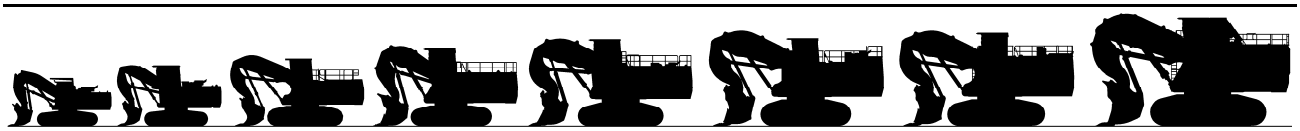
Operating Instructions

Hydraulic Excavator

RH120E Electric No.

Bucyrus HEX GmbH



1 INTRODUCTION

	Operating instructions	Target group
Part 1	**INTRODUCTION FUNDAMENTAL SAFETY INSTRUCTIONS**	**Operating personnel + Inspection and servicing personnel + Repair personnel**
Part 2	**OPERATION**	**Operating personnel** The operating personnel must have know-how relevant to the operation and the application of this or comparable machines.
Part 3	**INSPECTION AND SERVICING**	**Inspection and servicing personnel** The inspection and servicing personnel must have know-how relevant to the inspection and servicing of this or comparable machines.
Part 4	**REPAIR WORK**	**Repair personnel** The repair personnel must have know-how and experience relevant to the repair of this or comparable machines.
Part 5	**ANNEX**	**Operating personnel + Inspection and servicing personnel + Repair personnel**
Part 6	**INDEX**	**Operating personnel + Inspection and servicing personnel + Repair personnel**

Gas, dust, steam and smoke

Always start and operate the engine in a well-vented area;

If in an enclosed area, vent the exhaust to the outside;

Do not modify or tamper with the exhaust system

Diesel engine exhaust and some of its constituents are known to cause cancer, birth defects, and other reproductive harm

Operate fuel-operated heating systems only on adequately ventilated premises. Before starting the machine on enclosed premises, make sure that there is sufficient ventilation.

Observe the regulations in force at the respective site.

Carry out welding, flame-cutting and grinding work on the machine only if this has been expressly authorized, as there may be a risk of explosion and fire.

Before carrying out welding, flame-cutting and grinding operations, clean the machine and its surroundings from dust and other inflammable substances and make sure that the premises are adequately ventilated (risk of explosion).

Hydraulic equipment

Check all lines, hoses and screwed connections regularly for leaks and obvious damage. Repair damage immediately. Splashed oil may cause injury and fire.

Depressurize all system sections and pressure pipes to be removed in accordance with the specific instructions for the unit concerned before carrying out any repair work.

Hydraulic lines must be laid and fitted properly. Ensure that no connections are interchanged. The fittings, lengths and quality of the hoses must comply with the technical requirements.

Noise

During operation, all sound baffles of the machine must be closed.

Always wear the prescribed ear protectors.

Oil, grease and other chemical substances

When handling oil, grease or other chemical substances, observe the product-related safety regulations (see safety specifications).

Be careful when handling hot consumables (risk of burning or scalding).

Transporting and recommissioning

The machine must be loaded and transported only in accordance with the operating instructions.

Use only appropriate means of transport and lifting gear of adequate capacity.

The recommisioning procedure must be strictly in accordance with the operating instructions.

FIRE AND EXPLOSION HAZARD

Safety instructions

Prior to commencing work, obtain information on the national and corporate rules for the prevention of accidents.

Pay particular attention to hazards caused by combustible and easily flammable substances.on the safe handling of the fire extinguishers to be used.

Avoid smoking and open fire on, next to and below the excavator.

Combustible and easily flammable substances or liquids increase the fire and explosion hazard.

Do not store or handle any flammable substances during operation.

Clean the excavator thoroughly, if possible, with a steam jet (rubber parts and electric components with compressed air - refer to information label), when, for example, oil, grease, solvent or cleaner was spilled.

Such substances may spontaneously ignite if they get into the vicinity of hot units or objects.

Even battery gases can ignite in open flames or fire.

Avoid parking the excavator in places where

- combustible substances such as coal dust or tar are present.
- open or smouldering fire may occur.

Remove the excavator from such an area where combustible or easily flammable liquids have spilled from the excavator onto the ground.

Flying sparks (caused by welding, flame cutting, grinding, electrical short-circuit) may cause fire on the ground that can spread to the excavator.

Place suitable fire guardings (fire barriers) if open fire or flying sparks cannot be avoided during repair work.

Apply special protection to cables, cable ducts as well as to hose and pipe lines.

If necessary, also cover the ground with fire-protective blankets.

Ensure sufficient ventilation.

Clean the excavator before starting a job.

Do not keep any fire extinguishers that are not suitable or have not been tested.

Do not extinguish flammable liquids with water. Use:

- dry-powder,
- carbon-dioxide or
- foam extinguishing compounds.

When getting into contact with burning substances, the fire-fighting water would abruptly evaporate and distribute the substance such as burning oil over a wide area. Water causes short-circuits in the electrical system thus possibly entailing new hazards.

DANGER TO LIFE

Call the fire brigade.

Have all your welding, flame cutting and grinding work approved.

Swinging ladder

Raising resp. lowering the swinging ladder (Fig. 2-12:**).**

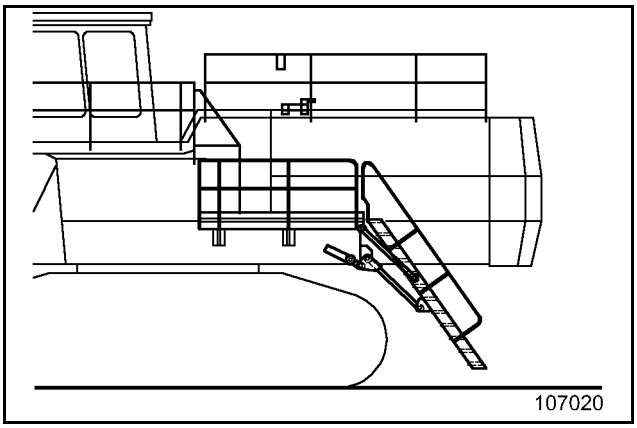


Fig. 2-12:

Raising the swinging ladder (from the upper carriage)

➲ Start electric motor.

➲ Pull lever (1, , Fig. 2-13:) on control valve (2) upwards to position **" I "**.
The swinging ladder is raised (Fig. 2-14:).

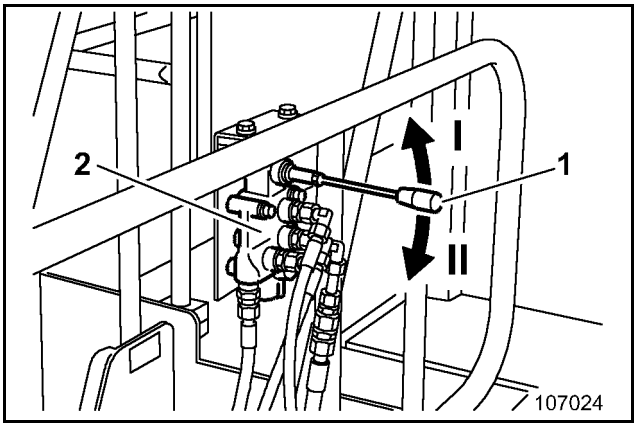


Fig. 2-13:

The upper carriage can only be swung when the folding ladder is raised completely (Fig. 2-14:).

Lowering the swinging ladder (from the upper carriage)

➲ Start electric motor.

➲ Push lever (1, Fig. 2-13:) on control valve (2) downwards to position **" II "**.
The swinging ladder is lowered (Fig. 2-12:).

The swinging ladder can also be lowered when the electric motor ist stopped.

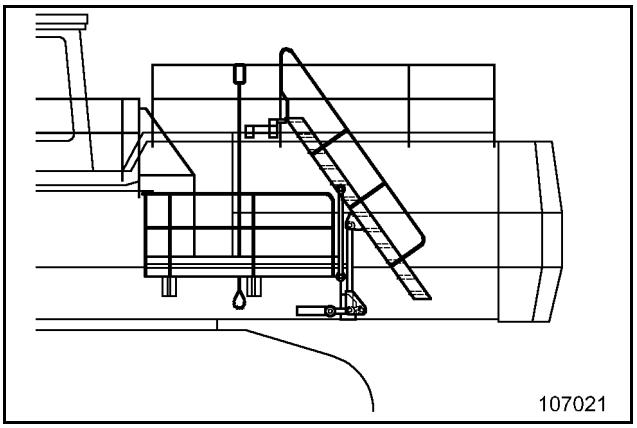


Fig. 2-14:

Lowering the swinging ladder (from the bottom)

➲ Pull down rope (3, Fig. 2-15:).
The swinging ladder is lowered (Fig. 2-12:).

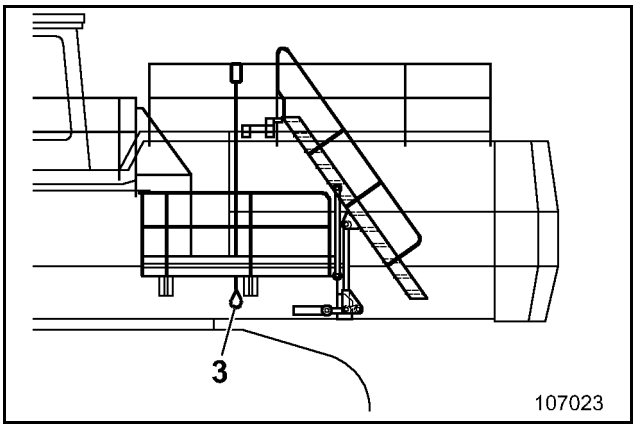


Fig. 2-15:

Emergency escape device (optional)

Elements of the harness

(Fig. 2-36:- Fig. 2-38:)

Pos.	Designation
1	Back support
2	Shoulder belt
3	Shoulder belt
4	Loop (chest belt)
5	Loop (chest belt)
6	Loop (back support)
11	Holding device
12	Fall arrester
13	Guidance line
14	Hanging up line
15	Handbag with harness
16	Snap hook
17	Hook safety device

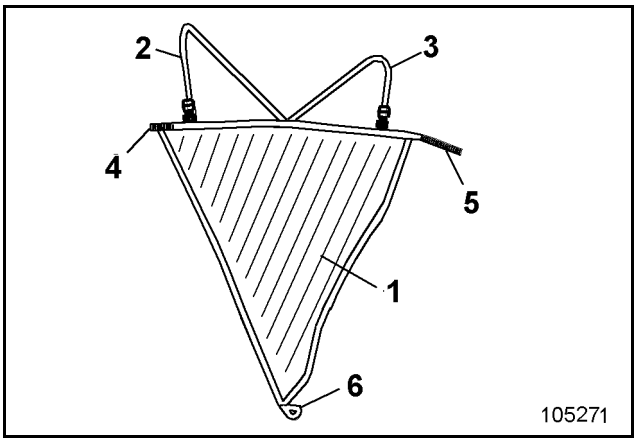


Fig. 2-36:

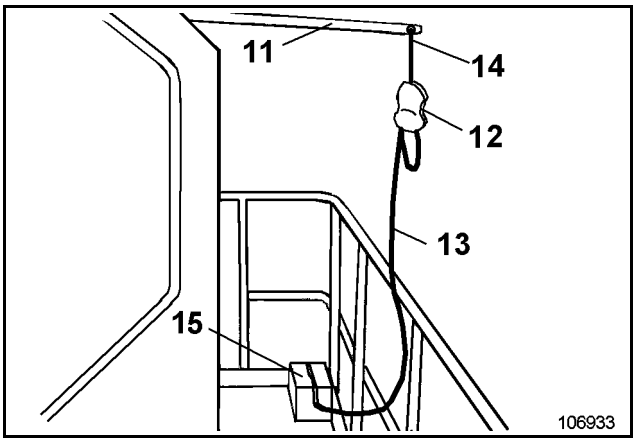


Fig. 2-37:

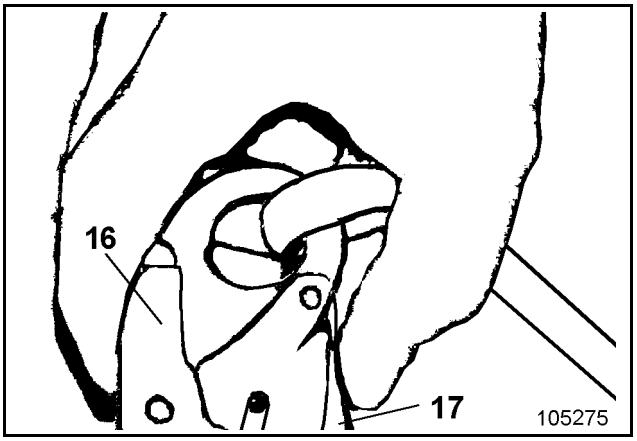


Fig. 2-38:

See Description of the supplier.

Important hints

Before using operator shall have received adequate training.

The harness must be used by one person only.

He is responsible for the appropriate use and maintenance.

Visual inspection is recommended prior to each use; if necessary it must be checked by an expert.

Harness must be checked annualy (every 12 month) by an expert.

(Fig. 2-50:)

No.	Element		Function	Symbol
41	**Indicator lamp**	**Medium voltage**	Lamp is lit up when the circuit breaker is switched on. Medium voltage 6.3 kV applied.	
42	**Indicator lamp**	**Rotary field monitoring**	Lamp is lit up when the rotary field (phasing) is correct.	
51	**Button**	**Electric motor ON**	Switches on the electric motor.	
52	**Button**	**Electric motor OFF**	Switches off the electric motor.	

(Fig. 2-55:) **Optional equipment**

No.	Element		Function	Symbol
121	**Rotary switch**	**Fan**	Selects the intensity level of the blower (3 levels).	
122	**Rotary switch**	**Mode**	Selects the desired control function (heating, cooling, ventilation, defrosting).	
123	**Knob**	**Thermostat**	Sets the desired temperature inside the cab.	
125	**Control**	**Additional heating (optional equipment)**	Controlling the additional heating device via touch screen, see Back-up heating manufacturers manual.	
126	**Momentary switch**		Switches additional heating control OFF.	
127	**Momentary switch**		Switches additional heating control ON.	
128	**Momentary switch**		Not used on this machine.	
129	**Momentary switch**		Not used on this machine.	
130	**Momentary switch**		Reset fault monitoring.	

Switching the electric motor on and off

Before switching on the electric motor

Before switching on the electric motor, check that nobody is working on the electrical system or on the excavator itself.

Switch on the electric motor only when all these work on the excavator is finished and all persons leave the danger area.

- Switch on battery main switch (see: "Battery main switch, switching on and off").
- Switch on electrical system (24V) (see: "Electrical system (24V), switching on and off").
- Check telltales (14 and 16, Fig. 2-66:), they must lit up in green colour.
  If so, electric motor can be switched on (see: "Switching the electric motor on").

If telltales didn`t lit up in green colour, BCS has detected critical operating conditions or faults which prohibit starting the electric motor. BCS indicates this case with telltales (for instance 15, Fig. 2-66:) as well as by displaying corresponding text.

Switching the electric motor on

- Actuate switch-key (51, Fig. 2-67:), the electric motor is switched on.

During starting period the electric motor heavily warm up. Therefore it is not allowed to switch it on and off at will. By means of an electronical time-out circuit (PLC) the electric motor can be switched on only three times a hour (time-out period is 30 minutes).

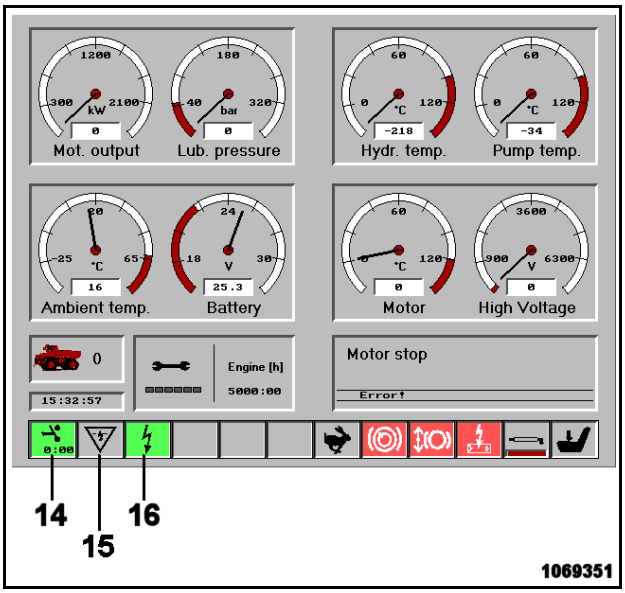


Fig. 2-66:

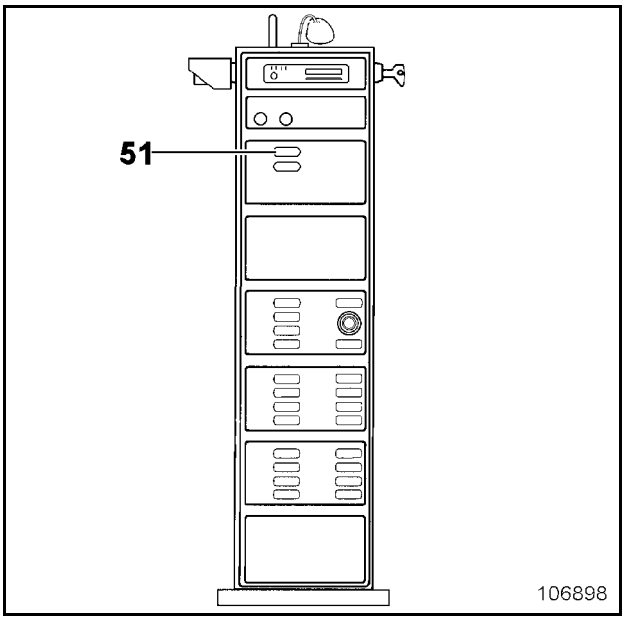


Fig. 2-67:

Travelling

Superstructure basic position

Travel direction and sense of actuation of pedals (112 and 113, Fig. 2-84:) are identical only when the excavator is in its BASIC POSITION (Fig. 2-83:).

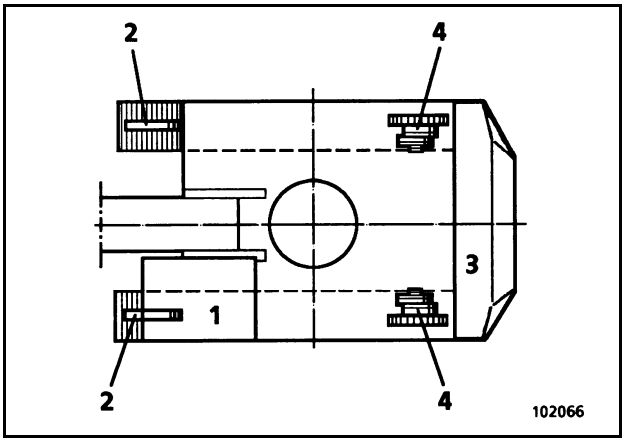


Fig. 2-83:

If the superstructure is slewed out of its basic position by more than 90° (Fig. 2-85:), the excavator moves in a direction opposite to that expected when pedals (112 and 113, Fig. 2-84:) are depressed.

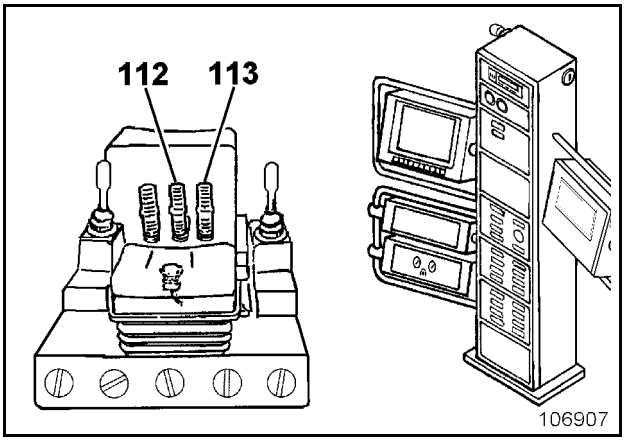


Fig. 2-84:

If the operator is not completely sure of the position of the superstructure with regard to the undercarriage, pedals (112 and 113) should be depressed slightly in order to find out which way the excavator moves before initiating the full travelling movement.

Travelling forwards/backwards

➲ Travelling forwards:
depress pedals (112 and 113) forwards.
The excavator travels in the direction of the idler (2, Fig. 2-83:).

➲ Travelling backwards:
depress pedals (112 and 113, Fig. 2-84:) backwards.
The excavator travels in the direction of the drive sprocket (4,Fig. 2-83:).

During travelling, an acoustic warning signal sounds (Travel Alarm).

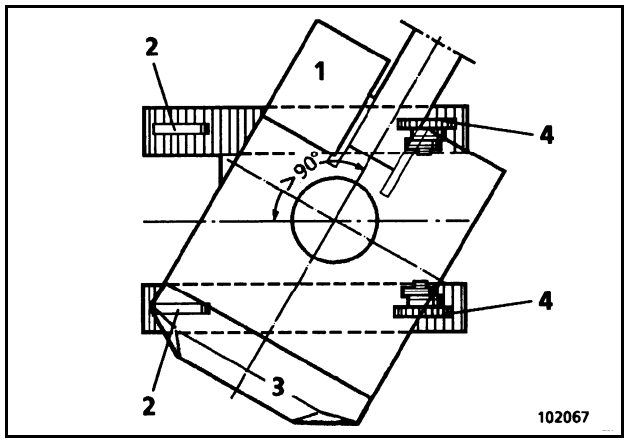


Fig. 2-85:

The pedals return automatically to their **"0"** positions when released.

Reverse the excavator only over short distances and with the assistance of marshallers because of restricted rear-view conditions.

Do not travel across slopes.

When travelling uphill or downhill, the travel gears must always be at the rear. Travel only in the basic position of the excavator and only forwards. Be extremely careful on slippery and greasy ground.

All instructions with regard to travelling speed regulation and travel direction control are applicable only as long as the crawler tracks have sufficient grip and do not slip.

WORKING OPERATION

Before starting work

Prior to initial commissioning and after repairs on the central lubricating system or the hydraulic cylinders, move the unloaded equipment for abt. 5 minutes.

This is required to ensure an adequate supply of grease to the cylinder bearings when the work starts.

Warming up

At low outside temperatures it is necessary to run the hydraulic system up to operating temperature. The temperatures at which warming up is necessary depend on the type of hydraulic oil used; see also "Oils for hydraulic systems".

➲ Switch on the electric motor and start to perform no-load working movements for abt. 10 minutes with the excavator.

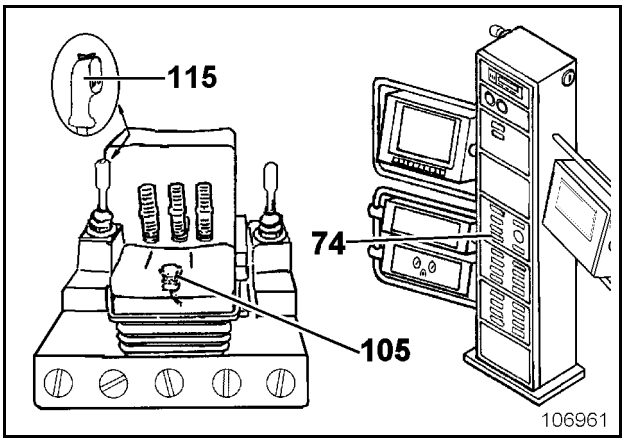


Fig. 2-99:

Switching on the electronic excavator control

You can only move the working equipment after the electronic excavator control is switched on via switch (74, Fig. 2-99:) and the switch inside the driver's seat (105).

Electronic excavator control activated - operator is sitting on his seat.

Electronic excavator control deactivated - driver's seat is empty.

Swinging the superstructure

The superstructure can only be swung if the superstructure holding brake is released.

➲ To swing the superstructure to the right: shift control lever (115) to the right.

➲ To swing the superstructure to the left: shift control lever (115) to the left.

After releasing, the control lever returns automatically to position **"0"**. But the superstructures motion will not be braked automatically then. To bring the superstructure to standstill, shift control lever (115) into the opposite direction of superstructures motion (countering).

Braking the superstructure

After releasing, the control lever returns automatically to position **"0"**. But the superstructures motion will not be braked automatically then.

The superstructure is braked only by setting control lever (115) into the opposite direction (countering).

In an emergency apply parking brake with switch (82, Fig. 2-100:)

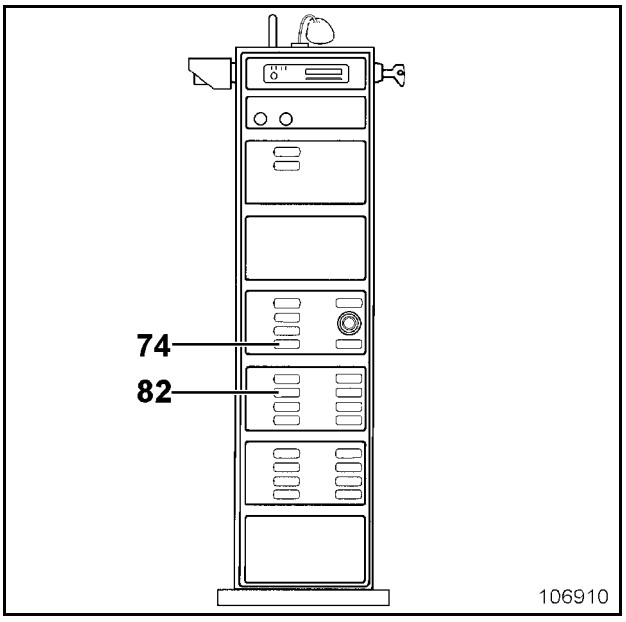


Fig. 2-100:

SAFETY INSTRUCTIONS FOR EXCAVATORS WITH ELECTRIC MOTOR

Maintenance and inspection work on electrical systems may only be performed by qualified electricians or by workshops employing such personnel.

A qualified electrician for the purpose of this regulation is a person who has the corresponding technical training, know-how and experience as well as knowledge of the pertinent prescriptions and who is therefore in a position to judge the work entrusted to him and the potential dangers in connection therewith.

Before carrying out any maintenance and inspection work on the electrical system, the following precautions must be taken:

In the transformer station

- Cut out the supply voltage.
- Secure against switching on; apply a warning sign.
- Check that the electrical system is off circuit.
- Connect to earth and short-circuit.
- Protect adjacent and live parts against accidental contact.

On the excavator

- Cut out the switch-disconnector (see the " Switching off the circuit breaker " chapter in part 2 of the present operating instructions)
- Secure the circuit breaker against switching on, e.g. seal in the actuating lever in a cabinet.
- Apply a warning sign.
- Remove the cover (1, Fig. 3-1:).
- Check that the electrical system is off circuit and dead.
- Connect to earth and short-circuit: (connect the earthing and short-circuiting line (8, Fig. 3-2:) in the following order to points (1 – 4):
  first to the fixed point (1), then
  one after another to the earthing points (2, 3 and 4).
- Slide partition (6, Fig. 3-3:) into guide (7).

Connect the earthing kit (8) to the earthing points (2, 3 and 4) only by means of extension (5).

The earthing points may still carry residual voltages.

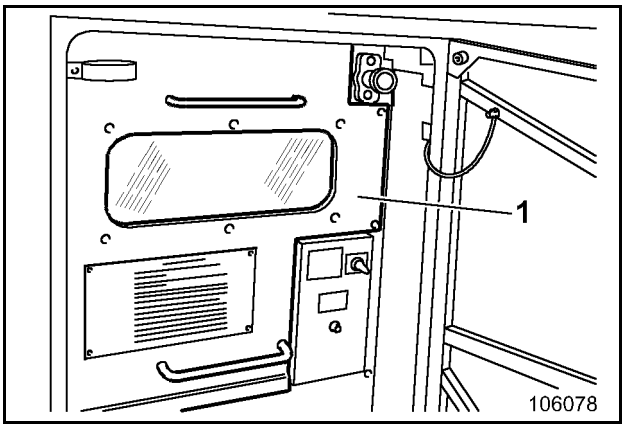


Fig. 3-1:

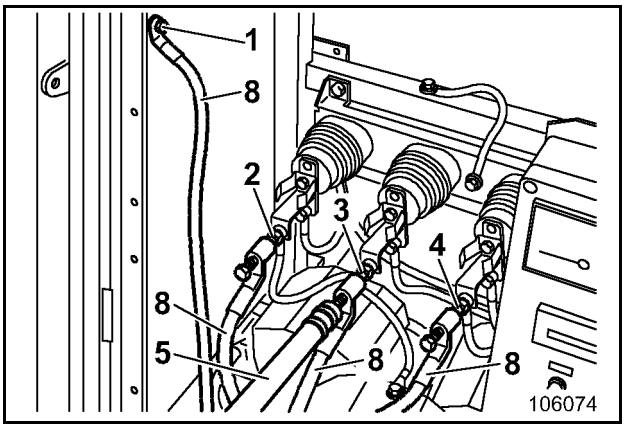


Fig. 3-2:

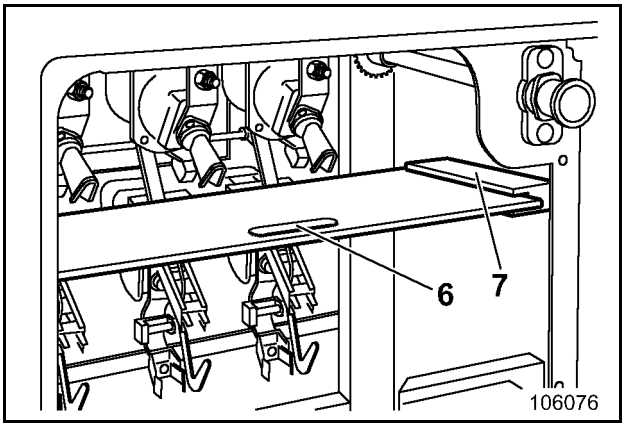


Fig. 3-3:

INSPECTION AND SERVICING PLANS - INSTRUCTIONS

Intervals

The inspection and Servicing plan lists all jobs which have to be done on the machine at regular intervals.

The individual inspection and Servicing plans are marked with letters providing a link between the operating hours (OH) recorded by the hours-run meter of the machine and the inspection and sServicing plans.

Plan	Do all jobs ....
V	...once prior to initial commissioning.
N	...after initial commissioning and during the running-in period (after 100OH).
T	...every 10 OH or every working shift [1)]
W	...every 60 OH or weekly .[2]
B	...after every 500 OH.
C	...after every 1000 OH.
D	...after every 5000 OH.
E	...after every 10000 OH.
OH = Bh = Operating hours	

Oils / Greases

For the specification of oils and greases to be used refer to the "Lubricants" section.

The numerals mentioned in the "Oil / Grease" column in the inspection and Servicing plans have the following meaning:

I	Oils for combustion engines and compressors
II	Oils for hydraulic systems
IIIa, b, c	Oils for gearboxes
V	Greases for bearings and slewing rings

Cleaning jobs

Cleaning jobs, especially on cooling systems, must be done at shorter intervals if the machine is exposed to severe dust build-up.

Components

The maintenance intervals for components, e.g. electric motor and gearboxes, are listed in the following Bucyrus HEX maintenance schedules.

It is possible that the manufacturer's documentation for these components states intervals deviating from the above-mentioned intervals.

In such case, only the maintenance intervals specified by Bucyrus HEX shall apply.

[2] Whichever comes first.

Plan **A** - after every 250 OH
(at 250, 750, 1250 ... OH)

Plan **B** - after every 500 OH
(at 500, 1500, 2500 ... OH)

Plan **C** - after every 1000 OH
(at 1000, 2000, 3000, 4000 ... OH)

Plan **D** - after every 5000 OH
(at 5000, 15000, 25000 ... OH)

Plan **E** - after every 10000 OH
(at 10000, 20000, 30000, ... OH)

Location	Servicing work	Menge / No.	Plan A	Plan B	Plan C	Plan D	Plan E
Hydraulic system	Check pressure (cf. Technical handbook)				●	●	●
Oil cooler							
- Bearing							
- Fastening screw	Check for tightness				●	●	●
- Rubber bearing	Check condition				●	●	●
Return-flow filter	Replace	7			●	●	●
Return-flow filter (cooling circuit)	Replace	2			●	●	●
Bypass valve	Check / clean filter sieve	4			●	●	●
Bypass valve (cooling circuit)	Check / clean filter sieve	1			●	●	●
Magnetic rod	Check / clean	1		●	●	●	●
High-pressure filter	Check / clean	4			●	●	●
	Replace	4				●	●
High-pressure filter (control circuit)	Check / clean	1			●	●	●
	Replace	1				●	●
High-pressure filter (auxiliary control circuit)	Check / clean	1			●	●	●
	Replace	1				●	●
High-pressure filter (slewing circuit)	Check / clean	2			●	●	●
	Replace	2				●	●
High-pressure filter (feeding circuit)	Check / clean	2			●	●	●
	Replace	2				●	●
Breather filter	Replace	4			●	●	●
Hydraulic oil reservoir	Carry out oil analysis	1		●	●	●	●
	Change oil	1 [6] [7]					●
Pressure accumulator	Check pressure (cf. Technical handbook)	1					●
Cylinder (seals and guide rings)	Replace						●

[6] cf. “Refilling quantities – Oil“ table

[7] Unless it is regulary analyzed, the hydraulic oil must be changed every 5000 OH or after 3 years at the latest

III.a Oils for pump gearbox

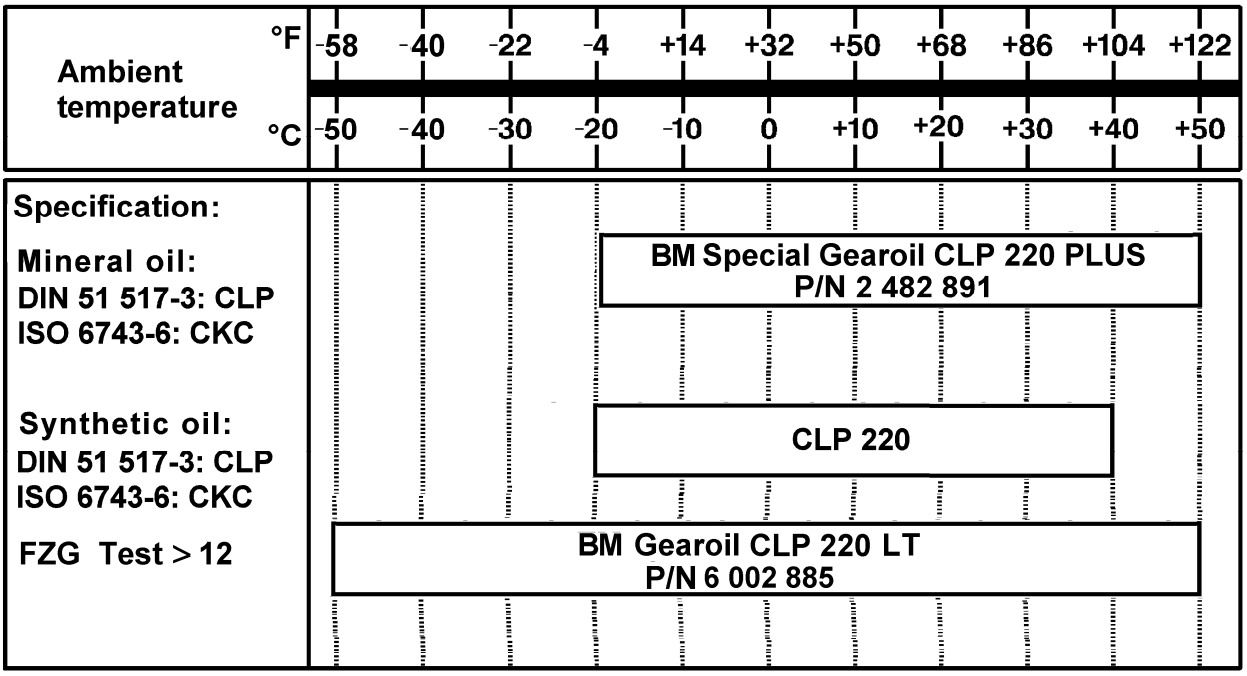


Fig. 3-10:

Charging the batteries

The batteries are charged by the battery charger (Fig. 3-23:) only if the electrical system with the circuit breaker is switched on.

The battery main switch (Fig. 3-24:) must be in position **I "ON".**

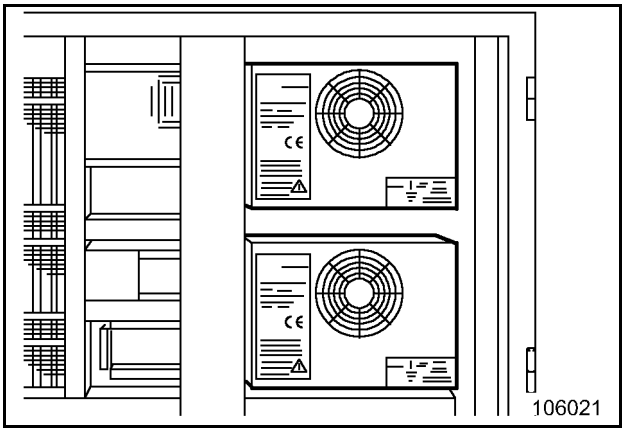


Fig. 3-23:

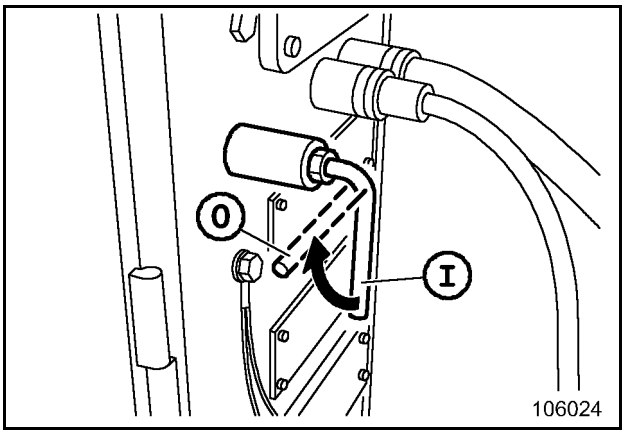


Fig. 3-24:

Switchgear cabinet

Breather filter

In the switchgear cabinet

- For the 6.3 kV power supply (2, Fig. 3-25:),
- For the 400 V system (1, Fig. 3-25:),
- For the 24 V system (3, Fig. 3-26:).

The air is drawn in and cleaned by a ventilator with filter.

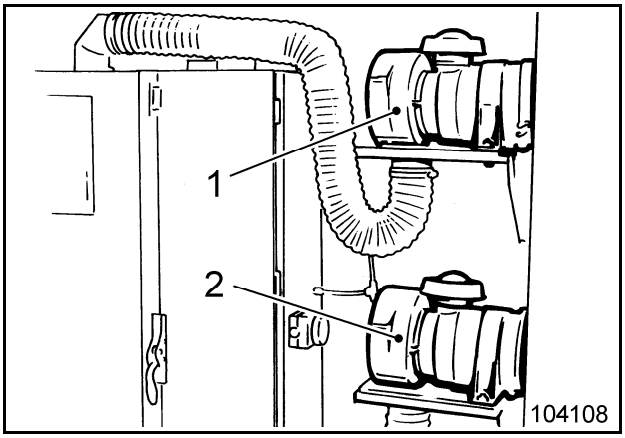


Fig. 3-25:

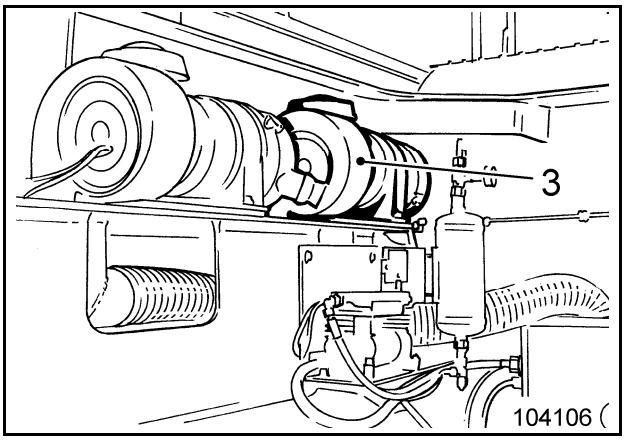


Fig. 3-26:

- Loosen screws (13, Fig. 3-47:) and take off spring clip (14) and disk (15).
- Remove basket (12) and clean in paraffin oil.
- Install basket (12).
- Insert filter element (9) together with sealing ring (11) and cap (8) with sealing ring (10).
- Refit cover (3).
- Clean the magnetic rod
  The magnetic rod is located under cap (19).

If metal filings are detected, locate cause and rectify.

Contact the Bucyrus HEX Service, if required.

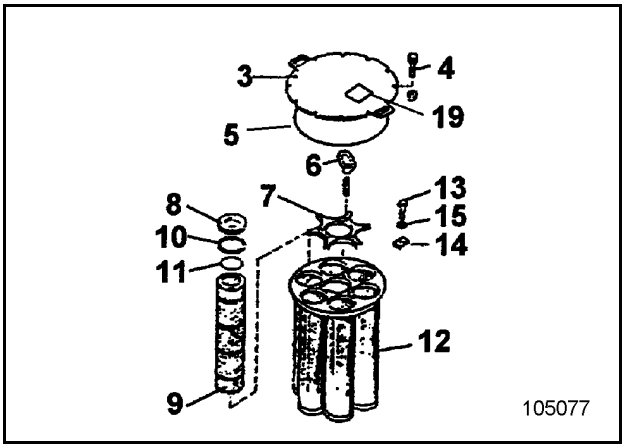


Fig. 3-47:

Drawing off hydaulic oil

The hydraulic oil can also be drawn off through the service station (Fig. 3-64:).

- ➲ Bring hydraulic oil to operating temperature (ca. 50° C / 122°F).
- ➲ Retract hydraulic cylinders as far as possible and stand working equipment on the ground.
- ➲ Switch off the electric motor.
- ➲ Unscrew cap of express coupling (10).
- ➲ Connect hose line of the service vehicle.

The hose line and its use are described in the "Hose line for oil change" section.

- ➲ Remove hose line. The coupling closes automatically.
- ➲ Screw on protective cap.

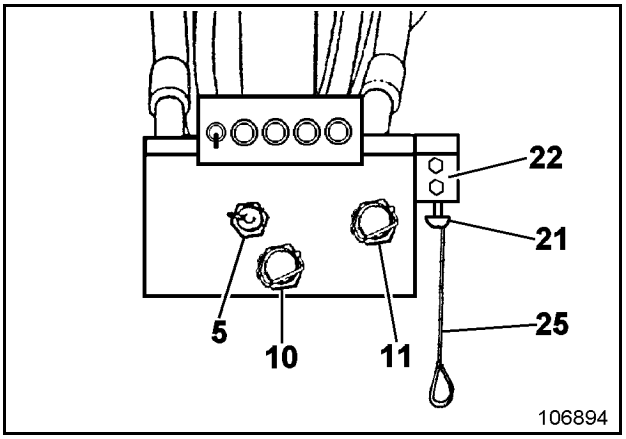


Fig. 3-64:

Cleaning the hydraulic oil reservoir

Explosion hazard.

Do not use white spirit, paraffin oil or other solvents for cleaning.

Use diesel fuel or a special flushing oil.

Read and observe the "Inspection and servicing - Safety instructions" chapter.

Switch off the electric motor.

Skin contact with hydraulic oil may cause skin injury.

Avoid skin contact.

Wear protective gloves and firm working clothing.

Dispose of contaminated hydraulic oil without polluting the environment and separately from other waste.

- ➲ Drain off hydraulic oil as described under "Draining off the hydraulic oil".
- ➲ Remove cap (3, Fig. 3-65:).
- ➲ Detach the return-flow filter.

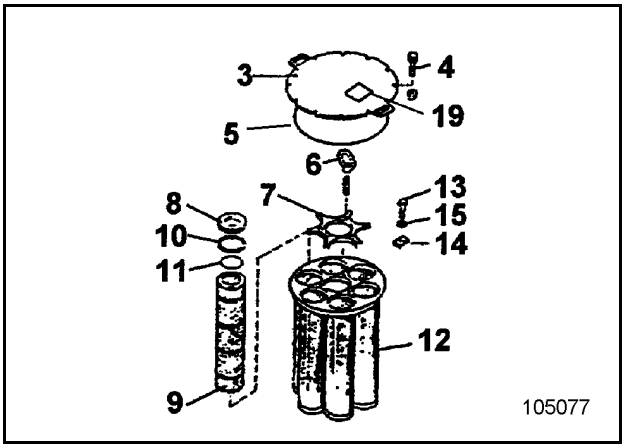


Fig. 3-65:

- ➲ Place a collecting recipient for the flushing oil under the hydraulic oil reservoir.
- ➲ Clean the inside of the hydraulic oil reservoir with diesel fuel or flushing oil.
  Remove all sediments and also the residues of the cleaning agent thoroughly.
- ➲ Refit cap (3).

Pump transfer gearbox lube oil filters

Check filter tell-tales (1, Fig. 3-83:) regulary - at operating temperature - for indication of contamination.

If the red sector is visible through transparent cap (2), the filter element must be cleaned or changed.

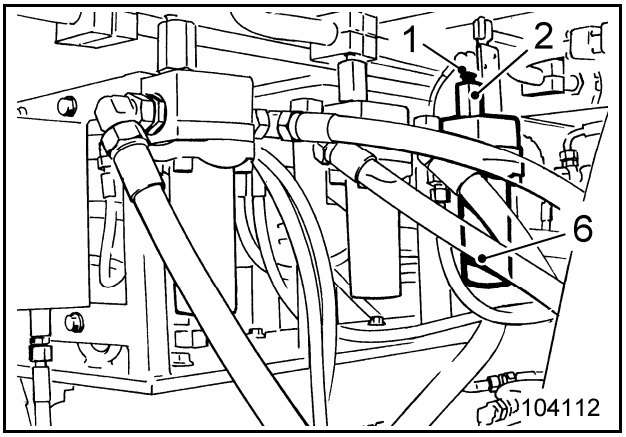


Fig. 3-83:

- Remove flange (3, Fig. 3-84:).
- Pour oil out of filter pot (4) and remove filter element (5).
- Clean filter element in spirits or petroleum;
- Replace if damaged
- Clean filter head (6, Fig. 3-83:) and filter pot (4). Check o-ring (7, Fig. 3-84:) for damage; change if necessary.
- Oil the o-ring lightly. Place filter element into filter pot and re-assemly.
- Check filters for leakages after recommencing operation.

Filter element (5) must be changed after having been cleaned 8 - 10 times; at the latest however, after 1000 operating hours.

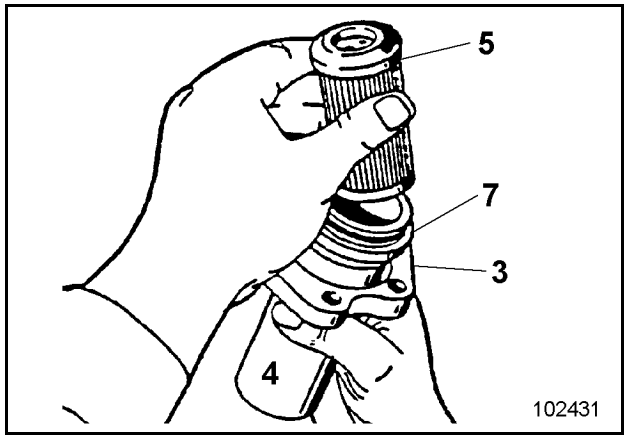


Fig. 3-84:

Track roller, Support roller

Inspect all track and support rollers visually for leaks and free movement at regular intervals.

Track roller fastening

➲ Check fastening screws (4 Fig. 3-101:) regularly for tightness.

➲ Tighten screws with a torque wrench to the prescribed tightening torque (see Technical Handbook).

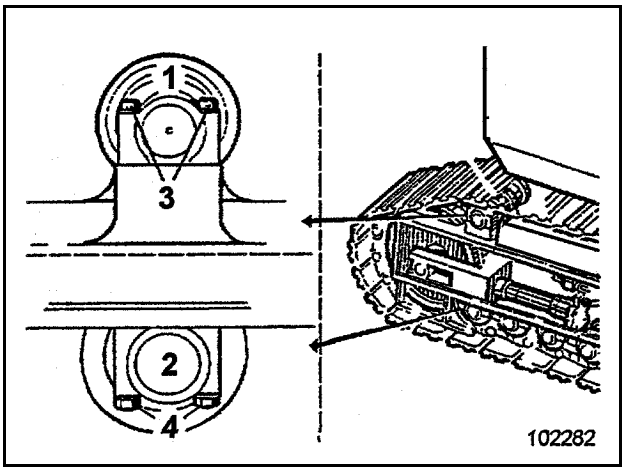


Fig. 3-101:

Support roller fastening

➲ Check fastening screws (3, Fig. 3-101:) regularly for tightness.

➲ Tighten screws with a torque wrench to the prescribed tightening torque (see Technical Handbook).

Grease filter (grease lines)

Read and observe the "Inspection and servicing –Safety instructions" chapter.

Shut off the electric motor.

Grease filter (12, Fig. 3-118:) is installed in the greasing line to the grease container.

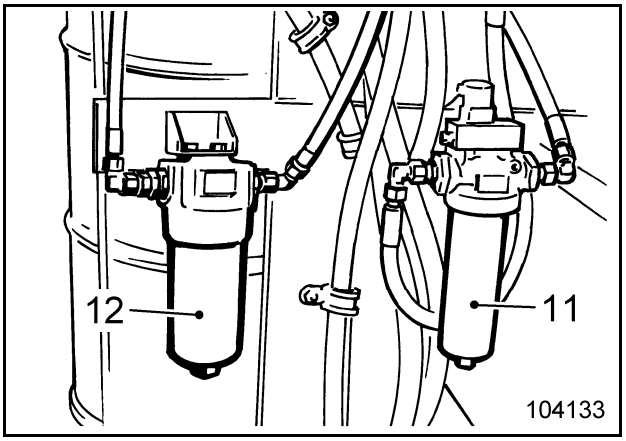


Fig. 3-118:

Checking the filter element

- Unscrew filter housing (42, Fig. 3-119:).
- Withdraw filter element (43) from housing (42).
- Remove the grease.
- Clean filter housing and contact faces at the filter head with white spirit or paraffin oil.
- Insert filter element into housing (42) and attach to the filter head with a new, slightly oiled sealing ring (46).
- Check the high-pressure filter for leaks after the system has been put into operation.

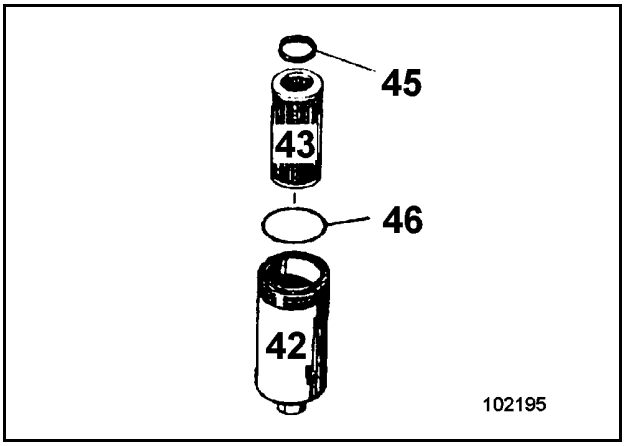


Fig. 3-119:

Replacing the filter element

- Remove filter element as described under "Checking the filter element".
- Insert new filter element and reassemble.
- Check high-pressure filter for leaks after the system has been put into operation.

SAFETY INSTRUCTIONS FOR EXCAVATORS WITH ELECTRIC MOTOR

Repair work on electrical systems may only be performed by qualified electricians or by workshops employing such personnel.

A qualified electrician for the purpose of this regulation is a person who has the corresponding technical training, know-how and experience as well as knowledge of the pertinent prescriptions and who is therefore in a position to judge the work entrusted to him and the potential dangers in connection therewith.

Before carrying out any repair work on the electrical system, the following precautions must be taken:

In the transformer station

- Cut out the supply voltage.
- Secure against switching on; apply a warning sign.
- Check that the electrical system is off circuit.
- Connect to earth and short-circuit.
- Protect adjacent and live parts against accidental contact.

On the excavator

- Cut out the switch-disconnector (see the " Switching off the circuit breaker " chapter in part 2 of the present operating instructions)
- Secure the circuit breaker against switching on, e.g. seal in the actuating lever in a cabinet.
- Apply a warning sign.
- Remove the cover (1, Fig. 4-1:).
- Check that the electrical system is off circuit and dead.
- Connect to earth and short-circuit: (connect the earthing and short-circuiting line (8, Fig. 4-2:) in the following order to points (1 – 4):
  first to the fixed point (1), then
  one after another to the earthing points (2, 3 and 4).
- Slide partition (6, Fig. 4-3:) into guide (7).

Connect the earthing kit (8) to the earthing points (2, 3 and 4) only by means of extension (5).

The earthing points may still carry residual voltages.

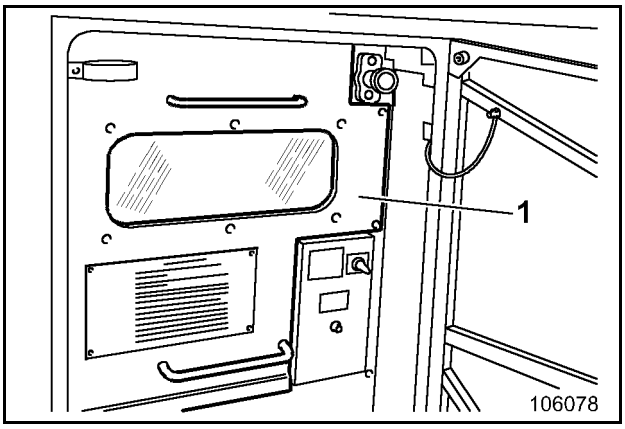


Fig. 4-1:

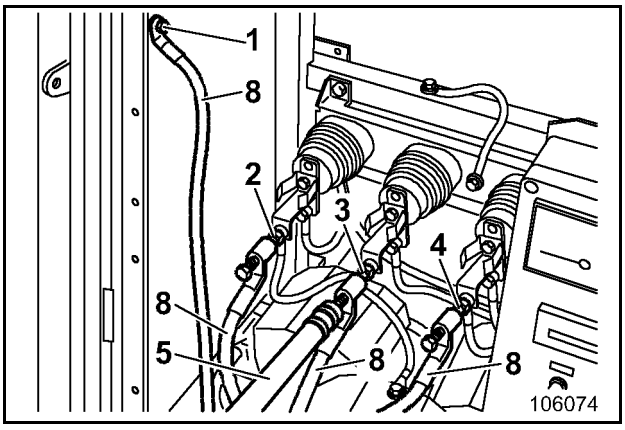


Fig. 4-2:

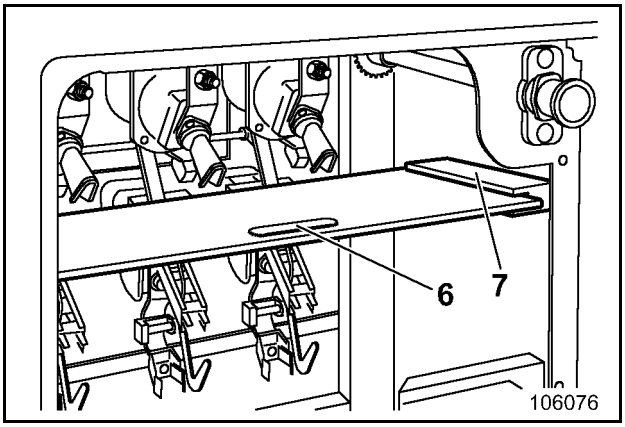


Fig. 4-3:

5 ANNEX

	Operating instructions	Target group
Part 1	**INTRODUCTION FUNDAMENTAL SAFETY INSTRUCTIONS**	**Operating personnel + Inspection and servicing personnel + Repair personnel**
Part 2	**OPERATION**	**Operating personnel** The operating personnel must have know-how relevant to the operation and the application of this or comparable machines.
Part 3	**INSPECTION AND SERVICING**	**Inspection and servicing personnel** The inspection and servicing personnel must have know-how relevant to the inspection and servicing of this or comparable machines.
Part 4	**REPAIR WORK**	**Repair personnel** The repair personnel must have know-how and experience relevant to the repair of this or comparable machines.
Part 5	**ANNEX**	**Operating personnel + Inspection and servicing personnel + Repair personnel**
Part 6	**INDEX**	**Operating personnel + Inspection and servicing personnel + Repair personnel**

TECHNICAL DATA