# PANICKKER SWITCHGEAR

## Vacuum Circuit Breaker Up to 36 kV

Fig. 1. View of the Truck

Fig. 2. External view of single busbar switchgear type DPVM Standard blank instrument and relay panel is shown.

## HISTORICAL BACKGROUND OF VACUUM CIRCUIT BREAKERS

Over last few decades, Switchgear technology has undergone considerable advances by the utilisation of new arc extinguishing media such as Air, Oil, Compressed Air, SF-6 and Vacuum. As in any technical development, the advent of new technology does not mean that the existing ones are completely replaced. In some countries, bulk oil circuit breakers are still being manufactured in appreciable numbers. This is even more with Minimum Oil Circuit Breakers (MOCB). However, one of the major constraints in use of these conventional oil circuit breakers for industrial applications is their limited switching life at normal and short circuit currents.

In many of the industrial applications, the switching frequency can be more than 10 to 20 operations per day and in certain cases like furnace duty as high as 50 to 100 times a day. This aspect combined with high degree of industrial pollution makes the conventional breakers unsuitable for many of the applications. Therefore, the modern Vacuum circuit breakers offer ideal solution to these switching applications because they meet almost all the requirements of the industry.

## PRINCIPLES OF VACUUM CIRCUIT BREAKER

In a Vacuum circuit breaker, Vacuum interrupters are used for breaking and making load and fault currents. When the contacts in Vacuum interrupter separate, the current to be interrupted initiates a metal vapour arc discharge and flows through the plasma until the next current zero. The arc is then extinguished and the conductive metal vapour condenses on the metal surfaces within a matter of micro seconds. As a result the dielectric strength in the breaker builds up very rapidly. The properties of a Vacuum interrupter depends largely on the material and form of the contacts. Over the period of their development, various

types of contact materials have been used. At the moment it is accepted that a copper chrome alloys is the best material for High voltage circuit breaker. In this alloy, chrome is distributed through copper in the form of fine grains. This material combines, good arc extinguishing characteristic with a reduced tendency to contact welding and low chopping current when switching inductive current. The use of this special material is that current chopping is limited to 4 to 5 Amps.

At current under 10 KA, the vacuum arc burns as a diffuse discharge. At high values of current the arc changes to a constricted form with an anode spot. A constricted arc that remain on one spot for too long can thermically over stress the contacts to such a degree that the deionisation of the contact zone at current zero can no longer be guaranteed. To overcome this problem the arc route must be made to move over the contact surface. In order to achieve this the contacts are so shaped that the current flow through them results in a magnetic field being established which is at right angles to the arc axis.

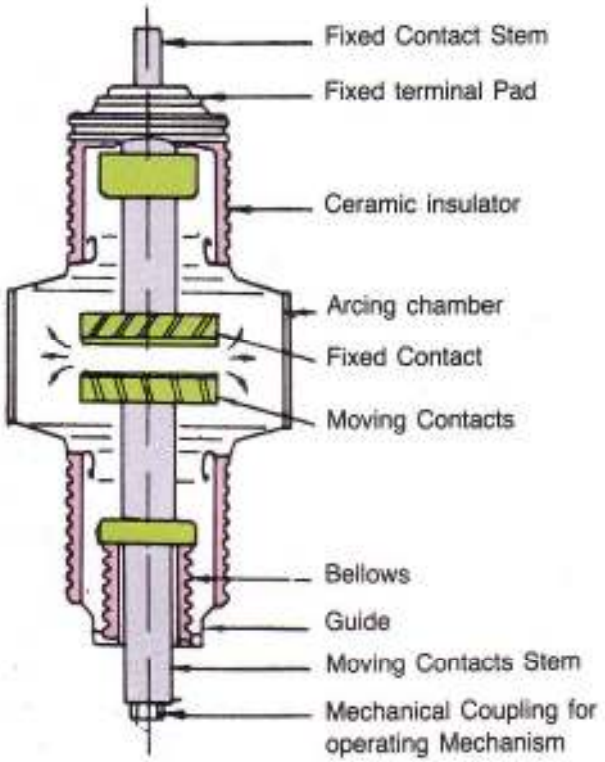


Fig. 3. Internal view of vacuum bottle.

This radial field causes the arc route to rotate rapidly around the contact. resulting in a uniform distribution of the heat over its surface. Contacts of this type are called radial magnetic field electrodes and they are used in the majority circuit breakers for HV applications.

A new design has come in Vacuum interruptor in which switchingover the arc from diffusion to constricted state by subjecting the arc to an axial magnetic field is made. Such a field can be provided by leading the arc current through a coil suitably arranged outside the vacuum chamber. Alternatively, the field can be provided by designing the contact to give the required current path. Such contacts are called axial magnetic field electrodes. This principle has advantage when the short circuit is in excess of 31.5 KA. Typical contact arrangement is shown in figure 3.

## DESIGN FEATURES

### HOUSING

The fixed housing is of bolted construction segregated into three main compartments.

(1) Busbars
(2) CT Cable/Earth switch
(3) VCB/secondary plugs/main spouts and shutters.

On the top of the housing is the relay/instrument chamber with a front hinged door for easy access. Control wiring can enter the top of this chamber, or through the bottom via a trough inside the VCB compartments.

### CIRCUIT BREAKER - TRUCK

The carriage is a sturdy welded steel construction.

It houses the Vacuum interrupters, main isolating contacts, secondary plugs, independent spring charged mechanism, indicators, auxiliary switches etc.

A removable front cover carries full operating instructions, and indications for all mechanism/truck and VCB positions required by the operator.

## VACUUM INTERRUPTERS

The interrupters are mounted in an epoxy resin housing. The interrupters are operated by epoxy resin drive rods.

## MECHANISM

Two types of mechanisms are available. Motor wound spring and manual wound spring charged. Local/remote electrical operation is available on request.

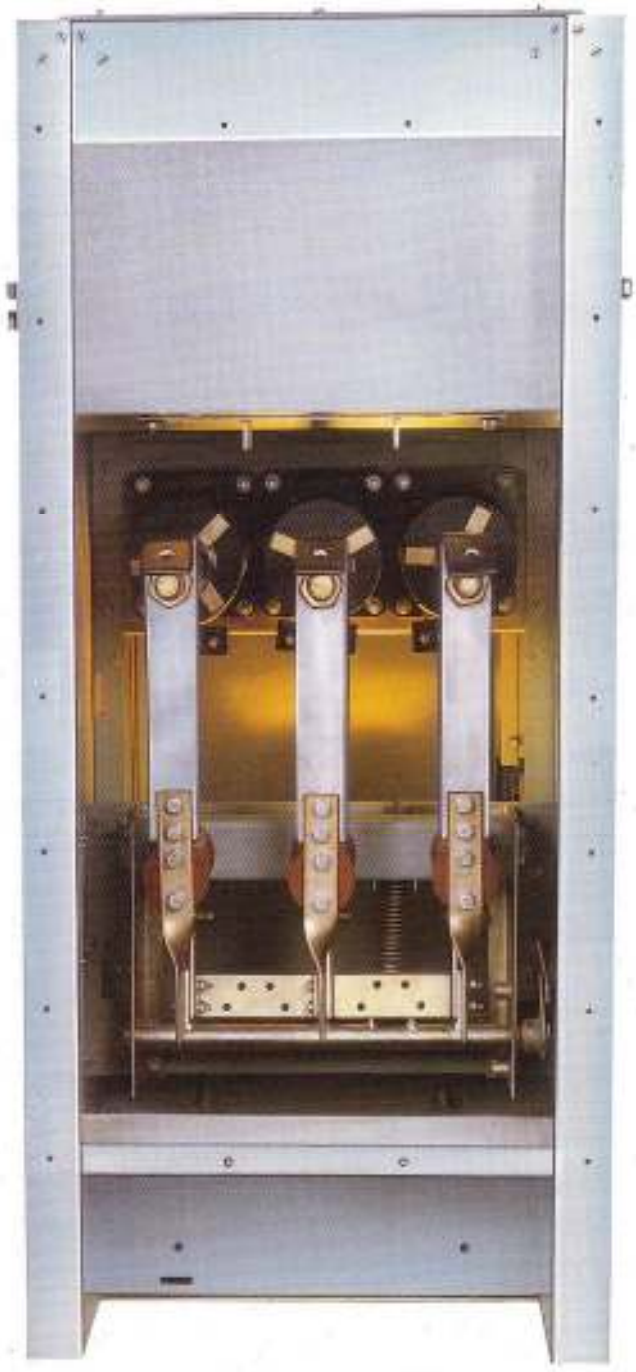

Fig. 4. Rear view of VCB.

## BUS BAR CHAMBER

The main spouts and connections to the busbars are cast in epoxy resin as a three phase monoblock or single phase moulding. The conductor is a high conductivity hard drawn flat copper bar which also forms the main spout isolating contact.

The busbars are of unit length and are made of high conductivity hard drawn copper bar and are insulated with heat shrunk sleeving on epoxy resin coating and are fully insulated for the system voltage.

Access to the busbar compartment is through removable top plate which also acts as a pressure relief flap.

## INTERLOCKS

For maximum operator's safety robust mechanical interlocks are provided to ensure that:

The circuit breaker cannot be closed unless the carriage locking mechanism or shoot-bolt is in the LOCKED position.

VCB cannot be engaged or withdrawn unless it is in the open position. VCB cannot be operated unless it is in the engaged or isolated position (not in between).

Earthing switch cannot be closed when the VCB is in the engaged position.

VCB cannot be inserted into the engaged position as long as the earthing switch is closed.

Other optional mechanical key interlocks (Castell locks) are provided on specific operational requirements.

## SAFETY SHUTTERS

Automatic safety shutters cover the busbar and circuit spouts when the VCB is withdrawn or isolated. They can be padlocked in the closed position and either or both sets of shutters can be manually latched open for testing or maintenance purposes. The manual latch is automatically cancelled when the VCB is inserted into the compartment.

### MAIN ISOLATING CONTACTS

The contacts are fitted to high conductivity hard drawn copper bars connected to the top of the interrupters for the busbar contacts and to the bottom of the interrupters for the cable contacts.

Highly self adjusting single contacts of adequate cross section are used and no hot spot is generated in the contact area.

The main spouts and connections of the cable terminations are cast in epoxy resin, which forms the primary for ring type CT's. The conductor is of high conductivity hard drawn copper and forms the main spout isolating contact.

### SECONDARY PLUGS

Secondary wiring is carried from the mechanism with flexible cables in a bunch through secondary plugs to the instrument/relay chamber.

Thus all incoming supplies enter the instrument/relay chamber automatically when the truck is inserted.

### EARTH SWITCH

Fully rated earth switch, interlocked with the VCB, seperated from the front and fully lockable is fitted as optional equipment. The earth switch handle is removable.

### VOLTAGE TRANSFORMER

PT to provide voltage signals for metering, protection and control is accommodated at the rear of the cubicle above the circuit compartment. The PT may be circuit or busbar connected, although circuit connection is more common.

Two options are available. Either fixed mounted PT or swing-out isolatable PT can be provided. PT is fused at both primary and secondary sides.

### CABLE BOX

A seperate detachable cable box can be provided if necessary.

Integral cable box can be supplied as standard.

Cabling arrangement are suitable for dry jointing on two connections.

### SALIENT FEATURES

### HIGH BREAKING PERFORMANCE

Short make and break time makes it suitable for synchronising duty as well.

Arcing time is always less than half a cycle.

Low current chopping to avoid dangerous over voltages.

100 short circuit current interrupting operations.

### HIGH SWITCHING LIFE

100 short circuit current interrupting operations.
20000 Load current switching operations.
30000 mechanical operations.

### HIGH OPERATIONAL SAFETY

Dead front structure, in which operating mechanism is arranged on the front side while the main circuit is mounted at the rear, ensures operating safety.

The operating mechanism is enclosed in steel housing thus protected from dust and dirt.

As no inflammable material is used there is no danger of accidental fire leading to explosion.

### LESS MAINTENANCE

Since current is interrupted in a closed Vacuum

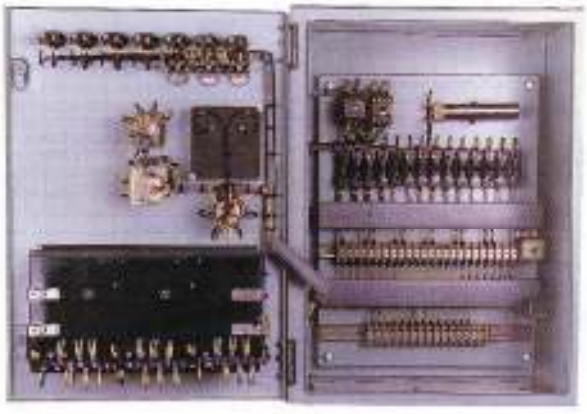

Fig. 5. Interior of instrument and relay chamber

chamber, the contact points never require any inspection for maintenance.

Since the life of the contacts is long the Vacuum interrupter rarely require replacement.

### LOW NOISE

Operating noise is very low as the current is interrupted inside the Vacuum interrupter. Only operating noise is audible.

### RELIABILITY

Simple operating mechanism.
Unique Arc Interruption Characterists.
Well designed components.

### IMMUNE TO POLLUTION

Hermetically sealed interrupters ensures reliable and consistant performance under polluted conditions.

### COMPACTNESS

Compact construction minimises the installation space.

Fig. 7. Assembly of double busbar switch gear type DPVMD.

Fig. 6. View of the porcelain clad VCB type PCVCB details on requ

## TESTS

PANICKKER VCBs

Confirm to IEC 56
Following type tests have been carried out

★ Short time current ★ Short circuit making

★ Short circuit breaking ★ Mechanical Endurance

★ Low inductive current ★ Capacitive current

★ Temperature rise ★ BIL

## TYPE DPVMD
## DOUBLE - BUSBAR TYPE
## VACUUM CIRCUIT BREAKERS

The type DPVMD double-busbar switchgear is a development of the type DPVM single-busbar design. Almost all the standard features are retained.

Main and Reserve busbars are selected by raising and lowering the circuit breaker. A raise/lower mechanism is built into the circuit breaker truck. This method of busbar selection is well-proven and has the following advantages:
Simple, error-free operation.
Perfect interlock.
Minimum floor space (Same size as single busbar version).

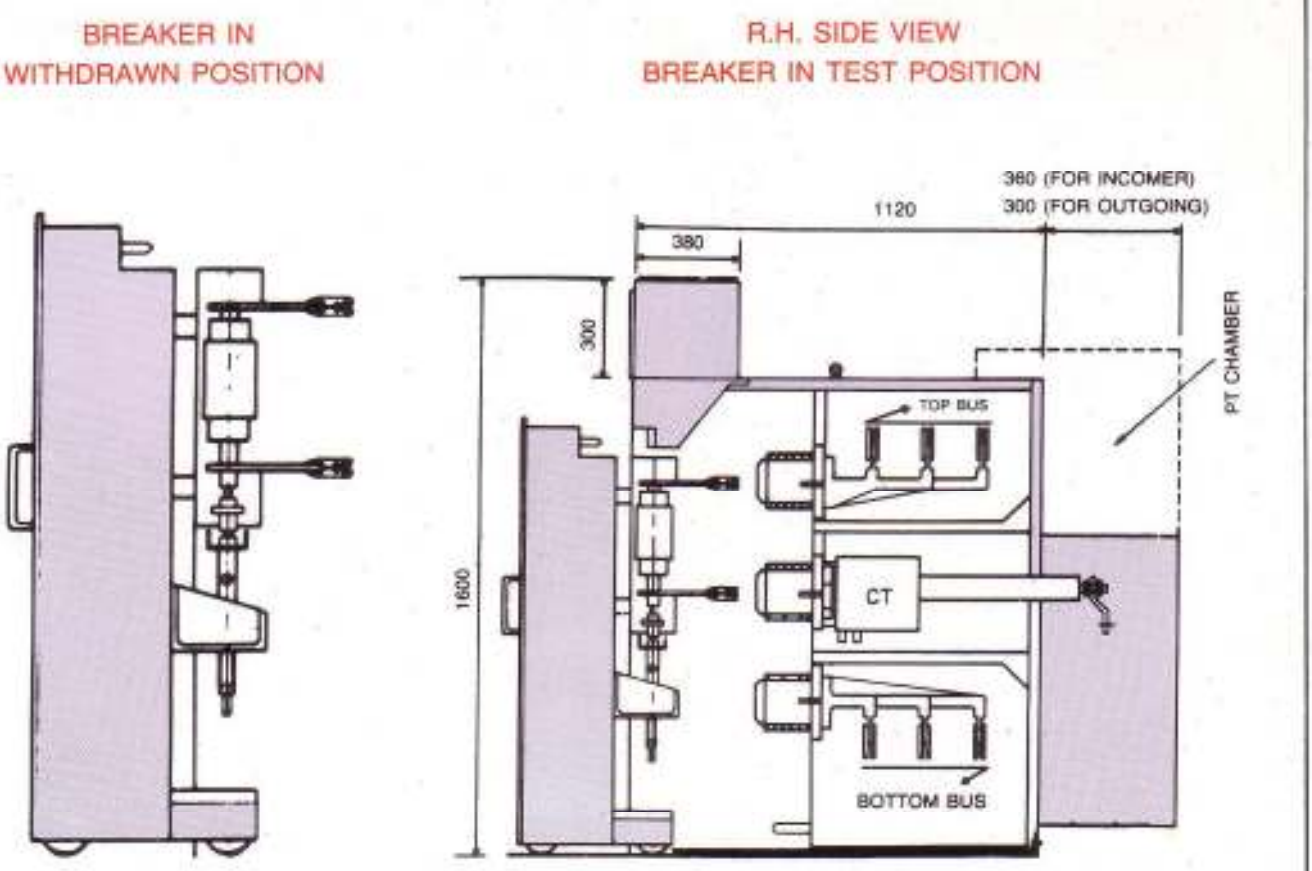


Fig. 8. Side View of double busbar arrangement.

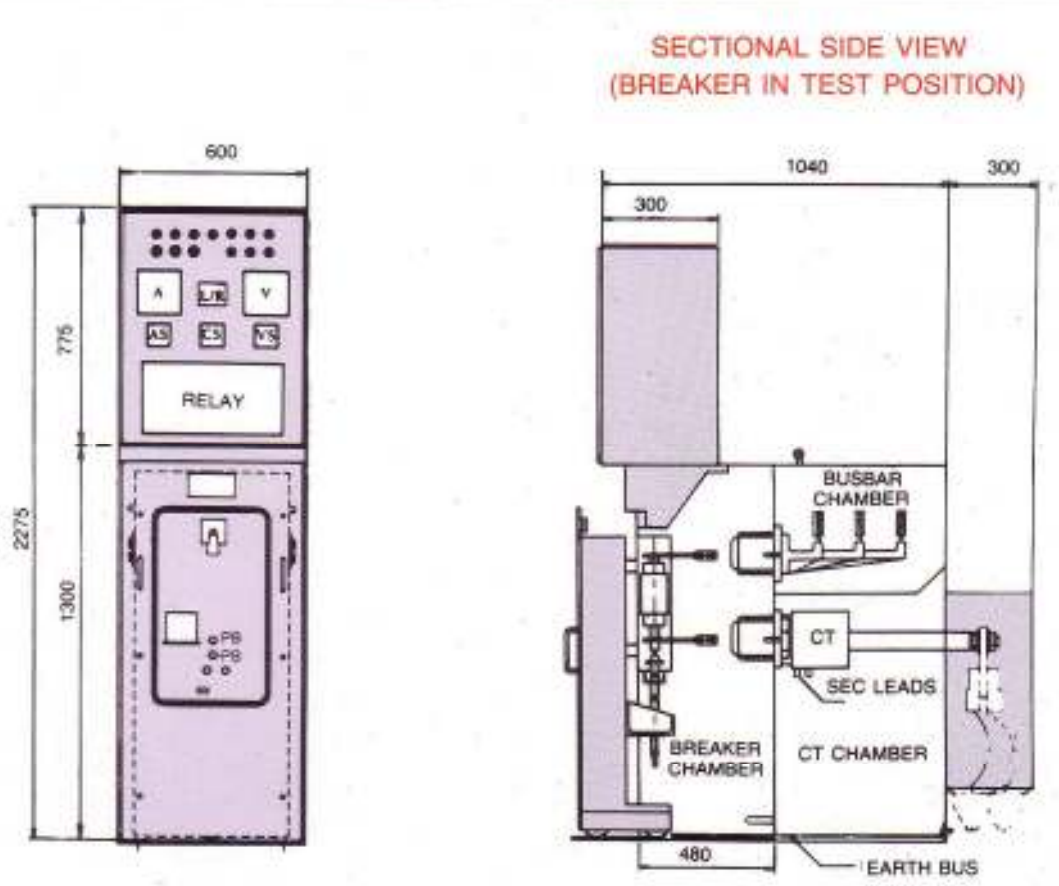


Fig. 9. View of typical single busbar arrangement.