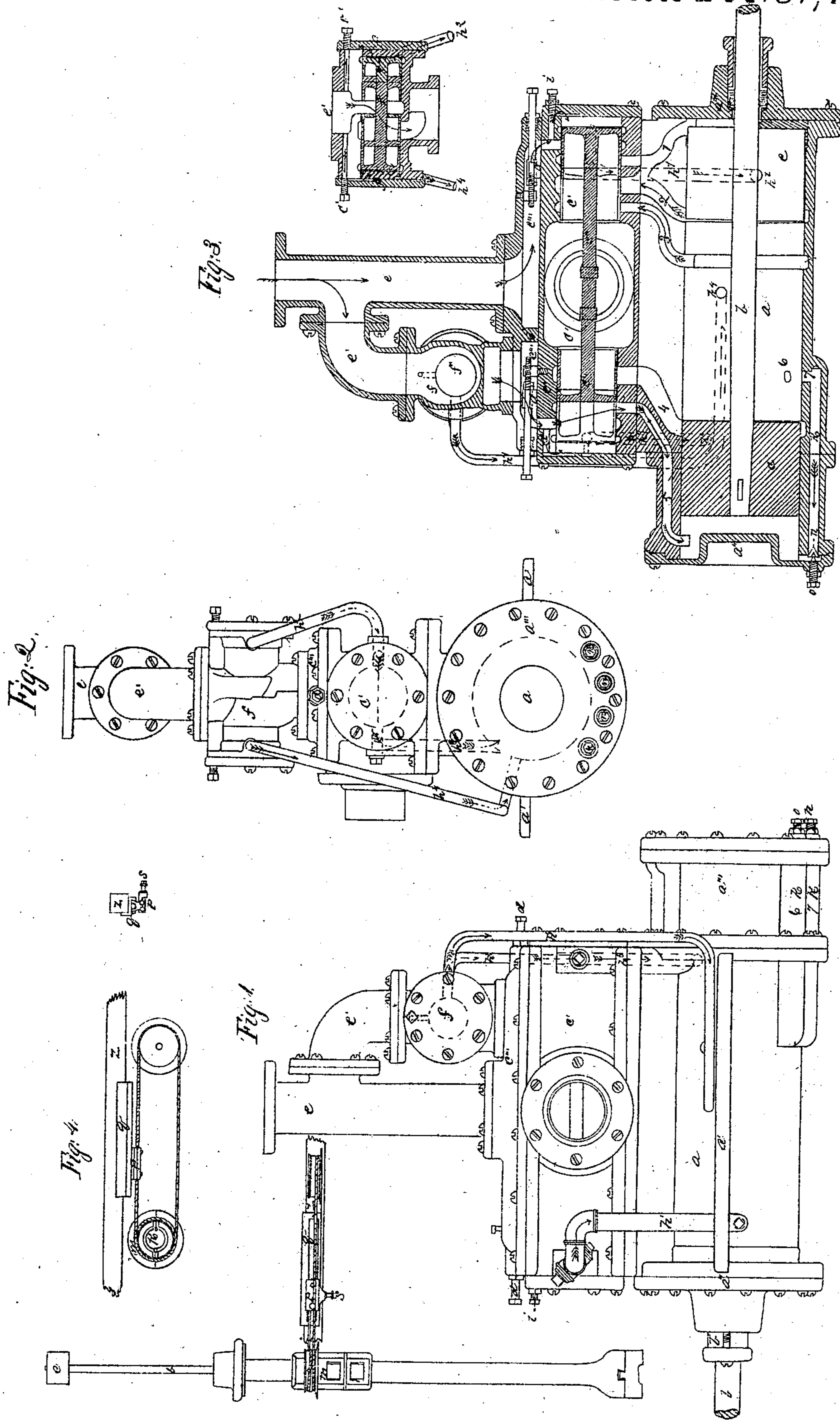


W. Ball. Steam-Engine.

N^o 72714

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Witnesses

E. P. Ball
J. W. Ball

Inventor
W. Ball

United States Patent Office.

WILLIAM BALL, OF CHICOPEE, MASSACHUSETTS.

Letters Patent No. 72,714, dated December 31, 1867.

IMPROVEMENT IN STEAM-ENGINES.

The Schedule referred to in these Letters Patent and making part of the same.

TO ALL WHOM IT MAY CONCERN:

Be it known that I, WILLIAM BALL, of Chicopee, county of Hampden, and State of Massachusetts, have invented certain new and useful Improvement in Steam-Cylinders for Hammering or Stamping Mineral Rock or other Material; and to enable others skilled in the art to make and use the same, I will proceed to describe by referring to the drawings, in which the same letters indicate like parts in each of the figures.

The nature of this invention consists in so constructing and arranging the various parts and portions of a steam-cylinder, with its adjuncts, for hammering or stamping material, that it will become self-acting, and produce irregular and positive motion to its shaft or piston. The nature of this invention will be further understood from the specification and drawings. In the accompanying drawings—

Figure 1 is a right-hand side elevation, which, when placed in position for operation, is secured to a perpendicular post by means of flanges.

Figure 2 is a top view of the same.

Figure 3 is a left-hand side sectional view.

Figure 4 is a side view of the stamp-shaft connected to the piston-rod of the cylinder, with the *modus operandi* for rotating, partially rotating, or vibrating said piston, or piston and shaft, during its rising and falling motion.

a is a steam-cylinder. *a'* are flanges, formed on the sides of the cylinder for the purpose of securing said cylinder firmly in a vertical position for use. *a''* is the lower head of the cylinder, through which the piston-rod *b* is fitted and works, and is provided with a stuffing-box, *b'*. *c* is the piston-head, secured to the upper end of the piston-rod or shaft *b*. *a'''* is the upper head of the cylinder, between which and the piston-head is provided spare room to form a steam-cushion for the piston-head. *c'* is a valve-cylinder, closely joining the front side of the steam-cylinder. *c''* is a balance-valve, which, by the change of its position from one end of its cylinder to the other, admits steam into the main cylinder, first at one end then at the other. *c'''* is a chamber, through which the steam is admitted into the valve-cylinder *c'*. *d d'* are valves, for regulating the amount of steam to be admitted from the steam-chamber into each end of the cylinder *a*. *e e'* are steam-pipes, through which the steam is introduced into the steam-chamber *c'''*, thence to the valve-chamber or cylinder *c'*, thence into the steam-cylinder *a*. *f* is a cut-off balance-valve, arranged between the pipe *e'* and the upper end of the steam-chamber *c'''*. This steam-chamber *c'''* is divided by a partition, *g*. The dark shading shows the steam-passages. The arrows indicate the course of the live and exhaust steam on the down stroke of the piston-head *c*. *h¹ h² h³ h⁴* are pipes or passages, which conduct the exhaust-steam from the valve-cylinder into the main cylinder.

The steam enters the valve and main cylinder through open ports, in the common way, which presses the valve or piston against the opposite side of the cylinder, which produces friction or binding tendency. To obviate this objection I provide depressions *t*, of about equal width and depth, from one edge of the ports around the inside circumference of the cylinder, between its ends to the other edge of the ports, thus allowing the steam to pass around the valve or piston, and allow it to work free from lateral-pressure steam.

The port 4 is for an exhaust-port, and serves two purposes: first, after the downward stroke of the piston *c* is made, the valve *c''* changes from the position shown in red line, to that shown in blue line, when the port 4 is open for free exhaust; and second, when the piston *c* is driven up by the pressure of steam, and if its lower edge passes the lower edge of the port 4, the steam will exhaust through said port, and diminish the pressure, and with the action of the steam-cushion will prevent any injury occurring to the cylinder, and at the same time the valve *c''* will move downward, closing port 4, and readmitting steam to the upper end of the piston. The lower edge of the piston is not designed, when working in a proper manner, to rise above the lower edge of the port 4. But when from any cause it, (the piston *c*), is driven or rises above the lower edge of the port 4, the steam is allowed to escape, and thereby relieve the pressure of steam from the under side of the piston through the port 4, which, jointly with the action of the steam-cushion, between the piston and cylinder-heads, effectually prevents all accidents from occurring thereto. The live steam which operates the piston-head *c* is admitted through the pipes *e e'*.

At the commencement of the operation, the piston is down at the lower end of the cylinder, as shown in blue line. In order to produce the rising motion of the piston-head *c*, the steam is admitted through the lower end of the steam-chamber to the valve-cylinder *c'*, through a steam-passage regulated by a screw, *i*, to the lower end of the balance-valve *c''*. The piston-head being down, it covers the port *h¹*, which prevents the steam escaping into the cylinder *a*, consequently it throws up the valve *c''* into position, as shown in blue lines, (which, in its quick ascent, cushions against steam in the upper end of its cylinder,) and allows the exhaust steam to escape from the cylinder through the port 4, and at the same time allows the steam in the steam-chamber to

pass direct through the valve-cylinder and steam-port 1, to the lower end of the piston-head *c*, which acts upon and throws up the piston-head to its position, as shown in red line. When the piston-head, in ascending, closes the port *h*³, it cuts off the escape of steam from the left-hand end of the cut-off valve-cylinder *f*, having its passage through the pipe *h*² and the upper end of the balance-valve cylinder *c'*, thence through the passage or pipe *h*³ into the cylinder, which causes the cut-off valve *f'* to move to the opposite end of the cylinder *f*, which opens the direct passage for steam from the pipe *c'*, to the upper end of the steam-chamber *c'''* through a steam-passage, *i'*, to the upper end of the valve-cylinder *c'*, which causes the valve *c''* to move from its position, as shown in blue line to the position shown in red lines, thereby closing the exhaust-port 4 and opening the exhaust-ports 2 and 3, and at the same time completing a direct passage from the cut-off valve *f'*, through port 5, to the upper end of the piston-head *c*, which acts against said piston-head to throw it down with the stamp-hammer with great power into the mortar below; and as the piston-head descends and covers the port *h*⁴, it cuts off the escape of steam from the right-hand end of the valve-cylinder *f* while the steam is escaping from the left-hand end thereof, and thereby changes the position of said valve *f'*, from that shown in red line to that shown in blue line, by which it cuts off the supply of steam from the upper end of the cylinder *a*, and allows it to work expansively during the rest of its stroke.

When the upper end of the piston-head has descended below the port 3, the steam escapes through said port 3 into the exhaust-passage, and if there is not sufficient supply of rock or material in the mortar or under the hammer to prevent the piston-head from dropping below the upper edge of the port 2, the steam will enter the cylinder *a*, when the valve assumes the position shown in blue lines, on each end of the piston-head, through the ports 1 and 2, and thus prevent any further action until it is raised by manual or mechanical effort, so as to take steam in the usual way. *k* are steam-pipes, which receive steam from the cylinder *a*, a short distance down from the upper end of said cylinders, immediately after the piston-head has passed their ports 6 and 7 in its ascent, and conducts it to the upper end of the cylinder, between the head and piston; and when the pressure of steam between the head of the cylinder and the piston is greater than the pressure of steam below the piston, it will close the puppet-valves *n*, and thus form a perfect cushion for the piston. *o* are screws for regulating the play of the puppet-valves *n*. The screw *i* is for regulating the quantity of steam for operating and cushioning the lower end of the valve *c''*. *o'* are screws for regulating the amount of steam for operating the valves *f'*.

In fig. 4, *m* is a framework-pulley, made in two parts, and secured together by bolts or screws, and is fitted to the stamp-shaft *k*, having splines which work in grooves formed in the sides of said shaft. The office of this pulley is to give a rotary or a partial rotary or vibratory motion to the shaft or piston-rod *b*, by means of a belt, chain, or cord, the centre of which is firmly secured to the framework-pulley, and passes once or more around said pulley, above and below said fastening, the ends of which are secured firmly in a sliding reciprocating block, *p*, having its bearings formed in a guide-way plate, *q*, which plate is secured in a horizontal position, when in use, upon a timber, *r*, just one side of the shaft *k*, so that when one end of a pitman is secured to the pin *s* on the sliding block *p*, and the other end is secured to a crank-pin, each revolution of the crank-shaft will cause the shaft *k* or piston-rod *b* to rotate, partially rotate, or vibrate, more or less, according to the eccentricity of the driver or crank-pin. Thus, while the shaft *k* or piston *b* is rising and falling, it also, at the same time, rotates, partially rotates, or vibrates, first in one direction then in the opposite direction, by the action of this device; the object of which is to change the position of the hammer each successive blow thereof, and prevent the open space between the packing-rings of the piston from coming in contact with the steam-ports in the body of the cylinder, while it, the piston, vibrates therein.

I believe I have thus shown the nature, construction, and operation, so as to enable others skilled in the art to make and use the same therefrom.

What I claim, therefore, and desire to secure by Letters Patent, is—

1. I claim in a steam-cylinder the arrangement of the depressions *t*, formed with reference to their induction and eduction ports at points intermediate between the ends of and around the inside circumference of the cylinder, substantially as and for the purpose described.
2. I claim the arrangement of the steam-passages *k* for conducting steam from the cylinder, below the piston-head, in its ascent, around into space, between the piston and cylinder-head, to form a cushion for said piston, substantially as shown and described.
3. I claim, in said cylinder, the arrangement of ports *h*¹ *h*³ *h*⁴ for operating the valves thereof, substantially as described.
4. I claim the cut-off valve *f*, in combination with the balance-valve *c''* and piston *c*, substantially as described.
5. I claim the steam-port 1, in combination with port 2, so arranged as to hold the piston in a fixed position until released, to prevent damage to the lower head of the cylinder, substantially as shown and described.
6. I claim the arrangement of the steam-exhaust port 4, by which a free exhaust of steam from the upper end of the cylinder is effected before the ascent of the valve *c''*, substantially as shown and described.
7. I claim producing a rotary reciprocating in connection with a vertical motion of the piston *c*, in connection with one or more ports *h*¹ *h*³ *h*⁴, substantially as shown and described.
8. I claim the port 4, arranged with reference to the ports 6 and 7, whereby a free exhaust is secured after the ascent of the piston *c*, and by which, in connection with the steam-cushion at the upper end of the cylinder, all injury is prevented to the cylinder in its ascent, substantially as described.

WM. BALL. [L. S.]

Witnesses:

E. P. BALL,

JEREMY W. BLISS.