Dec. 30, 1947. W. C. HESS 2,433,759

PISTON ROD ACTUATED VALVE FOR FLUID MOTORS OF THE EXPANSIBLE CHAMBER TYPE

Filed June 17, 1944

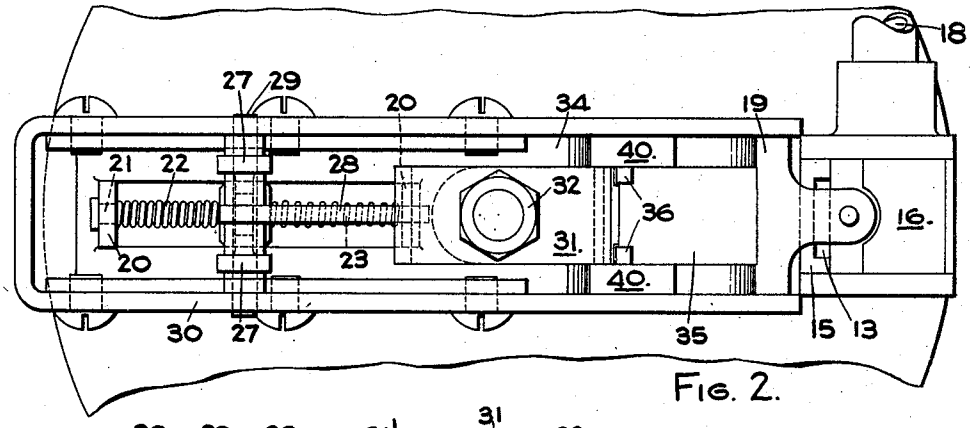


FIG. 2.

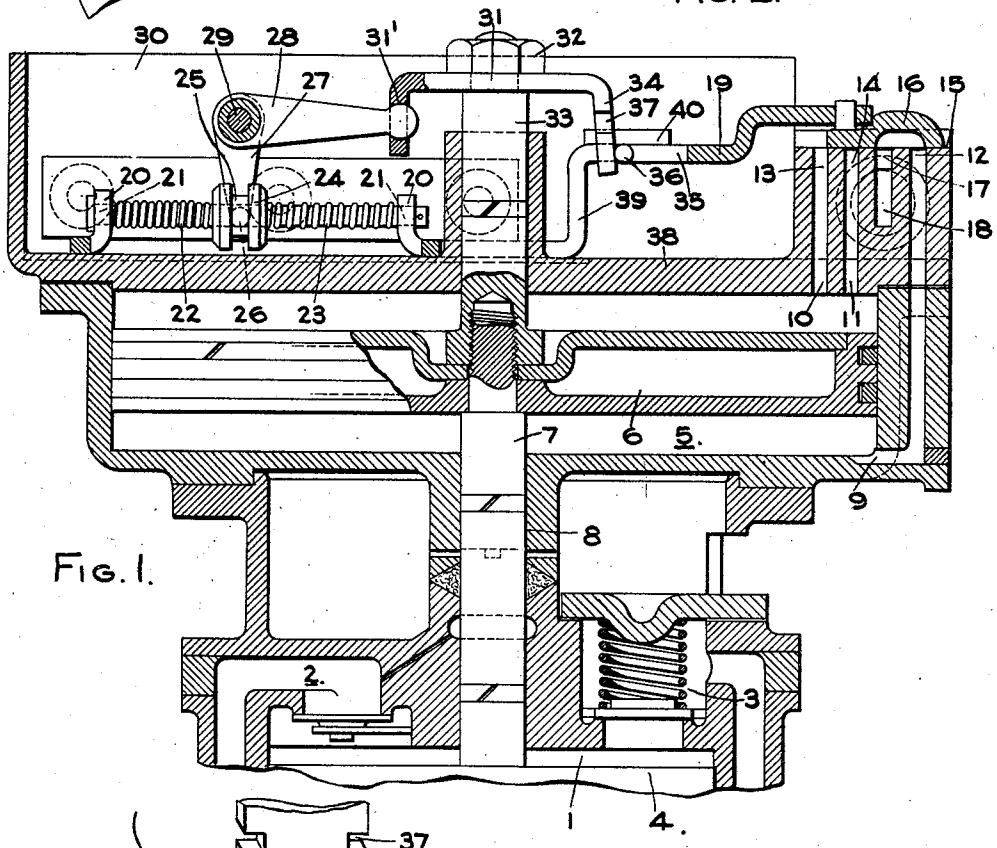


FIG. 1.

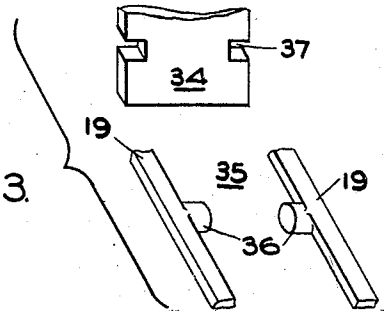


FIG. 3.

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Patented Dec. 30, 1947 2,433,759

UNITED STATES PATENT OFFICE

2,433,759

PISTON-ROD ACTUATED VALVE FOR FLUID MOTORS OF THE EXPANSIBLE CHAMBER TYPE

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Application June 17, 1944, Serial No. 540,840

6 Claims. (Cl. 121—164)

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This invention relates to a fluid motor and primarily to the automatic valve mechanism for reversing the pressure differential on the piston or moving part of the motor. Snap action valve mechanisms are well known and are of various designs, some utilizing the construction wherein the line of spring force is shifted across a high point sometimes referred to as a dead center position.

The object of the present invention is to provide an improved valve action wherein the spring energy is stored up for subsequent release by a mechanical interlock with the power actuating member of the motor.

A further object of the invention is to provide a valve action which is efficient and practical against any sticking or failure of the valve while insuring a consistent and uniform timing of operation.

In the drawing:

Fig. 1 is a vertical sectional view through the improved valve action and a fragment of the motor to which it is applied.

Fig. 2 is a top plan view of the valve action; and

Fig. 3 is an exploded view more clearly showing the release arrangement.

Referring more particularly to the drawings, the numeral 1 indicates a fuel pump chamber having a valved inlet 2 and a valved outlet 3 for the displacement of liquid fuel or other fluid by means of the reciprocating plunger 4. The numeral 5 indicates a motor chamber in which operates a piston 6 connected to the plunger 4 by a rod 7 suitably packed in the bearing 8. The motor chamber is provided with a port 9 opening thereinto at one side of the piston 6 and a pair of ports 10 and 11 opening into the chamber at the opposite side of the piston. These three ports are connected by passageways to ports 12, 13 and 14 respectively, opening through a valve seat 15 on which slides a valve 16 adapted to connect a pressure supply port 17 alternately to the chamber communicating ports 14 and 12 and opening the venting port 13 when the ports 12 and 17 are connected. The ports 10 and 13 could be combined with the ports 11 and 14 if desired by shortening the slide bearing contact for the valve 16. The pressure supply port 17 is connected to a supply passage 18 which, in turn, communicates with the source of operating pressure, either positive or negative, such as the intake manifold of the usual internal combustion engine of an automobile.

The valve 16 is moved back and forth on its

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seat by means of an operating member 19 formed with a pair of upstanding ears 20 which support a guide rod 21. Interposed between the ears and mounted on the rod is a pair of springs 22 and 23, and interposed between these springs is a sleeve or collar 24 which is slidable on the guide rod 21 to alternately compress the two springs. The collar 24 is formed with a groove 25 adapted to receive inturned lugs 26 provided on the lower ends of a pair of rocker arms 27, these rods in turn being integrally connected with an arm 28 to form in effect a bell crank lever having journal support on a shaft 29 fixed in a surrounding wall 30. The outer end of the rocker arm 28 has pivotal support in a recess 31' formed in a cross head 31, the latter being detachably secured by a nut 32 to an extension section 33 of the piston rod 7. As the piston 6 is fluid driven back and forth it will rock the bell crank lever and effect the alternate compression and release of the two springs in succession.

To hold the operating member 19 against movement during compression of either spring the power member is formed with a release device which, for practical purposes, may be a part of the cross head 31. To this end the cross head is provided with a part 34 extending in the direction of movement of the extension 33 and transversely of the slide or operating member 19. This part 34 is disposed within a cut-out or opening 35 that has a pair of opposed and inwardly extending keeper lugs 36 which bear against one face or the other of the part 34 during compression of the springs, and when the particular spring has been compressed a predetermined degree lugs 36 will pass through the oppositely disposed notches or recesses 37 in the release part 34 or over the lower free end of the latter as the case may be. The extent of travel of piston 6 is limited to and by the spacing of the notches 37 above the lower edge of the release part 34 and is such as to preclude the withdrawal of the arm 28 from the recess 31'. The operating member 19 is slidably arranged within the well defined by the upstanding surrounding wall 30 and in order to provide clearance for the movement of the release part 34 back and forth through the opening 35 said operating member is offset from the bottom wall 38 of the well, as indicated at 39. Guiding lugs 40 retain the slide in place.

In operation, and assuming the parts to be in the position shown in Fig. 1, the suction influence will be conveyed to the lower side of the piston 6 while the upper side is open to the at-

mosphere through port 13, thereby causing downward movement of the plunger 4 and a rocking of the bell crank lever 27, 28 to compress the left hand spring 22 until the recesses or notches 37 come to a position opposite the lugs 36 whereupon the latter will pass through the recesses under the urge of such spring. This passage of the lugs will shift the valve to uncover port 12 to the atmosphere and connect ports 14 and 17 while blocking or closing the port 13, whereupon the suction will be admitted to the upper end of the motor chamber 5 for creating the desired pressure differential with the atmospheric pressure entering the lower end of the chamber through port 9. During this upward movement of the motor the bell crank lever will release the spring 22 and compress the spring 23 while the keeper lugs 36 slide with increasing pressure against the left face of the keeper part 34 until such keeper lugs are free to pass across the lower end of said part under the urge of the spring 23, which action will return the valve 16 to the position illustrated in Fig. 1.

The cross head 31 may be replaced by another having a longer or shorter extension of the release part 34 to vary the motor stroke and consequently the fluid displacement of the plunger 4. From the foregoing it will be observed that the power actuator unit 6, 31 during the major portion of its movement on either stroke, will store up energy in one spring or the other to be subsequently expended when the keeper lugs 36 are released by the part 34. The energy storing mechanism has no part passing through a dead center position or any other position where it might become stalled against functioning to shift the valve.

While the foregoing description has been given in detail for clarity, it is not intended thereby to restrict the invention since the inventive principles involved may be applied to other physical embodiments without departing from the scope and spirit of the invention claimed.

What is claimed is:

1. Automatic valve action for reversing the application of fluid pressure to the opposite sides of a piston, or the like, comprising a movable valve member, an actuator slidable back and forth and having a relatively fixed arresting part, said valve member having a slide part connected thereto for movement in a path transverse of the path of said arresting part and engageable thereby first on one side and then on the opposite side to hold the slide part against movement first in one direction and then in the reverse, one of said parts straddling the other part with one part having oppositely disposed notches and the cooperating part having oppositely extending keeper lugs engaging said one part but passable through the notches to release said valve, and spring means conditioned by the actuator for moving the slide part back and forth in its transverse path when released by said arresting part.

2. Automatic valve action for reversing the application of fluid pressure to the opposite sides of a piston, or the like, comprising a movable valve member, an actuator adapted for movement back and forth by such piston, a slide member operatively connected to the valve member for shifting the latter back and forth between two operative positions, said slide member being in the form of an open frame through which the actuator moves at right angles to the path of movement of the frame, spring means

carried by the slide frame, and means operable by the actuator for storing up energy in the spring means, said actuator having a fixed part movable back and forth through the slide frame and cooperable with the latter for releasably holding the slide frame arrested until a predetermined energy storing operation has been determined.

3. Automatic valve action for reversing the application of fluid pressure to the opposite sides of a piston, or the like, comprising a movable valve member, an actuator adapted for movement back and forth by such piston, a slide member operatively connected to the valve member and slidable transversely of the path of the actuator back and forth between two operative positions, spring means carried by the slide member for actuating the latter, and means operable by the actuator for conditioning the spring means to so actuate said slide member, said actuator having an arresting part movable transversely across the path of movement of a co-operating part on the slide member for holding the latter arrested until said spring means have been conditioned and thereafter releasing said slide member part for the spring actuation of the slide member thereby disposing the slide member part on the opposite side of the actuator part for arresting the slide member against reverse movement until the spring means are again conditioned.

4. Automatic valve action for reversing the application of fluid pressure to the opposite sides of a piston, or the like, comprising a movable valve member, an actuator adapted for movement back and forth by such piston, a slide member operatively connected to the valve member for shifting the latter back and forth between two operative positions, and spring means carried by the slide member for actuating the latter, said actuator being in the form of a cross head having one arm acting upon said spring means to condition the same for so actuating the slide member and a second arm serving to hold the slide member against movement during the conditioning of the spring means and thereafter to release the slide member for spring actuation.

5. Automatic valve action for reversing the application of fluid pressure to the opposite sides of a piston, or the like, comprising a movable valve member, an actuator adapted for movement back and forth by such piston, a slide member operatively connected to the valve member for shifting the latter back and forth between two operative positions, spring means carried by the slide member for actuating the latter, said actuator being in the form of a cross head having one arm acting upon said spring means to condition the same for so actuating the slide member and a second arm serving to hold the slide member against movement during the conditioning of the spring means and thereafter to release the slide member for spring actuation, and a bell crank lever interposed between the spring means and the first arm for being rocked by the latter to so condition said spring means.

6. Automatic valve action for reversing the application of fluid pressure to the opposite sides of a piston, or the like, comprising a movable valve member, an actuator adapted for movement back and forth by such piston, a slide member operatively connected to the valve member for shifting the latter back and forth be-

tween two operative positions, and spring means carried by the slide member for actuating the latter, said actuator being in the form of a cross head having one arm acting upon said spring means to condition the same for so actuating the slide member and a second arm serving to hold the slide member against movement during the conditioning of the spring means and thereafter to release the slide member for spring actuation, said slide member having an opening through which said second arm operates, the opposite margins of the opening in the slide member being provided with opposed inwardly extending lugs, and said second arm having marginal recesses to pass the lugs from one side to the opposite side of the arm subsequent to a conditioning operation of the spring means.

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