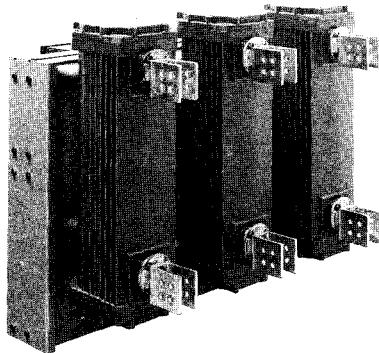
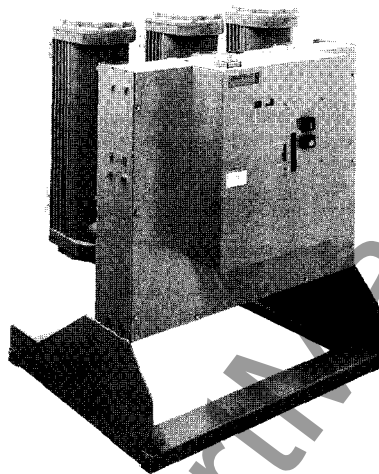


MERLIN GERIN

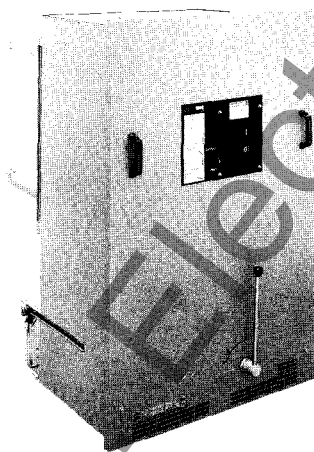
**Fluarc FG4
24 to 40.5 kV**



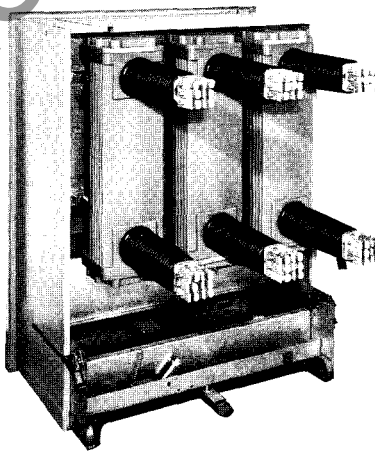
fixed FG4 2500 A



fixed FG4 with 2500 A support frame



withdrawable FG4 630 A-1250 A



withdrawable FG4 2500 A

mastering electrical power



description

presentation

The Fluarc FG4 circuit-breakers are designed for control and protection of medium voltage public distribution networks. These circuit-breakers use sulphur hexafluoride (SF6) for insulation and breaking.

Breaking is by the puffer technique.

They are made up of three pole-units and an operating mechanism on a support frame. Each pole-unit encloses all active parts in an insulating enclosure. This enclosure is filled with SF6 to a relative pressure of 2.5 bars. It is of the sealed pressure system type according to the IEC 56 definition, 1987 edition, appendix EE.

Their main qualities are:

- long life expectancy,
- no maintenance of active parts,
- high electrical endurance,
- very low surge level,
- operating safety,
- insensitivity to the environment,
- possibility of permanent circuit-breaker pressure control (optional pressure switch),
- well-suited to high-speed reclosing and capacitor bank switching.

characteristics

The characteristics given below are as defined by the IEC regulations, publication 56 and 694, UTE volume C 64.100-101, VDE 0670, BS 5311 and ANSI C37-06.

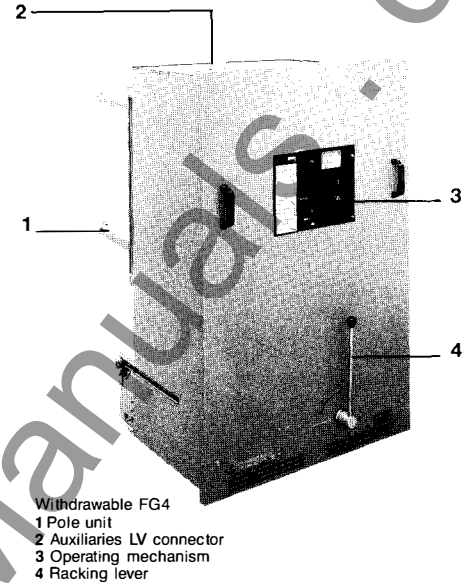
Rated frequency: 50-60 Hz.

Operating times at rated voltage:

- opening time between application of voltage to the opening device and arc contact separation: 45 to 65 ms;
- breaking time between application of voltage to the opening device and final arc extinction: 60 to 80 ms;
- closing time between application of voltage to the closing device and contact closing: 60 to 90 ms.

Rated operating sequences:

- O-3 mn - CO - 3 mn - CO (standard)
- O-0.3 s - CO - 15 s - CO (option)



ratings to IEC 56, VDE 0670, BS 5311, UTE C64.100/101

rated voltage (kV)	rated insulation level		rated breaking capacity at U (kV) kA	rated continuous current A	making capacity (2) kA peak	3-second withstand current kA rms	capacitor breaking capacity for a rated current of (A)			index
	impulse (1) 1.2 / 50 μs kV peak	1 mn 50-60 Hz kV rms					630	1250	2500	
24	125	50	U: 17.5 to 24 kV 40	630 1250 2500	100	40	440	875	1750	
36	170	70	U: 24 to 40.5 kV 25 31.5		62.5 80	25 31.5				

ratings to US Standards ANSI C37-06

a) fixed FG4 outdoor circuit-breakers (DFE)

rated voltage		rated insulation level		symmetrical breaking capacity (Isc) kA at rated kV	rated continuous current at 60 Hz A rms	3-second withstand current kA rms.	closing and latching capability (2.7 Isc) kA peak	index
max. voltage	voltage range factor $= \frac{U \text{ max.}}{U \text{ min.}}$	impulse (1) 1.2/50 μs kV peak	1 mn 60 Hz kV rms					
kV		kV peak	kV rms		A rms	kA rms.	kA peak	
25.8	1	150	60	25	1200-2000	25	68	
38	1	150	80	31.5	1200-2000	31.5	85	

b) FG4 indoor circuit-breakers

class		rated voltage (kV)			rated insulation level :		breaking capacity Isc at kV		rated current A	3-second withstand current kA rms	closing and latching capability 1.6 Isc (U min.) kA rms	index
kV	MVA	min.	factor K $= \frac{U \text{ max.}}{U \text{ min.}}$	max.	impulse (1) 1.2/50 μs kV peak	1 mn 60 Hz kV rms	min. kA	max. kA				
38	1500	23	1.65	38	150	80	35	21	1200-2000	35	56	

(1) Guaranteed dielectric withstand values are for the circuit-breaker only. See inter-phase distances on pages 4 and 6. For circuit-breakers installed in cubicles, the dielectric withstand is the responsibility of the panelbuilder. Merlin Gerin can be consulted for recommendations on installation.

(2) The making capacity corresponds to 2.5 times the breaking capacity at rated voltage.

For other ratings, please consult us.

operating mechanism and auxiliary devices

operating mechanism

The Fluarc FG4 circuit-breaker is equipped with a GMh type spring stored-energy operating mechanism for fast opening and closing independent of operator action. It is equipped with a manual and an electrical charging mechanism.

This system comprises:

- an operations counter ;
- a position indicator (ON/OFF).

The electrical operating mechanism can also be charged manually by the removable lever in front in the event of auxiliary power failure.

The electrical spring charging system includes a motor (M), automatically recharging the operating mechanism as soon as the breaker is closed (recharging time < 15 s).

IEC rated supply voltages

D.C.: 24 - 48 - 60 - 110 - 125 - 220 V

A.C.: 110 - 127 - 220 V

Closing

Manual closing by mechanical action via a pushbutton on the front panel.
Electrical closing by a closing release (YF) and anti-pumping relay (KN).

Consumption at rated U

	charging motor	closing release
in D.C.:	220 to 600 W	70 W
in A.C.:	350 to 700 VA	100 VA

Opening

Manual opening by mechanical action via a pushbutton on the front panel.
Electrical opening via indirect releases. Several types of indirect releases can be fitted.

The 17 possible combinations are set out in the table below.

Release type

n°	shunt trip	under-voltage (1)	over-current (2)	Mitop (3)
1	■ 1 coil			
2	■ 1 coil	■		
3	■ 1 coil		■ 1 coil	
4	■ 1 coil		■ 2 coil	
5		■		
6		■	■ 1 coil	
7		■	■ 2 coil	
8			■ 1 coil	
9	■ 2 coil			
10			■ 2 coil	
11	■ 2 coil	■		
12	■ 2 coil		■ 1 coil	
13				■
14	■ 1 coil			■
15			■ 1 coil	■
16	■ 2 coil			■
17			■ 2 coil	■

Consumptions at rated U

release type	D.C. W	A.C. VA
single-coil shunt	70	100
undervoltage	15	75
single-coil overcurrent		120

self-current Mitop : 1 VA

auxiliary devices

Auxiliary contacts

The Fluarc FG4 operating mechanism is equipped with:

- 14 auxiliary contacts including:
 - 2 used for the electrical operating mechanism ;
 - 1 used for the opening shunt trip release (Y01) ;
 - 11 contacts remain available for customer's use.

Characteristics of auxiliary contacts:

rated current: 10 A

breaking capacity:

- in D.C.: 3 A at 110 V or 220 V
- in A.C.: at 0.3 pf: 10 A at 220 V

Options

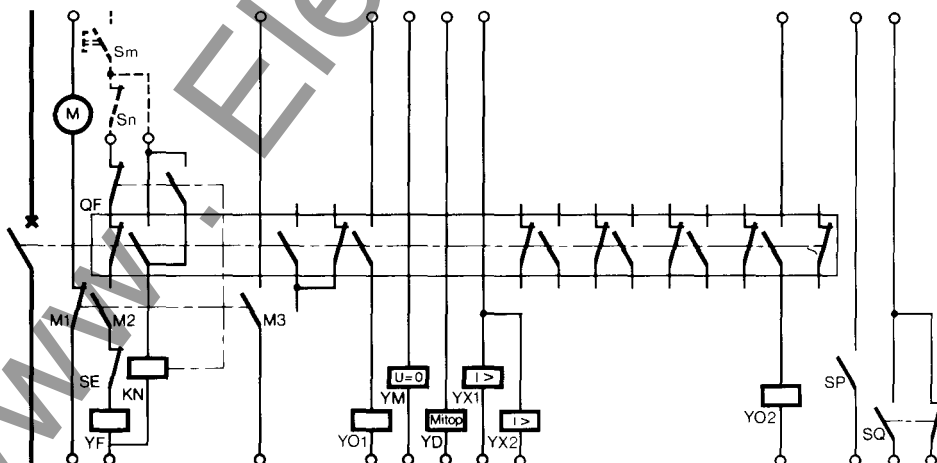
- open-position locking facility by Ronis EL S 11A key-lock (lock not supplied) ;
- a closing contact pressure switch (SP) for indication of any SF6 pressure drop (1 per pole-unit),
- a Statimax protection device, without auxiliary power supply, with Mitop release ;
- operating mechanism charged indication contact (M3) ;
- green-red open/closed indicator instead of green-white (standard).

(1) A withdrawable circuit-breaker fitted with an undervoltage release must always be provided with an operating mechanism automatic discharging system.

(2) Overcurrent release power supply: 2 A - 5 A.

(3) The Mitop release is made up of a low consumption bi-stable electromagnet designed to receive a low power order from the Statimax protection system ensuring protection without the use of an auxiliary source (see leaflet AC 42).

Electrical operating mechanism wiring diagram



Always supplied:

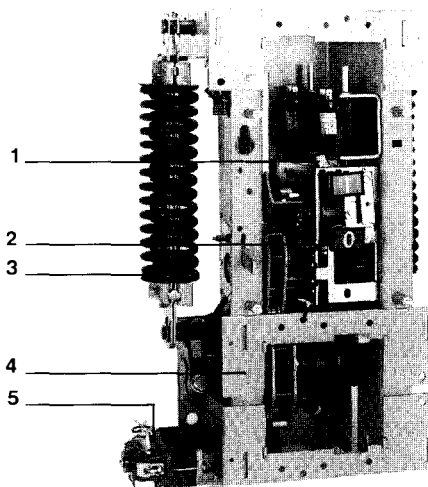
- M spring charging motor
- YF closing release
- M1-M2 end-of-charging switch
- QF auxiliary contacts
- KN anti-pumping relay

Options:

- Y01-Y02 shunt trip release
- YM undervoltage release
- YX overcurrent release
- YD MITOP release
- M3 operating mechanism charged indication contact

GMh electrically charged operating mechanism:

- 1 closing and opening release
- 2 latching unit
- 3 closing springs
- 4 frame
- 5 spring charging motor



fixed FG4

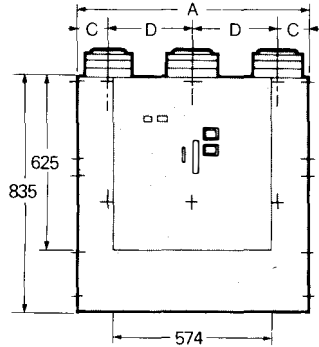
fixed unit

The fixed Fluarc FG4 is equipped with the operating mechanism and the auxiliary devices mentioned on page 3. It is supplied with its connection pads.

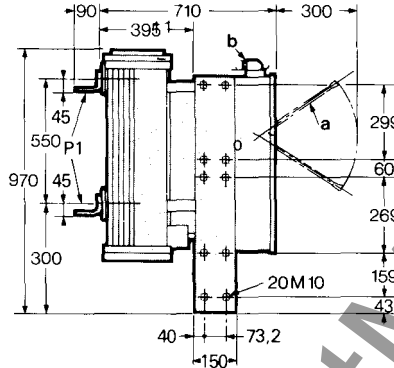
Options for fixed units

- male and female LV 36-pin connection comprising a fixed connector on the circuit-breaker and a socket equipped with a 2 m cable;
- support frame (see below).

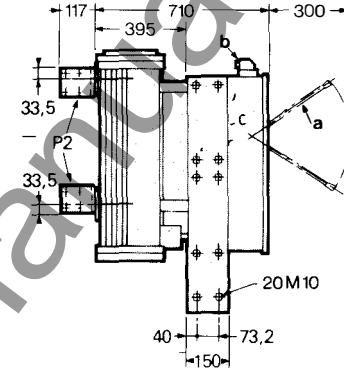
dimensions (mm)



FG4 front view

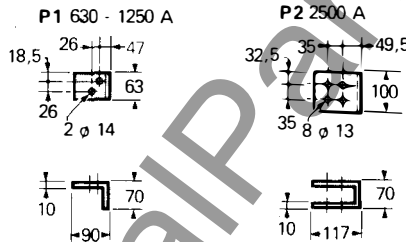


FG4 : 630 - 1250 A



FG4 : 2500 A

connection pads



a : removable charging lever
b : LV connector

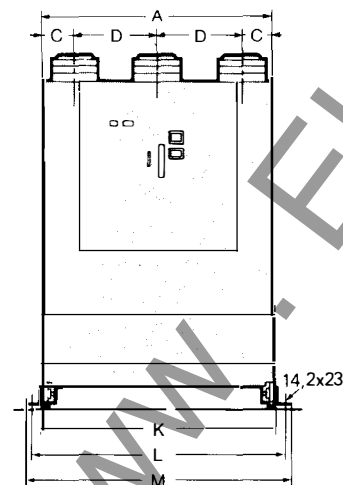
fixed unit mounted on a support frame

The FG4 may be supplied with an optional support frame.

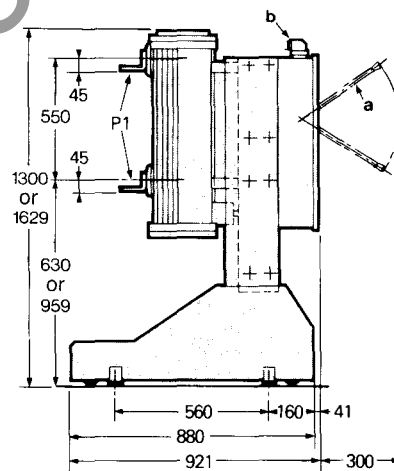
The support frame is fitted with rollers for easy circuit-breaker handling and installation.

The frame is provided with fixing lugs for anchoring to the floor.

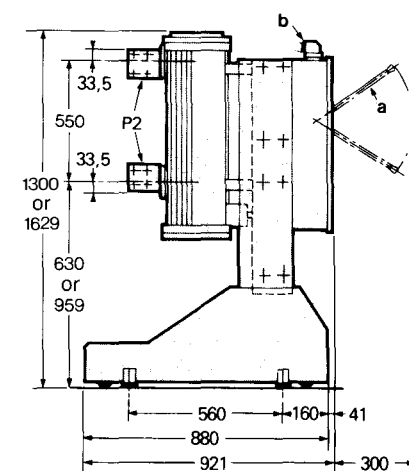
dimensions (mm)



FG4 front view



FG4 : 630 A - 1250 A



FG4 : 2500 A

rated current A	rated impulse insulation lev I kV peak	inter-phase distance D mm	A	C	K	L	M	Weights kg	
			mm	mm	mm	mm	mm	C-B alone	support frame
630 - 1250 - 2500	125	300*	836	118	826	906	936	315	45
630 - 1250 - 2500	170	400	1026	118	1026	1122	1122	365	15

a : removable charging level
b : LV connector

withdrawable FG4

Fluair 400 cubicle

"panelbuilder" cubicle

For easy installation and maintenance as well as upstream and downstream disconnection with visible break, the Fluarc FG4 can be supplied as a withdrawable unit.

The circuit-breaker is fitted with:

- the operating mechanism and auxiliary devices mentioned on page 3,
- a frame earthing contact,
- a guide rail at the bottom (c),
- a mechanical system securing the breaker in "service" or "disconnected" position.

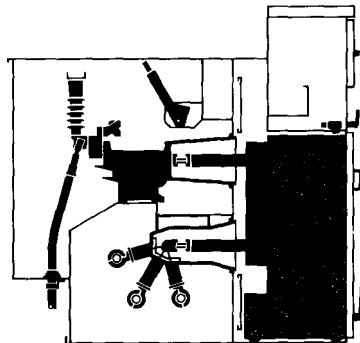
FG4 circuit-breaker installed in a Merlin Gerin Fluair 400 cubicle.

In this case, the FG4 is equipped with:

- a LV male connector (connector fixed on the circuit-breaker),
- racking lock-out system preventing breaker insertion if the LV cable is not connected.

Options:

- Version for Fluair cubicle with internal arc withstand,
- disconnection carriage (all ratings).



FG4 circuit-breaker installed in a Fluair 400. (See technical leaflet AT 16E)

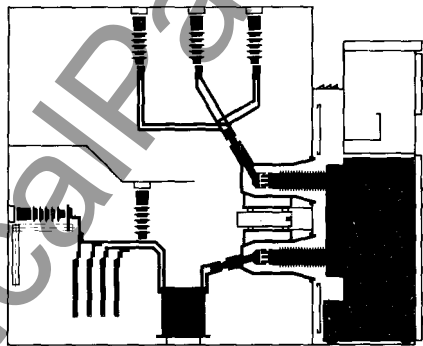
The circuit-breaker can be operated (drawing-in/-out) by positioning the removable racking lever (d) on marks 1, 2 or 3 on the front panel:

- **mark 1:** breaker secured in "service" or "test" position, or free in "removed" position. Breaker operation (closing/opening) is only possible with the lever on mark 1.
- **mark 2:** the lever releases the securing system and allows the breaker to be moved from "service" to "test" position and vice versa. The lever can only be moved to mark 2 if the circuit-breaker is open.
- **mark 3:** the lever releases the securing system allowing the breaker to be fully removed from the cubicle. It also provides a stop function when the breaker is reinserted in the cubicle.

FG4 circuit-breaker installed in "panelbuilder" cubicle.

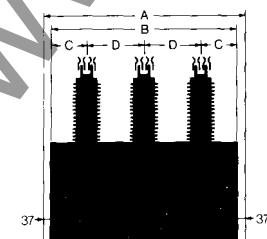
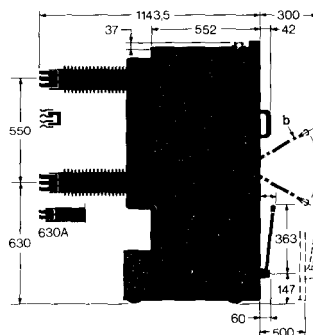
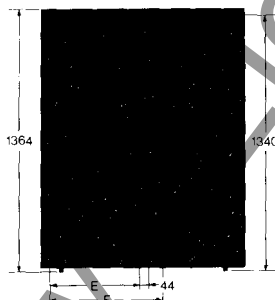
In this case, the FG4 is equipped with:

- male and female LV 36-pin connection (fixed connector on the circuit-breaker and socket equipped with a 2 m cable).



Example of a cubicle produced by a panelbuilder.

dimensions and weights



Fluair 400 cubicle	rated current	rated impulse insulation level	inter-phase distance D	A	B	C	E	F	weight
	A	kV peak	mm	mm					kg
	630 - 1250	170	250	868	794	147	375	503	340
	2500	170	300	1068	994	197	475	603	390
"Panel-builder" cubicle	630 - 1250	150 (1)	250	868	794	147	375	503	340
	630 - 1250	170	300	1068	994	197	475	603	370
	2500	150 (1)	300	1068	994	197	475	603	390

FG4 pole-unit

FG4 pole-unit description

The FG4 pole-unit consists of:

■ **a main circuit** including the fixed contact 21 and the self-wiping, self-compensated blades making up the moving contact 20;

■ **a breaking circuit** including the fixing arc contact 4, moving arcing contact 6, main rod 10, flexible connector 19, moving piston 7 and insulating nozzle 5 directing the SF6 flow towards the arc.

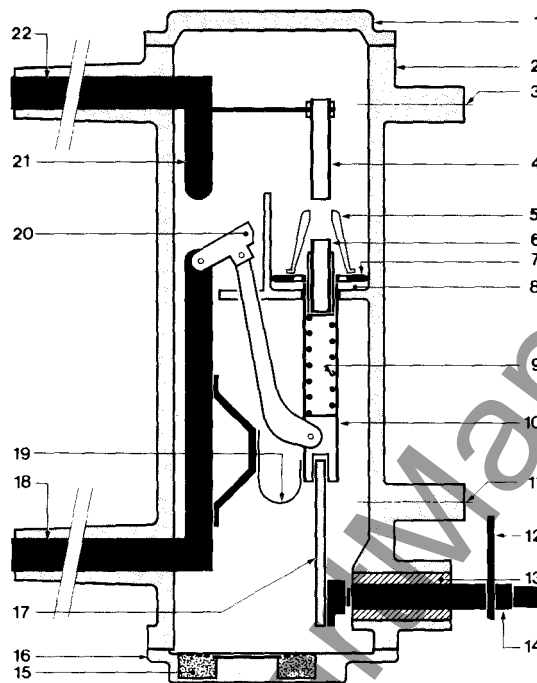
The main circuit, designed for the continuous flow of current, is distinct from the breaking circuit subjected to the arc;

■ **a transmission mechanism** conveying the mechanical energy to the moving contacts, including the crank-handle 12, shaft 14, insulating connecting rod 17, main rod 10 and spring 9;

■ **a sealing system** 13, highly reliable for any number of operations;

■ **an insulating enclosure** 2, enclosing all active parts.

The filling pressure and breaker performance characteristics are maintained for at least 20 years, corresponding to the operating life of a circuit-breaker on a normally disturbed network.



- 1 cover
- 2 insulating enclosure
- 3 pole-unit attachment
- 4 fixed arcing contact
- 5 insulating nozzle
- 6 moving arcing contact
- 7 piston
- 8 pressure chamber
- 9 spring
- 10 main rod
- 11 pole-unit attachment
- 12 crank-handle
- 13 sealing system
- 14 shaft
- 15 molecular sieve
- 16 cover
- 17 insulating connecting rod
- 18 lower current terminal
- 19 flexible connector
- 20 moving contact of main circuit (tilting blade)
- 21 fixed contact of main circuit
- 22 upper current terminal

FG4 operation

The main contacts and the arcing contacts are initially closed (fig. 1)

Precompression (fig. 2)

From the beginning of the movement, the SF6 gas is compressed by the piston. The main contacts separate and the current flows via the arcing contacts, which are still closed.

The arcing time (fig. 3)

The arc then forms between the arcing contacts and the piston continues its downward movement. A small quantity of gas leaves the pressure chamber. It is directed by the insulating nozzle and injected onto the arc. The cooling of the arc is thus achieved through forced convection for the interruption of low currents; however, during the interruption of high currents, it is thermal expansion which is responsible for the transfer of the hot gases towards the cold parts of the pole-unit. Towards current zero, the dielectric strength between the contacts is recovered due to the intrinsic qualities of SF6.

Sweeping overstroke (fig. 4)

The moving parts finish their travel whereas the cold gas injection continues until the contacts are completely open.

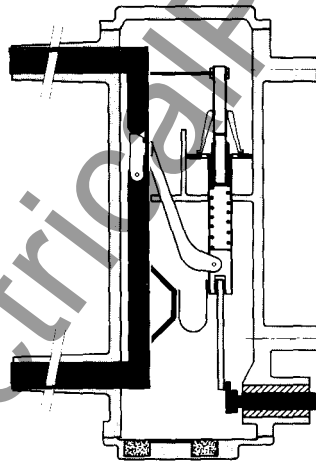


Fig. 1 - Closed circuit-breaker

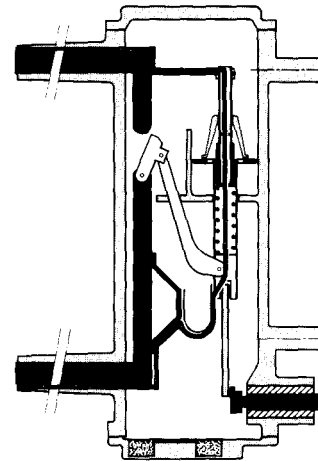
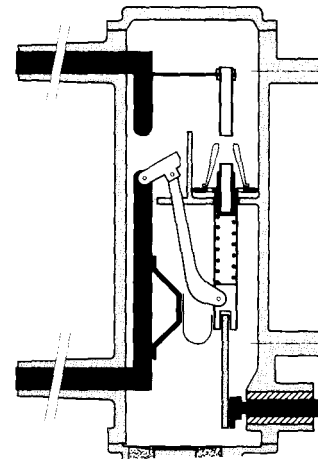
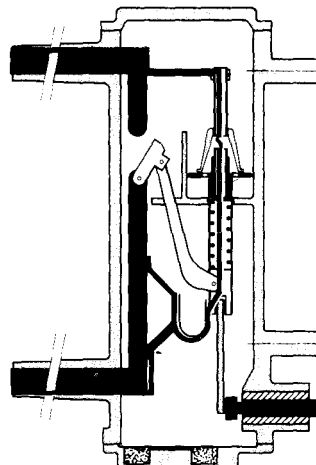
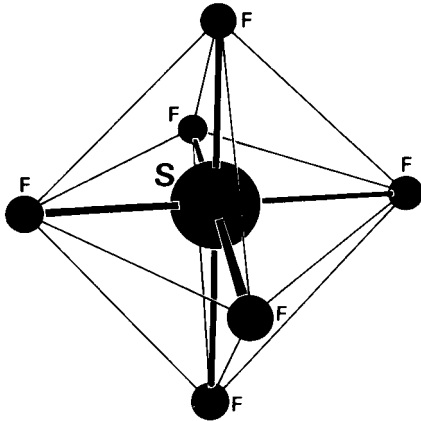


Fig. 2 - Opened main contacts



Fluarc FG4 technology

sulphur hexafluoride gas (SF₆) properties



SF₆ is an **unflammable**, very stable, non toxic gas, five times heavier than air. Its dielectric strength is much higher than that of air at atmospheric pressure.

breaking gas

SF₆ is "the" breaking gas, combining the best properties:

- **high capacity for carrying the heat** produced by the arc. The latter is strongly cooled by convection during the arcing period;

- **high radial thermal conduction and high electron captation capacity.**

When the current passes through zero, the arc is extinguished by the combination of these two phenomena:

- SFT permits rapid heat exchange from the center of the arc towards the exterior,
- fluorine atoms, which are highly electronegative, act as veritable "traps" for electrons.

Since it is electrons which are mainly responsible for electric conduction in the gas, the gap between the contacts recovers its initial dielectric strength through this electron capture phenomenon at zero current;

- **the decomposition of the SF₆ molecule is reversible.**

The same mass of gas is therefore always available, making the device self-sustained throughout its operating life.

advantages of the Fluarc

The Fluarc circuit-breaker using the puffer technique features a new design concept in which the injected gas is optimized and thermal expansion is used to its fullest advantage.

This produces the following advantages:

long life

This results from:

- high product reliability,
- very low wear of the active parts which require no maintenance,
- the excellent enclosure sealing. These units need no complementary filling.

mechanical endurance

The operating energy is reduced by using the natural expansion of the hot gases during breaking.

The operating mechanism is the standard GMh-type and benefits from over 20 years of experience.

The Fluarc circuit-breaker is able to carry out 10 000 operations without any parts being replaced.

Periodic lubrication of the operating mechanism is recommended, and depends on the environment and operation.

electrical endurance

The long life of the Fluarc is due to the negligible degeneration of the gas and to low wear of the contact.

The energy dissipated in the arc is low due to:

- the intrinsic properties of the gas,
- the short length of the arc,
- the very short arcing time.

Wear of the arcing contacts can be checked, without opening the poles, by means of a wear indicator.

The unit is capable of breaking all load and short-circuit currents for a period of 20 years, even in the case of frequent operation, and requires no maintenance of the active parts.

low switching surges

The intrinsic properties of the gas and the soft break resulting from this technology means that the switching surges are very low.

operating safety

The Fluarc operates at low pressure with a relative pressure of 1 to 2.5 bars. The pressure rise during the arcing phase occurs mainly in the confined volume between the arcing contacts. During short-circuit interruption, this pressure rise is limited to around 1 bar.

insensitivity to external conditions

The Fluarc pole-unit provides a completely insulated system. It is a hermetically sealed enclosure filled with SF₆ gas and housing the following essential parts:

- the breaking chamber,
- the insulating rod which activates the moving contacts,
- the electrical connection between the moving contact and the corresponding fixed terminal.

The Fluarc pole-unit is therefore a **Gaseous Insulated System (G.I.S.)**

permanent control of the circuit-breaker state

Possibility of adding a pressure control

order form for Fluarc FG4 circuit-breakers

choice of switchgear

Circuit-breaker only
Disconnection carriage
Operating mechanism only

choice of installation

Fixed unit
Withdrawable unit (in Fluair 400 cubicle)
Withdrawable unit (in "panelbuilder" cubicle)

general characteristics

Impulse insulation level (kV) 1.2/50 μ s: 125 150 170
Rated current (A): 630 1200/1250 2000/2500
Inter-phase distance (mm): 250 300 400
Pressure switch (option): yes no

IEC standards: required voltage (from 12 to 40.5 kV) kV
 required breaking capacity (max. 40 kA) kA
ANSI standards: 38 kV/1500 MVA range factor = 1.65
 38 kV/31.5 kA range factor = 1

operating mechanism, auxiliary devices and options

Operating mechanism with: standard sequence rapid sequence
Automatic discharging of operating mechanism (withdrawable FG4)
Charging motor (M) V DC AC Hz
Closing release (YF) V DC AC Hz
Opening release
(shunt trip release) V DC AC Hz
Undervoltage opening release
downstream installation:
Overcurrent opening release: 2 A 5 A
Mitop release
Open-position breaker operating mechanism locking facility:
Standard Ronis lock for above locking facility:
"Operating mechanism charged" indication (M3)
"Breaker secured in position" indication (SQ) (withdrawable FG4)
Locking (without padlock or key-lock) in "service" "disconnected" position
O.C. green-red mech. indicator (instead of green-white)
Internal arc withstand (Fluair 400 cubicle)

additional equipment:

Support frame (fixed FG4)
Statimax protection system 1 A 5 A
Male and female LV connection (fixed FG4)
Racking lock-out on LV connector (withdrawable "panelbuilder" FG4)

packing and delivery:

By ground By sea Inter-plant
Packing with Fluair 400 cubicle