

G. J. WARDWELL.
Reciprocating-Engines.

No.156,686.

Patented Nov. 10, 1874.

Fig. 1

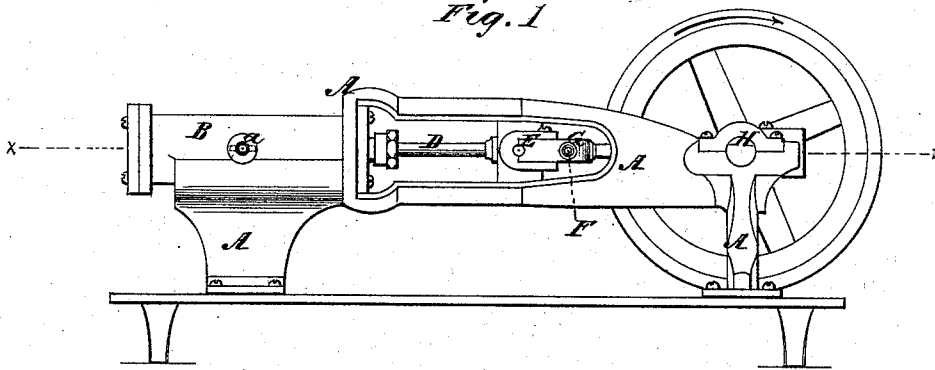


Fig. 2

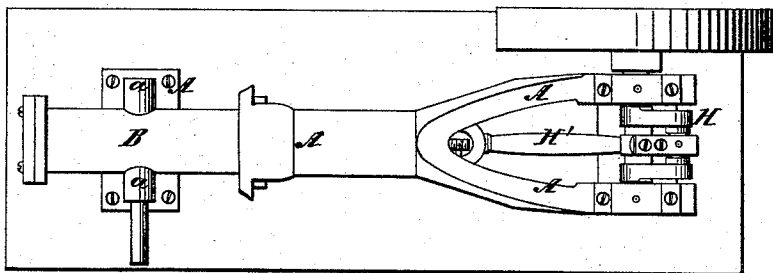
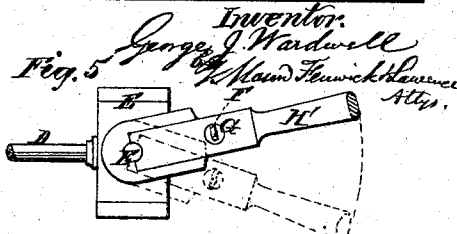
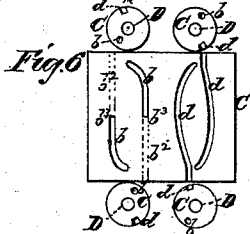
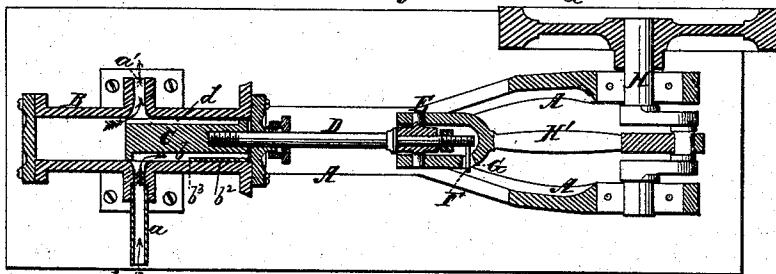
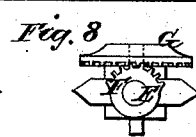
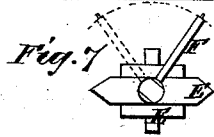
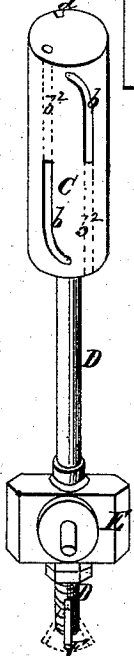


Fig. 4



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UNITED STATES PATENT OFFICE.

GEORGE J. WARDWELL, OF RUTLAND, VERMONT.

IMPROVEMENT IN RECIPROCATING ENGINES.

Specification forming part of Letters Patent No. **156,686**, dated November 10, 1874; application filed October 1, 1874.

To all whom it may concern:

Be it known that I, GEORGE J. WARDWELL, of Rutland, county of Rutland and State of Vermont, have invented a new and useful Improvement in Reciprocating Cross-Head Engines; and I do hereby declare that the following is a full, clear, and exact description thereof, reference being had to the accompanying drawings making part of this specification, in which—

Figure 1 is a side elevation of a horizontal cross-head engine constructed in accordance with my invention. Fig. 2 is a top view, and Fig. 3 a horizontal section, of the same. Fig. 4 is a perspective view of the piston with the cross-head and the pin of the device by which the piston is turned partly around in the cylinder. Fig. 5 is a side view of the cross-head and portions of the piston-rod and pitman; also, the pin of the device, which turns the piston partly around in the cylinder. The pitman and pin are shown in two positions. Fig. 6 is a diagram, showing the working and exhaust ports of the piston projected on a plane, and also illustrating the operation of the piston during its longitudinal movement, end views of the piston in its different positions at the beginning and ending of the back and forward strokes being shown for this purpose. Figs. 7, 8, and 9 show details, the latter two of which are modifications of the device for turning the piston in its cylinder.

The nature of my invention consists, first, in the combination, with the pitman and piston-rod of a reciprocating engine, of mechanism for turning a piston having reverse-operating working ports and reverse-operating exhaust-ports, of curvilinear or other suitable form in its circumference, and thereby bringing and keeping its working and exhaust ports in proper range with the induction and eduction ports of the cylinder during the inward and outward strokes of the piston; second, in a certain construction of the ports in the piston whereby a free exhaust is secured, the cut-off effected at the proper time or at any point that it is desired to work the steam on the expansion, and this while the piston is balanced, said construction involving partly open and partly inclosed receiving-passages,

in combination with fully-open exhaust-passages.

To enable others skilled in the art to make and use my invention, I will proceed to describe it.

A represents the frame of the engine. This frame may be of cast metal, and it may consist of end standards for boxes of the crank-shaft, upper and lower guides for the cross-head, a cylinder-supporting stand with the steam-cylinder formed upon it—that is, all the parts named, except the upper halves of the crank-shaft boxes, may be cast in one piece. In order to have the frame light and strong, it is made tubular lengthwise and circular in transverse section, with metal left out at the sides opposite the cross-head and at the place where the crank and pitman are located and play.

Any other suitable construction of frame may be employed, but this plan is a cheap and strong one.

B is the cylinder of the engine, made of greater length than usual, and with its bore perfectly plain, there being no channels or steam-ports cut in it longitudinally or circumferentially, except that at diametrically-opposite points midway of its length, and on a plane with its horizontal axis, an inlet-passage, *a*, and an exhaust-passage, *a'*, are cut through hubs or bosses cast on the cylinder, as shown in the drawings. This cylinder has the usual screw-heads or end plates and stuffing-boxes. The passages *a* and *a'* are elongated and narrowed as they approach to the inside of the cylinder so as to be equal in their discharging to their receiving capacity. C is the piston proper of the engine. This is of a length a little greater than one-half the length of the cylinder, and is turned perfectly true to fit the cylinder snugly at all points, except where the ports are formed in its circumference. It is connected to its rod D in the usual or any suitable manner. *b b'* are working steam-ports formed in the circumference of one side of the piston. The port *b* receives steam to move the piston inward, and the port *b'* receives steam to move the piston outward. The port *b* is commenced near the outer end of the piston, and the port *b'* near the inner end of the piston, and each is continued out entirely

to the respective opposite ends of the piston. Along about one-half, more or less, of the length of these ports, they are inclosed channels, and along the other portion they are open grooves. These ports are so curved or shaped, as represented, that they respectively keep in range with the induction-port a —that is, one comes into range therewith just as the other moves out of range, there being a little "lead" given to each in order to insure a perfect operation. The partial inclosing of the ports, as at $b^2 b^2$, insures the cutting off of the steam when the points $b^3 b^3$ pass by the induction-port a , and thus the steam is worked on the expansion during the remainder of the stroke, both in the inward and outward motions of the piston. $d d'$ are exhaust-ports on the opposite side of the piston. These ports are so curved and shaped, as represented, that they respectively keep in range with the exhaust-port of the cylinder during the inward and outward strokes of the piston—that is, one comes into range therewith just as the other passes out of range. These ports are simply grooves or open channels along their whole length, and they commence respectively near opposite ends of the piston, and continue entirely out to opposite ends, as shown. To render these ports capable of operating, as stated, the piston must make a vibrating circular movement in its cylinder as it moves longitudinally therein. And to produce this movement the piston-rod must be coupled to the pitman-rod H , and to effect this the piston-rod is extended through the cross-head E , and fastened by jam-nuts, which do not prevent the piston-rod from turning, and in this extended end a pin, F , is inserted on one side, and this pin is fitted in a flaring hole, G , cut through one of the side jaws of the yoke or strap of the pitman, as shown. Instead of having the pin back of the cross-head, the strap or yoke of the pitman may be extended forward, and the hole G cut in one of the jaws forward of the cross-head, and a pin inserted into the pitman at a point forward of the cross-head, and passed into the hole, and instead of a pin a segment-wheel, F , Fig. 8, may be confined on the rear end of the piston-rod, and a toothed wheel, G , Fig. 8, fitted upon a shaft fastened to the pitman. And, if desired, the pin may pass and work through a short tumbling-box, G , Fig. 9, fitted in or to one of the jaws of the strap or yoke of the pitman.

In all of these plans freedom for the ports to accommodate themselves to the motions of the pitman H , when operated by the crank-shaft H' , should be allowed both laterally and longitudinally.

It will be evident from an inspection of the drawings, in connection with the foregoing description, that, as the crank revolves, and lifts and lowers the pitman, the pin F , if that be the device used, will be raised and lowered, and that, consequently, the piston-rod and the piston will be caused to vibrate, as they move inward and outward within the cylinder

of the engine. This vibration of the piston causes the respective ports of the piston to come at proper times into range with the inlet and exhaust ports of the cylinder, in which range they keep on account of their shape corresponding with the movements imparted to the piston by the crank-shaft, pitman, and coupling device combined.

The coupling-pin, shown in Fig. 7, moves in the arc of a circle in a vertical plane, as the pitman moves from the position shown in full lines in Fig. 5 to the position shown in dotted lines in same figure, and there is a loose gliding of the pin over the inner edge of the flaring hole G , through which it is passed during the movement mentioned. To avoid having the pin fitted so loosely, it may be passed snugly through the vertical-rolling longitudinally-sliding box G , and the rolling and sliding box will accommodate itself to the motions imparted to the pin. The modification of the coupling shown by Fig. 8 operates by the wheel G gearing with the segment F as the pitman moves in the arc of a circle, as illustrated in Fig. 5.

The operation of the piston is as follows: The piston being in the position shown in Fig. 3, the receiving-port for the back stroke is in range with the steam-inlet passage a , and the exhaust-port for the forward stroke is in range with the exhaust-passage a' . The inflowing steam passes to the forward end of the piston, and moves the piston to the opposite end of the cylinder, the exhaust steam passing off during this movement, and while this movement is taking place a portion of the live steam has passed into the open end of the channel, which is on the opposite side of the piston, and acted as a balance to the pressure of the steam in the receiving-port during said movement; and, further, during said movement the cut-off formed by the portions b^2 of the circumference of the piston, which partly inclose the working ports, closes the inlet-port and causes the steam in the port to work on the expansion during a portion of the stroke. From the beginning of the back movement the piston has a gradual circular movement imparted to it, which keeps the receiving and exhaust ports in working range with the inlet and outlet passages, and by the time the stroke is completed the piston is turned enough to move the ports for the back stroke out of range, and bring the receiving and exhausting ports for the forward stroke in range with said passages, and, of course, the forward stroke is produced in precisely the same manner as was the back stroke, all the operations of the parts being the same, except that the direction of the moving parts and of the inflowing steam is reversed.

It may be found desirable to use other power than steam for working this engine, and therefore, I reserve to myself the privilege of using either steam, air, gas, or any other suitable agent as the power for operating the piston.

What I claim as new is—

1. The combination, with a reciprocating and turning piston-rod D and a pitman, H', of mechanism F G for turning the piston while it is being moved back and forth, substantially as and for the purpose described.

2. The receiving steam-ports formed in a longitudinally-reciprocating and circularly-vibrating piston, partly inclosed along their length, in combination with the exhaust-ports

open along their whole length, whereby the working of the steam on the expansion, when the receiving-passage is closed, is effected while the piston is balanced, substantially as described.

GEORGE JEFFARDS WARDWELL.

Witnesses:

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C. CLARK.