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Dzaack et al.

[11] **3,872,732**

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[54] **DEVICE FOR MOVING THE PISTON ROD OF A PISTON PUMP**

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[52] **U.S. Cl.** **74/25**

[51] **Int. Cl.** **F16h 21/16**

[58] **Field of Search** 74/25, 100, 568, 56

[56] **References Cited**

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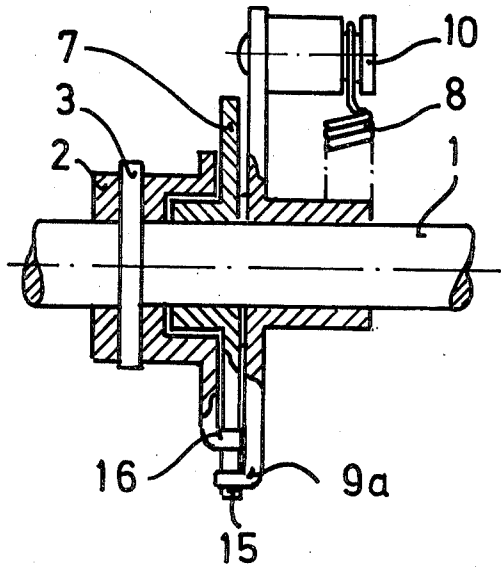
Primary Examiner—Wesley S. Ratliff, Jr.

[57] **ABSTRACT**

A device for moving the piston rod of a pump in reversible longitudinal directions consists of a reversibly rotatable shaft having a radially projecting driving member secured thereon; the shaft also rotatable carries a connecting member and a driven member, the latter being connected to the piston rod; the rotation of the shaft being transmitted by the driving member to the driven member through the connecting member by springs which equalize the forces regardless of the length of the stroke of the piston rod.

2 Claims, 2 Drawing Figures



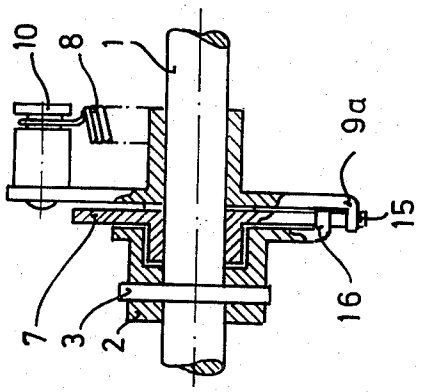
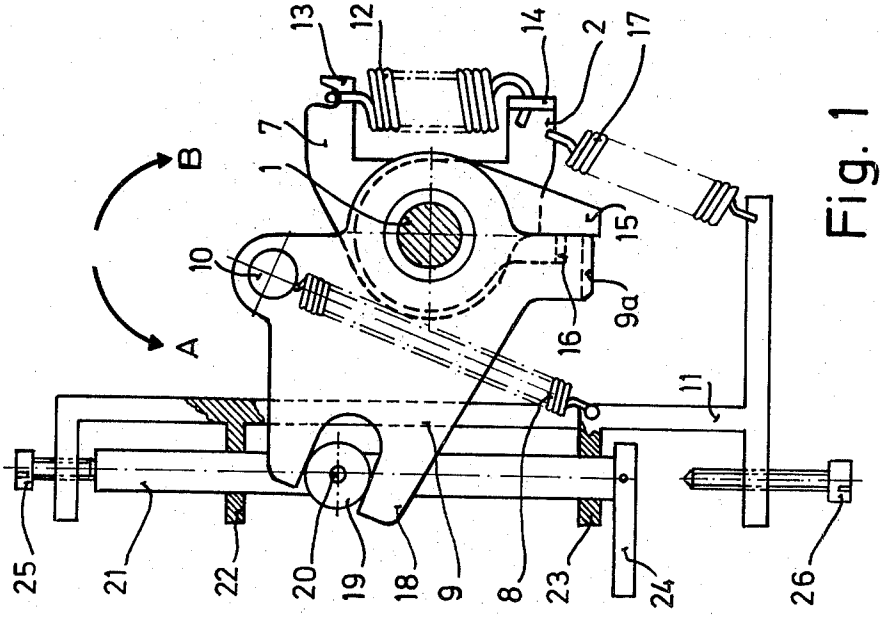

10
8
1
9a
15
16
7
3
2

Fig. 2


13
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14
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B
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Fig. 1

DEVICE FOR MOVING THE PISTON ROD OF A PISTON PUMP

The present invention refers to a device for moving of the piston rod of a piston pump, for instance for use in diluting different liquid volumes in clinical laboratory investigations.

As a result of the heavily increasing quantities of samples in the clinical laboratories in recent years the requirements for a higher degree of automization of the analysis methods used have increased. In a great number of analyses a well-defined quantity of a reagent is added to a liquid sample, the effect of the reagent on these samples thereafter being studied e.g., by means of optical methods. In order to automate this process there is a required a diluting device by means of which a well-defined quantity of the reagent can be added to the samples. The accuracy of this amount will have to be high for big as well as for small volumes and furthermore the adding of the reagent has to be fast in view of the enormous quantities of samples often at hand. It is furthermore important that the reagent is added smoothly since it is otherwise difficult to get the sufficient accuracy. Usually the dilution consists in connecting a reagent vessel to a piston pump which via a valve sucks a well defined quantity of the reagent into the pump cylinder and then sprays the reagent into the sample vessel. The piston is thereby usually driven from a shank excentrically journalled on a rotating disc, the shank being connected to the piston rod. In such a device a smooth dilution will be obtained, since the velocity of the piston will approximately follow a sine curve. The drawbacks of such a device are however that it is difficult to obtain small diluting volumes of high accuracy and furthermore the diluting time will be the same for all volumes. Furthermore, the driving disc has to be stopped at the ends of the piston stroke in order to make it possible to switch the valve from intake to spray position or vice versa.

It is an object of the present invention to provide a driving means for a piston pump wherein the above mentioned drawbacks are eliminated. The characteristics of the invention will appear from the claims attached to the specification.

The device according to the invention will now be described in detail, reference being made to the enclosed drawing, in which:

FIG. 1 is a side view of a device according to the invention and

FIG. 2 is a cross-section along the driving axis at the device shown in FIG. 1.

In FIGS. 1 and 2, reference 1 denotes a driving shaft, which is alternatively rotated in opposite directions from a driving means not shown in the figures. To the shaft there is atttached a driving disc 2 by means of a connecting pin 3. Close to the driving disc 2 a connecting disc 7 is journalled on the shaft 1. The driving disc 2 and the connecting disc 7 are resiliently engaged to each other by means of a draw spring 12, having one end connected to the spring mounting 13 of the disc 7 and its other end connected to the spring carrier 14 of the disc 2. By means of the tension of the spring 12 a shank 15 of the disc 7 is pressed against a bent portion 16 of the disc 2. The shaft is further provided with a driven plate 9 journalled on the axis and provided with a bent portion 9*a* which is pressed against the shank 15 of the connecting plate 7 by means of a spring 8 having

one end connected to a spring pin 10 of the driven plate 9 and the other end connected to a stationary frame 11. Furthermore a spring 17 is connected between the driving disc 2 and the frame 11, the spring force of the spring 17 affecting the device in a direction opposite to the direction of the force from the spring 8.

The driven disc 9 is provided with a protruding fork-shaped part 18 which engages a roll 19 journalled on a shaft 20 attached to a rod 21 which is axially movable within two guidings 22 and 23 respectively. The rod 21 is provided with an extension arm 24 to which the piston rod (not shown) can be connected. The displacement of the rod 20 is limited by two screws 25 and 26, the screw 26 in practice consisting of a number of stop pins at different levels so as to make it possible to obtain different strokes of the rod 21.

The device described above operates as follows. If it is assumed that the rod 21 is in the position shown in FIG. 1 and the shaft 1 is driven in the direction of the arrow A, the driving disc 2 which is attached to the shaft will also turn and consequently also the connecting disc 7 and its shaft 15. When the shaft 15 is moving in the direction of the arrow A, the spring 8 will move the driven disc 9 in the direction of rotation of the shaft 1 and the spring 17 will be stretched. The rod 21 will thus move downwards till the arm 24 meets the screw 26. At this point the driven plate 10 will stop whereas the driving plate 2 and the connecting plate 7 will move on till the direction of rotation of the shaft 1 is reversed. At this point of time the bent portion 9a of the driven plate 9 has been disengaged from the shank 15 of the disc 7.

When the direction of rotation of the shaft 1 has been reversed the driving disc 2 and the connecting disc 7 will move back in the direction of the arrow B. The driving means for the shaft 1 will then be assisted by the force from the spring 17. When during this movement the shank 15 reaches the bent portion 9*a*, the driven disc 9 and thus the rod 21 will be moved upwards. This movement continues till the rod 21 reaches the screw 25. Thereby the movement of the driven disc 9 ceases and thus also the movement of the disc 7, since the shank 15 is engaged to the bent portion 9*a*. The driving disc 2 will however continue its rotation since it is fixed to the shaft 1. Thereby the spring 12 is stretched, i.e., that the bent portion 16 is disengaged from the connecting disc 7. The stretching of the spring will continue till the direction of rotation of shaft 1 is reversed. After this reversal the bent portion 16 will eventually engage the shank 15 and the process described above will be repeated.

In the device described above one can simply achieve an adjustment of different desired strokes of the rod 21 and thus the stroke of a piston connected to the rod via the extension arm 24. This could be achieved by replacing the single screw 26 by a number of screws of different length which by means of push buttons can be introduced into the frame 11. By means of moving the screw 25 one could then make a final adjustment of the different volumes. A further advantage of this device consists therein that the motor driving the shaft 1 will have approximately the same load during each of the half-cycles of the movement of the rod 21 since the force of the spring 17 has a direction opposite to the force of the spring 8. A further advantage is that the shaft 1 continues its rotation after the rod 21 has stopped and this movement of the axis could be used

for switching the valves in the pump, e.g., for switching the valve to the intake position after a spraying cycle but before the axis is stopped in the position where the direction of rotation is reversed. This is very advantageous in such devices where the liquid storing vessel is directly connected to the pump and the pump is moved from the frame together with this vessel. If the valve is not switched there is otherwise the risk that when storing the pump and vessel, liquid is sprayed from the pump, e.g., due to changes of temperature or minor movements of the piston.

We claim:

1. Device for moving the piston rod of a piston pump, wherein a piston driving rod is axially movable between two stops, at least one of said stops being movable for obtaining different piston strokes, characterized in,

that it comprises an alternatively in two directions of rotation driven shaft, provided with a driving disc, a connecting disc, journalled on said shaft and resiliently engaged to said driving disc and a driven disc journalled on said axis and engaged to said rod so as to move the rod axially when rotated with said shaft, said driven disc being engaged to said connecting disc by means of a spring connected between said driven disc and a mounting which is fixed in relation to the rotation of said shaft.

2. Device according to claim **1,** characterized in, that it is provided with a spring connected between said driving disc and a mounting which is fixed in relation to the rotation of said shaft.

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