April 18, 1961 J. A. POPE 2,980,024

VARIABLE-DELIVERY POSITIVE DISPLACEMENT PUMP

Filed March 3, 1958

Fig.1.

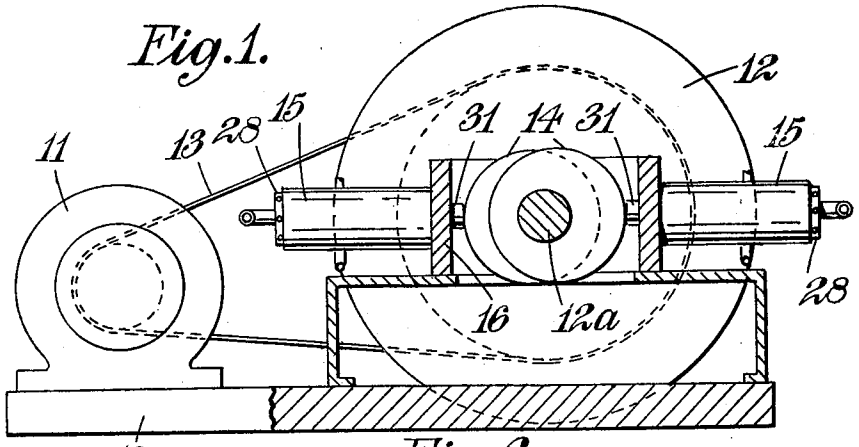


Fig.2.

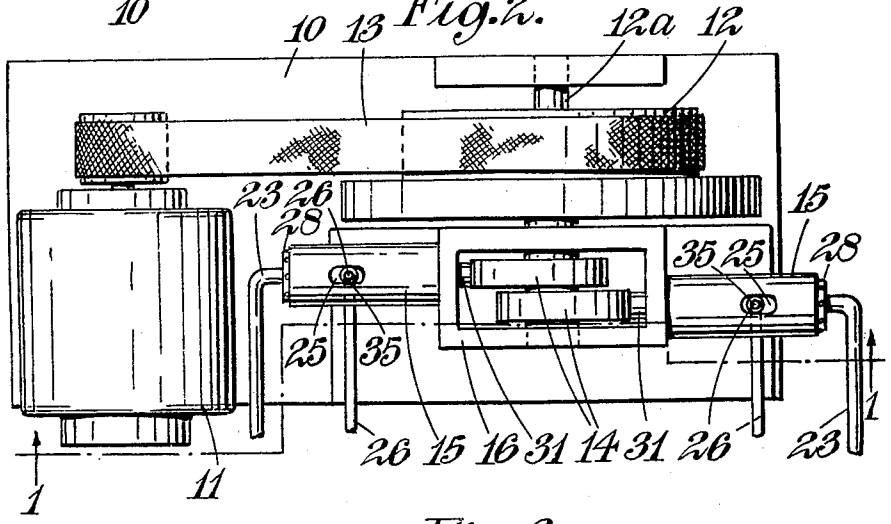
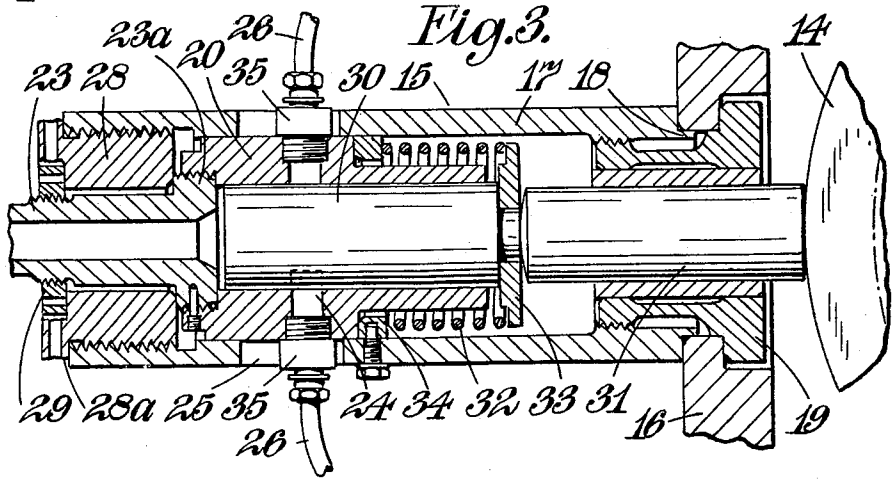


Fig.3.



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VARIABLE-DELIVERY POSITIVE DISPLACEMENT PUMP

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4 Claims. (Cl. 103—37)

This invention comprises improvements in or relating to liquid pumps and has for an object to provide a variable-delivery positive-displacement pump whereof the delivery can be varied readily during operation of the pump.

According to the present invention, a variable-delivery positive-displacement liquid pump comprises a pump body having an internal bore, a pump cylinder having an outlet at one end and an inlet at a point intermediate its ends, which cylinder is slidably accommodated within the bore in the pump body and bears at its outlet end against an abutment member adjustably mounted preferably threaded in the pump body to permit adjustment of the abutment member lengthwise of the body, and a pump piston which is reciprocated in the cylinder towards and away from the outlet and is arranged in its stroke to cover and uncover the inlet to the cylinder. In operation the liquid pressure within the cylinder maintains the cylinder in abutment with the abutment member and thus by adjusting the abutment member, the point in the stroke of the piston at which the piston just covers the inlet can be varied so varying the delivery of the pump.

If desired, locking means may be provided whereby the pump cylinder may be locked to the abutment member during normal operation, the locking means being released when it is desired to adjust the pump delivery. In this case, the cylinder is reqiured to be maintained against the abutment member by fluid pressure only when the locking means is released.

In one preferred form, the abutment member is an annular plug threaded in the end of the body adjacent the outlet end of the cylinder, the outlet is a union member rigid with the cylinder and projecting through the plug to externally of the body, and the locking means is a lock threaded on the projecting portion of the union member and adapted when tightened to engage the plug and to draw the cylinder against the plug. Also, the abutment member has a portion projecting externally of the body and engageable by a tool to permit its adjustment during operation of the pump.

The invention also comprises pumping apparatus comprising a pair of like circular eccentrics carried on a driven spindle with their centres offset from the spindle axis by equal amount on opposite sides of the spindle, and a pair of pumps as above set forth disposed one on each side of the spindle, the pistons of the pumps being reciprocated each by a corresponding one of the eccentrics.

One construction of pumping apparatus incorporating pumps of this invention will now be described with reference to the accompanying drawings, in which:

Figure 1 is an elevation of the pumping apparatus with parts in section,

Figure 2 is a plan view of the pumping apparatus and

Figure 3 is a section through a pump showing details of the construction.

Referring to Figures 1 and 2, the pumping apparatus comprises a base **10** wherein is mounted an electric motor **11** driving a fly-wheel **12** through a belt **13**. The fly-

wheel spindle **12***a* has secured on it a pair of circular eccentrics **14** each of which operates a pump **15**. The eccentrics are alike and are set with their centres offset by equal amounts on opposite sides of the axis of spindle **12***a*, and the pumps **15** are mounted on a frame **16** secured on the base **10**, the pumps being respectively on each side of the spindle **12***a*. The pumps **15** thus operate in synchronism.

Referring now to Figure **3**, each pump **15** comprises a pump body **17** of cylindrical form with a boss **18** at one end which projetcs through a hole in the frame **16** and receives a retaining nut **19** by which the pump body **17** is secured to the frame **16**.

The body **17** has a bore housing a pump cylinder **20**. The cylinder **20** has an outlet union **23** threaded into its end remote from the frame **16** and is formed between its ends with two inlet ports **24**. Liquid is fed to each inlet port **24** through a flexible inlet pipe **26** which is secured to a bored plug **35** which extends through and slides in a slot **25** in the body **17** and which is threaded into the port **24**. This permits the cylinder **20** to be adjusted lengthwise of the body **17** without rotation in the body **17**. The cylinder **20** has associated with it an abutment member in the form of an annular plug **28** which is threaded into the end of the body **17** remote from the frame **16**, encircles the union **23** and is normally locked to the cylinder **20** by being gripped between a flange **23***a* on the union **23** and a lock nut **29** threaded on to the union **23**. The plug **28** has a capstan end **28***a* to enable it to be rotated by means of a tommy bar or other suitable tool.

Each pump **15** also comprises a piston **30** working in the cylinder **20** under control of the associated eccentric **14** which effects the delivery stroke through a plunger **31** and a spring **32** which effects the return stroke. The spring **32** at one end abuts a plate **33** secured on the end of the piston **30** and at its other end abuts a ring **34** secured to the body **17**. The ring **34** also serves to limit the adjustment of the cylinder **20** to the right as viewed in the drawing so that the cylinder cannot take up a position in which the inlet port **24** is never uncovered in the travel of the piston **30**.

In operation, the piston **30** is reciprocated with a fixed length of stroke under control of the eccentric **14** and the spring **32**. During the intial part of the delivery stroke, the port **24** is uncovered so that the liquid is not pressurized. However, when in moving to the left, the piston **30** moves beyond the position in which it just covers the port **24**, a quantity of liquid is trapped in the cylinder **20** and further movement to the left of the piston delivers the trapped liquid under pressure through the outlet union **23**.

The quantity of liquid delivered at each stroke is varied by adjusting the plug **28** to vary the position of port **24** relative to the piston and this can be done while the pump is working. This adjustment is effected by releasing the lock nut **29** and rotating the plug **28** by means of the tommy bar or like tool. If the pump is working, the flange **23***a* is maintained in abutment with the plug **28** by the pressure within the cylinder even though the lock nut **29** is released.

The pumping apparatus as above described may be employed in connection with test apparatus as described in United States application Serial No. 718,679, filed on March 3, 1958, by Pope et al., and in this case, if desired, means may be provided to adjust the position of the plug **28** cyclically so that the delivery of the pump **15** is varied cyclically to obtain a varying pressure effect in the test apparatus.

I claim:

1. A variable-delivery positive-displacement liquid pump comprising a pump body having an axial bore, a pump cylinder slidable axially within the bore of the body,

said pump cylinder having an internal cylinder bore open at one end, an inlet to the cylinder bore intermediate its ends and an outlet at its opposite end, and said pump cylinder also having an abutment surface at said opposite end facing axially away from said one end, an abutment member mounted in said pump body axially in line with the cylinder and beyond the outlet end thereof, said abutment member having an abutment face facing towards and cooperating in axial abutment with the abutment surface of the pump cylinder to limit sliding of the pump cylinder in one direction, said abutment member being adjustable in the pump body axially of the bore to vary the position of the pump cylinder, said abutment member having a portion projecting externally of the pump body and engageable by a tool to permit its adjustment axially of the pump body during operation of the pump, a pump piston extending axially into said pump cylinder through the open end thereof, and drive means imparting to the piston a stroke to cover and uncover the inlet.

2. A variable-delivery positive-displacement liquid pump according to claim 1, comprising also locking means adapted to hold the cylinder in abutment with the abutment member, said locking means being releasable to permit adjustment of the abutment member in said body.

3. A variable-delivery positive-displacement liquid pump comprising a pump body having an axial bore, a pump cylinder slidable axially within the bore of the body, said pump cylinder having an internal cylinder bore open at one end, an inlet to the cylinder bore intermediate its ends and an outlet member at its opposite end, and said pump cylinder also having an abutment surface at said opposite end facing axially away from said one end, an abutment member in the form of an annular plug threaded in the end of the body adjacent the outlet end of the cylinder, the outlet member being a union member rigid with the cylinder and projecting through the plug externally of the body, said abutment member having an abutment face cooperating with the abutment surface of the pump cylinder to limit sliding of the pump cylinder in one direction, said abutment member being adjustable in the pump body axially of the bore to vary the limit of sliding of the pump cylinder, a lock nut threaded on the projecting portion of the union member and adapted when tightened to engage the plug and to draw the cylinder against the plug, said lock nut being releasable to permit adjustment of the abutment member in the body, a pump piston extending axially into said pump cylinder through the open end thereof, and drive means imparting to the piston a stroke to cover and uncover the inlet.

4. A variable-delivery positive-displacement liquid pump comprising a pump body having an axial bore, a pump cylinder slidable axially within the bore of the body, said pump cylinder having an internal cylinder bore open at one end, an inlet to the cylinder bore intermediate its ends and an outlet member at its opposite end, and said pump cylinder also having an abutment surface at said opposite end facing axially away from said one end, an abutment member in the form of an annular plug threaded in the end of the body adjacent the outlet end of the cylinder, the outlet member being a union member rigid with the cylinder and projecting through the plug externally of the body, said abutment member having an abutment face cooperating with the abutment surface of the pump cylinder to limit sliding of the pump cylinder in one direction, said abutment member being adjustable in the pump body axially of the bore to vary the position of the pump cylinder, a pump piston extending axially into said pump cylinder through the open end thereof, and drive means imparting to the piston a stroke to cover and uncover the inlet.

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