2 Sheets—Sheet 1.

Locke, Warrington, Carrett, Marshall, & Telford,

Mining Coal.

No. 54,833. Patented May 15, 1866.

Fig 2.

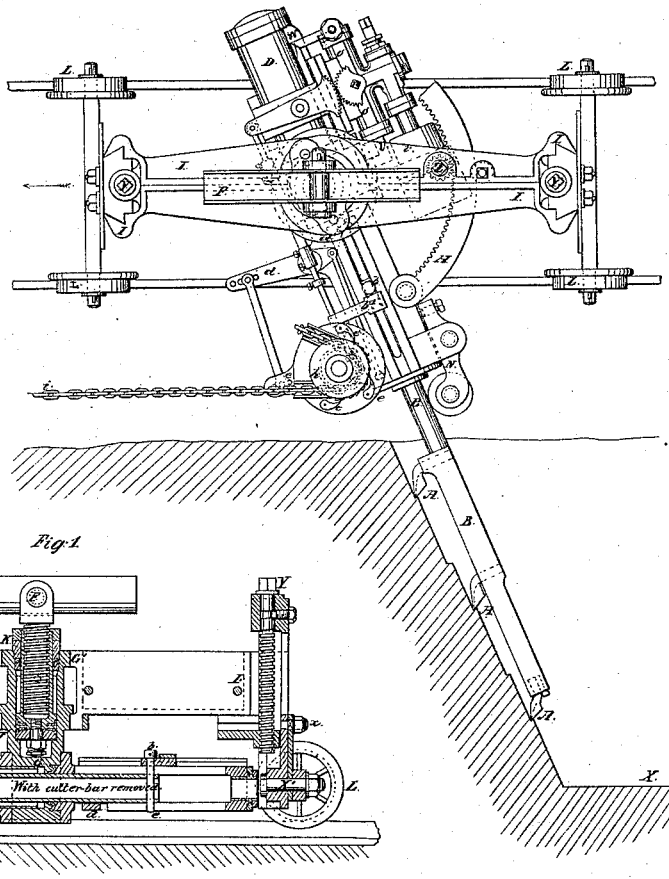

Fig 1

Fig 3.

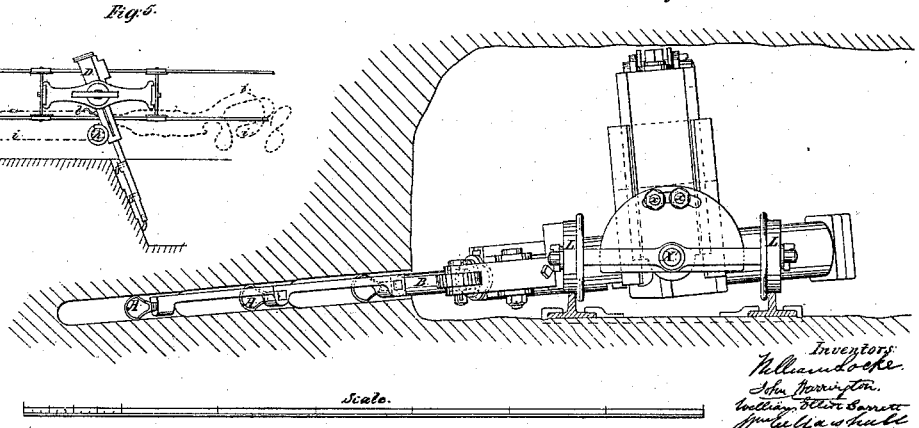

Fig 5.

Scale.

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2 Sheets—Sheet 2.

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Fig. 6.

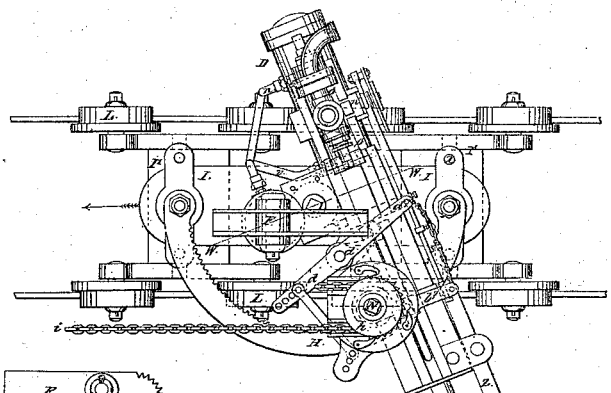


Fig. 4.

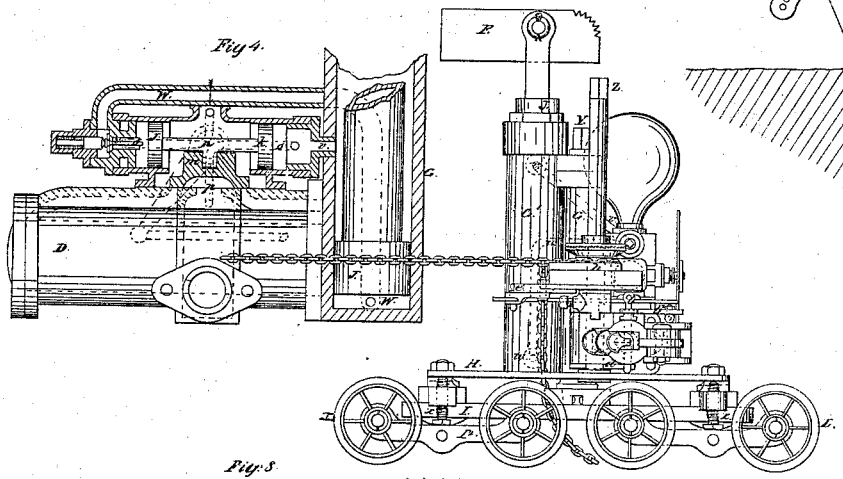


Fig. 5.

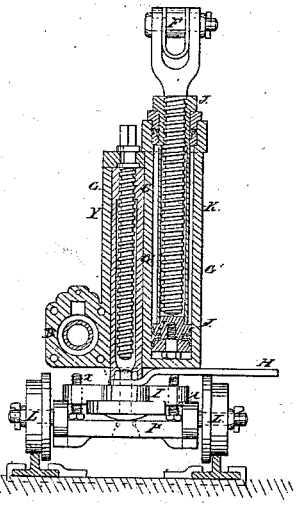
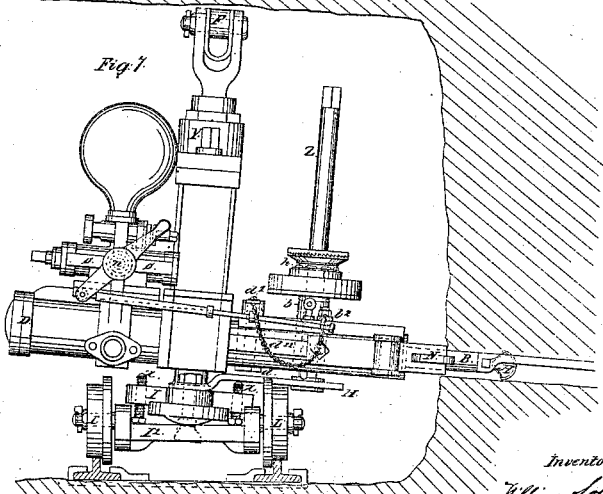


Fig. 7.



Witnesses.
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Inventors:
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William Garrett
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UNITED STATES PATENT OFFICE.

WILLIAM LOCKE AND JOHN WARRINGTON, OF KIPPAX, NEAR LEEDS, AND W. E. CARRETT, W. E. MARSHALL, AND J. TELFORD, OF LEEDS, ENGLAND.

IMPROVED METHOD OF MINING COAL, MINERALS, &c.

Specification forming part of Letters Patent No. **54,833**, dated May 15, 1866.

To all whom it may concern:

Be it known that we, WILLIAM LOCKE and JOHN WARRINGTON, of Kippax, near Leeds, coal-owners, and WILLIAM ELLIOT CARRETT, WILLIAM EBENEZER MARSHALL, and JOHN TELFORD, of Leeds, all in the county of York and Kingdom of Great Britain, have invented certain new and useful Improvements in the Working and Mining of Coal, Minerals, and Earthy Matters, and in the machinery, apparatus, and means to be employed therein, of which the following is a specification.

Our invention has for its object the application of machinery or apparatus actuated by the pressure of water or other practically-incompressible fluid to the getting and mining of coal or other minerals or earthy matters generally; and it consists, essentially, in the application and use for those purposes of a longitudinally-reciprocating slotting tool or cutter or cutters actuated by the pressure of water or other practically-incompressible fluid so as to produce a steady to-and-fro motion or powerful cut or cuts without any striking or percussive action, in lieu of employing steam, air, gas, or other elastic fluid or vapor for such purpose. One or more reciprocating tools or cutters are actuated by the pressure of water or other comparatively non-elastic fluid so as to produce longitudinal or horizontal or upright grooves or narrow cuttings to any desired extent into the upright face or end of the coal or other substance to be operated upon, and thus facilitate its subsequent removal or detachment.

The machine or apparatus may be mounted upon or become part of a carriage having wheels, slides, or skids traversing on tramways or rails or guide ways placed parallel or along the face or end of the coal or mineral working. The actuating pressure of the water or other non-elastic medium is conveyed to the apparatus by a flexible pipe or pipes, which adapt themselves to the different positions of the machine as the work progresses.

The slotting tool or tools receive an even steady longitudinal reciprocating motion at any desired angle with the face or end of the working, a set-screw or other equivalent device being employed for holding the tool-actuating cylinder and the tool itself at the angle required. The mechanism to be employed for actuating the slotting tool or tools consists of a double or single acting hydraulic reciprocating motive-power engine provided with proper valves and with one or more cylinders and pistons or rams, or, in lieu thereof, with a movable diaphragm or diaphragms which either directly or indirectly actuate the cutting tool or tools. In all cases the cutting stroke of the cutting tool or tools is produced by the pressure of the water or other practically-incompressible fluid. The return or non-cutting stroke may either be effected by water-pressure from the same source either directly or indirectly or by springs or weights or other agent. Thus the hydraulic reciprocating engine may be either single or double acting to effect the desired object—viz., to make a steady slotting cut at the desired angle without any striking or percussive action.

In some cases, when found requisite, it is intended to hold fast or steady the machine as each cut of the tool or tools is being made by causing a hydraulic ram or cylinder, piston, plunger, or rod, or a combination thereof, to be forced against the roof of the working-place, or to force any suitable bar or feeler against the same, and thereby hold the machine firmly down upon its guiding rails or slides while the cut is being made, but to release it again at the return or back stroke of the cutter or cutters in order to allow the machine to be moved forward for the succeeding cut. We produce this alternate fixing and releasing of the machine by allowing the fluid medium to operate on the before-mentioned hydraulic ram, cylinder, pistons, plunger, or rod, or a combination thereof, at the time such fluid medium enters the tool-actuating cylinder, and thus a pressure is obtained against the roof to hold the machine firmly upon its rail or guide driving the cutting operation of the tool or tools. This condition is further secured by the application of a keep-valve or other equivalent contrivance. The release of the machine from such hold against the roof is effected by allowing such incompressible fluid medium to escape during the time the back stroke of the cutting tool or tools is being made.

In any other apparatus having the same object in view, worked by air or other elastic medium, to which we make no claim, the method herein described of holding down against the roof by means of a practically non-elastic fluid can be brought about by letting such air or elastic medium operate upon water or other practically non-elastic fluid, the latter being subject to the conditions before specified, and which we consider as forming one part of our invention.

The entire machine is traversed forward after each stroke or cut by any self-acting or other suitable motion. Thus, as longitudinal grooves are made in the end or face of the work, they can be deepened by lengthening out the cutting-tools and passing a second or more times along the same. We prefer, however, to make the full depth of cut at one operation or by once passing over the work by employing two or more separate cutters fitted into one common cutter-bar, such cutters being made to project laterally from the advancing side of the bar, and situate at suitable distances from each other along such bar, the said distances being less than the stroke of the said bar. Each cutter is also caused to project farther from the side of the bar than the one next toward the end thereof, so that every cutter will work in a different plane and make its own cut, beginning to cut at the point where the last one left off. When such grooves are required to be upright or vertical the same apparatus fed by its flexible water or other fluid feed-pipe is applicable, provision in this case being made for raising and lowering the machine in lieu of traversing it along the tram or guide way, and a permanent hold of the roof is retained until the process is complete.

Having thus set forth the nature of our said invention, we will now proceed more particularly to describe the same, and for the sake of brevity we shall hereinafter term the beforementioned fluid medium "water."

Figure 1 on Sheet 1 of our drawings represents a vertical longitudinal section of a machine for working and mining coal, minerals, and earthy matters constructed according to our invention, and disposed in a transportable condition with the cutter-bar removed. Fig. 2 is a ground plan of the same in operation. Fig. 3 is an end elevation thereof, also in operation. Fig. 4, Sheet 2, represents a sectional detail of the arrangement of valves we prefer to adopt; and Fig. 5, Sheet 1, is a plan of a machine in operation, showing the mode we prefer to adopt for traversing the same.

In these figures, D is the hydraulic motive-power cylinder, actuated by a continuous stream of water-pressure supplied through a flexible pipe. C is the piston combined with its hollow piston rod or trunk or ram, within which the tool-bar B can be inserted and fixed by the pin *b c*, and at the end and advancing side of such bar are fixed the cutting-tools A, which also are removable for repairs and renewal.

We have shown three cutters, A, fitted to the bar B, but one, two, or any other number may be so applied. When more than one cutter is used we prefer to place them at a distance asunder equal to, rather less than, the stroke of the cutter-bar, so that the hinder cutter will finish its cut at the part about where the next forward cutter commenced, as is clearly shown in Figs. 2 and 6.

We also cause each hinder cutter A to project or stand out beyond the advancing side of the cutter-bar B rather more than the next forward cutter. Hence no two cutters work in the same plane, but each makes an independent cut of its own. According to the length of bar and the number of cutters therein, so will be the depth of cut made at once passing over the work. For example, supposing the cutters in the drawings to be eighteen inches apart and the stroke of the bar equal to eighteen inches, then we have three cutters, each making a cut of eighteen inches in depth, which is equivalent to a depth of cut of four feet six inches at one operation. The bottom of the groove is shown at X, Figs. 2 and 6.

N is an adjustable lever and anti-friction roller fitted onto the end of the cylinder with a view to steadying the cutter-bar by the pressure of the roller against the rear side thereof, such pressure being varied by a set-screw for that purpose in the other end of the lever pressing against the side of the cylinder.

The axis G G, which is, by preference, vertical, as shown, carries the parts above referred to in such a manner that they shall be adjustable in height and also to any desired angle.

We also prefer that the apparatus be mounted on or become part of a carriage, I, on wheels L L.

According to our invention the cutting stroke is, in all cases, effected by the water or other practically non-elastic fluid medium, being admitted by any suitable or well-known arrangement of valves and passages (see Fig. 4, Sheet 2, for example) behind the piston, thus producing a steady even slotting action of the tool or tools into the coal or mineral, whether the desired depth of slot be produced at one or more times going over by the cutting tool or tools. The return or non-cutting stroke may be produced variously by springs or weights, or by causing the opposite or inferior area of the piston (which is annular) to be constantly open to the pressure of the water.

Fig. 4, Sheet 2, shows a further method—namely, by making the motive-power cylinder D double-acting, such cylinder being fed and exhausted at each end alternately, thus producing the required reciprocating action of the piston and rod or ram and its tool-bar and cutting tool or tools attached thereto.

In order to further insure the stability of the whole apparatus upon its guides or rails during the cutting stroke, another hydraulic cyl-

inder, G′, or ram or plunger may be added, or any equivalent arrangement, giving to a feeler or holding-on head, F, a rising motion, which is, by preference, vertical, or thereabout, so as to be pressed against the roof by the water-pressure, the release of such holding-on head from the roof during the return or back stroke of the cutter or cutters being effected either by making the ram J double-acting or by simply allowing it to descend by its own gravity or by the action of springs or otherwise. We prefer, however, in practice, to make it double-acting, as hereinafter more fully described, and illustrated by our drawings. Thus the water which forces the piston C to make the cutting-stroke of the tool or tools acts simultaneously under the piston J of the holding-down cylinder G′, and thereby secures periodically or intermittently the entire machine fast between the roof and floor. With the return stroke of the tool the water-pressure under the ram J is released, and thus the machine is free again to be traversed forward for the next cutting stroke.

It is further sometimes convenient to retain for the time this water or incompressible fluid in the holding-down cylinder or under the ram J, so that it has no escape for the time being, and the apparatus is thus dead fast between the roof and floor. This is accomplished by letting the keep-valve *v*, Fig. 4, retain the water under the ram J until the motion of the main valve or slide *m* and parts *j k* connected therewith open the keep-valve *v*, and also provide egress from the water from behind the piston C in the actuating-cylinder D at the return stroke.

We do not confine or restrict ourselves to any particular arrangement of valves for regulating the inlet and outlet of the water to and from the working-cylinder and hydraulic holding-on ram, as any well-known or suitable arrangement may be used; but the arrangement shown in our drawings will be found to answer in practice. It consists of a slide-valve, *m*, working on the usual three-ported valve-face, actuated by the water-pressure being admitted by a four-way cock, *n*, and passages *o o′* (shown dotted in Fig. 4) upon one or other of the two pistons, *j k*, which, on being forced in one direction or the other in their cylindrical chamber, carry with them the slide-valve *m* and cause it to open one or other of the ports leading to the two ends of the actuating-cylinder D, at the same time opening the opposite port to the eduction-pipe. Supposing the main actuating-piston C is at the inner or rear end of the cylinder D, then the four-way cock *n*, which is worked by a sliding tappet motion from the piston-rod, is so placed as to open a water-communication with the face of the piston-valve J through the passage *o*. The water-pressure will then move the piston *j k*, which is attached, and cause the slide-valve *m* to open the port leading to the rear end of the cylinder D and force out the cutters so as to make a cut. At the same time part of the water which actuates J will pass the keep-valve *v* and through the pipe W to the under side of the ram J, forcing it up and holding the feeler F firmly against the roof. On the piston C completing its stroke the tappet will reverse the four-way cock *n*, whereupon the water will enter the passage *o′*, and by acting upon the piston *k* will move the slide-valve *m* in the opposite direction and cause it to open the port leading to the front end of the main cylinder D with a view to making the return or back stroke of the cutters. At the same time the water passes by the pipe *v′* to the upper surface of the ram J, and by its downward pressure thereon assists the descent of the feeler from the roof. During this time the water is escaping from the opposite end of the cylinder D by the eduction-port, and is also escaping from the underside of the ram J back through the keep-valve *v*, held open by the contact of the piston *j* therewith, and along the passage *o*, whence it escapes by the outlet-passage *p* (shown dotted in Fig. 4) into the eduction-pipe, in company with that escaping from the cylinder D.

The screw K is for regulating the height of the feeler or holding-on head. Thus the machine is dead fast upon the rail when the cutting stroke is being made, but is set free when the cutting-tool makes its return stroke, so as to be ready to traverse forward for the next cut. The traverse, which determines the thickness of cut, may be produced by the pin *b c* pressing at the end of its return stroke against a lever, *d*, actuating a ratchet-motion, *e*, which drives the chain-pulley *h* to the desired amount, and thus progressing the machine along the chain *i*, which may be either made fast at its end or disposed as shown in Fig. 5, which latter arrangement we prefer. In this arrangement the chain *i* is an endless chain, which is passed round an anchor-pulley, *k′*, fixed ahead of the machine, and is secured on one side at *l* to the cylinder, so that the strain on the chain may tend to keep the cutter-bar well up to its work. The other side of the chain, after passing around the anchor-pulley, as shown, passes over the chain-hauling pulley *h* and the slack part of the chain in disuse upon the floor. So soon as the machine has hauled itself up to the anchor-pulley *k′* the chain is detached from the hook at *l*, the anchor-pulley and slack chain in the rear of the machine are carried forward another stretch, and the anchor-pulley again fixed, when the operation of hauling is recommenced.

By using an endless chain in the manner above described the necessity for drawing the chain over the hauling-pulley *h* on the machine at every stretch is obviated.

The horizontal angle (with regard to the coal face) of the cylinder D and cutter-bar B may be varied by turning the pinion Z, which is in gear with the segmental rack H, secured to the

end of the cylinder. The cylinder may further by this means, be caused to turn or swivel on its axis G longitudinally with the carriage when the machine is desired to move from place to place, having first removed the cutter-bar. In order to vary the vertical angle of the cutter-bar, the carriage may be caused to turn upon the two end pivots, X′ X′, and is then fixed at any desired angle by the tightening-screws *x x* in the segmental slots *y y*, as shown more clearly in Fig. 3.

Y Y are two screws for varying the height of the working parts of the machine.

In the modification above described (Sheet 1) the actuating-cylinder is represented as being situate beneath the carriage, so as to be at a minimum height above the rails; but as the position of the cylinder forms no part of our invention we do not limit ourselves to such an arrangement, and reserve to ourselves the right of placing it in such positions as may be found most convenient in practice.

Fig. 6 on Sheet 2 of our drawings represents a ground plan of a coal-cutting machine in which the motive-power cylinder is situate above the carriage in lieu of beneath the same, with the cutters in operation. Fig. 7 is an end elevation of the same, also in operation, the machine being represented as cutting at a slight downward angle. Fig. 8 is a transverse vertical section taken along the line W W in Fig. 6, and represents the actuating-cylinder turned round so as to be parallel with and above the carriage, in a position suitable for transport.

In all these views the same letters of reference indicate corresponding parts to those indicated in the figures on Sheet 1 of our drawings, and need only, therefore, to be briefly referred to.

D is the hydraulic motive-power cylinder, acting precisely in the manner hereinbefore described, and supported on the axis G, forming part of the carriage I, the cylinder and parts connected therewith turning freely round such axis by the aid of the pinion Z and segmental rack H, the pinion being carried by the cylinder and the rack secured to the carriage.

B is the tool-bar, fitted with one, two, or more cutters, arranged by pressure in the manner hereinbefore described.

Although we do not confine ourselves to any particular form of cutter, we prefer to use the form shown at Figs. 2, 3, 6, and 7, which we have found to answer well in practice where a steady slotting cut, as distinguished from percussion, is required. This tool consists of a gouge with its cutting-edge ground straight and slightly beveled in lieu of being curved, as is the case with our ordinary gouge-chisel. It is provided with a short shank or stem for the purpose of readily securing it into the cutter-bar, which is provided with holes for that purpose.

G′ is the hydraulic cylinder, in which the piston J and its trunk or rod of the holding-on head F works, and K is the screw for adjusting the height of the holding-on head or feeler.

The height of the groove or cut above the rails is varied by the elevating-screw Y inside the axis G.

The valves and valve-motion may be precisely the same as hereinbefore described, or otherwise arranged and constructed so as to produce the required steady slotting cut of the tools.

In order to facilitate the passage of the machine along sharp curves, the carriage may be mounted on bogies I′.

The vertical angle of the cutter-bar may be varied by means of the adjusting-screws *x x*, which serve also to fix the machine at the adjusted angle. The hauling along a chain suitably fixed ahead is effected in the manner before described.

In case the cutters should meet with any extra hard substance or obstruction which they cannot overcome at the first cut, an arrangement may be employed whereby the traverse of the machine is arrested until such obstruction is overcome. This may be effected by connecting the end *d′* of the lever *d*, which actuates the pawl *e*, by means of a chain, *d″*, with the arm *b′* attached to the cutter-bar, such arm serving, also, to work the tappet which gives motion to the four-way cock of the valve mechanism.

In lieu of a chain, *d″*, as shown, or other flexible attachment, any other arrangement may be employed which shall be capable of pulling, but not of pushing.

The action of this arrangement is as follows: Supposing the cutters to encounter a piece of pyrites or other hard substance which cannot be cut through at one cut, the bar B, by not making its full outward stroke, will fail to act upon the lever *d* through the chain *d″*, and consequently the pawl *e* will not be moved back to take a fresh tooth of the ratchet-wheel, but will remain stationary, and hence no motion will be imparted to the chain-pulley *n* on the return of the bar, and the machine will remain in the same place and continue to work in that spot until, the obstruction being removed, the bar B will make its full outward stroke, and by pulling upon the chain *d″* will move the lever *d* and cause the pawl *e* to take a fresh tooth to be drawn forward at the completion of the back or return stroke of the bar by the striking of the pin *b c* against the lever *d*.

What we claim as our invention is—

1. The system or mode of actuating the cutting tool or tools of machines for working coal and other minerals and earthy matters by the direct pressure of a flow of water or other practically non-elastic fluid medium, by the means and in the manner substantially as herein shown and set forth, so as to produce a steady even slotting action of the tool or tools at any angle into the substance to be cut.

2. The application and use to and in ma-

chines for working coal and other minerals and earthy matters of a holding-on head or feeler, which is pressed against the roof during the cutting action of the tool or tools, and released therefrom to allow the machine to move forward during the return or back stroke of the tool or tools, the movements of this head or feeler being obtained from the pressure of water or other practically non-compressible fluid medium, substantially as herein shown and described.

In testimony whereof we have signed our names to this specification in the presence of two subscribing witnesses.

WILLIAM LOCKE.
JOHN WARRINGTON.
WILLIAM ELLIOT CARRETT.
WM. E. MARSHALL.
JOHN TELFORD.

Witness:
WM. L. RAYMOND,
U. S. Consul, Leeds.