No. 728,283. PATENTED MAY 19, 1903.

T. OFFICER & H. H. MERCER.

ENGINE.

APPLICATION FILED FEB. 13, 1902.

NO MODEL. 3 SHEETS—SHEET 1.

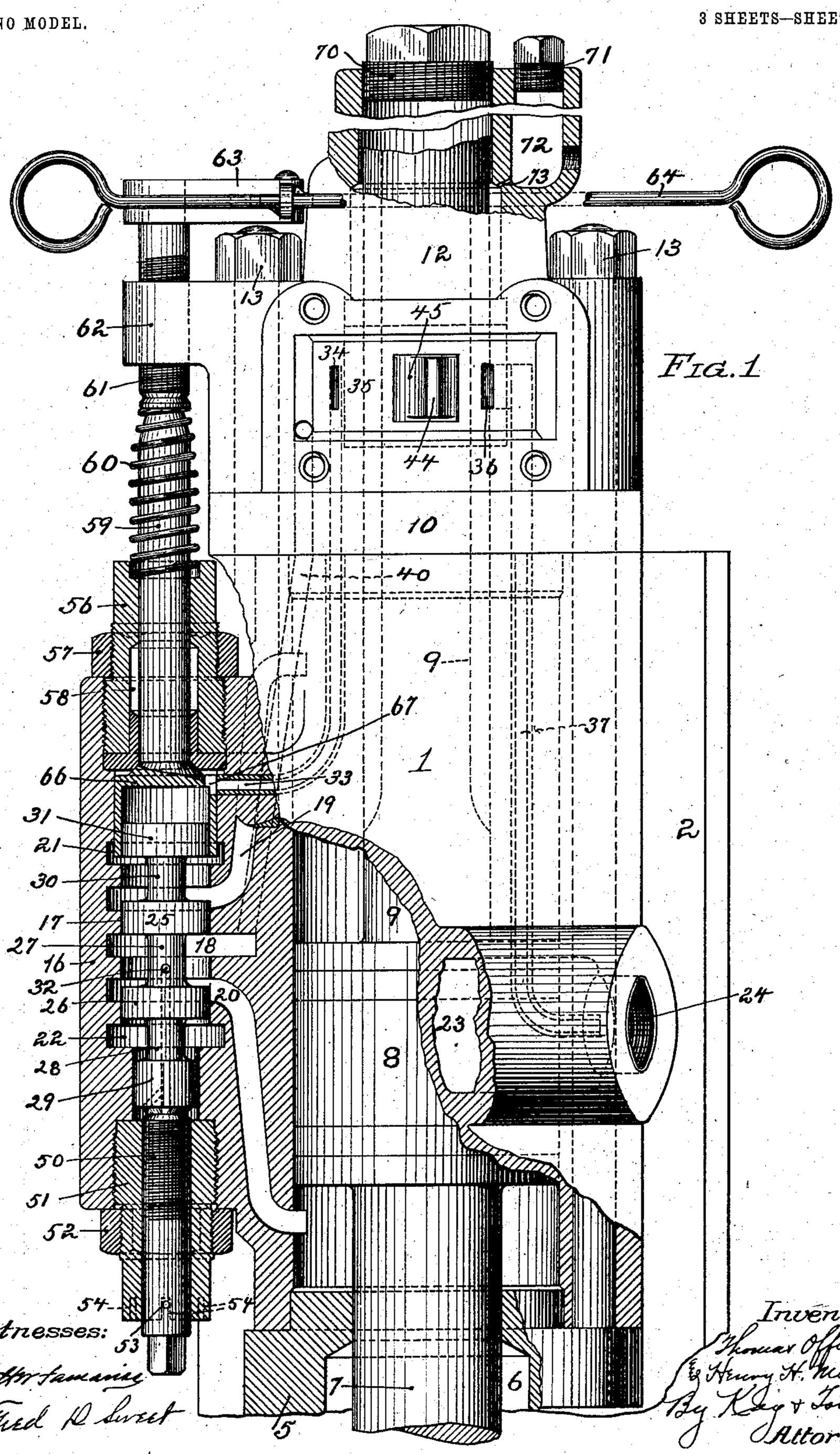

FIG. 1.

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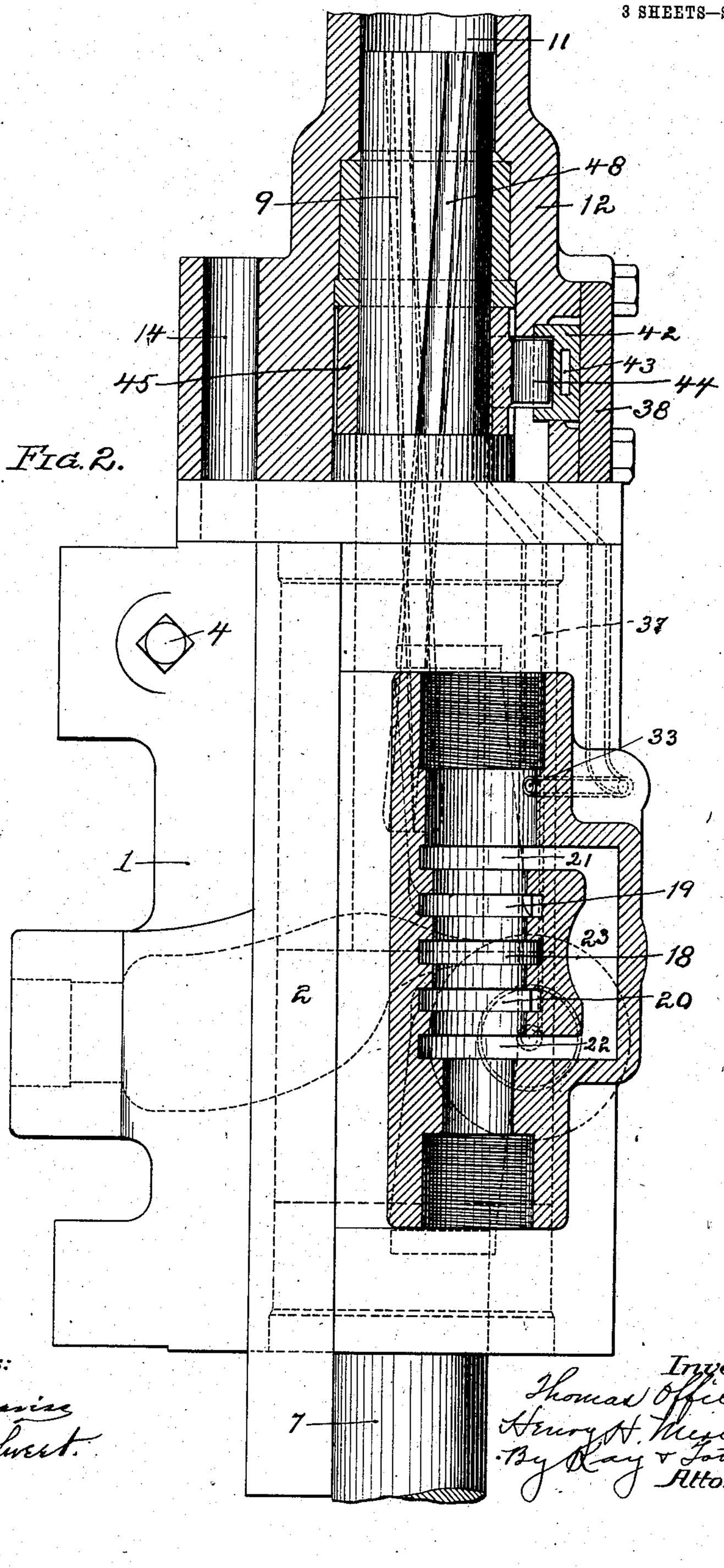
NO MODEL. 3 SHEETS—SHEET 2.

FIG. 2.



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NO MODEL. 3 SHEETS—SHEET 3.

FIG. 3.

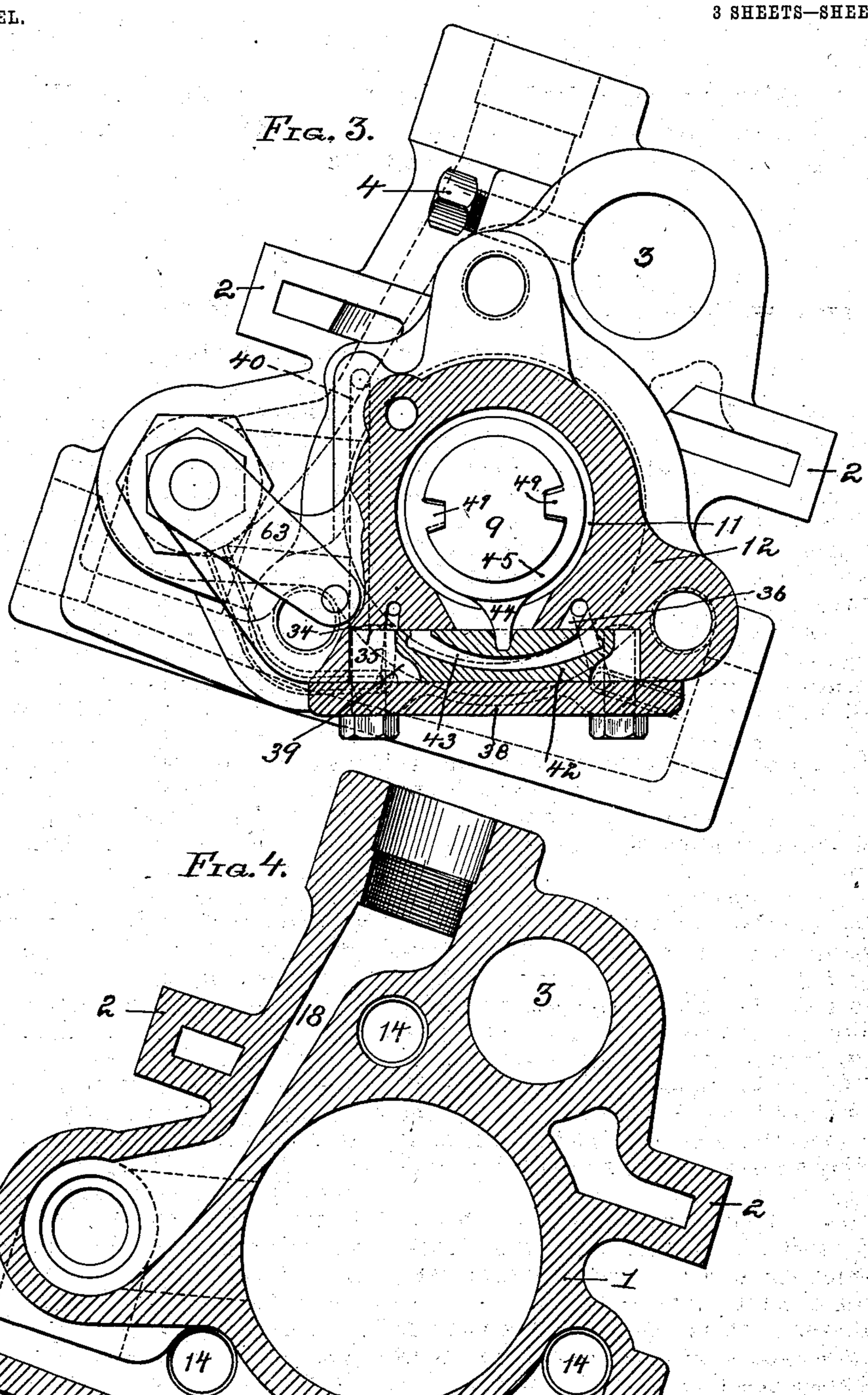

FIG. 4.

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No. 728,283. Patented May 19, 1903.

UNITED STATES PATENT OFFICE.

THOMAS OFFICER AND HENRY H. MERCER, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNORS TO SULLIVAN MACHINERY CO., OF CHICAGO, ILLINOIS, A CORPORATION OF NEW HAMPSHIRE.

ENGINE.

SPECIFICATION forming part of Letters Patent No. 728,283, dated May 19, 1903

Application filed February 13, 1902. Serial No. 93,931. (No model.)

To all whom it may concern:

Be it known that we, THOMAS OFFICER and HENRY H. MERCER, residents of Claremont, in the county of Sullivan and State of New Hampshire, have invented a new and useful Improvement in Engines; and we do hereby declare the following to be a full, clear, and exact description thereof.

Our invention relates to direct fluid-pressure engines—such, for instance, as are used for operating drills or other reciprocating tools, although the invention is applicable to any type of direct-acting engine.

The invention relates to that type of direct-acting engines wherein the main valve is operated by fluid-pressure, preferably by live fluid at approximately the normal working pressure.

One of the objects of our invention is to provide improved means for operating the main valve; and to this end it consists in providing a differential piston for operating the valve, which differential piston is continually subjected on its smaller area to live-fluid pressure, and providing means for alternately admitting similar fluid-pressure and exhausting it from the other area of said piston. The means for performing this latter function is preferably a valve which is actuated by a tail-rod on the main piston.

A further object of our invention is to provide adjustable buffers for limiting the travel of the main valve, so as to regulate the stroke of the main piston. One of these buffers is under the control of the operator of the machine and is arranged to throttle the exhaust, so as to check the speed of the main piston.

Further objects of our invention are to improve engines of this type in details of construction, as will hereinafter appear.

In the accompanying drawings, Figure 1 is a front view of the engine-cylinder, partly in section to better show the main-valve buffers and piston. Fig. 2 is a side view of the same, partly in section. Fig. 3 is a transverse section through the reversing-valve and upper steam-chest; and Fig. 4 is a similar section through the main-valve chest and main cylinder, the valve and piston being omitted.

The engine embodying our invention may be operated by either steam, air, or other gas under pressure; but for convenience of description we shall designate the operating-fluid as "steam," that being the agent preferably employed in this engine; but it will be understood that the invention is not limited to steam-engines.

Our invention has been shown in the drawings as applied to an engine used on stone drilling and channeling machines in which the cylinder is placed in a vertical position; but this is merely illustrative, and the invention is not limited thereto. In the following description, however, terms are used which refer to the vertical arrangement of the cylinder, this being done merely as a matter of convenience, and said terms will be understood to indicate only the relative and not the absolute positions of the parts, as the engine may be placed in a horizontal or any other position, if desired.

In the drawings the main-cylinder body is shown at 1, and it is provided on opposite sides with the guides 2, which move up and down in the grooves of the standard in drilling or channeling machines, as will be readily understood. The cylinder-body is provided with a vertical opening or hole 3, which is adapted to receive the feed-nut in which works the ordinary feed-screw of a well-known type of stone-drilling machine and will be understood without further description. At 4 is shown the set-screw for holding the feed-nut in place. A portion of the lower head of the cylinder is shown at 5, said head being provided with a recess 6 for an ordinary stuffing-box and having the piston-rod 7 projecting through an opening therein. This piston-rod is formed integrally with or suitably secured to the main piston 8, and said piston in turn has attached thereto, preferably by being forged thereon, the tail-rod 9, which projects upwardly through the upper cylinder-head 10 and into a chamber 11, formed in an extension-head 12. The heads 5 and 10 are secured to the body of the cylinder by means of the bolts 13, said bolts extending through the holes 14 in the cylinder-body.

The parts so far described, except for the tail-rod 9 and extension-head 12, are or may be of the usual construction, and further description is not necessary.

On one side of the cylinder-body and cast with it is the valve chamber or chest 16, in which is located the main valve 17. The valve-chamber 16 has communicating therewith, preferably about at its vertical middle, the inlet-port 18, and just above and below this inlet-port the said valve-chamber communicates, by means of the ports 19 and 20, with the upper and lower ends of the cylinder. Above and below these ports 19 and 20 the valve-chamber 16 communicates, by means of the ports 21 and 22, with the exhaust-port 23, which extends through the casting of the cylinder-body and may be connected, as at 24, with any convenient exhaust-pipe. The main valve 17 is provided with the pistons or disks 25 and 26, which are connected by the neck 27, these pistons or disks fitting snugly in the valve-chamber and closing the different ports by passing beyond the same, as will be readily understood. In Fig. 1 the main valve 17 is in such position that the steam or other fluid from the inlet-port 18 will pass through the port 20 to the lower end of the cylinder, while the upper port 19 is opened to the exhaust-port 21. When said valve is moved upward to its other position, the port 20 will be cut off and communication established between the inlet-port 18 and the port 19, leading to the upper end of the cylinder, while at the same time the port 20 would be opened up to the exhaust-port 22. This main valve is adapted to be operated by fluid-pressure, and for this purpose we employ a differential piston, which differential piston may be formed separate from the main valve and may work in a separate chamber, but which preferably is integral with the main valve and works in the same chamber therewith. As shown, the said valve has connected to its lower end by means of a neck 28 the head or piston 29, which is of comparatively small area, while at its upper end it has connected thereto by means of a neck 30 the head or piston 31, which is of comparatively large diameter. These two heads or pistons 29 and 31 constitute the differential piston for moving the main valve. Fluid-pressure is constantly maintained below the piston 29 by means of a suitable port or passage 32, which, as shown, is bored through the valve and the piston 29 and connects the chamber below the piston 29 with the inlet-port 18 at all times, so that fluid-pressure is maintained constantly on the lower face of the piston 29. This port or passage 32 might, however, be cored out in the casing of the valve-chamber, as will be readily understood, the essential being that a constantly-open communication be formed between the source of live fluid and the valve-chamber underneath the piston 29. The result of this is that there is always present fluid-pressure underneath the piston 29, which in the absence of pressure above the piston 31 will elevate the valve, but which pressure will be overbalanced by the admission of an equal fluid-pressure into the chamber above the larger piston 31. A port or passage 33 leads into the chamber above the piston 31 for the purpose of supplying at the proper time the requisite pressure above said piston to lower the valve. This port or passage 33 may be controlled by a valve operated in any suitable manner or from any suitable source; but we have shown the same controlled by means of a valve which is actuated from the tail-rod 9, as will now be described.

The port or passage 33 extends up through the cylinder body and head 10 and into the extension 12 and opens through a port 34 in a valve-seat 35, formed in said extension. This valve-seat is also provided with a port 36, which communicates, by means of a passage 37, with the exhaust-port 23. A cover-plate 38 is secured to the extension 12, so as to form substantially a steam-chest 39, which is in constant communication, as through the port or passage 40, with the source 18 of live fluid. Working in this valve-chest on the valve-seat 35 is a valve 42, which has a passage 43 cored therethrough and opening on the face thereof at such distance apart that such openings will bridge the ports 34 and 36. This valve may be moved by any desirable mechanism; but we have shown the same engaged by a finger 44 on a collar 45, located in the chamber 11 and surrounding the tail-rod 9. The tail-rod is provided with one or more spiral grooves 48, which is or are engaged by a suitable projection or projections 49 on the collar 45. As a consequence the reciprocation of the main piston and the tail-rod will impart a rocking or oscillatory movement to the collar 45, which through the finger 44 will move the valve 42 on the seat 35. When the valve is in the position shown in Fig. 3, the live fluid entering through the port 40 will pass, by means of the port 33, into the valve-chamber above the large piston 31, thereby overbalancing the fluid-pressure underneath the small piston 29 and holding the main valve in its lowermost position, as shown in Fig. 1, thereby admitting fluid-pressure underneath the main piston 8. As the piston and tail-rod travel upwardly, however, and after the piston has made a sufficient portion of its upward stroke, the spiral grooves on the tail-rod will rock the ring 45 and move the valve 42 over toward the left in Fig. 3, so as to connect the port 34 with the port 36, thereby connecting the valve-chamber above the piston 31 with the exhaust-port and relieving the fluid-pressure above said piston. The pressure underneath the smaller piston 29 will then raise the main valve, thus admitting fluid-pressure to the upper end of the main cylinder, which will drive the main piston 8 down. When said main piston has traveled a sufficient distance on its downward stroke, the valve 42 by means

of the spiral grooves in the tail-rod will be again moved back to the position shown in Fig. 3, thus again admitting fluid-pressure above the larger piston 31 to again depress the main valve. These operations will continue in succession at the will of the operator.

To regulate the amount of steam admitted to the cylinder, suitable adjustable buffers are provided to limit the movement of the main valve in both directions. The buffer shown at the lower end comprises the rod 50, which is threaded into a holder or sleeve 51, which in turn is threaded into an opening in the lower end of the casing 16. The holder 51 is adapted to be secured in place by means of the lock-nut 52, and in order to hold the buffer 50 in its adjusted position it is provided with a transverse opening 53, and the lower end of the holder 51 is provided with a series of slots 54, six such slots being indicated on the drawings. A suitable pin, preferably a split pin, is passed through the slots 54 and opening 53, thus locking the buffer 50 in the holder and preventing it from turning. It will be readily understood by an inspection of Fig. 1 that if said buffer is screwed upwardly it will limit the downward travel of the main valve 17, and thus restrict the opening from the valve-chamber to the port 20 and in that way limit the amount of steam passing to the lower end of the cylinder. Inversely, when said buffer 50 is screwed downwardly the main valve 17 can travel down farther, thus increasing this opening and the amount of steam passing to the lower end of the cylinder. The upper end of the casing 16 has also threaded thereinto a sleeve or holder 56, which is held in position by means of the lock-nut 57 and which has formed therein the stuffing-box 58, through which passes the buffer 59. This buffer is normally held up by the spiral spring 60, and its position is determined by means of the screw 61, which is tapped through a lug 62 on the extension-head 12 or other suitable part. Connected to the screw 61 is an arm 63, to which is attached a rod 64, whose ends will be conveniently accessible to the operator of the machine. By working this rod the operator can adjust the screw 61 and in that way adjust the position of the buffer 59, so as to limit the upward travel of the main valve 17. This in the manner above described will regulate the amount of steam or other fluid passing to the upper end of the cylinder. The screw 61 is never locked in adjusted position, but is always free to be rotated, so that it can be quickly adjusted by the operating-rod 64.

Formed upon or suitably secured to the lower end of the buffer 59 is a cup 66, in which the head or piston 31 works. This cup is provided with an opening 67 for admitting into its interior the fluid-pressure coming through the port 33, and its lower end extends downwardly into the exhaust-passage 21. By operating the screw 61 to the desired degree the buffer can be depressed to such an extent that the cup 66 will either entirely close this exhaust-port 21 or will throttle it to such an extent as to cause the fluid-pressure to cushion above the main piston 8, and in this manner the speed of the main piston can be checked.

The tail-rod chamber 11 is closed by means of the plug 70, and a plug 71 closes an oil-chamber 72, which is arranged at the side of the tail-rod chamber and communicates with the latter by means of a hole or opening 73. The oil-chamber is arranged to hold quite a quantity of oil, and this flows through the hole 73 into the tail-rod chamber, oiling the moving parts, such as the collar 45, the reversing-valve 42, and the piston 8. The oil-cup is preferably cast with the tail-rod case 12.

The operation of the engine will be gathered from the foregoing description and is as follows: Supposing the main piston 8 to be in its uppermost position and the main valve also be in its elevated position, in this position the reverse-valve 42 connects the port 34 with the exhaust-port 36, so that there is no fluid-pressure above the piston 31, and the steam-inlet 18 is in communication with the port 19, leading to the upper end of the cylinder, while the port 20 is opened to the exhaust-port 22. After the piston 8 has traveled a sufficient distance downward the spiral groove in the tail-rod will move the valve 42, so as to disconnect the port 34 from the exhaust and to uncover said port 34, thereby admitting live fluid through the passage above the piston 31. This will overbalance the pressure underneath the piston 29 and force the valve against the lower buffer 50. This will connect the upper end of the cylinder with the exhaust-port 21 and connect the lower end of the cylinder with the steam-inlet 18, which will force the piston 8 upwardly. After it has traveled upwardly a sufficient distance the valve 42 will be reversed to connect the port 34 with the port 36, and the steam above the piston 31 will be exhausted. This will permit the fluid-pressure underneath the piston 29 to move the valve against the top buffer 59 and again put the valve in such position that the steam will be exhausted from the lower end of the cylinder and admitted to the upper end thereof. There is always live fluid-pressure in the space between the pistons 25 and 26 which can flow through the port 32 to the chamber underneath the piston 29, so that in the absence of pressure above the piston 31 the valve will be held elevated, and, on the other hand, it will be overbalanced by admitting pressure onto said larger piston. If it is desired to give more lift to the piston, the buffer 50 will be lowered, which will give the valve a greater travel downward and open the port 20 wider. This will admit more steam to the lower end of the cylinder and give the piston a stronger and quicker motion upward. By screwing the buffer 50 upward the reverse result will be given—that is, the valve travel

will be shortened and the amount of steam passing to the lower end of the cylinder will be lessened. Similar adjustment can be given to the upper buffer 59 by means of the screw 61 in order to increase or decrease the power and speed of the downstroke. This buffer 59, however, has a twofold function, one being that just described—that is, for varying the amount of steam passing into the upper end of the cylinder—and the other being that by a greater movement of the governing-screw 61 the exhaust-port 21 can be entirely or nearly closed, so as to cushion the piston 8 in its upward travel. It can also be moved downwardly to such an extent so as not to allow the valve 17 to come up high enough to let steam out of the port 20 into the exhaust-port 22, thus cushioning the downward stroke of the piston, as well as checking its upward stroke. The important cushioning, however, is in the lower end of the cylinder, as just described; but this does not stop the movement of the piston entirely, but checks it, so that it does not strike with sufficient force to injure the lower head. The closing of the exhaust-port 21 is accomplished by the cup 66, which is sufficiently long when forced down to entirely or partially close this port and is always sufficiently long to allow the extreme travel of the piston 31 in it when it is not used for cushioning purposes. By means of the screw 61, therefore, the control of the piston 8 is in the hands of the machine operator, and as in channeling-machines the tool-holder or cross-head is usually attached to the piston-rod 7 direct control over the same is had.

What we claim as our invention, and desire to secure by Letters Patent, is—

1. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure-actuated means for operating said main valve, a screw-threaded buffer for limiting the travel of the main valve, and a slot-and-pin connection between said buffer and its holder for locking the buffer in its adjusted position.

2. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure-actuated means for operating said main valve, a freely-adjustable buffer for limiting the upward travel of said main valve, and means under the control of the operator for varying the position of said buffer.

3. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure means for operating said main valve, a buffer for limiting the upward travel of said main valve, a freely-adjustable abutment for regulating the position of said buffer, and means under the control of the operator for varying the position of said abutment.

4. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure-actuated means for operating said main valve, a buffer for limiting the upward travel of said main valve, a freely-rotatable screw for regulating the position of the buffer, and means permanently connected to said screw and under the control of the attendant for adjusting said screw.

5. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure-actuated means for operating said main valve, and means under the control of the operator for throttling the exhaust from said cylinder.

6. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure-actuated means for operating said main valve, a buffer for limiting the travel of said main valve, and means for adjusting said buffer, said buffer being arranged to throttle the exhaust-port and check the speed of the piston.

7. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, a differential piston for operating said main valve, a movable cup in which the larger area of the differential piston operates, said cup being adapted to throttle the exhaust-port, and means for adjusting the position of said cup.

8. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, a differential piston for operating said main valve, a movable cup in which the larger head of said differential piston moves, said cup being adapted to throttle the exhaust-port, means for adjusting the position of said cup, and means for admitting fluid-pressure into said cup above said piston.

9. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure-actuated means for operating said main valve, an adjustable buffer for limiting the downward travel of the main valve, means for locking said buffer in its adjusted position, a quick-moving adjustable buffer for limiting the upward travel of the main valve, and means under the control of the operator for varying the position of said last-named buffer.

10. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, a main valve for controlling the same, fluid-pressure-actuated means for operating said main valve, an adjustable buffer for limiting the downward travel of the main valve, means for locking said buffer in its adjusted position, a freely-

rotatable screw for limiting the upward travel of the main valve, and means connected to said screw and under the control of the operator for adjusting said screw.

11. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, of a main valve for controlling the same, a piston working in said cylinder, a tail-rod connected to said piston, fluid-pressure-actuated means for operating said main valve, a valve and ports and passages for controlling the fluid-pressure-actuated means, and connections between the tail-rod and last-named valve for operating the latter.

12. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, of a main valve for controlling the same, a piston working in said cylinder, a tail-rod connected to said piston, fluid-pressure means for operating said main valve, a valve and ports and passages for controlling the fluid-pressure-actuated means, and spirally-arranged connections between the valve and tail-rod for actuating said last-named valve.

13. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, of a main valve for controlling the same, a piston working in said cylinder, a tail-rod connected to said piston, fluid-pressure-actuated means for operating said main valve, a steam-chest connected to the source of live steam, a valve-seat therein having an exhaust-port and a port leading to the main-valve-operating means, a valve on said seat for controlling said ports, and connections between the tail-rod and last-named valve for operating the same.

14. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, of a main valve for controlling the same, a piston working in said cylinder, a tail-rod connected to said piston, a differential piston for operating said main valve, a valve and ports and passages for admitting fluid-pressure to said differential piston, and connections between the tail-rod and last-named valve for actuating the same.

15. In a direct-acting fluid-pressure engine, the combination with a cylinder provided with inlet and exhaust ports, of a main valve for controlling the same, a piston working in said cylinder, a tail-rod connected to said piston, a differential piston for operating said main valve, a port or passage for maintaining fluid-pressure on the smaller area of said differential piston, a valve and ports for admitting pressure to and exhausting it from the larger area of said differential piston, and connections between the tail-rod and last-named valve for actuating the same.

16. In a direct-acting fluid-pressure engine, the combination with a vertically-arranged cylinder provided with inlet and exhaust ports, of a main valve for controlling the same, a piston working in said cylinder, a tail-rod connected to said piston and working in a chamber connected to the upper cylinder-head, fluid-pressure-actuated means for operating said main valve, a valve actuated by the tail-rod for controlling the fluid-pressure-actuated means, and an oil-chamber communicating with the upper end of the tail-rod chamber.

In testimony whereof we, the said THOMAS OFFICER and HENRY H. MERCER, have hereunto set our hands.

THOMAS OFFICER.
HENRY H. MERCER.

Witnesses:
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ASA H. HARRIS.