(No Model.)

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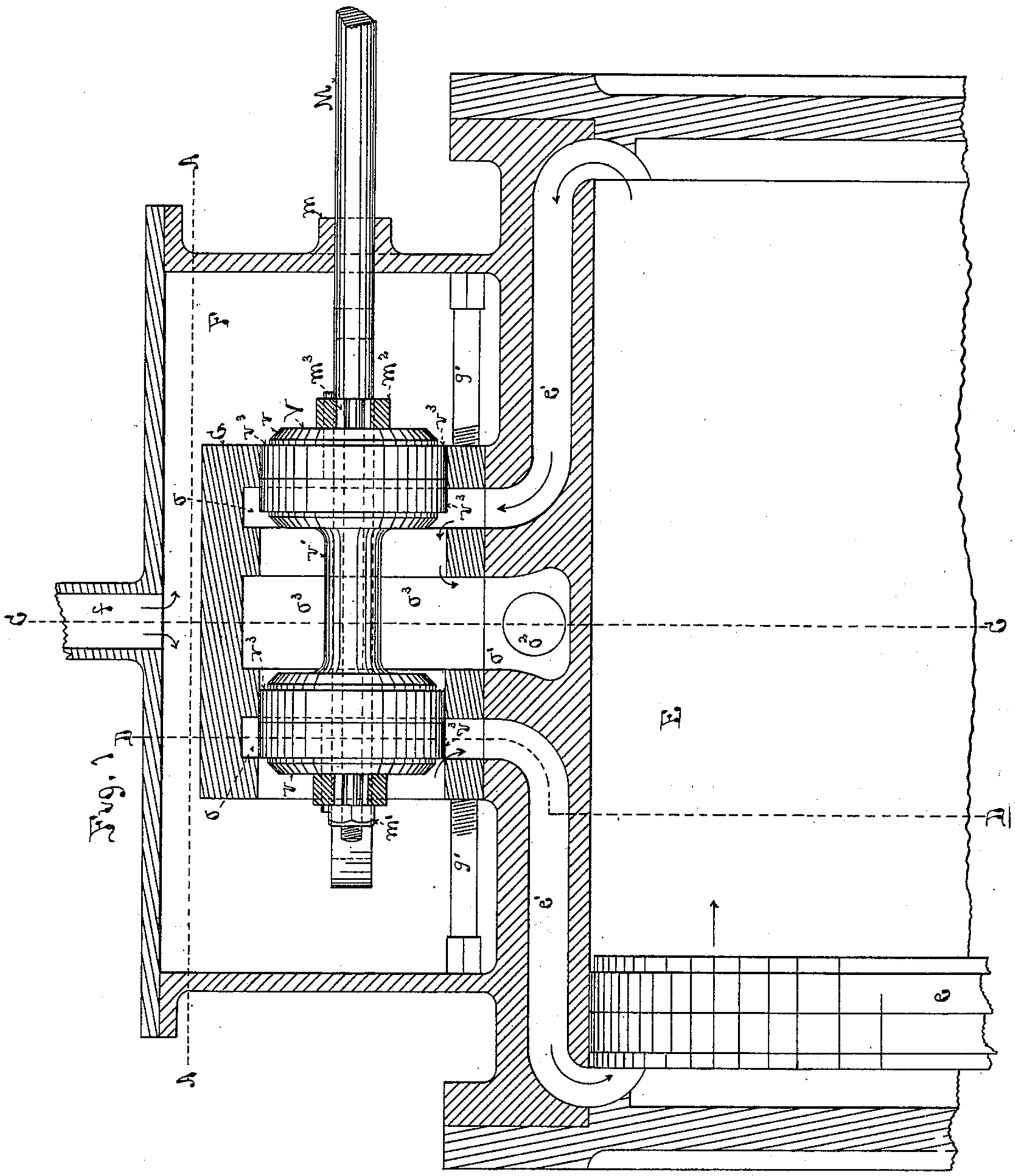
J. FERGUSON.

ENGINE VALVE.

No. 335,571. Patented Feb. 9, 1886.



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5 Sheets—Sheet 2.

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ENGINE VALVE.

No. 335,571. Patented Feb. 9, 1886.

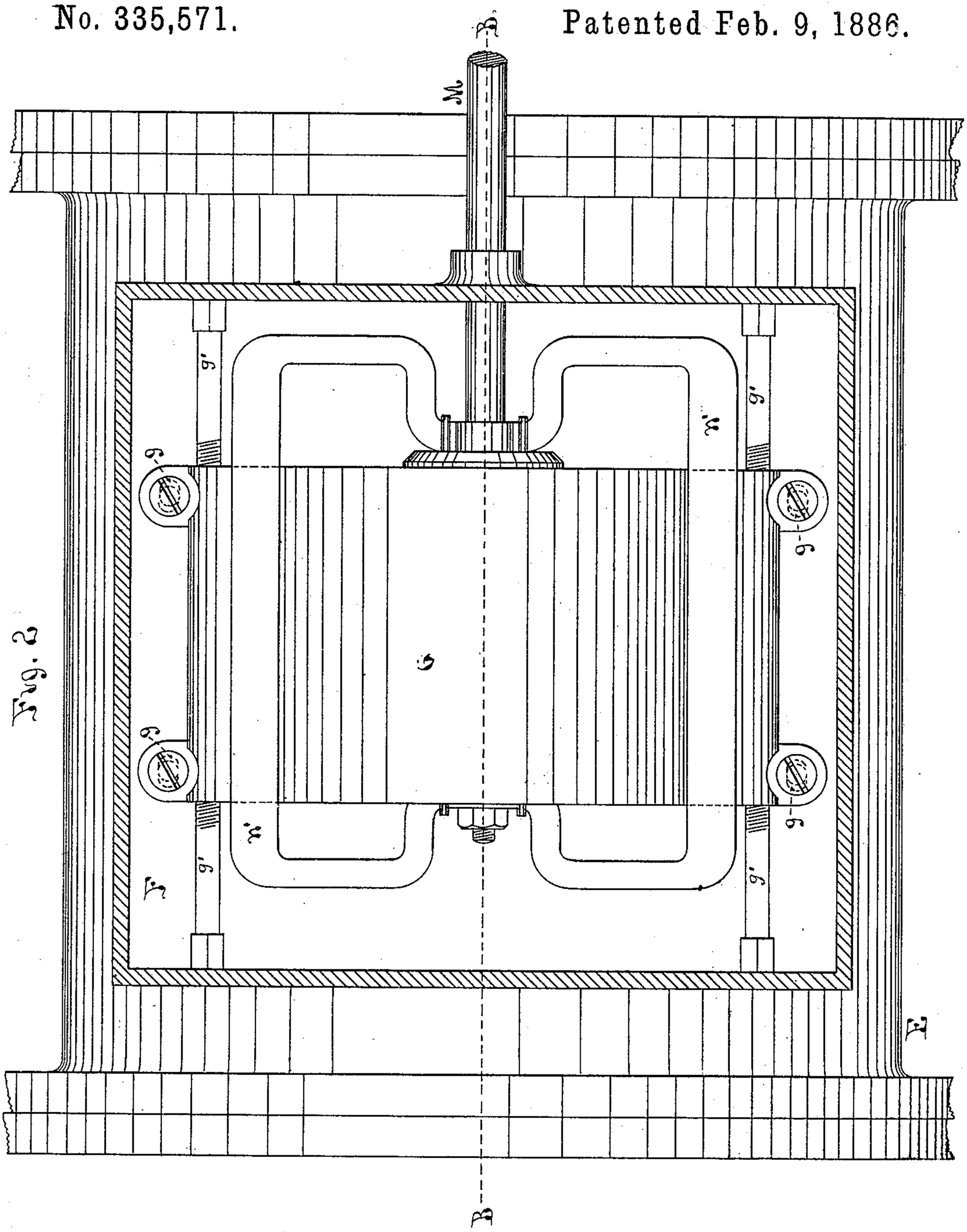

Fig. 2.

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5 Sheets—Sheet 3.

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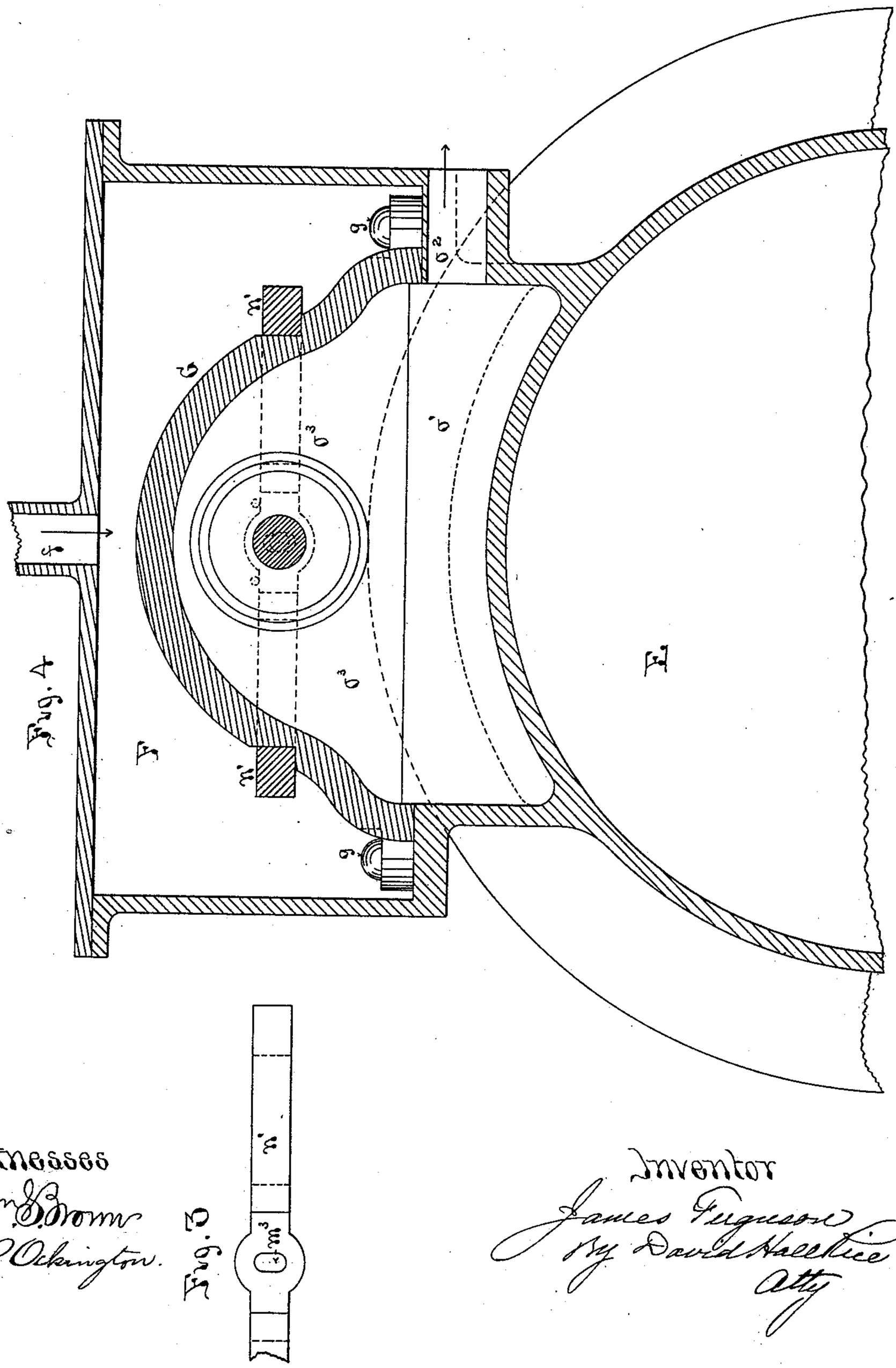
ENGINE VALVE.

No. 335,571. Patented Feb. 9, 1886.



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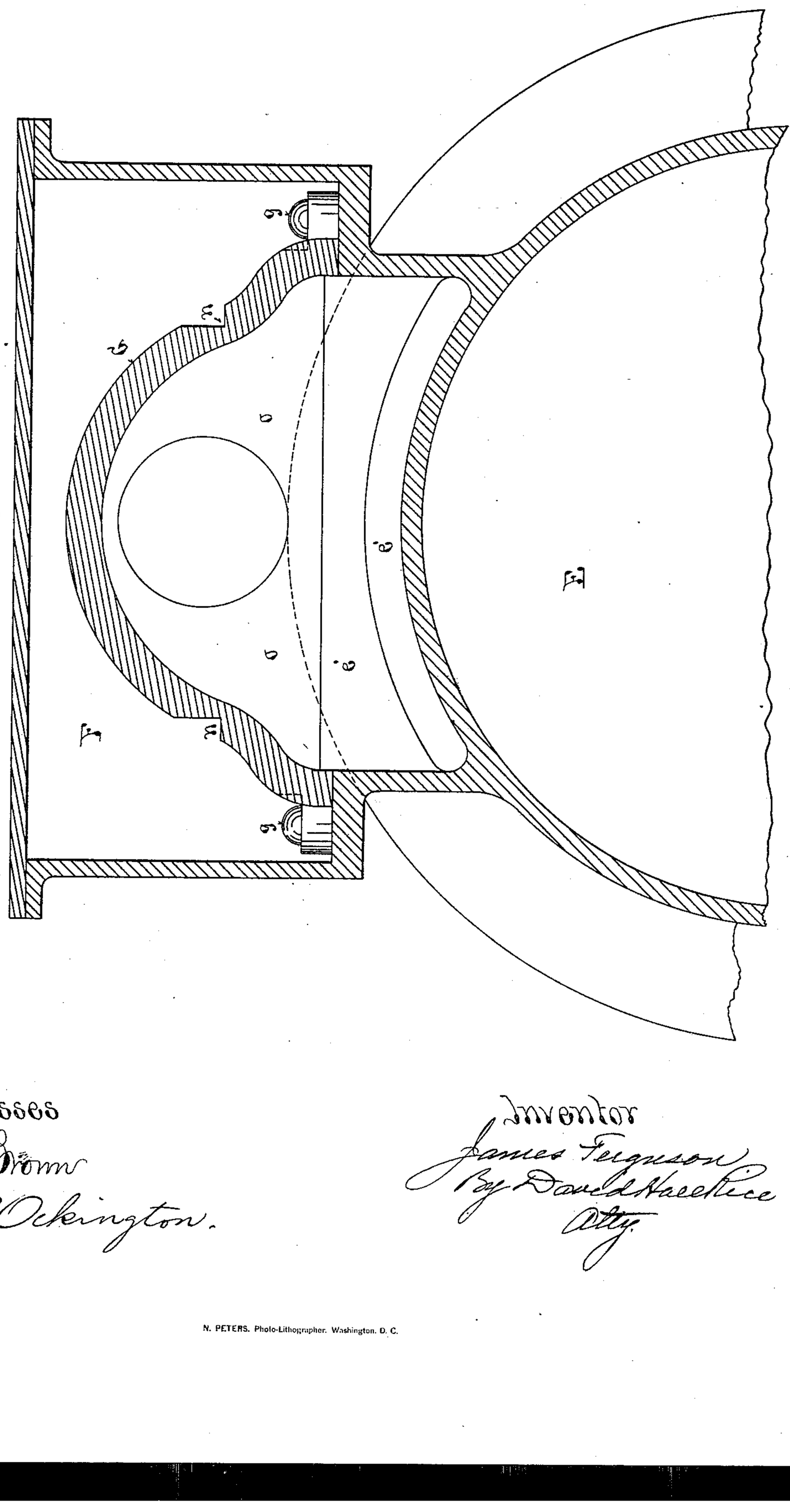
ENGINE VALVE.

No. 335,571. Patented Feb. 9, 1886.



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(No Model.) 5 Sheets—Sheet 5.

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ENGINE VALVE.

No. 335,571. Patented Feb. 9, 1886.

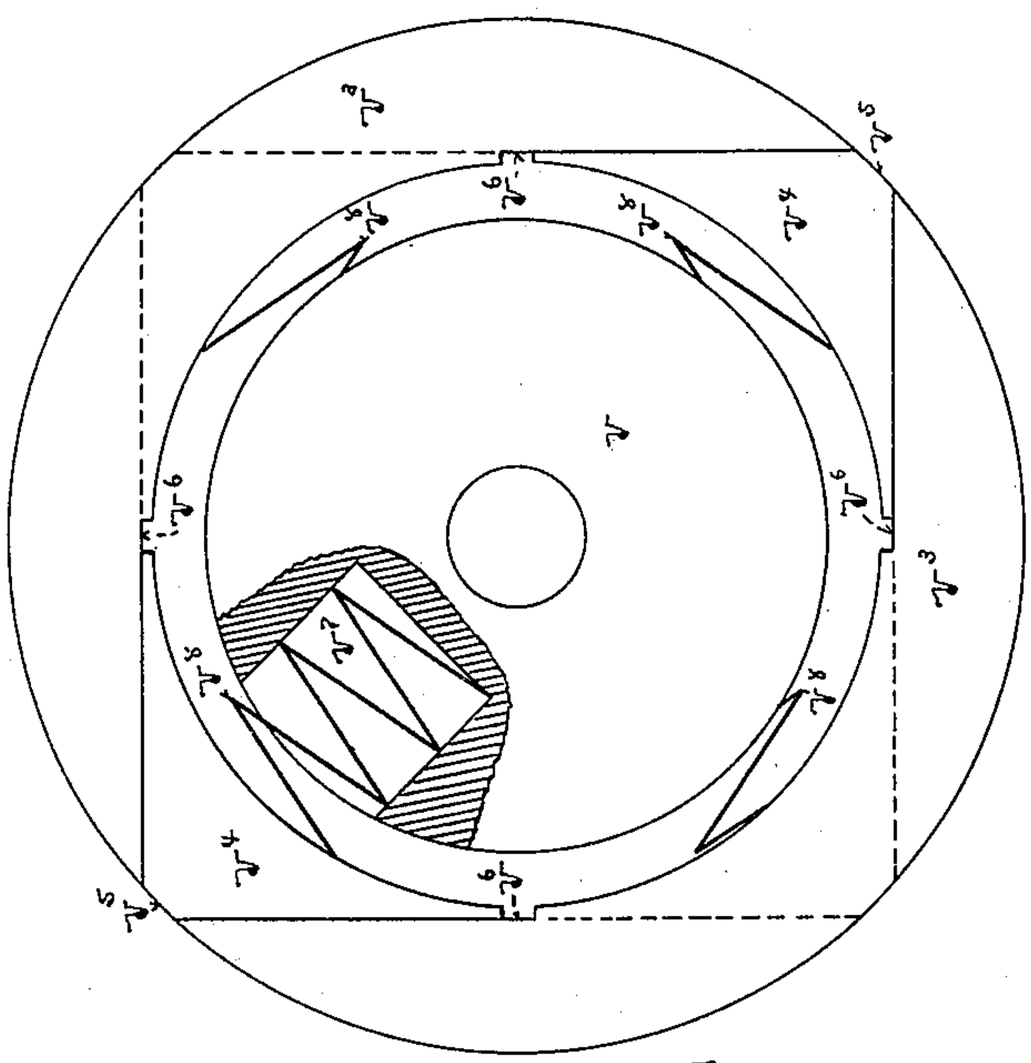

Fig. 7.

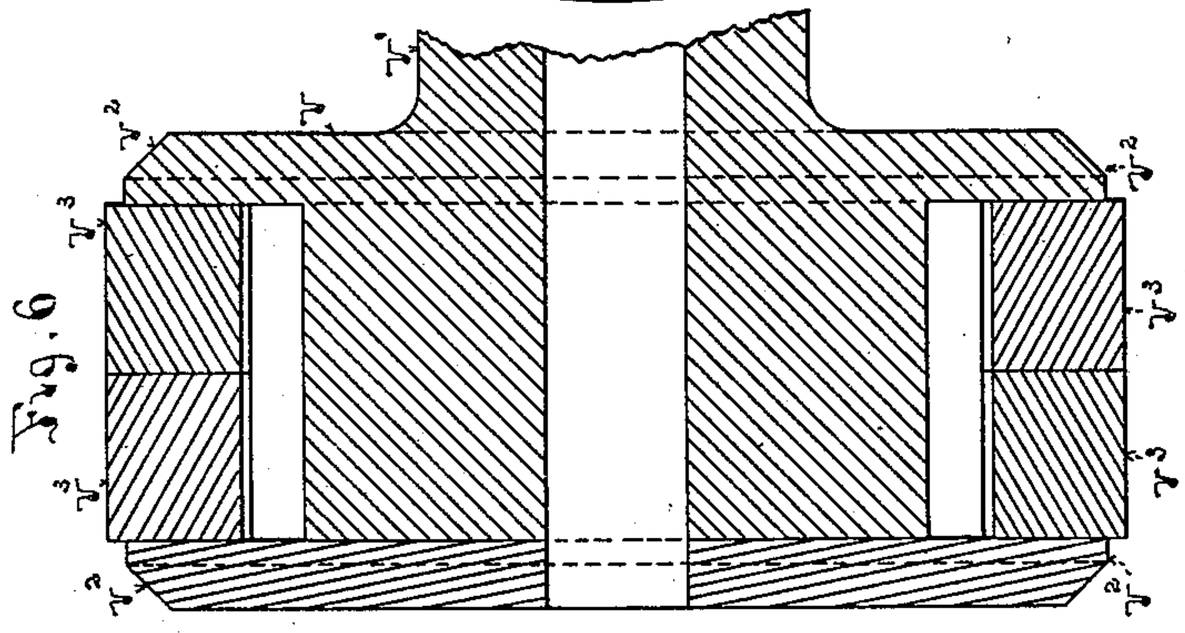

Fig. 6.

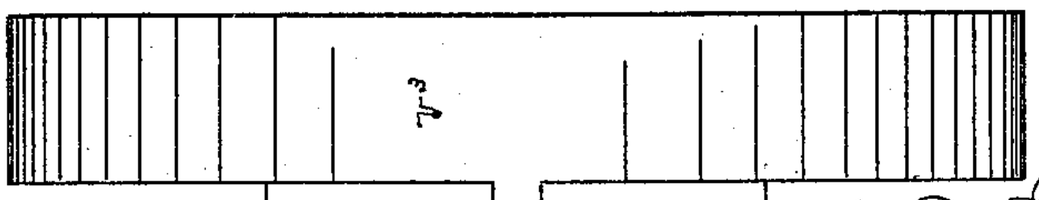

Fig. 8.

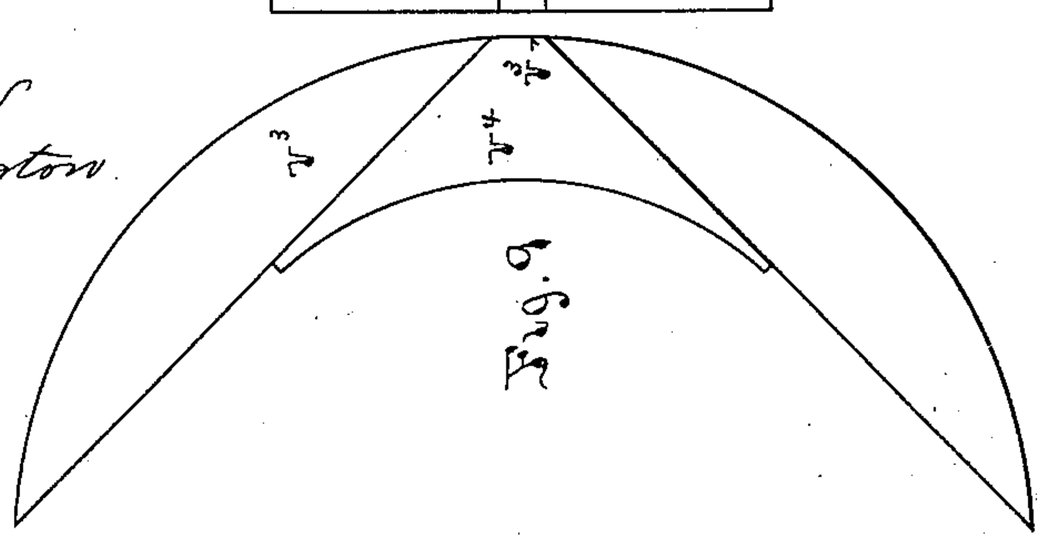

Fig. 5.

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UNITED STATES PATENT OFFICE.

JAMES FERGUSON, OF BRIDGEWATER, MASSACHUSETTS.

ENGINE-VALVE.

SPECIFICATION forming part of Letters Patent No. 335,571, dated February 9, 1886.

Application filed September 14, 1885. Serial No. 177,045. (No model.)

To all whom it may concern:

Be it known that I, JAMES FERGUSON, of Bridgewater, in the county of Plymouth and State of Massachusetts, have invented a new and useful Improvement in Engine-Valves, of which the following is a specification.

My improvement relates to valves for engines; and it consists in certain novel combinations and arrangements in relation thereto, substantially as hereinafter described and claimed.

In the drawings, Figure 1 is a longitudinal vertical sectional view of a portion of a steam-engine cylinder with the valve attached thereto, on the line B B of Fig. 2. Fig. 2 is a horizontal section of the same through the dotted line A A of Fig. 1. Fig. 3 is a detail view of a portion of Fig. 2. Fig. 4 is a vertical section of Fig. 1 on the dotted line C C. Fig. 5 is a vertical section of Fig. 1 on the dotted line D D. Fig. 6 is a detail sectional view of a portion of the valve, showing the manner of applying the packing thereto. Fig. 7 is an end view of the same, partly in section. Fig. 8 is an edge view of one of the packing semi-rings. Fig. 9 is a side view of the same.

My invention relates to that class of engine-valves known as "balanced valves," in which the pressure of the steam in the steam-chest upon one end of the valve neutralizes that upon the other end and obviates friction; and it consists of certain improvements, as above mentioned, for allowing the free passage of steam through the ports of such valves, for sustaining and supporting such valves in a manner to prevent their undue wear in use, and for a packing for them, which not only forms a steam-tight union between the valve and its seat, but also materially assists in preventing the wear of the valve.

E is the steam-cylinder containing the piston-head *e*, and having ports *e' e'*, for the introduction and escape of the steam which drives the piston.

On top of the cylinder E is secured the valve-chest F, into which the steam is discharged from the boiler through the pipe *f*.

Within the valve-chest F is secured the valve-cylinder G, which has a tubular bore through its center having both ends opening into the interior of the chest F, and being secured to the lower face of the chest, directly over the ports *e' e'* of the engine-cylinder, by screw-bolts *g g*. These bolts pass downward through elongated holes in ears upon each side of the valve-cylinder, which holes are elongated in a direction parallel to the bore through the cylinder. Set-screws *g' g'* enter holes in the ends of the valve-cylinder, and are adjusted to have their heads bear outwardly against the inner faces of the steam-chest F. By means of these and the elongated holes mentioned I am enabled to adjust the valve-cylinder in its place over the steam-ports *e' e'* easily, and secure it when so adjusted. The bolts *g g* and screws *g' g'* mutually assist each other in holding the valve-cylinder in place. This capacity of adjustment is especially important in applying the valve mechanism described to steam-engines which have been before used with common valves and had the latter removed to apply my invention. The valve-cylinder is thus exposed to the steam entering the chest F on its top and both its ends, and its base, which rests upon the steam-cylinder, is the widest portion of it, as shown in Figs. 4 and 5, in order to allow of the formation of the passages for the ingress and egress of steam, substantially as hereinafter described.

The valve V of the engine is of the general form known as a "piston-valve," consisting of two heads, *v v*, united by a stem or shaft piece, *v'*. The heads are provided with packing, as hereinafter described, which causes them to fill the cylindrical bore of the valve-cylinder G steam-tight, while allowing them to reciprocate back and forth through it. This packing maintains an equal pressure outward in all directions against the valve-cylinder, and serves to hold the heads *v v* centrally therein.

On each side of the exterior of the valve-cylinder are formed longitudinal notches or grooves *n n*, Fig. 5, and two bars, *n' n'*, rectangular in cross-section, are fitted to these grooves and have their ends brought around and attached to the heads *v v* of the valve on their outer faces, in such a position that when the stem *v'* is axial in the bore of the valve-

cylinder the bars n' will bear upon their seats in the grooves n. The bars n' extend far enough beyond the ends of the valve-cylinder G, as shown, to have the necessary scope between their ends, which are carried around to the valve and the ends of the valve-cylinder, to allow the valve to reciprocate to and fro in the latter, as hereinafter described.

M is the piston-rod which moves the valve to and fro in the valve-cylinder. It passes through a stuffing-box, m, of ordinary construction, in one end of the valve-chest F, and through the valve and its stem v' axially, having a nut, m', on its end securing the valve to it. The portion passing through the valve and the bars n' n' attached thereto is formed smaller than the hole through them, leaving a shoulder, m^2, on the rod, between which and the nut m' the valve is secured by the nut. The hole through the valve and the bars n' n' (lettered m^3) is made of an elongated form in cross-section, as shown in Fig. 3, in an up-and-down direction, which permits the valve to center itself in its cylinder and bring the bars n' n' to a bearing in their seats without pressing upon and wearing one side of the stuffing-box m, and also gives the valve-packing free play to center the valve at all times in its cylinder independently of its piston-rod M.

Within the valve-cylinder, and opposite to the steam-ports e' e' of the engine-cylinder, are formed steam-passages o o, each of which expands from its extreme upper side outward and downward around the bore of the valve-cylinder to a point below said bore, as shown in Figs. 1 and 5, and this construction enables the steam passing through the bore of the valve-cylinder into the ports e' to reach the same without being choked or retarded by itself in passing through the passages o o—that is, no part of the steam entering from the bore of the valve-cylinder into one of the passages o below a horizontal diameter of said bore will, by rushing outward against the walls of the passages o o, choke up or prevent the steam which enters the passage above said horizontal diameter from passing freely downward through the same, as would be the case if the transverse expansion of the passage o were not continued below said horizontal diameter as well as above it. By this construction of the passage o and port e', I am enabled to give the passage an area which will be equivalent to that of the area of the bore of the valve-cylinder in cross-section, plus what is required to prevent the rush of the steam into the passage from choking or retarding any portion of itself in reaching the port e'. This is requisite, because the steam in entering the passage o has its direction changed from that which it has in passing through the bore of the valve-cylinder, and if the expansion of the passage o were not as described steam entering the passage on the upper side of the bore of the cylinder would be retarded, or prevented from passing downward to the port, by the steam entering the passage nearer the port, and that portion of the passage o above the bore of the valve-cylinder would thus be rendered comparatively useless.

o' is the exhaust-port, having a pipe, o^2, leading outward from the engine. This exhaust-port is made of the same breadth transversely of the engine-cylinder as the steam-ports e', and the valve-cylinder has formed around its bore the steam-passage o^3, opposite said exhaust-port. This steam-passage o^3 expands outward and downward around the bore of the valve-cylinder in substantially the same way as the steam-passage o, thus enabling the exhaust-steam flowing outward through the steam-port e' and through the passage o, to enter the bore of the cylinder without being choked or obstructed by itself, and to pass through said bore around the valve-stem v' and through the passage o^3 to the exhaust-port without obstructing or choking itself, in the same manner as has been described above for the passages o. Every part of the passage o^3 around the bore of the valve-cylinder is therefore utilized by constructing it in this form, and the full capacity of the bore of the valve-cylinder for the escape of steam through it is made available, for if any part of the passages for the steam between the ports e' and the exhaust-pipe o^2 choked or retarded the steam more than the passage which preceded it, then the full area of such preceding passage could not be rendered available, and this disposition of the passages o o and o^3 with relation to each other and the bore of the valve-cylinder derives its importance from the cylindrical form of the valves, which in cutting off and admitting steam deflect it around in these passages differently from a flat surface.

In order to maintain the valve centrally in the bore of its cylinder, I provide each head v of the valve with a steam-tight metallic packing constructed as shown in Figs. 6, 7, 8, and 9. Each valve-head v has a broad groove turned in its periphery between the shoulders v^2 v^2. In this groove are disposed four semi-circular packing strips or pieces, v^3 v^3, so as to form a continuous expanding packing pressing equally outward in all directions and steam-tight, in the following manner: Each of the packing-pieces v^3 has attached to it midway between its ends on one side the piece of metal v^4, the outer faces of which are in planes at right angles to each other, with a corner cut off at v^5, where the curved exterior of the packing-piece v^3 cuts these planes. The internal faces of the piece v^3, from the piece v^4 outward to the ends of the packing-piece lie in the same planes, respectively, as the adjacent outer faces of the piece v^4. When four of these packing-pieces, v^3, are put together in their groove around the valve-head v, two of them, v^3 v^3, will appear upon one side of the groove, as shown in Fig. 7, and their attached pieces v^4 will be behind them, as shown in

dotted lines. The other two of said packing-pieces will be behind those shown, but their attached pieces v^4 will appear, as in Fig. 7, in such a position that the internal plane faces of the visible packing-pieces v^3 will rest upon the external plane faces of these metallic pieces v^4, and the similar faces of the packing-pieces behind the visible ones will rest upon the similar faces of the pieces v^4, attached to the visible ones, bringing the packing-pieces side by side, as shown in Fig. 6, and causing the joints between the packing-pieces on one side and the pieces v^4, belonging to the packing-pieces of the other side, to be broken or covered over by the continuous surface of such packing-piece on the other side. A space, v^6, is left between the ends of the pieces v^4 belonging to the packing-pieces on the opposite sides, as shown in Fig. 7, so as to allow the packing-pieces to slide outward and inward away from or toward the axis of the valve-head to expand or contract the packing, and immediately beneath the widest part of each packing-piece—viz., where it is composed of its curved portion and the metallic piece v^4, combined—a cavity, v^7, is formed in the valve-head, into which a spiral spring, v^8, is introduced, which presses the packing-piece outward against the bore of the valve-cylinder and keeps it steam-tight.

It is evident that as no one packing-piece can move outward without pressing outward the adjacent ends of two other packing-pieces resting upon the plane faces of its attachment v^4, and as the attachment v^4 of such other packing-pieces in turn presses outward the ends of those first named, the whole packing must move outward together, and cannot press harder upon one side of the bore of the valve-cylinder than upon another. Hence it holds the valve central in the bore and causes the latter to wear equally all around, preserving the valve steam-tight in the bore of the cylinder.

Instead of two bars, n' n', sliding in the grooves n n in the valve-cylinder, only one may be employed with good effect; or more than two may be used without departing from the spirit of my invention.

The construction of parts I have described renders the valve V practically a perfectly balanced valve, as well as having capacity to admit and exhaust a large volume of steam through it in proportion to its diameter, and this enables me to use a smaller valve and reduce its friction.

I do not claim in this application the piston-packing, broadly, as shown, as I have made application for a patent thereon, dated December 26, 1885, No. 186,706.

What I claim as new and of my invention is—

1. In combination with the valve-cylinder G, provided with passage o, formed around and opening through the side of the cylinder-bore, the piston-valve head v, provided with the packing-pieces v^3 v^3 v^3 v^3, having attachments v^4, co-operating together, respectively, and provided with springs v^8 v^8, pressing outwardly against said packing-pieces, substantially as described.

2. In combination with the valve-cylinder G, provided with a cylindrical bore, the piston-valve V, having its piston-rod M adjustably secured through its longitudinal center, and each of its valve-heads v provided with the packing-pieces v^3 v^3 v^3 v^3, having attachments v^4, simultaneously moving outward, and provided with springs v^8 v^8, pressing outwardly against said packing-pieces, substantially as described.

3. The combination of the steam-engine cylinder E, provided with steam-ports e' e', the valve-cylinder G, provided with a longitudinal bore having unobstructed passages o o formed within it, each of which expands transversely outward from its shallowest part on one side of the bore around the same and leads into the steam-port e' on the other side, and the balanced valve V, formed with a connecting-stem, v', and two heads, v v, of the length to cover said passages and uncover the same simultaneously by its reciprocation, substantially as described.

4. The combination of the steam-engine cylinder E, provided with steam-ports e' e' and exhaust-port o', the valve-cylinder G, provided with a longitudinal bore having unobstructed passages o o, and an intermediate passage, o^3, formed within it, each of which expands transversely outward from its shallowest part on one side of the bore around the same and leads into its engine-cylinder port on the other side, and the balanced valve V, formed with a connecting-stem, v', and two heads, v v, of the length to cover the passages o o and uncover the same simultaneously by its reciprocation, substantially as described.

5. The combination of the valve-cylinder G, the valve V, and one or more supporting sliding bars, n', attached to the ends of said valve and seated in a groove or grooves, n, in said cylinder, substantially as described.

6. The combination of the steam-engine cylinder E, provided with ports e' e', the steam-chest F, and the valve-cylinder G, provided with bolts g g, and set-screws g' g', adapted to adjust and secure the latter inside the steam-chest against the end-thrust of the valve-piston, substantially as described.

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