

On-Load  
Tap Changer Type V  
Operating Instructions



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### NOTE

Data contained herein may differ in details from the tap changing equipment delivered.  
We reserve the right to make alterations without notice.

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## 1 General

### 1.1 Safety instructions

All personnel involved in installation, commissioning, operation, maintenance or repair of the equipment must:

- be suitably qualified and
- strictly observe these Operating Instructions.

Improper operation or misuse can lead to

- a reduction in the efficiency of the equipment
- damage to the equipment and property of the user
- serious or fatal injury.

Safety instructions in this manual are presented in three different forms to emphasize important information.



#### **WARNING**

This information indicates particular danger to life and health. Disregarding such a warning can lead to serious or fatal injury.



#### **CAUTION**

This information indicates particular danger to the equipment or other property of the user. Serious or fatal injury cannot be excluded.



#### **NOTE**

These notes give important information on a certain subject.

### 1.2 Specified application



#### **CAUTION**

Only use the on-load tap changer with the transformer specified in the order. Installation, electrical connection and commissioning of the on-load tap changer may only be carried out by qualified, skilled personnel and only in accordance with these operating instructions.

It is the responsibility of the user to make sure that the tap changer is used for the specified application only.

For safety reasons, any unauthorized work, i.e. installation, modification, alteration of the tap changer equipment, electrical connection or commissioning of the equipment is forbidden without first consulting MR!

The trouble-free operation of the drive, the on-load tap changer and the transformer may be put at risk.



#### **CAUTION**

All relevant fire protection regulations must be strictly observed.

## 2 Design

The tap changer is constructed as a selector switch of tubular design. It combines the functions of a diverter switch and of a tap selector. The switching oil is separated from the transformer oil by means of the cylindrical pressure-proof oil compartment. The tap changer is attached to the transformer cover by means of the tap changer head.

If required, the tap changer is equipped with a change-over selector. The design and the designation of the most important parts of the tap changer can be understood from the installation drawings (see section 16, drawings 893 945, 893 821 and 894 566).

Tap changer models V 200 and V 350 without change-over selector are available up to a maximum of 14 and with change-over selector up to a maximum of 27 operating positions.

The tap changer model V 500 is available for up to 12 or 23 operating positions, respectively.

These Operating Instructions apply to all tap changer variants specified below (with or without change-over selector):

### Three-phase tap changers:

V III 200 Y, V III 350 Y, V III 500 Y

V III 200 D, V III 350 D, V III 500 D

### Tap changers in special design:

V III 250 Y, V III 250 D, V III 400 Y, V III 400 D

### Single-phase tap changers:

V I 200, V I 350, V I 700

All single-phase tap changers are also available as a tap changer group 3 x V I ... with a common motor drive.

## 3 Shipment

Tap changer and motor drive are shipped in the adjustment position.

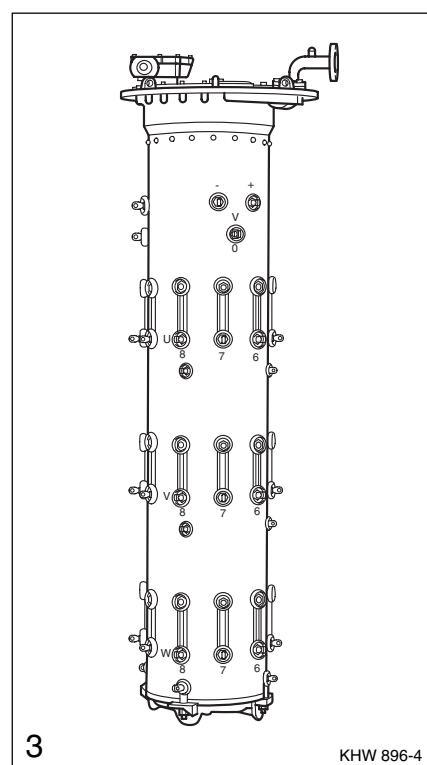
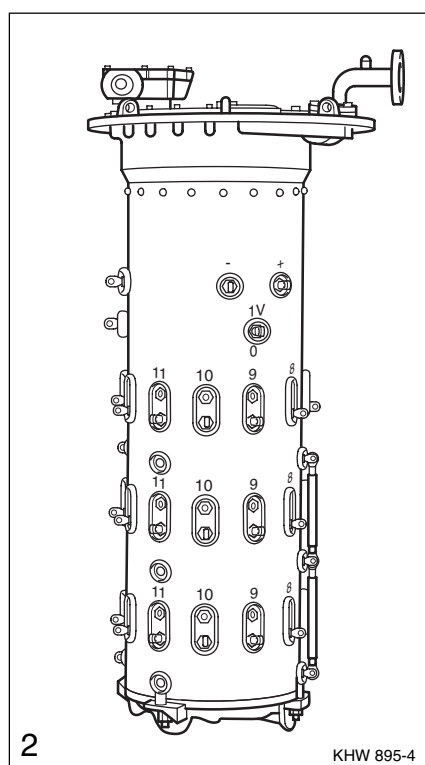
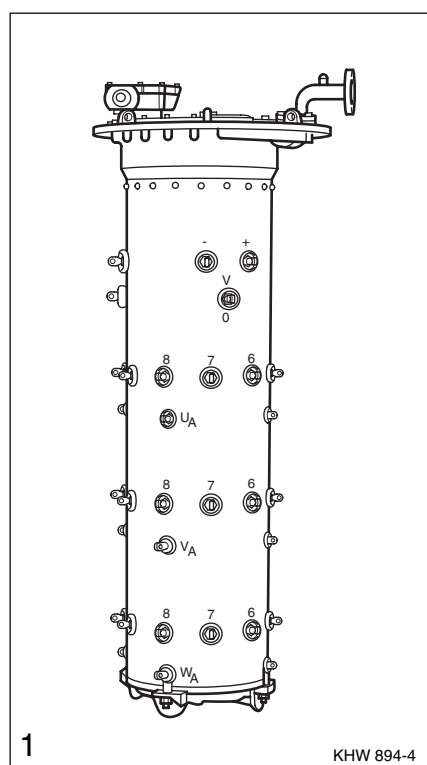
The tap changer equipment is shipped as follows (insulating parts are protected against moisture):

Tap changer type V:

**fig. 1** (type V 200, max. weight approx. 140 kg),

**fig. 2** (type V 350, max. weight approx. 150 kg),

**fig. 3** (type V 500, max. weight approx. 200 kg),



Motor drive unit MA 9 (approx. 60 kg) or  
Motor drive unit MA 7 (approx. 90 kg),  
Motor drive unit ED 100/200 **S** (approx. 80 kg), or  
Motor drive unit ED 100/200 **L** (approx. 130 kg), **fig. 4.**

Drive shafts with coupling parts and bevel gear  
(max. weight approx. 20 kg), **fig. 5.**

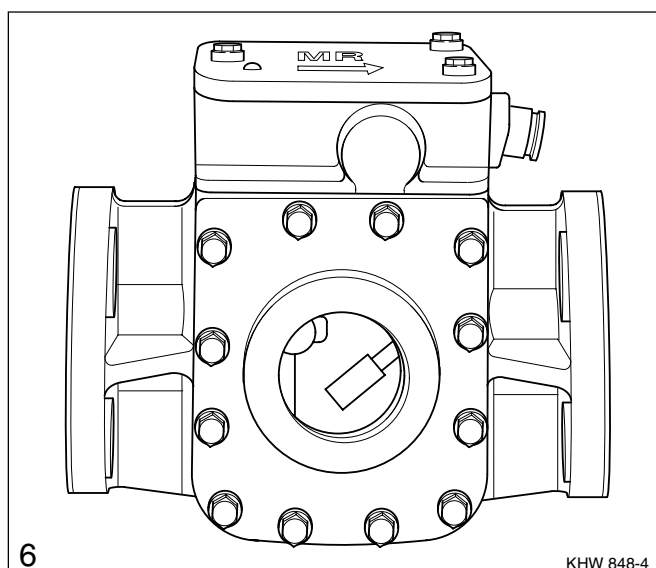
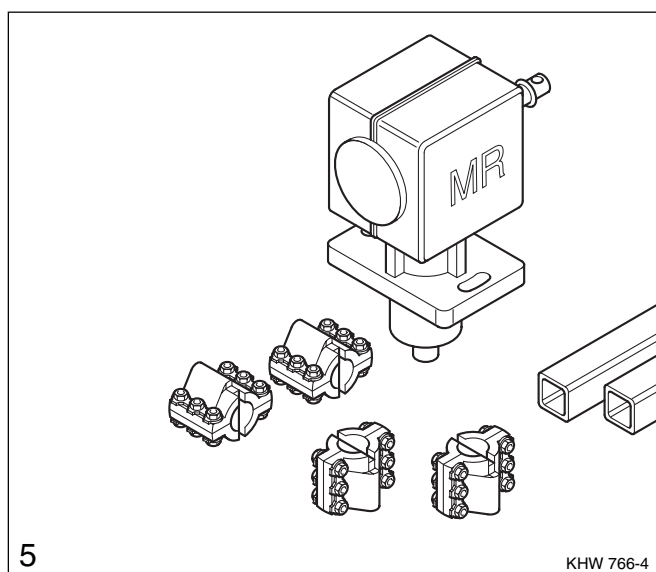
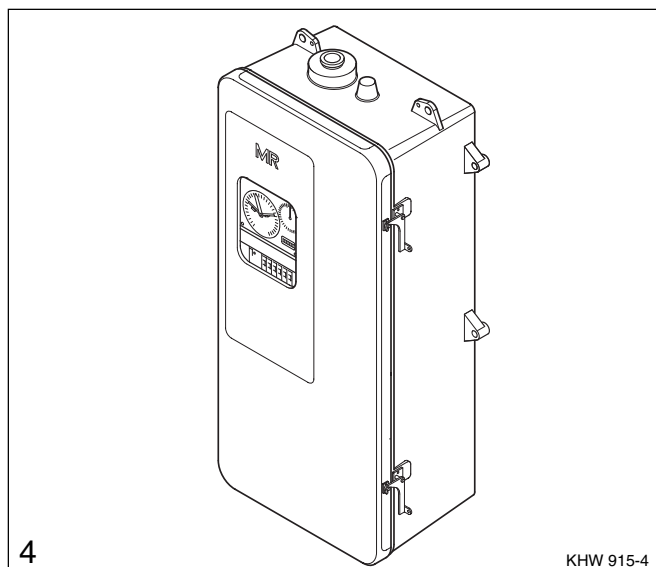
Protective relay RS 2001 (3,5 kg), **fig. 6.**

The shipment is to be fully checked against consign-  
ment documents. The parts must be stored in a dry  
place until assembly.

All tap changer parts must be left wrapped in their  
airtight protective cover and are to be removed only  
shortly before installation.

**NOTE**

In general, drive shaft parts, bevel gear and protective  
relay are packed with the tap changer.



## 4 Installation of the tap changer for cover mounting (fig. 7)

### 4.1 Mounting flange

A mounting flange is necessary in order to mount the tap changer head to the transformer cover. This mounting flange is to be constructed in accordance with the sealing surface of the tap changer head (see **fig. 8** and section 16, drawing 893 945, 893 821 and 894 566).

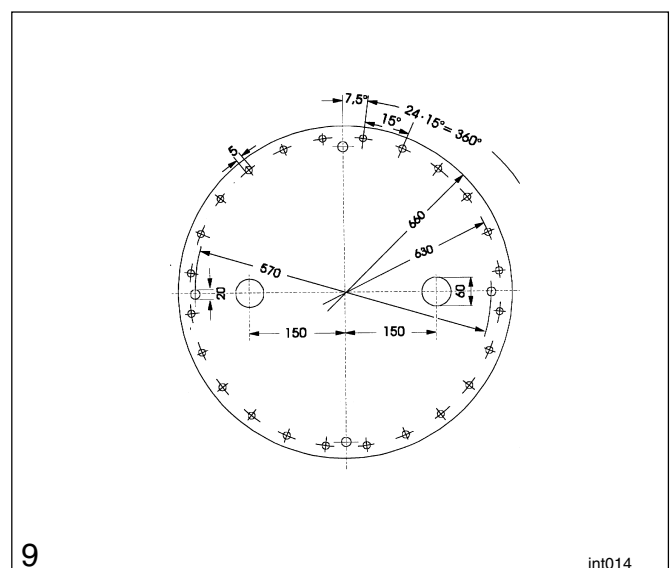
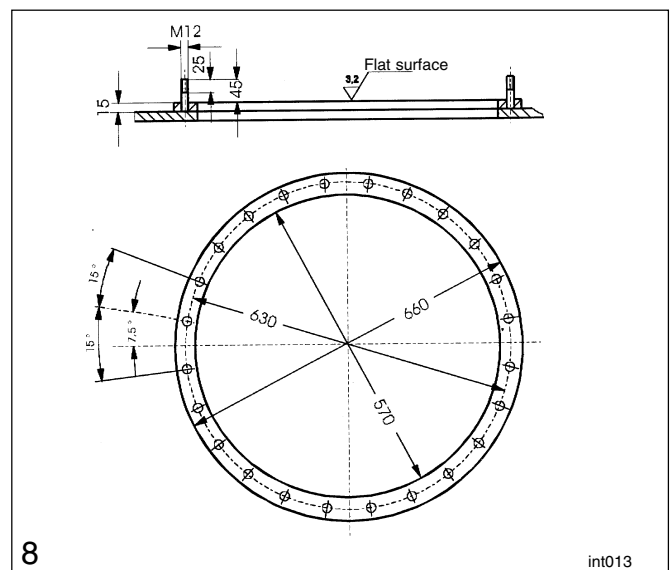
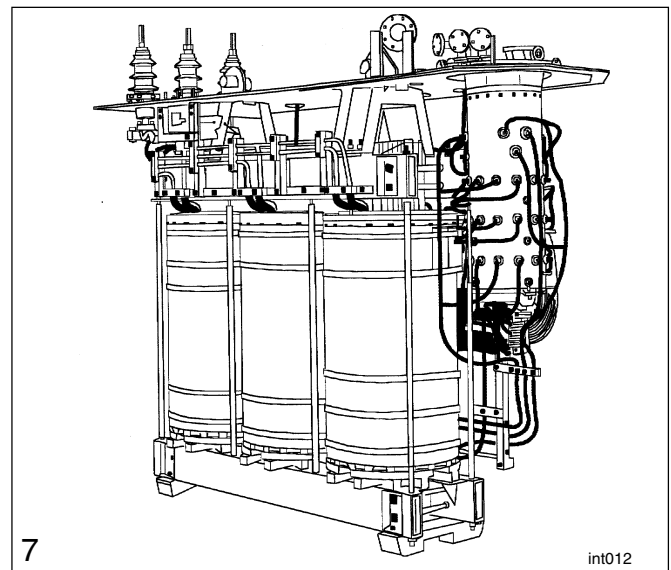
To position the studs (M12, max. length = 45 mm) we recommend the use of a drilling template (see **fig. 9** and section 16, dwg. 893 787). If requested, the drilling template will be supplied with the first installation of a tap changer type V free of charge.

### 4.2 Attachment of the tap changer head to the transformer cover

The tap changer is lowered through the cover aperture (= mounting flange) of the transformer and bolted by the tap changer head to the mounting flange.

Proceed as follows:

1. Place the tap changer on a level surface.
2. Clean the sealing surfaces of the mounting flange and the tap changer head.
3. Put an oil-resistant gasket on the mounting flange.
4. Lift the tap changer by hooking up the tap changer head and carefully lower it into the opening of the mounting flange.
5. Make sure not to damage the terminals.
6. Check installed position of the tap changer.
7. Fix the tap changer head to the mounting flange.





## 5 Installation of the tap changer into a bell-type tank

To install the on-load tap changer into a transformer with a bell-type tank the tap changer has to be mounted onto a supporting structure.

Therefore the on-load tap changer is equipped with a supporting flange at the oil compartment (= special design, see dwg. 893 864 in section 16).

First of all, lift the tap changer into the supporting structure and connect it to the tap winding. For this purpose the tap changer has to be attached to the supporting structure in such a way that it cannot be displaced.

The supporting flange is provided with bores, so that it can, without further measures, be provisionally secured to the supporting structure. It is advantageous to put spacer blocks temporarily between supporting structure and supporting flange and to remove them before setting up the bell-type cover.

After mounting the bell-type cover raise the on-load tap changer by means of the lifting traverse (see drawing 893 805 in section 16) and attach both tap changer and tap changer head to the bell-type cover.

To attach the tap changer head to the bell-type cover we recommend the use of a mounting flange as described in section 4.1.

### 5.1 Installation of the on-load tap changer into the supporting structure

Lift the tap changer into the supporting structure. Make sure that the tap changer is in its proper mounting position and fasten it there safely.



#### NOTE

In the supporting structure the tap changer must be suspended in an exactly vertical position. The tap changer must be mounted so that it need not be lifted by more than 5 to 20 mm to reach its final position after the bell-type cover has been set up.

Due to the provisionally installed spacer blocks between supporting structure and supporting flange, the tap changer is in its envisaged final position after the bell-type cover is set up. By this measure the leads to be connected to the tap changer can be correctly dimensioned in length.

To connect the tap winding and the tap changer take-off terminal follow the instructions according to section 6.



#### CAUTION

The connected leads must not exert any force on the tap changer. Moreover, there must be sufficient clearance, so that it is possible to raise the tap changer to its final installation position after the bell-type tank has been mounted.

Drying procedure and transformer ratio test are to be performed in accordance with sections 7 and 8.

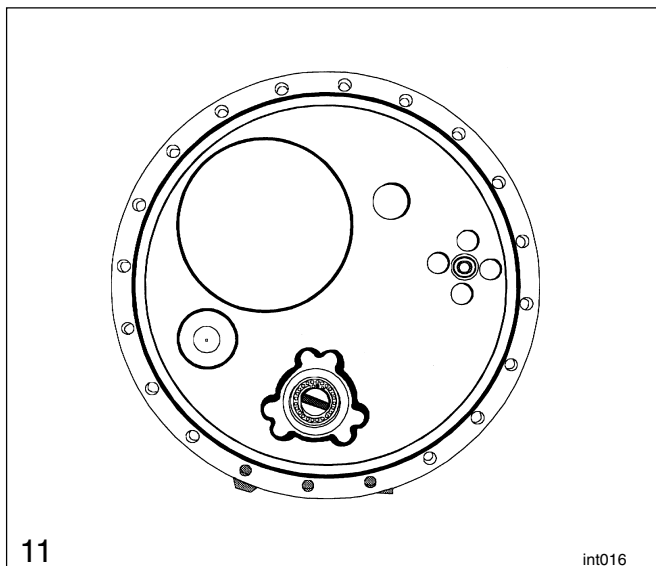
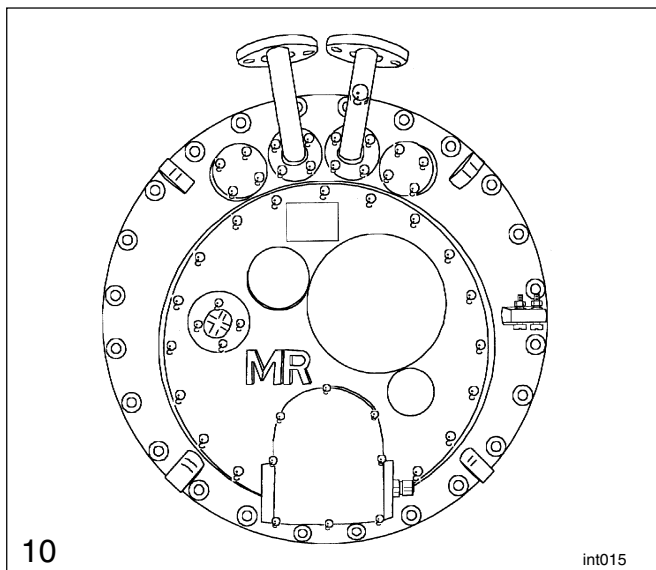
### 5.2 Preparations

Before setting up the bell-type tank, the tap changer head must be separated from the tap changer.

For the removal of the tap changer head the gear mechanism has to be removed. Make sure that the tap changer is in its adjustment position. This position is indicated in the connection diagram which is supplied with the tap changer.

### 5.3 Removal of the tap changer cover (fig. 10)

- Unscrew the 20 cover screws M10 x 35 / wrench size 17, with 20 lock washers.
- Take off the tap changer cover.  
Take care of the cover gasket (fig. 11).



## 5.4 Removal of the gear mechanism

The gear plate is attached to the tap changer head by 5 screws M8 (**fig. 12**). Note the positions of the gear markings.

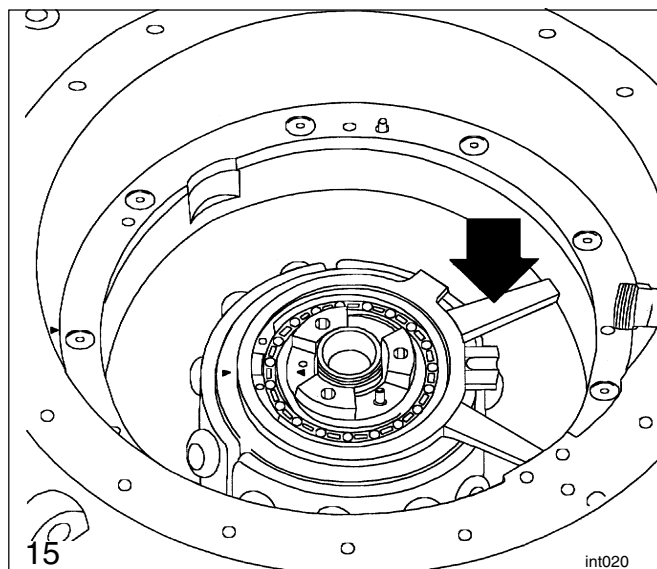
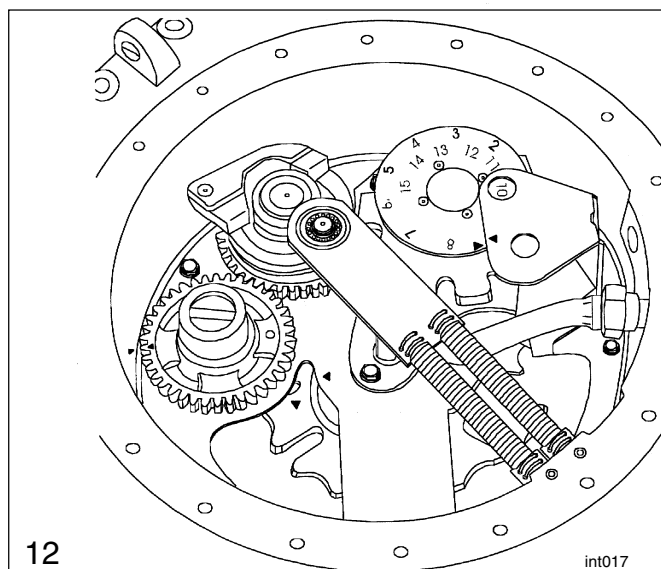
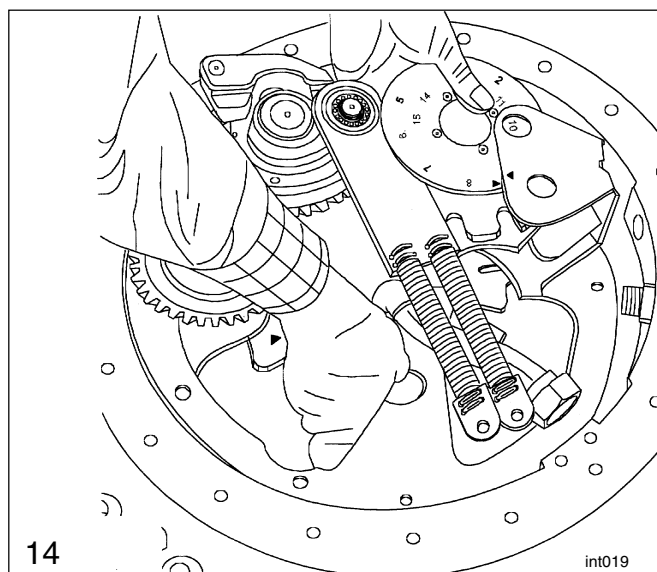
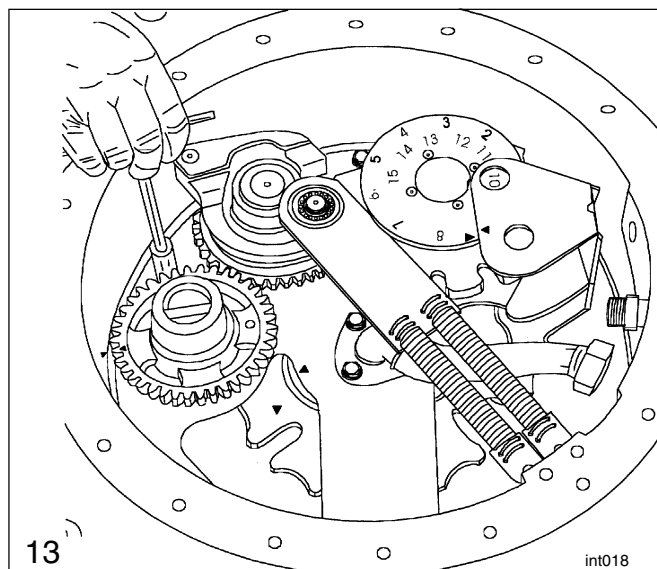
Disconnect the suction pipe and the spring energy accumulator:

- Unscrew the suction pipe elbow R 3/4" (wrench size 27 and 39) and take care of the gasket.
- Push the corresponding plug into the tap changer head.
- Withdraw the fixing bolts for spring energy accumulator by means of a screw M5 x 20.

Removal of the gear mechanism:

- Loosen 5 screws M8 x 20, wrench size 13 (**fig. 13**). Take care of lock washers.
- Remove the gear mechanism in upward direction (**fig. 14**).
- Take note of the position of the centering support for later reinstallation (**fig. 15**).

Keep all removed parts for reinstallation.



### 5.5 Separating the tap changer head from the tap changer

Loosen the fixing screws on the tap changer head (9 six-spline socket screws M8 x 25/w.s. T40, lock washers, **fig. 16**). Keep the loose parts for reinstallation.

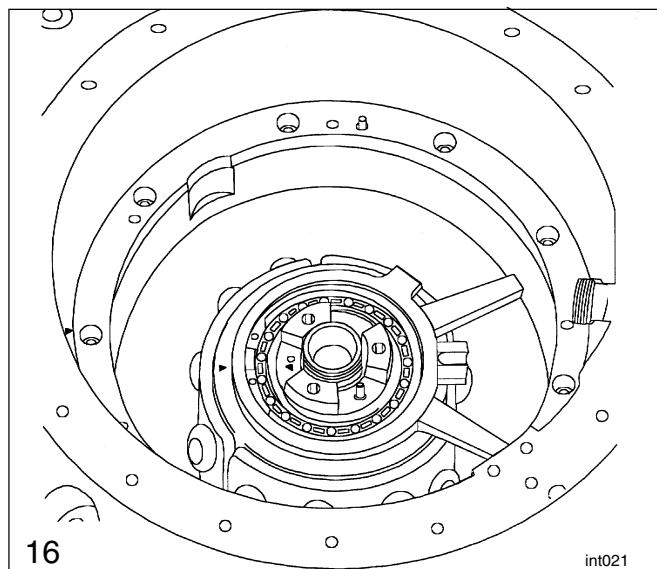


#### CAUTION

Under all circumstances avoid dropping any parts into the tap changer oil compartment. Otherwise there is the risk that the tap changer will block and both tap changer and transformer will be damaged.

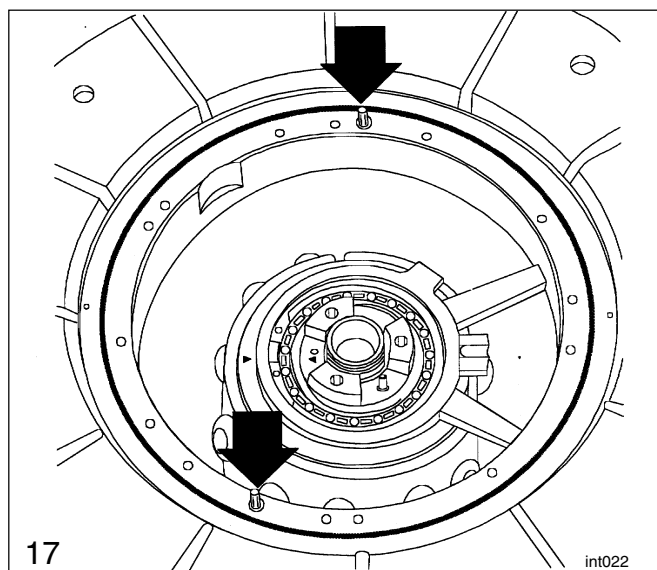
Therefore, make sure that the number of small parts is complete when disassembling and reinstalling. Count them to be sure.

Lift off the tap changer head from the supporting flange. Take care of the round rubber gasket of the supporting flange (**fig. 17**).



### 5.6 Setting up the bell-type transformer cover

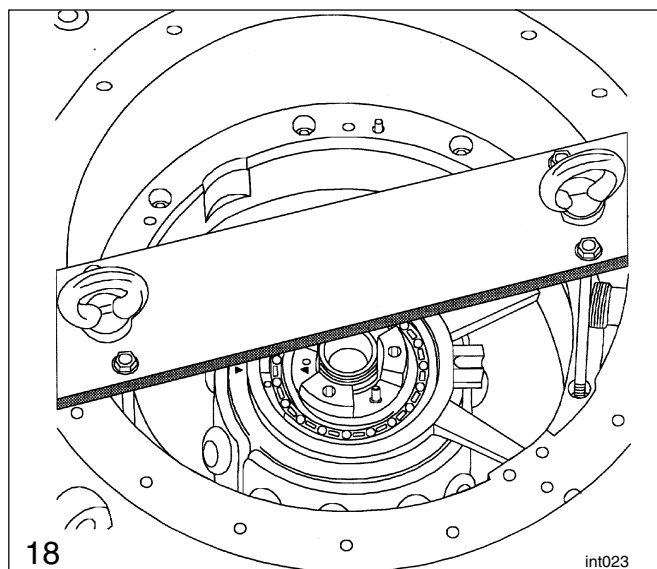
1. Before setting up the bell-type transformer cover clean the sealing surface of the supporting flange. Withdraw the spacer blocks (see section 5.1).
2. Lift the bell-type cover over the transformer active part and set up the bell-type cover.
3. Before mounting the tap changer head, clean the sealing surfaces (bottom surface of the tap changer head, mounting flange). Put an oil-resistant gasket on the mounting flange.  
Depending on the final height adjustment leave a clearance of 5 to 15 mm between tap changer head and supporting flange. Check the installation position of the tap changer head with the help of the two adjusting bolts (**fig. 17**) which ensure assembly in the correct position in the supporting flange of the oil compartment. Fasten the tap changer head to the mounting flange.



#### CAUTION

It is absolutely necessary to use the lifting traverse for the installation. Otherwise damage may occur.

Place the lifting traverse (must be used) on the tap changer head and screw the 4 bolts M8/w.s. 13 into the supporting flange (**fig. 18**).



4. Lift the tap changer slightly by means of the **lifting traverse** (see section 16, drawings 893 864 and 893 805) so that the oil compartment screws (9 six-spline socket screws M8, wrench size T40, to be secured by lock washers) can be screwed in. Tighten the screws uniformly with a maximum torque of 14 Nm (**fig. 19**).

### 5.7 Reinstallation of the gear mechanism and attachment of the tap changer cover

Reinstallation of the gear mechanism is carried out in the reverse order of its removal.

Set the gear mechanism in the adjustment position (see section 5.4, **fig. 12**), as installation and coupling can be done only in this position.

Attachment of the tap changer cover:

Check the gasket before closing the cover. Use 20 screws M10 x 35/wrench size 17 with lock washers and fasten them uniformly (max. torque 35 Nm).



#### CAUTION

Check the adjustment position.

## 6 Connection of tap winding and tap changer take-off leads

The connection of the tap winding and the tap changer take-off leads has to be carried out according to the connection diagram supplied with the particular tap changer equipment.



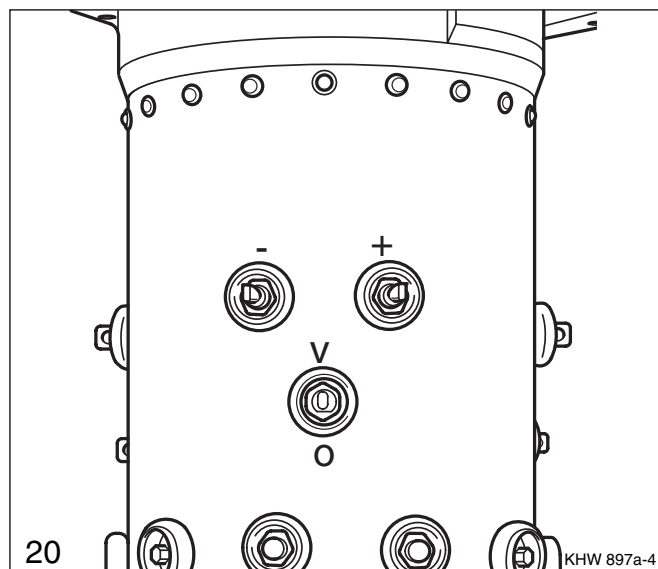
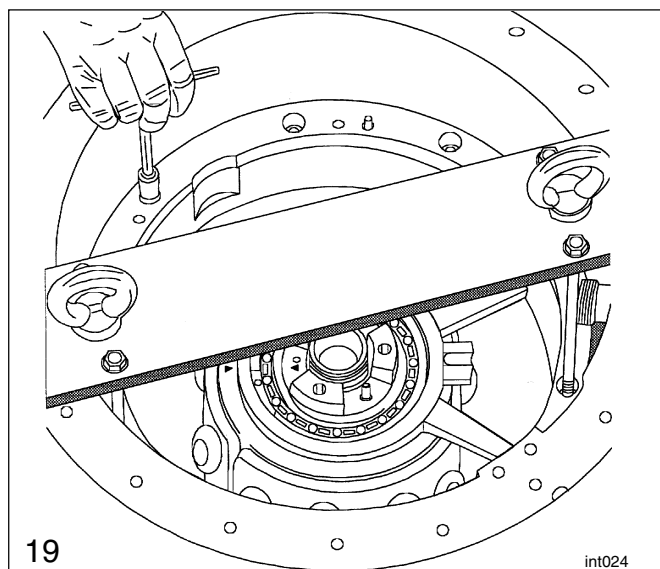
#### CAUTION

All connections to the tap changer must be carried out carefully and secured. The connecting leads must be assembled in such a way as to allow all leads to be connected to the tap changer without tension.

If leads are crossing the surface of the oil compartment leave a clearance of at least 50 mm between the leads and the surface of the oil compartment.

The tap changer terminals are designated according to the connection diagram. They are provided with bores for the connection of cable shoes to one side of the terminals as follows:

**at the change-over selector (fig. 20):**  
11 mm dia. for M10 screws.



**at the selector switch V 200 (fig. 21):**

9 mm dia. for M8 screws.

**at selector switches V 350 (fig. 22) or V 500 (fig. 23)**

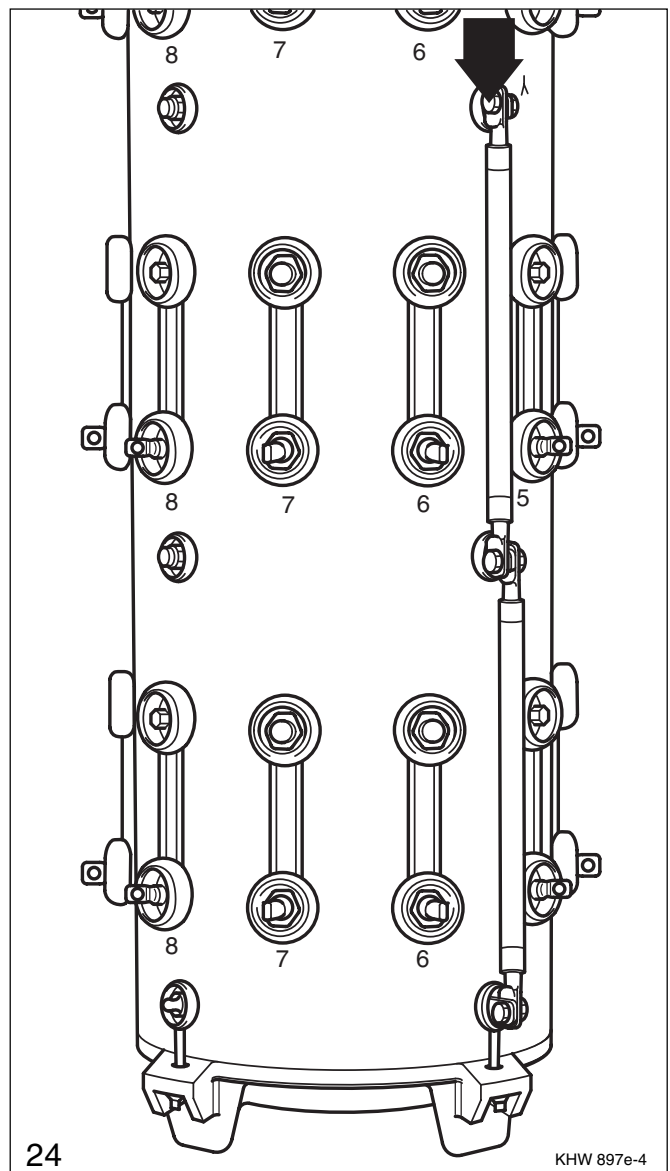
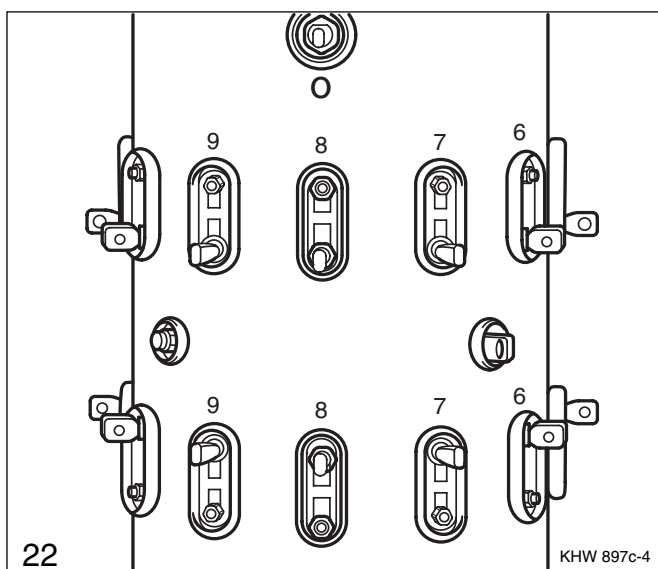
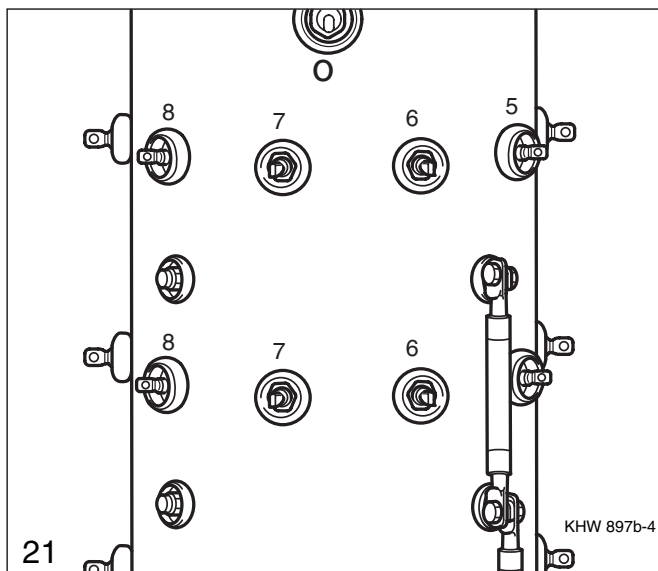
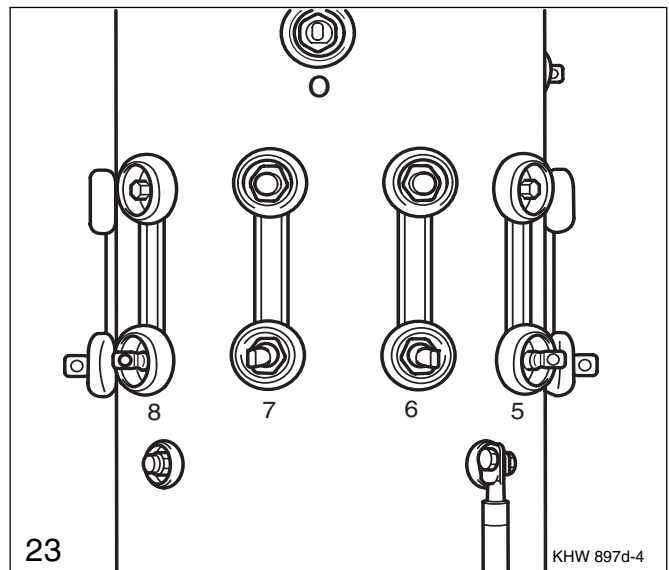
11 mm dia. for M10 screws.

**at selector switches V 200, V 350 and V 500,**  
for tap changer current take-off lead or neutral point,  
respectively:

11 mm dia. for M10 screws

Neutral connection for tap changers type V III 200 Y,  
V III 350 Y and V III 500 Y (see **fig. 24**).

This lead forms the neutral point of the tap changer and  
must not be removed. The neutral point terminal is to be  
connected at this location.





## 7 Transformer ratio test

We recommend to carry out ratio-testing before drying of the transformer.

To operate the drive shaft in the tap changer head a short tube of 25 mm nominal width with a screwed-in coupling bolt of 12 mm dia. together with a hand wheel or a hand crank may be used.

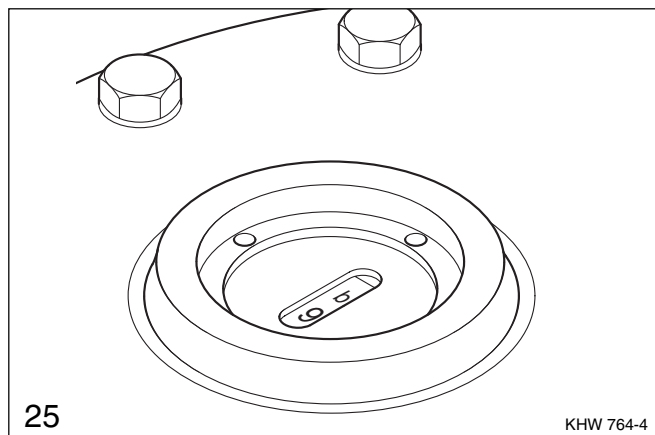
In case of motor drive MA 9 one drive shaft revolution is required for one tap change operation, in case of motor drive MA 7 33 drive shaft revolutions and in case of motor drive ED 16.5 drive shaft revolutions are required. The selector switch action can be heard distinctly.

When operating the change-over selector (adjustment position  $\pm 1$  step), which can be noticed as it takes more effort, the commenced tap change operation must always be completed **without changing the rotation sense**.

Keep the number of tap change operations without oil to a minimum.

The end positions which can be inferred from the connection diagram supplied with the tap changer equipment (position designation) must never be over-run. It is therefore necessary to check the attained operating position through the inspection window in the tap changer head (**fig. 25**).

After the transformer ratio test the tap changer has to be set back to the adjustment position (see connection diagram delivered with the equipment).



Vacuum-drying:

with a temperature of 110 °C max. applied to the tap changer and the same drying time as for the transformer.

### 8.1.1.2 Drying in the transformer tank



#### NOTE

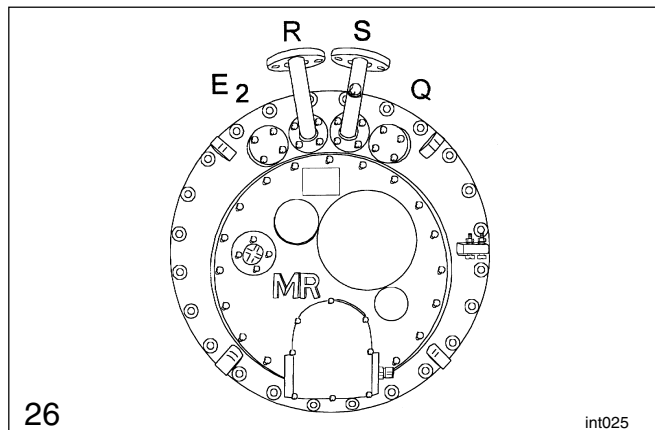
If the transformer is to be dried in its own tank, the interior of the tap changer must be connected to vacuum by a connecting pipe, as the tap changer cover remains closed during the entire drying process.

The tap changer cover is vacuum-proof.

To ensure sufficient drying of the interior of the oil compartment and the incorporated tap changer insert, a short by-pass tube of 25 mm nominal width must be connected between the transformer tank and a connecting flange at the tap changer head that leads directly into the oil compartment.

Connect this by-pass tube either between flanges E<sub>2</sub> and Q or flanges E<sub>2</sub> and R at the tap changer head (for position of connecting flanges see **fig. 26** and section 9).

Procedure, temperature, pressure and duration of the drying process are described in section 8.1.1.1.



## 8 Drying procedure and filling with oil

### 8.1 Drying procedure

As a precondition of MR's guarantee of the dielectric properties of the tap changer, a minimum drying treatment must be carried out according to the following instructions (either 8.1.1 or 8.1.2):

#### 8.1.1 Vacuum-drying

##### 8.1.1.1 Drying in the vacuum autoclave



#### NOTE

When drying the transformer in the autoclave remove the tap changer cover and store it outside the vacuum autoclave.

Heating up:

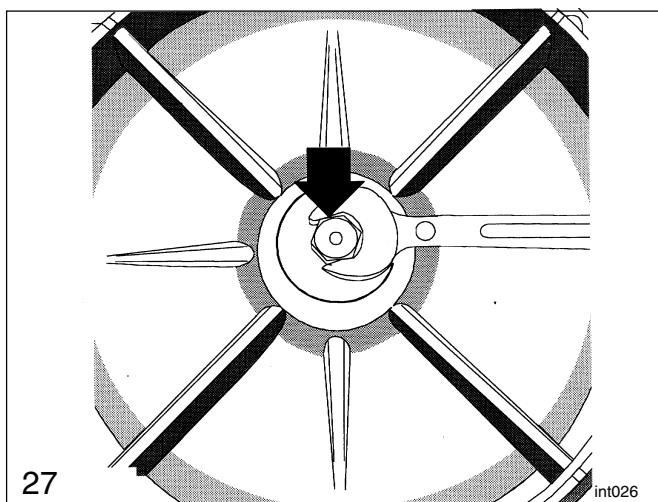
the tap changer in air of atmospheric pressure with a temperature rise of approx. 20 °C/hour to a final temperature of at most 110 °C.

Preparatory drying:

in circulating air at 110 °C max. applied to the tap changer for a duration of 10 hours.

### 8.1.2 Vapor-phase drying process

Before starting the drying procedure, the kerosene drain plug in the oil compartment bottom must be opened to drain the condensate from the oil compartment. The kerosene drain plug has a hexagon socket (w.s. 24) and can be unscrewed from outside (**fig. 27**) or inside. The kerosene drain plug is loss-proof and must be closed again after the drying procedure (max. torque 39 Nm).



#### 8.1.2.1 Vapor-phase drying in the vacuum autoclave



#### NOTE

When drying the transformer in the autoclave remove the tap changer cover and store it outside the vacuum autoclave.

Heating up:  
by admitting the kerosene vapor at a temperature of about 90 °C. Keep this temperature constant for about 3 to 4 hours.

Drying:  
by increasing the kerosene vapor temperature by about 10 °C per hour to the desired final temperature, but at most to 125 °C applied to the tap changer. The duration of the drying procedure is normally the same as that of the transformer. Make sure that the kerosene drain plug has been closed after the drying process.



#### CAUTION

The kerosene drain plug must be closed safely after the drying process to ensure that no oil from the tap changer oil compartment can flow into the transformer tank.

#### 8.1.2.2 Vapor-phase drying in the transformer tank

For vapor-phase drying in the transformer tank the tap changer insert has to be withdrawn to enable opening of the kerosene drain plug from inside. Please contact us for further instructions on removal and reinstallation.

### 8.1.3 Operating the tap changer



#### CAUTION

Do not operate the tap changer after drying without oil wetting, otherwise bearings and gaskets will be damaged.

The tap changer must not be operated before the oil compartment has been filled with oil.

### 8.2 Filling with oil

Close the tap changer head by lowering the cover. Tighten all 20 cover bolts M10 equally (wrench size 17, max. torque 34 Nm).

Tap changer and transformer are simultaneously filled with new oil under vacuum. When filling the tap changer with oil, pipe connection S or R on the tap changer head is to be used. To apply vacuum to the tap changer a by-pass tube between connections E<sub>2</sub> and Q is to be installed in order to evacuate both transformer and oil compartment simultaneously.



#### CAUTION

The tap changer oil compartment and the associated oil conservator must be filled only with new mineral insulating oil for transformers according to IEC 296. The use of other oil puts at risk the trouble-free operation of tap changer and transformer.



## 9 Pipe connections

The tap changer head is provided with 3 pipe connections for different purposes. After loosening the thrust collar (4 bolts M10/w.s.17) these pipe connections can be freely swivelled (see **fig. 28** and section 16, drawing 893 779).

### 9.1 Pipe connection R for protective relay RS 2001

The mounting of the protective relay RS 2001 (see section 16, dimension drawing 892 608) is pursuant to our Operating Instructions No. 59.



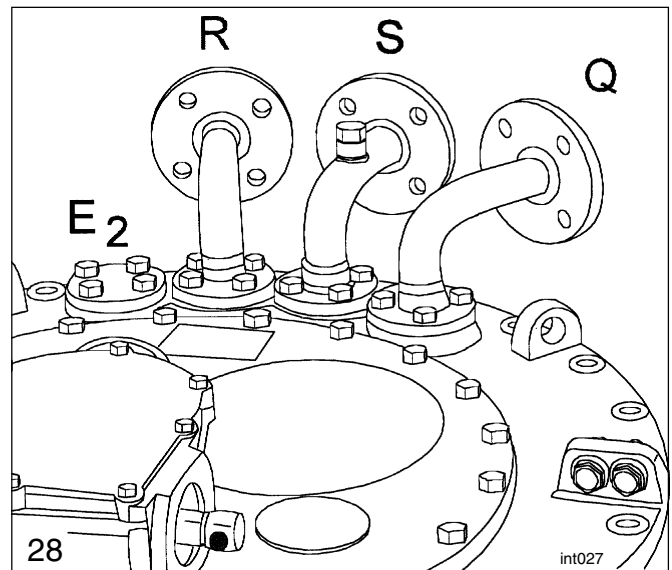
#### NOTE

The stamped-on serial number must be the same as that of the tap changer.

The relay must be mounted as near to the tap changer head as possible and in horizontal position.

The directional arrow on the relay must point towards the oil conservator in the mounted state.

The pipe extending to the oil conservator must have an inclination of at least 2%.



### 9.2 Pipe connection S for suction pipe

This is the connection for the feeding pipe of a stationary oil filter unit. If no filter is used, a pipe must be connected which ends with a drain cock at the side of the transformer tank at operating height.

### 9.3 Pipe connection Q (special design, required only with oil filter unit)

This pipe connection serves as the connection of the oil return pipe of a stationary oil filter unit. If no oil filter is connected, a dummy plug is mounted instead of the pipe connection.

### 9.4 Connection flange E<sub>2</sub>

This connection is closed by a dummy plug. It leads into the oil chamber of the transformer tank directly beneath the tap changer head and can, in case of need, be connected to an accumulating tube for the Buchholz relay.

## 10 Mounting the motor drive unit, the bevel gear and the drive shaft

### 10.1 Mounting the motor drive unit (see section 16, dwgs. 895 660, 893 381, 898 420 resp.)

You may find comprehensive mounting instructions in our Operating Instructions No. 40 for motor drive unit MA 7 or No. 80 for motor drive unit MA 9 and No. 138 for motor drive unit ED.



#### NOTE

The serial number of motor drive unit and tap changer must be identical (rating plate).

Motor drive unit and tap changer must be in the same operating position. The adjustment position is indicated in the tap changer connection diagram supplied with the equipment.

The motor drive unit must be mounted at the provided place on the transformer tank in a vertical position and protected against excessive transformer vibrations.

### 10.2 Mounting the bevel gear

The bevel gear is to be attached to a support on the transformer cover with 2 bolts (through-bores of 18 mm dia., see section 16, dwg. 892 916).



#### NOTE

The stamped-on serial number of bevel gear and tap changer must be identical.

The horizontal drive shaft must be in proper alignment with the shaft end of the tap changer head.

After loosening the thrust collar (6 screws M8/ w.s. 13) the upper gear unit can be freely swivelled (**fig. 29**). When having adjusted the upper gear unit, tighten the thrust collar (max. torque 15 Nm).

**The bolts are to be secured.**

In case of bevel gears and diverting gears in special design and intermediate bearings of the vertical or horizontal drive shaft, the above instructions apply analogously.

### 10.3 Mounting the drive shaft (square tube)

The drive shaft must be mounted according to our Operating Instructions No. 42. The drive shaft is the mechanical connection between the motor drive and the tap changer head. The diverting from the vertical to the horizontal direction takes place through the bevel gear.

Accordingly, when mounting, the vertical drive shaft is to be mounted between motor drive unit and bevel gear, whereas the horizontal drive shaft is to be mounted between bevel gear and tap changer head.

The drive shaft itself consists of a square tube and is to be connected at both ends to the respective implement by two coupling brackets and one coupling bolt.

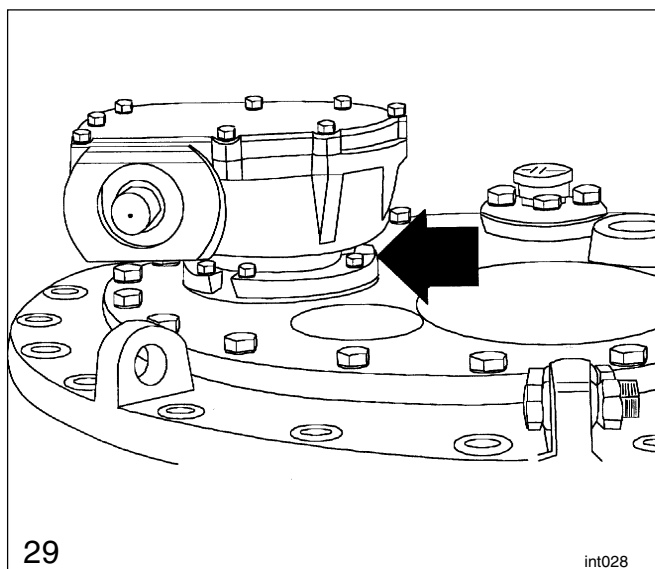


#### NOTE

When mounting the drive shaft make sure that the shaft ends to be connected are aligned exactly.

Square tubes, coupling brackets, coupling bolts, screws, nuts and lock tabs are corrosion-resistant. We recommend, however, to apply the same outside coating to these parts as to the transformer tank.

The square tubes and the guard plate, which serves as foot step protection for the horizontal drive shaft at the transformer cover, are supplied in oversize (various standard lengths). These parts must be cut to the required size before mounting.



Before coupling of the upper gear unit of the tap changer head, adjust the correct adjustment position (inclusive idling) as follows:

- a) in case of motor drive unit MA 9  
(1 revolution per tap change operation):

Turn the drive shaft of the upper gear unit manually in both directions until you feel that the spring energy accumulator winds up (**fig. 30, 31**).

The centre of the rotation angle (approx.  $180^\circ$ ) is the exact adjustment position (**fig. 32**). Couple the drive shaft in this position. When producing the coupling, the square tube and the upper gear unit should be aligned with the smallest possible rotation angle (max.  $45^\circ$ ).

- b) In case of motor drive unit MA 7 respectively ED  
(33 revolutions per tap change operation respectively  
16.5 revolutions per tap change operation)

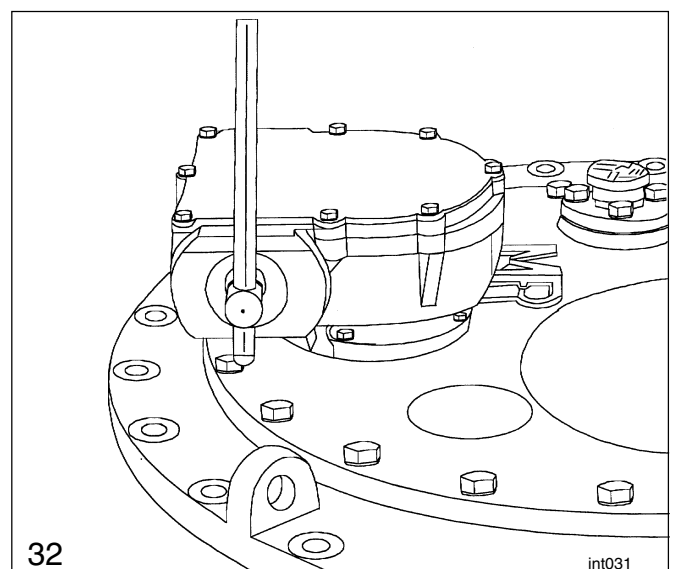
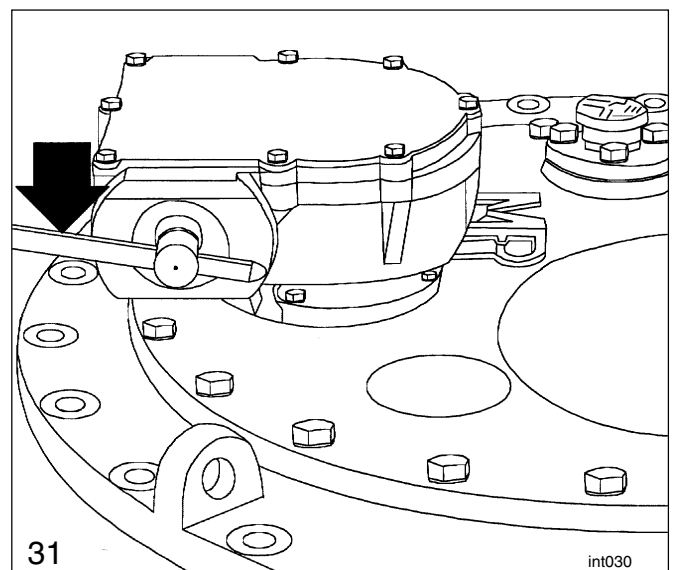
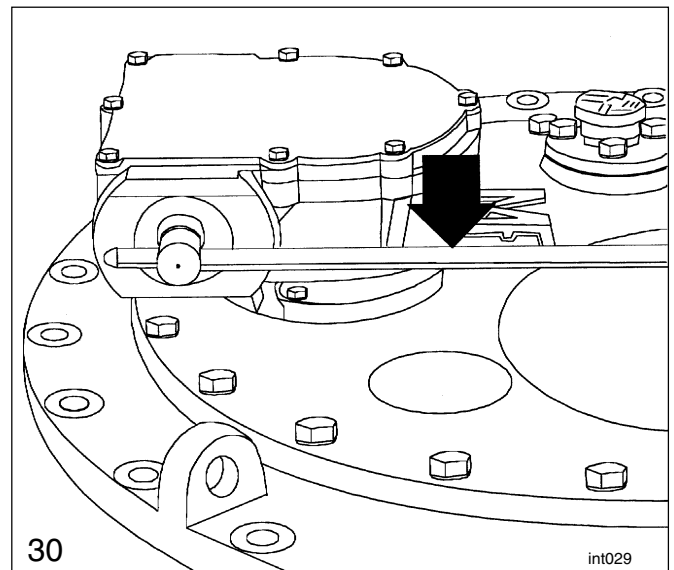
Loosen the screws of the tap changer cover (20 screws M10/w.s. 17, lock washers) and lift the tap changer cover by at least 15 mm until the gear unit disengages. Support the tap changer cover in this position by suitable pieces of wood or the like.

Turn the upper gear unit in the desired direction, so that the drive shaft can be properly coupled.

Check the position of the driven shaft on the output side of the gear unit below the tap changer cover and turn the drive shaft manually until the driven shaft engages into the coupling of the gear unit.

Remove the wooden supports and fasten the tap changer cover again by 20 screws M10/w.s. 17, max. torque 34 Nm and secure with spring washers.

Finally, checking the symmetrical coupling of the motor drive to the selector switch according to Operating Instructions No. 40 for MA 7 or No. 80 for MA 9 and No. 138 for ED.



## 11 Putting the tap changer into service at the transformer manufacturer

### 11.1 Operational test

Before applying voltage to the transformer some test operations must be carried out to check the mechanical functions of tap changer and motor drive.

For these test operations the tap changer has to be run through the entire operating cycle.

Make sure that **in each operating position** the indications of motor drive and tap changer (inspection window in the tap changer head) read the same position.

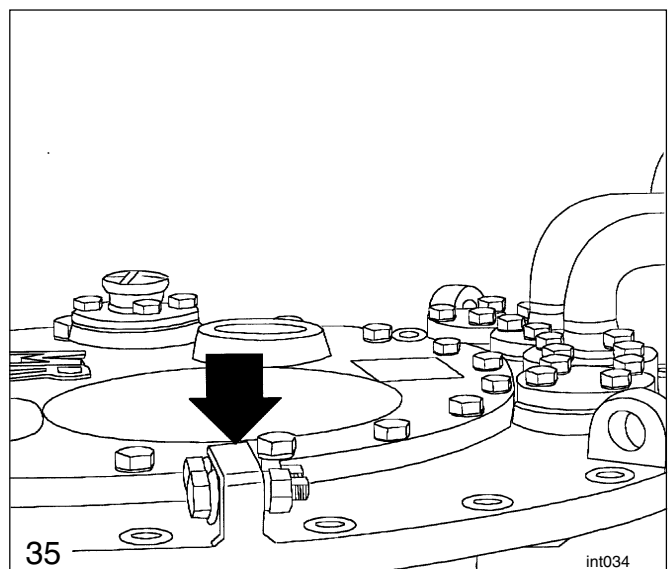
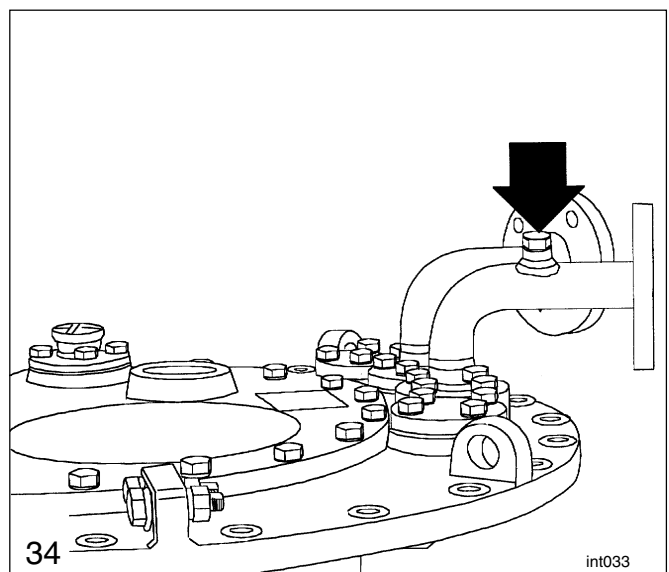
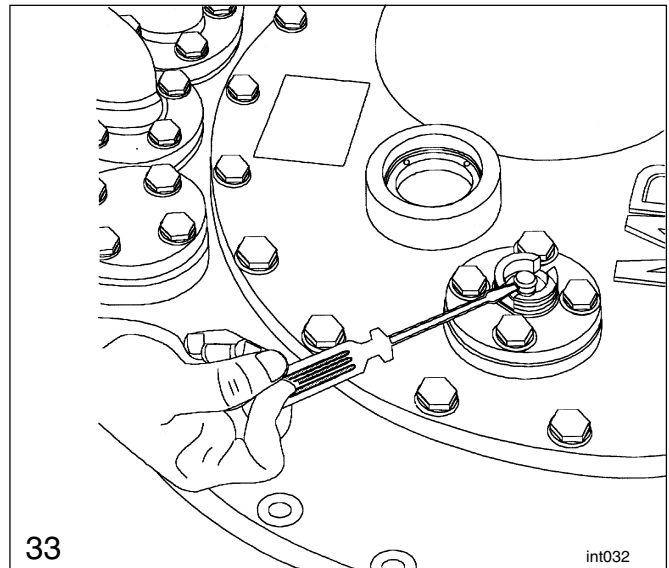


#### CAUTION

A coupling fault between tap changer and motor drive unit exists, if tap changer and motor drive unit show different operating positions.

Misalignment of coupling between tap changer and motor drive unit leads to severe damage of tap changer and transformer, if operation is continued. The transformer must not be put into service.

Check, in both end positions, the automatic switching off and the function of the electrical and mechanical end position limitation (see Operating Instructions No. 40 for motor drive unit MA 7 or No. 80 for motor drive unit MA 9 and No. 138 for motor drive unit ED).



## 11.2 Final oil filling

Fill up the tap changer completely with transformer oil via the oil conservator and bleed as follows:

- The tap changer head via the bleeder valve in the tap changer cover (E1):  
Open the screw cap M30/w.s. 36 (**fig. 33**), lift the valve tappet by means of a screwdriver.
- The suction pipe (S) via the bleeder screw at the connecting elbow: cap nut M16/w.s. 22, max. torque 9 Nm, slotted bleeder screw M6 (max. torque 2 Nm, **fig. 34**).



### CAUTION

Make sure that the suction pipe has been bled completely. The insulation capability of the tap changer to ground is otherwise significantly impaired.

## 11.3 Ground connections

Connect the ground screws of the tap changer head (2 screws M12 mit nuts, w.s. 19, max torque 60 Nm, **fig. 35**) to the transformer cover.

Connect the ground screw M12/w.s. 19, max. torque 60 Nm, of the motor drive protective housing to the transformer tank.

## 11.4 Electrical transformer tests

After the afore-mentioned steps the electrical tests necessary for acceptance of the transformer can now be performed.

## 12 Transport to the operating site

If the motor drive unit is to be demounted for transport of the transformer to the installation site, move the motor drive into the adjustment position and then uncouple.



### CAUTION

Do not operate the motor drive while the tap changer is uncoupled.

To remount the motor drive unit follow the instructions according to sections 10.1 and 10.3.



### NOTE

If the transformer is filled with oil but stored or transported without oil conservator, a by-pass tube must be installed between the interior of the tap changer oil compartment and the transformer tank to equalize the pressure caused by the expansion of the oil.

Install this by-pass tube at the tap changer between pipe connections E2 and Q of the tap changer head.

For short stand-by periods of 2 to 4 weeks without oil conservator, it is also sufficient to lower the oil level by approx. 5 litres.

If the transformer is to be completely emptied, drain also the switching oil of the tap changer completely.

The interior of the tap changer oil compartment should be conserved and protected in the same way as the transformer (e.g. by filling with nitrogen).

If a longer stand-by period is expected, the heater of the motor drive unit must be connected and put into operation.

## 13 Putting into service at the operating site

Before putting the transformer into service operational tests of tap changer and motor drive have to be performed according to section 11.1. At the same time check the function of the protective relay.



### NOTE

The protective relay has to be inserted into the tripping circuit of the circuit breakers so that on response of the protective relay the transformer is immediately switched off (see Operating Instructions No. 59 for protective relay RS 2001).

Make sure that the circuit breakers switching off the transformer operate when test button »OFF« of the protective relay is pressed. Be sure that they energize the transformer only after test button »IN SERVICE« of the protective relay has been pressed.



### CAUTION

Check that all stop valves between oil conservator and tap changer are open.

When having energized the transformer, tap change operations under load can be performed. The then arising switching gas accumulating under the cover of the tap changer head will cause minor oil displacement or escape via the oil conservator.

## 14 Supervision during service, failures

Supervision of tap changer and motor drive unit is limited to occasional visual checks of tap changer head, protective relay and motor drive.

### Pay special attention to:

- oil tightness at the sealing locations of the tap changer head, the protective relay and the pipe connection,
- sealings at the protective housing of the motor drive,
- proper function of the incorporated electrical heater inside the motor drive housing,
- the condition of the control devices in the motor drive unit.



### WARNING

After a response of the protective relay, do not reset until the tap changer and the transformer have been checked. For this purpose withdraw the tap changer insert and check it according to our Inspection Instructions. Proceed in detail according to Operating Instructions No. 59 for the protective relay RS 2001. Before returning to operation, make sure that the cause of the trouble has been corrected and that tap changer and transformer are free of damage. Reconnection of the transformer without prior checking is prohibited and can lead to severe damage of tap changer and transformer.

In case of major faults with tap changer or motor drive which cannot be easily overcome on the spot and in case of a response of the protective relay, please contact the authorized MR representative, the transformer manufacturer or directly

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Telex: 6 5 881

## 15 Inspections

**NOTE**

The tap changing equipment must be inspected at regular intervals to maintain a high level of operating reliability.

The inspection can be carried out by **qualified and MR-trained personnel** usually within one day, provided it is well prepared and organized.

We strongly recommend to have the inspections carried out by our Technical Service. This guarantees a professional performance of the inspection and ensures the updating of specific components to the latest operational state.

If the inspection is not to be carried out by MR personnel, we recommend that you ask for a quotation of the spare parts required for the inspection (please quote the tap changer serial number and the number of switching operations).

The numbers of tap change operations determining the inspection intervals indicated in **table II** are figures based on experience with use of usual oil qualities.

After reaching 800 000 operations the OLTC insert and the complete gear must be replaced.

If the number of tap change operations per year exceeds 15,000 we recommend the use of our stationary oil filter unit type 51 (see Operating Instructions No. 18).

When the tap changer V III 200 D, V III 350 D and V III 500 D is in operation in countries with a tropical or subtropical climate where the relative humidity is extremely high and the temperature in the oil conservator usually falls below the dew point every day, the use of an oil filter unit with a combined filter insert is recommended to maintain the dielectric properties of the switching oil.

If, under such circumstances, the highest operating voltage between the phases of the tap changer is > 55 kV, the use of an MR oil filter unit with combined filter is always required (see Operating Instructions No. 18).

Filtering of the switching oil allows the inspection intervals to be extended.

The insulating oils in the transformer are to be monitored by the operator according to the appropriate directions.

If inspections are not carried out by MR personnel, we request a report to supplement our inspection data.

**CAUTION**

Disregard of the inspection intervals puts at risk the trouble-free operation of the tap changer and transformer.

The following standard values for oil testing according to CIGRE report 12-13 (1982) apply to transformer oil at service temperature:

On-load tap changer	Water content*)	Dielectric strength**)
V III 200 Y, V III 350 Y, V III 500 Y	< 40 ppm	> 30 kV/2.5 mm
V III 200 D, V III 350 D, V III 500 D	< 30 ppm	> 40 kV/2.5 mm
V I 200, V I 350, V I 700	< 30 ppm	> 40 kV/2.5 mm

\*) measured according to Karl-Fischer method based on IEC-Publication 814

\*\*) measured according to DIN VDE 0370 Teil 1

**Table I** Guide values for monitoring the tap changer oil



On-load tap changer	Transformer-rated current	Number of tap changer operations	
		without MR oil filter unit	with MR oil filter unit
V III 200 Y, V III 200 D, V I 200 V III 250 Y, V III 250 D	up to 100 A up to 250 A	100 000 70 000	150 000 140 000
V III 350 Y, V III 350 D, V I 350 V III 400 Y, V III 400 D	up to 200 A up to 400 A	100 000 70 000	150 000 140 000
V III 500 Y, V III 500 D	up to 350 A up to 500 A	100 000 70 000	150 000 140 000
V I 700	up to 350 A up to 700 A	100 000 70 000	150 000 140 000

**Table II** Inspection intervals

If the number of operations indicated in **table II** has not been reached an inspection is to be carried out after the following number of years:

**On-load tap changer type:** V III 200 Y, V III 350 Y, V III 500 Y

First inspection: 6 - 7 years

Further inspections: 6 - 7 years with or without MR oil filter unit

**On-load tap changer type:** V III 200 D, V III 250 D, V III 350 D, V III 400 D, V III 500 D, V I 200, V I 350, V I 700

Arrangement of the on-load tap changer at the line end of the delta winding or in autotransformers

First inspection: 2 years

Further inspections: 4 years without MR oil filter unit / 6 - 7 years with MR oil filter unit

Arrangement of the on-load tap changer in the middle of the delta winding

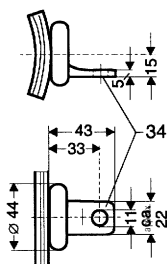
First inspection: 2 years

Further inspections: 6 - 7 years with or without MR oil filter unit

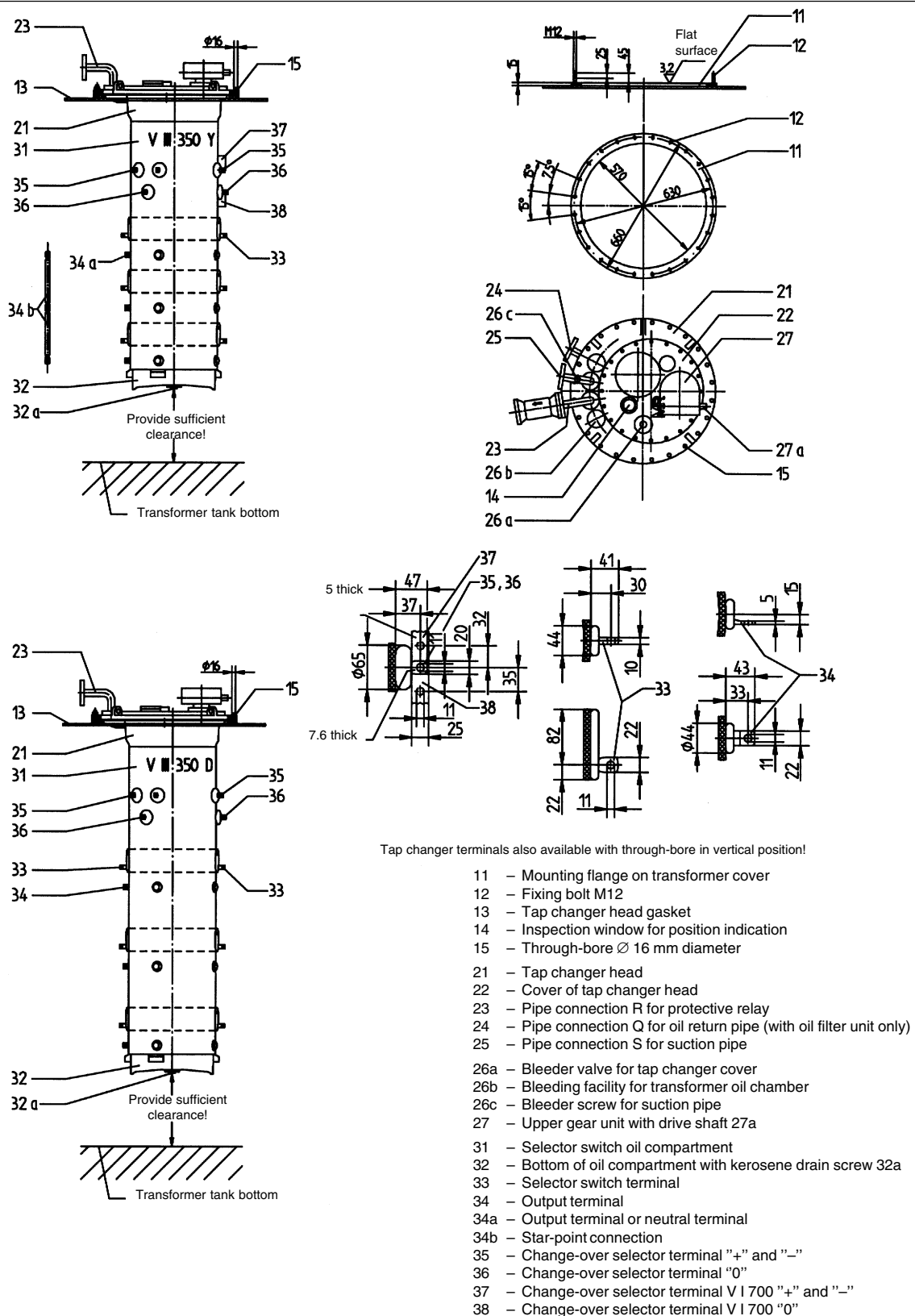
## 16 Appendix

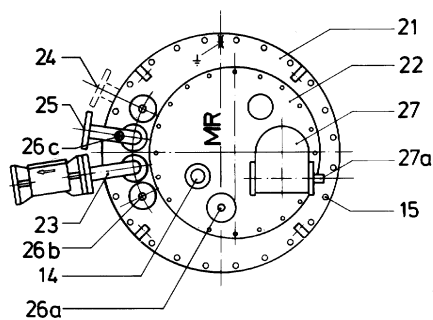
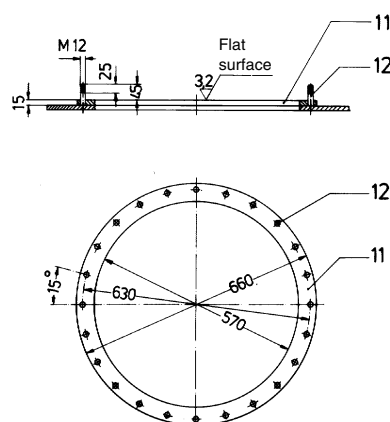
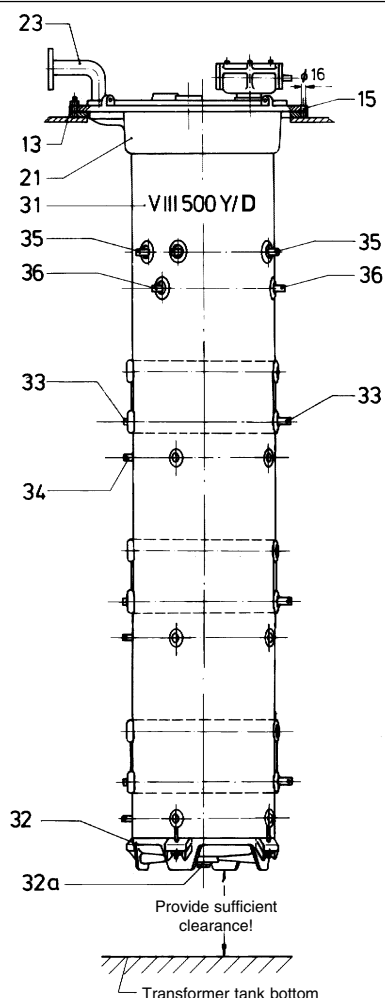
On-load tap changer type V 200, installation drawing	893 945
On-load tap changer type V 350, installation drawing	893 821
On-load tap changer type V 500, installation drawing	894 566
Drilling template for tap changer head	893 787
Tap changer head, dimension drawing	893 779
Supporting flange for installation into a bell-type transformer tank	893 864
Lifting traverse, dimension drawing	893 805
Protective relay RS 2001, dimension drawing	892 608
Motor drive unit MA 7, dimension drawing	895 660
Motor drive unit MA 9, dimension drawing	893 381
Motor drive unit ED-S, protective housing	898 420
Bevel gear CD 6400, dimension drawing	892 916



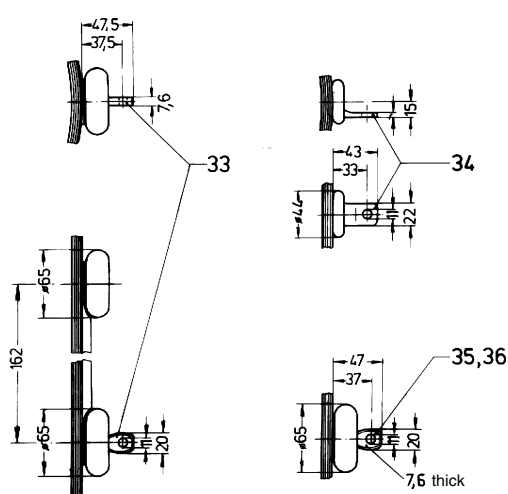


- 11 – Mounting flange on transformer cover
- 12 – Fixing bolt M12
- 13 – Tap changer head gasket
- 14 – Inspection window for position indication
- 15 – Through-bore Ø 16 mm
- 21 – Tap changer head
- 22 – Cover of tap changer head
- 23 – Pipe connection R for protective relay
- 24 – Pipe connection Q for oil return pipe (with oil filter unit only)
- 25 – Pipe connection S for suction pipe
- 26a – Bleeder screw of tap changer cover
- 26b – Bleeder screw for transformer oil
- 26c – Bleeder screw for suction pipe
- 27 – Upper gear unit with drive shaft 27a
- 31 – Selector switch contact cylinder
- 32 – Bottom of oil compartment with kerosene drain screw 32a
- 33 – Selector switch terminal
- 34 – Output terminal or neutral terminal
- 35 – Change-over selector terminal "+" and "-"
- 36 – Change-over selector terminal "0"

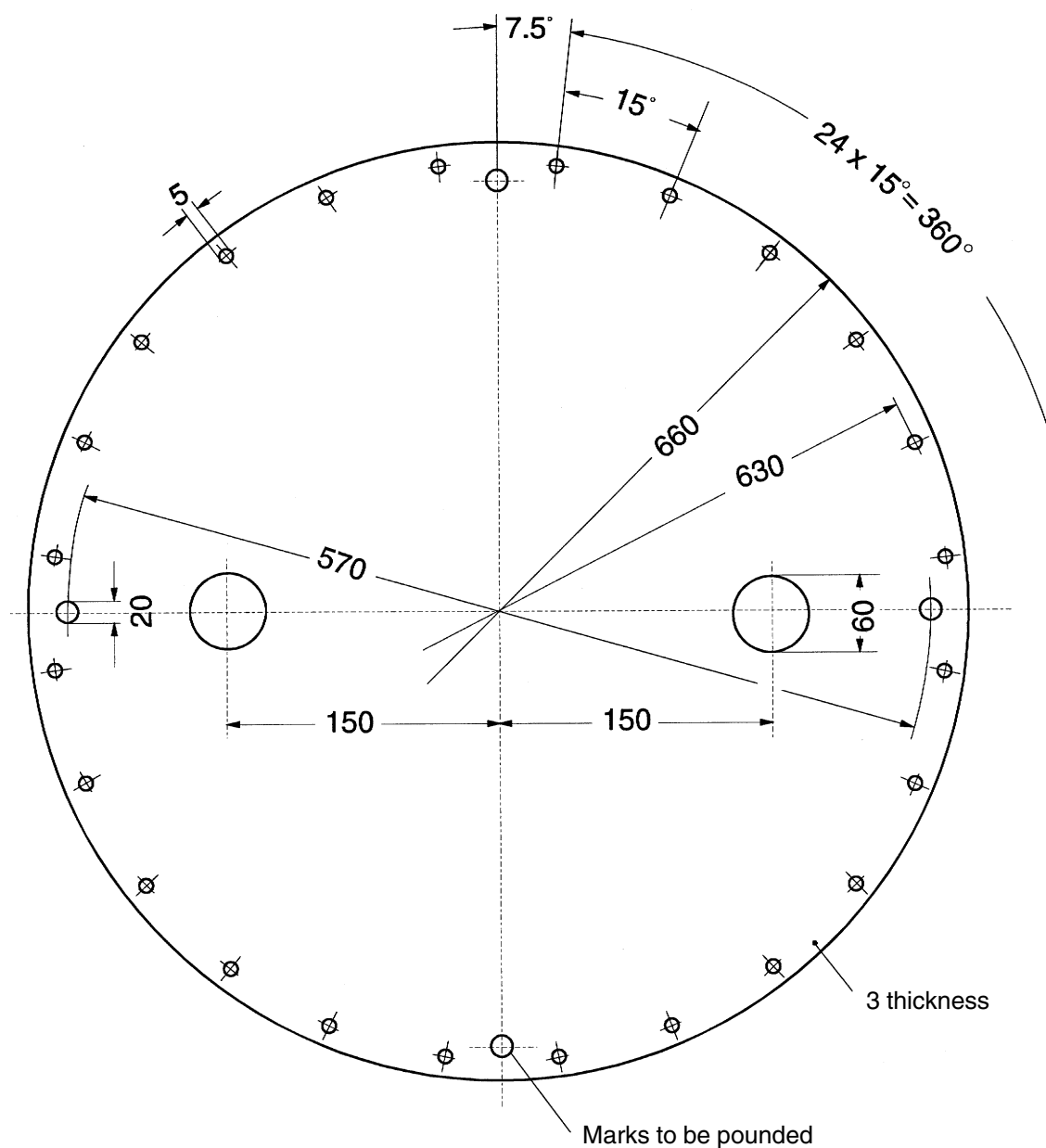


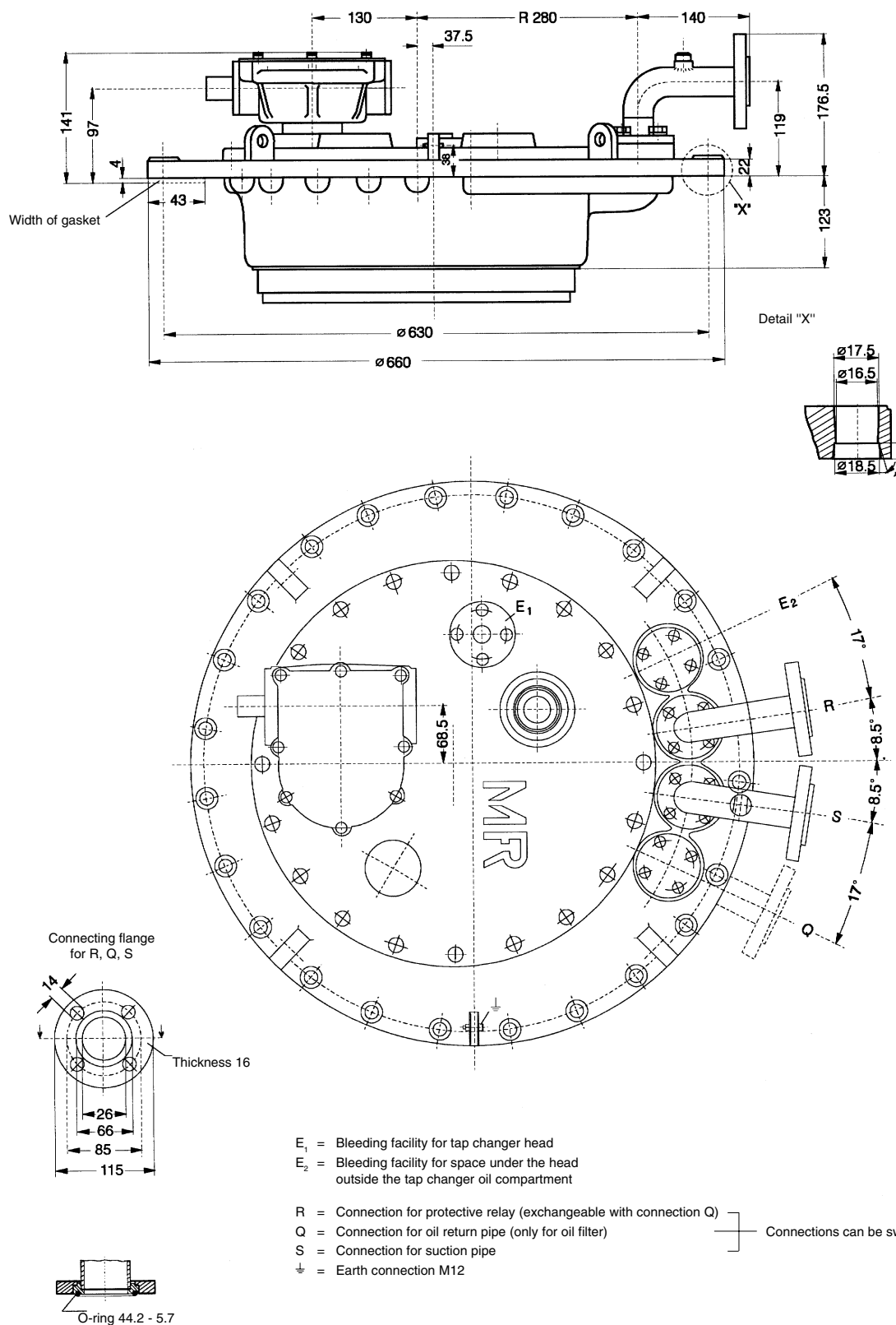


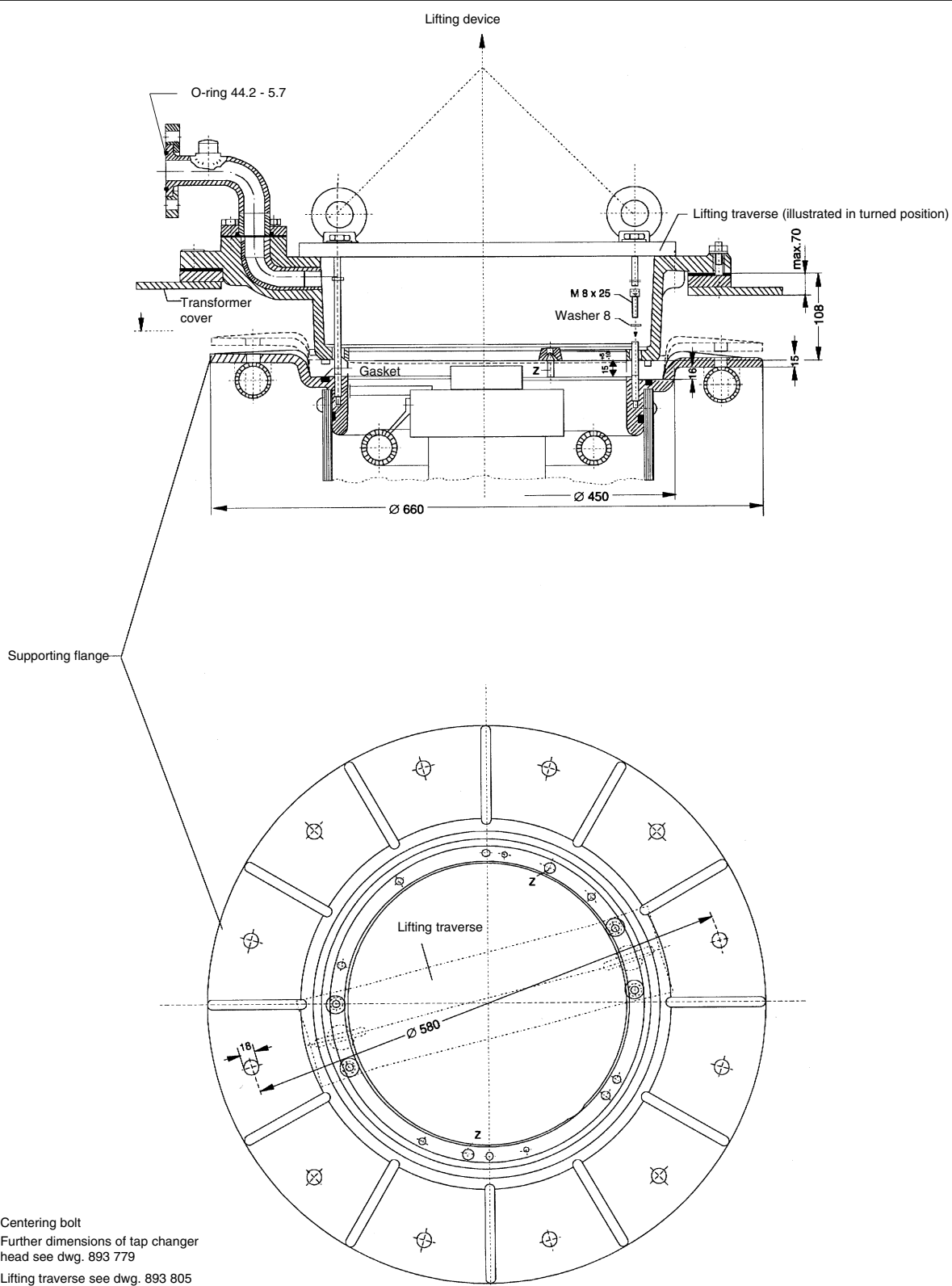
- 11 – Mounting flange on transformer cover
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- 25 – Pipe connection S for suction pipe
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- 33 – Selector switch terminal
- 34 – Output terminal or neutral terminal
- 35 – Change-over selector terminal “+” and “-”
- 36 – Change-over selector terminal “0”

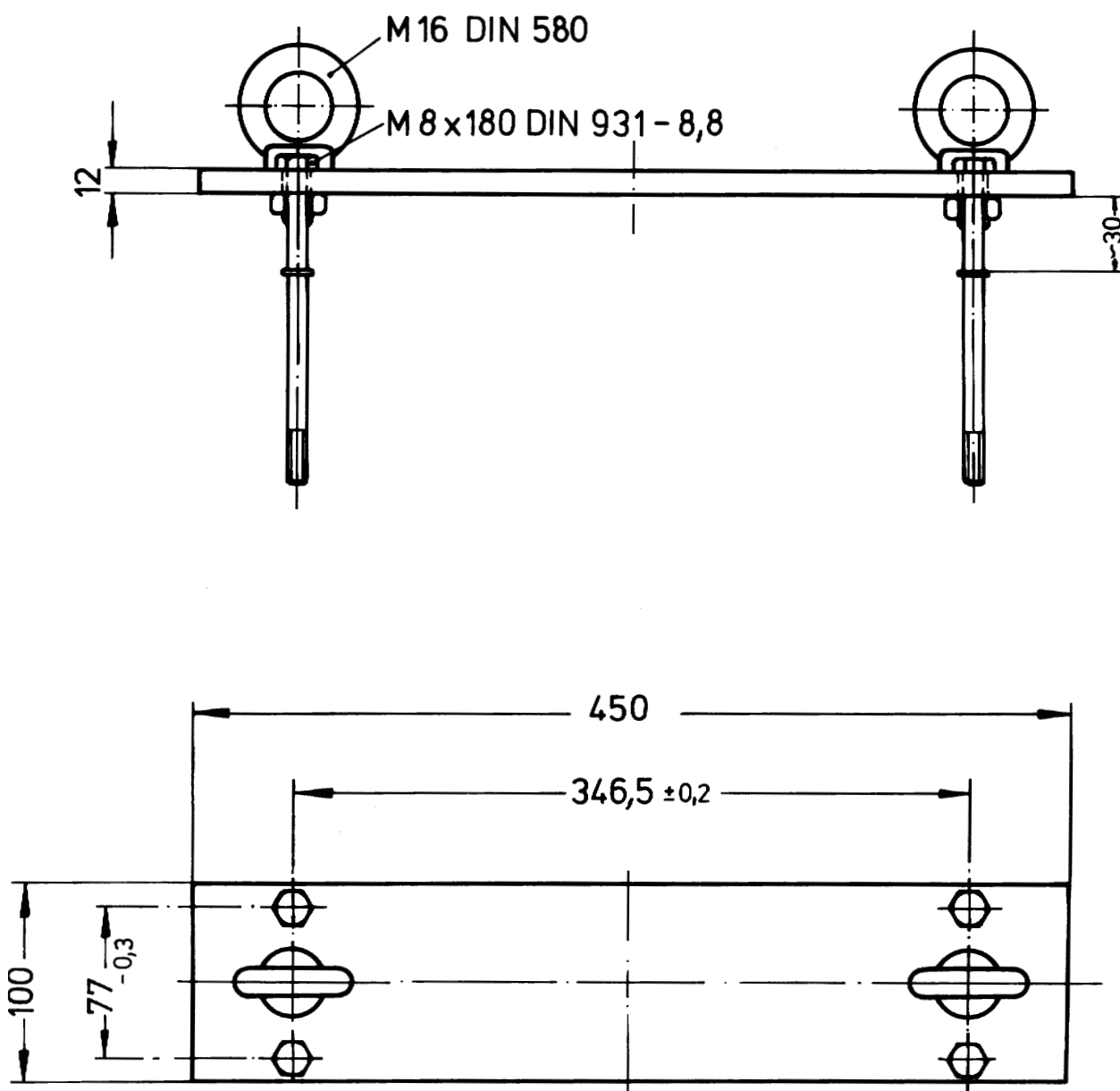


Tap changer terminals also available with through-bore in vertical position!



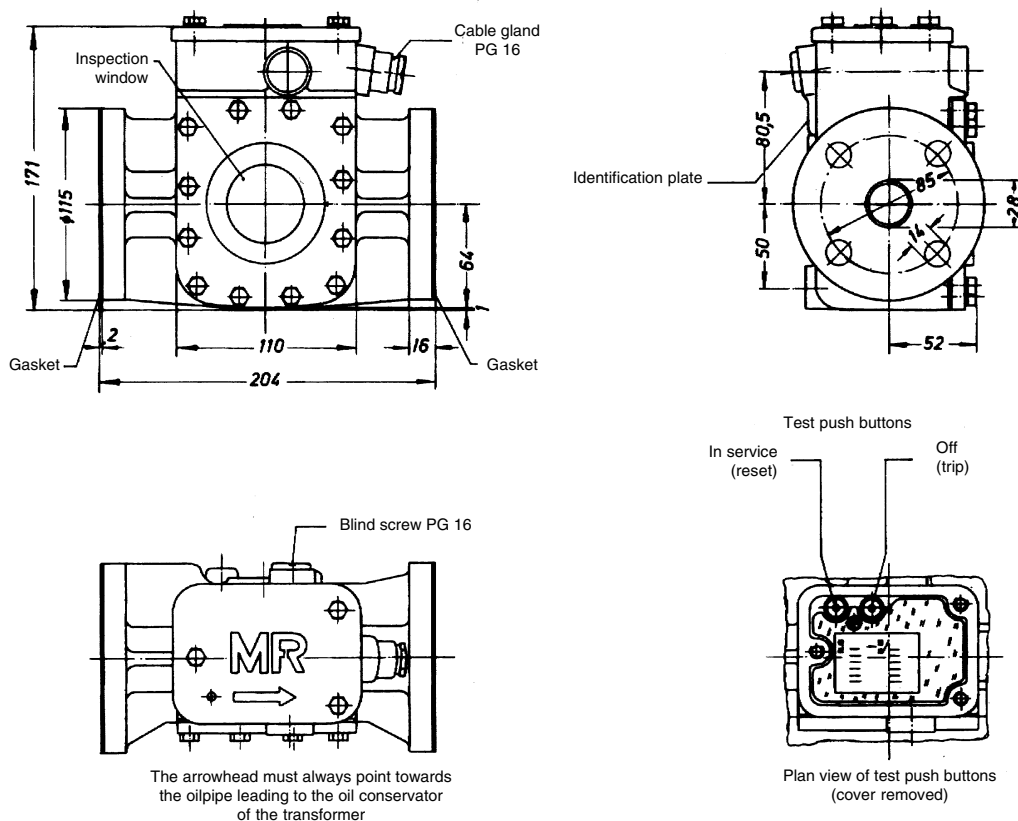






(Part no. for subassembly: 086 402)

Sheet steel U St- 37-1K  
DIN 1652

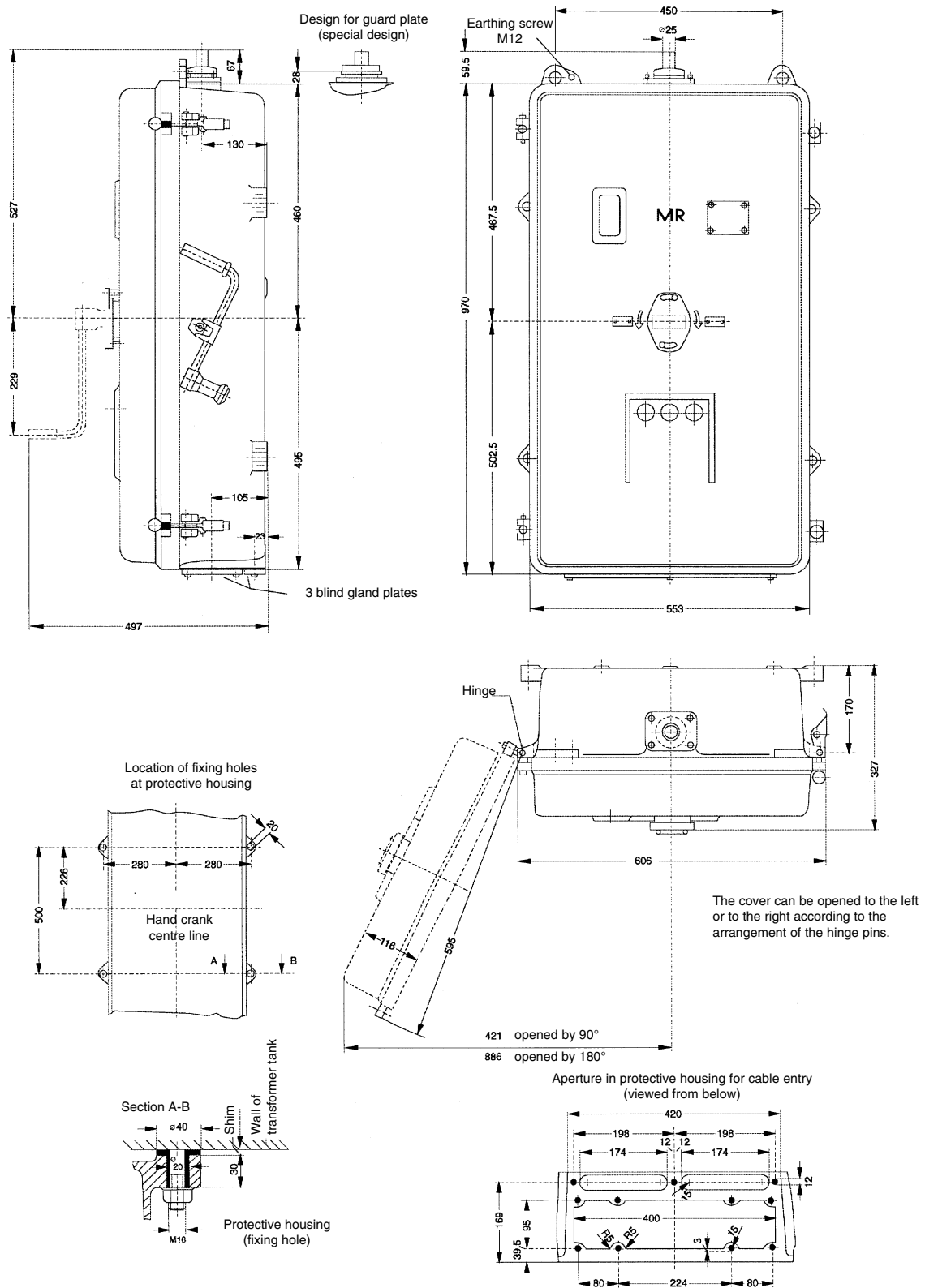


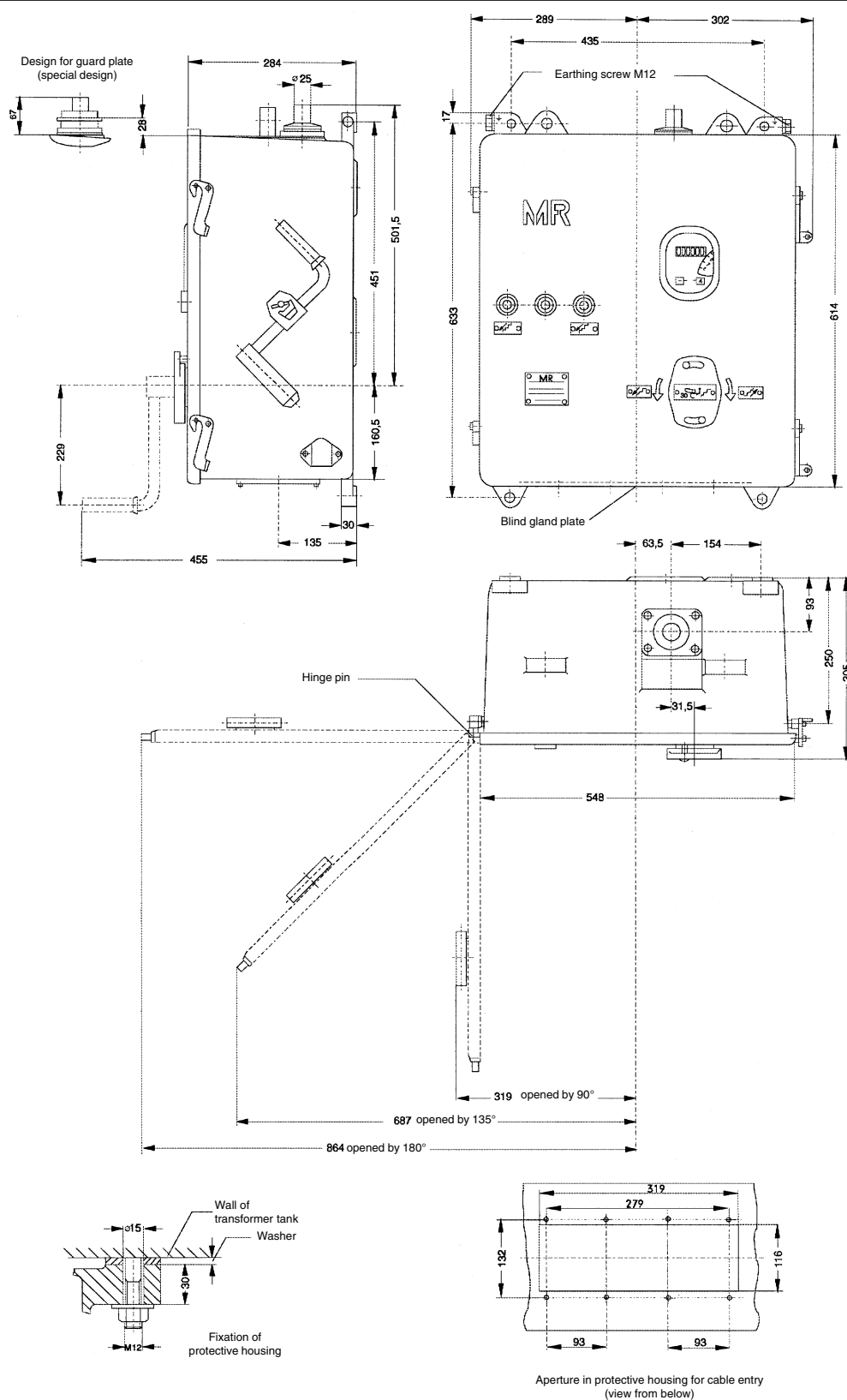
Key of variants						
Variant	Designation of relay <sup>1)</sup>	Reed contact	Contact positions		Arrangement of terminals	Design
			in service	off		
01	1.2 - NO	A				Standard design
02	3.0 - NO					
03	1.2 - NC	B				
04	3.0 - NC					
05	1.2 - CO	C				Special design against surge
06	3.0 - CO					
07	1.2 - 2NO	2A				
08	3.0 - 2NO					
09	1.2 - 2NC	2B				
10	3.0 - 2NC					
11	1.2 - NO + NC	1A&1B				
12	3.0 - NO + NC					

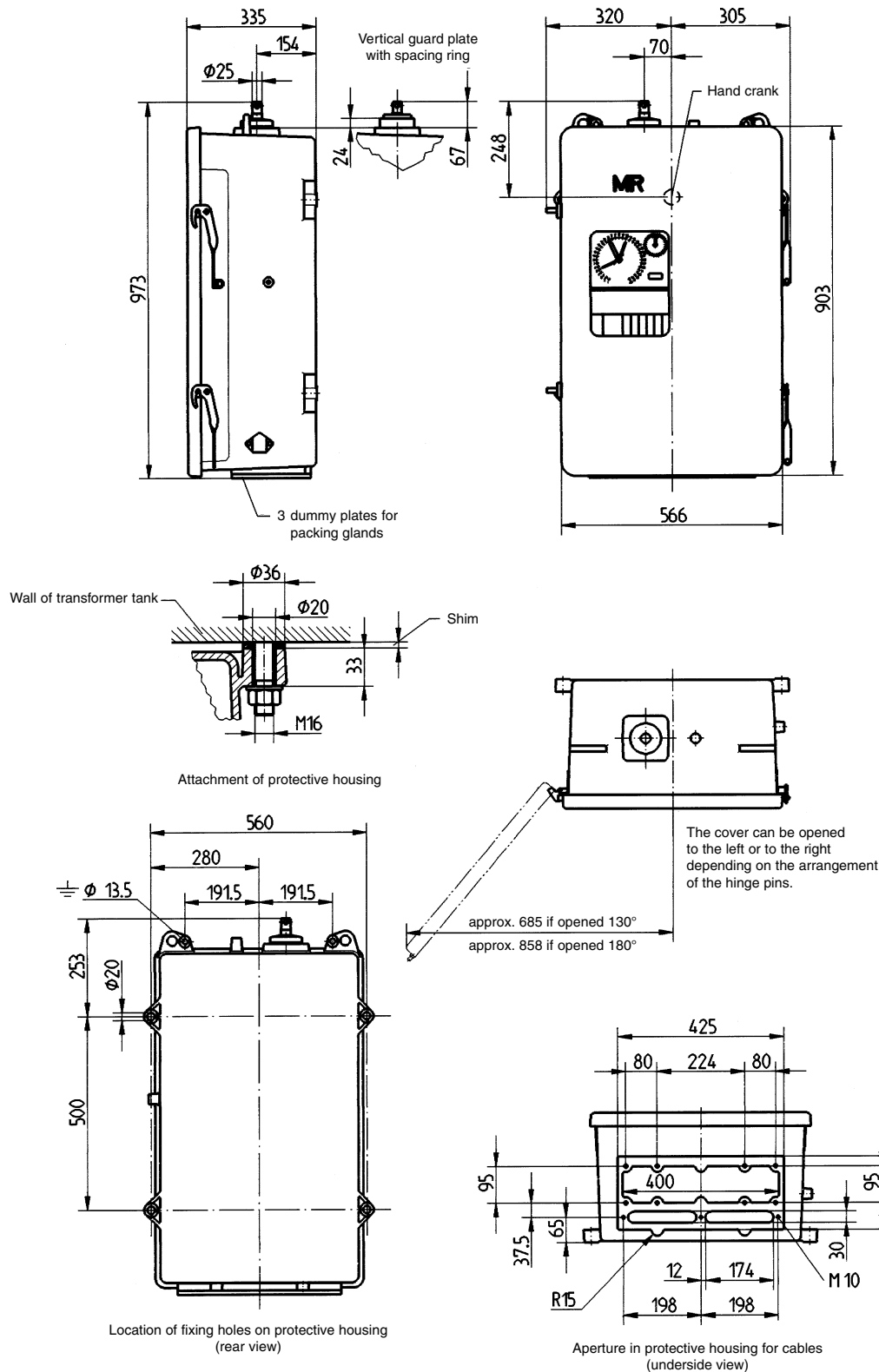
<sup>1)</sup>NO - normally open, NC - normally closed, CO - change-over contact

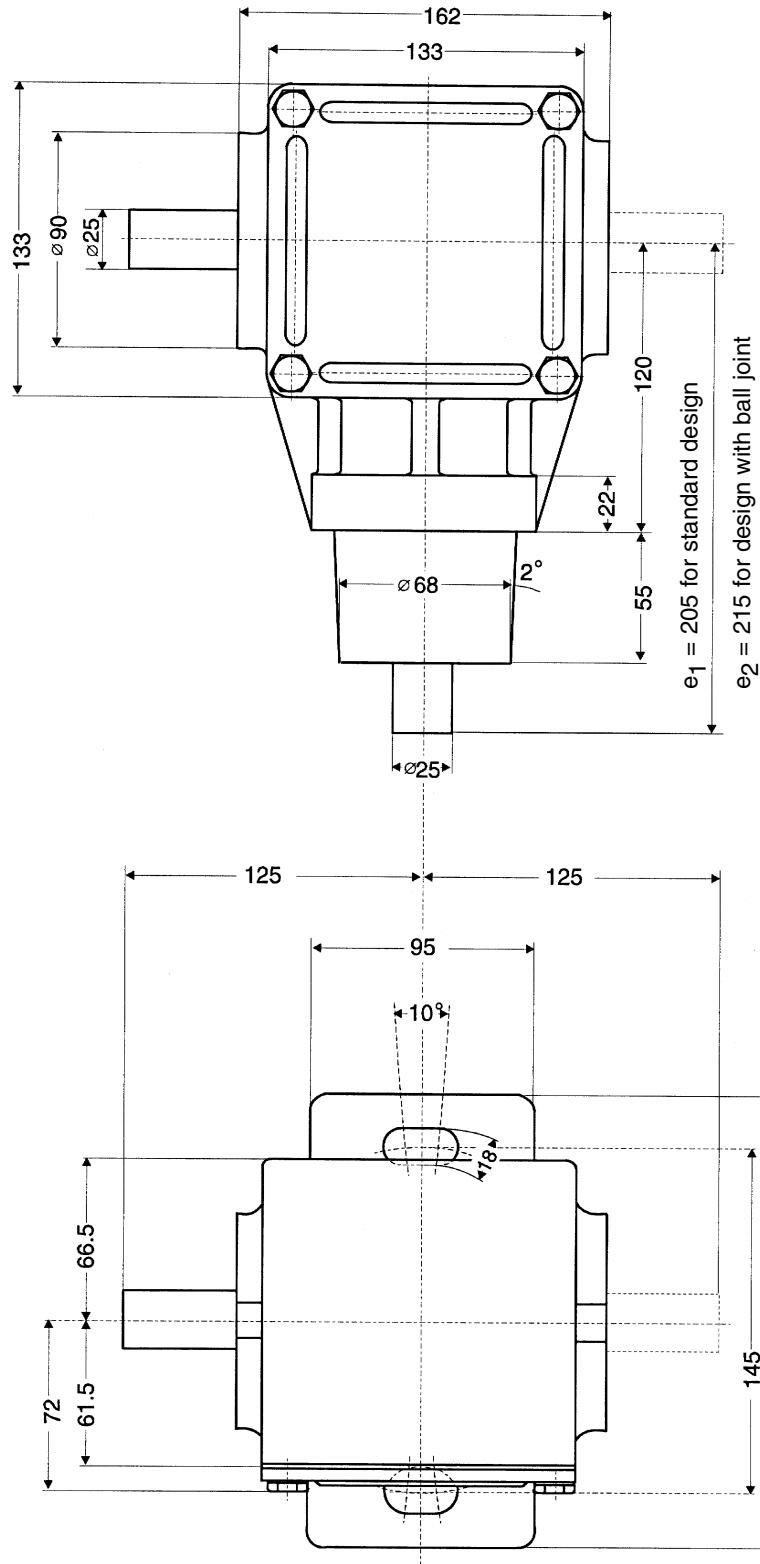
The protective relay is to be connected in such a way that if it is energized, the power transformer is switched-off immediately by its circuit breakers















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BA 081/04 en - 0802/1000  
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Printed in Germany