ZM 有载分接开关

On-Load Tap-Changer Type ZVMD

使用说明书

Operating Instructions

贵州长征电气有限公司

GUIZHOU CHANGZHENG ELECTRIC CO., LTD.

Welcome to Use Guizhou Changzheng OLTC

Please read this instruction carefully before you operate the purchased on load tap changer. Be sure to pay attention to the following matters:

1. Check and accept the products according to the packing list when receiving products. Keep the evidence if there are any damages during transportation in order to claim compensation from the responsible party and protect your rights.
2. The tap changer only can be used with the transformer which specified in the order. You need to consult with our company in advance if you want to change the purpose of this product.
3. The installation, put into operation, maintenance and repair of the product should be complied with the operating instruction and relevant provisions of security.

The figures, charts, and other data in this manual may differ from the products delivered. These drawings are for reference only and we reserve the right to make changes. If there is any change, no further notice.

Give the word of “Warning” when ignoring a requirement will cause the life damage of operator. This is a warning of danger to life and health, disregarding this warning can lead to the serious or fatal injury.

Give the word of “Careful” when ignoring a requirement will lead to the damage to the equipment. This information indicates particular danger to this device or other equipment of the user, but the serious or fatal injury can’t be excluded.

In order to emphasize at any time, the word of “Caution” will be used, remind it should be careful when operating according to the requirements of “Warning” and “Caution”.

These are additional explanations for a certain subject.

Content

Note

All data in this manual may be different in details from the tap-changer that we delivered. We reserve the right to change without notice.

June, 2018

1. General introduction

ZM on load tap changer applies to the electrical transformer or industrial transformer with the rated voltage 35-220kV, max. rated through current three-phase 300-600A, single-phase 300-1500A, the frequency is 50Hz or 60Hz under the situation of load to change the taps in order to achieve the purpose of voltage regulation.

ZM on load tap changer is combined type tap changer of embedded type and with resistance transition, it consists of diverter switch and tap selector.

The technical function of ZM on load tap changer meets to the requirement of GB/T10230.1-2007 <Tap changer section 1: Performance requirements and test methods>, IEC60214-1:2003 <Tap changer section 1: performance requirement and test methods>.

WARNING

Only use the on load tap changer with the transformer specified in the order.

The installation, electrical connection and commissioning of the on load tap changer must be carried out by qualified and skilled personnel according to these operating instructions.

Any unauthorized modification and alteration of the tap changer is forbidden without first consulting Changzheng.

In the process of installation, electrical connection and commissioning of on load tap changer, if didn't operate according to this instruction, it may causes the faults of tap changer and transformer and even leads to personal injury and equipment damage.

These operating instructions apply to the ZM on load tap changer that designed according to the follow models, they can be equipped with or without change-over selector:

Three-phase tap changer Y connection:

ZMIII300， ZMIII500， ZMIII600

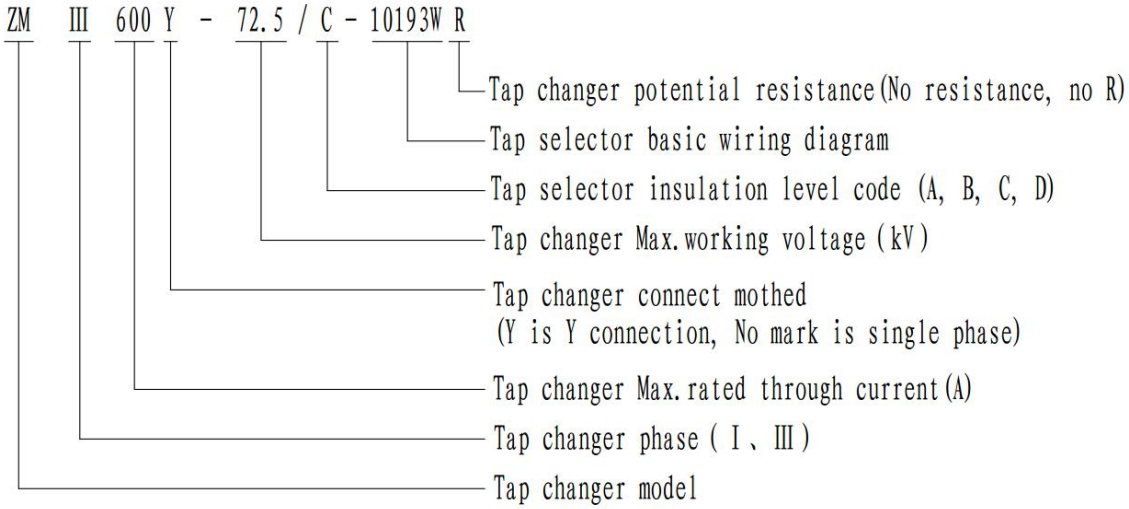
Single-phase tap changer:

ZMI301， ZMI501， ZMI601,

ZMI800， ZMI1200， ZMI1500.

All single-phase tap changer can be provided according to three-phase group 3×ZMI, equip with a common use motor drive unit. Under the special situation, every tap changer can equip with a motor drive unit to achieve the voltage regulation at the same time by parallel controller, each tap changer carries out the voltage regulation separately while not using parallel controller.

1.1 Model representation



Note:

① OLTC connection mode: Y is Y connection, no mark is single phase.

② Tap selector insulation level number indicates: tap selector is divided into 4 different insulation levels, respectively denoted by A, B, C, D

③ The basic wiring diagram is as follows:

10 19 3 W

10 ----- Number of contacts per circumferential distribution of tap selector.
19 ----- Number of Max.working tap position.
3 ----- Middle position: 3 kind, 0,1,3
W ----- Change-over selector:
W for Reversing regulating, G for coarse and fine regulating

④ Tap changer potential resistance, R is provide potential resistance (No potential resistance , no mark R).

1.2 Environmental Conditions

1.2.1 The oil temperature is not higher than +100° C and not lower than -25° C.
1.2.2 The ambient air temperature is not higher than +40° C and not lower than -25° C.
1.2.3 The inclination of the mounting plane and the vertical plane does not exceed 2%.
1.2.4 The installation site is free of serious dust and other explosive and corrosive gases.

1.3 Basic parameters

1.3.1 The main parameters of the switch are shown in Appendix 1 and Appendix 2, and the overall installation layout of the switch is shown in Appendix 3.
1.3.2 The contact resistance of each single contact of the contact is not more than 500 μ Ω.
1.3.3 On-load tap-changer Under 1.2 times the maximum rated passing current, the temperature rise of each long-term current-carrying contact and conductive part does not exceed 20K.

2. product structure

ZM on load tap changer consists of diverter switch and the tap selector (Fig 1).

Figure 1

2.1 Diverter switch

Diverter switch (Fig 2) consists of diverter switch body (Fig 2a) and diverter switch oil compartment (Fig 2b).

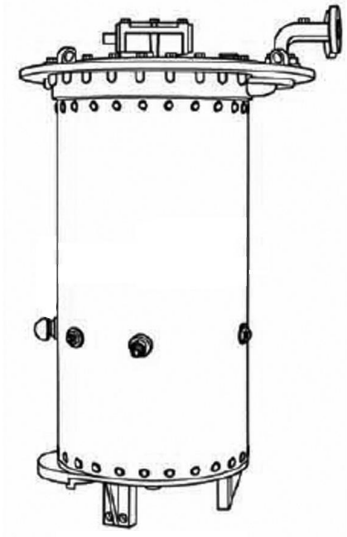


Figure 2

Figure 2a

Figure 2b

2.1.1 Diverter switch body consists of insulation shaft (Fig 3), energy storage unit (Fig 4), diverter unit(contacts system)(Fig 5) and transition resistance (Fig 6).

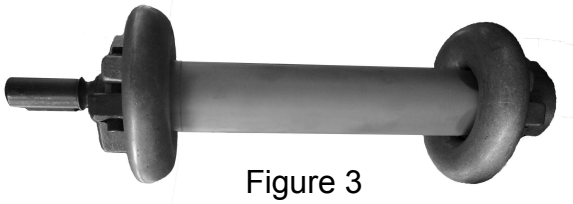


Figure 3

(1) Insulation shaft

Insulation shaft consists of epoxy glass strengthened tube, grading ring, weak link and shaft pins. It isn't only the drive shaft to drive diverter switch & tap selector operating; but also the main insulation of the switch to bear the grounding voltage withstand of the switch. And it will protect the switch by the preset fractured part.

(2) Energy storage mechanism

The operation of diverter switch is achieved by the energy storage chanism. Energy storage mechanism adopts gunlock release principle and it consists of upper and lower slide with eccentric wheel operation, energy storage compression spring, lead rail, claw, cam plate, pedestal bracket and so on.

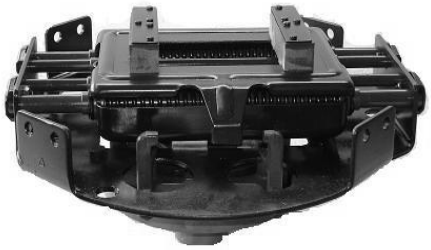


Figure 4

The compression spring is mounted on the lead rail between the upper and lower slides, the claw controlled by the lower slide side wall locks the cam plate to keep the lower slide on the original position, when the upper slide is drove by eccentric wheel to move along the lead rail, the spring compress the storage energy, once the upper slide side wall moves the corresponding claw away from the locked cam plate, the moving of lower slide transfer the turning force to the sleeve shaft of the cam plate to make the diverter switch change the action.

(3) Switching mechanism

The contacts system of diverter switch adopts "double resistance transition" and parallel double fracture "tail thrust compensation" open type contacting, it includes fixed contacts and moving contacts system, the specific mechanism as shown in Fig 5.

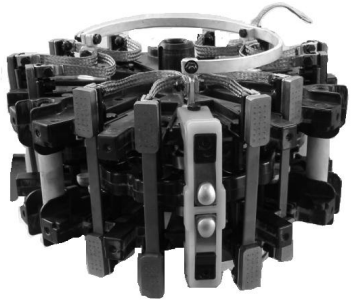


Figure 5

Contacts system is a part, the inside of a part of moving contact of Y connection three-phase tap changer is star connection, three parts of moving contact system among the single phase tap changer is connected as parallel.

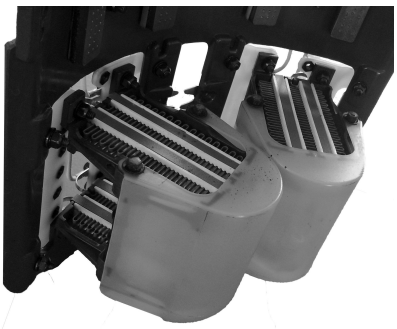
Every part has two pair of main switching contacts and two pair of transition contacts, the transition contacts connect to the transition resistor, the main switching contact is made of copper tungsten alloy in order to improve the

electrical life of contacts, the moving contact is mounted in the guide groove between the upper and lower guide plate that is mould by the insulation material and driven by the change-over fan type parts, it also installs a "horn type" parallel main contact to keep the contacting of the tap changer long term operation is good, the fixed contacts are separated by the arcing chamber each other and they are placed above the insulation arc type board.

When the switching mechanism is operated, the moving contact is controlled by the change-over fan type part to perform the liner contact motion along the guide groove of the guide plate, it carries out the switching operation according to the change-over procedure with the fixed contacts that arranged in the inside wall of the arc shape plate. The fan shape tail part equips with a compensating spring in order to ensure the4 change-over program is not confuse after the burning loss of the contact.

(4) Transition resistor

The transition resistor is winded as a convolute shape by the nichrome of high heat resistance, it is separated from each other by the ceramic clamping piece and installed in the insulation frame and connect with the transition contact of diverter switch body. The cooling of oil medium makes the heat effect of transition resistance low.



2.1.2 Diverter switch oil compartment consists of tap changer head, insulation cylinder and cylinder bottom.

(1) Tap changer head

Tap changer head consists of head flange, head cover, head worm gear pair mechanism, blasting cap, oil compartment observation window, oil overflow bleed screw and so on parts.

The tap changer head flange equips with four connection flange, three of them equip with bending pipe. Bending pipe R connects with oil conservator through gas relay. Bending pipe S connects with the oil pumping tube inside of the tap changer, oil pumping tube reaches into the bottom of the oil compartment to suck the oil. Q is used for oil filtering to send the oil back to oil compartment after filtering, E2 is used for transformer oil bleeding.

The head cover can be equipped with or without pressure release valve (Fig 7a, b). The one with pressure release valve is special design, its connection method should be carried out ccording to Fig 8.

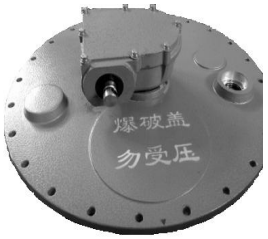


Figure 7a

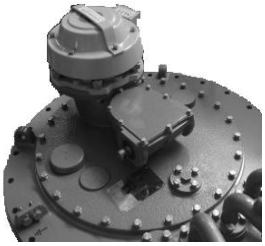


Figure 7b

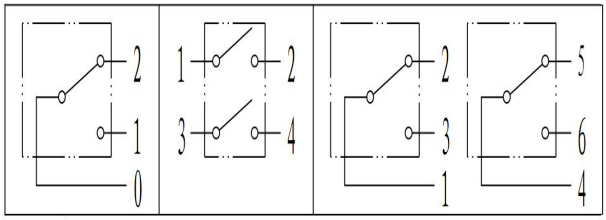


Figure 8

Tap changer is mounted on the transformer oil tank cover with the help of tap changer head. The head cover uses O ring to seal. The head gear can turn according to the mounting position.

(2) Insulation cylinder

Insulation cylinder is a epoxy glass winding cylinder, its upper part connects with tap changer head, the lower part connects with cylinder bottom. The insulation cylinder, tap changer head and cylinder bottom is jointed together by rivet, the tap selector is mounted at the bottom of the insulation cylinder.

(3) Cylinder bottom

The cylinder bottom is precise casted from cast aluminum alloy, on the above there is a drive shaft cross through the cylinder bottom, the upper connector of the shaft connects with the diverter switch body, the lower end of the shaft drives with the tap selector via cylinder bottom gear device.

The cylinder bottom is provided with a tap position indication self-locking mechanism, when diverter switch body lifts insert, the position indication transmission mechanism is self-locking in case the tap position is in disorder.

2.2 Tap selector

Tap selector consists of progressive mechanism and contacting system, tap selector can be equipped with or without change-over selector (Fig 9).

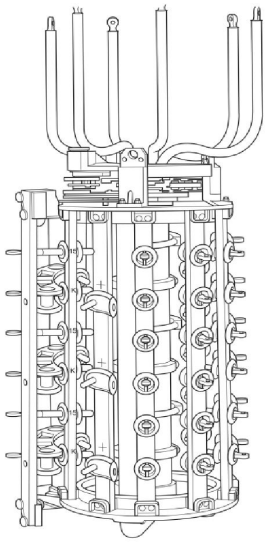


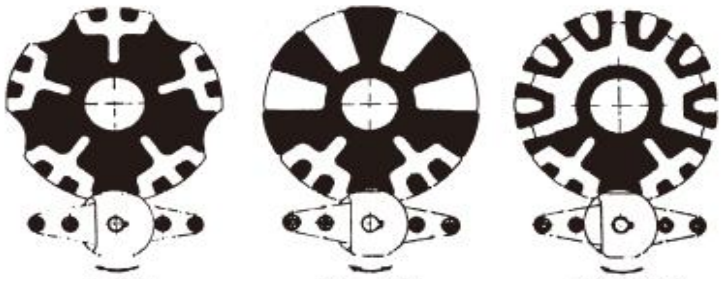
Figure 9

2.2.1 Progressive mechanism

It is the progressive drive device (Fig 10) that consists of two grooved wheels and a slotware. When the device performs every tap change operation, the slotware rotate half circle, then convert to progressive motion of anomalous 72° or smaller than 72° . Thus moves tap selector bridge type contact from one connection terminal to another connection terminal, two slotwares are alternating intermittent work.

The coupler on the slotware drive shaft of progressive grooved wheel mechanism and the coupler of the cylinder bottom gear is sliding type coupling, when the tap change direction is opposite, the transmission of motor drive unit only makes the diverter switch change the action and don’t make the tap selector action.

The mechanical positioning pin of progressive slotware mechanism prevents the tap selector exceeding the head position and end position.



9±9 step　　11±11 step　　15±15 step

Figure 10

2.2.2 Contacting system

The contacting system of tap selector adopts sleeve shaft structure of cage type “outside sleeve inside leading”, it consists of the centre insulation cylinder with contacting ring, insulation cylinder with fixed contact, drive pipe, bridge type contact of bow type parts, upper and lower flange and so on.

Insulation bar is arranged under the circle of upper and lower flange, the bar equips with odd number and even number fixed contacts and “orange type” shield case in order to make the surface electric field well-distributed, the fixed contacts connect with contacting ring of center insulation cylinder via bridge type contact, the connecting wire of contacting ring is led out from the inside of center insulation cylinder and connect with the diverter switch.

Tap selector bridge type contact adopts upper and lower clamp type structure of curving into epsilon-type, through the drive pipe, driven by progressive mechanism and rotates along the conductive ring of center insulation cylinder so as to select the taps of insulation cylinder, the two main springs of bridging type contacts clasp on the moving contact tightly, therefore it always keeps 4 points contacting, see Fig 11, and can achieve the effect of automatic adjusting and effective cooling.

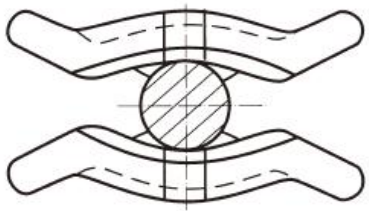


Figure 5

2.2.3 Change-over selector

Change-over selector includes reversing change-over selector and coarse change-over selector.

Reversing change-over selector applies to reversal regulating, it is a simple and compact device. The center fixed contact of reversing change-over selector is also the contact of tap selector, the insulation rod of the other two reversing

change-over selector fixed contacts connect to the circumference of upper and lower flange of tap selector. Coarse change-over selector applies to coarse fine regulation, the fixed contact bar of coarse change-over selector is set up on the two cantilevers, these two cantilevers are on the pedestal between the upper and lower flange.

The change-over selector is operated by the lower grooved wheel of the progressive mechanism.

2.3 Moto Driver unit and Its Controllers, Other Components

2.3.1 Motor Mechanism and Its Controller

For details of the motor-drive unit, please read the corresponding instruction manual in the attachment.

2.3.2 Other accessories

The connection of the ZM on-load tap-changer to the motor-drive unit is connected via a bevel gear box and horizontal and vertical drive shafts. (See Appendix 3)

2.3.3 Potential resistance

For change-over selector of combined type OLTC, when the recovery voltage ⩾ 35kV, it should be equipped with potential resistance to connect the transformer regulating winding and tap changer, so that can limit this recovery voltage in order to ensure the recovery voltage is lower than the insulation level of OLTC.

For the liner regulation tap changer, the main winding and regulation winding is fixed connection, there is no the problem of recovery voltage and it is unnecessary to install the potential resistance.

The equipped potential resistances of ZM OLTC are normally cylinder structure, it is installed at the bottom of the tap selector (Fig 12).

The installation way of ZM OLTC cylinder type potential resistance:

Move the cylinder type potential resistance to the bottom of tap changer, use the standard parts (provided with accessories) to fix the potential resistance on the pedestal of tap selector. Then every end of the three equipped leading wires (provided with accessories) connects with the middle step (e.g. middle step of 10191/3W is 5 step, for 12231/3W is 6 step, for 14271/3W is 7 step, for 16311/3W is 8 step, for 18351/3W is 9 step) of every phase of selector switch, the other end connects with U, V, W terminal of the cylinder type potential resistance respectively.

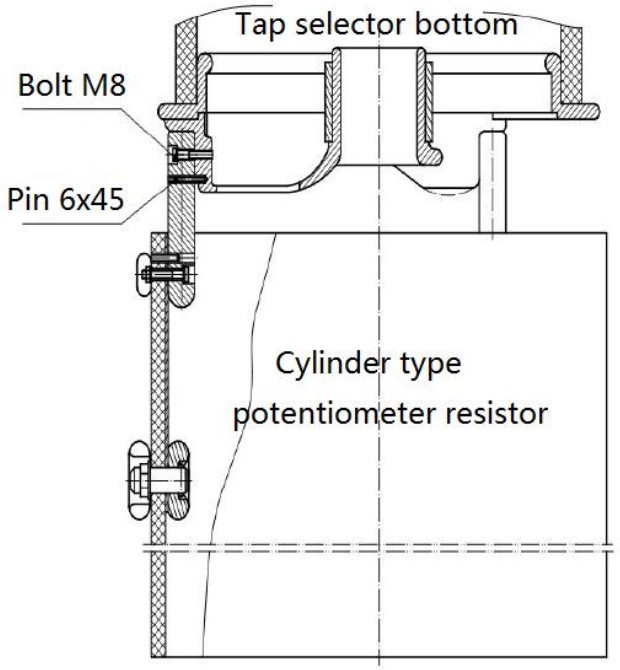


Figure 14

3. Receipt notice

After the on-load tap-changer and motor-drive unit are tested in the factory, they are set in the specified working position. Then take a moisture-proof protective package.

Both the changeover switch and the tap selector are locked in the setting position.

When the product is received, it shall be checked and accepted according to the packing list. If any damage is found, you should take pictures of the damage of the packing box and the packaged goods to keep the evidence to the responsible party to protect your rights and interests.

The on-load tap-changer shall be stored in the warehouse where the air is free, the relative humidity is not more than 85%, the temperature is not higher than +40° C, and not lower than -25° C. The storage environment shall not contain corrosive gas and shall not be affected by rain or snow.

The on-load tap-changer is stored in an air-tight envelope and opens when installed.

Typically, tap selectors, drive shafts, brackets, bevel gear boxes, protection relays, controllers, and accessories are housed in the same package.

When working on on-load tap-changers, motor-drive mechanism and various components, these components must be firmly secured. Otherwise, there may be danger of overturning, resulting in serious injury and even personal accidents.

4. Installation

4.1 Installation of on-load tap-changer in box top transformer (Fig 13)

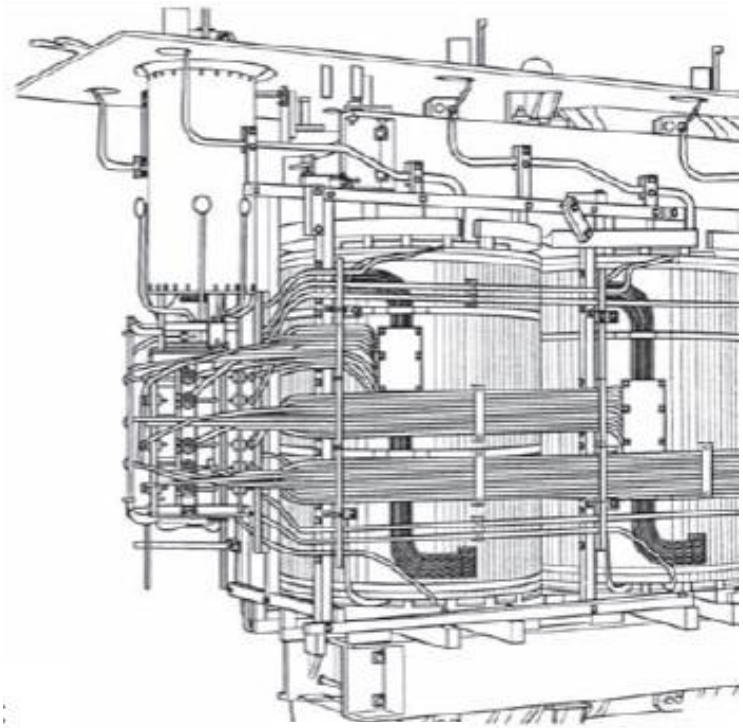


Figure 13

4.1.1 Installation flange

The on-load tap-changer head must be mounted on the tank cover with a mounting flange (see appendix 7) and an oil-resistant sealing gasket (Fig 14).

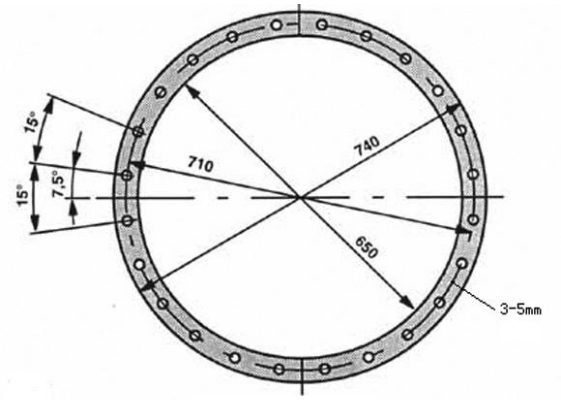


Figure 8

The design of the mounting flange and the oil seal gasket must be identical to the seal face of the on-load tap-changer switch head.

4.1.2 On-load tap-changer with change-over selector, tap changer head mounted on transformer tank cover

The diverter switch oil compartment falls through the opening of the transformer cover and the switch head is bolted to the mounting flange. Then connect the tap selector below the diverter switch oil compartment (Section 4.1.3).

The steps are as follows:

(1) Place the diverter switch housing on the water platform.

(2) Wipe the sealing surface of the switch head and mounting flange.

(3) Place an oil-resistant seal on the mounting flange of the transformer cover (Fig 14).

(4) Lift the diverter switch oil compartment and carefully drop it into the opening of the mounting flange.

Note: Avoid damage to grading ring (only for Um≥170kV)

(5) Correct the position of the switch head.

(6) Fasten the switch head to the mounting flange with bolts.

(7) Remove the positioning piece on the coupler at the bottom of the diverter switch oil compartment (Fig 15).

Figure 15

4.1.3 Assembly of the diverter switch oil chamber and tap selector

Lift the tap selector to align the switch oil chamber, first connect the two with bolts, and then mechanically couple the drive unit of the tap selector.

The steps are as follows:

(1) Place the tap selector on the surface of the water platform. Remove the bolts (6 M12 hex socket bolts, 8th wrench) and nuts on the tap selector holder. And save it. Also check and tighten the mounting screws (M6 socket head cap screws) of the tap selector connection wires (Fig. 16).

Figure 16

(2) Remove the red paint mark locating member of the lock coupling on the tap selector. Do not rotate the coupler and the dial member (Fig 17).

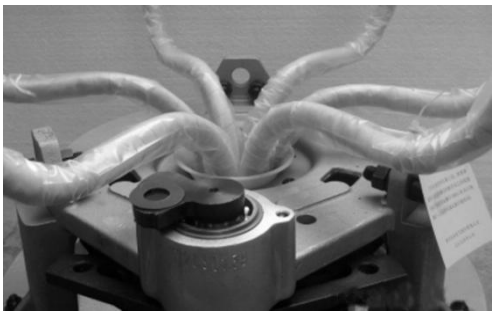


Figure 17

(3) The tap selector is fitted with a suitable lifting device.
(4) Raise the tap selector below the diverter switch oil compartment.
(5) Align the position of the two coupling members, and the bearing on the tap selector should be aligned with the hole in the base of the oil chamber.
(6) Raise the tap selector to the appropriate height.
(7) Connect the tap selector to the oil chamber base with the six M12 bolts and nuts removed from the front. The tightening torque is 60 Nm (Fig. 18).
(8) Remove the M10 bolts, shields and other parts of the connecting wires on the diverter switch oil compartment, and fasten the tap selector wires to the corresponding outlet contacts of the diverter switch, and cover the shield. The tightening torque is 50 Nm (Fig. 19).

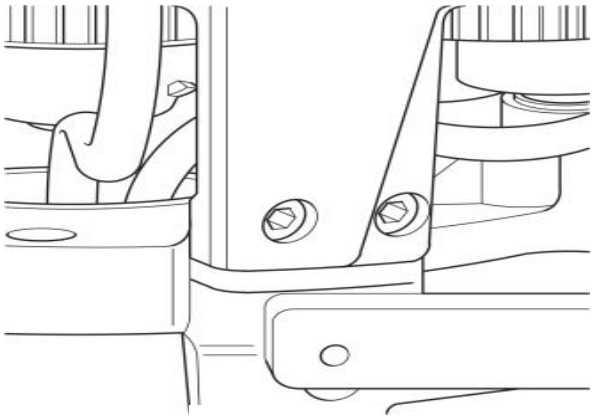


Figure 18

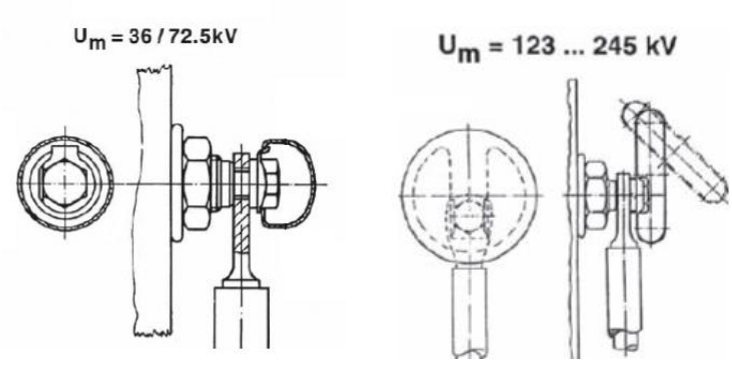


Figure 19

BE CAREFUL

Do not damage the insulation of the tap selector connection wires. All lead connections must be handled in detail. The specified tightening torque must be applied. Make sure that each connecting bolt is securely connected and shielded with a shielded cap supplied with the switch.

4.1.4 On-load tap-changer without conversion selector

This design involves the assembly of a complete tap changer from the opening of the transformer cover. The assembly of the tap selector and the diverter switch and the connection of the tap selector connection wires are carried out as described in Section 4.1.3.

Lift the entire tap-changer over the mounting flange of the transformer cover and carefully drop into the opening of the mounting flange. Check the installation position of the entire tap-changer and switch head. Fasten the tap-changer to the mounting flange.

Note:
Avoid damage to grading ring (only for Um≥170kV)

4.2 Installation of on-load tap-changer on bell-type transformer (Fig. 20)

When the on-load tap-changer is installed on a bell-type fuel tank, the tap-changer is designed with a support flange temporarily mounted on the transformer bracket and a detachable head flange fixed to the bell-type transformer cover. The two flanges are connected by an O-ring and a solid piece.

When the tap-changer head flange is installed on the transformer cover, the mounting flange (see Appendix 7) and the oil-resistant gasket (Fig. 14) must be used.

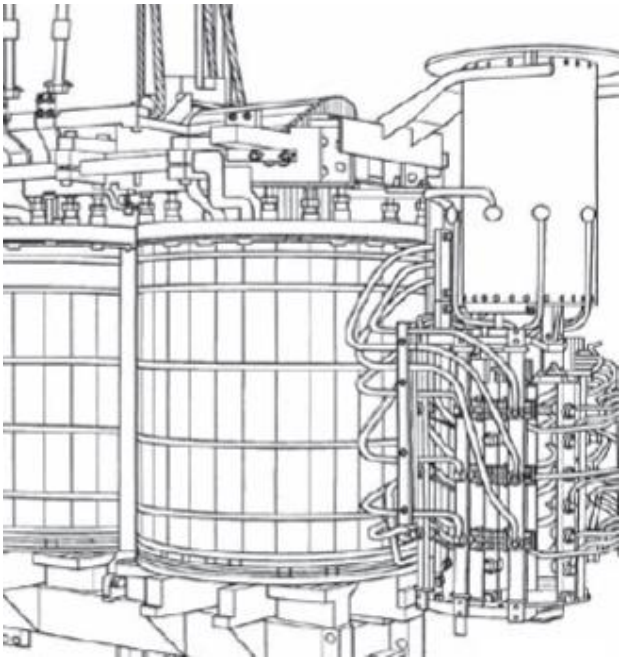


Figure 20

Installation steps

4.2.1 Disconnect the switch head flange

Place the diverter switch on a clean water platform.

(1) Remove the tap-changer head cover (24 M10 bolts, wrench No. 17), taking care not to damage the O-ring on the head cover (Fig. 21).

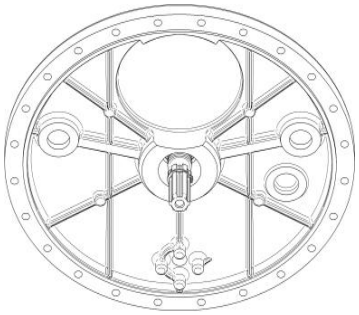


Figure 21

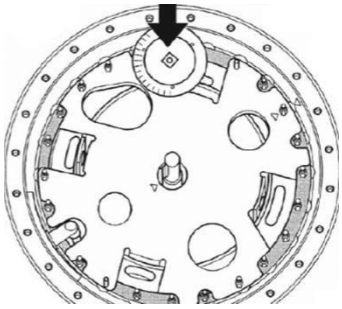


Figure 22

(2) Remove the tap position indicator disc (pull the open spring retainer ring from the shaft end) (Fig. 22).

(3) Remove the fastening nut (5 M8 nuts, No. 13 wrench) on the switch support body support plate (no red area) (Fig. 23).

(4) Carefully pull the diverter switch core vertically from the oil chamber (Fig. 24).

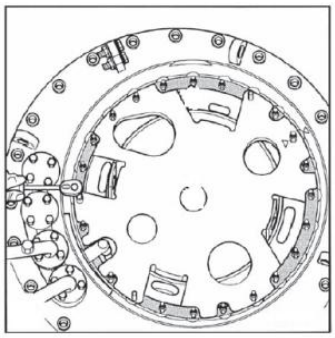


Figure 23

Figure 24

(5) Take down the oil suction pipe, pull out the connection bending pipe (Fig. 25) which inserted into the head flange, pay attention to do not damage the O seal ring of the bending pipe.

(6) Remove the fixed nuts in the red painting mark area of the head flange (17 M8 nuts, No. 13 wrench), lift the tap changer head (Fig. 26) from supporting flange. Pay attention to do not damage the O ring. Put the tap changer head flange on the flat ground with laying on clean oil paper for using.

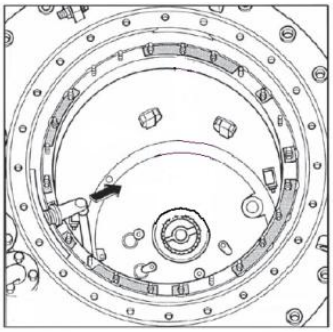


Figure 25

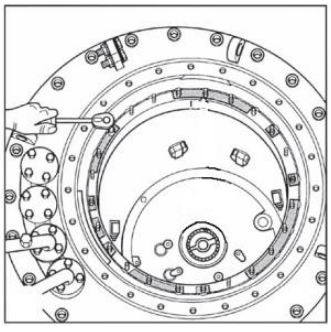


Figure 26

Do not turn the head gear mechanism drive shaft after the switch head is separated from the support flange.

Always avoid any parts falling into the diverter switch oil compartment, otherwise there is a danger of jamming the diverter switch and damaging the tap-changer and transformer. Therefore, the number of small parts must be fully counted during disassembly and reassembly, and no shortage of parts is guaranteed.

Place the tap selector and diverter switch on a clean water platform.

(1) Check and tighten the mounting screws (M6 socket head cap screws) of the tap selector connecting wires (Fig. 16).

(2) Remove the red paint mark on the tap selector on the tap selector. Do not turn the coupler and the dial (Fig. 17).

(3) Remove the bolts on the tap selector holder (6 M12 hex socket bolts, 8th wrench) and prepare the connection between the diverter switch and the tap selector.

(4) Lift the diverter switch oil chamber with the lifting plate (see Appendix 9), wipe the contact surface, align the two coupling parts, and slowly place them on the tap selector. Be careful not to touch the tap selector connector wire. Insulation. Fasten with 6 M12 bolts removed from the front.

(5) Remove the positioning piece coated with the red paint mark on the diverter switch (Fig. 15).

(6) Remove the M10 bolts, shields and other parts of the connecting wires on the diverter switch oil compartment, fasten the tap selector wires to the corresponding contacts of the diverter switch, and cover the shield (Fig. 19).

4.2.3 Preloading of the tap changer

In order to ensure that the tap-changer is installed in the correct position, an adjustable mounting bracket must be designed inside the transformer and must be pre-installed. Specific steps are as follows:

(1) The support flange is aligned with the head flange.

Use the hanger plate of Appendix 9 to lift the tap-changer to the appropriate position on the bracket.

Do not lift the tap-changer with the fixing bolts at any time, as this may damage the parts on the upper part of the switch head.

Lift the transformer tank cover and put it to the service position of the transformer.

Pre-install the head flange onto the mounting flange (the sealing gasket is necessary) of the transformer tank cover, align the two flanges with △ mark, adjust the position of the tap changer and mounting supporting structure to make the two positioning pins of the spacer flange and all the bolts can go through the connection hole (Fig. 27) of the head flange smoothly.

CAUTION

Make sure that all the screws on the intermediate flange slide easily in the fixing holes of the switch head.

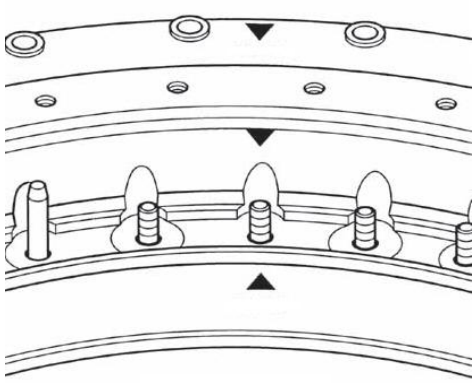


Figure 27

(2) Adjust the assembly clearance between the support flange and the head flange.

Adjust the height position of the mounting bracket to ensure that the clearance between the middle flange and the head flange meets the requirements of 5~20mm, and the actual clearance value is measured (see Appendix 6).

After the tap-changer is pre-installed on the transformer mounting bracket, lift the transformer box cover, use the lifting plate to slowly lift the tap-changer (be careful not to move the position horizontally), and place the actual clearance value on the mounting bracket. Pad, then lower the switch and fix it to prevent displacement when connecting the leads.

(3) Wiring of the voltage regulating winding and the tap changer is described in Section 4.3.

BE CAREFUL

The connected tap leads must not have any pulling force on the tap changer. The tapping leads should be provided with sufficient room for the tap-changer to be raised to the final position after the bell jar cover is snapped.

(4) Installation of the bell cover

Before the bell cover is fastened, wipe the sealing surface of the oil chamber support flange (Fig. 31) and place the seal on the flange.

Hang the transformer bell cover over the transformer body and fasten the transformer bell cover.

(5) Before installing the switch head, clean the sealing surface (the lower edge of the switch head and the mounting flange). Place an oil-resistant gasket on the mounting flange (see Appendix 7).

(6) Place tap changer head on mounting flange, paying attention to the position of the two positioning pins and the markings on the support flange and switch

head (Fig. 28). These two mark alignments ensure that the switch head is installed in the correct position. Depending on the final height, a gap of 5 to 20 mm should be left between the tap changer head and the support flange.

(7) Gently lift the tap-changer with the spreader to ensure that all the screws of the support flange can slide easily in the fixing holes of the switch head. Secure the switch head to the mounting flange with 24 M8 nuts, tighten the torque to 14 Nm, and lock the lock washer on the nut.

(8) Secure the switch head to the mounting flange with 24 M12 bolts.

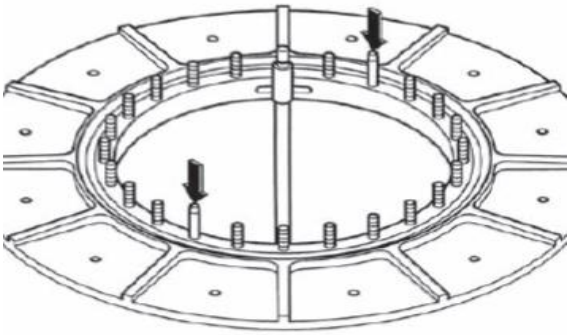


Figure 28

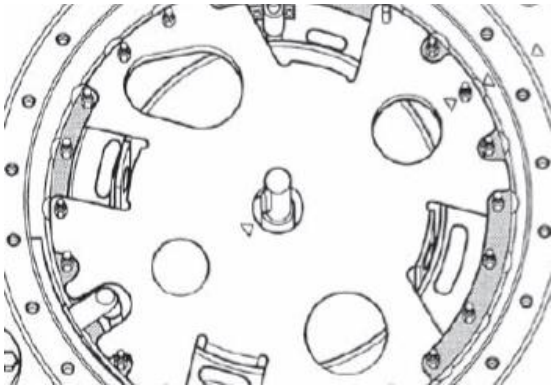


Figure 29

(9) Install the diverter switch core

a. Check if the gear mechanism on the base of the diverter switch oil compartment is in the recording position. Confirm the coupling head size direction.

b. Lift the diverter switch core with a crane and move it to the top of the diverter switch oil compartment. Observe the direction of the sleeve size of the bottom of the switch core, align the sleeve size gap with the size of the coupling head, and ensure that the suction pipe notch on the switch core support plate is facing the suction pipe side.

c. The calibration mark (red triangle) on the diverter switch core support plate and the tap changer head (Fig. 29) must be aligned with each other.

d. Slowly insert the diverter switch core into the oil chamber to the final position.

e. Gently apply pressure to the upper support plate to the flange support surface.

f. Fix the switch core support plate to the flange support surface with a nut.

(10) Put the switch head cover and cover the tap changer. The O-ring on the head cap must be placed in the correct position.

(11) Evenly tighten the 24 M12 bolts on the cover of the tap-changer with a tightening torque of 34 Nm (Fig. 30).

Figure 30

4.3 Connection of voltage regulating winding lead and tap changer tap

The connection of the voltage-regulating winding leads to the tap-changer taps must be in accordance with the specified wiring diagram supplied with the tap-changer (see Appendix 12-17, Special Design Additional).

All lead connections must be careful and secure. All tap leads must be assembled with no pull on the leads attached to the tap selector. If necessary, the end of the tapping lead should be bent into a buffered arc.

4.3.1 Wiring of the tap selector terminal

The number of tap selector terminals is marked on tap selector insulation strip.

The taper of the tap selector terminal has a hole for the M10 bolt, and is provided with an M10 bolt, an M10 nut, a washer 10, and a shield cover for facilitating the connection of the winding lead terminal and the tap selector terminal. (Fig. 31)

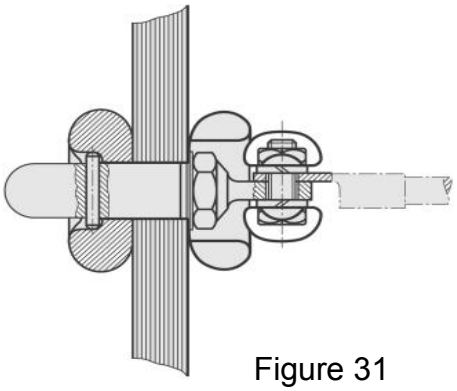


Figure 31

4.3.2 Polarity selector wiring terminals

The terminals (+) and (-) of the polarity selector are in the shape of a lug with M10 wiring holes. The polarity selector terminal K is an extension of the tap selector terminal (also has a M10 wiring hole), and the portion extending outside the insulating strip (see Fig. 32) serves as a fixed contact for the polarity selector.

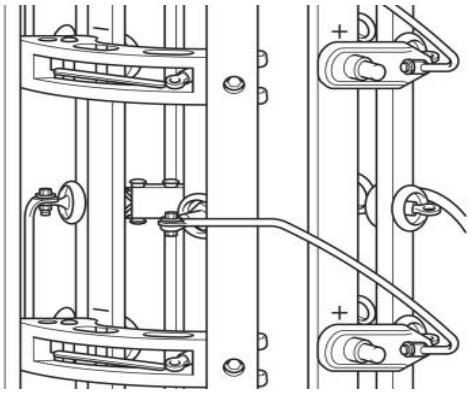


Figure 32

BE CAREFUL

Terminal K must not be bent or twisted, otherwise it will affect the function of the polarity selector.

4.3.3 Terminal of the coarse adjustment selector

The terminals (+) and (-) of the coarse selector are the same as the tap selector terminals, and the direction of the M10's wiring holes is always vertical and is located on each coarse selector insulation strip (Fig. 33).

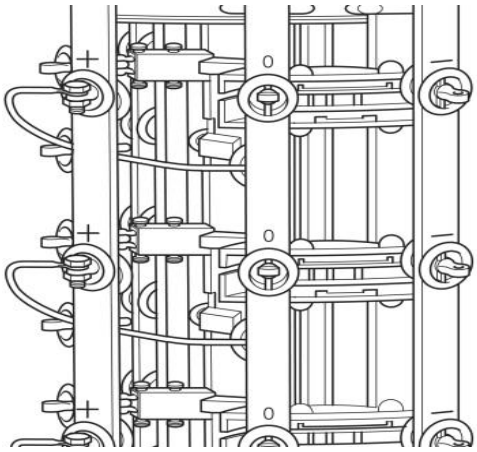


Figure 33

BE CAREFUL

The wiring of the tap selector lead near the converter selector (polar selector or coarse selector) must leave enough space for the active part of the converter selector (polar selector see Fig. 34a. Coarse selection, See Fig. 34b). Otherwise, the action of the conversion selector may be hindered.

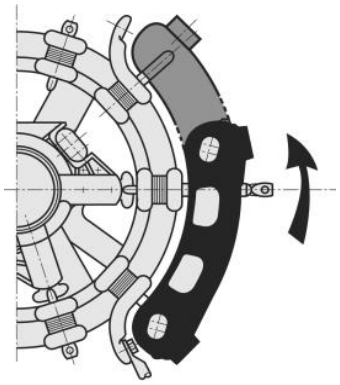


Figure 34a

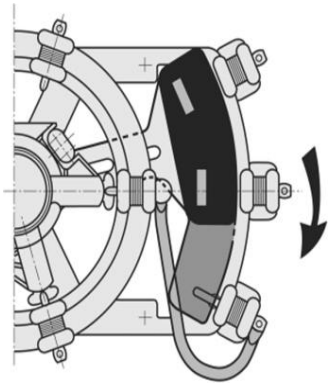


Figure 34b

CAUTION

(1) The connecting lead should be bidirectionally led from both sides of the tap selector insulator to the voltage regulating coil to avoid the one-way force of the tap selector, and the connecting lead should not be attached to the insulating barrel.

(2) The end of the lead connecting the tap selector should be bent out of the curve, leaving a certain degree of deflection, not too short.

4.4 transformation ratio test

It is recommended to use low-voltage alternating current as the transformer transformation ratio test before drying.

When operating the tap-changer, a short tube with a nominal inner diameter of Ø25 can be inserted into the horizontal shaft of the tap-changer head cover gear box, and the M8 bolts are used to connect the two. The other end of the short tube can be equipped with a hand wheel or crank. .

BE CAREFUL

Remember to always operate the on-load tap-changer from the head cover gear. Acting directly from the coupling axis can cause some trouble.

For the 3 × ZVMI three-phase group, there are three switch heads, which are connected to each other by a horizontal axis.

Each time the tap change operation, the horizontal axis needs to be rotated 16.5 turns, and the working position of the tap changer can be observed by the glass observation window that the head cover gear is closed (see Figure 35). Since the tap-changer has not been immersed in oil, the number of tap-changes must be minimized.

After the transformation ratio test, the tap changer must be transferred to the original factory working position of the switch manufacturer.

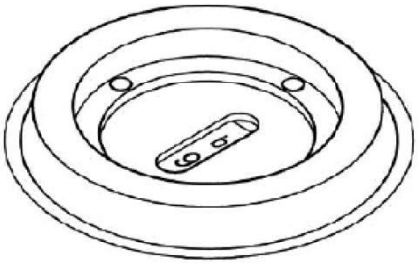


Figure 35

4.5 Drying and oiling

4.5.1 Drying step

In order to ensure the insulation level of the tap-changer, the tap-changer (generally with the transformer) must be subjected to a minimum drying process as described below.

4.5.1.1 Vacuum drying treatment

(1) Drying in a vacuum tank

> **CAUTION**
>
> When drying in a vacuum tank, the OLTC head cover must be removed and placed outside the vacuum tank.

Warming up:

The tap changer heats up in a normal air pressure at a rate of 10℃ per hour until the final temperature, up to 110℃.

Pre-drying:

The tap changer was continuously dried for 20 h in circulating hot air at a maximum temperature of 110℃.

Vacuum drying:

The tap changer was continuously dried for 50 h at a maximum temperature of 110℃ and a residual pressure of up to 133 Pa.

(2) Drying in the transformer tank

If the transformer is dry in its own tank, the cover of the switch head must be closed during the entire drying process, so it must be connected to the oil-filled flange of the tap-changer and the oil-filled flange of the transformer tank with a bypass pipe (see Appendix 8). between. In order to speed up the drying speed of the switching device, a bypass pipe with a nominal inner diameter of at least 25 mm must be connected between the transformer fuel tank and the tap changer head directly to the pipe joint of the diverter switch oil chamber.

The drying process steps, temperature, pressure and duration are as described in the previous section.

4.5.1.2 Vapor phase drying treatment

The drain plug at the bottom of the oil compartment must be opened before the drying process begins (Fig. 36), and after the vapor phase drying process, re-tighten the drain screw.

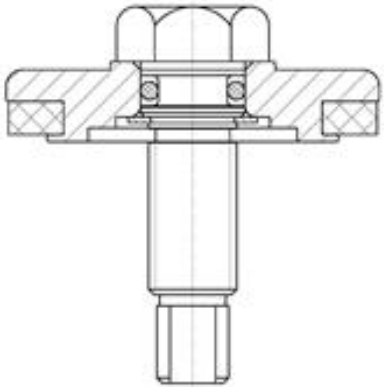


Figure 36

BE CAREFUL

After drying, the kerosene drain plug must be resealed to ensure that the oil in the diverter switch oil compartment does not flow into the transformer tank.

CAUTION

When drying in an oven, the tap-changer head cover must be removed.

Heating: Pass kerosene vapor at around 90℃. This temperature is kept constant for 3 to 4 hours.

Drying: Increase the vapor temperature at 10℃ per hour until the specified final temperature (maximum 125℃). The drying duration is usually the same as the drying time of the transformer.

(2) Vapor phase drying in the transformer tank

If the transformer is vapor-phase dried in its fuel tank, the tap-changer head cover must remain sealed throughout the drying process. At this time, the transformer tank and the diverter switch oil chamber should be simultaneously connected to the kerosene steam to dry. In order to accelerate the drying speed of the switch oil compartment and the diverter switch device, at least one kerosene steam input pipe with a diameter of Φ50 mm is coupled to the tapping switch head oil filler flange or the oil suction flange.

The steps, temperature and duration of the drying process are as described in the previous section.

After drying, check if the fastener is loose. If it is loose, it must be retightened and retracted. If the tap-changer needs to be operated, the diverter switch oil compartment must be filled with insulating oil and the tap selector must be lubricated with oil.

4.5.2 Oiling

The oil filling of the tap-changer oil compartment and its oil conservator must use the transformer oil that meets the requirements of GB2536. The use of other oils will endanger the safe operation of the tap-changer and transformer.

The tap changer and the transformer simultaneously inject new transformer oil under vacuum.

The ZM series of on-load tap-changers are suitable for switching switch oils operating from -25℃ to +115℃.

Use the pipe connection Q or R on the tap-changer head for oil filling. When the on-load tap-changer is evacuated, a communication pipe is connected between the pipe joints E2 and Q, so that the diverter switch oil chamber and the transformer can simultaneously draw a vacuum.

4.6 Installation of other on-load tap-changer components

4.6.1 Installation of connecting pipe

There are three pipe joints on the tap changer head. Loosen the pressure ring (4 M10 bolts, No. 17 wrench), and these pipe joints (Fig. 37) can be rotated freely.

Figure 37

(1) Pipe joints for protective relays

For details on the installation of the protective relay QJ4-25, refer to the instruction manual of the protective relay.

The relay should be installed in the connecting line between the head of the switch and the oil pillow, and as close as possible to the head of the switch, usually directly attached to the flange of the elbow, and keep the relay in a horizontal position.

When installing, the arrow mark on the relay should point to the oil pillow.

The connecting pipe should be raised at least 2% in the direction of the oil pillow

Elbow - [R and elbow Q positions can be interchanged as needed.

If the height difference between the on-load tap-changer head cover and the oil level of the oil conservator is greater than 5M, please contact us to discuss the problem of static over-pressure rise.

(2) Pipe joint trumpet of oil suction pipe

This is the pipe joint that connects the fixed oil filter inlet pipe. If the oil filter is not used, this connector is connected to a pipe with a valve at the end, which is placed on the side of the transformer tank for easy operation. It is used to pump oil from the diverter switch oil compartment when the switch is overhauled or changed.

(3) Pipe joint of oil injection pipe Q

This pipe joint is used to connect the oil return pipe of the online oil filter. It is recommended to use a pipe with a valve at the end. If there is no oil filter, you can seal it with a stuffy cover.

This pipe joint can also be used for special design and is used to install a tap change monitoring device when there is a tap change monitoring device.

(4) Connector flange E2

This flange is usually sealed with a cover. The flange hole is straight through the transformer tank from under the switch head.

If necessary, it can also be connected to the collector of the transformer gas relay.

4.6.2 Installation of the motor-drive unit

Detailed installation instructions can be found in the instruction manual of the MA7B or MAE motor-drive unit.

⚠ CAUTION

The factory number of the motor-drive mechanism must match the tap-changer.

The motor-drive unit and the tap-changer must be in the same set working position. This position is indicated in the tap-changer wiring diagram provided with the switch.

The motor-drive mechanism is mounted vertically on the side wall of the transformer tank and must not be skewed and can prevent the effects of excessive vibration of the transformer.

4.6.3 Installation of the bevel gearbox

The bevel gearbox (see Appendix 10) is fastened to the bracket welded to the transformer cover with two M16 bolts.

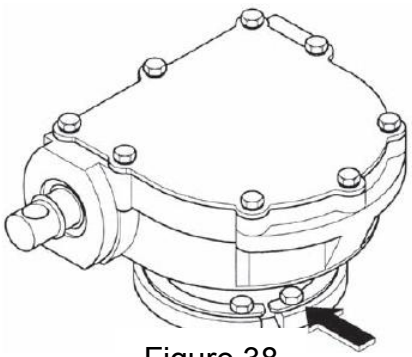


Figure 38

CAUTION

The bevel gear transmission box should be matched with the tap changer. The factory serial number of the print must be the same.

The horizontal drive shaft of the bevel gearbox must be in line with the shaft end of the switch head gearbox.

After removing the pressure plate of the head gear box and loosening the pressure ring of the gear box, the head gear box can be freely rotated.

After the position of the head gear box is adjusted, the pressure ring (maximum torque 15Nm) must be tightened, the gear box pressure plate is covered, and the bolts are locked with the locking piece (Fig. 38).

The installation of a specially designed bevel gear box and its intermediate bearing of a vertical or horizontal drive shaft can be performed as described above.

The motor-drive mechanism is mounted vertically on the side wall of the transformer tank and must not be skewed and can prevent the effects of excessive vibration of the transformer.

4.6.4 Installation of the drive shaft

The drive shaft (see Appendix 11) is the mechanical connection between the motor-drive unit and the tap-changer, which converts the vertical rotation into a horizontal rotation through the bevel gearbox.

The drive shaft and shroud should be cut to the actual required size according to the assembly requirements before installation.

When installing, first install a vertical drive shaft between the motor-drive unit and the bevel gear transmission box, and then install a horizontal drive shaft between the bevel gear transmission box and the switch head.

When the length of the drive shaft exceeds 2m, the intermediate support box should be provided to prevent sloshing, but it must be made at the time of ordering and special supply.

3 × ZMI... Three single-phase switch consisting of tap changer drive shaft installation steps:

The following procedure also applies to all other structured ZM on-load tap-changers.

For a special arrangement of three phases, the switch heads must be coupled together above the transformer cover. Since the transmission shaft of the slewing head gear mechanism causes the switching switch to operate, it is necessary to check whether the switching switch is accurately returned to the set position after the gear mechanism is adjusted.

The steps are as follows:

(1) First check whether the operation positions of the respective tap-changers are the same (see the head cover observation window), and each single-phase switch must be in the set position.

(2) Turn the head gear mechanism to the appropriate mounting position and fix it (tighten the ring bolt and lock the lock pad). Note that the position of each head gear mechanism must be the same.

(3) Rotate each shaft end counterclockwise to make the switch act once, that is, the single tap changer changes one stage, and then check whether the operation positions of the switch heads are consistent.

(4) Install a horizontal drive shaft between each switch head.

(5) Turn the coupled switch group together to the set position.

Note that the position must be in the middle of the direction in which the tap changer descends. Check that all tap-changers and motor-drive units are in the same position.

(6) Install a protective cover.

(7) Install the vertical drive shaft.

4.6.5 Tap-changer and motor-drive unit connection check

After the tap changer is connected with the motor-drive unit, it must be manually operated to check that the diverter switch operating time should be completed before the motor-drive unit stops, and there is an obvious time interval (1.5~2 grids before the center of gree area on the tap change indicator), and It should be symmetrical in both directions.

Check that the tap-changer is in the same set position as the motor-drive unit.

Use the handle to shake in the direction of 1→N. When the OLTC is activated (when the switching sound is heard), continue to rotate the handle and start recording the number of rotations of the handle until the motor driver unit tap change pointer to the red mark in the center of the green band (MAE), or the red indicator of the center of the green area of the tap change indicator wheel appears in the middle of the observation window (MA7B), stop shaking, and record the number of rotations of the handle m.

Shake the handle in the direction of N→1, and record the number k of the handle rotation as described above.

If m=k, the connection is correct. If m≠k and m-k>1, it is necessary to balance the rotation difference, that is, loosen the coupling between motor-drive unit and the vertical transmission shaft, and swing the 1/2 (mk) circle in the direction of multiple turns with the handle, and then vertical. The drive shaft is coupled to motor-drive unit. Re rotate number of turns in both directions until m-k < 1.

4.7 tap changer commissioning at transformer manufacturer

4.7.1 Mechanical operation test

Before the transformer is energized, the tap changer must perform a complete operation cycle. Check that the tap changer and the motor-drive unit should not have any faults; the position indication of the motor-drive unit, the remote position indication, and the position indication of the tap-changer in each operating position. The same should be true; the electrical and mechanical terminal limit protection should be reliable at both end positions.

Do not operate the tap-changer after drying without oil lubrication. Otherwise the bearings and seals will be damaged.

The coupling position of the tap-changer and the motor-drive unit must be the same, otherwise the tap-changer and motor-drive unit will be seriously faulty.The motor-drive mechanism is mounted vertically on the side wall of the transformer tank and must not be skewed and can prevent the effects of excessive vibration of the transformer.

4.7.2 Final oiling

Pay attention to the full transformer oil and deflate through the oil conservator. The steps are as follows:

Use the bleed screw plug (Fig. 39) of the switch head cover to deflate the switch head: Open the bolt and remove the slotted plug screw M6 with a maximum torque of 2Nm.

Use the bleed plug on the elbow (Fig. 40) to deflate the suction pipe (S): Remove the M16 cap nut, wrench No. 22, maximum torque 9 Nm, and remove the slotted plug screw M6 with a maximum torque of 2 Nm.

Figure 39

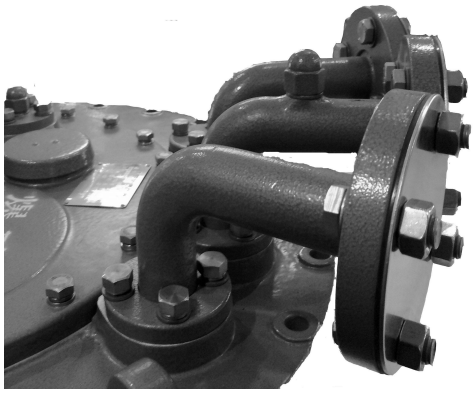


Figure 40

The suction pipe must be completely deflated. Otherwise, the grounding resistance of the tap-changer will be significantly impaired.

4.7.3 Ground Connection

Connect the tap-changer to the transformer tank through the conductor, switch head grounding bolt (2-M12 bolt and nut, wrench #19) (Fig. 41).

Connect the motorized mechanism box to the transformer tank through the conductor and grounding bolt M12.

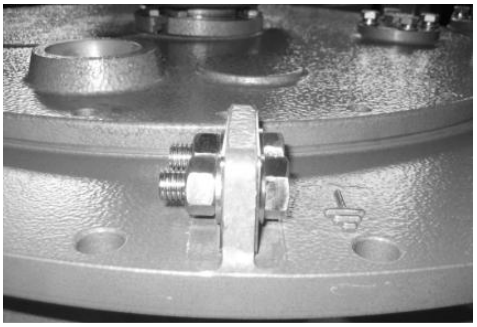


Figure 41

4.7.4 Electrical test of transformers

After the above operations are completed, the electrical test required for transformer acceptance can be performed.

4.7.5 Setting working position of the tap changer

After all tests have been completed, the tap-changer and motor-drive unit should be rotated to the working position at the time of delivery.

4.8 Transformer together with the tap changer

If the transformer is to be removed from the motor-drive unit at the installation site, the motor-drive unit should be placed in the set position and the coupling removed. Then remove the drive shaft and motor unit.

The motor-drive mechanism cannot be operated when the tap-changer is not coupled.

The reassembly of the motor-drive unit shall be carried out in accordance with the instructions in 4.6.2 and 4.6.4.

If the transformer is filled with oil but not stored and transported with oil pillows, a bypass pipe must be installed between the inside of the diverter switch oil compartment and the transformer tank to compensate for the static pressure generated by oil expansion. The bypass pipe is mounted between the pipe joints E2 and Q of the switch head.

For short-term storage of 2 to 4 weeks without oil conservator, the oil level of the tap-changer should be reduced by about 5 liters.

If the transformer is not fully transported or stored, the oil in the diverter switch oil compartment should also be released. At this time, it is still necessary to install a bypass pipe to balance the pressure inside the switch oil chamber and the transformer tank.

The bypass pipe should be removed before the transformer is installed and put into service at the work site.

4.9 put into operation at the operation site

Before the transformer is put into operation, both the on-load tap-changer and the motor-drive unit must be filled in accordance with Section 4.7.2 and tested in accordance with Section 4.7.1. Also check the function of the protective relay.

The protective relay must be connected to the trip circuit of the circuit breaker so that the transformer can be removed immediately when the protective relay is activated.

When the test button "trip" of the protective relay is pressed, the circuit breaker must trip and the transformer is removed. And check to confirm that only after pressing the "Reset" button of the protection relay, the circuit breaker can be closed and the transformer can be re-energized.

Open the valve between the oil pillow and the tap changer, close the transformer, and confirm that the tap changer is all normal, then it can be put into use.

Be sure to follow the safety precautions specified by the transformer manufacturer.

Always check that all throttles between the oil conservator and the tap-changer head have been opened.

5. Operational monitoring

The operational monitoring of the on-load tap-changer and the motor-drive unit is only a periodic visual inspection of the on-load tap-changer switch head, protective relay and motor-drive unit.

These checks can be performed simultaneously with the usual transformer control checks. There are the following points:

5.1 Check the switch head to protect the seal of the relay and the connection of the pipeline from leaking oil.

5.2 Check that the motor-drive unit is sealed properly.

5.3 Check if the function of the electric heater installed in the motor-drive unit case is normal.

5.4 Check whether the appearance of each electrical component installed in the chassis of the motor-drive unit is normal.

5.5 Check that the silicone moisture absorber of the on-load tap-changer oil storage cabinet is in good condition.

5.6 Perform the functional test of the protective relay according to the instruction manual.

5.7 The insulating oil in the transformer shall be monitored by the user in accordance with the relevant regulations. The quality of the on-load tap-changer oil must be monitored simultaneously with the transformer oil. It is recommended to perform a sampling test after switching about 1000 times under the rated working current, and check that the oil withstand voltage is not lower than 30kV.

5.8 When replacing the silicone moisture absorber of the on-load tap-changer oil storage cabinet, as a precautionary measure, the insulation strength of the diverter switch oil should be determined.

5.9 When the transformer is overloaded, the on-load tap-changer cannot be operated frequently. If the user installs the automatic control, there must be “ overcurrent

self-locking”, so that the tap-changer is not switched when the load current is greater than 2In.

5.10 The head cover of the tap changer is equipped with an overpressure protection blasting cover. The blasting cover should not be damaged during the normal change operation of the diverter switch. Only when the internal switch fails, the pressure inside the fuel tank exceeds 4.5 × 105Pa and blasts. Pressure protection to prevent accidents from expanding.

Once the protection relay is activated, it must not be reclosed until the tap-changer and transformer have completed the inspection. In this case, the diverter switch core should be taken out for inspection. It is necessary to check whether the tap changer and the transformer are damaged, find out the cause of the fault, and discharge the fault, and the transformer can be put back into operation. Failure to do so may result in serious damage to the tap-changer and transformer.

This warning also applies to the action of other protective devices, such as the pressure relief valve of an on-load tap-changer. The device can only be re-run if it is believed that the on-load tap-changer and transformer are indeed not damaged. At the same time, when the on-load switch is overhauled, be careful not to bump the blast cover.

6. Maintenance and overhaul

In the long-term operation of the on-load tap-changer, only the switch needs to be regularly inspected, and the tap selector does not need to be repaired under normal circumstances.

6.1 Periodic maintenance and overhaul cycle

In the long-term operation of the on-load tap-changer, only the switch needs to be regularly inspected, and the tap selector does not need to be repaired under normal circumstances.

6.1.1 The transformer oil in the oil tank of diverter switch is carbonized after repeated tap change, and the pressure drop is reduced. It is recommended to periodically take the oil sample test according to 5.7. When the transformer oil withstand voltage is lower than 30kV, it must be replaced with new oil. Even if the insulating oil meets the requirements of Table 1, it must be replaced with new oil once a year.

Table 1: Limits of the diverter switch oil replacement process

On Load Tap Changer	Water content	Water content
Neutral point regulation	<40ppm	>30kV/2.5mm
In addition to the neutral point regulator	<30ppm	>40kV/2.5mm

Note: 1. The maximum working voltage of the tap-changer equipment is 126kV, 170kV grade tap changer water content≤30ppm, breakdown voltage≥40kV / 2.5mm;

2. The tap changer with the highest working voltage of 252kV is ≤25ppm and the breakdown voltage is ≥40kV/2.5mm.

When changing the oil, first drain the insulating oil in the diverter switch, then rinse the diverter switch and the insulation tube with clean oil, and then drain the flushed oil again, then fill it with clean oil.

6.1.2 The maintenance and used of the oil pillow and respirator in the tap changer are the same as those of the general transformer.

6.1.3 The insulating oil injected into the diverter switch oil compartment and its oil conservator must comply with the GB2536 standard and the IEC60422 standard (guidelines for monitoring and maintenance of mineral insulating oil for electrical equipment).

6.1.4 If the number of operations per year exceeds 15,000, it is recommended to install an

online oil purifier on the tap-changer.

6.1.5 Maintenance cycle

It is recommended that the tap-changer be used for maintenance after 7 years of operation or the number listed in Table 2;

The number of tap-changer operations listed in Table 2 as the determination of the maintenance cycle is based on empirical figures using conventional oil quality.

Table 2: ZM on-load tap-changer maintenance interval

OLTC	Operating current	Number of operating of OLTC (ten thousand time)	
		Without oil filter	With oil filter
ZMIII300Y	＜300A	10	15
ZMIII500Y	＜300A	10	15
	＜500A	8	15
ZMIII600Y	＜300A	10	15
	＜600A	8	15
ZMI301	＜300A	10	15
ZMI501	＜500A	10	15
ZMI601	＜600A	10	15
ZMI800	＜500A	10	15
	＜800A	8	15
ZMI1200	＜800A	8	15
	＜1200A	7	14
ZMI1500	＜1200A	7	14
	＜1500A	6	12

Neglecting the inspection cycle or incomplete and irregular inspections can result in serious damage to the OLTC and transformer.

The OLTC must be regularly maintained and serviced to maintain a high degree of operational reliability.

For the sake of safety, it is recommended that the new tap-changer be put into operation for maintenance after 2 years of operation or 20,000 times of tap change. Check on the earlier time.

Thereafter, to maintenance once 4 years if you don't use the Guizhou Changzheng oil filter or according to the number of times required in Table 2, take the earlier time to maintenance; To maintenance once 7 years if you use the Guizhou Long March oil filter for according to the number of times in Table 2, take the earlier time to maintenance.

In addition to the above-mentioned maintenance cycle, the diverter switch core must be maintained after 800,000 operations.

The tap selector of the on-load tap-changer must be serviced after a tap operation of 1 000 000 times (calculated by the counter of the motor-drive unit).

If the overhaul is not carried out by our after-sale service department, it must be ensured that the personnel engaged in maintenance have received training from our company or qualified to undertake maintenance. For repairs not performed by our customer service department, please send a suitable maintenance report for our company to update the maintenance record. If you need to repair spare parts, please specify the factory serial number (see the on-load tap-changer and motor-drive name plate) and the number of operations that have been performed.

6.2 Inspection contents and steps

Regular maintenance includes the following:
Lifting and reassembling the diverter switch core;
Clean the diverter switch oil compartment and the diverter switch core, and if necessary, clean the diverter switch oil pillow;
Check the diverter switch oil compartment and the diverter switch insert;
Check the contract loss of burning;
Measuring the transition resistance;
Replace the switch insulating oil;
Check protective relay, motor-drive unit, drive shaft, controller, oil filter, etc.

During the overhaul, care must be taken to keep it clean and the inspection process should not be interrupted. The time when the diverter switch core is exposed to the air shall not exceed 10 hours (in the case of relative humidity not greater than 65%), otherwise it shall be dried as specified in this manual.

6.2.1 Inspection preparation work

(1) The tap changer is usually stopped after being set to the working position.
(2) Necessary equipment:

Max.service voltage of tap changer (kV)	72.5	126	170	252
Oil filling of tap changer (L)	130	150	170	190

Empty bucket for loading dirty oil and new oil;
An oil pump for draining and filling oil;
A plate for dripping oil;
Various brushes for cleaning, absorbents and rags that are not velvet;
Lifting equipment;
Overhaul tool
Various spare parts.

CAUTION

Spring washers and self-locking nuts are not reusable after they have been removed and should be replaced with new ones.

The transformer must be cut from network and ensure that it is no longer closed. All bushing terminals must be grounded(using a ground wire or grounding switch).
Be sure to clearly mark the work area.
Maintenance work may not begin until safety measures are implemented.

(3) Security measures

On-site users must take the following security measures:
The transformer must be cut from the network and ensure that it is no longer closed.
All bushing terminals must be grounded (using a ground wire or grounding switch).
Be sure to clearly mark the work area.
Maintenance work may not begin until safety measures are implemented.

6.2.2 Diverter switch lifting core step

(1) Reduce the oil level

Close the valve between the oil conservator and the tap changer, open the exhaust oil spill screw on the head cover, and then open the drain valve of the tap changer to lower the oil level of the switch.

WARNING

The oil of the tap-changer must be treated as flammable liquid. In addition, flammable gases may accumulate under the switch head cover, in the switch oil, or inside the switch oil chamber. Therefore, you must avoid open flames. Use only oil rigs that are approved for use with flammable gases.

(2) Disassemble the head cover

Remove the 24 M10 bolts, washers on the head cover and store them. Remove the cover and take care not to damage the O-ring on the cover.

(3) Remove the fixing nut of the switchboard body support plate. Be careful to keep nuts and washers.

(4) Use the hook to carefully lift the diverter switch core vertically and place it in a flat, clean place. Be careful not to damage the suction pipe.

WARNING

Do not remove the nut on the screw in the red mark area of the switch head. Otherwise, the tap changer may fall into the transformer tank, causing serious damage to the tap changer and transformer.

6.2.3 Cleaning

Oil storage cabinet, oil room cleaning:

Discharge all the oil in the diverter switch oil compartment and open the valve between the switch head and the conservator until the clean oil flows out of the

conservator. Flush the oil conservator with clean transformer oil if necessary.

Release the oil from the oil compartment and flush the oil compartment with clean transformer oil. If necessary, use a brush to wash carbon dust that attach to the inner wall of the insulation tube.

Remove the suction pipe, rinse it with clean transformer oil, and then reinstall it.

For safety reasons, after the diverter switch core is lifted, cover the cap and tighten the bolts.

Toggle switch core cleaning:

After the diverter switch core is lifted out, first check the appearance, rinse with clean transformer oil, and clean the supporting insulation strip with a brush. Thorough cleaning will be carried out during the disassembly and inspection.

Use only clean insulating oil when cleaning the oil compartment, suction pipe and diverter switch insert. Do not use other cleaning fluids.

6.2.4 Diverter switch core maintenance

(1) Record the hanging position:

Before starting maintenance, record the last stop position of the switch and record the release position of the slide on the spring energy storage mechanism to return to this position after the switch is reassembled.

(2) Check if the fasteners are loose.

(3) Check whether the main spring, return spring, and claw of the energy storage mechanism are deformed or broken.

(4) Check if the contact soft coupling line is damaged.

After the tap changer has been tapped and changed 100,000 times, even if the soft coupling line of the above contact is not damaged, the soft coupling line that has been taken out must be replaced regardless of whether the above contact is replaced or not.

(5) Check the conversion procedure of the moving contact.

(6) Measuring transition resistance:

The measurement of the transition resistance is performed between the main arc contact and the transition contact on the upper and lower sides of the open side of the switching switch segment. When measuring the other side, turn the switch to the opposite position and measure.

The measured value is compared with the nominal value on the nameplate and the error should be within 10%.

Reassembly of the diverter switch core:

Lift the diverter switch core over the oil chamber and slowly drop it into the oil chamber. Secure the diverter switch core support plate to the oil chamber with nut.

6.3 oiling

Inject the new required transformer oil into the switch oil compartment until the oil level reaches the support plate. Then replace the O-ring on the head cover, cover the switch head cover, and tighten the switch head cover with 24 M10 bolts. Open the

valve between the protective relay and the switch oil pillow, loosen the bleed screw cap on the head cover with a wrench, and loosen the plug with a screwdriver to remove the air from the switch head. At the same time, the deflation screw on the suction pipe should be vented, and the oil pump should be injected to inject new oil.

If the tap changer is equipped with an oil filter, the oil filter unit is activated and deflated.

The oil conservator injects new oil into the original oil level.

Parking time of the transformer after oil filling for at least 1 hour.

6.4 Further inspection

It is forbidden to send power to the transformer before the following inspections (1) to (4) are completely completed.

(1) Transmission shaft

Check whether the bolts and nuts at the horizontal drive shaft and the vertical drive shaft coupling bracket are tight and the lock pieces are locked. If necessary, add some grease to the coupling bolts and O-rings.

(2) Functional test of motor-drive unit and tap changer

Check that the motorized mechanism and the tap changer are in the same position. If it is inconsistent, there is a coupling error between the motor-drive unit and the tap-changer.

Check the symmetry of the coupling of the motor-drive unit and the tap-changer. The hysteresis stop of the motor-drive unit must be the same in both directions. If it is not the same, it must be readjusted. After adjusting, press the coupling of (1) section to tighten the bolt and lock the locking piece.

Perform a full-scale test operation to check the electrical and mechanical end limit protection of the motor-drive unit.

(3) Protection relay

Once the protective relay is activated, the transformer must be removed immediately by the circuit breaker. To this end, the operational test of the protective relay should include checking that the function of the circuit breaker is good.

In this test, it must be ensured that the transformer is not energized and the ground connection of the transformer is not removed. Secondly, if the trip circuit of the protective relay is connected to the fire fighting equipment, it is also necessary to ensure that the fire fighting equipment does not operate.

The inspection method is as follows:

Open the isolating switch, ground the transformer terminal, and close the circuit breaker.

Open the protective relay cover (3-M6 screw) and press the trip button. The circuit breaker must be disconnected.

Check that the protective relay is in the trip position and the circuit breaker must not be closed.

Reposition the protective relay in the reset position and close the shield.

Once the protective relay is activated, the tap-changer and transformer are not allowed to re-close before the inspection is completed. In this inspection, the core check of the diverter switch must be performed.

Be sure that the cause of the fault has been eliminated or that the tap-changer and transformer are indeed not damaged before they can be put back into operation. The transformer must never be put back into operation before it has been inspected, otherwise it may cause serious damage to the tap-changer and transformer.

(4) Voltage regulator

If the tap-changer has voltage regulator control, check the voltage level, sensitivity (bandwidth) and action delay settings according to their operating instructions to avoid unnecessary tap-change actions.

When further inspection confirms that the tap-changer is all right, it can be put into operation.

7. Common faults and their treatment

7.1 DC resistance is unqualified

Cause of issue:

(1) The static contact produces an oxide film:

Due to the presence of traces of moisture in the transformer, the static contacts on stalls that have not been used for a long time produce an oxide film under the action of oil temperature.

Inspection and elimination method: Combine the transformer minor repair every year and perform 3 cycles of tap change.

(2) When the main contact spring is subjected to high temperature and pressure for a long time, the spring force is reduced to cause poor contact.

(3) Poor contact in a part of the tap changer:

Poor contact between the main contact of the diverter switch and the static contact.

Poor contact between the oil chamber static contact and the core contact.

Poor contact in the connecting wire between the diverter switch insulation barrel and the selector.

The contact between the moving and closing contacts of the selector switch is not good.

The selector is deformed by an external force.

The transformer lead tap is not properly fastened to the selector terminal.

7.2 Tap changer oil leakage

Symptoms and causes:

(1) Oil leakage at each seal of the head cover - seal aging.

(2) Oil leakage between the upper and lower flanges - the seal is aging or the bolts are not tightened.

(3) Oil leakage at the output shaft at the bottom of the oil chamber - oil seal aging.

(4) Oil leakage in the oil switch of the tap-changer - sealing aging.

(5) New switch oil leakage:

The drain valve is not tightened after the second drying.

The bolts between the upper and lower flanges are not tightened.
The head seal is damaged during secondary assembly.
If the oven temperature is too high, the seal will be baked.

7.3 Light gas action

Cause of issue:

(1) The inclination of the connecting pipe from the gas relay to the switch oil bolster (2%) does not meet the requirements, and the gas generated by the normal pressure regulation cannot be smoothly discharged.
(2) The gas relay malfunctions.
(3) The pressure resistance of the oil in the OLTC oil tank drops, causing the arc extinguishing ability of the oil to decrease, thereby causing an increase in the amount of gas generated during the voltage regulation.

7.4 Heavy gas action

Cause of issue:

(1) The internal screw of the switch is loose and falls off, causing the transition resistance to be short-circuited.
(2) The energy storage mechanism trips, causing an open circuit.
(3) The switch spring breaks to cause slow motion, causing the transition resistance to generate a large amount of gas due to the long switching time.
(4) The contact pressure between the diverter switch and the oil chamber contact is insufficient, causing the contact temperature to be too high and burning.
(5) The insulation is aged and broken down.
(6) The oil insulation is lowered due to poor sealing, so that the tap changer is subjected to the breakdown of the ground insulation portion.

7.5 The motor-drive unit completes a tap-change operation, but the tap-changer does not operate.

Cause of issue:

(1) The mechanical connection of the tap changer to the motor-drive unit is disengaged (for example, the vertical or horizontal rotation of the connecting pin is detached).
(2) The combined tap changer drive shaft is broken. (The drive shaft includes a connecting shaft that protrudes from the upper portion of the switching core and meshes with the head gear, an intermediate insulating shaft, a transmission shaft that passes through the contact system, and an output shaft that is at the bottom of the oil chamber.)

(3) The gears inside the gear cover of the switch head cover or the gears of the angle gear box are detached or damaged.
(4) The number of connection points of the tap changer and the motor-drive unit is incorrect (the switch has not been switched after the motor-driven unit stops).

Inspection and troubleshooting methods:

Parts that have been damaged must be replaced. After checking that the position of the tap-changer is the same as the position indicated by the motor-drive unit, reconnect and perform the connection test.

7.6 Reflecting the switching time is too long or not switching in the oscillogram

Cause of issue:

The energy storage spring is fatigued, weakened, broken or mechanically stuck.

Inspection and troubleshooting methods:

Replace the spring or overhaul the transmission machinery.

7.7 The oil level of the oil storage cabinet of the tap changer is abnormally raised

Cause of issue:

If the similar fault phenomenon continues to occur after adjusting the oil level of the tap changer oil storage cabinet, it should be judged that the oil chamber seal is defective, causing the oil in the oil chamber to leak with the transformer body oil. During installation, the oil release valve at the bottom of the oil compartment is not closed or the communication pipe between the oil compartment and the transformer tank is not removed. If the oil drain bolts in the oil compartment are not tightened, it will also cause oil leakage.

Inspection and troubleshooting methods:

The tap-changer is uncovered to find the leaking point. If there is no leakage oil, the core should be lifted out, the insulating oil in the oil chamber should be exhausted, and the inner wall of the insulating cylinder, the tapped lead bolt and the shaft seal should be observed under the oil pressure of the transformer body. Is there any leakage oil? Then, replace the seal or seal it. If there are venting holes or oil drain bolts, tighten the bolts and replace the seals. Remove the connecting pipe between the oil compartment and the transformer tank.

7.8 Hydrogen, acetylene and total hydrocarbon content in the chromatographic analysis of the insulating oil in the transformer body

Cause of issue:

Chromatographic tracking analysis of the insulating oil of the transformer body, if the dissolved gas combination content and the gas production rate show a downward trend, it is judged that the insulating oil of the oil chamber leaks into the transformer body.

Inspection and troubleshooting methods:

Check the oil chamber first and check the oil chamber for leaks. After this reason is ruled out, it may be caused by poor contact of the selector.

7.9 Failure of the energy storage mechanism (only for the combined tap changer with the gun type energy storage mechanism)

Cause of issue:

After the tap changer is dry, there is no oil operation; the foreign matter falls into the diverter switch core; the misplaced gun machine causes the mechanism to be in the tripped state.

Inspection and troubleshooting methods:

It is strictly forbidden to operate without oil after drying to remove foreign matter.

7.10 waveform is not normal

cause of issue:

(1) The three phases are not synchronized during switching - after the repair, the curved plate is not installed.

(2) A half-wave waveform appears—the switch resistance is too small, and the sensitivity of the measuring instrument is low and cannot be triggered.

(3) Half of the oscilloscope is open-circuited — the transitional resistance is singular or even-numbered.

(4) The oscillogram shows irregular bounce:

The curved plate fastening screws are loose.

The contact fastening screws are loose.

The transition resistance fastening screw is loose.

(5) The so-called "zero crossing" phenomenon - caused by the oxide film of the switch contact and the inductance effect of the transformer.

8. Warranty

The manufacturer shall provide free repairs if the product fails to function properly due to manufacturing quality problems within 12 months from the date of installation or use, or within 18 months from the date of shipment to the manufacturer.

If the tap changer or motor-drive unit has a serious fault, and it is not easy to repair at the operation site, or the protection relay has tripped, please contact the after-sales service department of Changzheng Electric Co., Ltd. directly.

9. Appendices

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. and wiring diagram
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Appendix 1 ZM OLTC technical data

Item	Specification		III300	III500	III600	I301	I501	I601	I800	I1200	I1500
1	Max. rated through current (A)		300	500	600	300	500	600	800	1200	1500
2	Rated frequency (Hz)		50 or 60								
3	Phase & Connection method		3 Phase Y connect neutral point			Single phase Arbitrary connection mode					
4	Max. rated step voltage (V)		3300								
5	Rated step capacity (kVA)		1000	1400	1500	1000	1400	1500	2640	3100	3500
6	Short circuit current (kA)	Thermal (3s)	6	8	8	6	8	8	16	24	24
		Dynamic (peak)	15	20	20	15	20	20	40	60	60
7	Operating position number		Linear regulating 7, 10, 12, 14, 16, 18, 22, 34 Reversing and coarse regulating: ±3~±17								
8	Insulation level of tap changer (kV)	Rated voltage	35	66		110		150		220	
		Max. service voltage	40.5	72.5		126		170		252	
		Power frequency withstand voltage (50Hz, 1min)	85	140		230		325		460	
		Lightning impulse withstand voltage (1.2/50μs)	200	350		550		750		1050	
9	Tap selector		4 Grades of A, B, C, D according to insulation level								
10	Mechanical service life		⩾800000 times								
11	Electric service life		⩾20000 times								
12	Oil compartment for diverter switch	Service pressure	3×10^4Pa								
		Sealing property	No leakage under 6×104Pa for 24 hours								
		Over pressure protection	Blasting cap blast at (4~5) ×105Pa								
		Protective relay	QJ4-25 oil flow speed set at 1.0m/s±10%								
13	Oil drainage volume (L)		Above 190~270								
14	Oil filling volume (L)		Above 125~190								
15	Weight (kg)		Above 240~350								
16	Motor-driven mechanism		ZD/MAE/MA7B								

Note:

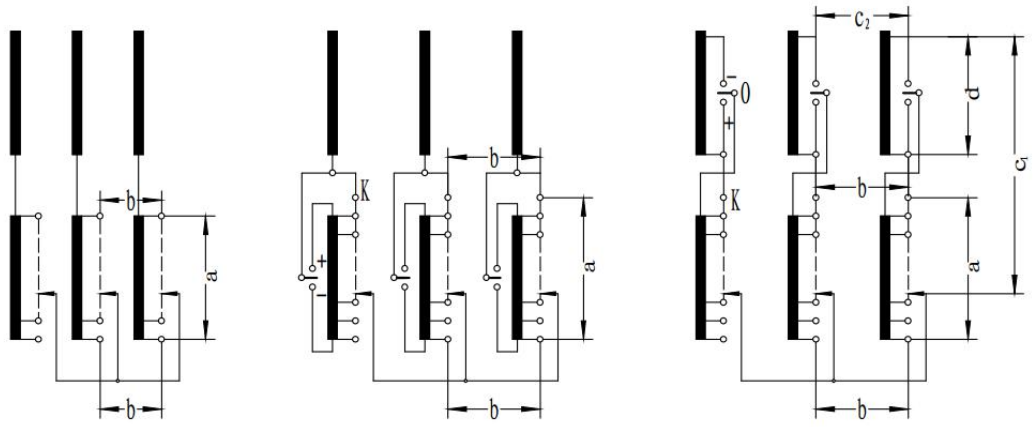
1. Step capacity=Step voltage×Load current, Rated step capacity is the maximum allowed continuous capacity.
2. When 3 phase tap changer parallel to be a single phase tap changer, should think about transformer coil shunt, ZMI800 two way shunt, ZMI1200, I1500 three way shunt.
3. The single-phase linear tap changer with 34 working positions only has: I500A、I800A、I1500A.

Appendix 2 ZM OLTC internal insulation level

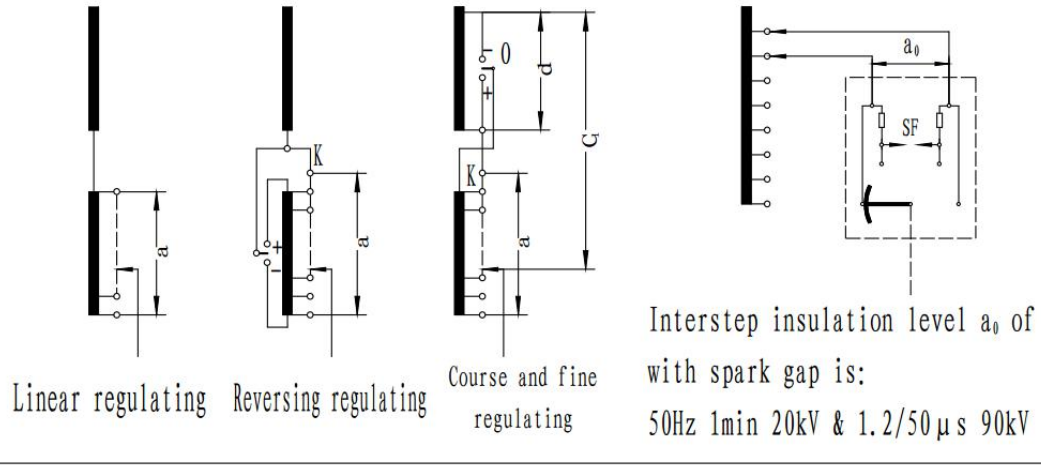
Insulation distance symbol	Tap selector type A		Tap selector type B		Tap selector type C		Tap selector type D	
	kV 1.2/50μs	kV 50Hz1min	kV 1.2/50μs	kV 50Hz1min	kV 1.2/50μs	kV 50Hz1min	kV 1.2/50μs	kV 50Hz1min
a	135	50	265	50	350	82	490	105
b	135	50	265	50	350	82	490	146
c_1	200	95	485	143	545	178	590	208
c_2	200	95	495	150	550	182	590	225
d	135	50	265	50	350	82	490	105

Insulation distance of every part of voltage regulating coil

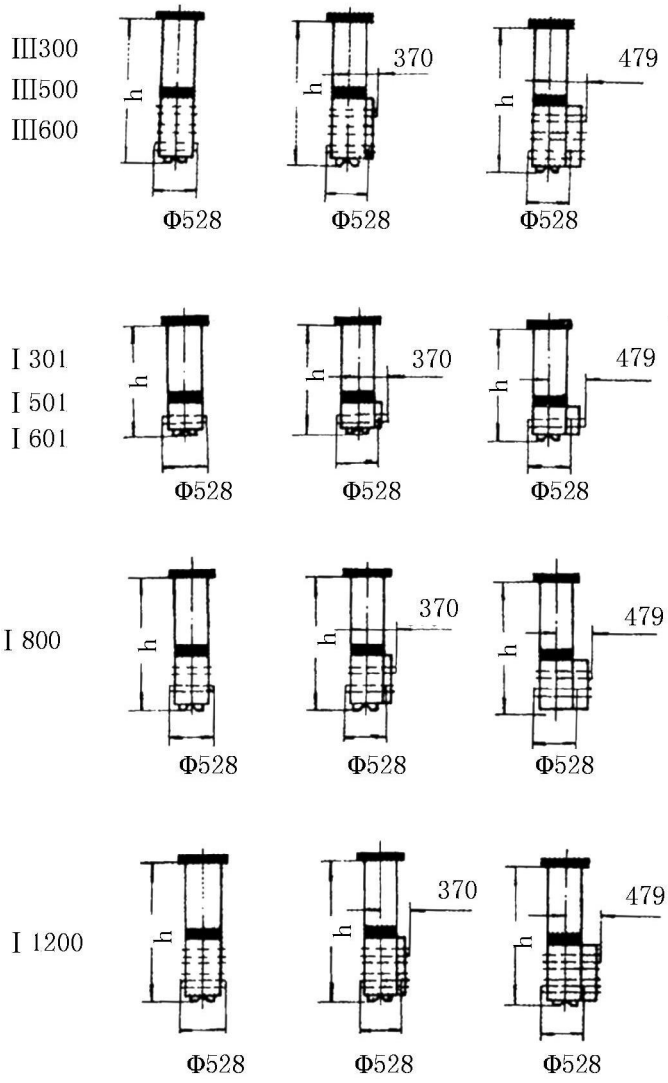
Ⅲ300、Ⅲ500、Ⅲ600



Ⅰ301、Ⅰ501、Ⅰ601、Ⅰ800、Ⅰ1200、Ⅰ1500



Appendix 3 Overview of the dimensions of the ZM OLTC



Installating high K

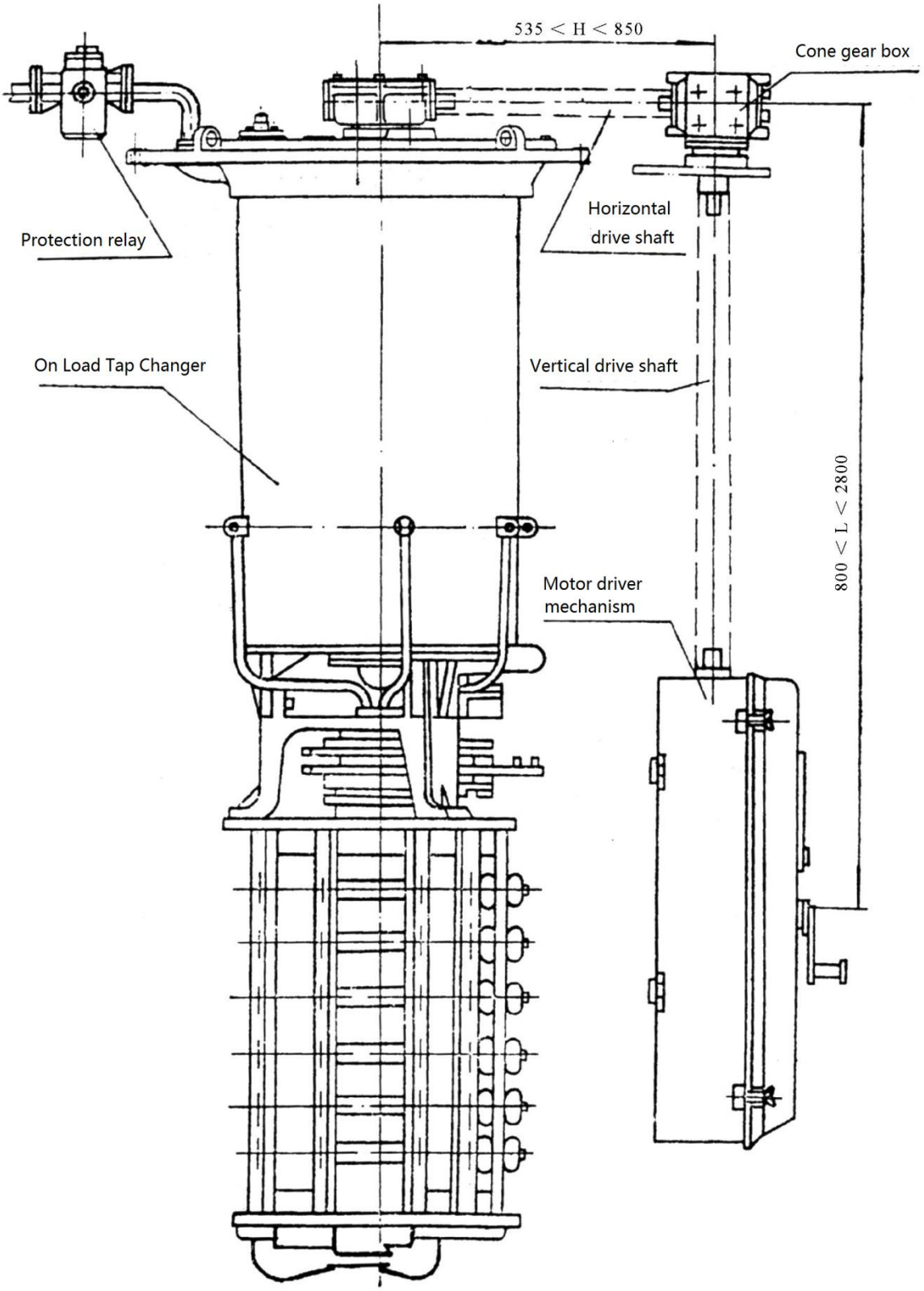
OLTC highest voltage	Selector insulation level				
	A	B	C	D	
				change-over selector	
				W/O	With
40. 5kV	1795	—	—	—	—
72. 5kV	1795	1893	2068	2253	2523
126kV	—	2023	2198	2383	2653
252kV	—	2253	2428	2613	2883

OLTC highest voltage	Selector insulation level		
	B	C	D
72. 5kV	1513	1588	1783
126kV	1643	1718	1913
252kV	1873	1948	2143

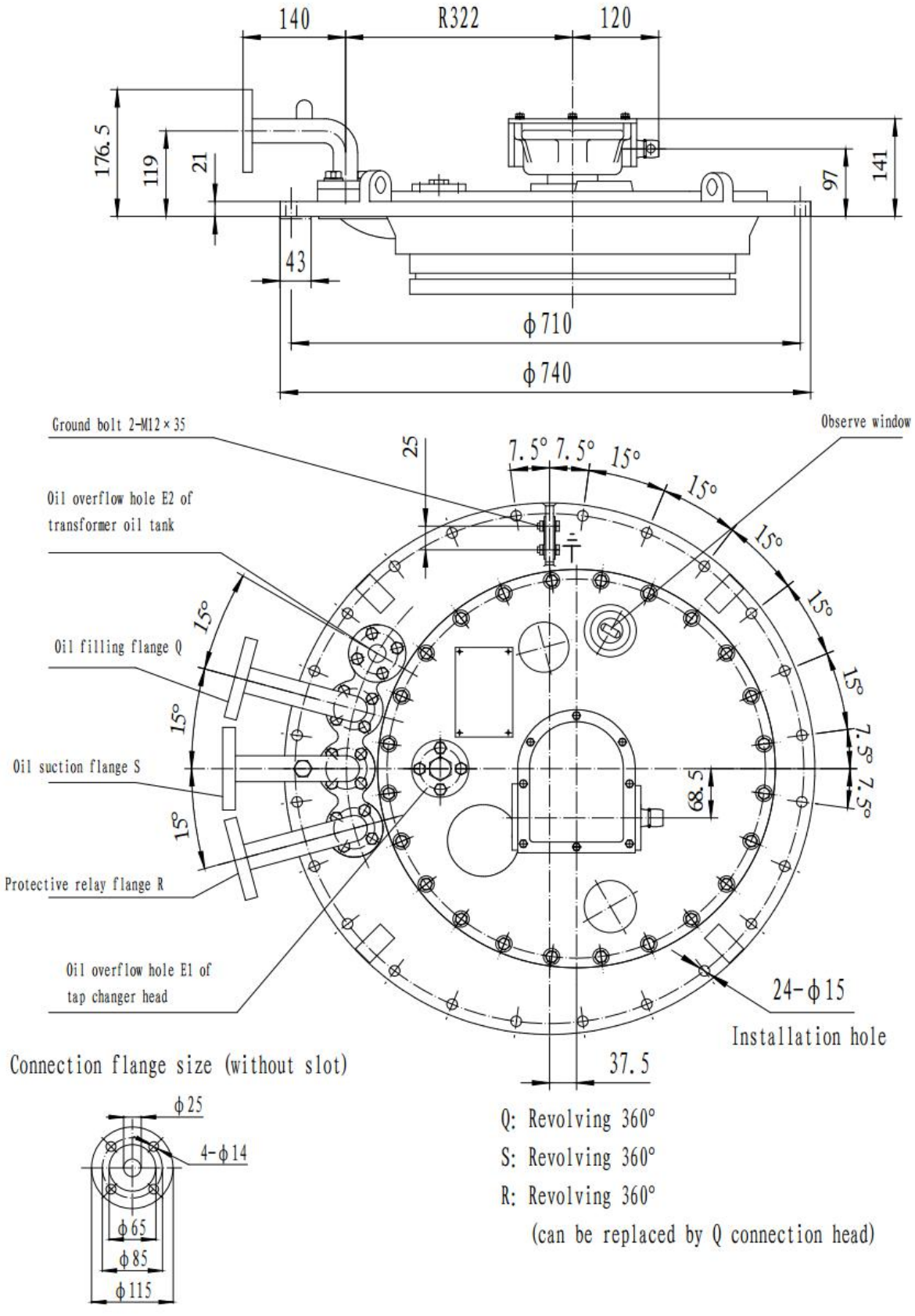
OLTC highest voltage	Selector insulation level		
	B	C	D
72. 5kV	1698	1773	1968
126kV	1828	1903	2098
252kV	2058	2133	2328

OLTC highest voltage	Selector insulation level		
	B	C	D
72. 5kV	1883	1958	2153
126kV	2013	2088	2283
252kV	2243	2318	2513

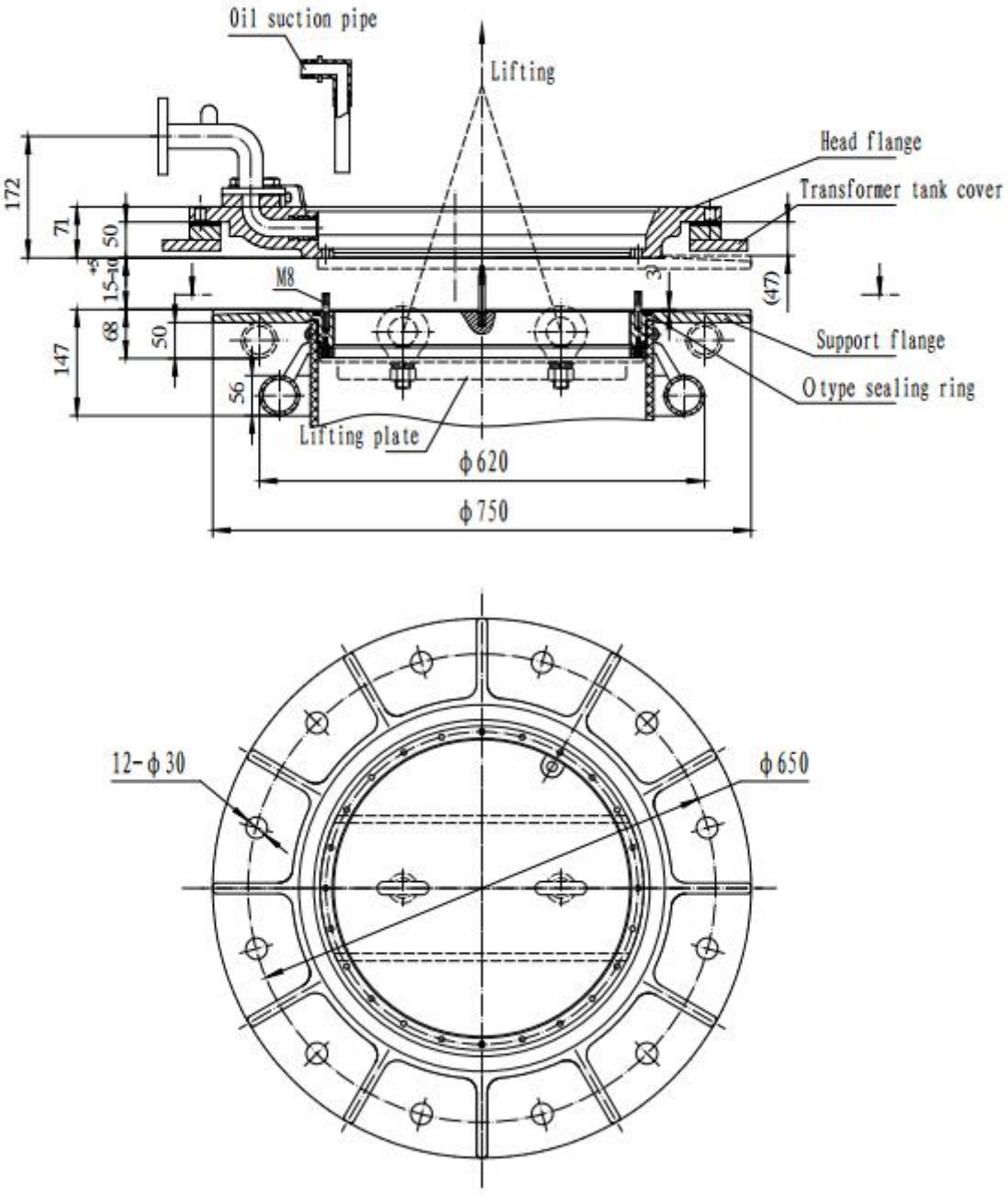
Appendix 4 OLTC overall installation layout



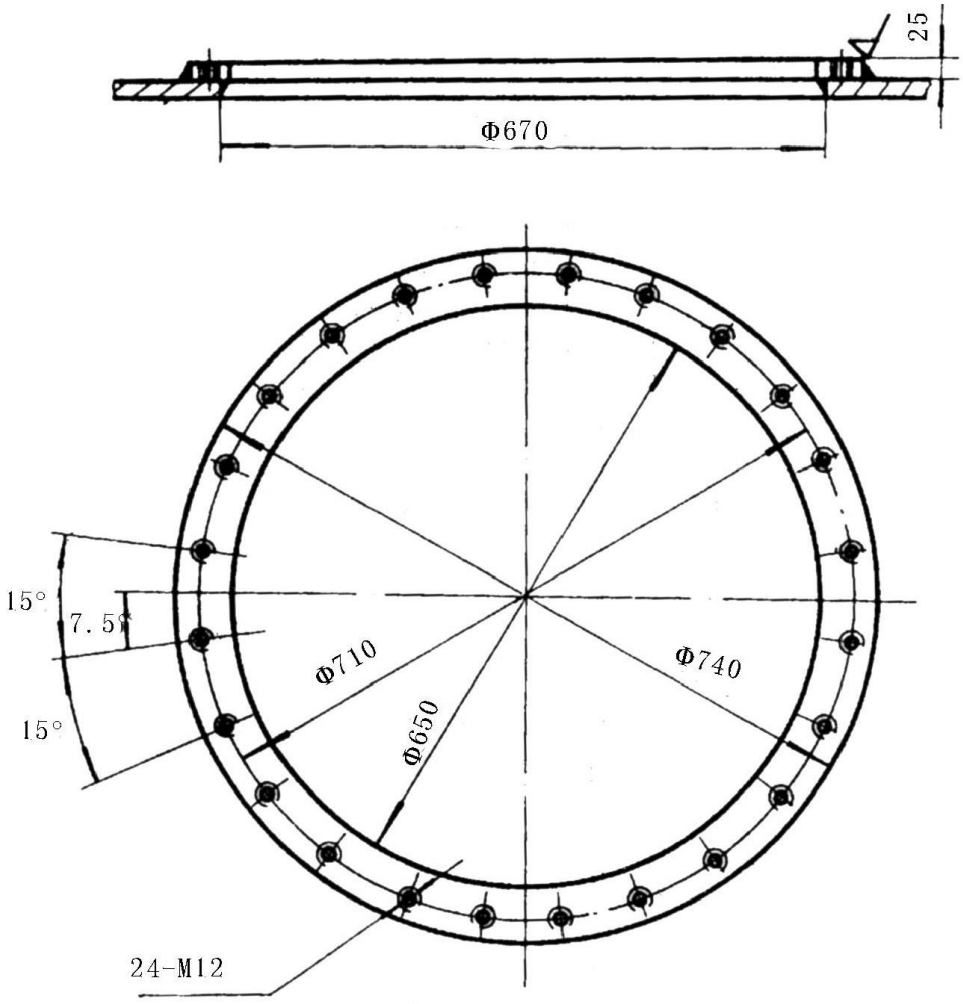
Appendix 5 Box type installation dimension drawing



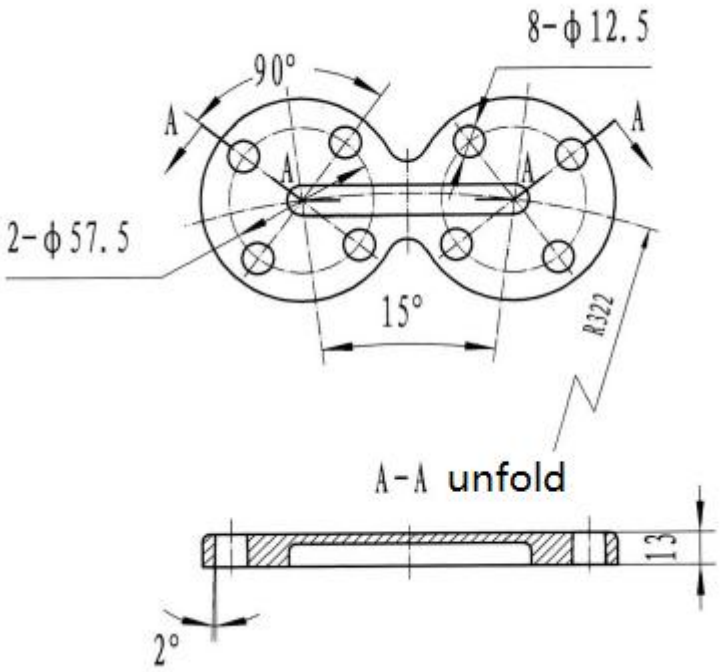
Appendix 6 Bell type installation dimension drawing



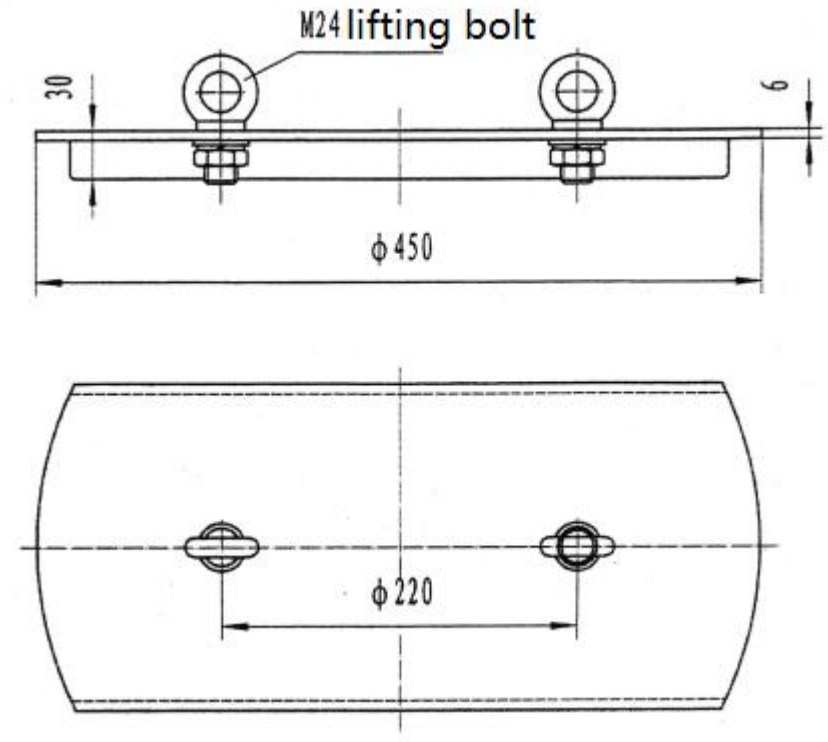
Appendix 7 Box cover installation flange drawing



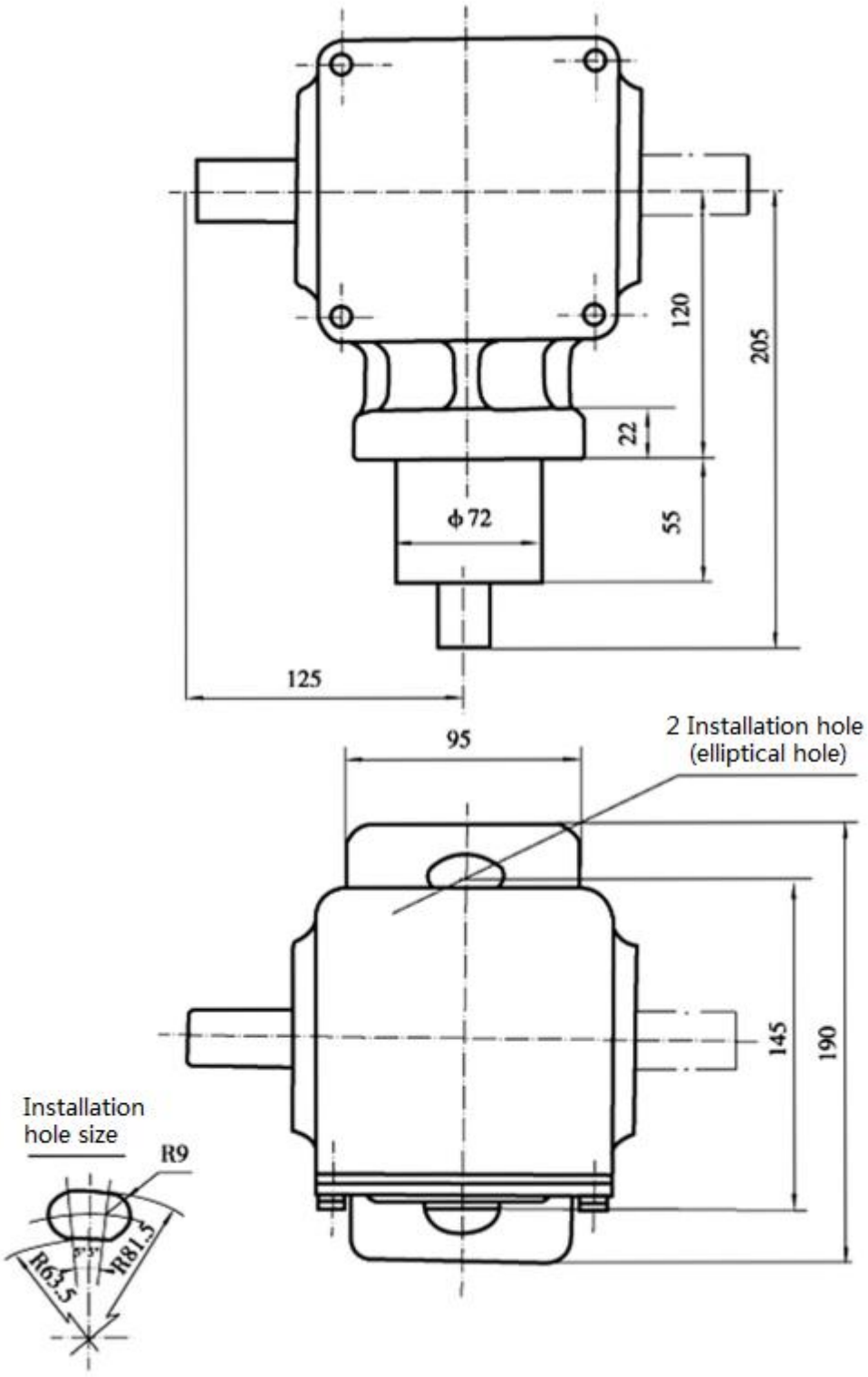
Appendix 8 Bypass structure drawing



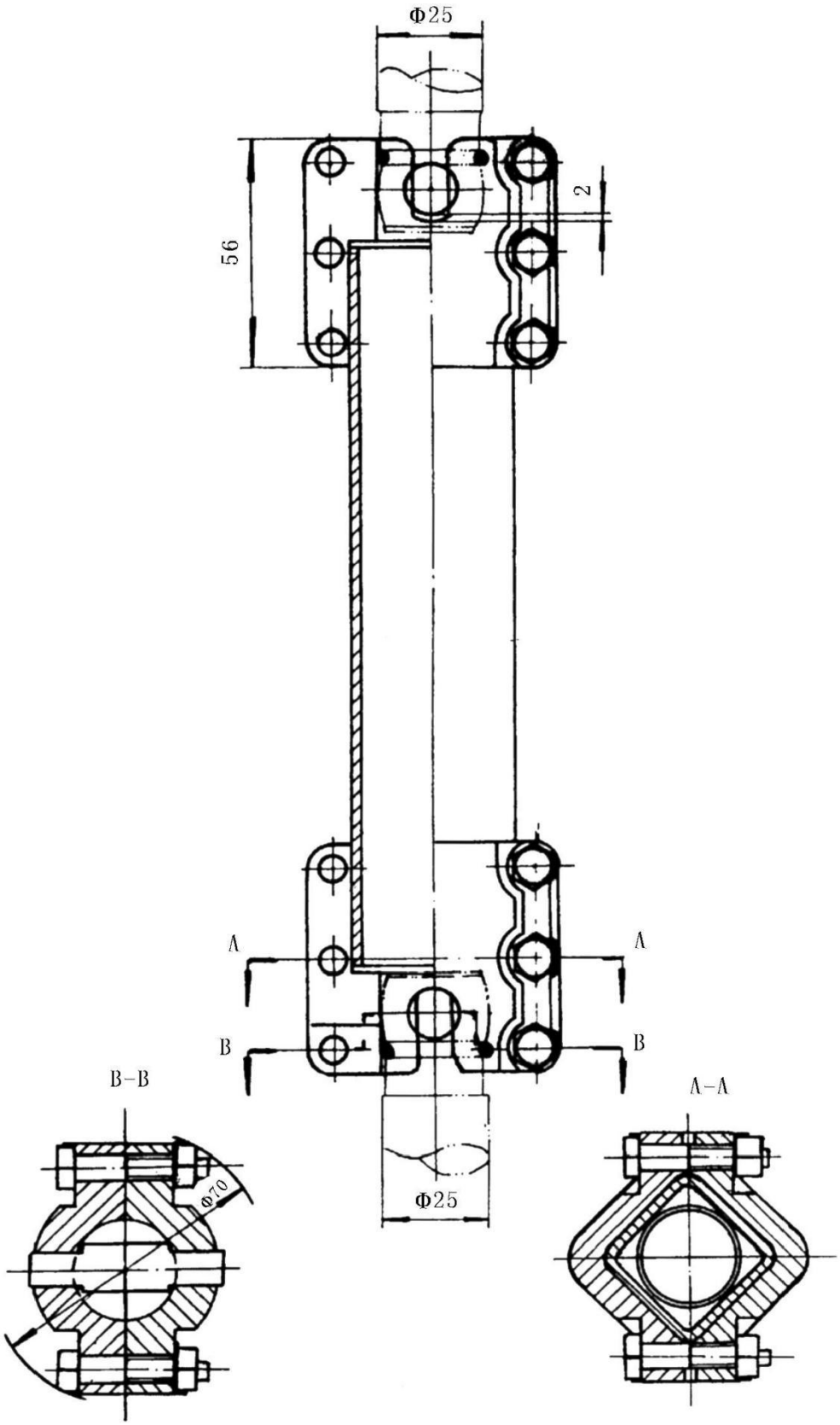
Appendix 9 Lifting plate



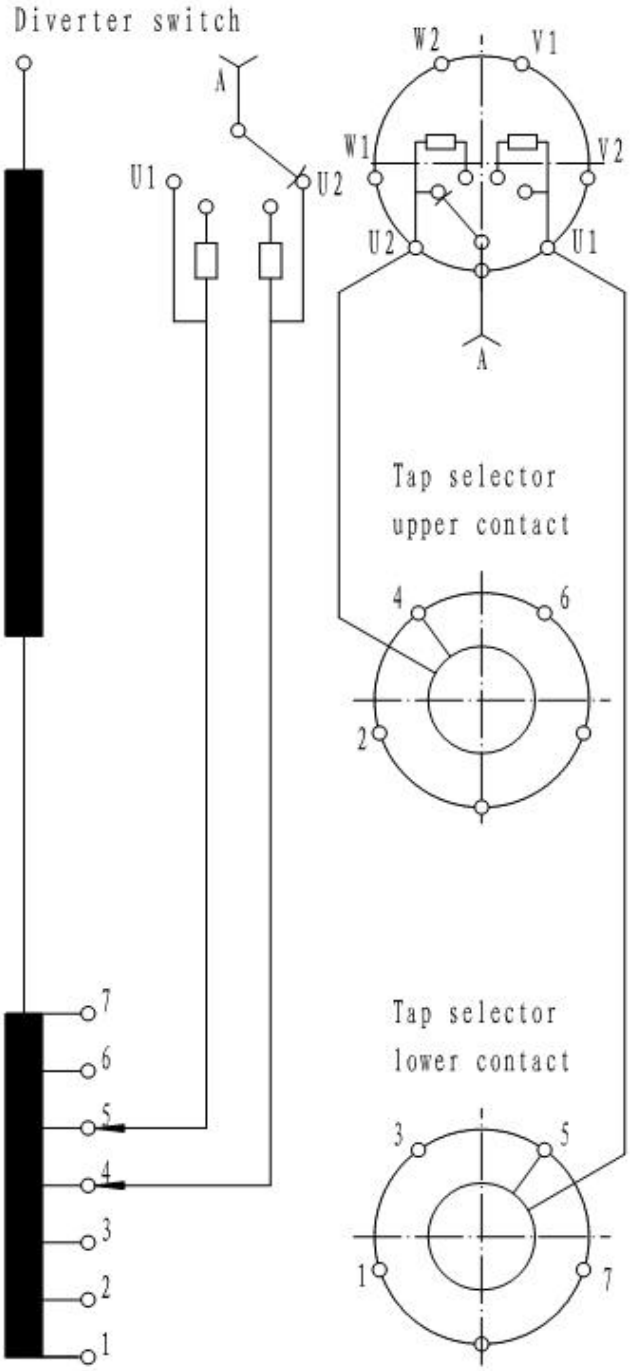
Appendix 10 Cone gear box installation dimension



Appendix 11 Horizontal and vertical drive shaft installation diagram



Appendix 12 ZM OLTC 10070 Working position table and wiring diagram

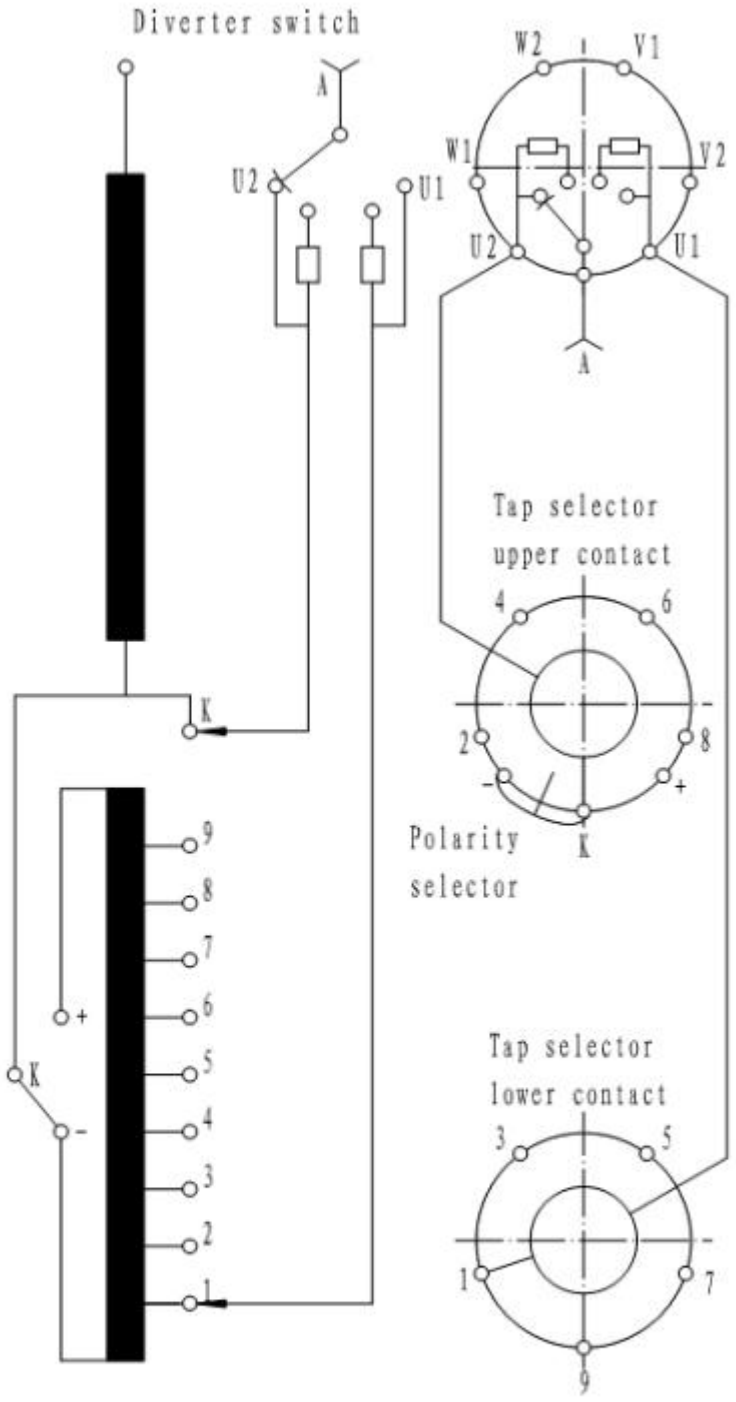


Indicated position	Tap selector position	Diverter switch position	Switching direction 1 → N	Contact position Tap selector Upper	Contact position Tap selector Lower	Switching direction	Contact position Tap selector Upper	Contact position Tap selector Lower
1	1	U1		2	1		2	1
2	2	U2		2	1		2	3
3	3	U1		2	3		4	3
● 4	4	U2		4	3		4	5
5	5	U1		4	5		6	5
6	6	U2		6	5		6	7
7	7	U1		6	7		6	7

Note:

1. " ● "mark is setting working position.
2. " ◤ "mark is working contact of tap selector contact.

Appendix 13 ZM OLTC 10191W Working position table and wiring diagram

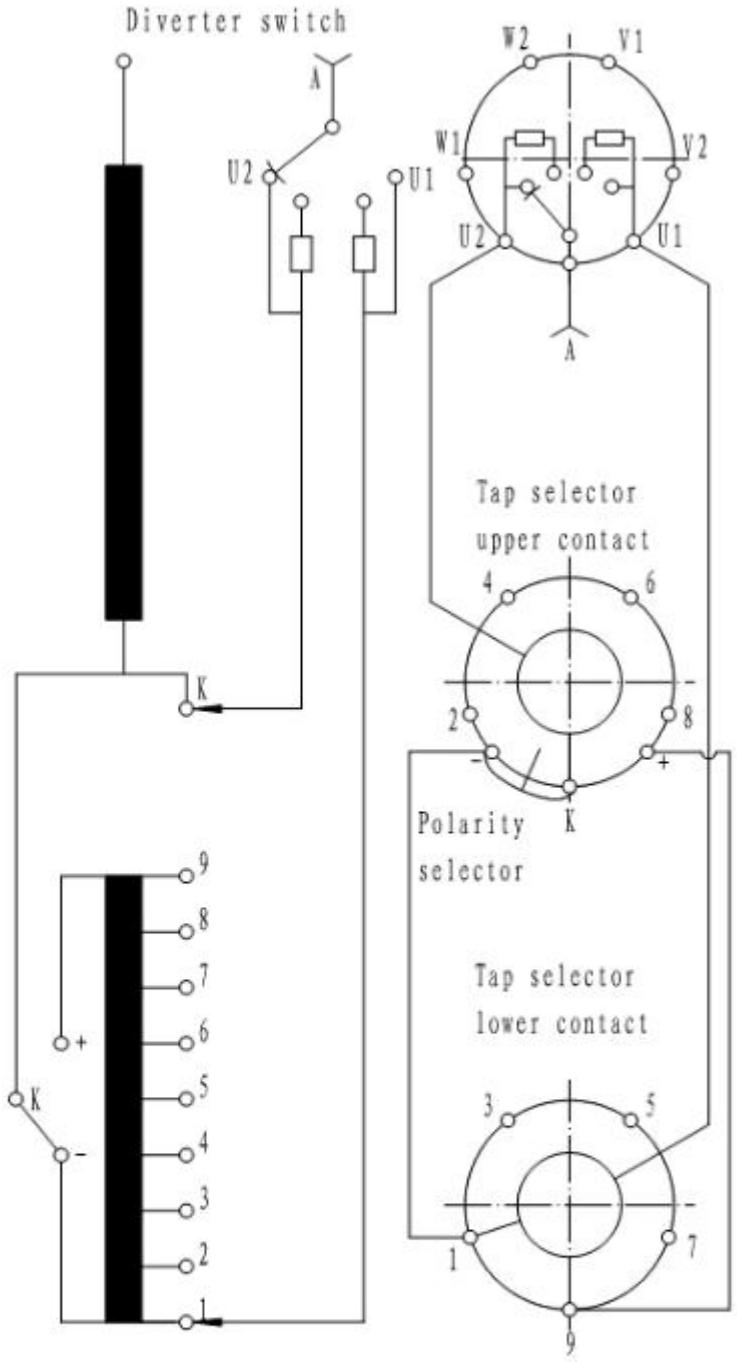


Indicated position	Tap selector position	Polarity selector position	Diverter switch position	Switching direction	Contact position: Tap selector: Upper	Contact position: Tap selector: Lower	Switching direction	Contact position: Tap selector: Upper	Contact position: Tap selector: Lower
1	1		U1		2	1		2	1
2	2		U2		2	1		2	3
3	3		U1		2	3		4	3
4	4		U2		4	3		4	5
5	5		U1		4	5		6	5
6	6		U2		6	5		6	7
7	7		U1		6	7		8	7
8	8		U2		8	7		8	9
9	9		U1		8	9		K	9
●10	K		U2		K	9		K	1
11	1		U1		K	1		2	1
12	2		U2		2	1		2	3
13	3		U1		2	3		4	3
14	4		U2		4	3		4	5
15	5		U1		4	5		6	5
16	6		U2		6	5		6	7
17	7		U1		6	7		8	7
18	8		U2		8	7		8	9
19	9		U1		8	9		8	9

Note:

1. "●" mark is setting working position.
2. "◤" mark is working contact of tap selector contact.

Appendix 14 ZM OLTC 10193W Working position table and wiring diagram



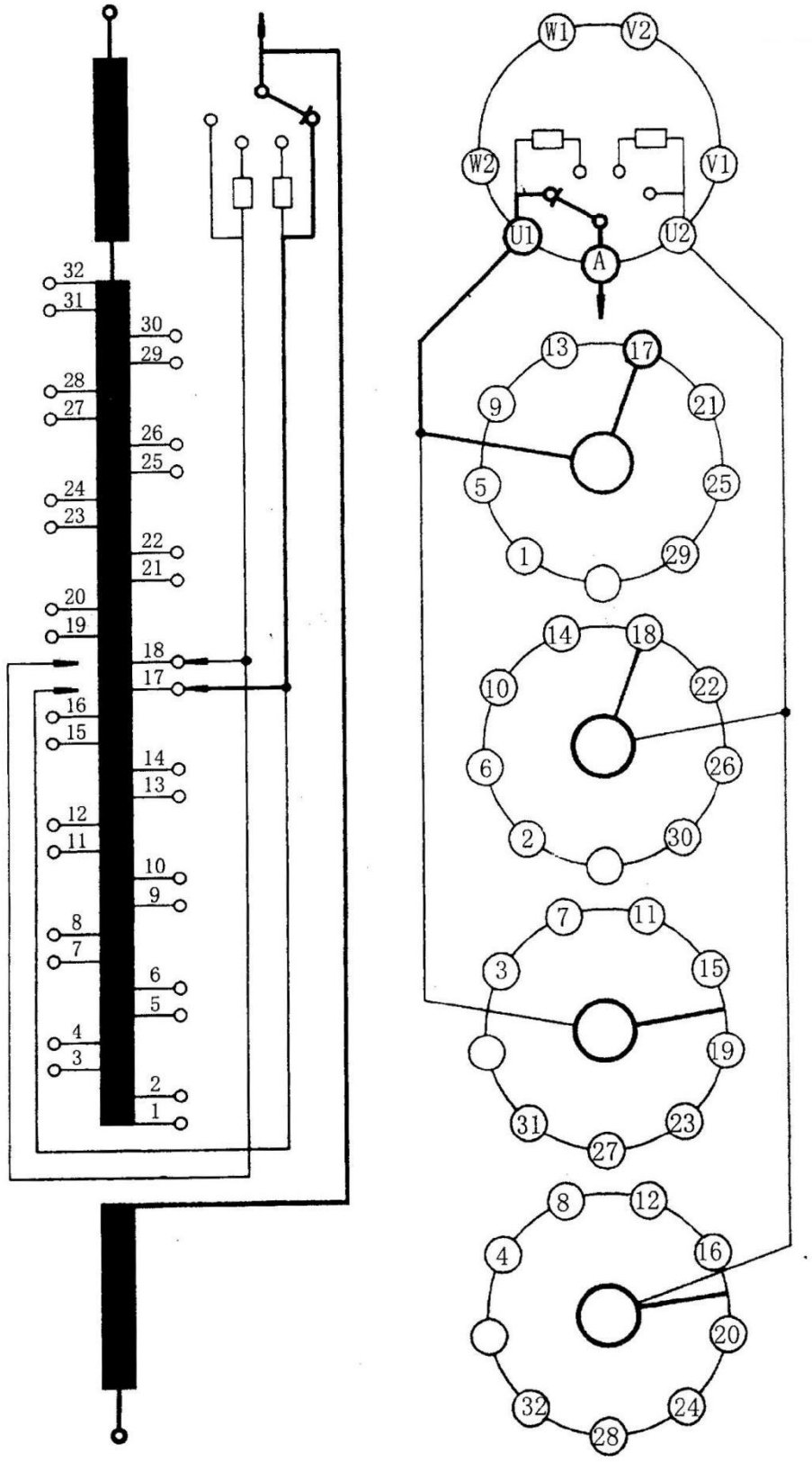
Indicated position	Tap selector position	Polarity selector position	Diverter switch position	Switching direction 1 → N	Contact position Tap selector Upper	Contact position Tap selector Lower	Switching direction N → 1	Contact position Tap selector Upper	Contact position Tap selector Lower
1	1		U1		2	1		2	1
2	2		U2		2	1		2	3
3	3		U1		2	3		4	3
4	4		U2		4	3		4	5
5	5	+K	U1		4	5		6	5
6	6		U2		6	5		6	7
7	7		U1		6	7		8	7
8	8		U2		8	7		8	9
9a	9		U1		8	9		K	9
●9b	K		U2		K	9		K	1
9c	1		U1		K	1		2	1
10	2		U2		2	1		2	3
11	3		U1		2	3		4	3
12	4		U2		4	3		4	5
13	5	-K	U1		4	5		6	5
14	6		U2		6	5		6	7
15	7		U1		6	7		8	7
16	8		U2		8	7		8	9
17	9		U1		8	9		8	9

Note:

1. "●" mark is setting working position.
2. "◤" mark is working contact of tap selector contact.
3. 9a, 9b, 9c the 3 position are equipotential.

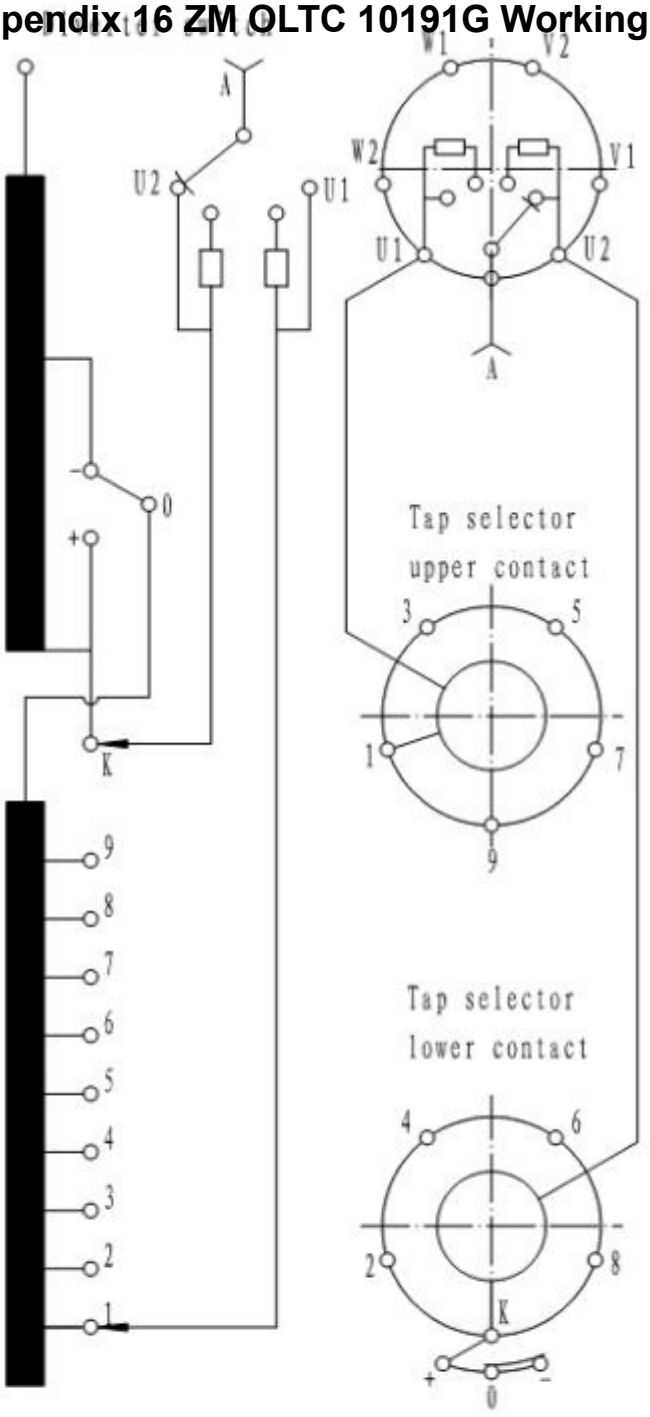
Appendix 15 ZM OLTC I500 Multiple linear regulating

34320 working position table and wiring diagram



Indicted position	Tap selector position
32	32
31	31
30	30
29	29
28	28
27	27
26	26
25	25
24	24
23	23
22	22
21	21
20	20
19	19
18	18
•17	17
16	16
15	15
14	14
13	13
12	12
11	11
10	10
9	9
8	8
7	7
6	6
5	5
4	4
3	3
2	2
1	1

Appendix 16 ZM OLTC 10191G Working position table and wiring diagram

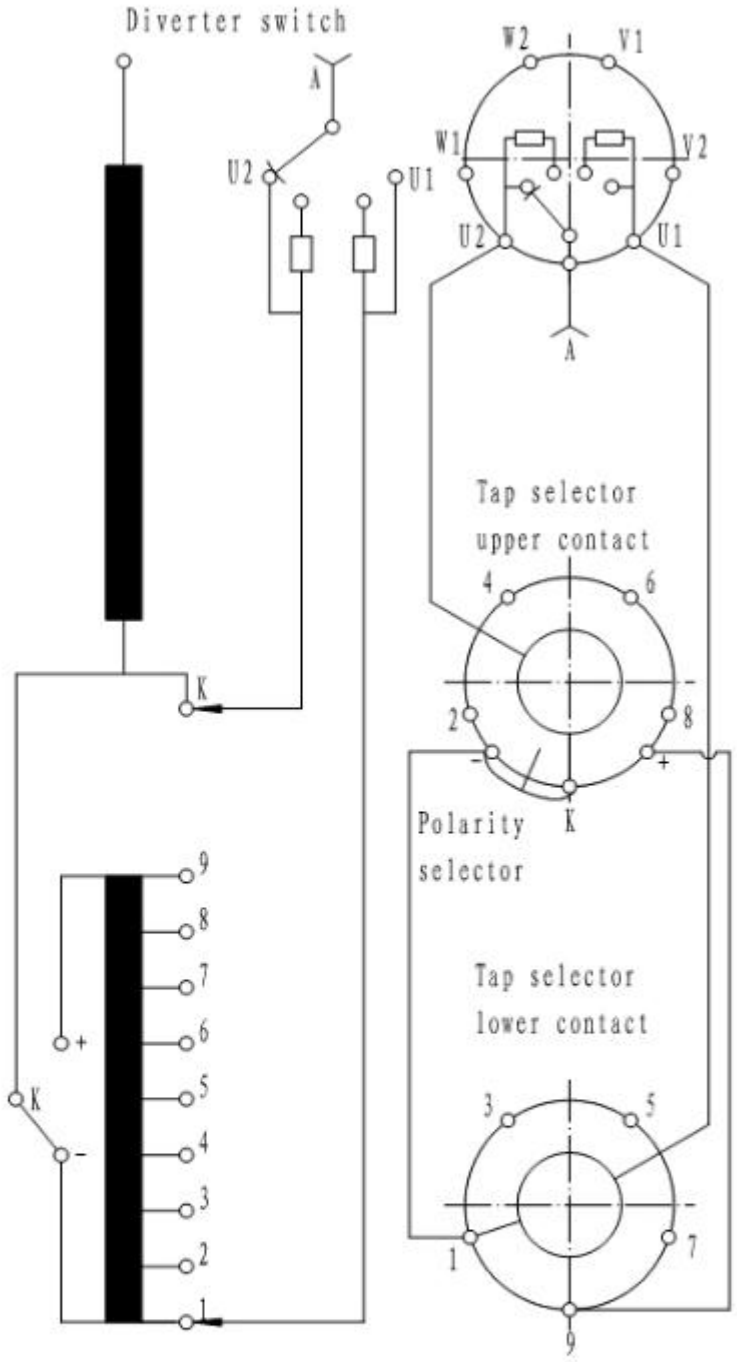


Indicated position	Tap selector position	Polarity selector position	Diverter switch position	Switching direction 1 → N	Contact position		Switching direction N → 1	Contact position	
					Tap selector			Tap selector	
					Upper	Lower		Upper	Lower
1	1		U1		1	2		1	2
2	2		U2		1	2		3	2
3	3		U1		3	2		3	4
4	4		U2		3	4		5	4
5	5		U1		5	4		5	6
6	6	+	U2		5	6		7	6
7	7		U1		7	6		7	8
8	8		U2		7	8		9	8
9	9		U1		9	8		9	K
●10	K		U2		9	K		1	K
11	1		U1		1	K		1	2
12	2		U2		1	2		3	2
13	3		U1		3	2		3	4
14	4		U2		3	4		5	4
15	5	−	U1		5	4		5	6
16	6		U2		5	6		7	6
17	7		U1		7	6		7	8
18	8		U2		7	8		9	8
19	9		U1		9	8		9	8

Note:

1. " ● "mark is setting working position.
2. " ◤ "mark is working contact of tap selector contact.
3. Connection between tap selector contact"+ - 4", "- - 1", "2-2", "3-3" by user.

Appendix 17 ZM OLTC 10193G Working position table and wiring diagram



Indicated position	Tap selector position	Polarity selector position	Diverter switch position	Switching direction 1 → N	Contact position Tap selector Upper	Contact position Tap selector Lower	Switching direction N → 1	Contact position Tap selector Upper	Contact position Tap selector Lower
1	1		U1		2	1		2	1
2	2		U2		2	1		2	3
3	3		U1		2	3		4	3
4	4		U2		4	3		4	5
5	5	+K	U1		4	5		6	5
6	6		U2		6	5		6	7
7	7		U1		6	7		8	7
8	8		U2		8	7		8	9
9a	9		U1		8	9		K	9
●9b	K		U2		K	9		K	1
9c	1		U1		K	1		2	1
10	2		U2		2	1		2	3
11	3		U1		2	3		4	3
12	4		U2		4	3		4	5
13	5	-K	U1		4	5		6	5
14	6		U2		6	5		6	7
15	7		U1		6	7		8	7
16	8		U2		8	7		8	9
17	9		U1		8	9		8	9

Note:

1. "●" mark is setting working position.
2. "◤" mark is working contact of tap selector contact.
3. 9a, 9b, 9c the 3 position are equipotential.

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