

## A SIMPLE RECORDING IMPULSE COUNTER

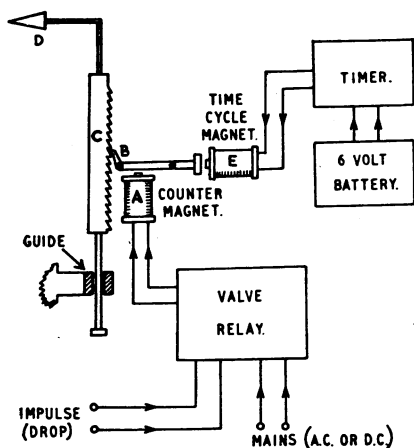
BY

R. H. THORP

*From the Wellcome Physiological Research Laboratories, Beckenham, Kent*

(Received March 27, 1948)

During an investigation of the action of drugs upon the isolated mammalian heart by means of the Langendorff preparation, it was observed that certain substances produced a marked acceleration in the rate of the heart beat. In order that such observations could be recorded, an impulse counter was designed capable of making a permanent record on a kymograph.



SCHEMATIC DIAGRAM OF RECORDING IMPULSE COUNTER.

FIG. 1.

The principle of the impulse recorder is shown diagrammatically in Fig. 1. Each impulse operates the electromagnet *A* and draws down the pawl *B*. When the circuit is broken at the end of the impulse, the return of the armature pawl lifts the rack bar *C* by one tooth. There is a second pawl, concealed by *B* in the diagram, which prevents the rack bar from falling while the pawl *B* is in motion.

The rack bar is cut to give 50 teeth each of one millimetre pitch and a writing point *D* is attached to the top of the bar. Impulses are therefore

recorded by a line which rises 1 mm. per impulse on the kymograph drum and may be a stepped diagonal line on a fast moving drum, or a virtually vertical line on a slow moving drum. The impulse count is recorded over timed intervals which can be derived from any time marker clock used in physiological laboratories. At the end of the counting cycle an impulse from the time clock energizes the electromagnet *E* which pulls back the complete armature and pawl assembly so that the rack bar is reset to the base line.

The electromagnet used for counting the impulses is wound to a resistance of 1,500 ohms and needs an operating current of 15 milliamps. This has been so constructed for convenience in operating the device from a valve relay of the pattern described by Winton (1936, 1939).

The time cycle release magnet coil is wound to a resistance of 4 ohms and operates on a 6 volt supply, but could be arranged to operate at mains voltage if necessary.

The photograph Plate I shows the construction of the device and the same lettering has been used as in the diagram. The two projecting screws *F* and *G* enable the counter to be set or released manually.

In recording the rate of the isolated heart the impulse was derived from two contacts on the lever recording the individual beats; these contacts were connected to the valve relay unit.

The counter can be used for recording a drop outflow with very satisfactory results, by using a silver drop tube of the pattern mentioned by Winton (1936), and connecting this to the valve relay.

Several workers have described instruments of this type, but the earliest is probably that of Negrin (1919) followed by the instruments of Fleisch and later that described by Gaddum (1938).

It is common experience in the science of measurement that several instruments are neces-

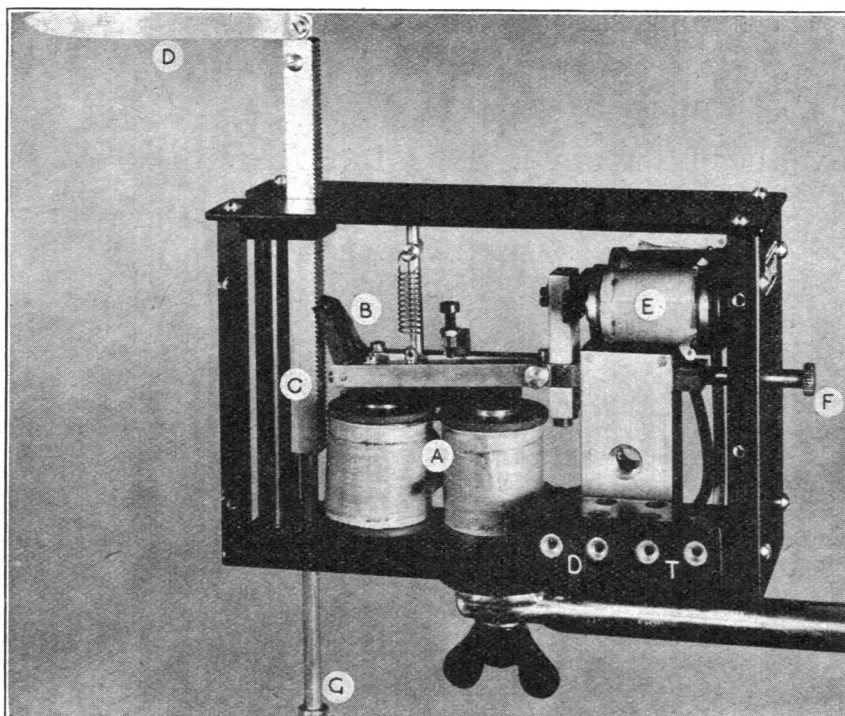


PLATE I.—Recording impulse counter: with cover removed to show mechanism.

sary to cover a wide range of variation in a given function. Gaddum's device records on the kymograph the time elapsing between two successive impulses, and is excellent when these impulses are several seconds apart, but unsuitable for impulse rates faster than 100 per minute. The instrument at present described counts the impulses and by alterations in the slope of the recorded trace gives an indication of a change of interval between impulses within any one timing cycle, which can be of any length greater than 5 seconds. The fastest rate the present model can record is between 550 and 600 impulses per minute.

The applications of such a device are many, and its fundamental advantage is its inherent linearity and the ease with which the individual impulses can be counted on the record.

I should like to thank Mr. Ellis, of Messrs. C. F. Palmer (London), Ltd., who constructed the instrument illustrated from a simple prototype.

#### REFERENCES

- Fleisch, A. (1941). *C.R. Soc. physiol. suisses*. No details given. Full description in maker's leaflet (Arthur Utz, Berne).  
 Gaddum, J. H. (1938). *J. Physiol.*, **94**, 87.  
 Negrin, J. (1919). *Bol. Soc. esp. biol.*, No. 9, 60.  
 Winton, F. R. (1936). *J. Physiol.*, **87**, 20P.  
 Winton, F. R. (1939). *J. Physiol.*, **95**, 60P.