No. 628,630. Patented July 11, 1899.

A. G. MATHER & F. T. SNYDER.

VALVE FOR ENGINES.

(Application filed June 6, 1898.)

(No Model.) 2 Sheets—Sheet 1.

Fig. 1.

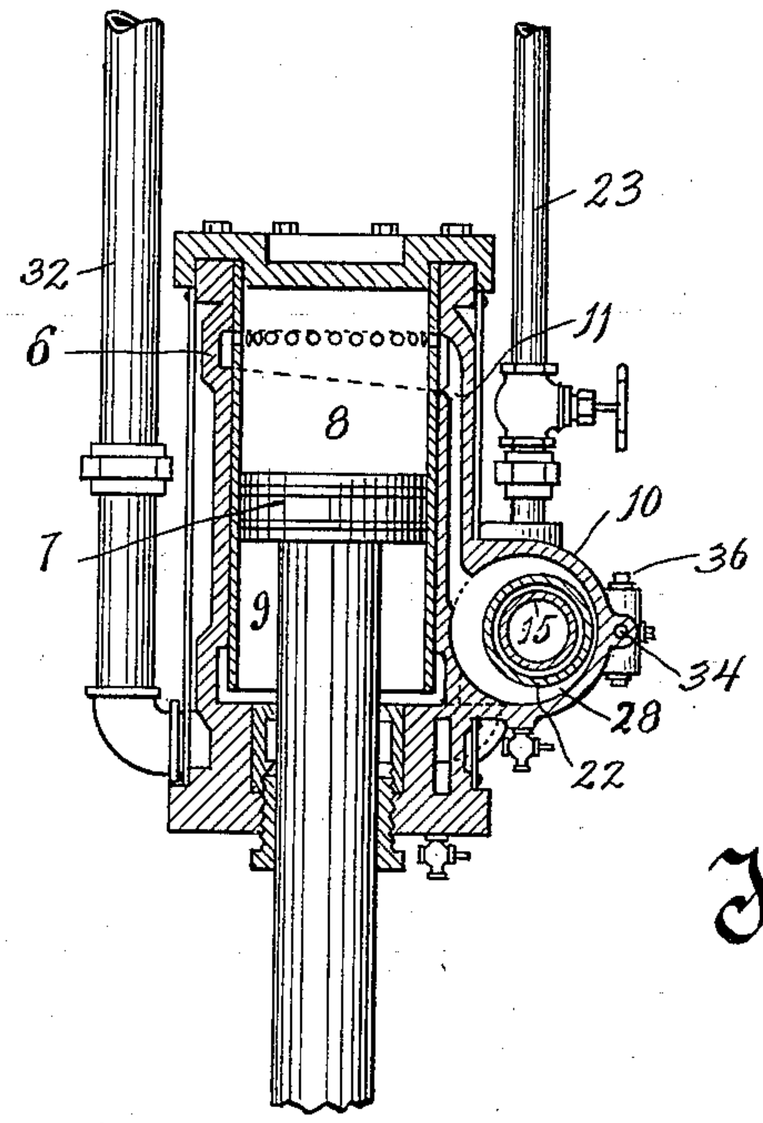
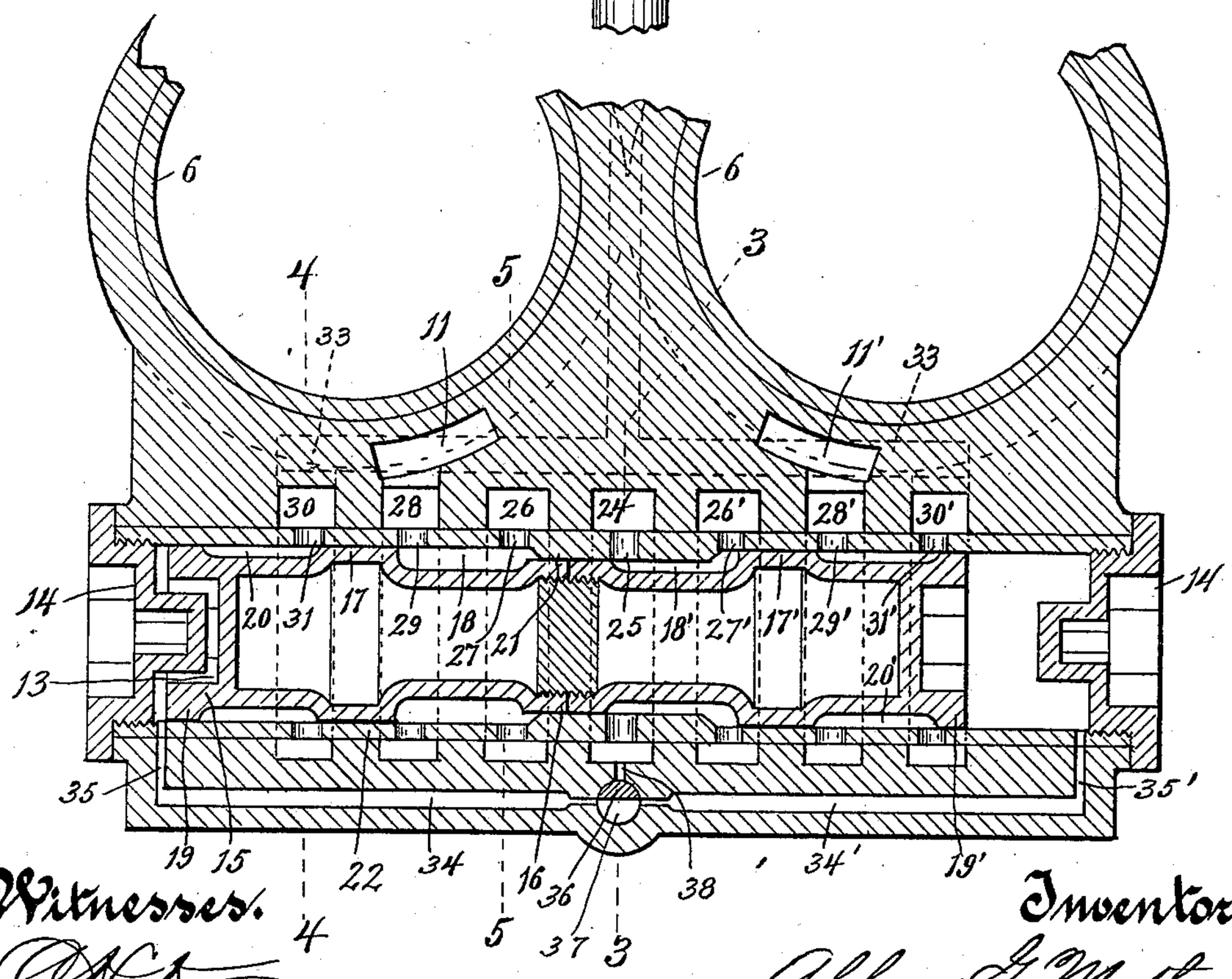


Fig. 2.



Witnesses.

A. F. Keeney.

Anna V. Faust.

Inventors.

Allan G. Mather.

Frederick T. Snyder.

By Benedick and Morsell

Attorneys.

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Fig. 4.

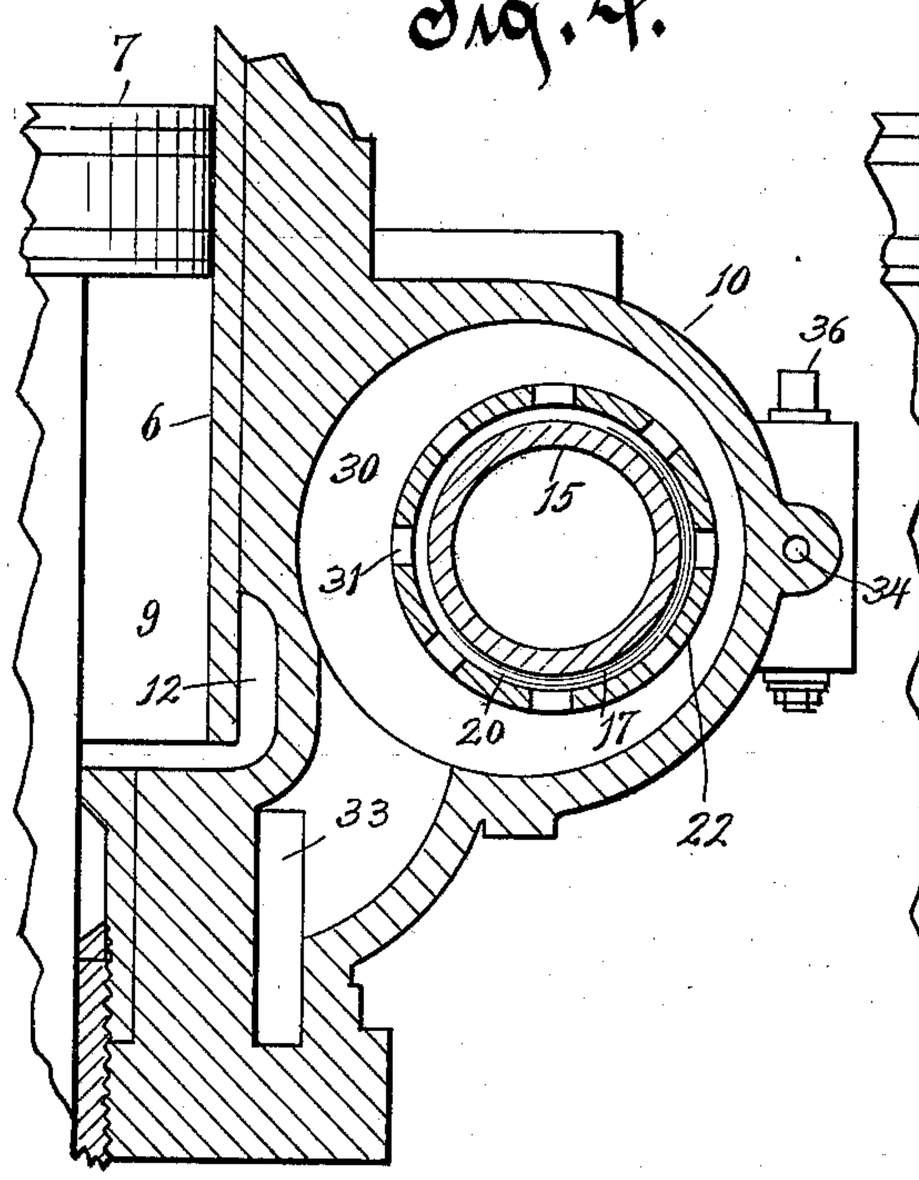


Fig. 3.

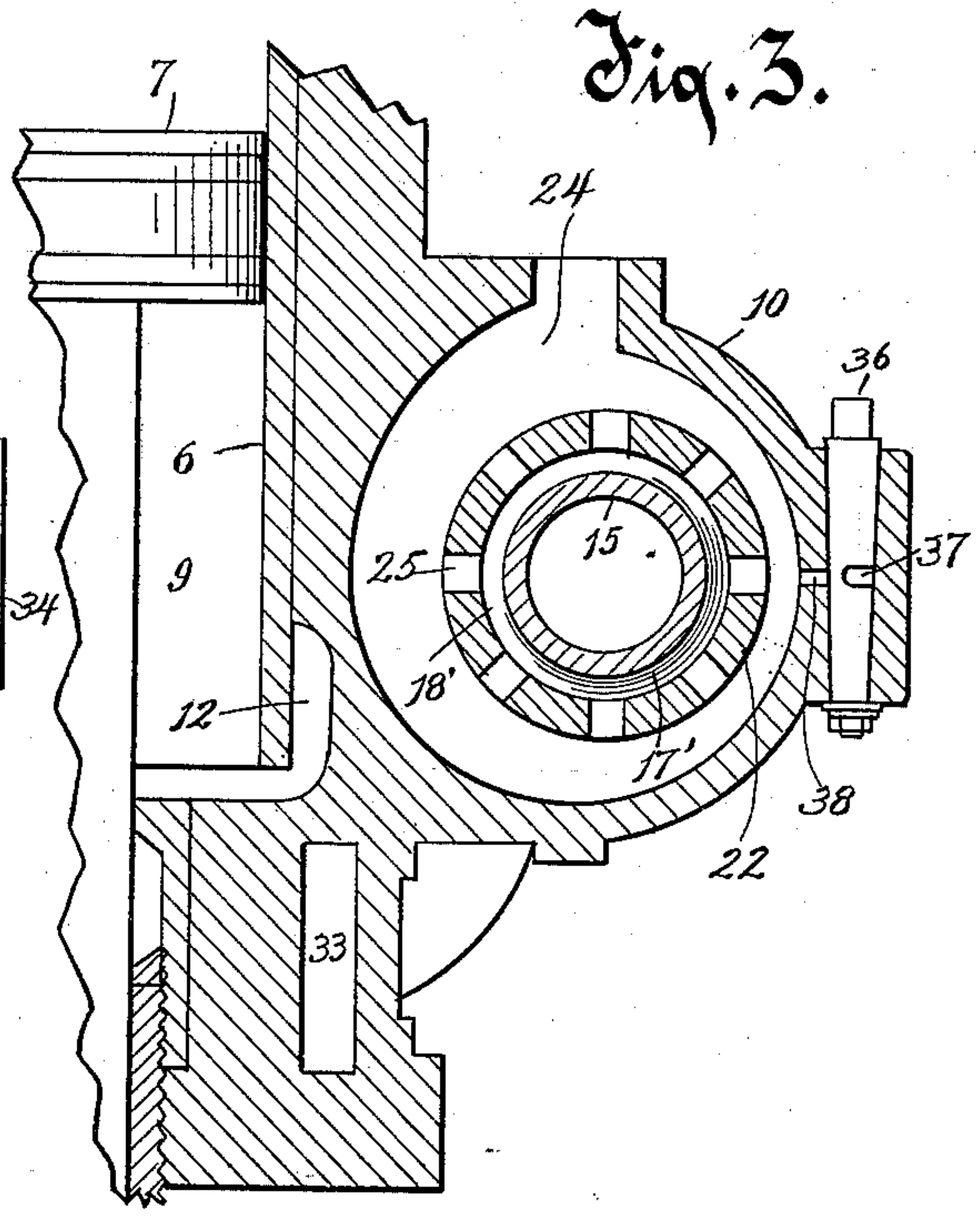
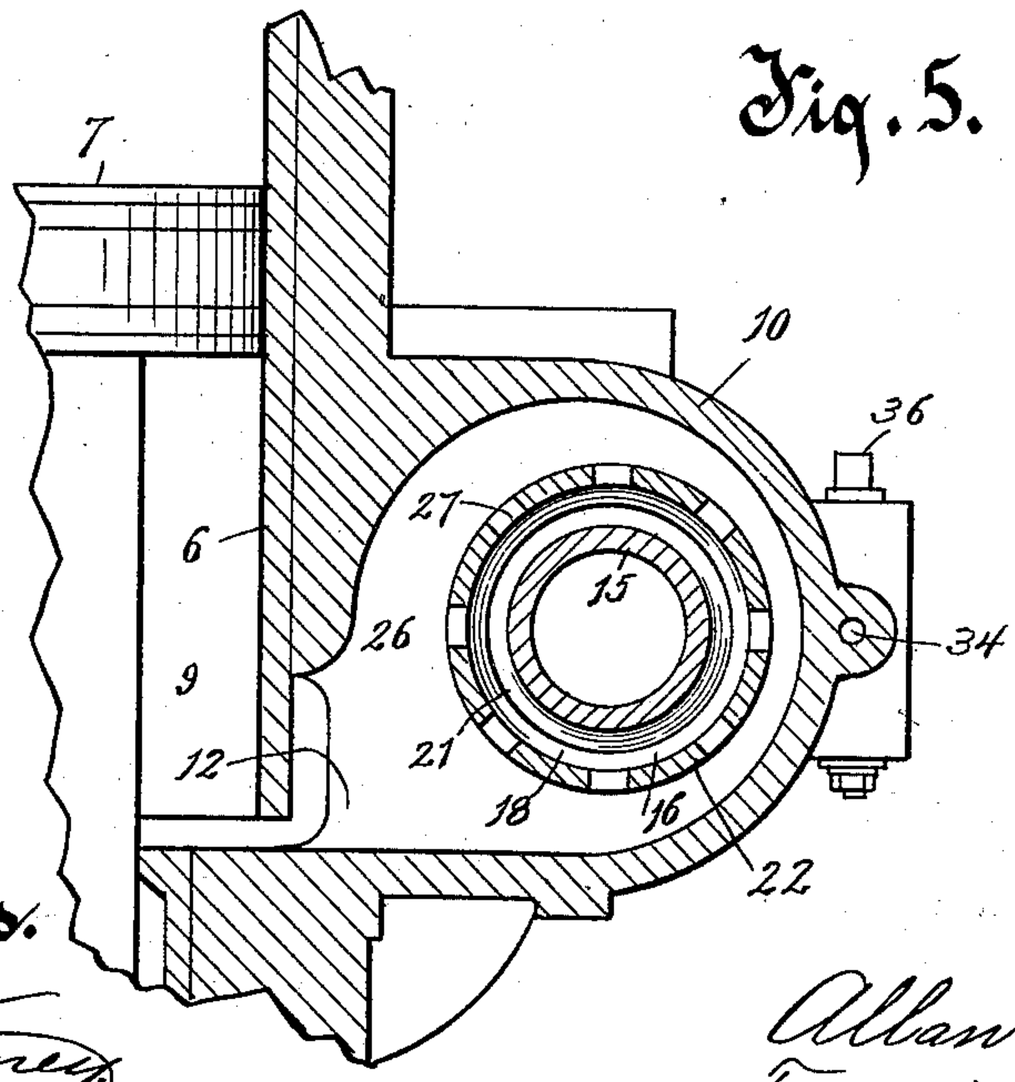


Fig. 5.



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Attorneys.

UNITED STATES PATENT OFFICE.

ALLAN G. MATHER AND FREDERICK T. SNYDER, OF MILWAUKEE, WISCONSIN.

VALVE FOR ENGINES.

SPECIFICATION forming part of Letters Patent No. 628,630, dated July 11, 1899.

Application filed June 6, 1898. Serial No. 682,679. (No model.)

To all whom it may concern:

Be it known that we, ALLAN G. MATHER and FREDERICK T. SNYDER, of Milwaukee, in the county of Milwaukee and State of Wisconsin, have invented a new and useful Improvement in Valves for Engines, of which the following is a description, reference being had to the accompanying drawings, which are a part of this specification.

Our invention has relation to improvements in valve and engine mechanism.

The invention contemplates as an object the provision of an improved valve mechanism forming part of an engine mechanism of such character that it is entirely automatic in operation and independent of any outside mechanism—that is to say, it is capable of being operated by steam-pressure without aid from exterior means.

A further object contemplated is the provision of a construction wherein, in connection with the reciprocating pistons employed, provision is made for an improved construction for the admission of steam to and exhaust from the cylinders of said pistons in such manner as to permit one piston and its rod being reciprocated, even though the other piston and its rod are prevented from being reciprocated from any cause, or in the event of both pistons and their rods being prevented from working the valve mechanism can still continue to operate without any injurious effects to any part of the mechanism, and, furthermore, the construction provides for one piston and its rod being held stationary in order to enable repairs to be made or work performed beneath the same, and yet the other piston and its rod permitted to operate. This construction will be of especial advantage when the piston-rods are employed as stamp-stems in stamp-mills and have fitted to their lower ends the usual shoes for crushing and pulverizing ores carrying valuable materials. In such application of our invention if the mortar becomes so clogged that one stamp is prevented from working the proper working of the other will not be interfered with, or, on the other hand, if the clogging is such that both stamps are prevented from working the valve mechanism can still continue to operate without any injurious effects to any part of the mechanism.

With the above primary and other incidental objects in view the invention consists of the devices and parts or their equivalents, as hereinafter more fully set forth.

Referring to the drawings, Figure 1 is a vertical sectional view through one of the cylinders and transversely through the valve-chest. Fig. 2 is a horizontal section through the valve-chest and through the cylinders, the pistons being removed. Fig. 3 is a section on the line 3 3 of Fig. 2. Fig. 4 is a section on the line 4 4 of Fig. 2, and Fig. 5 is a section on the line 5 5 of Fig. 2.

Referring to the drawings the numerals 6 6 indicate the cylinders, in each of which is adapted to reciprocate a piston 7, said piston having a piston-rod extending from one side and projecting through the end of the cylinder, as usual. The space between one side of the piston and the end of each cylinder is indicated by the numeral 8 and the space between the opposite face of the piston and the opposite end of the cylinder by the numeral 9. This space 9 is necessarily of less area than the space 8, owing to the piston-rod passing through said space, and necessarily forming merely an annular space around the piston-rod.

Extending across and communicating with the steam-cylinders is a steam-chest 10, and leading from certain chambers, hereinafter referred to, of this steam-chest are passages 11 11′. Other passages 12 lead from certain other chambers of the steam-chest to the annular spaces 9 of the cylinders.

The steam-chest is provided longitudinally with a valve-chamber 13, closed at opposite ends, preferably by removable heads 14 14. Within the valve-chamber is located a piston-valve 15. Exteriorly and centrally the piston-valve has formed therearound a projection 16. On each side of this central projection and at equal distances therefrom are other projections 17 17′, and between said central projection and the projections 17 17′ are formed concavities or recesses 18 18′. At opposite ends the valve is provided with other projections 19 19′, and between these projections and the projections 17 17′ are likewise

formed concavities or recesses 20 20′. These several projections 16, 17 17′, and 19 19′ are in the nature of pistons, being acted upon by the steam, so as to cause the longitudinal reciprocation of the valve. Fig. 2 of the drawings shows the valve at the end of its stroke in one direction. When in this position, the central projection 16 is adjacent to and contacts with a corresponding inward projection 21 from the valve-chamber or, more properly speaking, from the lining 22 of said valve-chamber, said lining being thickened at this point to form the projection 21. It will be noticed that the projection 16 of the valve does not extend outwardly quite so far as the other projections of the valve, so that the valve is of less diameter centrally or where the projection 16 is located. It follows, therefore, that as the projections 17 17′ extend out farther than the central projection 16 when the steam enters either of the cavities 18 or 18′ there will be greater steam-pressure against the shoulder 17 or 17′, which shoulder is larger than the opposed shoulder of the central projection 16, and consequently a differential pressure is produced, which causes the valve to move longitudinally.

Leading to the steam-chest is a valve-controlled inlet-pipe 23. This pipe connects with an inlet-chamber 24 in the steam-chest, which inlet-chamber is in communication with the valve-chamber 13 through a series of ports 25, extending to the wall or lining of the valve-chamber. On opposite sides of the steam-inlet chamber are other chambers 26 26′. These chambers respectively communicate with the valve-chamber by means of a series of ports 27 27′. The chambers 26 26′ also lead to the spaces 9 beneath the pistons 7 by means of the passages 12, hereinbefore referred to. Next to the chambers 26 26′ are other chambers 28 28′, (see Figs. 1 and 2,) which are in communication with the valve-chamber through the ports 29 29′. The chambers 28 28′ are also in communication, respectively, with the spaces 8 of the cylinders by means of the passages 11 11′, respectively, hereinbefore referred to. Next to the chambers 28 28′ are exhaust-chambers 30 30′, which are in communication with the valve-chamber by means of ports 31 31′. The exhaust-chambers 30 30′ lead to the exhaust-pipe 32 by means of a passage 33. (See Figs. 2 and 4.)

In the operation of this engine and valve mechanism if the piston-valve is in the position shown in Fig. 2—that is to say, if it has completed its stroke toward the left-hand end of Fig. 2—the projection or piston 16 will bear against the projection or thickened portion 21 of the lining 22 on the left hand of the ports 25. The result is that the steam is free to pass through the inlet into the concavity 18′, and thence through ports 27′ into chamber 26′. While this is taking place the valve is moved toward the right, owing to the excess pressure of steam against the projection or piston 17′. With this movement the projection or piston 16 is shifted so as to close the ports 25, and thereby prevent further entrance of steam into the concavity 18′. The result is that the steam passes into the chamber 26′ and from said chamber through the passage 12 into the space 9 of one of the cylinders and presses upwardly against the face of the piston. The steam therefore acts expansively between this face of the piston and the chamber 26′, and this expansive force causes the up movement of the piston and its piston-rod, and any steam which may be above the piston in the space 8 is free to exhaust through the channel 11′ into the chamber 28′, thence by way of the concavity or recess 20′ through the ports 31′ into the exhaust-chamber 30, and thence through the exhaust-channel 33 to the exhaust-pipe 32. With the continued movement of the piston-valve communication is established by way of the concavity 18′ between the chambers 26′ and 28′ through the ports 27′ and 29′. The steam therefore which has filled up the space 9 below the piston is now free to flow from the chamber 28′ through the channel 11′ into the space 8 above the piston. Inasmuch, however, as the top surface of the piston is greater in area than the under surface the down pressure on the upper surface will overbalance the up pressure on the under surface, and consequently cause a descent of the piston and its rod. The same steam therefore causes both the up movement and down movement of the piston and its rod. The piston-valve also by this time has been moved longitudinally to the right far enough to cut off further discharge through the ports 31′ by reason of the position of the projection 17′, and this extended movement of said piston-valve also brings the projection or piston 16 on the right-hand side of ports 25, and hence the inlet-steam will be free to pass into and fill up the concavity or recess 18, from which the steam passes into the chamber 26 and from said chamber through the channel 12 to the space 9 in order to act against the under surface of the piston of the left-hand cylinder, and thereby cause the left-hand piston 7 and its rod to ascend, any steam remaining above the piston 7 being free to exhaust through the channel 11 into the chamber 28, thence through the ports 29 into the cavity or recess 20, through the ports 31 into the exhaust-chamber 30, and thence through the exhaust-channel 33 to the exhaust-pipe 32. The steam which passes in and fills the concavity or recess 18, as just explained, also acts expansively on the projection or piston 17 and causes a movement of the piston-valve toward the left hand of Fig. 2. With the continued movement of the piston-valve in this direction communication is established, by way of the cavity or recess 18, between the chambers 26 and 28 through the ports 27 and 29. The steam, therefore, which has filled up the space 9 below the piston is now free to flow from the

chamber 28, through the channel 11, into the space 8 above the piston of the left-hand cylinder 6, and at the same time the position of the projection or piston 17 cuts off further outflow through the exhaust. The valve is now again in the position illustrated in Fig. 2, so as to admit steam into the concavity or recess 18′. Again, recurring to the longitudinal movement of the piston-valve toward the right of Fig. 4, it will be seen that just before the initial start the chambers 28 and 26 are in communication, so that steam is above the piston 7 of the left-hand cylinder 6 and also beneath the under surface of the piston 7. This piston 7 therefore starts to descend, owing to the overbalancing steam-pressure on the top, while the right-hand piston 7 is being raised. In the Fig. 2 position of the piston-valve, however, there is necessarily equal steam-pressure against the pistons 17 and 17′, and consequently the piston-valve is at a standstill. When, however, the piston 7 has descended sufficiently far to cause the steam above said piston and in the chamber 8 to expand, then the pressure of the steam in the concavity or recess 18 is to that extent diminished and the pressure of the steam in the concavity 18′ will overbalance and start the piston-valve on its movement toward the right of Fig. 2. With the continued movement of the piston-valve toward the right the ports 29 on the left are closed, and consequently the steam in the concavity 18 passes only into the chamber 26, and from thence to the space 9 to act against the under side of the left-hand piston 7, and this occurs at the same time the chambers 26′ and 28′ on the right are brought into communication, so as to cause a down movement of the right-hand piston 7, and at the same time the chambers 28 and 30 on the left hand are brought into communication, so that the steam above the piston 7 of the left-hand cylinder 6 can exhaust. It will therefore be seen that while one piston 7 is descending the other is ascending, and this is true in case of the longitudinal movement of the piston-valve in either direction. It will also be observed that the longitudinal reciprocation of the piston-valve is entirely automatic—that is to say, it is actuated by the steam-pressure without aid from any exterior means.

An important feature of this mechanism is its adaptability to permit one piston and its rod to make its full stroke, even though the rod of the other piston is raised by clogging material or otherwise, the valve under such circumstances still continuing to operate. If the clogged piston-rod is only raised partially by the clogging material, it will make a partial stroke, whereas if it is raised sufficiently to bring its piston to the upper end of the cylinder it will remain stationary. It is equally true that the valve mechanism will continue to work uninterruptedly, even though both piston-rods become clogged to such an extent as to make but a partial stroke or to prevent the stroke entirely. This feature is of peculiar importance where the piston-rods are employed as stamp-stems in stamp-mills designed for crushing and pulverizing ores. Furthermore, the valve-chest is so constructed as to admit, under certain circumstances, steam to either end of the piston-valve. This construction adapts the piston-rod of either of the pistons 7 to be held up so that repairs can be readily made without danger of accident to the attendant. This is also of importance when the engine and valve mechanism are employed in connection with stamp-mills in which the piston-rods of the pistons 7 serve as the stamp-stems. The accomplishment of the function just described is obtained by providing channels 34 34′, which channels are provided with end extensions 35 35′, leading to the spaces between the opposite ends of the piston-valve and the ends of the valve-chamber. A rotatable valve 36 intersects the channel 34 34′, and this valve is constructed with somewhat more than one-half of its surface cut away, as indicated at 37. The chamber in which the valve 36 fits communicates with the inlet-chamber 24 through a port 38. When the piston-valve is reciprocated, steam at one end is forced through the channel and valve to the opposite end, and vice versa. By turning the valve 36 the connection between the channels 34 34′ is adjusted, so that the flow of steam between the spaces at the opposite ends of the piston-valve is regulated, and the degree of cushioning thereby adjusted and the piston-valve prevented from striking the ends of the steam-chest. By turning the rotatable valve 36, however, so as to cut off communication between the channels 34 34′ and connect channel 34′ with the inlet steam-chamber 24 through the port 38, full steam-pressure will be admitted to the right-hand end of the piston-valve and said valve held immovable in the position shown in Fig. 2. This will admit steam through the concavity or recess 18′, ports 27′, and the chamber 25′, thence by passage 12 to space 9, where it will act against the under surface of the piston 7 and raise said piston to the top of its stroke and hold it there. This will admit of any work being done with safety beneath the piston-rod or in the mortar under the stamp when the invention is used in connection with a stamp-mill. By turning the valve 36 in the opposite direction, so as to shut off channel 34′ and connect channel 34 through the port 38 with the steam-supply from chamber 24, full steam-pressure will be applied to the left-hand end of the piston-valve, and said piston-valve will then be forced to the right-hand end of its stroke and held there. This, through the concavity or recess 18 and ports 25 and 27′, will admit full steam-pressure to

the under side of the left-hand piston 7, and this piston will be thereby raised to the top of its stroke and held there as long as the valve 36 remains in said position. If the piston-valve should stop in the central position, so that the projection or piston 16 covers the ports 25, this action just described will enable the valve to be moved from said central position to a position at one end, as shown, when its normal function will take place.

While we have herein described steam as the actuating medium, yet we do not wish to be understood as restricting ourselves thereto inasmuch as it is obvious that any other actuating agent capable of acting on the pistons may be employed.

What we claim as our invention is—

1. The combination of a cylinder, a piston reciprocative therein, and having a rod extending therefrom, a steam-chest having a series of live-steam and exhaust passages communicating between said valve-chest and the cylinder, a valve within the steam-chest, said valve provided with a plurality of pistons, with recesses formed therebetween, the central piston of the valve being smaller than the other pistons thereof, whereby a differential pressure is obtained, and means for automatically operating the valve directly by the inflowing steam, whereby, as the valve reciprocates, the steam is caused to flow alternately to opposite sides of the piston of the cylinder, and to be exhausted alternately from opposite sides of said piston, to thereby cause a reciprocation of the piston.

2. The combination of cylinders, pistons reciprocative therein, said pistons provided with projecting rods, a steam-chest having a series of live-steam and exhaust passages communicating between said valve-chest and the cylinders, a valve within the steam-chest, said valve provided with a plurality of pistons, with recesses formed therebetween, the central piston of the valve being smaller than the other pistons thereof, whereby a differential pressure is obtained, and means for automatically operating the valve directly by the inflowing steam, whereby as the valve reciprocates the steam is caused to flow alternately to opposite sides of the pistons of the cylinders, and to be exhausted alternately from opposite sides of said pistons, to thereby cause alternate reciprocations of the pistons.

3. The combination, of cylinders, pistons adapted to be reciprocated therein, said pistons provided with projecting rods, the pressure area on one side of each piston being greater than the pressure area on the opposite side, a valve-chest having a valve-chamber and a series of other chambers, one of said other chambers being an inlet-chamber, other of said chambers having passages leading to the spaces of the cylinders above the pistons, other of said chambers leading to the spaces of the cylinders below the pistons, and the remaining chambers leading to the exhaust, and a reciprocating valve provided centrally with a piston adapted, when the valve is at the end of its stroke in either direction, to open the port leading from the inlet-chamber, and said valve also provided with other pistons of greater diameter than the central piston, and with cavities or recesses between the pistons.

4. The combination, of cylinders, pistons adapted to reciprocate therein, and provided with projecting rods, a steam-chest provided with ports communicating with opposite ends of the valve-chamber of the steam-chest, a reciprocating valve working in said valve-chamber, and adapted to control the flow of steam against opposite sides of the pistons of the cylinders, a rotatable valve intersecting the ports, and provided with a passage which is normally in register with the ports, and means for turning the valve, whereby the area of the channel between opposite ends of the steam-chest is regulated.

5. The combination, of cylinders, pistons adapted to be reciprocated therein, and provided with projecting rods, a steam-chest having a valve-chamber in communication with the spaces above and below the pistons of the cylinders, and also having a chamber in communication with the source of steam-pressure, and said steam-chest further provided with channels communicating with opposite ends of the valve-chamber of the steam-chest, and said channels also communicating with the chamber which is in communication with the source of steam-pressure, a reciprocating valve working in the valve-chamber and adapted to control the flow of steam against opposite sides of the pistons of the cylinders, a rotatable valve intersecting the channels, and provided with a passage which is normally in register with said channels, and means for turning the valve, whereby communication between the channels is interrupted, and either channel connected with the source of steam-pressure.

6. The combination, of cylinders, pistons adapted to be reciprocated in said cylinders and provided with projecting rods, the pressure area of one side of each piston being greater than the pressure area on the opposite side, a steam-chest having a valve-chamber and a series of other chambers leading to said valve-chamber, one of said other chambers being an inlet-chamber, other of said chambers having passages leading to the spaces of the cylinders above the pistons, other of said chambers leading to the spaces of the cylinders below the pistons, and the remaining chambers leading to the exhaust, and said steam-chest also provided with channels communicating with opposite ends of the valve-chamber of the steam-chest, and said channels also communicating with the inlet-chamber, a reciprocating valve working in the

valve-chamber and adapted to control the flow of steam against opposite faces of the pistons of the cylinders, a rotatable valve intersecting the channels and provided with a passage which is normally in register with said channels, and means for turning the valve whereby communication between the channels is interrupted, and either channel thereby connected with the source of steam-pressure.

In testimony whereof we affix our signatures in presence of two witnesses.

ALLAN G. MATHER.
FREDERICK T. SNYDER.

Witnesses to A. G. Mather's signature:
C. T. BENEDICT,
A. L. MORSELL.
Witnesses to F. T. Snyder's signature:
G. W. DIXON,
HARRY A. GNEIS.