(No Model.)

G. CLARKE.

STEAM ACTUATED VALVE.

No. 344,032. Patented June 22, 1886.

FIG. 1.

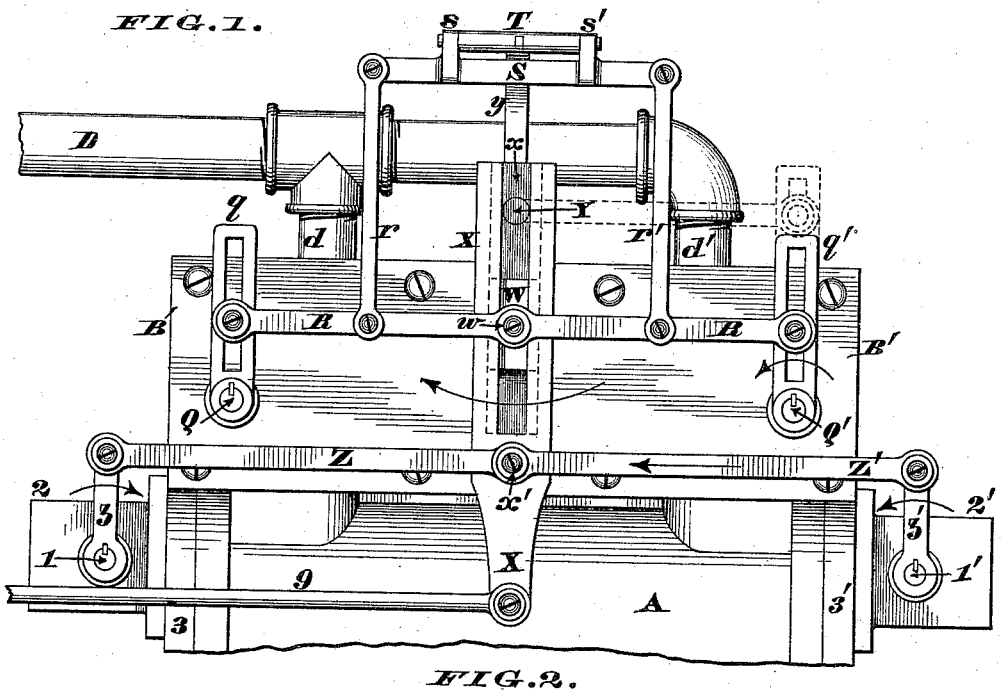


FIG. 2.

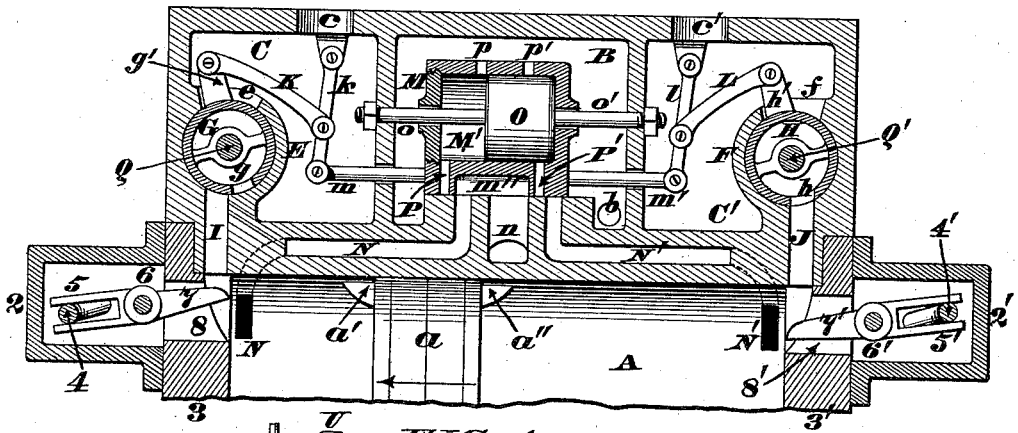


FIG. 3.

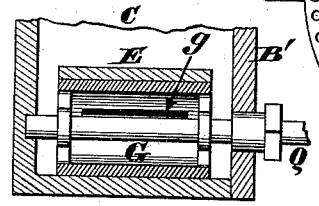


FIG. 4.

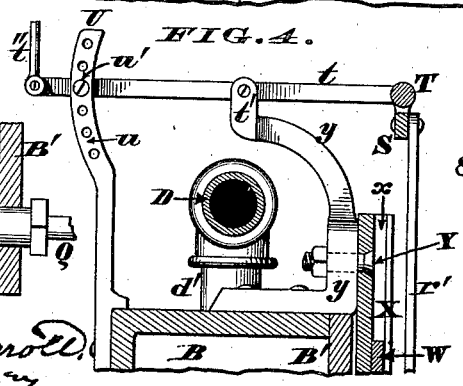
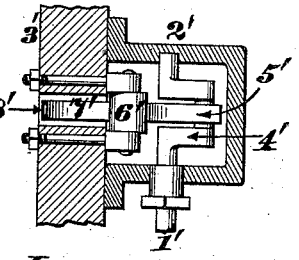


FIG. 5.



Attest.
Rob't W. Carroll
W. Dibrell

Inventor.
George Clarke
By James H. Layman
Atty

UNITED STATES PATENT OFFICE.

GEORGE CLARKE, OF CINCINNATI, OHIO, ASSIGNOR TO THE CLARKE AUTOMATIC STEAM-VALVE COMPANY, OF SAME PLACE.

STEAM-ACTUATED VALVE.

SPECIFICATION forming part of Letters Patent No. 344,032, dated June 22, 1886.

Application filed February 23, 1886. Serial No. 192,830. (No model.)

To all whom it may concern:

Be it known that I, GEORGE CLARKE, a citizen of the United States, residing at Cincinnati, in the county of Hamilton, State of Ohio, have invented certain new and useful Improvements in Steam-Actuated Valves, of which the following is a specification, reference being had therein to the accompanying drawings.

The object of this invention is to improve the peculiar form of direct-acting steam-engine seen in Letters Patent No. 281,836, granted to me July 24, 1883, which patent was subsequently assigned to "The Clarke Automatic Steam Valve Company," of Cincinnati, Ohio.

The first part of the present improvements comprises a novel combination of devices for operating the main valves of the engine so as to cut off steam at any part of the stroke, the cut-off devices being arranged to act automatically, or to be controlled by the engineer, as hereinafter more fully described.

The second part of the present improvements comprises a novel combination of devices for reversing the engine, which devices can, if desired, be suddenly brought into service without closing the throttle-valve, thereby rendering the engine especially serviceable for locomotive purposes, as hereinafter more fully described.

The third part of the present improvements consists in providing the engine with a pair of reciprocating rotary valves that control the inlet-ports, said valves being operated by a peculiar combination of devices, the details of which will be hereinafter more fully described.

In the annexed drawings, Figure 1 is a side elevation of my improved direct-acting steam-engine. Fig. 2 is a vertical section through the steam-chest and the upper part of the cylinder, the piston being supposed to be traveling in the direction indicated by the arrow on the same. Fig. 3 is a horizontal section through one of the inlet-valves. Fig. 4 is a transverse section through the upper part of the steam-chest and its attachments. Fig. 5 is a horizontal section through one of the bonnets of the engine.

A represents the upper part of a steam-cylinder of any desired diameter and stroke, and *a* is a portion of the piston of the same. Secured to this cylinder, or cast therewith, is a steam-chest consisting of a central or exhaust chamber, B, and a pair of live-steam chambers, C C′, the latter having suitable openings, *c c′*, to admit the branches *d d′* of a steam-pipe, D. Furthermore, the chambers C C′ have, respectively, shells E F to receive inlet-valves G H, said valves being preferably cylinders open at each end and having at bottom ports *g h* and at top lugs *g′ h′*, which lugs traverse slots *e f* of said shells. These ports *g h* communicate with the inlet-ports I J of the cylinder, while the lugs *g′ h′* have attached to them rods K L, that connect with hangers *k l*, whose upper ends are suitably pivoted within the chambers C C′. The lower ends of these hangers are coupled to the stems *m m′*, projecting rigidly from the opposite ends of a slide-valve, M, having on its under side a customary recess, *m″*, adapted to communicate alternately between the passages N N′ and exhaust-port *n*. This slide-valve is chambered or bored out at M′ to admit a fixed cylindrical piston, O, which is maintained in position by rods *o o′*, secured to the partitions that separate the steam-chambers C C′ from the exhaust-chamber B.

P P′ are inlet-ports in the lower side of valve M, and *p p′* are exhaust-ports in the upper side thereof.

b is the outlet of the exhaust-chamber B, which ventage may communicate with the escape-pipe of the engine.

Q Q′ are the stems of the cylindrical valves G H, said stems being passed through the cap B′ of the steam-chest and having slotted arms *q q′* secured to their outer ends. These slotted arms are coupled to the opposite ends of a side bar, R, supported by two links, *r r′*, the latter being jointed to a bearer, S, having ears *s s′*, within which is journaled a rock-shaft, T. Projecting rigidly from this rock-shaft, and extending across the steam-chest, as seen in Fig. 4, is a lever, *t*, pivoted to a suitable bearing, *t′*, and having a governor-rod, *t″*, attached to it. One end of this lever traverses a keeper, U, provided with a series of perforations, *u*, to receive a screw, bolt, or pin, *u′*, when it is desired to retain said lever at any specific adjustment. *w* is a wrist-pin that connects the side bar, R, to a slide, W, capable of being shifted within the groove *x* of a

pendulous yoke, X, the latter being pivoted at Y to a bracket, *y*, bolted to the steam-chest. The inner ends of a pair of connecting-rods, Z Z′, are coupled to this yoke at *x*′, the outer ends of said rods being jointed to the arms *z z*′ of a pair of shafts, 1 1′, journaled in bonnets 2 2′, bolted to the opposite cylinder-heads, 3 3′. The inclosed portions of these shafts have cranks 4 4′, operated by the slotted levers 5 5′ of a pair of rockers, 6 6′, the latter being hung in suitable bearings of the cylinder-heads, as seen in Fig. 5, and being provided with toe-pieces 7 7′, playing within slots 8 8′ of said heads.

Attached to the yoke X is one end of a rod, 9, the other extremity thereof being coupled to an ordinary reversing-lever.

a′ *a*″ are spurs projecting from opposite sides of the piston *a*, which spurs are chamfered off to avoid any sudden jar when they come in contact with the respective toe-pieces of the rockers.

To illustrate the action of this engine, I will suppose the arm *z*′ has first been swung over in the direction indicated by the arrow on the same in Fig. 1, which act will cause all the operative parts to assume the positions seen in Fig. 2. Reference to this last illustration shows that the toe-piece 7 is elevated, the toe-piece 7′ depressed, the cylindrical valve G closed, the other cylindrical valve, H, opened, and the slide-valve M advanced to afford communication between the passage N and the exhaust-port *n*. Consequently live steam flows through the chamber C′, open-ended cylinder-valve H, and communicating ports *h* J, thus filling the cylinder A and driving its piston *a* in the direction of the arrow on the same. This advance of the piston expels the exhaust-steam through the channel N, recess *m*″, and port *n*, because the inlet-port I is now closed by the valve G, it being understood there is no communication between said port I and channel N. It will also be noticed that the inlet-ports P P′ of the chambered slide-valve M M′ are now closed, on account of said ports being over the solid portions of the seat upon which this valve travels. The instant the piston completes its stroke the spur *a*′ comes in contact with the toe-piece 7, thereby depressing the latter and elevating the slotted lever 5 of rocker 6, which act raises the crank 4 and swings its arm *z* over in the direction indicated by the arrow on the same in Fig. 1. While the valve G is opening the slide-valve M is being shifted far enough to bring its inlet-ports P P′ in communication with the upper ends of channels N N′, in order that the live steam between the piston *a* and head 3′ may flow up the channel N′ and port P′, so as to act against the fixed piston O, thereby completing the retraction of said slide-valve before valve G is fully opened, and causing the recess *m*″ to form a communication between the channel N′ and exhaust-port *n*; but when valve G is completely opened its port *g* is in line with the inlet-port I, while the opposite inlet-port, J, is immediately closed by the other valve, H. Live steam then flows through the chamber C, valve G, ports *g* I, and drives the piston toward the head 3′, the exhaust-steam being discharged through the channel N′, recess *m*″, and outlet *n*; but before the piston can strike against said head the spur *a*″ comes in contact with the now elevated toe-piece 7′, thereby forcing the latter down, again opening the valve H, and closing the other valve G, as previously described, which operations are repeated at each and every stroke of the engine.

From the above description it is apparent that the retraction of the slide-valve M is initiated by the opening of the appropriate inlet-valve, but is completed by the action of live steam at boiler-pressure, thus retaining the principal feature of the invention seen in my old patent, previously alluded to. It is also apparent that the steam which is exhausted from the chamber M through the ports *p p*′ at every stroke of the valve M′ escapes at the outlet *b* in the same manner as described in said patent. The present invention, however, includes a cut-off and reversing appliances not seen in said patent, the cut-off being rendered positive by inserting the bolt *u*′ in either one of the perforations *u* of the keeper U, according to the duty required of the engine. If it is desired to have but a limited cut-off, the lever *t* is depressed within said keeper, so as to elevate the side bar, R, and cause it to approach the pivot Y of pendulous yoke X. Consequently said bar will impart a very limited stroke to the slotted arms *q q*′, that operate the stems Q Q′ of inlet-valves G and H. If, on the contrary, it should be desired to open and close said valves very quickly, the lever *t* is set so as to drop the side bar, R, and cause the yoke to impart a greater swing to the same. To work the cut-off automatically, the pin or bolt *u*′ is dispensed with and a governor-rod, *t*″, is then coupled to the lever *t*.

Another feature peculiar to my present invention consists in attaching the rod 9 to the yoke X, which rod enables the engineer to "reverse" in an instant and without taking time to close the throttle, thus rendering the new engine especially serviceable for locomotives. This instantaneous reversal is due to the fact that the engine is perfectly balanced in all its parts and can be "pulled over" when running at the highest possible speed and without employing much force or breaking any of the connections.

In some cases it may be desirable to connect the lever *t* with another lever or appliance that will enable the engineer to operate said lever from a cab, and thereby adjust the cut-off to the special requirements of any locomotive service. By prolonging the slotted arms *q q*′, so as to enable the side bar, R, to be elevated as high as the pivot Y of swinging yoke X, as indicated by the dotted lines in Fig. 1, the swinging motion of said arms will be instantly arrested. Hence it is apparent the engineer

can immediately stop the engine without taking time to close the throttle. Finally, reference to Fig. 3 shows there is ample space at each end of the valve G *g* to permit the unobstructed entrance of steam into this inlet device.

I claim as my invention—

1. The combination, in a direct-acting steam-engine, of a pair of reciprocating rotary inlet-valves, a chambered and ported outlet-valve sliding within a special exhaust-chest, and devices for initiating the movement of this outlet-valve from the main piston of the engine, the stroke of said valve being completed by live steam operating against a stationary piston fitted within it, substantially as herein described.

2. The combination, in a direct-acting steam-engine, of a pair of reciprocating rotary inlet-valves, a chambered and ported outlet-valve sliding within a special exhaust-chest, and devices for initiating the movement of this outlet-valve from the main piston of the engine, the stroke of said valve being completed by live steam operating against a stationary piston fitted within it, said reciprocating rotary valves being coupled either to a positive or automatic cut-off mechanism, for the purpose described.

3. The combination, in a direct-acting steam-engine, of the spurred piston *a a' a''*, rockers 5 6 7 5' 6' 7', cranks 4 4', shafts 1 1', arms *z z'*, and suitable connections for operating the inlet-valves of the engine, substantially as herein described.

4. The combination, in a direct-acting steam-engine, of the valve-stems Q Q', slotted arms *q q'*, side bar, R, slide W *w*, pendulous yoke X *x* Y, and links *r r'*, which latter are capable of being raised and lowered for the purpose of regulating the stroke of said arms, substantially as described.

5. The combination, with the side bar, R, slide W *w*, pendulous yoke X *x* Y, and links *r r'*, for operating the valves of a direct-acting engine in the manner described, of the rod S *s s'*, rock-shaft T, pivoted lever *t t'*, and devices for retaining said lever at any specific adjustment, substantially as set forth.

6. In combination with a direct-acting steam-engine, having its valve-operating devices and cut-off appliances coupled to a pendulous yoke in the manner described, the rod 9, attached to said yoke for the purpose of enabling the engineer to reverse said engine in the manner described.

7. A direct-acting steam-engine consisting of cylinder A, piston *a*, steam-chest B C C', valve-seats E *e* F *f*, reciprocating rotary valves G *g* H *h*, ports I J, rods K L, swinging hangers *k l*, chambered sliding valve M M' *m m' m''* P P' *p p'*, and channels N N' *n*, the opposite sides of said piston being furnished with spurs *a' a''*, for actuating rockers that operate said valves G *g* H *h*, in the manner described.

8. The bonnets 2 2', secured to the opposite cylinder-heads of a direct-acting steam-engine, and having fitted within them the cranked shafts 1 4 1' 4', and rockers 5 6 7 5' 6' 7', that actuate the inlet-valves of the engine in the manner described.

9. A pendulous yoke situated at the side of a direct-acting steam-engine, and having coupled to it a pair of rods that receive motion from devices actuated by the main piston, and another pair of rods that transmit motion to the inlet-valves, said rods being connected to said yoke below its point of suspension, as herein described, and for the purpose stated.

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

GEORGE CLARKE.

Witnesses:
ROBT. W. CARROLL,
WM. DISNEY.