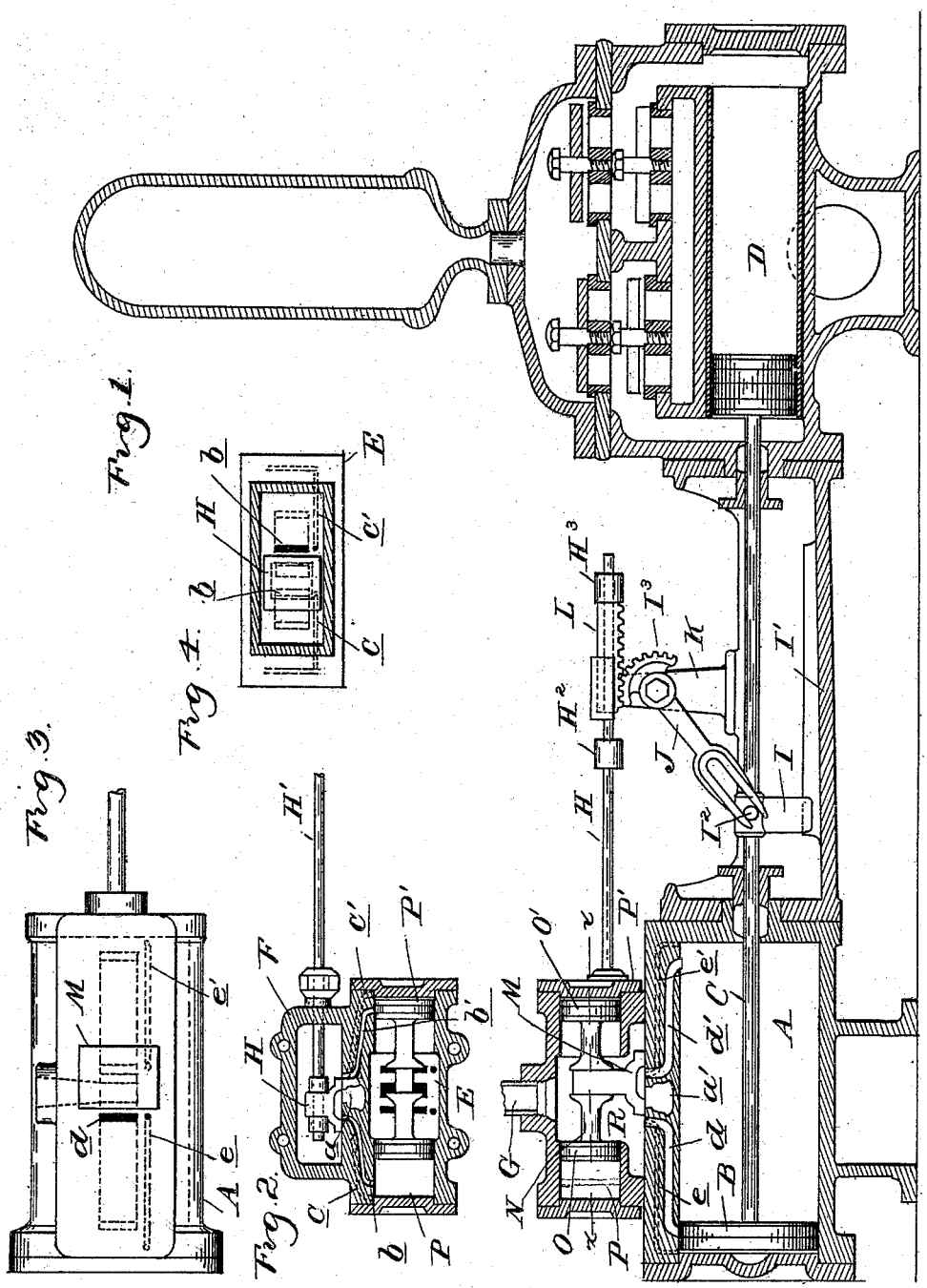
(No Model.)

F. A. BURNHAM.

VALVE FOR DIRECT ACTING ENGINES.

No. 492,188. Patented Feb. 21, 1893.



Witnesses
A. L. Hobbs
N. L. Lindop.

Inventor
Frank A. Burnham
By Thos. G. Sprague & Son
Atty's

UNITED STATES PATENT OFFICE.

FRANK A. BURNHAM, OF BATTLE CREEK, MICHIGAN, ASSIGNOR TO THE UNION MANUFACTURING COMPANY, OF SAME PLACE.

VALVE FOR DIRECT-ACTING ENGINES.

SPECIFICATION forming part of Letters Patent No. 492,188, dated February 21, 1893.

Application filed July 5, 1892. Serial No. 438,970. (No model.)

To all whom it may concern:

Be it known that I, FRANK A. BURNHAM, a citizen of the United States, residing at Battle Creek, in the county of Calhoun and State of Michigan, have invented certain new and useful Improvements in Valves for Direct-Acting Steam-Engines, of which the following is a specification, reference being had therein to the accompanying drawings.

This invention relates more particularly to that class of direct acting steam engine in which there is a main valve actuated by the steam alone and an auxiliary valve actuated by mechanical connection with the piston of the cylinder, and mainly designed for use in connection with steam pumps.

My invention consists first, in the construction and arrangement of the gear which connects the auxiliary valve with the cylinder piston for moving it at the ends of the stroke of said piston; second in the peculiar combination and arrangement of the auxiliary and main valve and their valve chests with two small preadmission ports from the auxiliary valve chest into the main valve chest, whereby the main piston is initially started by the admission of a small volume of live steam and also cushioned at the end of its movement; third in the combination and arrangement of the main valve and its chest with two like preadmission ports leading from the main valve chest into the cylinder, whereby the cylinder piston is gradually started to begin its stroke and cushioned at the end of the stroke, all as more fully hereinafter described and shown in the accompanying drawings, in which

Figure 1 is a vertical central section through a steam engine provided with my improved valve and shown in connection with a pump of known construction. Fig. 2 is a horizontal section on line *x*—*x* in Fig. 1 with the auxiliary valve, however, shown in the position it would occupy when the cylinder piston is at the other end from that shown in Fig. 1. Fig. 3 is a plan of the main cylinder showing the valve ports and the position of the main valve corresponding to Fig. 1. Fig. 4 is a plan of the auxiliary valve and valve ports.

A is the main cylinder, B its piston.

C is the piston rod and D a pump directly actuated by the steam engine and otherwise of known construction and forming no part of the invention described herein.

Upon the cylinder are mounted the two steam chests E and F preferably cast in one piece and mounted side by side on top of the cylinder. The steam chest E is provided with a suitable connection G for admitting the steam from the boiler into the interior of the chest and from there it passes through a communicating opening into the interior of the steam chest F. The steam chest F contains the auxiliary valve H which is an ordinary D valve connected to a valve stem H′ which passes through a stuffing box and is mechanically operated by the movement of the piston rod in the following manner: The piston rod is provided with a cross-head I which engages into a guide I′ formed on or secured to the frame connecting the steam cylinder with the pump cylinder. This cross-head has a roller wrist I^3, which engages into the slot or end of an oscillating lever J. The oscillating lever is pivoted to the side of a standard K and carries a circular segmental rack I^3, which engages into a sliding rack bar L which is held in suitable guides on top of the standard K. The valve rod H′ slides freely through the rack bar and has two adjustable collars H^2 H^3 which project in the path of the sliding rack bar L, all so arranged that the movement of the piston rod actuates the sliding rack bar in the opposite direction, and the latter at or near the completion of the stroke engages upon one of the collars on the stem of the auxiliary valve thereby moving the latter in a direction opposite to that of the piston. As the travel of the rack bar is only one-fifth of the piston travel it will be seen that the auxiliary valves move slowly and without jar or noise.

The steam chest E contains the main valve which is composed of an ordinary D slide valve M which controls the cylinder ports and has an upward projecting stem which engages between two fixed collars on the stem N. To the opposite ends of this stem the valve moving pistons O O′ are secured and move in cylinders P P′ formed respectively at the opposite ends of the valve chest.

The auxiliary valve chest is provided with the exhaust port *a* which connects into the

main exhaust port a' of the cylinder and with induction and eduction ports b b' leading to near the opposite ends of the main valve chest. In addition to these ports two small pre-admission ports c c' lead into the extreme ends of the main valve chest respectively. The ports b b' and c c' are all controlled by the auxiliary valve H and are closed and opened by the steam valve at the same moment of time respectively, but while the ports b b' are adapted to communicate into the exhaust cavity under the valve, the pre-admission ports c c' are placed to one side of the ports b b' whereby they cannot communicate with this exhaust cavity, but are completely closed when the valve moves over them.

The steam chest E and cylinder A are connected by the usual main steam ports d d' which lead to near the opposite ends of the cylinder and the pre-admission ports e e' which lead to the extreme ends of the steam cylinder. These ports d d' and e e' are controlled by the same sliding valve N, but while the ports d d' are adapted in the operation of the valve to communicate into the exhaust cavity thereof, the ports e e' are placed to one side, whereby they are simultaneously opened and closed by the valve corresponding with the ports d d', but become closed by the flat portion of the valve when the latter moves over them.

In practice, the parts being constructed and arranged substantially as shown and described, the operation is as follows: Steam being admitted to the steam chest through the connection at G it fills the space R between the valve moving pistons O O' and the face of the main cylinder, within the valve chest, and through the communication provided for the steam is also admitted into the auxiliary valve chest. In the position of the parts shown in Fig. 1 the admission port d is closed by the piston in the cylinder and steam is permitted only to flow into the cylinder through the small pre-admission port e, this port like the port e' being never covered by the piston. As the port e is small the space behind the piston is filled slowly with steam and the piston moves off gradually until it uncovers the large port d when the full volume of steam is admitted. When the piston has moved over to the opposite end of the chest cylinder, the port d' which was during this movement opened to the exhaust is now closed by the piston and whatever exhaust steam has remained in the cylinder is now compressed between the piston and the cylinder head as it cannot escape through the small preadmission port e', as the same is closed by the main valve M in connection with the exhaust. Therefore there being no outlet for the exhaust vapor it thereby forms a cushion for the main piston at the end of the stroke. While the piston has thus been traveling to the right hand of the cylinder, the valve H has been moved by the connections described to the left and at the end of the stroke is in the position shown in Fig. 2. In this position it will be seen that it uncovers the ports b' and c', and connects the port b to the exhaust, while the port c is closed by the valve. As the valve moving piston O' covers the inner end of the port b', steam is admitted only through the small pre-admission port c', which like the port c is in the position where it cannot be closed by the valve moving piston, thus a small volume of live steam only is admitted behind the valve moving piston O', and the latter will thus start slowly until it has passed the inner end of the port b', when the full volume of live steam is admitted to complete the throw of the valve moving piston to reverse the main valve. The steam chamber P of the other valve moving piston O is in connection with the exhaust through the port b, but as soon as the piston O closes this port the exhaust vapor remaining in the steam chamber is compressed, as the pre-admission port c is closed by the valve H, thus a steam cushion is formed for the valve. This construction and arrangement of valves and ports has the advantage of forming a perfect cushion for the main valve and piston which insures a uniform travel of the piston under varying conditions of load. It further results in a momentary pause of the piston at each end of the stroke, causing thereby the water valves to seat quietly without shock or jar and a slow initiatory movement is imparted to the piston whereby the water columns are started gradually relieving the pump and piping of all undue strain.

What I claim as my invention is—

1. In a direct acting engine, the combination with the main cylinder, piston and piston rod therein, of a main slide valve provided with valve moving pistons moving in steam chambers in the valve chest, an auxiliary slide valve mechanically operated by connection with a moving part of the engine, suitable ports controlled by said auxiliary valve for admitting and exhausting steam into and from the steam chambers of the valve moving pistons through the main portion of the movement of said pistons, suitable ports controlled by the main valve for admitting and exhausting steam into and from the main cylinder during the main portion of the stroke of the piston, preadmission ports leading directly from the auxiliary valve chest and directly controlled by the auxiliary valve to admit steam into the steam chamber, of the valve moving pistons for the initiatory movement of said main valve and preadmission ports leading directly from the main valve chest and directly controlled by the main valve for admitting steam into the cylinder for the initiatory movement of the main piston, substantially as described.

2. In a direct acting engine, the combination with the main cylinder, piston and piston rod thereof, of a main slide valve provided with valve moving pistons moving in steam chambers in opposite ends of the valve chest, an auxiliary slide valve mechanically

operated by connection with the main piston rod, suitable ports controlled by said auxiliary valve for admitting and exhausting steam into and from the steam chambers, of the valve moving pistons through the main portion only, of the movement of said pistons, suitable ports controlled by the main valve for admitting and exhausting steam into and from the main cylinder during the main portion only, of the stroke of the piston, preadmission ports directly controlled by the auxiliary valve to admit steam into the steam chambers, of the valve moving pistons for initiating the movement of the main valve and preadmission ports directly controlled by the main valve for admitting steam into the cylinder for initiating the stroke of the piston, said preadmission ports admitting steam in small volume only and having no connection with the exhaust cavity of the valves by which they are respectively controlled, substantially as described.

3. In a direct acting engine, the combination with the main cylinder, piston and piston rod of the main slide valve M provided with valve moving pistons O, O′, the valve chest E inclosing said valve having cylindrical steam chambers P P′ in which said valve moving pistons travel, the ports *d d′* controlled by said main valve to admit exhaust steam into and from the cylinder and adapted to be closed by the main piston near the ends of its stroke, the preadmission ports *e e′* controlled by a flat portion of the face of the main slide valve and leading into the extreme ends of the cylinder and the auxiliary valve H arranged to control the admission and exhaust of steam into and from the steam chambers of the valve moving pistons, substantially as described.

4. In a direct acting engine, the combination with the main cylinder, piston and piston rod, of the steam actuated main slide valve M provided with valve moving pistons in steam chambers of the valve chest, the mechanically moved auxiliary valve H controlling the admission of steam into said steam chambers, the ports *b b′* for admitting and exhausting steam into and from said steam chambers and adapted to be closed by the valve moving pistons in said chambers near the end of their stroke and the preadmission ports *c c′* leading into the extreme ends of the steam chambers of the valve moving pistons and adapted to be closed by the auxiliary valve without being connected into the exhaust cavity thereof, substantially as described.

5. In a direct acting engine, the combination with the main cylinder, piston and piston rod thereof, of the steam actuated main slide valve controlling the admission of steam into the main cylinder and provided with valve moving pistons in steam chambers of the valve chest, the auxiliary valve controlling the admission of steam into the steam chambers of the valve moving pistons, the oscillating lever J operated by the movement of the main piston rod and provided with the circular rack, the reciprocating rack bar engaging with said circular rack, and the valve rod of the auxiliary valve slidingly engaging with said rack bar and having collars adapted to be engaged by said rack bar, substantially as described.

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

FRANK A. BURNHAM.

Witnesses:
ROLDEN P. KINGMAN,
FREDERICK A. ALLWARDT.