

## **Operating Instructions No. 2136 (EN)**

**Device:** Center-Break Disconnect  
**Type:** D  
**Rated Voltage:** 72.5 - 170 kV  
**Rated Normal Current:** 1250 A - 2000 A  
**Rated Short-Time Current:** 31.5 kA / 40 kA

**Manufacturer:** AREVA Energietechnik GmbH  
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**Note:** Please read the operating instructions carefully before beginning installation and commissioning.



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# 1 Technical Data

Type		D			
<b>Rated voltage</b>	kV	72.5	123	145	170
<b>Rated normal current</b>	A	1250/1600/2000			
<b>Rated short-time withstand current</b>	kA	31.5/40			
<b>Rated peak withstand current</b>	kA	80/100			
<b>Rated power frequency withstand voltage</b>					
- To earth and between poles	kV	140	230	275	325
- Across the isolating distance	kV	160	265	315	375
<b>Rated lightning impulse withstand voltage</b>					
- To earth and between poles	kV	325	550	650	750
- Across the isolating distance	kV	375	630	750	860
<b>Rated mechanical terminal load</b>					
- Static	N	1500			
- Static plus dynamic	N	4500			
<b>Ice load</b>					
- Class		0/10/20			
<b>Temperature range</b>					
- I	°C	-25/40			
- II	°C	-50/50			
<b>Contact pressure</b>	N	200 ± 25			
<b>Operating mechanism</b>		CMM motor-operated mechanism Manually operated mechanism			

For operating mechanism specifications, please refer to the operating instructions for the specific unit. Other values available on request.

## **2 Description**

### **2.1 General**

Center-break disconnectors can be used as single-pole or multipole units, in side-by-side or tandem configurations. Mounting on the wall or on the ceiling is also possible. These devices are designed for the straight loads and cross-loads listed in IEC 129, Table III.

Multipole center-break disconnectors require only one operating mechanism, which in the standard configuration is mounted on the middle pole (other mechanism configurations are also possible). Motor-operated mechanisms are preferable, but manually operated mechanisms can also be used, if requested. Operating mechanisms are described in separate operating instructions.

As an option, each disconnector pole can be equipped with one or two add-on earthing switches (grounding switches). Add-on earthing switches are installed and adjusted separately from the disconnector (see separate operating instructions). All center-break disconnectors can also be retrofitted with add-on earthing switches at a later time. The center-break disconnectors conform to the current editions of DIN VDE 0670:

- Part 1000 “Common Specifications for High Voltage Switchgear and Controlgear” (equivalent to IEC Publication 694)
- Part 2 “Alternating Current Disconnectors and Earthing Switches” (equivalent to IEC Publication 129)

This document and the equipment described herein are subject to change without notice in the interest of further development.

No claims may be derived from the specifications, figures, or descriptions.

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### **2.2 Design**

The main components of a disconnector pole are shown in Figures 1.1 and 1.2. Two rotary units (2) are mounted on a base frame (1). Post insulators (3) are mounted on the rotary units. They are moved by a disconnector operating mechanism (4) via the mechanism rocker arm (4.1), mechanism linkage (9) and diagonal linkage (10). The post insulators support contact heads (5.2) on which are mounted rotatable high voltage terminals (5.1) and the two arms of the main circuit (5). The main contact system (6) is attached to the ends of the main circuit arms. In disconnectors designed for the rated voltage of 170 kV, the main contact system also has corona shields (7).

#### **Base Frame**

The hot-dip galvanized base frame of a disconnector pole consists of two U sections with welded-in connecting elements.

## **Rotary Units**

The rotary units consist of a housing and a rotatable flange mounted on two ball bearings. The bearings are prelubricated (greased for life) and protected against water and dust penetration, which guarantees that they will move easily under all operating conditions. In the center of the bottom of the housing is a drain hole for condensation drainage. Wall-mounted disconnectors are provided with additional drain holes.

Each rotary unit has four adjustable studs for easy adjustment of the rotary unit on the base frame.

The following elements are mounted on the rotary flanges:

- post insulators (3),
- locking plate that functions as a mechanical interlock between disconnector and earthing switch (optional),
- operating lever (9.1), diagonal linkage lever (10.1) and connecting linkage lever (11.1).

## **Operating Linkages**

### **Mechanism Linkage (9)**

This linkage connects the operating mechanism to the operating lever (9.1) that is mounted on the rotary unit of the directly operated pole. The mechanism rocker arm (4.1) that is mounted on the operating mechanism is equipped with an eccentric bushing that is used to adjust the rocker arm radius.

### **Diagonal Linkage (10)**

This linkage connects the diagonal linkage levers (10.1) of the two rotary units of a disconnector pole.

The factory setting must not be changed.

### **Connecting Linkage (11)**

In multipole disconnectors with group drive, this linkage transmits the operating motion from the directly operated pole to the other poles.

### **Post Insulators (3)**

The post insulators (support porcelains) are dimensioned for operating requirements with respect to overall height, creepage path, and specified failing load.

Referenced standards:

- IEC Publication 273 or VDE 0674, Part 4
- IEC Publication 815

### **Main Circuit**

The two-part main circuit (5) consists of U-shaped aluminum section with an integrated main contact (6), contact heads (5.2), and high voltage terminals (5.1).

### **Main Contact System**

The main contact system (Figure 2) consists of a contact tip (14) that protrudes beyond the end of one half of the main circuit and a fixed contact that is mounted on the end of the other half of the main circuit. The contact fingers (15) of the fixed contact are mounted in pairs, one above the other, inside the U-section of the main circuit and are therefore largely protected from environmental influences. The number of contact finger pairs varies with the rated current-carrying capacity and the short-circuit current. The contact force is already factory-set by means of contact springs (16).

Contact parts in maintenance-free contact systems (optional) are marked with a permanent blue stripe for easy identification.

### **Contact Heads**

The contact heads (5.2) with rotatable high voltage terminals (5.1) form a movable, current-carrying connection to the main circuit (5). The high voltage line can be connected to either flat-type or bolt-type screw terminals.

### **Operating Mechanisms**

Motor-operated mechanisms, if provided, are mounted either in lowered position or on the base frame of the disconnecter. Motor-operated mechanisms are described in separate operating instructions.

## **2.3 Method of Operation**

For the following description of the principle of operation, please refer also to Figures 1.1, 1.2 and 2. When the operating mechanism is actuated, the rotary movement of the operating shaft is transmitted to one rotary unit (2) of the operated pole by the mechanism rocker arm (4.1), the mechanism linkage (9) and the operating lever (9.1). The diagonal linkage (10) between the rotary units of a pole brings about a contra-rotating movement of the second rotary unit, thus ensuring simultaneous movement of the two halves of the main circuit (5). In multipole disconnectors, the rotary motion is transmitted by the connecting linkages (11.2 and 11.3) to the other poles.

When the contact tip (14) enters the fixed contact and the contact fingers (15) are spread apart, the required contact force is built up by the individual contact springs (16). A self-cleaning effect occurs during both closing and opening of the contact system. Dirt deposits and coatings of ice are removed.

The angle of rotation of the mechanism rocker arm (4.1) is 192°. Thus the mechanism linkage moves beyond the dead-center point to reach the two end positions and locks the disconnecter mechanically against the effects of external forces.

## **2.4 Special Options**

- Mechanical interlock between disconnecter and earthing switch
- Mounting on wall or ceiling
- Corona shields for increased RIV requirements

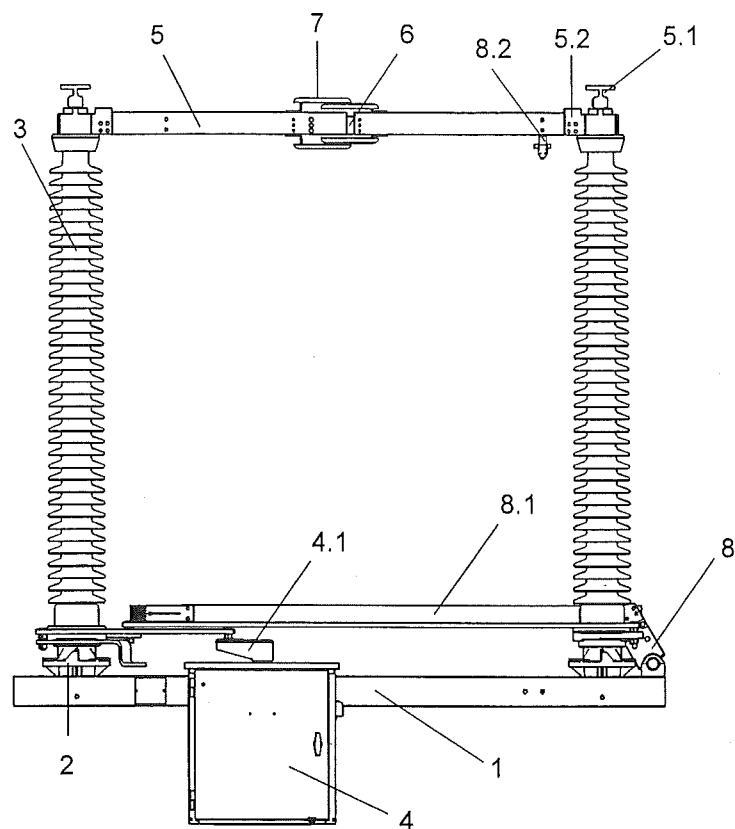


Fig. 1.1 a: Main components (I) with operating mechanism on base frame

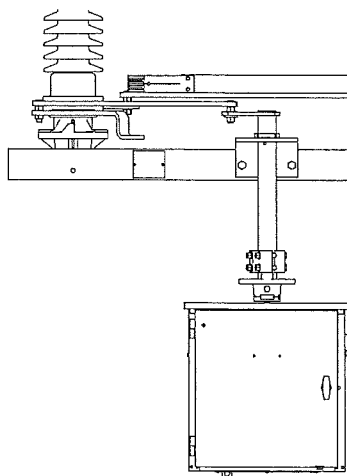
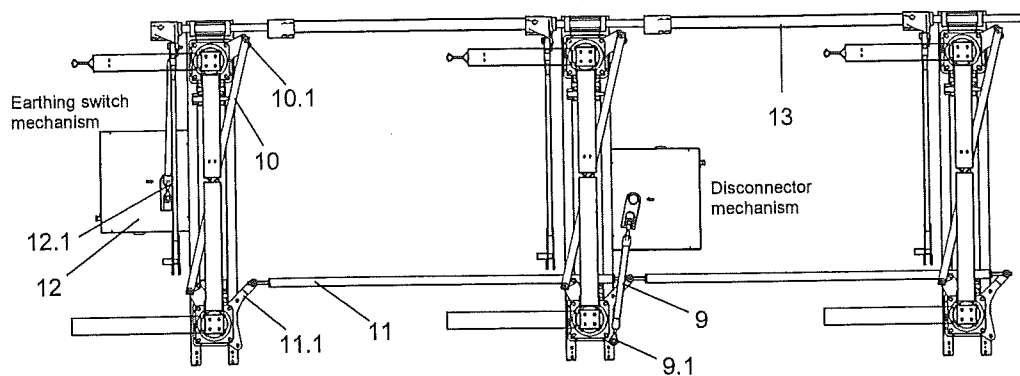


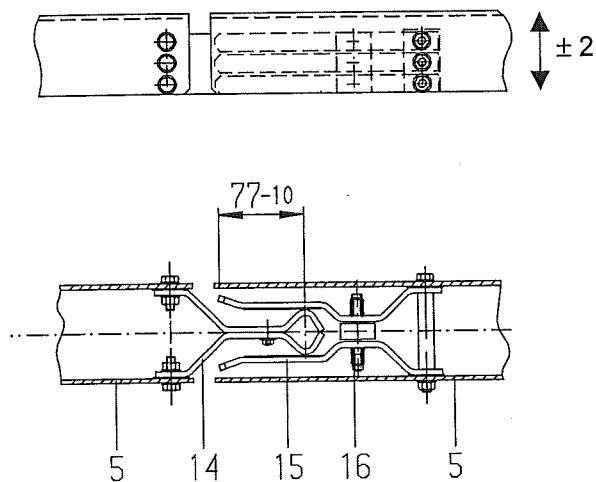
Fig. 1.1 b: Lowered operating mechanism

1	Base frame	5.2	Contact head
2	Rotary unit	6	Main contact
3	Post insulator	7	Corona shielding
4	Operating mechanism	8	Add-on earthing switch
4.1	Mechanism rocker arm	8.1	Main circuit of earthing switch
5	Main circuit	8.2	Fixed contact of earthing switch
5.1	High voltage terminals		



- |      |                                    |      |   |
|------|------------------------------------|------|---|
| 9    | Mechanism linkage                  | 11.1 | Connecting linkage lever                      |
| 9.1  | Operating lever                    | 12   | Operating mechanism of add-on earthing switch |
| 10   | Diagonal linkage                   | 12.1 | Mechanism rocker arm                          |
| 10.1 | Diagonal linkage lever             | 13   | Connecting linkage of add-on earthing switch  |
| 11   | Connecting linkage of disconnecter |      |   |

Fig. 1.2: Main components (II)



- |    |              |    |                 |
|----|--------------|----|-----------------|
| 5  | Main circuit | 15 | Contact finger  |
| 14 | Contact tip  | 16 | Contact springs |

Fig. 2: Main contact system

### **3 Transport and Storage**

#### **3.1 Packaging**

For shipping purposes, center-break disconnectors are broken down into the following subassemblies, which are easier to transport:

- Completely assembled and adjusted single-pole center-break disconnector with one or two add-on earthing switches, not including operating mechanisms. Each pole is securely bolted to two square timbers to prevent tilting or tipping. The units are shipped in slightly open position. A transport lock is used to secure the main circuit.
- Operating mechanisms
- Connecting linkages
- Special options + accessories

Packaging consists of timber beams, crates, or boxes. Operating mechanisms are shipped on pallets wrapped in sheeting. The number, dimensions, and weights of the packing units are given in the shipping documents. The manufacturer may select special types of packaging depending on the shipping route and the climatic conditions of the specific regions through which or to which the equipment will be shipped.

#### **3.2 Transport and Handling**

- Packing units must be transported to the site as intact packages.
- Secure the packing units to prevent tilting and shifting when loading them onto vehicles or other means of transport.
- Always use hemp or synthetic rope for hoisting the disconnector poles. The use of steel cable is prohibited since it may damage anticorrosive coatings and porcelain insulators.
- Please use the rope configurations shown in Figure 3 for hoisting and moving the post insulators when they are in the following positions:
  - horizontal position: around the studs of the rotary unit and between the 3rd and 4th shed of the upper end of the post insulator
  - vertical position: around the studs of the rotary unit
- Check shipments against the shipping documents to make sure shipments are complete and to determine if there is any shipping damage. Notify both the freight carrier or forwarder and the manufacturer if there is any visible damage.
- Comply with the instruction and warning labels on the packaging.

#### **3.3 Storage**

The operating mechanisms are delivered in separate transport units. They require special storage conditions. Always follow the instructions given in the mechanism operating manuals.

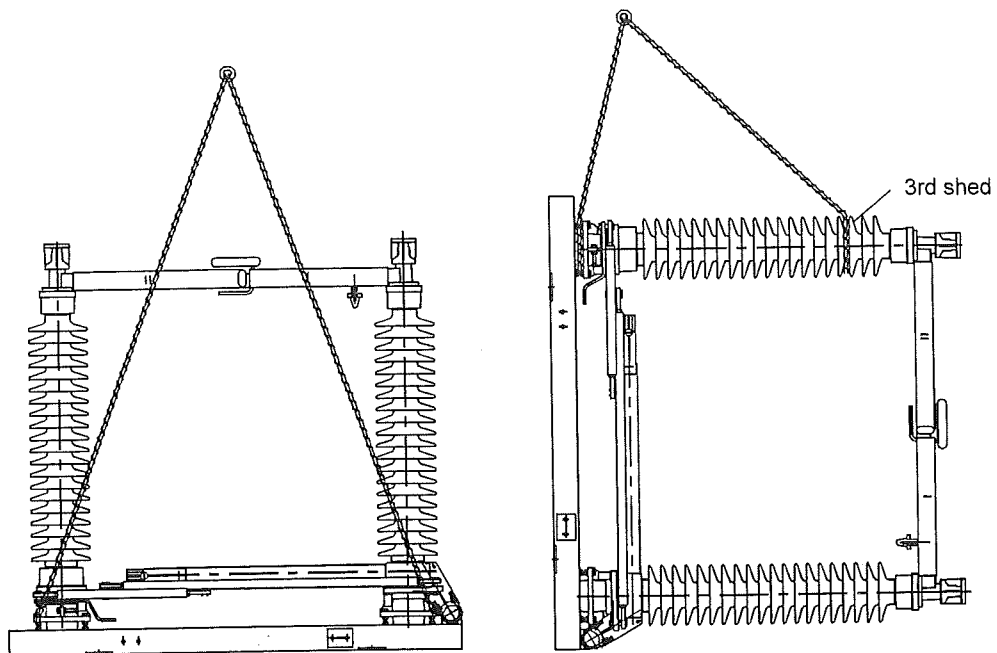


Fig. 3: Transport and handling

## 4 Installation

### 4.1 General Instructions

Only personnel familiar with the contents of these operating instructions shall be permitted to assemble and install this equipment.

The disconnecter poles – with add-on earthing switches, if applicable, – have been assembled and adjusted at the factory. On-site installation involves the following main steps:

- Installing the poles
- Mounting the operating mechanisms
- Connecting the mechanism linkages to the operating mechanisms and making adjustments
- Connecting and adjusting the connecting linkages between poles

The disconnecter serial number is shown on the nameplates. Disconnector nameplates are located on the base frame for the poles. The nameplates of the motor-operated mechanisms are inside the mechanism covers.

### 4.2 Bolted Joints

Lubricate bolted joints with Molykote BR 2 Plus, a lubricating grease, before assembly. Apply it to the thread flanks and to the contact surfaces between nut and washer. Tighten all bolted joints using a torque wrench. Always apply torque to the nut. The required tightening torques are given in the following table.

Thread	Tightening Torque in Nm		
	Strength Class		
	8.8	A2-70	A2-80
<b>M 6</b>	10	10	14
<b>M 8</b>	25	25	33
<b>M 10</b>	49	49	65
<b>M 12</b>	86	83	110
<b>M 14 x 1.5</b>	---	140	---
<b>M 16</b>	210	202	270
<b>M 20</b>	410	394	525
<b>M 24</b>	710	377	---

### 4.3 Instructions Regarding the Base Frame

The holes in the base frame are used for the following purposes (Figure 4):

- (17): Inserting the studs for mounting the rotary units
- (18): Mounting the bearing blocks for earthing switch shafts
- (19): Mounting the operating mechanisms for disconnector and add-on earthing switch, if included
- (20): Earth (ground) connections
- (21): Nameplate
- (22): Mounting the base frame on the support structure

### 4.4 Installing the Disconnector Poles

- Remove the shipping packaging.
- Remove transport locks (Figure 5).
- Clean the main contact system and lubricate it with Molykote BR 2 Plus, a lubricating grease.
- Close the disconnector poles.
- Place the poles on the support structure and make sure the operated pole is in the correct position.
- Align the base frame:
  - Equal distance between poles
  - Parallel alignment for side-by-side configuration, maximum deviation from parallelism 3 mm
  - In line for tandem configuration, maximum lateral deviation 3 mm
  - Top surface of base frame must be level, maximum height deviation 3 mm (2 mm maximum for rated voltage of 72.5 kV). Use shims, if necessary.
- Fasten the base frame to the support structure using bolts, washers and nuts and re-check the adjustment of adjacent poles. The fasteners are not supplied with the equipment.

## 4.5 Mounting the Operating Mechanism

### Mounting the Mechanism on the Base Frame

- Match up the operating mechanism with the corresponding operating pole as shown in the dimension drawing.
- Mount the operating mechanism in the three holes (19) in the base frame that are provided for this purpose. Make sure that the plane of movement of the mechanism rocker arm is parallel to the plane of the base frame. Adjust the position of the operating mechanism by using shims, if necessary.

### Mounting the Mechanism in Lowered Position (Figure 6)

The standard option for mounting an operating mechanism in lowered position below the base frame is shown in Figure 6 and applies both to motor-operated and manually operated mechanisms:

- Fasten the bracket (30) to the holes (19) in the base frame (1). This bracket supports the bearing for the extension of the operating shaft.
- Fasten the operating mechanism to its support structure (not supplied with the equipment).

<b>Note</b>
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In order to mount the mechanism in lowered position, the mechanism tube must be shortened to the proper length. Surface protection (cold galvanizing) must then be applied to the cut face of the tube.

- Move the operating mechanism to closed position. Then turn the tube until the mechanism rocker arm (4.1) is also in closed position. Before the mechanism tube can be connected to the operating mechanism, the thrust bearing must be fitted onto the mechanism tube from below in the following sequence:
  - Thrust washer
  - Thrust bearing ring
- Connect the mechanism tube (25) to the operating mechanism by means of the mechanism coupling (26).
- Tighten the bolts to the specified torque. Make sure to follow the alignment dimensions given in Figure 6. It may be necessary to utilize the clearance in the holes for fastening the bracket (30) to the base frame (1).
- Make sure that the axes of the operating shaft (27) and the mechanism tube are aligned and at right angles to the upper surface of the base frame. If necessary, adjust the position of the operating mechanism by inserting shims.

## 4.6 Operating Linkages

As-delivered assembly condition:

- The mechanism linkage (9) of the disconnecter is mounted on the operating lever (9.1).
- The diagonal linkages (10) have been factory-assembled and pre-adjusted. **This setting must not be changed.**
- The connecting linkages (11) to be installed between the poles of multipole disconnectors are packaged separately.

## 4.7 Adjusting the Mechanism Linkages

Adjustment of the mechanism linkages (Figures 7 and 8) ensures that the end positions (closed or open) of both halves of the main circuit on the operated pole are reached exactly and that dead-center interlocking occurs in both end positions. This is done by adjusting an eccentric bushing (31) in the mechanism rocker arm (4.1).

The following adjustment instructions apply both to motor-operated mechanisms mounted on the base frame and to motor-operated or manually operated mechanisms mounted in lowered position below the base frame.

### Note

When the operating mechanism is mounted in lowered position, there is only one half of an eccentric bushing (Figure 7 b).

To adjust, loosen the bottom nut until the eccentric bushing can be turned (adjust as for the operating mechanism mounted directly on the base frame).

Tighten the bottom nut to the proper torque. Hold the top nut steady using an open-end wrench.

Figure 7 shows a side view of the area where the mechanism linkage is connected to the mechanism rocker arm (4.1), and Figure 8 shows a top view of the same area.

Carry out the following steps:

- Move the operated disconnecter pole to closed position. Note: The mechanism rocker arm (4.1) on the operating mechanism will be in closed position when delivered.
- Insert the bolt (33) mounted on the mechanism linkage (9) and the eccentric bushing (31, Figures 7 and 8), into the mechanism rocker arm (4.1) by unscrewing the two hexagon nuts (32). Make sure that the eccentric bushing is turned 45° from the longitudinal axis of the mechanism rocker arm (see Figure 8) and that the mechanism linkage is parallel to the base frame. If necessary, readjust the operating mechanism in the holes in the base frame (19).
- By manually actuating the operating mechanism, check to see whether the respective stops on the housing of the rotary unit are reached in both closed and open positions.
- If the stops are not reached, proceed as follows:
  - Adjust the eccentric bushings so that the aperture angle of the main circuit arms will be 90° when the stop is reached in open position.

Both eccentric bushing halves must be adjusted by the same angle. Do this by loosening the nut on the bolt until the eccentric bushing half located under the mechanism rocker arm moves easily. If you encounter problems, remove the lower half of the eccentric bushing completely, re-insert it in the same position as the upper half after adjustment, and tighten the nut on the bolt.

When the alignment dimensions are followed, the longitudinal axis (4.11) of the mechanism rocker arm (4.1) and the longitudinal axis of the mechanism linkage (9) will intersect in closed position, as shown in Figure 8. This creates a dead-center interlock that prevents external forces from changing the operating position.

#### 4.8 Mounting the Thrust Bearing

- Push the thrust bearing ring and thrust washer up against the bracket until the position shown in Figure 6 is reached.
- Tighten the setscrew on one side slightly so that so that the thrust bearing ring can no longer slide.
- Using a 7.2-diameter drill bit, drill a hole through the opposite side into the mechanism tube.
- Insert the setscrew and tighten it slightly (until the point engages in the drilled hole).
- Drill a hole in the opposite side.
- Then connect the thrust bearing to the setscrews and mechanism tube.

<b>Note</b>
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Tightening torque of setscrews: 10 Nm. Lock the screws with Loctite blue (locking adhesive). Apply surface protection to drilled holes before final assembly.

#### 4.9 Connecting the Disconnecter Poles

Figure 9 shows a completely assembled connecting linkage.

- Move all poles to the closed position.
- Unscrew the hexagon nut (32) from the bolt (33).
- Screw the pre-assembled connecting linkages (11.2 and 11.3) to the double eye-bolt (34).
- Pre-set the length of the connecting linkage (for center-to-center distance between poles see the documentation supplied with the equipment).
- Insert the joined connecting linkages and bolts into the hole in the connecting linkage levers (11.1) and tighten using a hexagon nut (32).
- Check to make sure the stops bear against the stop bolts on all poles. If this is not the case, adjust the length of the connecting linkage by turning the tube until the stop elements are in contact and then tighten the lock nuts.

#### 4.10 Adjusting the Post Insulators and Main Contact

The post insulators and the main circuits are factory-adjusted to conform to the alignment dimension specified in Figure 2 and so that the main circuits are in alignment. However, the adjustment of the post insulators should be checked and corrected, if necessary – particularly after attaching cables.

If the tensile cable load is applied transversely, proceed as follows:

- Unscrew the two lateral stop screws on each rotary unit (2).
- On the side of the rotary unit opposite the tensile load, loosen the two nuts of the stud joint above the base frame by one turn.
- Tighten the loosened studs again by tightening the nuts below the base frame.
- Move the lateral stop screws until they again bear against the housing of the rotary unit.
- Operate the disconnecter manually and check for proper lead-in (making movement) of the main contacts, as shown in Figure 2.
- Re-adjust the post insulators again, if necessary.
- Check to make sure that all poles reach the stop elements on the housings of the rotary units when operated. If necessary, repeat the adjustment procedure described in Section 4.7 above.

If the tensile cable load is applied in the longitudinal direction, re-adjust by changing the inclination of the rotary units with respect to the base frame in the direction of the tensile load, as described for transverse cable loads. Make sure to comply with the alignment dimensions given in Figure 2. As a final step, readjust the stop screws.

In disconnectors rated for 170 kV, there is a catch attached to the main contact. The alignment dimensions given in Figure 2 apply here as well, regardless of the catch.

#### 4.11 Completing Installation

- Check to make sure that all bolted joints have been tightened to the required tightening torques (see Section 4.2) during installation and adjustment.
- Before final connection of the high voltage lines, brush all aluminum terminal faces and then immediately apply a thin coating of SF 1377 silicone grease and connect the lines.
- Connect the earth (ground) conductors after first cleaning and lubricating the terminal faces.
- Connect the control and supply voltages to the mechanism terminal strips.
- Check all electrical functions.
- Touch up any surface finish damage that might have occurred during installation. Use the paint supplied with the equipment.
- Perform several test operations manually in order to check the movement sequences.

**Do not operate the control contactors of motor-operated mechanisms manually.**

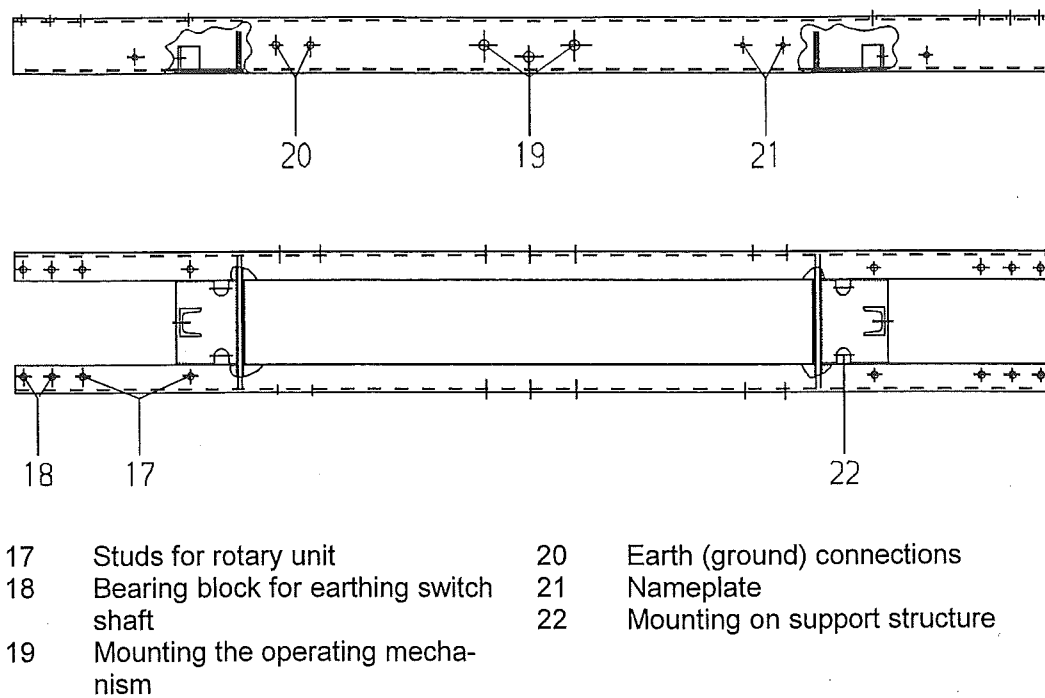
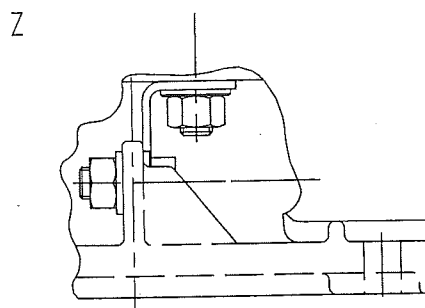
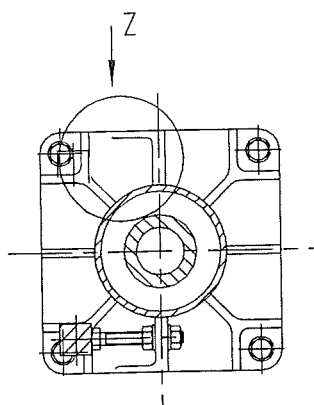
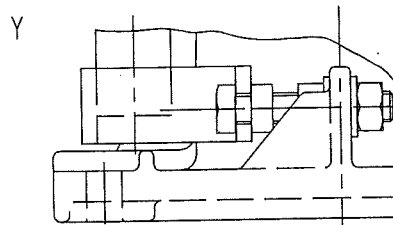
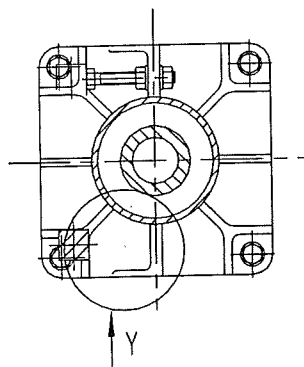


Fig. 4: Purpose of the holes in the base frame

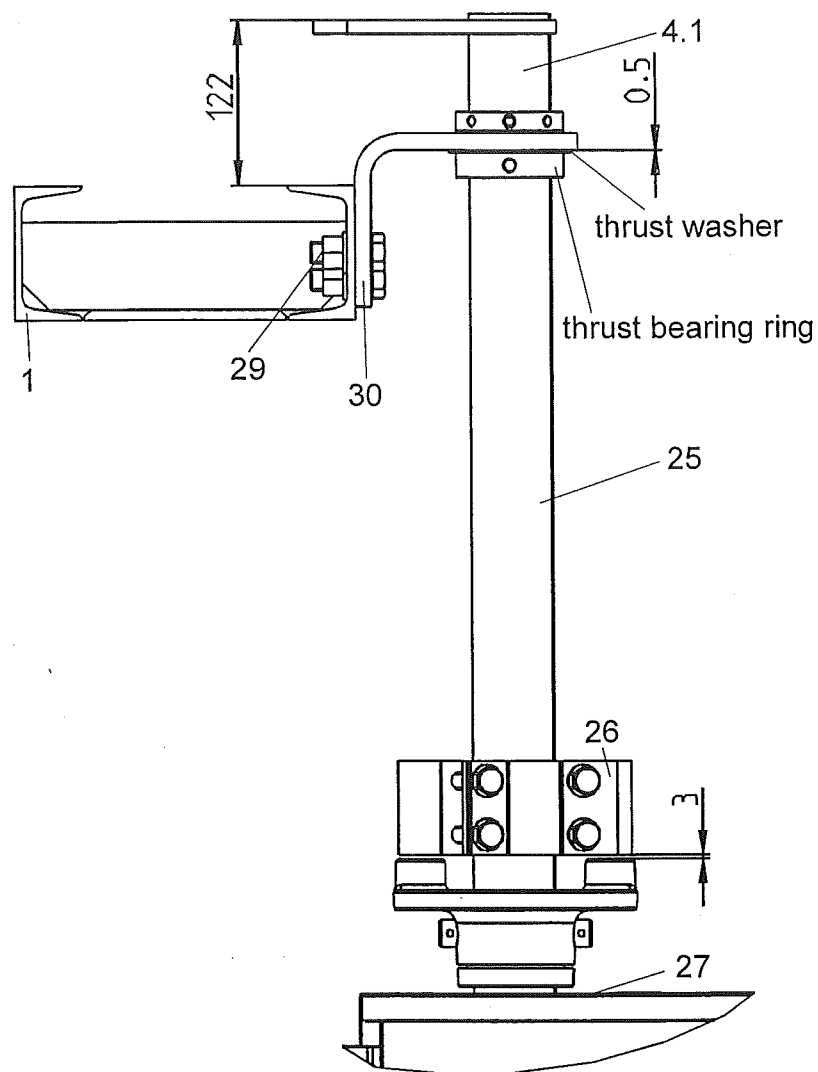


Installing the transport lock with disconnecter in open position



Installing the transport lock with disconnecter in closed position

Fig. 5: Installing the transport lock



1	Base frame	27	Operating shaft
4.1	Mechanism rocker arm	29	M16x45 hexagon bolts (with washers and hexagon nuts)
25	Tube	30	Bracket
26	Mechanism coupling (with hexa- gon nuts and clamping members)		

Fig. 6: Mounting a lowered operating mechanism (motor-operated or manually operated mechanism)

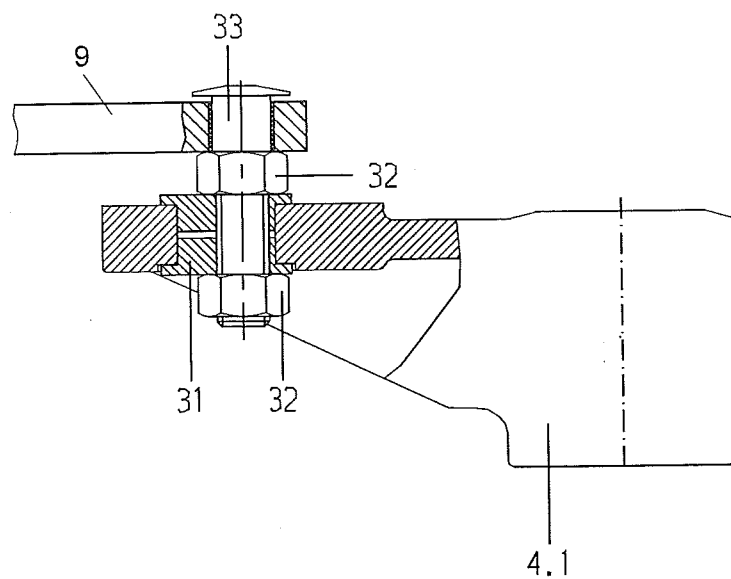
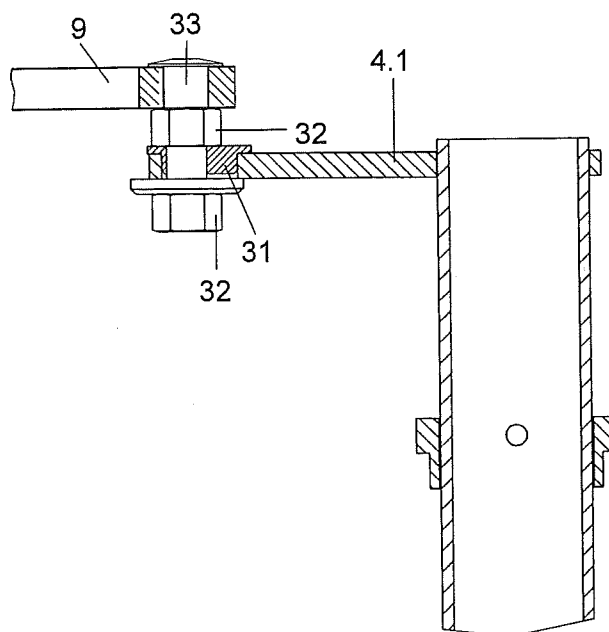
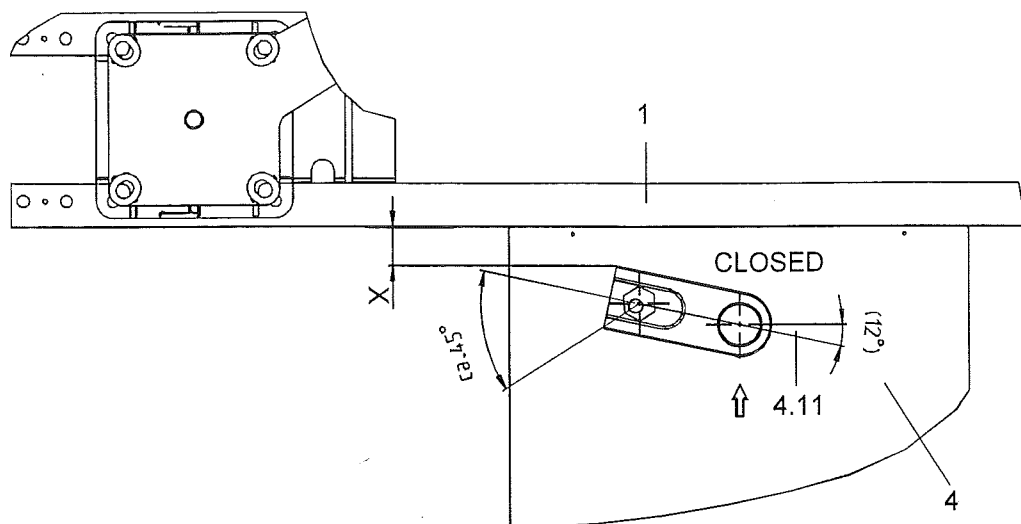


Fig. 7 a: Connecting the mechanism linkage when the mechanism is mounted on the base frame



4.1	Mechanism rocker arm	32	Hexagon nut
9	Mechanism linkage	33	Bolt
31	Eccentric bushing		

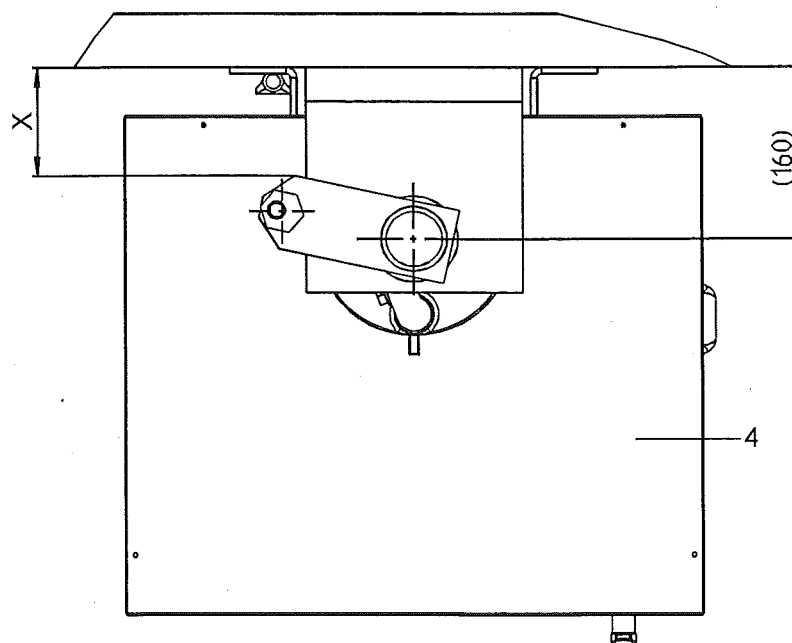
Fig. 7 b: Connecting the mechanism linkage when the mechanism is mounted in lowered position



$X = 46 + S$      $S$  = thickness of intermediate plate

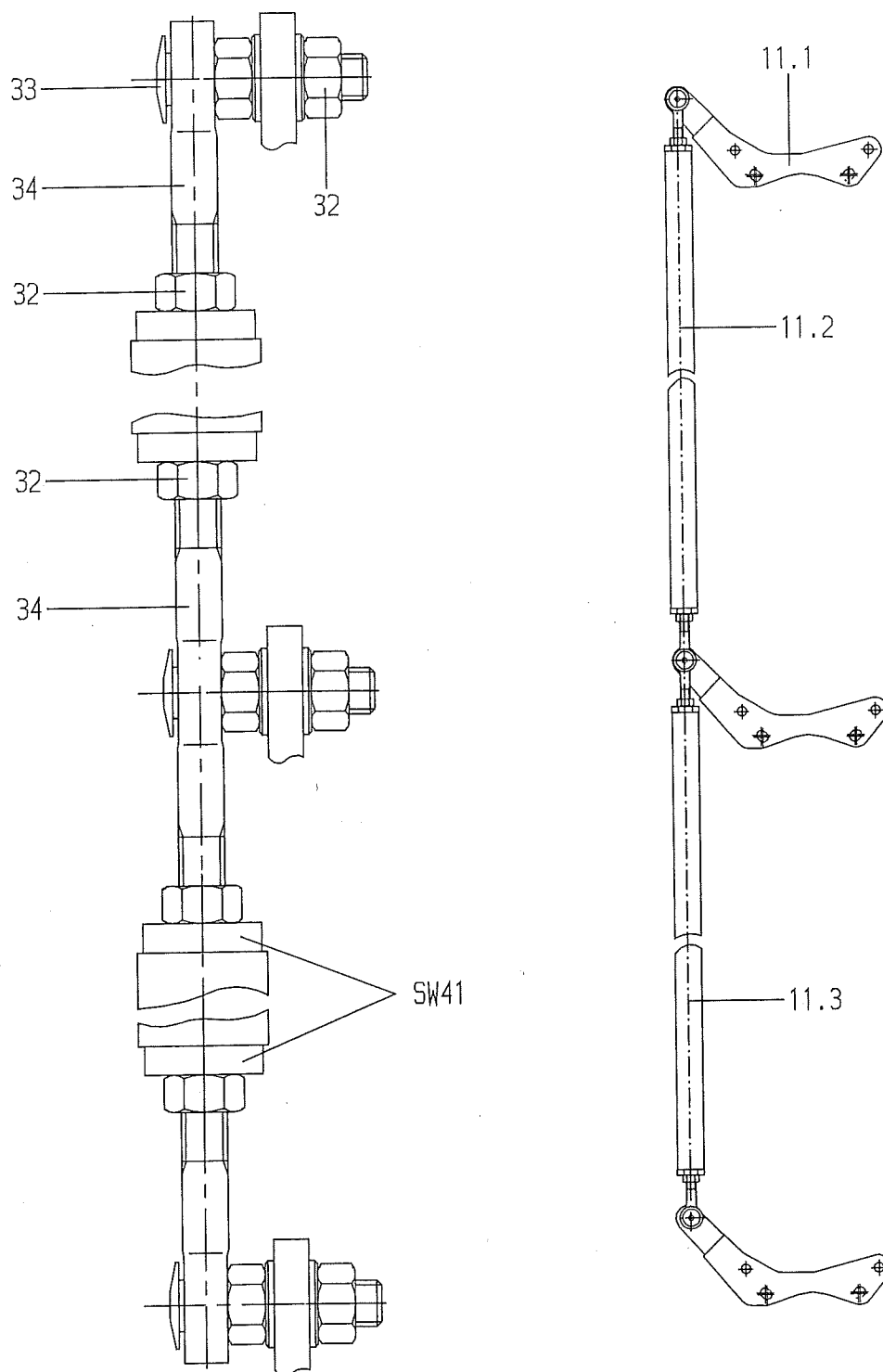
1	Base frame	4.11	Longitudinal axis of mechanism
4	Operating mechanism		rocker arm

Fig. 8 a:        Operating mechanism mounted directly on base frame



$X = 101 + S$      $S$  = thickness of intermediate plate

Fig. 8 b:        Operating mechanism mounted in lowered position



- 11.1 Connecting linkage lever
- 11.2 Connecting linkage – A-B
- 11.3 Connecting linkage – B-C

- 32 M16 hexagon nut
- 33 Bolt
- 34 M16 eyebolt  
(middle pole: double eyebolt)

Fig. 9: Connecting linkage

## **5 Maintenance**

Under normal conditions, the equipment must be serviced about every 5 years. Service shall include the following procedures at a minimum:

- Inspect the equipment visually for damage caused by unacceptable external influences.
- Clean the insulators.
- Inspect the paint finish and touch up, if necessary.
- Clean and lubricate the main contact system using Molykote BR 2 Plus (not required with maintenance-free contacts).
- Check all electric control functions.
- Perform test operations.
- Check to make sure all drain holes on the bottom of the rotary unit housings and the vent holes on the operating mechanisms are not stopped up.

### **Required Materials**

- Molykote BR 2 Plus lubricating grease (not required with maintenance-free contacts)
- SF 1377 silicone grease

## **6 Inspections**

Inspections shall be performed

- at intervals of 5 to 10 years, depending on operating conditions;
- when the operating frequency is very high, but after 2000 switching cycles maximum;
- after severe short-circuit currents;
- when environmental conditions have been severe.

Procedures to be performed:

- Check the main contacts and replace them if major wear is found.
- Check to make sure that the rotary units and contact heads move easily.

## **7 Replacement Parts**

- Main circuit arms (5) including contact heads (5.2) and main contact system (6)
- Main contact system (14, 15)
- Post insulators
- Molykote BR 2 Plus lubricating grease (not required with maintenance-free contacts)
- SF 1377 silicone grease.
- Operating mechanisms (see separate operating instructions)

In the event of questions, orders for replacement parts, or equipment malfunction, please contact your nearest AREVA representative, citing the information given on the nameplate.