

An Improved Electromagnetic Sphygmograph¹

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The apparatus described here is a technical improvement of the Electromagnetic Sphygmograph previously described by the authors (1), but differs in two important respects: (1) the use of a dynamic speaker magnet in the recording unit and (2) the placement of a variable resistor in series with the microphone. These improvements make for greater stability of the apparatus and make it possible to obtain sphygmograms of practically any desired amplification and clarity.

A 200-ohm, single-button, Model W carbon granule microphone, described previously (1) and manufactured by Universal Microphone Company, Inglewood, California (Fig. 2, 7), has a light aluminum knob fastened to the diaphragm by Duco cement. This knob, when placed on any superficial

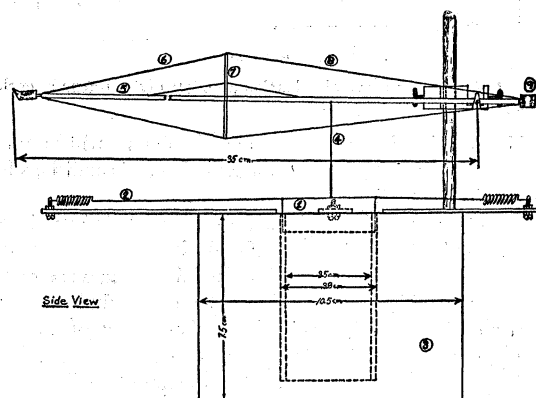


FIG. 1. The improved Electromagnetic Sphygmograph: (1) movable coil—25 turns of #28 enameled wire; (2) flexible radial support with adjustable spring tension; (3) dynamic speaker magnet; (4) stiff connecting wire; (5) wood heart lever; (6, 7, 8) stiffening members; (9) adjustable counterbalance.

artery, serves to transmit to the diaphragm the fluctuations in pressure of the pulse-pressure waves. Since the internal resistance of the microphone varies with the pressures exerted on the diaphragm, the fluctuations in pressure caused by the pulse beat are converted into corresponding fluctuations of resistance. Since the current through the microphone is a function of its internal resistance, in accordance with Ohm's law, $I = E/R$, the fluctuations of pressure are ultimately converted into corresponding pulsations of current. The voice coil of a 20-watt dynamic speaker, consisting of 25 turns of #28 enameled wire (Fig. 1, 1; Fig. 2, 1), is connected in series with the microphone. As shown in Fig. 2, the pulsating current passes through the movable coil, suspended in the magnetic field of a *dynamic speaker magnet* (Fig. 1, 3) by means of three

adjustable radial supports (Fig. 1, 2). The possibility of using a permanent magnet speaker field suggests itself here.

The pulsations of current cause the movable coil to move up and down through the magnetic field of the speaker magnet by an amount which is at any time directly proportional to the pressure the artery is exerting, through the layers of surrounding tissues, upon the diaphragm of the microphone. The movements of the coil are transmitted by a stiff wire (Fig. 1, 4) to a trussed heart lever (Fig. 1, 5) equipped with an adjustable counterbalance (Fig. 1, 9), which then accurately transcribes the movements of the artery on an ordinary kymograph drum.

In order to regulate the strength of the current flowing through the movable coil, a *variable resistor* (Fig. 2, 2) is

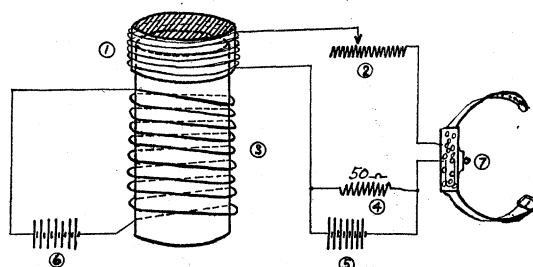


FIG. 2. Wiring plan: (1) movable coil; (2) variable resistance in series; (3) radial field winding and core; (4) 50-ohm damping resistance in parallel; (5) battery for microphone and movable coil circuit; (6) battery for field circuit; (7) microphone with adjustable straps.

placed in series with the microphone-movable coil circuit. The amplitude of the recording can be regulated by varying the resistance. Ideal records for all subjects tested were obtained with the resistor set at values from 50 to 200 ohms when the system is used in conjunction with a 6-volt battery (Fig. 2, 5).

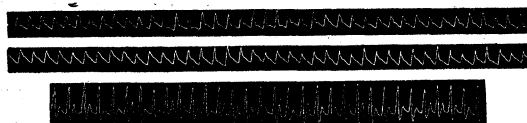


FIG. 3. Typical sphygmograms: top to bottom—normal radial, normal carotid, normal radial (strong amplification).

A 50-ohm damping resistor (Fig. 2, 4) is placed in parallel with the microphone circuit in order to assure a "dead beat movement" of the coil and hence a "damping down" of the rebounds of the writing lever. Both the field magnet and the microphone-coil circuit are energized by an ordinary 6-volt, wet-cell battery or, preferably, separate batteries should be used for each circuit, as shown in Fig. 2, 5, 6.

As seen from the sphygmograms (Fig. 3), clear and well-defined transcriptions of practically any desired amplitude may be obtained with this apparatus from the carotid, radial, or any of the other superficially located arteries.

Reference

- BALDWIN, F. M., and PANZER, B. I. *Proc. Soc. exp. Biol. Med.*, 1946, 63, 263-264.

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