A SIMPLE PISTON PUMP

DEREK P. HENDRY, A. M. PERRY,
C. VAN-TOLLER AND M. G. ROLLING

DURHAM UNIVERSITY

The principle of the piston pump is simple and elegant. Difficulties arise in practice because of characteristics of conventional valves. If small, they require high pressure to open them. If large, they require a large volume of flow to open them. In addition, most valves leak unless the seat pressure is high.

A piston pump with unusual valves has given several years of very satisfactory service in this laboratory. The valves are self-closing and yet open under very little pressure. They consist of thin rubber tubing fitted into a

smoothly ground cylindrical hole of exactly the same diameter. The valve inlet is another small hole leading into the "cylinder wall". Pressure of fluid in the inlet port causes the rubber tubing to deform inwards, allowing fluid to pass through the cylinder. On releasing the pressure the rubber tubing snaps back into place, closing off the inlet.

The pump, shown in Fig. 1, was operated by a 24 v 1 amp solenoid (Rotax H/D, government surplus, cost 15 shillings or \$2). Other methods of supplying power might be suitable,

but a solenoid is probably the simplest. The whole pump can be made in about four man-hours. The angles of valves and inlets were made so that air bubbles passed through with-

out lodging where they could be compressed and produce inaccuracies in the amount pumped. The spatial arrangement of the valves is shown in Fig. 2.

The pliability of the rubber tubing is important. Lengths of rubber sacs manufactured as fountain pen reservoirs (o.d. 6 mm, i.d. 5 mm) were used. The relative diameters of the cylinder and inlet port are also important. We used a 4 mm diameter inlet port. With these values, the valve opened under a pressure of about 100 g/cm²; *i.e.*, under a force of about 8 g applied to the inlet port.

The accuracy of the pump, determined on many different occasions, was about 5%. It could reliably deliver volumes down to about .001 ml.

The pump was designed and has been used for delivering water reinforcements (volumes in the region of .05 ml.). It has the advantage that delivery of the water is practically instantaneous. It could be used in any application requiring delivery of a small, accurately-timed volume of fluid, but it would probably not be suitable for providing relatively slow infusions.