# A SIMPLE MODEL INTERVAL RECORDER

I. M. Rodionov

Institute of Biophysics, AN SSSR
(Presented by Active Member AMN SSSR V. V. Parin)
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An interval recorder is an extremely convenient means of recording blood flow. A special device is used to transform each drop of blood falling from the peripheral end of a vein into an electrical signal. A mechanical system moves a pen upwards at a constant rate and the electrical impulse derived from the falling drop returns it to the starting position. This system enables the time interval between the two falling drops to be represented by a vertical line whose height is directly proportional to the interval, i.e., inversely proportional to the frequency of the drops. Recording is continuous. The curve reflects the changes in the rate of blood flow. A wide variety of mechanical constructions enables such a record to be obtained [1, 6, 13].

The interval recorder may be used for recording blood flow from a vein or artery [12, 11], as well as for other periodically repetitive processes [3, 7].

The wide use of this kind of apparatus is restricted by the fact that the preparation, even of the simplest models, [1, 4] demands elaborate mechanical work. The system we have proposed is so simple that it may be prepared even when no workshop is available. The use of compressed air to raise the writer in devices similar to the one described was proposed by Brecht [4], and by Jung and Eisenmann [10]. The sensitive element and the amplifier for the present device incorporate circuits previously described [2, 8, 9, 11, 12].

The mechanical part is shown diagrammatically in Fig. 1. In the vessel b pressure is produced because the communicating vessel a is raised to a height of a few tens of centimeters. Air from the vessel passes along tubes to the chamber c, dilates it, and steadily raises the writer attached to it. The rate of entry of air into the chamber and consequently the rate of rise of the writer are regulated by a screw clamp d. In the system there is a valve e which may be opened or shut by means of an electromagnet (the electromagnet of a rather powerful relay was used). If the valve e is closed the entering air expands the chamber; when e is open, air from the chamber passes out through it and the writer rapidly falls downwards. There is also a valve f which operates at a certain pressure. It consists

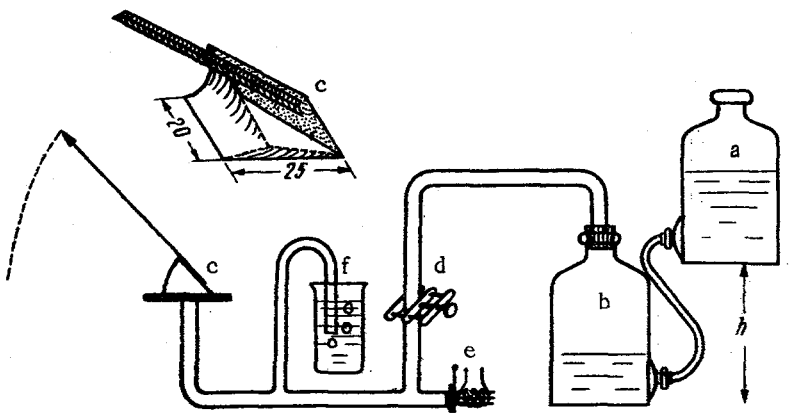


Fig. 1 Diagram of the apparatus. The recording chamber is drawn separately at the top of the picture.

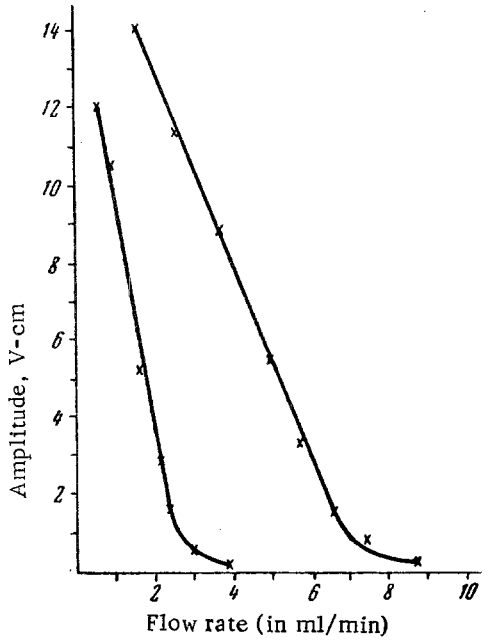


Fig. 2. Graph of amplitude of recording against flow rate.

of a U-tube, one end of which is connected with the system and the other immersed in a vessel of water to a depth which will determine the pressure at which the valve will operate.

The apparatus works as follows. The chamber is expanded by the air which enters, and the writer is raised. Valve e is normally closed and opens only under the influence of a stimulus received as a result of a drop falling onto the sensitive element. The amplitude of the stroke recorded by the pen is higher the greater the time interval between two successive drops. If there is a marked slowing of the blood flow and the writer becomes raised to the uppermost position it will then remain in this position until the next drop arrives, and the excess air will escape through valve f.

Probably the most complex part of the apparatus is the chamber. It is rather like a miniature blacksmith's bellows. The method of preparation of such a chamber has been described by Brodie [5]. The volume is increased through the corrugations in the walls with the result that the movement of the writer upwards requires no great increase of pressure within. The rate of movement of the writer is therefore directly proportional to the volume of air entering. The bellows are made out of thin rubber which is stuck on by adhesive BF-2.

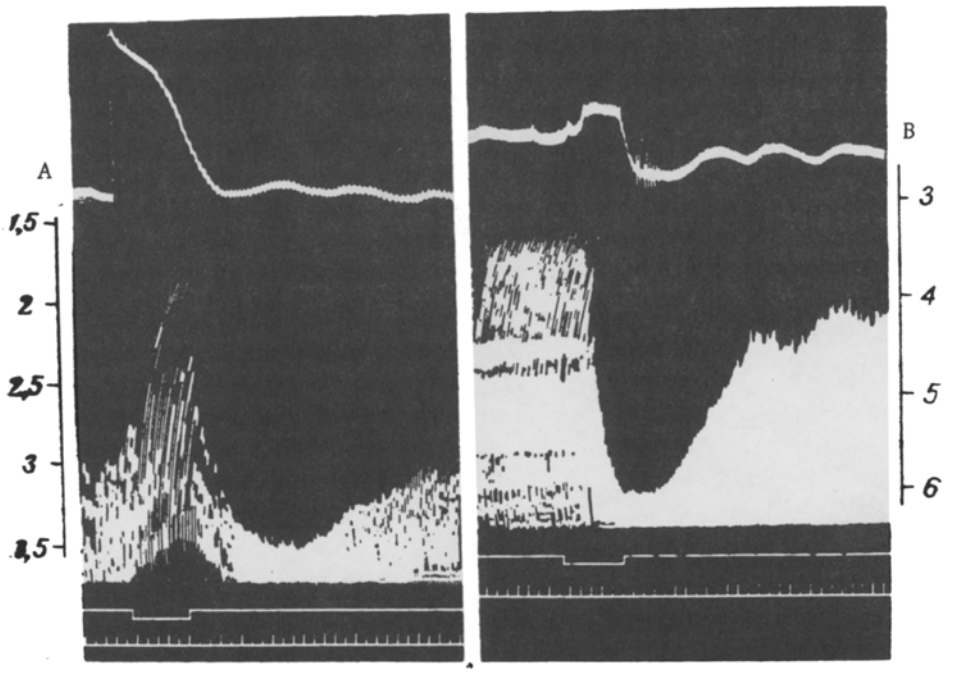


Fig. 3. Blodd flow in vessels of skeletal muscle during stimulation of the spinal cord.

Figure 2 shows the relationships between the amplitude of the stroke and the rate of flow for two different rates of movement of the pen. The relationship is linear throughout except for the very lowest portion recording the greatest flow rates. The steep slope alone indicates the high sensitivity.

Figure 3 shows two examples of the measurement of flow rate in vessels of skeletal muscles of a limb during stimulation of the spinal cord with an electrode introduced by a stereotactic apparatus. To determine the absolute value of the flow rate for a given record two portions must be chosen corresponding to different flow rates and am-

plitudes, and the number of drops flowing in a given time interval are counted (i.e., the flow rate is calculated); then the amplitude of each portion is measured. The results obtained enable two points on the graph to be fixed (see Fig. 2). Because the relationship between flow rate and amplitude is linear, these two points determine the remainder.

## SUMMARY

A description is given of a simple interval meter for recording blood flow rates (number of drops per minute). Air passes into a chamber to which is attached a recording which is raised steadily. A valve is operated by an electromagnet. When this valve is opened the air escapes from the chamber and the recording device drops rapidly. The valve is normally closed; it opens only when a drop falling through the monitor induces an electrical signal. The amplitude of the deflection is directly proportional to the time interval between two drops, i.e., is in inverse proportion to the flow rate. The advantage of the design is its simplicity.

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