R. EICKEMEYER.

Steam-Engines.

No. 155,933. Patented Oct. 13, 1874.

Fig. 1.

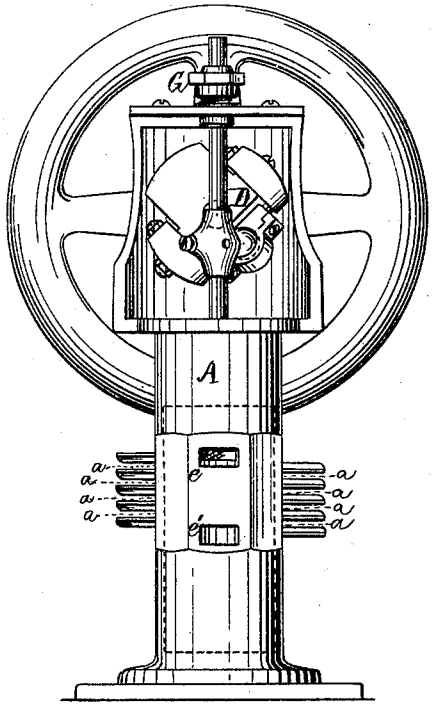


Fig. 7.

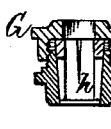


Fig. 2.

Fig. 3.

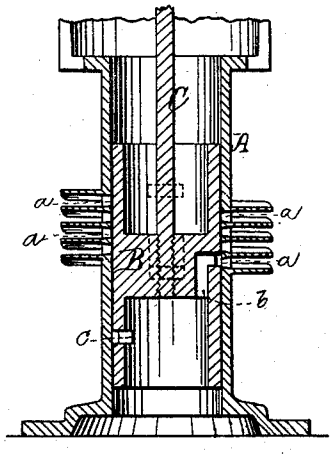


Fig. 4.

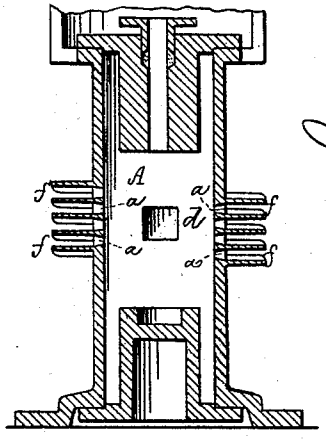


Fig. 5.

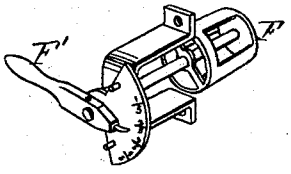
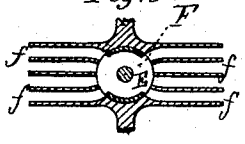


Fig. 6



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UNITED STATES PATENT OFFICE.

RUDOLF EICKEMEYER, OF YONKERS, NEW YORK.

IMPROVEMENT IN STEAM-ENGINES.

Specification forming part of Letters Patent No. **155,933**, dated October 13, 1874; application filed January 12, 1874.

To all whom it may concern:

Be it known that I, RUDOLF EICKEMEYER, of Yonkers, in the county of Westchester and State of New York, have invented certain new and useful Improvements in Steam-Engines, of which the following is a specification:

My improvements relate generally to that class of reciprocating-piston engines in which the pistons operate as valves for controlling the induction and eduction of steam to and from the cylinder; and the principal features thereof relate to and are more particularly applicable to those engines which have a reciprocal, rotative, and longitudinal movement, substantially as described by me in the specification of Letters Patent issued to me for improvements in steam-pumps, dated May 6, 1873, No. 138,622.

My present invention embraces a novel method of controlling the passage of steam to the cylinders of engines of the class referred to, whereby they may be worked expansively by cutting off the steam at any desired fractional part of the stroke without the employment of any of the complicated cut-off valves and valve-tripping mechanism heretofore employed in other kinds of engines for similar purposes. My invention consists in providing the cylinder with two or more centrally-located induction-ports, arranged side by side at different longitudinal points, and in connecting each of said ports by means of an independent steam-duct or passage with the steam-chest, or its equivalent, in which is a valve of simple and ordinary construction, which is arranged, when operated by hand or by any well known automatic steam-governor, to successively close the entrances to said ducts, and thereby limit the induction of steam through the valve-port in the piston to the time during which the said piston-port, in its transit, is in successive coincidence with the several cylinder-ports whose passages or ducts remain unclosed. My invention further consists in effecting a complete balance of pressure on the piston by means of a piston of peculiar construction, provided with no longitudinal channels, and having for each end but one main valve-port for controlling induction and eduction of steam, and an auxiliary exhaust valve-port, in combination with a cylinder which has coincident induction-ports located at opposite points therein, and also eduction-ports similarly located. My invention also consists in a piston-rod guide of novel construction, which is adapted to be readily adjusted to the rod when any undue wear of the parts has occurred; and I do hereby declare that the following specification, taken in connection with the drawings furnished and forming a part of the same, is a true and accurate description of an engine embodying my invention.

Referring to the drawings, Figure 1 represents, in front elevation, a vertical engine embodying my invention, with the outer casings of the several steam-ducts removed, and the exhaust-pipe connection detached for the purposes of illustration. Fig. 2 represents the same in side elevation. Fig. 3 represents the cylinder and piston in vertical section, with the cylinder-heads removed. Fig. 4 represents the cylinder and its heads in vertical section. Fig. 5 represents, in perspective, the controlling valve detached. Fig. 6 represents the valve and the several steam-ducts in section. Fig. 7 represents the piston-rod guide in vertical section.

In the several figures, A denotes the cylinder. It is provided on each side with four induction-ports, *a*, arranged one above the other, in the same vertical line. Those on the right hand, as shown in Figs. 1, 3, and 4, are arranged to supply steam for forcing the piston upward, and those on the left hand provide for its downward movement. Three of the ports on each side are opposite each other; but the upper port on the left and the lower one on the right are, respectively, nearer the ends of the cylinder than the lowest and highest port on the same side. The cylinder is also provided with one main exhaust-port, *d*, located at the rear of the cylinder, midway between its two ends, and is shown in Fig. 4. Through this port a large portion of the steam is exhausted from both ends of the cylinder. Two auxiliary exhaust-ports, *e e'*, are cut through the front side of the cylinder. One is on a line a little above the highest, and the other a little below the lowest induction-ports. B denotes the piston, which is tubular in form, and provided with

a solid central partition, to which the piston-rod C is attached. The piston is provided with two main valve-ports, one of which, *b*, communicates with the lower portion of the cylinder, as shown in Fig. 3. The duplicate of port *b*, which communicates with the upper end of the cylinder, is located a little below the lateral line of the port *b*, with its center one-eighth of the circumference of the piston from the center of the port *b*, and is clearly indicated in dotted lines. The piston is also provided with an auxiliary exhaust-port adjacent to each end. One of these is shown at *c*, and its duplicate is located adjacent to the opposite end of the piston, at a point opposite the port shown in dotted lines. Each of the two auxiliary exhaust-ports is, therefore, on the side of the piston exactly opposite the main valve port, which communicates with the same end of the cylinder. The piston-rod is connected to the fly-wheel shaft by means of a novel complex crank, D, of my own invention, constructed substantially in accordance with the Letters Patent issued to me May 27, 1873, No. 139,379, and in relation to which it is only necessary to explain, in this connection, that, in imparting to the crank-shaft the rotary movement converted by it from the longitudinal movement of the piston-rod, it also imparts to the piston-rod a reciprocal rotation on its axis. With the cylinder and ports constructed as shown, the piston should receive a full quarter-revolution in one direction at the lower end of the stroke, and a return movement at the upper end; but during its longitudinal movement but little, if any, rotation should occur. By a change in the relative proportions and positions of the several parts composing the complex crank one may be made to rotate the piston to any desired degree.

The steam-chest E is connected with each of the several cylinder induction-ports *a* by separate and distinct steam ducts or passages *f*, which enter the steam-chest at points opposite each other.

F denotes a common plug-valve. (Shown detached and in perspective in Fig. 5.) The valve has two ports of equal size, and each of an area equal to that of all the entrances to the ducts *f* on one side. The closed portion of the plug has also areas equal to and slightly greater than its ports, in order that the several entrances to the steam-ducts may be wholly closed. The valve is controlled by a hand-lever, F′; or any automatic steam-governor well known can be attached thereto, in an obvious manner, for operating the valve. An indicator may be provided in connection with the lever, whereby the exact position of the valve with relation to the steam-passages may be readily determined.

It will be seen in Fig. 6 that, by rotating the valve to the left hand, that upper passage on the left and the lower on the right will be simultaneously closed, and so on until any desired number, or all of them, may be successively closed. The form and character of this valve may be widely varied, and it is only necessary that the several entrances of the ducts to the steam-chest or equivalent supply-chamber should be arranged to conform to the character of the valve—as, for instance, they should enter through a plane-surfaced valve-seat, and be arranged, side by side, in one or two parallel lines for a slide-valve; or, if for a disk-valve, the same plane-surfaced seat would be requisite, with the entrances to the passages arranged in radial lines, and all embraced within the circumferential line of the valve.

From the fact that the steam-ports in the cylinder are coincident, occupying opposite points therein, and that both sets have the same area, the steam pressure on the piston is perfectly balanced. The two auxiliary exhaust-cylinder ports on one side of the cylinder have an aggregate area equal to that of the main exhaust-cylinder port on the opposite side, and the auxiliary and main piston-ports at each end of the piston have an equal area, and are also on opposite sides of the piston, and hence a balance of pressure, so far as relates to the exhaust, is also practically effected.

The piston-rod guide G is composed of a conical interior seat, *g*, a split bushing, *h*, and a screw-nut, *i*. The bushing *h* is tubular in form, and constructed in one piece. Its exterior surface is tapered to correspond with the interior surface of the seat *g*, and its interior surface corresponds with the surface of that portion of the piston-rod which it embraces. In order that both ends of the bushing may be made to engage with the piston-rod with uniformity, it is split or slotted from the upper edge downward for a portion of its length at opposite sides, and is also slotted from its lower edge upward in like manner, at points equidistant between the slots first mentioned. On being forced downward into the conical seat, the bushing is equally contracted at both ends, and thereby made to engage as a self-centering guide bearing with the piston-rod. Inasmuch as the rod reciprocates rotatively, as well as longitudinally, it is desirable that the bushing sections be rendered immovable in both directions, and this is effected by having the sections united in one piece, and having it as a whole under the control of the conical seat and nut. As the slots in neither instance extend from one end of the bushing to the other, they do not occasion any undue discharge of oil from the guide-bearing, but on the contrary they serve, in a measure, to retain the lubricant.

The operation of my engine is as follows: As seen in Figs. 1, 2, and 3, the piston is at its lowest point. The crank-head D, by its passage of the centers, is rotating the piston, which is so turned that the lower piston-valve port *b* is brought coincident with the lower right-hand steam-port in the cylinder. The same movement also brought the upper aux-

iliary exhaust-piston port *c* into coincidence with the upper auxiliary exhaust-cylinder port *e*, and at the same time the upper piston-valve port *b* is brought into coincidence with the main exhaust-port *d*, so that as steam enters through lower port *b* into the lower end of the cylinder as the piston rises, it freely exhausts from the upper end through both the main and auxiliary ports. When the piston reaches its highest point, its rotation is effected in the opposite direction, which brings the lower piston port *b*, through which steam had last entered, into coincidence with the main exhaust-port *d* in the cylinder, and its proper auxiliary exhaust-port in coincidence with its cylinder-port. Meantime the upper piston-port *b* will be brought into coincidence with the upper left-hand cylinder steam-port, and the descent will be made, and so on. It will be seen that the four cylinder steam-ports occupy a longitudinal portion of the cylinder equal to about four-fifths of the entire stroke of the piston, and, therefore, steam may be taken in during that portion of the stroke, if all the steam-ducts *f* are open. If the valve F be turned so that the upper right-hand and lower left-hand duct *f* is closed at its entrance to the steam-chest, then steam can be taken in at only three-fifths of the stroke, and so on until but one passage on each side being open, the engine will cut off at one-fifth of its stroke, or it may be cut off from the cylinder entirely.

It will readily be seen that if the valve be controlled by a governor properly adapted and adjusted, the cut off operation may be, practically, as effectually accomplished, as with the heretofore employed complex valve tripping mechanism.

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

1. The steam-induction cylinder-ports arranged side by side, and centrally located at different longitudinal points in the cylinder, and provided with an independent steam duct or passage for each of said ports to connect the same with the steam-chest, in combination with a valve or valves, arranged to close successively the said steam ducts and ports, substantially as and for the purposes specified.

2. The cylinder provided with coincident duplicate steam-ports located at opposite sides thereof, and the main and auxiliary exhaust-ports also located at opposite sides, in combination with a reciprocating and partially rotative piston, having at each of its ends a main valve-port for alternately communicating with one of the steam-ports, and with the main exhaust-port in the cylinder, and also an auxiliary exhaust valve-port for communicating with its co-operative auxiliary exhaust cylinder-port, substantially as described.

3. The conical-seat, in combination with the tubular bushing slotted from both ends, and the actuating-nut, constituting a piston-rod guide, substantially as described.

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Witnesses:

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