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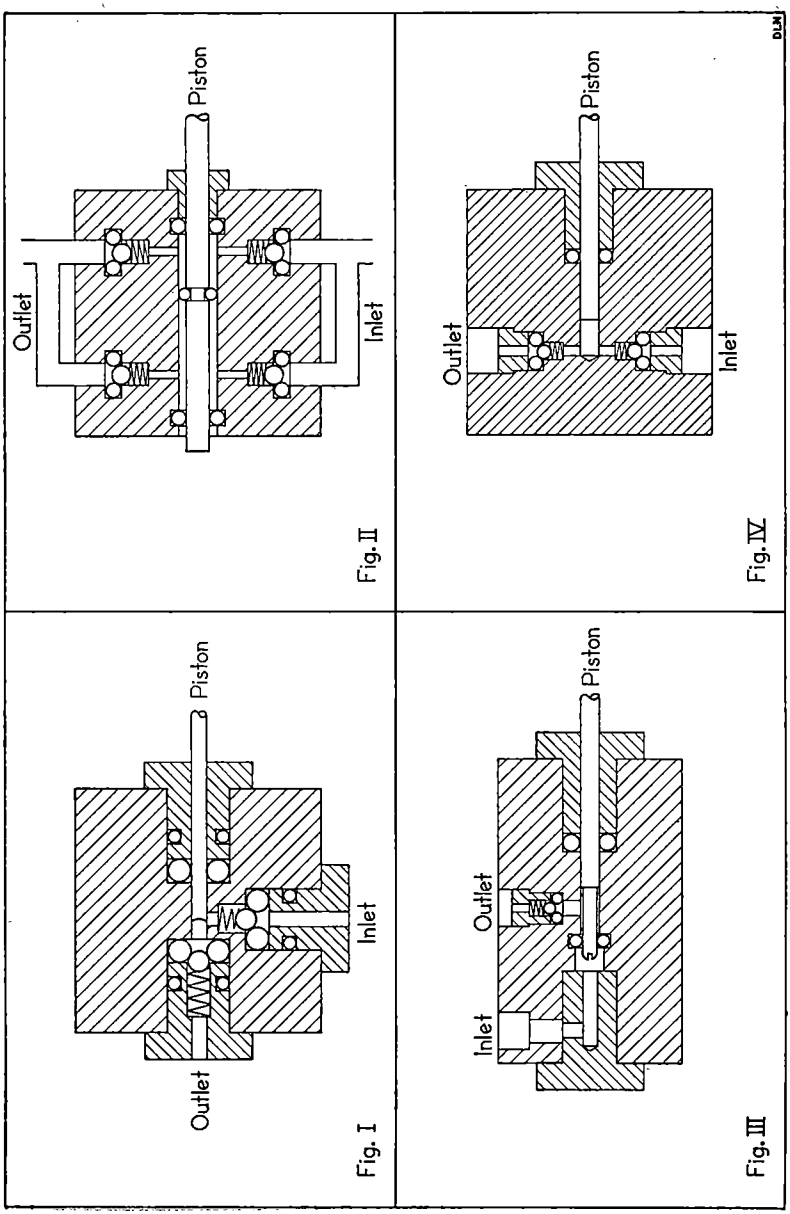
Piston
Outlet
Inlet
Fig. II
Piston
Outlet
Inlet
Fig. IV
Piston
Outlet
Inlet
Fig. I
Piston
Outlet
Inlet
Fig. III

THE DEVELOPMENT OF MINIATURE PUMPS

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An accurate pump for a viscous liquid was required adjustable from one ml. to four ml. per minute and able to purge itself of air against 75 psi. The flow needed to be continuous or have a sufficient number of pulses in a given time, and should be reliable and economical. None of the pumps investigated would fit the application. A diaphragm pump, for example, would not purge and did not give the requisite accuracy. Therefore, efforts were directed toward the design of a suitable pump.

Gears, bellows, diaphragms, belloframs, and other systems were investigated. "O" rings and quad rings were chosen as having suitable properties. The design field was narrowed to variations with these elements.

A pump with the desired characteristics is shown in Figure I. Its uniqueness lies in the passage of the piston through the head of the cylinder, which is formed by a ball seated on an "O" ring.

This system avoids lost cylinder head space, thereby providing purging against high pressures. It also gives a simple method of adjusting the pump displacement. This is easily observed by noting that liquid is drawn into the cylinder only when the outlet check is closed and the piston is moving away from it. Therefore, by adjusting the position where the piston ceases its fill stroke the variations in displacement are obtained. The piston diameter is .0750 inches and the maximum stroke length .250 inches. The inlet check spring is of .0035 inch diameter wire and its relaxed length is .090 inches. The pump will purge against 100 psi and is adjustable from zero to four ml. per minute at 200 rpm. Another feature is that the piston linkage is by means of a spring wire eliminating inaccuracy due to the wear of a universal joint type connection.

Figure II shows a double acting pump. The displacement is determined by the difference in the annular area between the "O" ring fixed in the cylinder block and the "O" ring in the shaft grove. The pumping rate is adjusted by the length of the stroke. This pump was tested and gave good results.

The pump shown in Figure III is an interesting variation. The liquid flow is through the cylinder head and out through the check on the side of the cylinder. The adjustment is obtained by screwing various length tips into the end of the piston. This pump cavitates until the tip leaves the "O" ring in the cylinder head.

A more conventional type of pump is shown in Figure IV. This pump is adjusted by setting the length of the stroke.

The pump shown in Figure I is now in production and giving satisfactory service. Information on quad and "O" rings as to sizes, tolerances and fits may be obtained from various rubber manufacturers.