E. C. MORGAN.

COAL MINING APPARATUS.

APPLICATION FILED NOV. 10, 1896.

1,116,356.

Patented Nov. 3, 1914.

7 SHEETS—SHEET 1.

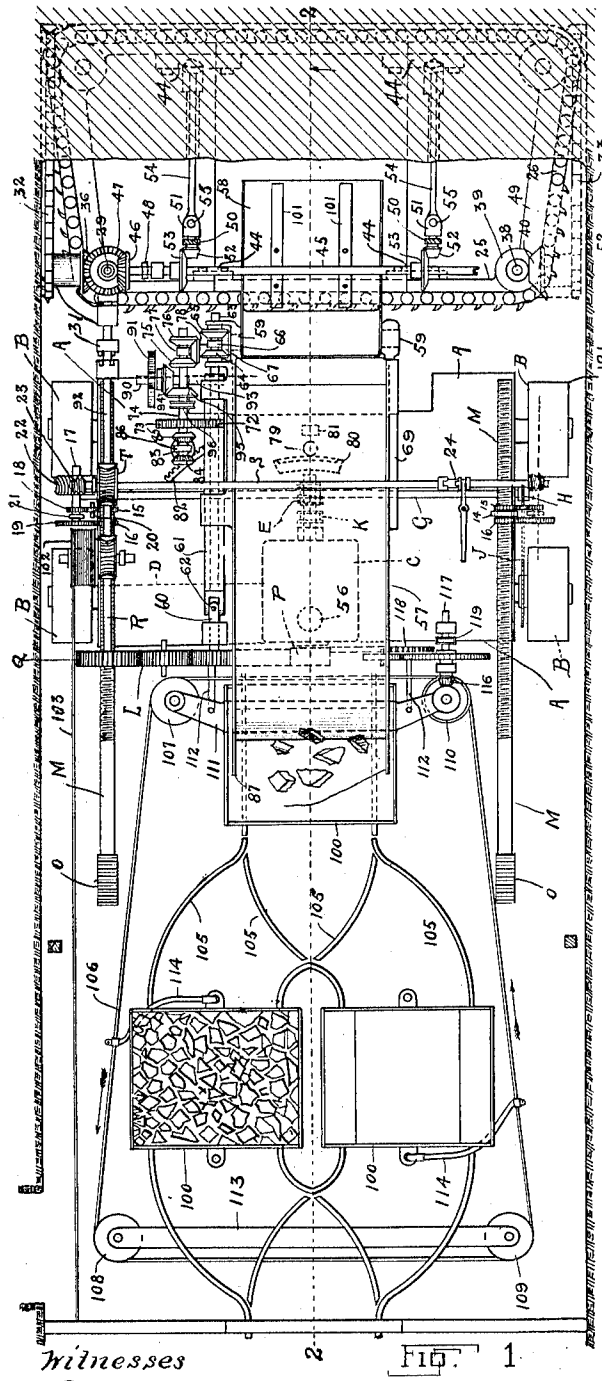


FIG. 1.

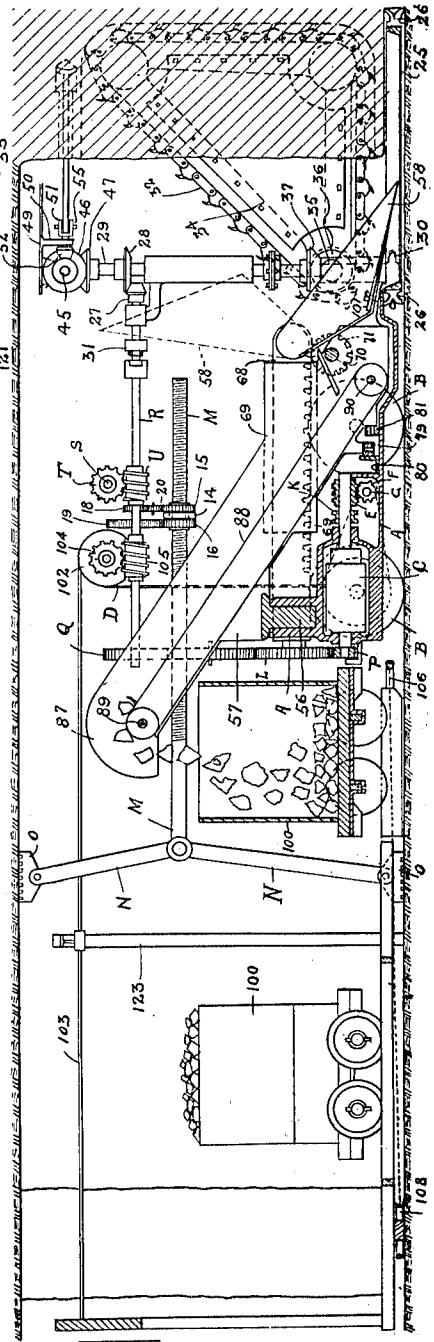


FIG. 2.

Witnesses

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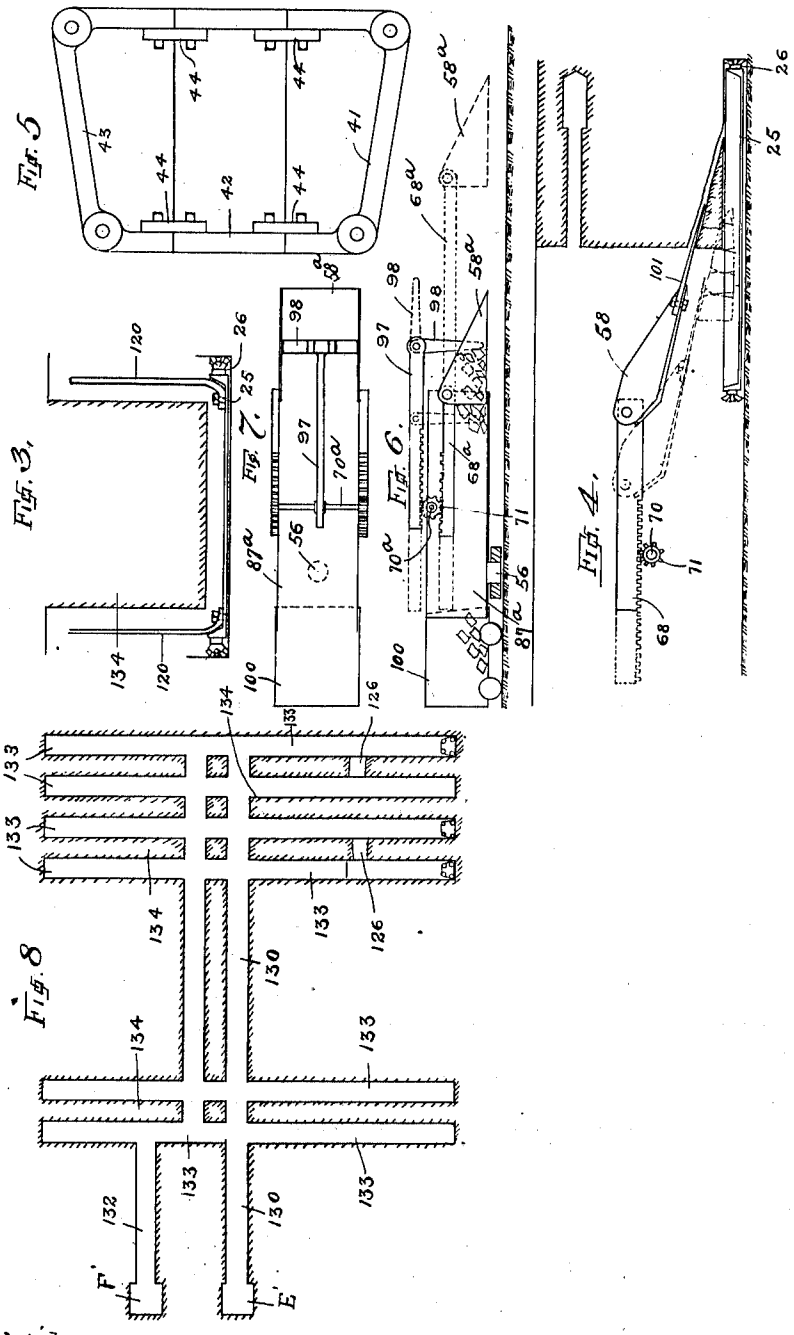
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7 SHEETS—SHEET 3.

Fig. 9.

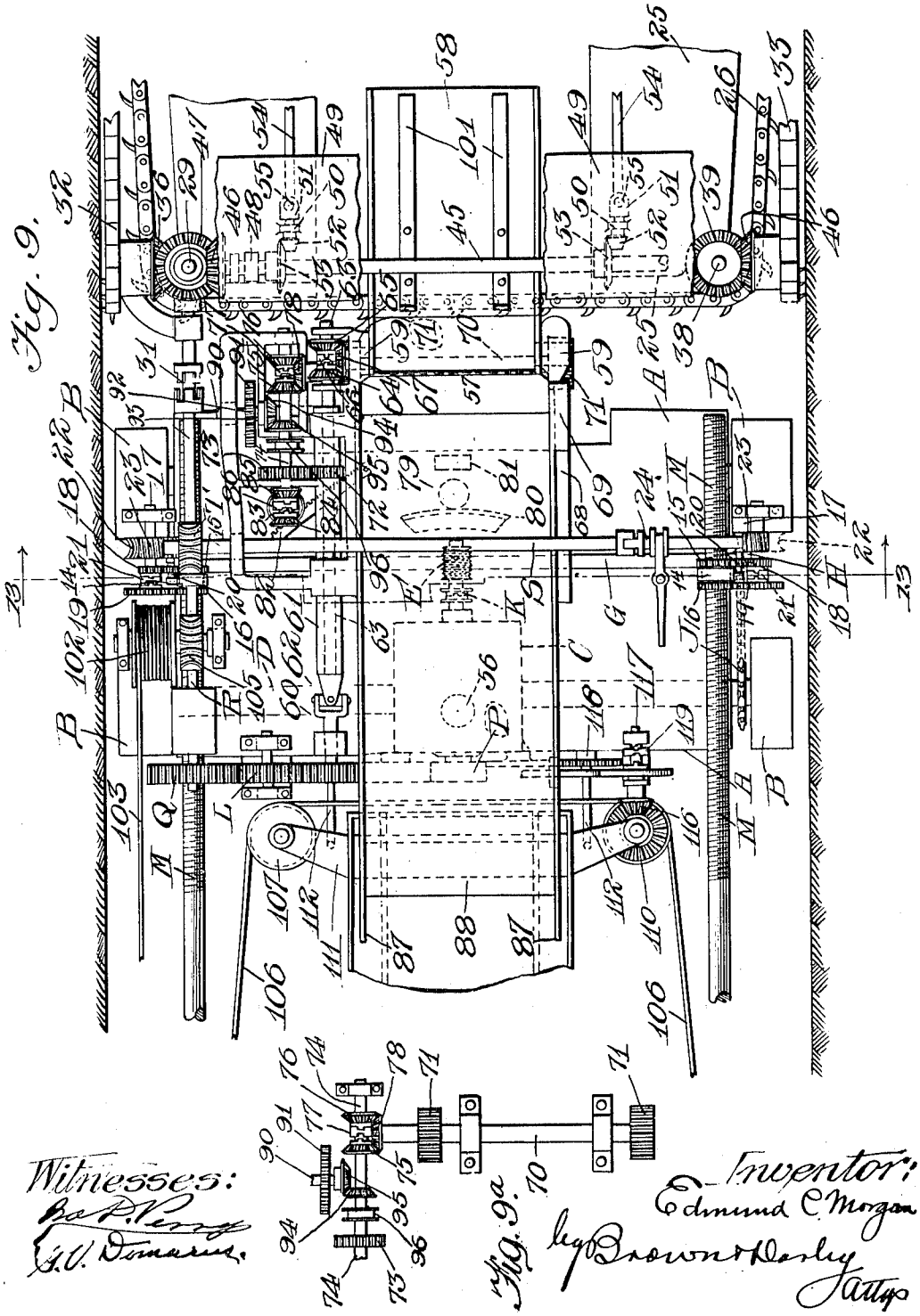


Fig. 9a.

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7 SHEETS—SHEET 4.

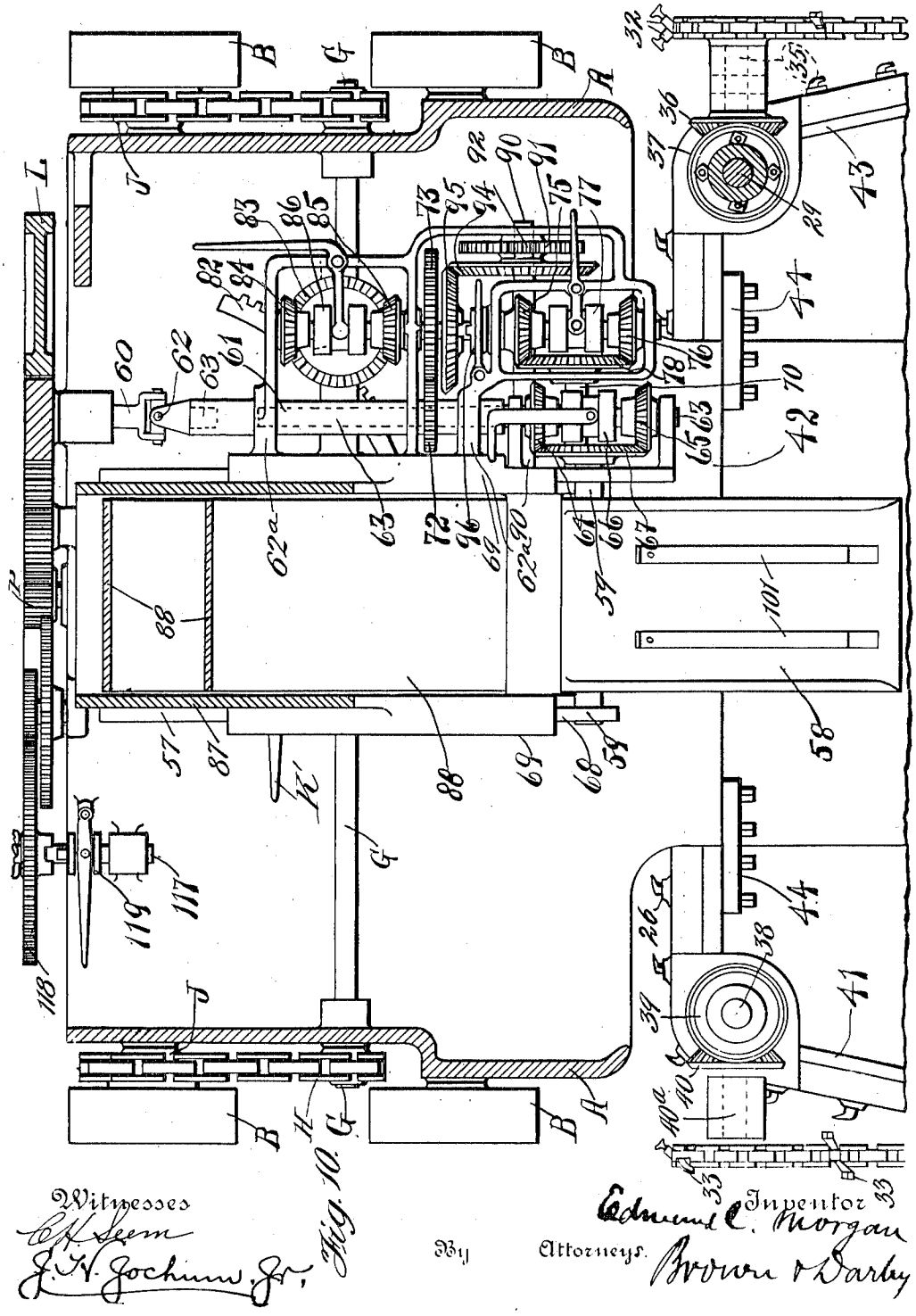


Fig. 10.

Witnesses

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7 SHEETS—SHEET 5.

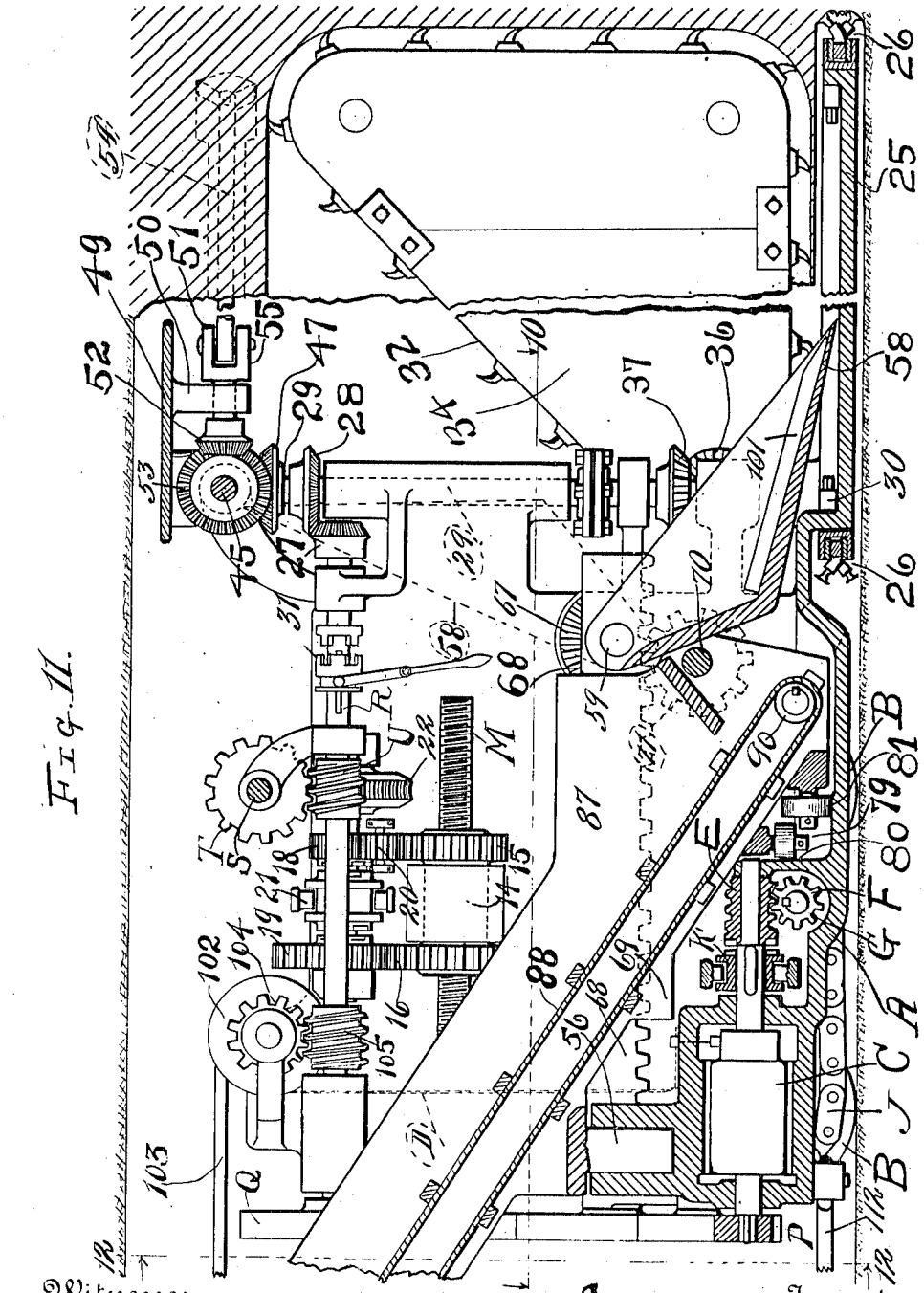


Fig. 11.

Witnesses

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7 SHEETS—SHEET 6.

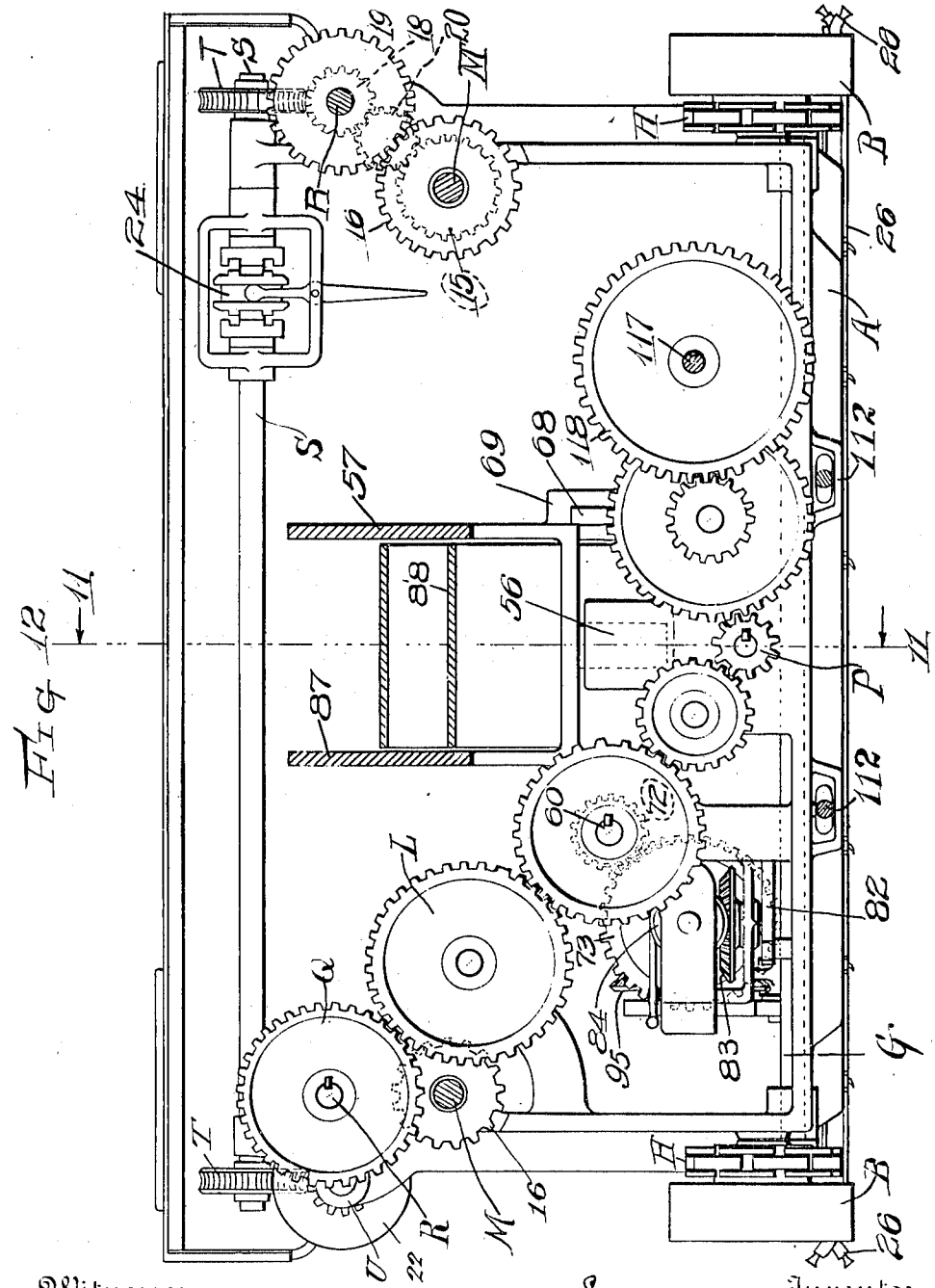


Fig 4

Witnesses

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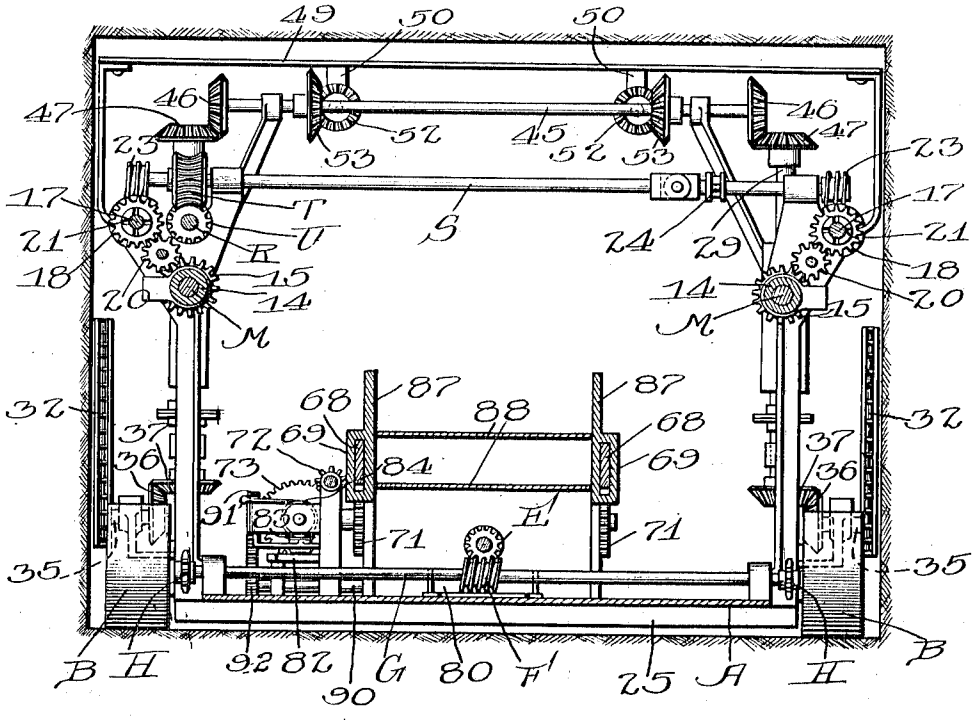
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7 SHEETS—SHEET 7.

Fig. 13.



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UNITED STATES PATENT OFFICE.

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COAL-MINING APPARATUS.

1,116,356. Specification of Letters Patent. Patented Nov. 3, 1914.

Application filed November 10, 1896. Serial No. 611,603.

To all whom it may concern:

Be it known that I, EDMUND C. MORGAN, a citizen of the United States, residing at Chicago, in the county of Cook and State of Illinois, have invented a new and useful Improvement in Coal-Mining Apparatus, of which the following is a specification.

This invention relates to apparatus for mining coal.

The object of the invention is to provide a novel, efficient and economical apparatus for mining coal.

The invention consists substantially in the construction, combination, relative location and arrangement, all as will be more fully hereinafter set forth, as indicated in the accompanying drawings and finally specifically pointed out in the appended claims.

Referring to the accompanying drawings and to the various views and reference signs appearing thereon—Figure 1 is a general view, partly in plan and partly in horizontal section, of an illustrative form of operative apparatus for mining coal embodying the principles of my invention. Fig. 2 is a vertical central longitudinal sectional view of the same, taken on the line 2, 2, Fig. 1. Fig. 3 is a view in end elevation and partially diagrammatically, illustrating the method of removing the pillars between adjacent or contiguous rooms. Fig. 4 is a detached detail view, in side elevation, illustrating an arrangement for automatically "snubbing" or enlarging the cut made by the cutter preparatory to blasting out the under-cut coal. Fig. 5 is a detached detail view in plan of the frame in which the chain cutter is mounted, showing said frame made in sections for convenience in moving the machine from one part of the mine to another. Fig. 6 is a detached detail view in side elevation, illustrating a slightly modified arrangement for loading the coal on the mine cars. Fig. 7 is a plan view of the construction and arrangement shown in Fig. 6. Fig. 8 is a diagram illustrating my improved system of mining. Fig. 9 is an enlarged general and partial plan view similar to Fig. 1. Fig. 9ª is a view in detail showing the gearing for moving the shovel carrying frame backward and forward. Fig. 10 is a top plan view on line 10—10 of Fig. 11. Fig. 11 is a sectional view on line 11—11 of Fig. 12. Fig. 12 is an end elevation on line 12—12 of Fig. 11, with parts removed. Fig. 13 is a transverse vertical section of the machine taken on line 13—13 of Fig. 9.

The same part is designated by the same reference sign wherever it occurs throughout the several views.

I will first describe the construction, function and mode of operation of my improved coal mining apparatus, particular reference being had to Figs. 1 and 2, wherein—

Reference sign A designates the framework upon which is mounted the several operative parts of the apparatus, as will more fully hereinafter appear. The framework should be of such form, size, proportion and arrangement as to properly accommodate the several parts of the apparatus. The framework A is mounted on suitable traction wheels, B, B, as shown, whereby the machine may be readily advanced to its work or retracted therefrom or may be transported from one part of the mine to another. These traction wheels may be positively driven in any suitable or convenient manner or by any suitably arranged mechanism adapted to such purpose, and I will presently describe more fully an illustrative arrangement for accomplishing this purpose.

Suitably mounted upon the framework of the machine is a motor, C, arranged and adapted to operate the several mechanisms hereinafter to be referred to, as will presently be more fully described. The motor, C, may be of any suitable or convenient type of motor, adapted to the purpose required. In the form shown and as merely illustrative of an operative means, the motor comprises an electric motor, the current being supplied thereto through a suitable electric conductor, D, as will be more fully explained hereinafter.

A gear, E, arranged to be driven by the motor is arranged to engage and drive a gear, F, mounted on a shaft, G, arranged to extend transversely across the machine, and which carries suitable gears, H, by which, through sprocket or other suitable form of gearing, J, the traction wheels, B, B, are driven, see particularly Figs. 1 and 10. The gearing J is shown between the shaft G and the traction wheels in Fig. 10. Any suitable, well known form or arrangement of clutch,

K, see Figs. 9 and 11 may be employed for throwing the driving gearing of the traction wheels into and out of operation at will, and this clutch may be controlled by a suitable operating lever K^1, which is suitably located so as to be readily accessible, as shown more clearly in Fig. 10. By suitably actuating or reversing the motor, the traction wheels may be driven in any desired direction to advance the machine to its work or to withdraw the same or to move the same from one part of the mine to another, and by suitably manipulating the clutch, K, the driving gearing for the traction wheels may be thrown into or out of action. It will be understood that by means of the traction wheels, the machine is only fed up to the point where the cutters, hereinafter to be described, are ready to begin to cut into the coal, for, obviously, the resistance offered to the cutter during the operation thereof is too great to be overcome by the traction wheels. When this point is reached, therefore, it becomes important and necessary to brace the machine against the resistance offered by the coal to the cutter, and to provide means for advancing the cutter into the coal. In order to accomplish this purpose, I mount upon the frame, A, in any suitable or convenient manner, a pair of screw rods, M, each being pivoted at one end thereof to a pair of arms, N, in toggle-joint fashion, each arm being in turn pivotally connected to an anchor shoe, O, the members of each pair of shoes, O, being, if desired, suitably serrated on their engaging faces, and respectively arranged to engage the floor and roof of the walls of the room, as clearly shown in Fig. 2. From this construction and arrangement it will be seen that when an endwise pressure is exerted upon the screw rods, M, in a direction away from the point where the cutter is operating, the toggle arms N will be operated to force the anchor shoes, O, away from each other and into engagement with the floor and roof of the room respectively, thereby securing and firmly anchoring the entire machine. If the pressure is continued to be exerted longitudinally of the screw rods, the machine is advanced or fed forward away from the anchor shoes and in a direction to advance the cutter into the coal. In practice, and when the anchor shoes are arranged to engage the floor and roof of the room, I prefer to employ two or more screw rods, and hence, also, two or more pairs of toggle arms, N, and shoes, O, for the reason that by suitably arranging one pair of these anchoring and feeding devices on one side of the machine and another pair on the opposite side, as clearly indicated in Fig. 1, I am enabled to straighten the machine in case its feed departs from a straight line. This can be easily accomplished by throwing the one or the other set of anchoring and feeding devices into or out of action, as occasion may require.

I will now describe a suitable and efficient construction and arrangement for exerting the pressure above-mentioned longitudinally upon the screw rods, M, whereby the machine is first anchored and then fed forward to advance the cutter to its work. In the particular form shown, I provide a gear, P, arranged to be driven from motor, C, and to engage and drive a train of gears, L, Q. The gear Q is mounted on to rotate with and adapted to drive a shaft R, suitably mounted in the frame of the machine. A shaft, S, is suitably mounted in the frame of the machine to extend transversely thereacross and carries a gear, T, arranged to engage a suitable gear, U, mounted on shaft, R. An internally threaded sleeve or nut, 14, is mounted on each screw rod, M. By rotating said nuts or sleeves in one direction or the other, the desired pressure is exerted upon the screw rods in one direction or the other to effect an anchoring of the machine and the feed thereof, or else, to effect a release of the machine. As the arrangement of gearing for rotating the nuts is the same for all the screw rods I will specifically describe the arrangement for only one screw rod. The nut 14 carries or has formed integrally therewith two gears, 15, 16. Upon a suitably and conveniently mounted short stub shaft 17 are mounted two gears, 18, 19, said gear 19 being of relatively large diameter and meshing directly with the gear 16 or nut 14, while gear 18 is of relatively small diameter and engages and drives gear 15 through an intermediate idler gear 20. From this construction it will be seen that when gear 19 is idle and gear 18 is acting, the sleeve 14 will be slowly rotated in one direction, namely in a direction to effect a longitudinal pressure on the screw rod M in a direction to cause the anchor shoes, O, to grip the roof and floor or side walls of the room and to effect a feeding of the machine forward, while if gear 18 is idle and gear 19 is acting, said sleeve 14 is more rapidly revolved in the opposite direction, and an endwise movement of the screw rod in the opposite direction is effected, thereby releasing the anchor shoes, O. Any suitable or well known form of clutch, 21, Figs. 1 and 11, may be employed to throw either gear 18 or 19 into or out of action at will. A gear, 22, mounted on shaft 17 is arranged to engage a gear 23 on shaft S, whereby the train of gearing above referred to is driven. By means of a suitably and conveniently arranged clutch, 24, the mechanism for actuating the anchoring and feeding means on one side or other of the machine may be thrown into or out of action at will. From the foregoing description it will be seen that

when the cutter is advanced to the limit of the feed screws, M, by suitably manipulating the clutch, 21, the said screws may be moved in the opposite direction to advance the anchoring shoes to a point closer to the machine, thereby securing a fresh grip when the feeding action may be repeated.

I will now describe the cutting mechanism and the means for actuating the same. In practice I prefer to use the usual sprocket chain cutters. Upon the front end of the framework I mount a cutter frame, 25, in such relation that the chain cutter, 26, mounted to operate thereon will operate in a horizontal plane to cut the floor kerf, as clearly indicated in Figs. 1, 2 and 11. The cutter frame 25 may be supported in any suitable manner, preferably by means of the bottom of the frame A, as shown more clearly in Fig. 11. Any of the usual or well known types of sprocket chain cutters employed in the art may be used. This chain cutter 26 is actuated from shaft R through a gear 27 mounted on said shaft R and arranged to engage and drive a gear, 28, mounted on a vertical shaft 29, suitably mounted in the framework, said vertical shaft carrying a sprocket gear, 30, arranged to engage and drive the chain 26. The shaft 29 may be thrown into or out of operation at will by means of any suitable, convenient or well known form of clutch, 31, carried by shaft R.

It will be observed that I arrange the horizontal cutter 26 to cut a kerf extending the entire width of the room and that as the machine advances farther and farther into the vein or wall of coal, the cutter cuts all the way across to form the floor for the room. In order to cut the side walls of the room at the same time, and in order to facilitate the breaking down of the coal, thereby after breaking down leaving the side walls smooth and regular to permit the machine to advance and also requiring small blasting charges, I provide the side cutters, 32, 33, arranged to operate in a vertical plane. In the form shown, and preferably, I employ chain cutters for cutting the side walls. A suitable frame, 34, is provided upon which the side cutters, 32, 33, operate. The side cutters are actuated in the following manner: A short horizontal shaft, indicated at 35, Figs. 2 and 10, carries a suitable sprocket at the outer end thereof upon which the side cutter chain 32 is mounted and at the inner end of said shaft is carried a gear, 36, arranged to engage a gear, 37, carried by shaft 29. From this construction it will be seen that when the shaft 29 is rotated the side cutter 32 is actuated. A similar arrangement is provided on the opposite side of the machine for actuating the side cutter, 33, except that in this case the vertical shaft 38, corresponding to shaft 29 is rotated by the movement of the horizontal chain cutter, 26, said chain cutter engaging a sprocket gear on said vertical shaft 38, and thereby rotating said shaft, and hence, through the engagement of gears, 39 and 40 effecting a rotation of the short horizontal shaft 40^a (see Fig. 10), corresponding to shaft 35, and which carries a sprocket upon which is mounted the side cutter 33.

In order to withdraw the cutters from the kerf in which they are operating, that is, when it is desirable or necessary, for instance, to withdraw the entire machine from the room in which it is operating, and also, for the purpose of facilitating the transportation of the machine from place to place or point to point, it is desirable to make provision for so collapsing the cutters that undue friction against the walls of the kerf in case of the horizontal cutter, or of the walls of the kerf and room in the case of the side cutters will not be opposed to the ready or easy withdrawal of the machine. In order to accomplish this purpose I construct the frames, 34 and 25, upon which the cutters operate, in detachable sections. I have shown in Fig. 5 an embodiment of this idea, as carried out in the case of the frame 25, upon which the horizontal cutter 26 operates, and while I have not shown the frames 34, for the side cutters, 32, 33 specifically and in the same degree of detail, it will be sufficiently clear from the specific description and illustration of frame 25 to enable persons skilled in the art to apply the same principles to said frames, 34. In Fig. 5 I have shown the frame 25 upon which the cutter 26 operates, as composed of three sections, 41, 42, 43, detachably bolted together, as shown at 44. By removing some of the links of the chain cutter in a manner well understood by persons skilled in the art, any one or more or all of the sections, 41, 42, 43 may be removed.

In the operation of mining coal, after the cutters have been advanced to the desired depth of cut, it has heretofore been the custom to withdraw the machine in order to effect a breaking down of the undercut body of coal. This necessitated an arresting of the action of the machine for a considerable time to withdraw it and again advance it to its work. I have made an arrangement wherein the withdrawal of the machine is unnecessary during the breaking down operation, and I will now describe the construction and arrangement wherein I attain the desired object. Suitably journaled in the framework of the machine is a shaft 45 arranged to extend transversely across the machine and carrying a gear, 46, arranged to mesh with and be driven from a gear, 47, carried by shaft 29. Through this gearing rotation is imparted to said shaft 45. By means of any ordinary or well known

form of clutch 48, the rotation of shaft 45 may be arrested or effected at will. A sheet metal plate 49, preferably extending entirely across the machine is journaled upon to swing about shaft 45, and carries depending arms 50, in which are mounted short shafts carrying at one end a socket, 51, and at the other end a gear, 52, arranged to be engaged and driven by a gear 53 mounted on shaft 45. From this construction it will be seen that the plate or shield 49 may swing about shaft 45 and the mesh of gears 52, 53 will always be maintained. A suitable and convenient form of boring or other type of tool, 54, is provided for forming the holes in which the blasting charge is placed, and which latter in the present exemplification of the invention constitutes the breaking down means for the coal. The shanks of the tools are arranged to be detachably secured in the sockets, 51, as by means of the pins, 55. From this construction it will be seen that when the machine is advanced to its work the augers or tools, 54, effect a boring of the holes for the breaking down means at the same time that the side and undercuts are made. When a sufficient depth of cut has been made and it is desired to break down the body of the undercut coal, the pins, 55, are removed, and without withdrawing the entire machine the boring or other form of tools, 54, are withdrawn by hand and in the holes formed thereby are placed the breaking down means. When the shanks of tools, 54, are detached from the sockets, 51, the entire sheet or shield, 49, is permitted to rock about shaft 45 until the surface of said shield is presented toward the holes in which the blasting charges are placed. By this arrangement it will be seen that the gearing which drives the boring tools and other parts of the machine is protected from the effects of the explosion of the blasting charges. It will be understood, of course, that the shield or plate 49 is supported a sufficient distance back from the front edge of the frame work, to enable said plate or shield to perform its functions without withdrawing the side and under-cutting cutters. It will be seen that by cutting the coal on three sides a comparatively small blasting charge is all that is required to effect a blasting down of the coal and, as above explained, this blasting may be effected without the loss of time incident to the withdrawal of the entire machine, as it is a matter of but a moment to detach the tools 54 and withdraw the same.

In the operation of mining machines, as heretofore carried out and whereas provision is not made for automatically removing the coal when broken down, and while the machine is still withdrawn from the cut, operators remove the broken down coal which has fallen upon the floor of the room, either by hand or else manually by shovels before the machine can again be advanced to its work. This has consumed valuable time, which might otherwise be employed in effecting another cut preparatory to making another breaking down. I have devised an arrangement wherein this time may be saved and wherein instead of removing the broken down coal by hand this work may be accomplished automatically and without in the least interfering with the continuous action of the machine in making the next cut. I will now describe my construction and arrangement for securing these desirable ends and objects:—The frame, 25, upon which the cutter 26 operates, is arranged in the form of a platform, as clearly indicated in the drawing, and receives the coal which is detached by the breaking down operation. As this platform is carried by the machine, it will be readily seen that no obstruction is offered impeding the progress of the machine as it is advanced to the next cut. The detached coal carried by the platform, 25, is removed therefrom in the following manner:—Mounted upon frame A of the machine is a supplemental frame, 57, which I shall hereinafter designate the carrier frame. Suitably mounted on the carrier frame 57 at the front end thereof is a shovel, 58, having the toe thereof presented forwardly and arranged to gather up the coal from the platform 25 and remove the same. The shovel may be operated in any suitable manner, but a simple and efficient means for accomplishing this end will now be described. In the form shown, I pivotally mount the shovel, 58 on horizontal gudgeons or pintles or the like, as indicated at 59, whereby said shovel may be rocked about a horizontal axis, as indicated in dotted lines, Figs. 2 and 11. By this construction it will be seen that when the shovel has scooped up a quantity of coal, as will more fully appear hereinafter, such coal is dumped from the shovel.

I will now describe means for tilting the shovel, particular reference being had to Figs. 1 and 10. One of the gears of the train of gears, L is mounted on a short shaft, 60, suitably journaled in the frame-work. This short shaft 60 is flexibly connected in any ordinary or well known manner with a hollow shaft 61, as indicated at 62 and is provided with suitable bearings 62^a (see Fig. 10), preferably secured to the trough or way 87. The flexible connection 62 permitting said trough or way to turn upon its pivot 56, as hereinafter set forth. Arranged within the hollow shaft to slide longitudinally therein but adapted to rotate therewith is a shaft, 63, carrying loosely upon the forward end thereof a pair of oppositely faced bevel gears 64, 65, either of which may be clutched to rotate with the said shaft at will in any suitable or well

known manner, as by means of an ordinary form of clutch, 66. A bevel gear, 67, is arranged to intermesh with and be driven by the gears, 64, 65. This gear, 67, is mounted on and rotates with the axle or pivot, 59, of the shovel. From this construction it will be seen that when one or the other gears 64, 65, is clutched to rotate with shaft 63, the shovel is tilted or swung about its pivots or axle, as above explained.

It is important that the shovel be advanced and retracted independently of the machine in order that the detached coal may be scooped up. I will now describe an operative form of means for accomplishing this purpose. The pintles or gudgeons 59, upon which the shovel is mounted and by which it is supported are mounted in bars, 68, mounted to slide longitudinally in guides 69 in supplemental frame, 57. These bars are provided with rack teeth, as clearly indicated in dotted lines in Figs. 2 and 11. Upon shaft 70, suitably mounted in the supplemental frame, 57 are mounted gears 71 arranged to intermesh with the gear teeth on rack bars, 68. From this construction it will be seen that when shaft 70 is rotated in one direction or the other, the rack bars 68 may be slid forward or back, longitudinally carrying with them the shovel, and hence it will be seen that the shovel will be advanced to scoop up the coal from the platform, 25, and then withdrawn to the point where the dumping is to be made. The longitudinal movement of shaft 63 with respect to the hollow shaft permits the gearing for tilting the shovel to remain in mesh during such movement of the shovel, as will be readily understood.

I will now describe a convenient arrangement of gearing for effecting a rotation of shaft 70, in either direction at will reference being had to Fig. 10. The hollow shaft 61 is provided with a suitable gear, 72, arranged to engage and drive a gear, 73, mounted upon a shaft 74, suitably journaled in the supplemental frame, 57. Loosely mounted on shaft 74 are the oppositely arranged bevel gears, 75, 76. A suitable clutch, 77, of ordinary or usual construction, may be employed to engage either of the said gears, 75, 76, with shaft 74. A bevel gear, 78, is mounted on shaft 70 and is arranged to intermesh with the gear, 75, 76. From this construction it will be seen that the shaft 70 may be revolved in either direction at will, thus advancing the shovel to scoop up the coal or retracting it after the coal is scooped up to the point where the dumping is to be made.

It is desirable that the shovel shall be mounted so as to move transversely across the machine in order that the entire width of the room may be commanded thereby, to the end that all the coal detached or broken down may be removed and loaded in the mine cars. A suitable and efficient means for causing the desired transverse movement will now be described. In the particular form shown I pivotally mount the supplemental frame, 57, to swing upon a vertical step or pivot, 56. A suitable bearing, 79, carried by the supplemental or carrier frame is arranged to engage a bearing flange, 80, carried by the main frame, (see Figs. 1, 9 and 11) whereby the thrust of the shovel advancing mechanism is resisted, and the supplemental frame is guided in its swinging movements. For the same purpose I arrange a bearing, 81, upon the main frame, upon which the forward end of the supplemental frame bears, in order to steady and guide the same in its movements. If desired, and as shown, the bearings, 79 and 81, may be anti-friction rollers, in order to reduce friction.

I will now describe an arrangement of gearing for effecting a swinging movement of the supplemental frame upon the main frame and above the upright pivot 56. Reference sign, 82, designates a segment rack bar, suitably mounted in the supplemental frame 57, and arranged to be engaged by a gear, 83, and which is also arranged to intermesh with gears, 84, 85, loosely mounted on shaft 74. Any ordinary or suitable form of clutch indicated at 86, may serve to couple either of said gears, 84, 85, to the shaft 74, whereby the gear 83 may be rotated in either direction at will, and hence, the supplemental frame 57 may be swung or moved in either direction at will, thereby enabling the shovel 58 to command the entire area of the room.

In order to obtain the highest degree of efficiency and speed in mining coal and in the operation of the apparatus as above described, it is important that the work of loading the coal into the mine cars be carried on automatically, and if desired concurrently and simultaneously with the operation of the machine. In the arrangement, as above described, this can be most conveniently and expeditiously effected by arranging the shovel to deliver the coal therefrom to the mine car, and a suitable and efficient means for accomplishing this end will now be described. In the arrangement shown in Figs. 1, 2 and 11, I mount in the supplemental frame, 57, a trough or way, 87, upwardly inclined from the forward end thereof, said forward end being so relatively arranged with respect to the shovel as to receive the coal therefrom when said shovel is tilted as above explained, and the rear end of said trough or chute being arranged in suitable position to deliver into a mine car, as clearly shown in Figs. 2 and 11. In the chute or trough, 87, I mount a suitable form of carrier. As illustrative of

the idea I have shown an endless belt, band or carrier, 88, arranged upon and to be driven by shafts, 89, 90, respectively arranged at the upper and lower ends of the chute or trough. The shaft, 90, is rotated through the engagement of gear 91, (see Fig. 10) mounted thereon with a gear, 92, mounted upon a shaft 93, suitably mounted in the supplemental frame and arranged to receive rotation through the engagement of gears, 94, 95, respectively, arranged on said shaft 93 and on shaft 74. A suitable or any ordinary form of clutch, 96 may be employed to clutch or unclutch at will said gear 95 to or from said shaft 74, whereby the actuation of the carrier belt, 88, may be started or arrested at will. In Fig. 6 I have shown a modified form and arrangement for effecting a loading of the coal from the shovel to the mine car. In this form the chute or way, 87^a, is not arranged upon an incline, but the shovel 58^a is arranged to slide longitudinally with respect to said chute, as indicated by dotted lines in said figure. Suitably mounted in the supplemental frame is a rack bar, 97, having pivotally mounted upon the forward end thereof an ejector, 98. Any suitable or convenient arrangement of gearing for positively swinging said ejector at will may be provided, but as my invention does not reside in the specific form or arrangement of such gearing, I have not deemed it necessary to specifically show any gearing for this purpose. The rack bar, 97, is mounted to move in a direction opposite to that in which the bar 68^a moves. A convenient arrangement for accomplishing this purpose is to drive both rack bars, 68^a and 97, from the same drive shaft 70^a, and which shaft 70^a corresponds with the shaft 70 in Figs. 2 and 11 by mounting said rack bars on opposite sides of said shaft, as shown. The operation of this form of arrangement will be clearly understood from the foregoing description. Suppose the shovel, 58^a, has been advanced to scoop up a load of coal from platform 25, and has then been retracted to the point shown in full lines in Fig. 6. The ejector, 98, is then lowered to the position shown in said Fig. 6, in full lines, and the gear 71^a is actuated to again advance the shovel to scoop up another load of coal. Simultaneously with such movement the rack bar 97 is moved in the opposite direction. The apron 98 not only prevents the coal from being advanced with the shovel by acting as a stop or scraper, but also sweeps the coal rearwardly through the chute and into the mine car, 100, as clearly shown. In this arrangement the shovel is open ended and the coal is loaded onto the car through one side thereof, as clearly indicated. This arrangement is particularly well adapted for operation in thin or shallow veins of coal where a particularly low framework is necessary.

In the case of a mining machine wherein the undercut is made with a chain cutter, it is desirable to snub off the lower corner of the wall of the undercut coal, in order that when the breaking down operation is effected the coal may have sufficient room to fall and properly disintegrate. Heretofore this snubbing has been performed by hand. In such case it was necessary to first withdraw the machine from the cut in order to give proper access to the wall of coal. I have devised an arrangement wherein this snubbing may be accomplished automatically and during the operation of the apparatus. In carrying my invention into practical operation, I provide two or more snubbing cutters, 101, adapted to be detachably bolted to the front edge of the shovel, 58. When the proper time to effect a snubbing of the wall of coal is reached in the operation of the machine, an attendant bolts the snubbing cutters, 101, in position upon the shovel to project forwardly therefrom. The shovel is then advanced by the gears 71 and the snubbing is effected as clearly indicated in Fig. 4 and without withdrawing the machine from the cut. After the proper snubbing has been accomplished, the shovel is withdrawn in a manner which will be readily understood from the foregoing description and the snubbing cutters, 101, detached and slid back into the floor of the shovel, as clearly indicated in Figs 1 and 2. It will be understood that the snubbing requires the expenditure of but a small amount of power, which can be readily and easily applied through the shovel advancing mechanism. The means for snubbing the coal may be used to break down as much of the coal above the undercut as may be desired, and therefore, the snubbing means may also constitute breaking down means for the coal.

In case I employ an electric motor, C, for operating the several parts of the machine, as above described, and such a form of motor, for many practical reasons, I prefer to use, it becomes a matter of importance to supply the operating current thereto in a manner that will permit of the advancement of the machine farther and farther into the bed of coal. As an illustrative form of operative means for accomplishing the desired object, I have shown a suitable conductor, D, leading from the motor to a reel, 102, suitably mounted to rotate upon the main frame. A flexible conductor, 103, is arranged to be wound upon the reel, 102, reference being had to Fig. 2, or to be unwound therefrom, as the case may be, and electrical connection in any suitable or well known manner, as will be readily understood by persons skilled in the art, may be made from conductor, 103, to reel 102, and

from said reel to conductor, D, whereby current may be supplied to the motor, C. Of course, it will be understood that the conductors, 103 and D are of the ordinary type of insulated conductors, whereby short-circuiting is prevented. By providing means for winding or unwinding the conductor 103 from reel 102 synchronously with the advancing or retracting movements of the machine, the current is supplied to the motor for actuating the several parts of the apparatus, as above-explained. The reel 102 may be conveniently rotated in the following manner: A gear, 104, mounted on the axle of the reel engages and is driven by a worm, 105, mounted on shaft R. From this construction and arrangement it will be readily seen that when the motor C is actuated in one direction or the other, the conductor, 103 is correspondingly reeled up or paid out accordingly.

In order to carry out the general system of removing the coal from the room as it is mined and to accomplish such removal automatically, it is desirable to make provision for the automatic withdrawal of the loaded cars and the coincident advancement of empty cars from and to the point where the coal is delivered by the delivery devices above described. As an illustrative practical arrangement for accomplishing the desired object, I have shown a system of tracks, 150, upon which the cars, 100, run. The tracks are shown as arranged after the fashion of a turnout in a street car line, upon one branch of which the empty cars are run, and upon the other part of which the loaded cars are run, it being understood that in the general operation of a mining system a mine locomotive will be employed to run a train of empty cars down the mine tracks to the particular room in which the machine is at work and thence onto the side or turnout track and then remove from the other branch of the side or turnout track the loaded cars. It is not desirable, however, to depend upon the mine locomotive to remove the loaded cars from the point where the coal is loaded thereon, nor to advance the next succeeding empty car into place to be loaded. I will now describe an automatic arrangement wherein as fast as the cars are loaded, they are temporarily removed to one side of the switch or turnout and an empty car is advanced to take its place. Referring to Fig. 1, reference sign 106 designates an endless belt or cable suitably mounted upon guide pulleys 107, 108, 109, 110, conveniently arranged. The pulleys 107 and 110 are mounted on an arm or bar 111, adapted to be detachably connected in any suitable manner to any suitable support, such as a portion of the frame, as indicated by the connections 112. The bar 111 is arranged to extend transversely across the room and the pulley 107 is mounted on one end thereof and pulley 110 is mounted on the opposite end thereof. In similar manner the pulleys 108 and 109 are mounted in the respective ends of a bar 113 arranged to extend transversely across the room. In order that the bars 111 and 113 may not obstruct or interfere with the movement of the cars upon the tracks, 105, I preferably arrange said bars underneath the tracks, as shown. A coupling link or connection, 114, having a hook shaped extremity is adapted to be detachably connected at one end to a car, and at the opposite end is adapted to be clamped to the belt or cable, 106. An attendant may readily attach or detach the connection 114 to or from the car or cable, as occasion may require. From the arrangement as above described, it will be readily seen that one run or leg of the cable is arranged to extend alongside of or in the direction of the tracks of one side of the turnout, and that another run or leg of the cable is arranged to extend in the direction of the tracks on the other side of the turnout, and that since the cable is arranged to form a loop, the one leg or run is moved in one direction and the other leg or run moves in the opposite direction and therefore, if, as fast as the cars are loaded, they are connected to one of the runs above-mentioned and an empty car is connected to the other run of the cable, a removal of the loaded car and an advancement of the empty car is effected when the cable is actuated. The cable may be actuated in any suitable or convenient manner. I have shown as illustrative of the idea involved an arrangement of gearing for accomplishing the desired purpose, wherein I mount a gear upon the axle of one of the cable guide wheels say, for instance, the axle of pulley 110, and arranged to be engaged and driven by gear 116 mounted on a shaft 117, driven through suitable gearing 118 from the motor axle. Any suitable or ordinary clutch, 119, may be employed to control the rotation of said shaft. From the foregoing description it will be seen that I make provision for the removal of the cars as fast as they are loaded and the advancement of the empty cars into position to be loaded. It will be understood that as fast as the machine advances into the bed of coal, the tracks must be lengthened. This is mentioned, although it is a matter of common knowledge in the art, for the reason that as fast as the track is lengthened, just so fast can the bar, 113, be advanced to proper relative position with reference to bar 111. Of course, it will be understood that the machine is not being advanced during the operation of the loading mechanism.

In the practical operation of my invention it is important to form "rooms" par-

allel with each other and a distance apart about equal to the width of the rooms, thus leaving intervening walls or pillars of coal of substantially the same thickness as the width of the room as a support for the roof. After the particular portion of the mine being worked is exhausted, it is desirable to mine the coal forming the pillars. In such case, in the use of my apparatus, as above explained, it is only necessary to undercut the pillars, as the side cuts have already been made. I therefore omit the side cutters 32 and the frames 34 on which said cutters are mounted and bolt or otherwise detachably secure to the main frame in place thereof the side plates or casings, 120, as clearly indicated in Fig. 3. The function of these side plates or casings is to retain the coal forming the pillar, when detached by a blast after being undercut, whereby such blasted coal is prevented from being strewn over the adjacent rooms. In other respects, the operation of the apparatus continues substantially in the manner as above explained.

As has already been described, the frame 25 upon which the under cutter or kerf cutter operates, is constructed in detachable sections, and with this structure it will be manifest that if desired the cutter 26 may be removed as well as the frame 25. When thus removed the cutters 101 may be employed for performing the under cutting or kerf cutting operation, as well as the breaking down operation, and this may be accomplished by reciprocating the support upon which the cutters are mounted, and also moving the cutter support in a vertical plane about the horizontal pivot of their support.

From the foregoing description, taken in connection with the drawings, the operation of the machine will be fully and clearly understood by persons skilled in the art.

I do not herein claim any of the subjects-matter specifically claimed in my application No. 210,174, filed May 28, 1904, or application No. 293,004, filed December 22, 1905, or application No. 607,753, filed February 10, 1911.

I have herein shown a mining mechanism together with means for receiving and taking up the coal that is broken down during the mining operation and conveying it away from the place where it falls; the mechanism herein shown also being intended to carry the broken down coal to a vehicle such as a mine car, for taking it out of the mine. But the specific features of construction and mode of operation incident to the particular devices for receiving, picking up and conveying away the coal I do not herein claim; preferring to have the claims herein relate to the devices which pertain to mining, and to the combination with a mining machine capable of performing the functions of that herein described, of a receiving and carrying away mechanism for clearing away the broken down material coming within the claims herein.

The novel and patentable features of structure which are incident to the specific form of mechanism for picking up the coal and carrying it away I have made the subject-matter of claims in my aforesaid application, Serial No. 607,753, filed February 10, 1911.

Nor do I herein present specific claims for a mining mechanism combined with means for taking away the mined coal comprising a conveying apparatus, which is situated directly below the mining mechanism, having presented claims for the novel features therefor in my aforesaid application No. 293,004, filed December 22, 1905. And, again, I have herein illustrated two forms of devices for getting down the loosened coal, one being the cutters at 101 adapted to be thrust against the coal by mechanical devices connected with the power mechanism, and the other being the rotary drills for forming holes that can be used in the way now well known for getting down coal in loosened form; while in said other applications No. 210,174, of May 28, 1904, and 293,004, filed December 22, 1905, I have shown and described, and presented specific claims for breaking down mechanisms of the sort known to the mining engineer as "pick" machines, these being devices capable of giving rapid, powerful, percussive blows produced by one of several well known agencies, and, under many circumstances, preferable to the breaking down means herein shown and described because of their wider range of efficiency, the possibility to have them operate simultaneously with the conveying mechanism which takes away the broken down material as fast as it is dislodged by the pick mechanism, and their susceptibility of being mounted in such way as to have not only a horizontal and a vertical adjustment, but so that they can be carried on inclined lines relatively to the vertical and the horizontal.

In order that the invention might be fully understood, the details of an embodiment thereof have been thus specifically described, but

What I claim is:

1. In a mining apparatus, an undercutting cutter, means for actuating the same, a hinged shield carrying a socket, gearing for rotating said socket, and having a tool adapted to be detachably connected to said socket, whereby said tool may be withdrawn without withdrawing said cutter; as and for the purpose set forth.

2. In a mining machine, a framework, an

undercutting cutter, and side cutters arranged to cut the side walls of the cut made by the undercutting cutter and a boring tool arranged to bore the blast holes, in combination with a shield pivotally mounted on said framework and arranged to be received in front of the blast holes when a blast is made; as and for the purpose set forth.

3. In a mining apparatus, a framework, an undercutting cutter and side cutters arranged to cut the side walls of the cut made by the undercutting cutter, and means for actuating the same, a boring tool, means for detachably connecting said boring tool with the actuating means of said cutters whereby said boring tool may be withdrawn without withdrawing said cutters, in combination with a shield pivotally mounted on said framework and adapted to be received in front of the holes formed by said boring tool; as and for the purpose set forth.

4. In a mining apparatus, an undercutting cutter, a driving shaft therefor, a transversely arranged shaft arranged to be driven therefrom, a shield pivotally mounted on said transverse shaft, boring tools, gearing for actuating said boring tools from said transverse shaft, and means for detachably connecting said boring tools with their actuating gearing; as and for the purpose set forth.

5. In a mining apparatus, an undercutting cutter, a driving shaft therefor, a transverse shaft arranged to be driven by said driving shaft, a protecting shield pivotally mounted on said transverse shaft and carrying sockets, gearing for rotating said sockets from said transverse shafts, and boring tools adapted to be detachably connected to said sockets; as and for the purpose set forth.

6. In a mining apparatus, means for removing the wall or pillar separating adjacent rooms, comprising a machine carrying a chain cutter at the front end thereof and plates or casings mounted at the sides of said cutter and arranged to confine the coal blasted from said wall or pillar; as and for the purpose set forth.

7. In a mining apparatus, a main frame, coal cutting and removing devices carried by said main frame, feed screws mounted on the opposite sides of said main frame, a pair of toggle arms connected to each of said feed screws, clamping jaws carried by said pairs of arms and respectively arranged to engage opposite walls of the room and means for actuating said feed screws endwise, whereby the main frame is fed; as and for the purpose set forth.

8. In a mining machine, a framework, cutters mounted thereon on opposite sides and at the front end thereof and arranged to project in advance of said framework and operating in vertical planes, in combination with an under-cutting cutter also mounted on the front end and projecting in advance of said framework and arranged to operate in an horizontal plane to undercut the body of coal between the vertical kerfs made by the side cutters, means for advancing said framework and means for snubbing the kerf made by the undercutting cutters, as and for the purpose set forth.

9. In a mining machine, a framework, a horizontally arranged cutter mounted on the front end thereof and operating in advance of said framework to undercut the body of coal, a boring tool, detachably mounted on said framework above said cutter and projecting forwardly from the front end of said framework, gearing for operating said boring tool, in combination with a shield pivotally mounted on said framework in advance of said gearing, whereby said shield may be moved into or out of position to protect said gearing when a blast is made, as and for the purpose set forth.

10. In a mining machine, a framework, vertically arranged cutters mounted on opposite sides of said framework at the front end thereof, and a horizontally arranged cutter also mounted on said framework at the front end thereof, said cutters arranged to operate in advance of said framework, said horizontal cutter undercutting the body of coal between the kerfs made by said vertical side cutters, in combination with a platform carried by the front end of said framework and arranged to receive the coal when blasted from between the cuts made by said several cutters without the withdrawal of said cutters from their kerfs, and means for actuating said cutters and advancing said framework, as and for the purpose set forth.

11. In a mining machine, a framework, cutters mounted on opposite sides of the front end thereof and operating in a vertical plane in advance of said framework, a horizontally arranged platform also carried by the front end of said framework, a cutter arranged around the edge of said platform and operating in advance thereof to undercut the body of coal between the kerfs made by said side cutters, boring tools also carried by said framework for forming blast holes in the body of coal, means for actuating said several cutters and tools, and means for advancing said framework, whereby the body of coal blasted from between the kerfs made by said cutters may be received upon said platform, as and for the purpose set forth.

12. In a mining machine, a framework, cutters mounted on opposite sides of the front end thereof and operating in a vertical plane in advance of said framework, a horizontally arranged platform carried by said

framework and projecting forwardly from the front end thereof, a cutter arranged to operate in advance of the front edge of said platform to undercut the body of coal between the vertical kerfs made by said side cutters, boring tools mounted on said framework and projecting forwardly from the front end thereof above said horizontal cutter for forming blast holes, means for actuating said several tools and cutters and advancing said framework whereby the coal blasted from between the kerfs made by said cutters is received upon said platform without withdrawing said cutters from their kerfs, and means also mounted on said framework for removing the blasted coal from said platform, as and for the purpose set forth.

13. In a mining machine, a framework, cutters mounted on opposite sides of the front end thereof and operating in a vertical plane in advance of said framework, a horizontally arranged platform carried by said framework and projecting forwardly from the front end thereof, a cutter mounted on said platform and arranged to operate in advance of the front edge thereof to undercut the body of coal between the kerfs made by said side cutters, and boring tools also carried by said framework for forming blast holes above said undercut, whereby when the coal is blasted it is received upon said platform without withdrawing said cutters from their kerfs, in combination with snubbing cutters carried by said framework and arranged to snub the undercut body of coal, and means for actuating said snubbing cutters, as and for the purpose set forth.

14. In a mining apparatus, the combination of an endless cutter, arranged to undercut the coal to be mined, a frame upon which said cutter is carried, said frame comprising detachable sections, endless side cutters, and frames for carrying said side cutters, the last said frames comprising detachable sections.

15. A mining machine, embodying means for undercutting the coal, and receiving means adapted to project into the kerf, and means to convey away the broken down coal.

16. A mining machine, embodying means for undercutting the coal, and a receiving means adapted to extend into the kerf made by the under-cutter to receive the coal when it is broken down, and means for conveying the coal away.

17. A mining machine, embodying means for under-cutting the coal, a platform adapted to extend into the under-cut to receive the coal when broken down, and means associated with the platform for conveying the coal away therefrom.

18. In a mining machine, the combination of means for under-cutting the coal, means for forming a cut or incision in the coal above the under-cut to facilitate the breaking down of the coal, and means arranged to receive the coal when broken down, and means to convey it away.

19. In mining apparatus, the combination with cutting mechanism, of devices for boring holes in the breast wall of a mine preparatory to blasting, and a shield in an upright position in front of said holes for protection while blasting.

20. In mining apparatus, the combination with cutting mechanism, of means for boring holes preparatory to blasting, and a hinged shield associated with said boring means and capable of being swung into position in front of the holes for protection while blasting.

21. In mining apparatus, the combination with cutting mechanism, of means for actuating the same, a boring tool, means for detachably connecting said boring tool with said actuating means, and a pivotally mounted shield capable of being turned to a position in front of the holes formed by said boring tool.

22. The combination with a mining machine, of bracing mechanism, two longitudinal screw rods between said bracing mechanism and said machine, one at or near each side of said machine, and means connected to said screw rods to effect the feeding forward of the machine at both sides simultaneously or at either side alone to effect the forward movement of the machine in a straight line or in a curve.

23. A mining machine comprising means for making a cut across the wall of a mine chamber, means arranged to break down the section severed, and a device in position to receive the material as it is broken down.

24. A mining machine comprising a cutting mechanism for making a cut across the wall of a mine chamber, breaking means arranged to follow the cutting mechanism to break down the section severed, and loading means connected with the cutting mechanism and breaking means.

25. A mining machine comprising cutting means to make a cut across the wall of a mine chamber, breaking means following said cutting means, and loading apparatus arranged to extend into a kerf at the base of the wall and thereby receive the material as it is broken down.

26. A mining machine comprising cutting means for making a cut across the wall of a mine chamber, simultaneously operable breaking means following the path of the cutting means to break down the coal, and loading means connected with said cutting means and breaking means to move therewith.

27. In a mining machine, the combination

with cutting mechanism, of apparatus for boring one or more holes preparatory to blasting, means for slowly feeding forward said cutting mechanism, apparatus for removing and conveying away the material broken down, and connections for operating all of the aforesaid parts from a single source of power.

28. The combination with a chain cutter, of a platform within the boundary of said chain cutter, means for operating said chain cutter, and loading apparatus for removing the material broken down onto said platform.

29. The combination with an undercutter, of the platform within the boundary of said undercutter, means for operating said undercutter, and apparatus for scooping up the material from said platform and conveying it away.

30. In a mining machine, the combination with an undercutter and side cutters, of a motor, gearing connected between said motor and said cutters to effect simultaneous operation of the latter, loading apparatus for taking up material broken down and conveying it away, and connections between said motor and said loading apparatus to effect the operation of said loading apparatus while said cutters are operating.

In witness whereof I have hereunto set my hand this 7th day of November, 1896.

EDMUND C. MORGAN.

Witnesses:

S. E. DARBY,

M. I. CAVANAGH.