

(No Model.)

3 Sheets—Sheet 1.

# J. McGRATH. STEAM PUMPING ENGINE.

No. 534,569.

Patented Feb. 19, 1895.

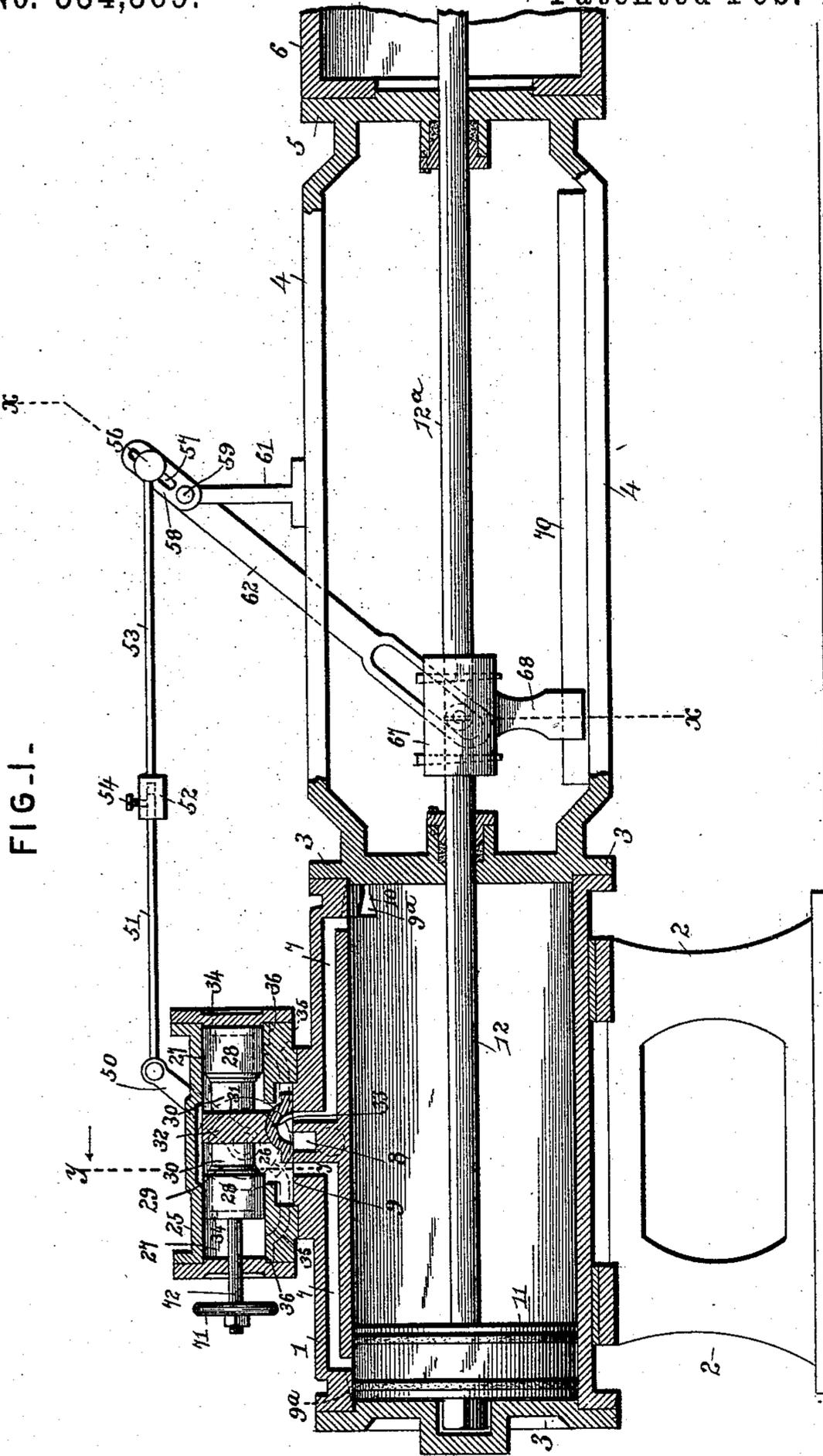


FIG. 1-

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By *his* Attorneys,

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(No Model.)

3 Sheets—Sheet 2.

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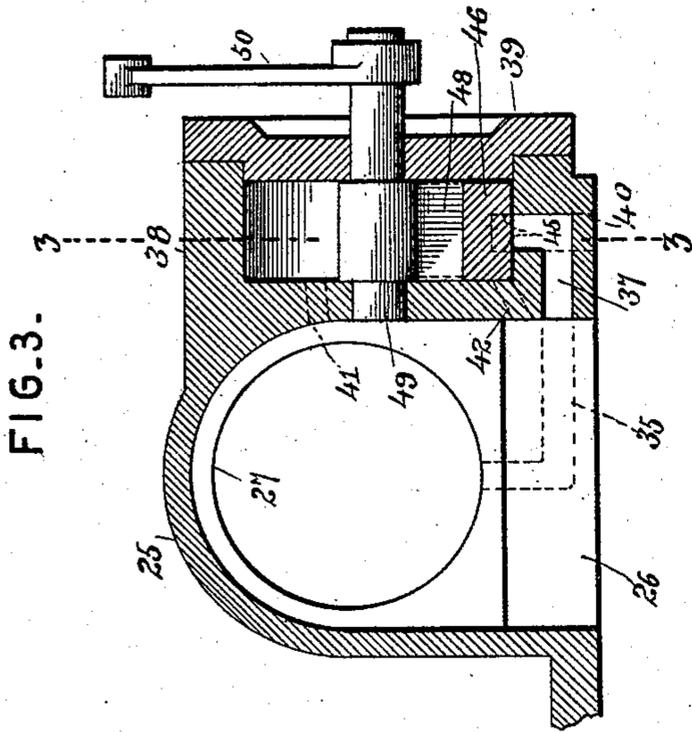


FIG. 3.

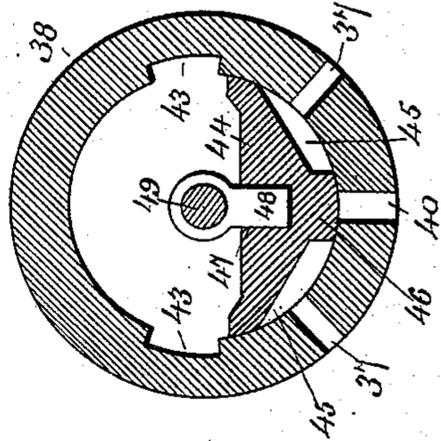


FIG. 4.

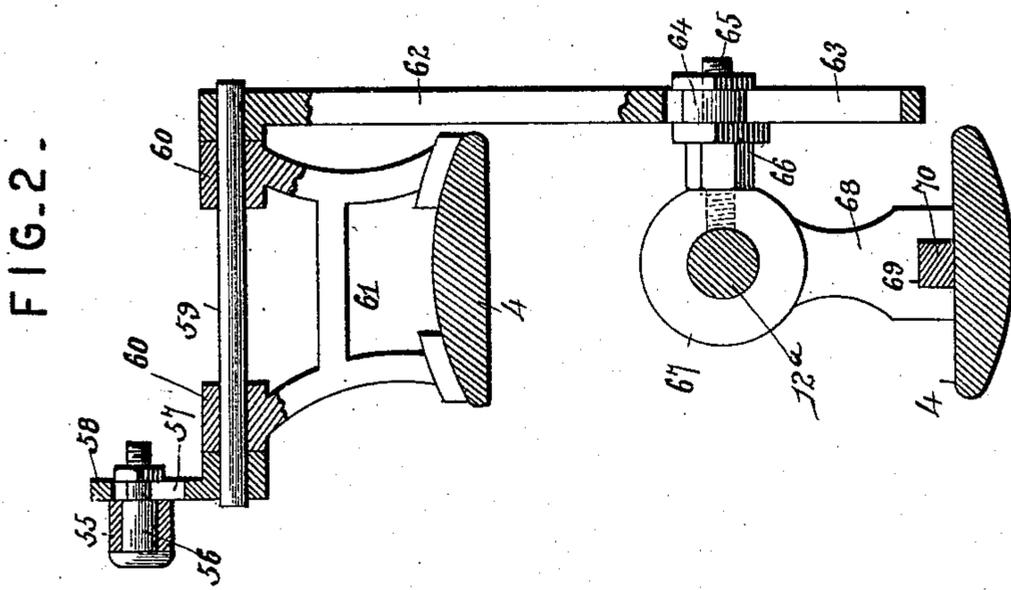


FIG. 2.

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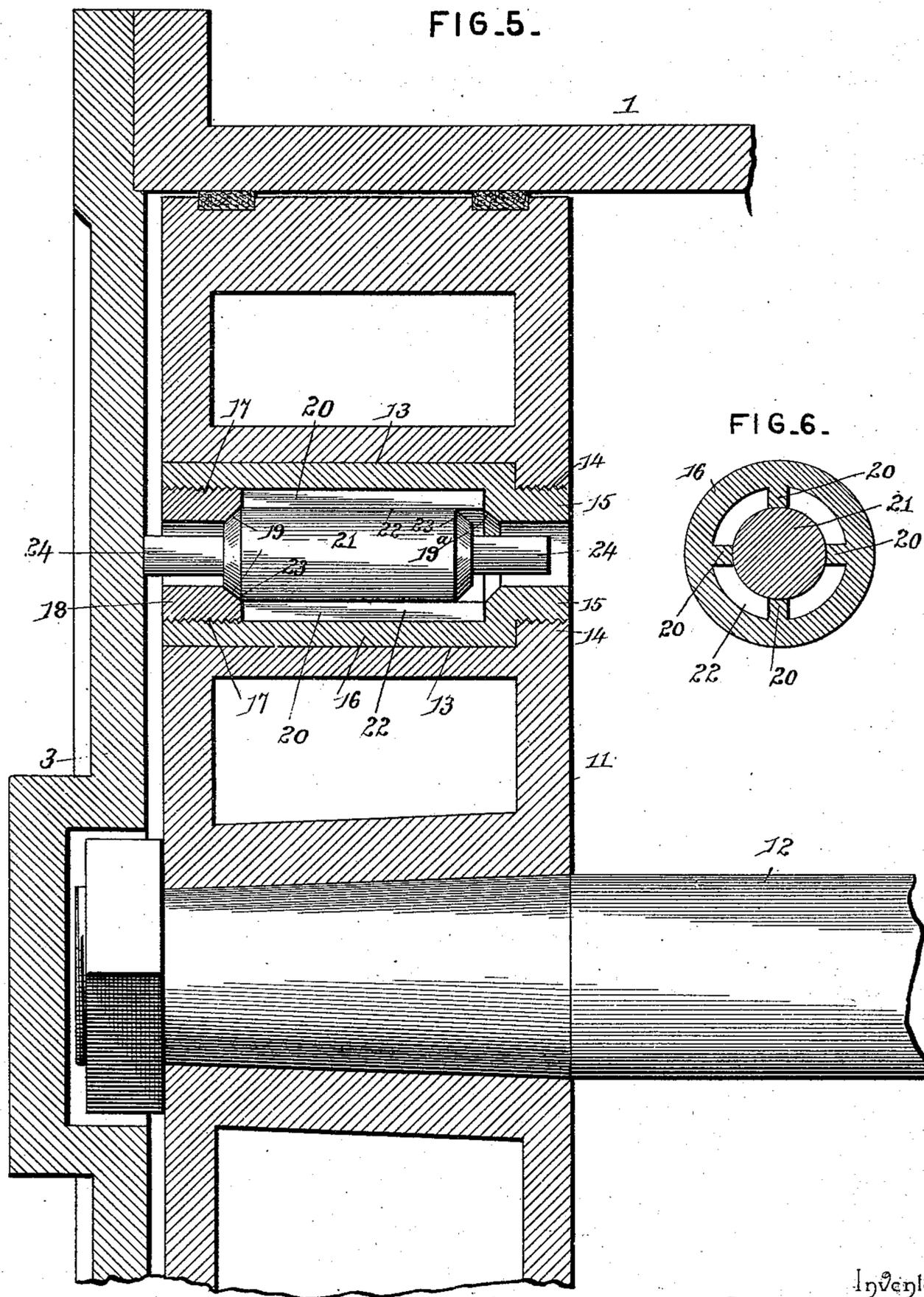
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3 Sheets—Sheet 3.

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# UNITED STATES PATENT OFFICE.

JAMES McGRATH, OF CONNELLSVILLE, PENNSYLVANIA.

## STEAM PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 534,569, dated February 19, 1895.

Application filed June 6, 1894. Serial No. 513,695. (No model.)

*To all whom it may concern:*

Be it known that I, JAMES McGRATH, a citizen of the United States, residing at Connellsville, in the county of Fayette and State of Pennsylvania, have invented a new and useful Steam Pumping-Engine, of which the following is a specification.

This invention relates to steam pumping engines; and it has for its object to effect certain improvements in engines of this character, whereby their efficiency specifically for pumping purposes shall be greatly increased.

To this end therefore, the principal object of the present invention is to so construct and arrange the several working parts thereof, whereby a positive and regular motion shall be secured, which is very essential in working steam pumps.

The invention also contemplates an engine in which the piston will never strike the cylinder head at any rate of speed, and that even at a high piston speed, before the piston comes to the end of its stroke, it will gradually slow up to a dead stop, whereby the water valves in the pump will be allowed to lower slowly and easily to their seats, and thus avoid the heavy thud that is the result of the valve dropping suddenly to the seat from the height to which it is forced by the rapid flow of water consequent upon the fast piston speed.

Furthermore, the improvements aim to secure an arrangement whereby the steam piston shall accumulate pressure behind it and will gradually maintain its highest speed as in stopping, and the invention also provides for a valve gear free from complications, easily adjusted to control the stroke of the pump and working positively and noiselessly. These features are the necessary requisites of a perfect pumping engine, and the present invention is intended to accomplish as far as possible the desired results.

With these and other objects in view, which will readily appear as the nature of the invention is better understood, the same consists in the novel construction, combination, and arrangement of parts hereinafter more fully described, illustrated, and claimed.

In the accompanying drawings:—Figure 1 is a central vertical longitudinal sectional view of a steam pumping engine constructed in accordance with this invention. Fig. 2 is a

transverse sectional view on the line  $x-x$  of Fig. 1. Fig. 3 is a similar view on the line  $y-y$  of Fig. 1, with the auxiliary piston removed. Fig. 4 is a similar view on the line  $z-z$  of Fig. 3. Fig. 5 is an enlarged detail sectional view of a portion of the piston head. Fig. 6 is a cross section of the piston or cushion valve and its casing or bushing.

Referring to the accompanying drawings, 1 designates a steam cylinder supported on an ordinary bed or stand 2, and inclosed at its opposite ends by the usual cylinder heads 3, from one of which is extended the intermediate connecting housing 4, that also connects with the cylinder head 5, of an ordinary pump cylinder 6, that is provided with the usual appurtenances, which form no part of the present invention and are not illustrated.

The steam cylinder 1, is provided in the top thereof with the opposite live steam ports 7, and the intermediate exhaust port 8, located between the ports 7, and communicating with the ordinary central exhaust pipe at one end, and at its other end opening through the flat valve seat 9, through which the outer ends of the ports 7, also open for the purpose of admitting steam to and exhausting it from the cylinder 1, in the ordinary manner. The ports 7, extend toward opposite ends of the cylinder and open at their inner ends into said cylinder at the opposite ends therefrom, in from the cylinder heads 3, in order to leave a cushion space for steam between the inner ends of said ports and the opposite cylinder heads.

The cylinder 1 is provided at both ends thereof in the space between the inner ends of the ports 7, and the heads 3, with steam pockets 9<sup>a</sup>, that are cut thereinto after the cylinder is bored, and communicate with the ports 7. The steam pockets 9<sup>a</sup> open into the ends of the cylinder through the V-shaped or tapered openings 10, that provide for the admission of steam into the pockets and thence to the ports 7, as the piston head 11 travels over the said openings and beyond the inner ends of the ports 7. It will be noted that when the piston head 11, travels toward either end of the cylinder, after passing the inner end or edge of either of the ports 7, it entraps a certain amount of remaining exhaust steam and air, which in ordinary cases cannot escape and are compressed to an intense degree, thereby

causing the piston head to rebound and then travel more slowly onto the end of its stroke. This action which is common to most steam pumping engines causes an excessive thud of the valves of the pump, whereas the arrangement described obviates this difficulty by allowing the entrapped steam first to escape, but as the piston head arrives at the point where, by the action of the valve gearing to be hereinafter described, the direction of live steam is reversed and the piston is started on its return stroke, the same will be started just as easily and gradually as it stops. This is largely due to the shape of the port or opening 10, which gives a gradual admission of steam at one side of the piston head before it passes the inner end of that port 7, which is feeding live steam.

The piston head 11, is mounted on the inner end of the piston rod 12, that works through one end of the cylinder, and said piston head is of the ordinary general construction having the usual packing rings and in the present invention the said piston head is provided with a transverse valve opening 13, at one end of which is formed the interiorly threaded flange 14 that removably receives the exteriorly threaded neck 15, of the tubular bushing 16, fitted into the valve opening 13, and also provided at its open end opposite the neck 15, with the interiorly threaded portion 17, to receive the exteriorly threaded valve seat ring 18, that is provided at its inner edge with the beveled valve seat 19, opposed to the beveled valve seat 19<sup>a</sup>, formed at the inner end or edge of the neck 15.

The tubular bushing 16 is provided with an interior series of longitudinally arranged guide ribs or wings 20, that form a bearing for the longitudinally movable cylindrical valve plug 21. The cylindrical valve plug 21, is held centrally in position within the bushing by means of ribs or wings 20, which ribs or wings also provide there-between longitudinal steam passages 22, that provide for the passage of steam through the piston head. The cylindrical valve plug 21, is provided at both ends thereof with the beveled portions 23, that are adapted to fit tight on the valve seats 19 and 19<sup>a</sup>, and projected from the beveled ends of the said valve plug, are the extended tappet stems 24, that are designed to work through and beyond the opposite ends of the bushing 16, that is fitted within the valve opening 13. It is of course understood that the length of the main body of the valve plug 21, is less than the distance between the opposed valve seats 19 and 19<sup>a</sup>, so that the valve plug can only be closed against one valve seat at a time, and this valve plug provides means whereby the live steam is admitted into the cushion space at the ends of the cylinder as the piston head nears the cylinder head. With the steam pressing against one side of the piston head and impelling it toward one end of the cylinder, it will be understood that the valve plug will be closed

against the valve seat toward the end of the cylinder to which the piston head is moving. The pressure of the steam holds the valve tight on its seat until the piston head arrives within a fraction of an inch of the cylinder head, and at this point one of the tappet stems 24, which projects beyond one side of the piston head, engages against the inner face of the cylinder head, and causes the valve to be pressed backward away from its seat, admitting steam into the cushion space from the pressure end of the cylinder. This at once equalizes the pressure and prevents the piston from striking the cylinder head. This action of the cushion valve is in no way detrimental to the easy reversing of the pump, but on the contrary facilitates reversal, while the provision of this valve is of the highest importance in very fast running, and to positively prevent the disastrous results of "racing," a common occurrence in isolated pumps, caused by an exhaustion of the water and resulting from various other causes.

Mounted on the steam cylinder 1, directly over the flat valve seat 9, thereof in the usual manner is the main steam chest 25, to which the steam is carried from the boiler in the usual manner, and said steam chest is open at the bottom as at 26, to communicate with the seat 9, and is provided at both sides of the bottom opening 26, with the opposite cylinder portions 27, which accommodate therein the opposite hollow cylindrical heads 28, of the reciprocating auxiliary piston 29.

The reciprocating auxiliary piston 29, is provided with a solid intermediate shank portion 30, connecting the heads 28, and provided with a mortise opening 31, which receives the squared neck 32, projected from the upper side of an ordinary slide valve 33, that is arranged to slide on the seat 9, over the ports 7 and 8, to control the admission and exhaust of steam to and from the cylinder 1 in the ordinary manner. The opposite hollow cylindrical heads 28, of the piston 29, are pierced with the small steam holes or openings 34, that provide a communication between the inclosed steam chambers of the hollow heads 28 and the opposite cylinder portions 27, of the steam chest 25, to provide for the admission of sufficient steam into the ends of the cylinder portions 27, for the purpose of cushioning the ends of the auxiliary piston valve and preventing the same striking the heads of the steam chest 25 at the end of its stroke.

Steam is admitted to and exhausted from the opposite cylinder ends 27, of the chest 25, through the bottom steam ports 35, that open at one end into the bottom of the said cylinder portions 27 and communicate at such ends with the short off-standing steam grooves or pockets 36, that are drilled in the bottom and the extreme ends of the cylinder portions 27, in order to provide for a complete exhaustion of steam from both ends of the auxiliary piston, and for the proper admission of live

steam to such piston, while at the same time the disposition of the grooves or pockets 36, secures a positive and not too quick motion of the said auxiliary piston.

5 The bottom steam ports 35, lead downwardly from the bottom of the opposite cylinder portions 27, and open at their other ends at 37, in opposite bottom portions of the cylindrical or circular valve casing 38 formed at one  
10 side of the steam chest 25. The cylindrical or circular valve casing 38, is inclosed at its outer side with a cap plate 39, and is provided in the bottom thereof at a point intermediate of the ends 37 of the ports 35, with  
15 the bottom exhaust opening 40, that is adapted to lead into the main exhaust port 8, of the main cylinder 1. Steam is admitted into the valve casing 38, from the steam chest 25, through the steam supply opening 41, formed  
20 centrally in the inner wall of the casing 38, and opening into the chest 25 at a central point, and any accumulations of water of condensation are drained through the bottom drain opening 42 formed in the inner wall  
25 and at the bottom of the casing 38, to direct such water into the main steam chest where it can be disposed of without interfering with the working of the engine, and it is to be observed that the disposition of the ports 35, provides for relieving the cylinder portions 27,  
30 of the steam chest, of accumulations of water, carrying the same into the bottom of the casing 38, where it will flow out through the bottom exhaust opening 40.

35 The valve casing 38, is provided at opposite inner sides thereof with the oppositely disposed steam recesses 43, that provide for admitting steam around the ends of the segmental auxiliary oscillating valve 44. The segmental valve 44, has the curved periphery thereof work in contact with the circular side  
40 of the casing 38, and in its curved periphery the said segmental oscillating valve 34, is provided with opposite peripheral steam grooves 45, that are separated from each other by the intermediate abutment boss 46. The travel of the valve 44, is so regulated that the opposite ends thereof will never pass entirely  
50 above the steam recesses 43, in the opposite sides of the valve casing, so that the valve will always retain a perfect bearing on its seat formed by the circular bottom portion of the valve casing, and in its extreme limit of movement at either side of the vertical center of the valve casing 38, one end of the valve  
55 will be disposed midway of one of the recesses 43, so as to permit live steam to pass freely into one of the peripheral grooves 45, which groove is also in communication with one of the ports 35, and the other peripheral groove  
60 serves to connect the other port 35, with the bottom exhaust opening 40. The oscillation of the valve 44, provides for a reversing of the position of the steam grooves thereof.

65 The auxiliary oscillating valve 44, is provided centrally in the top portion thereof

with the socket 47, into which fits the shaft lug 48, projected from the oscillating valve stem 49, journaled centrally in the casing 48, and projecting outside of the same, and fitted  
70 on one end of the stem 49, is the rock arm 50, to the upper end of which is pivotally connected one end of the connecting rod 51, the other end of which rod is adjustably secured in the socket 52, at one end of a rod 53, which  
75 together with the rod 51, composes a sectional connecting rod which may be adjusted lengthwise to provide for adjusting the movement of the valve 44, and the rods 51 and 53, are held clamped in their adjusted positions by  
80 means of the set screw 54, working through the socket 52, and impinging against one end of the rod 51. One end of the rod 53, is provided with a collar 55, mounted on the pin  
85 56, that is adjustably secured in the slot 57, of the rock arm 58, that is mounted on one end of the rock shaft 59. The rock shaft 59, is journaled in suitable bearings 60, at the upper end of the bearing bracket 61, that is securely bolted on top of the intermediate connecting housing 4.  
90

The rock shaft 59, has mounted on the end opposite the rock arm 58, the lever bar 62. The upper end of the lever bar 62, is fitted to the shaft 59, and the lower end of said bar is  
95 longitudinally slotted as at 63, to loosely receive therein the roller 64, mounted on the roller pin 65, projected from the outer side of the stud pin 66, securely screwed into the cross head coupling 67, that connects the  
100 outer end of the piston rod 12, with an aligned piston rod 12<sup>a</sup>, that forms the piston rod of the pump to be operated by the engine. The coupling cross head 67, is provided at its lower side with the side arms 68, having a lower  
105 notched end 69, that embraces the guide strip 70, secured at the bottom inner side of the housing 4.

As the piston head moves within the cylinder the gearing connections just described,  
110 provide means for operating the valve 44, which will provide for actuating the slide valve 33, to control the admission and exhaust of steam to and from the cylinder. In first starting the engine to operate the pump the  
115 hand wheel 71, is grasped by the hand in order to provide for moving the auxiliary piston 29, back and forth until the working parts become properly started. The hand wheel 71, is removably secured to the outer end of  
120 the valve stem 72, that works through one end of the steam chest 25, and is secured to one end of the piston valve 29, it being understood that either the hand wheel 71 or the stem 72, may be disconnected while the pump  
125 is running.

It is thought that the construction, operation and many advantages of the herein described pumping engine will be readily apparent to those skilled in the art, and it is to  
130 be understood that changes in the form, proportion and the minor details of construction,

may be resorted to without departing from the principle or sacrificing any of the advantages of this invention.

Having thus described the invention, what is claimed, and desired to be secured by Letters Patent, is—

1. In a steam engine, the combination of the cylinder provided with the ordinary live steam and exhaust ports, said live steam ports opening into opposite ends of the cylinder in from the cylinder heads, steam pockets formed in the ends of the cylinder beyond the live steam ports and communicating therewith, and V-shaped or tapered openings formed in the walls of the cylinder and communicating with said pockets, the valve devices, and the reciprocating piston, substantially as set forth.

2. In a steam engine, the combination with the cylinder and valve devices; of a piston head provided with a transverse valve opening and an interiorly threaded flange at one end of the valve opening, a tubular bushing fitted within the transverse valve opening and having an exteriorly threaded neck at one end engaging the threads of said flange, a beveled valve seat at the inner end of said neck, and a longitudinal series of integral interior ribs or wings, a valve seat ring removably fitted into one end of the bushing and having at its inner edge a beveled valve seat opposed to the seat at one end of the bushing, and a cylindrical valve plug arranged to work within the bushing between the opposed valve seats and provided at both ends with beveled portions and integral extended tappet stems adapted to project beyond the ends of the bushing, substantially as set forth.

3. In a steam engine, the combination with the cylinder and the piston moving therein; of the steam chest mounted on the cylinder over the ports thereof and provided with opposite cylinder portions, a valve casing at one side thereof, downwardly extending steam ports connecting opposite bottom portions of the valve casing with opposite cylinder portions of the steam chest, and a steam supply opening connecting the central portion of the steam chest with the said valve casing, a steam-actuated auxiliary piston having opposite hollow cylindrical ends working within the opposite cylinder portions of the steam chest and pierced with small steam holes or openings, which provide communication with the interior of said hollow ends a slide valve working over the cylinder ports and connected to said auxiliary piston, an auxiliary valve working within the valve casing, and suitable valve gearing for actuating the auxiliary valve, substantially as set forth.

4. In a steam engine, the combination with the cylinder, and the piston moving therein; of the steam chest mounted on the cylinder over the ports thereof and provided with opposite cylinder portions, a valve casing at one side, ports connecting the opposite bottom portions of the valve casing with the opposite cylinder portions of the steam chest, short off-standing steam grooves or pockets communicating with the ends of said ports opening into the steam chest, and a steam supply opening connecting the central portion of the chest with the said valve casing, the slide valve arranged to work within the steam chest over the cylinder ports and having a squared neck, a steam actuated auxiliary piston having opposite cylindrical heads working within the opposite cylinder portions of the steam chest and an intermediate shank portion having an opening receiving the squared neck of the slide valve, a valve stem detachably connected at one end to the auxiliary piston, an auxiliary valve working within the valve casing, and valve gearing for said auxiliary valve, substantially as set forth.

5. In a steam engine, the combination with the cylinder and the piston moving therein; of the steam chest provided with opposite cylinder portions, a circular valve casing at one side and ports connecting the opposite ends of the chest with the opposite bottom portions of said valve casing, said valve casing having a central bottom exhaust opening, a steam supply opening communicating with the steam chest, a bottom drain opening also communicating with the steam chest, and oppositely disposed steam recesses formed in opposite inner sides thereof, a slide valve working within the steam chest over the cylinder ports, a steam actuated auxiliary piston working within the steam chest and connected to the slide valve, a segmental auxiliary oscillating valve working within the circular valve casing and provided with opposite peripheral steam grooves, an intermediate abutment boss, and a socket in the top thereof, an oscillating valve stem journaled in said casing and provided with a lug fitting into the socket of said valve, and suitable gearing connected with said oscillating valve stem, substantially as set forth.

In testimony that I claim the foregoing as my own I have hereto affixed my signature in the presence of two witnesses.

JAMES McGRATH.

Witnesses:

CHAS. H. WAYS,  
THOS. F. MAHON.