

## MOBILETT Plus / - E/ - M

**SP**

### Service Instructions

From Serial No.

MOBILETT Plus	3040
MOBILETT Plus E	10810
MOBILETT Plus M	20001

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Chapter	Page	Revision
All	All	05

## Document revision level

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Please contact your local Siemens office to order current revision levels.

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## Training of customer support engineers

Due to the technology used in this equipment, setup, service and maintenance should be performed only by customer support engineers who have a work authorization for MOBILETT Plus.

## Text emphasis

 <b>DANGER</b>	<b>DANGER</b> indicates when there is an immediate danger that leads to death or serious physical injury.
 <b>WARNING</b>	<b>WARNING</b> indicates a risk of danger that may lead to death or to serious physical injury.
 <b>CAUTION</b>	<b>CAUTION</b> used with the safety alert symbol indicates a risk of danger that leads to slight or moderate physical injury and/or damage to property.
<b>NOTICE</b>	<b>NOTICE</b> used without the safety alert symbol indicates a risk of danger that if disregarded leads or may lead to a potential situation which may result in an undesirable result or state other than death, physical injury or damage to property.
<b>NOTE</b>	<b>NOTE</b> contains information provided with special emphasis to facilitate proper use of the equipment or proper execution of a procedure, i.e. hints, tips.

## Symbols



Checks and adjustments that must be performed with radiation ON are identified by the radiation warning symbol.



This symbol means "Dangerous voltage".



This symbol means "Attention, consult the documentation".



This symbol means: equal to or less than.

U  
S  
A

Several of the sections in these instructions are for the USA only. These sections are identified with this symbol.



Sections marked with this symbol have been included in the Siemens Training Video (part of the self-study packet), which can be ordered through Siemens customer service.



This symbol indicates components sensitive to Electro-Static Discharge (ESD).

### Required documents

- |   |                    |
|---|--------------------|
| • Wiring Diagram                              | RXR8-215.051...    |
| • Function description                        | SPR8-215.850...    |
| • Installation Instruction                    | SPR8-220.031.02... |
| Installation of remote exposure switch system |                    |

### Required tools, measurement and auxiliary devices

<b>NOTE</b>
-------------

**All tools, measurement and auxiliary devices with the exception of those marked " \* ", are listed along with their specifications in the STC (Service Tools Catalogue).**



- Standard service equipment\*
- Digital multimeter
- Storage oscilloscope with  $\pm 2.5$  % accuracy
- Torque wrench, 1 Nm - 3 Nm
- Spring scale
- Lux meter
- Rope \*
- Pulley block \*
- Adjustment device for belt tension, part No. 65 64 301

### Lubricants

- All-purpose grease PD 2
- Viscogen oil

## Safety information and protective measures

**⚠ CAUTION**

- When performing service work and tests adhere to:
  - the product-specific safety information in the documents,
  - as well as the general safety information contained in ARTD Part 2.
- Connect the MOBILETT Plus/Plus E/Plus M only to mains power supply outlet (receptacle) , that corresponds to the installation requirements of VDE 0107 or country-specific regulations.
- Remove or install boards only when the generator is switched OFF. Adhere to the ESD guidelines  .
- Checks and adjustments performed with radiation ON are identified by the radiation warning symbol  . During these types of adjustments, radiation protective clothing must be worn.

**⚠ WARNING**

- Never work with the system open if the capacitor is charging or has just charged.
- The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected. Life-threatening electric shock hazard exists.  
To avoid danger, refer to the section entitled  
“Protective measures when working on the capacitor bank”.

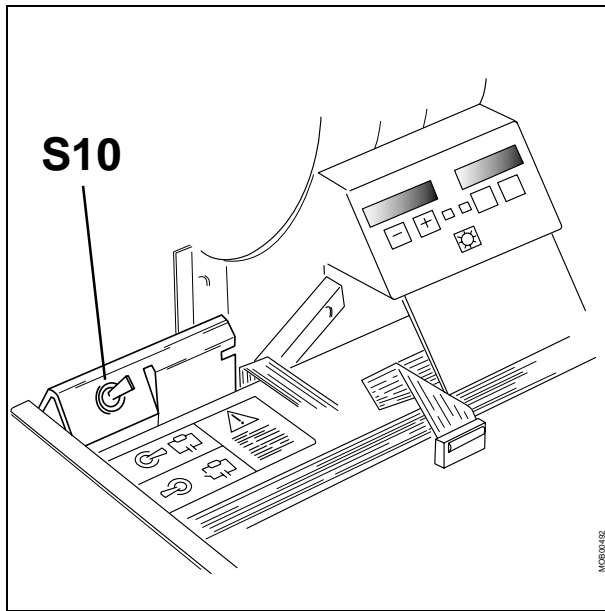


Fig. 1

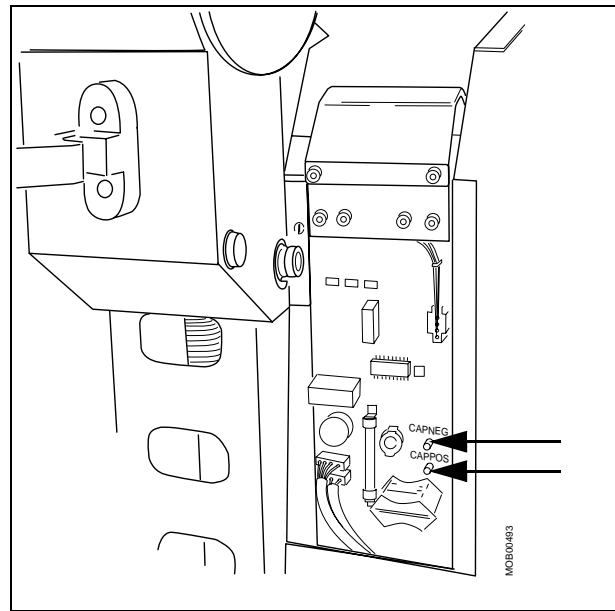


Fig. 2



### Protective measures when working on the capacitor bank



Comply with the information given in this section, before opening the system.



#### **⚠ DANGER**

**Never work with the system open if the capacitor is charging or has just been charged.**

**The capacitor bank may still be charged even if the system is switched OFF and the line voltage cable is disconnected.  
Life-threatening electric shock hazard exists.**

**Consult the information in this chapter.**

- System OFF.
- Disconnect the mains cable.
- Remove the system upper cover.
- Discharge the capacitor bank with S10 (D7) (Fig. 1).
- Wait 5 minutes; then remove the left, right and front covers.



- Measure the residual voltage at test points CAPPOS and CAPNEG on board D7 (Fig. 2). The voltage measured must be less than 10 V.

**⚠ WARNING**

If the voltage measured between CAPPOS and CAPNEG is 0V, the measurement device could be defective or the wires between the CAPPOS and CAPNEG test points on the capacitor bank could be damaged.

The capacitors could still be charged.

In this case, proceed as follows:

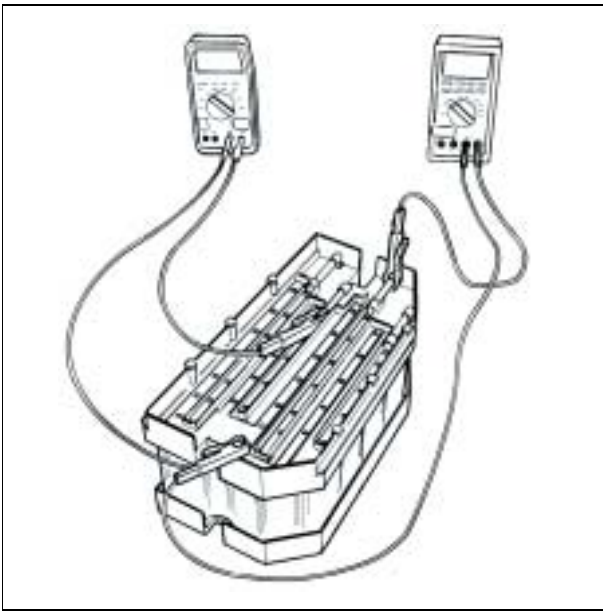


Fig. 3

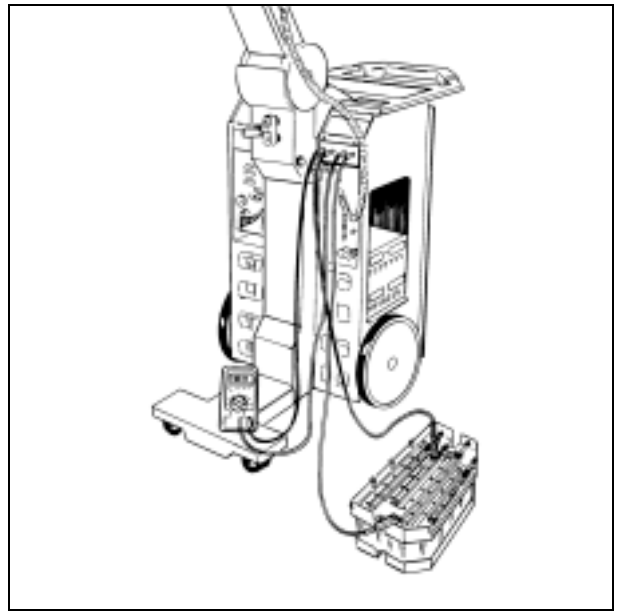


Fig. 4

- Make sure that the correct measurement range is set on the measurement device.
- Connect the measurement device to CAPPOS and CAPNEG.
- Switch S10 off. Connect the mains cable and switch the system ON.
- Check whether the voltage increases.
- Switch the system OFF, disconnect the mains cable and switch S10 on.
- Check whether the voltage decreases.
- If the measurement device indicates no voltage, check the measurement device.
- Measure the voltage for the capacitor bank at the bus bar. (Fig. 3).

**⚠ WARNING**

If the charging/discharging does not function, the capacitor bank must be considered “charged”.

This means a risk of high voltage.

Use caution when performing measurements at the bus bar of the capacitor bank. Use only the specified measurement devices (350 V DC). If one of the fuses in the capacitor series has blown out, this series must be considered fully charged.

- Only use insulated tools when pulling out the capacitor units.

- Measure the capacitor bank voltage on the bus bar (Fig. 3).
- If one of the capacitor series of the capacitor bank is still charged ( $U > 10\text{ V}$ ), it can be discharged via resistor R103 on D7.
- Connect the voltmeter to the measurement points parallel to the insulated cables which will be used to discharge the capacitor bank ( $U < 10\text{ V}$ ) (Fig. 4).

Dis- played messages	Mode of operation	Cause	Possible reason
Err 3*	During exposure	Interrupted expo- sure because of over voltage >142 kV	<p>Only with "Err 3".</p> <ul style="list-style-type: none"> <li>• Check the filament heating value for the selected kV, see section "P07 - Read-out filament values from battery backed RAM". Compare the value with the value in the delivery protocol. If the difference is large, make a new adaptation, see section "P10 - Fast adaptation".</li> </ul> <p>Err 3" in combination with:</p> <ul style="list-style-type: none"> <li>• Err 21" &amp; "Err 22". Check the measuring point "FIL_VAL" on D1, see page 160** and page 110**.</li> <li>• CAL 13". Check the 60 V-supply voltage on D4, see page 160**.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis-played messages	Mode of operation	Cause	Possible reason
Err 4*	During exposure	Measured kV value deviates more than 5 kV from selected kV.	<p>The deviation can depend on the adaptation.</p> <ul style="list-style-type: none"> <li>• Measure the kV curve at measuring point "HTPEAK", see page 140**. Compare measured curve with the reference curve, see page 141**.</li> </ul> <p>For a large deviation:</p> <ul style="list-style-type: none"> <li>• Check the filament value, see section "P07 - Read-out filament values from battery backed RAM", and compare it with the values in the delivery protocol.</li> <li>• If the difference is large a new adaptation is needed, see section "P10 - Fast adaptation"</li> <li>• See also section "Error diagnosis HT and single tank".</li> <li>• Check the connection K9 between D1 and H1 (single tank) and the connection between D1 and D13 (K8), see page 140**</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
Err 5*	During exposure	No X-ray tube current. The measured tube current < 5 mA ("MAPOS" < 50 mV).	<p>The check starts 0.8 ms after the exposure is started and ends at the end of the exposure. If an error occurs, the exposure is normally interrupted earlier by "Err 3" or "Err 23".</p> <p>If the message appears in connection with service or maintenance on the generator, a defective connection may be the cause.</p> <ul style="list-style-type: none"> <li>• Check the connections K64/1 and K64/2 on D13 and the K64 connection to the single tank, see page 140**.</li> <li>• Check cables K9 and K8, see page 140**.</li> <li>• Check main fuse U101, see page 140**.</li> <li>• Check the trigger pulses INV A and INV B to the inverter, page 140**.</li> <li>• Check the capacitance in the capacitor bank, see section "P03 - Capacitor bank and charging test".</li> <li>• Check the current to the single tank and compare it with the curves in section "Error diagnosis HT and single tank".</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
<b>Err 6</b>	During preparation or exposure	The rotating anode frequency cannot be maintained above 142 Hz.	<p>At preparation: The anode is accelerated for 2 s, the speed is measured. If the rotation is too slow, the acceleration phase is repeated and retested. If the rotation is still too slow or the anode loses speed, a message will be displayed.</p> <p>Remove K64 page 140** during the next test.</p> <ul style="list-style-type: none"> <li>• Activate the radiation release switch to the first level (preparation) and listen for the anode to start up; refer to page 150**.</li> <li>• Check that the following supply voltages are present on D4, +100 V, +15 V, +5 V DC, refer to page 150**.</li> <li>• Check that the trigger pulses are present at "ROT"; when the anode is accelerated, refer to page 150**.</li> <li>• Check that the measuring signals "ROT_VAL" on D4 and "ROT" on D1 are OK, refer to page 150**.</li> <li>• Turn off the unit and remove K61. Measure the stator winding in the power plug. <ul style="list-style-type: none"> <li>⇒ K61: 3-12 = 8 <math>\Omega</math></li> <li>⇒ K61: 1-2 = 5 <math>\Omega</math></li> </ul> </li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
<b>CAL 7</b>	During exposure	The exposure time is too long.	<p>The maximum exposure time is 2 s.</p> <ul style="list-style-type: none"> <li>• The exposure is normally interrupted earlier by "Err 5".</li> <li>• Check the capacitance in the capacitor bank, refer to section "P03 - Capacitor bank and charging test".</li> <li>• Check the filament heating, refer to section "P01 - Filament test".</li> <li>• Check the tube current in measuring point "MAPOS" on D1, see page 140 and 141.</li> <li>• Check the current to the single tank, see section "Error diagnosis HT and single tank".</li> </ul>
<b>Err 9</b>	During exposure	When measuring the kV value, a large high tension asymmetry is detected.	<p>Normally the kV value is symmetric around ground. The acceptable deviation is <math>\pm 19.5</math> kV. This corresponds to HTD <math>2.5 \text{ V} \pm 0.5 \text{ V}</math>.</p> <ul style="list-style-type: none"> <li>• Intermittent measurement cables or defective single tank.</li> <li>• Check the measurement cable K9 between D1 and the single tank, refer to page 140**.</li> <li>• Check the current to the single tank, refer to the section "Error diagnosis HT and single tank".</li> <li>• Measure the HTD signal on D1 and compare it with notes and curves on page 140 and 141**.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
<b>Use 10</b>	Generator ON. The message does not inter- rupt a running exposure.	The single tank tem- perature measured is > 55°C or < 15°C.	<ul style="list-style-type: none"> <li>• The generator is overheated and must cool down or the generator was stored in a cold room and must warm up prior to use.</li> <li>• Too high or too low environmental temperature.</li> <li>• As soon as the single tank temperature is &lt; 50°C, check the measurement circuit for the temperature; refer to page 140**, contact K9.</li> </ul>
<b>CAL 12</b>	During preparation	Stored filament value is lost.	<ul style="list-style-type: none"> <li>• Check the voltage in the backup battery, refer to page 110**. The battery should have a voltage &gt; 2.8 V</li> <li>• Check that the battery jumper is securely attached, see page 110**.</li> <li>• Make a new adaptation, see section "P10 - Fast adaptation".</li> </ul>
<b>CAL 13</b>	Generator ON	The voltage supply (60 V DC) to the fila- ment circuit is beyond its limit.	<ul style="list-style-type: none"> <li>• Check fuse U6 on D8, refer to page 160**.</li> <li>• Check the filament supply voltage +60 V DC, refer to page 160**.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1



Dis- played messages	Mode of operation	Cause	Possible reason
<b>CAL 14</b>	Generator ON	The voltage in the capacitor bank exceeds 360 V	<ul style="list-style-type: none"> <li>• Check the voltage level in the capacitor bank, see page 130**. Measure at measuring points "CAPPOS" and "CAPNEG" on D7.</li> <li>• Check if LED V12 on D7 is lit, see page 130**. Check all supply voltage on D7.</li> <li>• If the voltage is close to 360 V it can depend on the charger on D7. If the transistor in the Buck-converter is short-circuited, the current will flow until fuse U8 on D8 blows. Replace the D7 charging unit.</li> </ul>
<b>USE 15</b>	During preparation	The exposure switch has been in preparation position longer than 20 s***.	<ul style="list-style-type: none"> <li>• The user has kept the exposure release switch in preparation position longer than 20 s*** after the "Ready" light indicator indicates that preparation is ready (anode speed is correct).</li> <li>• If the fault returns continuously, check the exposure release handle, see page 140**.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

\*\*\* Max. preparation time is 10s if FW lower than V1.2 or V1.2E.

Tab. 1

Dis-played messages	Mode of operation	Cause	Possible reason
<b>Err 16</b>	Generator ON	The capacitors are charging too rapidly ( $>7$ V/s)	<ul style="list-style-type: none"> <li>• Check the capacitance in the capacitor bank, refer to section "P03 - Capacitor bank and charging test".</li> <li>• If the capacitance is too low, one or more capacitor rows are disconnected. If there is an internal error in a capacitor, the whole row is disconnected by a fuse, refer to page 130** and section "Capacitor bank".</li> <li>• If the error appears after working on the capacitor bank, it may be that the internal residual voltage in the modules was too high when they were connected to each other. This caused the fuse to blow, refer to page 130**.</li> </ul>
<b>Err 17</b>	Generator ON	The capacitors are charging too slowly ( $\leq 1.4$ V/s)	<ul style="list-style-type: none"> <li>• Check that S10 on D7 is switched off.</li> <li>• If the error appears after working on the capacitor bank, check the cabling and the connections to the capacitor bank, refer to page 130**.</li> <li>• Check fuse U8 on D8 and fuse U1 on D7.</li> <li>• Check the capacitance in the capacitor bank, refer to section "P03 - Capacitor bank and charging test".</li> <li>• Internal short-circuiting in a capacitor or in the capacitor bank, refer to section "Capacitor bank".</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
<b>Err 18</b>	Generator ON The kV value changes via the kV+ or kV- but- ton.	The change in volt- age level in the capacitor bank takes too long ( $>0.5$ s/V). Refer also to "Err 17".	<ul style="list-style-type: none"> <li>• Check whether S10 on D7 is switched off.</li> <li>• Check if any of the capacitors in the capacitor bank are defective. The output energy may be consumed by a defective capacitor, refer to section "Capacitor bank".</li> <li>• Check the signals "CHARGE_HIGH", "DISCHARGE" and "CHARGE_LOW", refer to page 130**. Check fuse U1 on D7, U5 and U8 on D8 and resistors R100 and R101.</li> </ul>
<b>CAL 19</b>	Generator goes ON before the ready lamp glows.	The leakage current in the capacitor bank is too large.	<p>The measurement is performed dur- ing charging at 150 V DC. Charging is interrupted for 5 s. If the voltage drops more than 1.6 V, a message will be displayed. See also "Err 17".</p> <ul style="list-style-type: none"> <li>• In cases where the generator has not been operated for several months, the leakage current in the capacitors has increased. Use the formation program P06, refer to section "P06 - Capacitor formation".</li> <li>• If the unit was in regular use before the message occurred, the error may result from increased leakage current or a damaged capacitor, refer to the section "Capacitor bank".</li> <li>• Check the capacitance in the capacitor bank, refer to the section "P03 - Capacitor bank and charging test". Refer also to page 130**.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis-played messages	Mode of operation	Cause	Possible reason
<b>USE 20</b>	During exposure	The exposure release switch was activated during the exposure. The exposure is manually interrupted.	<ul style="list-style-type: none"> <li>• The user activated the switch by mistake.</li> <li>• There may be a defective contact in the exposure release cable/handle. Check the function in the exposure release handle and the connections k11 and k1, refer to page 140**.</li> </ul>
<b>Err 21</b>	Generator ON	The measured value of the stand-by filament current has exceeded the limit.	<p>"FIL_VAL" on D1 shall be within 0.16 - 2.5 V when the filament is in stand by mode.</p> <ul style="list-style-type: none"> <li>• Check the supply voltages on D4, +60 V, +15 V and +5 V, refer to page 160**.</li> <li>• Check the pulses at measurement point "FIL" on D4, refer to page 160**.</li> <li>• Check the value in "FIL_VAL" on D1, refer to page 160**.</li> <li>• Check the connection between D4 and the filament transformer, refer to page 160**.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
Err 22	Preparation	The exposure/ preparation filament current is not stabile.	<p>If the exposure filament level is OK ,it should stabilize within 3 s.</p> <ul style="list-style-type: none"> <li>• Check the voltages on D4, +60 V, +15 V and +5 V, refer to page 160**.</li> <li>• Check the connection between D4 and the filament transformer (K60), refer to page 160**.</li> <li>• Check the trigger pulses in measurement point "FIL" on D4, refer to page 160**.</li> <li>• Check the value in "FIL_VAL" on D1. The value must be stabile in stand-by filament. After change-over to preparation, the value should stabilize again.</li> <li>• Refer also to the section "P01 - Filament test".</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
Err 23	During exposure	The HT inverter has been interrupted several times, e.g. overcurrents.	<p>When the HT inverter has been interrupted more than 3 times, the exposure will be interrupted.</p> <ul style="list-style-type: none"> <li>Faulty inverter/inverter control</li> <li>Check the inverter current, refer to the section "Error diagnosis HT and single tank".</li> <li>The X-ray tube may have arced during the exposure. If the first exposure after a long interval is an exposure with high kV values, tube arcs can occur.</li> </ul> <p>The unit has to be started with several exposures at high mAs values. The kV values selected should be from 40 kV increased to 133 kV.</p> <p>Refer also to the section "Error diagnosis HT and single tank".</p>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
<b>USE 24</b>	During exposure	The last selected kV and/or mAs value is lost. The value has been replaced with 40 kV and 0.5 mAs.	<ul style="list-style-type: none"> <li>• The X-ray tube may have arced several times, which temporarily disrupted the control system.</li> <li>• Check the voltage in the backup battery &gt;2.8 V, refer to page 110**.</li> <li>• Check that the battery jumper is attached, refer to page 110**.</li> <li>• If the error occurs repeatedly, the single tank must be inspected according to the section "kV and single tank error diagnosis". If the single tank is working properly and the backup battery with battery jumper are okay, replace D1. Refer to page 110** and 140**.</li> </ul>
<b>USE 25</b>	Generator ON	The calculated load of the anode target has been lost .	<p>The value is lost from CMOS memory. See also CAL 31.</p> <ul style="list-style-type: none"> <li>• Check all supply voltages on D1, see page 110**.</li> <li>• Check that the battery jumper is properly mounted and that the voltage in the backup battery is &gt; 2.8 V, refer to page 110**.</li> <li>• A tube arcing has caused a temporary disturbance of the control system.</li> <li>• If the error occurs repeatedly, the single tank must be inspected according to the section "kV and single tank error diagnosis". If the single tank is working properly and the backup battery with battery jumper are okay, replace D1. Refer to page 110** and 140**.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis-played messages	Mode of operation	Cause	Possible reason
<b>CAL 26</b>	Generator ON	The CMOS memory cannot be read or programmed.	<ul style="list-style-type: none"> <li>• Check all supply voltages on D1, refer to page 110**.</li> <li>• Check the voltage in the backup battery (&gt;2.8 V) and the battery jumper, refer to page 110**.</li> <li>• If all power supply voltages are present, the error is probably on D1. If the message "CAL 26" occurs repeatedly or if the message can not be acknowledged by pressing kV+ or switching the unit OFF and ON, replace D1.</li> </ul>
<b>CAL 27</b>	Generator ON during start-up	Error in ROM memory. Check sum is not correct.	<ul style="list-style-type: none"> <li>• Check that all supply voltages on D1 are present, refer to page 110**.</li> <li>• The ROM containing the program is defective. Replace the software (IC's I72, I66 and I74) on D1 ; refer to page 110**.</li> <li>• If the error occurs again after replacing I72, I66 and I74, D1 should be replaced.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1



Dis- played messages	Mode of operation	Cause	Possible reason
<b>CAL 28</b>	Generator ON during start-up	An error was detected during pro- gram execution. The program is inter- rupted.	<ul style="list-style-type: none"> <li>• Check that all supply voltages on D1 are present, refer to page 110**.</li> <li>• If CAL 28 occurs again or remains displayed: the ROM containing the program may be defective. Replace the software (IC's I72, I66 and I74) on D1 ; refer to page 110**.</li> <li>• If the error remains after replacing the software, D1 should be replaced.</li> <li>• Enter the cause and the error message "CAL 28" in the service protocol.</li> </ul>
<b>CAL 29</b>	Generator ON	The single tank is not correctly con- nected.	<ul style="list-style-type: none"> <li>• The single tank is missing or the cable harness is incorrectly connected.</li> <li>• Check that connection K9 on D1 is connected.</li> <li>• Check for possible damage in the main cable harness between D1 and the single tank. Measure K9: 13-4 and move the arm and single tank while the connections are being measured. See page 140**. If damage is detected, replace the main cable harness (both cables). Refer to the section "Replacement of the arm cable harness".</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis-played messages	Mode of operation	Cause	Possible reason
<b>USE 30</b>	Generator ON	The portion of the CMOS memory where the customer kV and mAs limit values are stored, was erased.	<ul style="list-style-type: none"> <li>• The pre-programmed values are replaced with MOBILETT standard values. Refer also to "CAL 31".</li> <li>• Check the supply voltage on D1, see page 110**.</li> <li>• Check that the voltage in the backup battery is &gt; 2.8 V and that the battery jumper is connected. Refer to page 110**.</li> <li>• If the message appeared once it may indicate a tube arc which has disturbed the system. If the "USE 30" message occurs repeatedly, the single tank must be checked according to Error diagnosis HT and single tank. If the function of the single tank is OK and "USE 30" appears repeatedly, replace D1.</li> </ul> <p>If necessary, reinstall the customer kV and mAs limit values. Refer to the section "P14 - Number of kV steps and upper kV limit and P15 - Upper mAs limit".</p>
<b>CAL 31</b>	Generator ON	The voltage in the backup battery on D1 is below 2.8 V	<ul style="list-style-type: none"> <li>• The battery is worn out.</li> <li>• The battery jumper J1 on D1 is lost or has bad connection.</li> <li>• To change a battery, refer to the section on replacing the backup battery.</li> </ul>
<b>Err 32 Not used</b>			

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
<b>Err 33</b> The mes- sage is not shown to the opera- tor.	Generator ON	Temporary signal fault during the pro- gram execution.	<ul style="list-style-type: none"> <li>• "Err 33" messages can be ignored. This message can only be read out from the message history, P08. <b>The message is only used as aid for the software development.</b></li> <li>• Acknowledge and clear the mes- sage history.</li> </ul>
<b>Err 34</b> The mes- sage is not shown to the opera- tor. This message can only be read out from the mes- sage his- tory, P08.	Generator ON	The number of mes- sages is beyond the maximum limit.	<p>Messages are being lost and not dis- played for the customer. All mes- sages are stored in the error memory.</p> <ul style="list-style-type: none"> <li>• Using section "P08 - Display of message protocol ", display and record the messages contained in the error memory. Using the error message list, try to determine which module, board, etc. is generating the messages.</li> </ul>
<b>Err 35</b>	Generator ON	Temporary fault in the program execu- tion, which was cor- rected by the "watch dog"	<ul style="list-style-type: none"> <li>• Check the supply voltages on D1, see page 110**.</li> <li>• If the message appeared once, it may have been caused by a tube arc that disturbed the program execution. If the message "Err 35" occurs repeatedly, the single tank must be checked according to "Error diagnosis HT and single tank". If the function of the single tank is OK and "Err 35" appears several times, replace D1.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis-played messages	Mode of operation	Cause	Possible reason
<b>Err 36</b> The message is not shown to the operator. This message can only be read out from the message history, P08.	Generator ON	The inverter was interrupted once, e.g. overcurrent.	If the inverter has been stopped more than 3 times, the exposure will be interrupted and the Err 23 message is shown on the display. <ul style="list-style-type: none"> <li>• Check the inverter current, refer to the section "Error diagnosis HT and single tank". Refer also to "P13 - Inverter test".</li> <li>• The X-ray tube may have arced during the exposure. If the first exposure after a long interval is an exposure with high kV values, tube arcs can occur. The unit has to be started with several exposures at high mAs values. The kV values selected should be from 40 kV increased to 133 kV. Refer also to "Error diagnosis HT and single tank".</li> </ul>
<b>Err 37</b> The message is not shown to the operator. This message can only be read out from the message history, P08.	Generator ON	The error message history is lost. It is indicated with 0's and "Err 37".	<ul style="list-style-type: none"> <li>• Check the supply voltage on D1, see page 110**.</li> <li>• Check that the voltage in the backup battery is &gt; 2.8 V and that the battery jumper is connected, refer to page 110**.</li> <li>• If the message appeared once, a tube arc may have disturbed the program. If the "Err 37" occurs repeatedly, the single tank must be checked according to section "Error diagnosis HT and single tank". If the function of the single tank is OK and "USE 37" appears repeatedly, replace D1.</li> </ul>

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

Dis- played messages	Mode of operation	Cause	Possible reason
<b>Err 38</b> The mes- sage is not shown to the opera- tor. This message can only be read out from the mes- sage his- tory, P08.	Generator ON	The error statistics are lost.	See "Err 37". If <b>"Err 38" is the only message in the history memory, it will not be necessary to replace D1.</b> These statistics are only used in the factory.
PC Node		The switch S:1 on board D1 is set in the wrong position.	This mode is only used at the factory. To quit this mode; put switch S1:2 in the OFF position.

\* See section "Monitoring the kV- and mA-controls"

\*\* Wiring diagram X037E

Tab. 1

## Monitoring the kV- and mA-controls

### \* Note on Err 3, Err 4 and Err 5:

Under the following conditions, the corresponding Err.. message is signaled:

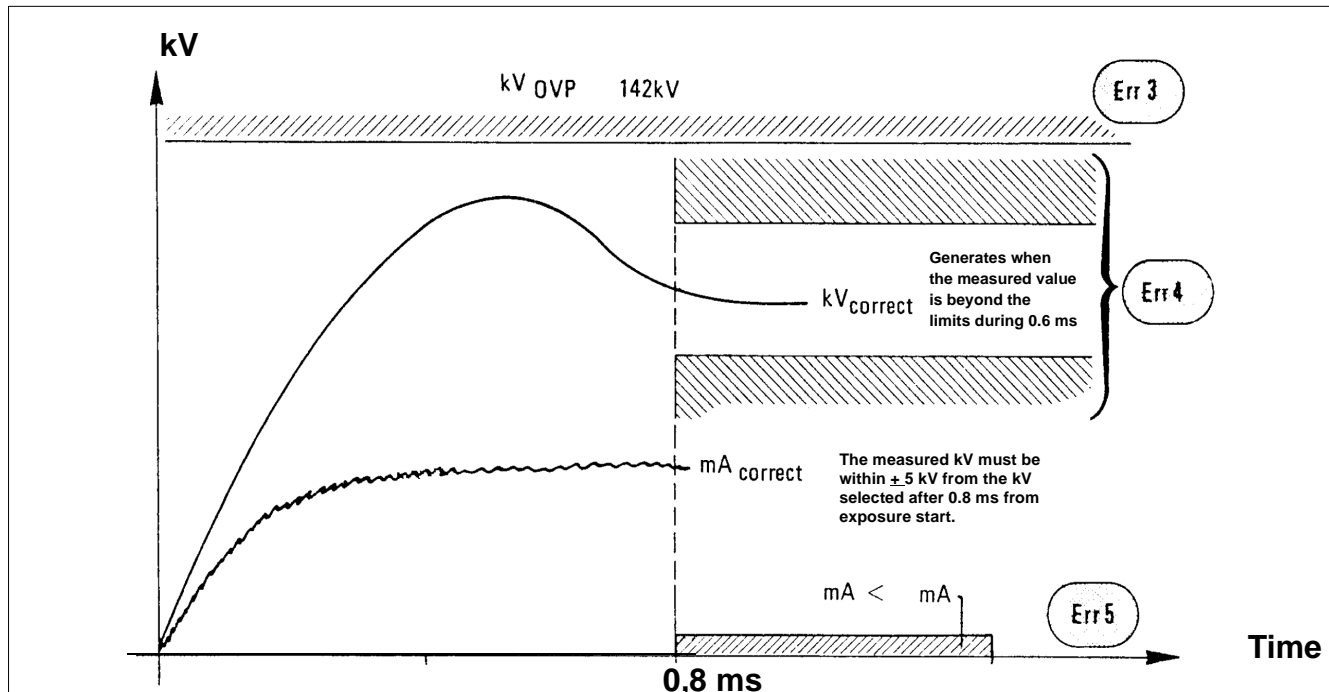


Fig. 1

### NOTE:

A change in heating value may be due to the following causes:

1. Measurement error in the kV measuring circuit.
  - a. too high +  $kV_{actual}$  value results in **increased** heating value (positive correction)
  - b. too low +  $kV_{actual}$  value results in **decreased** heating value (negative correction)
2. Change in generator output.  
 This may occur when exchanging the inverter or the single tank. In each case, the heating values must be readjusted and recorded (refer to P10 and P07 in the service program).
  - a. If the generator output is increased, this results in an increase in heating value.
  - b. If the generator output decreases, the heating value will be decreased.

Any change of the tube current involves a change in exposure time ( $mAs = i \times t$ )!

## List of displayed messages

Err 3	Overvoltage >142 kV
Err 4	Poor kV regulation
Err 5	No tube current
Err 6	Anode speed too slow
CAL 7	Exposure time too long
—	—
Err 9	High-tension asymmetry
USE 10	Single tank >55° or <15°C, measured at the location of the temperature sensor
—	—
CAL 12	Values in CMOS memory lost
CAL 13	Filament voltage, 60 V DC on D4 not present
CAL 14	Overvoltage in the capacitor bank (>360 V)
USE 15	Preparation level held by the user >20 s*
Err 16	Capacitor bank charging too fast
Err 17	Capacitor bank charging too slow
Err 18	Capacitor voltage charging too slowly
CAL 19	Leakage current too high in the capacitor
USE 20	Radiation release button was released during the exposure
Err 21	Filament current incorrect for stand-by
Err 22	Filament current incorrect for exposure
Err 23	During exposure, the main inverter was interrupted >3 times
USE 24	The selected kV and mAs values are lost
USE 25	The calculated anode load is lost
CAL 26	Error in RAM
CAL 27	Error in ROM
CAL 28	Error in the operating system
CAL 29	No single tank connected or an error in the connection
USE 30	The customer values stored in CMOS memory are lost
CAL 31	Replace backup battery <2.8 V.
—	—
—	—
Err 34	Error log overfull
Err 35	Watchdog responded

\* Max. preparation time is 10 s if the FW version is lower than 1.2 or 1.2E.

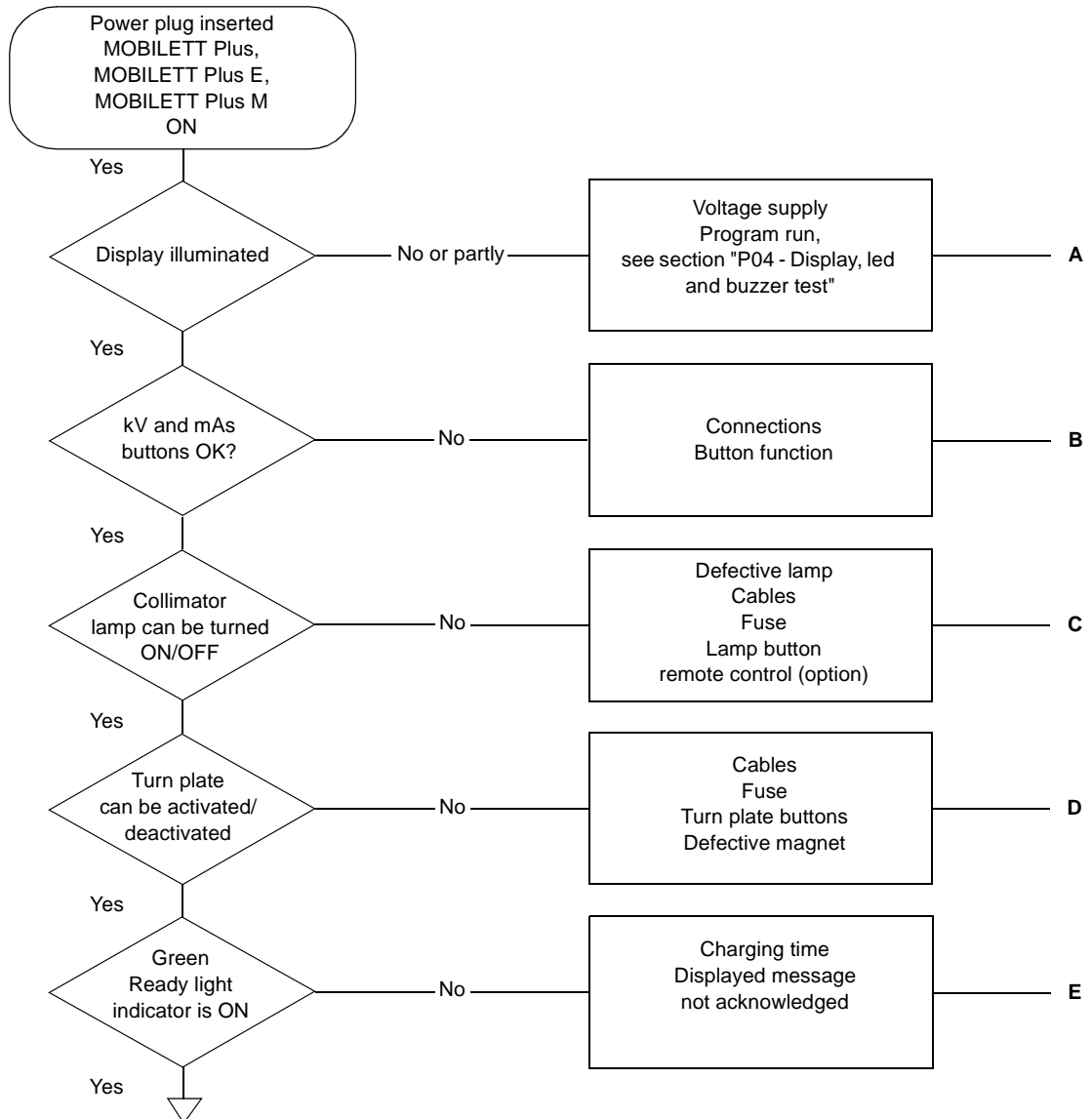
**List of messages in the error memory**

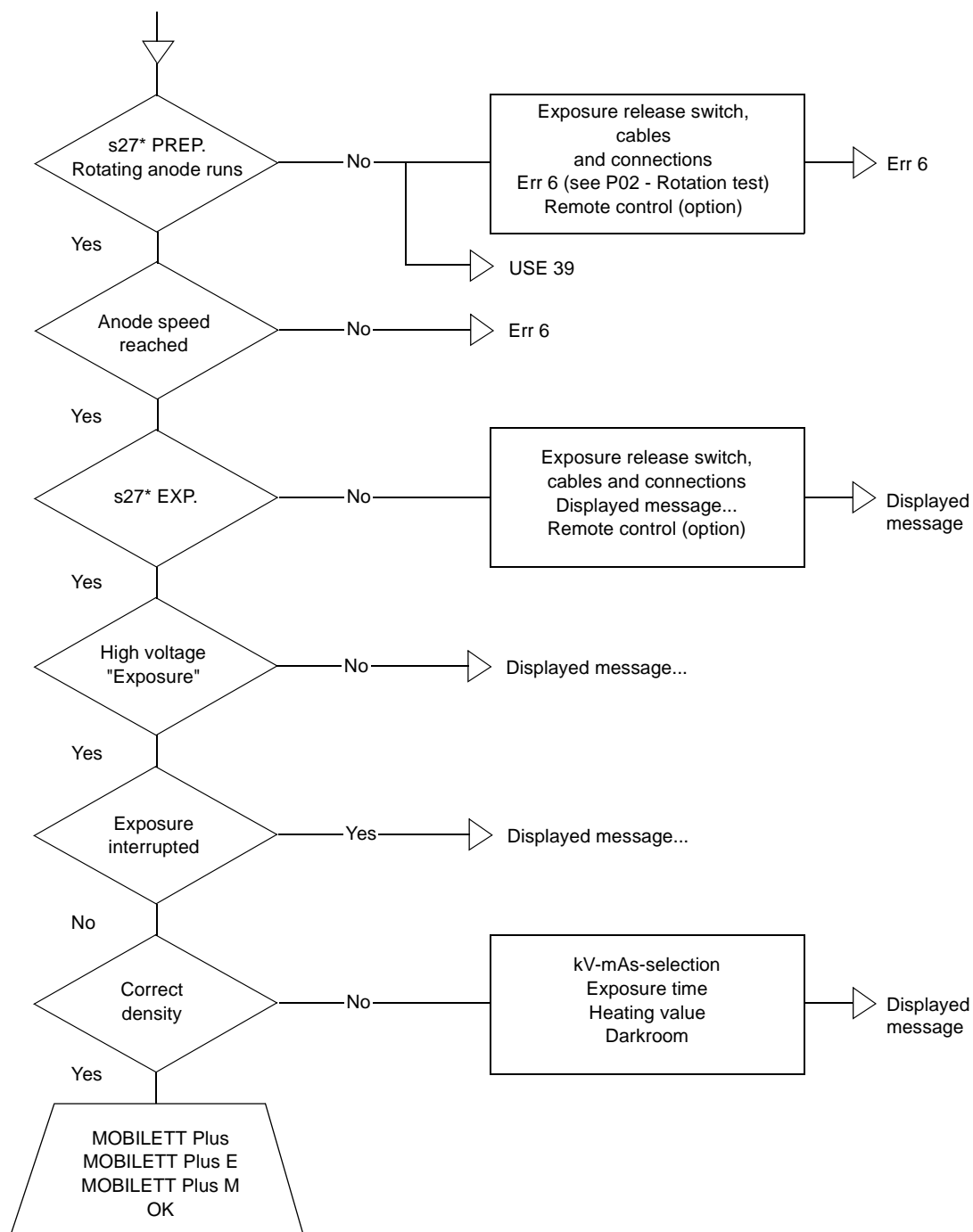
Err 33	Signal fault during program execution
Err 36	Overcurrent in HT inverter
Err 37	Error memory contents lost
Err 38	Error statistics lost



This chart shows the sequence beginning with the generator start, the exposure release and ends with the developed X-ray film. Potential errors are mentioned in the function box.

Additional hints that may be helpful during troubleshooting are listed under A-E in the section "Troubleshooting instructions".





\* S27 is the exposure release switch. First step = PREP, second step = EXP.

- A**
  - Look for a small red light to the right at the kV display. The light indicates that the program is in the start-up phase.
  - If there is neither a small red light nor text on the display, it indicates that the voltage supply is missing. Check the mains connection and the main fuses, see wiring diagram, page 20, K6.
  - Test the voltage supply to the CPU board and the display board, see wiring diagram X037E, page 110, and 120.
  - Check that all connectors on D8, D1 and D3 are connected.
  - Check that the Reset LED on D1 is not lit; refer to the circuit diagram on page 110, V33. If it lights continuously, there is an error on board D1.
  - Check the voltage supply on D1 and D3. Refer to wiring diagram, page 110 and 120.
- B**
  - Check button functions. Refer to the wiring diagram, page 120 and 180.
- C**
  - Press the collimator lamp button and listen for a "click" from LR1, refer to the wiring diagram, page 180.
  - If no "click" is heard, check the voltage supply on D4.
  - Check the measuring point "LAMPON". If there is no signal, check k5, k9, k3 and k2.
  - If a "click" is heard, check the voltage supply in the lamp bracket, refer to the wiring diagram, page 180.

## ***MOBILETT Plus and Plus M only***

- D**
  - Press the turn plate button and check if a "click" is heard from MR1 and MR2, refer to the wiring diagram, page 170. If a "click" is heard, check the voltage in K68:1-2 and compare it with the references given in the wiring diagram. Check the resistance in the turn-plate magnet as well, refer to the wiring diagram, page 170.  
If no "click" is heard, check the voltage supply on D4 and measuring points "PIVOTON" and "PIVOTHOLD". If there are no signals check k1, k5 and the buttons.

- E**
  - After exposures with high mAs values, there is a delay for the ready light indicator until it lights again. The delay is to distribute the temperature in the anode target sufficiently and to allow time for the capacitor bank to charge.  
During start-up, it can take up to 90 s before the ready light indicator lights. A message will be displayed if the ready light indicator does not light.

### **NOTE**

**If the MOBILETT Plus is equipped with a remote exposure switch system, please see Installation Instruction: Installation of remote exposure switch system.**

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## Entering service mode

- Remove the top cover.

To activate the service program, adjust the switch to the service position (S1:1 -> ON, on board). This will display the program version:

kV mAs

**vEr x.x** = Version x.x (depends on software version installed)

Exit the service mode by adjusting the switch to the operating position (S1:1 -> OFF on board D1). This will cause program execution to be aborted.

## Selecting test programs with the kV+/- buttons

There are 13 different test programs available. The display shows the program number in the kV window, the mAs display will be dark. Example, program 06:

kV mAs

**P06**

Pressing the "kV+" button will display the next test program. When the last test program is displayed, pressing the "kV+" button will show the program version again and so on. Pressing the "kV-" button will display the previous test program. The lamp button has a toggling function and is used both to start and stop the displayed test program. For example, after the lamp button has been pressed, the formation of the capacitor bank starts and the following is shown on the display:

kV mAs

**CAP For** = Capacitor formation program

The test program can be stopped by pressing the lamp button a second time. After the lamp button is pressed, the display shows:

kV mAs

**P06 StoP**

The program P06 has ended and a new service program can be selected with the kV+/- buttons or P06 can be started with the lamp button.

## Error messages in service mode

Messages appearing in service mode, except in "Fast adaptation" are only displayed, they are not logged into the memory history.

## List of test programs available in service mode

### P01 - Filament test

(Wiring diagram X037E, page 160)

At the beginning of the program, the tube is heated for 5 seconds in stand-by mode, followed by 12 seconds at high heating. During the test "FIL\_VAL" is checked and must be stable and within the limits. During the test the display shows:

kV mAs

**FIL tESt** = Filament test

If an error is detected, the test program will be aborted. An audible beep will sound and a message will be displayed:

kV mAs

P01 **Err 22** = Filament preparation error

P01 **Err 13** = Filament supply error

If the test ends successfully, the display will show:

kV mAs

**P01 PASS** = Filament test in program P01

Duration: Max. 20 seconds.

### P02 - Rotation test, if the FW version is higher than 1.4 or 1.4E

(Wiring diagram X037E, page 150)

Accelerates the anode with a 160 Hz control signal during two seconds. After this first acceleration, the speed is measured and if necessary, a second acceleration of two seconds is made. When the correct speed is reached, the anode will rotate freely for 20 seconds or until the rotation frequency is below 142 Hz before it is braked during 9 seconds to a stop. An error message will be displayed after two unsuccessful attempts to accelerate the anode or if the anode loses speed too fast. When the test is activated, the display shows:

kV mAs

**Rot tESt** = Rotation test

After acceleration, the display shows the actual rotation frequency:

kV mAs

**Rot 143** = Rotation frequency 143 Hz: Normal value 158 Hz. Min. value 142 Hz.

If an error is detected, the test program will be aborted, an audible beep will be signaled and a message will be displayed:

kV mAs

**P02 Err 6** = Rotation error

If the test ends successfully, the display shows:

kV mAs

**P02 PASS** = Rotation test passed in program P02

## P02 - Rotation test, if the FW version is lower than 1.5 or 1.5E

(Wiring diagram X037E, page 150)

Accelerate the anode with a 150 Hz current during two seconds. After this first acceleration, the speed is measured and if necessary, a second acceleration of two seconds occurs. When the correct speed is reached, the anode will rotate freely for 10 seconds\* before it is braked during 7 seconds\*\* to a stop. An error message will be displayed after two unsuccessful attempts to accelerate the anode. When the test is activated, the display shows:

kV mAs

**Rot tES** = Rotation test

After acceleration, the display shows the actual rotation frequency: If an error is detected,

kV mAs

**Rot 143** = Rotation speed 143 Hz: Normal value 149 Hz. Min. value 142 Hz.

the test program will be aborted, an audible beep will be signaled and a message will be displayed:

kV mAs

**P02 Err 6** = Rotation error

If the test ends successfully, the display shows:

kV mAs

**P02 PASS** = Rotation test passed in program P02

\* 20 seconds if FW lower than V1.2 or V1.2E

\*\* 9 seconds if FW lower than V1.4 or V1.4E

**P03 - Capacitor bank and charging test**

(Wiring diagram X037E, page 130)

When the test is started the display will show:

kV    mAs

**CAP tES**t = Capacitor test

During the test, the capacitor voltage is displayed except when the capacitance is shown. The capacitor will first be charged to 350 V, then discharged to 229 V.

kV    mAs

**CAP 350** = 350 Volt

The voltage will be held for 5 seconds before it is restored to 350 V. During the test, the voltage in the capacitor bank is indicated, except when the capacitance is displayed:

kV    mAs

**CAP 0.31 F** = Capacitance 0.31 Farad

If an error is detected, the test program will be aborted. An audible beep will be signaled and a message will be displayed:

kV    mAs

**P03 Err"xx"** = See actual "xx" in separate displayed message list

If the test ends successfully, the display will show:

kV    mAs

**P03 PASS**

Duration: Approx. 1.5 minutes.

**P04 - Display, led and buzzer test**

(Wiring diagram X037E, page 120)

When the test starts, both displays are dark. Then the displays lights in sequence, beginning with the outermost character. The following characters are lit in the same way until all segments are on. The ready and exposure LED's light up in sequence and the test ends with an exposure beep. After a short time, the sequence is repeated. When ending the test with the lamp button, the displays returns to P04 mode.



**P05 - "Automatic" Maintenance test**

**Only valid if the FW version is lower than 1.5 or 1.5E.**

This test is a summary of tests made in test program P01 to P04.

These tests will, once started, run automatically. Observe the display during the test. If errors are detected during the tests, P05 is interrupted, a message will be displayed and an audible beep will be heard. The following describes the test sequence:

- A.     **(P04)** Display test. Visually check that the display and the LED's lights and listen for the buzzer to sound.
- B.     **(P01)** Filament test. If the test ends successfully, a message will be displayed for 4 seconds:  
  
      **FIL   PASS** = The filament part of the test is passed.
- C.     **(P02)** Rotation test. During the test, the actual rotation frequency is displayed. If the test ends successfully, a message will be displayed for 4 seconds:  
  
      **red   PASS** = The rotation part of the test is passed.
- D.     **(P03)** Capacitor bank and charging test. During the test, the actual voltage in the capacitor bank is displayed. If the test ends successfully, a message will be displayed for 4 seconds:  
  
      **CAP   PASS** = The capacitor part of the test is passed.
- END.**   If the tests B-D end successfully, the program will be ended and the display will show:  
  
      **P05   PASS** = The automatic section (A not included) of the tests is OK.  
  
      If there was an error during the test, P05 is stopped and the display will show:  
  
      **P05   Error xx** = The test result is "not valid" . See individual test programs.

**P06 - Capacitor formation**

(Wiring diagram X037E, page 130)

This program is used only if the unit has not been operated for several months or if several capacitors have been replaced. The capacitors are slowly charged up to 353 V in a controlled sequence. The test program starts by displaying:

kV   mAs

**CAP For** = Capacitor formation program

After a short time, the program displays the actual voltage in the capacitor bank:

kV   mAs

**CAP 150** = 150 Volt.

Approximately every six minutes, the voltage value is increases. The charging sequence increases as follows:

150-250-299-325-337-345-348-351-353 V. At the 353 V level, the charging will continue for another 48 minutes to decrease and stabilize the capacitors internal leakage current. If an error is detected during the formation program, the program is aborted. When the program is aborted, there is an audible beep and a message is displayed:

kV mAs

**P06 Err"xx"** = See actual "xx" in separate message list

If the formation ends successfully, the display will show:

kV mAs

**P06 PASS** = Capacitor formation completed

Duration: Approx. 100 minutes.

### P07 - Query filament values from the battery-backed RAM

The kV-values are displayed in the "kV" field. The corresponding filament values are displayed in the "mAs" field. Pressing the "kV +" button will display the next higher kV and corresponding filament value and vice versa with "kV -".

The program starts at 40 kV in the table containing the filament values. The program shows only the selected number of kV steps (25 or 49 for MOBILETT Plus/Plus M and 24 or 47 for MOBILETT Plus E).

The kV is changed in steps by briefly depressing the "kV + or kV -" buttons. By keeping the buttons pressed, the kV value will be continuously stepped up or down.

The generator filament values are self-adjusted to produce a kV value with minimum deviation. If the software was optimized, a filament value for a specific kV value was indicated with the letter "A" in the extreme right position on the mAs display.

### P08 - Display the message history

The history contains two parts. The first is the appearance number and the second the actual message. The appearance number will be displayed in the "kV" field. The corresponding message will be displayed in the "mAs" field. Pressing the "kV +" button will display the next higher number and corresponding message and vice versa with "kV -". The program starts by showing the latest message in the history. If there are no messages the display will show:

kV mAs

**0 Error** = Message history empty

The latest message has the highest number, for example:

kV mAs

**20 CAL13** = There are total 20 new messages, number 20 is "CAL 13".

To exit P08, use the "lamp" button.

**P09 - Clear the message history****NOTE**

When this program is run, the history will be cleared and the file will be empty. Use program P08 and record all messages before using program P09.

Activate the program with the "lamp" button. The display shows:

kV    mAs

**P09   CLEAR**

To clear the message history, press the "mAs +" button for 5 seconds. The program confirms that the history is clear:

kV    mAs

**0    Error = Message history empty**

After the message clears, the program is ended.

**P10 - Fast adaptation**

This program is run after replacing the single tank or if the memory loses the values programmed. The user must make a number of exposures.

The generator calculates and stores the optimized filament values for each kV value from these exposures.

After activating the program, the user must press the exposure button every time the ready light indicator lights. The program starts at a low kV value and when the actual value is stable, it increases to the next kV value automatically.

**Example:**

kV    mAs

**40   Ad Pr = Generator in adaptation mode**

During the adaptation, some messages may appear, most of these can be ignored since the generator has incorrect filament values. However, check every message against the message list, and confirm them by pressing the "kV +" button. When the generator is ready with an adaptation on a kV value, it continues to the next value. When the adaptation is finished, the program will stop and the display will show:

kV    mAs

**P10   PASS = Adaptation program completed**

**P11 - Backup battery test**

(Wiring diagram X037E, page 110)

After activating the program, it will display the battery voltage:

kV    mAs

**bAt 3.2** = 3.2 Volt

When the battery voltage is <2.8 V, the battery needs to be replaced. Refer to the section "Replacement of backup battery". After 5 seconds, the program will be aborted. If the battery voltage is too low, there will be a message displayed with a message beep:

kV    mAs

**P11 CAL 31**

If the battery voltage is OK, the display will show:

kV    mAs

**P 11 PASS** = Battery OK

**P12 - Inverter and single tank test**

Only available if the FW version is lower than or the same as 1.5 or 1.5E.

(Wiring diagram X037E, page 140)

The program is activated with the "lamp" button. Wait for the ready light indicator.

When the "exposure" switch is pressed the test program makes an "exposure" without filament heating and rotation. The "exposure" will be approximately on 90 kV and the duration is 10 ms.

During the test the display shows:

kV    mAs

**Ht tEst** = High tension test

To repeat the "exposure" just press the button a second time. The test can be stopped by pressing the lamp button.

**NOTE**

**During the "exposure" the inverter pulses are fixed and no kV regulation is active. The capacitor bank has a reduced voltage level during the test. The voltage is reduced to 150 V during the test.**

**P13 - Inverter test**

Only available if the FW version is lower than or the same as 1.5 or 1.5E.

Wiring diagram X037E, page 140)

**NOTE**

**When the test is started, it will take approximately 5 minutes to reduce the voltage in the capacitor bank. The ready light indicator indicates when the unit is ready for test.**

The main purpose of the test is to check the gate pulses on the transistors in the main inverter. Each time the exposure button is pressed, the program runs the main inverter for 10 ms. During the test, there is no filament heating or rotation activated and the voltage in the capacitor bank is <10 V. The display shows the following:

kV mAs

**Inv tEst** = Inverter test

The test is stopped with the lamp button.

**P14 - Number of kV steps and upper kV limit**

The program consists of two parts. The number of kV steps is selected in the first part and a kV limit is selected in the second part. When the first part is finished, the second starts automatically.

The first part, selecting the number of steps:

In this program, it is possible to choose between a fixed number of 25 or 49 steps for MOBILETT Plus/Plus M and 24 or 47 steps for MOBILETT Plus E. The number of steps corresponds to Siemens point scale with integer points or half integer. The factory setting is 25 steps for MOBILETT Plus/Plus M and 24 steps for MOBILETT Plus E. To change or check the valid setting, activate the program with the lamp button.

The display shows the selected number of kV steps, change with kV + or - buttons.

**Example:**

kV mAs

**25 StEPS** = 25 kV steps selected

Pressing the lamp button stores the currently displayed values and activates the second part.

The second part of P14 is the selection of the upper kV limit:

The display shows the selected highest available kV (min. 40 and max. 133 kV). This can be changed with the kV + or - buttons.

**Example:**

kV mAs

**133 SEt** = kV values up to 133 kV is allowed.

Pressing the lamp button stores the currently displayed values and also exits the program P14.

**NOTE**

**Always check that the values selected correspond to the desired values after exiting the service program.**

---

**P15 - Upper mAs limit**

The program enables you to set the upper mAs limit. The available range is 0.5 - 200 mAs for MOBILETT Plus/Plus M and 0.5 - 100 for MOBILETT Plus E. The maximum mAs value depends on the actual kV but can be additionally limited. When selecting an mAs limit value, all prior higher mAs values will be blocked and vice versa.

To change or check the highest available mAs, activate the program with the lamp button. The display shows the selected mAs limit, change with mAs + or mAs - buttons.

**Example:**

kV    mAs

**SEt 100** = The mAs value is limited to 100 mAs

Press the lamp button to store and currently displayed values and to exit P15.

**P16 - Show the exposure counter**

This program is activated by the lamp button and shows the actual number of exposures.

**Example: 1**

kV    mAs

**599** = The number of exposures is 599.

**Example: 2**

kV    mAs

**1 15055** = The number of exposures is 115.055

Exit the program by pressing the lamp button.

**NOTICE**

**The exposure counter can not be cleared via any of the service programs. The value is stored in the CMOS memory.**

**If the backup battery is depleted, the value could be lost.**

---



## Tests and measurements in the high voltage circuit

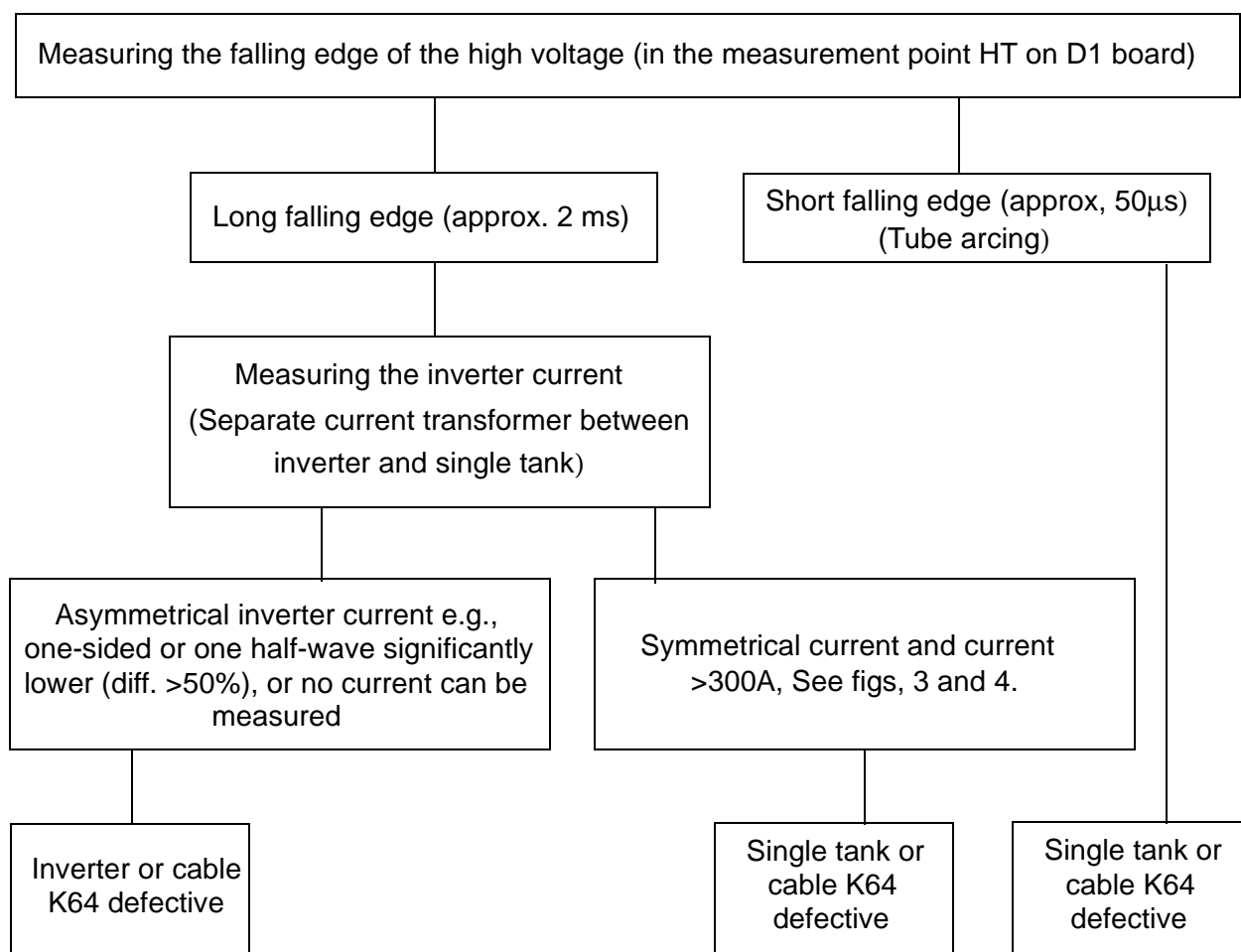
- Connect the oscilloscope measurement cables to measuring points HTPOS and HTNEG or HT on D1.
- Adjust the trigger point to the falling edge of the high voltage curve and set the time to 20 - 50 ms/Div.
- If the high voltage cannot be displayed, check the tube current at measurement point MAPOS on D1. Check the inverter current with an external current transformer.
- Measure HTPOS and HTNEG on D1. Record the fall times (90 - 10% of HT), high voltage levels and whether the exposure was interrupted prematurely. Compare with fig. 2 "HT signal, inverter and single tank normal".
- Measure the inverter current using an external current transformer and the HT. Compare with fig. 1 "HTPEAK and inverter current, inverter and single tank normal".
- In case of an error, compare the oscillogram with Fig. 1 "HTPEAK and inverter current, inverter and single tank normal"

### Malfunction in the inverter or single tank

The following procedure will help you to determine whether the problem is caused by the inverter or the single tank.

**The current flow between the inverter and the single tank must be approx. symmetrical. If this is not the case, the inverter is defective.**

Measure the resistance between K63/POS and K64/1 or K64/2 or K63/NEG and K64/1 or K64/2. The value must be larger than 0.5 Mohm. If the value is less than 100 ohms, the inverter is defective (transistors in the modules are bad).



#### NOTE

**The inverter current is always measured using a separate current transformer between the inverter and single tank. The procedure is described in the training video.**



## Overview

Faulty curve	Possible causes	What to do
Inverter current normal HT+ discharges	Defective tube Defective high voltage capacitor (+) Arching to ground on plus side	Replace single tank
Inverter current normal High speed HT - discharges  Figures 7 and 8	Defective tube Defective high voltage capacitor (-) Defective filament transformer Defective insulation on the wires to the cathode Arcing to ground on minus side	Replace single tank
Inverter current normal High speed HT+ and HT- discharges  Figure 6	Defective tube Defective high voltage capacitor (-) Arcing between plus and minus side	Replace single tank
Abnormal inverter current; e.g. triangle shaped HT-discharges  Figures 9 and 10	Defective high voltage transformer Defective diode strip Defective tube	Replace single tank
Abnormal inverter current e.g. asymmetric  Figure 10	Defective inverter	Replace inverter
Very low tube current (Normal inverter current) (Err 5)	Connection K64/1 and K64/2 reversed between D13 and single tank	Connect K64/1 and K64/2 properly
Full output voltage not obtained after adaptation	Defective high voltage transformer	Replace single tank
Rapid series of voltage peaks (increasing voltage)	Arcing in HT measurement resistor or series resistor	Replace single tank

Exposure values: 90 kV 2.0 mAs, "HTPEAK" 20 kV/div, Inverter current 100 A/div

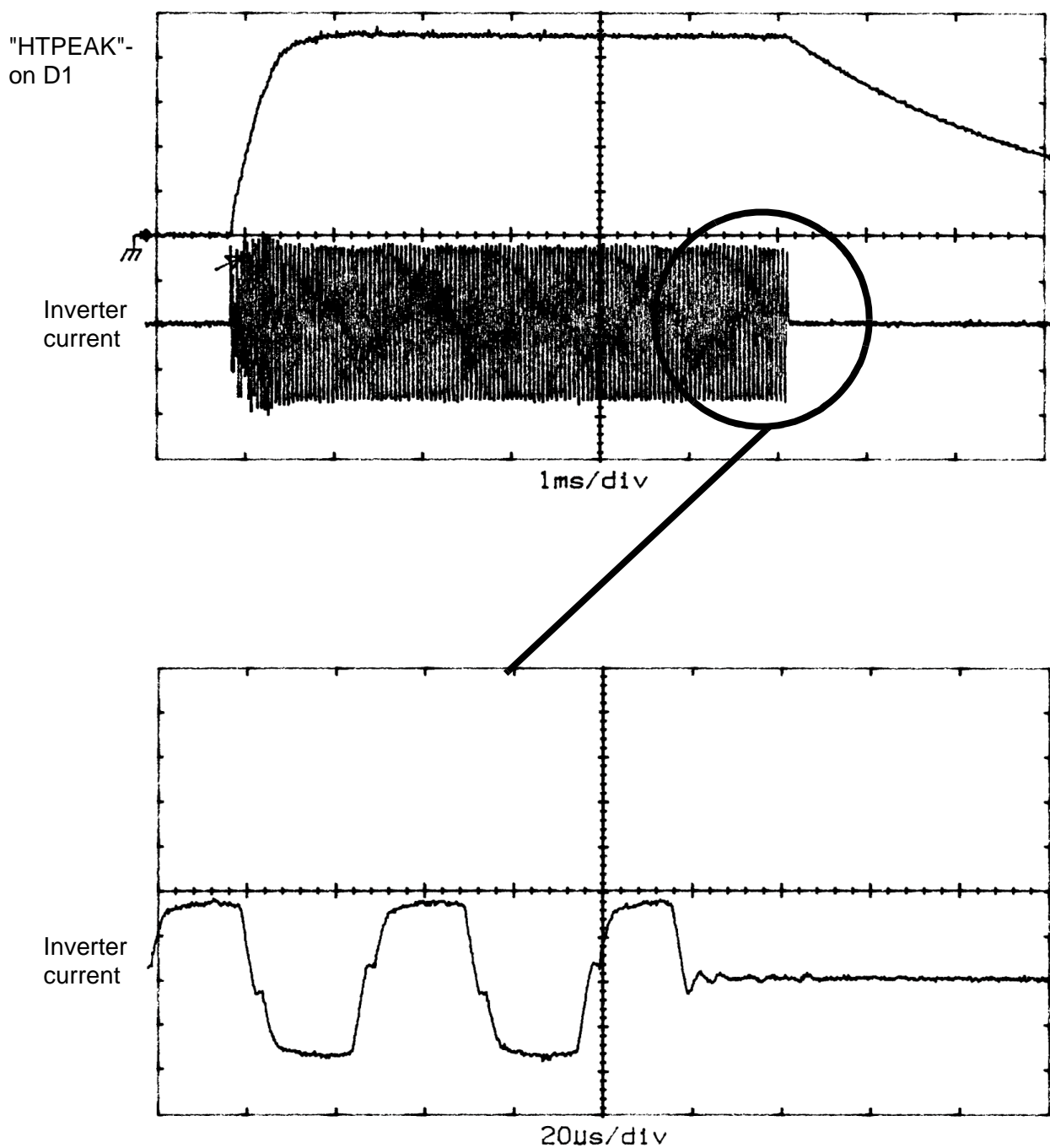


Fig. 1 "HTPEAK" and inverter current, inverter and single tank normal

Exposure values: 40 kV 5 mAs, HT 8 kV/div (200 mV/div),  
 $I_{\text{inverter-single tank}}$  100 A/div (only the end of the exposure is shown)

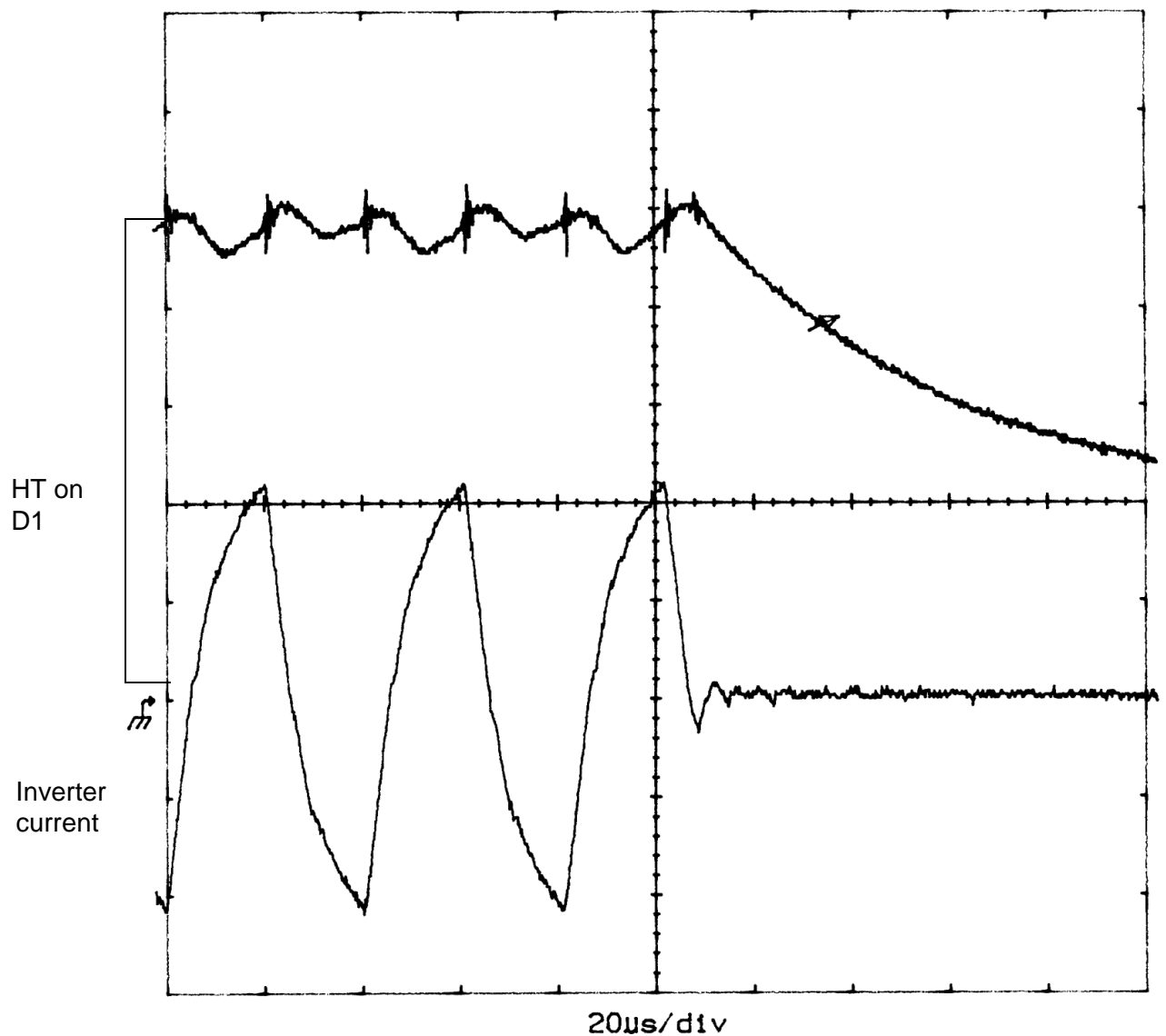


Fig. 2 HT and inverter current, inverter and single tank normal

Exposure values: 90 kV 5 mAs, HT 20 kV/div (500 mV/div)

$I_{\text{inverter-single tank}}$  50 A/div (only the end of the exposure is shown)

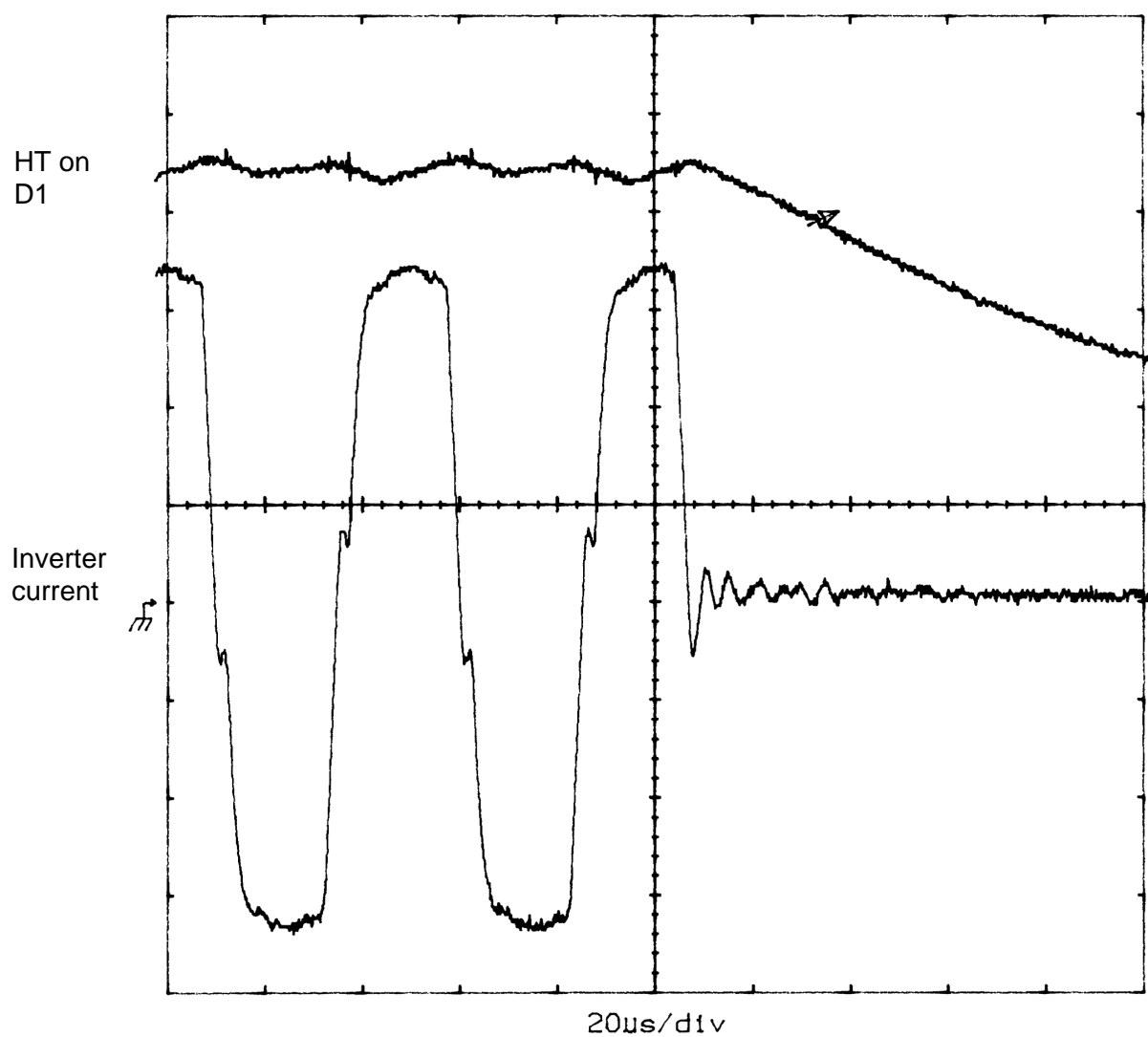


Fig. 3 HT and inverter current, inverter and single tank normal

Exposure values: 33 kV 5 mAs, HT 40 kV/div (1 V/div),  
 $I_{\text{inverter-single tank}}$  100 A/div (only the end of the exposure is shown)

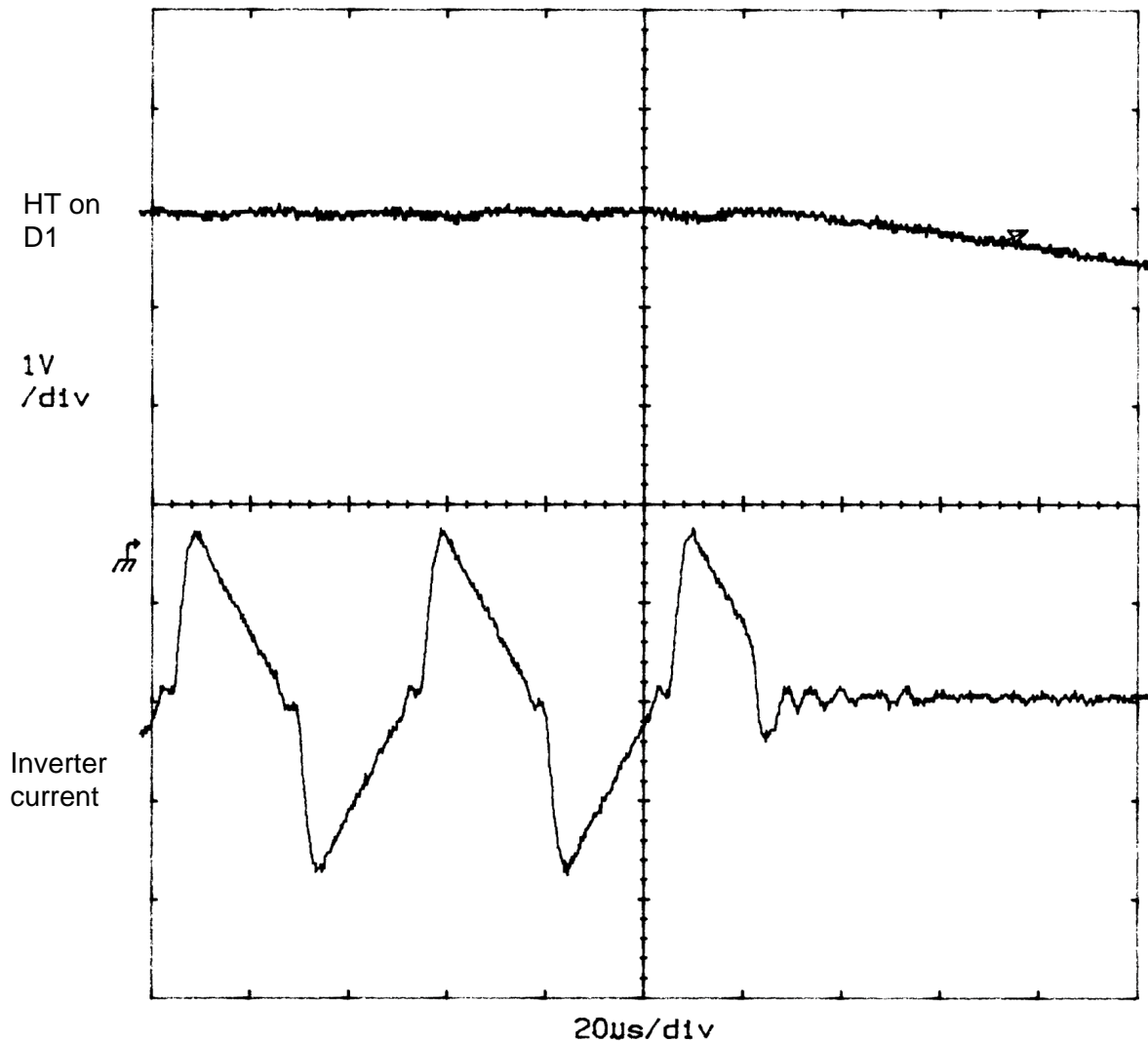


Fig. 4 HT and inverter current, inverter and single tank normal

Exposure values: 133 kV 5 mAs, HTPOS & HTNEG 2 V/div,  
20 kV/div., 200  $\mu$ s/div (only the end of the exposure is shown)

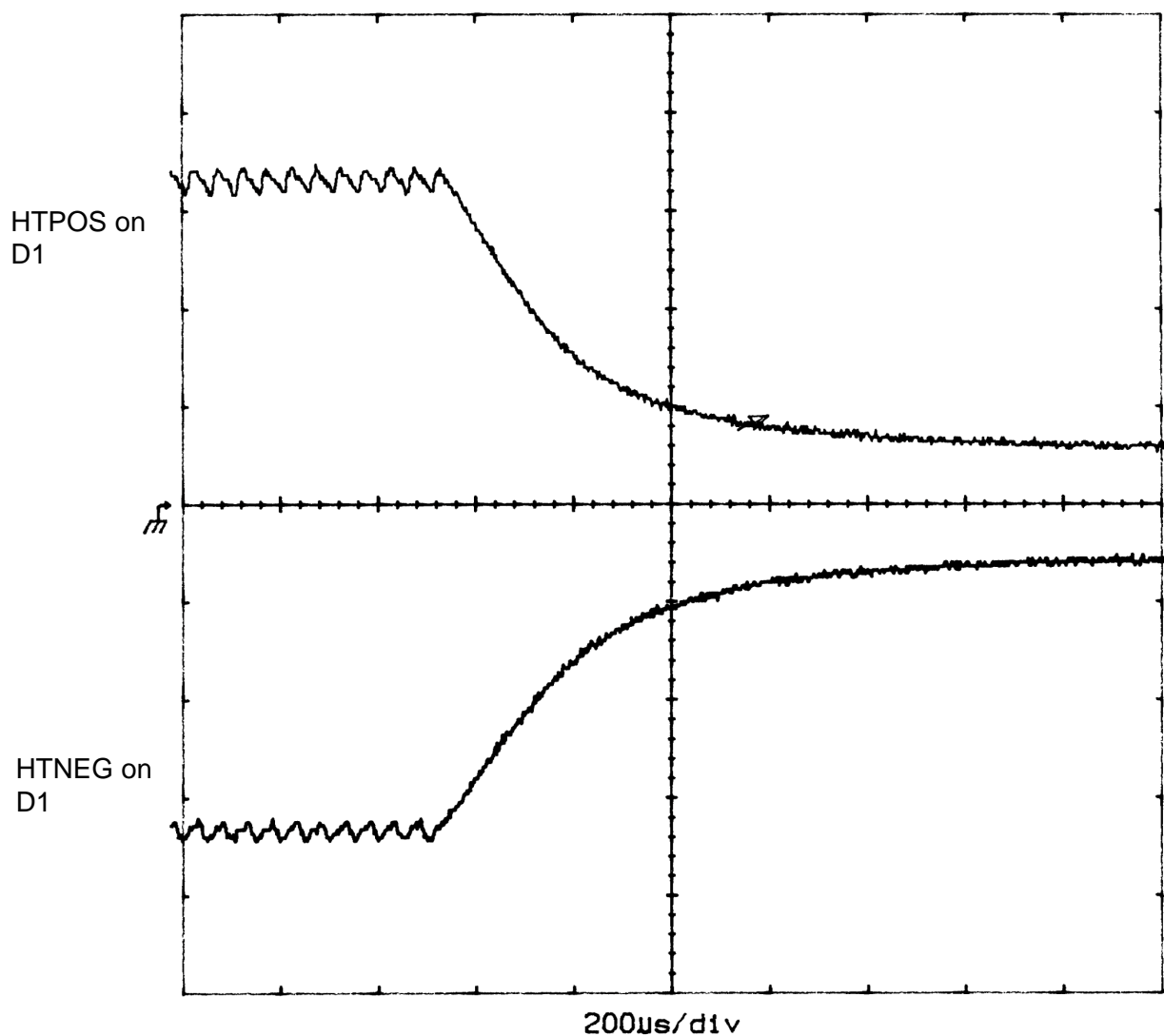


Fig. 5 HT-signal, inverter and single tank normal

Exposure values, 133 kV 5 mAs, HTPOS & HTNEG 2 V/div,  
20 kV/div; 200  $\mu$ s/div (only the end of the exposure is shown)

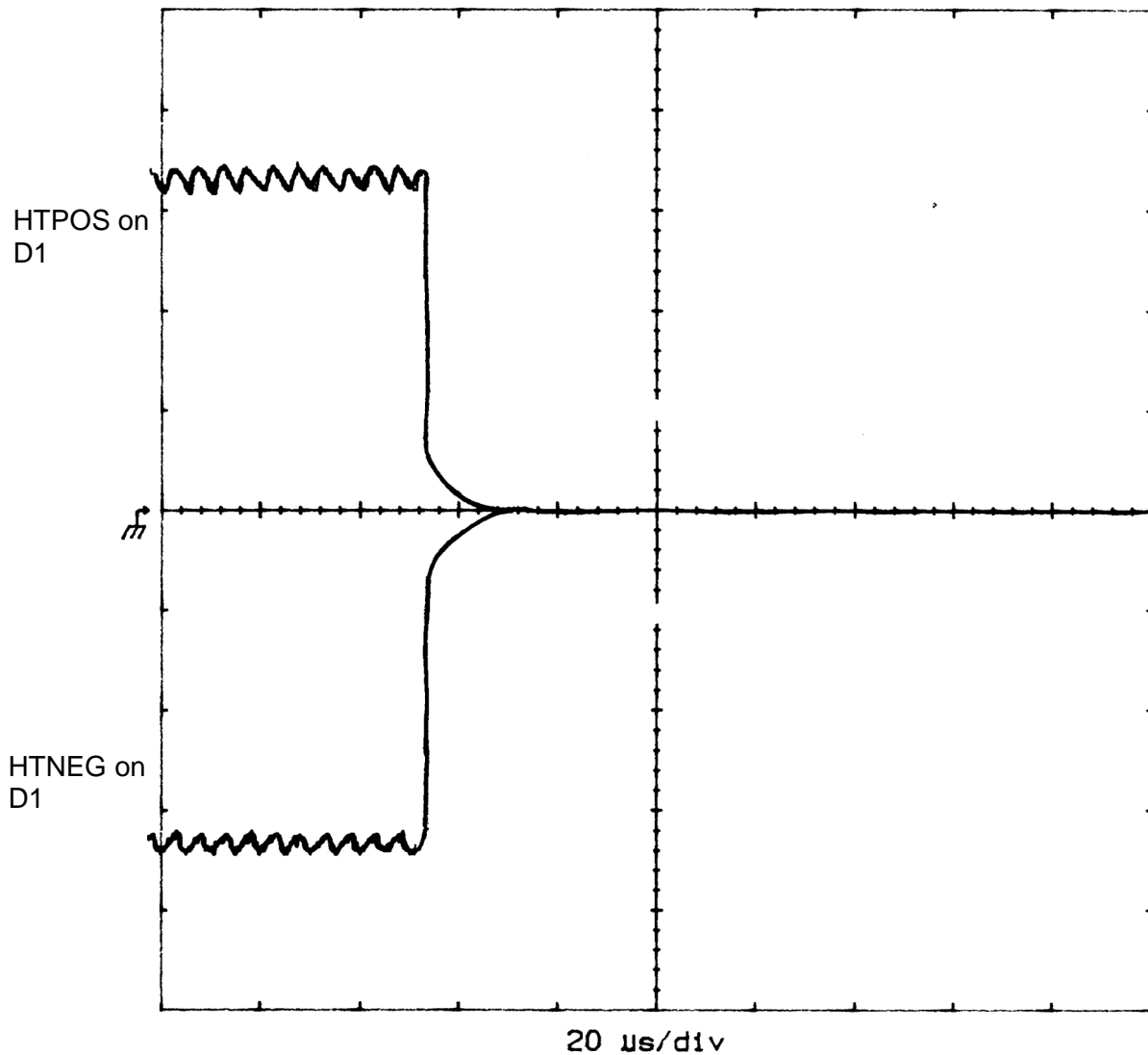


Fig. 6 HT-signal, Arcing between plus and minus side (Defective tube). Replace single tank.

Exposure values: 133 kV 5 mAs, HTPOS & HTNEG 2 V/div,  
20 kV/div; 100  $\mu$ s/div (only the end of the exposure is shown)

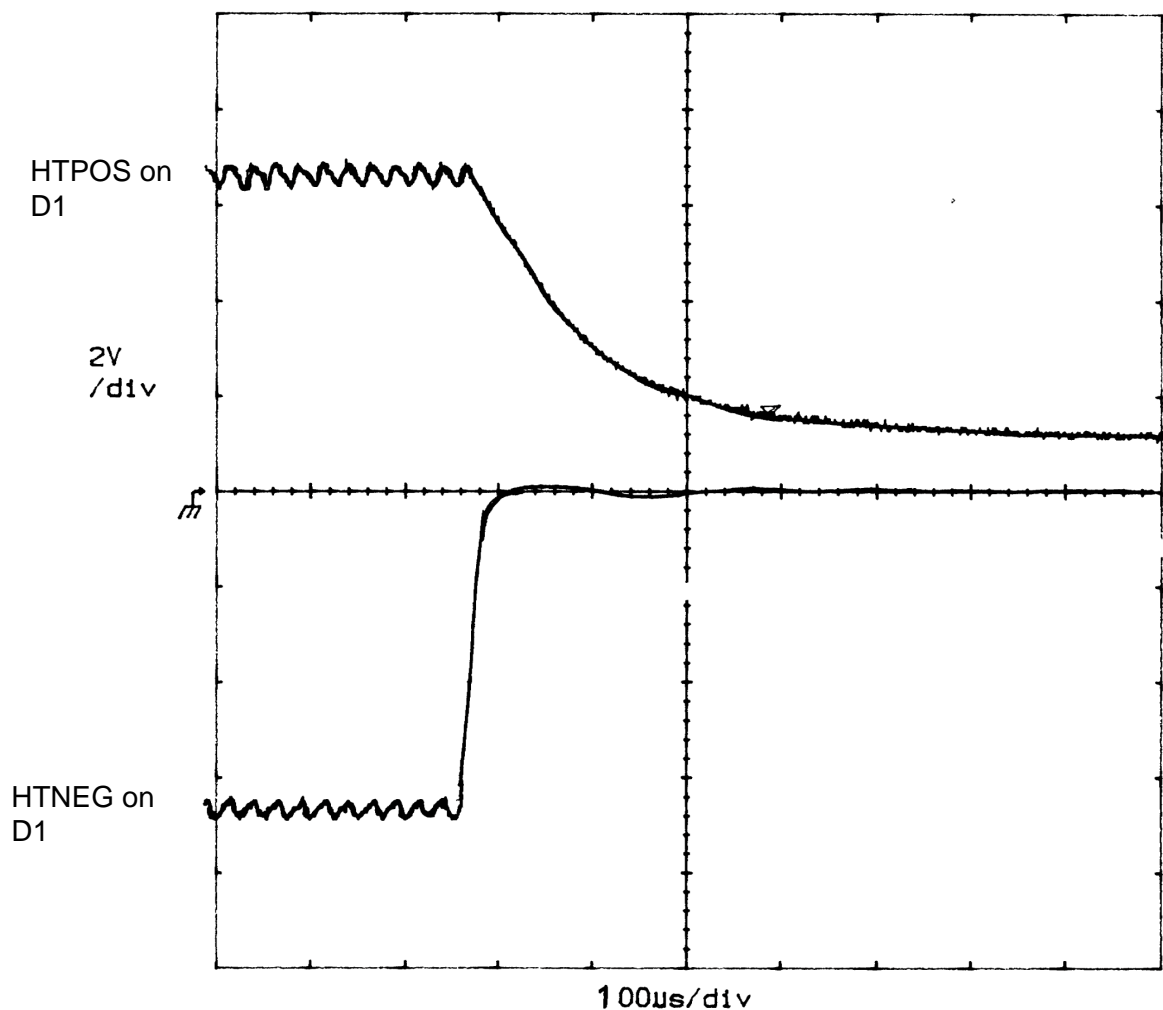


Fig. 7 HT-signal, high speed HTNEG discharges (Defective tube, filament transformer, wires to the cathode).



CH1: 20 mV/div, (100 A/div), 10  $\mu$ s/div (Inverter current);  
CH2: 500 mV/div, 20 kV/div (HT)

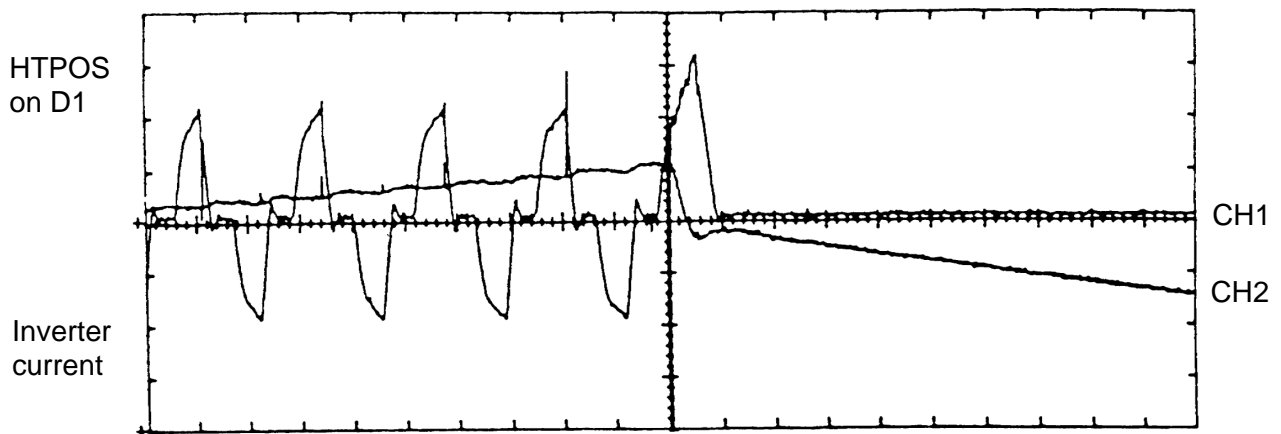


Fig. 8 High speed HT discharges (Defective tube, transformer, capacitor)

CH1: Inverter current 50 A/div, 10  $\mu$ s/div

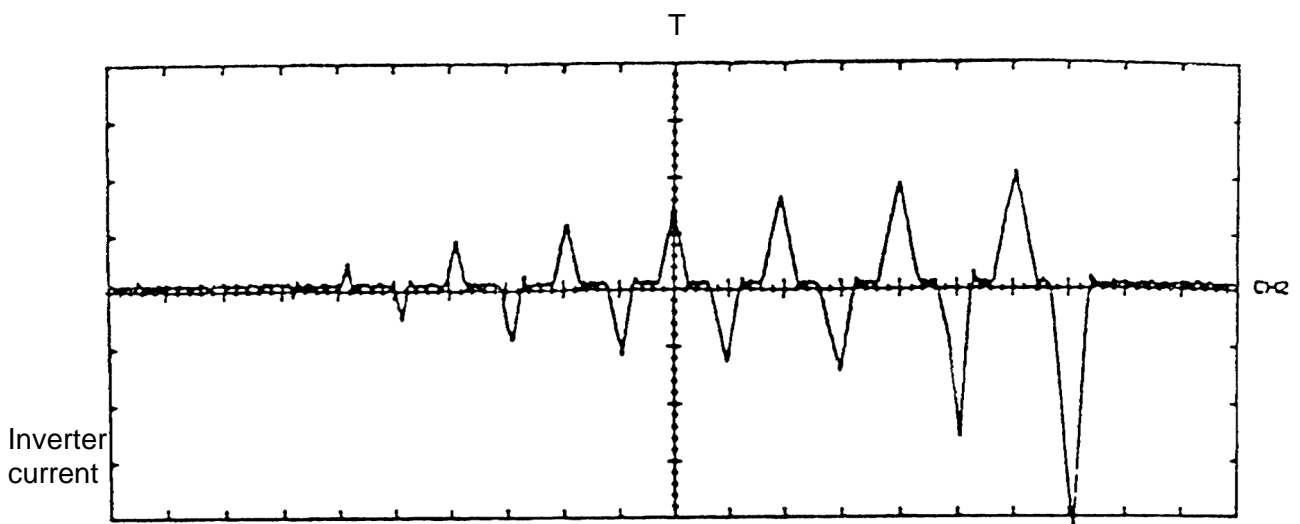


Fig. 9 Abnormal inverter current (Defective single tank)

CH1: Inverter current 50 A/div; 20  $\mu$ s/div

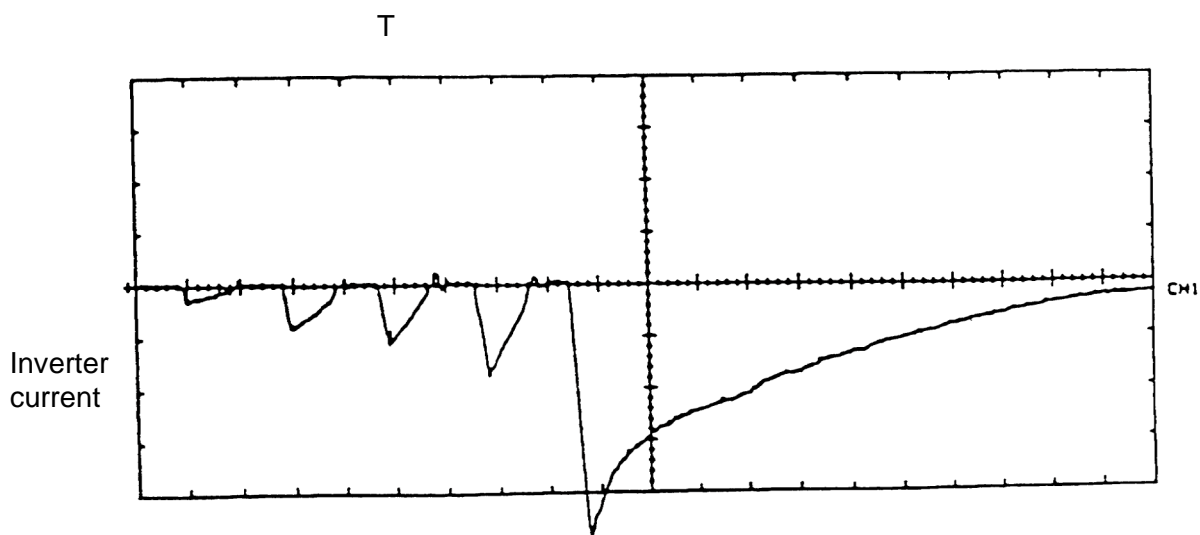


Fig. 10 Abnormal inverter current (Defective inverter)

CH1: 1 V/div, 40 kV/div, 20  $\mu$ s/div (HT);  
CH2: 100 A/div. (Inverter current)

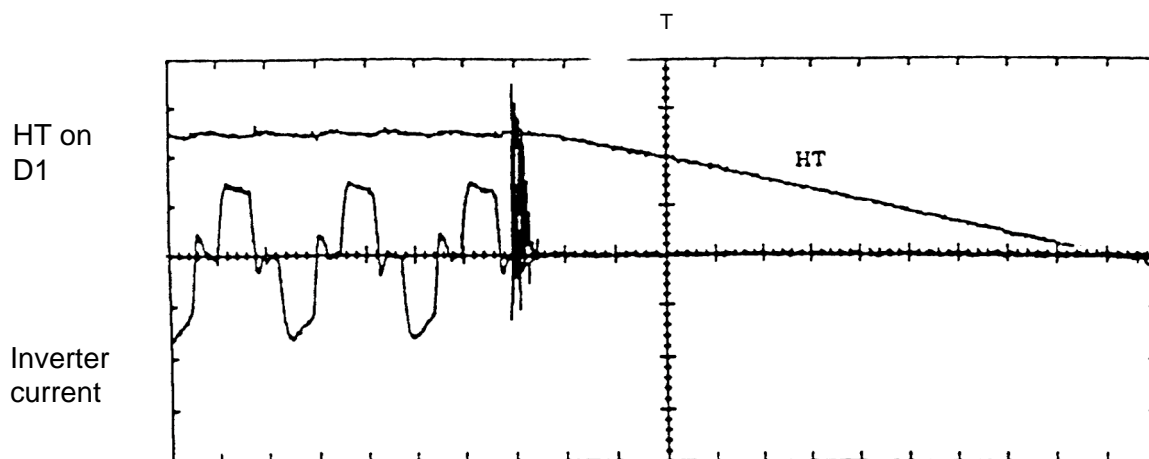


Fig. 11 Abnormal inverter current (Defective inverter)



## Malfunctions detected from the generator:

### Leakage current too high

The leakage current increases when the capacitor bank has been discharged for a long time. The generator displays a corresponding message:

- Perform a formation according to section "P06 - Capacitor formation".

### Capacitance too low

If a capacitor malfunctions, the internal series fuse will blow and the capacitor series will be disconnected. Depending on the tolerance in the capacitors, the generator will display a message. If a large positive tolerance is present in the capacitors, the balance of the capacitor bank will be able to maintain the total capacitance above the lower limit. Both the capacitor and the fuse must be replaced according to the following.

- Switch off the generator and disconnect the power plug.

## **WARNING**

**Dangerous residual voltage may still be present in the capacitor bank.**

**Risk of high voltage.**

**Consult the safety information in chapter 1.**

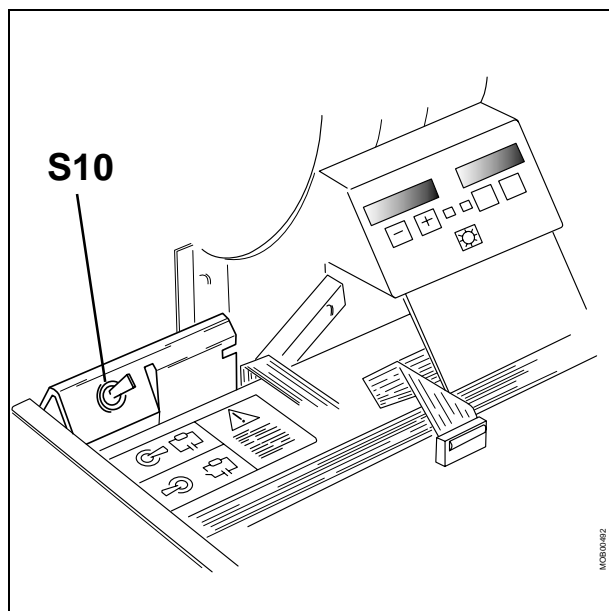


Fig. 1

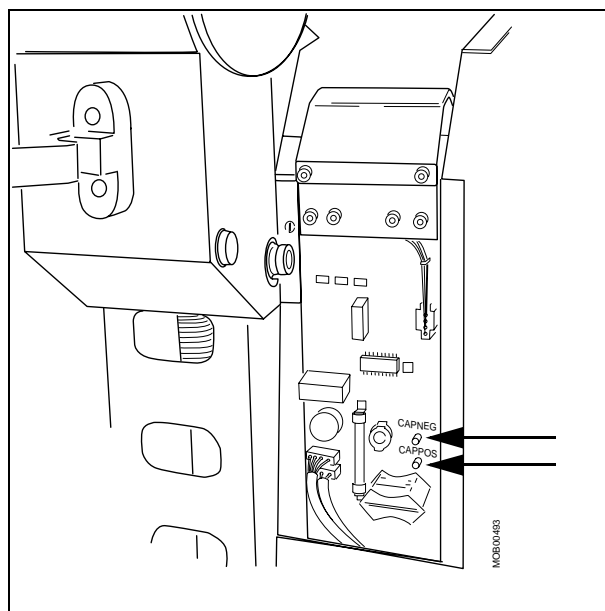


Fig. 2

- Remove the top cover.
- Discharge the capacitor bank with S10 (D7) (Fig. 1).
- Wait for 5 minutes before removing the left, right and rear covers.
- Measure the residual voltage at measuring points, CAPPOS and CAPNEG. The voltage must be less than 10 V (Fig. 2). If the voltage is measured to 0 V, the measuring device could be defective or the cables between the capacitor bank and CAPPOS, CAPNEG could be damaged. In this case, proceed as described in items a - e below to avoid personal injury.
  - a. Connect the power plug.
  - b. Connect the measurement device.
  - c. Switch on S10 on D7. Check whether the voltage increases.
  - d. Switch off S10. Check whether the voltage decreases.
  - e. If the measurement device does not register any voltage, disconnect the power plug and check the measurement device.

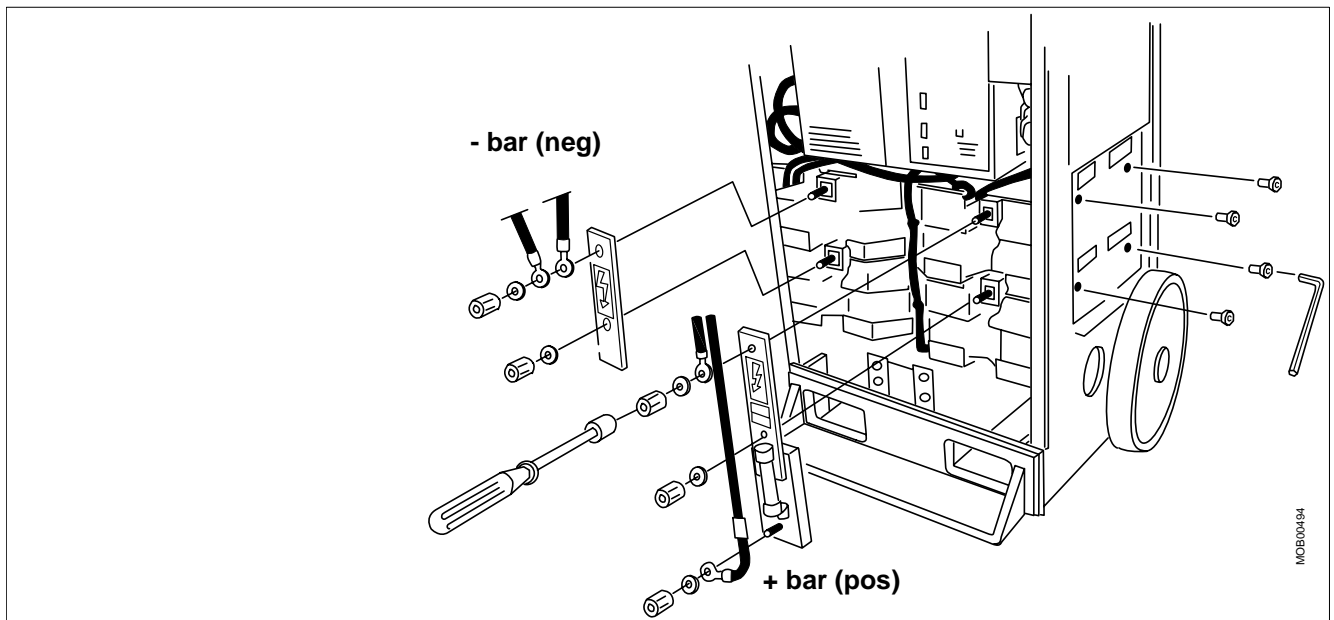


Fig. 3 MOBILETT Plus/ Plus M

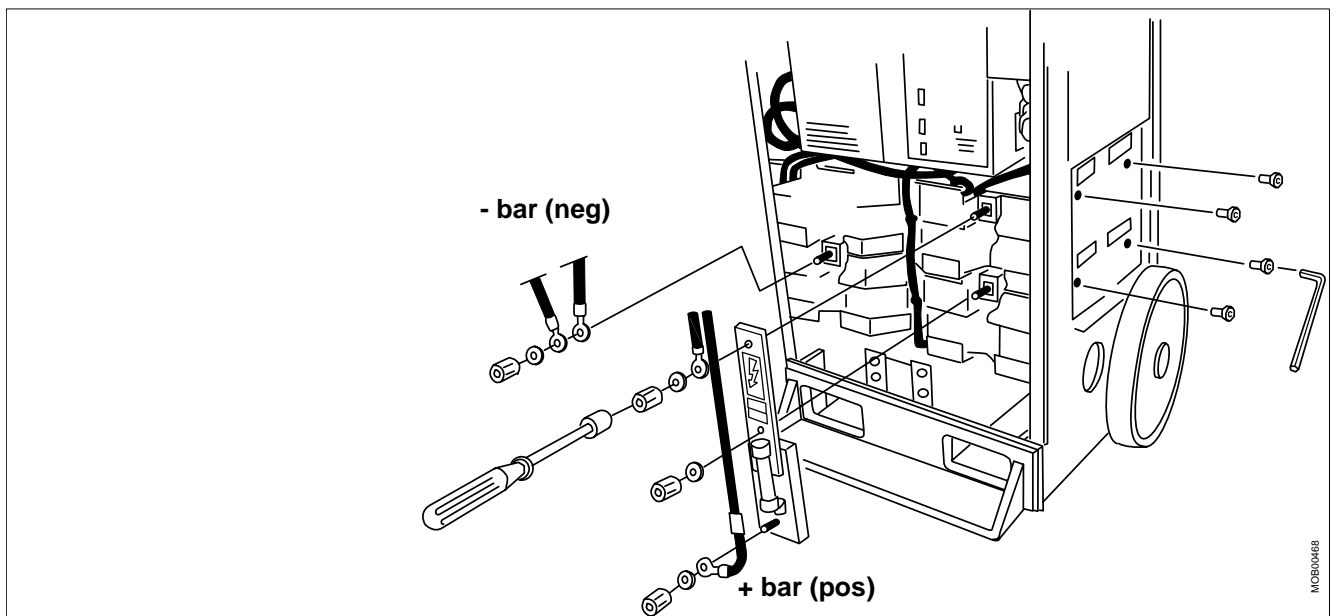


Fig. 4 MOBILETT Plus E

- Measure the voltage between the + and - bars; the voltage must be less than 10 V.
- Note the cable connections to the capacitor bank (Fig. 3 for MOBILETT Plus/ Plus M and Fig. 4 for MOBILETT Plus E)

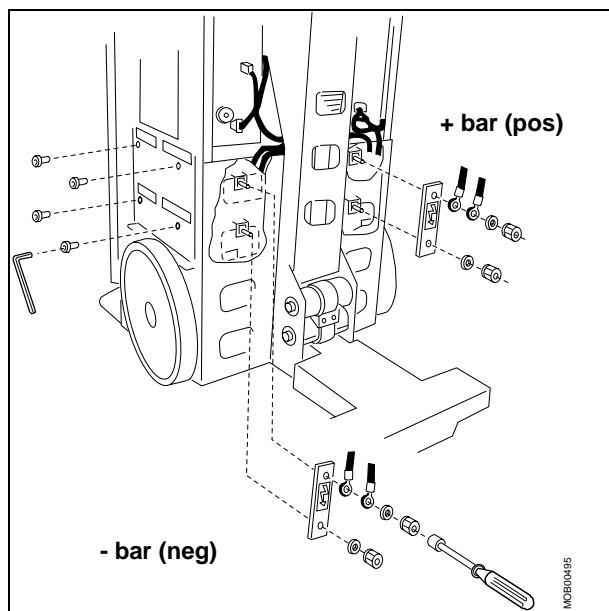


Fig. 5 MOBILETT Plus/ Plus M

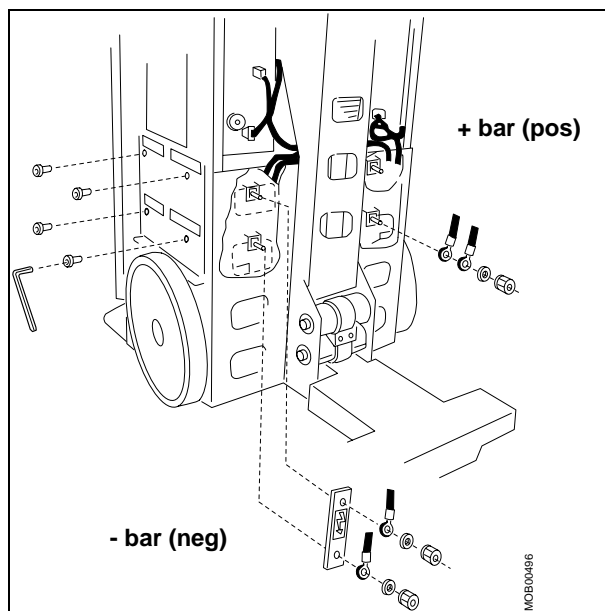


Fig. 6 MOBILETT Plus E

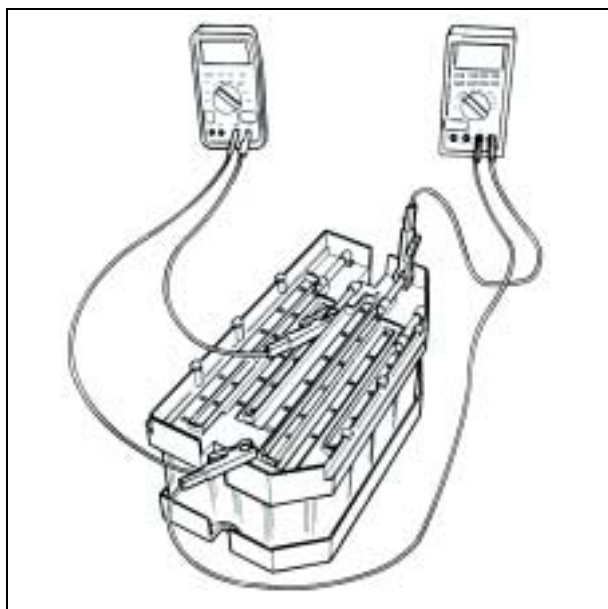


Fig. 7

- Remove the main bars (Fig. 5 for MOBILETT Plus/ Plus M and Fig. 6 for MOBILETT Plus E).
- Remove the capacitor module.

**WARNING****Residual voltage up to 353 VDC may still be present.****Risk of high voltage.****Use insulated tools and do not touch bars that may contain voltage (Fig. 7).**

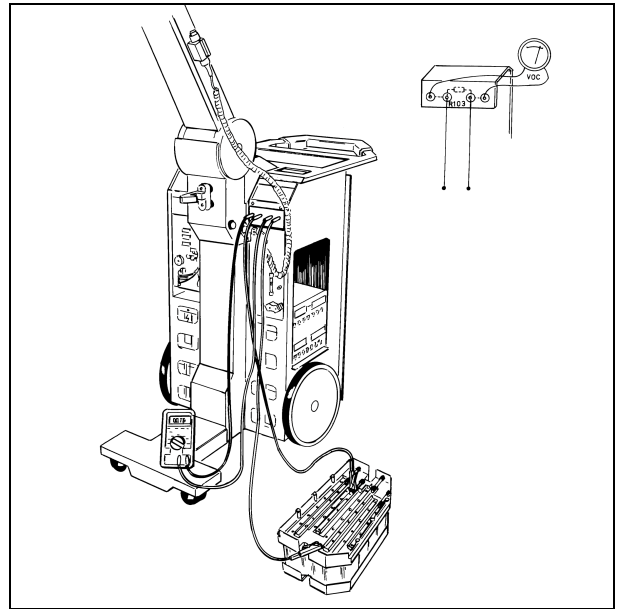


Fig. 8

- Remove the cap and foam rubber from the capacitor module.
- Measure the voltage in all capacitor series and check that the voltage level is the same as on the main bar <10 V DC. If a series has a different voltage from the rest, the fuse may possibly have blown. Discharge that series with R103 (Fig. 8).
- Check all rubber membranes through the inspection holes at the top of the capacitors. If there are cracks or holes in the membrane, the capacitor must be replaced.

**⚠ WARNING**

**Electric shock hazard!**

**Risk for physical injury.**

**Prior to installing a new capacitor or a new fuse, ensure that the voltage difference between capacitor series or capacitor modules does not exceed 2 volts.**

If you cannot determine the error visually, perform tests A - D on the capacitor series with the blown fuse.

- Remove the fuse and + bar in the defective series. Wait 5 minutes.
- Measure the voltage in all capacitors in that series. The defective capacitor will have a lower voltage than the rest.
- Replace both the defective capacitor and the fuse in the defective series.
- If the fuse has blown and no defective capacitor is found, replace all the capacitors and the fuse in the defective series.

- If no malfunction can be detected, reinstall the module and check the remaining modules according to the instructions above. Start with the item: "Remove the cap...".
- Reinstall the main bars and connect them.
- Tighten all screws and nuts on the upper side of the capacitor module with a torque of 3 Nm and all screws and nuts on the under side with a torque of 1 Nm.
- Reattach the left and right and rear covers.
- Connect the power plug and switch off S10 on D7.
- Switch on S 1:1 on D1.
- Read the information about the formation program P06 in section "P06 - Capacitor formation" if you have replaced one or more capacitors.
- Switch on the main power switch.
- Perform a formation with program P06.
- Switch off S 1:1 on D1.
- Reattach the top cover.



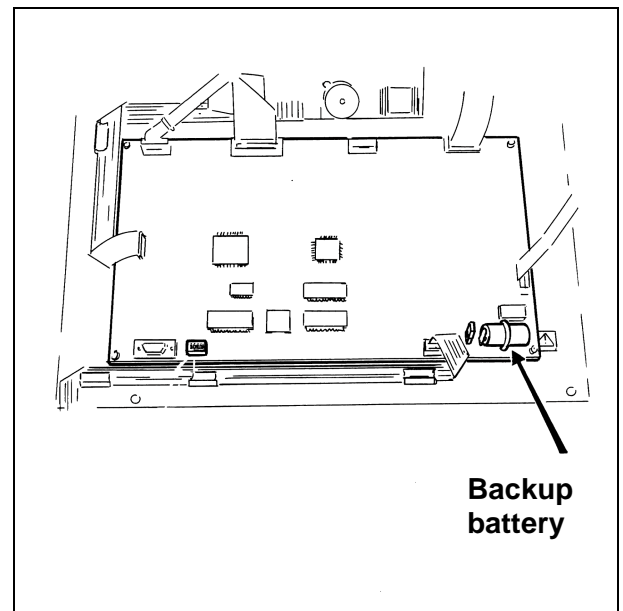


Fig. 1

## Replacing the backup battery



The backup battery can be replaced without turning off the unit. Make sure that the board does not short-circuit and that the soldering iron is not connected to main power while soldering.

- Read out the exposure counter, refer to the section "P16 - Show the exposure counter".
- Read out the mAs limit, refer to the section "P15 - upper mAs limit".
- Read out the kV step and limit, refer to the section "P14 - Number of kV steps and upper kV limit".
- Loosen the screws to the system upper cover and remove it.
- Loosen the screws and remove the protection plate.
- Locate the battery, refer to the wiring diagram, page 110.
- To avoid damage to components or assemblies, ensure compliance with ESD guidelines.
- Remove the battery jumper.
- Desolder the battery and connect the new battery with the soldering iron.
- Reattach the battery jumper.
- Reattach the protection plate.
- Switch off the unit for 20 s.

- Switch on the unit and check that no messages are displayed. If an Err or CAL message is displayed, proceed as follows:
- Change to service mode by switching ON S 1:1 on D1.
- Perform the adaptation according to section "P10 - Fast adaptation".
- Set the selected mAs limit, refer to the section "P15 - Upper mAs limit".
- Set the selected kV step and limit, refer to the section "P14 - Number of kV steps and upper kV limit".
- Read out the exposure counter, refer to the section "P16 - Show the exposure counter".
- Switch off S 1:1 on D1 (OFF).
- Reattach the system upper cover.
- Make an exposure at 90 kV, 10 mAs to check that everything is functioning correctly.



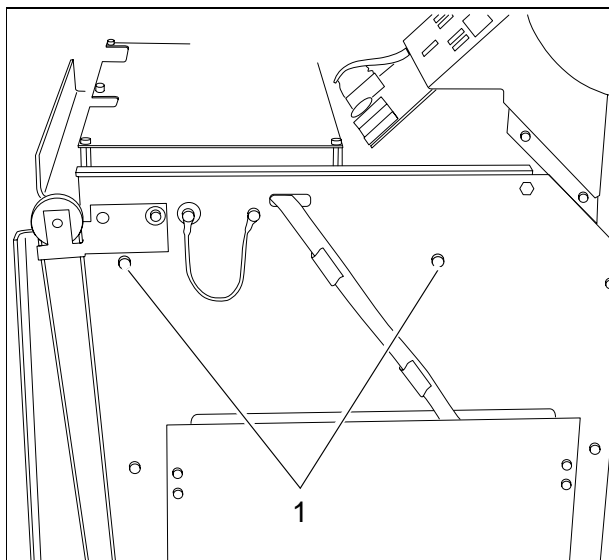


Fig. 2

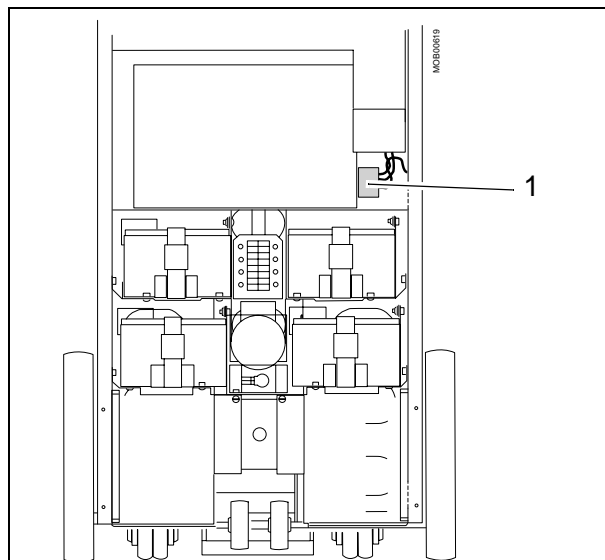


Fig. 3

### Replacement of mains cable/cable winder

- Remove side covers and the cover with the cassette compartment.
- Remove the four (two on each side) screws that fix the cable winder assembly (pos. 1 / Fig. 2).

**CAUTION****Sharp edge!****The brake handle could be damaged.****Lock the brake handle, otherwise it is damaged by the sharp upper edge of the cable winder assembly.**

- Pull out the cable winder assembly approximately 10 cm.
- Disconnect main switch plug K52 (pos. 1 / Fig. 3).

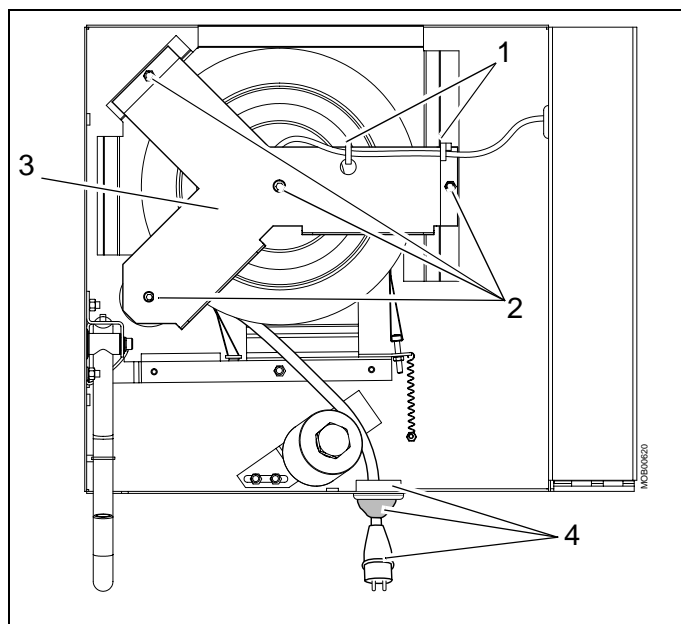


Fig. 4

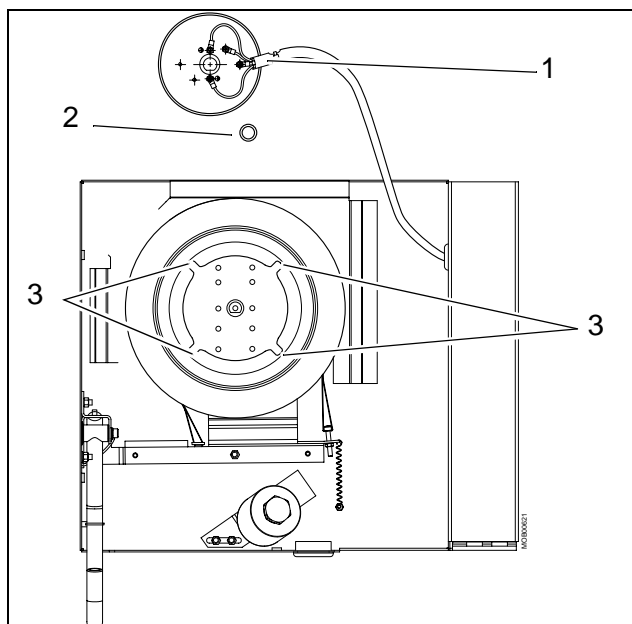


Fig. 5

- Remove the cable winder assembly.
- Remove the two cable ties (pos. 1 / Fig. 4).
- Remove four screws and four nuts (pos. 2 / Fig. 4) and Y-plate (pos. 3 / Fig. 4).
- Disconnect cable from upper plate (pos. 1 / Fig. 5).
- Remove the distance ring (pos. 2 / Fig. 5) from the axle.
- Loosen the brake carefully to loosen the tension of the cable winder spring.
- Remove securing screw (pos. 1 / Fig. 7).
- Pull out the cable winder.

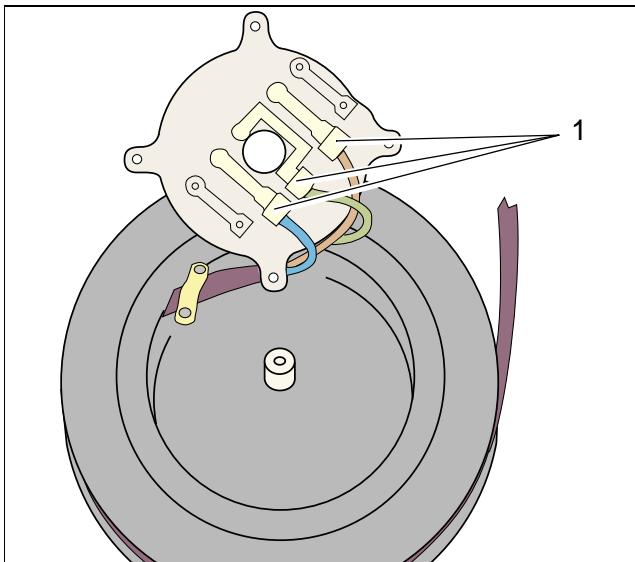


Fig. 6

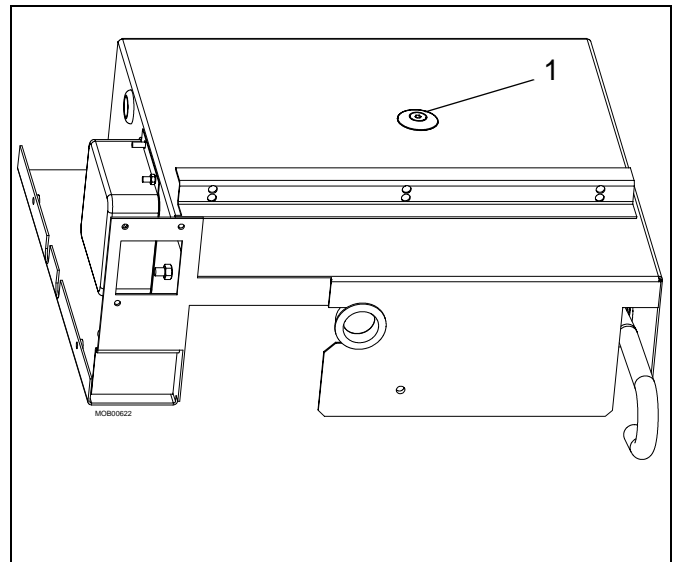


Fig. 7

- Clean cable winder box.
- Remove plug, cable stop and ring (pos. 4 / Fig. 4).

**If cable winder has to be replaced:**

- go to "B".

**If mains cable has to be replaced:**

- Remove four screws (pos. 3 / Fig. 5).
- Remove connection plate and disconnect the mains cable (pos. 1 / Fig. 6).
- Install new mains cable and connection plate.

**NOTE**

**Wind the mains cable to the cable winder without any play.**

**"B"**

- Reinstall ring, cable stop and plug.
- Reinstall cable winder.
- Reinstall the securing screw (pos. 1 / Fig. 7).

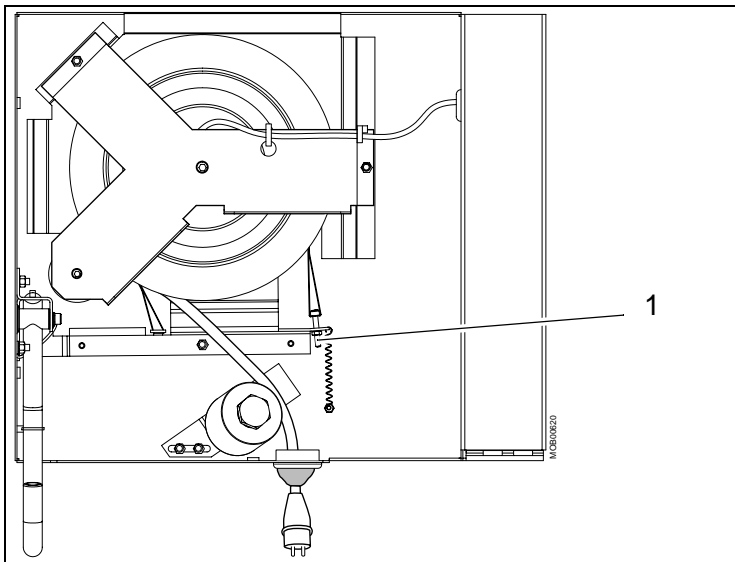


Fig. 8

- Pull out the cable and rewind it to bring the tension back to the cable winder spring. Repeat that six times.
- Reinstall upper plate with distance ring, plastic role and Y-plate.
- Pull out the cable completely.
- Test cable winder and brake function.

**NOTE**

**The cable winder should not rewind by itself.  
The brake force is adjusted via right screw.  
nut clockwise -> stronger (pos. 1 / Fig. 8).  
nut counterclockwise -> softer.**

- Reinstallation is performed in the reverse order.

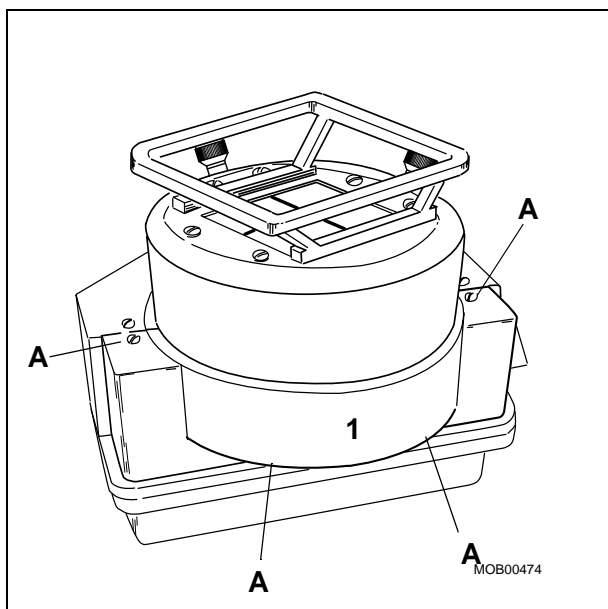


Fig. 1

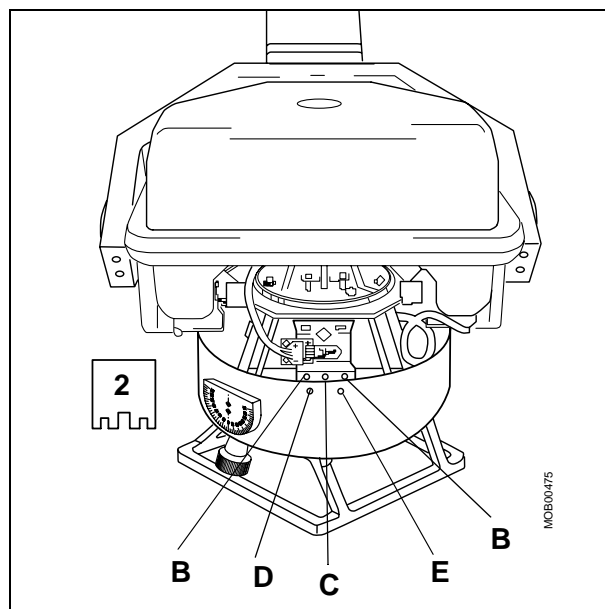


Fig. 2

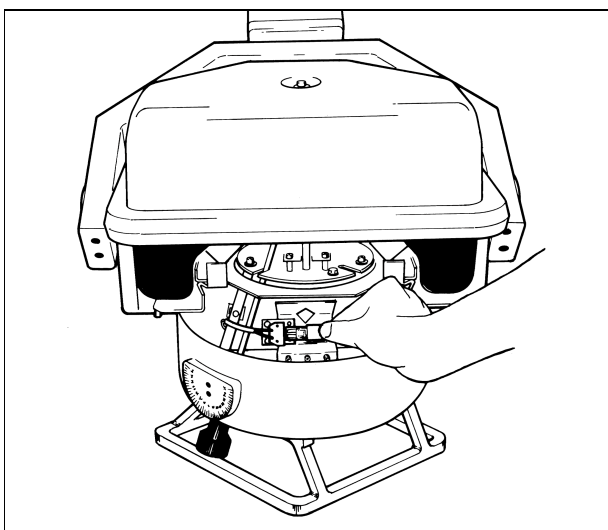


Fig. 3



## Replacing the collimator lamp

**Equipment required:** Lux meter

- Remove the cover (1) by removing the screws (4) marked "A" (Fig. 1). Turn the collimator around so that the lamp housing is in front of the cover opening.
- Remove the protective plate (2), covering the collimator lamp by loosening, not removing, the screws marked "B" one turn. Do not adjust screws "C", "D", or "E" (Fig. 2).
- Remove the defective lamp and replace it with a new lamp (Fig. 3). **Do not touch the bulb with bare fingers.** (See "list of spare parts".)
- Reinstall the protective plate. Tighten the screws marked "B".

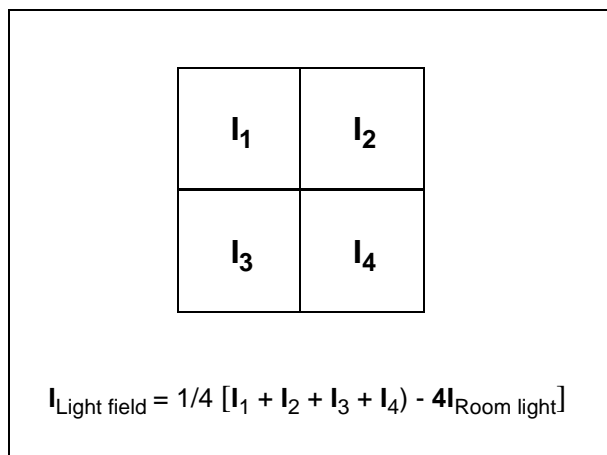


Fig. 4

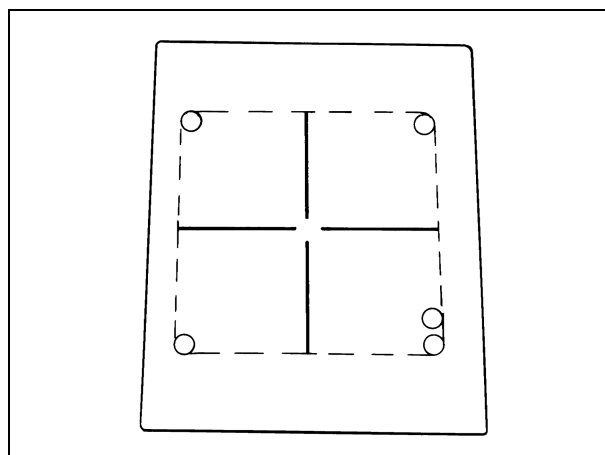


Fig. 5

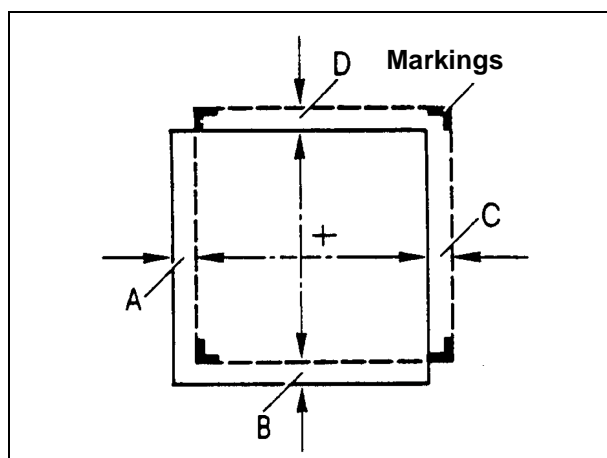


Fig. 6

$$\frac{A + C}{SID} \leq 1,7 \%$$

SID

$$\frac{B + D}{SID} \leq 1,7 \%$$

SID

SID = Source-Image Distance

----- Light field

\_\_\_\_\_ X-ray field

### Checking the light intensity

**Equipment required:** Lux meter

When a light localizer is used to define the X-ray field, it shall provide an average illumination of not less than 180 lux at 100 centimeters. The average illumination shall be based upon measurements made in the approximate center of each quadrant of the light field (Fig. 4).

If the illumination is less than 180 lux, check the lamp supply. Refer to wiring diagram X037E, page 180.



### Light field relative to the X-ray field

**Equipment required:** Cassette, X-ray film and coins

- Load a 35 x 35 cm (14" x 14") cassette with film.
- Put the cassette on a table or a similar surface.



- Set a SID of 100 cm (39"). Use a measuring tape.
- Switch on the light localizer and align the cassette. Collimate the light field to 25 x 25 cm (10" x 10").
- Mark the four corners with coins and mark one of the corners with two coins (Fig. 5).
- Set 52 kV, 2.0 mAs on the control panel.

**CAUTION****X-ray radiation!****If not observed, risk for exposure to radiation.****Use radiation protection!**

- Release an exposure.
- Develop the film and measure the deviation between the light and the radiation fields. Acceptable deviation  $\pm 1.7\%$  of SID, (Fig. 6).
- If the deviation is more than 1.7%, adjust with the screws marked C and D (Fig. 2), to move the light field closer to the radiation field.
- Repeat the test with a new exposure.
- If necessary, adjust again until the deviation between the light field and the radiation field is within the tolerance specified.
- Reattach cover 1 (Fig. 1).

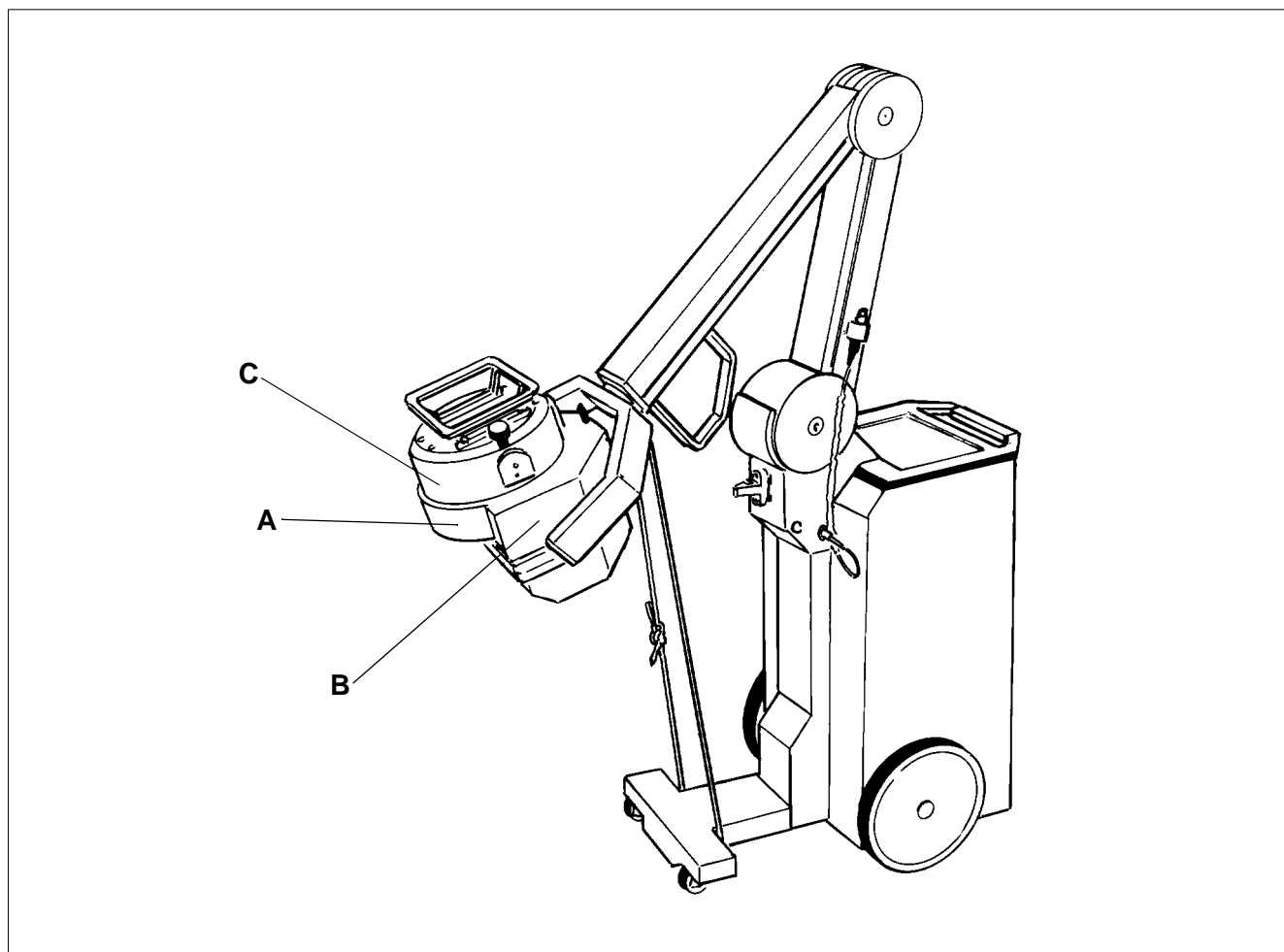


Fig. 7

## Replacing the collimator

**Equipment required:** Rope

- Switch off the unit and disconnect the power plug.
- Turn the single tank so that the collimator is facing upwards (Fig. 7).
- Secure the arm and the single tank with a rope (Fig. 7).
- Remove covers "A" and "B".
- Remove collimator cover "C".

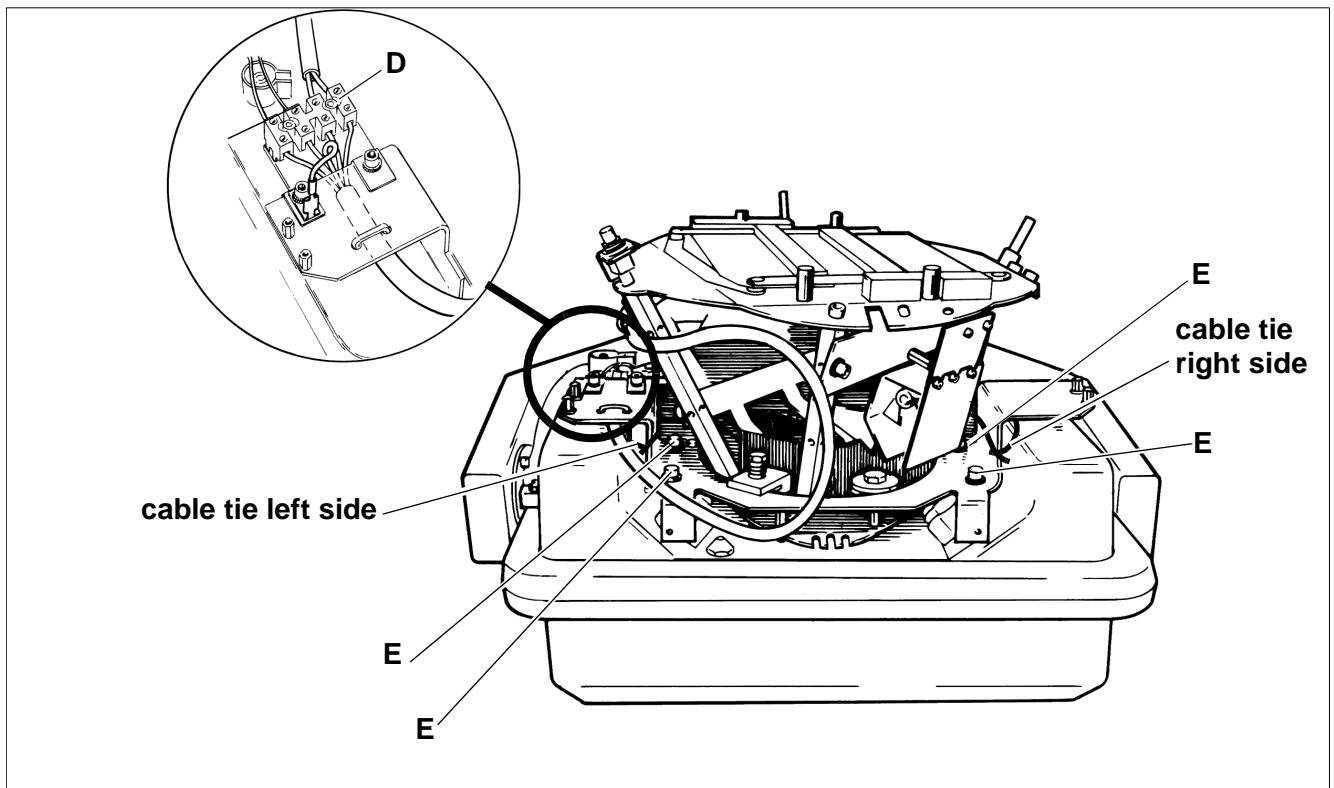


Fig. 8

- Disconnect the cable to the connection terminal board "D" (Fig. 8).
- If there are cable ties, cut them (Fig. 8).
- Remove the collimator by loosening the four screws "E" (Fig. 8). Reserve the hardware.
- Install the new collimator. Center the rotary-flange so that the screws marked "E" are centered in the grooves before tightening.
- Connect the wires to connection terminal board "D".

- Replace the cable ties (Fig. 8). The cable ties have to be mounted exactly as shown in Fig. 9 and Fig. 10. The cable ties should not be tightened hard. Fig. 9 and Fig. 10 shows how the cable tie on the right side is mounted. Repeat for the left side, but with the cable tie mirror-inverted.

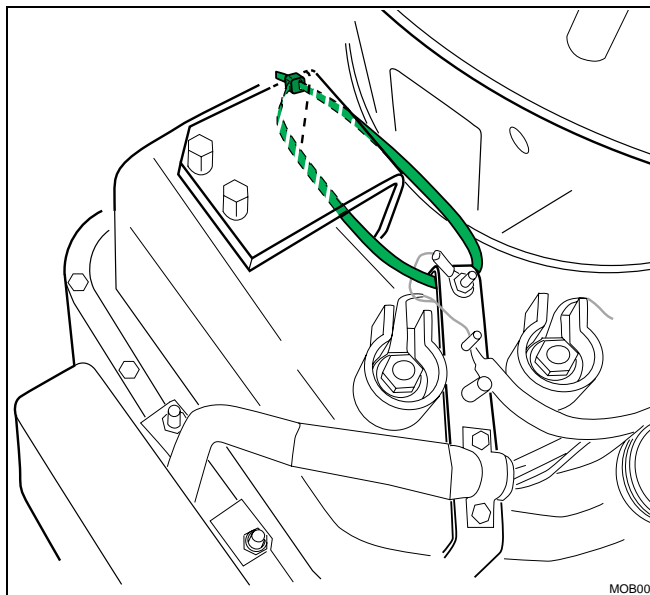
**NOTE****Make sure not to forget to attach the cable ties!**

Fig. 9

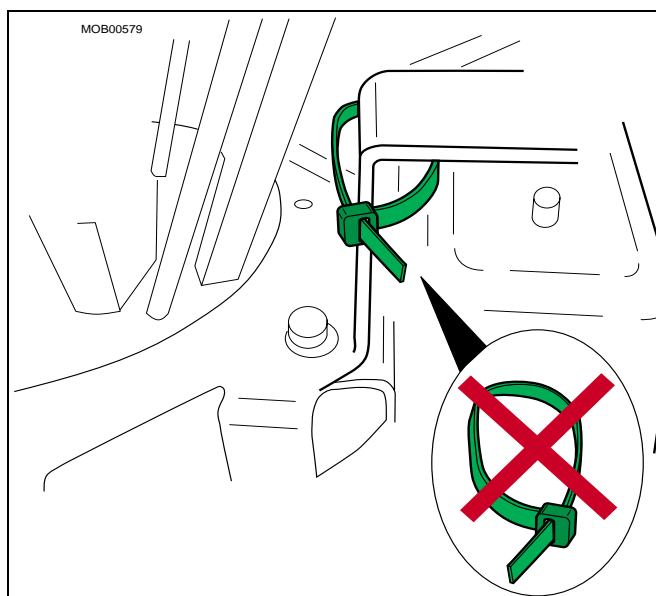


Fig. 10

- Rotate the collimator through the whole interval, and make sure the cable ties does not come in contact with the collimator / moving parts.
- Reattach collimator cover "C".

**NOTICE****When replacing the collimator, the new collimator should be positioned and adjusted so that the light and radiation fields correspond.****The adjustment should be performed by moving the whole collimator, not just changing the position of the collimator bulb.**

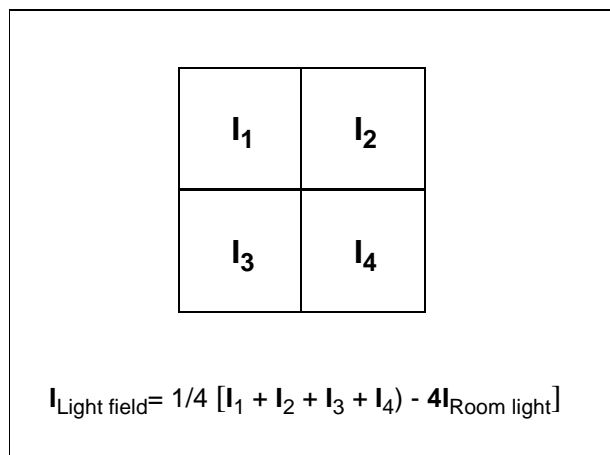


Fig. 11

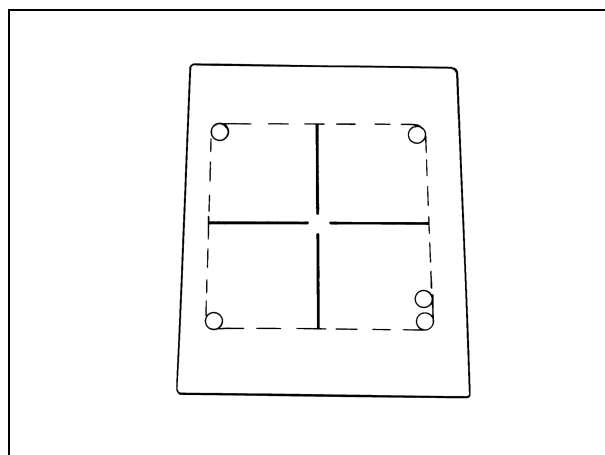


Fig. 12

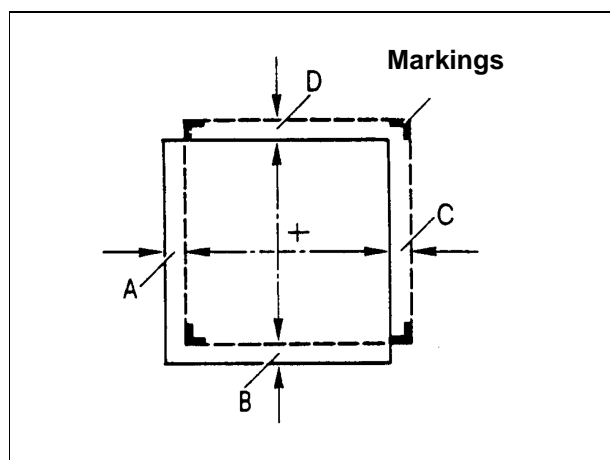


Fig. 13

$$\frac{A + C}{SID} \leq 1,7 \%$$

SID

$$\frac{B + D}{SID} \leq 1,7 \%$$

SID

SID = Source-Image Distance

----- Light field

\_\_\_\_\_ X-ray field

## Checking the light intensity

**Equipment required:** Lux meter

When a light localizer is used to define the X-ray field, it shall provide an average illumination of not less than 180 lux at 100 centimeters. The average illumination shall be based upon measurements made in the approximate center of each quadrant of the light field (Fig. 11).

If the illumination is less than 180 lux, check the lamp supply. Refer to wiring diagram X037E, page 180.

## Light field relative to the X-ray field

**Equipment required:** Cassette, X-ray film and coins

- Load a 35 x 35 cm (14" x 14") cassette with film.
- Put the cassette on a table or a similar repository.

- Set a SID of 100 cm (39"). Use the measuring tape.
- Switch on the main power switch.
- Switch on the light localizer and align the cassette. Now, collimate the light field to 25 x 25 cm (10" x 10").
- Mark the four corners with coins and mark one of the corners with two coins (Fig. 12).
- Set 52 kV, 2.0 mAs on the control panel.



**X-ray radiation!**

**If not observed, risk for exposure to radiation.**

**Use radiation protection!**

- Release an exposure.
- Develop the film and measure the deviation. Acceptable deviation  $\pm 1.7\%$  (Fig. 13).

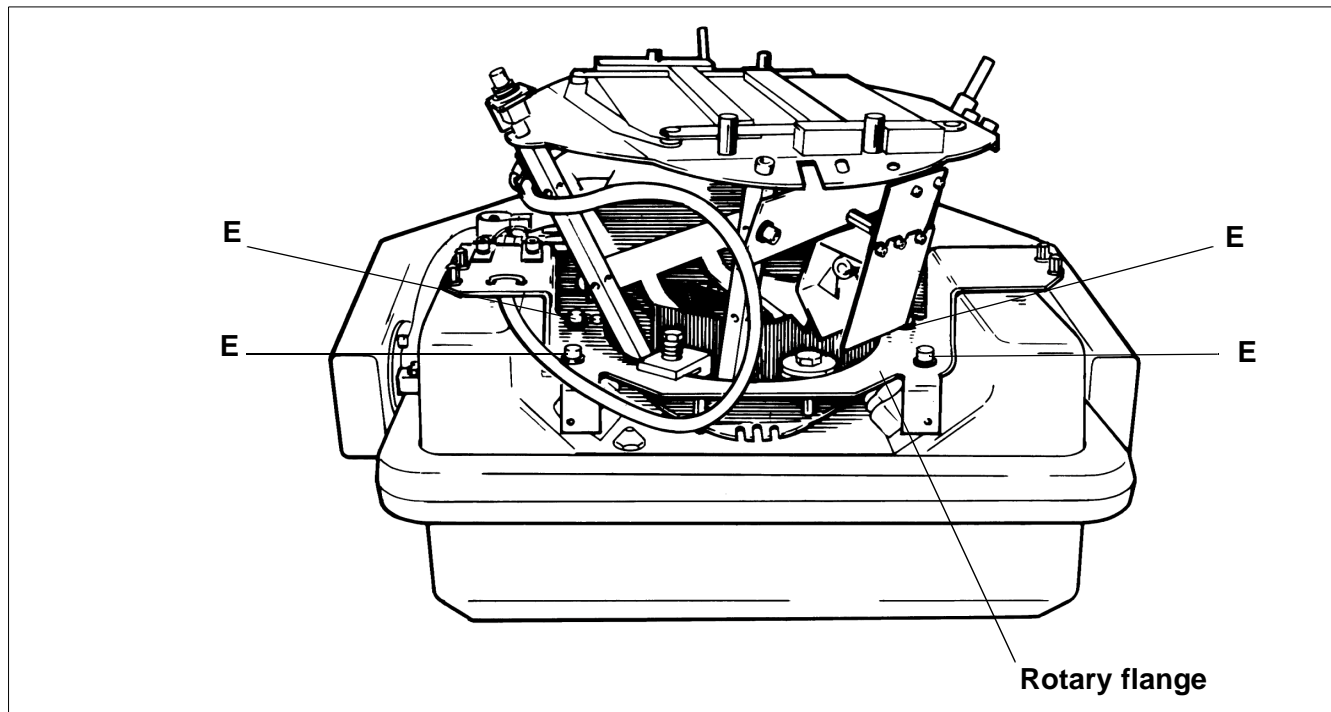


Fig. 14

- If the deviation is greater, loosen the Allen screws marked "E" slightly and move the rotary-flange to desired position.
- Tighten the screws marked "E" (Fig. 14).
- Repeat the test and adjustment of the rotary flange position until the deviation between the light and radiation fields is within the tolerance specified.
- Reinstall covers "A" and "B".



## Adjusting the arm system



**DANGER**

Never work with the system open if the capacitor is charging or has just been charged.

The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected.  
Life-threatening electric shock hazard exists.

See Chap.:

"Protective measures when working on the capacitor bank".

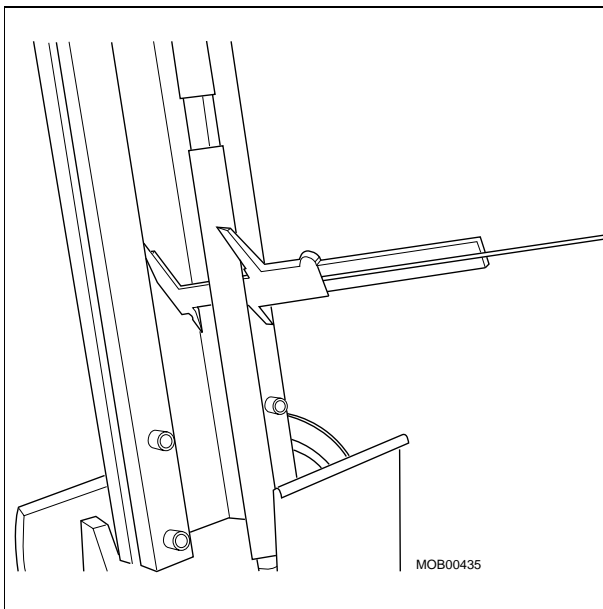


Fig. 1

## Parallelism

**Equipment required:** Slide caliper and a rope. If the parallelism must be adjusted, a ceiling support is required.

The parallelism adjustment affects the maximum height and the counterbalance and must be performed prior to performing any other adjustment of the arm system.

- Remove all arm and joint covers so that the adjustment rod is visible (Fig. 1).
- The adjustment rod must always be parallel with the arm. This can be checked by measuring at two points as far away from each other as possible but with the same diameter of the pull rod (Fig. 26). The parallelism must not deviate more than 0.6 mm. The measurements must be performed with the arm in the uppermost and lowermost positions. If not parallel loosen the locking nuts and adjust by turning the pull rod.

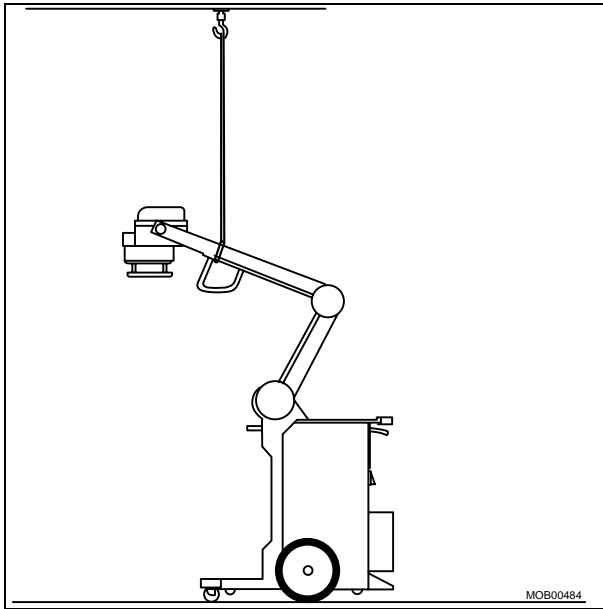


Fig. 2

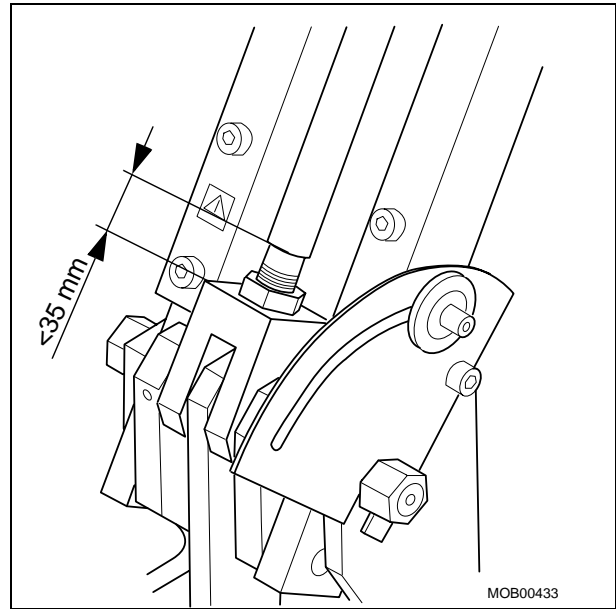


Fig. 3

**⚠ WARNING**

**Danger of personal injury !**

- Make sure the visible part of the thread between the link and the key grip at the adjustment rod is always less than 35 mm (Fig. 3). If the visible part of the adjustment rod is longer than specified, the single tank and the arm might fall.

If any adjustment is needed, the single tank should be secured in its uppermost position with a ceiling support (Fig. 2). After the single tank has been secured, the two nuts can be loosened and the adjustment rod can be turned.

- Lock the rod with the nuts and repeat the parallelism check until it is within the specified limit.



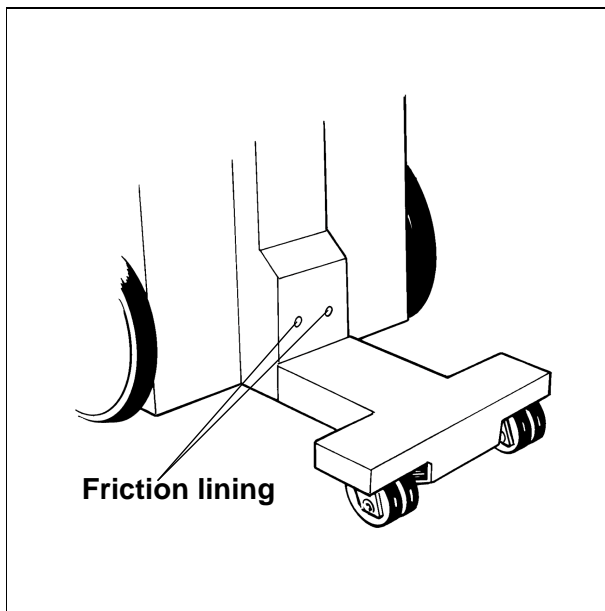


Fig. 4 For upper arm stability

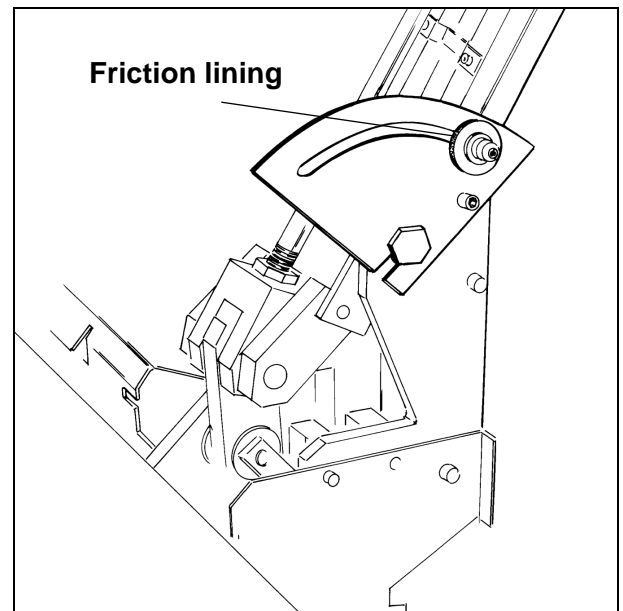


Fig. 5 For lower arm stability

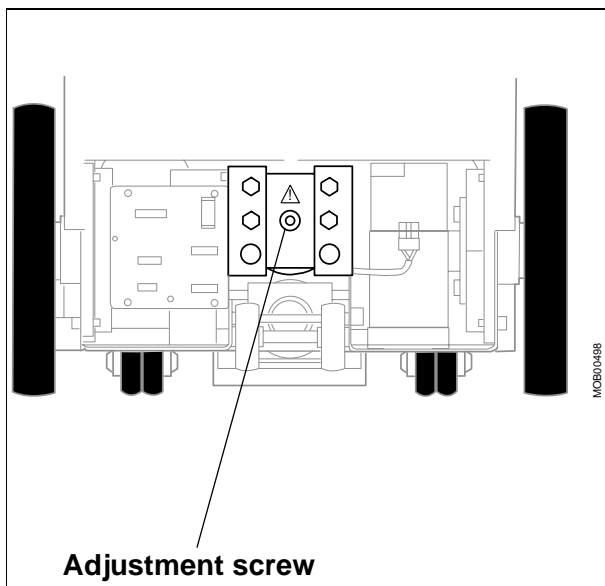


Fig. 6

## Counterbalance

- Remove the plastic plugs covering the friction linings in the column.
- Loosen the friction linings through the holes in the column (Fig. 4) and the lining in the lower joint (Fig. 5).
- Check that the arm system stops in any position.  
If does not stop, but moves lower or higher:
- Adjust the arm system with the adjustment screw (Fig. 6), until it balances in all positions.  
If the arm moves lower, the screw must be tightened; if it moves up, the screw must be loosened.

**Adjusting the friction linings****Upper arm**

If the upper arm does not hold the position set, the friction lining can be adjusted through the holes in the cover (Fig. 4).

- Loosen the screws completely with a 4 mm Allen wrench.
- Retighten the screws until there is no play.
- Tighten the screws evenly until the upper arm holds its position but is still easy to move.

**Lower arm**

If the lower arm does not hold its position, it must be adjusted (Fig. 5).

- Loosen the screw completely.
- Retighten the screw until there are no play.
- Tighten the screw until the lower arm holds its position but is still easy to move.
- Reattach the cover.

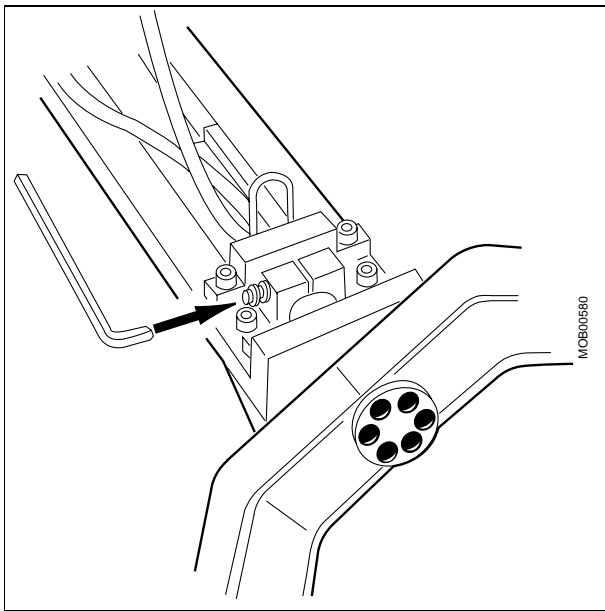


Fig. 7

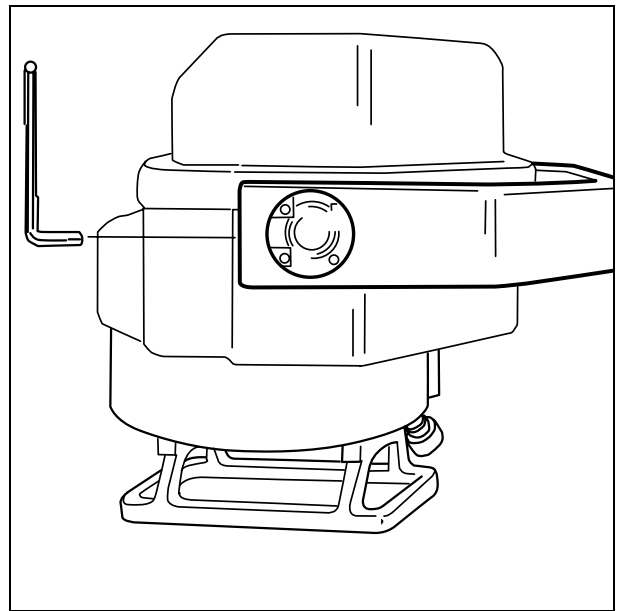


Fig. 8

## **Movement of the fork**

If the fork does not hold its position, it must be adjusted (Fig. 7).

- Loosen the screw completely.
- Retighten the screw until there is no play.
- Tighten the screw until the fork holds its position.

## **Movement of the single tank**

If the single tank rotates too easily or does not hold its position in the fork:

- Remove the caps on the fork.
- Tighten or loosen the friction adjustment (one on each side of the fork) (Fig. 8)

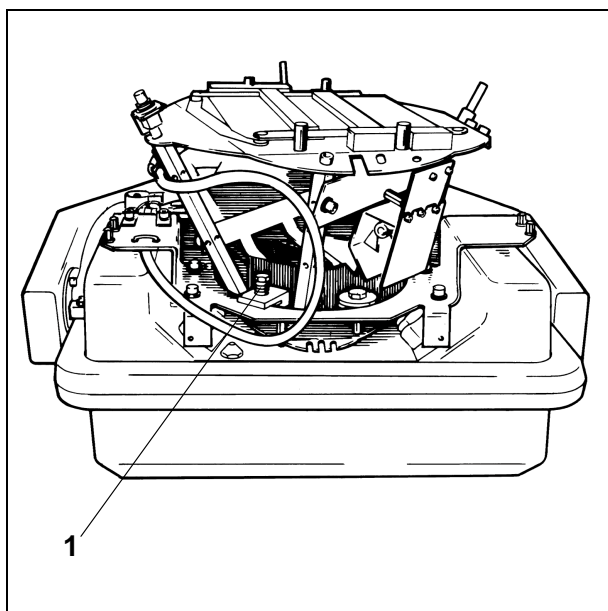


Fig. 9

**Movement of the collimator**

- Remove the collimator cover.
- Adjust the collimator movement resistance with the screw (1) (Fig. 9).
- Reattach all covers.

## Replacing the spring pack



**DANGER**

**Never work with the system open if the capacitor is charging or has just been charged.**

**The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected.  
Life-threatening electric shock hazard exists.**

**See Chap.:**

**"Protective measures when working on the capacitor bank".**

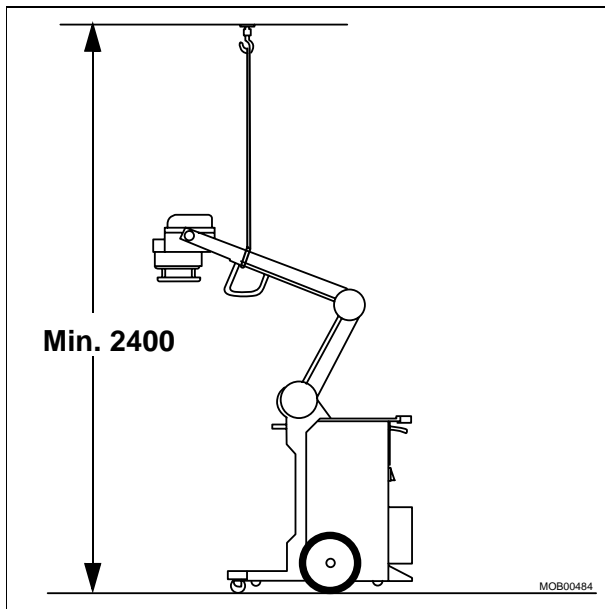


Fig. 10

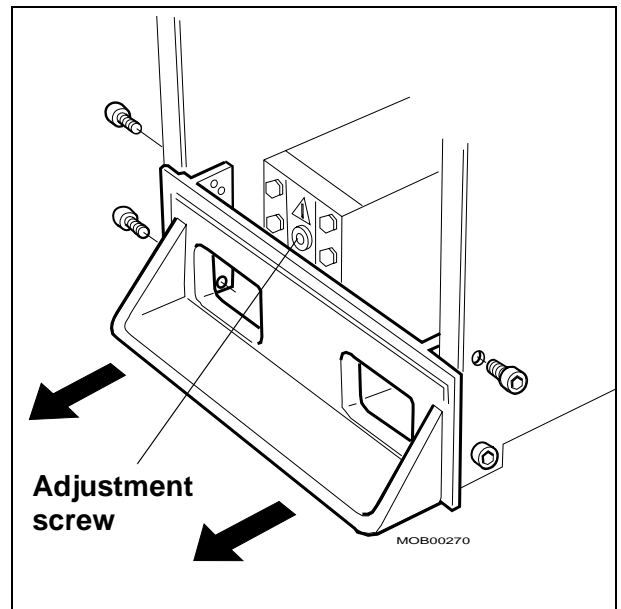


Fig. 11

**Equipment required:** 2 pieces of wood (50 x 70 x 500 mm), rope, ceiling support and a protective mat.

**NOTICE**

**Difficult operations.**

**We recommend that two service engineers do this replacement.**

- Ensure compliance with the safety information in the section entitled: "Safety information and protective measures".
- Block the rear wheels and apply the parking brake.
- Jack up and block the unit securely 5 cm above the floor. This must be done properly so that the unit does not tip over.
- Remove the upper column cover by removing the transport handle and the lower column cover by lifting it upwards.

- Raise the single tank to maximum height and secure it with a ceiling support (Fig. 10).

**CAUTION**

The ceiling suspension must be able to hold a weight of 100 kg, since the entire weight of the arm will be on the ceiling support once the spring is removed.

If not, the arm and single tank will fall.

Make sure the ceiling support is sufficient.

**NOTE**

Do not stand under the single tank or the arm system during the work that follows.

- Remove the tilt bar (Fig. 11).
- Remove the supporting wheels behind the tilt bar.
- Put the protective mat under the unit to protect the floor from damage.

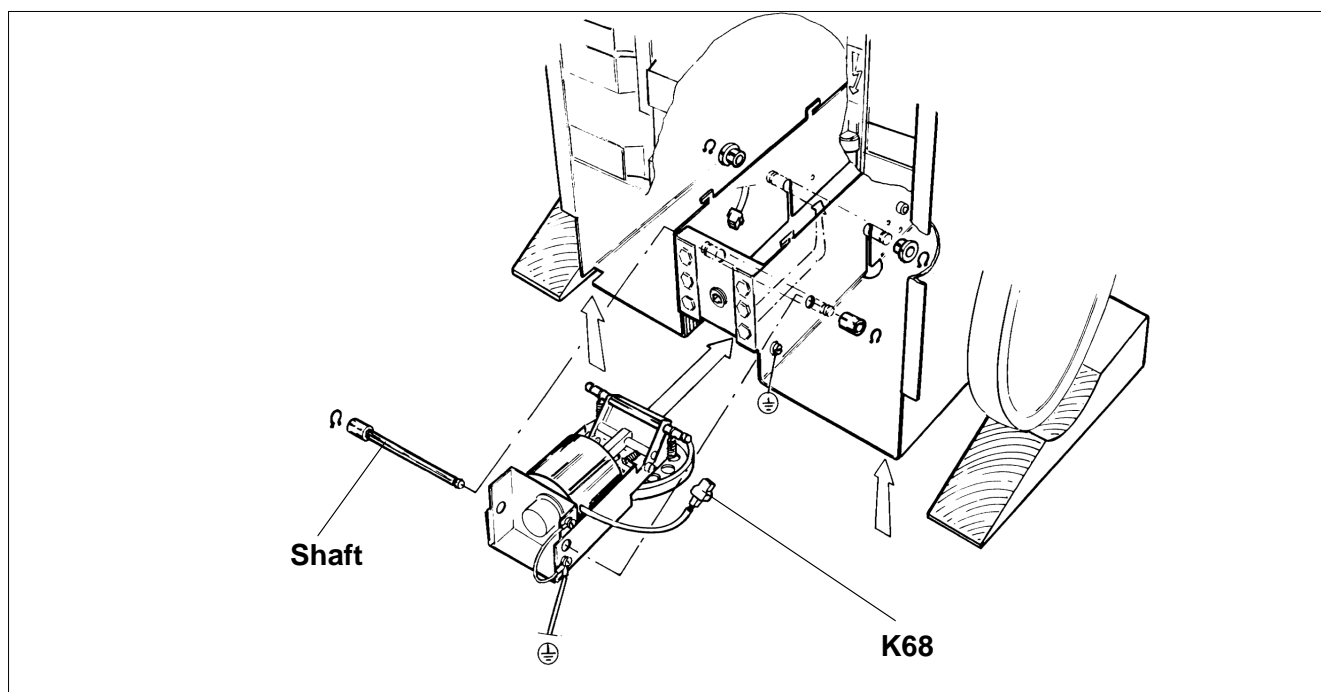


Fig. 12

**MOBILETT Plus and Plus M only**

- Disconnect all cables, ground connections and K68, according to (Fig. 12).
- Remove the locking rings.
- Remove the bearing rings.
- Remove the shaft.
- Let the turn plate down and remove it.

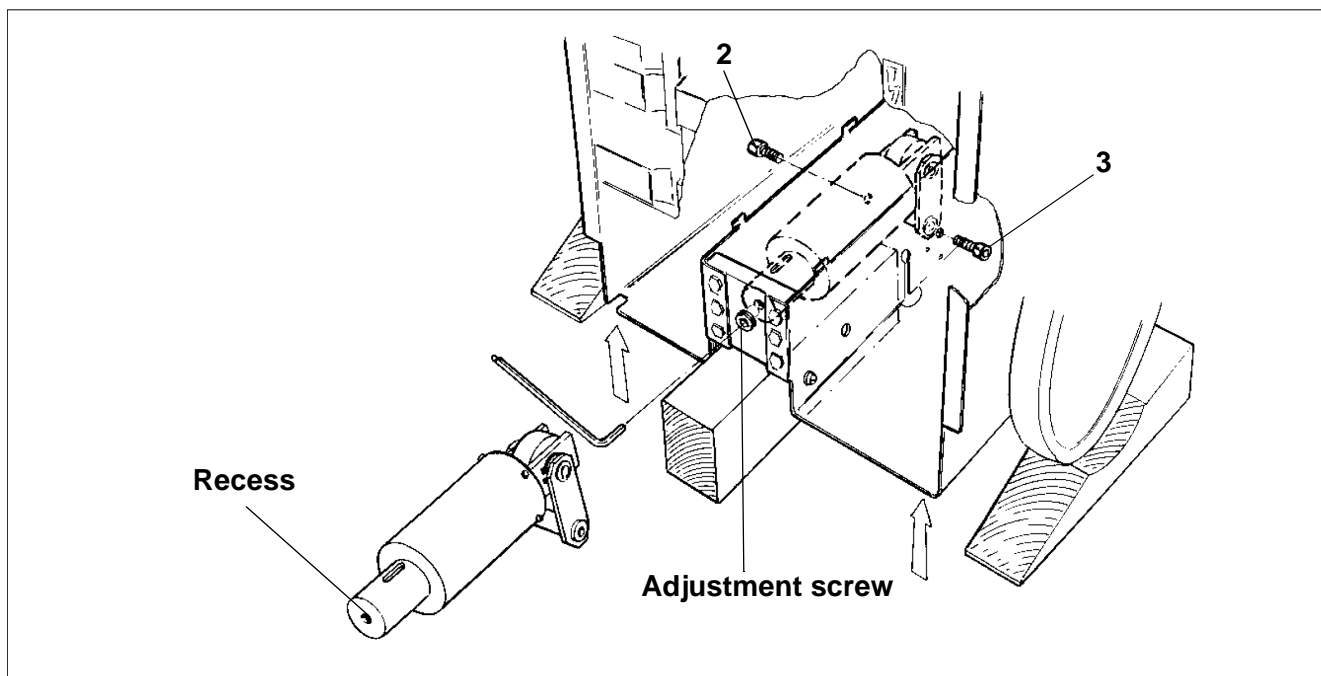


Fig. 13

**⚠ WARNING**

**Risk of injury to the hands!**

**The strong tension in the spring pack could cause undesirable actions.**

**Be careful during the following procedures.**

- Loosen the adjustment screw so that the spring pack is loosened and the nearest part of the pack is lowered (Fig. 13).

**⚠ WARNING**

**If the spring pack does not lower, there is still spring tension.**

**The strong tension in the spring pack could cause undesirable actions.**

**Check whether the single tank is in its uppermost position; if not, raise the single tank to this position. Check whether the adjustment screw is loose enough. Do not use any force to remove the spring pack.**

- Loosen the two large Allen screws (2) and (3) on the end of the spring pack. The whole spring pack will then fall down on the floor.
- Remove the spring pack.
- Install the new spring pack with the two Allen screws (2) and (3) on the end of the spring pack.
- Lift up the spring pack in the front end and check through the hole for the adjustment screw that the front of the spring pack with recess is visible.
- Mount the adjustment screw and tighten until the spring pack is held in position.

- Tighten screws (2) and (3).
- Tighten the adjustment screw until the arm and single tank are held in the uppermost position by the spring force alone.

**MOBILETT Plus and Plus M only**

The installation of the turn plate is performed in the reverse order.

- Install the turn plate.
- Reattach the shafts.
- Reattach the bearing rings.
- Reattach the locking rings.
- Connect the ground cable and K68.

**All MOBILETT:s**

- Reinstall the supporting wheels behind the tilt bar.
- Reattach the tilt bar.
- Remove the ceiling support carefully and check that the single tank remains in the uppermost position by itself. If not, tighten the adjustment screw.
- Move the arm into the park position.
- Lower the unit to the floor and block the rear wheels.
- Check the arm and single tank movement. If necessary, adjust according to section "Adjustment of the arm system".
- Reattach all covers except the top cover.
- Set switch S10 in the ON position to charge the capacitor bank.
- Reattach the top cover.
- Check the function of the turn plate and the unit by releasing one exposure.





MOBILETT Plus and Plus M only

## Adjustment and replacement of the turn plate



 **DANGER**

Never work with the system open if the capacitor is charging or has just been charged.

The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected.

Life-threatening electric shock hazard exists.

See Chap.:

"Protective measures when working on the capacitor bank".

**Equipment required:** 2 pieces of wood (50 x 70 x 500 mm)

- The turn plate mechanism must be removed for adjustment or replacement.
- Ensure compliance with the safety information in the section: "Safety information and protective measures".

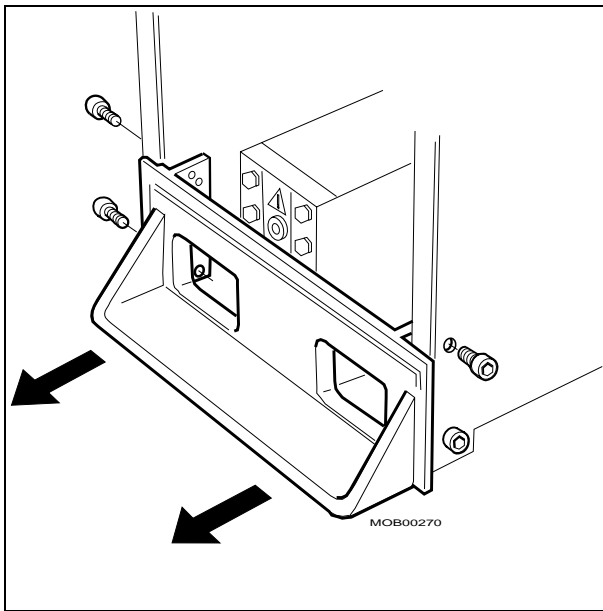


Fig. 14

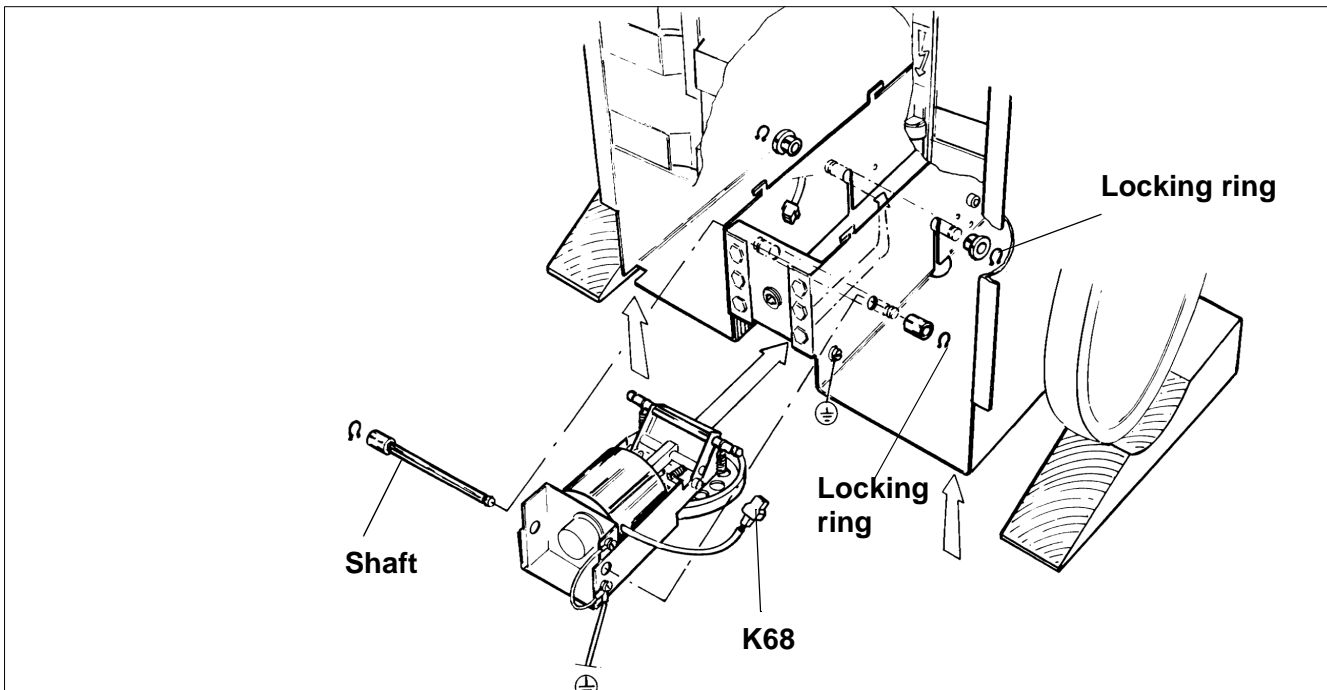


Fig. 15

**MOBILETT Plus and Plus M only**

- Remove the tilt bar (Fig. 14).
- Remove the supporting wheels behind the tilt bar.
- Jack up and block the unit securely 5 cm above the floor. This must be done properly so that the unit does not tip over.
- Disconnect all cables, ground connection and K68, according to (Fig. 15).

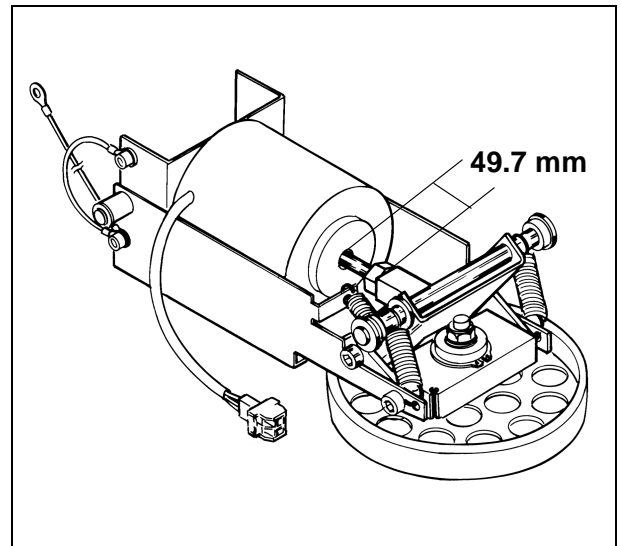


Fig. 16

## MOBILETT Plus and Plus M only

- Remove the locking rings.
- Remove the bearing rings.
- Remove the shaft.
- Lower the turn plate and remove it.
- Check all springs for correct mounting and damage (Fig. 16).
- Check that the dimension between the screw connection and the magnet housing is 49.7 mm. Adjust, if necessary.

A new or inspected turn plate should be installed in the reverse order:

- Reinstall the turn plate.
- Reinstall the shafts.
- Reinstall the bearing rings.
- Reinstall the locking rings.
- Connect the ground cable and K68.
- Reinstall the supporting wheels behind the tilt bar.
- Reinstall the tilt bar.
- Reattach the side covers and the rear cover.
- Set switch S10 in OFF position to charge the capacitor bank.
- Reattach the top cover.
- Connect the unit to mains power supply outlet and switch it on.
- Check the function of the turn plate by pressing one of the turn plate buttons and turning the unit. Check also that the turn plate returns to the park position when the button is pressed a second time.

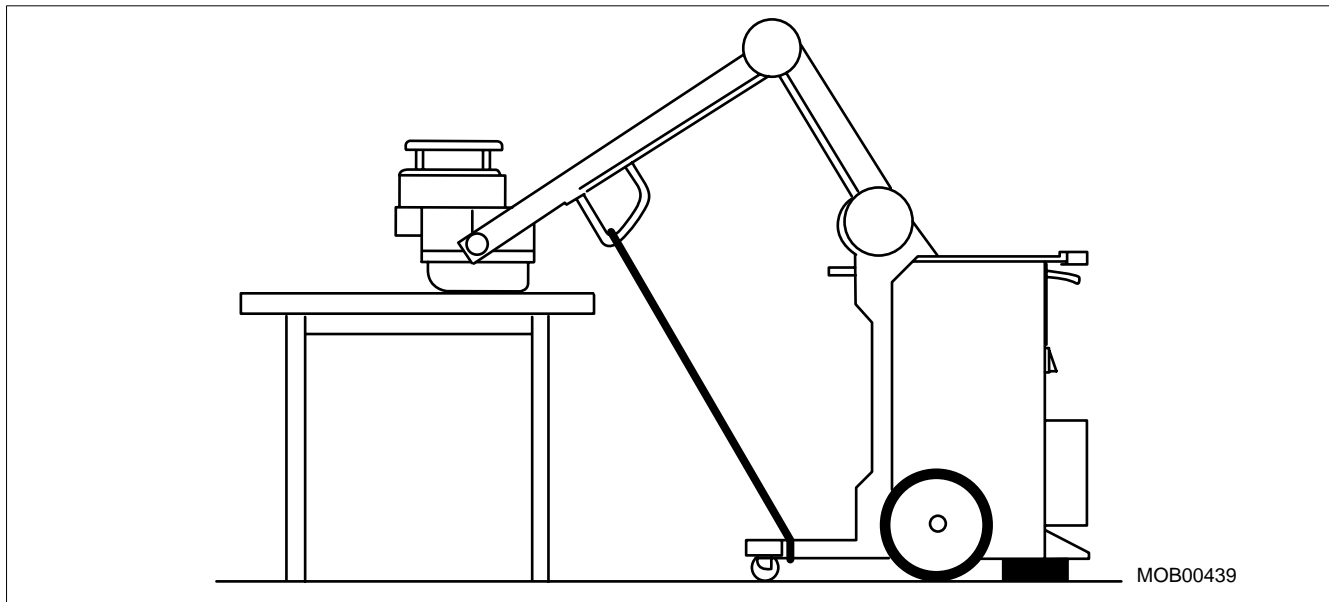


Fig. 17

### Replacement of the single tank

**DANGER**

Never work with the system open if the capacitor is charging or has just been charged.

The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected.

Life-threatening electric shock hazard exists.

See Chap.:

"Protective measures when working on the capacitor bank".

**Equipment required:** Rope

- Position the unit with the single tank resting on a table (Fig. 17).
- Secure the arm with a rope.
- Block the rear wheels and apply the parking brake.

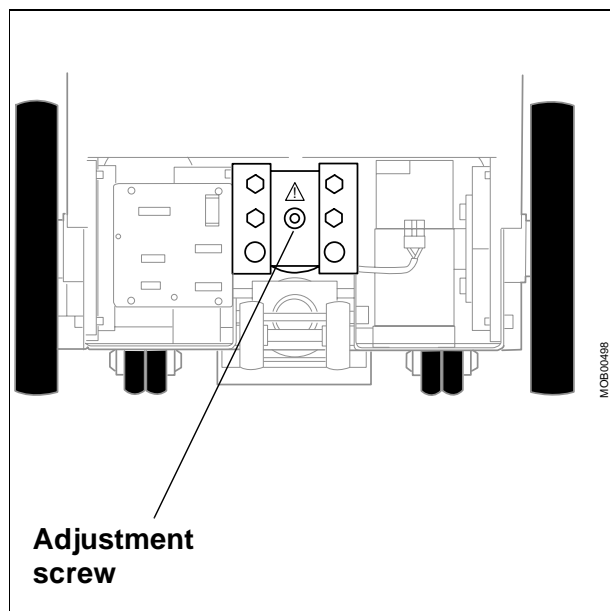


Fig. 18

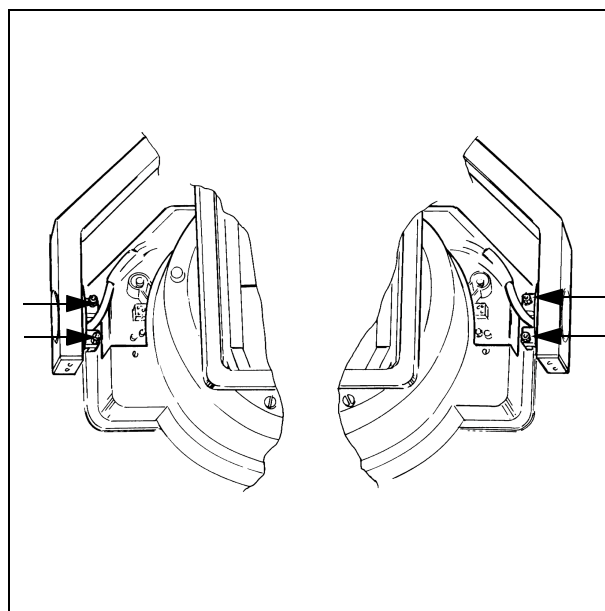


Fig. 19

- Relieve the spring tension by loosening the adjustment screw (Fig. 18).
- Remove all collimator covers and grounding cables.
- Disconnect all cables to the collimator.
- Cut the cable ties (see Page 9 - 5).
- Remove the collimator.
- Disconnect all electrical connections to the single tank.
- Remove the screws and nuts (Fig. 19) bolts placed in the ends of the axis of rotation.
- Lift up the fork and remove the single tank. **Do not turn the fork around.**  
The new single tank has to be installed in the same position as the old one.
- Replace the locking nuts with new nuts enclosed with the new single tank.
- Install the four screws according to (Fig. 19).

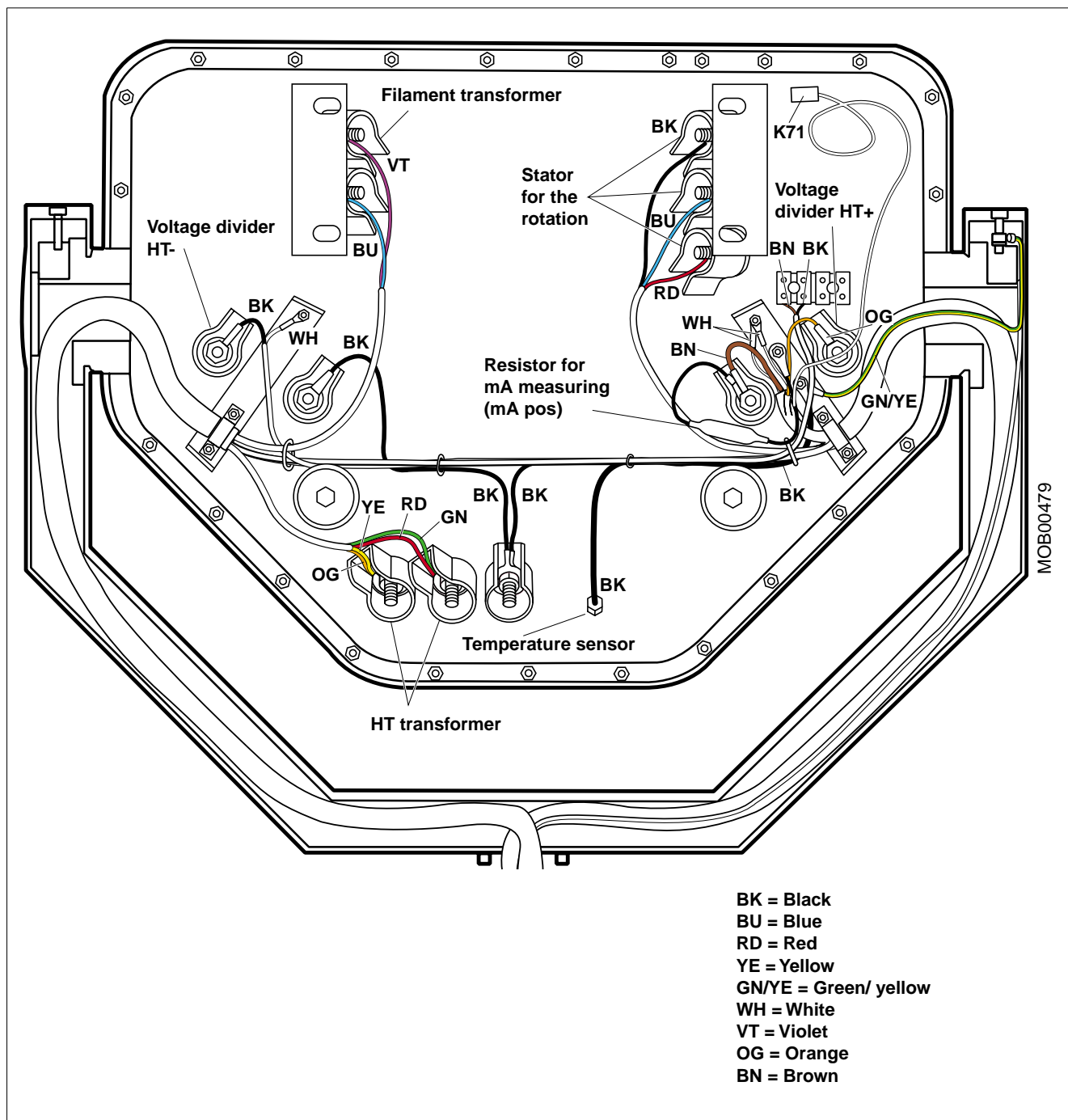


Fig. 20

- Reconnect all electrical connections according to (Fig. 20).
- Install the collimator.
- Replace the cable ties according to information on Page 9 - 5 and 9 - 6.
- Tighten the adjustment screw (Fig. 18), so that the single tank is balanced.
- Set switch S10 in the OFF position.

- Switch on the light localizer and check the coincidence of the light and radiation fields according to the specifications in the section on "Replacement of collimator".
- Reattach all covers on the single tank.
- Adjust the adjustment screw so that the single tank is balanced. If any problems occur, refer to the section "Adjustment of arm system".
- Use the service program "P16 - Show the exposure counter" and record the values of the exposure counter in the service protocol and in the unit documentation.
- Use the service program "P10 - Fast adaptation" to adjust the filament values to the new single tank.
- Reattach the remaining covers.



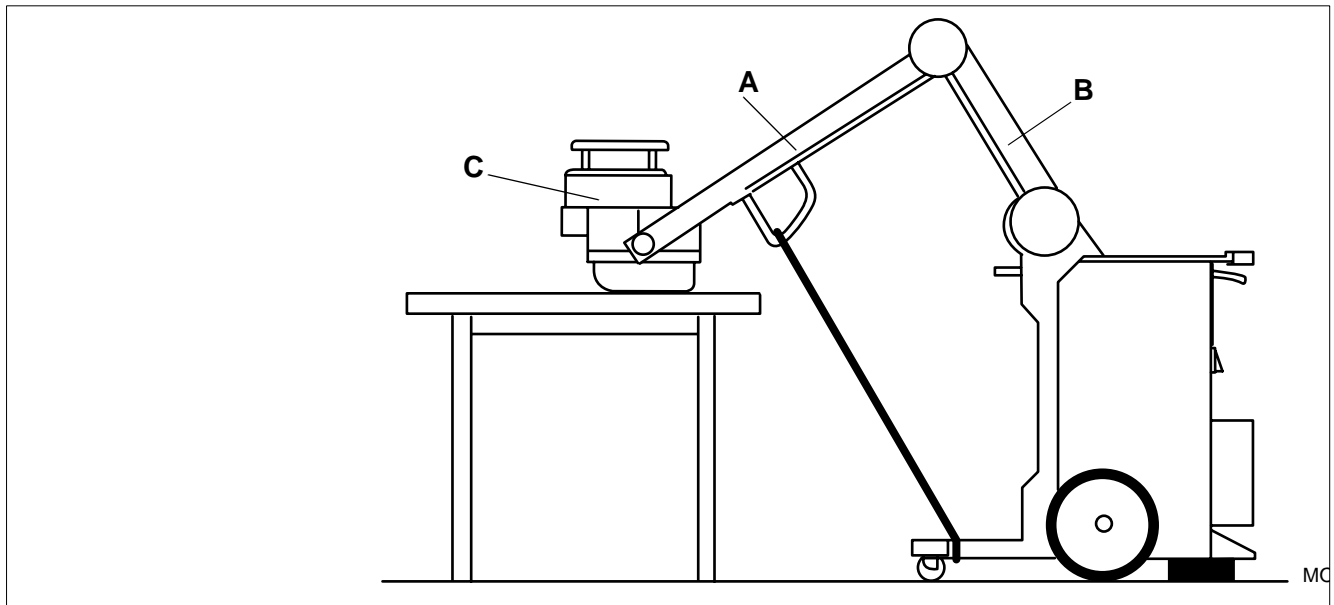


Fig. 21



## Replacement of the support arm cable harness

**⚠ DANGER**

Never work with the system open if the capacitor is charging or has just been charged.

The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected.

Life-threatening electric shock hazard exists.

See Chap.:

"Protective measures when working on the capacitor bank".

**Equipment required:** Rope

- Position the unit with the single tank resting on a table. Secure the support arm with a piece of rope (Fig. 21).
- Remove covers "A" and "B".
- Remove collimator cover "C".



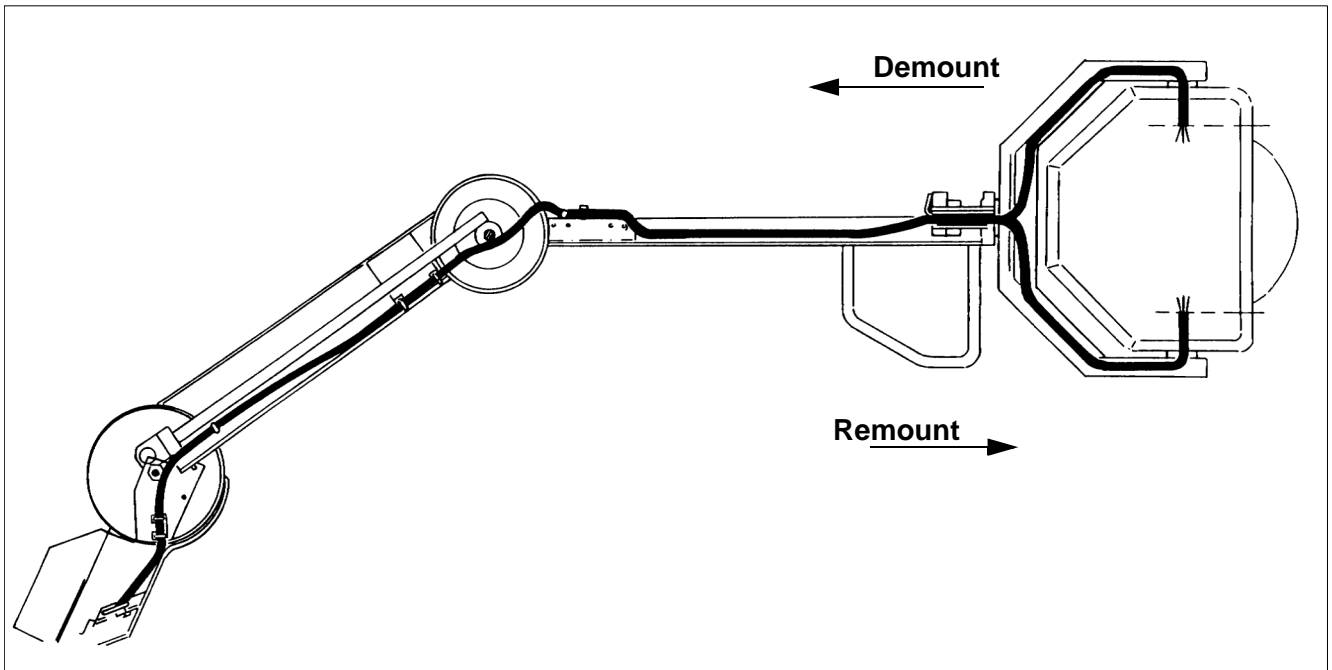


Fig. 22

- Remove the **all** arm covers and the column covers.
- Relieve the tension in the spring pack by loosening the adjustment screw above the tilt bar.
- Disconnect all cables to the collimator.
- Remove the collimator.
- Disconnect all electrical connections to the single tank.



## **Danger of injury!**

**The arm may move uncontrollably when the weight of the fork and single tank is removed.**

**Ensure that the arm is properly secured to the unit foot with the rope.**

- Remove the supporting hub in the rotation axis of the fork.
- Remove all cable clamps and cable ties on the arm and the chassis.
- Disconnect the single tank and the fork from the arm.
- Disassemble the fork so the cables can be removed.
- Disconnect the chassis connections and remove the cables (Fig. 22).

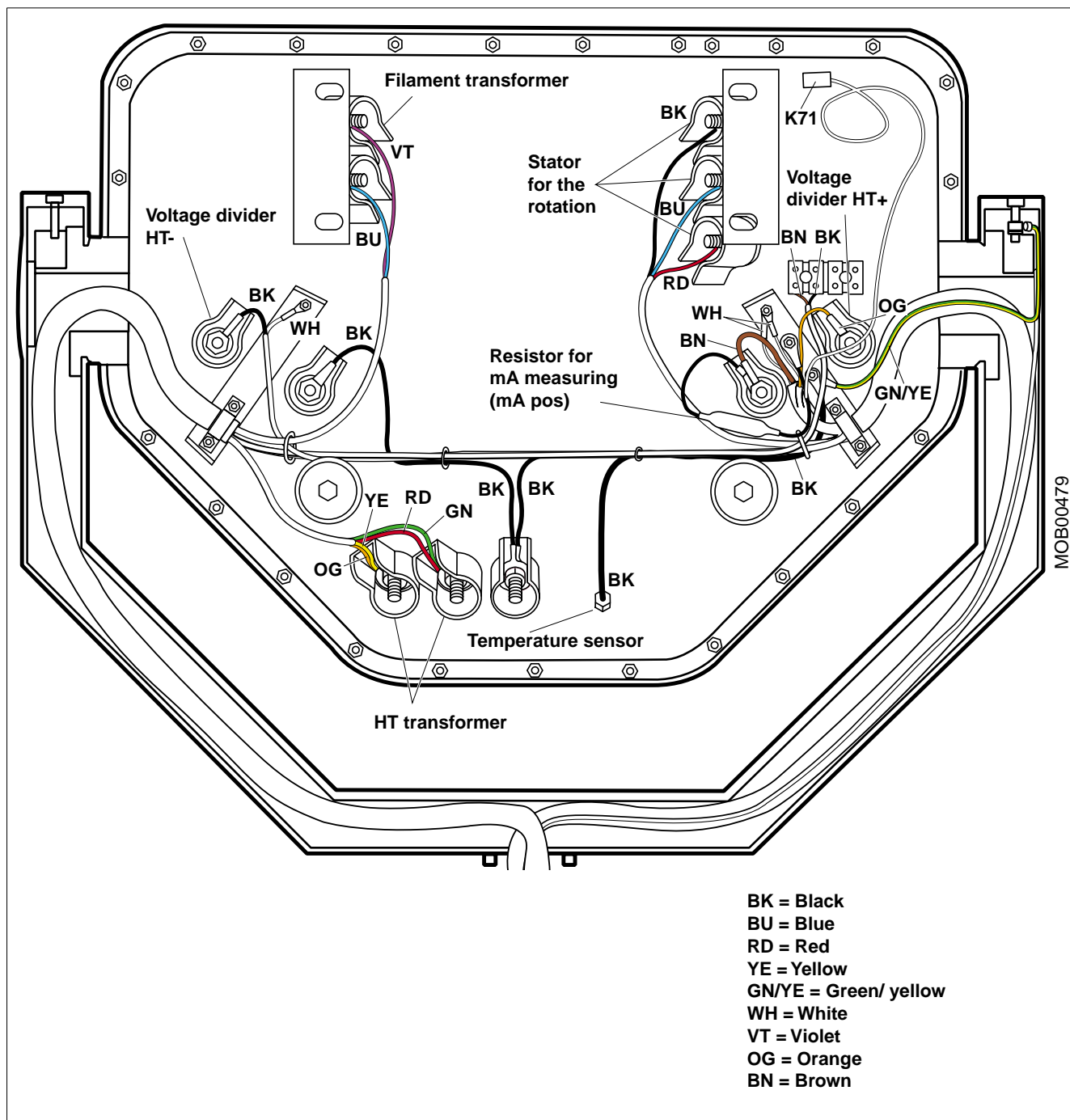


Fig. 23

The installation of the new arm cable harness is performed in the reverse order.

- Connect all wires on the single tank according to (Fig. 23).
- Install the collimator and its wires. Attach only cover "C".
- Connect all connections and reinstall all cable clamps. Install new cable ties.

**NOTICE**

**Do not stretch the cable too tightly in the arm.**

**There must be enough slack so that the cable is not pulled by the mechanical movements.**

- Set S10 to the OFF position.
- Reinstall all covers except single tanks covers "A" and "B".
- Make sure that the screw mountings between the fork and the arm are tightened properly.
- Remove the rope between the handle and the foot while keeping the single tank on the table.
- Tighten the adjustment screw until the single tank and arm are balanced. Refer to the section "Adjustment of arm system".
- Switch on the light localizer and check the coincidence of the light and radiation fields according to the specifications in the section "Replacement of collimator".
- Reattach the remaining covers.

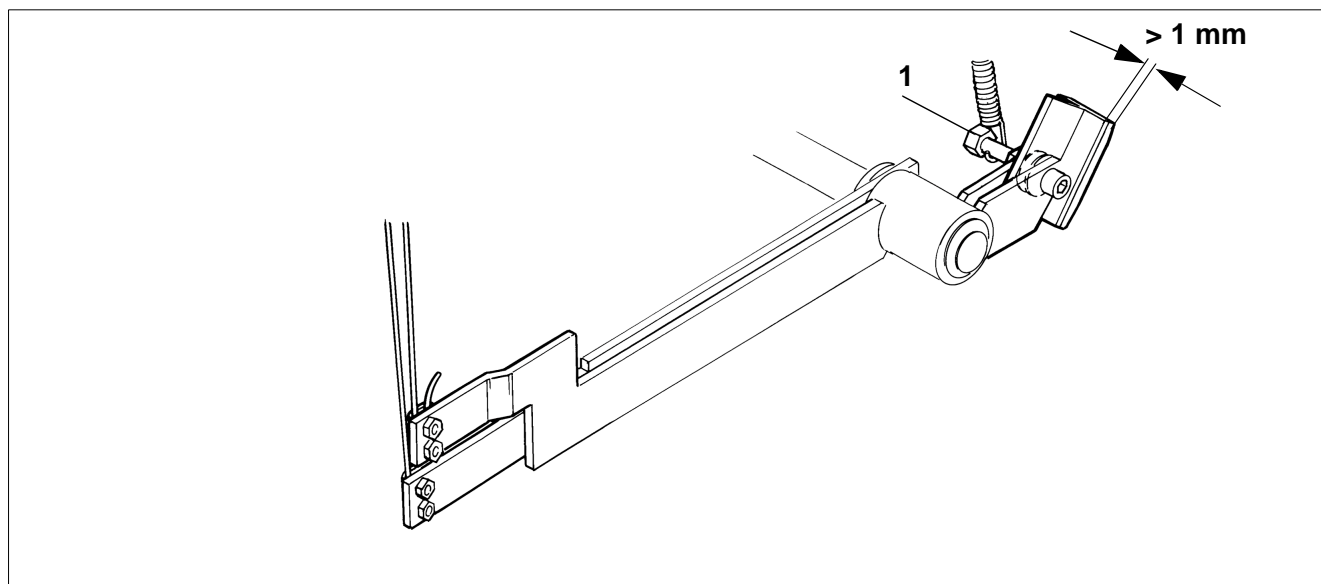


Fig. 24

### Adjustment of the hand/ parking brake



**DANGER**

Never work with the system open if the capacitor is charging or has just been charged.

The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected.  
Life-threatening electric shock hazard exists.

See Chap.:

"Protective measures when working on the capacitor bank".

**Equipment required:** Spring scale

- Disconnect the unit from the wall outlet.
- Block up the unit on both sides with 5 x 5 cm pieces of wood. The wheels must be able to rotate independently.
- Remove the rear wheel by removing the screw.
- Check the brake linings. If the brake linings are thinner than 1 mm, they must be replaced (Fig. 24).
- Remove the old lining by loosening screw (1) (Fig. 24).
- When installing the new lining, make sure that the lining is **facing the right way**.
- If the braking linings meet the requirements and the braking force is still low, check the tension of the brake wire.
- Remount the rear wheels.

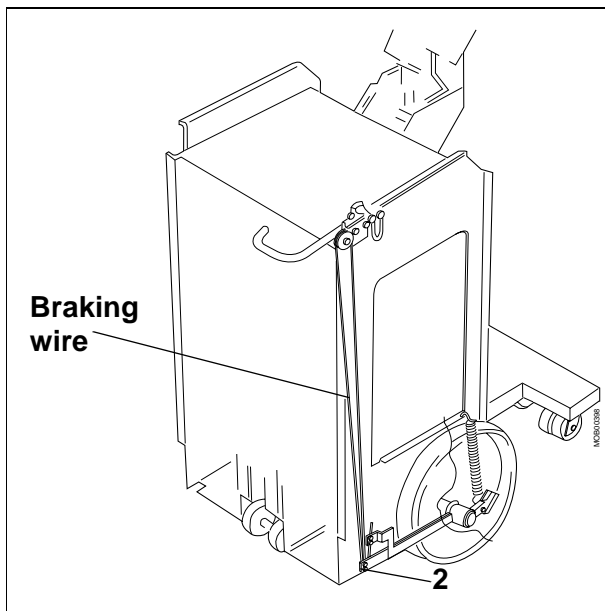


Fig. 25

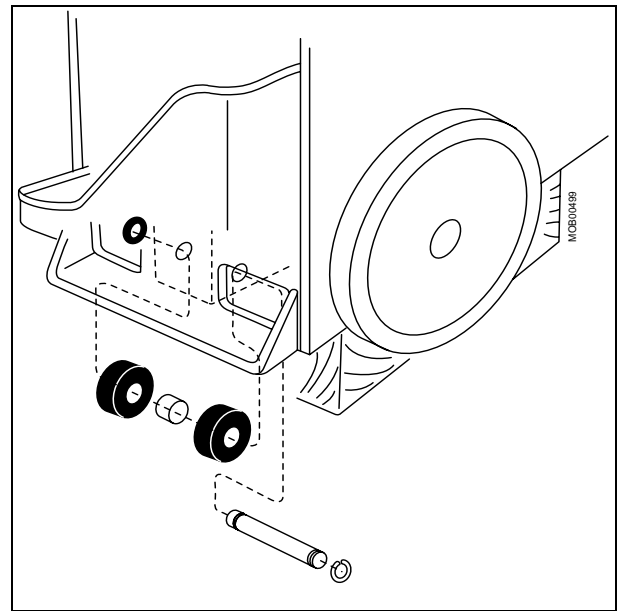


Fig. 26

- Lock the brake. It should not be possible to move the unit with average manual force. A slight skip is acceptable when using greater force, i.e. more than 350 N.
- Measure the power required for lifting the brake handle to locked position with a dynamometer. If the power is not between 100 and 120 N, an adjustment must be done.
- Loosen the wire locking screws (2) with the brake released (Fig. 25).
- Stretch the wire and secure it with the screws when the required brake force is obtained.

## Replacing the supporting wheels

**Equipment required:** 1 piece of wood (50 x 70 x 500 mm)

- Jack up the unit with a wood block measuring 5 x 5 cm.
- Block the rear wheels so that they cannot turn.
- Remove the locking ring through the hole in the tilt bar (Fig. 26).
- Remove the wheel shaft so that the supporting wheels can be removed.
- Install the new support wheels and secure the shaft with the locking ring.
- Check that the wheels move easily.
- Remove the wood block and lower the unit.

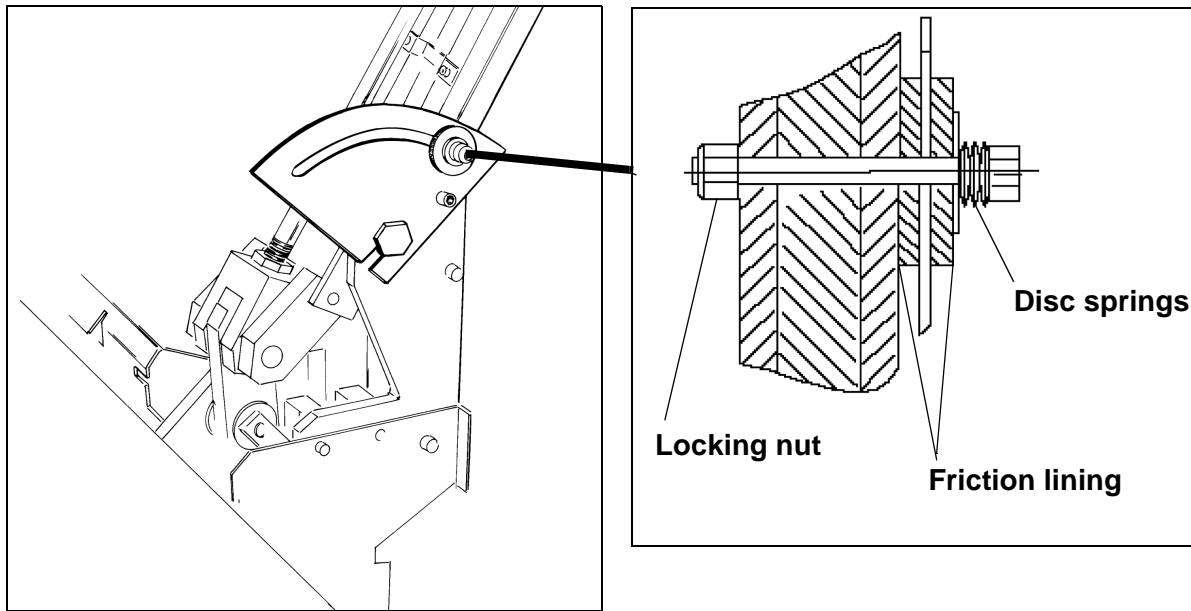


Fig. 27

## Replacing the friction linings

### Replacing the horizontal friction lining

- Remove the joint covers.
- Remove the locking nut.
- Remove the screw and the disc springs.
- Replace the horizontal friction lining.
- Remount the screw and the disc springs (fig. 27). Secure the screw with the locking nut.
- Adjust the horizontal friction linings. Refer to the section: "Adjustment of the friction linings", Page 10 - 4.
- Reattach all covers.

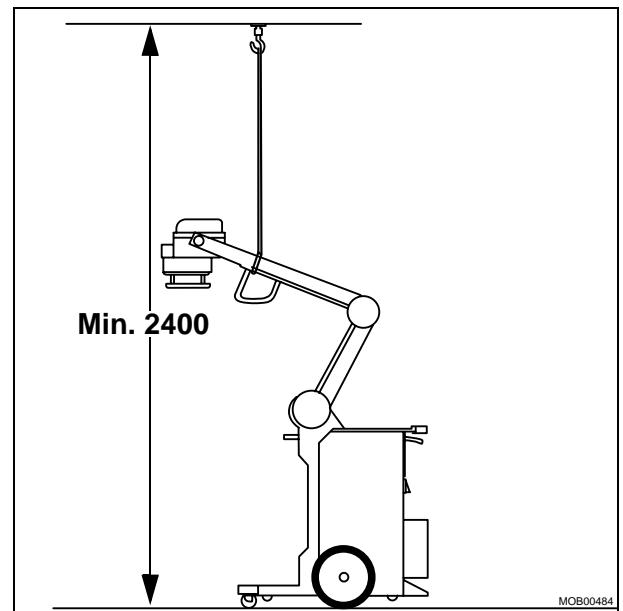


Fig. 28

## Replacing the vertical friction linings



### **DANGER**

Never work with the system open if the capacitor is charging or has just been charged.

The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected. Life-threatening electric shock hazard exists.

See Chap.:

"Protective measures when working on the capacitor bank".

**Equipment required:** Large caliper, rope, ceiling support.

- Raise the single tank to maximum height and secure it with a ceiling support (Fig. 28).

### **CAUTION**

The ceiling suspension must be able to hold a weight of 100 kg, since the entire weight of the arm will be on the ceiling support once the spring is removed.

If not, the arm and single tank will fall.

Make sure the ceiling support is sufficient.

### **NOTE**

Do not stand under the single tank or the arm system during the work that follows.

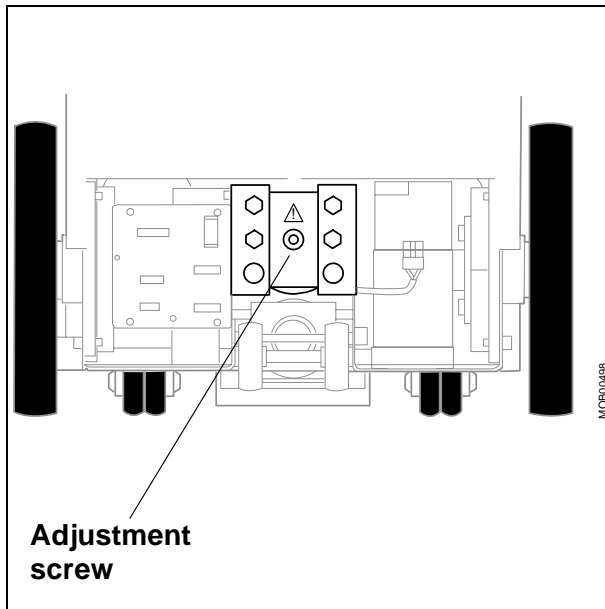


Fig. 29

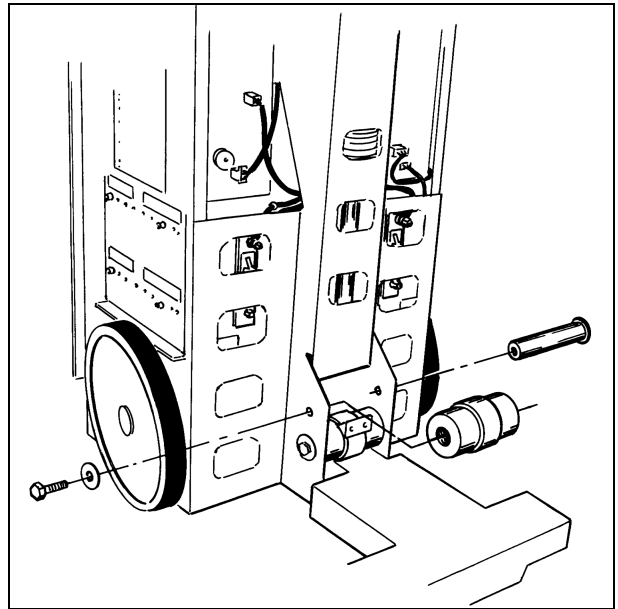


Fig. 30

- Loosen the adjustment screw so that the arm is no longer balanced, however the spring mechanism remains in position (Fig. 29). Do not allow the spring mechanism to fall out.
- Remove the screw and washer from the upper counter bearing (Fig. 30).
- Remove the friction linings.



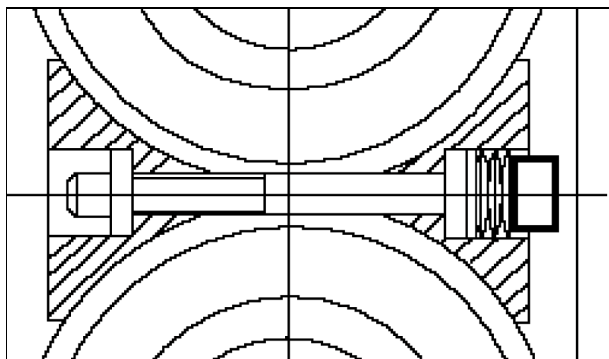


Fig. 31

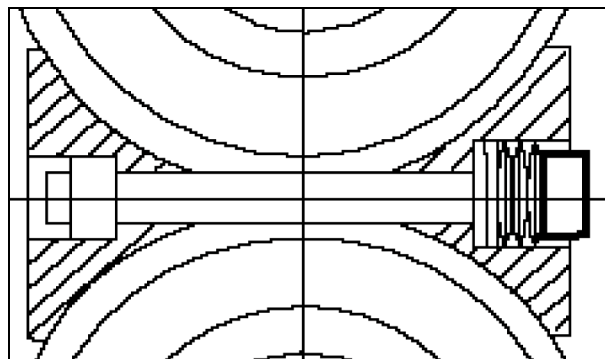


Fig. 32

- Install the new friction linings according to (Fig. 31 or Fig. 32). There are two different vertical friction linings. Both are equally suitable for the unit.
- Reinstall the upper counter bearing.
- Tighten the screws.
- Check that there is no braking action on the counter bearings.
- Tighten the adjustment screw. Make sure that the spring mechanism is under tension before releasing the ceiling support.
- Attach the rear, left right and front covers.
- Check parallelism, refer to section "Parallelism".
- Adjust counterbalance, refer to section "Counterbalance".
- Adjust friction linings, refer to section "Adjusting the friction linings".

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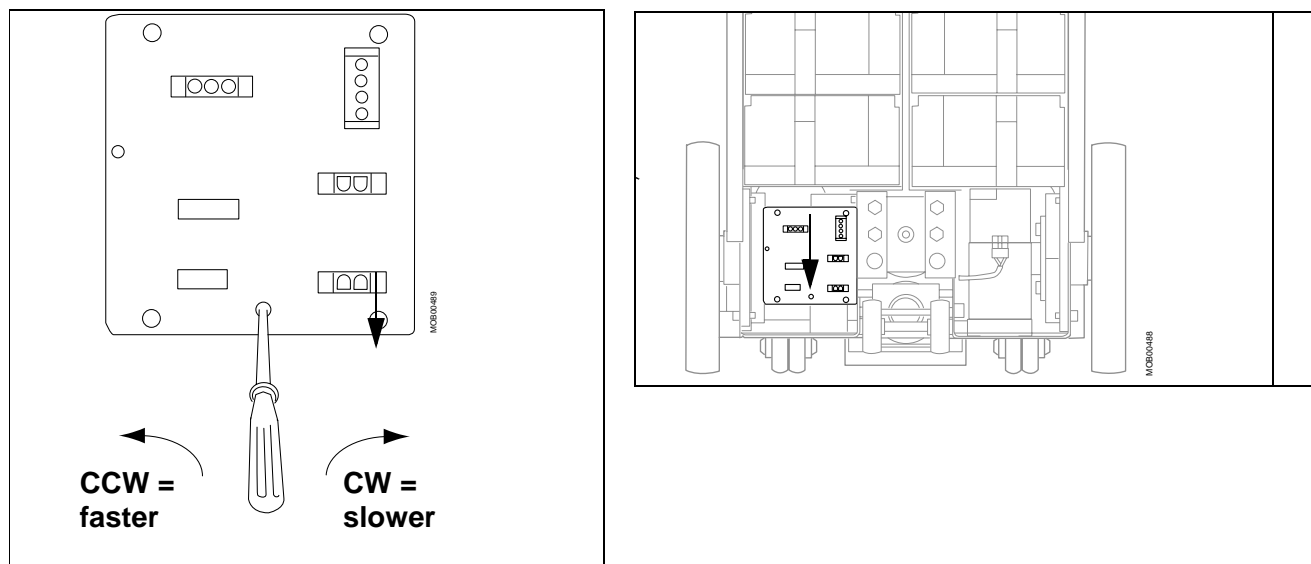


Fig. 1

## Adjustment of the speed



**DANGER**

Never work with the system open if the capacitor is charging or has just been charged.

The capacitor bank may still be charged even if the system is switched OFF and the mains cable is disconnected.  
Life-threatening electric shock hazard exists.

See Chap.:

"Protective measures when working on the capacitor bank".

- Adjust the speed with a screwdriver as shown in (Fig. 1).
- Clockwise rotation decreases the speed.
- Counterclockwise rotation increases the speed.

**NOTE**

The front cover does not have to be removed to adjust the speed.  
On the lower left of the cover there is a hole (covered with a plastic cap), through which you can reach the adjustment potentiometer.

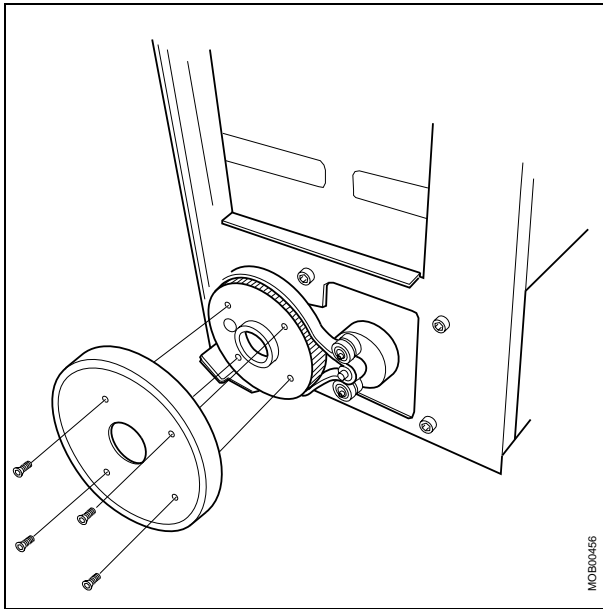


Fig. 2

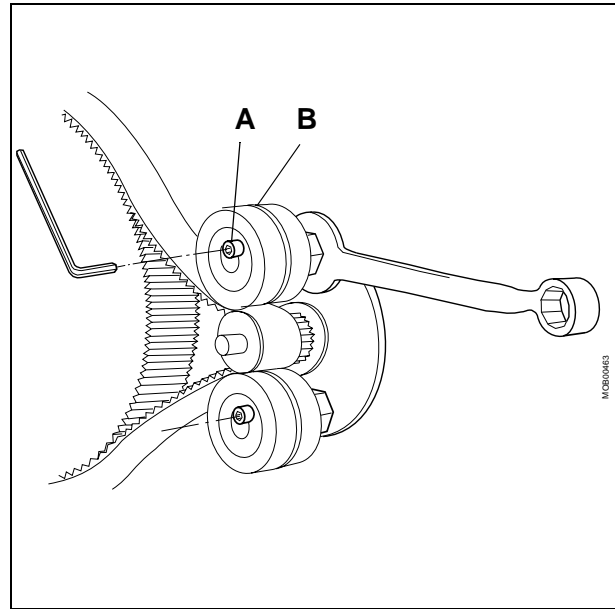


Fig. 3

## Replacement of the transmission belt and belt tension adjustment

### NOTE

Under normal circumstances, the belt drive does not require any adjustments for the entire lifetime of the unit.

### Belt replacement

- Remove the side covers.
- Tilt the unit and support the relevant side with a piece of wood.
- To prevent the other wheel from turning, secure it with a pair of wedges.  
**Do not use the parking brake.**
- Remove the wheel according to (Fig. 2).
- Loosen the 2 screws (**A**/Fig. 3).
- Loosen the tension bearings (**B**/Fig. 3) with a 13 mm wrench.
- Remove the belt.
- Install the new belt.
- Tighten the tension bearings (**B**/Fig. 3) and the screws (**A**/Fig. 3).
- Rotate the large toothed wheel by hand and check for smooth operation and that the belt is aligned over the toothed wheels.
- Adjust the tension according to "Tension adjustment".

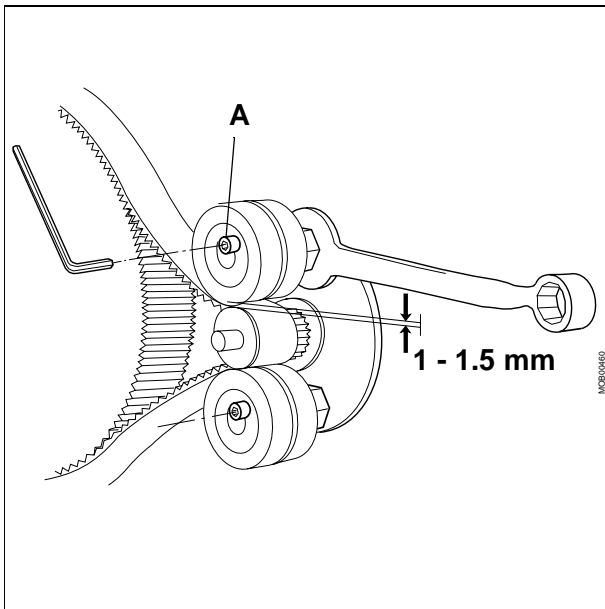


Fig. 4

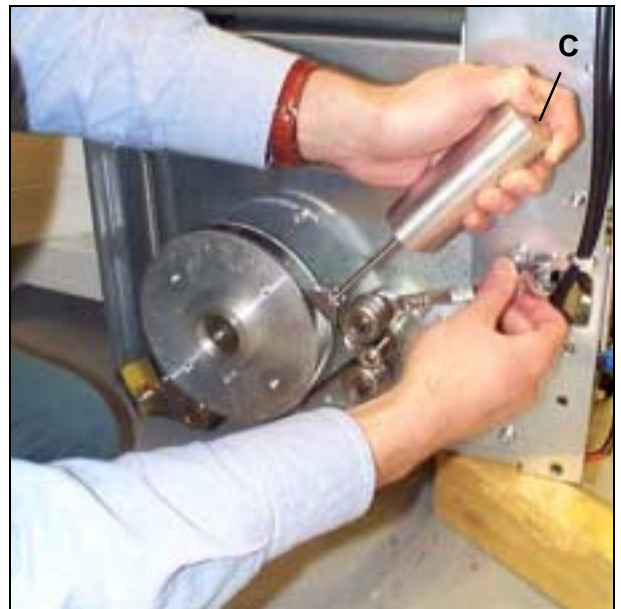


Fig. 5

## Tension adjustment

- Loosen the screws (**A**/Fig. 4). The tension of the transmission belt can then be adjusted with a 13 mm wrench.
- Press the special adjustment device to the transmission belt and hold a finger on top of it. When the button (**C**/Fig. 5) is in the same level as the top of the adjustment device a proper pressure is applied.

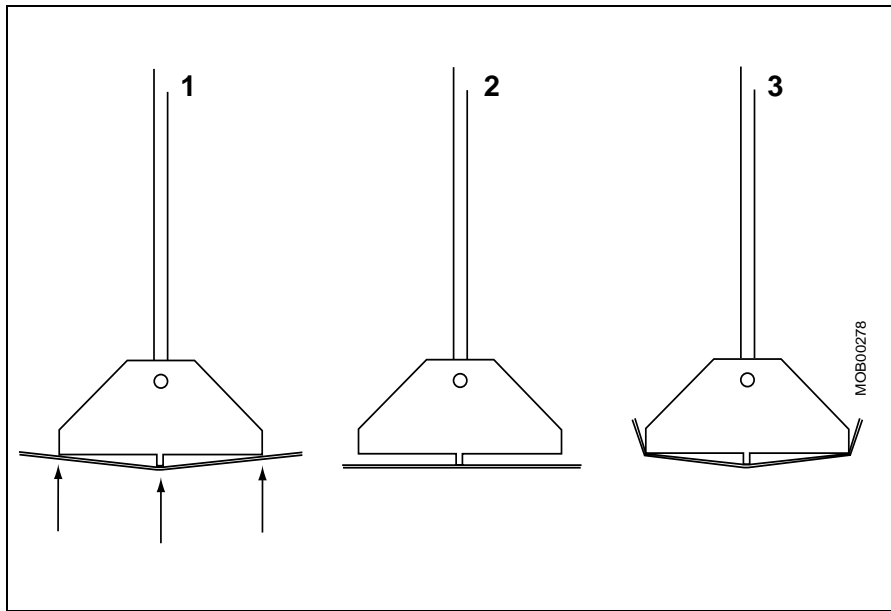


Fig. 6

- With the wrench, adjust the tension of the transmission belt equally on the two tension bearings to a minimum distance of 1-1.5 mm between the bearing and the washer (Fig. 4). The tension of the transmission belt is right when the adjustment device and the belt are in contact in exactly three points (**1**/Fig. 6). In (**2**/Fig. 6) the belt is too tight and in (**3**/Fig. 6) the belt is too slack.
- Tighten the screws (**A**/Fig. 4).
- Remount the wheel.
- Fit the covers.

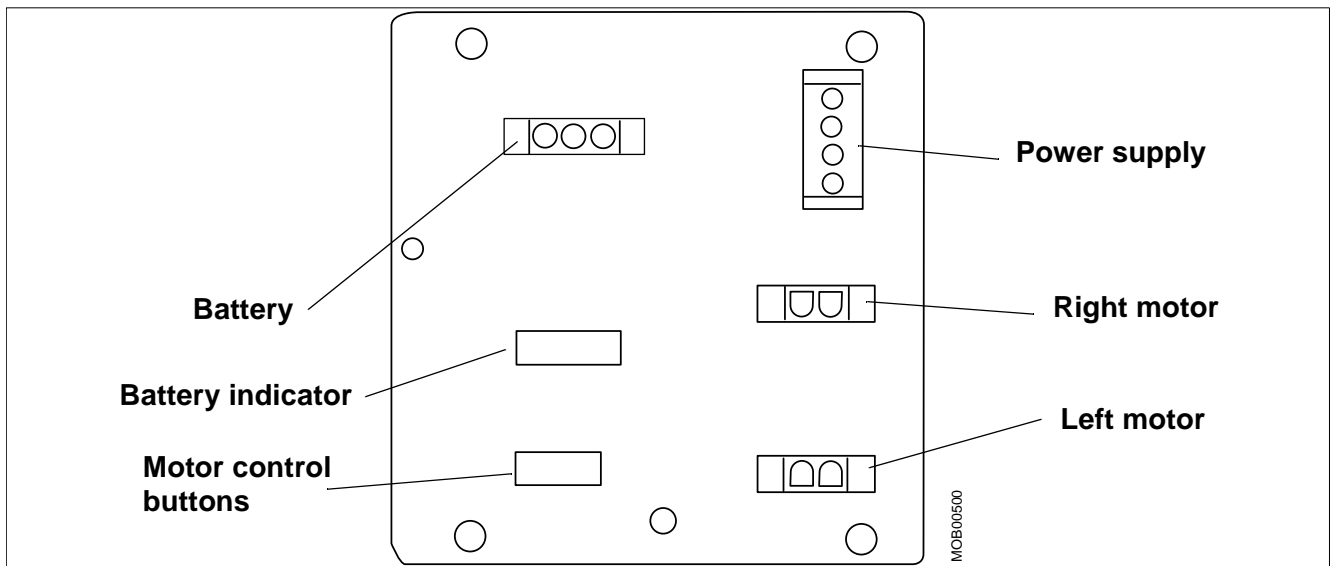


Fig. 7 Motor power unit, electrical connections

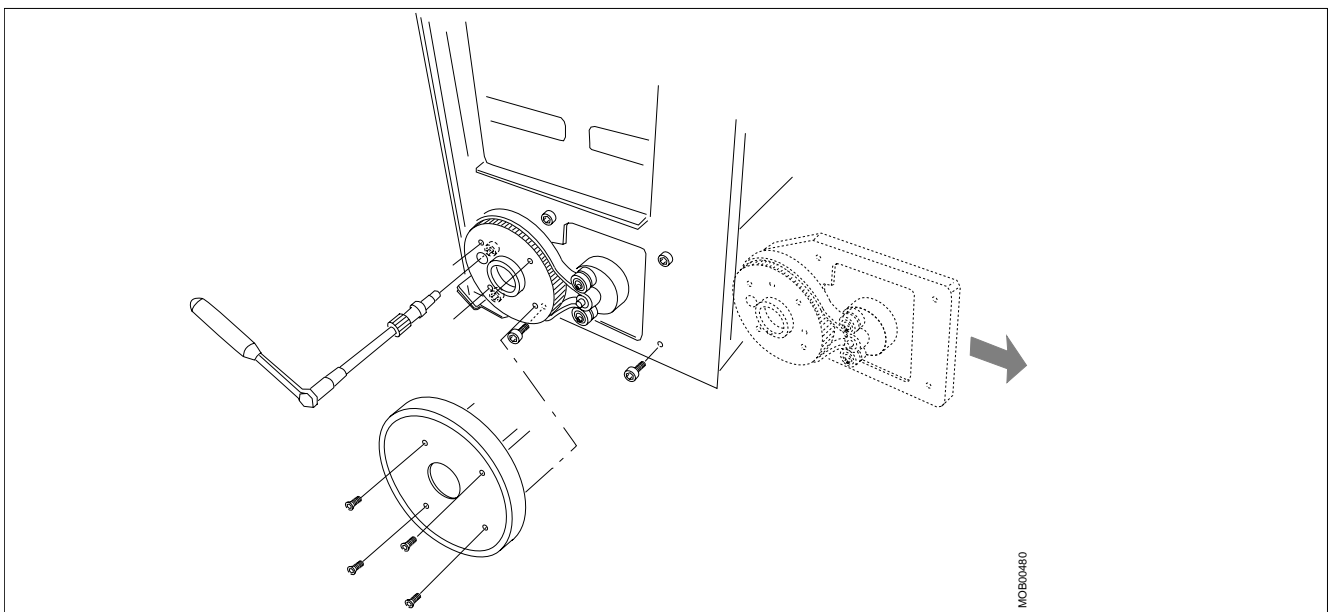


Fig. 8 Removing wheel and motor

## Replacing the motor unit

**Equipment required:** Ratchet with Allen socket

- Remove the side and front covers.
- Remove the motor drive unit or battery pack depending on the side where the motor is being replaced. Refer to (Fig. 7) for electrical connections.
- Tilt the unit and support the affected side with a block of wood.

- To prevent the other wheel from turning, secure it with several wedges.  
**Do not apply the parking brake.**
- Remove the wheel, 4 screws, according to (Fig. 8).
- Remove the 6 screws holding the motor. 2 of the screws can be accessed through a hole in the toothed wheel.
- Remove the complete motor unit inward through the opening in the chassis.
- Install the new motor with the 6 screws.
- Install the charging unit and/ or battery pack. Refer to (Fig. 7) for electrical connections.
- Install the wheel with the 4 screws.
- Remove the block of wood.
- Reattach the covers.

### Repairs to the motor power unit

The motor drive units should not be repaired. If the motor drive unit is defective (with the exception of 2.5 A fuses), the entire unit should be replaced.

### Replacement of batteries

The batteries are two 12 V sealed lead-acid batteries connected in series and placed in a battery box. The batteries are maintenance free with an estimated lifetime at normal use of more than 2 years.

To replace the batteries, connect the new units according to the drawing on top the battery compartment.



Chap. 2	Information about Error 33 revised.
Chap. 8	Information and images revised.

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