

E. PURVIS.

VALVES FOR DIRECT-ACTING ENGINES.

No. 178,465.

Patented June 6, 1876

Fig. 1.

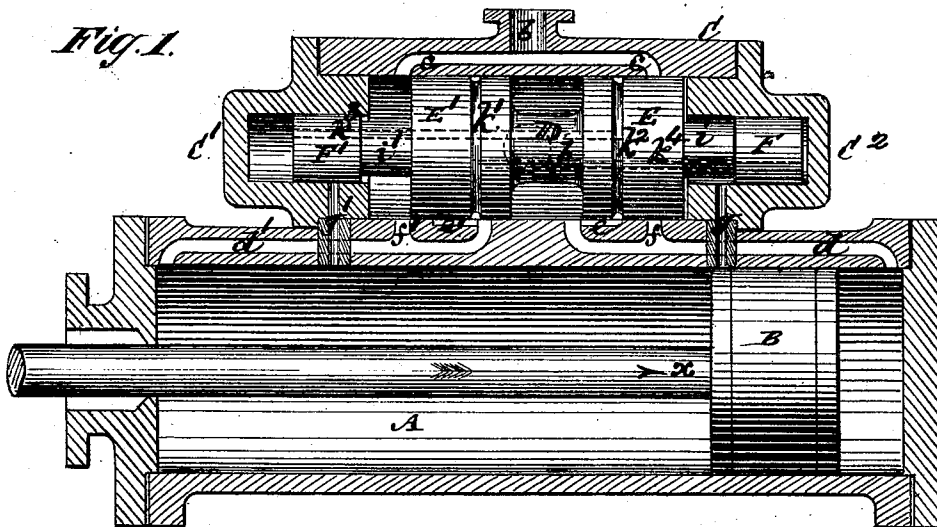


Fig. 2.

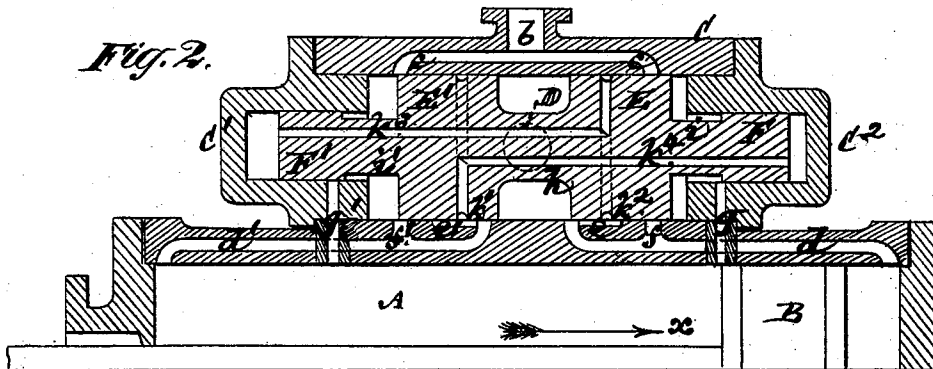
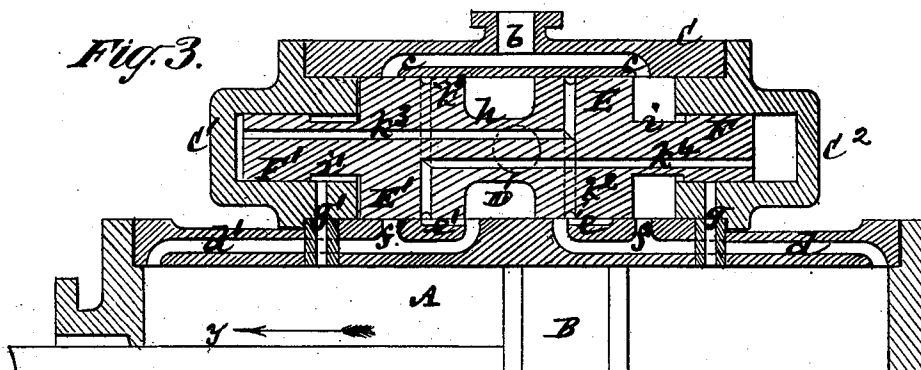


Fig. 3.



Witnesses

John Becker
Fred Haynes

Edward Purvis
by his Attorneys
Brown & Allen

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Fig. 4.

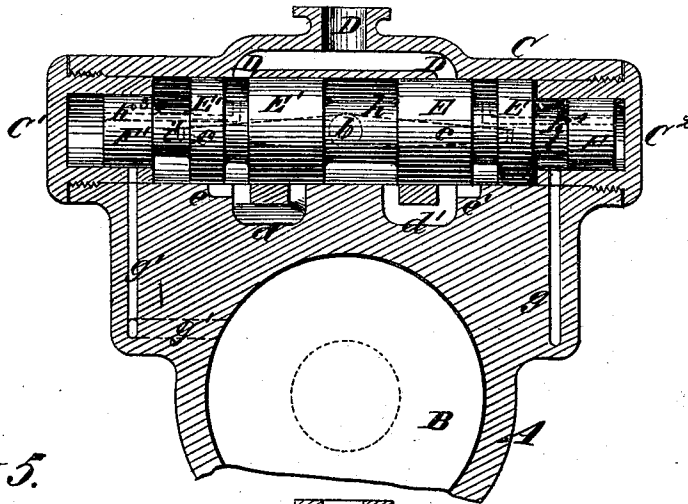


Fig. 5.

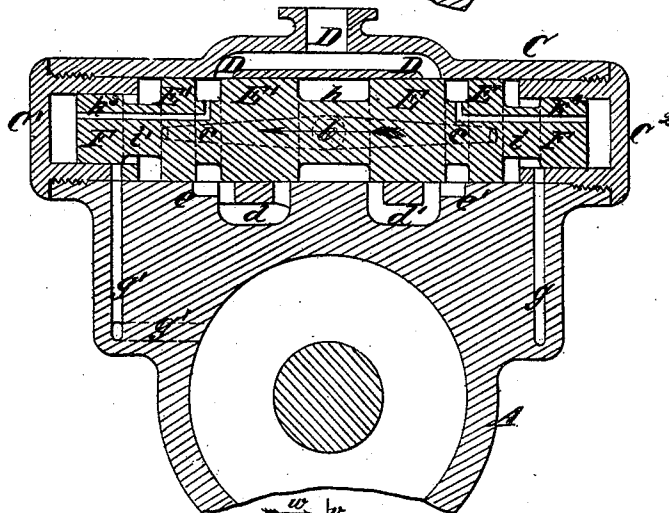
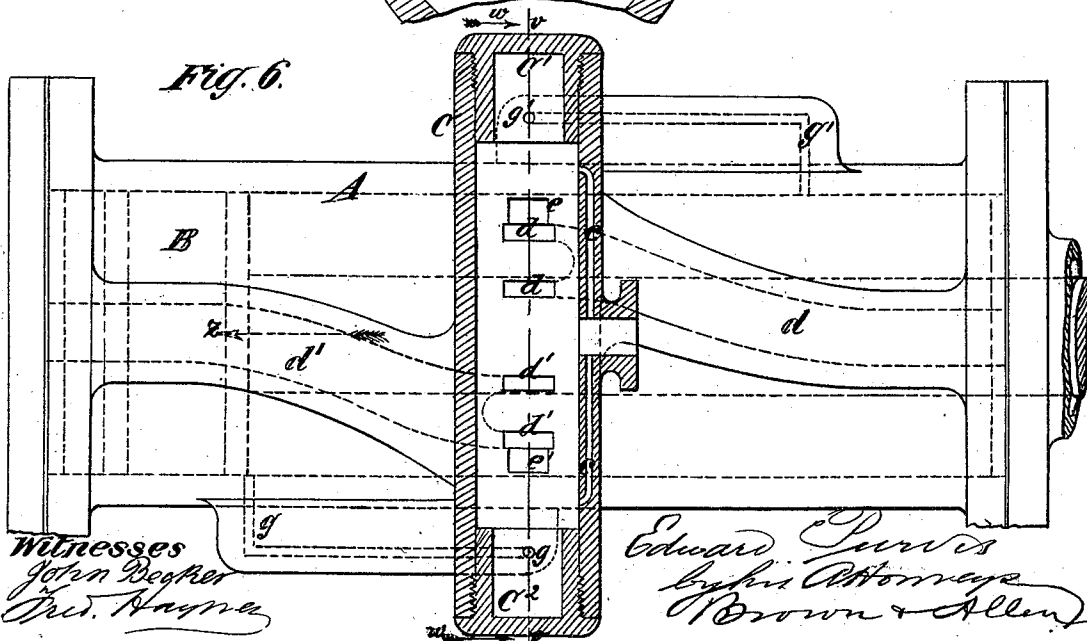


Fig. 6.



Witnesses
John Decker
Thos. Hays

Edward Purvis
by his Attorneys
Brown & Allen

UNITED STATES PATENT OFFICE.

EDWARD PURVIS, OF NEW YORK, N. Y.

IMPROVEMENT IN VALVES FOR DIRECT-ACTING ENGINES.

Specification forming part of Letters Patent No. **178,465**, dated June 6, 1876; application filed April 4, 1876.

To all whom it may concern:

Be it known that I, EDWARD PURVIS, of the city, county, and State of New York, have invented certain new and useful Improvements in Valves for Direct-Acting Engines; and I do hereby declare that the following is a full, clear, and exact description of the same, reference being had to the accompanying drawings, which forms part of this specification.

This invention consists in a valve for direct-acting engines, propelled by steam, gas, or other vapor or fluid, but which will here, to simplify explanation, be described as propelled by steam, in which the motion of the engine-piston is made to actuate the valve which controls said piston without the aid of valve-gear and without the assistance of an auxiliary valve, by the direct pressure of the propelling-fluid on the piston-controlling valve, as derived in part by the initial pressure of said fluid on said valve, and in part by the spent fluid of the engine-cylinder, as opposed to the reduced pressure of the exhaust. To this end, the piston-controlling valve is constructed with a series of piston-heads of different area and passages in or through said valve, operating in combination with a main inlet, and with passages leading to opposite ends of the engine-cylinder, whereby a differential pressure is obtained on the valve, to throw or reverse it by the action of the propelling-fluid as the engine-piston reaches the end of its stroke in opposite directions, alternately. The mere form of the valve may be variously changed, as also the arrangement of the passages in or through it; likewise, the disposition of the main inlet, and of the passages which connect with opposite ends of the engine-cylinder, without departing from the characteristic feature or principle of the invention.

Having thus explained the object and nature of the invention, its description will be proceeded with in reference to the accompanying drawings.

Figure 1 represents a longitudinal section of a steam-engine cylinder, with piston therein, and one form of the piston-controlling valve as arranged for operation in parallel relation with the engine-piston. Figs. 2 and 3 are similar sections of the same, in part, with the engine-

piston and its controlling-valve in different positions. Fig. 4 represents a transverse section of a steam-engine cylinder, with piston therein, through the center of the valve-chest, showing another form of the piston-controlling valve as arranged for operation in transverse relation with the engine-piston. Fig. 5 is a similar view, with the valve in a different position; and Fig. 6, a longitudinal view of the engine-cylinder, with the valve-box in section, but having the valve removed. The dotted line *v v* in Fig. 6 represents the plane in which the sections Figs. 4 and 5 are taken, and the arrows *w w* the direction in which the same are viewed.

Referring, in the first instance, to Figs. 1, 2, and 3 of the drawing, A is the cylinder of a direct-acting steam-engine, and B its reciprocating piston. C is the valve box or chest, of cylindrical construction on its interior, and fitted with hollow cylindrical heads or ends C¹ C². The steam is admitted to the valve-box C by means of a central inlet, *b*, and a longitudinal connecting-passage, *c*, which opens at its opposite end into the valve-box within the inner ends of the heads C¹ C². The ordinary or main induction and eduction passages *d d'*, which connect with opposite ends of the engine-cylinder, communicate with the valve box or chest near its center. D is the main exhaust-outlet from the valve-chest, which outlet is also central. The induction and eduction passages *d d'* also communicate, near their inner ends, with the valve-chest, (or, rather, with passages through the valve,) by backwardly-running passages or branches *e e'*, and, further, connect with the valve-chest by apertures *f f'* in rear or outside of the passages *e e'*, which latter, although here referred to as separate passages or branches, are virtually but extensions or enlargements of the inner ends of the passages *d d'*, and may altogether be omitted by enlarging said inner ends. Independent passages *g g'* connect the interiors of the hollow valve-chest heads C¹ C² with the engine-cylinder at points within the range of the piston B as it completes its stroke in opposite directions, and so that said piston uncovers the same as it approaches the ends of its stroke in either direction. The valve, which is a cylindrical or piston one, is com-

posed, in part, of two main piston-heads or cylindrical body portions, $E E'$, constructed to work in a free but close manner within the body or main portion of the chest C , and arranged at a suitable distance apart, so as to leave the main exhaust-outlet D always exposed between them, where said valve-bodies or piston-heads $E E'$ are connected, by a neck, h , thus causing the space between the piston-heads $E E'$ of the valve to correspond with the exhaust-cavity of a **D**-shaped slide-valve. Furthermore, the valve which is now being described is also composed, in part, of two outer and smaller heads or pistons, $F F'$, arranged to work in close but free contact within the hollow cylindrical valve-chest heads $C^1 C^2$, and connected with the main or larger piston-heads $E E'$ of the valve by necks $i i'$. These several pistons or piston-heads $E E'$ and $F F'$ of the valve control, respectively, the main induction and eduction passages $d d'$, their branch passages $f f'$, and the independent passages $g g'$. The branch passages $e e'$, connect, either directly, or by annular cavities $k^1 k^2$, around the piston-heads $E E'$ of the valve, with passages $k^3 k^4$, which project longitudinally through the valve, in reverse direction to the ducts $d d'$, into the hollow valve-chest heads $C^1 C^2$ in rear of the valve's smaller piston-heads $F F'$.

The operation is as follows: Supposing the parts to be in the position represented in Fig. 1, and the engine-piston B to be moving in direction of the arrow x , the steam entering by the inlet b escapes at the one end of the passage c , between the piston-heads $E' F'$, and through the aperture f' , which is uncovered by the piston-head E' , and, flowing along the passage d' , continues to propel the piston B in direction of the arrow x . The live steam, thus entering by the one end of the passage c , also passes, by the branch e' , annular cavity k^1 , and longitudinal valve-duct k^4 , to the right-hand valve-chest head C^2 , in rear of the small piston-head F , which then is free from covering the independent passage g , that, prior to the piston B crossing it, had been open to the exhaust in front of said piston, and so exposed the outside face of the larger piston-head E also to the exhaust, thereby assisting the throw of the valve to the right by the pressure of the steam on the greater area of the piston-head E' , as against the pressure on the end of the piston-head F of less area. At the same time the other main induction and eduction passage d is open to the exhaust between the piston-heads $E E'$ of the valve, and the left-hand valve-chest head C^1 is similarly open to the exhaust in rear of the small piston F' , by the branch e , the annular cavity k^2 , and the longitudinal valve-duct k^3 , the small piston-head F' then covering the independent passage g' , and the larger piston-head E closing aperture f and right-hand outlet of the passage c . When this is the position of the parts, then there is a differential pressure of the live steam, entering by the inlet b , against

the back of the larger piston-head E' , as against the live-steam pressure on the outer end of the small piston-head F , to hold the valve to the right until the engine-piston B , traveling in direction of the arrow x , uncovers, as shown in Fig. 2, the independent passage g , when the spent steam of the engine flows through said passage to the back of the piston-head E , and counteracts the pressure on the back of the piston-head E' , so that the live-steam pressure on back of the small piston-head F starts the valve to the left. This action is continued until the small piston-head F closes the independent passage g , by which time the duct d' will be open to the exhaust, and the live steam will enter by the right-hand end of the steam-passage c and act upon the back of the piston-head E , to continue the throw of the valve to the left, and to hold it there, as represented in Fig. 3, against the pressure of the steam entering by the duct d , passage e , annular cavity k^2 , and longitudinal valve-duct k^3 , to the back of the small piston-head F' , the other small piston F being, at the same time, exposed to the exhaust by the valve-duct k^4 and passage e' , and the outer face of the larger piston-head E' being also exposed to the exhaust by the independent passage g' . This change in the position of the valve causes the engine-piston to be reversed and to continue its travel in direction of the arrow y , Fig. 3, until said piston passes the independent passage g' , when the valve, by the reversal of the passages or their exposure, is thrown to the right again, substantially as described, for its throw to the left.

In this way, or by these means, the valve which controls the motion of the engine-piston is automatic, and operates by the difference of pressure on its respective heads $E F$ and $E' F'$, such action being due to the different areas of said heads, and to the passages through the valve in conjunction with the fixed passages, as hereinbefore described.

Referring, in the next instance, to Figs. 4, 5, and 6 of the drawing, which show a modified construction of the valve, and of the passages connected with and controlled by it, and represent the valve as arranged for operation in transverse relation with the engine-piston, A is the engine-cylinder, B its piston, and C its valve-chest, provided with hollow heads $C^1 C^2$, as before. The valve itself is also mainly of similar construction to that shown in the previous figures, and is operated in substantially the same manner; but its larger piston-heads $E E'$, connected by the neck h , are each duplicated or divided transversely, leaving a space in between each connected division of them, into which space the longitudinal passages $k^3 k^4$ through the valve open, said passages extending, as before, through the smaller end piston-heads $F F'$, and the necks $i i'$, which attach them to the larger piston-heads $E E'$. In this valve, the chest is supplied with steam by an inlet, b , between the larger piston-heads $E E'$, and connected with this

inlet is a longitudinal passage, *c c*, arranged to branch from either side of said general inlet, and controlled by the piston-heads *E E'* of the valve. The exhaust-outlet *D* is also made with a longitudinal extension branching from opposite sides of it, and which is likewise controlled by the piston-heads *E E'*. The main induction and eduction passages *d d'*, which connect the valve-chest with opposite ends of the engine-cylinder, have each duplicate openings into the valve-chest at a suitable distance apart in direction of the travel of the valve, corresponding with the inner end openings and branch passages *f f'* of the passages *d d'*, in the modification herein first described. Furthermore, said induction and eduction passages also have longitudinally and backwardly branching passages *e e'* connected with them at their one opening into the valve-chest, as in the herein previously-described modification. There are also independent passages *g g'*, controlled by the smaller piston-heads *F F'*, and connecting the hollow valve-chest heads *C¹ C²* with the opposite ends or portions of the engine-cylinder.

The operation is the same as before. Thus, in Fig. 4, the valve has been thrown to its extreme position to the right, and is held in said position by the pressure of the live steam entering by the left-hand branch of the passage *c*, and acting on the outer face of the larger piston-head *E'*, as against the pressure of steam on the outer end of the smaller piston-head *F* supplied from the engine-cylinder by the passage *d*, its branch *e*, and the longitudinal valve-duct *k⁴*. When, however, the engine-piston *B*, which is supposed to be traveling in direction of the arrow *z*, has passed the passage *g* it allows steam from behind said piston to act upon the outer face of the larger piston-head *E*, and by its counteracting action to the pressure on the outer face of the other larger piston-head *E'*, the valve is started to the right, as shown in Fig. 5, by the pressure of the steam on the back of the smaller piston-head *F* until the piston-head *E* uncovers the right-hand outlet of the live-steam passage *c*, which admits live steam to the back of the piston-head *E* to complete the throw of the valve to the right, the piston-head *E'* in the meantime closing the left-hand outlet of the passage *c*, and opening communication by the passage *d*, the branch passage *e*, and the valve-duct *k³*, for steam to enter behind the smaller piston-head *F'*. The motion of the engine-piston having been thus reversed, the valve is held in its extreme position to the right till said piston passes the independent passage *g'*,

when a like action of the valve as before, but in a reverse direction, takes place. The hollow valve-chest heads are alternately exhausted by the valve-ducts *k³* and *k⁴* being brought by the movement of the valve alternately in communication with either induction and eduction passage *d d'* open to the exhaust, and with the general exhaust-outlet *D*, all substantially as hereinbefore explained, with reference to the first-described modification.

To prevent misconception as to the action of the various passages, or certain of them, it may here be observed that in both of the modifications here shown of the valve the passages *e e'* are virtually a part of the induction and eduction passages *d d'*, and they might altogether be omitted by suitably enlarging or forming the passages *d d'* at such part, and in the modification of the valve shown in Figs. 1, 2, and 3 the passages *e e'*, might be extended back to join the branch passages *f f'*, thus making one continuous passage of the several passages *d e f* or *d' e' f'*. In fact, so far as controlling the motion of the valve is concerned, the passages *d d'* might be enlarged or formed to altogether dispense with the separate passages or branches *e e'* and *f f'*.

I claim—

1. A valve for controlling and reversing the piston of a direct-acting engine, composed of, or provided with, duplicate piston-heads at its opposite ends of different areas, and longitudinal ducts passing through the valve and connecting the intermediate portion of the valve-chest with the opposite ends thereof, in combination with fixed passages in the valve-chest and engine-cylinder, organized substantially as described, whereby the valve is automatically thrown in reverse directions alternately by differential pressure of the propelling-fluid on the piston-heads of the valve, subject to the control of the engine-piston, essentially as herein set forth.

2. The combination, with the engine-cylinder *A* and its piston *B*, of the valve-chest *C*, with its hollow ends or heads *C¹ C²*, the valve composed of piston-heads *E E'* and *F F'* of different areas, as described, the longitudinal valve-ducts *k³ k⁴*, the main induction ports or passages *d d'*, the independent passages *g g'*, the steam-inlet *b* with its longitudinal branch *c c*, and the exhaust duct or outlet *D*, substantially as specified.

EDWARD PURVIS.

Witnesses:

MICHAEL RYAN,
FRED. HAYNES.