(No Model.)

A. BALL.

DIRECT ACTING ENGINE.

No. 603,358. Patented May 3, 1898.

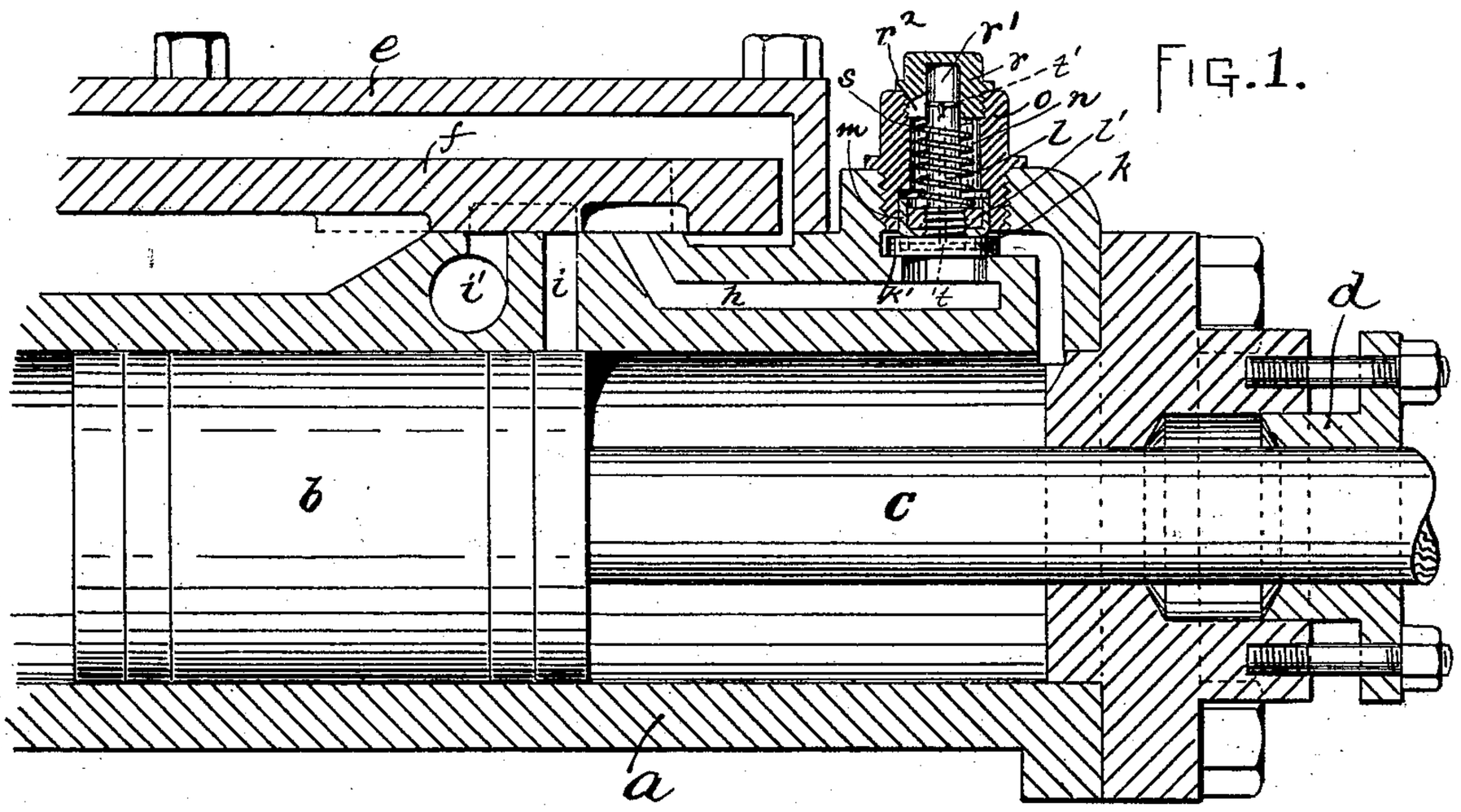


FIG. 1.

FIG. 2.

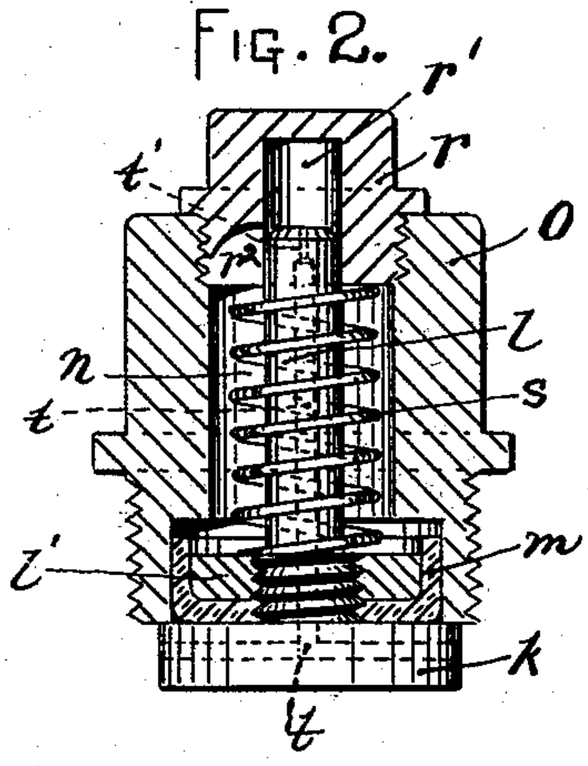


Fig. 4.

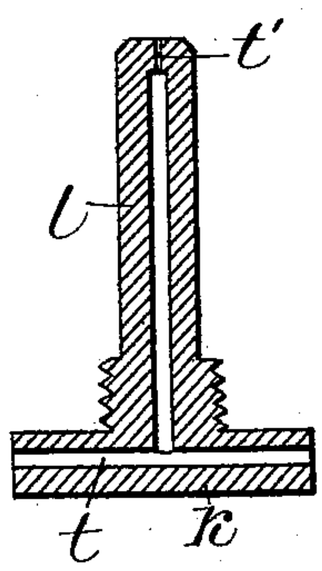
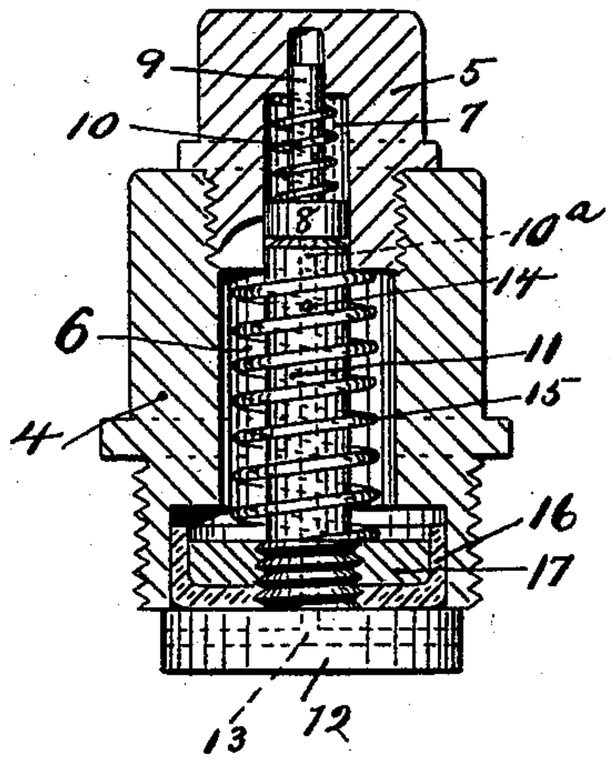


FIG. 3.



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UNITED STATES PATENT OFFICE.

ALBERT BALL, OF CLAREMONT, NEW HAMPSHIRE, ASSIGNOR TO THE SULLIVAN MACHINERY COMPANY, OF SAME PLACE AND CHICAGO, ILLINOIS.

DIRECT-ACTING ENGINE.

SPECIFICATION forming part of Letters Patent No. 603,358, dated May 3, 1898.

Application filed September 23, 1897. Serial No. 652,685. (No model.)

To all whom it may concern:

Be it known that I, ALBERT BALL, a resident of Claremont, in the county of Sullivan and State of New Hampshire, have invented a new and useful Improvement in Direct-Acting Engines; and I do hereby declare the following to be a full, clear, and exact description thereof.

My invention relates to a direct-acting engine such as is particularly applicable to that class of coal or rock cutting machines in which a reciprocating cutter-bar is employed which is constructed to strike the coal and cut the same. These machines being constructed on the principle of a direct-acting engine, when the cutter-bar fails to strike the coal, such as when the machine is being adjusted to its work or being shifted on the runner-board while the machine is in motion, the tendency is to increase the number of blows or strokes of the cutter-bar. The reciprocating undercutting-machines strike a very hard blow, and if the pick happens to miss the coal for any reason the jar or shock on the operator is very severe, and more especially so when the machine increases its number of blows per minute, as it will do when not striking the coal and when there is nothing to regulate or control its speed. It is now the general custom in this class of machines to cushion the blow of the piston when the pick fails to strike the coal by compressing the air in the front end of the cylinder. This compression of the air, however, increases the speed of the piston. It is in connection with this compression of the air that my invention is particularly applicable.

The object of my invention, therefore, is to provide a direct-acting engine which, when applied to a coal-cutting machine, will regulate and control the movement of the piston when the machine is not doing any work and so relieve the wear and tear on the machine as well as the strain on the operator.

To these ends my invention comprises, generally stated, a cylinder with a piston therein, suitable ports and valves controlling same for causing the reciprocation of said piston, an auxiliary valve controlling the admission of air or steam to one end of said cylinder, and means for regulating the movement of said valve by the cushioned air, whereby the said air holds said valve to its seat, and means for gradually reducing the pressure of said cushioned air on said valve.

In the accompanying drawings, Figure 1 is a longitudinal sectional view of a portion of an engine with my invention applied thereto. Fig. 2 is an enlarged detail of the check-valve. Fig. 3 is a modified form of my invention. Fig. 4 is a vertical section of the auxiliary valve and its stem.

While I will describe my invention with reference to its use in connection with that class of coal-cutting machines hereinbefore referred to, yet I do not wish to limit its use to this particular machine, as there may be other machines to which it may be found applicable.

The letter *a* designates a portion of a suitable cylinder, and *b* the piston adapted to reciprocate therein. The piston-rod *c* passes out through the front head *d*, provided with a suitable stuffing-box. Where the invention is to be applied to a coal-cutting machine, the piston-rod will carry the pick at its outer end, by means of which the cutting is done. The air or steam chest *e* is secured to the cylinder *a*, and said chest contains the main slide-valve *f*, which controls the inlet and outlet of air to the front end of cylinder. As only the front end of cylinder is shown, the letter *h* designates the inlet-port, and *i* and *i'* the exhaust-ports.

Located in the inlet-port *h* is the check-valve *k*, provided with the stem *l*. The check-valve *k* rests on the valve-seat *k'*. A cup *m*, of leather or other suitable material, is interposed between the valve *k* and the head *l'* of the stem *l*. The stem *l* passes up within a chamber *n*, formed in the nut *o*, which is threaded into the cylinder *a*. This nut *o* has a cap *r* threaded into it, said cap having a guideway *r'* therein to receive the upper end of the stem *l*. A spring *s* is interposed between the cap *r* and the head *l'* of the stem *l* for the purpose of closing the check-valve more quickly and to overcome the friction of the leather cup *m* on the walls of the chamber above the said valve.

A port *t* is formed in the check-valve *k*, said

port extending up through the stem l, as clearly indicated in dotted lines, Fig. 2. The upper end of the port t is reduced in size, so as to form a contracted opening t', which will tend to retard the escape of the air from the chamber n.

The cap r is notched, as at r^2, to permit the air passing up through the stem l to enter the chamber n.

When my invention is applied to a coal-cutting machine, its operation is as follows: Under ordinary circumstances in cutting coal with such a machine the pick at the forward end of the piston-rod strikes the coal. As long as the pick continues to strike the coal no compression of the air takes place in the front end of cylinder and live air passes freely under the check-valve k and through the port h to operate the piston. When, however, the pick fails to strike the coal for any reason, the compression of the air takes place at the front end of cylinder. Highly-compressed air then passes through the port t in the valve k and stem l, said air entering through the contracted opening l' into the chamber n. At the same time a certain amount of air finds its way into the chamber n by its being forced around the cup m. The effect of the air in the chamber n under heavy pressure is to hold the check-valve k closely to its seat and prevent the flow of live air through the port h to the front end of cylinder. Just as soon as the pressure of the air in the front end of cylinder begins to decrease, as it does the moment the piston starts on its backward stroke, the air confined within the chamber n begins to escape therefrom. Owing, however, to the size of the contracted opening t', leading to the port t, the escape of the air is slow and gradual. It is of course apparent that the size of this opening t' regulates the rapidity with which the air escapes and that the reduction in the speed of the piston is dependent on the size of this opening. Until the pressure in the chamber n decreases below that of the live air in the port h the check-valve k will remain closed and the live air will be prevented from acting to force the piston back on its backward stroke.

It is to be noted that while air can be forced up around the cup m into the chamber n, yet the air from said chamber cannot escape around said cup, as the pressure of air in said chamber will cause said cup to hug the walls of the chamber and form a tight joint.

Just as soon as the air-pressure in the chamber n has fallen below that of the live-air pressure the live air will lift the check-valve and act on the piston.

It is apparent from the above that when the pick fails to strike the coal the speed of the piston is reduced at once, so that if the machine is running normally at, for instance, two hundred strokes per minute if the pick failed to strike the coal the speed can be maintained at two hundred strokes or instantly reduced to sixty strokes, according to the rapidity with which the air is permitted to escape from the chamber n. This reduction in the speed of the piston when the pick is not striking the coal greatly reduces the labor of handling the machine, as it may be adjusted to its work when in motion or may be shifted on the runner's board without jarring the operator severely. Besides this there is a saving in air, and the wear and tear on the machine are greatly reduced.

In Fig. 3 I have illustrated a modified form of my invention. The parts are in this case indicated by numerals. The numeral 4 designates the nut adapted to be threaded into the cylinder; 5, the cap; 6, the chamber; 7, the recess formed in said cap for the reception of the retaining-valve 8, which has the stem 9 and the spring 10 encircling same. This retaining-valve 8 closes the opening 10^a at the upper end of the stem 11 of the check-valve 12. This check-valve 12 has a port 13, which extends through its stem. A small opening 14 is also formed in the stem, bringing the port 13 always into communication with the chamber 6. A spring 15 encircles the stem 11. A cup 16 is interposed between the valve 12 and the head 17 on said stem. In the operation of this modified form, when the pick fails to strike the coal, the air, in the same manner as before described, is compressed at the front end of cylinder and passes by the port 13 into the chamber 6. The retaining-valve is raised so as to allow the air to pass by the opening 10^a into said chamber. A portion of the air also finds its way by the opening 14 into said chamber. In the same manner as before described just as soon as the pressure at the front end of the cylinder begins to decrease on the back stroke of the piston the retaining-valve 8 closes, and the only means of escape for the air held under pressure within the chamber 6 is through the opening 14. The rapidity with which the air escapes from the chamber 6, as before, regulates the time when the valve 12 will open to permit live air to pass to the front end of cylinder.

The retaining-valve 8 holds the air within the chamber and may be employed where a large amount of air is required in the chamber to reduce the speed.

While I have described my invention where air is employed as a motive power, yet steam or other motive power may be employed.

I do not wish to limit myself to the invention as illustrated, but wish to include within its scope such changes and variations as may be made without departing from the spirit of said invention.

What I claim as my invention, and desire to secure by Letters Patent, is—

1. In a direct-acting engine, the combination with a cylinder having inlet and exhaust ports, of a main valve controlling same, a piston working in said cylinder, an auxiliary valve located so as to control the inflowing

air to the front end of said cylinder, and means for regulating the movement of said auxiliary valve by the cushioned air, substantially as set forth.

2. In a direct-acting engine, the combination with a cylinder having inlet and exhaust ports, of a main valve controlling same, a piston working in said cylinder, an auxiliary valve located so as to control the inflowing air to the front end of said cylinder, said auxiliary valve having an air-chamber back of same, and said chamber communicating with said cylinder, substantially as set forth.

3. In a direct-acting engine, the combination with a cylinder having inlet and exhaust ports, of a main valve controlling same, a piston working in said cylinder, an auxiliary valve located so as to control the inflowing air to the front end of said cylinder, said auxiliary valve having an air-chamber back of same, said chamber communicating with said cylinder, and means for reducing the pressure in said chamber, substantially as set forth.

4. In a direct-acting engine, the combination with a cylinder and a piston working therein, of a check-valve controlling the inlet-port of said cylinder, said valve having an air-chamber back of same, said check-valve having a port forming communication between said cylinder and said chamber, substantially as set forth.

5. In a direct-acting engine, the combination with a cylinder and a piston working therein, of a check-valve controlling the inlet-port of said cylinder, said valve having an air-chamber back of same, said check-valve having a port forming communication between said cylinder and said chamber, and said port having a contracted opening, substantially as set forth.

6. In a direct-acting engine, the combination with a cylinder and a piston working therein, of a check-valve controlling the inlet-port of said cylinder, said valve having an air-chamber back of same, a stem, said valve having a port formed therein and in the stem, said port forming communication between said cylinder and chamber, substantially as set forth.

7. In a direct-acting engine, the combination with a cylinder and a piston working therein, of a check-valve controlling the inlet-port of said cylinder, said valve having an air-chamber back of same, said chamber communicating with said cylinder, and a packing-cup on said valve engaging the walls of said chamber, substantially as set forth.

8. In a direct-acting engine, the combination with a cylinder and a piston working therein, of a check-valve controlling the inlet-port of said cylinder, said valve having an air-chamber back of same, said chamber communicating with said cylinder, and a packing-cup inserted between said valve and a head on the stem thereof and engaging the walls of said chamber, substantially as set forth.

In testimony whereof I, the said ALBERT BALL, have hereunto set my hand.

ALBERT BALL.

Witnesses:
FRANK A. BALL,
H. H. MERCER.