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**SPRING STORED ENERGY
OPERATING MECHANISMS
TYPES AE - AEM**

**INSTRUCTIONS
FOR SERVICE AND MAINTENANCE**



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1. GENERAL (fig. 1)

The independent spring closing mechanism is designed for medium voltage breakers, in the two versions AE (springs manually loaded) and AEM (springs motor and manually loaded).

It is totally enclosed and quite reliable both for the safety during the closing operation and for the correct service working.

All the fittings listed under § 2 can be accomodated inside the enclosure. The manual version AE can be easily converted into the motor version AEM.

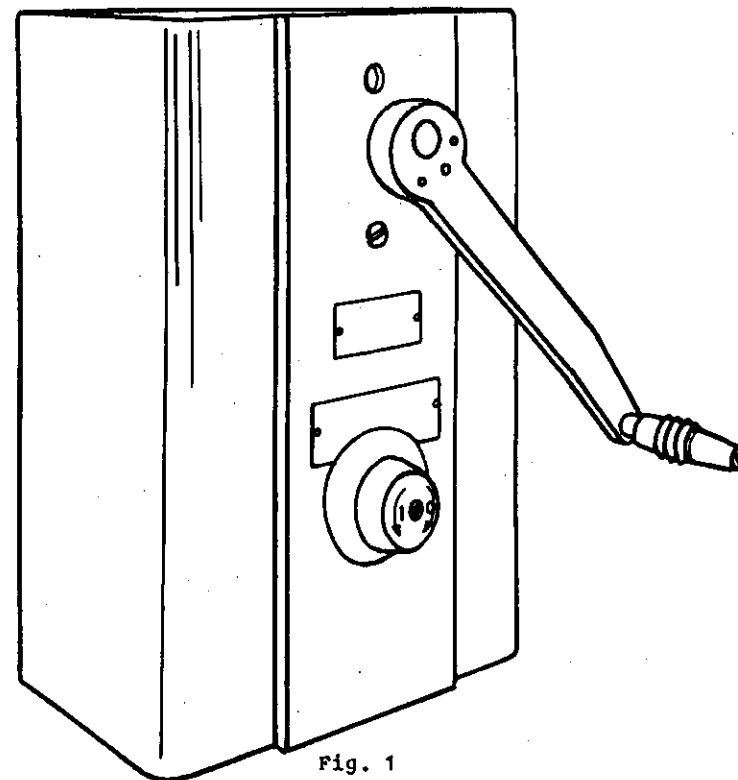


Fig. 1

2. CHARACTERISTICS

The operating mechanism is manufactured in the following two versions:

Type AE : closing springs manually loaded

Type AEM: closing springs automatically motor loaded

The electrical spring loading time is 20 to 35 secs according to the size of springs.

Both types AE and AEM are capable of performing the following cycles:

1) starting with the breaker open and springs loaded
CO - Tc - CO - Tc - CO

Tc = spring loading time

2) starting with the breaker closed and springs loaded

0 - t - CO - Tc - CO

t = idle time 0.3 secs approx.

2.1. Normal fittings (figs 2 - 3)

Both versions are equipped with:

- "Breaker open" -O- and "breaker closed" -I- mechanical indications (1)
- "Loaded spring" (yellow) and "released spring" (white) mechanical indications (2)
- Knob for tripping and closing the breaker manually, with the operation sense indication (3)
- Detachable crank for loading the springs manually (4)
- Two signal or interlock auxiliary switch boxes type CR (5) each housing one NO and one NC contacts; one box is available while the other is reserved to shunt trip and closing release

rated voltage	500 V
rated current	10 A
breaking capacity	5 A at 500 V a.c.
	1 A at 220 V d.c.

The AEM version is also equipped with:

- Spring loading motor (6)

service voltage	24 - 48 - 60 V d.c.
	100 to 127, 160 V d.c. and a.c.
	208 to 220 V d.c. and a.c.
input	300 VA a.c.
	330 W d.c.

- Two contacts (7) for the loaded spring electrical indication and for the "consent" to the closing release

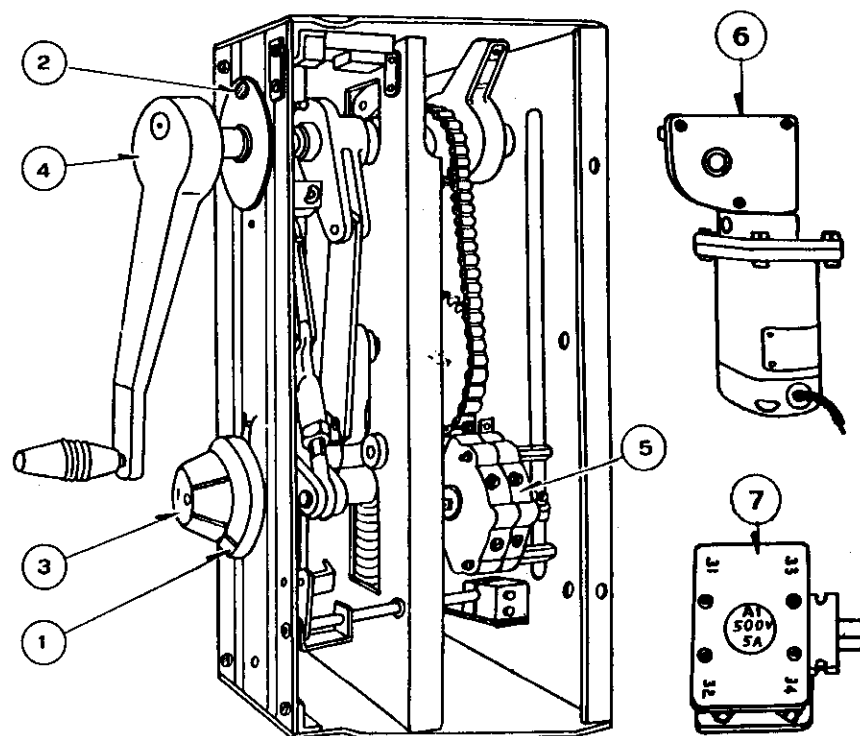
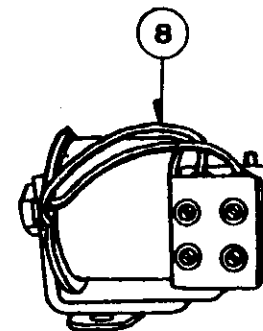


Fig. 2

- Closing release type SC (8)

service voltage	127 - 220 V 50 c/s
	24 - 48 - 60 -
	110 - 220 V d.c.
input	250 VA a.c.
	150 W d.c.
- Antipumping device (9)

service voltage	127 - 220 V 50 c/s
	24 - 48 - 60 -
	110 - 220 V d.c.
inrush	55 VA a.c.
	70 W d.c.
sealed	10 VA a.c.
	8 W d.c.



- Main terminal board (10)

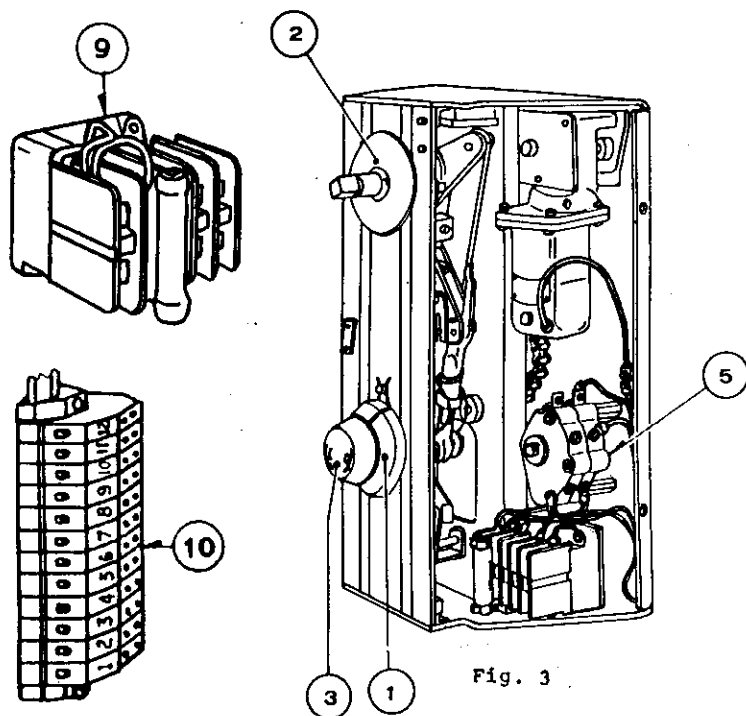


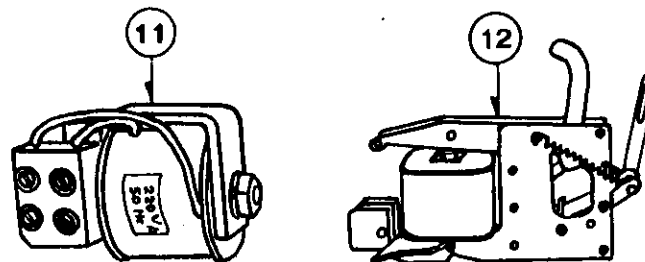
Fig. 3

2.2. Optional extras

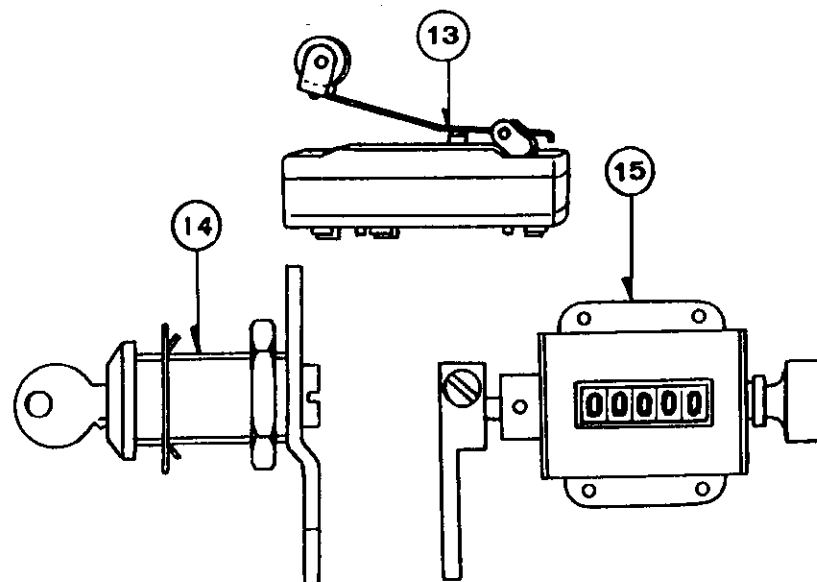
- Shunt trip SA (11)
service voltage 127 - 220 V 50 c/s
24 - 48 - 60 - 110 - 220 V d.c.
inrush 500 VA a.c.
300 W d.c.
- Undervoltage release (12) fitted on the supply or on the outgoing side of the breaker (to be specified with the order, being the two versions mechanically different)

service voltage 127 - 220 - 380 - 500 V 50 c/s
24 - 48 - 60 - 110 - 220 V d.c.
input 30 VA a.c.
12 W d.c.

- Closing release type SC (8)
(normally fitted to the AEM version)
- Contact for the "loaded spring" electrical indication
(normally fitted to the AEM version)



- Microswitch (13) for the "tripped breaker" indication on overload releases (fitted to the breaker) or undervoltage release operation, with manual or automatic reset; it is located inside the operating mechanism enclosure.
When the breaker is equipped both with overload releases and undervoltage release, two independent signals are available. The microswitch operated through the undervoltage release can be manually or automatically reset and is located inside the operating



mechanism enclosure, while the one operated through the overload releases is only automatically reset and is located outside the operating mechanism enclosure

rated voltage 500 V
 rated current 5 A
 breaking capacity 3 A at 500 V a.c.
 5 A at 220 V a.c.
 0.5 A at 220 V d.c.

automatic reset contact duration 70 to 80 ms

- Key interlock (14) preventing the breaker from being manually or electrically closed, when the key is removed. This device enables to interlock two or more breakers so that only one or some of them can be closed
- Operation counter (15) for counting the breaker operations

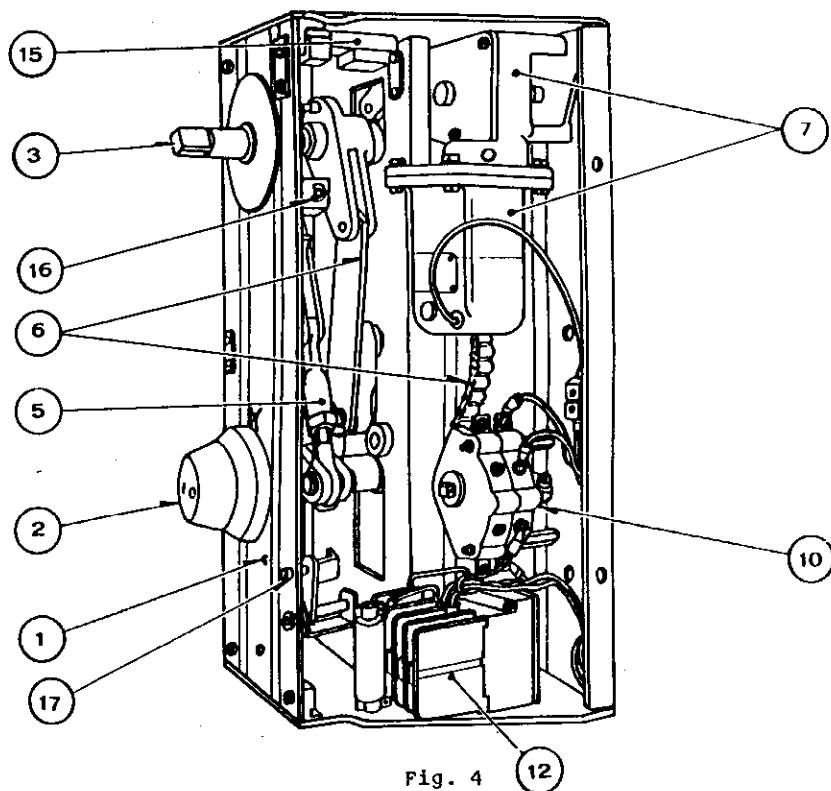


Fig. 4

3. CONSTRUCTION

The main parts of the operating mechanisms AE and AEM are the following: (figs 4 - 5)

- 1 - Supporting frame
- 2 - Operating knob
- 3 - Loading spring shaft
- 4 - Helical tension springs
- 5 - Trace for the breaker independent trip
- 6 - Loading spring mechanism
- 7 - Device for the remote loading of springs (4) (for AEM version only)
- 8 - Terminal board

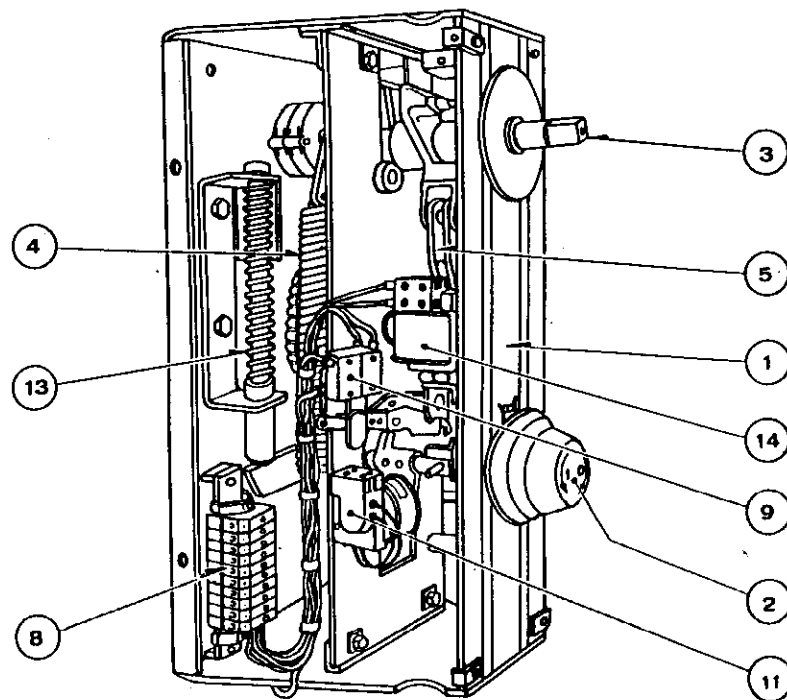


Fig. 5

- 9 - Contacts for the "consent" to the closing control and for "loaded springs" signal (for AEM version only)
- 10 - Contacts type CR for the "consent" to the electrical tripping
- 11 - Closing release type SC (on request for AE version)
- 12 - Antipumping device (for AEM version only)
- 13 - Auxiliary device for tripping the breaker (for breakers RM, RMr, RG, 6-10-15-20 kV only)
- 14 - Shunt trip type SA (on request)
- 15 - Loading spring shaft stop

4. WORKING

The working positions of the operating mechanism are displayed on fig. 6 tables I, II, III, IV

Breaker open:
closing springs released

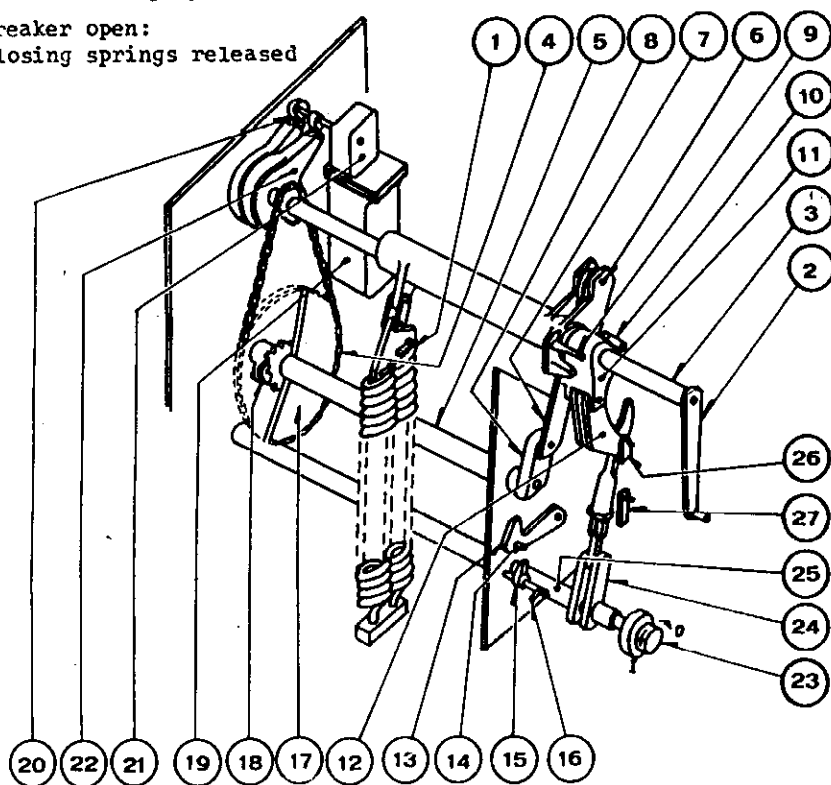


Fig. 6 Table I

1 - Breaker open with closing springs (1) released

The breaker is in this position after each CO cycle. In the AEM version this is a transient position

2 - Breaker open with closing springs (1) loaded

This is the normal service position of the open breaker. The springs are to be loaded as follows:

a) Manual loading

Turn the shaft (3) by one half turn clockwise by means of detachable crank (2), which corresponds to the complete loading of the springs. When the shaft (3) is rotated, it drives through the chain (4) the shaft (5) which, being con-

Breaker open: closing springs loaded

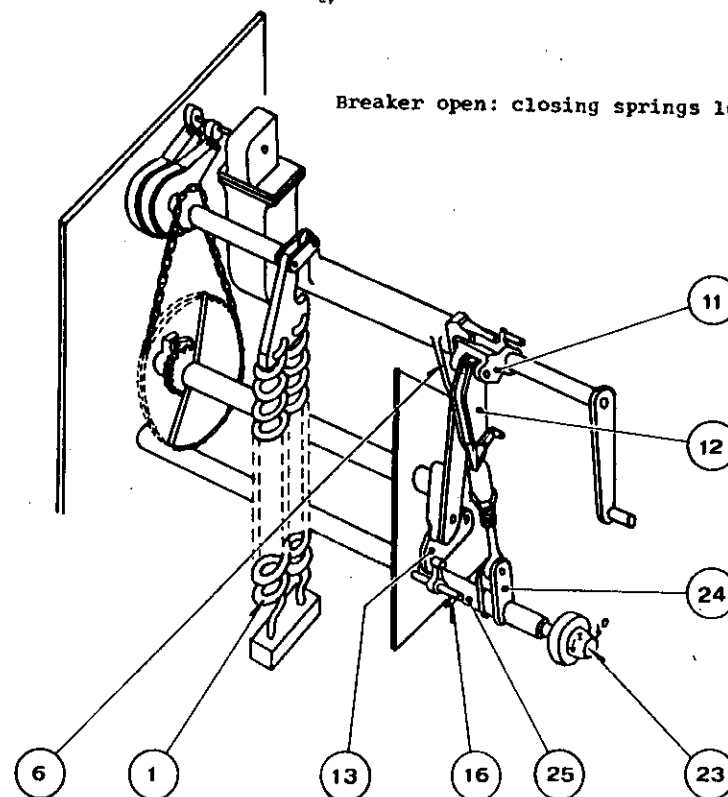


Fig. 6 Table II

nected to lever (6) through connecting rod (7) and crank (8) causes, in its turn, the loading of the springs (1). At the end of this motion the pin (9), integral with lever (6), actuates the pin (10) causing the rotation of the neutral lever (11) and the quick reloading (table II) of the trace (12) mechanism.

At the loading limit, the closing hook (13) holds up lever (15) of shaft (17) by means of bearing (14) so assuring the loaded state of springs, whilst the sprocket wheel (17) free from ratchet (18) idles for a short while. If springs (1) are not completely loaded the breaker cannot be closed.

b) Motor loading

When motor (19) is energized, it rotates the camshaft (20) through the reduction gear (21); the levers (22) are actuated in such a way as

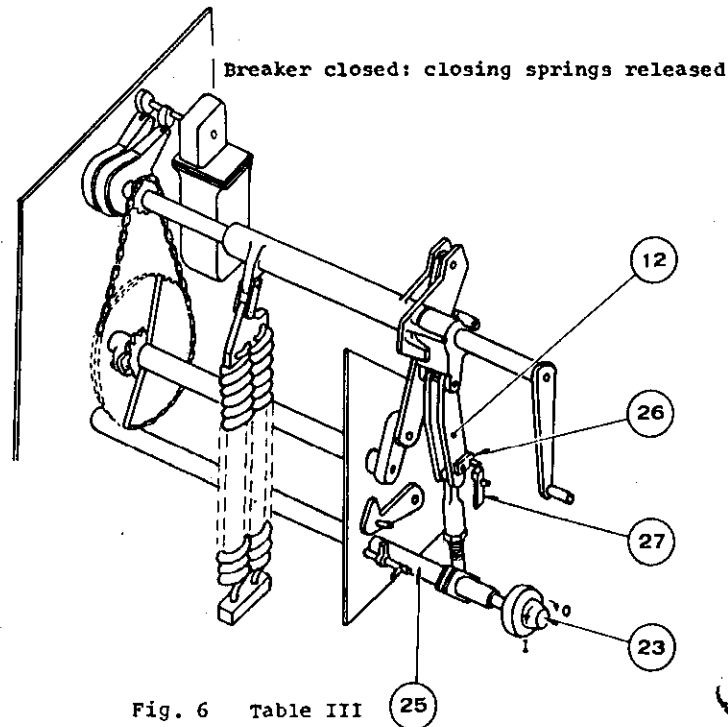


Fig. 6 Table III

to load the springs as described above under § a).

If during the loading operation the voltage supply fails, the motor is always in a position - when the voltage is restored - of continuing the loading operation which, if necessary, can be continued manually.

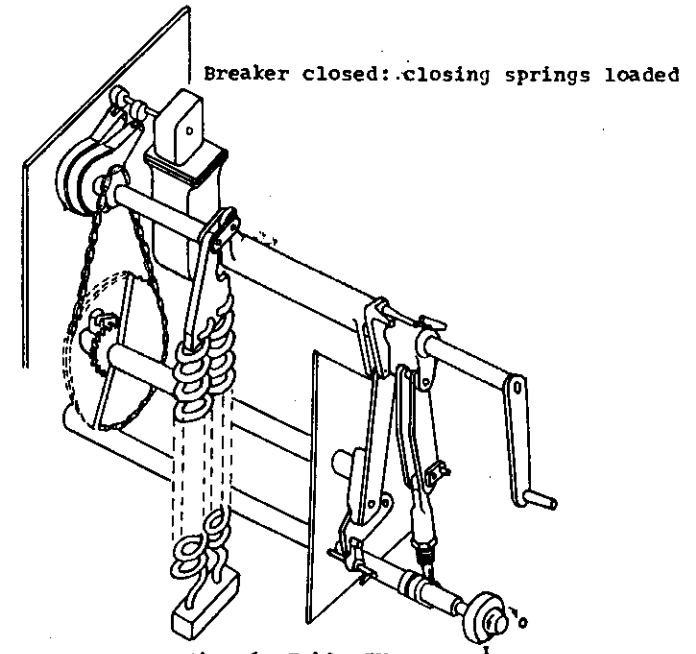


Fig. 6 Table IV

3 - Breaker closed with closing springs released

This is a transitory condition for AEM version, which occurs whenever the breaker is closed, before a subsequent closing operation and before the springs are reloaded.

The operating mechanism is passed from the position illustrated on table II to the one illustrated on table III as follows:

- the shaft (16) is rotated either on the electrical trip operation or manually through knob (23)
- the hook (13) is lowered and springs (1) are released by rotating the lever (6) anticlockwise. This rotates the shaft (25) clockwise through the neutral lever (11) and lever (24) connected to the trace (12), which operation closes the breaker.

4 - Breaker closed with loaded springs

This is the normal service state of the breaker closed. The trip operation can be performed as follows:

- manually, by rotating knob (23)
 - remote, by energizing the shunt trip
 - automatically, on operations either of the overload releases fitted to the poles or of the undervoltage release fitted, on request, to the operating mechanism.
- The trip operation is caused by the rod (27) which, when lifted, rotates the lever (26) releasing the trace system (12) and allowing the shaft (25) to rotate anticlockwise

5. FITTING OF THE OPERATING MECHANISM TO THE BREAKER

The operating mechanism is fitted to medium voltage small oil volume or air circuit-breakers and can be positioned as follows (fig. 7)

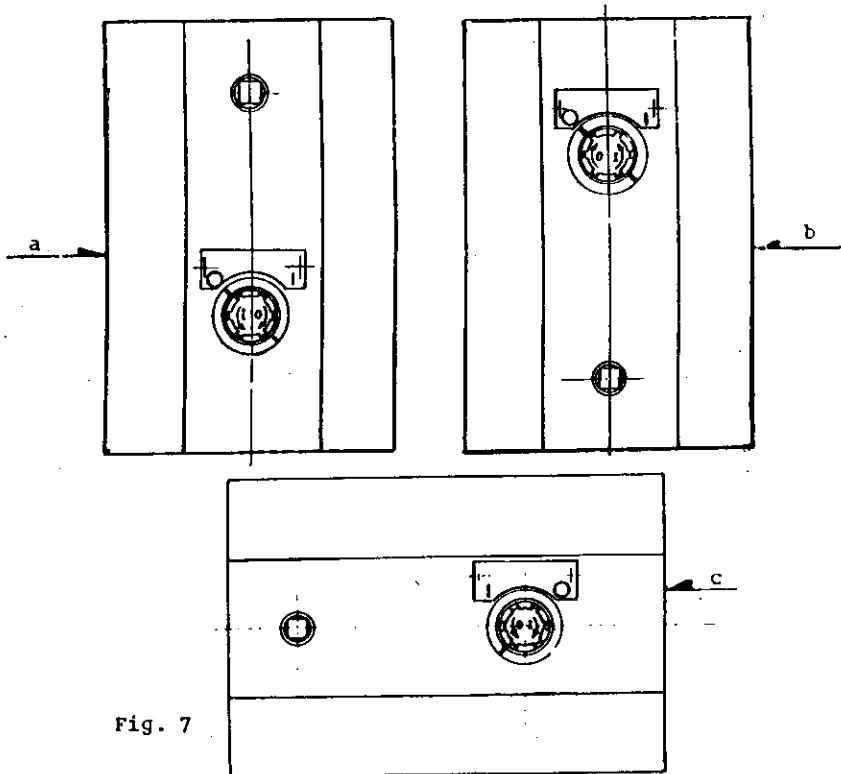


Fig. 7

- Vertical upper mounting for front operated breakers types RM, RMC, RMr, RG (fig. 7a)
- Vertical lower mounting for side operated breakers types RM, RMC, RMr, RG, RP (fig. 7b)
- Right side horizontal mounting for front operated breakers types DIARC and RP (fig. 7c)

The fixings of the operating mechanisms to the different types of breakers are shown in fig. 8

DIARC	holes 1-2-8-9
RP, side operated	holes 1-2-3-4
RM, RMC, RMr, RG	holes 3-4-5-6
RP, front operated	holes 2-7-9

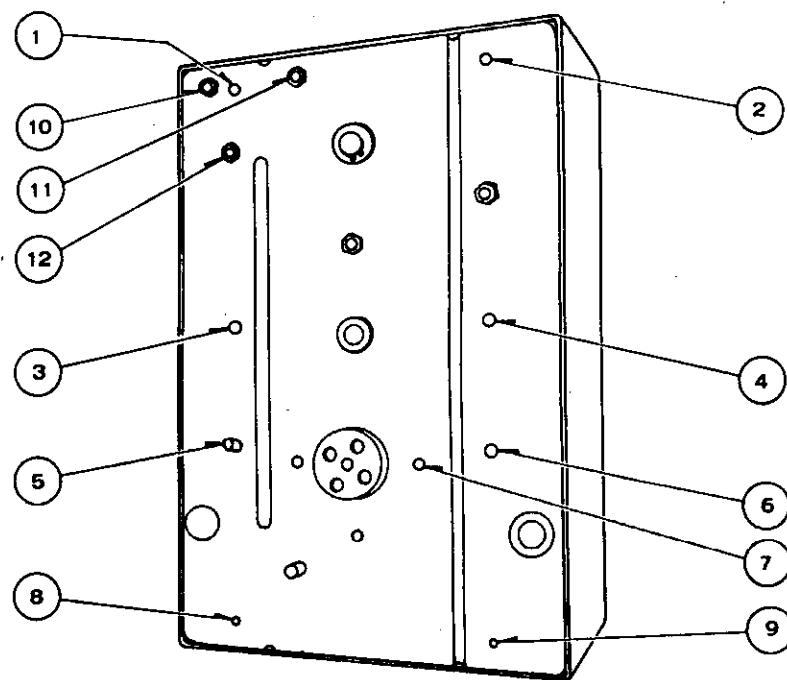


Fig. 8

In table I the TN numbers illustrating the overall dimensions of the breakers series DIARC and RP, RM, RMC, RMr, RG are quoted

TABLE I

Circuit-breaker type	Position	TN
06-1250A - fixed constr.	right side, horizontal	3350-3352
06-2000A - fixed constr.	right side, horizontal	3351-3353
06-1250-2000A - draw-out constr.	right side, horizontal	3349-3354
010-D15-1250A-2000A - fixed constr.	right side, horizontal	3317-3318
010-D15-1250A-2000A - draw-out constr.	right side, horizontal	3279
RP	front, horizontal	3205
RP	side, vertical	3241
RM, RMC, RMr 630A	front, vertical	3272-2927
RM, RMC, RMr 630A	side, vertical	3273-3202
RG-800A	front, vertical	2939-3038
RG-800A	side, vertical	3210
RG-1250A	front, vertical	3165
RG-1250A	side, vertical	3211

6. MAINTENANCE

The operating mechanism is supplied thoroughly lubricated and is not in need of any special care during its lifetime, yet it is advisable to clean it carefully after every 2 000 operations or, at least, once a year.

The clearing should be made by means of a paint-brush drenched with Diesel oil and petrol, with the breaker open and springs released.

During normal service troubles attributable to pieces being maladjusted due to continued vibrations and shocks, imperfect tightening etc., might occur. This might hinder the closing or opening of the breaker and damage the motor (figs 4 - 7) and the pitch chain (figs 4 - 6).

The operating mechanism can be easily set-up at site, by making the following adjustments:

6.1. When the breaker cannot be closed

This may be due to:

- looseness of eccentric (6) (fig. 9); adjust as instructed under § 6.4.
- warpage of the trip rod (8) (fig. 9); check as instructed under § 6.5.
- wear of lever (7) (fig. 10)

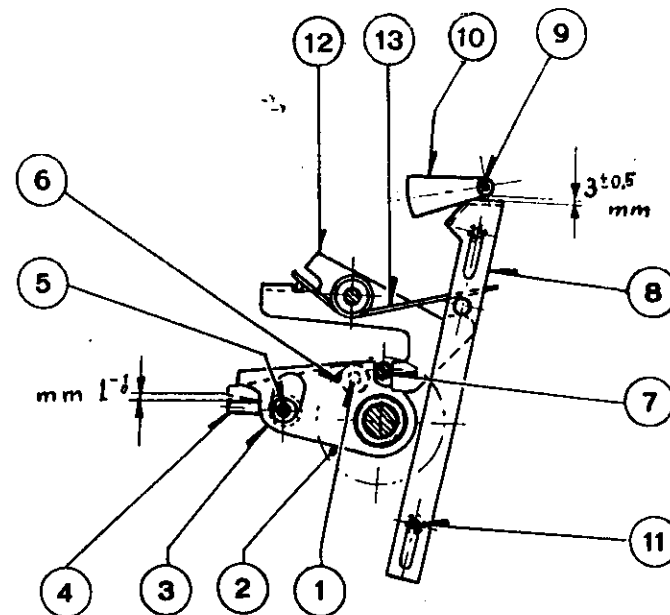


Fig. 9

This trouble is very uncommon and may occur after a number of operations much greater than that stated. The lever (7) is to be replaced at our works or by the service of our technical engineer

- clearance between the ratchet pawl (3) and the sprocket wheel (4) not to prescriptions; adjust as instructed under § 6.6.

6.2. Troubles to the spring loading motor or to the pitch chain (8') (fig. 10)

These are due to a wrong gap between the ratchet pawl (3) and the sprocket wheel (4); adjust as instructed under § 6.6.

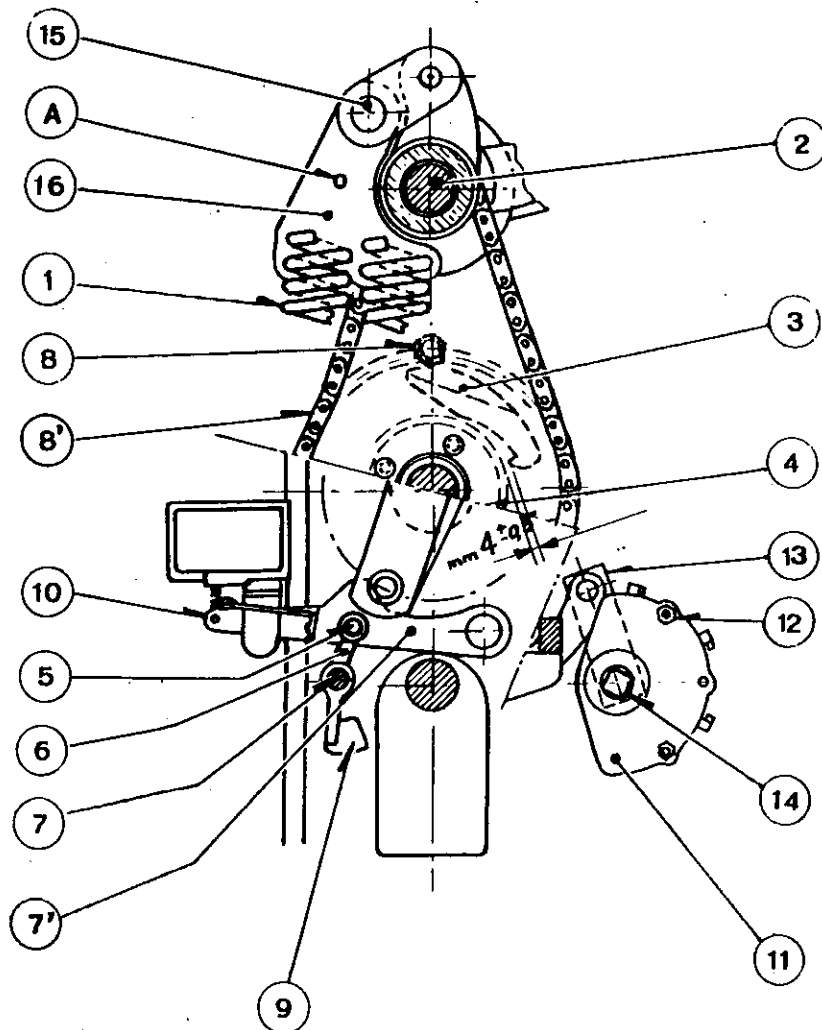


Fig. 10

6.3. The breaker cannot be opened

This may be due to the auxiliary circuit being not energized. Verify the circuits and their connections to the terminal board.

6.4. Adjustment of the closing spring mechanical lock (fig. 9)

Being this adjustment to be made with the breaker closed, lock first the eccentric (6) by tightening screw (1) in such a way as the lobe is opposite to pin (7), then with the breaker closed and springs released:

- loosen scantily the screw (1)
- turn the knob (2) anticlockwise till the clearance between lever (3) and pin (4) of trip bar (5) is 0 to 1 mm
- rotate the eccentric (6) until it touches the pin (7) of the knob (2) and lock it in this position by tightening the screw (1)

6.5. Checking of the trip bar (8) for opening the breaker (fig. 9)

When the breaker is closed, the clearance between the pin (9) of the trace trip lever (10) and the trip rod (8) actuated by the knob (2) is to be 3 mm approx. Should this clearance be shorter, the pin (9) would foul the trip bar (8) so tripping the breaker.

Therefore it is necessary to check that the trip bar (8) is not warped and is not kept upwards due to foreign substances, that pins (11) are provided with washers and split rings, that the lever (12) is not warped and moves freely, that the spring (13) is accommodated in its seat.

6.6. Adjustment of the clearance between the ratchet pawl (3) and the sprocket wheel (4) to prevent undue stresses to the pitch chain or to the spring loading motor (fig. 10)

Starting from "released spring" (1) position, rotate the shaft (2) by one half turn clockwise, which corresponds to the full closing spring loading.

The ratchet pawl (3) must clear the sprocket wheel (4) at the instant when the bearing (5) leans on the upper

part of lever (6) of trip bar (7) so assuring the loaded state of springs.

If the ratchet pawl (3) clears the sprocket wheel (4) before that the bearing (5) leans on the lever (6) the closing springs (1) are not completely loaded and the breaker could not be closed.

If, on the contrary, the ratchet pawl (3) clears the sprocket wheel (4) after that the bearing (5) has leant on the lever (6), the pitch chain (8) would be submitted to undue stresses and the motor would be excessively overloaded.

Therefore with the springs in the "loaded" state, the clearance between the ratchet pawl (3) and the sprocket wheel (4) must be 4 mm plus or minus 0.5 mm. This is achieved by adjusting the eccentric (8) fixed to the base plate to get the clearance required.

6.7. Checking of the trip bar (7) for closing the breaker (fig. 10)

With the breaker open and springs released:

- check the free movement of trip bar (7) and make sure that when it is in the rest position the lower end of lever (6) is stopped by the slot (9) in the dividing plate

- lower the lever (10) end and check that the bearing (5) is leaning on lever (6) by a section at least 1.5 mm large. If not, check that between lever (6) and the trip bar (7) there is no clearance and that the bearing (5) has not any end float.

7. FITTINGS

7.1. Terminal board (1) (fig. 11)

Only for the AE version.

Up to 12 elements are fitted in accordance with the accessories to be supplied.

It is fixed to the base plate by means of screws (2) and spacers (3) the connections are to be made as per the wiring diagrams shown on tables V, VI, VII.

The internal connections of the board are to be lead through the hole on the rear of the board, after piercing the rubber gasket.

7.2. "Loaded spring" electrical indication contacts (4) (fig. 11)

Only for the AE version.

- fit the contact (4) to the dividing plate by means of the two screws (5)

- press repeatedly the push button (6) to make sure of its free movement

- connect the contact (4) wires and the feeders to the terminal board (1) as per wiring diagrams shown on tables V, VI, VII and energize the feeding circuit

- carry out some spring loading operations and check the correct working of signal contacts and of the indicating lamp

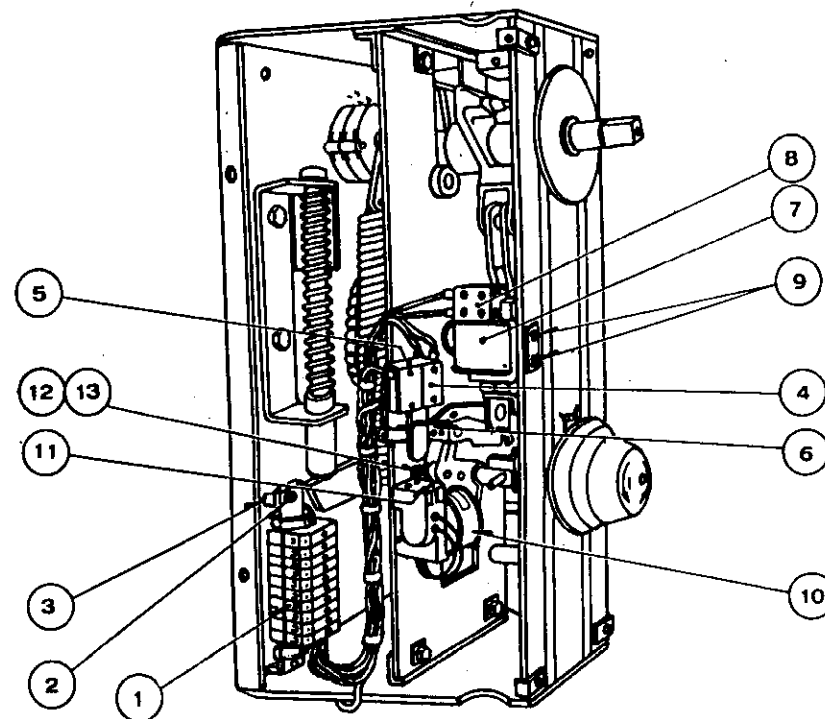


Fig. 11

7.3. Shunt trip type SA (7) (fig. 11)

It is equipped with a two-element terminal board (8); at the end of its stroke it is de-energized being it connected to the terminal board (1) through a contact type

CR (see tables V, VI, VII) which is operated by the shaft of the breaker.

It is to be fitted as follows:

- fix the unit to the front plate by means of screws (9)
- connect the supply cables to the terminal board (1) through the contact CR as shown on tables V, VI, VII
- energize the shunt trip coil at its rated voltage and check its regular working with the breaker closed

N.B. The supply voltage must never be below 70% or over 110% the rated voltage

7.4. Closing release type SC (fig. 11)

Only for AE version. It is equipped with a two-element terminal board (11); at the end of its stroke it is de-energized being it connected to the terminal board (1) through a contact CR (see tables V, VI, VII) which is operated by the shaft of the breaker.

It is to be fitted as follows:

- fix the unit to the dividing plate by means of bolts (12) and plate (13)
- connect the supply cables to the terminal board (1) through the contact CR as shown on tables V, VI, VII, having care that the cables do not contact the moving pieces of the operating mechanism
- with the breaker open and springs loaded, energize the release at its rated voltage and check the correct working

N.B. The supply voltage must never be below 85% or over 110% the rated voltage

7.5. Auxiliary switches type CR (11) (fig. 10)

The operating mechanism is normally equipped with the contact boxes, i.e.

- 2 NO contacts with breaker open
- 2 NC contacts with breaker open

Up to seven contact boxes can be provided, on request, including the two boxes normally supplied.

The boxes are to be fitted as follows:

- remove the boxes (11) provided on the operating mechanism
- add the new boxes, fit the new bolts (12) to the base plate
- make the connections as shown on tables V, VI, VII and check the contact working both with the breaker open and closed
- should the operation not be satisfactory, check that the length of the adjusting lever (13) is 47 mm; when in the correct position the axis of the lever must be in line with the diagonal of the square shaft (14)
- the feeding cables are to be lead through the hole on the rear of the switches after piercing the rubber gasket

N.B. The auxiliary switch unit is to be free from oil or grease traces

7.6. Undervoltage release

7.6.1. Accommodation on the supply side (figs 12a-b-c)

When the supply voltage decreases under 35% the rated voltage, the release trips the breaker and locks the trip bar of closing springs which makes the closings of the breaker both electrical and manual impossible, until the supply voltage is restored to 75%- 85% the rated voltage.

Fitting procedure:

- Open the breaker, release the springs and remove the operating mechanism cover
- loosen the nut (17) (fig. 4) and rotate the pin (2) till the peg (3) is horizontal position for vertical mounting operating mechanism, and vertical position for horizontal mounting operating mechanism, then tighten the nut (17) (fig. 4)
- loosen the bolt (4)
- close the breaker, rotate the lever (5) until it touches the crank (6) and rotate the lever (7) to a 6-7 mm clearance from the trip bar (8), then tighten the bolt (4)

- e) open the breaker
- f) fit the shaft (11) bearing the locking levers (12-13) of the closing trip device, by means of the support (9) which is fixed to the dividing plate by the screw (10)
- g) fit the release having care to introduce the pin (14) of lever (15) into the slot of lever (13)

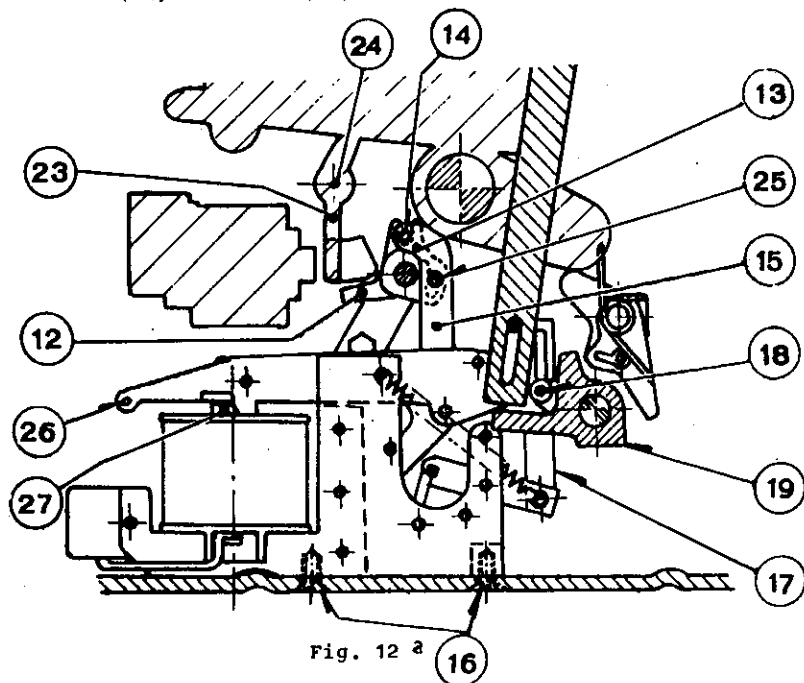


Fig. 12 a

- h) fix the release to the base by screws (16) and connect the rod (17) to the pin (18) of trip lever (19) fitting the relevant washer and split washer
- i) loosen the screws (20) of the resetting lever (21) and keeping the latter against the lever (22), rotate the lever (19) to a 2-3 mm clearance from the locking lever (7), then tighten the screws (20)
- l) adjust the lever (12) so that its end, when the release is de-energized, locks the lever (23) of trip bar (24) and projects from the lower end of lever (23) by 2.5 - 3.5 mm
- m) tighten the screw (25) of the lever (13)

- n) close the breaker keeping the moving element (26) close to the core (27) by the hand; open the breaker releasing the element (26) check and, if necessary, adjust the clearance previously indicated
- o) repeat the operation above; should the breaker open though the moving element (26) is kept close to the core (27), a spacer 0.5 mm thick is to be interposed under the release
- p) connect the release and auxiliary circuit cables to the terminal board following the diagrams shown on tables V, VI, VII. With the breaker closed de-energize the release and check the opening of the breaker

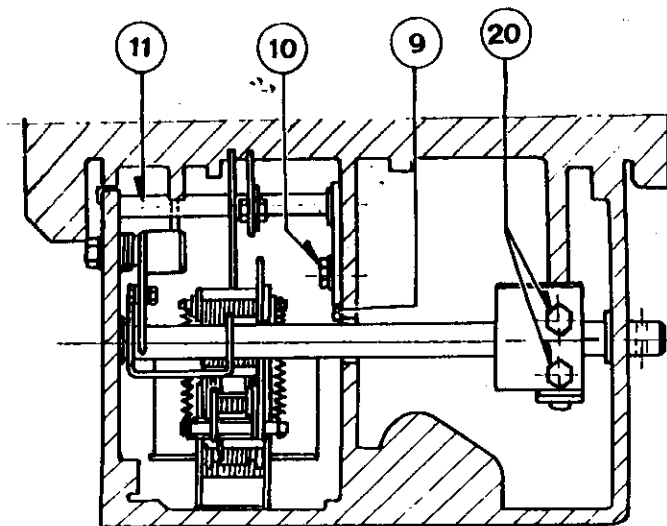


Fig. 12

7.6.2. Accomodation on the outgoing side (figs 12a-b)

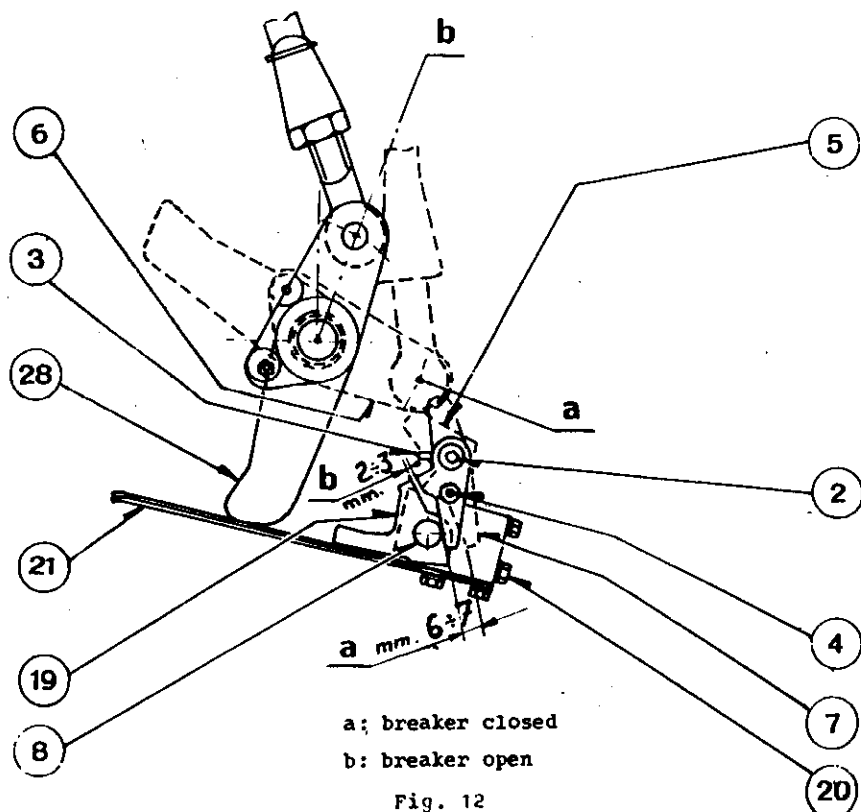
This is mechanically different from that on the supply side as the undervoltage release automatic tripping occurs only when the main contacts of the breaker are completely closed.

Therefore the locking device constituted by elements (9), (10), (11), (12), (13) is missing and the release is not provided with the lever (15).

The fitting procedure is the same as that instructed under §§ a), b), c), d), e), h), i), n), o), p), above.

7.6.3. Overload releases

To fit the overload releases to the breaker poles, follow the instructions reported in the instruction booklet for series DIARC and R, RMc, RMr, RG, RP breakers. LI 2-2 and LI 5-2 respectively.



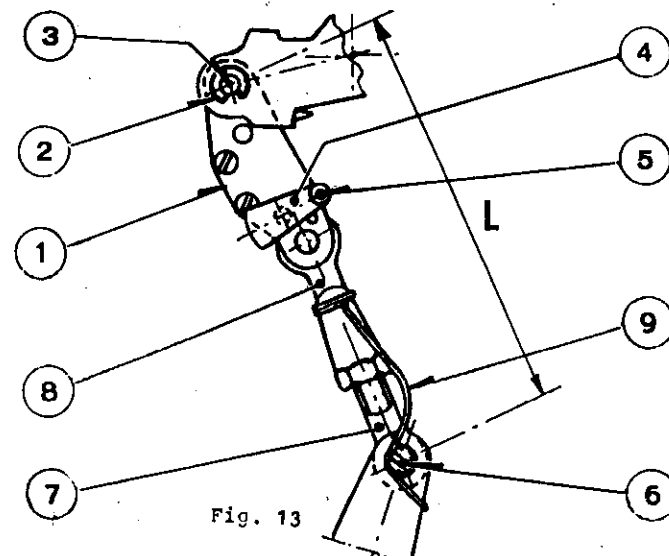
7.7. Conversion of AE type operating mechanism into AEM type

To fit the spring loading motor to the AE version, it is necessary to send the unit to our works or to request the services of our technical engineer.

8. ASSEMBLY

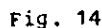
8.1. Fitting up, replacement and adjustment of the trace (fig. 13)

- Open the breaker and release the springs
- De-energize the auxiliary circuits
- Load the closing springs until the neutral lever trips to the left so causing the reloading of the trace (1) system, which will pass to the position shown on fig. 13
- Remove the split washer (2) and slip out the pin (3)
- Lift the lever (4) by operating on the pin (5). The trace will be allowed to lower by rotating on the pin (6)
- Remove the circlips and washers from the pin (6), the left and right side leaf springs (9), then slip out the pin (6)
- Remove and replace the trace
The adjustment of the length (dimension L) according to table II, can be performed by rotating the lower part (8) of the trace on the threaded stem (7). A clockwise rotation shortens the trace, while anticlockwise rotation lengthens the trace; the pitch is 1.5 mm
- To refit the trace operate as above, backwards



Breaker type	Dimension L (mm)
DIARC - D6-D10-D15	194 ± 0.75
RM - RMC - RMr RG 6-10-15-20	192 ± 0.75
RG 30 - RP	194 ± 0.75

The closing springs can be fitted with the help of the special hook shown on fig. 14, supplied on request, by operating (see fig. 10) as follows:

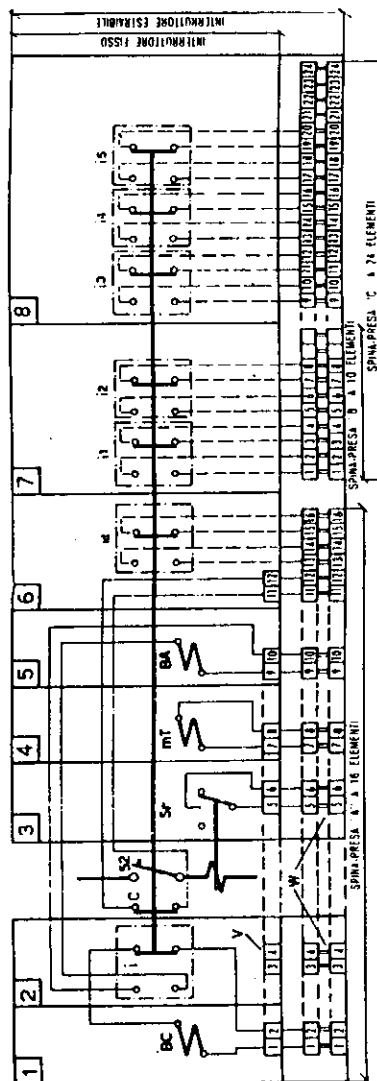


- Introduce a 5 mm diameter pin into hole (A) of the closing springs support (16)
- Fit the hook to the pin and introduce the threaded portion of the hook into the hole drilled in the upper part of the operating mechanism support
- By means of the nut (fig. 14) supplied with the hook load the spring to such an extent as the pin (15) (fig. 10) can be fitted. Then remove the hook and check the loading spring operation

- Trace
- Closing spring
- Trace leaf springs
- Contacts
- CR contacts
- Closing release
- Shunt trip
- Antipumping device
- Spring loading motor with reduction gear
- Loading spring shaft stop (fig. 4 n. 15)
- Loose elements for terminal board
- Special tool for replacing the springs

N.B. When requesting spare parts, the operating mechanism serial number and version are to be quoted

Table V 10. OPERATING MECHANISM ELECTRICAL DIAGRAMS
Operating mechanism Type AE



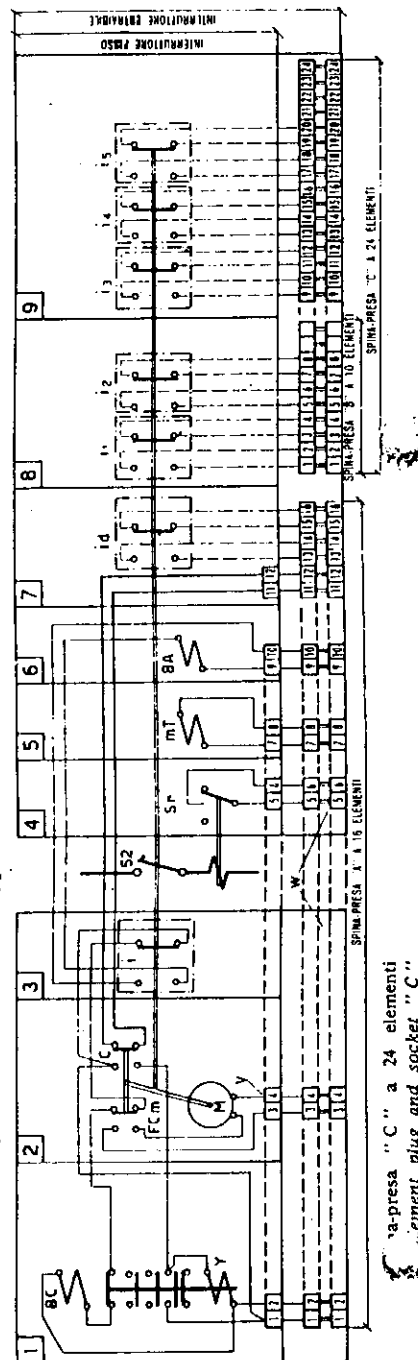
spina-presa "A" a 16 elementi
16-element plug and socket "A"

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

interruttore fisso
fixed breaker

interruttore sezionabile
draw-out breaker

Table VII Operating mechanism type AEM a.c.



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

NOTES

- The circuit-breaker is represented in the "open" position with springs loaded
- The circuit-breaker is equipped only with the fittings listed in our confirmation of order
- Plugs and sockets A, B, C, and relevant connections (in dash) are supplied only for draw-out breakers
- The contact Sr is supplied open or, at choice, closed, with automatic or manual resetting
- 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
- 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)
- 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.

CAPTION

52	Automatic circuit-breaker
BC	Closing release
BA	Shunt trip
MT	Undervoltage release
Sr	Microswitch for "tripped" position indication
i1-15	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	Antipumping device
C	Contact for Y and electric indication of "springs loaded" (on request for AE version)
V	Terminal board
W	Plug-socket