A PORTABLE CLINICAL RHEOGRAPH

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Living human tissues have a relatively high electrical conductivity.

Two kinds of tissue resistance may be distinguished. The first is a constant resistance determined by the portion of the body or organ under investigation; reported values vary, for different parts of the body, between 50 and 300 ohm. The second kind of resistance depends to a large extent on the blood supply to the part considered, and on the rate of flow of blood in the vessels; consequently it varies synchronously with the cardiac contractions and with the breathing. This variation in the resistance may be recorded by the method known as rheography.

Normally, the pulse variation is of the order of 0.5—0.01 ohm.

In 1941, A. A. Kedrov [1] studied the variation of resistance of various parts of the animal and human body, and used an alternating current of 100,000—300,000 cycles. In 1945, Holzer, Polzer and Marko [5] used audiofrequency currents, and called their method rheocardiography. In recent years, rheography has been quite widely introduced into clinical practice abroad.

In our country it has not been used much, because of the technical difficulties of the method. Nevertheless, at the 1959 All-Union Conference and at the Republican Conference in Riga, in December, 1960, which was concerned with problems of the application of electronics in medicine, V. V. Parin [4] pointed out the value of rheography, and the importance of introducing this promising method into medical practice.

We have designed and constructed a portable, simple, and convenient rheograph (Fig. 1). The apparatus consists of a high-frequency generator which is inductively coupled to a Wheatstone bridge, in which a high-frequency amplifier replaces the usual galvanometer. The output of the amplifier is connected to a diode detector, from which the current passes via the voltage-dividing condensers to the low-frequency amplifier, and thence to the recording system, which consists of an electrocardiograph having a time constant of about four seconds. A diagram of the apparatus is shown in Fig. 2.

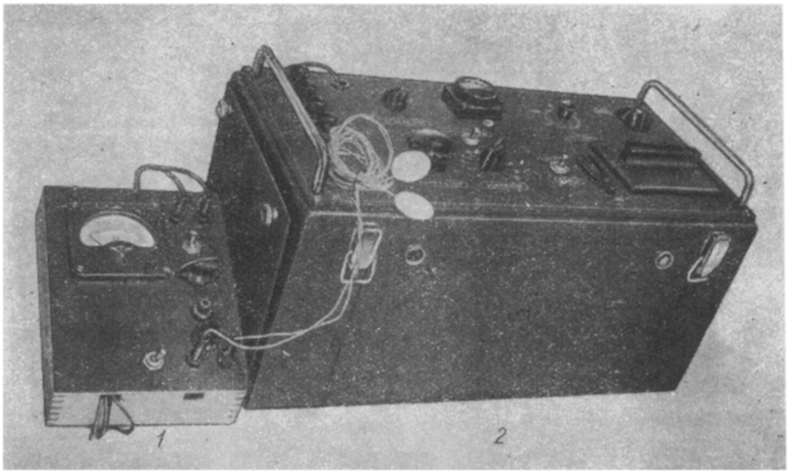

Fig. 1. Portable rheograph. 1) Rheograph attachment; 2) electrocardiograph ĖKP-4M.

We have used small currents of not more than 8 ma at a frequency of 270,000 cycles, and have also made provision for the use of a frequency of 500,000 cycles. We have used silver electrodes, fixed by a rubber band to the region to be studied.

To study the condition of the circulation in different vessels, and also in the limbs, and especially their distal parts, we have used electrodes measuring 8-10 mm in diameter; to record the rheogram of the different parts of the body or organs, we have used electrodes 25 mm in diameter. The circulatory condition may be followed for a long time, while the electrodes remain in place.

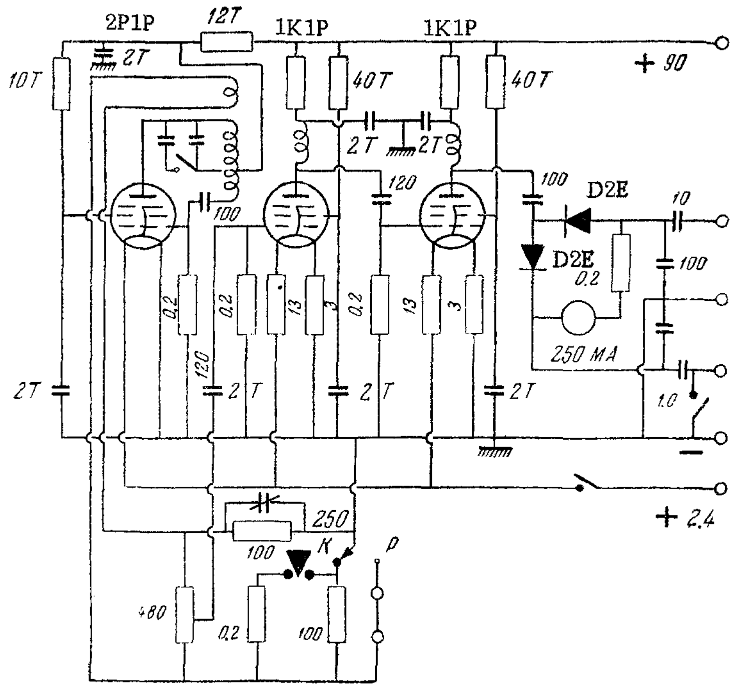

Fig. 2. Circuit of the rheograph attachment.

Normally, the pulsatile excursions of the rheogram show a sharp rise with no subsidiary peaks, which is followed by a slow descent, containing a few notches (secondary waves). The apex of the main wave of the rheogram is fairly sharp, as can be seen from the rheogram of the external temporal artery (Fig. 3a).

The rheograms which we obtained do not differ appreciably from those of A. A. Kedrov and A. I. Naumenko [2, 3], and of foreign authors. As an illustration, we have shown the rheograms recorded from different parts of the body of a healthy subject (Fig. 3b, c, d).

The different components of the rheogram may show a change in various organic and functional circulatory disturbances. The variations show as alterations of amplitude, rhythm, frequency and form of the pulse waves, and of the respiratory waves. Rheography holds out particular promise for the study of internal circulatory conditions, which cannot be investigated by existing methods.

SUMMARY

A portable rheograph used for clinical examinations is described. The instrument consists of a high-frequency generator inductively coupled with a Wheatstone bridge in which a high-frequency amplifier is connected instead of a galvanometer. The amplifier's outlet is connected with a diode detector from which the current passes to a low-frequency amplifier and to an optic recording system (electrocardiograph with a time constant of about 4 sec).

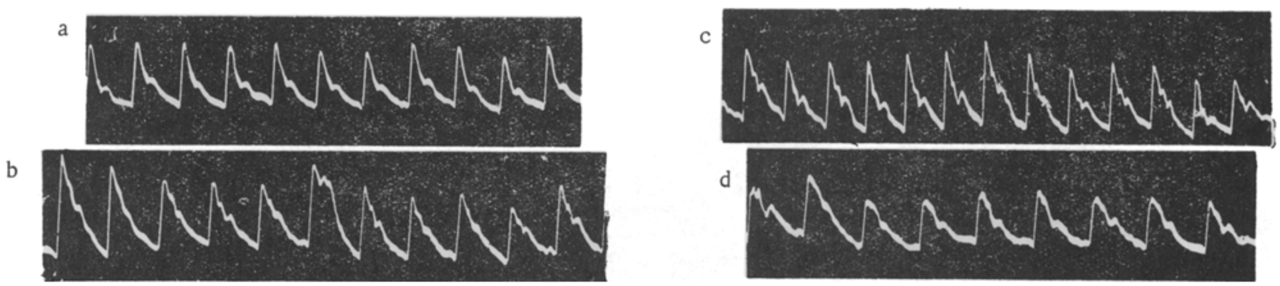

Fig. 3. Rheograms of portions of the body of a healthy individual. a) Rheogram of the external temporal artery – electrodes placed along the path of the artery; b) rheogram indicating the condition of the intracranial circulation – electrodes fixed on the forehead and occiput; c) rheogram of the radial artery; d) rheogram of the third finger.

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