

## A COMPACT TWO-CHANNEL TRANSISTOR BIOLOGICAL STIMULATOR

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In modern electrophysiological experiments wide use is made of electronic stimulators. One of the most important requirements of such a device is its ability to operate without coils, and without producing artefacts. This requirement is extremely difficult to fulfill when the stimulator is supplied from the mains. Even the utilization of high frequency rectifying units and insulation transformers does not always remedy the difficulty.

This apparatus has been built on the basis of the stimulator described by R. E. George, and has been based on Soviet transistors.

The stimulator (Fig. 1) has the following characteristics:

1. Repetition frequency variable from 0.3 to 300 per second.
2. Pulse length 0.1, 0.5, 1.0, 5.0, 10, and 50 mseconds.

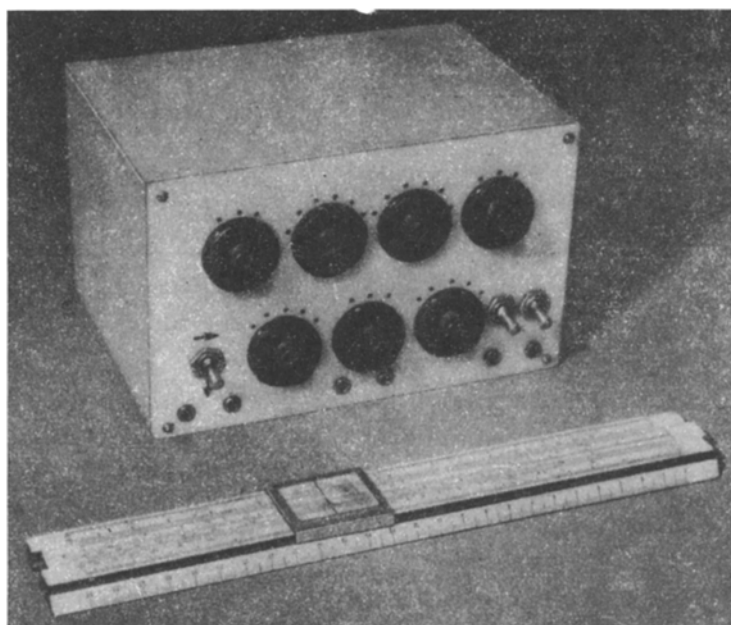


Fig. 1. General appearance of the stimulator.

3. Amplitude of pulses variable from 0.01 to 20 v.
4. Output resistance of each channel does not exceed 1500 ohm.

5. Range of the first delay (time of the delay of the first pulse relative to the synchronizing pulse (0.2-50) mseconds.
6. Range of the second delay (time of delay of the second pulse with respect to the first) 0.15-75 mseconds.
7. The apparatus is supplied from a 24 v storage cell, and draws a current of about 18 ma, which makes it possible to operate continuously for 100 hours without changing the storage cell.
8. The apparatus measures  $190 \times 140 \times 120$  mm.

The relationship of the different circuits is shown in the block diagram of Fig. 2. The master oscillator is made up of transistors  $T_1$ ,  $T_2$  type P104 and consists of an emitter-coupled multivibrator (see Fig. 3). Pulses from the collector  $T_2$ , after passing through a differentiating circuit are fed to the synchroamplifier ( $T_3$ ), and to the trigger release of the single shot multivibrator of the 1st delay ( $T_4$ ,  $T_5$ ).

The 1st delay multivibrator supplies a pulse which through the emitter repeater ( $T_6$ ) triggers the pulse-forming circuit for the 1st pulse ( $T_7$ ,  $T_8$ ) and the 2nd delay circuit ( $T_{12}$ ,  $T_{13}$ ). The delay circuits, the pulse-forming circuits, and the output circuits of both channels of the stimulator are similar.

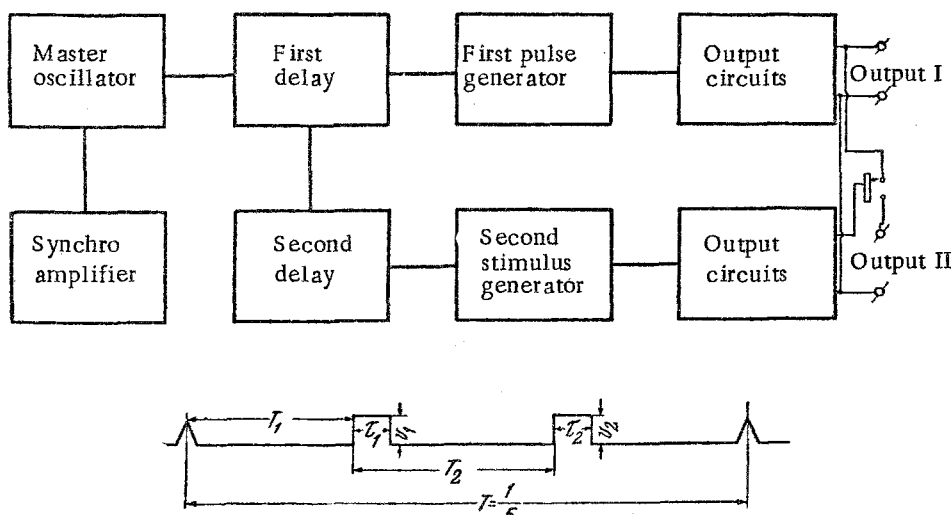


Fig. 2. Block diagram of the stimulator. The switch  $P_3$  serves to feed impulses from the second channel to either output I or output II. The diagram below illustrates the voltages at the output terminals.  $T_1$ ,  $T_2$ ) Time of the 1st and 2nd delays;  $T_1$ ) repetition period of the pulses;  $\tau_1$ ,  $\tau_2$ ) duration of the 1st and 2nd impulses;  $v_1$ ,  $v_2$ ) amplitude of the 1st and 2nd impulses.

The distinguishing feature of this apparatus is the smooth variation of pulse repetition frequency, and also the application in the output circuits of n-p-n transistors, which makes it possible to obtain a good match of the circuits without an additional positive bias voltage. A test of the operation of the stimulator was made under the following conditions. The potentials were applied to the differential amplifier, and observed visually on the screen of the ENO-1 oscillograph. Signals were obtained from a unipolar lead connected to the first somatic zone of the cortex. The indifferent electrode was attached to the bones of the frontal sinus.

1. Bipolar stimulation of the sciatic nerve of the cat with pulse lasting 1msecond and amplitude 0.8 v produced absolutely no artefact.
2. Bipolar stimulation was applied to the cortex and consisted of 1 msecond pulses of amplitude of 0.1 v; the electrodes were placed 1 mm from the pickup electrode. When the amplitude of the evoked potential occupied 15 mm on the screen of the cathode ray tube, the artefact measured 3 mm.

The stimulator we have devised has characteristics which make it applicable to a wide range of neurophysiological studies.



#### SUMMARY

A description is given of a simple miniature two-channel transistor stimulator for electrophysiological experiments. It has the following characteristics: 1) repetition frequency 0.3 to 300 per second. 2) Pulse duration 0.1, 0.5, 1.0, 5.0, and 50 mseconds. 3) Amplitude of pulses 0.01 to 20 v. 4) Range of first and second delays 0.2 to 50 mseconds, and 0.15 to 75 mseconds respectively. 5) Dimensions: 190 × 140 × 120 mm.

#### LITERATURE CITED

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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.

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