

W. B. MASON.
VALVE MECHANISM.

No. 522,071.

Patented June 26, 1894.

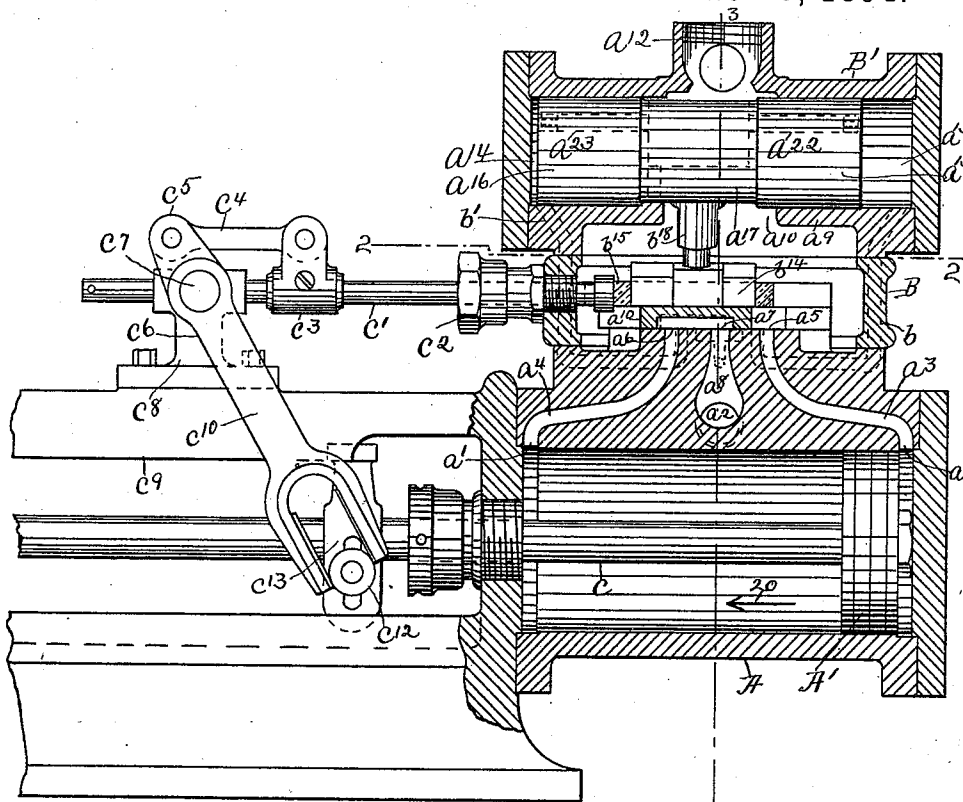


Fig. 1.

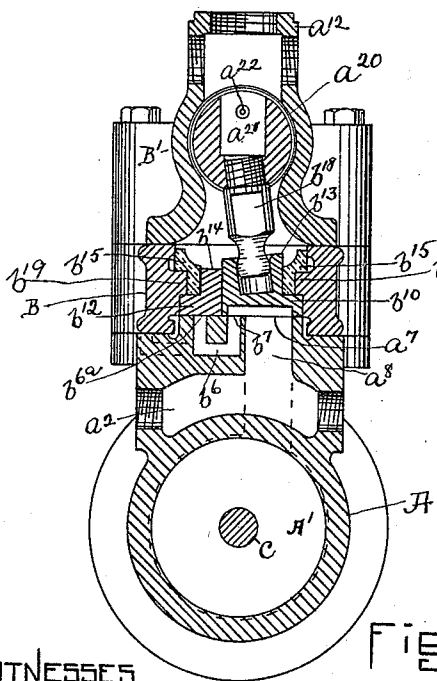


Fig. 3.

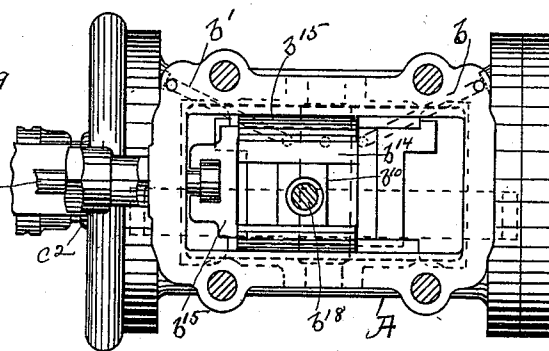


Fig. 2.

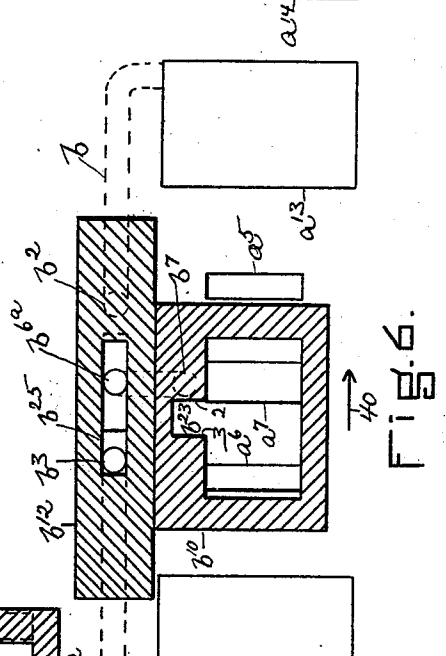
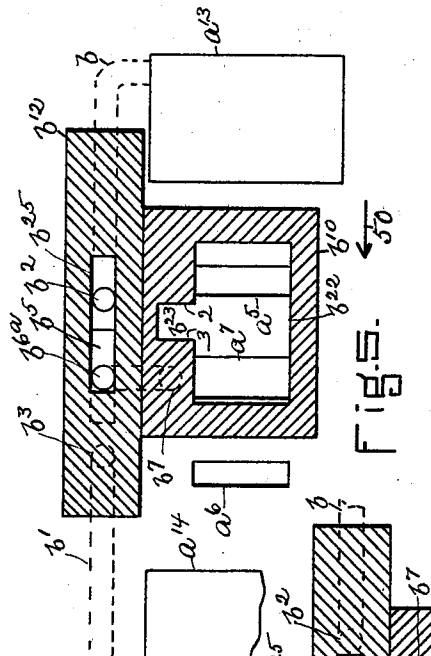
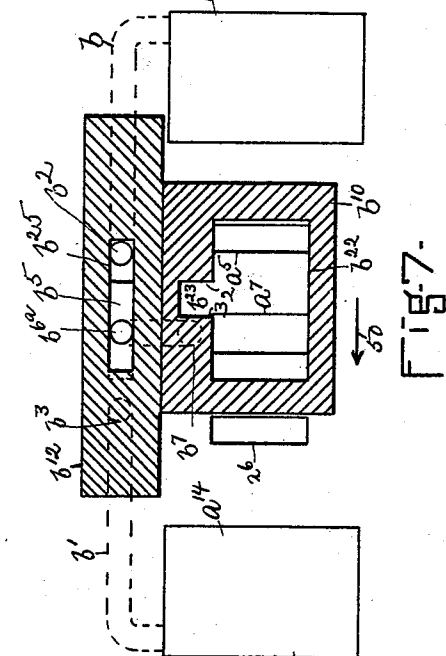
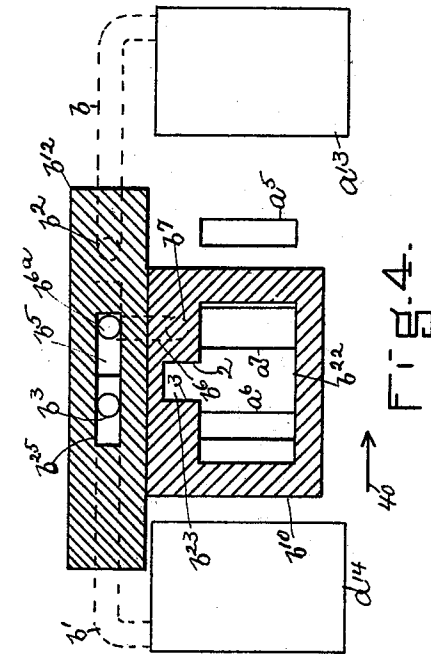
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UNITED STATES PATENT OFFICE.

WILLIAM B. MASON, OF BOSTON, MASSACHUSETTS, ASSIGNOR TO THE
MASON REGULATOR COMPANY, OF SAME PLACE.

VALVE MECHANISM.

SPECIFICATION forming part of Letters Patent No. 522,071, dated June 26, 1894.

Application filed February 14, 1894. Serial No. 500,147. (No model.)

To all whom it may concern:

Be it known that I, WILLIAM B. MASON, residing in Boston, in the county of Suffolk and State of Massachusetts, have invented an Improvement in Valve Mechanism, of which the following description, in connection with the accompanying drawings, is a specification, like letters on the drawings representing like parts.

This invention relates to a novel valve mechanism for engines and is especially applicable for steam pumps to avoid dead centers and sticking of the valve mechanism and to obtain a smoother and easier running pump.

My present invention is more particularly applicable to that class of pumps in which the main valve is operatively connected to auxiliary pistons.

In accordance with this invention, the main valve controls the movement of the auxiliary pistons in opposite directions and is itself operated for a portion of its movement by the said pistons, and it is also operated for a portion of its movement by the piston of the pump as will be hereinafter set forth. The main valve in the present instance has co-operating with it an auxiliary, or what I prefer to designate as a preliminary valve, controlling in part the pressure in the cylinders of the auxiliary pistons. The main valve and the preliminary valve may and preferably will be made as flat slide valves reciprocating in a straight or substantially straight path, and the said valves are located in a valve chest provided with a main exhaust port, and with inlet ports leading to the opposite end of the main cylinder, and also with ports communicating with the cylinders for the auxiliary pistons. The valve chest is further provided with a port intermediate of the exhaust port and the ports leading to the piston cylinders, and the connection of which intermediate port with the exhaust port is controlled by the main valve, as will be described. These and other features of this invention will be pointed out in the claims at the end of this specification.

Figure 1 represents in section and elevation a sufficient portion of a steam pump embodying this invention to enable it to be understood; Fig. 2, a horizontal section through the

valve chest on the line 2—2, Fig. 1; Fig. 3, a transverse section on the line 3—3, Fig. 1, and Figs. 4 to 8 inclusive diagrams of the valve mechanism to more clearly enable the invention to be understood.

The cylinder A provided with the piston A' and having the inlet ports $a a'$ communicating with the opposite ends of the said cylinder and provided with the main exhaust port a^2 , may be of any suitable construction, such as now commonly formed in steam pumps. The ports $a a'$ are connected by passages $a^3 a^4$ to ports $a^5 a^6$ in a valve seat secured to or forming part of the cylinder A, and the said valve seat is provided with a port a^7 connected to the main exhaust a^2 by the passage a^8 .

The cylinder A supports a valve chest B having its top a^9 provided with a substantially large opening a^{10} by which direct communication is established between the valve chest B and the steam inlet a^{13} , the port or opening a^{10} communicating with a cylindrical casing B', which for the purpose of this invention may be regarded as two cylinders $a^{13} a^{14}$ containing pistons $a^{15} a^{16}$ connected together preferably by a central portion a^{17} constituting a common piston rod for the said pistons. The piston rod a^{17} may and preferably will be made as herein shown, it being made of a diameter a little less than the diameter of the cylinder B' so as to form an annular passage a^{20} (see Fig. 3) for the passage of steam from the steam inlet a^{13} to the port or opening a^{10} and thence into the valve chest B. The piston rod a^{17} is provided with a pocket or opening a^{21} preferably made substantially rectangular in shape and which pocket is connected with the cylinders $a^{13} a^{14}$ by suitable holes or passages $a^{22} a^{23}$ extended through the pistons $a^{15} a^{16}$ respectively (see Figs. 1 and 3) so that a free passage for the steam is afforded from the steam inlet a^{13} into the cylinders $a^{13} a^{14}$ behind the pistons $a^{15} a^{16}$, and as a result, the said pistons are balanced under normal conditions as will be described.

In accordance with this invention, the cylinders $a^{13} a^{14}$ communicate with the valve chest B by passages $b b'$ (see dotted lines Fig. 1 and Figs. 5 to 8 inclusive), the said passages terminating in ports $b^2 b^3$ in the bottom of the

valve chest, which bottom constitutes the seat for the valve mechanism to be hereinafter specifically described.

The valve seat between the ports b^2 b^3 is preferably provided with a cavity b^5 with which communicates, by a port b^{6a} , a passage b^6 in the valve seat (see Figs. 3 to 8 inclusive) terminating in a port b^7 , which port for purpose of distinction will be hereinafter referred to as the pressure reducing port, by uncovering which the pressure in the cylinders a^{13} a^{14} may be reduced, as will be described.

The steam ports a^5 a^6 leading to the cylinder A, and the exhaust port a^7 , together with the ports b^2 b^3 communicating with the cylinders a^{13} a^{14} are in accordance with this invention controlled by a main valve b^{10} and an auxiliary valve b^{12} , which latter for purpose of distinction may be hereinafter referred to as the preliminary valve. The valves b^{10} b^{12} are herein shown as flat slide valves and are provided with uprights or projections b^{13} b^{14} (see Fig. 3) which may be regarded as valve stems. The valve stems b^{13} b^{14} are located within a yoke or frame b^{15} herein shown as of substantially rectangular form, and the valve stem b^{14} is made of substantially the same length as the opening in the yoke, so that it fits substantially tight therein and is positively moved by the same.

The valve stem b^{13} of the main valve is shown as rectangular in form and of such width as to substantially fill the space between one side of the yoke and the valve stem b^{14} of the preliminary valve, while its length is much less than the length of the opening formed by the yoke, which permits the yoke and the preliminary valve b^{12} to have a movement independent of the valve b^{10} , and also permits the valve b^{10} to be moved as will be described independent of yoke and the preliminary valve b^{12} . In the present instance, the valve stem b^{13} of the main valve b^{10} is hollow on its upper side to receive the end of an arm, rod or projection b^{18} (see Figs. 1 and 3,) firmly secured to the stem or rod a^{17} connecting the pistons a^{15} a^{16} , the valve connecting rod b^{18} being preferably fitted somewhat loosely into the socket in the valve stem b^{13} to permit the valve b^{10} to readily accommodate itself to its seat. The yoke b^{15} is movable upon suitable guideways b^{19} secured to or forming part of the side walls of the valve chest B (see Fig. 3), and by means of which the said yoke is guided in its longitudinal movement in the said valve chest. The main valve b^{10} is provided on its under side with a substantially rectangular cavity, socket or cut-away portion b^{22} , of a width substantially equal to the length of the steam inlet and exhaust ports for the cylinder A, and the said valve on its under side is further provided with an auxiliary cavity, socket or cut-away portion b^{23} , which communicates with the main opening or cavity b^{22} , and which cooperates in the movement of the main valve with the reducing port b^7 , so as to connect the

said port with the cavity b^{22} , which latter at all times is in communication with the main exhaust port, a^7 . The auxiliary cavity or opening b^{23} is preferably made narrow or of substantially little size as compared with the size of the main cavity or opening b^{22} , so that in the movement of the main valve b^{10} , the reducing port b^7 will be connected with the main exhaust port a^7 for substantially an instant. The preliminary valve b^{12} is provided on its under side with a cavity or opening b^{25} , preferably made of less length than the distance between the ports b^2 b^3 but of sufficient length to connect the port b^{6a} with either of the ports b^2 b^3 for a purpose as will be described.

The port b^7 is located in the valve seat in such relation to the main valve b^{10} and vice versa, that the said valve covers said port, except when the cavity b^{23} , in the movement of the main valve in either direction, is brought over or so as to connect the port b^7 with the main cavity b^{22} and thereby with the exhaust port a^7 .

The preliminary valve b^{12} and its yoke b^{17} are positively operated by the movement of the piston A', and may be connected to the piston rod c of the said piston by a suitable mechanism, which may be made as herein shown, it consisting of a rod or stem c' connected to the yoke b^{15} and extended through a suitable stuffing box c^2 in one end of the valve chest B, and having fast on it a collar c^3 , joined by a link c^4 to one arm c^5 of a lever c^6 , pivoted as at c^7 in a suitable upright c^8 secured to a stationary part or frame c^9 , and having its other arm c^{10} forked at its end to embrace a stud, roller or projection c^{12} carried by a collar c^{13} fast on the piston rod c .

By an inspection of Fig. 1, it will be readily seen that the movement of the piston A' in one direction, produces, by means of the mechanism connecting the piston rod c with the stem or rod c' , a movement of the yoke b^{15} in an opposite direction.

The relative position of the parts is shown in Fig. 1, when the piston A' has reached the end of its stroke in one direction and is about to commence its stroke in the opposite direction, for instance, in the direction indicated by arrow 20, Fig. 1. The position of the valves b^{10} b^{12} in this position of the piston A' is indicated in Fig. 4, to wit:—the steam port a^5 is uncovered by the main valve b^{10} and is in direct communication with the valve chest B, which is in direct communication through the opening a^{10} and passage a^{20} with the steam inlet a^{12} , and therefore, steam is being admitted into the cylinder A behind the piston A'. The steam port a^6 is uncovered by the cavity b^{22} in the under side of the main valve b^{10} and is connected with the exhaust port a^7 . The preliminary valve b^{12} at such time has the cavity b^{25} on its under side over the port b^3 and also over the cavity b^5 in the valve seat, so that the piston cylinder a^{14} is in communication with the passage b^6 , but the port b^7 of

the latter passage is closed by the main valve b^{10} . The port b^2 is closed by the preliminary valve b^{12} . By means of the passages a^{22} a^{23} in the pistons a^{15} a^{16} , the steam pressure on the opposite ends of the said pistons is equal, and the said pistons are therefore balanced, and thereby rendered sensitive to a slight change in pressure in the cylinders a^{13} a^{14} .

On the commencement of the movement of the piston A' in the direction of arrow 20, Fig. 1, the yoke b^{15} and the preliminary valve are moved coincident therewith in the direction opposite to that indicated by arrow 20, that is, in the direction indicated by arrow 40, Fig. 4. As the preliminary valve b^{12} is moved in the direction of arrow 40, the cavity b^{25} is brought over the port b^2 and is removed from over the port b^3 , so that the port b^3 is connected with the passage b^6 through the cavities b^{25} b^5 , while the port b^3 is covered by the solid part of the valve b^{12} . The pressure in the cylinders a^{13} a^{14} remains unchanged in this movement of the valve b^{12} , which acts as a preliminary to the main valve to place the reducing port b^7 in communication with the proper cylinder, to enable the pressure in such proper cylinder to be reduced by the main valve, which is positively operated by the yoke b^{15} for the first portion of its movement, that is, until the main valve has been moved sufficiently to bring the edge of the cavity b^{23} above the reducing port b^7 and connect it with the exhaust a^7 , whereupon, the pressure in the piston cylinder thus connected with the exhaust is reduced, and the greater pressure in the other piston cylinder acts to move the pistons and thereby the main valve, which movement is substantially instantaneous. In the movement of the valves above stated, the yoke b^{15} is brought into engagement with the left hand side of the stem of the main valve b^{10} (viewing Fig. 4) and positively moves the main valve as well as the preliminary valve, which latter, before the yoke engages the main valve stem, has done its work. The main valve b^{10} is positively moved until the edge or wall 2 of the cavity b^{23} passes by the edge of the port b^7 , and thereby connects the piston cylinder a^{13} with the exhaust passage a^2 , through the passage b , port b^2 , cavities b^{25} b^5 , port b^{6a} , passage b^6 , port b^7 , cavities b^{23} b^{22} , exhaust port a^7 , passage a^8 . As soon as the cylinder a^{13} is thus connected with the exhaust, the steam pressure acting on the piston a^{15} is reduced or rendered less than that in the cylinder a^{14} , and consequently, the greater pressure in the cylinder a^{14} acts on the piston a^{16} and quickly forces or moves the pistons a^{16} a^{15} toward the opposite end of their cylinders, thereby, through the valve rod b^{18} and valve stem b^{13} , moving the main valve so as to carry the cavity b^{23} over and beyond the reducing port b^7 and into substantially the position shown in Fig. 5.

The auxiliary piston and the main valve

are moved as long as the pressure in the piston cylinders a^{13} a^{14} is unequal, and by an inspection of Fig. 4, it will be seen that as soon as the wall or edge 3 of the cavity b^{23} is carried by the reducing port b^7 , the cylinder a^{13} is cut off from the exhaust a^7 by the solid portion of the main valve, and the pressure in the said cylinder again becomes substantially in an instant, equal to the pressure in the cylinder a^{14} , and both pistons are again balanced. When the valves b^{10} b^{12} are brought into the position shown in Fig. 5, the main piston A' will have completed its stroke in the direction indicated by arrow 20 and will then commence its return stroke, being acted upon by steam admitted from the valve chest B, through the passage a^4 , the steam passage a^3 being at such time connected with the exhaust as shown in Figs. 5 and 7. On the return movement of the piston A', the valves b^{10} b^{12} , are moved from the position shown in Fig. 5 back into that shown in Fig. 4, the said valves moving in the direction indicated by arrow 50, Figs. 5 and 7. In the movement of the piston A' in a direction opposite to that indicated by arrow 20, the yoke b^{15} and preliminary valve b^{12} are moved, and the said valve b^{12} in its movement brings the cavity b^{25} over the port b^2 , thereby connecting the cylinder a^{14} with the passage b^6 , and at the same time, covering the port b^3 and cutting off the cylinder a^{13} from said passage. The continued movement of the yoke b^{15} uncovers the port b^7 by the cavity b^{23} and connects the cylinder a^{14} with the exhaust, thereby reducing the pressure in this cylinder and causing the greater pressure in the cylinder a^{13} to force the auxiliary pistons a^{15} a^{16} back into the position shown in Fig. 1, thereby moving with them the main valve b^{10} into its first position shown in Fig. 4.

In the movement of the main valve in either direction, there is a time when both steam ports a^5 a^6 are covered by said valve and thus cut off from the valve chest B and from the exhaust port a^7 , but by an inspection of Fig. 8, it will be seen that at such time, the cavity b^{23} is over the reducing port b^7 and the latter is connected with the exhaust, thereby placing one of the piston cylinders a^{13} a^{14} in communication with the exhaust. As a result, the reduction of pressure in the piston cylinder connected with the exhaust causes the greater pressure in the other piston cylinder to positively move the auxiliary piston and the main valve connected therewith, and therefore, the main valve cannot stick or remain in its central position with the ports a^5 a^6 covered. In this manner, dead centers in the engine are entirely obviated and the latter works with greater ease and steadiness. It will be noticed that a single port b^7 is connected alternately with both auxiliary piston cylinders, and that the main valve controls this port in addition to the ports of the main cylinder, and consequently the main valve

controls the movement of the piston in the main cylinder and also the piston in the auxiliary cylinders.

I prefer to employ the cavity b^5 in the valve seat between the ports b^2 b^3 as by such construction, the preliminary valve may be made of minimum length, as the cavity b^5 co-operates with the cavity b^{25} and forms practically a continuation thereof, but the cavity b^5 may be dispensed with and the cavity b^{25} made longer.

I have hereindescribed my invention as applied to the steam engine of a pump, but I do not desire to limit myself to this particular application, as it is evident that the invention is applicable to an engine employing other mediums as the motive power, such as gas, hot air, &c.

I claim—

1. In an engine, the combination of the following instrumentalities, viz:—a main cylinder, a valve chest having a valve seat provided with ports communicating with the said cylinder and with an exhaust for said cylinder, auxiliary cylinders connected to ports in the said valve seat, a reducing port in the valve seat adapted to be connected with the ports in communication with the auxiliary cylinders and also with the exhaust for the main cylinder, pistons in said auxiliary cylinders, a main valve in the valve chest operatively connected to the auxiliary pistons and controlling the said cylinder ports and the said reducing port, an auxiliary or preliminary valve in the valve chest controlling the ports in communication with the auxiliary cylinders, a piston in said main cylinder, and mechanism to operatively connect the said piston with the preliminary valve, substantially as described.

2. In an engine, a valve chest provided with the usual inlet and exhaust ports and with an additional port b^7 , combined with a main valve controlling said usual ports and constructed to connect the said additional port with the exhaust port of the valve chest for the purpose specified, substantially as described.

3. In an engine, a main valve chest, and auxiliary cylinder ports in the main valve chest in communication with the auxiliary cylinders, a preliminary valve in the main valve chest controlling in part said ports, a main valve in said valve chest also controlling in part said ports, pistons in the auxiliary cylinders connected to the main valve to move the same, and means to move the preliminary valve and the main valve independent of the auxiliary pistons, substantially as described.

4. In an engine, the combination of the fol-

lowing instrumentalities, viz:—a valve chest, a main valve therein, a cylinder communicating with the valve chest, an auxiliary piston in said cylinder, an intermediate connection joining the said auxiliary piston to the main valve to move the latter for a portion of its stroke or travel, an additional valve controlling in part the movement of the said auxiliary piston, and means to positively move the said additional valve and also the main valve for another portion of its stroke independent of the auxiliary piston, substantially as described.

5. In an engine, the combination of the following instrumentalities, viz:—a valve chest, a main valve therein, a cylinder independent of the valve chest, an auxiliary piston in said cylinder controlled in its movement by the main valve and itself operating the main valve for a portion of its movement, a preliminary valve to place the auxiliary piston in condition to be operated by the main valve, and means to positively move the preliminary valve and to also move the main valve for a portion of its travel to place the latter in condition to effect the movement of the auxiliary piston and thereby its own movement for the remaining portion of its travel, substantially as described.

6. In an engine, the combination of the following instrumentalities, viz:—a main cylinder, a piston therein, a valve chest communicating with the main cylinder and with the exhaust therefor, auxiliary cylinders in communication with the valve chest and provided with passages connected with the valve chest, normally balanced auxiliary pistons in said cylinders, a reducing port in the valve chest adapted to be connected with each of the auxiliary cylinders, a preliminary valve to select which auxiliary cylinder the said reducing port is to be connected with, a main valve operatively connected to the auxiliary piston controlling the ports of the main cylinder and also the reducing port, and mechanism operated by the piston rod to move the preliminary valve and also the main valve for a portion of its movement so as to uncover the reducing port and unbalance the auxiliary piston, whereby the said auxiliary piston and the main valve are moved to complete the movement of the said main valve, substantially as described.

In testimony whereof I have signed my name to this specification in the presence of two subscribing witnesses.

WILLIAM B. MASON.

Witnesses:

JAS. H. CHURCHILL,

J. MURPHY.