No. 728,708. PATENTED MAY 19, 1903.

J. HARDILL.

COMPOUND TANDEM ENGINE.

APPLICATION FILED JULY 14, 1902.

NO MODEL. 2 SHEETS—SHEET 1.

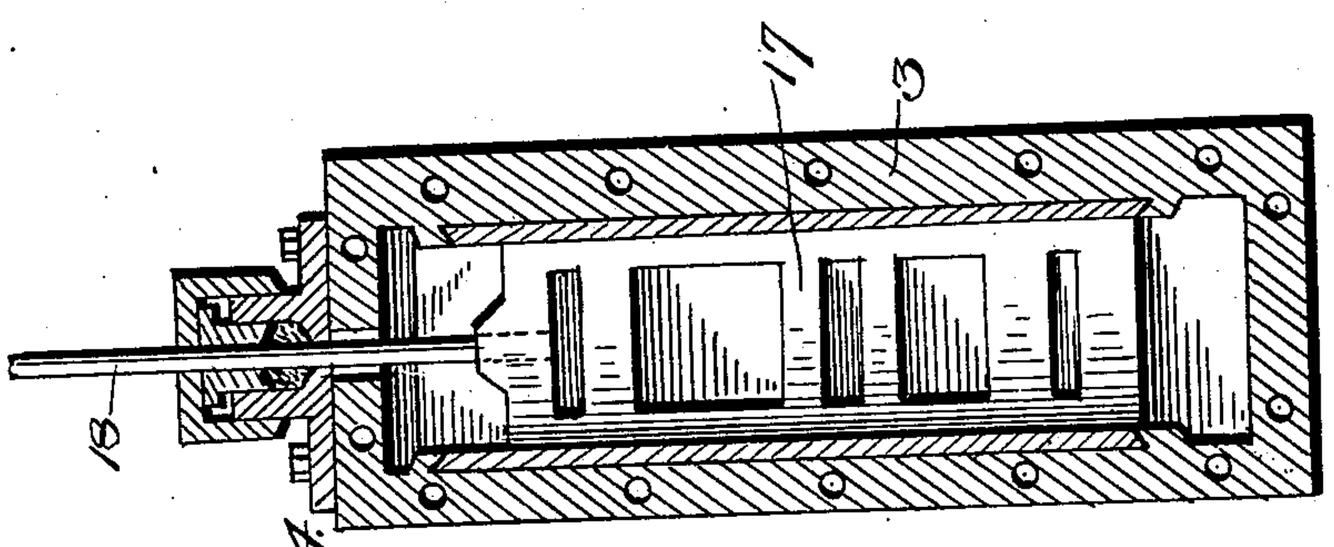

Fig. 4.

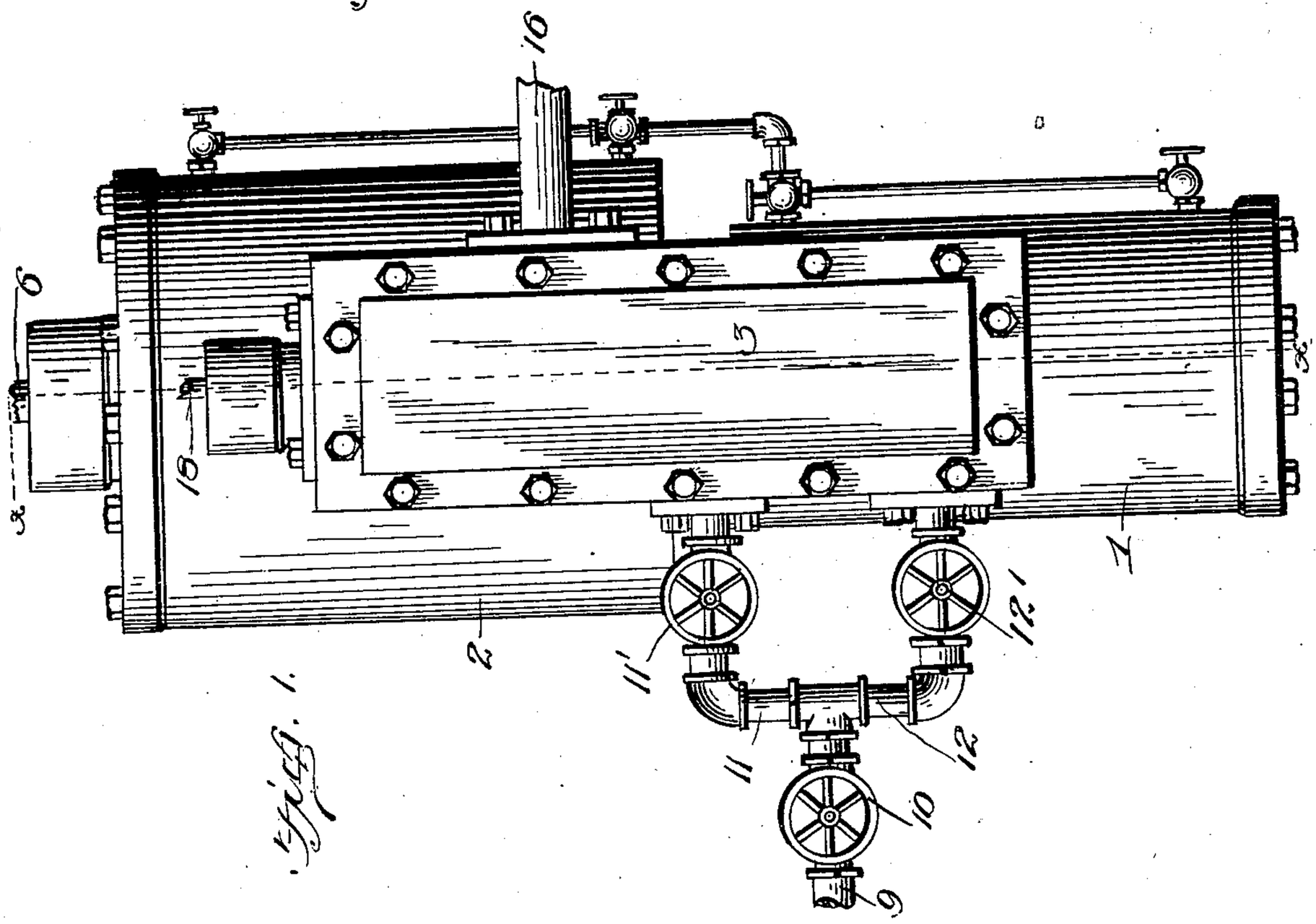

Fig. 1.

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NO MODEL. 2 SHEETS—SHEET 2

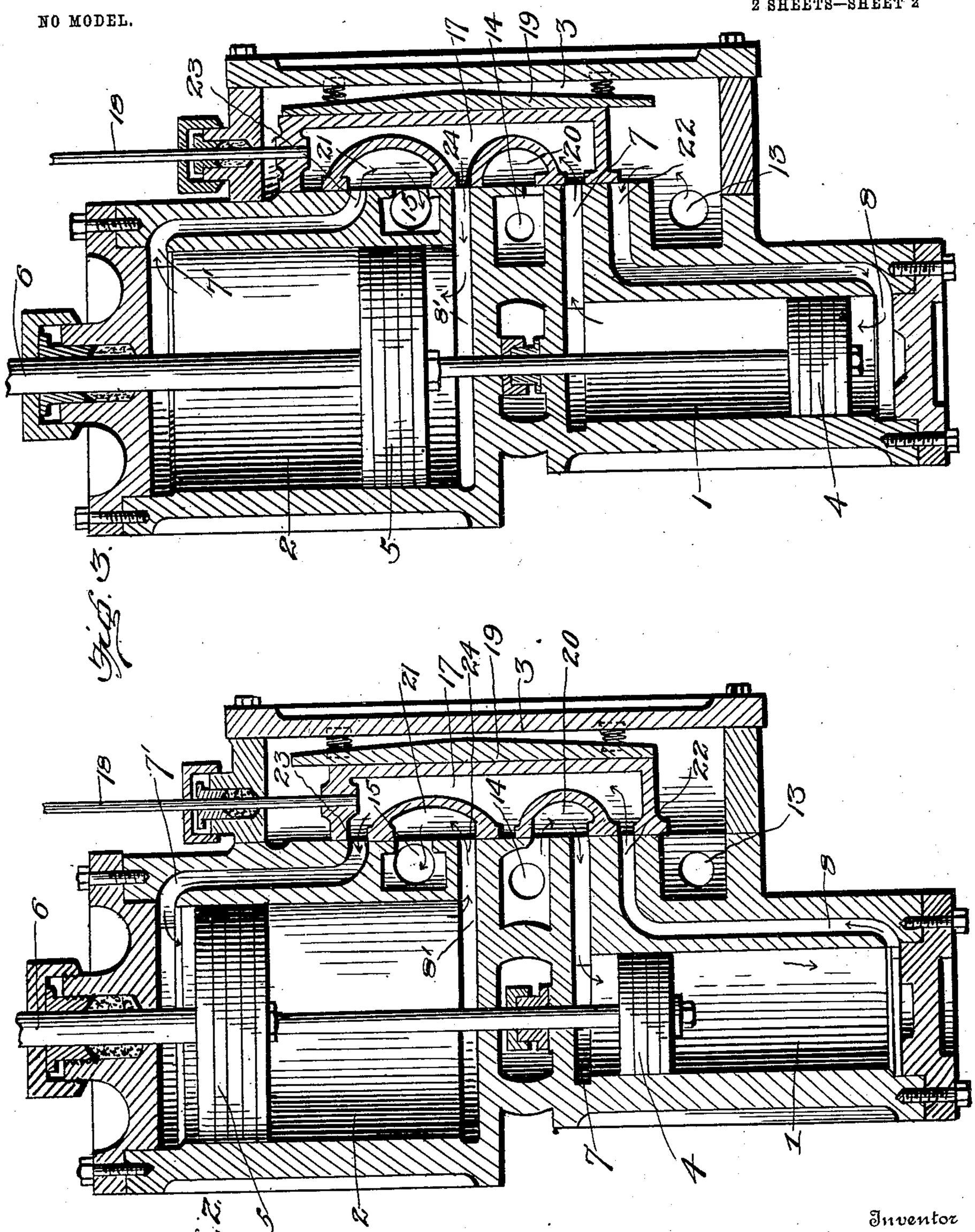

Fig. 3.

Fig. 2.

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UNITED STATES PATENT OFFICE.

JOSEPH HARDILL, OF MITCHELL, CANADA, ASSIGNOR OF ONE-HALF TO ROBERT BENSON, OF BUFFALO, NEW YORK.

COMPOUND TANDEM ENGINE.

SPECIFICATION forming part of Letters Patent No. 728,708, dated May 19, 1903.

Application filed July 14, 1902. Serial No. 115,515. (No model.)

To all whom it may concern:

Be it known that I, JOSEPH HARDILL, a subject of the King of Great Britain, residing in the town of Mitchell, in the county of Perth and Dominion of Canada, have invented certain new and useful Improvements in Compound Tandem Engines; and I do declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

This invention relates to engines of the tandem compound type.

The objects of the invention are, first, to provide an engine of this type in which the supply and exhaust ports and passages and the valve mechanism are so constructed and arranged that the engine may be used as either a single or double acting compound engine at will; second, to attain this result by one double-D valve actuated by a single eccentric, and, third, to provide for the change from double-acting to single-acting compound, or vice versa, by two auxiliary throttle-valves located in the steam connections.

With the above and other objects in view, which will readily appear as the nature of the invention is better understood, said invention consists in certain novel features of construction and combination and arrangement of parts, which will be hereinafter fully described and claimed, and illustrated in the accompanying drawings, in which—

Figure 1 is a side elevation, looking toward the steam-chest side, of an engine embodying my invention. Figs. 2 and 3 are sections on about the line *x x* of Fig. 1, showing the parts as arranged for taking steam from the two inlet-ports. Fig. 4 is an inner elevation of the steam-chest removed, showing a face view of the slide-valve.

Referring now more particularly to the drawings, the numeral 1 represents the high-pressure and 2 the low-pressure cylinder of my improved compound tandem steam-engine, 3 a valve-chest common to said cylinders, and 4 and 5 the high and low pressure pistons respectively working in said cylinders and connected to each other and to a rod 6 to operate in unison in the ordinary way.

The high-pressure cylinder 1 is in communication at its opposite end with one end of the chest 3 through passages 7 and 8, and the low-pressure cylinder 2 is in communication with the central portion and one end of the steam-chest through the medium of passages 7′ and 8′, said passages serving for the supply and exhaust of steam to and from said cylinders.

9 is a steam-supply pipe provided with a controlling-valve 10 and having two branches 11 and 12, communicating, respectively, with steam-supply ports 13 and 14, opening into the chest 3. These branches are respectively provided with valves 11′ and 12′ for controlling the flow of steam to said ports. By this construction and arrangement of the steam-supplying connections it will be seen that steam may be admitted into the steam-chest only through port 13 and steam from port 14 can be admitted into opening 20 of valve 17.

15 is a port connecting with a pipe 16 for the exhaust of the spent steam.

A slide-valve 17 operates in the chest 3 and is attached to a stem 18, which is adapted to be connected in the usual manner to a controlling-eccentric, whereby the action of the valve is timed to alternately supply steam to the two cylinders. The valve 17 is held to the face of the valve-seat by means of a compression-plate 19 on the back of the valve. This plate is held in place by means of springs, as shown and described. The valve is substantially of double-D form, being provided upon opposite sides of the center thereof with arched portions forming channels or passages 20 and 21. The valve is also provided with ports 22 and 23 in the face of the valve near the ends and between the two channels with a central passage 24, said passages 22, 23, and 24 being in communication with the intermediate receiving-chamber located back of the D-openings and extending nearly the entire length of the valve in order to afford a channel for the flow of steam therethrough to the several ports and passages from high to low pressure cylinders.

Fig. 2 of the drawings shows the arrangement of the parts when the valve is in position to take steam through the port 14 around D-port 20 into passage 7, causing high-pressure piston 4 in cylinder 1 to move down-

ward, at the same time exhaust-steam from high-pressure cylinder below piston is exhausting through port 8 and opening 22 of valve into intermediate receiving-chamber and from receiving-chamber through port 23 into passage 7′, causing low-pressure piston 5 in cylinder 2 to move downward in unison with high-pressure piston 4, at the same time exhausting from below low-pressure piston 5 through passage 8′, through D-port 21, to final exhaust 15 or condenser.

Fig. 3 shows position of ports when the engine is taking steam from inlet 13 through port 22 into channel 8, causing high-pressure piston 4 to move upward, at the same time exhausting steam from above piston 4 through channel 7 into intermediate receiving-chamber, thence through port 24 into channel 8′, causing low-pressure piston 5 to move upward in unison with high-pressure piston 4, at the same time exhausting steam from above piston 5 through channel 7′, through D-opening 21, into final exhaust 15 or condenser.

When it is desired to change the engine from single-acting to double-acting, this may be conveniently accomplished by opening both valves 11′ and 12′ to supply steam to both ports 13 and 14, thus simultaneously supplying steam to both ends of each cylinder alternately and to similar ends of the two cylinders simultaneously, as will be readily understood.

From the foregoing description, taken in connection with the accompanying drawings, it is thought that the construction, mode of operation, and advantages of my improved tandem compound engine will be readily apparent without requiring a more extended explanation.

Various changes in the form, proportion, and the minor details of construction may be resorted to without departing from the principle or sacrificing any of the advantages of this invention.

Having thus described my invention, what I claim as new, and desire to secure by Letters Patent, is—

1. A tandem compound engine provided with high and low pressure cylinders, a steam-chest, pistons working in said cylinders, passages between the chest and opposite ends of the cylinders, two live-steam-supply ports located, respectively, below the inlets to the passages of the high-pressure cylinder and between the two cylinders, an exhaust-port located between the inlets to the passages of the low-pressure cylinder, a hollow or chambered slide-valve provided with intermediate and end passages and on opposite sides of the intermediate passage with channels for governing the supply of steam to and exhaust of steam from the passages, and valved connections independently controlling the supply of steam to the two steam-supply ports, whereby, owing to the described location of said live-steam-supply ports and the exhaust-port, the engine may be made single or double acting at will, substantially as described.

2. A tandem compound steam-engine provided with high and low pressure cylinders, a steam-chest, pistons working in said cylinders, passages between the chest and opposite ends of the cylinders, two live-steam-supply ports located, respectively, below the inlets to the passages of the high-pressure cylinder and between the two cylinders, an exhaust-port located between the inlets to the passages of the low-pressure cylinder, a hollow or chambered slide-valve provided with intermediate and end passages and on opposite sides of the intermediate passage with channels for governing the supply of steam to and exhaust of steam from the passages, a steam-supply pipe branched to connect with both steam-supply ports, and valves in said branches, whereby, owing to the described location of said live-steam-supply ports and the exhaust-port, the engine may be made single or double acting at will, substantially as deseribed.

In testimony whereof I have hereunto set my hand in presence of two subscribing witnesses.

JOSEPH HARDILL.

Witnesses:
FRANK A. SHOEMAKER,
ROBERT BENSON.