TECHNICAL METHODS

A MAGNETICALLY OPERATED BLOOD CELL PIPETTE SHAKER

BY

C. SANDERS, K. C. PARRY, A. E. BENNETT, AND J. C. H. GEISOW

From the Medical and Electronics Divisions, Atomic Energy Research Establishment, Harwell

(RECEIVED FOR PUBLICATION JUNE 22, 1950)

A blood cell pipette shaking machine has been reported by Parry and Simmonds (1950). The approximate cost of a commercial model was estimated at £70. Small laboratories, however, find this sum considerable in a limited budget. Using a different principle, a small instrument has been designed and tested here which shakes pipettes in a vertical plane and at the same time causes them to rotate. Early defects have now been eliminated, and it is considered that this instrument used in the way described will give highly satisfactory results. The great advantage is the low cost of the instrument; a provisional estimate is £7 or less.

Description of the Instrument

The instrument embodies two holders each capable of carrying four pipettes which are shaken by means of a special type A.C. magnet. This magnet is in effect a modified mains transformer built from U and T shaped laminations. When a normal transformer is assembled the laminations are interlaced by alternating the positions of the U and T shapes with respect to the coil. In this application the U laminations are first modified by removing an eighth of an inch from each leg of the U, and then assembled into a stack. The T laminations (unmodified) are assembled together in one stack and inserted into the former on which the magnet or "transformer" coil has been wound. The U laminations are arranged to encircle the coil in the normal manner. This assembly is fastened together by standard transformer clamping frames, giving what appears to be a transformer with eighth-of-an-inch air gaps in the iron circuit. The magnet coil comprises a single winding of 24 S.W.G. enamelled wire, the former being fully wound as no secondary winding is required.

On the top of the magnet is pivoted a length of $\frac{1}{2}$ in. by $\frac{3}{16}$ in. dural bar which has mounted at one end a piece of mild steel sheet $\frac{1}{16}$ in. thick. This piece of steel is arranged so that it bridges the top one of the two gaps in the iron circuit, and it acts as the armature of the magnet. The other gap in the laminations ensures that the flux is distributed evenly round the whole of the iron circuit.

A small block of rubber is inserted between the dural bar and the magnet laminations. This piece of rubber is kept under slight compression by a strip of brass mounted over the armature which restricts the movement of the dural bar. The rubber, being under compression, acts as the return spring for the bar when it has been attracted

to the magnet core. A piece of thin rubber attached to the underside of the armature behaves as a residual stud, thereby preventing the armature from making metallic contact with the magnet core. This ensures that the armature is released rapidly as the current falls to zero, and further that the shaker is quiet in operation.

Attached to the other end of the dural bar there is a length of beryllium copper strip in the shape of a U. This U piece carries two holders each capable of taking up to

FIG. 1a.

FIG. 1b.

FIGS. 1a and 1b.—The shaker and a diagram showing its construction.

four pipettes. A pipette is supported on either side of the bulb by a rubber grommet, one grommet being slit to allow the insertion of the pipette into the holder. This type of support will take pipettes of varying length.

When the magnet coil is energized by the 230 volts 50 cycle mains, the flux across the air gap rises and decays one hundred times per second. The armature follows the growth and decay of this flux and consequently the dural bar vibrates in the vertical plane one hundred times per second. This vibration is transmitted to the holders via the beryllium copper spring, and further, due to the resilience of the spring, a small horizontal vibration is imparted to the holders.

The pipettes are loosely held in their holders. The resultant force from the two vibrations causes the pipettes to roll round the inside of the rubber grommets. This rotary motion is very pronounced, and in fact the pipettes rotate rapidly while they are being shaken vigorously in the vertical plane.

Method of Use

In this instrument the ends of the pipettes are free and are not held in concave rubber seatings to prevent fluid loss as in the machine previously described. One of the difficulties encountered was the considerable fluid loss from the ends of the pipette. This is overcome by the use of a "rubber policeman" (Fig. 1) placed over the tip. In practice it has been found that it is only necessary to close the tip of the pipette; the other end is left free. Small perforations are punched through the rubber near the tip. This is necessary to allow the displaced air in the "rubber policeman" to escape when it is slipped over the tip of the pipette, otherwise the fluid contents of the capillary portion of the pipette are displaced into the bulb and alter the dilution. It has been found that with practice in slipping on the rubber there is no fluid displacement, and when the rubber is in place there is no fluid loss however long the pipette is shaken. By placing the perforated "rubber policeman" on the dilution pipettes at the time of taking the blood sample, accidental loss of the contents is avoided during transit from the ward or clinic to the laboratory.

The pipettes are placed in the shaker by inserting the blunt end of the pipette through the circular rubber grommet and pressing the capillary portion of the pipette into the slit rubber grommet. The instrument is switched on. Pipettes can, however, be removed and inserted while the shaker is in motion. The shaker has been in use for two months, and, although no statistical work has been undertaken in connexion with this instrument, it is thought that satisfactory mixing is attained in two minutes.

Summary

A magnetically operated blood cell pipette shaker is described. The shaker holds up to eight pipettes at one time in two rows of four. The pipettes are shaken vigorously in a vertical plane and at the same time rotate rapidly.

The use of perforated "rubber policemen" in order to prevent fluid loss from the pipettes is described.

Acknowledgment is made to the Director, Sir John Cockcroft, Atomic Energy Research Establishment, Harwell, for his permission to publish this article; also to Dr. K. Williams, Principal Medical Officer, for assistance in the preparation of this paper.

REFERENCE

- Parry, K. C., and Simmonds, G. E. (1950). *J. clin. Path.*, 3, 164.