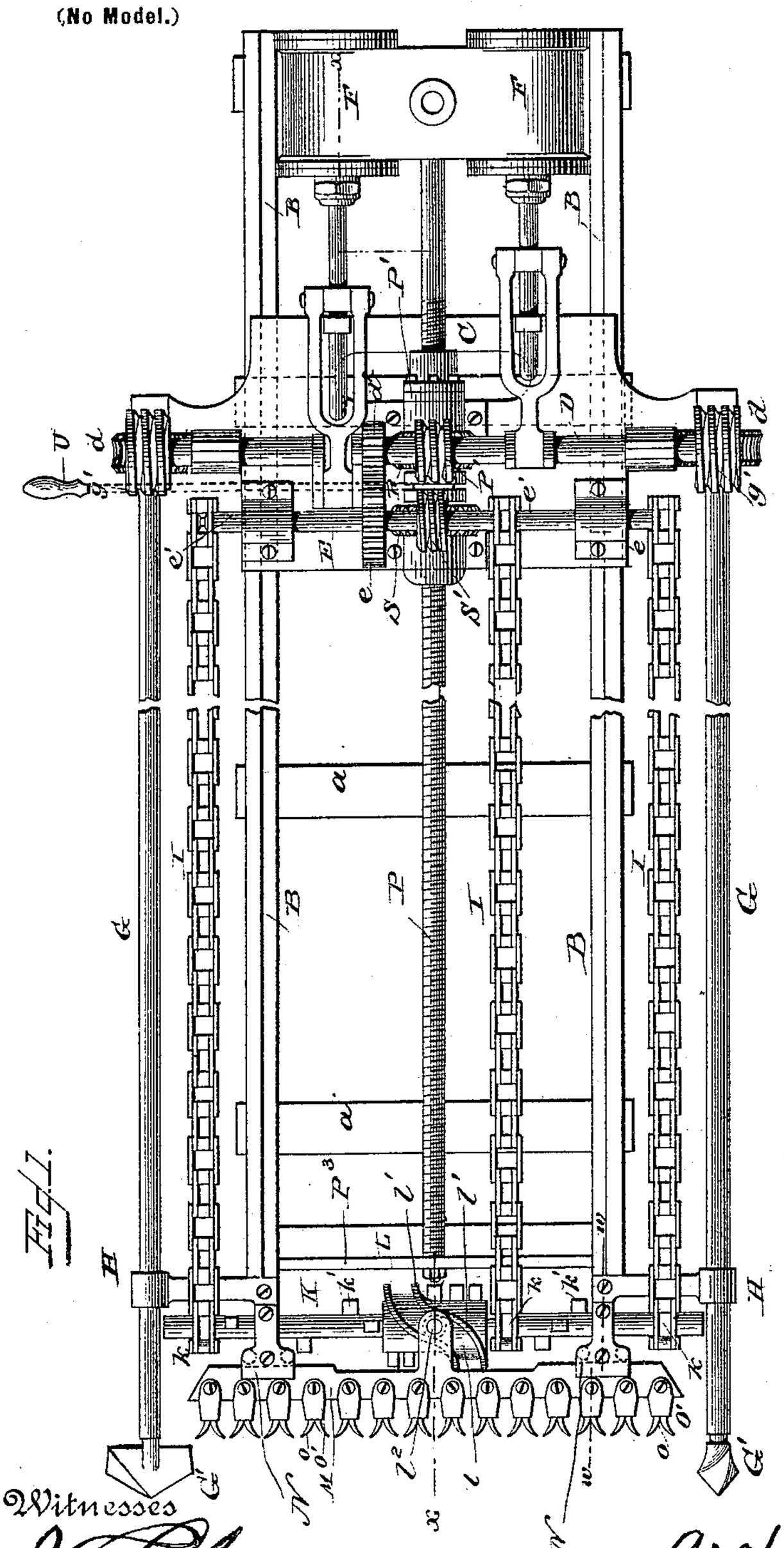
No. 640,621. Patented Jan. 2, 1900.

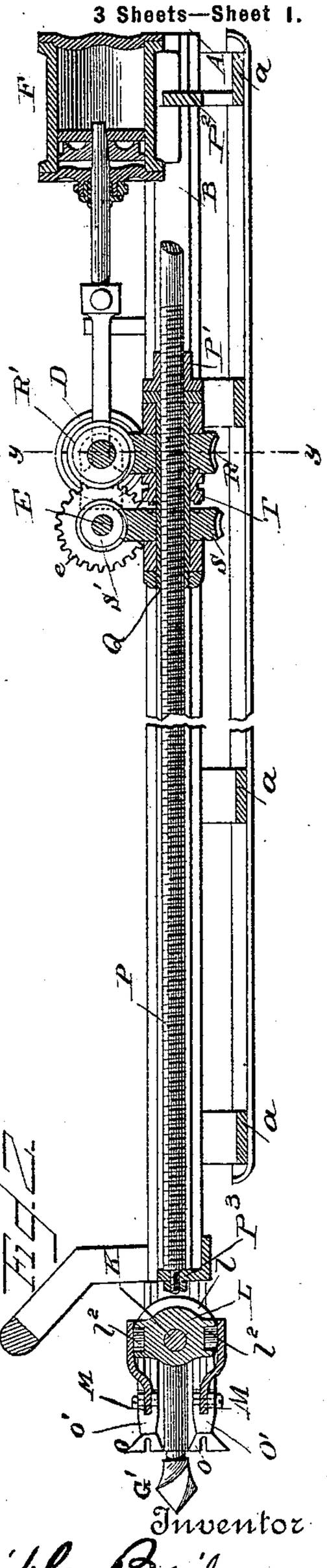
A. BAILEY.

MINING MACHINE.

(Application filed Sept. 29, 1891.)

(No Model.) 3 Sheets—Sheet 1.





Witnesses

J. F. Coleman

H. B. May

Inventor

Archible Bailey

By his Attorneys

Doubleday & Bliss

No. 640,621. Patented Jan. 2, 1900.

A. BAILEY.

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(No Model.) 3 Sheets—Sheet 2.

Fig. 3.

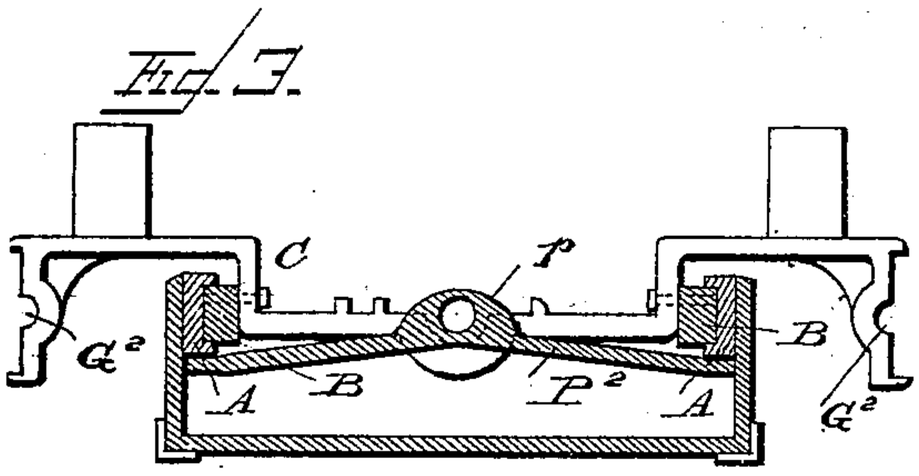


Fig. 5.

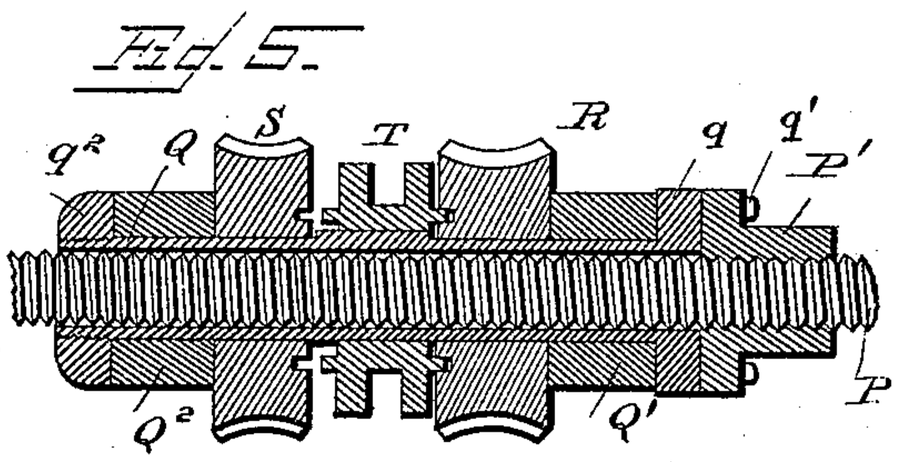


Fig. 4.

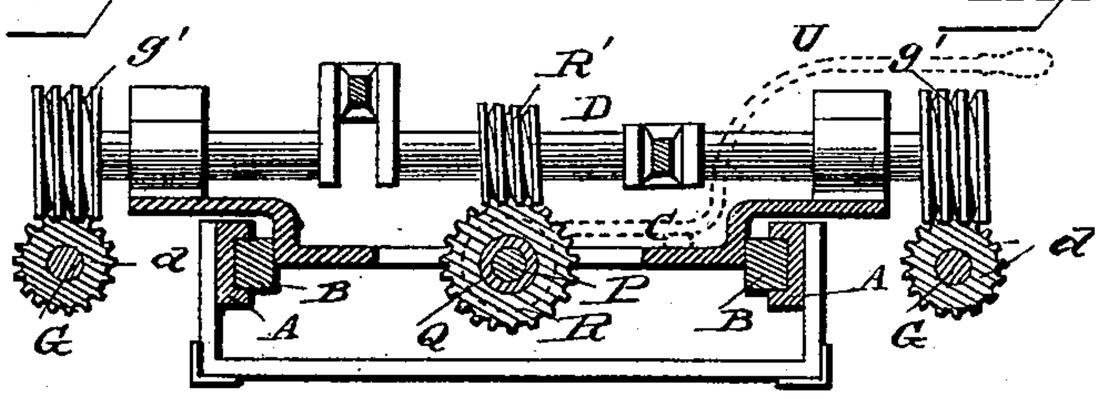


Fig. 11.

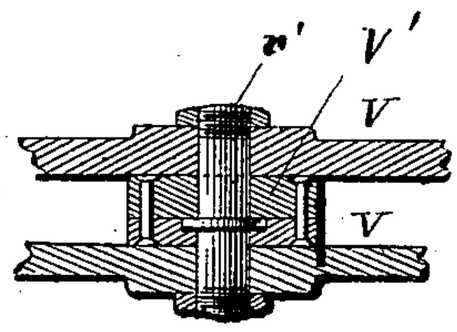


Fig. 7.

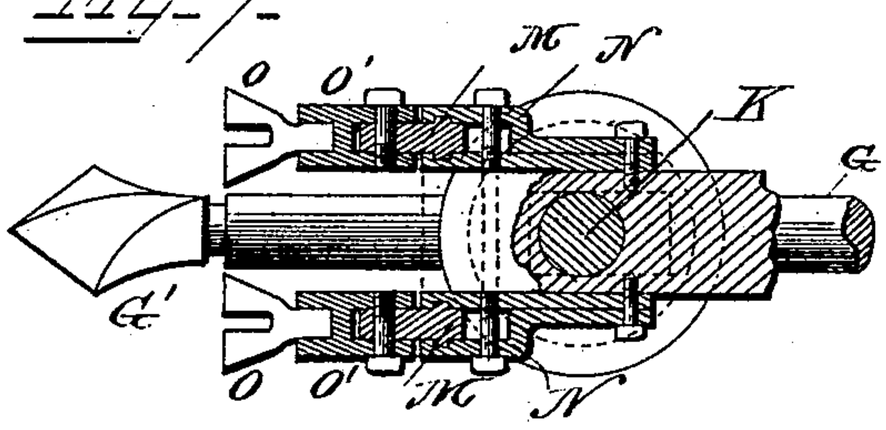


Fig. 8.

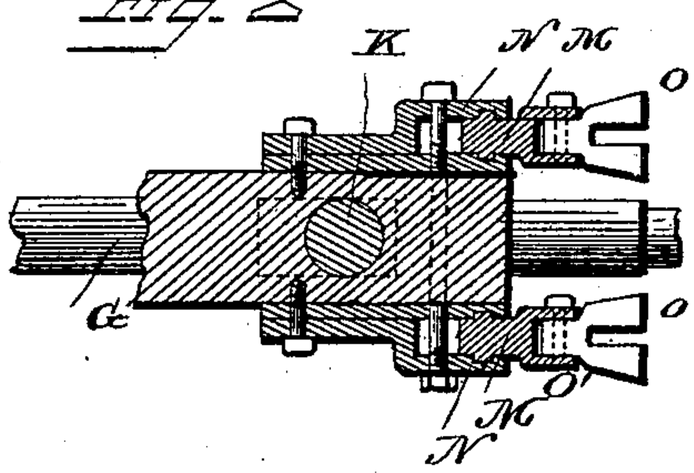
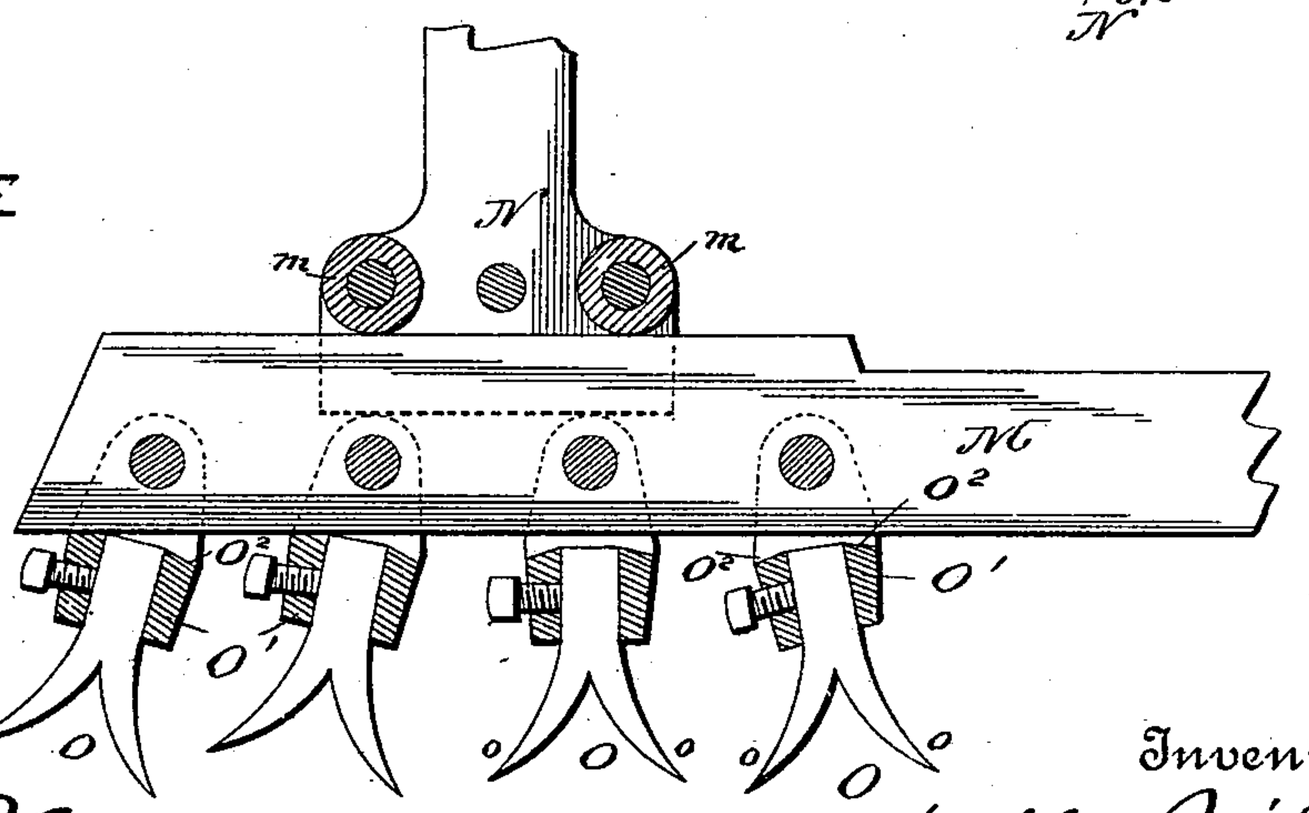


Fig. 6.



Witnesses

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No. 640,621. Patented Jan. 2, 1900.

A. BAILEY.

MINING MACHINE.

(Application filed Sept. 29, 1891.)

(No Model.) 3 Sheets—Sheet 3.

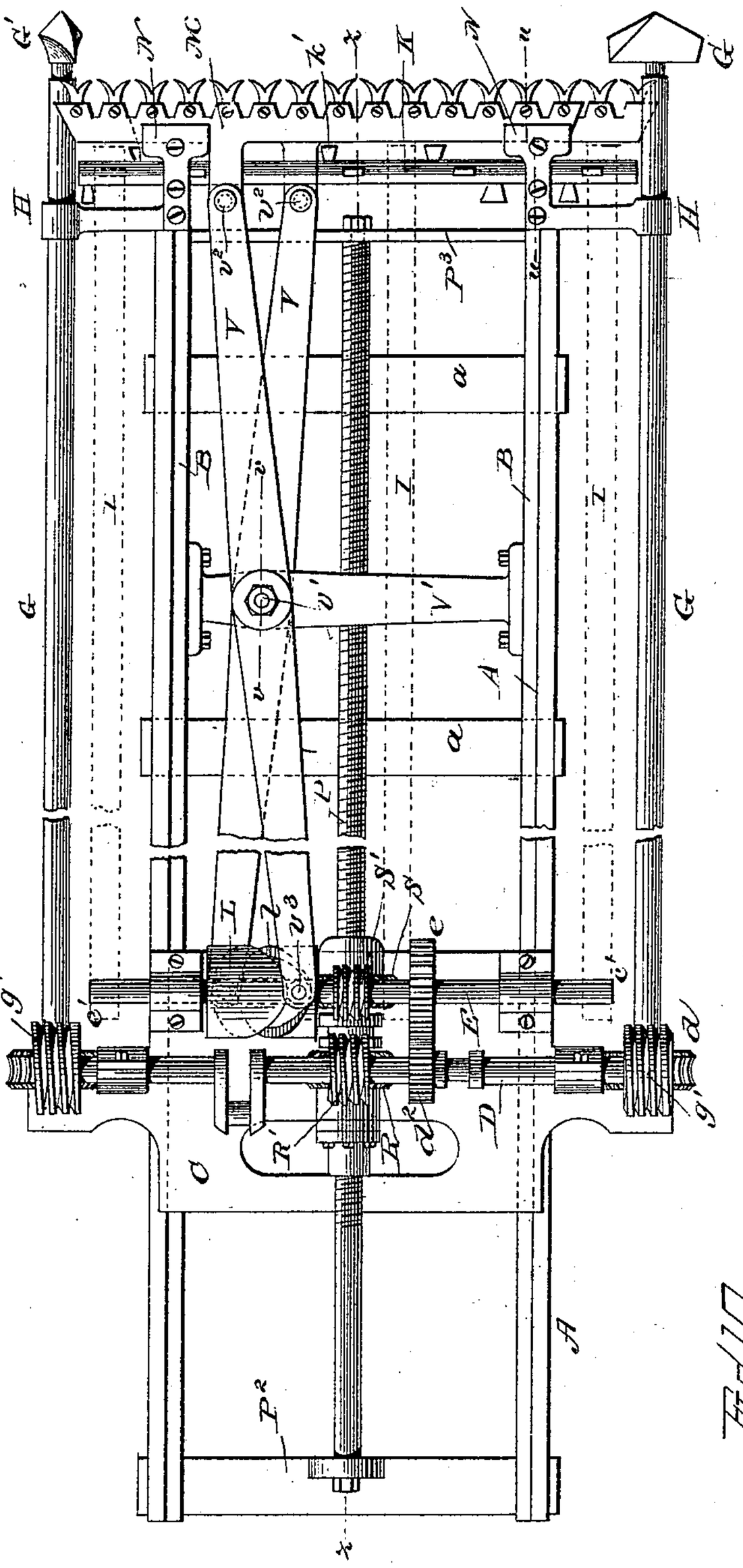

Fig. 9.

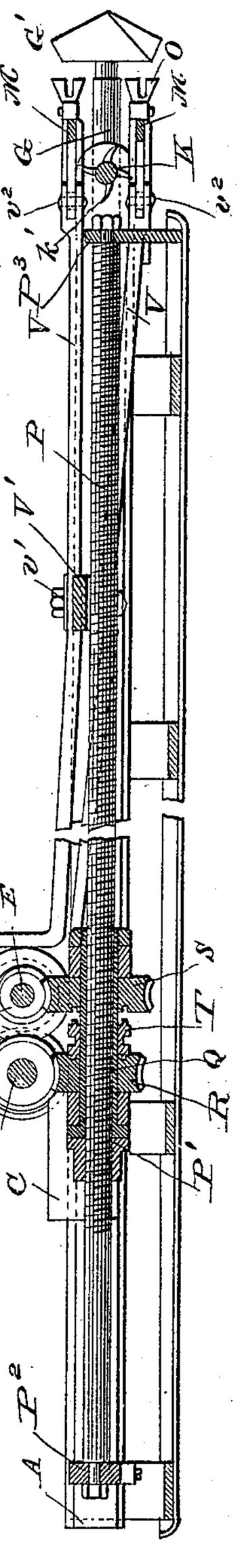

Fig. 10.

Witnesses

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UNITED STATES PATENT OFFICE.

ARCHIBLE BAILEY, OF PHILIPSBURG, PENNSYLVANIA.

MINING-MACHINE.

SPECIFICATION forming part of Letters Patent No. 640,621, dated January 2, 1900.

Application filed September 29, 1891. Serial No. 407,155. (No model.)

To all whom it may concern:

Be it known that I, ARCHIBLE BAILEY, a citizen of the United States, residing at Philipsburg, in the county of Centre and State of Pennsylvania, have invented certain new and useful Improvements in Mining-Machines, of which the following is a specification, reference being had therein to the accompanying drawings.

My invention relates generally to mining-machines, and more particularly to coal-mining machines.

The object of my invention is to produce an improved machine that shall consist of a few and simple parts that will so coact in their operation that they will remedy a great many existing evils in this class of machines.

With these objects in view my invention consists in the various constructions hereinafter described and claimed.

In the drawings forming a part of this specification, Figure 1 is a plan view of my improved machine. Fig. 2 is a longitudinal section of the same on the line $x\,x$, Fig. 1. Fig. 3 is a rear view of the bed-plate and carrying-frame. Fig. 4 is a cross-sectional view on the line $y\,y$, Fig. 2. Fig. 5 is a longitudinal section, on a larger scale, of the carriage-feeding devices. Fig. 6 is a detail of part of a cutter-bar. Fig. 7 is an enlarged section on the line $w\,w$, Fig. 1, looking toward the right-hand side of the machine. Fig. 8 is a view at the same line looking toward the left of the machine. Fig. 9 is a plan view, and Fig. 10 a longitudinal section, of a modified machine. Fig. 11 is a section through the lever-pivot on the line $v\,v$, Fig. 9.

In carrying out my invention I employ a bed-plate A, the inner sides of which are grooved longitudinally upon their opposing faces and within their grooves fit the bars B. The side bars A of the bed are joined by girths a, which are extended down far enough to elevate sufficiently the operative parts of the machine. The sliding bars D carry not only the cutters, but the mechanism which drives them. These bars are joined by a plate or frame C, and, if necessary, by cross-braces in front of it. The frame or plate C has mounted upon it two transverse shafts D and E, the former being the crank-shaft, which receives power from the engines F, the latter being also bolted to the bars B. The frame is extended outward far enough to support the side drills, which have the shafts G, mounted in rear bearings G^2, preferably cast with the carriage frame or plate C. At the forward ends the drill-shafts are supported in bearings H, carried by bracket-arms which are secured to the carriage-bars B.

Upon the forward ends of the drill-shafts are arranged the drills G′, and upon the rear ends of said shafts are mounted the worm-gears g', which mesh with corresponding gears d upon the ends of the shaft D. The shaft D is provided at or near its center with a pinion d^2, which meshes with a gear e upon the shaft E. One or more sprocket-wheels are mounted on the shaft E, and around said wheels are run the drive-chains I, said chains passing over and driving sprocket-wheels k, mounted upon the transverse shaft K, said shaft being journaled in the forward end of the sliding frame. One of the ends that can be accomplished by this shaft in a machine like that in Figs. 1 and 2 is the actuating of the cutting mechanism, which, as concerns this part of the invention, may be of any preferred form.

The cutting mechanism in the present case consists of the cutter-bars M, adapted to reciprocate transversely to the path of advance of the carriage. There are two bars M, shown one above the other, and they are supported by guides N, secured to the carriage, wherein they are held, preferably, by a tongue-and-groove connection. There are antifriction-rollers at n to receive the thrust of the cutter-bars. The cutters O are detachably fastened by set-screws to socket-pieces O′, which are pivotally connected to the cutter-bars in such way that the teeth can rock to a limited extent. At O^2 there are shoulders or stops on the socket-pieces O′, adapted to impinge squarely against the cutter-bar, so as to hold the teeth firmly when in operation. Each cutter is shown as having two prongs $o\,o$, extending out in different directions. When the cutter-bar is moving in one direction, the socket-pieces will swing or rock so that all of the left-hand prongs will engage with the material, and vice versa when the cutter-bar is moving in the other direction. Moreover, the cutters are so constructed and arranged as to

form horizontal kerfs of vertical dimensions large enough to permit the free entrance of the guides *n*. The cutters on the upper bar extend up to a plane above those of the carriage and the cutters on the lower bar extend to a plane below those of the carriage. The cutter-bars are arranged to have the cutters lie in transverse planes immediately behind those of the drill-heads G′ and are so adjusted that the cutters at the ends of the series shall move into or close to the apertures formed by the drills.

As above said, the cutting mechanism is actuated by the shaft K. This is accomplished by means of mutually-engaging projections, one set being carried by the cutting mechanism and one by the bar in rear of the cutting mechanism, and as the bar is rotated by the chains its motion is by the said engaging projections converted into the desired motion of the cutters. The projections on the bar K consist of two spirally-arranged flanges *l′*, with a groove or passage-way *l* between them, and those of the cutting mechanism consist of teeth or pins l^2, connected to the cutting mechanism and lying in the path of the projections *l′*. As shown, the projections or flanges *l′* are formed upon a hub or cylinder L, secured to the shaft K. When the shaft K is rotated by the chains, it in turn, through the devices just described, imparts the desired motion to the cutting mechanism, which in this case is a reciprocating motion.

Heretofore it has been common to extend the chains forward far enough to engage directly with the cutter-bar. This has been disadvantageous, from the fact that special devices were necessary to cut paths for the chains and their sprocket-wheels, which latter have always been necessarily of very small diameter. The special cutters have consisted of small points or chisels inserted in the sprocket-teeth and arranged to pass through the central openings of the links. Use must be made of very large links or of very small cutters, and the latter have generally been chosen; but they frequently break, not only because of the enormous strain upon them of the material, but also because they frequently become loosened in their sockets and then strike the chain-links, which results immediately in a breakage of the cutter or the chain. By applying the chains to a bar immediately behind the cutting mechanism I obviate these difficulties and can furnish all the requisite power without danger to the chain and without requiring special devices to cut a path for it.

By having two cutter-bars one above the other I provide for obtaining one of the ends which is absolutely essential in a machine of this sort—namely, to provide for the escape of the cuttings and allow them to be immediately withdrawn—and by having them move in opposite directions I overcome the side strain or thrust which, as is well known to those practically acquainted with such machines, is very severe and has been the bar to successful use of earlier machines having reciprocating cutters.

I am aware of the fact that use has been heretofore proposed of a machine having side drills and a single intervening transversely-reciprocating cutter-bar, as is shown in the patent to B. A. Legg, No. 347,813, dated August 22, 1886. The machine therein shown illustrates the class to which reference is above made—namely, those which provide no direct escape backward for the cuttings or slack and have no balancing of the cutters or provision for overcoming the side thrust. I am also aware of the fact that use has been made of two sets of transversely and oppositely moving cutters, not reciprocating, but moving continuously, they being secured to chains which move across the front end of the machine and backward and forward; but, as is well known, these double-chain machines have, because of several disadvantages, never gone into use. The oppositely-moving chains and their teeth have in practice been found to constantly engage and interfere with each other, the chains not only being slack and loose longitudinally, but also apt to rock laterally away from the normal working planes of the links. Machines of the sort referred to are typified in the patent to Lechner *et al.*, No. 340,791, dated April 27, 1886. Again, the cutters in machines of this sort both just as they enter upon and just as they leave their normal working lines engage with the material on lines more or less nearly parallel to the path of the machine, and there are therefore at all times some which are tending to press backward and some tending to press forward in relation to the carriage. Another objection to machines of this sort is that they tend to carry the cuttings to the two sides and to pack them in reduced spaces as the chains move continuously from side to side.

A machine of the sort herein, while retaining the advantages incident to the two oppositely and transversely moving sets of cutters, provides for the bringing of the cuttings backward along longitudinal lines, and therefore distributing them, and provides clearance at the side lines, so that the outermost cutters and the adjacent parts of their carriers have always sufficient clearance.

I prefer to have the two kerfs formed by the cutters separated from each other and to leave a shallow web of material between them, although some of the ends of the invention can be attained without leaving such web. By arranging the parts as shown—that is, so as to leave a web—the kerfs can be shallow, and therefore the amount of cuttings or pulverized coal can be reduced to a minimum, and a large amount can be removed in the shape of lumps or large particles, which, as is well known, are more valuable than the slack, and yet the depth of the total "undercut" need not be any greater than the ordinary—

namely, from four to six inches. For removing the web use can be made of projections on the bar K, of the nature of teeth or spurs, as at k'. These need not be particularly sharp, as the coal in the web will be readily broken in comparatively large pieces. The cutters O and the teeth k' open up the entire kerf for the backward escape of the loosened material, which is immediately engaged by the backwardly-moving part of the chain, and of the latter use may be made of as many as are necessary to effect the rapid withdrawal. The cuttings and loosened material tend to occupy a space much larger than that occupied when they were in solid form, and unless they are speedily withdrawn, the cutting mechanism is choked and stopped after entering but a short distance into the coal.

The carriage feeding and withdrawing mechanism comprises a screw-shaft or rod P, fastened to cross-bars P^2 P^3, secured to the bed-frame.

P′ is a reversible nut which engages with the shaft or rod P and which is secured to a sleeve Q. The sleeve surrounds shaft P loosely and is mounted upon cross-bars Q′ Q^2, secured to or formed with the carriage-plate C. The sleeve has a flange q for receiving the nut-bolts q' and a nut or suitable fastening device q^2. Upon the sleeve are two loosely-mounted worm-wheels S and R, which revolve continuously in opposite directions and with different speeds. Either can be engaged with the sleeve by a sliding clutch T, splined to the sleeve and movable by any suitable lever, as at U. Wheel S is rotated by worm S′ on the aforesaid shaft E, and wheel R is rotated by a worm R′ on the crank-shaft D. The aforesaid wheels d^2 and e are related to reduce the speed, and the pitches of the worms S′ and P′ are so related as to further modify the relative speeds of the wheels R and S, so that a slow continuous rotation of the one (at E) can be attained at the same time that a rapid, continuous, and opposite rotation of the wheel R is being caused.

To advance the carriage and cutters the clutch T is moved into engagement with wheel S, whereupon said wheel and the clutch slowly rotate sleeve Q and nut P′, and to withdraw the carriage and cutters without changing the speeds and directions of any of the parts between the engine and the clutch, the latter is moved into engagement with wheel R, whereupon the nut and the sleeve are reversed in their motion and rapidly rotated.

By arranging that member of the carriage-moving mechanism which is secured to the bed (and which here is the threaded shaft or bar P) at the axis of those parts which constitute the other member and which are secured to the carriage I can apply the power for this purpose more effectively than when the first aforesaid member is arranged eccentrically—as, for instance, when use is made of a cogged rack below or at the sides. Moreover, the carriage-moving parts are arranged much more compactly than in the machines referred to, and this part of the machine is simplified in many respects.

The reversible nut and sleeve can be used with a driving mechanism of a modified form, as other devices are now well known for such purpose.

In Figs. 9 and 10 I have shown one of the other forms of mechanism which can be used to impart opposite reciprocations to the cutter-bars. Here levers V V are used, they being pivoted at v' to the carriage, the latter having a cross-bar V′ for carrying them. They are also pivoted, respectively, to the cutter-bars M at v^2 v^2. They are vibrated by a drum L, which in this case is secured to one of the rear cross-shafts—as, for instance, that at E. The bar V and the pivot v' should be placed at the point adapted to provide the best leverage.

In this machine a carriage-feeding mechanism similar to that above described can be used—that is to say, a screw-threaded shaft and reversible nut with clutch and gearing—and the threaded shaft can be arranged here in relation to the other parts the same as the machine in Figs. 1 and 2. By reference to the said figures it will be seen that this feed shaft or rod P is in a horizontal plane between those of the topmost and lowermost cutters, it being, in fact, preferably as near as practicable to the central horizontal plane of the cutting apparatus, so as to provide the most nearly perfect forward thrust—that is to say, a thrust in the horizontal plane of the cutting apparatus. The machine in this respect is superior to those in which the threaded shaft is arranged above or below the planes of the cut, for when arranged in the latter way there is a tendency to cramp and bind to such an extent as to not only interfere with the proper motions of the feed mechanism, but also to strain and bend the parts of the machine, and particularly the feed-rod itself, so that many parts of the machine must be made larger and heavier than is desirable and a surplus of power must be provided for. In my case the parts can be lightened and the machine be made lighter and more compact, as above described. This arrangement of the feed-shaft relative to the cutters is not necessarily dependent upon all the details that have been described. It was well known at the date of this application that there could be an inversion of parts in respect to the arrangement I have shown without materially altering the machine—as, for instance, the threaded shaft could be rotated and the nut held stationary. So, too, any of the numerous well-known devices can be used for rotating the nut.

I know that two oppositely-reciprocating cutters by themselves and broadly considered have been used for various purposes—as in shears, clippers, harvesters, &c.; but it is unnecessary to set forth at length the peculiarities which characterize the present ma-

chine in conjunction with these cutters and those which characterize the work to be accomplished by it in comparison with the other machines referred to, such as harvesters, and the uses to which they are put. I do not know of any machine having such cutters intended for a material which produces a side strain on the machine when the cutters are at work, for one which requires the backward escape of the cut material on lines in the horizontal planes of the cutters, or one which would be rendered inoperative by the material (which is being attacked) striking the cutter-bars at the ends of their strokes and therefore requiring a clearance at said ends, which clearance is provided by supplementary cutters.

It has been heretofore proposed to employ horizontally-rotating circular cutter-carriers mounted at the front end of a carriage, one carrier being in an upper horizontal plane and one in a lower plane, with a space between them wherein moves a driving-chain; but it will be seen that in my case the transversely-moving cutters travel on lines which are practically straight, and therefore the coal is undercut the full distance, not only at the center of the kerf, but also at the ends. This has been found to be necessary with heading-machines, and is a result not attainable by those having the aforesaid horizontally-rotating circular cutter-carriers of the nature of saw-wheels, as they necessarily leave large masses of material at the side lines of the cut. Under such circumstances the coal will not fall properly, as it must be relieved of support from end to end. When the back line of the kerf is straight, the superincumbent mass is permitted to break sharply off at the desired distance back from the face, so that its fall shall be complete.

I have herein shown two drills G′ G′, one on each side of the machine and adapted to form clearance-apertures at each end of the kerf formed by the intermediate cutters, and while it is necessary that both of these drills should be at work to form such apertures when the first cut is being made in a "room," yet it will be understood that after the first cut is made it is not always necessary that both drills should be caused to enter the material, as under many circumstances I prefer that one should run idle, it being at such times arranged so as to advance and recede on lines intersecting the edge part of the kerf last formed, and at such times the drill which is at work may be regarded as the one which is providing the necessary clearance for the transversely-moving cutters, the last said cutters being then so situated that they have a clearance provided for them in the previously-formed kerf.

What I claim is—

1. In a mining-machine, the combination with the bed, the carriage, the two reciprocating cutters each forming a separate kerf and means for simultaneously reciprocating said cutters in opposite directions whereby they balance the machine laterally, of a drill mounted on each side of the carriage and forming an aperture at the end of the kerf, substantially as set forth.

2. In a mining-machine, the combination of the bed, the advancing and receding carriage, the two cutters moving rectilineally in different horizontal planes to form two separated kerfs, with a horizontal web between them, and a breaking or cutting mechanism independent of the said cutters, to remove the said web, substantially as set forth.

3. In a mining-machine, the combination of the bed, the carriage, two oppositely-acting cutters moving transversely to the path of advance of the carriage and forming separate kerfs, cutting devices independent of the aforesaid cutters for connecting the two said kerfs at the ends, and means substantially as described for breaking or cutting the web which lies between the separated kerfs, substantially as set forth.

4. In a mining-machine, the combination with two oppositely-working cutter-bars arranged one above the other, of a shaft journaled in the rear thereof and provided with breaking or cleaning teeth, substantially as and for the purpose set forth.

5. In a mining-machine, the combination with the bed and the advancing and receding carriage, of a revolving shaft having a cam-groove, and two cutter-bars provided with pins simultaneously engaging said cam-grooves at the top and bottom respectively, whereby said cutter-bars are simultaneously reciprocated in opposite directions, substantially as set forth.

6. In a mining-machine, the combination of the bed, the advancing and receding carriage, the oppositely-reciprocating cutters mounted on the end of the carriage, a rotary transverse cutter-bar upon the front end of the carriage immediately behind the cutting apparatus, power-transmitting devices connecting said shaft with the reciprocating cutters for imparting motion to the latter, the chains engaging with said cutter-bar and extending backward on the longitudinal lines of the carriage, the rear chain-driving shaft, and power mechanism for actuating the latter, substantially as set forth.

7. In a mining-machine, the combination with the bed and the carriage, of the vertically-separated transversely-arranged cutters mounted at the front end of the carriage, the cross-shaft mounted in said carriage immediately behind the cutters, a cam mounted on said shaft for operating the cutters, and cutters secured to the cam for cutting a path therefor, substantially as set forth.

8. In a mining-machine, the combination with a shaft carrying a drum provided with a cam-groove, and cutter-bars arranged one above the other and provided with pins work-

ing in said groove, of breaking or cleaning teeth projecting from said shaft, substantially as set forth.

9. In a mining-machine, the combination of the bed, the carriage, the cutting apparatus on the carriage, the longitudinally-arranged stationary threaded feed-shaft, the reversible nut surrounding said shaft and rotating independently thereof, the sleeve around the shaft and secured to the nut, and the loose wheels mounted upon the said sleeve and rotating in opposite directions at different speeds, and adapted to be alternately engaged with said nut, substantially as set forth.

10. The combination of the bed, the carriage, the cutting apparatus on the carriage, the longitudinally-arranged, stationary threaded feed-shaft secured to the bed, the rotating, reversible nut surrounding said shaft, the two continuous revolving worms transverse to the feed-shaft, the two oppositely-rotating, differently-speeded worm-wheels surrounding said feed-shaft, and the clutch adapted to slide relatively to the rotating nut and to alternately connect the worms therewith, substantially as set forth.

11. The combination of the bed, the carriage, the cutting apparatus on the carriage, the stationary, threaded feed-shaft fastened rigidly to the bed, the rotary, reversible nut surrounding and engaging with said shaft, the rotary sleeve carrying the said nut and mounted in bearings on the carriage, the two loosely-mounted, oppositely-rotating wheels on said sleeve, the two differently-speeded trains of gearing respectively driving the said loose wheels, and the clutch for alternately engaging the loose wheels with the sleeve, substantially as set forth.

12. In a mining-machine, the combination with a stationary bed, a carriage mounted upon and sliding in guides in said bed, a motor mounted on said carriage, and cutting apparatus actuated by the motor, of the carriage advancing and withdrawing mechanism, consisting of the two parallel cross-shafts, D, E, mounted on the carriage, pinions *d e* connecting said shafts, worms on said shafts, a longitudinally-arranged, threaded shaft, an internally-threaded sleeve surrounding and engaging said threaded shaft and secured to the carriage, two worm-wheels engaging said worms and loosely mounted on said sleeve, a clutch device arranged to alternately engage the said worm-wheels, and means for securing said threaded shaft against rotation when the cutters are advancing, substantially as set forth.

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

ARCHIBLE BAILEY.

Witnesses:

JOS. M. ANDERSON,

H. D. MCLAUGHLIN.