AN ATTACHMENT TO THE ELECTROCARDIOGRAPH FOR RECORDING THE PULSE

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To record pulse curves on the electrocardiograph we developed an attachment incorporating a transducer generating a potential and requiring no power supply or reorganization of the rest of the apparatus before use. The attachment was connected to the main instrument by a cable corresponding to leads I, II, or III.

The attachment (Fig. 1) consists of three main parts: the pulse transducer, a manometer, and a tap, all enclosed in a metal case. The attachement contains a narrow flat pneumatic sleeve of width 35 mm and length 370 mm, a set of ring-shaped sleeves, and one bulb fitted with a valve for inflation. The flat sleeve is intended for recording the pulse from the shoulder, upper arm, thigh, lower leg, and foot, while the ring-shaped sleeves are used for the fingers and toes.

The manometer and inflator (from a sphygmomanometer) serve to raise the pressure in the sleeve and in the pulse transducer to 40-80 mm Hg.

The sleeves are connected to the device by means of a plastic tube 1.5 m long, and the inflator is connected by a short rubber tube equipped with a metal cannula.

After the required pressure has been obtained the inflator is disconnected from the rest of the system by means of a tap.

As a pulse transducer we used an induction unit producing a EMF proportional to the rate of displacement. The element (Fig. 1) consists of a ring-shaped permanent magnet 1 with pole-pieces 2 within whose working gap there is a coil consisting of many turns 3 firmly fixed to a double-diaphragm 4, one face of which move in the magnetic gap

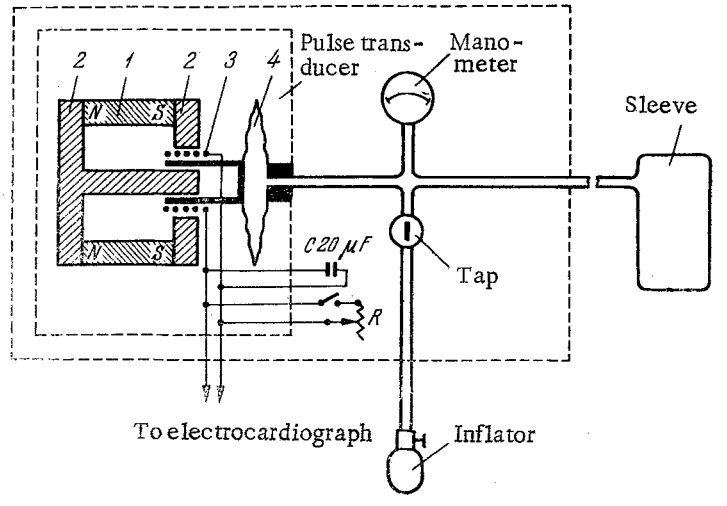

Fig. 1. Diagram of the attachment for recording the peripheral volume pulse.

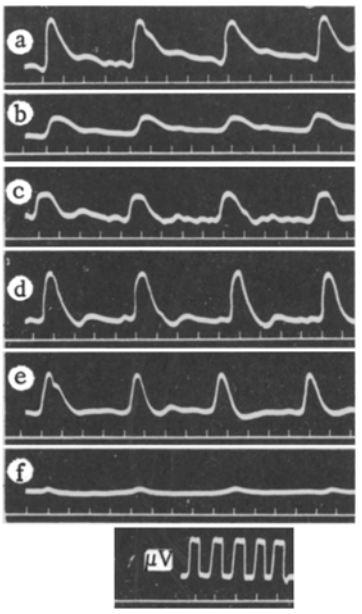

Fig. 2. Curves of the volume pulse recorded from (a) upper-arm, (b) the thumb (c) the thigh, (d) the lower-leg, (e) the foot, and (f) the big toe.

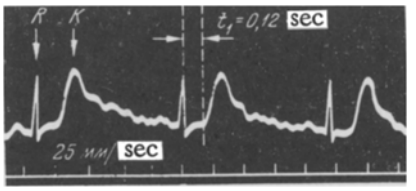

Fig. 3. Simultaneous recording of the ECG and pulsed from the upper arm on a single-channel electrocardiograph.

in response to changes of pressure in the space within. The shaping capacitor C is connected in parallel with the winding, and when it is in circuit the record of the pulse oscillation resembles that obtained on a normal sphygmorgram. It also plays the part of a high-frequency cut-off filter, which considerably reduces various interferences. In addition to the capacitor in parallel with the coil a tumbler switch may be used to connect in the resistance R of 5 kohm. It is used only in the measurement of the rate of spread of the pulse wave, in order to record the pulse and the ECG on a single channel of the electrocardiograph. This variable resistance may be used to control the amplitude of the pulse curve.

The sensitivity of the element is such that when a record is made of the volume pulse, for example from the upper third of the lower-leg in a healthy person, (arterial pressure 120/80), when a standard upper-arm sleeve is used at a pressure of 70 mm the induced EMF is 1-1.5 mv. When the volume pulse is recorded from the big toe the EMF is 0.1-0.2 mv. The principle of action of the instrument is as follows: the sleeve is placed in position to record a peripheral pulse, and is at some excess pressure; a pulsation of a limb causes pressure oscillations of the air which are transmitted along the tube to the transducer where they are converted into a EMF.

Figure 2 shows the record from a patient of a pulse obtained by means of this device working together with a Russian electrocardiograph and ink writer (model 047).

The attachment may also be used for recording the rate of spread of the pulse wave, and the use of only one channel of the electrocardiograph is required. For this purpose the attachment is connected in series with a second electrocardiograph lead into the circuit from the left leg. The curve obtained (Fig. 3) consists of the ECG with the pulse oscillation K superimposed on it and displaced with respect to the R wave. The RK interval between the apex of the R wave and the start of the K wave of the pulse curve indicates the time required for the passage of the pulse wave from the heart to the point at which the pulse is recorded.

By means of this device the contraction of the muscles of a limb can be recorded by use of the same set of sleeves. In this case the electrocardiograph is operated at low amplification to eliminate the influence of the pulse oscillations in the limbs.

SUMMARY

We described an attachment by which air pressure changes are converted into electrical potentials; it may be connected to a normal electrocardiograph, and used for recording the volume of the peripheral pulse at various points on human limbs. The sensitive element is a transducer requiring no power supply.