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HIGH VOLTAGE REED SWITCH		ממסר למתח גבוהה

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HIGH VOLTAGE REED SWITCH

This invention relates to electric engineering and more particularly to reed switch relays with magnetocontrolled contacts and it can be used in automation devices for medial voltage (22-36kV) electric networks.

Reed switch relay containing a dielectric body with a magnetocontrolled contact mounted in line with a control winding separated by a cylindrical pipe-shaped insulator is known [1].

The drawback of this device is very low switching current of thousandth of ampere at high voltages.

High voltage reed switch relays in which magnetocontrolled contacts are provided with additional ferromagnetic plates-magnetic circuits and additional massive contact areas are known [2,3].

The drawback of these devices is their limited switching capacity owing to the impossibility of providing sufficient clearance between contacts. Limited clearance between contacts is derived from the fact that it is at the same time the clearance in the magnetic system. With increasing the clearance in the magnetic system the needed power in the control winding will be drastically increased so that at a certain critical clearance closing the contacts will become impossible. In addition the limited switching capacity is determined by low contact pressure of the closed contacts.

The embodiment closed to that claimed hereinafter is a high voltage reed switch containing a dielectric body with mobile and fixed contacts and a ferromagnetic core mounted in it and a control winding mounted on the top of the body in the ferromagnetic core location area [4]. The core is positioned normally to the mobile contact and one end of the mobile contact is cantilevered in the body. As the core in magnetized, the mobile contact is bent and its free end is joined with the fixed end located inside the core.

The drawback of this embodiment is that likewise the systems discussed above the clearance between the contacts is also the magnetic system clearance. This puts a strict limitation on the switching capacity of the relay and limits its application field.

The object of this invention is to extend the possible uses of the relay.

To attain the above object, to the high voltage relay with magnetocontrolled contact formed with a dielectric body with fixed and mobile contacts and ferromagnetic core mounted in it, along with control coil mounted on the top of the body in the ferromagnetic core location area, a fixed contact, an insulator, a second control coil, three permanent magnets, spring buffer are added, furthermore the mobile contact is formed as a bridge with a dielectric rod connected to it in the center with allowed clearance, the rod in turn is connected to a ferromagnetic core, the first permanent magnet in its casing is fastened in the central part at the opposite (lower) side of the bridge, furthermore at the center of the body base in line with the first permanent magnet a second permanent magnet in a dielectric casing is connected and directed towards the first magnet with its opposite sign so that when the contacts are closed a gap of 1-3 mm is preserved between the first and the second magnet; dielectric body is formed with two closed contacting cavities with a big and a small cross-section and one more insulated open cavity which is coaxial with the small cavity, furthermore the big cavity contains contacts, the first and the second magnets and dielectric rod, while the small cavity holds the ferromagnetic core with the third permanent magnet at its end allowed for coaxial shift, which is forced between the support and the upper closed face with a spring buffer; in the third mentioned concentric cavity two coaxial control coils are mounted on the walls of the small mentioned cavity as if it was a core, furthermore the ferromagnetic core is longer than each one of the control coils by 20-30%, while the length of each control coil is set to about the half of the total clearance between the mobile and fixed contacts which is determined by the level of the switched voltage; when the contacts are engaged the center of the ferromagnetic core lengthwise nearly coincides with the center of the first (lower) control coil, while the third mentioned permanent magnet is withdrawn from the second (upper) control coil so that the entire ferromagnetic core whose face touches this magnet face is set inside the field of action of the magnetic field of the second (upper) control coil, moreover, the vectors of the magnetic field of this coil and the third magnet coincide; the big cavity and a part of the small cavity are filled with dielectric liquid or gas (for example SF_6 gas), while the concentric cavity holding the control coils - with epoxy compound.

Apart of this the second (upper) control coil is connected to the first stabilized ac power supply in series with break contacts of the “STOP” button and rectifying bridge at the output of which a light diode is connected shunted with a resistor, as well as to the second dc power supply via closing contact of the “STOP” button, while the first (lower) control coil is connected to the mentioned second dc power supply in series with the closing contacts of the “START” button.

Moreover, both control coils have spark-protecting circuits, while in parallel to the spark-protecting circuit of the second (upper) control coil a circuit formed with a diode and a pair of back-to-back connected Zener diodes with stabilization voltage exceeding the voltage of the stabilized ac power supply.

In this relay design the clearances in the magnetic system are undependable on the clearance between the contacts, which allows for their considerable increase in size in comparison with the prototype, furthermore the use of permanent magnets as the contact position locator allows for the contact pressure increase.

Fig. 1 shows the high voltage relay with magnetocontrolled contact (cross-section).

Fig. 2 shows the general electrical block diagram of the high voltage relay control unit.

High voltage relay with magnetocontrolled contact consists of a dielectric body formed with two closed contacting cavities: big cross-section cavity 1 and small cross-section cavity 2, and one more insulated open cavity 3 which is concentric with small cavity 2. In big cavity 1 symmetrically positioned are two fixed contacts 4, mobile bridge-type contact 5, fixed magnet 6 and mobile magnet 7 fixed in housing 8 which is connected to the central part of bridge-type contact 5. This housing 8 enters special guides 9 that limit the degrees of freedom of housing 8. From the other side of the central area of bridge-type contact 5 a dielectric rod is attached with a certain clearance with ferromagnetic core 10 fixed to its other end. Permanent magnet 11 with steel bushings 12 is located in small cavity 2 which is free to move in the upper part of cavity 2 along its longitudinal axis by 1-1.5 cm. Two control coils 13 (the lower) and 14 (the upper) mounted on cavity 2 and provided with magnetic circuits 15 are located in open concentric cavity 3. With the control coils mounted in cavity 3 it is filled with epoxy compound and covered with cover 16 with partition insulators with outputs 17 formed as wires with high voltage insulation drawn through them.

Ferromagnetic coil 10 is by 20-30% longer than the control coils. Small cavity 2 is closed with threaded plug 18. Buffer 19 such as a disk spring is placed between this plug and magnet 11. The outputs of fixed contacts are formed as high voltage wires 20 drawn through partition insulators 21.

Upper control coil 14 is connected to first stabilized ac power supply 22 via break contact 23.1 of the "STOP" button and rectifying bridge 24. Light diode is connected at the bridge output 25 shunted with resistor 26. The same control coil 14 is connected to the second dc power supply 27 via closing contact 23/2 of the same "STOP" button. Lower control winding 13 is connected to dc power supply 27 via closing contact 28 of the "START" button.

Both control windings have spark-protecting circuits. In winding 13 this circuit is formed with diode 29, and in winding 14 - a circuit formed with diode 30 connected in series with Zener diodes 31 and 32 whose stabilization voltage exceeds the voltage of stabilized ac power supply 22.

The device operation is as follows.

With external power supply cut off the relay can be in one of its extreme positions: either engaged when core 10 with contacts 5 are in their lower position and magnet 7 being attracted to magnet 6 fixes this position and generates the required contact pressure, or disengaged when core 10 with contacts 5 and magnet 7 are in their upper position which is fixed owing to core 10 attraction to permanent magnet 11.

When the switch is disengaged (this state is illustrated in Fig.1) a small alternating voltage from stabilized power supply 22 is applied to upper winding 14. The current in this coil is very small owing to high inductive reactance of winding 14 with core 10 enclosed in it. Voltage drop on resistor 26 is insufficient to illuminate light diode 25.

The device is started by pressing and releasing “START” button 28. As a result lower winding 13 is momentarily connected to dc power supply (rectifier) 27. Magnetic field generated by this winding detaches core 10 from permanent magnet 11 and imparts motion pulse to the core owing to which the core quickly moves downwards carrying away contacts 5 and magnet 7 coupled with it. As fixed contacts 4 are attained and the velocity reduced by the elasticity of the spring located at the center of the bridge that interconnects contacts 5, core 11 and all the mobile elements connected to it are stopped in the lower position so that a few millimeters gap is left between magnets 6 and 7. Mutual attraction between magnets 6 and 7 prevents springing back of contacts 5 from contacts 4 at their initial touch, providing for the required contact pressure and fixation of the mobile device elements in the lower position. As core 10 leaves upper winding 14 its inductive reactance is considerably reduced, the current is increased illuminating light diode 25 which induces the device activation.

The device is switched off by pressing and releasing “STOP” button 23. As a result upper winding 14 is disconnected from ac power supply 22 (contact 23.1) and is connected to dc power supply 27 (contact 23.2). Magnetic field generated in this winding acts on core 10 and imparts motion pulse owing to which magnet 7 is detached from magnet 6 and together with contacts 5 quickly moves upwards until core 10 reaches permanent magnet 11. Owing to that the magnet is not fixed permanently and can move along the axis inelastic impact of core 10 on magnet 11 is prevented, so that after they come in touch their joint movement is proceeded and damped by spring 19 elasticity. As the movement pulse is damped the mobile relay elements together with magnet 11 are lowered under gravity and owing to spring 19 elasticity through magnet 11 allowed clearance and remain in this position expecting for the relay engagement command.

Spark-protection circuits formed with components 29-32 protect the contacts of buttons 23 and 28 from electric erosion resulting from switching windings 13 and 14 featuring considerable inductivity.

INFORMATION SOURCES

1. High Voltage Relay Package. Patent USA N **3.958.199,** 1976
2. Magnetic Switches. Patent USA N **2.987.593**
3. Improvements in Relating to Reed Switch. UK Patent N **1.315.253**
4. Relay. Patent USA N **2.360.941**

What is claimed is:

1. High voltage reed switch relay consisting of a dielectric body with a fixed and mobile contacts and ferromagnetic core as well as a control coil mounted on the body from the top in the area of ferromagnetic core f e a t u r i n g t h a t another fixed contact, an insulator, a second control coil, three permanent magnets, spring buffer are added, furthermore the mobile contact is formed as a bridge with a dielectric rod connected to it in the center with allowed clearance, the rod in turn is connected to a ferromagnetic core, the first permanent magnet in its casing is fastened in the central part at the opposite (lower) side of the bridge, furthermore at the center of the body base in line with the first permanent magnet a second permanent magnet in a dielectric casing is connected and directed towards the first magnet with its opposite sign so that when the contacts are closed a gap of 1-3 mm is preserved between the first and the second magnet; dielectric body is formed with two closed contacting cavities with a big and a small cross-section and one more insulated open cavity which is coaxial with the small cavity, furthermore the big cavity contains contacts, the first and the second magnets and dielectric rod, while the small cavity holds the ferromagnetic core with the third permanent magnet at its end allowed for coaxial shift, which is forced between the support and the upper closed face with a spring buffer; in the third mentioned concentric cavity two coaxial control coils are mounted on the walls of the small mentioned cavity as if it was a core, furthermore the ferromagnetic core is longer than each one of the control coils by 20-30%, while the length of each control coil is set to about the half of the total clearance between the mobile and fixed contacts which is determined by the level of the switched voltage; when the contacts are engaged the center of the ferromagnetic core lengthwise nearly coincides with the center of the first (lower) control coil, while the third mentioned permanent magnet is withdrawn from the second (upper) control coil so that the entire ferromagnetic core whose face touches this magnet face is set inside the field of action of the magnetic field of the second (upper) control coil, moreover, the vectors of the magnetic field of this coil and the third magnet coincide; the big cavity and a part of the small cavity are filled with dielectric liquid or gas (for example SF_6 gas), while the concentric cavity holding the control coils - with epoxy compound.

2. High voltage reed switch relay in claim no. 1 f e at u r i n g the second (upper) control coil is connected to the first stabilized ac power supply in series with break contacts of the “STOP” button and rectifying bridge at the output of which a light diode is connected shunted with a resistor, as well as to the second dc power supply via closing contact of the “STOP” button, while the first (lower) control coil is connected to the mentioned second dc power supply in series with the closing contacts of the “START” button.

3. High voltage reed switch relay in claim no. 1 f e at u r i n g t h a t both control coils have spark-protecting circuits, while in parallel to the spark-protecting circuit of the second (upper) control coil a circuit formed with a diode and a pair of back-to-back connected Zener diodes with stabilization voltage exceeding the voltage of the stabilized ac power supply.

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High Voltage Reed Switch Relay

2 Sheets
Sheet 1 of 2

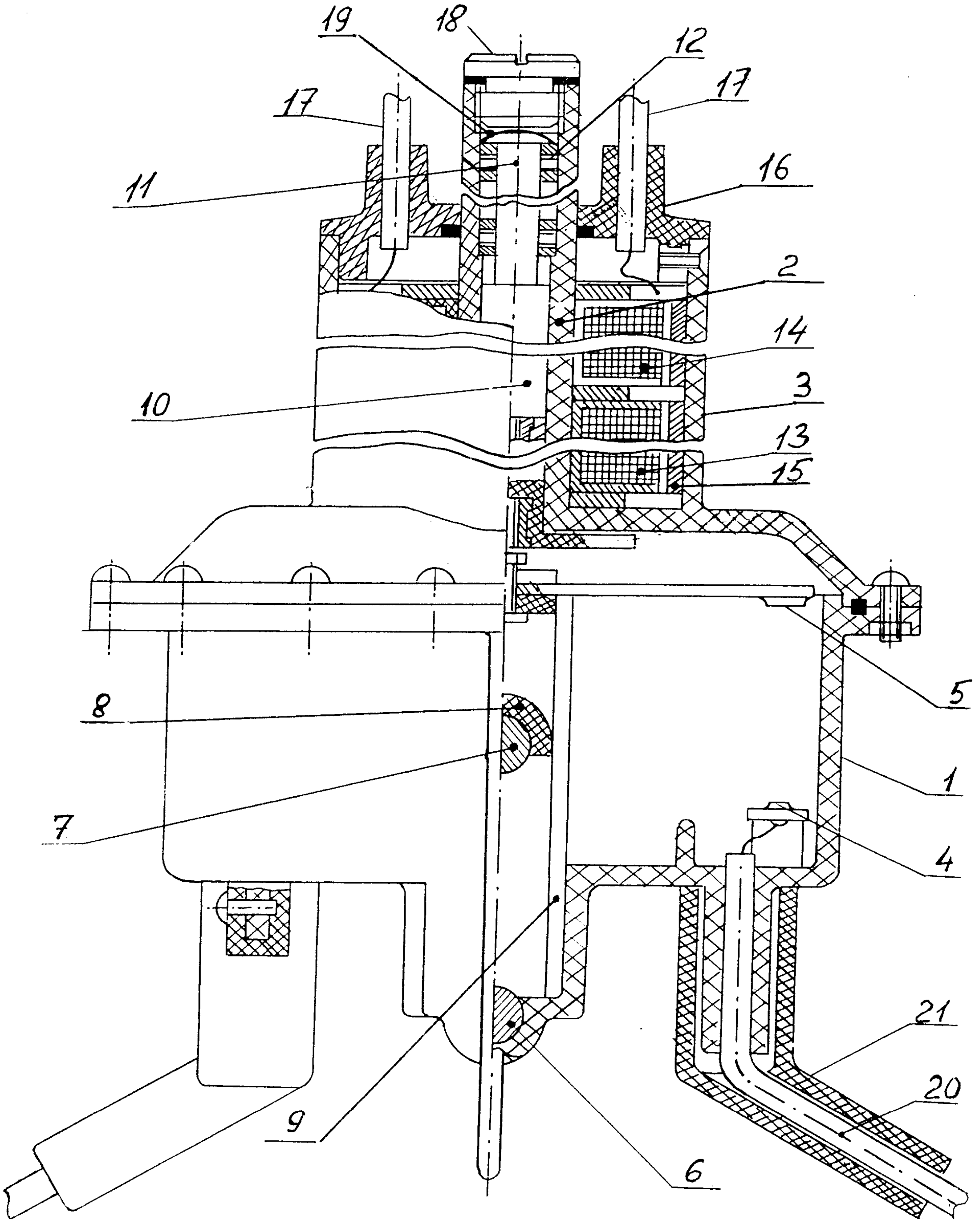

Fig. 1

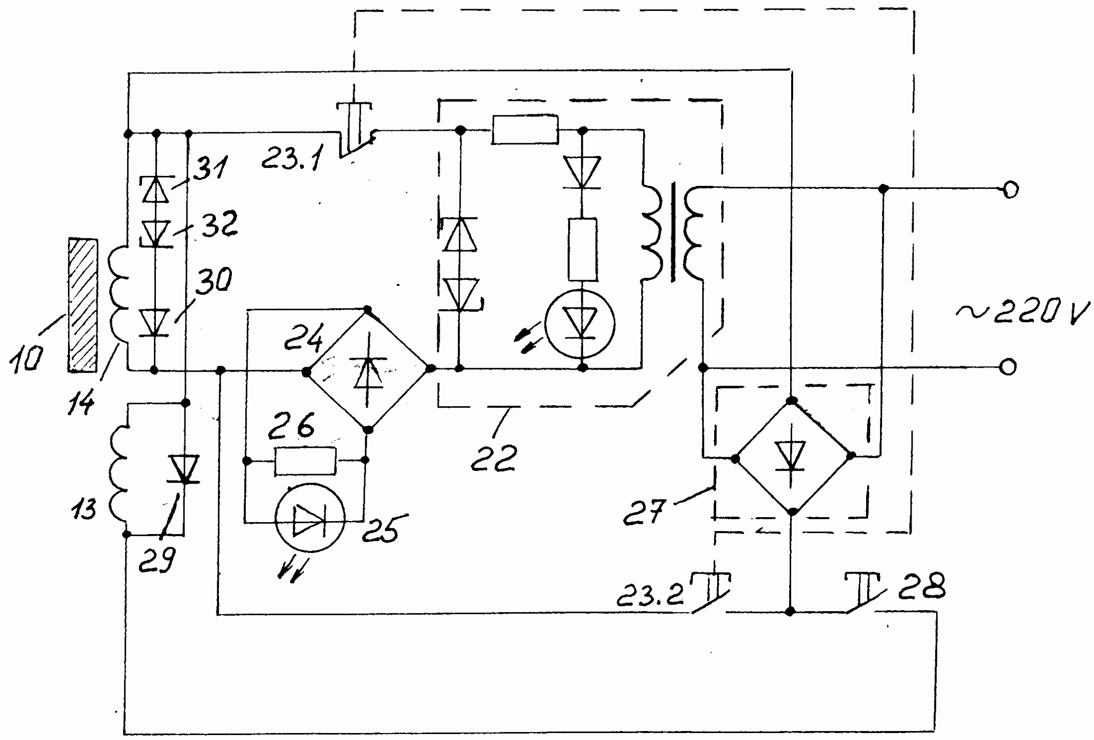

Fig. 2