CX220C
Hydraulic Excavator

Service Manual

Part Number
71114551
1st Edition
English 03/2015

CASE CONSTRUCTION

Personal safety

Safety precautions

- Before servicing an air conditioning system, read and comply with the following safety precautions. Make sure that any repairs are performed by duly trained and skilled personnel only.
- Never attempt to remove the air conditioning system. Refrigerant leaks can cause serious burns to the eyes and hands.
- The refrigerant must always be handled very carefully in order to avoid accidents.
- Keep the refrigerant packaging as well as the air conditioning system away from flames or heat sources, as the resulting increase in pressure may cause the package or system to explode.
- If there is direct contact with naked flames or heated metal surfaces, the refrigerant will decompose and will produce toxic products and acids.
- Never discharge refrigerant into the atmosphere. A certified refrigerant recovery unit operated by a technician should be used to repair air conditioning units.
- When discharging the refrigerant in the system, do so in a well-ventilated area with perfect air circulation and away from naked flames.
- When charging or discharging the system, always wear safety goggles and take adequate precautions to protect the face in general and the eyes in particular, in case of accidental refrigerant spillage.
- The refrigerant and oil mixture inside the air conditioning system is pressurised. Because of this, never loosen the joints or work with the tubes without first depressurising the system.
- Before loosening any connector, cover it with a thick rag and use goggles and gloves to prevent the refrigerant from coming into contact with the skin or eyes.
  If an accident does happen, proceed as follows:
- If refrigerant gets into the eyes, wash immediately with copious amounts of distilled or tap water, and take the victim to hospital for specialist medical care.
- If refrigerant comes into contact with the skin, wash with cold water and seek medical assistance immediately at a hospital.

PIPE THREAD FITTING TORQUE

Before installing and tightening pipe fittings, clean the threads with a clean solvent or Loctite cleaner and apply sealant **LOCTITE® 567 PST PIPE SEALANT** for all fittings including stainless steel or **LOCTITE® 565 PST** for most metal fittings. For high filtration/zero contamination systems use **LOCTITE® 545**.

PIPE THREAD FITTING	
Thread Size	**Torque (Maximum)**
1/8-27	**13 N·m** (**10 lb ft**)
1/4-18	**16 N·m** (**12 lb ft**)
3/8-18	**22 N·m** (**16 lb ft**)
1/2-14	**41 N·m** (**30 lb ft**)
3/4-14	**54 N·m** (**40 lb ft**)

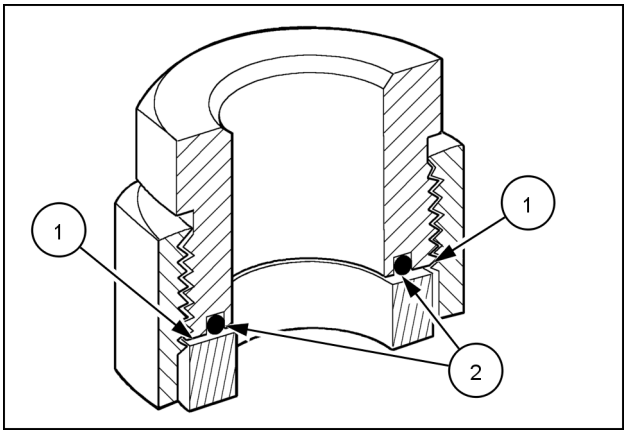
INSTALLATION OF ORFS (O-RING FLAT FACED) FITTINGS

When installing ORFS fittings thoroughly clean both flat surfaces of the fittings **(1)** and lubricate the O-ring **(2)** with light oil. Make sure both surfaces are aligned properly. Torque the fitting to specified torque listed throughout the repair manual.

NOTICE: *If the fitting surfaces are not properly cleaned, the O-ring will not seal properly. If the fitting surfaces are not properly aligned, the fittings may be damaged and will not seal properly.*

NOTICE: *Always use genuine factory replacement oils and filters to ensure proper lubrication and filtration of engine and hydraulic system oils.*

The use of proper oils, grease, and keeping the hydraulic system clean will extend machine and component life.



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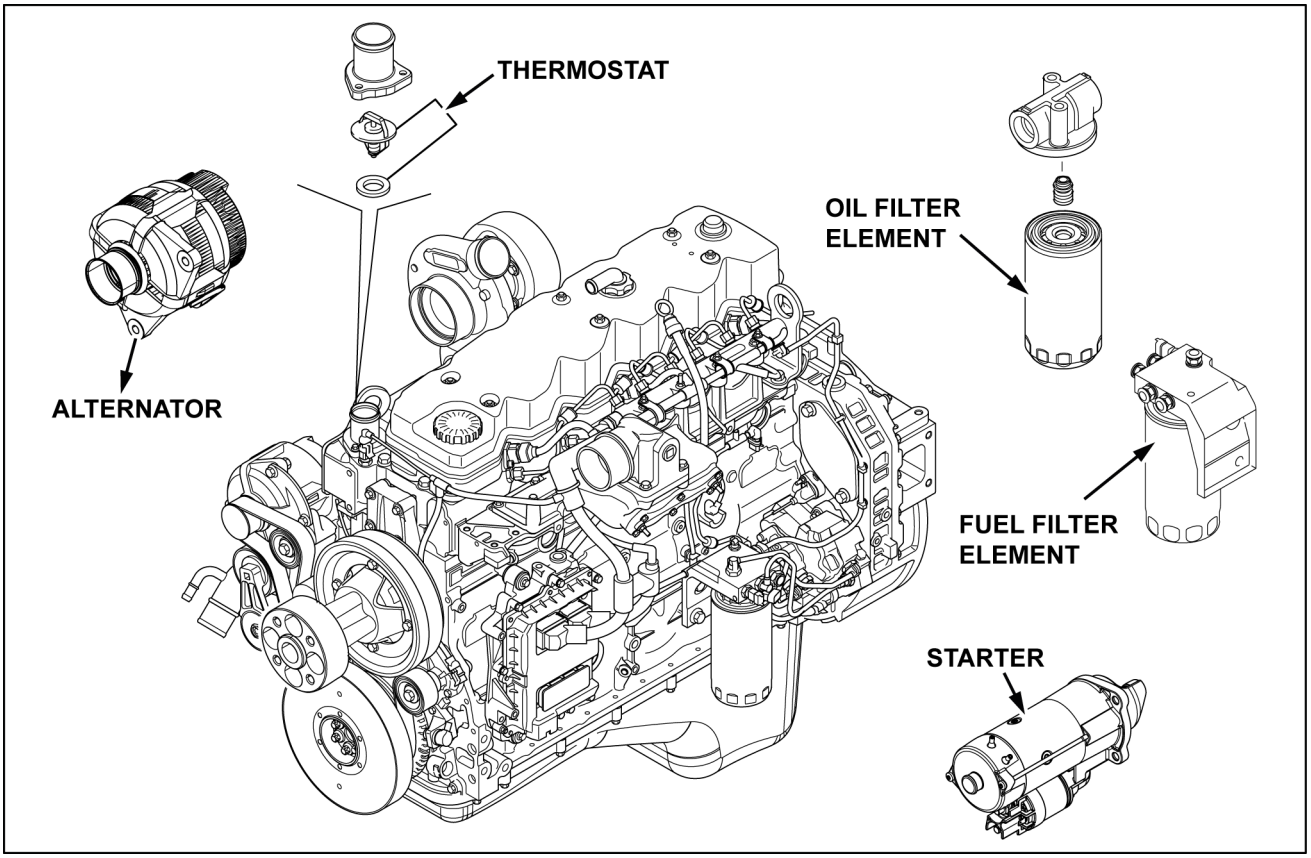

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Av. General David Sarnoff, 2237 - Inconfidentes, Contagem (MG) - Brasil, CEP:32210-900

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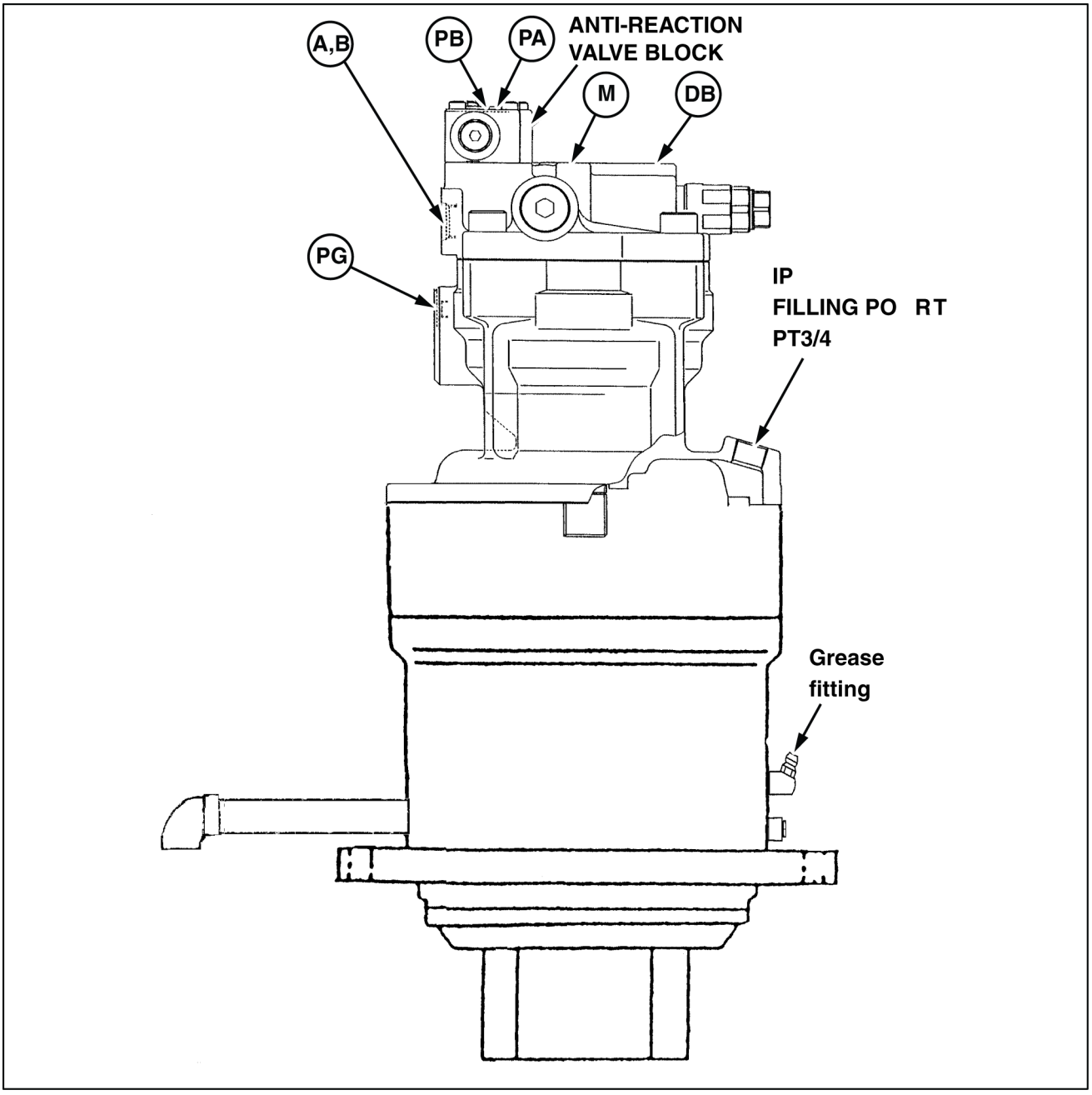

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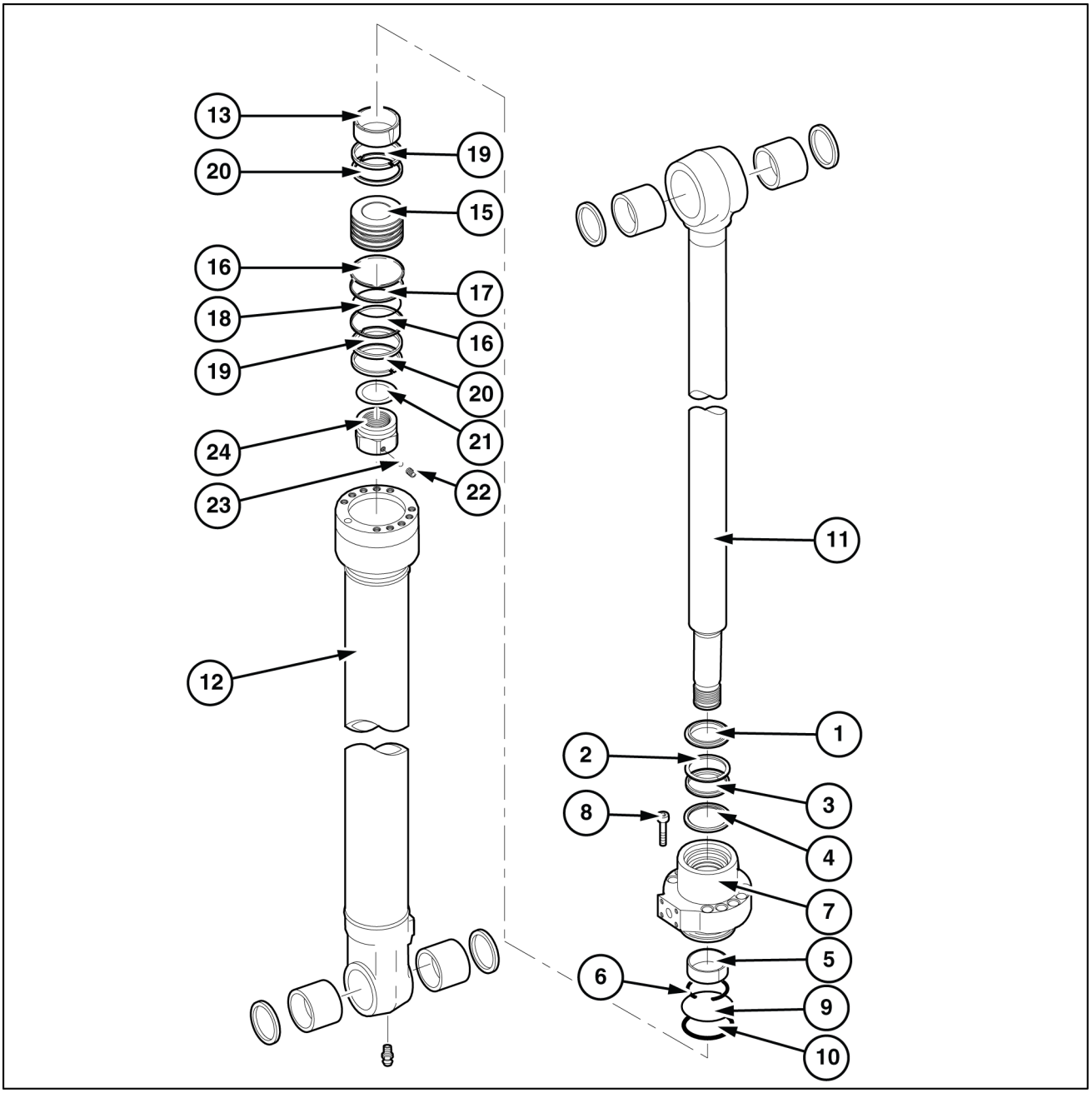
Hydraulic systems - Component localization

Bucket cylinder



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1. Wiper ring
2. Backup ring
3. Seal
4. Seal
5. Bushing
6. Snap ring
7. Cylinder head
8. Socket bolt (Qty. 12)
9. Backup ring
10. O-ring
11. Cylinder rod
12. Cylinder tube
13. Cushion bearing
15. Piston
16. Backup ring (Qty. 2)
17. Seal ring
18. O-ring
19. Slide ring (Qty. 2)
20. Slide ring (Qty. 2)
21. Shim
22. Set screw
23. Steel Ball
24. Nut

Holding valve for boom & arm hydraulic circuit

Positioning circuit (triple articulation version)

On that occasion, the oil returning from the head **(H)** goes through the recirculation path in the boom spool, pushes the check valve in the spool open, is recirculated to the Bb port and is supplied to the rod **(R)**. When the **(R)** pressure is larger than the head **(H)** pressure, the check valve in spool closes.

Thereupon, the recirculation is stopped.

5. Remove drain hose **(2)**.

   : **27 mm** (**1.06 in**)

   : **73.5 - 83.5 N·m** (**54.2 - 61.6 lb ft**)

6. Remove hoses **(4)** and **(6)**.

   : **36 mm** (**1.42 in**)

   : **159 - 195 N·m** (**117.3 - 143.8 lb ft**)

7. Remove hoses **(1)** and **(3)**.

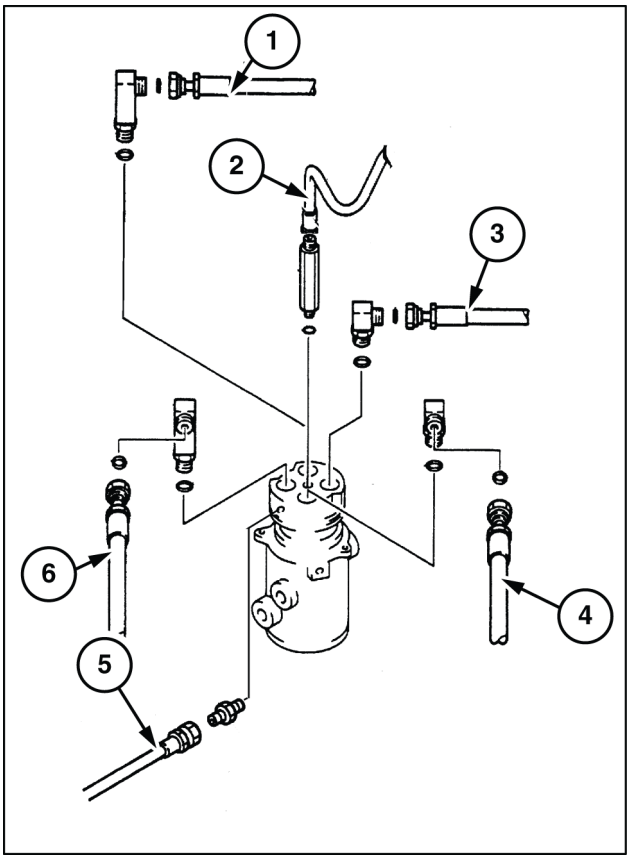
   : **36 mm** (**1.42 in**)

   : **159 - 195 N·m** (**117.3 - 143.8 lb ft**)

8. Remove hose **(5)**.

   : **19 mm** (**0.75 in**)

   : **24.4 - 34.4 N·m** (**18.0 - 25.4 lb ft**)

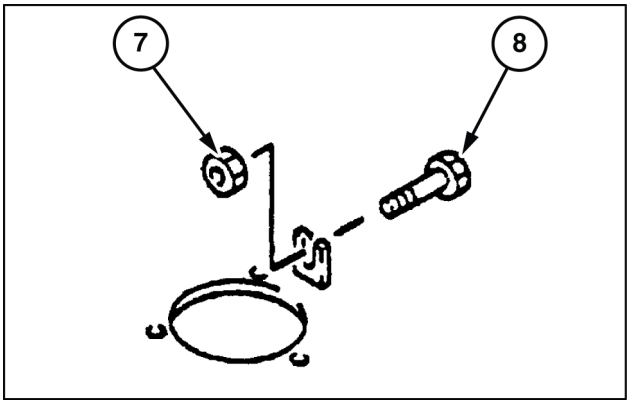


TULI12ECX1777BC 2

9. Loosen the stop nut **(7) M20** of swivel joint and remove the screw **(8) M20 x 120**.

   : **36 mm** (**1.42 in**)

   : **157 N·m** (**115.8 lb ft**)



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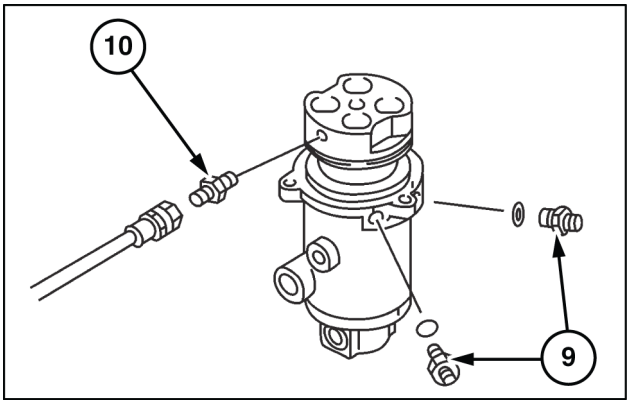
10. Remove two adapters **(9)** and **(10)**.

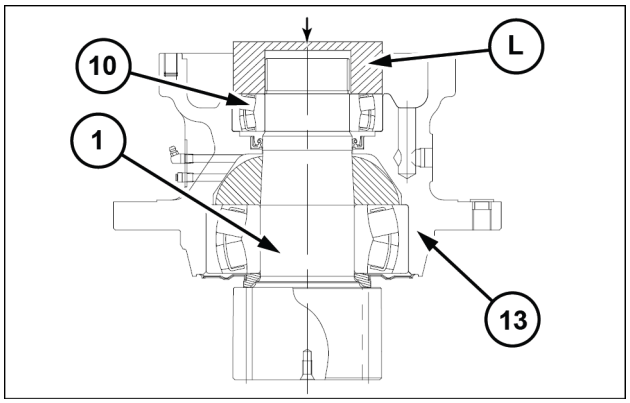
    : **19 mm** (**0.75 in**)

    : **36 N·m** (**26.6 lb ft**)



TULI12ECX1779AB 4

10. Press fit spherical bearing (upper) **(10)** in pinion shaft **(1)** and housing **(13)** at the same time by means of special tool **(L)**. Press fit spherical bearing (upper) **(10)** in pinion shaft **(1)** and housing **(13)** at the same time by means of special tool **(H)**.
11. Attach retaining ring **(20)**. Attach the snap ring **(20)**.
12. Assemble No. 1 spider assy performing the following operations:
    A. Coat the bore surface of pinion **(3)** with grease. Put pinion **(3)** on thrust washer **(15)** and assemble needle bearings **(16)** into the bore surface.
    B. Fit thrust washers **(15)**, pinions **(3)** and fit snap rings **(28)** by means of pliers.



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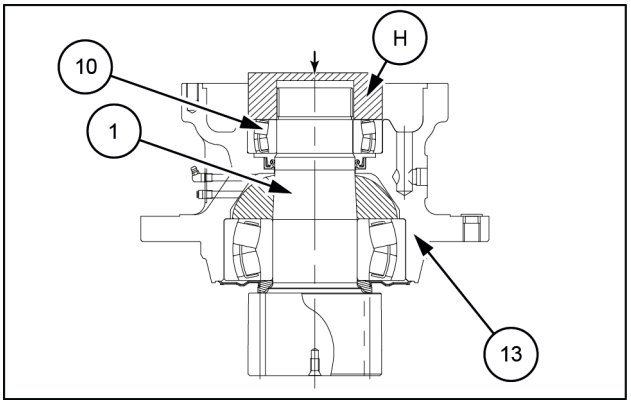

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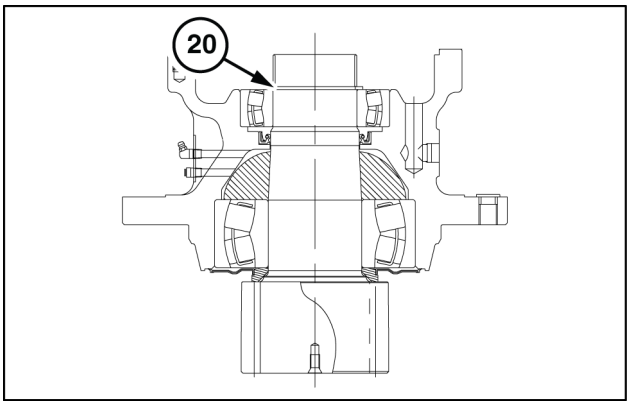

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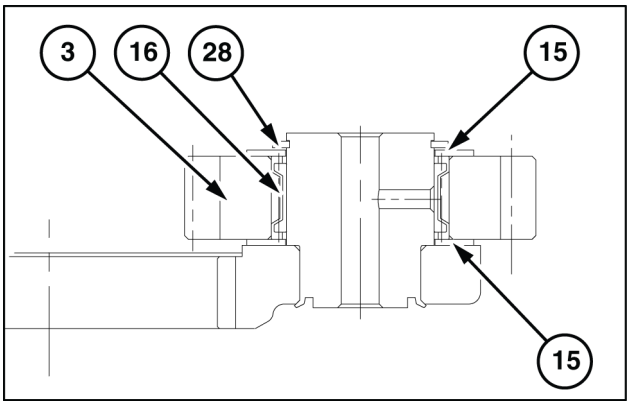

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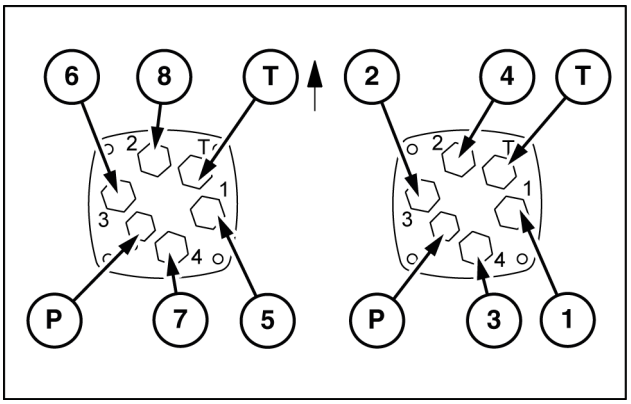
Pump control valves - Install

1. Install pilot valve **(8)** on the frame tightening securing screws **(9) M6 x 25** complete with washers.
   : **5 mm** (**0.2 in**)
   : **11.8 N·m** (**8.7 lb ft**)
2. Connect hoses to pilot valve body **(8)**.
   : **19 mm** (**0.7 in**) (Port: P)
   : **29.4 N·m** (**22 lb ft**)
   : **22 mm** (**0.9 in**) (Port: 1 to 8, T)
   : **49 N·m** (**36 lb ft**)



TULI12ECX1664AB 1

3. Tighten the handgrip on the pilot valve, tighten lock-nut **(5)** and reconnect the electric connector.
   : **22 mm** (**0.9 in**)
   : **41.2 N·m** (**30.4 lb ft**)

Left side			Right side		
5	Swing (L)	Gray	1	Bucket (H)	Red
6	Swing (R)	Red	2	Bucket (R)	Blue
7	Arm (H)	Blue	3	Boom (H)	Green
8	Arm (R)	Green	4	Boom (R)	Gray

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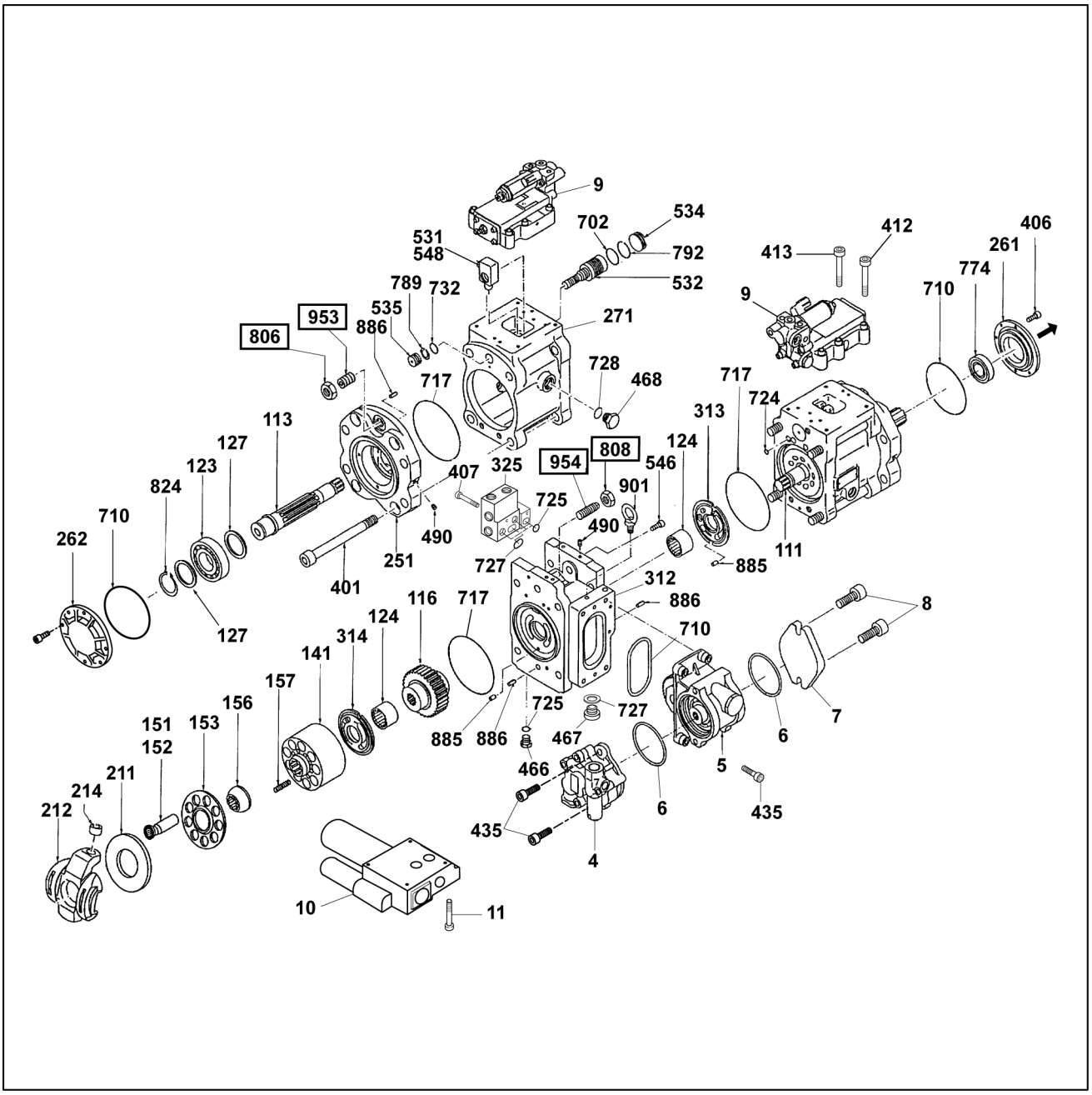
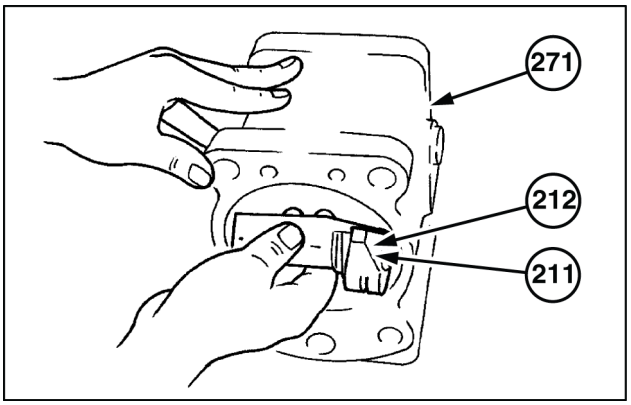
Pump - Exploded view



TULI12ECX3158GA 1

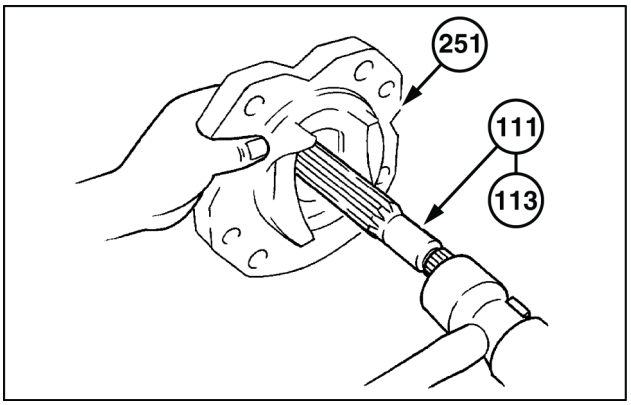
NOTE: *The number in a rectangle represent adjust screws. Do not tamper with the adjust screws as much as possible.*

9. Draw out shoe plate **(211)** and swash plate **(212)** from pump casing **(271)**.



TULI12ECX0921AB 9

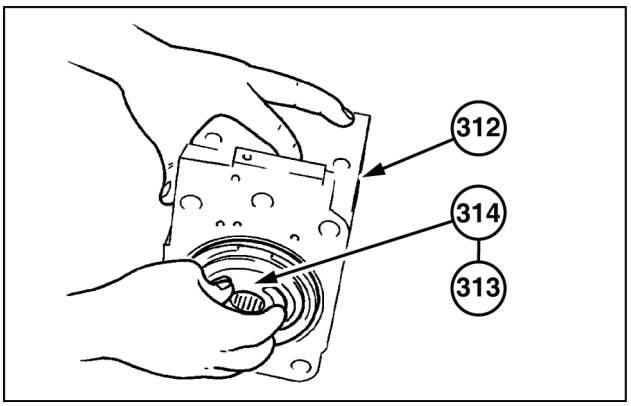
10. Tap lightly the shaft end **(111)** and **(113)** by means of a plastic hammer and draw out the shaft from the swash plate support.



TULI12ECX0922AB 10

11. Remove valve plate **(313)** and **(314)** from valve block **(312)**.

NOTE: *The valve plate may come off during the separation of pump casing from valve block.*



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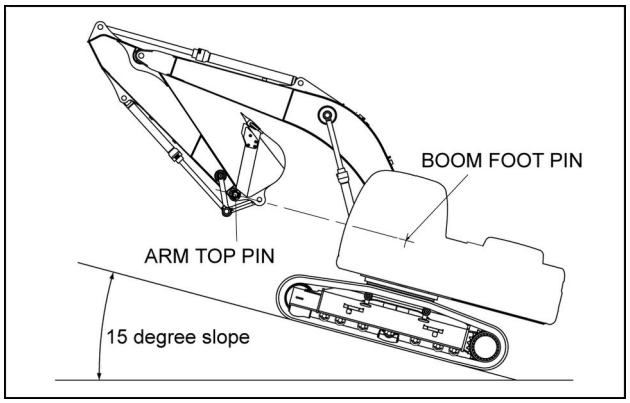
Hydraulic travel system - Check

Performances of parking brake

Purpose

Confirm that the parking brake holds a stopped condition of the machine in a no-load travel position and on a 15° slope.



TULI12ECX0443AA 1

Condition

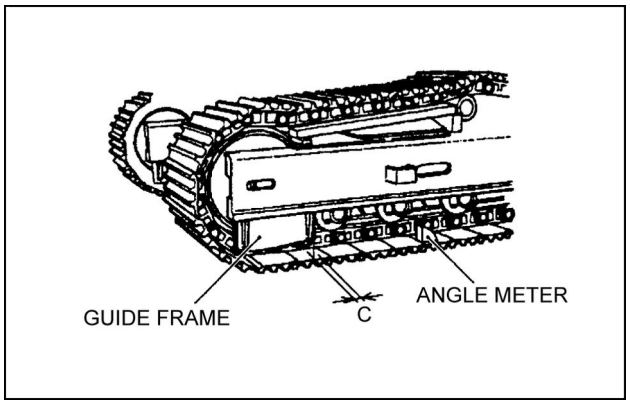
A slope with (Approx. 15°) gradient and a stopped condition in a no-load travel position.

Preparation

Place an angle meter on the shoe plate and confirm that it makes an angle more than 15°.
Hang a perpendicular in parallel with the guide frame rib on the track frame and put a mark (matching mark) on the shoe plate.

Measurement

Five minutes after the engine stops, measure the movement distance of the matching mark.

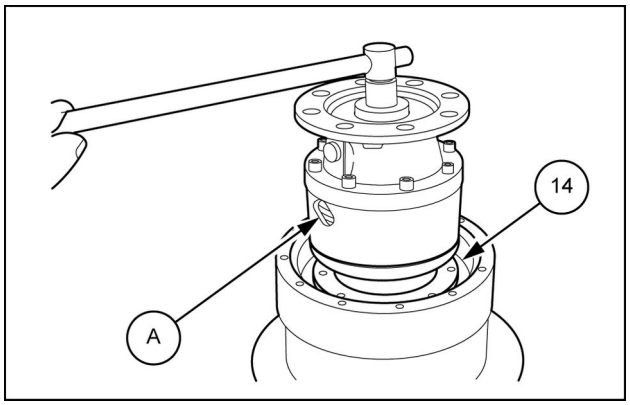


TULI12ECX0444AA 2

Parking brake/ 5 min

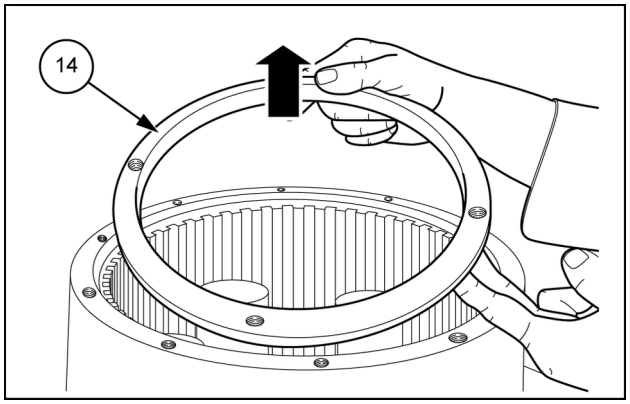
Measuring position	Standard value	Reference value for remedy	Service limit
C	0	**1 mm** (**0.04 in**)	**2 mm** (**0.08 in**)

13. By using a tackle place the torque multiplier **(A)** on the ring nut **(14)** and, by using the torque multiplier, loosen the ring nut **(14)**.



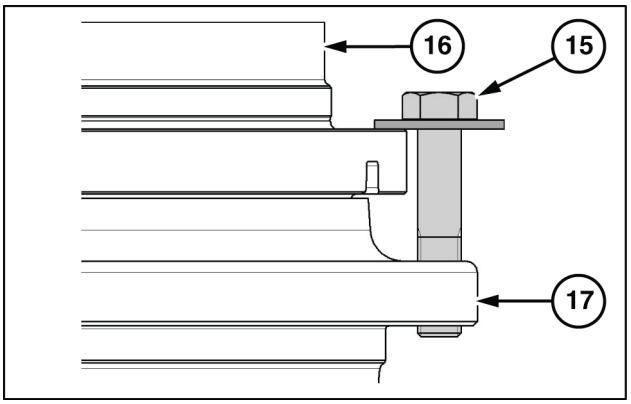
COIL14CEX1221AB 13

14. Take out the ring nut **(14)**.



COIL14CEX1220AB 14

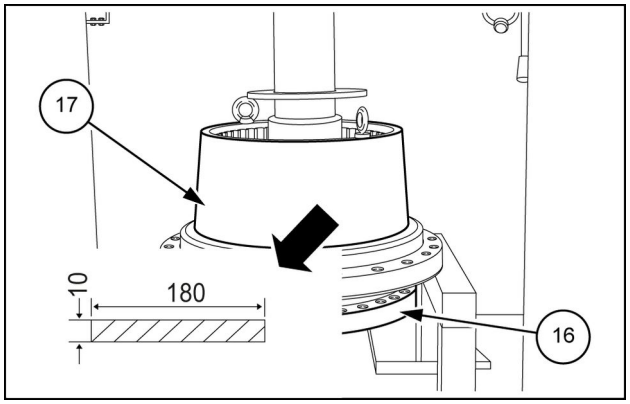
NOTE: *Tighten the No. 2 bolts* ***M20 x 100*** *-8.8 ISO 4017* ***(15)*** *to 180° with No. 2 ISO 7093 22x60x4 washers in the thread orifices of the gearbox housing* ***(17)*** *to keep the housing from coming out of the hydraulic motor* ***(16)*** *during the movement of the unit. Remove the screws when the unit is positioned.*



TULI12ECX1119AB 15

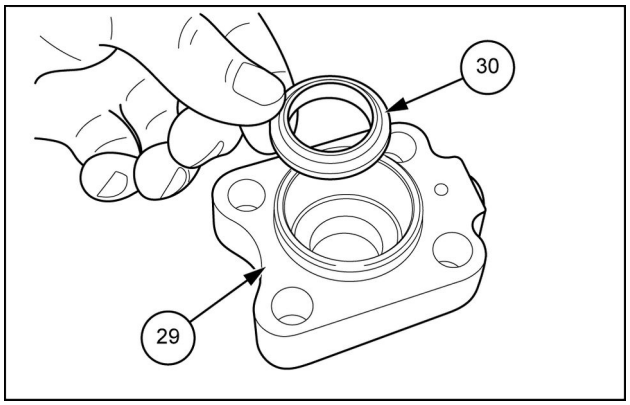
15. By using a press, push on a metal stopper and remove the hydraulic motor **(16)** from the gearbox housing **(17)**.

NOTE: *In case of oil leakages, it might be necessary to check and eventually replace the lifetime seals* ***(18)****, which means both the metal rings parts and the O-ring seals.*



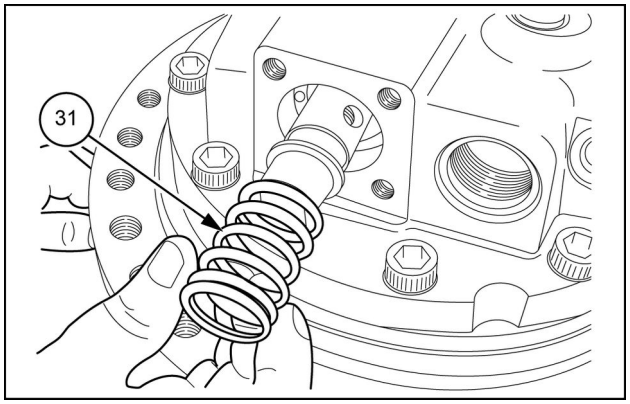
COIL14CEX1329AB 16

41. Take out the spring seat **(30)** from the second flanged plug **(29)**.



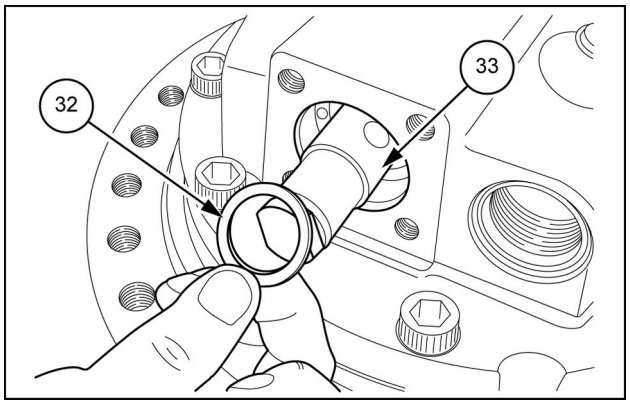
COIL14CEX1177AB 61

42. Remove the second spring **(31)**.



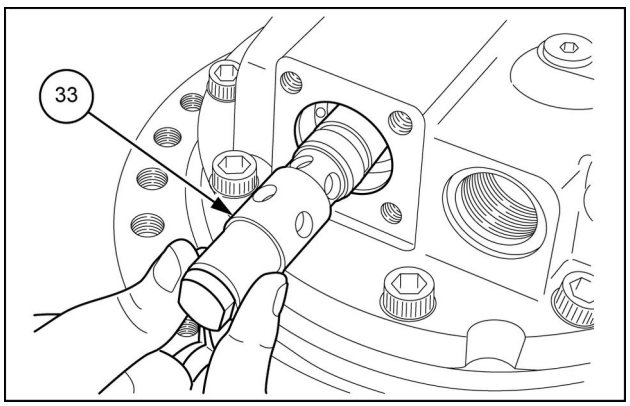
COIL14CEX1815AB 62

43. Take out the second spring seat **(32)** from the counterbalance valve spool **(33)**.



COIL14CEX1175AB 63

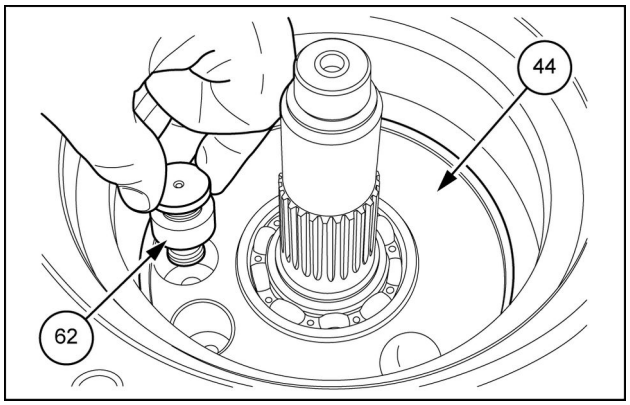
44. Take out the counterbalance valve spool **(33)**.



COIL14CEX1174AB 64

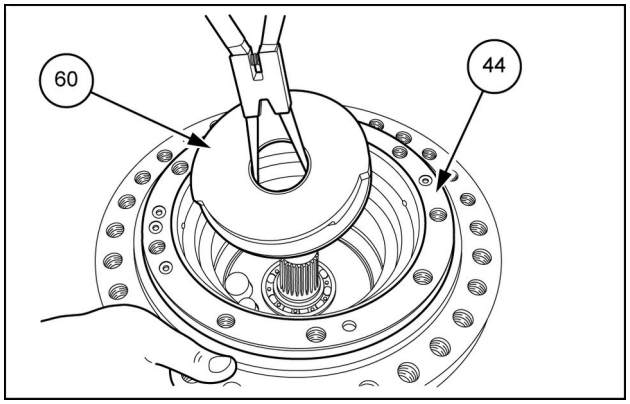
9. Mount the No. 2 pins **(62)** in their seats inside the flanged hub **(44)**.

ATTENTION: *Be sure that the pistons **(62)** can move freely into the seats.*



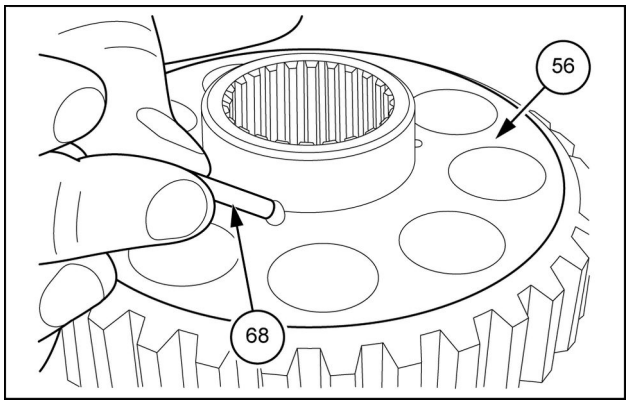
COIL14CEX1130AB 9

10. Insert the swash plate **(60)** inside the flanged hub **(44)** being careful that spherical housings matches with the 2 steel balls.



COIL14CEX1129AB 10

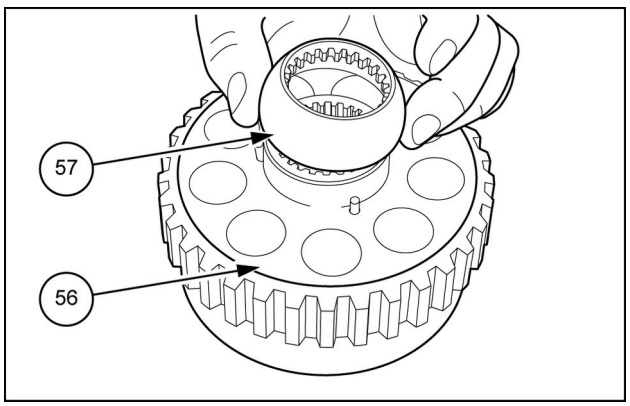
11. Mount the No. 3 pins **(68)** in their seats inside the cylinder block **(56)**.



COIL14CEX1128AB 11

12. Assemble the spherical retainer holder **(57)** on the cylinder block **(56)**.

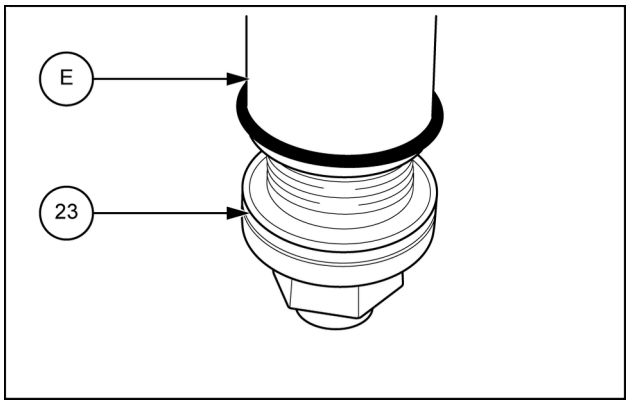
NOTE: *The two splines must be aligned together.*



COIL14CEX1127AB 12

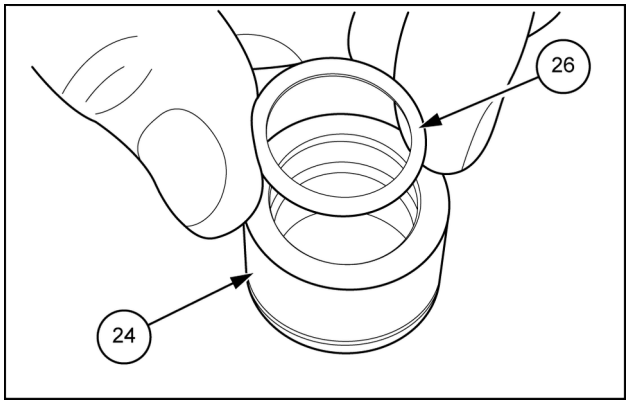
Reassembly of the relief valve assy

54. By using the stopper **(E)** assemble the O-ring seal in its seat in the relief valve **(23)**.



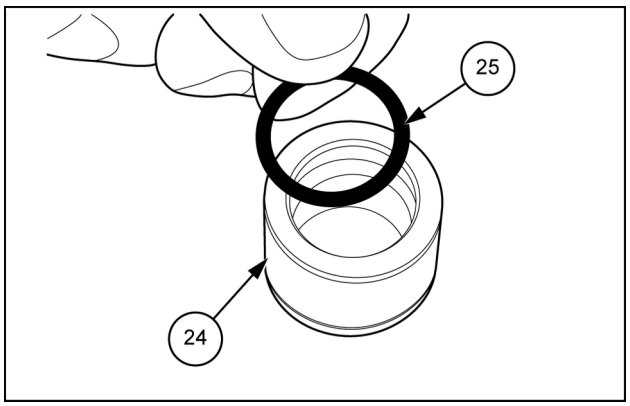
COIL14CEX1084AB 57

55. Assemble the first backup-ring **(26)** into its seat in the free piston **(24)**.



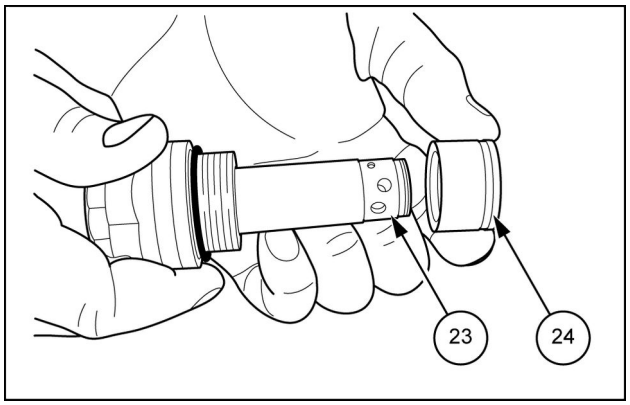
COIL14CEX1083AB 58

56. Assemble the O-ring seal **(25)** into its seat in the free piston **(24)**. After this step assembly the second backup ring as shown on the sketch.



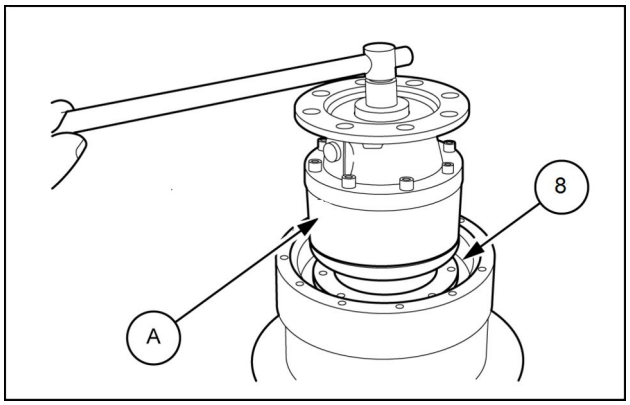
COIL14CEX1082AB 59

57. Insert the free piston **(24)** in the relief valve **(23)** checking that the groove side is turned toward the inside of the motor.



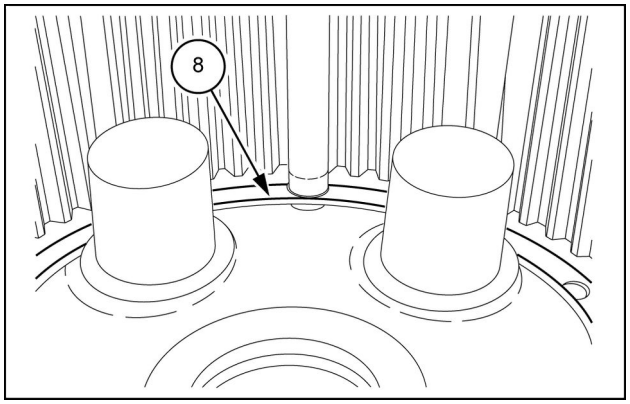
COIL14CEX1081AB 60

11. By using a tackle place the torque multiplier **(A)** on the ring nut **(8)** and tighten by a torque wrench with an input multiplier torque of **138 - 148 N·m** (**101.78 - 109.16 lb ft**) corresponding to an output multiplier torque of **7000 - 7500 N·m** (**5162.93 - 5531.72 lb ft**).



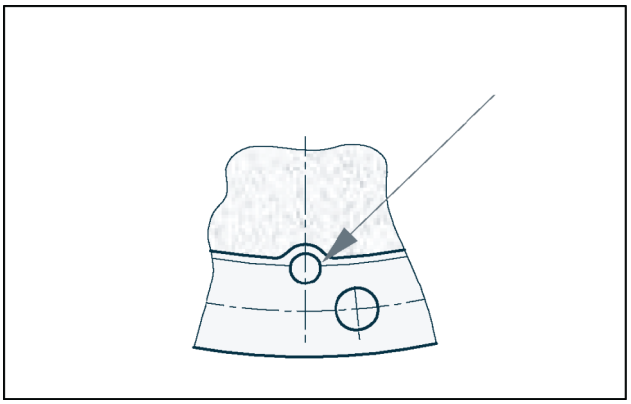
COIL14CEX1221AB 104

12. Stake the ring nut **(8)** near 2 seats of the hydraulic motor.



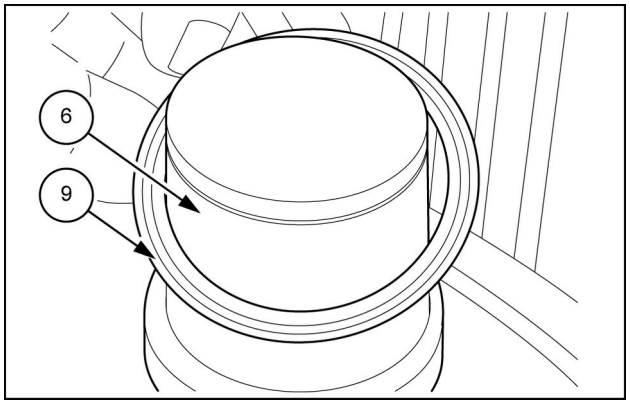
COIL14CEX1045AB 105

NOTE: *Stake Ø **4 - 5 mm** (**0.16 - 0.20 in**) (depth **1 - 1.5 mm** (**0.04 - 0.06 in**)).*



TULI12ECX2892AA 106

13. Assemble correctly the spacers **(9)** on the pins of the hydraulic motor **(6)**.



COIL14CEX1845AB 107

Hydraulic swivel - Disconnect

Disconnect the hose on the lower side of swivel joint.

NOTE: *Close all openings with plugs to keep clean.*

Disconnect the two hose **(1)**. (E Port: **PF 1/2**)

: **27 mm**

Tightening torque : **78.5 N·m** (**58 lb ft**)

Disconnect the hose **(2)** and **(3)**. (A and B Port: **PF 1**)

: **36 mm**

Tightening torque: **177 N·m** (**130.5 lb ft**)

Disconnect the hose **(4)** and **(5)**. (C and D Port: **PF 1**)

: **36 mm**

Tightening torque: **177 N·m** (**130.5 lb ft**)

Disconnect the two hose **(6)**. (F Port: **PF 1/4**)

: **19 mm**

Tightening torque: **29.4 N·m** (**21.7 lb ft**)

Contents

Hydraulic systems - 35

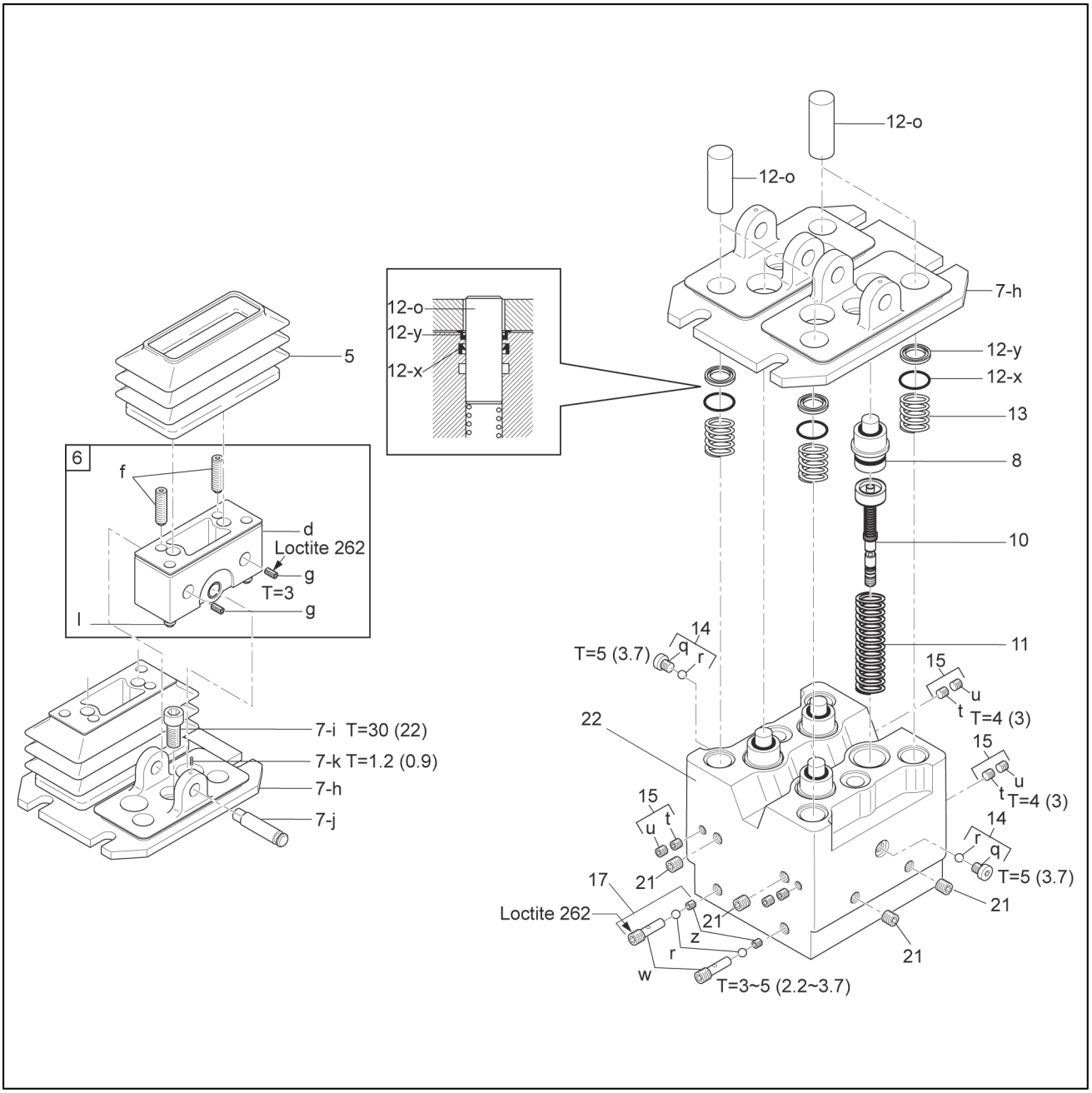
Hydraulic hand control - 355

Cleaning parts

1. Clean parts with wash oil roughly and the parts of pilot valve completely.
2. Dry parts by swabbing clean rag.
3. Apply rust preventives on parts.

Hydraulic foot control - Exploded view

Pilot valve (for travel)



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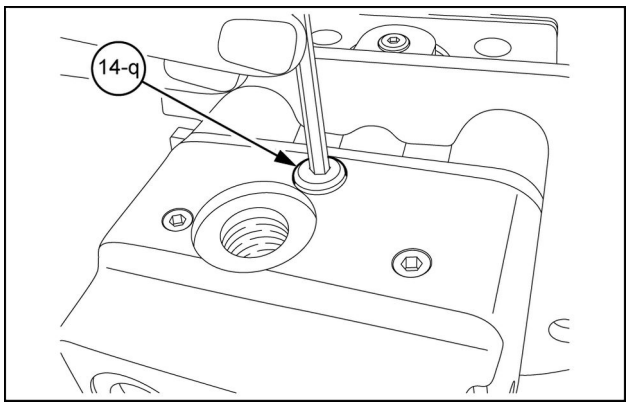
NOTE: *T = Tightening torque Nm (lbf·ft)*

Hydraulic foot control - Drain fluid

Drain of hydraulic pilot control unit

1. When removing the retaining plate, the throttle kit or the shuttle valve kit, it is necessary to drain the pilot unit.
2. Reassemble the pilot unit control completely.
3. Install the pilot unit control in the machine.
4. Slightly unscrew the check valve plug (14-q) using a **4 mm** (**0.2 in**) socket wrench.
5. Switch on the machine.
6. Operate gently the pedal until the bubbles disappear.
7. Tighten the check valve plug (14-q).
   Torque: **5 N·m** (**3.7 lb ft**)
8. Repeat the operation for the other check valve plug.



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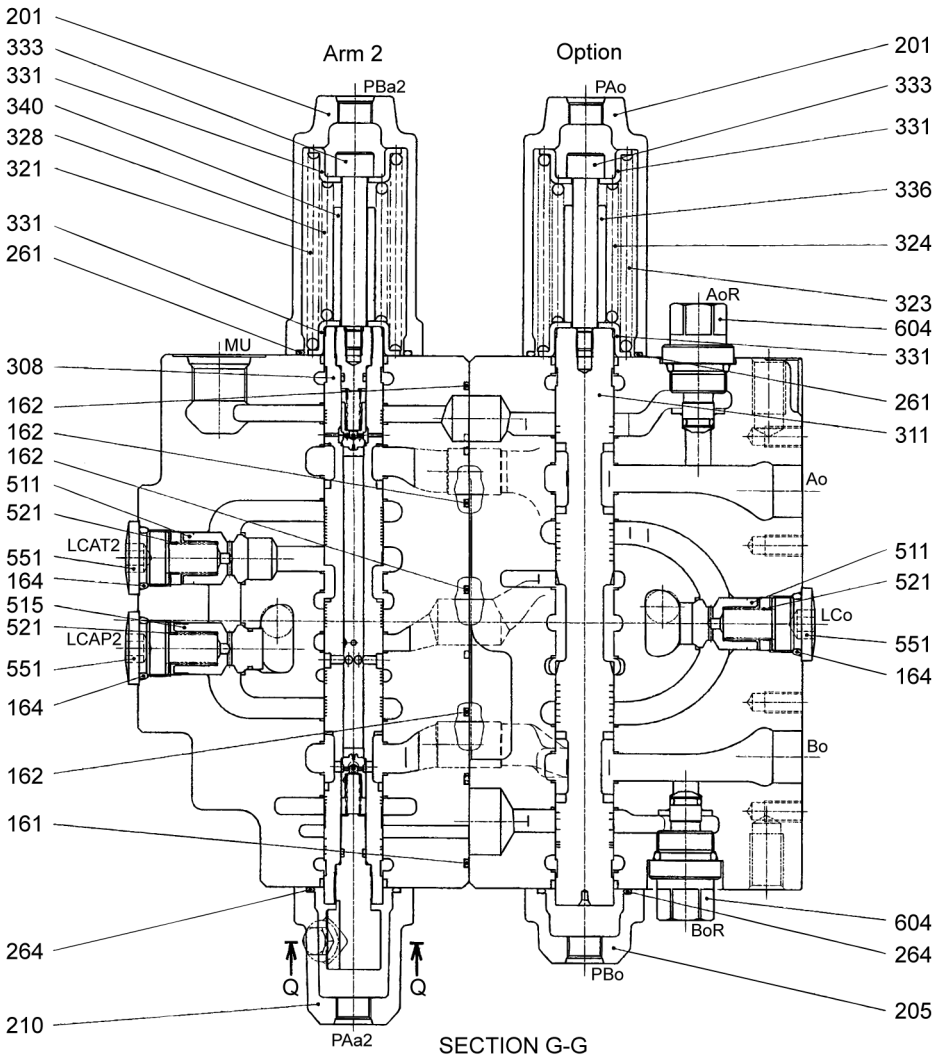
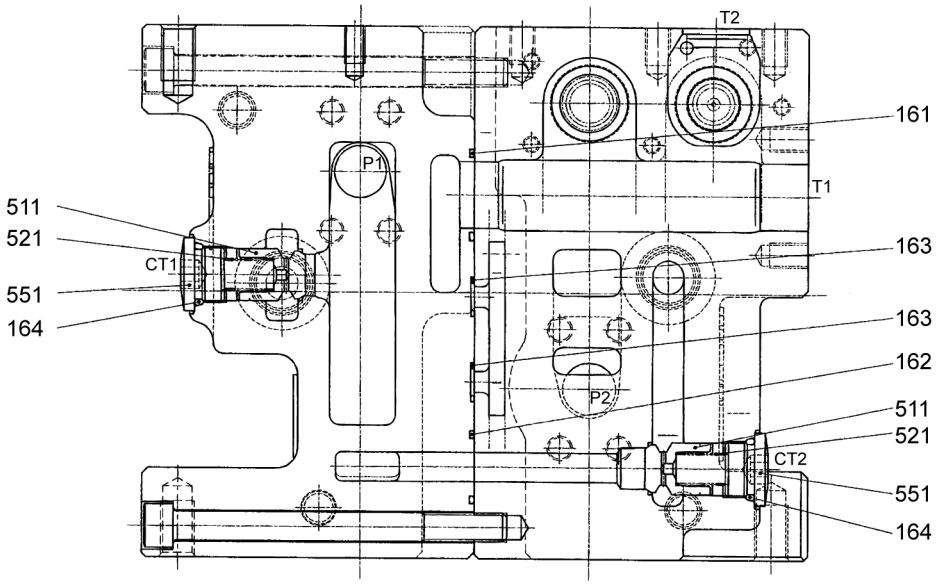
Control valve (5/6)

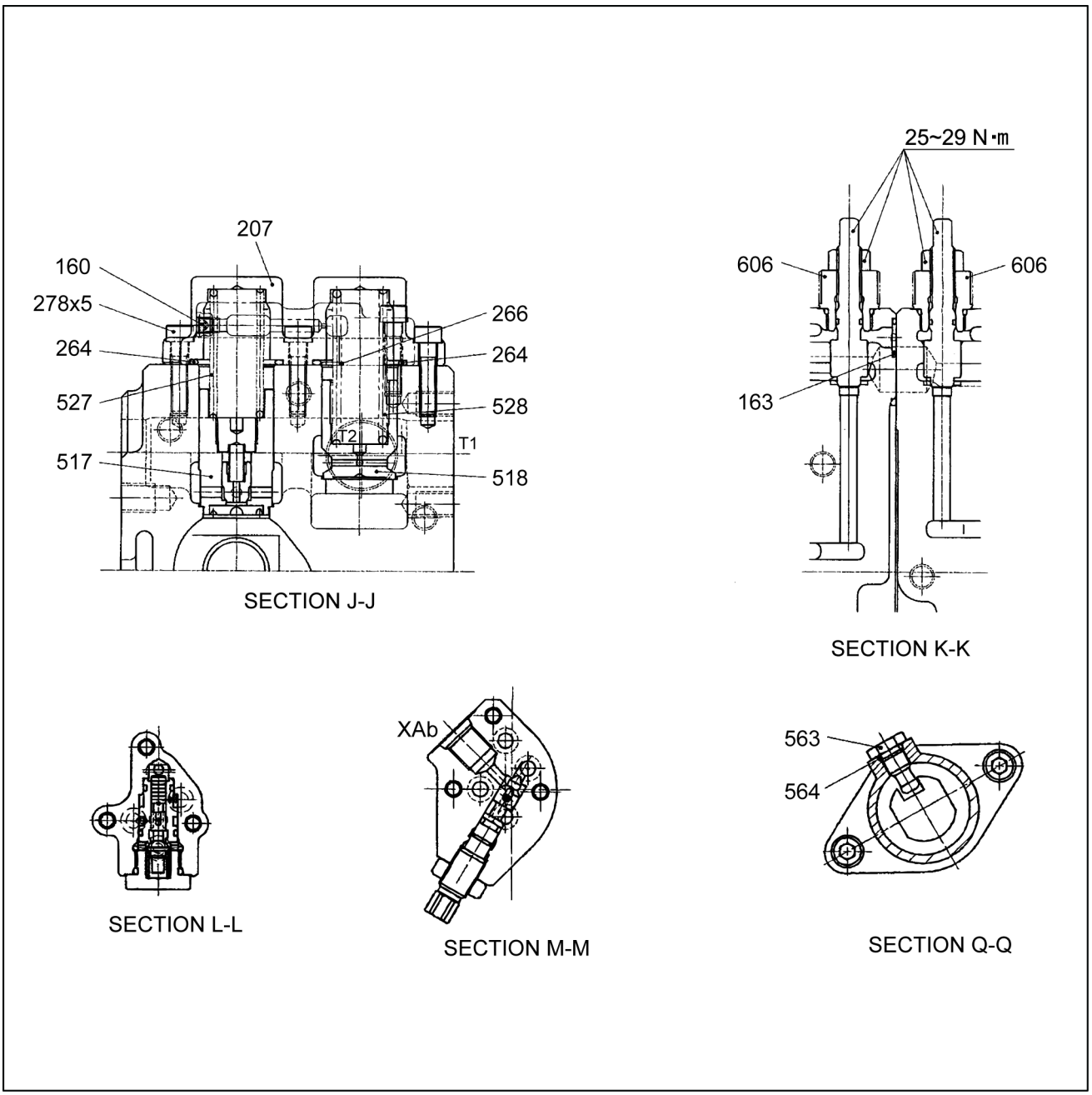


SECTION G-G



SECTION H-H

TULI12ECX1000HB 7



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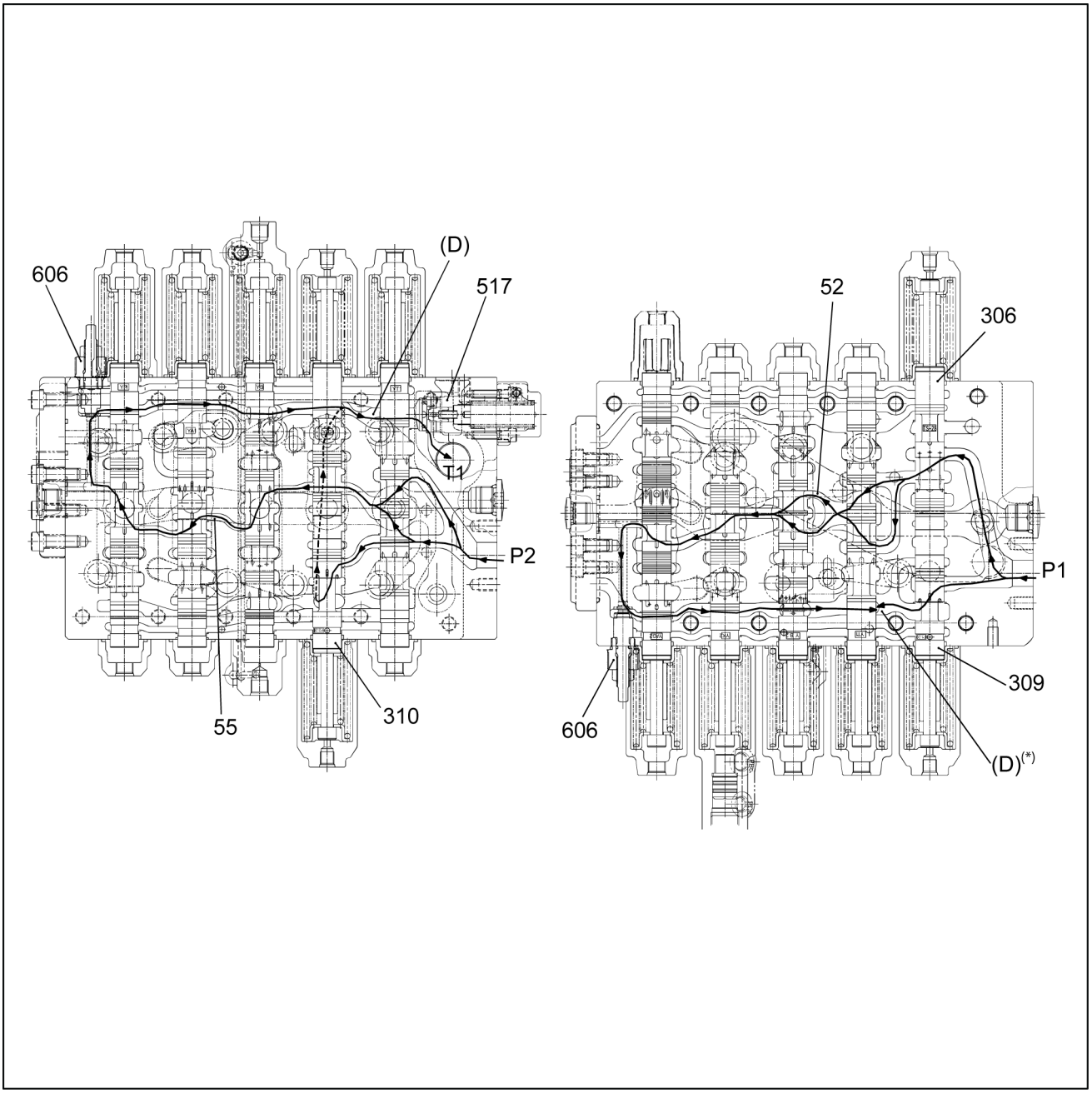
Tightening torque	No.	Parts Name	Qty.
	101.	Casing A	1
	102.	Casing B	1
220 - 250 N·m (**162 - 184 lb ft**)	154.	Plug **R0H**	3
20 - 24 N·m (**15 - 18 lb ft**)	159.	Plug **PT 1/4** MEC (Pre-coat bolt)	1
7.8 - 9.8 N·m (**5.8 - 7.2 lb ft**)	160.	Plug **PT 1/16 NPTF1/16** MEC (Pre-coat bolt)	5
	161.	O-ring	7
	162.	O-ring	15
	163.	O-ring	11
	164.	O-ring	19
	201.	Cover	3
	202.	Cover	6
	203.	Cover	1
	204.	Cover	1
	205.	Cover	6
	206.	Cover	1

Tightening torque	No.	Parts name	Qty.
	205	Cover	7
	206	Cover	1
	207	Back pressure check valve cover	1
	209	Cover	1
	210	Cover	2
9.8 - 14 N·m (7.2 - 10.3 lb ft)	211	Lock valve selector sub	2
	212	Plate	1
	213	Plate	1
	215	Boom lowering valve	1
	216	Piston	1
	261	O-ring	12
	264	O-ring	10
	266	O-ring	4
25 - 34 N·m (18 - 25 lb ft)	273	Socket bolt	40
98 - 120 N·m (72 - 89 lb ft)	274	Socket bolt	4
98 - 120 N·m (72 - 89 lb ft)	275	Socket bolt	4
25 - 34 N·m (18 - 25 lb ft)	278	Socket bolt	5
9.8 - 14 N·m (7.2 - 10.3 lb ft)	279	Socket bolt	3
	301	Boom spool sub	1
	302	Arm 1 spool	1
	303	Swing spool	1
	304	Bucket spool	1
	305	Boom conflux spool	1
	306	Travel spool	2
	307	Travel priority spool	1
	308	Arm 2 spool sub	1
	309	P1 unload spool	1
	310	P2 unload spool	1
	311	Option spool	1
	321	Spring	5
	322	Spring	4
	323	Spring	3
	324	Spring	3
	325	Spring	1
	326	Spring	1
	327	Spring	3
	328	Spring	1
	329	Spring	3
	331	Spring seat	24
16 - 18 N·m (11.8 - 13.3 lb ft) **LOCTITE® 262™**	333	Spacer bolt	12
	336	Stopper	10
	339	Stopper	1
	340	Stopper	1
	511	Poppet	11
	563	Plug	2
	564	O-ring	2
	512	Poppet	2
	514	Poppet	2
	515	Poppet	1
	517	Boost check valve	1
	518	Poppet	1
	521	Spring	11
	522	Spring	2
	523	Spring	1



TULI12ECX0595GA 1

In neutral position

(*) Connected to low pressure circuit of P2 side casing

Actuation in travel operation

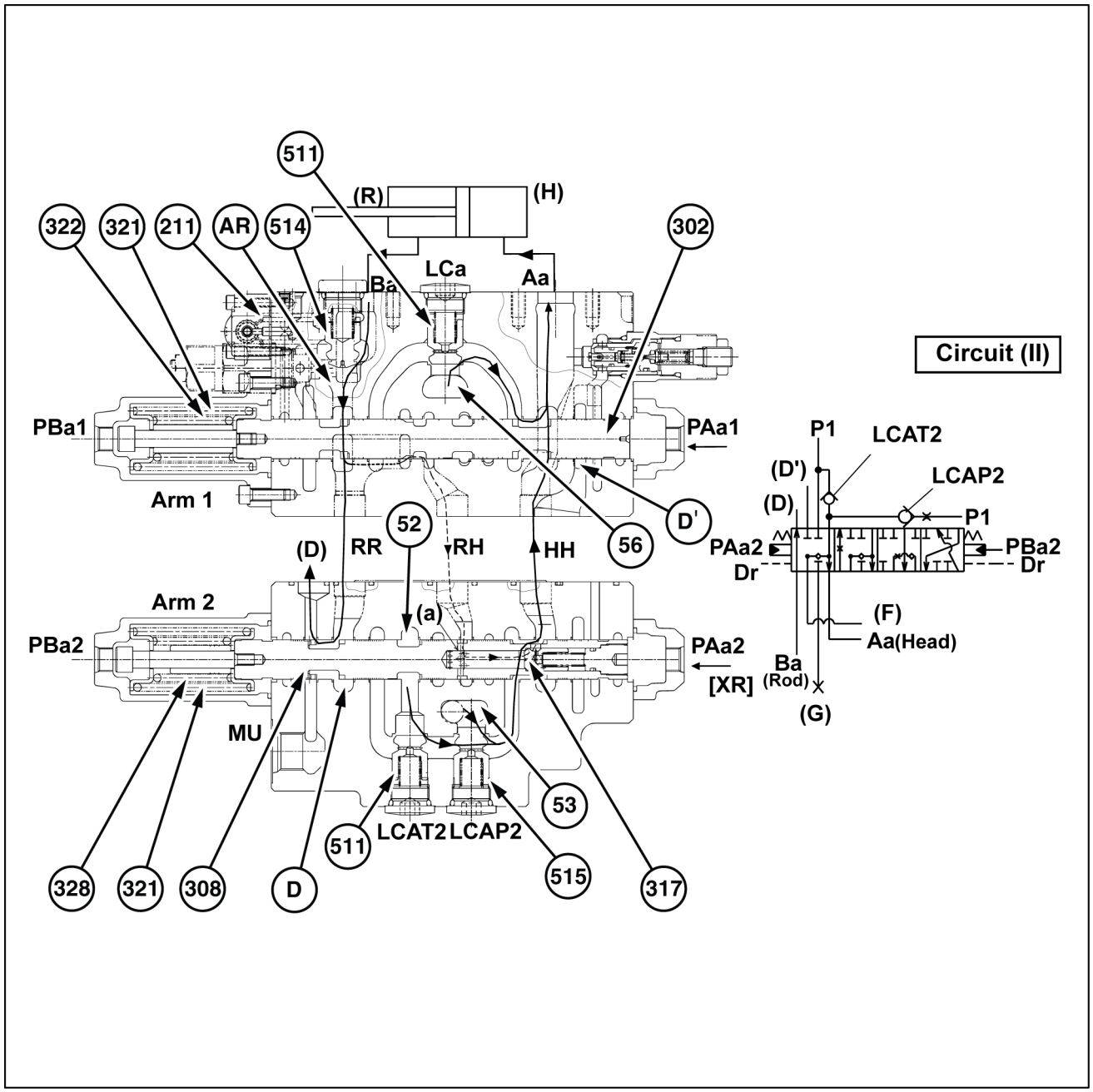
a) In travel independent operation

On starting travel operation (forward) started, the hydraulic oil delivered by hydraulic pump P1 is fed into travel right motor, and the hydraulic oil delivered by hydraulic pump P2 is fed into travel left motor. The pilot pressure enters ports PAr and PAL, and the right and left travel spools **(306)** move rightward the force of springs **(323) (324)** and the secondary pressure of solenoid proportional valves [X1] and [X2] acts on ports PCb and PCa and switches unloading spools **(309) (310)**.

The hydraulic oil delivered by hydraulic pump P1 passes through travel straight spool **(307)** and flows into main circuit, and flows through between the perimeter of right travel spool **(306)** and casing and is fed into A side of right travel motor through port Ar. The hydraulic oil delivered by hydraulic pump P2 flows through between the perimeter of left travel spool **(306)** and casing and is fed into A side of left travel motor through port AL similarly to the stream of hydraulic oil delivered by hydraulic pump P1.

through between the perimeter of arm 2 spool **(308)** and casing and flows through boost check valve **(517)**) through low pressure **(D)** and returns to the hydraulic tank through tank port T1.

The return oil from AR chamber passes through between the perimeter of arm 1 spool **(302)** and casing and flows through casing inside passage **(RH)** and then is led to the inside of arm 2 spool **(308)** through circular notch **(a)** of arm 2 spool **(308)**. In heavy load operation, since the pressure on arm cylinder head side **(H)** is higher than the rod side, the hydraulic oil in arm 2 spool **(308)** does not flow into casing inside passage **(HH)**, but flows through check valve **(319)** and passes through boost check valve **(517)** through low pressure **(D)** and returns to the hydraulic tank through port T1.



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(F): To arm 1 spool
(G): To pilot cut valve
In arm in operation (In heavy load operation)

Main control valve - Service instruction

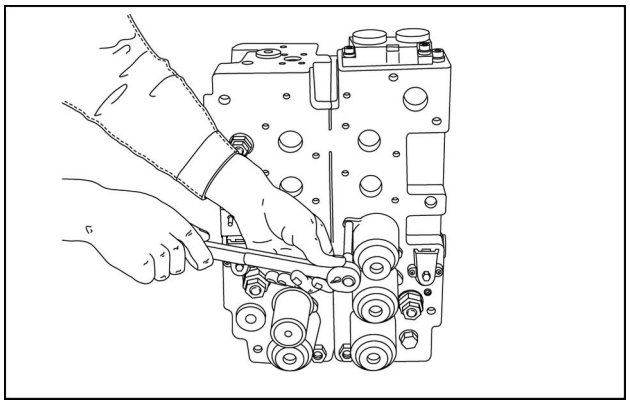
Inspection of components

Part name	Inspection item	Criterion and remedy
Casing	1. Look for scratches, rusting and corrosion.	1. If any of the following parts are damaged, replace the casing. • Sliding part of casing hole and spool, particularly the land, to which holding pressure is applied. • Area of sealing part that is in contact with O-ring. • Sealing and seating part of main or overload relief valve. • Area of seating part or sliding part of poppet. • Sealing part of plug. • Defects of other parts that seem to prevent normal function.
Spool	1. Look for scratches, galling, rusting and corrosion. 2. Insert the spool in the casing bore, and move it while turning it.	1. If a detectable defect with your fingernail is found on the sliding part of the outer circumference, replace the spool. 2. If the spool damages the O-ring or does not move smoothly, repair or replace the spool.
Poppet	1. Look for damage on the poppet and the spring. 2. Insert the poppet in the casing, and move it.	If spring is damaged, replace it. 1. If the seat of poppet or spring are damaged, correct or replace it. 2. If the poppet moves lightly without catching, it is normal.
Spring and related parts	1. Look for rust, corrosion, deformation, and breakage of the spring, spring seat, stopper, spacer bolt and cover.	1. If damaged heavily, replace.
Main relief valve, Port relief valve, By-pass cut valve	1. Look for rust and damage on outer surface. 2. Inspect the contact face of the valve seat. 3. Inspect the O-ring, backup ring, and seal.	1. Replace. 2. If damaged, replace. 3. As a general rule, replace all parts with new ones. (Between casing and seal)

Disassembling the swing spool

1. Loosen the socket bolts **(273)** and remove the spring cover sub **(204)** and the O-ring **(261)**, **(266)** for swing. Do not disassemble spring cover sub **(204)** further unless there is special reason.
2. Draw out the swing spool assembly **(303)**, spring seat **(331)**, springs **(321)**, **(322)**, stop **(336)** and bolt **(333)** from housing A **(101)**.

ATTENTION: *When drawing out the spool assy., use care so as not to score casing A **(101)**.*



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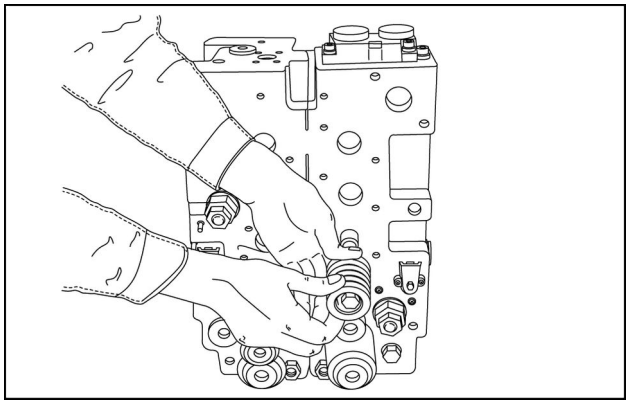
3. Fix the swing spool assy with vise via a protective plate (aluminum plate, etc.) and remove bolt **(333)**. Then separate spring seat **(331)**, springs **(321)**, **(322)** and stopper **(336)** from swing spool **(303)**.



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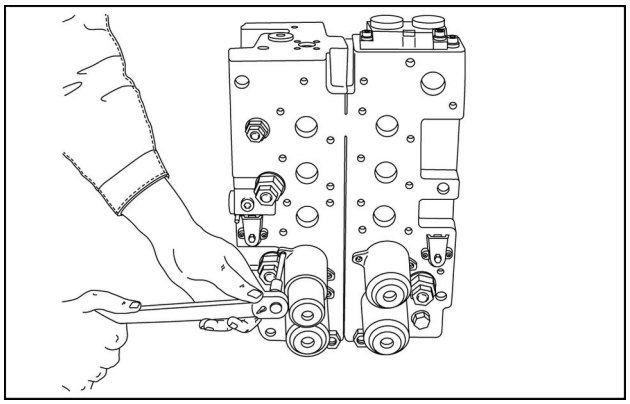
Disassembling bucket spool

1. Loosen socket bolts **(273)** and remove bucket spring cover **(209)** and O-ring **(261)**.



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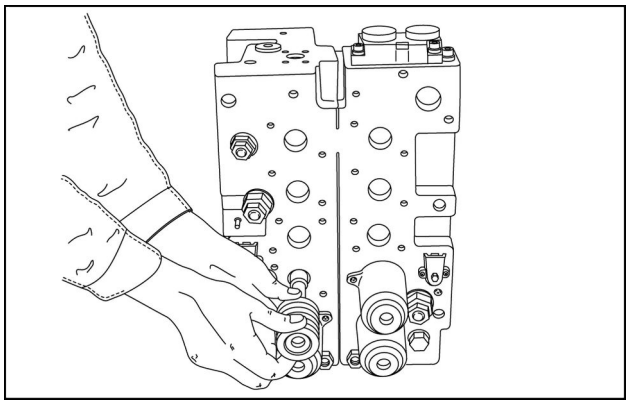
2. Draw out the bucket spool assembly **(304)**, spring seat **(331)**, springs **(321)**, **(322)**, stop **(336)** and bolt **(333)** from housing B **(102)**.

ATTENTION: *When drawing out the spool assy., take care so as not to score the casing B **(102)**.*



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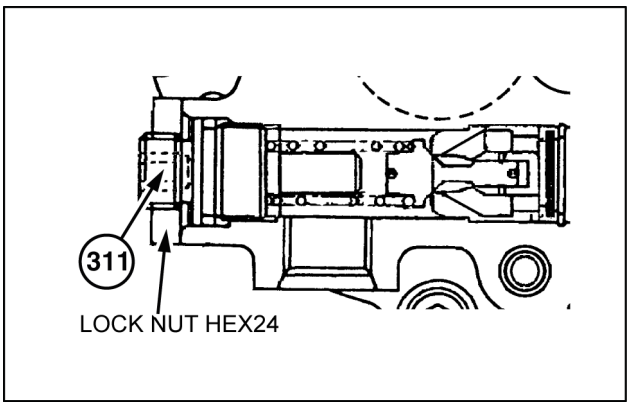
Main control valve - Adjust – Relief valve

Pilot relief valve

1. Adjust it with adjust screw **(311)**.

: **24 mm** (**0.9 in**)
: **29.4 N·m** (**22 lb ft**)
: **6 mm** (**0.2 in**)



TULI12ECX0430AB 1

No. of turns of adjust screw	Pressure change
1 turn	Approx. **2.1 MPa** (**305 psi**)

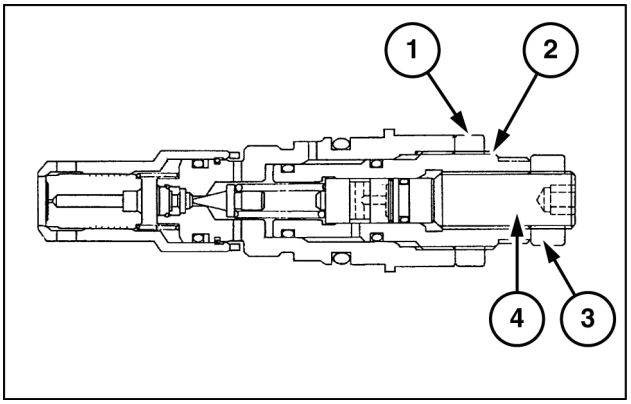
2-stage main relief valve

(commom for travel and ATT sections)

Start from the boosting side, first. Loosen nut **(1)**, adjust the pressure with adjusting screw **(2)** and tighten nut **(1)** after completion of the adjustment on the boosting side.

2. Then, loosen nut **(3)**, adjust the pressure on the standard side with adjusting screw **(4)** and tighten nut **(3)** after completion of the adjustment.

: **32 mm** (**1.3 in**)
: **27.4 - 31.4 N·m** (**20 - 23 lb ft**)
: **22 mm** (**0.9 in**)
: **27.4 - 31.4 N·m** (**20 - 23 lb ft**)
: **19 mm** (**0.7 in**) adjust screw
: **6 mm** (**0.2 in**)



TULI12ECX0425AB 2

No. of turns of adjust screw	Pressure change
Boosting side 1 turn	Approx. **17.6 MPa** (**2553 psi**)
STD side 1 turn	Approx. **17.6 MPa** (**2553 psi**)

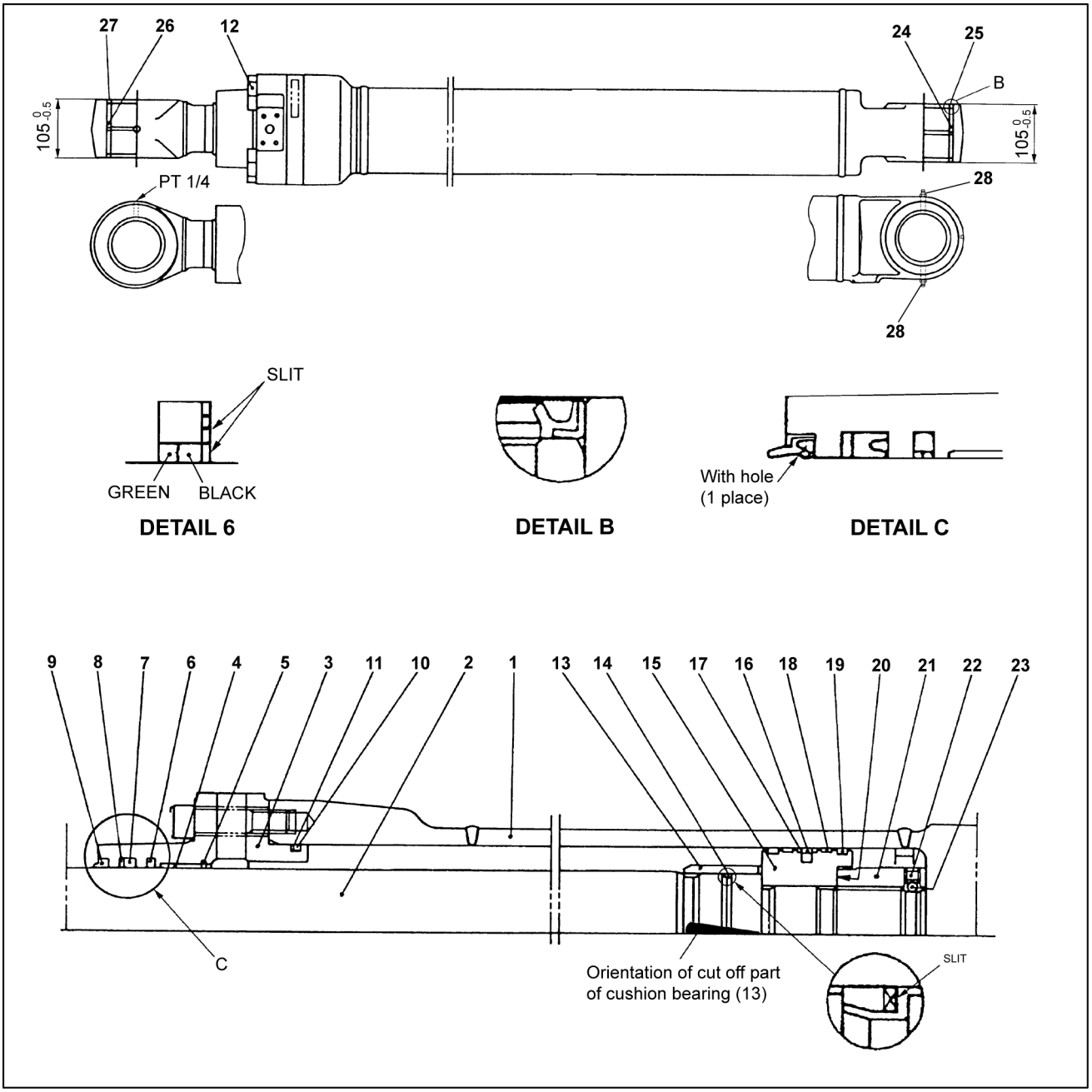
Over load relief valve

(boom, bucket, arm sections)

Boom cylinder - Static description

Construction

Boom cylinder



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Excavator and backhoe bucket hydraulic system - 738

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Frames and ballasting - 39

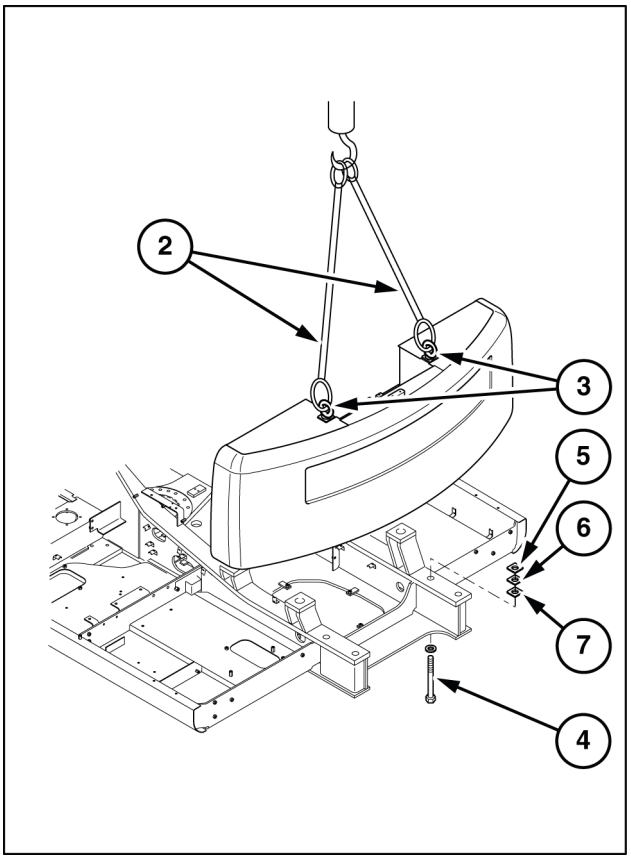
Upper frame - 101

Counterweight - Install

NOTE: *Approximate weight of counterweight:* ***4900 kg (10803 lb)****.*

1. Attach lifting tools **(2)** to eyebolts **(3)** of counterweight.
2. Install shim **(5)**, **(6)**, **(7)** onto the frame as it was.
3. Lift counterweight and install it onto the frame.
4. Install bolts **(4)** and washers to counterweight and tighten temporarily.

   : **46 mm**

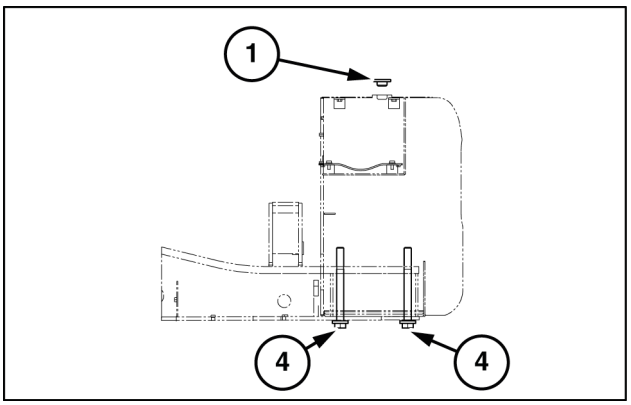


TULI12ECX1604BB 1

5. Remove wire rope.
   Tighten the bolts **(4)** with a power wrench and torque wrench.

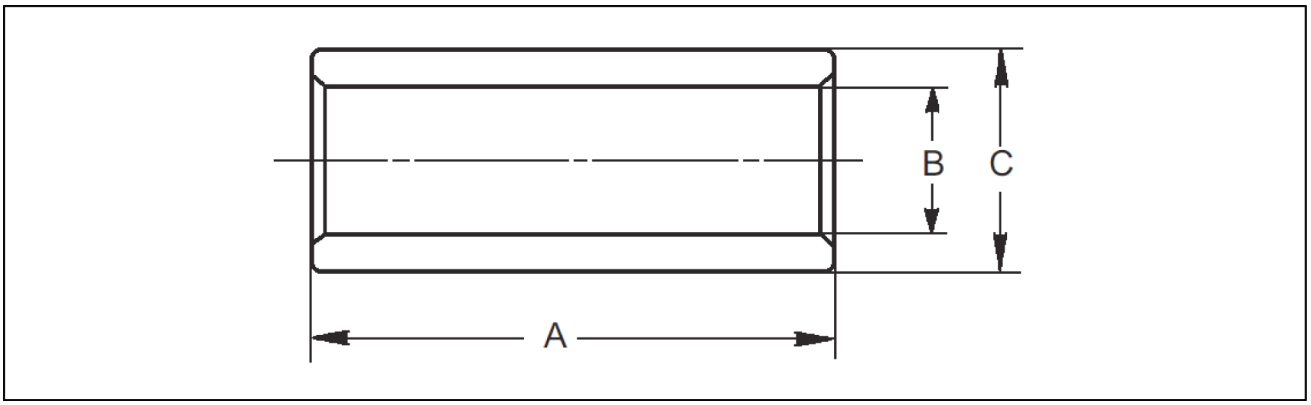
   : **46 mm**

   : **1471 - 1765 N·m** (**1085 - 1302 lb ft**)
6. Remove eyebolts **(3)** and install plugs **(1)** onto the counterweight.



TULI12ECX1608AB 2

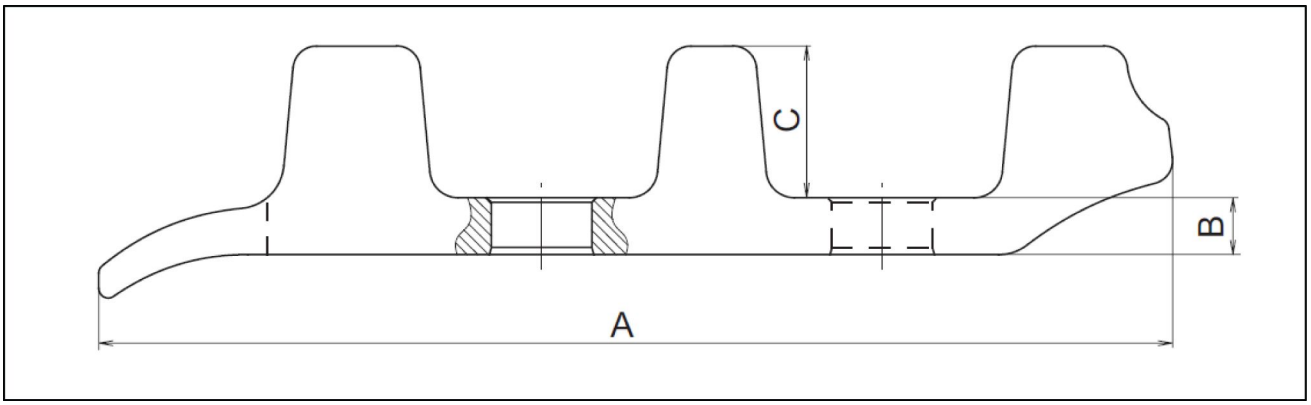
Master bushing



TULI12ECX2770EA 3

Ref.	Standard	Allowable limit	Remedy
A	**128.7 mm** (**5.07 in**)	-	
B	**Ø 37.1 mm** (**1.46 in**)	**Ø 38.6 mm** (**1.52 in**)	
C	**Ø 58.7 mm** (**2.31 in**)	**Ø 54.1 mm** (**2.13 in**)	

Grouser Shoe



TULI12ECX2771EA 4

Ref.	Standard	Allowable limit
A	**220 mm** (**8.66 in**)	-
B	**10 mm** (**0.394 in**)	-
C	**26 mm** (**1.024 in**)	**15 mm** (**0.591 in**)

Track chain - Service limits

Link pin and track bushing

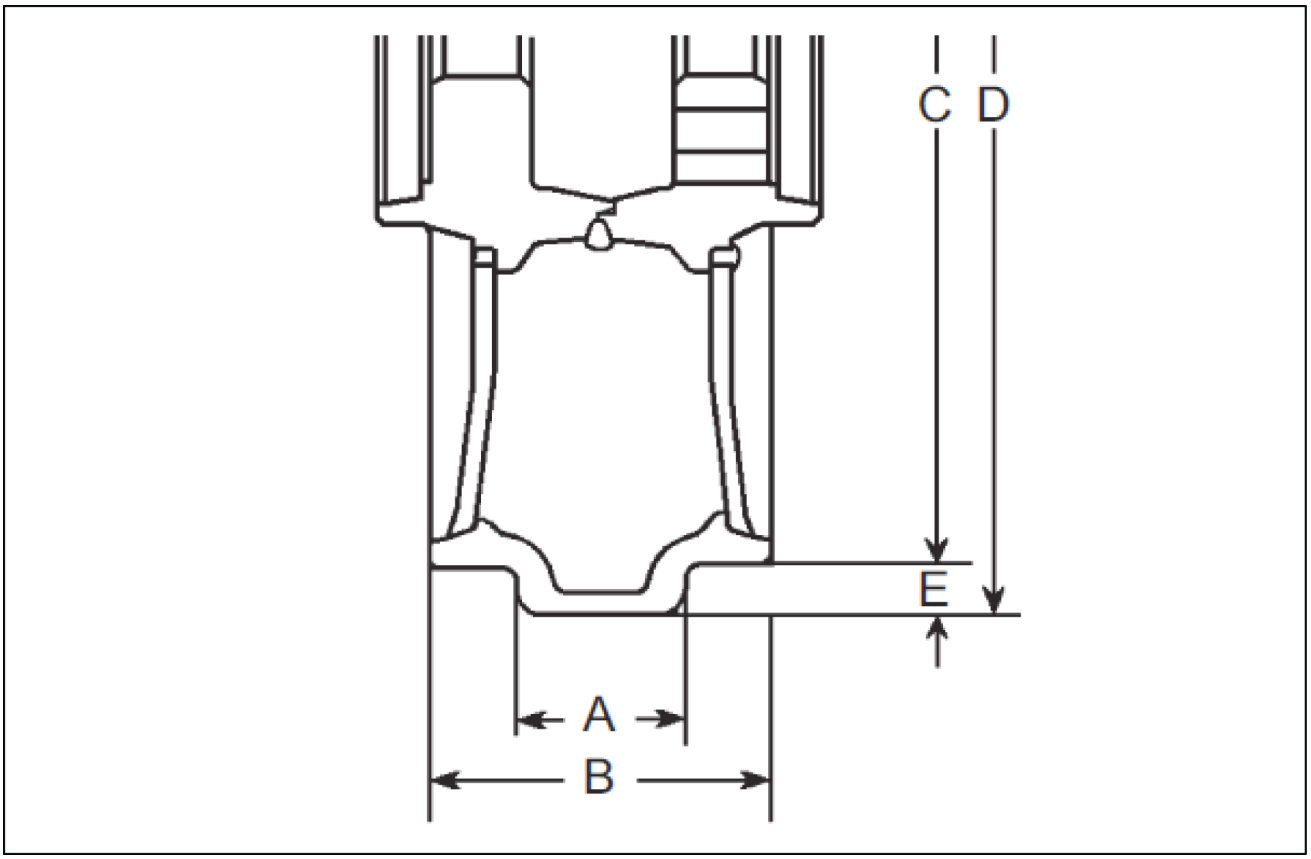
- Measure the length of four links, as illustrated, with tension on the track.
- Do not measure the track where the master pin is located.

Idler wheel - Special tools

Tool No.	Description
380001051	Pin push bar
380001052	Push-out jig
380001053	Punch for upper roller bushes
380001054	Bushing press-fitting jig

Idler wheel - General specification

Axle and bushing



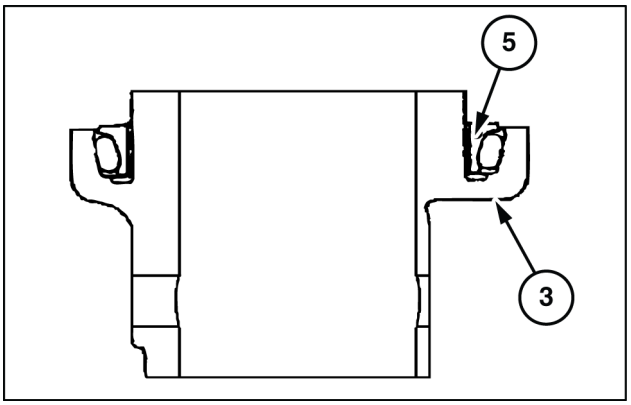
TULI12ECX2340FA 1

	Standard	Allowable	Remedy
A	**84 mm** (**3.307 in**)	**66 mm** (**2.598 in**)	Buildup weld and finishing
B	**160 mm** (**6.299 in**)	–	
C	**Ø 497 mm** (**19.567 in**)	**Ø 479 mm** (**18.858 in**)	
D	**Ø 537 mm** (**21.142 in**)	–	
E	**20 mm** (**0.787 in**)	–	

		Standard	Allowable	Action
Axle	External Diameter	**75 mm**	**74.2 mm**	Replace
Bushing	Bore	**75 mm**	**76 mm**	
Bushing	Flange thickness	**2 mm**	**1.2 mm**	

ATTENTION: *Consult CASE CONSTRUCTION for any inquiries concerning welding procedures*

5. Remove the floating seal **(5)** from the collar **(3)**.



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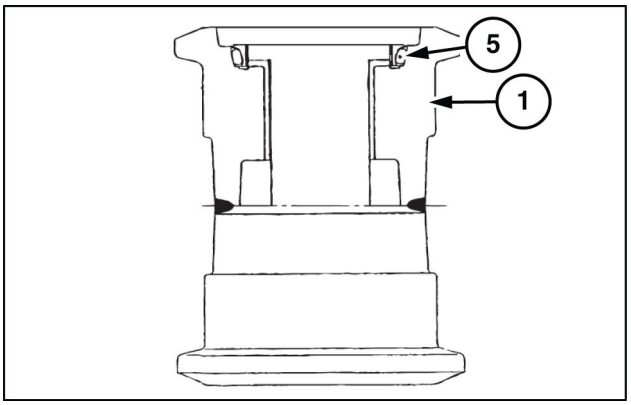
6. Remove the floating seal **(5)** from the roller **(1)**.



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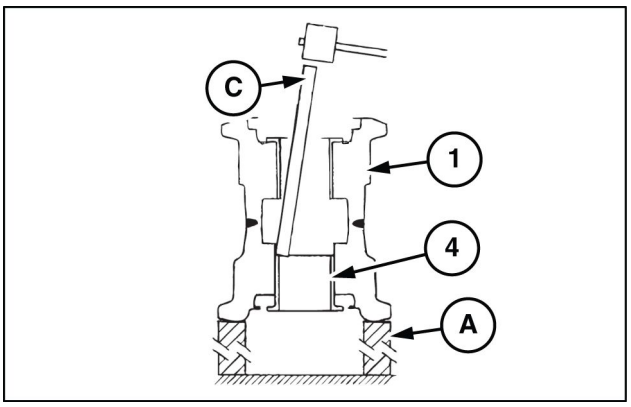
7. Remove bushing **(4)** from the roller **(1)**. Since the bushing is so thin, you may need to remove it using a lathe. Remove it with extreme care so as not to damage the inner hole of the roller **(1)**. When the bushing is not worn and therefore not as thin, you can remove it with a push-out jig **(C)**. Use a repair stand **(A)** to hold the roller **(1)**, then using a mallet, push out the bushing **(4)** with the push-out jig **(C)**.

NOTICE: *Use caution when using the push-out jig **(C)**. Hammer carefully around the circumference of the bushing little by little to remove it.*



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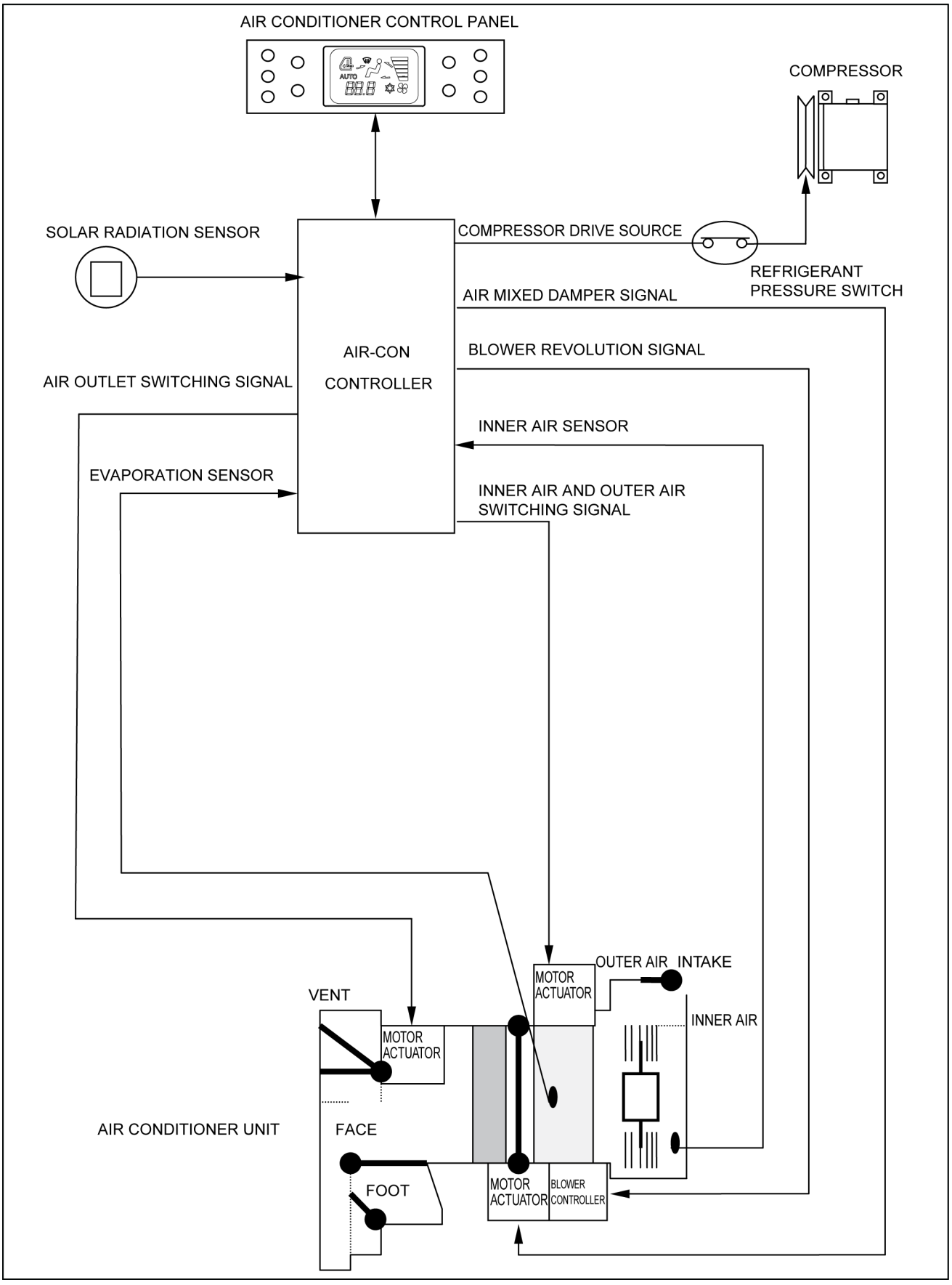
Auto air-conditioner system outline



TULI12ECX1071HA 1

Receiver/Dryer - Dynamic description

Function

Mechanism of cooling circuit

In the cooling process, the refrigerant that flows through the cooling circuit changes its phases from liquid to gas and vice versa during which process heat is transferred from the low temperature part (compartment) to the high temperature part (outside of the vehicle).

HFC R134A	
Chemical formula	CH_2FCF_3
Molecular weight	102.03
Boiling point	**-26.19 °C** (**-15.14 °F**)
Critical temperature	**101.14 °C** (**214.05 °F**)
Critical pressure	**4.065 MPa** (**590 psi**)
Critical density	511 kg/m3
Density of saturated liquid **25 °C** (**77 °F**)	1206 kg/m3
Specific volume of saturated vapor **25 °C** (**77 °F**)	0.0310 m3/kg
Latent heat of vaporization **0 °C** (**32 °F**)	197.5 kJ/kg
Flammability	Non flammable
Ozone destruction coefficient	0

Kind of refrigerant

Many kinds of refrigerants that change in that way are available, but the following requirements are needed for use in such applications:

- Latent heat of vaporization (heat of vaporization) is large.
- It is easy to liquefy (condense). (It does not require very high pressure for condensation.)
- It is easy to gasify (evaporate). (It evaporates sufficiently at not too low pressure, i.e. cools down an object.)
- It has small specific heat. (Since the refrigerant itself is cooled by the expansion valve, the loss resulting from it must be held down to a minimum.)
- It has a high critical temperature and a low solidification point.
- It is stable chemically and does not corrode and permeate into the circuit parts.
- It is free from toxicity, objectionable odor, flammability and explosiveness and excels in thermal conductivity and electric insulation.
- It has small specific volume.
- It is easy to find out leakage.

Out of refrigerants meeting the above-mentioned requirements, ones having characteristics that suit the intended cooling unit are chosen and used. If a refrigerant other that those designated is used, sufficient refrigeration will not be performed or the equipment in which the refrigerant is used may be broken. Therefore, always use a designated refrigerant for the cooling unit.

Table shows the principal characteristics of the **R134A** refrigerant that is used in this machine.

4. Amount of oil for compressor
   The compressor SD7H (HD type) is filled with **135 cm³** (**8.2 in³**) of oil. If the oil volume is small, seizure at high revolution and shortening of service life will occur. If the oil volume is large, the cooling ability will be deteriorated.
   Once the air-conditioner is operated, part of the oil is dispersed in the refrigeration circuit. Therefore, when replacing the parts in right Table, adjust the oil level to that of table.
5. Before performing operation, stop the engine and turn Off all power supplies to the equipment related to the air-conditioner.
6. After the operation is over, confirm that all faults have been repaired completely, by operating the air-conditioner.

Replaced parts	Amount to be filled in
Evaporator	**40 cm³** (**2.4 in³**)
Condenser	**40 cm³** (**2.4 in³**)
Compressor	Drain out the volume of oil left in the compressor to be replaced, from the new compressor
Receiver dryer	**20 cm³** (**1.2 in³**)
Hoses	**20 cm³** (**1.2 in³**)

Contents

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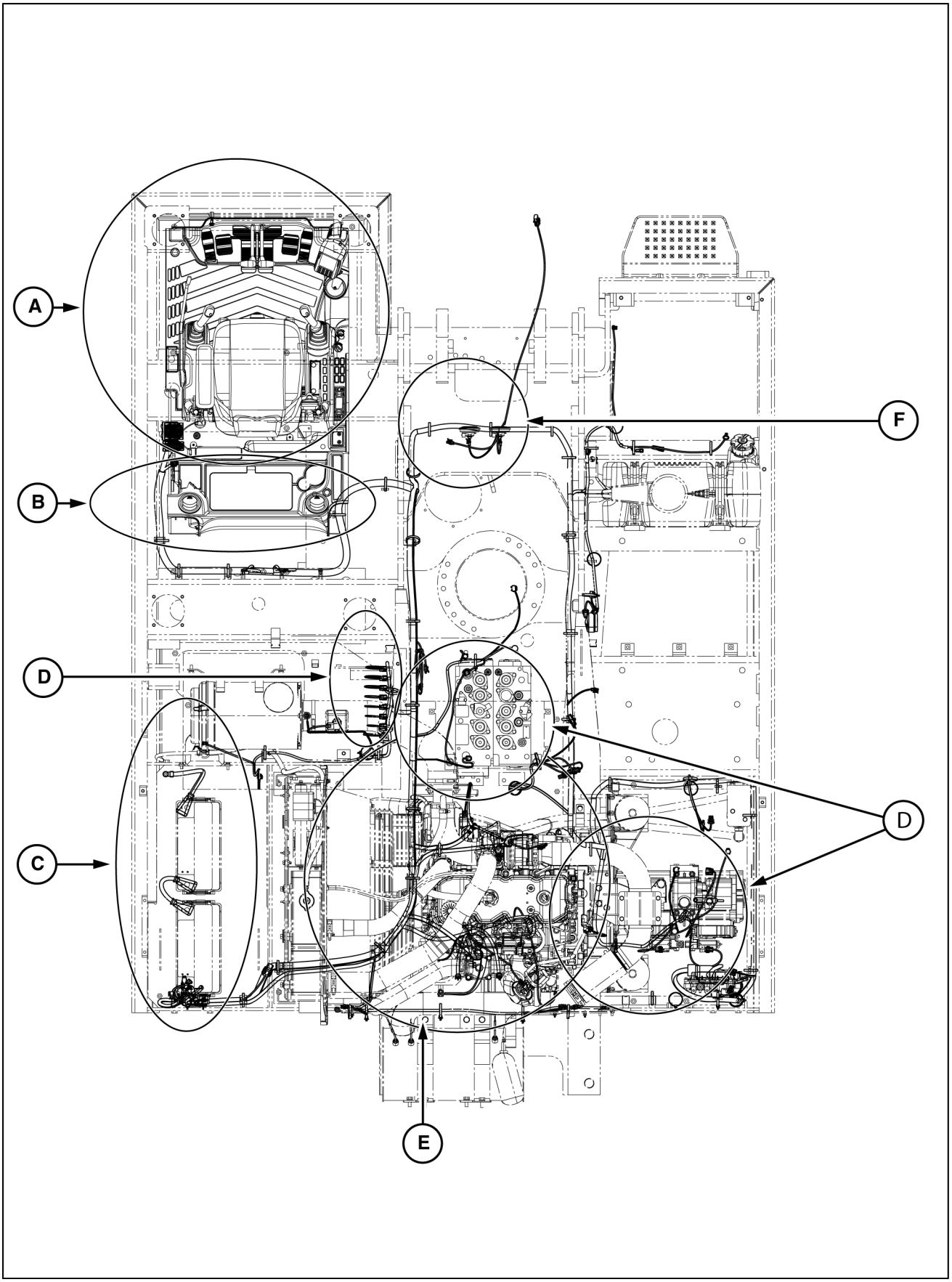
Electrical system - 000

Electrical system - Component localization

Electrical system main components – Electrical system (Overall system)



TULI12ECX0353HB 1

Table 4

Table 5

Error code		A225		
Trouble		The data of ROM adjustment is written incorrectly		
Judging condition		Check adjustment data, and judge the data is correct or not		
Symptom		It is not normal output, but no problem in normal operation		
Control in the event of failure		Control can be done by default value		
Returned in normal condition		It does not regain. Replace controller		
Service diagnosis checking screen		Screen No.		
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	Mechatro controller			Check that the error is corrected after replacement of controller
2				
3				

Table 5

Table 6

Error code		A235		
Trouble		The data of ROM adjustment is written incorrectly		
Judging condition		Check hourmeter memory, and judge the data is correct or not. (Trouble history only)		
Symptom		No affect		
Control in the event of failure		Control at side of correct memory data		
Returned in normal condition		It does not regain. Replace controller		
Service diagnosis checking screen		Screen No.		
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	Mechatro controller			Check that the error is corrected after replacement of controller
2				
3				

Table 28

Table 29

Error code		B074		
Trouble		Swing pressure sensor's power source is shortcut		
Judging condition		The input voltage from swing pressure sensor is **4.7 V** or more		
Symptom		The swing operability becomes poor		
Control in the event of failure		Set proportional valve output rate of P1 and P2 pumps to constant current (Current when all operation is in neutral) Only on independent operation of swing, set output of P2 unload proportional valve to **750 mA**		
Returned in normal condition		It returns automatically in normal condition		
Service diagnosis checking screen		Screen No.	6	B–7 SWING
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	Swing pressure sensor SE–5			When B074 is cancelled and other error occurs by turning starter switch On after exchanging the connector with other sensor Check sensor unit for possible failure. If failure found, replace it
2	Wiring between swing pressure sensor and controller CN–169F CN–103F			When B074 is displayed after turning the starter switch On after the connector is exchanged with other sensor Check wiring for possible failure according to the wiring checking procedure and repair it if necessary
3	Mechatro controller			Check that the error is corrected after replacement of controller

Table 29

Table 30

Error code		B092		
Trouble		Travel right pressure sensor outputs error		
Judging condition		After starter switch On and engine does not start yet. And the input voltage from the travel right pressure sensor after starter switch On is in the range of **1.4 V** or more to less than **4.7 V**		
Symptom		The travel right operability becomes poor		
Control in the event of failure		Normal control		
Returned in normal condition		Not returned automatically under normal condition. Switch the power OFF once and turns on it again		
Service diagnosis checking screen		Screen No.	6	B–9 TRAVEL (R)
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	Travel right pressure sensor SE–9			When B092 is cancelled and other error occurs by turning starter switch On after exchanging the connector with other sensor Check sensor unit for possible failure. If failure found, replace it
2	Wiring between travel right pressure sensor and controller CN–301F CN–102F			When B092 is displayed after turning the starter switch On after the connector is exchanged with other sensor Check wiring for possible failure according to the wiring checking procedure and repair it if necessary
3	Mechatro controller			Check that the error is corrected after replacement of controller

Table 50

Table 55

Error code		D013		
Trouble		P1 unload proportional valve's wiring is disconnected		
Judging condition		The feedback value from proportional valve is **100 mA** or less (If output is **100 mA** or less, judging is not done)		
Symptom		Option conflux can not be done		
Control in the event of failure		Normal control		
Returned in normal condition		It returns automatically in normal condition		
Service diagnosis checking screen		Screen No.	7	D–1 P1 UNLOAD (BP-CUT)
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	P1 unload proportional valve PSV–D			When D013 is cancelled and other error occurs by turning starter switch On after exchanging the connector with other sensor Check sensor unit for possible failure. If failure found, replace it
2	Wiring between P1 unload proportional valve and controller CN–120F CN–105F			When D013 is displayed after turning the starter switch On after the connector is exchanged with other sensor Check wiring for possible failure according to the wiring checking procedure and repair it if necessary
3	Mechatro controller			Check that the error is corrected after replacement of controller

Table 51

Table 56

Error code		D022		
Trouble		P2 unload proportional valve and output transistor ON are failure		
Judging condition		The feedback value from proportional valve is **1000 mA** or more		
Symptom		Independent operations of boom up and of bucket digging/dump become slow		
Control in the event of failure		Normal control		
Returned in normal condition		It returns automatically in normal condition		
Service diagnosis checking screen		Screen No.	7	D–2 P2 UNLOAD (BP-CUT)
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	P2 unload proportional valve PSV–B			When D022 is cancelled and other error occurs by turning starter switch On after exchanging the connector with other sensor Check sensor unit for possible failure. If failure found, replace it
2	Wiring between P2 unload proportional valve and controller CN–118F CN–105F			When D022 is displayed after turning the starter switch On after the connector is exchanged with other sensor Check wiring for possible failure according to the wiring checking procedure and repair it if necessary
3	Mechatro controller			Check that the error is corrected after replacement of controller

Table 74

Table 79

Error code	F043		
Trouble	Option selector solenoid valve and output transistor ON are failure, and disconnection		
Judging condition	The feedback signal is **24 V** level while exciting command is not output		
Symptom	Option selector valve does not change to breaker side or it does not change from breaker to nibbler		
Control in the event of failure	Normal control		
Returned in normal condition	The feedback signal is ground level while exciting command is not output		
Service diagnosis checking screen	Screen No.	7	F–4 OPT SELECT
	Screen No.		
	Screen No.		

Checking object		Checking contents and remedy
1	Option selector solenoid valve SV–13	When F043 is cancelled and other error occurs by exchanging the connector for other solenoid valve Check solenoid valve unit for possible failure. If failure found, replace it
2	Wiring between option selector solenoid valve and controller CN–251F CN–105F	When F043 is displayed after the connector is exchanged with other solenoid valve Check wiring for possible failure according to the wiring checking procedure and repair it if necessary
3	Mechatro controller	Check that the error is corrected after replacement of controller

Table 80

Error	G011			
Trouble	Stepping motor and output transistor are failure			
Judging condition	The feed back value from stepping motor is **2000 mA** or more			
Symptom	Engine revolution can not be changed by accel potentiometer			
Control in the event of failure	Stepping motor output is stopped.			
Returned in normal condition	When the power if OFF.			
Service diagnosis checking screen	Screen No.	2	G-1	COIL A
	Screen No.	2	G-1	COIL B
	Screen No.	–	–	–

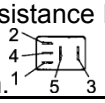
Checking diagnosis checking screen		Checking contents and remedy
1	Stepping motor *M-2	Check that resistance between line No 771 and 772 is **5.1 - 6.3 kΩ** after removing CN-135F connector.
2	Wiring between Stepping motor and controller CN-135F * CN-106F	Check wiring for possible failure according to the wiring checking procedure and repair it if necessary
3	Mechatro controller	Check that the error is corrected after replacement of controller

Table 81

Error code	G013
Trouble	Stepping motor and output transistor are failure
Judging condition	The feed back value from stepping motor is **2000 mA** or less.
Symptom	Engine revolution can not be changed by accel potentiometer

Table 89

Table 97

Error code		R024		
Trouble		Wiper motor forward rotation relay error		
Judging condition		The mechatro controller output line to wiper motor forward rotation relay is short-circuited with the power source		
Symptom		Wiper does not move		
Control in the event of failure		Relay output is stopped		
Returned in normal condition		When the power is OFF		
Service diagnosis checking screen		Screen No.	19	CW MOTOR RLY
		Screen No.		
		Screen No.		
Checking object				Checking contents and remedy
1	Wiper motor forward rotation relay R–29			When error is cancelled after removing wiper motor forward rotation relay, check relay unit for failure, replace it with new one if failed. When resistance between relays (1) and (2) is **0 Ω**, it is in abnormal condition. 
2	Wiring between wiper motor forward rotation relay and controller CN–109F, CN2–1 Fuse& relay box E–1			When R024 is left displayed with the relay removed Check that no power **24 V** is produced on relay (-) line according to the wiring checking procedure and replace it if necessary When no failure found after checking on wiring and R024 is left displayed. Replace fuse/relay box
3	Mechatro controller			Check that the error is corrected after replacement of controller

Move at lever neutral position

No.	Sections	Contents/normal value		Corrective action, others
1.	Pilot pressure sensor	Carry out service diagnosis	Check that targeted pilot pressure of sensor is **0 MPa** (**0 psi**) in high idling	Check remote control valve
2.	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage	Replace
3.	Main spool	Check targeted spool visually	Check that spool is free from abnormal damage and spring is free from breakage	Replace
4.	Over load relief valve	Check targeted spool visually	Free from dust entered in port relief valve Seat is free from abnormality	Replace
5.	Lock valve poppet (in case of boom and arm)	Check targeted poppet visually	Seat is free from abnormality	Replace
6.	Lock valve selector (in case of boom and arm)	Exchange lock valve selector of boom/arm and boom/arm	Check that the trouble is reversed	Replace
7.	Holding valve spool for boom (in case of boom)	Check that smooth sliding of spool in sleeve	Free from abnormal resistance against sliding	Replace Do not pull spool out of sleeve forcibly
8.	Holding valve relief valve for boom (in case of boom)	Check targeted spool visually	Filter free from abnormal contamination	Replace
9.	Cylinder	Check targeted cylinder visually	Make sure of no problem of seals by disassembling and investigation	Replace cylinder or seals

Poor fine operability

No.	Sections	Contents/normal value		Corrective action, others
1.	Pressure sensor	Carry out service diagnosis	• See Service Diagnosis Data List Operation No. 1 Operation is nil • All low pressure sensors are **0 - 0.1 MPa** (**0 - 15 psi**)	Replace pressure sensor
2.	Actual measuring current value of P1/ P2 unload proportional valve	Carry out service diagnosis	• No.7 D-1 P1 unload valve (cut valve) D-1 P2 unload valve (cut valve) • See Service Diagnosis Data List Operation No. 1 Operation is nil	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure
3.	Secondary pressure of unload proportional valve	Measure the proportional valve secondary pressure directly at the ports A7 and A8 of 8 sections solenoid block	Check that P1/ P2 unloads secondary pressures is within the range of **2.7 MPa** (**392 psi**) or more in control lever neutral and high idling operation	Replace proportional valve

No.	Sections	Contents/normal value		Corrective action, others
10.	P2 by-pass cut valve, Only P2 pressure is low	Visual check	Poppet should be tightened Seated surface should be free from damage and entry of foreign matter	Clean and replace
11.	Check stroke limiter, Pilot pressure is low	Visual check	Free from abnormal damage and wear on outside of piston inside cover	Replace (Check on the casing side for damage.)
12.	Remote control valve	Check targeted remote control valve	Check that spool is free from abnormal damage and spring is free from breakage	Replace
13.	Main relief valve, Relief pressure is low	Check set pressure	• See Service Diagnosis Data List Operation No.3 Boom up full lever and relief	Reset or replace
14.	Travel straight spool P2 pressure is high	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface	Replace (Check on the casing side for damage)
15.	Bucket spool, Both P1, P2 pressures are high	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc on outside surface Spring is free from breakage	Replace (Check on the casing side for damage)
16.	Over load relief valve	Check targeted spool visually	Free from dust entered in over load relief valve Seat is free from abnormality	Replace

Swing does not move/slow

No.	Sections	Contents/normal value		Corrective action, others
1.	Swing pressure sensor	Carry out service diagnosis	• See Service Diagnosis Data List Operation No.11 Swing full lever and in operation	Check and replace pressure sensor Check remote control valve
2.	Remote control valve	Measure directly remote control pressure of swing	Check that pressure is **3 MPa** (**435 psi**) or more in boom up full lever and high idling operation	Check remote control valve When equipped with multi control valve, check it while changing lever pattern
3.	Swing parking brake solenoid	Carry out service diagnosis	No.3 F-2 SWING-BRAKE Lever neutral: COMP ON, MEAS ON Swing: COMP OFF, MEAS OFF	Check swing pressure sensor Check harness
4.	Swing parking brake solenoid	Measurement of solenoid valve A2 port	Lever neutral: **0 MPa** (**0 psi**) In operation: **4 MPa** (**580 psi**) or more	Replace solenoid valve
5.	Shuttle valve, Pilot pressure is low	Visual check	No contamination on spool cover (short side) and orifice No damage on spool cover (long side) and shuttle	Clean or replace
6.	Pump pressure sensor	Carry out service diagnosis for P2 pump pressures in operation	• See Service Diagnosis Data List Operation No.11 Swing full lever and in operation	Check high pressure sensor

No.	Engine condi-tion	Safety lock lever SW's input	Safety lock lever relay's output	Work mode	Optional selector valve COMP. MEAS.	Spool position	Selector valve detecting pressure sensor	Warning display	Failure diagnosis display
8.	Running	ON	OFF	B	OFF	Breaker	Normal	—	[F043] displayed
9.	Running	ON	OFF	—	—	—	Failure	“SELECTOR VALVE FAILURE”	[B113] displayed
10.	Stopping	—	—	—	—	—	—	—	—
11.	—	OFF	—	—	—	—	—	—	—
12.	—	—	ON	—	—	—	—	—	—

No.	Sections	Contents/normal value		Corrective action, others
14.	Arm 2 spool, P1 pressure is high	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc., on outside surface Spring is free from breakage	Replace (Check on the casing side for damage)
15.	Check arm 2 spool and recirculation, Both P1, P2 pressures are low	Disassembly and investigation (spring side)	Free from abnormal resistance against sliding Spring is free from breakage	Replace spool assembly
16.	Check lock valve poppet, Both P1, P2 pressures are high	Visual check	Free from abnormal resistance against sliding Free from abnormal damage, etc., on outside surface	Replace (Check on the casing side for damage)

Bucket digging is slow

No.	Sections	Contents/normal value		Corrective action, others
1.	Bucket digging pressure sensor	Carry out service diagnosis	• See Service Diagnosis Data List Operation No.12 bucket digging full lever and relief	Check and replace pressure sensor Check remote control valve
2.	Remote control valve	Measure directly remote control pressure of bucket digging	Check that pressure is **3 MPa** (**435 psi**) or more in bucket digging full lever and high idling operation	Check remote control valve When equipped with multi control valve, check it while changing lever pattern
3.	Pump pressure sensor	Carry out service diagnosis for P1, P2 pump pressures in operation	• See Service Diagnosis Data List Operation No.13 Bucket digging full lever and in operation	When there is difference between P1 and P2 pump pressures, check high pressure sensor
4.	Actual measuring current value of P1/ P2 unload proportional valve	Carry out service diagnosis	• No.7 D-1 P1 unload valve (cut valve) D-1 P2 unload valve (cut valve) • See Service Diagnosis Data List Operation No.12 Bucket digging full lever & relief	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure
5.	Secondary pressure of P1, P2 unload proportional valve	Measure the proportional valve secondary pressure directly at the ports A7 and A5 of 8 sections solenoid block	Check that P1/ P2 unload secondary pressures are within the range of **0.6 - 1 MPa** (**87 - 145 psi**) in bucket digging full lever and high idling operation	Replace proportional valve
6.	Actual measuring current value of P1/ P2 pump proportional valve	Carry out service diagnosis	• No.6 E-1 P1 pump E-2 P2 pump • See Service Diagnosis Data List Operation No.13 Bucket digging full lever & in operation	In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure
7.	Secondary pressure of P1, P2 pump proportional valve	Measure the pump proportional valve secondary pressure directly (Ports a3, a4)	Check that P1 pump proportional valve pressures is **2.3 MPa** (**334 psi**) or more and P2 pump proportional valve pressure is **1.9 - 2.5 MPa** (**276 - 363 psi**) in bucket digging full lever and high idling operation	Replace proportional valve

Machine does not travel straight in simultaneous operation of travelling and attachment

No.	Sections	Contents/normal value		Corrective action, others
1.	Actual measuring current value of travel straight proportional valve	Carry out service diagnosis	No. 7 D-3 S-TRAVEL is should be COMP **720 mA** and MEAS **690 - 750 mA** (**690 - 750 mA**) in both travel full lever and in boom-up full lever at high idling	• Check voltage of low pressure sensor other than travel sensor • In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure
2.	Secondary pressure of travel straight proportional valve	Measure directly the proportional valve secondary pressure	Check secondary pressure is within range of **2.6 - 3 MPa** (**377 - 435 psi**) in both travel full lever and in boom-up full lever at high idling	Replace proportional valve
3.	Command current value of bypass valve	Carry out service diagnosis	Travel right and left in full lever + Boom-up in full lever + High idling No.12 D-15 Check that the current value is COMP **530 mA** and MEAS **500 - 560 mA** (**500 - 560 mA**)	• Check voltage of low pressure sensor other than travel sensor • In case where the reading is largely differed from the actually measured value, check proportional valve and controller for possible failure
4.	Proportional valve secondary pressure of bypass valve	Measure the proportional valve secondary pressure directly (G port)	Travel right and left in full lever + Boom-up in full lever + High idling Check that the secondary pressure is within the range of **1.5 - 1.9 MPa** (**218 - 276 psi**)	Replace proportional valve
5.	Travel straight spool	Visual check	When removing, free from abnormal resistance against sliding Free from abnormal damage, etc., on outside surface Spring is free from breakage	Replace (Check on the casing side for damage)
6.	Spool of bypass valve	Visual check	When removing, there is no abnormal resistance against sliding Free from abnormal damage etc., on outside surface Spring should be free from breakage	Replace the spool (Check on the casing site for damage)

Breaker works slowly and power is poor (In case of conflux, check p1 unload/pump and travel straight)

No.	Sections	Contents/normal value		Corrective action, others
1.	Pressure sensor for optional attachment	Carry out service diagnosis	• See Service Diagnosis Data List Operation No.16 P2 side OPT full lever and relief	Check and replace pressure sensor Check remote control valve
2.	Remote valve control	Measure directly control travel remote pressure of right and left	Check that pressure is **2.1 MPa** (**305 psi**) or more in optional attachment full lever and high idling operation	Check remote control valve

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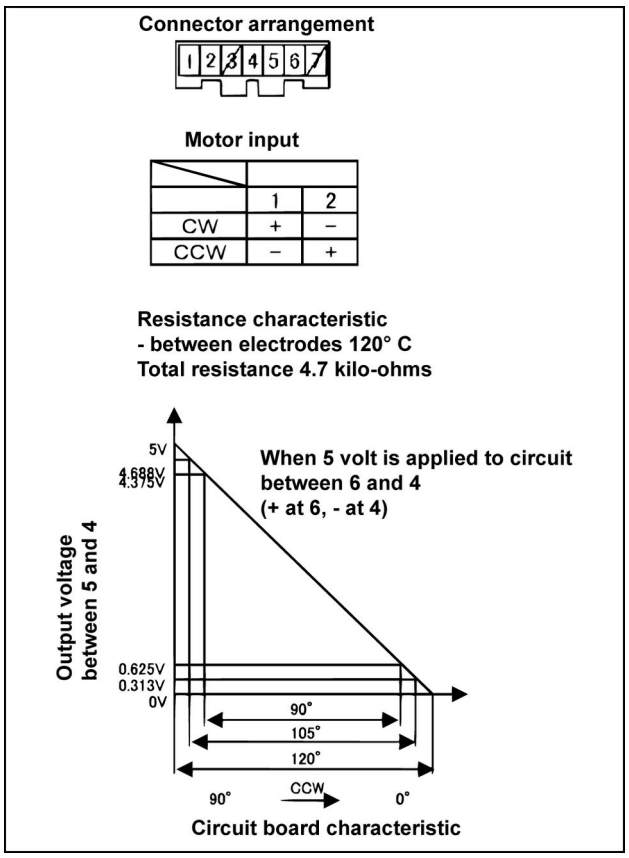
5. Mode actuator
   Mode actuator is located in outlet of air-conditioner unit. And it opens or closes mode door through link motion.
   The mode actuator incorporates potentiometer which is switched by linked shaft with actuator. When the target air mix door position is determined through the temperature control switch, the control unit reads the level of potentiometer of the actuator. And it determines the rotating direction of motor in either normal or reverse rotation. And the motor rotates, the contact point is detached or the output signal of control unit turns Off, the motor stops.
6. The actuator for air inlet/outlet **12 V**.
   The actuator for inlet and outlet air mode select is installed on the blower intake unit, and opens and closes inlet or outlet air damper through the link motion. The actuator for inlet and outlet air mode select incorporates position detection switch which is switched with the movement of shaft of the actuator.
   When the inlet and outlet damper position is set by the inlet and outlet switch on the control panel, the control unit reads the signal of the position detection switch in the actuator and determines the rotation direction of motor in either normal rotation or reverse rotation. And the motor rotates, the position detection switch also rotates and makes it stop at the set position of the inlet or outlet air damper.



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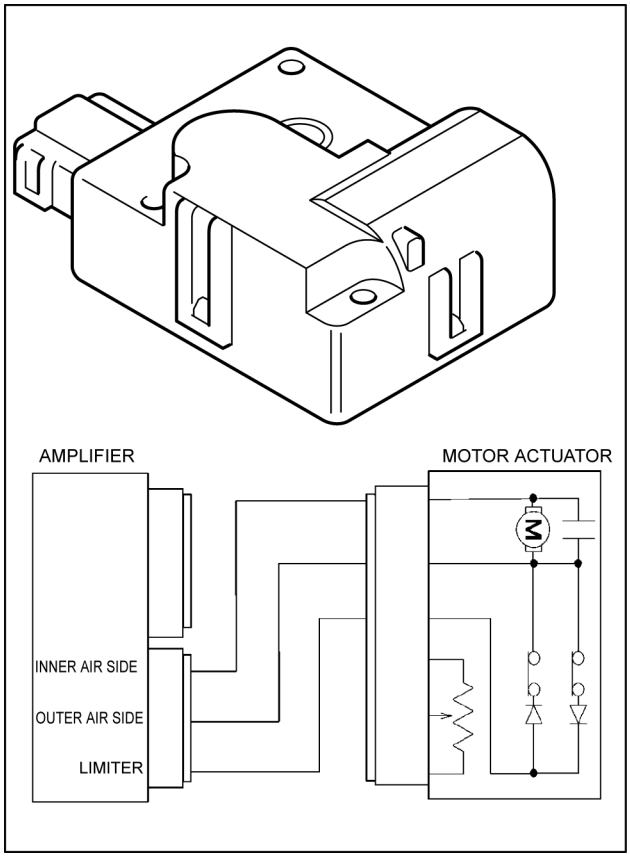

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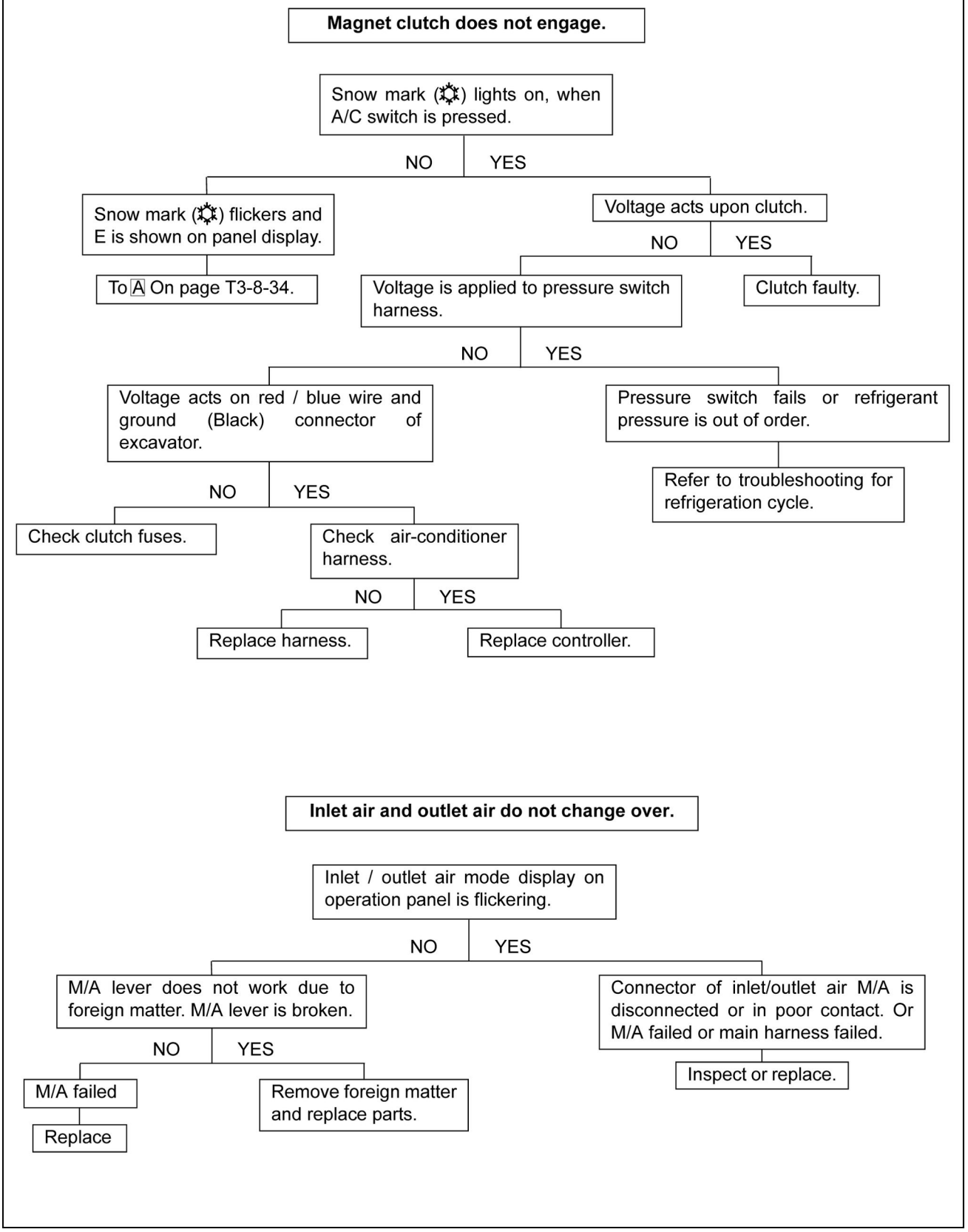

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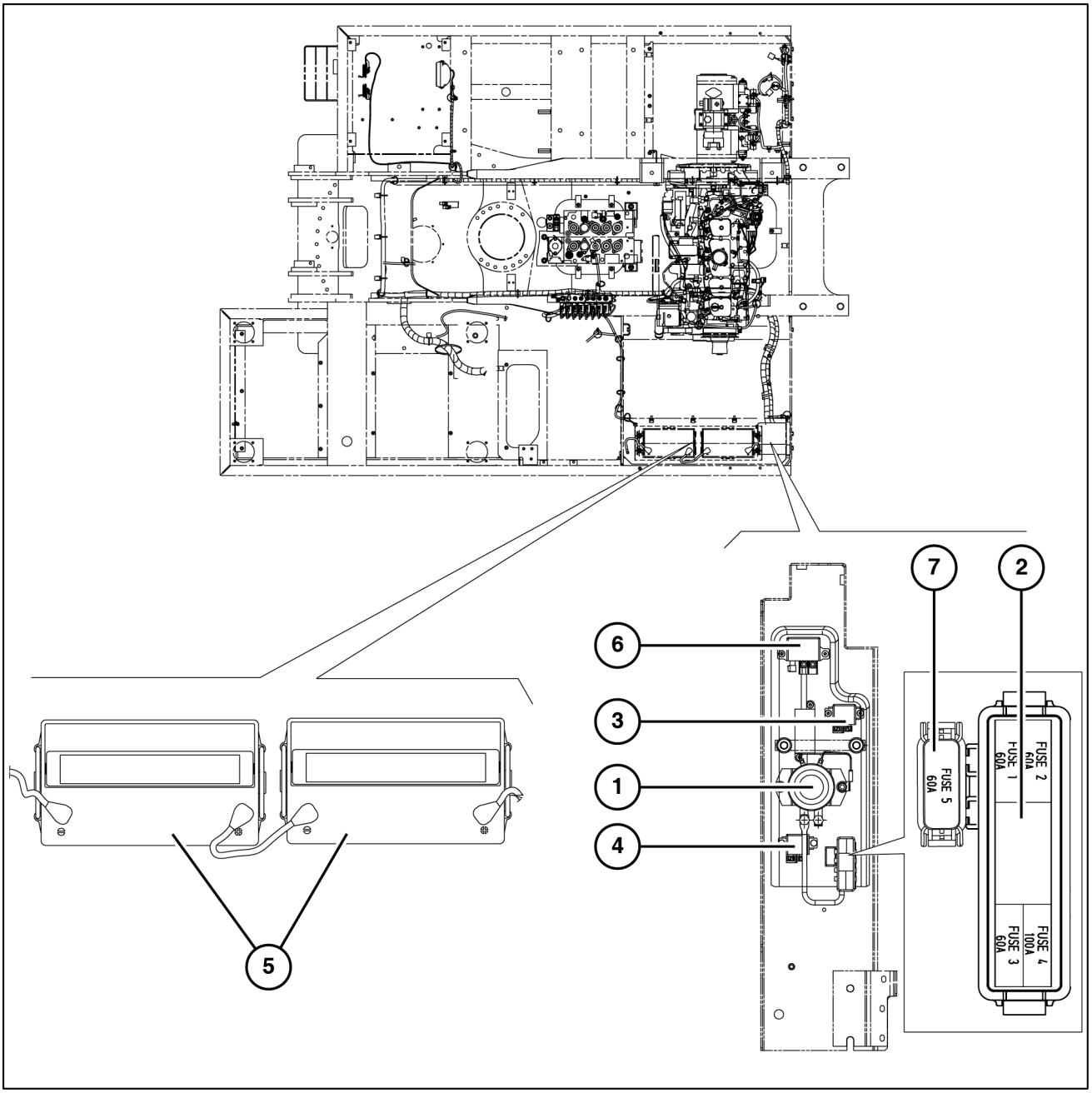
Battery - Overview

Batteries, battery relay, fuse link



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1. Battery relay (R-1)
2. Fuse link **(1)**, **(2)**, **(3)**, **(4)** (E-25)
3. Starter motor relay (R-2)
4. Fuel filter heater relay (R-40)
5. Batteries (E-12)
6. Pre-Heater relay (R-3)
7. Fuse link **(5)** (E-26)

Fuses located into radiators compartment

No. of fuse	Protected circuit	Value
Fuse 1	Fuse power supply (1 – 6)	**60 A**
Fuse 2	Fuse power supply (17 – 32)	**60 A**
Fuse 3	Alternator	**100 A**
Fuse 4	Starter relay, fuel heater filter relay	**60 A**
Fuse 5	Fuse power supply (10 – 15)	**60 A**

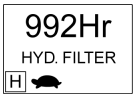
This menu is available for confirmation of the following items.

The maintenance screen changes each time the screen change switch is pressed.

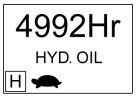
1. Display of remaining time until engine oil change. This screen shows the time remaining until the next engine oil change.

2. Display of remaining time until fuel filter change. This screen shows the time remaining until the next engine fuel filter change.

3. Display of remaining time until hydraulic oil filter change. This screen shows the time remaining until the next hydraulic oil filter change.



4. Display of remaining time until hydraulic oil change. This screen shows the time remaining until the next hydraulic oil change.

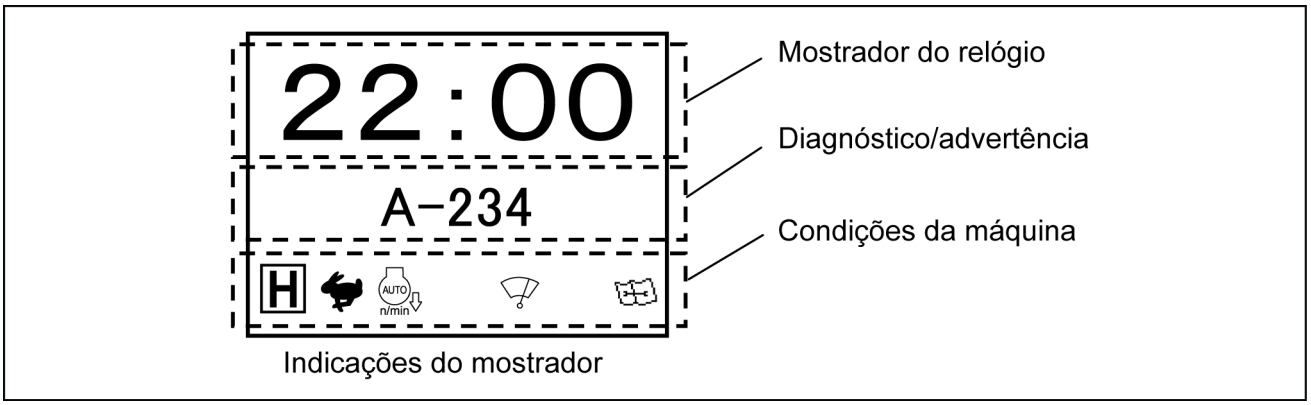


NOTE: *If no switch is pressed for **30 s**, the display automatically changes to the main screen.*

NOTE: *To adjust the period until the next oil and filter change of each type, refer to "Maintenance schedule adjustment procedure".*

Instrument cluster display

Once the key has been turned on and the logo disappears, the operator's screen appears on the multi-function display. The functions of the multi-function display are explained below.



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1.	Display function for operator	Screen usually shown during operation
	Clock display function	Shows current time
	Self-diagnostic display	Displays an error code when the mechatro system detects an abnormal condition, such as sensor, proportional valve, etc.
	Warning display	Displays the warning symbol when the machine goes into a danger status, or has a failure. (For the meaning of the warning, refer to the items on the next page.)
	Machine condition display	Displays machine operating condition
2.	Maintenance display function	Displays the time remaining until change of the following items. **(1)** Engine oil **(2)** Fuel filter **(3)** Hydraulic oil filter **(4)** Hydraulic oil
3.	Failure history display function	Stores the abnormal conditions that occurred in the mechatro system. Displays the conditions in order of occurrence

Part No.	Displays			Contents
22.	NO.22	DIGITAL OUTPUT		
	DO8	COMP.	ON	Set value in computer
		MEAS.	ON	Measured value
	DO9	COMP.	OFF	Set value in computer
		MEAS.	OFF	Measured value
	DO10	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO11	COMP.	OFF	Set value in computer
		MEAS.	OFF	Measured value
	DO12	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO13	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO14	COMP.	---	Set value in computer
		MEAS.	---	Measured value
23	NO.23	DIGITAL OUTPUT		
	DO15	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO16	COMP.	ON	Set value in computer
		MEAS.	ON	Measured value
	DO17	COMP.	OFF	Set value in computer
		MEAS.	OFF	Measured value
	DO18	COMP.	OFF	Set value in computer
		MEAS.	OFF	Measured value
	DO19	COMP.	OFF	Set value in computer
		MEAS.	OFF	Measured value
	DO20	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO21	COMP.	ON	Set value in computer
		MEAS.	ON	Measured value
24.	NO.24	DIGITAL OUTPUT		
	DO22	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO23	COMP.	OFF	Set value in computer
		MEAS.	ON	Measured value
	DO24	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO25	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO26	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO27	COMP.	---	Set value in computer
		MEAS.	---	Measured value
	DO28	COMP.	---	Set value in computer
		MEAS.	---	Measured value

Failure history diagnostics

The errors detected by the self-diagnostic function are stored in the mechatro controller in the form of a history. It is possible to show the errors on the multi-function display.

- A part of the warning contents is stored (the stored items are listed in the warnings table).
- The self-diagnostic error code is stored.

How to display

1. Turn on the starter switch.
2. Press the audio alarm stop switch five times, continuously, to display the failure history screen.

(Example)

No errors	NO ERROR	
Error detected in the past	**10530 h**	F023
	8500 h	G033
	1500 h	C013

3. Transmits the failure history data (one or more) and the hourmeter to the instrument cluster.
   - The screen displays the hourmeter and four failure data.
   - In the case of more than four failure data, four data are shown at a time for **10 s**.
4. Scrolling (up and down)
   - Press the washer switch (▲) to move the item up.
   - Press the wiper switch (▼) to move the item down.
5. Turn off the ignition key to clear the display.

How to delete the failure history contents

1. Display the failure history screen.
2. Press the work mode change switch and the audio alarm stop switch simultaneously for at least **10 s**.
3. When "NO ERROR" appears, the exclusion will be complete.
4. Turn the Key start OFF.

NOTE: *All the stored items will be erased. You cannot erase partial data.*

Failure diagnostics mode

The failure diagnostics mode is used to automatically specify the sections with failure that cannot be detected through use of the self-diagnostic function (the fault can be specified through use of the error code), such as disconnection and abnormal output. This is useful to save time in troubleshooting.

1. Role
   There are two modes of failure diagnostics.
   1. Failure diagnostics mode 1: Used to diagnose the unloading, pump, and straight travel systems.
   2. Failure diagnostics mode 2: Used to diagnose the pilot system. In any mode, with the implement stopped, both the directional valve and the proportional valve are automatically triggered. The sensor detects the status of the machine and the mechatro controller identifies the abnormal condition or system failure condition.

For the details of how to use, refer to the "Failure diagnostics mode" chapter.

Maintenance schedule adjustment procedure

This machine is equipped with a multi-function display that allows confirmation of the time remaining until the next change of the engine oil, fuel filter, hydraulic oil filter and hydraulic oil. Therefore, when the time remaining reaches zero (0), change the item indicated. Perform the initial adjustment as follows.

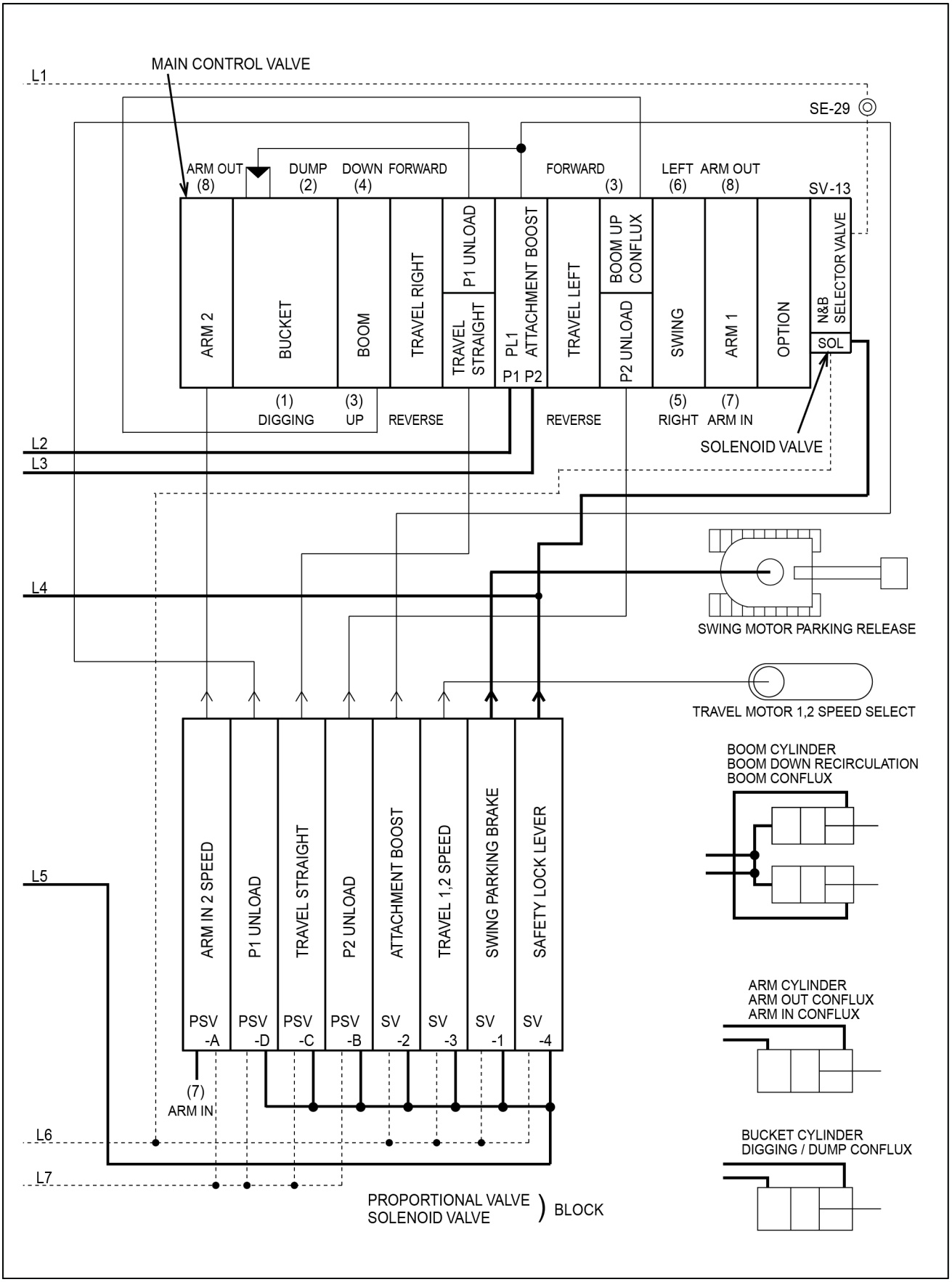
Role

A. It processes signals by communication between the gauge cluster and the mechatro controller, displays them in lamps, displays them in LCD's and actuates the buzzer.

B. It outputs coolant temperature signals, fuel level signals and panel switch signals to the mechatro controller through the communication port.

Summary of display and drive item

No .	Item	Remarks
1.	Display screen	LCD dot 120X168
2.	–	
3.	–	
4.	Buzzer	Piezo-electricity type
5.	Screen change switch	
6.	Buzzer stop switch	
7.	Work mode select switch	
8.	Digging mode switch	
9.	Nibbler mode switch	
10.	Breaker mode switch	
11.	Up arrow switch	
12.	Down arrow switch	
13.	Next arrow switch	
14.	Back arrow switch	
15.	Back light	LED



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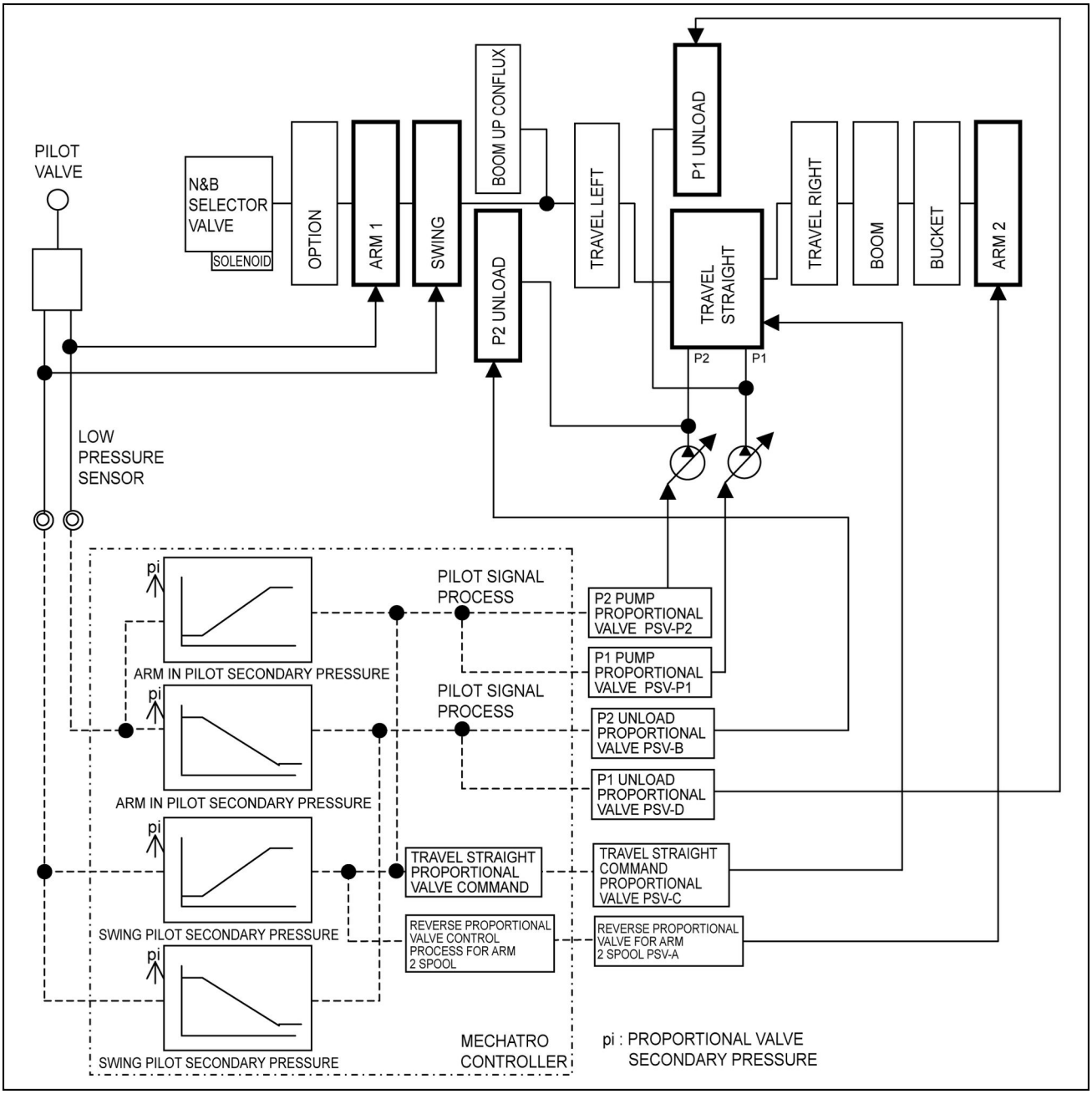
Electronic modules - Dynamic description

Swing priority control



TULI12ECX0212GA 1

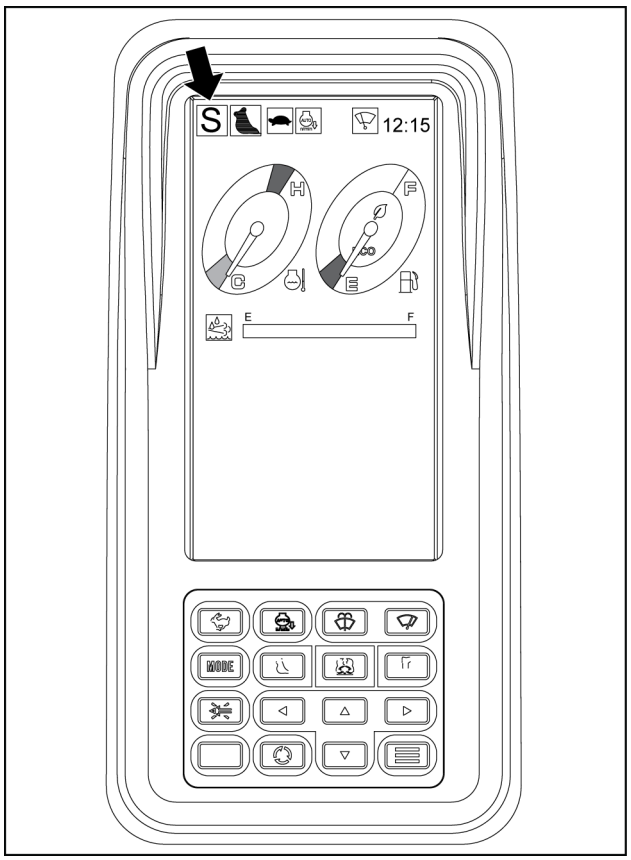
1. During arm-in operation, arm operating pilot secondary pressure switches arm spool and is input to low pressure sensor on starting swing operation (or arm-in operation during swing operation), and swing operation pilot secondary pressure switches swing spool and is input to low pressure sensor.
2. The output voltage of low pressure sensor is input to mechatro controller and the mechatro controller processes pilot signal and outputs command according to the input voltage to P1 and P2 pump proportional valves, P1 and P2 unload pressure proportional valves, travel straight valve and reverse proportional valve for arm 2 spool.
3. Each proportional valve outputs pilot proportional valve secondary pressure according to the command output by mechatro controller and changes P1 and P2 pump delivery rate and switches P1 and P2 unload spool, travel straight spool, arm 2 spool.
4. With original hydraulic pressure command, arm 1 spool and swing spool are switched and also with the command by mechatro controller, P1 and P2 unload spools, travel straight spool and arm 2 spool are switched enabling for

3. Screen selection by work mode select switch

The mode after the engine starting is always the start from “S” mode. The work mode is switched in order of “S” to “E” to “H” to “S” each time the work mode select switch is pressed.

Select proper work mode shown below according to the work condition and the purpose. For the selected work mode, refer to the upper left corner of display.

- S mode: For standard excavating work
- E mode (ECO): For low fuel consumption excavating work
- H mode: For heavy duty excavating work



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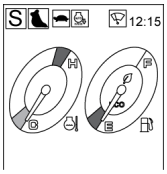
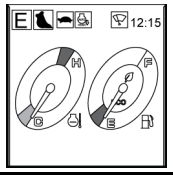
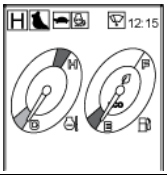
Work mode	Monitor	Contents
S mode		“S mode” is suitable for standard digging and loading works and is in saving fuel consumption and is in good balance to the workload
E mode (ECO)		“E mode (ECO)” is the mode focusing on better fuel economy, allowing for normal digging operation with lower fuel consumption than S mode
H mode		“H mode” is suitable for heavy duty digging work which gives priority to the workload at the high speed

Service diagnosis display screen (Example)
The service diagnosis display screen list is shown below. The conditions for display are H mode, engine low speed and lever to neutral position.)
1) Service diagnosis “Mode No.1”

Part No.	Displays			Contents
1.	NO.1			
	MAIN CONT. P/N			
	YN22E00474TEMP			P/No. indication
	PROGRAM VERSION			
	1-VER 1.00			Program version indication
	2-VER 0.00			
	SERVICE DIAG 1			Service diagnosis mode
	CLUSTER GAUGE P/N			
	YN59S00028F5			
	PROGRAM VERSION			
	07.00			
2.	NO.2	ENG		
	G-3	SPEED SET	1000	No load setting RPM
		MEAS	1003	Actual RPM
	G-5.	ENG PRS.	LIVE	Engine oil pressure
		WATER TEMP **73 °C**	OFF	Coolant temperature sensor / Coolant temperature switch
		MODE	H	Work mode
		ATT MODE	BKT	
	H-1	ACCEL VOLT.	**0.27 V**	Potentiometer voltage
		POS.	0%	Voltage % indication
	G-1	MOTOR STEP	84	Number of step
		POS.	100%	Step % indication
		COIL A	**1.4 A**	A phase current
		COIL B	**1.3 A**	B phase current
	G-2	LIMIT SW .	OFF	Limit switch
3.	NO.3	SOL.VALVE		
	F-1	POWER BOOST		
		COMP.	OFF	Set value in computer
		MEAS.	OFF	Measured value
		SWITCH	OFF	Switch
	F-2	SWING-BRAKE		
		COMP.	ON	Set value in computer
		MEAS .	ON	Measured value
		RELEASE SW	OFF	Switch
	F-3	1/2-TRAVEL		
		COMP .	OFF	Set value in computer
		MEAS.	OFF	Measured value
		SWITCH	OFF	Switch
4.	NO.4	RELAY		
	K-1	AIS RELAY 2	ON	Indicated value
	K-2	SAFETY RLY	ON	Indicated value
	K-3	ENG STOP	OFF	Indicated value
		KEY SWITCH	ON	Key switch
		START SWITCH	OFF	Starter switch
		CHARGE	LIVE	Alternator
	K-4	LOCK LEVER	OFF	Indicated value
		SWITCH	ON	Switch

Operation No.6: Arm-in in full lever operation & relief H mode Hi idle		
No.24 Arm, swing		
C–1	P1-PRES	**33.0 - 35.8 m** (**1299.2 - 1409.4 in**)
C–2	P2-PRES	**33.0 - 35.8 m** (**1299.2 - 1409.4 in**)
E–1	P1-PSV	**415 - 525 mA**
E–2	P2-PSV	**415 - 525 mA**
D–1	P1-UL(BPC)	**360 mA**
D–2	P2-UL(BPC)	**360 mA**
D–3	S-Travel	**350 mA**
D–6	Arm-IN-2	**200 mA**
B–3	Outer arm	**0.0 m** (**0.00 in**)
B–4	Arm in	**3.0 m** (**118.11 in**)
B–1	Boom raising	**0.0 m** (**0.00 in**)
B–7	Swing	**0.0 m** (**0.00 in**)
G–3	Engine Speed	**1970 - 2060 RPM**
	Powershift	**0 mA**

Operation No.7: Arm-in in full lever operation & in operation H mode Hi idle		
No.24 Arm, swing		
C–1	P1-PRES	**12.5 - 16.5 m** (**492.1 - 649.6 in**)
C–2	P2-PRES	**12.5 - 16.5 m** (**492.1 - 649.6 in**)
E–1	P1-PSV	**550 - 750 mA**
E–2	P2-PSV	**550 - 750 mA**
D–1	P1-UL(BPC)	**360 mA**
D–2	P2-UL(BPC)	**360 mA**
D–3	S-Travel	**350 mA**
D–6	Arm-IN-2	**400 mA**
B–3	Outer arm	**0.0 m** (**0.00 in**)
B–4	Arm in	**3.0 m** (**118.11 in**)
B–1	Boom raising	**0.0 m** (**0.00 in**)
B–7	Swing	**0.0 m** (**0.00 in**)
G–3	Engine Speed	**1970 - 2060 RPM**
	Powershift	**0 mA**

Operation No.8: Arm-out in full lever operation & relief H mode Hi idle		
No.24 Arm, swing		
C–1	P1-PRES	**33.0 - 35.8 m** (**1299.2 - 1409.4 in**)
C–2	P2-PRES	**33.0 - 35.8 m** (**1299.2 - 1409.4 in**)
E–1	P1-PSV	**415 - 525 mA**
E–2	P2-PSV	**415 - 525 mA**
D–1	P1-UL(BPC)	**360 mA**
D–2	P2-UL(BPC)	**360 mA**
D–3	S-Travel	**350 mA**
D–6	Arm-IN-2	**750 mA**
B–3	Outer arm	**3.0 m** (**118.11 in**)
B–4	Arm in	**0.0 m** (**0.0 in**)
B–1	Boom raising	**0.0 m** (**0.00 in**)
B–7	Swing	**0.0 m** (**0.00 in**)
G–3	Engine Speed	**1970 - 2060 RPM**
	Powershift	**0 mA**

* Measure the values after a lapse of **5 min** or after release of low temperature mode.

Electronic modules - Service instruction

Trouble history diagnosis

The items of error detected by mechatro controller self diagnosis function are stored in mechatro controller as one of history. And the errors are able to be indicated on the multi display.

- A part of warning contents is stored (the stored items are listed in warning table).
- The error code for self diagnosis is stored.

1. How to display
    1. Hold down buzzer stop switch and turn starter switch. The service diagnosis screen is displayed.
    2. During holding down the menu switch, press buzzer stop switch 3 times. “SERVICE MENU” screen is displayed. Using “UP” or “DOWN” switch point the cursol to “TROUBLE HISTORY”. Press “NEXT” switch, and “TROUBLE HISTORY” is displayed. And select “TROUBLE HISTORY” to display the trouble history diagnosis.

(Example)

No errors	NO ERROR	
Error detected in the past	**10530 h**	F023
	8500 h	G033
	3000 h	P1211
	1500 h	C013

3. Transmit trouble history data (One or many) and hour meter to gauge cluster.
    - Hourmeter and 10 failure data are displayed on screen.
    - In case of more than 10 failure data, turn a page to check next data.
4. Paging (Up and down)
    - Press “Up arrow switch” (▲), to move the item up.
    - Press “Down arrow switch” (▼), to move the item down.
5. Turn starter switch Off, and the display is disappeared.

2. How to delete contents of trouble history
    1. Display trouble history screen.
    2. Press work mode change switch and buzzer stop switch simultaneously for **5 s** or more.
    3. When “NO ERROR” is displayed, the deletion is completed.
    4. Turn starter switch Off.

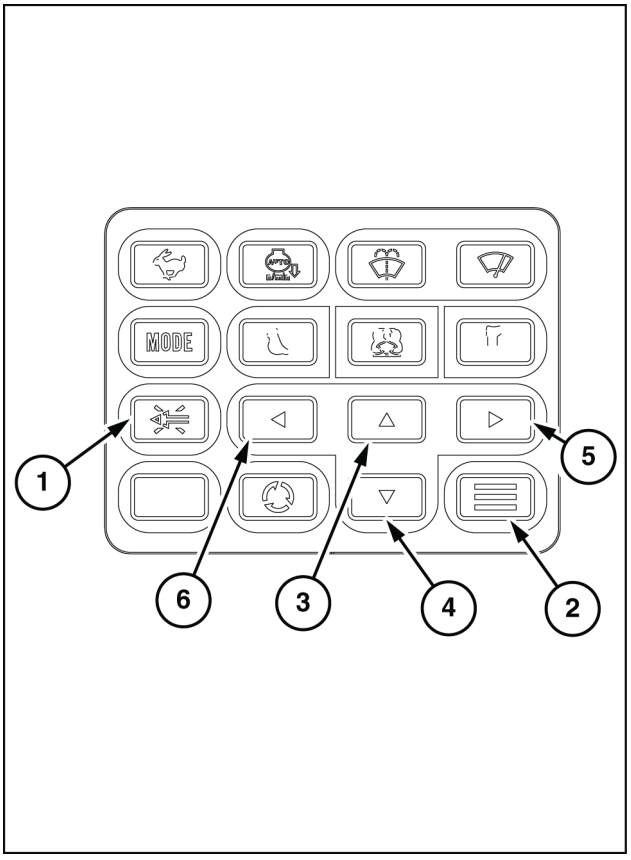
NOTE: *All the stored items are erased. It is impossible to erase data partially.*

Function	Explanation	Note	Range	Default
HAMMER SETTING	To adjust pressure and flow for hammer (10 set)		20 - 35 Pressure 30 - 220 Flow rate	**20 MPa** (**2901 psi**) (at **220 l/min** (**58.12 US gpm**)) **220 l/min** (**58.12 US gpm**)
NIBBLER SETTING	To adjust pressure and flow for nibbler (10set)		20 - 35 Pressure 30 - 220 Flow rate	**20 MPa** (**2901 psi**) (at **220 l/min** (**58.12 US gpm**)) **220 l/min** (**58.12 US gpm**)

(*) Autodetect

Setting of language

1. Buzzer stop switch
2. Menu switch
3. Up arrow switch
4. Down arrow switch
5. Next arrow switch
6. Back arrow switch



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1. Turn starter switch On. After pressing Breaker mode switch **(4)** to select Breaker mode, turn starter switch Off.
2. Hold down buzzer stop switch **(1)** and turn starter switch On. The service diagnosis screen “a” is displayed.
3. Start the engine.
4. Hold down buzzer stop switch **(1)** and press menu switch **(2)** 3 times. “SERVICE MENU” screen “b” is displayed.
5. Using switch “UP ARROW SWITCH” **(5)** or “DOWN ARROW SWITCH” **(6)**, point the cursor to “SERVICE ADJUST 1” display “b”. Press “NEXT ARROW SWITCH” **(7)**, and SERVICE ADJUST 1-2 “c” is displayed.
6. Using switch “UP ARROW SWITCH” **(5)** or “DOWN ARROW SWITCH” **(6)**, point the cursor to “BREAKER SETTING” display “c”. Press “NEXT ARROW SWITCH” **(7)**, and BREAKER SETTING “d” is displayed.
7. There are 10 steps from “SET 1” to “SET 10". Using switch “UP ARROW SWITCH” **(5)** or “DOWN ARROW SWITCH” **(6)**, and select desired set number. To set desired set number, press “NEXT ARROW SWITCH” **(7)**.
8. Using switch “UP ARROW SWITCH” **(5)** or “DOWN ARROW SWITCH” **(6)**, set the desired flow rate. Then press menu switch **(2)** and the cursor is pointed to pressure display “f”.
9. During pressing front (toe side) of optional right pedal (P2 pump optional operation), use switch “UP ARROW SWITCH” **(5)** or “DOWN ARROW SWITCH” **(6)**, and adjust pump pressure. When you reach the desired pressure, press menu switch **(2)** to set. (If you fail to press front (toe side) of optional right pedal, **0 MPa** (**0 psi**) is displayed.)
10. Then, the display returns to “SERVICE ADJUST 1-2” screen “c”.

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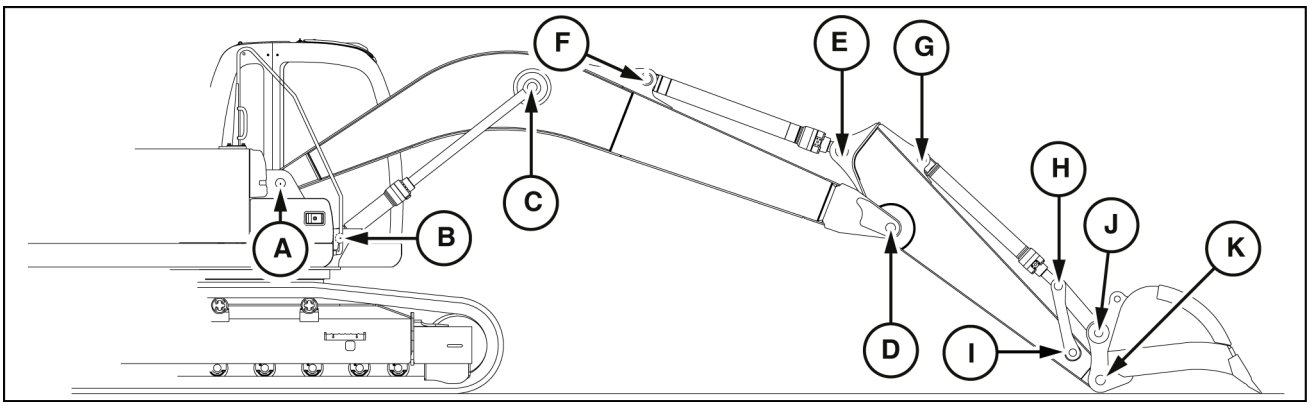
Boom - Service instruction — Monoblock version



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Item	Name of parts	Standard	Allowable limit	Solution
A	Pin	**90 mm (3.54 in)**	**89 mm (3.50 in)**	Replace
	Bushing	**90 mm (3.54 in)**	**91.5 mm (3.60 in)**	
B	Pin	**85 mm (3.35 in)**	**84 mm (3.31 in)**	
	Boss (Main frame)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
	Bushing (Boom cylinder)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
C	Pin	**85 mm (3.35 in)**	**84 mm (3.31 in)**	
	Bushing (Boom cylinder)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
	Flange (boom)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
D	Pin	**90 mm (3.54 in)**	**89 mm (3.50 in)**	
	Bushing	**90 mm (3.54 in)**	**91.5 mm (3.60 in)**	
E	Pin	**85 mm (3.35 in)**	**84 mm (3.31 in)**	
	Boss (Arm)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
	Bushing (Arm cylinder)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
F	Pin	**85 mm (3.35 in)**	**84 mm (3.31 in)**	
	Boss (Boom)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
	Bushing (Arm cylinder)	**85 mm (3.35 in)**	**86.5 mm (3.41 in)**	
G	Pin	**80 mm (3.15 in)**	**79 mm (3.11 in)**	
	Boss (Arm)	**80 mm (3.15 in)**	**81.5 mm (3.21 in)**	
	Bushing (Bucket cylinder)	**80 mm (3.15 in)**	**81.5 mm (3.21 in)**	
H	Pin	**80 mm (3.15 in)**	**79 mm (3.11 in)**	
	Bushing	**80 mm (3.15 in)**	**81.5 mm (3.21 in)**	
	Bushing (Bucket cylinder)	**80 mm (3.15 in)**	**81.5 mm (3.21 in)**	
I	Pin	**70 mm (2.76 in)**	**69 mm (2.72 in)**	
	Bushing	**70 mm (2.76 in)**	**71.5 mm (2.81 in)**	
J	Pin	**80 mm (3.15 in)**	**79 mm (3.11 in)**	
	Bushing	**80 mm (3.15 in)**	**81.5 mm (3.21 in)**	
K	Pin	**80 mm (3.15 in)**	**79 mm (3.11 in)**	
	Bushing	**80 mm (3.15 in)**	**81.5 mm (3.21 in)**	

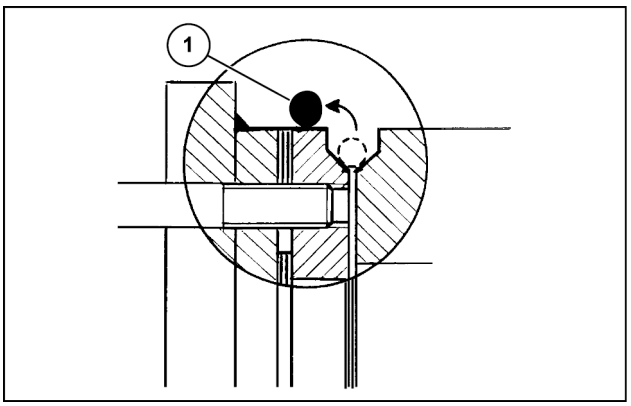
ATTENTION: *Be sure to install front attachment bushings using a press.*

Bucket - Install

Installing the bucket

- Using a suitable hoist, place the bucket at the same level as the tracks.
- Place the O-rings **(1)** on the outside of their seats.
- Using the arm cylinder and boom cylinder controls, make small vertical and horizontal movements to install the hinge pin **(B)** that connects the bucket to the arm into the hole **(A)**.
- Use the bucket cylinder control to align the connecting rod **(C)** with the hole **(D)**. Install the hinge pin **(E)**.
- Attach the hinge pins using lock pins and retaining rings. Then reposition the O-Rings into their seats.

NOTICE: *During removal of the bucket, ensure that the pins are clean and free of sand, etc. After reinstalling the bucket, lubricate the pins with grease using the appropriate nozzles.*



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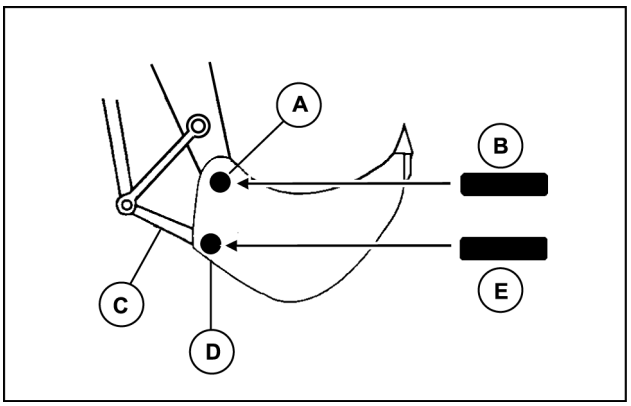

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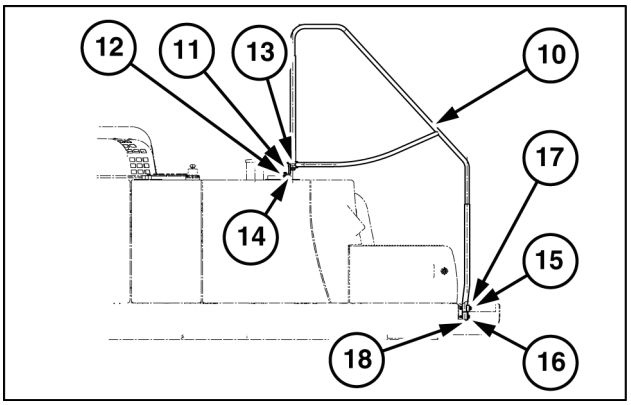
Remove stay **(10)**.

1. Remove the 2 bolts **(11) M16 x 70**.
   : **24 mm** (**0.9 in**)
2. Remove the 2 bolts **(12) M12 x 30**.
   : **19 mm** (**0.7 in**)
3. Remove clamp **(13)** and plate **(14)**.
4. Remove a bolt **(15) M12 x 65**.
   : **19 mm** (**0.7 in**)
5. Remove a bolt **(16) M10 x 55**.
6. Remove clamp **(17)**, bracket **(18)** and stay **(10)**.
   Weight : **12 kg** (**26.5 lb**)



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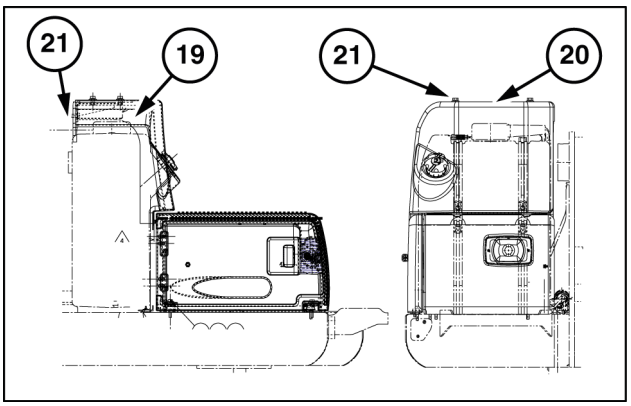
Remove cover **(19)** and cover **(20)**.

1. Remove 4 bolts **(21) M12 x 25**.
   : **19 mm** (**1 in**)
2. Remove cap **(20)**.
   Weight : **3.7 kg** (**8.2 lb**)
3. Remove 3 bolts **(21) M12 x 25**.
   : **19 mm** (**0.7 in**)
4. Remove cap **(19)**.
   Weight : **7.3 kg** (**16.1 lb**)



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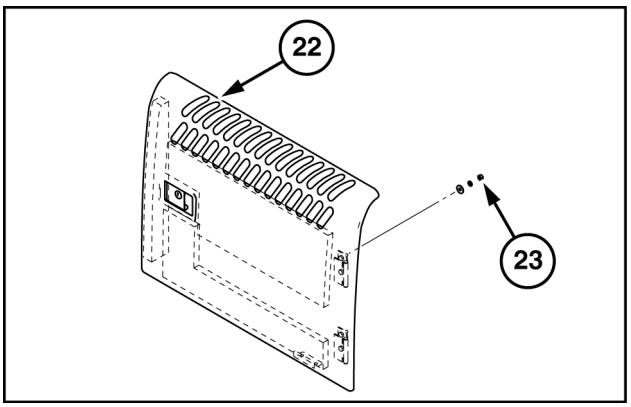
Remove panel assy. **(22)** .

1. Unlock panel assy. **(22)** .
2. Remove 4 nuts **(23) M10**.
   : **17 mm** (**0.7 in**)
3. Remove panel assy. **(22)** .
   Weight : **15 kg** (**33 lb**)



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