No. 615,234. Patented Dec. 6, 1898.

# A. BALL & T. OFFICER.

## VALVE MECHANISM FOR MINING MACHINES.

(Application filed Jan. 20, 1898.)

(No Model.) 2 Sheets—Sheet 1.

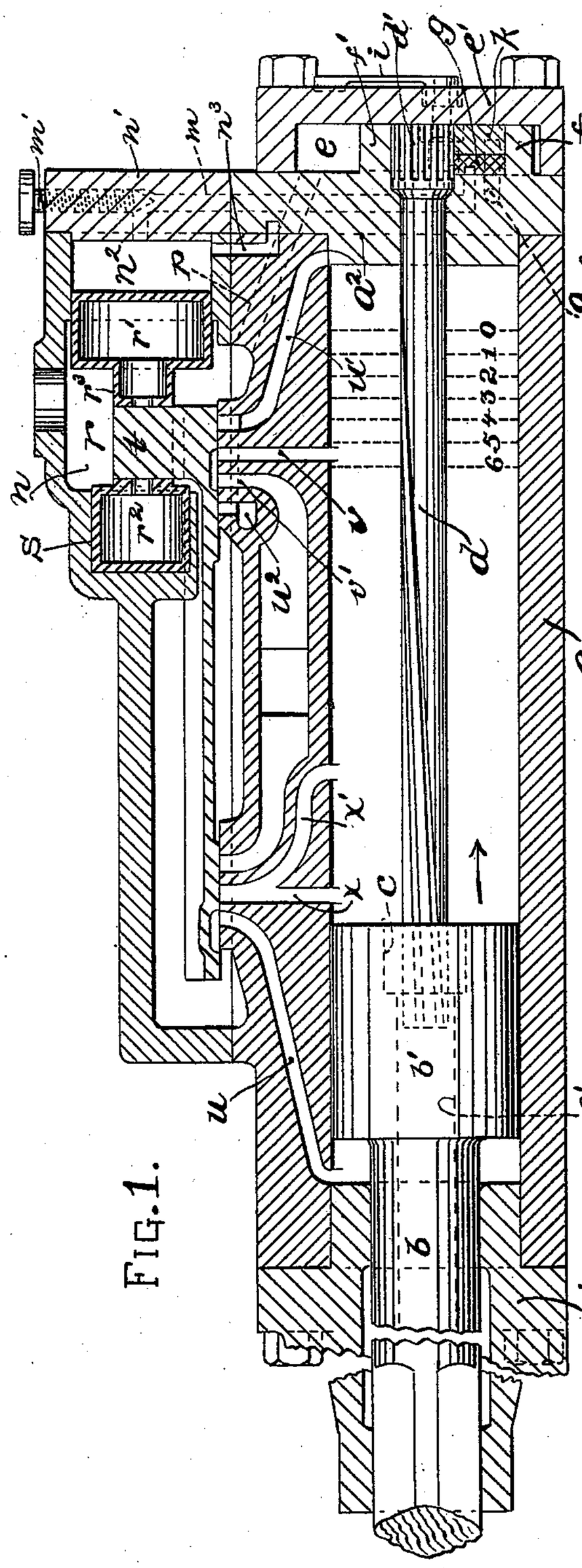

FIG. 1.

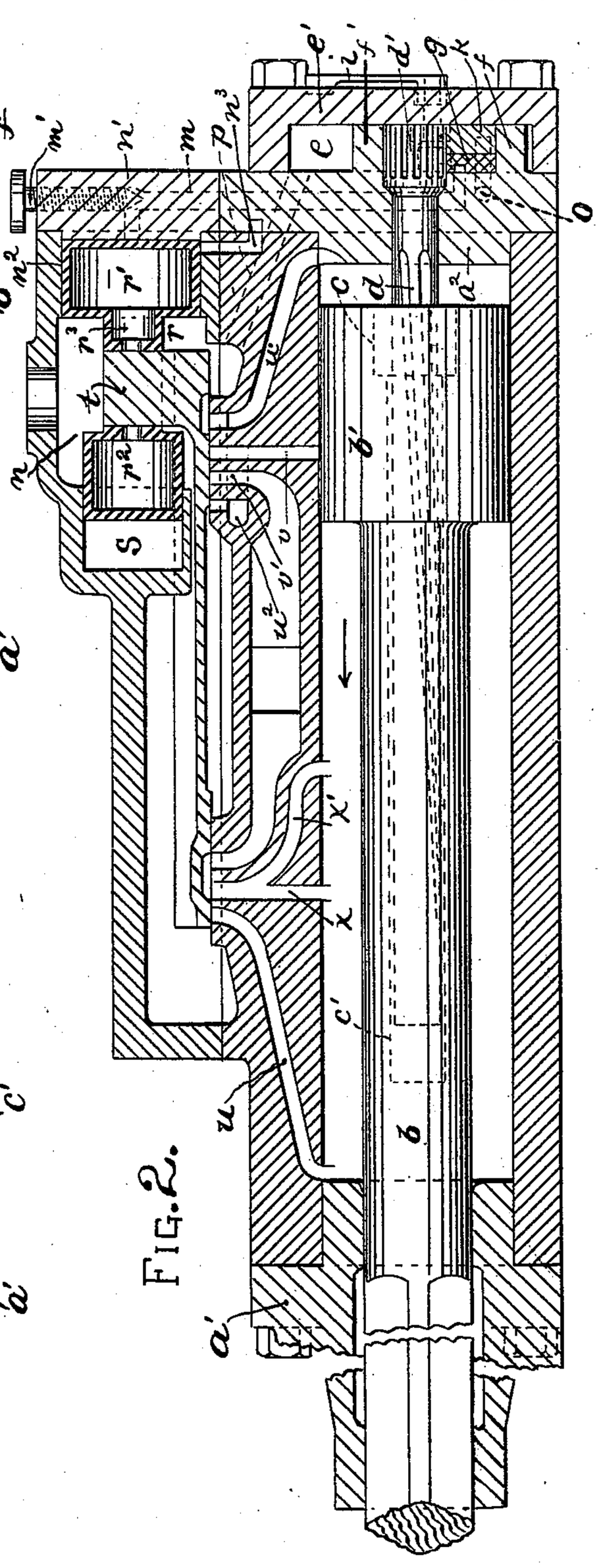

FIG. 2.

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FIG. 6.

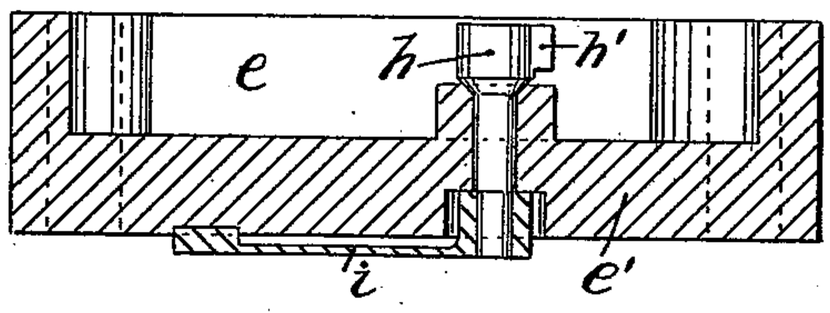


FIG. 7.

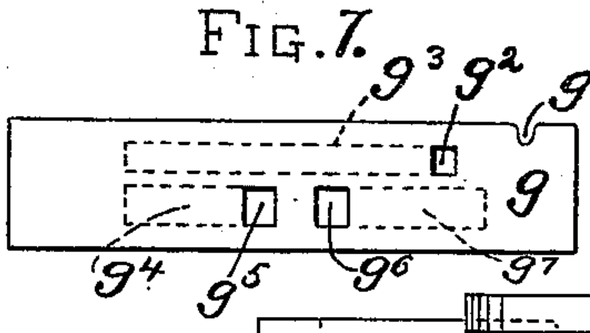


FIG. 4.

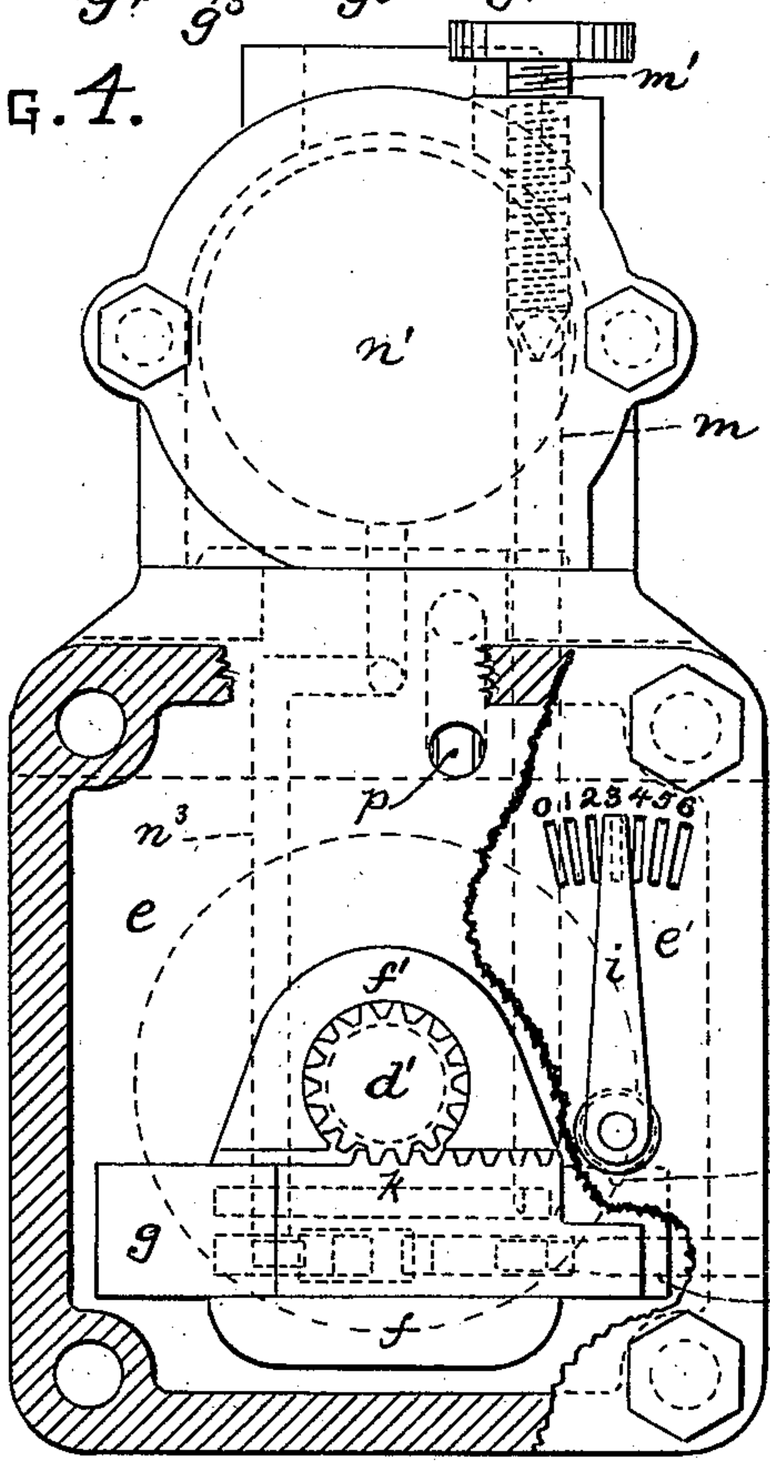


FIG. 8.

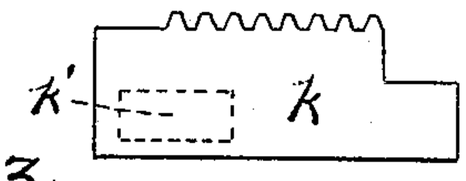


FIG. 9.

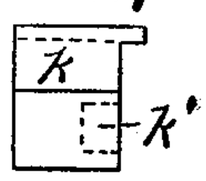


FIG. 3.

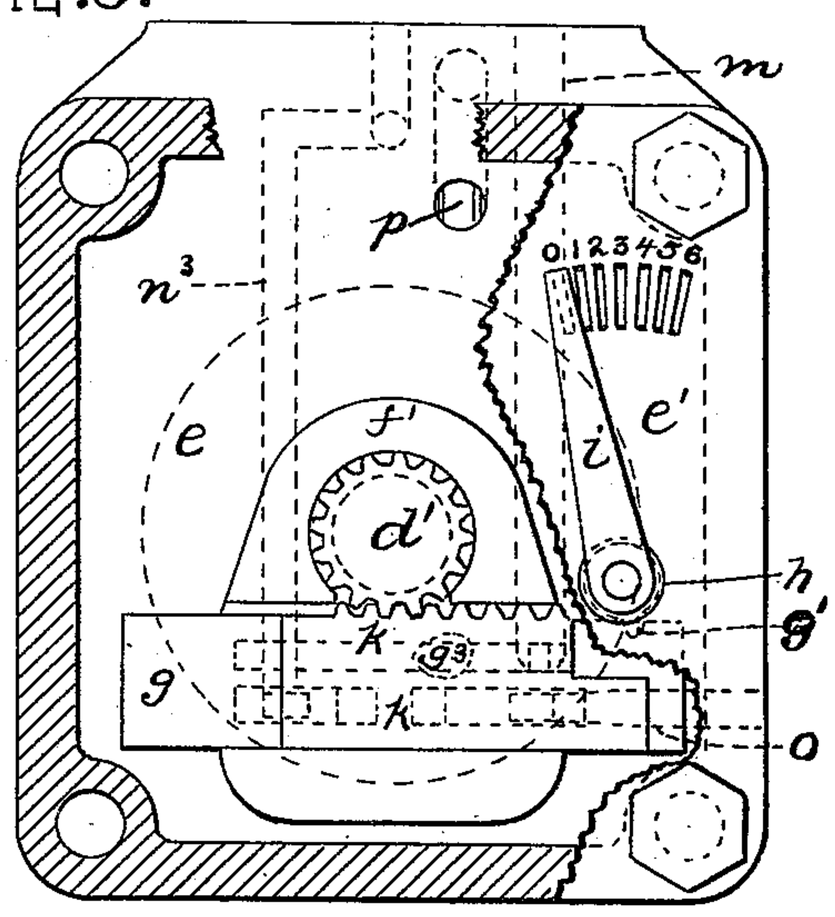


FIG. 5.




WITNESSES.

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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.

## VALVE MECHANISM FOR MINING-MACHINES.

SPECIFICATION forming part of Letters Patent No. 615,234, dated December 6, 1898.

Application filed January 20, 1898. Serial No. 667,331. (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 Valve Mechanism for Mining and Like Machines; and we do hereby declare the following to be a full, clear, and exact description thereof.

Our invention relates to valve mechanism for regulating the stroke of the piston in a direct-acting engine, coal-cutter, or other machine to which it may be found applicable.

As we have illustrated our invention as applied to an undercutting coal-machine, where the piston controls the movement of the valve, we will refer to the merits of the invention as applied to that particular use, although we do not wish to be understood as placing any limit to the scope of its use thereby. One of the greatest difficulties encountered in the operations of this class of coal-cutters heretofore made is that they have not had fine enough adjustment to the work to be done and have been wasteful in the use of air.

The object of our invention is to provide a cut-off for the above form of valve mechanism whereby the speed and force of the piston can be quickly changed, according to the increase or decrease in the supply of air or other motive power employed to operate the same.

Our invention comprises, generally stated, a cut-off in conjunction with a suitable cylinder and its piston, ports leading to opposite ends of said cylinder, a valve controlling same, and a mechanism for controlling the time of movement of said valve, whereby the air is cut off from the back ports at given points, so as to give a nearly uniform blow when using high or low pressure of air or to vary the strength of blow as the operator may desire when running the machine on hard or soft deposits.

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 our invention applied thereto, the piston being shown at the forward end of the cylinder. Fig. 2 is a like view showing the piston at rear end of cylinder. Fig. 3 is an end view, partly in section, showing one position of the cut-off lever. Fig. 4 is a like view showing another position of the cut-off lever. Fig. 5 is a like view showing a different position of the reversing-plate. Fig. 6 is a section of back head-plate, showing the cut-off lever. Fig. 7 is a face view of the reversing-plate. Figs. 8 and 9 are detail views of the reversing-valve.

Like letters and numerals indicate like parts in each view.

In the drawings, $a$ 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 rifle-bar nut $c$ therein and a passage $c'$, which extends through said piston and for a suitable distance into the piston-rod $b$. This rifle-bar nut $c$ and passage $c'$ receive the rifle-bar $d$. This rifle-bar $d$ at its rear end passes through an opening in the rear head-plate $a^2$, the portion of said rifle-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 held by bolts going the whole length of the cylinder and through front head to hold both the heads and 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 $i$, having 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 $e'$, which govern the point of cut-off.

The reversing-valve $k$ 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 and port $g^4$ $g^5$ by means of the bridge $k'$ in the reversing-valve $k$. A port $o$, communicating with the groove $g^7$ and port $g^6$, 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 $t$ and by means of which said valve is actuated by the movement of said valve-piston. Ports $u$ $u'$ lead from the air-chest $n$ to the front and rear ends, respectively, of the cylinder $a$. Besides the inlet-port $u'$ there is an auxiliary port $u^2$ in the form of a run-around, which communicates with the port $u'$. By this construction we obtain a large inlet from short movement of valve at the rear end of cylinder, so as to give a quick forward blow when the pick at the end of the piston-rod advances into the coal. This system of porting, together with that of the exhaust about to be described, forms the subject-matter of a separate application filed of even date herewith. The rear exhaust is through the ports $v$ $v'$. The front exhaust is through the ports $x$ $x'$. The port $x$ must be so located as to obtain the desired cushion for the piston on its forward stroke. The branch port $x'$ can be carried back to a point of travel of piston when the blow will be given to the coal. This acts to relieve the cushion of such a high pressure when catching the piston on the cushion. This arrangement of ports is of importance in that it makes the machine work with less jar when the cutter does not hit the coal.

The operation of our invention as applied to a coal-cutter is as follows: With the parts in the positions shown in Fig. 1 the inlet-port $u$ will be open, permitting the air from the chest $n$ to pass to the front end of cylinder. The valve-piston $r$ will be at the extreme front end of its stroke. The valve-piston $r$ is held in this position by the action of the air, which according to the position of the reversing-valve $k$ shown in Fig. 5 has passed from the chamber $e$ by the ports $g^2$ and $m$ to the chamber $n^2$. Owing to the difference in area of the heads of the valve-piston $r$ the said valve-piston is accordingly held in the position shown in Fig. 1. The piston $b'$, however, starts on its back stroke and a portion of the air exhausts through the ports $v$ $v'$. When the piston reaches the point indicated by the dotted line 3, at which point it has previously been determined to limit the movement of the piston, and for which purpose the spring-lever $i$ has been moved into the notch 3 of the register, then the rifle-bar $d$ will have turned sufficiently to cause the gear $d'$ to move the reversing-valve $k$ far enough to close the port $g^2$ and bring the bridge $k'$ in such position as to open communication from the exhaust $n^3$ to the open air, as previously described. Immediately the pressure in the chamber $n^2$ is reduced the valve-piston $r$ will be moved by the pressure of the air in the air-chest until the larger head $r'$ is forced into contact with the head $n'$ of the air-chest. This movement on the part of the valve-piston carries the valve $t$ with it, closing the port $u$ and opening the port $u'$, together with the auxiliary port $u^2$. The ports will now be in the position shown in Fig. 2. The air now passes by the ports $u'$ $u^2$ to the rear end of cylinder $a$. A large quantity of air is admitted at this end of the cylinder owing to the employment of the auxiliary port $u^2$, and there is consequently a more rapid forward stroke of the piston and a quicker harder blow is given to the coal. The exhaust is now through the ports $x$ $x'$, the port $x$ being arranged far enough forward to form a cushion for the piston, while the branch port $x'$ is located at the point where the coal will be struck. After the piston passes said branch port $x'$ the air behind the piston can escape to the exhaust, and the blow having been struck the cushion is relieved of such a great pressure, while at the same time if the cutter does not hit the coal there will be less jar on the machine. The piston by its forward stroke has turned the rifle-bar sufficiently to cause the gear $d'$ to move the reversing-valve $k$ so as to open

the port $g^2$ and close the exhaust $n^3$. The air from the chamber $e$ passes by the ports $g^2$ and $m$ to the chamber $n'$ and moves the valve-piston to the position shown in Fig. 1, whereupon the valve $t$ is reversed.

If for any reason it is desired to increase or diminish the amount of air admitted to back of cylinder to drive the piston, this can readily be accomplished by moving the lever from one notch to another of the register. The blow given by the piston can thus be made to vary as the spring-lever is moved from 0 to 6, the air following the piston to points indicated by dotted lines represented in Fig. 1.

One important advantage of our invention lies in the fact that the force of the blow may be kept almost uniform on low or high pressure of air—that is, if air is at high pressure the end of spring-lever will be dropped into notch 0. If air is at lower pressure, it will be set at any number that will give the desired blow, and the machine will then do the same work as with a high pressure of air. This advantage becomes more significant when it is remembered that the pressure of air varies in every part of the mine, according to the distance from the compressor and the number of machines taking air from the same pipe, for it is seldom that the mines are piped up with as large pipes as proper, owing to increased cost of large pipe. Again, no two mines carry the same air-pressure, and the machine can be adjusted to suit the conditions in a moment of time. Furthermore, the coal varies in hardness, even in the same mine, and requires a heavier or lighter blow. The weight of the blow can be changed to suit the coal, or, in other words, this cut-off as arranged can be adapted to all conditions to be met with in mines.

We do not wish to limit ourselves to the construction illustrated, as that may be varied without departing from the spirit of our invention.

What we claim is—

1. The combination of a cylinder having inlet and exhaust ports, a valve controlling same, a piston, an auxiliary valve operated by said piston controlling a port leading to a valve-operating device controlling said first-mentioned valve, and valve mechanism for controlling the movement of said auxiliary valve, whereby the distance said piston recedes may be varied.

2. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar controlling a port leading to a valve-operating device controlling said first-mentioned ports, and mechanism for regulating the movement of said valve, whereby the distance said piston recedes may be varied.

3. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a slide-valve operated by said bar controlling a port leading to a valve-operating device controlling said first-mentioned ports, and valve mechanism for regulating the movement of said slide-valve, whereby the distance said piston recedes may be varied.

4. The combination of a cylinder having inlet and outlet ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar, a plate having a port therein communicating with a port leading to a valve-operating device controlling said first-mentioned ports, said valve controlling the port in said plate, and mechanism for adjusting said plate, substantially as set forth.

5. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar, a slide-plate having a port therein communicating with a port leading to a valve-operating device controlling said first-mentioned ports, said valve controlling the port in said plate, and mechanism for sliding said plate to and fro, substantially as set forth.

6. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar, a slide-plate having a port therein communicating with a port leading to a valve-operating device controlling said first-mentioned ports, said valve controlling the port in said plate, and connections between said plate and a lever for adjusting same, substantially as set forth.

7. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar, a slide-plate having a port therein communicating with a port leading to a valve-operating device controlling said first-mentioned ports, said valve controlling the ports in said plate, a tumbler engaging a notch in said plate, and a lever connected to said tumbler, substantially as set forth.

8. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar, a slide-plate having a port therein communicating with a port leading to a valve-operating device controlling said first-mentioned ports, said valve controlling the port in said plate, connections between said plate and an operating-lever, and means for locking said lever at different positions, substantially as set forth.

9. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar, a slide-plate having a port therein communicating with a port leading to a valve-operating device controlling said first-mentioned ports, said valve controlling the ports in said plate, connections between said plate and an operating-lever, and

a series of registering notches with which said lever is adapted to engage, substantially as set forth.

10. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar, a movable plate having a port therein communicating with a port leading to a chamber in the air-chest, a valve-piston in said chamber, connections between said valve-piston and a valve controlling said first-mentioned ports, said first-mentioned valve controlling the port in said plate, and mechanism for adjusting said plate, substantially as set forth.

11. The combination of a cylinder having inlet and exhaust ports, a piston, an air-chest, a valve controlling said ports, a valve-piston having heads of different areas in said air-chest and connected to said valve, a bar engaged by said piston and turned thereby, a valve operated by said bar, a movable plate having a port therein communicating with an inlet-port leading to the chamber containing the larger head of said valve-piston, said valve controlling said inlet-port and exhaust-port of said chamber, and mechanism for adjusting said plate, substantially as set forth.

12. The combination of a cylinder having inlet and exhaust ports, a piston adapted to reciprocate therein, a valve controlling said ports and operated by the stroke of said piston, and valve mechanism for checking the back stroke of said piston at predetermined points, substantially as set forth.

13. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar and controlling a port leading to a chamber in the air-chest, a valve-piston in the air-chest, said valve-piston having heads of different areas, the larger of said heads entering said chamber, and connections between said valve-piston and a valve controlling said first-mentioned ports, substantially as set forth.

14. The combination of a cylinder having inlet and exhaust ports, a piston, a bar engaged by said piston and turned thereby, a valve operated by said bar and controlling a port leading to a chamber in the air-chest, a valve-piston in the air-chest, one of the heads of said valve-piston entering said chamber, a valve for increasing or diminishing the size of said port, and connections between said valve-piston and a valve controlling said first-mentioned ports, 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.