

METHODS

AUTOMATIC DEVICE FOR ELABORATING CONDITIONED REFLEXES

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The basic criteria of evaluating the effect of psychopharmacological drugs are the behavioral reactions and first of all the conditioned reflex activity of animals. In recent years a number of automatic devices have been suggested for elaborating conditioned reflexes [1, 2, 4, 5]. All of them are semiautomatic instruments since each device is designed for conditioning only 1 animal, and thus, the constant presence of a laboratory technician is required, and in order to obtain a large number of observations it is necessary to increase the number of instruments.

In the present report we will describe the design of an automatic device for alternate elaboration of defense conditioned reflexes in a group of animals with recording of the experimental results on a paper tape. We used the method of elaborating defense conditioned reflexes in the so-called two-chamber unit. As the conditioned stimulus we selected light stimulation—electrical current. According to our program the action of the conditioned stimulus preceded by 3 sec the unconditioned stimulus and during the subsequent 30 sec the stimuli coincided. The defense response was the movement of the animal to the 2nd half of the cage; in this case the conditioned stimulus was switched off, and the unconditioned stimulus lasted the following 7 sec. * The time of each cycle of training the animal was 10 min, thus during each conditioning the conditioned stimulus was repeated a minimum of 20 times and a maximum of 45 times.

The above-described scheme of instruction was programmed on an instrument mounted on MTKh-90 cold-cathode thyatrons. The principle of operation of the thyatrons is based on the passage of a current upon achieving the firing voltage with respect to the control electrodes [3]. Thus, all time parameters are determined by the RC charging circuit (in the circuit of the keep-alive electrode of the thyatrons) and the relays and stepping selector are the actuating elements (Fig. 1). Five double chambers (with a double electrode floor) are switched alternately at 10 min intervals to the programming unit. The switching of the signals and the time of response of the animals are recorded by an automatic recording instrument.

Operation of the Device

1. Program of switching the conditioned and unconditioned signals. The animal on moving from one half of the cage (chamber A) to the other (chamber B) crosses the circuit of the photocell which is connected in series with polarized relay R_1 (see Figs. 1 and 2). The relay fires thyatron T_2 , which causes the operation of R_2 which entails the following operations: a) switch-on of time relay T_3 (resting time of animal, 7 sec), b) switch-off of the recorder (the moment of moving from A to B).

After 7 sec thyatron T_3 (relays R_3, R_4) operates. Here, the following operations take place: a) switch-off of the conditioned light signal in chamber B (flopper of trigger T_4-T_5 , relays R_5, R_6) to the opposite position; b) switch-off of the pain stimulus in chamber A and preparation for switch-on in chamber B; c) switch-on of light signal and marker on recorder; d) switch-on of time relay on thyatron T_6 . After 3 sec, T_6 operates, the established level of the pain stimulus is delivered and noted on the recorder. Then when the animal intersects the circuit of the photocell the cycle ends and the next one begins (see below "Program of switching chambers").

* The latter conditions precluded the possibility of the animal returning to the first half of the cage.

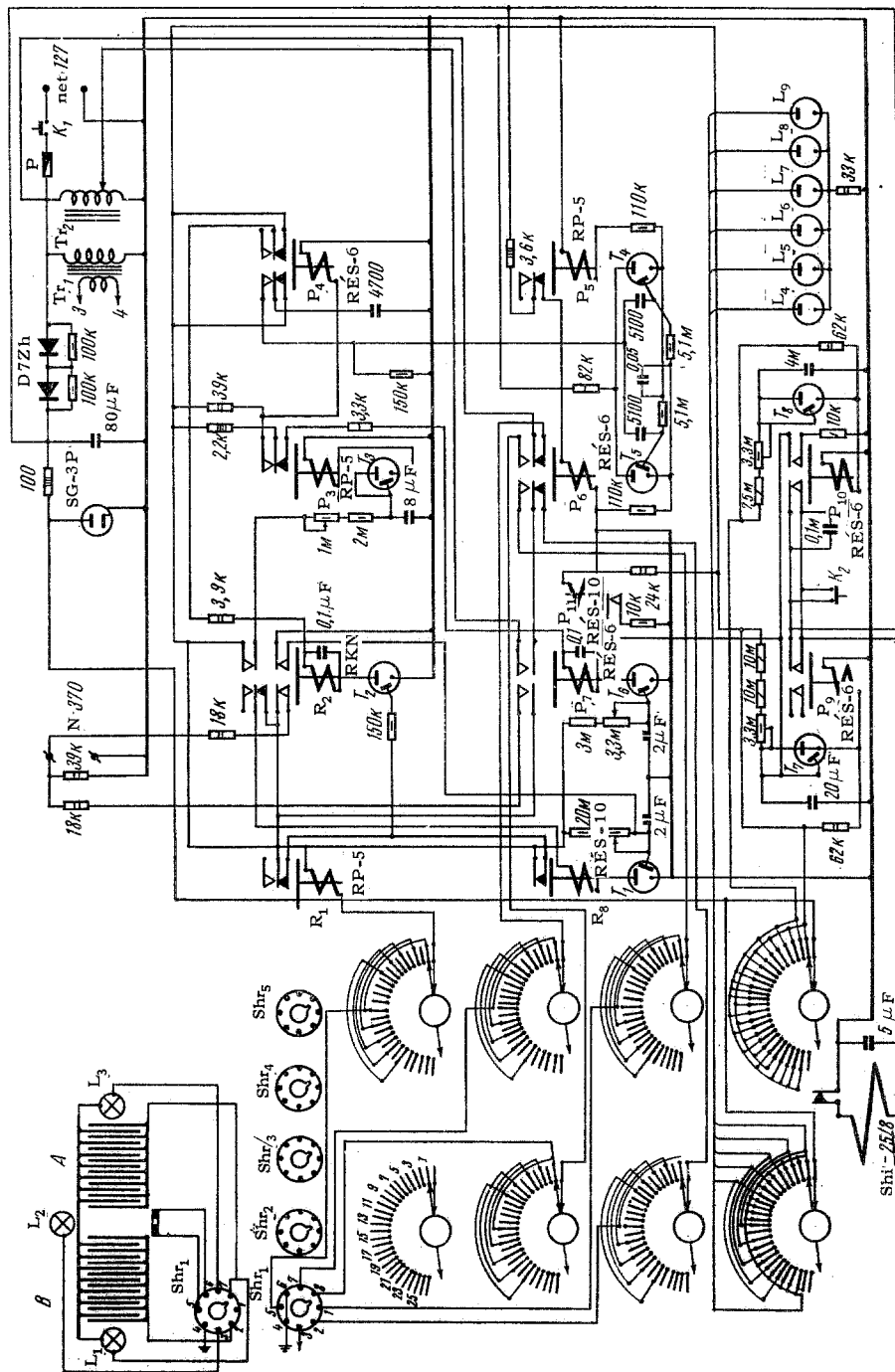


Fig. 1. Basic circuit of instrument.

Some of the following Russian abbreviations may be found in the figure: I = tube, λ = diode, Tr = transformer, λp or ∂p = choke, B_k = switch, σ = V, M = MΩ, κ = kΩ, MK = μF or μH, n = pF or pH, and n = nF or nH.

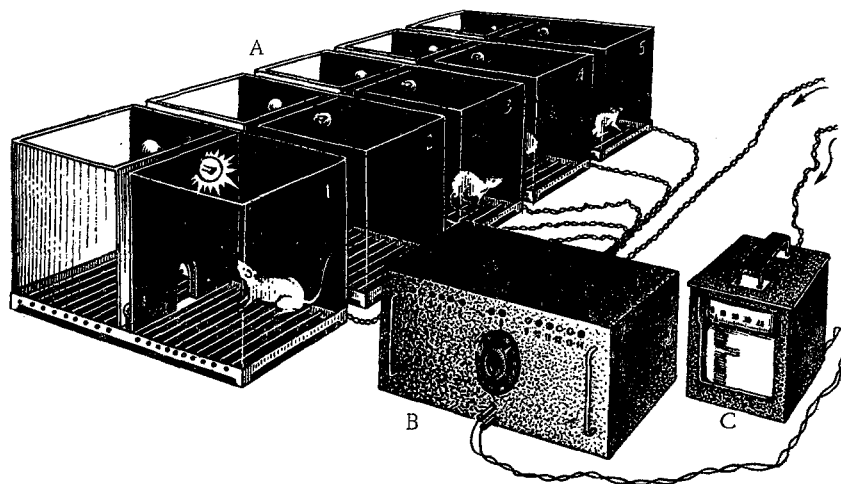


Fig. 2. General view of device. A) Group of chambers; B) instruments; C) N-370 AM recorder.

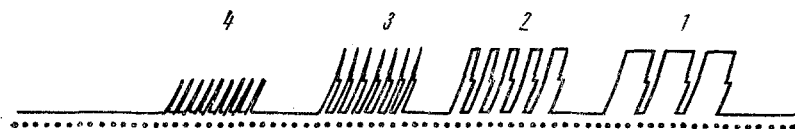


Fig. 3. Protocol of operation of the apparatus. 1) Operation of apparatus without animal; 2, 3) elaboration of conditioned reflex (lower wave—conditioned signal, upper wave—unconditioned signal); 4) conditioned reflex.

The program takes into account the possibility of the animal returning to chamber A (random running about, insufficient pain stimulus). In these cases after a 30 sec interval the above-indicated instructions are transferred to chamber A (operation of T_1).

2. Program of switching chambers. Time relay T_9 operates after 10 min, switching the stepping selector to a neutral position. For a time demarcation of the recording of the work of individual cages, a horizontal line is deleted for 30 sec on the moving tape of the recorder.

Then operation of T_{10} switches the stepping selector (which performs switching of the program) into the circuit of the next chamber.

The instrument is mounted on a $600 \times 300 \times 300$ mm frame. The N-370 AM recorder is connected separately. The chambers of plastic, measuring $300 \times 300 \times 300$ mm, are sectional and are connected by means of plugs. The floor of the cages is assembled from 4 mm diameter steel chrome-plated electrodes with a distance of 10 mm between electrodes.

The thyratrons, which carry out the indicated operations, are mounted on a panel, which makes it possible to control the work of the device. Hand switching of the position of the operation of the chambers is provided. The supply voltage is about 127 V.

Experiments showed that the instrument is a reliable automatic device which makes it possible to carry out independent elaboration of conditioned reflexes in a group of animals. Under the conditions of the experiments carried out on rats, conditioned and unconditioned signals are supplied at least 40 times during the 10 min cycle of training. In this case in certain animals the conditioned signals were elaborated by the end of the first day of conditioning.

The protocol of the experiment (Fig. 3) is easily deciphered and very accurately reproduces the behavior of the animal during conditioning.

Thus, the described design of the apparatus is a reliable automatic device ensuring completely automated experiments on the elaboration and control of defense conditioned reflexes and is quite convenient for the quantitative characteristics of the activities of psychopharmacological drugs.

SUMMARY

The article describes the development and experimental testing of a unit for successive development of defensive conditioned reflexes in small laboratory animals with the registration of data on paper chart.

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All abbreviations of periodicals in the above bibliography are letter-by-letter transliterations of the abbreviations as given in the original Russian journal. *Some or all of this periodical literature may well be available in English translation.* A complete list of the cover-to-cover English translations appears at the back of this issue.
