

ZN105-12/T5000-63型发电机保护用真空断路器

安装使用说明书

一、概述

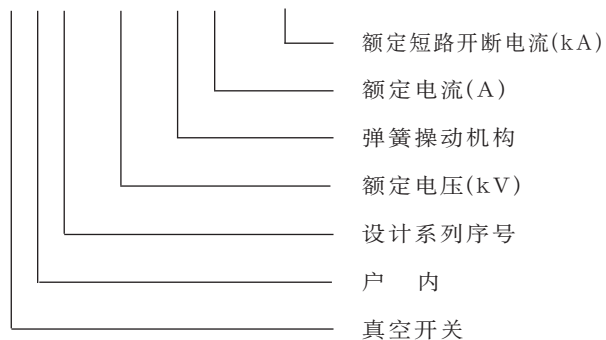
ZN105-12/T5000-63型发电机保护用真空断路器是北京北开电气股份有限公司针对我国电力行业 and 大型企业对大容量负荷用和发电机出口保护用断路器严重不能满足需求的现状，在已经开发成功并推向市场的ZN65A-12/4000-63和ZN105-12/6300-80真空断路器基础上，同时借鉴、消化、吸收引进的德国西门子公司3AF(即国产ZN12系列真空断路器)技术而自行设计、研制的又一种集大额定电流(5000A)和高开断容量(63kA)于一体的大容量真空断路器。适用于额定电压12kV，三相交流50Hz的电力系统和大型企业供电系统，作为发电厂、变电所的控制和保护开关。

二、引用标准

GB1984-2003	交流高压断路器
GB/T14824-1993	发电机断路器通用技术条件
DL/T427-1991	户内型发电机断路器订货技术条件
GB/T11022-1999	高压开关设备和控制设备标准的公用技术条件
GB/T3309-1989	高压开关设备常温下的机械试验
JB/T8738-1998	3.6~40.5kV交流高压开关设备用真空灭弧室
JB/T3855-1996	户内交流高压真空断路器
GB16927.1-1997	高电压试验技术

三、产品型号含义

ZN105-12/T5000-63



四、产品特点

本断路器采用一体式弹簧储能操动机构，可以用交流或直流操作，也可以手动操作。断路器设计先进、合理、结构简单，开断能力强，机械寿命长，操作功能齐全，无爆炸危险。断路器采用空气绝缘方式，绝缘性能优异，利于散热，可全面满足户内Ⅱ级污秽环境的使用要求。作为发电机断路器，符合GB/T14824-1993《发电机断路器通用技术条件》标准及DL/T427-1997《户内型发电机断路器订货技术条件》。

五、产品使用环境

海拔高度：低于1000m；
 环境温度：最高+40°C，最低-15°C；
 相对湿度：日平均不大于95%，月平均不大于90%；
 地震裂度：低于8度、无火灾、爆炸、无腐蚀性气体及无剧烈振动的场所。

六、产品技术参数（见表一）

(表一)

序号	参数名称	单位	数值
1	额定电压	kV	12
2	额定电流	A	5000
3	额定短路开断电流	kA	63
4	额定峰值耐受电流	kA	176
5	额定短时耐受电流	kA	63
6	额定短路关合电流	kA	176
7	额定短路持续时间	s	3
8	额定短路电流开断次数	次	5
9	额定操作顺序		合分-15min-合分
10	额定频率	Hz	50
11	雷电冲击耐受电压(峰值)	kV	对地、相间 75 断口 85
12	1min工频耐受电压	kV	对地、相间 42 断口 50
13	合闸时间	ms	40~65
14	分闸时间	ms	35~65
15	开断时间	ms	50~80
16	机械寿命	次	10000
17	储能电动机额定功率	W	275
18	储能电动机额定电压	V	AC DC 220
19	储能时间	S	≤15
20	合分闸电磁铁额定电压	V	DC 220
21	辅助开关额定电流	A	AC 10、DC 5

Installation and Use Guides of Type ZN105-12/T5000-63 Vacuum Breaker

I General description

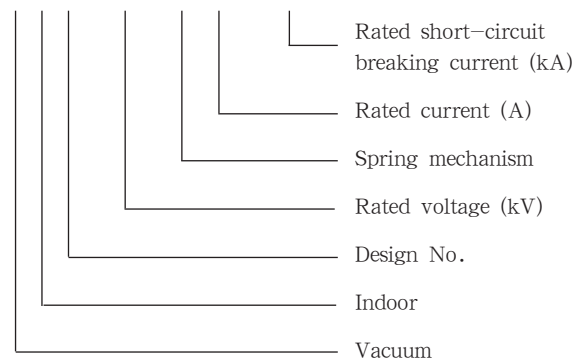
ZN105-12/T5000-63 vacuum circuit breaker for generator protection use, featured of big rated current of 5000A and high breaking capacity of 63KA, is designed and developed to relieve badly supply of circuit breaker of big capacity and generator protection in power industry and big enterprise, on the basis of ZN65A-12/4000-63 and ZN105-12/6300-80 which have been successfully designed and put into market and simultaneously, learning, analyzing and absorbing technology of 3AF of Siemens, Germany. For control and protection of power generating plant and substation use, the switch is suitable for rated voltage of 12kV and three-phase AC 50Hz power system and supply system of big enterprise.

II Applicable standards

GB1984-2003	AC high-voltage circuit breaker
GB/T14824-1993	Common technical requirements for generator circuit breaker
DL/T427-1991	Order technical requirements for indoor generator circuit breaker
GB/T11022-1999	Common technical requirements for high-voltage switchgear and controlgear standards
GB/T3303-1989	Mechanical test at ambient temperature for high-voltage switchgear
JB/T8738-1998	Vacuum interrupter for 3.6~40.5kV AC high-voltage switchgear
JB/T3855-1996	Indoor AC high-voltage vacuum circuit breaker
GB16927.1-1997	High-voltage test techniques

III Model implication

Z N 105 - 12 / T 5000 - 63



IV Features of product

Integrated spring mechanism available for AC, DC or manual operation. Advanced and reasonable design, easy structure, high breaking capacity, comprehensive operational function and no risks of explosion. Air insulation assures excellent insulation performance and is favorable for radiating heat, which can completely meet with requirements of indoor II class pollution environment. Comply with GB/T14824-1993 «Common technical requirements for generator circuit breaker» and DL/T427-1997 «Order technical requirements for indoor generator circuit breaker».

V Service conditions

- The altitude does not exceed 1000m.
- Ambient air temperature does not exceed 40°C, and the minimum ambient air temperature is -15°C.
- Average relative humidity: The average value of relative humidity, over a period of 24h, does not exceed 95%; the average value of relative humidity, over a period of one month, does not exceed 90%;
- Seismic degree: lower than 8 degree. The product shall be applied in place with no fire, explosion, corrosive gas and severe vibration.

七、机械特性调整参数 (见表二)

(表二)

序号	参数名称	单位	数值
1	触头开距	mm	11 ± 1
2	触头超行程	mm	5 ± 1
3	合闸速度	m/s	1.0 ~ 1.5
4	分闸速度	m/s	1.2 ~ 1.6
5	合闸时间	ms	40 ~ 65
6	分闸时间	ms	35 ~ 65
7	三相触头合分闸同期性	ms	≤ 5
8	触头合闸弹跳时间	ms	≤ 5
9	回路电阻	μΩ	≤ 20
10	相间中心距	mm	300 ± 2

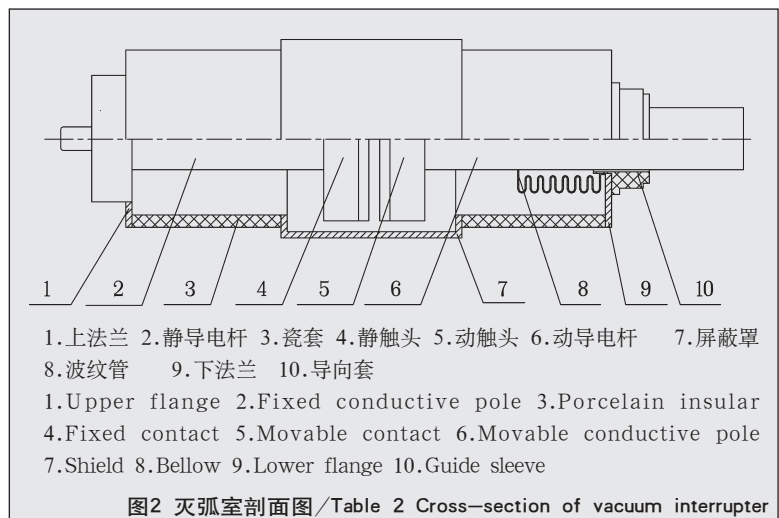
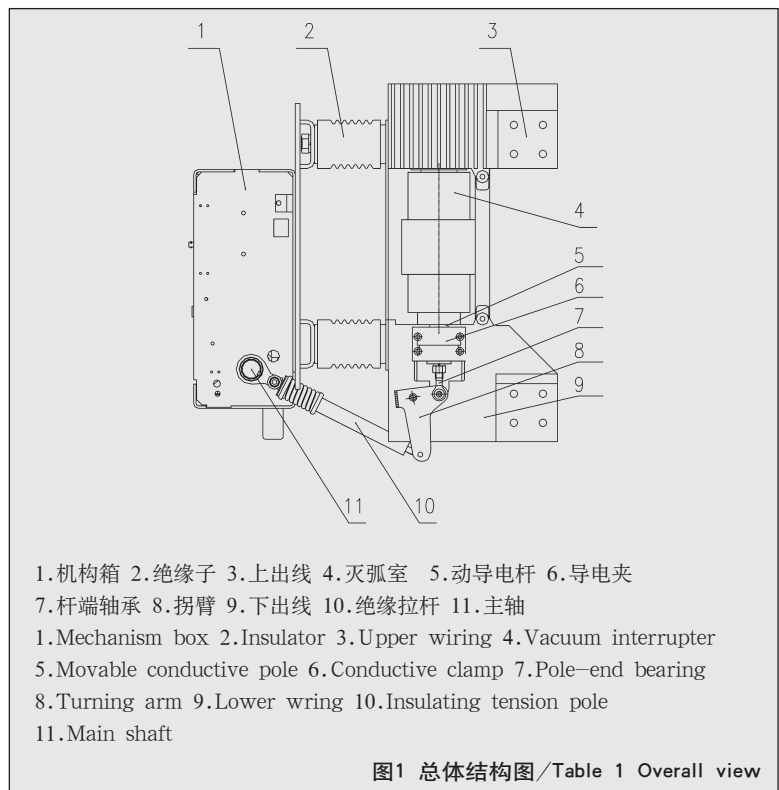
八、产品结构及工作原理

1. 整体结构

断路器(图1)主要由真空灭弧室、操动机构及支撑部分组成。在机构箱上装有6组绝缘子用于固定上、下出线端。灭弧室固定于上出线端下方，下出线通过软连接和导电夹与真空灭弧室的动导电杆相连，构成断路器主回路。在导电杆的底部装有万向杆端轴承，该轴承与拐臂通过一销轴连接，开关主轴通过三根绝缘拉杆，将力传递给拐臂，由拐臂带动动导电杆运动完成断路器动作。

2. 真空灭弧室

由于在真空中气体分子的平均自由行程很大，气体不容易产生游离，真空比大气绝缘强度要高得多。当开关分闸时，触头间产生电弧，触头表面在高温下挥发出金属蒸气，由于触头设计为特殊形状，在短路电流通过时产生与电弧平行的纵向磁场，将电弧约束在磁场内，保持其扩散型态，并均匀分布在触头表面，不集聚，因而电弧电压低，燃弧时间短，触头烧蚀甚微，电弧在电流自然过零时就熄灭了，此时触头间的介质强度又迅速恢复起来。真空灭弧室一般由静导电杆；静触头；动触头；动导电杆；波纹管；屏蔽罩；上、下法兰；导向套和瓷套组成(图2)。



VI Specifications (See table 1)

(Table 1)

No.	Item	Unit	Data
1	Rated voltage	kV	12
2	Rated current	A	5000
3	Rated short-circuit breaking current	kA	63
4	Rated peak value withstand current	kA	176
5	Rated short time withstand current	kA	63
6	Rated short-circuit making current	kA	176
7	Rated short-circuit duration	s	3
8	Rated breaking times of short-circuit	times	5
9	Rated operation sequence		CO-15min-CO
10	Rated frequency	Hz	50
11	Rated impulse test voltage, kV peak	kV	to earth, phase to phase 75
			gaps 85
12	1min Rated power frequency test voltage	kV	to earth, phase to phase 42
			gaps 50
13	Closing time	ms	40~65
14	Opening time	ms	35~65
15	Breaking time	ms	50~80
16	Mechanical life	次	10000
17	Rated power of motor	W	275
18	Rated voltage of motor	V	AC DC 220
19	Energy-storage time	S	≤15
20	Rated voltage of closing and opening electro-magnet	V	DC 220
21	Rated current of auxiliary switch	A	AC 10、DC 5

VII Adjustable parameters of mechanical characteristic

(Table 2)

No.	Item	Unit	Data
1	Clearance between open contacts	mm	11±1
2	Over travel of contacts	mm	5±1
3	Closing speed	m/s	1.0~1.5
4	Opening speed	m/s	1.2~1.6
5	Closing time	ms	40~65
6	Opening time	ms	35~65
7	Closing and opening simultaneity of switch device	ms	≤5
8	Contact bounce time	ms	≤5
9	Circuit resistance	μΩ	≤20
10	phase-to-phase spacing	mm	300±2

VIII Structure and service principal

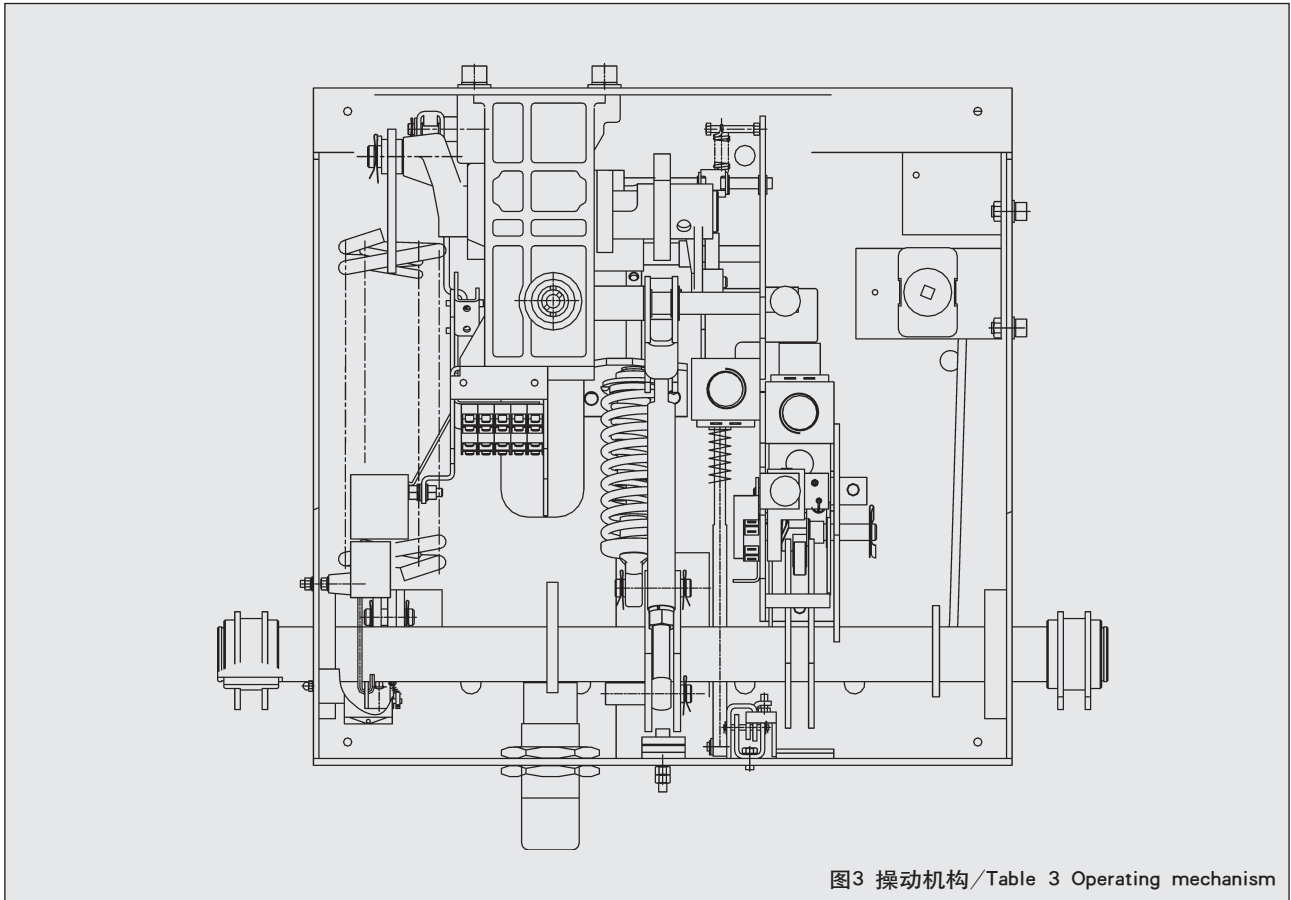
1. Overall structure

The circuit breaker (see table 1) mainly consists of vacuum interrupter, operating mechanism and supporter. Six sets of insulators are fixed on mechanism box to fasten upper and lower wiring terminals. The interrupter is installed under the upper wiring terminal and the lower wiring terminal

is connected to movable conductive pole via soft connection and conductive clamp to form main circuit of circuit breaker. Universal pole-end bearing fixed on the bottom of conductive pole is connected to turning arm via a pin shaft. Main shaft passes the force to turning arm by three insulating tension poles and completes the action of circuit breaker by pulling movable conductive pole.

3. 操动机构

操动机构(见图3)主要由储能机构, 锁定机构, 分闸弹簧、开关主轴, 缓冲器及控制装置组成。



3.1 储能机构

储能机构由减速器、储能电机和储能弹簧组成。

3.2 锁定机构

锁定机构为合、分闸两部分, 分别由杠杆掣子和滚针轴承组件等组成, 合闸锁定机构作用是维持储能, 分闸锁定机构作用为维持合闸。

3.3 合闸机构

合闸机构由凸轮、连杆机构、合闸电磁铁、合闸按钮组成。

3.4 分闸机构

分闸机构分别由分闸掣子、分闸电磁铁、分闸弹簧、分闸按钮组成。

3.5 缓冲器

缓冲器分两种, 一种为合闸缓冲器, 是橡胶缓冲, 装在机构箱左下方; 另一种为分闸缓冲器, 为油缓冲, 装在机构箱中下方处。

3.6 分闸弹簧

位于机构箱之内, 其作用在分闸时施加分闸力, 使断

路器分闸。

3.7 控制装置

控制装置包括合分闸电磁铁, 辅助开关, 整流装置(选装)。辅助开关具有十一对常开、常闭接点, 其最大通过电流为10A。

4. 操作

4.1 储能

a. 电机储能: 接通电动机电源, 合闸弹簧被减速器带动拉伸进行储能。当合闸弹簧拉伸一定程度后, 合闸锁定机构工作, 储能完毕。同时, 微动开关将电机电源切断。此时, “储能指示”显示在面板孔中。

b. 手动储能: 将手摇把插入减速箱前端孔中, 顺时针旋转, 储能完毕后, 摇把将会空转, 此时将手把取下。

4.2 合闸

接通合闸电磁铁电源或用手按动合闸按钮, 合闸掣子被解脱, 合闸力通过凸轮传给连杆, 带动开关主轴转动, 使导电杆向上运动。当动静触头接触后, 主轴被分闸掣子锁住, 断路器完成合闸。在合闸的同时, 分闸弹簧被压

2. Vacuum interrupter

The average mean-free of gas molecule is larger in vacuum and the gas is not subject to be dissociated, so dielectric strength of vacuum is higher than that of the air. While opening, arc occurs between contacts, and metal vapor is volatilized off the surface of contacts. Longitudinal magnetic field, paralleling with arc occurs while short circuit passing through contacts of special design and confines arc within it and keep it evenly diffused on the surface of contacts. With voltage declining and time of arcing shortened, there is little damage on contacts and arc will go out when the circuit goes zero. After that, dielectric strength will restore quickly.

Vacuum interrupter is generally composed of fixed conductive pole, fixed contacts, movable contacts, movable conductive pole, bellow, shield, upper and lower flange, guide sleeve as well as porcelain insulator. (See table 2)

3. Operating mechanism

The operating mechanism is composed of stored energy operating device, locking mechanism, opening spring, main shaft, buffer and controlling device.

3.1 Stored energy operating device

Stored energy operating device is made up of decelerator, stored energy motor, stored energy spring.

3.2 Locking mechanism

Locking mechanism is divided into closing and opening parts composed by lever block and needle bearing. The function of closing locking device and opening locking device is separately for retaining energy and keeping closing.

3.3 Closing mechanism

Closing mechanism is made up of cam, connecting lever mechanism, closing electro-magnet as well as closing button.

3.4 Opening mechanism

Opening mechanism is made up of opening block, opening electro-magnet, opening spring and opening button.

3.5 Buffer

There are two kinds of buffers; one is called closing buffer, also rubber buffer which is installed under left of mechanism box, and the other one is called opening buffer, also oil buffer which is installed under middle of mechanism box.

3.6 Opening spring

It is installed inside mechanism box with function of bringing opening force to realize opening move.

3.7 Controlling device

Controlling device consists of closing and opening electro-magnet, auxiliary switch and rectifier (selectable). Auxiliary switch has eleven NO, NC contacts with allowable current 10A.

4. Operation

4.1 Energy storing

a. Motor storing energy: when the motor is electrified, closing spring is extended to store energy. When the spring is pulled to some length, the closing locking mechanism acts and the energy storing move is finished. At this time, the travel switch turns off the power supply and the signal "Energy Indication" appears inside the hole.

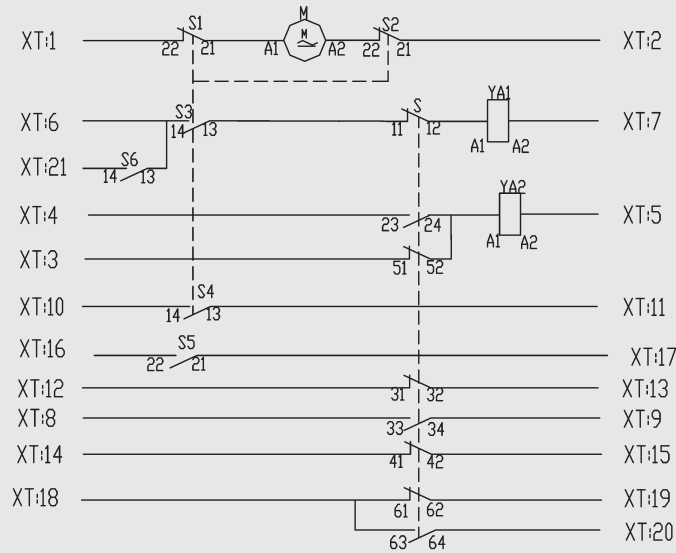
b. Manual stored energy: Insert the handle into the front hole of decelerating box and revolve it clockwise. The handle will be racing if energy storing is finished and then take off the handle.

4.2 Closing

When powering closing electro-magnet or pressing closing button, the closing block will be released, and the closing force is passed on to lever to push main shaft to move and the conductive pole moves forward. The main shaft will be locked by opening block, when movable contact touches fixed contact, and closing move is finished. Meanwhile, opening spring is pressed, and the signal "Closing Indication" appears inside the pole.

4.3 Opening

When powering opening electro-magnet or pressing opening button, the opening block will be released, and the movable conductive pole moves under the



XT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24		
S1:22	S2:21	S5:1	S2:3	S2:3	YA2:A2	S3:14	YA1:A2	S3:3	S3:4	S4:14	S4:13	S3:1	S3:2	S3:14	S4:2	S5:22	S5:21	S6:1	S6:2	S6:4	S6:14	S6:14	S6:2	S6:3	S6:4

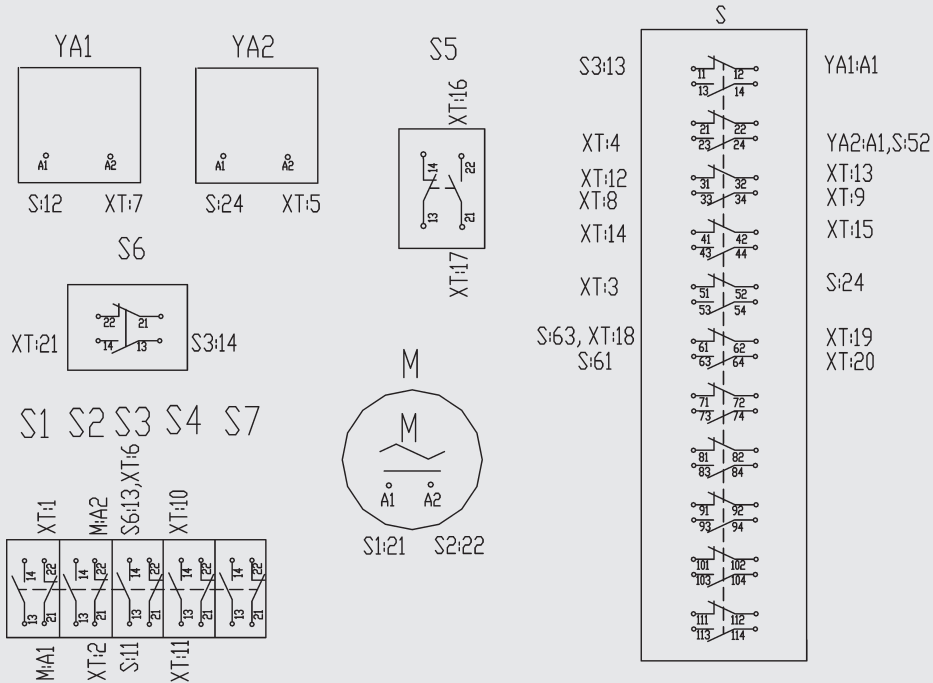
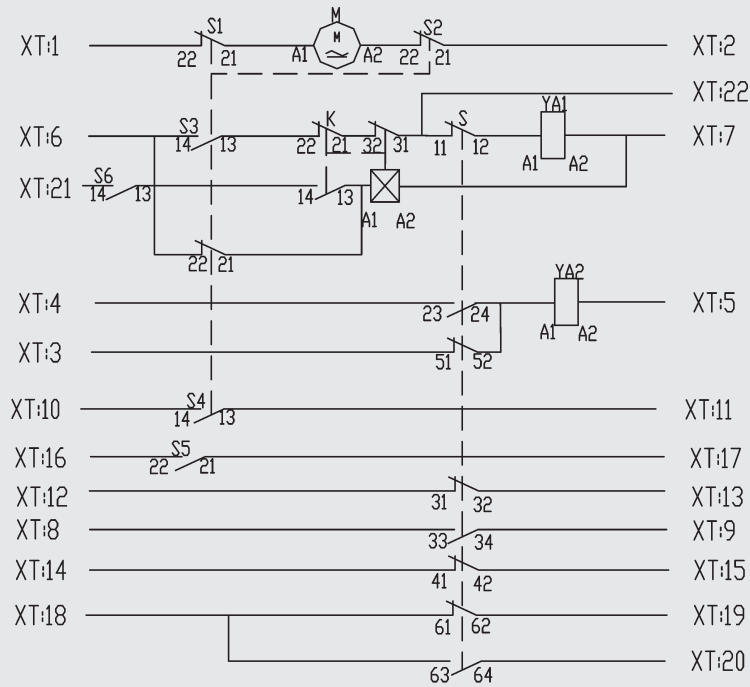


图4 机构原理及接线图

Table 4 Principle and wiring diagram of mechanism



XT

1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19	20	21	22	23	24	
S1:22	S2:21	S5:1	S:23	YA2:A2	S3:14	YA1:A2	S:33	S:34	S4:14	S4:13	S3:1	S:32	S4:1	S4:2	S5:22	S5:21	S6:1	S6:2	S6:4	S6:14	K:31			

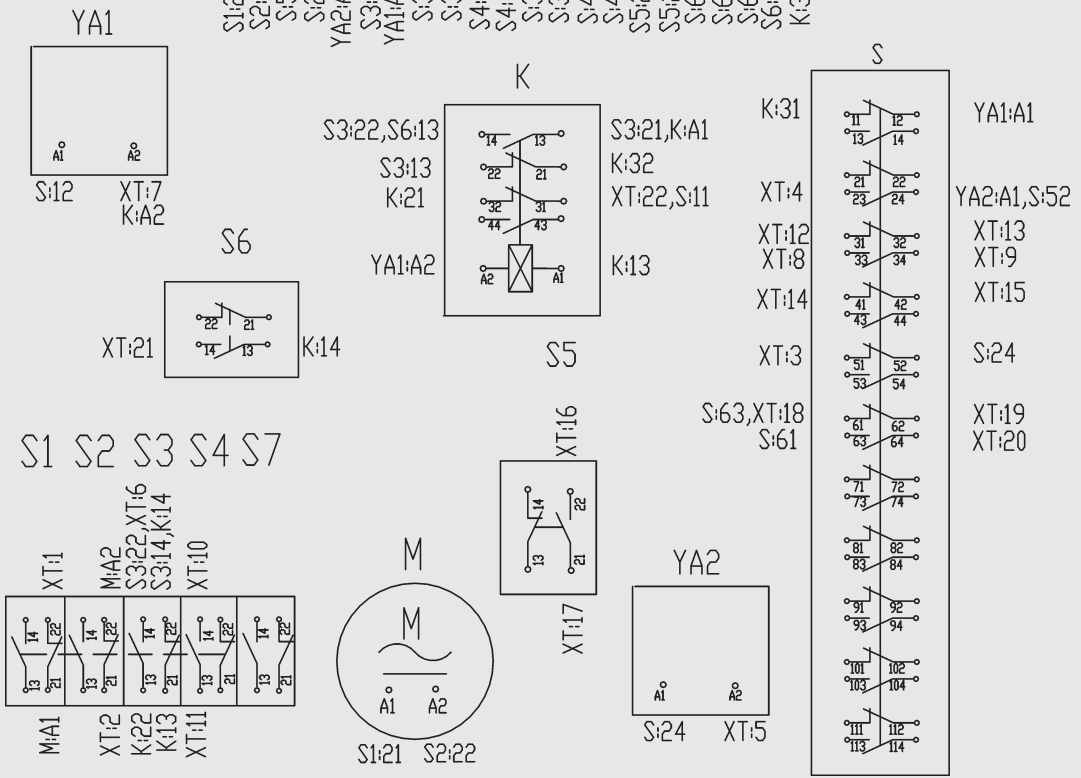


图5 机构原理及接线图

Table 5 Principle and wiring diagram of mechanism

缩、“合闸指示”显示在面板孔中。

4.3 分闸

接通分闸电磁铁电源或用手按下分闸按钮。分闸掣子解脱，动导电杆在分闸弹簧力作用下运动实现分闸。“分闸指示”显示在面板孔中。

4.4 断路器在合闸后，电动机将立即给合闸弹簧储能，断电时也可用手动再次储能。

4.5 机构原理、接线图见图4、图5。

九、运输、验收和储存

1. 断路器在出厂时为合闸状态，合闸弹簧不得储能。
2. 断路器安装在手车上时与开关柜一起包装，如果单独供货则按其包装规范包装。
3. 断路器在运输时处于合闸状态，不得倾斜及受强烈震动或雨淋。
4. 用户收到断路器时应进行以下工作：
 - a. 检查包装是否损坏和受潮。
 - b. 开箱取出装箱单，并对照其检查装箱文件是否齐全。
 - c. 检查断路器铭牌上的技术参数是否符合订货要求。
 - d. 检查附件及备品是否齐全。
 - e. 检查断路器是否受潮，如果已受潮则需将绝缘隔板与绝缘拉杆拆下放入70~80℃的烘箱中烘烤48h。
 - f. 断路器长期不用时需在导电面上涂以工业凡士林油，并用清洁油纸包上绝缘件。
 - g. 断路器应放在通风干燥的室内储存，垂直放置，不得叠放。
 - h. 在机构箱上装有专用起吊装置。作为起吊时挂钩用。不得勾住绝缘子或断路器的其他部位吊起。

十、安装

1. 机构外形尺寸及安装孔位置尺寸见图6,用开关底板上的安装孔安装。
2. 导电部分用钢刷刷出金属光泽后用干布擦净，涂上工业凡士林油。

3. 将机构箱侧面的接地孔挫出金属光泽，并涂以工业凡士林油再接地线。

4. 用手动使开关分、合闸。检查“储能”、“合闸”、“分闸”指示是否正确。

5. 将起吊装置卸下，安装绝缘隔板。

十一、运行前的准备

1. 运行前不需对断路器进行任何调整。仅需检查各部位螺钉有无松动现象，若有则紧固。
2. 断路器各转动部分应涂润滑油。
3. 绝缘件表面擦拭干净。
4. 断路器通电进行试操作，无异常现象时即可投入运行。

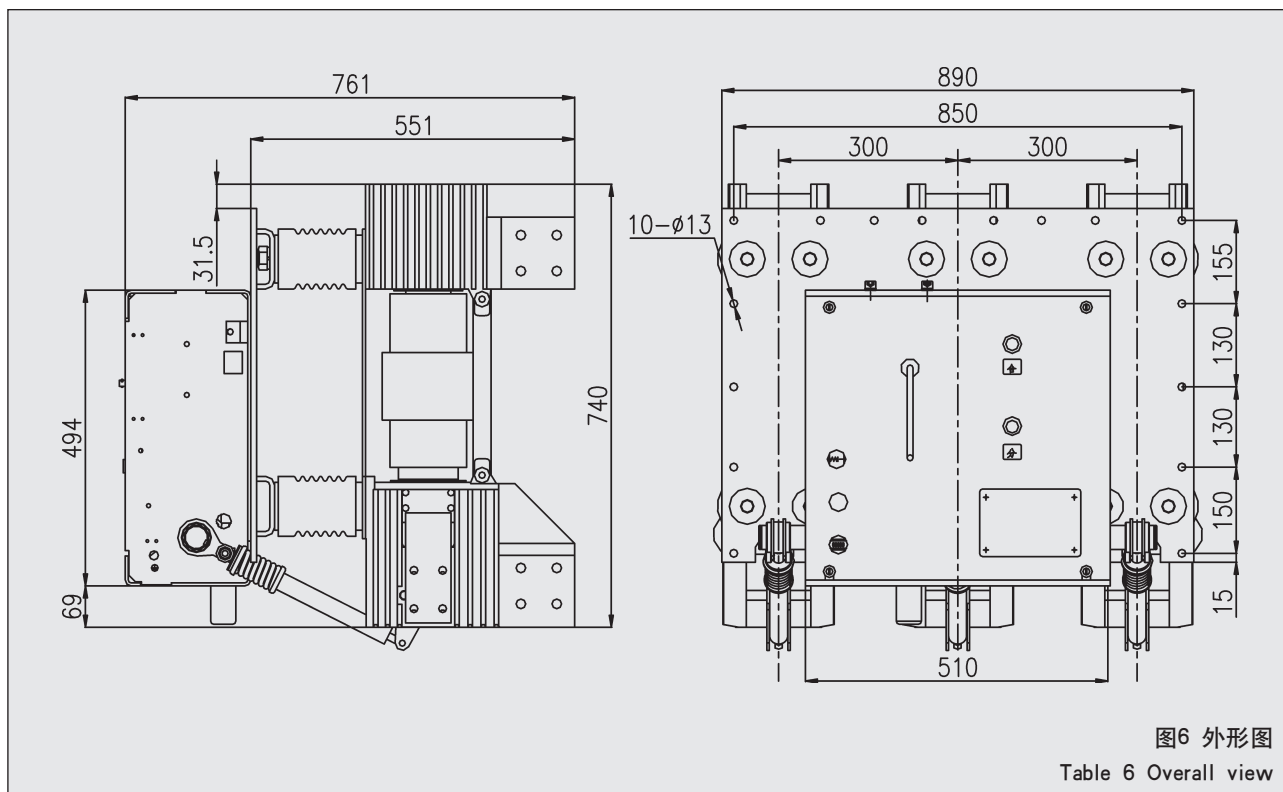
十二、使用、维修与检修

1. 当断路器安装在海拔1000m以上，但不超过4000m时，其试验电压应按本文件规定的额定耐受电压乘以系数Ka。

$$K_a = \frac{1}{1.1 - H \times 10^{-4}}$$

式中：H — 安装地点的海拔高度m。

2. 断路器在使用10年或操作达到1000次后应上润滑油一次，并紧固各部位螺钉。
3. 真空灭弧室在使用20年或达到技术参数表中规定的短路电流开断次数后即需更换灭弧室。
4. 更换灭弧室时，首先将开关分闸，然后按以下顺序进行(见图7)。
 - a. 先拆下绝缘支杆，然后拧下上出线与管子连接的螺栓和上出线与绝缘子的螺栓，最后卸下上出线。
 - b. 先卸下绝缘拉杆与拐臂连接的带槽销，将紧固导电夹与软连接的螺栓卸下，卸下动导电杆与拐臂联接的带槽销，最后双手握住灭弧室往上提即可卸下。
 - c. 测量旧灭弧室上的杆端轴承到灭弧室顶端的高度，将杆端轴承安装到新的灭弧室上并调整好高度，将螺母锁紧。
 - d. 将新灭弧室导电杆用银砂纸磨光并用工业酒精擦拭干净



force of opening spring to realize opening, and the signal "Closing Indication" appears inside the pole.

4.4 Closing spring will be pressed by motor immediate closing, and manual operation can be used if there is no power.

4.5 As for principle and wiring diagram of mechanism, please refer to table 4, 5.

IX Transportation, acceptance and storage

1. Circuit breaker shall be closed before delivery, and the closing spring shall not be pressed.

2. The circuit breaker installed on the trolley shall be packaged together with switchgear. If delivered separately, it shall be packaged according to package guide.

3. The closed circuit breaker on delivery shall not be inclined, severely vibrated or watered.

4. The following items shall be considered on arrival of the circuit breaker:

- Whether the package is damaged or wetted.
- Check documents, equipment, spare parts and auxiliary parts against packing list attached to be sure all parts have been received.

c. Whether parameters on nameplate of circuit breaker comply with requirements of contract.

d. If the circuit breaker is wetted, the insulating screen and the insulating tension pole shall be removed and baked in the oven under temperature of $70^{\circ}\text{C} \sim 80^{\circ}\text{C}$.

e. If the circuit breaker is not put into operation immediately, petroleum jelly shall be daubed on conductive surface and the insulating parts shall be packed by purified oilpaper.

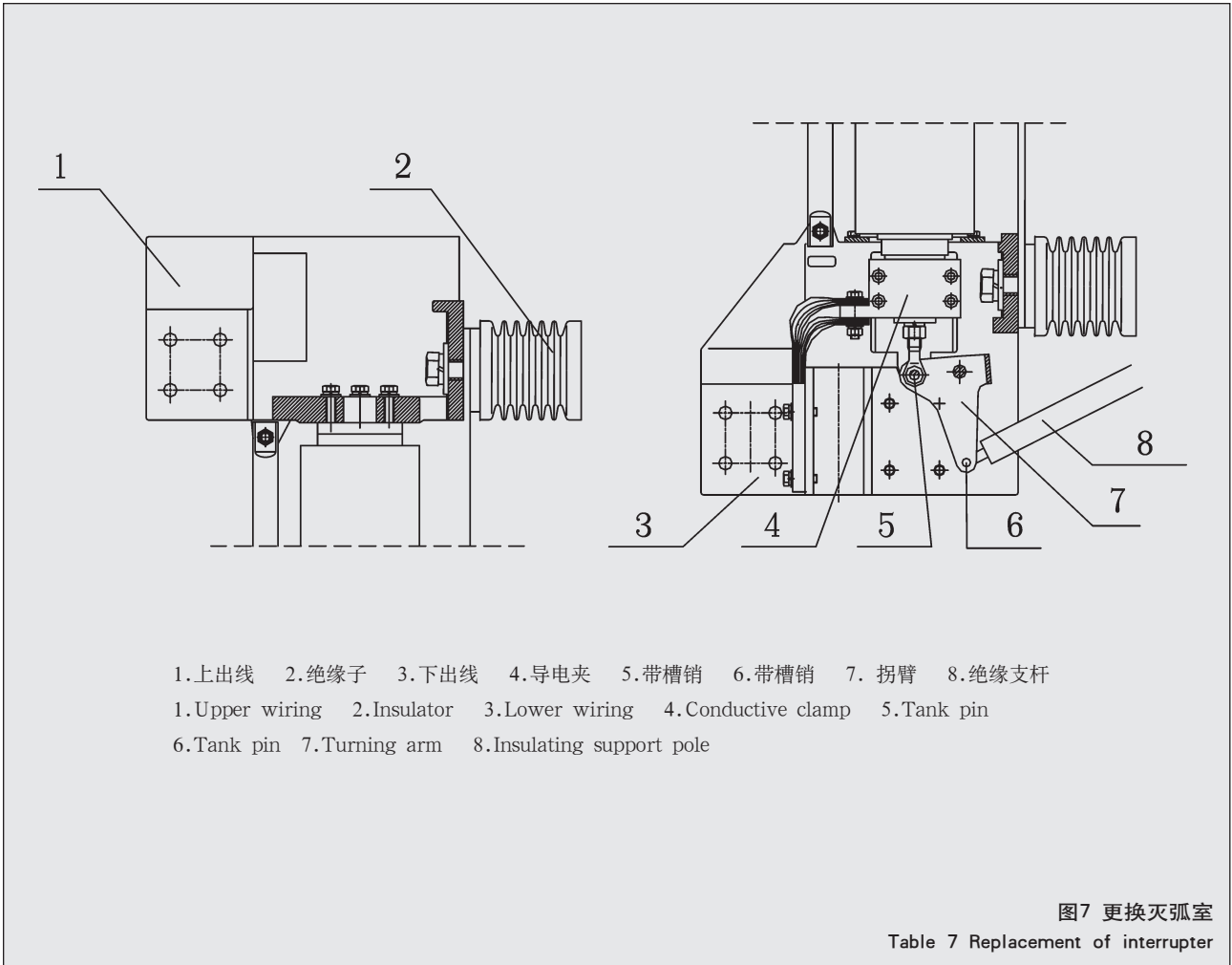
f. The circuit breaker shall be vertically placed in ventilating and dry room, lapping over is not permitted.

g. Special lifting device shall be installed on mechanism box for lifting and insulators, and other parts of circuit breaker shall not be hooked.

X Installation

1. As for dimension of mechanism and fixing hole, please refer to table 6. The users should fix circuit breaker by installing hole on the bottom of circuit breaker.

2. The conductive parts shall be daubed on petroleum



后涂上工业凡士林。

- e. 双手握紧新灭弧室装入导电夹的孔中。
- f. 装上上出线，注意三相垂直及水平位置不超过1mm，拧紧各部位螺栓。
- g. 按拆卸的相反顺序重新装上各个部分的轴销和螺栓。

十三、随机文件

- a. 产品合格证明书
- b. 安装使用说明书
- c. 装箱单

十四、备品及附件

名称	摇把	护套	压接端头
数量(个)	1	24	24

十五、订货须知

订货时应注明断路器型号、名称、主要技术参数及订货数量；电动机电压种类及参数、辅助开关接点对数；合、分闸电磁铁电压等，用户如果有特殊要求或需要备品备件须在订货时提出。

提示：

本说明书所涉及的内容，包括文字、图形、参数等，如做任何修改，恕不另行通知！

包装物不回收，请做好包装物及废弃物的处理，保护环境。

注意安全，保护人身健康。

jelly after burnished by steel brush and wiped off.

3. The earthing hole on side of mechanism box shall be daubed on petroleum jelly and then earthed.
4. Close and open by manual to check out correctness of the signal "Energy storing", "Close" and "Open".
5. Remove lifting device, and install insulating screen.

XI Preparation before delivery

1. No need to regulate circuit breaker, but to fasten bolts and nuts.
2. Movable parts of circuit breaker shall be painted by petroleum jelly.
3. The surface of insulators shall be wiped off.
4. The circuit breaker shall only be put into operation after successful pre-commissioning.

XII Usage, maintenance and repair

1. Test voltage of circuit breaker shall be calculated by multiplying rated power frequency test voltage specified in the document by coefficient K_a , if it services at altitude of higher than 1000m, but lower than 4000m.

$$K_a = \frac{1}{1.1 - H \times 10^{-4}}$$

Where H (m) is the altitude of service place.

2. The circuit breaker shall be lubricated and at an interval of 10 years operation or up to 1000 times operation, and the bolts and nuts shall be refastened.
3. The vacuum interrupter shall be replaced after twenty years operation or achieving breaking operations of rated short-circuit current specified in technical parameter table.
4. The vacuum interrupter shall be replace as follows, after disconnecting the switch; (see table 7).
 - a. First, remove insulating support pole, and then screw bolts connecting upper wiring and interrupter, and the bolt connecting upper wiring and insulator. Finally, remove upper wiring.
 - b. Remove tank pin connecting insulating tension pole and turning arm, and then remove bolt

fastening conductive clamp and soft connection as well as that connecting movable conductive pole and tuning arm, finally, take out of the interrupter.

- c. Measure the height from pole-end bearing to the top of interrupter and install pole-end to the new interrupter to be sure the proper height. Finally, fasten the bolts.
- d. Burnish conductive pole by silver emery paper and wipe off by industrial alcohol, finally daub on petroleum jelly.
- e. Insert new interrupter into the hole of conductive clamp.
- f. Install upper wiring to be sure error of upright position and horizontal position of three phases shall not exceed 1mm, and fasten bolts.
- g. Reinstall pin shafts and bolts of all parts reversely.

XIII Attached documents

- a. Product certificate
- b. Product manual
- c. Packing list

XIV Spare parts and auxiliary parts

Item	Handle	Sheath	Crimped joint
Amount	1	24	24

XV Order notice

Type, description, and main parameters should be notified while ordering as well as variety of voltage of motor, pairs of auxiliary contacts; voltage of closing and opening electro-magnet; special requirements and spare parts.

Caution:

All the contents covered in this specification, including words, diagram, parameters etc, can be modified without prior notice.

Properly dispose of the wrapped and wastes. Strengthen environment protection.

Attach importance to human health and safety.