MERLIN GERIN

Fluarc FG1

application

Substation up to 15.5kV
Metalclad up to 13.8kV
Retrofit up to 17.5kV

description

FG1 circuit-breakers are applied for switching and protection on medium voltage networks; FG1 breakers are using rotating arch technology with SF6 medium for insulation and breaking. Three segregated phases are encapsulated into a single epoxy bottle.
Pressure of inside SF6 gas is 2.5 bars (relative pressure). FG1 bottle is a "sealed for life pressure system".

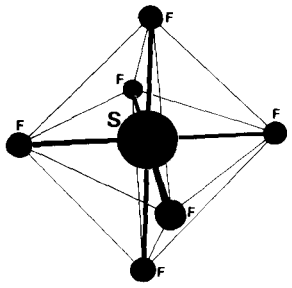
main features

- extremely compact for reduced space and easy adaptation to switchgear
- low maintenance
- because of sealed bottle, breaker is not affected by hostile environments
- soft interruption reduces transient over voltages due to restrikes/prestrikes
- option pressure switch allows permanent check of dielectric/breaking medium
- ideal for capacitor bank switching
- comes in fixed version as standard; drawout on request

mastering electrical power

MERLIN GERIN

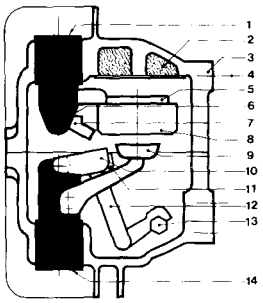
sulfur hexafluoride gas properties



SF6 is an uninflammable, colorless, odorless, non-toxic gas, five times heavier than air. Its dielectric strength is much higher than air at atmospheric pressure. Thanks to SF6 gas qualities and to rotating arc principles.

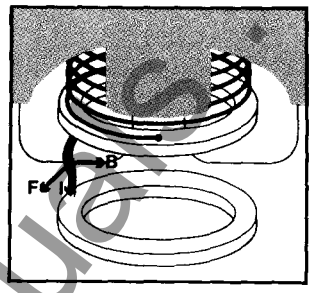
- when switching motors and tranformers, overvoltages are very low: no successive prestrikes/restrikes
- excellent capability for capacitor switching

FG1 pole cross section



1 upper current terminal
2 absorbent material
3 insulating enclosure
4 attachment
5 solenoid
6 fixed main contact
7 fixed arcing contact
8 upper arcing ring
9 lower arcing ring
10 moving main contact
11 moving arcing contact
12 insulating rod
13 shaft with sealing device
14 lower current terminal

breaking principle



Rotation of the arc between the circular arcing contacts is caused by an intense electromagnetic field. This field is produced by a solenoid through which the current to be interrupted flows at the moment of opening.

ANSI ratings C 37-06

outdoor Fluarc FG1 15.20

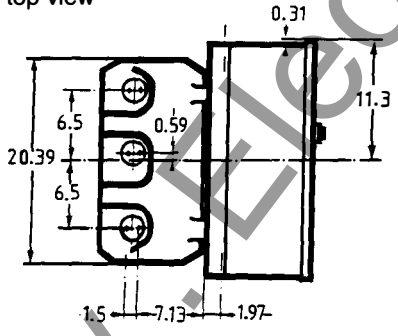
rated maximum voltage	voltage range factor (K)	rated insulation impulse 1.2/50us	level 1 mn 60 Hz	sym I.C. at rated voltage	continuous ampere rating	closing and latching capability
15.5kV	1	110kVcrest	50kV	20kA	600-1200A	54kA crest

indoor Fluarc FG1 500 – 13.8kV/500MVA class

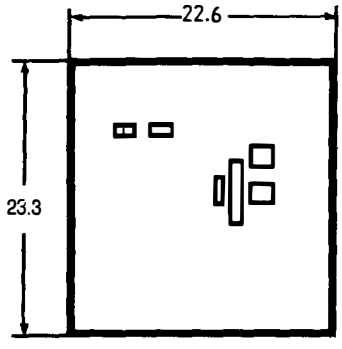
rated voltage range factor (K)	rated insulation impulse 1.2/50 us	level 1 mn 60 Hz	sym I.C. at rated max kV	continuous ampere rating	short time rating (3 sec)	closing and latching capability
1.3	95kVcrest	36kV	18kA	600-1200A	23kA	37kA rms

dimensions (inches)

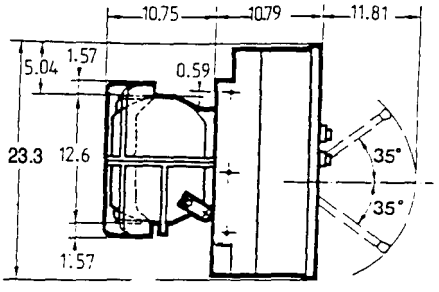
top view



front view



side view



approx. weight: 265 pounds

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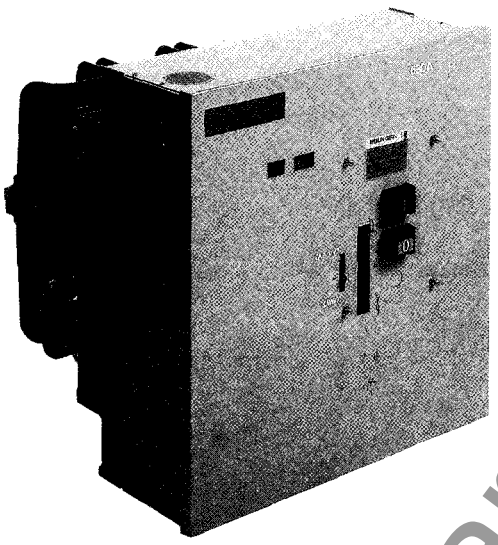
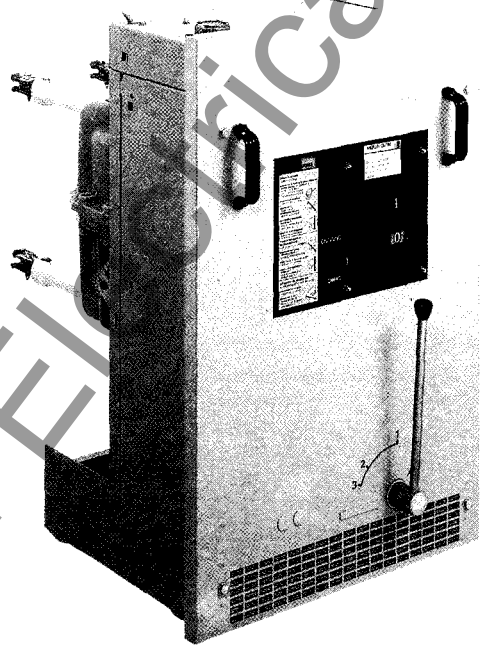
MERLIN GERIN

Fluarc FG1
3 to 15 kV



fixed FG1



withdrawable FG1

description

presentation

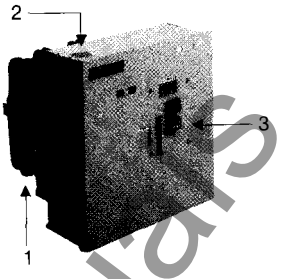
The Fluarc FG1 type three-pole circuit-breakers are designed for control and protection of medium voltage public distribution and industrial networks.
These circuit-breakers use sulphur hexafluoride **SF6** for insulation and breaking.
They are made up of three pole-units and an operating mechanism.
The insulating enclosure housing the active parts of these pole-units is filled with SF6 gas at a relative pressure of 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 state control (optional pressure switch),
- well-suited to high-speed reclosing and capacitor bank control.

characteristics

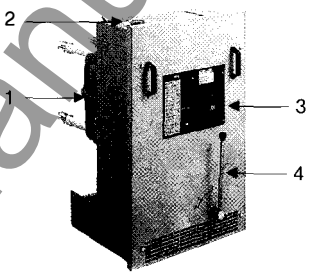
The characteristics given below are as defined by the:
IEC regulations, publication 56 and 694,
UTE volume C 64 100/101,
VDE 0670 and BS 5311.

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 FG1



withdrawable FG1

1 Three-pole enclosure
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) 1.2/50 µs	1 mn 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 rms	kA peak	kA rms	**630 A**	**1250 A**	
7.2	**60**	20	kV 3 to 7.2								
			20			630-1250	50	20	440	875	a
			29				73	25 (3)	440	875	b
12	**75**	28	KV 7.2 to 10	11	12						
			20	20	20	630-1250	50	20	440	875	c
			29	26.2	25		73-66-63	25 (3)	440	875	d
15	**95**	38	kV 13.8 to 15								
			20			630-1250	50	20	440	875	e

ratings to US standards ANSI C37-06

outdoor DFE Fluarc fixed circuit-breaker

rated voltage		rated insulation level		breaking capacity Isc	rated continuous current at 60 Hz	3-second withstand current	closing and latching capability 2.7 times rated short-circuit current	index
max. voltage	K factor = U maxi / U mini	impulse (1) 1.2/50µs	1 mn 60 Hz	kA at rated kV	A	kA rms	kA peak	
kV		kV peak	kV rms					
15.5	1	**110**	50	20	600-1200	20	54	g

Fluarc indoor circuit-breaker

Class	rated voltage (kV)		U maxi / U mini		rated insulation level impulse(1) 1.2/50 µs	1 mn 60 Hz	breaking capacity Isc kV mini	kV maxi	rated continuous current at 60 Hz	3-second withstand current	closing and latching capability 1.6 Isc (U mini.)	index
kV	MVA	Mini	factor K	Maxi	kV peak	kV rms	kA	kA	A	kA rms	kA rms	
13.8	500	11.5	1.3	15	**95**	36	23	18	600-1200	23	37	f

(1) For installation in cubicles, the dielectric withstand is the responsibility of the cubicle designer. Merlin Gerin can provide recommandations upon specific request. When the circuit-breaker is supplied separately, in either the fixed or draw-out version, the insulation level rating is 75 kV (peak).
(2) The making capacity corresponds to 2.5 times the breaking capacity at rated voltage.
(3) Or 20 kA 1s.

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-**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).

Consumptions at rated U

	charging motor	closing release
in D.C.:	120 to 250 W	70 W
in A.C.:	180 to 350 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 opposite.

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 FG1 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

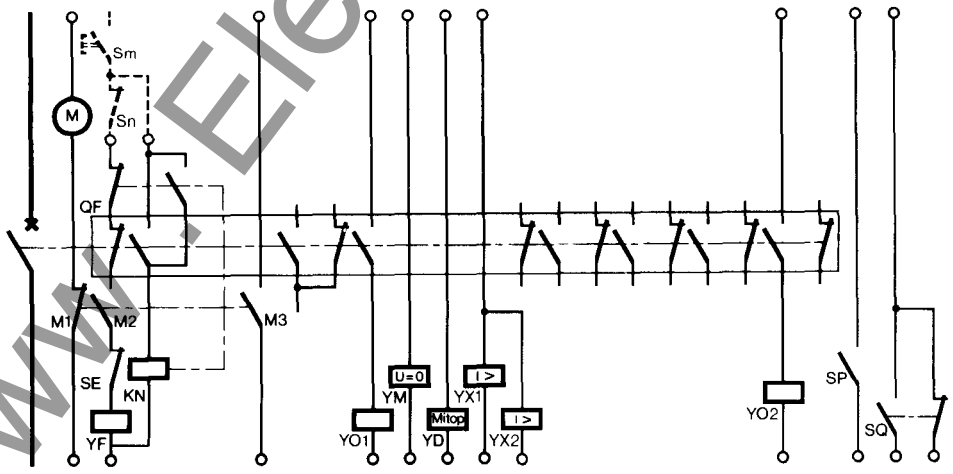
Rated current: 10 A

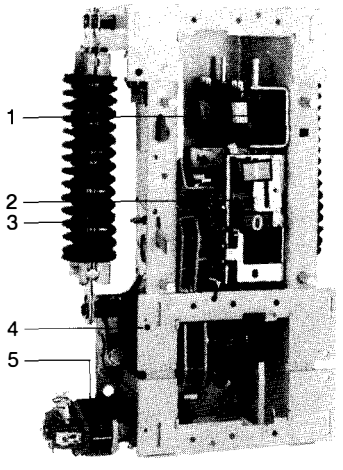
Breaking capacity:
□ in D.C.: 3 A at 110 V or 220 V
□ in A.C. at 0.3 pf: 10 A at 220 V

Options
■ 9 additional auxiliary contacts with manually-charged mechanisms,
■ open-position locking facility by Ronis ELS 11A key-lock (lock not supplied),
■ a closing contact pressure switch (SP) for indication of possible pressure drop.
■ a STATIMAX protection device without auxiliary power supply, with MITOP release,
■ "operating mechanism charged" indication contact (M3),
■ green-red O-C indicator instead of standard green-white.

(1) Withdrawable circuit-breaker with undervoltage release always has automatic discharging of the operating mechanism.
(2) Overcurrent release power supply: 2 A - 5 A.
(3) The MITOP release includes 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

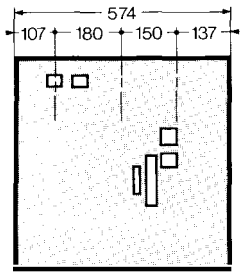
dimensions and weights
fixed FG1

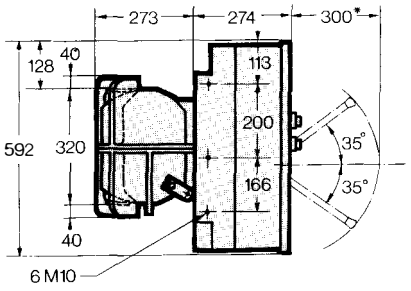
fixed unit

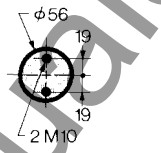
The fixed FG1 is furnished with the operating mechanism and the auxiliary devices mentioned in page 3.
It is delivered for connection with busbars.

Optional:

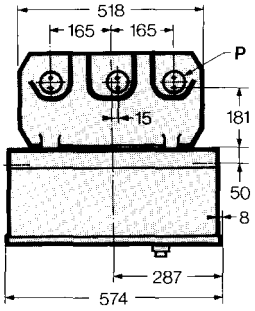
- a male and female LV 36 pin connection comprising a fixed connector on the circuit-breaker and a socket equipped with a 2 m conductor,
- supporting frame.





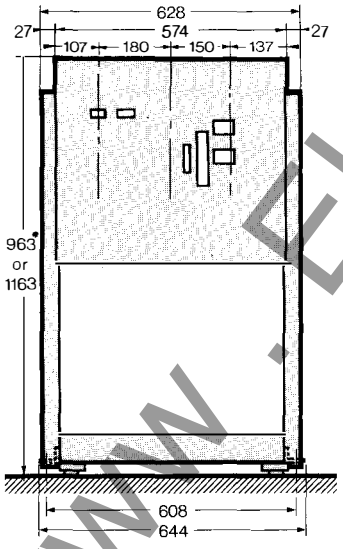


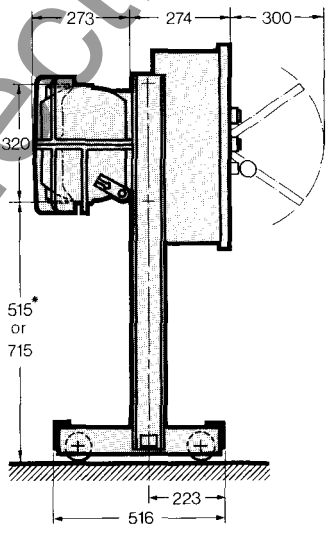
connection terminals "P"



***removable loading lever travel**
Weight: 120 kg

unit mounted on a support frame





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.

*** The units mounted on a support frame may take two positions**
Frame weight: 15 kg

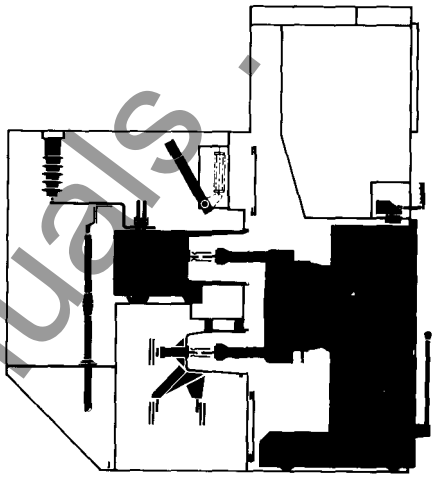
withdrawable FG1

description

The withdrawable version of the Fluarc FG1 circuit-breaker 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 circuit-breaker is operated by a removable racking lever (d) on the front plate which can be set in 3 positions:
position 1:
Circuit-breaker set in ''service'' or ''test'' position or disconnected outside of cubicle. For circuit-breaker 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.

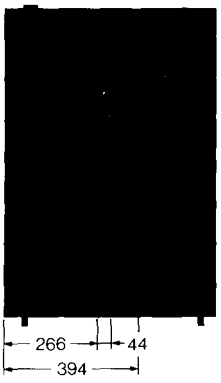
Options for withdrawable unit:
■ a female 36 pin LV connector with a 2 m conductor,
■ automatic discharging of the operating mechanism beyond the ''test'' or ''disconnected'' position (see note 1 page 3),
■ racking lock-out system preventing breaker insertion if the LV cable is not connected,
■ auxiliary contact indicating the breaker is secured in ''service'' position (SQ).
■ drawn-in/-out interlocking (keylock or padlock).



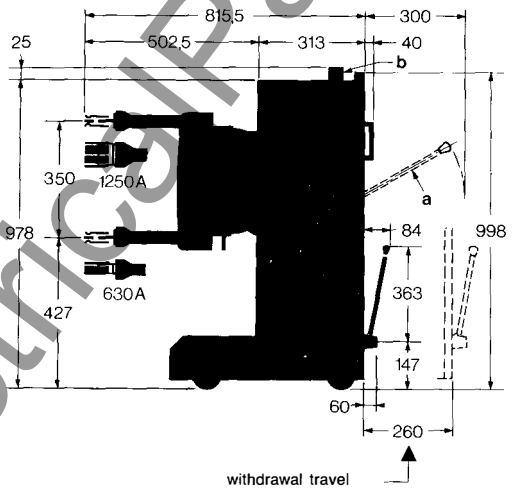
FG1 circuit-breaker installed in a F100 cubicle.

dimensions and weights

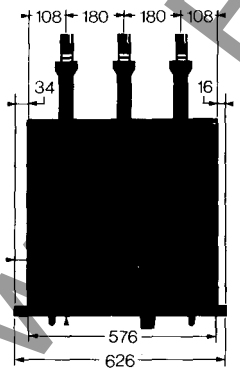
630 - 1250 A



withdrawable FG1 - front view



withdrawal travel



Weight: 140 kg

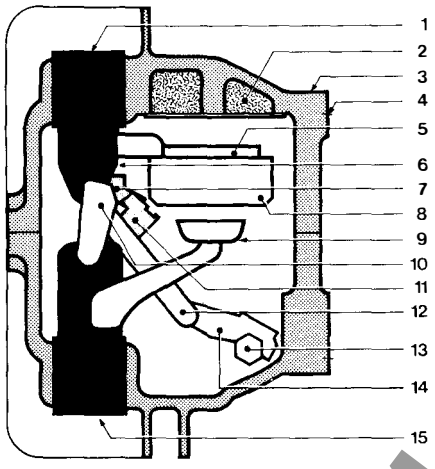
a = removable charging lever
b = LV connector
c = guide rail
d = removable 3-position racking lever

FG1 pole-unit

pole-unit description

Each pole-unit consists of:
■ **a main circuit** including the fixed contact **6** and the self-wiping, self-compensated blades making up the moving contact **10**,
■ **a breaking circuit** including the fixed arcing contact **7**, moving arcing contact, two fixed arcing rings, upper **8**, and lower **9**.
An arc-quenching coil **5** is in series in this circuit,
■ 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 shaft **13** which activates the rods **12** and **14**,

An insulating enclosure 3 encloses all active parts. It is provided with a sealing system highly reliable for any number of operations.
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 upper current terminal
2 adsorbent material
3 insulating enclosure
4 attachment
5 arc-quenching coil
6 fixed main contact
7 fixed arcing contact
8 upper arcing ring
9 lower arcing ring
10 moving main arcing contact (tilting blade)
11 moving arcing contact
12 insulating rod
13 shaft with sealing device
14 rod
15 lower current terminal.

operation

The FG1 circuit-breaker is a magnetic unit which uses the arc rotating technique to interrupt the current.
■ At the beginning of the opening operation, the main contacts and the arcing contacts are closed (fig. 1).
■ The main circuit is disconnected by separation of the tilting blades **10** and the current flows via the arcing contacts, which are still closed (fig. 2).
■ When the arc appears between the arcing contacts, it is magnetically transferred between the arcing rings under the effect of the loop.
During its passage the arc inserts the arc-quenching coil which produces a magnetic field dependent upon the current to be interrupted.
The arc is put into rapid rotation under the effect of the original electromagnetic force. The arc is thus cooled by forced convection through the movement of this rotation.
Due to the phase shift between the current and the magnetic field, this force continues to have a significant value at current zero (fig. 3).
■ Towards current zero, the dielectric strength between the contacts is very rapidly recovered due to the intrinsic qualities of SF6 (fig. 4)

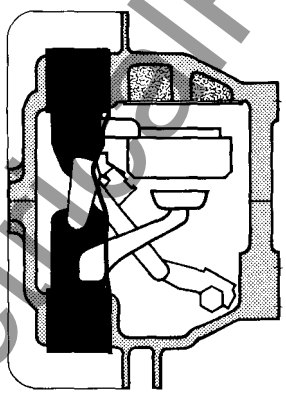


Fig.1 closed circuit-breaker

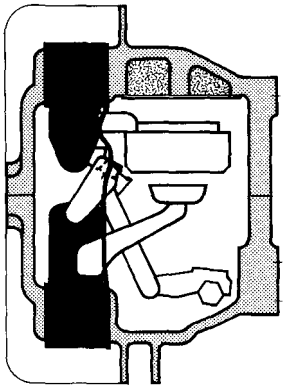


Fig. 2 opened main contacts

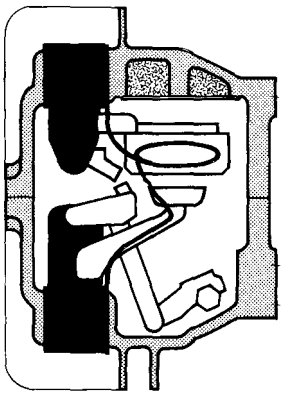


Fig. 3 arcing time

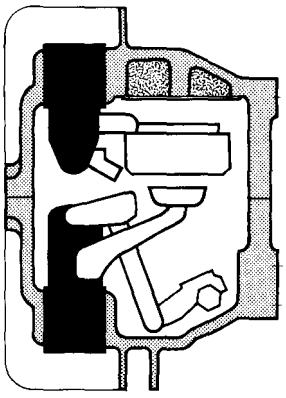
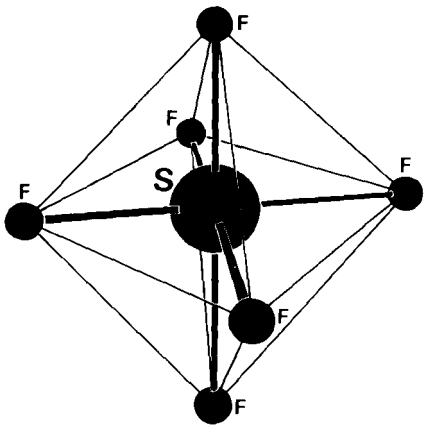


Fig. 4 opened circuit-breaker

Fluarc technology

sulphur hexafluoride gas (SF6) properties



SF6 is an **uninflammable**, 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 FG

The Fluarc FG1 is a modern circuit-breaker making use of the rotating arc technique; it offers ideal arc cooling by forced convection, resulting in 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 endurances
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 the low wear of the contacts.
The energy dissipated in the arc is low due to:
■ the intrinsic properties of the gas,
■ the short arc length,
■ 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 2.5 bars.
A slight pressure rise occurs between the arcing rings only during the arcing period.

Insensitivity to external conditions
The Fluarc pole-unit provides a completely insulated system. Its 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 moving contact and the corresponding fixed terminal.
The Fluarc pole-unit is therefore a **G**aseous **I**nsulated **S**ystem (**G.I.S.**)

Permanent control of the circuit-breaker state
Possibility of adding a pressure controlling device to the switchgear.

order form
for Fluarc FG1 circuit-breakers

Name of project . . . . . **date:** . . . / . . . / . . .
Name of client . . . . . order no:
Language for user manual . . . . . Qty ☐☐☐☐

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 1.2/50μs . . . . . ☐☐☐☐☐ kV

Operating sequence: ■ standard: O - 3 mn - CO - 3 mn - CO . . . . . ☐
■ on request: O - 0.3 s - CO - 15 s - CO . . . . . ☐
Standards IEC . . . . . ☐ ANSI . . . . . ☐

installation and application characteristics

Fixed unit . . . . . ☐
Withdrawable unit MG Fluair eqt.. ☐ other equipment . . . . . ☐
Merin Gerin incomplete panel / basic housing / compartment (separate form to be filled) . . . . . ☐
Outdoor installation (DFE). . . . . ☐
Manual operating mechanism . . . . . ☐
Electrical operating mechanism . . . . . ☐

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 Ronis ELS 11A . . . . . ☐
Pressure switch (SP) . . . . . ☐
STATIMAX system with MITOP . . . . . ☐
Operating mechanisms charged indication contact (M3) . . . . . ☐
O.C. green-red mech. indicator (instead of green-white) . . . . . ☐

Options for fixed unit (see page 4)

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

Options for 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) . . . . . ☐
Drawn-in/out interlocking (keylock or padlock) . . . . . ☐
Key for above interlock . . . . . ☐
Special conditions . . . . . .

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