ABB
ASEA BROWN BOVERI

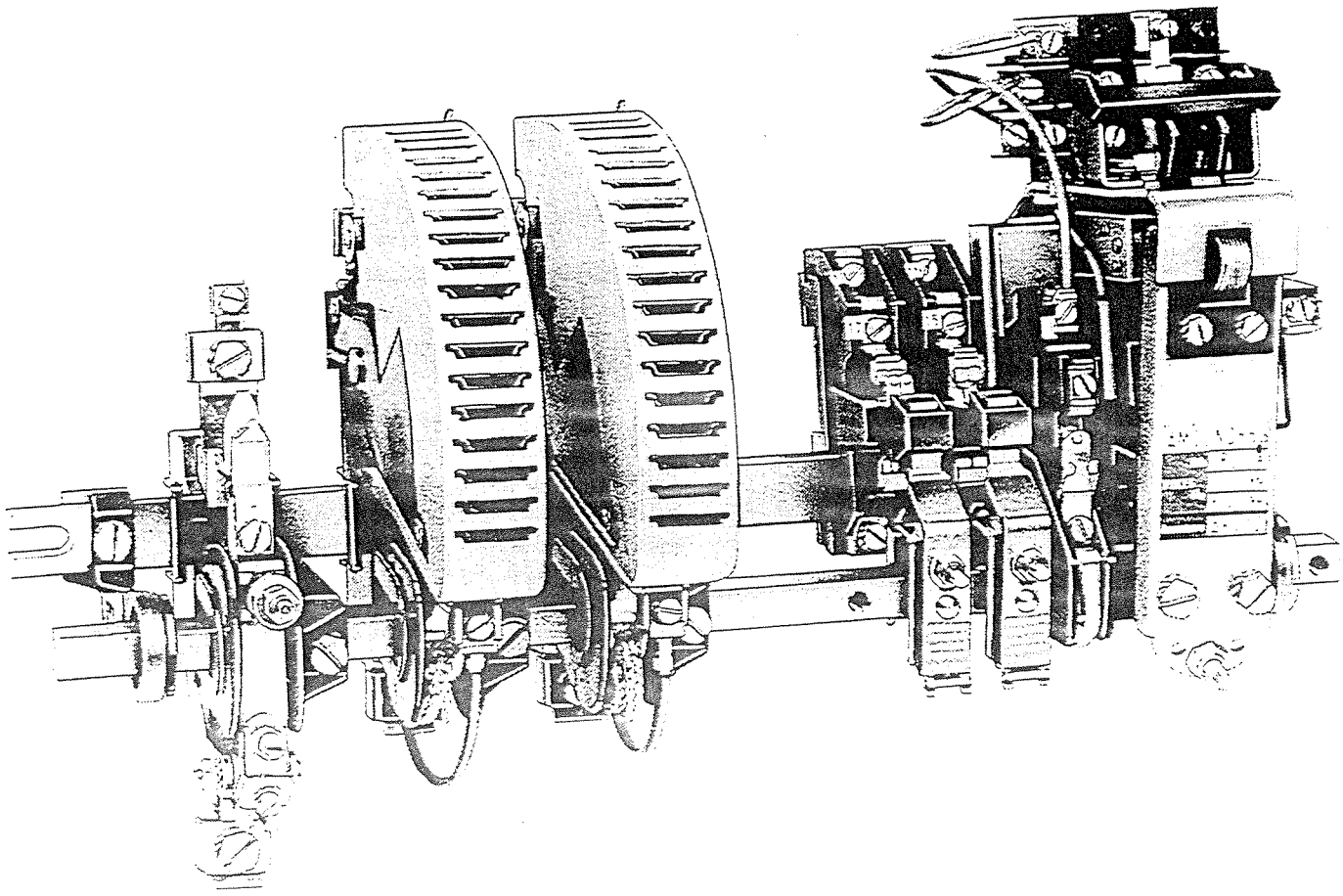
Field Circuit Breaker Types AM-CC-NOR AM-CC-XDR

Rated continuous current
63 to 3000 A
Rated nominal voltage
600 and 1000 V

Publication No. HEIR 91 575 E Rev. b 1990

Description and technical data

Contents

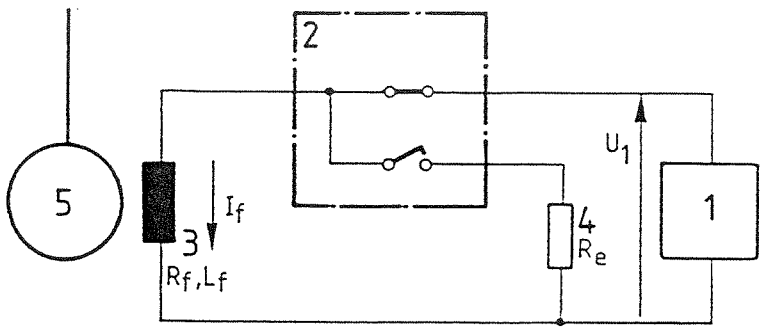


This description booklet contains extensive data on the field breakers (electromagnetically operated field discharge contactors) of the type AM-CC-NOR as well as AM-CC-XDR for rated continuous current from 63 A to 3000 A at rated nominal voltages of 600 V or 1000 V.

These breakers, derived from high power dc-contactors produced by CEM-Petercem and specially adapted to the field discharge conditions, will replace the former field circuit breaker type G up to a rated continuous current of 3000 A. For rated currents above 3000 A up to 6400 A we recommend field breakers type CEX manufactured by UNELEC/ St. Quentin - France.

1. Application field

The field windings of synchronous machines or exciter machines are normally fed via a special and suitable direct current circuit breaker, so that in the case of disturbance a definite disconnection from the supply source and subsequent discharge of the energy in the magnetic circuit takes place. The principle circuit diagram is shown in the Fig.1.



1. DC-source
2. Breaker
3. Field winding
4. Field discharge resistance
5. Generator

Fig. 1

The source 1 delivers the current I_f through the closed circuit breaker 2 to the field winding 3 of the electrical machine 5. The current at stationary condition is given by the source supply voltage U1 and the field resistance R_f. When the field breaking contact opens, the field current is commutated to the field discharge resistance 4 and dies down according to the time function.

The source 1 can be a direct current voltage (battery, dc-exciter) or a rectified a.c. voltage (non-controlled or controlled valves). Mostly, the source voltage is variable for regulating purposes, e.g. by means of a field rheostat or an AVR (electro-mechanical or electronic).

Modern control means like thyristors (SCR's) permit complete deexcitation down to zero. This feature is used under normal operating conditions to relieve the field breaker from unnecessary wear. However, the breaker may not be left away, as the aim of disconnection and the energy discharge must be achieved independent of all kinds of failures including the regulator failure.

2. Main features

The standard dc-contactors of the series R, from which the field breakers AM-CC-NOR and AM-CC-XDR are derived, corresponds to the important international standards: IEC(158-1), UTE(NFC 63-110), VDE(0660), BSI(775) and NEMA. They are recognized by the following institutions: SEV, CSA and VERITAS.

In Europe no specific standard exists for field breakers. In the USA the American standard C 37.18 - 1968 refers to them. The type AM-CC-NOR with delayed reclosing according to fig. 6 on page 18 or the type AM-CC-XDR comply with this standard.

The design principle is based on a single driving shaft with a variable number of main poles with different rupturing capacity. Furthermore, an electromagnetic drive as well as the auxiliary contacts are mounted on the shaft. The circuit breakers are characterized by easy access for supervision and maintenance. All wear-out parts are easily exchangeable from the front side. The same applies for the fixation and connection of the switchgear.

The fixed and moving contacts of the main poles are made of copper with hard soldered plates made of silver with cadmium oxide.

By studying the contact cinematics as well as the magnetic circuit it has been possible to eliminate all bouncing, thus increasing the lifetime considerably.

All metal parts are protected against corrosion by an appropriate surface treatment. In case of an abnormally aggressive and chemically impure atmosphere, it is advisable to demand the additional anti-corrosive processing of the appliances.

The coils are vacuum-impregnated with polyester under pressure and resist high air humidity and temperature (all weather-proof). The making contacts are provided with magnetic arc quenching and arc chamber. If several contacts are used in parallel in order to increase the rated continuous current, then only the last opening pole is provided with arc chamber (Fig. 2). The breaking main contact, henceforth called the field breaking, deexcitation or field suppression contact, can carry the current only during the field discharge. This contact does not have an arc quenching coil and therefore has no breaking capability.

Two different basic designs of field breakers should be distinguished:

a) The normal execution with type designation AM-CC-NOR

In addition to the making contacts this breaker possesses only the field breaking contact without rupturing property and therefore may not be switched on during the field breaking. The best way to achieve this is by blocking the making coil with the help of a time relay (refer circuit sketches Fig. 6, page 18).

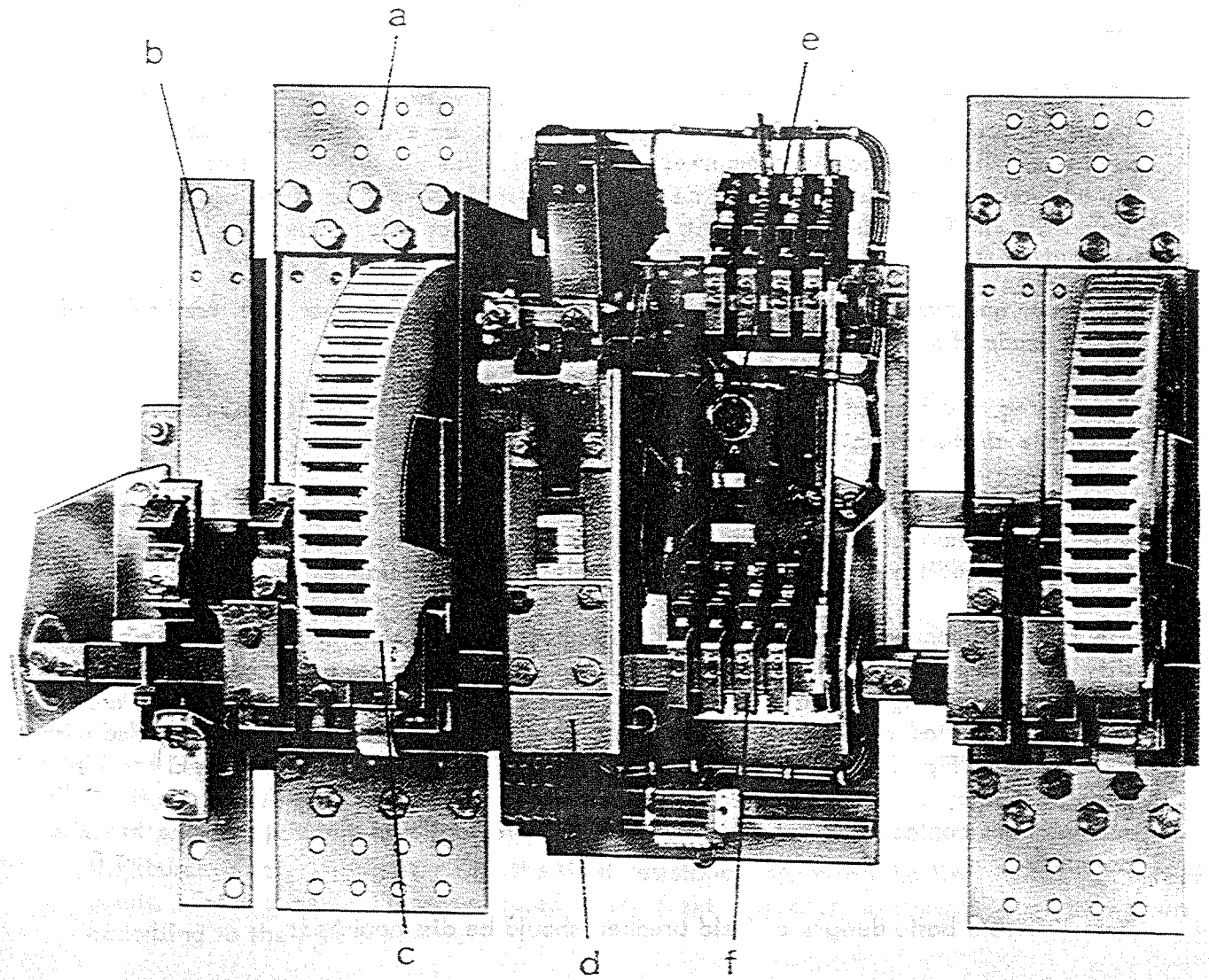


Fig. 2 Field breaker type AM-CC-NOR for 2000 A

a) Parallel connected main contacts
b) Field breaking contact
c) Arc chamber with arc control
d) Electromagnetic drive
e) Time relay
f) Auxiliary contacts

b) Special execution with the type designation AM-CC-XDR

This consists of a main breaker of standard execution AM-CC-NOR and an auxiliary contactor type CC-IORE fitted on a common frame. The auxiliary contactor has 1 or 2 making contacts with magnetic arc quenching, which are connected in parallel to the field breaking contact. If necessary, the breaking capability of these contacts allows the reswitching of the excitation at any arbitrary time. The main breaker and the auxiliary one are interconnected in such a way that the latter actuates before the field breaking contact is open and its contacts are interrupted only after the breaking contact is already open.

The switching on or off is done by pulsewise supply of a making or breaking coil. The minimum pulse duration is 0.1 sec.

For rated continuous currents of 63 and 200 A the switched-on condition is maintained by permanent magnets (residual flux latching). The control is done with direct current and coil voltages from 24 V to 440 V. Even a rectified alternating current arrangement can be provided on demand.

For rated currents from 500 A to 2000 A the breakers have a mechanical interlocking. In the case of this execution an auxiliary contactor and a time relay are provided for the control. The actuation is possible with direct current or rectified alternating current. The coil voltage can be freely selected between 24 V and 440 V. The closing and tripping coils can be made for separate actuation and for different control voltages. The standard model can be equipped with a second independent trip coil and receives the type designation AMF-CC-NOR.

3. Construction and function

The field breakers AM-CC-NOR and AM-CC-XDR are of a simple, functionally optimized and compact design. They are foreseen for mounting in dry rooms (Protection type P00), on the bars of the rack or in the cubicles. The fastening is done either with 2 or 4 screws. (Compare dimensional drawings page 24 and further)

The breakers are composed of a few normalised basic elements such as main poles, auxiliary poles, four corned shaft and drive module. This design principle has the advantage that only a small spare parts assortment is needed (refer page 23).

The function will be explained taking account of the physical sequence during field breaking. The breakers are switched on or off by energizing the corresponding coil via a push-button or a control switch according to the circuit sketches on the pages 18 and 19.

The connection of the main poles is shown in Fig. 3a and 3b on page 6. In the "off" position the discharge contact 1-2 is closed and thus the field discharge resistor Re is connected in series with the field winding. The voltage source 1 is completely separated.

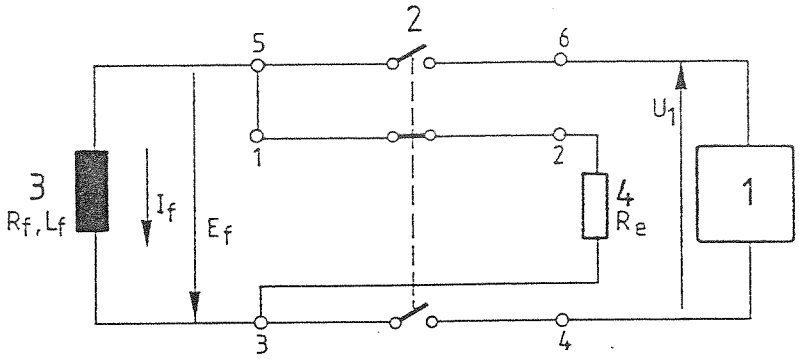


Fig. 3a : Series 21 Rated voltage 600 V

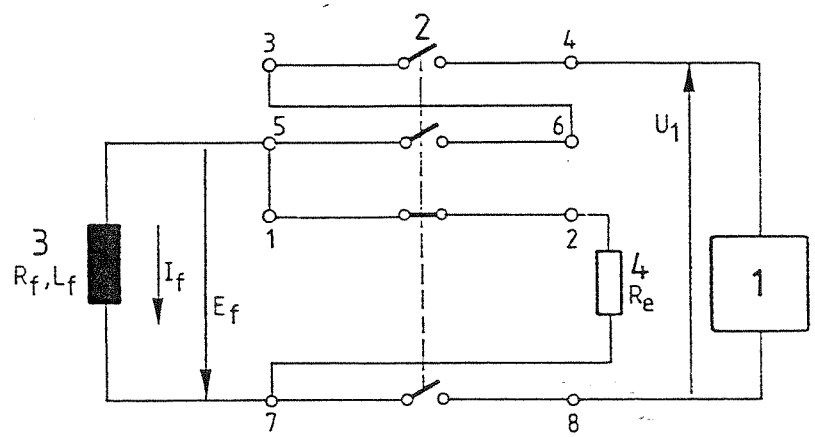


Fig. 3b : Series 31 Rated voltage 1000 V

1 D.C. source

2 Field breaker

1-2 Field breaking contacts
3-4
5-6 Main contact
7-8

3 Field winding

4 Field discharge resistor

3.1 Initial excitation

With the command switch on, the making contacts 3-4 and 5-6 touch in the same moment as the discharge contacts starts to open. For a rated voltage of 1000 V an additional main pole 7-8 connected in series is added to the circuit.

The voltage of the source 1 may be present at the moment the switching-on is done. The current then rises to its stationary final value after the switching-on according to the time constant of the circuit.

In the case of circuit breaker type AM-CC-XDR, the switching command goes only to the auxiliary contactor, which is energized and bridges the discharge contact 1-2. An auxiliary contact on this auxiliary contactor delivers the switch-on command to the main breaker which functions analogous as described above. Only after its main poles are closed, it drops the auxiliary contactor again with an opening auxiliary contact. Thus, contacts of the auxiliary contactor take over the rupturing capacity for a current which may still flow in the discharge circuit at the instant of switching on. Here the electrical coupling causes during the switching-on an overlapping of 15 to 30 ms compared to approx. 1 ms in the case of AM-CC-NOR. The overlapping during the switch-off for both the executions is approx. 1-3 ms.

3.2 Deexcitation

The switch-off command initiates the deexcitation. The field discharge is explained in detail because the maximum excitation current, the voltage strength of the winding as well as type and size of the field discharge resistor decide the selection of a suitable field circuit breaker.

The discharge contact 1-2 closes first and thus the voltage of the field winding U_f appears across the field discharge resistor Re. The main poles begin to break immediately. The field current I_f is compelled to commutate on to the field discharge circuit. Since the current decreases only slowly, the voltage across the field discharge resistor increases first to the value $U_{Re} = I_f \cdot Re$. The inductance of the field winding acts here as driving source, whereby the induced voltage E_f is added to the source voltage U_1.

This rising voltage appears across the main poles during breaking and causes an arc. The maximum arc voltage U_{1max}, which can be mastered surely by the contacts, is therefore a defining magnitude for the field breaker and the maximum permissible field discharge resistance R_{emax}.

After the extinguishing of the arc, which means after 40 ms, the current flows over the field discharge resistor. In the case of linear field discharge resistor (1) the current dies out with the time constant

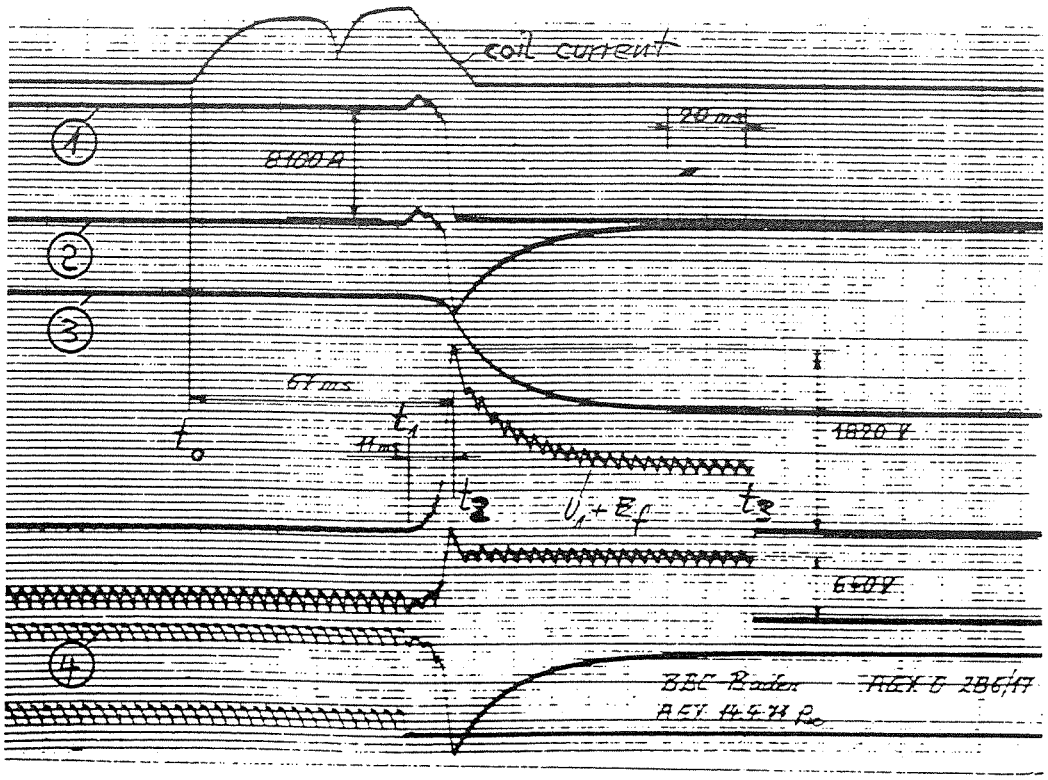
$$T = \frac{L_f}{R_f + R_e}$$

Upon using a non-linear field discharge resistor (2), the deexcitation is realized faster.

(1) We deliver both linear and non-linear field discharge resistors. Further information on request.

(2) The determination of optimum non-linear field discharge resistor is done with the help of computer

The physical behaviour becomes very distinct when plotted with the help of an oscillograph. The following photo was taken while testing the rupturing capacity of the circuit breaker type AM-CC-NOR 800-21. The test was simulated to the practical operational conditions.



Oscillograph No. 286/17 dated 14.4.1971.

Source voltage	U_1	640 dc
Field current	I_f	8100 A dc
Max. voltage	$U_1 + E_f$	1820 V dc

t_o : breaking command (coil current)
t_1 : main contacts begin to open
t_2 : commutating ends
t_3 : source U_1 disconnected, test finish

① Current of the source
② Current in the field discharge resistor
③ Current in the field winding
④ Voltage across the field discharge resistor

The coil current of the breaking coil begins to increase with exponential function at t_o. The starting of the mechanical movement is marked by a voltage drop. At the instant the main contact opens, a sudden increase of the total voltage begins. The duration of the commutation or the overlapping is determined by the circuit inductance. The current in the discharge circuit dies out with an exponential function.

4. Technical data

Field circuit breaker types AM-CC-NOR, AMF-CC-NOR
AM-CC-XDR

Test voltage		5000 V / 50 Hz / 1 min.	
Protection type		IP 00	
		Series 21 2 main contacts 1 field breaking contact	Series 31 3 main contacts 1 field breaking contact
Rated continuous voltage	V =	600	1000
max. interrupting voltage	V =	1500	2250
Rated short-time voltage	V =	900	1500

Types AM-CC-NOR AM-CC-XDR AMF-CC-NOR		63-21 63-31* **	200-21 200-31* **	500-21 500-31 **	800-21 800-31	1500-21 1500-31	2000-21 2000-31	3000-21* 3000-31*
Main contacts								
Rated cont. current	A	80	250	550	800	1500	2000	3000
Rated interrupting current at rated max. interrupting voltage	A	800	2000	5000	8000	8000	8000	8000
Rated interrupting current at rated short-time voltage	A	1000	2600	6500	10000	10000	10000	10000
Rated short-time current 0.5 s	A	1200	3500	7000	12000	20000	27000	32000
max. time constant	ms	5	5	5	5	5	5	5
Opening time	ms	20	20	35	60	60	60	60
Discharge contact								
Rated making current	A	500	1200	2600	5000	5000	5000	5000
Rated 0.5 sec short-time current	A	1000	2500	6500	10000	10000	10000	10000
Rated 15 sec. short-time current	A	250	600	1700	2250	2250	2250	2250
Max.interrupting current at rated nominal voltage								
AM-CC-NOR:		The discharge contact has no breaking capability. To be interlocked with time relay (fig. 6, page 18)						
AM-CC-XDR:	A	500	500	1200	2000	2000	5000	-
		This type is used when the field flashing can be introduced immediately after the breaking command.						
Auxiliary breaker Type CC-IORE:								
Series 21, 600 V dc		63-1	63-1	125-1	200-1	200-1	500-1	-
Series 31, 1000 V dc		-	-	125-2	200-2	200-2	500-2	-

* Cannot be delivered as type AM-CC-XDR
** Cannot be delivered as type AMF-CC-NOR

Auxiliary contacts — Lead capacity acc. to contact type ref. separate table

Caliber of breaker		63	200	500	800	1500	2000	3000
No. of contacts:								
Make contact type	CA12	1	1	–	–	–	–	–
	CA15 (3)	1	1	3	3	3	3	3
	CARB	1	1	–	–	–	–	–
Break contact type	CA12	1	1	–	–	–	–	–
	CA15	1	1	2	2	2	2	2
Drive		Electromagnetic with making and breaking coil*						
Keeping		permanent-magnetic	mechanical interlocking					
Current mode		dc	dc or rectified ac					

Coil voltage V dc: 24(1) - 48(1) - 110 - 125 - 220 - 440 — Tolerance 85 to 110 % of rated voltage

Other values between 24 and 440 on request

Control power of closing coil									
Series 21, 600 V	NOR	W	250	500	350	600	900	900	900
	XDR	W	275	525	340	640	940	965	–
Series 31,1000 V	NOR	W	250	500	400	800	1200	1200	1200
	XDR	W	–	–	440	840	1240	1265	–
Tripping coil		W	150	250	135	250	250	250	250
2nd trip coil AMF-CC-NOR(2)		W	–	–	–	250	250	250	250
Circuit (Page 14 and further)									
AM-CC-NOR			A	A	B	B	B	B	B
AM-CC-XDR			C	C	D	D	D	D	–

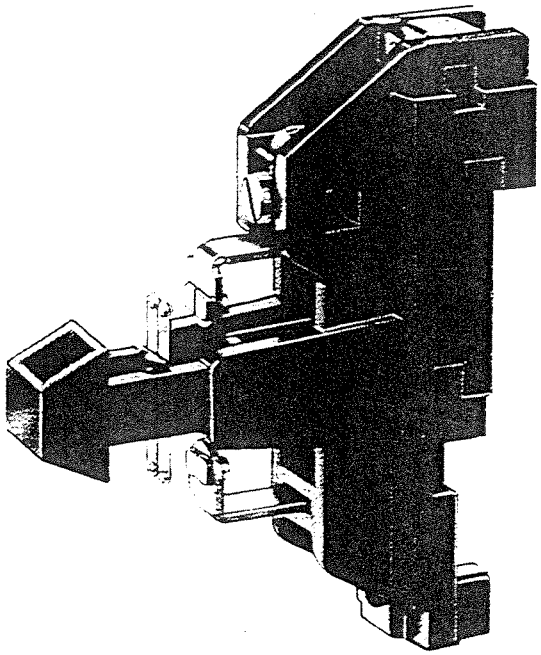
Load capacity of auxiliary contacts (compare fig. on page 11)

Contact type	Rated current A	Fig.	Current mode	Normal current load in A for inductive circuit at a nominal voltage of				
				24/48 V	127 V	220 V	380 V	440/500 V
CA12	12	8	ac	12	10	8	6	3
			dc	5	4	2	0.6	–
CA15	15	9	ac	15	15	12	10	5
			dc	6	6	4	3	2
CARB	6	10	ac	5	4	3	2	1
			dc	3	1.5	0.4	0.1	–

* In case of caliber 63 and 200 as continuous winding executed with 3 contacts

(1) Only for caliber 63 and 200
(2) Instead of circuit diagram B see separate diagrams acc. to list on page 20
(3) With type AMF-CC-NOR 2 make contacts only

Auxiliary contacts



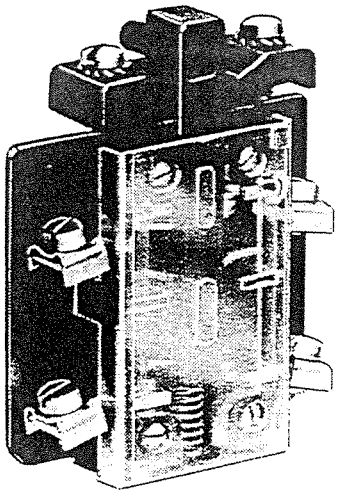


Fig. 8 Type CA 12

Fig. 9 Type CA 15

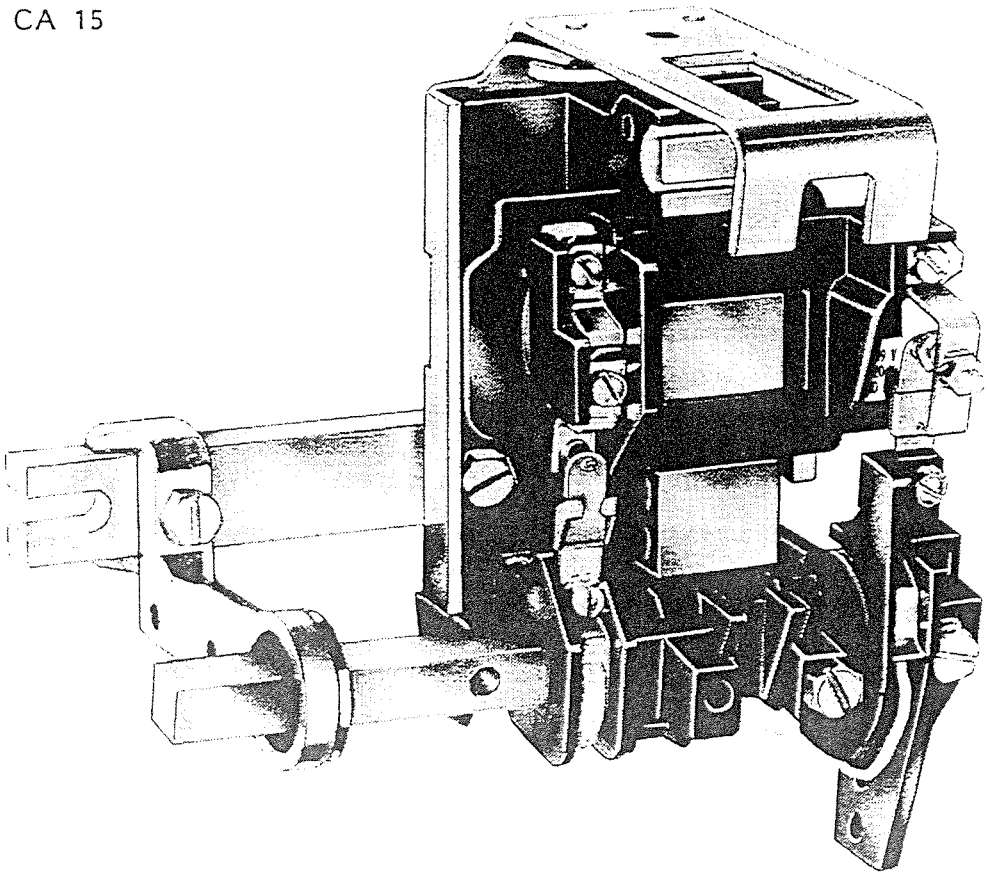


Fig. 10 contact CARB (left)

Dimensions and weights (refer to page 23)

Type AM-CC-NOR		63-21 63-31	200-21 200-31	500-21 500-31	800-21 800-31	1500-21 1500-31	2000-21 2000-31	3000-21 3000-31
Height	mm	284	335	474	595	595	613	690
Depth	mm	148	190	267	325	325	325	325
Series -21 (600 V)								
Width	mm	368	464	664	630	725	975	975
Weight	kg	4	10,5	21	58	72	86	100
Series -31 (1000 V)								
Width	mm	468	559	789	630	975	1040	1240
Weight	kg	5	12,5	27	70	90	110	130
Type AM-CC-XDR		63-21 -	200-21 -	500-21 500-31	800-21 800-31	1500-21 1500-31	2000-21 2000-31	- -
Height	mm	400	700	800	1000	1000	1250	-
Depth	mm	198	250	330	385	385	385	-
Series -21 (600 V)								
Width	mm	368	464	664	630	725	975	-
Weight	kg	8,5	16	30	69	83	106	-
Series -31 (1000 V)								
Width	mm	-	-	789	630	975	1040	-
Weight	kg	-	-	39	84	104	137	-

5. Ordering details

In order to avoid the time consuming inquiries and eventual wrong supplies, we request you to communicate to us the following data completely.

1. Number required
2. Complete type designation, e.g. AM-CC-NOR 500-21. If the type determination is not possible, then the following data are necessary: (1)
   - maximum current which can flow continuously through the field winding (2)
   - maximum current which can flow when the field breaking is initiated
   - test voltage of field winding
   - type and technical data of the field discharge resistor if not ordered with us at the same time.

(1) If a voltage regulation system has been ordered, then the completion of our special questionnaires for voltage regulator and field breaking system is sufficient.

(2) For the type 63 the breaker is equipped with an appropriate arc-quenching coil if this current is below 40 A or 25 A resp.

3. Current mode (frequency, if ac involved) and coil voltage for the control, separately for closing and trip circuit as well as for second trip coil, if required.

4. If special treatment is desired due to the strong corrosive atmosphere

5. Accessories, e.g. field discharge resistance, time relay, push-buttons, control switch.

For the ordering of spare parts, the following data are necessary:

1. Number

2. Designation according to the spare parts list on page

3. Complete type designation and delivery year of the field breaker for which the spare parts are foreseen.

Key to determination of the field breaker size

It should be checked up with the help of technical data on page 9 that the following conditions are fulfilled:

- Rated continuous current of the main contact must be equal or greater than the maximum continuous permissible field current I_{fdd}. (Excitation at overload or 5/4 load.)
- Rated interrupting current at rated max. interrupting voltage must be equal or greater than the highest possible field current which can occur during the fault (ceiling excitation current in the case of exciter machines, short circuit reaction in the case of synchronous machines (3).
- Rated continuous voltage must be equal or greater than the field voltage at maximum continuous permissible field current I_{fdd}.
- Max. interrupting voltage must be greater than the sum of supply voltage U1 and inducted voltage $E_{fmax} = I_{fmax} \cdot Re$, this means at highest possible field current (4).

The test voltage of the field breakers AM-CC-NOR and AM-CC-XDR is above the maximum permissible interrupting voltage. However, it should be checked that the test voltage of the field winding is also higher.

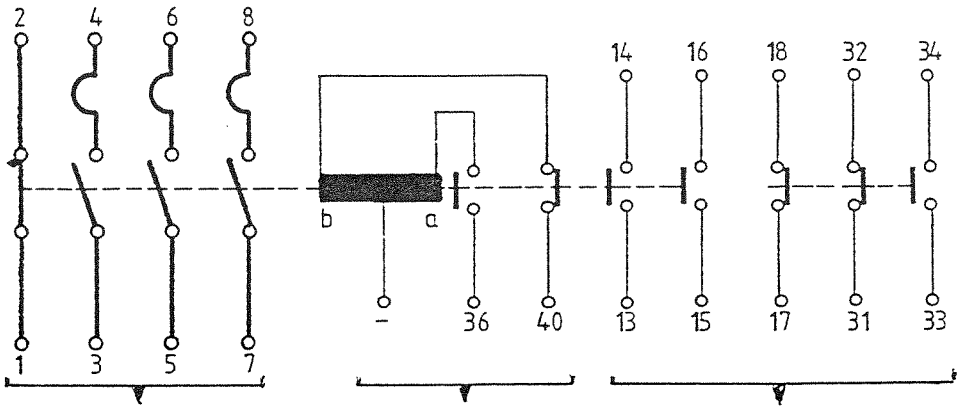
(3) Refer to description for the design of field breaking equipment HEIR 91576.

(4) This condition is often used inversely to determine the highest permissible field discharge resistance: $R_{emax} = (U_{smax} - U_{ceiling}) / I_{fmax}$.

6. Circuit diagrams and dimensions

Circuit diagram A

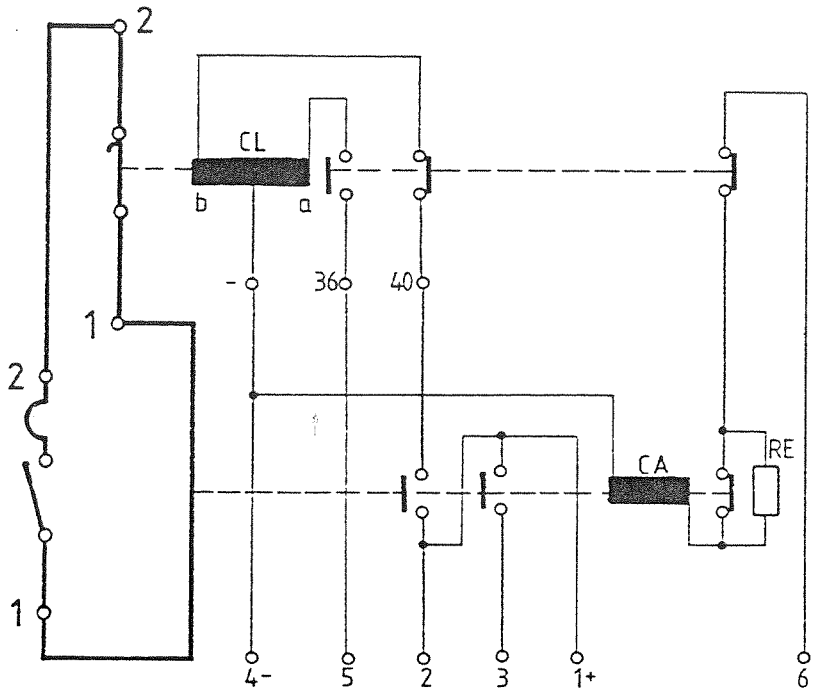
Field circuit breaker with permanent-magnet locking Type AM-CC-NOR 63 and 200



1-2	Field breaking contact without arc quenching coil
3-4, 5-6, 7-8	Main contacts with arc quenching coil and arc chambers (contacts 7-8 only for series 31, for 1000 V dc)
	Connection of the main contacts according to fig. 3, page 6
	Connection of the control according to fig. 4, page 18

Circuit diagram C

Type AM-CC-XDR 63 and 200



Other main contacts and free auxiliary contacts as in the circuit diagram A

CL Field circuit breaker type AM-CC-NOR

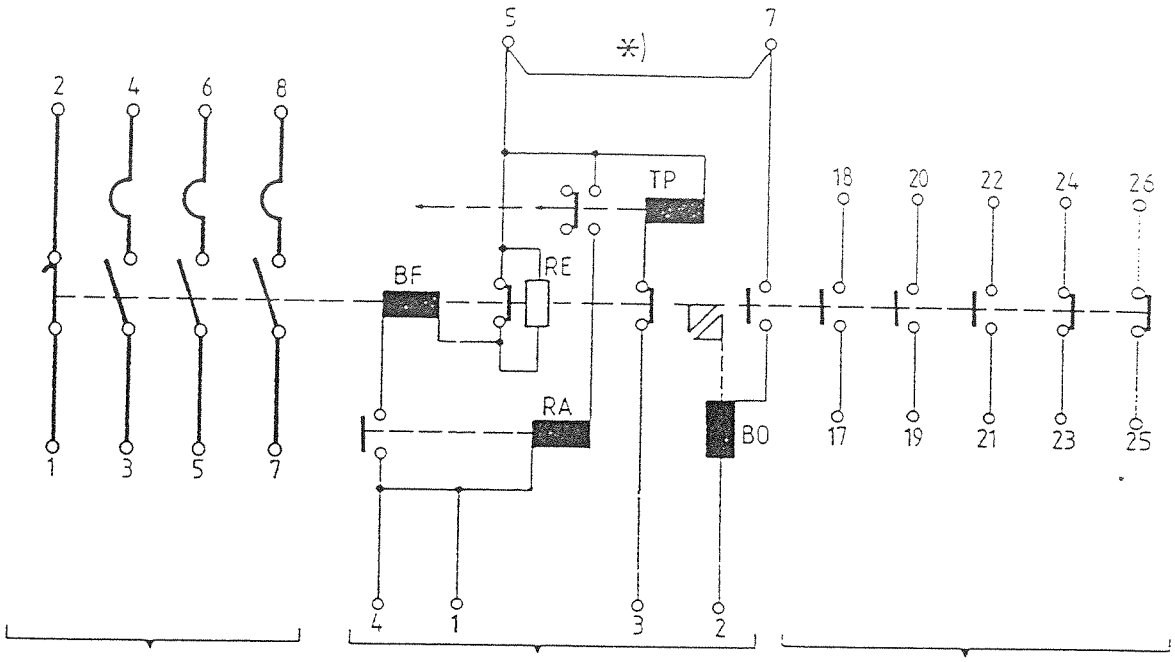
CA Auxiliary contactor type CC-1ORE
Series 21 with 1 contact, series 31 with 2 contacts in series

RE Economizing resistor

Connection of the main contacts according to fig. 3, page 6
Connection of the control according to fig. 7, page 19

Circuit diagram B

Numbering of contacts. Field breakers with mechanical interlocking. Types AM-CC-NOR 500, 800, 1500, 2000 and 3000



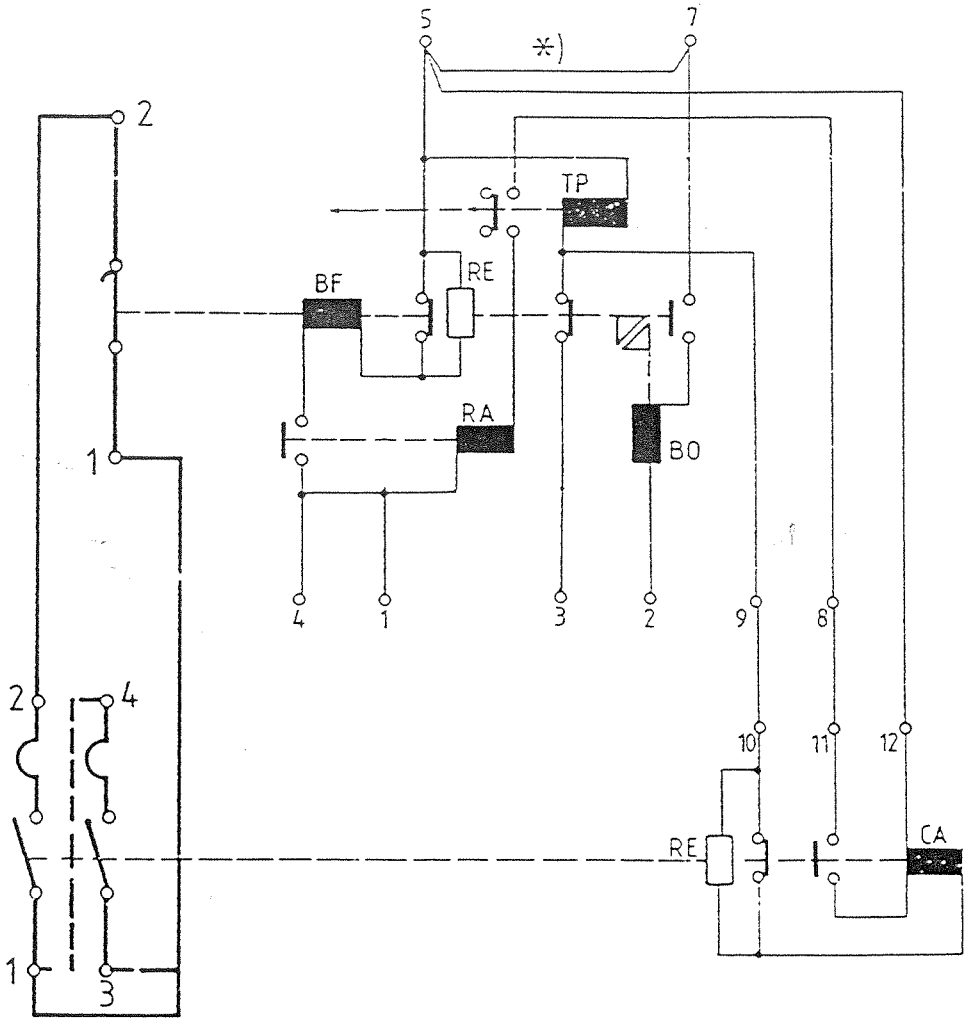
1-2	Field breaking contact without arc quenching coil
3-4, 5-6, 7-8	Main contacts with arc quenching coil and arc chambers (contacts 7-8 only for series 31, for 1000 V dc)

BF	Closing coil
BO	Trip coil
RA	Auxiliary contactor
TP	Pneumatic time relay
RE	Economizing resistor (only for dc voltage, in the case of ac voltage connected directly)

*) In case of galvanically separated tripping circuit, the bridge between terminals 5 and 7 is omitted.

Circuit diagram D

Numbering of contacts. Field breakers with mechanical interlocking and auxiliary relay. Types AM-CC-XDR 500, 800, 1500, 2000 and 3000



Other main contacts and free auxiliary contacts as in the circuit diagram B

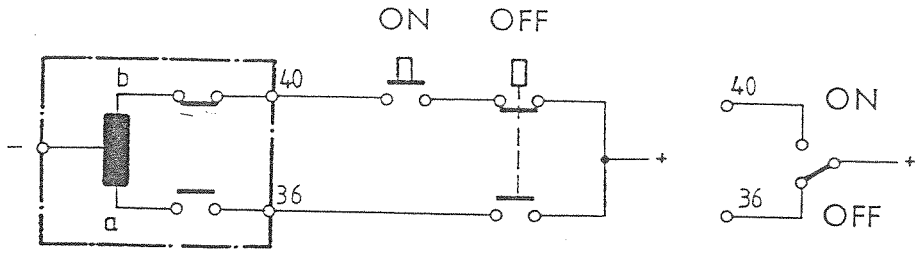
BF	Closing coil	
BO	Trip coil	main contactor
RA	Auxiliary contactor	
TP	Pneumatic time relay	type AM-CC-NOR
RE	Economizing resistor (only for dc voltage, for ac voltage connected directly)	
CA	Coil	auxiliary contactor
RE	Economizing resistor (for dc-voltage)	type CC-IORE

Series 21 with 1 contact, series 31 with 2 contacts in series

*) In case of galvanically separated tripping circuit, the bridge between terminals 5 and 7 is omitted.

Principle circuit diagrams for the control

Breakers with permanent magnetic latching AM-CC-NOR
Caliber 63 and 200

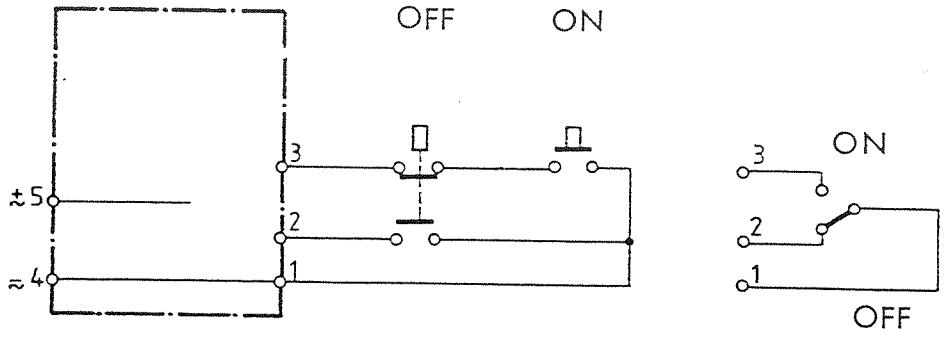


with push-buttons

with control switch,
permanent contact permissible

Fig. 4

Breakers with mechanical interlocking AM-CC-NOR and AM-CC-XDR
Caliber 500, 800, 1500, 2000 and 3000

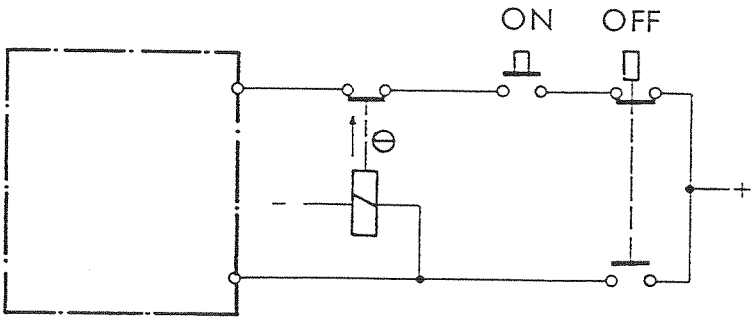


with push-button

with control switch,
permanent contact permissible

Fig. 5

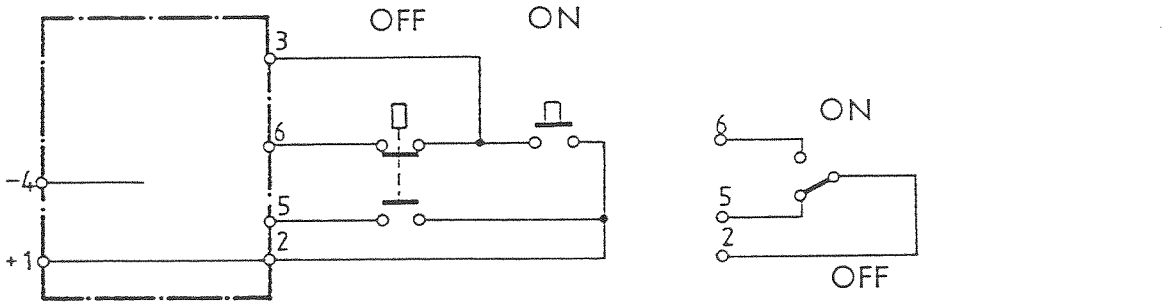
Blocking of reclosing during the deexcitation with the help of time relay for field breaker type AM-CC-NOR.



Time relay, delayed release
(e.g. type PR5 or type KOSC 8 + TPA)

Fig. 6

Control for breakers AM-CC-XDR 63 and 200



with push-buttons

with control switch, permanent contact permissible

Fig. 7

Control in the case of galvanic separation of closing and tripping circuits (only for breakers with mechanical interlocking)

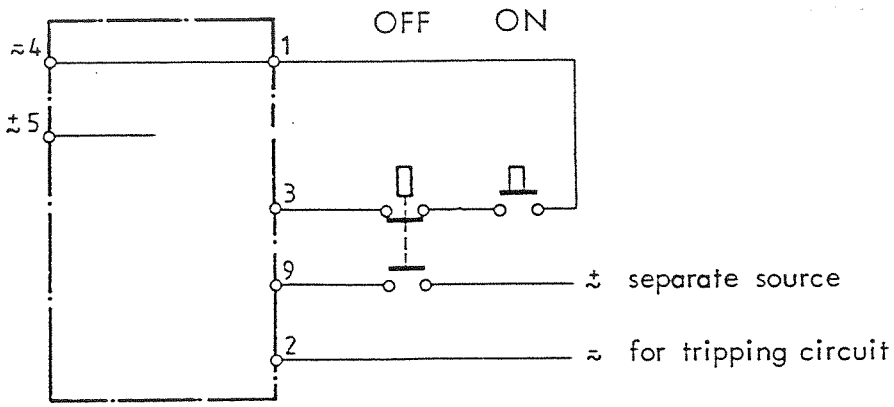


Fig. 8

Recommended protection for the control circuits

External fuses in the supply links are recommended for the control circuit and specially for the making coil. The thermal automatic circuit breaker can also be used when the voltage drop on the tripping contact, caused by the inrush current, is less than 5 % of the nominal control voltage.

Caliber of field breaker		63	200	500	800	1500 2000 3000
Energy required E_{max} for $\vartheta = 75^{\circ}C$	Ws	140	200	800	2000	2000
Tripping time t_{ex} of protective element	s	0.55	0.4	2.4	3.4	2.3
Energizing power P_a	W	250	500	340	570	865

At first the coil resistance $R_{sp} \approx \frac{U_{St}}{P_a}$ is calculated.

The current time integral of the coil until the max. permissible temperature is attained is

$$(i^2 \cdot t)_{coil} = \frac{E_{max}}{R_{Sp}} \leqslant (i^2 \cdot t)_{protective\ element}$$

This value should not be exceeded by the tripping integral. The typical tripping time t_{ex} denotes here the basic point of the breaker characteristic and allows the calculation of the corresponding tripping current. Thus the judgement is possible for a given breaker characteristic.

List of individual circuit diagrams and dimensional drawings

Type	Remarks	Circuit diagram No.	Dimensional drawing No.
AM-CC-NOR			
63-21 200-21	Control voltage $\leqslant 110\ V_=$	FPTS 410 315	FPTE 210 512
63-21 200-21	Control voltage $> 110\ V_=$	FPTS 410 316	FPTE 210 512
63-31 200-31	Control voltage $\leqslant 110\ V_=$	FPTS 410 317	FPTE 210 516
63-31 200-31	Control voltage $> 110\ V_=$	FPTS 410 318	FPTE 210 516
500-21		FPTS 210 609	FPTE 210 821
500-31		FPTS 210 618	FPTE 210 822
800-21 1500-21		FPTS 210 610	FPTE 210 515
800-31		FPTS 210 619	FPTE 210 518
2000-21		FPTS 210 617	FPTE 210 515
1500-31 2000-31		FPTS 210 620	FPTE 210 519
3000-21		FPTS 210 617	FPTE 210 711
3000-31		FPTS 210 620	FPTE 210 712
AMF-CC-NOR	with 2nd trip coil		
800-21 1500-21		FPTS 210 621	FPTE 210 776
2000-21 3000-21		FPTS 210 622	FPTE 210 775
800-31		FPTS 210 623	FPTE 210 716

Type	Remarks	Circuit diagram No.	Dimensional drawing No.
AMF-CC-NOR			
1500-31 2000-31 3000-31		FPTS 210 624	FPTE 210 717
AM-CC-XDR			
63-21 200-21	Control voltage $\leq$ 110 $V_{=}$	2NTS 10276	2NTE 10222
63-21 200-21	Control voltage $>$ 110 $V_{=}$	2NTS 10277	2NTE 10222
500-21		FPTS 210 611	2NTE 10223
500-31		FPTS 210 612	2NTE 10224
800-21 1500-21		FPTS 210 613	2NTE 10225
800-31		FPTS 210 614	2NTE 10226
2000-21		FPTS 210 615	2NTE 10227
1500-31 2000-31		FPTS 210 616	2NTE 10228

7. Spare parts

Designation	Device Type	Device Caliber	Number per device Series -21	Number per device Series -31	Reference No.	Weight kg/piece
Making coil of field breaker	AM-CC-NOR AMF-CC-NOR and AM-CC-XDR	63* 200* 500 800, 1500, 2000, 3000	1 1 1 1	1 1 1 1	NEF 43... (1) NEF 45... (1) NEF 72... (1) NEF 77... (1)	0,15 0,19 0,70 1,30
Breaking coil of field breaker	AM-CC-NOR and AM-CC-XDR	500 800, 1500, 2000, 3000	1 1	1 1	FPL 141 1001 NEF 73... (1)	(2) 0,18
	AMF-CC-NOR	800, 1500, 2000, 3000	2	2	NEF 73... (1)	0,18

* These breakers are equipped with a continuous winding having 3 terminals

(1) When ordering, please indicate the data inscribed on the coil or the voltage

(2) Not available as spare part. Replace contactor.

Designation	Device Type	Caliber	Number per device Series -21	-31	Reference No.	Weight kg/piece
Coil of auxiliary breaker	CC-IORE	63-1/2	1	1	NEF 73... (1)	0,18
		125-1/2	1	1	NEF 75... (1)	0,20
		200-1/2	1	1	NEF 70... (1)	0,30
		500-1/2	1	1	NEF 72... (1)	0,70
Contact pieces (main poles) 1 fixed and 1 moving	AM-CC-NOR AMF-CC-NOR and AM-CC-XDR	63	2	3	NEM 1755	0,05
		200	2	3	NEM 1757	0,25
		500	2	3	NEM 1759	0,48
		800	2	3	NEM 1813	0,52
		1500	4	6	NEM 1813	0,52
		2000	6	9	NEM 1813	0,52
		3000	8	12	NEM 1813	0,52
Contact pieces (Discharge pole) 1 fixed and 1 moving	AM-CC-NOR AMF-CC-NOR and AM-CC-XDR	63	1	1	FPTN 301780 R2	0,04
		200	1	1	FPTN 301780 R4	0,18
		500	1	1	FPTN 301780 R5	0,25
		800, 1500, 2500, 3000	1	1	NEM 1813	0,52
Contact pieces 1 fixed and 1 moving (2)	CC-IORE	63-1/2	1	2	NEM 1755	0,05
		125-1/2	1	2	NEM 1756	0,15
		200-1/2	1	2	NEM 1757	0,25
		500-1/2	1	2	NEM 1759	0,48
Arc quenching chamber (Main poles)	AM-CC-NOR AMF-CC-NOR and AM-CC-XDR	63	2	3	FPTN 401938 R1	0,47
		200	2	3	FPTN 401940 R1	1,36
		500	2	3	FPTN 401941 R1	3,60
		800, 1500, 2000, 3000	2	3	NER 1095	2,57
Arc quenching chamber (2) (Auxiliary breaker CA)	CC-IORE	63-1/2	1	2	FPTN 401938 R1	0,47
		125-1/2	1	2	FPTN 401939 R1	0,93
		200-1/2	1	2	FPTN 401940 R1	1,36
		500-1/2	1	2	FPTN 401941 R1	3,60
Auxiliary contact type CA 12	AM-CC-NOR and AM-CC-XDR	63,200	1	1	CA 12(0+0)	0,200
			1	1	CA 12(F+F)	0,200
			1	1	CA 12(0+F)	0,200
						0,200
	CC-IORE (2)	63,125, 200, 500	1	1	CA 12(F+F)	0,200

(1) When ordering, please indicate the data inscribed on the coil or the voltage
(2) Exists with type XDR only

Designation	Device Type	Caliber	Number per device Series -21	-31	Reference No.	Weight kg/piece
Auxiliary contact type CA 15	AM-CC-NOR AMF-CC-NOR and AM-CC-XDR	63,200 500 800, 1500, 2000, 3000	2 6 8	2 6 8	CAF 15 + CAO 15 CAF 15 + CAO 15 CAF 15 + CAO 15	0,150 0,150 0,150
Auxiliary contact type CARB	AM-CC-NOR and AM-CC-XDR	63,200 500	1	1	CARB (NEM 1613)	0,4
Auxiliary contact type CAOVE	AM-CC-NOR AMF-CC-NOR and AM-CC-XDR	63,200 500			CAOVE (NEM 1415)	0,4
Auxiliary contact type CAOR 15	CC-IORE (2)	63,125, 200, 500	1	1	CAOR 15	0,150
Time relay type TPA	AM-CC-NOR AMF-CC-NOR and AM-CC-XDR	500,800 1500, 2000, 3000	1	1	KC 40E + TP401 Time delay TDO 2 sec (1)	0.61
Auxiliary contactor type RA	AM-CC-NOR AMF-CC-NOR AM-CC-XDR	500,800, 1500, 2000, 3000	1	1	BC 9-40-00 (1)	0.54

(1) When ordering, please indicate the data inscribed on the coil or the voltage
(2) Exists with type XDR only