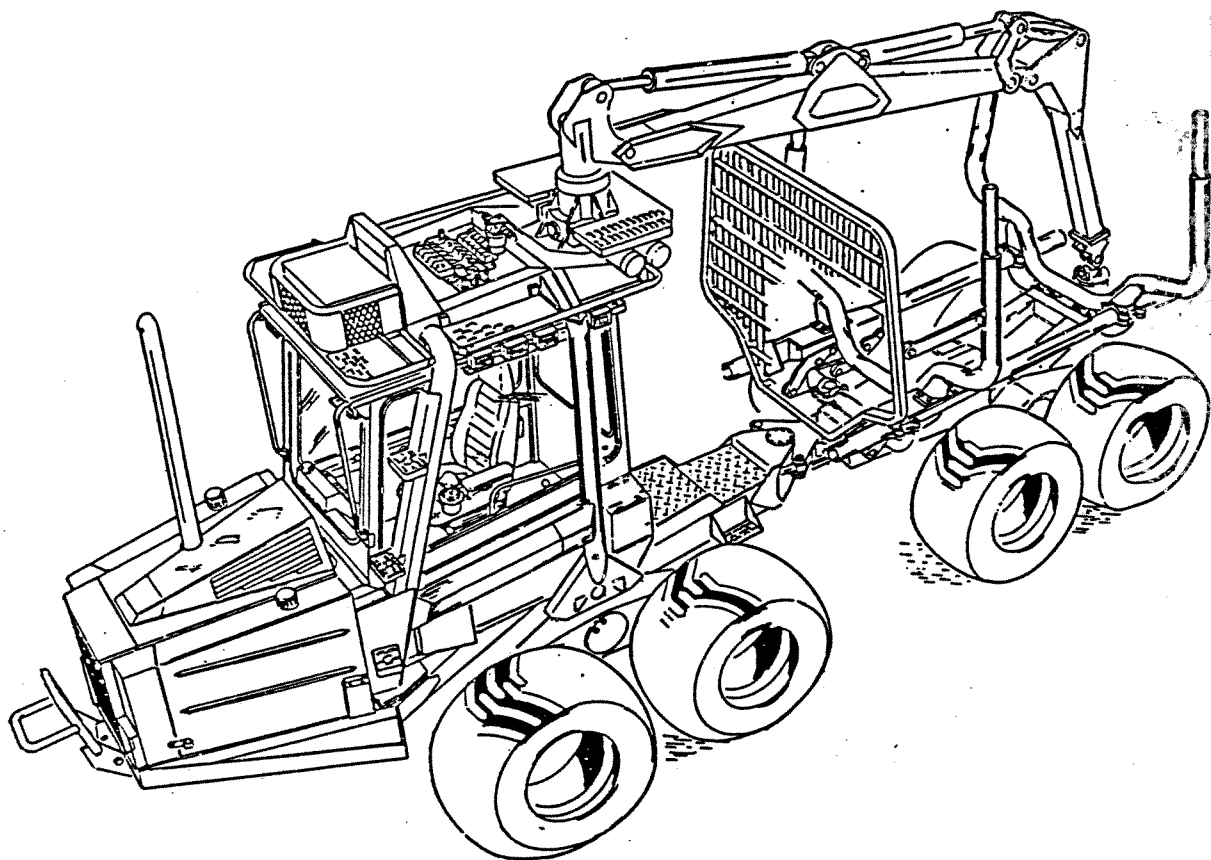


FMG 678 MINI

INSTRUCTION BOOK MANUEL D'INSTRUCTION BETRIEBSANWEISUNG



FMG 

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PRODUCT NO.....MFG NO.....

OWNER.....

EQUIPMENT.....

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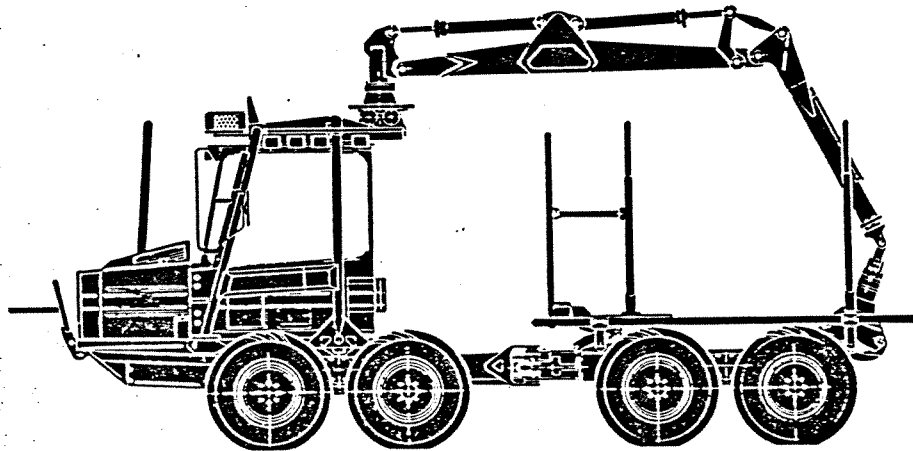
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NEAREST SERVICE DEPOT.....

SERVICE ENGINEER.....



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This instruction book has been written as a guide to the maintenance and operation of the Bruunett Mini 678 F.

Since the machine is of unconventional design it is extremely important that you familiarise yourself with the content of the book and follow its recommendations, even if you are an experienced operator of forestry machines.

We are convinced that, given proper servicing, you and your Bruunett Mini will be a perfect team. Our specially trained fitters and service personnel are ready to put right any problems that may arise, and will do so quickly and economically.

We reserve the right, without prior notice, to modify the design, specifications and maintenance instructions of the machine.

BRUUN SYSTEM AB

TYPE DESIGNATIONS

Complete machine:

Bruunett Mini 678F

Engine:

International Harveset, DT 239

Gearbox:

Hydrostatic with two speed ranges

Differentials:

International Harvester

Cab:

BSAB 6, approval no: T0687 Trh

Seat:

Bostrom Viking 303

Crane:

ÖSA 363M

WARRANTY AND SERVICE

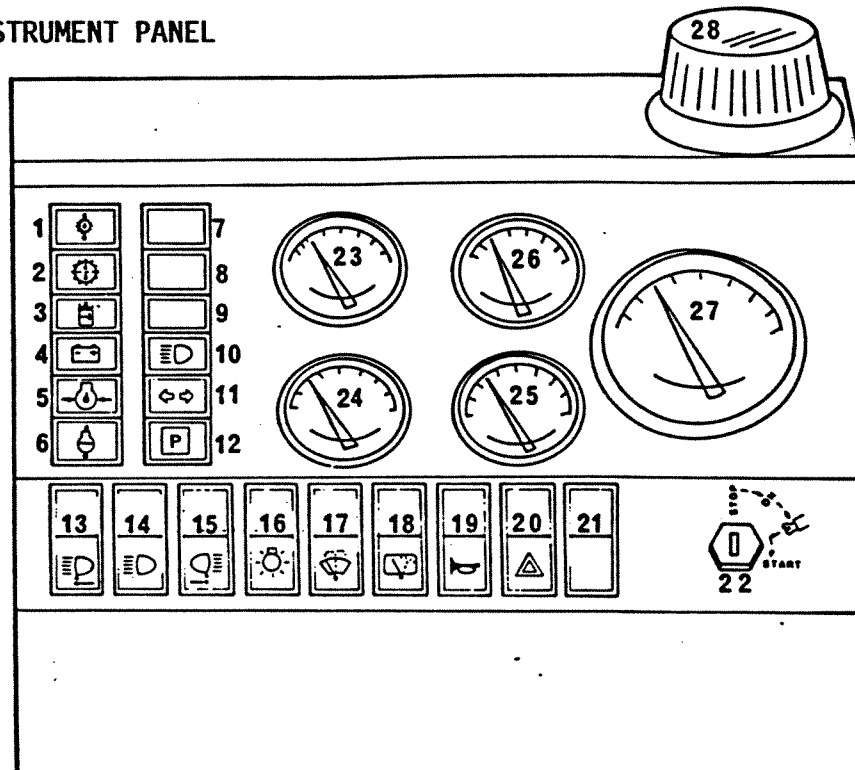
The manufacturer guarantees the operation and performance of the machine for 6 months or 1000 running hours, whichever occurs first. For the warranty to apply, the owner or driver must ensure that the content of this instruction manual is carefully observed, and that the 50 and 200 hour services are carried out.

The machine is inspected and trial-driven before delivery, so that it can be put into service without delay, but experience has shown that it is extremely important for future reliability to carry out comprehensive servicing on a few occasions in the early part of the life of the machine.

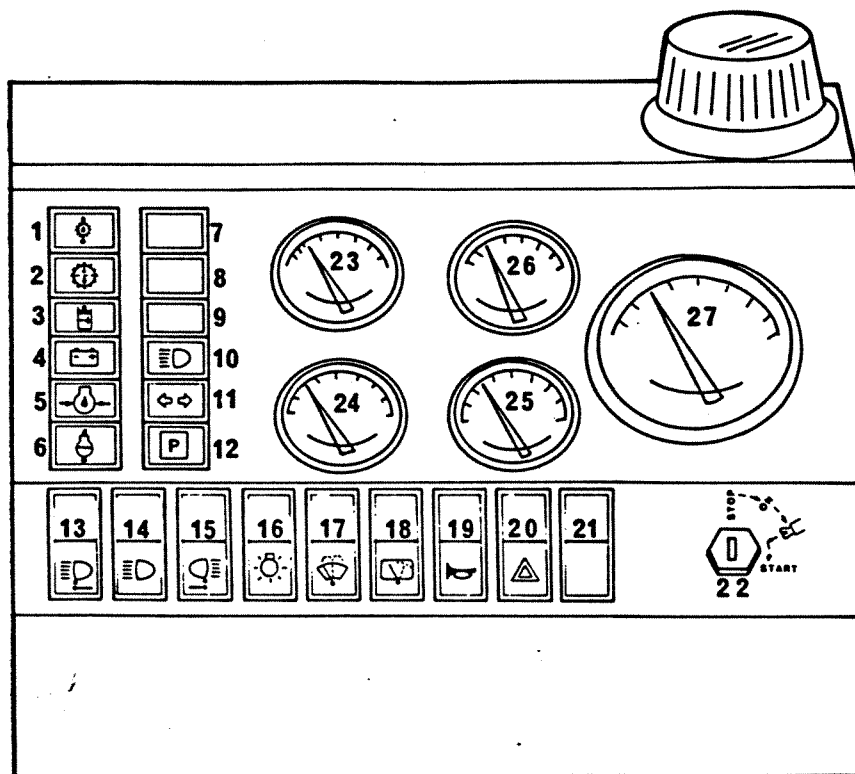
The manufacturer therefore services the machine at 50 hours and 200 hours. Labour costs are covered by the manufacturer; consumables are charged to the owner of the machine.

INSTRUMENTS AND CONTROLS

INSTRUMENT PANEL



1. Indicator lamp for hydraulic oil temperature
A red lamp which lights up when the hydraulic oil temperature is too high.
2. Indicator lamp for the transmission filter
A red lamp which lights up when the transmission filter is clogged.
3. Indicator lamp for hydraulic oil level
A red lamp which lights up when the hydraulic oil level is low.
4. Charging indicator lamp
This lamp will normally not be lit when the diesel engine is running; this indicates that the battery is being charged.
The lamp, which is yellow, is lit when the starting key is turned to the 'ON' position.
5. Indicator lamp for engine oil pressure
This red lamp is lit when the engine oil pressure is low.
6. Indicator lamp for coolant temperature
This red lamp is lit when the coolant temperature is too high.
7. Indicator lamp for diesel engine over-revving
This yellow lamp flashes when the diesel engine is over-revved.
8. Spare
9. Gear position indicator lamp
This yellow lamp is lit when one of the gear positions, low, neutral or high, is not engaged.

10. Main beam indicator lamp

This blue lamp is lit when the main beams are on.

11. Indicator lamp for direction indicators

This green lamp flashes when the direction indicators are operating.

12. Parking brake indicator lamp

This red lamp is lit when the parking brake is on.

13. Working light switch

Lights the rear right and left working lights.

14. Working light switch

Lights the front right and left working lights.

15. Working light switch

Lights the front working lights.

16. Driving lights switch

Used to switch on the driving lights (see item 31 for dipped/main beam switch).

17. Windscreen wiper switch (optional)18. Rear window wiper and washer switch (optional)19. Horn switch20. Hazard warning flasher switch

21. Automatic stop switch

The switch lights up when auto-stop is disconnected.
The automatic stop feature should be disabled when driving on the road.

Automatic engine stop is installed for the following functions:

Item 1 High hydraulic oil temperature

3 Low hydraulic oil level

5 Low engine oil pressure

6 High coolant temperature.

These functions are indicated by a buzzer and a central indicator lamp, Item 29, and by an appropriate warning lamp on the instrument panel. The auto-stop function must always be connected. The switch is used only for movement of the machine in an emergency, once the fault has been investigated.

22. Starting key

In the 'ON' position, the ignition is on.

In the ' ' position, the glowplug is on.

In the 'START' position, the starter motor + glowplug are on.

23. Coolant temperature gauge

24. Hydraulic oil temperature gauge

25. Fuel gauge

26. Time counter Speed-dependent

27. Tachometer (rev counter) Runaway speed 2700 r/min

28. Sprinkler alarm lamp

Flashes red in the event of fire. (See page 7)

29. Central warning lamp

A yellow lamp which flashes for the following functions:

High hydraulic oil temperature.

Low hydraulic oil level.

Low engine oil pressure.

High coolant temperature.

30. Direction indicator switch

31. Main/dipped beam switch

32. Forward/reverse travel switch

33. RM/LH steering levels

34. Acceleration pedal, front

35. Hand throttle

36. Brake pedal

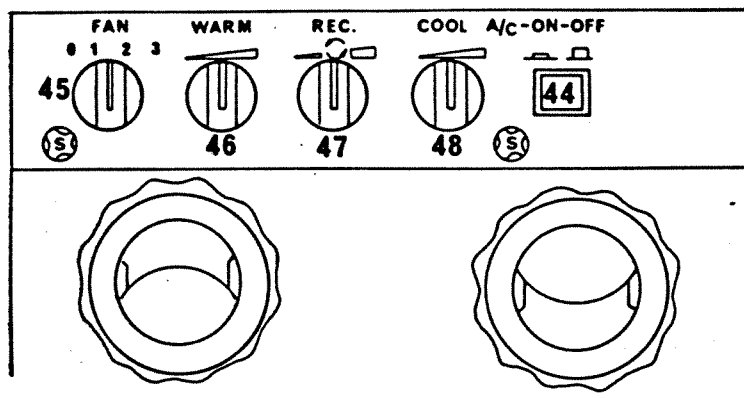
37. Parking brake switch

38. Differential lock switch**39. Selector level for low, neutral and high gears**

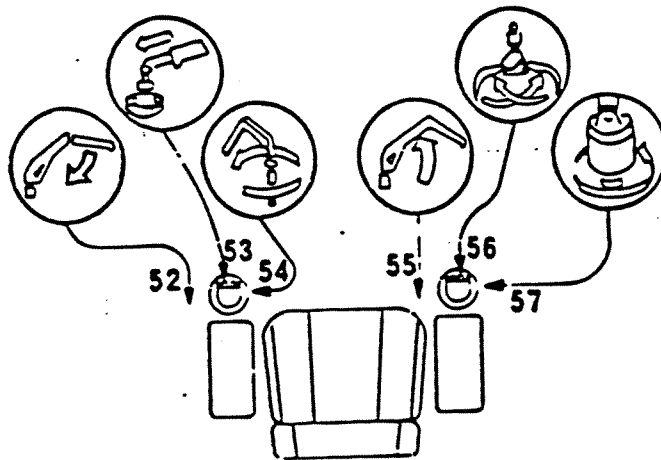
This lever is used to change between low, neutral and high gear ration.

40. Crane slew float position switch

The crane slew float position must always be selected when the crane is fixed to the load or to the load carrier.

41. Rear accelerator pedal**42. Footpedal forward - reverse****43. IPS 302 regulating unit****Air conditioning unit****44. Air conditioning unit on/off switch****45. Air conditioning unit fan switch****46. Heat control. Must be in open position if engine pre-heater is in use.****47. Rec= fresh air valve normally closed when using air conditioning unit.****48. Thermostat control****49. 12 V outlet****50. Friction brake setting, driving lever****51. Switch to disconnect rear drive**

Crane operation



52. Outer boom

53. Extension

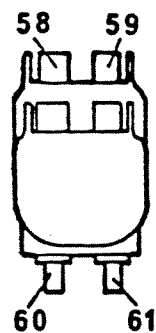
54. Crane slew

55. Main boom

56. Grapple

57. Rotator

Left crane lever



58. Switch: terrain steering left

59. Switch: terrain steering right

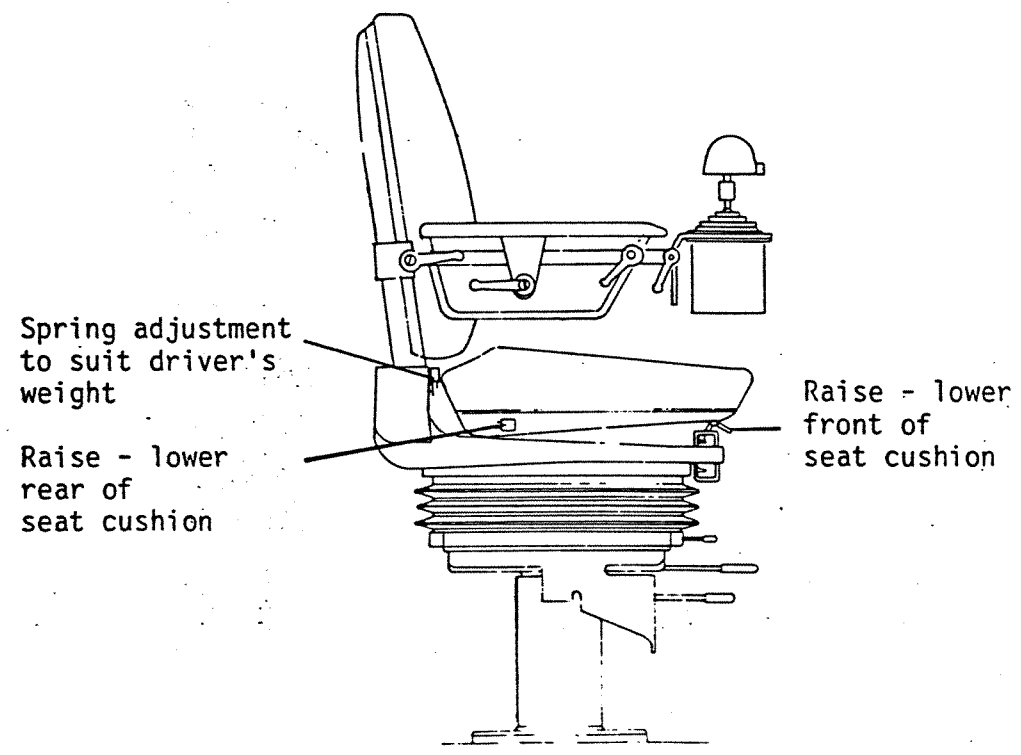
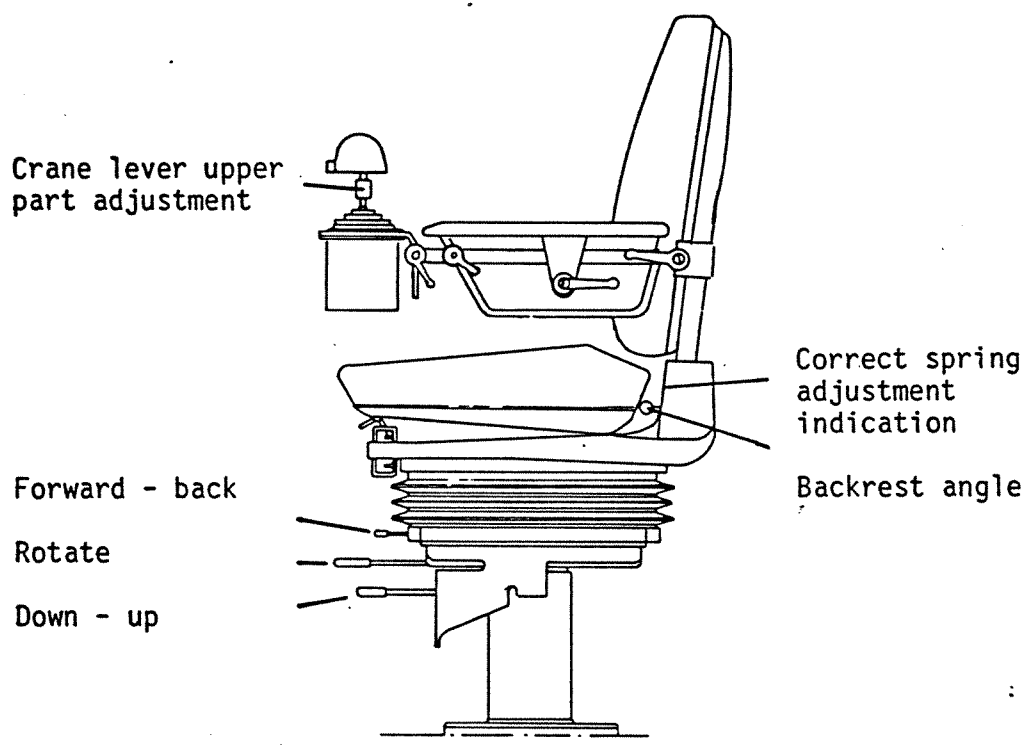
60. Switch: crane slew float valve

Crane slew should always be in the float position, with green light showing, when the crane is secured on the load or crane support.

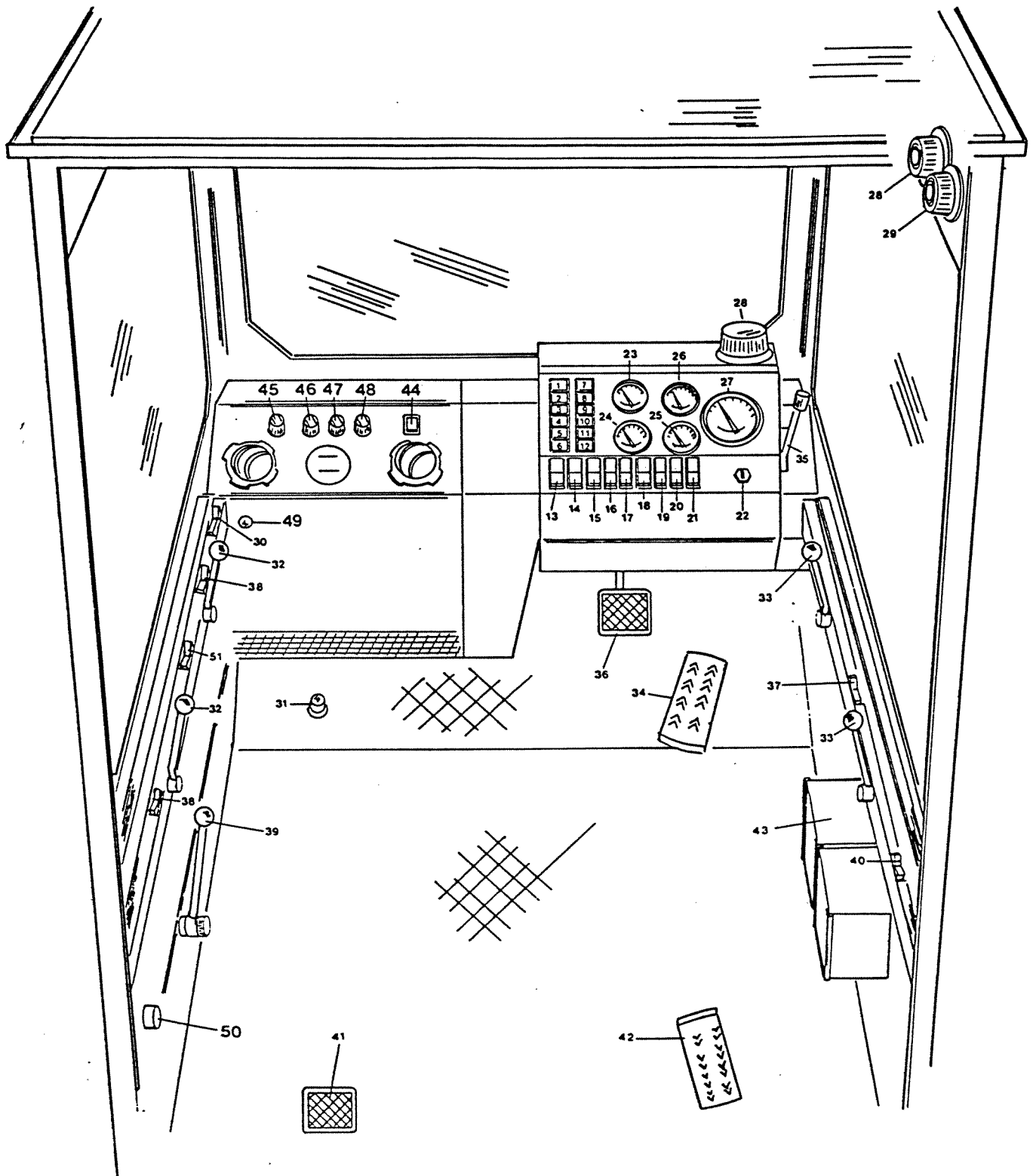
61. Switch: parking brake

Red light on switch shows when parking brake is on.

Instructions for adjusting the driver's seat



INSTRUMENTE und BEDIENUNGSEINRICHTUNGEN



SAFETY REGULATIONS

General

1. The machine may only be driven and repaired by personnel trained by the manufacturer or who have received other training approved by the manufacturer.
2. Before starting the machine, check that no-one is close by.
3. Never leave the machine unsupervised with the engine running.
4. Do not leave the cab without first positioning the crane jib securely on the trailer or lowering it to the ground.
5. Whenever working on the machine, keep in mind the risk of slipping and wear a hard hat.
6. Always apply the parking brake before leaving the cab.
7. Keep the windows clean and the cab floor free from loose items.
8. Bear in mind the risk of fire; keep the machine clean. Check the fire-fighting equipment in accordance with the instructions in the manual.
9. It is your responsibility to read and carefully follow the instructions given by the various legend plates on the machine.
10. For a safe working environment, always follow the instruction manual.

Before driving on public roads

1. Check that the machine is roadworthy (lighting, brakes etc).
2. Secure loose parts such as band tracks etc.
3. Band tracks must not be fitted for winter driving on public roads. Use snow chains (not the studded chain type).
4. Position the crane in the transport position and discharge the cylinders.

For off-road driving

1. Match the speed to the structure of the terrain.
2. Use anti-skid devices if necessary.
3. On steep slopes, try to plan to drive directly up or down the slope. Avoid driving across and cornering on slopes. Remember, the steeper the slope, the poorer the lateral stability.
4. Check the ground adhesion before driving on steep terrain.
5. If, despite taking care, you get into a critical situation with the machine, do not take risks. Call for help to recover the machine.

6. The machine must not be driven with the crane jib raised below or close to electric overhead lines or other overhead lines.
7. Keep the door open when driving on ice over water.
8. Check the air pressure in the tyres. If it is too low, the machine will tend to sway; if it is too high, it will tend to bounce.
9. Proper care and maintenance of the machine always guarantees safer working.

On repair and servicing

1. Make sure that the machine is standing level and is securely anchored by its brakes and, if necessary, wheel blocks.
2. If the machine has broken down in difficult terrain and cannot be moved before it is repaired, extra care must be taken to anchor the machine as a whole, as well as slewable or movable parts.
3. The necessary supports must be provided before load-bearing parts, hydraulic cylinders, stays and wheels etc are removed, in order to eliminate the risk of accidents.
4. Keep out of the area below the crane jib.
5. Ensure that unauthorised persons are kept away from the immediate vicinity of machine. The driver or repair fitter is responsible for safety on and around the machine.

Safety regulations and training

The safety regulations state that 'the machine may only be driven and repaired by personnel trained by the manufacturer or who have undergone training approved by the manufacturer'.

Why was this regulation introduced?

It is a question of responsibility in safety matters etc, affecting not only the driver but also the machine manufacturer and the employer.

The significance of the need for training affects the parties in the following ways, for example:

1. Driver: Special training for the machine type provides increased security against accidents, reduces the feeling of stress during the familiarisation period and provides knowledge of the limitations of the machine and how to operate it correctly.
2. Employer: Accidents and machine breakdown due to insufficient knowledge of the machine can result in unnecessary disputes on questions of responsibility. Machine damage and downtime can cost both time and money; proper driver training will only be a fraction of the cost.
3. Machine manufacturer: He is responsible for the machine as far as normal strength in normal driving is concerned. In certain circumstances a forestry machine has huge power resources which must be handled with responsibility and skill for the safety of both driver and machine. Training provides the basic safety which no-one involved in sensible planning would wish to do without, and for which a high price sometimes has to be paid when the proper training has not been given. When there are serious accidents and dangerous incidents, the machine manufacturer is always contacted by the industrial safety authorities as a party to the investigation.

What is meant by 'other training approved by the manufacturer'?

All meaningful training has an objective, directly aimed at providing course participants with the knowledge needed to carry out a particular skilled task.

For the manufacturer to approve 'other training', the instructor must therefore be specially trained on the machine type, must broadly follow the manufacturer's course plan and possess the necessary aids for effectively illustrating system functions etc.

DRIVING INSTRUCTIONS

Before starting:

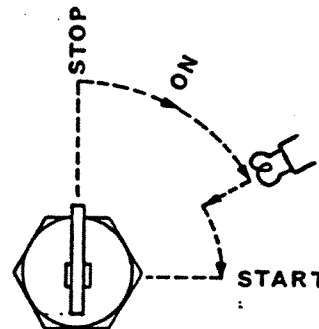
1. Check engine oil level
2. Check coolant level
3. Check hydraulic oil
4. Check the cyclone cleaner for the fuel tank
5. Turn on the main switch

Starting the engine:

1. Turn the starter key to "On"
2. Check the warning system

NOTE! The parking brake warning lamp item 12 must light up when tested as described in Group 6 page 3.

3. Check that the driving lever is in neutral
4. Set the hand throttle to at least half throttle
5. Turn the starter key to "START"



Warning

A cold engine will be damaged by over-reving. Allow the engine to run at around 1500 r/min until temperature gauge begins to register.

To protect the hydraulic transmission on starting, get into the habit of not driving the machine with higher engine speeds than 2000 r/min on the tachometer until the hydraulic oil temperature (item 24) has passed 20°C.

To ensure that the turbo is lubricated, the engine must RUN AT IDLING FOR ABOUT 1 MINUTE ON STARTING AND BEFORE STOPPING.

To stop the engine, turn the starter key to "STOP".

Cold start at low temperatures:

Depress the gas pedal to half-throttle position.

Turn the starter key to the glowplug "L" position and hold the key there for max 10 s.

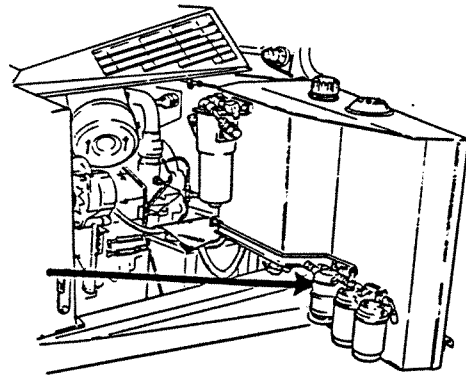
Turn the key to "START".

When the engine starts, release the accelerator pedal.

Never run the starter motor for more than 15 s at each start attempt.

If the motor does not start after 3 to 4 attempts:

Check that the fuel valve is open.



For easier starting at low temperatures, carry out the following operations at the end of every working day:

Fill the fuel tank. At extremely low temperatures, special measures must be taken to protect the engine, e.g. an engine heater.

Operations at the end of the working day:

Fill the fuel tank.

Check the cyclone cleaner, and drain if necessary.

Clean the machine and make sure that there has been no damage of leakage during the day.

Check the tyres. Use a pressure gauge to check the air pressure if you are uncertain.

NOTE: Not when the temperature is below freezing.

Do any lubrication and oil changes while the machine is warm.

Lock the cab door. Do not leave valuables in the cab.

Switch off the main switch.

At extremely low temperatures, special measures should be taken to safeguard the engine, e.g. an engine pre-heater.

Differential locks:

Both the front and rear axle of the machine are fitted with a diff lock. It is operated with a switch, item 38. The diff locks must only be engaged and disengaged when the machine is stationary. The switch must be held pressed for the diff lock to be engaged.

Until you are absolutely certain that the diff lock has engaged, drive the machine carefully forwards and backwards.

The diff lock should only be used in exceptional circumstances and with discretion. If there is a risk of the machine getting struck, engage the diff lock before this happens. If possible, avoid having the diff locked when the machine is cornering

Recovery

In the case of all towing when the machine cannot be driven, the gear selector (Item 39) must be moved to the neutral position, and the parking brake must be released by mechanical means.

If the machine is loaded, it must be unloaded before towing.

The towing cable should, wherever possible, be attached around bogie trumpets so that frame members or bolted connections are not subjected to unnecessary stress. Avoid pulling at an angle.

In the case of a machine which has overturned, the towing cable is attached to the rear arc leg: the machine should preferably be lifted, and pulling should be avoided. Before starting to tow, the hoses to the control cylinders should be slackened so that the central articulation is able to move freely and does not generate additional forces. The crane slewing mechanism should also be freed so that it does not impose unnecessary loads. The hoses to the air cylinder should be slackened so that the crane job can be lowered as far as possible in relation to the machine, in the event of it having been raised at the time of overturning.

If the machine is to be towed, the following points should be checked before starting and before the machine is taken back into service:

- 1) Check the water and oil levels in the engine.
- 2) Check the oil levels in the bogie boxes and the gear box and differential.
- 3) Check whether the engine can be turned over by hand, in order to verify that the engine is not full of oil or water which has leaked in: otherwise the injectors will have to be dismantled.
The engine should then be turned over with the help of the starter motor until the cylinders are free of liquid: the injectors should then be reassembled.
- 4) Remove the plug on the suction line from the hydraulic reservoir if the machine has overturned, and check that no air has entered the suction line. Fill the hydraulic reservoir until oil exits from the plug hole. Refit the plug.
- 5) Refit all the hoses, and adjust the parking brake. See Group 6, "Brake adjustment".
- 6) Check the frame members and bolted connections which may have been subjected to stress during overturning or towing.

Towing:

Use existing towing points and always apply a straight pull. If the machine requires towing and the engine will not run, the parking brake must be released; see Group 6. The low/neutral/high lever, item 39, must be set to neutral before towing. A drawbar must be used towing is to take place on the public road. The parking brake must be adjusted before the machine goes back into service, see Group 6 'Adjusting the parking brake'.

Gear changing:

The gearbox provides a low range, a high range and a neutral position. The gear selector, item 39, is on the left-hand side of the cab.

The machine must be stationary for gear changing.

If the selector, item 39, is difficult to engage, the operation can be made easier by moving the steering lever, item 33, and moving the driving lever, item 32, in the opposite position, while increasing the engine speed to around 1300 r/min and at the same time moving the gear lever in the required direction. Avoid changing gear when driving up or down a slope.

BEFORE MOVING THE MACHINE, MAKE SURE THAT THE GEAR POSITION INDICATOR LAMP, ITEM 9, IS NOT LIT.

THE MACHINE MUST NOT BE COASTED WITH THE GEAR LEVER IN NEUTRAL.
(EXCEPT WHEN THE MACHINE IS BEING TOWED)

Driving:

The Bruunett Mini 678 F is fitted with power-regulated hydrostatic-mechanical transmission, which makes maximum use of engine output and greatly simplifies control of the machine. The position of the driving lever (item 32) always determines the direction of travel and maximum speed of the machine. If the power of the machine is insufficient for driving at the set speed, the speed is automatically reduced by the power-regulation function of the transmission. If the engine stops, the driving lever must be moved to the neutral positions.

Road driving:

Before the machine is driven on a public road it must be fitted with the legally required plates and lighting in the correct position.

Open the covers of the road lighting.

Check that the road lights are working properly.

- . Clean the breather nipples on all bogie boxes.
- . Fit the rear mirrors and check that they are properly adjusted.
- . When the machine is running empty, the crane should be slewed to the backward position and the grapple set as low as possible.
- . Check that the floating position of the crane is selected.
- . It is recommended that the anti-skid devices should be suspended in the intended places on the gate.
- . If the available braking power from the transmission is insufficient, the foot brake must be used to reduce the speed.

NEVER MOVE THE DRIVING LEVER FROM FULL DEFLECTION TO NEUTRAL, SINCE THIS MAY CAUSE OVER-REVING OF THE DIESEL ENGINE.

Off-road driving:

Remove the rear lights, position lights, rear view mirrors and any plates that may be required for road driving.

Close the covers on the road driving.

Use low gear ratios.

For off-road transport driving use the accelerator, with the driving lever set to a suitable speed range. On steep slopes, in the case of steep downhill slopes, the drive control lever should be set between the neutral position and position one, and the engine speed should be set to approximately 1600 r/min. Additional braking effect is achieved by moving the drive control lever carefully towards the neutral position.

NOTE: The engine speed must not exceed 2500 r/min.

For off-road driving, the power regulating system provides the same maximum utilisation of the engine power as for road driving. It also means that there is no risk of the engine stalling. If maximum tractive effort is used in extremely steep upward gradients, the pressure cut-off of the transmission may operate. This means that the engine speed increases as a result of the transmission pump maintaining maximum pressure but not delivering any flow. If this happens, the driver can usually change the position of the vehicle to reduce the tractive effort demand to a more favourable level for the machine.

For maximum tractive effort to be achieved, the engine speed must be at least 2000 r/min.

NOTE: When driving on gradients, the driver's seat must be locked in the forward-facing position so that the driver can reach the road brake.

Hints for off-road driving:

Wet ground

Some of the most outstanding characteristics of the Bruunett come into their own on ground with poor load-bearing capacity. Where the loadbearing capacity is particularly poor, keep steering charges to a minimum.

In our opinion, chains should not normally be used on wet ground.

Steep gradients

The hydrostatic transmission enables the machine to travel at extreme crawl speeds at which it can negotiate upward and downward gradients which would be impossible at normal speed.

Side slope

The most dangerous manoeuvre as far as the risk of tipping over is concerned is traversing sloping ground.

Crane position can be useful; it is permissible to drive briefly with the crane extended towards the slope. Extreme care must be taken.

Stony ground

Where there are large numbers of stones in the size range 40 - 70 cm, attempt to avoid these with the centre line of the machine. Often it is better to drive over such obstacle with the wheels than to straddle them. Avoid rapid steering actions.

Loading:

Because of the special design of the Bruunett Mini, it is extremely important for the load to be distributed in accordance with the technical specification of the machine. When hauling 3 m pulp wood, the grille must be placed in the pulp wood position and the load height must not exceed the top of the grille.

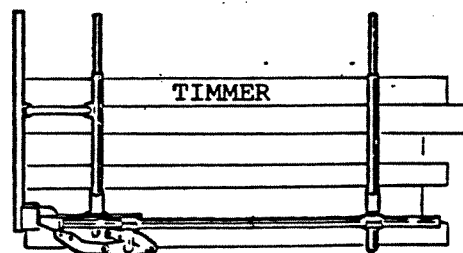
When carrying timber, note the following:

The load space is designed for a mean timber length of about 450 cm. With this length there is no weight transfer forwards or backwards, and the load is in balance.

When carrying timber longer than 450 cm, the butt ends must face forwards and the timber must be pulled right up against the gate.

NOTE: This is important; if these instructions are not observed, the stability of the machine will be adversely affected and there will be a considerable increase of tipping over.

When hauling ordinary timber, the grille must be in the front position, and the load height must not exceed the level shown in the drawing.



The crane and how to handle it:

The crane, which is located on a special arch over the cab of the Bruunet, has the following advantages:

- Crane stability is constant whether the machine is empty or loaded.
- The working range of the crane is within the area of vision.
- The centre of the crane pillar is at an ideal distance from the centre of gravity of the load. This means that effective loading is obtained with small movements of the main boom.

The design of the machine gives precise tracking, an important feature on a machine to be used for thinning, and which also results in practically optimal weight distribution for the loaded vehicle. When driving the vehicle empty, the rear end may sometimes feel too light from the point of view of steering; if this happens, the grapple should be positioned towards the rear of the load space.

Unless there are special reasons not to do so, the grapple should be in its front fixing during all terrain road driving with full load. When driving during loading, the grapple should be secured to the load and the floating setting should be selected (switch item 40). When driving timber over 450 cm long, all butt ends must face towards the cab.

When working with the crane you can either set a fixed speed (approx 1800 r/min) or use the accelerator pedal. When travelling, the machine achieves its maximum tractive effort at not less than 2000 r/min.

ALWAYS LOAD THE TIMBER TOWARDS THE GATE.

Anti-skid devices:

For the Bruunett Mini there are suitable combinations of anti-skid devices; we recommend that they should be used as follows:

1. During the bare ground period, anti-skid devices should only be used if there are difficulties due to extremely slippery conditions.
2. During the winter period, anti-skid devices are used on each set of bogies.
3. The anti-skid devices should be removed when driving on public roads or for long distances.

Load size:

It is a common mistake to believe that the capacity of a forwarder is governed by the load size.

The loading time per cubic metre varies considerably depending on the load height. The last few cubic metres loaded simply to top up the load are a great disadvantage, partly because of the risk of losing one or more pieces, and partly because of the difficulty of loading them.

It is important to remember that, for all normal runs, the loading and unloading time is much longer than the driving time.

Driving system:

Because of its special design, the Bruunett Mini has a considerable advantage in thinning, because it can be reversed as easily as driven forward.

On driving during thinning, major organisational advantages can often be achieved by backing into spur roads and not having to make a turning area at the end of the spur road. When several size ranges are being handled, the smallest range can often be taken on what would normally be the empty run.

TYRES

Warranty conditions

Every tyre and tube is guaranteed free from defects in manufacturing and materials. If goods supplied turn out to contain such defects, the manufacturer will replace them at a cost in proportion to the service given by the goods up to the time of the complaint.

In Sweden, replaced, repaired or reworked goods are delivered to the manufacturer free of charge to the original destination. Unless otherwise agreed, the purchaser bears the cost and accepts the risk of return freight charges to the manufacturer.

However, other costs for freight, assembly, retreading or other charges are not reimbursed by the manufacturer.

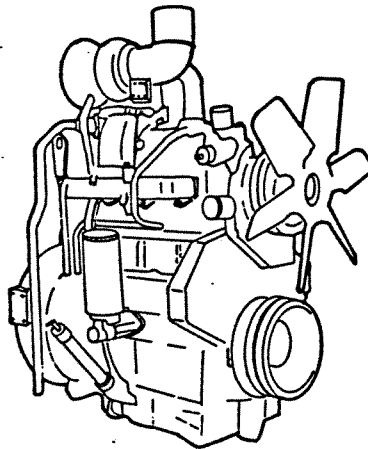
Any complaints must be addressed to an authorised tyre dealer.

General points on tyre care

Tyre pressures are of crucial importance for their life and for the performance of the machine, and is therefore essential to check the air pressure regularly. The tyres represent a major element in the value of a forestry machine.

The air pressure stated in the instruction manual is recommended for the machine; see Group 10.

ENGINE



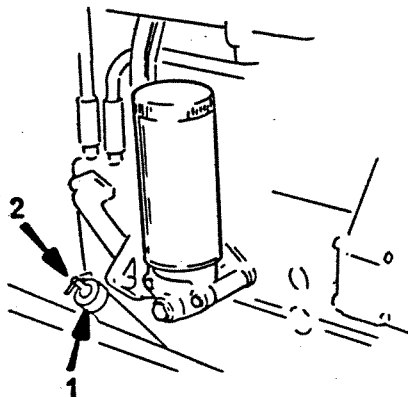
Changing the engine oil

Oil is drained by removing the plug in the bottom of the sump. The plug is easily accessible through a hole in the belly plate.

Oil should be drained after the machine has been driven, since it flows more easily. Fresh oil should be poured in through the dipstick tube.

Removing and refitting the dipstick:

- Hold dipstick cover 1 and turn screw 2. This prevents damage to the rubber seal in the dipstick cover.



The oil capacity of the engine and filter is 9.5 litres.

Recommended oils are listed in Group 9.

Oil filter

This is a spin-on type oil filter. Use only oil filters intended for upright mounting.

Replacing the oil filter:

1. Unscrew the filter from the filter mounting.
2. Clean the filter mounting.
3. Lubricate the mating face of the new filter with clean engine oil.
4. Screw the new filter to the filter mounting.
5. Start the diesel engine and check for leaks.

Fuel system

The fuel filters must be changed every 400 hours. During the winter, the fuel filters must be changed more often, and it is important to use the correct grade of fuel. The system must be vented when the filter is changed, or if there has been a fuel stoppage.

The cyclone cleaner, which is installed in front of the fuel filter, is present for the purpose of separating any water and large particles of dirt in the fuel. The cyclone cleaner must be checked daily and drained through the plastic plug, Item 1, in the bottom of the cleaner if water droplets are found. If any particles of dirt are present, the glass bowl should be removed and cleaned by slackening the central screw, Item 2. The glass bowl is then replaced, although it is tightened only once fuel which is free of air has run out.

N.B.! The ignition must be switched on during purging. The fuel level in the tank must be above the highest point of the pipe (see Item 3) leading from the fuel valve, and the diesel tank filler cap must be open.

Purging is done by gravity. The air bleed screws are opened on the filter holders and on the pipe union on the suction side of the injection pump. Fuel is allowed to flow out until all the air has left the system. Start the engine. If it runs unevenly, further purging can be done by slackening an injector pipe.

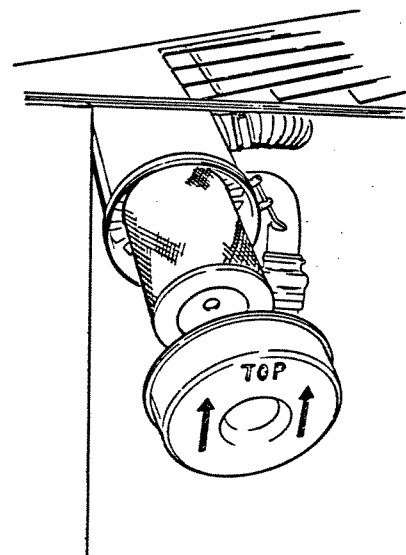
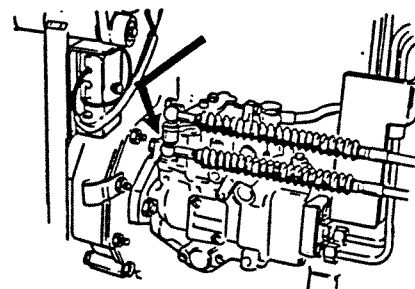
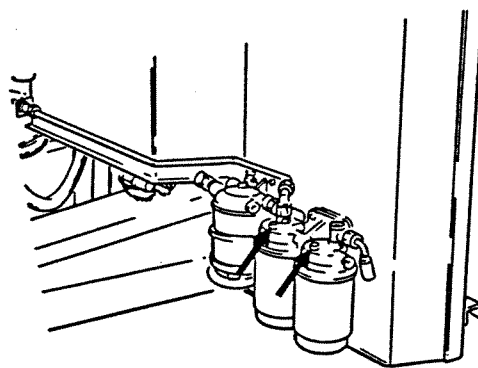
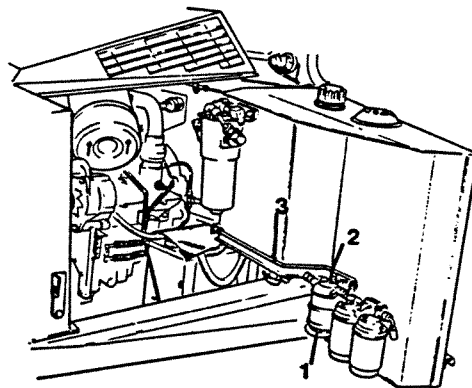
Air cleaner

The air filter must be changed every 800 hours, if the machine is operating under normal conditions.

in dusty conditions the filter must be changed more frequently.

Clean every 50 hours.

Remove the cover from the air cleaner, and shake out any dirt through the hole on the inside of the cover. Remove the filter element and shake out the filter by tapping it against the hand or against a rubber tyre (NOT against a hard object!). Refit the items, positioning the cover with the arrows facing upwards, as shown in the drawing.



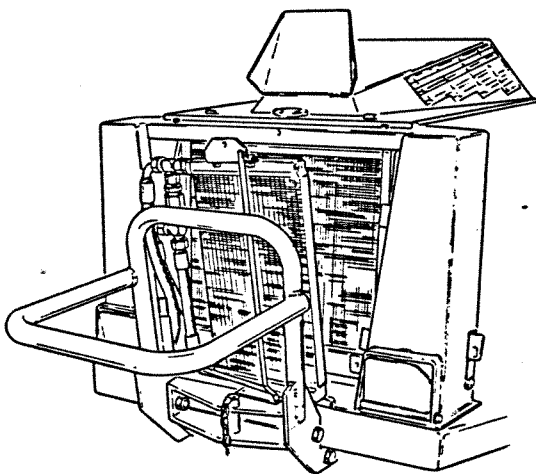


Battery

The electrolyte level must be checked every 50 hours.

Unscrew the plugs and check the level of the electrolyte in all cells. Top up with distilled water, so that the surface of the electrolyte is 10 to 15 mm above the plates.

Radiator



Check the coolant level daily. Make sure that the coolant contains enough antifreeze. See Table. During the warm season, the antifreeze can be replaced by radiator anti-corrosion agent.

The water and oil radiators must be cleaned if necessary. This must be done at least every 50 hours.

Since the corrosion-inhibiting and lubricating properties of the coolant gradually deteriorate, anti-corrosion additives and additives to lubricate the water pump should be added every 450 h.

Changing the coolant

Since the coolant gradually loses its corrosion-inhibiting and lubricating characteristics, the coolant should be changed every year or every 1600 hours. If it looks contaminated, in other words dirty and opaque, it must be changed. The coolant must be clear and transparent.

Antifreeze table

<u>Percentage of antifreeze by volume</u>	<u>Freezing point</u>
10	-4 °C
20	-9 °C
30	-15 °C
40	-22 °C
50	-38 °C
60	-60 °C

The properties of the mixture deteriorate if a mixture with more than 60% antifreeze is use.

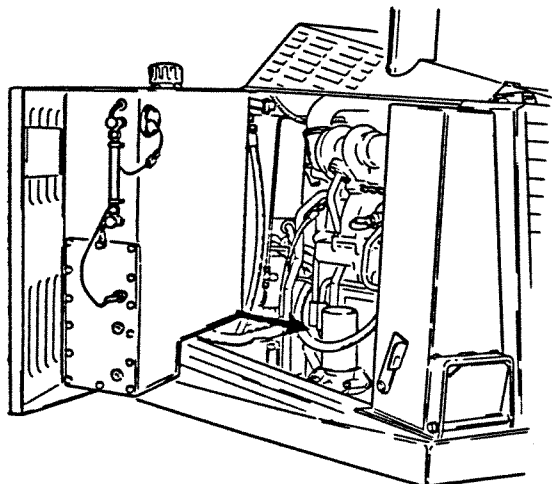
Use good quality antifreeze and take care to use clean water.

Generator and air conditioning compressor

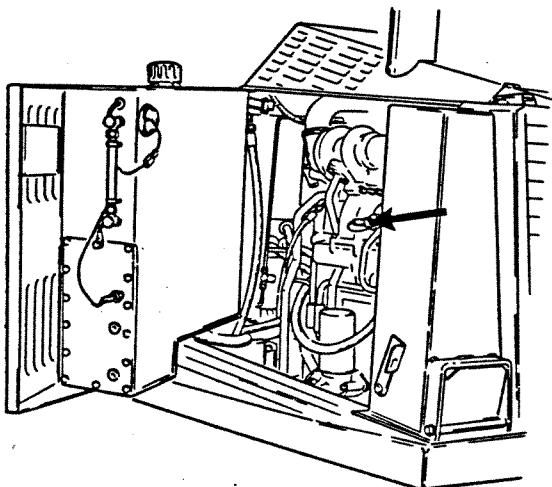
Check belt tension every 50 hours.

TRANSMITTERS MOUNTED ON THE ENGINE**Oil pressure switch**

Indicates when engine oil pressure is below 50 kPa.

**Coolant temperature switch**

Indicates when the coolant temperature exceeds $98\text{ }^{\circ}\text{C} \pm 3\text{ }^{\circ}\text{C}$.





POWER TRANSMISSION

General

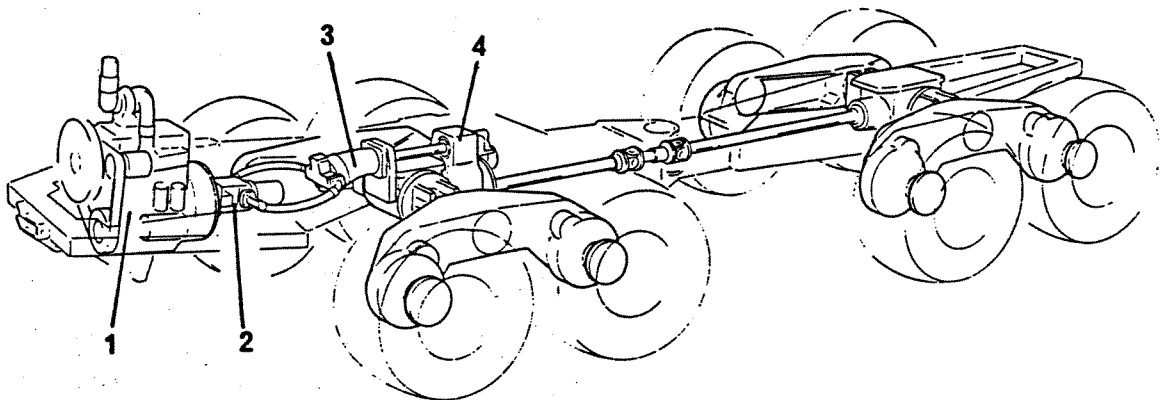
Power is transmitted between the engine and the wheels by a combination of hydraulic and mechanical systems.

The hydraulic system transmits the power from the diesel engine to the gearbox and is used to change between forward and reverse travel.

The mechanical system distributes the tractive power between the front and rear differentials and to the eight wheels. The gearbox provides low and high ratios.

The tractive power is always transmitted to all eight wheels.

When the machine is in use, the diesel engine (1) drives the hydraulic pump (2). Oil from the pump (2) drives the hydraulic motor (3), which in turn directly drives the gearbox (4).



HYDROSTATIC TRANSMISSION

Main circuit

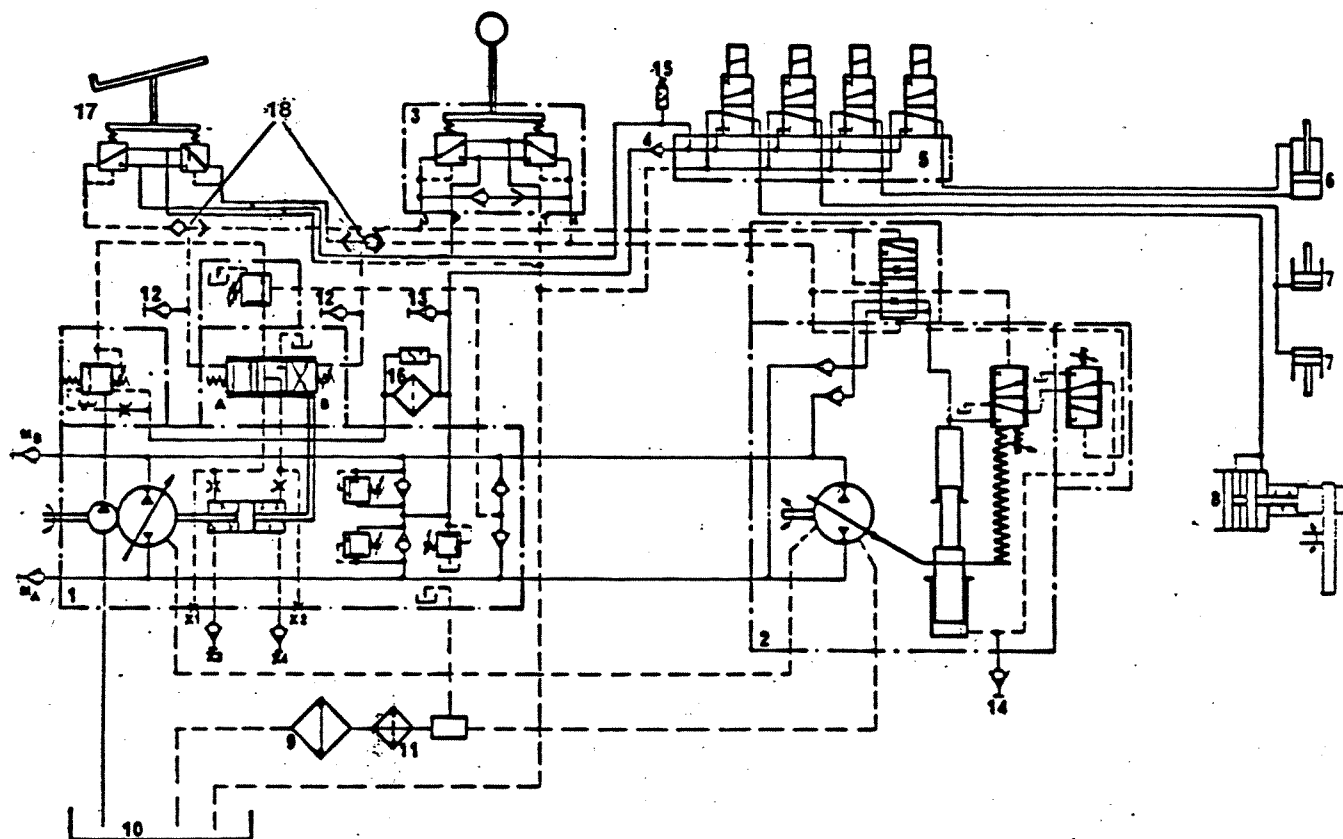
The main parts of the hydrostatic transmission are a hydraulic pump and a hydraulic motor. These are coupled together both on the flow and return sides, forming a closed system. The pump and motor are both piston-type units with steplessly variable displacement. The direction of flow of the oil in the pump can be changed without changing the direction of rotation of the pump.

The displacement of the pump and motor is varied by the servo pressure and drive pressure controlling the stroke of the pistons.

Operation

Since the machine has a speed range of between 1000 to 2700 r/min approx, when it is idling the driver can move the driving lever fully forward and backward without the machine moving. (Idling speed 800 to 900 r/min). When the engine speed is increased to around 1000 r/min or above, the machine begins to move. Control follows the power curve of the engine; this means that power is always delivered in proportion of the throttle opening, so that, when driving at full engine power, the machine moves at an optimum mean speed proportional to the available engine power. The accelerator pedal should always be used when driving on a road.

Hydraulic diagram - transmission

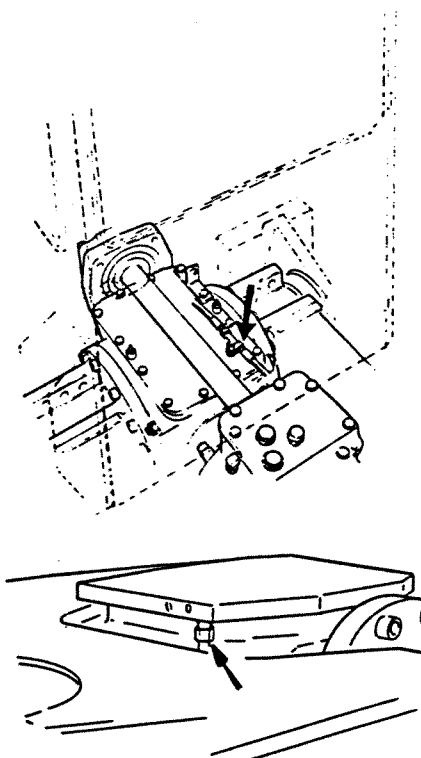


- 1 Hydraulic pump
- 2 Hydraulic motor
- 3 Driving lever
- 4 Check valve
- 5 Solenoid valves
- 6 Rear axle drive
- 7 Dif lock
- 8 Parking brake
- 9 Oil cooler
- 10 Hydraulic oil tank
- 11 Temperature-controlled thermostatic valve
- 12 Pressure gauge connection, motor control pressure, Sm
- 13 Pressure gauge connection, supply pressure, G
- 14 Pressure gauge connection, motor setting chamber pressure, Tri
- 15 Pressure switch, emergency brake
- 16 Transmission filter
- 17 Foot transmission control (extra equipment)
- 18 Gear valve (extra equipment)

Differential lock

The diff lock is operated electro-hydraulically with pushbutton switch item 38, Group 2. To vent the system, hold the diff lock switch down with the engine idling. Slacken the pipe union on top of the front diff casing cover. When oil free from air bubbles emerges, tighten the union again.

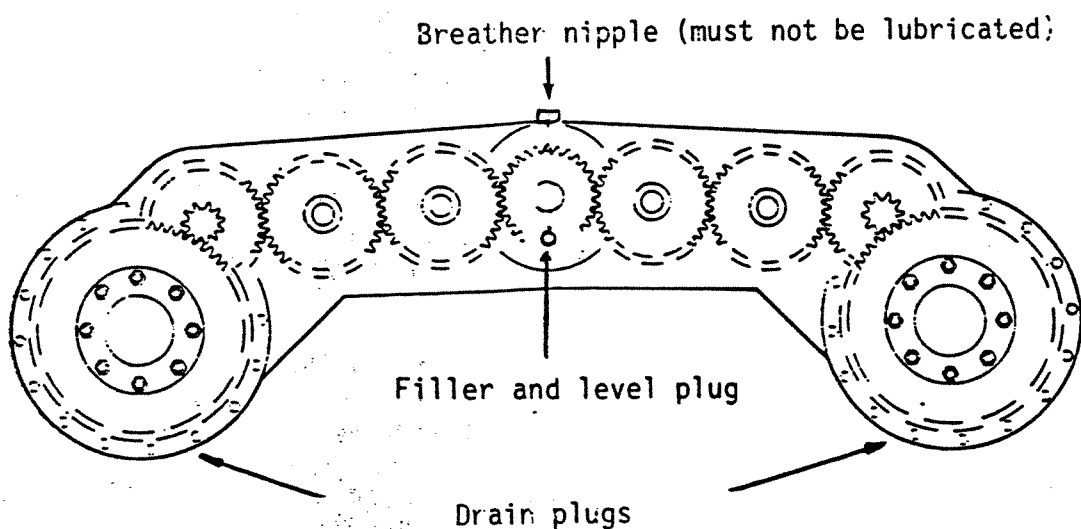
Then vent the rear diff lock in the same way by slackening the pipe union below the diff casing cover.



Bogie

The tractive power from the differentials is transmitted to the bogie wheels via a gear train.

Check that the breather nipples are clean before driving on the public roads.



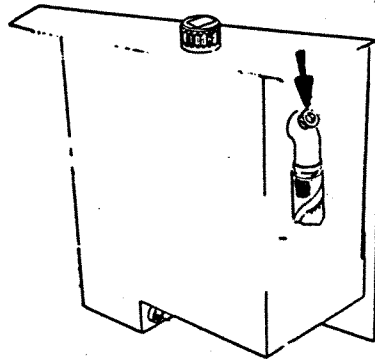
Drain off any condensation water before and after the winter months. In the event of bogging-down in wet ground, check for any discolouration of the oil caused by the ingress of water.

Venting

When replacing components and changing hydraulic oil, the plug on the suction line from the hydraulic tank must be removed.

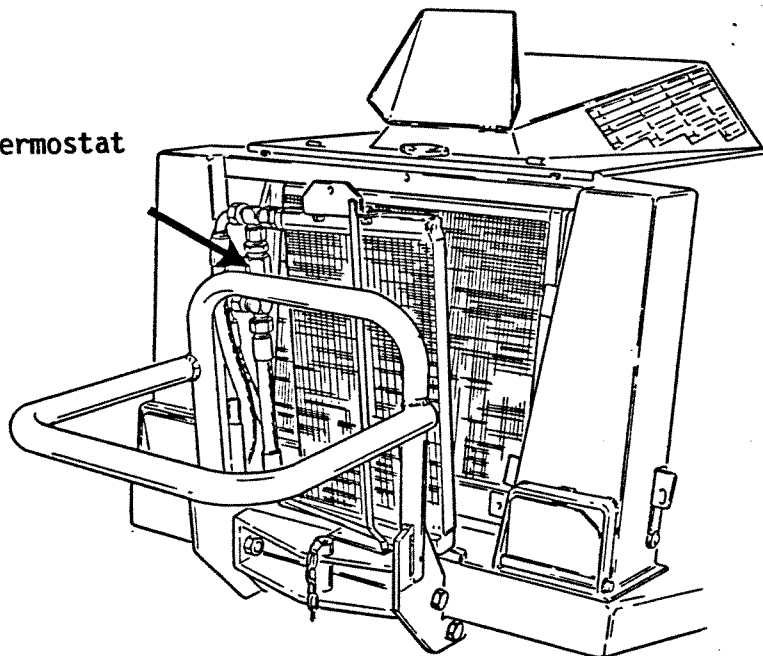
Fill the hydraulic tank until oil emerges from the plug hole.

Refit the plug.



Hydraulic oil cooler with thermostat

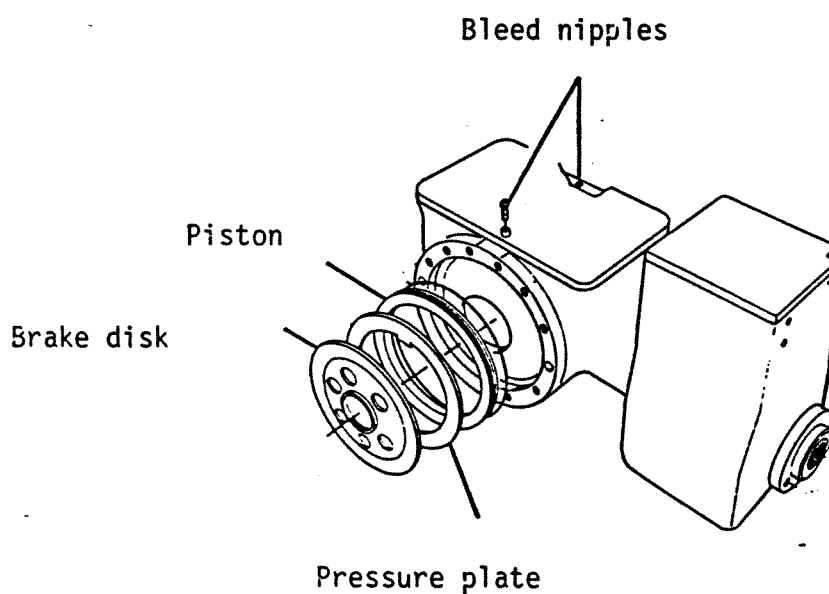
Thermostat



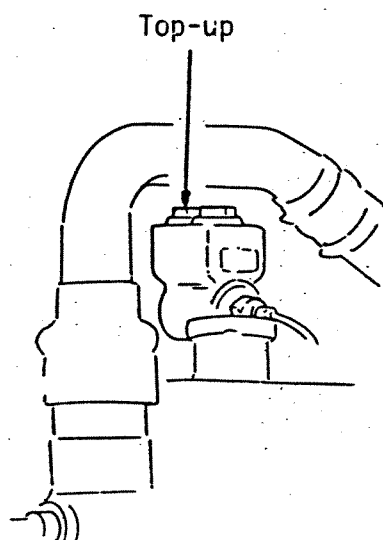
BRAKE SYSTEM

Travel brake

Normally, the travel brake need not be adjusted. If air has got into the system during component replacement, pump up pressure in the system and vent off the air through the bleed nipples, as shown on the diagram. Repeat until all the air has been bled off. Make sure that there is a sufficient quantity of oil in the reservoir during purging.



The brake fluid reservoirs are in the engine compartment. Check the brake fluid level every 50 hours. Oil grade SHS 46. NOTE: DO NOT USE BRAKE FLUID.



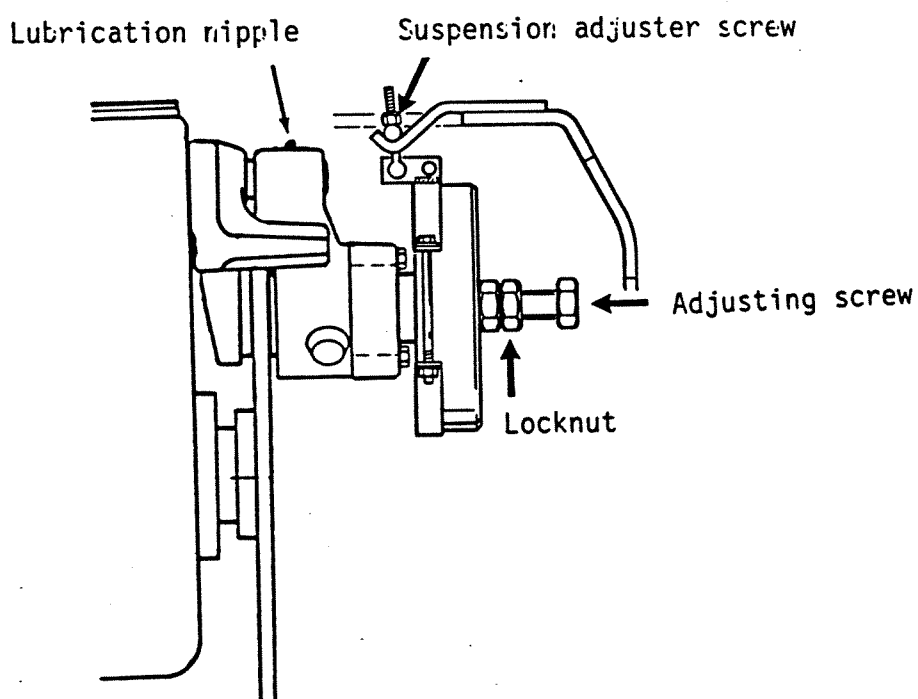
Parking brake

Parking brake

The parking brake is operated with switch 37 on the right-hand cab wall.

The supply pressure is used to release the parking brake via an electrically-operated hydraulic valve.

The brake is also used as an emergency brake. In the circuit there is a pressure switch which automatically drains the brake at 1.2 to 1.3 MPa. The lamp on the panel always indicates if the brake is activated (both manually and automatically).



Adjusting the parking brake

The engine must be switched off. Back off the locknuts and screw in the adjusting screw half a turn at a time. After each half turn, lock the adjusting screw with the locknuts and test the brake. Release pressure (supply pressure) is applied by starting the engine. When the brake is correctly adjusted and the brake disk is dry, the machine cannot be driven in high gear at an engine speed above 2000 r/min.

Also check that the suspension for the slave cylinder is correctly adjusted so that the brake yoke is able to slide freely on the shaft and does not become jammed when the parking brake is released.

When the brake is correctly adjusted, drive the machine about 500 m in high gear check that the brake disk does not heat up.

NOTE: Do not apply release pressure until the locknut on the adjusting screw has been tightened - the rear end plate of the large cylinder may burst.

Testing the pressure switch and indicator lamp

Begin the test with the engine at a standstill; turn the starter key to ON.

The lamp, item 12, on the instrument panel must be lit when switch 37 is in both positions.

Start the engine.

The warning lamp must now light up with the switch (Item 37) in parking brake position "On", or Item 61. (XU).

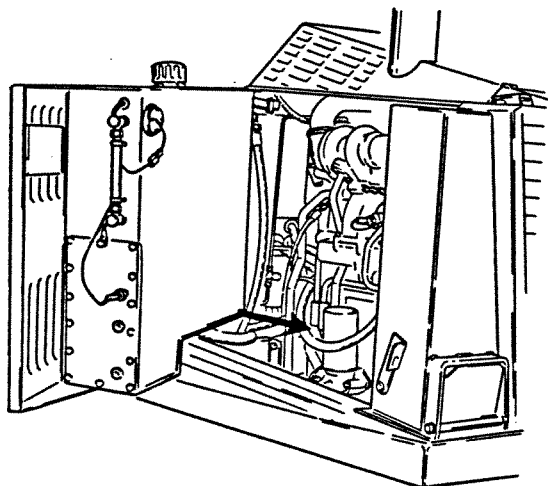
WORKING HYDRAULICS

Item list for hydraulic system diagram

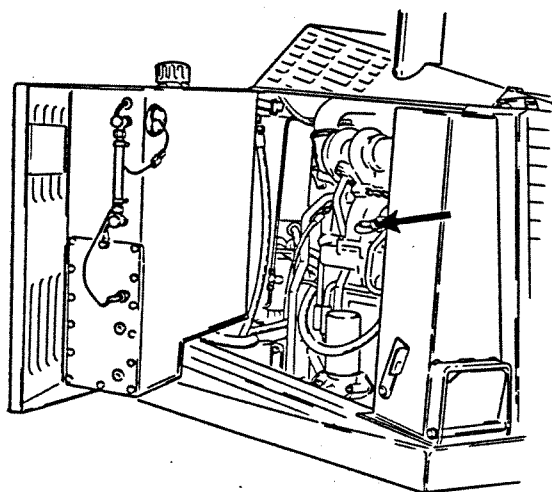
1. Hydraulic pump mounted on the shaft extension of the transmission pump. The pump is a variable-displacement axial-piston pump with a capacity of 40 dm³/min at 1000 r/min. It is a constant-pressure pump, in other words it maintains a constant working pressure of max. 16.5 MPa. On the other hand, the pump delivers no oil flow to the machine until one of the hydraulic functions of the machine performs a motion. The system operates with automatic pump load relief; this means that, as long as no hydraulic function is activated, the pump pressure is approx. 2.2 to 2.4 MPa (pressure gauge connection 10). When a hydraulic function is activated, the pump pressure goes up to the constant pressure figure.
2. Directional valve for crane operation. The valve is operated by an EHC two-lever control unit.
3. Twelve EHC valves convert the electrical signal from the crane lever control unit into hydraulic pressure.
4. Pressure-limiting valve; used to set the 16.5 MPa working pressure of the ÖSA 363 crane. Measured at pressure gauge connection 10.
5. Pressure-reducing valve for servo pressure to EHC solenoids. Fixed pressure settings 3.5 to 4.0 MPa, measured at pressure gauge connection 11.
6. 1 mm constriction fitted in the block on the crane pump.
7. Floating position valve for crane slew cylinder. Activated when switch 40, Group 2, is in the off position.
8. Directional valve for steering cylinders.
9. Return filter; all return oil from crane cylinders and steering cylinders passes through this filter before returning to the tank.
10. Pressure gauge connection. The working pressure of pump 1 can be measured here. The pressure gauge connection is located on the outgoing pressure hose of the pump, below the cab.
11. Pressure gauge connection. Here the servo pressure and pump stand-by pressure are measured.
12. Slew cylinders
13. Lift cylinder
14. Outer boom
15. Extension cylinder
16. Grapple cylinder
17. Rotator
18. Steering cylinders
19. Hydraulic oil tank

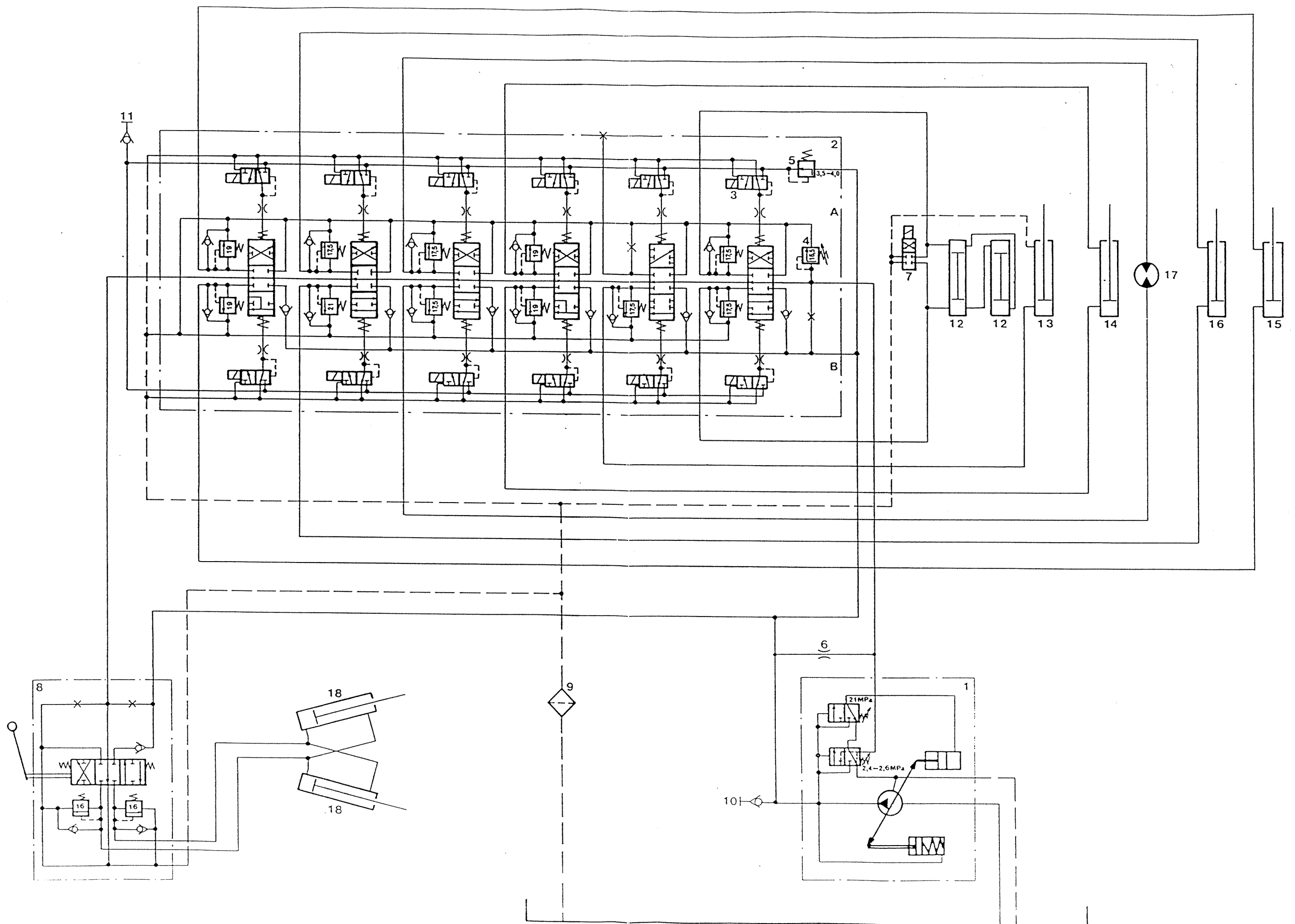
HYDRAULIC TANK LEVEL SWITCH AND TEMPERATURE TRANSMITTER

Level switch



Temperature transmitter





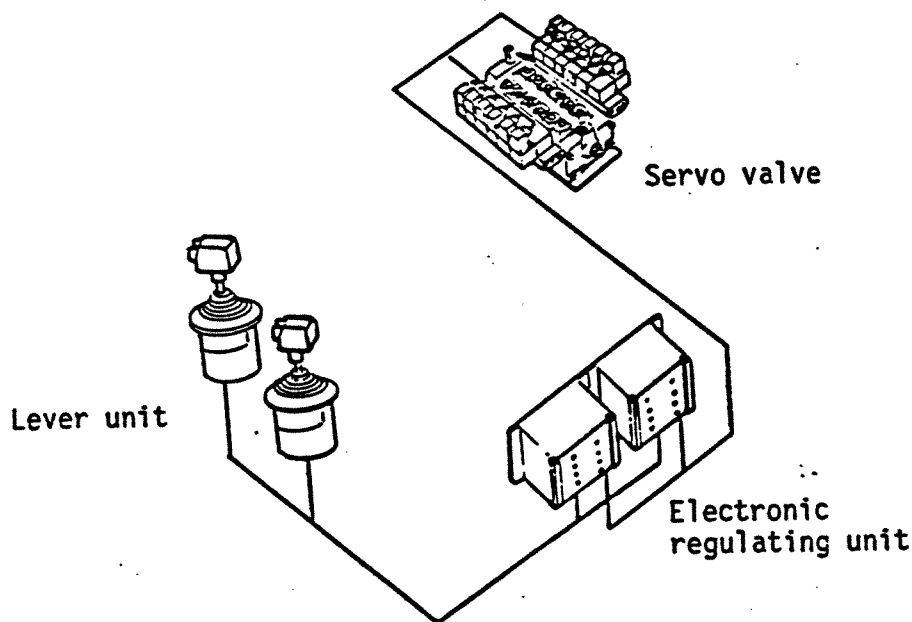
HYDRAULSCHEMA Bruunett Mini 678F
kran ÖSA 363M

EHC 35

Your machine is equipped with an EHC system for the crane functions. EHC, Electric Hydraulic Control, is an electro-hydraulic system for crane operation. It offers considerable freedom in terms of positioning of the controls. This means that the driver's position can be ergonomically designed, and the system is therefore highly suitable for our machines, which must meet the latest ergonomic requirement.

Briefly the system works as follows:

EHC-35 is an electrohydraulic control system made up of three basic components: lever unit, electronic regulating unit and servo valve.



The lever unit is a coordinate lever unit with three double-acting functions that can be proportionately controlled.

The regulating unit consists of a voltage stabiliser that supplies the lever unit and the rest of the electronics of the system. The pulsed output signal energises the magnetic coil in the servo valve. The starting pressure and the slope of the control curve can be set by means of potentiometers on the front of the box. Each function is set individually.

The servo valve is the electrohydraulic converter of the system; it provides an outgoing control pressure that is linearly proportional to the input current. The spool is controlled by an encapsulated electro-magnet with proportional force.

ADJUSTING OF THE CRANELEVER

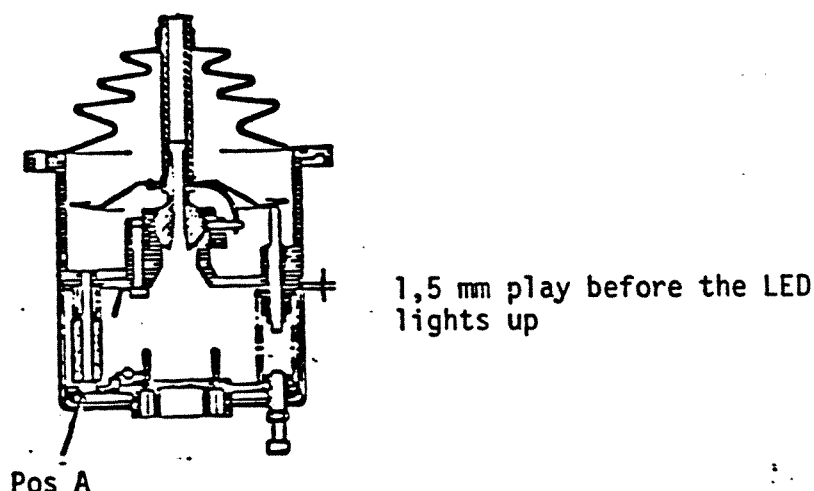
Checking the lever unit potentiometers

Check that all potentiometers are free from faults by connecting an ohm-meter to pins 1 and 5 on the lever. Move the lever from the neutral position to the maximum position and check that the resistance decreases in proportion to the lever deflection. Check all potentiometers (there are 12).

Check that the distance the slider must move to establish electrical contact with the resistance is 1,5 mm; see diagram.

Screw the potentiometer down to the correct level using the internal hexagon screw; see Figure 1.

Figure 1



NOTE: After about 1600 hours operation it may be necessary to clean the struts and potentiometers in the lever to maintain smooth crane control.

When cleaning, use clean gasoline or thinners.

Before cleaning, cut off the electrical supply to the system.

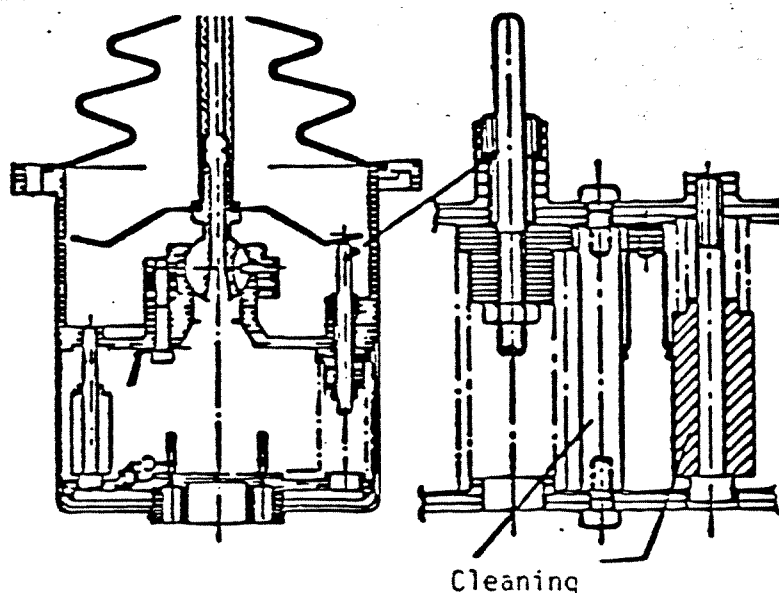
Clean the four struts completely with the cleaning agent. The levers must be deflected for the entire strut to be cleaned.

NOTE: The contact tongue must not be touched with the cleaning agent.

Then clean the potentiometers in the same way; see Figure 2.

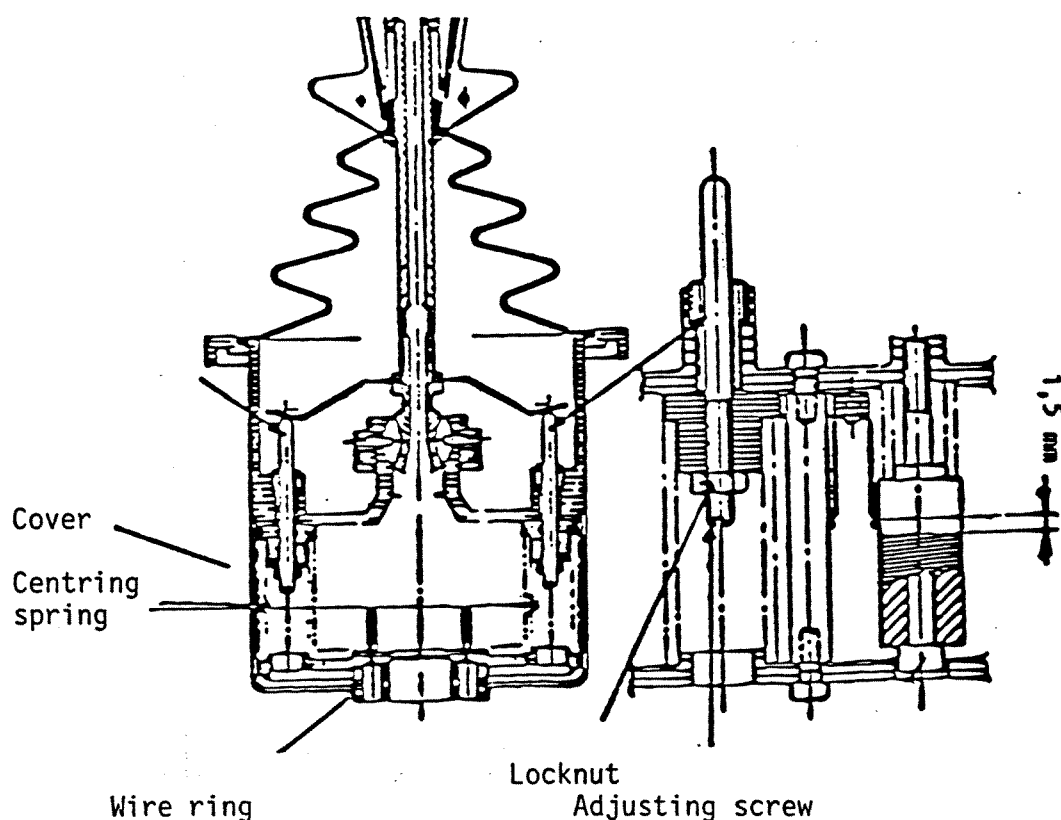
Then apply one drop of contact oil to the potentiometers. Do not use contact spray.

Figure 2



Checking play in the lever unit

Check that there is no play in the lever when it is in the rest position (0 position). When adjusting the play, remove the wire ring and protective cover over the potentiometers in the lever unit. Remove the centring spring; see diagram. Slacken the locknut. Screw in the adjusting screw so that both the adjusting screws make contact with the metal plate as shown in the diagram.



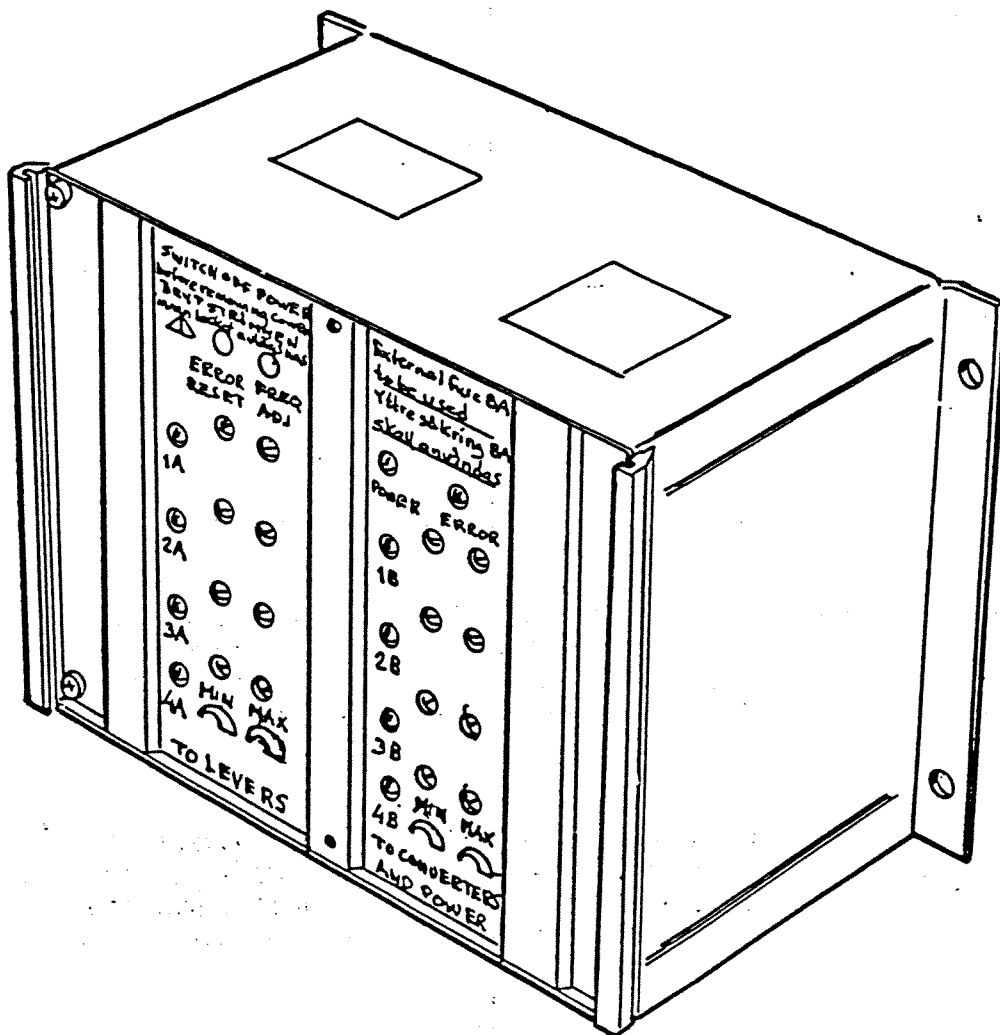
IPS regulating units

The regulating unit has 12 LEDs to indicate when a function is activated; see diagram.

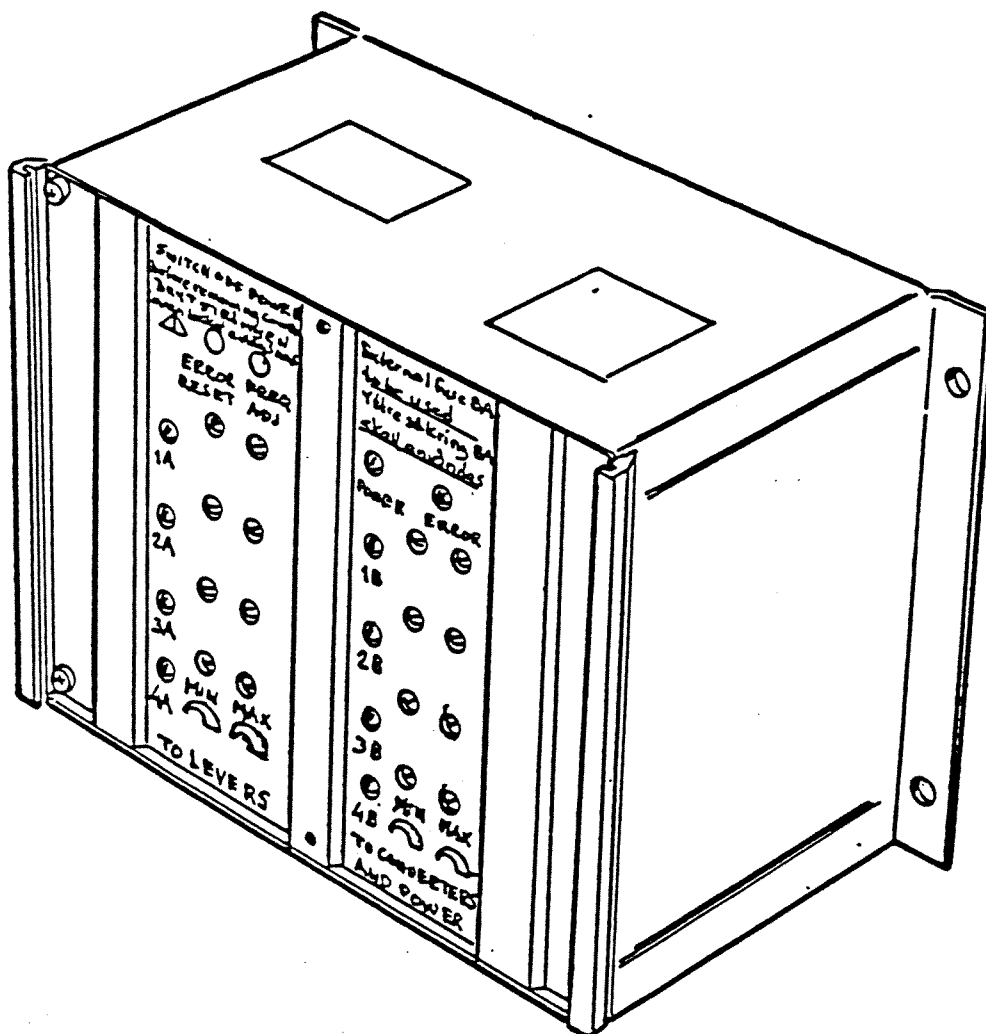
There are also LEDs for 'Error' and 'Power'. These are common to the entire IPS box, which contains three dual functions. If the power to a servo valve is cut off, this function fails. If an incorrect control signal appears between the regulating unit (IPS 302) and a servo valve, i.e. + from another conductor, the 'Error' lamp will light up. As a result of this, all functions associated with this regulating unit will fail. When the fault has been corrected, the Error lamp is reset by pressing the 'Error reset' button.

NOTE! The function that was being run when 'Error' lit up is the function that caused the fault.

If the switch (Item 40) is not in the "Off" position when the engine is started, the "Error" warning lamp will light up and the functions will not operate: the switch must now be moved to the "Off" position, waiting for about one second before moving the switch to the "On" position.



Adjustment of IPS 302



The settings are made with the potentiometers on top of the unit; see diagram. Each servo valve corresponds to one group on IPS 302, consisting of on LED, one minimum potentiometer and one maximum potentiometer, marked 1A, 1B, 2A and so on. 1A can control the supply to A-port of the main spool, whilst 1B controls the supply to the B-port. A screwdriver is needed to adjust the potentiometers. Small indicator lamps in each box indicate when a function is activated.

LH crane lever

- 1A Open grapple
- 1B Close grapple
- 2A Rotator anti-clockwise
- 2B Rotator clockwise
- 3A Lift down
- 3B Lift up

RH crane lever

- 1A Extension in
- 1B Extension out
- 2A Slew anti-clockwise
- 2B Slew clockwise
- 3A Jib out
- 3B Jib in

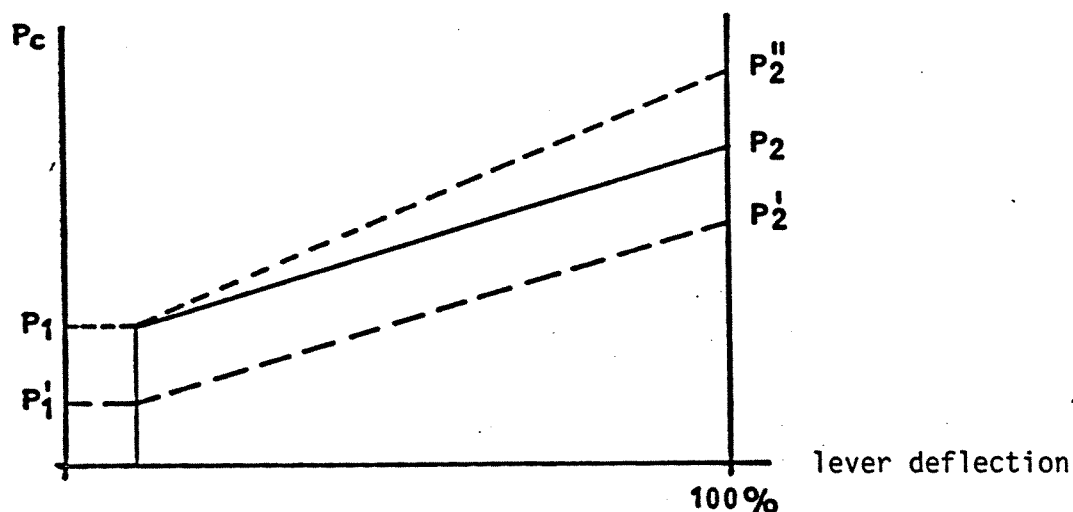
Turning clockwise increases the final speed.
Turning anti-clockwise reduces the final speed.

Start the machine and set the engine to working speed.
(The engine must be warm, 45 - 50 °C, before measurement begins.)

Set the required starting pressure with the 'Min' potentiometer, i.e. so that the start and stop processes are smooth, with no jerking and no unnecessary slack.

When the starting value, P_1 , is adjusted with the 'Min' potentiometer, the entire pressure curve is shifted in a parallel manner. This means that the final pressure, P_2 , changes by the same amount as P_1 .

The 'Max' screw is used to change the slope of the pressure curve. This means that the starting pressure remains unchanged but the slope and final pressure of the curve change, as shown in the diagram.



Adjust the maximum speed with the 'Max' screw individually for each function, as stated below.

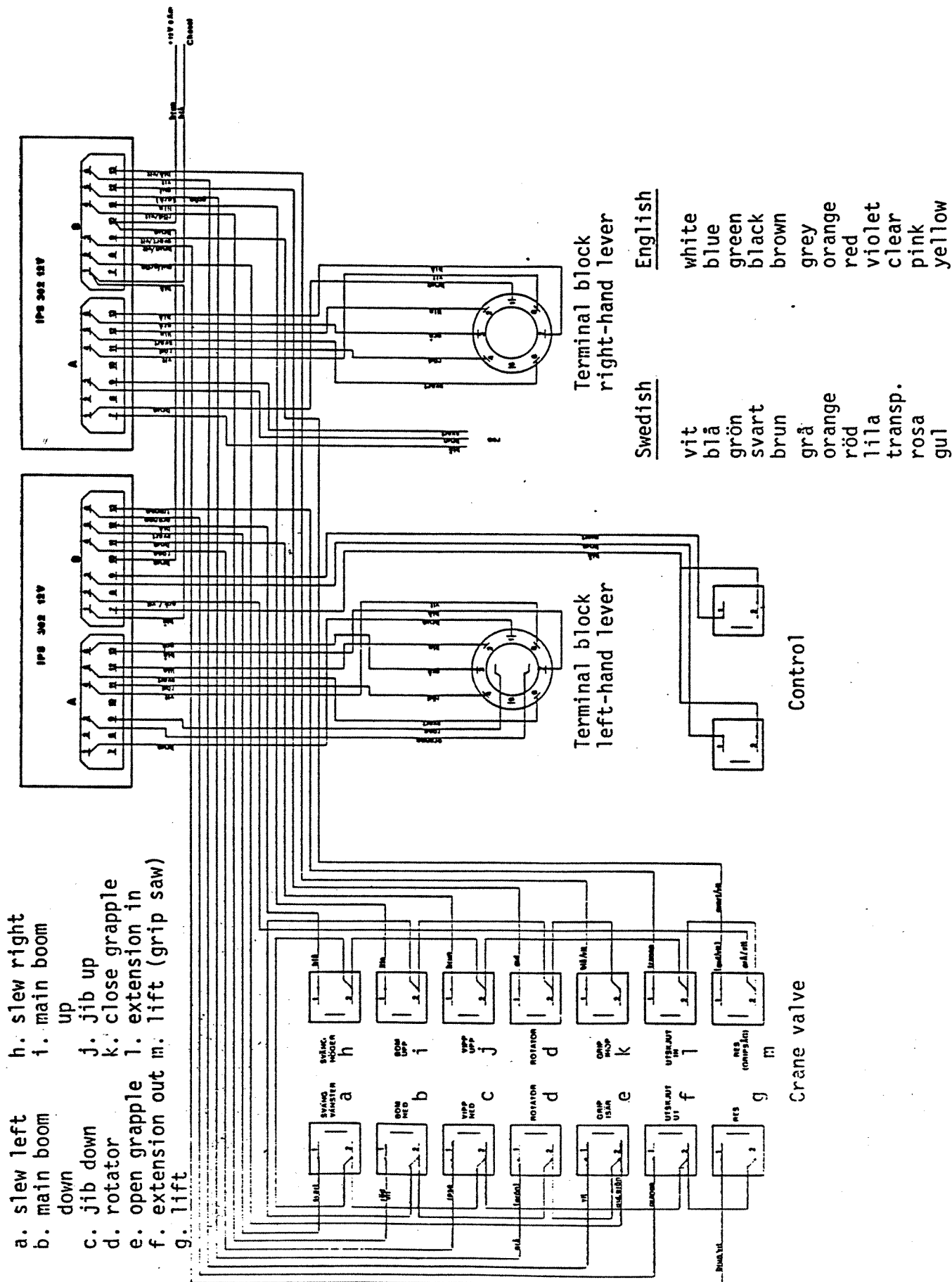
The times below are for full lever deflection, running between the limit positions of each function, at a diesel engine speed of 1800 r/min.

Function	Seconds
Slew anti-clockwise	15
Slew clockwise	15
Lift arm up	5,5
Lift arm down	5,5
Jib out	6,0
Jib in	5,5
Rotator right	3,5
Rotator left	3,5
Close grapple	1,9
Open grapple	1,6
Extension out	4,0
Extension in	3,0

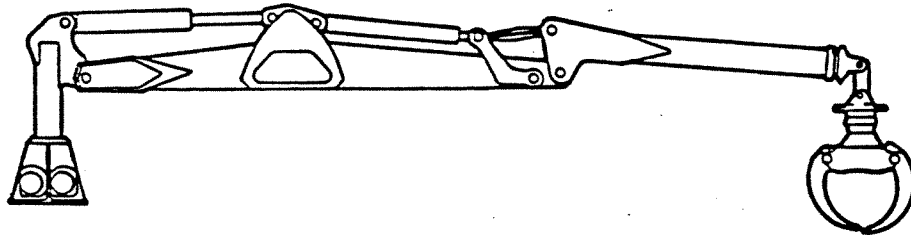
These times should be regarded as minimum times on delivery from the factory.

When the system has been set up, starting and stopping must be very smooth, without jerking or slack. As soon as the LED lights up, the pump pressure must rise and the crane must move slowly when the lever is moved further.

ELECTRICAL DIAGRAM FOR EHC

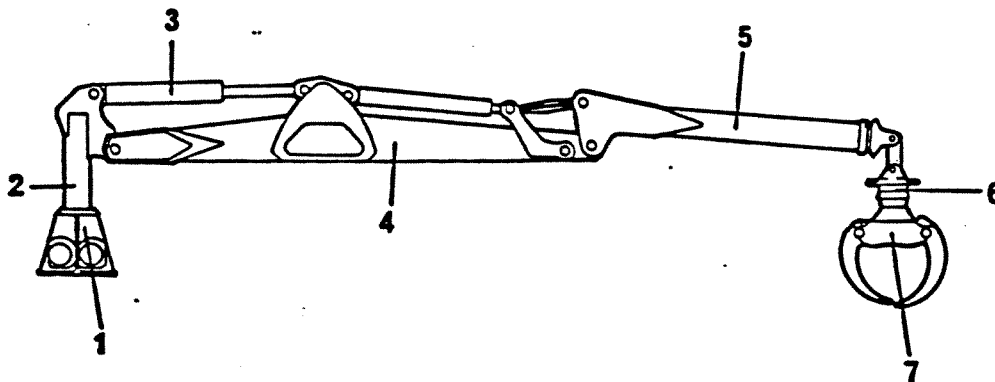


ÖSA 363 M CRANE



Technical data of the 363M

Max reach	6,65 m
Reach with extension retracted	5,45 m
Lifting moment, gross	55 kNm
Lifting force, max reach	106°
Turning moment, net	12 kNm
Practical grapple grip area, max.	0.35 m ²
Rotator	continuous
Crane slew angle	380°
Working pressure	16.0 MPa, (160 bar)
Pillar height	0.75 m
Total weight including grapple, rotator, hoses	1164 kg



General description

The ÖSA 363M is a hydraulic grapple loader made up of the following main parts:

1. Slewing mechanism 2. Crane pillar 3. Lifting cylinder 4. Main boom
5. Outer boom 6. Rotator 7. Grapple

The SLEWING MECHANISM has twin slewing cylinders with 'floating' pistons.

The slewing angle is 380°, and hydraulic limit position damping ensures that the slewing speed of the crane is reduced before the limit position is reached.

The CRANE PILLAR is of the narrow type and forms one piece with the toothed ring. The pillar has attachments for a horizontal lifting cylinder.

The LIFTING CYLINDER is of the double-acting type, but is operated as a single-acting cylinder.

The CRANE JIB is made up of the main boom and outer boom.

These are fabricated from special sheet in a box-section profile for high strength. The attachment of the main boom to the crane pillar and the attachment of the outer boom to the main boom have replaceable bushings. This is also the case with all other joints.

The outer boom has a hydraulic extension.

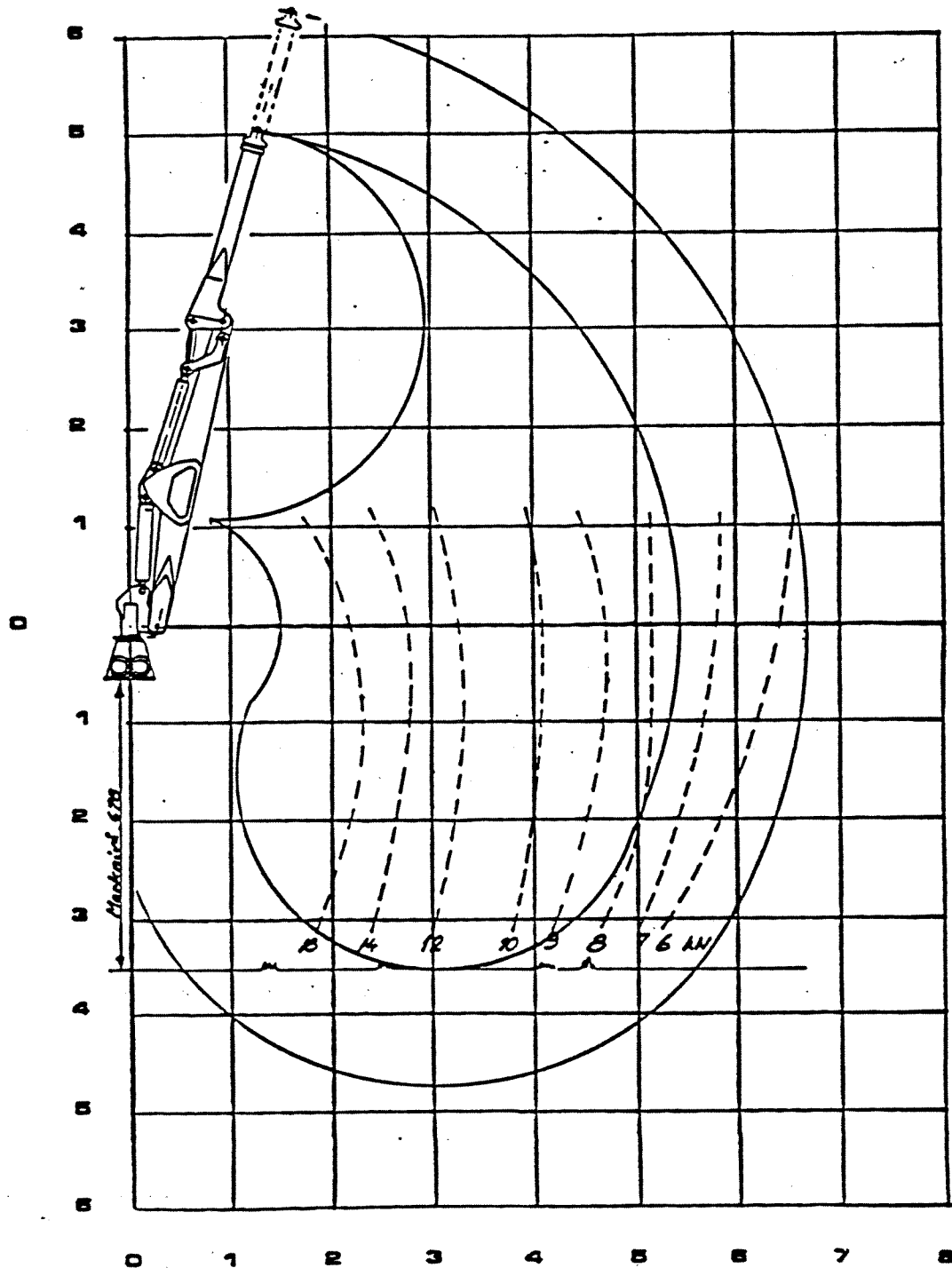
The manufacturing number of the crane is stamped on the main boom at its attachment to the crane pillar, and the manufacturing number of the outer boom is located at its attachment to the main boom.

The HYDRAULIC CYLINDERS of the crane are made from honed steel tube with chromium-plated piston rods and spherical end fittings to eliminate bending forces on the cylinder.

The ROTATOR provides continuous rotation and is flange-mounted on to the grapple.

The recommended GRAPPLE is of a size which permits quick, convenient working during both loading and unloading.

Motion diagram



General inspection

The crane is designed with a view to the severe operating conditions that are inevitable in off-road forestry operations. To avoid unnecessary down-time, the crane should be inspected in accordance with local industrial safety regulations.

Operating the crane

Smooth, precise crane motions, giving high capacity and low wear, are achieved by operating several functions simultaneously and only using full lever deflection in exceptional cases. Fast, jerky operation only gives an illusion of higher performance.

When the machine is being driven empty, the grapple must be placed at the rear on the load carrier. The grapple should not be fully closed. When driving with a loaded machine, the grapple must be placed on the grapple holder in front of the radiator. The position of the grapple is important for the weight distribution of the machine.

Hoses

All hydraulic hoses must be fitted without torsional stresses.

OBSERVE THE GREATEST POSSIBLE CLEANLINESS WHEN FITTING HOSES. Make it a habit ALWAYS TO WIPE HOSE CONNECTIONS before unscrewing them, to PLUG ALL PIPES AND HOSES after removal and NEVER FIT AN UNPLUGGED HOSE without cleaning it first.

USE FACTORY-ASSEMBLED HOSES; this avoids leakage and prevents contamination in the form of rubber and steel particles from the braid etc; which may happen when fitting re-usable couplings.

Fault tracing

A pressure gauge graduated 0 to 60 Mpa is an invaluable aid in operation checking and fault tracing. The pressure gauge must be damped and must have a long enough hose to be read from the driver's position.

During all tests, the temperature of the hydraulic oil must be 30 to 40 °C.

Exchange units

Exchange units are available for the slewing mechanisms and rotators. Using these units reduces down-times, should repair work be necessary.

Maintenance instructions

HYDRAULIC OIL

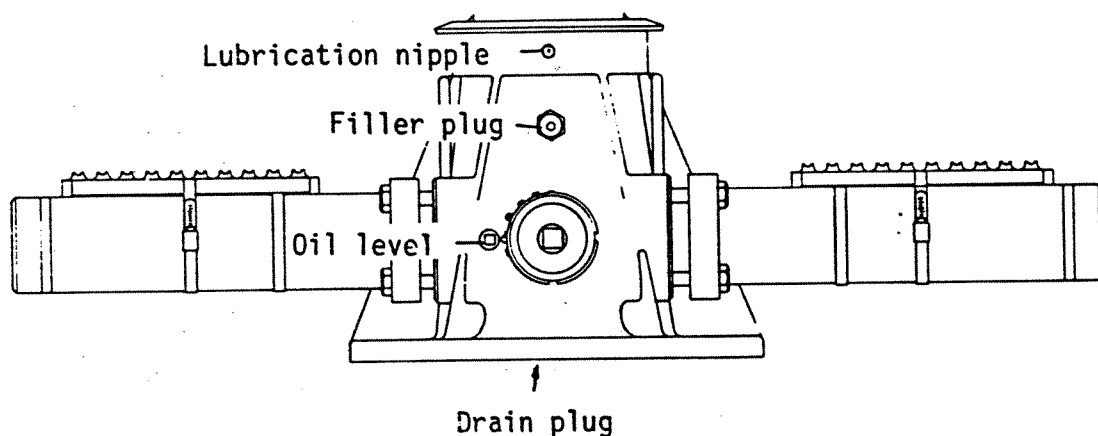
Air entering the hydraulic tank always takes with it a certain amount of impurities and moisture, which forms condensation. In addition, the hydraulic oil in the system undergoes natural deterioration due to oxidation as a result of the heat.

The oil should therefore be changed every 800 running hours or, if the machine is little used, at least once a year. Only high-grade oils must be used; oils of different grades should not be mixed.

HYDRAULIC FILTER; see the maintenance and servicing recommendations.

SLEWING MECHANISM

The oil in the slewing mechanism of the crane must be changed annually or every 1600 running hours. Drain off the oil by removing a plug in the bottom of the casing. The filler plug has a filter.
Oil capacity 5.5 dm³ approx, SP 80-90



Lubrication and inspection instructions

The crane has sealed lubrication points and must be lubricated every 50 hours running with a short-fibre grease known as molybdenum sulphide grease. Longer lubrication intervals may be applied if higher-grade grease is used.

The arrows shown on page 3 in Group 9 indicate the bearings with lubrication nipples which must be lubricated with a lubrication gun. (For ÖSA crane 363M). See the manufacturer's maintenance instructions if the machine is equipped with a different crane.

Make sure that scratches and wear damage on the extension are dressed, otherwise the sliding surface in the o.b. will be 'planed', resulting in play. Any play must be taken up with shims.

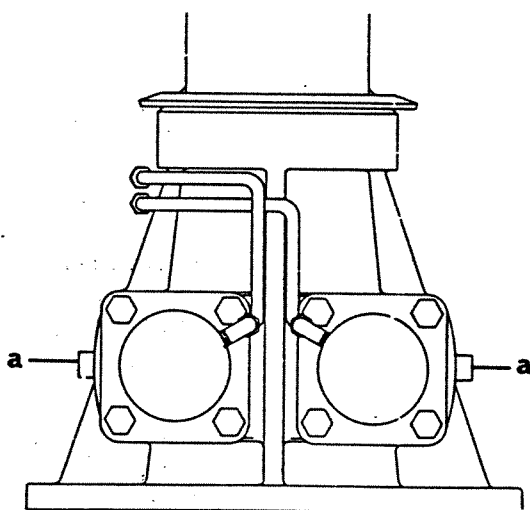
The sliding surfaces wear down gradually and must be renewed. When this is done, they must be shimmed for minimum possible play between o.b. and extension.

Adjustment of the slew housing

The slew housing must be adjusted when the play at the end of the boom is more than 20 cm. Adjust as follows:

1. Release the locking ring on whichever of adjusting screws (a) is towards the front and unscrew the adjusting screw one to two turns.
NOTE: Do not unscrew the adjusting screw so far that the teeth of the gears can jump each other.
2. Release the locking ring of the rear adjusting screw (a) and screw in the adjusting screw until the play at the end of the boom is less than 20 cm.
3. When the play is correct, mark the position of the adjusting screw and unscrew it two turns.
4. Then screw in the front adjusting screw until the play at the end of the crane is less than 20 cm. Then screw in the rear adjusting screw to the mark made under item 3 above. Lock the two adjusting screws.

The adjustment is complete.



ELECTRICAL SYSTEM

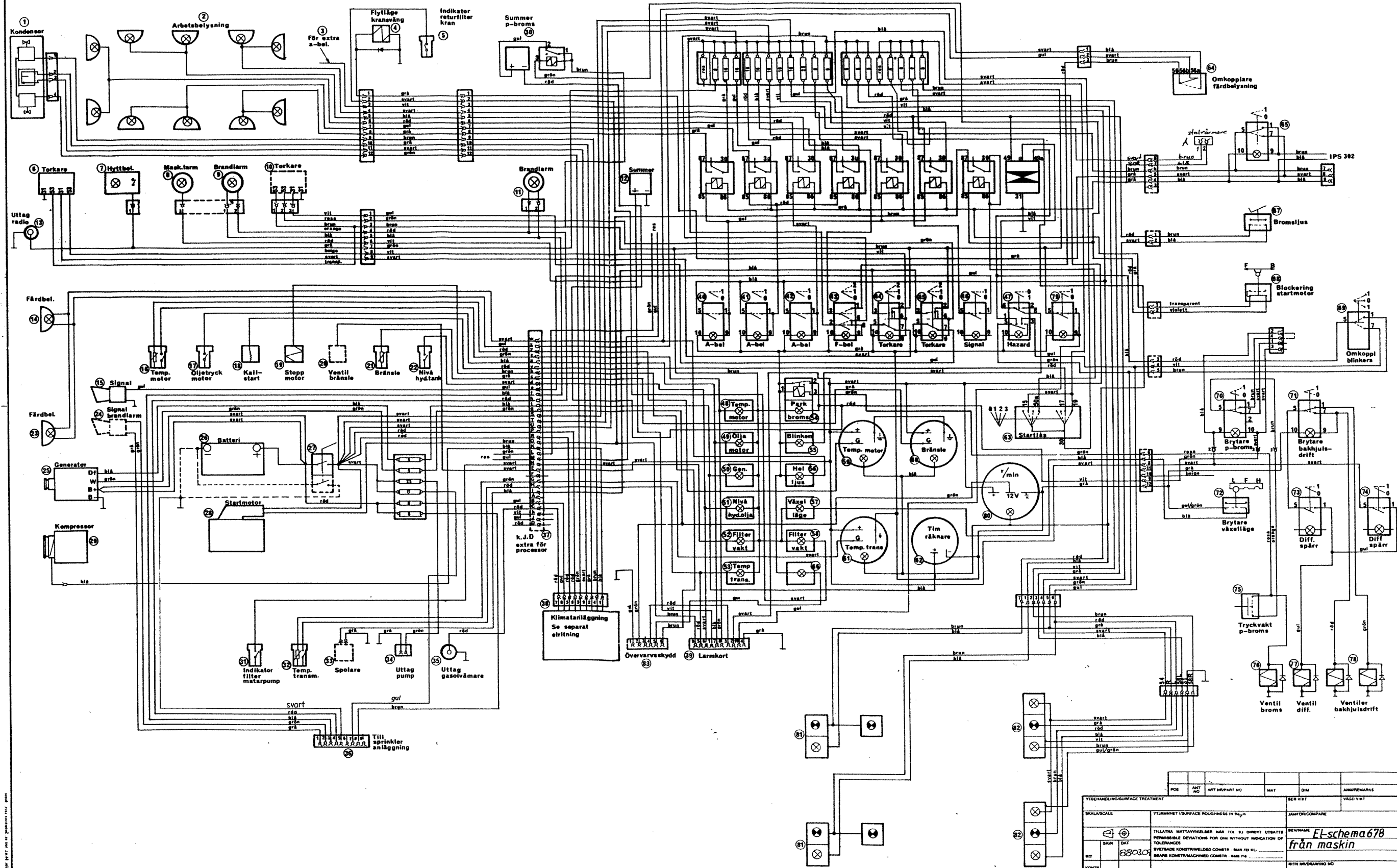
Component positions on electric diagram

1. Condensor	D1
2. Working lights	D1, D2
3. Cable for extra working light	D2
4. Solenoid, crane slew float	D2
5. Indicator returnfilter crane	D2
6. Windscreen wiper	D1
7. Cab lighting	D1
8. Central warning lamp	D1
9. Sprinkler alarm lamp	D1
10. Rear window wiper	D2
11. Warning lamp sprinkler	D3
12. Buzzer	D3
13. Radio connection	C1
14. Travel lighting	C1, C2
15. Horn	C1
16. Warning switch and transmitter, coolant temperature	C1
17. Warning switch, engine oil pressure	C1
18. Heater element, cold starting	C2
19. Stop solenoid	C2
20. Fuel valve	C2
21. Transmitter, fuel level	C2
22. Warning switch, hydraulic oil level	C2
23. Travel lighting	C1, C2
24. Signal, fire alarm	C1
25. Alternator	B1
26. Battery	B2
27. Battery isolator switch	B2
28. Starter motor	B2
29. Compressor	B1
30. Buzzer parking-brake	D3
31. Warning switch, transmission filter	B2
32. Warning switch and transmitter, hydraulic oil temperature	B2
33. Washer	B2
34. Hydraulic pump connection	B2
35. Connection for gasheater	B2
36. Sprinkler	A2
37. Connector engineroom	B-C3
38. Air conditioning unit	B3
39. Alarm board	B4
40. Working lights switch	C4
41. Working lights switch	C4
42. Working lights switch	C4
43. Driving lights switch	C4
44. Windscreen wiper switch	C4
45. Rear window wiper and washer switch	C4

46. Horn switch	C5
47. Hazard warning flasher switch	C5
48. Indicator lamp for coolant temperature	C4
49. Indicator lamp for engine oil temp	C4
50. Charging indicator lamp	B4
51. Indicator lamp for hydraulic oil level	B4
52. Indicator lamp for the transmission filter	B4
53. Indicator lamp for hydraulic oil temperature	B4
54. Parking brake indicator lamp	C4
55. Indicator lamp for direction indicators	C4
56. Main beam indicator lamp	B4
57. Gear position indicator lamp	B4
58. Spare	B4
59. Coolant temperature gauge	C4
60. Fuel gauge	C4
61. Hydraulic oil temperature gauge	B4
62. Hour meter	B4
63. Starting key	C5
64. Main/dipped beam switch	D6
65. Crane slew float position switch	D6
66. Indicator lamp for diesel engine over-revving	B4
67. Brake pedal	C6
68. Forward/reverse travel switch	C6
69. Direction indicator switch	C6
70. Parking brake switch	C6
71. Switch to dis-connect trailer drive	C6
72. Selector lever	B6
73. Differential lock switch	B6
74. Differential lock switch	B6
75. Pressure switch, parking brake	B6
76. Solenoid valve, parking brake	B6
77. Solenoid valve, dif lock	B6
78. Solenoid valves, trailer drive (optional)	B6
79. Automatic stop switch	C5
80. Tachometer (rev counter)	B5
81. Position lights and flashers	A4
82. Position lights, rear lights and flashers	A5
83. Circuit board, over-revving protection	B3

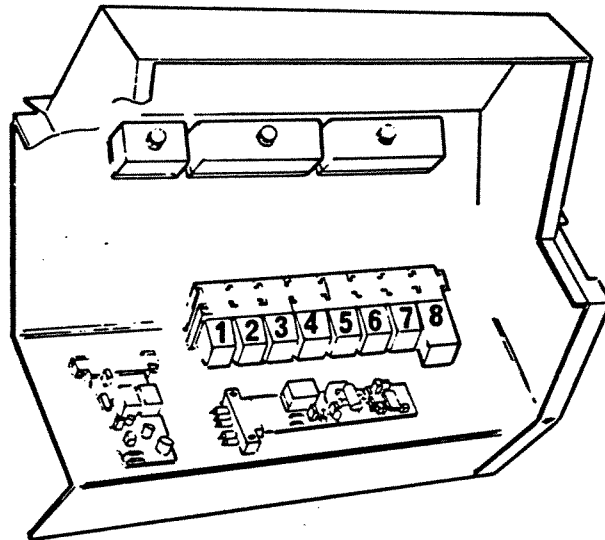
SwedishEnglishSwedishEnglish

Blå	Blue	Brun	Brown
Grön	Green	Vit	White
Grå	Grey	Beige	Beige
Gul	Yellow	Transp	Clear
Svart	Black	Violett	Violet
Röd	Red	Rosa	Pink



RELAYS

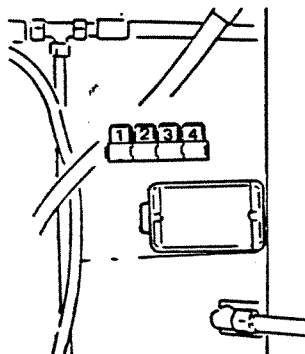
Relays located under the instrument panel



1. Working lights
2. "-
3. "-
4. "-
5. "-
6. Relays for extra working lights
7. Starter relay
8. Flasher relay

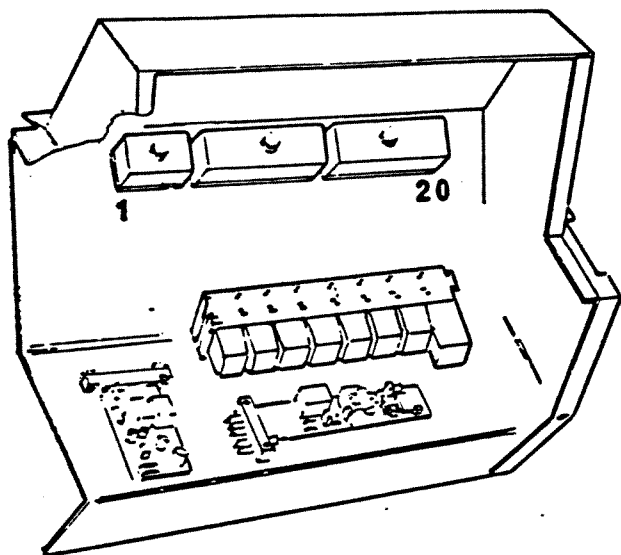
Located in the engine compartment

1. Working lights (XU)
2. "-
3. "-
4. "-



FUSES

Fuses located under the instrument panel



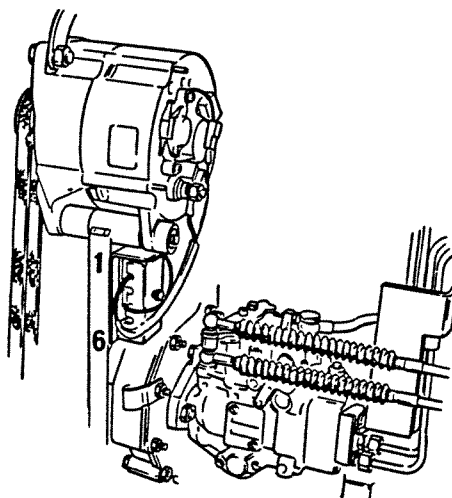
Item	Ratings	Function
------	---------	----------

1.		Spare
2.	8 A	Cab lighting and radio
3.	16 A	Working lights
4.	16 A	"-
5.	16 A	"-
6.	16 A	"-
7.	16 A	"-
8.	16 A	"-
9.	16 A	Travel lighting
10.	25 A	Glowplug and starter relay
11.	8 A	Brake lights, horn and flashers
12.	5 A	Position and rear lights
13.	5 A	"-
14.	5 A	"-
15.	5 A	"-
16.		Spare
17.		"-
18.	8 A	Crane floating position
19.	8 A	Instrumentation
20.	8 A	Wipers, parking brake buzzer

FUSES

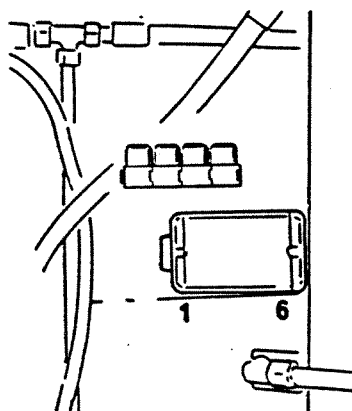
Located in the engine compartment

Item	Ratings	Function
1.	8 A	Sprinkler
2.	8 A	Air conditioning unit
3.	Spare (25 A)	(Filler pump for XU hydraulic oil)
4.	8 A	Sprinkler
5.	5 A	Tachometer
6.	5 A	Hour recorder, charging warning lamp

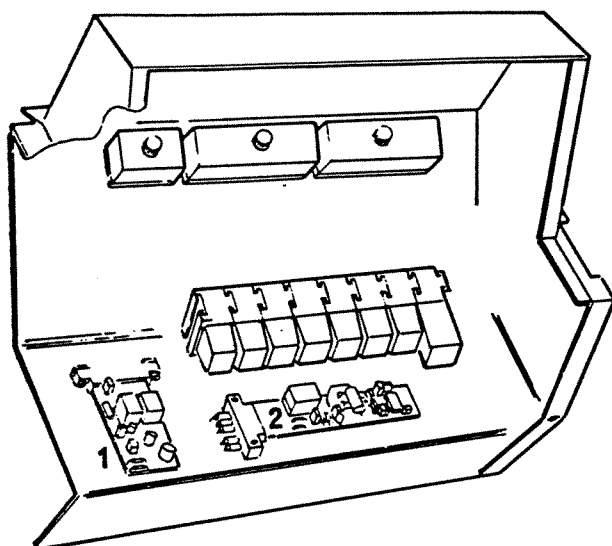


Fuses working lights (XU)

1. Spare
2. 16 A Working lights (XU)
3. 16 A "-
4. 16 A "-
5. 16 A "-
6. Spare



CIRCUIT BOARDS located under the instrument panel



1. Alarm board

The following functions go via the alarm board:

Low hydraulic oil level, high hydraulic oil temperature, high coolant temperature and low engine oil pressure.

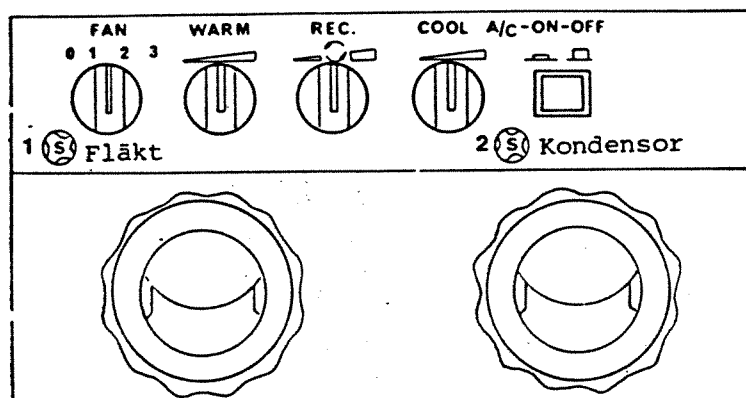
If one of these conditions occurs in service, the voltage supply to the stop solenoid is interrupted. The diesel engine will then stop.

2. Overspeed protection

Interrupts the power supply to the injection pump at speed in excess of 2700 r/min.

Fuses for air-conditioning system

Items 1-2 Current 30 A Type No. 9 400 527



LAMPS

	Qty	Watts	Type
Headlights	2	45/40	12620
Position lights, front	2	5	12844
Position lights, rear	2	10	12866
Engine unit, flashers, forward	2	21	12498
Engine unit, flashers, rear	2	21	12498
Rear and brake lights, load unit	4	21	12498
Rear lights, engine unit	2	21	12498
Flashers, load unit	2	21	12498
Working lights	10	55	12336
Cab lighting	2	10	12866
Instrument lighting	2	2	12829
Indicator lamps in switches	8	1,2	12516
Alarm lamps	3	5	12844

SERVICING AND MAINTENANCE

Servicing and maintenance procedures are sub-divided into time intervals: Daily maintenance (max. 8 hours), and after 50, 200, 400, 800 and 1600 hours.

Lubrication of the machine should be performed during interruptions in work, when the machine is hot and using warm lubricating grease. Daily maintenance should also include the systematic inspection of important bolted connections. This is particularly important when the machine is new or if it has been stripped down. The greater the attention paid to detail points at this stage, the smaller the subsequent risk of loose bolted connections.

SERVICING INSTRUCTIONS FOR CLEANING THE "MARGARD" SAFETY GLASS SCREENS

CLEANING, GENERAL:

Wash the MARGARD screen with lukewarm water and a liquid, mild, neutral cleaning agent such as washing-up detergent or soap solutions.

Rinse the screen thoroughly with water.

Wipe the screen carefully with a soft, clean cloth, e.g. a chamois leather or a moist cellulose sponge cloth, in order to remove any marks left by the water.

CLEANING OF VEHICLE SCREENS:

ALWAYS WASH THE SCREEN BEFORE WIPING.

Wash the screen thoroughly, so that the wipers do not operate on a dry screen. Check that the washer reservoir is always full.

The washer fluid must consist of a mixture of water and ÖSA "Plexiklar" washer fluid, Part No. 79 189 755.

REMOVAL OF SPLASHES:

Any splashes of resin, paint, grease or oil, etc., should be removed before they have dried. Use a soft cloth moistened with one of the following approved solvents:

APPROVED SOLVENTS:

- | | |
|------------------------------|---------------------------|
| - Pure isopropyl alcohol IPA | - White spirit |
| - Ethanol | - Methanol |
| - Heptane | - Hexane |
| - Light petroleum | - Butyl alcohol (butanol) |
| - Butyl ethyl glycol | |

- Then wash the screen in accordance with the above instructions.

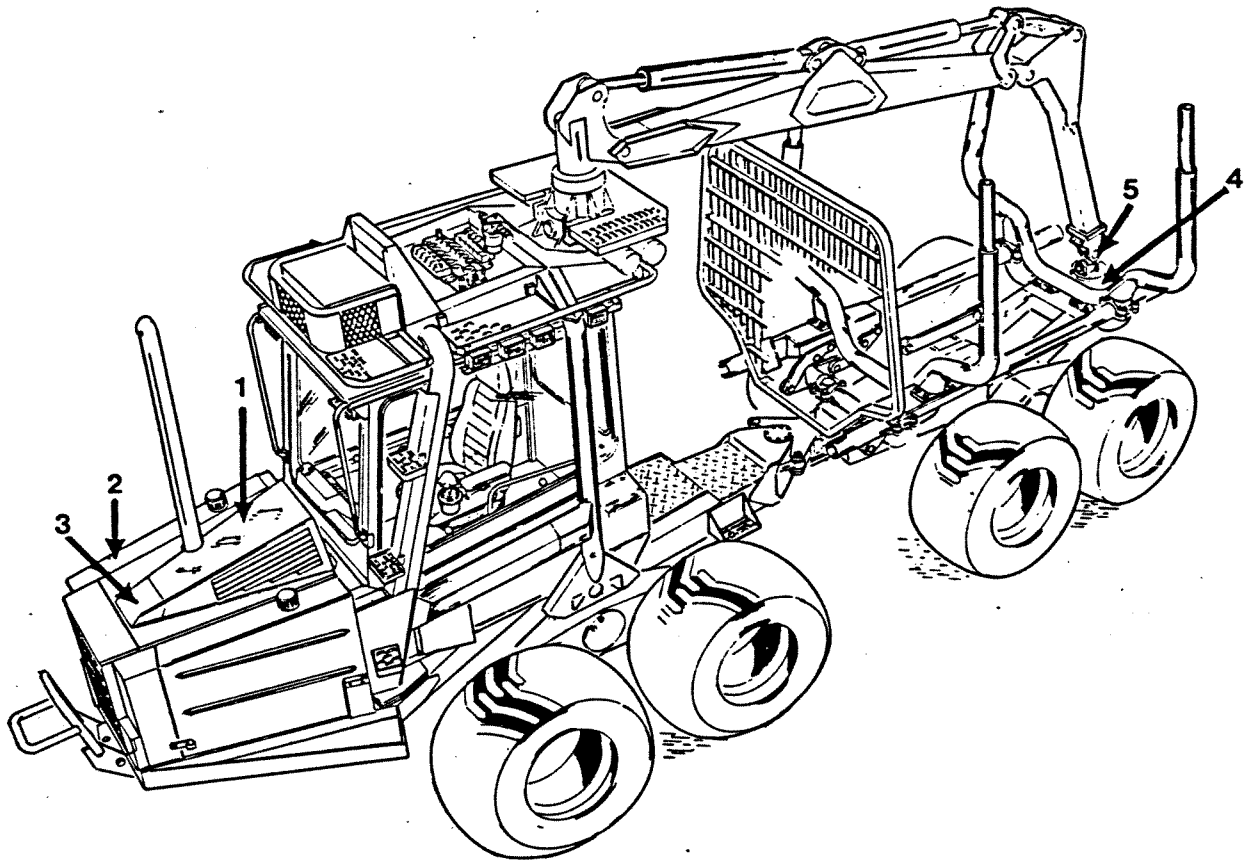
N.B.

- NEVER use thinners, petrol, motor fuel, acetone, or triethylene glycol or similar on the MARGARD screen.
- NEVER use abrasive or alkaline cleaning agents.
- Ensure that your cleaning cloth is not contaminated with sharp particles, gravel or similar.
- NEVER scrape the MARGARD screen with sharp implements.
- Protect the screen against the sparks from grinding operations or welding spatter.
- The screen should be replaced if there are any visible defects, such as chips and scratches in the screen, which could weaken it.

SERVICING AND MAINTENANCE

Daily lubrication and maintenance points

1. Check engine oil level
2. Check hydraulic oil level
3. Check coolant level
4. Lubricate grapple with molybdenum disulphide grease, 11 nipples
5. Lubricate rotator link with molybdenum disulphide grease, 2 nipples
6. General clearing of snow, twigs and soil from the machine.



Engine lubricating oil

The diesel engine must be lubricated with oils conforming to API service CD.

SAE 10W/30, winter.

SAE 15W/40, summer.

Hydraulic oil

Summer oil must conform to SMR standard SH68.

Winter oil must conform to SMR standard SHS32.

An alternativ is SHS46, which is a year-round oil.

Gulf hydraulic oil SHS 46.

Nynäs hydraulic oil 46 F.

ESSO hydraulic oil SH 46.

Shell Tellus Oil T46.

Mobil Florex SHS 46.

BP Energol SHF46.

The filterability factor of all oils must not be lower than 70, as laid down in CETOPG 6 15 01D.

Other oils

Diff casings front and rear and gearbox: Hy-Tran

Bogie boxes: Hy-Tran or hydraulic oil as above

Crane slewing unit: Hypoid-(EP) oil as per API-Service G1-5 LS 80W/90

Travel brake: Oil grade SHS 46. NOTE: NOT brake fluid.

CAPACITIES

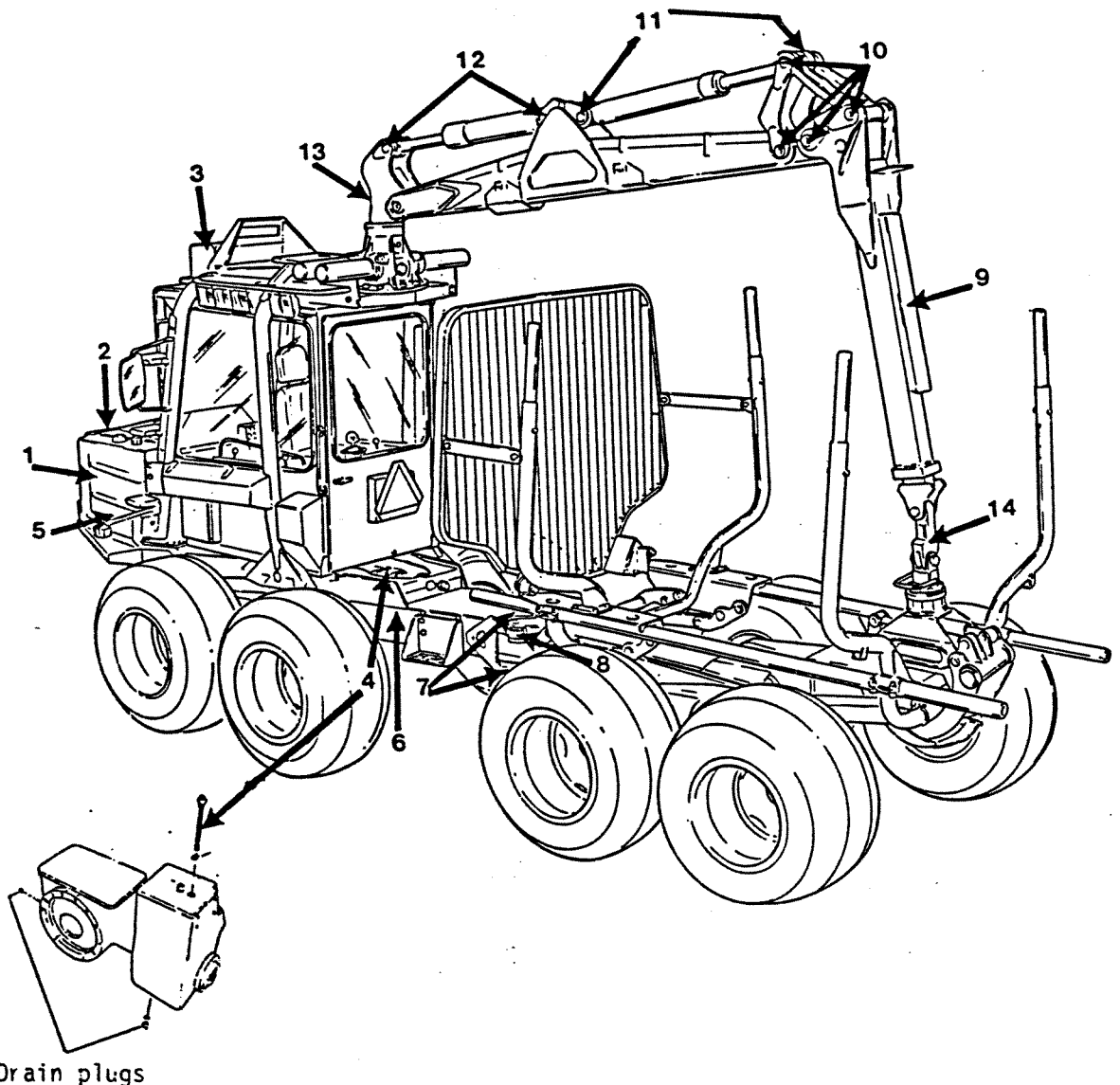
Engine including filter	9.5 l (litres)
Hydraulic system, oil	85.0 l
Rear diff casing, oil	10.0 l
Bogie box, oil	21.0 l
Cooling system, water/glycol	20.0 l
Fuel tank	90.0 l
Slewing unit, crane	5.5 l
Gearbox + front diff casing	11.0 l

TIGHTENING TORQUES**Special tightening torques**

Wheelnuts	350 Nm
Axle casing - diff casing, M16	200 Nm
Chassis fixing, M20	400 Nm
Roll bar, M16	300 Nm
Roll bar, M20	600 Nm
Roll bar, M24	800 Nm
Crane foot, M20	610 Nm
Clamps, timber cradles	300 Nm
Pullrods through valve assembly	18 Nm
Clamping screw in vertical bearing arrangement, M20	350 Nm
Gearbox - front diff casing, M16	200 Nm
Hydraulic motor - front diff casing, M16	200 Nm

LUBRICATION AND MAINTENANCE POINTS EVERY 50 HOURS

1. Clean air filter
2. Clean radiator, maintenance see Group 4 page 3
3. Clean condensor
4. Check level in front diff casing/distribution box
5. Check battery
6. Check travel brake
7. Lubricate steering joint with molybdenum disulphide grease, 2 nipples
8. Lubricate steering cylinders with molybdenum disulphide grease, 4 nipples
9. Lubricate extension cylinder with molybdenum disulphide grease, 2 nipples
10. Lubricate outer boom links with molybdenum disulphide grease, 4 nipples
11. Lubricate outer boom cylinders with molybdenum disulphide grease, 2 nipples
12. Lubricate crane pillar with molybdenum disulphide grease, 2 nipples
13. Lubricate main boom cylinders with molybdenum disulphide grease, 2 nipples
14. Check rotator link swing damper and adjust if necessary
15. See the crane manufacturer's servicing instructions if a make of crane other than the ÖSA 363M is being used.



Engine lubricating oil

The diesel engine must be lubricated with oils conforming to API service CD.

SAE 10W/30, winter.

SAE 15W/40, summer.

Hydraulic oil

Summer oil must conform to SMR standard SH68.

Winter oil must conform to SMR standard SHS32.

An alternativ is SHS46, which is a year-roand oil.

Gulf hydraulic oil SHS 46.

Nynäs hydraulic oil 46 F.

ESSO hydraulic oil SH 46.

Shell Tellus Oil T46.

Mobil Florex SHS 46.

BP Energol SHF46.

The filterability factor of all oils must not be lower than 70, as laid down in CETOPG 6 15 01D.

Other oils

Diff casings front and rear and gearbox: Hy-Tran

Bogie boxes: Hy-Tran or hydraulic oil as above

Crane slewing unit: Hypoid-(EP) oil as per API-Service G1-5 LS 80W/90

Travel brake: Oil grade SHS 46. NOTE: NOT brake fluid.

CAPACITIES

Engine including filter	9.5 l (litres)
Hydraulic system, oil	85.0 l
Rear diff casing, oil	10.0 l
Bogie box, oil	21.0 l
Cooling system, water/glycol	20.0 l
Fuel tank	90.0 l
Slewing unit, crane	5.5 l
Gearbox + front diff casing	11.0 l

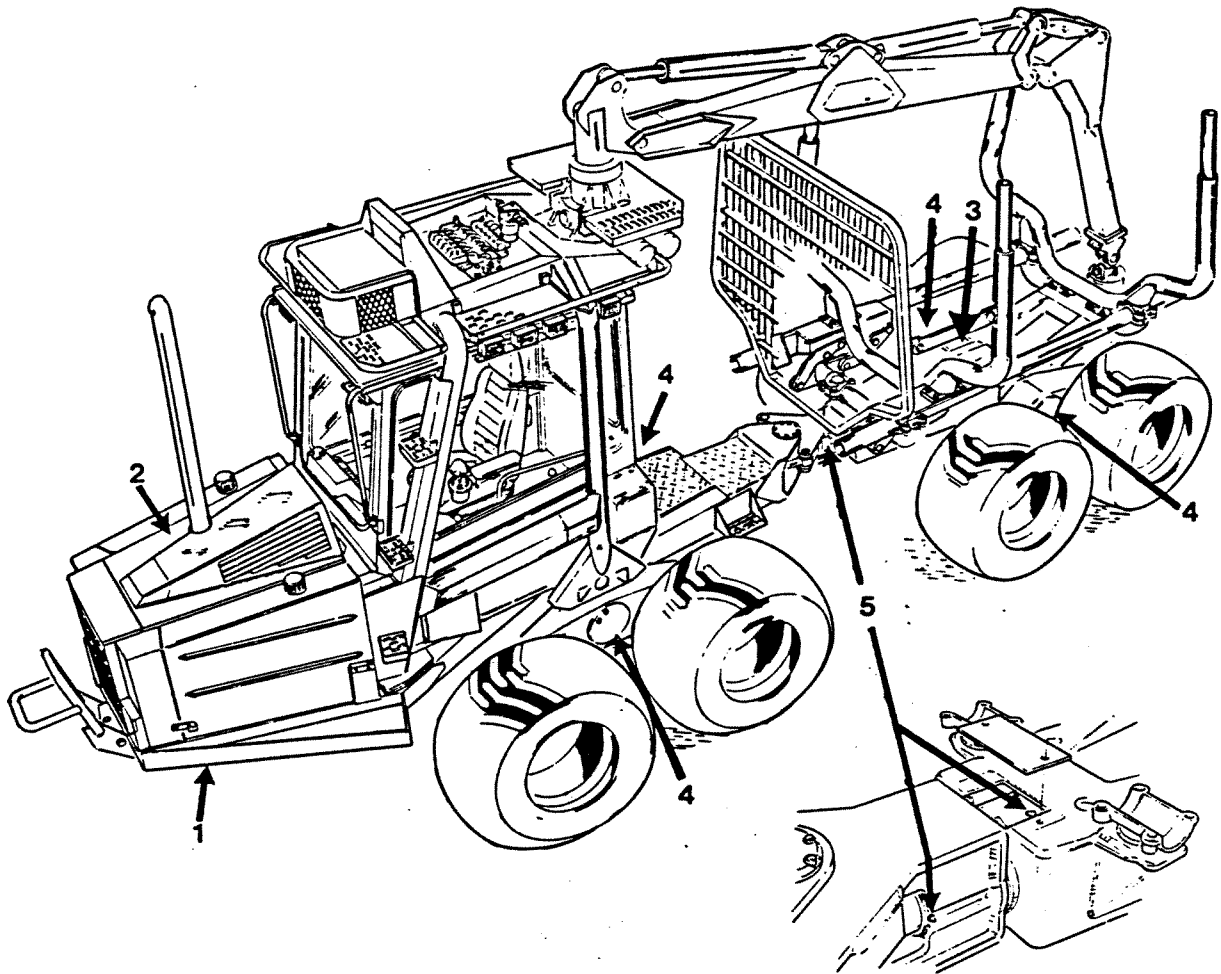
TIGHTENING TORQUES

Special tightening torques

Wheelnuts	350 Nm
Axle casing - diff casing, M16	200 Nm
Chassis fixing, M20	400 Nm
Roll bar, M16	300 Nm
Roll bar, M20	600 Nm
Roll bar, M24	800 Nm
Crane foot, M20	610 Nm
Clamps, timber cradles	300 Nm
Pullrods through valve assembly	18 Nm
Clamping screw in vertical bearing arrangement, M20	350 Nm
Gearbox - front diff casing, M16	200 Nm
Hydraulic motor - front diff casing, M16	200 Nm

LUBRICATION AND MAINTENANCE POINTS EVERY 200 HOURS

1. Change engine oil
 2. Change engine oil filter; see Group 4
 3. Check level in rear diff casing
 4. Check level in bogie boxes
 5. Lubricate propshaft, support bearings and steering joint with molybdenum disulphide grease, 6 nipples
- When lubricating the steering joint the crane must be slewed forward and backward to ensure full penetration of the lubricant.



Engine lubricating oil

The diesel engine must be lubricated with oils conforming to API service CD.

SAE 10W/30, winter.

SAE 15W/40, summer.

Hydraulic oil

Summer oil must conform to SMR standard SH68.

Winter oil must conform to SMR standard SHS32.

An alternative is SHS46, which is a year-round oil.

Gulf hydraulic oil SHS 46.

Nynäs hydraulic oil 46 F.

ESSO hydraulic oil SH 46.

Shell Tellus Oil T46.

Mobil Florex SHS 46.

BP Energol SHF46.

The filterability factor of all oils must not be lower than 70, as laid down in CETOPG 6 15 01D.

Other oils

Diff casings front and rear and gearbox: Hy-Tran

Bogie boxes: Hy-Tran or hydraulic oil as above

Crane slewing unit: Hypoid-(EP) oil as per API-Service G1-5 LS 80W/90

Travel brake: Oil grade SHS 46. NOTE: NOT brake fluid.

CAPACITIES

Engine including filter	9.5 l (litres)
Hydraulic system, oil	85.0 l
Rear diff casing, oil	10.0 l
Bogie box, oil	21.0 l
Cooling system, water/glycol	20.0 l
Fuel tank	90.0 l
Slewing unit, crane	5.5 l
Gearbox + front diff casing	11.0 l

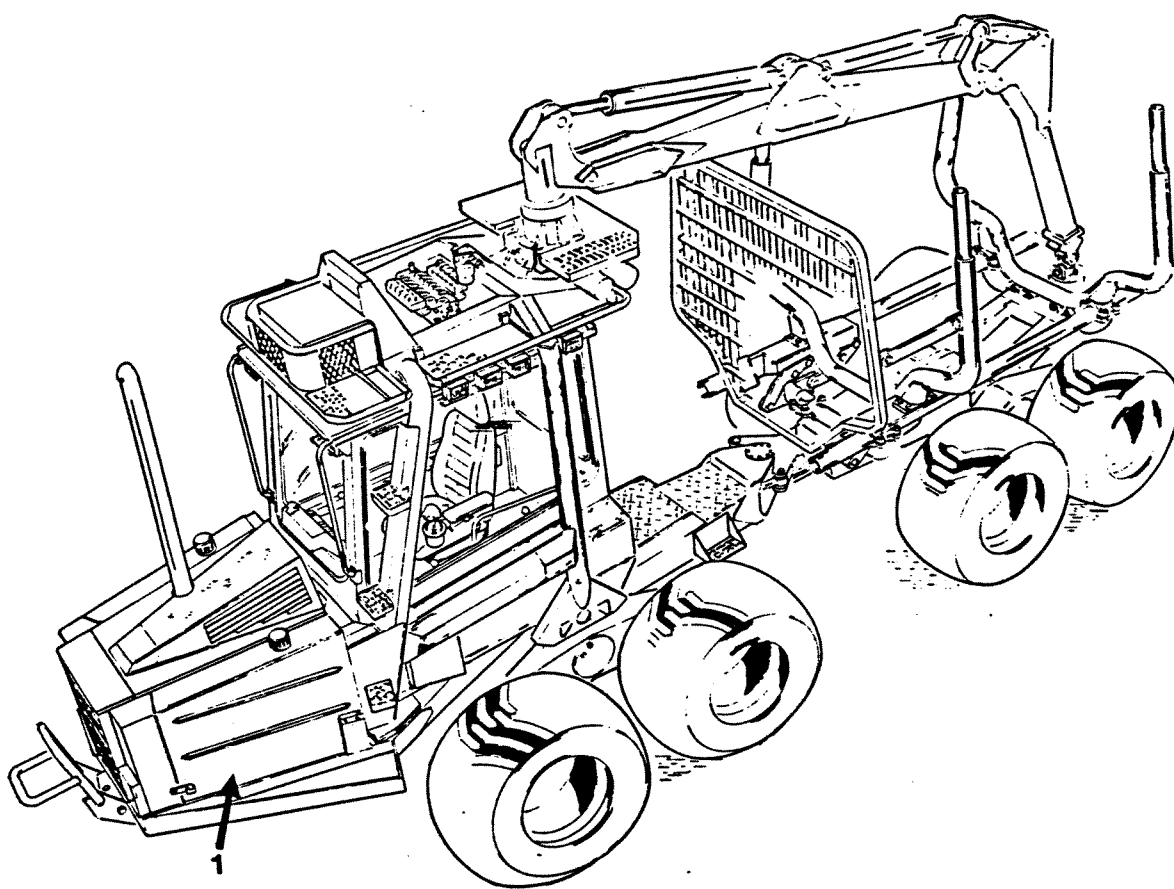
TIGHTENING TORQUES

Special tightening torques

Wheelnuts	350 Nm
Axle casing - diff casing, M16	200 Nm
Chassis fixing, M20	400 Nm
Roll bar, M16	300 Nm
Roll bar, M20	600 Nm
Roll bar, M24	800 Nm
Crane foot, M20	610 Nm
Clamps, timber cradles	300 Nm
Pullrods through valve assembly	18 Nm
Clamping screw in vertical bearing arrangement, M20	350 Nm
Gearbox - front diff casing, M16	200 Nm
Hydraulic motor - front diff casing, M16	200 Nm

LUBRICATION AND MAINTENANCE POINTS EVERY 400 HOURS

1. Change fuel filter, see Group 4.



Engine lubricating oil

The diesel engine must be lubricated with oils conforming to API service CD.

SAE 10W/30, winter.

SAE 15W/40, summer.

Hydraulic oil

Summer oil must conform to SMR standard SH68.

Winter oil must conform to SMR standard SHS32.

An alternative is SHS46, which is a year-round oil.

Gulf hydraulic oil SHS 46.

Nynäs hydraulic oil 46 F.

ESSO hydraulic oil SH 46.

Shell Tellus Oil T46.

Mobil Florex SHS 46.

BP Energol SHF46.

The filterability factor of all oils must not be lower than 70, as laid down in CETOPG 6 15 01D.

Other oils

Diff casings front and rear and gearbox: Hy-Tran

Bogie boxes: Hy-Tran or hydraulic oil as above

Crane slewing unit: Hypoid-(EP) oil as per API-Service G1-5 LS 80W/90

Travel brake: Oil grade SHS 46. NOTE: NOT brake fluid.

CAPACITIES

Engine including filter	9.5 l (litres)
Hydraulic system, oil	85.0 l
Rear diff casing, oil	10.0 l
Bogie box, oil	21.0 l
Cooling system, water/glycol	20.0 l
Fuel tank	90.0 l
Slewing unit, crane	5.5 l
Gearbox + front diff casing	11.0 l

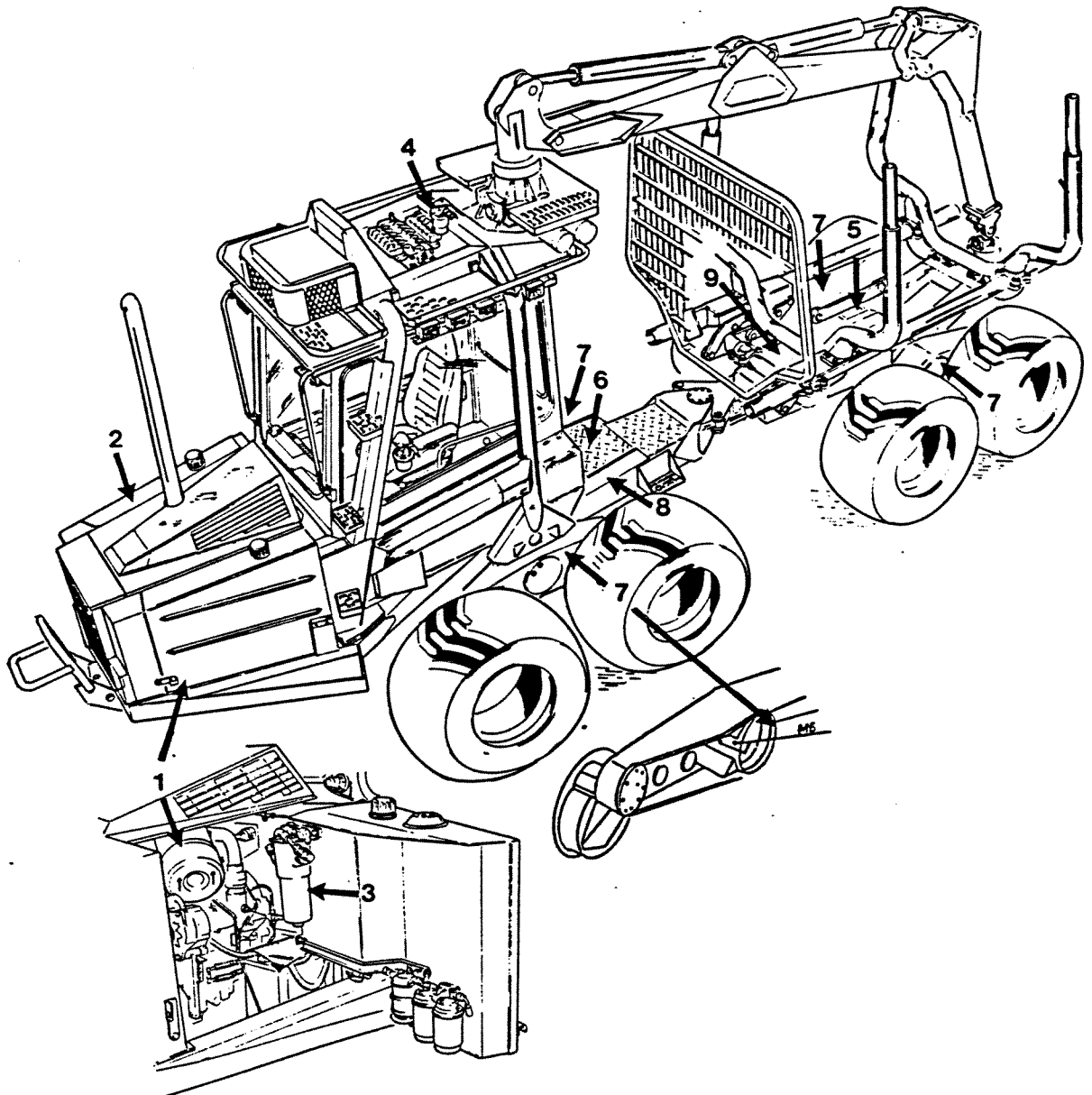
TIGHTENING TORQUES

Special tightening torques

Wheelnuts	350 Nm
Axle casing - diff casing, M16	200 Nm
Chassis fixing, M20	400 Nm
Roll bar, M16	300 Nm
Roll bar, M20	600 Nm
Roll bar, M24	800 Nm
Crane foot, M20	610 Nm
Clamps, timber cradles	300 Nm
Pullrods through valve assembly	18 Nm
Clamping screw in vertical bearing arrangement, M20	350 Nm
Gearbox - front diff casing, M16	200 Nm
Hydraulic motor - front diff casing, M16	200 Nm

LUBRICATION AND MAINTENANCE POINTS EVERY 800 HOURS

1. Change the air filter.
2. Change the hydraulic oil and clean the hydraulic tank.
3. Change the transmission filter.
4. Change the crane return filter.
5. Change the oil in the rear diff casing.
6. Change the oil in the front diff casing/distribution box.
7. Lubricate bogie bearing with molybdenum disulphide grease, 4 nipples.
Fit the nipple to the middle hole. Lubricate until grease emerges.
Then slacken the outer screw and lubricate until grease emerges.
8. Lubricate the parking brake yoke with molybdenum disulphide grease: 1 nipple
9. Release the locking ring and move the rear splined sleeve out of the way, lubricate the splines with molybdenum disulphide grease, replace the sleeve, and fit the locking ring.
10. A service technician should be called in to provide a more extensive range of servicing operations, including checking and adjustment, where required, of all pressures.



Engine lubricating oil

The diesel engine must be lubricated with oils conforming to API service CD.

SAE 10W/30, winter.

SAE 15W/40, summer.

Hydraulic oil

Summer oil must conform to SMR standard SH68.

Winter oil must conform to SMR standard SHS32.

An alternative is SHS46, which is a year-round oil.

Gulf hydraulic oil SHS 46.

Nynäs hydraulic oil 46 F.

ESSO hydraulic oil SH 46.

Shell Tellus Oil T46.

Mobil Florex SHS 46.

BP Energol SHF46.

The filterability factor of all oils must not be lower than 70, as laid down in CETOPG 6 15 01D.

Other oils

Diff casings front and rear and gearbox: Hy-Tran

Bogie boxes: Hy-Tran or hydraulic oil as above

Crane slewing unit: Hypoid-(EP) oil as per API-Service G1-5 LS 80W/90

Travel brake: Oil grade SHS 46. NOTE: NOT brake fluid.

CAPACITIES

Engine including filter	9.5 l (litres)
Hydraulic system, oil	85.0 l
Rear diff casing, oil	10.0 l
Bogie box, oil	21.0 l
Cooling system, water/glycol	20.0 l
Fuel tank	90.0 l
Slewing unit, crane	5.5 l
Gearbox + front diff casing	11.0 l

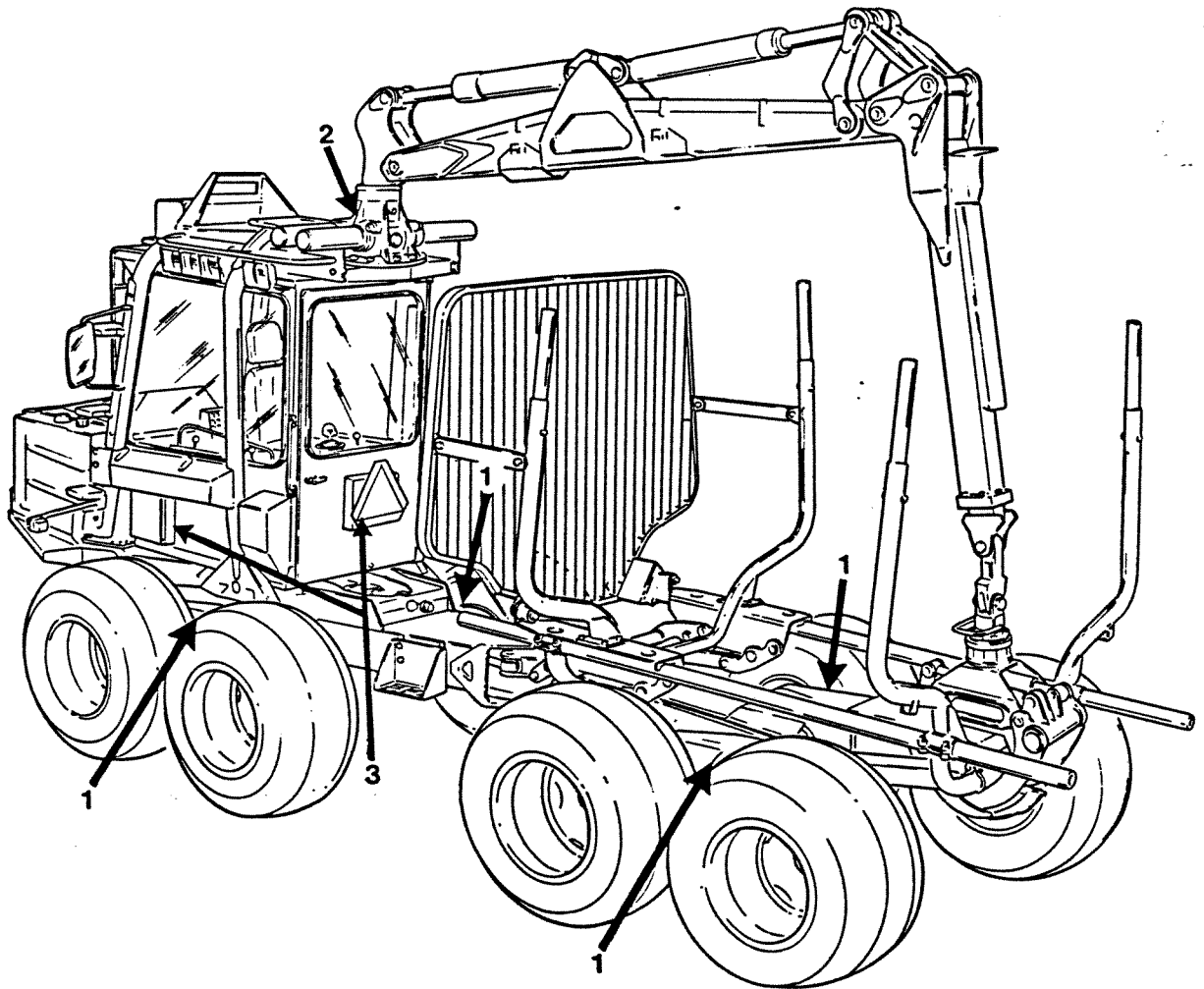
TIGHTENING TORQUES

Special tightening torques

Wheelnuts	350 Nm
Axle casing - diff casing, M16	200 Nm
Chassis fixing, M20	400 Nm
Roll bar, M16	300 Nm
Roll bar, M20	600 Nm
Roll bar, M24	800 Nm
Crane foot, M20	610 Nm
Clamps, timber cradles	300 Nm
Pullrods through valve assembly	18 Nm
Clamping screw in vertical bearing arrangement, M20	350 Nm
Gearbox - front diff casing, M16	200 Nm
Hydraulic motor - front diff casing, M16	200 Nm

LUBRICATION AND MAINTENANCE POINTS EVERY 1600 HOURS

1. Change the oil in the bogie box.
2. Change the oil in the crane slewing motor casing.
3. Clean the filters in the door and in the LH cab wall.



Engine lubricating oil

The diesel engine must be lubricated with oils conforming to API service CD.

SAE 10W/30, winter.

SAE 15W/40, summer.

Hydraulic oil

Summer oil must conform to SMR standard SH68.

Winter oil must conform to SMR standard SHS32.

An alternative is SHS46, which is a year-round oil.

Gulf hydraulic oil SHS 46.

Nynäs hydraulic oil 46 F.

ESSO hydraulic oil SH 46.

Shell Tellus Oil T46.

Mobil Florex SHS 46.

BP Energol SHF46.

The filterability factor of all oils must not be lower than 70, as laid down in CETOPG 6 15 01D.

Other oils

Diff casings front and rear and gearbox: Hy-Tran

Bogie boxes: Hy-Tran or hydraulic oil as above

Crane slewing unit: Hypoid-(EP) oil as per API-Service G1-5 LS 80W/90

Travel brake: Oil grade SHS 46. NOTE: NOT brake fluid.

CAPACITIES

Engine including filter	9.5 l (litres)
Hydraulic system, oil	85.0 l
Rear diff casing, oil	10.0 l
Bogie box, oil	21.0 l
Cooling system, water/glycol	20.0 l
Fuel tank	90.0 l
Slewing unit, crane	5.5 l
Gearbox + front diff casing	11.0 l

TIGHTENING TORQUES

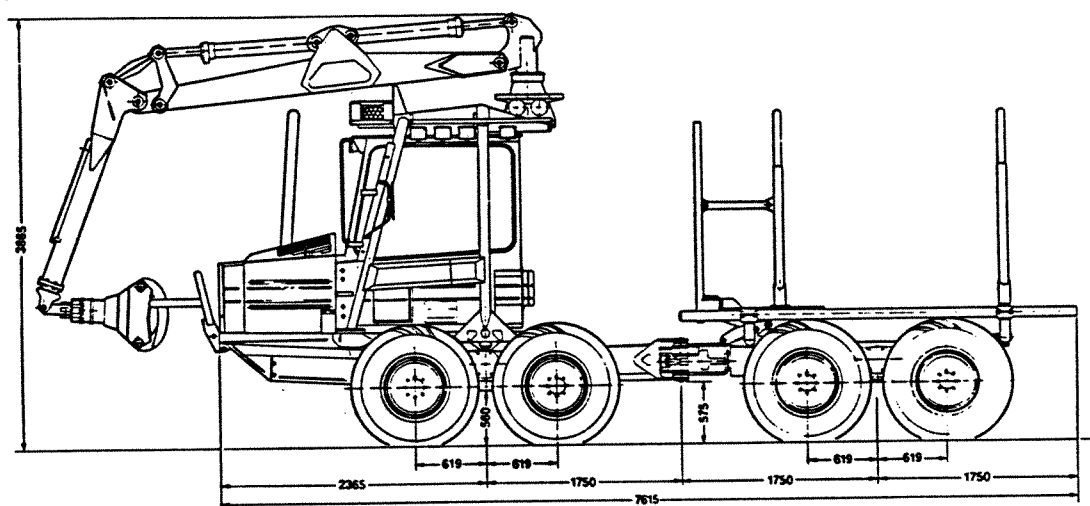
Special tightening torques

Wheelnuts	350 Nm
Axle casing - diff casing, M16	200 Nm
Chassis fixing, M20	400 Nm
Roll bar, M16	300 Nm
Roll bar, M20	600 Nm
Roll bar, M24	800 Nm
Crane foot, M20	610 Nm
Clamps, timber cradles	300 Nm
Pullrods through valve assembly	18 Nm
Clamping screw in vertical bearing arrangement, M20	350 Nm
Gearbox - front diff casing, M16	200 Nm
Hydraulic motor - front diff casing, M16	200 Nm



TECHNICAL DATA

Dimensions



	<u>500x22,5</u>	<u>600x22,5</u>
Width, front	2400 mm	2600 mm
Width, rear	2400 mm	2600 mm

Wheels and tyres

LP 500 x 22,5 eight-ply on all wheels

Air pressure 0.12 - 0.15 MPa

On stony ground up to 0.18 MPa

LP 600 x 22.5 eight-ply

Air pressure 0.16 - 0.18 MPa

On stony ground up to 0.20 MPa

Weights

Empty weight 8 800 kg

With crane forward:

- on front axle 7 760 kg
- on rear axle 1 040 kg

With crane to rear:

- on front axle 6 260 kg
- on rear axle 2 540 kg

Max load 7 500 kg

Total weight:

- with max load 16 300 kg
- front axle weight 7 760 kg
- rear axle weight 8 540 kg

Capacities

Engine including filter	9.5 l
Hydraulic system, oil	85.0 l
Rear diff casing, oil	10.0 l
Bogie box, oil	21.0 l
Cooling system, water/glycole	20.0 l
Fuel tank	90.0 l
Slewing motor, crane	5.5 l
Gearbox + front diff casing	11.0 l

Engine

Type	International Harvester
Output at 2400 r/min	-62 kW DIN (84.5 hp SAE) DT 239
Torque Nm/r/min	-285/1600
Turbo speed	Max 100 000 r/min
Cylinders	4
Swept volume	3.91 litres
Cylinder bore	98.4
Stroke	128.5
Compression ratio	16:1
Compression pressure	16 - 18 kPa
Max speed	2700
Working speed - on road	min 2000 r/min for max traction
Working speed - off road and crane work	"- 1750 r/min
Valve clearance, inlet, warm	0.30 mm
Valve clearance, exhaust, warm	0.30 mm
Injection pump	Eosch
Injection timing	8° BTDC
Injection sequence	1, 3, 4, 2
Injector, opening pressure	24.0 - 24.8 MPa

Transmission

Hydrostatic - mechanical with two speed ranges.
 Gear-driven bogies with final-drive gear units on both axles
 Differential locks on both axles
 Permanent eight-wheel drive

Hydraulic pump Hydromatik A4V
 Displacement 6 - 56 cm³/revolution

Hydraulic motor Hydromatik A6V
 Displacement 38 - 107 cm³/revolution

Speed range

Off-road gear ratio 0 - 9.2 km/h
 Transport gear ratio 0 - 30 km/h



Brakes

Travel brake

Hydraulically-actuated wet disc brakes on front axle

Parking and loading brake

Spring-actuated disc brake

Steering

Double lever-operated hydraulic steering

Electrical system

Voltage	12 V
Battery capacity	128 Ah
Alternator output	1600 W
Starter motor	3 kW
Warning system	
2 headlights	
Removable rear lights and position lights	
10 working spotlights	

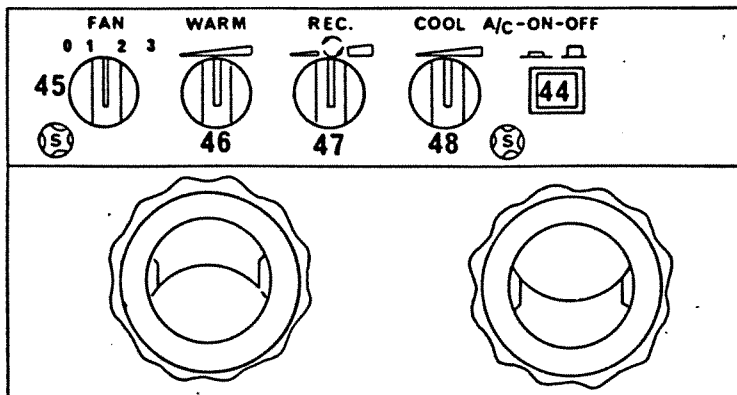
Cab equipment

Combination-type air conditioning unit
Tachometer
Hours counter (independent of engine speed)
Fuel gauge
Cooling water temperature gauge
Hydraulic oil temperature gauge
Equipped for two-way radio
Seat: Bostrom Viking 303
Stereo radio mounted in holder

Crane

ÖSA 363M with 6.5 m reach
Continuous rotator
Grapple, practical area 0.35 m²
Pressure-relieved constant-pressure system with variable displacement piston pump
Working pressure 16.5 MPa

AIR CONDITIONING UNIT



- 44. Air conditioning unit on/off switch
- 45. Air conditioning unit fan switch
- 46. Heat control
- 47. Recirculation damper control
- 48. Thermostat control

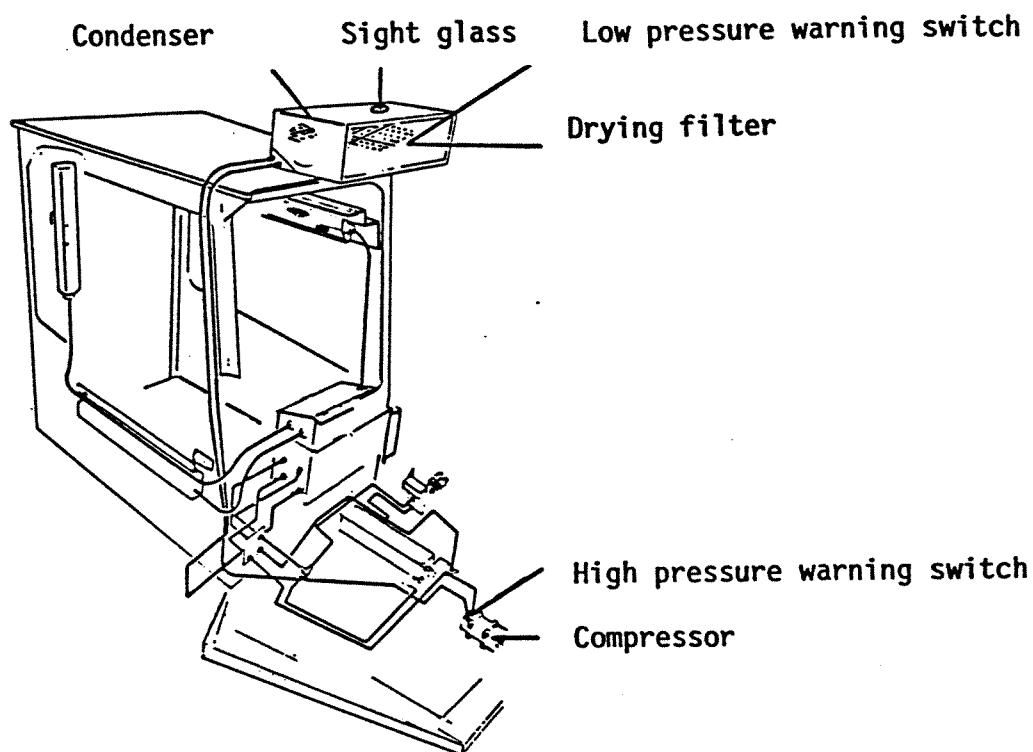
Winter use (heating required)

1. Start the engine of the machine and allow the coolant to reach normal temperature.
2. Turn the heat control (46) to max.
3. Set the fan (45) to the required speed.
4. Close the recirculation damper with control knob (47).
5. Check that the air conditioning (44) is off.
6. Open the air outlets and defroster outlets at the windows.
7. When the windows are clear and the correct temperature has been reached, adjust the air outlets, reduce the fan speed and the heat to maintain the required temperature. Open the recirculation damper (47) for normal ventilation.
8. If the humidity in the cab is so high that the windows mist up, it is a good idea to run air conditioning together with the heating for a while. The air conditioning is switched by pressing the air conditioning switch (44) and turning the thermostat knob (48) clockwise.

Summer use (cooling required)

1. Start the engine of the machine.
2. Set the fan control (45) to the required speed.
3. Press the air conditioning switch (44).
4. Open the recirculation damper with control knob (47).
5. Turn the thermostat control knob (48) to max cooling.
6. Check that the heat control knob (46) is set to min.
7. When the desired temperature has been reached, adjust the air outlets and the fan and thermostat control to maintain pleasant conditions.

Watch out for the coolant hoses. Never uncouple any coolant hose connections. If cooling medium has leaked, the system must be refilled using special equipment. Keep the condenser (the radiator on the roof) clean at all times (clean it every 50 hours' running).



Simple checks

The air conditioning system has a sight glass fitted in the pipe between the drying filter and the expansion valve. This makes it possible to see the cooling medium through the sight glass and check for air bubbles or other contaminants. Before observing the sight glass, it is essential to make sure that the operating conditions are correct. The ambient temperature must be around 20 °C. The air conditioning plant must be run at max cooling for a few minutes, the diesel engine must be running at 1000-1500 r/min to obtain sufficient compressor output.

A quick check can be made by feeling the hoses to and from the compressor (suction and pressure hoses). The suction hose, marked SUC, must be cold, and the pressure hose, marked DIS (to the condenser), must be warm. If there is no significant temperature difference between the two hoses, the cooling medium level is very low, or the system is empty. In this case, it is possible that no bubbles will be seen in the glass and there may be sufficient oil on the glass to give a clear indication of these conditions. The hose temperatures must always be checked before it is assumed that the cooling medium level is OK.

The sight glass provides a great deal of information about what is happening in the air conditioning system.

1. Occasional or slow-moving bubbles indicate either that the cooling medium is low, or that the drying filter is saturated and is giving off moisture.
2. Foam or an uninterrupted stream of bubbles indicates that the cooling medium is very low.
3. Streaks of oil on the glass indicate complete absence of cooling medium.

4. If the sight glass is clear, either the system is fully loaded and running normally, or the system is empty.

Poor cooling may also be due to overfilling of the coolant. This can easily be checked by first starting and stabilising the air conditioning system, then briefly disconnecting the compressor coupling. Observe the sight glass. The cooling medium should begin to foam and disappear from the sight glass within less than 45 s. If the glass remains clear and full medium flow continues for more than 45 s, the system has been overfilled, and a small amount of cooling medium should be drained off.

Two other preparatory methods which may be taken when checking the sight glass are to check the compressor belt tension and to check that air flow to and from the condenser is not blocked. Material is often caught in the condenser, and this can prevent sufficient air passing through the condenser, thus affecting its cooling performance. A slack compressor drive belt is also a common cause of unsatisfactory cooling. Tighten the compressor drive belt and the diesel engine fan belt.

Pressure warning switches

There is a low pressure warning switch in the cooling circuit of the air conditioning system. The low pressure warning switch opens the cooling compressor magnetic coupling circuit when the gas pressure in the circuit is low. The switch is incorporated in the drying filter in the condenser on the roof.

There is a high pressure warning switch on the filler connection of the cooling compressor. The switch opens the circuit of the magnetic clutch of the cooling compressor if the pressure in the circuit exceeds 2.6 MPa (26 bar). The high pressure switch is connected in series with the magnetic coupling of the cooling compressor.

Simple pressure tests

The usual method is to connect pressure gauges for low and high pressure to the suction and pressure sides of the compressor; this is done with the pressure gauge valves closed and the diesel engine stopped. Having done this, start the diesel engine and let it run at 1000 - 1500 r/min; set the air conditioning system to max cooling and allow it to run for 2 to 3 minutes. Then note the high and low pressures on the pressure gauges. With an ambient temperature of 20 to 30 °C, the low pressure is usually in the range 50 to 200 kPa (0.5 to 2.0 bar) and the high pressure 0.7 to 1.5 MPa (7 to 15 bar).

Remember that the system pressure will vary considerably depending on the ambient temperature. On a hot day it may be assumed that the high-pressure side will go up 2 MPa (20 bar) or more, although the low pressure is hardly affected. Wherever possible, do these checks at normal ambient temperatures.

Here are some examples of pressure changes where the system pressures can differ greatly from those stated above, and of conditions that may arise.

High-pressure side too high, low-pressure side normal. This is probably due to a restriction in the system - blocked condenser, pressure filter, hoses - or an obstruction of the air from the cooling element of condenser, so that the cooling is not satisfactory. The latter problem is the same as at high ambient temperature.

Both pressure too high. This also indicates insufficient cooling from a blocked condenser, cooling element, stationary fan etc, but is more serious than the above case. The high pressure rises first, and after a while the low pressure begins to go up.

Low pressure too high, high pressure too low. This usually indicates a problem in the compressor, either valves not working or possibly a faulty seal, so that the output of the compressor is affected.

Both pressures too low. This usually indicates insufficient cooling medium in the system, generally because of a leak.

Low-pressure side vacuum, high-pressure side normal or low. This indicates problems with the expansion valve; usually the valve has stuck open. The valve is sticking and the two pressures tend to equalise. A blocked dryer can also give rise to vacuum on the low-pressure side.

Varying pressure. If there is air or moisture in the system, it may cause the pressures to vary and be unstable. If the system is thought to be heavily contaminated, it must be drained and refilled.

Correcting minor leaks

If you find a minor leak at a hose connection, you can correct this by tightening the connection.

If the connection is tight, do not attempt to tighten it further with heavier tools. The torque required for a good seal is moderate, 14 to 20 Nm for a hose with an outside diameter of 1/4 inch (6mm) and 7/16 inch (11 mm) coupling, and 41 to 48 Nm for all other sizes. These figures are for steel hoses. The figures for aluminium and copper hoses are lower, 15 to 18 Nm for a 1/4 inch (6 mm) hose with a 7/16 inch (11 mm) coupling and 38 to 45 Nm for 3/4 inch (19 mm) hoses. In some cases the torque does not increase with increasing size. Some 3/8 inch (10 mm) hoses with a 5/8 inch (16 mm) coupling have a torque as low as 7 to 9 Nm. The best way to tighten a coupling is to use a hose-type torque wrench.

