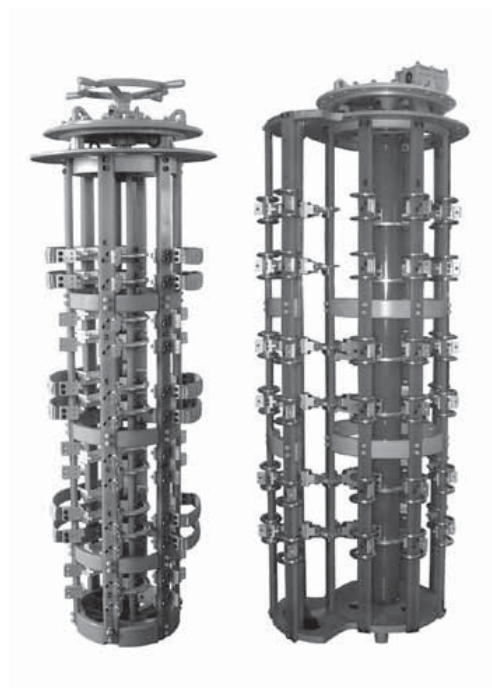




Type WSL Off-Circuit Tap Changer

Operating Instructions

HM 0.460.602-03.08/2015



Shanghai Huaming Power Equipment Co., Ltd.

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1. GENERAL

The W□L Off-Circuit Tap changer is designed like a cage without oil compartment and can be installed vertically on the transformer tank cover through flange directly.

As per different operating modes there are three different types: motor drive, manual drive and top hand wheel. Please find detail in Fig.1, Fig, and Fig.3.

As per different internal structures, and regulating mode there are six different types: Linear regulation, Single –bridging regulation, Double-bridging regulation, Y-D change-over regulation, Serial-parallel regulation, and Reversing regulation. Please find connecting detail in Fig. 1 and connection diagram in Fig.4.

As per different sizes, there are four different types: A, B, C, D and E.

There are two types of flange mounting: tank cover and bell type.

This operating instructions contains all operating and installation materials of the Tap changer.

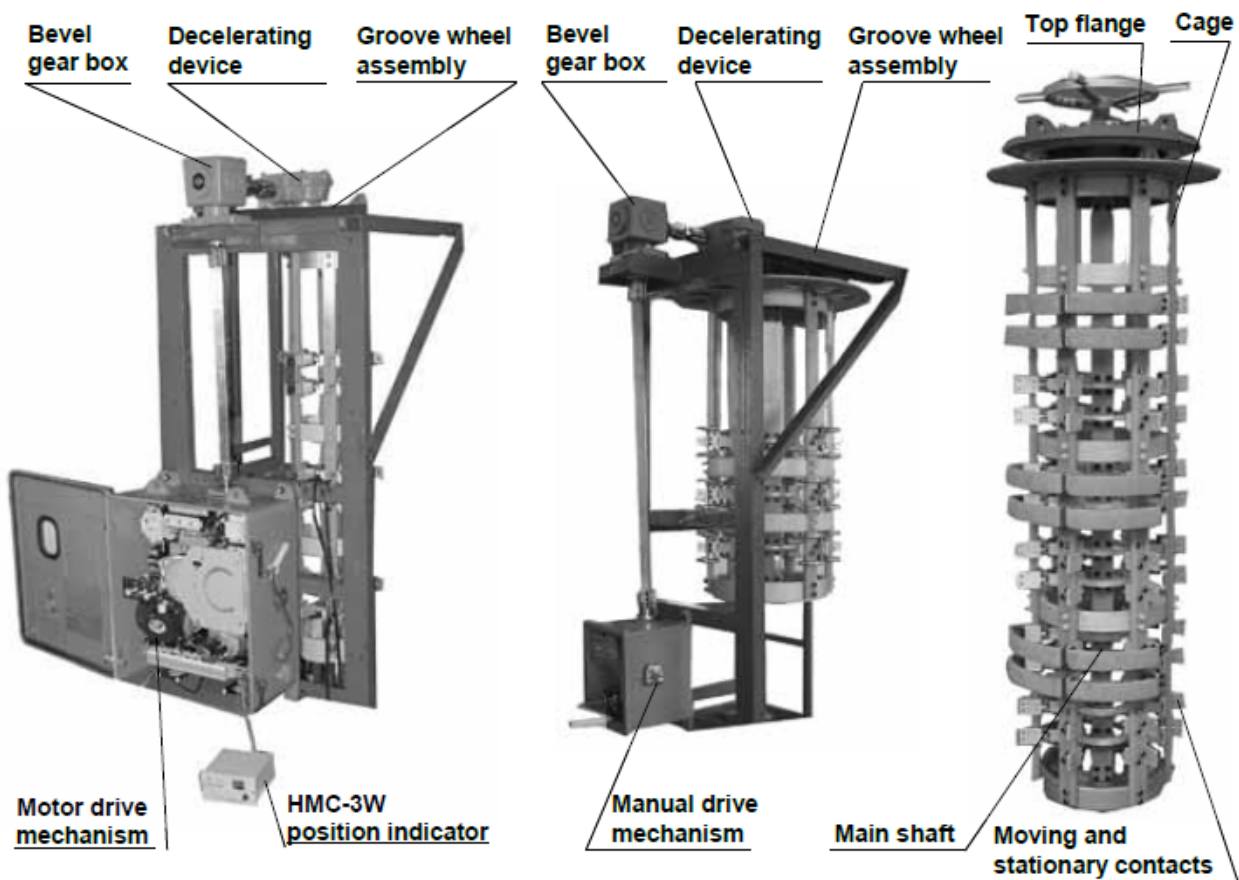
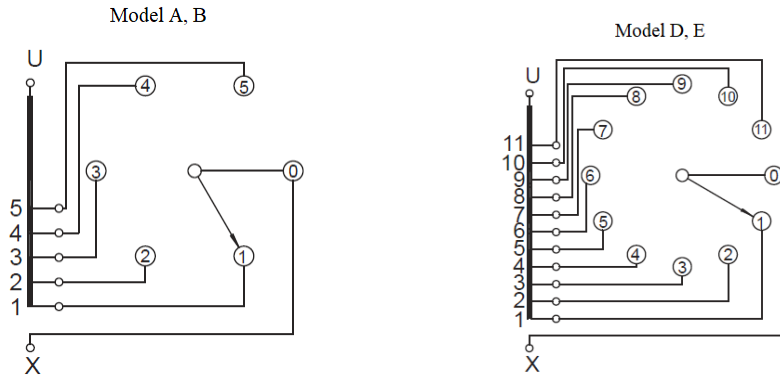


Fig.1 Ground motor drive type

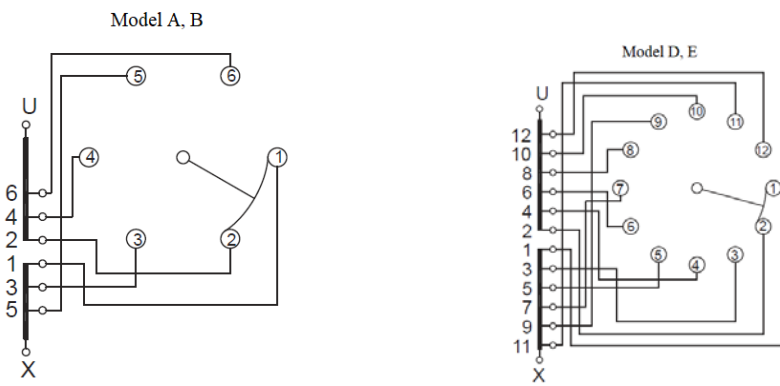
Fig.2 Ground manual drive type

Fig.3 Top hand wheel type

Linear regulation



Single-bridging regulation



Double-bridging regulation

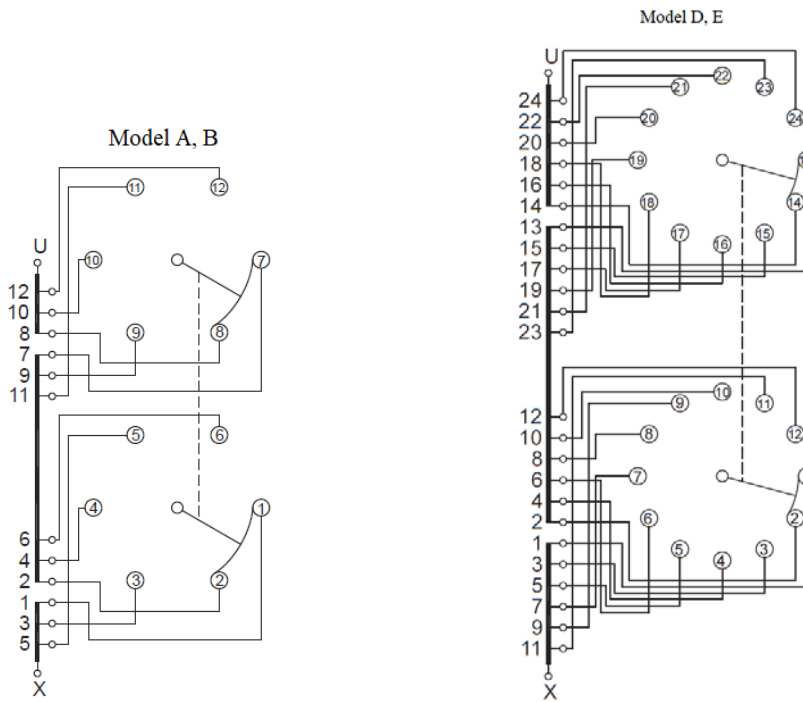
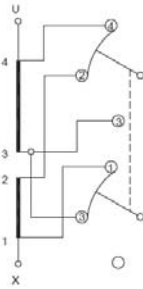
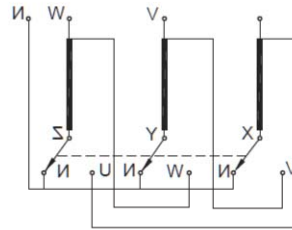


Fig. 4(a) Basic connection diagram

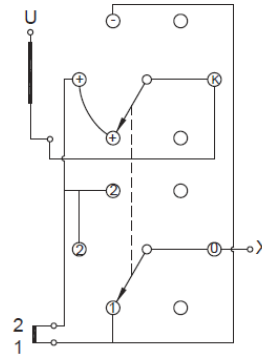
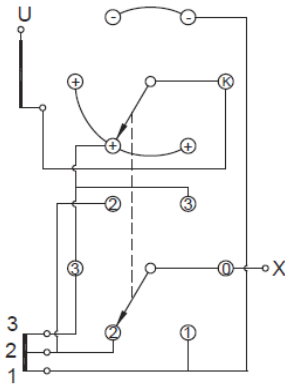
Serial-parallel transform



Y-D transform



Reversing



Tap position	1	2	3	4	5
Position for regulation	+2	+1	0	-1	-2
Connection mode	$\text{K}-+$	$\text{K}-+$	$\text{K}-+$	$\text{K}-$	$\text{K}-$
Connection mode	$\text{O}-1$	$\text{O}-2$	$\text{O}-3$	$\text{O}-2$	$\text{O}-3$

WSLII-XXX/XX-6×5

Tap position	1	2	3
Position for regulation	+1	0	-1
Connection mode	$\text{K}-+$	$\text{K}-+$	$\text{K}-$
Connection mode	$\text{O}-1$	$\text{O}-2$	$\text{O}-2$

WSLII-XXX/XX-4×3

Fig. 4(b) Basic connection diagram

1.1 Designation of tap changer model

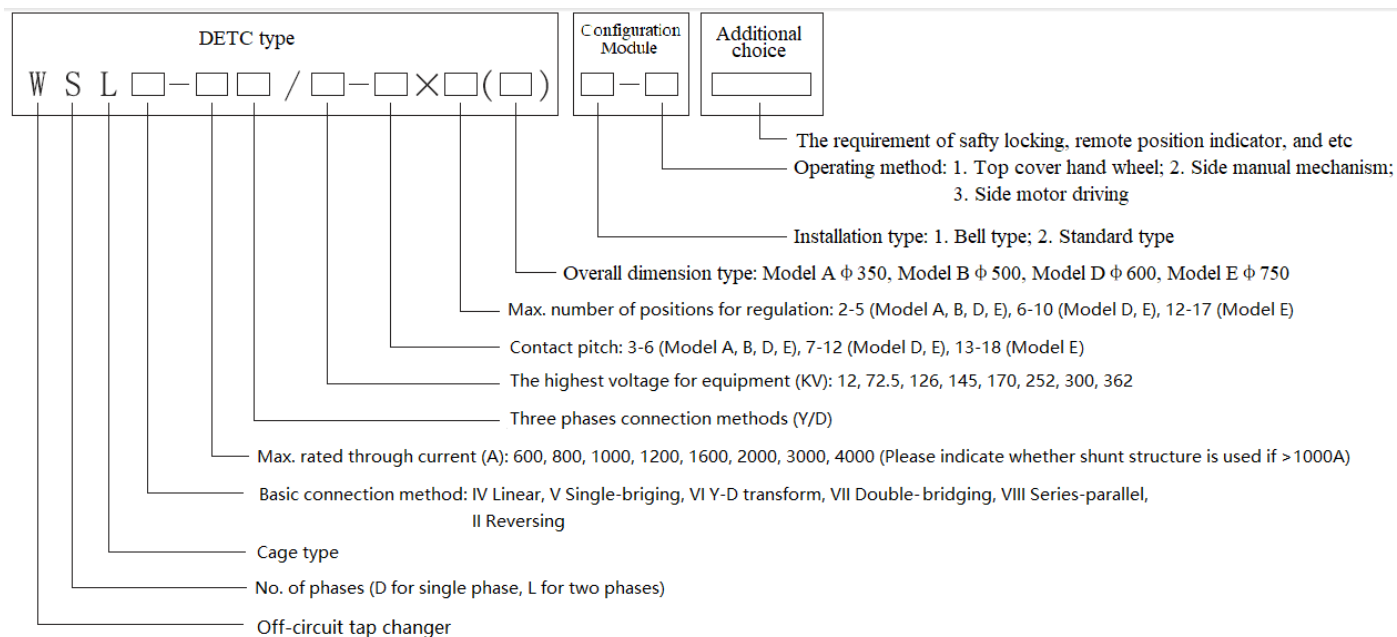


Table 1 Basic connection method and code

Code	IV	V	VI	VII	V III	II
Connection	Linear off-circuit tap changer for neutral application	Single-bridging off-circuit tap changer	Star-delta off-circuit tap changer	Double-bridging off-circuit tap changer	Series-parallel off-circuit tap changer	Reversing off-circuit tap changer

1.2 Functions and Application

Type WSL off-circuit tap changers apply to single pole or three poles oil immersed non excitation voltage regulating power and special transformers with the max. rated through current of 600A,800A,1000A,1200A and highest voltage for equipment of 12 kV, 72.5 kV and 126kV. The operating positions are: model A and model B are 5; model C and D are 11; model E is 17. The rated frequency is 50Hz~60Hz.

1.3 Working condition

1.3.1 The temperature of the transformer oil shall be less than 100°C, and higher than -25°C.

1.3.2 The storage humidity of the OLTC should be no more than 85 percent. The service temperature of standard designed OLTC is -25°C to 40°C. If the temperature exceeds the range of standard (-25°C to 40°C), please specify when ordering. To meet the ordering requirements

and comply with operating environment, if the requested service temperature is out of the range of -60°C to 40°C, the material and accessories of the OLTC will be specially designed and selected.

1.3.3 Vertical inclination of the tap changer should not be over 2% when it is installed on the transformer.

1.3.4 The tap changer shall be operated in areas without a corrosive or explosive gas.

2. Technical Data

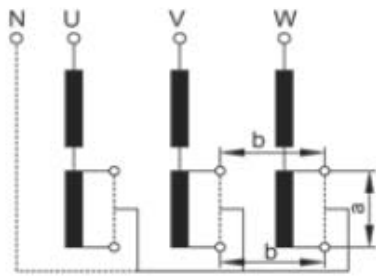
All technical data are given in table 2, table 3, and table 4.

Overall dimensions of the tap changers refer to Appendix 10-31.

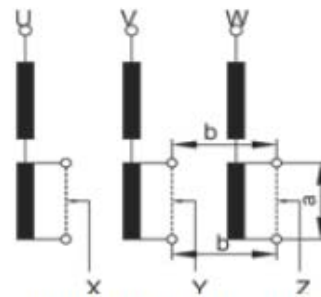
Table 2 Technical data of the tap changer

ITEM	Type	WSL, WDL								
1	No. of phases	3-phase (WSL), single-phase (WDL)								
2	Max. rated through current (A)	600	800	1000	1200	1600	2000	2400	3000	
3	Short-circuit current test (kA)	Thermal (3s)	9	12	15	15	20	24	26	30
		Dynamic (Peak)	22.5	30	37.5	37.5	50	60	65	75
4	Rated frequency (Hz)	50 or 60								
5	Insulation to ground (kV)	The highest voltage for equipment	12	72.5	126	145	170	252		
			single or 3 phase	single or 3 phase	single or 3 phase	single or 3 phase	single or 3 phase	single or 3 phase	single or 3 phase	
		Rated lightning impulse withstand voltage (kV, 1.2/20 μ s)	75	325	550	650	750	1050		
		Rate separate source AC withstand voltage (kV/50Hz, 1min)	35	140	230	275	325	460		
6	Internal insulation (kV)	see Table 4								
7	Overall dimension type	Model A \varnothing 350, Model B \varnothing 500, Model D \varnothing 600, Model E \varnothing 750								
8	Max. operating positions	Max. 5 for type A, max. 5 for type B max. 11 for type D, max. 17 for type E								
9	Mechanical life	manual driving >20,000 operations, motor driving > 100,000 operations								
10	Weight (kg)	Model A				Model B, D, E				
		max:100				max:195				

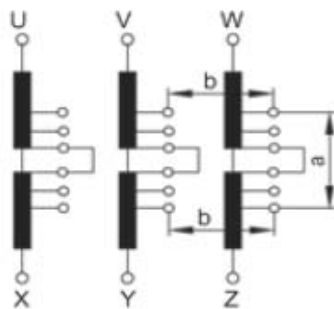
Table 3 Voltage gradient for each part of voltage regulation segment



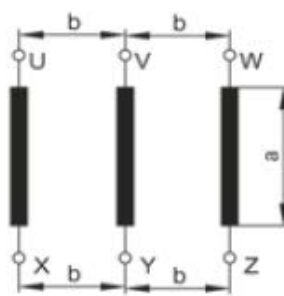
Linear neutral point



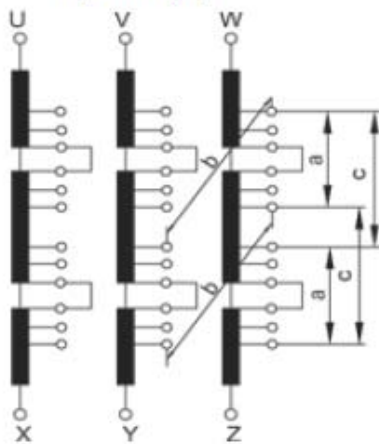
Linear delta connection



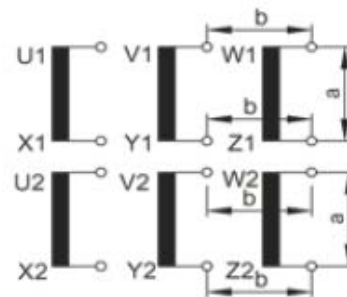
Single-bridging



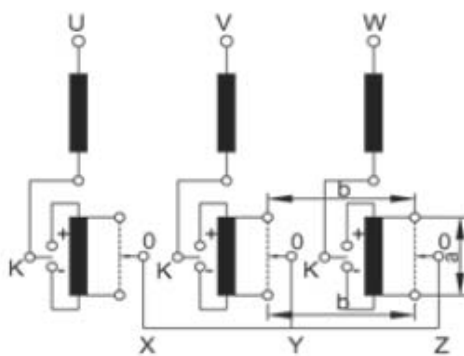
Y-D transform



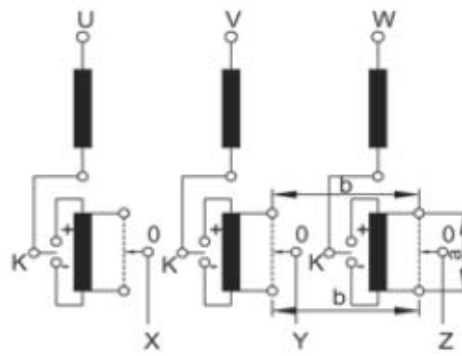
Double-bridging



Serial-parallel



Y connection reversing



D connection reversing

Table 4 Internal insulation level (Unit: kV)

Basic connection mode		Linear for Y connection (IV Y)					
Contact circle diameter		Model A ϕ 350mm			Model B ϕ 500mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	65	158	2-5	90	258
	b	-	50	125	-	50	125
72.5	a	2-5	65	158	2-5	90	258
	b	-	50	125	-	50	125
126	a	2-5	65	158	2-5	90	258
	b	-	70	170	-	70	170
		Model D ϕ 600mm			Model E ϕ 750mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
72.5	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
126	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
	b	-	50	125	-	50	125
		-	70	170	-	70	170
		-	-	-	-	-	-

Basic connection mode		Linear for D connection (IV D)					
Contact circle diameter		Model A ϕ 350mm			Model B ϕ 500mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	65	158	2-5	90	258
	b	-	50	125	-	50	125
72.5	a b	2-5	65	158	2-5	90	258
		-	140	325	-	140	325
126	a b	2-5	65	158	2-5	90	258
		-	230	550	-	230	550
		Model D ϕ 600mm			Model E ϕ 750mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
72.5	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
126	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
	b	-	50	125	-	50	125
		-	140	- 325	-	140	325
		-	230	550	-	230	550

Table 4 Internal insulation level (cont' 1)

(Unit: kV)

Basic connection mode		Single-bridging connection (V)					
Contact circle diameter		Model A ϕ 350mm			Model B ϕ 500mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	65	158	2-5	90	258
	b	-	50	125	-	50	125
72.5	a	2-5	65	158	2-5	90	258
	b	-	140	325	-	140	325
126	a	2-5	65	158	2-5	90	258
	b	-	230	550	-	230	550
Model D ϕ 600mm				Model E ϕ 750mm			
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	- 50	- 125	12-17	38	75
72.5	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	- 140	- 325	12-17	38	75
126	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
126	b	-	230	550	-	230	550

Table 4 Internal insulation level (cont' 2)

(Unit: kV)

Basic connection mode		Double-bridging connection (VII)					
Contact circle diameter		Model A $\phi 350\text{mm}$			Model B $\phi 500\text{mm}$		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μs)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μs)
12	a	2- 5	65	158	2- 5	90	258
	b	-	50	125	-	50	125
	c	-	38	95	-	38	95
72. 5	a	2- 5	65	158	2- 5	90	258
	b	-	140	325	-	140	325
	c	-	65	158	-	65	158
126	a	2- 5	65	158	2- 5	90	258
	b	-	230	550	-	230	550
	c	-	70	170	-	70	170
Model D $\phi 600\text{mm}$				Model E $\phi 750\text{mm}$			
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μs)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μs)
12	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
	-	-	-	12-17	38	75	
	b	-	50	125	-	50	125
72. 5	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
	-	-	-	12-17	38	75	
	b	-	140	325	-	140	325
126	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
	-	-	-	12-17	38	75	
	b	-	230	550	-	230	550
c	-	70	170	-	70	170	

Basic connection mode		Serial-parallel transform (VIII)			
Contact circle diameter		Model A $\phi 350\text{mm}$		Model B $\phi 500\text{mm}$	
Highest voltage for equipment	Insulation gap	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μs)	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μs)
12	a	65	158	90	258
	b	50	125	50	125
72. 5	a	-	-	90	258
	b	-	-	140	325
126	a	-	-	90	258
	b	-	-	230	550

Table 4 Internal insulation level (cont'3)

(Unit: kV)

Basic connection mode		Y-D transform (VI)			
Contact circle diameter		Model A ϕ 350mm		Model B ϕ 500mm	
Highest voltage for equipment	Insulation gap	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	50	125	140	325
	b	50	125	50	125
72.5	a	-	-	140	325
	b	-	-	140	325
Model D ϕ 600mm					
Highest voltage for equipment	Insulation gap	Power frequency withstand voltage (50Hz/1min)		Impulse test voltage (1.2/50 μ s)	
12	a	275		650	
	b	50		125	
72.5	a	275		650	
	b	140		325	
126	a	275		650	
	b	230		550	

Basic connection mode		Y connection reversing (II Y)					
Contact circle diameter		Model A ϕ 350mm			Model B ϕ 500mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a b	2- 5	65	158	2- 5	90	258
		-	50	125	-	50	125
72.5	a b	2- 5	65	158	2- 5	90	258
		-	50	125	-	50	125
126	a b	2- 5	65	158	2- 5	90	258
		-	70	170	-	70	170
Model D ϕ 600mm						Model E ϕ 750mm	
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
	b	-	-	-	12-17	38	75
		-	50	125	-	50	125
72.5	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
	b	-	-	-	12-17	38	75
		-	50	125	-	50	125
126	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
	b	-	-	-	12-17	38	75
		-	70	170	-	70	170

Table 4 Internal insulation level (cont'4)

(Unit: kV)

Basic connection mode		D connection reversing (II D)					
Contact circle diameter		Model A ϕ 350mm			Model B ϕ 500mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2- 5	65	158	2- 5	90	258
	b	-	50	125	-	50	125
72.5	a	2- 5	65	158	2- 5	90	258
	b	-	140	325	-	140	325
126	a	2- 5	65	158	2- 5	90	258
	b	-	230	550	-	230	550
		Model D ϕ 600mm			Model E ϕ 750mm		
Highest voltage for equipment	Insulation gap	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)	Tap position	Power frequency withstand voltage (50Hz/1min)	Impulse test voltage (1.2/50 μ s)
12	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	- 50	-	12-17	38	75
72.5	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
126	a	2-5	185	450	2-5	275	650
		6-11	50	125	6-11	115	280
		-	-	-	12-17	38	75
126	b	-	230	550	-	230	550

Table 5 Motor Drive Unit Technical Data for Type SHM-D

Item	Data	
Step motor and Subdivision drive	Rated voltage (V)	220V/AC
	Rated current (A)	6
	Rate frequency (Hz)	50、60
Rated torque on drive shaft (N·m)	35	
Revolution of the drive shaft per switching operation (Turns)	33	
Revolution of the hand crank per switching operation (Turns)	33	
Running time per switching operation (S)	约5	
Maximum number of operation position	107	
Insulation level KV (50Hz 1min)	2	
Weight (kg)	80	
Protective degree	IP66	
Controller	Type	SHM-K
	Rated voltage (V)	220V/AC
	Frequency (Hz)	50、60

3. Structure of the Tap changer

This tap changer adopts cage structure and is categorized into three types by operation made: ground motor driving, ground manual driving and top cover hand wheel.

3.1 Top cover hand wheel type tap changer (Fig. 3): Top cover hand wheel type tap changer composes of head flange and contacts system.

3.1.1 Head flange: The force is transmitted through the hand wheel to the driving shaft and then to the moving contacts of the contacts system through coupling box.

3.1.2 Contacts system: the contacts system consists of moving contacts on a shaft and stationary contacts attached to a cage.

3.2 Ground manual driving type tap changer (Fig.2): Ground manual driving type tap changer composes of head flange, contacts system, manual operating unit and bevel gear box.

3.2.1 Head flange: This head flange is different from the hand flange of top cover hand wheel type tap changer. It has a set of groove wheels and a gear decelerating device.

3.2.2 Contacts system: This contacts system is the same as the contacts system of top cover hand wheel type tap changer.

3.2.3 Manual operating unit (Fig.5): Manual operating unit consists of tank, tank cover, internal gear mechanism and position indicator. 10 turns manual operation makes one position tap change.

3.2.4 Distance switch positioning provides double protections which make the off circuit tap changer more reliable.

3.3 Ground motor driving type tap changer (Fig.1)

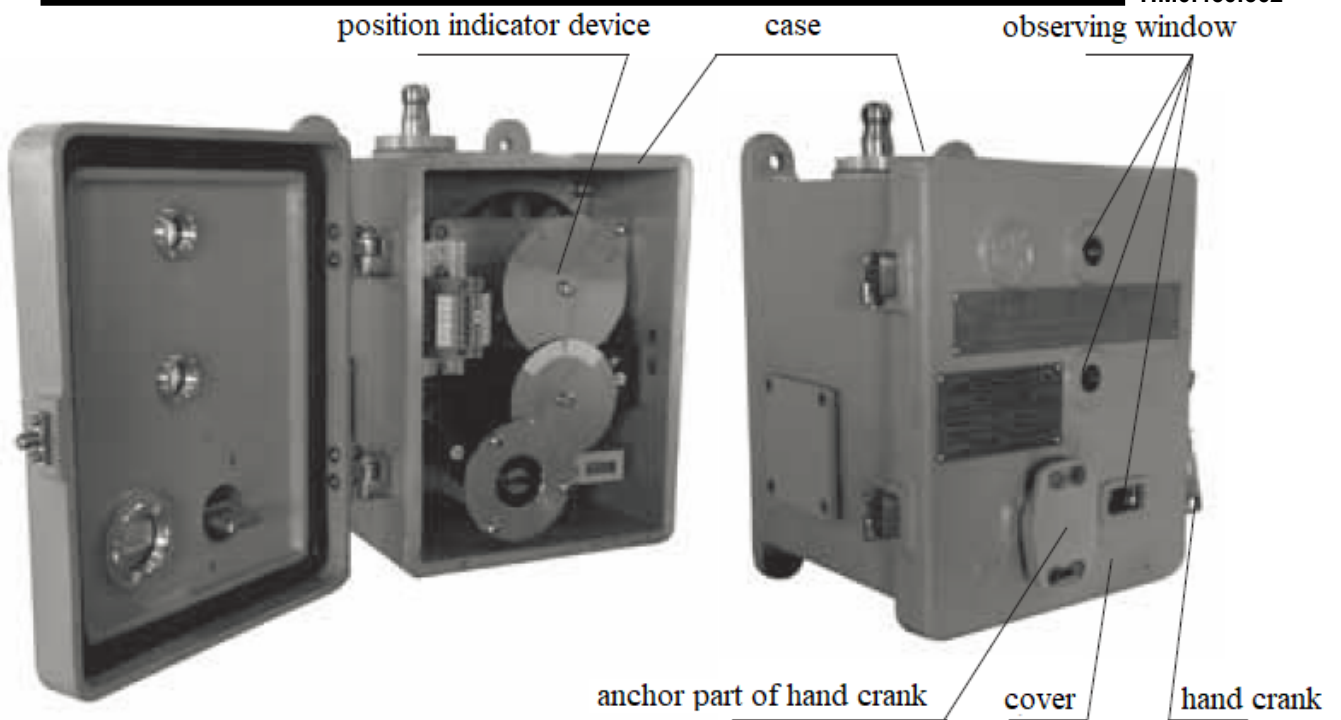


Fig. 5 Manual operating unit



Fig. 6 Motor driving unit

(Install the motor driving unit according to different request of clients)

4. Technical requirements of the Tap changer

4.1 The tap changer should apply for 10 operation cycles of mechanical operation test without any failure after the tap changer is connected with the motor drive unit.

4.2 Measure the contact pressure and contact resistance after assembled all the contact pieces. Pressure should be $50\text{N} \pm 10\text{N}$, the pressure of the upper and lower contact point should be even and the contact resistance $\leq 350 \mu \Omega$.

4.3 Perform gas pressure test after the head flange of tap changer is well mounted. Without any leakage within 24 hours under the air pressure of 0.08MPa.

4.4 Top cover hand wheel type tap changer: when the head position indicator is at one position, the moving contact should be match with the fixed contact accordingly and both contacts should stay intermediate contact position.

4.5 Ground motor driving type tap changer: The working position of moving contact must match with the position indicate by motor drive unit after motor drive unit stop, and stay in intermediate contact position of fixed contact.

4.6 Ground manual driving type tap changer: The working position of moving contact must match with the position indicate by manual driving device after 10 turns position of manual driving device, and stay in intermediate contact position of fixed contact.

4.7 When the tap changer in the transformer oil undergoes through 1.2 times of max. rated current, the temperature rise of oil over contacts should not be over 15K.

5. Storage and Transportation

5.1 Tap changer should be kept in a warehouse where it is clean, dry and free of corrosive gas with anti-dust and anti-moisture protection; Temperature is between -25°C and $+40^{\circ}\text{C}$, and the relative humidity should not be over 85%.

5.2 Temporary support is necessary during transportation for tap changer over 2 meters long in order to prevent tap changer from distortion or damage due to wobble. Dismantle the temporary support before putting the equipment into service.

6. Documents

- 6.1 Quality certificate
- 6.2 Packing list
- 6.3 Operating instructions

7. Scope of delivery

- 7.1 Main body of off circuit tap changer
- 7.2 For ground motor driving type tap changer, the tap changer will be delivered with Motor drive Unit SHM-D, bevel gear box, vertical and horizontal drive shafts.
- 7.3 For ground manual driving type tap changer, the tap changer will be delivered with manual driving device, bevel gear box, vertical and horizontal drive shafts.

8. Installation

- 8.1 Initial check before installation
 - 8.1.1 Check the tap changer whether match the requirements of the transformer or not and make sure the approval, operating instruction, packing list and other technical documents are all available.
 - 8.1.2 Check whether the all components of tap changer are in good condition and free of distortion or damage.
 - 8.1.3 Operate a cycle to check whether there is any stagnation of movement and damage of parts, and whether the working position of the contact is the same as that indicated by the position indicator.
 - 8.1.4 Measure contact resistance for each position, to check whether the results are match on the certificate.

8.2 Installation

This type of tap changer does not contain oil compartment and can be directly mounted into the transformer oil tank. Corresponding to two different box structures of the transformer, the tap

changer also has two different installation methods as follows:

8.2.1 Installation of the off-circuit tap changer in standard type transformer (fig. 7)

Clean all the surfaces for the sealing, and put oil -proof gasket on the mounting flange, then slowly lower the tap changer into the transformer. Make sure that to avoid that damage the tap changer wire terminals and screen cap during lifting. Mount the tap changer into transformer installation flange after confirm the mounting position tap changer is in correct position.

8.2.2 Installation of the off-circuit tap changer in bell type transformer (fig. 8)

8.2.2.1 Place the tap changer vertically and dismantle the head flange.

8.2.2.2 Remove the three hex screws which connect between the middle flange and the supporting flange. Take out the middle flange; make sure to keep all the demounted parts.

8.2.2.3 Sling the tap changer and place the supporting flange onto the temporary supporting shelf of transformer, then adjust the relative position between the supporting flange and the head flange then fixed the position. In order to have easily adjustment, bell head cover can be pre-mounting with transformer main body, if it is too difficult to verify the relative position.

Pre-mounting Process:

Lift the bell type box cover of the transformer, cover the transformer, clean the sealing surface and install the sealing gasket. Fix the intermediate flange on the transformer mounting flange.

Use the two lifting rings of support flange to lift the tap changer, adjust the set position, fix the tap changer on the middle flange, clean the sealing surface, put on the sealing gasket, and finally install the head flange.

Note: the three red triangle marks on the support flange, middle flange and head flange shall be in a straight line (Fig. 23-24).

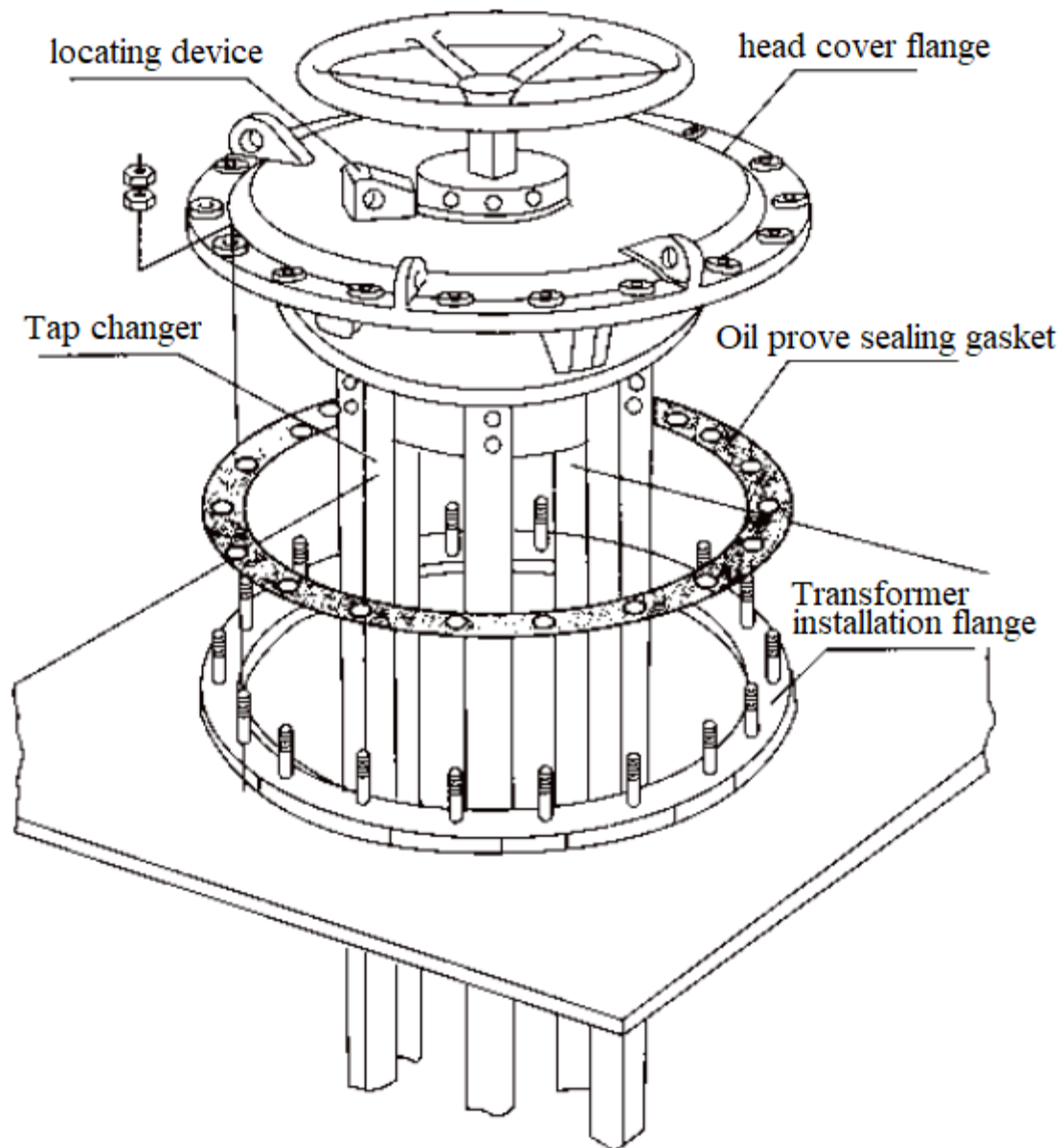
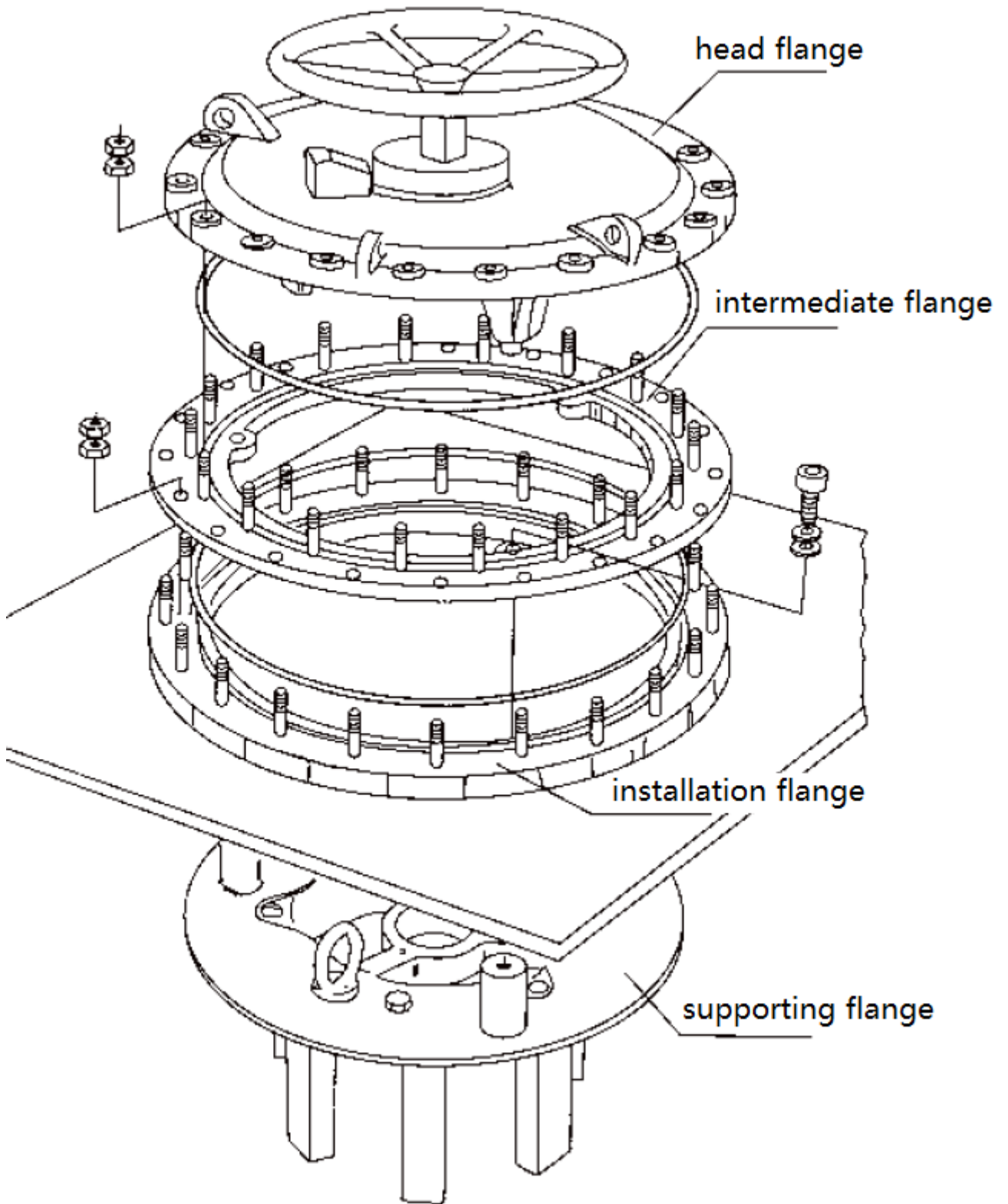


Fig. 7 Installation diagram of the tap changer on the tank cover type transformer

- (a) All of the tap leads should be carefully handled and properly fastened.
- (b) There should be no pulling force between any tap leads and the tap changer.
- (c) The leads between flange of the tap changer cover and the transformer cover are to be grounded.



(d)

Fig. 8 Installation diagram of the tap changer mounting on the bell type transformer

8.2.3 Mounting of the motor drive unit or the manual drive unit

Caution!

The transformer cannot be energized until the drive unit and the off-circuit tap changer are in the same operating position. That is, the connection between the tap changer and the motor drive unit must be checked before energizing the transformer.

8.2.3.1 The tap changer is installed according to 8.2.1 and 8.2.2

Install the bevel gear box on the support plate protruding from the top of the transformer, pay attention to the alignment of the horizontal output shaft of the bevel gear box and the output shaft of the gear box at the head of the tap changer, determine the size of the transmission shaft, leave a gap of about 2mm. Connect the bevel gear box with the gear box on the flange of the tap changer head after the length of the square shaft is processed. Pay attention to adjust the horizontal position, and make the gear box, the transmission shaft and bevel gear box are in a straight line.

8.2.3.3 Install the motor drive unit or the manual unit onto the side tank of the transformer.

Caution!

The surface of the installation box must be flat. The output shaft of the mechanism must be vertical to the ground, and should be aligned with the vertical output shaft of the bevel gear box on the support plate at the top of the transformer. Determine the size of the transmission square shaft, and leave a gap of about 2mm. Connect the motor mechanism or manual mechanism with the bevel gear box after the length of the square shaft is processed, and turn the locking plate 90 ° after fastening the connecting screws, so as to prevent loosening.

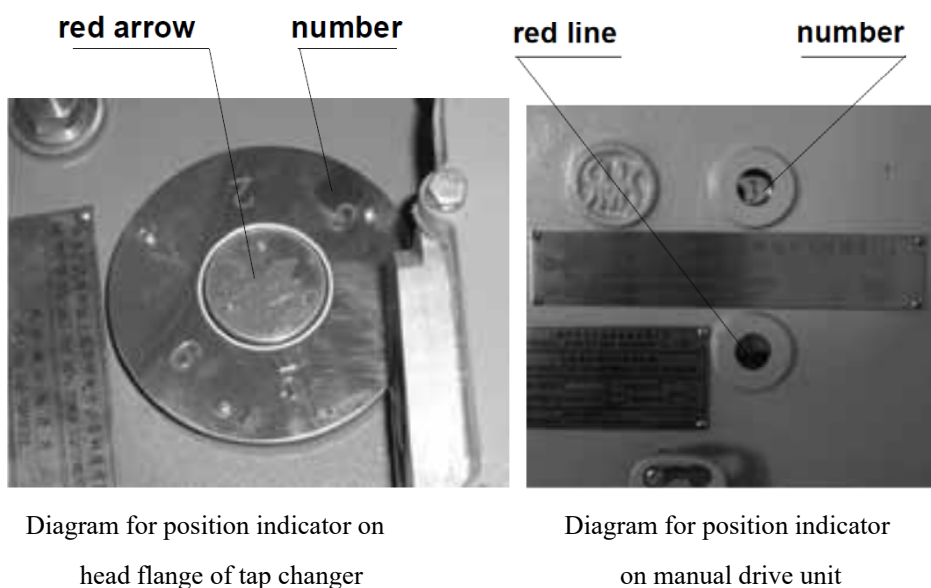
8.2.4 Connection of the motor unit and the tap changer

8.2.4.1. The indicated position in the motor unit should be match with the indicated position in the tap changer and then connect horizontal shaft with vertical shaft.

8.2.4.2 Manually operate the motor unit in both directions with the following method and record the turns of the tap changer: Operate the motor unit in one direction until the red arrow in the center of the tap changer's cover stops at a number. Then keep on operating and start recording the operating turns until the middle of the green zone is shown in the center of the displaying window. "m" is the turns needed. Reverse to record the number of turns in the same way as "n" (see Fig. 9) .

8.2.4.3 Adjustment: if $m-n$ or $n-m \leq 3.75$ turns, no adjustment is required. Otherwise, the following method may be applied: disconnect the vertical shaft from the motor drive unit and operate the motor unit by 3.75 turns towards the bigger number direction then reconnect the vertical shaft to meet the " $m-n$ or $n-m \leq 3.75$ " requirement.

8.2.4.4 Measure the transformer's transforming ratio at each tap position.



9. Drying Procedure

The tap changer is to be dried with the transformer; the drying temperature and time are the same as that of the transformer. The electric insulation level of the tap changer can only be guaranteed after the drying procedure.

In order to guarantee the electric insulation level of the tap changer, the tap changer should be dried with the transformer, and the drying process is same as the transformer.

Note:

- Do not operate the tap changer without oil after drying. If necessary, smear all contacts with some transformer oil before operation
- The tap changer should be immersed into the transformer oil immediately after the drying process.
- Loosen the bleeder on the head flange of the tap changer to release gas during oil refilling of the transformer tank. The transformer oil should strictly adhere to the standard, especially regarding the insulation level and the water percentage level.

10. Operation

The off-circuit tap changer can only be operated when both high voltage side and low voltage side of the transformer are de-energized.

10.1 Operation of top hand wheel tap changer:

Firstly, make sure the transformer is disconnected. Loosen the locating-screw on the positioning device of the tap changer; Turn the wheel and operates the tap changer to next position, check whether the position is incorrect through the position indication window. Fasten the locating-screw on the positioning device after confirmed everything is correct, until next operation (See Fig. 10).

10.2 Operation of ground manual drive tap changer:

Firstly, make sure the transformer is disconnected. Open the hand crank cover, take out the locating device and insert the hand crank and turn 10 cycles. Observe through the window whether the position indication is correct. Keep turning after confirm everything is correct until the red arrow lined up with the red line of the indication plate. Take out the hand crank and insert the locating device so that one tap change is completed, the transformer can resume operating. (See Fig. 5).



stop screw

Fig.10 Stop screw

position-locking hole

10.3 Operating of ground motor drive tap changer

Firstly, make sure the transformer is disconnected.

The SHM-D motor mechanism is equipped with a terminal, which is connected with the auxiliary passive contact of the transformer circuit breaker. When the circuit breaker is in the closed position, the motor mechanism cannot operate (motor protection switch trips).

Press the step-up or step-down button on the motor drive unit or SHM-K controller, the tap changer can tap change from one position to the next position, and complete one tap change.

11. Maintenance

11.1 Operate the tap changer through its complete operating cycle at least once a year to scrub contact surface.

11.2 If the tap changer has remaining in one tap position for over one year, then should operate tap changer for several circles when it need to tap change. Then tap change the tap changer to the position needed.

11.3 The wiring position must be checked carefully before putting into operation, if the transformer winding tap is reconnected to the tap changer terminal block.

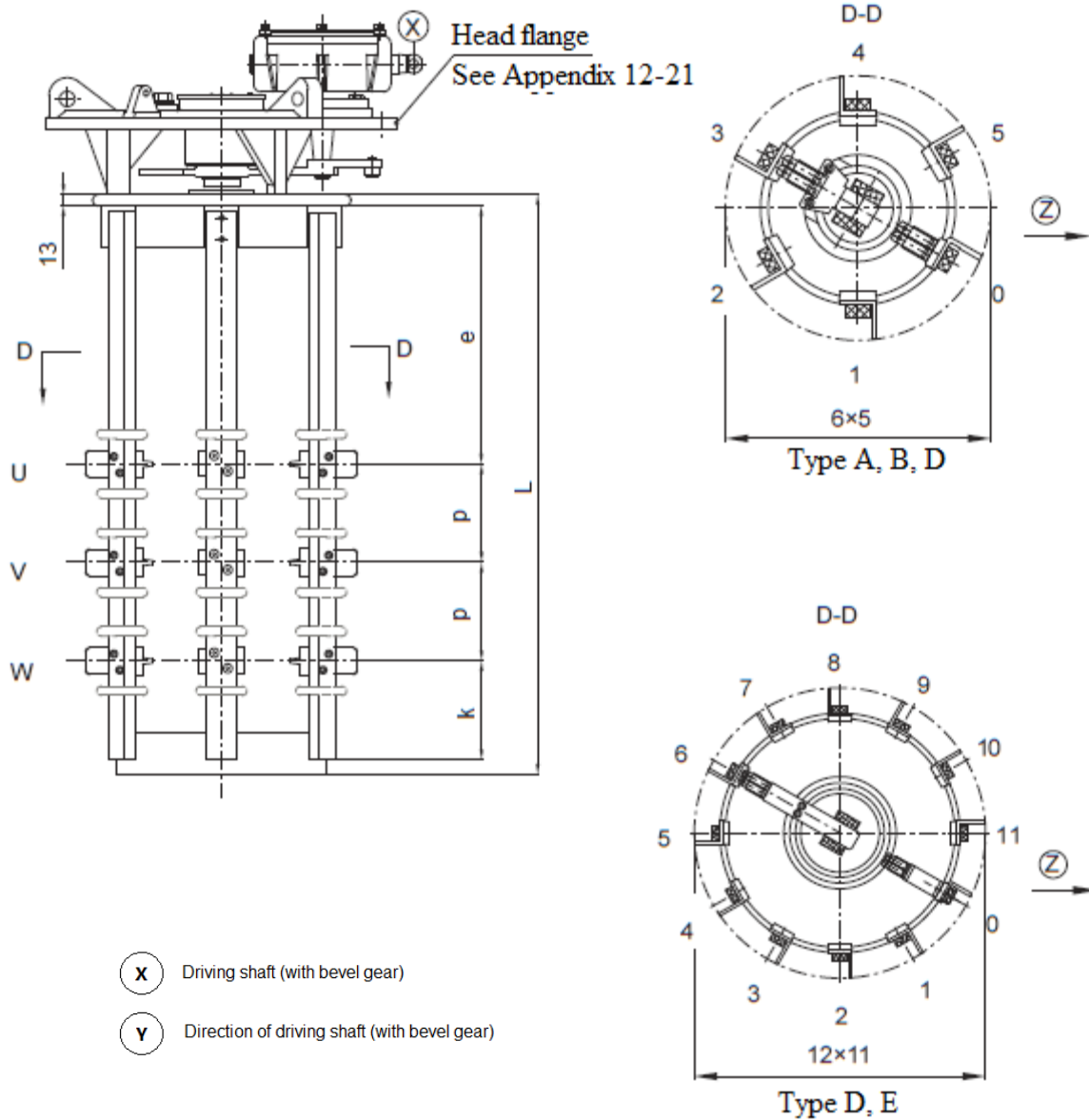
11.4 Check the reliability of the grounding connection

11.5 Check the interlock function between the tap changer motor drive unit and the transformer circuit breaker whether it is reliable or not at least once a year to ensure its reliability.

12. Appendix

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Appendix 1 600-1000A Linear regulation, overall dimension

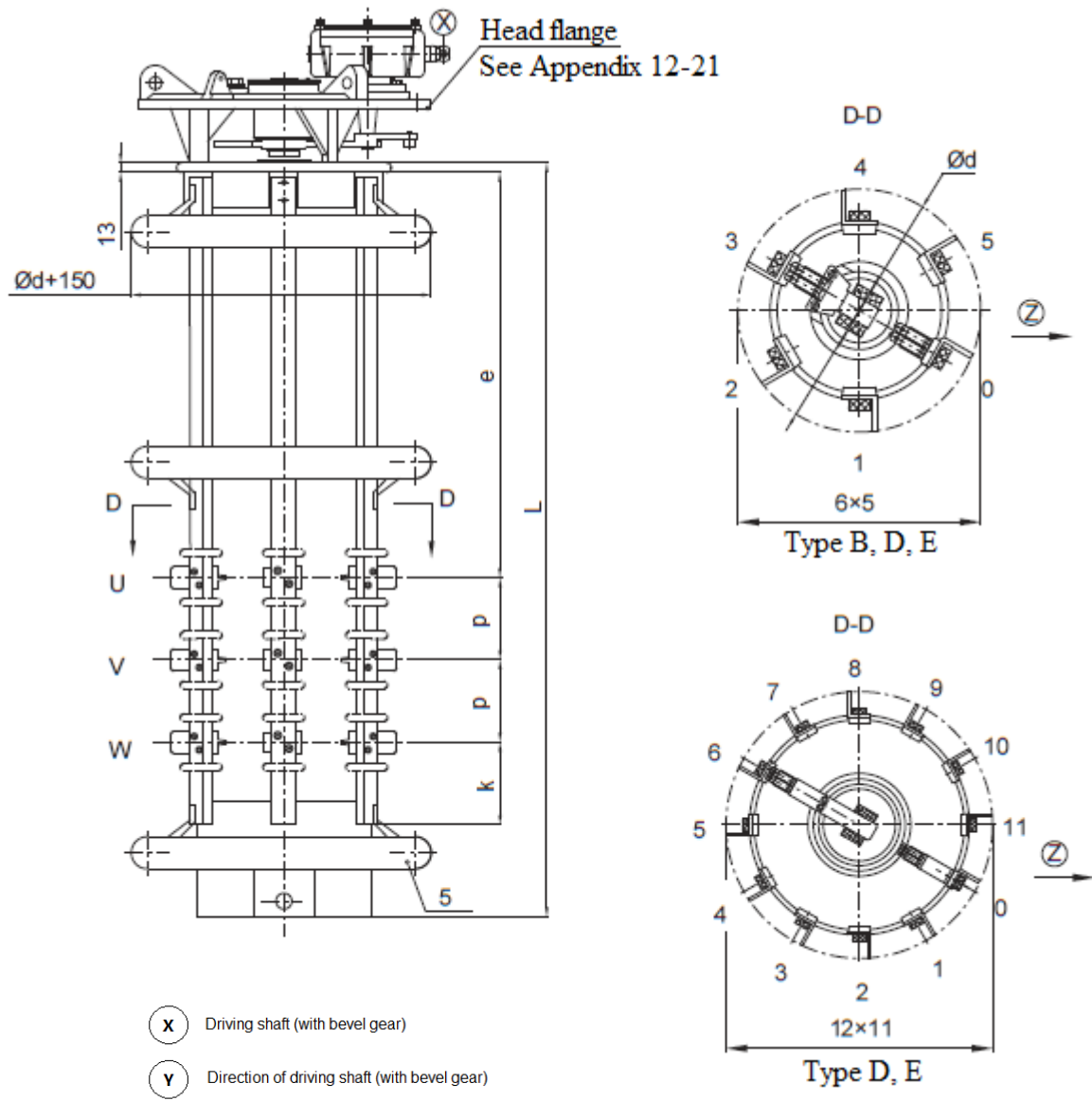


- Note:
- ① Type A only for $I \leq 800A$
 - ② Contact size see appendix 20
 - ③ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

3-phase	Y				D			
	e	p	k	L	e	p	k	L
Highest voltage for equipment								
12 kV	200	130	135	630	200	130	135	630
72.5 kV	340	130	145	780	340	280	145	1080
126 kV	470	170	155	1000	470	410	155	1480

Unit: mm

Appendix 2 600-1000A 252kV Linear regulation, overall dimension

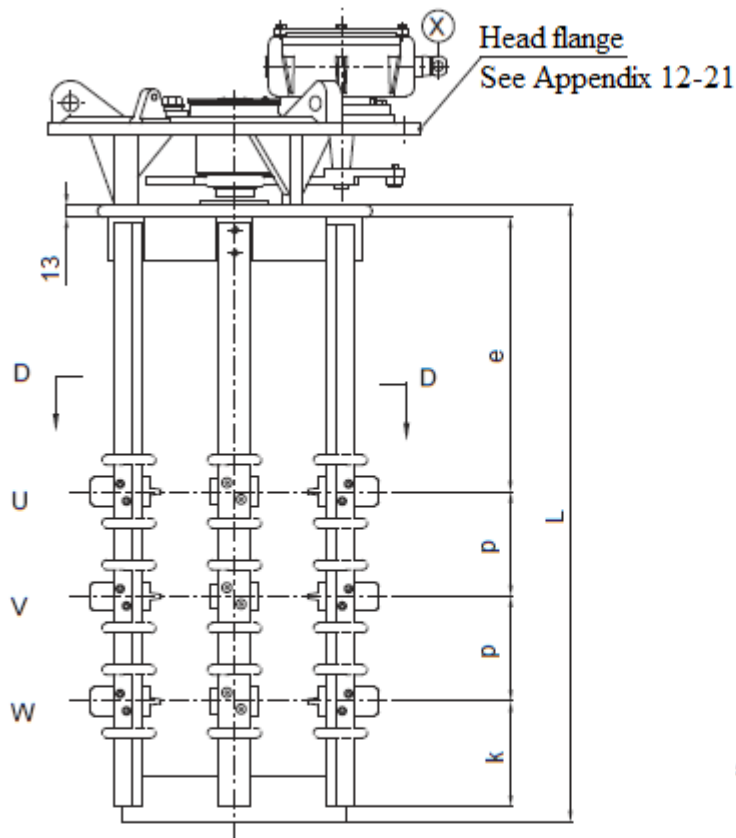


- Note:
- ① Type A only for $I \leq 800A$
 - ② Contact size see appendix 20
 - ③ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

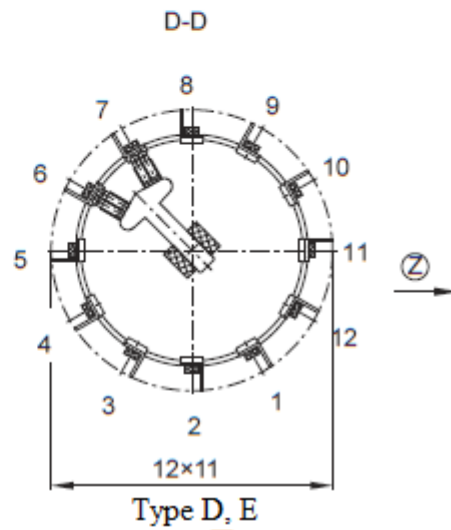
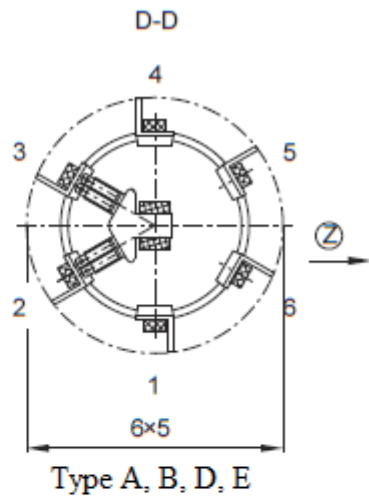
3-phase	Y			
	e	p	k	L
Highest voltage for equipment				
252 kV	980	170	155	1690

Unit: mm

Appendix 3 600-1000A Single-bridging regulation, overall dimension



- X** Driving shaft (with bevel gear)
- Y** Direction of driving shaft (with bevel gear)

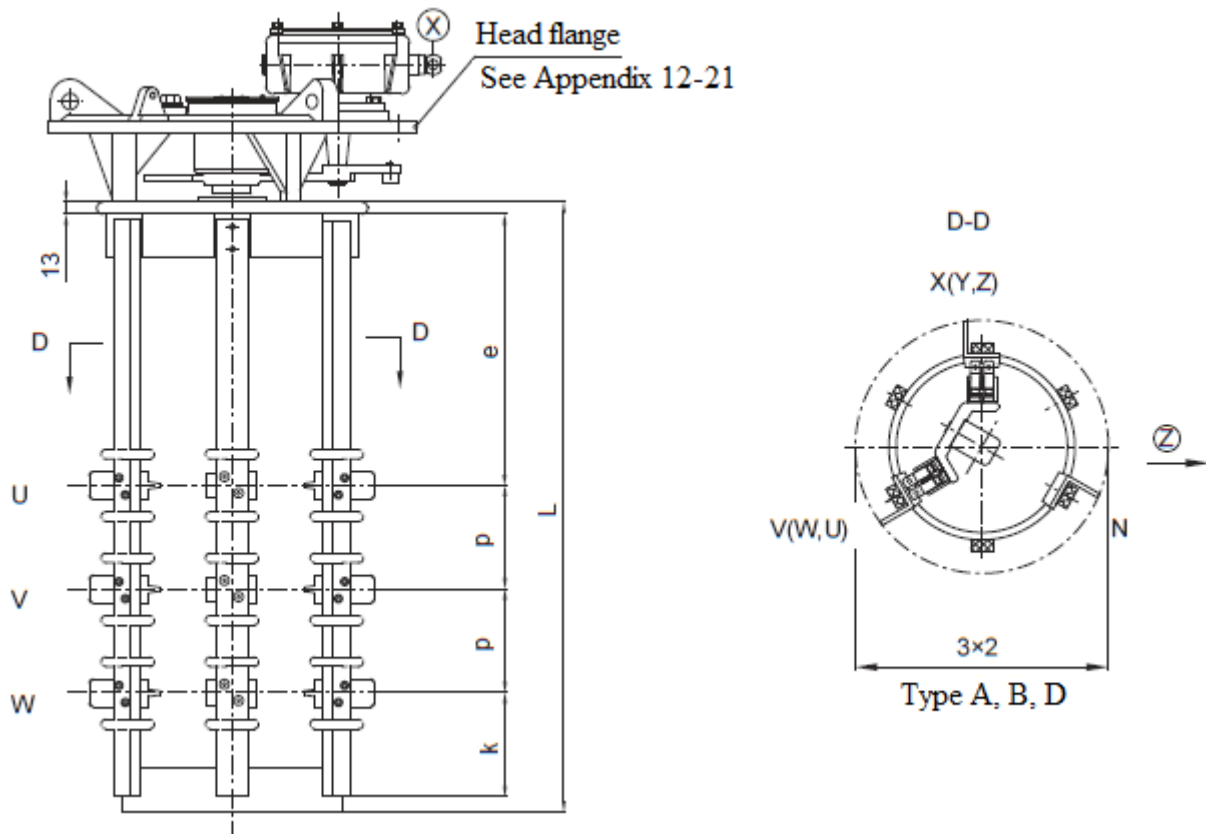


- Note:**
- ① Type A only for $I \leq 800A$
 - ② Contact size see appendix 20
 - ③ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

Highest voltage for equipment	e	p	k	L
12 kV	200	130	135	630
72.5 kV	340	280	145	1080
126 kV	470	410	155	1480

Unit: mm

Appendix 4 600-1000A Y-D transform regulation, overall dimension



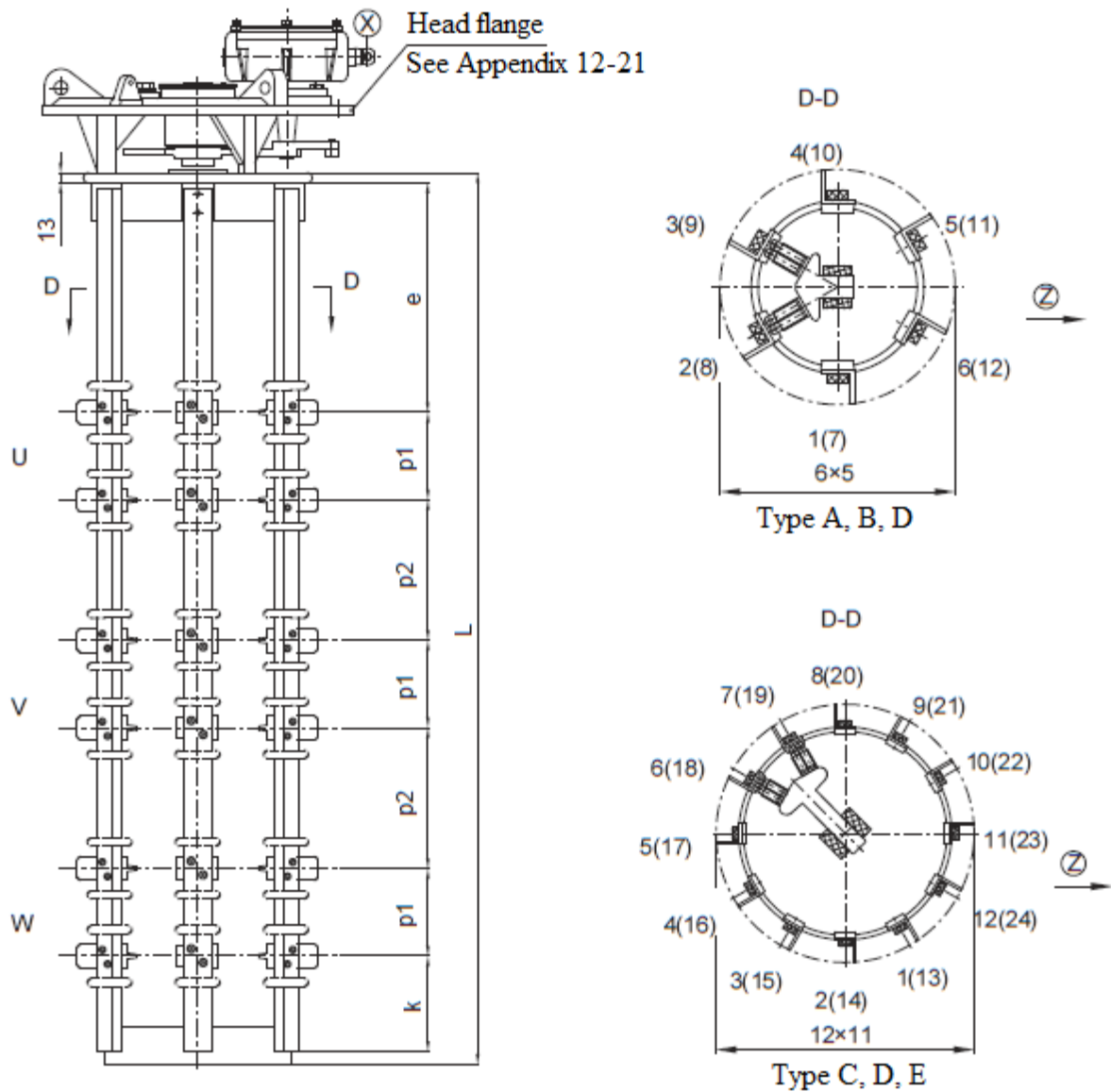
- X** Driving shaft (with bevel gear)
- Y** Direction of driving shaft (with bevel gear)

- Note:**
- ① Type A only for $I \leq 800A$
 - ② Contact size see appendix 20
 - ③ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

Highest voltage for equipment	e	p	k	L
12 kV	200	130	135	630
72.5 kV	340	280	145	1080
126 kV	470	410	155	1480

Unit: mm

Appendix 5 600-1000A Double-bridging regulation, overall dimension



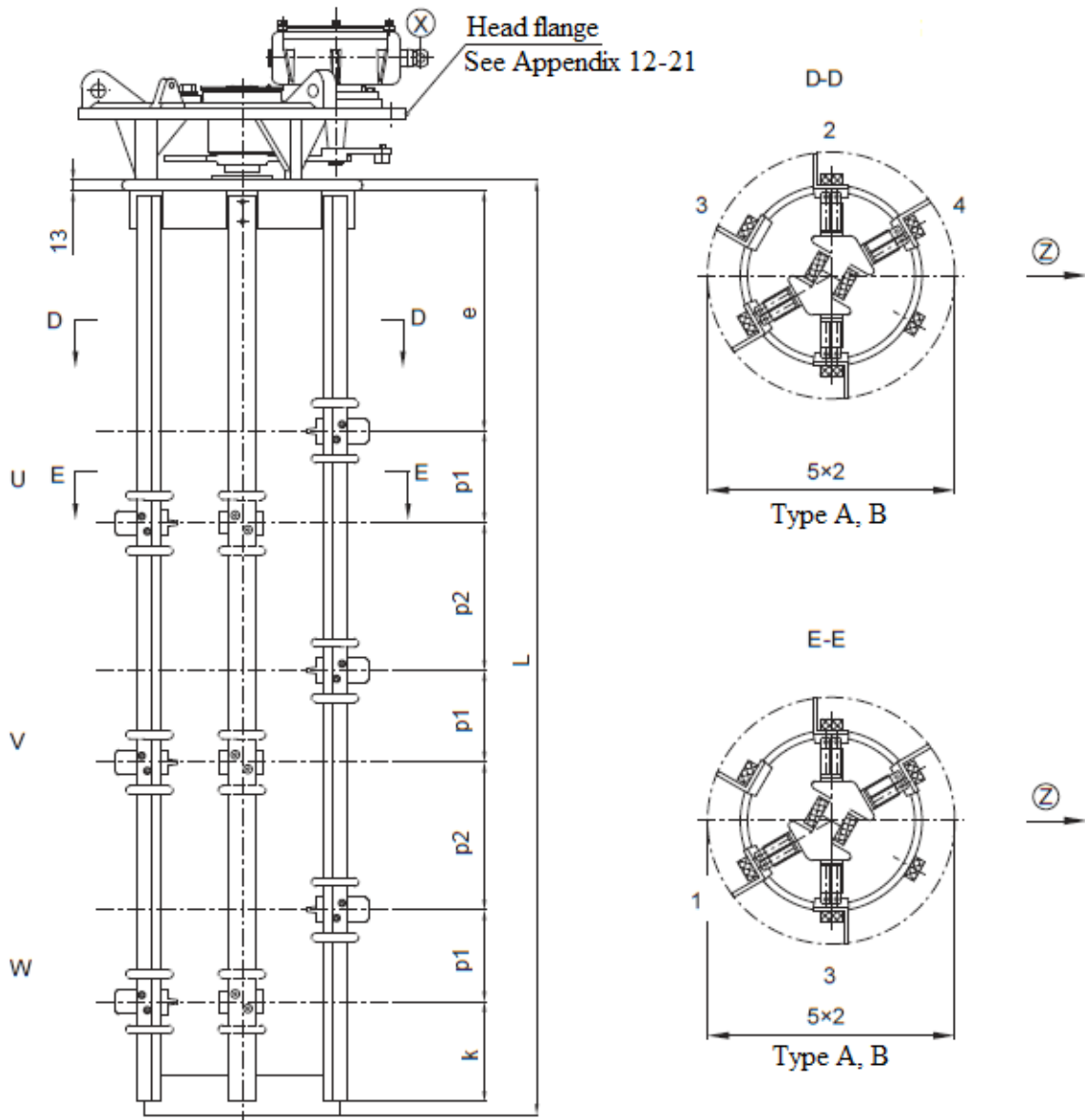
- Note:
- ① Type A only for $I \leq 800A$
 - ② Contact size see appendix 20
 - ③ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

- (X) Driving shaft (with bevel gear)
- (Y) Direction of driving shaft (with bevel gear)

Highest voltage for equipment	e	p1	p2	k	L
12 kV	200	120	150	125	1020
72.5 kV	340	160	280	145	1560
126 kV	470	170	410	155	1990

Unit: mm

Appendix 6 600-1000A Serial-parallel transform regulation, overall dimension



Note: ① Type A only for $I \leq 800A$

② Contact size see appendix 20

③ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

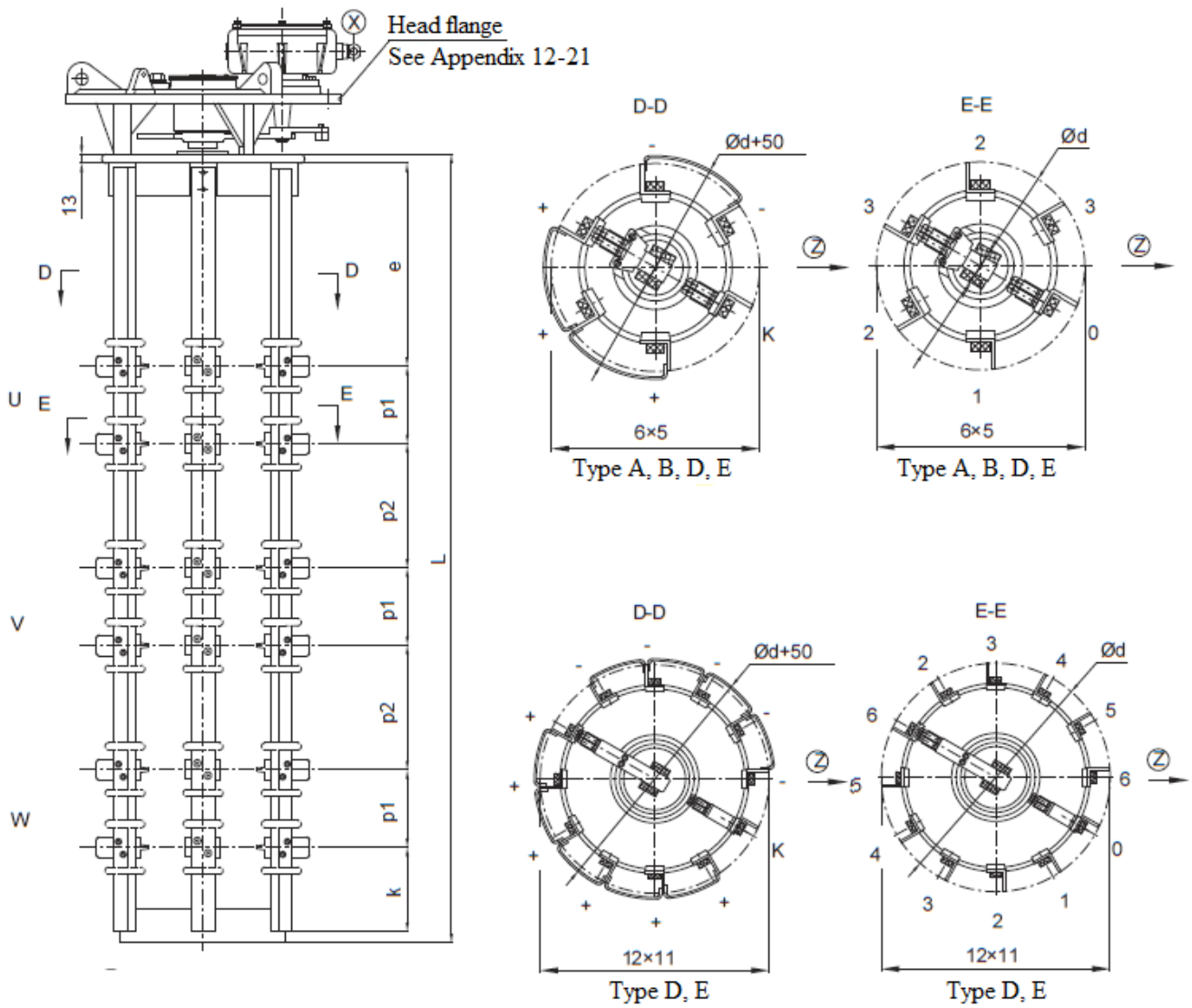
(X) Driving shaft (with bevel gear)

(Y) Direction of driving shaft (with bevel gear)

Highest voltage for equipment	e	p1	p2	k	L
12 kV	200	120	150	125	1020
72.5 kV	340	160	280	145	1560
126 kV	470	170	410	155	1990

Unit: mm

Appendix 7 600-1000A Reversing regulation, overall dimension



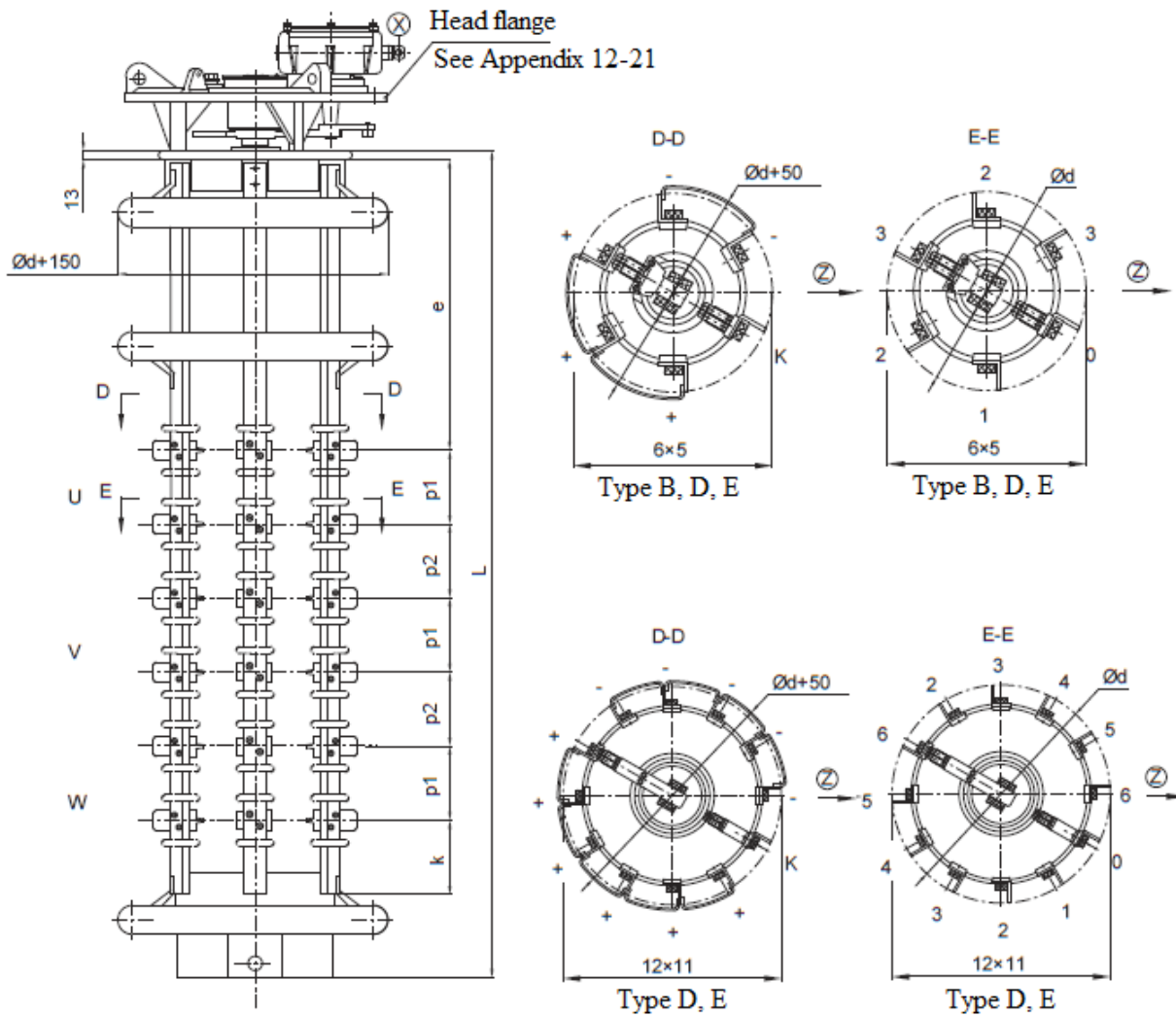
- Note:**
- ① Type A only for $I \leq 800A$
 - ② Contact size see appendix 20
 - ③ Only connect "+" with "+", "-" with "-" for general product before delivery;
 - As "D-D" shown, the user should connect other contacts;
 - ④ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

- X** Driving shaft (with bevel gear)
- Y** Direction of driving shaft (with bevel gear)

3-phase	Y					D				
	e	p1	p2	k	L	e	p1	p2	k	L
Highest voltage for equipment										
12 kV	170	120	120	125	930	200	120	150	125	1020
72.5 kV	340	135	160	150	1250	340	160	280	145	1560
126 kV	470	170	170	155	1510	470	170	410	155	1990

Unit:
mm

Appendix 8 600-1000A 252kV Reversing regulation, overall dimension



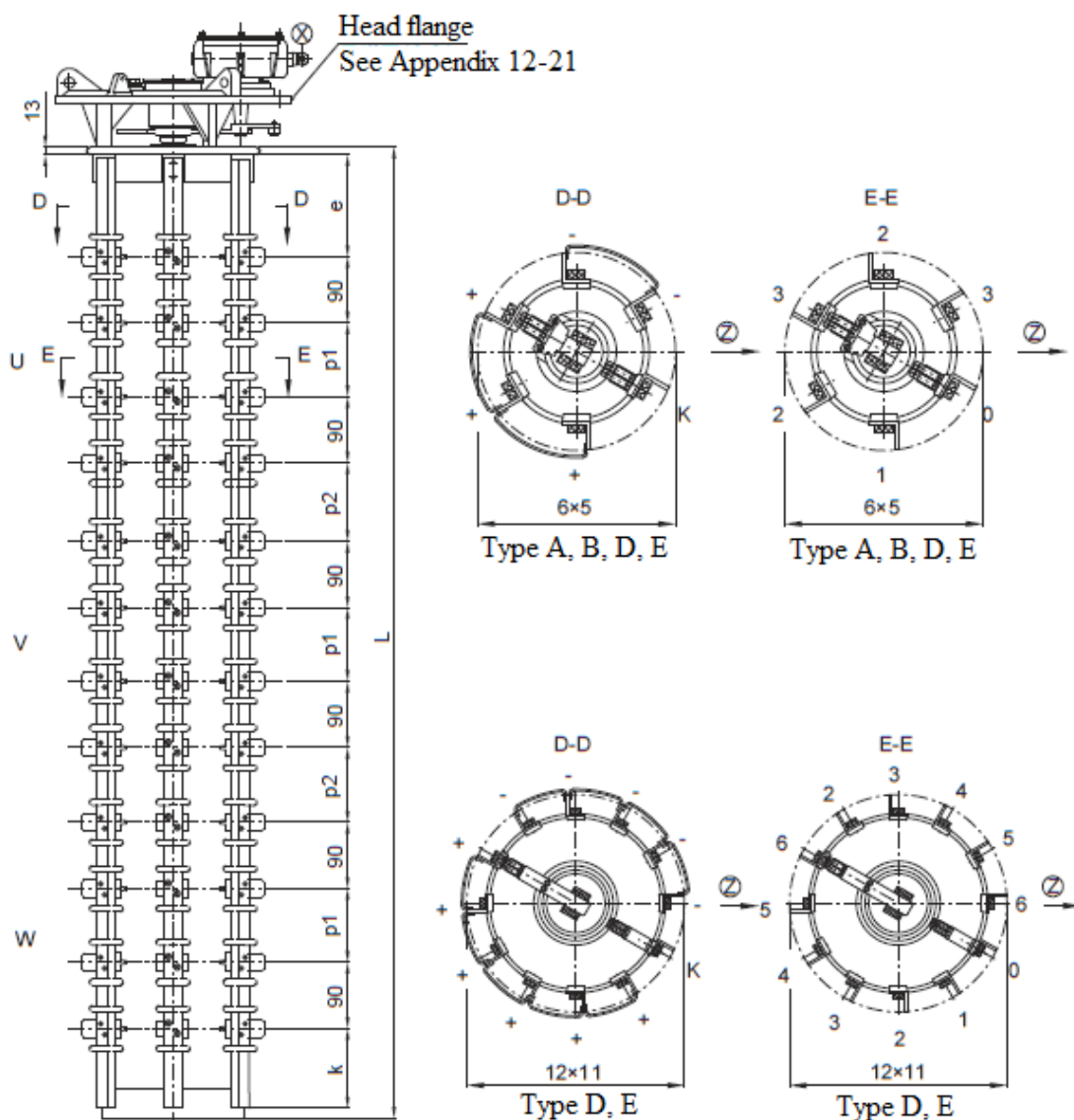
- Note:**
- ① Type A only for $I \leq 800A$
 - ② Contact size see appendix 20
 - ③ Only connect "+" with "+", "-" with "-" for general product before delivery;
- As "D-D" shown, the user should connect other contacts;
- ④ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

- Driving shaft (with bevel gear)
- Direction of driving shaft (with bevel gear)

3-phase	Y				
Highest voltage for equipment	e	p1	p2	k	L
252 kV	980	170	170	155	2200

Unit: mm

Appendix 9 1000-2000A Reversing regulation, overall dimension



Note: ① Type A only for $I \leq 800A$

② Contact size see appendix 20

③ Only connect "+" with "+", "-" with "-" for general product before
As "D-D" shown, the user should connect other contacts;

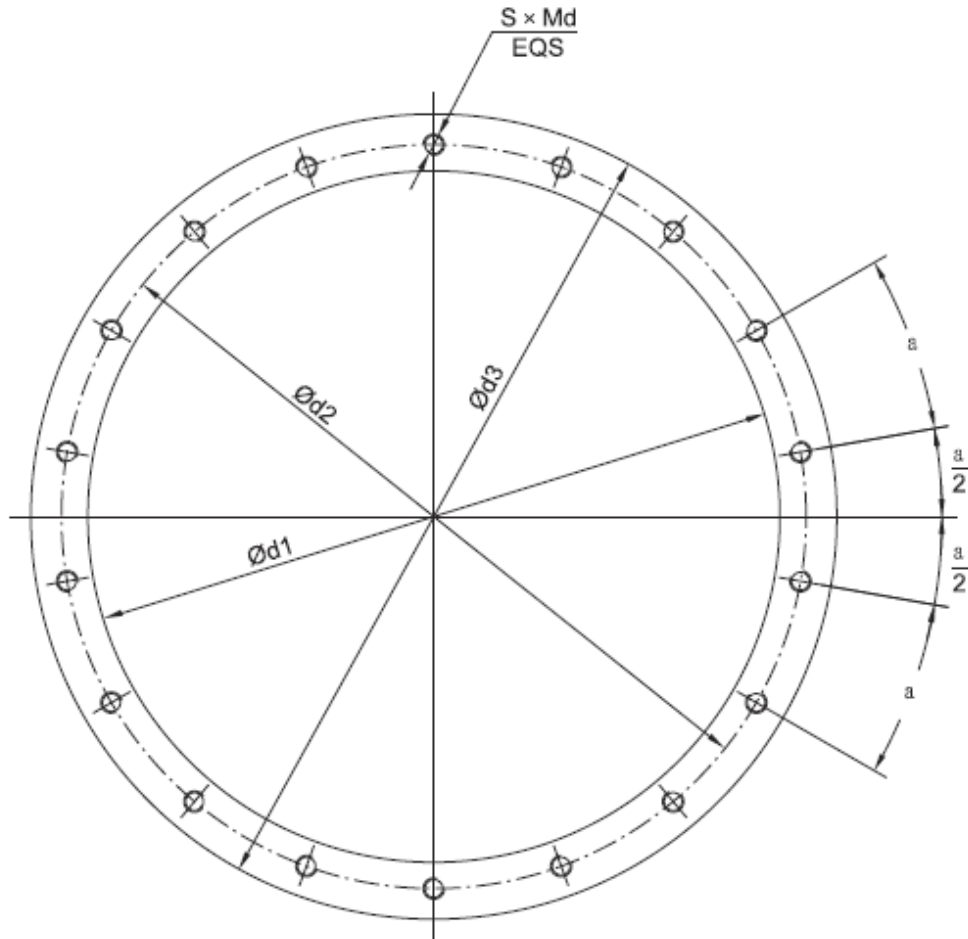
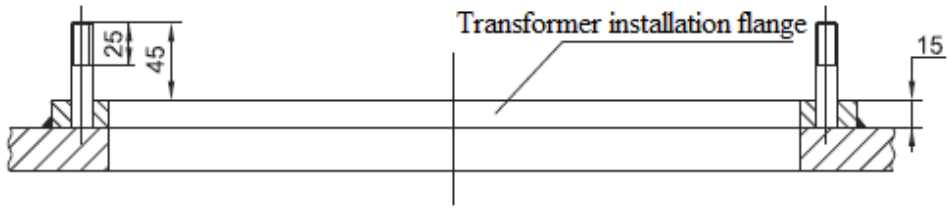
④ The size of A, B, D, E is $\Phi 350mm$, $\Phi 500mm$, $\Phi 600mm$ and $\Phi 750mm$

- ⊗ Driving shaft (with bevel gear)
- ⊙ Direction of driving shaft (with bevel gear)

3-phase Highest voltage for equipment	Y				
	e	p1	p2	k	L
12kV	170	135	135	105	1525
72.5 kV	340	135	160	150	1790
126 kV	470	170	170	155	2050

Unit: mm

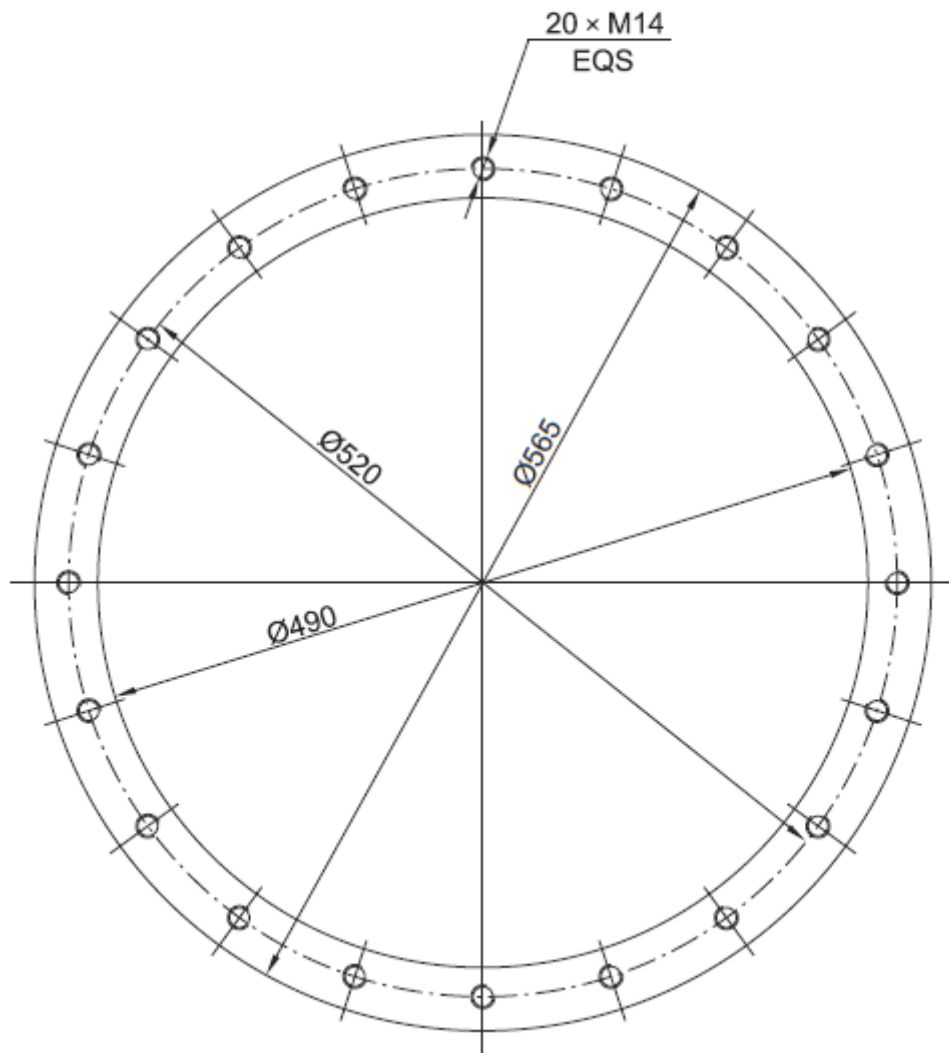
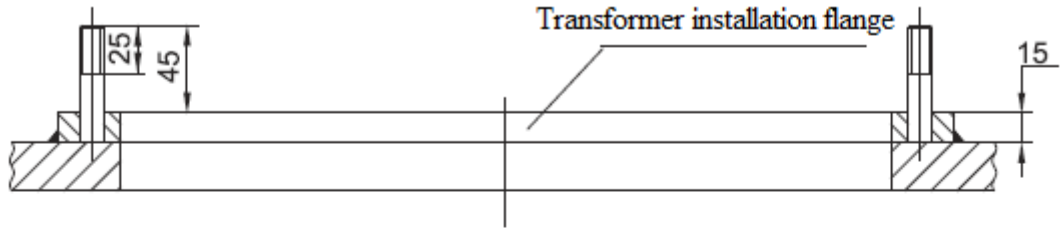
Appendix 10 Installation flange for standard tank type cover, overall dimensions



Type	d1(Dia)	d2(Dia)	d3(Dia)	Screw distribution S-Md	Distribution angle a
A	Φ395	Φ425	Φ460	18×M12	20°
B	Φ520	Φ550	Φ590	20×M12	18°
D	Φ620	Φ650	Φ690	20×M12	18°
E	Φ770	Φ800	Φ840	20×M12	18°

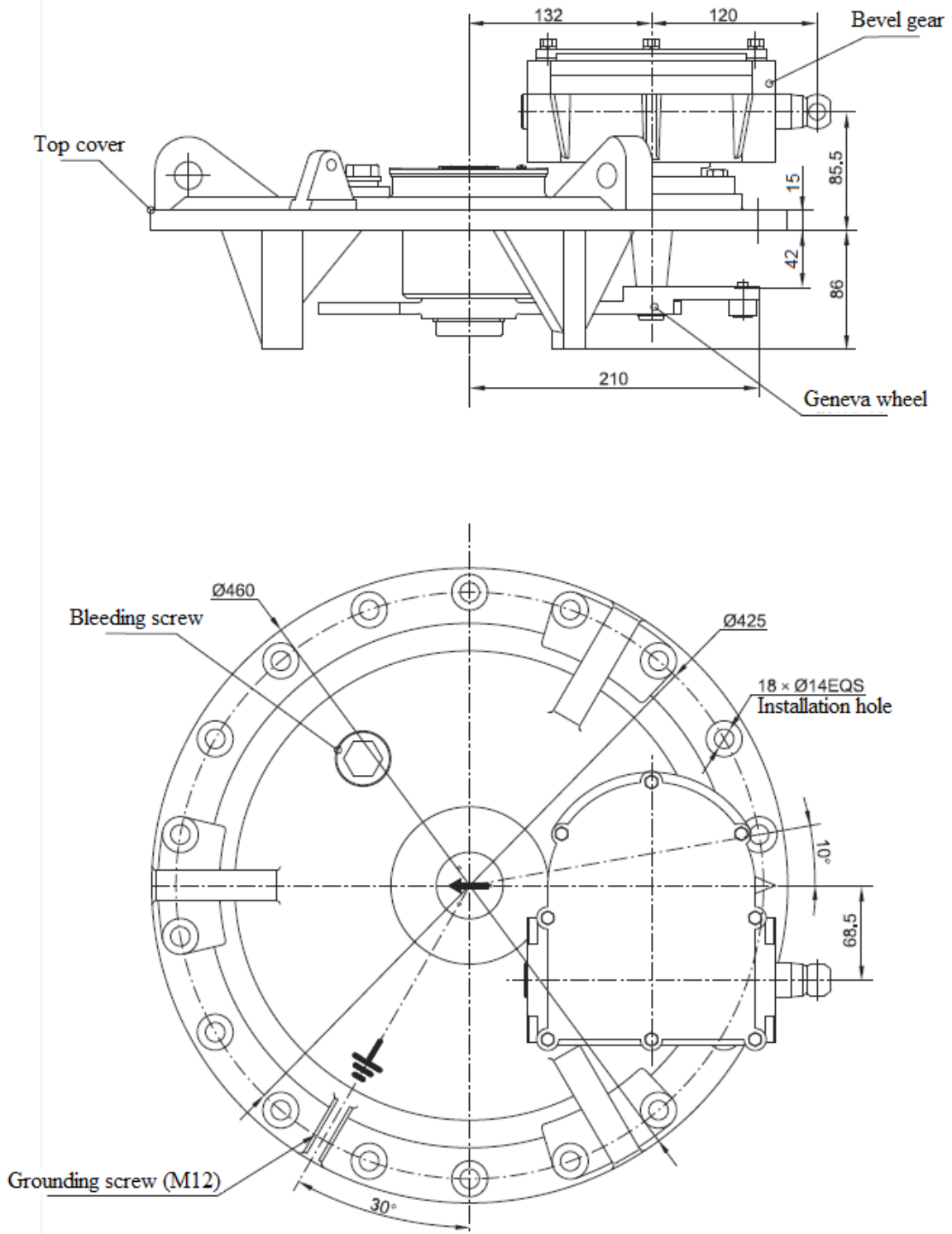
Unit: mm

Appendix 11 Installation flange for bell tank type cover, overall dimensions



Unit: mm

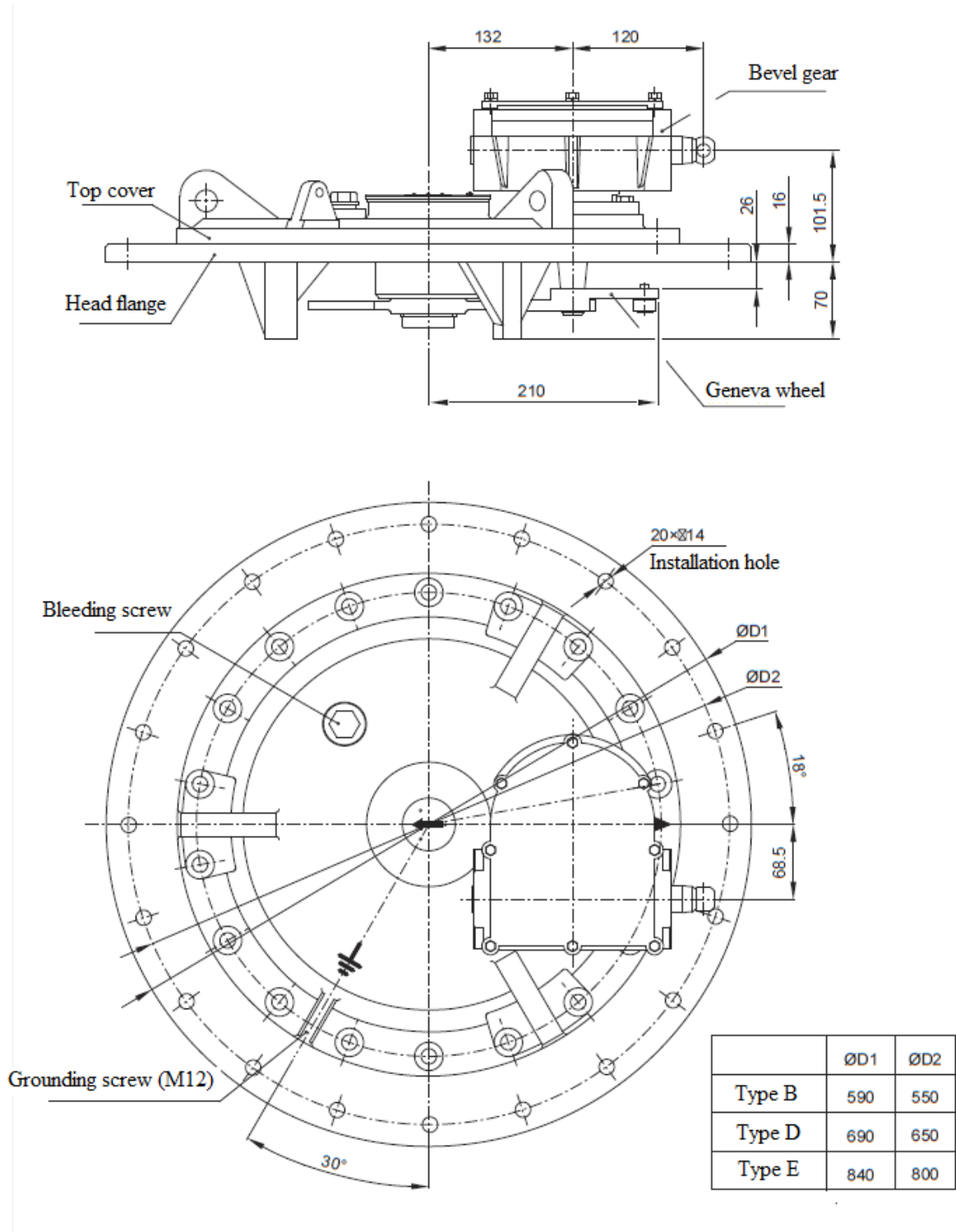
Appendix 12 Ground motor (manual) drive, head flange dimension (type A for standard tank)



Unit: mm

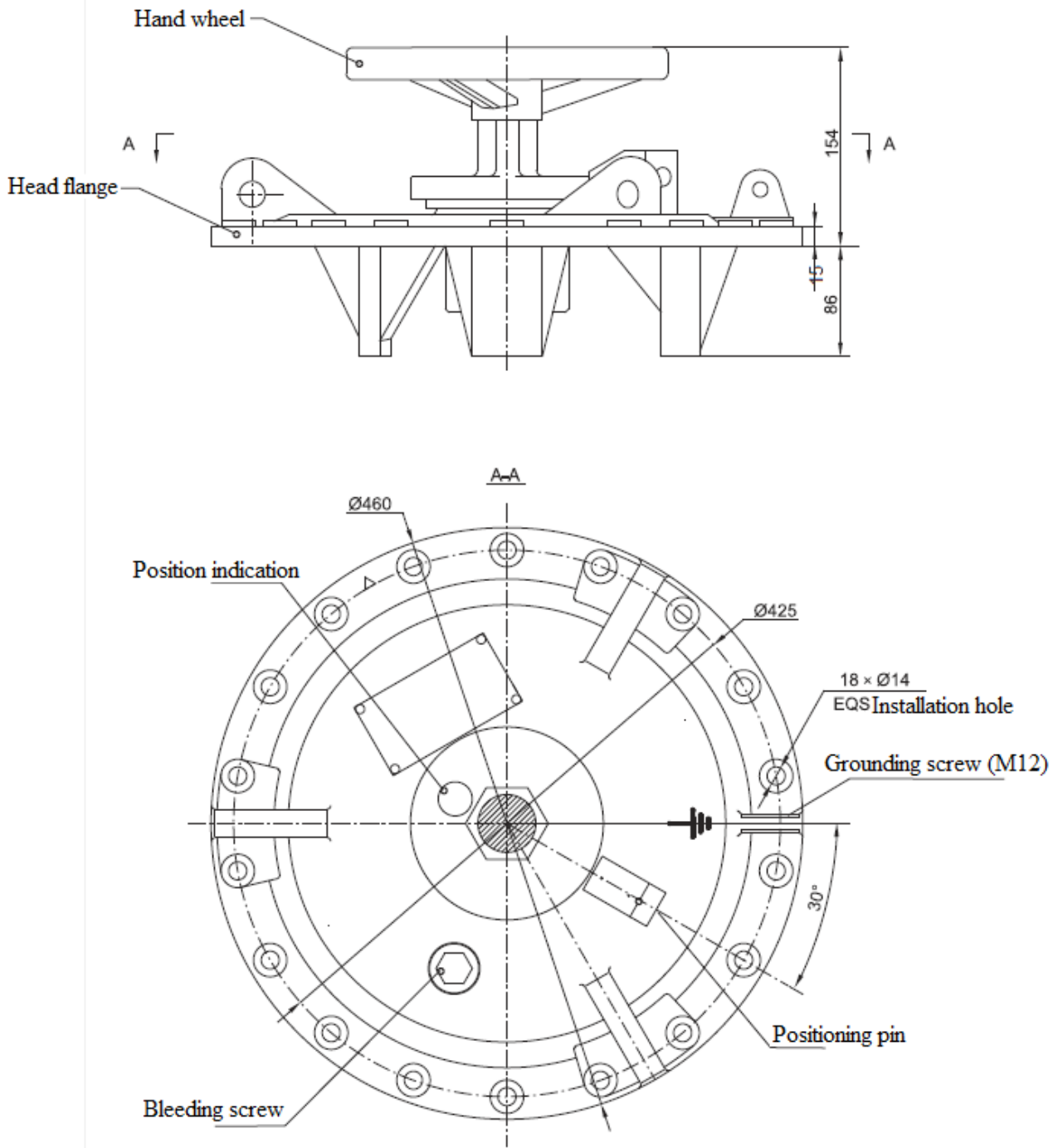
Appendix 13 Ground motor (manual) drive, head flange dimension

(type B, D, E for standard tank)



Unit: mm

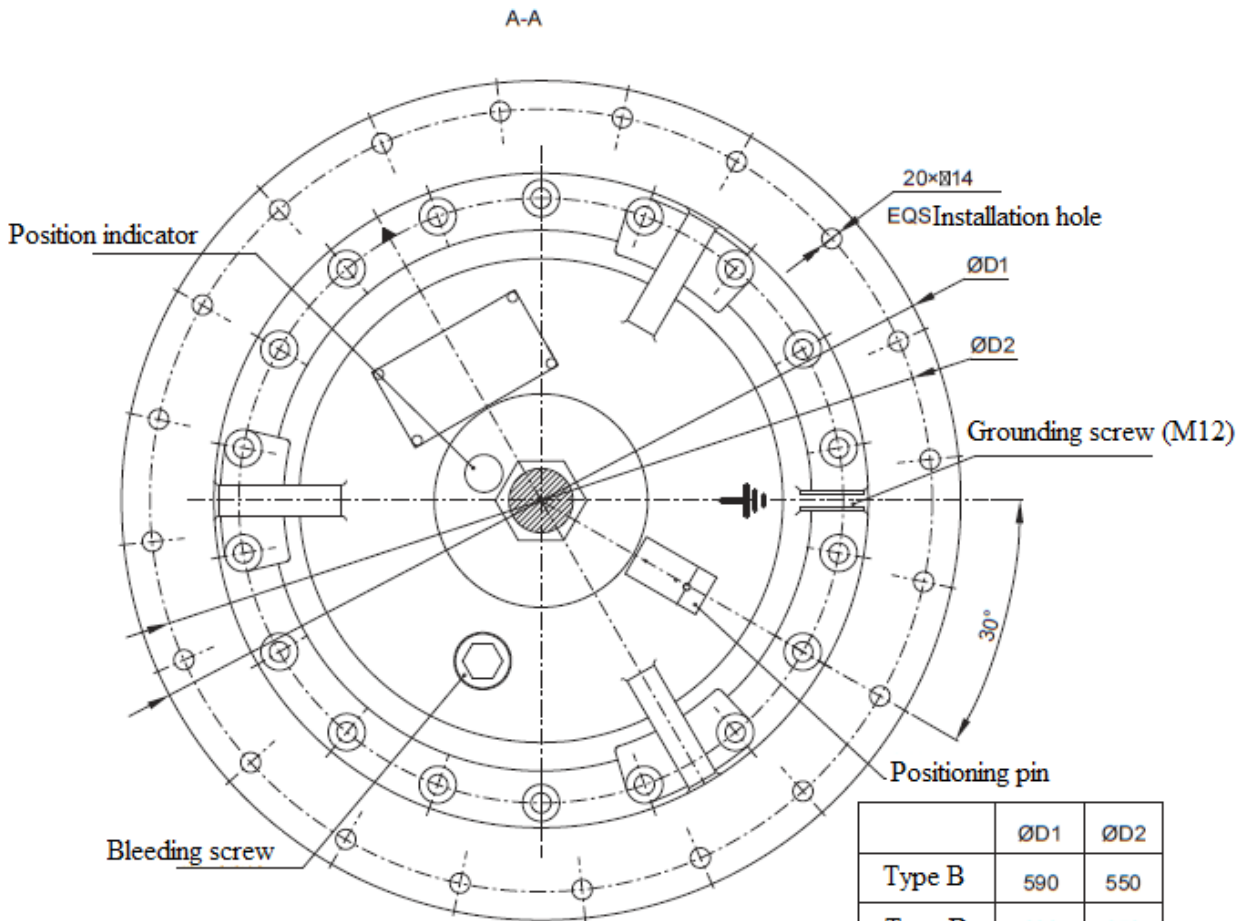
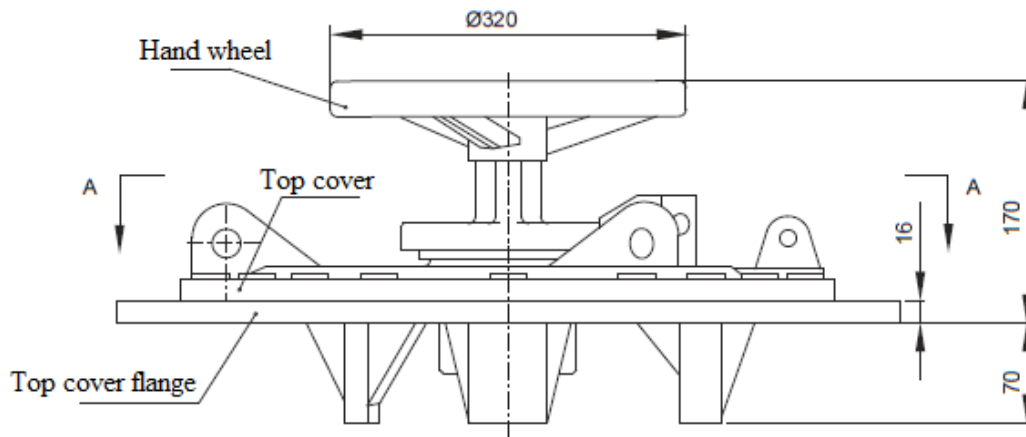
Appendix 14 Top cover hand wheel, head flange dimension (type A for standard tank)



Unit: mm

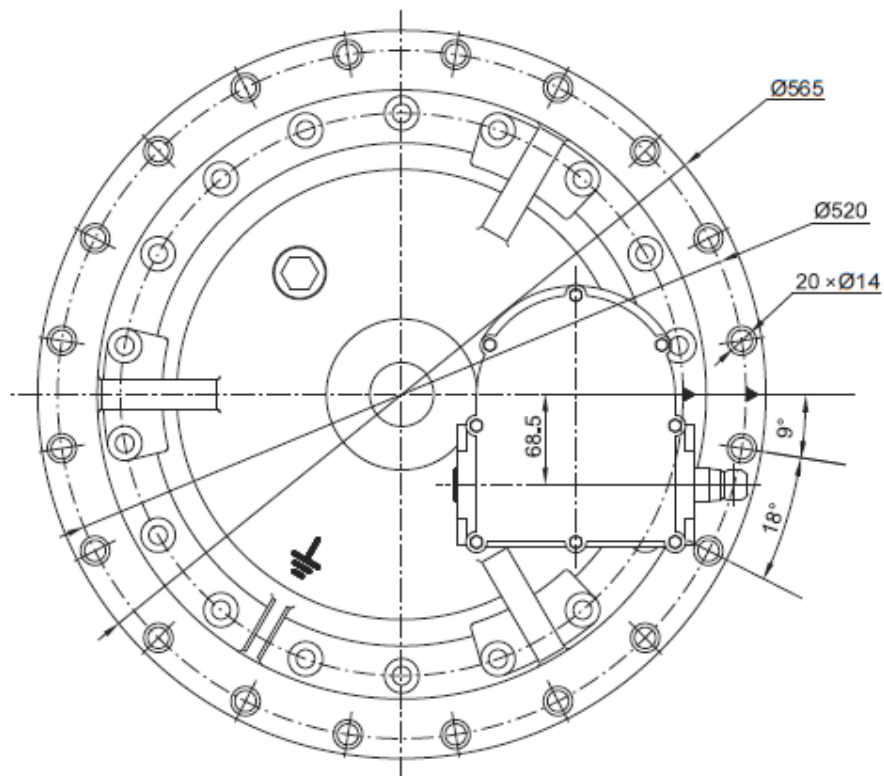
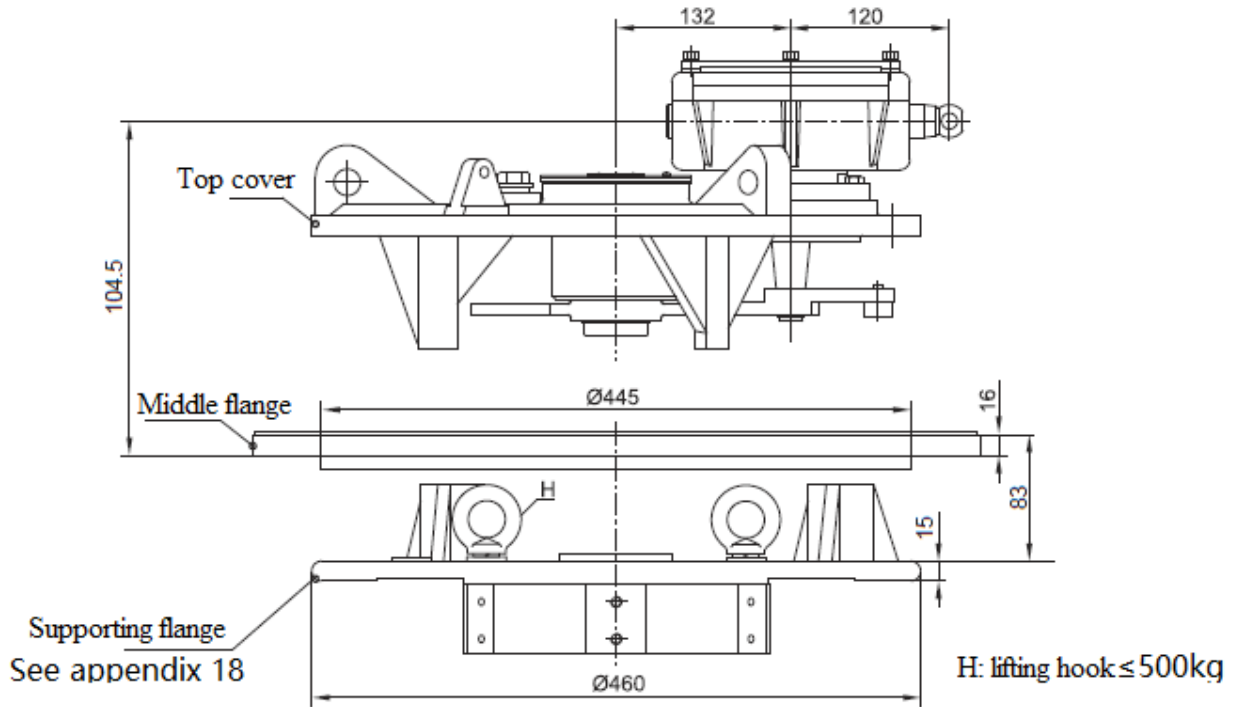
Appendix 15 Top cover hand wheel, head flange dimension

(type B, D, E for standard tank)



Unit: mm

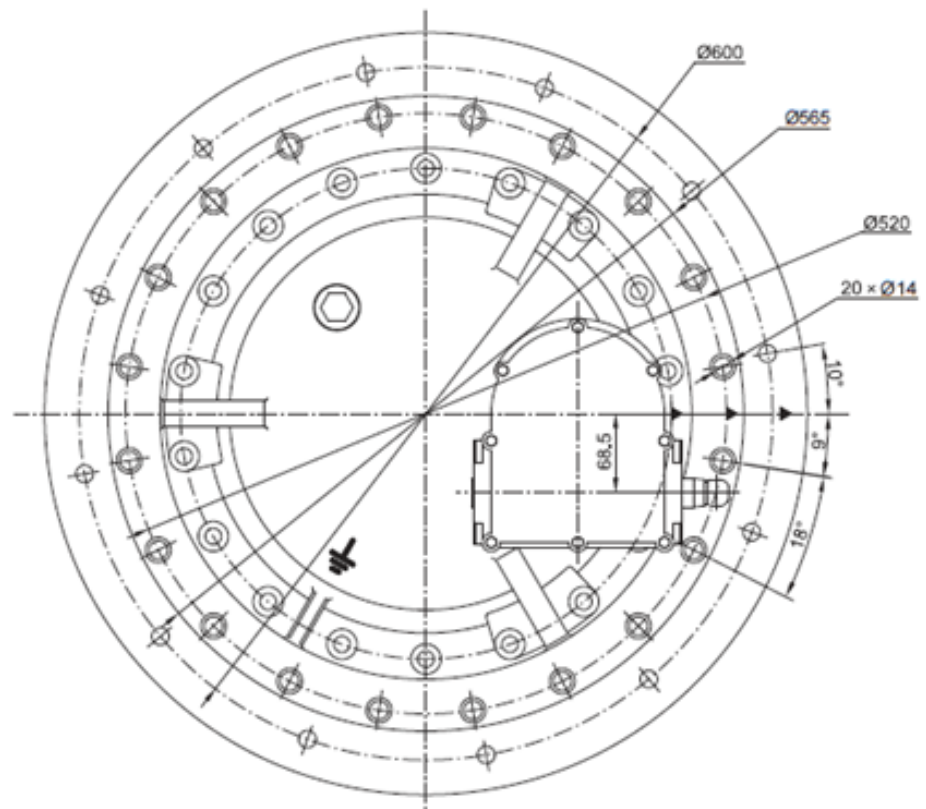
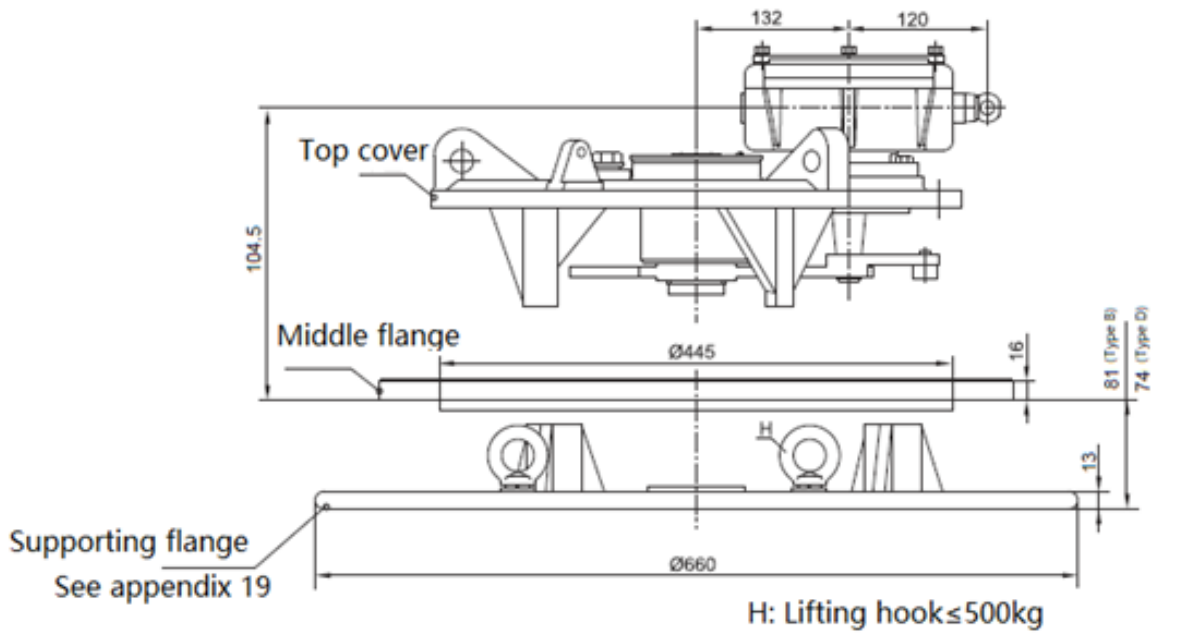
Appendix 16 Ground motor (manual) drive, head flange dimension (type A for bell tank)



Unit: mm

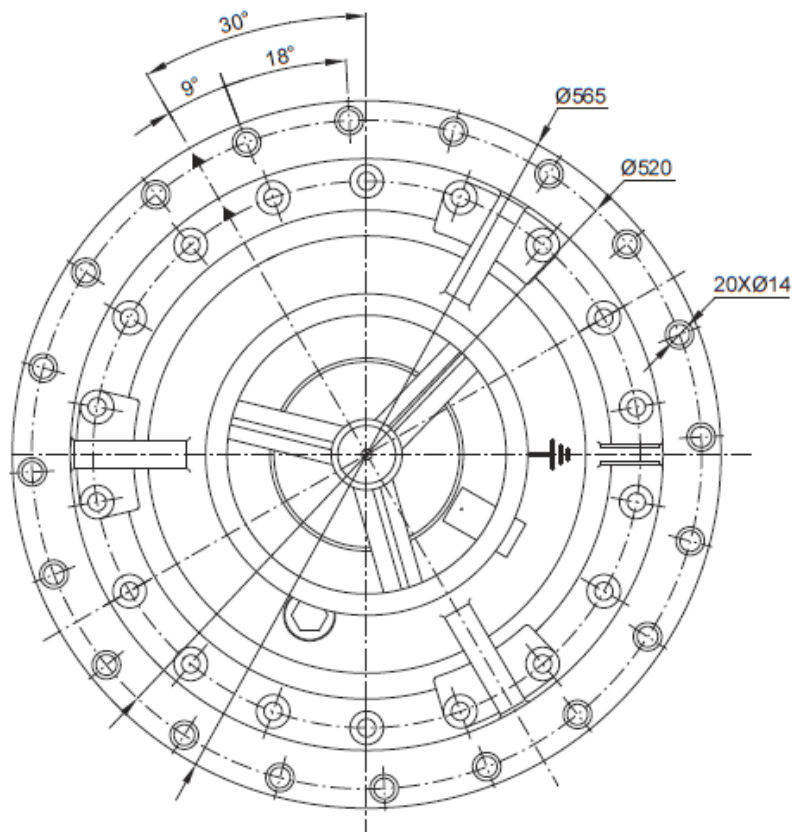
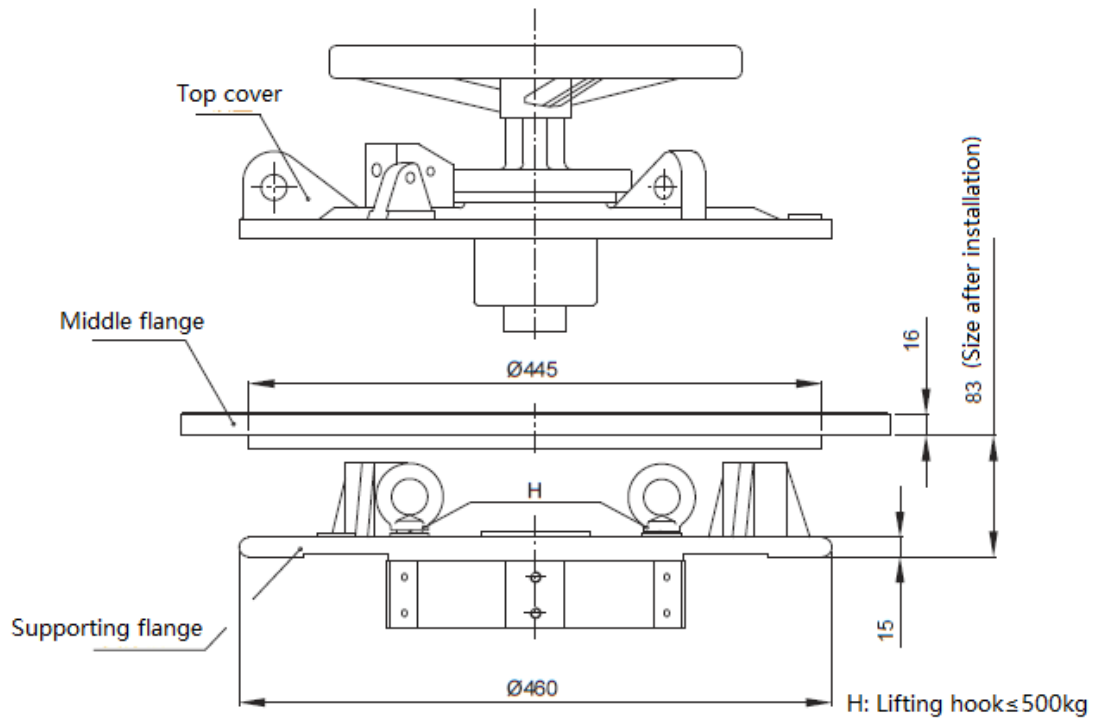
Appendix 17 Ground motor (manual) drive, head flange dimension

(type B, D for bell tank)



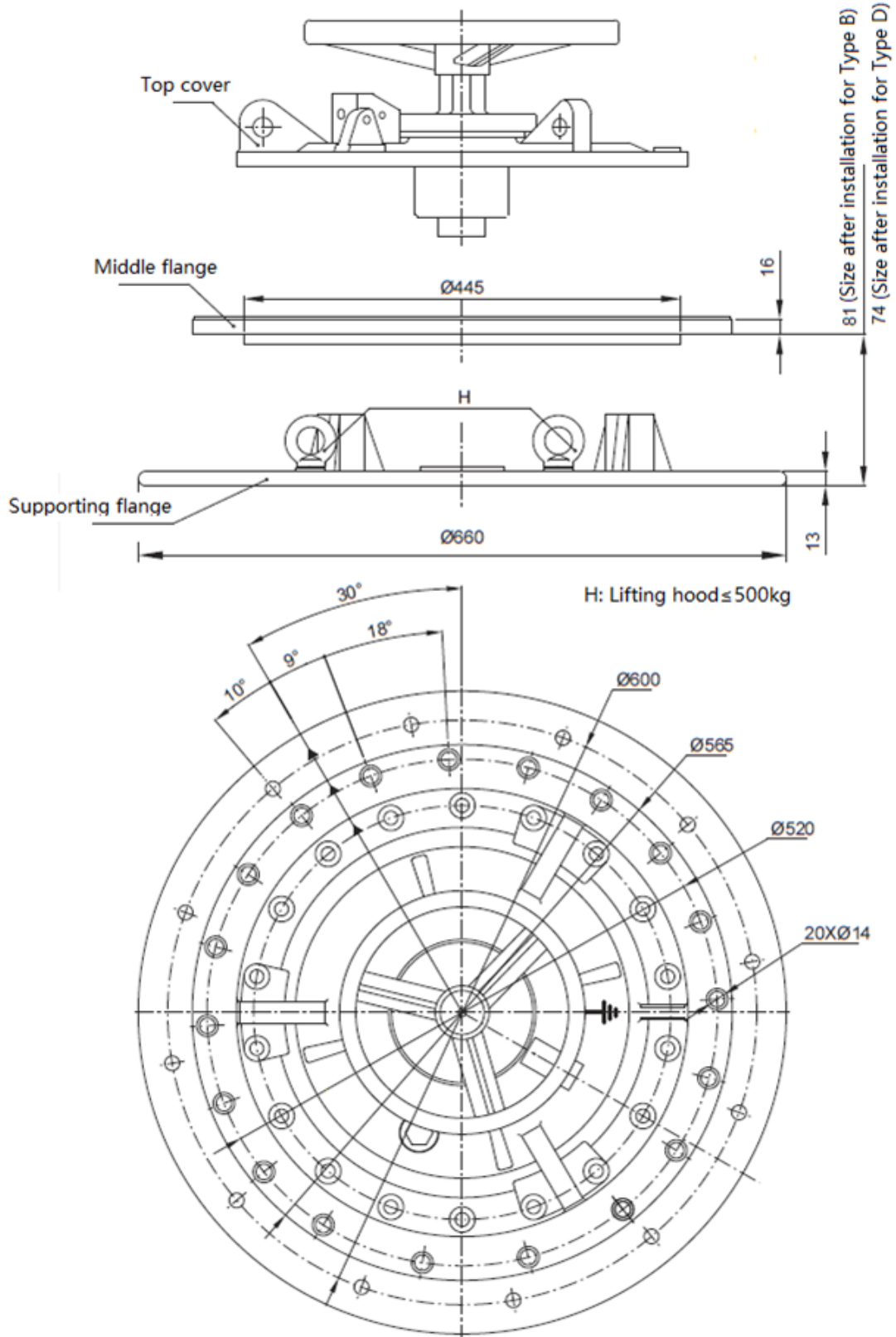
Unit: mm

Appendix 18 Ground motor (manual) drive, head flange dimension of (type E for bell tank)



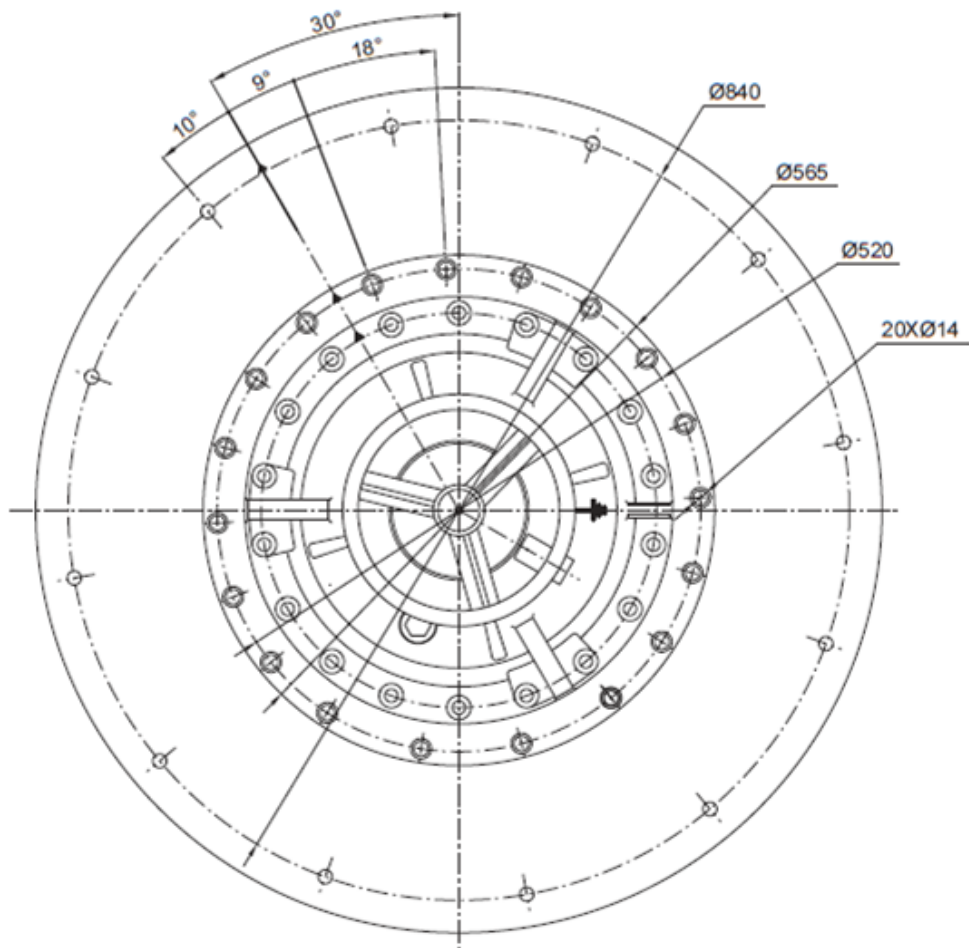
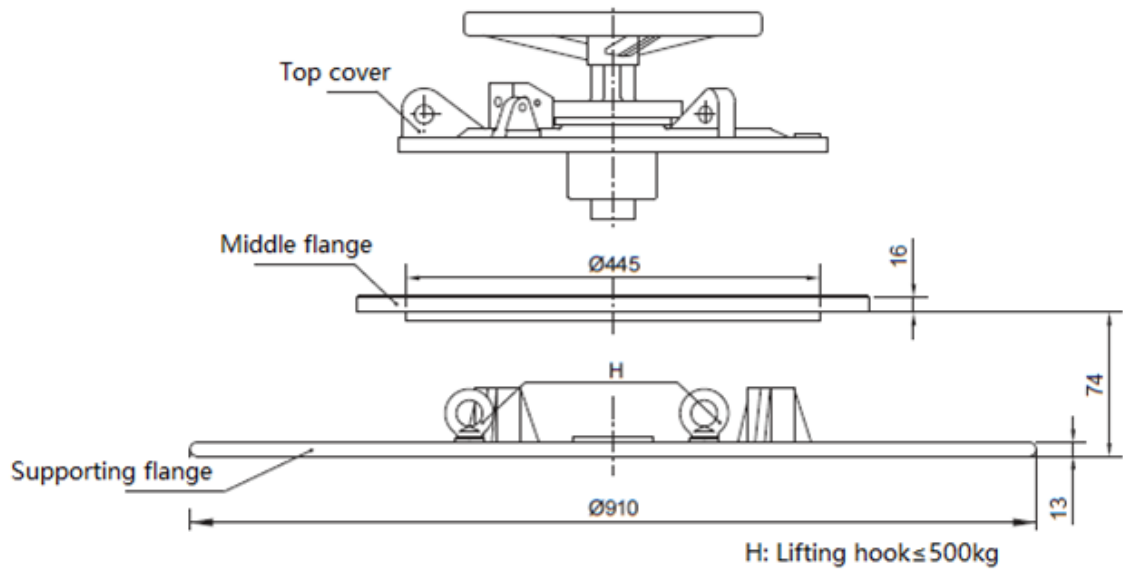
Unit: mm

Appendix 20 Top cover hand wheel, head flange dimension of (type B, D for bell tank)



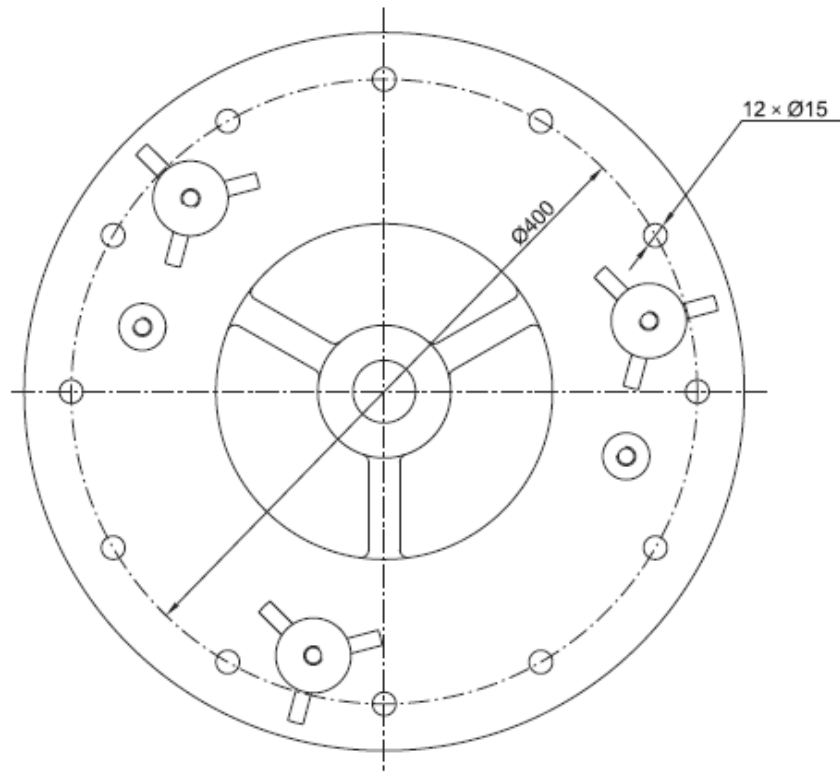
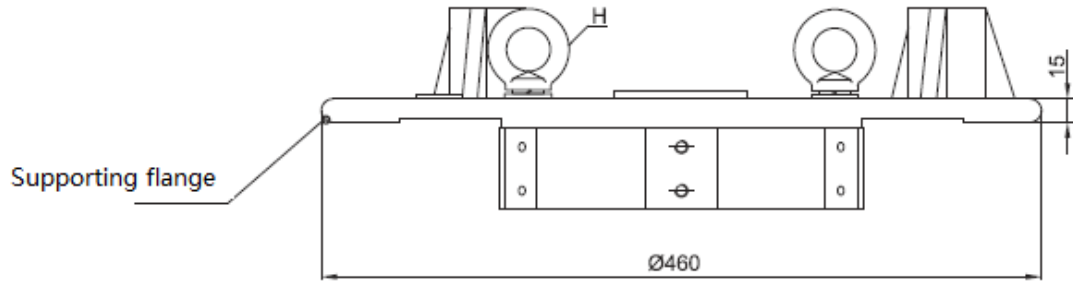
Unit: mm

Appendix 21 Top cover hand wheel, head flange dimension of (type E for bell tank)



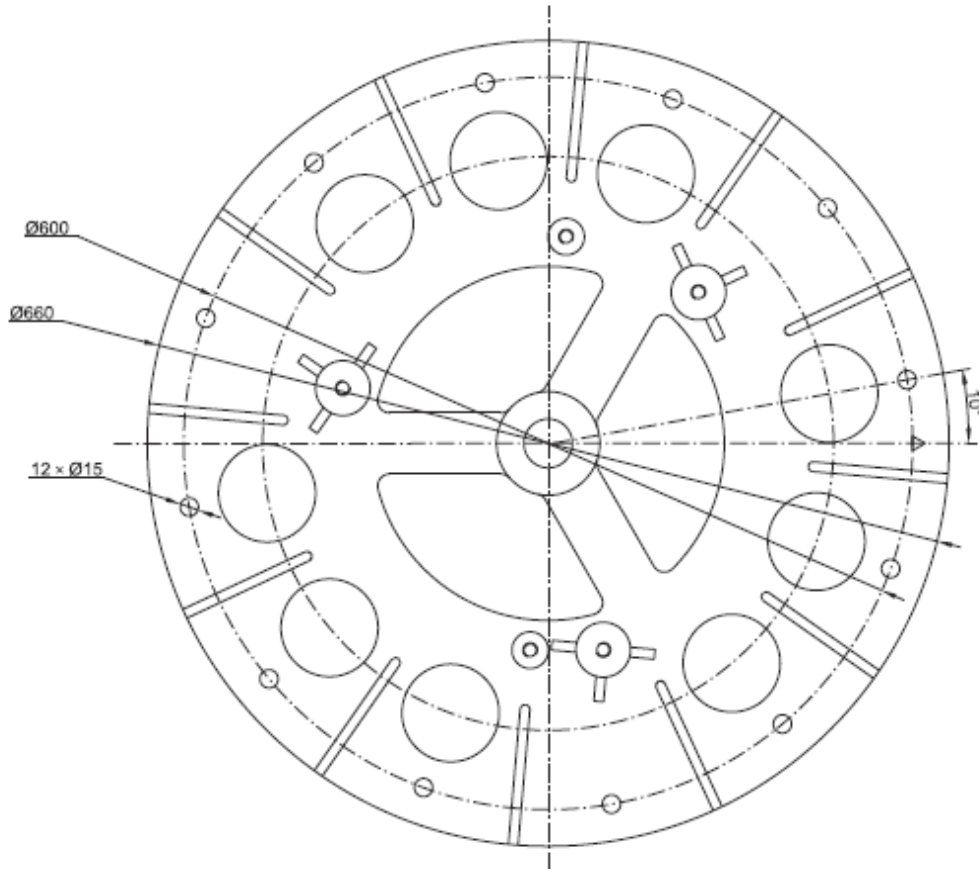
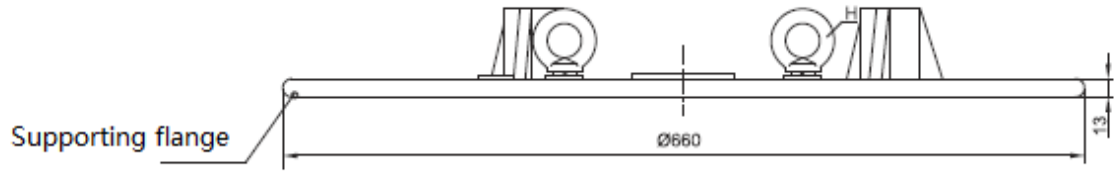
Unit: mm

Appendix 22 Supporting flange dimension of type A for bell tank



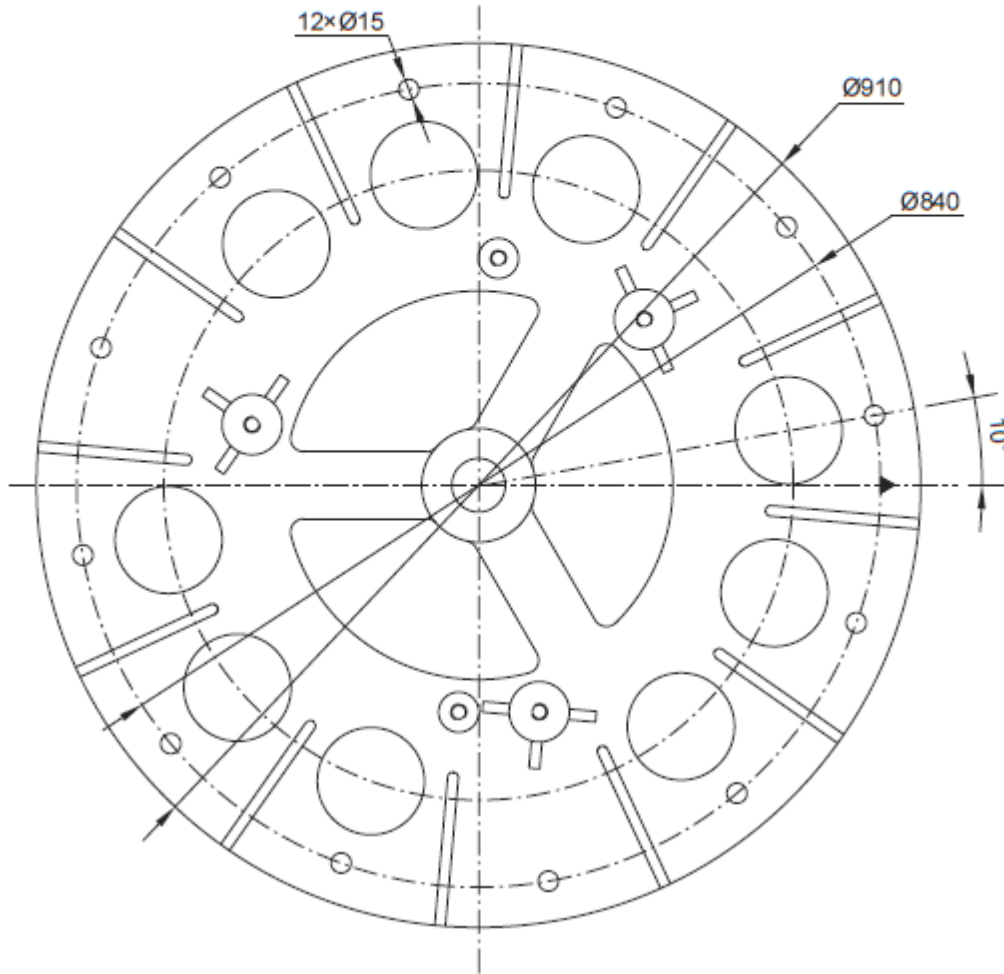
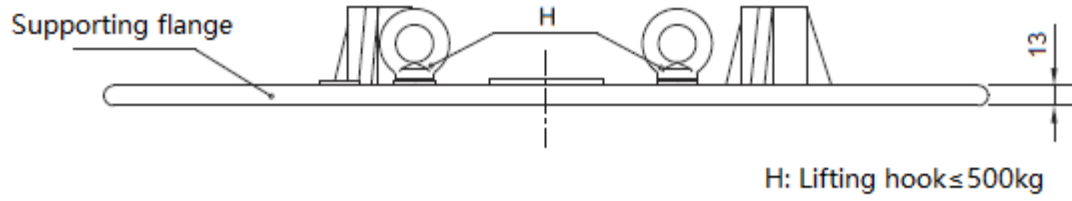
Unit: mm

Appendix 23 Supporting flange dimension of type B, D for bell tank



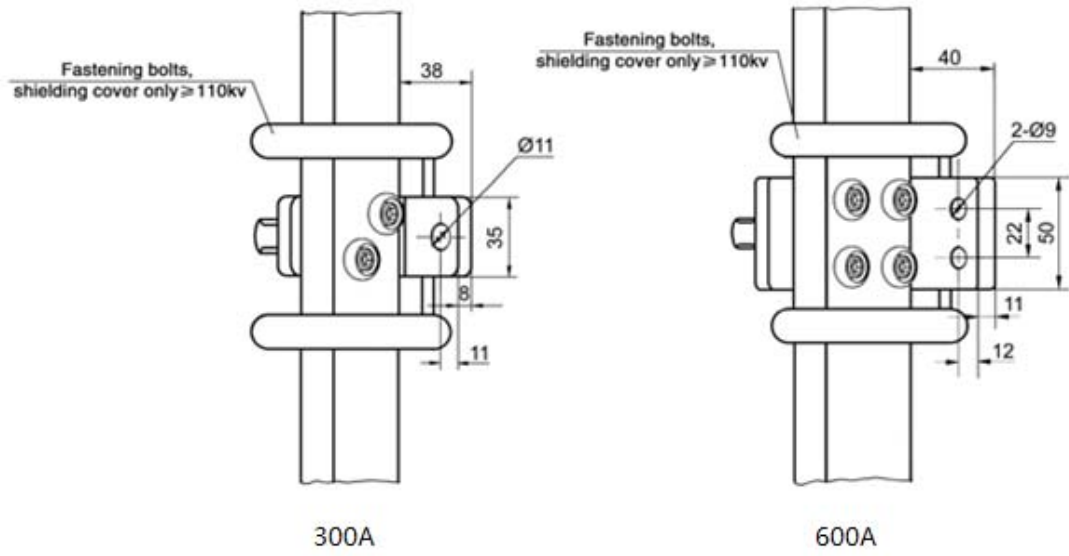
Unit: mm

Appendix 24 Supporting flange dimension of type E for bell tank



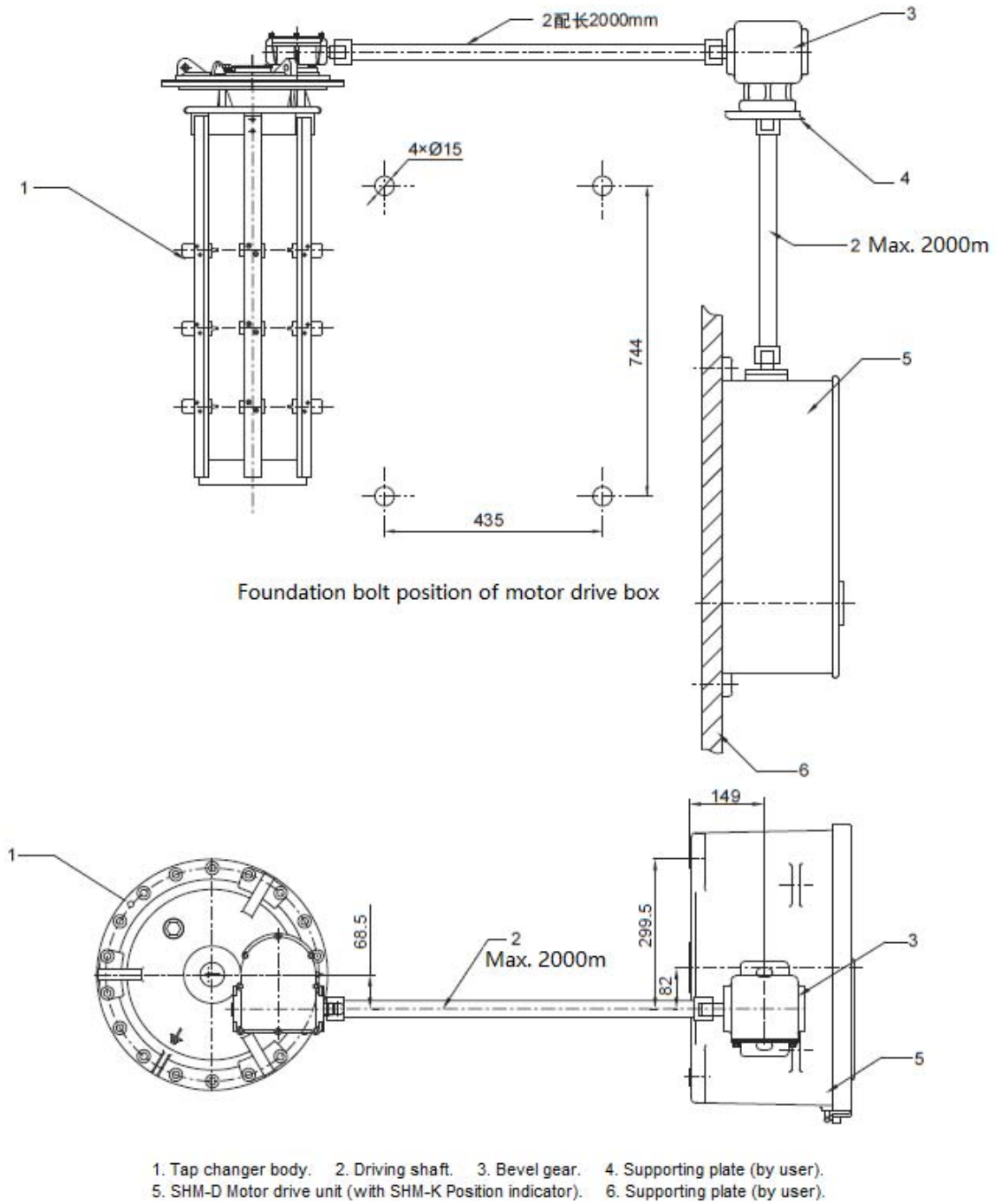
Unit: mm

Appendix 25 Tap changer terminal overall dimension



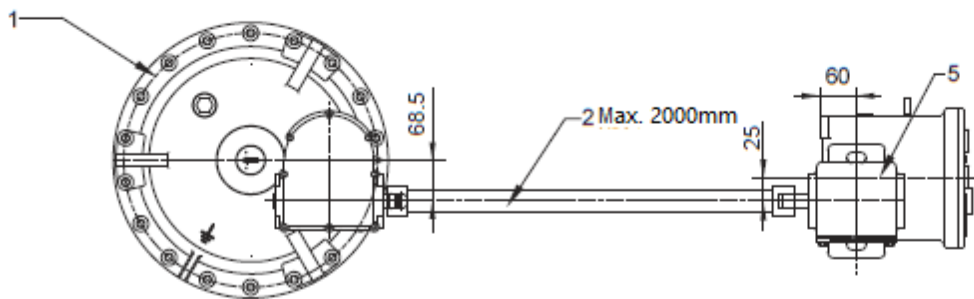
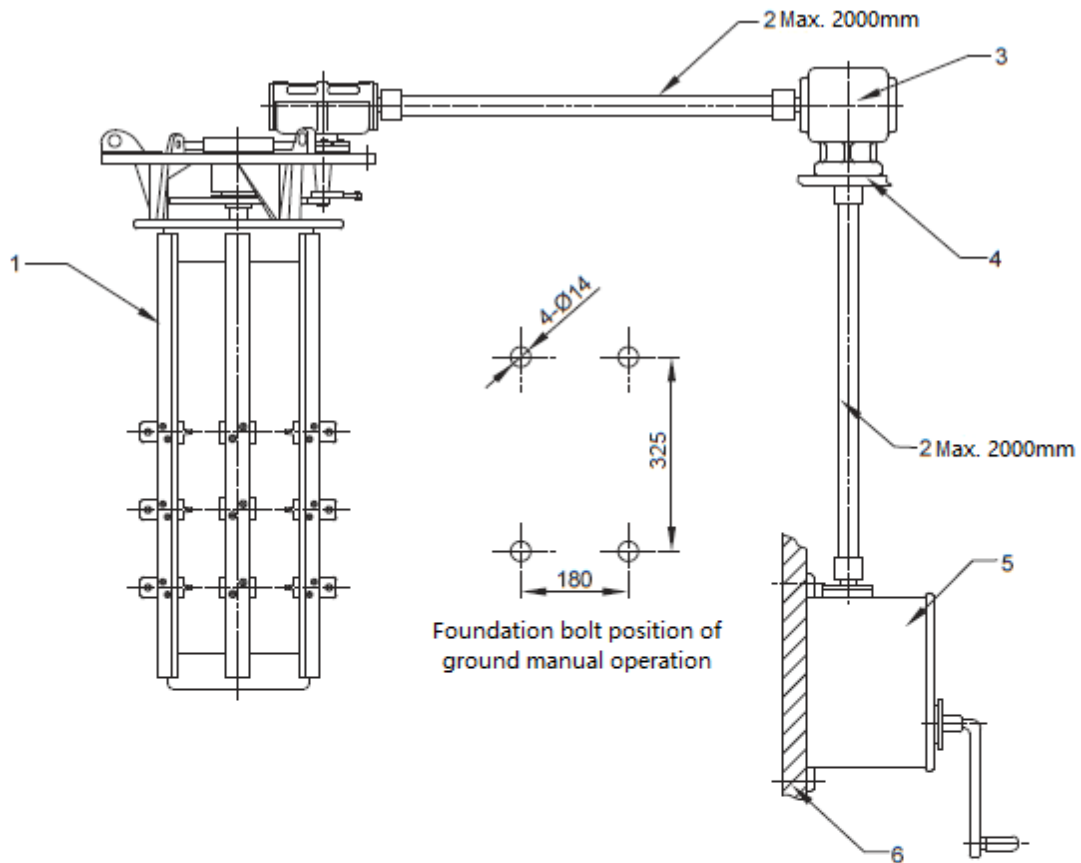
Unit: mm

Appendix 26 Ground motor drive, tap changer installation illustrating drawing



Unit: mm

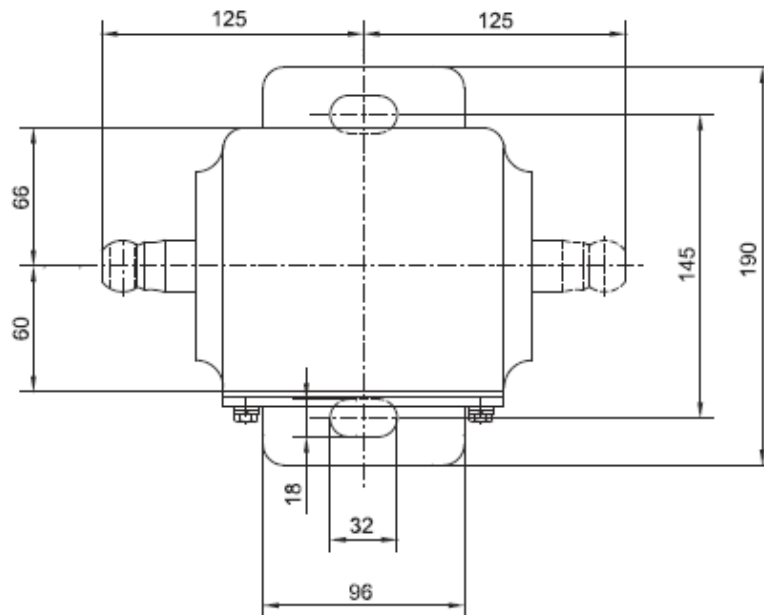
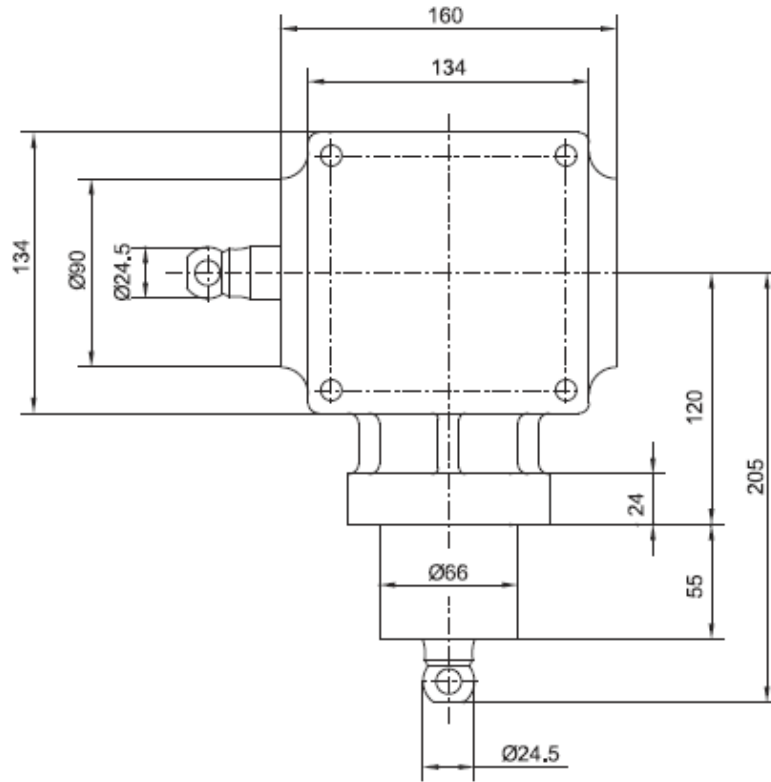
Appendix 27 Ground manual drive, tap changer installation illustrating drawing



1. Tap changer body. 2. Driving shaft. 3. Bevel gear. 4. Supporting plate (by user).
 5. SL mechanism. 6. Supporting plate (by user).

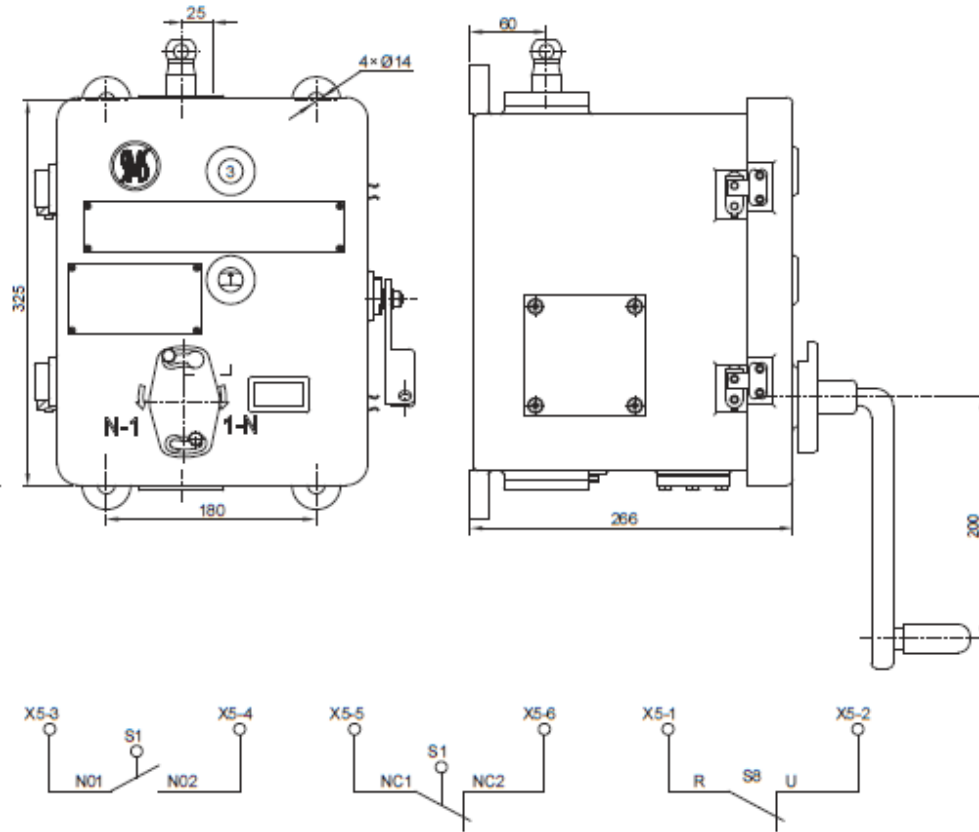
Unit: mm

Appendix 28 Bevel gear box, overall dimension



Unit: mm

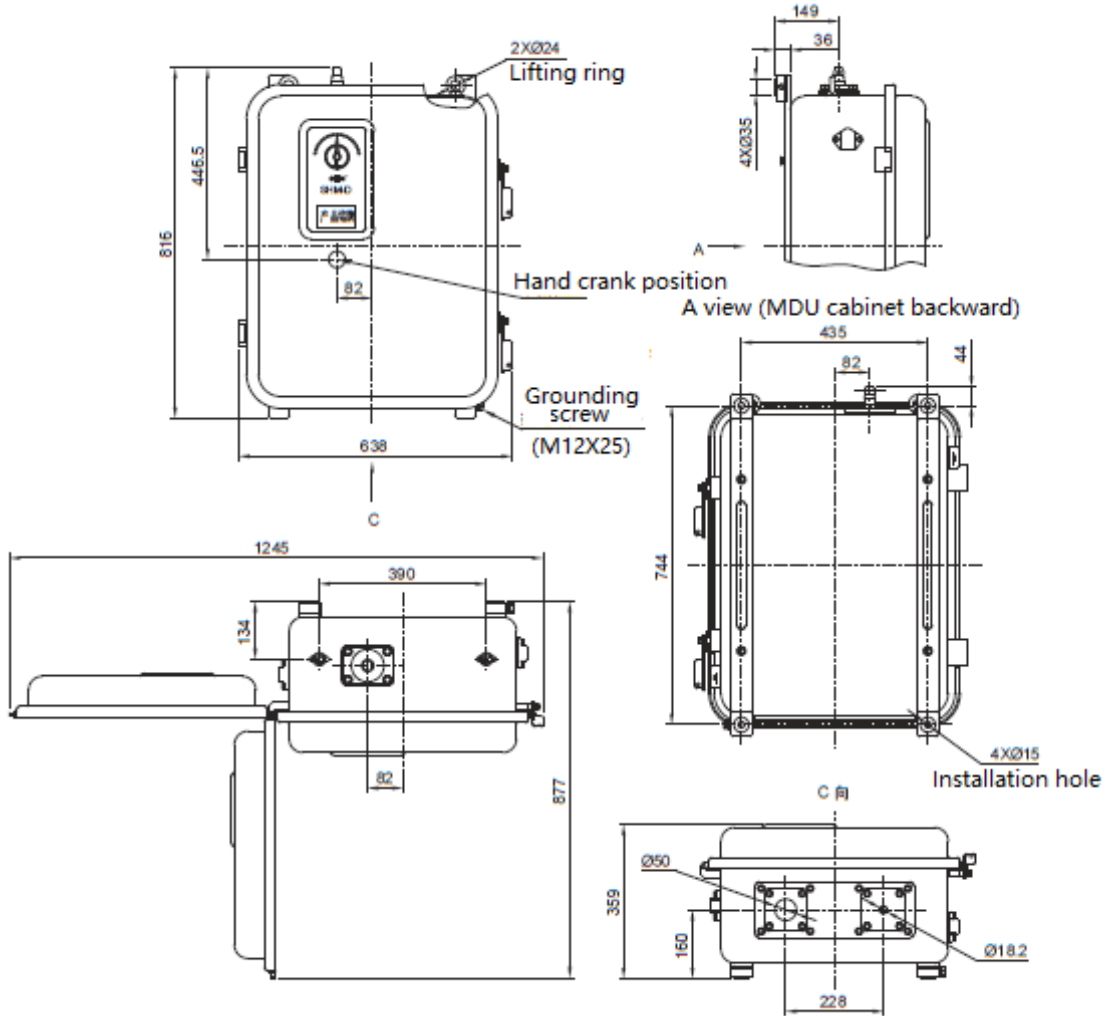
Appendix 29 Side manual drive mechanism, overall dimension



S1-N01, S1-N02 for in-operation signal, S1-NC1, S1-NC2 for operation in-position signal Leads out S8-R、S8-U from manual mechanism to terminals X5-1, X5-2, If handle crank is inserted in, then X5-1、X5-2 break; If handle crank is taken out, then X5-1、X5-2 close, User should take this terminal as block out for manual mechanism and circuit breaker of transformer

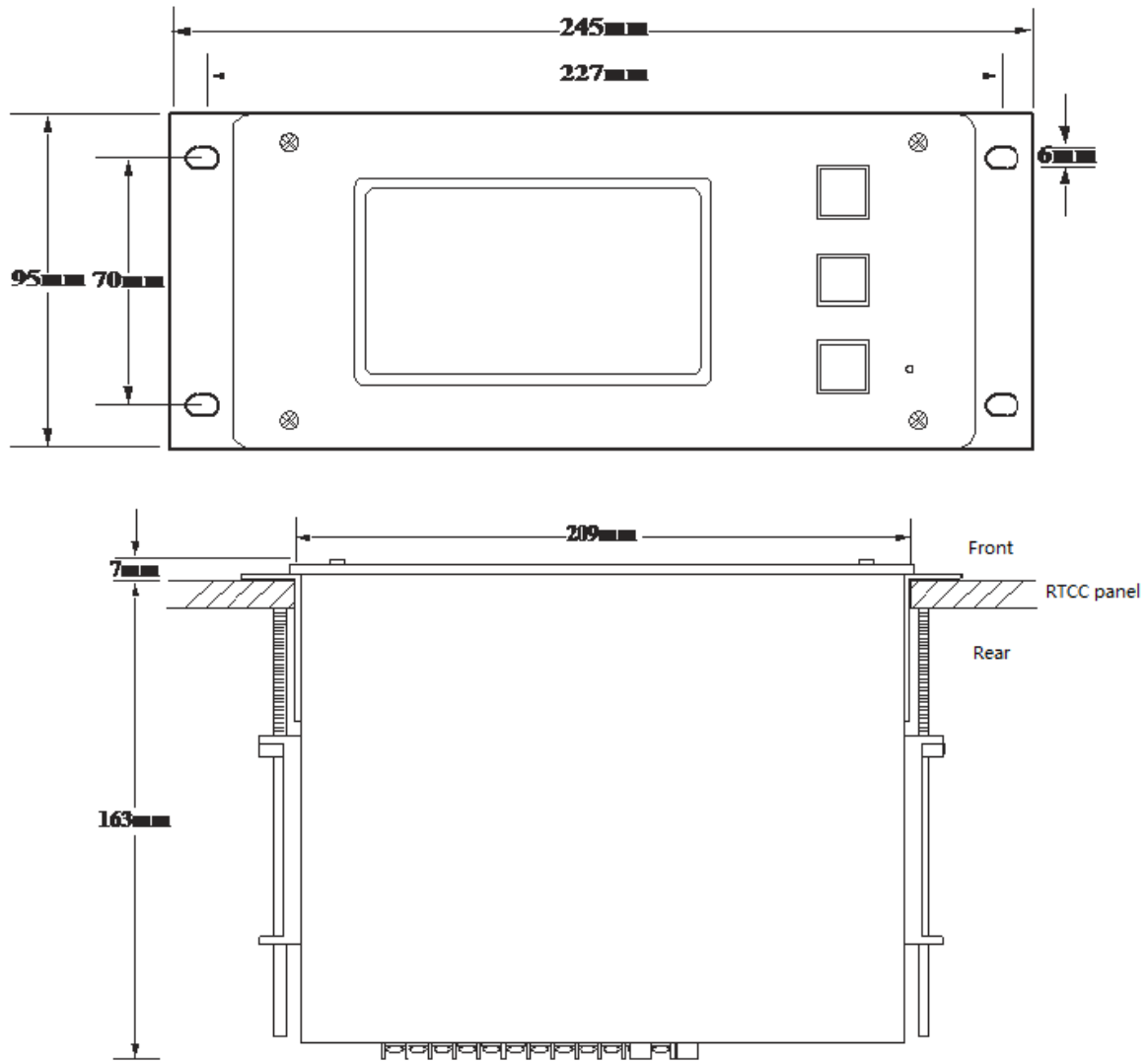
Unit: mm

Appendix 30 SHM-D motor drive unit, overall dimension



Unit: mm

Appendix 31 SHM-K remote controller overall dimension

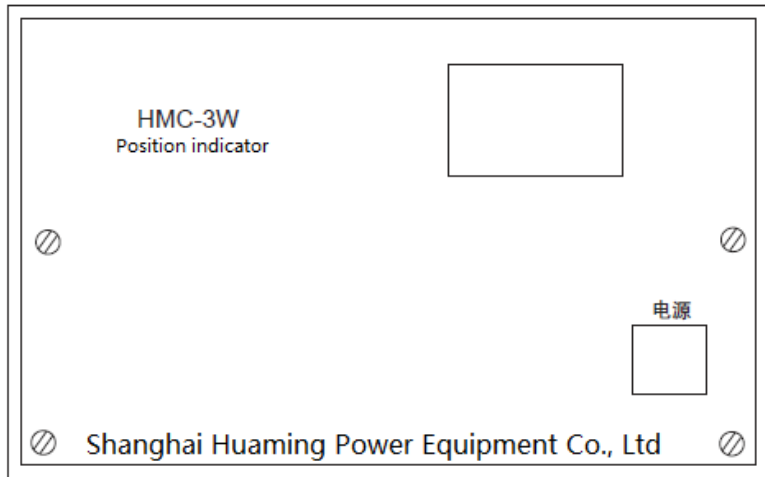


Notice: The installation method can be fixed by the front screw, or it can be locked by the pins on both sides as shown in the figure above.
 Size of hole: 210mm X 9mm (Long X Width)

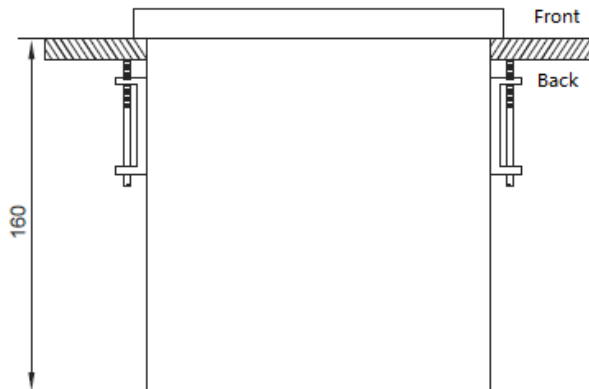
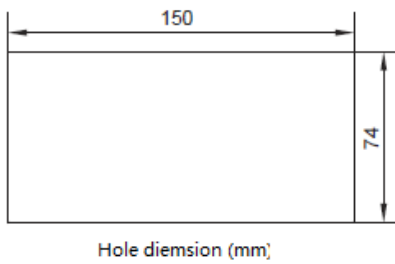
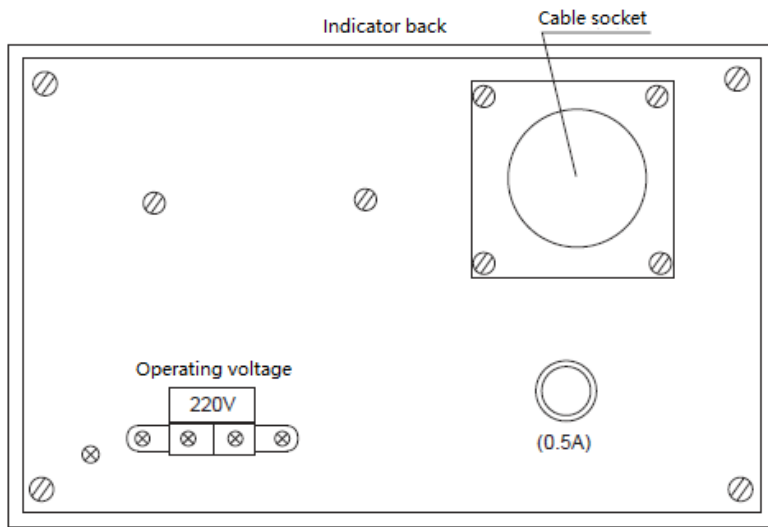
Unit: mm

Appendix 32 HMC-3W position indicator overall dimension

Indicator Front



Indicator back



Unit: mm

Shanghai Huaming Power Equipment Co., Ltd.

Address: No 977 Tong Pu Road, Shanghai 200333, P.R.China
Tel: +86 21 5270 3965 (direct)
+86 21 5270 8966 Ext. 8688 / 8123 / 8698 / 8158 / 8110 / 8658
Fax: +86 21 5270 2715
Web: www.huaming.com E-mail: export@huaming.com