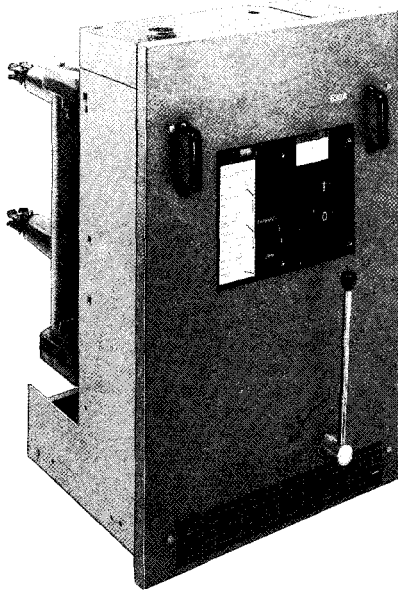
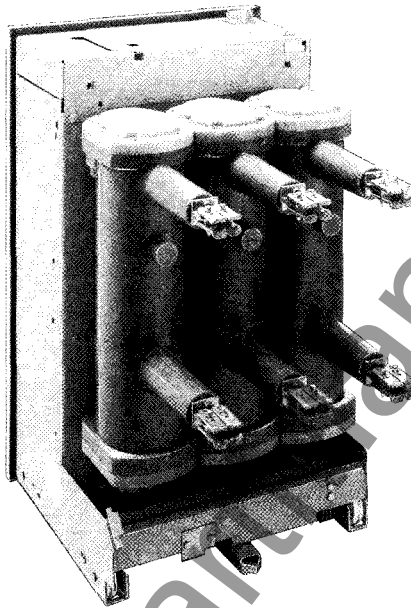


MERLIN GERIN

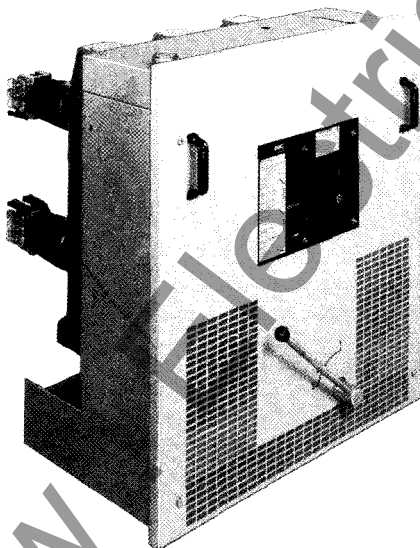
Fluarc FG2
3 to 17.5 kV



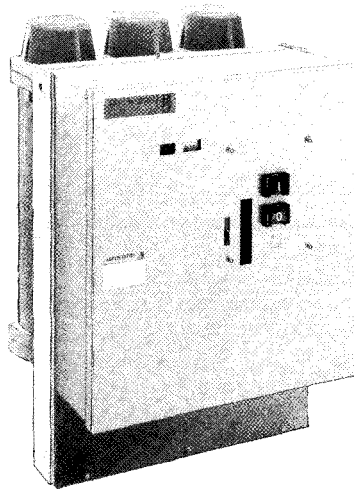
FG2 630 A and 1250 A withdrawable



FG2 630 A and 1250 A withdrawable



FG2 3150 A - 50 kA withdrawable



FG2 630 A fixed

mastering electrical power



description

presentation

The Fluarc FG2 type three-pole circuit-breakers are designed for control and protection of medium voltage public distribution and industrial networks. These circuit-breakers use sulphur hexafluoride **SF6** for insulation and breaking. The breaking technique is autocompression.

They are made up of three pole-units and an operating mechanism fixed on a supporting structure. Each pole-unit encloses all active parts in an insulating enclosure.

This enclosure is filled to a relative pressure of 1.5 to 2.5 bars. It is of the sealed pressure system type according to the IEC 56 definition, appendix EE, 1987 edition.

Their main qualities are as follows :

- 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 and BS 5311

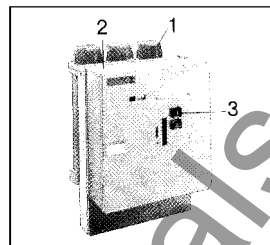
Rated frequency : 50 / 60 Hz

Operating times at rated voltage (indicative values) :

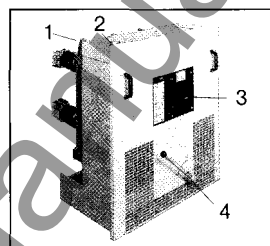
- opening time between application of voltage to the opening device and arc contact separation : 45 to 65 ms ;
- breaking time between application of voltage to the opening device and final arc extinction : 60 to 80 ms ;
- closing time between application of voltage to the closing device and contact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

rated operating sequence :

- standard :
O - 3 mn - CO - 3 mn - CO
on request :
O - 0.3 s - CO - 15 s - CO



fixed FG2



withdrawable FG2

1. pole unit
2. auxiliaries LV connector
3. operating mechanism
4. racking lever

ratings to IEC 56, VDE 0670, BS 5311, UTE C 64.100/101

rated voltage	rated insulation level impulse (1) 1 mn 1.2 / 50 μ s 50 - 60 Hz		rated breaking capacity at U (kV)	rated continuous current	making capacity (2)	3-second withstand current	capacitor breaking capacity for a rated current of (A)	index
kV	kV peak	kV rms	kA	A	kA peak	kA rms	630 1250 2500 3150	
7.2	60	20	U : 3 to 7.2 kV :	630-1250 2500-3150	63 79 100 125 150	25 31.5 40 50 50	440 875 1750 2200	a
			25					b
			31.5					c
			40					d
			50					e
12	75	28	U : 7.2 to 12 kV :	630-1250 2500-3150	63 79 100 125	25 31.5 40 50	440 875 1750 2200	f
			25					g
			31.5					h
			40					i
			50 (4)					
17.5	95	38	U : 12 to 13.8 15 17.5 kV	630-1250 2500-3150	63 79 105-96-83	25 31.5 41.8	440 875 1750 2200	j
			25					k
			31.5					l
			41.8					
			38.5 33					

ratings to US Standards ANSI C37-06

class		rated voltage (kV)			rated insulation level : impulse (1) 1.2 / 50 μ s 1 min. 60 Hz		breaking capacity I _{sc} kV mini maxi		rated continuous current at 60 Hz	3-second withstand current	closing and latching capability 1.6 I _{sc} (U mini)	index
kV	MVA	Mini	factor K	Maxi	kV peak	kV rms	kA		A	kA rms	kA rms	
4.16	250	3.85	1.24	4.76	60	19	36	29	1200-2000-3000	36	58	r
4.16	350	4	1.19	4.76	60	19	49	41		49	78	s
13.8	500	11.5	1.3	15	95	36	23	18		23	37	t
13.8	750	11.5	1.3	15	95	36	36	28		36	58	u
13.8	1000	11.5	1.3	15	95	36	48	37		48	77	v

(1) For installation in cubicles, the dielectric withstand is the responsibility of the cubicle designer. Merlin Gerin can provide recommendations upon specific request. For fixed or withdrawable circuit-breaker supplied separately from cubicle, see values on pages 4 and 5.

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

(3) Only for the withdrawable FG2 in F100 cubicles. Equipment approved by the EDF Thermal and Nuclear Research and Projects Division.

operating mechanism and auxiliary devices

operating mechanism

The Fluarc 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 either a manual or an electrical operating mechanism.

These two systems comprise :

- an operations counter ;

- a position indicator (ON / OFF)

The springs are charged electrically, or manually by a 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).

rated supply voltages

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

A.C. : 110 - 127 - 220V

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).

Consumptions 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 herebelow.

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

Fluarc FG2 incorporates :

- 5 auxiliary contacts if manually operated :

- 1 used for the closing release ;

- 1 used for the opening shunt trip release ;

- 3 contacts remain available for customer's use ;

- 14 auxiliary contacts if electrically operated :

- 2 used for the electrical operating mechanism ;

- 1 used for the opening shunt trip release ;

- 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

- 9 additional auxiliary contacts with manually-charged mechanisms ;

- open-position locking facility by Ronis ELS11A key-lock (lock not supplied)

- a closing contact pressure switch (SP) for indication of possible pressure drop.

- (1 per pole unit) ;

- a STATIMAX protection device, without auxiliary power supply, with MITOP release ;

- "operating mechanism charged" indication contact (M 3)

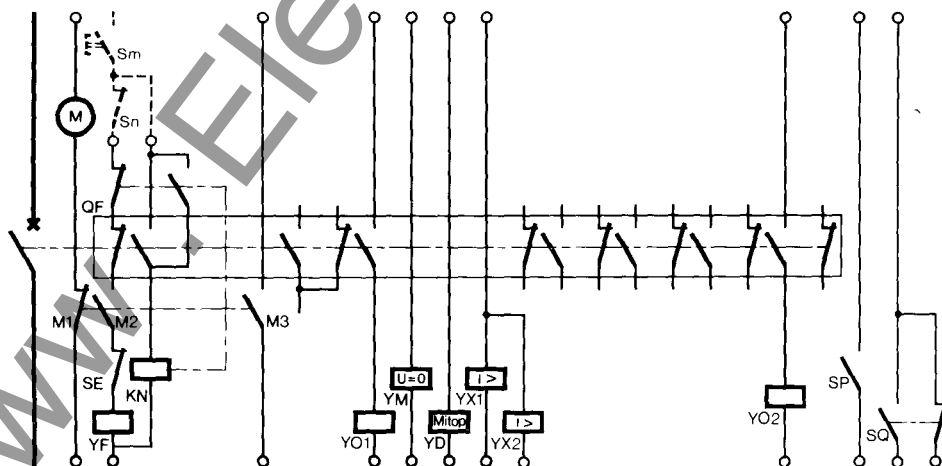
- green-red O-C indicator instead of standard green-white

(1) Withdrawable c.b. with undervoltage release always has automatic discharging of the operating mechanism.

(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 AC42)

Electrical operating mechanism wiring diagram

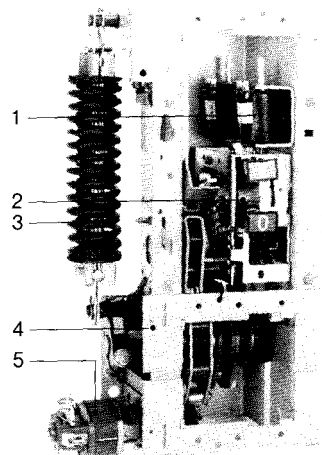


Always supplied

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

Options

Y01 - Y02 shunt trip release
YX undervoltage release
YD overcurrent release
YS "MITOP" release
YQ operating mechanism charged indication contact
YS pressure switch contact
SP "breaker secured in position" contact



GMh electrically charged operating mechanism

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

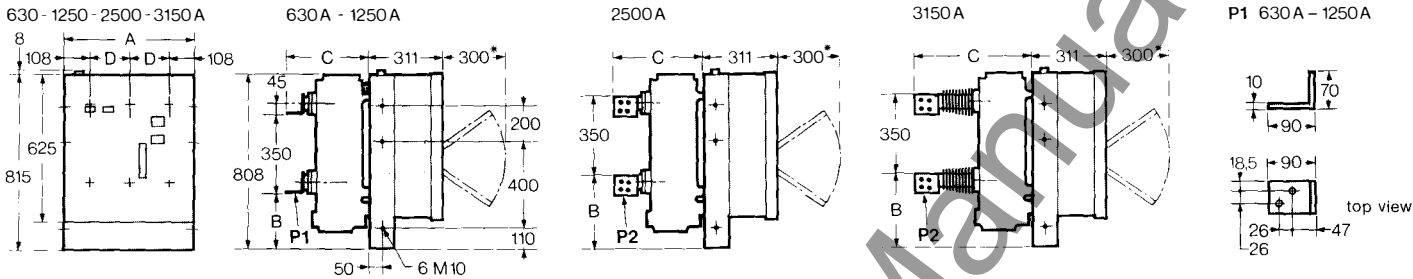
fixed FG2

fixed unit

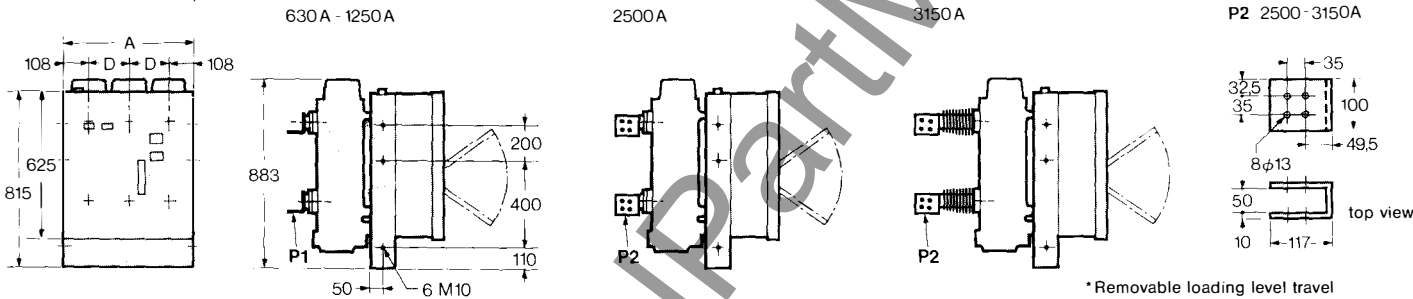
The fixed FG2 is furnished with the operating mechanism and the auxiliary devices mentioned in page 3. It is delivered for connection with busbars.

- Optional :**
- a male and female LV36 pin connection comprising a fixed connector on the circuit-breaker and a socket equipped with a 2 m conductor,
 - supporting frame.

index a-b-f-g-j-r-t (see table page 2)



index c-d-e-h-i-k-l-s-u-v)



rated normal current A	rated impulse insulation level kV peak	D (mm) inter-phases (1)	A (mm)	B	C	weight (kg)
630-1250	75	180	576	315	345	195
630-1250	95	240	696	315	345	200
2500	75	240	696	394	372	210
3150	75	240	696	394	517	250

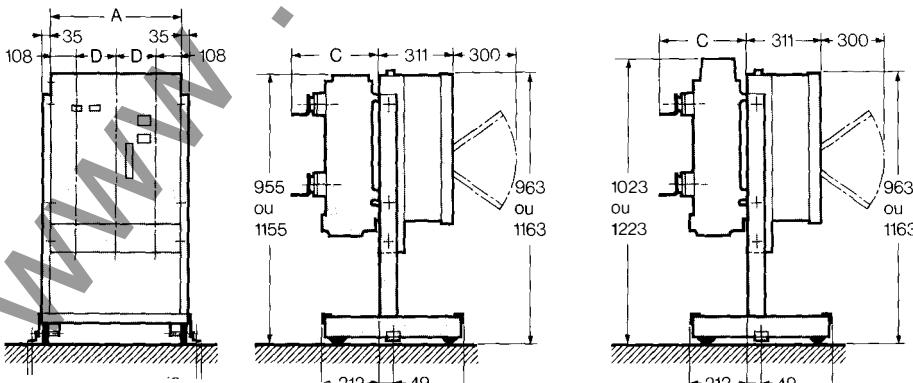
(1) If the requested making capacity is of the order of 150 kA peak, the inter-phase (index D) should be 240 mm regardless of the rating.

unit mounted on a support frame

630 - 1250 - 2500 - 3150 A

index a-b-f-g-j-r-t (see table page 2)

c-d-e-h-i-k-l-s-v-u



The support frame is fitted with rollers to make handling and installing the circuit-breaker easy. Anchoring to the ground is possible by means of fixing lugs provided on the frame. Frame weight : 15 kg removable loading lever. The unit below may be mounted on

FG2 withdrawable

withdrawable unit

The withdrawable version of the Fluarc FG2 c.b. is designed to facilitate installation and maintenance and to ensure upstream and downstream positive isolation indication.

The unit is equipped 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 to secure the breaker in "service" or "disconnected" position.

The c.b. is operated by a removable racking lever (d) on the front plate which can be set in 3 positions :

position 1 :

c.b. set in "service" or "test" position or disconnected outside of cubicle. For c.b. operating (opening-closing), the lever must be set in position 1.

position 2 :

The lever unlocks the system and allows

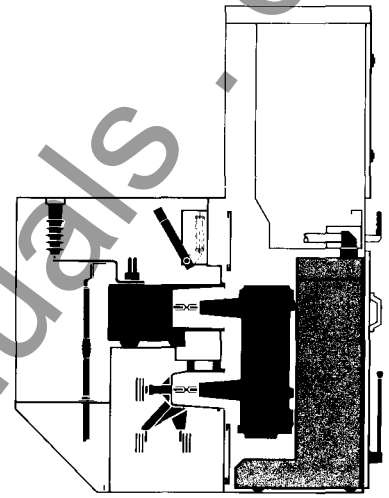
moving the breaker from the "service" position to the "test" position, and inversely. The breaker must be opened before going into position 2.

position 3 :

The lever unlocks the system and allows withdrawal of the breaker from the cubicle. It also provides a stop motion action when the breaker is presented into the cubicle.

Options for withdrawable unit :

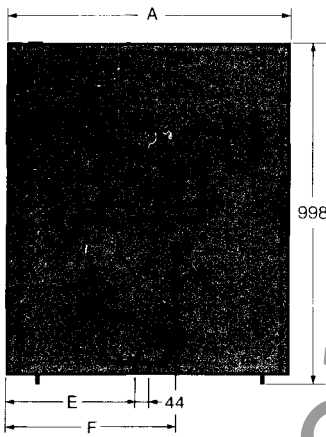
- a female 36 pin LV connector with a 2 m conductor,
- automatic discharging of the operating mechanism beyond the "test" or "disconnected" position (see note 1 page 3),
- racking lock-out system preventing breaker insertion if the LV cable is not connected ;
- auxiliary contact indicating the breaker is secured in "service" position (SQ).



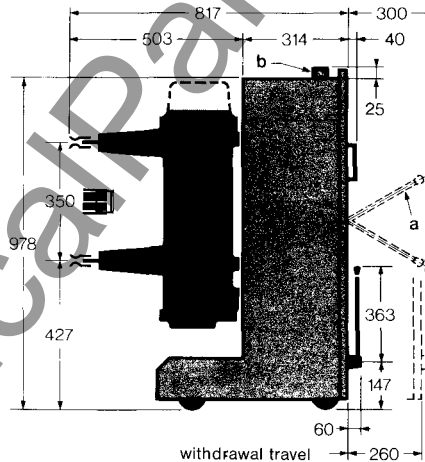
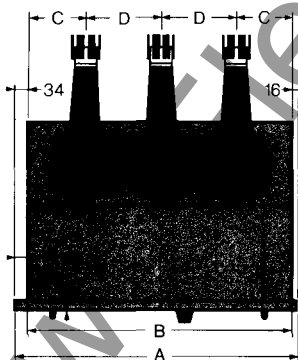
FG2 circuit-breaker installed in a Fluair 200 cubicle

dimensions and weights

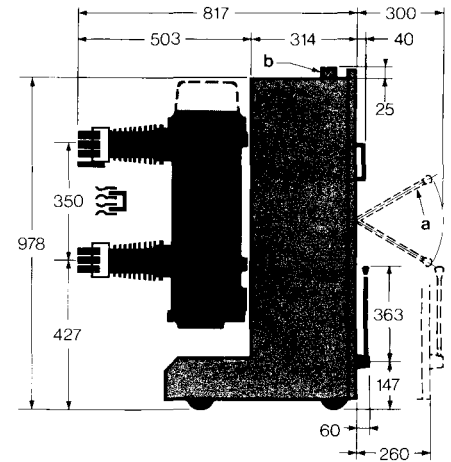
630 - 1250 - 2500 - 3150 A



FG2 withdrawable



FG2 630 A - 1250 A



FG2 2500 A - 3150 A

- a = removable charging lever
- b = LV connector
- c = guide rail
- d = removable 3-position racking lever

rated normal current A	rated impulse insulation level MG equipment kV peak	rated impulse insulation level circuit-breaker only kV peak	D inter-phases (1) (mm)	A (mm)	B (mm)	C (mm)	E (mm)	F (mm)	weight (kg)
630 - 1250	95	75	180	626	576	108	266	394	200
630 - 1250	95	95	240	876	826	173	391	519	210
2500	95	75	240	876	826	173	391	519	250
3150	95	75	240	876	826	173	391	519	350

(1) If the requested making capacity is of the order of 150 kA peak, the inter-phase (order D) should be 240 mm, regardless of the rating.

FG2 pole-unit

pole-unit description

The FG2 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 fixed arcing contact (4), moving arcing contact, main rod (10), flexible connector (18), moving piston (7), and insulating nozzle (5) directing the SF6 flow towards the arc.

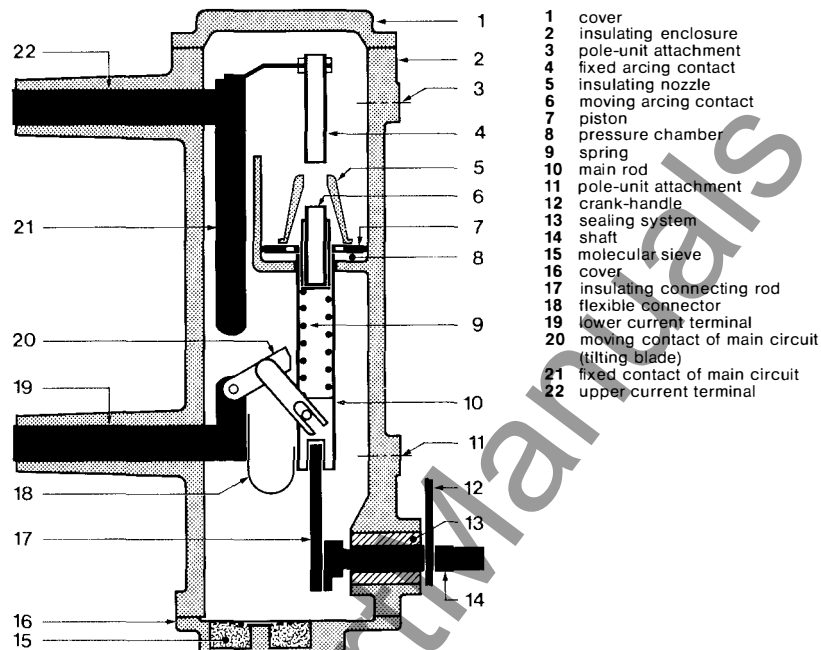
The main circuit, designed for the continuous flow of the current, is distinct from the breaking circuit subjected to the arc.

- **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 (8).

- **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.



FG2 operation

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

Precompression (fig. 2)

As 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 on to 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 course whereas the cold gas injection continues until the complete opening of the contacts has occurred.

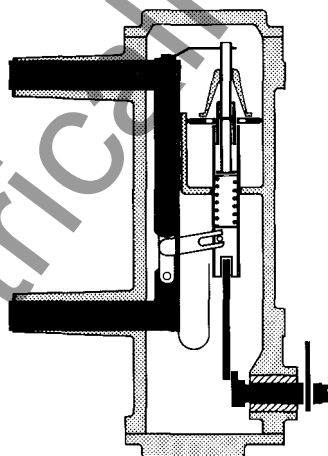


Fig. 1 - closed circuit-breaker

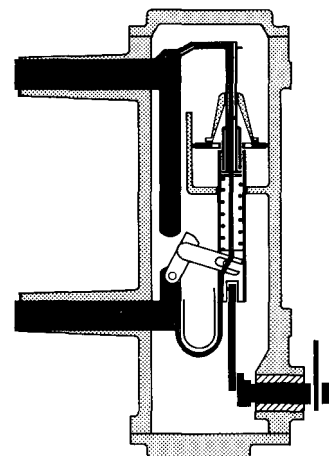
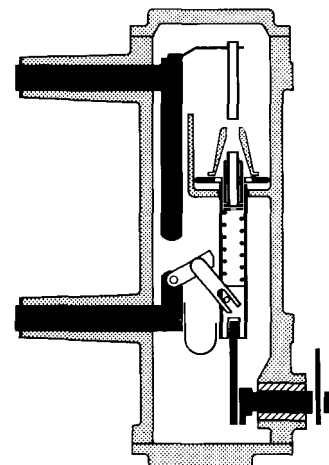
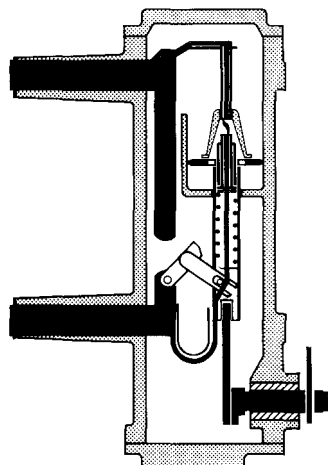
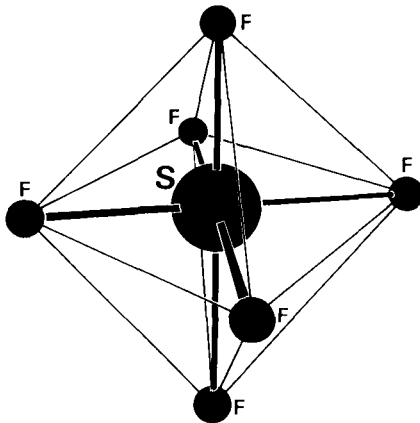


Fig. 2 - opened main contacts



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 :

- SF₆ permits rapid heat exchange from the centre 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 with autocompression features a newly designed conception in which the injected gas is optimized and thermal expansion is advantageously conserved.

This produces the following advantages :

long life

This quality 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.

The 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.

Concerning motor start-up, the unit provokes no multiple preignitions nor multiple reignitions which could damage the insulation between coil turns.

operating safety

The Fluarc operates at low pressure with a relative pressure of 1 to 2.5 bars.

The pressure elevation during the arcing phase occurs mainly in the confined volume between the arcing contacts.

This short elevation during short-circuit interruption is the order of 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 in which are housed the following essential parts :

- the breaking chamber ;
- the insulating rod which activates the moving contacts ;
- the electrical connection between

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

permanent control on the circuit-breaker state

Possibility of adding a pressure controlling device to the switchgear.

order form for Fluarc FG2 circuit-breakers

network characteristics

Requested service voltage kV
Short-circuit current at requested service voltage kA
Rated operating current A
Frequency Hz
Insulation level :
■ Power frequency 1 mn. kV
■ Impulse 1.2 / 50 μ s kV
Operating sequence : ■ standard : O - 3 mn - CO - 3 mn - CO ☐
 ■ on request : O - 0.3 sec - CO - 15 sec - CO ☐

installation and application characteristics

Standards IEC ☐ ANSI ☐
Withdrawable unit ☐ Fixed unit ☐
Inter-phase distance (mm)
Manual operating mechanism ☐
Electrical operating mechanism ☐
Withdrawable unit with elements of the MG cubicle ☐

Common auxiliary devices (fixed and withdrawable units)

Charging motor (M) V ☐ DC or ☐ AC Hz
Closing release (YF) V ☐ DC or ☐ AC Hz
Opening release (shunt trip release) V ☐ DC or ☐ AC Hz
Other opening releases

Common options (see page 3)

9 additional auxiliary contacts with manually charged mechanisms ☐
Open-position breaker locking facility (lock not included) ☐
Lock (for above locking device) ☐
Pressure switch ☐
Statimax system with Mitop ☐
Male and female 36 pin LV connector with a 2 m conductor ☐
Operating mechanism charged indication contact (M3) ☐
O.C. green-red mech. indicator (instead of green-white) ☐

Option for a fixed unit (see page 4)

Male and female 36 pin LV connector with a 2 m conductor ☐
Supporting frame ☐

Options for a withdrawable unit (see page 5)

A female 36 pin LV connector with a 2 m conductor ☐
Automatic discharging of the operating mechanism ☐
Racking lock-out on LV connector ☐
"Breaker secured in position" contact (SQ) ☐