NEW TECHNIQUES & DEVICES

AN ELECTRONIC METHOD OF RECORDING FLUID DROPS WITH E.C.G. OR E.E.G. MACHINES

By

C.L. PATHAK

Department of Physiology, S.P. Medical College, Bikaner

The recording of drops as an indication of output or outflow from a system is a common procedure in Physiology and Pharmacology. Although oscilloscopes and oscillographs are available in most of the modern laboratories, suitable accessories specially input sources or transducers are not as frequently available resulting in restricted use of the main instrument. However, with a little understanding of electronics, it is possible to modify or adapt available instruments for purposes other than the one for which they are originally meant.

This paper describes a couple of simple electronic devices which permit the adaptation of drop recording assemblies like Palmer B 146 (English) or Techno (Indian) drop recording assembly as input source for oscilloscopic display or oscillographic recording. The use of Palmer drop recording assembly for this purpose is being described here in details.

The Palmer assembly has a phototransistor as drop detector. The phototransistor generates a voltage change (electrical impulse or signal), which is amplified with a gas tetrode. The signal so amplified operates an electromagnetic marker or lever which in turn writes on a smoked paper.

The devices being described here pick up the amplified signals and provide an electronic matching of output impedance with nput impedance of an oscilloscope or oscillograph so that the electrical signals could be injected into the recording instruments. Now the drops can be seen on the screen of an oscilloscope and can be photographed or the drops can be recorded with E.C.G. or E.E.G. recorder on a chart paper.

MATERIAL AND METHODS

The circuit diagram of the phototransistor recording assembly is given in Fig. 1. The problem at the output terminals is that the amplified signal is too large and 50 cycle a.c. noise is also present. A device is needed which will permit a reduction in the signal amplitude and will also abolish 50 cycle interference so that the signal could be converted into a form suitable for injection into an oscilloscope or oscillograph.

This aim can be achieved by introducing a step down transformer at the output terminals of the drop recording assembly (Fig. 2A). The signal voltage is attenuated giving greater current

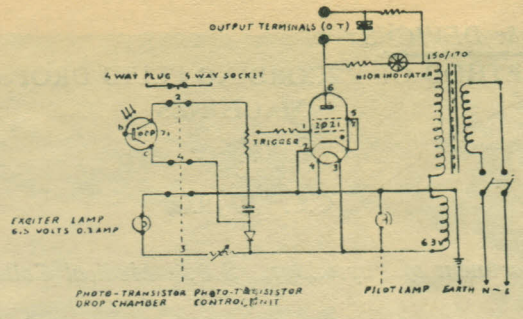

Fig. 1

Circuit diagram of Palmer B 146 Phototransistor drop recording unit.

strength. The a.c. interference is suppresed by suitable earthing.

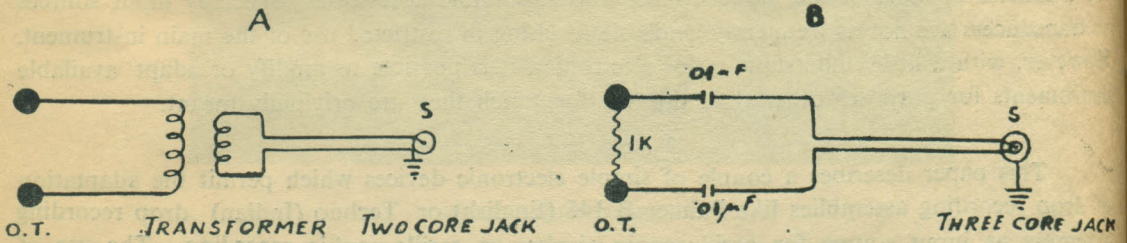

Fig. 2

Simple adapting devices using a transformer (A) and a resistance or coil (B)

An alternate method is the use of a coil or a resistance between the output terminals with suitable condensers as shown in Fig. 2B.

The introduction of transformer is better as it also acts as an isolator. The circuit diagram of the recording assembly as modified by the introduction of the transformer is given in Fig. 3. The output jack carrying the adapted signal at S is now ready for introduction into the input socket of an oscilloscope or oscillograph. The transformer can also be placed inside the assembly with reversed connection, so that the output terminals can be directly connected to the recording instruments.

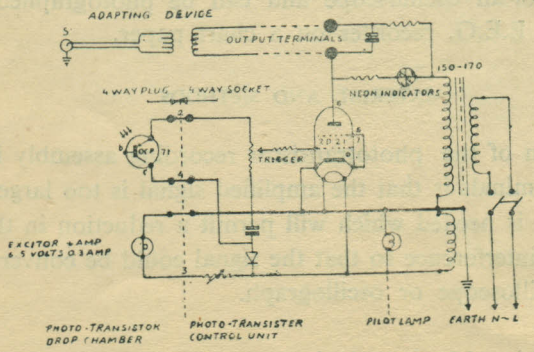

Fig. 3

Circuit diagram of modified drop recording assembly (Fig. 1 and 2A) incorporating transformer adapting device. The jack at S carrying the drop signal can be directly introduced into the input socket of an oscilloscope or oscillograph.

RESULTS

The result obtained with the above modification (Fig. 3) are shown in Fig 4. The upper trace shows the E.C.G. while the lower trace shows the fluid drops pumped out by perfused isolated frog heart.

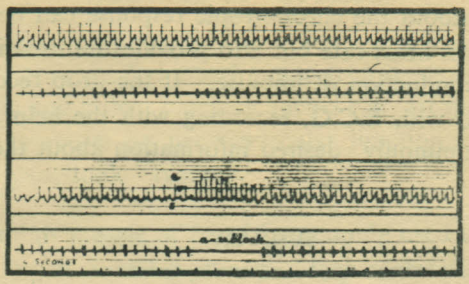

Fig. 4

Isolated frog heart. Slow speed. Continuous record of E.C.G. (upper trace) and output in drops (lower trace). Drop/min × calibration factor gives output/min (see text).

The number of drops falling in a given time can be calibrated in terms of output in ml. per minute. Drops falling in one minute are collected in a small graduated cylinder and their volume is recorded and the calibration factor is calculated. If N is the number of drops in one minute and V the volume of N drops in ml, the calibration factor is given by V/N. Now if it is desired to calculate the output/min. when the number of drops/min. changes to x, one has just to multiply x by the calibration factor::

Thus :

$$\text{Calibration factor} = \frac{V}{N}$$

$$\text{Output in ml/min.} = \text{Calibration factor} \times \text{drops/min} = \frac{V}{N} \times x$$

DISCUSSION

It is clear from the record presented in Fig. 4 that the attempted modification has permitted satisfactory adaptation of the drop recording assembly (originaly using the crude mechanical response of the electromagnetic lever) to provide a refined electrical response suitable for electronic recording.

The inotropic response of the heart has been recorded by a number of techniques with varying implications and sensitivity. The output of the heart is a fair indication of the inotropic response. Since the recording of the drops permits calculation of output/min. it provides a simple method for the asessment of inotropic response if the heart rate is also simultaneously recorded.

In the majority of physiological and pharmacological experiments on the heart, it is desirable to have an accurate record, at least, of two parameters :

1. Pacemaker activity (chronotropic response)

2. Force of contraction or degree of shortening of muscle (inotropic response)

Valuable information about the chronotropic response can be obtained from the record of E.C.G. which not only gives heart rate but also provides information about electrical activity of the heart and about the conduction of impulse. If the drop recording method of assessing inotropic response is coupled with E.C.G. recording with the help of a two channel recorder (as in Fig. 4), most of the commonly desired information about the mechanical and electrical acitivity is available.

SUMMARY

1. The introduction of a transformer or resistance or coil across the terminals of conventional phototransistor or similar drop recording assemblies permits them to be adapted for electronic recording. The mechanical response is replaced by an electrical signal, electronically matching with input impedance of an oscilloscope or oscillograph.

2. By suitable calibration the number of drops can be expressed in terms of output or outflow per minute and relative changes in inotropic response of the heart can be assessed if the heart rate is also known.

3. With the help of a two channel recorder, the E.C.G. and output can both be recorded simultaneously providing valuable information about the chronotropic and inotropic responses, besides other additional information about the electrical and mechanical activity of the heart. This combination is, therefore, very suitable for a number of physiological and pharmacological experiments on heart.

ACKNOWLEDGEMENT

The financial support of the Indian Council of Medical Research for conducting work on "Minimum Effective Concentration of Acetylcholine in Isolated Hearts," during the course of which this equipment was developed, is gratefully acknowledged.