(No Model.) 2 Sheets—Sheet 1.

W. CRAIG

STEAM ACTUATED VALVE.

No. 292,541. Patented Jan. 29, 1884.

Fig 5.

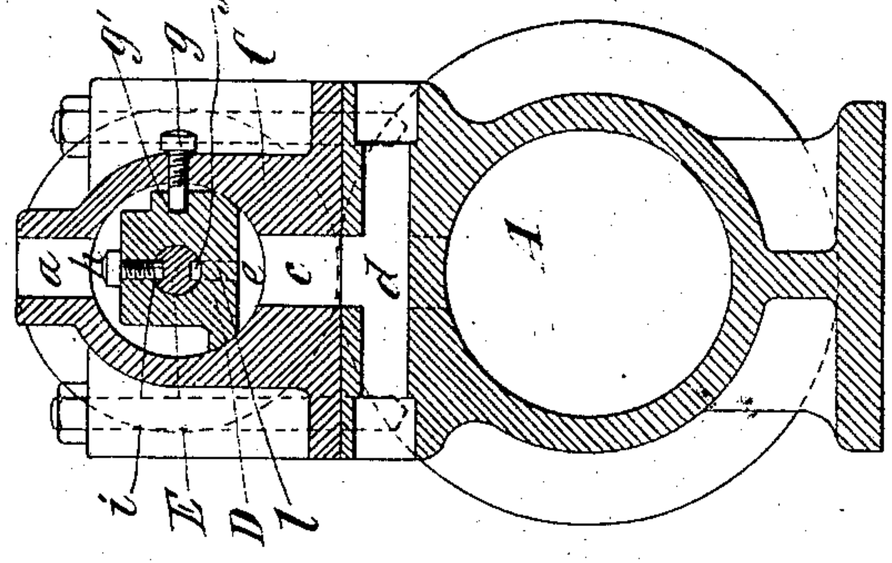

Fig 2.

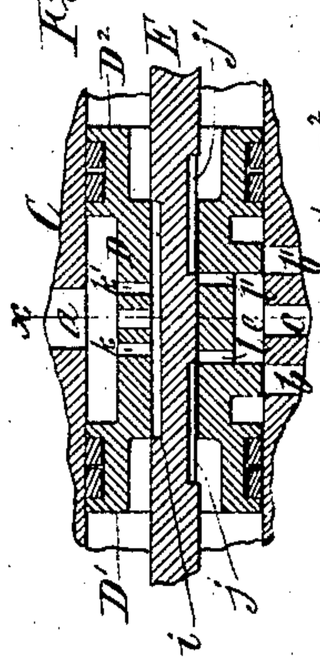

Fig 1.

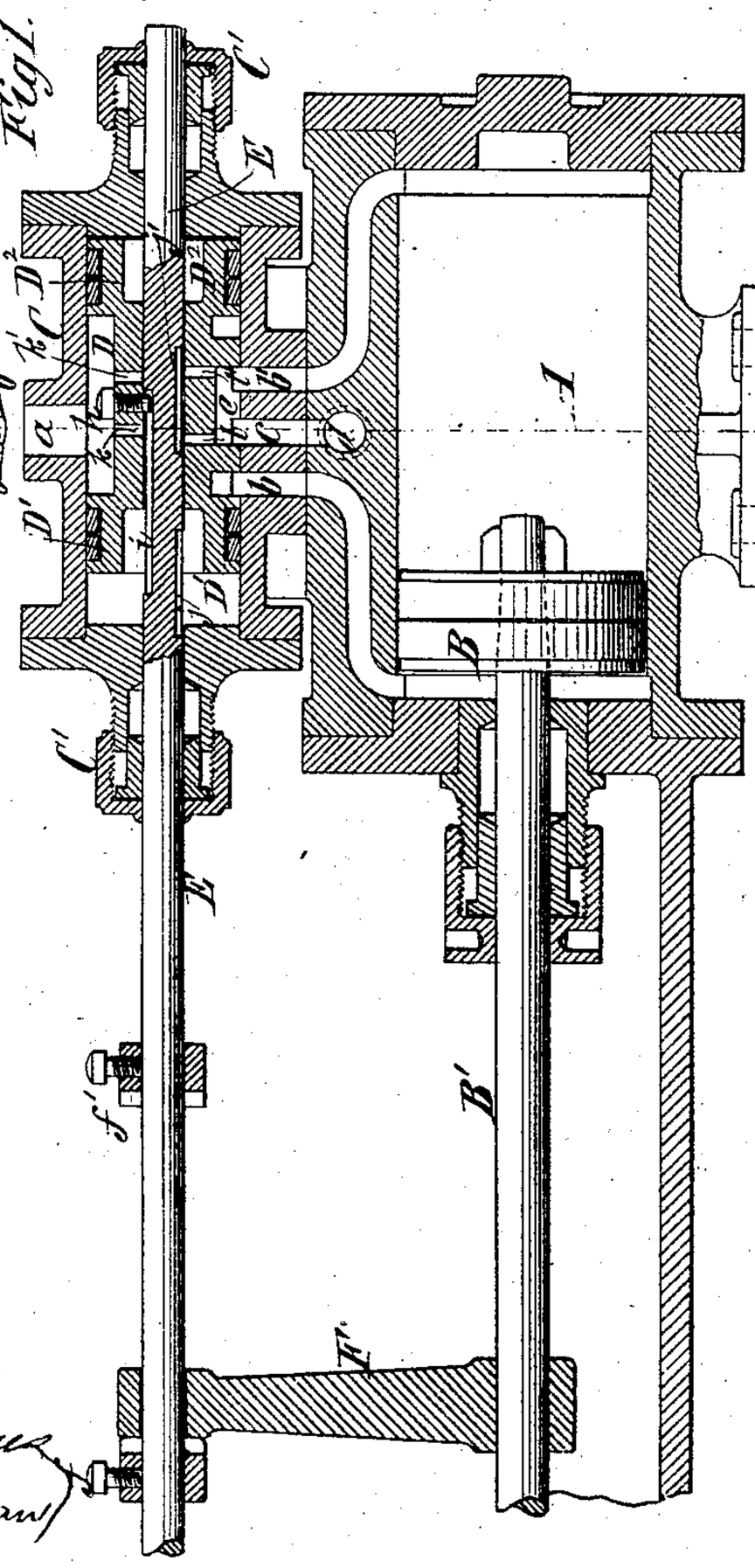

Fig 4.

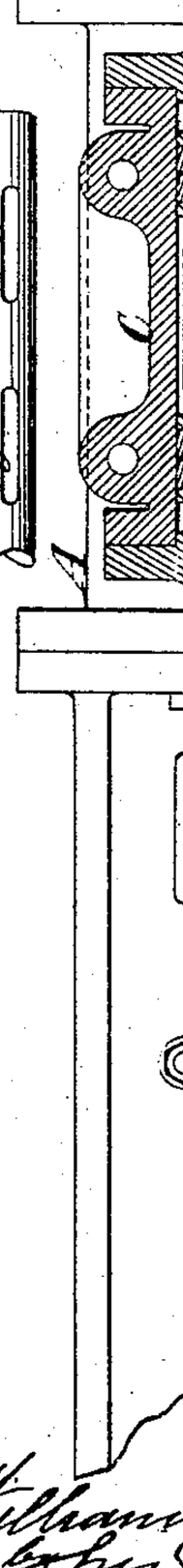

Fig 3.

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(No Model.) 2 Sheets—Sheet 2.

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STEAM ACTUATED VALVE.

No. 292,541. Patented Jan. 29, 1884.

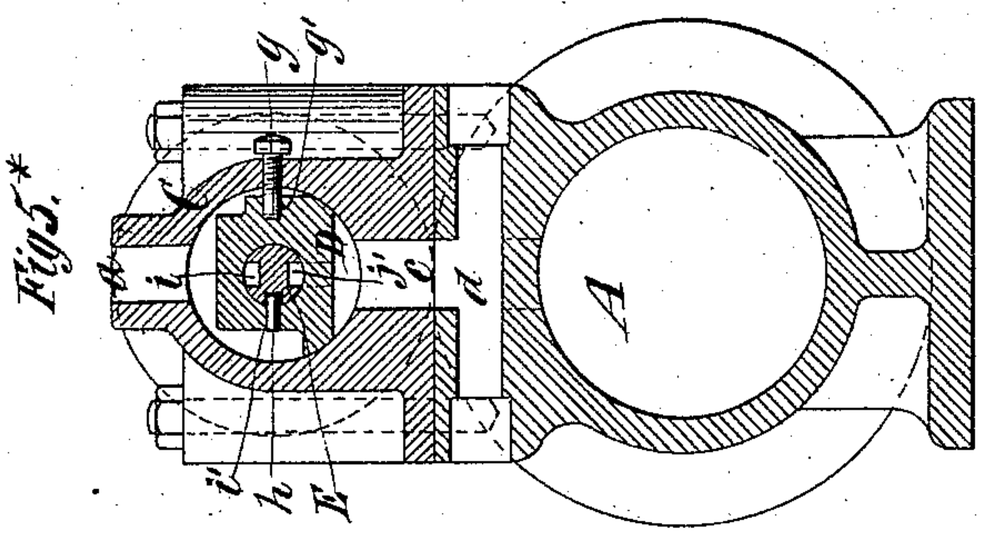

Fig 5.*

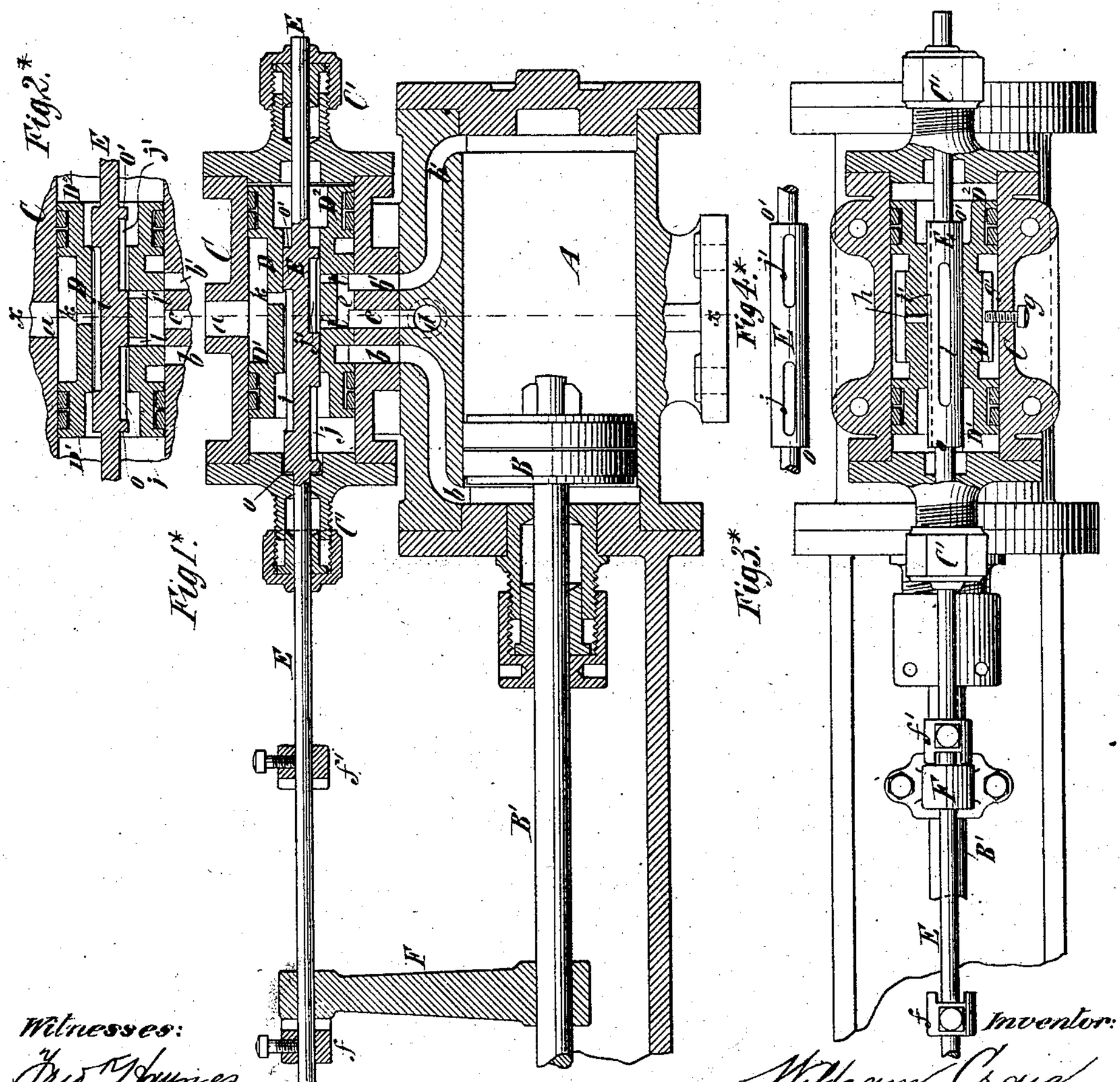

Fig 2.*

Fig 1.*

Fig 4.*

Fig 3.*

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UNITED STATES PATENT OFFICE.

WILLIAM CRAIG, OF BROOKLYN, NEW YORK.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 292,541, dated January 29, 1884.

Application filed May 9, 1883. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM CRAIG, of Brooklyn, in the county of Kings and State of New York, have invented a new and useful Improvement in Steam-Actuated Valves for Direct-Acting Engines, of which the following is a specification.

In direct-acting engines such as are used for working pumps, and for other purposes, the main valve, which controls the admission of the motive agent to and its egress from the main cylinder, has connected with it an auxiliary piston or pistons, upon which the motive agent acts to move the main valve, and the motive agent is admitted to act upon said auxiliary piston or pistons by an auxiliary valve which is actuated positively from the piston-rod or other reciprocating part of the engine.

My invention relates to that class of direct-acting engines in which the auxiliary valve consists of a rod or stem passing centrally through the auxiliary piston or pistons and main valve, and operated by a tappet-arm on the piston-rod of the engine striking tappets on the said rod or stem.

An important object of my invention is to dispense with all ports in the valve-chest except the induction and eduction ports leading to the main cylinder, and also to construct the engine so that the main valve, with its auxiliary pistons, and the auxiliary valve will, when moving, always travel in opposite directions, so as to insure the ports which admit the motive agent to act upon the auxiliary pistons being opened positively and remaining open until the movement of the main valve and auxiliary pistons is completed.

The invention consists in novel details of construction and combinations of parts hereinafter described, and pointed out in the claims, and whereby the desired end is attained.

In the accompanying drawings, Figure 1 is a longitudinal section of an engine embodying my invention, the parts being shown in the position which they occupy just after the movements of the main and auxiliary valves have been completed. Fig. 2 is a similar section of the valves, showing them in their middle position. Fig. 3 is a horizontal section of the valves and valve-chest and a plan of other parts of the engine, showing the main valve in a central position. Fig. 4 is an inverted plan of a portion of an auxiliary valve. Fig. 5 is a transverse vertical section on the dotted line *x x*, Figs. 1 and 2; and Figs. 1*, 2*, 3*, 4*, and 5* are views similar to those above described, illustrating a slight modification of my invention.

Similar letters of reference designate corresponding parts in all the figures.

A designates the main cylinder of the engine. B designates the main piston, and B′ designates the main piston-rod. The cylinder A is surmounted by a valve-chest and auxiliary cylinder, C, to which steam or other motive agent enters through an inlet, *a*. From the valve-chest and cylinder C induction and eduction ports *b b′* lead to the ends of the main cylinder A, and an exhaust-port, *c*, leads to the exhaust cavity or outlet *d*.

D designates the main valve, which has a cavity, *e*, and constitutes a simple D slide-valve. It is located between two auxiliary pistons, D′ D², formed with or rigidly attached to it, so that they all move together; and the pistons may be provided with any suitable packing.

E designates the auxiliary valve, which consists simply of a rod or stem working in stuffing-boxes C′ in the heads of the chest and cylinder C, and having applied to it tappets or collars *f f′*.

Between the tappets or collars *f f′* there is a tappet-arm, F, which is fast on the main piston-rod B′, and, by striking one or the other of the tappets or collars, moves the auxiliary valve E. The auxiliary valve E works in a tight manner through the main valve and auxiliary pistons.

As here represented, the valve D is held against turning in its chest by means of a screw or projection, *g*, on the chest entering a groove, *g′*, in the valve D, and the auxiliary valve E is prevented from turning by a screw or projection, *h*, on the valve D entering a groove, *i*, Fig. 1, or *i′*, Figs. 1* and 5*, in the auxiliary valve E. This screw or projection *h* may be inserted downward, as shown in Fig. 1, or horizontally, as in Figs. 1* and 5*. The groove *i* also forms a port, as hereinafter described, and in the under side of the said

valve E are two other grooves, *j j'*, which form exhaust-ports. Steam or other motive agent is supplied to the port *i* by a port or ports in the valve D. In Fig. 1 two ports, *k k'*, are shown, one on each side of the screw *h;* but one port only will suffice, like the port *k* in Fig. 1*. In the under side of the valve are two exhaust-ports, *l l'*, which lead from the bore or hole in the valve D, through which the valve E passes, to the cavity *e* in the valve. When the main valve D occupies the position shown in Fig. 2 relative to the induction and eduction ports *b b'*, the auxiliary valve E would never be in the position there shown; but it is here shown in such arbitrary position so that the relative dimensions of the valves and ports may be seen.

In Fig. 1 I have represented the main valve D and pistons D' D² in the extreme right-hand position and the auxiliary valve E in the left-hand position. Steam is now admitted to the port *b* and left side of the piston B, to force the piston toward the right, and at the same time the ports *b' c* are in communication through the cavity *c* in the valve D, so as to allow steam to exhaust from the right-hand side of the piston. When the piston B approaches the right-hand end of the cylinder, the tappet-arm F will strike the tappet or collar *f'* and carry the auxiliary valve E toward the right. As soon as the port *i* in the auxiliary valve E is exposed on the right of the piston D², the steam passes from the cylinder C through the ports *k'* and *i* in Fig. 1 or *k* and *i* in Fig. 1*, into the right-hand end of the cylinder C, and, acting on the piston D², throws the valve D toward the left, opening the port *b'* to the steam and placing the ports *b* and *c* in communication, to allow steam to exhaust from the left-hand end of the cylinder A, and the piston B to make its return-movement.

As shown in Fig. 2, the port *i* is just about to be exposed at the right of the piston D², and the port *j* is brought into communication with the port *l* at the same instant, and consequently, as soon as steam passes to the right hand of the piston D², it can exhaust from the left-hand end of the cylinder C, through the ports *j* and *l*, into the valve-cavity *e*, and consequently the main valve and auxiliary pistons are free to move toward the left.

It will be seen that by my invention I enable the steam for operating the main valve and auxiliary pistons to be passed to and from the ends of the cylinder C through the main valves and pistons themselves, and thus dispense with any ports in the chest, except the main induction and eduction ports to the main cylinder.

It will be observed that the exhaust-ports *j j'* are considerably shorter than the induction-port *i*, and as the valve E and main valve D move always in opposite directions, the port *j* passes beyond the left-hand end of the piston D' before the main valve completes its movement, and sufficient vapor is trapped in the cylinder or chest to cushion the auxiliary pistons and prevent slamming.

The construction shown in Figs. 1* to 5*, inclusive, differs from that shown in Figs. 1 to 5, inclusive, in that the portion of the stem or auxiliary valve E which is within the cylinder C and works through the main valve D and auxiliary pistons D' D² is larger in diameter than the portions which work through the heads of said cylinder C, thus forming shoulders *o o'*. The pressure of steam on one or the other of these shoulders aids in moving the said stem or valve and relieves the tappet-arm of a part of the work required to move said stem or valve. Suppose, for example, that the auxiliary pistons and main valve have been moved to the right, as shown in Fig. 1*, the live steam being in the left-hand end of the cylinder C, and suppose that the area of the shoulder *o* on the stem is one square inch. Now, when the tappet-arm F strikes the tappet-collar *f'*, the auxiliary valve is moved toward the right; but the steam, pressing upon the shoulder *o*, aids in moving the valve to the extent of its pressure on one square inch, and to that extent relieves the strain upon the tappet-arm. After the stem or valve has moved far enough to admit live steam to the right-hand end of the auxiliary cylinder C, and to place the left-hand end thereof in communication with the exhaust, the live steam acting on the shoulder *o'*, being unbalanced by any material pressure on the shoulder *o*, will check the movement of the stem or valve E and prevent its moving beyond the desired point.

It will be observed that all the ports for admitting steam to and exhausting steam from the auxiliary cylinder are formed in the main valve and auxiliary valve, and that there are no ports or passages whatever in the auxiliary cylinder, except the main induction and exhaust ports.

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

1. The combination, with the auxiliary cylinder C, the auxiliary pistons D' D², fitting the bore of said cylinder, and the main valve D, interposed between said pistons, said pistons and valve being constructed with a central bore or aperture, and with a port, *k*, or ports *k k'*, leading from the induction-space of the chest, and ports *l l'*, leading from the exhaust-cavity of the valve to said aperture or bore, of the auxiliary valve working through said main valve and pistons, and constructed with grooves which form ports, for establishing communication between the ends of the auxiliary cylinder and the said ports in the main valve, substantially as and for the purpose herein described.

2. The combination of the auxiliary cylinder C, the main valve and auxiliary pistons D D' D², constructed with a port, *k*, or ports *k k'*, and ports *l l'*, and the auxiliary valve E, constructed with the long port *i* and the two

shorter ports *j j'*, all substantially as and for the purpose described, whereby communication is afforded between the ends of the auxiliary cylinder, the live-steam space, and the exhaust-cavity of the main valve through the said ports in the main valve and auxiliary pistons and the said ports in the auxiliary valve, and without the necessity of ports or passages through the auxiliary cylinder C.

3. The combination, with an auxiliary cylinder and a main valve and auxiliary pistons working therein, of an auxiliary valve working through the main valve and said pistons, to control the admission of a motive agent to the ends of said auxiliary cylinder and its exhaust therefrom, the portions of the auxiliary valve which work through the ends of said cylinder being of smaller diameter than the portion within the cylinder, so as to form the shoulders *o o'*, substantially as and for the purpose described.

WILLIAM CRAIG.

Witnesses:
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