AEG High-Voltage Switchgear Lilienthalstraße 150 34123 Kassel

Operating instructions No. 127 B

Apparatus SF6 circuit-breaker
Type S1-145 F1/4031/SR
with spring operating mechanism CRR 5

Manufacturer: AEG Aktiengesellschaft

Remarks

1. The operating instructions are consisting of 3 parts

   part A: Erection and commissioning
   part B: Inspection, maintenance and reconditioning
   part C: General description

   The three parts are bound separately. Parts A and B are circuit-breaker specific whereas part C is valid for the whole AEG circuit-breaker generation S1 F (SF6 circuit-breaker with spring operating mechanism).

2. The SF6 circuit-breakers type S1 F have been designed for low maintenance and long maintenance intervals. However, adequate care and adherence to these instructions in this manual will ensure the reliability of the circuit-breaker.

3. It is impossible to consider every eventuality which might occur during operation of a mechanical device. Therefore, kindly contact your local AEG agency in case you have any queries which have not been included in this manual.

4. AEG reserves the right to alter these instructions if necessitated by ongoing development of the breaker.

5. From the statements, figures and descriptions no claims can be asserted.
   Errors and omissions excepted

6. No part of this manual may be reproduced or copied by any means nor transmitted to a third party without the written permission of AEG.

Contents

Operating Instructions

1 General

The maintenance and reconditioning works recommended include only those parts that are subject to wear and tear and aging.

The crucial variables influencing the condition of the breaker are:

- number of short circuit interruptions
- number of switching operations
- time in service

The AEG maintenance program takes these variables into consideration by offering suitable inspection, maintenance and reconditioning intervals.

Maintenance and reconditioning should be carried out according to the following guidelines.

When equipment is operated in extreme ambient conditions, it is advisable to shorten the inspection and maintenance intervals.

Such conditions are the following:

- permanent high ambient temperature
- abrasive dust in the atmosphere
- high dust content atmosphere

  permanent high humidity
- corrosive gas or vapors in the atmosphere

Due to the use of highly stable grease resp. dry self-lubricating friction components the spring operating mechanisms do not require any maintenance under normal conditions.

Note:

Maintenance and reconditioning should preferably be carried out by AEG specialists.

Service personnel can be thoroughly trained on the job in courses offered by AEG.

2 Survey of the Inspection-, Maintenance- and Reconditioning Works

Time schedule:

Inspection	occasionally visual inspection at latest after six years. Regional standards may shorten the intervals.
Maintenance	after 12 and 24 years
Reconditioning	after 2.000 CO-operations at rated normal current or: after a summarized current according to appendix II

2.1 Inspection

To be carried by trained staff. Adopt the relevant safety precautions. An opening of the pole columns is not necessary.

Type of work	Notes
- Visual check for damages	especially porcelains
- Check for corrosion on metallic parts and pipings	-
- Check the ventilation apertures	at the base frame and at the cubicle
- Check of the anti-condensation heating	see chapter 3.2
- Check of the SF6-pressure	the SF6 density monitor in the green range

Table B1: Survey of inspection

2.2 Maintenance

To be carried out by trained staff or AEG specialists. Take the circuit-breaker out of service, an opening of the pole columns is not necessary.

The safety precautions (chapter 3.1) have to be adopted.

Type of work	Notes
- Check of the cable connections	fixed inside the operating mechanism cubicle
- Check of the securing elements of the linkage	bolts and sleeves
- Functional check of the electrical control circuits	chapter 3.3
- Measurement of the operating times	chapter 3.4
- Check of the SF6 gas quality	chapter 3.5
- Measurement of the resistance of the main circuit	chapter 3.6
- Check of the bolt connections	chapter 3.7

Table B2: Survey of maintenance

2.3 Reconditioning

To be carried out by trained staff or AEG specialists. Take the circuit-breaker out of service, an opening of the pole columns is necessary.

Type of work	Notes
Replacement of the arcing contacts	chapter 3.8

Table B3: Survey of reconditioning

3 Notes for the Works to be performed

3.1 Safety Precautions

Take care of the relevant safety precautions.

Mandatory:

- Isolate the breaker.
- The position indicator of the closing spring shows "discharged".
- Earth both sides of the breaker as specified in the relevant standards.
- Disconnect supply and motor voltage. (For the works described in the chapters 3.2, 3.3, 3.4 the voltages are still necessary).
- Mind the relevant safety regulations.
- When opening a pole column, pump the SF6 gas in a service unit and evacuate the columns. Then ventilate the pole columns.

Note:

When opening a pole column, proceed as follows:

- Wear rubber gloves, protective clothing, gas mask and breathing equipment during opening and cleaning.
- Remove decomposition products immediately after having opened the breaker (pole) or any subassembly.
- Wipe off decomposition products with a piece of cloth or use a vacuum cleaner.
- Do not agitate decomposition products unnecessarily.
- Neutralize deposits (arc products), adsorption filter and used cloth with a 3 % soda solution for 24 hours, or dispose of as harmful substances.

C A U T I O N

Take notice of the chapter "Handling of SF6 Gas", Appendix I

3.2 Check of the Anti-Condensation Heating

Check the proper function of the anti-condensation heating within the cubicle (see figure B4).

3.3 Functional Check of the Electrical Control Circuits

Perform one CLOSE- and one OPEN-operation.

3.4 Measurement of the Operating Times

Take the operating times on one CLOSE- and one OPEN-operation at rated supply voltage.

The values have to correspond to those given in the routine test-certificate.

Note:

The opening time is the time from energizing the opening release to contact separation.

The closing time is the time from energizing the closing release to contact touch.

3.5 Check of the SF6 Gas Quality

Check the gas quality with respect to the water content, SF6 content and acidity. Use the devices mentioned in chapter 6.3, pos. 9, 11 and 18.

Nominal value (dew point):	-10 °C at nominal pressure.
Nominal value (SF6 content):	> 98 %
Nominal value (acidity):	≤ 10 ppm

3.6 Measurement of the Resistance of the Main Circuit

Measure at the hv-terminals directly. The values have to correspond to those given in the routine test-certificate.

3.7 Check of the Bolt Connections

Check for the correct tightening torque on all accessible bolt connections.

Strength grade	8.8		A2-70		A2-80	
	Nm	ftlb	Nm	ftlb	Nm	ftlb
M6	10	7.4	10	7.4	13.7	10.1
M8	24.8	18.3	24.8	18.3	33	24.4
M10	49	36	49	36	65	48
M12	86	63	83	61	110	81
M16	210	155	202	149	270	200
M20	410	303	394	291	525	388
M24	710	525	377	278	-	-

Table B4: Tightening torques for bolts and nuts

3.8 Replacement of the Arcing Contacts

3.8.1 Preliminary Remarks

This chapter describes the replacement of the arcing contacts as required in table B3. Chapter 3.9 describes the disassembling of the complete pole column.

Replace the arcing contacts in closed, dry and undusty rooms only.

Do not replace the arcing contacts in the substation in inclement weather conditions or in windy conditions.

Clean all functional elements with a piece of cloth that has been soaked in alcohol and grease according to the greasing instructions. Replace parts when necessary.

If bolt connections have been unscrewed during work, replace the securing elements.

Always use new elastomer gaskets when assembling.

The adsorption filter must be replaced whenever a pole column has been opened.

CAUTION

Exposure of the SF6 gas compartments to the atmosphere should be kept to a minimum. Water (rain) must be prevented at all circumstances.

3.8.2 Provisions

a) tools

Item	Designation	Weight	Order-No.	Quantity
1	Torque wrench 30 - 150 Nm	2.0 kg	1 278 793	1
2	Wrench for fixed arcing contact	0.5 kg	1 915 617	1
3	Revision set	26.0 kg	1 360 943	1
4	Assembling tool	0.5 kg	1 915 622	1

Table B5: Tools for the replacement of the arcing contacts

b) accessories

Item	Designation	Weight	Order-No.	Quantity
1	CRC anti-corrosion spray	0.5 kg	1 061 830	1
2	Loctite green		1 271 250 1 250 770	10 cm³ 250 cm³
3	Loctite blue		1 271 249 1 250 782	10 cm³ 250 cm³
4	Scotch abrasive pad	-	1 260 765	10 m x 100 mm
5	Cleaning alcohol	-	1 242 244	5 l

Table B6: Accessories for the replacement of the arcing contacts

c) spare parts

Part No.		Designation	Pieces per pole	
1.1.02	**	Fixed arcing contact	1	
1.1.03	**	Main contact segment (upper)	2	*
1.1.04	**	Main contact clamping ring (upper)	1	*
1.1.05		PTFE-shield	1	
1.1.07		Bolt	1	
1.1.08		Thrust piece	1	
1.1.09		Main contact segment (lower)	2	*
1.1.10		Main contact clamping ring (lower)	1	*
1.3		Interrupter unit complete	1	
1.4		Chamber porcelain gaskets	2	
1.5.03		Guide strip PTFE	1	
1.5.04		Guide strip PTFE	2	
1.8.02		Locking pin	1	
1.8.04		Filter cartridge	1	
1.8.36		O-ring	1	
1.10		Set of expansion bolts, complete	1	
[107]	***	Pin	1	
[108]	***	Bolt M6x16	1	
[109]	***	Sleeve	1	

* Replacement not required. Only after heavy duty performed
** Special tools required
*** These parts are shown in fig. A11, part A

Table B7: Spare parts list for the replacement of the arcing contacts

3.8.3 Procedure

a) Disassembling of the pole columns

Note: For detailed figures refer to part A of the operating instructions.

- Breaker in end-position OFF.
- Closing spring "discharged".
- Store the SF6 gas in a service unit and evacuate the columns. Then ventilate the pole columns.
- Disconnect the SF6 piping at poles A, B and C at the crank cases.
- Disconnect the linkage between pole columns and spring operating mechanism.
- Fix a rope to the upper HV-terminals (fig.1, 1.9) of the pole columns.

- Undo the four fastening bolts of the crank case.

- Lift the pole columns, transport to the workshop and mount them on an assembling trestle in upright position.

b) Change of the arcing contacts

- Loosen the expansion bolts at the fixed contact (1.1) and proceed as described in chapter 6.2.

- Lift the fixed contact upwards out of chamber porcelain, place it on a dry pad, clean the surfaces and remove any adhering decomposition products.

- Replace the fixed arcing contact (1.1.02).

- Undo the bolts of the upper flange of the support porcelain (1.6) (see figure B1, item B).

- Lift the chamber porcelain, place it on a dry pad and clean the inner surfaces from any decomposition products.

- Uncouple the complete interrupter unit (1.3) by loosening the locking pin (1.8.02) (see figure B1, item D). Use the assembling tool mentioned in table B5.

- Pull out the complete interrupter unit (for disassembling of the complete pole columns proceed as described in chapter 3.9.3).

- Mount a new interrupter unit in the lower support for contact (1.5) and couple with a locking pin. Use the assembling tool mentioned in table B5.

C A U T I O N

- Replace the guide strips PTFE (1.5.03, 1.5.04)
- Replace the locking pin (1.8.02)
- Replace the gaskets (1.4)
- Take notice of the greasing instructions, chapter 4

- Mount the chamber porcelain, fasten the bolts and tighten with 83 Nm.

When mounting the fixed contact on the chamber porcelain, the contact has to be positioned with respect to the interrupter unit.

Fix the revision set at the assembling trestle (chapter 6.1):

- Move the interrupter unit in end-position ON.
- Position the fixed contact in the interrupter unit.
- Fasten the fixed contact by expansion bolts (chapter 6.2).

Replace the adsorption filter (see figure B2)

- Undo the cover (1.8 21) and pull out the filter housing (1.8.05).
- Remove used filter cartridge (1.8.04) from the filter housing, insert a new cartridge and replace a complete filter housing.
- Mount the cover (1.8.21) and fasten the bolts with 10 Nm.
- Couple the linkage
- Connect the SF6 piping at poles A, B and C.
- Evacuate the breaker, top up with SF6 to the rated pressure and put it into operation. (The procedure is described in part A, chapter 4.)
- Check all flange-connections opened and the SF6 piping by a SF6 leak detector.

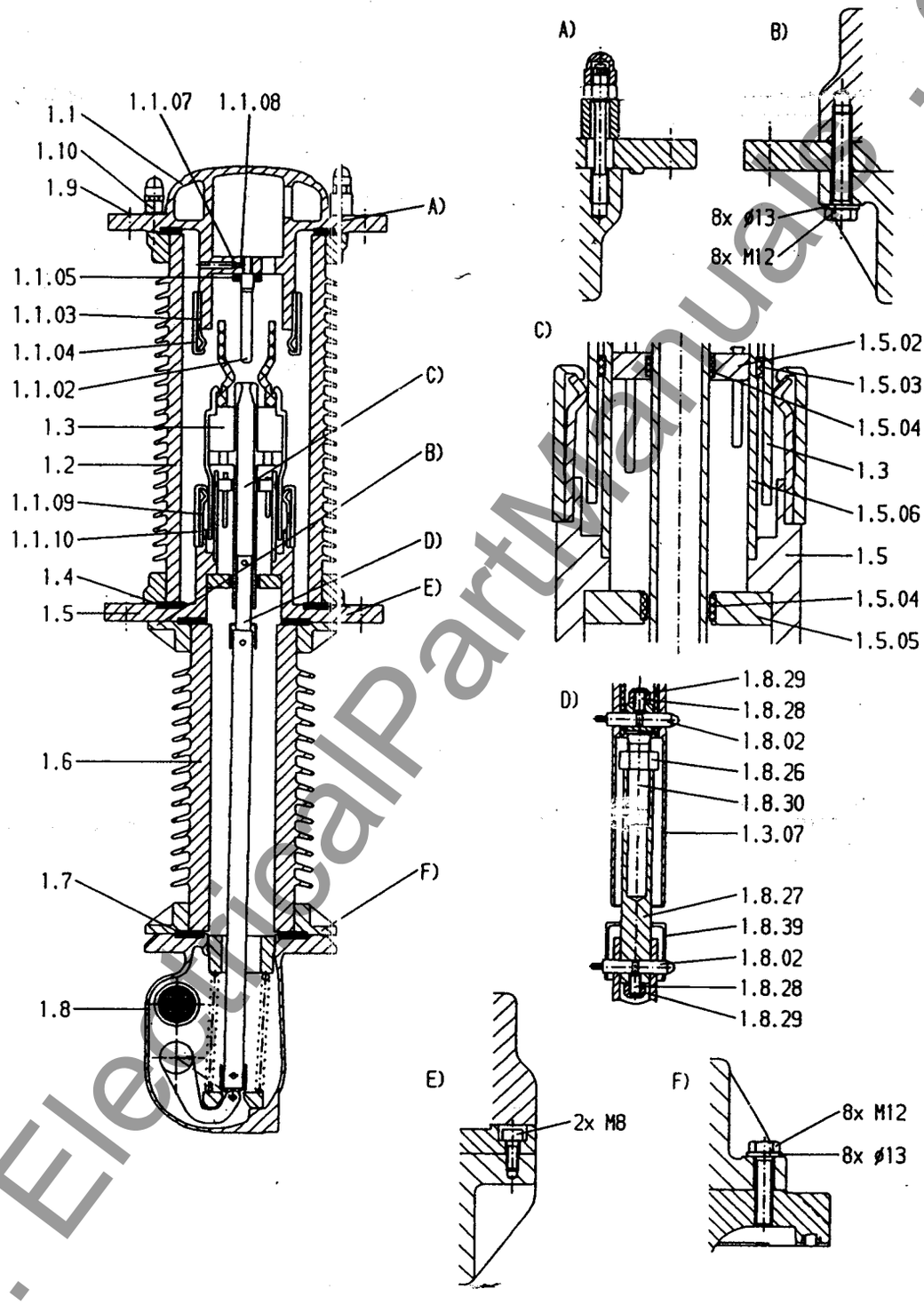

Fig. B1: Disassembling of the pole columns

Legend to figure B1

Item A: Disassembling of the fixed contact (1.1)

(see chapter 6.2)

Item B: Disassembling of the chamber porcelain (1.2)

- 8 bolts M12 / 8 washers ϕ 13

Item C: Interrupter unit (1.3) - lower support for contact (1.5)

- Interrupter unit	1.3
- Lower support for contact	1.5
- Guide strip PTFE	1.5.03
- Guide strip PTFE	1.5.04

Item D: Uncoupling interrupter unit (1.3)

- Connecting tube	1.3.07
- Locking pin	1.8.02
- Nut	1.8.26
- Connection	1.8.27
- Thrust piece M10	1.8.28
- Cap nut	1.8.29
- Connetion	1.8.30
- Pin	1.8.38
- Sleeve	1.8.39

Item E: Disassembling of the lower support for contact (1.5)

- 2 bolts M8

Item F: Disassembling of the support porcelain (1.6)

- 8 bolts M12 / 8 washers ϕ 13

3.9 Disassembling of a Complete Pole Column

3.9.1 Preliminary Remarks (see chapter 3.8)

3.9.2 Provisions

a) Tools (required in addition to 3.8)

Item	Designation	Weight	Order-No.	Quantity
1	Torque wrench 150 - 650 Nm	3.0 kg	1 004 163	1
2	Wrench for the threaded insert	4.0 kg	1 915 611	1

Table B8: Additional tools for disassembling

b) Accessories (see chapter 3.8)

c) Spare parts (required in addition to 3.8.2)

Part No.	Designation	Pieces per pole
1.7	Support porcelain gasket	2
1.8.15	O-ring	1
1.8.33	Pin	1
1.8.35	O-ring	2
1.8.36	O-ring	1

This list does not take into account the replacement of separate parts (e.g. contacts, insulating rod etc.).

Table B9: Spare parts list for disassembling the complete pole column

3.9.3 Procedure

- Proceed as described in the chapter "renewal of the arcing contacts", up to:
- Pull out the complete interrupter unit.
- Remove the lower support of contact (1.5, figure B1, item E).
- Undo the support porcelain (1.6) at the lower flange (figure B1, item F) and lift it off.
- Undo the threaded insert (1.8.03) of the opening spring (1.8.06, figure B2). Use the special wrench.
- Remove the opening spring from the crank case.

- Remove the filter housing (1.8.05).

- Dismount the shaft (1.8.19) by pulling off the cover shaft (1.8.16) and the insert (1.8.25) with the outer part of the needle bearing (1.8.13). Pull out the shaft with the inner ring of the needle bearing.

CAUTION

Take care that the surface of the shaft gasket is not damaged.

- Withdraw the complete assembly of "insulating rod (1.8.07), spring seat (1.8.09) and lever (1.8.10)" upwards out of the crank case.

- Loosen the pin (1.8.33) and disassemble completely.

- Clean all parts from all decomposition products, check and, if necessary, replace the parts.

Reassemble in reverse order and obey the following instructions:

- Greasing instructions for contact and jointing surfaces as well as for static and dynamic gaskets.

- Replace all gaskets.

- Tighten the threaded insert with 80 Nm.

- Replace the sleeve (1.8.01) when coupling.

- Replace three guide strips PTFE for the interrupter unit (fig. B1, item C).

- Fit a new filter cartridge just prior to evacuating.

The mounting of the pole columns is described in detail in part A, chapter 3.6 to 3.10.

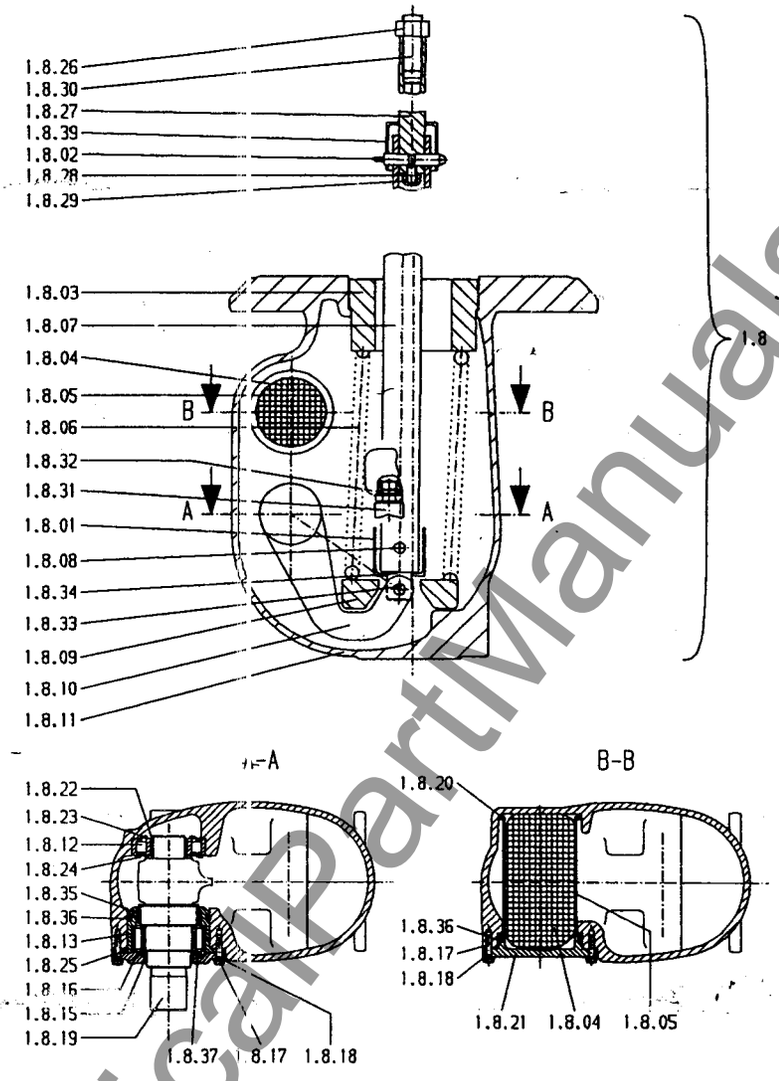

Fig. B2: Crank case

- Crank case complete	1.8	- Shaft	1.8.19
- Sleeve	1.8.01	- O-ring	1.8.20
- Locking pin	1.8.02	- Cover	1.8.21
- Threaded insert	1.8.03	- Sleeve	1.8.22
- Filter cartridge	1.8.04	- Gasket	1.8.23
- Filter housing	1.8.05	- Gasket	1.8.24
- Opening spring	1.8.06	- Insert	1.8.25
- Insulating rod	1.8.07	- Nut	1.8.26
- Locking pin	1.8.08	- Connection	1.8.27
- Spring seat	1.8.09	- Connection	1.8.30
- Lever, internal	1.8.10	- SF6 coupling	1.8.31
- Crank case	1.8.11	- O-ring 13.95x2,62 B	1.8.32
- Ball bearing	1.8.12	- Pin	1.8.33
- Needle bearing	1.8.13	- Connection	1.8.34
- O-ring 50.39x3.53 C	1.8.15	- O-ring 62.87x5.33 C	1.8.35
- Cover shaft	1.8.16	- O-ring 78.74x5.33 B	1.8.36
- Bolt M6 x 25	1.8.17	- Bearingplate	1.8.37
- Washer	1.8.18	- Sleeve	1.8.39

3.10 Cleaning, Greasing and Lubricating of the Operating Mechanism

3.10.1 Preliminary Remarks

At normal ambient conditions the spring operating mechanism does not require any greasing. At extreme ambient conditions the points indicated by the symbol o on the exploded view B3 should be lubricated.

Note:

- Ensure that the opening spring is "discharged"
- Before lubricating disassemble the cabinet.

Lubricate all parts carefully. The reassembled parts should be greased by using a highly stable grease (ASEL SYLITEA 4-018; DIN 51825 T2-KTCLE 1C, see chapter 4.2).

CAUTION

Never use a molybdenum lubricant for a bearing with dry plane bearing bush.

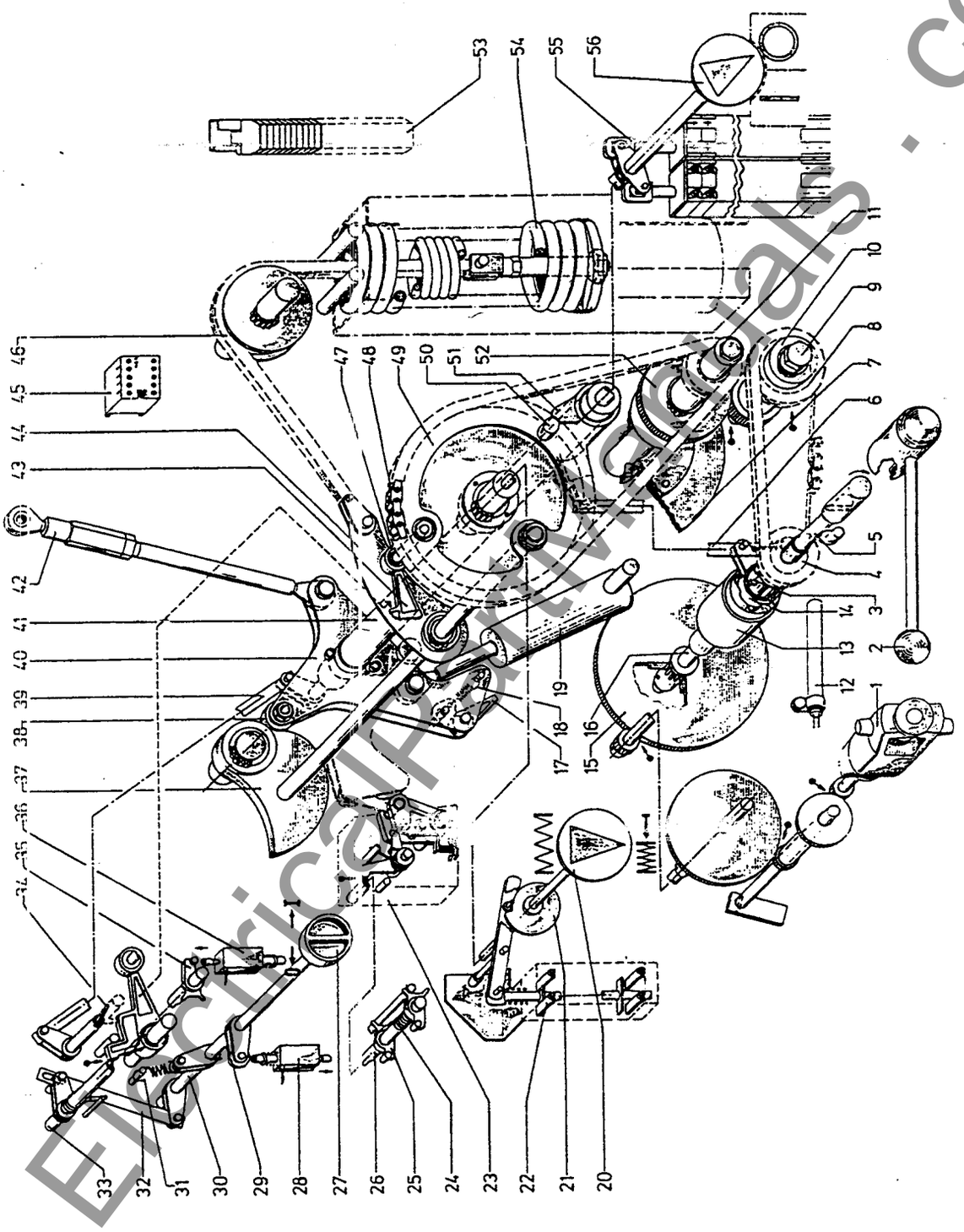

Fig. B3: Exploded view of the spring operating mechanism

Parts according to figure B3

Item	Designation
3.0.01	Motor
3.0.02	Manual charging crank
3.0.03	Actuating pin
3.0.04	Sprocket
3.0.05	Return spring
3.0.06	Linkage
3.0.07	Flywheel
3.0.08	Chain
3.0.09	Shaft
3.0.10	Sprocket
3.0.11	Sprocket
3.0.12	Anti-condensation heater
3.0.13	Roller carrier
3.0.14	Coupling sleeve
3.0.15	Sprocket
3.0.16	Operating shaft
3.0.17	Pawl (latch)
3.0.18	Spring
3.0.19	Dashpot
3.0.20	Position indicator closing spring
3.0.21	Cam
3.0.22	Motor limit switch
3.0.23	Trip blocking mechanism
3.0.24	Return spring
3.0.25	Lever
3.0.26	Shaft
3.0.27	Manual emergency operating device
3.0.28	Shunt opening release
3.0.29	Cam follower
3.0.30	Shaft
3.0.31	Return spring
3.0.32	Manual operating linkage
3.0.33	Shaft
3.0.34	Bolt M5 x 25
3.0.35	Lever
3.0.36	Shunt closing release
3.0.37	Cam Disc
3.0.38	Cam follower NATV 10
3.0.39	Linkage
3.0.40	Flange
3.0.41	Main shaft
3.0.42	Linkage, complete
3.0.43	Closing pawl (latch)
3.0.44	Linkage
3.0.45	Anti-pumping relay 1

3.0.46	Chain, complete
3.0.47	Cam follower KRV26
3.0.48	Chain
3.0.49	Sprocket
3.0.50	Stud
3.0.51	Lever
3.0.52	Sprocket
3.0.53	Terminals (optional)
3.0.54	Closing spring
3.0.55	Auxiliary switch
3.0.56	Breaker position indicator

Recommended spare parts:

3.0.01
3.0.12
3.0.19
3.0.22
3.0.28
3.0.36
3.0.45
3.0.55

3.10.2 Replacement of parts

a) Shunt opening release (3.0.28) (fig. B4)

- Remove the two bolts which hold the angle support on the forward main mounting plate. These bolts can be seen on the plate; the corresponding nuts behind the plate are crimped in position.
- Take out the complete assembly, i.e., angle support and opening release(s).
- Disconnect the leads and remove the faulty opening release.
- After replacement of the opening release, wire up and complete assembly work. After replacement of the angle support, no adjustments are required as precise assembly is ensured by the mounting system.

b) Shunt closing release (3.0.36) (fig. B4)

- Remove the plate which may be fitted on the angle support.
- Remove the two bolts which hold the angle support on the forward main mounting plate; the corresponding nuts behind the plate are crimped in position.
- Disconnect the leads and remove the faulty closing release.
- After replacement of the closing release, wire up and complete assembly work.
- Mount the angle support on the forward main mounting plate with two bolts in correct position. The clearance between the lever and the ram of the coil should be 2 mm.
- Press the ram manually and check, that in final position of the shaft (3.0.33) the closing pawl (3.0.43) moves.

c) Motor (3.0.01) (fig. B5)

- Remove the electrical connections.
- Unscrew the three bolts of the support on the mounting plate. The three nuts at the rear of this plate are crimped on.
- Unscrew the four bolts securing the motor to its support.
- Pull out the pin securing the pinion on the motor shaft (pin dia. 3 mm).
- Replace the motor and proceed vice versa.

d) Anti-condensation heater (3.0.12) (fig. B4)

- Remove the electrical connections.
- Unscrew the support from the wiring plate.
- Replace the heater and proceed vice versa.

e) Motor limit switch (3.0.22) (fig. B5)

- Remove all electrical connections.
- Remove the two securing rings and then pull out the small axle from the switch eyelet.
- Press the lever into upright position.
- Remove the two nuts securing the switch to its support.
- After replacing the switch, tighten the two nuts on the support.
- Reset the axle and the two bushes in the eyelet and fit the two securing rings.
- Make all electrical connections.

f) Auxiliary switch (3.0.55) (fig. B5)

- Remove all electrical connections.
- Remove the nylon pin off the eyelet.
- Remove the two nuts securing the switch to its support.
- After replacing the switch, tighten the two nuts.
- Insert a new nylon pin through the eyelet.
- Make all electrical connections.
- Check the contacts.

g) Operation counter (3.0.71) (fig. B5)

- Unscrew the two mounting bolts.
- After replacing the counter, tighten the bolts.
- By means of the set bolt on the counter's axle, set the lever of the counter against the eyelet of the switch when the circuit breaker is switched on.

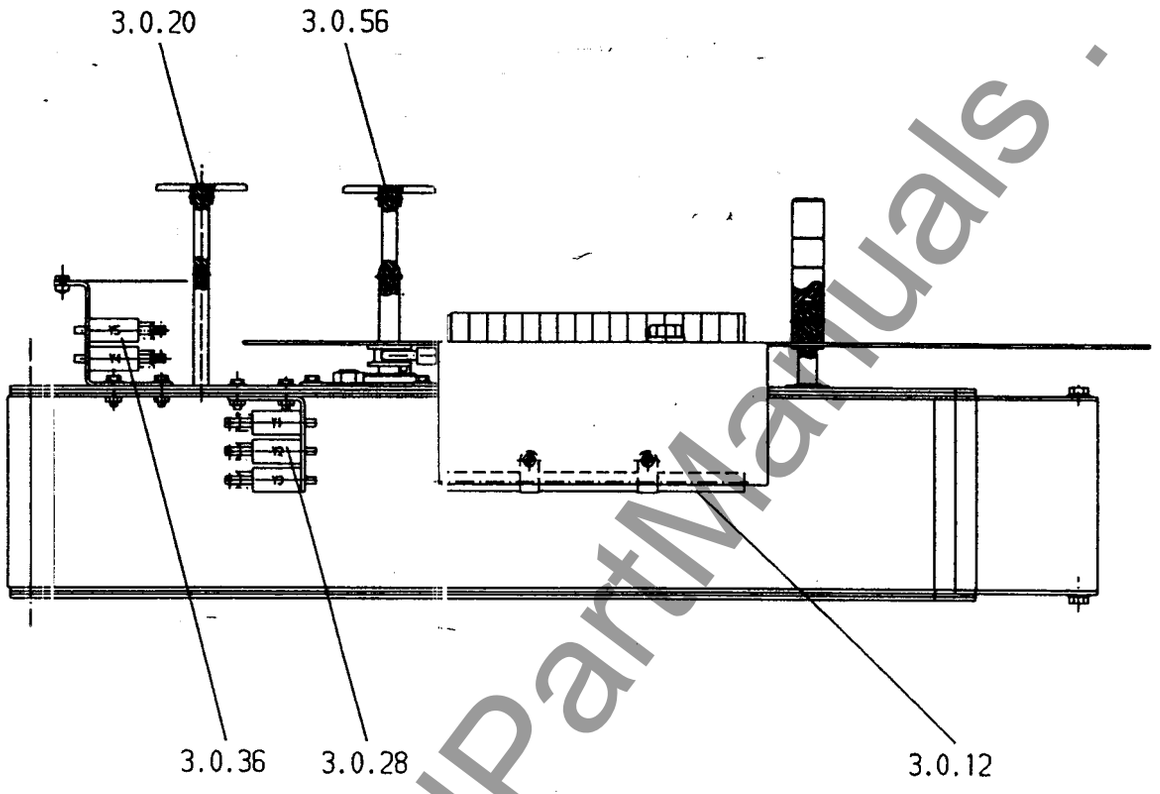

Fig. B4: Accessories - Side view

-	Anti-condensation heater	3.0.12
-	Position indicator closing spring	3.0.20
-	Shunt opening release (Option: Y3)	3.0.28
-	Shunt closing release (Option: Y5)	3.0.36
-	Breaker position indicator	3.0.56

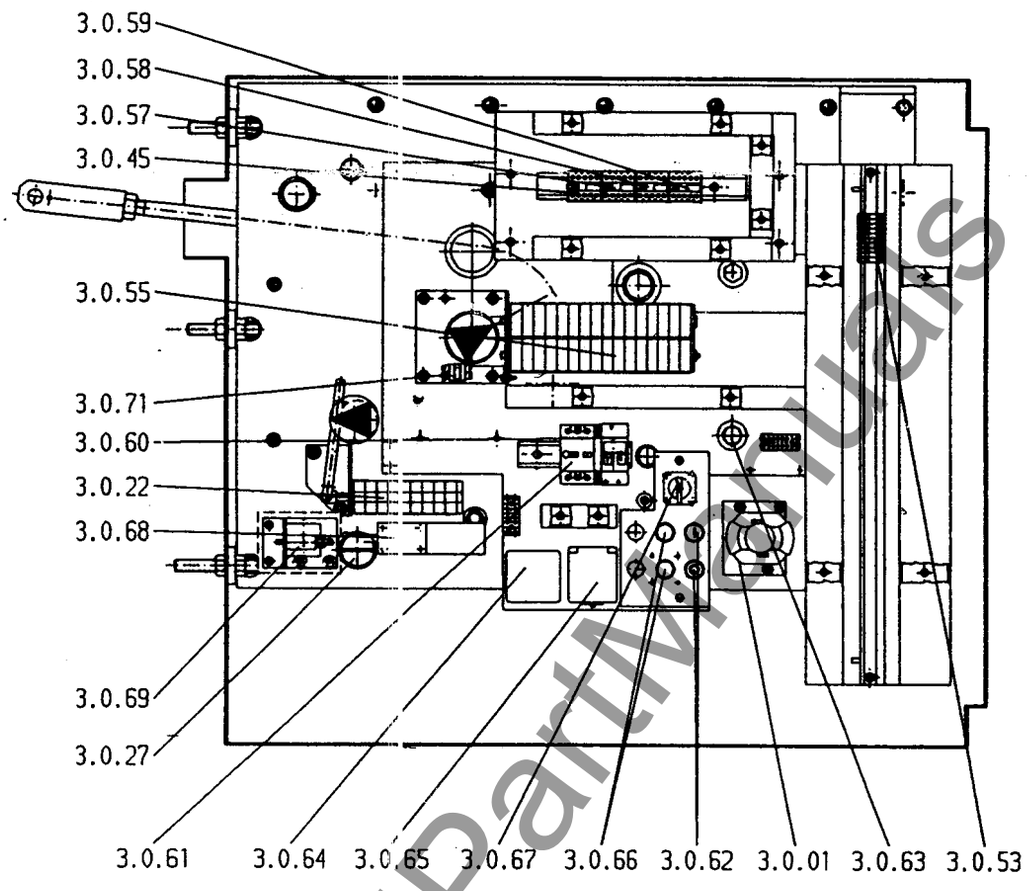

Fig. B5: Accessory equipment - Front view

- Motor	3.0.01
- Motor limit switch	3.0.22
- Manual emergency operating device	3.0.27
- Anti-pumping relay 1	3.0.45
- Terminals (optiona)	3.0.53
- Auxiliary switch	3.0.55
- Contactor, SF6 lockout 1	3.0.57
- Contactor, SF6 alarm	3.0.58
- Contactor, SF6 lockout 2 (optional)	3.0.59
- Overload release (optional)	3.0.60
- Motor protection contactor (optional)	3.0.61
- Close/open push button (optional)	3.0.62
- Shaft for manual charging	3.0.63
- Thermostat (optional)	3.0.64
- Outlet (optional)	3.0.65
- Close/open indicator (optional)	3.0.66
- Local/remote selector switch (optional)	3.0.67
- Mechanical interlocking (optional)	3.0.68
- Nameplate	3.0.69
- Operation counter	3.0.71

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4 Lubrication and Greasing

4.1 Designation of Lubricants

Item	Designation	Weight	Order no.	Quantity
1	Silicone grease JBF - SF 1377	0.125 kg	1003 498	1
		0.250 kg	1001 624	1
		0.500 kg	1001 073	1
		1.0 kg	1241 202	1
2	Molykote grease BR2 plus	0.125 kg	1003 497	1
		0.250 kg	1266 427	1
		0.500 kg	1266 439	1
		1.0 kg	1266 440	1
3	Berulub grease FK 33	0.100 kg	1002 705	1
		1.0 kg	1002 706	1
4	Aseol-Sylitea-4-018	0.125 kg	1004 145	1
5	Vaseline, acid-free			

Table B10: Lubricants

4.2 Application of Lubricants

Four different lubricants are used. The silicone grease SF 1377 has four different applications (see a-d) (the relevant application is indicated in the figures B6, B7 and B9 by the appropriate letter).

Acid-free vaseline can be used instead of SF 1377 in the application d).

a) Silicone grease SF 1377 for sealing grooves between parts.

Grease the groove up to the outer part. Do not use a brush, apply a thin layer with the fingers.

b) Silicone grease SF 1377 for greasing O-rings.

Clean the grooves, surfaces and O-rings with alcohol. Apply a thin layer with the fingers. Do not use a brush or fuzzy clothes.

c) Silicone grease SF 1377 for greasing sliding- and bearing surfaces.
Apply a thin layer to the surfaces.

d) Silicone grease SF 1377 for greasing contact surfaces of current-carrying connections (HV-terminals).
Apply a thin layer to the total surfaces.

e) Berulub grease FK 33 for greasing sliding and bearing surfaces.
Apply a thin layer to the surfaces.

f) Molykote grease BR2 plus for greasing strongly stressed sliding- and bearing surfaces in air.
Apply a thin layer to the surfaces.

g) Aseol-Sylitea-4-108 for greasing parts of the spring operating mechanism.

h) Acid-free vaseline for greasing contact surfaces of current-carrrying connections (HV-terminals) if SF 1377 is not available.
Apply a thin layer to the total surface.

4.3 Points of Lubrication

4.3.1 Pole Column

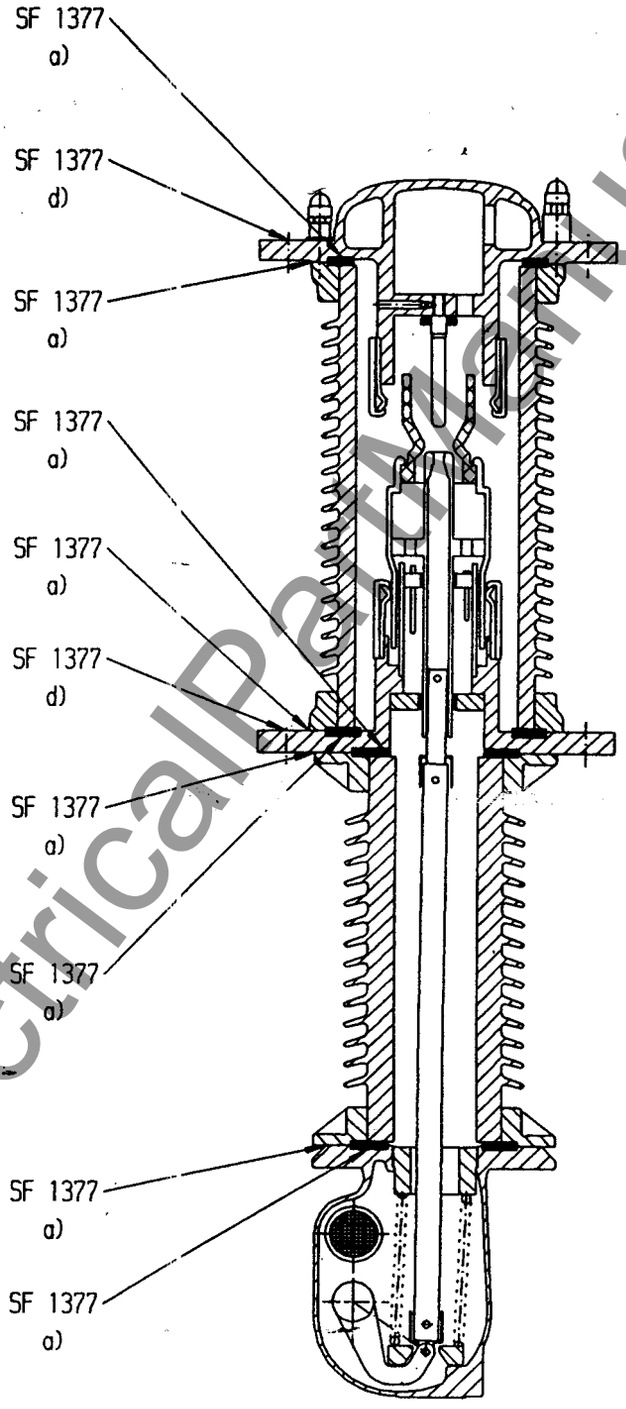

Fig. B6: Points of lubrication at the pole column

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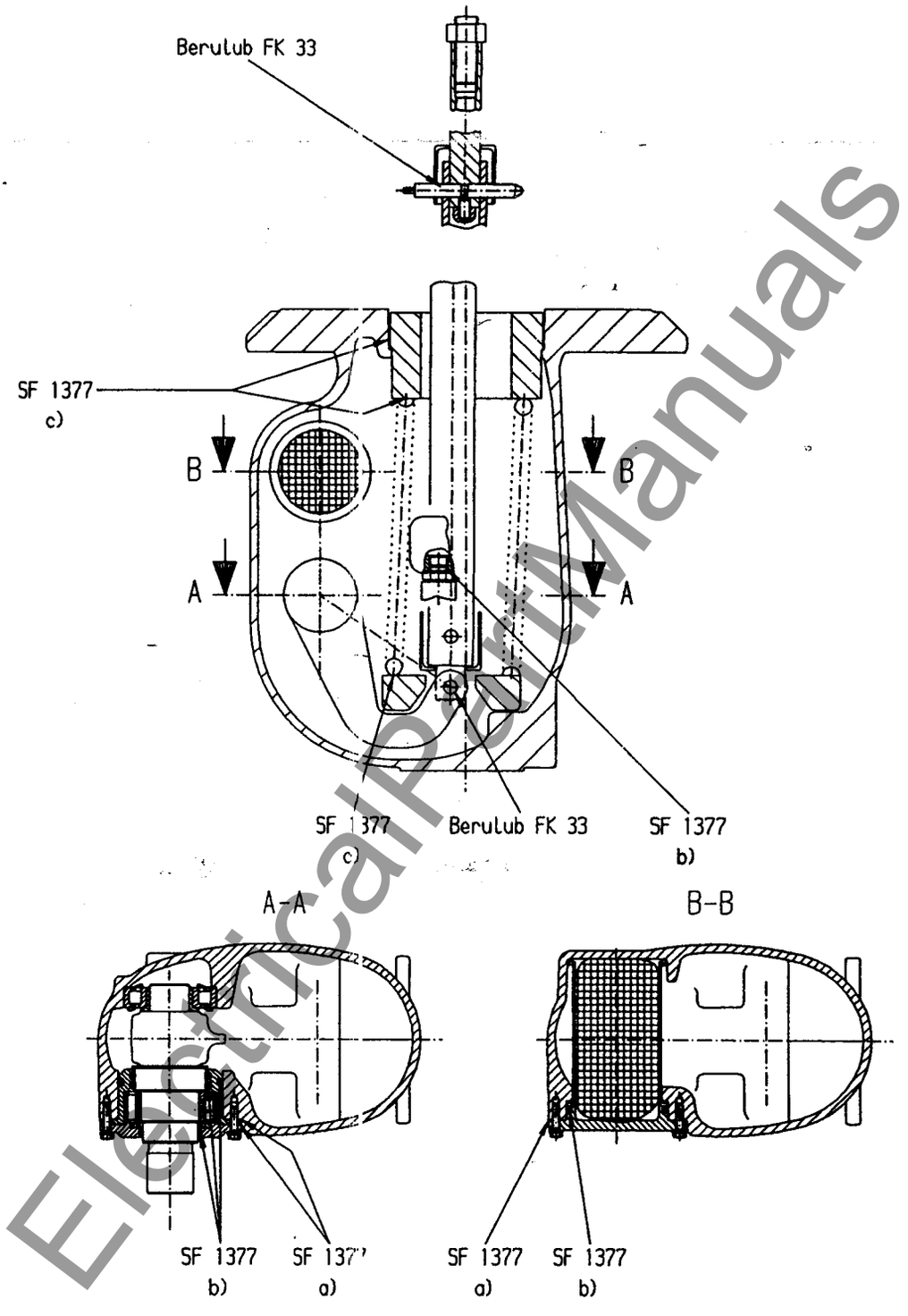

Fig. B7: Points of lubrication at the crank case

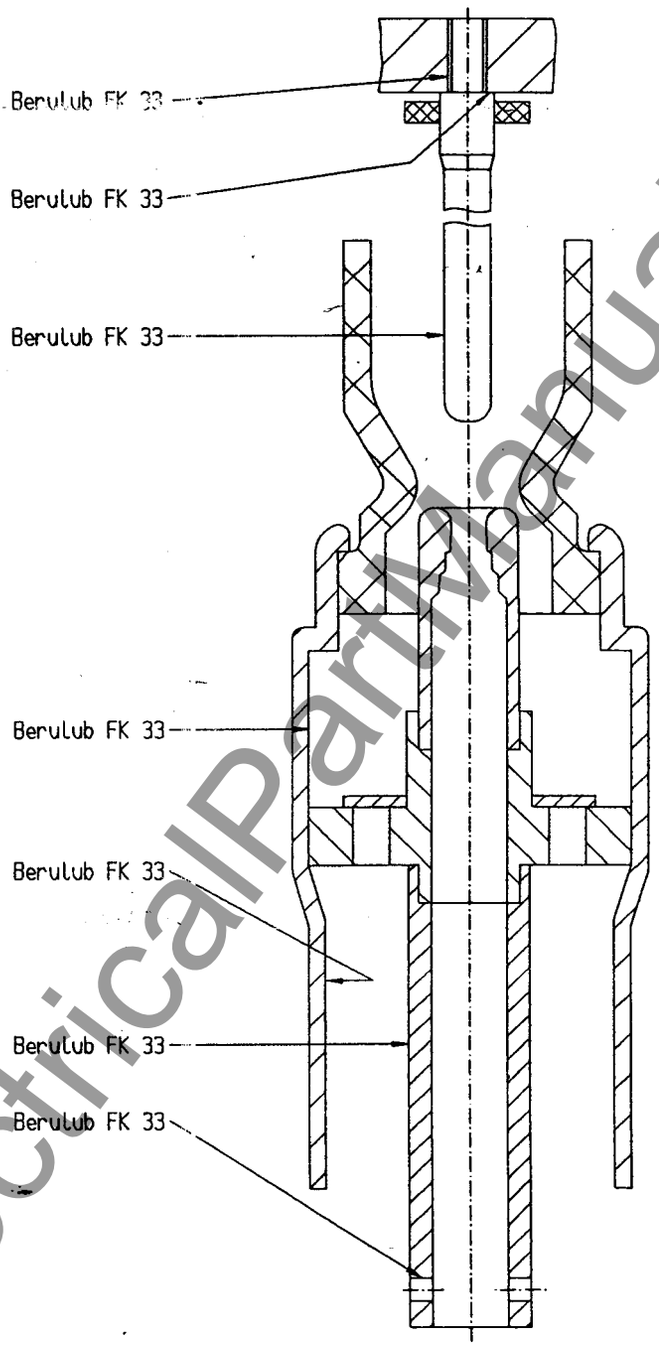

Fig. B8: Points of lubrication at the interrupter unit and at the arcing contacts

4.3.2 Base frame

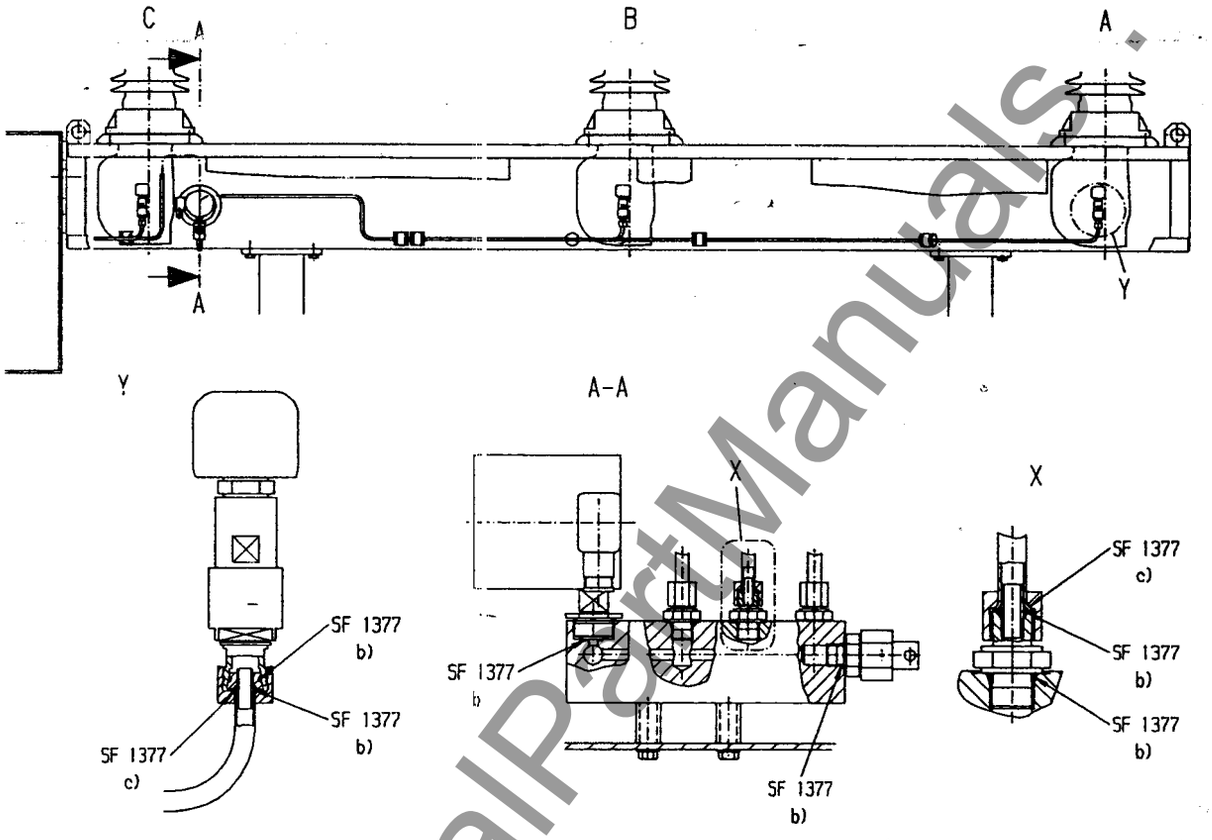

Fig. B9: Points of lubrication at the base frame

4.3.3 Linkage

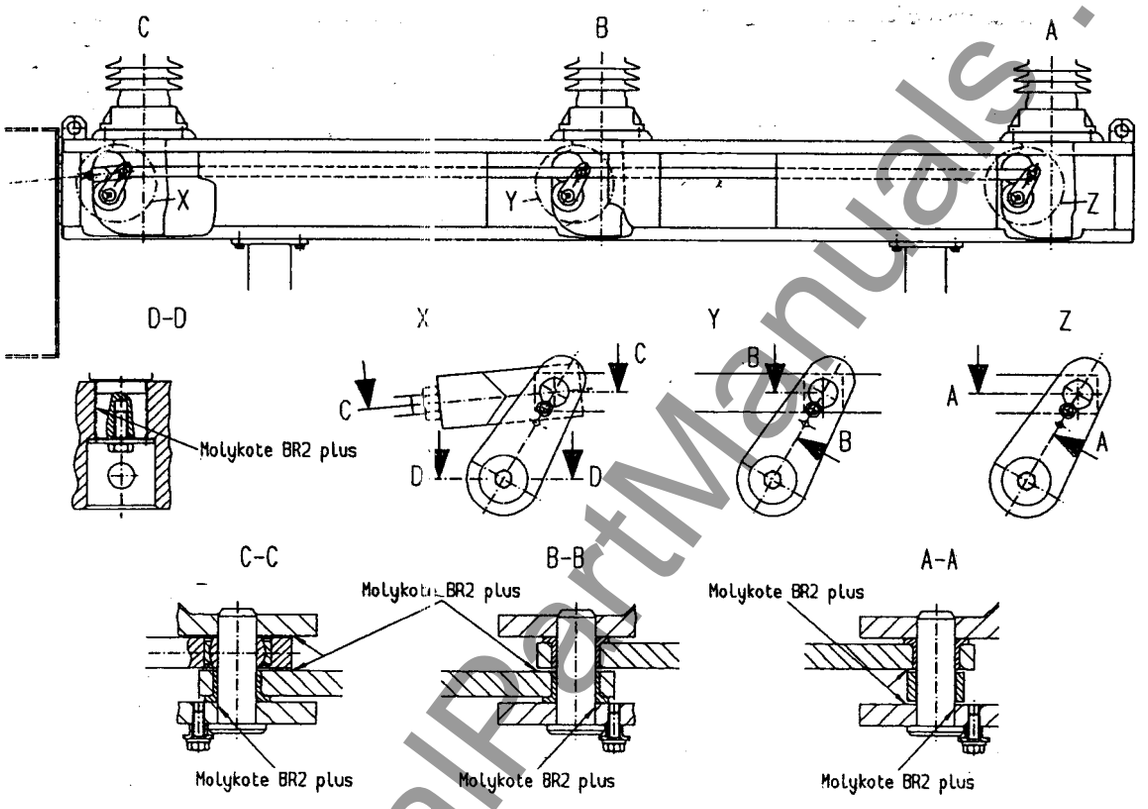

Fig. B10 Points of lubrication at the linkage

5 Fault Clearance

Before beginning any fault clearances, disconnect the breaker from the high voltage system and earth it in accordance with the regulations applicable.

5.1 Control system

In the event of a failure of electrical commands or if these are delayed, proceed as follows:

- Check the position of the closing spring
- Measure the supply voltage
- Disconnect the control circuits
- Check the SF6 gas pressure
- Check the terminal connections if tight and correct
- Check the wiring against the diagrams. Correct, if necessary
- Check the shunt release, replace defective coils. Check the reason and eliminate any mechanical jamming
- Check, if necessary replace, the contactors in the defective circuit
- If the SF6 density monitor is defective, replace it
- Switch on the supply voltage

5.2 SF6 Gas Supply

In the event of an "SF6 alarm" check the gas pressure and refill. Check the density monitor and, if necessary, replace it.

Should a gas leakage be assumed, check all flange connections as well as all pipe and soldered fittings with a leak detector, leak detection spray or soap suds.

Renew faulty soldered connections, thighten leaking connections. In case of leaking flanges, disassembly of the respective pole column may be necessary.

6 Miscellaneous

6.1 Revision Set

On reconditioning use the revision set (2.7, figure B11) to move the contacts in end-position ON or end-position OFF manually. The adjustment of the fixed contact can be performed easily.

- Fix the revision set on the assembling trestle. For this purpose, at the bottom of the frame (2.7.01) are four holes with diameter 22 mm and a modular dimension of 500 mm x 290 mm.

- Mount the pole column on the revision set. Fasten with bolts M16x70 (2.7.16), nuts (2.7.17) and washers (2.7.18). Tighten the bolts with a torque of 202 Nm.

- Position the lever (2.7.06) in such way, that the edge of the cover (1.8.21) is visible when looking through the adjustment hole (P). Secure the lever with washer (2.7.20) and bolt (2.7.21).

- Couple the connection piece (2.7.04) with the pin (2.7.07) and secure with sleeve (2.7.08), washer (2.7.10) and bolt (2.7.09).

To determine the adjustment position proceed as follows:

- Fasten the nut (2.7.12) up to the revision set is free from backlash when in end-position OFF.

- Measure the length L1 in end-position OFF.

- To move the interrupter unit to end-position ON turn the nut (2.7.12) to the right so that L2 = L1 + 103 mm is reached. The accuracy of L2 has to be ± 3 mm.

By turning the nut (2.7.12) slowly to the left, the interrupter unit is opened.

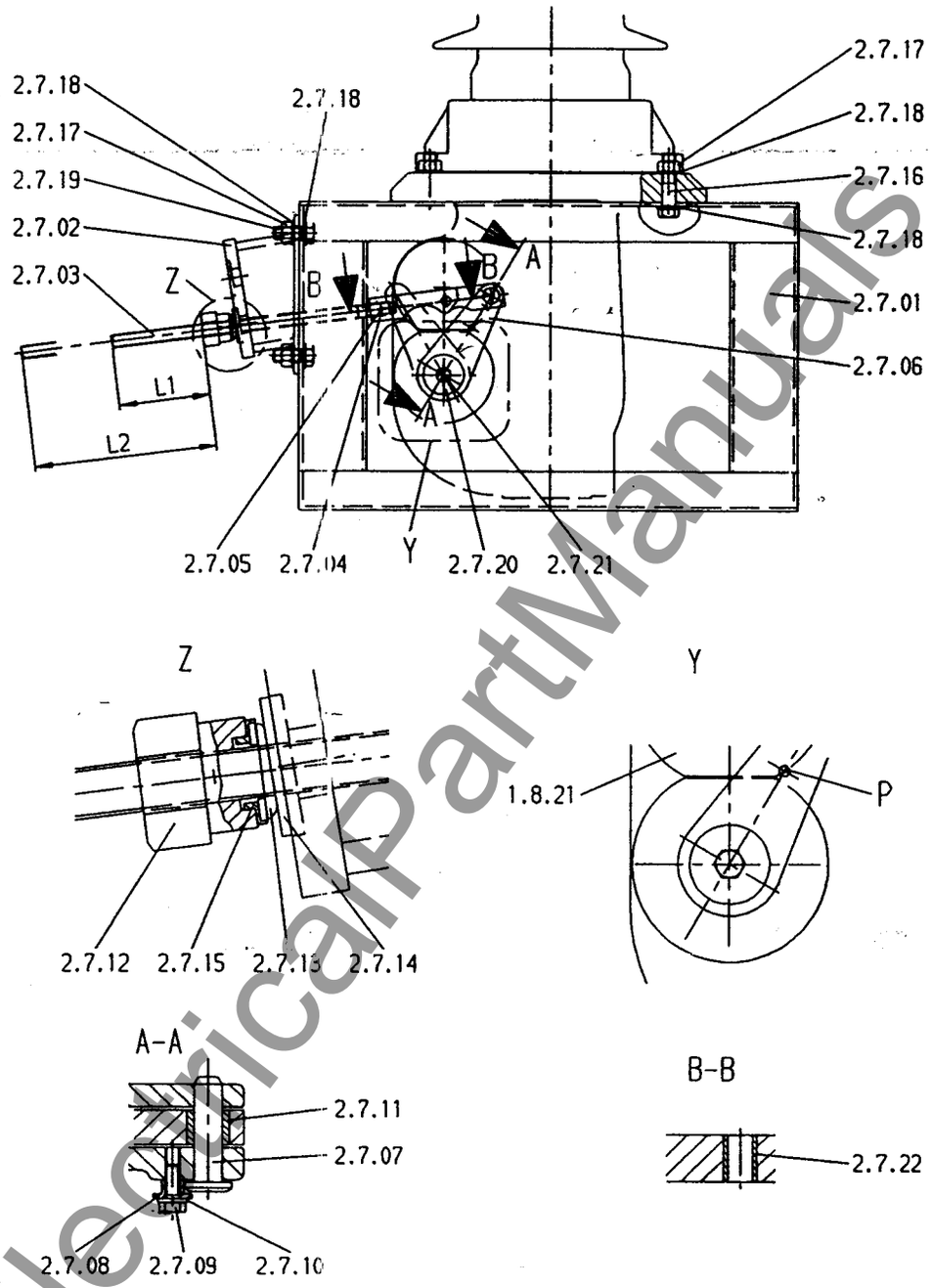

Fig. B11 Revision set

Parts according to figure B11

Part No.	Designation
2.7	revision set
2.7.01	frame
2.7.02	support
2.7.03	threaded rod
2.7.04	connection piece
2.7.05	pin
2.7.06	lever
2.7.07	coupling pin
2.7.08	sleeve
2.7.09	bolt M6
2.7.10	washer
2.7.11	bearing
2.7.12	nut
2.7.13	spherical washer
2.7.14	conical seat
2.7.15	needle bearing
2.7.16	bolt M16
2.7.17	nut M16
2.7.18	washer ϕ 17
2.7.19	bolt M16
2.7.20	washer
2.7.21	bolt M10
2.7.22	bearing bush

6.2 Overpressure Safety Device

The break chamber is equipped with an overpressure safety device. The fixed contact (1.1) is connected to the flange of the porcelain by expansion and retaining bolts. In case of overpressure the expansion bolts will be elongated and release the pressure to atmosphere. The porcelains will not be damaged.

The internal pressure exerts a force on the expansion bolts (1.10.01) which will be elongated at a set pressure of more than 400 % of the rated pressure. The fixed contact lifts from the flange of the porcelain and creates an opening between the flanges. The bolts (1.10.05) retain the fixed contact.

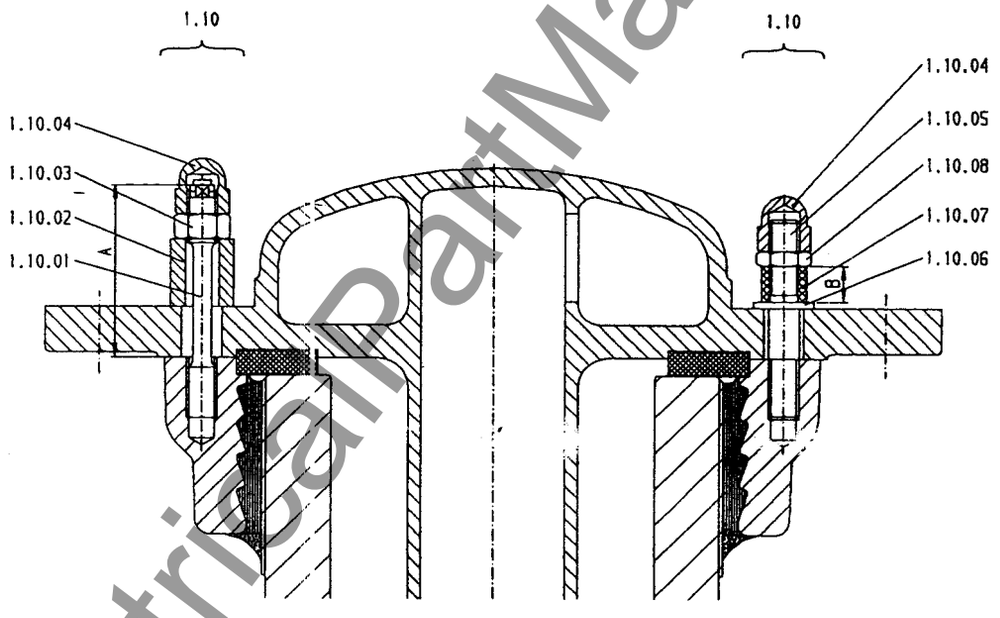

Fig. B12: Overpressure safety device (complete) (1.10)

	Number	Designation	Quantity
Expansion bolt	1.10.01	Expansion bolt	4
	1.10.02	Metal spacer	4
	1.10.03	Nut M12	4
	1.10.04	Cap nut	4
Retaining bolt	1.10.04	Cap nut	4
	1.10.05	Bolt M12	4
	1.10.06	Washer ϕ 13	4
	1.10.07	Compression sleeve	4
	1.10.08	Nut M12	4

Assembling

At reassembling new expansion bolts are mandatory. An assembly instruction is with the expansion bolts.

Proceed as follows:

- Precondition: breaker in end-position OFF
- Disassemble the old expansion bolts
- Install new expansion bolts into the flange of the chamber porcelain until the dimension A is reached.
- If necessary, install new retaining bolts.
- Place the fixed contact in the chamber porcelain and fasten with two retaining bolts. Use nuts (1.10.08) without compression sleeves (1.10.07). Tighten with 75 Nm. It could be necessary to use additional washers (1.10.06).
- Put the metal spacers (1.10.02) on the expansion bolts, grease threads with Molykote grease BR 2 plus and tighten the nuts (1.10.03) manually without a wrench.
- Mark the nuts.
- To prevent turning hold the expansion bolts (1.10.01) in place by means of a wrench and tighten half a turn.
- Remove the nuts (1.10.08) from the retaining bolts (1.10.05) one by one. Place washer (1.10.06) and compression sleeve (1.10.07). Hand-tighten the nut (1.10.08) to sleeve position tighten one more turn without wrench and lock with second nut (1.10.08). Check dimension E.
- Install the cap nuts (1.10.04) onto the ends of the expansion bolts and secure with Loctite blue.

CAUTION

It is mandatory to follow the safety precautions described in chapter "Handling of SF6".

6.3 Spare Parts and Accessories

The necessary accessories for renewing the arcing contacts and for disassembling a complete pole column are listed in the chapter 3.8 resp. 3.9, item c).

Other parts, which are normally not required as spare parts, can be ordered by their part numbers given in the instruction manual.

For spare parts of the spring operating mechanism please refer to chapter "Cleaning, Greasing and Lubricating of the Operating Mechanism".

Ordering of accessories and spare parts

Please provide the following details when ordering:

- Type, specification of breaker) see nameplate
- Serial number of breaker)
- Number of instruction manual) see cover sheet
- Part number or order number
- Designation
- Quantity

Accessories, test- and maintenance devices

Item	Designation	Weight	Order-No.	Quantity
1	SF6 gas cylinder (40 kg)	110 kg	1275 703	1
2	SF6 gas cylinder (10 kg)	27 kg	1264 374	1
3	Pressure reducing valve for SF6	3 kg	1264 386	1
4	SF6-filling hose (40 m)	16 kg	-	1
5	Gas refilling device DILO type 3-001	30 kg	1000 867	1
6	Gas refilling device with vacuum pump DILO type 3-001/2	50 kg	1000 597	1
7	Service cart with compressor DILO type 3-010	240 kg	1001 933	1
8	Leak detector type HI 300	0.5 kg	1274 369	1
	Battery		1001 903	1
9	SF6 sampling device for measuring moisture DILO type 3-028	16 kg	1003 433	1
10	SF6 analysis kit type AW	2 kg	1965 464	1
11	Acidity detector tube	20 g	1000 629	10
12	Adapter DILO-AEG	0.3 kg	1977 977	1
13	Micro ohmmeter	40 kg	1001 397	1
14	Metalpaper recorder	15 kg	1000 676	1
	Paper		1071 473	1
15	Travel recorder CBT4	19 kg	1003 896	1
16	Potentiometer	1 kg	1002 109	1
	+			
	Adapter	-		1
17	Test-boy	0.3 kg	1206 144	1
18	SF6-content measuring device	8.5 kg	1003 654	1

Table B11: Accessories (test- and maintenance devices)

Appendix I

Handling of SF6 Gas

Sulphur hexafluoride (SF6) is a colourless and odourless gas. Pure SF6 is non-poisonous, therefore no risk classification has to be followed.

As reference for the degree of toxicity the German MAK-values (maximum ambient concentration value for an eight-hour stay) are given:

The maximum concentration at a place of work, assuming that a person spends 8 hours per day there, is 1000 ppm (or 0.1 %) by volume. This very low value is the standard value adopted for all gases considered harmless, but not normally present in the atmosphere.

Under the influence of an arc, decomposition products occur which are partly toxic.

The decomposition products of SF6 are of different toxicity. They may irritate mucous membranes, respiratory tracts and other unprotected skin. Almost immediately - prior to the danger of poisoning arising - even smallest amounts of gaseous decomposition products can be recognised by their strongly pungent, disagreeable odour.

It is mandatory for maintenance personnel to follow these safety precautions:

C A U T I O N

- Inside rooms with SF6 installations, eating, drinking and smoking as well as storage of food is forbidden. This applies especially to maintenance work, when the pole columns are opened.
- Direct contact with parts which were in contact with the insulating gas should be avoided.
- Do not touch the powdery decomposition products.
- Ensure sufficient ventilation of the room.
- Only maintenance personnel that are absolutely necessary to carry out the work, should be in the area.
- Shower thoroughly after completion.

When handling SF6 gas, the maintenance personnel should be equipped as follows:

- appropriate gas mask and breathing equipment. Best is full gas mask or gas mask and breathing equipment plus gastight safety glasses.
- dust tight protective overalls (disposable overalls)
- rubber gloves or disposable gloves
- rubber boots or disposable boots

After completion wash gas mask and breathing equipment, safety glasses, rubber boots and rubber gloves with water. The water used as well as the protective clothing have to be disposed of.

Appendix II

Permissible number of short-circuit operations

The replacement of the arcing contacts is necessary, when a cumulative current (r.m.s. value) is reached. Fig. B13 shows the permissible number of operations under normal service conditions versus breaking current.

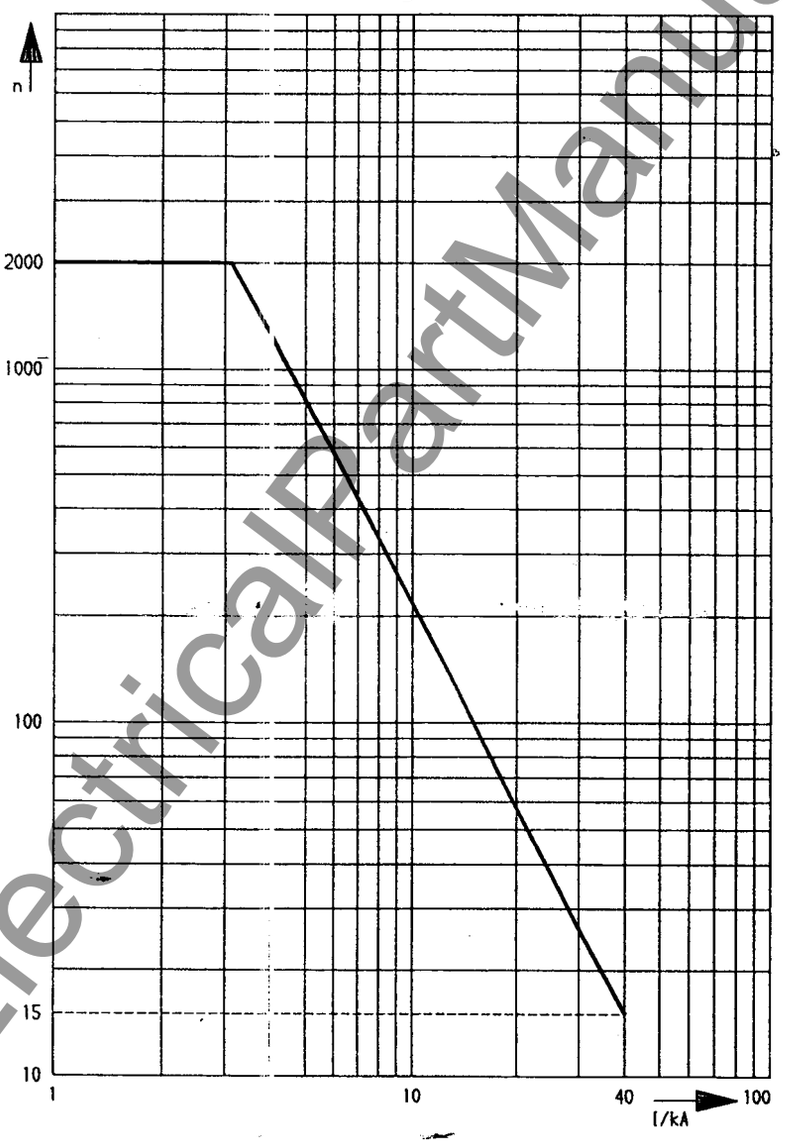

Fig. B13 Permissible number of CO-operations without maintenance of the arcing contacts versus breaking current.

Appendix III

List of Figures and Tables: