(No Model.)

R. L. FROST.

VALVE FOR STEAM PUMPING ENGINES.

No. 533,798. Patented Feb. 5, 1895.

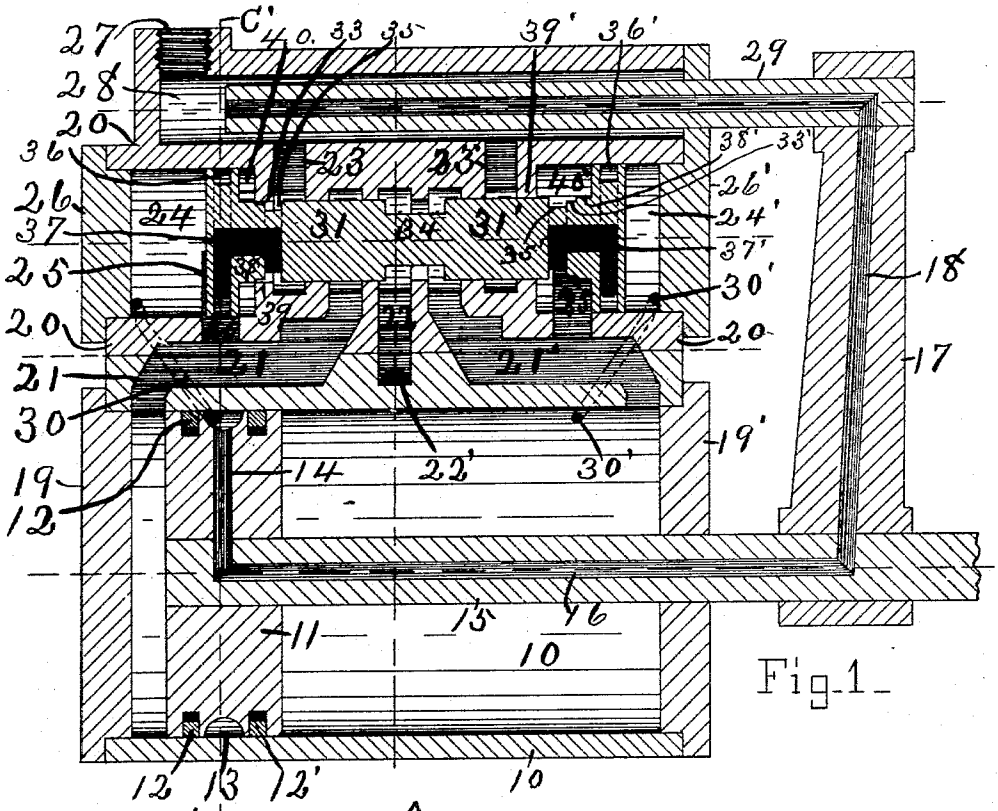

Fig. 1.

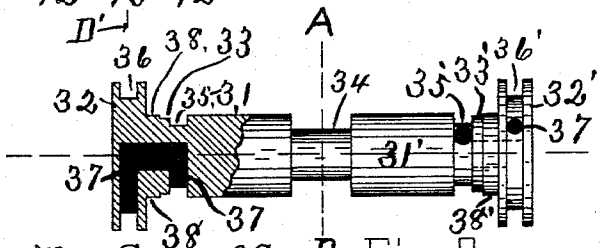

Fig. 2.

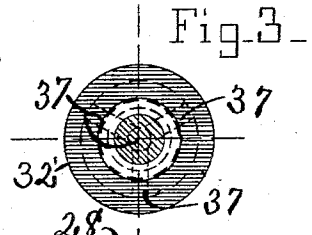

Fig. 3.

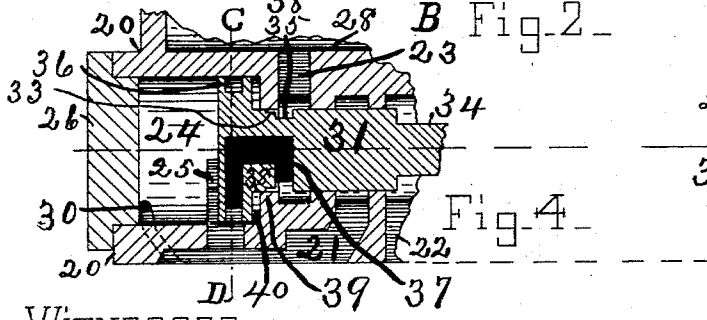

Fig. 4.

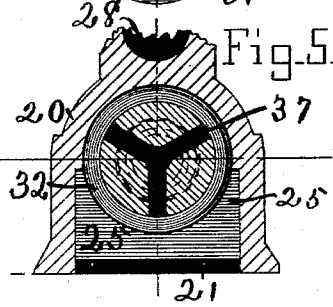

Fig. 5.

WITNESSES.

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VALVE FOR STEAM PUMPING-ENGINES.

SPECIFICATION forming part of Letters Patent No. 533,798, dated February 5, 1895.

Application filed August 13, 1894. Serial No. 520,219. (No model.)

To all whom it may concern:

Be it known that I, RICHARD L. FROST, a citizen of the United States, residing at Manistee, in the county of Manistee and State of Michigan, have invented certain new and useful Improvements in Valves for Steam Pumping-Engines; and I do 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 steam pumping engines; the principal object of the invention being to regulate the pressure of steam in the cylinder, so as to produce isochronal movements of the pump and steam-piston under varying resistances, thus dispensing with the usual governor.

To this end my invention consists, generally, of the combination of a steam-engine valve, steam-ports, and chambers constructed and arranged, as hereinafter described, to admit, cut off, or regulate the admission of steam to the cylinder, to increase or diminish the pressure therein through the medium of and to correspond with the varying resistance to the movement of the piston.

The details of the invention will be hereinafter particularly described and pointed out in the claims.

While the steam-engine herein disclosed is especially intended for steam-pumps, it may be used for other purposes where power is needed.

In the drawings forming a part of this specification, Figure 1, is a longitudinal vertical section through the steam-chest, steam-cylinder, and the live steam tripping or reversing ports. Fig. 2 is an external view of the steam valve with the left hand end in vertical longitudinal section. Fig. 3, is a vertical cross section of Fig. 2, on the line A. B., and looking to the right. Fig. 4, is a vertical longitudinal section of a portion of the left hand end of the steam valve and steam chest shown in Fig. 1, with the steam valve in a different position and which will be explained hereinafter. Fig. 5, is a vertical cross section of Fig. 4, on the line C. D., and of the portion of the steam-chest and steam-valve of Fig. 1, on the line C′ and D′ and looking to the right.

Similar numerals refer to similar parts throughout the several views.

10 represents the engine cylinder; 11, the steam piston provided with the packing rings 12 and 12′, the annular depression or port 13, and the steam port 14.

15 is a piston-rod provided with the central ongitudinal steam-port 16.

17 is an arm attached or securely fastened to the piston-rod 15, with the central steam-port 18.

19 and 19′ are steam cylinder heads; the steam piston-rod 15 passing through the steam cylinder-head 19′ and when in use is properly journaled in the same.

20 represents the steam chest mounted on the steam engine cylinder 10 in the usual manner and provided with steam-ports 21, 21′, 22, 23, and 23′; the enlarged end chambers 24, and 24′, the steam-ports 25, 25′.

26, and 26′ are steam chest heads.

27, is the port where the live steam pipe from the generator is attached.

28, is the live steam chamber or port attached to the upper portion of the steam chest casting 20.

29, is a tube or pipe securely fastened to the arm 17, and journaled in the steam chest head 26′ and adapted to reciprocate longitudinally therein and in unison with the piston rod 15.

30, and 30′, are small steam ports connecting the outer ends of the end chambers 24, and 24′, with their respective ends of the steam cylinder 10.

31,—31′, is a steam or actuating valve of the engine, and closely fitted to the central bore of the steam-chest. The valve 31—31′, is also provided with enlarged heads 32, and 32′, which are closely fitted to the bore of the enlarged end chambers 24, and 24′. The area of the inside of these heads 32, and 32′, is reduced by the area of the reduced portions 31—31′, of the valve.

The valve 31,—31′, as is shown having the annular ports 33, and 33′, near the heads 32, and 32′; the central exhaust port at 34; and the annual induction or admission ports 35, and 35′, next to the annual ports 33, and 33′. The enlarged heads 32, and 32′ are also provided with the annular ports 36, and 36′. At each end of the valve 31,—31′, are also the ports

37, and 37′, leading from the annular induction or admission ports 35, and 35′, internally and longitudinally through said valve into the annular ports 36, 36′.

The ports 25, and 25′ are a sufficient distance away from the inner end walls of the enlarged end chambers 24, and 24′, and also the portion 38, and 38′, of the steam valve 31, 31′ are sufficiently long to form a confined chamber between the inner ends of the end chambers 24, and 24′ and the inner faces of the valve heads 32, and 32′. These two confined chambers may be termed the "steam cushion chambers" 40, and 40′.

39, and 39′ are bridges separating the end chambers 24, and 24′ from the live steam ports 23, and 23′. The ports 35, and 35′, may be termed "annular induction ports."

The size, capacity or relative proportion of the ports 25, and 25′; and 37, and 37′ have nothing to do with the speed or governing element of the engine.

The operation of my invention is as follows:—The steam is admitted from the live steam port 27. It first passes from the port 27 and fills the live steam chamber or port 28; thence through the ports 29, 18, 16, 14, and into the depression or port 13 in the steam piston 11, from thence through the port 30 to the enlarged end chamber 24, and acting on the head 32, drives the valve to the right and opens the annular induction or admission ports 35 and 33. This being done the steam passes through the annular induction or admission port 35, and while the valve is moving to the right a very small portion of the live steam from the annular induction or admission port 35 enters the small port 33 and fills the "steam cushion chamber" 40. The main induction or admission port 35 of the steam valve 31—31′ now being open, the steam from the live steam chamber or port 28 and steam port 23 passes through the annular induction or admission port 35, thence through the port 37, thence through the port 36, thence through the port 25, thence through the port 21 into the left hand end of the steam cylinder 10 and acts on the steam piston 11 and moves it to the right until it passes by and opens the port 30 to the left hand end of the steam cylinder 10. While this is being done the steam in the outer end of the end chamber 24 acts against the larger outer surface of the valve head 32 and tends to move the valve to the right and thus open or increase the annular induction or admission port 35, while at the same time the confined steam in the "steam cushion chamber" 40 has been compressed by the action of steam in the outer portion of the end chamber 24 and tends to move the valve to the left and close the annular induction or admission port 35. Now the proportions of the areas of the outer and inner surfaces of the valve heads 32, and 32′ are such, that, the greater resistance the steam piston 11 meets or is compelled to overcome in order to travel its course, the greater the steam pressure in the steam cylinder 10 augments or increases to overcome the said resistance to the steam piston 11. Since the end chamber 24 and the steam cylinder 10 are coupled together by the steam port 30, the steam in the end chamber 24 is correspondingly augmented or increased, and this increased pressure of steam acts on the larger outer surface of the valve head 32 and tends to still increase the annular induction or admission port 35. In case the resistance to the steam piston 11 decreases, the pressure in the end chamber 24 will be correspondingly decreased and the compressed steam in the steam cushioning chamber 40 acting on the smaller inner surface of the valve head 32 will move the said valve to the left and decrease the annular induction or admission port 35 to the proper point. Since steam moves more rapidly than the steam piston 11, the steam will almost instantly raise or fall in pressure to meet the varying resistances to which the steam piston 11 is subjected; but when the steam in the steam cylinder 10 becomes of so high or low a pressure as to be out of proportion to the resistance of the steam piston 11, the steam piston 11 will rapidly increase or decrease in speed before the force, and the pressure will become reduced by reason of rapid expansion or increased by rapid augmentation, and this rising and falling of the pressure in the steam cylinder 10 will act correspondingly on the pressure of steam in the end chambers 24 or 24′, and thus move the steam valve to the right or left until the forces of steam on each side of the valve heads 32 or 32′ are neutralized. The steam valve thus automatically operated, is the governor and regulator of the engine.

The normal speed of the engine is fixed by the longitudinal capacity of the "steam cushion chamber" 40; the speed increasing as the "steam cushioning chambers" are reduced in capacity longitudinally and vice-versa.

The steam piston 11 having moved to the right so that the depression or port 13 registers with the port 30′, thus forming a continuous portage 29, 18, 16, 14, 13, and 30′ for live steam from the live steam chamber or port 28 to the outer end of the end chamber 24′ is made, and the pressure on the surface of the valve head 32′, moves the valve to the left and reverses the current of steam. The annular port 34 of the steam valve 31—31′ now couples the passage or ports 22 and 21 and exhaust takes place from the left of the cylinder 10 through the ports 21, 22, and 22′ into the atmosphere. The steam piston 11 is driven to the left until the depression or port 13 is again registered with the port 30, when the movement of the engine is again reversed, and so on.

When the engine piston 11 is overcoming a low resistance the steam valve is in about the position shown in Fig. 1 at the left end of the

steam chest, and when the engine piston 11 is overcoming a greater resistance, the steam valve is in about the position shown in Fig. 4.

I am aware that prior to my invention, steam actuating valves have been invented which employ pockets, cylinders, or cushioning chambers for cushioning the steam valves and steam valve plungers to prevent contact of parts, jar, and noise; and as such is old and well known; I therefore do not claim such a combination, broadly; but

What I do claim as my invention, and desire to secure by Letters Patent, is—

1. In combination, a steam-chest having enlarged end chambers, one end of which forms cushioning chambers said end chambers being suitably connected at their outer ends by ports to the respective ends of the cylinder, and other suitable ports in and from the steam-chest to the cylinder, and an actuating-valve having heads with faces of unequal area, whereby said valve is operated to diminish or increase the flow of steam, and thereby regulate the pressure in the cylinder to correspond with the resistance to the piston or work to be done, substantially as described.

2. In combination, a steam-chest having enlarged end chambers, their outer ends being suitably connected by ports to or near the ends of the cylinder to the cylinder and the inner ends of the said enlarged end chambers forming cushioning chambers to regulate the flow of steam from the valve chamber to the cylinder and an automatic valve having heads with faces of unequal area operating to produce isochronism of the piston by equal and differential steam pressure acting upon the unequal areas of the heads, the resistance of the piston serving to automatically regulate the pressure in the cylinder to correspond with the work required, substantially as described.

3. An automatic valve for steam engines, provided with exterior enlargements having faces of different areas, in combination with induction ports, enlarged end chambers, one end of which forms cushioning chambers said end chambers being suitably connected at their outer ends by ports to the ends of the cylinder, substantially as described.

4. The combination, with a steam-chest having annular induction or admission ports, enlarged end chambers, one end of which forms cushioning chambers, said end chambers being suitably connected at their outer ends by ports to the cylinder at or near its respective ends, of a valve provided with heads having faces of unequal area, whereby the portage is reduced when the pressure in the engine is beyond that required to do the work, and said portage is increased when the pressure is insufficient, substantially as described.

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Witnesses:
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