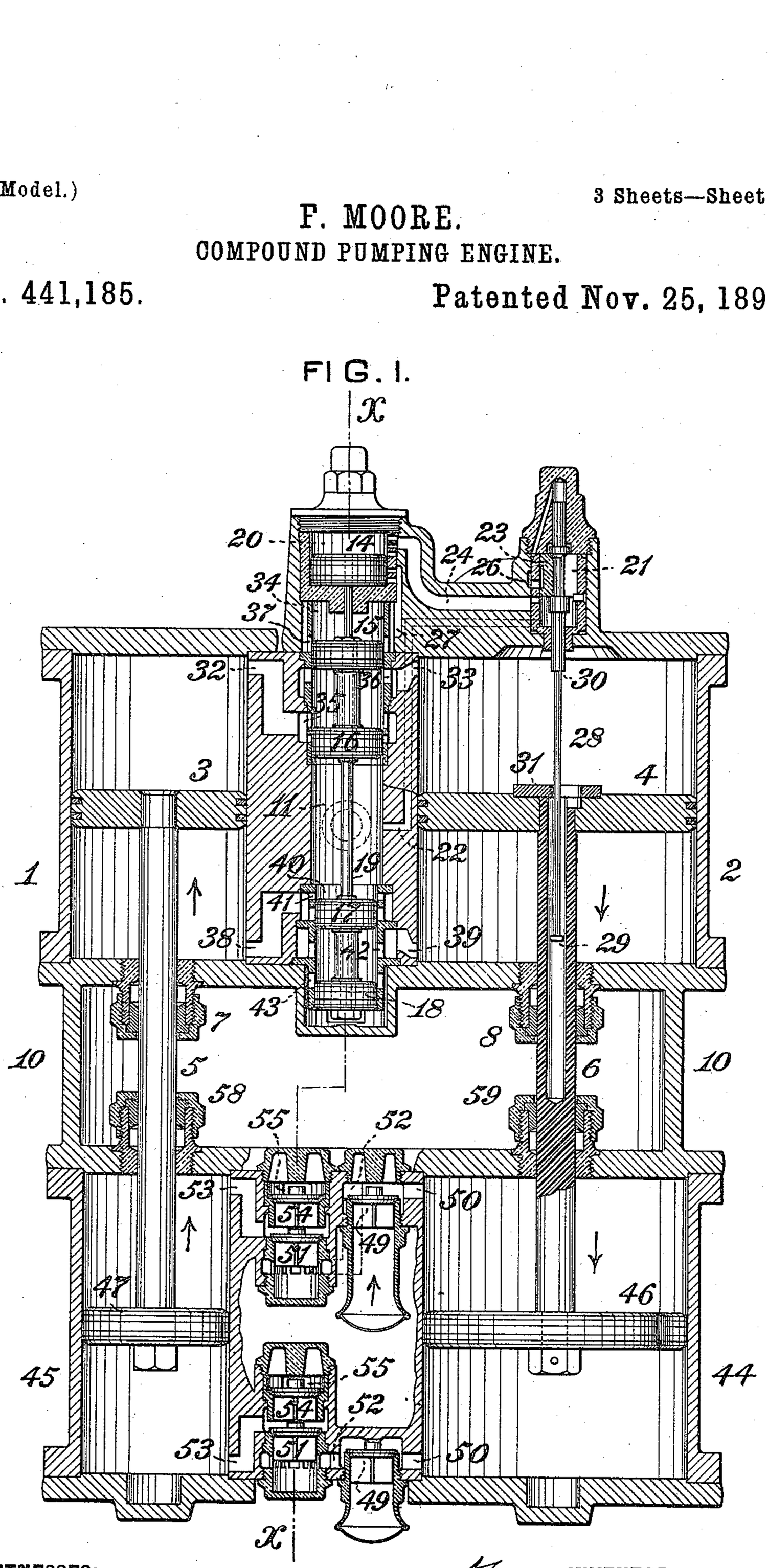
(No Model.) 3 Sheets—Sheet 1.

F. MOORE.

COMPOUND PUMPING ENGINE.

No. 441,185. Patented Nov. 25, 1890.

FIG. 1.



WITNESSES:

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Att'y.

(No Model.)

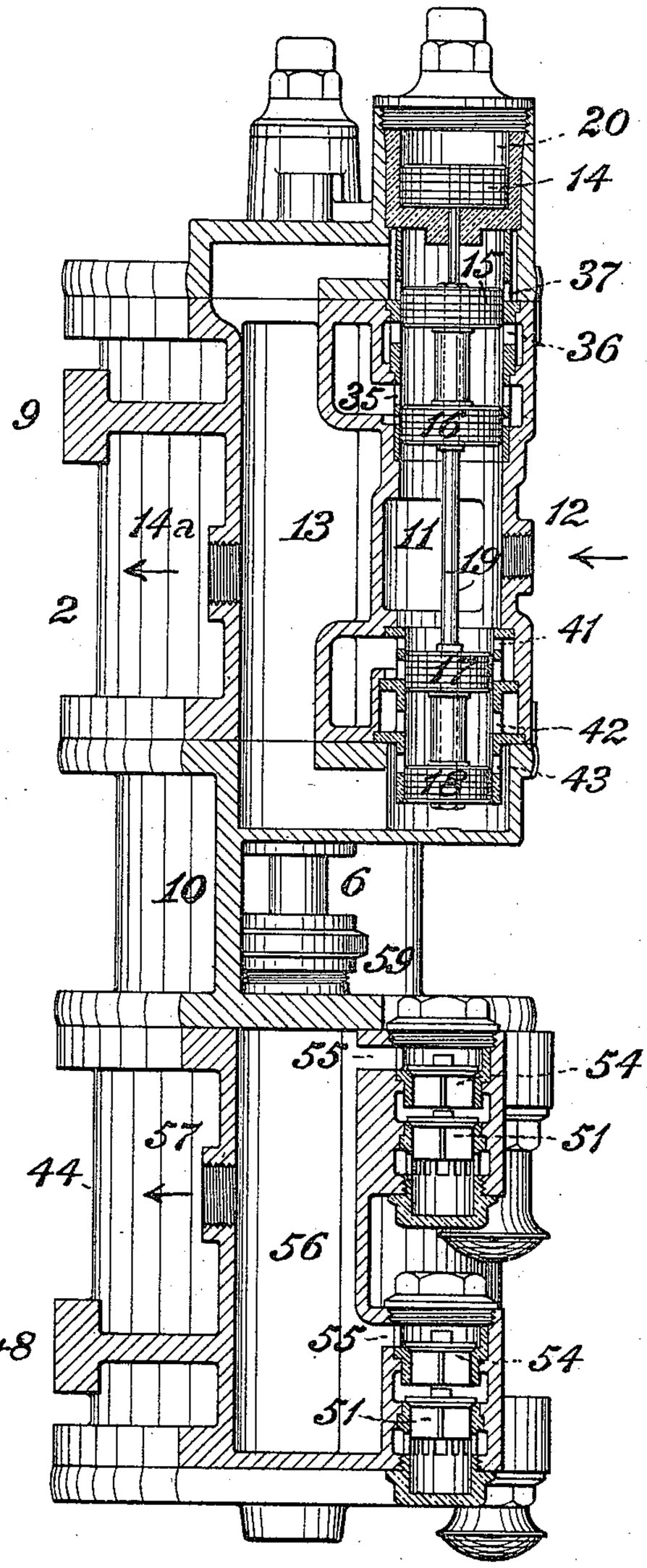
3 Sheets—Sheet 2.

F. MOORE.

COMPOUND PUMPING ENGINE.

No. 441,185. Patented Nov. 25, 1890.

FIG. 2.



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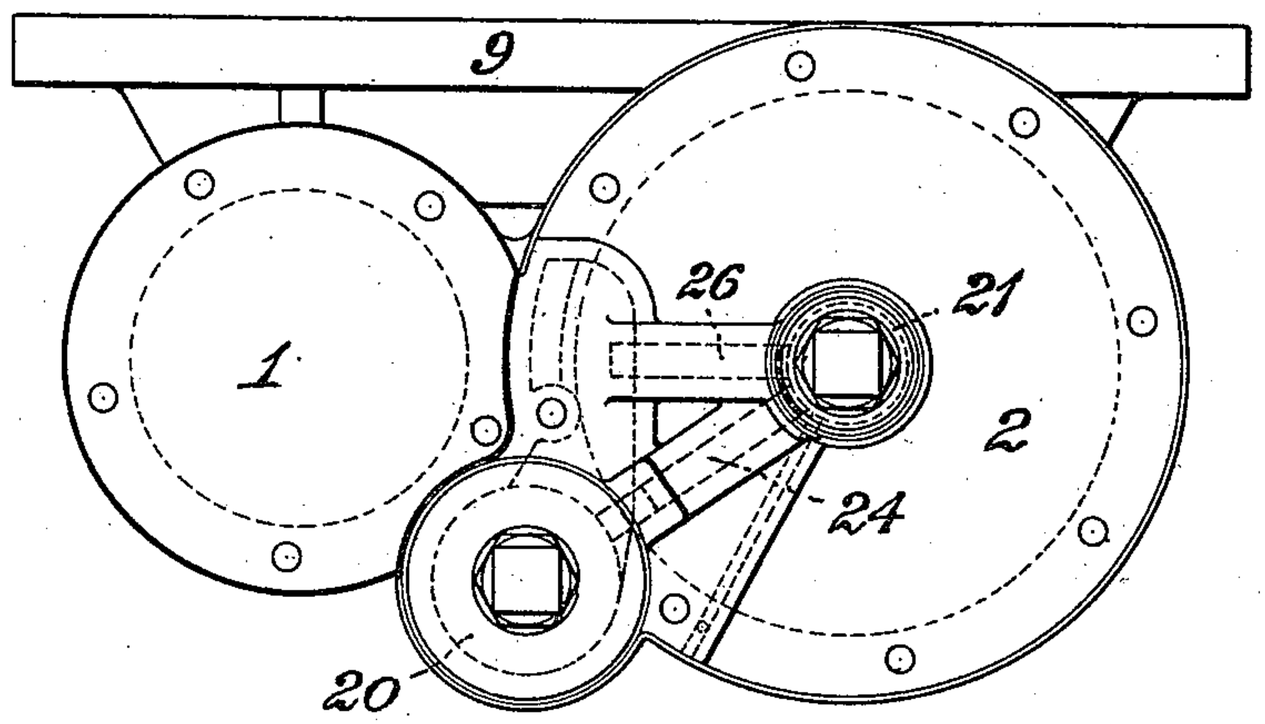
(No Model.) 3 Sheets—Sheet 3.

F. MOORE.

COMPOUND PUMPING ENGINE.

No. 441,185. Patented Nov. 25, 1890.

FIG. 3.



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UNITED STATES PATENT OFFICE.

FRANK MOORE, OF PITTSBURG, PENNSYLVANIA, ASSIGNOR TO THE WESTINGHOUSE AIR BRAKE COMPANY, OF SAME PLACE.

COMPOUND PUMPING-ENGINE.

SPECIFICATION forming part of Letters Patent No. 441,185, dated November 25, 1890.

Application filed August 6, 1890. Serial No. 361,184. (No model.)

To all whom it may concern:

Be it known that I, FRANK MOORE, a citizen of the United States, residing at Pittsburg, in the county of Allegheny and State of Pennsylvania, have invented or discovered a certain new and useful Improvement in Compound Pumping-Engines, of which improvement the following is a specification.

My invention relates to compound pumping-engines of the type which is set forth in the application of George Westinghouse, Jr., filed August 6, 1890, Serial No. 361,175; and its object is to obviate liability of the high-pressure piston to strike the cylinder-head when working against a comparatively light pressure of the fluid under compression, as well as to equalize, as nearly as may be, the traverse of the pistons under such conditions.

To this end my invention, generally stated, consists in the combination of a compound non-rotative direct-acting engine having the parts of its cylinders controlled by a distribution-valve actuated primarily by the movement of the low-pressure piston and a compound compressing-pump having its pistons connected to and actuated by those of the engine.

The improvement claimed is hereinafter fully set forth.

In the application of George Westinghouse, Jr., as aforesaid, a construction is illustrated in which the reversal of the direction of movement of the pistons is effected by that of the high-pressure piston, under which construction, when working against a comparatively low pressure in the discharge-passage and storage-reservoir, the high-pressure piston will, if the supply of motive fluid be not regulated with proper care, make a quick stroke, and not having a sufficient resistance to oppose it will not be cushioned at the end of its stroke, and will therefore strike the cylinder-head with greater or less force, according to the pressure acting upon it. By reason of the comparatively small size of the induction-ports the steam admitted during this quick traverse fails to fill the high-pressure cylinder at a pressure approximating that of the supply, and consequently when exhausted into and expanded in the low-pressure cylinder does not exert sufficient pressure therein to effect the degree of compression desired in the pump-cylinder whose piston is connected to that of the low-pressure piston. During this stroke of the high-pressure piston the low-pressure piston will move much less rapidly, inasmuch as the pressure thereon is much less in excess of the resistance against the connected pump-cylinder piston. Consequently while the high-pressure piston makes a complete stroke the low-pressure piston moves through only a portion of its full traverse. These conditions subsequently change, the high-pressure piston moving more slowly and the low-pressure piston moving through a longer traverse proportionately as the degree of compression effected by the pump is increased.

The objections above indicated are obviated under my invention, in the operation of which, when there is little or no pressure in the discharge-chamber and storage-reservoir, the high-pressure piston of the engine will remain stationary after the completion of its first stroke until the low-pressure piston has made a complete stroke. The direction of movement of the pistons is then reversed by the low-pressure piston and the air or gas in the final compression-cylinder of the pump is compressed into the discharge-chamber and storage-reservoir by the next succeeding stroke of the high-pressure piston, after which the operation continues with a uniform traverse of the respective pistons, the initial compression being effected to a higher degree by reason of the complete stroke of the low-pressure piston.

In the accompanying drawings, Figure 1 is a vertical central section through the cylinders and valves of a compound pumping-engine embodying my invention; Fig. 2, a transverse section through the same, and Fig. 3 a plan or top view.

The compound pumping-engine, in which my invention is herein illustrated, accords, in its general features of construction with that of the application of George Westinghouse, Jr., aforesaid, and need not, therefore, except so far as relates specifically to the applica-

tion of my improvement thereto, be fully and at length described. As in said application, I provide, in the practice of my invention, a compound non-rotative direct-acting engine, having a high-pressure cylinder 1 and a low-pressure cylinder 2, whose pistons 3 and 4 are fixed upon piston-rods 5 and 6, passing through stuffing-boxes 7 and 8, and are controlled by a steam-actuated distribution-valve composed of a series of valve-pistons 14, 15, 16, 17, and 18, the last four of which are fixed upon a common stem 19, and the piston 14, for convenience of construction, upon a separate stem bearing upon the piston 15. Steam is supplied to the distribution-valve chamber 11 through a pipe connected to a nozzle 12, and is finally exhausted from the low-pressure cylinder through a pipe connected to a nozzle 14ª on an exhaust-chamber 13. The lower port 39 of the low-pressure cylinder 2 communicates with ports 42 in a bushing 40, which is also provided with ports 41, communicating with the lower port 38 of the high-pressure cylinder, and with ports 43, communicating with the exhaust-chamber 13. The cylinders 1 and 2 are provided with a flange 9 for connection to a fixed support, and their lower heads are preferably cast integral with a frame or casing 10 for connection to a compound compressing-pump, having an initial compression-cylinder 44 and a final compression-cylinder 45, provided with suitable inlet, outlet, and discharge valves 49, 51, and 54, discharge-port 55, and delivery-chamber 56, and, fitted with pistons 46 and 47, are secured upon the piston-rods of the engine, which pass through stuffing-boxes 58 and 59 on the pump-cylinders.

The admission and exhaust of motive fluid to and from the engine-cylinders are effected by the distribution-valve, which is controlled by an auxiliary slide-valve, as now to be described. The auxiliary slide-valve 23 is, as in the application aforesaid, fitted to work in a chamber 21, which communicates by a constantly-open passage 22 with that portion of the valve-chamber 11 which is continuously open to the supply-inlet 12. The valve 23 is also secured upon a stem 28, having, as in the application aforesaid, a collar 29 on its lower end and an upper shoulder 30; but in lieu of being located above the high-pressure cylinder and actuated by the piston thereof, as in the application aforesaid, the chamber of the valve 23 is, under my invention, fixed upon the head of the low-pressure-engine cylinder 2, and the valve is actuated by a slotted plate 31, fixed upon the top of the piston 4 thereof, the valve-stem 28 extending into and fitting freely within a central bore in the piston-rod 6.

In operation, assuming the high-pressure piston 3 to be at the lower extremity of its stroke, motive fluid is admitted from the valve-chamber 11 through the ports 41 and 38 to the high-pressure cylinder 1 on the lower side of its piston 3, effecting the upward stroke of said piston and of the connected pump-piston 47. These pistons remain stationary at the termination of the upward stroke until the low-pressure piston 4 has made a complete downward stroke, (its initial downward stroke being effected by the slight leakage of motive fluid past the high-pressure piston 3,) when the slotted plate 31 of the low-pressure piston 4 strikes the collar 29 of the stem of the auxiliary slide-valve 23, and moves said valve downwardly, so as to place the interior of the chamber 20, above the valve-piston 14, in communication with the exhaust-chamber 13, through the ports 24 and 26 and the exhaust-cavity of the valve. The preponderance of motive-fluid pressure in the valve-chamber 11 on the valve-piston 16, above that on the opposite valve-piston 17, thereupon raises the distribution-valve, admitting motive fluid to the high-pressure cylinder 1, above its piston 3, through the ports 35 and 32, and effecting the succeeding downward stroke of the pistons 3 and 47. The admission and exhaust of motive fluid from the high-pressure cylinder 1 to the low-pressure cylinder 2 and from the low-pressure cylinder to the atmosphere or to a condenser are effected by the distribution-valve, as in the application aforesaid, and not having special reference to my present invention need not be herein again described.

It will be seen that, inasmuch as the auxiliary valve which controls the movements of the main distribution-valve is actuated by the low-pressure piston, a complete stroke of said piston is insured in proper relation to each stroke of the high-pressure piston, and the motive fluid is exhausted fully into the low-pressure-cylinder, so as to enable the compressing effect of the piston of the latter to be exerted to the desired degree, as well as to provide a proper cushion for the high-pressure piston at the terminals of its stroke.

The structural features of the engine herein set forth, in so far as they accord substantially with those of the application, Serial No. 361,175, aforesaid, are not claimed as of my invention, which is, moreover, described and shown in connection with a further improvement, but is not claimed, in a separate application (Case B) filed by me of even date herewith, Serial No. 361,185.

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

1. In a compound pumping-engine, the combination, substantially as set forth, of a compound non-rotative direct-acting engine having a distribution-valve controlling the ports of both its cylinders and actuated primarily by the movement of the low-pressure piston, and a compound compressing-pump having its pistons connected to and actuated by those of the engine.

2. In a compound pumping-engine, the combination, substantially as set forth, of a high-

pressure cylinder, a low-pressure cylinder, a distribution-valve controlling the ports of said cylinders, an auxiliary valve actuated by the piston of the low-pressure cylinder and controlling the movement of the distribution-valve, and a compound compressing-pump having its pistons connected to and actuated by those of the engine.

In testimony whereof I have hereunto set my hand.

FRANK MOORE.

Witnesses:
J. SNOWDEN BELL,
J. L. RALPH.