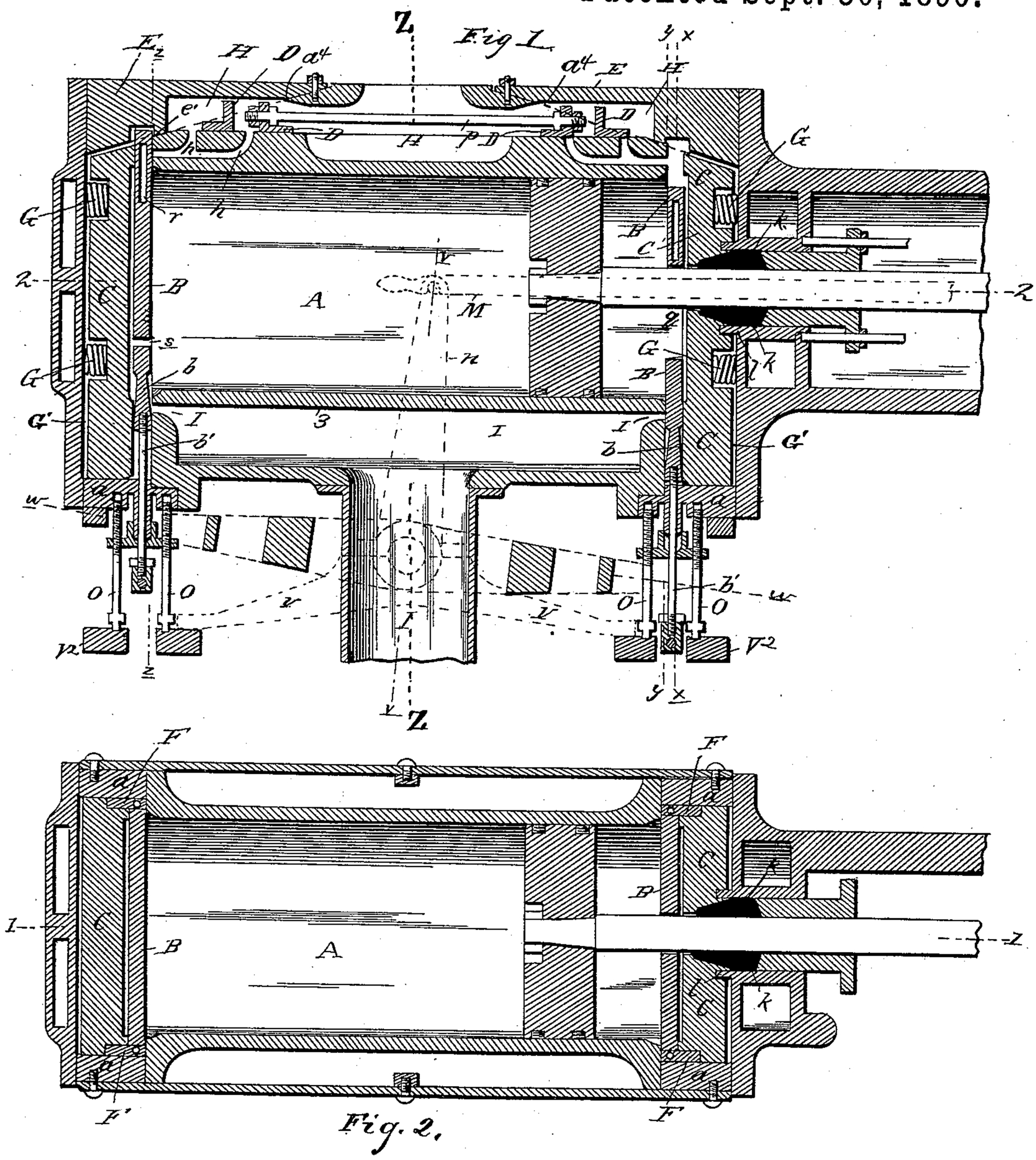
(No Model.)

4 Sheets—Sheet 1.

F. PILKINGTON.

STEAM ENGINE VALVE.

No. 437,618. Patented Sept. 30, 1890.



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(No Model.) 4 Sheets—Sheet 2.

F. PILKINGTON.

STEAM ENGINE VALVE.

No. 437,618. Patented Sept. 30, 1890.

Fig. 3.

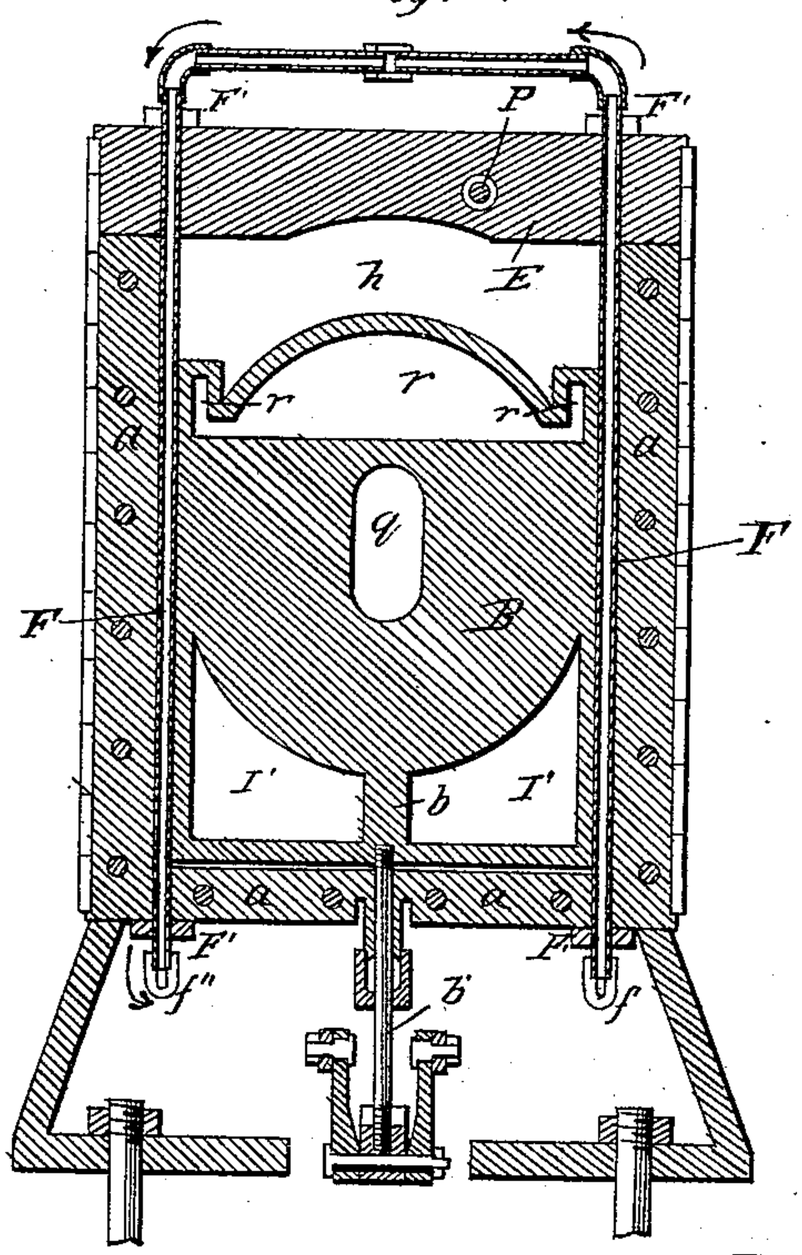


Fig. 4.

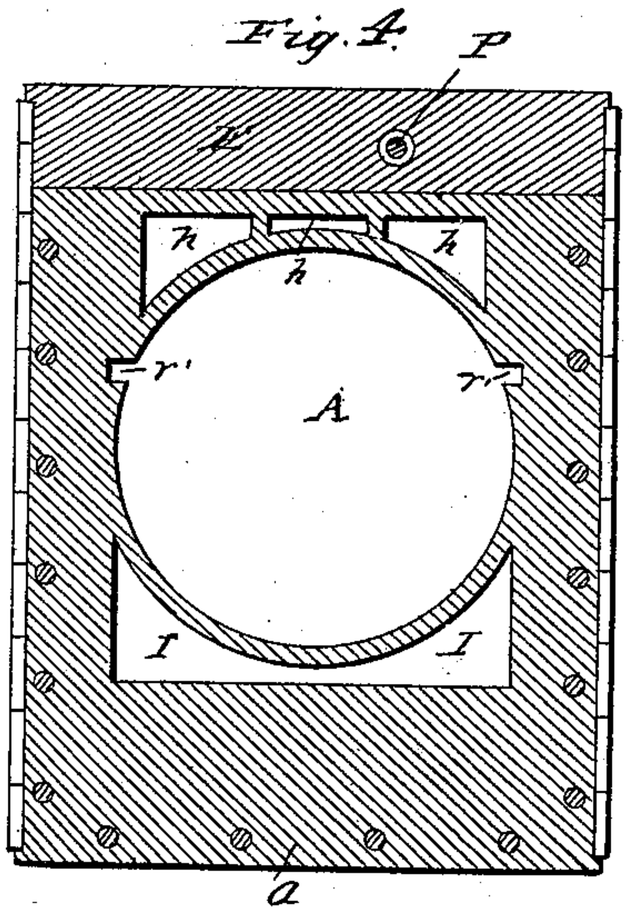
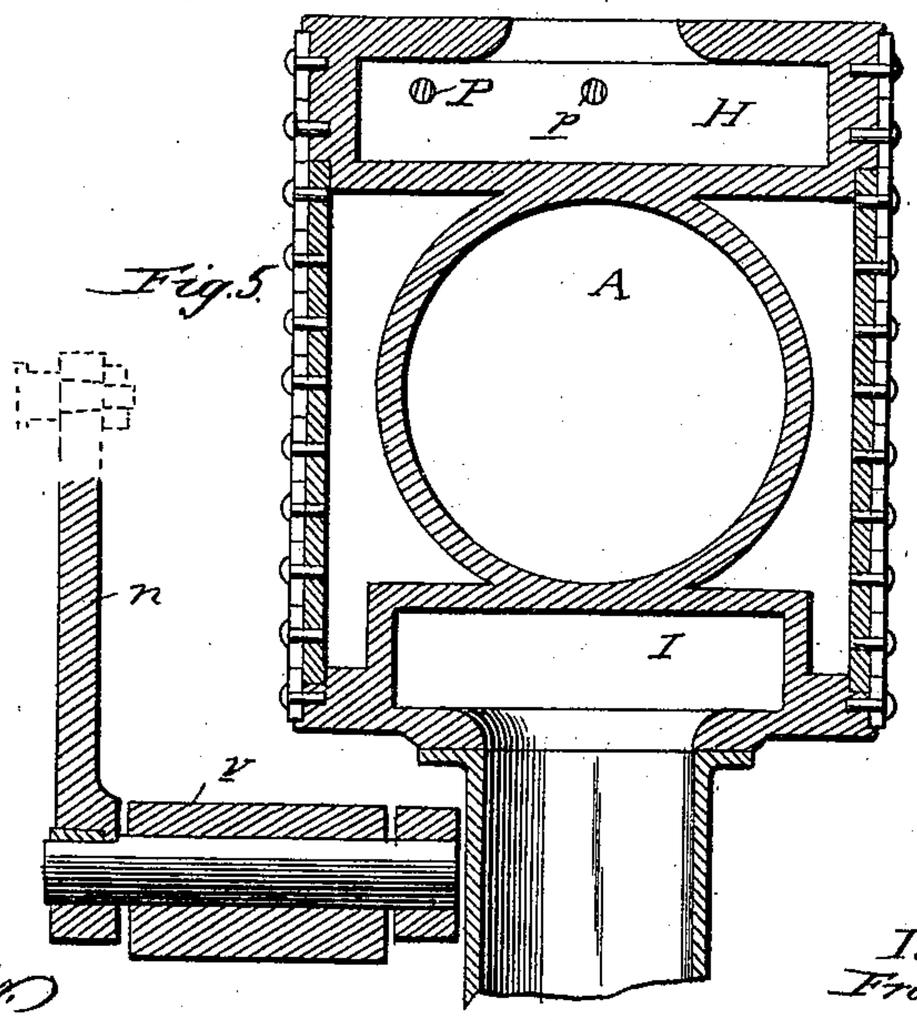


Fig. 5.



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STEAM ENGINE VALVE.

No. 437,618. Patented Sept. 30, 1890.

Fig. 6.

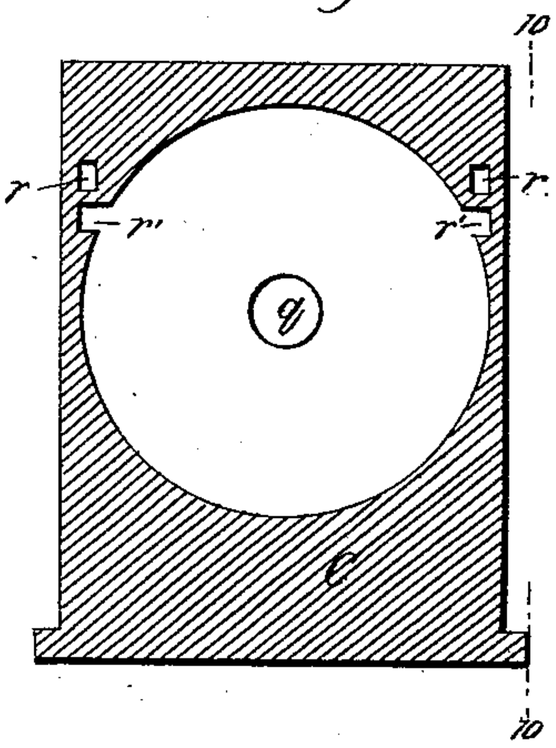


Fig. 7.

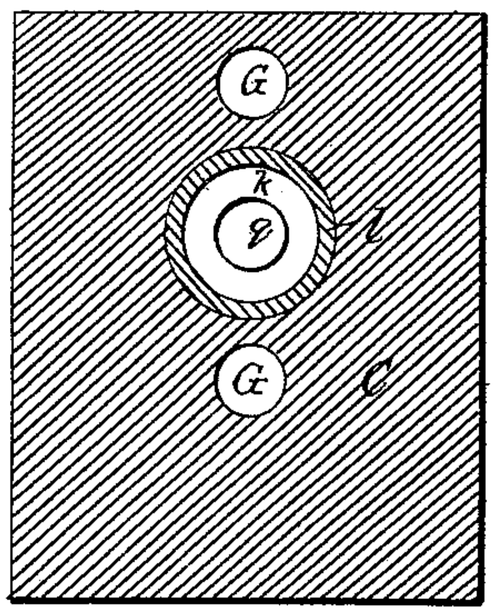


Fig. 8.

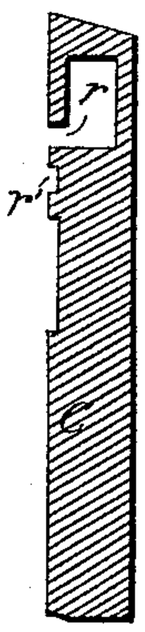


Fig. 9.

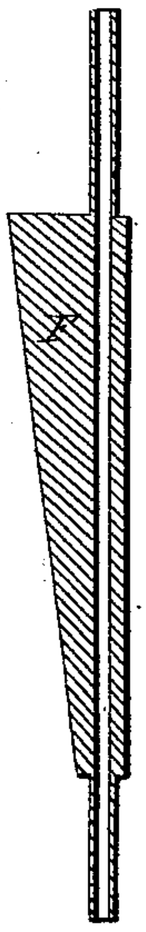
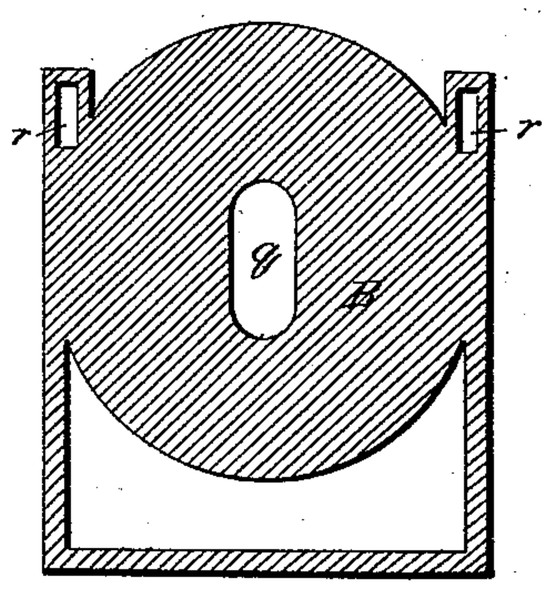


Fig. 10.

Fig. 11.



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STEAM ENGINE VALVE.

No. 437,618. Patented Sept. 30, 1890.

Fig. 12.

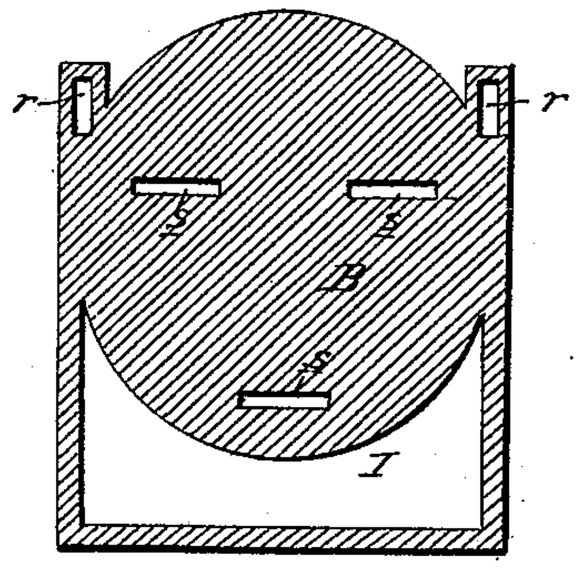

Fig. 15.

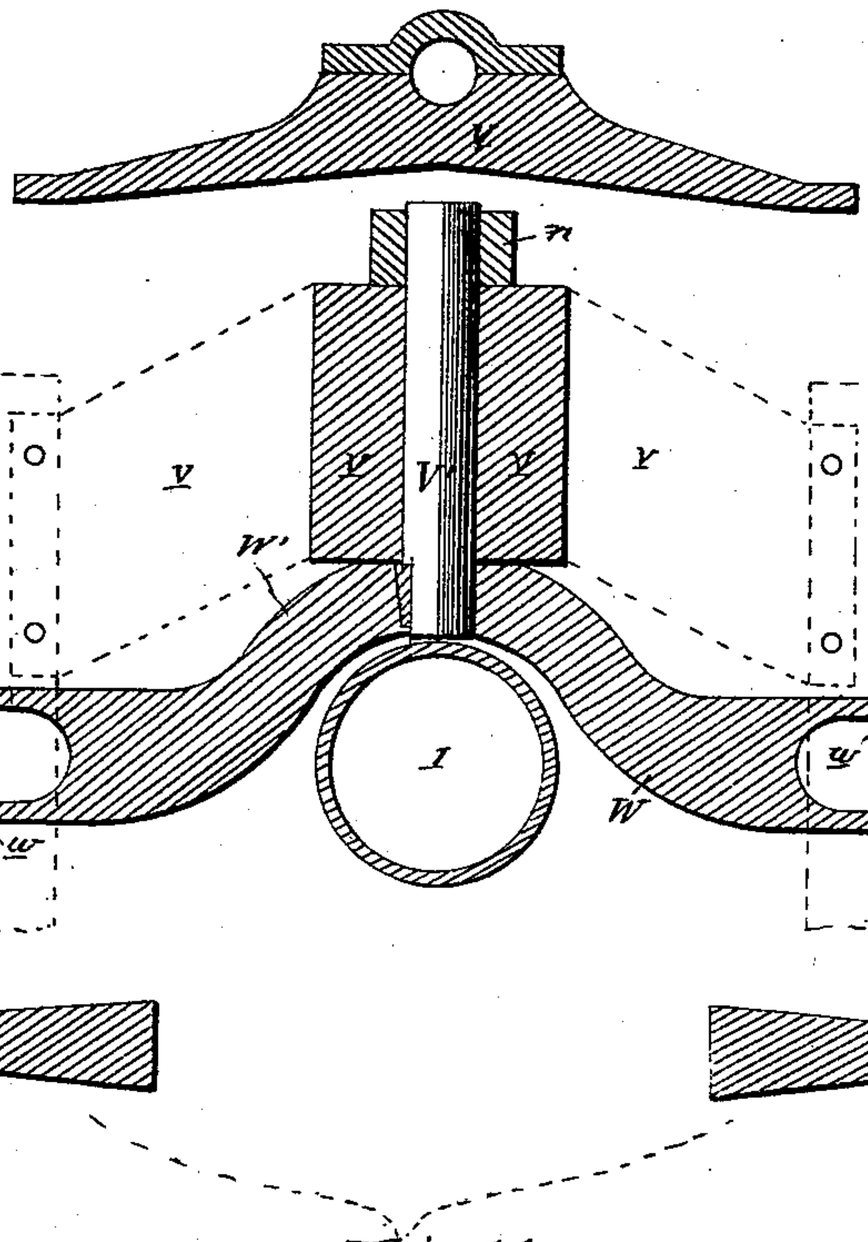

Fig. 13.

Fig. 14.

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UNITED STATES PATENT OFFICE.

FRANKLIN PILKINGTON, OF ANNISTON, ALABAMA.

STEAM-ENGINE VALVE.

SPECIFICATION forming part of Letters Patent No. 437,618, dated September 30, 1890.

Application filed December 26, 1888. Serial No. 294,585. (No model.)

To all whom it may concern:

Be it known that I, FRANKLIN PILKINGTON, a citizen of the United States, residing at Anniston, in the county of Calhoun and State of Alabama, have invented certain new and useful Improvements in Steam-Engine Valves; 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 of reference marked thereon, which form a part of this specification.

This invention relates to steam-engines, and has for its object to improve the ends of cylinders, the main valves, their location, openings in and through same for compression in and balancing, the back valve-seats and openings for compression in same, the stuffing-box in back valve-seat at crank end, the hollow wedges for adjusting the back valve-seat to valve and method for expanding them before starting the engine, and the cap on steam-chest at ends of cylinder.

The improvement consists in the details of construction and the novel combination of the parts, which will be hereinafter more fully described and claimed, and which are shown in the annexed drawings, in which—

Figure 1 is a vertical longitudinal section through center of cylinder about on the line 1 1 of Fig. 2. Fig. 2 is a horizontal section about on the line 2 2 of Fig. 1. Fig. 3 is a vertical cross-section on the through line $x\,x$ of Fig. 1. Fig. 4 is a vertical cross-section on the line $y\,y$ of Fig. 1 Fig. 5 is a vertical cross-section on the line $z\,z$ of Fig. 1. Fig. 6 is a face view of the back valve-seat next to valve at crank end. Fig. 7 is a rear view of the said back valve-seat at crank end. Fig. 8 is a cross-section of the back valve-seat on the line 8 8 of Fig. 6. Fig. 9 is a longitudinal section on an enlarged scale of the hollow wedge for adjusting the back valve-seat to the valve. Fig. 10 is an edge view of back valve-seat and side view of the hollow wedge on line 10 10 of Fig. 6. Fig. 11 is a face view of valve on line $y\,y$, Fig. 1. Fig. 12 is a face view of the valve at back or head end of cylinder on line $z\,z$, Fig. 1. Fig. 13 is a detail view of the curved rocker around the exhaust-pipe to drive the valves on line $w\,w$, Fig. 1. Fig. 14 is a detail view of the ends of rocker, Fig. 13. Fig. 15 is the bearing for rocker, shown in dotted lines $v\,v$, Fig. 1.

D D is a cut-off valve. It is a plain twin valve of ordinary construction and is placed to one side of center of steam-chest, so that the rocker which drives it will not come over the center of cross-head.

E is a cap over the twin valve. It is oblique at the sides near each end, as indicated by the dotted lines a^4 in Fig. 1, thereby making a steam-tight joint across top of cylinder. The wedges F (the two being provided for each end of the cylinder, one located at each side of the valves and the valve-seats, as shown most clearly in Fig. 2) are made hollow and connect by pipe from bleeder at throttle-valve to elbow f' at bottom of wedge, Fig. 3, the water and steam from steam-pipe passing in wedge at bottom, thence up and over top of cylinder, thence down the wedge on the other side, as shown by arrows, Fig. 3, thence by pipe from elbow f'', Fig. 3, to exhaust-pipe, thereby expanding the wedges before the engine is started, so the valves cannot bind by getting hot first at top and center.

G are coil-springs interposed between the ends of the cylinder and the balance-plates C, which are provided at each end of the cylinder to hold said balance-plates against the hollow wedges F when the throttle is shut and the engine is stopping. At all other times the pressure on the rear side of said valve-seats is equal to or greater on the back than the pressure on the front side thereof.

H is a steam-chest; h, steam-ports; I, exhaust-chamber in cylinder-casting, and I′ exhaust-ports in lower ends of the valves B. The lower end bar of the valves is strengthened by the rib b, Fig. 3, which in Fig. 1 obstructs the view of the said exhaust-ports I′.

k is the piston-rod stuffing-box in the end of cylinder and balance-plate, Figs. 1, 2, and 7, and is designed to prevent steam escaping near the piston-rod either externally or through the balance-plate into cylinder. The flange l on the end of the cylinder-head projecting into the balance-plate forms part of stuffing-box, Figs. 1, 2, and 7.

M is an eccentric-rod to rocker-arm, Fig. 1;

P, cut-off-valve stem to rocker, Figs. 3 and 4; *p*, rods connecting the parts of the twin cut-off valve D D together, Figs. 1 and 5; *q*, openings in valve and valve-seat at the crank end of the cylinder for piston-rod to pass through, Figs. 1, 3, and 11; *r* and *r'*, passages in valves and valve-seats for compression space, Figs. 1, 3, 4, 6, 8, 11, and 12; *s*, openings through valve B at head end of cylinder for balancing the said valve.

The hole *q* in the valve B at the crank end of the cylinder is sufficiently large for the piston-rod to pass through and at the same time admit the cylinder-pressure at all times back of the said valve, thereby balancing the same. The valves B B and their connection are so disposed with reference to each other and the rocker that they balance themselves on the rocker and take up all lost motion or looseness in rocker-joints and valve-stem connections, thereby allowing plain pin-joints—non-adjustable—to be used. The openings through the valves for balancing and the piston-rod, act as auxiliary ports both for admission and exhaust. The main valves B B control admission, exhaust, and compression, and they could with slight variation be adapted to a single-valve engine. The hollow wedges are held by nuts F' at top and bottom of cylinder. (See Fig. 3.) The main valves also act as a safety-valve for cylinder, in that they do not fill the space by one-eighth of an inch to cylinder-heads, Figs. 1 and 2, and in case the cylinder is flooded from any cause the piston-head will force the valves back in the clearance-space G' next to cylinder-heads, thereby opening both steam and exhaust ports to the instant relief of the cylinder, and also doing away with the necessity for cylinder-cocks. The balance-plates are countersunk on side next to valves one-sixteenth of an inch, the same area as end of cylinder, which is counterbored three-eighths of an inch deep to allow reboring without interfering with the valves. The improvement by this arrangement is this: The valves being virtually in the cylinder and the edge of the counterbore and end and edge of valves acting as edges of ports, the width of port-opening being made by valve travel, there are no ports to be filled and emptied at each stroke of the piston, and as a result the ordinary port area is done away with and the clearance or waste room made that much less, and as a result the engine would use less steam for a given amount of work, and, if a condensing-engine, the condenser would have that much less volume to condense, and on that account taking less water or increasing the vacuum, or both. The said passages *r*, *r'*, and *r* are for the purpose of increasing the compression-space when the exhaust closes to produce the proper cushion for the rotating parts—piston head and rod, cross-head, and connecting-rod. For seventy-five revolutions per minute or less they would not be needed.

The operation of the engine is as follows: The valve has a travel of four (4) inches up and down. At about mid-travel the exhaust closes immediately. The passages *r* in Figs. 1, 3, 6, 11, and 12 coincide with passages *r'* in the cylinder, the passages *r'* being always open to cylinder by passages *r*, Figs. 3, 11, and 12, sliding down over passage *r*, Figs. 4, 6, and 8, thereby opening the passages *r* in Figs. 1, 3, and 8 to compression, and they remain open during admission and expansion and close holding the terminal pressure—that is, the pressure in cylinder just before the exhaust opens—by the valve sliding up and bringing passage *r*, Figs. 3, 11, and 12, above passage *r*, Figs. 4, 6, and 8, just before the exhaust opens. There is a cavity in Fig. 12 same as *r*, Fig. 3, (not shown in Fig. 12,) as it is the face and not the center of valve. The cavities *r*, Figs. 1, 3, and 8, remain closed, holding the inclosed pressure during all the time the exhaust is open, so that they are not subject to exhaust at all. Then as the valve slides down and closes the exhaust the cavities are again opened to receive compression, and so the process continues at each revolution, getting the benefit of large compression without exhausting from compression-space. The area of the cavities being drawn in about one per cent. of piston displacement, the clearance in counterbore and between piston head and valve and in openings through and back of valve would be about one per cent., which would give two per cent. for compression and one per cent. subject to exhaust, thereby saving one per cent. of the steam admitted to the cylinder at terminal pressure, if this one per cent. in cavities was in steam and exhaust ports, and getting just as smooth running engine.

In engines for electric lighting, where the clearance is usually about ten per cent., the clearance by this valve would be about two to three per cent. and the cavities would be made to hold any amount desired for smooth running—if necessary seven to eight per cent.—thereby saving that much at each stroke of the piston. If the space in cavities was made less and the exhaust to close later, there would then be a saving due to earlier cut-off and lower terminal pressure; so it will be a saving over present practice either way. In this valve any desired increase of port area only increases the clearance by increasing the thickness of valve to get exhaust-openings, and the clearance only increases by making the openings for piston-rod and balancing longer. Thus, in example before us, doubling the capacity of valve would increase the clearance at crank end three inches by four inches by one and one-half inch minus thirteen cubic inches, or about one-fifth of one per cent., whereas if the ports were doubled it would be about sixteen inches by four inches by one and one-half inch minus ninety-six cubic inches, and if an engine with separate steam and exhaust ports it would be about sixteen inches by four inches minus sixty-four cubic inches or more,

or ninety-six plus sixty-four equals one hundred and sixty cubic inches, or one and seven-ninths per cent., in place of one-fifth of one per cent., or eight times as much. In the example before us the piston is at quarter-stroke, the valves full open for steam, and exhaust cut-off just closed. The cavities *r* are placed in the top end of valve and valve-seat, so as to drain themselves of condensed steam, so as not to wait for re-evaporation to empty them for compression.

The stuffing-box bolts O, Fig. 1, for the valve-rods *b* are made long enough to set in engine-base stands and act as guides to stuffing-box gland and valve-stem *b'*. The gland can thus be screwed up while the engine is running without getting the wrench in the way of the rocker, Fig. 13, or *w w*, Fig. 1. The stuffing-boxes are made upside down to be convenient for packing.

There is a separate casting *a* at each end of cylinder inclosing hollow wedges, balance-plate, and valve at bottom and sides for convenience in making, and the bolt for connecting cylinder to cylinder-head goes through this casting, as shown in Figs. 3 and 4.

The balance-plate is made thick, so as not to spring with the full pressure against it during exhaust when there is no pressure against it next to cylinder. The pin-holes *w* in Figs. 13 and 14 are slotted to get the pins in or out after the valve-stem *b'* is in place. The valve-rods *b'* at each end of cylinder and the exhaust-pipe I are in the same straight line, and the rocker W, for operating the valves, is deflected midway of its ends at *w'* to extend around the said exhaust-pipe, as shown most clearly in Fig. 13. The bearing V, in which the short shaft V' is journaled, is mounted at its ends on the bases V^2, in which the lower ends of the bolts O are stepped.

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

1. In an engine, the combination of the cylinder having steam-chests and steam inlet and exhaust ports at each end and the caps closing the tops of the steam-chests and extending to or against the cylinder-heads and having oblique edges, substantially as and for the purpose described.

2. In a steam-engine, the combination, with the cylinder, the front valve, and the balance-plate, of the cylinder-head having an inner flange, as *l*, to fit into the said plate, substantially as and for the purpose described.

3. In a steam-engine, the combination of the cylinder, the front valve, the balance-plate, the cylinder-head, and the packing *k*, extending across the joint between the plate and cylinder-head and fitting in each, substantially as and for the purpose described.

4. The combination, with the cylinder and the valve working in the end thereof, of the balance-plate placed between the cylinder-head and the valve, and the springs arranged between the said plate and the cylinder-head, substantially as and for the purpose described.

5. The combination, with the cylinder having cavities *r'* and passages *r*, of the valves having corresponding passages *r*, substantially as and for the purpose described.

6. The combination, with the cylinder and the valve, of the balance-plate having a recess in the side opposing the valve, said recess being equal in area to the area of the cylinder in cross-section, substantially as and for the purpose described.

7. The combination, with the cylinder and the valve, of the wedge between the cylinder and the valve, having a steam-passage through it, substantially as and for the purpose described.

8. The combination, with the cylinder, the valve, and the plate, of the wedges interposed between the end of the cylinder and the valve-seat and having steam-passages through them, substantially as and for the purpose described.

9. The combination, with the cylinder and the valve, of the hollow wedge, the steam-pipe extending from the ends of the wedge and having threaded portions, and the nuts mounted on the threaded portions of the said pipes for adjusting the wedge, substantially as described.

10. The combination, with the steam-cylinder, the valves at its ends, and the exhaust-pipe between its ends, the valve-stems and the exhaust-pipe being in a straight line, of the rocker connected at its ends with the valve-stems and having its middle portion deflected to extend around the said exhaust-pipe, substantially as described.

11. The combination of the cylinder, the valve, the valve-stem, the bed, the stuffing-box, the stuffing-box gland, and the set-screws having their lower ends stepped in the bed and having their upper ends journaled in the cylinder and passing through the said gland, substantially as described.

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

FRANKLIN PILKINGTON.

Witnesses:
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