No. 785,172. PATENTED MAR. 21, 1905.

T. KASAI.

STEAM ACTUATED VALVE.

APPLICATION FILED JUNE 30, 1904.

2 SHEETS—SHEET 1.

Fig. 1.

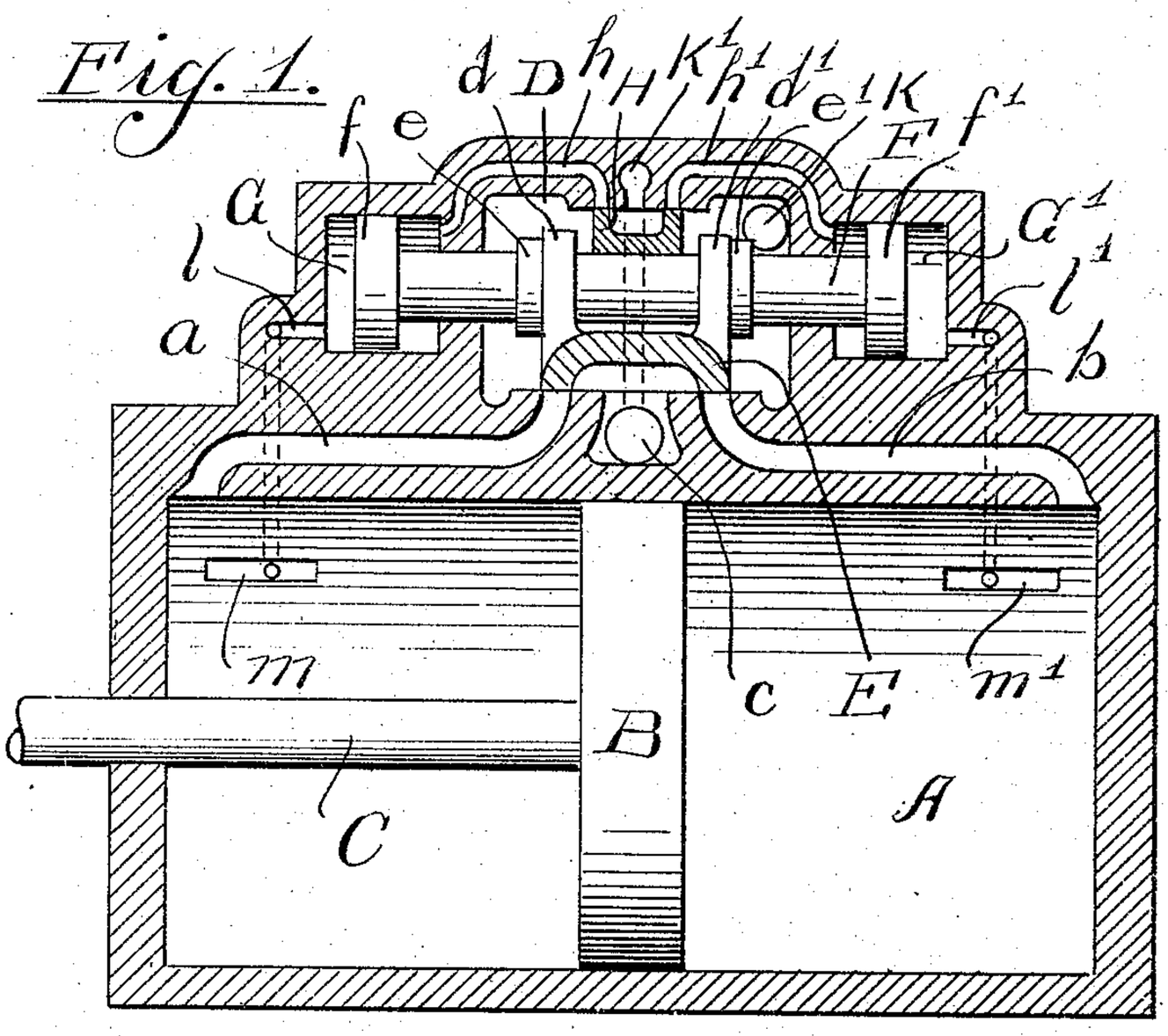
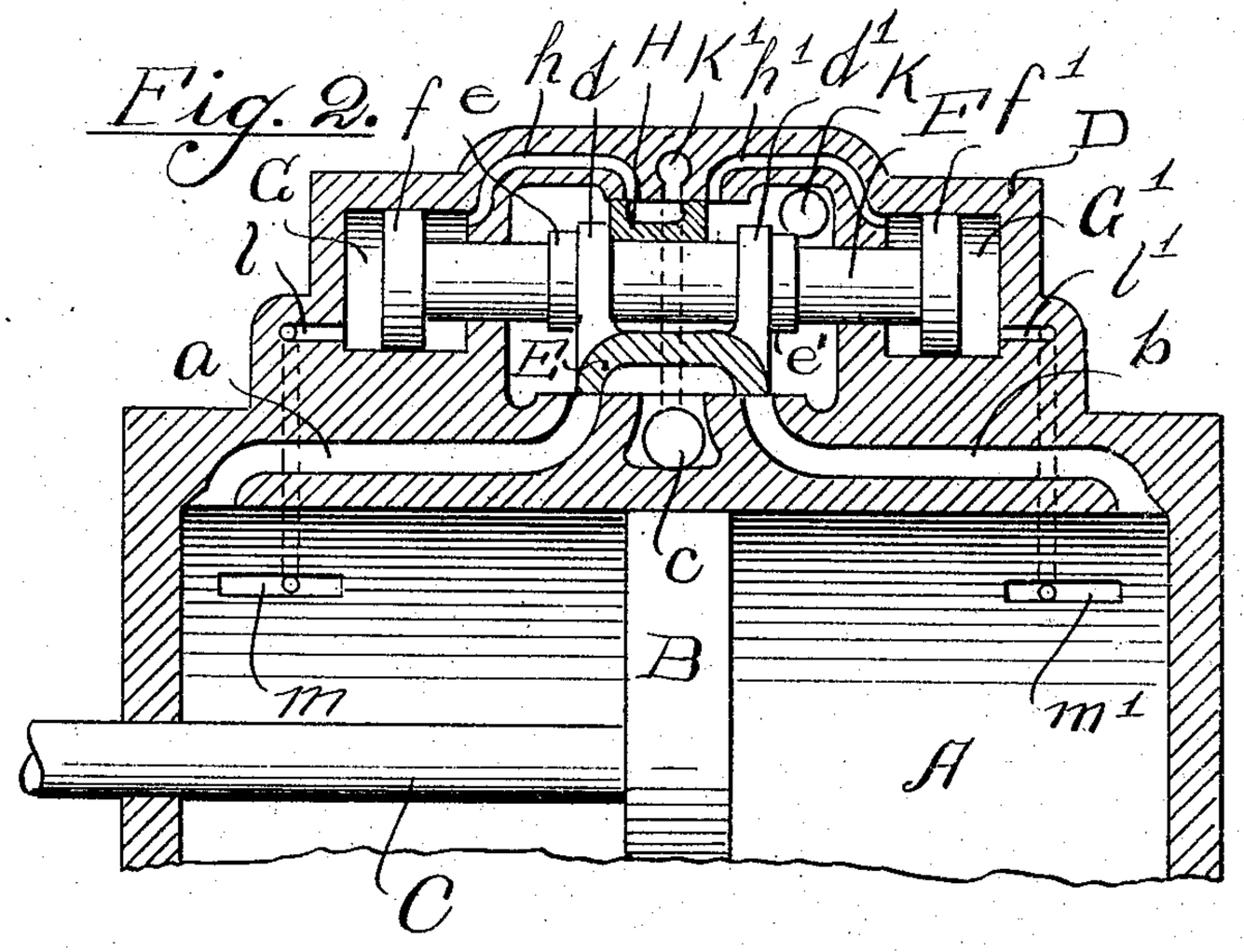


Fig. 2.



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2 SHEETS—SHEET 2.

Fig. 3.

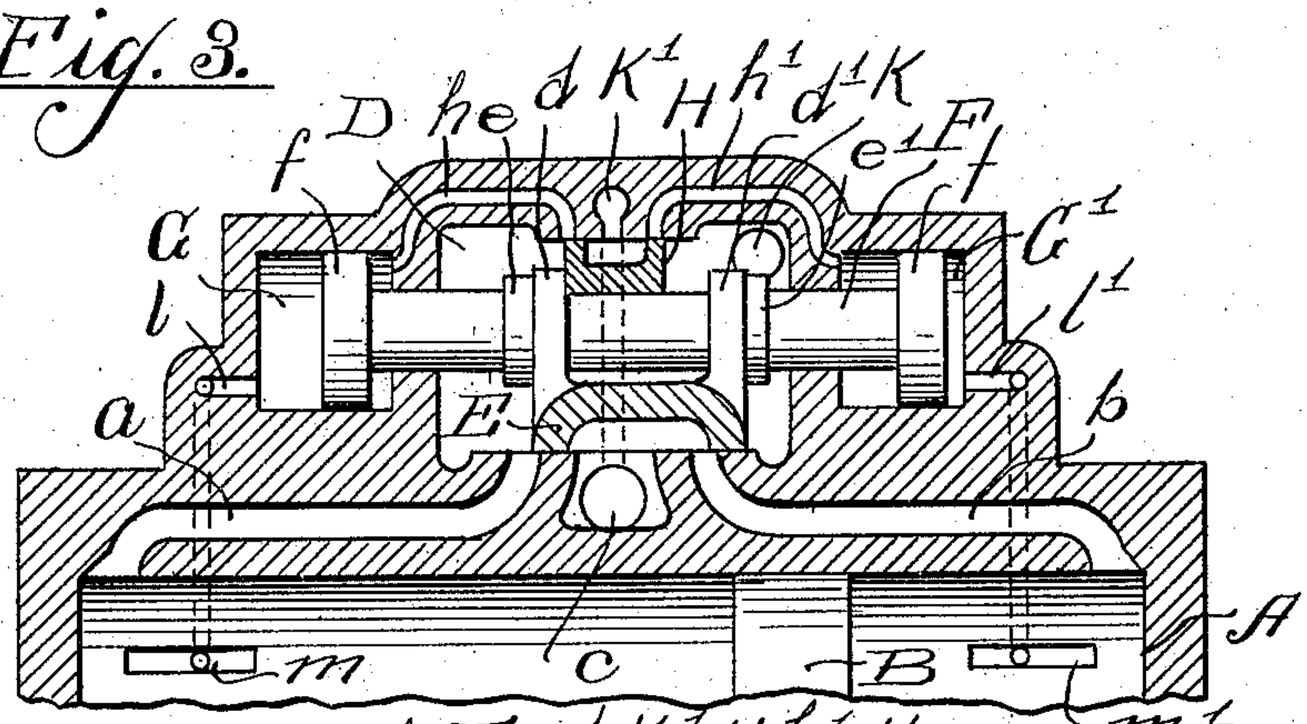


Fig. 4.

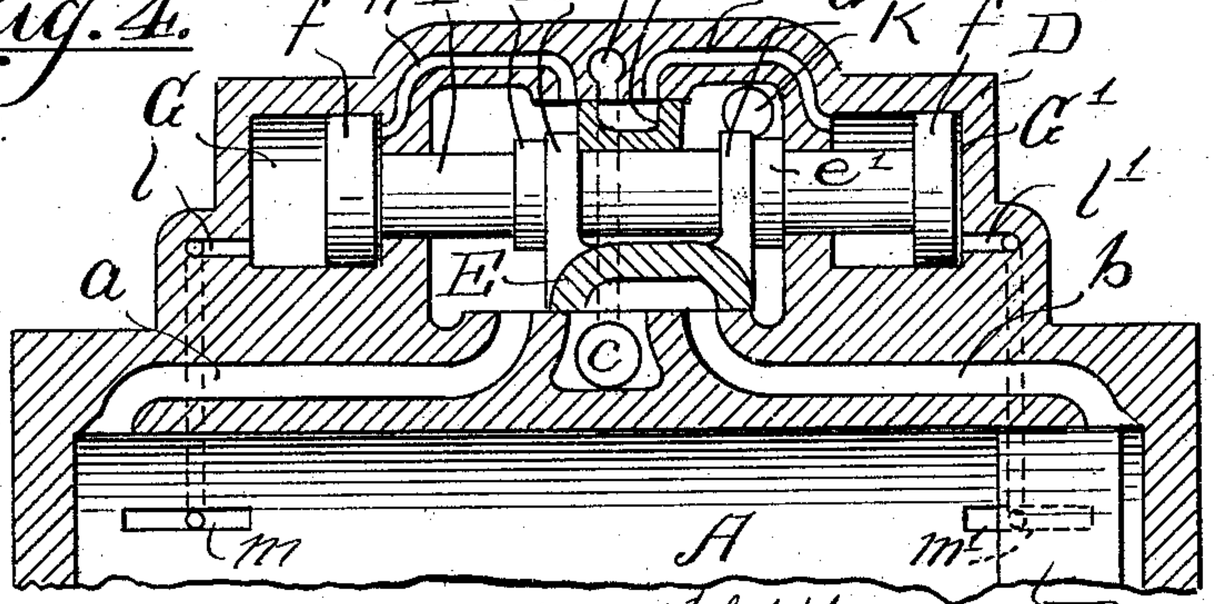


Fig. 5.

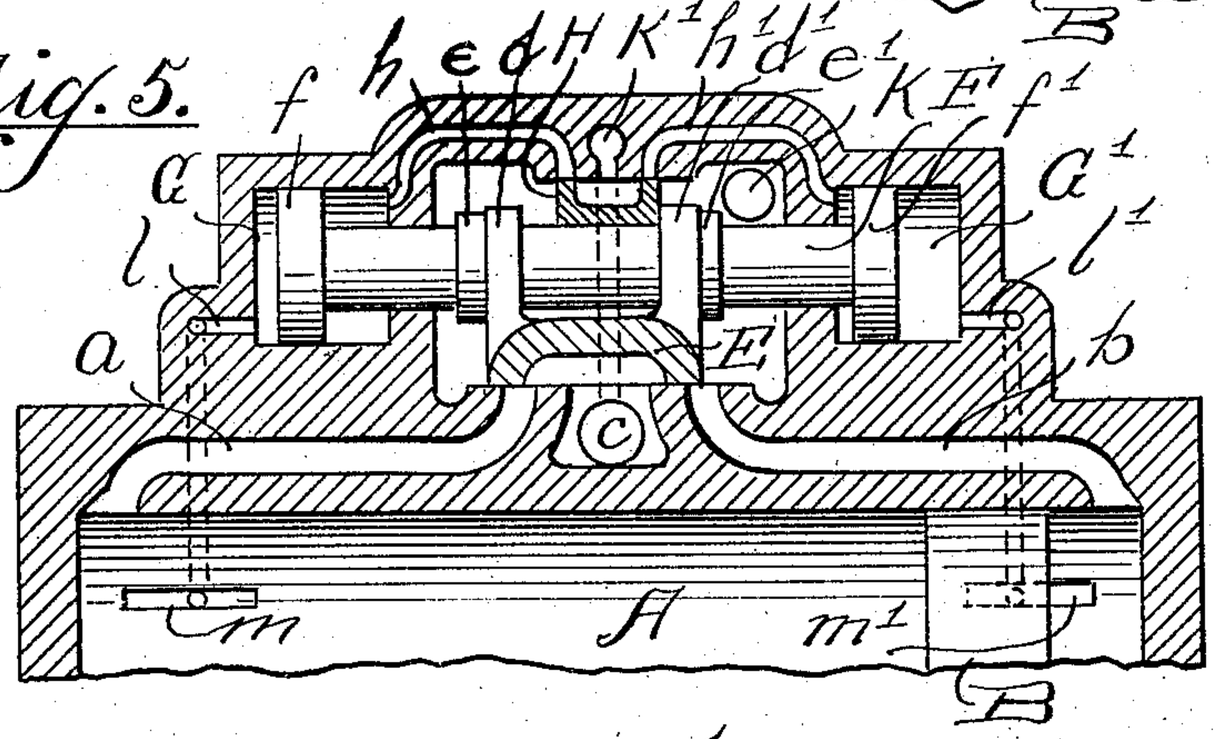
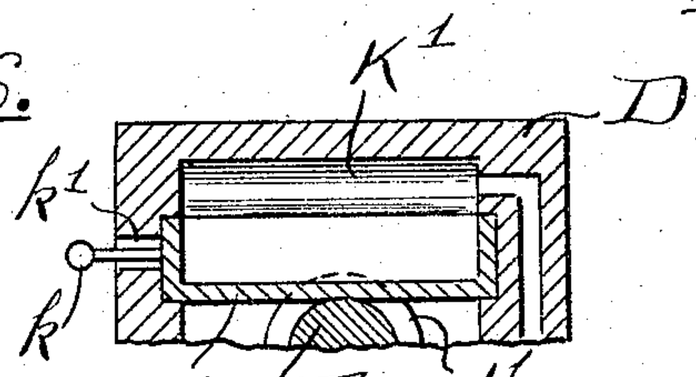


Fig. 6.



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UNITED STATES PATENT OFFICE.

TOKUICHIRO KASAI, OF AOMORI, JAPAN.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 785,172, dated March 21, 1905.

Application filed June 30, 1904. Serial No. 214,731.

To all whom it may concern:

Be it known that I, TOKUICHIRO KASAI, mining engineer, a subject of the Emperor of Japan, residing in the city of Aomori, in the Empire of Japan, have invented certain new and useful Improvements in Steam-Actuated Valves, of which the following is a specification.

My invention relates to steam-actuated valves wherein a primary and auxiliary valve coöperating with each other are employed to effect ingress and egress of motive fluid to the actuating-cylinder of an engine or pump.

One object of my invention is to provide means whereby the auxiliary-valve mechanism may be manually operated when the piston and primary valve occupy non-acting or dead-center positions to effect initial movement of the power-piston by admission to the cylinder of motive fluid, thereby avoiding the laborious operation of prying the parts off center. I preferably construct the auxiliary valve in a manner to cause the same to be primarily operated by the main valve, which construction possesses many advantages over constructions of the prior art, wherein the auxiliary valve primarily actuates the main valve. It will be obvious that in constructions wherein it is necessary to operate the main valve in order to effect initial movement of the piston from a position of dead-center such movement can be effected only by an application of great manual power, inasmuch as the cushioning action of the steam caused by closure of the various ports when the parts are all in an intermediate position would serve to lock the main valve. In my improved construction, where the main valve is locked in a dead-center position, movement of the auxiliary valve may easily be accomplished, inasmuch as the same is at all times steam-balanced, and instead of actuating the main valve by mechanical contact therewith effects initial movement of said valve by the admission of steam thereto.

It is well known in pumping machinery employing steam-actuated valves that when the piston and valves cease operating at a point where the same occupy an intermediate position in the cylinder and steam-chest it is impossible to effect entrance of steam on either side of the main piston unless the said valve mechanism is given a slight initial movement. This is a serious defect, especially where the pump is of large capacity, as the parts are heavy and very difficult to move. By the employment of my improved device the operator may with comparative ease actuate the auxiliary portion of the valve mechanism to displace the same from its intermediate position, and thereby effect an initial reciprocation of the primary valve, which action results in the admission of steam to the main cylinder, causing reciprocation of the piston therein.

My invention will be more fully described by reference to the accompanying drawings and will be more particularly pointed out in the appended claims.

In the drawings, Figure 1 represents an axial section of a cylinder and piston, showing my improved valve mechanism in coöperation therewith. In said figure the piston and valve mechanism are shown in an intermediate position. Fig. 2 is a view similar to Fig. 1, showing the manually-operable mechanism of the valve in a slightly-changed position. Fig. 3 is a sectional view similar to the above-described figures, showing the main piston and the valve mechanism reciprocating toward the right of the cylinder. Fig. 4 is a similar view showing the piston and valve mechanism reciprocated to an extreme position. Fig. 5 is a similar view showing the parts traveling toward the left of the cylinder. Fig. 6 is a transverse fragmentary section of the manually-operable portion of the valve mechanism, showing the manner in which the same is mounted in the steam-chest.

Like characters of reference designate similar parts throughout the different figures of the drawings.

My improved valve structure is shown in connection with a cylinder A, having a reciprocating piston B, connected with a piston-rod C in the usual manner. A steam or valve chest D is provided and communicates with said cylinder A by means of ports *a* and

b, which respectively extend from a central position in the valve-chest to points adjacent the outer ends of said cylinder. Said steam-chest D is provided with an inlet K and an exhaust *c*, the latter communicating with the steam-chest by means of a port terminating at the point abreast of the chest-terminals of the ports *a* and *b*. The valve E, having a centrally-disposed exhaust-cavity, travels upon a valve-seat, in which the exhaust *c* and ports *a* and *b* of the cylinder terminate. Said valve E is provided with vertical extensions *d d'*, which are adapted to receive an auxiliary piston-rod F. Said piston-rod is provided with collars *e e'*, engaging, respectively, the outer faces of the extensions *d d'*, which hold said piston-rod F in a fixed position upon the valve E. Said rod F carries upon its outer ends auxiliary piston-heads *f f'*, the same being housed in auxiliary cylinders G G', located at opposite ends of the steam-chest D. The length of said cylinders G and G' is preferably equal to the length of stroke of the valve E, the heads *f f'* thereby engaging the end walls of said auxiliary cylinders to limit endwise reciprocation of said valve. Said cylinder G communicates with the steam-chest D by means of a by-pass port *h*, the cylinder G' being likewise provided with a communicating by-pass port *h'*, terminating in the steam-chest. Communication is also provided between the auxiliary cylinder G and the main cylinder A by means of an auxiliary port *l*, which terminates in a slot *m*, which latter intersects the inner periphery of the cylinder A. The auxiliary cylinder G' is similarly provided with an auxiliary port *l'*, terminating in a slot or groove *m'* within the cylinder A. An auxiliary valve H, Fig. 6, adapted to slide in horizontally-recessed portions in the walls of the steam-chest D, is provided, which valve is adapted to be moved by the operator independently of the movement of coöperating elements of the valve structure. Said valve H preferably extends across the auxiliary piston F and is located in a position to be engaged and reciprocated by the extensions *d d'* of the valve E. Said valve H communicates with ports *h h'* and has a centrally-disposed exhaust-cavity communicating with an auxiliary exhaust-port K'. Said exhaust-port K' extends downwardly and communicates with the main exhaust *c*. The valve H, as will be seen from the various figures, is located in a position reverse to that occupied by the main valve, although both operate in the same general direction. Means are provided whereby said valve H may be manually operated to cause an initial movement of the primary valve mechanism when the latter occupies an intermediate position, which means consist in the preferred form of a lever *k*, adapted to extend through a slot *k'* in the side wall of the steam-chest D. (See Fig. 6.)

The operation of my improved valve structure is as follows: When the piston B and the valves E and H occupy an intermediate position, the ports *a* and *b*, leading from the steam-chest D to the cylinder A, and the ports *h h'*, leading from the steam-chest to the auxiliary cylinders G G', are closed. It will be obvious that when the parts cease operating and are in the position just described the piston B cannot be reciprocated without giving the valve H an initial movement. When pressure exists in the cylinder A, it would be difficult to effect movement of said valve E by an application of manual power, inasmuch as the steam would form a cushion between the outer as well as the inner faces of the auxiliary pistons and cylinders. This defect is present in all pumps and engines of the prior art employing steam-actuated valves and is avoided in my construction by providing an auxiliary valve H, adapted to be moved independently to the valve E. To start the pump when the piston and valves are in an intermediate or dead-center position, it is merely necessary to reciprocate the valve H in one of two directions, according to the direction which it is desired that the piston B should reciprocate. Referring now to the action which takes place when the auxiliary valve has been moved to the left, it will be seen that live steam is permitted to enter the auxiliary cylinder G' from the steam-chest D through port *h'*. Steam-pressure acting upon the left side of piston *f'* will cause the valve E and the auxiliary valve H to move toward the right, as shown in Fig. 3, thereby effecting closure of the port *h h'*. It will be noted, however, by reference to Fig. 2, that before the port *h'* has been cut off by valve H the port *a* will have been opened by valve E, thereby admitting steam to the left-hand side of piston *f* by means of port *l*, which communicates directly with the cylinder A. As the parts move toward the right, Fig. 3, the auxiliary valve H opens communication between the auxiliary cylinder G and the steam-chest D through port *h*, thereby admitting pressure to the right-hand side of piston *f*. This counter action or resistance on the piston *f* does not prevent but merely retards further reciprocation of the valve E to the right, owing to the increased surface area acted upon by steam entering the port *l* over the surface area of piston *f*, acted upon by steam entering through port *h*. The parts are thereby slowly but continuously driven to the right until they occupy the position shown in Fig. 4, wherein the piston B and the valve mechanism occupy an extreme position. Reverse reciprocation of the piston B must be preceded by reciprocation of the valve E to the left, in order to close the port *a* to the steam-chest and establish communication between the steam-chest D and port *b*. This is effected in the fol-

lowing manner: As the piston B reaches its extreme limit of movement to the right of cylinder A the inner end of the slot *m'* will have been put into communication with the port *a*, through which live steam admitted into the cylinder A will have access to the cylinder G' by means of port *l'*, thereby forcing the valve E to the left. It will be noted that this action upon the piston *f'* is supplemented by steam passing through the port *h* and acting upon the piston *f*. This pressure upon both of the auxiliary pistons not being resisted by a counter-pressure will effect a very rapid movement of the valve E to the left until the same is in the position shown in Fig. 5, wherein the port *b* is partially open. Further movement of valve E to the left will be resisted by steam passing through port *h'* (about to open) and engaging the piston *f'* on its left surface. It will also be noted that steam-pressure on the left of piston *f* has been cut off by the closure of port *h*. Further movement of the valve E toward the left will now be effected by steam entering the port *l'* and overcoming the pressure of steam entering port *h'*, which movement is caused by the fact that the surface area of the piston-head *f'* on the right side thereof is greater than the surface area on the left side. This counter-pressure thus effects a very slow movement of the valve E during the remainder of its travel to the left, and thereby a gradual opening of the port *b*. This action is advantageous in pumps, since it is injurious to the mechanism to cause a sudden forceful action upon a column of water.

Heretofore in devices designed to effect initial displacement of pump-valves when the parts are on a dead-center the operator has been forced to move the entire valve mechanism, where in my improved device it is not essential to move or in any way alter the position of the main valve E, movement thereof being effected by steam-pressure caused by reciprocation of the auxiliary valve. After the pump mechanism has been started the auxiliary mechanism will be primarily operated by the main valve.

While I have herein shown and described the specific form of my device, it will be obvious that changes may be readily made therefrom without departing from the spirit of the invention.

Therefore what I claim, and desire to secure by Letters Patent, is—

In an engine, the combination with a primary cylinder, of a reciprocating piston therein, a steam-chest, primary-cylinder ports leading from said chest to said primary cylinder, a main exhaust-port common to said cylinder-ports, a primary slide-valve coöperating with said primary and main exhaust-ports, an auxiliary piston-rod rigidly secured to said primary slide-valve, auxiliary pistons mounted on the opposite end of said rod, auxiliary cylinders for said pistons, said cylinders being formed in compartments separate from the steam-chest, by-pass ports leading from said steam-chest to the inner ends of said auxiliary cylinders, an exhaust K' adjacent said ports, auxiliary ports leading from the outer ends of said auxiliary cylinders to said primary cylinder, said auxiliary ports terminating in open grooves formed in the wall of said primary cylinder, a steam-balanced auxiliary valve mounted in said steam-chest and actuated by said primary slide-valve, said auxiliary valve coöperating with the chest-terminals of said auxiliary cylinder ports and said exhaust K', and a handle for said auxiliary valve projecting through a slot formed in the wall of said valve-chest.

In testimony whereof I affix my signature in presence of two witnesses.

TOKUICHIRO KASAI.

Witnesses:

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U. ISHIWARA.