Workshop Manual

STILL
ELECTRONIC
DOCUMENTATION
SYSTEM

Electric Fork Truck

R20-15
R20-16
R20-17
R20-20

2001 2002 2003 2004 2005 2006 2007

Ident. Nr. 171 085 - 01.06 [en]

Functional Group 02

Steer axle

Wheel lock angle	80° - 82°
Toe-in	0 ± 1mm
Wheel camber	0°
Trail	0°

Torque loading

Wheel hub	MA =145 Nm
Wheel nuts	MA = 195 Nm
Axle bearings	MA = 195 Nm
Steer cylinder fixing	MA = 210 Nm
Nut on king pin	MA = 290 Nm

Bolt fastening

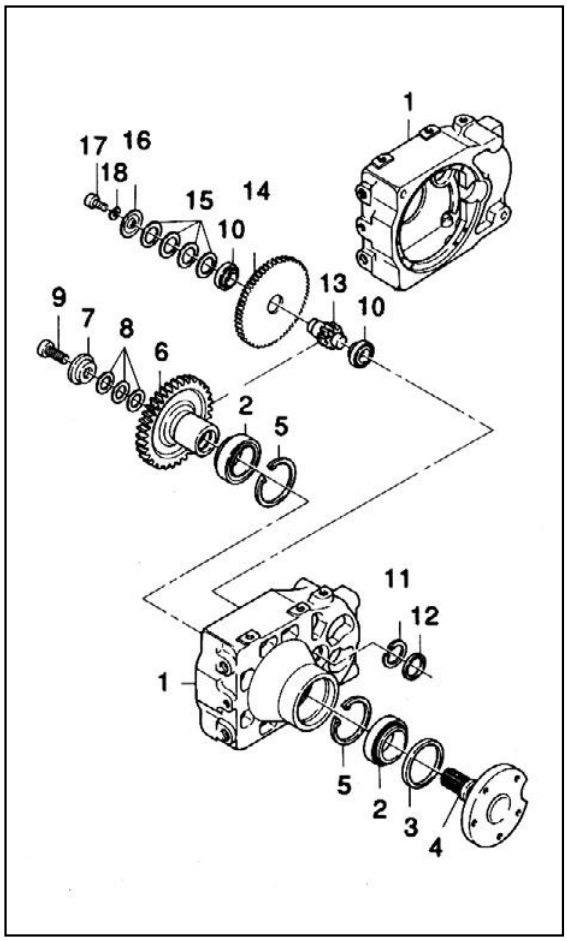
Wheel hub bolts	Loctite 270
Steering turntable mounting bolts	Loctite 270

Lubricants

Wheel hub bearings	Grease F to DIN 51825-KP2K-20 lithium soap based Grease F to DIN 51825-KP2K-30 lithium soap based
Stub axle bearings	Grease F to DIN 51825-KPF2N-20 lithium soap based STILL- Id No. 148659

Gearbox / Gear shaft

1 = gear case
2 = tapered roller bearing
3 = chevron seal
4 = gear
5 = circlip
6 = gear
7 = washer
8 = shim 0.1 mm
8 = shim 0.3 mm
8 = shim 1.0 mm
9 = socket hd screw
10 = tapered roller bearing
11 = circlip
12 = cover
13-14 = pinion shaft
15 = shim 0.1 mm
15 = shim 0.3 mm
15 = shim 0.5 mm
15 = shim 1.0 mm
16 = cover / washer
17 = socket hd screw M6 X 16 8.8
18 = washer DIN 125



Tyre fitting

The relevant regulation should be observed.
Only rims of the exact size and free of rust should be used. These should be neither damaged nor worn.

When replacing tubeless tyres a new valve is also necessary for safety. The valve caps prevent dust and dirt from entering and causing leaks. The caps should always be screwed on firmly and should be immediately sealing ring are preferable because they have replaced if they get lost. Valve caps with an additional sealing function, compared with the simple dust protection caps.
If tyres are improperly fitted, damage may occur. They should therefore be fitted by an expert. Only ever use recommended fitting aids. The tyre fitting pressure should not exceed 150 % of the maximum tyre pressure given in the tables.
When tubeless car tyres are being fitted, attention should be paid to the fact that the tyre beads coming from the well-base must first clear the hump on the rim ledge. In order to avoid cracks in the bead core the pressure necessary to clear the safety humps should not exceed 3.3 bar. Only when the beads are seated correctly against the rim flange can the pressure be increased to achieve the necessary fit and firm grip on the rim flanges. This „fitting“ pressure should not exceed 4 bar.

Tyre damage

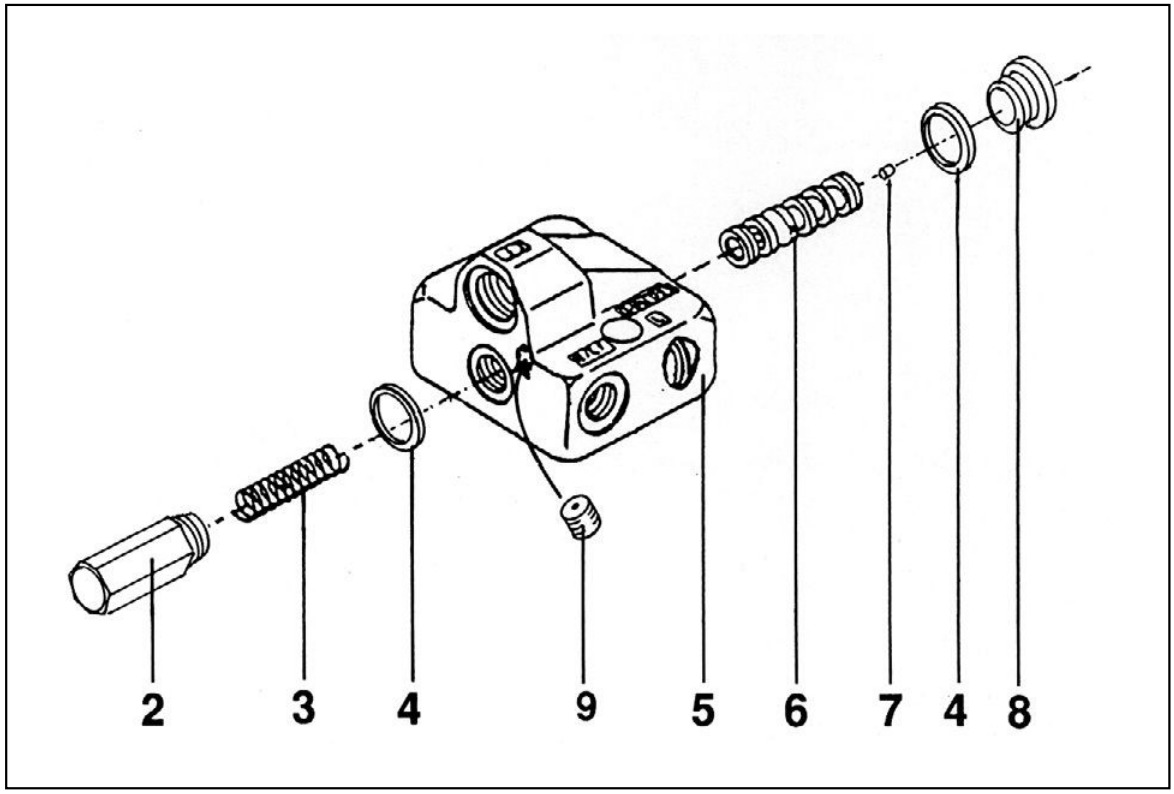
Excessive strain caused by rapid starts, braking with the wheels locked or extremely high cornering speeds always leads t o excessive tyre wear and limits the tyre’s economical use.

The following damage moreover represents a threat to road safety:

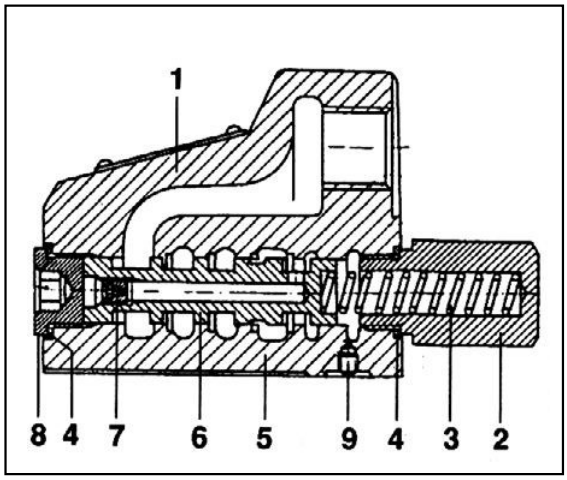
Neglecting the tyre pressure i. e. driving with insufficient pressure leads to excessive flexing and overheating of the tyre and can ultimately destroy it. Pressure losses can be caused by nail punctures, faulty valves or damaged rims.
Therefore it is necessary to maintain pressure and the tyres should be examined regularly to make sure that no foreign bodies have become lodged in the tread grooves.

Repairing or cleaning the priority valve

Contaminants in the system hydraulic oil will cause improper operation of the priority valve.
Freedom of movement of the spool (6) in the valve body (5) will be impaired due to foreign particles, resulting in heavy steering.
In such a case the cause of improper operation can be corrected by cleaning the priority valve.

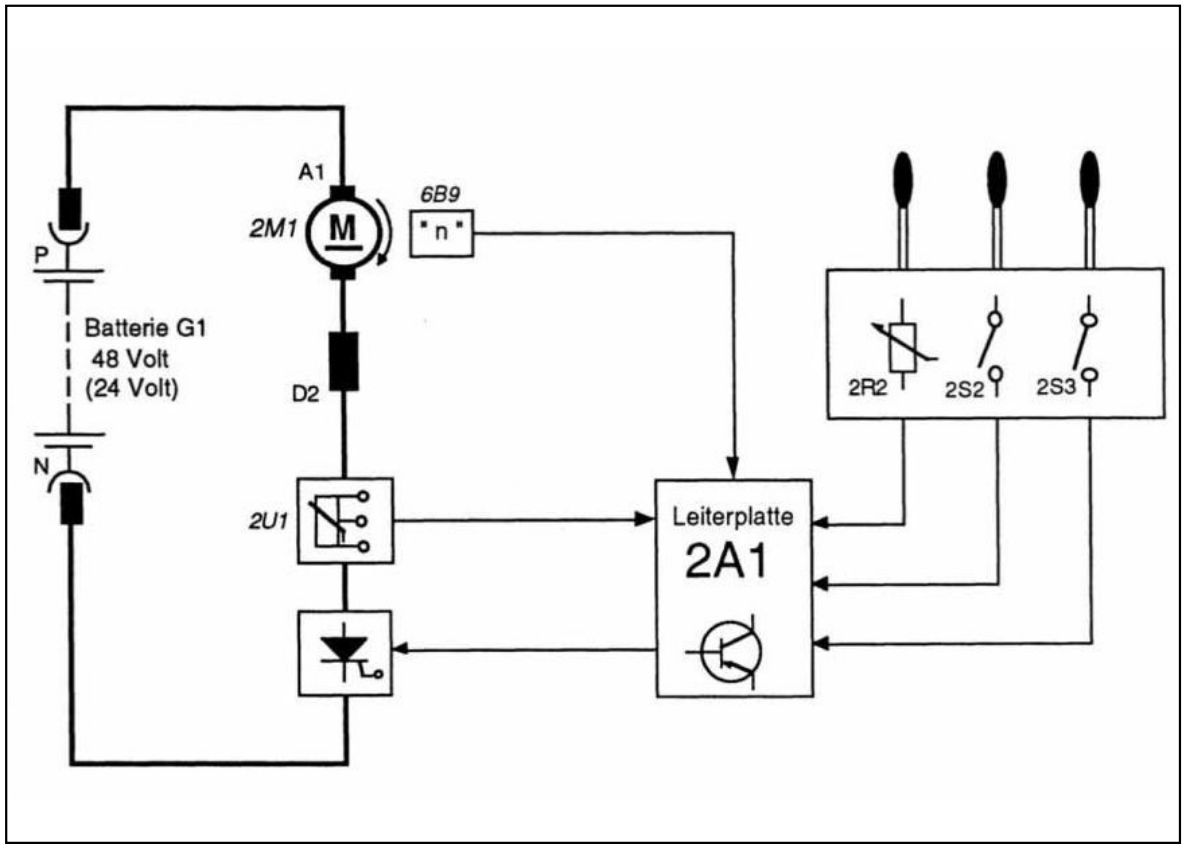


1 = priority valve
2 = plug for pre-loaded spring
3 = pre-loaded spring
4 = seal ring
5 = valve body
6 = sliding spool
7 = restrictor fitting
8 = plug
9 = integrated LS (load-sensing) restrictor valve



Operating principle of the Stilltronic SCR control

1. SCR Pump Controller



The Stilltronic SCR control is a device for stepless control of motor speed from zero to full speed.

1. Motor current/Hydraulic pump motor
2. Motor current/Drive motor

Motor speed control for both SCR controlsystems is obtained by the use of a thyristor power unit via a printed circuit board.

1.1 Hoisting/tilting

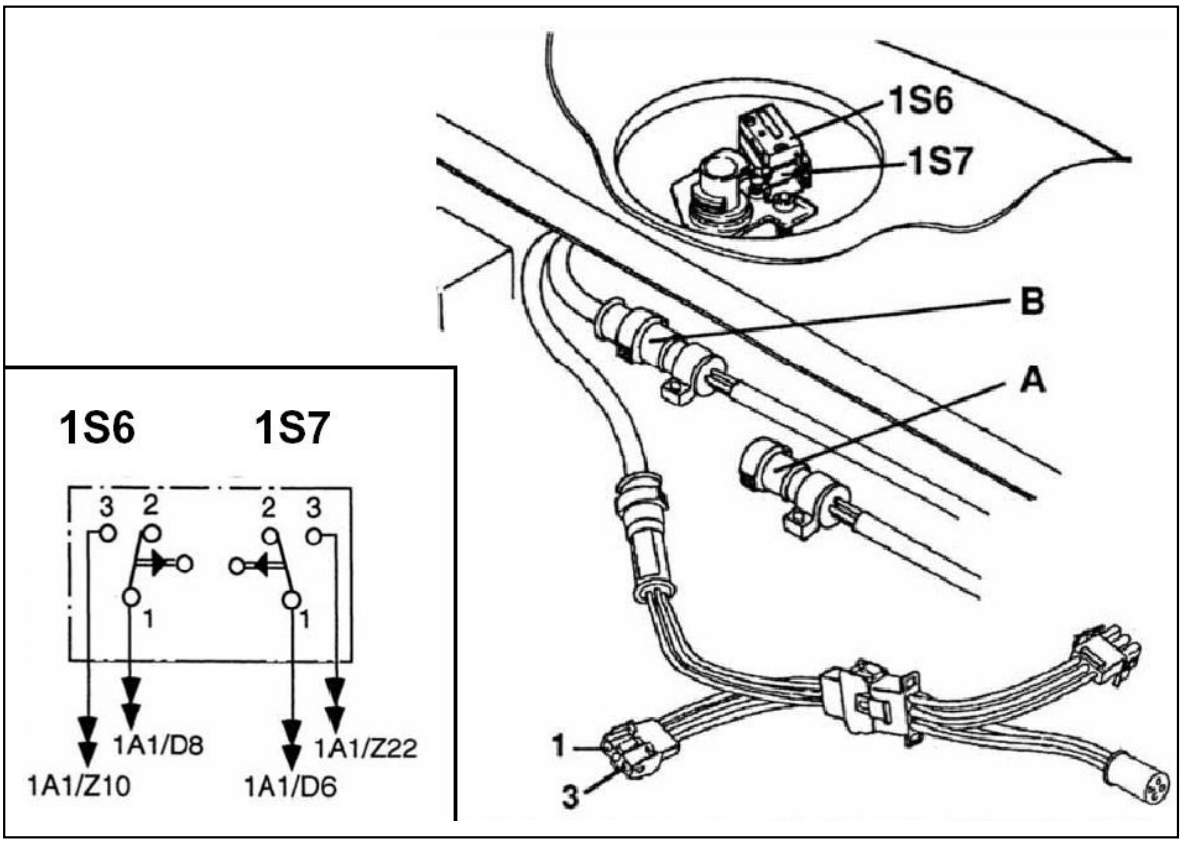
The Stilltronic controlling pump motor speed is brought intooperation when the keyswitch (S1) is turned to “on”. Initial movement of either the ”tilt” or “hoist” control lever will actuate the conesponding hydraulic microswitch/potentiometer (2S2, 2S5, 2R2) for operating the hydraulic pump motor.

Upon being actuated, the relevant hydraulic microswitch will supply an input signal to the pump controller logic card comprising potentiometers by means of which the speed of the hyd. pump motor can be adjusted to suit the application (“hoisting / tilting”).
The current sensor (2U1) on the power unit senses the actual current flowing in the pump motor comparing it with the setting on the p.c.b. Once the current has risen to a pre-set value the p.c.b. will restrict the output from the power unit to a safe limit thus keeping the current constant.
Motor current is restricted to its maximum limit also by the current sensor. (Make current).

Curve limit switches

Curve switches 1 S6/1 S7
Housed in the rear counterweight, the curve switches are accessible after removal of a black cover.

They are actuated mechanically by a curve disc which in turn is actuated by the steering turntable via a mechanical link.



When the truck is driven round a sharp bend, the microswitches which are electrically connected directly with the pcb. 1A1 cause the motor on the inside of the bend to be cut off from the drive.

1S6: upper switch- when actuated, cuts off the left drive motor from the drive.
1S7: lower switch: when actuated, cuts off the righl drive motor from the drive.

When the truck leaves the bend, the drive motor that had just been switched off is switched on again and is traversed by the motor current whose rate is reduced briefly.

Checking for continuity with Testofon buzzer

Before carrying out the check place the steer wheels in the straight ahead position.

Checking 1S6: Unplug connector A and connect adaptorcable. Check between connections 1 and 3. When operating the switch 1S6 manually, it must switch to continuity. Reconnect the connector A.

Checking 1S7: Unplug connector B and connect adaptorcable. Check between connections 1 and 3. When actuating the switch I17 manually, it must switch to continuity. Reconnect the connector B.

Current flow:1 S6/1 - - 1 A1/D8
1S6/3 - - 1A1/Z10
1 S7/3 - - 1 A1/Z22
1S7/1 - - 1A1/D6

Switch removal and installation

- Pull off spade type cable plug
- Unscrew fixing screws of switch

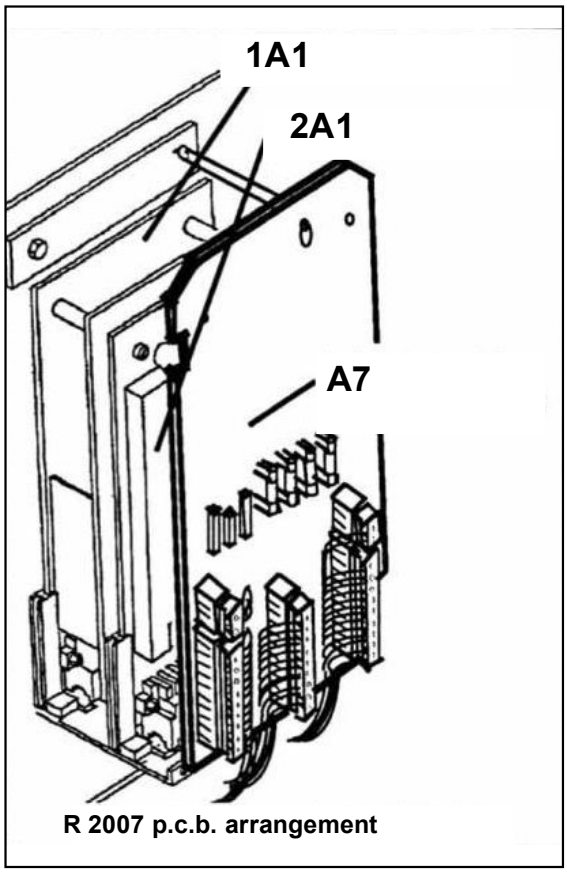
When installing the switches it will do to merely screw them into place with their respective base plate with which they form a complete unit. Their installation does not require any adjustment.

Contactor control panel

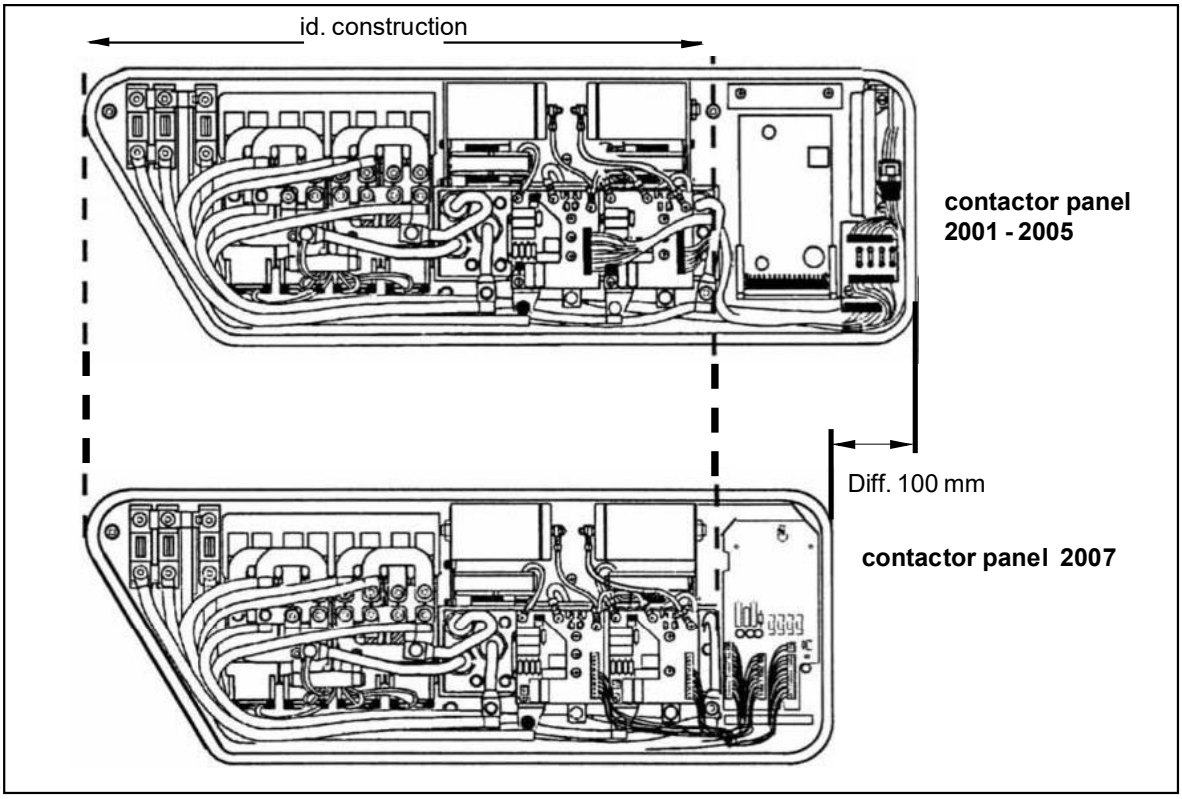
On account of the reduced length of the 2007 model in the R20-15 (2007) range, there now exists a modified contactor panel which is by 100 mm shorter compared to the standard panel.
As is apparent from the figure below, the contactor panels from power circuit fuses l.h.s. to commutating capacitors and current sensors do not differ from each other.

On contactor panel of the R2007 model the electronic unit of the battery discharge indicator has been eliminated. The p.c.b A7 comprising the control circuit fuses has been redesigned and is now fitted before the p.c.b 1A1 (traction controller) and 2A1 (pump pulse controller).

The battery discharge indicator has been removed from contactor panel and now forms in this range an integral part of the steering column.
For closer details regarding the battery discharge indicator incorporated in the steering column, refer to F.G. 09.
The R2007 contactor panel will be fitted as standard to the complete range of R20 units since 1995.



R 2007 p.c.b. arrangement



Contactor mounting - Forced ventilation

Contactor mounting cover, additional ventilation.

In those cases, where the standard ventilation for the contactor mounting is insufficient, we offer an additional ventilation unit as a spare.

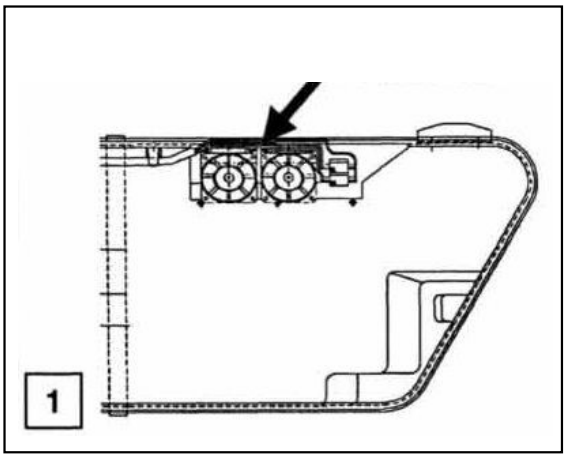
This ventilation unit provides for constant replacement of the internal air in the contactor mounting by means of two additional fans in the cowl above the contactors which extract the warm air from the contactor mounting above the contactors (Fig. 1). Fresh air enters the contactor mounting through slots in the right hand side of the cowl (Fig. 2). These slots are protected with filter mats

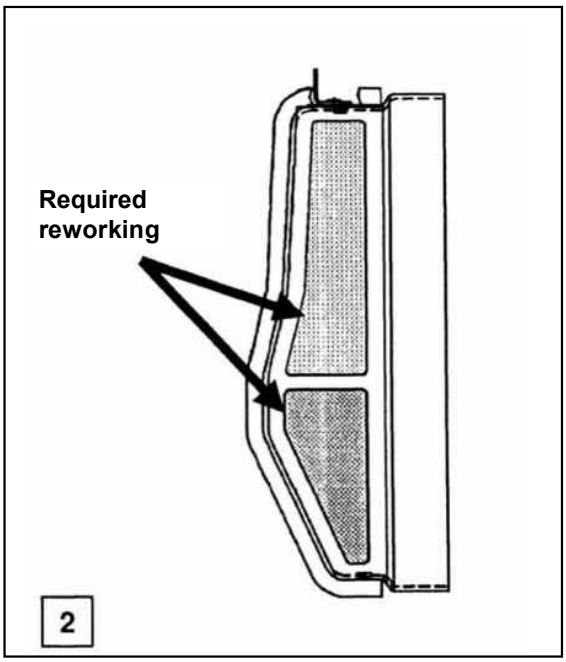
Important: the conversion set 383841 for additional ventilation available as a spare can only be used for the old contactor mounting unit (long version).

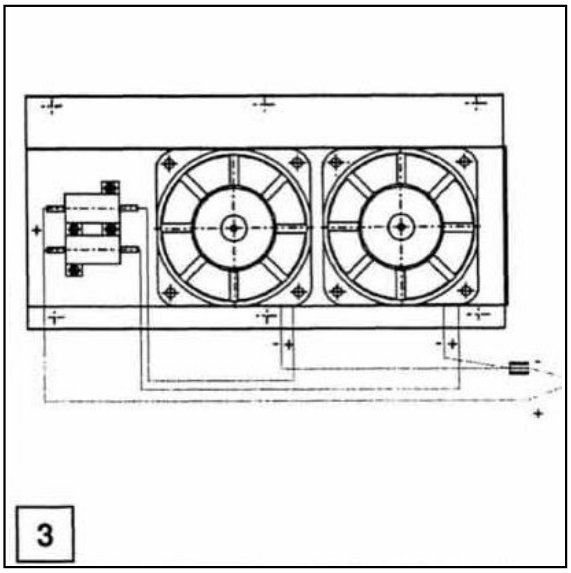
For the standard contactor mounting (2007), now in use, the existing cowl must be refinished as shown.

Reworking:

Air intake slots are cut into the side wall of the cover as shown in Fig. 2. These must then be protected with filter inserts (323 637) to prevent contamination of the contactor mounting.
In addition, holes need to be cut into the cowl above the contactor for the fan assembly (Fig.3) which makes it possible to extract the hot internal air.
The fans should be connected in accordance with Fig. 3 (ballast resistors KKA5 200 Ohm 10%)
The fan power supply is taken from plug X29 (X29/1 1 (+) and X29/12 (-)) by means of a twin core lead through the contactor mounting..





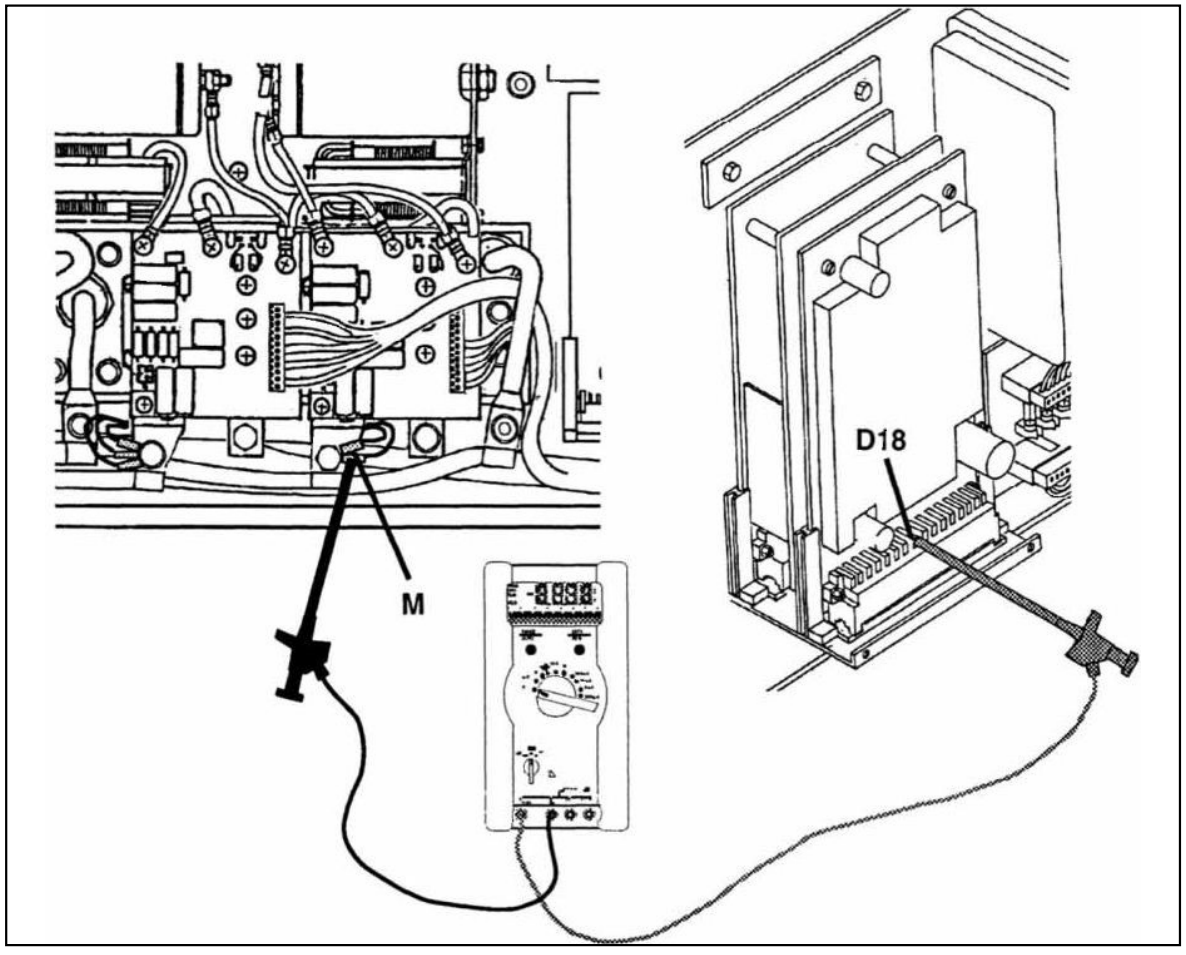


Checking the medium voltage of the pump drive current sensor 2U1

The medium voltage of the current sensor 2U1 is determined by the motor current. It can be measured between motor current **I** = 0 amps and max. amps.

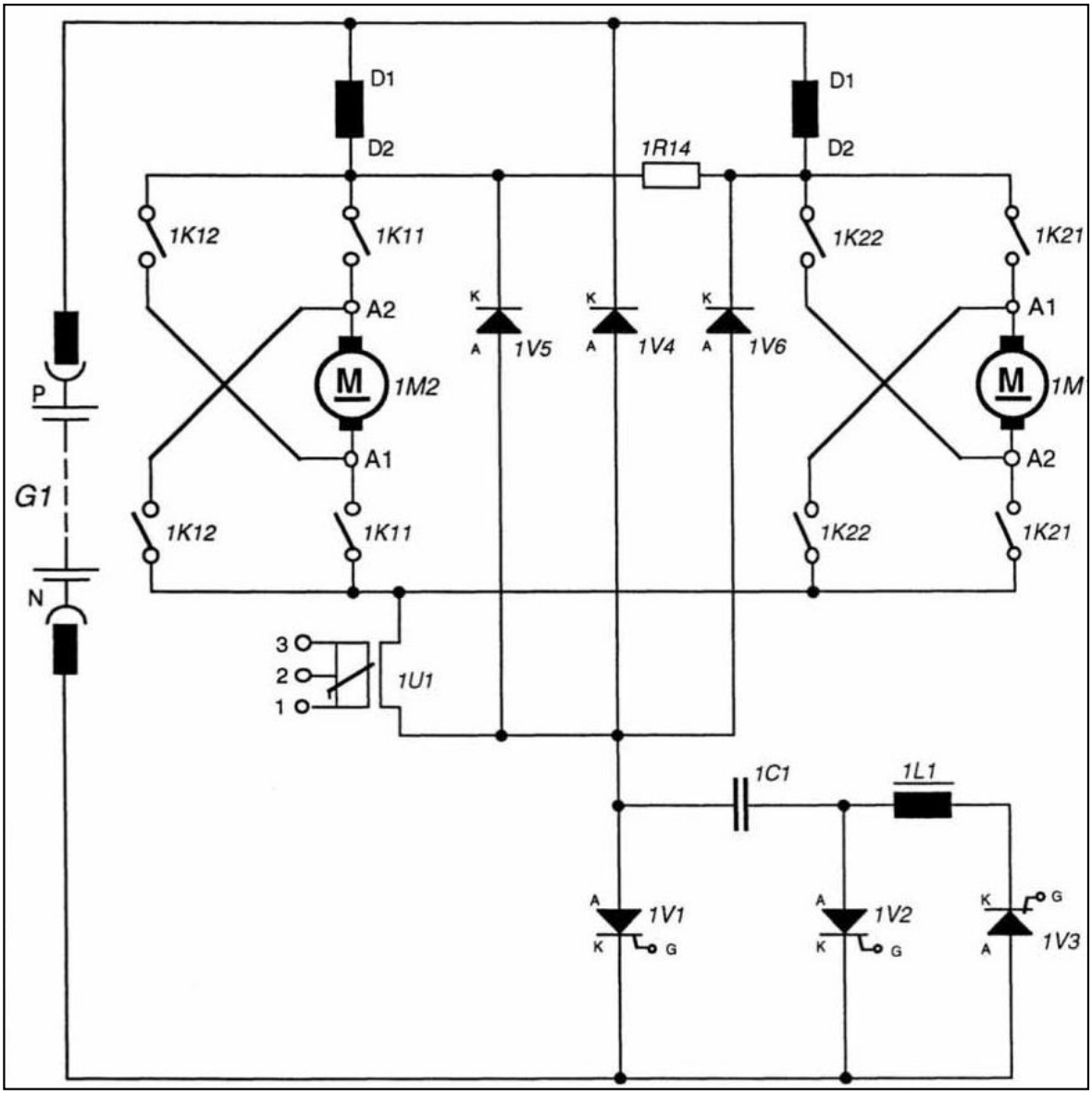
Testing procedure:
- Raise the drive wheels clear of the ground and place chocks beneath the front end of the truck frame
- Disconnect battery
- Connect black test prod (-) to point M (-) (neg. battery)
- Connect red test prod (+) to connection D18 of p.c.b. 2A1
- Reconnect battery
- Voltage check (with **I** = 0 amps):The reading should be between 4.9 volts and 5.1 volts (applies to 48 volt and 24 volt systems alike)
- Voltage check with max. pump motor current. Tilt mast completely forwards or back to bypass pressure
- Note the meter reading
- To enable a comparison to be made between the two measurements we call your attention once more to the fact that for a current rise of 100 amps the medium voltage drops by 0.25 volts.

Example: In the case of a pump motor current of the order of 300 A the medium voltage must amount to approx. 4.25 volts



Drive impuls controller

Electrical functions inside the power unit

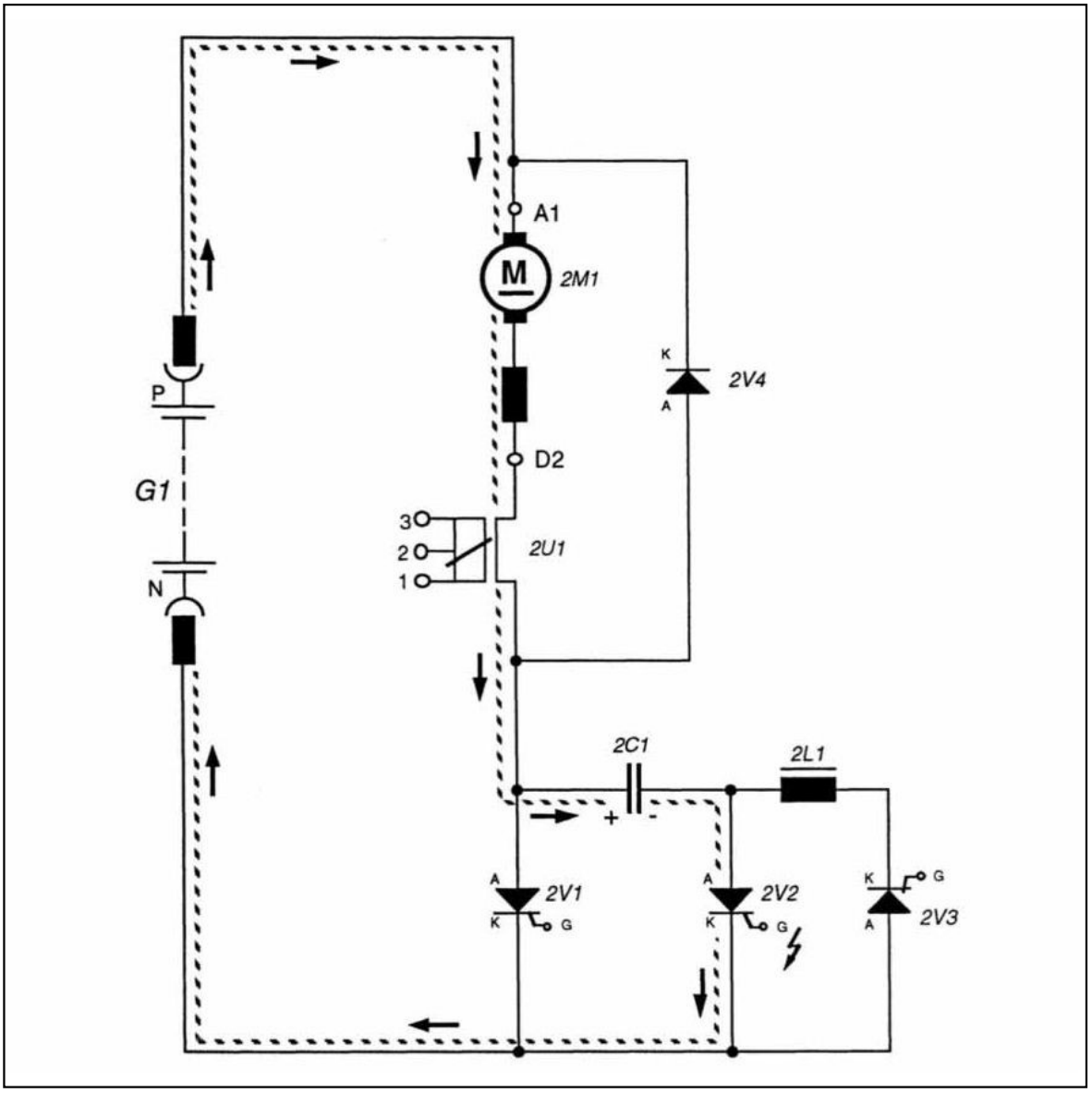


G1 -battery
1C1 - turn-off capacitor / drive control
1K11 - fwd. contactor
1K12 - rev. contactor
1K21 - fwd. contactor
1K22 - rev. contactor
1L1 - commutating choke
1M1 - drive motor (right)
1M2 - drive motor (left)

1R14 - compensating resistor
1U1 - current sensor
1V1 - main SCR-drive control
1V2 - turn-off SCR-drive control
1V3 - commutating SCR-drive control
1V4 - 'free wheel' diode-drive control
1V5 - 'free wheel' diode-drive control
1V6 - 'free wheel' diode-drive control

Pump impuls controller

Electrical functions inside the power unit



Firing turn-off thyristor 2V2:

The instant one of the hydraulic microswitches is actuated by operation of one of the hydraulic control levers, the logic card 2A1 will first apply a firing pulse to the gate of the turn-off SCR 2V2. In this way capacitor 2C1 changes to the opposite polarity:

positive pole connected to the anode 2V1
negative pole connected to the anode 2V2 (2L1)

Direction of current flow:

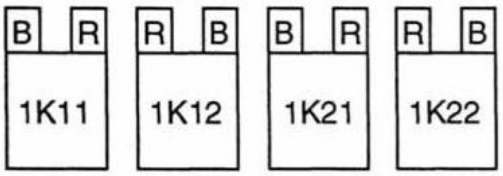
Diagram showing the sequential operation of contactors

○ Contactor open

● Contactor pulls in

✕ Contactor drops out

	1K11	1K12	1K21	1K22
Driving in bends (continued from page 57)				
Direction switch into FORWARD Operate accelerator pedal Turn steering wheel from the centred position to extreme right	●	○	✕	○
Direction switch into FORWARD Operate accelerator pedal Turn steering wheel from the centred position to extreme left	✕	○	●	○
Direction switch into REVERSE Operate accelerator pedal Turn steering wheel from the centred position to extreme right	○	●	○	✕
Direction switch into REVERSE Operate accelerator pedal Turn steering wheel from the centred position to extreme left	○	✕	○	●
Plug braking:				
Reversing from forward travel	✕	●	✕	●
Reversing from reverse travel	●	✕	●	✕
Reversing from forward travel with steering wheel turned right	✕	●	○	○
Reversing from reverse travel with steering wheel turned turned right	●	✕	○	○
Reversing from forward travel with steering wheel turned turned left	○	○	✕	●
Reversing from reverse travel with steering wheel turned left	○	○	●	✕



R = red magnet
B = blue magnet

Hour meter

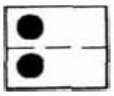
Hour meter design (6P1)

Mounted on the instrument panel, the work hour meter (1) is a crystal-controlled d.c. hour meter with digital display.

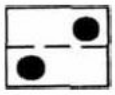
Operating voltage: 10-80 volts

The hour meter will begin to register immediately one of the following modes of operation is selected:

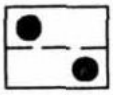
1. Keyswitch turned “ON”
2. Keyswitch turned“ON”and switch closed (load on seat)
3. Drive or pump impulse controller is activated



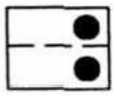
The hour meter begins to register as soon as the keyswitch is turnd to “ON”



The hour meter begins to register as soon as the keyswitch is turned to “ON, the seat switch is closed and the pump impulse controller is activated.

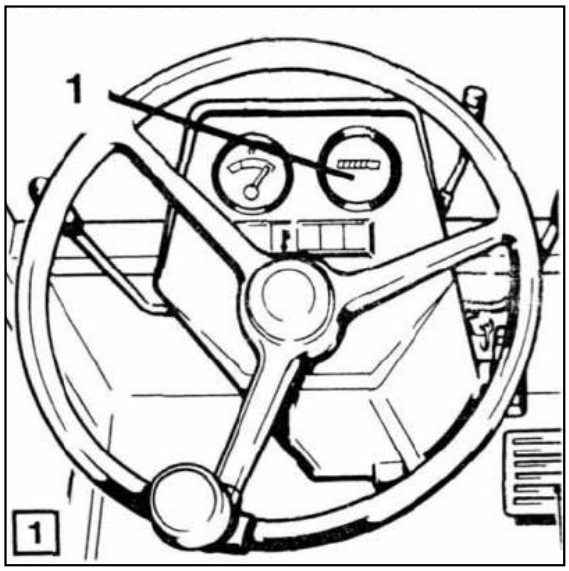


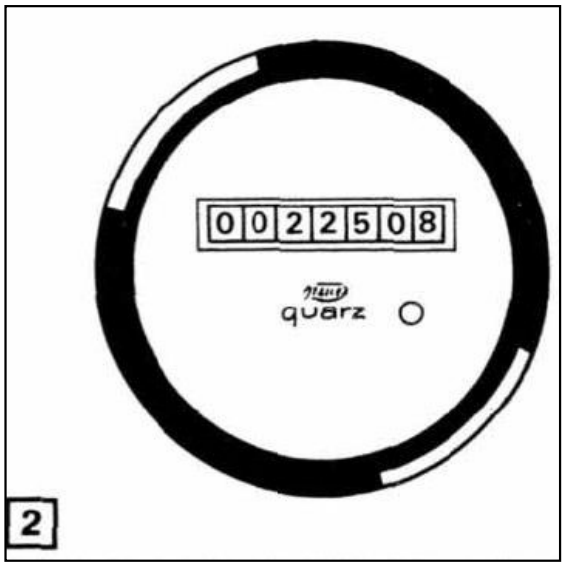
The hour meter begins to switch is turned to “ON, the register as soon as the seat switch is closed

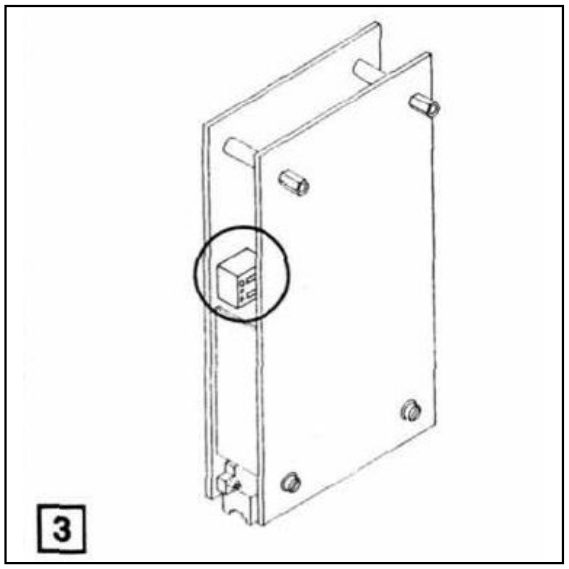


The hour meter begins to register as soon as the keyswitch is turned to “ON, the seat switch is closed and the pump or drive impulse controller is activated.

The selector switches for selecting the different modes of operation are arranged on p.c.b. 1A1 (see Fig. 3).



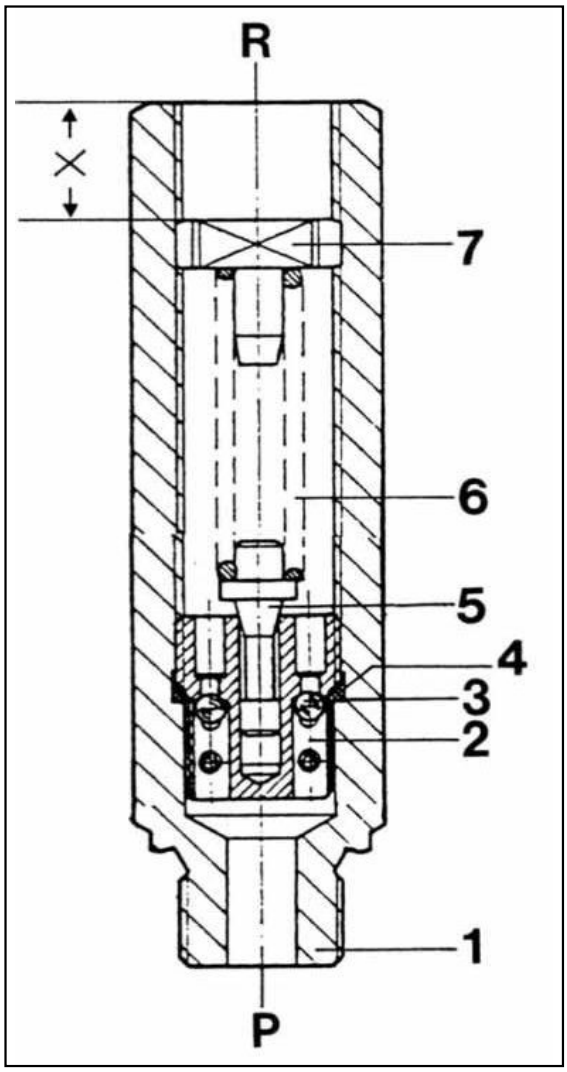




Anti-cavitation valve

Pre-set pilot pressure: 125 bar

1 = housing
2 = valve seat housing
3 = ball
4 = sealing ring
5 = sealing cone with cushioning effect
6 = spring
7 = adjusting screw



Operation

Ftted between control valve bank and tilt cylinder, the anti-cavitation valve prevents the mast from drifting forward on its own with or without load.
The anti-cavitation valve permits tilting only when pump pressure is present.
The anti-cavitation valve carries the designation (“P”) and (“R”) on the connector sides.

R —> P = free flow
P —> R = restricted

Fitting position: See Figure on page 3

Checking anti-cavitation valve

- Pick up rated load
- Place truck on level ground
- Attach an angle-measuring instrument (level) to mast section
- Turn keyswitch ‘OFF‘

Note:
The mast should not move forward by more than 0.5’°/min. If the mast drifts forward more rapidly, this is usually evidence that the cone seat (5) is contaminated.

Removal:

- Remove anti-cavitation valve
- Screw out adjusting screw (7)
- Withdraw spring (6) and cone (5)
- Inspect valve seat for dirt; clean if necessary
- Screw in adjusting screw (7) until it has reached its original position (measure -X-)

Drive motor, construction

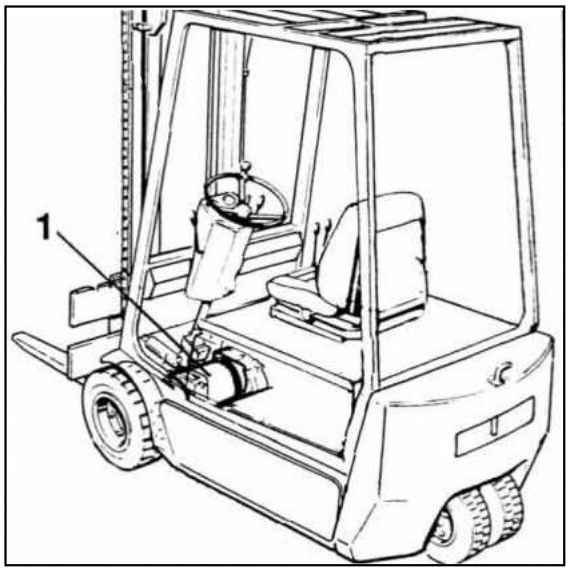
- 4-pole series-wound motor, forced-ventilated, motor supported both sides.

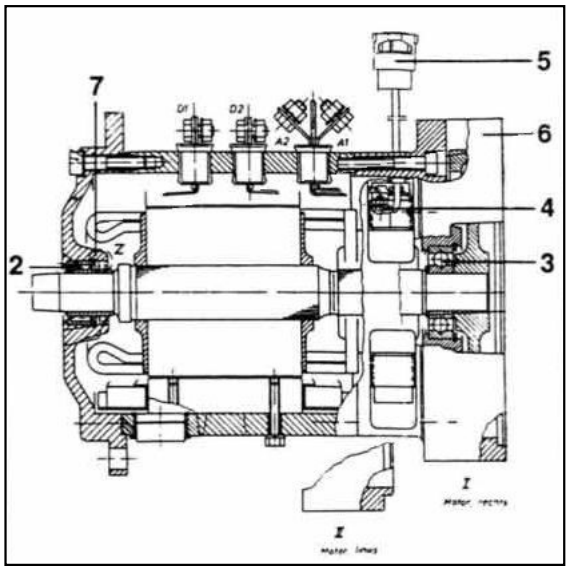
  Drive-end - needle roller bearing (2)
  Commutator end - grooved ball bearing (3)

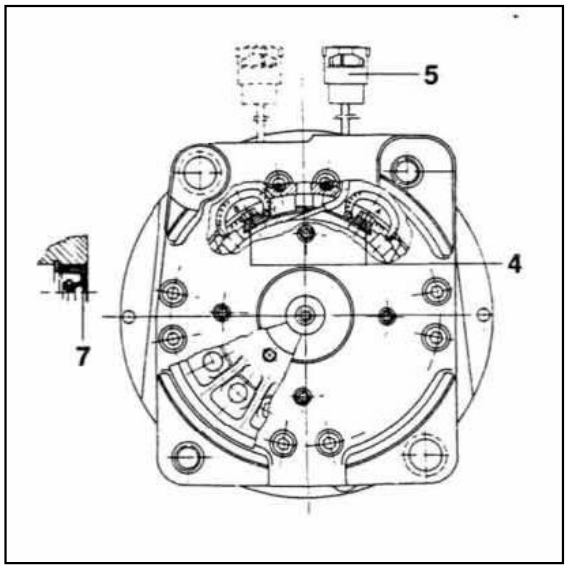
- 2 thermal switches (4) with waterproof connectors (5) fitted in the motor for thermal monitoring
- Brake disc (6) forced on commutator end armature shaft by pressure
- Drive shaft sealing with chevron seal (7).

The fork truck is fitted with 2 drive motors which are bolted together to form a complete drive unit with the two flange-connected gearboxes.

1 = drive motor
2 = needle roller bearing
3 = grooved ball bearing
4 = thermal switch
5 = waterproof connectors for thermal switch
6 = Brake disc
7 = chevron seal



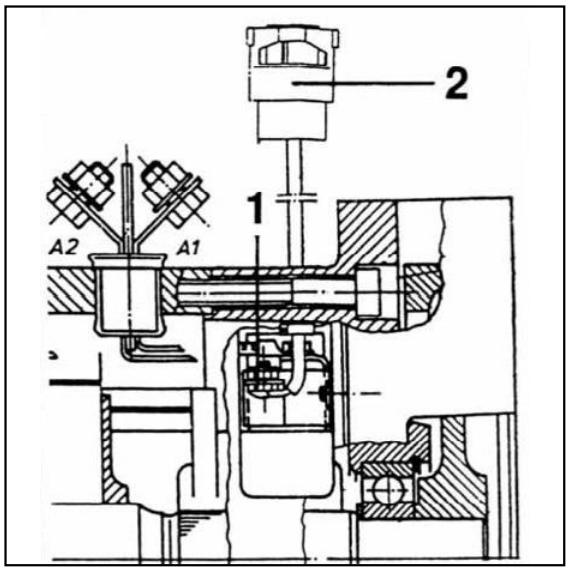




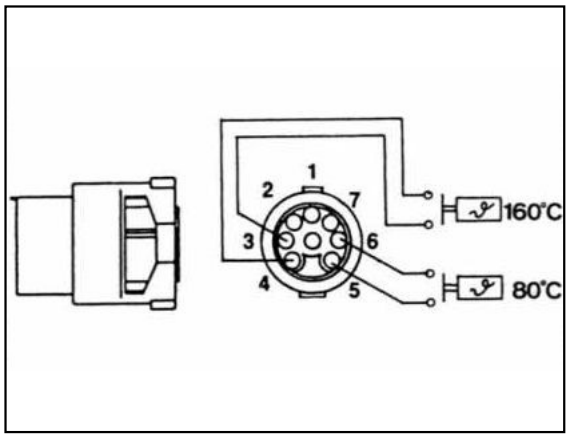
Thermal switch in drive motor

Two thermal switches (1), each with a response temperature of 80 °C and 160 °C respectively, are fitted in each drive motor for thermal monitoring and fan motor control. The switches (with N/O type contacts) are bolted to the brush holder. All four switch leads are connected to a female plug (connector half).

1 =thermal switch
2 = female plug



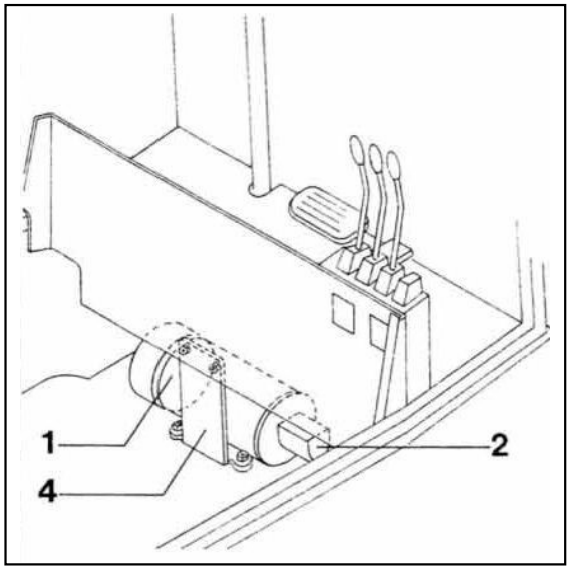
Connection of thermal switches to the female plug (connector half)



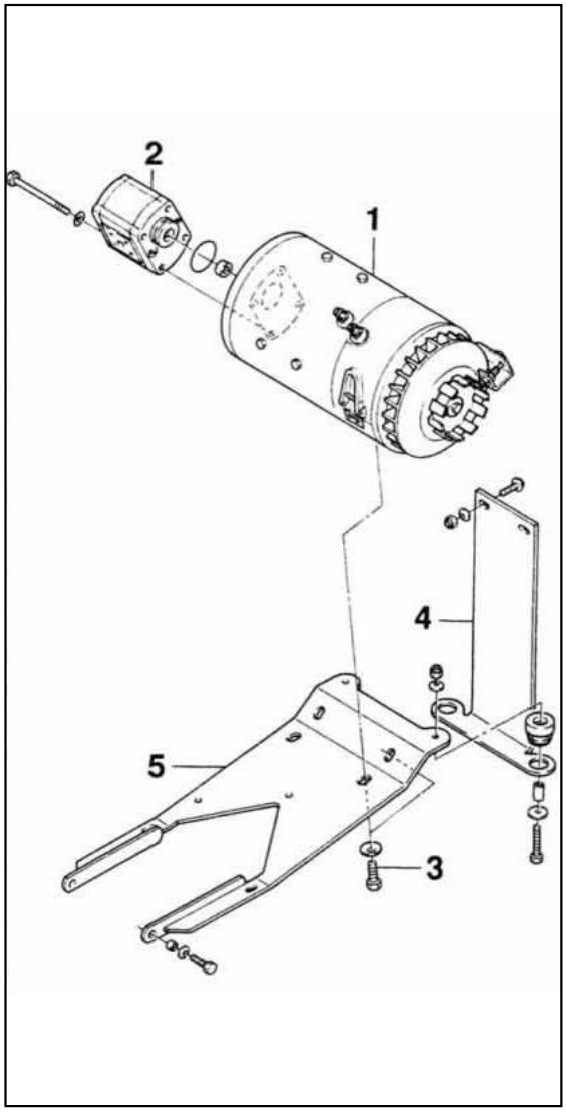
Pump motor

Pump motor removal

- Remove floor plate.
- Disconnect motor cables (1).
- Unplug harness to speed (rpm) sensor and cut off existing cable links (plastic strips).
- Remove battery.
- Unscrew the hydraulic pump (2) (oil will flow out).
- Next undo and remove the four retaining screws (3) which hold the pump motor in place.
- Unscrew bracket (4).
- The motor support bracket (5) with the pump motor (1) will now hinge down. The motor can at this stage be lifted out from the rear through the battery compartment.



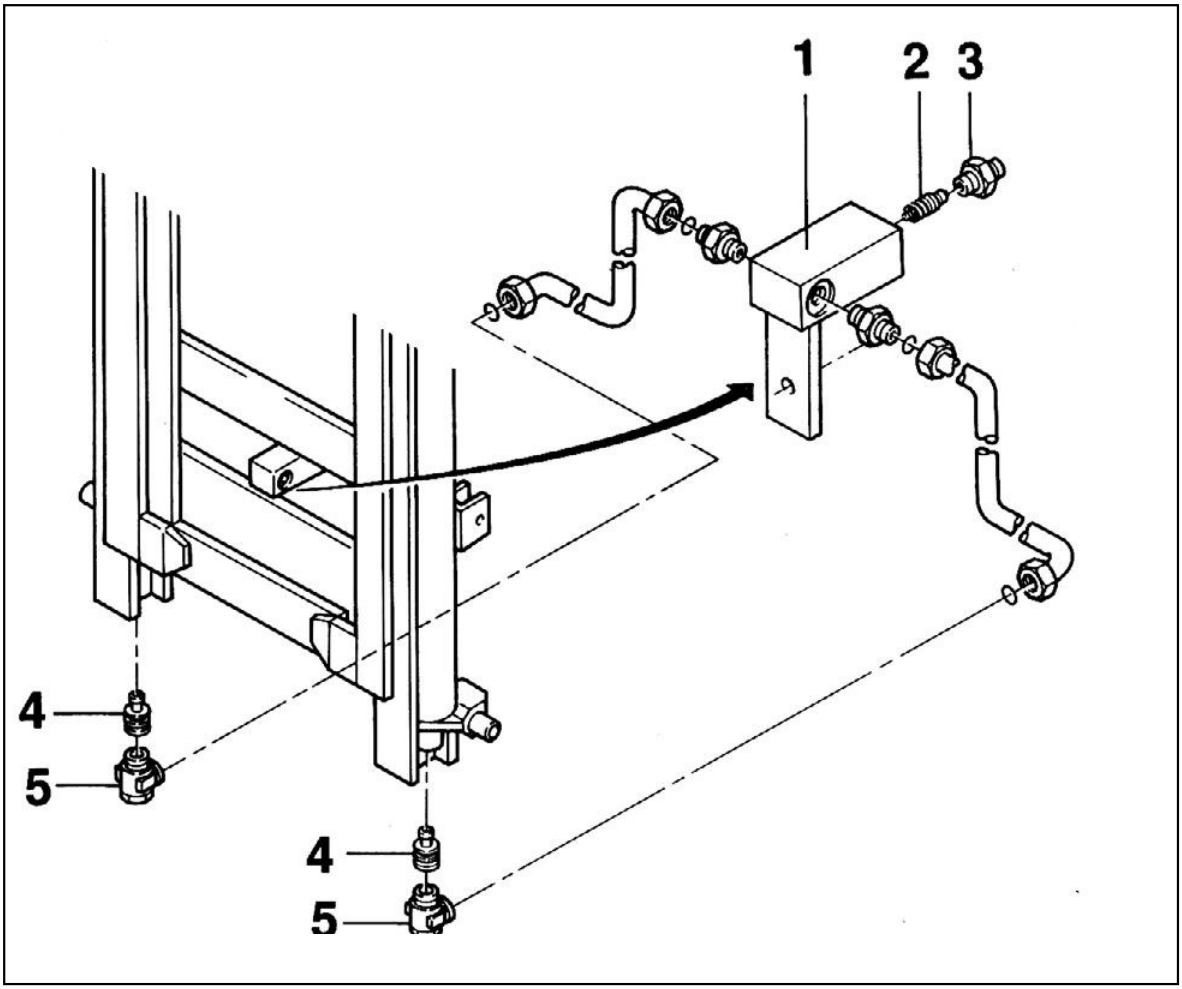
1 = pump motor
2 = hydraulic pump
3 = hex hd screw M 10x20
4 = bracket
5 = motor support bracket



Oil flow in mast

The oil enters at the lowering valve (1) whence it goes to the l.h. and r.h. cylinders.

The line failure safety devices (4) in the outer cylinders prevent the load dropping too quickly if a pipe fractures.



1 = orifice block
2 = lowering valve
3 = union male stud
4 = line failure safety device
5 = union

Note:

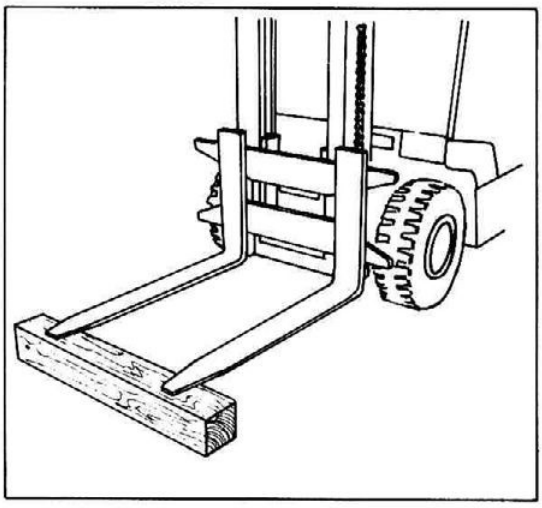
On the telescopic mast with up to 2580 of lowered height only the r.h. cylinder incorporates a line failure safely device, whereas both cylinders right and left incorporate such a device from 2630 mm of overall mast height (lowered).

Fork carriage support rollers

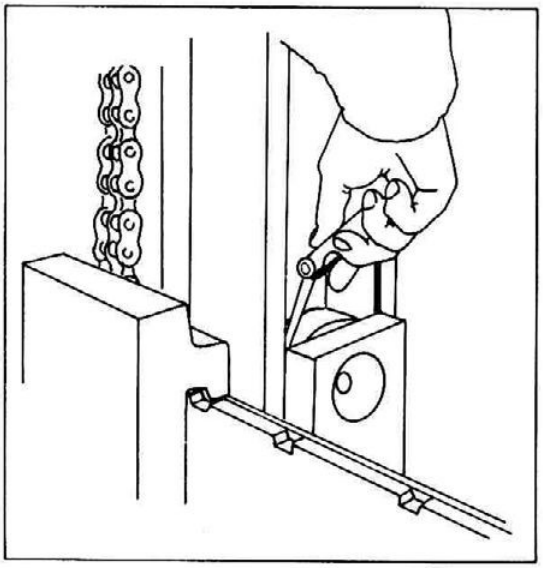
Check

(see figures on the right)

- Raise fork carriage
- Place a square piece of wood under the forks
- Lower carriage. The fork carriage will tilt backwards, whereas the upper rollers will come to rest against the rear running surface.

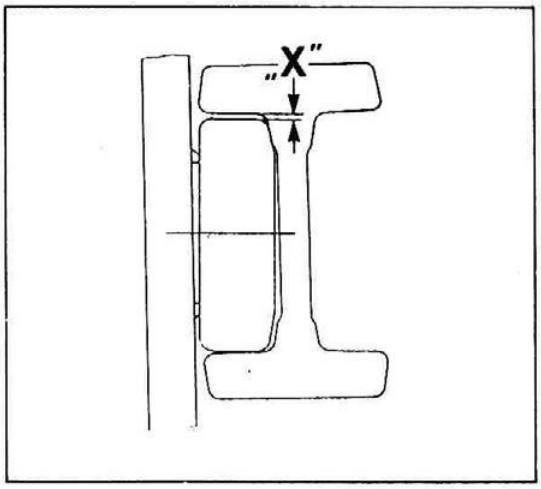


Using a feeler gauge measure gap between support roller and running surface.



Max. permissible gap ‘X‘ = 0.5 mm.

Note:
Before carrying out this operation check the lateral clearance “Y” of the carnage. (Page 13)



Fork arm

Design: to DIN 15174/151 75

Material:
Heat-treatable steel

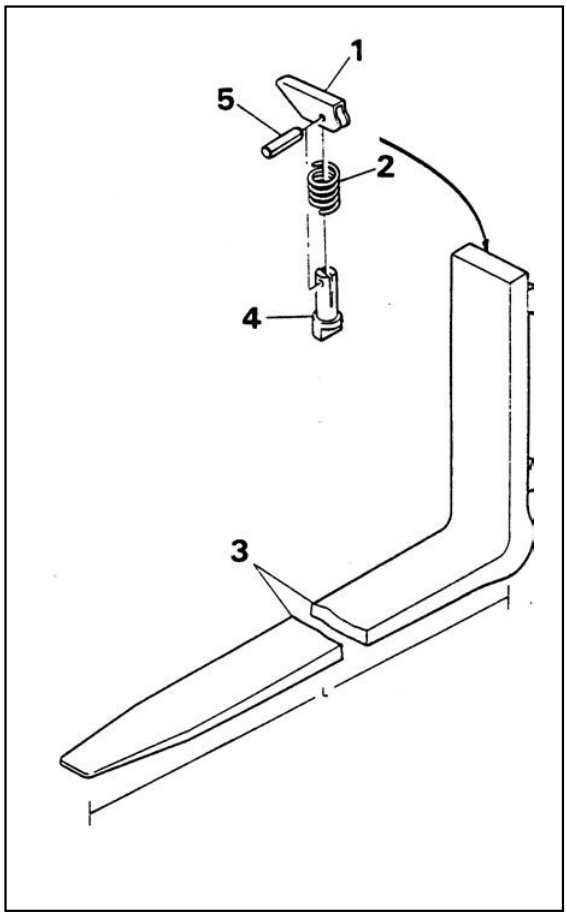
1 = positioning lock

2 = pressure spring

3 = fork arm

4 = spring mounted stop or retaining pin

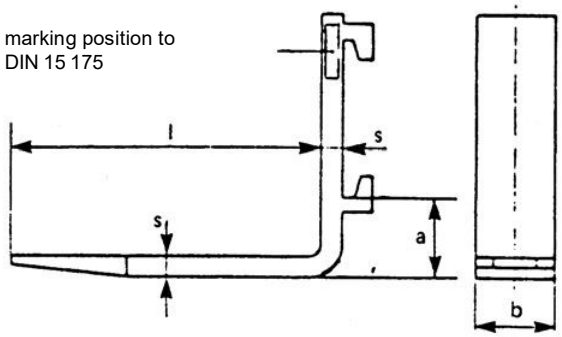
5 = roll pin



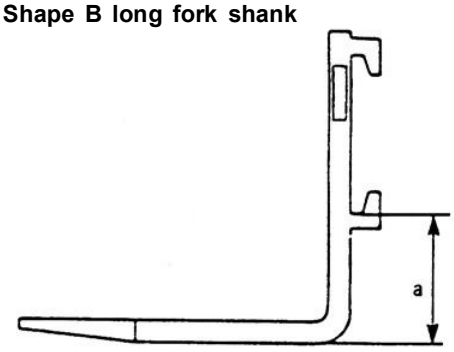
Definition, fork arm dimension diagram

Example: Definition of a fork arm shape A suitable for the rated load class 2, having a width “b”= 130 mm,
a thickness “s” = 45 mm and a length “l” = 1150 mmi: Fork arm complying with DIN 15 174 - A2 - 130x 45 x 1150

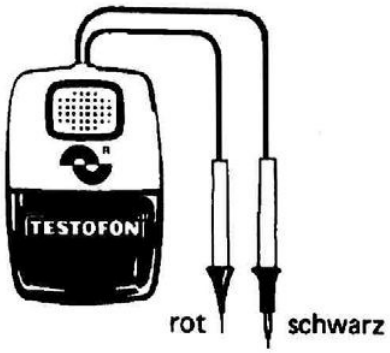
Shape A short fork shank



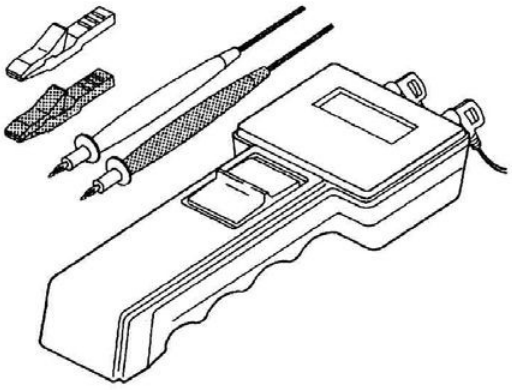
Shape B long fork shank



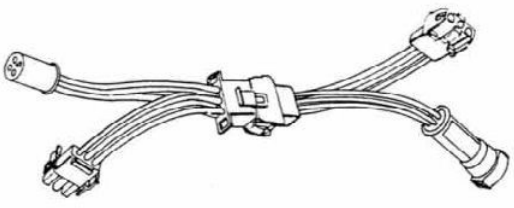
Testofon, Continuity Tester
Part No. 120 644

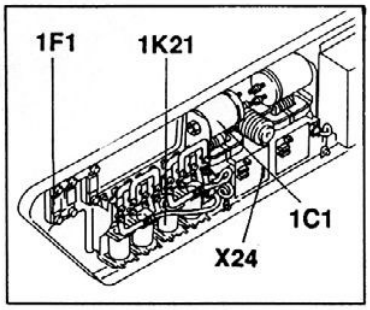


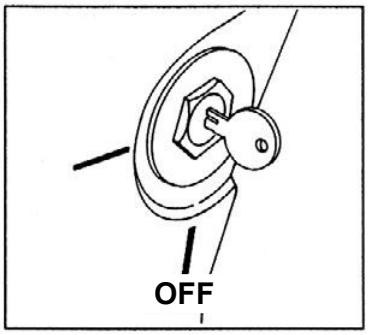
Insulation tester
Part No. 145 120

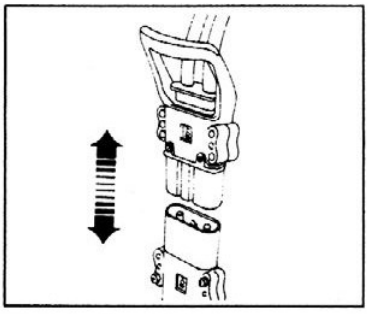


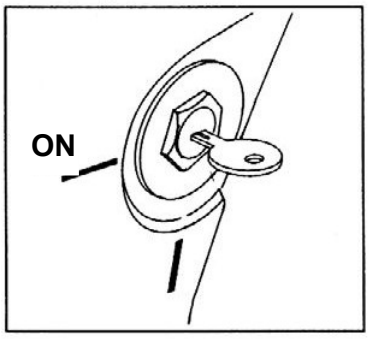
Adaptor cable
Part No. 319 806

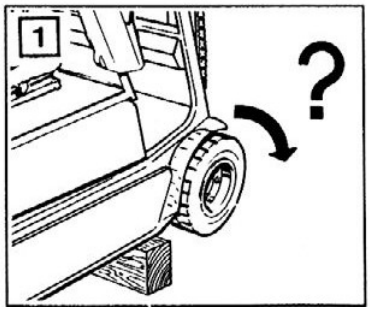


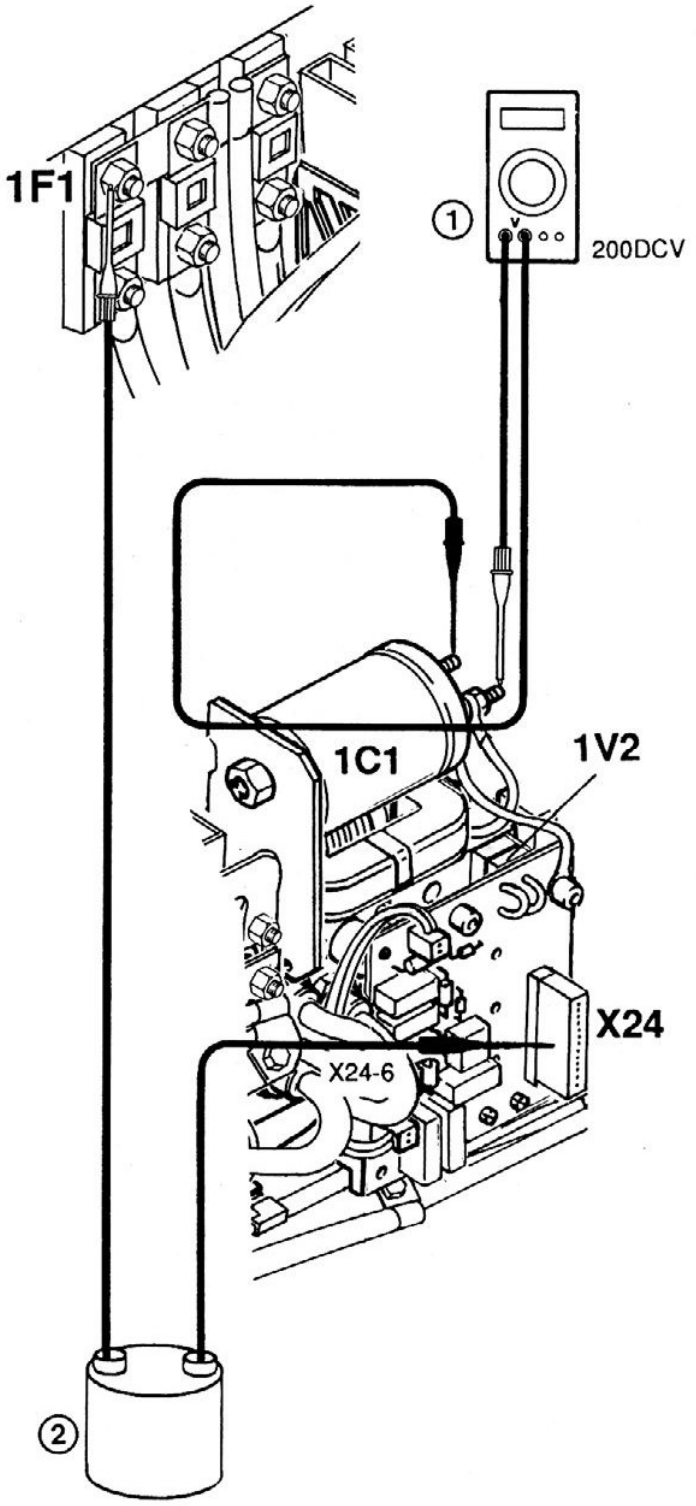

1F1
1K21
1C1
X24

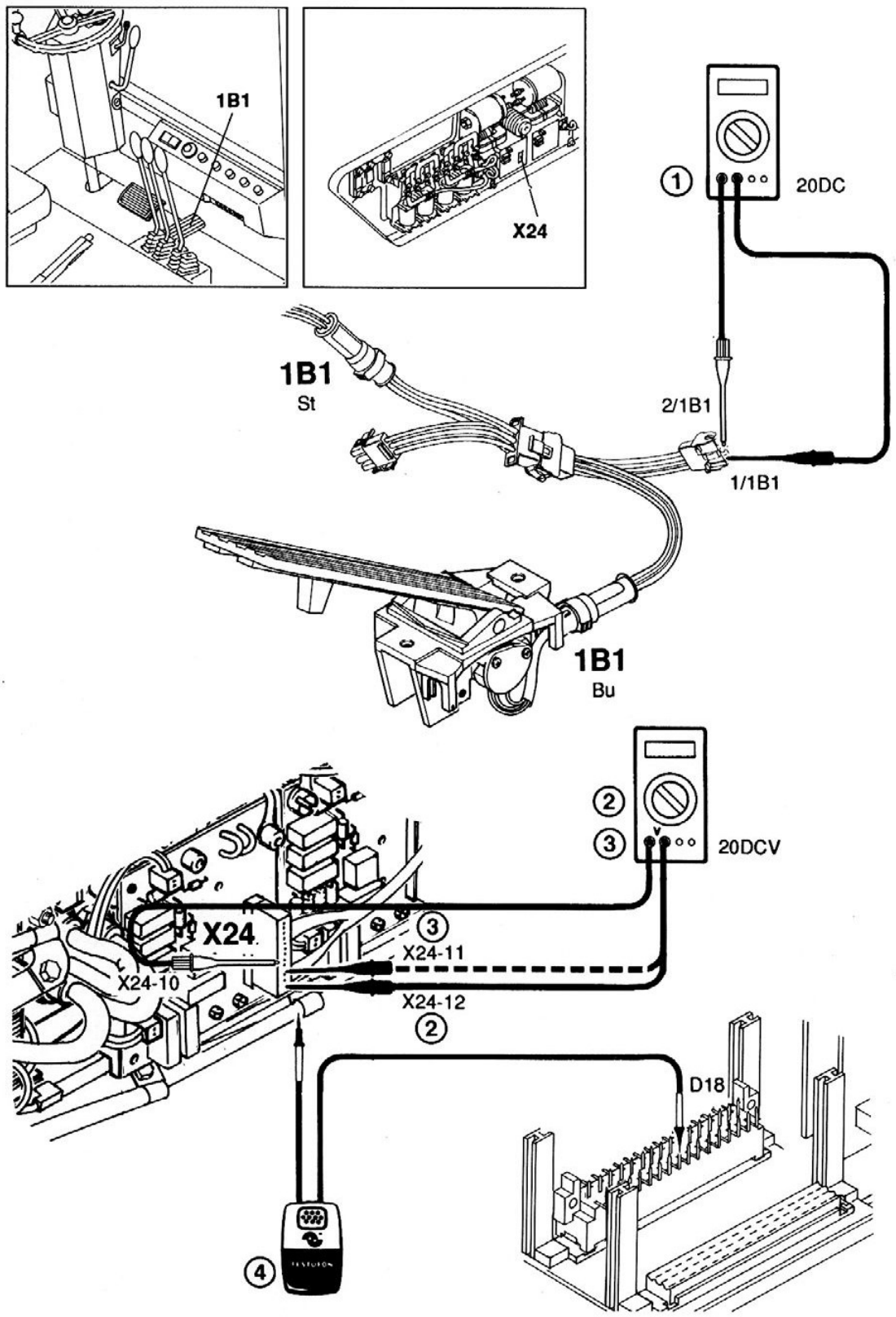

OFF




ON


1
?


1F1
1
200DCV
1C1
1V2
X24
X24-6
2


1B1
X24
1
20DC
1B1
St
2/1B1
1/1B1
1B1
Bu
2
3
20DCV
X24
3
X24-11
X24-10
X24-12
2
D18
4