(No Model.)

H. BALL.

VALVE MOTION FOR ROCK DRILLS.

No. 455,089. Patented June 30, 1891.

Fig. 1.

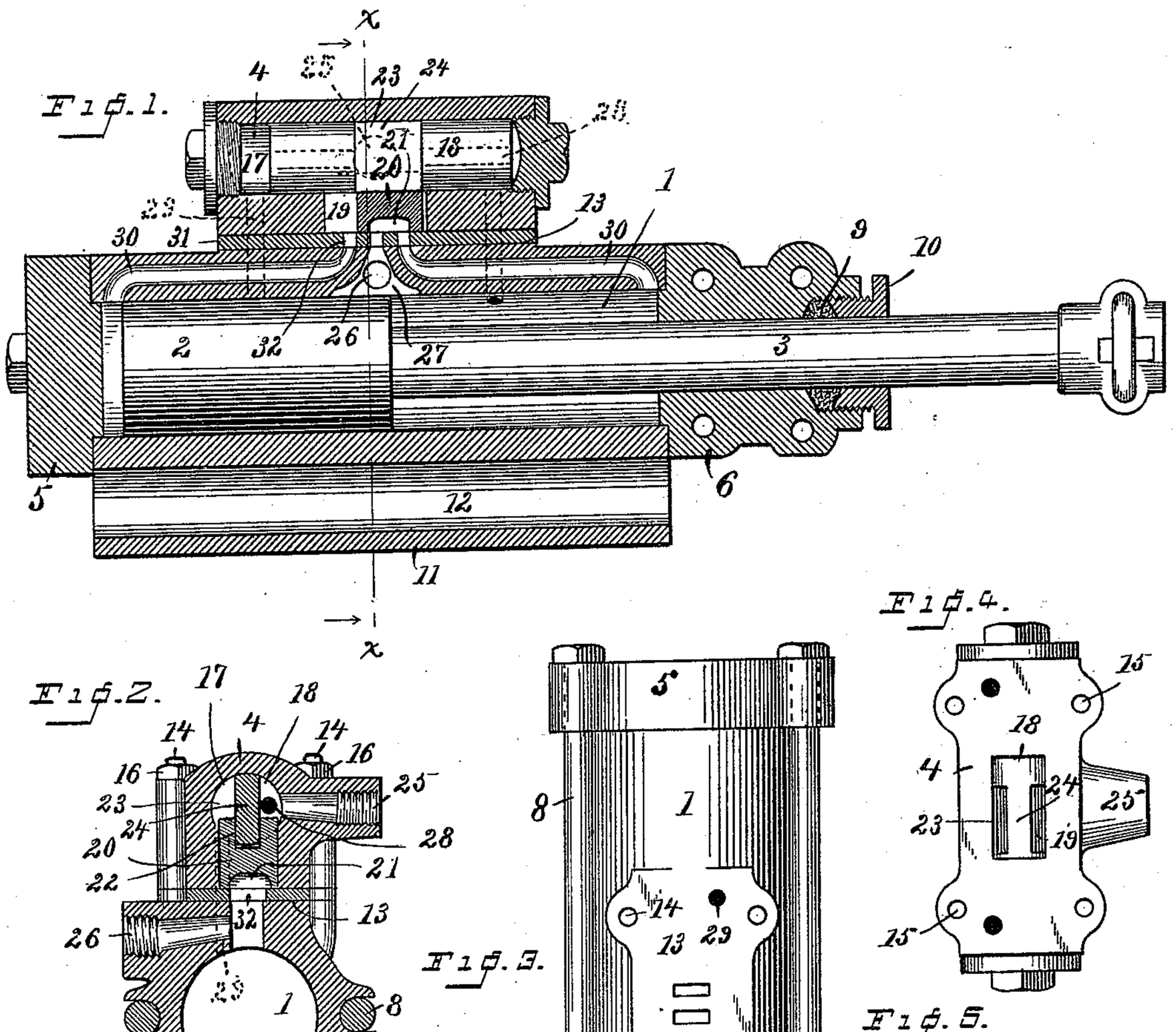


Fig. 2.

Fig. 3.

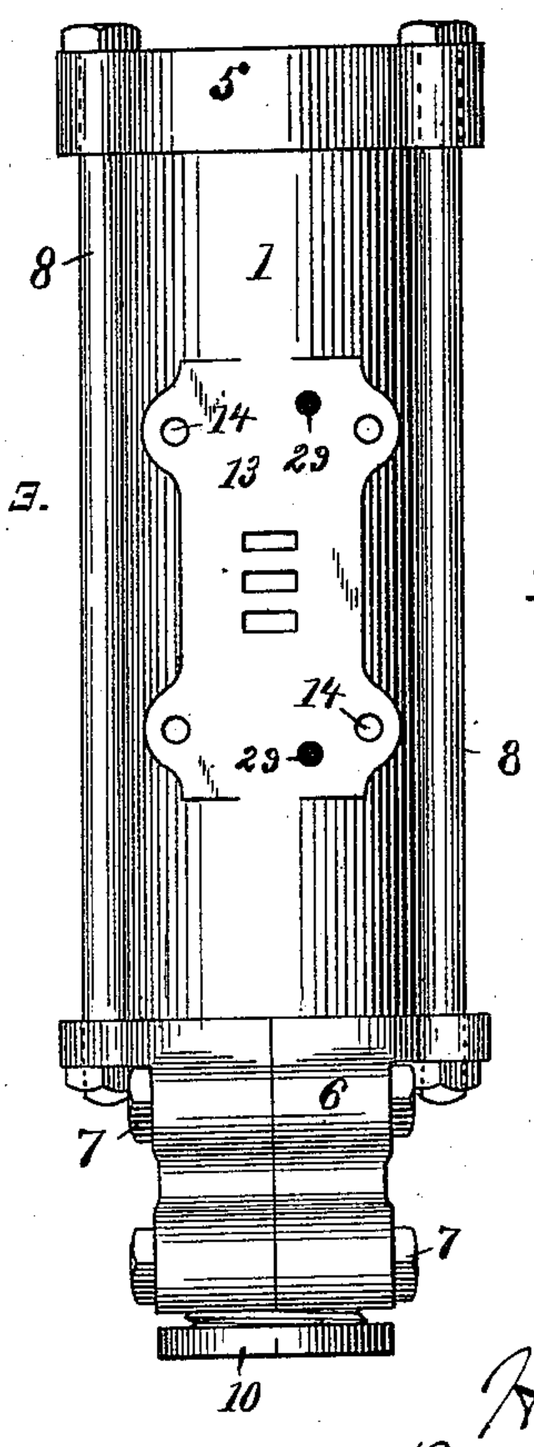


Fig. 4.

Fig. 5.

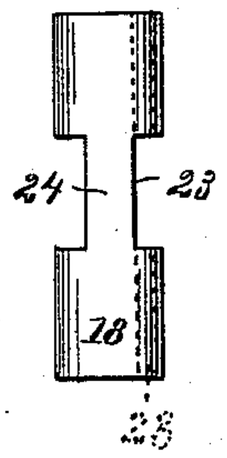
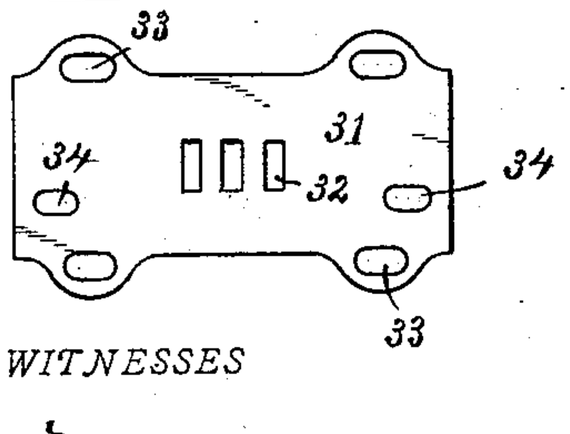


Fig. 6.



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VALVE-MOTION FOR ROCK-DRILLS.

SPECIFICATION forming part of Letters Patent No. 455,089, dated June 30, 1891.

Application filed August 25, 1890. Serial No. 362,959. (No model.)

To all whom it may concern:

Be it known that I, HARRY BALL, a citizen of the United States, residing at Stamford, in the county of Fairfield and State of Connecticut, have invented certain new and useful Improvements in Valve-Motions for Rock-Drills; and I do hereby declare the following to be a full, clear, and exact description of the invention, such as will enable others skilled in the art to which it appertains to make and use the same.

My invention is applicable to all classes of direct-acting engines operating either by steam or compressed air, and is especially applicable to rock-drills. For this reason I have illustrated my invention as applied to a rock-drill.

The general object of the invention is to so improve the construction and arrangement of the parts comprising the valve-motion as to greatly improve the durability of the machine and increase its capacity for all grades of work, while at the same time the cost of construction shall be reduced to the minimum. With these ends in view I have devised the simple and novel construction of which the following description, in connection with the accompanying drawings, is a specification, numerals being used to denote the several parts.

Figure 1 is a vertical section of the cylinder and steam-chest, the piston, piston-rod, and auxiliary piston being in elevation, also showing the arrangement of the steam-passages; Fig. 2, a vertical section on the line *x x* in Fig. 1; Fig. 3, a plan view of the cylinder, the steam-chest and adjusting-plate being removed; Fig. 4, an inverted plan view of the steam-chest, the valve being removed; Fig. 5, a view of the auxiliary piston detached, and Fig. 6 a view of the adjusting-plate detached.

1 denotes the cylinder; 2, the piston; 3, the piston-rod, and 4 the steam-chest. The exact construction of these parts is not of the essence of my invention, and the details may be varied greatly without departing from the principles thereof.

5 denotes the upper head of the cylinder, usually cast in one piece, and 6 the lower head, which is usually cast in two parts, said parts being secured together by transverse bolts 7, the two heads being rigidly secured to the cylinder by longitudinal bolts 8. The lower head of the cylinder is provided with a recess to retain suitable packing 9, which is held in position by a screw-plug 10, through which the piston-rod passes, and upon the under side of the cylinder is the usual flanged base 11, having an opening 12 through it to receive the feed-screw. (Not shown.) Upon the top of the cylinder is a flat surface 13, over which the steam-chest is placed, the latter being secured in place by bolts 14, which extend upward from the cylinder and pass through openings 15 in the steam-chest, the latter being locked in position by nuts 16. Within the steam-chest is a longitudinal opening 17, in which an auxiliary piston 18 reciprocates.

19 denotes a recess in the under side of the steam-chest and extending into the longitudinal opening. Within this recess a valve 20, which may be of the ordinary construction commonly known as a "flat" or D valve reciprocates. This valve is provided with the usual opening 21 in its under side and with a longitudinal groove 22 in its upper side. The opposite sides of the auxiliary piston are cut away, as at 23, these cut-away portions being of sufficient length to receive the ends of the valve, the central portion of the auxiliary piston (denoted by 24) lying when assembled in groove 22 in the valve, as will be clearly understood from Fig. 2 in connection with Figs. 4 and 5. It will thus be seen that the movement of the auxiliary piston in either direction must carry the valve with it. 25 denotes the steam-port and 26 the exhaust-port. It will be noticed (see Fig. 1) that the exhaust-opening 27 in the cylinder which connects with the exhaust-port leads into recess 19 in the steam-chest, and that at its lower end, where it opens into the cylinder, it is very much elongated, the purpose of which will presently be explained.

Upon the side of the auxiliary piston toward the steam-port and leading from the cut-away portion 23 on that side to the ends of the auxiliary piston are openings 28. 29 denotes steam-passages leading from the opposite ends of the steam-chest into the cylinder, and 30 denotes steam-passages leading from recess 19 in the steam-chest to the op-

posite ends of the cylinder. Passages 29 open into the cylinder approximately midway between the exhaust-opening and the openings of passages 30 into the cylinder. Opening 21 in the under side of the valve is of sufficient length to permit perfect communication between one of the steam-passages 30 and exhaust-opening 27.

In Fig 1 the valve is shown as at the extreme of its movement toward the right and the auxiliary piston as at the extreme of its movement toward the left. In this position of the parts steam will pass from the steam-chest through the left passage 30 into the left end of the cylinder to drive the piston toward the right, and steam will exhaust from the right end of the cylinder through the right passage 30, which communicates directly with the exhaust. At the opposite extreme of the movement of the valve steam will pass through the right passage 30 into the right end of the cylinder and the exhaust will be from the left end of the cylinder through the left passage 30.

The operation of the valve mechanism is as follows: The steam when it enters the steam-chest passes through openings 28 in the auxiliary piston to the opposite ends of said piston and into recess 19 in the under side thereof, the action being to hold the valve down hard on its seat. In the position of parts shown in Fig. 1 there can be no movement of the auxiliary piston, as the pressure at both ends is equal, it being apparent that there can be no exhaust from either end of the steam-chest until the piston has passed far enough toward the right to open the left steam-passage 29, the right passage 29 being closed by the auxiliary piston itself. As soon as the left passage 29 is opened the right corresponding passage will be closed by the piston and there will be an exhaust from the left end of the steam-chest into the cylinder, which will permit the steam passing to the right end of the auxiliary piston to drive it instantly to the left end of the steam-chest, which of course shifts the valve from the position shown to its reverse position just described. At the time this movement of the valve toward the left takes place the piston will have nearly reached the extreme of its movement toward the right—that is, the reverse of the position shown in Fig. 1. By elongating the exhaust-opening in the cylinder it will be seen that during the last portion of the stroke of the piston in each direction I permit the steam to exhaust directly through opening 27 and the exhaust-port. I thus relieve the pressure behind the piston and also absolutely prevent back-pressure on the piston at the instant the forward movement commences, as the steam is for an instant entirely free to pass directly out at the exhaust-port. This construction enables me to greatly increase the power exerted by the piston with a given consumption of steam and also to increase the speed.

In Fig. 1 the opening 21 in the under side of the valve is shown as forming a connection between the right steam-passage 30 and the exhaust-opening. The shifting of the valve to its reverse position by the movement of the auxiliary piston just described causes opening 21 to serve as a connection between the left steam-passage 30 and the exhaust-opening. In this position of the parts (not shown in the drawings) the steam will pass from recess 19 through the right steam-passage 30 into the right end of the cylinder and will act to drive the piston toward the left, the steam in the left end of the cylinder exhausting through the left passage 30, which is at this time in connection with the exhaust-opening by means of opening 21 in the under side of the valve. The construction just described is operative in every respect. It will be seen, however, that steam is admitted at both ends of the cylinder at the same instant relatively, and that the cut-off takes place at the same point in the stroke when the cylinder is moving in each direction—that is to say, the passage of steam into the lower end of the cylinder to move the piston upward is continued just as long as it is into the upper end of the cylinder to drive the piston downward. I use the term "lower end of the cylinder" to designate the end through which the piston-rod passes, the drill being attached thereto when the engine is used as a rock-drill. In order that steam may be admitted an instant sooner into the upper end of the cylinder to drive the piston downward, and the entrance of steam into the lower end of the cylinder to drive the piston upward may be slightly retarded, the object being to increase the force of the blow delivered through the piston-rod by the downward movement of the piston and to lessen the force of the upward movement of the piston, thereby greatly increasing the effective power of the drill, I provide an adjusting-plate 31 between the steam-chest and the cylinder. This plate is provided with openings 32, which are adapted to register with steam-passages 30 and exhaust-opening 27, as shown in Fig. 1, or to be moved more or less out of alignment therewith. I have not shown this last position, as it is thought to be too obvious to require illustration.

33 denotes slots in plate 31, through which bolts 14 pass, and 34 denotes slots which are at all times in alignment with the parts of steam-passages 29 in the steam-chest and cylinder, respectively, these slots being made long enough so that the adjustment of the plate will not affect the movement of steam through the passages. Suppose that it is desired to increase the force of the downward movement of the piston and piston-rod—that is, the movement toward the right, as shown in Fig. 1, relatively to the upward movement thereof. Nuts 16 on bolts 14 are loosened sufficiently to permit plate 31 to be moved toward the left. This movement, of course, carries openings 32 in the adjusting-plate farther toward the left. This

does not affect the passage of steam into the exhaust-opening under the valve; but when the movement of the valve toward the right commences it permits steam to enter the left steam-passage 30 and pass to the left end of the piston sooner than when openings 32 are adjusted in alignment with steam-passages 30. On the other hand, when the piston is at the lower—*i. e.*, the right—end of the cylinder, the entrance of steam at the lower end of the piston to drive it upward through the left passage 30 will be retarded, owing to the fact that the right side of said passage is covered by the adjusting-plate.

Having thus described my invention, I claim—

1. The cylinder having steam-passages 30 and an exhaust, in combination with a steam-chest, a valve having an opening in its under side adapted to connect one of the steam-passages with the exhaust, and a plate lying under the steam-chest and valve and having openings corresponding with the exhaust-opening and steam-passages 30, so that when said plate is moved in either direction steam is admitted at that end of the cylinder more quickly to drive the piston in the opposite direction, and at the opposite end of the cylinder the admission of steam is retarded, as and for the purpose set forth.

2. In combination, the cylinder, the steam-chest, the valve, steam-passages 29 and 30 and the exhaust, and an adjusting-plate having openings 32 corresponding with steam-passages 30 and the exhaust-opening, said plate being provided with slots, so as to permit adjustment of openings 32 more or less out of alignment with steam-passages 30 and the exhaust.

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

HARRY BALL.

Witnesses:
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