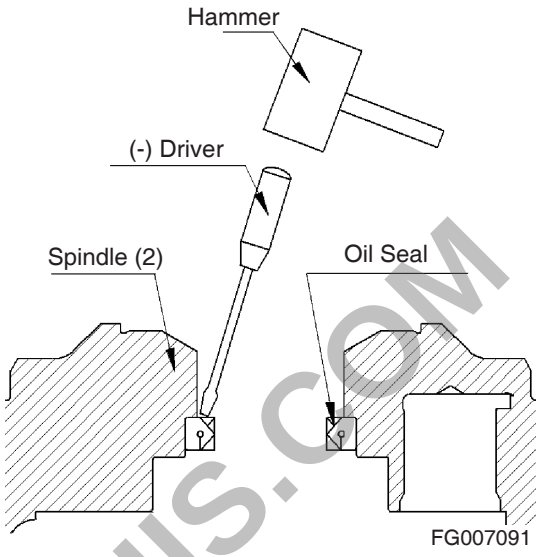


Figure 40

   C. Remove floating seal (26) from spindle (2).

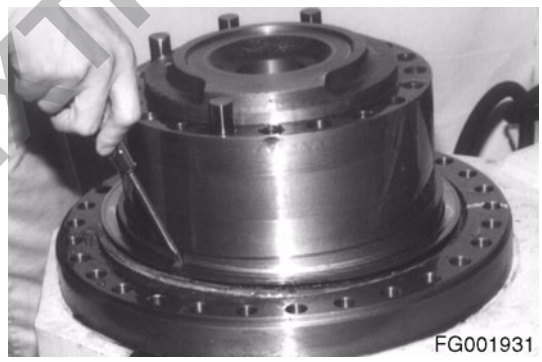


Figure 41

4. Disassembly of Parts in Hub (1)

   A. Remove floating seal (26) from hub (1).

   B. Remove ball bearing (24) from hub (1) as shown in the figure below. Remove sealing (23) too.

   NOTE: *Basically, do not remove ball bearing (24) from hub (1) because the bearing is thermal driven into hub (1). Do not reuse removed ball bearing (24).*

   C. Put hub (1) on the working die with its spindle facing upward.

   – Steel rod and hammer

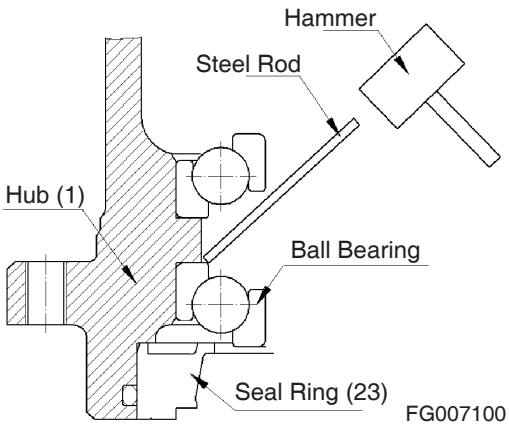


Figure 42

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C. Insert parallel pin (27) in hub (1).

D. Fill lubricating oil in the reducer. Amount of lubricating oil: About 3.3 liter

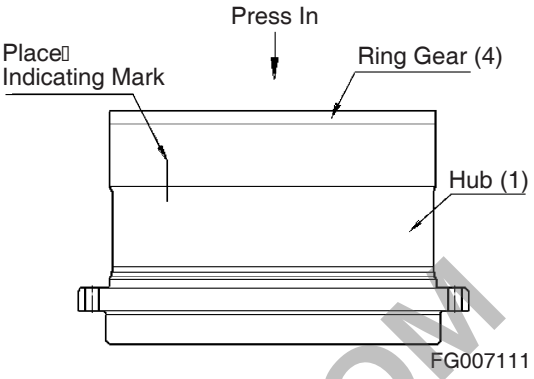


Figure 73

15. Assembly of Cover (13)

A. Install thrust plate (20) on carrier (3).

NOTE: *Apply a thin coating of molybdenum bisulfide grease to the surface of thrust plate (20).*

B. Install cover (13) on hub (1).

NOTE: *Apply a thin coating of herme seal (NO.SS60F) to the hub connection area of cover (13).*

– Hanger and eye bolt PT 1/2



Figure 74

C. Install cover (13) in hub (1) with socket bolt (32) and snap ring washer (33) with specified torque.

NOTE: *Tightening torque: 10.4 ± 1.6 kgf•m*
Apply a thin coating of Loctite #242 to socket bolt (32) before installing it.

– Torque wrench

D. Install plug (30) on cover (13) with specified torque.

NOTE: *Tightening torque: 10 ± 2 kgf•m*
When installing plug (30) on cover, wrap seal tape around it and the teeth should be within ±1 tooth than the end of counter boring of cover (13).

– Torque wrench and seal tape

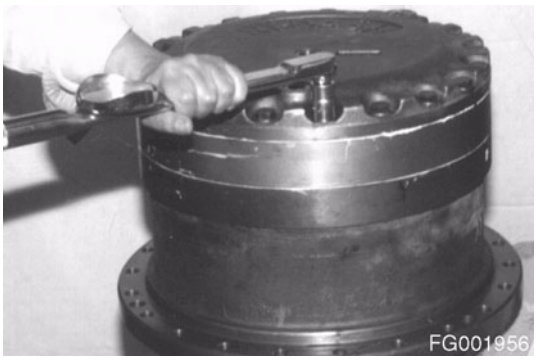


Figure 75

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Arm Spool Shift

1. Neutral

   This valve also works with an anti drift valve that is installed on rod side of the arm cylinder.

   When in neutral, poppet (AD1) is closed by port (A5) pressure that is sent through passage (AD2), spool (AD3) and to spring chamber (AD4).

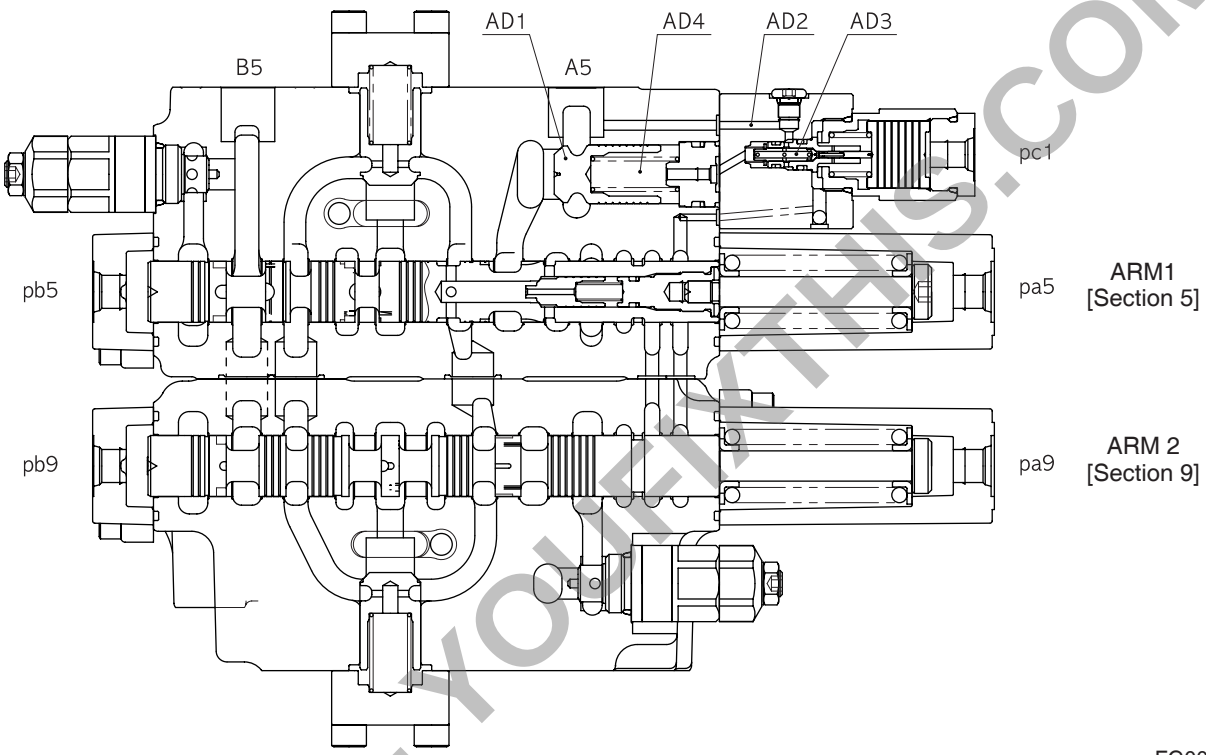


Figure 11

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Relief Valve

Problem	Possible Cause	Remedy
Press does not increase.	Main poppet, sleeve or pilot poppet are stuck open and valve seat part has dust.	Replace relief valve.
Unstable relief pressure.	The seat part of pilot poppet has groove.	
	Piston or main poppet gets stuck.	
Abnormal relief pressure.	Abrasion of seat part by dust.	
	Locking screw and adjustment equipment are loosened.	Re-set pressure and tighten locking screw with regular Torque.
Oil leakage.	Damage to relief valve seat part.	Replace relief valve.
	Each part is stuck with dust.	
	The O-ring is worn out.	Replace adjustment equipment or O-ring of loading part.

Overall Oil Pressure

Problem	Possible Cause	Remedy
Oil pressure condition is bad or not operate at all.	Breakdown of pump.	Check pressure or replace pump.
	Breakdown of relief valve.	Replace relief valve.
	Breakdown of cylinders.	Repair or replace.
	Pump load pressure is significant.	Check circuit pressure.
	Valve has crevice.	Replace valve assembly.
	Spool does not make full stroke.	Check operation of spool.
	Tank surface is too low.	Add operation oil.
	Filter in circuit is clogged.	Wash or replace filter.
	Circuit pipeline is tightened.	Check pipeline.

Adjustment of Valves

Main Relief Valve

1. Connect an accurate pressure gauge to inlet port.
2. Start engine and maintain rated pump speed.
3. Shift control valve spool and read pressure gauge from stroke end of cylinder.

   NOTE: *Shift a spool that the actuator pressure setting of the overload relief valve is higher than the pressure of the main relief valve.*

4. High-pressure adjustment (1st stage) (Refer to Figure 38 on page 54.)

   A. Loosen lock nut (7) and tighten plug (8) until piston contacts step (* mark) of plug (6). Plug (8) should be torque below 2.0 kg•m (15 ft lb). While plug (8) is tightened, plug (6) should not be turned. Distance A

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No.	Parts
11	Piston and Shoe Assembly
13	Cylinder Block and Valve (R)
14	Cylinder Block and Valve (L)
30	Swash Plate Assembly
41	Check 1 Assembly
42	Check 2 Assembly
79	Professional Valve
111	Drive Shaft
113	Drive Shaft
114	Gear
123	Roller Bearing
124	Spacer Bearing
127	Bearing Spacer
153	Push Plate
156	Flexible Bush
157	Cylinder Spring
158	Spacer
211	Shoe Plate
250	Support Kit
251	Support
261	Seal Cover
271	Pump Casing
312	Valve Block
401	Socket Bolt
406	Socket Bolt
466	Plug

No.	Parts
468	Plug
490	Expander
530	Tilted Pin Assembly
532	Piston
534	Stopper
535	Stopper
702	O-ring
710	O-ring
717	O-ring
724	O-ring
725	O-ring
723	O-ring
732	O-ring
774	Oil Seal
789	Backup Ring
792	Backup Ring
806	Nut
808	Nut
824	Snap Ring
885	Pin
886	Spring Pin
901	Eye Bolt
953	Set Screw
954	Adjustment Screw
985	Cover
986	Socket Bolt

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Specifications

Performance

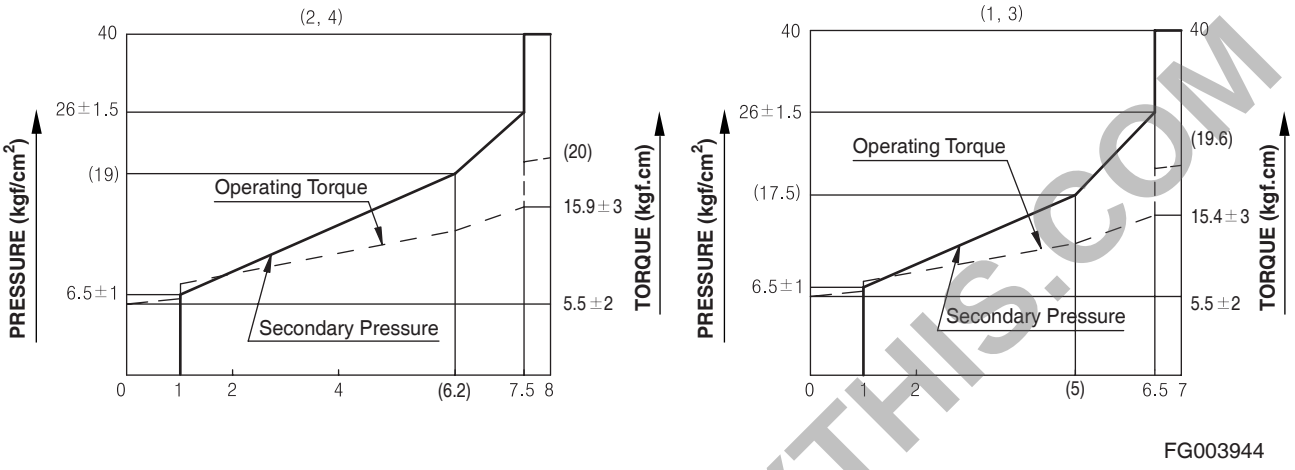


Figure 2

Torques

No.	Tool	Standard	Remark
3	Plug	PF 3/8	500 kg•cm (36 ft lb)
19	Swash Plate	27 mm	1,660 kg•cm (120 ft lb)
20	Hex Nut	22 mm	1,660 kg•cm (120 ft lb)
22	Nut	22 mm	1,660 kg•cm (120 ft lb)

TOOLS AND MATERIALS

No.	Tool	Standard	Remark
3	L Wrench	8 mm	
19	Spanner	27 mm	
20	Spanner	22 mm	
22	Spanner	22 mm	

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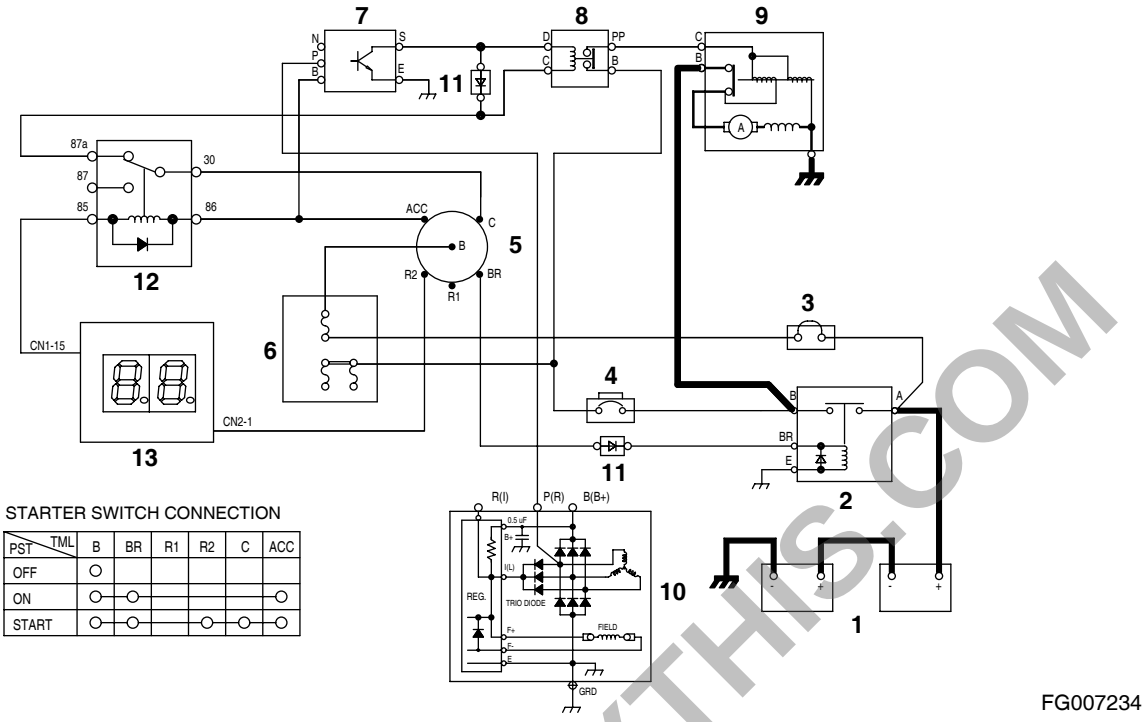


Figure 3 STARTER CIRCUIT (1) - WHILE STARTING

Reference Number	Description
1	Battery
2	Battery Relay
3	Fusible Link
4	Circuit Breaker
5	Starter Switch
6	Fuse Box
7	Starter Controller

Reference Number	Description
8	Starter Relay
9	Starter
10	Alternator
11	Diode
12	Starter Relay 2
13	e-EPOS Controller

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SPECIAL MENU

In this menu, many types of operating conditions and functions can be accessed and displayed, including the e-EPOS controller. This menu is mainly used for machine testing and failure diagnostics.

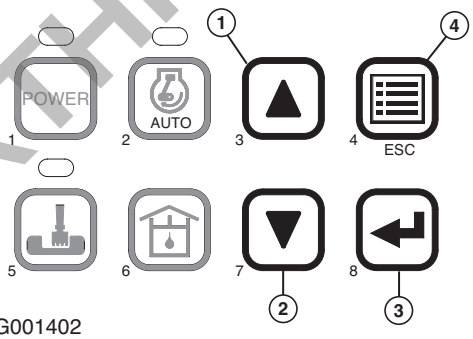
The special menu offers three sub-menus:

1. Machine status.
2. Failure information.
3. Information on machine operation.

Entering/Accessing and Exiting/Escaping Menus

Entering/Accessing Menus

When normal mode screen is displayed, if the enter button (↵, 3) and escape button (ESC, 4) are pressed simultaneously for more than 3 seconds, normal mode screen (Figure 25) will be changed to special menu screen (Figure 26).

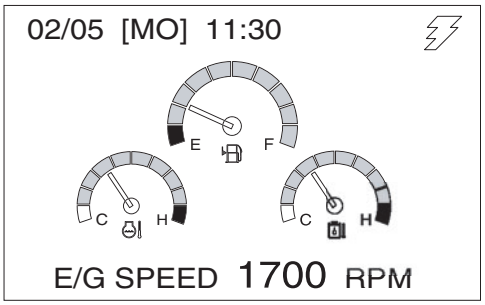


FG001402

Figure 24

Normal Mode Screen

NOTE: *Normal mode screen can display many kinds of display mode by selecting, for example, engine speed (RPM), battery voltage (VOLT), front pump pressure (BAR), rear pump pressure (BAR) and so on by selecting.*



FG000043

Figure 25

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POWER MODE CONTROL

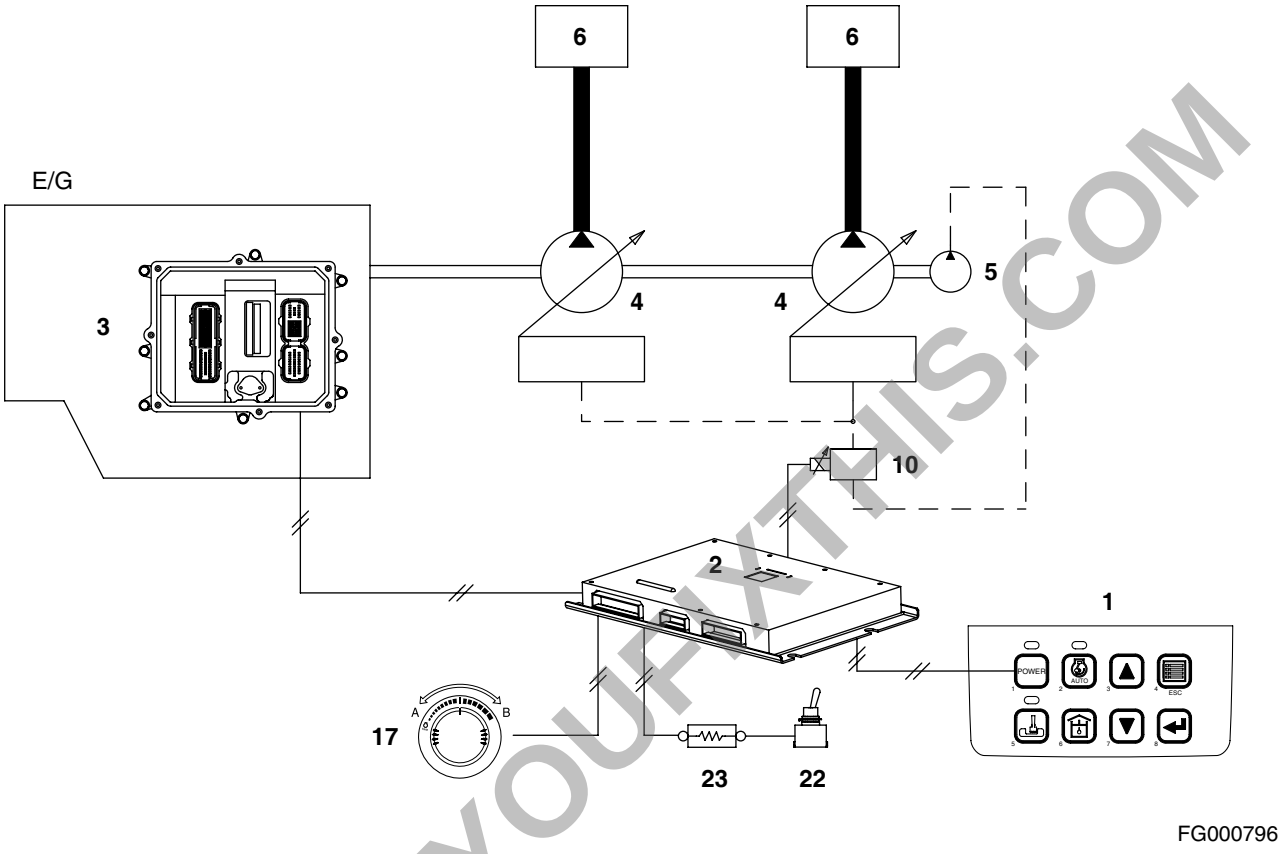


Figure 51

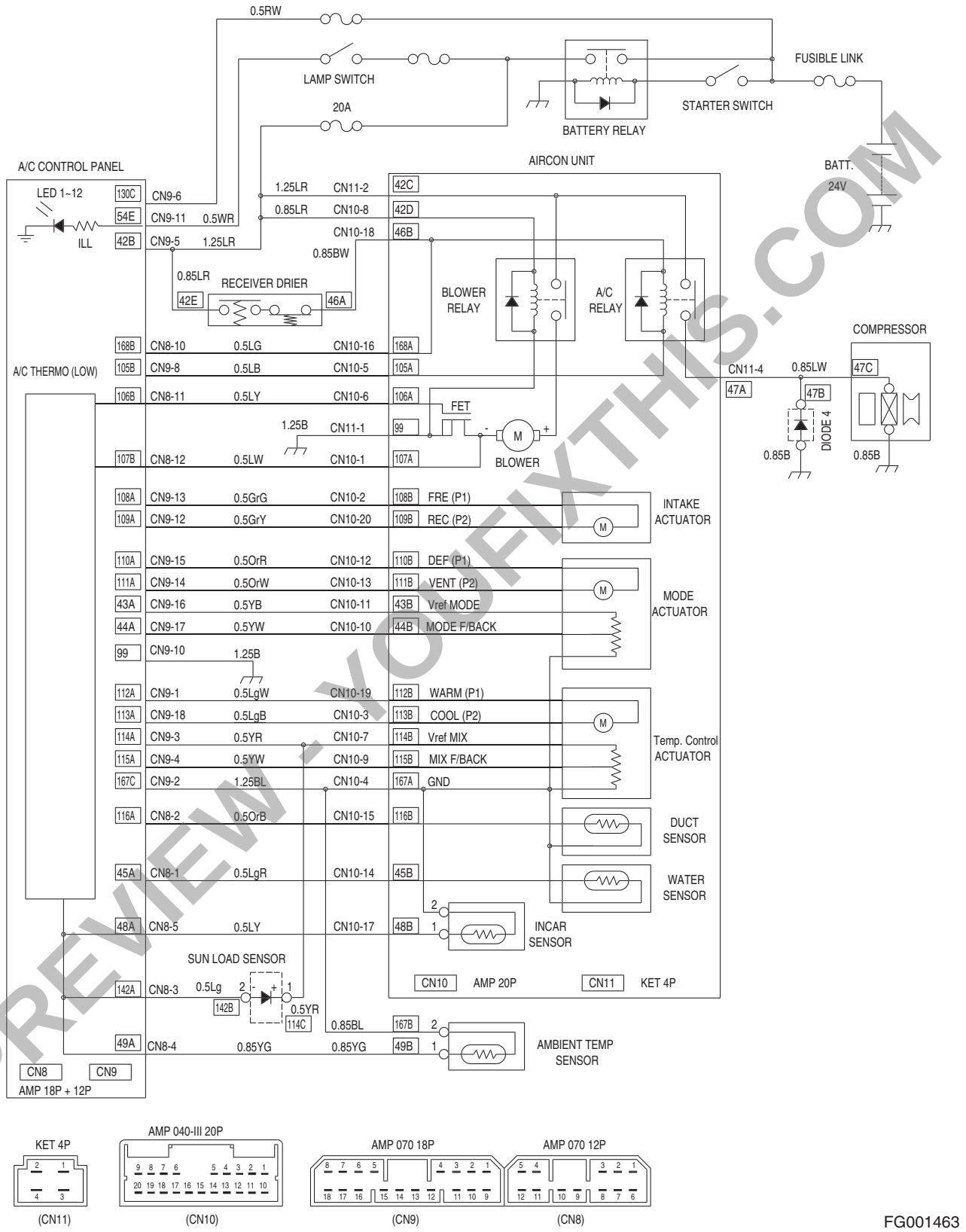
Reference Number	Description
1	Instrument Panel (Power Mode Selector Switch)
2	e-EPOS Controller
3	Engine Controller (ECU)
4	Main Pump
5	Aux Pump
6	Control Valve

Reference Number	Description
10	Electromagnetic Proportional Pressure Reducing Valve (Mode Control)
17	Engine Control Dial
22	Aux Mode Switch
23	Aux Mode Resistor

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Air Conditioner/heater Circuit Diagram



FG001463

Figure 75

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REFRIGERANT SYSTEM REPAIRS

⚠ WARNING!

Always wear protective glasses and gloves when handling refrigerant. If refrigerant comes in contact with the skin or eyes, immediately flush with clean, running water and consult a physician.

Select a clean and well ventilated area to work.

The refrigerant container is under high-pressure and should be stored below 40°C (104°F). Be careful not to drop the container from a high location.

The contents are under high-pressure and should not be used with compressed air or near an open flame.

Refrigerant Safe Handling Procedures

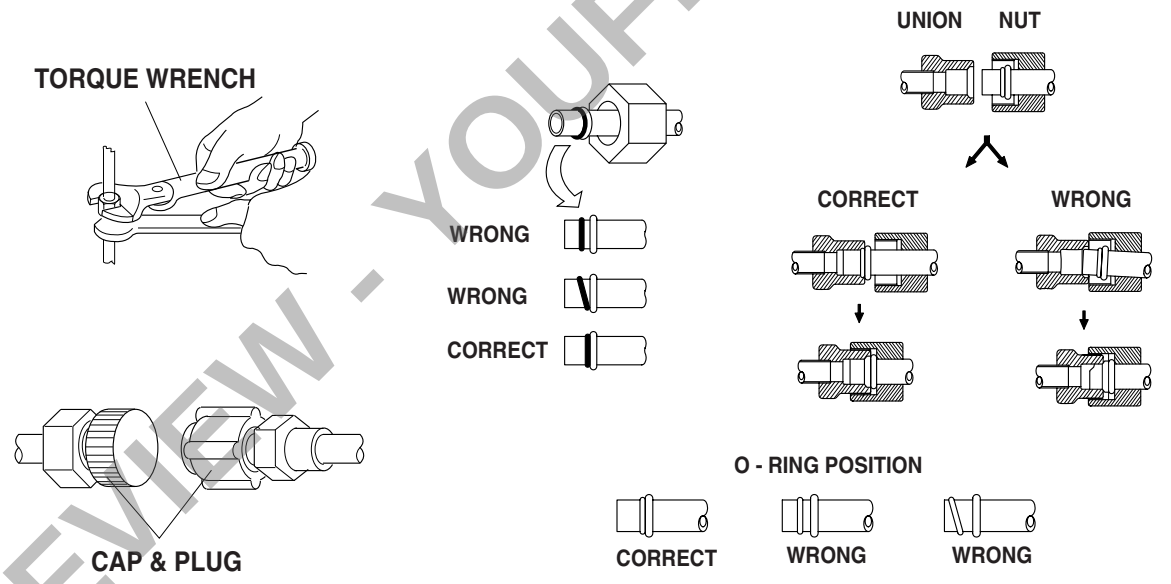


Figure 95

The following procedures should be observed for safe handling of refrigerant during vacuum and charging process.

1. Use an approved recovery / charging device which can safely perform vacuum and charge work simultaneously.
2. The new refrigerant has improved cooling characteristics than the old type and care should be used not to overcharge the system.

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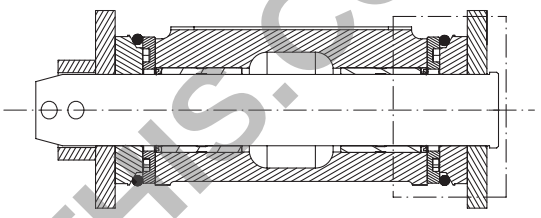
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BUCKET O-RING REPLACEMENT

WARNING!

Due to possibility of flying metal objects, always wear safety helmet, protective gloves and eye protection when changing pins.

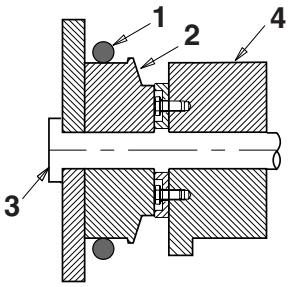
1. Inspect the bucket O-rings on a routine basis. If worn or damaged, replacement is necessary.



FG007780

Figure 3

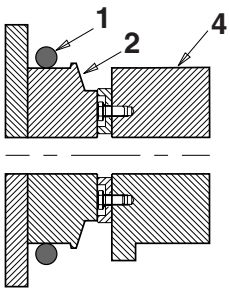
2. Roll the old O-ring (1, Figure 4) onto the boss (2) around the bucket pin (3). Remove the bucket pin and move the arm or bucket link (4) out of the way.



ARO1390L

Figure 4

3. Remove the old O-ring and temporarily install the new O-ring (1, Figure 5) onto the bucket boss (2). Make sure that the O-ring groove on both the bucket link (4) and boss have been cleaned.
4. Realign the arm or link with the bucket pin hole and insert the bucket pin (3, Figure 4).



ARO1391L

Figure 5

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