

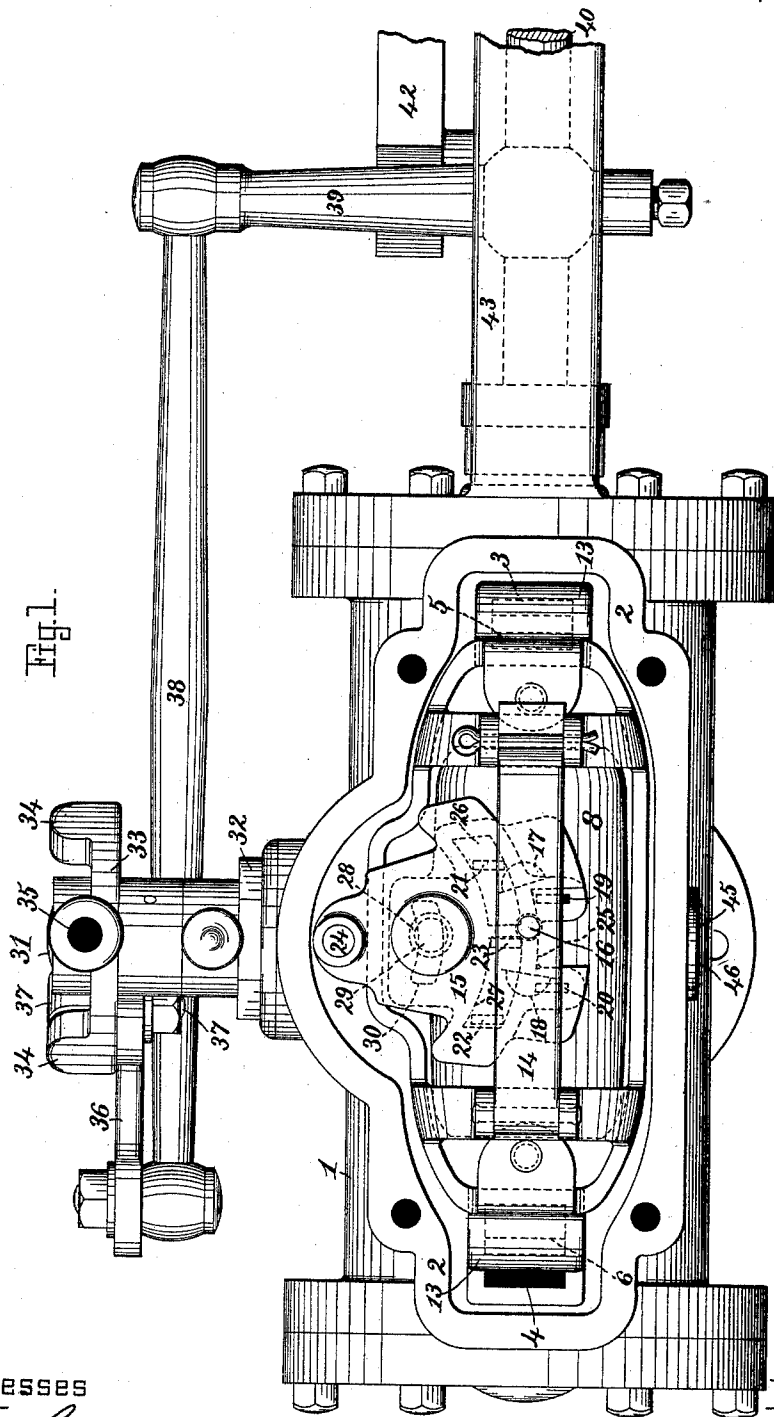
(No Model.)

4 Sheets—Sheet 1.

D. E. KEMPSTER.
STEAM ACTUATED VALVE.

No. 485,945.

Patented Nov. 8, 1892.



Witnesses

Henry Chadbourne.

Frank E. Greenwood.

Inventor

Daniel E. Kempster.

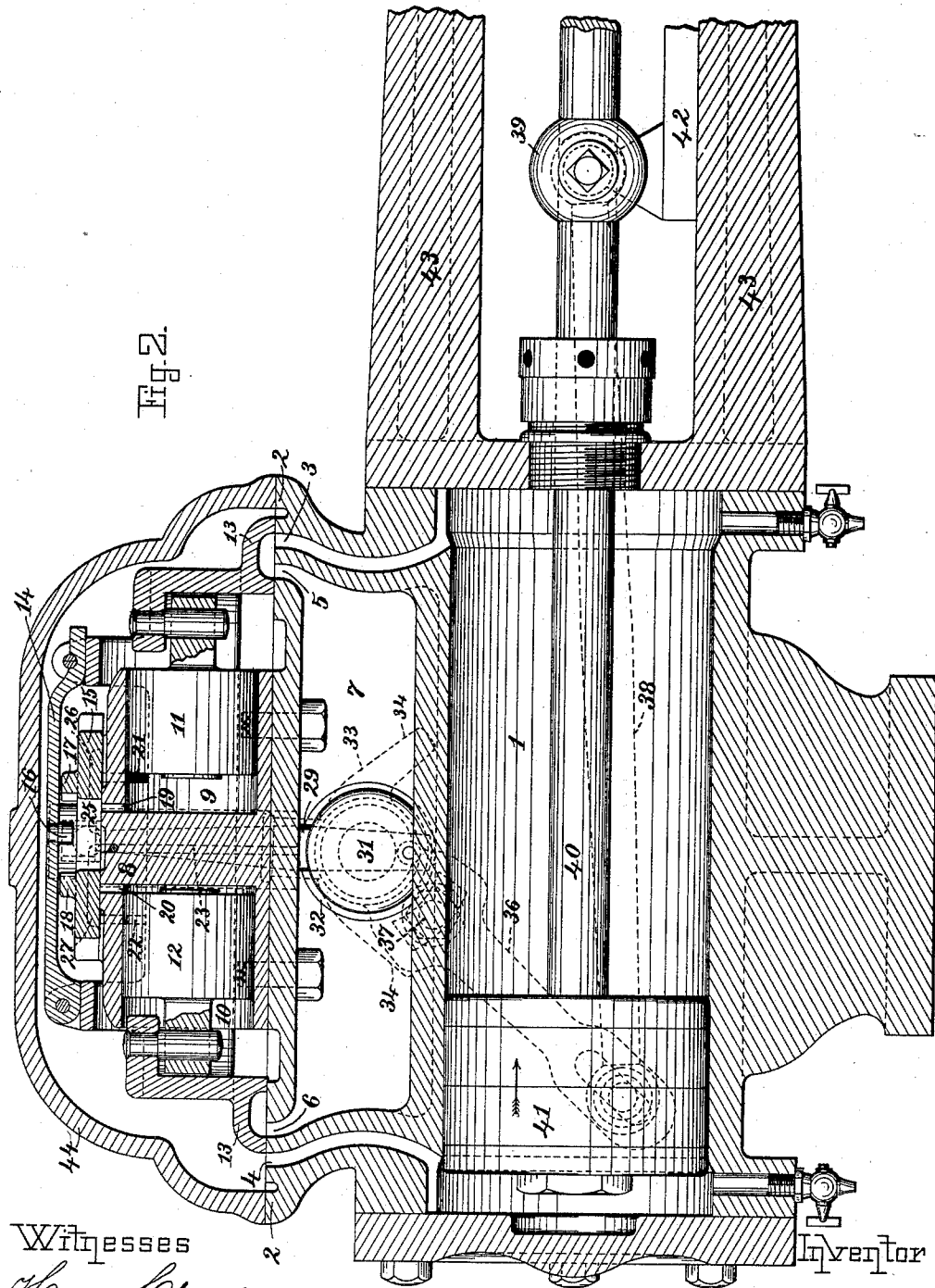
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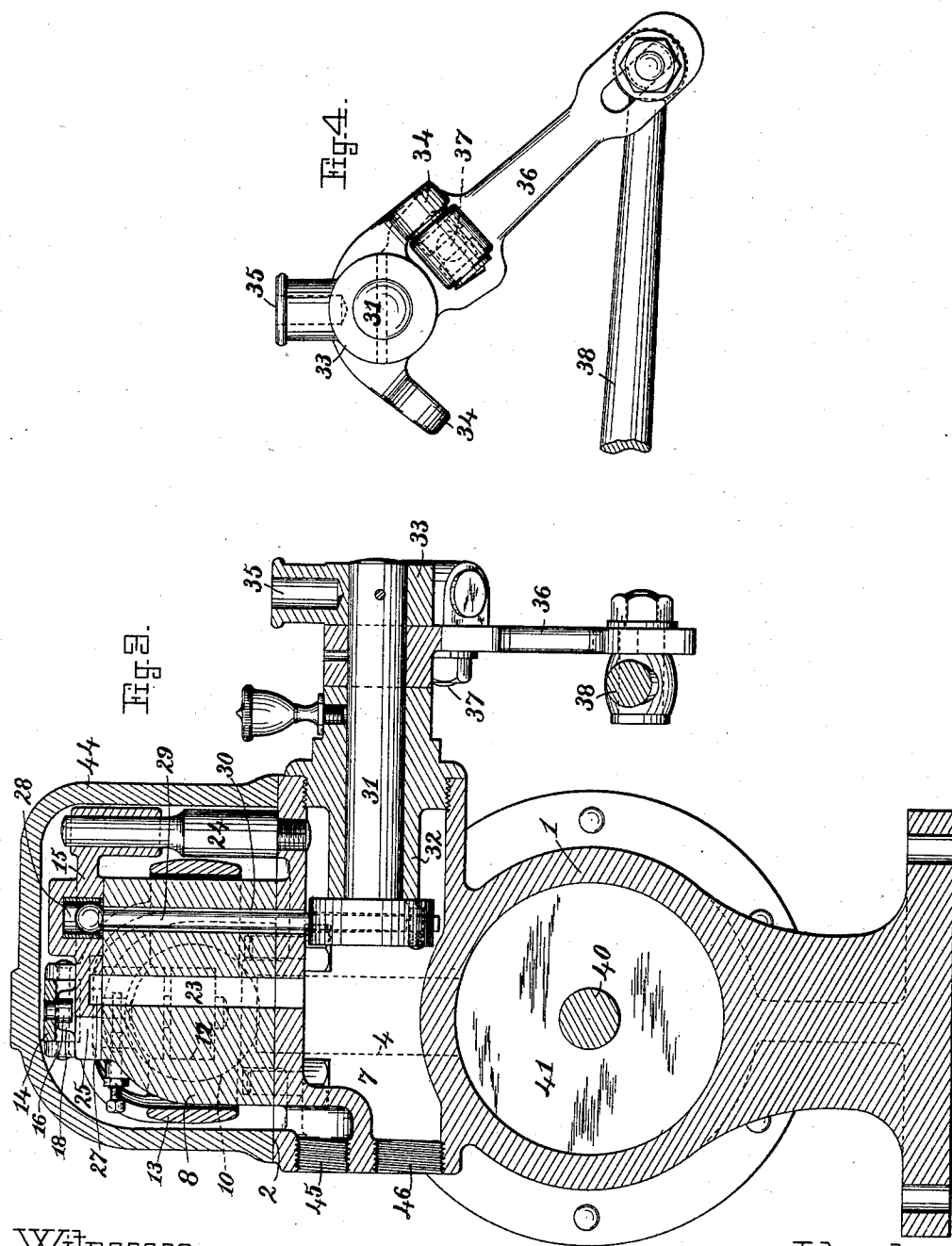
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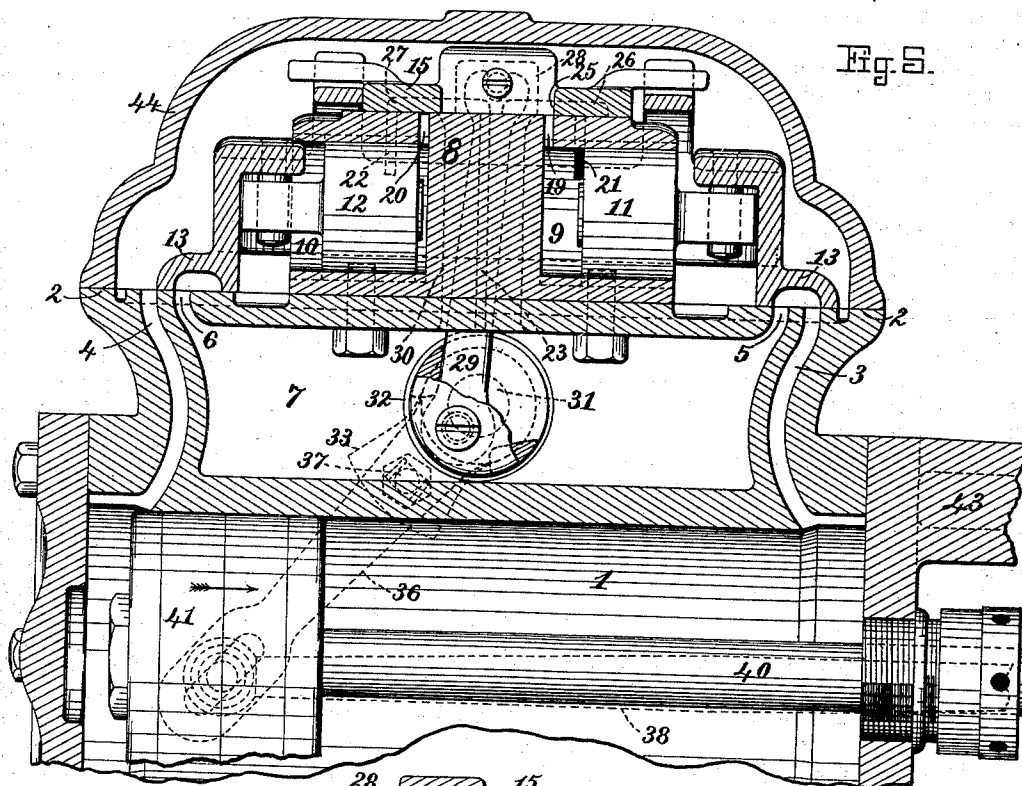


Fig. 5.

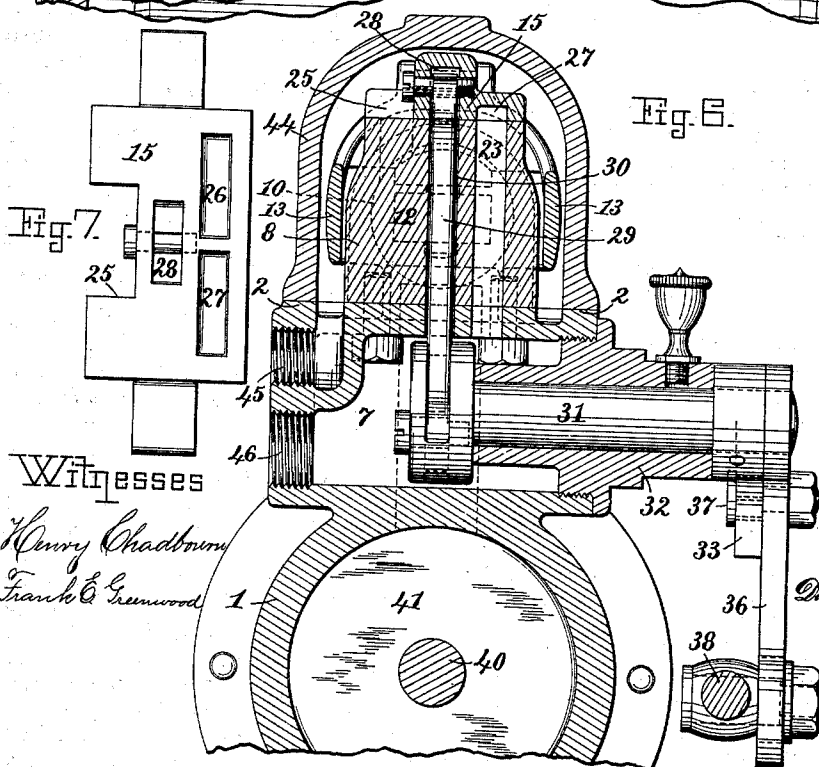


Fig. 6.

Fig. 7.

Witnesses

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UNITED STATES PATENT OFFICE.

DANIEL E. KEMPSTER, OF BOSTON, MASSACHUSETTS.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 485,945, dated November 8, 1892.

Application filed February 21, 1891. Serial No. 382,295. (No model.)

To all whom it may concern:

Be it known that I, DANIEL E. KEMPSTER, of Boston, in the county of Suffolk and State of Massachusetts, have invented certain new and useful Improvements in Steam-Actuated Valves, of which the following, taken in connection with the accompanying drawings, is a specification.

My invention relates to steam-actuated valves for direct-acting engines of that class in which the main valve is actuated by steam or other fluid under pressure through the medium of minor pistons working in minor cylinders, which are controlled by an auxiliary valve operated by the main piston-rod of the engine, similar to that shown and described in the United States Patent No. 436,830, for a steam-actuated valve, granted to me September 23, 1890.

My present invention has for its object to improve and simplify the construction shown and described in my said prior patent; and it consists in the special construction and combination of mechanical devices herein after described, and particularly pointed out in the claims.

In the accompanying drawings similar figures of reference indicate corresponding parts wherever they occur thereon.

Figure 1 represents a top or plan view of the main steam-cylinder with the valve casing or hood removed. Fig. 2 is a longitudinal section of the said steam end complete. Fig. 3 is a central cross-section of the same. Fig. 4 is a detail view of a portion of the valve mechanism. Fig. 5 is a longitudinal section of my invention, showing a little different form of construction, more preferable for the larger sizes of engines. Fig. 6 is a central cross-section of the same. Fig. 7 is a face view of the auxiliary valve used in the aforesaid latter construction.

The complete steam end as shown in the drawings is especially designed and adapted for service in a pumping or blowing engine, boiler-feeder, or other direct-acting engine, said drawings showing a portion of the intermediate frame between said steam end and the water or air cylinder, as the case may be.

Referring to Figs. 1, 2, 3, and 4 of the drawings, 1 represents the main steam-cylinder, having a suitable base and steam-tight heads,

one of which is provided with a stuffing-box, all in the ordinary manner.

On the main cylinder, preferably on the top thereof, is located a raised portion 2, having a face provided with the main-valve seat, having steam-ports 3 4 and exhaust-ports 5 6. Said steam-ports extend downwardly into opposite ends of the main cylinder, and said exhaust-ports extend into an exhaust-chamber 7, located within the aforesaid raised portion 2, and between the face thereof having the main-valve seat and the body of the main cylinder. On said raised portion or face of the main cylinder is centrally located an upwardly-extending portion or casting 8, said part being cast integral with the main cylinder, if preferred, or secured thereon by suitable bolts or screws, as shown in the drawings. Within the said portion 8 are formed minor cylinders 9 10, provided with suitable pistons 11 12, said pistons being attached to opposite ends of the main valve 13 by suitable connections, shown in the present case as pins fast in ears on said main valve, passing through suitable holes in lugs on the backs of said minor pistons, thus forming a simple and cheap connection and one which permits the main valve to follow down as said valve and its seat wear away, and also to be easily and quickly removed from its seat when so required.

The main valve is preferably a flat-faced reciprocating slide-valve of a double-D pattern, provided in its face with the usual exhaust-cavities and covers the ports at opposite ends of the central portion 8, containing the minor cylinders, said valve having side arms which encircle said central portion and connect the two ends or faces of the main valve together. It is of course evident that the side arms of the main valve might be dispensed with and said valve made as two separate pieces, each of said pieces being connected to its own minor piston, but in such case it would be necessary to connect the two minor pistons, either through the central head between the minor cylinders or by some outside connection, so as to insure the two minor pistons moving together as one piece. This will be readily understood by any mechanic without illustrating in the drawings. Said main valve is constructed with a bar 14,

formed integral therewith or made separate and attached thereto, preferably by hinging it at one end to said valve and securing the opposite or free end of said bar by any suitable fastening. (Shown in the present instance as a split pin.) This arrangement admits of swinging the bar 14 around from over the auxiliary valve 15, so that the latter may be removed without removing the main valve. It is evident, however, that, if preferred, the bar 14 might be formed integral with the main valve, and the side arm of said main valve, which lies beneath the auxiliary valve, might pass above the latter, and in that case the main valve would be free to be removed first and the auxiliary valve next. The present construction of a swinging or removable bar 14 is the preferable arrangement, as it admits of removing the auxiliary valve first and the main valve afterwards.

Upon the main valve, preferably upon the bar 14 and in a central position thereon with relation to the width and length of said main valve, is located a projection or pin 16, extending downwardly above the auxiliary valve and in a position to be engaged by projections or pins 17 18 on the back of said auxiliary valve when the latter is oscillated a certain distance upon its seat on the upper face of the upright portion 8. The office of these co-operating projections is for the purpose of establishing a positive mechanical connection between the main and auxiliary valves, as will be further explained hereinafter. It is of course evident that the two projections 17 18 might be upon the main valve and the single central projection 16 might be on the auxiliary valve; or the projection 16 might be dispensed with and the projections on the main valve arranged to be engaged by the sides or outer edges of the auxiliary valve. The present construction is preferred, as it brings the contacting projections when in engagement nearer the center of the steam-chest, so as to act more in a central longitudinal line, and cannot therefore exert any side pressure, which would tend to press the main valve over laterally, so as to cause undue friction between the minor pistons and their cylinders. The projection 16 is shown as a pin; but in practice said projection would preferably be formed integral with the main valve or bar 14.

The auxiliary-valve seat on the upper face of the part 8 is provided with small steam-ports 19 20, extending through into the minor cylinders 9 10, said steam-ports being located at one side of a central longitudinal line and close up to the central head, which separates the two cylinders. Said auxiliary-valve seat is also provided with small exhaust-ports 21 22 23. Said exhaust-ports are located at the opposite side of a central longitudinal line from that of the steam-ports 19 20. The exhaust-ports 21 22 extend through into the minor cylinders and are situated a sufficient distance from the central head to insure a proper amount of cushion for the minor pis-

tons reciprocating therein. The small exhaust-port 23 opens into a passage extending through the central head between the two minor cylinders into the exhaust-chamber 7.

The particular arrangement of the auxiliary ports, as above described, is a preferable manner of locating them; but I do not limit myself to such arrangement, as there are several ways of locating them to accomplish the same result, as will readily be seen by any mechanic without my pointing them out herein.

The auxiliary valve 15 is a flat-faced slide-valve pivoted at one side preferably upon an upright stud 24, so as to be freely oscillated thereon and be free to rise or fall vertically, so as to be readily removed therefrom and also to admit of its following down to compensate for the wear upon the face of said valve and its seat. Said auxiliary valve is provided at its outer edge with an aperture or recess 25, which intermittently and alternately registers with the auxiliary steam-ports 20 21. Said valve 15 is also provided on its under or face side with two exhaust-cavities 26 27 of suitable size and adapted to intermittently and alternately register with and connect the small exhaust-ports 21 and 22 with the central exhaust port or passage 23 as said valve 15 is oscillated back and forth upon its seat by mechanism which I will now describe. The auxiliary valve 15 is provided on its under or face side with a socket 28, preferably formed by a hardened-steel bushing fitted tightly within a hole formed within the valve, a boss on the back thereof preventing said socket-hole from going through. (See Fig. 3.) A bar or lever 29, having a hardened-steel ball upon its upper end adapted to freely fit within the valve-socket 28, passes through an aperture or slot 30 within the minor-cylinder casting 8, said slot being located at one side of said minor cylinders and extends from the auxiliary-valve seat through the casting 8 into the exhaust-chamber 7, and is of sufficient size to accommodate the movement of said bar or lever. The opposite or lower end of said bar or lever is tightly fitted within a tapering slot in a head or enlargement on the horizontal shaft 31, said shaft having a bearing in a suitable casting 32, secured to the side of the steam-chest. On the outer end of said shaft 31 is secured fast an arm 33, having two projecting ears or stops 34, and preferably, also, a socket 35 for the reception of a hand-lever. On the shaft 31, between the arm 33 and the bearing 32, is loosely fitted a side lever 36, free to oscillate thereon. Said lever 36 is slotted laterally and provided with the stop-bolt 37, said bolt having its head recessed upon its two sides adjacent to the two stops on the arm 33, said recesses containing disks of rawhide, leather, or other suitable substance adapted to deaden the sound and prevent the metals from striking together. The slot in the lever 36 admits of laterally adjusting the single stop 37, so as to

shorten or lengthen the stroke of the engine in either direction, and by raising or lowering the pivoted connection of the connecting-rod 38 in the longitudinal slot of the lever 36 the whole stroke of the engine may be shortened or lengthened, as desired, as will be readily understood by any mechanic without further explanation. The connecting-rod 38 at its end opposite from the lever 36 is pivotally attached to the cross-head 39, fast on the piston-rod 40, said rod passing into the steam-cylinder and suitably attached to the piston 41. The cross-head is provided with a bearing, which is adapted to travel upon the slide 42, attached on the intermediate frame 43. The steam-chest comprises all that part above the main cylinder and is formed in part by the enveloping hood or casing 44, and has formed below the hood and within the raised portion 2 the steam and exhaust pipe openings 45 and 46, respectively, said exhaust-outlet entering into the exhaust-chamber and said steam-inlet entering into the hood or casing. (See Fig. 3.)

It will be observed that the slot 30 for the lever 29 is tightly packed by the auxiliary valve 15, and steam cannot pass through into the exhaust-chamber from the hood except by going through the proper ports or passages. It is evident that the lever 29 might pass up through a slot outside of the casting 8, and so that the auxiliary valve would not cover and pack the slot; but this would necessitate a partition in the exhaust-chamber just inside the enlarged head on the horizontal shaft to prevent the live steam from passing into said chamber. It would also necessitate a stuffing-box on the outer end of the bearing 32, which would be objectionable.

The arrangement of the arm fast on the valve-shaft and capable of a limited movement independent of its side lever, whereby the auxiliary valve may be moved by hand from the outside, without having to move the main piston, is an advantage in the larger sizes of this class of engines, from the fact that sometimes in transportation both the main and auxiliary valves may slide into a central position, thus closing all ports, and when the engine is set and all connections made it is necessary to move said valves so as to admit steam to the cylinder to start the engine, and while it is true that the valves may have no lap, and it would seem almost impossible for them to accidentally get into a position whereby no steam could enter either the main or minor cylinders, yet it will sometimes occur in transportation from the different positions the engine may be placed in, it of course being understood that such position of the valves could not possibly occur in the operation of the engine by steam.

With my arrangement a small hand-lever may be used in the socket 35 of the shaft-arm and the auxiliary valve moved upon its seat so as to admit steam to one of the minor cylinders, and thereby move the main valve

into a position to permit steam to enter the main cylinder. In starting large pumping-engines this arrangement of the auxiliary-valve-operating hand-lever is very convenient, as it allows the engineer to control the action of the valves by hand, and thus regulate the strokes of the engine until all the water from condensation is worked out of the steam-cylinders, thereby lessening the danger of breakage of parts, as will be readily understood.

In Figs. 5, 6, and 7 I have shown a little different construction of the main and auxiliary valves. In this construction the auxiliary valve 15 is not pivoted, but reciprocates in a straight line with the main valve, the valve-operating lever 29 and its slot 30 being in the center of the casting 8 and within the central head between the minor cylinders 9 and 10. The ends of the auxiliary valve (see Fig. 7) are narrower than the body of said valve and slide back and forth between the ears on the back of the main valve, within which was formerly fastened the bar 14, said bar in this case being dispensed with and the ears forming guides for holding the auxiliary valve in a central position on its seat and also in connection with the shoulders on the auxiliary valve formed by the wide body of the said valve joining the narrower end portions thereof, forming the co-operating projections for mechanically connecting the main and auxiliary valves together, similar to the projections 16, 17, and 18 in the construction first described. This arrangement of a straight reciprocating auxiliary valve with its operating-lever centrally located between the two minor cylinders is a preferred form of construction in the larger sizes of engines, wherein the minor cylinders may be separated sufficiently to admit of an aperture or slot within the central head between said cylinders, of a sufficient size to accommodate the movement of the valve-operating bar or lever therein.

In Figs. 5 and 6 is shown, also, a little different construction and arrangement of the auxiliary-valve-operating lever, its connected shaft, outside arm, and side lever. The upper end of the lever 29 is forked and embraces a cross-pin in the auxiliary valve, the lower end of said lever being pivoted to the slotted head of the shaft 31, said slot being made of sufficient size to permit said shaft to be rocked by the movement of the main piston without vibrating said lever and moving the auxiliary valve except at or near the extreme ends of said movement or stroke of said piston, the ends of said slot forming stops, which limit the movement of said main piston with relation to its movement of the valves in a similar manner to the outside stops on the arm and side lever, before described. This arrangement permits the use of an arm and side lever on the outer end of the shaft 31 similar to that shown in my former patent, hereinbefore referred to, wherein the arm is

fast on the shaft and the side lever is adjustably secured thereto, so as to give a continuously rocking or oscillating movement to said shaft. This construction is preferable in the smaller sizes of this class of engines, as they can readily be operated by the usual hand-lever when so desired.

It is evident to any mechanic that, if preferred, I may give either the pivoted oscillating or the straight reciprocating auxiliary valve a continuous movement, instead of the intermittent movement described, by simply dispensing with the described inside or outside stops and making the lever 29, shaft 31, and side lever 36 move as one piece, the side lever being lengthened to give the required movement to the auxiliary valve. I prefer the intermittent movement of the auxiliary valve, however, as I find the engine is better able to take care of water from condensation when first starting by having the auxiliary port remain open during nearly the entire stroke of the engine. I prefer in the larger sizes of this class of engines to arrange the stops on the main and auxiliary valves for mechanically connecting said valves together, as shown in Fig. 5, whereby, when the auxiliary valve is caused to commence to move by the movement of the main piston through the intermediate mechanism between said valve and piston, the main valve is moved, also, by the auxiliary valve engaging and carrying said main valve with it until just before the main valve reaches the center of its stroke, which would cut off the supply of steam to the main cylinder, when the auxiliary valve will have moved far enough to admit and exhaust steam to and from opposite minor cylinders, thereby moving the main valve the balance of its stroke or travel by direct steam-pressure, thus positively insuring the movement of the main valve its full stroke in time to admit steam to the opposite end of the main cylinder and prevent the main piston from ever striking the cylinder-head. Furthermore, in the larger sizes of this class of engines, having heavy valves, I find it better to mechanically handle the main valve and start it upon its travel, as the strokes of the engine are thereby made more uniform, especially when running at a high rate of speed.

The operation of my invention, briefly stated, is as follows: Referring to the drawings, steam or other motive fluid enters the inlet and fills the valve casing or hood, passing down through the main port into the main cylinder, where it forces the main piston, together with its rod, to the right, as indicated by the arrow thereon. The steam or other vapor on the opposite side of the main piston, passing up through the main port and turning in the exhaust-cavity of the main valve, passes down through the exhaust-port into the exhaust-chamber and thence through the outlet into the exhaust-pipe. As shown in Figs. 2 and 5, the auxiliary valve, main valve, and its actuating minor pistons all stand

to the right of their stroke, and as the main piston and rod travel to the right they remain in said position with the auxiliary steam-port 19 and main steam-port 4 both open to the direct steam or other fluid pressure until the main piston has nearly reached the limit of its stroke, when the auxiliary valve (either the pivoted oscillating or the straight reciprocating, as the case may be) will be moved to the left by the lever 29, through the engagement of the hereinbefore-described intermittently-operating stops, (either inside or outside, as the case may be,) under the influence of the connected mechanism attached to and actuated by the main piston-rod of the engine. The movement of the auxiliary valve to the left admits and exhausts steam to and from the minor cylinders so as to reverse the main valve, which in turn admits and exhausts steam to and from the main cylinder so as to reverse the stroke of the engine, as will readily be understood by any mechanic without further description.

The object of the mechanical connection between the main and auxiliary valves and the main piston of the engine is to positively insure the movement of said main valve under all circumstances, being in proper time to prevent the main piston from ever striking the cylinder-heads, which would otherwise occur if at any time the small auxiliary ports should become clogged up, or if by some reason the engine should become suddenly relieved of the load against which it is working. The contacting parts on the two valves are so located with relation to each other as to positively engage when required, and the reversal of the main valve is then assured by the operation of the mechanical connections between said valves and the main piston-rod backed by the full power of the engine.

It will be observed that in my invention both the main and auxiliary valves are preferably flat-faced slide-valves, easily resealed in case of wear, and their arrangement is such that both of said valves, together with the main-valve-actuating pistons, may all be readily inspected or quickly removed from the steam-chest, without disconnecting any pipes or outside connections, by simply removing the valve casing or hood. This feature, together with the simplicity of the valves and their connecting mechanisms, will commend my invention to the notice and appreciation of all engineers and others familiar with this class of engines.

It will of course be evident to any mechanic that my invention is applicable to any fluid-pressure engine, and is susceptible to minor changes and modifications within the power and scope of mechanical skill without departing from the essential spirit of my invention.

Having thus fully described the nature and construction of my invention, I wish to secure by Letters Patent and claim—

1. In a direct-acting steam-engine, the combination of a main cylinder, a piston and rod

therefor, a steam-chest on said cylinder having the upwardly-extending portion 8, minor cylinders, and pistons therein, a main-valve seat having suitable induction and eduction ports, a main valve controlling said ports, suitable connecting devices between said main valve and minor pistons, an auxiliary-valve seat on said upwardly-extending portion, having suitable ports for said minor cylinders, an auxiliary valve on said seat, the aperture or slot 30, a lever therein for operating said valve, a shaft to which said lever is connected, passing through the side of the steam-chest, a side lever and its co-operating arm on said shaft, a connecting-rod pivoted to said side lever, and a cross-head fast on the main piston-rod and the other end of said connecting-rod pivoted thereto, all constructed and arranged to operate substantially as described.

2. In a direct-acting steam-engine, the combination, with a steam-chest having the upwardly-extending portion 8, provided with an auxiliary-valve seat, of a flat auxiliary valve thereon, its operating bar or lever passing through an aperture or slot in said seat into an exhaust-chamber, a shaft connected with said bar or lever, and mechanism actuated by the main piston of the engine, substantially as described.

3. In a direct-acting steam-engine, the combination, with an auxiliary-valve seat on a raised portion of the steam-chest and having suitable ports for the minor cylinders, of a flat pivoted auxiliary valve therefor, its pivotal center or stud at one side of the steam-chest, a vertical lever adapted to connect with and operate said auxiliary valve, a horizontal shaft to which said lever is connected, and mechanism outside the steam-chest, connected with said shaft and the main piston of the engine, substantially as described.

4. In a direct-acting steam-engine, the combination, with a steam-actuated reciprocating main slide-valve and an auxiliary slide-valve pivoted at one side and oscillating parallel therewith, but on a different plane, and actuated by the main piston of the engine, of co-operating projections on said valves or equivalent mechanism, adapted to operate substantially as and for the purpose herein set forth.

5. In a direct-acting steam-engine, the combination, with a steam-chest having steam and exhaust chambers and a main valve actuated by minor pistons working in stationary minor cylinders on the face of the main-valve seat or cylinder and controlling the motive-fluid supply and exhaust of said main cylinder through suitable ports, of a flat-faced auxiliary valve controlling the motive-fluid supply and exhaust of said minor cylinders through suitable ports in an auxiliary-valve seat on the top of said minor cylinders, an aperture or slot extending from the face of said

auxiliary-valve seat through into the exhaust-chamber, and an operating bar or lever connected with said auxiliary valve and passing through the said slot into engagement with mechanism connected with and actuated by the main piston-rod of the engine, substantially as shown and described.

6. In a direct-acting steam-engine, the combination, with the steam-chest thereof, having stationary minor cylinders provided with suitable pistons adapted to operate the main valve, an auxiliary-valve seat located on said minor cylinders and having suitable ports, and a flat-faced auxiliary valve on said seat, of an oscillating lever or device connected with said valve and mechanism actuated by the movement of the main piston, for the purpose set forth.

7. In a direct-acting steam-engine, the combination of a steam-chest, a stationary upright portion or casting therein, minor cylinders and pistons within said casting, an auxiliary-valve seat in said casting, an auxiliary valve on said seat, auxiliary-valve operating mechanism actuated by the movement of the main piston, a main-valve seat, and a main valve constructed and arranged so as to be engaged by the auxiliary valve and moved mechanically thereby the first part of its stroke on the first movement of said auxiliary valve and then moved the balance of its stroke by direct steam-pressure admitted to the valve-actuating minor cylinders by said auxiliary valve, substantially as described.

8. In a direct-acting steam-engine, a main valve having side arms for encircling the stationary minor cylinders and having upright ears on the back, substantially as described, in combination with a flat-faced reciprocating auxiliary valve having its ends narrower than the body thereof, substantially as and for the purpose herein set forth.

9. In a direct-acting steam-engine, the combination, with an auxiliary valve, a valve-actuating shaft, and connected mechanism between said valve and shaft, of the arms 33, fast on said shaft and provided with stops 34 34, and a side lever loose on said shaft and having the laterally-adjustable stop 37, adapted to co-operate with said arm-stops, and mechanism connected with said side lever, adapted to oscillate the latter by the movement of the main piston of the engine, substantially as and for the purpose herein set forth.

In testimony whereof I have signed my name to this specification, in the presence of two subscribing witnesses, on this 18th day of February, A. D. 1891.

DANIEL E. KEMPSTER.

Witnesses:

HENRY CHADBOURN,
FRANK E. GREENWOOD.