Aug. 11, 1953 E. F. N. McGAUCHIE 2,648,198

MEANS FOR AUTOMATICALLY VARYING THE STROKE OF PUMP RODS OR LIKE RECIPROCATING MEMBERS

Filed July 25, 1951 2 Sheets-Sheet 1

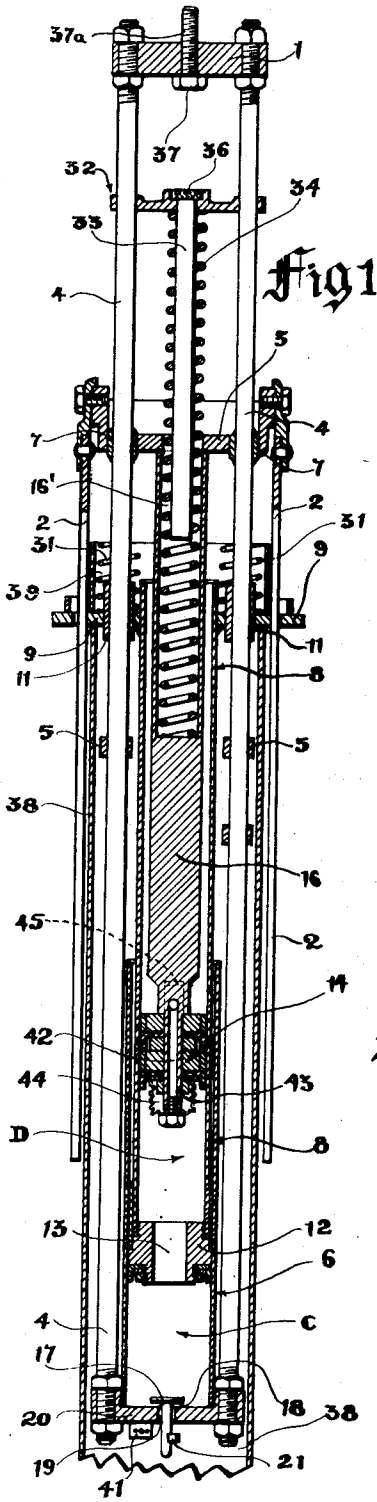


Fig1

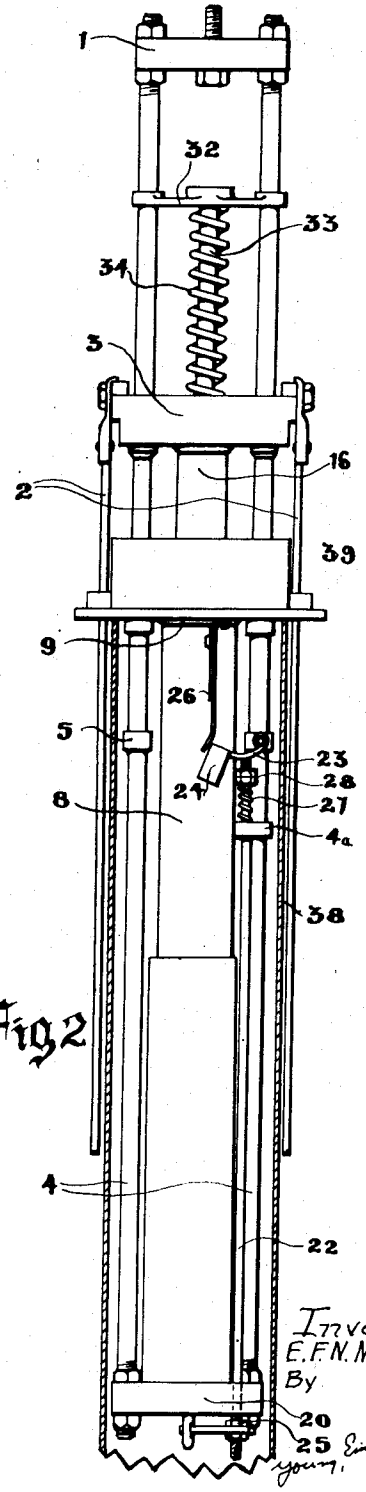


Fig2

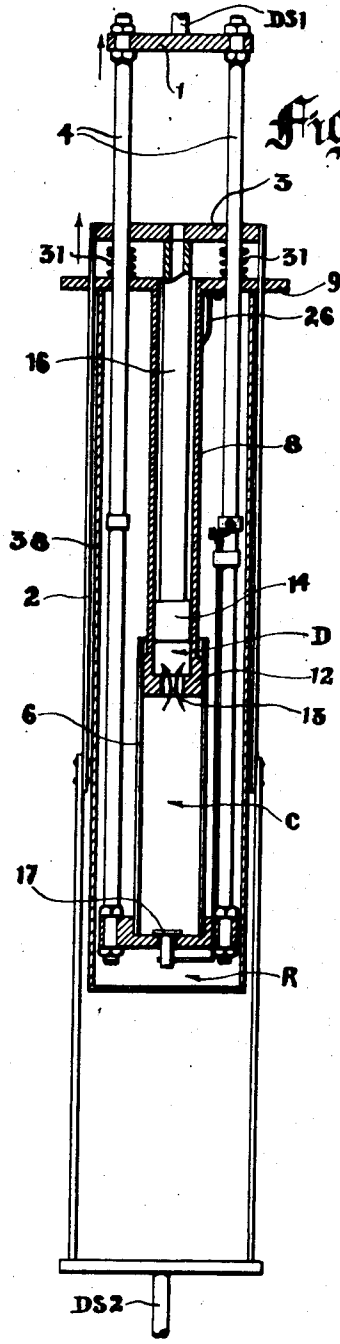
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Fig 3



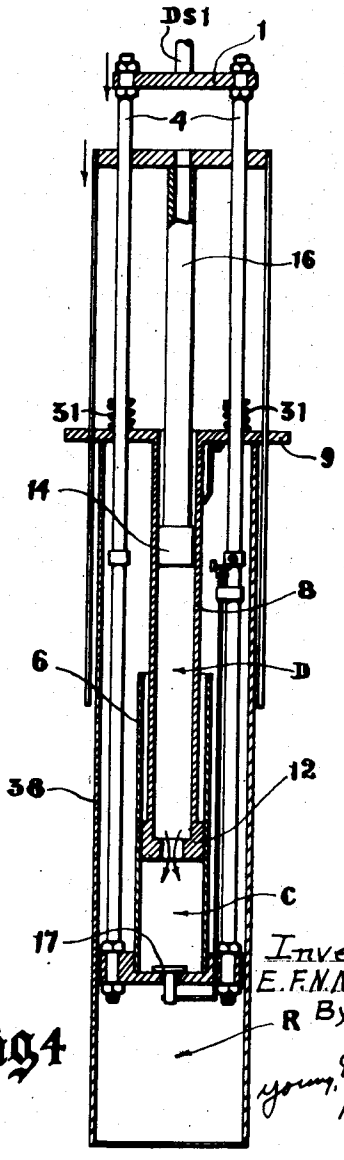


Fig 4

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MEANS FOR AUTOMATICALLY VARYING THE STROKE OF PUMP RODS OR LIKE RECIPROCATING MEMBERS

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12 Claims. (Cl. 60—54.5)

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This invention relates to improved means for automatically varying the stroke of pump rods or like reciprocating members and is particularly applicable to, though not necessarily limited to, the pump rods of windmills.

The invention relates to an improvement on that kind of apparatus utilizing hydraulic or fluid operated means for varying the stroke of a pump or like reciprocating part according to circumstances, such as for example as disclosed in my prior Patent No. 2,135,011. More specifically the present invention relates to improvements in the construction and operation of the general kind of apparatus as disclosed in my said previous specification.

It is an object of the present invention to devise an improved means for automatically varying the stroke of pump rods or like reciprocating members characterised by a relatively simple and compact construction and capable of more efficient operation under various conditions of use.

In apparatus according to said prior specification a valve control was operated by wind velocity actuating a wind vane and the present invention proposes an improved means for the purpose specified and including a valve which is automatically controlled and operated according to the operative speed of the driving section of a pump rod.

The invention may be said to comprise improved means for automatically varying the stroke of the driven section of a pump rod or the like, having driving and driven sections, comprising major and minor cylinders mounted in longitudinal alignment, the minor cylinder being stationarily mounted by one end and provided at its remote end with a stationary piston or plunger having an aperture longitudinally therethrough and encompassed by a movable barrel constituting the major cylinder, the major cylinder being adapted to be reciprocated by the driving section of the rod, a valve device mounted in the otherwise closed end wall of the major cylinder which is arranged to be immersed in a fluid, and a piston or plunger within the minor cylinder operatively connected to and adapted to impart reciprocating motion to the driven section of the rod.

In order that the invention will be more readily understood reference will be made to the accompanying drawings which show a practical embodiment of the invention which is at present preferred.

Referring to the drawings which form part of this specification:

Figure 1 is a vertical sectional view of the embodiment with portion of a casing broken away.

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Figure 2 is an elevation similar but unsectioned to the view shown in Figure 1.

Figures 3 and 4 are semi-diagrammatic views showing the embodiment in two phases of operation.

Referring now to Figure 1 the driving section of a pump rod is adapted to be connected to a yoke 1 by bolt 37a and the driven section of the rod is adapted to be connected to the lower ends of a pair of connecting bars 2 which depend from a uniting yoke 3 (the connection of the driving section DS1 of the pump rod and driven section DS2 of the rod is better shown in Figure 3).

A pair of rods 4 extend from the yoke 1 to the lower end wall 20 of a major cylinder 6 and are secured to the latter.

The rods 4 and cylinder 6 are vertically reciprocable and to enable such a movement the yoke 3 is provided with bearing apertures 7 through which the rods may reciprocate.

A minor cylinder 8 is mounted in longitudinal alignment with the major cylinder 6 and the upper end of the minor cylinder 8 is secured to a bracket 9 which is adapted to be mounted and secured to a windmill frame or like fixed structure. Thus the minor cylinder 8 is stationarily mounted. Bearing apertures 11 are provided in the bracket 9 through which the rods 4 are freely reciprocable.

Abutments or flanges 5 are formed on each of the rods 4, positioned so as approach closely but not actually engage against the underside of the bracket 9 when the driving section is at its upper limit of stroke.

The lower end of the minor cylinder is provided with a piston or plunger 12, with an aperture 13 therethrough, which piston is a neat fit in and encompassed by the major cylinder 6. For this purpose the piston or plunger 12 may be provided with cup leathers, rings or such devices to form a substantially fluid tight fitting in the cylinder.

A piston or plunger 14 is provided in the minor cylinder to be reciprocable therein and this piston 14 may also be provided with cup leathers, rings or the like to form a substantially fluid-tight fit. The piston 14 is secured to the lower end of a rod 16 the upper end of which is secured to the yoke 3.

A valve device 17 is mounted in the lower end wall 20 of the major cylinder 6.

The valve device 17 is desirably of the flat seating kind, i. e., is provided with an annular facing adapted to seat on an annular seating. A relatively small bleed indent or recess, indicated

at 18, is provided on the facing of the valve for a purpose later indicated.

The valve is reciprocable axially within an aperture 19 formed in the end wall 20 of the major cylinder and is influenced towards an open condition by a spring or like member, but means are provided to ensure that the valve will be positively and mechanically influenced to a closed state under certain conditions.

Such means includes a bar 21 (see Figure 2) engaged in a slot in the stem of the valve and mounted on the lower end of a rod 22 the upper end of which is adapted to be engaged and influenced by a pivoted arm 23 provided at its outer end with a cam follower member 24 which is adapted to engage on a ramp or cam face strip 26, constituting a stationary ramp member, which is preferably adjustable for length according to working conditions required.

The rod 22 and the pivoted inner end of the arm 23 are mounted on and carried by one of the rods 4 (the rod 22 being axially movable within bearing holes in wall 20 and in lug 4a outstanding from the rod 4) and are reciprocable with the major cylinder and those rods 4. When these latter parts are approaching the upper end of a stroke the cam follower 24 will engage the ramp or cam face 26 and thereby cause the rod 22 to be moved downwardly and effect a closure of the valve device 17.

The rod 22 is provided with a compression spring 27 and a screw and a nut adjustment device 28, the spring being to ensure that the rod is normally influenced upwardly, and the valve opened, and the screw and nut device being to enable an adjustment of the operative effect of the spring on the valve 17, in accordance with varying conditions of operation in service. Adjustment means, indicated at 25, are also provided on rod 22 by which means the maximum displacement of the valve above its seat may be varied in accordance with requirements.

Thus the major cylinder may be reciprocated with the rods 4 by the driving section DS1 of the pump rod, and that movement of the piston 14 will be conveyed by the rod 16, yoke 3 and connecting bars 2 to the driven section DS2 of the pump rod.

Means such as compression springs 31 may be mounted on the upper side of the bracket 9 to provide a resilient stop for the yoke member 3 and driven section of the pump rod when it approaches its lower extremity of travel.

A bridge member 32, slidable on the rods 4, has a downwardly depending stem 33, encompassed by a spring member 34 which is adapted to be accommodated in a tubular portion 16' of the rod 16. The upper central surface of the bridge member 32 is provided with a rubber or like resilient insert 36 which is adapted to engage on an abutment 37 on the underside of the yoke 1, the purpose of these parts being to provide resilient means to positively influence the yoke 3, rod 16, piston 14, and the driven section DS2 of the pump rod downwardly when the driving section DS1 (including the yoke 1) is travelling downwardly. Under normal conditions the driven section will move downwardly by gravity.

A casing 38 is secured to and depends downwardly from the bracket 9 and the casing is adapted to contain a quantity of oil or other suitable fluid up to a level to ensure that the lower end of the reciprocable major cylinder is at all times immersed therein. The bars 2 connected

to the driven section DS2 of the pump rod are mounted externally of the casing.

Ventilating ducts (for clarity not shown in the drawings) are formed through the bracket 9, and a cup-like wall 39 extends around the upper portion of the bracket 9 to restrain oil which may be "pumped" to above the bracket from running onto the exterior of the casing, and openings are provided through the bracket to drain such oil back into the interior of the casing.

The bore diameters of the major cylinder 6 and the minor cylinder 8 are desirably in the approximate ratio of 1¼:1 respectively.

In operation, and referring more particularly to Figure 3 with the assumption that the driving section DS1 of the pump rod, and the major cylinder, are moving upwardly at an appropriate speed the velocity or flow of oil or fluid escaping from a lower chamber C in the major cylinder will influence the valve 17 towards a closed condition by hydrodynamic forces and oil or fluid will be displaced through the aperture 13 into a chamber D in the minor cylinder above the piston 12. Depending upon the speed and power of the driving section so will valve 17 be influenced more or less quickly into a seated condition, against the influence of spring 27, and thus less or more fluid will escape through the valve 17 back into the reservoir R in the casing and more or less fluid will be displaced into the chamber D to move the piston or plunger 14, and the driven section DS2 of the pump rod, upwardly.

Thus, when the driving section DS1 moves upwardly relatively quickly, the valve 17 will be caused to be seated promptly (as shown in Figure 3) enabling maximum displacement, of fluid, length of stroke, speed and power to be imparted in an upward direction to piston 14 and the driven section DS2 of the pump rod.

When the driving section DS1 is moving upwardly relatively slowly, as will be the case when actuated by a windmill driven by a relatively low velocity wind, a major proportion of the oil or fluid will escape from the chamber C through the open valve 17 (which in those circumstances will be open by influence of spring 27) and thus no movement will be imparted to the driven section DS2 of the pump rod until such time as the driving section approaches its upper end of travel whereupon the cam follower 24 will engage on the ramp 26, cause the valve 17 to be seated, and a limited but positive impulse will be imparted to the driven section DS2 of the pump rod.

Referring now to Figure 4, and assuming that the driving section of the pump rod and the major cylinder are moving downwardly, the driven section of the pump rod and operative parts connected thereto will normally be influenced downwardly by gravity, but to ensure positive downward movement of those parts if not effected by gravity the abutment 37 (see Figure 1) on the driving section will engage with the resilient insert 36 on the bridge member 32 and influence the rod 16, connected to the driven section, downwardly by medium of the spring 34.

Under normal operative conditions, the weight of the driven shaft when moving downwardly will maintain pressure on the fluid in chambers C and D, and the valve 17 will be retained seated by hydraulic pressure in the chambers C and D until such time as the driven section reaches its lower extremity of stroke when its weight will be supported by the springs 31. If the driving section is positively influencing the driven section downwardly pressure will be released in chambers C

and D and the valve will open under the influence of spring 27 and permit fluid to pass from reservoir R into chambers C and D, which chambers will always be charged with fluid when in operation.

In the event that the driving section should become stationary during an upward stroke under load (i. e. by stopping of the windmill, for example) with the valve 17 seated the bleed indent 18 on the face of the valve will permit fluid to slowly escape from the chamber C into the reservoir R, and thus enable the piston 14 and the driven section of the pump rod to move slowly downwardly independently of the driving section and effect its downward stroke, whereupon in such circumstances, and pressure of fluid in the chamber C being relieved, as the driven section engages the springs 31 which will then support the weight of the driven section, the valve 17 will open under the influence of spring 27. Thus, the driving section will not be handicapped by a "load" when it resumes an upward stroke.

A safety valve device of any suitable kind, indicated at 41, may be provided in the lower end wall 20 of the major cylinder so that in the event of an abnormal pressure developing in the major cylinder, fluid may escape through the safety valve back into the reservoir, thus obviating any damage to operative parts.

The lower end of the rod 16, carrying the plunger 14, is preferably provided with an aperture 42 therethrough, the lower end having a relatively minute bleed hole 43 in communication with chamber D. The bleed hole and aperture, which is in communication with the upper portion of the minor cylinder 8 and open to the atmosphere, through a manually operable valve device 45, are proposed to ensure that any air which may be trapped in the chamber D, particularly when the apparatus is initially charged with oil and started in operation, may be permitted to escape and thus obviate any air lock in chambers C and D with the possibility of consequent inefficiency of the apparatus in operation. The lower end of the rod 16, around the bleed aperture 43, is provided with a protective wire gauze strainer 44 to prevent any foreign matter which may be in the fluid from blocking or restricting the aperture 43.

Suitable covers (not shown) to prevent or minimize the entry of dust and rain into the mechanism of the apparatus may also be provided.

It is to be understood that modifications may be made without departing from the spirit and scope of the invention as defined by the appended claims.

Having now described my invention, what I claim as new and desire to secure by Letters Patent is:

1. Improved means for automatically varying the stroke of the driven section of a pump rod or like reciprocating member having driving and driven sections, comprising major and minor cylinders telescopically arranged in relation to each other in a substantially vertical attitude, a stationary support, means for securing the minor cylinder to said stationary support, a piston stationarily mounted at the lower end of said minor cylinder, said piston having an aperture extending longitudinally therethrough, said major cylinder being a close sliding fit around said piston, means connecting the major cylinder to said driving section of the rod so that the major cylinder will reciprocate with the latter, the lower end of said major cylinder being closed with the exception of an aperture in its base, a valve device mounted in said aperture, a casing encompassing the lower portion of said major cylinder for containing a body of fluid, the lower end of said major cylinder being at all times immersed in said fluid, a piston reciprocable within the minor cylinder, and means for operatively connecting said piston to the driven section of the pump rod.

2. Improved means as claimed in claim 1, in which means are provided for mounting said valve device in said aperture in the base of said major cylinder so that said valve device is reciprocable axially within said aperture, and resilient means for yieldingly urging said valve device towards an open position.

3. Improved means as claimed in claim 1, in which means are provided for mounting said valve device in said aperture in the base of said major cylinder so that said valve device is reciprocable axially within said aperture, resilient means for yieldingly urging said valve device towards an open position, and adjustment means for adjusting the operative effect of the said resilient means on the valve device to provide for variable operative conditions under which the apparatus may be called upon to operate.

4. Improved means as claimed in claim 1, in which valve-closing means are provided to positively seat said valve device when the major cylinder and driving section of the rod are moving upwardly relatively slowly and approaching the upper limit of a stroke, said valve-closing means including a cam follower member pivoted on a part fixed relatively to the major cylinder and reciprocable therewith, a stationary ramp member mounted on said stationary support, the cam follower member being adapted to engage said stationary ramp member towards the upper limit of travel of the major cylinder, a rod for actuation by the cam follower member when the latter engages said stationary ramp member, a spring member for opposing actuation of the rod, and operative connections between the rod and the valve device to effect a seating of said valve device against the influence of said spring member when the said rod is actuated by the cam follower member.

5. Improved means as claimed in claim 1, in which valve-closing means are provided to close said valve device when the major cylinder and driving section of the rod are moving upwardly relatively slowly and approaching the upper limit of a stroke, said valve-closing means including a cam follower member pivoted on a part fixed relatively to the major cylinder and reciprocable therewith, a stationary ramp member mounted on said stationary support, the cam follower member being adapted to engage said stationary ramp member towards the upper limit of travel of the major cylinder, a rod for actuation by the cam follower member when the latter engages said stationary ramp member, a spring member for opposing actuation of the rod, and operative connections between the rod and the valve device to effect a seating of said valve device against the influence of said spring member when the said rod is actuated by the cam follower member, and in which an adjustable screw and nut arrangement is provided mounted on the rod and operatively associated with the spring member, said adjustable screw and nut arrangement constituting means for adjusting or varying the operative effect of the spring member on the valve device.

6. Improved means according to claim 1, in

which said valve device is provided with a relatively small bleed means.

7. Improved means as claimed in claim 1, in which resilient means are provided for yieldingly urging said valve device towards an open position, the strength of said resilient means being co-related to those hydrodynamic forces of the fluid which tend to influence the valve device towards a seated position at an optimum speed of the driving section so that said valve device will automatically control the amount of fluid which can pass said valve device into the minor cylinder to influence the piston reciprocable therein to transmit power from the driving section of the pump rod to the driven section thereof, in accordance with the operative speed of the said driving section.

8. Improved means as claimed in claim 1, in which a resilient member is provided interposed between the driving section and the driven section and constituting means to positively force the driven section downwardly when the driving section is travelling downwardly.

9. Improved means as claimed in claim 1, in which a resilient member is provided mounted on the stationary support for engagement by the driven section of the pump rod to thereby limit downward movement of said driven section.

10. Improved means according to claim 1, in which said stationary support comprises a bracket adapted for connection to a windmill frame, the minor cylinder being stationarily mounted on said bracket and the said casing depending from said bracket, and wherein said major cylinder is entirely mounted and reciprocable within said casing.

11. Improved means according to claim 1, in which said stationary support comprises a bracket adapted for connection to a windmill frame, the minor cylinder being stationarily mounted on said bracket and the said casing depending from said bracket, and in which said major cylinder is entirely mounted and reciprocable within said casing, and a cup-like wall is formed on the upper side of the bracket adjacent the upper extremity of the casing.

12. Apparatus for automatically varying the stroke of the driven section of a pump rod or like reciprocating member having driving and driven sections, comprising a bracket adapted to be supported by a fixed structure, a minor cylinder attached at its upper end to the bracket, a stationary piston mounted at the lower end of the minor cylinder, said stationary piston having an aperture extending longitudinally therethrough, a major cylinder encompassing said stationary piston, a connecting member connecting said major cylinder to the driving section of the pump rod to axially reciprocate the major cylinder, a piston mounted and reciprocable within the minor cylinder, a member connecting said last-mentioned piston to the driven section of the pump rod to impart reciprocatory motion thereto, a valve device mounted in the lower end of the major cylinder, an outer casing supported by and depending from the bracket for containing a body of fluid in which the lower end of said major cylinder will be immersed at all times, a resilient means for yieldingly urging said valve device towards an open condition, adjustment means for adjusting the operative effect of the said resilient means in the valve device, said valve device being influenced quickly into a seating condition by hydrodynamic forces of the fluid according to an appropriate speed and power developed by the driving section, and mechanical valve-closing means to effect seating of the valve when the major cylinder and driving section of the rod are moving upwardly relatively slowly and approaching the upper limit of their stroke.

ERNEST FRANCIS NAISMITH McGAUCHIE.

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