

DESIGN AND STUDY OF TIME RELAYS DIZAINS UN STUDIJU LAIKA RELEĶI

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Annotation. *By operation of security circuits and automatic equipment it is often required to create time delay between actuating of two or several devices. In case of automation of technological processes there can also be a need to make operations in a certain temporal sequence. Automated systems of industrial production rather often use electric drives (adjustable) which consist relays (time elements), they allow exercising control on the given algorithm. It can be algorithms of serial switching on or implementation of start of the electric drive in strict sequence including a starting element. The time relay is used in cases when it is necessary to perform automatically some operation not right after appearance of the managing director of a signal, and through the set period. For creation of a time delay there are devices called time relays [1].*

Keywords: *time relays, time delay, analog and digital relays.*

Introduction

Design and study of time relays pursues the following all-engineering practical aims and tasks:

1. To get acquainted with methods and ways of creation of time delay in the relay with electromagnetic, pneumatic and other delay mechanisms.
2. To study the principle of action of electronic analog and digital timers.
3. To develop the basic electric circuit of an electronic analog timer with the power output part executed on the electromagnetic relay of a direct current.
4. To make and adjust an electronic analog time relay.
5. To investigate characteristics of the made time relay, to define errors of a task of endurance of time depending on recurrence of work, change of ambient temperature and other conditions.
6. To indicate application fields.
7. To offer versions of the design decision on optimization of characteristics of the studied time relay.

Materials and methods

Time delays are divided into two look according to the method of switch programming: with analog and digital programming. At the same time each of types has advantages and intends for more effective use of their functions. For example, the analog time relay is rather easily programmed, recustomized, it is much more easy-to-work and is cheaper at cost. The digital relay allows setting the most exact time slot and excludes a possibility of appearance of a software failure.

Analog relays are constructed on property of a charge or the capacitor discharge through adjustable resistance belongs to them: the relay of a pneumatic time delay, the relay with electromagnetic deceleration, the electronic relay.

Digital works by the principle of pulse counting of the stable generator. They can be executed on transistors, chips, microprocessors, but they don't have charge circuits (or discharge) the condenser via the variable resistor.

All schemes of electronic relays apply two options of contours (fig. 1). In the first case the uncharged capacitor C is charged from the power supply with U tension through R resistance (curve 1 in fig. 1).

In the second case the capacitor C which is previously charged up to the tension of U is discharged through R resistance (curve 2 in fig. 1).

Regulation of time delay is usually carried out by change of a constant of time of a contour of RC. Accuracy of time delay in electronic relays depends on a condition of isolation of wires connected to the capacitor, stability of resistance, capacity and other elements of the scheme, and also supplies voltage. In addition, there are used thermal compensation elements: semiconductor thermistors and posistors.

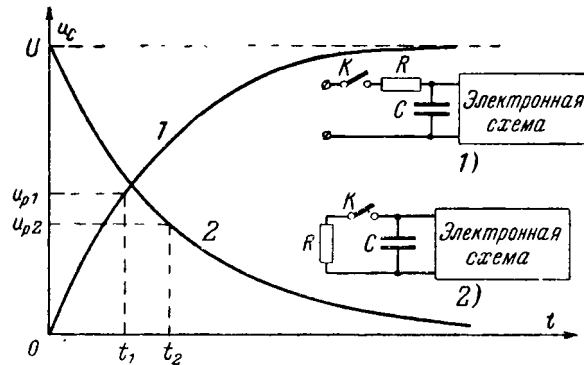


Fig. 1. Change of voltage on the time-consuming capacitor C: 1 - with charge, 2 - with discharge

The electrical schematic diagram of the electronic time relay and its appearance are shown in Fig. 2.

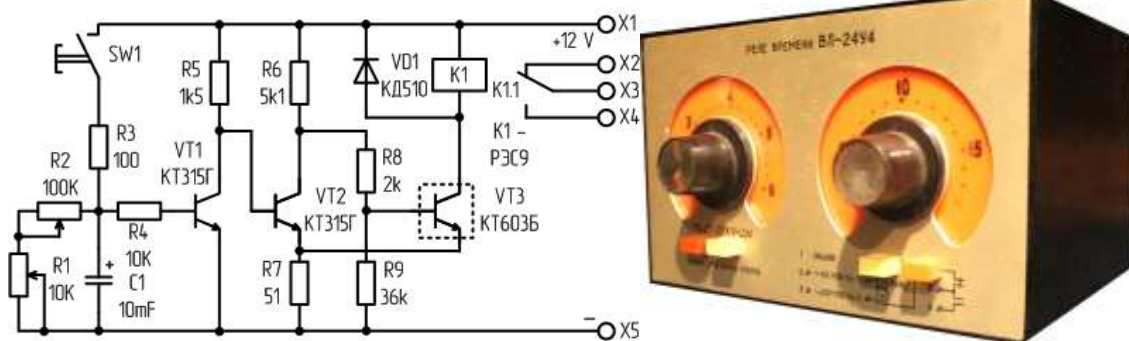


Fig. 2. Schematic diagram of electronic time relay and its appearance

The time-setting element of the time relay is the capacitor C1, its capacitance determines the maximum possible the device pull-in time. Regulation of a time delay is carried out by means of potentiometers of R1 and R2.

Results

The device works as follows: in the initial status VT1 and VT3 transistors are closed, VT2 – is open. When clicking the SW1 button, the C1 capacitor is charged to supply voltage, the VT1 transistor opens. At the same time the VT2 transistor is closed, and VT3 opens (Schmitt trigger) that leads to switching on of the electromagnetic K1 relay and closing of the controlling contacts of HZ-H4. The timer activates loading during the period determined by discharge time of the C1 [2] condenser.

Characteristics of stability of time delay, depending on ambient (20 ° C and 40 ° C), are shown on fig. 3.

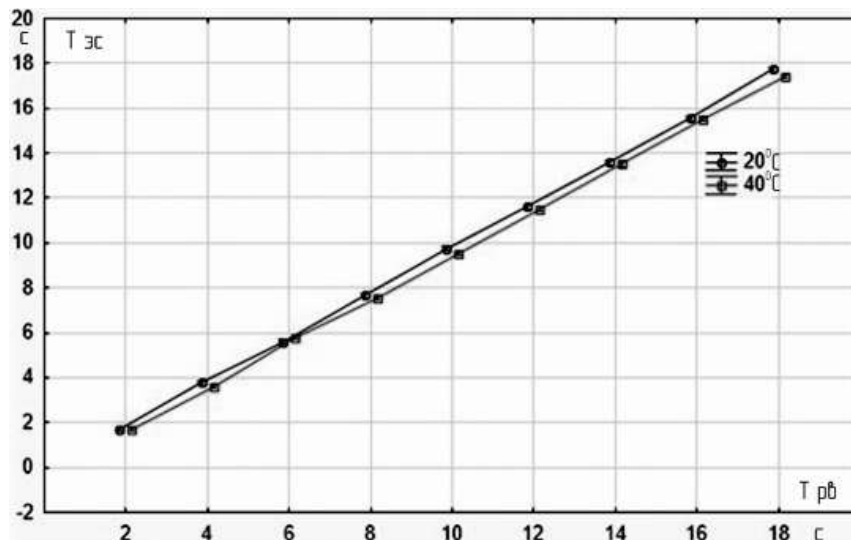


Fig. 3. Stability characteristics of time delay: $T_{рв}$ – time delay on the relay scale, $T_{эс}$ – by electronic stopwatch

In case of statistical measurement of a time delay in case of 20 and 40 degrees almost match that it is possible to explain with a uniform thermal field in the casing of the instrument. In cases of dynamic measurement of duration of a delay (cycles in 10 sec.) there is an error caused by impermanent update of conductivity of the transistor because of course of current, and also change of resistance of the relay winding.

Summary

The multifunction program time relay has rather extensive scope. The simple diagram of connection allows applying it to control of lighting in houses, to creation of artificial light, in particular on poultry farms, to equipment of pumps which are used to water supply, in lighting and billboards, in the refrigerating, air, and test equipment, etc. Besides, the time relay is set on irrigating systems and thermofurnaces.

That is why the modernization and improvement of characteristics of the electronic time relay should be carried out in the following directions:

1. To reduce dependence of a time delay on instability of power voltage, it is necessary to apply a compensation-type stabilizer in the integral design.
2. To replace the bipolar transistor VT1 on field, with high input resistance (see fig. 2). As R1 and R2 to use precision potentiometers, and as C1 – the capacitor with a small current leakage.
3. To make changeover of R8 and R9 resistors for thermal compensation of parameters of the diagram of the relay (see fig. 2) on semiconductor thermistors.
4. To use exhaust ventilation to reduce heating of parts.
5. To execute the electronic time relay with use of a digital, but not analog element basis: on chips of tough logic, microcontrollers, programmable logic controllers and so forth.

Bibliography

1. V. J. Shmur'ev. Rele vremeni poluprovodnikovye. – M., NTF Jenergopro-gress, 2009. – 72 p.
2. G. V. Druzhinin. Rele vremeni. – M.–L., Jenergija, 1966. – 104 p.
3. https://ru.wikipedia.org/wiki/Реле_времени.