

**Heavy-duty Vacuum Circuit-breaker VAH
12 kV to 17.5 kV**

Operating Instructions
No. 531 271, Edition 12/98

ALSTOM



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1 Standards, Specifications, Operating Conditions

The three-pole heavy-duty vacuum circuit-breaker VAH

- is designed for operation in power plants and transformer substations in the industry and power generating companies.
- complies with the regulations for AC switchgear for voltages above 1 kV in accordance with VDE 0670, parts 101 - 108 as well as IEC Publication 56.
- as regards switching and insulating capacity it complies substantially in addition to the aforementioned regulations, with the following standards:
 - ANSI C37.06/table 2 (for switching capacity and dielectric strength)
 - NEMA Standards Publication No. SG 4
- is suitable for normal operating conditions in compliance with DIN EN 60694 and IEC Publication 60694 (replacing DIN VDE 0670 part 1000).
Temperature class: „minus 25 indoor“
 - Ambient temperature
max. + 55 °C
At temperatures > 40 °C
reduction of rated current
 - Ambient temperature
min. - 25 °C
(indoor temperature)

The operator should check the operating conditions at intervals, which he decides in compliance with his own experience, by inspecting the insulating parts for contamination (e.g. dust).

If necessary clean insulating parts in accordance with Section 8.


Observe the following for operating the heavy-duty vacuum circuit-breaker:

- the accident prevention regulations VBG 4 of the industrial injuries insurance institution for light and electrical engineering which apply for the Federal Republic of Germany
- DIN VDE 0101
- DIN VDE 0105 part 1
- DIN VDE 0141

Operators outside the Federal Republic of Germany should

- consider the accident prevention regulations and standards as a basis.
- apply the appropriate relevant local specifications.
- perform any necessary modifications on site.

Maintenance work must be performed only by qualified persons, who have had experience with circuit-breakers and their drive.

 **The reliability and life of the switchgear depend on proper operation in accordance with regulations. The instructions contained in these operating instructions must be observed. Non-compliance may jeopardise claims under guarantee.**

In the event of enquiries and ordering spare parts the following data of the name plate must be stated:

- type designation
- factory number
- year of manufacture

2 Technical Data

Type designation

The type designation of the heavy-duty vacuum circuit-breaker - cf. name plate (Fig. 6.1) - gives information about important technical data. The meaning of the type designation is explained below by means of an example:

Example	VAH 12-63-40-27
Type	VAH
Rated voltage	12 kV
Rated short time current (rated short-circuit breaking current)	63 kA
Rated current	4000 A
Pole centre spacing (PCS)	275 mm

Control and actuation units

The drive is designed fundamentally for manual tensioning of the energy-storing device (make spring).

The drive may be equipped with further control and actuation units.

- Push switch S21 – S25
 - actuated by the energy-storing device
- Auxiliary switches S1
 - are actuated by the switch shaft. The switching positions of the switch elements are dependent on the switch status "Make" and "Break" of the circuit-breaker.
 - 12 / 16 / 20 pole versions may be supplied.
 - They are set in compliance with the circuit diagram. Cf. Fig. 13 regarding other settings.

A number of switch elements are reserved for internal breaker-control.

Switching times *

Rated voltage	[kV]	12	13.8	17.5
Opening time at rated release voltage for release 25 W	[msec]		80 - 115	
Arcing time (max.)	[msec]	12	12	14
Closing time at rated release voltage	[msec]		30 - 60	
Minimum actuation time "Break" electrical release for release 250 W	[msec]		50	
Minimum actuation time "Make"	[msec]		20	
Minimum actuation time "Break" mechanical release	[msec]		90	

* Rated frequency in accordance with name plate rating (50 or 60 Hz)

Weights

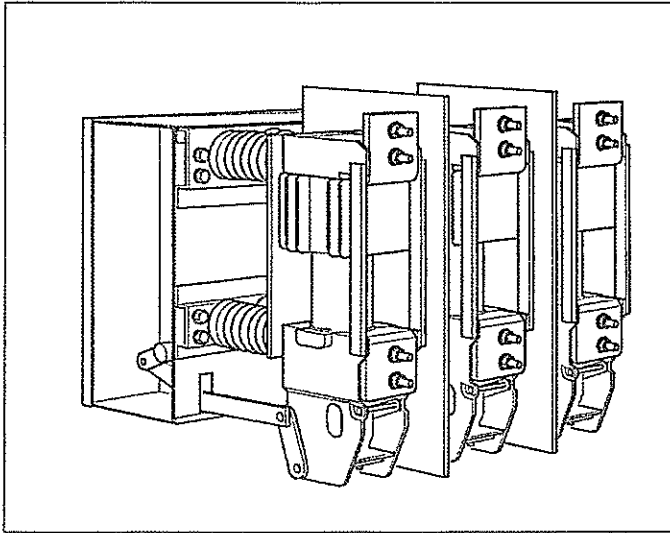
Rated current	[A]	1250/2500	3150	≥ 4000
Weight *	[kg]	200	380	500

* The weights of the vacuum circuit-breaker VAH are approximate and do not include packing.

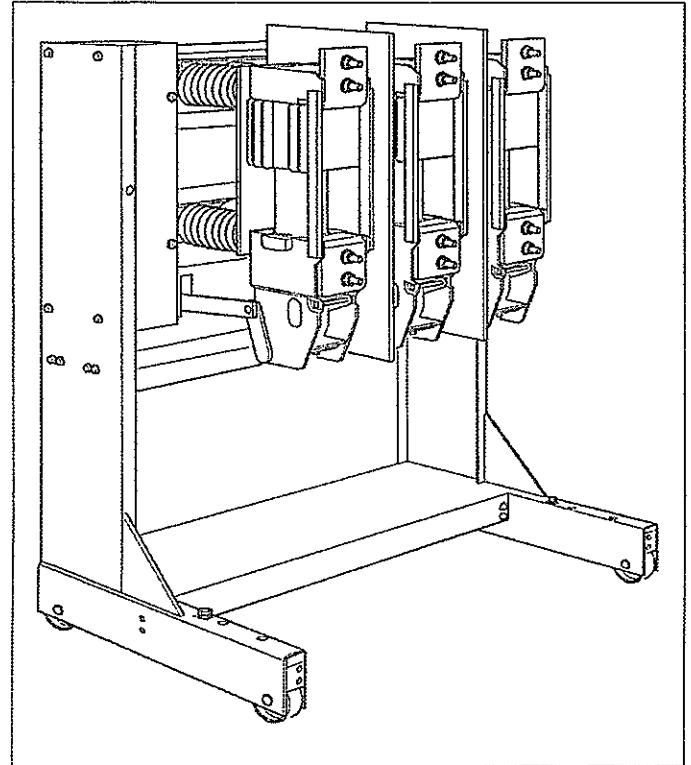
- Shunt opening releases F11 - F12
- Shunt closing release F2
- Push switches S41 – S43
 - S41 and S42 actuated by the button "Make" and "Break"
 - S43 actuated by the button "Break"
- Motor M1
 - for tensioning the energy-storing device (closing spring)

Power consumption of magnet coils and motor:

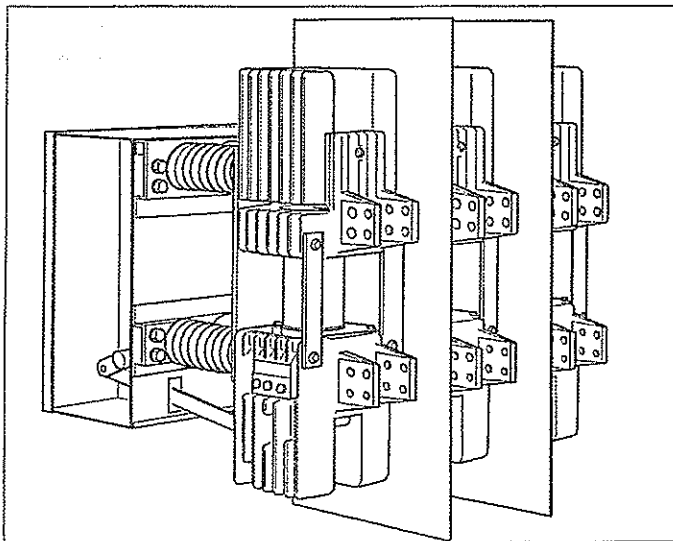
Magnet coils	Power consumption [W]
Shunt closing release	160
Shunt opening release	25
Under-voltage release without time delay	15
Indirect overcurrent release	12
Blocking magnet	12
Motor	200 – 250
Motor tensioning time	≤ 12 s



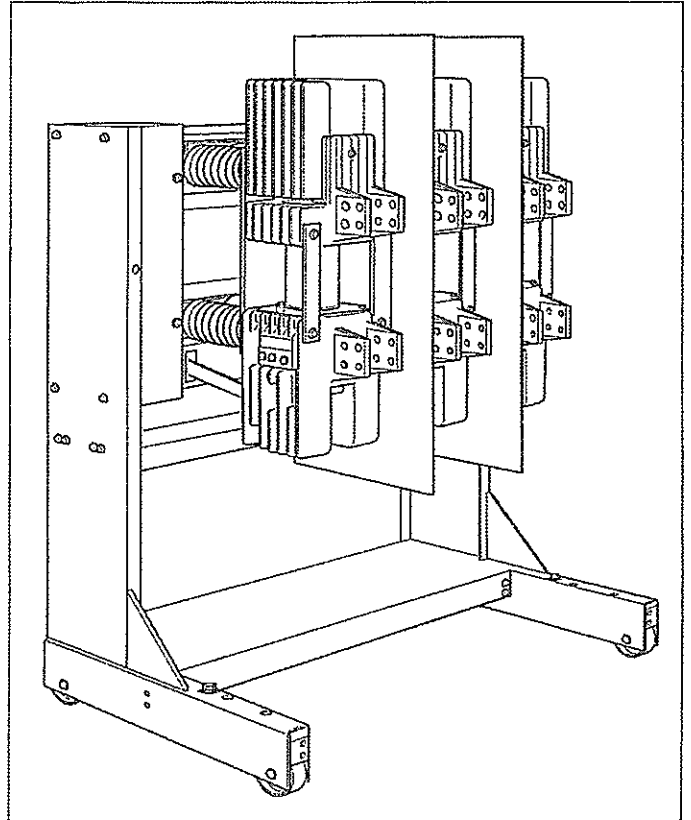
1
Heavy-duty vacuum circuit-breaker VAH, 1250 A



2
Heavy-duty vacuum circuit-breaker VAH,
1250 A on
transport cassette



3
Heavy-duty vacuum circuit-breaker VAH, 4000 A



4
Heavy-duty vacuum circuit-breaker VAH,
4000 A on
transport cassette

3 Installation

Before installation

- Dimensional drawings are supplied on request.
- Check the technical data on the name plate.
- Check rated supply voltage of the incorporated control and actuation units.

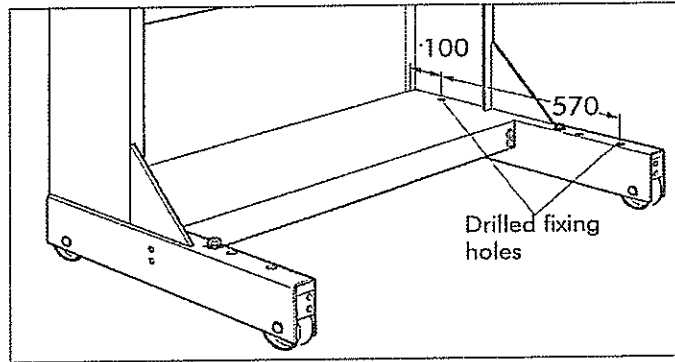
The circuit-breaker is delivered in the position "Broken" and energy-storing device "detensioned".



Do not tension the energy-storing device before completing installation. Danger of injuries.

Interlocking further units

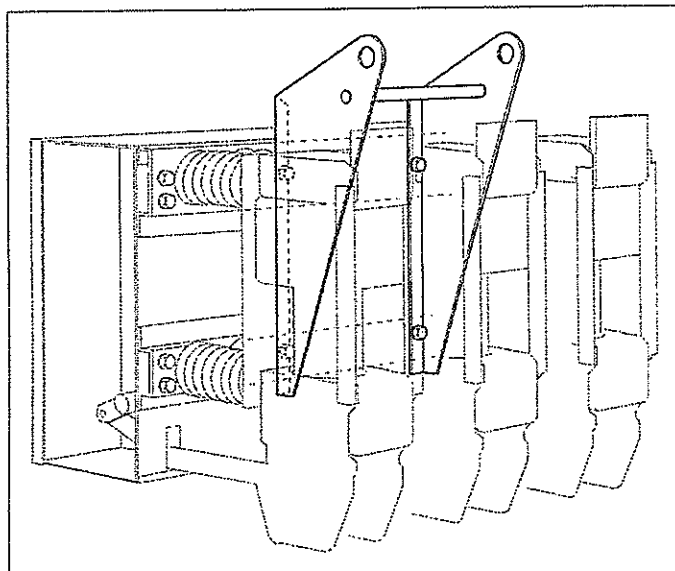
If, dependent on the position of the circuit-breaker, other devices shall be interlocked or controlled, it must be borne in mind that the masses and forces acting for interlocking purposes do not influence the switching behaviour of the circuit-breaker.



5
Fastening points in the transport cassette

Switching devices on transport cassette

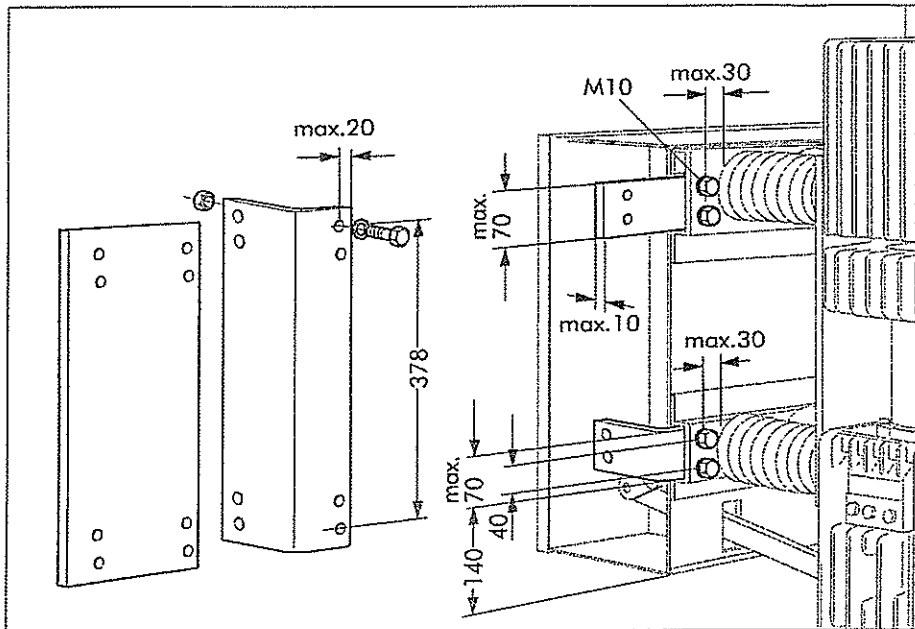
Four drilled holes diam. 18 mm each are provided in the transport cassette for fastening on the floor or on rails.



6
Crane hooks (remove after fitting the breaker)

Switching devices for direct attachment

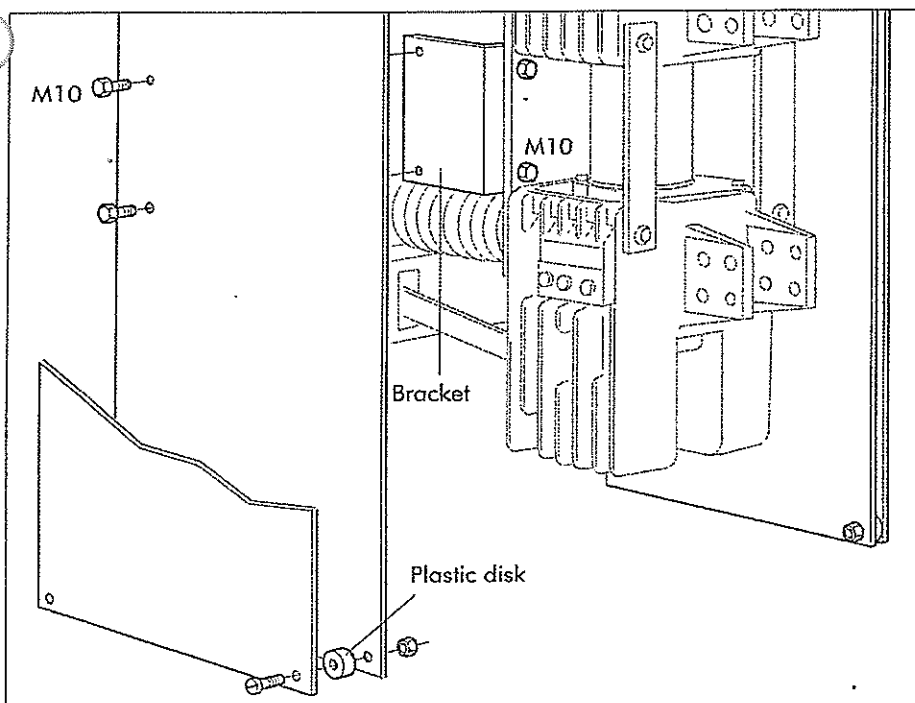
The circuit-breakers are supplied with fitted crane hooks. After attachment the crane hooks must be removed.



7
Examples for fixing

Fixing the circuit-breaker in place

- Fastening points are provided at the ends of the insulator supports with predefined hole positions (Fig.7).
- In the event of an installation position (service position) differing from the standard, harmonise installation position with the manufacturer.
- The circuit-breaker must not be distorted by the fastening.
- Observe torques on tightening screws.
- Screws and fitting parts are not supplied with the breaker



8
Attachment of partitions

Fitting the partitions

- Fit two brackets on the supporting plate (centre switch pole) using 2 x M10 plastic screws.
- Screw partitions onto brackets using 2 x M10 plastic screws.
- In the case of double partitions, screw on 2nd partition at four places using plastic disc spacers).

Conditioning the contact surfaces

Contact surface material	Conditioning
Silver-plated copper	Clean (1)
Copper	Clean (1) polish bright (2)
Steel or galvanised steel	Clean (1) polish bright (2) Remove any passivation

Conditioning fixed bolted contact surfaces

(e.g. contact surface on switching device - busbar)

Immediately before bolting contact surfaces together:

(1)

Clean

- with a non-fuzzy cloth, with a detergent on strong soiling.

(2)

Polish

- with emery cloth (grain 100 or finer) or with a metal brush which is used for only copper or with Scotch Brite Handpads and
- apply contact lubricant KL to the two contact surfaces, apply in such manner that the space between them is filled when they are bolted together. Apply a moderate film of lubricant to busbar screw and bolt connections.

- Make busbar bolt and screw connections in compliance with DIN 43 673.

The heavy-duty vacuum circuit-breaker must not be distorted by screwing on the busbars.

Observe table 3, Section 8.


Busbar cross-sections for connection to the heavy-duty vacuum circuit-breaker VAH

Rated current [A]	Minimum busbar cross-section [mm ²]	Material
< 5000	Connection as DIN 43 671	Copper
≥ 5000	4000	Copper
8000 *	8000	Copper

* with ventilator set

Connecting the busbars

Connection surfaces are surfaces for the passage of current. Material of the connection surfaces on the heavy-duty circuit-breaker: *silver-plated copper*.

 **Aluminium busbars must never be connected to silver-plated connection surfaces of the heavy-duty vacuum circuit-breaker.**

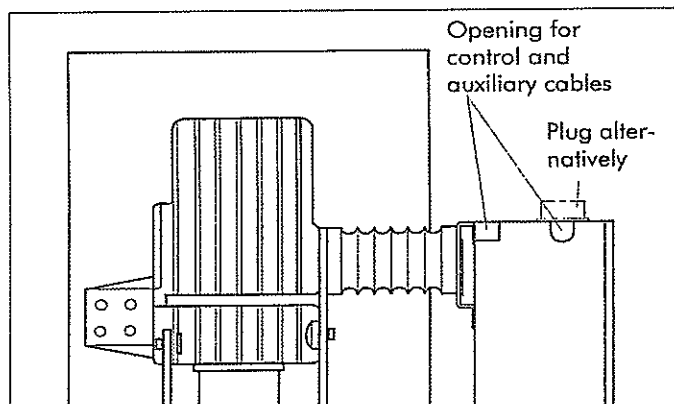
- Take into consideration DIN 43 671 as regards the rating of continuous current. Operators outside Germany should apply the relevant local regulations.
- Maximum spacing from the nearest support point of the connections of the circuit-breaker towards the switch pole axis:
 - at rated short-circuit breaking current 50 kA = 825 mm (3 x pole centre spacing).
 - at rated short-circuit breaking current 63 kA = 500 mm.

If the nearest supporting point is not situated in the direction of the breaker pole axis, care must be taken that no higher currents forces act on the circuit-breaker switch pole.

Connecting the control cables

Connection by means of:

- plug or
- terminal strip in the drive cabinet



9
External
control cables

On connection by terminal strip remove the cover plate (five screws).

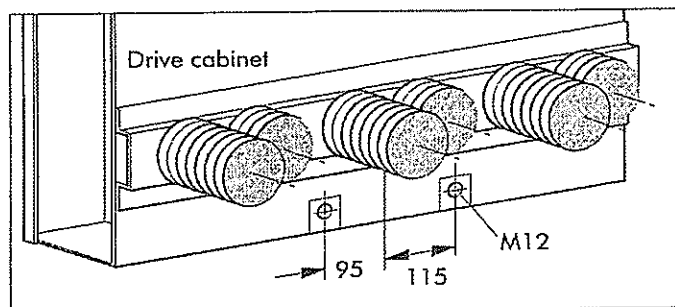
Connect the external control cables through the terminal strip and lay them to the outside through the opening in the drive cabinet or connect by plug.

The following may be connected:

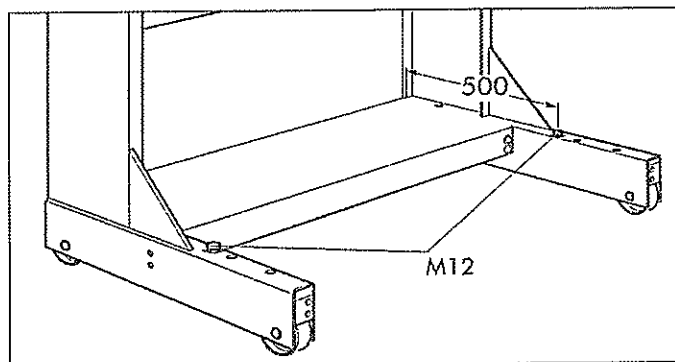
- flexible wires up to 2.5 mm² (only on connection by plug)
- solid single wires up to 4.0 mm²

The binding connection plan is situated as adhesive circuit diagram on the inner side of the cover plate.

- If additional control cables are installed in the drive cabinet, sufficient spacing to moving parts of the drive must be provided.
- Re-install cover plate after the external control cables have been connected.



10
Earth connection on
heavy-duty vacuum
circuit-breaker
(steel)



11
Earth connection on
transport cassette
(steel)

Earth connection

(Connect station earth to the earth connection of the circuit-breaker.)

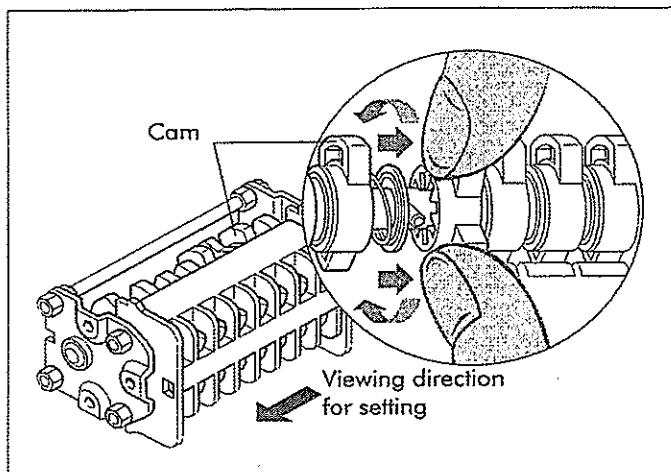
- Choose cross-section and material of the earth conductor in compliance with DIN VDE 0141 or national installation specification.
- Condition connection point in compliance with this Section.
- Screw and bolt connections in compliance with Section 8.
- Protective earthing may also be established through the fastening screws in the profile of the rear plates of the drive cabinet if galvanised ratchet screws are used as fastening screws whose ratchet penetrates the varnish.

Admissible thermally active short-time current per ratchet screw M12 and M10:

4 kA (1 sec.); 2.7 kA (3 sec)

4 Auxiliary switches

12
Setting switch
functions



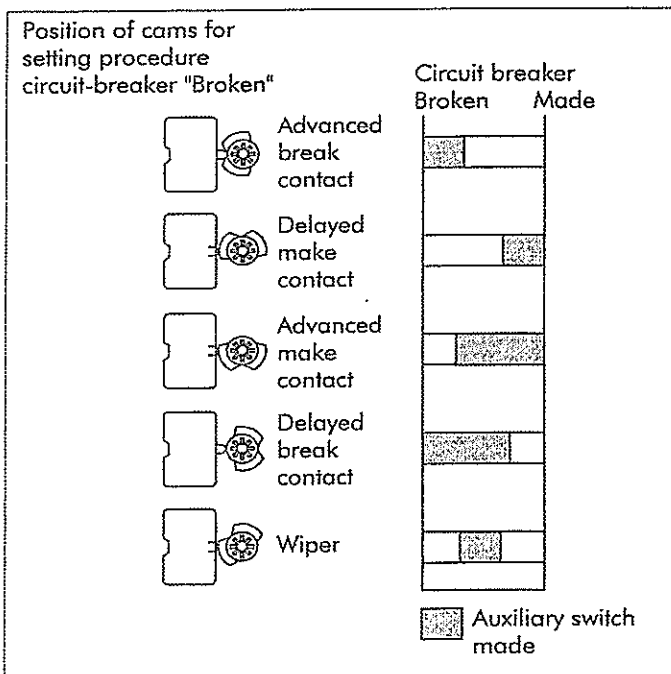
Please refer to the circuit diagram regarding switch functions on delivery.

Other functions of the auxiliary switch may be set by means of adjustable cams.

Setting procedure:

1. Set circuit-breaker to "Broken"; energy-storing device detensioned.
2. Remove cover plate (loosen five screws).
3. Set desired switch function.
4. Latch cam in the driver again.
5. Check whether or not the cam has latched in the changed position.
6. Replace cover plate on completion of settings.

13
Switching pro-
gramme of the
auxiliary switch



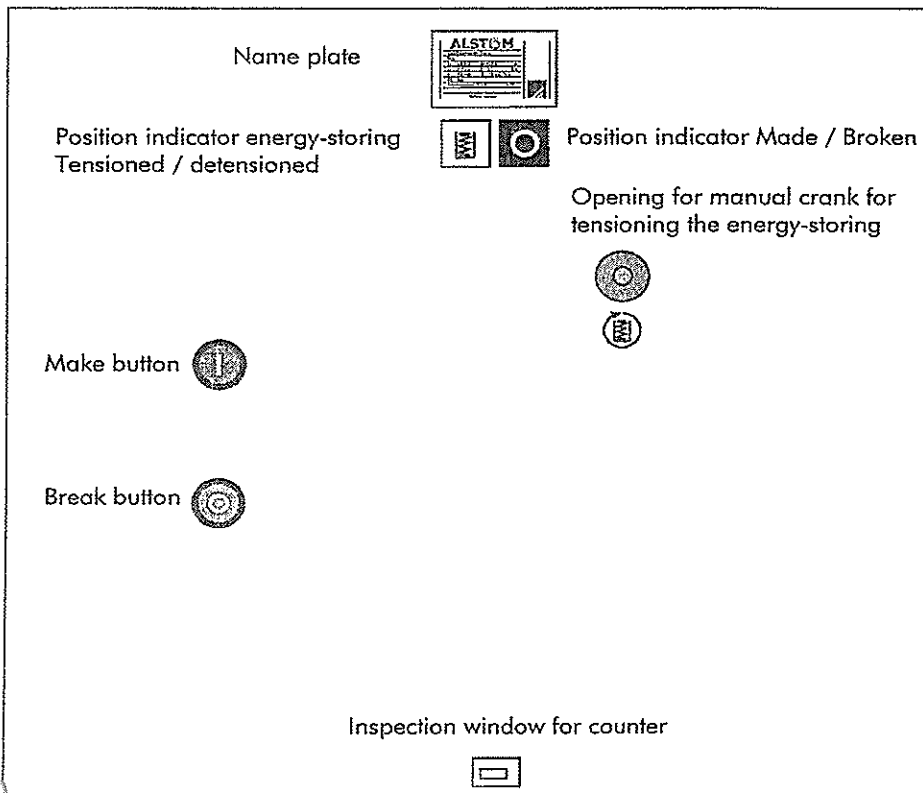
Technical Data

		Direct voltage					Alternating voltage	
Rated supply voltage	[V]	24	48	60	110	220	110	220
Switching capacity	[A]	8	4	3	2	1	10	10
Short-circuit level	[kA]	1					-	
Time constant	$T = L/R$	≤ 30 msec					-	

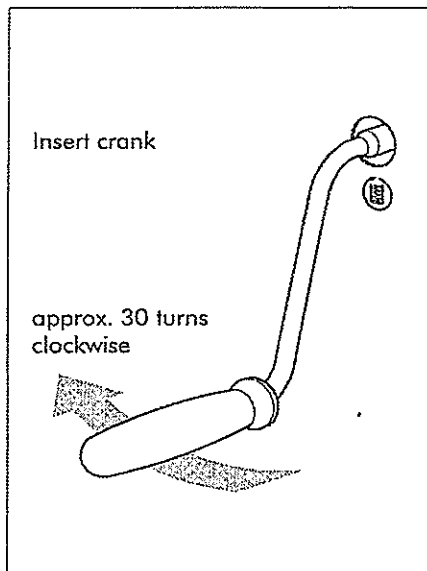
5 Commissioning

- Check installation work:
 1.
Check fastening screws.
 2.
Check screws of busbar and cable connections with torque spanner.
 3.
Check screws of earth connection.
 - Apply rated supply voltage.
Absolutely essential for heavy-duty circuit-breakers with under-voltage release or blocking magnet.
 - Check whether serviceability has been impaired through transportation or installation work.
 1.
Check heavy-duty circuit-breaker for visible damage.
 2.
Perform trial switchings (cf. Section 6).
 3.
Tension energy-storing device with crank. Press buttons "Make" and "Break" in sequence. Check position indicators.
 4.
Check electrical functions of control and actuation units.
- Apply rated supply voltage. Perform switching procedures and check functions by energising auxiliary switches and blocking magnet. Observe position indicators.

6 Operation



14
Control elements



15
Tensioning the energy-storing device manually

Initial position

- Circuit-breaker in position "Broken"
- Energy-storing device "Detensioned"

Tensioning the energy-storing device (Make spring) manually

Set circuit-breaker to position ready for closing:

- Insert crank in the opening for tensioning the energy-storing device.
- Turn the crank approx. 30 turns clockwise until the position indicator shows "Tensioned" (There is no hazard if the motor starts running during this procedure.)
- Withdraw crank after tensioning. The circuit-breaker is ready for closing (Fig. 15).

Tensioning the energy-storing device (making spring) by motor:

In circuit-breakers with motor the energy-storing device is automatically tensioned once the rated motor supply voltage is applied.

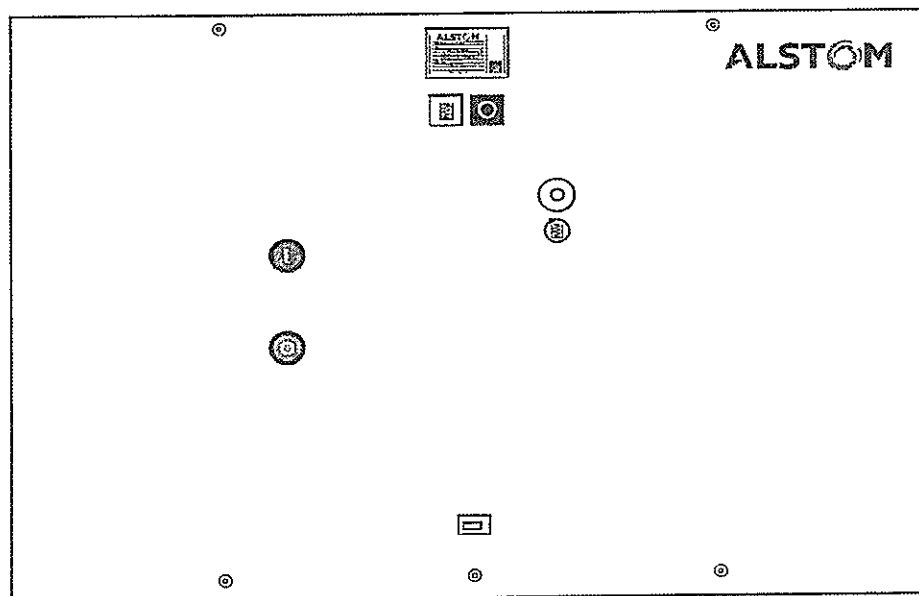
Making - breaking

- **Making**
Press button switch "Make" or apply the rated supply voltage to the shunt closing release. After making the energy-storing device may be tensioned again immediately (manually or by motor). If the rated supply voltage is applied to the motor, tensioning takes place automatically.
- **Breaking**
Press button switch "Break" or break by means of the shunt opening release, undervoltage release or indirect overcurrent release.

Position indicators on heavy-duty circuit-breaker and possible switching sequences

Pos.	Position indicator Energy storing de- vice (make spring)	Position indicator Make/Break Breaker position	Circuit breaker positions			possible switch- ing sequence
			Energy storing de- vice (Make spring)	Breaker position	(Break spring)	
1			detensioned	Broken	detensioned	none
2			tensioned	Broken	detensioned is tensioned by C	C – O C O
3			detensioned	Made	tensioned	O
4			tensioned	Made	tensioned is tensioned again by C	O – C – O O – C O

C=Making,
O=Breaking



16
Control side of the circuit-breaker

Testing for proper condition

Depending on the loads in service and on operating conditions a visual inspection of the heavy-duty circuit-breaker is recommended.

The inspections should be made every four years. If contamination is found, the heavy-duty circuit-breaker must be cleaned by qualified staff. Cf. Section 8.



Take care when working on the drive. Danger of injury.

The energy-storing device must be detensioned and the circuit-breaker "Broken"!

In cases of doubt or if deviations from the proper condition of the circuit-breaker are found, the manufacturer should be consulted.

7 After 10,000 switching cycles

Heavy-duty vacuum circuit-breakers type VAH may be operated for more than twenty years without maintenance.

After 10,000 switching cycles the circuit-breaker drive and switch poles must be conditioned in accordance with the lubrication instructions (Section 9).

On reaching the sum current limit (cf. following diagrams) or after 10,000 switching cycles the vacuum switching chambers must be replaced.

For instructions on replacement of the vacuum switching chambers consult the manufacturer.

Enquire with the manufacturer regarding the number of breaking operations at rated currents of >5000A.

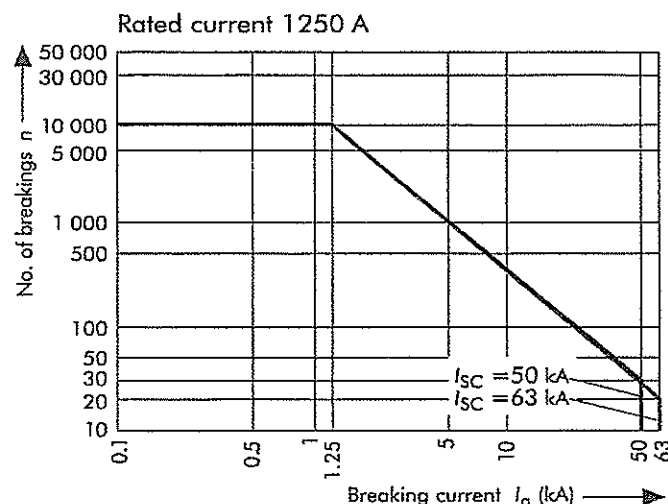


Fig. 17

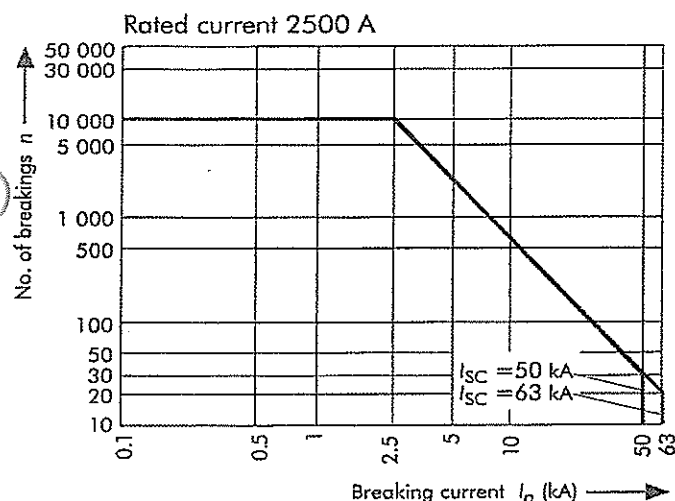


Fig. 18

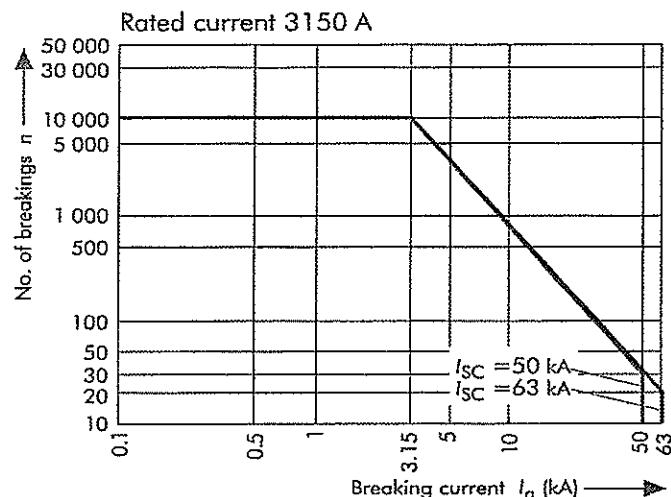


Fig. 19

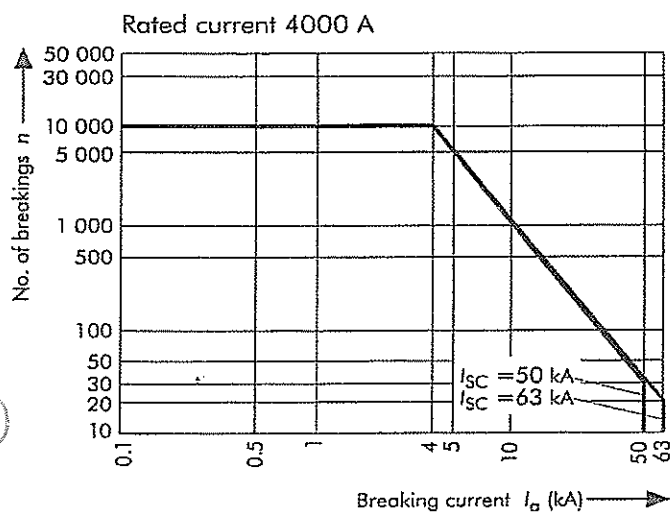


Fig. 20

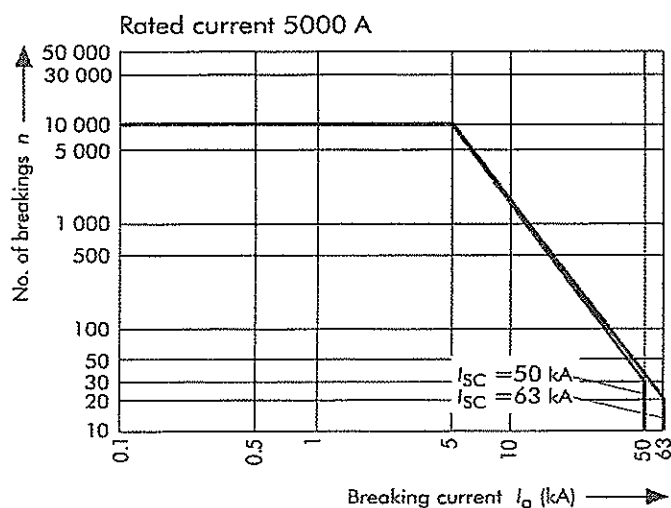


Fig. 21

8 Appendix

Screw and bolt connections

Thread size	Fixing torque-[Nm]	
	min.	max.
M6	7	9
M8	18	22
M10	36	44
M12	63	77
M16	153	187
M20	297	363

Table 1:

Hex and machine screws (except slot-headed screws) and nuts without ratchet.

Thread size	Fixing torque [Nm]	
	min.	max.
M6	13	15
M8	32	40
M10	65	80
M12	90	110
M16	240	300

Table 2:

Screws and nuts with ratchet.

Thread size	Fixing torque [Nm]	
	min.	max.
M6	4.5	6
M8	10	14
M10	20	27
M12	40	56
M16	80	108

Table 3:

Bolt connections between switching device and busbar.

Thread size	Fixing torque [Nm]	
	min.	max.
M6	0.7	0.9
M8	1.5	2
M10	3	3.9
M12	5.1	6.7
M14	7.6	9.9
M16	10.2	13.2

Table 4:

Plastic screws and nuts (partition attachment). No conditioning of the thread.

For all metal screw connections the following must be used:

- screws:
hardness class ≥ 8.8
- nuts:
hardness class 8

Condition screws and nuts as follows:

- Apply a thin film of multi-purpose lubricant ML to screw threads and heads.
- Tighten the screw connections with the torque shown in tables 1 to 4.

Lubricants and detergents

	Order No.
Contact lubricant KL 0.5 kg can	008 157
Multiple purpose lubricant ML 0.5 kg can	008 154
Liquid lubricant FL 0.5 l tin	008 153
Detergent 1 l can	008 152
Other lubricants and detergents must not be used.	

Accessories

	Order No.
Manual crank	617 810

Cleaning insulation and vacuum switching chambers

Cleaning parts made of plastic and ceramic:

- partitions
- post insulators
- operating rods
- connection lugs
- ceramic of the vacuum switching chambers
- Clean with a dry non-fluffy cloth. Change the cloth frequently depending on contamination.

Type approval of the vacuum switching chambers in compliance with German regulation R6V

The vacuum switching chambers have been approved in compliance with the X ray regulations (R6V) of the Federal Republic of Germany up to a maximum voltage amounting to the design short-time AC voltage (rated power-frequency withstand voltage) in compliance with DIN VDE/IEC. Thus they satisfy the conditions for operation not requiring approval up to this voltage in accordance with the X ray regulations.

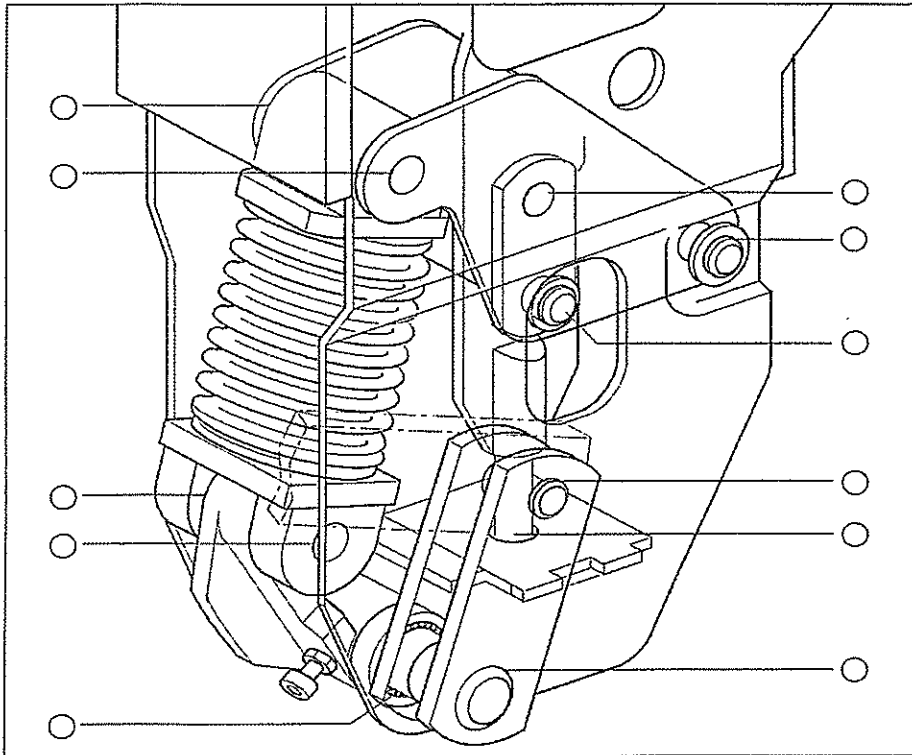
Disposal at end of life

A disposal manual is available for disposal of the heavy-duty vacuum circuit-breakers VAH at the end of their life. To order the Service Centre in the manufacturer's factory undertakes disposal.

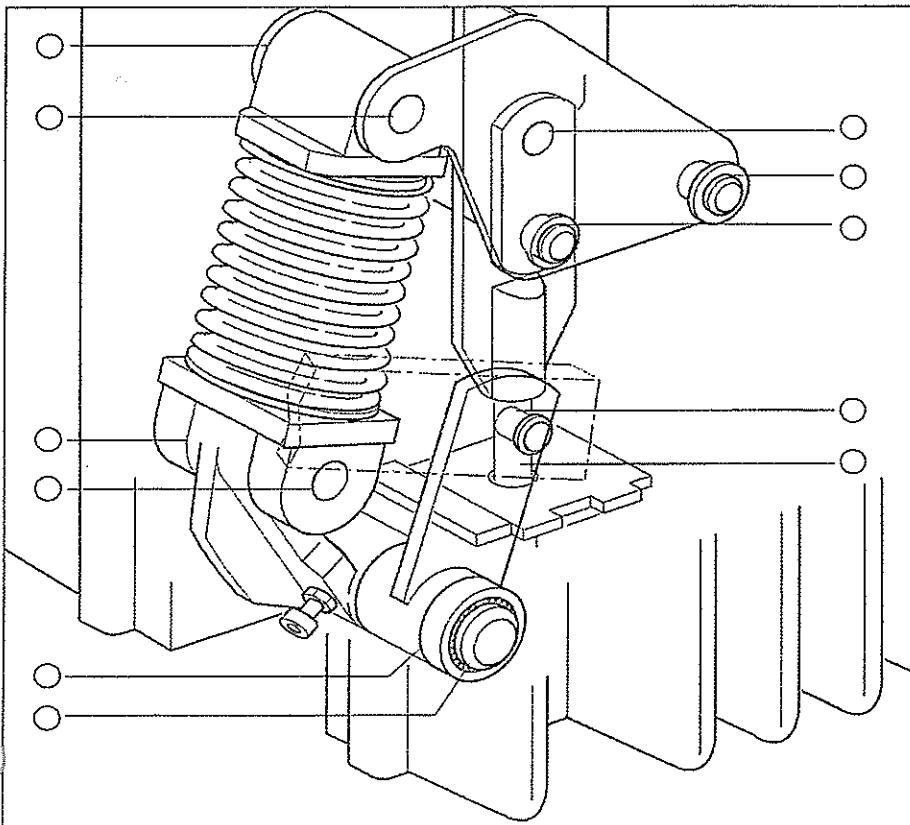
Delivery address:

ALSTOM Sachsenwerk GmbH
Service-Centre V71-R
Rathenaustasse 2
D-93055 Regensburg
Tel.: ++49 - 941 - 4620 - 771
Fax: ++49 - 941 - 4620 - 776

Instructions for Lubrication



22
Circuit-breaker pole VAH 1250 A / 2500 A / 3150 A, lower section, lubrication points



23
Circuit-breaker pole VAH 4000 A / 5000 A, lower section, lubrication points

Measures before starting maintenance work

Maintenance work must be undertaken only by skilled and qualified staff, who have had experience with circuit-breakers and their drive.

The circuit-breaker must not be dismantled for maintenance work.

Before starting maintenance work the circuit-breaker must be disconnected from the supply and secured in compliance with the relevant safety regulations in accordance with DIN VDE 0105, Part 1.


1.
Set circuit-breaker to the position "Broken".
2.
Detension energy-storing device:
 - Disconnect rated supply voltage.
 - Press in sequence the buttons Break, Make and Break (make and break spring detensioned).
 - Perform a switching cycle at zero current by pressing the buttons Make and Break.
3.
On completion of the maintenance work (the high-voltage connections not being live):
 - tension energy-storing device.
 - press button Make - press button Break.

Switch poles

- Liquid lubricant FL on bearings, articulated joints and guides.

Apply liquid lubricant in drops (oil can, drop-feed oiler) in the bearing gap. Through capillary action the liquid lubricant runs between the bearing surfaces. Use extension pipe or spray at inaccessible lubrication points.

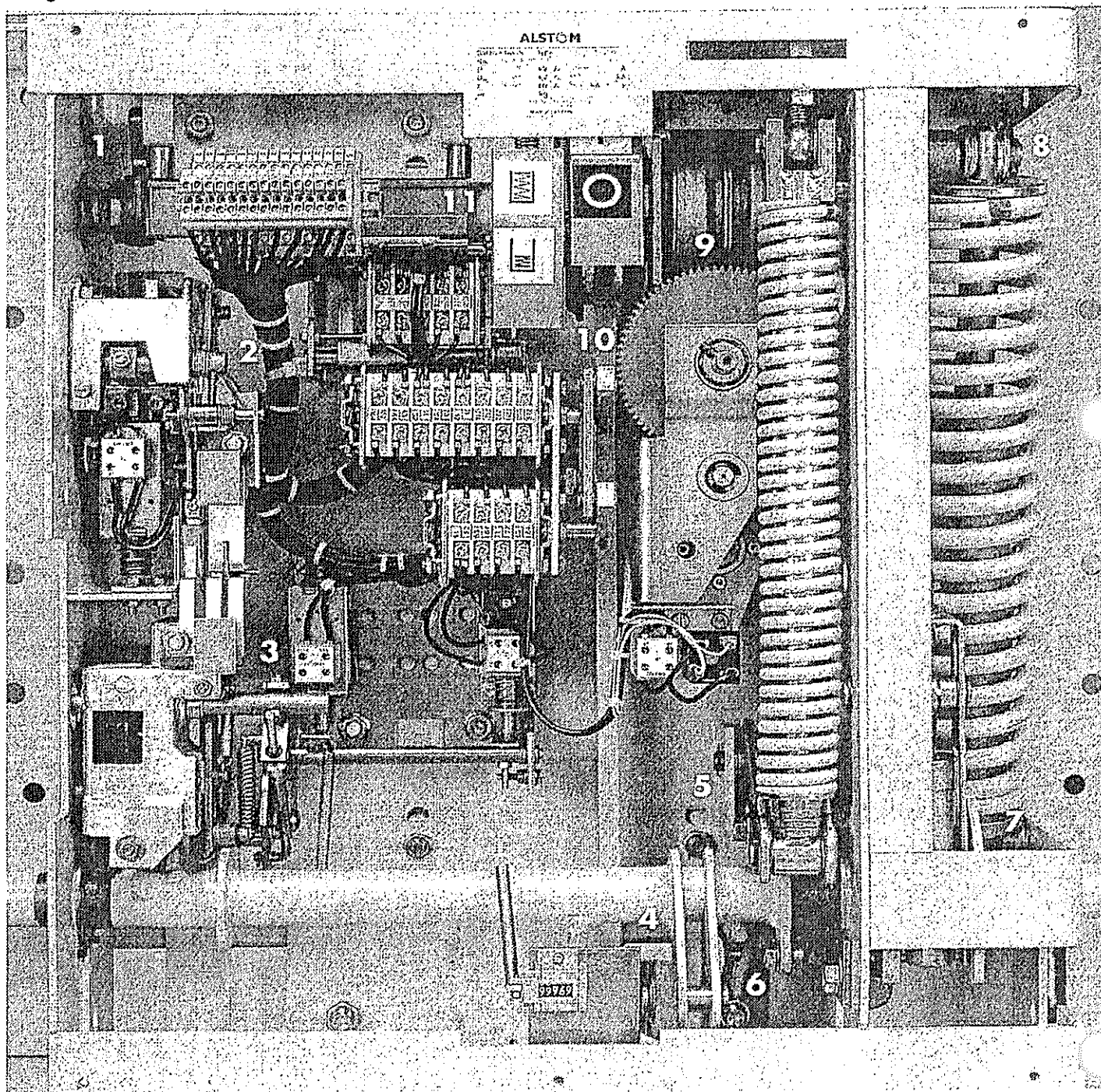
Drive

 Work may be carried out on the drive only when the energy-storing device is detensioned and the circuit-breaker is disconnected.

The front cover is removed by loosening five screws.

Do not lubricate:

- tensioning gears
- motor
- ball-bearings and sliding bearings
- auxiliary make release
- auxiliary Break release
- push switch Make-Break
- push switch "Energy-storing device"
- auxiliary switches
- tappets of all release coils



Lubrication methods

- △ Contact lubricant KL on sliding surfaces.

Clean lubrication points with a non-fluffy cotton cloth.

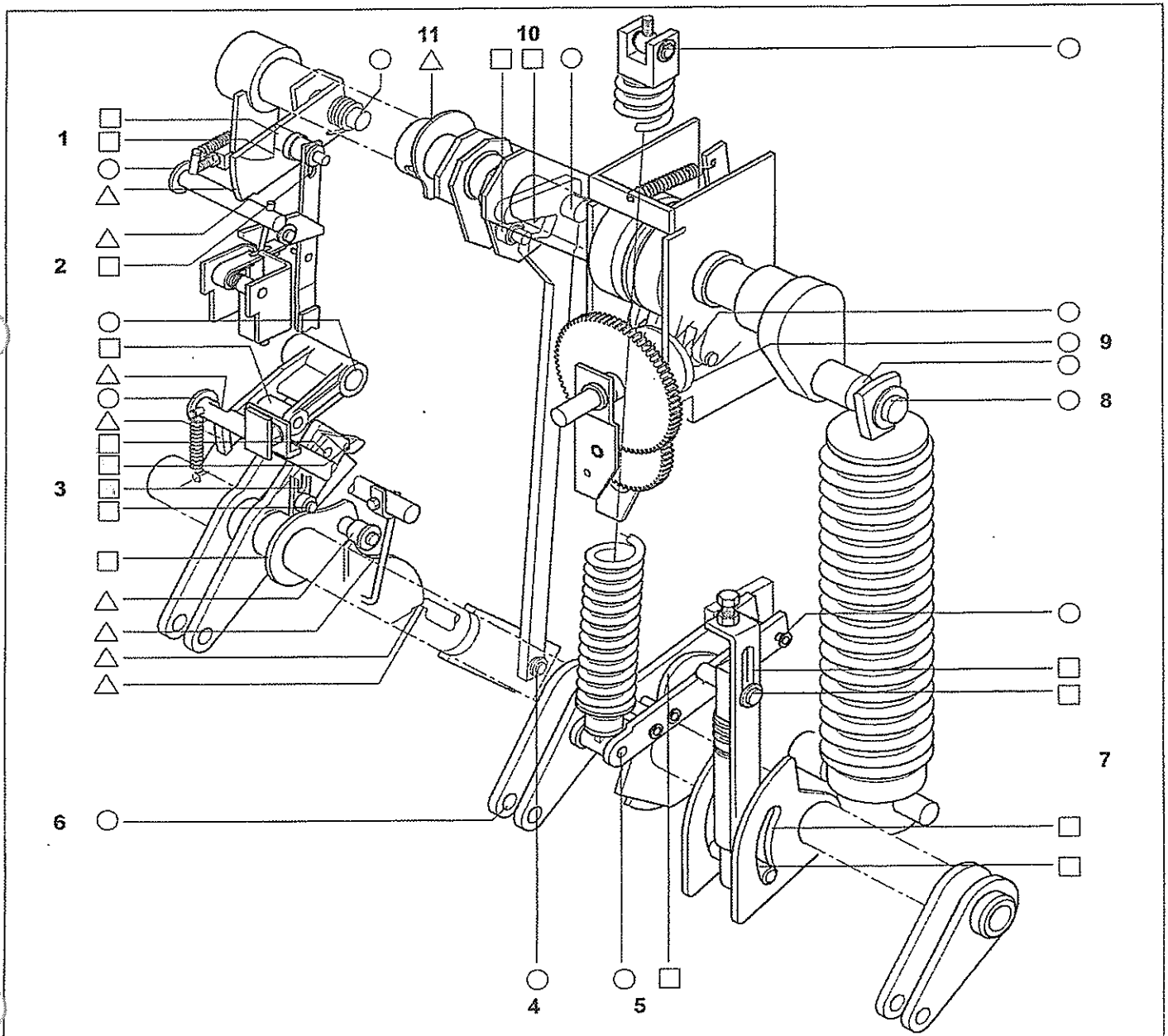
Apply a thin film (e.g. with a brush)

- Multi-purpose lubricant ML on running off and bearing surfaces.

Clean lubrication points, e.g. with a non-fluffy cotton cloth of soft brush and detergent (use little, moisten only lubrication points). Apply a thin film of multi-purpose lubricant.

- Liquid lubricant FL on bearings, articulated joints and guides.

Apply the liquid lubricant in drops (oil can, drip feed lubricator) in the bearing gap. The liquid lubricant runs between the bearing surfaces through capillary action. Use extension pipe or spray at inaccessible points.





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