

(No Model.)

3 Sheets—Sheet 1.

C. C. POOLE.
VALVE FOR STEAM ENGINES.

No. 369,552.

Patented Sept. 6, 1887.

Fig 1.

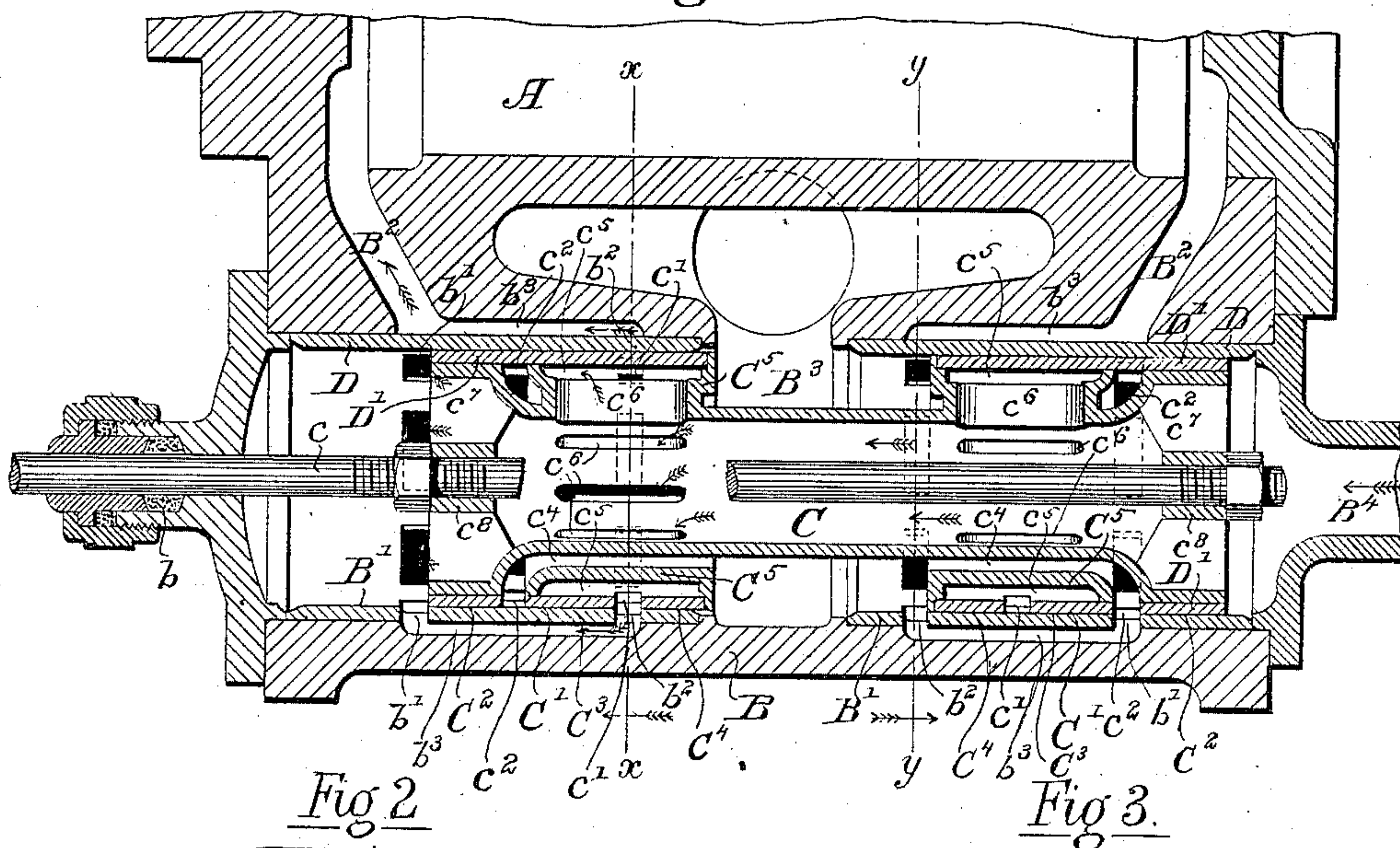


Fig 2.

Fig 3.

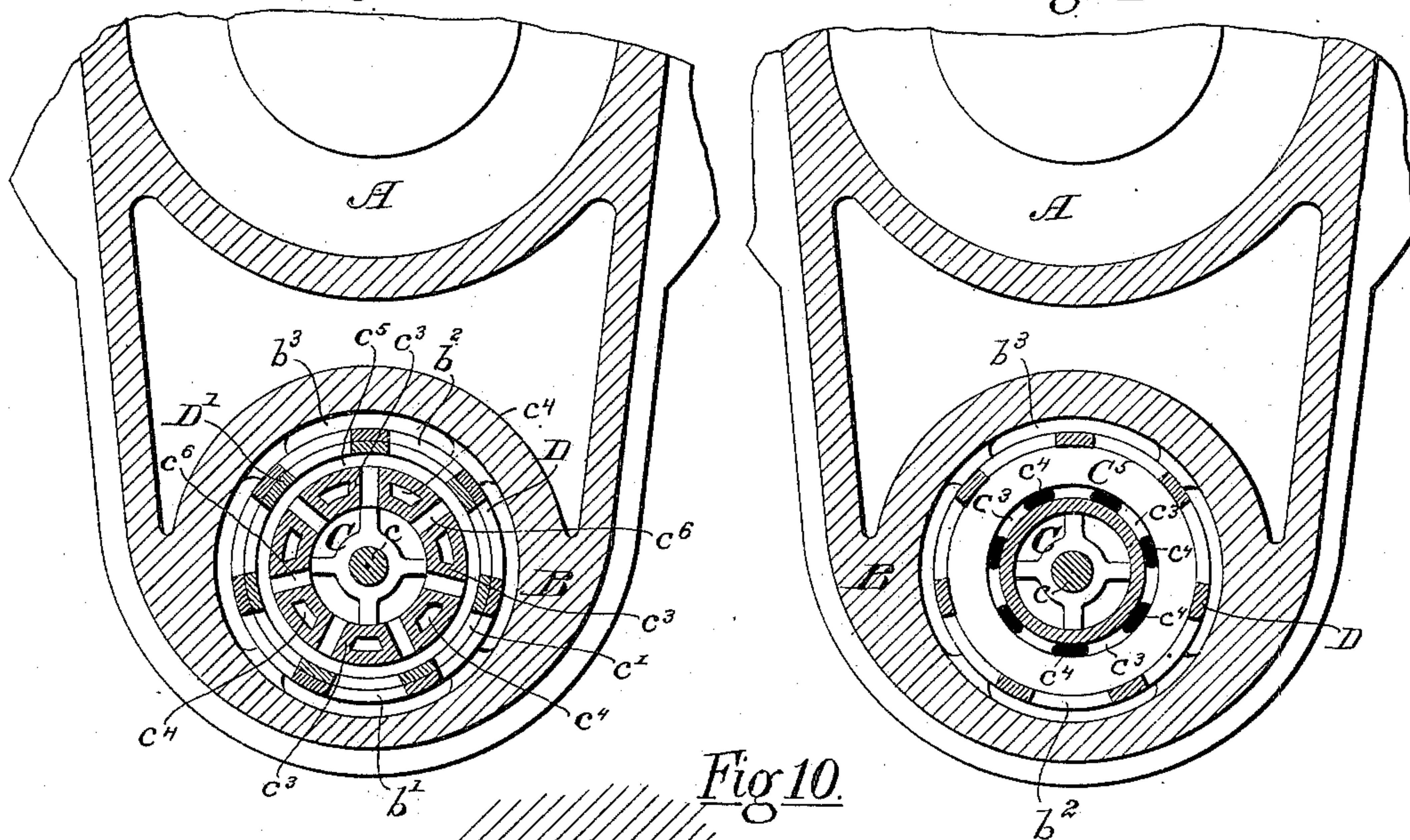
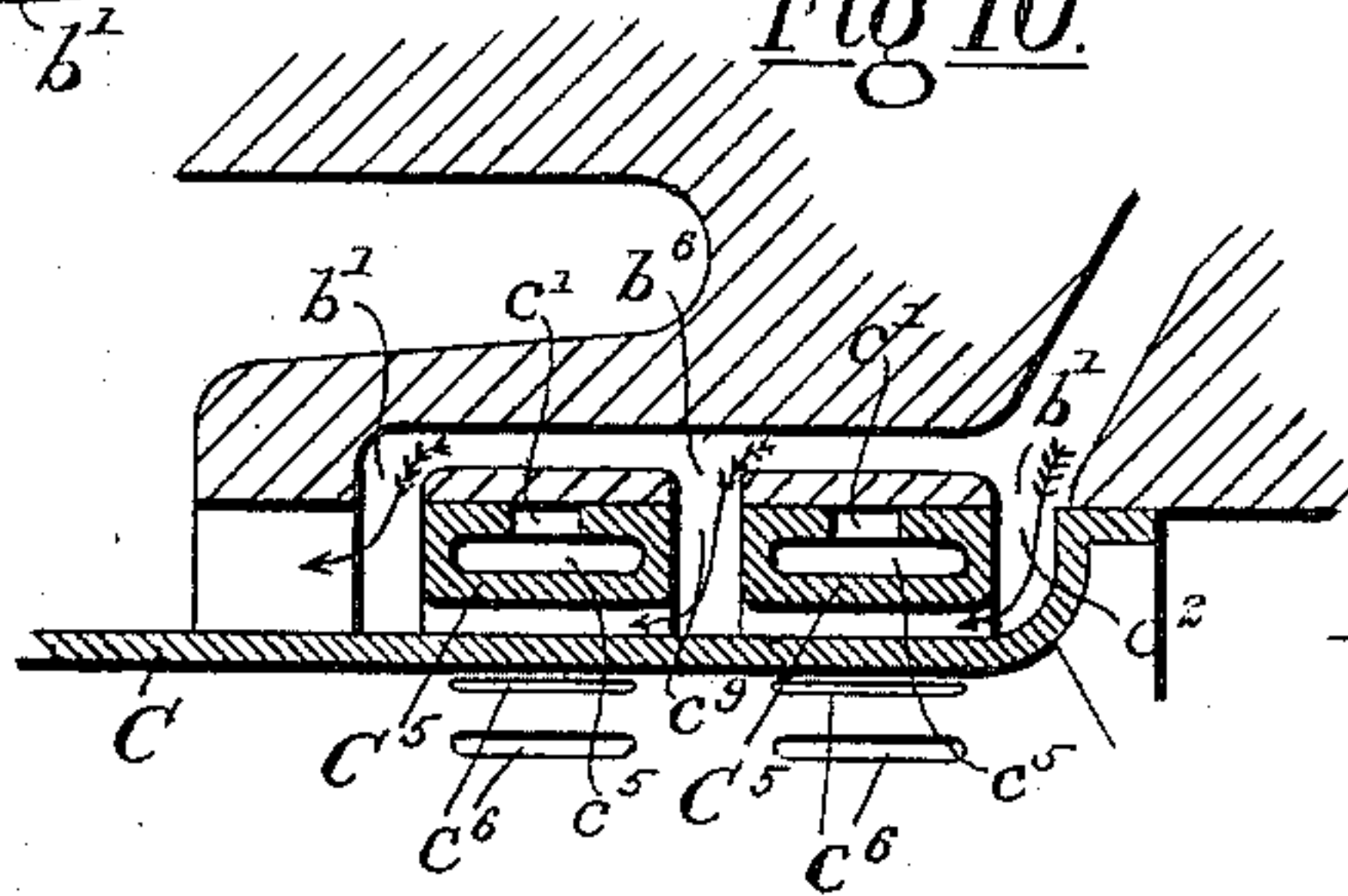


Fig 10.



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(No Model.)

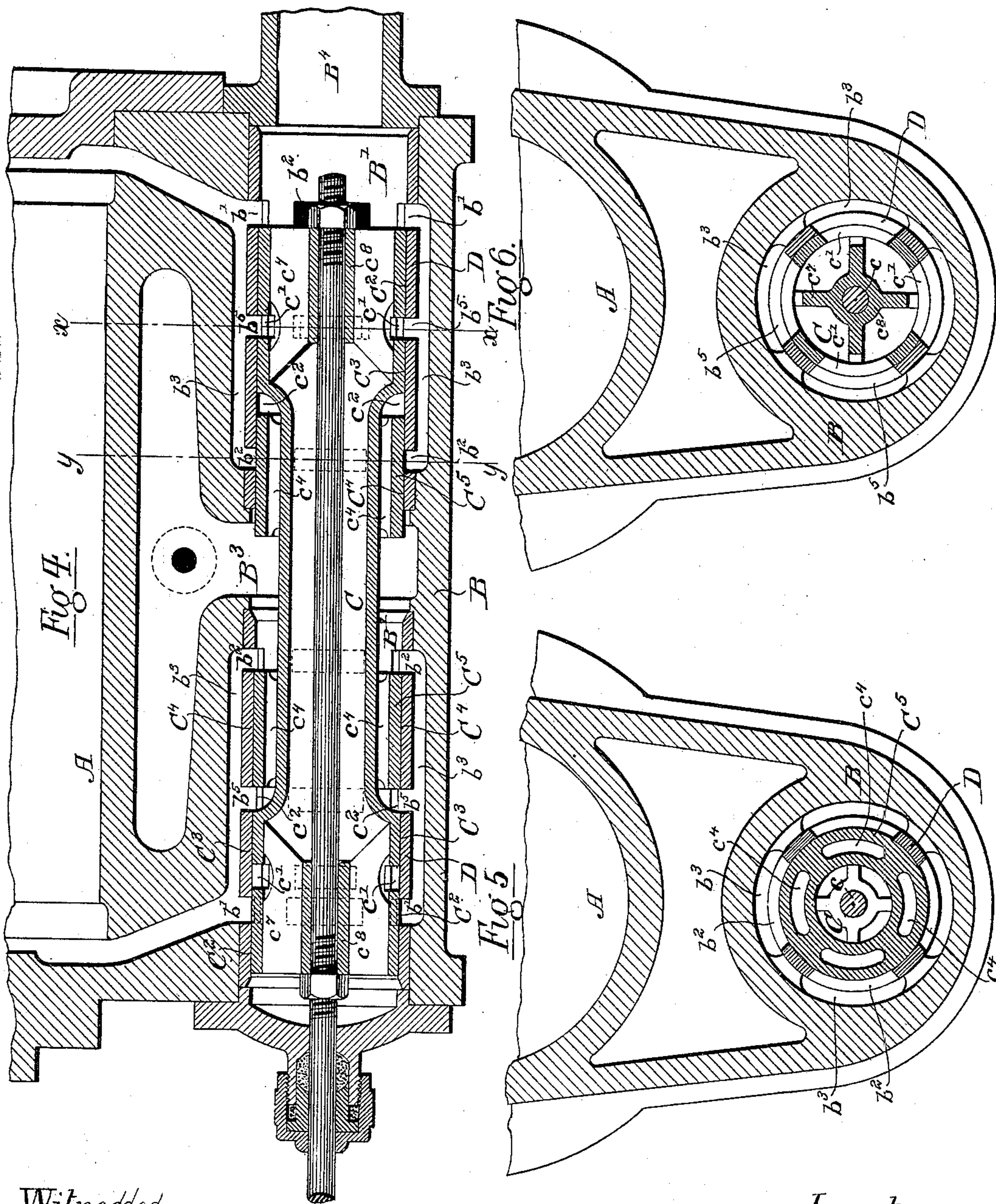
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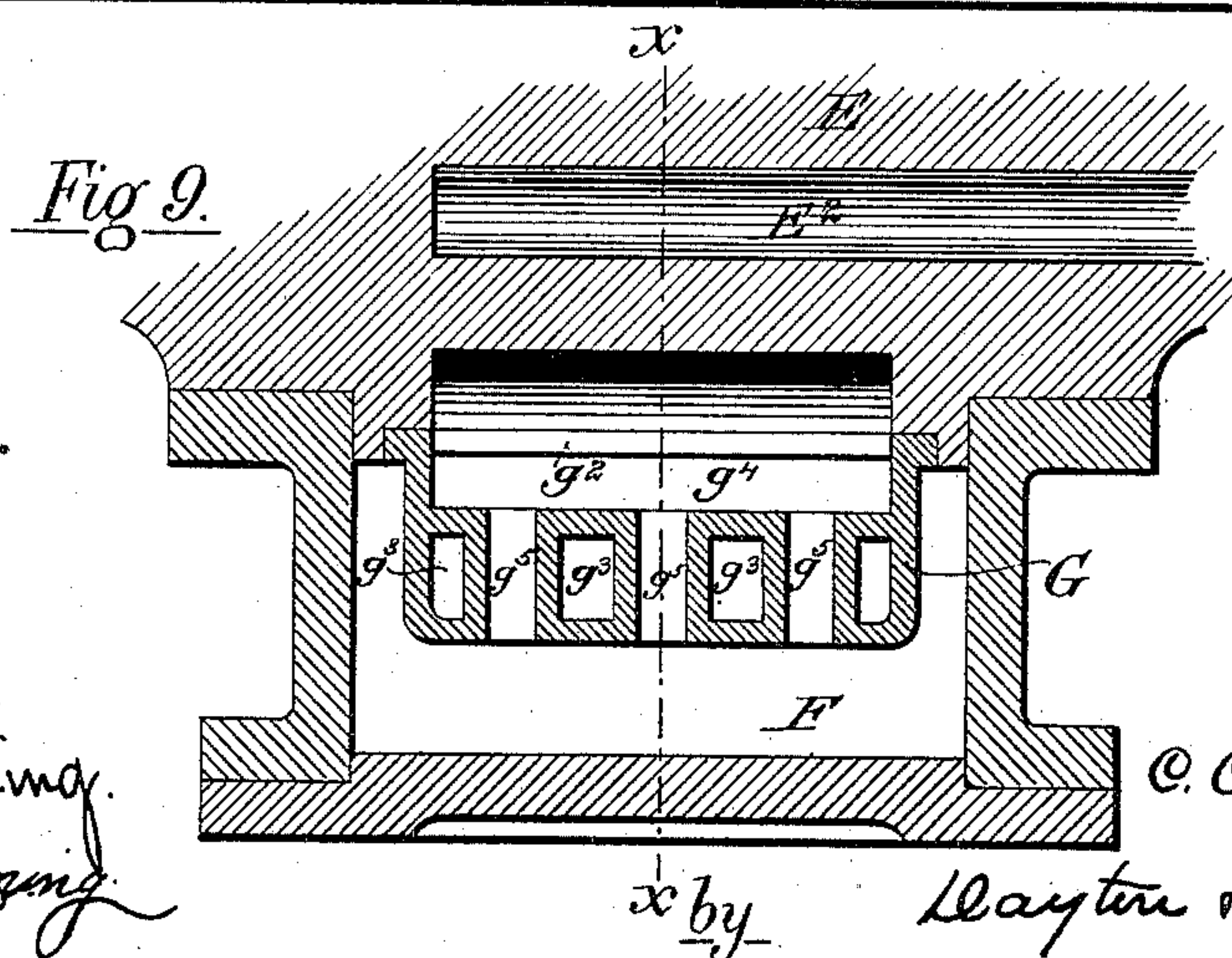
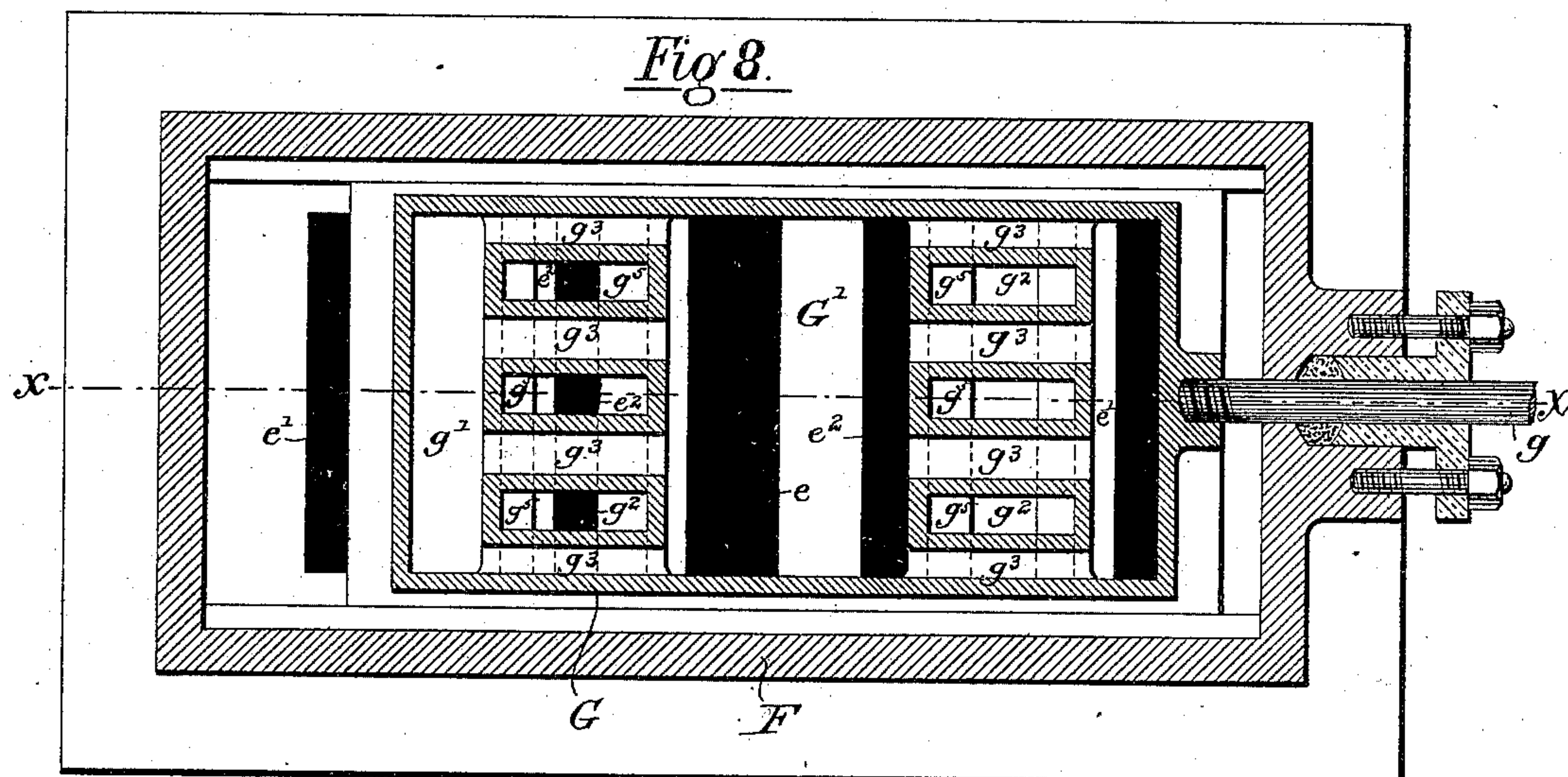
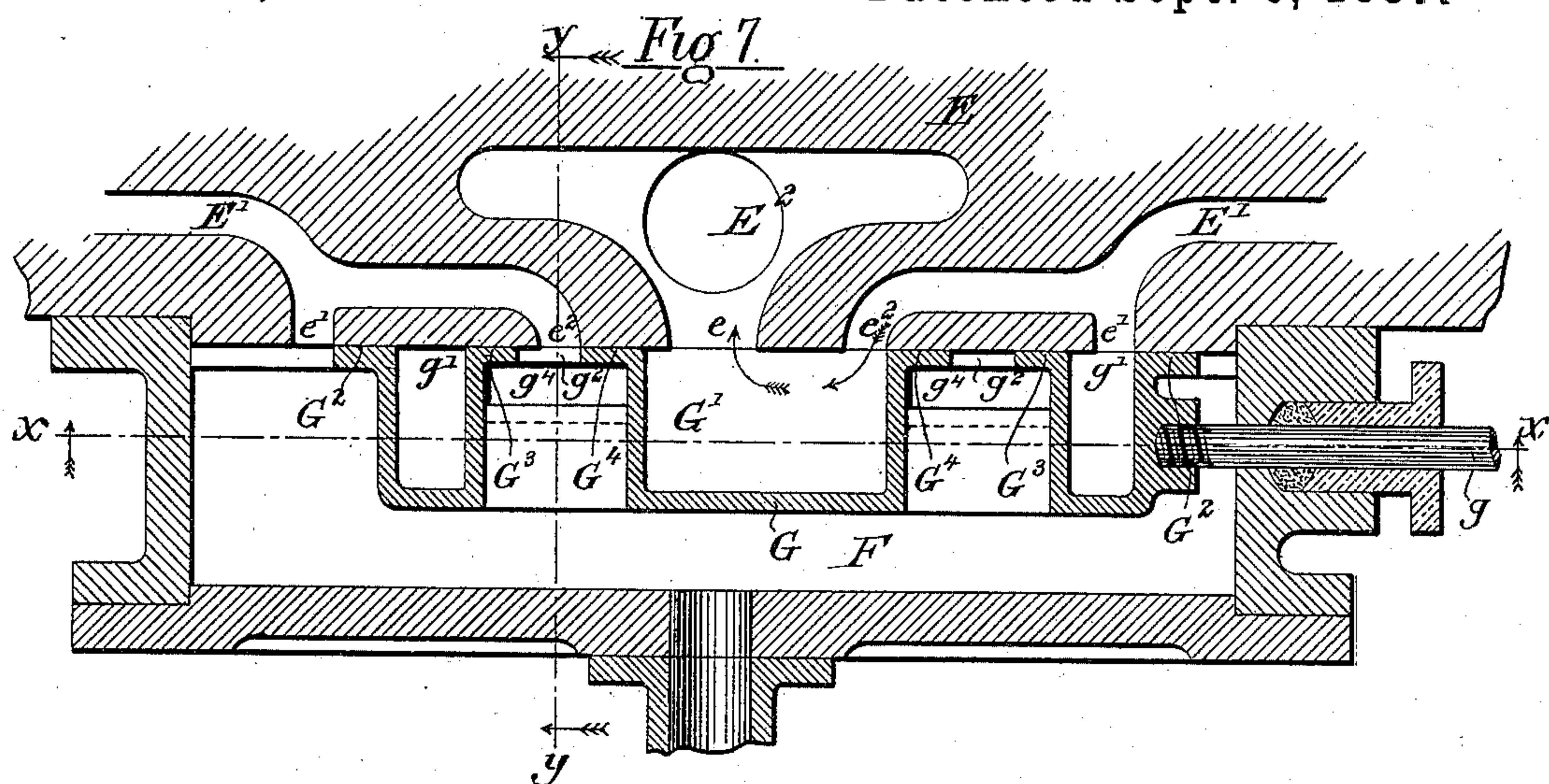
3 Sheets—Sheet 3.

C. C. POOLE.

VALVE FOR STEAM ENGINES.

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UNITED STATES PATENT OFFICE.

C. CLARENCE POOLE, OF EVANSTON, ASSIGNOR TO ALBERT L. IDE, OF
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VALVE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 369,552, dated September 6, 1887.

Application filed March 16, 1887. Serial No. 231,124. (No model.)

To all whom it may concern:

Be it known that I, C. CLARENCE POOLE, of Evanston, in the county of Cook and State of Illinois, have invented certain new and useful
5 Improvements in Valves for Steam-Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings, and to the letters of reference marked
10 thereon, which form a part of this specification.

The object of this invention is to provide an improved construction in steam-engine slide-valves, whereby two or more openings or ports
15 are afforded for the passage of steam both in the admission of steam to the cylinder and in its exit therefrom to the exhaust-passage. The invention consists in the matters hereinafter described, and pointed out in the appended claims.

I have illustrated in the accompanying drawings the general principles of construction embraced in my invention as applied both to what is known as a "hollow" piston-valve, or one
25 in which the movable part of the valve consists of a hollow tube having enlarged parts or pistons at both ends fitted to slide in cylindric valve-seats containing annular steam-ports—such, for instance, as illustrated in a
30 prior Letters Patent, No. 319,261, granted to Albert L. Ide upon the 2d day of June, 1885, and also to a valve similar to the common D-valve.

In a slide-valve embodying my invention
35 the steam-passages leading from the ends of the cylinders to the valve-seats are provided with two or more openings or ports arranged side by side along the valve-seats in the manner heretofore common in what is known as
40 "gridiron" valves, and the movable part of the valve is provided with working-surfaces corresponding in number and relative position with the several ports and having steam-passages between them, an equal number of
45 which passages communicate with the central steam-space of the said movable part of the valve and with the central exhaust or inlet passage of the steam-chest or valve-casing, so that a plurality of ports is provided both for
50 the influx and exit of steam, as will hereinafter more fully appear. By the construction

described a large area for both the admission and exit of steam is obtained without materially increasing the width of the ports or the throw of the valve, with the obvious advantage of allowing a rapid passage of steam to
55 and from the cylinder and of enabling a high pressure to be quickly established within the cylinder and of allowing a rapid exit of the exhaust-steam therefrom. A construction affording a large area of steam-passages for the
60 inflow and exit of steam is of special utility in the case of high-speed engines and has important advantages in all engines, inasmuch as it enables them to do a greater amount of work
65 with a less consumption of fuel.

In the accompanying drawings, illustrating my invention, Figure 1 is an axial longitudinal section through a steam chest and valve embodying one form of the invention. Fig. 70
2 is a transverse sectional view of the same, taken upon line *xx* of Fig. 1. Fig. 3 is a similar sectional view taken upon line *yy* of Fig. 1. Fig. 4 is a longitudinal sectional view of a valve somewhat different from that shown in
75 Figs. 1, 2, and 3. Fig. 5 is a transverse sectional view of the said valve, taken upon line *yy* of Fig. 4. Fig. 6 is a transverse section of the same, taken upon line *xx* of Fig. 4. Fig. 7 is a sectional view taken upon line *xx* of
80 Figs. 8 and 9, illustrating my invention as applied to a D-valve. Fig. 8 is a plan section of the same, taken upon line *xx* of Fig. 7. Fig. 9 is a transverse section taken upon line *yy* of Fig. 7. Fig. 10 illustrates a valve differing
85 somewhat from that shown in Fig. 1.

As shown in the said drawings, Figs. 1 to 3, both inclusive, A indicates the steam-cylinder of an engine; B, the valve-casing of the steam-chest, and C the movable part or valve proper,
90 which is of the form or type known as a "hollow" piston-valve. Said valve C is provided with a stem, *c*, passing through a gland, *b*, at the end of the steam-chest, by which the valve is operated in a familiar manner. The valve
95 C is furthermore provided with the usual enlarged parts or portions, *C'*, at its ends, which enlarged parts are fitted to slide in annular cylindric valve-seats *B' B'*, formed in the steam-chest B. Said steam-chest is connected with the
100 ends of the cylinder by means of the usual steam-passages, *B²*, and the said valve-seats *B'* are

each provided with two annular steam-ports, $b' b^2$, connected with each other and with the passages B^2 by means of longitudinal passages b^3 , formed in the walls of the steam-chest and extending entirely around the valve, as clearly shown in the sectional view, Figs. 2 and 3.

The enlarged portions $C' C'$ of the valve C are each provided with three separate annular working or bearing surfaces, $C^2 C^2 C^4$, between which are located steam-passages $c' c^2$, herein shown as formed by a series of apertures arranged annularly about the valve, as will hereinafter more fully appear.

The annular bearing-surfaces C^2 operate in connection with the ports b' to bring said port alternately into connection with the live-steam space of the steam-chest and with the central exhaust-passage, B^3 , thereof, and, similarly, the annular bearing-surfaces C^4 operate in connection with the ports b^2 to bring said ports either in communication with the live-steam space or with the central exhaust-passage.

$C^5 C^5$ are hollow rings attached to and surrounding the main part of the valve C near its ends. The outer surfaces of said rings are constructed to form the annular bearing-surfaces $C^3 C^4$, and the steam-passages $c' c'$ are formed in said rings. Said rings $C^5 C^5$ are supported from the central or main part, C , of the valve by means of radial ribs $c^3 c^3$, as more clearly shown in Fig. 2, between which are formed a series of longitudinal passages, c^4 . The passages $c^4 c^4$ are located between the said main part of the valve and the ring C^5 and serve to connect the annular steam-openings $c' c'$ of the valve with the central exhaust-space, B^3 , of the steam-chest. The steam-openings $c^2 c^2$ communicate directly with the annular interior chambers or passages, c^5 , of the hollow rings C^5 , and said passages c^5 communicate with the interior space of the main part of the valve by means of a series of radial passages, c^6 , extending through the ribs $c^3 c^3$, by which the rings C^5 are connected with the body of the valve, as clearly shown in Fig. 2.

In the valve constructed in the manner above described, when the valve is at one limit of its movement—as, for instance, when moved to the right, as shown in the drawings—the live steam admitted through the inlet steam-pipe B^1 passes through the hollow piston-valve and gains access to the ports b' , which are at this time uncovered, as clearly indicated at the left-hand side of Fig. 1. At the same time that steam passes through the port b^4 at the end of the valve steam will also pass from the interior of the valve through the radial openings c^6 into the annular passages c^5 , and thence through the annular steam-openings c^2 into the annular port d^2 , from which it reaches the passage B^2 through the space b^3 . When the steam is entering the valve-ports in the manner described, exhaust-steam from the opposite end of the cylinder passes from the port b^2 , which is at this time uncovered by the surface C^4 , into the central steam-passage, B^3 , and exhaust-steam also passes from

the port b' to said passage B^3 through the steam-opening c^2 of the valve and the longitudinal passages c^4 , which connect said steam-opening c^2 with the said exhaust-passage B^3 , in the manner before described. It will of course be understood that when the valve is shifted to the opposite end of its throw the operation of the several ports and passages will be reversed, and that steam will enter the ports $b' b^2$ at the right-hand end of the steam-chest in the same manner as before described.

For the general purposes of my invention the several ports and passages described may be formed in the valve C and in the valve-seat in any manner found convenient or desirable. As herein shown, the bearing-surfaces of the valve-seats are formed by annular rings or bushings $D D$, which are fitted to the walls of the steam-chest and are provided with two separate series of apertures, forming the steam-ports $b' b^2$, the passages $b^3 b^3$ in this instance being formed by means of recesses cast in the wall of the steam-chest and covered by the parts of the bushings between the ports. A construction in which cylindric valve-seats are constructed in this manner is illustrated and described in an application for Letters Patent, Serial No. 201,823, filed May 11, 1886, and such construction is not herein claimed as new. The said valve-seats and the ports $b' b^2$ may, however, in practice be made otherwise than as herein shown—as, for instance, the said ports $b' b^2$ may be made continuous or in the form of annular grooves in the surface of the valve-seats and arranged to communicate with passages cast in the walls of the steam-chest.

As a convenient means of forming the annular chambers $c^5 c^5$ of the valve C , and at the same time providing the ports or passages $c' c'$, leading into said annular chambers $c^5 c^5$, I preferably cast the valve with open annular recesses in the outer surfaces of the rings $C^5 C^5$ and cover such recess with separate metal cylinders or sleeves $D' D'$, which are apertured to form the ports $c^2 c^2$, and for convenience in construction are extended outwardly to the ends of the valve and over the space between the bearing-surfaces C^2 and C^3 , the sleeves being apertured to form the ports $c' c'$. In case the sleeves are made of continuous rings and the body of the valve C in one piece, it is obviously necessary to extend the sleeves to the ends of the valve, in order that they may be slipped over said ends in putting them in place.

Inasmuch as the construction in the valve above described is a novel one, and one by which the valve may be cheaply and easily made, this construction is herein claimed as part of my invention. It is to be understood, however, that as far as the main features of novelty embraced in my invention are concerned the valve C , provided with ports and passages arranged as above described, may be made of one or more parts attached together in any manner found convenient or desirable. The tubular port or body of the valve, as

illustrated in said Figs. 1, 2, and 3, is attached at both ends to the valve-stem c by means of radial plates or arms $c^7 c^7 c^7$, cast integral with the said tubular port of the valve, and connected at their inner ends with hubs $c^8 c^8$, which are centrally apertured for the passage of the said valve-stem, which passes through the valve from end to end thereof, and is held in place relatively to the valve by nuts placed thereon outside of the hubs $c^8 c^8$, and bearing against said hubs in the manner shown.

In Figs. 4, 5, and 6 I have shown a valve embodying the main features of construction above set forth, but in which provision for both the inflow and exit of the steam through a plurality of ports is provided for in a somewhat different manner. In this instance, as clearly shown in Fig. 4, the valve-seat B' is provided with three ports, $b' b^2 b^5$. The valve has at each end three bearing-surfaces, $C^2 C^3 C^4$, arranged in the same way as before described, and having between them an annular opening, c^2 , which in this case leads directly into the hollow interior of the valve, and an opening, c' , which leads to the central steam-passage, B^3 , of the valve through longitudinal passages c^4 , formed by annular parts or rings C^5 , sustained from the body of the valve by radial ribs c^3 , in the same manner as before described. In this case, however, the ring C^5 is solid, and takes in the width of the bearing-surface C^4 only. A valve constructed in this manner may take steam either at its ends or at its middle, this being true also of the form of valve before described, and shown in Figs. 1, 2, and 3. Supposing steam in this instance to enter at the middle of the valve through the central steam-valve, B^3 , (corresponding with the central steam-exhaust passage, B^3 , of Figs. 1, 2, and 3,) the ports, as shown in Fig. 4, will be in position for the inflow of steam to the cylinder at the left-hand end of the valve, and for the exit of steam at the right-hand end of the valve. Steam entering through the central passage, B^3 , passes through the port b^2 , uncovered by the surface C^4 , and also through the passage c^4 and the steam-opening c^2 into the port b^5 . At this time the port b' at the end of the valve-seat will be covered by the bearing-surface C^2 . At the opposite end of the valve the port b' will be uncovered by the bearing-surface C^2 , so that steam may pass from the said port to the exhaust-pipe, and the annular steam-opening c^2 of the valve will coincide with the annular port b^5 , so that exhaust-steam may pass also from said port b^5 , the third port at the inner end of this side of the valve-seat being at this time closed by the bearing-surface.

The bearing-surfaces of the valve-seats B B' of the valves shown in said Figs. 4, 5, and 6 are formed by bushings $D D$, apertured to form the ports $b' b^2 b^5$ in the same manner as before described in connection with the valve illustrated in Figs. 1, 2, and 3. In this instance the annular steam-openings $c' c'$ of the valve are continuous, and are formed by cut-

ting entirely through the walls of the valve, the parts of the valve upon either side of the opening being connected with each other, and also with the valve-stem c , by means of radial plates or arms $c^7 c^7 c^7$, which are attached at their inner ends to hubs $c^8 c^8$ upon the valve-stem in the same manner illustrated in Fig. 1.

A construction in which the novel features in the valve above described are applied to a valve of the kind known as a "D-valve" is illustrated in Figs. 7, 8, and 9. In these figures, E is an engine-cylinder provided with a rectangular steam-chest, F , and provided with steam-passages E' , leading from the steam-chest to the cylinder. As shown in said figures, live steam is admitted through a passage, E' , to the steam-chest, and the exhaust-steam makes its exit through a passage, E'' , communicating with the valve-seat by a central exhaust-port of the valve, e . The steam-passages $E' E'$ communicate with the steam-chest by means of ports $e' e^2$, the ports e^2 being those nearest the exhaust-ports e .

G is a slide-valve actuated by the usual valve-stem, g . Said valve is provided with the usual recess or cavity, G' , adapted to afford communication between the central exhaust-port, e , and the steam-ports of the valve. The valve is provided at each end with a series of transverse working-faces $G^2 G^3 G^4$, of which the surfaces $G^2 G^4$ act in conjunction with the ports $e' e^2$ in the same manner as before described in connection with the annular bearing-surfaces $C^2 C^3 C^4$ of the valve shown in Figs. 1, 2, and 3. Openings or ports $g' g^2$ are formed in the face of the valve between the surfaces $G^2 G^3 G^4$. The openings $g' g'$ communicate with the central space or recess, G' , of the valve by means of longitudinal passages $g^3 g^3 g^3$, cast in the valve in the manner clearly shown in the drawings, Figs. 8 and 9, and the openings $g^2 g^2$ communicate with recesses g^4 , which are connected with the live steam space of the steam-chest by means of the openings or passages $g^5 g^5 g^5$, located between the longitudinal openings $g^3 g^3 g^3$. In the operation of this valve, when the valve G is shifted to the right, as illustrated in said Fig. 7, the port e' at the left-hand side of the valve will be exposed at the end of the valve, and the adjacent port e^2 will be brought into communication with the steam-space of the steam-chest by means of the opening g^2 of the chamber g^4 , the passages $g^5 g^5 g^5$ at the opposite or right-hand side of the valve-port e^2 will be in direct communication with the exhaust-port or central exit-passage, e , while the port e' will communicate with said exhaust-port or exit-passage by means of the opening g' and longitudinal passages $g^3 g^3 g^3$. When the valve is shifted at the opposite limit of its movement, the position of the ports will be the same, so that at all times a passage for the passage of live and exhaust steam will be afforded through the two sets of ports or steam-openings.

It is entirely obvious that in either of the

several forms of valves described three or more steam openings or ports may be afforded for the steam inlet and exhaust by providing the necessary number of steam-ports in the steam-chest and a corresponding number of working or bearing surfaces and steam-passages in the moving part of the valve proper.

A construction of this kind is illustrated in Fig. 10 as applied to a hollow piston-valve generally similar to that shown in Fig. 1, but differing therefrom by having two hollow rings, $C^5 C^5$, at each end of the valve C , and by having in the valve-seat three ports, $b' b^2 b^6$. In this instance an additional annular steam-passage, c^9 , is formed between the rings $C^5 C^5$, which steam-passage communicates by means of the longitudinal passages $c^4 c^4$ with the central exhaust or steam-exit passage of the valve, and two separate annular passages, $c' c'$, are formed in the hollow rings $C^5 C^5$, both communicating with the interior of the valve C by means of radial passages $c^6 c^6 c^6$.

It will be readily seen that in the operation of a valve made as shown in said Fig. 10 three ports will be opened both for the admission and exit of steam. The said figure shows the valve in position for the exit of steam from the cylinder, the arrows showing the course of the steam through the three ports b' , b^2 , and b^6 to the exhaust-port or central steam-exit passage of the valve.

Inasmuch as a valve containing the general features of construction present in all of the different forms of valve illustrated is new, I desire to claim, broadly, such general features of construction without limitation to the particular construction in which such general features are or may be embodied. Specific claims are, however, also herein made to particular features of construction and combinations of parts herein illustrated, which are thought to be in themselves novel.

I claim as my invention—

1. The combination, with an engine-cylinder and valve-chest, of a valve-seat provided with a central space or opening, and with a plurality of steam-ports at each side of said central opening, and a slide-valve provided with a central steam-space opposed to the central opening of the valve-seat, and provided also with a plurality of working or bearing surfaces acting in conjunction with the said ports, and with intermediate steam-passages which communicate both with the central opening of the valve-seat and with the steam-space of the valve-chest, substantially as described.

2. The combination, with a steam-chest provided with cylindric valve-seats having each a plurality of annular ports communicating with one end of the cylinder, of a hollow piston-valve provided at each end with two annular steam-passages, one of which communicates with the exhaust-space of the valve-casing and the other with the live-steam space of said casing, substantially as described.

3. The combination, with a steam-chest having two cylindric valve-seats, each provided with two steam-ports, of a hollow piston-valve provided at each end with three annular bearing-surfaces, having between them two annular ports or passages, $c' c^2$, and with longitudinal passages $c^4 c^4$, connecting the annular passage c' with the central space of the valve-casing, and with radial passages c^6 , connecting the said port or passage c^2 with the interior of the hollow piston, substantially as described.

4. The combination, with a steam-chest having two cylindric seats, each provided with two steam-ports, of a hollow piston-valve provided at each end with three annular bearing-surfaces having between them two annular ports or passages, $c' c^2$, with a series of longitudinal passages, $c^4 c^4$, connecting the annular port or passage c' with the central space of the valve-casing, with an annular chamber, c^5 , extending around the valve exterior to the passages c^4 , and communicating with the ports or passages $c^2 c^2$, and with a series of radial passages, $c^6 c^6$, located between the passages $c^4 c^4$, and connecting the annular chamber c^5 with the hollow interior of the piston-valve, substantially as described.

5. The combination, with the hollow piston-valve C , provided at each end with ports $c' c^2$, longitudinal passages $c^4 c^4$, an annular chamber, c^5 , and with radial passages connecting said annular chamber with the interior of the valve, of separate rings or bushings containing the ports c^2 , and secured to the exterior of the valve, so as to form the outer wall of said annular chamber c^5 , substantially as described.

In testimony that I claim the foregoing as my invention I affix my signature in presence of two witnesses.

C. CLARENCE POOLE.

Witnesses:

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CHARLES T. LORING.