MITSUBISHI ELECTRIC

Changes for the Better

Hybrid Generator Main Circuit Breaker (HYBRID GMCB) TYPE 20-SFMG-63A

Main Ratings

Rated voltage	: 24/27.5kV
Rated continuous current	: 8000A(natural cooling)
Rated short-circuit current	: 63kA

MITSUBISHI HYBRID GENERATOR MAIN CIRCUIT BREAKER(HYBRID GMCB)

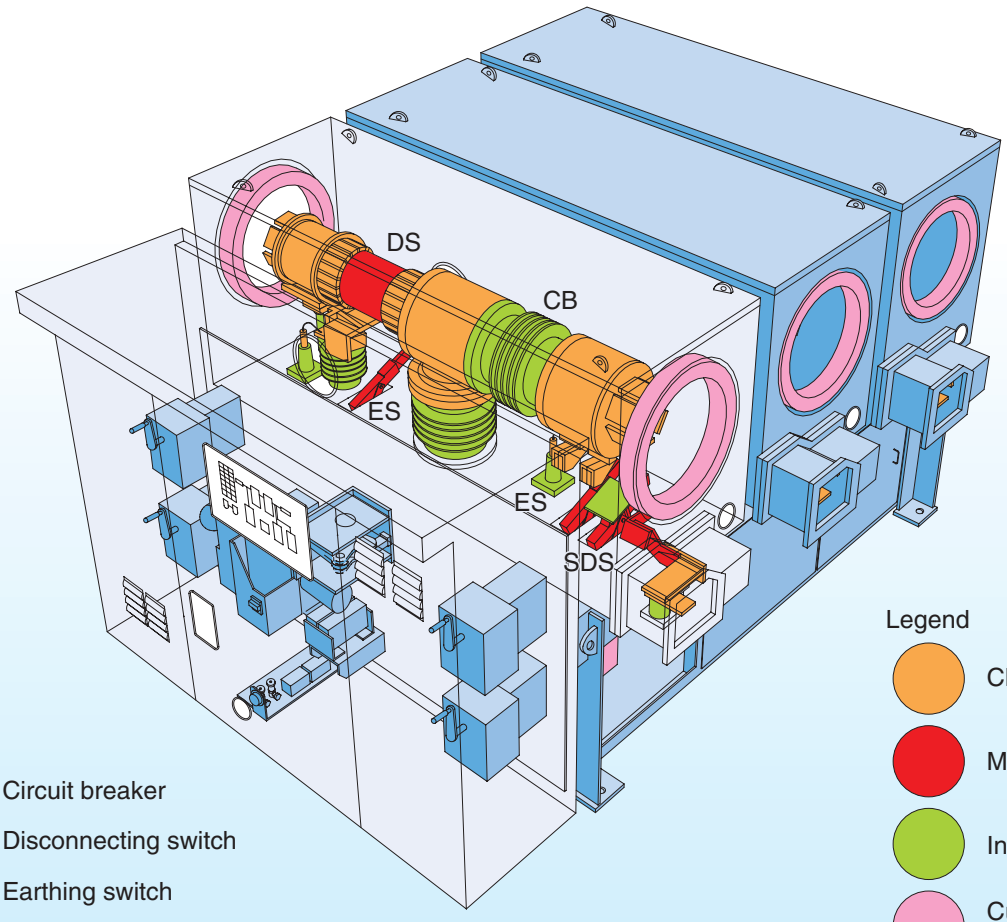
MITSUBISHI Hybrid GMCB is an integrated switchgear incorporating a circuit breaker (CB), a disconnecting switch (DS), earthing switches (ES), a starting disconnecting switch (SDS), current transformers (CT), a capacitor, voltage transformers (VT) and a surge arrester (SA) into one common unit. MITSUBISHI Hybrid GMCB provides you advanced and reliable generator main circuit system (GMCS).

① Space saving design by integrating CB, DS, ES, SDS, CT, and VT&SA into one common unit.

② High reliability by applying the advanced interruption technologies.

③ Labor savings during the installation, considering all assemblies are located in one common cubicle which is assembled in the factory. Maintenance is easily accomplished by the centralized location of the mechanisms and control equipment.

④ Power plant design flexibility by advanced mini-flux construction and direct connection with IPB.



CB : Circuit breaker

DS : Disconnecting switch

ES : Earthing switch

SDS : Starting disconnecting switch

Legend

Charged area

Moving area

Insulator

Current transformer, VT&SA

Enclosures, Supporting structure

Features of MITSUBISHI HYBRID GMCB

1. Space Saving

Integration of CB, DS, ES, SDS, CT, and VT&SA into a metal cubicle reduces required space for installation.

2. High Reliability

Application of current carrying parts, insulators and contacts used for MITSUBISHI switchgear based on over 35 years experience are accommodated in an airtight cubicle. For this reason these parts are hardly effected by outside atmosphere for long period.

3. Labor Saving

Full assembly and testing in our factory minimizes installation work and improves reliability, and centralizing mechanisms and control equipment simplifies maintenance work.

4. Power Plant Design Flexibility

Minimizing the magnetic field external to the equipment with mini-flux construction and direct connection with IPB achieves installation flexibility of the Hybrid GMCB.

Benefits of Application of GMCB

1.Elimination of Starting-up Transformer

Starting-up transformer, allied switchgears, and floor space for these apparatus are not required.

2. Elimination of In-house Bus

On starting and stopping generators, switching the in-house bus is not necessary and plant operations can be simplified.

3. Over-excitation Free

On starting generator, the risk of over-excitation would be eliminated.

4.Rationalization of Main Transformer

Main transformer for each generator would not be required.

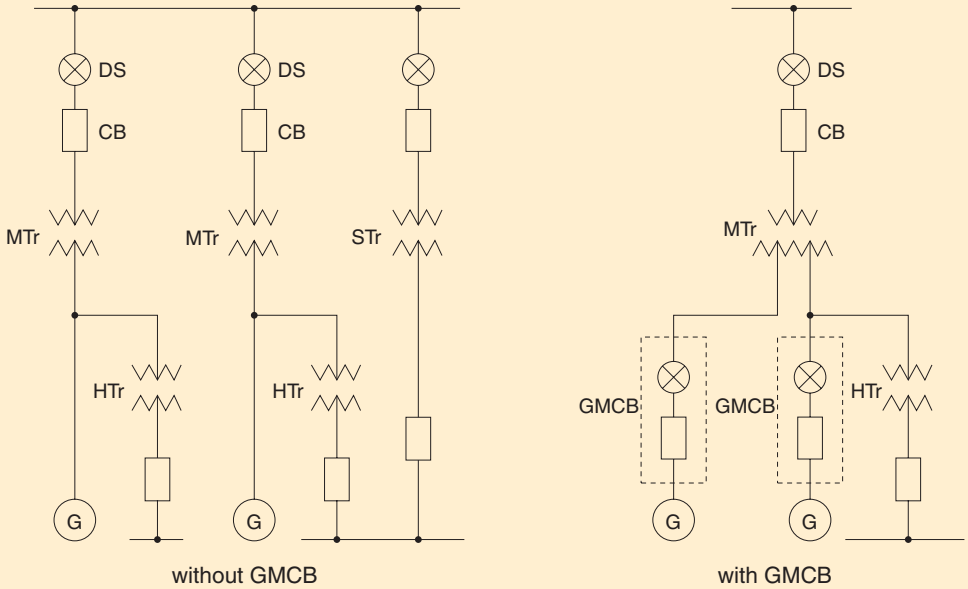
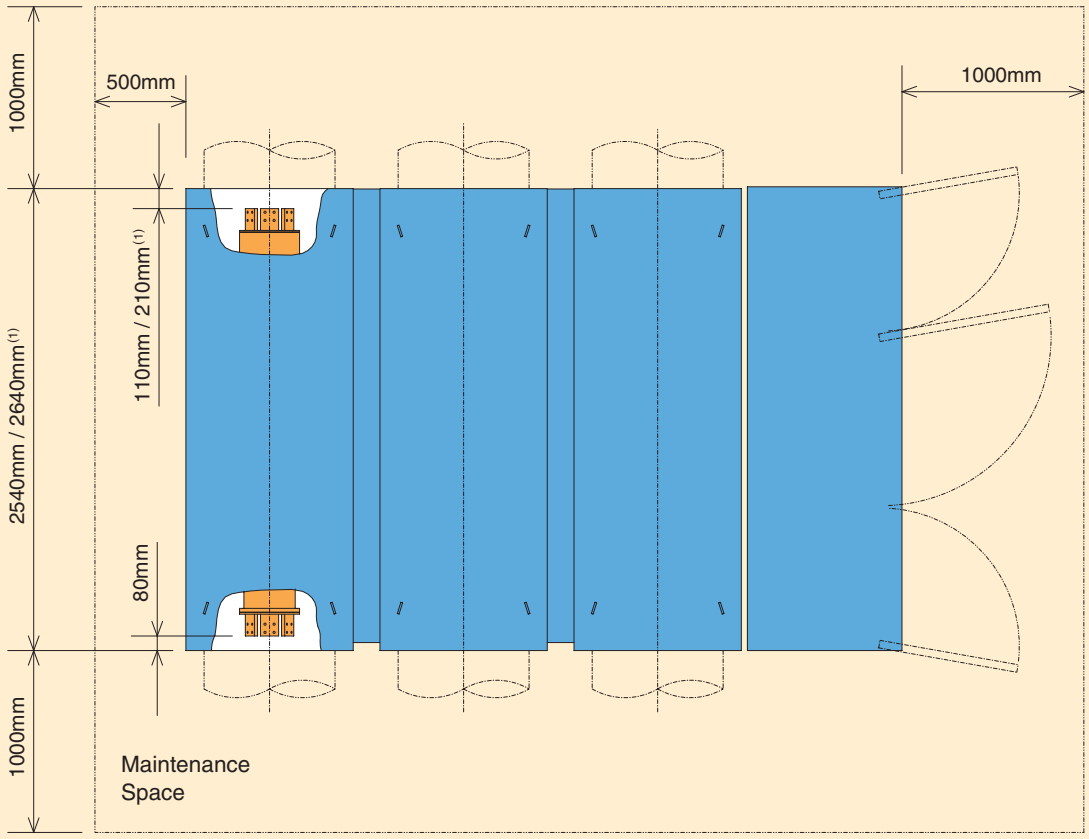
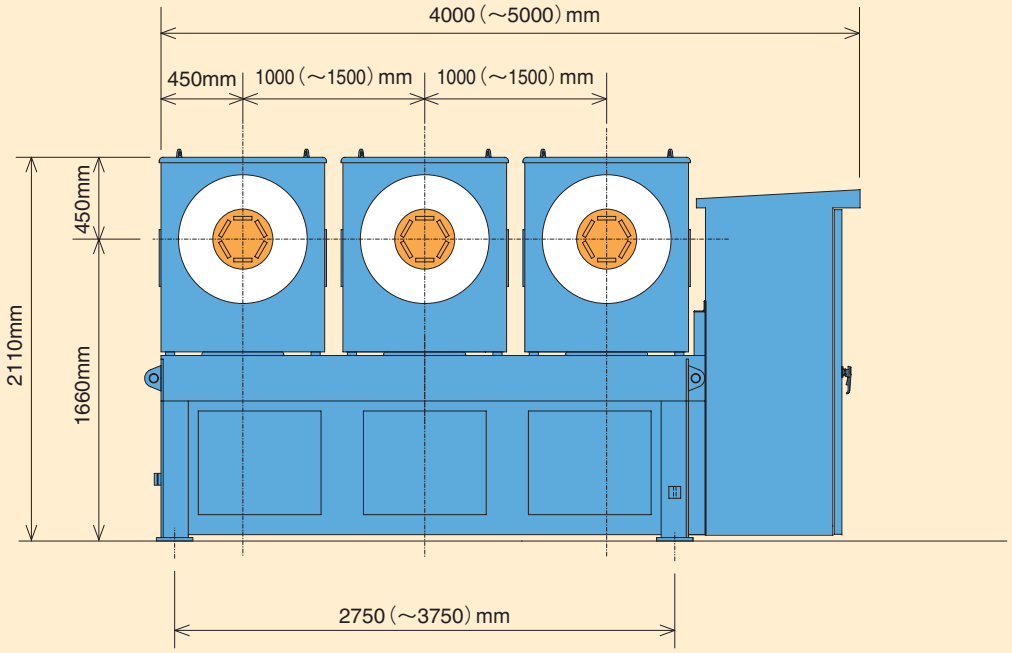


Fig.1 Comparison of Circuit Configuration

Outlines and Dimensions





Weight : app.7000kg(2)

(1) Assembled with Starting-DS
(2) with maximum apparatus

Fig.2 Outline

Construction

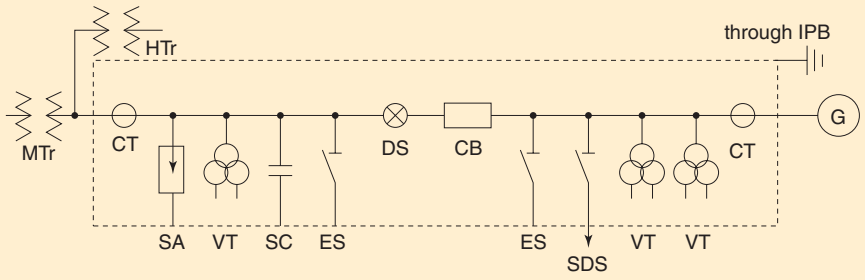
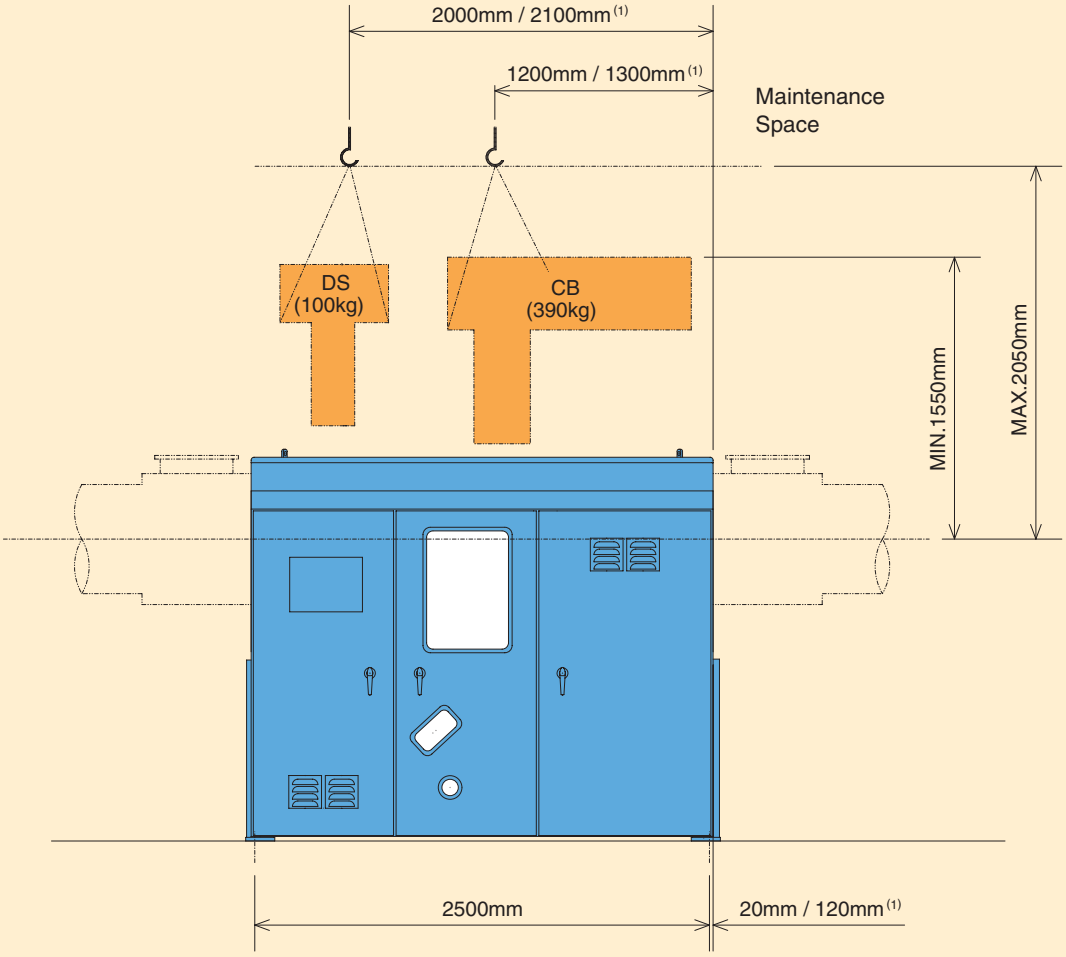


Fig.3 Single Line Diagram



Circuit Breaker

Circuit Breaker

The circuit breaker has a compact structure with high performance, high reliability and easy maintenance. This has been developed by the accumulation many experiences from field installations of GMCB and the latest design technologies.

Interrupter

Interrupter is a dual flow puffer-type, which has an excellent interrupting performance at every current level. New materials and advanced analysis technologies have been developed for it.

Fig.4 shows the construction of the circuit breaker.
Fig.5 shows the principle of interruption.

The interrupter has two separate contact systems, one for load current carrying and the other for arc interruption. At closed position, it carries current through the fixed main contact, the puffer cylinder and the finger contact.

–Opening Operation–

When a trip signal is provided, movable parts including puffer cylinder start opening process. At first main contacts are separated, and then arc contacts are separated accordingly arc arise between contacts.
SF6 gas inside puffer cylinder is compressed by the opening motion of the puffer cylinder and that it is bursted into the nozzle area where the arc is drawn between the arc contacts. The thermal energy of arc also pressurized SF6 gas inside puffer cylinder and generates high speed gas flow in nozzle. Nozzle concentrates the gas flow to arc and the gas flow cools it efficiently.

–Closing Operation–

When a close signal is provided, movable parts start the closing process. At first arc contacts, then main contacts are touched.

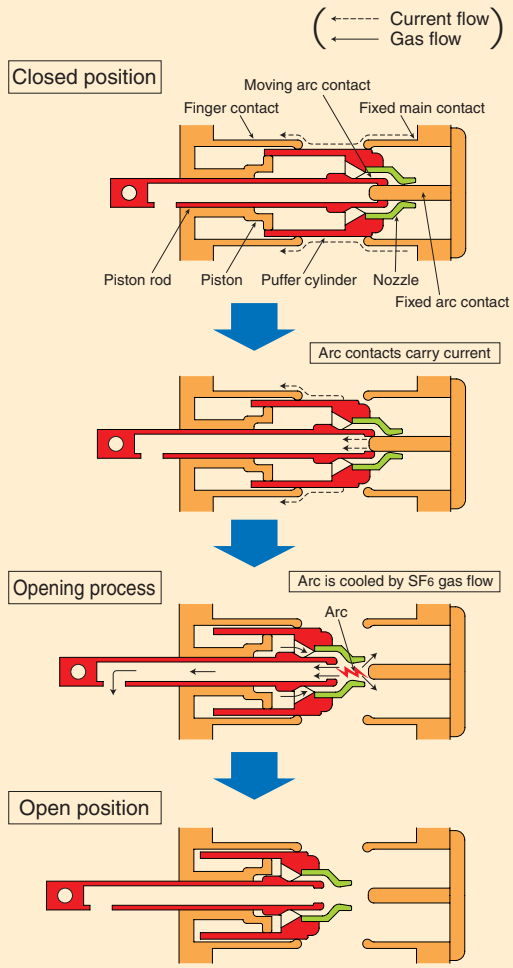


Fig.5 Principle of Interruption

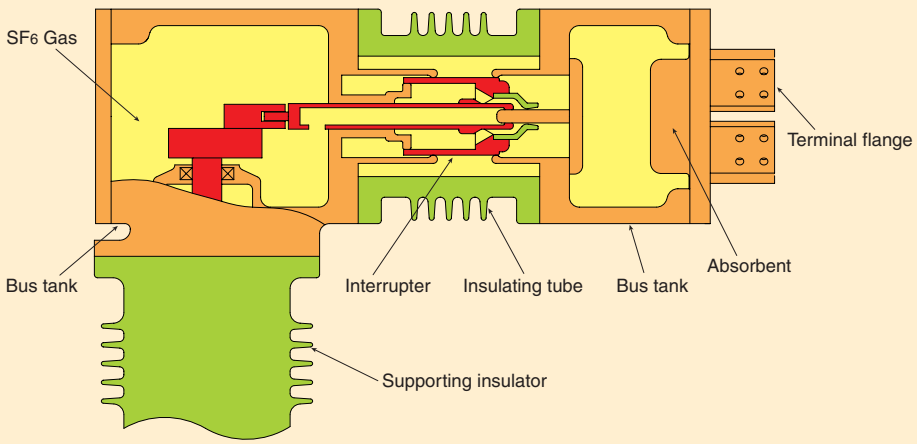


Fig.4 Construction of Circuit Breaker

BM-2 Operating Mechanism

The Type BM-2 operating mechanism is a carefully designed and time proven mechanism that utilizes a slight twist in a pair of torsion bars to develop the energy necessary to open and close the puffer interrupter. There is one pair of torsion bars for opening and one pair for closing. This mechanism has been in service since 1988.

A universal motor charges the closing torsion bars and operation charges the tripping torsion bars. Reliability and long service life have been confirmed by testing mechanisms to 50,000 operations and at up to 20% higher loads than normal operating conditions.

No maintenance is required on the BM-2 mechanism for the life of the breaker.

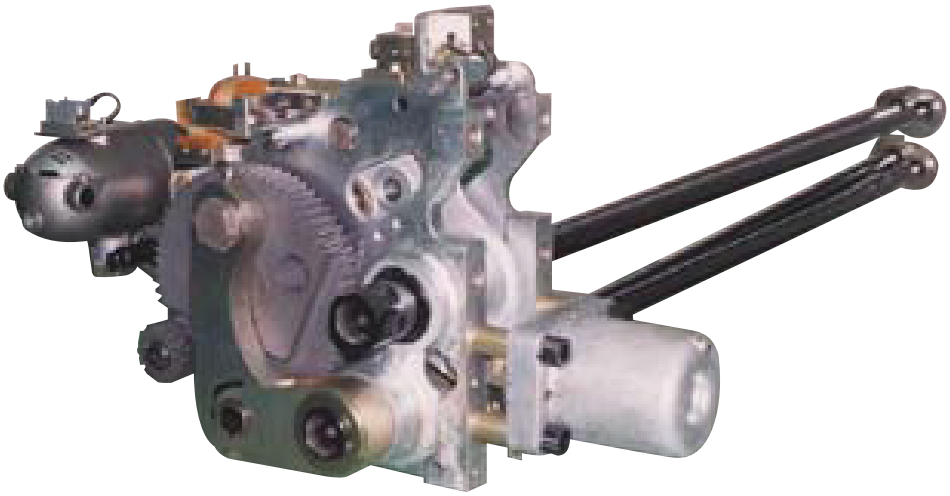


Fig.6 Type BM-2 Spring Operating Mechanism

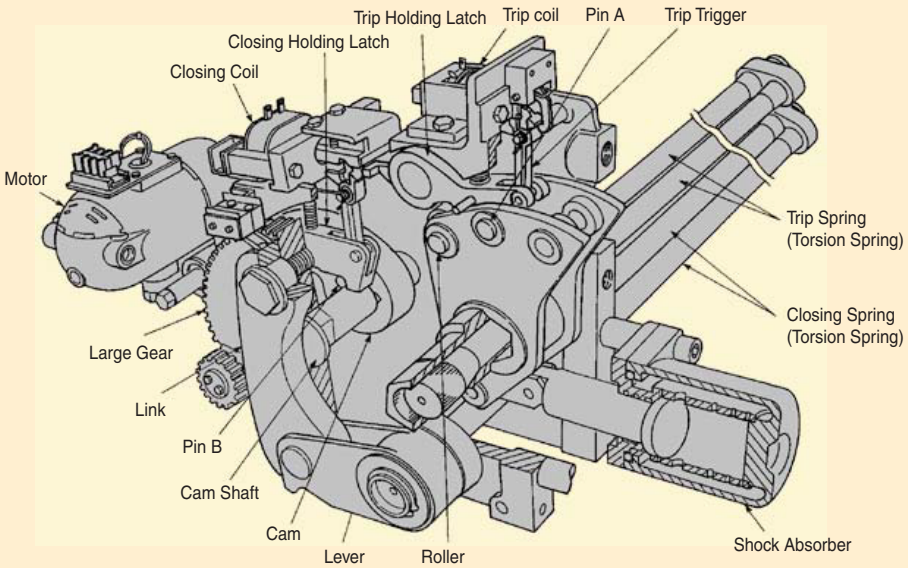


Fig.7 Construction of Type BM-2 Spring Operating Mechanism

Disconnecting Switch

The disconnecting switch is applied to open the main circuit after the circuit breaker is in open position.
The operating mechanism is driven by a motor. A window provided in the enclosure makes visual checking of contacts easy.
Fig.8 shows the construction of the disconnecting switch at open position as well as the closed position. The Open-Close operations are executed by the connecting and disconnecting of the moving contact with the fixed contact. The motor generates torque, and then this torque is transmitted to the lever through the reduction gear and the insulating rod. This lever makes the moving contact liner movement in the axial direction.

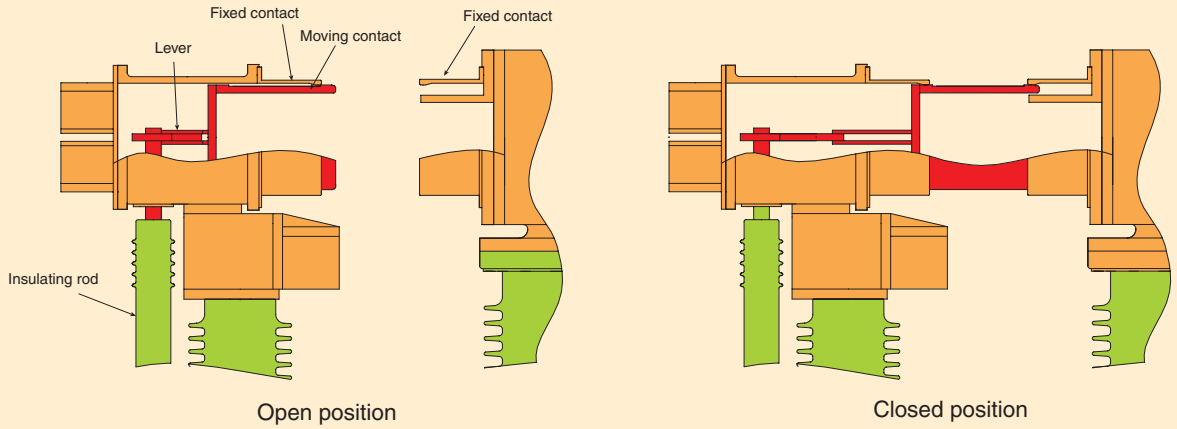


Fig.8 Construction and Operation of Disconnecting Switch

Earthing Switch

The earthing switch is used as a earthing device for the main circuit and other devices connected to the main circuit. Fig.9 shows the construction of the earthing switch at open position as well as the closed position. When the moving contact is connected with the fixed contact, the main circuit and other devices connected to the main circuit are earthed through the enclosure. The operating mechanism transmits torque through the link and lever, and it moves the moving contact to perform Open-Close operations.

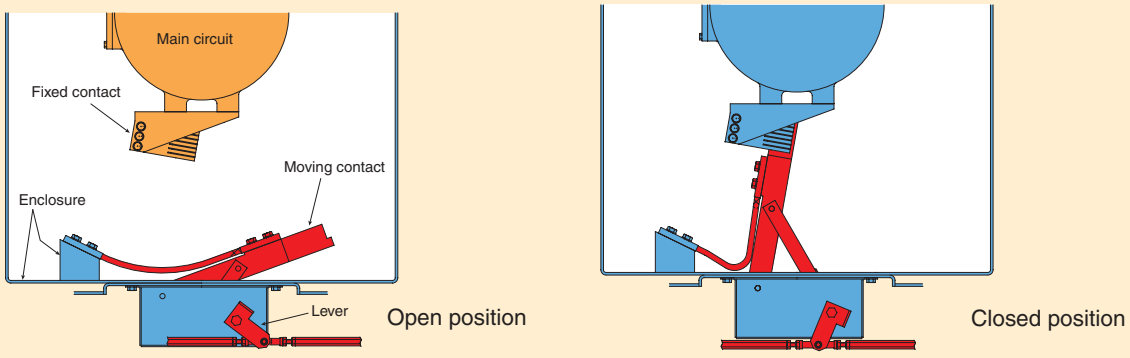


Fig.9 Construction and Operation of Earthing Switch

Starting Disconnecting Switch

The starting disconnecting switch is a device that provides a disconnecting switch to connect the static thyristor starting system and the generator main circuit in gas turbine plant.
Fig.10 shows the construction of the starting disconnecting switch at open position as well as the closed position.
When the moving contact is connected to the fixed contact, the circuit is connected to the main circuit and the static thyristor starting system. The operating mechanism transmits torque through the link and lever, and it moves the moving contact to perform Open-Close operations.

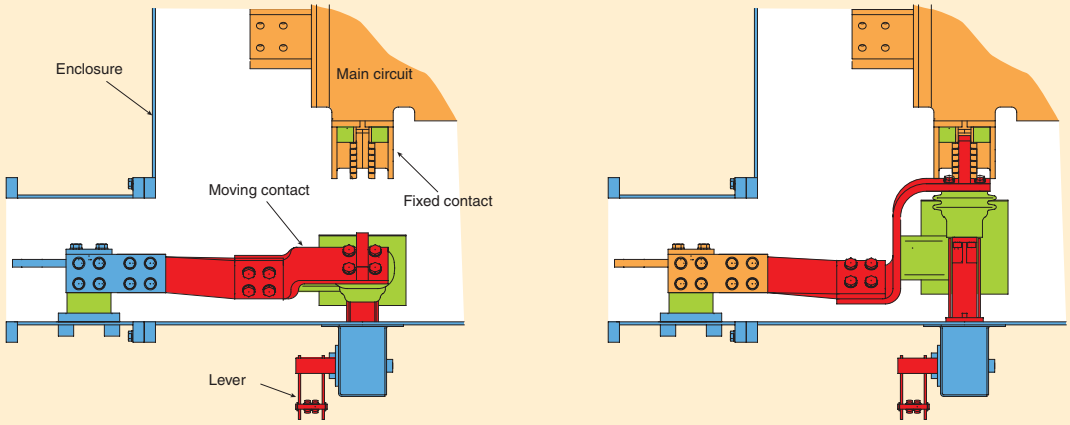


Fig.10 Construction and Operation of Starting Disconnecting Switch

Current Transformer

The current transformer is a fixed device that is directed mounted to the enclosure. The current transformer is used as a current monitoring device.

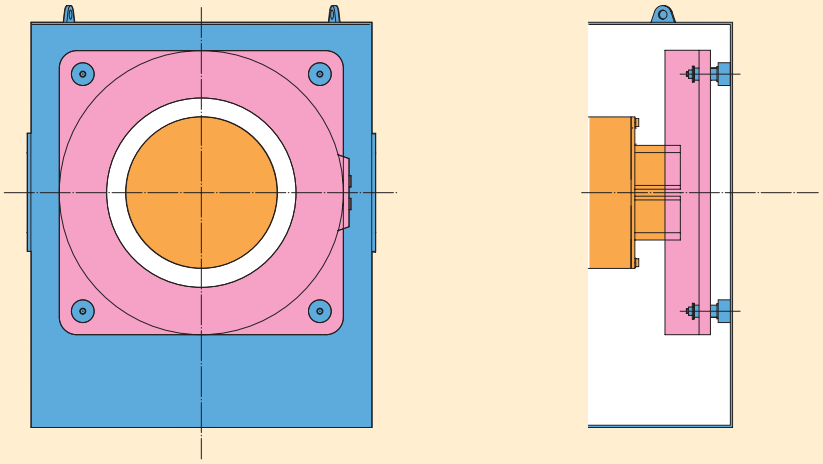


Fig.11 Current Transformer

VT & SA

This equipment is designed to measure the voltge of the generator main circuit and provide protection against abnormal voltages.
Fig.12 shows the standard layout of the VT&SA.

Voltage transformers, surge arresters, and capacitors in the VT&SA box are electrically connected with the main circuit in the enclosure the use of insulating bushings.

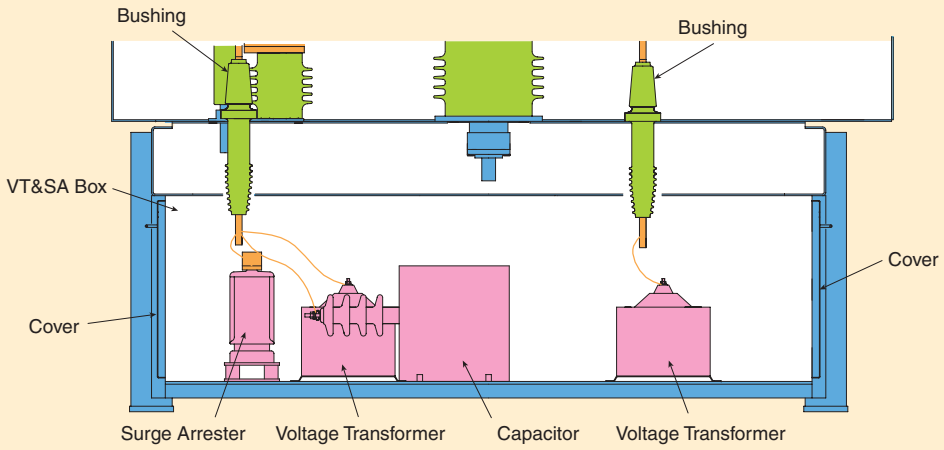


Fig.12 VT & SA

Connection to IPB

The GMCB conductors are connected to IPB conductors by bolted flexible connections.
The GMCB enclosures are to be welded to IPB enclosures at site.
Conductor terminals and flexible connection terminals are silver plated for reducing contact resistance.

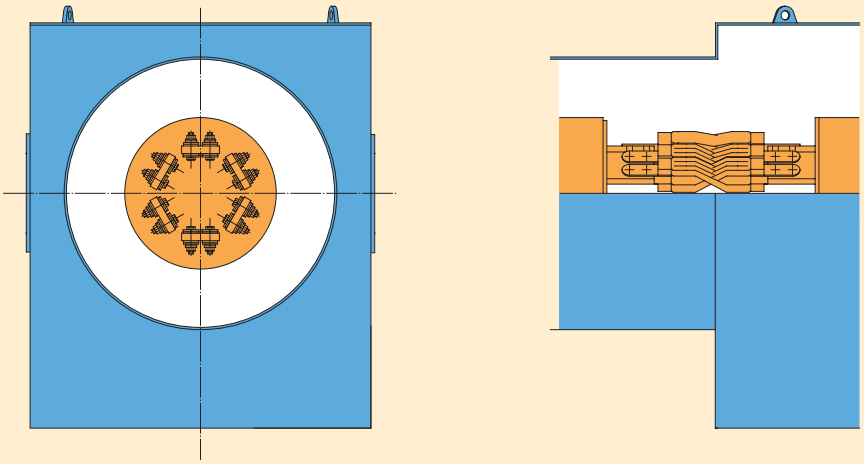


Fig.13 Connection to IPB

Maintenance

Inspection cover and windows on the enclosures, control units and SF6 gas monitoring unit that are centralized at the front panel of the equipment enable easy maintenance.

Also the avoidance of erosion / wear of contacts in the circuit breaker can make maintenance-free operation for a long period.

Ratings

Type				20-SFMG-63A
Rated voltage			(kV)	27.5 (ANSI) 24 (IEC)
Rated frequency			(Hz)	50/60
Rated continuous current			(A)	8000-natural cooling
Power frequency withstand voltage			(kV)	60[(1)]/70[(2)]
Impulse withstand voltage			(kV)	125[(1)]/145[(2)]
Circuit breaker	Rated short-circuit current		(kA)	63
	Rated short-time withstand current		(kA)	63 (3s)
	Rated short-circuit duty cycle			CO-3min-CO
	Operating mechanism			Spring operation
	SF_6 gas pressure		(MPa・20℃)	0.5
Disconnecting switch	Rated short-time withstand current		(kA)	63 (3s)
	Operating mechanism			Electric motor operation
Earthing switch	Rated short-time withstand current		(kA)	63 (1s)
	Operating mechanism			Electric motor operation
Current transformer	Rated load		(VA)	15～200, depends on class
	Class	IEC		5P10～10P20 (Protection), 0.2～3.0 (Metering)
		ANSI		～C800 (Protection), 0.3 (Metering)
Voltage transformer	Rated output		(VA)	50～200, depends on class
	Class	IEC		3P～6P (Protection), 0.2～3.0 (Metering)
		ANSI		～0.3WXY1.2Z
Surge arrester	Type			Metal oxide
	Normal discharge current		(A)	10,000
Capacitor	Type			Oil filled
	Capacitance		(μF)	0.10, transformer side
Starting disconnecting switch	Rated voltage		(kV)	7.2 (IEC)
	Power frequency withstand voltage		(kV)	20[(3)] / 60[(4)]
	Impulse withstand voltage		(kV)	60[(3)] / 125[(4)]
	Rated continuous/short-duration current		(A)	2000-continuous / 4000-20minutes
	Operating mechanism			Electric motor operation

(1) to ground and across the circuit breaker contact gap
(2) across isolating gap
(3) in position “C” and “O” to earth
(4) across isolating gap