LI2-2
LI 2-

SACE
BERGAMO

M V AIR
CIRCUIT-BREAKERS
SERIES DIARC
TYPE D 6

INSTRUCTIONS
FOR SERVICE AND MAINTENANCE

SACE S.p.A. COSTRUZIO
ELETTROMECCANICHE - BERGA
HEAD OFFICE AND WORKS: BERGAMO - VIA BAIONI, 35 - TELEF.23
BRANCH OFFICES: MILAN - VIA ROSELLINI, 2 - TEL. 688.265
ROME - VIA PANAMA, 58 - TEL. 848.831 - 85
TELEX 31676 SACE

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C O N T E N T S

1. DESCRIPTION (fig 1 and 2)

The medium voltage magnetic deionization air circuit-breaker series DIARC type D6 is composed of three separate poles supported by a sheet steel frame (1) provided with non-swiveling wheels (2) and of a quick make and -break type AE or AEM operating mechanism.

Each pole consists of two separate parts :

- arc chute (4) equipped with blow-out coils (5) and insulating barriers for elongation and cooling of the arc

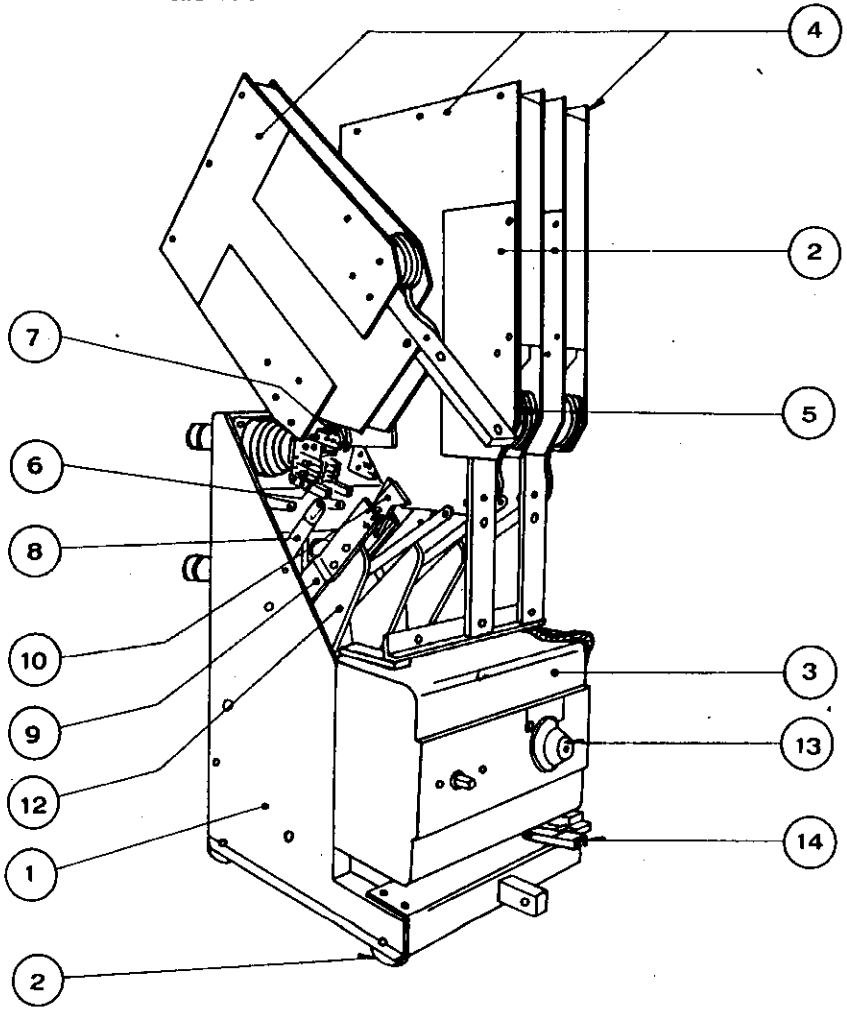


Fig. 1

- contact unit is constituted by the main contacts, fixed (6) and moving (9), by the arcing contacts, fixed (7) and moving (10)

The main contacts of silver plated heavy copper, carry the normal service current, therefore they are not affected by the interruption as they separate before the separation of arcing contacts occurs.

The arc-resisting faced fixed and moving arcing contacts, of copper and bronze respectively, are quite capable of withstanding undamaged the strong short-circuit currents.

The blow out hoses (8) are located under the fixed contacts.

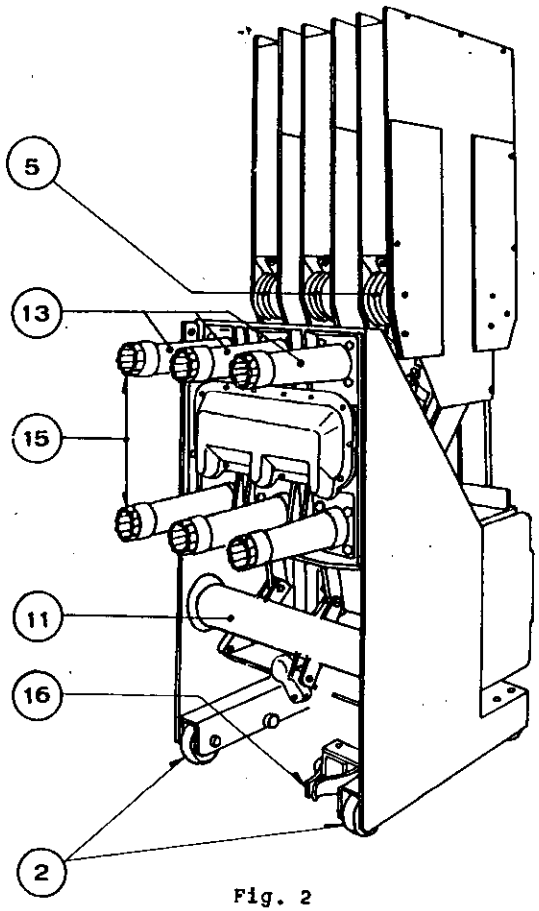


Fig. 2

The moving contact group is operated by the shaft(11) through the insulated material linkage (12);the metal frame is grounded through clamp (16).

A welded sheet steel grounded frame with insulated interphase barriers, houses the live parts of the breaker assuring safety to operating personnel.

The breaker can be manually , by means of knob (13), or remote operated provided that the operating mechanism is equipped with shunt trip and closing release.

1.1. Constructions

The breaker can be:
- fixed construction, type D6f
- draw-out construction, type D6e

Figs 3 and 4 show the fixed construction overall dimensions as well as the dimensions of terminals and the drilling template for the installation of the breaker behind sheet steel panel.

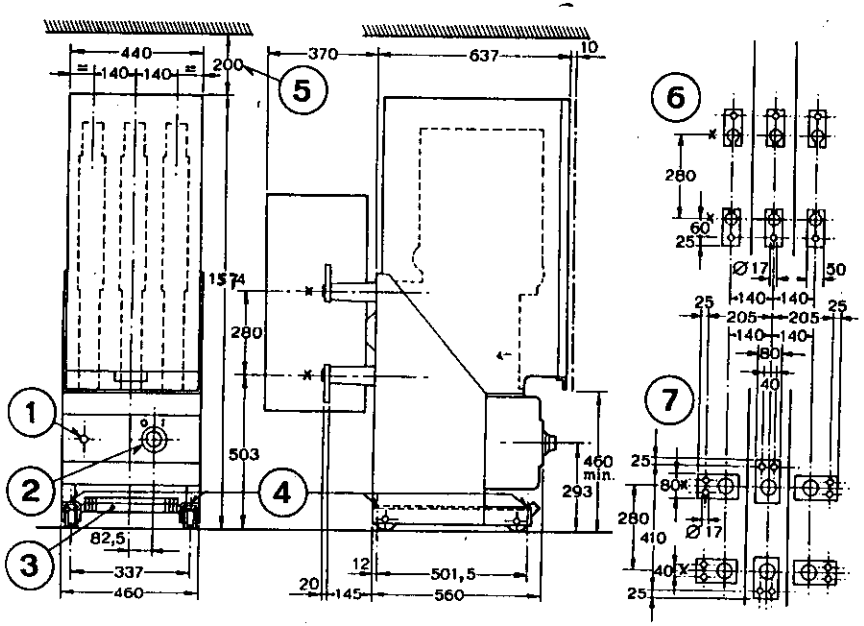


Fig 3 - Circuit-breaker type D6, 6 kV, 1250 - 2000 A, fixed construction

Legend figg. 3 - 4

1) Shaft for the manual loading of springs
2) Knob for the hand closing and opening
3) Terminal board
4) Ø9 holes for fixing the breaker
5) Minimum clearance to earth
6) Location and dimensions of 1250 A terminals
7) Location and dimensions of 2000 A terminals

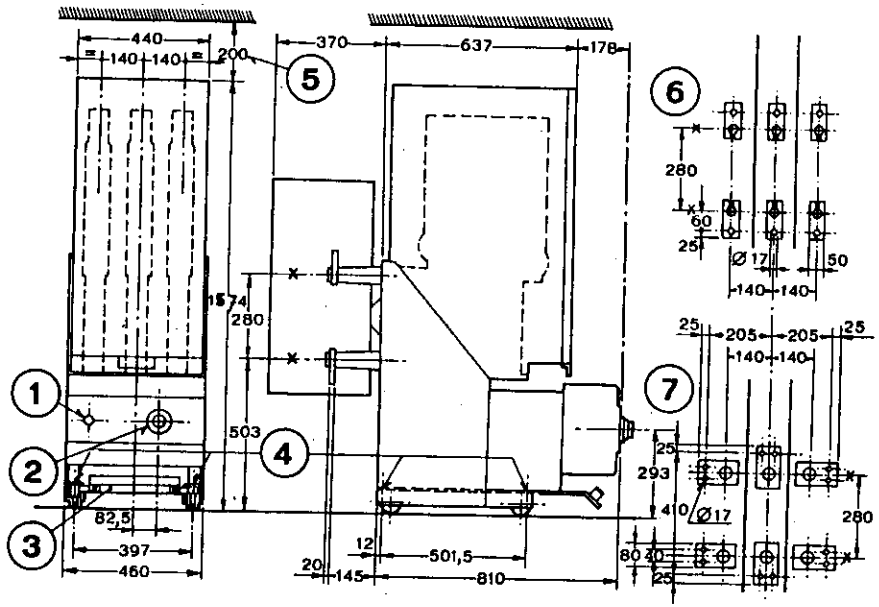


Fig 4 - Circuit-breaker type D6, 6 kV, 1250 - 2000 A, fixed construction

Besides on 1250 A type (fig 3) space for the accomodation of overcurrent releases is provided.
The draw-out construction breaker is supplied complete of stationary frame (fig 5) suitable for fitting to prefabricated switchboards; it can be

- inserted
- isolated
- drawn-out

by operating the racking-in lever; it is also provided with the relevant pedal locking device (14)(fig 1).

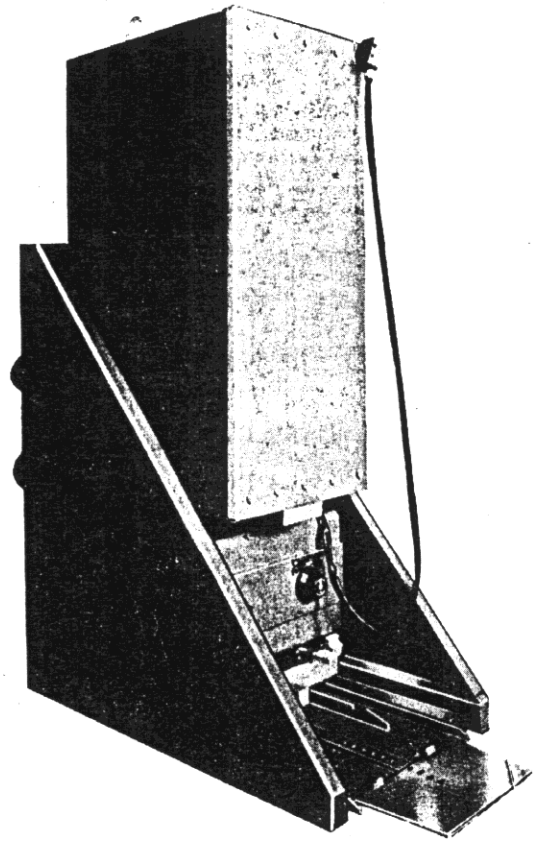


Fig. 5

The breaker is connected to the stationary portion by means of tulip terminals couplying with the insulated plug terminals embodied in the insulated bushings fitted to the stationary frame. When the breaker is isolated or drawn out, a grounded dropping steel panel, operated by racking action of the truck, covers the live parts giving a quite adeguate protection to personnel.

Rated current	Dimensions (mm) A	B	C
1250 A	203	168	10
2000 A	215	173	20

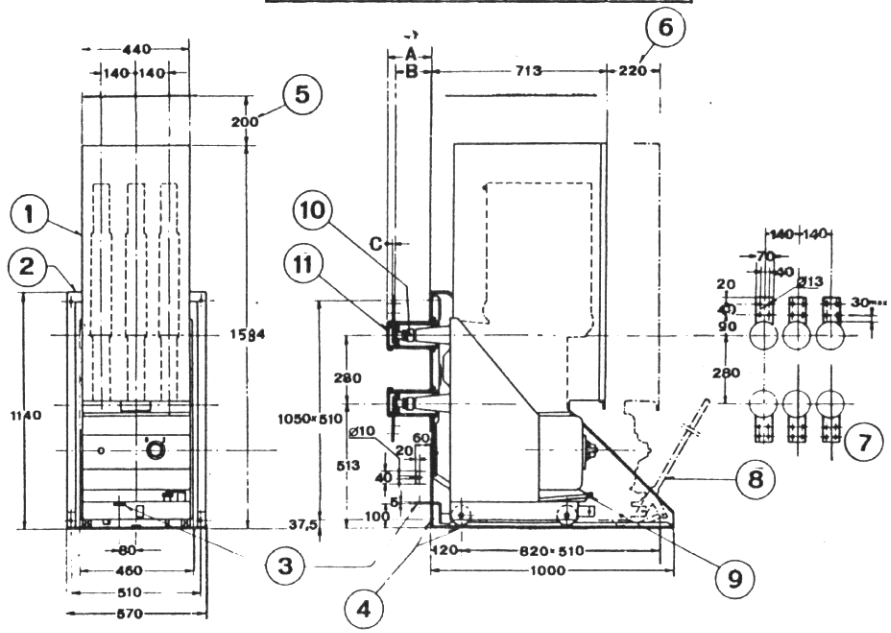


Fig 6 - Circuit-breaker type D6, 6 kV, 1250 - 2000 A, draw-out construction

Caption

1) Drawable portion
2) Stationary portion
3) Earthing connection
4) 8 holes Ø 12 for fixing the stationary portion
5) Minimum clearance to earth
6) Isolation travel
7) Positions and dimensions of terminals
8) Racking-in lever
9) Pedal locking device
10) Tulip connections
11) Insulating caps

Clearances are to CEI, IEC, VDE specifications.Due to their compactedness these breakers are particularly suitable for installation in protected switchboards. They also comply with the accident prevention laws.

Fig 7 - shows a breaker housed in a UNIARC switchboard

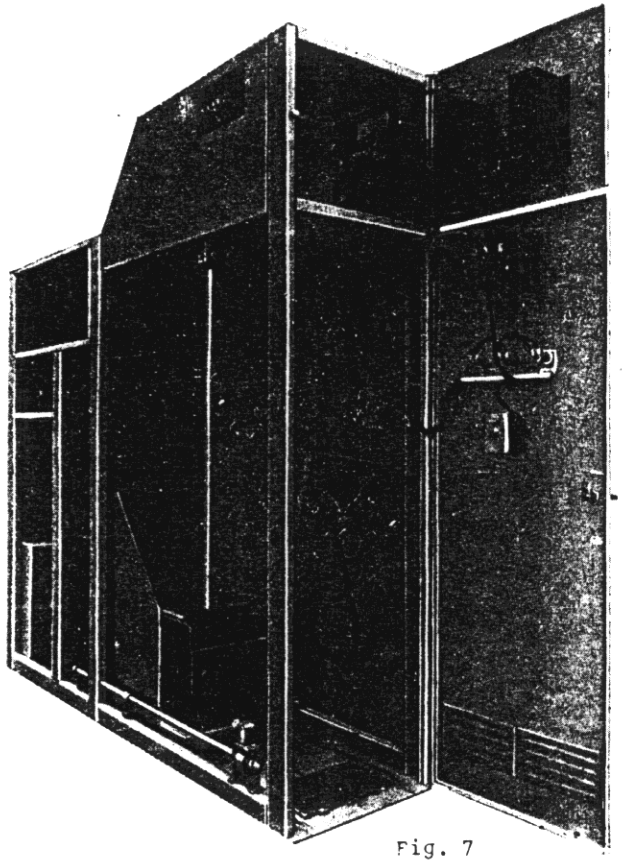


Fig. 7

1.2. Accessories and fittings

1.2.1. Basic accessories

Supplied with the breaker:

- racking-in lever, only for draw-out construction
- crank for the manual loading of closing springs
- metal stationary portion, only for draw-out construction

1.2.2. Optional extras

a) Overload releases (only for 1250 A type, fixed construction) types MF, MFSP, MO, MOSP instantaneous or dash-pot or clockwork lagged trips

Ratings:

rated current (n)	1-710A
adjusting trip current	0.6-1.2In
peak short circuit current	300xIn
short time permissible current	100xIn

More detailed information is given on catalogue 8-1 TN 2338.

b) Spring loading motor (•)

c) Shunt trip

d) Closing release (•)

e) Anti-pumping device (•)

f) Undervoltage release available for connection to either incoming or outgoing side of circuit-breaker

g) Auxiliary contacts

h) "Spring loaded" electrical indication

i) "Tripped" electrical indication

l) Key interlock between two or more breakers

m) Key interlock preventing the breaker from being closed

n) Operation counter

The characteristics of fittings b, c, d, e, f, g, h, i, l, m, n are illustrated in chapter 2 of the instruction booklet for AE and AEM operating mechanisms, LI8-1

(•) Normally supplied with the AEM operating mechanism

2. SHIPPING

The breaker is shipped in one wooden case while the arc chutes areshipped in another case apart,both cases being marked with the number of the advice-note a copy of which is sent along with the shipping documents.

The instruction booklet, the control card with the characteristics of the breaker and the quality control visa are enclosed in the breaker case.

. INSPECTION ON RECEIPT

When a shipment of circuit-breakers is received, each breaker should be examined carefully. If any damage is found, SACE is to be informed on the extent of the damage within five days after reception, quoting the several number of the breaker.

. STORAGE

A good preservation is secured provided that the following instructions are observed:

- handle the breaker with the utmost care, hoist it using a tackle or similar means and attach the sling hooks to the holes on the sides of the breaker
- after the inspection on receipt, release the closing springs and, if possible, store the breaker and arc chutes into their cases up to the installation time
- keep the cases in a dry place, protected against dust and chemical agents

INSTALLATION

5.1. Preliminary operations

Before setting at work a breaker which was stored for some time, the following operations should be carried out:

- to clean carefully any part of the breaker by means of a dry duster or brush
- to check the condition of contacts and terminals, the main contacts are to be coated with a thin layer of Molykote grase, while terminals and arcing contacts are to be cleaned with petrol or other solvent
- to tighten all the pieces listed in table IV

5.2. Mechanical checking

All the circuit-breakers are carefully controlled and tested at our factory before shipment for operational performance, yet it is advisable to carry out some closing and opening operations after removing the arc chutes and safety barrier (see § 5.3.2.) to check the operational performance. This is done following the instructions under § 4. of booklet LI 8-1.If any trouble occurs, check the operating mechanism as instructed under § 6. of booklet LI 8-1 for AE - AEM operating mechanism. If the breaker is equipped with overload releases, close the breaker and check that the breaker trips when the trip lever end is lifted by means of a screw driver as shown on fig 8.

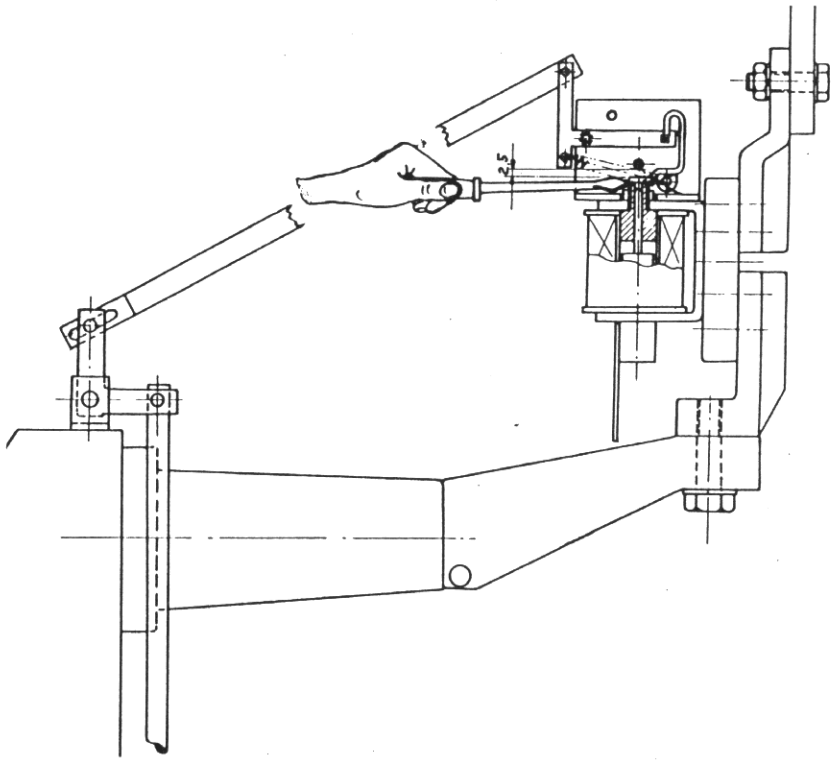


Fig. 8

5.3. Installation

5.3.1. Hoisting

This is to be make as instructed under § 4. If the breaker is equipped with overcurrent releases, take care not to damage the release rods.

5.3.2. Arc-chute fitting (fig 9)

Make sure that no foreign matter is inside the arc-chutes:

- remove screws (2), then remove the safety barrier(1)
- fit the conductor pin (3) to seats (4)
- rotate the arc-chute downwards till plates (6) are fitted to stud (7)
- fix the arc-chute by means of nuts on studs (7) having care that the connector (8) is to be fixed outside the arc-chute

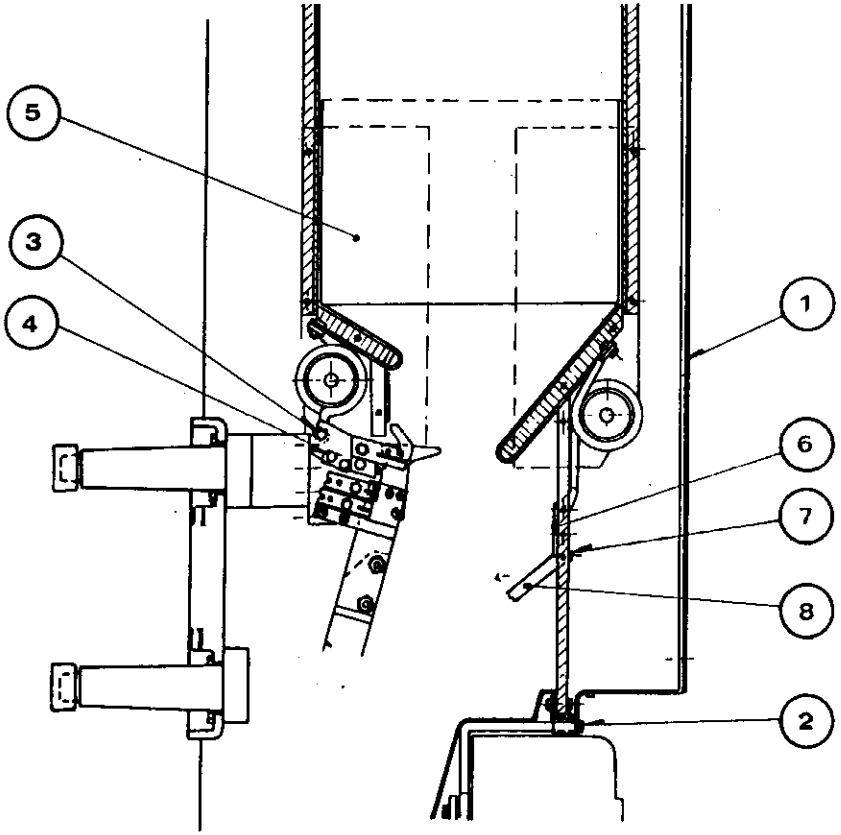


Fig. 9

5.3.3. Fixed breaker installation

Fix the breaker to the floor by means of bolts in correspondence to the four bolts made in the truck of the breaker (figs 3 - 4), having care that the truck is not warped when the nuts are tightened. Earth the breaker through the earthing clamp fitted to the truck, marked in yellow.

5.3.4. Draw-out breaker installation

Fix the stationary portion of the breaker to floor and to wall by means of screws through the 8 holes (see fig 6). Check that clamp (16)(fig 2)couples the earthing knife situated on the stationary portion of the breaker, then connect the earthing cable.

5.4. Racking operations

- Place the truck wheels on the rails and make sure that the breaker runs frictionless

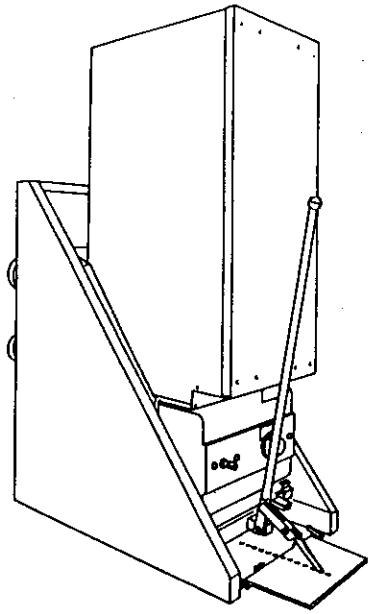


Fig. 10

- Move the breaker to isolated position, place the racking lever, as shown on fig 11 and operate it alternatively till the audible click of the lock releasing the rails is heard
- Rack the breaker in, do the same operation as above after releasing the locking device (1) by pressing the pedal (2)
- Rack the breaker out, place the lever as shown on fig 11 and do the same operations as above

Checking is to be made by pressing the pedal(2)which releases the rail lock (1) in the stationary portion; the breaker, if closed, must trip.

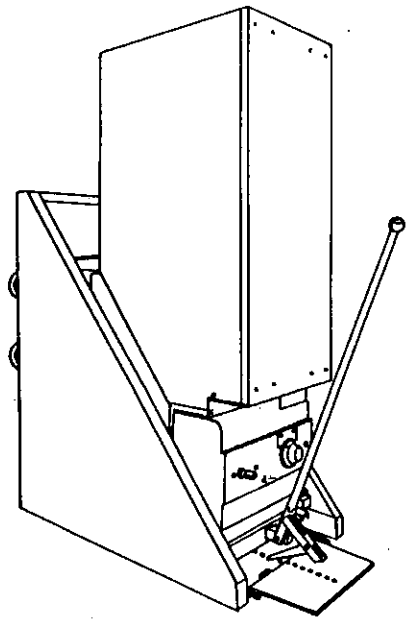


Fig. 11

Check the operational performance of the safety device(1)(fig 12) which is accomodated under the breaker truck and operates the trip lever of the breaker, whenever the breaker is racked in or out

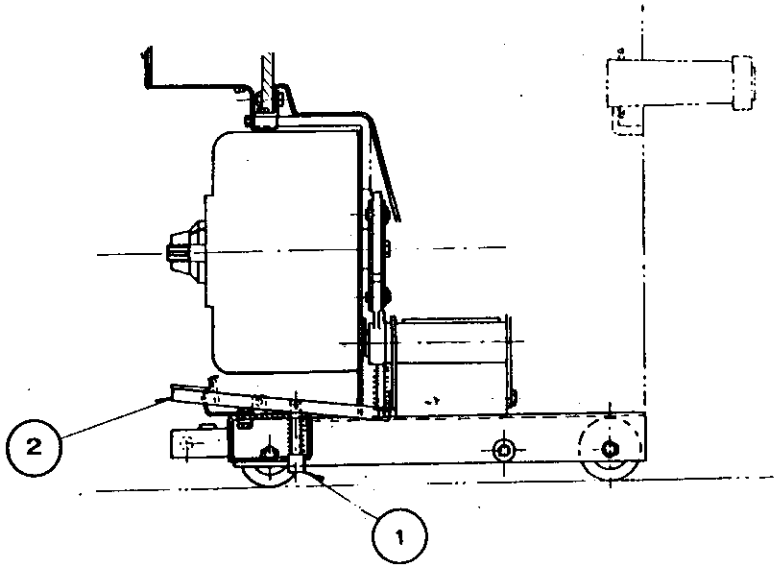


Fig 12

5.5. Electrical checking

5.5.1. Operating mechanism electrical connections

on fixed breaker they are made through the terminal board accomodated on the front of the truck

on draw-out breaker connect the supply circuits to the socket accomodated in the cell,being the breaker provided with a proper plug

See the electric diagrams shown on tables I, II, III.

5.5.2. Release checking

If the breaker is equipped with undervoltage release, shunt trip or closing release, their operational working is to be checked as instructed on LI 8-1 chap. 7.

If the breaker is equipped with overload releases, check as instructed under § 5.2. above. If the overload releases are of types MF or PF, lagged by dashpot, 3 cm3 of quite pure glycerine or of equal viscosity oil are to be poured into each dashpot cylinder. This is to be made following the instructions of cat 8-1 TN 2338 attached to the releases.Do not use industrial glycerine at all because,due to its impurities, the viscosity increases with time, which blocks the moving element of the release.

5.6. Manual checking of AE and AEM operating mechanisms

Refer to the instruction booklet LI 8-1.

- Load the closing springs by means of the proper cranck, then close the breaker manually or electrically (if the operating mechanism is provided with closing release).Should any trouble occur in the closing operation, make the following:
  - the mechanical checking of the operating mechanism as instructed on LI 8-1 chap. 6
  - check the continuity of the supply circuit
  - check that the supply voltage be comprised within 85% and 110% the rated voltage

On the AEM type, the spring loading motor must start just after the breaker is closed. In case this not occurs, check the continuity of the supply circuit and that the supply voltage be no lower than 85% the rated voltage.

5.7. Main connections

The connections on both incoming and outgoing sides of the breaker are to be carefully calculated and made. Conductors are to be dimensioned to the service current; conductors and associated insulating supports are to be dimensioned to the electrodynamic stresses due to the maximum short circuit asymmetrical current.

5.7.1. Copper connections

- Check that the contact surfaces of the connections do not have any burr or deformation resulting from drilling or blows.Any dent should be eliminated with a fine file without removing the silver layer from non dented surface
- Lap the connection contact surfaces and clean with petrol or other solvent the terminal contact surfaces
- Ensure a contact between connections and terminals; than tighten the bolts

It is advisable, but not necessary, to tin or better to silver the contact surfaces of the connections;when tinning, care must be taken to get even and flat surfaces.

5.7.2. Aluminium connections

- Check that the contact surfaces of the connections do not have any burr or deformation resulting from drilling or blows
- First file then lap the connection contact surfaces. Clean with petrol or other solvent the terminal contact surfaces
- Coat the contact surfaces with a non-acid grease
- Ensure a good contact between the connections and terminals, then tighten the bolts using a spring washer and a large diameter washer

N.B. The overall dimensions of connections are shown on figs 3 - 4 - 6

5.8. Safety precautions

The following final checkings should be made before setting the breaker at work:

- fixed breaker: check that the truck is earthed through the proper cable
  draw-out breaker: check the good contact between the coupling (16)(fig 2) and the earthing blade located on the stationary portion

- check that contacts and arc chutes are properly positioned. The moving contacts must separate simultaneously and touch, when the breaker closes, the fixed elements at the same time. The contact adjustment is described at§§ 7.1.3. - 7.1.4. - 7.1.5.
- check all the connections and the phase connections, especially in the power circuits where the breaker controls the outgoing feeders of a generator or synchronous motor
- never operate the breaker without the arc chutes
- never set the breaker at work without the front barrier;the breaker in this condition, even when open, is alive

6. INTERRUPTION PRINCIPLE

It is based on the natural deionization,by cooling,of the gases generated in the arc chutes.
The interruption of a current is accompanied by the elongation and cooling of the arc which is magnetically forced into a series of insulating barriers. The barriers fractionize the arc rising its resistance and absorb a great part of heat. Therefore at an early current zero, the arc is interrupted and being its path inside the arc chutes very long and the cooling very powerful, re-ignition cannot take place after the first half period.

7. IN-SERVICE CONTROLS AND CHECKINGS

7.1. Periodical inspections

Instructions for the maintenance of the breaker in service conditions are listed in table IV. Besides it is necessary to clean carefully any part of the breaker at least every six months.

The contacts and arc chutes should be frequently and carefully inspected as instructed in §§ 8.1. and 8.2. if the breaker has been submitted to frequent operations on short circuit with currents the value of which is unknown but is supposed to be not far from the rated breaking capacity.

The replacement of the operating mechanism pieces quoted in table IV is to be made as instructed in booklet LI 8-1 of AE and AEM types operating mechanisms.

7.1.1. Arc chute inspection (fig 9)

Draw the breaker out, remove the safety barrier(1) as instructed in § 5.3.2.,loosen the nuts of studs(7),lift the arc chutes rotating round pins (3), then check the conditions of arc chutes.

If any breakage or flaw on arc chutes or splitter plates and burning on blow-out coils are found, it is not advisable to make any repair and the arc chute is to be sent to the factory for replacing.

In urgent cases the services of our technical engineer are to be requested.

7.1.2. Arcing contact inspection

Draw the breaker out, remove the safety barrier and arc chutes as instructed in § 7.1.1.

The arcing contacts should be reasonably clean,without pittings and deformations. Small pittings can be lapped without modifying the shape of contacts. After interruptions of current values near to the rated one the arcing contacts might be slightly worn out to such an extent as replacement is not required.

In severer service conditions if an appreciable wear is noticed the arcing contacts are to be replaced following the instructions of § 7.1.3.

Table IV indicates the number of operations that can be made without replacing the contacts.

7.1.3. Replacement and adjustment of arcing contacts (figs 13 and 14)

Draw the breaker out, remove the safety barrier and the arc chutes as instructed in § 7.1.1.,then replace (fig 13) the arcing contacts as follows:

- open the breaker
- remove the three nuts (1) fixing the moving arcing contact (2) to the main contact (3) blade, then remove the worn out arcing contact

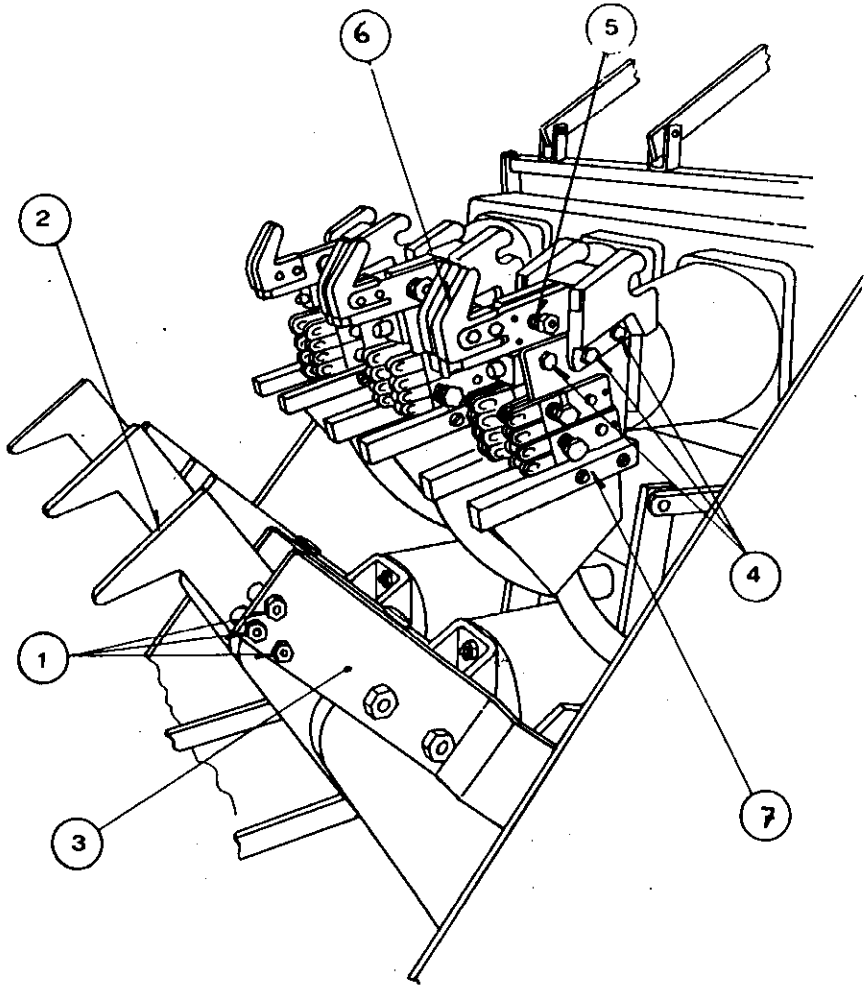


Fig 13

- remove the three nuts (4) fixing the fixed arcing contact (6) to the main contact, then remove the worn out arcing contact
- fit the new moving arcing contacts by means of nuts (1)
- fit the new fixed arcing contacts by means of nuts (4) and spiral springs (5)

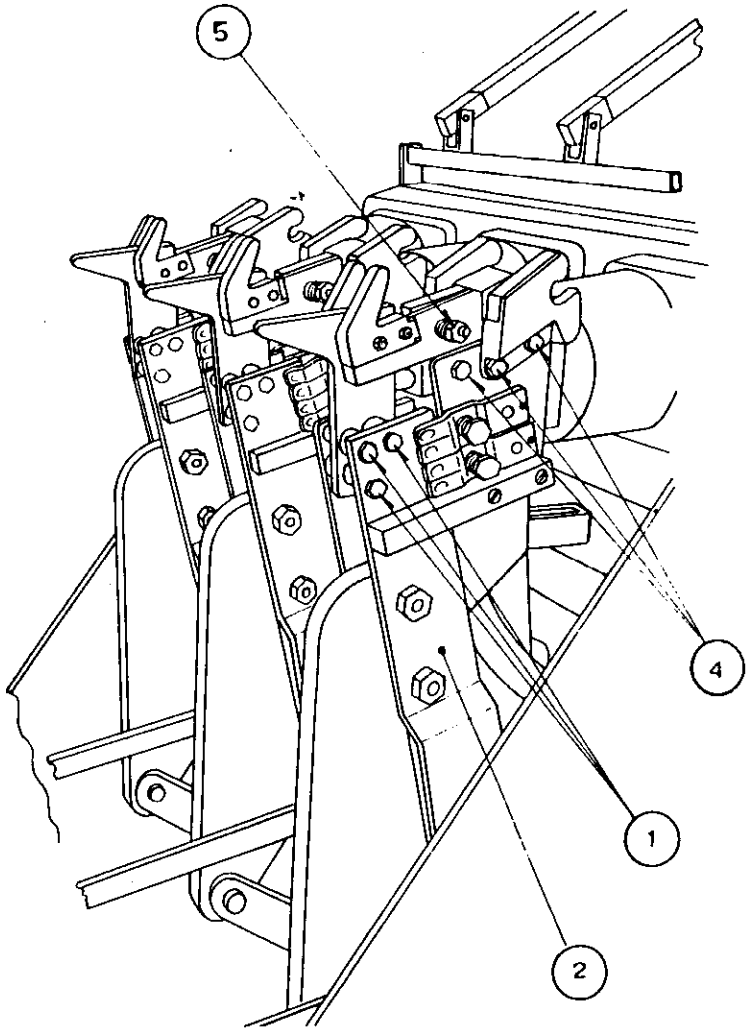


Fig. 14

- operate by means of a lever on the shaft(11)(fig 2) and check that the moving arcing contacts touch the fixed ones at the same time. If not, adjust the moving arcing contacts by displacing the position of bolts (1)
- close the breaker (fig 14) and adjust the length of springs (5) to 11 mm approx.
- make some closing and opening operations to check the operational performance
- refit the arc chutes and the safety barrier as instructed in § 5.3.2.

7.1.4. Main contact inspection

Draw the breaker out, remove the safety barrier as instructed in § 7.1.1., then inspect the main contacts which are to be in perfect conditions and Molykote grease coat faced. As these contacts do not break any current they must not be pitted or burnt at all.

Table IV indicates the number of operations that the main contacts can withstand prior to being replaced.

7.1.5. Main contact replacing

Send the breaker to the factory. In urgent cases request the services of our technical engineer.

7.2. Removal of AE and AEM types operating mechanisms

Operate as instructed in chapter 5 of booklet LI 8-1.

7.3. Maintenance

7.3.1. Operating mechanism maintenance

Operate as instructed in § 6. of booklet LI 8-1.

7.3.2. Basic circuit-breaker maintenance

The breaker is lubricated at works and does not require any maintenance yet, it is advisable to clean it carefully after every 2000 operations or,at least, once a year.

Cleaning is to be made with the breaker open and springs released by means of a brush drenched with diesel oil or petrol;then coat the main contact blades with a thin layer of Molykote and check the trip mechanism of the breaker which must operate very quickly and frictionless.

8. FITTINGS

8.1. Fitting and adjustment of overcurrent releases types MF, MFSP, MO, MOSP (fig 15)

1) When the breaker is equipped with provision for fitting the overcurrent releases, fitting and adjustment are to be made as follows:
   a) fit the release to the upper terminal of the pole, by means of support (1)
   b) connect the extensible rod(2)to the lever(4) of tripping device and to the arm(3)of trip bar(5) fixed to the frame of the breaker
   c) check that the tripping device(7)leans against the bracing (6) of lever (1)
   d) adjust the length of rod (2) by means of bolt (8) so as a 1.5 - 2 mm gap is obtained between the surfaces of elements (6) and (7)
   e) close the breaker and trip by operating each single release through the trip device(7)and check that the gap is 1.5 - 2 mm.If not,adjust again the connecting rod length by means of bolt (8)
2) If the breaker is not equipped with provision for fitting the overload releases, the following fitting and adjustment operations are to be made with the breaker open, out of the cubicle and without the safety barrier, arc chutes and relevant supports, as well as the insulating barrier placed on the top of the operating mechanism:

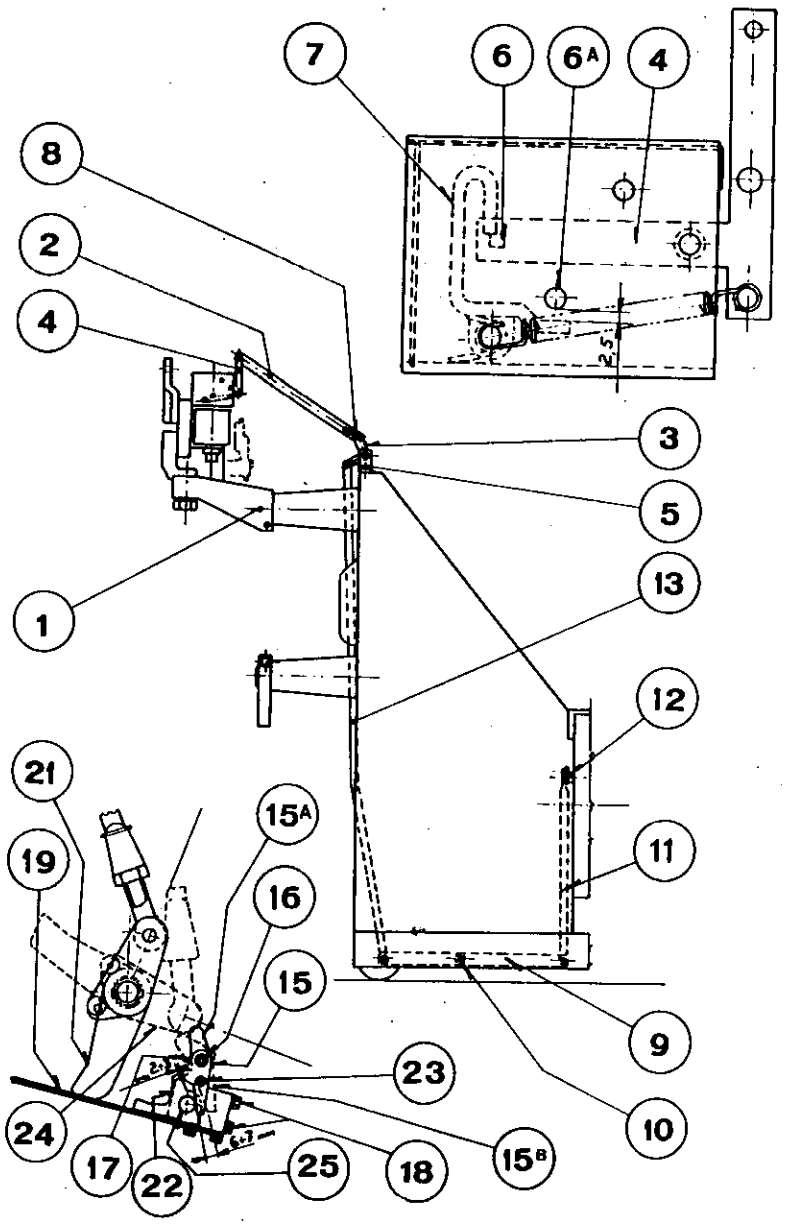


Fig. 15

- release the springs and remove the operating mechanism cover
- loosen the nut of the locking device(15), rotate the shaft (16) so that the pin (17)is horizontal, then tighten the nut
- loosen the screws (18) of the reset lever(19)and keeping the latter close to lever (21) of the operating shaft, rotate the lever (22) to a 2-3 mm gap from the lock (15). Tighten screws (18)
- loosen the lever screw (23) of lock (15)
- close the breaker
- rotate the lever(15A)of the lock till it touches the lever (24) of trip bar and rotate the lever (15B) to a 6-7 mm gap from the trip bar (25) and tighten the screw (23)
- fit the lever (9) to the breaker frame with the screw (10)
- connect lever (11) to the end of lever(9)and to crank (12) fitted to the trip bar of the operating mechanism and located as shown in the figure
- fit shaft (3) to the breaker frame
- connect the lever (13) to the end of levers (9) and (5)
- operate as instructed under points a), b),c),d), e) above

8.2. Fitting and adjustment of undervoltage release, shunt trip and closing release

Operate as instructed in chapter 7 of booklet LI 8-1.

9. BASIC ACCESSORIES

- Moving arcing contacts
- Fixed arcing contacts
- Fixed arcing contact springs
- Arc chutes

When requesting spare parts, the serial number and type of the breaker are to be quoted.

CAPTION

52	Automatic circuit-breaker
BC	Closing release
BA	Shunt trip
mT	Undervoltage release
Sr	Microswitch for "tripped" position indication
i1-i5	Auxiliary switch boxes (supplied on request)
i	Limit switches for BA and BC (supplied with the breaker)
id(CR)	Auxiliary switch box (supplied with the breaker)
M	Motor for loading the closing springs
FCm	Limit contact for the closing springs loading and "accept" contact for BC
Y	Anti-pumping device
C	Contact for Y and electric indication of "springs loaded" (on request for AE version)
V	Terminal board
W	Plug-socket

NOTES

a) The circuit-breaker is represented in the"open" position with springs loaded

b) The circuit-breaker is equipped only with the fittings listed in our confirmation of order

c) Plugs and sockets A, B, C, and relevant connections(in dash) are supplied only for draw-out breakers

d) The contact Sr is supplied open or, at choice closed, with automatic or manual resetting

e) For draw-out breaker equipped with any of the accessories 1, 2, 3, 4, 5, 6, 7 the plug and socket A fitted on the right hand side of the breaker(facing the front)is always supplied

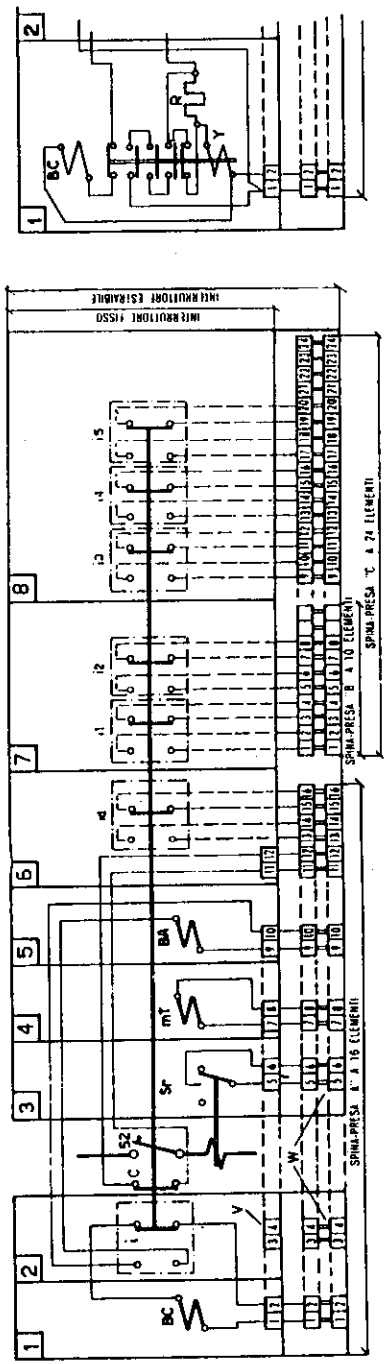
f) For draw-out breaker equipped in addition with auxiliary switches (fittings 8 and 9) one of the plugs and sockets B-C is also supplied according to the number of the auxiliary switches requested and it must be fitted on the right hand side (facing the front of the breaker)

g) The contacts of each box must be utilized only with the same polarity voltages or for making up a changeover switch

Caution - before energizing the operating mechanism motor of more breakers, the closing springs must be loaded manually to avoid the contemporary starting of more spring loading motors.

Table V - 10. *OPERATING MECHANISM ELECTRICAL DIAGRAMS*

Operating mechanism Type AE



spina-presa "A" a 16 elementi
16-element plug and socket "A"

spina-presa "B" a 10 elementi
10-element plug and socket "B"

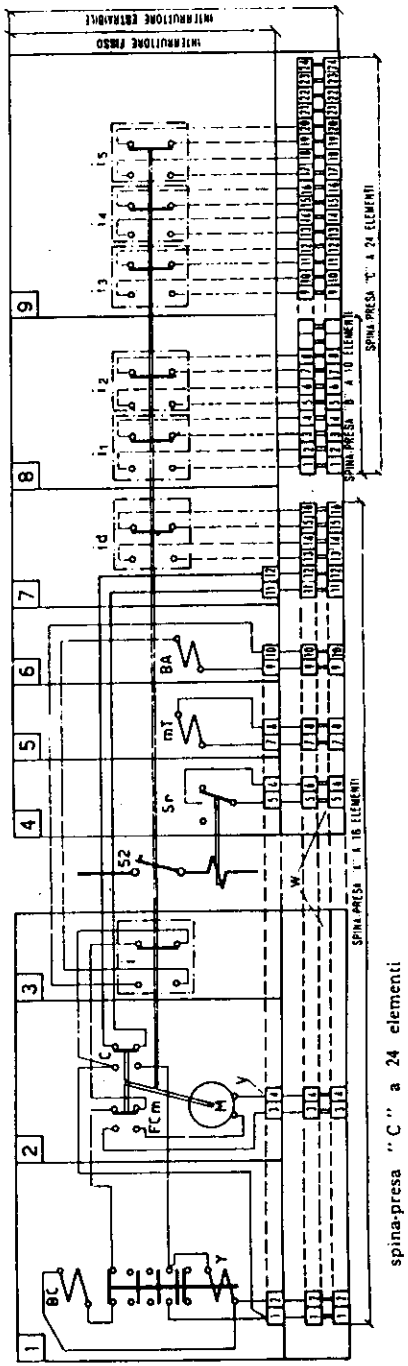
interruttore sezionabile
draw-out breaker

interruttore fisso
fixed breaker

Table VI

Operating mechanism type AEM d.c.

Table VII *Operating mechanism type AEM a.c.*



spina-presa "C" a 24 elementi
24-element plug and socket "C"

TABLE FOR THE "D6" TYPE BREAKERS MAINTENANCE

with 20-60 operations per day

	OPERATIONS TO BE CARRIED OUT	NUMBER OF OPERATIONS (up to 40,000 max.) (***) Every 5,000	Every 10,000	Every 20,000	REFERENCES paragraphs of this booklet	instruction booklet LI 8-1 for AE and AEM operating mechanisms
CHECKINGS	Arc chutes (*)	X			7.1.1.	
	Main contacts	X			7.1.4.	
	Arcing contacts (**)	X			7.1.2.	
	Main contact lubrication	X			7.3.2.	
	Tightening of nuts, screws etc.	X				
	Tightening of connections, shunt trip, closing and undervoltage releases	X				7.3-4-6
	Pitch chain of operating mechanism		X			6.2.
	Auxiliary contacts on the operating mechanism		X			7.2.
	Spring loading shaft clamp		X			3.15
REPLACINGS provided	Arcing contacts (**)		X		7.1.3.	
	Operating mechanism trace			X		8.1.
	Springs for the operating mechanism trace			X		8.2
	Operating mechanism limit switch			X		7.2.
	Closing spring set			X		8.2.
REPLACINGS to conditions	Arcing contacts				7.1.1.	
	Main contacts 1)				7.1.5.	
	Moving contact insulating guides(*)				Fig 14 (7)	
	Spring loading shaft clamp					3.1.5.
	Reduction gear of operating mechanism motor					Fig 2 (6)

(*) The arc chutes can withstand without being serviced;

MECHANICAL OPERATIONS		INTERRUPTIONS WITH I_n AT THE RATED VOLTAGE cosφ=0.7		INTERRUPTIONS WITH THE FULL SHORT - CIRCUIT CURRENT AT RATED VOLTAGE cosφ=0.15	
Number	with inspection every	number	with inspection every	number	with inspection after
40,000	5,000	40,000	5,000	6	3

(**) The lifetime of arcing contacts depends on the nature of operations. Their conditions are to be inspected; replacement is required when their wear is remarkable. Here under are indicated the numbers of operations that the arcing contacts can withstand without being replaced

MECHANICAL OPERATIONS	INTERRUPTIONS WITH $I_n/2$ AT RATED VOLTAGE cosφ=0.7	INTERRUPTIONS WITH I_n AT RATED VOLTAGE cosφ=0.7	INTERRUPTIONS WITH THE FULL SHORT-CIRCUIT CURRENT AT RATED VOLTAGE cosφ0.15
10,000	10,000	5,000	10

(***) The breaker is to be thoroughly and carefully overhauled after 40,000 operations

1) The replacement of these spare parts can be made either at the factory or by our technical engineer