# AN IMPROVED APPARATUS FOR MEASUREMENT OF REFLEXES

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In 1951 one of us in conjunction with P. N. Karpenko constructed and subsequently (1954, co-author P. I. Rumyantsev) improved a radioelectronic apparatus for the direct and radiotelemetric measurement of conditioned and unconditioned reflexes [1, 2, 3]. This apparatus (the telechronoreflexometer, i.e., the TKhR-56 radioreflexometer) successfully passed its tests and was recommended by the Technical Committee of the Ministry of Health of the USSR for serial production, which began in 1957. The apparatus was demonstrated at the Exhibition of Achievements of the National Economy of the USSR and at several Soviet exhibitions abroad [5, 6].

In 1958-59 the TKhR-56 apparatus was improved by the authors of this article as a result of further progress in radioelectronics. The new apparatus, with its important additional possibilities, was named the RRM-59 radioreflexometer.

Like the TKhR-56, the RRM-59 apparatus can be used for the investigation of conditioned and unconditioned reflexes in man and animals to both direct and verbal stimuli, for example motor, verbal and respiratory reactions in various combinations, as well as tendon, blinking, defensive, swallowing and certain other reflexes.

The apparatus may be used to determine the latent period and magnitude of a reaction, for example the sound intensity of a vocal reaction. It is possible to make a relative measurement of two different reactions to one stimulus, for example motor and verbal, or motor and respiratory. In conjunction with a radio link the radioreflexometer can be used for radiotelemetric investigations.

In order to measure the latent period of a reaction the apparatus is fitted with a time-measuring device, which is set in motion at the same time as the experimenter gives the stimulus signal, and is switched off at the moment the subject's reaction begins. The possibility of attachment of an oscillograph is foreseen.

The RRM-59 radioreflexometer possesses the following essential advantages over the TKhR-56 apparatus:

1. It is possible to measure not only the latent period but also the duration of the reaction.

2. The new radioreflexomter possesses a much greater accuracy of measurement (to 0.0001-0.0005 second).

3. It ensures the completely inertialess application of signals and makes the working of the time-measuring device independent of the duration of closure of the contacts.

4. The apparatus is completely silent in operation.

5. It can be used to measure the intervals between the most widely differing biological impulses, for example between pulse beats.

6. The RRM-59 apparatus may be used for remote speech control, i.e., for remote control by various electrical effector mechanisms by means of speech (and also by the voice or expiration).

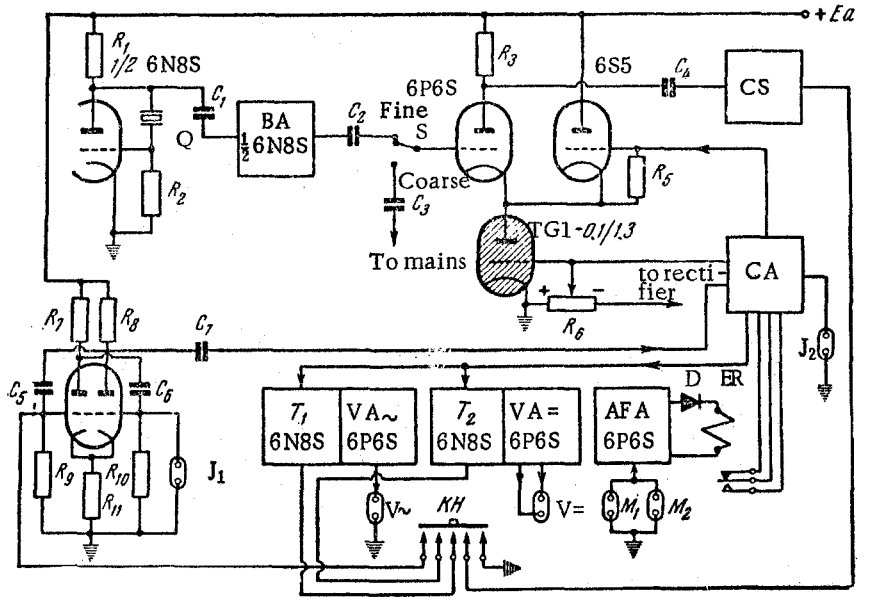


Fig. 1. Simplified scheme of the principle of the radioreflexometer. $T_1$ and $T_2$) triggers with two stable states of equilibrium; $VA_{\sim}$) alternating voltage amplifier; $VA_{=}$) constant voltage amplifier; AFA) audiofrequency amplifier; D) detector; ER) electromagnetic relay; CA) commutating apparatus; CS) counting system; BA) buffer amplifier; S) switch; Q) quartz; $J_1$) and $J_2$) jacks for coupling contact devices; $M_1$ and $M_2$) jacks for coupling microphones (laryngophones); $V_{\sim}$ and $V_{=}$) jacks for output of alternating and constant current.

The principal units of the radioreflexometer are a source of stable oscillations, a counting system, a commutating apparatus and a source of current (Fig. 1).

The source of stable oscillations consists of a master oscillator with quartz frequency stabilization. The counting system used in the apparatus is that of the type MSK-2 millisecond counter, assembled on tubes of types 6N8S, 6N9S and miniature cold thyratrons of the MTKh-90 type. The commutating apparatus consists of a tube relay-amplifier, an auxiliary tube, three triggers, each having two stable states of equilibrium, an audiofrequency amplifier, a detector, an electromagnetic relay and two voltage amplifiers. The tube relay-amplifier consists of an amplifier and a thyratron, included in the cathode circuit of the amplifier.

All units of the apparatus are supplied with current from a source consisting of a power transformer, a type 5Ts4S kenotron and three SG-4S gas stabilizers.

In order to measure the period of visible (the "visible" period of the reaction) feeding or the cessation of feeding of oscillations to the counting system, a change is made in the working conditions of the thyratron, as a result of the inclusion of an area of the grid-mass of the auxiliary tube by the electromagnetic relay during the complete "visible" period of the reaction. During the measurement of the latent period of the reaction the feeding or cessation of feeding of stable oscillations to the counting system is brought about by the action of verbal, respiratory and other reactions, transformed into electrical reactions, on the control grids of the thyratron and auxiliary tube or by closure of a section of the grid-cathode of the trigger with a contact device.

The new reflexometer can be operated in five ways:

1. The time-measuring apparatus (counting system) and stimuli are switched on and off by closure of the contact devices.

2. The counting system and stimuli are switched on by closure of contact devices and switched off by the beginning of the verbal reaction.

3. The counting system is switched on by the beginning of the verbal signal and switched off by closure of the contact devices.

4. The counting system is switched on by the ending of the verbal signal and switched off by the beginning of the verbal reaction. (In this variant the intervals between the pulse beats can be measured).

5. The counting system is switched on by the beginning and off by the ending of the verbal reaction, i.e., its "visible" period is measured. Measurement of the latent and "visible" periods of the same reaction may be carried out jointly in one variant of operation of the apparatus.

In all the variants listed above any electrical effectormechanisms may be switched on or off by the beginning or ending of a spoken word, and in the fifth variant they may be switched on for the period of pronunciation of a word (or a sentence). In the second and fifth variants it is possible to measure, besides a verbal reaction, motor and other reactions.

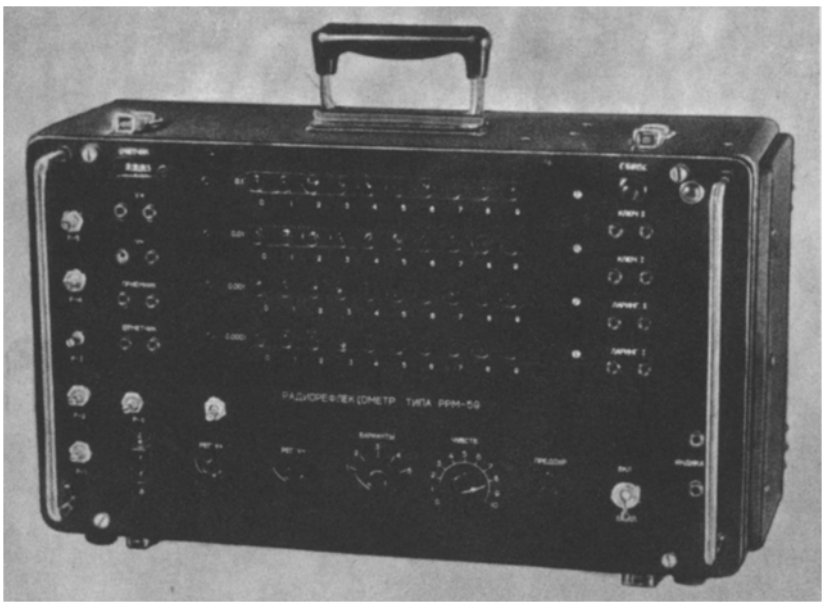

Fig. 2. The RRM-59 radioreflexometer. Front view.

The choice of variants of operation of the apparatus is made by means of a disk-coil changeover switch.

The complete apparatus is mounted in a metal box. On the front panel (Fig. 2), covered with a removable lid, are arranged all the necessary controls: the electromechanical counter, counting decades and jacks for coupling a radio receiver, an oscillograph, an electromagnetic marker, sources of stimuli, contact devices, laryngophones and other pick-up devices.

The apparatus is designed to be supplied from the ac mains at a voltage of 220, 127 or 110 v and a frequency of 50 cps. Its dimensions are 470 × 280 × 220 mm and its weight 10.9 kg. The radioreflexometer is delicate in operation and simple to operate.

## SUMMARY

A brief description of a new radioreflexometer is presented. It is an instrument for direct and radiotelemetric measurement of various conditioned and unconditioned reflexes, including motor, speech and respiratory ones.

The device is capable of measuring not only the latent but also "visible" periods of reactions. It may be used for the T. V. speech control by means of the electrical operating mechanisms.

The main parts of the radioreflexometer are: a master generator with a quartz frequency stabilizer, recomputation scheme and commutating device, consisting of several triggers, thyratron and other elements.

## LITERATURE CITED


1. O. Ya. Bokser, Byull. Éksp. Biol. i Med. 44, 10, 117 (1957).*
2. O. Ya. Bokser and P. N. Karpenko, Zhur. Nevropat. i Psikhiat. 54, 12, 1024 (1954).
3. O. Ya. Bokser and P. N. Karpenko, Author's Certificate No. 101428 (1953).
4. O. Ya. Bokser and M. I. Klevtsov, Author's Certificate No. 129283 (1959).
5. N. Vinokurov and S. Turushin, Krasnaya Zvezda, No. 161, July 11, 1959.
6. P. I. Rumyantsev, Med. Rabotnik, No. 78, September 27, 1957.


* Original Russian pagination. See C. B. translation.