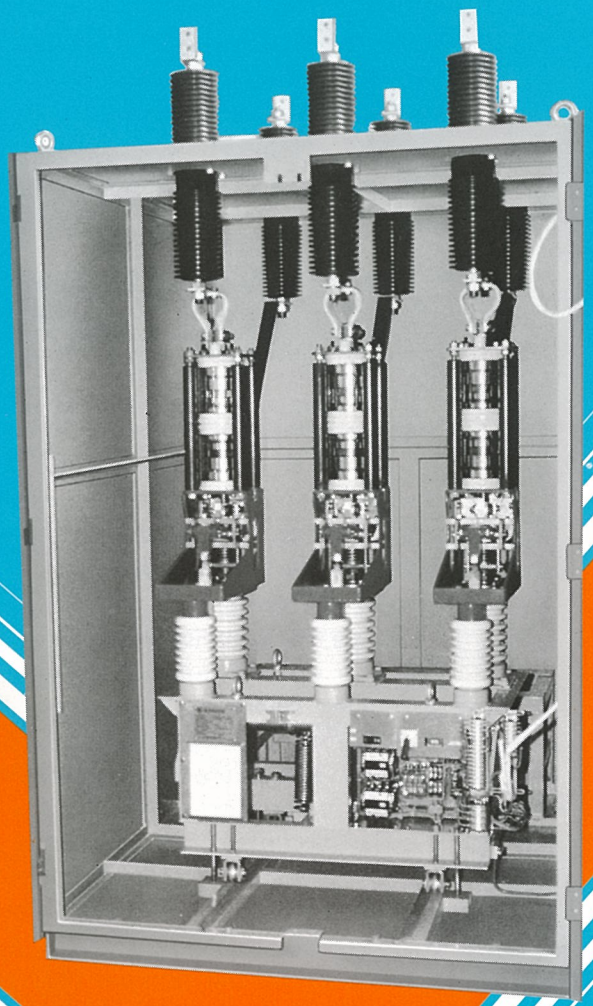
TAKAOKA

24/36 kV class
VACUUM SWITCHES



TAKAOKA ELECTRIC MFG. CO., LTD.

TOKYO, JAPAN

EB-004B

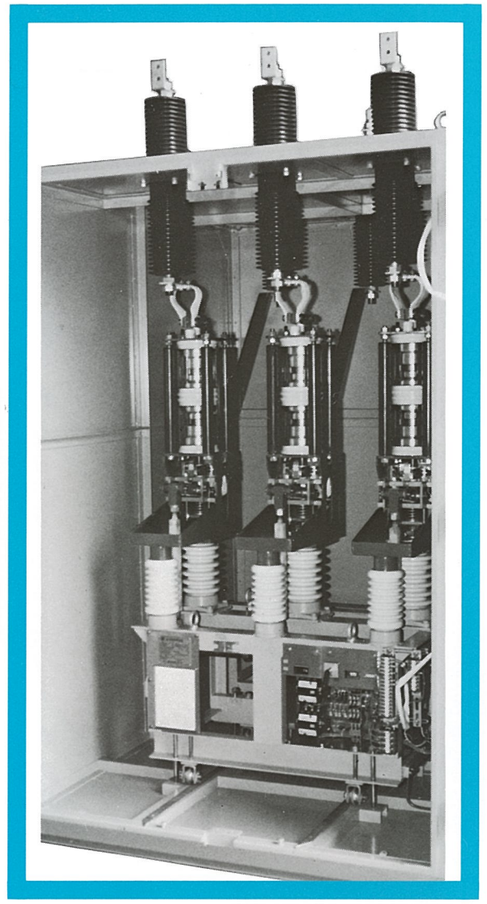


Fig. 1 24kV vacuum switch

1 DESCRIPTION

Takaoka's vacuum switch has capability of being used for electric furnace with easiness of maintenance and reliable safety.

Fig. 1 shows the appearance.

This vacuum switch has many advantages such as the mentioned below.

(1) Superiority in breaking performance.
(2) Longer service life.
(3) Easiness of maintenance & check.
(4) Little noise.
(5) Higher stability and safety.

Moreover, for surge generated when the exciting current of off-load transformer is switched, it has succeeded in controlling a multiple of switching over voltage under 1.4 times by using a capacitor of 0.1 μF as a surge absorber.

2 FEATURES

(1) Superior breaking performance

Owing to the excellent insulation recovery characteristics of vacuum interrupter arcing time is short and breaking performance is satisfactorys.

(2) Longer service life

Since vacuum interrupter is incorporating a special contact taking a high-frequency operation and longer life into consideration, the contact damage is very little and longer life is ensured along with a short arcing time.

Furthermore, in the operating mechanism, a link mechanism has been simplified successfully by adopting a normally energized closing holding system. And, for the design of the moving part and the supporting part thereof, a design standard different from that for electric power-use circuit breakers has been adopted taking a high-frequency operation and longer life into account, thus ensuring a very long service life.

(3) Maintenance- and check-free service

This switch is operable almost free of maintenance and checks except for lubrication to the moving part once or twice a year until the electrical life of 150,000-times operation with 600A and 100,000-times operation with 1,200A, 60,000-times operation with 2,000A and further, mechanical life of 300,000-times operation.

(4) Higher stability and safety

Since a type is available as the standard which contains the main body of load switch and surge absorber in a switch box, the live part is not exposed and the switch itself is not affected by bad working conditions such as dusty circumstances, thus permitting the switch to display its stable performance over long time periods together with a very high safety.

(5) Little noise and incombustibility

Since the interruption is accomplished in vacuum state and also, no oil is used, there is neither objectionable noise caused in breaking operation nor possibility of a fire.

3 SPECIFICATIONS AND RATINGS

The specifications and ratings of this switch are shown in Table 1. below.

Table 1 Specifications and ratings

stop of production

Type Form		20 VI 6VI-12ETF		20 VI 6VI-20ETF	30 VI 6VI-12ETF	
Mounting manner		Enclosing indoor-type metal housing (contains a switching surge absorber together)				
Rated voltage	(kV)	24			36	
Impulse with stand voltage	(kV)	125			170	
Rated normal current	(A)	600	1,200	2,000	600	1,200
Rated frequency	(Hz)	50, 60				
Rated load switching capacity	(A)	600	1,200	2,000	600	1,200
Max. breaking current	(kA)	6				
Max. Breaking capacity	(MVA)	250			390	
Rated short-time current	(kA)	25 • 2S				
Rated breaking-time	(cycle)	5				
Closing time	(s)	0.2				
Closing operation system		Solenoid operation				
Rated closing voltage		DC 100V or AC 110V				
Rated closing current	(A)	50				
Closing holding system		Electromagnet of solenoid				
Closing holding current	(A)	2.5				
Tripping operation system		No-voltage tripping by spring				
Electric life (Life of vacuum valve)		150,000-times operation	100,000-times operation	60,000-times operation	150,000-times operation	100,000-times operation
Mechanical life (Life of switch body)		300,000-times operation				

Accessories
(1) Metal housing (containing load switch and surge absorber)
(2) Switching surge absorber (capacitor and resistor)
(3) Manual closing device
(4) Gap gauge for check

4 CONSTRUCTION

Fig.2, 3 show the external view of vacuum switch for 24kV and Fig. 4, that of vacuum switch for 36kV, respectively.

In the vacuum interrupter of switch for 24kV, the glass part of the surface is left exposed to the air, whereas in the interrupter of switch for 36kV, the surface has been epoxy-molded for strengthening the creeping insulation.

For the vacuum switches for 24kV and 36kV, the same parts are in use except difference in the vacuum interrupter and the mounting part thereof, lengths of supporting insulator and operating rod and availability of barrier.

Tripping operation is made as follows; closing holding force is nullified by cancelling the holding current and the mechanism is tripped instantaneously by the energy of opening spring ④ which has been charged.

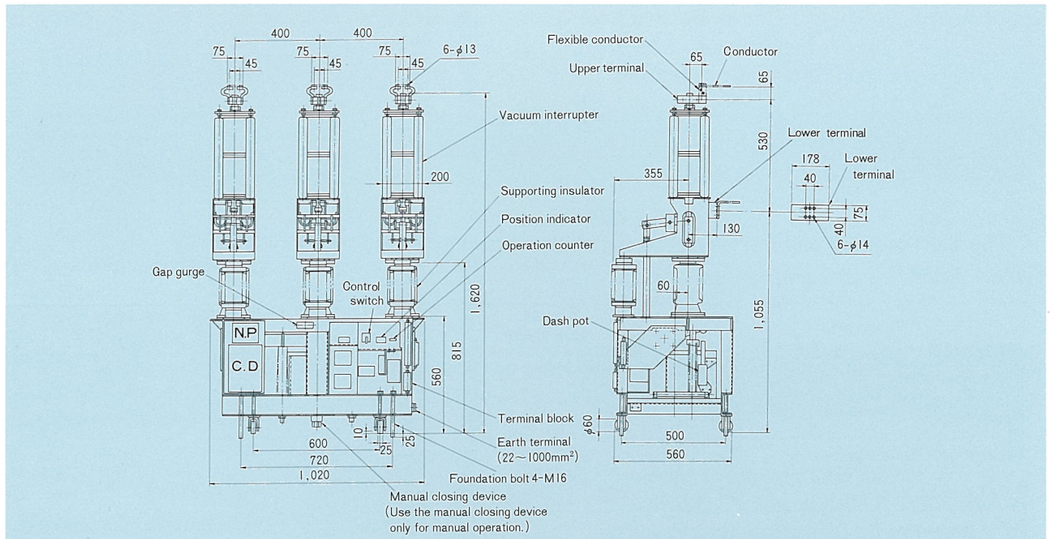


Fig. 2 External view of switch for 24kV, 600·1200A

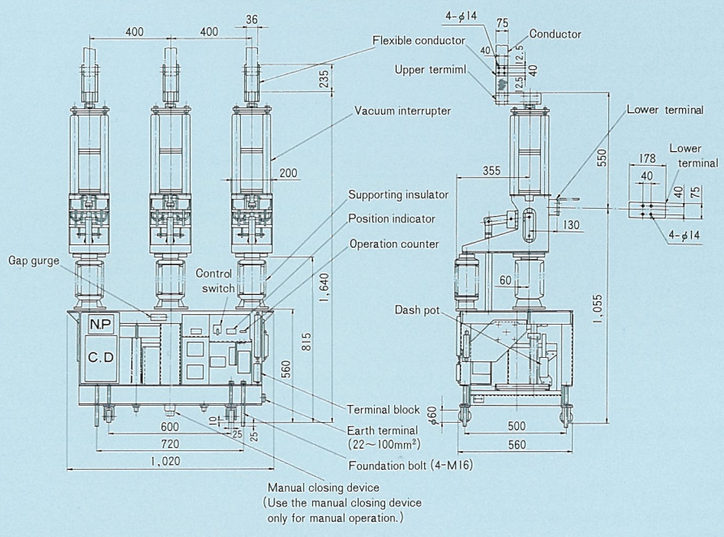


Fig. 3 External view of switch for 24kV, 2000A

stop of production

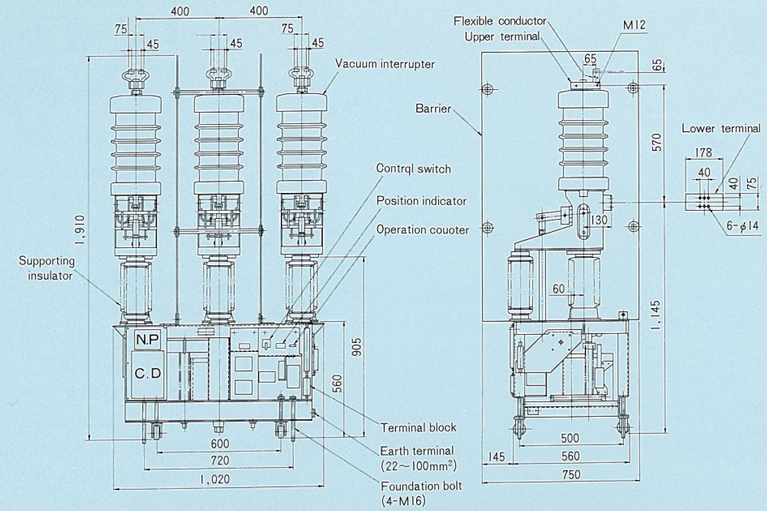


Fig. 4 External view of switch for 36kV, 600·1200A

4-1 Interrupting part

Fig. 5 shows the construction of the interrupting part of switch for 24kV and Fig. 6, that of switch for 36kV respectively.

The interrupting part consists substantially of a vacuum interrupter, contact spring, buffer also serving as a guide and upper, lower terminal.

The guaranteed service life of vacuum interrupter is 150,000-times operation for switch having load switching capacity of 600A and 100,000-times operation for that having load switching capacity of 1,200A and 60,000-times operation for that having load switching capacity of 2000A.

In order to enable controlling the life in the actual working condition even according to the extent of consumption of contact (allowable contact wear is 3mm), the interrupting part has been so contructed that damage in the contact of vacuum valve can easily be checked visually.

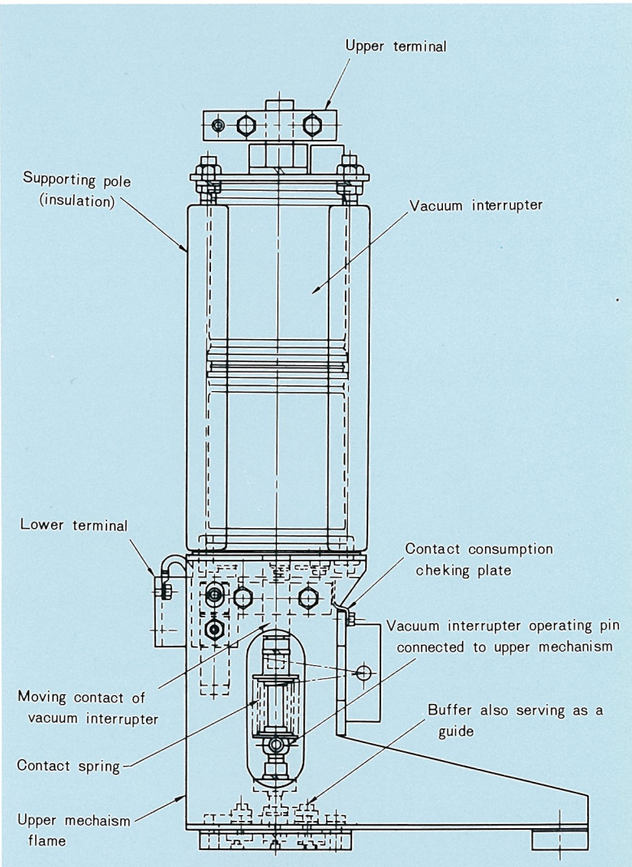


Fig. 5 Structural drawing of breaking part of switch for 24kV, 600·1200A (2000A)

stop of production

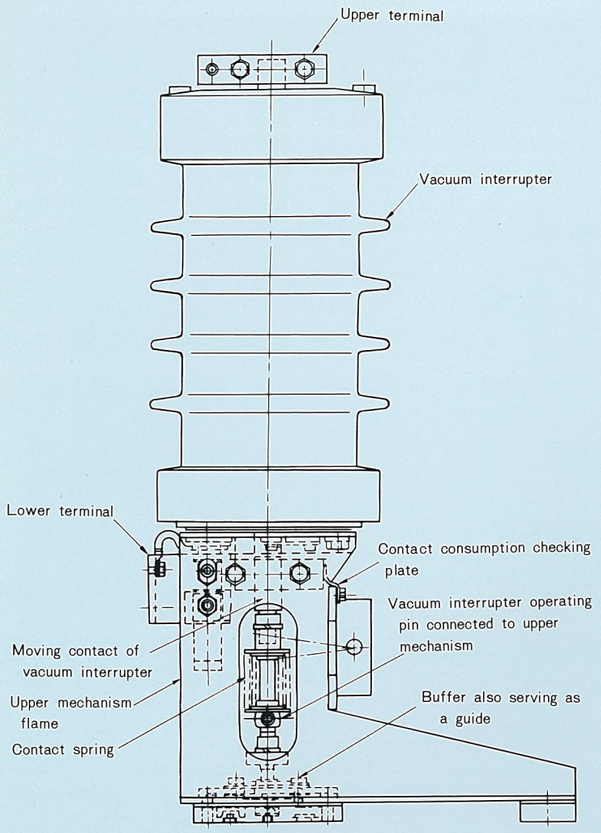


Fig. 6 Structural drawing of breaking part of switch for 36kV, 600·1200A

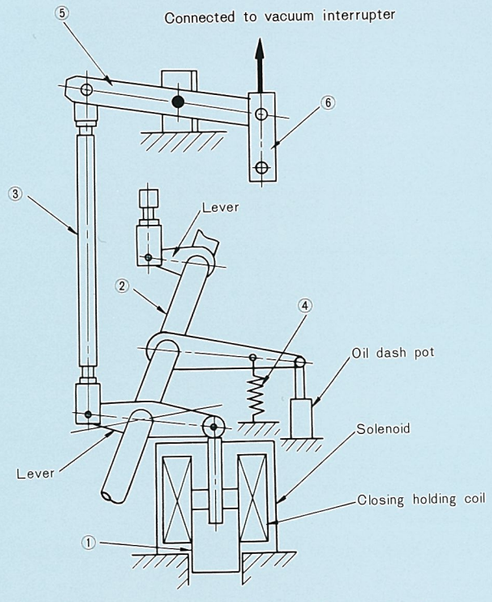


Fig. 7 Structural drawing of operating mechanism (showing the open condition)

4-2 Construction and operation of operating mechanism

Fig. 7 shows the construction of operating mechanism.

The operating mechanism comprises a solenoid, operating main shaft, operating insulation rod, upper mechanism, opening spring and oil dash pot.

This operating mechanism, taking account of high-frequency operation and longer service life, has incorporated the following arrangements to enable withstanding 300,000-time consecutive switching operation;

(1) As a result of a normally energizied closing holding system having been employed, the link mechanism has been simplified successfully and at the same time, the latch has been discontinued.

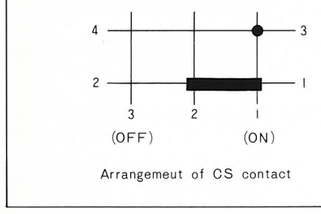
(2) Allowable pressure working on the pressure receiving face of rotary part and allowable stress on the moving part and moved part, and springs have been kept lower than the design standard of electric circuit breaker for electric power.

(3) An oil dash pot has been provided to buffer shock occurring in tripping operation. (Mechanical life 150,000-times)

The closing operation is accomplished as follows: When an electrical closing signal is given, solenoid are excited and armature ① is drawn upward, a lever secured to operating main shaft ② is pushed up and the operating main shaft ② rotates counter-clockwise to draw operating insulation rod ③ downward and at the same time, opening spring ④ is charged. When the operating insulation rod moves downward, link ⑤ turns counter-clockwise, idle link ⑥ moves upward to close the contact of vacuum interrupter and contact spring is compressed, completing the closing operation. While on the other hand, just before completion of the closing operation, a resistor is connected in series to the closing coil by a contact "ha" of auxiliary switch of this vacuum switch. The result is that closing current is changed over to holding current and closing condition is maintained by electro-magnetic force of solenoid due to this holding current. The operating mechanism has such construction as mentioned above. Fig. 8 shows the control circuit diagram.

Tripping operation is made as follows; closing holding force is nullified by cancelling the holding current and the mechanism is tripped instantaneously by the energy of opening spring ④ which has been charged.

AuS ····· Auxiliary switch
a ····· Open/close together with VS
b ····· Open/close opposite to VS
ha ····· ha contact
CC ····· Closing holding coil
CX_1 ····· Closing relay
CX_2 ····· Closing relay
TFR ····· Trip free relay
MCB ···· Molded case circuit breaker
CS_1 ····· Control switch(fitted to VS body)
◎ ····· Terminal board
R ····· Series resistor for holding
MCT ····· Operation counter
GL ····· Green indicator lamp
RL ····· Red indicator lamp
CS ····· Control switch
C ····· Capacitor
Rf ····· Rectifier
ZNR ····· Surge absorber



Arrangemeut of CS contact

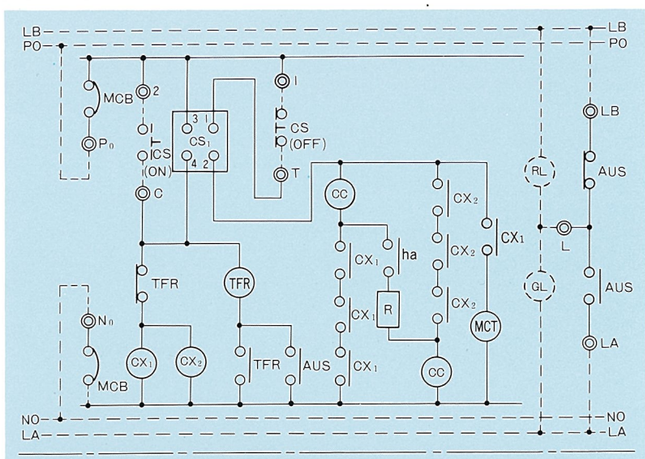


Fig. 8 Control circuit diagram (for DC 100V operation)

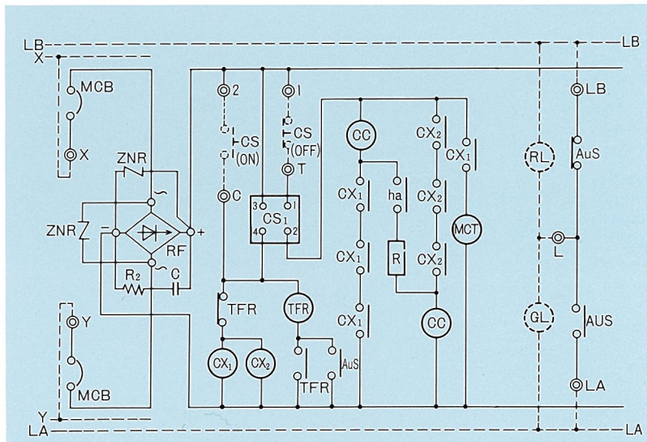


Fig. 9 Control circuit diagram (for AC 110V operation)

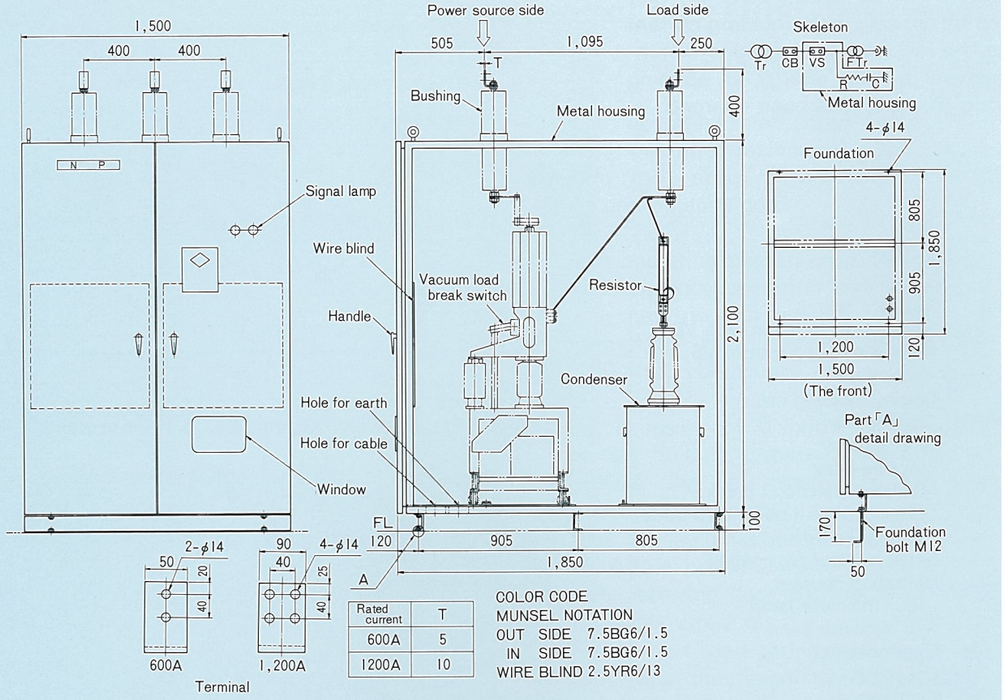
4-3 Metal-housing and surge absorber

Fig. 10, 11 and fig. 12 show the outline drawing of metal hausing containing a high-frequency use vacuum switch and surge absorber.

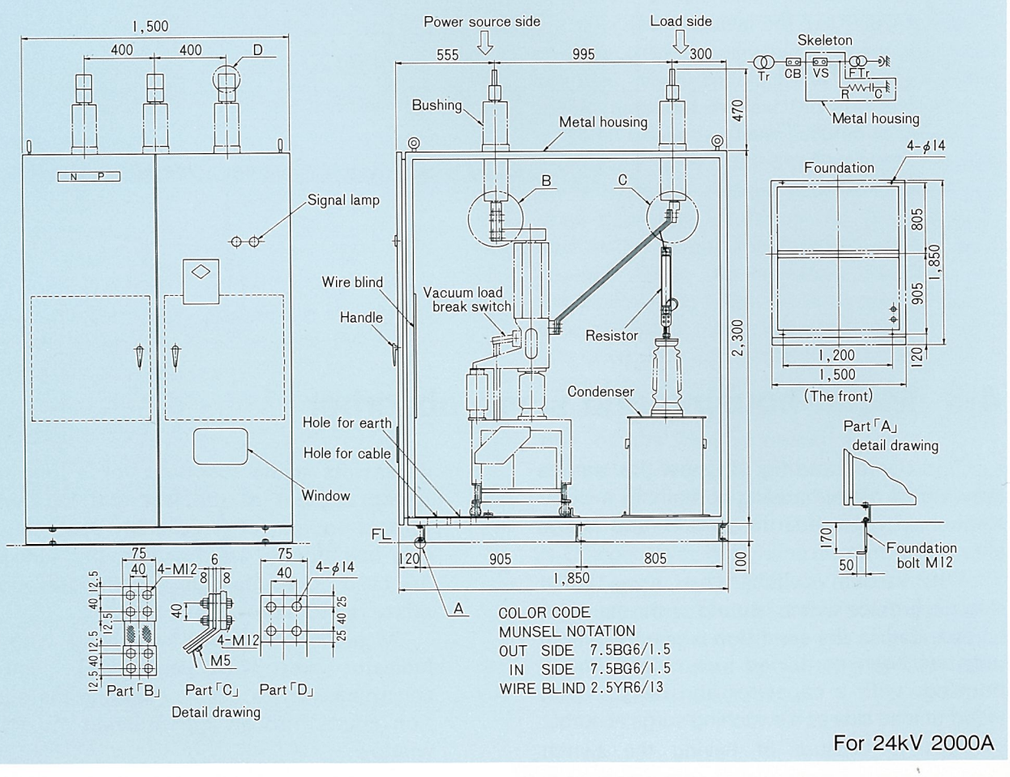
This vacuum switch, when using as an electric furnace switch, should as the standard be operated in the condition where the whole unit has been contained in a closed Metal-housing, with a capacitor and resistor provided at load side as a switching surge absorber.

This is because of having the switch display its stable functions for a long time taking account of the fact that an electric furnace equipment is generally operated in a very bad atomsphere. For this, the living part has been closed up tight and the operational safety is also high.

Moreover, metal housing is fitted with an indicator lamp "ON" and "OFF" and so constructed as to enable checking the operation count through a transparent inspection window.

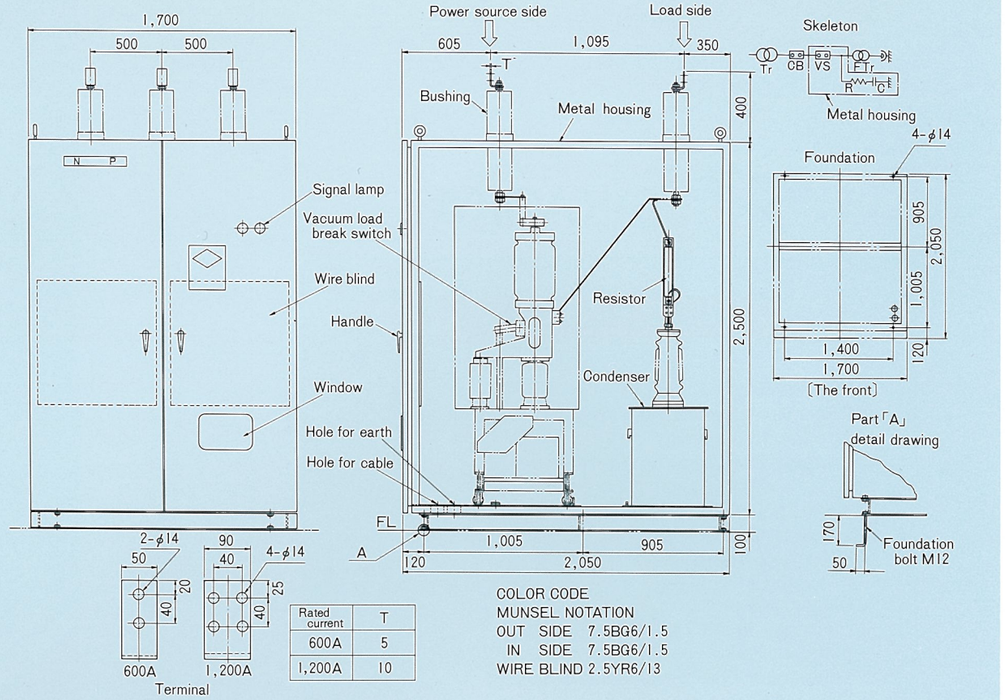


For 24kV 600A•1200A



For 24kV 2000A

stop of production



For 36kV 600A•1200A

5 INFORMATION FOR INQUIRY

① Type-form
② Rated voltage
③ Rated current
④ Rated frequency
⑤ Rated interrupting capacity (current)
⑥ Control voltage (DC 100 or AC 110V)
⑦ Color of exterior finish

TAKAOKA

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Furnace Transformers
On-Load Tap Changing Transformers
(Gas insulated, Oil immersed)
Distribution Transformers
Mobile Transformers
Mold Type Transformers

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Horizontal Break Type Disconnectors
Vertical Break Type Disconnectors
Pantograph Type Disconnectors
On Load Switches

Circuit Breakers:
Gas Circuit Breakers
Vacuum Circuit Breakers

Switchboards:
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Computerized Supervisory Remote Control Boards
Pad Mounted Distribution Boards

Instrument Transformers:
Oil-immersed Instrument Transformers
Mold Type Instrument Transformers

Gas Insulated Switchgears (GIS)

Electric Power System Control

Distribution System

Water Supply and Treatment System

Computer System

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TAKAOKA ELECTRIC MFG. CO., LTD.

Head office: New Ohtemachi Bldg., No. 2-1 Ohtemachi 2-chome, Chiyoda-ku,
Tokyo 100, JAPAN
Tel.: +81-3-3211-1671
Telex No.: 222-2247 TEMCO J

INTERNATIONAL SALES DIVISION

KANDA BRANCH OFFICE
TONEN KANDA BLDG.
1-11. SARUGAKU-CHO 2-CHOME,
CHIYODA-KU, TOKYO 101, JAPAN

TEL. +81-3-3292-6591
FAX. +81-3-3292-6597
TELEX. 222-2247 TEMCO J

TA 0009-05