

NEW METHODS

PIEZO-COUNTERS FOR RECORDING THE PULSE IN VESSELS OF THE FINGER AND THE EAR LOBE

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(Received June 24, 1955. Presented by V. N. Chernigovsky, Member Acad. Med. Sci. USSR)

Sphygmographs with mechanical or pneumatic systems for recording the pulse (for example, the Jacquet, Marey, and Frank sphygmographs) are applicable only to relatively large arteries, such as the carotid or radial. A shortcoming of these instruments is the necessity of maintaining a strictly horizontal position of the arm, and of avoiding movement.

We have designed a counter, which allows of the recording of the pulse in a finger or in the ear lobe, in any position of the hand, and without the need to apply the instrument to any particular skin surface. By attaching the counter to the lobe of the ear we were able to record the pulse not only at rest, but also during certain kinds of muscular activity, such as on a bicycle ergometer, or during static work.

We used piezo-elements, which are widely applied in radiotechnics, in the receiving part of our instrument. The piezo-element transforms the mechanical oscillations due to the pulse beat into potential oscillations, by means of the piezo-electric effect. By connecting the piezo cell to an amplifier these oscillations are magnified, and can be registered by means of an electromagnetic writer on paper.

Piezo-Counter for the Finger

The counter consists of a light brass frame, to which is attached the piezo-cell, fixed on a Plexiglas support (Fig. 1). The piezo-cell is in the shape of a square with 25 mm sides. At two diagonals of this square are small lugs carrying clips which fix the cell to the counter; the electric leads are also connected to these lugs; this arrangement permits of the ready replacement of the cell, in case of need.

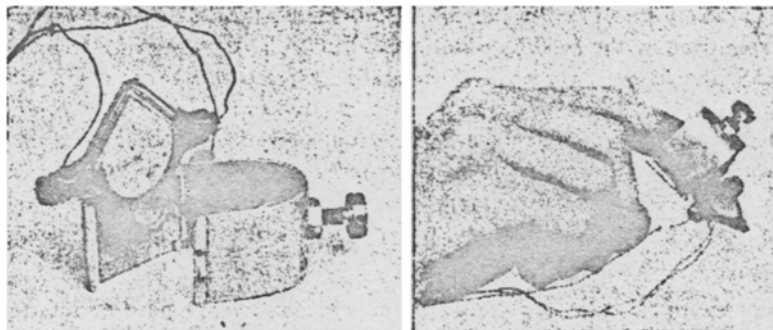


Fig. 1. Piezo-counter for recording the pulse in the vessels of the finger.
A) General view; B) working position.

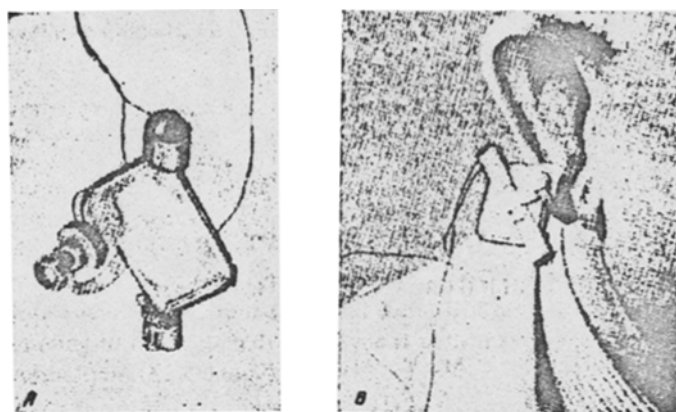


Fig. 2. Piezo-counter for recording the pulse in the ear lobe.
A) General view; B) working position.

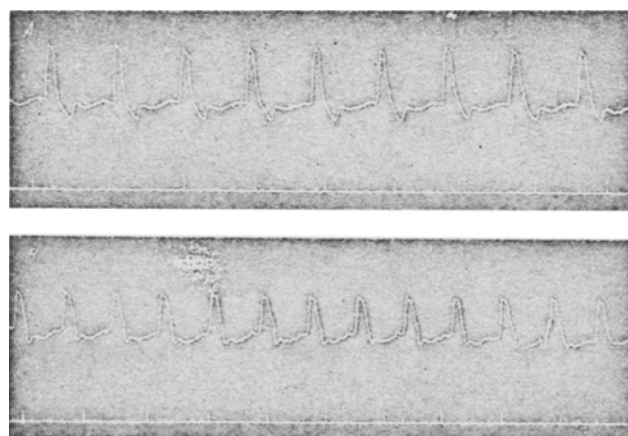


Fig. 3. Recording of pulse of the vessels of the finger (A) and of the ear lobe (B).
Time marker: 1 second.

The piezo-cell was made of a plate of Rochelle salt, held in a celluloid container. To one corner of the cell, marked with a dot, is fixed a small disc of Plexiglas (thickness 3 mm, diameter 7 mm). Any movements of the disc are readily transmitted by the flexible envelope to the Rochelle salt plate. In addition to the cell, a broad curved strip is fixed to the frame, covered on its concave surface with a layer of soft rubber. This pressure strip is in loose contact with a screw, which passes through a nut fixed to the frame. By turning the screw, the pressure strip can be lowered or raised over the piezo-cell; the counter can thus be adjusted to fingers of various thicknesses, and the screw allows of the regulation of the pressure exerted by the finger tip on the disc. The instrument is placed on the second or third phalanx of a finger (or toe), with the pressure strip on its dorsal surface, and the ball of the finger pressing on the disc. The leads from under the clips of the counter connect the piezo-cell to the input of the amplifier.

The metallic parts of the instrument are grounded in order to obviate any possible interference from the alternating current. The ground lead is usually entwined with the other leads to the amplifier, with the casing of which it is connected, or grounded in the usual way.

Movements of the finger should be avoided during recording, and the counter should not be shaken, as this leads to inaccurate readings.

Piezo-Counter for the Lobe of the Ear

The piezo-counter for the ear lobe also includes a square piezo-cell, fixed to the counter by means of clips.

In addition, it has a light aluminum C-shaped attachment, diameter 20 mm, at one end of which is a nut, through which passes a screw, which is in loose connection with a pressure disc (diameter 8-10 mm), the external surface of which is lined with soft rubber. The other end of the attachment is rigidly fixed to a T-shaped piece of Plexiglas, the upper end of which is attached to the piezo-cell; the center of the pressure disc is directly opposite the center of the Plexiglas disc attached to the corner of the Rochelle salt square. The aluminum strip is attached to the bottom of the T-shaped piece of Plexiglass, in such a way that its surface is parallel to the horizontal bar of the T. The counter is fastened to the ear lobe with the piezo-cell on the outside, squeezing the ear lobe between the pressure disc and the Plexiglas disc (Fig. 2); care should be taken that the counter is not in contact with the head or neck of the subject. We recommend warming the ear lobe with cotton soaked in hot water before attaching the instrument.

In order to prevent the leads dragging on the counter or causing it to sway, they are fixed in a loop to the clothing of the subject, by means of a clip (fairly close to the counter).

Fig. 3 shows pulse recordings from the finger and the ear lobe.