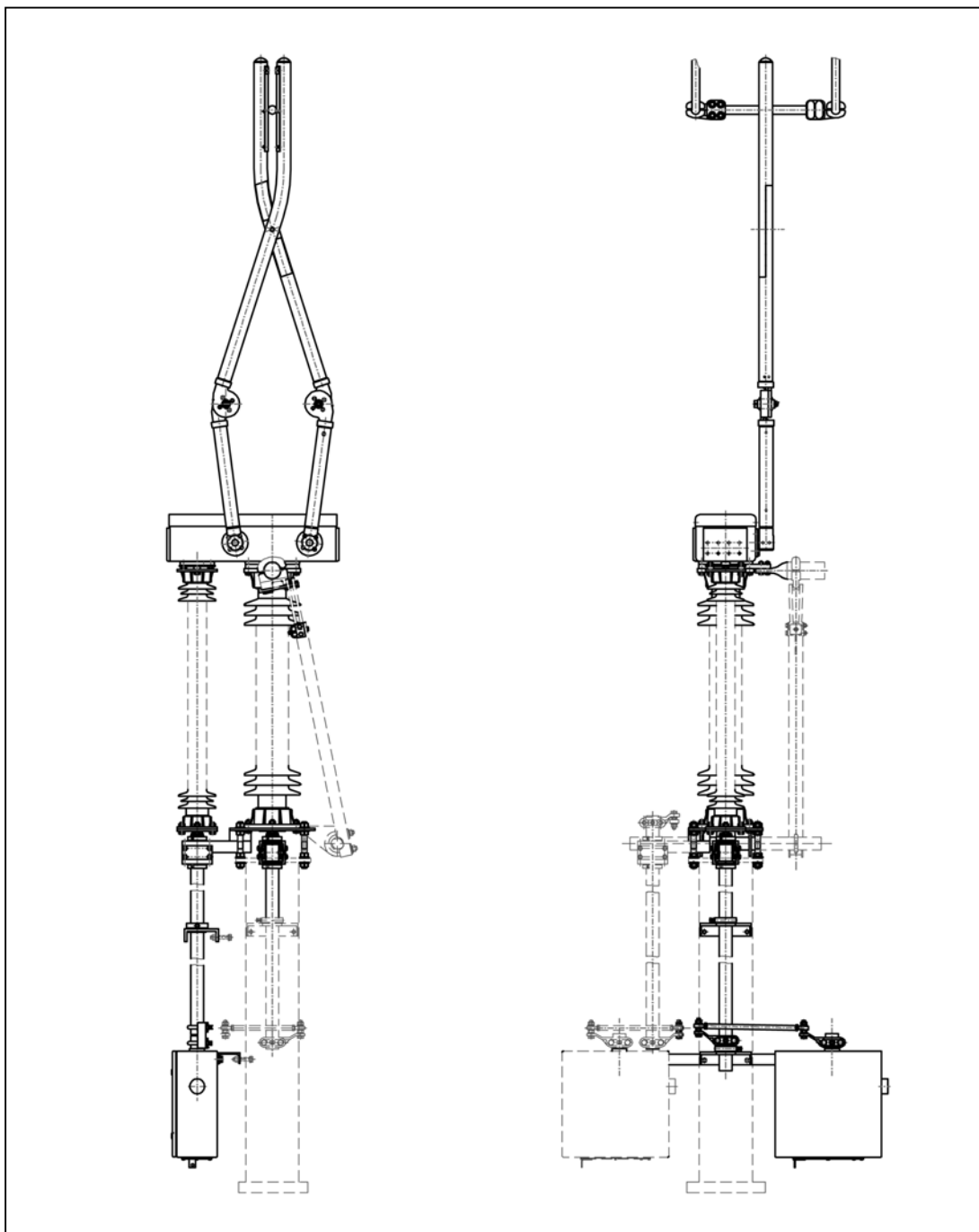


Single-Column Pantograph Disconnectors for Outdoor Installation Type TFB -three poles installation

Publication No.
1HPL 500 620a E

Rated Voltages
Rated Normal Current

123 to 145 kV
2500 A



HAPAM

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1. General remarks

Practical experience has shown, that strict adherence to the recommendation of this instruction manual will ensure the best possible safe performance of the equipment.

In an instruction manual it is not possible to cover every possible eventuality that might occur when using technical apparatus. It is therefore requested that all incidences, in particular those for which the instruction manual provides no plausible explanation, be reported to us directly or through our local representatives.

These instructions are based on the present technical design. We reserve the right to make any technical changes.

We cannot accept any responsibility for any damage resulting directly from incorrect handling or operation, irrespective of whether specific reference is to be found in the instructions for erection and operation or not.

With respect to this document we reserve all rights also in the event of a patent being issued and registration being made under other commercial rights. Misuse, in particular copying and handing over to third parties is prohibited and offenders can be prosecuted under law.

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2. Application

In open position disconnectors serve for metallic isolation of systems and form a visible isolating distance. They are designed for no-load switching and able to disconnect low charging currents. In combination with the special suspended contact for breaking commutation currents the single-column pantograph disconnector type TFB is suitable for interrupting commutation currents.

The pantograph disconnectors type TFB are designed for outdoor installation according to the Publications IEC 62 271-102; 2003, IEC 60 694/1996, and most other national regulations. They are single-pole disconnectors for a rated voltage of 123, 145. Single-column pantograph disconnectors are appropriate for outdoor installations with conductors arranged at two different levels, one above the other. They permit modern installation design and require only a small ground space. A three-pole disconnector group consists of three identical and interchangeable disconnector poles.

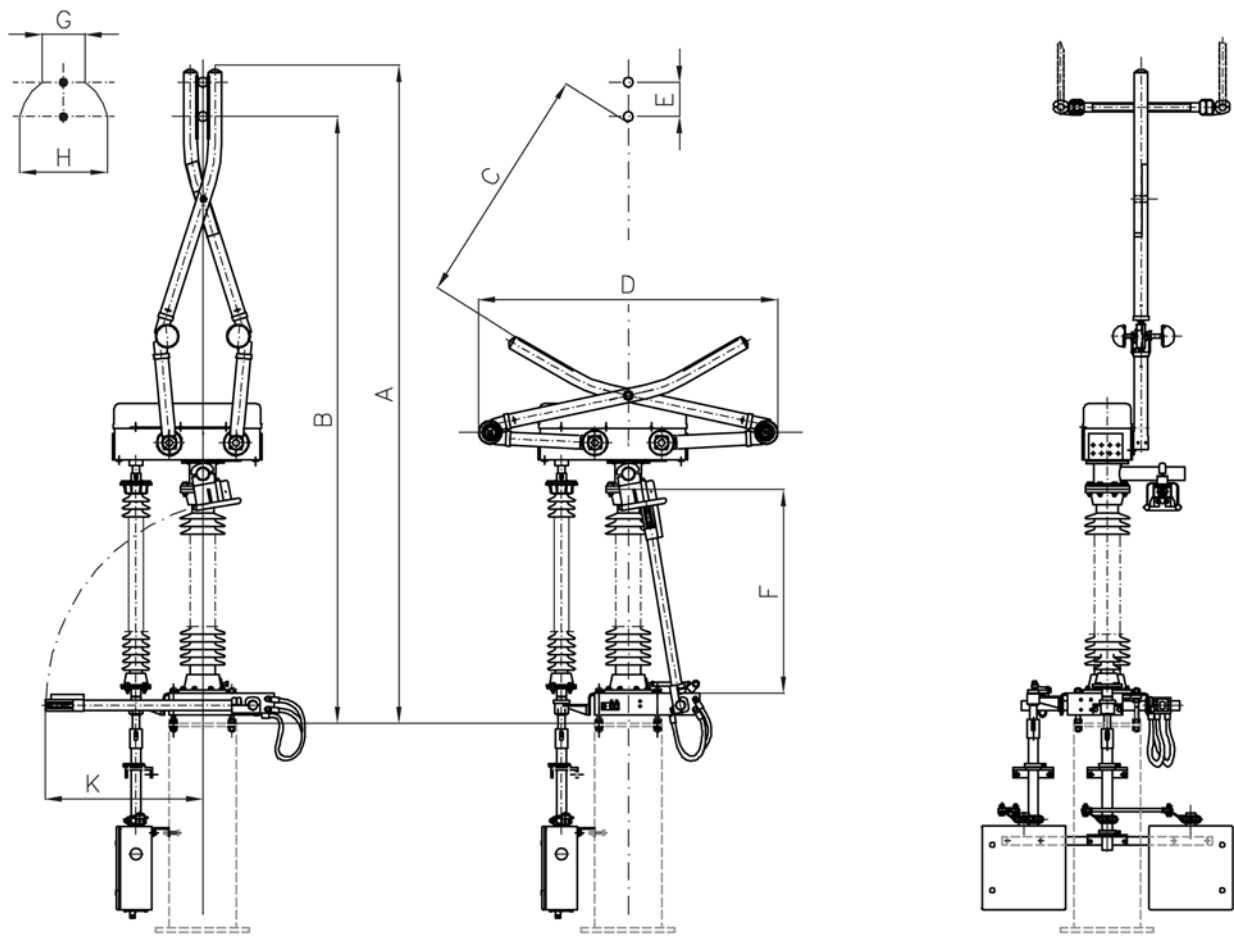
Each disconnector pole can be equipped with an earthing switch for earthing and short-circuiting disconnected plant sections, if required.

3. Technical Data

3.1 List of Types and Technical Data 123-145 kV

Disconnecter type Build in earthing switch type		TFB 123 TEC	TFB 145 TEC
Rated voltage	KV	123	145
Rated normal current (type p)			
Rated peak withstand current for disconnecter and earthing switch	A	2500	2500
Rated short-time current 1 s for disconnecter and earthing switch	KA(peak)	100-125	100-125
Rated 1 min power-frequency withstand voltage 50 Hz to earth and between poles across the isolating distance	kA(rms)	40-50	40-50
Rated lightning impulse withstand voltage 1,2/50 μ s to earth and between poles across the isolating distance	kV(rms)	230	275
	kV(rms)	265	315
Discharge inception voltage	kV(peak)	550	650
		650	750
Radio interference voltage at 156 kV	kV	>80	>95
Three-phase breaking capacity inductive, capacitive	μ V	<2500	<2500
Failing load of support insulator	A	2	2
Admissible mechanical terminal load*** static and dynamic static portion	kN	6-8-10	6-8-10
	kN	4,2-5,6-7,0	4,2-5,6-7,0
In combination with special suspended contact: (see Section 4.5)	kN	1,5-2,0-2,5	1,5-2,0-2,5
Breaking commutation currents at commutation voltages \leq 330 V			
In combination with special design of contact strips for pantograph and suspended contact: (see Section 7.5)	A	1600	1600
Breaking commutation currents at commutation voltages \leq 123 V			
	A	1000	1000

3.7 Main Dimensions and Weights



			TFB 123	TFB 145
A	Height of disconnector (CLOSED)	mm	3930	4210
B	Distance to suspended contact	mm	3500	3780
C	Minimum isolating distance	mm	1400	1400
D	Width of disconnector (OPEN)	mm	1990	1990
E	Catching range	mm	300	300
F	Height of insulator	mm	1220	1500
G	Envelope, top	mm	170	170
H	Envelope, bottom	mm	580	580
K	Earthing switch (OPEN)	mm	1580	1300

Weights

Disconnector, three-pole group ¹⁾²⁾	kg	850	950
Built-on earthing switch, three-pole group ¹⁾	kg	70	70

¹⁾ including operating mechanisms

²⁾ including insulators of standard design

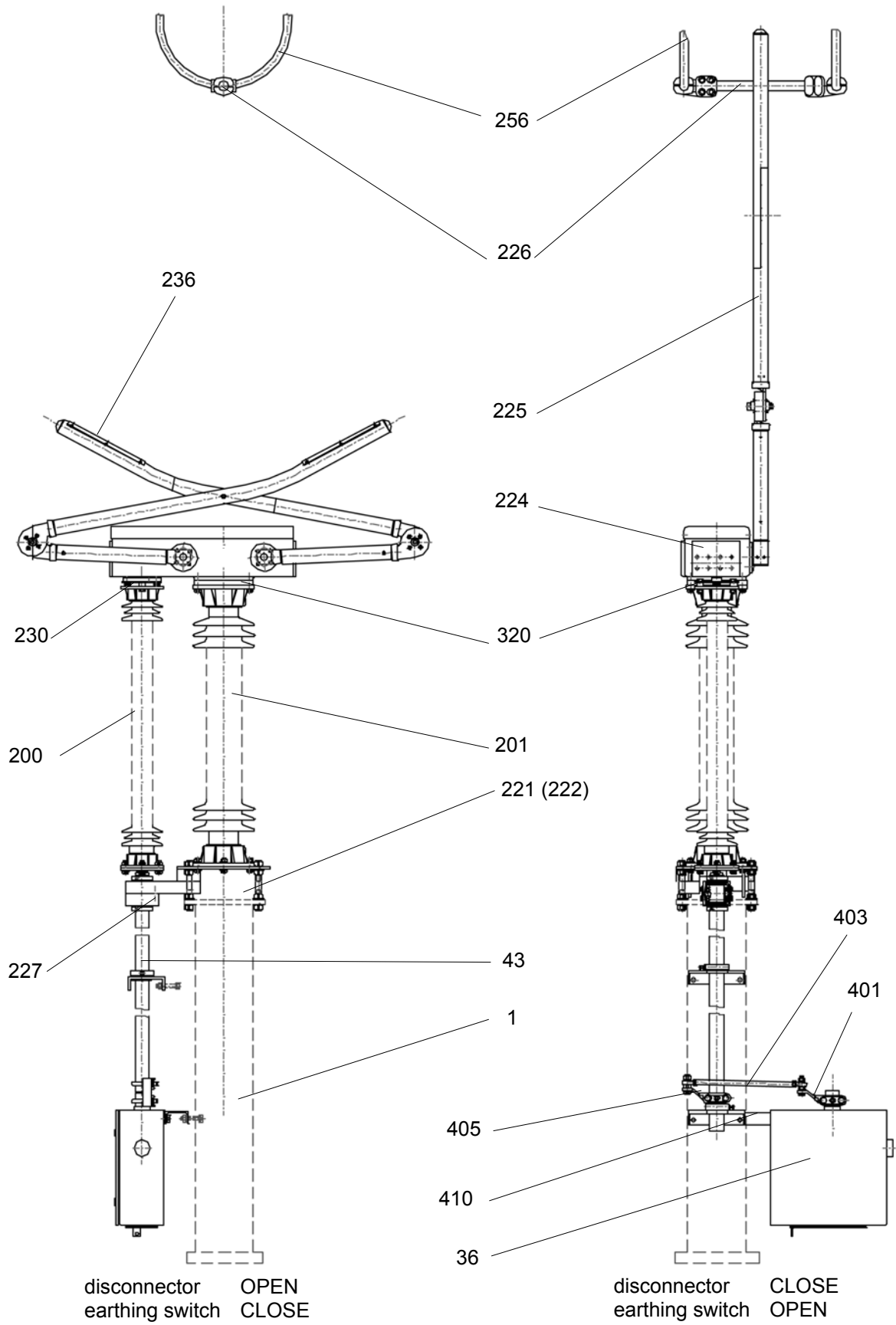


Figure 1 Pole of pantograph disconnector in switching positions (shown: type TFB 123 with motor-operated mechanism type MT)

4. Design

4.1 Disconnecter and Earthing Switch

The stable base frame 221 or 222 (in case of built-on earthing switch) is the carrying constructional element of the disconnecter. It is mounted to the foundation 1 by means of four stud bolts 13 and supports the insulator column 201 with the top intermediate piece 223, gear box 224 with the pantograph 225 as well as the pivot bearing 227 with the rotary insulator 200 and (if available) the built-on earthing switch 228 with its pivot bearing 229.

The pantograph 225 is a welded aluminium construction and together with the cast aluminium gear box 224 forms a mechanical unit. The construction guarantees the highest possible degree of mechanical stability and reliable current transfer especially in the case of the load involved in a short circuit. Bolt connections are intentionally avoided so that operating reliability is not impaired with time by bolts working loose or by corrosion in the joint. A counterbalance spring 235 is mounted in the gear box 224 for balancing the weight of the pantograph. Current is transferred in the pantograph joints and gear box by way of tapered roller contacts which are totally enclosed and protected against atmospheric influences.

The gear box is closed on all sides; thus, the installed components are protected against atmospheric influences, contamination and animals (e.g. birds, snakes) and their nests. Flat terminals 17 are provided on all 4 sides offering universal connection possibilities. Hole distance are according to DIN or NEMA depend on client requests. Other standards are available, too, if required. The entire transmission system has a simple mechanical design. All gear box and pantograph bearings are permanently lubricated and thus maintenance-free.

The top intermediate piece 223 is arranged between the support insulator 201 and the gear box 224 with the pantograph 225. An additionally support 320 - installed between insulator 201 and top intermediate piece 223 - can be used as mounting point for the bottom conductor; the cables or tubes can run laterally past the switch in one piece. This possibility of meeting the particular installation requirements helps to reduce the number of structural elements and thus the mounting work involved.

The suspended contact 226 or 301 is situated above the disconnecter on the overhead line and is grasped, when the pantograph is in closed position, with a high pressure, by a scissors action.

Readjustment of the nuts of the stud bolts 13 enables easy and exact adjustment of the disconnecter and/or compensation of foundation and inaccuracies caused by tensile forces.

The optionally available earthing switch 228 with its pivot bearing 229 is attached to the disconnecter frame 222. The tubular contact arm 23 is permanently connected with the earthed frame by means of a flexible connection 79. Earthing contact 18 is attached to the top intermediate piece 223.

4.2 Operating Mechanisms

The operating mechanisms are fastened on bracket 410 below the base frame at the foundation within easy reach. The pivot bearing 227 or 229 and the operating mechanism is connected by operating shaft 43 and operating rod 403 and operating lever 401. The disconnecters and earthing switches can be operated by way of manual or motor-operated mechanisms.

4.3 Pilot Switches

The pilot switches are attached directly within the operating mechanism concerned. The mechanical control of the pilot switches by means of the operating mechanism is designed in a way that the control signal is given only after the operating mechanism has passed through the dead center position and interlocking of the disconnecter or earthing switch has occurred.

4.4 Interlocking of Disconnecter with Earthing Switch

The disconnecter and earthing switch with manual operating mechanism can be interlocked with each other at the client's request so that it is only possible to operate the earthing switch with the disconnecter in open position and the disconnecter with the earthing switch in open position.

If required, manual operating mechanisms can be equipped with a blocking magnet which, when de-energized, makes any actuation of the operating mechanism impossible. In this case electrical interlocking of the manual operating mechanisms with each other is possible.

For disconnecters with motor-operated mechanism and earthing switches with manual operating mechanism, mechanic interlocking can also be provided for the earthing switch, whereas the operating mechanism of the disconnecter must be interlocked electrically.

5. Mode of Operation

Each disconnecter and earthing switch is operated:

- separately or (one operating for one pole)
- three poles (one mechanism on three poles)

5.1 Disconnecter

The energy is transmitted from operating mechanism to gear box 224 (Fig. 1) via operating rod 403 to shaft 43, rotary insulator 200 and coupling flange 230. The rotary movement is transmitted in the gear box 224 by operating lever 266 and operating rod 244 to the levers mounted together with the pantograph arms on a common shaft 267. A spring 235 is installed in the gear box 224 to counterbalance the weight of the pantograph.

The operating lever 266 in the gear box travels through a dead centre position during making and breaking before reaching its final position thus preventing the pantograph arms of the disconnecter from opening and closing automatically (e.g. due to breakage of the rotary insulator or to vibrations caused by an earthquake).

The contact strips 236 on the pantograph arms travel through a wide reach during making so that the suspended contact is reliably gripped even if its position changes considerably under the influence of adverse weather conditions. In the closed position, the contact strips 236 rest against the suspended contact with a high pressure. The high contact pressure does not only assure reliable current but also serves to reduce contact wear. The forces acting on the contacts due to the scissor action when making and breaking the disconnecter are concentrated on a single point so that even thick layers of ice can be easily broken and removed. The design of the disconnecter prevents formation of an ice block between the pantograph and gear box.

5.2 Earthing Switch

The design of the operating linkage of the earthing switch is such that a dead center position is passed through shortly before the respective end position is reached. Thus, automatic opening or closing of the units is avoided.

The energy is transmitted from operating mechanism to earthing switch shaft 73 via operating rod 404 shaft 43, operating lever 76, operating rod 71 and earthing switch operating lever 19. The tubular contact arm 23 swings upwards when the switch is closed. During switching-on, the contact fingers (20) glide over the earthing switch contact (18). In the ON position, they are in preloaded contact against the stop.

6. Transportation, Storage

Disconnecters are delivered, on pallets, in single assemblies which have to be mounted at site. The following transportation assemblies are delivered:

- Base frame 221 complete with stud bolts 13 or
in the case of built-on earthing switch:
Base frame 222 with built-on earthing switch complete with stud bolts 13
(however without tubular contact arm 23)
- Gear box 224 with pantograph 225
- Support insulator 201
- Rotary insulator 200
- Top intermediate piece 223, possibly with built-on earthing contact 18
- Support 320 for busbar carrier
- Coupling flange 230
- Suspended contact 226
- Operating mechanism 36 for disconnector
- Operating shaft 43 for disconnector
- Additionally in the case of built-on earthing switch:
 - Tubular contact arm 23
 - Motor-operated mechanism 36 or manual operating mechanism 55
 - Operating shaft 43
 - Mechanical interlocking (as loose items)
 - Small parts
 - bracket for operating mechanisms 410

As soon as the equipment arrives at the place of destination the parts should be checked for completeness. Furthermore, an inspection for damage in transit should be carried out to find out the extent of damage, the cause of damage and, if necessary, its originator. The damage report, if any, should immediately be sent to the appropriate forwarding agency to be passed on to the transportation insurance company.

The disconnector and earthing switch components and the operating mechanisms should be stored in normal mounting position to prevent damage due to ingress of water. Storage and installation should be done in a way suitable to prevent excessive contamination and any damage to the zinc coat. For this reason, the individual groups should be left on the transport pallets until installation is started.

To maintain corrosion protection provided by the special packing as long as possible the operating mechanisms should be left in this packing until installation is started.

In dry climate the duration for transportation and storage of the operating mechanisms must not exceed 6 months without heater. For longer times of storage or if there is danger of moisture condensation the heater has to be connected unless precautions were taken by appropriate packing or storage to prevent moisture condensation.

The bags with desiccative are to be removed prior to commissioning of the heater.

7. Installation

7.1 General

The disconnectors are delivered in assemblies. Since the pantograph and gear box form a unit and all mechanical adjustments have already been carried out in the factory, installation is limited to mounting of the assemblies and connection of the high-voltage leads as well as the electric connections leading to the operating mechanism.

For installation, it is advisable to use a crane or some other hoisting gear with a carrying capacity of 500 kg. All disconnector units can readily be installed by fitting and bolting, pinning, sawing and drilling. To ensure proper installation of the disconnector poles with respect to the earthing switches, operating mechanisms and suspended contacts, the dimension drawings listed in the works orders for the respective disconnector design are required in addition to these installation instructions:

The interior parts of the operating mechanisms (e. g. pilot switches, contactors etc.) are not resistant to the atmospheric conditions prevailing out of doors; therefore, care must be taken to ensure that these parts are not exposed to humidity during installation.

With motor-operated mechanisms adjustment or manual test operations are to be carried out using the emergency crank 39 only. Do not use a power drill for this purpose.

Care has to be taken that each disconnector is properly earthed.

In any case the heaters in the operating mechanisms must be connected and commissioned immediately, even if the associated disconnectors and earthing switches have not been commissioned yet. The bags with desiccative are to be removed prior to commissioning the heating.

7.2 Mechanical Terminal Loads

The admissible rated mechanical terminal load F comprises static and dynamic tensile forces and is also dependent on the support insulator installed. The values can be taken from the dimension sheet for each delivered disconnector.

7.3 Designations on Rating Plates

7.3.1 Designations of Disconnectors and Earthing Switches

500 xxxx	order number or
500 xxxx	order number
yy	group number (01 to 99)
z	pole designation (for three-pole groups: a, b, c)

For example: serial number 500 4430 04 c:
Pole c of a pantograph disconnector group, group No. 04, order No. 500 4430.

7.3.2 Designations of Operating Mechanisms

Allocation of operating mechanisms to the individual disconnectors or earthing switches can be seen from the serial number (see rating plate of operating mechanism).

500 xxxx	order number or
500 xxxx	order number
rr	consecutive counting number (01 to 99)
ss	designation of disconnector or earthing switch:
AT	for disconnector
AE	for earthing switch

For example: serial number **500 4430 04 AE**:
Operating mechanism number 04 for a built-on earthing switch of a pantograph disconnector, order No. 500 4430.

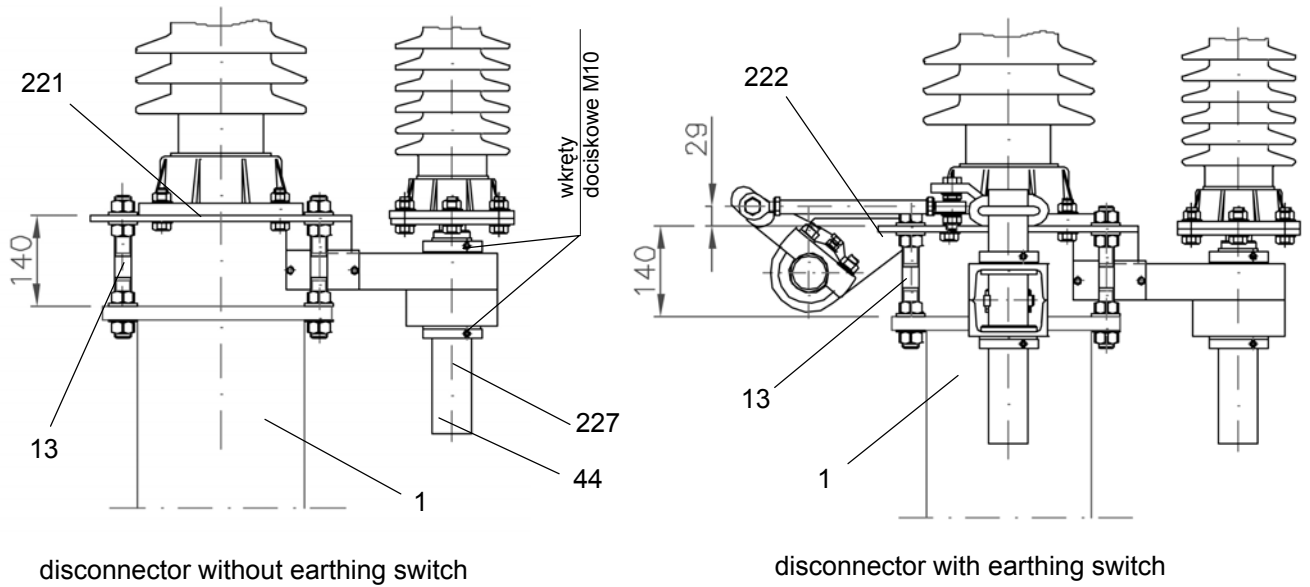
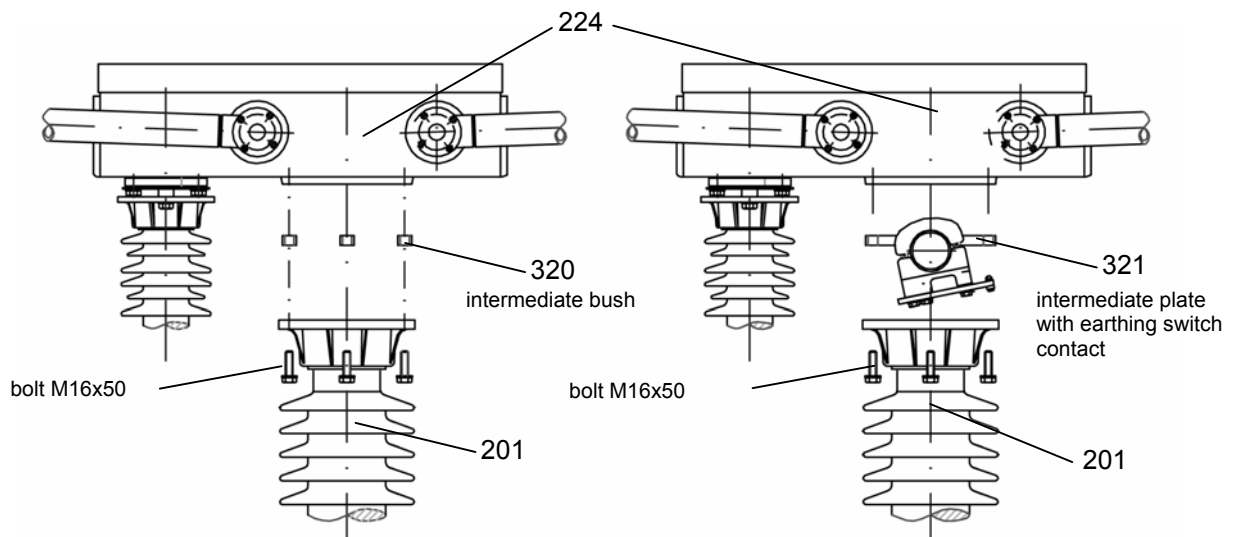


Figure 2 Installation of base frame on to structure



A – disconnecter without earthing switch

B – disconnecter with earthing switch

Figure 3 Fixing of post insulator to the gear-box

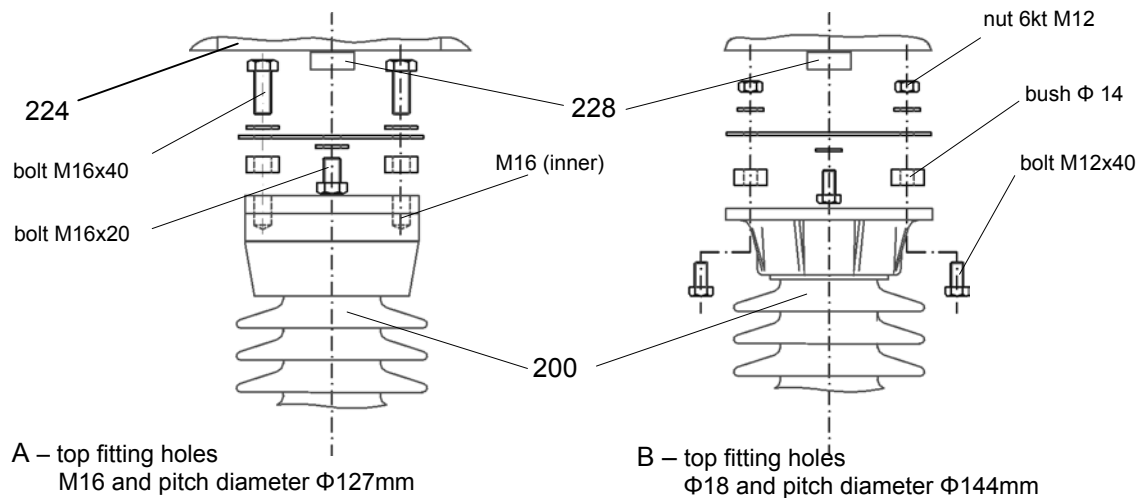


Figure 4 Fixing of rotary insulator to the gear-box

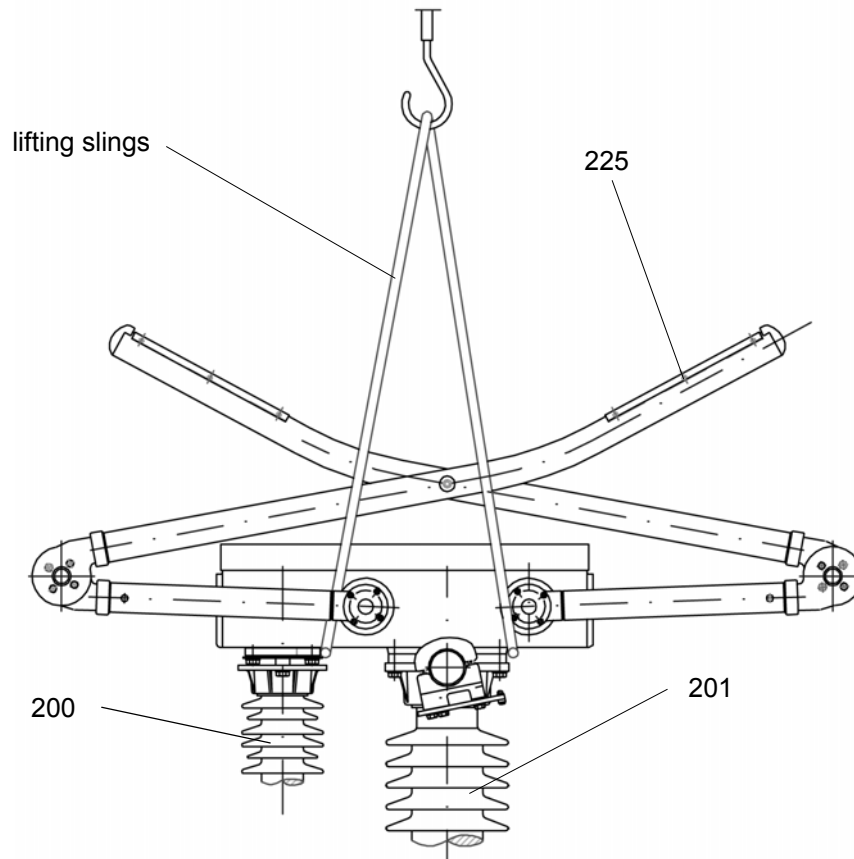


Figure 5 Lifting of gear-box together with insulators

7.4 Installation of the one pole of disconnecter

Each gear box bears a serial number on the pantograph side (machined surface, left-hand side, see Figure 7). When assembling the disconnecter, make sure that the gear boxes are matched with the corresponding frames bearing the same serial number (see nameplate).

- 7.4.1 Check the steel supports (also foundations, structures) in the horizontal and vertical positions. If necessary, align with the aid of a spirit level, using adjusting screws, if any (starting position for final adjustment of the pantograph disconnecter as described in Section 7.4.12).
- Make sure that all contact surfaces are bright, so as to ensure reliable earthing. Slightly grease all flange surfaces.
- 7.4.2 Mount frame 221 or 222 on the steel support. Dimension $a = 140 \pm 5$ mm and the horizontal position of the frame plate can be adjusted by means of the 4 stud bolts 13.
- 7.4.3 Loose set screws M10 in the bearing (227) and move shaft (44) down together with bearing set.
- 7.4.4 Fix the lifting slings on gear-box according to Fig.3 (pantograph arms have to be between slings in order to stabilize its position).
- 7.4.5 Lift the gear-box with pantograph. Bolt the top fitting of post insulator to the gear-box (Fig.3) inserting:
-four bushes $\varnothing 30 \times 20$ -without earthing switch version
-intermediate plate (320) with earthing switch contact –with earthing switch version
- 7.4.6 Bolt the top fitting of rotary insulator to coupling plate (228)
Attention: Depending on kind of rotary insulator, the way of assembling can be different –refer to Fig. 4
- 7.4.7 Lift assembled set on base frame (221 or 222) and bolt post insulator to the frame.
- 7.4.8 Move shaft (44) up together with bearing set and bolt bearing plate (227) to the bottom fitting of rotary insulator –Fig.2
- 7.4.9 Install operating mechanism in accordance with Section 7.5
- 7.4.10 Install suspended contact 226

Care has to be taken that the pantograph is closed only with the suspended contact installed.

- 7.4.11 Adjust the centre position of the pantograph with respect to the suspended contact by means of the 4 stud bolts 13, taking care that the suspended contact touches the contact strips 236 on both sides at the same time. If contact is not made simultaneously on both sides (pantograph is not properly aligned with the suspended contact), align the pantograph by means of stud bolts 13, so that contact touch between the contact strips 236 and contact tube 237, or auxiliary contact bars 303, takes place simultaneously on both sides. With the pantograph in CLOSED position, the pantograph's centre line must be in true alignment with the suspended contact.
- 7.4.12 Bolt cable clamps to the high-tension terminals 17 on gear box. Prior to this, clean aluminium surfaces in accordance with the treatment instructions of Section 11.
- 7.4.13 After closing the disconnecter, check and, if necessary, correct the vertical adjustment of the pantograph.
- The stop 292 (made of rubber) at the impact plate 355 (Figure 11) must not be painted or treated with a solvent or a paint thinner!
- 7.4.14 Care has to be taken that each disconnecter is properly earthed.

7.5 Installation of Suspended Contact

The suspended contacts are designed for connection to the line through rods or stranded conductors, depending on the layout of the installation. The design may differ significantly from one application to another.

7.5.1a **Standard design** (Fig. 9 A)

The factory's scope of supply includes the suspended contact 226, consisting of the silver-faced contact tube 391 with two aluminium contact clamps 392 with clamping covers (factory-mounted).

7.5.1b **Special version with AgNi inlay** (Fig. 9 B)

The factory's scope of supply includes the suspended contact 226, consisting of two main contact carriers 286 with contact strip 287 with AgNi inlay, and two aluminium contact clamps 392 with clamping covers (factory-mounted).

7.5.1c **Suspended commutation contact** (Fig. 9 B)

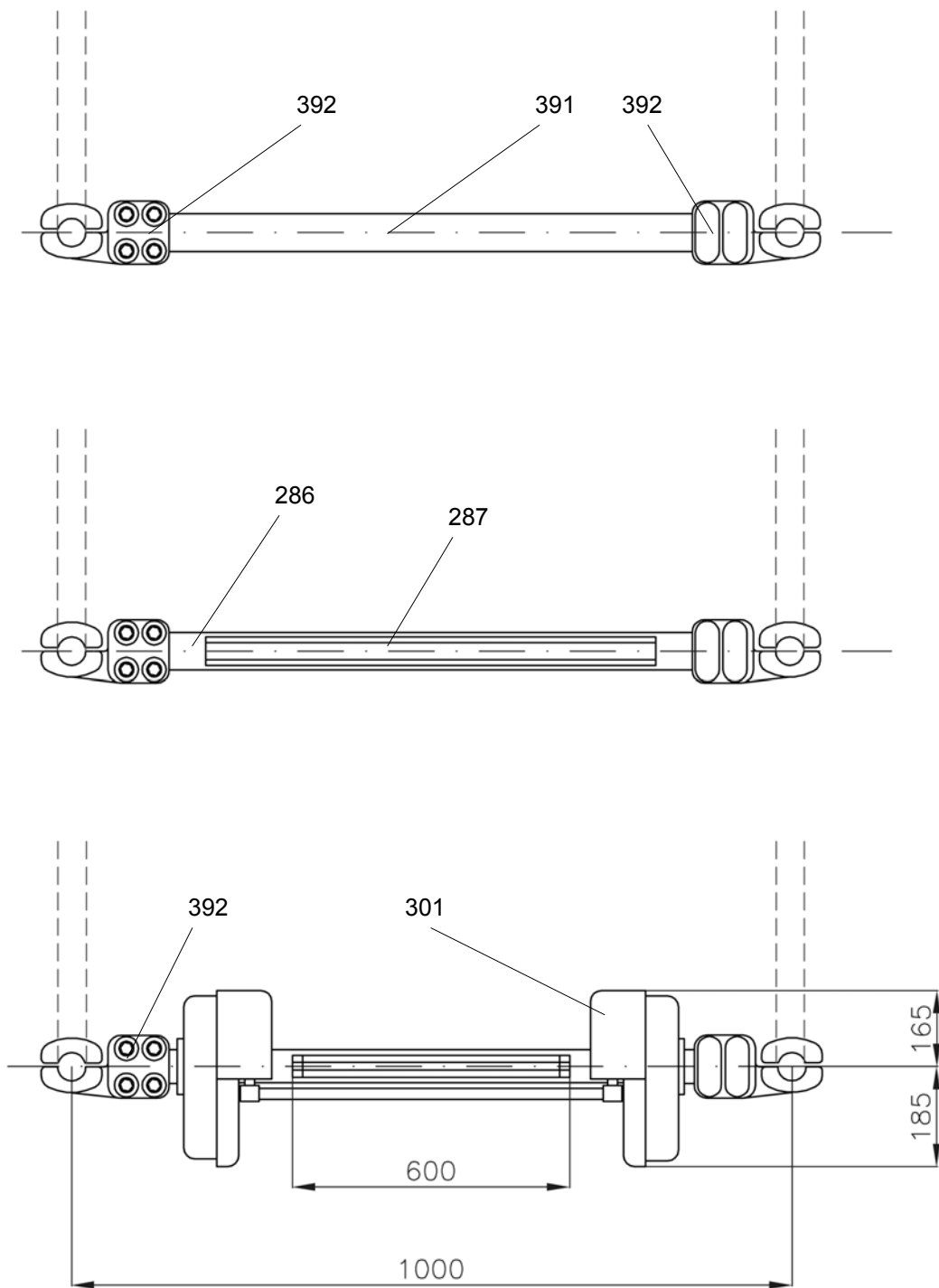
The factory's scope of supply includes the suspended commutation contact 301 (for construction, see instruction for commutation contact) as well as two aluminium contact clamps 392 with clamping covers (factory-mounted).

The clamps on the stranded-conductor busbar with the suspended aluminium bars 256 shall be furnished by the customer as installation material.

7.5.1.1 After treating all contact surfaces of the stranded-conductor busbar, clamps and suspended aluminum bars as specified in Section 11, mount the upper clamps with suspended aluminum bars 256 to the overhead busbar.

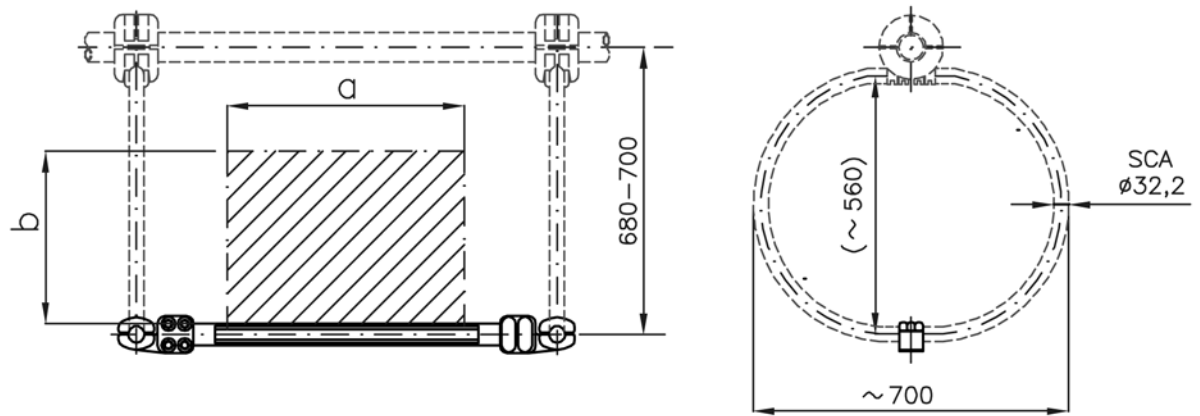
7.5.1.2 Remove clamping covers to install the suspended bars in clamps 392, treat the contact surfaces on clamps 392 and suspended bars 256 as specified in Section 11.

7.5.1.3 With the aid of the screws, attach the suspended contact to the suspended bars, adjusting the distance between the stranded conductor and the contact tube 391 as specified in the installation layout.

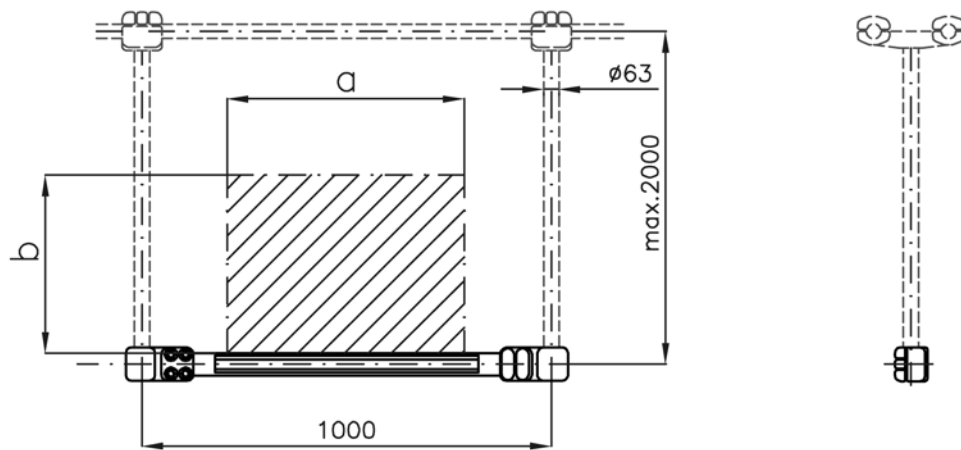


C Special commutation contact

Figure 6 Types of suspended contacts



A



B

Figure 7 Suspended contact for installation onto: A - tube conductors
B - stranded conductors

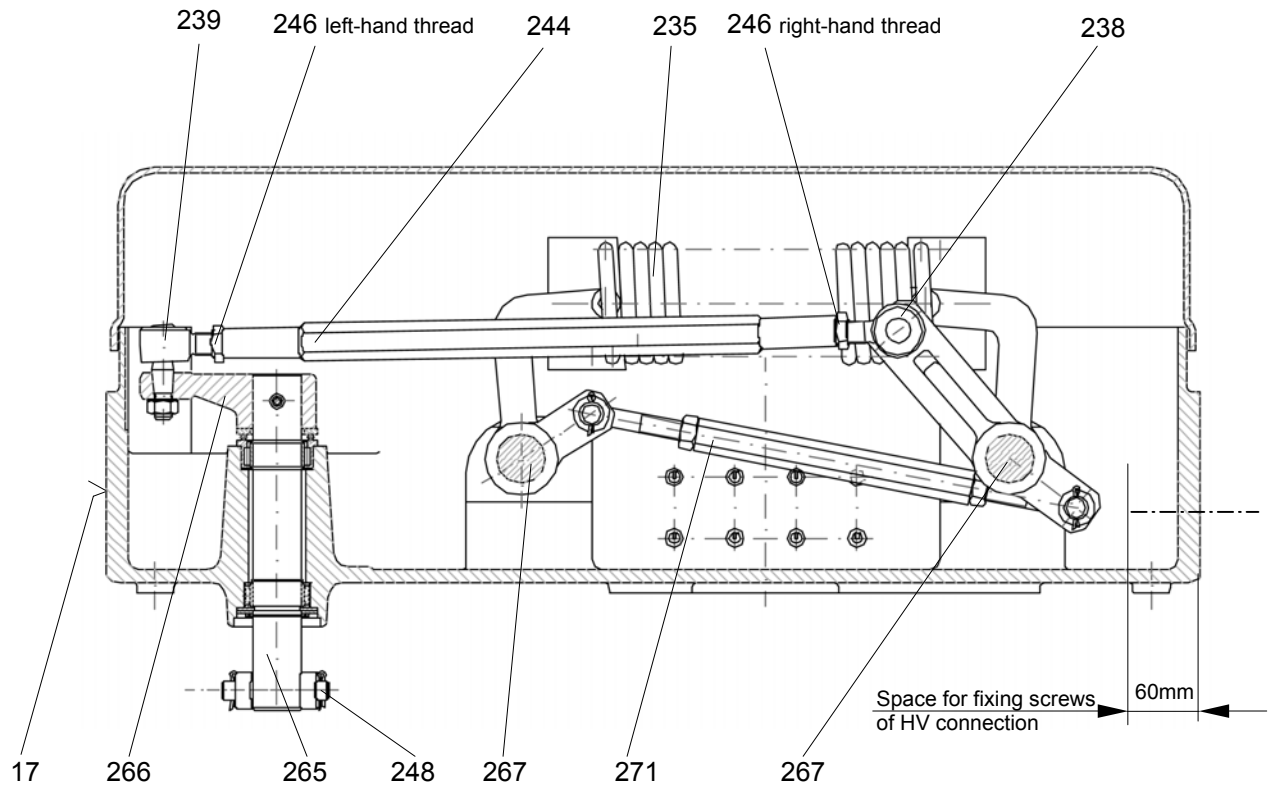


Figure 8 Gear box 224, sectional drawing: side view (switching position CLOSED)

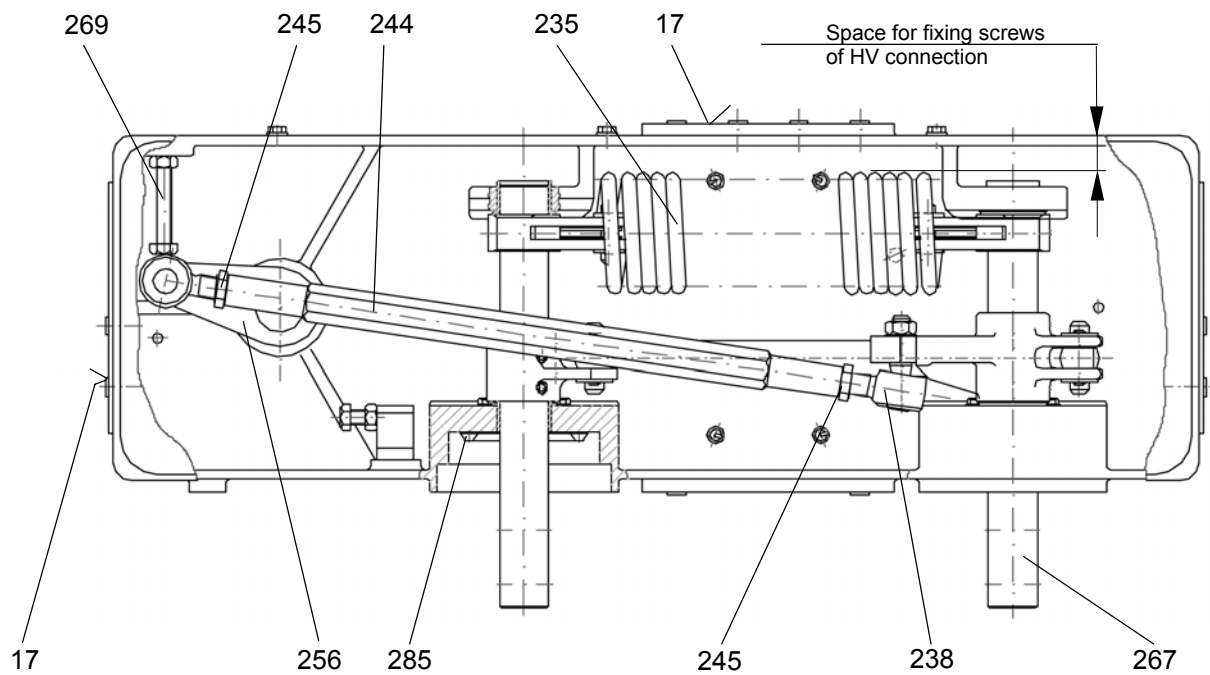


Figure 9 Gear box 224, sectional drawing: plan view (switching position CLOSED)

7.6 Installation of Motor-Operated Mechanism for Disconnecter

- 7.6.1 The motor-operated mechanism is completely adjusted in the factory. To avoid disturbances, the adjustment of the motor-operated mechanism may be changed by specialized personnel only.
- 7.6.2 Mount the bracket (410) with pivot bearing (409) to support structure.
- 7.6.3 Attach motor-operated mechanism (36) to the bracket. Operating mechanism and disconnecter must always have identical serial numbers (see nameplate).
- 7.6.4 Transfer the motor-operated mechanism and disconnecter to position OPEN.
(Note: When delivered, the motor-operated mechanism is in CLOSED position.)
- 7.6.5 Shorten operating shaft (43) by distance between operating pin (44) on pivot bearing (227) and pivot bearing (409) attached to bracket (401).
- 7.6.6 Paint the cut surface of the shortened operating shaft with the paint supplied to protect against corrosion. For details see Section 11.
- 7.6.7 Make sure that the operating shaft is in an exactly vertical position between the motor-operated mechanism and the opposite bearing; align the operating mechanism, if necessary!
- 7.6.8 Mount operating lever 401 on the coupling pin 40 of operating mechanism (36), and operating lever (405) on the shaft (43). For details see Fig. 10

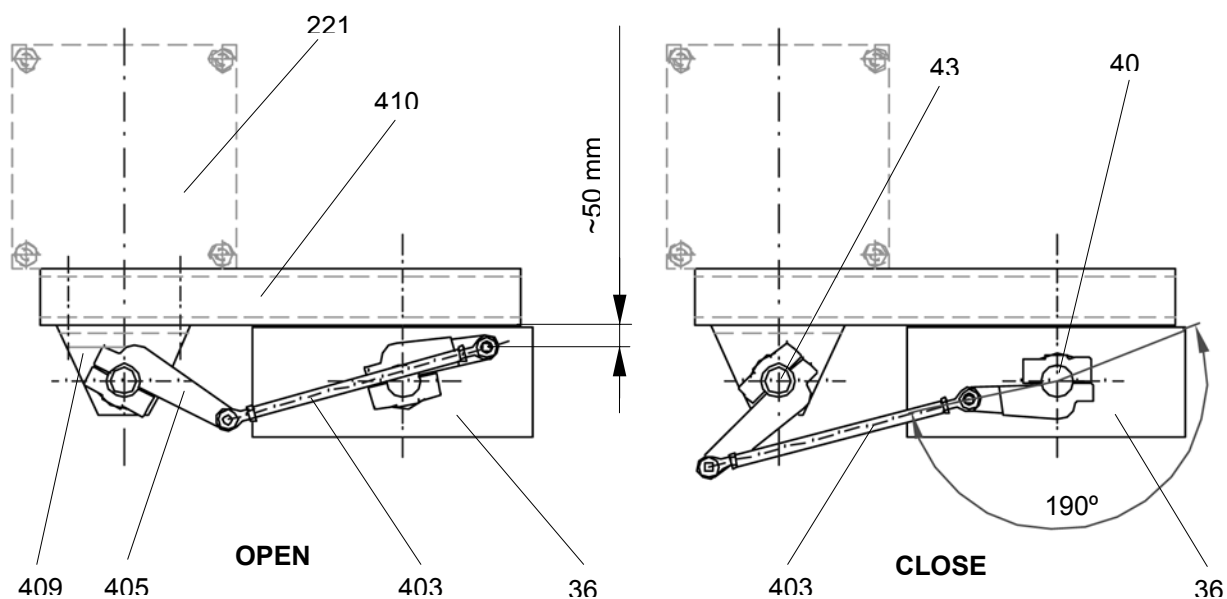


Figure 10 Mounting of operating mechanism for disconnecter, bracket of operating mechanism

- 7.6.9 If the disconnecter and the earthing switch are to be mechanically interlocked, install the appropriate interlocking components as specified in special amendment to the instruction.
- 7.6.10 Start closing the disconnecter by using hand crank 39 and check switching direction. Close disconnecter till stop 269 in the gear box 224 becomes effective. After passing the dead center position, ball joint 239 (installed on operating rod 244) will jump automatically against stop 269, clearly audible by a click.
- 7.6.11 Check that the operating mechanism has reached the end position too. If necessary, loosen clamping covers 334 and transfer operating mechanism correctly into the end position. Fix clamping covers again.
- 7.6.12 Mark position between coupling piece and operating shaft. Perform two manual switching tests with emergency crank 39. Check for perfect dead-center interlocking by the operating linkage 244 in the gear box (Figure 9).

Attention: *The transmission in the gear box will be exactly adjusted in our works and is marked with securing paint. Any re-adjustment afterwards will considerably influence functioning and the contact pressure of the apparatus. Re-adjustment may only be carried out by specialist technicians.*

- 7.6.13 Check the marking. Tighten the fixing bolts of the clamping covers, secure coupling piece 335 in place with locking screw and lock with counter-nut.
- 7.6.14 The operating mechanism is to be connected according to the plant layout. Detailed information is given in the Service Instructions for the associated operating mechanism.
- 7.6.15 To avoid condensation it is absolutely necessary to connect the heater. After installation the heater is to be commissioned immediately even if the associated disconnectors and earthing switches are not commissioned yet. The bags with desiccative serving to avoid corrosion during transport and storage are to be removed prior to commissioning of the heater.
- 7.7.11 Make sure that the filter insert of the ventilation gland in the motor housing is not plugged. If the units are painted, keep the filter insert free from paint.

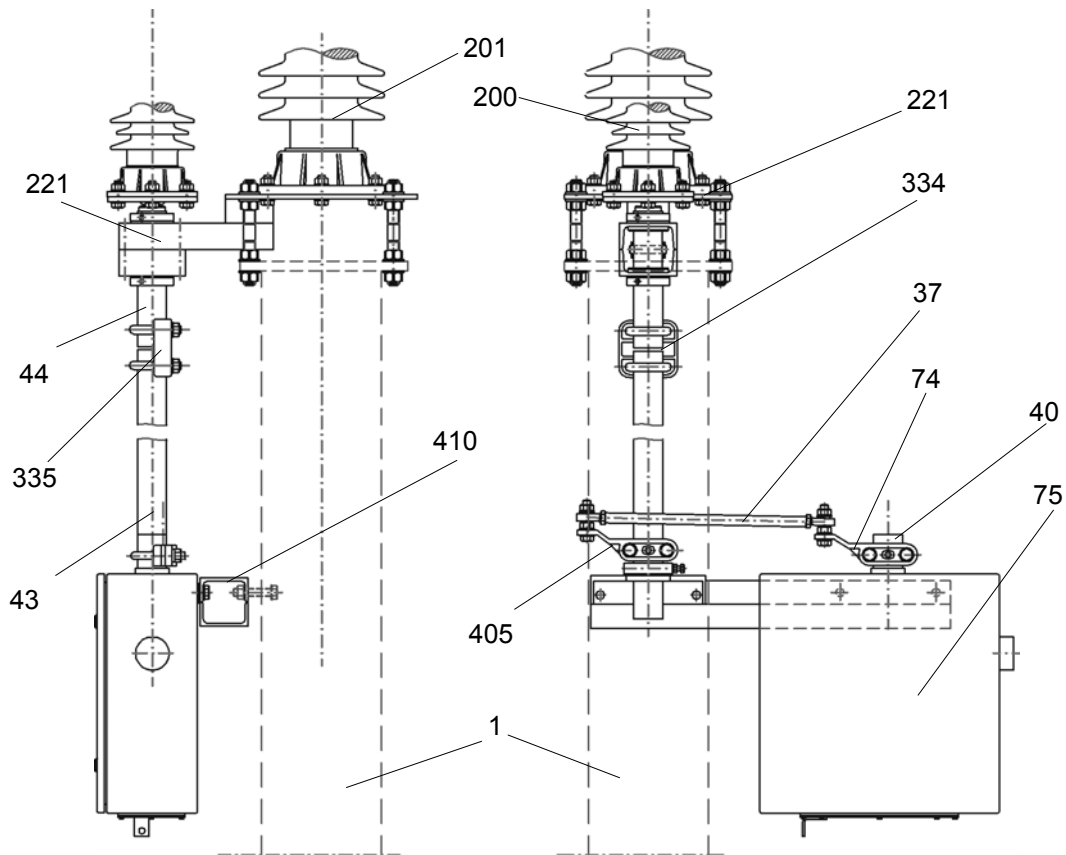


Figure 11 Mounting of operating mechanism for disconnector, operating shaft and pivot bearings, bracket for operating mechanism

7.7 Installation of the three poles of disconnector

Optionally three poles of disconnector can be operated by one mechanism. Operating mechanism can be installed in pole a, b or c.

For proper installation there is necessary to use dimension drawings delivered together with product, because each particular configuration can be different than presented in this instruction.

- 7.7.1 Install the first pole with operating mechanism according the points 7.4.1 to 7.4.12.
- 7.7.2 Install the next two poles (without operating mechanisms). Set three poles of disconnector in the open position.
- 7.7.3 Mount the coupling lever (413) on the operating shaft (43) of operating pole. The position of operating lever is shown on Fig. 10. The position of lever depends on proportion between pole distance "X" and "Y". In every case check the dimension drawing which concerns to installed equipment.
- 7.7.4 Mount the coupling levers (413) on the shafts of the next poles of disconnector group. Do not fix them finally.

- 7.7.5 Install coupling tubes between three poles of disconnector group. Length of coupling tubes are calculated according to pole distances (X and Y).
- 7.7.6 Connect the ends of coupling tubes 411 with coupling levers 413. If they do not fit, correct position of coupling levers. Tight the screws of coupling levers clamps.
- 7.7.7 Close there poles disconnector manually. Check if all three poles are fully closed. If necessary adjust the closing moment by regulation of coupling tubes 411 length. The ends of coupling tube are connected with right-hand thread on one end 412 and left-hand thread on the second. (Loose the fixing nuts at the ends 412 and turn the tube).
- 7.7.8 Fix all the nuts and screws of coupling levers and coupling tubes.
- 7.7.9 Make 3-5 open close operations and observe proper closing of pantograph arms.

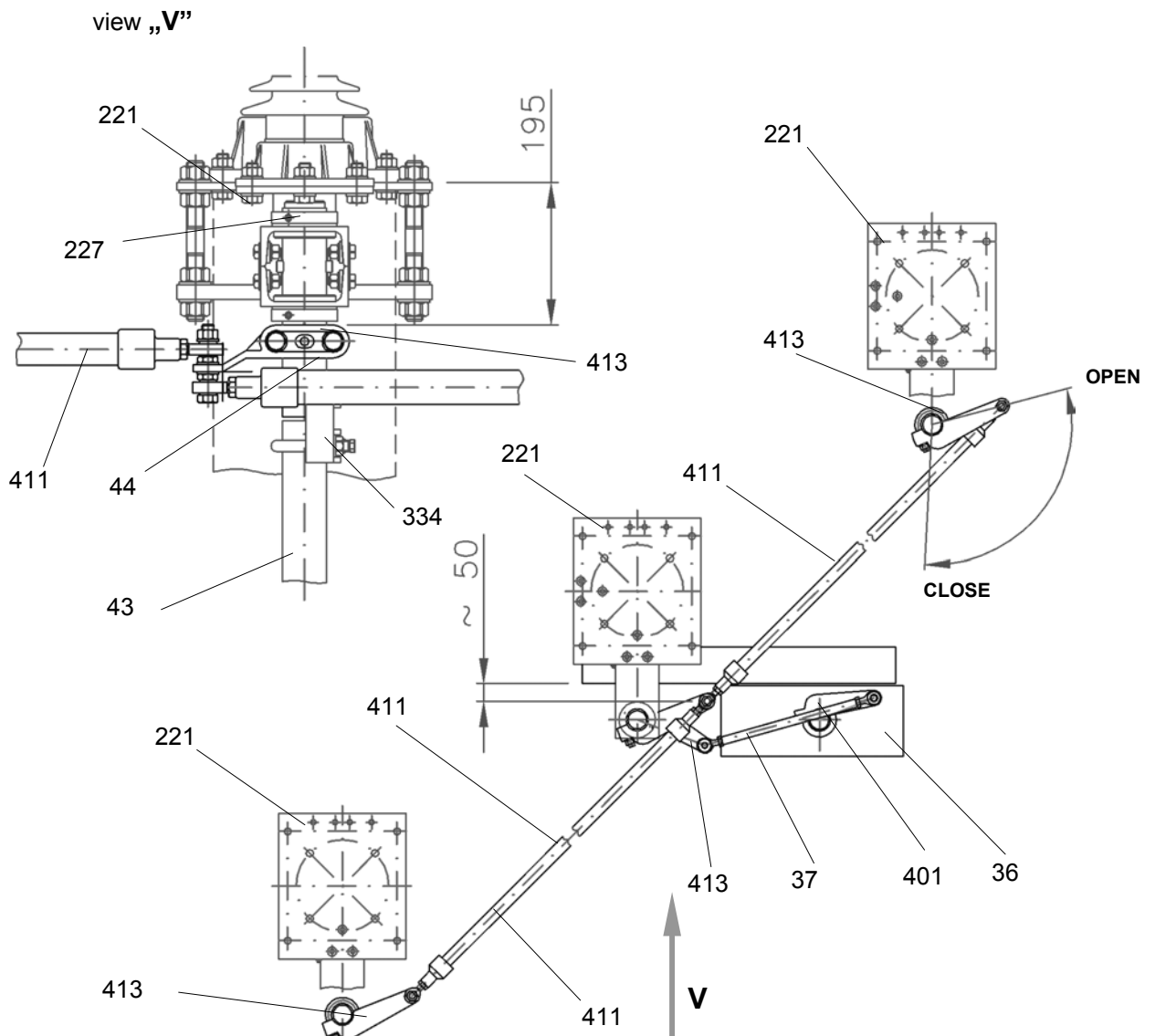


Figure 12 Three pole coupling , position of coupling levers (disconnecter in CLOSE position)



Figure 13 Three-pole coupling of disconnector. Position of coupling part (334)

8. Commissioning

Prior to commissioning check whether the disconnector and earthing switch function properly. Test and manual emergency operations on the motor-operated mechanism must be performed with the emergency crank 39 only. Do not use a power drill for this purpose.

In the case of the **disconnecter** check whether the operating lever 266 rests positively against stop screw 269 in switching position "CLOSED". Detailed information is given in Sections 7.5.10 to 7.7.11

Important! Diagonal rod 271 as well as operating rod 244 are exactly adjusted in the factory and marked with locking varnish. Any subsequent adjustment, will cause substantial changes in the unit's functioning; subsequent adjustments may only be carried out by specialized personnel.

Check the **operating mechanisms** as specified in the applicable operating instructions. With the mechanism in its end position, check for proper dead-centre position of the operating rods.

The switching time of the disconnector and earthing switch may vary over a wide range according to design, operating mechanism and external influences. For proper functioning it is not necessary to maintain a certain period of time. The switching time should be between 6 and 12

9. Maintenance

9.1 Disconnectors

Owing to the selection of the material used and in connection with a permanent lubrication the units are practically maintenance-free.

It is recommended to have an inspection carried out together with the inspection of the corresponding operating mechanism every 5 years of operations, at the latest, however, after 1,000 make and break operations. The inspection intervals mentioned above apply to normal ambient conditions. For extraordinary conditions (e. g. use in tropical climate or at excessively low temperature or heavy pollution) these intervals should be reduced by 50 %.

The following details should be observed during inspection:

- 9.1.1 Disconnect disconnecter; in the case of the operating mechanisms care should be taken that the heating circuit and control voltage of the blocking magnet are disconnected.
- 9.1.2 Observe IEC and the applicable national safety regulations.
- 9.1.3 Check contact strips 236 and contact tube 237, 391 or contact strip 287. Replacement is required if the silver facing of contact strips 236 or contact tubes is destroyed by pitting or mechanical wear, in the case of contact strip 287 if there are erosions of material to a depth of more than 1 mm. Details for replacement see Sections 9.3. In any case the clamping points of all contact elements which will be replaced by new ones have to be treated according to the instructions given in Section 11.

On disconnectors subject to icing, grease the pantograph tubes 242 and contact strips 236 (see Figure 12), and the suspended contacts (over their entire length between the clamps) all around with Mobil 28 Grease; thickness of grease layer: approx. 3 to 4 mm. In the case of suspended commutation contacts, the auxiliary contact bars 303 shall also be greased all around their circumference and over their entire length. .
- 9.1.5 As all the bearings of the disconnecter and earthing switch are supplied with a permanent lubrication, only a visual inspection of the bearings is required. If, against expectation, it is necessary to re-grease bearings of the earthing switch or joints of the operating rods use Mobilgrease 28
- 9.1.6 Check mechanical interlocks between disconnecter and earthing switch for easy movement. If necessary, clean the parts involved and spray all moving parts and contacting surfaces with lubricating varnish. .

On disconnectors subject to icing, grease the interlocking sleeves 385 all around with Mobil 28 Grease; thickness of grease layer: 3 to 4 mm. .
- 9.1.7 Check gear box 224 for inadmissible ingress of foreign bodies and moisture.
- 9.1.9 Check all screwed joints for tight fit. For admissible torques see table Section 12.
- 9.1.10 Clean insulators, if necessary, when an excessive amount of dirt has accumulated.
- 9.1.11 After the inspection carry out several test switching operations, checking the switching times, and reapply voltage to the heating circuit and blocking magnet.

9.2 Operating Mechanisms

Carry out maintenance of the operating mechanisms in accordance with the Service Instructions given for these units.

9.3 Replacement of Contact Strips 236 (Figure 12)

- 9.4.1 Switch pantograph to switching position OPEN.
- 9.4.2 Insert special holder 260 in tube 242 and push it onto nut 241.
- 9.4.3 Remove screw 240 and take out nut 241.
- 9.4.4 Clean zinc area on aluminium tube 242 and contact strip 236 in accordance with the treatment instructions of Section 11.
- 9.4.5 Insert special holder 260 with nut 241 into the tube and lock each fastening screw 240 with a nut. Tighten all screws equally (permissible torque: 7 Nm).

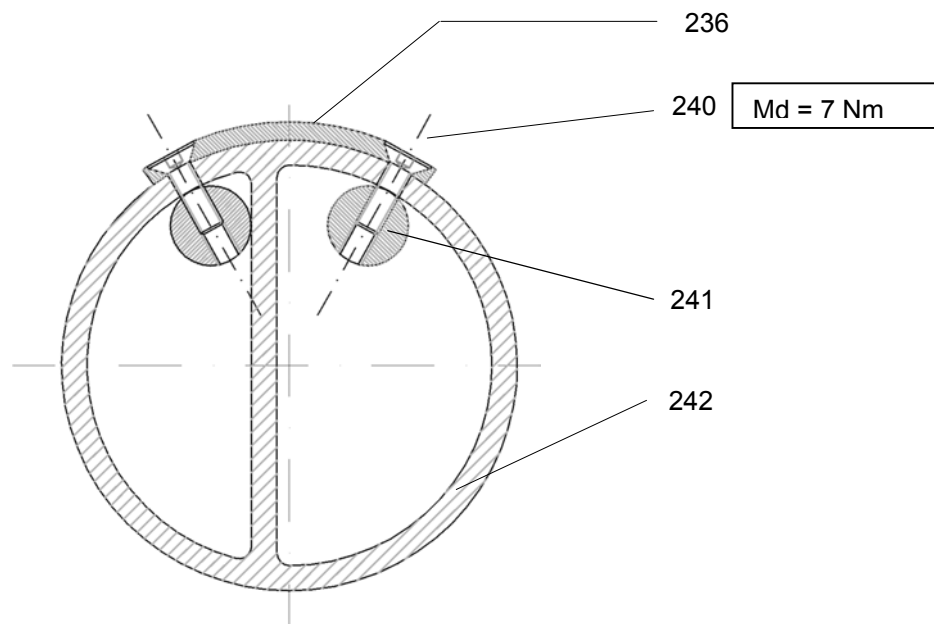


Figure 12 Replacement of contact strip 236

10. Spare Parts

It is recommended to keep a few of the following parts in stock so that in the case of any disturbance prolonged periods of interruption are avoided by rapidly replacing the defective parts.

When ordering spare parts, give the following details:

- Type and serial No. according to the rating plate of the specific unit,
- Designation of spare part, item No. and order No. according to these instructions.

Spare Parts

Spare parts for disconnectors	Item	Quantity on pole	Figure	Indent number
contact strip of pantograph	236	2	1; 10	GPDT 022291P0021 (refer to dimension drawing delivered with disconnector)
special nut for fastening contact strip	241	4	10	GPDT 02 2144 P0001
suspended contact tube	242	1	10	GPDT 02233P0007 (refer to dimension drawing delivered with disconnector)
grease Mobilgrease 28		450g	-	ZPL 0243001 P0020

11. Instructions for treatment of contact surfaces

The surface condition of the contact surfaces has a far greater influence on the contact resistance than their size or the contact pressure. Therefore, thorough treatment of the contact surfaces is necessary prior to screwing them together.

For treatment of aluminium, copper and galvanized contact surfaces separate tools must be used by all means.

11.1 Joining of Aluminium Contact Surfaces

Remove the oxide film with the aid of a steel wire brush (or a special tool, e.g. a slowly rotating brush, but no emery paper). It is advisable to slightly grease the contact surfaces prior to treatment. Subsequently remove the grease contaminated by the oxide film by means of a clean lint-free cloth. Immediately after the brushing operation apply another thin film of grease to the contact surface. After the brushing operation the surface must look mat grey, there must be no bright spots.

Because of the fact that a new film of oxide forms very quickly, one contact surface should be completely finished (brushed and greased) prior to treatment of the next surface. The contact surfaces thus finished should be screwed together immediately. After joining, cover the joint of the two contact surfaces with grease.

11.2 Joining of Silver-faced Contact Surfaces

Remove the grease from silver-faced contact surfaces and clean them without corroding the surface plating. Treatment with a cold cleaning agent and lint-free cloth is advisable. Apply a thin layer of grease to the contact surfaces and cover the joint of the two contact surfaces with grease.

11.3 Joining of Copper (as well as Silver-faced Copper) and Aluminium Contact Surfaces

When making a joint between copper or plated copper and aluminium surfaces for current transmission, it is important to insert a bimetal (copper-aluminium) plate to prevent the contact resistance from increasing in the course of time under the influence of the atmosphere, and burning-out of the joint. When installing the copper-plated aluminium sheets, make sure that its Cu side faces the copper surface and its Al side faces the aluminium surface. Aluminium-copper clamps may also be used for this purpose.

Treatment of the aluminium surface must be carried out in accordance with item 11.1.

Furthermore, for roughening the rolling skin the copper surfaces or the copper sides of the bimetal plate should also be brushed with a brass wire brush. Subsequently apply a thin layer of grease to the contact surfaces and cover the joint of the two contact surfaces with grease. For treatment of aluminium and copper contact surfaces separate tools must be used by all means.

Treatment of the silver-faced contact surfaces must be carried out in accordance with item 11.2.

11.4 Joining of Galvanized Contact Surfaces

Brush the galvanized contact surfaces with a steel wire brush. Subsequently apply a thin layer of grease to the contact surfaces and cover the joint of the two contact surfaces with grease.

11.5 Painting Cut Surfaces

Paint steel surfaces with cold zinc primer. If a different coat of paint was originally provided, allow zinc primer to dry and apply an additional coat of the original paint on top of the zinc primer. Touch up any areas where the original coat of paint has been damaged, following the same procedure.

Mixing proportion Paint : Hardener = 2 : 1

11.5 Joining of Galvanized and Aluminium Contact Surfaces

Treatment of the aluminium contact surfaces must be carried out in accordance with item 11.1, of the galvanized contact surfaces in accordance with item 11.4.

11.6 Greases to be Used:

Vaseline non-acid
Mobilgrease 28

Order No. ZPL 024 3001 P0020

11.7 Repeated Treatment

Whenever a connection is separated, the old grease has to be removed and treatment of the contact surfaces has to be repeated in accordance with these instructions.

12. Admissible Torques for Hexagon Screws and Hexagon Socket Head Cap Screws

The specified torques are standard values unless other torques are given in the service instructions.

Prior to mounting the screw thread has to be provided with a thin layer of grease.

Thread dimension (Φ mm)	Steel screws 8.8 (hot dip galvanized)	Stainless steel screws A2-70 or A4-70	Thread within light metal parts
M 6	-	7 Nm	5.5 Nm
M 8	-	16 Nm	14 Nm
M 10	42 Nm	33 Nm	26 Nm
M 12	72 Nm	56 Nm	45 Nm
M 16	174 Nm	122 Nm	100 Nm

13. List of Components

No.	Designation	
1	Foundation (by customer)	
13	Stud bolt	Base frame 221, 222
17	High-tension terminal	Gear box 224
36	Motor-operated mechanism MT 50/100	
40	Coupling pin	Motor-operated mechanism 36
43	Operating shaft	Operating mechanism
44	Operating pin	Pivot bearing 227, 229
46	Bolt	Operating pin 44
47	Fork	Operating shaft 43
48	Washer	Pivot bearing 229
49	Hexagon bush	Pivot bearing 227, 229
55	Manual operating mechanism HA 31-80	
56	Operating lever	Manual operating mechanism 55
115	Cotter pin 4x22	Bolt 46
124	Nut M10 + Washer	Axle 99
125	Threaded pin M6x16	Axle 99
126	Clamping sleeve 8x24	Axle 99
146	Composite sleeve 5x30/3x30	Mechanical interlocking, cap 386
147	Threaded pin M4x5	Mechanical interlocking, cap 386
148	Screw M10x30 + Nut + washer	Mech. interlocking, support plate 381,382
149	Clamping sleeve 5x70	Mech. interlocking, collar sleeve 380
150	Composite sleeve 10x80/6x80	Interlocking sleeve 385
151	Screw M12 + washer	Interlocking sleeve 385
200	Rotary insulator	
201	Support insulator	
218	Stop for tubular contact arm 23	Base frame 222
221	Base frame	
223	Top intermediate piece	
224	Gear box with pantograph 225	
225	Pantograph	
226	Suspended contact	
227	Pivot bearing of disconnecter	Base frame 221, 222
230	Coupling flange	Gear box 224, rotary insulator 200
233	Mounting bracket for gear box	
235	Counterbalance spring	Gear box 224
236	Contact strip	Upper pantograph arm 225
237	Contact tube	Suspended contact 226
238	Ball joint, right-hand thread	Operating rod 244
239	Ball joint, left-hand thread	Operating rod 244
240	Fastening screw	Contact strip 236
241	Special nut	Contact strip 236
242	Tube of pantograph	pantograph 225
244	Operating rod	Gear box 224
245	Counter-nut, right-hand thread	Operating rod 244
246	Counter-nut, left-hand thread	Operating rod 244
248	Carrier pin	Shaft 265
250	Corona protection fitting	Suspended contact 226
251	Cover	Clamping piece 252
252	Clamping piece	Suspended contact 226
253	Fastening screw	Contact tube 237
256	Suspended aluminium bar (by customer)	Suspended contact 226, 301
258	Stranded conductor ring (by customer)	Suspended contact 226, 301
260	Special holder	Change of contact strip 236
264	Top bearing	Gear box 224
265	Shaft	Top bearing 264

266	Operating lever	Top bearing 264
267	Shaft of pantograph	Gear box 224
268	Damper	Pantograph 225
269	Stop screw	Gear box 224
270	Corona protection hood	Toggle joint, pantograph 225
271	Diagonal rod	Gear box 224
285	Roller bearing with	Current transfer from gear box 224 to
286	Contact carrier or Main contact carrier	Suspended contact 226 with inlay, Suspended commutation contact 301
287	Contact strip with silver/AgNi inlay or Main contact bar	Contact carrier 286 Main contact carrier 286
288	Screw	Main contact carrier 286
290	Y-type clamp (by customer) for SCA conductor connection	Suspended contact > 125 kA
292	Stop (rubber)	Impact plate 255
300	Counter nut	Locking screw 247
301	Suspended commutation contact	
310	Sealing plate	Cover 302
311	Panel of switching chamber	Suspended commutation contact 301
320	Intermediate plate (bus bar carrier)	Top intermediate piece 223
320a	Distance plate	only when plate 320 is not ordered
322	Contact clamp for conductor ring connection	
334	Clamping cover	Coupling piece 335
335	Coupling piece	Operating mechanism 36, 55
355	Impact plate	Corona protection hood 234,
391	Contact tube	Suspended contact 226
392	Contact clamp for tube connection	Suspended contact 226
393	Corona protection fitting	Suspended contact 226
394	Hexagon fixing screw	Suspended contact 226
395	Hexagon nut	Hexagon fixing screw 394
396	Washer	Hexagon fixing screw 394
397	Distance spacer	Hexagon fixing screw 394
398	Hexagon fixing screw	Contact clamp for 322, 392
401	Operating lever of mechanism for disconnecter	
403	Operating rod of mechanism for disconnecter	
405	Operating lever of shaft for disconnecter	
410	Bracket for operating mechanism	
411	Coupling tube	
412	End of coupling tube	
413	Coupling lever	Operating shaft
818	Connection set GPDT 06 0004 R0059	Installation of operating mechanism
816 -	302 Screw with cone point M 10 x 35	
816 -	305 Screw M 16 x 110	
816 -	324 Nut M 16	
816 -	326 Nut M 10	
816 -	340 Washer A 17	
816 -	342 Washer A 10.5	

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Supplements to this instruction:

1. Earthing switch build on pantograph disconnecter
2. Special suspended contact for commutation currents

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