No. 662,515. Patented Nov. 27, 1900.

R. H. YALE.

PISTON STROKE REGULATOR.

(Application filed Oct. 10, 1899.)

(No Model.) 2 Sheets—Sheet 1.

Fig 3.

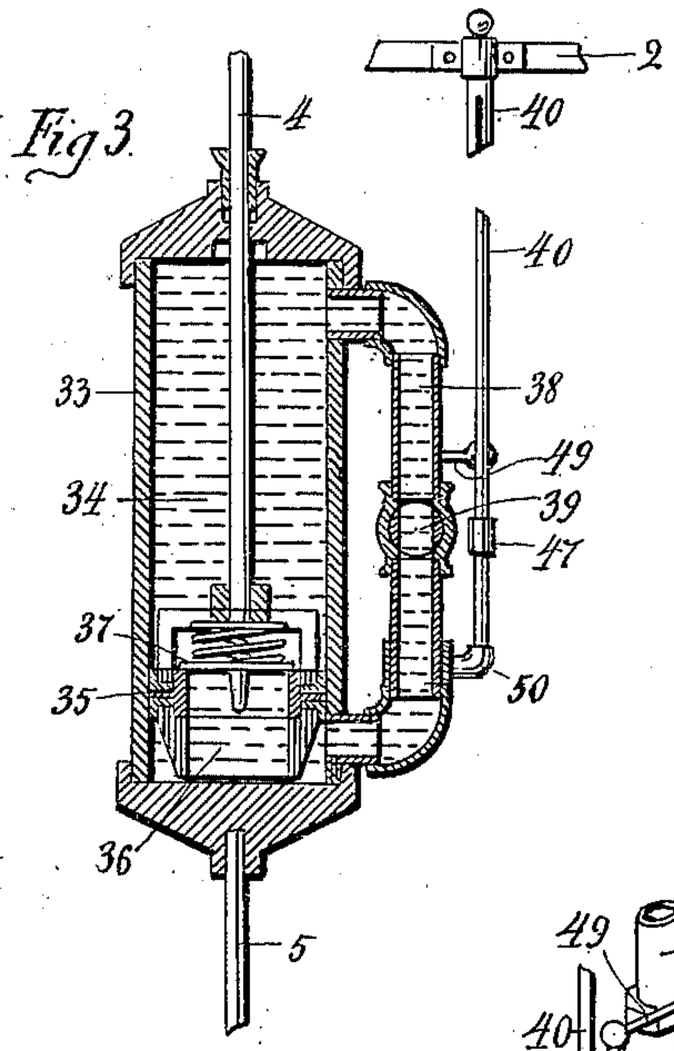
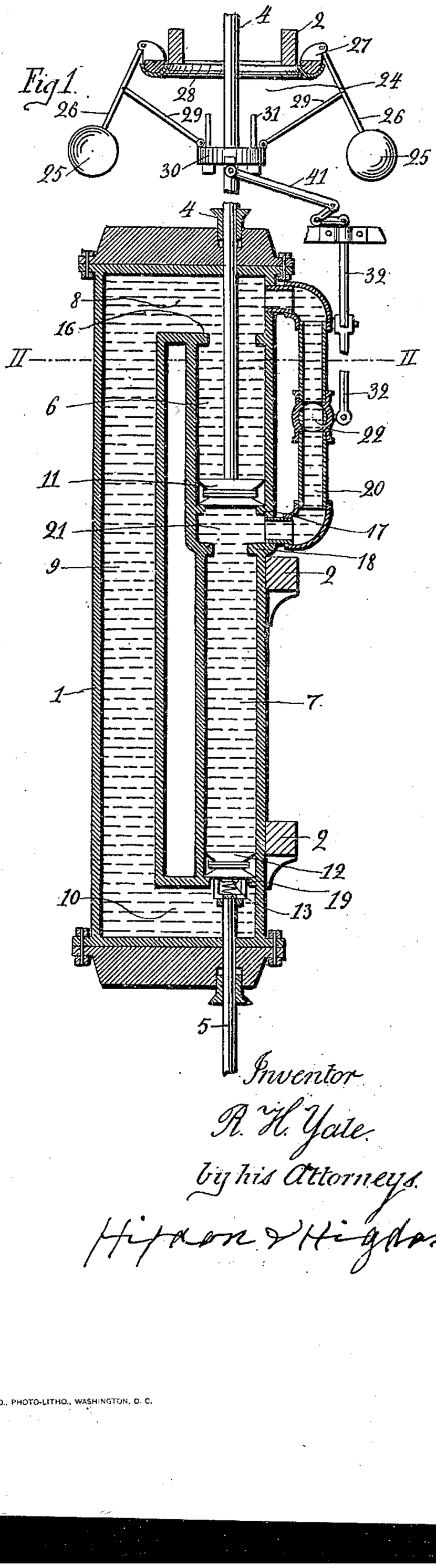


Fig 1.



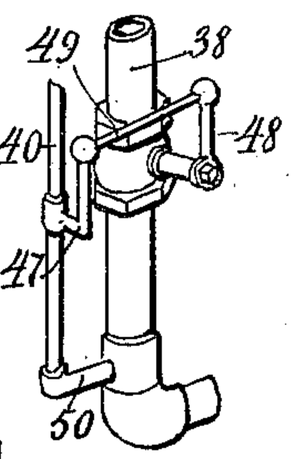
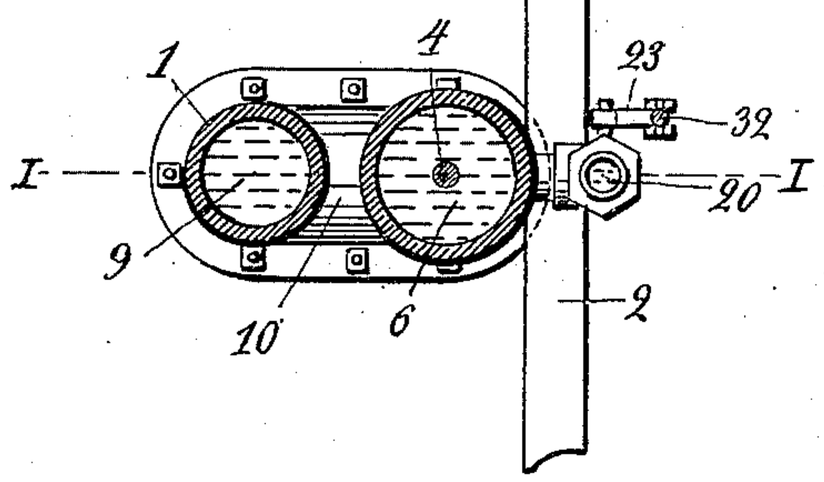


Fig 7.

Fig 2.



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(No Model.) 2 Sheets—Sheet 2.

Fig 4.

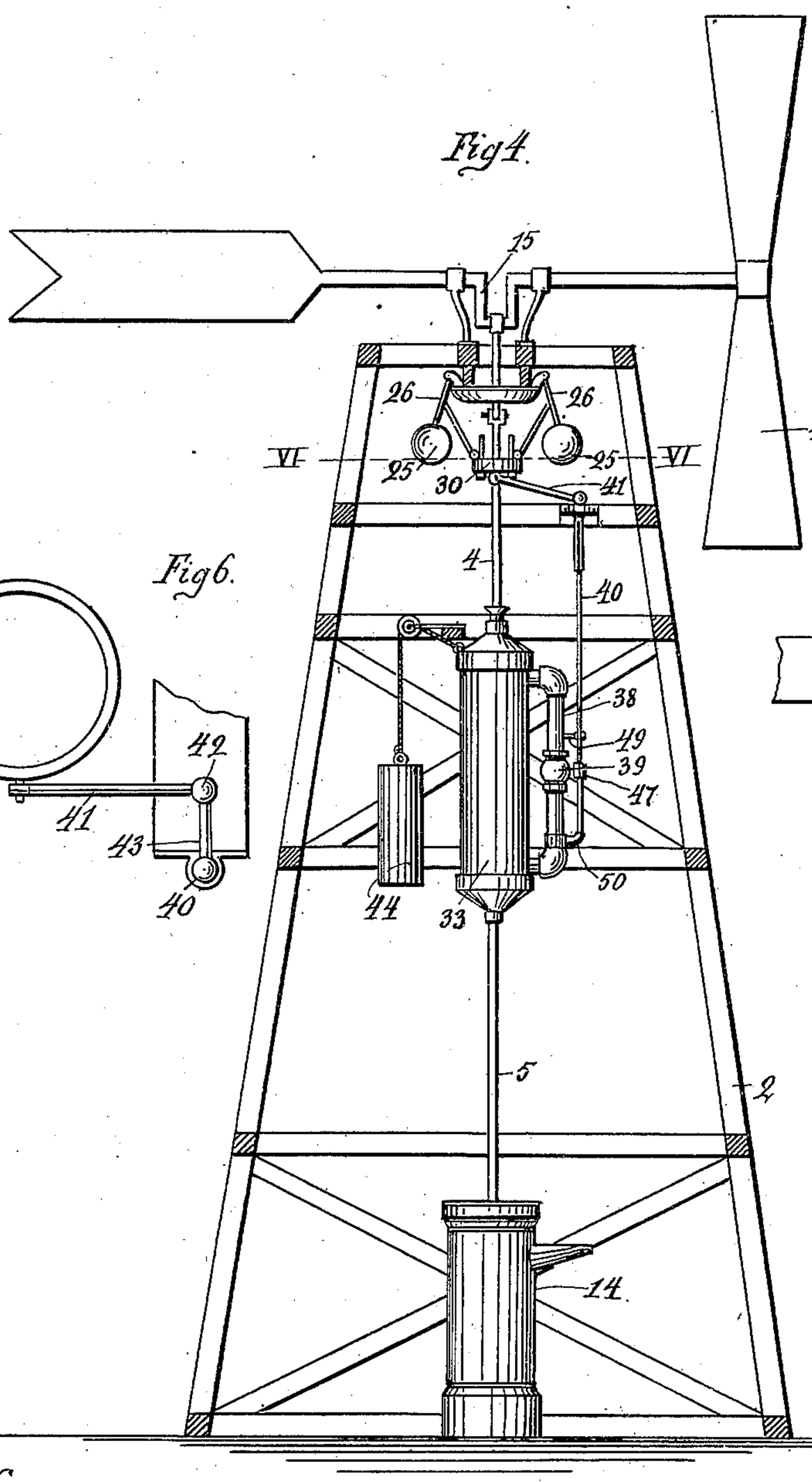
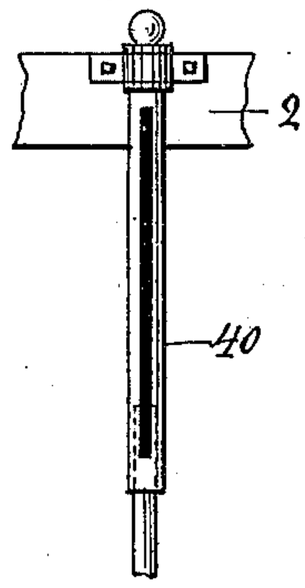


Fig 6.

Fig 5.



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UNITED STATES PATENT OFFICE.

RODNEY H. YALE, OF BEATRICE, NEBRASKA.

PISTON-STROKE REGULATOR.

SPECIFICATION forming part of Letters Patent No. 662,515, dated November 27, 1900.

Application filed October 10, 1899. Serial No. 733,154. (No model.)

To all whom it may concern:

Be it known that I, RODNEY H. YALE, of Beatrice, Gage county, Nebraska, have invented certain new and useful Improvements in Piston-Stroke Regulators, of which the following is a specification.

My invention relates to an apparatus for changing and regulating the length of the stroke of any piston-rod, pitman, pump-rod, or other similar device for imparting reciprocating motion; and it consists, substantially, in severing the rod at any convenient point between the power end and the working end of the same, thus leaving said rod in two divided sections and then interposing between such divided sections a body of liquid contained within an inclosed stationary or movable casing, within which casing and body of liquid a piston on the end of one or both of said sections of the rod operates, said casing being also so constructed and so connected with the sections of the rod that by the variation, either automatically or at will, of the hydrostatic or hydraulic pressure upon the liquid within such casing or the chambers thereof the two sections of the rod may be made to approach each other or recede from each other, to reciprocate in unison and equidistantly or with varying speed and at varying distances from each other, the effect being substantially to increase or decrease the total length of the rod, considered as a whole, including the two sections of the rod proper and also the interposed body of liquid, and thus correspondingly to increase or decrease the length of the piston-stroke, and therefore the amount of work done by the machine.

While my invention is capable of a wide range of uses, I have selected, for the purpose of convenient illustration and as a specially useful and advantageous application of the device, a windmill as the motive power, it being well known to all operators of such motors that it is often desirable and necessary, in order to obtain the most effective and economical work, to change the length of the stroke in the pump, according to the varying velocity of the wind, a high wind rendering a long stroke desirable, while a short stroke is more suitable in case of a light wind.

In the accompanying drawings, Figure 1 is a central vertical section through one form of my device on the line I I of Fig. 2, also showing, partly in section, a wind-actuated device for opening and closing a valve forming part of the apparatus. Fig. 2 is a cross-section on the line II II, Fig. 1, looking downward. Fig. 3 is a central vertical section of a modified form of the device shown in Fig. 4. Fig. 4 is a partially-sectional elevation of a windmill-frame and windmill with the form of my device shown in Fig. 3 attached thereto. Fig. 5 is a detail of a part of a telescoping and rotating valve-rod shown in Figs. 3 and 4. Fig. 6 is a view, looking downward at the line VI VI of Fig. 4, of a vertically-moving horizontal collar or ring and its connections which operate said valve-rod. Fig. 7 is a detail in perspective of the connections between said valve-rod and the valve shown in Fig. 3.

Referring to Fig. 1, 1 designates the preferred form of the hydraulic stroke-regulator, the same consisting of a metallic casing entirely filled with liquid and securely fastened to stationary supports 2 on a windmill-frame between two divided sections 4 5 of a pump-rod. Said casing is formed to contain two piston chambers or cylinders 6 7, in axial alinement with each other and opening into each other end to end, and also connected by free passage-ways 8 9 10 and fitted with movable pistons 11 12. Said cylinders and said pistons are of different diameters, the intention in the present instance being to represent piston 11 as having double the area of piston 12 and cylinder 7 of double the length of cylinder 6. Piston 12 contains a central passage-way provided with a spring-pressed valve 13, opening outwardly into passage 10, and said piston is rigidly connected to the piston-rod 5, which drives the pump 14. The piston 11 is mounted on the piston-rod 4, which is connected to the crank 15 of the windmill. The rods are furnished with the usual packing-boxes where they pass through the top and bottom of the casing.

The cylinders 6 7 are provided at top and bottom with inwardly-extending flanges or shoulders 16 17 18 19 to form seats for the pistons 11 12 and limit their movements.

The cylinder 6 and passage 8 are also provided with a connecting-pipe 20, external to the cylinder, extending from a point in the

casing above the highest point reached by piston 11 to an intermediate chamber 21 between cylinders 6 7. Said pipe is fitted with a cock or valve 22, controlled by an extending lever 23, Fig. 2.

24 designates a device to be driven by the wind, consisting principally of the disks 25, which are supported by arms 26, hinged to a ring 27, which revolves in and is supported by a concave ring 28, secured to the windmill-frame. Said arms are also hinged by secondary arms 29 to the movable collar 30, which is prevented from swinging laterally by the stationary guides 31. The movable collar 30 is connected to the cock or valve 22 by a pivoted arm 41, which actuates rod 32 longitudinally, by means of a bell-crank 51, in such a manner as to reduce or close the passage through said cock or valve as the movable collar 30 is carried upward by the disks 25 when revolved by the wind at such a velocity that the centrifugal force throws them outward and upward.

Figs. 3 and 4 show a modified form of the device, in which the casing 33 contains a single cylindrical chamber 34, filled with liquid and fitted with a single piston 35, mounted on the piston-rod 4, which passes through a stuffing-box in the top of the casing and upward to the windmill-crank 15. The lower or pump section of the piston-rod 5 does not enter the cylinder in this case, but is rigidly secured in the lower end of the casing. Piston 35 is provided with a central passage-way 36, having a spring-pressed valve 37, opening inward toward the cylinder.

The connecting-pipe 38 opens into the cylinder 34 at two points, one above and the other below the limit of movement of the valve in piston 35, and said pipe is provided with a cock or valve 39, connected by a rotating rod 40 to the device 24, heretofore described in connection with Fig. 1. In this form of the device, however, inasmuch as the casing 33 is not stationary, but moves up and down with the piston-rod 5, the valve-rod 40 is made in two sections, one of which telescopes within the other, as shown in Fig. 5. In this form a connection is provided between the ring or collar 30 and valve-rod 40, consisting of a pivoted arm 41, universal joint 42, and lever 43, as shown in Fig. 6, whereby a rotary motion is communicated to rod 40 to open or close valve 39. In order to facilitate its upward and downward movements, casing 33 is also provided with a counterweight 44, acting in the usual manner.

In the operation of the forms of the device shown in Figs. 1 and 2 it will be seen that the upper section 4 of the piston-rod and piston 11 in cylinder 6 are at the lowest points reached in the stroke of the windmill-crank. Now if the wind-wheel 45 is turned its crank 15 will draw rod 4 upward and also piston 11 until the crank reaches its highest point and piston 11 reaches the limit of its stroke at flange 16. Every part of the cylinders 6 7 and the passages 8 9 10 being filled with liquid and cock 22 closed it will be seen that when piston 11 moves upward, the casing 1 being fixed in a stationary position, it forces the liquid above it in cylinder 6 to move upward, and this pressure is transmitted by the liquid in passages 8 9 10 to piston 12 in cylinder 7, thereby causing it to move upward and draw with it piston-rod 5, and as piston 12 is of less diameter than piston 11 and cylinder 7 of correspondingly less diameter than cylinder 6 it follows, in accordance with a well-known law of hydraulics, that piston 12 must move a greater distance than piston 11. For example, if piston 12 is only one-half the area of piston 11 it must move twice as far, and if piston 11 moves upward eight inches piston 12 must move upward sixteen inches or to the limit of its stroke at flange 18. Now the two pistons 11 12 having reached their highest points, with the windmill-crank 15 at its highest point, the crank begins its downward movement and through the rod 4 forces piston 11 to move downward to the position shown in Fig. 1, meanwhile forcing the liquid below it in cylinders 6 and 7 to move and transmit power to piston 12, driving it back in the manner in which it was raised to the position shown in Fig. 1.

It will be seen in the operation just described that while the crank of the windmill and the upper section 4 of the piston-rod moved in a complete upward-and-downward stroke of eight inches the lower section 5 of the rod connected with the pump 14 moved in a complete upward-and-downward stroke of sixteen inches, and it thus appearing how this form of the regulator lengthens the stroke, executing work beyond the normal, the manner in which the stroke is decreased to the normal length of stroke of the power or below the normal will be more readily understood.

If when the piston 11 starts on its upward stroke the cock or valve 22 is opened sufficiently to permit seven-eighths of the liquid in cylinder 6 to pass from the space above the piston to the space below it through connecting-pipe 20 while said piston is moving to its upper limit at flange 16, it will be seen that piston 12 will only be forced to move upward one-eighth as far as it did when valve 22 was closed and that it has only moved two inches while piston 11 moved eight inches, and, conversely, if valve 22 remains open while piston 11 is moving downward on its return stroke to its original position the surplus liquid between the two pistons passes through pipe 20 and piston 12 is only forced downward two inches to its original position, as in Fig. 1.

The office of the valve 13 in piston 12 is to provide an outlet through the piston for the surplus liquid between the pistons in case the valve 22 should be closed after piston 12 reaches its upper limit or while it is moving downward. It will thus be understood that

by partly opening or closing the cock or valve 22 the length of stroke of the lower section 5 of the piston-rod may be varied from a minimum of two inches to a maximum of sixteen inches, while the upper section 4 of the rod is moving regularly at an eight-inch stroke.

The valve 22 is represented in the drawings as operated by the wind-actuated device 24, as hereinbefore described; but it may be operated by any other suitable device or by hand.

In considering the operation of the modified form shown in Figs. 3 and 4 it will be borne in mind that the casing 33 is rigidly connected to the lower or working section 5 of the rod and moves with it. Said figures represent the piston-rod 4 and the piston 35 in the cylinder 34 as being at the lowest point reached during the motion of the windmill-crank 15. If that motion continues, rod 4 and piston 35 will be drawn upward until the crank reaches its highest point; but inasmuch as cylinder 34 and connecting-pipe 38 are filled with liquid and valve 39 closed the piston 35 does not move in cylinder 34, but carries the casing 33 and all connections, including piston-rod 5, along with it. The crank then begins its descent and through rod 4 presses piston 35 against the bottom of cylinder 34 and carries the casing and connections back to first position.

It will be seen that in the operation just described the crank moved the piston-rod 4 and the piston 35 in the same way and the same distance that they would have been moved were the casing 33 entirely absent and the rod made continuous throughout. If, however, when rod 4 and piston 35 start on their upward stroke the valve 39 is opened sufficiently to permit enough of the liquid above piston 35 to pass around below said piston during its upward stroke to allow it to slide upward in cylinder 34 six-eighths of the total distance it is carried upward by the crank, it will be seen that though piston 35 and rod 4 are carried up eight inches the lower section 5 of the rod is only carried upward two inches. The crank then moves downward and piston 35 is pressed against the liquid, forcing six-eighths of it back through the connecting-pipe 38, and piston 35 is carried down six inches to its original position. As in the case of the other form, a valve 37 in the piston is provided, but in this case opening inwardly to permit the liquid to pass through the piston in case valve 39 in the connecting-pipe should be closed before or during the downward stroke. It will thus be seen that by partially or fully opening valve 39 the length of stroke of piston-rod 5 may be changed or varied from a minimum of two inches to a maximum of eight inches, while piston-rod 4 is moving regularly at an eight-inch stroke.

As in the preceding case, the valve 39 may be operated by the wind device 24 or in any other preferred manner or by hand. Fig. 7 shows in detail a method of transmitting the rotary motion of the valve-rod 40 to the valve 39 by means of the rigid arm 47 on rod 40, the lever 48 on the valve-stem, and a cross-rod 49, connected at each end to said arm and lever by universal joints. The valve-rod 40 is supported in a socket 50, mounted on pipe 38.

In the operation of either form of the device in connection with a windmill it will be observed that the closing of the valve in the connecting-pipe, so as to prevent passage of liquid from one side of the piston to the other, lengthens the stroke of the pump-rod and that opening said valve, and thus equalizing the pressure on opposite sides of the piston to a greater or less extent, shortens the stroke. The wind-actuated device 24 and its connections with the valves in the connecting-pipes are therefore so adjusted that a high-wind velocity closes the valve partially or wholly and a moderate velocity opens it in like manner. In the first form, as shown in Fig. 1, the preferred normal adjustment is for a medium stroke the length of which may be either increased or decreased. In the second form, as in Fig. 2, the normal is for a moderately-long stroke which by the operation of the valve may be shortened.

Any preferred liquid for filling the casings may be employed in the operation of my device, but I have found some variety of oil to be the most advantageous.

It is obvious that the dimensions of parts stated and the adjustments indicated herein are only illustrations, and that the same may be varied indefinitely, according to circumstances and the character of the work to be done. It is also apparent that in the general application of the device it might be arranged to operate horizontally or in any other desired position as well as vertically.

I claim as my invention and desire to secure by Letters Patent—

1. In a reciprocating-rod mechanism, the combination with a rod divided into two sections of a stroke-regulator interposed between and connected with said sections, the same consisting of an inclosed casing containing a piston-chamber into which one section of the rod extends, a piston mounted on said section, within the chamber, having a valved opening, a body of liquid within said chamber, and a valve-controlled passage-way for passing said liquid from that part of said chamber being subjected to pressure to that part of said chamber not being subjected to pressure, substantially as set forth.

2. In a reciprocating-rod mechanism, the combination, with a rod divided into two sections, of a stroke-regulating device, the same comprising a stationary closed casing containing two intercommunicating cylinders of different diameters, disposed end to end, one cylinder containing a piston mounted on the power-section of the rod, and the other a piston on the working section thereof, a passage-way connecting the outer ends of said cylin-

ders, a second passage-way connecting the outer ends of the power-cylinder, a valve in said last-mentioned passage-way, and a body of liquid within said cylinders and passage-ways, substantially as set forth.

3. The combination with two sections of a divided reciprocating rod, of a stroke-regulating device comprising a stationary closed casing containing two piston-chambers of unequal diameters, arranged end to end, an intermediate chamber between said piston-chambers, a piston within the larger chamber, mounted on the power-section of the rod, a piston within the smaller chamber mounted on the working section thereof, a passage-way connecting the outer ends of the piston-chambers, a second passage-way leading from said intermediate chamber to the opposite side of the power-piston, a valve for regulating said last-mentioned passage-way, and a body of liquid within said chambers and passage-ways, substantially as set forth.

4. In a windmill, the combination with the two sections of a divided pump-rod, of a stroke-regulating device comprising a closed casing secured on the windmill-frame, said casing containing two piston-chambers of unequal diameters, disposed end to end, a piston within the larger of said chambers, mounted on the power-section of the rod, another piston within the smaller chamber, mounted on the working section thereof, a passage-way connecting the outer ends of said piston-chambers, a second passage-way connecting the opposite ends of said power piston-chamber, and a valve within said last-mentioned passage-way, and means, operated by the wind, for automatically opening or closing said valve, substantially as set forth.

In testimony whereof I affix my signature in the presence of two witnesses.

RODNEY H. YALE.

Witnesses:
BERTHOLD W. MARRVILLE,
FRANKLIN E. WHEELER.