(No Model.) 2 Sheets—Sheet 1.

P. R. FOSTER.

VALVE FOR STEAM ENGINES.

No. 476,457. Patented June 7, 1892.

Fig. 1.

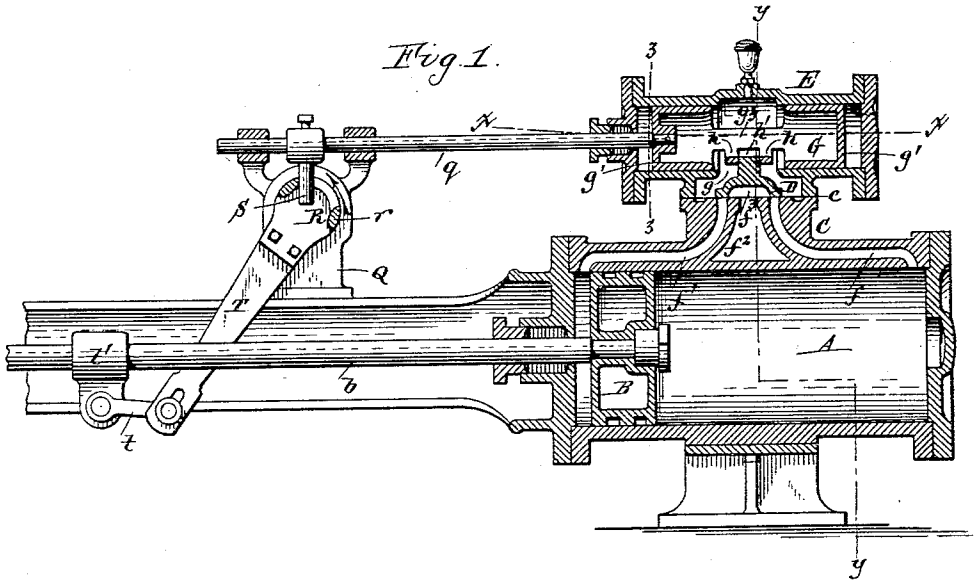


Fig. 2.

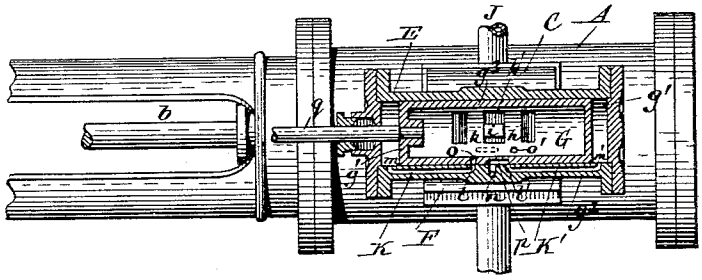


Fig. 3.

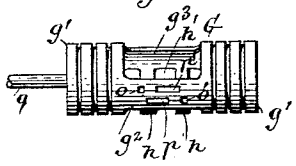
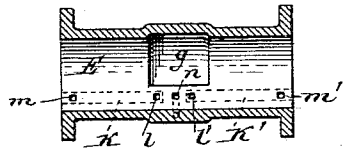


Fig. 4.



Witnesses:
Emil Neuhart.
Theo. L. Popp.

P. R. Foster Inventor.
By Wilhelm Bonnard
Attorneys.

(No Model.) 2 Sheets—Sheet 2.

P. R. FOSTER.

VALVE FOR STEAM ENGINES.

No. 476,457. Patented June 7, 1892.

Fig. 5.

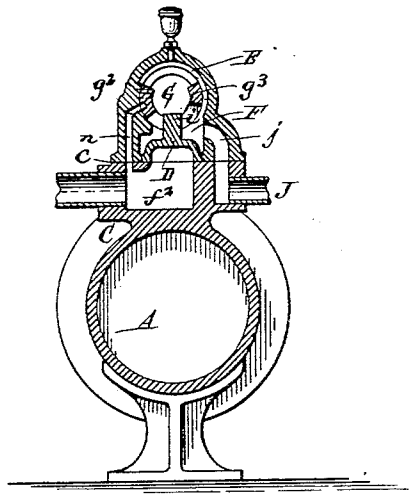


Fig. 6.

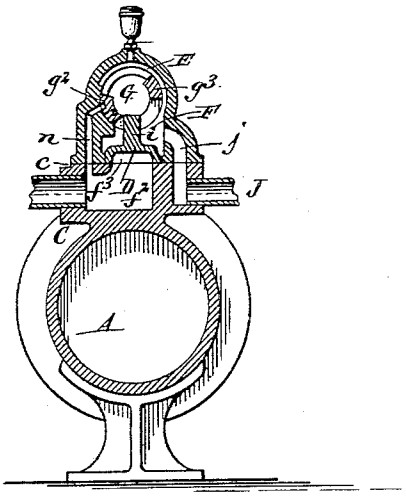


Fig. 7.

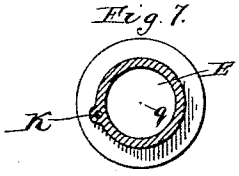


Fig. 8.

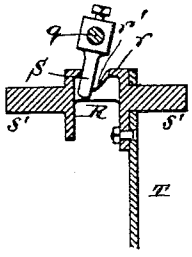


Fig. 10.

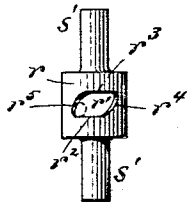
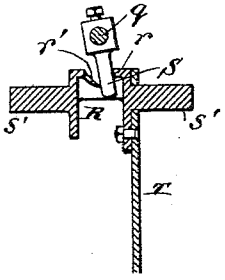


Fig. 9.



Witnesses:
Emil Neuhart
Theo. L. Popp.

P. R. Foster Inventor.
By Wilhelm & Bonner.
Attorneys.

UNITED STATES PATENT OFFICE.

PERCY R. FOSTER, OF BUFFALO, NEW YORK.

VALVE FOR STEAM-ENGINES.

SPECIFICATION forming part of Letters Patent No. 476,457, dated June 7, 1892.

Application filed March 2, 1891. Serial No. 383,413. (No model.)

To all whom it may concern:

Be it known that I, PERCY R. FOSTER, a citizen of the United States, residing at Buffalo, in the county of Erie and State of New York, have invented new and useful Improvements in Valves for Steam-Engines, of which the following is a specification.

This invention relates to that class of direct-acting steam-engines which are provided with a main steam-valve, an auxiliary piston-valve connected with the main valve and having a longitudinally-reciprocating and a transversely-oscillating movement, and a cam by which motion is imparted to the valves, the arrangement being such that the valves are partly actuated by mechanical means and partly by the steam-pressure applied to the piston-valve. Steam-engines of this kind are used, for instance, in steam-pumps.

The object of my invention is to produce a steam-engine of this character in which the principal actuating parts of the valve mechanism are arranged outside of the steam-chest, where they are easy of access, so that these parts can be readily lubricated, adjusted, and repaired.

In the accompanying drawings, consisting of two sheets, Figure 1 is a longitudinal sectional elevation of a direct-acting steam-engine provided with my improvements. Fig. 2 is a horizontal section through the steam-chest in line $x\,x$, Fig. 1. Fig. 3 is a detached elevation of the piston-valve. Fig. 4 is a detached horizontal section of the cylindrical steam-chest. Figs. 5 and 6 are vertical cross-sections in line $y\,y$, Fig. 1, showing the piston-valve in different positions. Fig. 7 is a cross-section in line $z\,z$, Fig. 1. Figs. 8 and 9 are fragmentary sectional elevations of the shifting-cam and connecting parts for operating the piston-valve. Fig. 10 is a plan view of the cam whereby the piston-valve is shifted.

Like letters of reference refer to like parts in the several figures.

A represents the steam-cylinder, B the piston, and b the piston-rod. The steam-cylinder is provided centrally on its upper side with an enlargement C, having a flat horizontal face c on its upper side, which forms a seat for the slide-valve D.

E represents the cylindrical steam-chest, which is arranged parallel with the steam-cylinder and provided centrally on its under side with a rectangular steam-chamber F, which surmounts the seat of the slide-valve and incloses the latter.

$f\,f'$ represent steam-ports leading from the steam-chamber F to opposite ends of the steam-cylinder, and f^2 is the exhaust-chamber formed between the steam-ports $f\,f'$. The face of the slide-valve is provided with the usual exhaust-cavity f^3. The cylindrical steam-chest is provided in its lower side with an opening g, leading to the steam-chamber F.

G represents a piston-valve whereby the slide-valve is moved. This piston-valve is composed of two cup-shaped heads $g'\,g'$, arranged in opposite ends of the cylindrical steam-chest, and two longitudinal bars $g^2\,g^3$, connecting said heads.

$h\,h$ represent transverse bridge-pieces connecting the bars $g^2\,g^3$ of the piston-valve and forming a transverse slot h' between them. The slide-valve is provided on its upper side with a lug i, which is loosely arranged in the slot between the bridge-pieces $h\,h$. The piston-valve is capable of both a longitudinal-reciprocating and a transversely-oscillating movement in the steam-chest. During the reciprocating movement the piston-valve carries the slide-valve with it; but its oscillating movement has no effect upon the slide-valve, owing to the slot h' in the piston-valve, which is of sufficient length transversely to allow the piston-valve to rock freely without disturbing the slide-valve.

J represents the steam-supply pipe, and j the main steam-inlet passage connecting the steam-supply pipe with the steam-chest.

K K' represent front and rear steam-passages whereby steam is conducted to and from the ends of the steam-chest and behind the heads of the piston-valve. These steam-passages are formed lengthwise in the side of the steam-chest and open with their inner ends into the central portion of the steam-chest by openings $l\,l'$, while the opposite ends of the steam-passages communicate with the end portions of the steam-chest by openings $m\,m'$.

n represents an exhaust-passage opening with its upper end in the steam-chest between the front and rear steam-passages $l\,l'$ and

leading with its lower end into the exhaust-chamber f^2.

The outer side of the longitudinal connecting-bar g^2 of the piston-valve bears firmly against the adjacent inner side of the steam-chest.

o o' represent front and rear steam-inlet ports extending through the bar g^2 and adapted to register with the inner openings l l' of the front and rear steam-passages, whereby steam is alternately admitted to opposite ends of the steam-chest.

p p' represent front and rear exhaust-port cavities formed in the outer side of the bar g^2 and adapted to alternately connect the inner openings of the steam-passages K K' with the exhaust-opening.

The ports in the piston-valve and the openings in the steam-chest are so arranged with reference to each other that the front inlet-port registers with the inner opening of the front steam-passage when the rear exhaust-port connects the rear steam-passage with the exhaust-opening and the rear inlet-port registers with the inner opening of the rear steam-passage when the front exhaust-port connects the inner opening of the front steam-passage with the exhaust-opening.

The connecting-bar g^2 of the piston-valve is wider than the opposite bar g^3, so that it exposes a larger surface to the steam-pressure than the bar g^3, which causes the steam in the steam-chest to exert a greater lateral pressure against the bar g^2, whereby the latter is held firmly against the inner side of the steam-chest and forms a tight partition between its inlet and exhaust ports and the exhaust and steam-passage openings formed in the steam-chest.

q represents the valve-rod secured to the front head of the piston-valve and passing through the front head of the steam-chest. The front end of this valve-rod is guided in a standard Q, secured upon the main frame of the engine.

R represents a shifting-cam whereby a reciprocating and a rocking motion is imparted to the valve-rod q and the piston-valve secured thereto. This cam consists of a curved plate r, provided with a slot r', having two longitudinal parallel sides r^2 r^3 and oblique ends or cam-faces r^4 r^5, which are inclined in opposite directions.

S represents a rock-pin secured to the front portion of the valve-rod and arranged with its free end in the slot r' of the cam. This pin is rocked by the oblique cam-faces engaging alternately against the pin, whereby the piston-valve and the steam-ports therein are transversely oscillated.

s' s' represent trunnions formed on opposite sides of the shifting-cam S and journaled transversely in the standard Q.

T represents a depending rock-arm whereby the shifting-cam is actuated. This rock-arm is secured with its upper end to the side of the shifting cam and is connected with its lower end by a link t to a sleeve t', secured to the piston-rod, whereby the movement of the latter is caused to operate the piston-valve through the medium of the shifting-cam.

In the position of the parts represented in Fig. 1 the piston has completed its forward stroke and the slide-valve cuts off communication with the ends of the steam-cylinder. In this position of the parts the rock-pin of the valve-rod bears against the longitudinal side r^2 of the cam-slot, as represented in Fig. 8, and the piston-valve has been turned and moved backward sufficiently to cause its front inlet-port to register with the front inlet-opening and admit steam to the front end of the steam-chest, while its exhaust-port connects its rear steam-passage with the exhaust-opening, as represented in Fig. 2. The steam in entering the front end of the steam-chest drives the piston-valve backward, thereby moving the slide-valve backward and admitting steam to the front end of the steam-cylinder. This causes the main piston to move backward and the piston-rod of the same to carry the rock-arm of the shifting-cam along with it, thereby moving the shifting-cam forwardly in the direction of the arrow in Fig. 1. When the cam approaches the end of its forward movement, its inclined front face r^4 engages against the depending pin of the valve-rod and shifts the latter to the opposite longitudinal side r^3 of the cam-slot, as represented in Fig. 9, thereby turning the piston-valve so that the rear inlet and exhaust ports of the latter are in line with the exhaust-opening and the inner opening of the rear steam-passage. The shifting-cam in continuing its forward movement carries the depending pin of the valve-rod and piston-valve forward until the rear inlet and exhaust ports of the piston-valve register with the inner opening of the rear steam-passage and the exhaust-opening, thereby admitting steam to the rear end of the steam-chest. The steam in entering the rear end of the steam-chest causes the piston-valve to continue its forward movement independent of the shifting-cam until the slide-valve has been moved forward sufficiently to admit steam to the rear end of the steam-cylinder. In this manner the piston-valve and slide-valve are actuated partly by mechanical means and partly by steam-pressure. The transversely-oscillating movement of the piston-valve and the first portion of the longitudinal movement of the same and of the slide-valve are effected by the shifting-cam and the last part of the longitudinal movement of both valves is effected by the steam-pressure.

By arranging the shifting-cam and the parts actuating the latter outside of the cylinder these parts can be readily lubricated and are easy of access in case they require to be adjusted or repaired.

I claim as my invention—

The combination, with the steam cylinder and piston, the steam-chamber, and cylindri-

cal steam-chest, of a slide-valve arranged in said steam-chamber, a piston-valve arranged in said steam-chest and capable of a longitudinal reciprocating motion with the slide-valve and a transversely-oscillating motion independent of the slide-valve, a cam actuated from the steam-piston and provided with two opposing oblique faces, and a projection on the valve-rod arranged between said faces, whereby the piston-valve is first turned and then positively moved forward by one of the cam-faces until the steam-pressure is applied to the piston-valve, when the stroke of both valves is completed by the action of the steam and the projection on the valve-rod is thrown against the opposite cam-face, substantially as set forth.

Witness my hand this 17th day of February, 1891.

PERCY R. FOSTER.

Witnesses:
THEO. L. POPP,
ALICE G. CONNELLY.