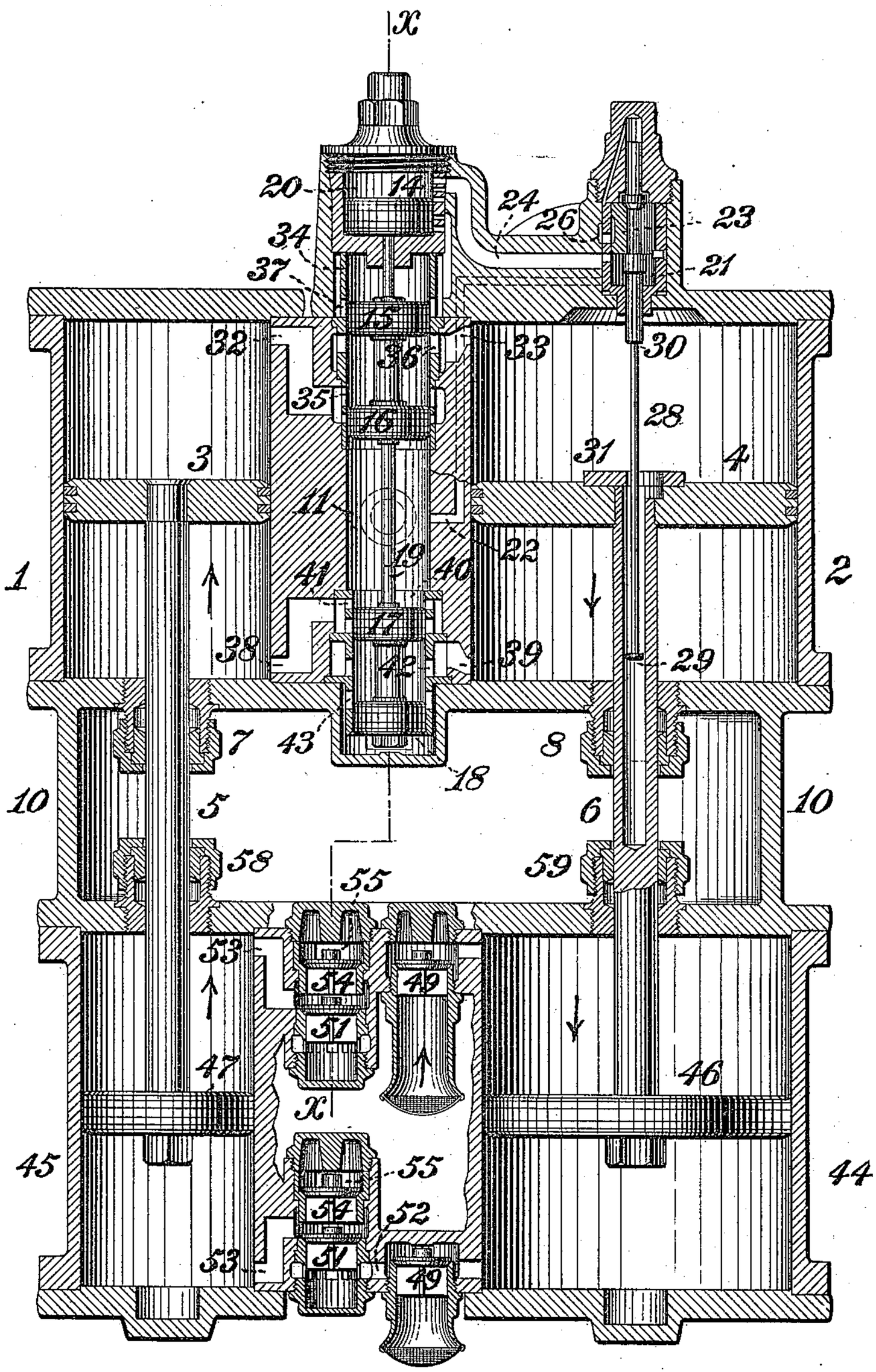
(No Model.) 2 Sheets—Sheet 1.

F. MOORE.

COMPOUND PUMPING ENGINE.

No. 441,186. Patented Nov. 25, 1890.

FIG. 1.



WITNESSES:

R. H. Whittlesey

F. E. Gaither.

INVENTOR,

Frank Moore,

by Howden Bell,

Att'y.

(No Model.) 2 Sheets—Sheet 2.

F. MOORE.

COMPOUND PUMPING ENGINE.

No. 441,186. Patented Nov. 25, 1890.

FIG. 2.

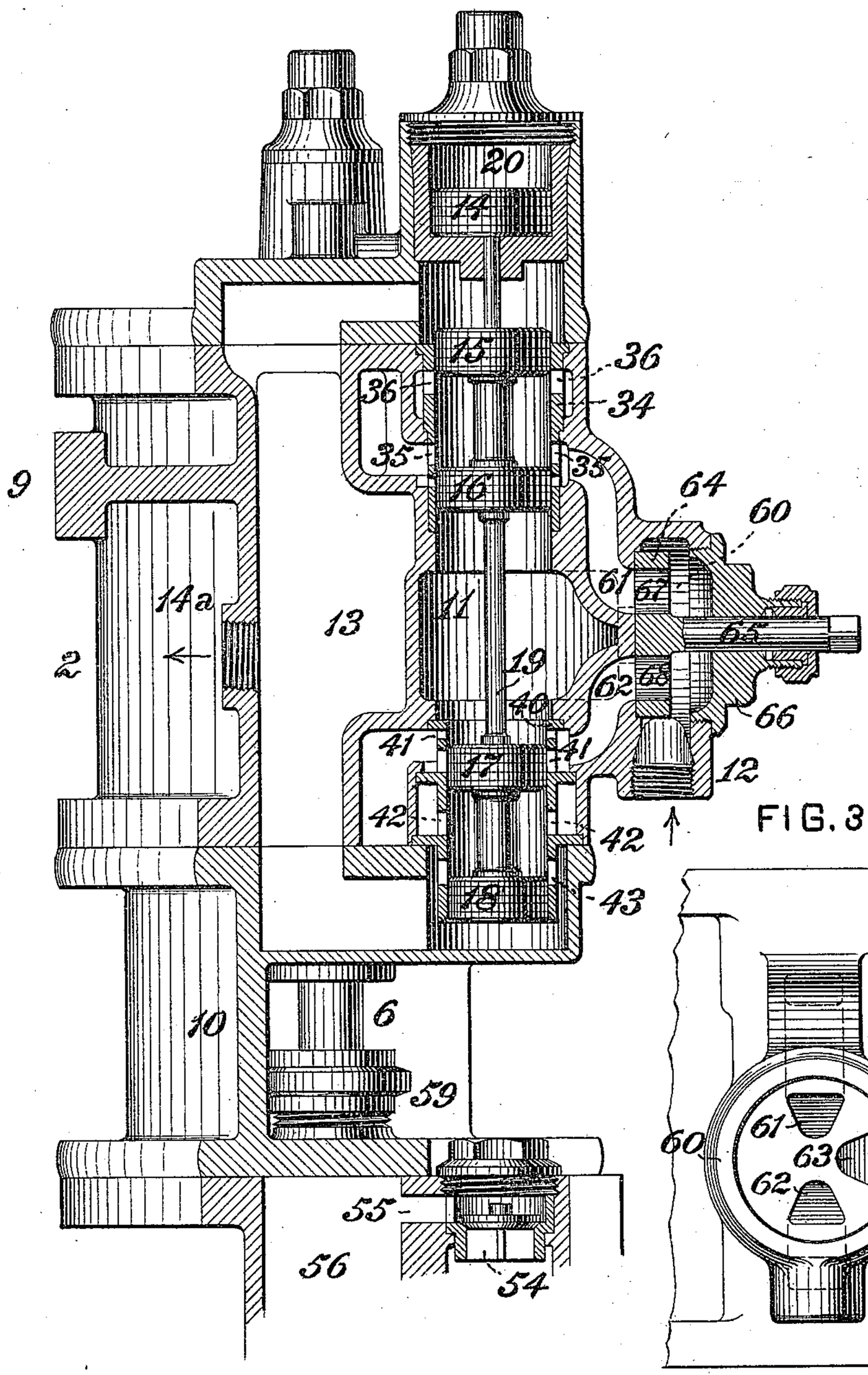


FIG. 3.

WITNESSES:

R. H. Whittlesey

F. E. Gaither.

INVENTOR,

Frank Moore

by Johnson Dell,

Att'y.

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. 441,186, dated November 25, 1890.

Application filed August 6, 1890. Serial No. 361,185. (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 filed August 6, 1890, Serial No. 361,175, and in an application filed by me of even date herewith, Serial No. 361,184, and its object is to render an engine of such type adaptable to use as a simple engine whenever and during such periods as a sufficiently high working pressure for its normal utilization as a compound engine is not available.

To this end my invention, generally stated, consists in the combination of a compound pumping-engine, a compound compressing-pump having its pistons connected to those of the engine, a distribution-valve controlling the admission and exhaust of motive fluid to and from the cylinders, and a direct-admission valve controlling direct supply to the low-pressure piston and equalization of pressure on opposite sides of the high-pressure piston.

The improvement claimed is hereinafter fully set forth.

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 similar section, on an enlarged scale, through the valve-chest, taken at right angles to Fig. 2; and Fig. 3, a front view of the direct-admission-valve chamber.

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 with the specific improvement thereon set forth in my aforesaid applications, and need not, therefore, except so far as relates to my present improvement, be fully and at length described. As in each of said applications, 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 14^a 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 intial 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 as controlled by an auxiliary slide-valve 23, which, as in my application aforesaid, is fitted to work in a chamber 21, communicating by a constantly-open passage 22 with the valve-chamber 11 between the valve-pistons 16 and 17. The chamber of the valve 23 is fixed upon the head of the low-pressure 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 order to admit of the direct supply of

motive fluid to the low-pressure piston and the equalization of pressure upon opposite sides of the high-pressure piston, so as to enable the engine to be operated as a simple engine whenever and during such periods as such operation may be necessary or desirable by reason of insufficient working pressure or from other causes, I provide a direct-admission valve 64, which is fixed to a stem 65 and is fitted on a valve-face in a chamber 60, formed or fixed upon the front of the main valve-chamber 11, the motive-fluid-supply nozzle or inlet 12 leading into the chamber 60 instead of into the valve-chamber 11, as in the applications aforesaid. The chamber 60 is closed at top by a suitable cap 66, and the stem 65 projects through said cap and through a suitable stuffing-box therein and is squared at its outer end for the application of a wrench to effect the rotative movement of the valve 64 as from time to time required. The valve 64 is provided with opposite ports 67 and 68, and, accordingly as turned about the axis of the stem 65 into one or another position, controls communication between the supply-nozzle 12 and chamber 60 and ports 61 and 62, leading from said chamber to the ports 35 and 41 of the valve-chamber 11, as shown in Fig. 2, or, as the case may be, between said nozzle 12 and chamber 60 and a port 63, leading from the chamber 60 to the valve-chamber 11 between the ports 41 and 35. When the valve 64 is in the former position, motive fluid will be admitted directly to the low-pressure piston and an equilibrium of pressure will be effected upon opposite sides of the high-pressure piston, the engine operating under such conditions as a simple engine. When the valve 64 is turned into the latter position, motive fluid will be admitted initially to the high-pressure cylinder, exhausted therefrom to the low-pressure cylinder, and finally exhausted from the low-pressure cylinder, as in the applications aforesaid.

In operation as a compound engine, assuming the high-pressure piston 3 to be at the lower extremity of its stroke, motive fluid is admitted from the supply-nozzle 12 and chamber 60 to the valve-chamber 11 through the port 63 and from the valve-chamber 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 on 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 applications aforesaid, and, not having special reference to my present invention, need not be herein again described. When it is desired to operate the engine as a simple engine, the direct-admission valve is turned into the position shown in Fig. 2, in which its ports 67 and 68 register with the ports 61 and 62, leading to the valve-chamber 11, and the port 63 is closed. Motive fluid will then, in the position shown in the drawings, be admitted directly to the low-pressure cylinder 2 above its piston 4 through the ports 35, 36, and 33, effecting the downward stroke of said piston and of the connected pump-piston 46, and will likewise be admitted through the ports 35 and 32 to the high-pressure cylinder 1 on the upper side of its piston 3 and through the ports 41 and 38 to said cylinder on the lower side of its piston, thereby instituting an equilibrium of pressure on the opposite sides thereof. Upon the elevation of the distribution-valve by the auxiliary slide-valve at the termination of the stroke of the pistons motive fluid will be correspondingly admitted directly to the low-pressure cylinder below its piston and to the high-pressure cylinder on opposite sides of its piston, as required for the succeeding upward stroke of the low-pressure piston, upon which the entire available working pressure is exerted in this position of the direct-admission valve.

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

1. The combination, substantially as set forth, of a compound pumping-engine, a compound compressing-pump having its pistons connected to those of the engine, a distribution-valve controlling the admission and exhaust of motive fluid to and from the engine-cylinders, and a direct-admission valve controlling direct supply to the low-pressure piston and equalization of pressure on opposite sides of the high-pressure piston.

2. The combination, substantially as set forth, of a high-pressure cylinder, a low-pressure cylinder, a compound compressing-pump having its pistons connected to those of the engine, a distribution-valve controlling the admission of motive fluid to the high-pressure cylinder and the exhaust thereof into and from the low-pressure cylinder, a chamber having a supply-inlet, a passage leading from the supply-chamber to the distribution-valve chamber in such relation to the ports thereof

and of the cylinders as to effect admission initially to the high-pressure cylinder and secondarily from the high to the low pressure cylinder, passages leading from the supply-chamber to the distribution-valve chamber in such relation to the ports thereof and of the cylinders as to effect admission initially to the low-pressure cylinder and to establish equilibrium of pressure in the high-pressure cylinder on opposite sides of its piston, and a direct-admission valve controlling the passages from the supply to the distribution-valve chamber.

In testimony whereof I have hereunto set my hand.

FRANK MOORE.

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