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A REED RELAY FOR ALTERNATING CURRENT

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In the paper observed problem of reed relay intended for control by alternating current. Describer new technical solution that not need to use smoothing filter with electrolytic capacitor.

Key words: reed relay, reed switch, alternating current, smoothing filter.

The reed relay is a widely used element of automation and is manufactured by dozens of factories all over the world. A switching element of this type of relay, hermetically sealed and magnetically controlled, is very fast (from fractions of milliseconds to several milliseconds) and that's why it is very sensitive even to some minor pulsations of the magnetic field created by the control coil. In the presence of such pulsations, the members of a reed switch manage to follow the changes in the magnetic flux and start vibrating instead of closing at once. This is why the majority of reed relays have a control coil, which is intended to be controlled by direct current only. Technical specifications of some types of industrial reed relays (e.g., RPG, RTG, etc. series) allow supplying 3-phase rectified current with pulsing frequency not less than 300 Hz to the control coil without an additional smoothing filter or when using a rectifier at 50 Hz frequency, which ensures pulsation of not more than 6%. It is clear that 3-phase rectified current with pulsing frequency not less than 300 Hz is unlikely to be used to supply the coil. This is why there is only one practical option for using reed relays controlled by AC. This option is represented by a rectifier with a smoothing filter based on a high capacity electrolytic capacitor. A great disadvantage of such a type of connection is the significant increase of actuation and release time because of a capacitor. This is why many authors have tried to ensure smoothening of magnetic current fluxes in the area of the reed switch without a capacitor, for example, by means of a copper tube put onto the reed switch [1]. Our research has shown that this method (as well as the use of a shaded pole of a magnet core with a press-fit copper rings) does not work with reed switches. In connection with this, another solution was found earlier: a reed switch vibrating in the alternating magnetic field was connected to the input terminals of a semiconductor circuit with transistors and with an additional output relay, filtering current fluctuations in the circuit of the reed switch members [2]. Availability of filters in a circuit of the reed switch's elements and additional output relay still resulted in a noticeable delay of actuation of such a relay. The only way to avoid the delay and obtain an ultra-high-speed relay was to connect the reed switch into the gate circuit of a powerful thyristor [3].

However, it is not always possible to use a reed switch vibrating in the alternating magnetic field with semiconductor elements converting vibrations of the reed switch into a clear signal. For instance, it is unacceptable when using reed switch relay in industrial automatic systems because a continuously operating vibrating reed switch will quickly be worn out.

Since there are no efficient technical solutions, which would ensure adequate operation of reed relay controlled by alternating current of industrial frequency without deterioration of key characteristics, we offer a new technical solution, which was experimentally tested (Fig.1).

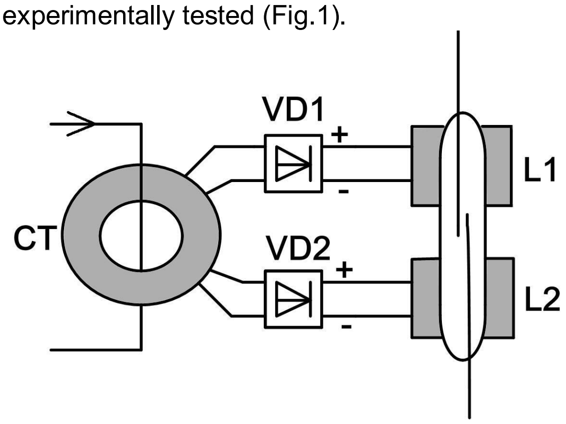

Fig. 1. Advertized reed relay for alternating current: CT – current transformer with two secondary windings; VD1 and VD2 – rectifying diode bridges; L1 and L2 – various inductivity control coils, put onto the reed switch

The idea of this technical solution is described further. The control coil put onto the reed switch is designed as two separate coils, which are wound with different wires and have different number of winds. Each of these coils is supplied through a miniature rectifying bridge from its winding of input current or voltage transformer (Fig. 2).

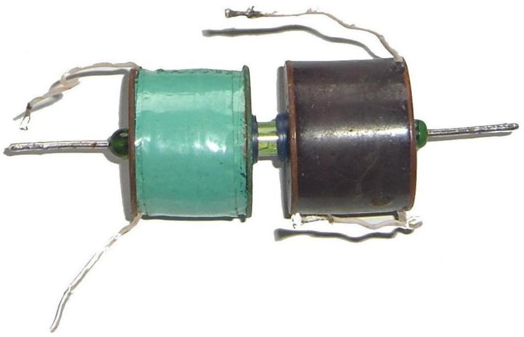

Fig. 2. The structure with a reed switch KEM-1 and two coils used in the experiment

The efficient and inertia-free smoothing of pulsations of magnet flux of rectified voltage near the reed switch is achieved due to natural differences in the speed of increase and decrease of current in the windings with different inductivity put onto the reed switch and determined by this difference phase shift between the maximums of the magnet flux pulsations of the rectified current. Moreover, as the number of impulses of the magnet flux is increased, its dips are decreasing and the value of a constant component is increasing, which prevents the opening of the reed switch's contacts.

We used a KEM-1 reed switch in the experimental model, Fig.2. The first control coil was wound with a 0.08 mm diameter wire and had 6500 winds (the coil's resistance to direct current is about 1000 Ohm), while the other coil had 1950 winds of 0.16 mm diameter wire (the coil's resistance to direct current is about 100 Ohm). In order to check the influence of the difference in the coil's parameters on the stability of relay operation, another variant of the second coil was tested, which had 20 winds of 0.5 mm diameter wire. In both cases there was accurate and stable actuation of the reed switch without vibration and delay. The measured time of relay actuation with both sets of control coils did not exceed 2.17 ms (the rated value of KEM-1 actuation is 2 ms).

During the trials the voltage on the coils was set in such a way in order to make the reed switch actuate (start vibrating) from each coil separately. The first coil had a rectified voltage of 10V, while the second coil had 4V. The current rate in the circuit of the additional variant of the second coil was about 80 Ma.

The input transformer can have a primary current or voltage winding and can be either individual (for each reed switch separately) or a group-type (for a group of reed switches in a multi-contact relay), but with higher capacity.

In the advertized layout the rectifier diode bridges are insulated from the input circuit, connected to low voltage and operate at very low current rates. This means that miniature rectifier bridges of any type can be used in general industry relays. However, when using this relay in military equipment, the rectifier bridges should be selected with significant allowance for both voltage and current. For example, we'd like to refer to DBLS159G rectifying bridge with maximum peak voltage of 1400V and average rectifying current of 1.5A (impulse current during the half-cycle – 50A). With these wonderful parameters this bridge has very modest dimensions: 8.5x6.5x2.6 mm, which facilitates its installation in the relay casing. The supply transformer in such a layout should have improved insulation and grounded screen between coils.

Thus, we have confirmed a possibility for creating a simple, inertia-less reed switch alternating current relay for industrial and military purposes.

Of course, practical realization of the suggested solution will require addressing many additional technical questions, e.g., it will be necessary to calculate and optimize parameters of supply transformer and control coils on the reed switch for specific types of reed switches and conditions of relay use, but this goes beyond the framework of conception of AC reed relay development discussed in this article.

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ГЕРКОНОВОЕ РЕЛЕ ПЕРЕМЕННОГО ТОКА

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Рассматриваются проблемы герконового реле, управляемого переменным током. Описано новое техническое решение, не требующее применения сглаживающего фильтра с электролитическим конденсатором.

Ключевые слова: герконовое реле, герконовый выключатель, переменный ток, сглаживая фильтр.