Type EVH1-12/T1250-31.5
High Voltage Vacuum Circuit Breaker
for Indoor Use

Instruction for
Installation and Operation

Z34.SM.06.01

Tianshui Changcheng Switchgear Factory
September, 2006
Warning: Read this instruction carefully before installing and operating this vacuum circuit breaker, incorrect installation and operation may cause quality reduction of the products or even cause personnel injuries.
1 General

Type EVH1-12/T1250-31.5 vacuum circuit breaker (called the product or the VCB) in the following) is an AC 50 Hz indoor switching device the rated voltage of which is up to and including 12 kV, it is suitable for controlling and protection of the electric equipments in industrial and mining enterprises, power plants, substations, and other fields. The product conforms to the following standard:

- GB1984-2003 High-Voltage Alternating-Current Circuit breakers;
- JB3855 Indoor High-Voltage Alternating-Current Vacuum Circuit breakers;
- DL403 Technical Specification of Indoor High-Voltage Alternating-Current Vacuum Circuit breakers of rated voltage 10~35 kV

The product can be used not only in the removable switchgears, but also in fixed switchgears. It is provided with the following advantages:

- Long life;
- Simple maintenance;
- No pollution to the environment;
- Without explosion;
- Low noise;
- Suitable to be used in the severe conditions, such as the condition in which the frequent operations are required.

2 Definitions

For the purpose of this Instruction, the following definitions as well as the definitions of IEC 60050(441), IEC 60050(151), IEC 60694, IEC 62271-100 apply.

2.1 VCB

Vacuum circuit breaker

2.2 Charge

The operation to elongate the closing springs for the purpose to provide the closing energy to the VCB.

2.3 VI

vacuum interrupter

2.4 Secondary plug

Connecting device used to connect the secondary circuit of the VCB with the secondary system of the switchgear, the removable one is called the secondary plug, the fixed one is called the secondary contactor.

2.5 Carrier chassis
A special part used to carry the VCB truck and move the truck inside the switchgear.

### 2.6 Truck operating device
An operating device used to move the truck inside the switchgear.

### 2.7 Truck operating table
A special transferring tool used to transfer the truck on the floor, push the truck into the switchgear and pull the truck out of the switchgear.

### 2.8 Middle position
Any position of the truck between the test position and the service position, it does not include the test position and the service position.

### 2.9 ES
Earthing switch.

### 2.10 Primary isolating contacts
The contacts used to connect the main circuit of the truck with the main circuit of the switchgear. The ones on the truck are called the movable isolating contacts, the ones in the switchgear are called the fixed isolating contacts.

### 3 Technical Data

#### 3.1 Main technical parameters of the VCB
The main technical parameters of the VCB are shown in the Table 1.

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Unit</th>
<th>Parameters</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Rated voltage</td>
<td>kV</td>
<td>12</td>
</tr>
<tr>
<td>2</td>
<td>Rated insulation level</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Power frequency withstand voltage within 1min (rms)</td>
<td>kV</td>
<td>42</td>
</tr>
<tr>
<td></td>
<td>Lightning impulse withstand voltage (peak)</td>
<td>kV</td>
<td>75</td>
</tr>
<tr>
<td>3</td>
<td>Rated current</td>
<td>A</td>
<td>1250</td>
</tr>
<tr>
<td>4</td>
<td>Rated short circuit breaking current</td>
<td></td>
<td>31.5</td>
</tr>
<tr>
<td>5</td>
<td>Rated short circuit making current (peak)</td>
<td>kA</td>
<td>100</td>
</tr>
<tr>
<td>6</td>
<td>Rated peak withstand current</td>
<td></td>
<td>100</td>
</tr>
<tr>
<td>7</td>
<td>Rated short time withstand current</td>
<td></td>
<td>31.5</td>
</tr>
<tr>
<td>8</td>
<td>Electric endurance</td>
<td>times</td>
<td>30</td>
</tr>
<tr>
<td>9</td>
<td>Rated short circuit duration</td>
<td>s</td>
<td>4</td>
</tr>
<tr>
<td>10</td>
<td>Rated operating sequence</td>
<td></td>
<td>O-0.3s-CO-180s-CO</td>
</tr>
<tr>
<td>11</td>
<td>Mechanical endurance</td>
<td>Times</td>
<td>20000</td>
</tr>
<tr>
<td>12</td>
<td>Rated single capacitor bank breaking current</td>
<td>A</td>
<td>630</td>
</tr>
<tr>
<td>13</td>
<td>Rated back-to-back capacitor bank breaking current</td>
<td>A</td>
<td>400</td>
</tr>
</tbody>
</table>

#### 3.2 The mechanical parameters of the products should conform to the values specified
in the Table 2 after the products having been adjusted.

Table 2

<table>
<thead>
<tr>
<th>No.</th>
<th>Items</th>
<th>Units</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Clearance between opened contacts</td>
<td>mm</td>
<td>8±1</td>
</tr>
<tr>
<td>2</td>
<td>Travel of the contacts</td>
<td>mm</td>
<td>3±0.5</td>
</tr>
<tr>
<td>3</td>
<td>Clearance between poles</td>
<td>mm</td>
<td>210±1.5</td>
</tr>
<tr>
<td>4</td>
<td>Bouncing time of closing contacts</td>
<td>ms</td>
<td>≤2</td>
</tr>
<tr>
<td>5</td>
<td>Opening simultaneity of three phases</td>
<td>ms</td>
<td>≤2</td>
</tr>
<tr>
<td>6</td>
<td>Opening time under Max. operating voltage</td>
<td>ms</td>
<td>30-50</td>
</tr>
<tr>
<td></td>
<td>Rated operating voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td></td>
<td>Min. operating voltage</td>
<td></td>
<td></td>
</tr>
<tr>
<td>7</td>
<td>Closing time</td>
<td>ms</td>
<td>35-75</td>
</tr>
<tr>
<td>8</td>
<td>Opening speed</td>
<td>m/s</td>
<td>1.4±0.2</td>
</tr>
<tr>
<td>9</td>
<td>Average closing speed</td>
<td>m/s</td>
<td>0.8±0.2</td>
</tr>
</tbody>
</table>

3.3 Resistance of the main circuit of the VCB

The resistance of the main circuit of the VCB is shown in the Table 3.

Table 3  The resistance of the main circuit of the VCB

<table>
<thead>
<tr>
<th>Name</th>
<th>Rated current</th>
<th>Unit</th>
<th>Value</th>
</tr>
</thead>
<tbody>
<tr>
<td>Resistance of the main circuit</td>
<td>630-1250A</td>
<td>μΩ</td>
<td>≤25</td>
</tr>
</tbody>
</table>

3.4 Charging motor

The permanent-magnet single-pole DC motors are used as the charging motors of the VCB. The technical data of the charging motors is shown in the Table 4.

Table 4  The technical data of the charging motors

<table>
<thead>
<tr>
<th>Rated voltage (V)</th>
<th>Rated input power (W)</th>
<th>Range of normal operating voltage (V)</th>
<th>Charging time (s)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DC220, DC110</td>
<td>75</td>
<td>85%~110% of the rated voltage</td>
<td>≤15</td>
</tr>
</tbody>
</table>

Note: The operating voltage can be supplied by both AC and DC power supply.

3.5 Technical data of the opening and closing coils.

The technical data of the opening and closing coils is shown in the Table 5.

Table 5  The technical data of the opening and closing coils

<table>
<thead>
<tr>
<th></th>
<th>Closing coils</th>
<th>Opening coils</th>
</tr>
</thead>
<tbody>
<tr>
<td>Rated operating voltage (V)</td>
<td>AC220, DC220</td>
<td>AC220, DC220</td>
</tr>
<tr>
<td>Current of the coils (A)</td>
<td>1.45</td>
<td>1.45</td>
</tr>
<tr>
<td>Range of normal operating voltage</td>
<td>85%~110% of the rated voltage</td>
<td>65%~120% of the rated voltage</td>
</tr>
</tbody>
</table>
3.6 Technical data of the auxiliary switches

The technical data of the auxiliary switches is shown in the Table 6.

<table>
<thead>
<tr>
<th>Names</th>
<th>Type</th>
<th>Specification</th>
<th>Usage</th>
</tr>
</thead>
<tbody>
<tr>
<td>Microswitch S1</td>
<td>CSK1</td>
<td>AC11 3A/380V</td>
<td>position switch for charging</td>
</tr>
<tr>
<td>Auxiliary switch S2</td>
<td>F10-16C</td>
<td>AC 10A/380V</td>
<td>Auxiliary for the main contacts of the VCB</td>
</tr>
<tr>
<td>Auxiliary switch SW, YW</td>
<td>FK-41/Y.H</td>
<td>AC 10A/660V</td>
<td>Position switch for test position and service position</td>
</tr>
</tbody>
</table>

4 Requirements on Service Condition

1) The ambient temperature should not be greater than +40℃ (upper limit) and not less than -15℃ (lower limit).
2) The elevation for the products to be installed should not be greater than 1000m. The daily average value of the relative humidity should not be greater than 95%, the monthly average value of the one should not be greater than 90%.
3) The daily average value of the saturation vapor pressure should not be greater than 2.2×10⁻³ MPa, the monthly average of the one should not be greater than 1.8×10⁻³ MPa.
4) The service site should be free from frequent heavy vibration.
5) The ambient air should not be obviously polluted by corrosive gas, flammable gas and water vapor.
6) The service site should be dry and clean.

5 Structure and Operating Principle

5.1 Structure

5.1.1 General layout

The operating device and the vacuum interrupters (VI) of the product are respectively located in the front and rear side of a common frame of the VCB. Such structure which is called integrated layout can make the operating characteristic of the operating device fit the opening and closing characteristic of the VIs. Thereby, the unnecessary intermediate driving sections can be cut down, the energy consumption and the noise can be reduced, The operation of the VCB becomes more reliable. The product can be used not only in the removable switchgears, but also in fixed switchgears.

5.1.1.1 The main circuits of the VCB are embedded in the solid-insulated poles. The VIs of the VCB are embedded in the insulation tubes (embedded poles). The insulation tubes are cast with the epoxy resin by APG technology. This kind of structure not only can prevent the
VIs from being damaged by the external factors, but also can ensure that high resistance characteristic can be provided against voltage effect under hot wet condition and heavy pollution.

5.1.1.2 The operating device employs independent spring charging method. It is provided manual and motor charging function. The operating device is located in the box of operating device in front of the VIs.

5.1.2 Overall dimension of the VCB

The Overall dimension of the VCB is shown in the Figure 1.

![Figure 1](image)

**Figure 1** The Overall dimension and fitting size of the VCB

5.2 Operating principle

5.2.1 VIs

The Siemens ceramic housing VIs which employs the news technologies are used in the VCB. These VIs select Cu-Cr contacts with cup-shaped axial magnetic field structure, and are provided with the with the following advantages:

- Less amount of wear;
- Long electric life;
- Stable insulation strength of the medium;
- High-speed recovery of insulation strength after arcing;
- Low cut-off current;
- High breaking capacity.

The VIs can meet the following requirements:

- The gas pressure inside the VIs is less than $1.33 \times 10^{-3}$ Pa;
- The normal storing time is at least 20 years;
- The mechanical endurance of the VIs is not less than the one of the VCB.

5.2.2 Arc-extinguishing principle
When it is necessary for the VCB to be opened, the movable contacts can be driven to separate from the fixed contacts by the operating device with load, and the vacuum arc can appear between the contacts. Due to the special structure of the contacts, the axial magnetic field between the contacts can make the arc holding in diffusing mode, as well as make the arc distributing and burning evenly on the surface of the contacts. The arc voltage is held in low level. When the current zero comes, the residual ions, electrons and metallic vapours can recombine and agglomerate on the surface of the contracts and the shields. Thereby, the insulation strength of the medium between the opened gap of the VI can recover in high speed, the arc can be extinguished, and the breaking purpose can be realized. Because the vacuum arc is controlled by the axial magnetic field structure, the VI is provided with stable and high breaking capacity.

5.2.3 Operating principle (shown in Figure 2)

5.2.3.1 Charging operation (shown in Figure 2)

The charging motor (No.1 of the Figure 2) or manual charging operation can drive the gear pair (No.2 of the Figure 2) to rotate, this operation can drive the sprocket wheel (No.5 of the Figure 2) to rotate through the chain (No.4 of the Figure 2), thereby, the cranks for hanging the springs (No.6 of the Figure 2) can be driven to rotate in clockwise direction to elongate the closing springs, the charging purpose can be realized. When the closing springs have been elongated to the specified length, the detents for holding the charged condition and the contact roller can hold the closing springs in the charged position. And the indicator can give out “charged” indication.

5.2.3.2 Opening and closing operation

1) Closing operation

After the charging operation being finished, The detents for holding the charged condition and the contact roller can be released by the manual closing button being pushed down or by the operation of the closing electromagnet, then the closing springs can be released to drive the closing cam to rotate in clockwise direction, thereby, the movable contacts of the VI can be driven to move upwards by the driving device and insulation rods, and the closing operation can be finished.

2) Opening operation

After the closing operation being finished, the locking between the opening semi
axles and the tripping devices for opening can be released by the manual opening button being pushed down to drive the tripping plate to rotate for the purpose to drive the opening semi axles to rotate in clockwise direction. Then, the movable contacts of the VIs can be driven to move downwards by the opening springs and the dished springs in the insulation rods, and the closing operation can be finished.

5.3 Operating device

5.3.1 Feature of the operating device

5.3.1.1 The operating device which stores the energy in the springs is located in the front side of the VCB. After being assembled, the operating device can be mounted in the frame of the VCB. The charging parts, closing parts and opening parts are located between two clamping plates. The operating device is provided with simple assembling, greatly reduced quantity of parts and elements and high reliability.

5.3.2 Closing unit

5.3.2.1 The main part of the closing functional unit of the operating device is the spring-charging device. The one end of the charging shaft is the crank for hanging the closing spring, another end of the charging shaft is connected with the freewheeling clutch and the driving cam. The charging motor connected with the charging shaft and the closing coil can elongate the closing spring to store the closing energy through the gear pair, chain and chain wheels. During closing, the closing spring can drive the cam and the driving devices to carry out the closing operation.

5.3.3 Opening unit

5.3.3.1 The main part of the opening functional unit is a closing holding device which can hold the VCB in the closed position. The one end of the closing holding device is correlated to the main driving shaft for the purpose of holding the VCB in the closed position reliably. The other end of the closing holding device is a tripping device. The tripping device can release the closing holding device when it is necessary to open the VCB, then, the opening operation can be finished.

5.3.4 Driving part

5.3.4.1 The driving part can carry out driving operation between the VIs and the operating device. It includes main driving shaft, driving device, operating springs, opening buffers, and others. The driving part can transfer the driving output of the operating device of the VCB to the movable contacts of the VIs under the specified mechanical parameters.

5.3.5 Auxiliary unit

5.3.5.1 This unit includes opening/closing electromagnets, auxiliary switches, secondary wires terminal, and others. It can finish the necessary connection between the VCB and the external equipments.

5.4 Inner electric connection of the VCB

5.4.1 Secondary electric diagram

The Figure 2 shows the basic secondary electric diagram for reference. The detailed
secondary electric diagram should be dependent on the one provided by the users.

<table>
<thead>
<tr>
<th>No.</th>
<th>Symbols</th>
<th>Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>S1</td>
<td>Microswitch for charging</td>
</tr>
<tr>
<td>2</td>
<td>S2</td>
<td>Auxiliary switch linked with the main shaft of the VCB</td>
</tr>
<tr>
<td>3</td>
<td>V1～V3</td>
<td>Rectifying elements</td>
</tr>
<tr>
<td>4</td>
<td>HQ</td>
<td>Closing electromagnet</td>
</tr>
<tr>
<td>5</td>
<td>TQ</td>
<td>Opening electromagnet</td>
</tr>
<tr>
<td>6</td>
<td>M</td>
<td>Charging motor</td>
</tr>
<tr>
<td>7</td>
<td>SW</td>
<td>Position switch (test position)</td>
</tr>
<tr>
<td>8</td>
<td>YW</td>
<td>Position switch (service position)</td>
</tr>
<tr>
<td>9</td>
<td>K0</td>
<td>Relay for preventing incorrect opening</td>
</tr>
<tr>
<td>10</td>
<td>Y1～Y3</td>
<td>Over-current release electromagnet</td>
</tr>
</tbody>
</table>

![Diagram](image)

Figure 3

5.4.2 Auxiliary switches, wiring terminals and inner secondary electric connection

F10 auxiliary switch is selected as the auxiliary switch of the VCB. Normally, 8 pairs of make contacts (IEV441-15-12) and 8 pairs of break contacts (IEV441-15-1s) can be provided. The auxiliary contacts can be increased at most to 12 pairs of make contacts (IEV441-15-12) and 12 pairs of break contacts (IEV441-15-1s) in accordance with the requirements from users.

The uninterrupted service current of the auxiliary switch is 10A, the breaking current of the auxiliary switch is 10 A under AC 220V, and 2 A under DC 220V.

The inner wires of the VCB can be led to the wiring terminals or the secondary plug in accordance with the usage. The VCB can be connected with the external electric system by the wiring terminals or the secondary plug.

6 Transportation

6.1 Transportation of the package box

1) The package of the products should be moistureproof and shockproof
2) The package boxes should be loaded and unloaded with special lifting equipments.
3) The package boxes should prevent from being heavily struck or being destructively oppressed during transportation.

6.2 Unpacking the package box
1) The VCB should stand in the normal state before being unpacked. It should not be placed with bottom upwards or side upwards.
2) The VCB should be unpacked in indoor condition to prevent it from being influenced by rain, wind and sands.
3) During the package box being unpacked, the VCB is not permitted to be shocked. Otherwise, the front plat or insulation parts may be damaged, or the VIs may be damaged.
4) The attached documents and accessories should be stored correctly.

6.3 Indoor transportation
The VCBs should be transported by the perfect equipment, lifted by the perfect lifting device. It is not permitted to drag the VCBs on the working station or even on the ground.

7 Installation

7.1 Check before installation
1) After the VCBs being unpacked, it should be checked whether the VCB is damaged, whether the nameplate and the quality certificate conform to the purchase order, and whether the goods conform to the packing list.
2) Clean the dust and dirt on the surface on the VCBs, and check the gas pressure in the VIs by testing the power frequency withstand voltage of the VCB (open the VCB and apply the rated power frequency withstand voltage(42 kV) across the opened gaps of the VI).
3) Check the connection of the primary circuits, the connection of the secondary circuits, and the earthing connection.
4) Charge with the charging handle, then, carry out manual closing and opening operation, check whether the operations are correct, and whether the related indications of the VCB are correct.

7.2 Installation

7.2.1 Installation of the VCB
When it is necessary to install the VCB, Lift the VCB up by the perfect lifting device smoothly, and aim the installing hole on the installing plate at the installing framework. Then calibrate the position of the VCB in accordance with the design requirement. Finally, mount the VCB on the installing framework with M12 bolts. The the tightening torque should not be less than 50N • m.
7.2.2 Connection of the terminals of the main circuit

The electric connection of the main circuit of the VCB should conform to the relative provisions. Each phase of the VCB is provided with upper outgoing terminal and lower outgoing terminal for the users to connect the main circuit. Each outgoing terminal should be connected with the bolts and tightening torque specified in Table 7.

<table>
<thead>
<tr>
<th>Rated current of main the circuit</th>
<th>Specification of the Bolts</th>
<th>Class of the bolts</th>
<th>Quantity of bolts</th>
<th>Tightening torque</th>
</tr>
</thead>
<tbody>
<tr>
<td>630A～1250A</td>
<td>M10</td>
<td>8.8 Class</td>
<td>4</td>
<td>30N • m</td>
</tr>
<tr>
<td></td>
<td>M12</td>
<td></td>
<td>1</td>
<td>50N • m</td>
</tr>
</tbody>
</table>

7.2.3 Connection of the terminals of the secondary circuit

The secondary circuit of the VCB is connected with the external electric system by the secondary plug JZ-58. This secondary plug take use of plug-in method to connect the wire. In order to obtain reliable secondary connection, the wiring regulation of JZ-58 plug should be followed, and the special wiring tools should be used.

8 Check

8.1 Check on fasteners

The fasteners inside the VCB have been completely checked by the manufacturer. The check on the fasteners after installation should be done on the connecting position between the VCB and the external system. The loosing fasteners, if any, should be tighten up.

8.2 Check on operation

This check should mainly refer to the charging, closing and opening operation of the VCB. The check should be carried out with the main circuit being dead.

Before checking, the indications of the indicating devices on the front plate of the VCB should be in the correct position, the closing spring should be in the uncharged position, and the main circuit should be in the opened state. The check on operation of the VCB is shown as the following:

1) Charging operation

**Manual charging** : Insert the special charging handle into the manual charging hole (No. 2 of Figure 4) and operate the manual charging handle in up and down direction for about 40 times, until the charging indicating device gives out “charged” indication, which can be observed through the inspection window for charging indication (No. 5 of Figure 4).

**Motor charging** : After the motor being electrifed, the VCB can be charged automatically, and the charging motor can be automatically opened after the charging operation being finished.
2) Closing and opening operation

**Closing operation**: operate the manual closing button (No. 7 of Figure 4) or the electric controlling elements.

**Opening operation**: operate the manual opening button (No. 3 of Figure 4) or the electric controlling elements.

The counter (No.4 of Figure 4) will automatically count a number after every time of opening operation, the result of the counter can be observed through the inspection window on the front plate.

![Figure 3](image)

**Figure 3**


3) Check on cooperation when the VCB truck being equipped with KYN28A or KYN79 switchgears

The carrier chassis is in the lower of the VCB truck. The VCB is mounted on the carrier chassis. The truck operating device which can be used to move the truck in the switchgear is located in the carrier chassis. The interlocking device between the truck and the switchgear is also designed in the carrier chassis.

4) Check on truck operation

The truck is designed in middle-located structure. The truck can be conveniently pushed in or pulled out the switchgear with a special truck operating table. The truck
has 3 positions inside the switchgear---the service position, the test position and the middle position. When it is necessary to move the truck from the test position to the service position, rotate the operating handle in clockwise direction; When it is necessary to move the truck from the service position to the test position or even out of the switchgear, rotate the operating handle in counter clockwise direction

8.2.1.1 Check whether the interlocking between the earthing switch (ES) and the VCB is correct, whether these operations are reliable.

When the ES is in the closed position, the VCB truck should not be able to be moved from the test position to the service position;

When the VCB truck is in the service position, the ES should not be able to be closed.

When the VCB truck is in the test position or removed out of the switchgear, the ES should be able to be operated normally.

8.2.1.2 Check on the interlocking: the truck can not be operated when the VCB is in the closed position

When the VCB is closed and the truck is in the test position or the service position, The interlocking parts on the VCB can lock the lead screws on the carrier chassis, the truck can not be moved. The truck can be moved only when the VCB has been opened.

8.2.1.3 Check on the interlocking: the VCB can not be closed when the truck is in the middle position.

When the truck is in the middle position, the interlocking device covers the closing semi axle, the VCB can not be opened.

8.3 Check on the resistance of the main circuit

The resistance of the main circuit of the 3 poles of the VCB should be measured respectively.

The voltage-drop method is recommended for such measurement. The detailed procedure is: apply 100A DC current from the lower outgoing terminal of a pole to the main circuit of the pole, then measure the voltage drop form the upper outgoing terminal to the lower outgoing terminal of the applied pole. The resistance of this pole can be calculated. The measuring time should not be too long, otherwise, the correctness of the measured value may be influenced.

It is always not accurate to measure the resistance of the main circuit with the bridge method.

8.4 Check on insulation level

Measure the power frequency withstand voltage (within short duration) of primary and secondary circuit of the VCB according to the relative installation specification.

9 Operation
9.1 Manual operation

Generally, the manual operation mentioned here is only suitable for adjusting, inspecting and testing the VCB without load. The VCB is provided with the following manual operation: manual charging, manual closing and manual opening.

**Manual charging**: Insert the special charging handle into the manual charging hole and operate the manual charging handle in up and down direction until the charging indicator gives out “charged” indication, which can be observed through the inspection window for charging indication.

**Manual closing**: Push down the manual closing button on the front plate of the VCB.

**Manual opening**: Push down the manual opening button on the front plate of the VCB.

Special provision is provided to the manual operation in special condition. Such as:

- The manual charging of the closing spring can be carried out when the secondary circuit has not been provided with power supply;
- The manual opening function can help the operators to directly open the VCB manually in the emergent case;
- The manual closing can only be operated when the main circuit is dead, it is not permitted to carry out manual closing when the main circuit is live.

9.2 Motor charging

The electric diagram for motor charging of the VCB is shown in Figure 3.

When the VCB is in the service position (no matter whether the main circuit of the VCB is living), the charging motor will automatically be provided with power and tension the closing spring to carry out charging. When the closing spring has been charged to the specified position, the charging position switch of the VCB will open the electric circuit of the motor.

9.3 Electric closing operation

The electric diagram of the electric closing operation is shown in Figure 3.

The operators can close the closing electromagnet to close the VCB by closing the electric contacts (such as electric button) in the closing circuit of the VCB.

9.4 Electric opening operation

The electric diagram of the electric opening operation is shown in Figure 3.

The VCB is provided with 2 kinds of electric opening method: opening electromagnet (supplied by the independent power supply) dependent electric opening and over-current release dependent opening.

9.4.1 Opening electromagnet (supplied by the independent power supply)dependent electric opening
The operators can close the coil of the opening electromagnet (supplied by the independent power supply) to open the VCB by operating the electric contacts (such as electric button) in the opening circuit.

9.4.2 Over-current release dependent opening

The coils of the over-current release of the VCB are connected in the electric circuit which is connected with the secondary side of the current transformers. When the VCB is running normally, the coils of the over-current release of the VCB are shortly connected by the break contacts (IEV441-15-13) of the over-current relay, thereby, the current of the secondary circuit of the current transformer will not flow across them. When faults appear in the main circuit, the over-current relay will operate, its break contacts (IEV441-15-13) will be opened, the current of the secondary circuit of the current transformer will flow across the coils of the over-current of the VCB to drive the over-current release to open the VCB.

9.5 Interlocking

Interlocking of the VCB truck includes the electric interlocking and mechanical interlocking.

9.5.1 Electric interlocking

9.5.1.1 Interlocking between the status of the charging springs of the VCB and the electric circuit of the coils of the closing electromagnet

When the charging springs have not been elongated to the specified length, the electric circuit of the coils of the closing electromagnet cannot be closed.

9.5.1.2 Interlocking between the state of the main circuit of the VCB and the electric circuit of the coil of the closing electromagnet

This interlocking function can ensure that electric circuit of the coil of the closing electromagnet can not be closed when the VCB has been closed.

9.5.1.3 Interlocking between the state of the main circuit of the VCB and the electric circuit of the coil of the opening electromagnet

This interlocking function can ensure that electric circuit of the coil of the opening electromagnet can not be closed when the VCB has been opened.

9.5.2 Mechanical interlocking

9.5.2.1 Interlocking which can prevent the truck from being moved when the VCB is in the closed position.

When the VCB is in the closed position, the lead screws on the carrier chassis is blocked by the four-bar mechanism connected with the closing shaft, the truck operating handle can not be rotated. The truck can be operated only when the VCB has been opened.

9.5.2.2 Interlocking which can prevent the VCB from being closed when the truck is in the middle position.
When the truck is in the middle position, the closing detent can be locked by the interlocking device, the manual closing is forbidden.

9.6 Emergent opening operation

When ever the VCB is in the closed position, emergent opening operation can be done in fault condition by the manual opening button.

10 Maintenance

10.1 Regular check

After being put into use, the VCB should be checked periodically in accordance with the relative regulations. The Check should be done when the main circuit is dead. The checking items is specified in chapter 8.

10.2 Sweeping and cleaning

After being put into use, the VCB should be swept periodically so as to ensure that the surface of the insulation parts and the conducting parts is clear. The primary and secondary circuit of the VCB should be dead during the VCB being swept.

10.3 Lubrication

10.3.1 The relative position of the VCB should be periodically lubricated with the primary and secondary circuit of the VCB being dead.

10.3.2 The positions necessary to be lubricated

1) All driving positions (including the operating device) of the VCB should be applied with No. 3# white special greases;

2) The driving parts concerned with the installation of the VCB(such as driving parts of the interlocking device between the VCB and the switchgear when the VCB is used in the removable switchgear).

10.3.3 The contacting position of the primary isolating contacts should be periodically swept and applied with new Vaseline oil when the VCB is used in the removable switchgear.

10.4 Notice for maintenance

1) Before being put into use, the VCB should be carefully checked whether the rated voltage and current of each operating component conform with the actual value; and charging, opening and closing operation should be tested to check whether the operation is correct.

2) During the VCB is running, the gas pressure in the VIs should be regularly examined by the means of measuring the power frequency withstand voltage. The particular method is: Open the VCB, and apply 42kV power frequency voltage for 1 minute across the opened gap of the VIs. If continuous breakdown appears inside certain VI, it ought be replaced.
3) The VCB in normal condition should be maintained, it is necessary to clear out the dust from the surface of the insulation parts and regularly lubricate the friction surfaces.

4) It is not permitted to strike the enclosure of the VIs with hard objects during installation and operation.

5) Users shouldn’t use the electric components the type and specification of which do not conform with the original ones.

6) It is necessary for the operators to preliminarily grasp the knowledge of the structure, feature, installation, adjustment and maintenance of the operating device, and to record the problems appearing during the circuit breaker running, and notice the manufacturer if necessary.

11 Documents Attached with the Products

1) Certificate;

2) Instruction for installation and operation;

3) Secondary control diagram;

4) Packaging list.

12 Accessories Attached with the Products

1) One truck operating handle;

2) One charging handle;

13 Information required when Ordering

The following information should be provided when ordering:

1) Type, name and quantity of the VCB;

2) Rated voltage, rated current and rated short-circuit breaking current of the VCB;

3) Rated operating voltage;

4) The name and quantity of spare parts and components;

5) The special requirements of the users, if any, should be explained when ordering.