(No Model.)

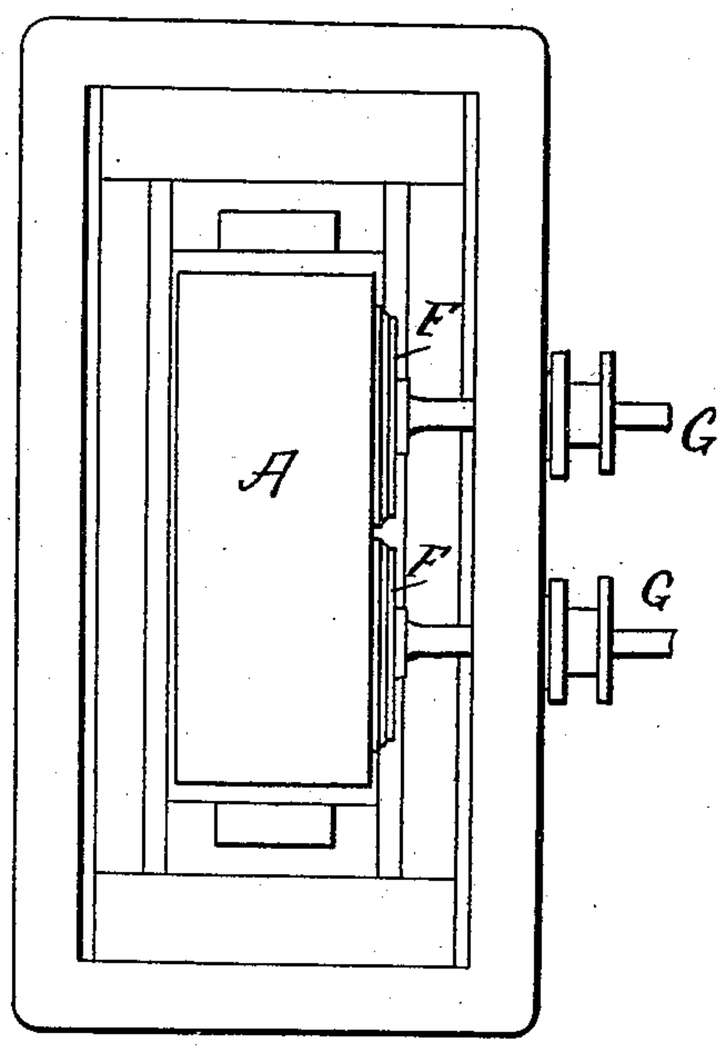
4 Sheets—Sheet 1.

J. H. MAN.

CUT-OFF VALVE.

No. 308,181. Patented Nov. 18, 1884.

Fig. 2.



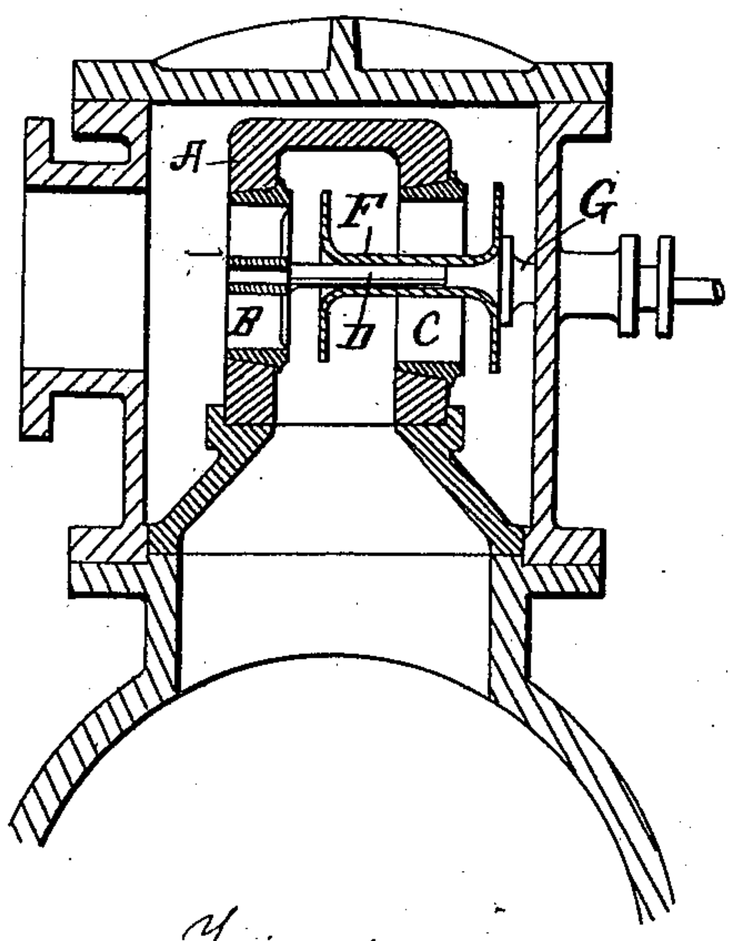


Fig. 1

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(No Model.) 4 Sheets—Sheet 2.

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Fig. 4.

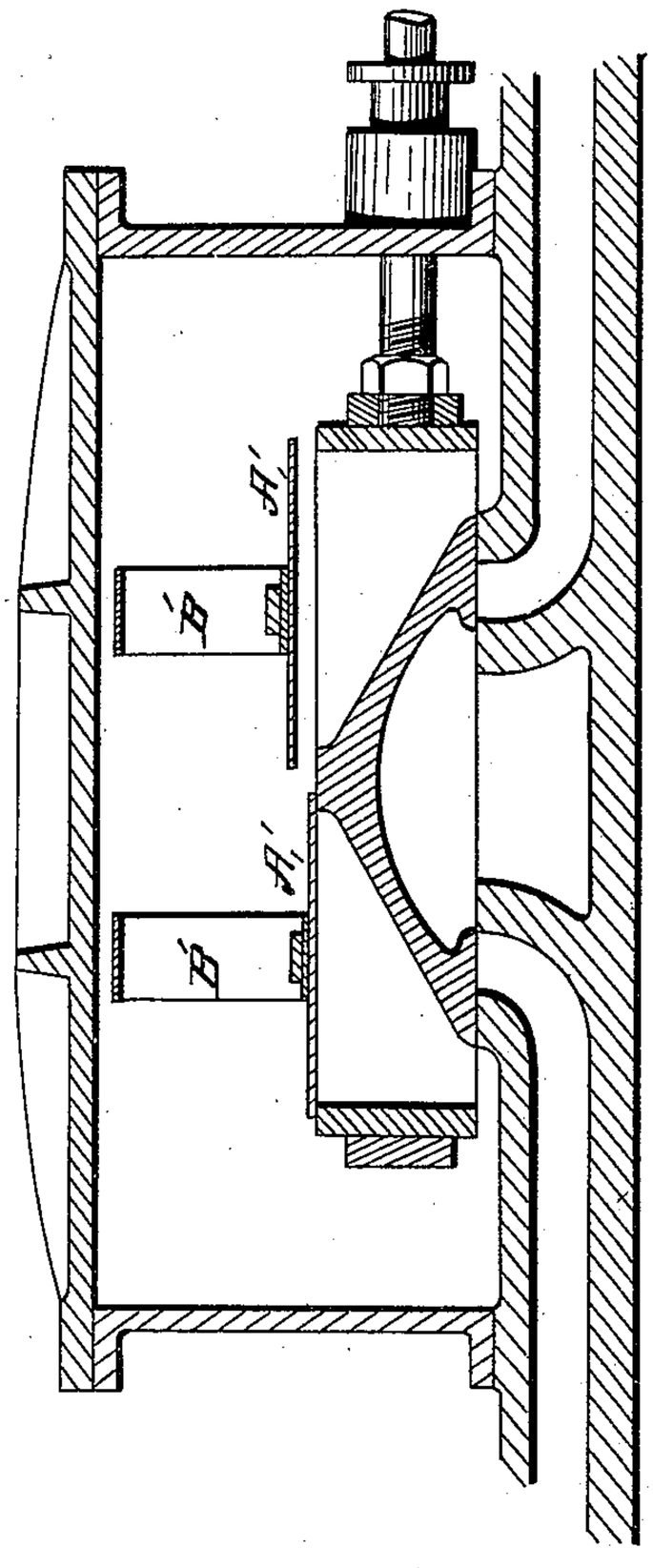
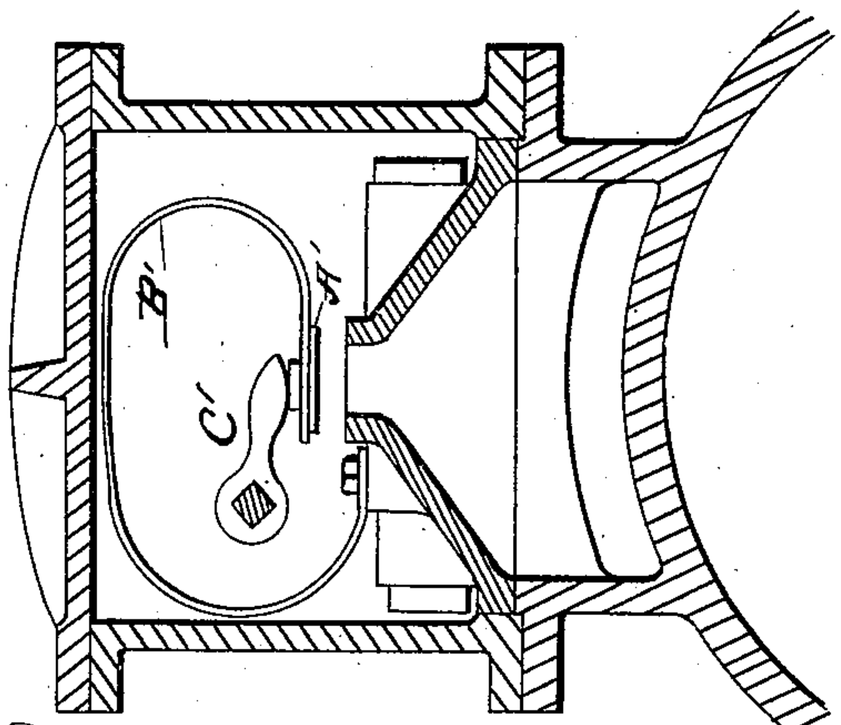


Fig. 3.



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(No Model.) 4 Sheets—Sheet 3.

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CUT-OFF VALVE.

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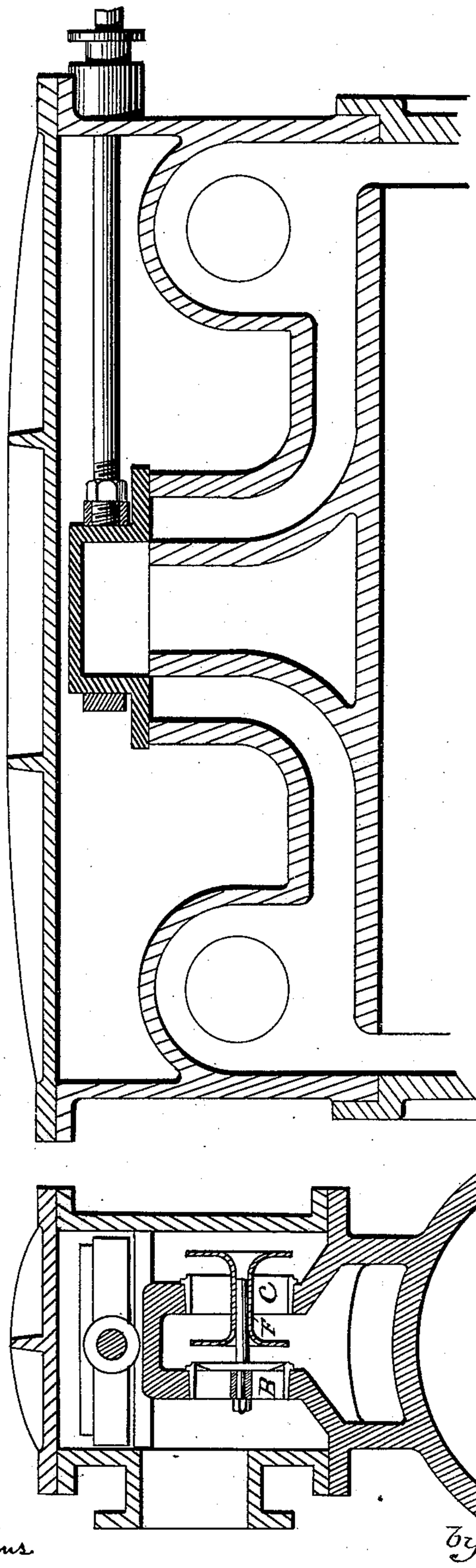

Fig. 6.

Fig. 5.

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4 Sheets—Sheet 4.

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CUT-OFF VALVE.

No. 308,181. Patented Nov. 18, 1884.

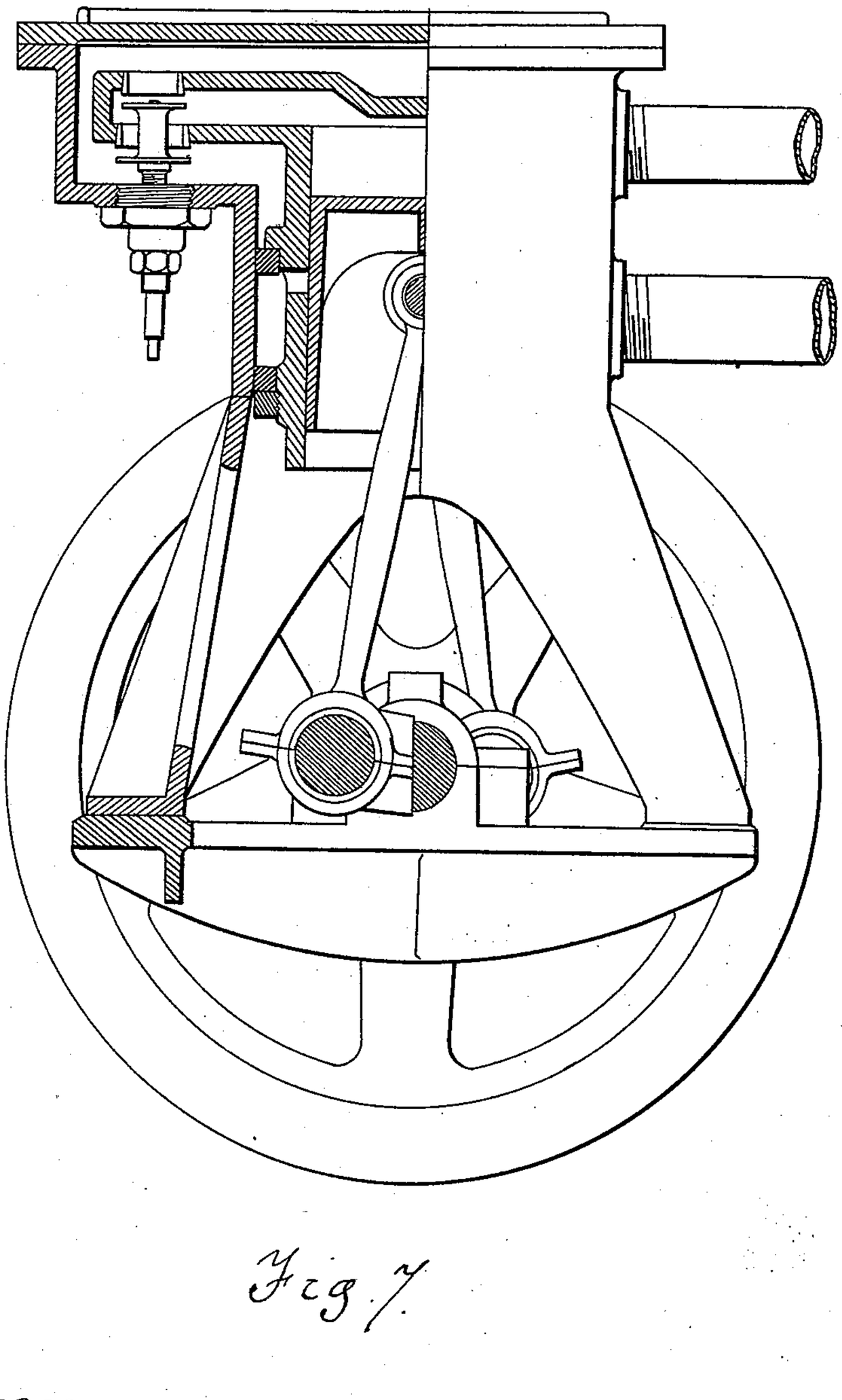

Fig. 1.

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UNITED STATES PATENT OFFICE.

JAMES H. MAN, OF DENVER, COLORADO.

CUT-OFF VALVE.

SPECIFICATION forming part of Letters Patent No. 308,181, dated November 18, 1884.

Application filed May 3, 1884. (No model.) Patented in England July 6, 1880, No. 2,765.

To all whom it may concern:

Be it known that I, JAMES H. MAN, a citizen of Great Britain, residing at Denver, in the county of Arapahoe and State of Colorado, have invented certain new and useful Improvements in Automatic Cut-Off Valves for Steam, Gas, or other Engines; and I do hereby declare the following to be a full, clear, and exact description, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention relates to automatic cut-off valves for steam, gas, or other engines, and is designed, objectively, to effect automatic and instantaneous cut-offs by means of a differential pressure acting on the valves, as will be more fully hereinafter set forth. When steam or gas at any pressure passes through an orifice into any lower pressure, its velocity is due to and varies approximately as the square root of the difference of pressures when this difference is small. If, then, the orifice be that of a valve free to close but kept open by its own weight or a spring, it is evident the valve will not remain open when the difference of pressures on either side of itself produces a force greater than that tending to keep it open. The valve is in equilibrium when these forces are equal and opposite, and the velocity of steam at the moment of equilibrium is therefore definable. By introducing such a valve between the slide-case and the cylinder, so that the velocity of the steam shall just produce equilibrium about the valve at the moment of maximum piston-speed, the valve will close and give an instantaneous cut-off at about half-stroke. To effect the cut-off earlier than half-stroke, the phenomenon of equilibrium has merely to take place at some previous moment, which may be accomplished, first, by an increase in the speed of the engine; second, a decrease in the area of the valve; and, third, a decrease in the load on the valve. From a study of the first of these causes it appears the valve when once adjusted should be an automatic regulator of speed, and this is actually the case to a limited extent, but in practice it will be necessary to adopt one of the other causes. Locomotive, marine, and other engines that require regulation of power at varying speeds can be fitted with mechanism by which the area of the valve or the load on it, or both, can be altered at pleasure, and so vary the point of cut-off to suit circumstances. In other engines requiring regulation of speed, any governor can be applied to actuate the cut-off valve or its load.

To more fully and completely explain the construction and set forth the operation of the valve and its connections recourse will be had to the accompanying drawings, forming part of this specification, in which—

Figure 1 is a vertical section of the valve and seat, showing the internal arrangements of the slide-case attached to a cylinder; Fig. 2, an elevation of the slide-case shown in Fig. 1 with cover removed, showing the valves in position. Fig. 3 shows a modification of the valve, the view being a cross-section through the slide-case; Fig. 4, a longitudinal section of the device shown in Fig. 3; Fig. 5, a cross-section of the slide-case, showing the valve of differential type applied to induction-ports independent of the slide-valve; Fig. 6, a longitudinal section of the application shown in Fig. 5; and Fig. 7, a vertical cross-sectional view of one cylinder of an engine known as the "single-acting trunk-piston" type, showing the valve of differential type applied to the induction-port of a cylinder.

The valve consists, primarily and essentially, of a disk that when closed shall fill or cover an orifice. It may be of any shape desired, and is adapted to enter its seating or sit on the edge thereof. It may be made of any suitable material, and may be either single or double beat, and there may be a single valve arranged to admit steam alternately to each end of the cylinder, or one or more valves for each end of the cylinder.

In Fig. 1 is shown a valve of the differential double-beat design, A representing the diaphragm separating the slide-case proper from the passages that lead to the cylinder. On each side of this are ports B and C, respectively, the lower one, C, being slightly the larger.

Projecting into the passage, and concentric with the ports B and C, is a spindle or bar, D, firmly secured in said position. Adapted to slide longitudinally on this bar is the valve F, in shape similar to a bobbin, and it consists

in a hollow stem of metal having two right-angle flaring projections forming two parallel disks, as shown. These two disks are different in area, the smaller resting, when the valve is closed, on the lower or inner edge of the port B, and the larger on the lower or outer edge of the port C. The valve rests normally on an adjustable stop, G, which is actuated by hand or by a governor, according to the requirements of regulation.

In the valve described above, and shown in Figs. 1, 2, 3, 6, 7, and 8, the weight of the same keeps it normally in contact with the stop, and it is necessarily placed in an upright position.

The operation of the valve will be clearly evident from the statements heretofore made. The steam entering at the port C being slightly impeded or throttled by the disk of the valve would tend to force the said valve inward till it engaged with the edge of the valve-seat, thus cutting off the steam; but the steam also enters the port B, and in consequence of the same throttling exerts a certain force on the inner disk of the valve, thus tending to keep it open. Were the disks of the same size, the force exerted on each would be the same, and the valve would remain resting on the stop, its weight keeping it in the said position; but the inner disk being smaller than the outer the force must be the greater, and when the difference between these forces is sufficient to overcome the weight of the valve it will close, and the closing will be practically instantaneous, as the valve in closing reduces the area for the passage of the steam, and causes it to pass through the diminished opening with greater velocity, thereby exerting a constantly-increasing force on the valve, the operation being so quickly performed as to be practically instantaneous, as stated.

The operation is the same whether the resistance to the closing of the valve be a spring or a weight, as described. The use of a spring allows the position of the valve to be other than perpendicular, as is evident. Thus it will be seen, if the valve be so adjusted that the steam passing through it at the moment when the piston acquires its maximum speed shall acquire a certain velocity, so as to become throttled, and exert force enough to close the valve, the steam will be cut off at about half-stroke, and that if the adjustable stop be raised so as to decrease the area presented for the passage of the steam the steam will become sufficiently throttled, and the maximum velocity requisite to close the valve will be attained earlier in the stroke, thus effecting cut-offs at any desired point earlier than half-stroke.

To regulate such engines as are used for locomotive and marine purposes suitable mechanism can be applied to the stops so as to adjust its position at pleasure; but in other engines requiring regulation of speed any governor can be applied to actuate the stop so as to automatically regulate the point of cut-off.

In the Figs. 1, 2, already described, the valves are placed in a box or chamber on the back of a slide-valve of the thoroughfare type, said box or chamber being secured in a stationary position, and is such that in the successive positions of the slide-valve each thoroughfare-port of the slide-valve is brought alternately opposite each corresponding valve-chamber, respectively; but in Figs 3 and 4 are shown the application of the principle in a valve of different construction to the ports of a thoroughfare slide-valve. This latter valve consists, essentially, of a flat piece of metal, A′, adapted to rest over and close the usual induction-port of the slide-valve. The valve is normally kept away from its seat, as shown, by a suspensory spring, B′, preferably flat and of elliptical shape, as shown. The spring keeps the valve against the adjustable stop C′ with a limited force. The action of the valve depends on the velocity of the steam passing into and through the port, as does that of the differential double-beat design already described. It is evident that the nearer the stop adjusts the valve to the port the greater will be the speed of the steam passing through the diminished area. In other words, the steam will become sufficiently throttled and the maximum velocity requisite to close the valve will be attained earlier in the stroke, thus effecting an earlier cut-off, and, vice versa, the greater the area the later will be the cut-off.

In Figs. 5 and 6 is shown the application of the differential double-beat design to separate induction-ports, one for each end of the cylinder, the function of the slide-valve being to admit steam to the cylinder for only a short portion of the stroke, and to exhaust in the usual way.

Fig. 7 shows the application of the differential double-beat valve to that class of engines known as the "single-acting trunk-piston engine." In this engine there is no connection between the rotating shaft and the inlet-valve, neither is there any slide-valve. The point of cut-off is determined by the amount of area presented for the passage of the steam and the speed of the engine at the time. The exhaust takes place at the end of the stroke by the piston uncovering an annular space, the remaining steam being compressed by the piston on its return-stroke till it reaches the initial pressure, when the weight of the valve is free to exert its force in opening the valve before the beginning of the next stroke.

It is evident any form of valve actuated by a differential pressure can be applied to this class of engines. In the several applications of the valve shown and described, when the cut-off has taken place, the pressure in the cylinder is being continually reduced by the expansion of the steam, and after the exhaust the pressure is still further reduced, while the pressure in the slide-case remains the same, which condition would cause the valve to remain firmly closed; but, at any time after the

exhaust-port is closed and before the valve is again required for use at the beginning of the next stroke, the pressure within the valve-chamber is raised, so as to be equal to that in the slide-case. This is effected in the case of its application to a slide-valve by causing the slide-valve, in its travel, to uncover a port for the admission of steam from the slide-case to the valve-chamber, and in the application to separate induction-ports by admitting steam during the early portion of the stroke by means of the slide-valve to the valve-chamber and the cylinder, and in the application to single-acting trunk-piston engines by causing the piston on its return-stroke to compress the steam remaining in the cylinder at the end of the stroke till it reaches the initial pressure.

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

1. The method of automatically actuating cut-off valves herein described, which consists in first opening the valve by a defined limited force and then closing the same against the operation of such force by differential pressures on opposite sides of said valve, as specified.

2. An automatic cut-off valve provided with means for normally holding the same open, such valve being so arranged with relation to the passages that it is automatically closed by the fluid-current induced by the difference of pressure on opposite sides thereof caused by the piston movement, substantially as described.

3. In combination, a valve actuated in one direction by differential pressures on its opposite sides, and means for adjusting the valve and thereby regulating the area of the steam-passages with relation to the speed of the engine and varying the point of cut-off, substantially as specified.

4. In combination, a valve actuated in one direction by differential pressures on its opposite sides, and an adjustable stop operated by suitable means for effecting an automatic regulation of speed, as set forth.

5. A valve consisting of a hollow stem having two flaring right-angle projections forming two parallel disks of different diameters, the stem being adapted to receive a spindle or bar, which supports and guides the said valve, and which in turn is firmly supported, so as to bear a fixed position relative to the valve-seats, the whole being arranged to operate to cut off the steam in its passage from the steam-chest to the cylinder, substantially as and for the purpose set forth.

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

JAMES H. MAN.

Witnesses:
OSCAR REUTER,
JAMES H. BROWN.