No. 671,007. Patented Apr. 2, 1901.

R. H. YALE.

STROKE REGULATOR.

(Application filed Sept. 7, 1900.)

(No Model.)

Fig. 1

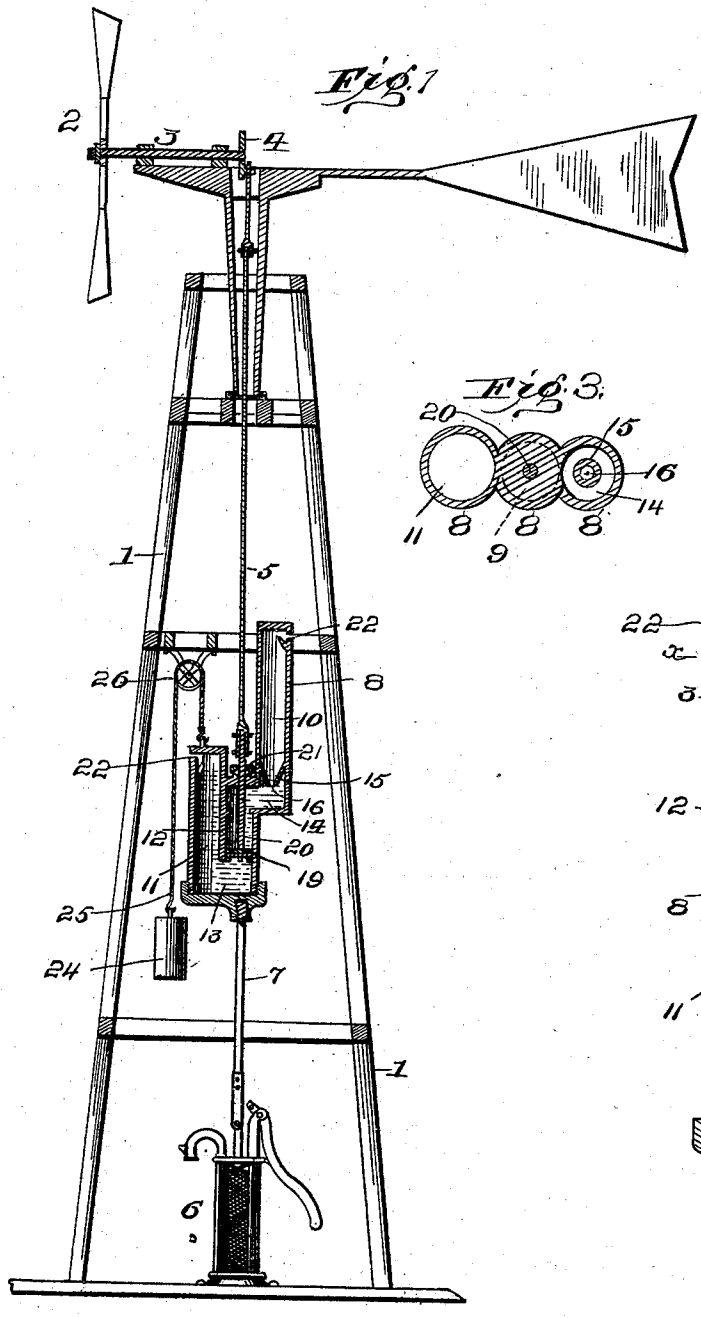
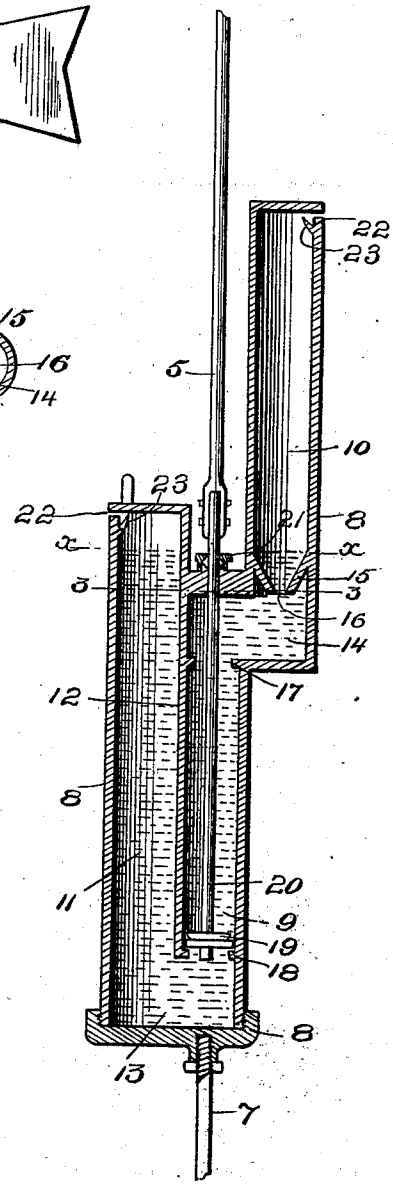


Fig. 3.

Fig. 2.



Witnesses:
J. M. Fowler Jr.
Augustus S. Lay.

Inventor:
Radney H. Yale,
By Frank A. Duncan, Atty.

UNITED STATES PATENT OFFICE.

RODNEY H. YALE, OF BEATRICE, NEBRASKA.

STROKE-REGULATOR.

SPECIFICATION forming part of Letters Patent No. 671,007, dated April 2, 1901.

Application filed September 7, 1900. Serial No. 29,313. (No model.)

To all whom it may concern:

Be it known that I, RODNEY H. YALE, a citizen of the United States, residing at Beatrice, in the county of Gage and State of Nebraska, have invented certain new and useful Improvements in Stroke-Regulators; and I hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to improvements in stroke-regulators for automatically adjusting or determining the length of stroke of a reciprocating piston-rod, pump-rod, or other similar device used in connection with a windmill or other variable source of power, the object being to provide for effecting a stroke of such reciprocating rod of moderate length when the prime mover is running at a low rate of speed and to increase the length of the stroke proportionately as the motor attains a higher rate of speed, so that the length of the stroke or throw of the rod will at all times correspond with the power available to produce it.

My device is especially adapted to use in connection with wind-wheels, as such motors are subject to frequent variations in the force of the driving agency, but is not necessarily limited to such use.

In the accompanying drawings, illustrating the device as applied to a windmill, Figure 1 is an elevation, partly in vertical section, of a portion of a windmill-tower and the wind-wheel thereon, also showing one of my stroke-regulators in vertical section and in working position. Fig. 2 is an enlarged view, in vertical section, of the regulator detached, with portions of the divided reciprocating pump-rod attached thereto. Fig. 3 is a horizontal section on the line 3 3 of Fig. 2.

The frame 1 carries the wheel 2, with its appendages, mounted thereon in any preferred manner, the axis 3 of said wheel being provided with the usual crank-plate 4, to which is connected the upper or power section 5 of the divided reciprocating rod for operating the pump 6. The lower or working section 7 of the rod operates the pump 6 in the usual manner. Between the two sections 5 7 of said rod, the division of which may be made at any preferred point, is interposed the stroke-regulator, which consists of a closed metallic casing 8, made up of separable parts, which may be secured together in any preferred manner, all joints being made water-tight. Said casing 8 contains three chambers, all preferably of substantially cylindrical form and disposed in the same vertical plane—to wit, a central piston-chamber 9, an upper relief-chamber 10, and a lower relief-chamber 11. The piston-chamber 9 is separated from the relief-chamber 11 by a partition 12, but communicates with said chamber 11 at the bottom by a free passage 13 and also communicates with chamber 10 by a passage 14. Near the bottom of chamber 10, between it and the passage 14, is secured a preferably conical collar or flange 15, having at its apex or center an opening 16 of considerably less diameter than chamber 9 or 10. The piston-chamber 9 is provided at its top and bottom with inwardly-projecting flanges 17 18, which form stops to limit the movement in either direction of the piston 19. Said piston 19 is secured to a piston-rod 20, which passes through a stuffing-box 21 in the upper wall of the casing 8 and is secured to the lower end of the upper section 5 of the pump-rod. The lower section 7 of said pump-rod is rigidly secured at its upper end to the bottom of casing 8 in alinement with the upper section 5.

When in use, the casing is kept partially filled with liquid, which extends up to about the normal level of the line $x\,x$ in Fig. 2, thus normally entirely filling piston-chamber 9, nearly filling chamber 11, and extending into the bottom of chamber 10. Said liquid may be water, oil, or other preferred liquid, and to permit free movement of the same into or out of chambers 10 11 air-vents 22 are provided near the upper ends of said chambers and also shields 23, extending from the inner walls of said chambers, near said vents, to deflect the liquid therefrom and prevent its being thrown out by any sudden movement.

A counterweight 24 is connected to the casing by a chain 25, which passes over a pulley 26 on the frame and sustains the weight of the casing, but permits it to move freely either upward or downward.

To illustrate the operation of the device, it may be supposed that the upper section 5 of

the rod is at the lower limit of its stroke, as shown in the drawings. If it then begins to move upward, the piston 19 will press against the liquid in piston-chamber 9, and some of said liquid, owing to such pressure, will immediately begin to flow through the contracted passage-way 16 into chamber 10, and such flow will continue, in greater or less quantity, during the upward stroke of the piston. While such stroke continues the piston will bear against the body of liquid remaining in chamber 9, and whenever the pressure is so great that the liquid cannot pass into chamber 10 fast enough to relieve it the casing 8, and therefore the lower section 7 of the pump-rod, will be lifted and carried up until the piston and the upper section 5 arrive at their highest points. While said movement is taking place the liquid in chamber 11 will pass through passage 13 into piston-chamber 9 and fill up the space therein vacated by the upward movement of piston 19. When section 5 of the rod begins its return movement downward, piston 19 will first press the liquid below it back into chamber 11 until said piston reaches its seat at lower stop 18, after which said piston will press against stop 18 and carry the casing and the lower section 7 of the rod against the stress of the counterweight 24 down to their original position. At the same time the liquid which has been forced into chamber 10, as heretofore described, will be drawn downward through the opening 16 until it again occupies the level of the line *x x*. It will now be seen that the range of movement of the piston 19 within its chamber and relatively to the casing 8 will depend upon the time occupied in the upward movement of rod 5, or, in other words, on the rate of speed of said rod. If said rod moves slowly at the beginning of and during its upward stroke, a considerable portion of the liquid above the piston will be forced into chamber 10 before the upper limit of the stroke has been reached and the piston will travel a corresponding distance within its chamber, thus making the stroke of rod 7 a short stroke, while if the rod 5 makes its upward throw at a higher rate of speed said liquid will resist being hurried through the opening 16 and will retard the movement of the piston in its chamber, and the limit of the upward throw of said rod will have been reached before any considerable movement of said piston in relation to the casing has taken place, thus making the stroke of rod 7 a long one. It will also be observed that the length of the stroke of upper section 5 of the rod is always the same, it being attached to the crank 4 and moving with it, while the stroke of the lower section 7 is variable and will always be equal to the difference between the distance which piston 19 travels in the casing and the total length of the stroke of upper section 5. For example, if the throw of rod 5 is twelve inches and it moves slowly while making its upward stroke the piston 19 will have moved upward during the same time in its chamber, say, eight inches, and the casing and pump-rod 7 have in consequence moved upward only four inches; but if the rod 5 moves upward at a higher rate of speed the piston 19, owing to the resistance of the liquid to being hurried through a small opening, will make but a slight movement upward in its chamber, and the pump-rod 7 will move nearly, if not quite, as far as rod 5.

It is well understood that a windmill will run at a higher rate of speed as the velocity of the wind increases, unless it be moved out of sail; but in making use of my invention it is not intended that the windmill shall be allowed to turn out of the wind as the velocity increases, unless the velocity should be so great as to place unsafe strain upon the mill. When the velocity is low and the windmill runs slowly and operates rod 5 at slow speed, the length of stroke of the pump-rod 7 will be at the minimum, and as the speed of rod 5 increases, owing to higher wind velocity, the stroke of pump-rod 7 increases in length, thus increasing or diminishing the working load on the windmill proportionately to the power to perform the work and with the result that more work is done than if the windmill operated the pump at a fixed length of stroke. The value of my invention as applied to a windmill consists in the fact that it retards the speed of the mill by increasing the load, and thus renders it possible to utilize high wind velocities which would otherwise not be available.

In setting forth my invention I have shown and described a windmill as the motive power and a pump as the machine to be operated thereby by means of a reciprocating rod; but equally beneficial results might be obtained by the use of my invention in a substantially similar manner for operating other machines or implements, whether in connection with a windmill or other variable motor. I therefore do not limit my invention to the special application of it shown and described.

While I have shown and described the piston 19 as mounted on the power-section of the rod and the casing attached to the working section 7 of the same, the arrangement might, with nearly equal effectiveness, be reversed, the piston being on the working section and the power-section 5 being attached to the casing. In such case, however, the contracted passage 16 would be removed from the position shown and placed between chamber 11 and passage 13 leading thereto, the requirement being that the obstacle to the movement of the liquid shall be so located with reference to the piston as to retard to a greater or less extent the movement of the liquid, and consequently of the piston, when the latter is performing work, as described.

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

1. In reciprocating-rod mechanism for com-

municating power from a prime mover to a machine to be operated, the combination with the rod divided into two sections, a power-section and a working section, of a stroke-regulator interposed between said sections and attached to the working section, said regulator comprising a closed casing containing three chambers adapted to hold liquid, one a piston-chamber, and two relief-chambers communicating respectively with opposite ends of said piston-chamber, and a piston within said piston-chamber mounted on the power-section of the rod, a contracted passage being provided between said piston-chamber and the relief-chamber on the power side of the piston, substantially as set forth.

2. In reciprocating-rod mechanism for communicating power from a prime mover to a machine to be operated, the combination with the rod divided into two sections, a power-section and a working section, of a stroke-regulator interposed between said sections and attached to the working section, said regulator comprising a closed casing containing a piston-chamber into which the power-section of the rod extends, a piston mounted on said section within said chamber, a relief-chamber connected with the end of the piston-chamber toward the source of power by a contracted passage-way, a second relief-chamber connected with the end of the piston-chamber toward the load by a free passage-way, a body of liquid within said chambers, and means for movably sustaining the weight of said casing independently of said rod, substantially as set forth.

3. In reciprocating-rod mechanism for communicating power from a prime mover to a machine to be operated, the combination with the rod divided into two sections, a power-section and a working section, of a stroke-regulator interposed between said sections, said regulator comprising a closed casing attached to one of said sections, a piston-chamber and a body of liquid therein within said casing, a piston working in said piston-chamber and connected to the other section of said rod, a relief chamber or space upon both the power side and the work side of said piston-chamber and communicating therewith, the passage-way between said piston-chamber and one of said relief-chambers being restricted, for retarding the movement of the liquid out of the path of said piston when pressure is applied thereby to said liquid in transmitting the power to the work, substantially as set forth.

4. In reciprocating-rod mechanism for communicating power from a prime mover to a machine to be operated, the combination with the rod divided into two sections, a power-section and a working section, of a stroke-regulator interposed between said sections, said regulator comprising a closed casing attached to one of said sections, a piston-chamber and a body of liquid therein within said casing, a piston working in said chamber and mounted on the other section of said rod, a relief chamber or space connected by a contracted passage-way with the end of said piston-chamber toward which said piston moves during the working stroke, and a second relief-chamber connected by a free passage-way with the end of said piston-chamber toward which said piston moves during the return stroke, substantially as set forth.

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

RODNEY H. YALE.

Witnesses:

WILLIAM Z. WARNER,

BERTHOLD W. MANVILLE.