

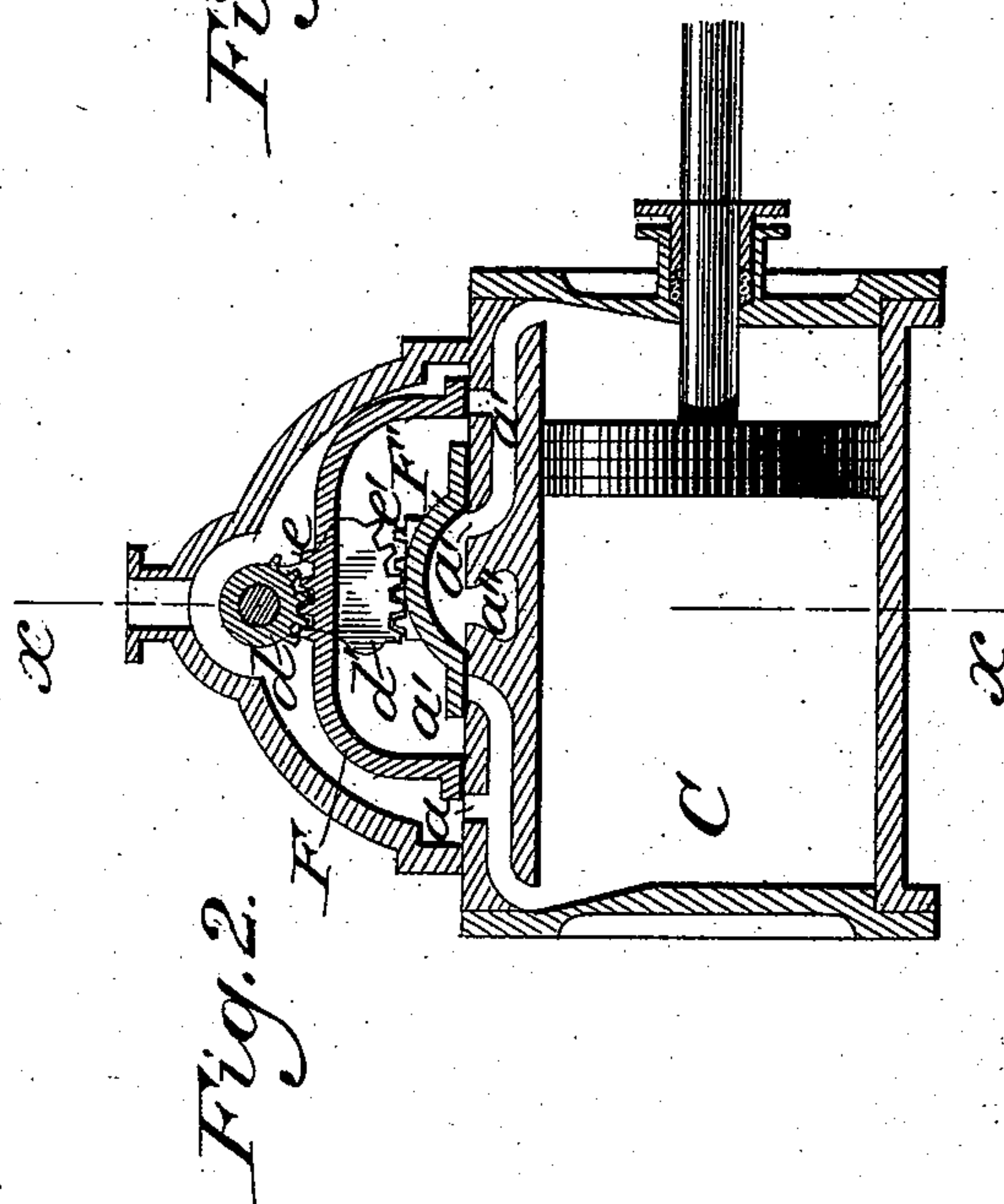
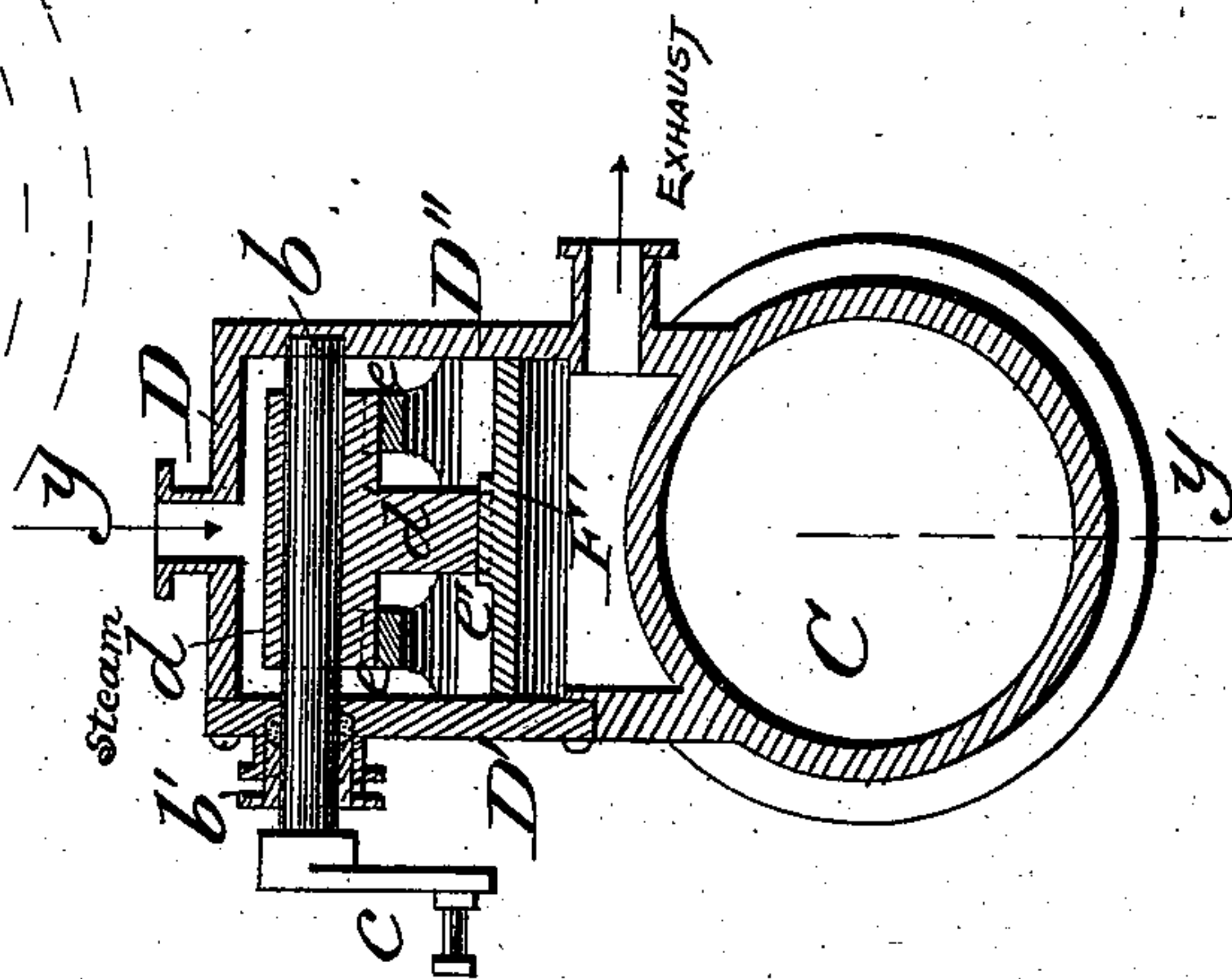
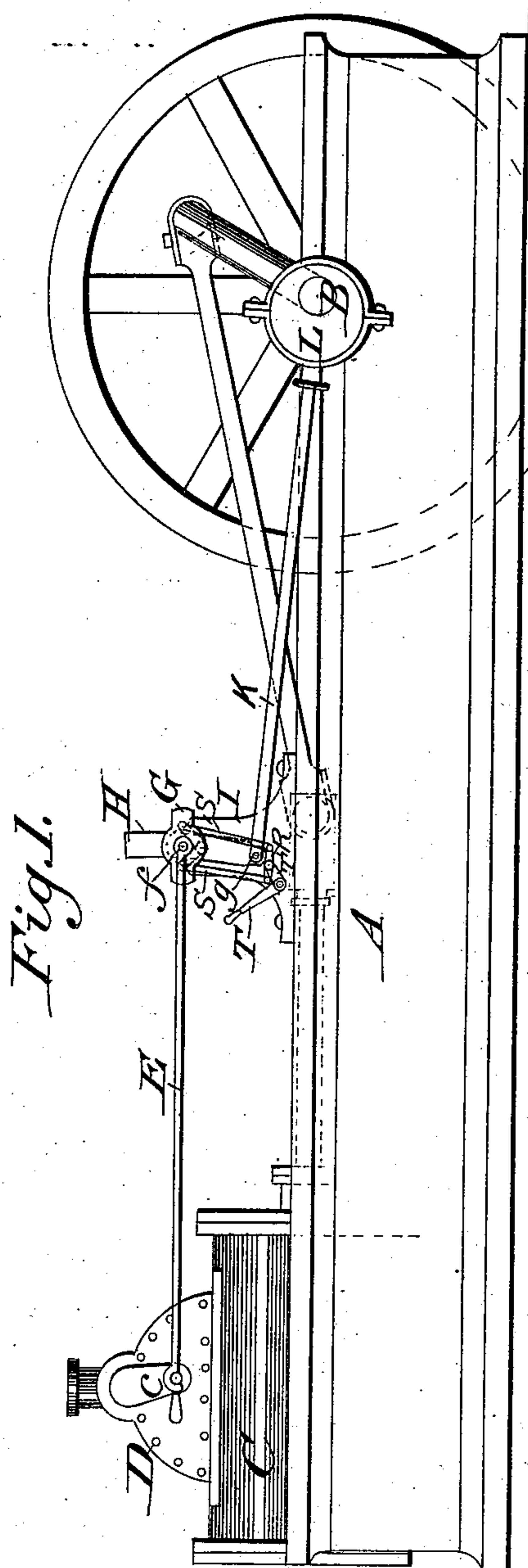
(No Model.)

2 Sheets—Sheet 1.

F. L. SMITH.  
VALVE FOR STEAM ENGINES.

No. 382,564.

Patented May 8, 1888.



Witnesses.

*H. H. Schott.*

*W. Burroughs.*

Inventor.

*Frank L. Smith.*

By *his* Attorney *W. P. Chandler.*

(No Model.)

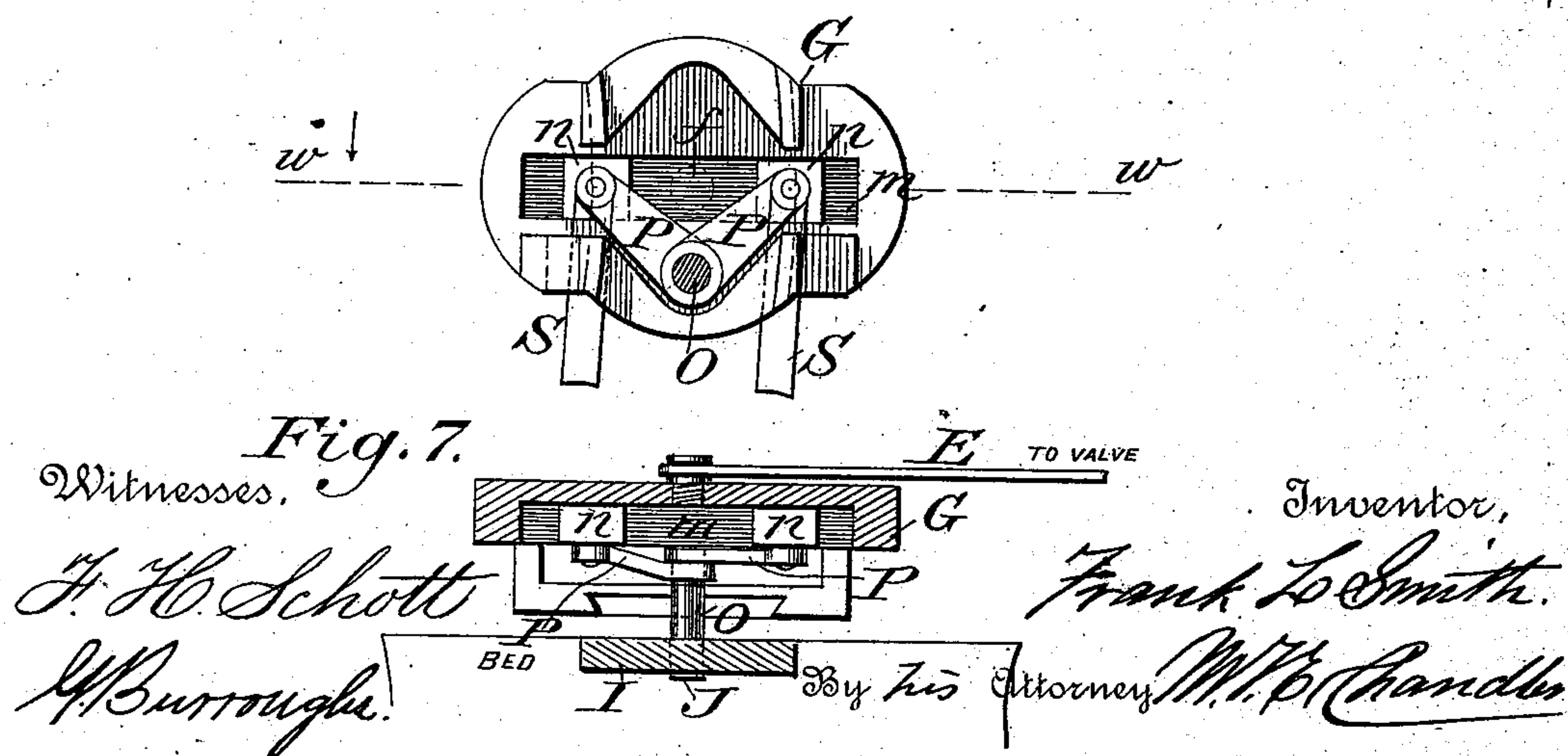
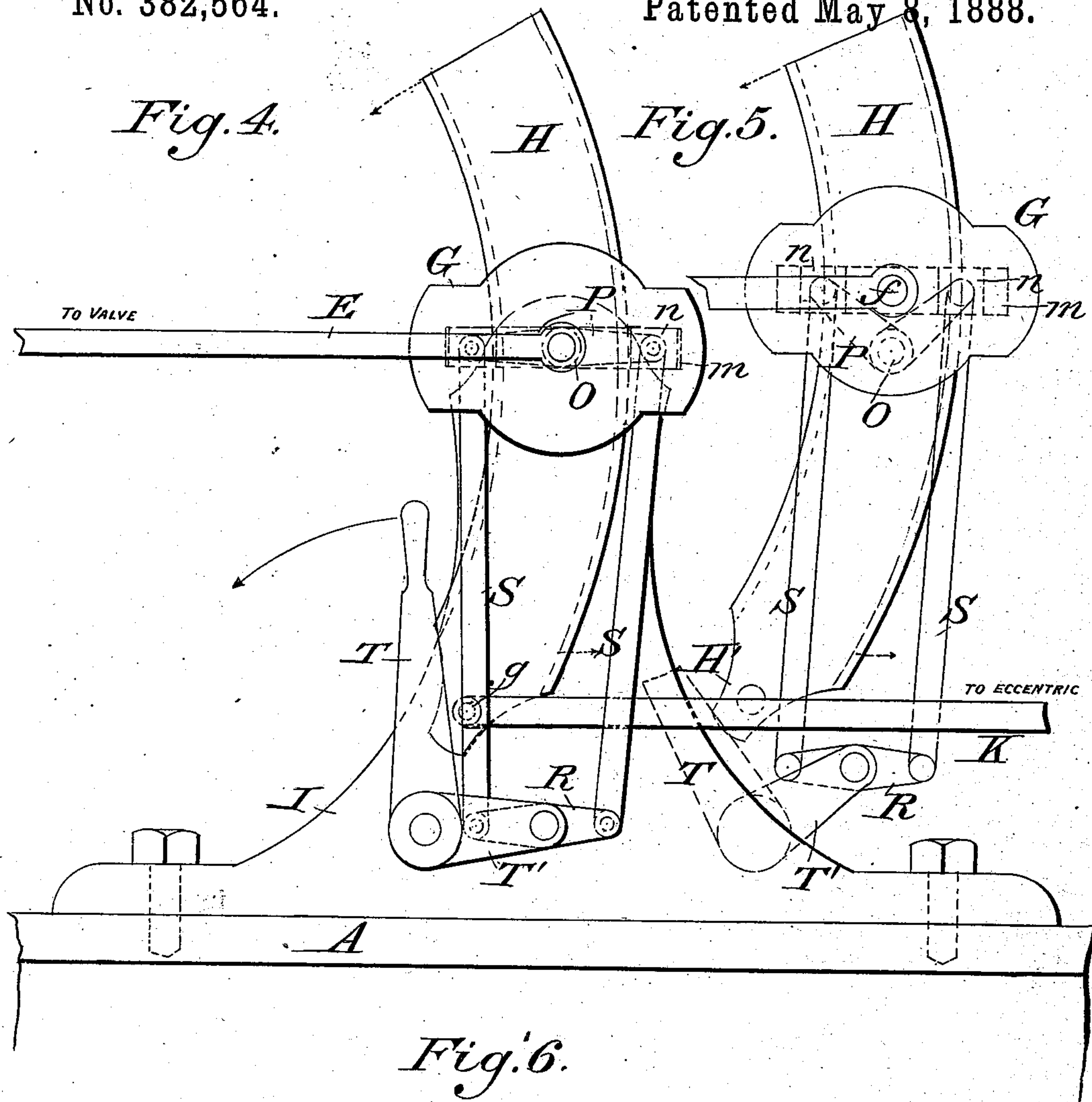
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F. L. SMITH.

# VALVE FOR STEAM ENGINES.

No. 382,564.

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# UNITED STATES PATENT OFFICE.

FRANK L. SMITH, OF HOLTON, MICHIGAN, ASSIGNOR OF ONE-HALF TO  
WILLIAM S. CLARK, OF SAME PLACE.

## VALVE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 382,564, dated May 8, 1888.

Application filed September 12, 1887. Serial No. 249,479. (No model.)

*To all whom it may concern:*

Be it known that I, FRANK L. SMITH, a citizen of the United States, residing at Holton, in the county of Muskegon and State of Michigan, have invented certain new and useful Improvements in Valves for Steam-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, reference being had to the accompanying drawings, and to the letters and figures of reference marked thereon, which form a part of this specification.

This invention relates to the construction and operation of valves for steam-engines, the object being to produce a valve by which the steam can be cut off at any desired point while the engine is in motion, and at the same time give a quick release to the exhaust-steam, and, further, to construct the valve and valve-gear in such a manner that the engine may be readily reversed, although but a single eccentric is used. To accomplish these objects I employ two slide-valves, one outside the other, the outer one serving to open and close the induction or steam ports and the inner one serving the same purpose with relation to the exhaust-ports. By means of the difference in length of the toothed arms, which form the connection between these valves and the rock-shaft which operates them, the travel of the inner or exhaust valve is greatly increased over that of the outer valve, which admits live steam to the cylinder. This increase of travel in said exhaust-valve causes it to release the steam quickly, thus allowing a free exhaust, no matter at what point the engine may be cutting off. To give motion to the rock-shaft which operates these valves, an ordinary eccentric is placed upon the engine-shaft, a rod from which connects with the lower end of a rocker-arm and guide-box carrying a sliding cross-head, which cross-head is connected by a rod with the rock-shaft that operates the valves. A suitable lever connected with the cross-head allows it to be moved to any desired point on the guide-bar. When it is at the axis or center of motion of

the guide-bar, the valve would cover both ports, and of course no steam could enter the cylinder, so the engine must come to a standstill; but when the cross-head is raised upon the guide-bar above such axis the engine will revolve its shaft in one direction, and when it is dropped to a corresponding point below the same, said shaft will be revolved in the opposite direction, thus forming a novel and convenient valve-gear, by means of which the steam is used economically and the reversal of the engine's movement readily accomplished. The valve is more easily balanced than the ordinary D-valve. By releasing steam quicker there is greater pressure on the under side of the exhaust-valve, causing less friction on the face of steam-chest that is traveled by exhaust-valve. The upper valve, having less travel or less surface to cover to admit steam to cylinder, would have less friction than the D-valve now in use.

In the accompanying drawings, in which similar letters of reference indicate like parts in the different figures, Figure 1 is a side elevation of an engine provided with my improved valves and valve-gear. Fig. 2 is a longitudinal section through the steam chest and cylinder on the line *y y* of Fig. 3. Fig. 3 is a transverse vertical section through the steam chest and cylinder on the line *x x*, Fig. 2. Fig. 4 is a side elevation of the reversing-gear upon an enlarged scale. Fig. 5 is a similar view with the cross-head in a different position. Fig. 6 is a detail view showing one side of the cross-head and the devices by which it is raised and lowered on the curved guide-bar. Fig. 7 is a horizontal section of the cross-head on line *w w* of Fig. 6.

In the several figures, A represents the engine-bed; B, the shaft, and C the steam-cylinder. These parts are all of the ordinary construction, and require no special description. Secured upon the valve-seat on top of the cylinder by bolts is the steam-chest D; or, if desired, this chest may be cast integral with the cylinder, an opening being left at one or both sides for the insertion and adjustment of the valves, as shown in the drawings, where D is the steam-chest, and D' D'' the covers



bolted to its sides and to the cylinder. Traversing this steam-chest transversely is a rock-shaft, *b*, which passes out at one side of the same through a stuffing-box, *b'*, and is provided at its outer end with a downwardly-projecting arm, *c*, carrying a pin with which the valve-operating rod *E* engages. Upon this rock-shaft *b*, within the steam-chest, are secured the toothed pinions or segments *d* and *d'*. The first of these segments, *d*, engages with the teeth *e* upon the top of the valve *F*, and communicates motion to the same for the purpose of opening and closing the steam-ports *a a* of the cylinder, thus admitting steam to its opposite ends alternately, as desired. This valve is in shape similar to the ordinary **D**slide-valve, with the exhaust-opening greatly enlarged, so as to admit within it the valve *F'*, which performs the functions of alternately opening and closing the exhaust-ports *a' a'*. This valve is provided with a toothed rack, *e'*, with which engages the toothed segment *d'* of the rock-shaft *b*. It will be seen that the segment *d'* is much longer or its teeth at a greater distance from the axis of the rock-shaft than the teeth of the pinion or segment *d*, and as they are both firmly secured to the rock-shaft it follows that as the latter oscillates it gives to the valve *F'* a longitudinal movement three times as great as that of the valve *F*, thus, as hereinbefore stated, allowing a perfectly free exit for the exhaust-steam from the cylinder through the ports *a a* and the port *a''*, which last is open to the cavity of the valve *F'* at all times.

The pinions or segments that operate these valves are made adjustable upon the rock-shaft, so that all wear of either valve or segment may be taken up and the movements of the parts upon each other made positive, thus preventing lost motion and consequent rattling or other noises resulting therefrom.

In order to impart the desired movements to these valves, the rod *E* connects with a pin, *f*, secured to the sliding cross-head *G*, which cross-head has a vertical movement upon the curved guide-bar *H*. This bar oscillates upon a journal, *J*, attached to it at a point near the middle of its length, said journal being supported in the bracket *I*, secured to the engine-bed. Forming a part of the guide-bar is an extension, *H'*, which carries the pin *g*, to which one end of the eccentric-rod *K* is connected, its opposite end forming a strap which encircles the eccentric *L*, secured upon the engine-shaft. The rotation of this shaft will impart a swinging movement to the guide-bar *H* through the agency of the eccentric and rod connecting said shaft and guide-bar, and this movement of the bar will be communicated to the valves through the valve-rod *E*, such motion being in proportion to the distance of the pin *f* from the axis upon which the guide-bar oscillates.

As it is desirable to change the position of the pin *f* from a point above or below the axis

of the guide bar to a similar point in the opposite end of said bar, for the purpose of reversing the direction of revolution of the engine, as well as changing its position on the same arm, in order to give a greater or less throw to the valves, for the purpose of changing the supply of steam in the cylinder, it becomes necessary to provide means for accomplishing this result. I attain this object by forming a transverse slot or recess, *m*, in the cross-head *G*, and placing on the journal *O* of said cross-head cranks *P*, the pins of which are connected with blocks *n n*, sliding in the slot *m* of the cross-head. These blocks are connected by the rods *S* with the lever *R*, pivoted at *u* to the short arm *T'* of the hand-lever *T*. An arc-shaped bar provided with suitable notches for the retention of the lever *T* in any desired position may be placed at a convenient point, and will hold said lever, and consequently the cross-head, at any point desired on the bar *H*. It is evident that any movement of this lever will act upon the cross-head and its connections, causing said cross-head to be raised or lowered upon the guide-bar as the lever is elevated or depressed.

The curved oscillating guide-bar having the form of a circular segment, its radius equal to the length of the valve-rod, does not change the position of the valve when the cross-head is moved up or down upon it, and therefore cannot affect a change in the lead of the valves, as it would if said bar were straight or formed upon any other curve. The two cranks attached to the sliding blocks in the cross-head take up the vertical movement that would otherwise be imparted to said cross-head by the swinging of the guide-bar, thus allowing the pin *f*, to which the valve-rod is attached, to move in a straight line.

Having thus described my invention, I claim as new and desire to secure by Letters Patent the following:

1. As an improvement in steam-engine valves, an outer valve acting as a steam-induction valve, in combination with the inner valve acting as an exhaust-valve, both valves having a simultaneous independent and positive motion in the same direction, in combination with the steam-cylinder having separate induction and exhaust ports opening into the steam-passage, and each port covered by its own valve, substantially as shown and described.

2. As an improvement in steam-engine valves, the combination of the inner and outer valves, each having toothed racks, with the rock-shaft traversing the steam-chest above the valves and connected therewith by toothed segments engaging the toothed racks of the valves and adapted to give a greater movement to the exhaust than the steam valve, substantially as specified.

3. As an improvement in steam-engines, the cylinder provided with separate steam and exhaust ports, a sliding steam-valve and a



sliding exhaust-valve inclosed within the steam-valve, and the rock-shaft for moving said valves, in combination with the valve-rod, adjustable cross-head, oscillating guide-  
5 bar, eccentric-rod, and eccentric, all operating conjointly to reciprocate the valves, as set forth.

In testimony whereof I affix my signature in presence of two witnesses.

FRANK L. SMITH.

Witnesses:

DAVID D. ERWIN,  
R. A. FLEMING.