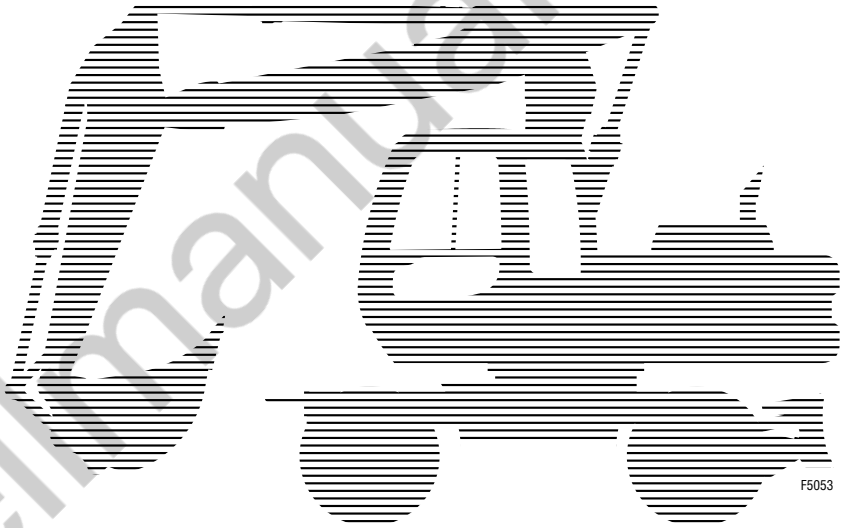
MODELS

EXCAVATOR EX135W

WORKSHOP MANUAL



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IMPORTANT: *The information contained in this manual are valid at printing time. As the Manufacturer continuously improves his products, some information may not be updated. In case of discrepancies, apply to Sales and Service Department.*

FIAT - HITACHI EXCAVATORS S.p.A. - ENGINEERING - PRINT 604.06.991
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3.2 BRIEF INFORMATION FOR MANUAL CONSULTATION

The manual is divided into section, each of them quotes a specific portion of the machine or specific related subject.

Some section (those related to main mechanical assembly) are divided into:

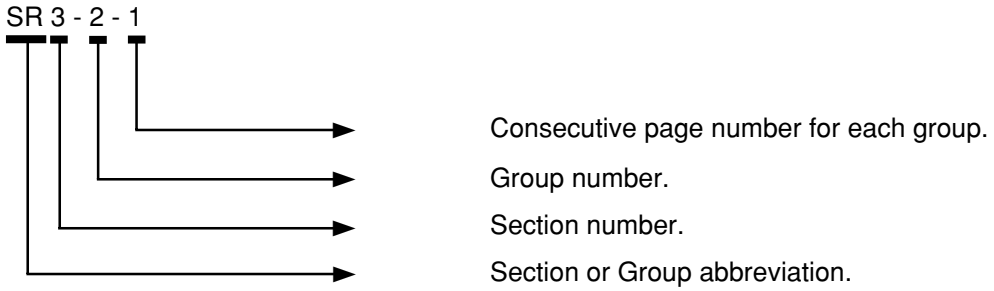
- **O/P** (Operation Principle)
- **D/A** (Disassembly/Assembly)

In the Operation Principle, the assemblies and their components are described with technical data.

In the disassembly and assembly the procedures are described to perform repair or overhaul, with special tool required and technical data.

Each section is divided into group, and the group, in turn, in pages. Each page has a number, located in the upper right corner. Each number contains the following information;

- **example:**




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SAFETY PRECAUTIONS

width, and weight. Have a signal-man help you when clearances are limited.
Check distance between boom/arm and dimensional limits during transfer or transportation.
Rough terrain may cause the machine to sway and roll to such an extent that boom/arm could get to contact electric lines or other obstacles. Cross obstacles at a right angle at low speed. Pay attention to machine shaking when the centre of gravity overcomes the obstacle.
Keep the bucket down at all times during transfers.
Drive with the lights on and use appropriate signals and flags.
Get to know and respect local and national regulations.
Consider boom/arm and upperstructure dimensions while turning.
Use a ramp to load the machine on a trailer. If a ramp is not available, fabricate one using blocks. The ramp should be sufficiently strong to support machine weight. Always load and unload on level surface.
Tow the machine following the instructions contained in the Operation and Maintenance Instruction Manual.

ENGINE

Do not run the engine in closed buildings without proper ventilation capable to remove harmful exhaust fumes.
Do not place head, body, limbs, feet, hands or fingers near rotating fans or belts. Be especially careful near blower fans.
Loosen the radiator cap very slowly to relieve system pressure before removing it. Always top-up coolant level with the engine off or idling if hot. See the Operation and Maintenance Instruction Manual.
Keep the exhaust manifold and tube free from combustible matters. Fit the machine with shields and guards when working in the presence of combustible matter free in the air.
Do not refuel with the engine running, especially if hot, as this increases fire hazard in case of fuel spillage.
Never attempt to check or adjust fan belt tensions when the engine is running.
Do not adjust the fuel injection pump when the machine is operating.
Do not lubricate the machine with the engine running.
Do not run the engine with the air intakes open and not protected. If this cannot be avoided for service reasons, place protection meshes on all intakes before servicing the engine.

ELECTRICAL SYSTEM

Pay attention to connect connecting cables to correct poles (+ to +) and (- to -) at both ends. Do not short-circuit terminals. Thoroughly follow instructions given in Operation and Maintenance Instruction Manual.
Always move the key-start switch in the lock position before servicing or repairing the machine.
Batteries contain SULPHURIC ACID. Protect the eyes when working near the batteries against possible sprays of the acid solution. Should acid contact skin, eyes, or clothes, RINSE IMMEDIATELY IN WATER FOR AT LEAST 15 MINUTES. Immediately seek medical attention.
Battery released gas is highly flammable. Leave the battery compartment cover open during recharging to improve ventilation. Never check battery charge by placing metal objects across the posts. Keep sparks or open flames away from batteries. Do not smoke near the battery to prevent explosion hazard.
Before any maintenance or repair, make sure that there are no fuel or electrolyte leaks from the batteries. If any, correct prior to proceeding with further work. Do not recharge batteries in confined spaces. Ensure proper ventilation is provided to avoid accidental explosions due to build-up of explosive gas released during charging.
Disconnect batteries before working on the electrical system or carrying out any other type of work.

HYDRAULIC SYSTEM

Pressure fluid escaping from a very small hole can be almost invisible and still have sufficient force to penetrate the skin. Always check any suspected pressure leaks using a piece of cardboard or wood. Do not use hands. If injured by escaping fluid, obtain medical attention immediately or serious infection or reaction may develop.
Stop the engine and ensure pressure is relieved from all systems before removing side panels, housings, guards and covers. See the Operation and Maintenance Instruction Manual.
Always use gauges of adequate capacity for pressure testing. Refer to the Operation and Maintenance Instruction Manual or Repair Manual.

TOOLS

Always keep head, body, limbs, feet, hands, and fingers away from the bucket and attachments, when in the raised position.
Prior to any maintenance or repair work, install all supports necessary to this aim according to local and national safety regulations.
In case the attachment is to be operated for maintenance or repair purposes, do so exclusively while sitting in the driver's seat. Sound the horn before starting the machine or moving the attachment. Require that nobody remain near the machine. Raise the attachment slowly.
Do not use the machine to transport loose objects, unless proper securing devices are provided.

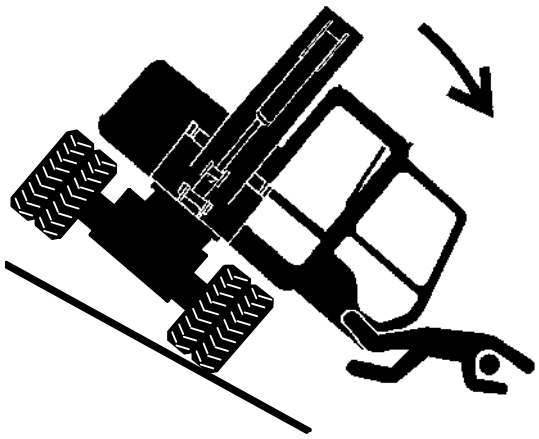
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SAFETY PRECAUTIONS

AVOID TIPPING

When operating on a slope, keep bucket low to ground and close to machine. Point chassis frame uphill to avoid tipping.
To avoid tipping:
- Be extra careful before operating on a grade.
- Prepare machine operating area flat by grading.
- Keep the bucket low to the ground and close to the machine.
- Reduce machine operating speed to avoid tipping or slipping.
- Avoid changing direction when travelling on grades.
- Never attempt to travel across a grade steeper than 15 degrees.
- Reduce swing speed as necessary when swinging loads.

Be careful when working on frozen ground.
- Temperature increases will cause the ground to become soft and make ground travel unstable.



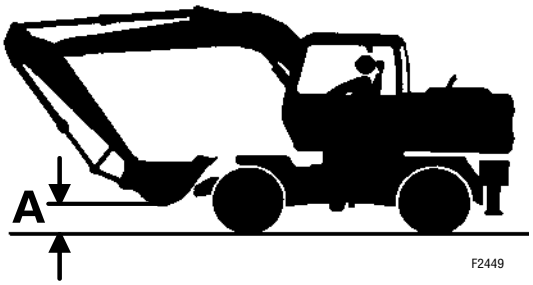
F5826

DRIVE MACHINE SAFELY

Before starting the machine, read carefully the "use and instructions manual" to get familiar with pedals and levers.

Before moving the machine, confirm which way to move travel pedals/levers for the corresponding direction you wish to go.

When traveling up or down a grade, keep the bucket in the direction of travel, approximately 20 to 30 cm (**A**) above the ground.



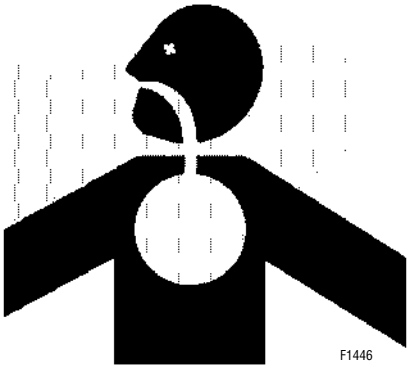
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BEWARE OF EXHAUST FUMES

Engine exhaust fumes can cause sickness or death.

If you must operate in a building, be sure there is adequate ventilation.

Either use an exhaust pipe extension to remove the exhaust fumes or open doors and windows to bring enough outside air into the area.



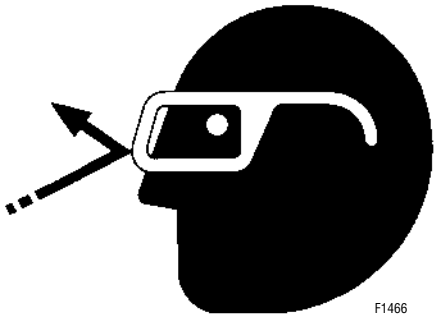
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SAFETY PRECAUTIONS

PROTECT AGAINST FLYING DEBRIS

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

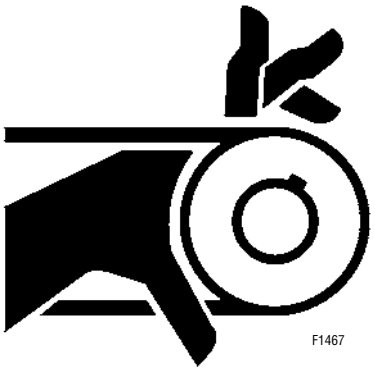
Keep bystanders away from the working area before striking any object, to avoid personal injury.


F1466

STAY CLEAR OF MOVING PARTS

Entanglements in moving parts can cause serious injury.

To prevent accidents, care should be taken to ensure that hands, feet, clothing, jewelry and hair do not become entangled when working around rotating parts.


F1467

SUPPORT MACHINE PROPERLY

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

Do not support the machine on cinder blocks, hollow tiles, or props that may crumble under ontinuous load.

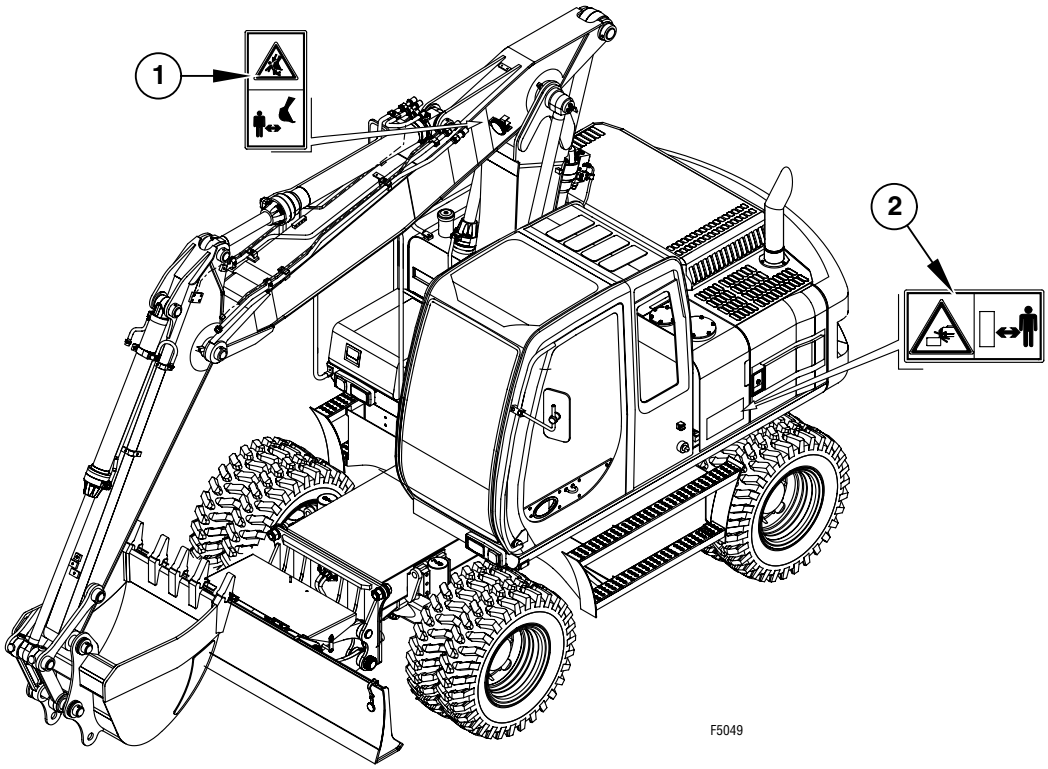
Do not work under a machine that is supported solely by a jack. Follow the procedures in this manual.


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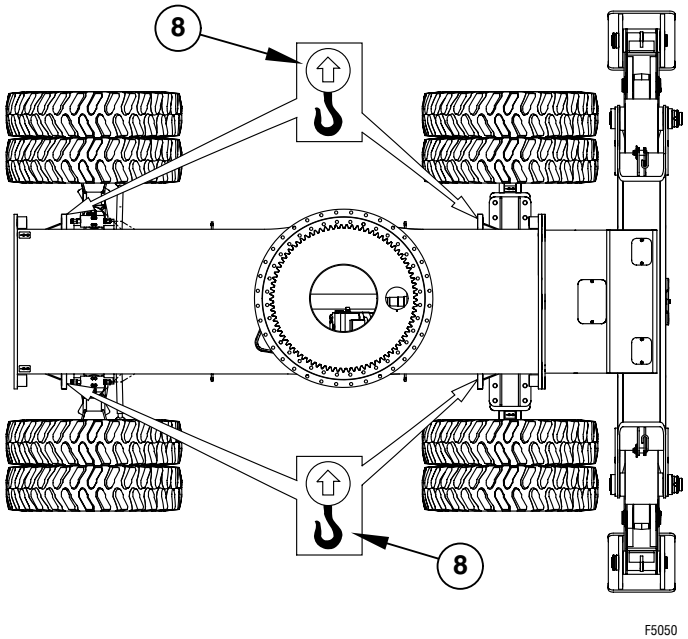
SAFETY SIGNS

TRIPLE ARTICULATION VERSION

1. Decal, equipment safe area of operation.
2. Decal, counterweight safe area of operation.



8. Hooking points.

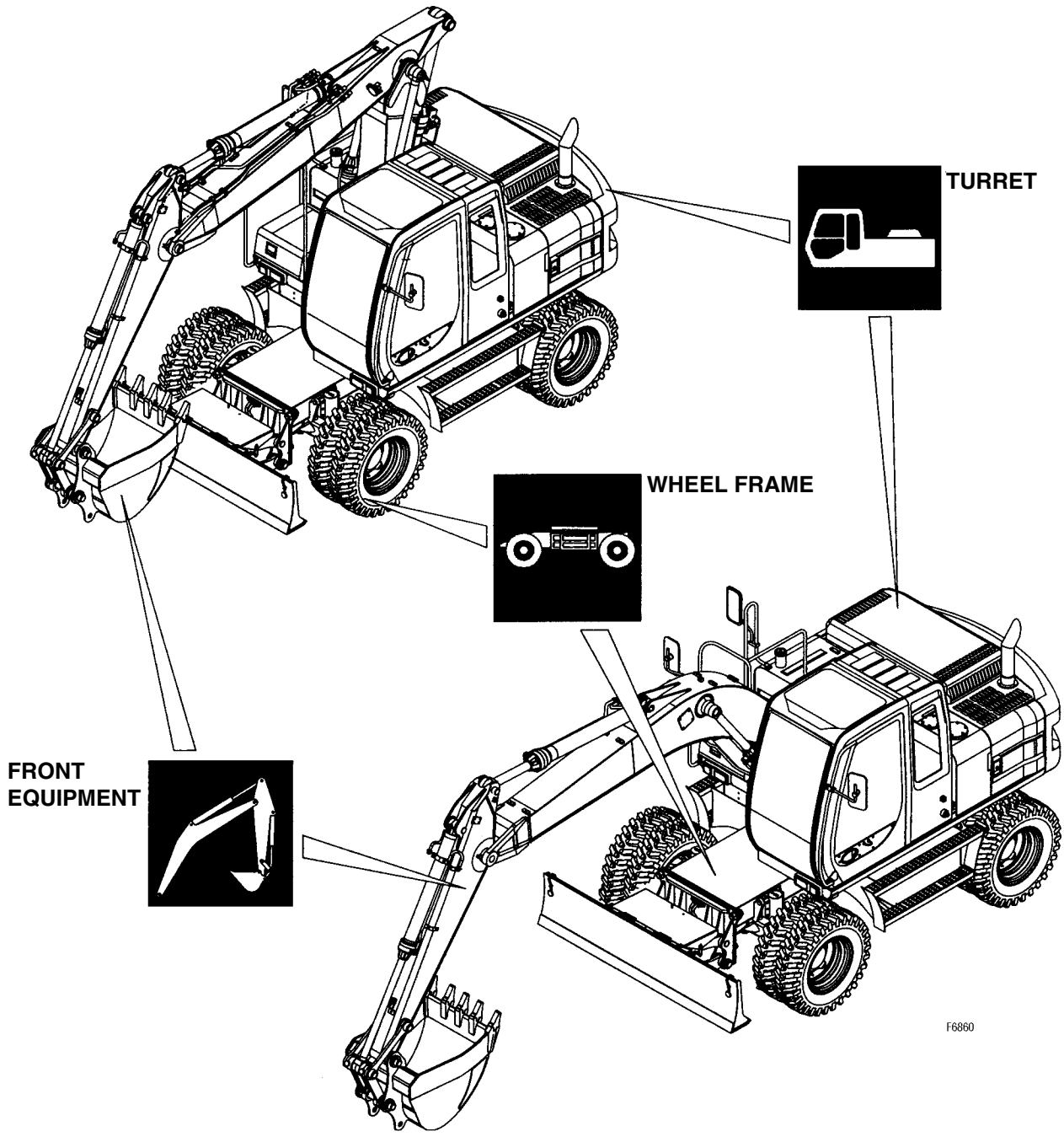


1. GENERALITY

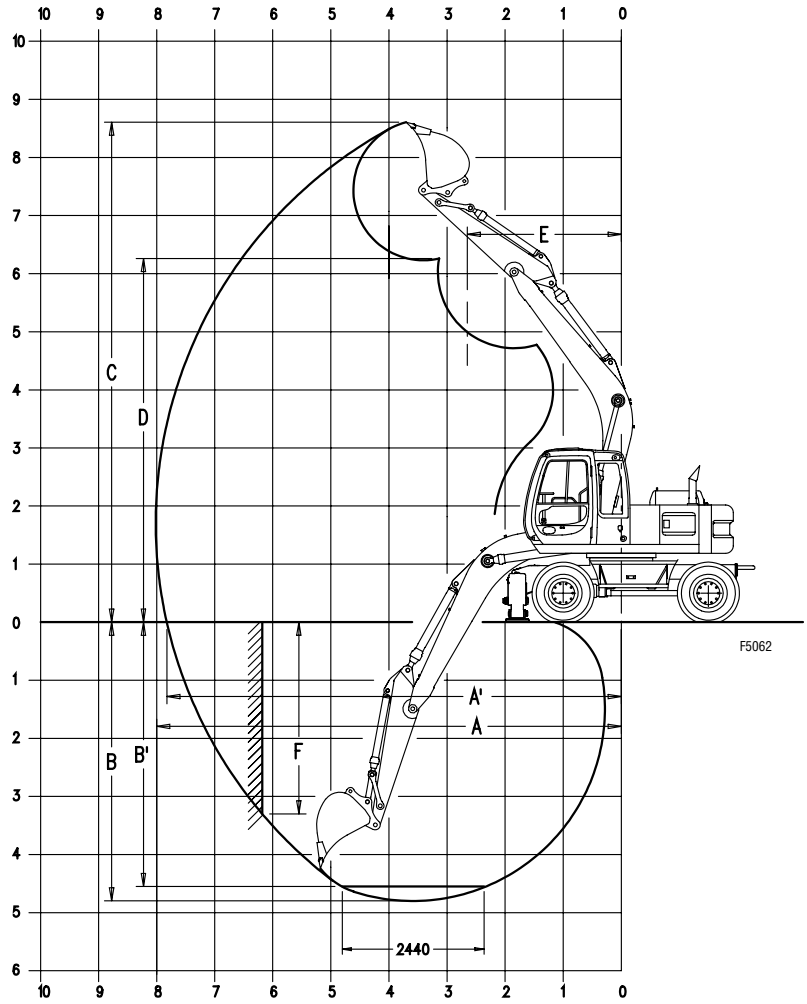
1.1 INTRODUCTION

The hydraulic excavator is essentially made of three main components: TURRET, WHEEL BASE and FRONT EQUIPMENT.

This machine is entirely controlled by an hydraulic system.
The mechanical energy of the engine is transformed into hydraulic energy, actuating cylinders and hydraulic motors, where it is reconverted into mechanical energy to perform an operation. In other words, travelling, swinging the turret, digging and all other operations are performed using hydraulic power.



DIGGING PERFORMANCES - (MONOBLOC VERSION)



Arm	mm	2090	2490	2990
A	mm	8020	8365	8860
A'	mm	7830	8185	8685
B	mm	4800	5200	5700
B'	mm	4560	4985	5520
C	mm	8610	8805	9170
D	mm	6260	6460	6820
E	mm	2700	2765	3020
F	mm	3780	4180	4600

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LIFTABLE AT THE HOOK LOAD CHART EX135W

NOTE: *Lift loads as per ISO 10567 Standards (75% stability, 87% hydraulic system). Load at the hook (hook, reverse cylinder, bucket, rod, idler gear, etc. excluded).*

NOTE: *If is necessary to lift of a load with the machine equipped with some or all the above mentioned parts (bucket, hooks, etc.), subtract their weight from the weights shown on the chart. This is done to calculate the lifting working capacity.*

EX135W (Monobloc)			3 m	4.5 m	6 m	7.5 m	max. lift load	max distance
4600 mm boom	**2090** mm arm	Z2	5.2* t	3.2 t	2.2 t	—	1.8 t	6.7 m
		Z1	5.2 t	2.9 t	2.0 t	—	1.8 t	6.8 m
		Z3	5.3* t	2.9 t	—	—	2.2 t	5.7 m
	2490 mm arm	Z2	5.9* t	3.2* t	2.2 t	—	1.7 t	7.0 m
		Z1	5.2 t	2.9 t	2.0 t	—	1.6 t	7.1 m
		Z3	5.2 t	2.9 t	2.0 t	—	2.0 t	6.1 m
	2990 mm arm	Z2	5.2* t	3.3* t	2.2 t	1.5 t	1.5 t	7.5 m
		Z1	5.1 t	2.9 t	2.0 t	1.5 t	1.5 t	7.6 m
		Z3	5.1 t	2.8 t	2.0 t	—	1.7 t	6.6 m

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* Value limited by machine hydraulic capacity.

EX135W (Triple articulation)				3 m	4.5 m	6 m	7.5 m	max. lift load	max distance
1950 mm boom	**3100** mm positioner	**2090** mm arm	Z2	5.2* t	3.3 t	2.2 t	—	1.8 t	6.8 m
			Z1	5.2 t	2.9 t	2.0 t	—	1.7 t	6.9 m
			Z3	5.2 t	2.9 t	—	—	2.1 t	5.8 m
		2490 mm arm	Z2	4.5* t	3.1* t	2.2 t	—	1.7 t	7.2 m
			Z1	5.1 t	2.9 t	2.0 t	—	1.6 t	7.3 m
			Z3	5.1 t	2.9 t	2.0 t	—	1.9 t	6.3 m
		2990 mm arm	Z2	—	3.2* t	2.2 t	1.6 t	1.5 t	7.7 m
			Z1	5.0 t	2.8 t	1.9 t	1.5 t	1.4 t	7.8 m
			Z3	5.0 t	2.8 t	1.9 t	—	1.6 t	6.8 m

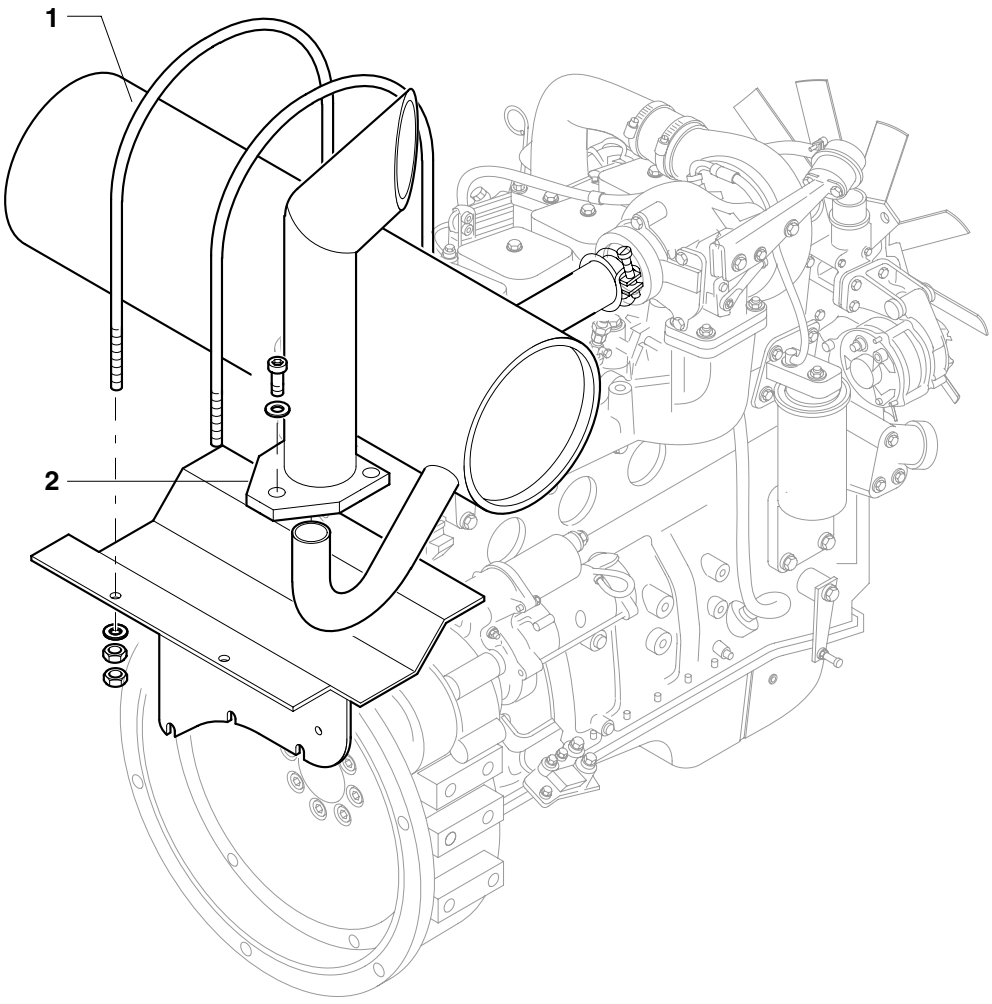
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* Value limited by machine hydraulic capacity.

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Exhaust gases silencer

The gases generated during the combustion are sent, through the turbocharger, to the exhaust silencer (**1**) and from the latter, they are discharged through duct (**2**) away from the machine.



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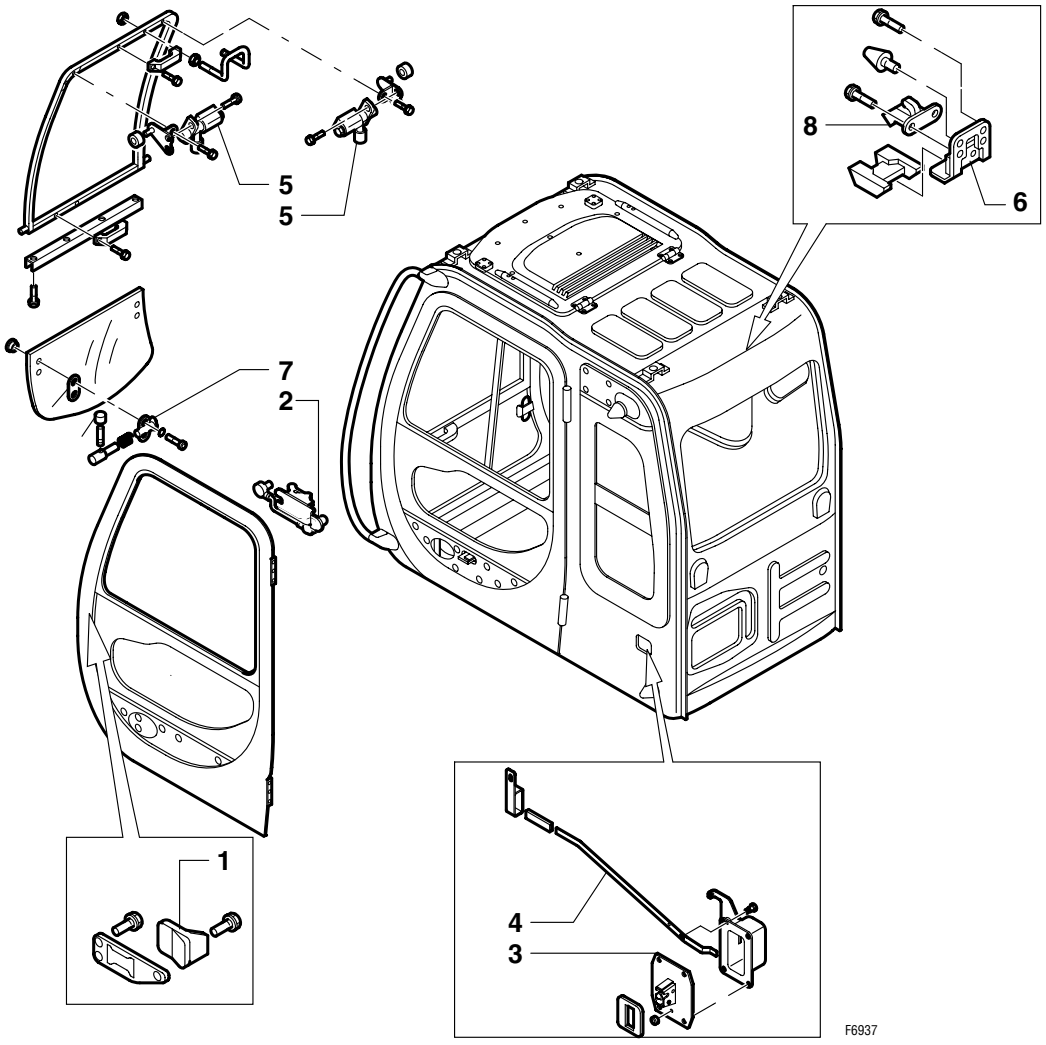
1.6 CAB GROUP

1.6.1 CONSTRUCTION

The cab group includes: cab, seat, steering and controls column, floor plate and carpet. The entire group is mounted on anti-vibration elastic blocks.

Cab

The cab is totally designed to suit the operator's comfort, in accordance with ISO standards, with an optimized sound proofing level. The dimensions of the glassed surfaces offer an excellent visibility in all directions.

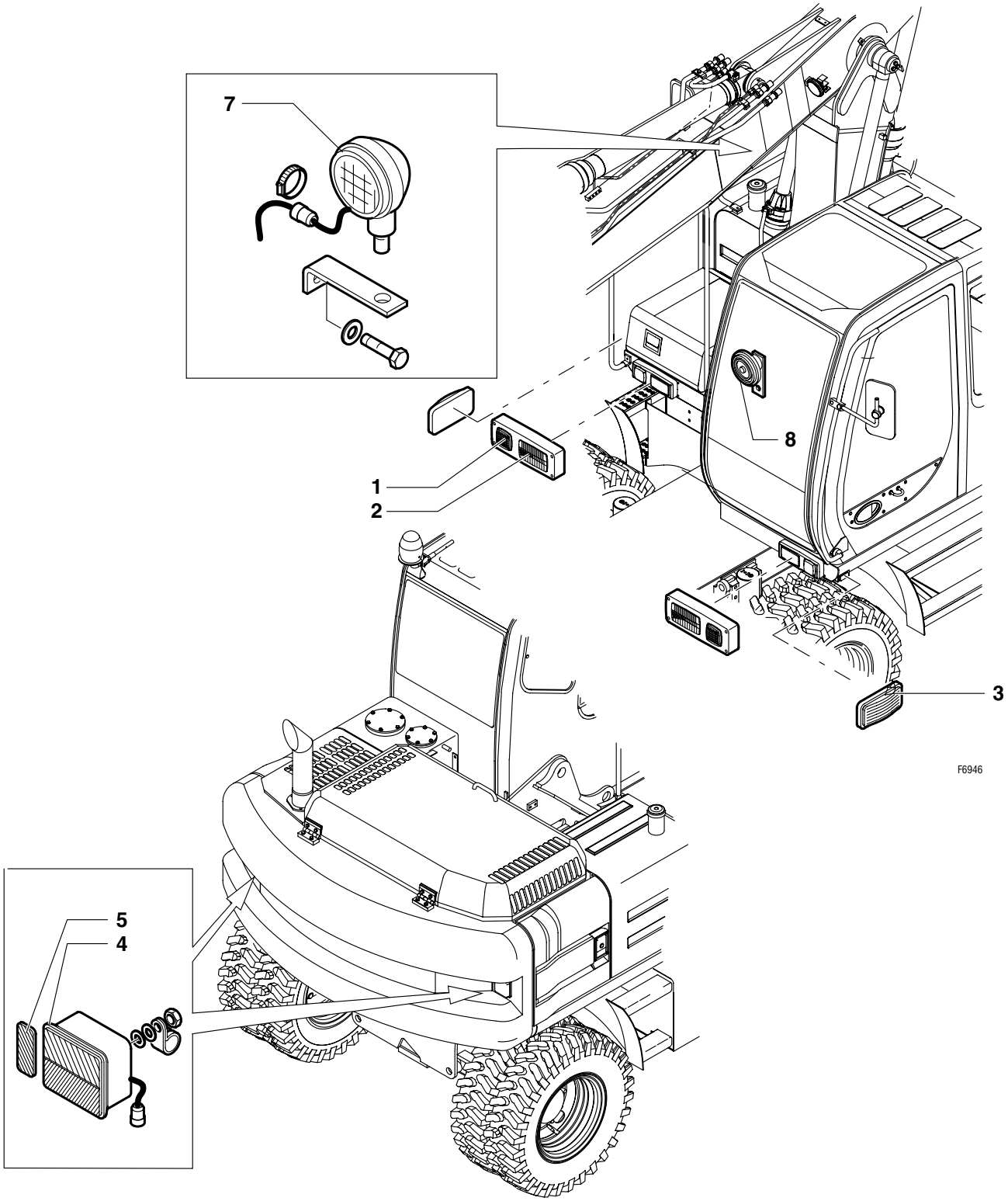


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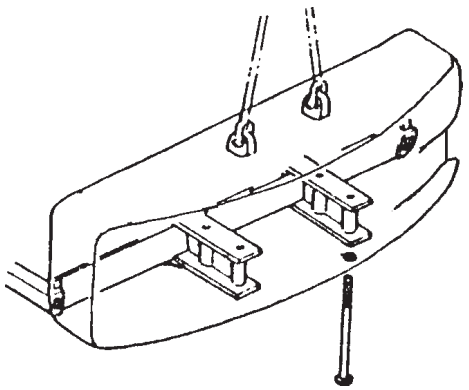
1 - Outer door opening handle
2 - Inner door opening handle
3 - Door locking mechanism in "open" position
4 - Door unlocking mechanism from "open" position
5 - Windshield locking latch in "closed" position
6 - Windshield locking latch in "open" position
7 - Lower windshield locking latch in "closed" position
8 - Windshield unlocking from "open" position

1.9.4 ROAD AND WORK LIGHTS LOCATION

1 - Direction light
2 - Head-light
3 - Direction light
4 - Tail light
5 - Reflector
7 - Work light
8 - Horn



5 Remove the screws securing the counterweight/ frame.



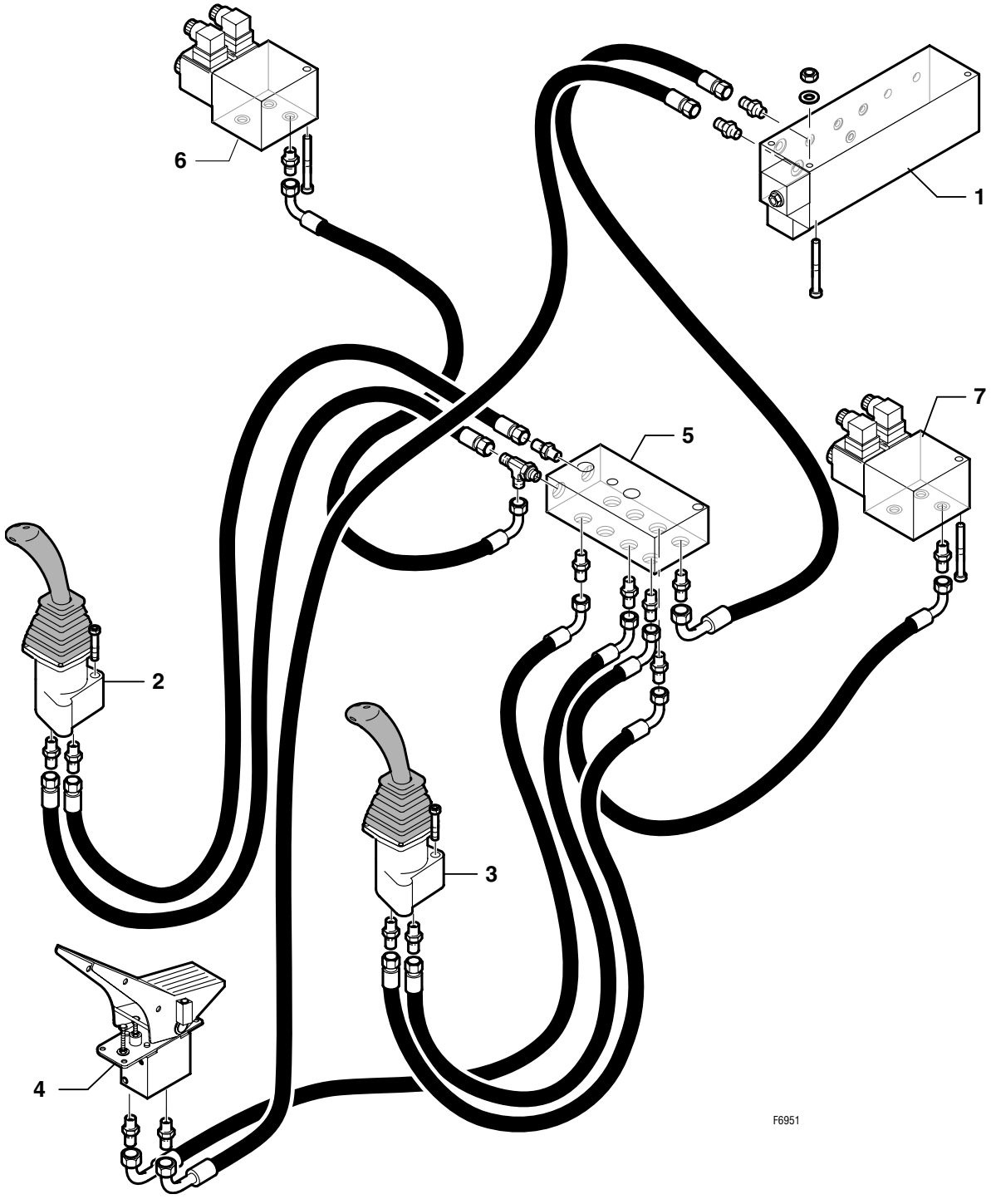
6 Lift the counterweight, move it away and lower it to the ground.

1.11.3 PILOT SYSTEM PIPES

The pilot system pipes include the suction and delivery pilot pump and the connection system between pilot valves and control valve.

(A) Pilot valves connections

1 - Solenoid valves block
2 - Pilot valves (boom/bucket)
3 - Pilot valves (arm/swing)
4 - Pilot valves (travel/positioner)
5 - Diverter block
6 - Solenoid valves B3/B4
7 - Solenoid valves B1/B2



Identification

The identification codes of hoses are stamped on the connecting sleeve.
Each hose has an identification code stamped on the sleeve.
If a hose is without marking and this cannot be traced on the spare parts catalog, describe the specifications when ordering a replacement.
The specifications of a hose is identified by the inner diameter, length of the hose including the connections, the type of connection (straight, 90°, 45°) the type of thread (metric, gas) or SAE flange.

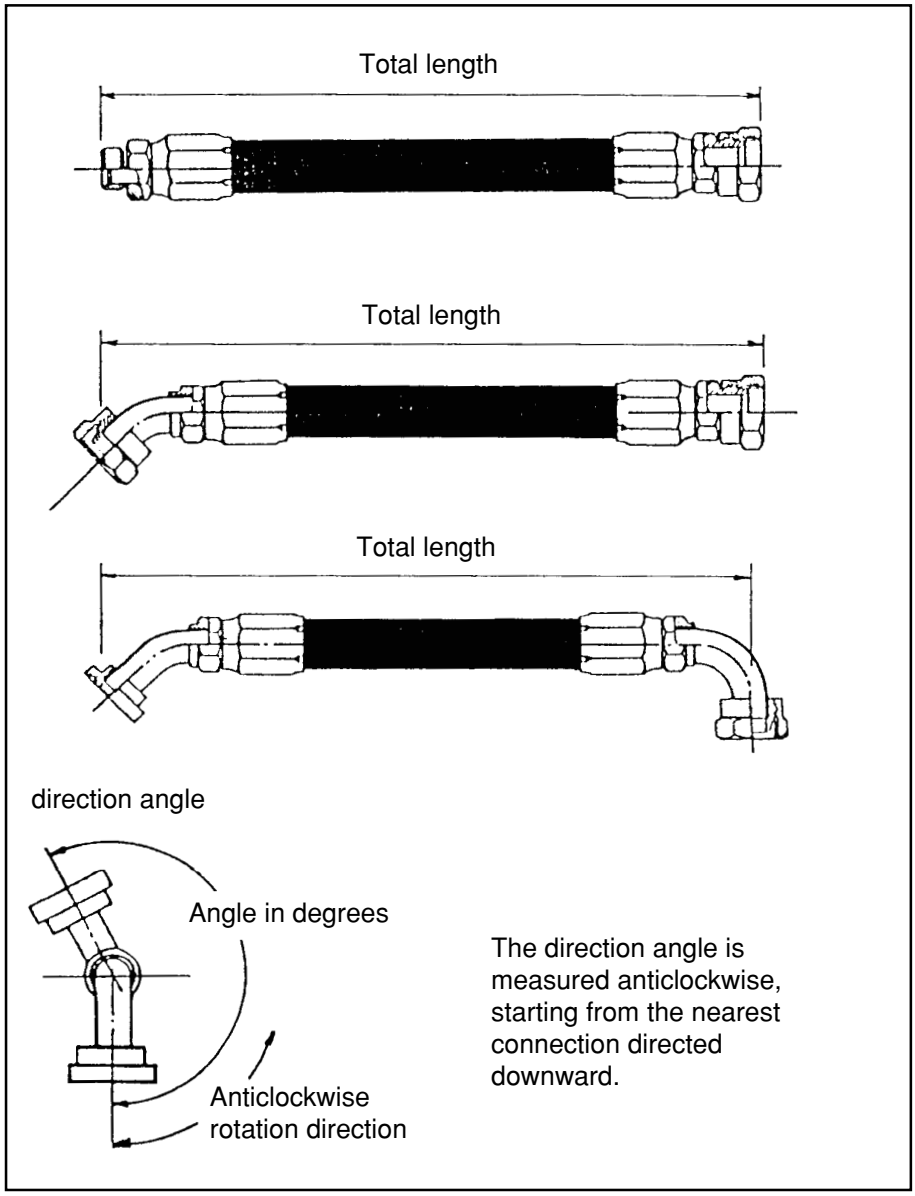


Fig. 3

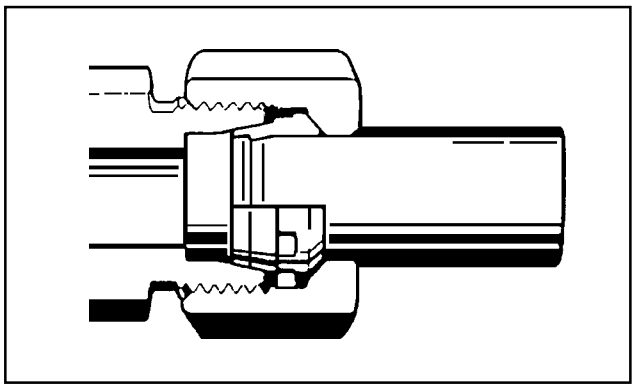
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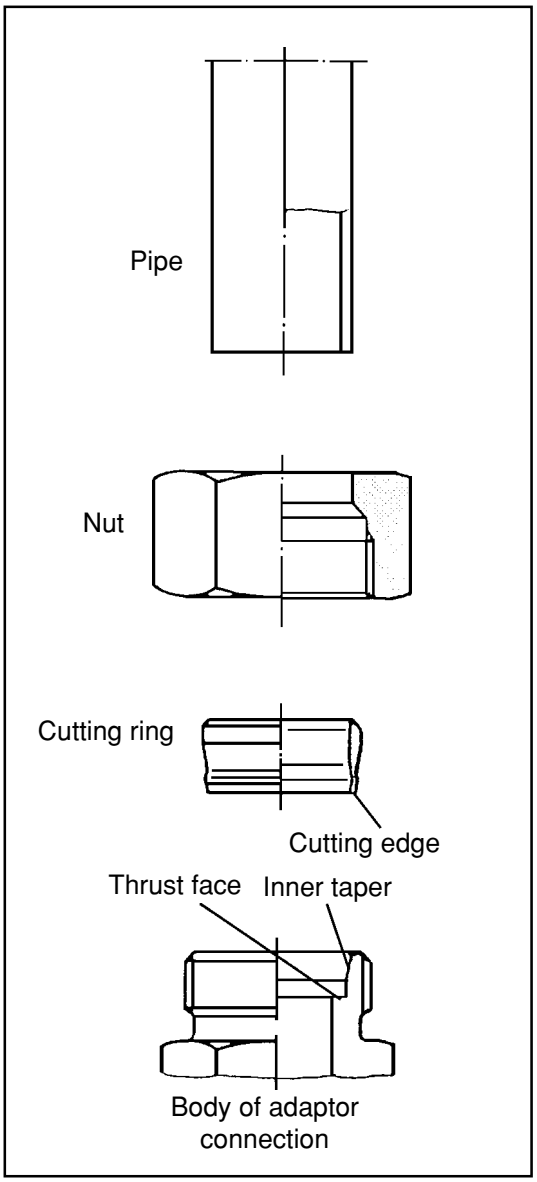
The operating safety of hoses depends, at a great extent, from their correct mounting on the components of hydraulic systems, as well, allowing eventual position movements linear and angular or both, if required.
The installation must, in fact, be made in such a manner that the hoses are not subject - in any position - to twisting , traction or excessive flexion effort. The latter data such to determine a reduction of the bending radius beyond admissible limits.
In case of frequent movements, it is recommended to increase the minimum bending radius to avoid reducing operating life.

1.12.5 INSTALLATION OF CONNECTIONS ON STEEL PIPES

Description

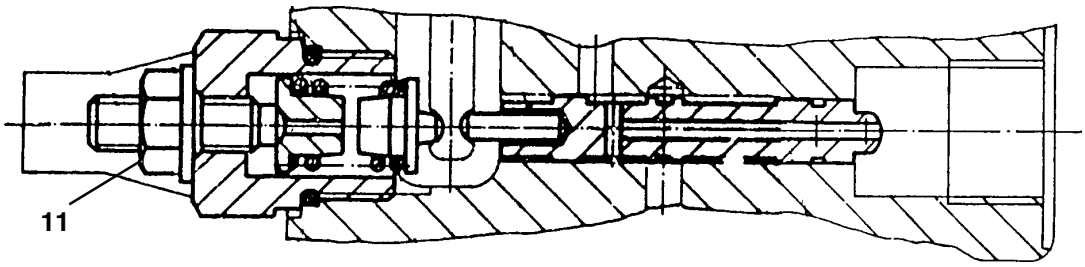
The cutting ring has two sinking edges.
The installation instructions must be thoroughly followed. This is vitally important for the proper performance of the connection.
For all systems with cutting ring - with one or two sinking edges - the advantages of a higher resistance can be obtained only when the single mounting phases prescribed are followed to the letter.
For a good operation and a perfect sealing of the connection it is of fundamental importance, during the tightening of the nut, not to rely on the tightening torque deriving from experience previously acquired, but counting accurately the number of turns made and check the sinking after the pre-mounting.





Constant power regulation circuit

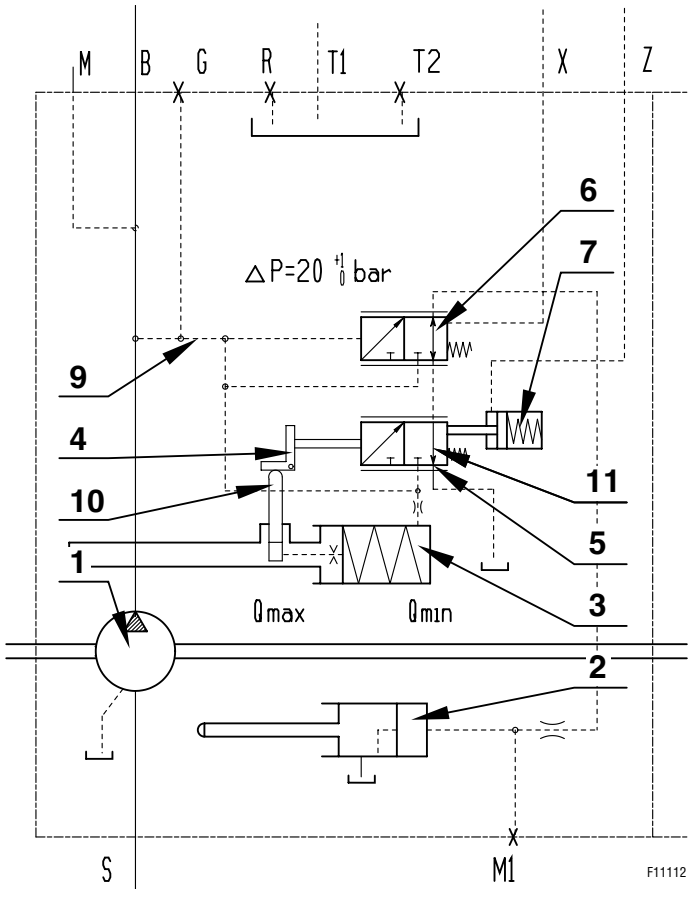
The constant power regulation circuit controls the volume of oil delivered by the pump related to the operating pressure of the circuit and the power output, so that, for a given speed of the pump, the driving power required from the engine is not exceeded, and the relation $N = \frac{P \cdot Q}{K}$ = constant (where N = Diesel Engine Power, P = Oil pressure, Q = delivery and K = coefficient).



The pressure of the hydraulic oil of the feeding circuit, acting on a plunger inside counter-piston (**3**), actuates a swinging arm (**4**).
On the other side of the swinging arm, a spring, adjustable from outside, is acting through a push-rod. When turning screw (**11**) the power regulation is changed.
If the operating pressure of the feeding circuit exceeds the load setting of the spring, the power regulation valve is commanded to open by the movement of the swinging arm. Thus, the feeding circuit line is connected with the swashplate control piston (**2**) that, when moving, changes the position of the swashplate toward smaller inclination angles. Consequently, the pump output decreases.

By reducing the oil flow, the new equilibrium value is re-established, so that P Q = constant is satisfied.

1 - Main pump
2 - Swashplate control piston
3 - Counter piston
4 - Swinging arm
5 - Power regulation valve
6 - Load sensing regulation valve
7 - Power regulation valve related to swing pump load (cross sensing)
9 - Operation pressure reference line
10 - Plunger
11 - Adjusting screw

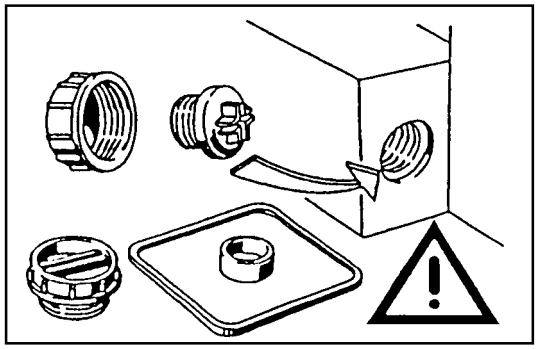


2.1 MAIN PUMP

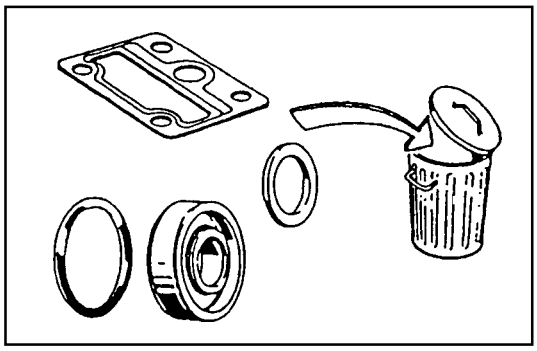
2.1.1 GENERAL REPAIR INSTRUCTION

Note - Observe the following notices when carrying out repair work on hydraulic components.

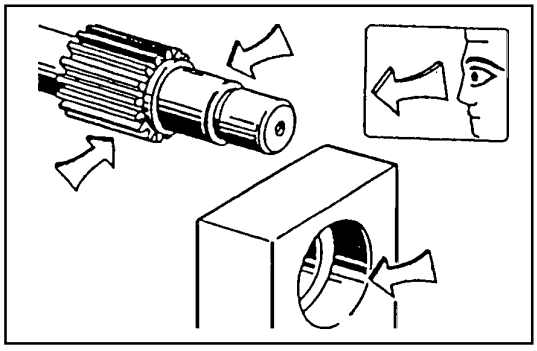
- Close all ports of the hydraulic components.



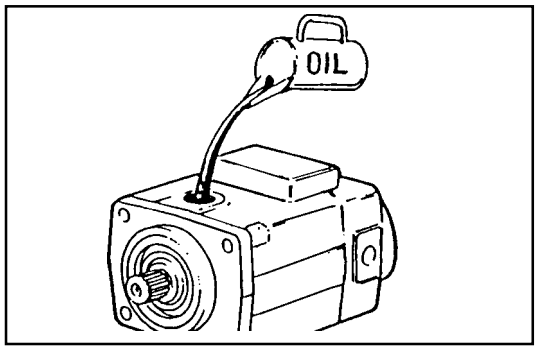
- Replace all removed seals.



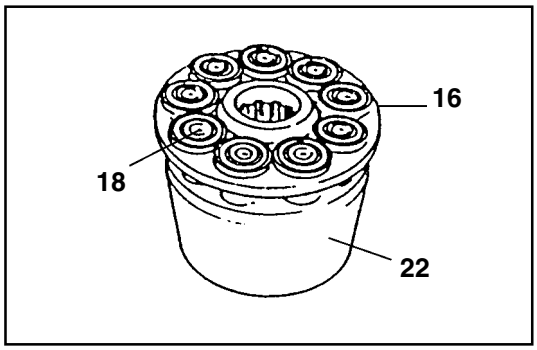
- Check all seals and sliding surfaces for wear.
  ATTENTION - Rework of sealing area f. ex. with abrasive paper, can damage surface.



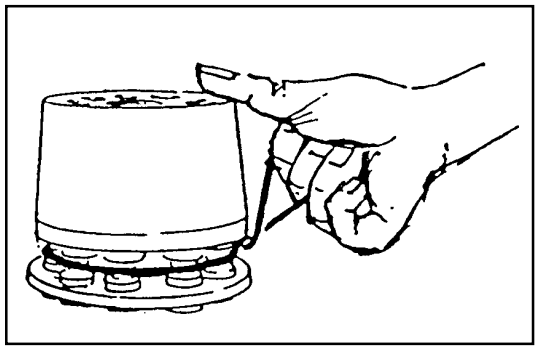
- Fill up main pump with hydraulic oil before start-up.



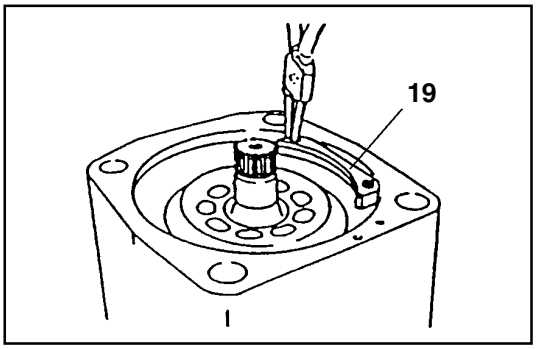
13 Place retaining plate (**16**) with piston (**18**) into cylinder (**22**).



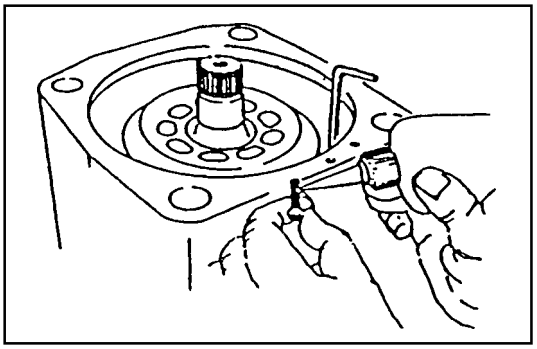
14 Holding assembled pistons with the aid of an O-ring as shown, install the assembly in the pump.



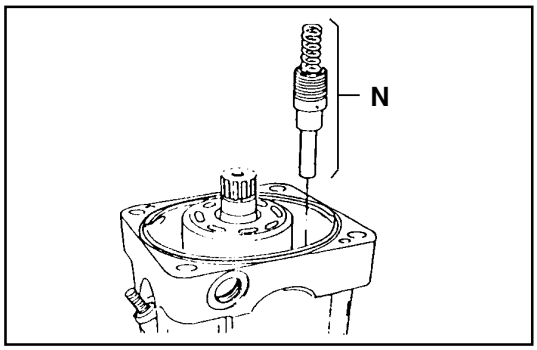
15 Insert fixing segments (**19**).



16 Install screws with Loctite. Tight screws with torque value.



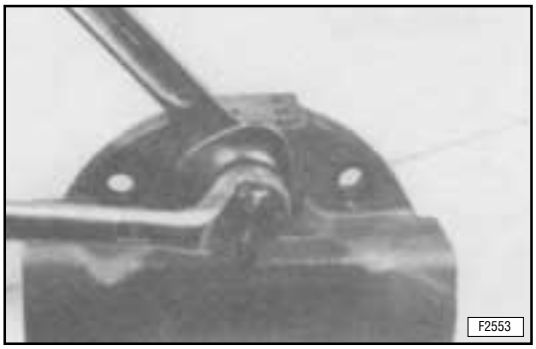
17 Install the complete control piston for swivel plate (**N**) on its seat.



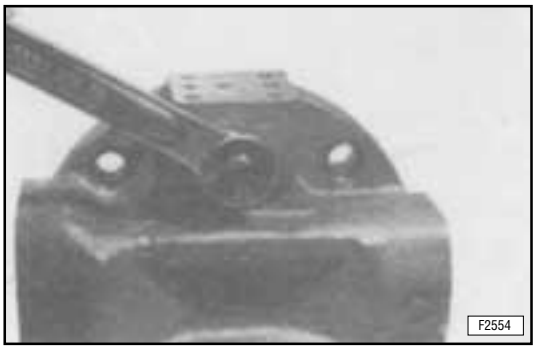
21 Remove the O-rings.



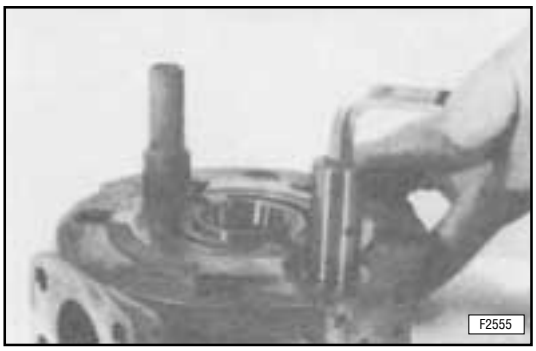
22 Disassemble the head nut of threaded pin.



23 Disassemble the hexagon fixing nut and the threaded pin.



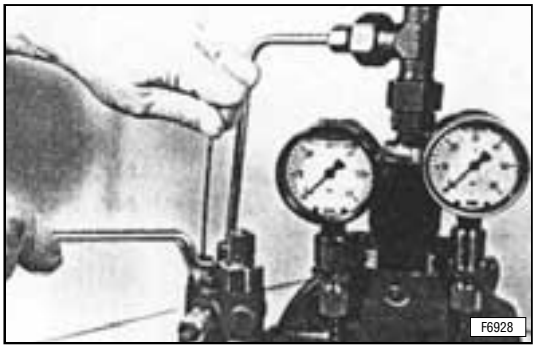
24 Disassemble the swash control piston.



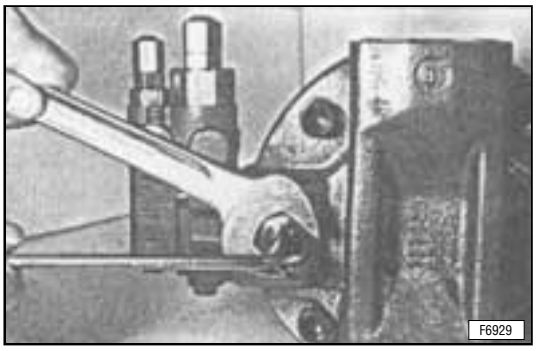
25 Disassemble the feedback piston.



22 FR: If swivel angle is in the mid position adjust differential pressure 14 bar (adjustable orifice in the system pressure line is partly closed).

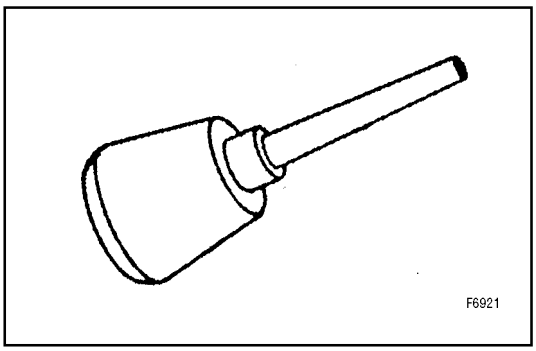


23 Mechanical flow limiter: While screwing in the threaded pin you will be able to reduce the flow from Vg max to 35% reduction of V_{gmax} dependent on the size of the pump (If you need more reduction of the flow, don't mount the fixing hexagon nut. Note: to adjust the threaded pin without the fixing hexagon nut do it by the existence of the working pressure).



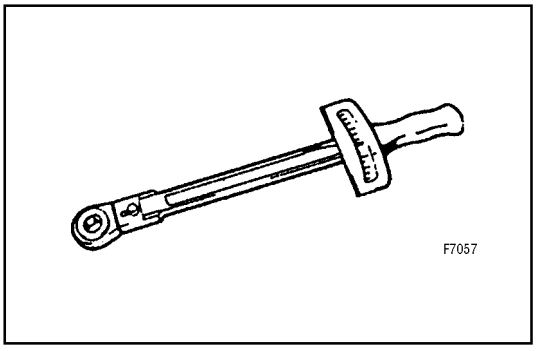
24 Loctite used:

break - off plugs	Nr. 601
normally	Nr. 242



Tightening torques

Bolt hardness grade: 8.8; 10.9; 12.9



		M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M24	M30
Ma	8.8	2.3	5.0	8.5	21	41	72	115	176	240	350	600	1220
	10.9	3.2	7.2	12	29	58	100	165	250	350	490	840	1670
	12.9	4.1	8.5	14.5	35	70	121	195	300	410	590	990	2000

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Ma (Nm) = max. tightening torques (screws lubricated $\mu = 0.125$)

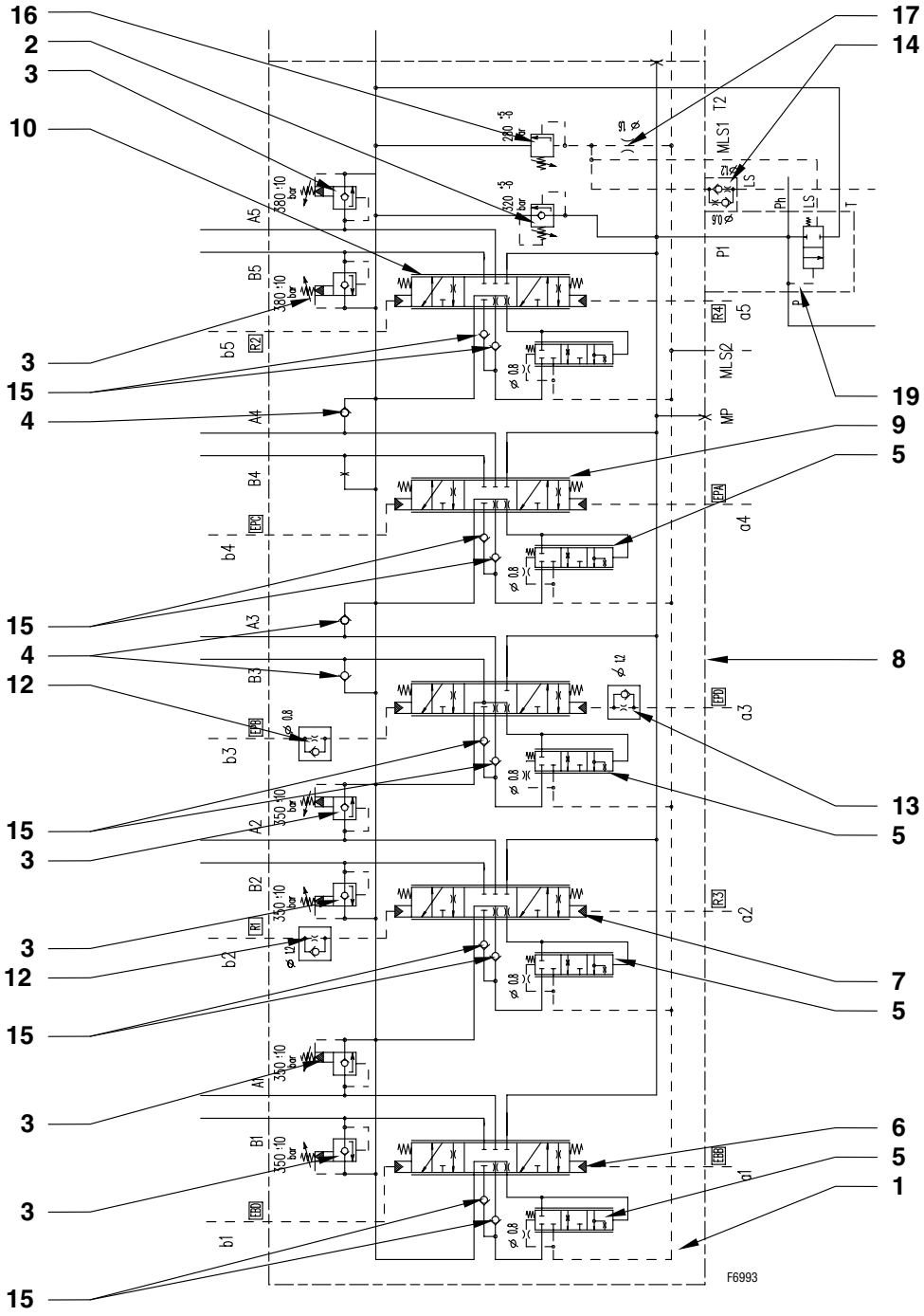


Fig. 3

1 - Control valve right body
2 - Main pressure relief valve
3 - Pressure relief and anticavitation valve
4 - Anticavitation and check valve
5 - Pressure compensator
6 - Arm control spool
7 - Boom control spool
8 - Travel control spool
9 - Positioning control spool
10 - Bucket control spool
12 - Throttle valve one way (Ø 1.2)
13 - Throttle valve one way (Ø 0.8)
14 - Throttle valve two way (Ø 1.2 and Ø 0.6)
15 - Check valve
16 - Pressure cut off valve
17 - Orifice (Ø 1.6)
18 - Spool stroke end adjusting screw
19 - Unloading valve

Unloading valve

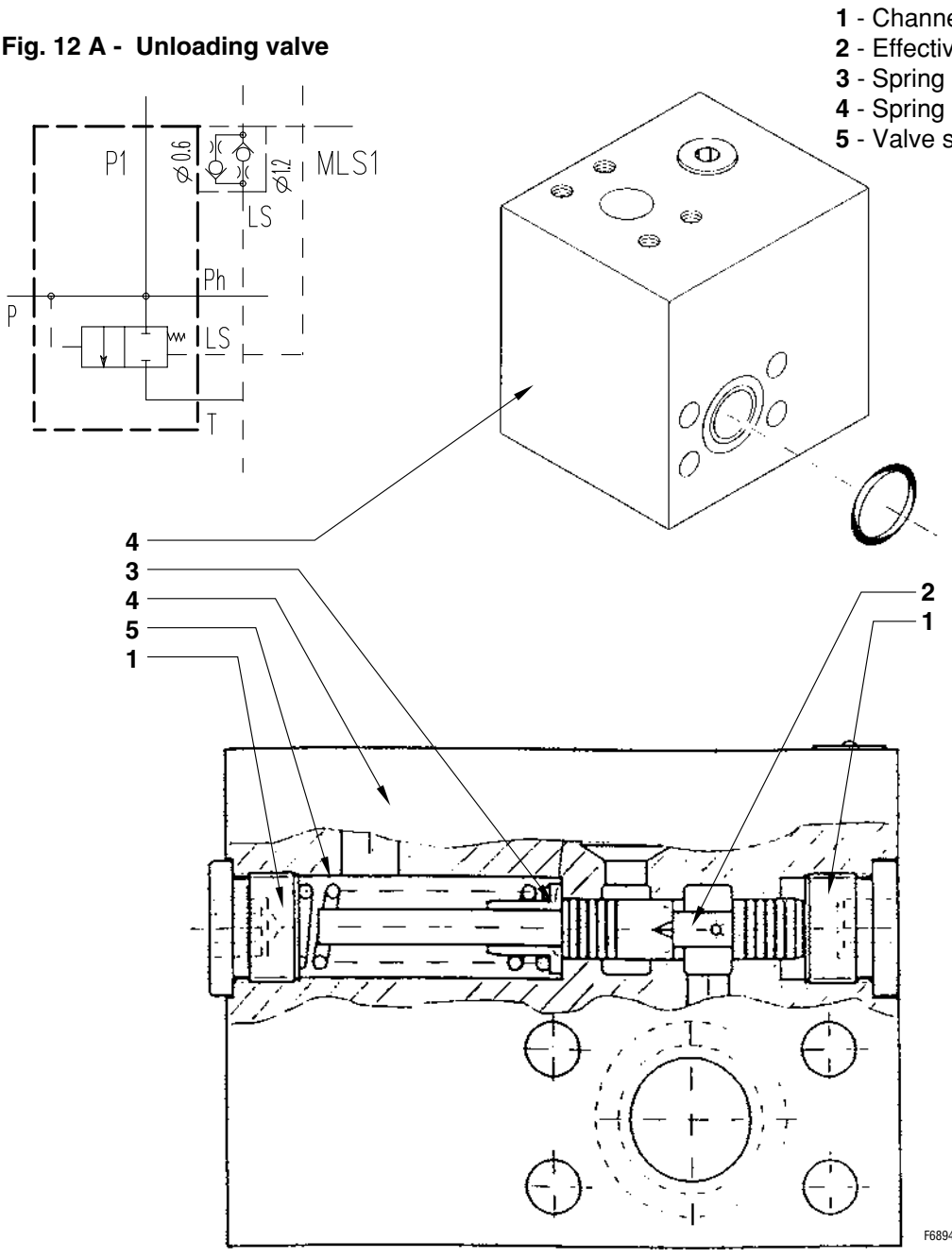
• Construction

It includes a block fastened to control valve (M7) right body, a spool and a cursor which keeps oil at disposal for control user.

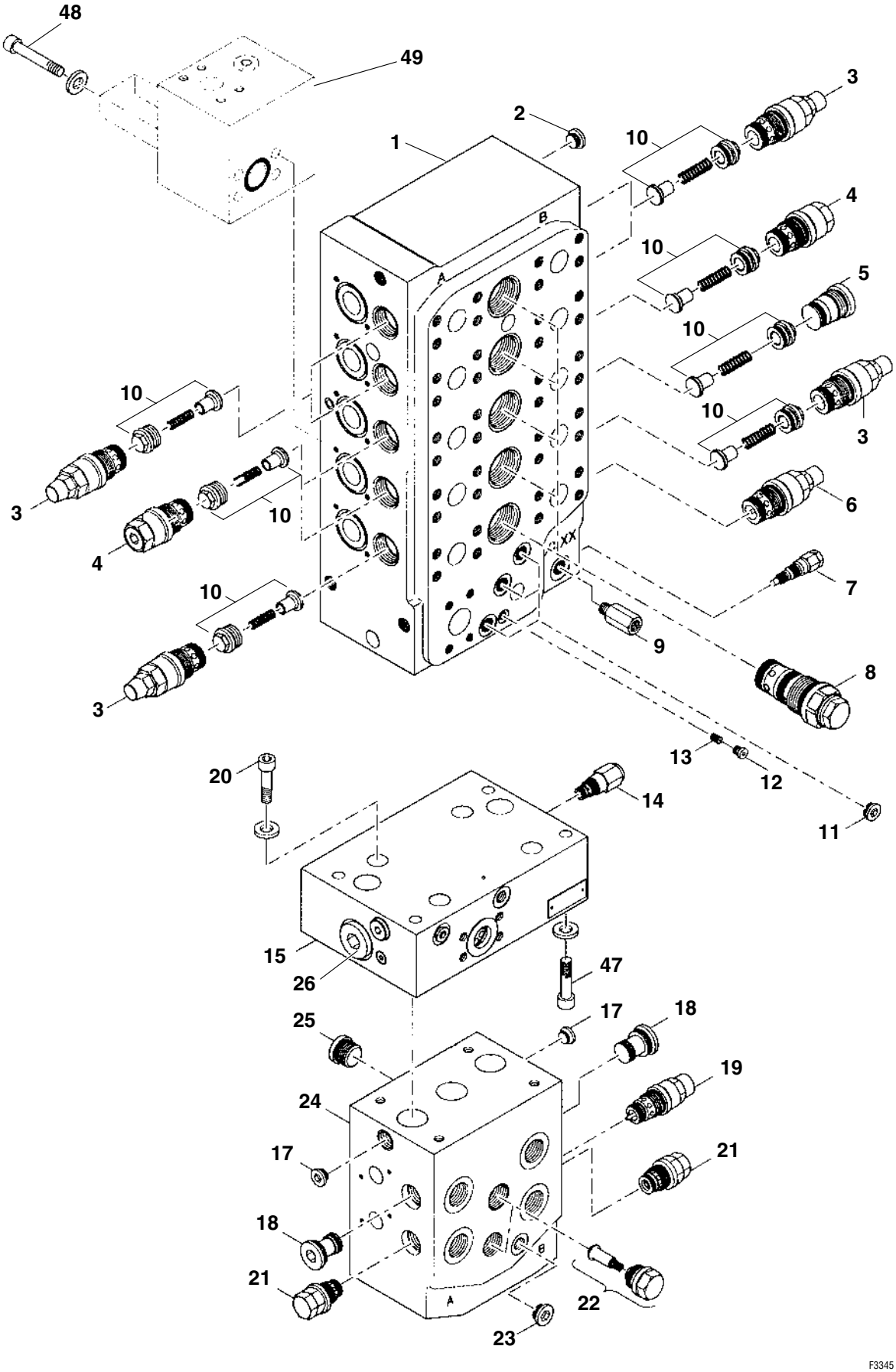
• Function

Main pump never stops sending oil to control valve. Unloading valve discharges oil directly when no control is used and guarantees a minimum quantity of oil for the control if used; this allows a prompt response at control operation.

Fig. 12 A - Unloading valve



CONTROL VALVE EX135W

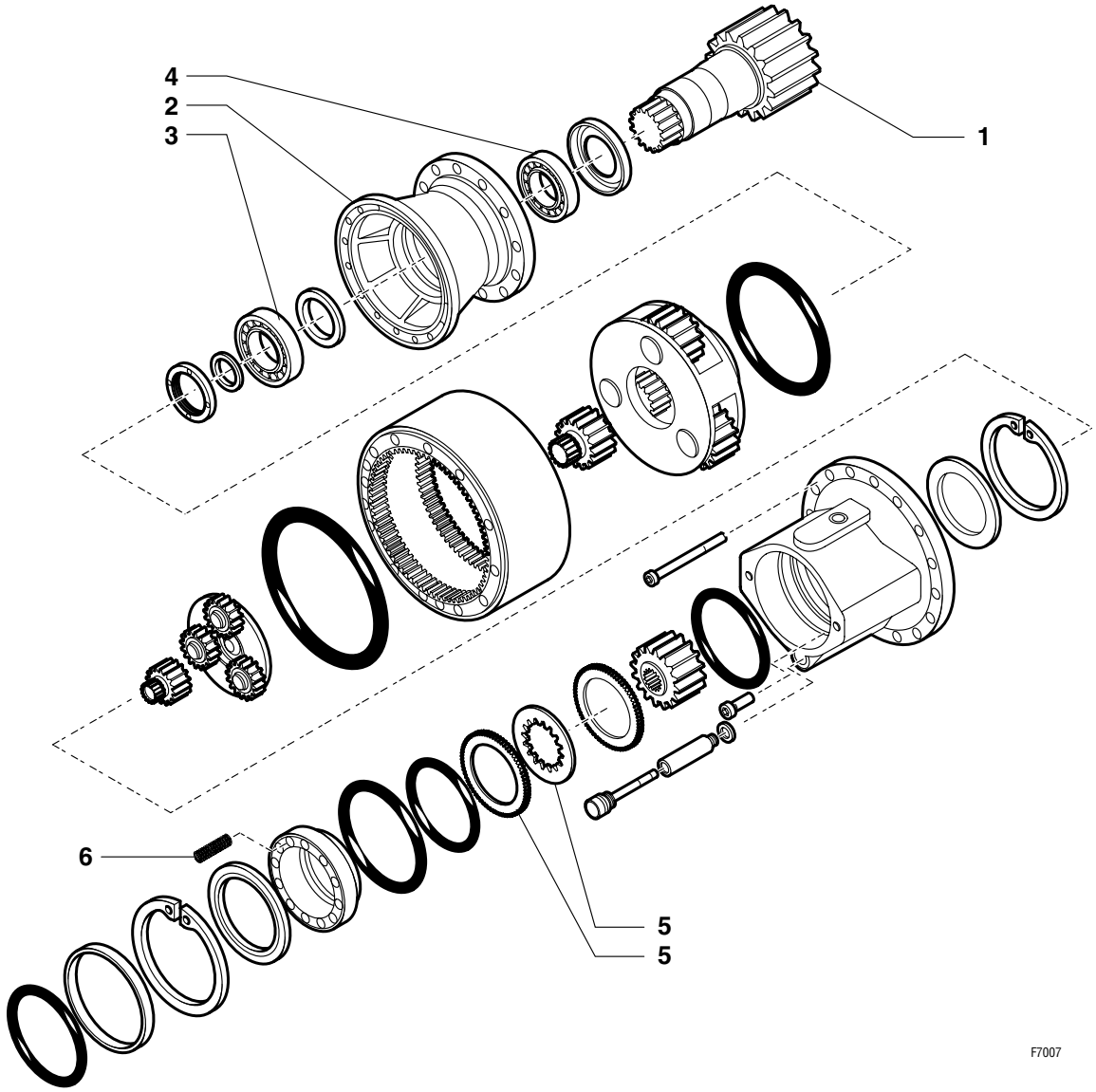


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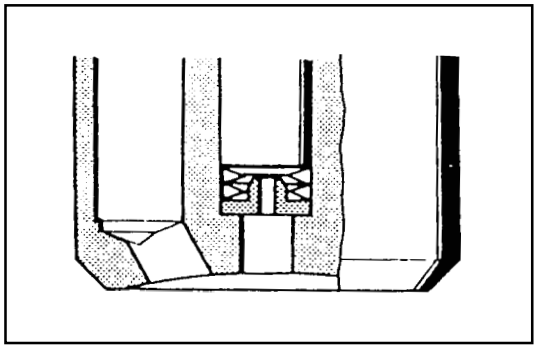
4.3 SWING REDUCTION DEVICE

4.3.1 DESCRIPTION

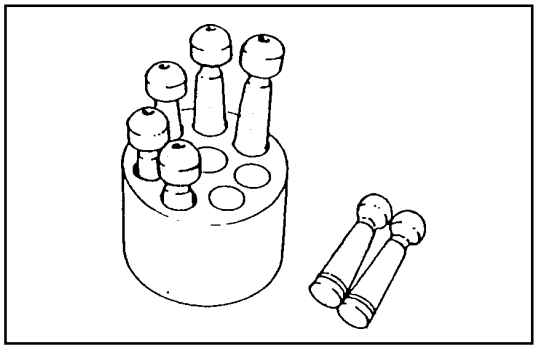
The swing reduction device is used to transfer the swing movement to the upperstructure.
The swing reduction device has an epicycloid final reduction from which the force is transfer, by means of drive shaft with built pinion (**1**) to the inner gear race bearing.
All gears, including the pinion shaft, are obtained from highly alloy steel.
The gears of planet carriers groups and the pinion are case-hardened and tempered.
The reduction housing (**2**) is built in spheroidal cast-iron.
The forged pinion is built in only one piece with the drive shaft, is cemented, tempered, and rectified, and it allows to obtain, with reduced number of teeth, high reduction ratios between pinion and race bearing.
The pinion shaft is sustained by a couple of bearings (**3**) and (**4**). The swing reduction components are lubricate by oil immersion.
The swing reduction is equipped with multiple discs brake (**5**) spring loaded (**6**) that, with machine at standstill are locked from integrated spring action.
Only when the pilot pressure is applied, the springs force are overcome, open the discs, and unlock the brake, allowing the swing movement.
The brake group, together with the swing reduction, makes only one assembly.
The swing reduction device is completed with a flange to allow the fixing on the machine.



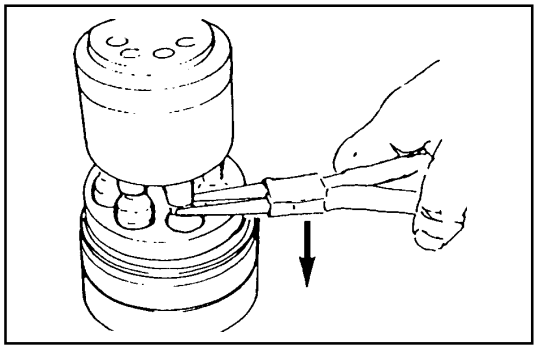
12 Make sure all parts are fitted in correctly.



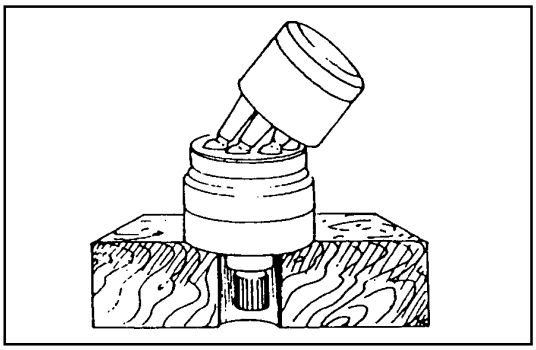
13 Fit pistons in the relate bores.



14 Press pistons in the relate cups with cylinder block held in central position.



15 Swivel cylinder block to maximum.



21 Turn upside down and loosen the fixing screws (**47**) of front cover (**48**) of reduction housing (**42**).



22 By means of press remove the pinion shaft (**1**) from reduction housing (**42**).



23 By means of an inner puller, extract the bearing (**44**) from reduction housing (**42**), then by means of outer puller, extract the bearing (**46**) from pinion shaft (**1**).

Note - The swing reduction device is now completely disassembled: therefore proceed to the check and inspection of all the items.

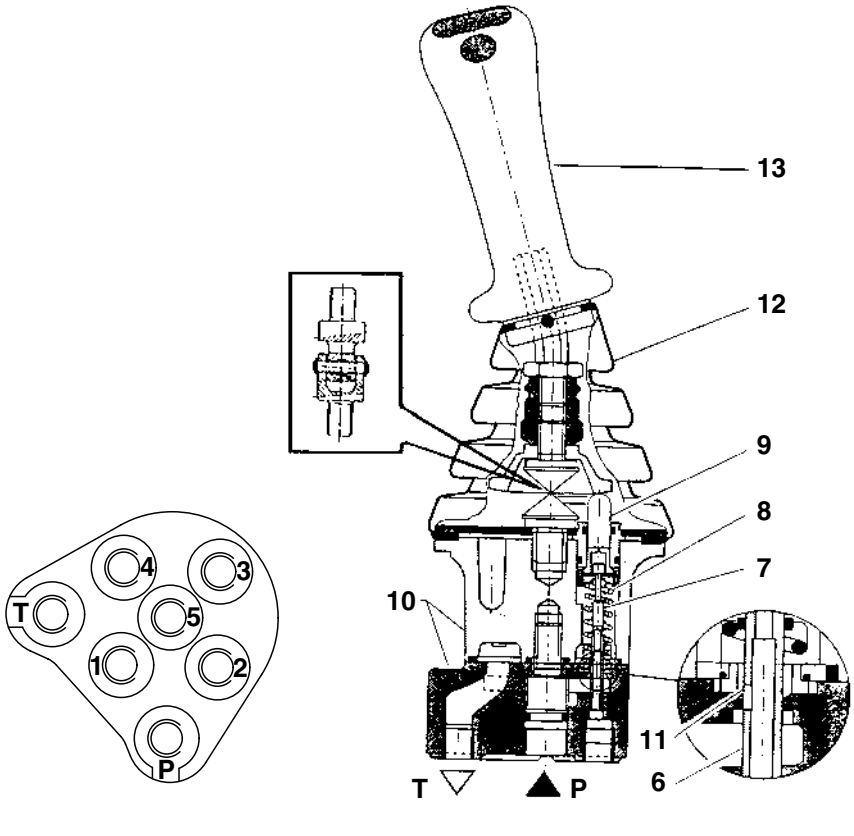


5. PILOT VALVES

5.1 HAND PILOT VALVE

5.1.1 OUTLINE

The pilot valve hydraulic device is an hand controlled type and operates as direct-operated pressure reducing valve.
Pilot valve basically consists of the control lever (**13**), four pressure reducing valves and the housing (**10**).
Each pressure reducing valve consists of a control spool (**6**), a control spring (**7**), a return spring (**8**) and a plunger (**9**).
When is in non-operative connection the control lever (**13**) is kept in zero position by the return spring (**8**).
The ports (**1**, **2**, **3, 4** and **5**) are connected to the tank port (**T**) via the boring (**11**).
With deflection of the control lever (**13**) the plunger (**9**) pushes at the same time against the return spring (**8**) and control spring (**7**).
The control spring (**7**) first moves the control spool (**6**) downwards and closes the connection between the appropriate port and the tank port (**T**). At the same time the appropriate port is connected to the port (**P**) via the bore (**11**).
The control phase begins as soon as the control spool (**6**) has found its balance between the force of the control spring (**7**) and the force which results from the hydraulic pressure.
Through the co-operation of control spool (**6**) and control spring (**7**) the pressure in the appropriate ports (**1,2,3,4**, and **5**) is proportional to the stroke of the plunger (**9**) and thus the position of the control lever (**13**).
The rubber sleeve (**12**) is used to protect the mechanical components of device from dust or foreign objects entrance.



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1, **2**, **3**, **4, 5** Ports - **6** Control spool - **7** Control spring - **8** Return spring - **9** Plunger - **10** Housing - **11** Boring - **12** Rubber sleeve - **13** Lever.

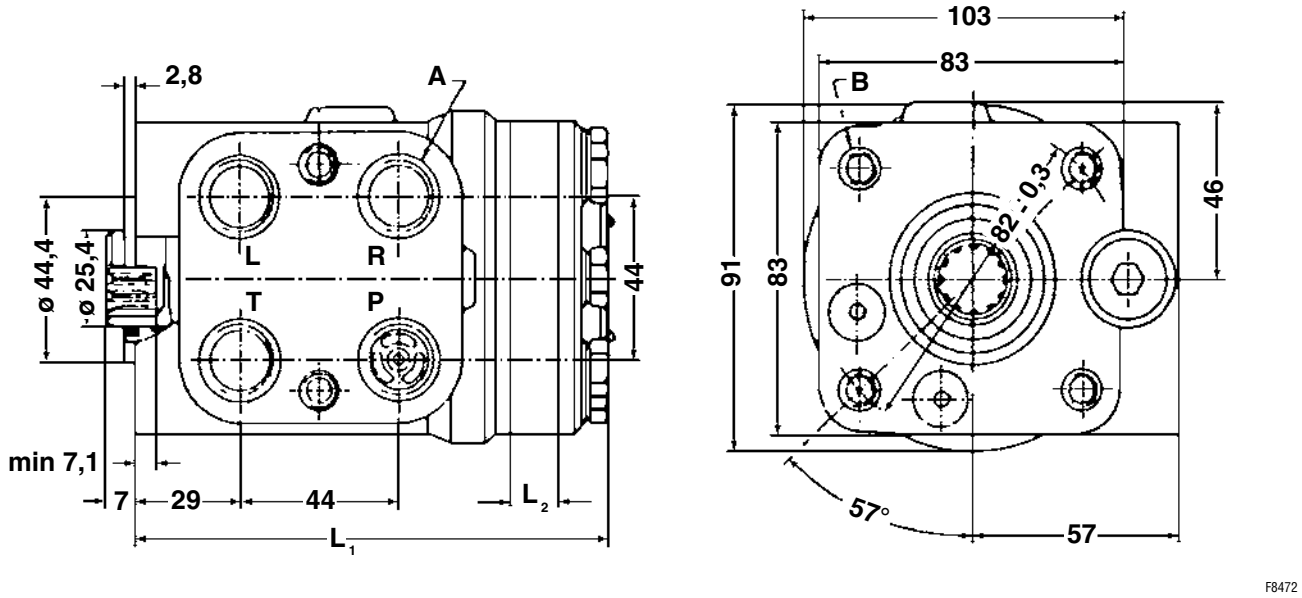
7. STEERING VALVE

7.1 STEERING VALVE

7.1.1 DESCRIPTION

The steering unit consists of (see fig. 3):
- Metering and emergency hand pump that includes a gear wheel assembly with fixed stator (with inner teeth) and a rotor (with outer teeth) (**15**).
- A 4 ways rotary distributor consisting of an outer sleeve (**A**) and an inner selection rotor (**B**). The selection rotor is connected to the steering wheel, through column.
- A cardan shaft (**11**), mechanically tied to gear wheel assembly and to outer sleeve, allows the movement transmission.
- Set of centering springs between outer sleeve and inner rotor.
- A relief valve (**24-25**) between the pump input and tank output ports.

Fig. 1 - Steering unit



Dimensions

A = G. 1/2
B = 3/8-16 UNC
L_1 = 139 mm
L_2 = 20.8 mm
Weight = 5.6 kg

Hydraulic connections

L - Left control port
R - Right control port
P - Inlet to steering pump
T - Outlet to hydraulic tank