April 19, 1966 H. D. BRAILSFORD 3,246,604

VARIABLE-RATE PUMP

Filed Nov. 20, 1963

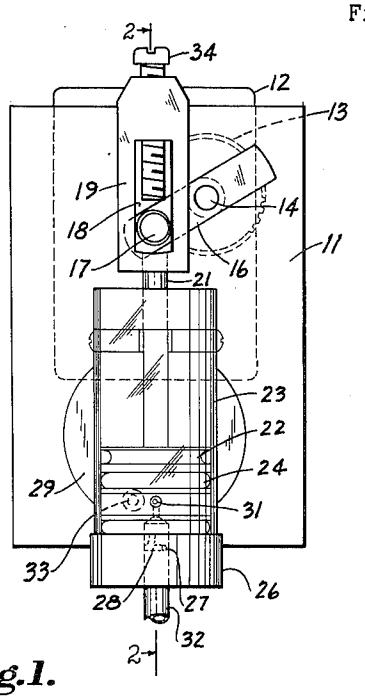


Fig.1.

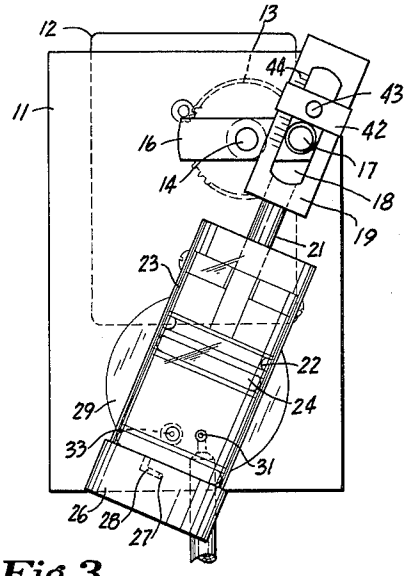


Fig.3.

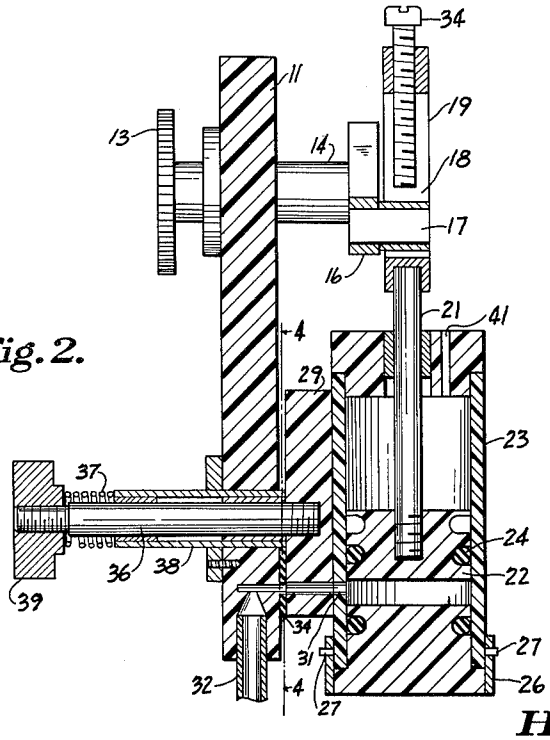
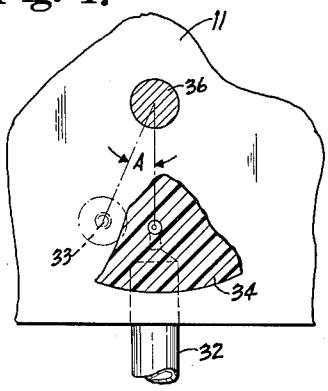


Fig. 2.

Fig. 4.



INVENTOR.

Harrison D. Brailsford

BY

Donald P. Gillette

HIS ATTORNEY

United States Patent Office 3,246,604 Patented Apr. 19, 1966

3,246,604

VARIABLE-RATE PUMP

Harrison D. Brailsford, 670 Milton Road, Rye, N.Y.

Filed Nov. 20, 1963, Ser. No. 325,045
4 Claims. (Cl. 103—38)

This invention relates to pumps of the type described in my United States Patent 3,059,586 and particularly to means for varying the stroke, and hence the pumping rate, thereof.

My previous pumps operated with a fixed stroke, which meant that the only way that the amount of fluid that they pumped in a given length of time could be varied was by controlling the number of revolutions turned by the crankshaft of the pump in that length of time. This, in turn, required either a variable-speed transmission between the driving motor and the pump, or a motor having controllable speed, or means for rendering the motor inoperative during part of the time. Each of these expedients has its own drawbacks: a variable-speed transmission is complicated, space-consuming, and expensive; a speed control, particularly in the unattended operation to which these pumps are subjected, tends to be inaccurate and inefficient; and in order to turn off the motor for predetermined intervals, a relatively expensive and complicated timer is required.

It is one of the principal objects of this invention to provide simple, inexpensive, and relatively accurate and constant means for controlling the stroke, and hence, pumping speed, of a pump of the type described in the aforesaid Patent 3,059,586.

Other objects are to provide means for varying the stroke without limiting the extent of angular excursions of the pump and to control the stroke by limiting the distance to which the piston is moved away from the inlet-outlet channel of the pump.

In accordance with the invention, I have provided a slotted yoke attached to the piston rod of the pump with the slot extending in the same direction as the piston rod. The crankpin of an eccentric fits into the slot to move therein to tilt the pump cylinder between its fixed, angular limits and to draw the piston back and forth in the cylinder. Means are also provided to change the length of that portion of the slot in which the crankpin is free to move. Further in accordance with the invention, the crankpin is restricted to that portion of the slot starting with, and always including, that point in the slot nearest the piston rod.

The invention will be further described in connection with the drawings in which:

FIG. 1 is a front view of a pump constructed according to the invention;

FIG. 2 is a cross-sectional view of the pump in FIG. 1 taken along the line 2–2;

FIG. 3 shows a front view of the pump of FIG. 1 in a different part of its operating cycle and with a modified stroke control; and

FIG. 4 is a cross-sectional view along the line 4—4 in FIG. 2 and shows the relative positions of the inlet and outlet channels of the pump of FIGS. 1–3.

The pump in FIG. 1 comprises a base plate **11** on which is mounted an electric motor **12** driving, by means of a pinion (not shown), a gear **13**. The latter is affixed to a shaft **14** which constitutes the crankshaft of the pump and has an eccentric **16** with a crankpin **17**. The latter fits relatively snugly with a slot **18** in a yoke **19** attached to one end of a piston rod **21**, the other end of which is affixed to a piston **22** with a cylinder **23**. The piston has a gasket, or piston ring, in the form of an O-ring **24** to prevent leakage of the pumped fluid past the piston. Preferably both the piston **22** and the cylinder **23** are made of plastic, although the cylinder has one end closed

by a cylinder head which may be held fast within a metal ring **26** attached to the end of the cylinder by bayonet pin means including a pin **27** and a slot **28**.

The other end of the cylinder is also closed, at least sufficiently to journal the piston rod **21** so that the cylinder will tilt substantially exactly in step with tilting of the rod as the eccentric **16** is rotated. To permit tilting of the cylinder, the latter is mounted on a pivotally mounted plate **29** which is free to pivot at least to an extent determined by operating principles to be described hereinafter. The pivot axis of the plate **29** is parallel to the axis of the crankshaft **14** and passes through the axis of the cylinder **23** in a perpendicular direction.

A channel **31** in the back wall of the cylinder facing the plate **29** and close to the closed end of the cylinder forms both the inlet and the outlet channel for fluid being pumped by the pump. In the view shown in FIG. 1, the cylinder **23** is pivoted counterclockwise to an extent which, while less than the maximum, is enough to permit the channel **31** to communicate with an inlet pipe **32** in the plate **11**. An outlet pipe **33** is spaced a shorter angular distance away from the inlet pipe, and, like the latter, the outlet pipe extends through the base plate **11**.

At the upper end of the yoke **19** is a control means in the form of a screw **34** which may be screwed in or out to change the lost motion, or distance through which the crankpin **17** may move lengthwise along the slot **18**. It should be noted that, no matter how the screw **34** is positioned, the crankpin **17** always goes to the bottom end of the slot **18** during one point of each rotation of the eccentric **16**. This assures good volumetric efficiency and that the fluid will be substantially entirely pushed out of the closed end of the cylinder **23** at one point in each cycle of operation.

The effect of unscrewing the screw **34** will be to provide more lost motion and thus to limit the length of stroke of the piston **22**. At the same time, the fact that the crankpin **17** substantially fills the width of the slot **18** assures that the cylinder **23** will be tilted back and forth between exactly the same limits, as required to permit the inlet-outlet channel **31** to communicate with both the inlet pipe **32** and the outlet pipe **33**.

FIG. 2 shows a cross-section of the pump in FIG. 1 and makes more clear the arrangement of the channel **31** through the plate **29**. As may be seen, there is a gasket **34** between the base plate **11** and the pivot plate **29** to prevent leakage of fluid passing through the channel **31** and, in the position illustrated, the pipe **32**.

The pivot plate **29** is held relatively firmly against the gasket **34** by a stud **36** journalled in the base plate **11**. Pressure is exerted by a spring **37** between a collar **38** and a knob **39** at the end of the stud **36** to hold the pivot plate **29** firmly enough against the gasket. A channel **41** may be observed at the end of the cylinder **23** to permit air to reach the space above the piston **22** and to be driven from such space as the piston moves upwardly.

FIG. 3 shows the cylinder **23** tilted over to place the channel **31** in position to communicate with the outlet pipe **33**.

While FIG. 3 shows a pump which is otherwise similar to that in FIG. 1, it does differ in the means for adjusting the stroke. Here, such means include a bridge member **42** fitted across the yoke and pinched into place by a knurled knob **43**. If desired, the yoke may be calibrated as shown to provide a scale **44** to show how much fluid will be pumped each interval of time.

FIG. 4 shows a fragment of the plate **29** to illustrate the angular relationship between the locations of the inlet pipe **32** and the outlet pipe **33**. Both are reached by holes pierced in the gasket **34**, the latter being shown in cross-section as cut along the partition line 4—4 in FIG. 2. The pipes **32** and **33** are spaced apart by an angle A.

The cylinder 23 must be pivoted through approximately the same angle for proper operation of the pump, although the finite width of the inlet-outlet channel 31 and the inlet pipe 32 and the outlet pipe 33 makes permissible some departure of the angle of tilt of the cylinder from the angle A.

While this invention has been described in terms of a specific embodiment, it will be understood by those skilled in the art that modifications may be made therein within the true scope of the invention as determined by the following claims.

What is claimed is:

1. A pump comprising: a hollow cylinder closed at one end; a piston axially slidable therein; a piston rod having one end rigidly attached to said piston; a yoke attached to the other end of said piston rod outside of said cylinder, said yoke having an axially elongated slot therein; a pivotal mounting for said piston to tilt said piston between two limiting positions and about an axis substantially perpendicular to the axis of said piston; an opening in the wall of said cylinder near the closed end thereof; a pair of of channels, one of said channels communicating with said opening when said piston is tilted to one of its limiting positions and the other of said channels communicating with said opening when said piston is tilted to the other of its limiting positions; an eccentric having a shaft substantially parallel with the axis of said pivotal mounting and an offset pin extending into said slot of said yoke and substantially filling the width of said slot to pivot said cylinder to both of its limiting positions as said eccentric rotates.

2. A pump comprising: a hollow cylinder closed at one end; a piston axially slidable therein; a piston rod having one end rigidly attached to said piston; a yoke attached to the other end of said piston rod outside of said cylinder, said yoke having an axially elongated slot therein; a pivotal mounting for said piston to tilt said piston about a pivotal axis and between two limiting positions and about an axis substantially perpendicular to the axis of said piston; an opening in the wall of said cylinder between said pivotal axis and the closed end thereof; a pair of channels, one of said channels communicating with said opening when said piston is tilted to one of its limiting positions and the other of said channels communicating with said opening when said piston is titlted to the other of its limiting positions; an eccentric having a shaft substantially parallel with the axis of said pivotal mounting and an offset pin extending into said slot of said yoke and substantially filling the width of said slot to pivot said cylinder to both of its limiting positions as said eccentric rotates.

3. A pump comprising: a hollow cylinder closed at one end; a piston axially slidable therein; a piston rod having one end rigidly attached to said piston; a yoke attached to the other end of said piston rod outside of said cylinder, said yoke having an axially elongated slot therein; a barrier on said yoke to partition off a section of said slot; a pivotal mounting for said piston to tilt said piston between two limiting positions and about an axis substantially perpendicular to the axis of said piston; an opening in the wall of said cylinder near the closed end thereof; a pair of channels, one of said channels communicating with said opening when said piston is tilted to one of its limiting positions and the other of said channels communicating with said opening when said piston is tilted to the other of its limiting positions; an eccentric having a shaft substantially parallel with the axis of said pivotal mounting and an offset pin extending into said slot of said yoke between said barrier and the end of said slot nearer said piston and substantially filling the width of said slot to pivot said cylinder to both of its limiting positions as said eccentric rotates.

4. A pump comprising: a hollow cylinder closed at one end; a piston axially slidable therein; a piston rod having one end rigidly attached to said piston; a yoke attached to the other end of said piston rod outside of said cylinder, said yoke having an axially elongated slot therein; a barrier and means to affix said barrier to selected positions along said yoke to partition off a section of said slot; a pivotal mounting for said piston to tilt said piston between two limiting positions and about an axis substantially perpendicular to the axis of said piston; an opening in the wall of said cylinder near the closed end thereof; a pair of channels, one of said channels communicating with said opening when said piston is tilted to one of its limiting positions and the other of said channels communicating with said opening when said piston is tilted to the other of its limiting positions; an eccentric having a shaft substantially parallel with the axis of said pivotal mounting and an offset pin extending into said slot of said yoke in the section of said slot between said barrier and the end of said slot nearer said piston and substantially filling the width of said slot to pivot said cylinder to both of its limiting positions as said eccentric rotates.

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LAURENCE V. EFNER, *Primary Examiner.*