No. 615,236. Patented Dec. 6, 1898.

A. BALL & T. OFFICER.

MINING MACHINE.

(Application filed Jan. 20, 1898.)

(No Model.) 2 Sheets—Sheet 1.

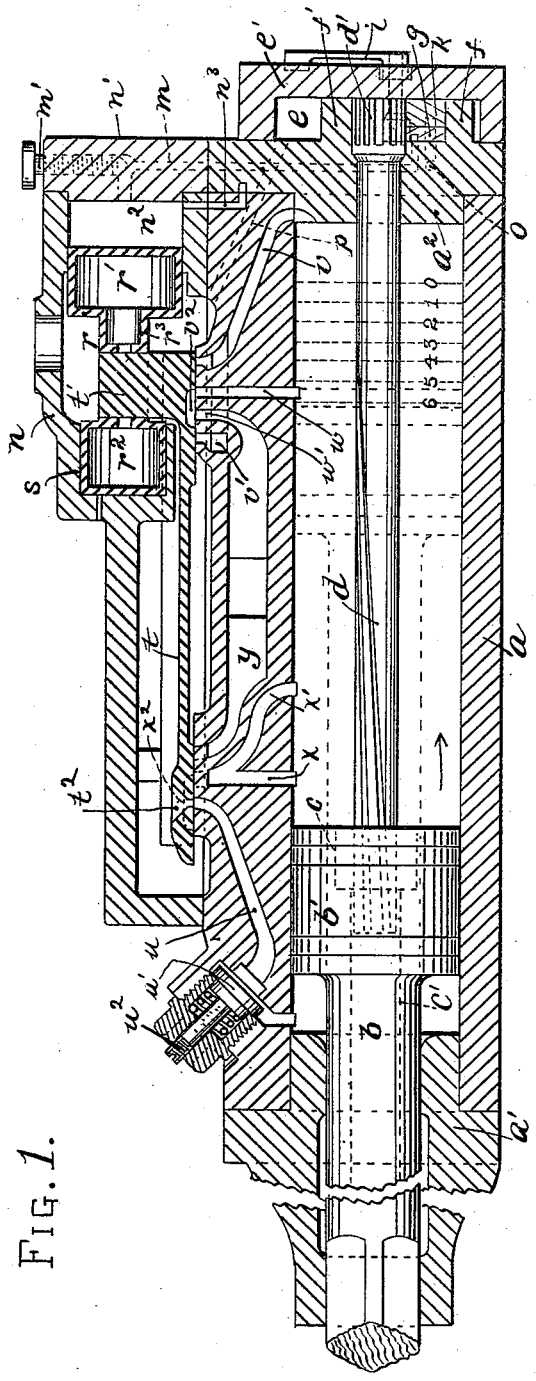

FIG. 1.

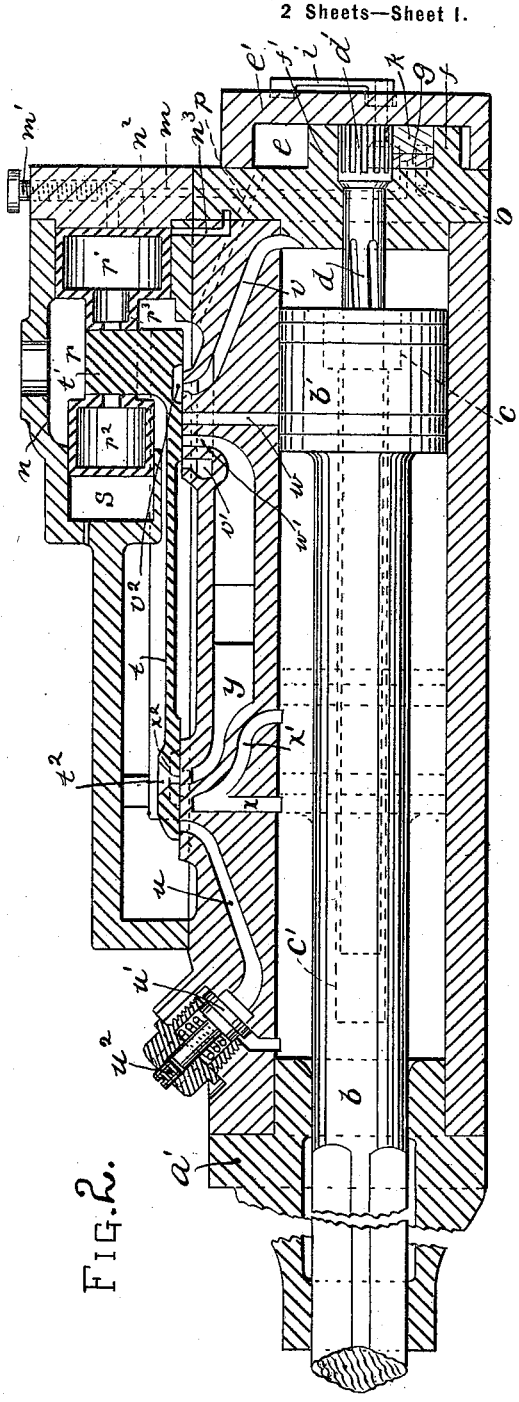

FIG. 2.

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FIG. 7.

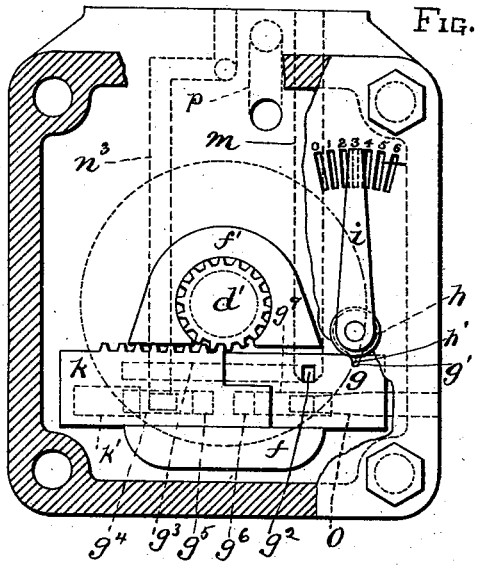


FIG. 6.

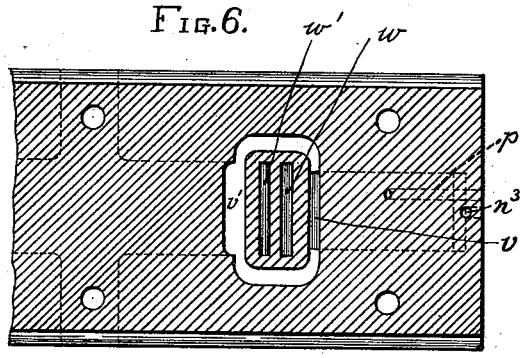


FIG. 3.

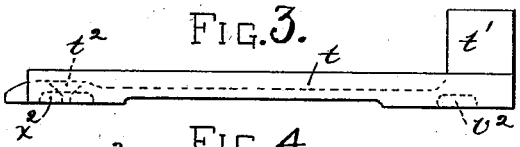
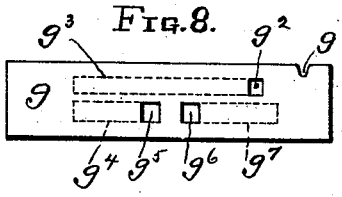


FIG. 8.



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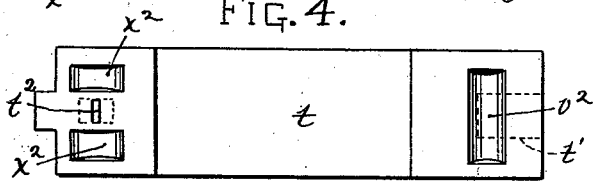


FIG. 5.

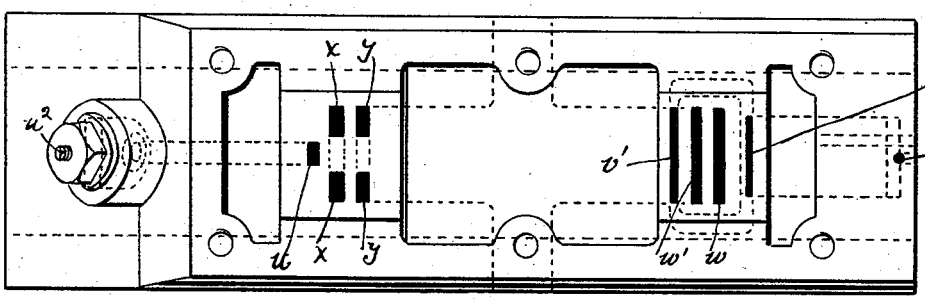


FIG. 9.

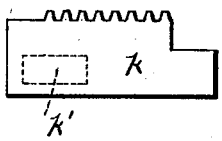
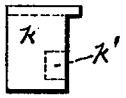


FIG. 10.



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Albert Ball and
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UNITED STATES PATENT OFFICE.

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

MINING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 615,236, dated December 6, 1898.

Application filed January 20, 1898. Serial No. 667,333. (No model.)

To all whom it may concern:

Be it known that we, ALBERT BALL and THOMAS OFFICER, residents of Claremont, in the county of Sullivan and State of New Hampshire, have invented a new and useful Improvement in Mining-Machines; and we do hereby declare the following to be a full, clear, and exact description thereof.

Our invention relates to coal-cutting and like machines, more especially to the arrangement of the inlet and exhaust ports.

In coal-cutting machines where the operation consists in driving a cutter into the wall of coal and withdrawing same by the reciprocation of a piston the great desire is to obtain a machine in which the jar and strain on the operator handling it will be reduced to a minimum, while at the same time the wear and tear on the machine will be correspondingly reduced.

The object of our invention, therefore, is to provide a system of ports for the entrance and exhaust of the air so arranged as to cushion the piston and regulate its movement in such a manner that the jar and shock to the machine will be reduced to a minimum.

What our invention comprises and what we claim as new will be found in the specification and claims which follow.

To enable others skilled in the art to make and use our invention, we will describe the same more fully, referring to the accompanying drawings, in which—

Figure 1 is a longitudinal section of a coal-cutting machine with the invention applied thereto, showing the piston at the front end of cylinder. Fig. 2 is a like view showing piston at opposite end of cylinder. Fig. 3 is a side view of slide-valve. Fig. 4 is a plan view of same. Fig. 5 is a plan view of the cylinder with the air-chest and valve removed to show the ports. Fig. 6 is a sectional view showing run-around port. Fig. 7 is a rear view of the machine, partly in section. Fig. 8 is a detail of the reversing-plate. Figs. 9 and 10 are details of the reversing-valve.

Like letters and figures indicate like parts in each view.

While we have illustrated and will now describe our invention as applied to a coal-cutting machine, we do not wish to be understood as limiting ourselves to any particular use, as it may be found applicable for other purposes.

The form of coal-cutting machine to which we have applied our invention in the present instance is the same as that shown and described in an application for Letters Patent of even date herewith, the mechanism for operating the valve-piston and slide-valve being identical.

The letter a designates a suitable cylinder, having the front head-plate a', with a suitable stuffing-box therein, through which the piston-rod b passes. The outer end of said piston carries the picks or cutters. (Not shown.) The rear head-plate is designated by the letter a^2.

Within the cylinder a is the piston b', said piston having a riffle-bar nut c therein and a passage c', which extends through said piston and for a suitable distance into the piston-rod b. This riffle-bar nut c receives the riffle-bar d. This riffle-bar d at its rear end passes through an opening in the rear head-plate a^2, the portion of said riffle-bar extending beyond said plate having a gear d' formed thereon or secured thereto.

The gear d' extends into a chamber e, formed by the rear head-plate cover e', which is bolted by long bolts running whole length of cylinder, securing front head to the back head-plate a^2.

Formed on the rear head-plate a^2 are the guides $f f'$. On the lower guide f rests the reversing-plate g, said plate being adapted to slide to and fro on the guide f. To provide for this movement, said reversing-plate has a notch g' formed in its upper edge, with which the tooth h' on the tumbler h is adapted to engage. This tumbler h is journaled in the cover e', and to its outer end is secured the spring-lever i. The outer end of the spring-lever i has a detent formed therein adapted to engage any one of the notches 0 1 2 3 4, &c., formed in the outer face of the cover e'. The reversing-valve k also rests on the guide f, being adapted to slide to and fro

thereon. The upper edge of the reversing-valve k is toothed to be engaged by the gear d'.

The reversing-plate g has the port g^2 formed therein, which communicates with a groove g^3, formed on the inner face of the said plate g. The port g^2 and groove g^3 communicate with the port m, formed in the rear head-plate a^2 and head n' of air-chest n. This port m leads into the chamber n^2. A regulating-screw m' acts as a valve to throttle the air through inlet-port m, which imparts to the differential valve-piston the forward travel in its cylinder, the rapidity of movement of said valve-piston varying according to the position of this regulating-screw. An exhaust-port n^3 leads from the chamber n^2 through the rear head-plate a^2 and communicates at its lower end with the groove g^4 and port g^5 in the reversing-plate g. Another port g^6 and groove g^7 in said reversing-plate may be brought into communication with the aforesaid groove g^4 and port g^5 by means of the bridge k' in the reversing-valve k. A port o, communicating with the groove g^6 and port g^7, leads to the open air. The course of the exhaust from the chamber n^2 is accordingly down the port n^3 to groove g^4, then up through the port g^5 under bridge k', down through port g^6 and groove g^7, then out through port o to the open air. A port p brings the chamber e into communication with the air-chest n.

Within the air-chest n is the aforementioned differential valve-piston r, such a valve-piston being illustrated and claimed in Letters Patent of the United States No. 582,944, granted to Thomas Officer, May 18, 1897. This valve-piston has two heads r' r^2 of different areas connected by the portion r^3. The larger head r' moves in the chamber n^2, while the smaller, r^2, moves in a chamber s of corresponding size at the opposite end of the chest. An opening in the connecting portion r' of the valve-piston receives the upright t' on the slide-valve t and by means of which said valve is actuated by the movement of said valve-piston. The valve t has at the front end thereof the inlet-opening t^2, which is adapted to register with the port u, leading to the front end of cylinder. This inlet-opening t^2 is funnel-shaped, the inlet proper being contracted for the reason more fully hereinafter explained. A check-valve u' is interposed in the port u to regulate the speed at which the piston returns to rear end of cylinder, the screw u^2 being provided for the purpose of effecting such change in speed. The check-valve also closes port, shutting in air to form cushion.

The opposite inlet-port v for admitting air to the rear end of cylinder has an auxiliary or run-around port v' communicating therewith, by the use of which a greater amount of air is admitted to that end of said cylinder. The bridge v^2 in the slide-valve t brings the air-chest into communication with the port v, and, as shown in Fig. 2, when the valve is in that position air also passes from the air-chest to said port v'. The form of this run-around port v' is clearly shown in Fig. 6.

The rear exhaust-port w is located at such distance from the rear end of cylinder to afford the proper cushion to the piston, being closed by the piston in its backward stroke. The exhaust-port w is likewise brought into communication with exhaust w' by the bridge v^2 of the slide-valve t. The front exhaust-ports x x' are also located at such distance from the front end of cylinder to afford a cushion for the piston, the branch port x' being considerably in advance of the port x as the piston is advancing. These ports x x' are brought into communication with main exhaust y by means of the bridges x^2 in the valve t.

The operation of our invention as applied to a coal-cutter is as follows: The lever i having been previously set to cause the movement of the valve t when the piston reaches the point 3 in the cylinder on its back stroke and the ports being in position shown in Fig. 1, the air will pass from air-chest through the inlet t^2 into the port u and thence to front end of cylinder. The piston recedes, its speed being regulated by the check-valve u' and that in turn by the screw m^2. Owing to the use of said check-valve u' and the contracted inlet-opening t^2 it is to be observed that the piston makes its back stroke at reduced speed. As the piston does not do any work on its back stroke, there is no necessity for the quick strong blow which is imparted by the forward movement of said piston. The consequence is that we have a saving in the amount of air employed, while at the same time the return shock does not jar and fatigue the operator to the same extent. When the piston closes the exhaust-port w, the cushion for said piston is forming, and when the point 3 is reached the reversing-valve k operates to reduce the pressure in the chamber n^2 to permit the valve-piston r to operate the valve t and bring it to the position shown in Fig. 2. The piston will, however, continue to about the position indicated in said Fig. 2 before said valve t is operated, so that an air-cushion is formed dense enough to stop the piston without jar or heavy shock to the machine. This movement of the valve t has closed the inlet t^2 and port u and opened the ports v v'. The air now enters the ports v v' to the rear end of cylinder to advance the same with proper force to cut the coal. By the employment of the auxiliary or run-around port v' we obtain a larger quantity of air and drive the piston forward at great speed. Although one large port would let in the same amount of air, yet it would take the valve longer to open the port or close it, which means waste of air in this class of machines. When the piston has advanced to about the position indicated by dotted lines, Fig. 2, the blow is given to the coal, so that no further work is

required of the air. Consequently when not striking the coal as the piston advances to form the cushion and it passes and opens the branch port x' the air in the rear of the piston and which has been driving same forward is permitted to escape to the exhaust. The result is that the blow on the cushion at front end of cylinder is reduced.

In order to permit of the quick escape of the air which has driven the piston forward, we prefer to arrange the exhaust-ports so that the exhaust-ports x, x', and y, being open when the piston comes to position indicated by dotted lines, Fig. 2, will remain open until the exhaust-port w has been opened.

By the employment of a properly-proportioned inlet-port for the admission of air to front end of cylinder we reduce pressure of air and the speed of the piston coming back. In other machines of this type there is a uniform pressure at both ends of cylinder, the consequence being that the pistons go back with the same force and speed as they advance. If the cutter is striking two hundred blows per minute, the piston returns at same rate, while by our invention we can reduce the rate of speed of the back stroke. On the other hand, we provide for the entrance of a greater amount of air at the rear end of cylinder by the use of the auxiliary port, so that the blow is quicker and has more force. It will also be observed that the air-cushion produced in back end of cylinder starts the piston back at a more rapid rate than would the inlet-air without the cushion, as it will give off as much power as it takes to make the cushion aside from the friction, and this gives a saving in air as it is helping to throw the piston forward.

What we claim is—

1. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, a valve controlling same, a piston adapted to travel back and forth in said cylinder, one of said exhaust-ports being located at the forward end of the cylinder and beyond which the entire piston travels, substantially as set forth.

2. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, a valve controlling same, a piston adapted to travel back and forth in said cylinder, the front exhaust-port having a branch extending toward the rear end of cylinder and communicating therewith, substantially as set forth.

3. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, a valve controlling same, said valve having a contracted opening adapted to coincide with the front inlet-port, a piston adapted to travel back and forth in said cylinder and an air-chest, substantially as set forth.

4. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, a valve controlling same, a piston adapted to travel back and forth in said cylinder, and a check-valve in the front port through which all the incoming air passes, substantially as set forth.

5. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, a valve controlling same, a piston adapted to travel back and forth in said cylinder, a check-valve in the front port through which all the incoming air passes, and means for regulating the movement of said check-valve, substantially as set forth.

6. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, the rear inlet-port having an auxiliary port communicating therewith, a valve controlling said ports, and a piston adapted to travel back and forth in said cylinder, substantially as set forth.

7. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, the rear inlet-port having a run-around port communicating therewith, a valve controlling said ports, and a piston adapted to travel back and forth in said cylinder, substantially as set forth.

8. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, a valve controlling same, a piston adapted to travel back and forth in said cylinder, one of said exhaust-ports being located at the forward end of the cylinder and beyond which the entire piston travels, said exhaust-ports being so controlled by said valve that they will both be open at the same time for a short period after the piston has passed beyond the front exhaust.

9. The combination of a cylinder having an inlet-port at each end thereof and exhaust-ports, a valve controlling same, a piston adapted to travel back and forth in said cylinder, an air-chest, and means for causing said piston to travel forward at a higher rate of speed than it returns, substantially as set forth.

In testimony whereof we, the said ALBERT BALL and THOMAS OFFICER, have hereunto set our hands.

ALBERT BALL.
THOMAS OFFICER.

Witnesses:
ARTHUR E. BLACKWOOD,
FRANK A. BALL.