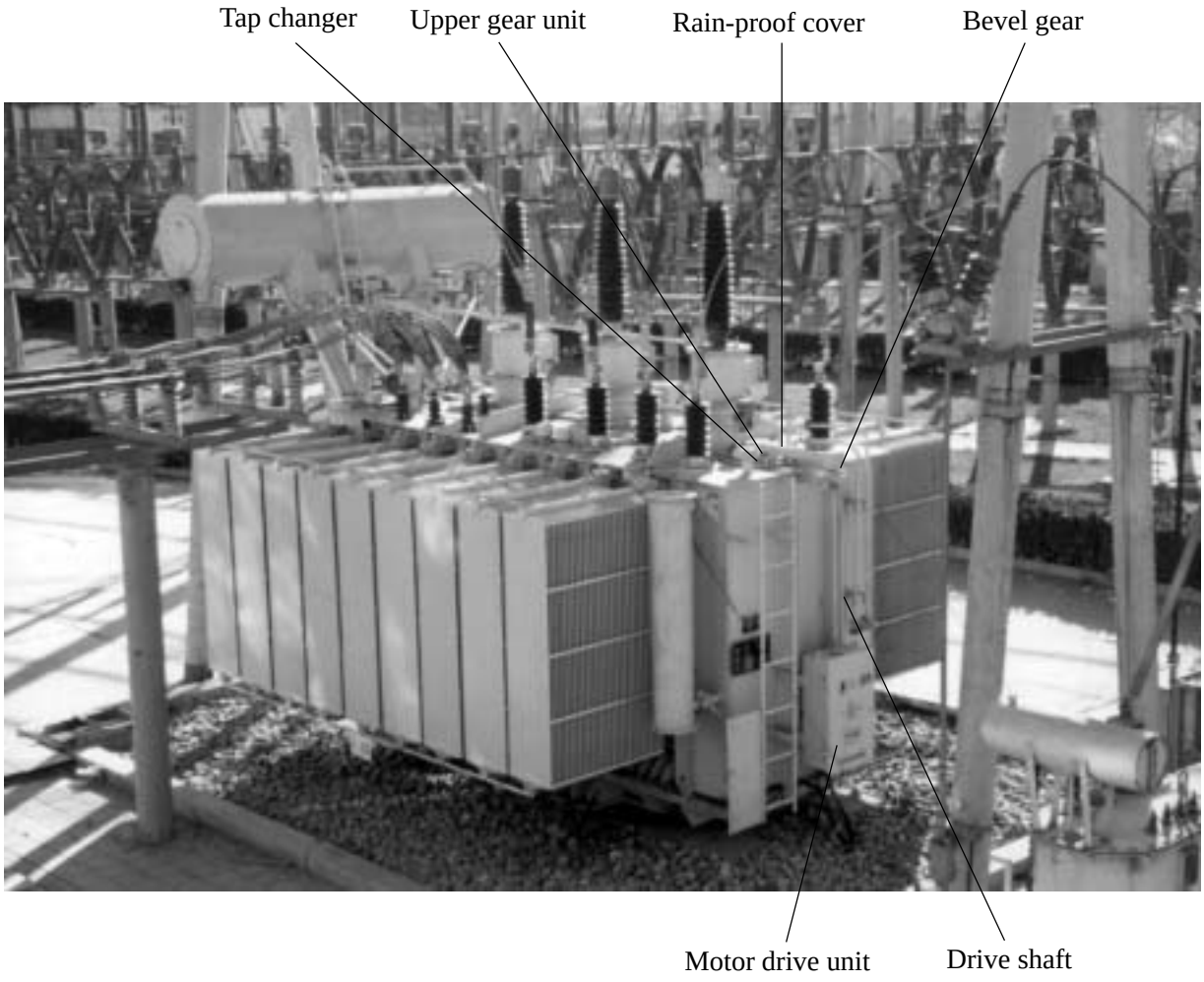
华明
HUAMING

ON-LOAD TAP CHANGER
TYPE CM
Operation Instructions

HM 0.460.301

Shanghai Huaming Power Equipment Co., Ltd


Tap changer
Upper gear unit
Rain-proof cover
Bevel gear
Motor drive unit
Drive shaft

Thank you for using our on load tap changer.

Prior to use our on load tap changer, make sure to pay attention to the following item:

1. Don’t remove Pins on diverter switch and tap selector before tap changer start up.

2. Check 6 lead wires on tap selector, if loosen, the fixing screw under lead wire must be secured.

3. Diverter switch、tap selector and motor driver unit must be connected at the same position (mid position).

4. The tap changer mustn’t be operated when it has been dried and not filled with oil. If the operation is inevitable, the turn part and touch part of diverter switch and tap selector must be lubricated with grease.

5. The tap changer must be checked and the motion angles must be adjusted after the drive shaft has been installed on transformer (See operation instruction for details).

6. The drive shaft must be exactly fit for operation, can’t be too short in order to prevent from falling off.

7. Tap changer head worm and worm gear reducer can be custom-made according to customer’s need. Loose press bolt to adjust angle. Please be sure to secure the press bolt upon the completion of adjustment.

Table of contents

1. General

CM on load tap changer (OLTC) applies to power and rectifier transformers with High Voltage for equipment 40.5kV, 72kV,126kV,170kV and 250kV, maximum rated through current 600A for three poles and 1500A for single poles, frequency 50Hz or 60Hz by changing the taps under load for the purpose of voltage regulation. Three phase OLTC are used at the neutral point of the Y connection, the single phase OLTC may be used for any connections. CM OLTC is a typical combination OLTC, which consists of three main portions: oil compartment, diverter switch and tap selector.

CM OLTC will be fastened to the transformer tank cover by its tap changer head which serves also for connecting to the motor driver unit CAM7 or SHM-1 via the worm wheel reducer and bevel gear box (attachment) for the purpose of tap changing.

When CM OLTC is used without change-over selector, the maximum operating positions available will be 17, and will be up to 35 in case it is used with change-over selector.
(special design is exclusive).

This operating instruction includes all the necessary information for the installation and operation of CM OLTC. Any change of structure without prior notice.

Figure 1. outline view of CM OLTC

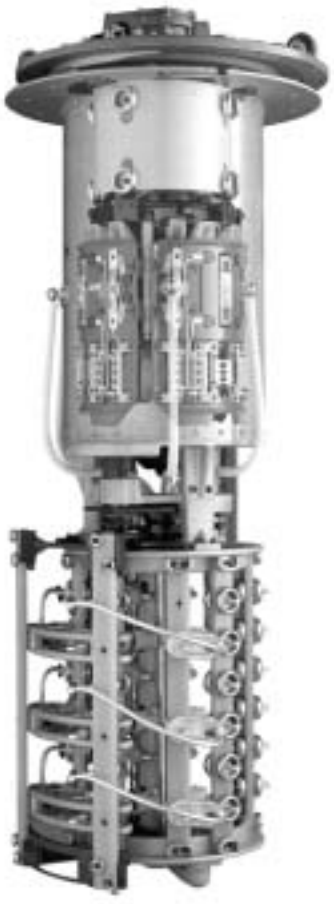
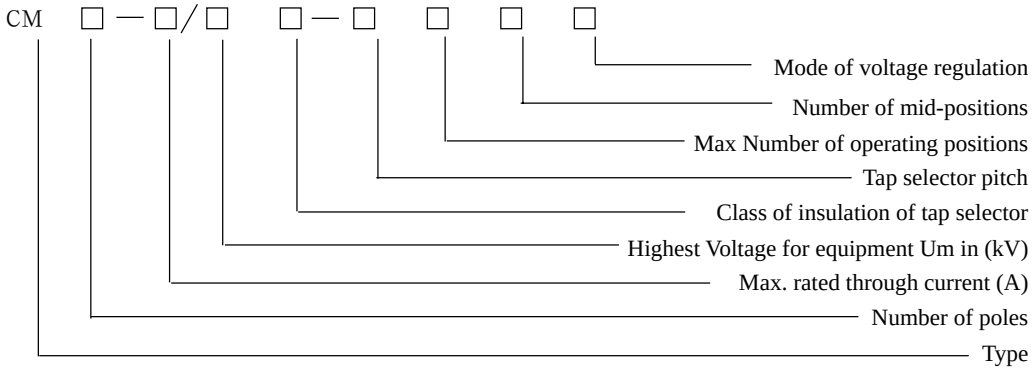


Figure 2. Perspective view of CM OLTC

1.1 Designation of the tap changer model



1.1.1 Indication of voltage regulation steps for OLTC

a. Linear voltage regulation: It is expressed by 5-digit number. For example, 14140 represents a OLTC with voltage regulation with 14 contacts circle pitch selectr, 14 operating position, and the number of mid-position is 0.

b. Direct and reverse voltage regulation: It is expressed by a 5-digit number plus a suffix W. For example, 14131 W represents a OLTC with reverse change-over selector with 14 operating contacts, 13 operating position and a mid-position of 1.

c. Coarse and fine voltage regulation: It is expressed by a 5-digit number plus a suffix G. For example, 14131 G represents an OLTC with coarse change-over selector with 14 contacts circle pitch selectr, 13 operating position and a mid-position of 1.

1.2 Indication of class of insulation of tap selector

The insulation for the tap selector can be classified into 4 grades, namely B, C, D,DE. Table 2 shows the data of the different insulation grades. The symbol for insulation distance is shown in Fig.4.

1.3 The operating condition of OLTC

1.3.1 The temperature of oil which the tap changer operates must not exceed 100℃ and not lower than -25℃.

1.3.2 The ambient temperature within the tap changer operates must not exceed 40℃ and not lower than -25℃.

1.3.3 The non-perpendicularity of OLTC on the transformer with the ground level should not exceed 2%.

1.3.4 The space for mounting OLTC should be free from serious dust and other explosive and corrosive gases.

1.4 Technical data of series CM OLTC

See table 1

1.5 Mode of voltage regulation

There are 3 modes of voltage regulation of CM OLTC, i.e. linear voltage regulation, direct and reverse voltage regulation, coarse and line voltage regulation. See Fig 4 for the mode of connections.

1.6 Under max. rated through current of OLTC, the temperature rise of each of the long term current carrying contacts and the current conducting parts should not exceed 20K.

1.7 OLTC, under 1.5 times the maximum through current, when continuously transfer from the first position for half a cycle, the maximum temperature rise of the transition resistor shall not exceed 350K (in oil).

1.8 The long term current carrying contacts of OLTC shall withstand the short circuit current test as shown in Table 3.

1.9 OLTC shall withstand a load tronsforming under rated step capacity as shown in Table 1, the electrical life of its contacts should not be lower than 200000 times.

1.10 OLTC should withstand 2 times the rated current interrupting capacity test for 100 times as shown in Table 1.

1.11 The mechanical life of OLTC should not be lower than 800,000 times.

Technical data of series CM on load tap changer

Table 1

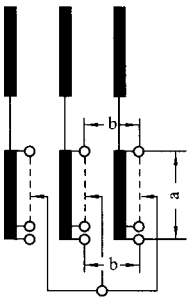
Item	Specification		CM Ⅰ 350 CM Ⅱ 350	CM Ⅰ 500 CM Ⅱ 500	CM Ⅰ 600 CM Ⅱ 600	CM Ⅰ 800	CM Ⅰ 1200	CM Ⅰ 1500
1	Max. rated through current (A)		350	500	600	800	1200	1500
2	Rated frequency (Hz)		50～60					
3	Number of phases and connection		3 poles Y connection single poles arbitrary connection					
4	Max. rated step voltage (V)		3300					
5	Rated step capacity (kVA)		1000	1400	1500	2000	3100	3500
6	Short circuit Strength(kA)	Thermmic (3Sec) (r.m.s)	6	8	8	16	24	24
		Dynamic (peak value)	15	20	20	40	60	60
7	Number of operating positions		See figure 3 basic circuit diagram					
8	OLTC Insulation level	Highest Votage for equipment Um (kV)	40.5	72	126	170	250	
		Power frequency withstand voltage (1min)	85	140	230	325	460	
		Impulse voltage lighting withstand (inkV)(1.2/50)	200	350	550	750	1050	
9	Tap selector		4 specifications according to insulation grade No. B, C,D and DE.					
10	Mechanical life		Not lower than 800,000 times					
11	Electrical life		Not lower than 200,000 times					
12	Diverter Switch oil corpartment	Operating pressure	3×10^4Pa					
		Sealing property	No leakage under 6×10^4 Pa for 24 hours					
		Over pressure protection	Bursting cap bursts at 300 ± 20% kPa overpressure					
		Protection relay	Set oil flow speed 1.0m/s ± 10%					
13	Motor Drive Unit		CMA7 or SHM-1					

Note:Step capacity equals to the product of step voltage and load current.
Rated step capacity refer to the max. allowable continuous step capacity.

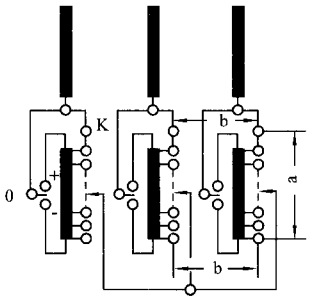
Table 2 Insulation grade of tap selector in kV

Insulating distance	Tap selector B		Tap selector C		Tap selector D		Tap selector DE	
	Full wave 1.2/50 μs	50Hz 1min	Full wave 1.2/50 μs	50Hz 1min	Full wave 1.2/50 μs	50Hz 1min	Full wave 1.2/50 μs	50Hz 1min
a	265	50	350	82	490	105	550	120
b	265	50	350	82	490	146	550	160
a_0	90	20	90	20	90	20	90	20

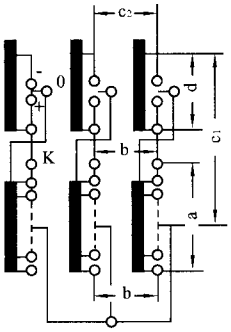
Note: a internal insulation level refers to an insulation level with spark distance protection, 100% response at full wave impulse voltage of 130kV,1.2/50.



10 10 0 ··· 18 18 0



10 09 1W ··· 18 17 1W
10 19 1W ··· 18 35 1W
10 19 3W ··· 18 35 3W

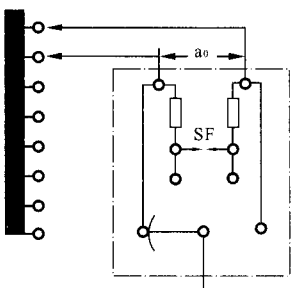


10 19 1G ··· 18 35 1G
10 19 3G ··· 18 35 3G

a. Linear regulation

b. Direct and Reverse Voltage regulating

c. Coarse & fine Voltage regulating



d. Drverter switch

Explanation of insulation distance symbol :

a — between max. tap and min. tap of same phase regulating voltage coils.

b — Between any phase of any tap of regulating voltage coil.

a_0 — between steps.

Figure 4

2. CONSTRUCTION OF OLTC

This product refers to immersed type combined on load tap changer. It consists of diverter switch unit oil compartment (referred to as oil compartment) and tap selector (with or without changer over selector), as shown in Fig. 1and 2.

2.1 Diverter switch unit

Diverter switch unit consists of driving unit, insulated rotating shaft, energy accumulation mechanism, switching mechanism (contact system) and transition resistor. The energy accumulation mechanism is paced directly on the switching mechanism and driven by the insulated rotating shaft and the transition resistor is installed on the lower part of the switching mechanism, thus if forms a complete plug-in set which facilitates to be installed in the diverter switch oil compartment, as shown in Fig.5.

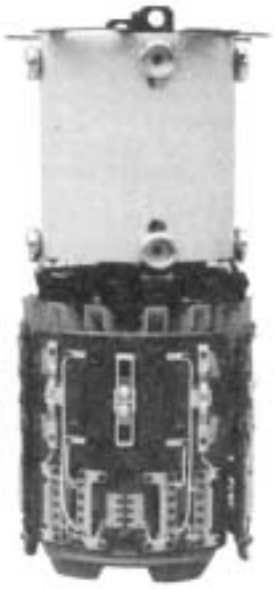


Fig.5 Diverter switch unit

2.1.1 Insulated rotating shaft

Insulated rotating shaft consists of specially fabricated insulating bar, equalizing ring and shaft pin. The shaft itself is not only a driving shaft, driving the diverter switch and the tap selector, but also it represents the main insulation of the tap changer which withstands the voltage to ground of the tap changer.

2.1.2 Energy accumulation mechamish(also called quick-acting mechanism)

The operation of the diverter switch is realized by the energy accumulation mechamish. This unit employs triggering principle and consists of eccentric wheel driven upper slide, lower slide, energy storing compressing spring, guide rail, chuck, cam wheel and bracket, as shown in Fig.6. The chuck, controlled by the side wall of the upper slide locks the cam wheel in place so as to maintain the lower slide in its original position. When the eccentric wheel moves the upper slide along the guide rail, the spring is compressed for energy storage. As soon as the side wall of the upper slide makes the corresponding chuck to move away from the locked cam wheel, the plate of the lower slide will transmit the rotating force to the shaft sleeve of the cam wheel, thus makes the diverter switch to operate.

Figure.6 Energy accumulation

2.1.3 Switching mechanism

The contact system of the diverter switch employs “dual resistor transiting”, parallel double break “tapered tail compensation” split contact. The contact system comprised of stationary contact system comprises of stationary contact system and moving contact system. Fig 7 and 8 illustrate the actual mechanism.

Figure 7. Contact structure of diverter switch

Moving contacts are installed in the guide slot of the upper and lower guide with good insulation behavior, and are connected to the curved slot of the converting segment with rolling pins. The stationary contacts are separated by arc extinguish chamber and placed on a curved plate, as shown in Fig.8.

When the switching mechanism operated, the moving contacts make rectilinear motion along the guiding groove of the guiding plate, and under go switching operation according

Figure 8. Curved plate
(stationary contact of the diverter switch and tramsition)

to specified sequence with the stationary contacts arranged on the inner wall of the curved plate.

There is a compensating spring installed at the fail of the segment place, so that the switching sequence will not be disturbed after the contacts have been burn down.

2.1.4 transition resistor

Transition resistor are arranged evenly in radically direction and connected to the transition contacts of the diverter switch.

Transition resistors are made of high heat resistant nickel chromium wire wound in spiral form and are separated by ceramic clamping plates mounted inside an insulating frame.

2.2 Diverter switch oil compartment

Diverter switch oil compartment functions to isolate the oil in the transformer oil tank from oil carbonized by the electrical arc of the switch, so as to maintain the cleanliness of the transformer. It is composed of four parts: head flange, top cover, insulated cylinder and bottom of the cylinder, See Fig.9.

Fig.9 Diverter switch oil compartment

2.2.1 Head flange

Head flange is precisely cast of aluminum alloy and riveted to the insulation cylinder. It is divided into tank top type and bell type. Tap changer is installed on the transformer tank cover by means of the head flange.

There are three bend pipe and a through tube on the tap changer head flange. The relay is connected to the conservator via the tap changers BuchhuH2 relay through the bend pipe R. Oil suction bend pipe: S is used to suck the oil in the bottom of the oil compartment during oil change of the diverter switch. It connects to a insulating pipe by the way of tap changer head flange. This oil suction pipe extents straight down to the bottom of the oil compartment. The oil filling bend pipe Q acts as the oil return pipe for the diverter switch. Another through pipe E acts as the vent pipe for transformer oil overflow. (See Fig A in the Appendix)

2.2.2 Top cover

A bursting cap is installed on the tap changer top cover to prevent the oil compartment from overpressure. Also on the top cover are installed horizontally driven worm wheel reducer, sight glass for tapping position and screw for overflow vent. See Fig.10

O ring is employed for sealing against leakage of tap changer.

Fig 10 Top cover

2.2.3 Insulating cylinder

Insulating cylinder is made of epoxy fiber glass, possesses excellent insulation property and mechanical property. The upper end of which is riveted to the head flange, while the lower end is riveted to the cylinder bottom. O rings are used for sealing the joint.

2.2.4 Compartment bottom

Compartment bottom is made of precisely cast aluminum alloy, a driving shaft passed through the compartment bottom. The upper end of the shaft is connected to the diverter switch unit via a connector and the lower end of which drives for tap selector through the gearing on the cylinder bottom. There is a

self-locking device for tap position indication on the cylinder bottom. The position indication driving mechanism will be self-locked during lifting the diverter switch unit so that the position will be self-locked during lifting the diverter switch unit so that the position will not be disturbed. See Fig.11

Fig.11 Compartment bottom

2.3 Tap selector

Tap selector is composed of step-by-step drive mechanism and contact system. Tap selector can be installed with or without change over selector. See Fig 12

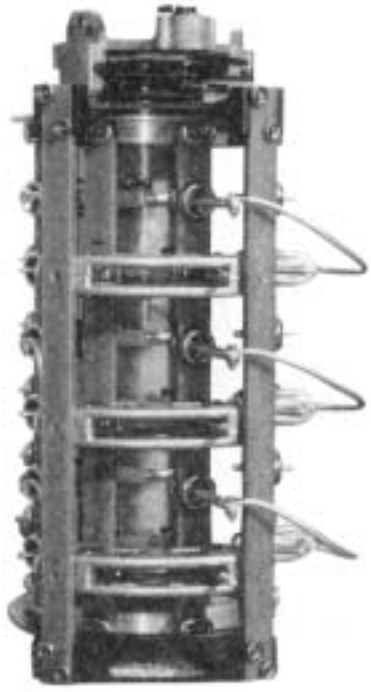


Fig. 12 tap selector (with change-over selector)

2.3.1 Step-by-step drive mechanism(also referred to as grooved wheel mechanism)

Grooved wheels and a groove moving piece. During each tap changing operation, the groove moving piece rotates a half turn, the motion of which is transformed into an irregular step-by-step drive motion of 72° or less, thus moving the bridge contact of the tap selector from one tap the other. The two grooved wheels running alternately.

The mechanical dowel pin in the groove wheel mechanism is used to prevent the tap selector from overriding at the start and end position.

2.3.2 Contact system

The tap selector contact system employs cage type “outer sleeve inner draw” shaft sleeve construction, including a central insulating cylinder with contacting ring, insulating strips with stationary contact member, driving tube, bridge contact and upper and lower flange.

The insulting strip are arranged around the periphery of the upper and lower flanges. Odd and even number stationary contacts are installed on the strips. In addition, an orange type shield cover is also installed, so as to even the surface electric field. The stationary contacts connect to the contacting ring on the central insulating cylinder through the bridge contactor.

The connecting wire of the contacting ring is leading out of the central insulating cylinder and connecting to the diverter switch.

Tap selector bridge contact pattern upper and tower clamping plate construction. It is driven by the grooved wheel mechanism through the driving tube, which makes it rotating around the contacting ring, thus contacts in turn with the taps on the selector insulating strops. Because the two main springs tensely compress on the moving contacts, Therefore, a four-point contact is always maintained as shown in fig.13, thus realizing free-adjustment and efficient cooling.

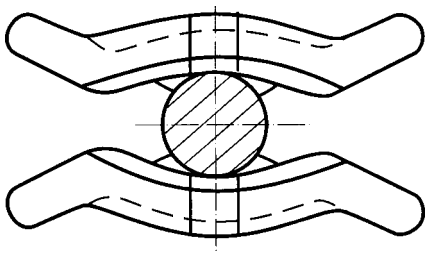


Fig 13 the contact of tap selector contact

2.3.3 Change over selector

Change over selector is classified into direct and reverse regulation and coarse and fine regulation. It is a simple and compact device. The insulating bars of the change over selector stationary contact are arranged on the upper and lower flange periphery of the tap selector.

Change over selector is operated by the lower grooved wheel of the grooved wheel mechanism.

3. OPRATING PRINCIPLE

On load tap changer employs resistor transition principle. It can transform under load the taps of transformer voltage regulating coil. The transformation operation of a tap changer lies in the alternate combination of the two transformations, the is, the odd and even number moving contacts take turns to select alternatively the tap in combination with the back-and forth switching of diverter switch. The sequence of tap transformation operation is shown in Fig.14 and 15. The heavy line denotes the path of the current.

Example 1 Transforming sequence form tap position 4 → 5

(a) 4 is under conduction before transforming operation of the tap changer. The odd number contact group of the tap selector are first transformed from tap position 3 to tap position 5.

(b) diverter to bridge connection K2,k3,a circulating current is generated between the transition resistors. The load current will then transmit through the contacts K2 and k3.

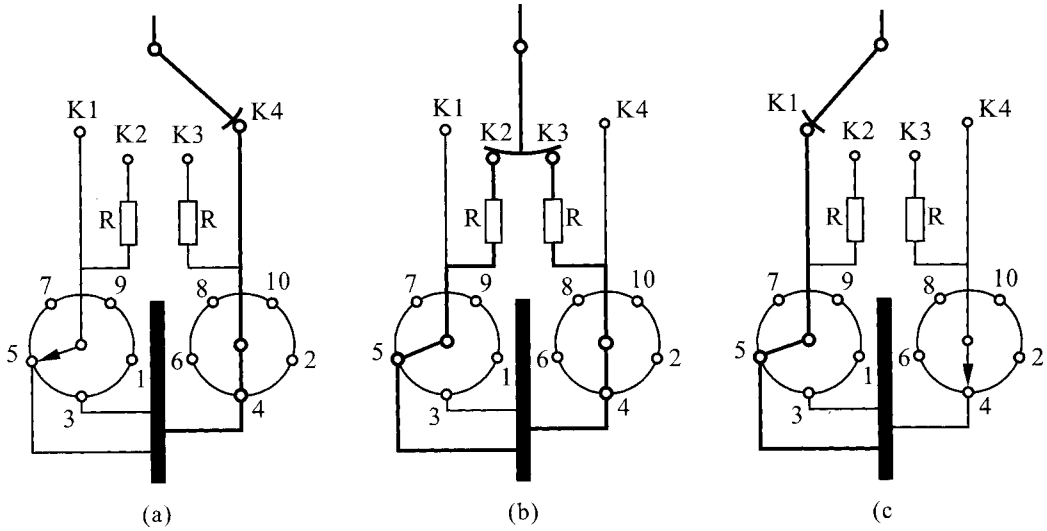


Fig 14 Transforming sequence from tap position 4 → 5

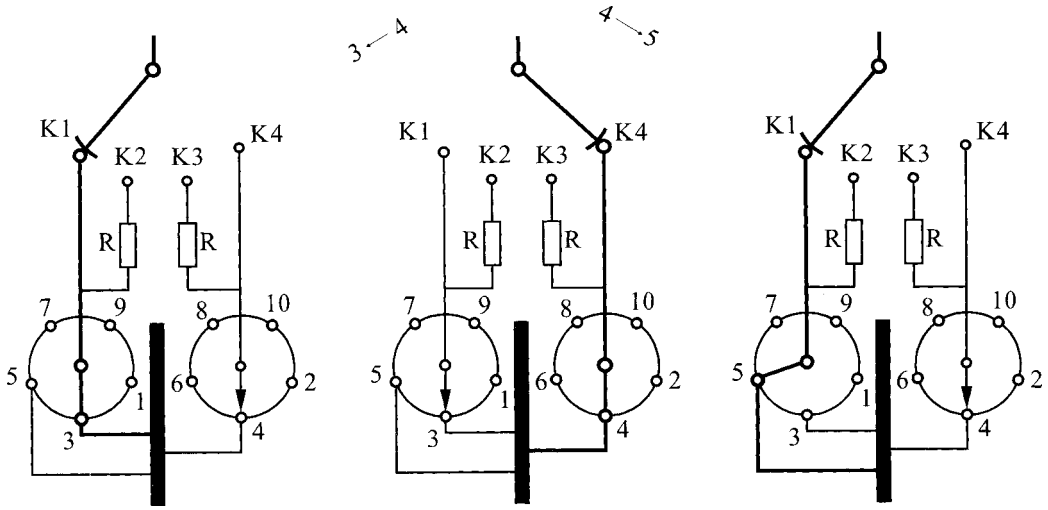


Fig 15 Transforming sequence from tap position 4 → 3 or 4 → 5

(c) The diverter is completed, tap 5 is now under conduction.

Example 2 Transforming sequence from tap position 4→3.

Because the tap transformation of diverter switch is always carried out to the left or to the right for each switching. If the transformation is form tap position 4 to tap position 3, the moving contacts of the tap selector may stand immovable. However, in case the continuous transformation is from tap 3 → 2, then the sequence and operation will be restored entirely to the same as that of Example 1.

3.1 Mechanical operation principle of the tap changer

The operation of tap transforming begins with the electric motor of the motor drive unit. The driving force is transmitted to the worm wheel reducer on the top cover of the tap changer through driving shaft and belt pulley box. After the reducer, it is transmitted to the energy storage mechanism and the shaft which passes through the diverter switch down to the cylinder bottom. There the cylinder bottom gear clutch is connected to the grooved wheel mechanism of the tap selector. The rotation of grooved wheel makes the contacting bridge to rotate an angle corresponding to one step, thus the connecting bridge will connected to the desired tap of the voltage regulating coil under no electric condition.

In the same time, the eccentric wheel of the energy storage mechanism makes the upper slide to move along the guide rail. The spring between the upper and lower slide is compressed to store energy, the cam wheel is locked by the clutch to hold the lower slide in its original position. When the upper slide moves to the release position, the side wall of the upper slide makes the corresponding jaw to move away from the locked cam wheel, thus releases the energy storage mechanism and operates the diverter switch. At this time, the lower slide moves to the new position, the clutch jaw again engages with the cam wheel, the mechanism is locked to prepare for the next tap transforming operation.

The motor of the power operated mechanism automatically stops after performing one tap transforming operation.

4. TAP SELECTOR

4.1 Basic mode of connection

For linear voltage regulation, there are 10100, 12120…… 18180 etc.

See Fig 16(a):

For reverseing voltage regulation with mid-position 1, there are 10191 W,12233W……18351W etc.

See Fig 16 (b)

For reverseing voltage regulation with mid-position 3, there are 10193W, 12233W……18353W, etc.

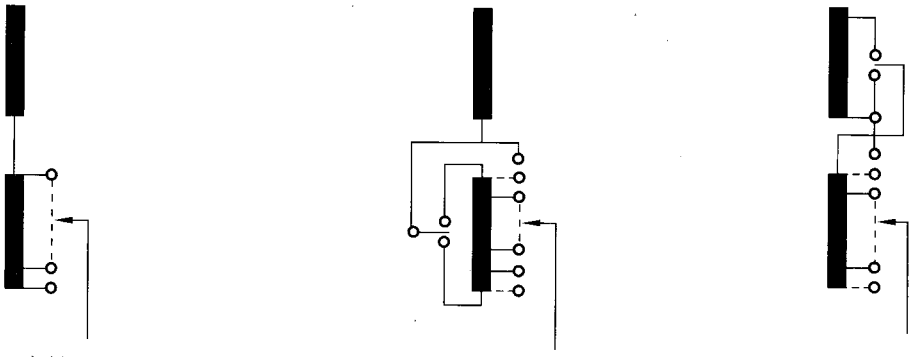
For coarse voltage regulation with mid-position 1, there are 10191G, 12231G……18351G etc.

see figure 16 (c)

For coarse voltage regulation with mid-position 3, there are 10193G,12231G etc.

4.2 Stepped grooved wheel mechanism

Stepped grooved wheel mechanism employs principle of alternate intermittent rotary movement. For the first time, the tap selector is operated by the upper groove wheel, and the next operation of the same direction will be driven by the lower groove wheel. The sequence of operation of the tap changer is shown in Fig 17.



(a) linear voltage regulation (b) reverse voltage regulation (c) coarse and fine voltage regulation

Fig 16 Basic connection mode of tap winding

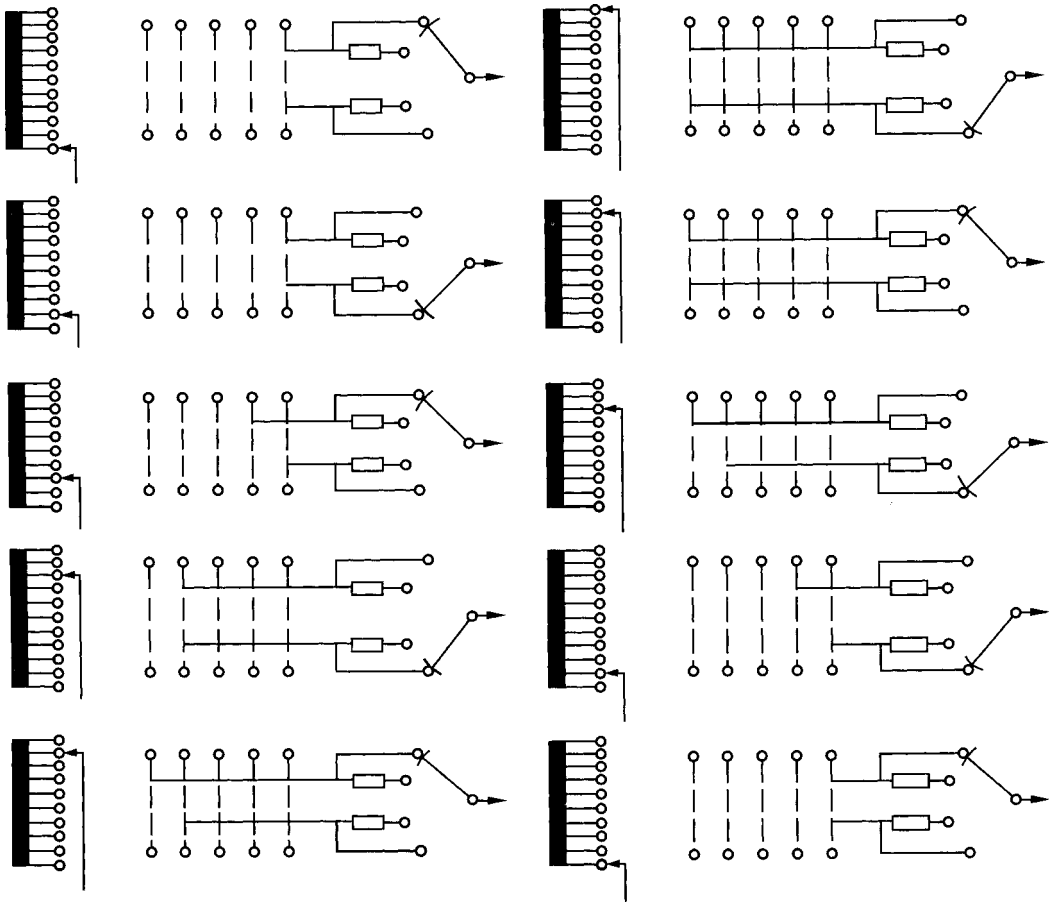


Fig 17 The operating sequence of tap selector's linear voltage regulation

5. INSTALLATION OF OLTC

5.1 The overall dimension of OLTC

5.1.1 Mounting dimension of the on load tap changer

The installation diagram of the tap changer and its mounting dimension are shown in the enclosed drawings A, B, C, D, E, F and G.

5.1.2 The tap changer is installed on the transformer oil tank cover with the aid of its head flange. Therefore, a mounting flange with 650mm inner diameter will be required on the tank cover together with oil resistant sealing gasket (supplied by the user). The thickness of the sealing gasket may be the same as the sealing gasket of the transformer oil tank cover (see Appendix D).

Studs will be used with its one end threaded into the mounting flange, the stud should project at least 45mm above the mounting flange.

5.1.3 The installation of OLTC tank-top type transformer tank cover.

The detailed installation procedures are as follows:

5.1.3.1 Put the diverter switch and tap selector of the tap changer separately on a level surface.

5.1.3.2 Remove the connecting screws (6 x M12) between the diverter switch and the tap selector.

5.1.3.3 Remove the red painted dowel pin from the sliding connector of the tap selector's stepped grooved wheel mechanism. Do not move the connector.

5.1.3.4 The conducting rod of the tap selector has been installed during factory delivery.

5.1.3.5 Lift the diverter switch and put it on the tap selector. Take care not to damage the sliding connector of the stepped grooved wheel mechanism.

5.1.3.6 Tighten six M12 socket head cap screws between the supporting stand of the tap selector's stepped grooved wheel mechanism and the cylinder bottom of the diverter switch. Pay attention to the perpendicularity of the diverter switch and tap selector.

5.1.3.7 Thoroughly clean the bottom surface of the tap changer

head flange and the sealing surface of the mounting flange. Put an oil-resistant sealing gasket on the mounting flange.

5.1.3.8 Lift the assembled tap diverter the mounting flange and carefully insert it into the transformer through the mounting hole on the transformer tank cover. Take care not to damage the terminals on the tap selector and the equalizing ring of the diverter switch oil compartment.

5.1.3.9 Check the head position and its setting position. Secure the tap changer head flange to the mounting flange. At last, remove the red-painted dowel pin from the intermediate gear wheel connecter at the cylinder bottom of the diverter switch. (See Fig 18)

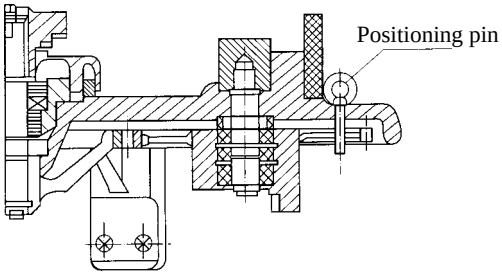


Figure 18 Diverter switch set positioning pin

5.1.4 Installation of OLTC on the bell type transformer cover

The "bell type" installation of OLTC has specially designed tap changer head which is able to be dismantled (See Figure B in the Appendix). It is composed of two parts: one is an intermediate flange temporarily installed on the transformer supporting structure. The insulating cylinder of the diverter switch oil chamber is installed on that flange; the second is the head flange secured on the bell type transformer tank cover. These two flanges are firmly connected together by means of sealing gasket and fasteners.

The procedures for installing OLTC on the bell type transformer tank cover are as follows:

5.1.4.1 Dismantle the tap changer's head

For installing the tap changer. It is required to separate the tap changer's head flange from the oil chamber.

a. Remove the top cover of the tap changer. Take care the O ring on the cover.

b. Remove the position indicator. Save the spring waster for future reassembling.

c. Unscrew the five M8 fixing nuts from the diverter switch proper without red paint, that is the upper supporting plate.

d. Carefully lift out the diverter switch proper. Pay close attention not to damage it. Keep the diverter switch unit in the upright position.

e. Remove the oil suction pipe. Take care of the O ring on the suction pipe head when the suction pipe is taken out of the tap changer.

f. Remove the 17XM8 nuts from the red painted area of the tap changer head flange.

g. Lift out tap changer head flange from the intermediate flange. Pay attention to the sealing gasket.

5.1.4.2 Fasten the tap selector to the bottom of the diverter switch oil compartment

a. Remove the joining screws between the diverter switch and the tap selector.

b. From the sliding connector of the stepped grooved wheel mechanism of the tap selector remove the red-painted dowel pin. Do not move the connector's groove moving piece.

c. With the lifting plate (see enclosed drawing E) provided by the factory, lift the diverter switch and place it on the tap selector. Take care not to damage the sliding connector of the stepped grooved wheel mechanism.

d. Tightening 6x M12 cylindrical head socket screw between the supporting stand of the tap selector's stepped grooved wheel mechanism and the diverter switch oil compartment bottom.

e. Fix the connecting conductor with M10 hexagonal screw. Be sure to directly stick the lead wire level with contacts on insulation cylinder. Don't clip the screening cover between them (See figure 19)

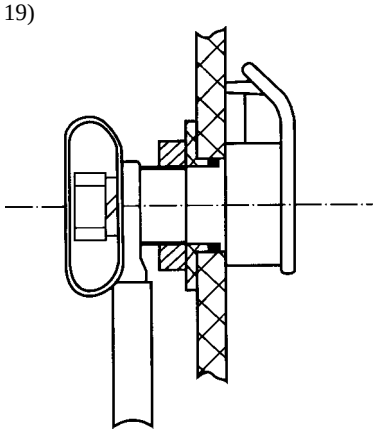
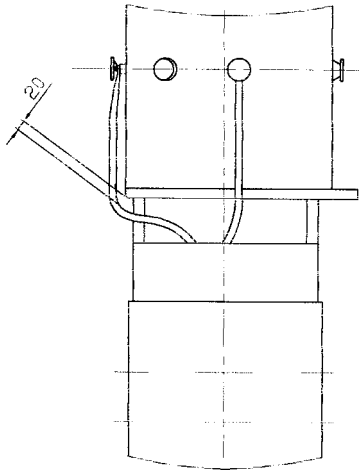


Fig.19 Diagram of connection between tap selector leading wire and diverter switch

f. From the intermittent gear connector at the oil compartment bottom remove the red-painted dowel pin (See Fig 18). To ensure the proper operation of the tap changer and the correct mounting position, the bell type tap changer should be pre-assembled. The actual procedure for pre-assembling are as follows:

a. Pre-matching of intermediate flange and head flange (alignment of "Δ" on both flange). For the installation and connection of bell type tap changer, there should be an adjustable supporting structure in the transformer. Temporary mounting of tap changer on the supporting structure: By means of the lifting



To ensure electrical insulation performance of switch, the distance between connecting lead wire and cylinder bottom metal element must be over 20mm.

plate (See enclosed drawing E) supplied by the factory, place the assembled tap changer on the supporting structure. Allow the intermediate flange to install temporarily on the supporting structure. Alignment of pre-installed flange and intermediate flange:

Move head flange to the flange installed on the cover of transformer, pay attention to the alignment of "Δ" symbol, adjust the position of tap changer and supporting structure, which allow the head flange is aligned naturally with intermediate flange, thus confirm the installation position of tap changer on supporting structure.

b. Adjusting the assembly space between intermediate flange and head flange.

To adjust flexible supporting structure, rise or lower the installation position of intermediate flange to ensure the installation space between intermediate flange and head flange conform to 5~ 20mm (see enclosed figure B).

When the pre-installation of tap changer on the supporting structure of transformer has been confirmed correct, connect the leading wire between tap changer and tap coil as per the section 5.2 of instruction manual.

After the tap leading wire has been connected, preinstall in once again, if the position of tap changer is unchanged and the leading wire is conformity with requirement (with suitable length, without the deformation and enforced on tap changer), it can ensured that the position of two flanges is correct when assembly the tap changer to transformer.

5.2 The connection of leading wire between voltage regulation coil and tap changer

5.2.1 Tap selector and connection leading wire

The voltage regulation windings should be connected according to the wire diagram supplied along with the delivery. The terminals of the tap selector are on the insulating rod where the contact position are marked.

There is a M10 bolt on each of tap selector terminals, the connectors of the voltage regulation winding can be installed directly on this bolt. Shield covers are employed and M10 locked the M10 nuts.

After tightening the connecting bolts, pry up the washer of the shield cover for 90°, thus lock the nut from loosening.(See figure 20)

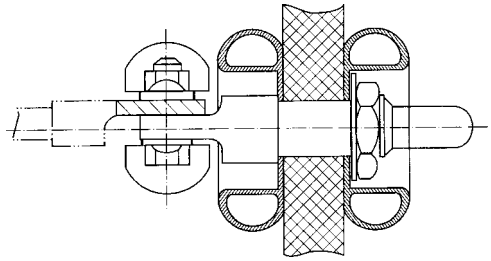


Fig 20 Schematic drawing showing the fastening of wire connection end of the tap selector

The position and negative (±) connecting terminals of the diverter selector is a tongue-shaped connecting plate, there is a hole for the hexagonal bolt on the plate . The connecting terminal K is an extension of the connecting terminal of the tap selector also has a hole for the hexagonal bolts.

Matters to be noted during the lead wire connection between the tap selector and the tapped winding:

5.2.1.1 The terminal wire of the tap selector should not cause the tap selector to deform by the stress (See figure).

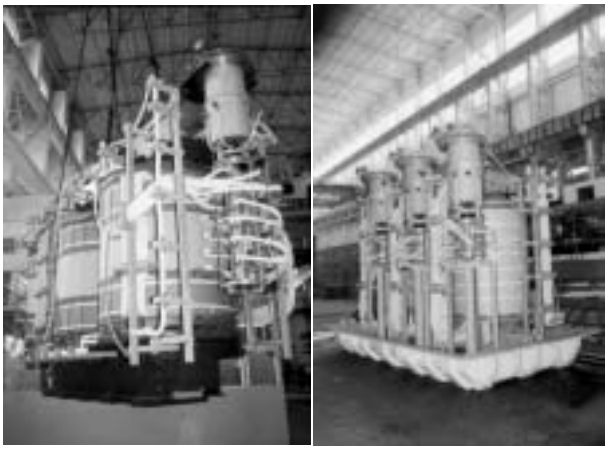
a. The connecting wire should be wired to the tap winding in dual directions from the tap selector. Avoid stressing the lead wire in single direction causing twist deformation of the cage of the tap selector.

b. The connecting wire between the end clamping of tap selector's terminal and the transformer lead wire should not be too short. If should be soft and should not be coated with insulating paint to avoid the hardening of the coated paint after drying which makes the insulating rod to deform under force.

c. The end of the lead wire connecting the tap selector should take the form of an expanded ring (circled), so that the insulating rod of the tap selector will not be influenced by force.

d. The terminal wire of the tap selector should be led out from the exterior of the cage. Never allow the wire passing through the interior of the cage.

e. The terminal wire of the change-over selector should be led out from the exterior of the insulating rod of change-over selector. Adequate gap shall be maintained between the lead



wire and the insulating rod of the change-over selector's moving contacts, so that the obstruction to the operation of the change-over selector can be avoided.

f. The bell type tap changer shall be lifted up 5-20mm after the connection of lead wire. Therefore, special care should be given to the degree of tightness of the connecting wire. It is recommended to install the inter mediate flange on the supporting structure, then put the pad between the intermediate flange and the head flange, so as to obtain the required actual assembly gap, then the lead will be wire and after that the temporary pad will be removed. Check for the degree of tightness of the lead wire and whether the tap changer is affected by force.

5.2.1.2 Don't damage the connecting terminal of the tap selector during installing the lead out wire.

5.2.1 The connecting wire of the tap changer

5.2.1.1 Three phase tap changer

For three phase tap changer, the interior of the diverter switch will be Y connected. Therefore, there is only one neutral point on the oil compartment of the diverterswitch, the connector of which can clamp directly ϕ 10 or ϕ 14 solid copper conductor. The neutral point connecting terminal has a M10 threaded hold.

5.2.1.2 Single phase tap changer

A single phase tap changer is formed by parallel connection of the contacts of three phase tap changer. On the oil compartment of the diverter switch, there is a waist type conducting ring. The lead out wire of the tap changer is connected to the conducting ring. On this ring, there are three ϕ 12.5 through holes, cheese head screws pass through these holes and connect with the lead-out wire and are locked by the shield cover together with the M10 nuts. After tightening up the nuts, the lock washer of the shield cover is pried up 90°, thus stop the nut from fastening.

5.3 Ratio test

Before drying the transformer, a ratio test should be carried out with alternating voltage. To operate the tap changer, insert a short pipe of ϕ 25mm nominal diameter into the horizontal shaft of the worm wheel reducer on the head of the tap changer, and fastened with a M8 set screw. A crank handle is filled on the other end of the short pipe. 16.5 turns of the horizontal driving shaft are required for each tap transforming operation. Because the tap changer is not oil immersed, so the number of tap transforming should be reduced to a minimum.

After the ratio test, the tap changer must be turned to the working position set at factory. This position can be seen from the working position diagram supplied together with the tap changer during delivery.

5.4 Drying and oil filling

5.4.1 The purpose of drying is to maintain the insulation level of the tap changer. Generally the tap changer is dried together with the transformer, however, it can be dried separately means of the same drying process. The process is as follows:

5.4.2 Vacuum drying

a. Drying in the oven room

During drying in the oven room, the tap changer's cover must be removed.

Care to keep the oil pipe unobstructed.

The tap changer is entered the oven room with a temperature of about 60℃, and heated in the air under atmospheric pressure. The rate of temperature rise is 10℃/h and the max. heating temperature is 110℃.

Preliminary drying:

Drying is carried out in the circulating air, max. Temperature is 110℃, duration 20 hours.

b. Drying in the transformer oil tank

When the transformer is vacuum drying in its oil tank, the top cover of the tap changer is kept tightly closed, throughout the whole process. To enhance the rate of drying of diverter switch oil compartment and switch mechanism, by-pass pipe supplied by our factory (see enclosed drawing G) must be used to connect the oil filling flange on tap changer head to the overflow pipe flange on the transformer oil tank (see enclosed drawing A for the flange position).

5.4.2.1 Vapor phase drying

When vapor phase drying is employed for drying the transformer and tap changer, the oil drain screw at the bottom of the oil compartment should be unscrewed to facilitatethe draining of kerosene vapor condensate. After the vapor phase drying, the drain screw should be tightened again.

a. Drying in the stove room

In the case of stove room drying, the top cover of the tap changer must be removed. Care to keep the oil extraction pipe unobstructed.

Heating:

Under the kerosene vapor temperature of 90℃, the duration of heating is 3-4 hours

Drying:

Raise the temperature of kerosene vapor with a temperature of 10℃/h. Max. temperature is 125℃. The time for drying basically depends upon the time required for transformer drying.

b. Drying in the transformer oil tank

If the transformer is vapor-phase dried in its oil tank, the head cover of the tap change should be tightly closed during the whole drying process. At the time, kerosene vapor for drying should enter the transformer oil tank and the diverter switch oil compartment in the same time. To accelerate the rate of drying of diverter switch oil compartment and its mechanism, at least one φ50mm kerosene vapor inlet pipe should be used to connect to the tap changer oil filling pipe flange and the oil suction pipe flange.

After the vapor phase drying, check the oil drain screw at the bottom of the oil compartment for tightness.

Matters to be noted after the drying process of a tap changer:

a. The tap changer without oil filling after drying process must not be operated. If operation is required after drying, then the diverter switch oil compartment shall be fully filled with transformer oil and the tap selector oil lubricated.

b. Check the tightness of fasteners. Of any fastener is found loose, it must be retightened and locked against looseness.

5.4.2 Oil filling

The head cover of the tap changer is again close. Tighten the 24 bolts M10. Take care the correct position of the O ring. Both the transformer and diverter switch are filled under vacuum. New transformer oil is filled into the tap changer up to the level of the transformer top cover. For this reason, by pass pipe supplied by our factory should be used to install between the tap changer's head oil filling flange and the transformer oil overflow pipe flange, in order that the oil compartment of the diverter switch and the transformer can be vacuum extracted in the same time.

5.5 The installation of connection pipes

The head flange of the tap changer is equipped with three connection pipes. The orientation of these connection pipes can be determined as required by the customer, that is after loosening the clamping ring, the connection pipes can be turned at will. So it is very easy to install the connection pipes.

5.5.1 Tube connection of QJ4G-25 gas relay

QJ4G Buchholz relay can be installed on the connection tube between the head of the tap changer and the oil conservator, and should be as close as possible to head of the tap changer. Frequently it is connected directly to the flange of the bend pipe R. It must be installed horizontally with the arrow pointing to the oil conservator.

5.5.2 Oil suction pipe connection

The tap changer is equipped with an oil suction connection pipe. It is used to suction the oil in the diverter switch oil compartment during maintenance or oil changing. Therefore, a pipe must be installed at a level below the bottom of the oil compartment. The upper end of the pipe is connected to the oil suction pipe flange, and the lower end is fixed with an oil drain valve.

This oil suction connection pipe may also be used as the oil discharge pipe of an oil filter.

5.5.3 Oil filling connection pipe

This pipe is used as the oil return pipe of the oil filter. It is sealed when no filtering is required. It is recommended that as pipe is also connected with the lower end filled with an oil drain valve. Thus circulating oil filtering through the oil suction and oil filling pipe may be performed by the oil filler.

5.6 The installation of motor drive unit

The motor drive unit performs the position control and the starting of the transforming operation of on-load tap changer. Within the box of the motor drive unit are installed complete set of mechanical and electrical components required to operate the tap changer. Electrical and manual operation are possible.

Matters to be noted during the installation of motor drive unit.

5.6.1 The serial number of the motor drive unit should be same as that of the tap changer.

5.6.2The motor drive unit must be of the same setting position as that of the tap changer. This position is indicated in the wiring diagram delivered with the equipment.

5.6.3 The installation of the motor drive unit should be square to transformer oil tank wall. No askew is permitted. Care not to be affected by the excessive vibration of the transformer. Adjust its horizontal and vertical position.

Attention: The mounting plate of the motor drive unit should be flat, otherwise it will be deformed by twisting and its operation will be affected. For the actual installation of the motor drive unit, see the operating instruction of type CMA7 motor drive unit.

5.7 Installation of conical gear driving box

The overall and mounting dimension of conical gear driving box, see enclosed diagram C.

5.7.1 Conical gear driving box is mounted on the supporting bracket of the transformer tank cover with 2 bolts M16 .

5.7.2 Driving shaft

5.7.2.1 Installation of horizontal driving shaft

a. Loose the collet (6 bolts M8) of the worm wheel reducer on the tap changer's head. Swiveling the reducer to align its horizontal shaft with the horizontal shaft of the conical gear driving box.

b. Find out the actual length of the horizontal riving shaft between the horizontal shafts of the worm wheel reducer of the tap changer and the conical gear reducer. A gap (a total of about 2mm) is reserved at the connection of the two horizontal driving shafts after taking into account of the expansion and contraction.

c. Install the collet on the horizontal driving shaft. Adjust the worm wheel reducer and tighten the collet.

d. After installing the horizontal driving shaft, machine off the surplus dimension of the guard plate according to the gap between the two connection flanges.

5.7.2.2 Installation of the vertical driving shaft:

a. According to the dimension between the helical gear driving box and the vertical driving shaft of the motor drive unit, determine the actual size of the steel tube of the vertical driving shaft. Machine the steel tube to the required dimension, taking account of the expansion and contraction. Certain gap (a total of gap about 2mm) should be reserved for connection of vertical driving shafts.

b. Install the vertical driving shaft, the connection pin near the motor drive unit can only be fixed after checking the connection of the motor drive unit.

c. The length of the vertical driving shaft may exceed 2m. In order to avoid swaying, the shaft shell carry an intermediate bearing. This can be extra supplied if requested during ordering.

5.8 Verification of the connection of the tap changer and motor drive unit

Having been connected the tap changer with the motor drive unit, the mechanism should first be manual turned a complete cycle of operation can be performed.

When the tap changer has been connected to the motor drive unit, the time elapsed between the instant of switching of the diverter switch and the ending of operation of the motor drive unit should be the same in both direction of rotation. Generally, the verification of the connection of the tap changer to the motor drive unit has been done in the factory and is positioned and lead sealed in the setting position. However, for proper operation of the tap changer, the verification shall still be performed.

The verification of connection is carried out according to the following procedure:

5.8.1 Rotate the handle in the 1→N direction. After the diverter switch has operated (start when the sound of switching is heard), turn the handle continuously and record the number of turns until a red mark within the green belt area on the indicating wheel of the tap transforming operation of the motor drive unit appears in the middle of the sight glass. Take the number of turns as m.

5.8.2 Turn the handle in the reverse direction N→1 tot return to its setting position. Recordthe number of turns K in the same way as mentioned above.

5.8.3 the connection will be correct if m=K. If m ≠K and m-K >1,then the difference of turns shall be compensated. Loosen the vertical driving shaft, turn the handle 1/2 (m-k) turns in the direction of increment of turns, and finally connect the vertical driving shaft to the motor drive unit.

5.8.4 Check the difference of turns between the motor drive unit and the tap changer in the same way as mentioned above, until the same number of turns, i.e. m=k is obtained.

Example:

The verification of connection of Type CM tap changer and Type CMA7 motor drive unit: Turn from position 10 (setting position) to position 11, m=5 turns, Turn backward from position 11 to position 10 (the original setting position), k=3 turns. The difference of turns of the handle m-k=5-3=2 turns.

Turns to be adjusted 1/2 (m-k)=1/2(5-3)=1 turn.

Loosen the connection between the vertical driving shaft and the motor drive unit. Turn the handle in the direction 10 → 11 for one turn.

Then again make connections.

Check that the difference of turns in both directions has been balanced.

a. Record number of turns m an k under connected condition.

b. Turn 1/2(m-k) turns in the direction in the increment of turns during loosening of connection.

c. Again make connection and verify until m=k.

5.9 Operating test of the tap changer

5.9.1 Mechanical operating test

Before voltage is applied to the transformer, 5 complete cycles of mechanical operating test (no less than 200 times) must be performed. There should be no damage to the tap changer and motor drive unit. The position indication of the motor drive unit, its remote position indication and the position indication of the tap changer should be the same. Both the mechanical and electrical limit protection should be reliable.

5.9.2 Final oil filling

Final oil filling is done after the operating test of the tap changer. Before oil filling, loosen the vent screw on the suction pipe and the top cover of the tap changer. Use a spanner to pry up vent oil overflowing pin on the top cover of tap changer. (See figure 21)

5.9.3 Grounding

Conical gear drive box grounding screw (M12) should be

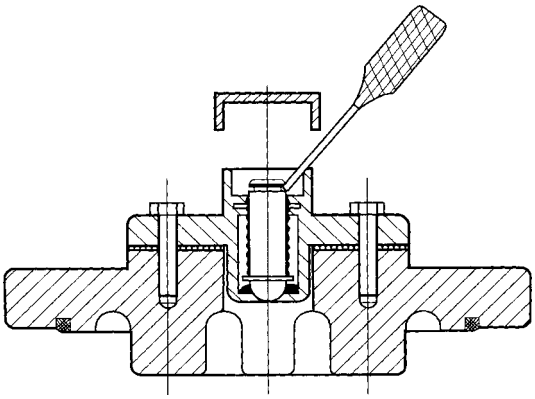


Figure 21. Schematic diagram of exhaust on top cover when filling tap changer with oil

connected to the cover of transformer box.

The grounding screw (M12) on tap changer head should also be connected to the cover of transformer box.

The grounding screw (M12) on motor mechanism box housing should be connected to the cover of transformer box.

Grounding screws for protective relay QJ4G-25 shall be connected to the transformer tank cover.

5.9.4 Transformer electrical test

After completing the above-mentioned operation, the transformer acceptance test can now be performed. The tap changer should be tested with the conservator connected.

5.9.5 The setting position of the tap changer:

When the test is completed, the tap changer and the motor drive unit should be turned to the setting position during equipment delivery.

5.10 Transportation of transformer together with the tap changer

When the tap changer is assembled to the transformer, careful consideration shall be given to the safety of transportation (for example, to increase the temporary supporting). The tap changer is of the immersed type, it is not necessary to remove it for transportation. If there is trouble which requires to dismantle the motor drive unit should be loosened at the setting position, so that it can be transported in the horizontal position. After arriving on site, the motor drive unit can be restored by means of the method mentioned above.

If the transformer is transported or stored without the conservator, then the bypass pipe (see the enclosed drawing G) supplied by our factory can be installed between the oil filling flange of the tap changer and the overflow pipe flange of the transformer (the position of the flange is shown in the enclose drawing A), so that the static pressure caused by the oil expansion can be balanced.

If transformer is required to be transported or stored without oil filling, then the oil in the oil compartment of the diverter switch must be completely drained. The bypass pipe must be installed at that time so that the oil compartment and the transformer oil tank will subjected to the same pressure (nitrogen sealing).

In order to avoid damaging the tap changer caused by the shifting of moving parts,they must be temporarily secured.

Note: The bypass pipe shall be removed from the tap changer head when the transformer is installed in-site and before putting it into operation.

5.11 Put into operation on-site

When the transformer is installed in site, the installed position of the tap changer and the tightness of the connecting wire should be checked either by lifting the iron core or by entering into the transformer oil tank, especially for the bell type tap changer, detailed examination shall be done as to the deformation under force of the tap changer due to the shifting of transformer core during transportation, so that the proper operation of the tap changer can be assured.

Before putting into operation of the transformer, the operating test of the tap changer and motor drive unit, must be done according to section 8.10, and in the same time, check the proper functioning of the Buchholz relay.

The Buchholz relay should be connected to the tripping circuit of the line circuit breaker, in case the Buchholz relay is energized, it will instantly cut off the transformer circuit. “Transformer Off test button on the top of the Buchholz relay can be used to test the function of the line circuit breaker.

Open all the valves between the conservator and the tap changer to prepare the tap changer for operation, at that time, the gas accumulated the tap changer top cover will expel a slight amount of oil. When the tap changer is determined to be everything all right, then it can be put into operation.

6 OPERATION SUPERVISION

Periodic examination of the contamination of oil in the insulating cylinder of the diverter switch is an effective measure to monitor the normal operation of the on load tap changer.

6.1 For periodic examination of the oil in the insulating cylinder of the diverter switch, we recommend to carry cut oil sampling for each 1000 times of operation under rated current to ascertain that the voltage endurance valued is not under 30kV.

6.2 Do not operate the on load tap changer frequently when the transformer is overloaded. If the customer has installed fully

automatic controls, then the tap changer must be equipped with "over current self-locking" device, so that the tap changer will not be operated when the load current exceeds 2 In.

6.3 The tripping contact of the QJ4G-25 Buchholz relay is set to operate at an oil speed of 1.0m/s ± 10%.This contact should be connected the tripping circuit of the transformer circuit breaker. Incase a fault occurs with the on load tap changer, then large amount of gas will generate, causing a rush of oil flow to move the relay flapper, which breaks the tripping contact, and cuts off the transformer incoming current, thus avoid the fault to extend.

6.4 On the top cover of the tap changer is installed an overpressure explosion protection cover which should not be damaged during ordinary transforming operation of the diverter switch. Only when a fault is generated within the switch, then the cover bursts when the pressure in the oil cylinder exceeds 2×10^5 Pa, thus if functions an overpressure protection to avoid extension of the fault.

During installation and maintenance of the on load tap changer, always pay special attention not to damage the bursting cover.

7 SCOPE OF THE COMPLETE SET OF EQUIPMENT

7.1.1 Scope of delivery of the complete set of equipment

The tap change and the motor drive unit are packaged separately for delivery after they have been conducted factory delivery test and set at the specified position.

7.1.2 Scope of delivery of the tap transforming equipment

7.1.2.1 Diverter switch: Including oil compartment of the switch and the diverter switch unit installed in the oil compartment.

7.1.2.2 Tap selector Including diverter selector

7.1.2.3 Buchholz relay

7.1.2.4 Driving shaft and conical gear driving box.

7.1.2.5 Motor Drive Unit

7.1.2.6 Accessories including remote position indicator, etc

Check the contents according to the packing list. Place the tap transforming equipment in a well-ventilated weather proof warehouse with relative humidity of less than 85% and temperature between − 25℃and +40℃. There should be no corrosive gas.

Note: The six lead wires on the tap selector may be loosened due to transportation therefore, at the time connecting the lead wires to the tap change, the selector end shall also be checked. Tighten it if it is loosened.

8. MAINTENANCE AND REPAIR

8.1 Periodical maintenance

The transformer oil in the diverter switch oil compartment will become carbonized after many times of switching and its voltage endurance value will decrease, so of is recommended that periodic oil sampling should be done according to Section 6.1 for laboratory test. The transformer oil shall be replaced when its voltage endurance value is less than 30kV. In addition, the oil shall be replaced annually even if the voltage endurance value exceeds 30kV.

During the oil changing, the dirt oil is completely extracted from the oil compartment, then the insulating cylinder and the diverter switch are flushed with clean oil, this oil is again completely extracted. Finally it is filled with clean oil.

If the number of tap transforming operation exceeds 20000 times annually, it is recommended to install a fixed oil filter to the tap changer.

The oil conservator and the breather in the safety duct of this on load tap changer is maintained usually the same as the transformer.

8.2 Periodical repair

During the long term operation of the on load tap changer, only the diverter switch required to be repaired periodically. Table 6 shows the time interval of the period repair. To enhance the reliability of the tap changer, it should be repaired after five-year operation, even if the number of switching has not been reached.

The item for repair includes lifting out the diverter switch unit, cleaning the entire switch proper, measuring the degree of contact burn-up, replacing the contacts of the diverter switch, etc. Small capacity lifting equipment may be used to lift out the diverter switch unit.

During the repair, the time of exposure of diverter switch unit shall not exceed 10 hours, or it shall be dried as specified in Section 5.5.

8.3 Lifting of diverter switch unit

All the terminals shall be shorted and grounded offer the transformer has been cut off from the network.

The diverter switch unit can be drawn out in any operating position, however, we recommend that the diverter switch unit will be drawn out in its setting position. (See Appendix for the table of setting positions)

8.3.1 Close all the oil valves on the conservator, transformer oil tank and the head of tap changer.

8.3.2 Loosen the vent and overflow screw, lower the oil level of

the tap changer head until it is flushed with the surface of the transformer tank cover.

8.3.3 loosen the horizontal driving shaft of the motor drive unit and the tap changer.

8.3.4 Dismantle the grounding connection of the tap changer head, loosen the connection bolts of the head cover. Remove the cover, take care of the sealing ring.

8.3.5 Remove the position indicator from the diverter switch .

8.3.6 Carefully lift out the diverter switch unit, don't damage the oil suction pipe and the driving shaft of the position indicator.

8.4 Cleaning

8.4.1 Cleaning of diverter switch oil compartment

Thoroughly drained the dirty oil from the diverter switch oil compartment and flush it with new. If necessary, brush away the carbon powder stuck to the inner wall of the insulating cylinder. Then again flush it with new oil, drain away all the dirty oil.

After cleaning, tightly closed the top cover of the diverter switch.

8.4.2 The diverter switch can be washed with new oil after it has been lifted out. It can be brushed if necessary. The thorough cleaning of the diverter switch can be done after it has been dismantled.

8.5 Preliminary examination of the diverter switch unit:

8.5.1 Check all fasteners for looseness.

8.5.2 Whether the main spring, reset spring and jaw plate of the energy storage mechanism are deformed or broken.

8.5.3 Whether the braided wire connection of each contact is not damaged.

8.5.4 Check the burn-out of moving and stationary contacts of the diverter switch.

8.5.5 Check for breaking of the flat wire of he transition resistor and whether its resistor value is identical to that stamped on the rating plate (The resistor value should be measured at the open side of the transition contact.)

8.5.6 Measure the contact resistor of the odd and even number contacts of each phase and the neutral lead-out point.

8.5.7 Measure the transforming sequence of the moving contact.

8.6 Dismantle the diverter switch unit for cleaning, examination and parts replacement.

Prior to dismantle, pay attention to the following items:

8.6.1 Note the current operating position of the diverter switch, so that it can be restored to the original operating position during reassembly.

8.6.2 When the contact mechanism of the diverter switch is dismantled for examination and cleaning, it should be done on the per-phase bases. Never dismantle the three phase in the same time to avoid confusion.

The sequence for dismantling diverter switch unit is as follows:

a. Release the jaw of the energy storing mechanism. Place the mechanism to a bridging position of the transition contact so as to facilitate dismantling and reassembling.

b. Loosen the connecting screw on insulating arc plates of the diverter switch stationary contacts. Remove the insulating arc plates.

c. Remove the arc isolating chamber of the contacts of the diverter switch.

d. Thoroughly cleaning the dismantled segmental contact system.

e. Check the amount of contact burn-out.

When the amount of burn-out of any one of the diverter switch arcing contacts exceeds 3mm, then all arcing contacts must be replaced.

f. Check the lead-out braided wire of the main arcing contacts and transition contacts.

g. Check for looseness of the M6X18 countersunk screws connecting to the arcing contacts.

After 100,000 times of tap changing operation of the tap changer, the lead-out braided wire must be replaced even if they are not damaged and regardless whether the contacts are replaced or not.

8.7 Reassembly of diverter switch unit

The contact mechanism of the diverter switch shall be reassembled when the mechanism has been dismantled for cleaning and parts replacement.

a. Install the contacts arc-isolating chamber.

b. Assemble the insulating arc plate of the diverter switch stationary contacts. Tighten and lock eight M6 bolts.

c. Shift the energy storage mechanism to the opposite side of the original operating position. Hook up the lower sliding plate of the mechanism and shift the eccentric wheel of the upper sliding plate, allowing the spring of the energy storage mechanism to shore energy. When the upper sliding plate is shifted to the highest point of the eccentric wheel release the lower sliding plate, so the energy storage mechanism is again latched.

d. Check the transforming sequence of the diverter switch (by oscilloscope)

The transforming time of diverter switch (direct current oscilloscope) will be 35-50ms. The bridging time for the transition contacts will be 2-7ms, as shown in Fig 22.

8.8 The installation of the diverter switch unit

When the diverter switch unit has been verified to be

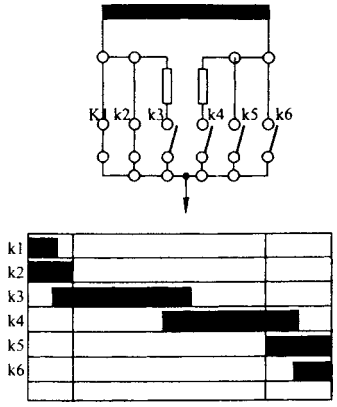


Figure 22. The change sequence of change-over switch contacts

acceptable, it is returned to its original operating position before maintenance, then carefully lifted it into the diverter switch oil compartment. Fasten the five bolts on the head and installed the position indicator, and after replace the tap changer head cover. Take care to place properly the sealing gasket.

8.9 Oil filling

Fill the diverter switch oil compartment with new oil up to the horizontal surface of the tap changer head. Open the valve between the Buchholz relay and the conservator, so as to allow the oil flows slowly into the oil chamber of the tap changer which is vented through the oil overflow tapped hole on its head cover. Open all the valves of the conservator and transformer oil tank, the conservator shall be replenished with new oil up to its original oil level.

8.10 Check before operation

8.10.1 Connect all the grounding screws on the head cover.

8.10.2 Check the tripping function of the Buchholz relay. Press the trip test button, this should cut off the power source of the transformer. The transformer can be put into operation after pressing the reset button.

8.10.3 Check if the position indicator of the tap changer and that of the motor drive unit are identical. Connect the tap changer to the driving shaft of the motor drive unit, and conduct connection check according to 5.8 section.

8.10.4 Mechanical operating test of on-load tap changer

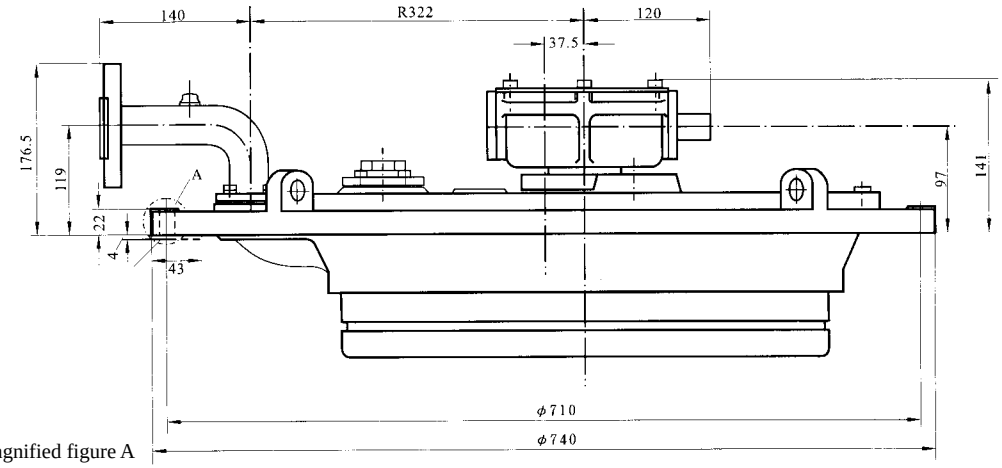
Ten cycles of cyclic power operation should be conducted, the result of which shall show no malfunctioning. The maintenance of the tap selector can only be performed along with the overhaul of the transformer. No separate repair is required.

Interval of checking and repairing CM on load tap changer

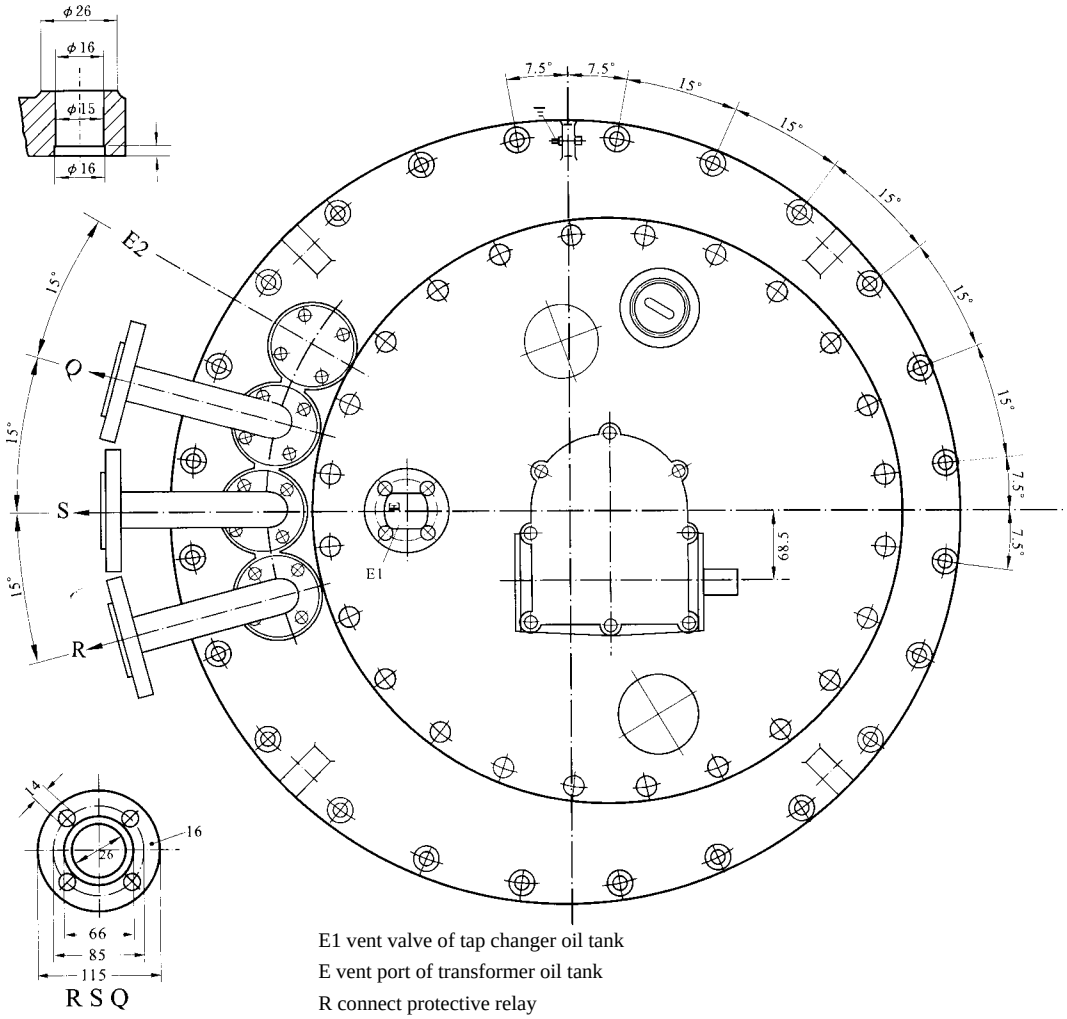
Tap changer model	CM Ⅲ 350 CM Ⅲ 500/600	CM Ⅰ 350 CM Ⅰ 500/600	CM Ⅰ 800	CM Ⅰ 1200
Operating current (A)	350/500/600	350/500/600	800	1200
Times of operating	50000	70000	50000	35000

9. Appendixes

Enclosed figure A: Overall dimension of tap changer head



Magnified figure A

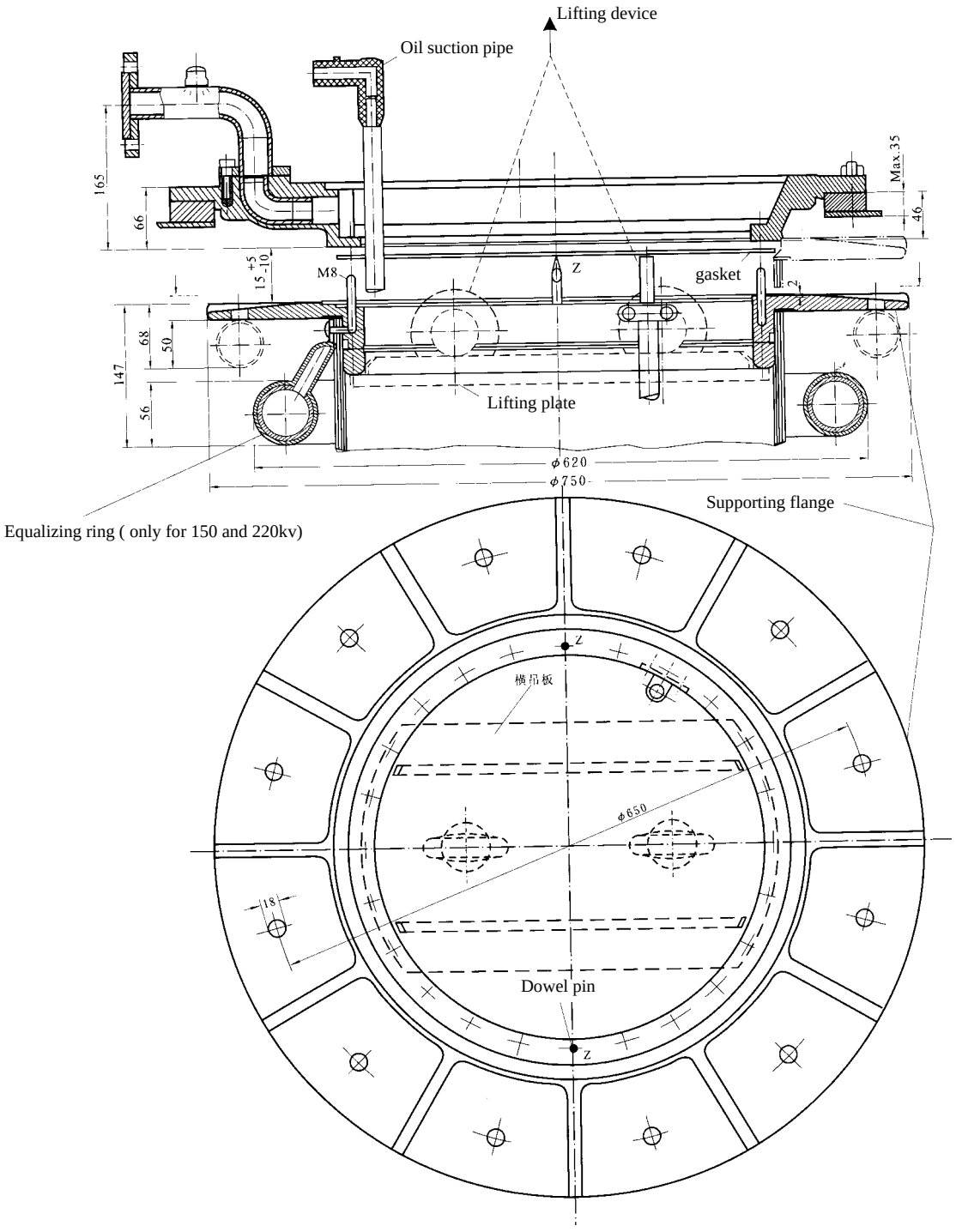


Connected flange

E1 vent valve of tap changer oil tank
E vent port of transformer oil tank
R connect protective relay
S connect oil pipe
Q connect return oil pipe

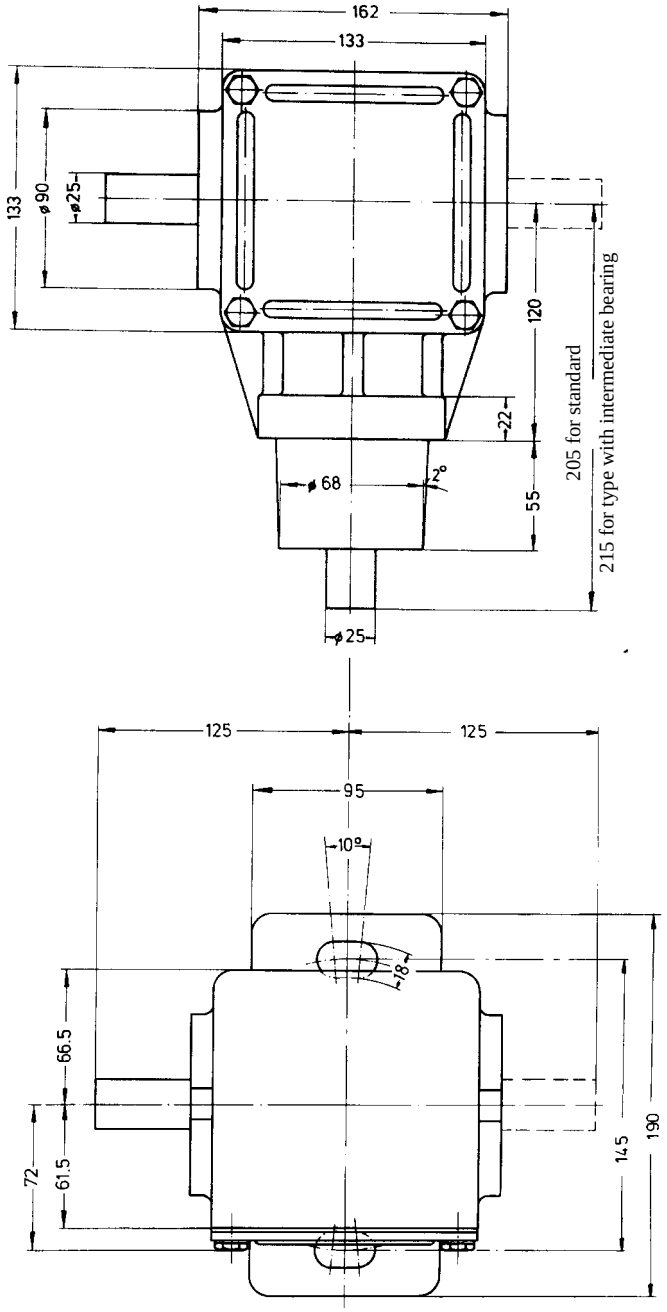
Unit: mm

Enclosed drawing B Overall dimension of tap changer flange on the bell



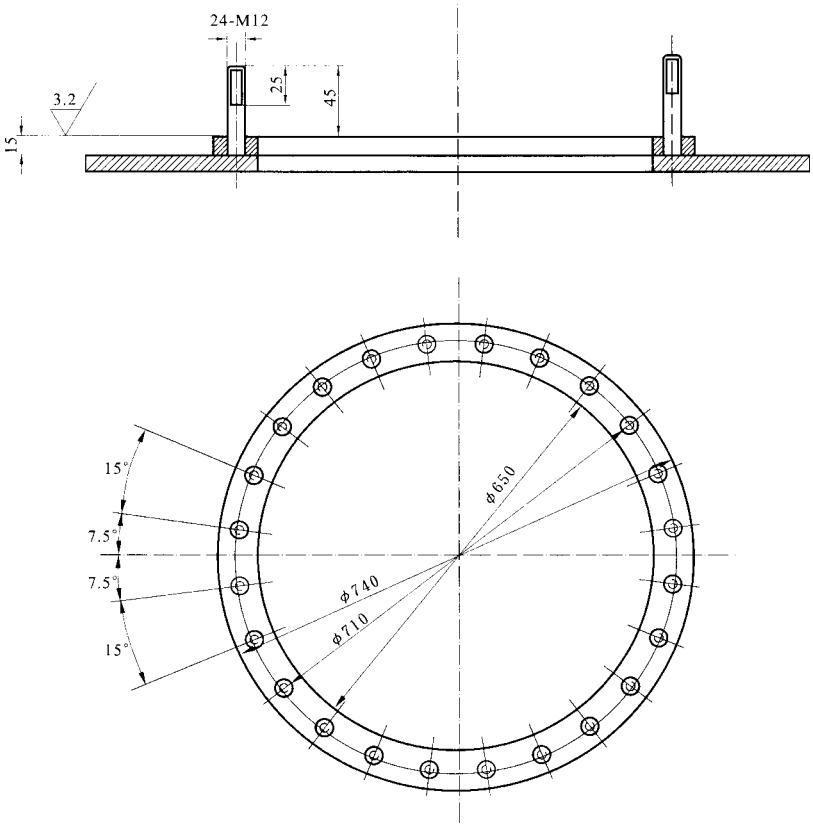
Unit: mm

Enclosed drawing C: overall dimension of bevel gear box

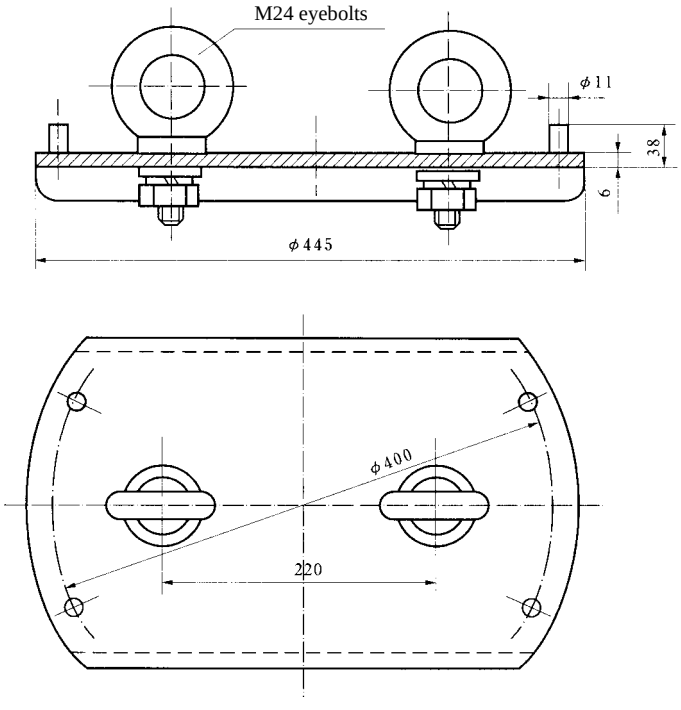


Unit: mm

Enclosed drawing D: Flange dimension for tank top installation

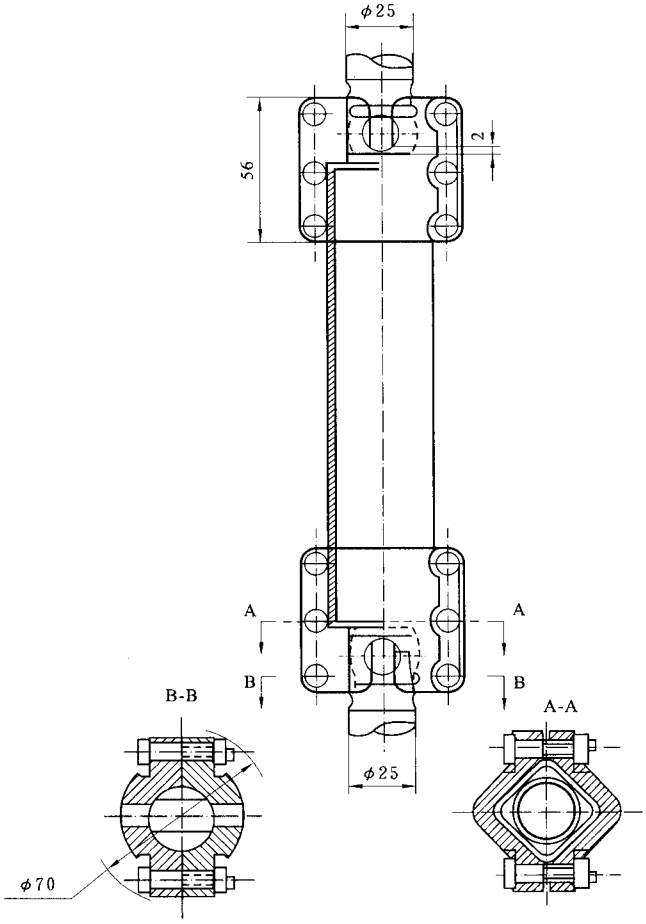


Enclosed drawing E: Dimension of lifting plate for bell type construction

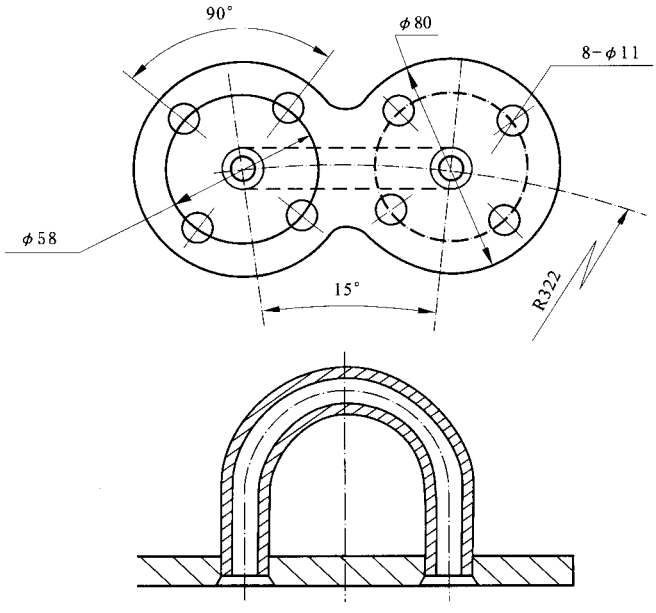


Unit: mm

Enclosed drawing F : Schematic drawing for the installation of horizontal and vertical drive

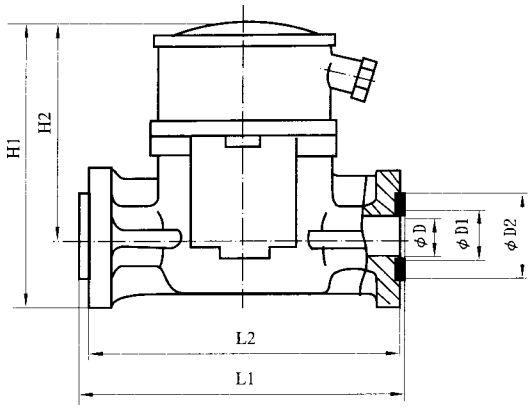


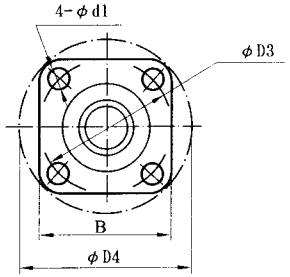
Enclosed drawing G: bypass pipe structure

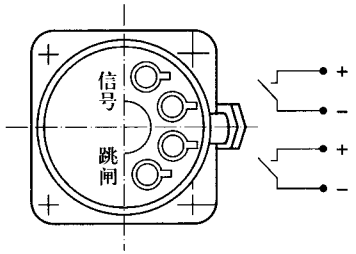


Unit: mm

Type QJ4-25 Buchholz relay

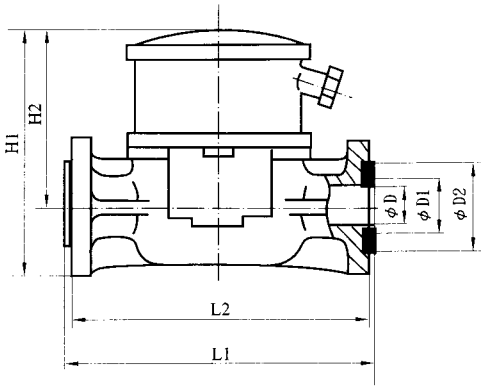


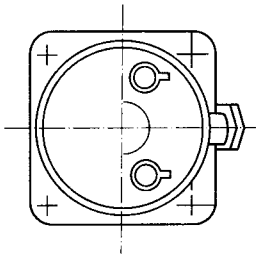




Signal trip

Type QJ4G-25 Buchholz relay





tripping

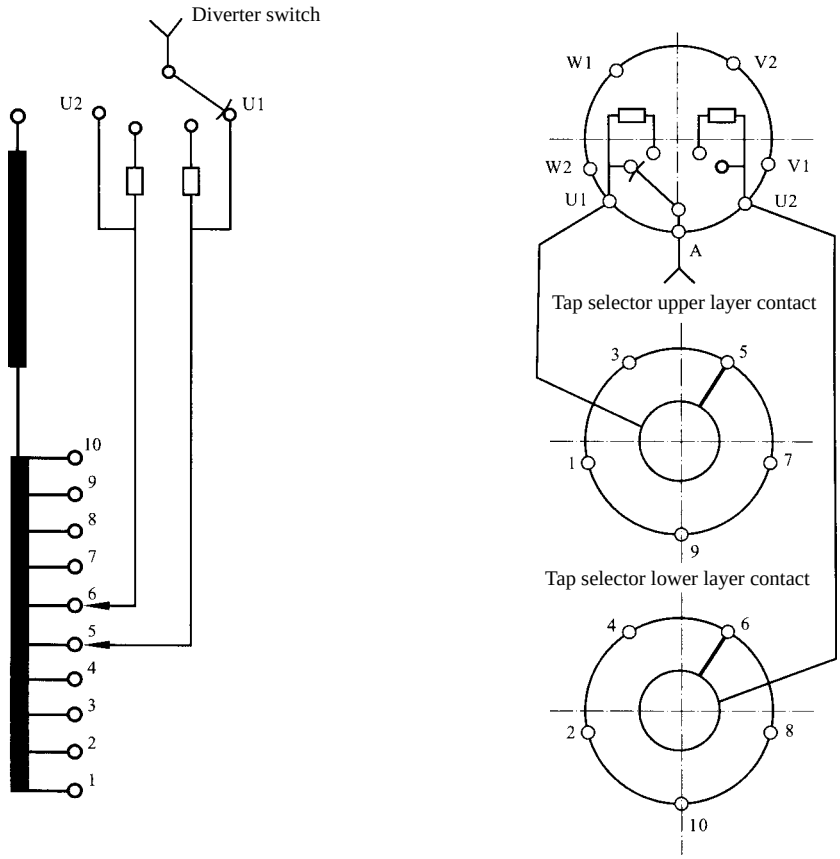
Model	code	Diameter	D1	D2	D3	Md	d1	H1	H2	L1	L2	B	h	Remarks
Type QJ4-25	5XJ、236、001、1(2)	25	31	56	85		14	186	141	206	200	90 × 90	⩾ 250	4 terminal ports with light float for OLTC
Type QJ4G-25	6ET、236、106、1(2)	25	31	56	85		14	154	109	206	200	90 × 90	⩾ 190	two terminal ports without light float for OLTC

Note: 1. Type QJ4-25 and QJ4G-25 Buchholz relay are classified into square and round flange; ϕ D4 115 is the dimension for round flange. Please specify “square”and “round” during making an order.

2. For the last digital of the code number, when no parentheses are added , it applies to general district, when parentheses are added, it applies to dampened hot region. For example 6ET, 236, 019 1 is suitable for general district and 6 ET, 236, 019 ,2 is suitable for damp and hot region.

Appendix 1

9 steps (10100) operating position and connection diagram for type CM



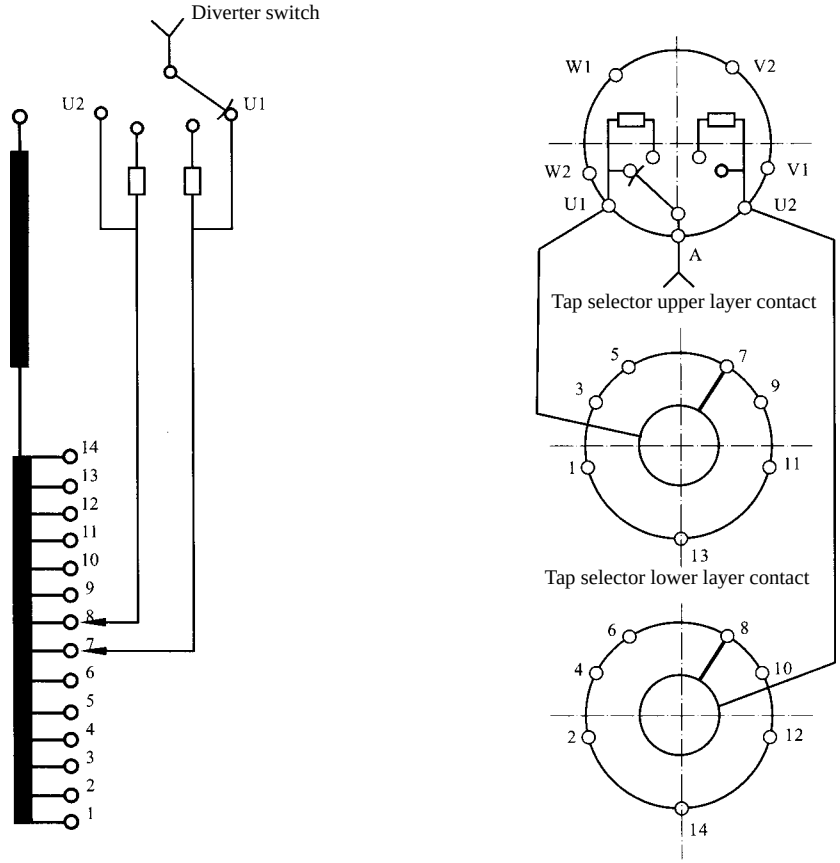
Note:

1. Indication position should be the set position shown with asterisk *
2. The contact position of tap selector marked with "▲" refers to working contact.

Indication position		1	2	3	4	*5	6	7	8	9	10
Position of tap selector		1	2	3	4	5	6	7	8	9	10
Position of diverter switch		U1	U2	U1	U2	U1	U2	U1	U2	U1	U2
Direction of transforming 1 → N		→									
Tap selector	Upper layer	▲1	1	▲3	3	▲5	5	▲7	7	▲9	9
Position of contact	Lower layer	2	▲2	2	▲4	4	▲6	6	▲8	8	▲10
Direction of transforming N → 1		←									
Tap selector	Upper layer	▲1	3	▲3	5	▲5*	7	▲7	9	▲9	9
Position of contact	Lower layer	2	▲2	4	▲4	6	▲6	8	▲8	10	▲10

Appendix 2

13 steps (14140) operating position and connection diagram for type CM



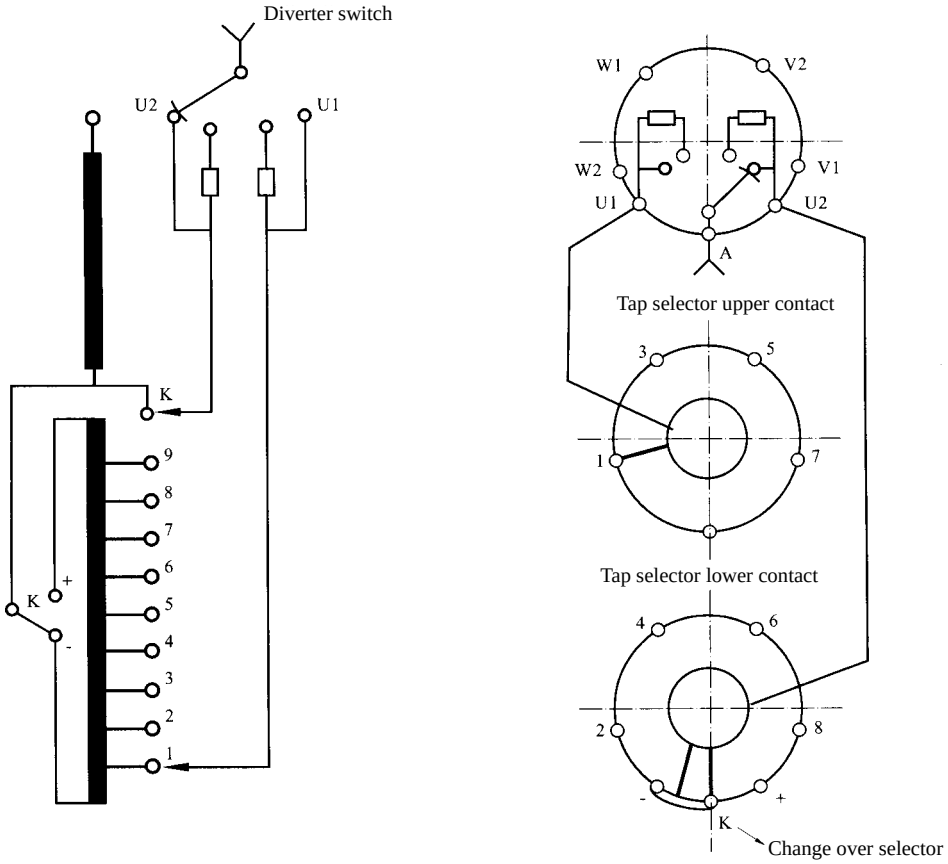
Note:

1. Indication position should be the set position shown with asterisk *
2. The contact position of tap selector marked with "▲" refers to working contact.

Indication position		1	2	3	4	5	6	*7	8	9	10	11	12	13	14
Position of tap selector		1	2	3	4	5	6	7	8	9	10	11	12	13	14
Position of diverter switch		U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2
Direction of transforming 1 → N		→													
Tap selector Position of contact	Upper layer	▲1	1	▲3	3	▲5	5	▲7	7	▲9	9	▲11	11	▲13	13
	Lower layer	2	▲2	2	▲4	4	▲6	6	▲8	8	▲10	10	▲12	12	▲14
Direction of transforming N → 1		←													
Tap selector Position of contact	Upper layer	▲1	3	▲3	5	▲5	7	▲7	9	▲9	9	▲11	13	▲13	13
	Lower layer	2	▲2	4	▲4	6	▲6	8	▲8	10	▲10	12	▲12	14	▲14

Appendix 3

± 9 steps (10191) operating position and connection diagram for type CM



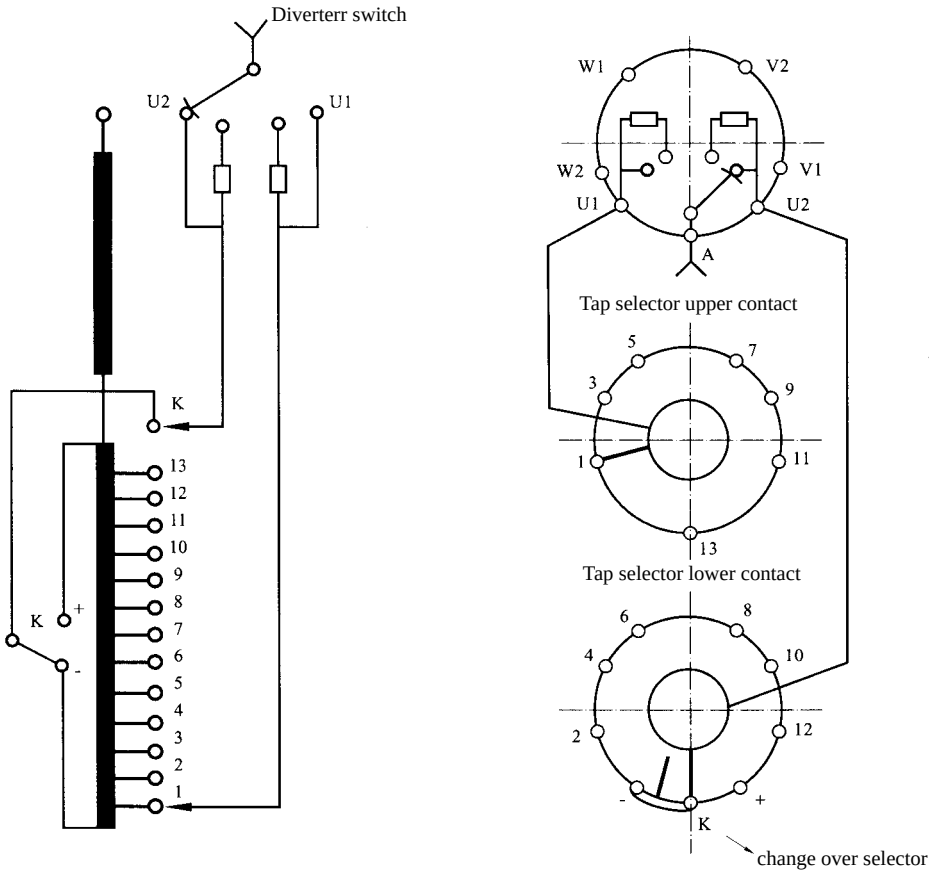
Note:

1. Indication position should be the set position shown with asterisk *
2. The contact position of tap selector marked with "▲" refers to working contact.

Indication position		1	2	3	4	5	6	7	8	9	10*	11	12	13	14	15	16	17	18	19
Position of tap selector		1	2	3	4	5	6	7	8	9	K	1	2	3	4	5	6	7	8	9
Position of change-over selector								K+								K−				
								K+								K−				
Position of diverter switch		U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1
Direction of transforming 1 → N																				
Tap selector	Upper layer	▲1	1	▲3	3	▲5	5	▲7	7	▲9	9	▲1	1	▲3	3	▲5	5	▲7	7	▲9
Position of contact	Lower layer	2	▲2	2	▲4	4	▲6	6	▲8	8	▲k	k	▲2	2	▲4	4	▲6	6	▲8	8
Direction of transforming N → 1																				
Tap selector	Upper layer	▲1	3	▲3	5	▲5	7	▲7	9	▲9	1	▲1	3	3▲	5	5▲	7	7▲	9	9▲
Position of contact	Lower layer	2	▲2	4	▲4	6	▲6	8	▲8	k	▲k	2	2▲	4	4▲	6	6▲	8	8▲	8

Appendix 4

± 13 steps(14271W)operating position and connection diagram for type CM



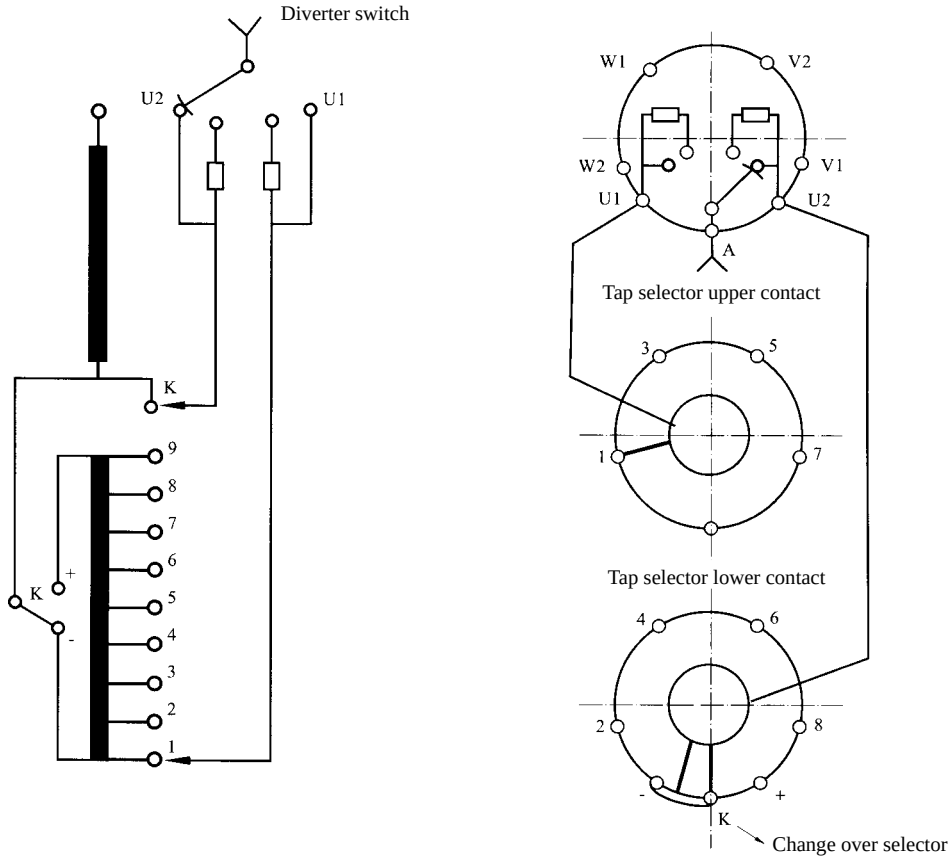
Note:

1. Indication position should be the set position shown with asterisk *
2. The contact position of tap selector marked with "▲" refers to working contact.

Indication position		1	2	3	4	5	6	7	8	9	10	11	12	13	14*	15	16	17	18	19	20	21	22	23	24	25	26	27
Position of tap selector		1	2	3	4	5	6	7	8	9	10	11	12	13	K	1	2	3	4	5	6	7	8	9	10	11	12	13
Position of change-over selector			K+																		K−							
			K+																		K−							
Position of diverter switch		U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1
Direction of transforming 1 → N																												
Tap selector	Upper layer	1▲	1	3▲	3	5▲	5	7▲	7	9▲	9	11▲	11	13▲	13	1▲	1	3▲	3	5▲	5	7▲	7	9▲	9	11▲	11	13▲
Position of contact	Lower layer	2	2▲	2	4▲	4	6▲	6	8▲	8	10▲	10	12▲	12	K▲	K	2▲	2	4▲	4	6▲	6	8▲	8	10▲	10	12▲	12
Direction of transforming N → 1																												
Tap selector	Upper layer	1▲	3	3▲	5	5▲	7	7▲	9	9▲	11	11▲	13	13▲	1	1▲	3	3▲	5	5▲	7	7▲	9	9▲	11	11▲	13	13▲
Position of contact	Lower layer	2	2▲	4	4▲	6	6▲	8	8▲	10	10▲	12	12▲	K	K▲	2	2▲	4	4▲	6	6▲	8	8▲	10	10▲	12	12▲	12

Appendix 5

± 8 steps(10193W)operating position and connection diagram for type CM



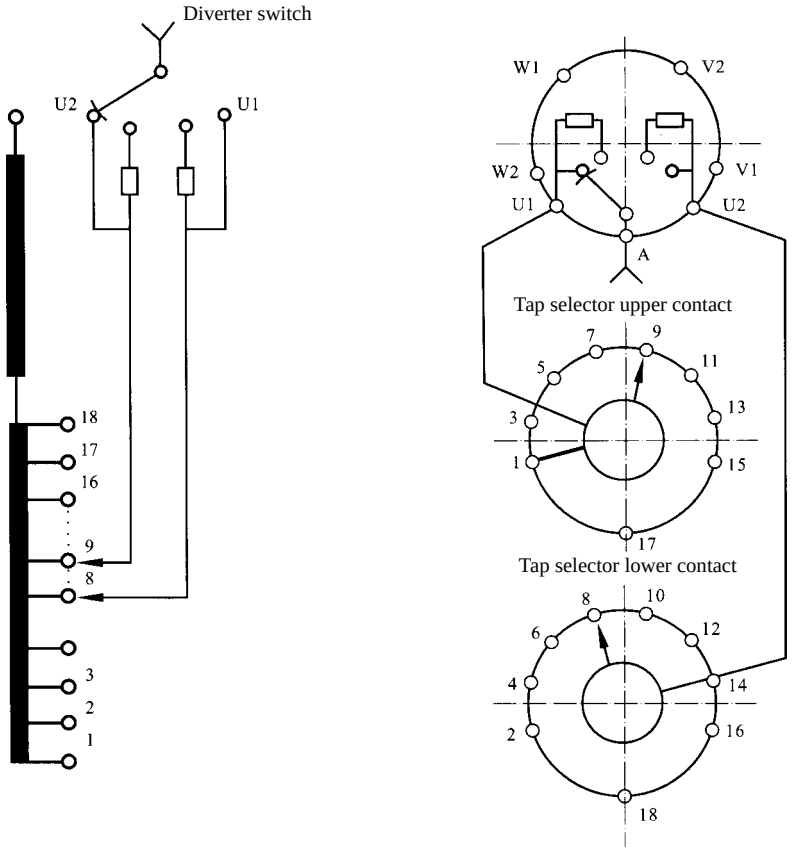
Note:

1. Indication position should be the set position shown with asterisk *
2. The contact position of tap selector marked with▲ refer to working contact.
3. The position 9a, 9b, 9c with same potential

Indication position		1	2	3	4	5	6	7	8	9a	9b*	9c	10	11	12	13	14	15	16	17
Position of tap selector		1	2	3	4	5	6	7	8	9	K	1	2	3	4	5	6	7	8	9
Position of change-over selector							K+									K−				
											K+						K−			
Position of diverter switch		U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1
Direction of transforming 1 → N																				
Tap selector	Upper layer	▲1	1	3▲	3	5▲	5	7▲	7	9▲	9	1▲	1	3▲	3	5▲	5	7▲	7	9▲
Position of contact	Lower layer	2	▲2	2	4▲	4	6▲	6	8▲	8	k▲	k	2▲	2	4▲	4	6▲	6	8▲	8
Direction of transforming N → 1																				
Tap selector	Upper layer	▲1	3	▲3	5	▲5	7	▲7	9	▲9	1	▲1	3	3▲	5	5▲	7	7▲	9	9▲
Position of contact	Lower layer	2	▲2	4	▲4	6	6▲	8	▲8	k	k▲	2	2▲	4	4▲	6	6▲	8	8▲	8

Appendix 6

17 steps (18180) operating position and connection diagram for type CM



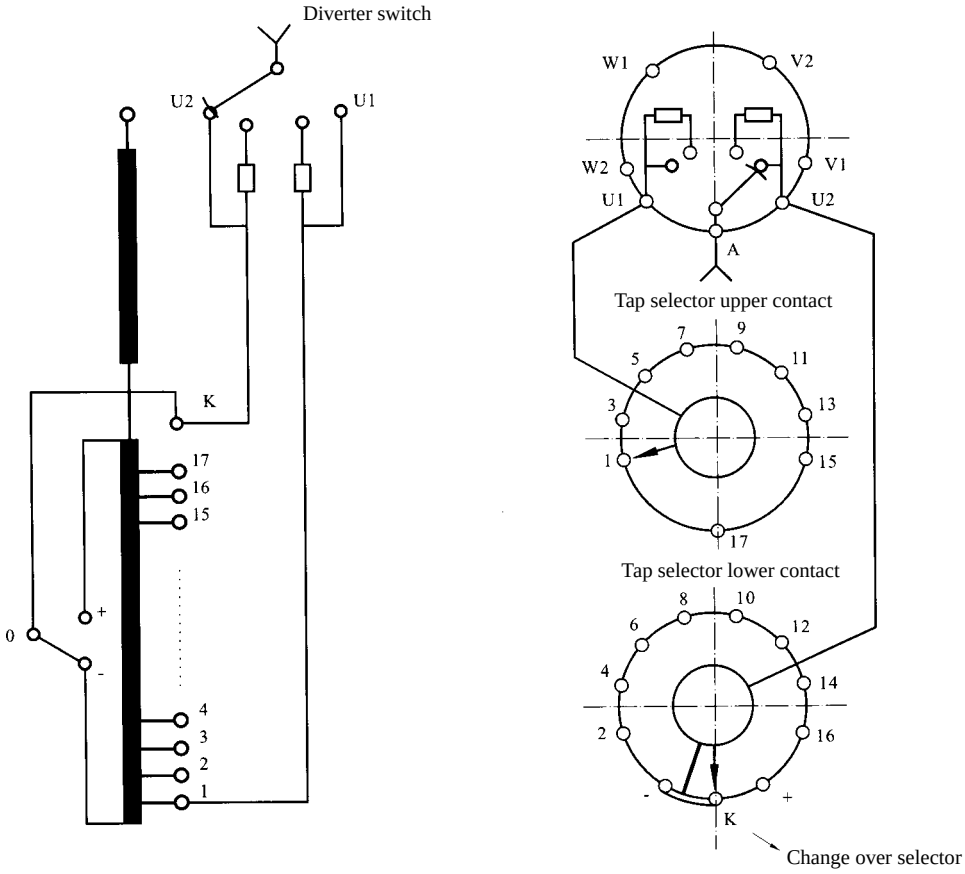
Note:

1. Indication position should be the set position shown with asterisk *
2. The contact position of tap selector marked with "▲" refers to working contact.

Indication position		1	2	3	4	5	6	7	8	9*	10	11	12	13	14	15	16	17	18
Position of tap selector		1	2	3	4	5	6	7	8	9	10	1	2	3	4	5	6	7	8
Position of diverter switch		U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2	U1	U2
Direction of transforming 1 → N			→																
Tap selector Position of contact	Upper layer	1▲	1	3▲	3	5▲	5	7▲	7	9▲	9	11▲	11	13▲	13	15▲	15	17▲	17
	Lower layer	2	2▲	2	4▲	4	6▲	6	8▲	8	10▲	10	12▲	12	▲14	14	▲16	16	18▲
Direction of transforming N → 1			←																
Tap selector Position of contact	Upper layer	▲1	3	3▲	5	5▲	7	7▲	9	9▲	11	11▲	13	13▲	15	15▲	17	17▲	17
	Lower layer	2	2▲	4	4▲	6	6▲	8	8▲	10	10▲	12	12▲	14	14▲	16	16▲	18	18▲

Appendix 7

± 17 steps (18351W)operating position and connection diagram for type CM



Note:

1. Indication position should be the set position shown with asterisk *
2. The contact position of tap selector marked with "▲" refers to working contact.

Indication position		1	2	3	4	……	16	17	18*	19	20	……	32	33	34	35
Position of tap selector		1	2	3	4	……	16	17	K	1	2	……	14	15	16	17
Position of change-over selector		K + →										K− →				
		← K +										← K−				
Position of diverter switch		U1	U2	U1	U2	……	U2	U1	U2	U1	U2	……	U2	U1	U2	U1
Direction of transforming 1 → N		→														
Tap selector Position of contact	Upper layer	▲1	1	3▲	3	……	15	17▲	17	1▲	1	……	13	15▲	15	17▲
	Lower layer	2	2▲	2	4▲	……	16▲	8	k▲	k	2▲	……	14▲	14	16▲	16
Direction of transforming N → 1		←														
Tap selector Position of contact	Upper layer	▲1	3	3▲	5	……	7	17▲	1	1▲	3	……	15	15▲	17	17▲
	Lower layer	2	2▲	4	▲4	……	▲8	k	k▲	2	2▲	……	14▲	16	16▲	16