No. 858,397. PATENTED JULY 2, 1907.

C. H. JOHNSON.

VALVE FOR PUMPING ENGINES.

APPLICATION FILED JULY 21, 1902.

2 SHEETS—SHEET 1.

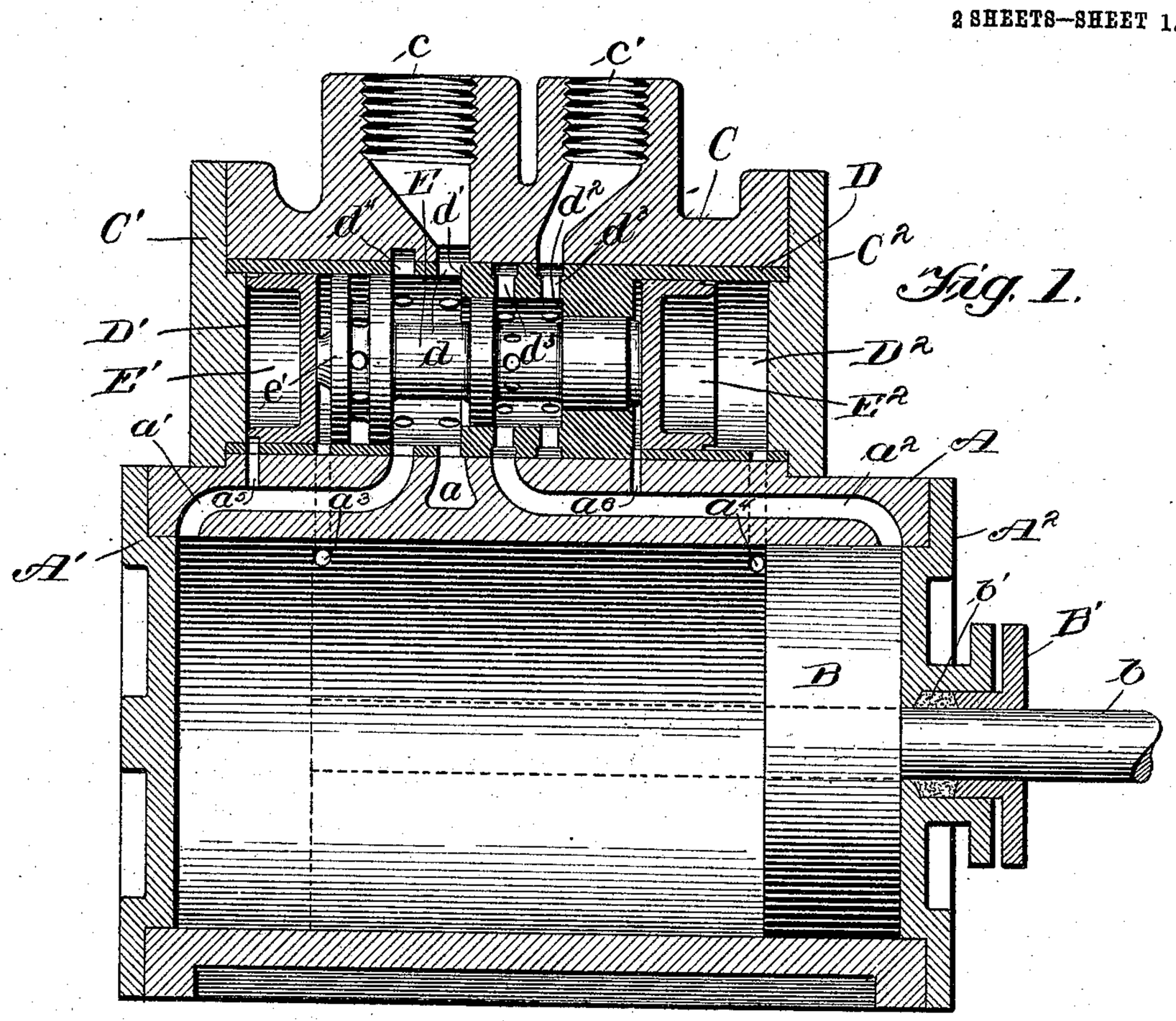

Fig. 1.

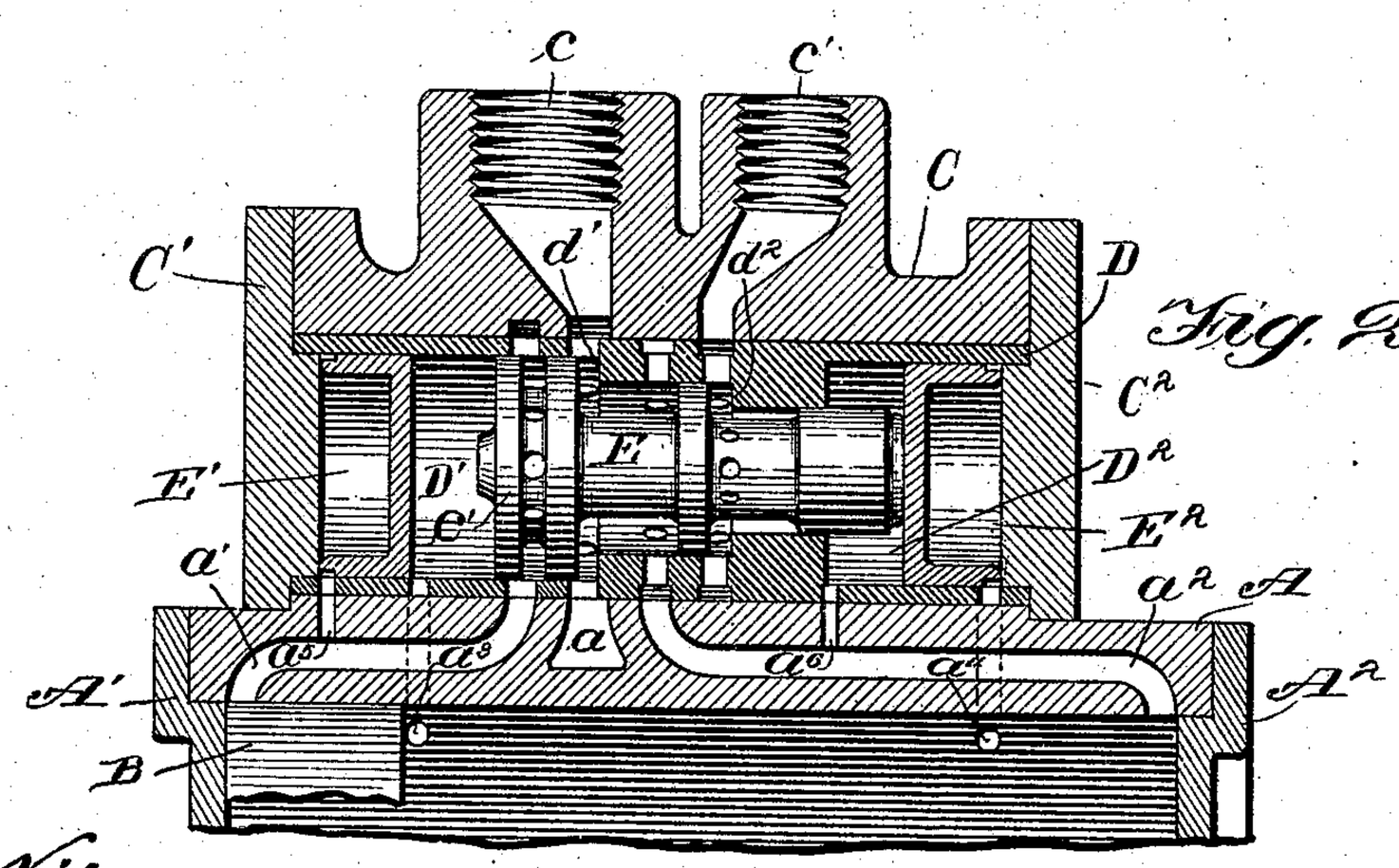

Fig. 2.

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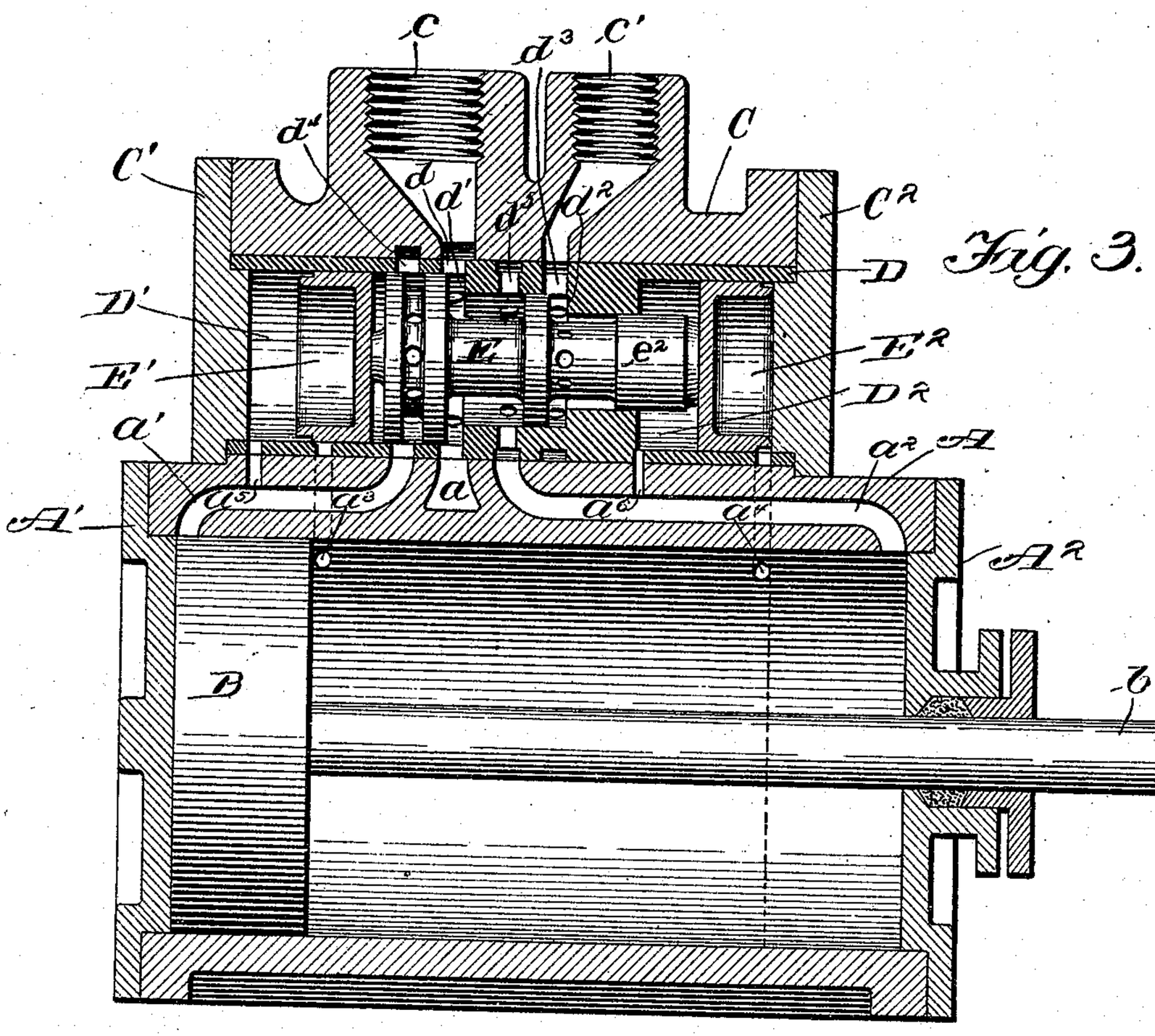
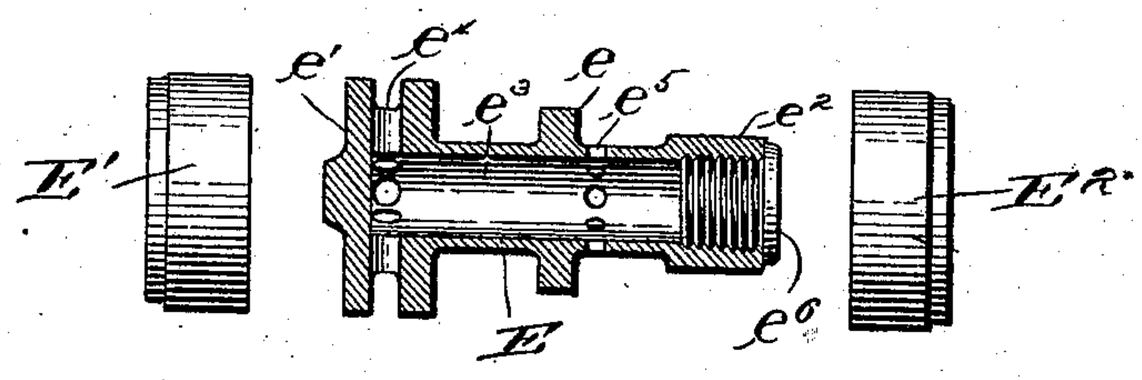


Fig. 3.

Fig. 4.



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UNITED STATES PATENT OFFICE.

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VALVE FOR PUMPING-ENGINES.

No. 858,397. Specification of Letters Patent. Patented July 2, 1907.

Application filed July 21, 1902. Serial No. 116,467.

To all whom it may concern:

Be it known that I, CHARLES H. JOHNSON, a citizen of the United States, residing at Canton, county of Stark, State of Ohio, have invented a certain new and useful Improvement in Valves for Pumping-Engines; and I declare the following to be a full, clear, and exact description of the same, such as will enable others skilled in the art to which it pertains to make and use the same, reference being had to the accompanying drawings, which form a part of this specification.

My invention relates generally to valves for fluid pressure operated engines, and more particularly to piston valve mechanism especially adapted for pumping engines.

In pumping engines it is desirable that the valve controlling the supply and exhaust of fluid pressure to the opposite sides of the piston should be quickly shifted from one position to another to reverse the direction of movement of the piston, and when shifted positively held in each position by a preponderance of pressure.

The object of my invention is to provide a valve mechanism for pumping engines which will be quickly shifted to reverse the connections between the supply and exhaust ports and the opposite ends of the cylinder upon the piston reaching a predetermined point in its stroke in each direction, and which will be firmly retained in each of its positions.

A further object of my invention is to provide a valve mechanism for fluid pressure operated pumping engines which will be comparatively simple in construction and efficient in operation.

My invention, generally described, consists in valve mechanism comprising three separate parts, namely a central part or valve proper controlling the communication between the supply and exhaust ports and the opposite ends of the cylinder which is moved in one direction by pressure exerted upon one of the separate end portions of the valve and retained in the position to which it is so moved by pressure exerted on radial surfaces of the valve proper, and which is moved in the reverse direction by pressure exerted on the opposite end surface of the valve proper and retained in such reverse position by pressure exerted upon the outer surface of the other separate part of the valve.

My invention will be more fully described hereinafter with reference to the accompanying drawings in which the same is illustrated as embodied in a convenient and practical form, and in which—

Figure 1 is a central longitudinal section through a cylinder and its valve mechanism; Fig. 2 a valve similar to Fig. 1 indicating the piston at the opposite end of its stroke and the valve mechanism in a shifted position; Fig. 3 a view similar to Figs. 1 and 2 showing the valve mechanism in a position opposite to that shown in Fig. 1; and Fig. 4 a detail view of the three-part valve removed from the valve casing.

Similar reference characters are used in the several figures of the drawings to indicate similar parts.

Reference character A designates a cylinder of a double-acting engine such as would be adapted for use in operating pumps or for similar purposes.

A′ and A² indicate the cylinder heads the latter of which is provided with a stuffing box B′ and packing *b*′ located therein through which the piston rod *b* passes.

B designates the piston connected to the end of the piston rod which projects into the cylinder.

C indicates the valve casing which may conveniently be formed integrally with the cylinder A.

Reference characters C′ and C² indicate the heads of the valve casing C. Located within the valve casing is a bushing D which is retained in proper position through engagement with the casing heads C′ and C². Chambers D′ and D² are provided in the opposite ends of the bushing D and are separated by annular partitions formed by reducing the bore through the bushing. An annular shoulder *d*′ is formed between the chamber D′ and the adjacent bore through the bushing while a second annular shoulder *d*² is provided between the bores of different diameters through the bushing between the chambers D′ and D². A series of ports *d* is formed through the bushing D adjacent to the shoulder *d*′ and communicating with an annular passage *a* formed in the valve casing C. The annular passage *a* communicates with an exhaust pipe *c*. A series of ports *d*³ is formed through the bushing D adjacent to the shoulder *d*² and communicate with an annular groove formed in the exterior surface of the bushing which communicates with a supply pipe *c*′. A third series of ports *d*⁵ is formed through the bushing intermediate of the series of ports *d* and *d*³ and communicate with an annular passage formed in the bushing which in turn is in register with a passage *a*² leading to the end of the cylinder at the right in Figs. 1, 2, and 3 of the drawings. A fourth series of ports *d*⁴ is formed through the bushing D at a point a short distance further away from the shoulder *d*′ than the series of ports *d* and which communicates with an annular passage formed in the valve casing which in turn communicates with a passage *a*′ leading to the end of the cylinder adjacent to the cylinder head A′.

A passage *a*³ leads from the interior of the cylinder A at a point slightly further away from the cylinder head A′ than the thickness of the piston B, to a point within the chamber D′ intermediate of the shoulder *d*′ and the casing head C′. A passage *a*⁴ leads from a point within the cylinder A located a distance away from the cylinder head A² slightly greater than the thickness of the piston B to a point within the chamber D² adjacent to

the casing head C^2. A passage a^5 connects the passage a' with the chamber D' adjacent to the casing head C'. A passage a^6 connects the passage a^2 with the chamber D^2 at the end thereof opposite to the casing head C^2.

Located within the bushing D and controlling the ports therethrough is a piston valve composed of three separate parts, namely a central part E and end portions E' and E^2. The end portions are located within the chambers D' and D^2 respectively and are of the same exterior diameter as each other and as the interior diameters of the chambers D' and D^2. The central portion E of the valve comprises a head e' of a diameter to closely engage the interior surface of the chamber D', a radial surface e of a diameter to closely engage the bore of the bushing D intermediate of the shoulders d' and d^2, and a reduced end portion e^2 of a diameter to fit within the reduced bore of the bushing D between the shoulder d^2 and the chamber D^2. A passage e^3 is formed longitudinally within the central portion E of the valve and is closed at one end by a screw threaded plug e^6. A series of ports e^5 connect the central passage e^3 with the exterior of the central portion of the valve adjacent to the radial surface e. A series of passages e^4 extend through the head e' of the central portion E of the valve terminating in the central passage e^3.

The operation of my improved valve mechanism is as follows: When the piston is in the position indicated in full lines in Fig. 1 fluid pressure flows from the supply pipe c' through the ports d^3 in the bushing, thence through the ports d^5, through the passage a^2 to the end of the cylinder adjacent to the cylinder head A^2, thereby forcing the piston toward the cylinder head A'. When the piston B approaches the cylinder head A' to the position indicated in dotted lines in Fig. 1, the port a^3 is uncovered, thereby admitting pressure from the cylinder to the chamber D' at a point between the end portion E' of the valve and the head e' of the central portion of the valve. The central portion of the valve is consequently moved to the position shown in Fig. 2 by reason of the area of the head e' being greater than the area of the annular shoulder e plus the area of the reduced end e^2. This movement of the central portion of the valve is not impeded by the separate part E^2 inasmuch as the same is balanced owing to the pressure being admitted to both surfaces thereof through the passages a^4 and a^6.

When the valve occupies the position shown in Fig. 2 the cylinder between the piston and the cylinder head A^2 is placed in communication with the exhaust port through the following ports and passages; passage a^2, ports d^5, ports d, annular passage a, and exhaust pipe c. It will be noticed that both surfaces of the part E^2 of the valve are exposed to atmospheric pressure, as is also the reduced end e^2 of the central portion of the valve which projects into the chamber D^2. It will also be noticed that the passage a^3 will be momentarily connected with the exhaust port during the interval occurring between the shifting of the central portion E of the valve and the closing thereof by the piston B. In order therefore to prevent the central portion E of the valve from instantly reversing owing to the exertion of pressure on the annular shoulder e, the end portion E' of the valve mechanism is provided which is moved from the position indicated in Fig. 2 to that shown in Fig. 3 by reason of the fluid pressure which passes to the outer end of the chamber D' through the passage a^5, the passage a' at such time placing the end of the cylinder adjacent to the cylinder head A' in communication with the supply pipe c' through the following ports and passages; passage a', ports d^4, passages e^4, e^3, and e^5 in the central part E of the valve, ports d^3 in the bushing D, thence to the supply pipe.

The flow of pressure through the ports and passages such as described forces the piston B toward the cylinder head A^2 and when the passage a^4 is uncovered, as indicated in dotted lines in Fig. 3, passes to the end of the chamber D' and is exerted upon the outer surface of the part E^2 of the valve mechanism. As the parts E' and E^2 of the valve mechanism are of the same area and are both exposed on their exterior surfaces to pressure, they balance each other and the valve mechanism is shifted to the position shown in Fig. 1 by the fluid pressure acting upon the shoulder c of the central portion of the valve. The cylinder between the cylinder head A' and piston B is then placed in communication with the exhaust port through the following ports and passages; a', d^4, d, and c. The passage a^4 will be connected with the exhaust port during the interval when it is uncovered by the piston B when the latter is in the position indicated by dotted lines in Fig. 3 and in full lines in Fig. 1, and consequently the part E^2 of the valve mechanism will be forced to the right by the exertion of fluid pressure on its inner face admitted to the chamber D^2 through the passage a^6. The central portion E of the valve however is firmly held in the position to admit fluid pressure to the end of the cylinder adjacent to the cylinder head A^2 by reason of the exertion of pressure on the annular shoulder e and on the reduced end e^2.

From the foregoing description it will be observed that I have invented an improved valve mechanism which is quickly moved from one position to another and when moved is firmly held in each position by reason of a preponderance of pressure and consequently any fluttering of the valve is avoided as well as any liability of the reversing of the valve before the piston has reached the predetermined point in its stroke where the admission and exhaust of fluid pressure to the opposites end of the cylinder are to be reversed.

While I have described more or less precisely the details of construction I do not wish to be understood as limiting myself thereto, as I contemplate changes in form, the proportion of parts, and the substitution of equivalents, as circumstances may suggest or render expedient, without departing from the spirit of my invention.

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

1. In a pumping engine, the combination with a cylinder, of a reciprocating piston therein, a piston valve comprising a plurality of independently movable parts, a valve casing having passages controlled by said valve to supply and exhaust fluid pressure to the opposite ends of said cylinder, and said cylinder having passages controlled by the piston therein for separately reciprocating the parts of said valve.

2. In a pumping engine, the combination with a cylinder, of a reciprocating piston therein, a piston valve comprising a plurality of independently movable parts, a valve casing having passages controlled by said valve to supply

and exhaust fluid pressure to the opposite ends of said cylinder, and said cylinder having a passage extending from a point within the same adjacent to one end thereof to one end of the valve casing, and a second passage extending from a point adjacent to the other end of the cylinder to a point spaced apart from the other end of the valve casing a distance slightly greater than the width of the separate part of the valve located in said end of the casing.

3. In a pumping engine, the combination with a cylinder, of a reciprocating piston therein, a valve casing, a piston valve comprising a plurality of independently movable parts one part of which directly controls the supply and exhaust of fluid pressure to the opposite ends of the cylinder while a second part is adapted to engage and shift the first part to one position, said cylinder having passages controlled by the piston for admitting pressure to the valve casing to be exerted upon the outer ends of said two parts of the valve to effect the reciprocation thereof.

4. In a pumping engine, the combination with a cylinder, of a reciprocating piston therein, a valve casing, a piston valve comprising a plurality of independently movable parts one part of which directly controls the supply and exhaust of fluid pressure to the opposite ends of the cylinder while another part is adapted to engage and retain said first part in one position, said cylinder having passages controlled by the piston for admitting fluid pressure to the valve casing to be exerted upon said parts of the valve to effect the reciprocation thereof.

5. In a double acting engine, the combination with a cylinder, of a reciprocating piston therein, and a piston valve comprising three independently movable parts one of which directly controls the supply and exhaust of fluid pressure to and from the ends of the cylinder and the other parts effecting the shifting of the first part and the retaining of the same in its shifted positions.

6. In a valve mechanism for double acting engines, the combination with a valve casing, of a piston valve therein comprising a central part having differential radial surfaces for shifting the same to one position and for retaining the same in its other position and separate end parts one of which retains the central part of the valve in one position and the other separate part shifts the central part to its other position.

7. In a valve mechanism for double acting engines, the combination with a valve casing having chambers separated by a reduced bore, of a piston valve comprising a central part having a head located within one chamber and a reduced portion fitting within the reduced bore and extending into the separate chamber, and separate end parts located in the chambers, said valve casing having ports and passages whereby the central part of the valve is shifted to one position by pressure exerted on the head thereof and retained in said position by pressure exerted on one of the end parts of the valve, and whereby said central part is shifted to its opposite position by pressure exerted on the other separate end part of the valve and retained in such position by pressure exerted on the central part of the valve.

8. In a double acting engine, the combination with a cylinder, of a reciprocatory piston therein, a piston valve comprising a plurality of separate and independently movable parts, a valve casing having passages controlled by said valve to supply an exhaust fluid pressure to the opposite sides of said piston, said valve casing and cylinder being connected by passages through which fluid pressure flows to individually move the parts of the piston valve.

In testimony whereof, I sign this specification in the presence of two witnesses.

CHARLES H. JOHNSON.

Witnesses:

GEO. L. WILKINSON,

C. C. CUNNINGHAM.