Dec. 2, 1930. E. C. MORGAN 1,783,443

MINING AND LOADING MACHINE

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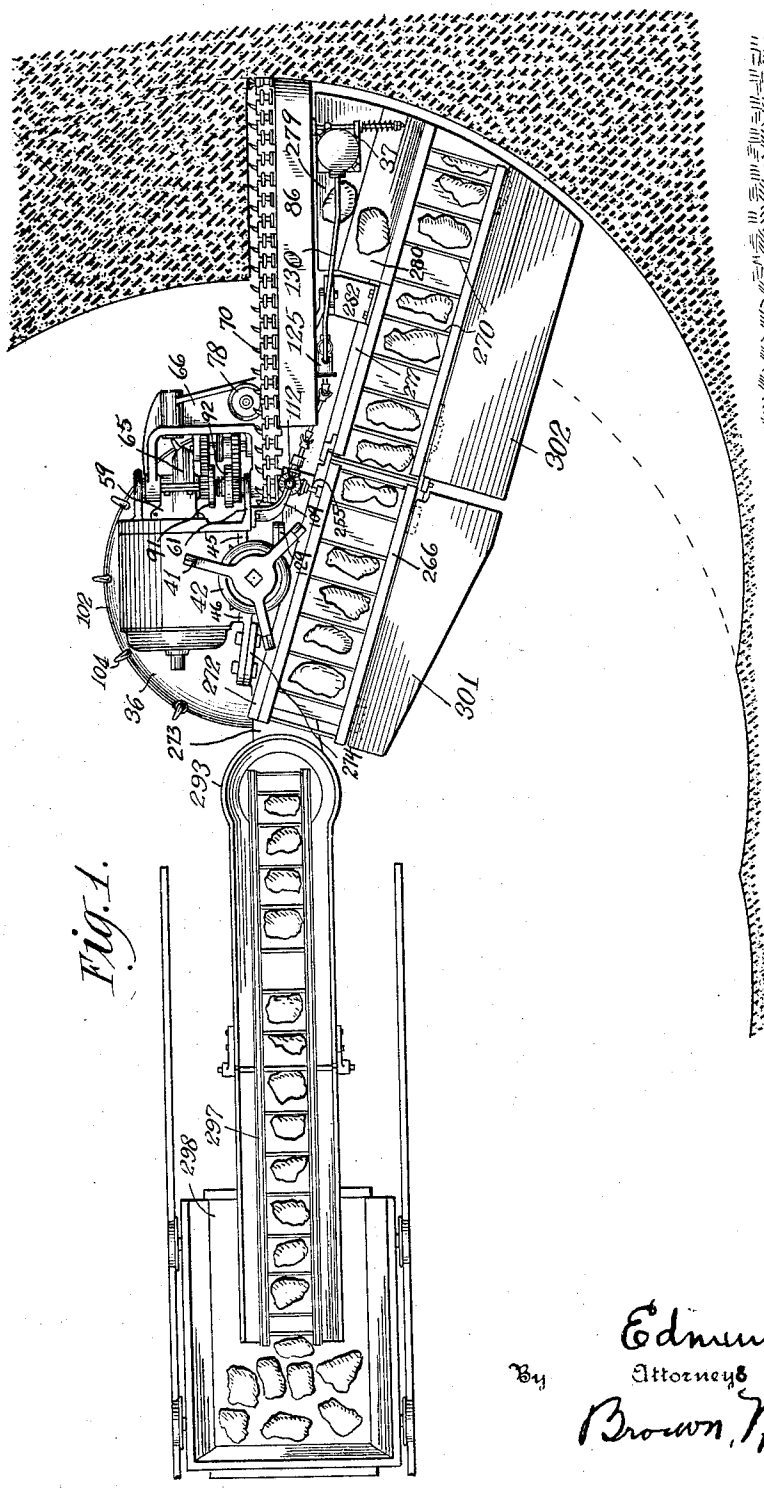


Fig. 1.

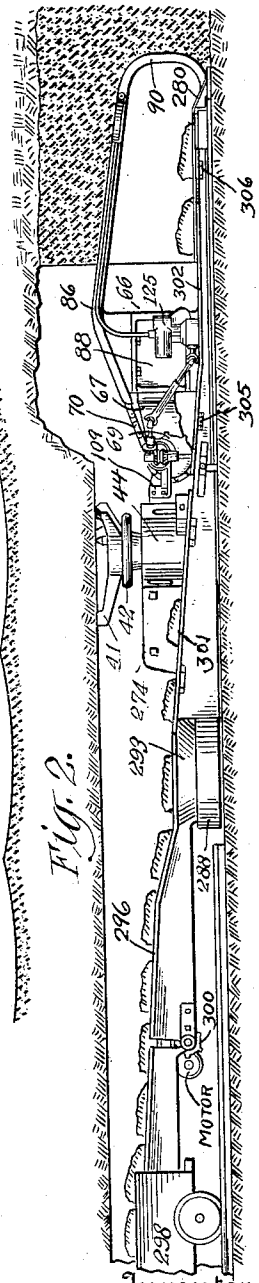


Fig. 2.

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MINING AND LOADING MACHINE

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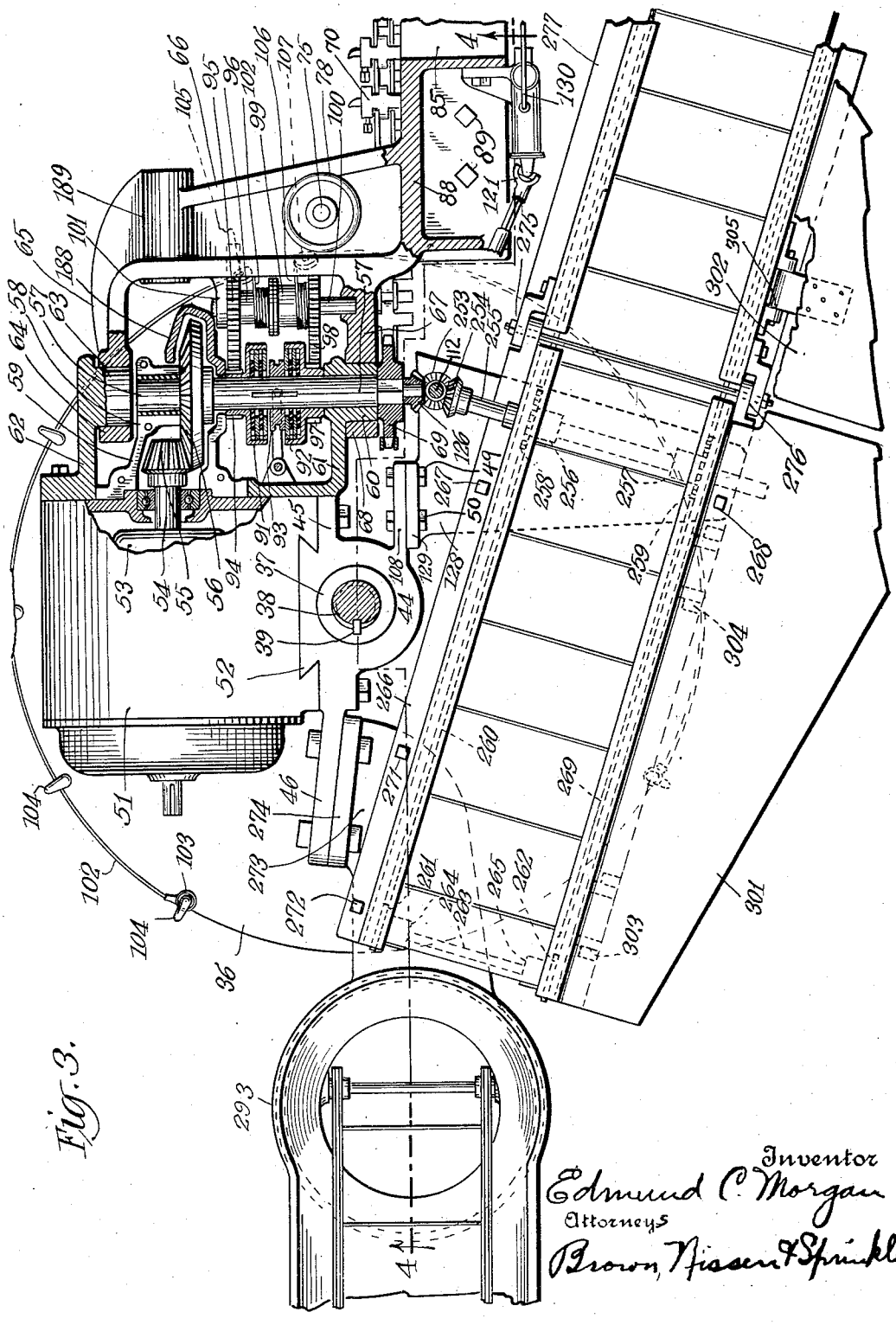


Fig. 3.

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MINING AND LOADING MACHINE

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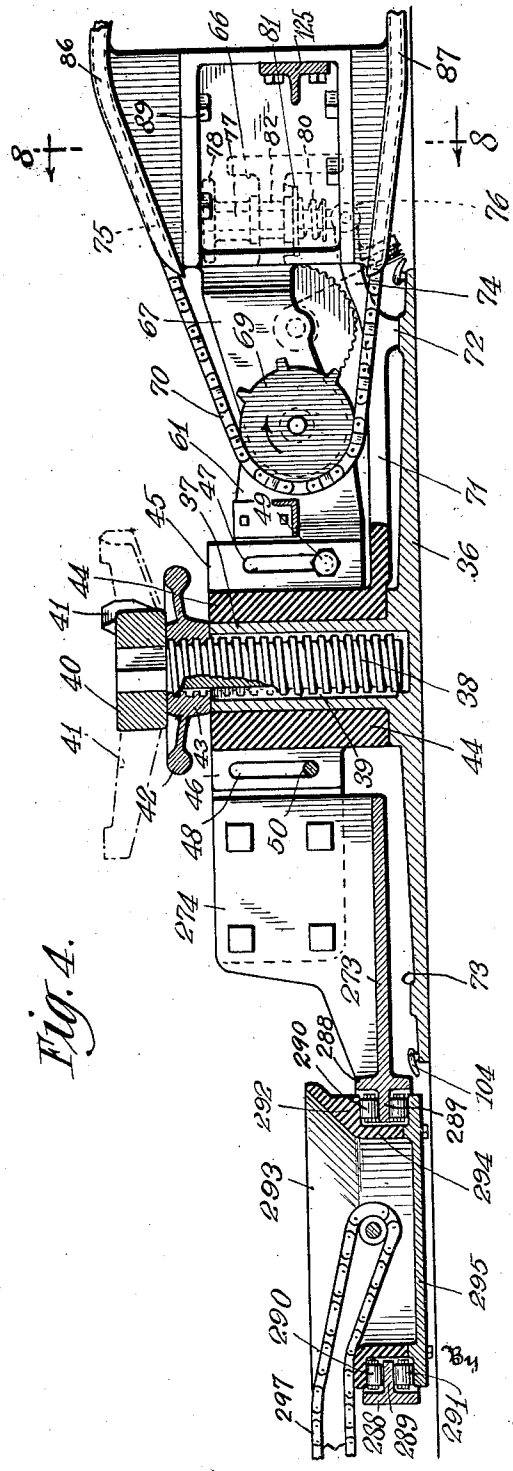


Fig. 4.

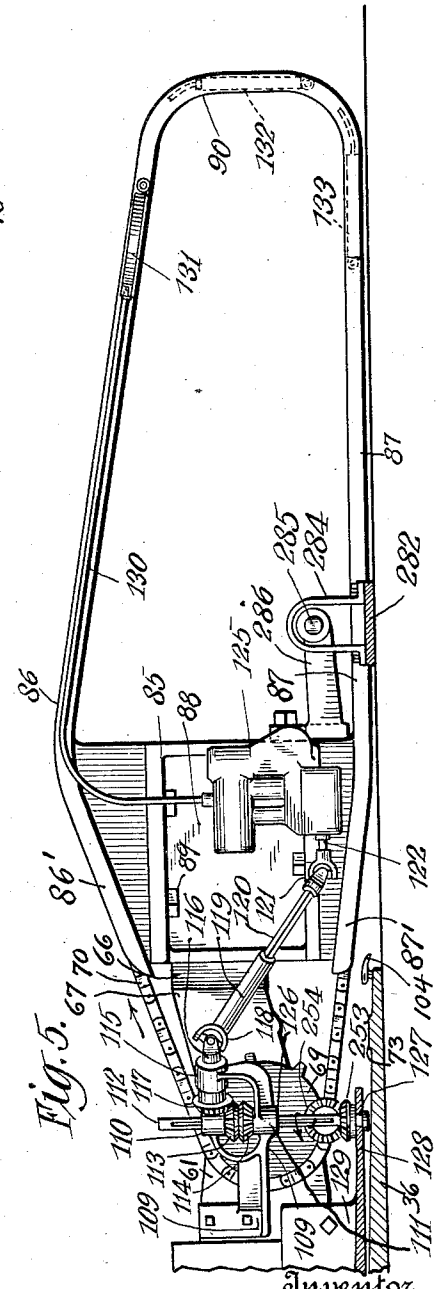


Fig. 5.

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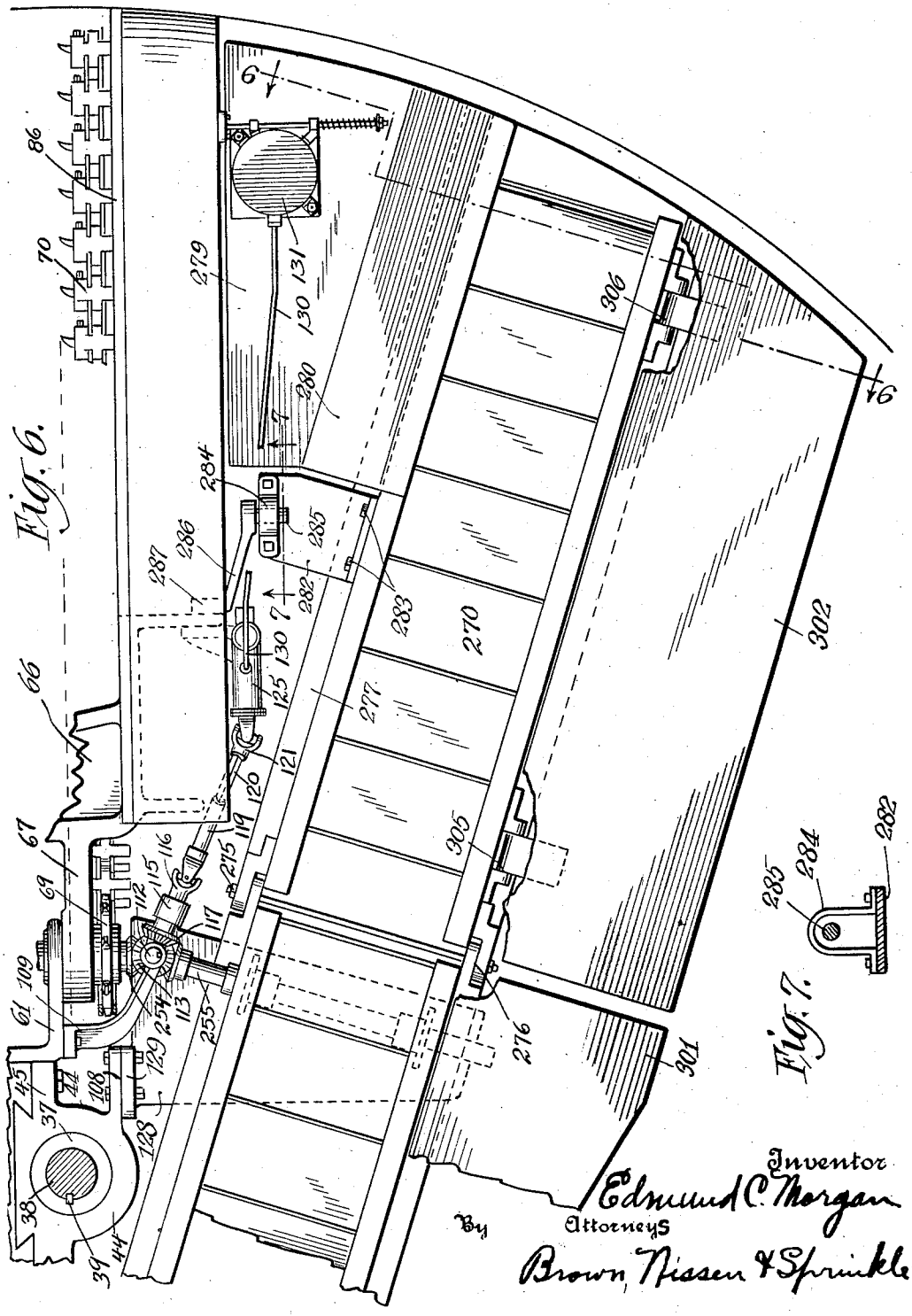


Fig. 6.

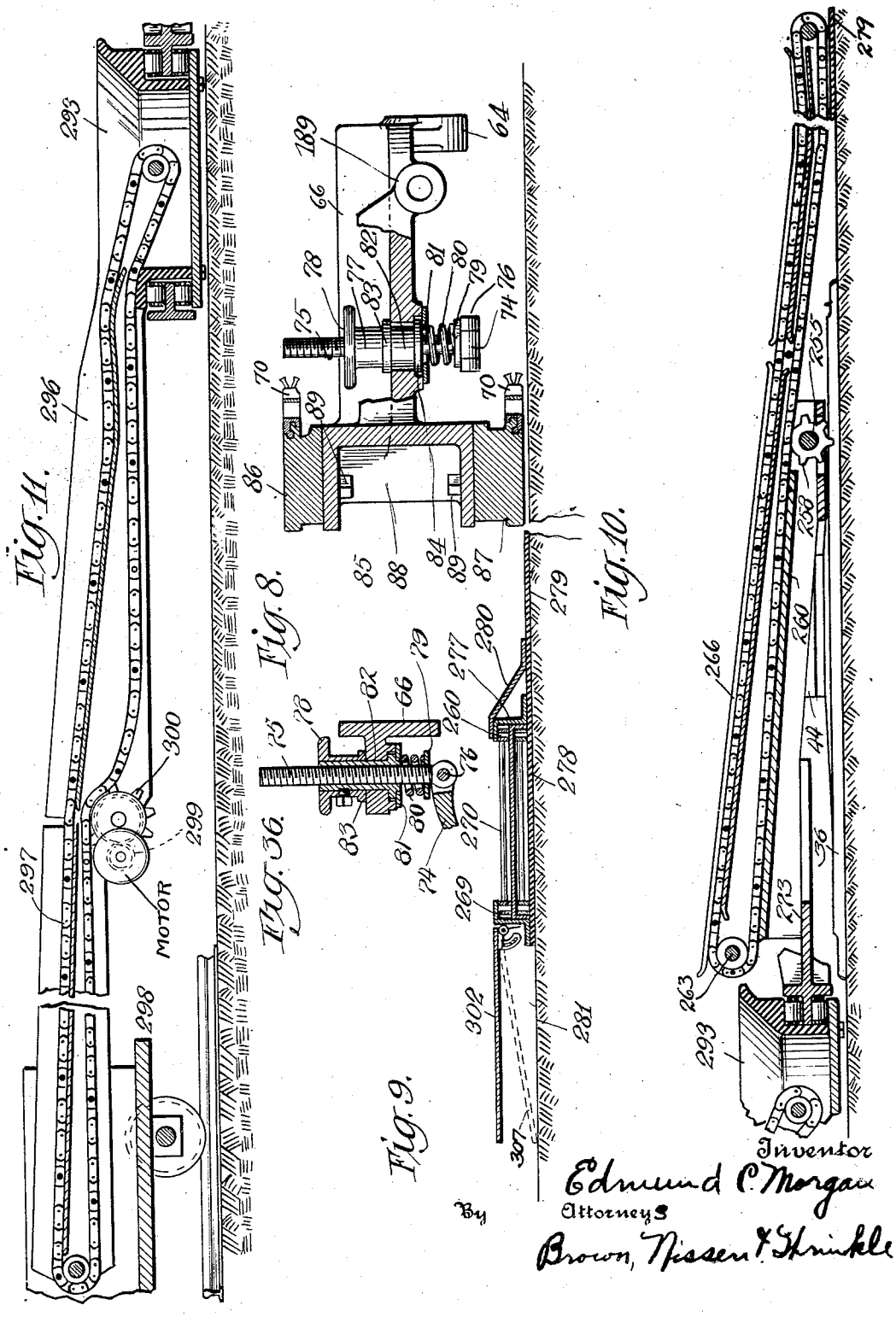
Fig. 7.

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MINING AND LOADING MACHINE

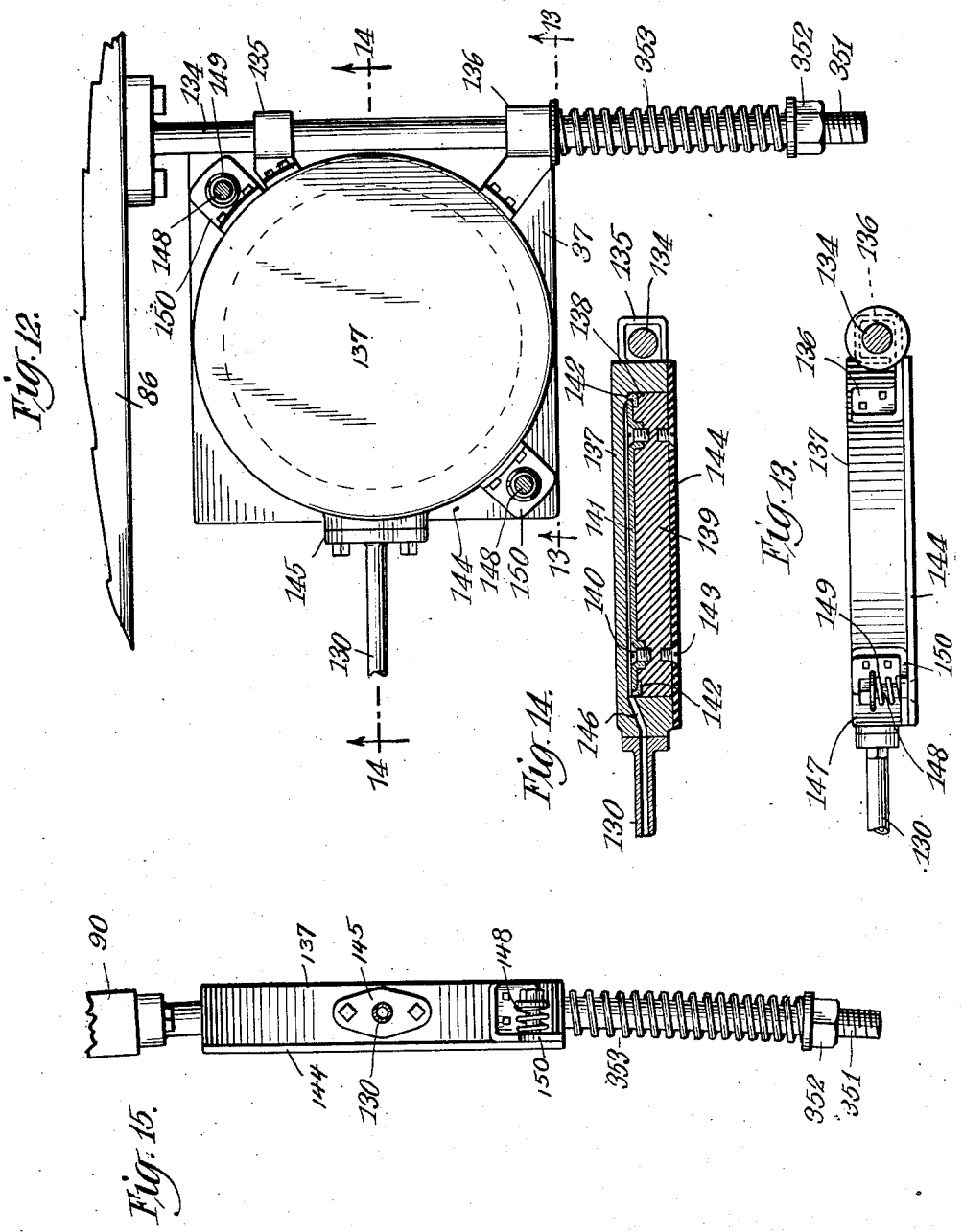
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Fig. 16.

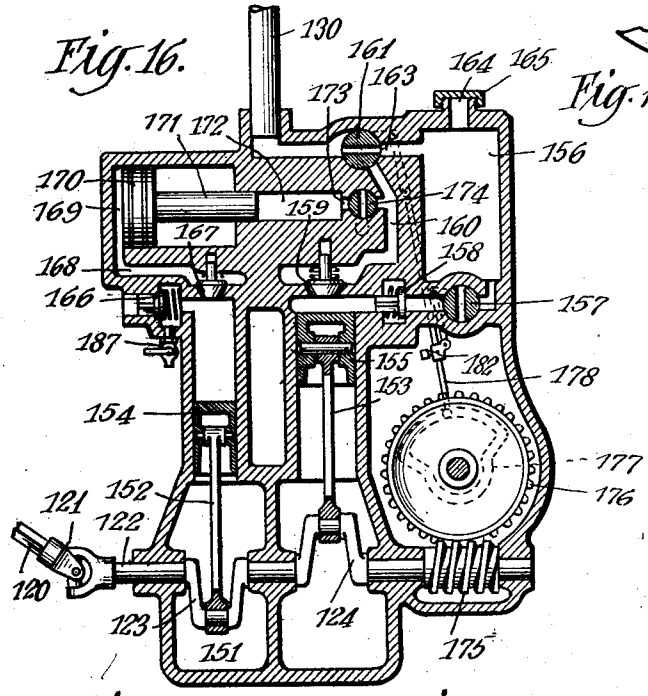


Fig. 17.

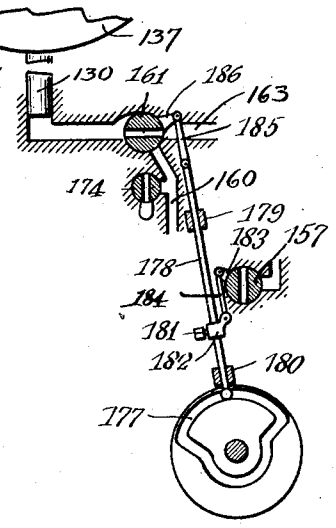


Fig. 20

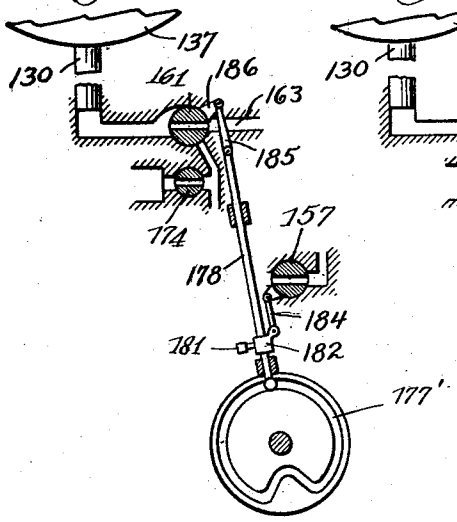


Fig. 19.

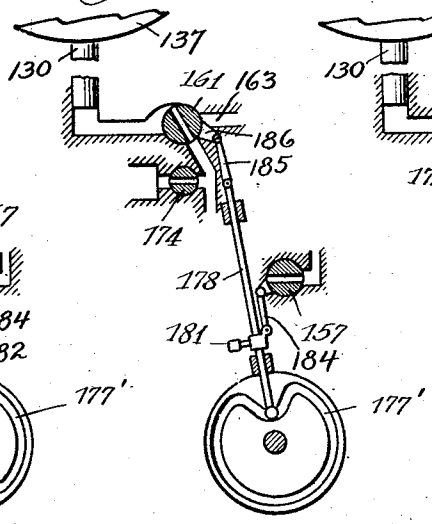
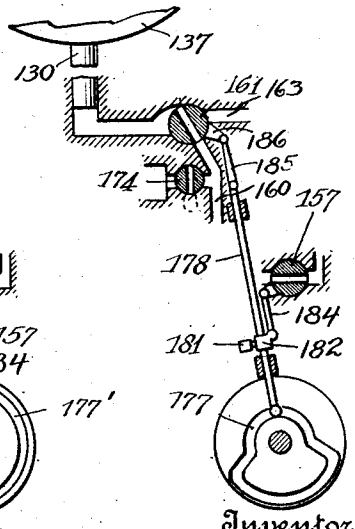


Fig. 18.

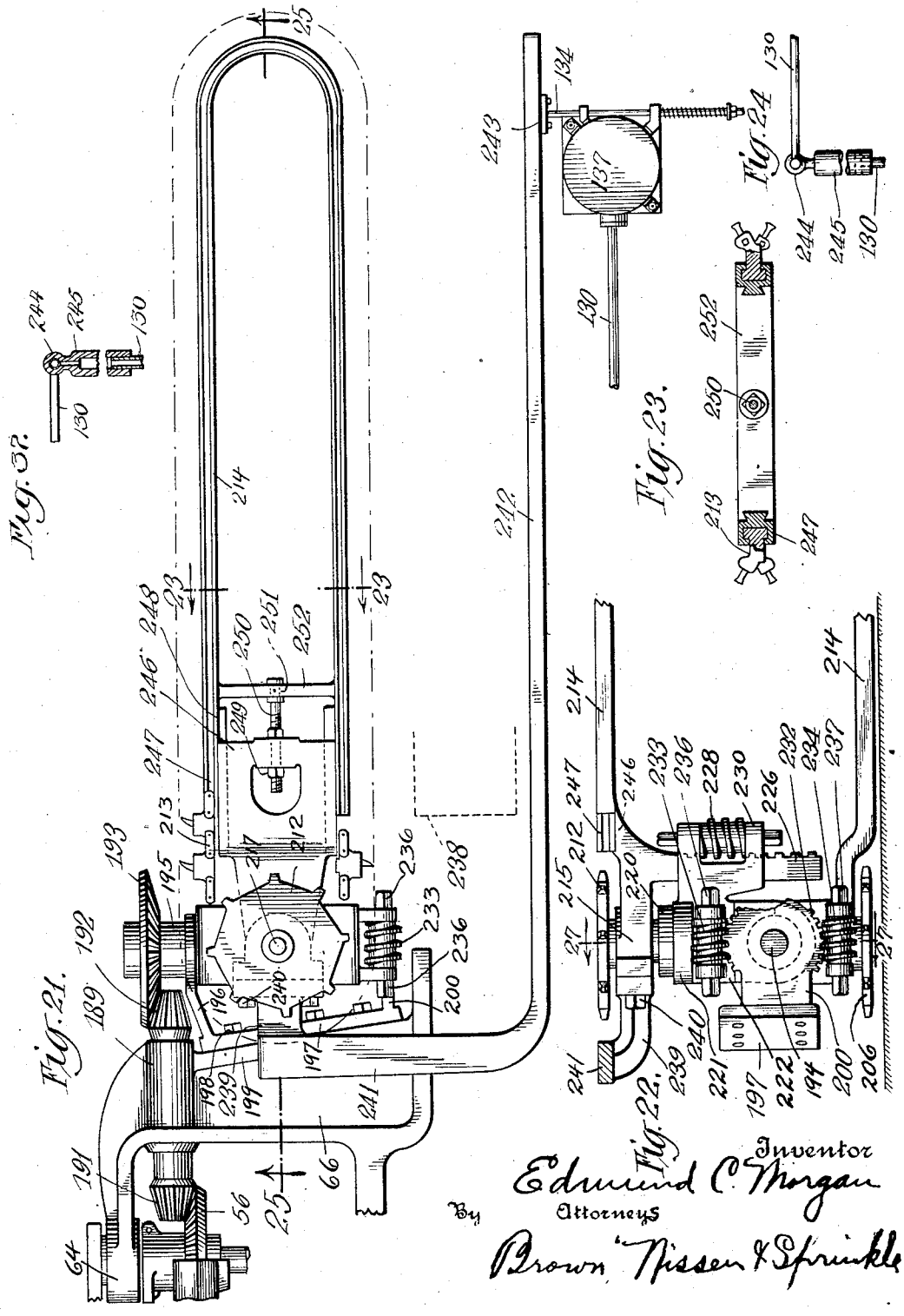


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MINING AND LOADING MACHINE

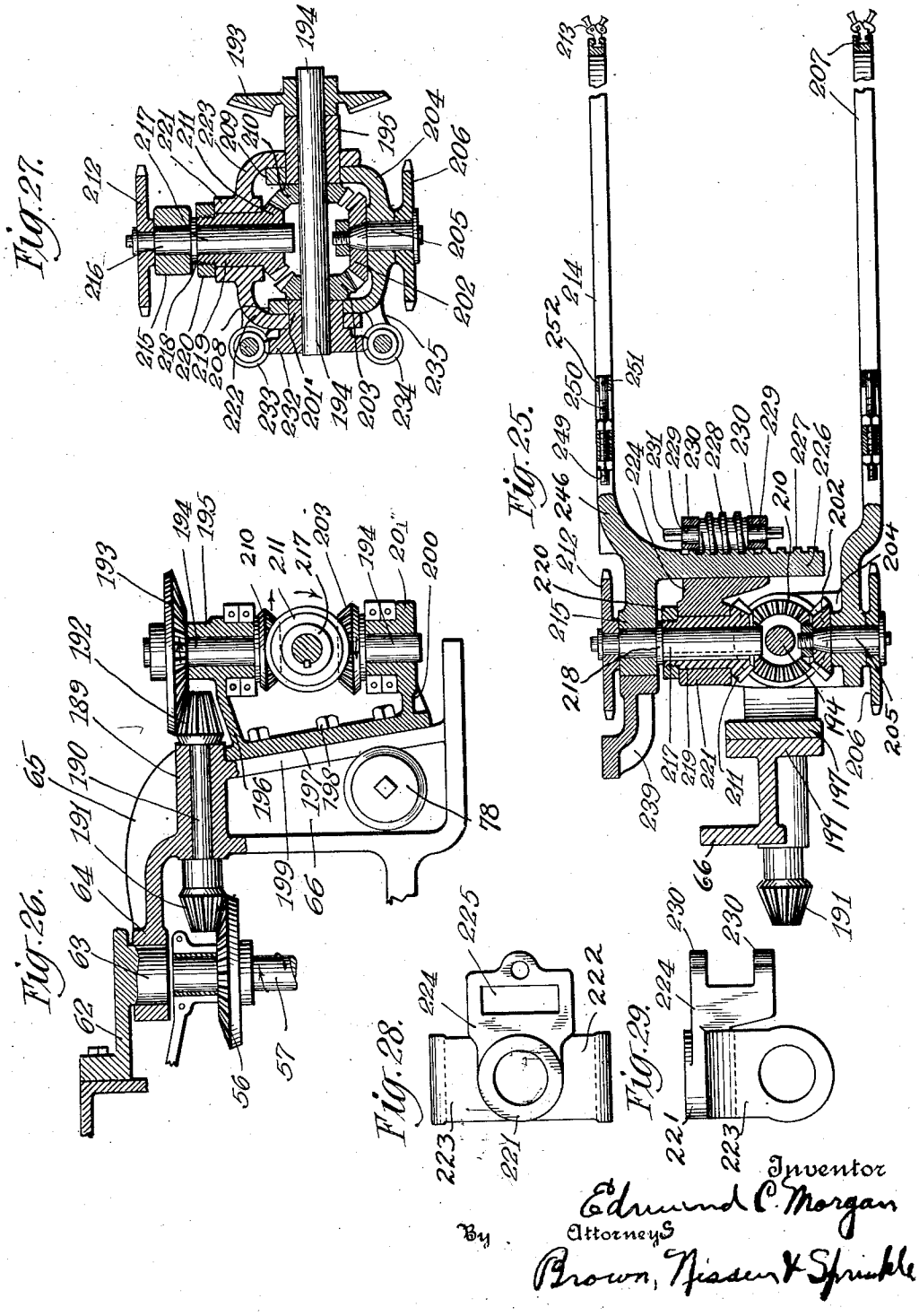
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MINING AND LOADING MACHINE

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MINING AND LOADING MACHINE

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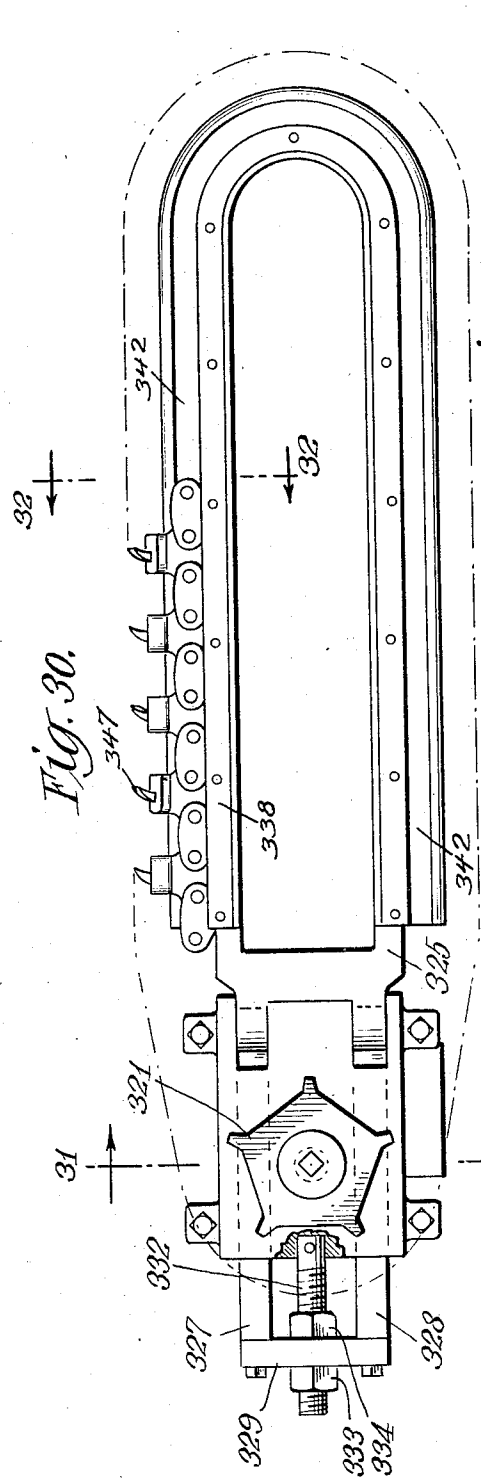


Fig. 30.

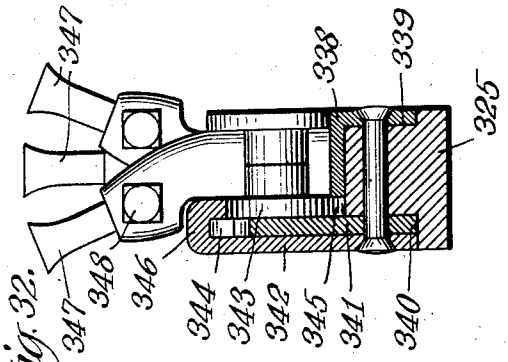


Fig. 32.

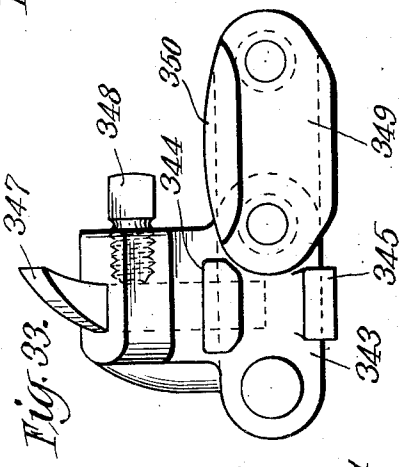


Fig. 33.

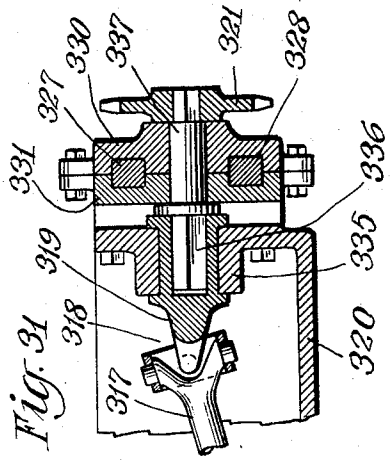


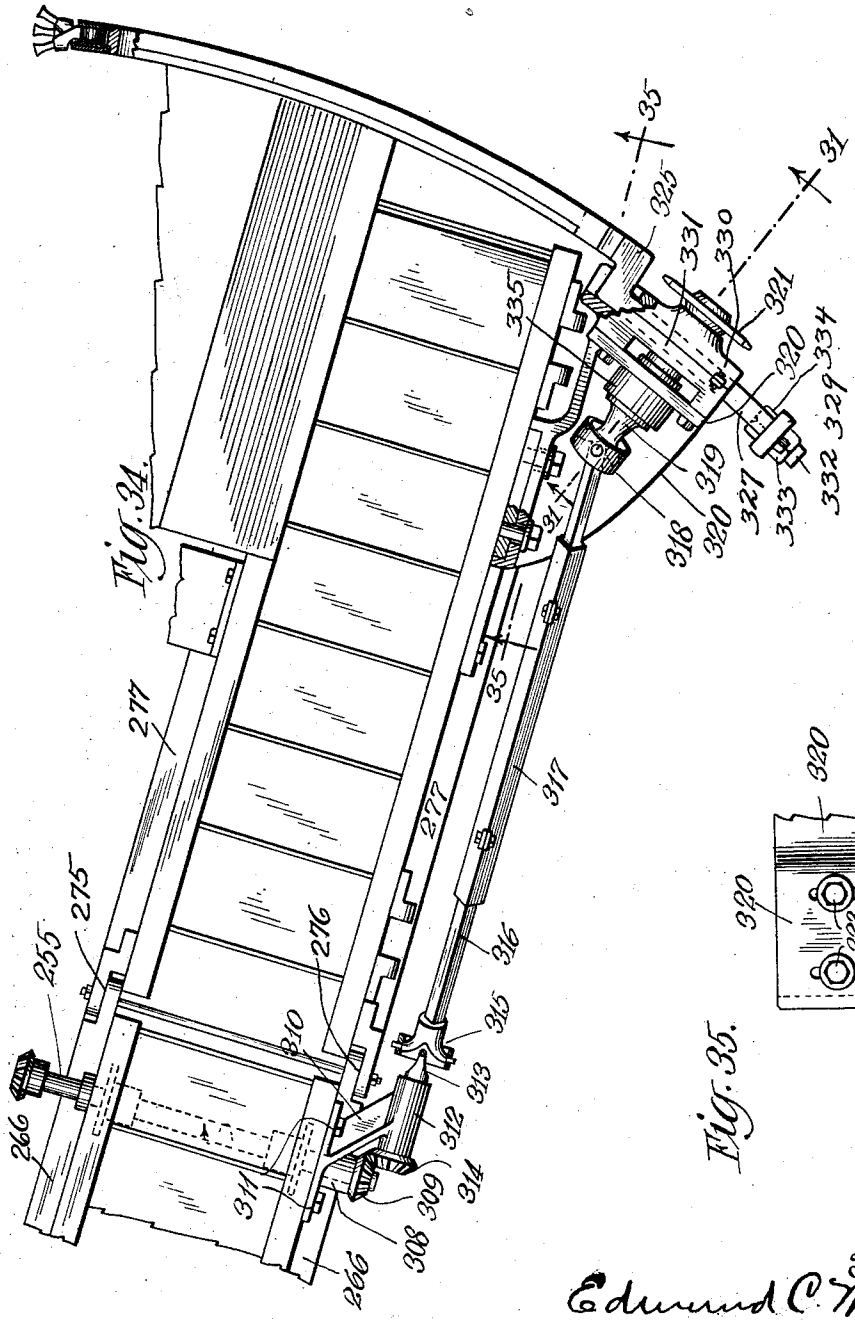
Fig. 31

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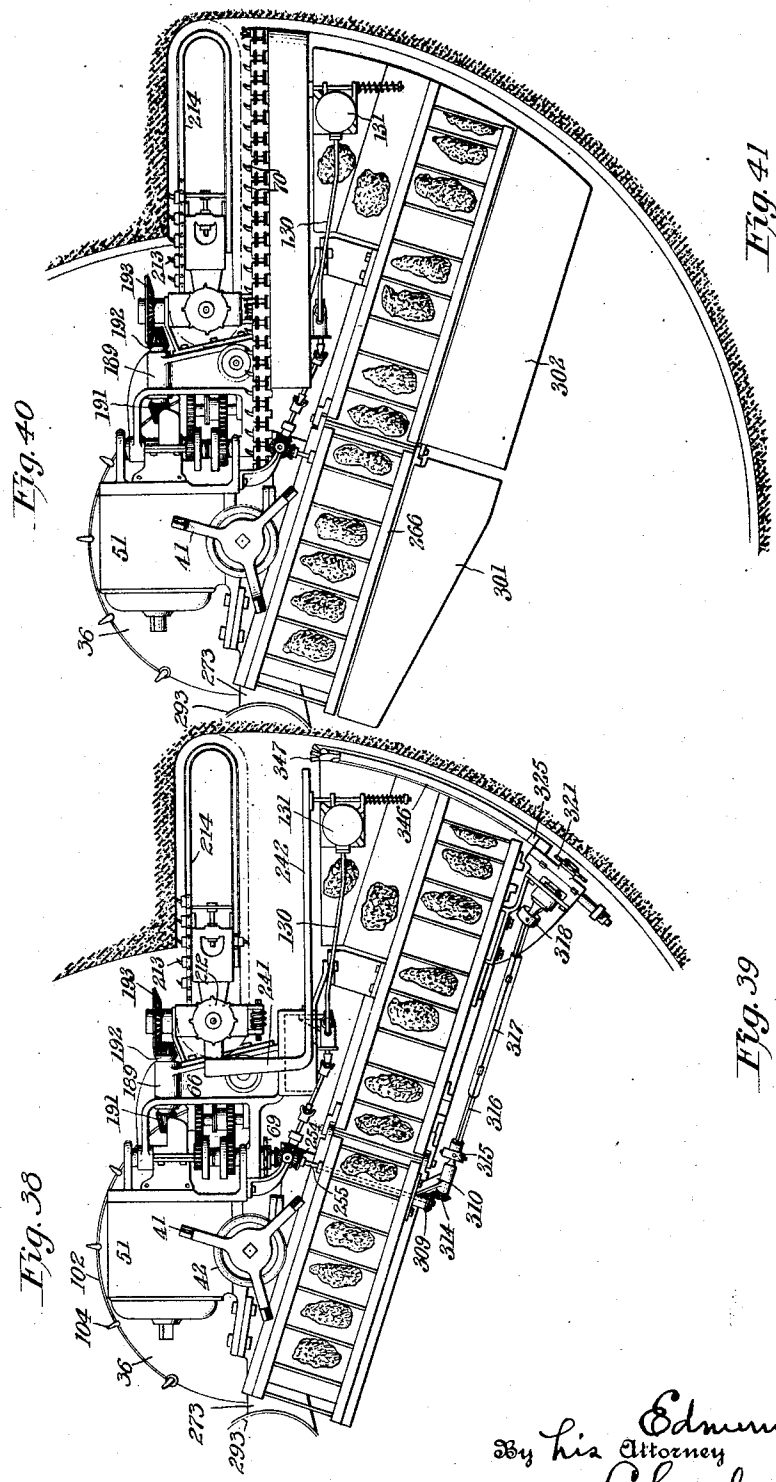


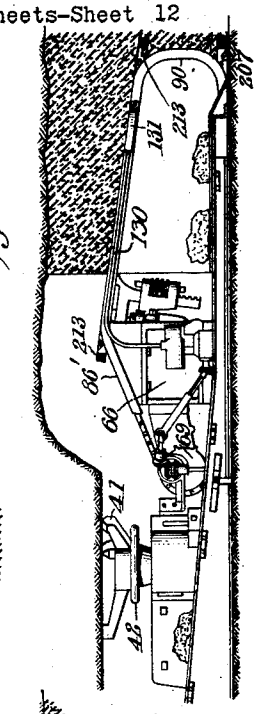
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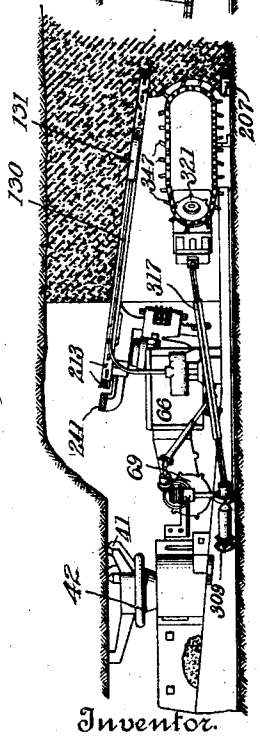
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MINING AND LOADING MACHINE

Filed May 9, 1917 12 Sheets-Sheet 12







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By his Attorney
Charles M. Nissen

Patented Dec. 2, 1930

1,783,443

UNITED STATES PATENT OFFICE

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MINING AND LOADING MACHINE

Application filed May 9, 1917. Serial No. 167,467.

My invention relates to combined mining and loading machines and also to mining machines and loading machines considered separately, and one of the objects of the invention is the provision of improved and simple means for mining and loading material.

A further object of the invention is the provision of kerf-cutting mechanism, tiltingly adjustable and also bodily adjustable to various elevations.

Another object of the invention is the provision of hydraulic breaking mechanism adapted to extend into a kerf in a mine wall and operate to dislodge material therefrom.

A further object of the invention is the provision of improved conveyor mechanism combined with dislodging mechanism whereby the strain on the various parts is reduced to a minimum.

Another object of the invention is the provision of various attachments to adapt the mining machine to different characters of material to be mined, as may be desired, and means for securing in position such attachments on the same general frame work.

A further object of the invention is the provision of kerf-cutting mechanism movable in an arc combined with conveyor mechanism, the forward portion of which, remains in receiving position and is also movable in an arc and continuously in connection with a hopper from which extends another conveyor for taking the material to a mine car.

More particularly it is the object of the present invention to provide a mining machine of the core-cutting type with means for actuating the same and also feeding the same slowly in one direction and quickly in the opposite direction, the core-cutting mechanism having straight upper and lower runs to cut a horizontal kerf at the floor of the mine and a horizontal kerf at the roof of the mine; the core-cutting mechanism being pivoted for adjustment in vertical planes and the actuating and feeding means together with the cutting mechanism being vertically adjustable as a whole, the main frame being provided with a ceiling jack to hold the same firmly in position. Following in the plane of the lower run of the core-cutting mechanism is a pivoted conveyor section arranged to be at or near the floor of the mine when the floor kerf is being cut so that material when dislodged will not transmit undue strain to the main frame or parts of the mining apparatus. Connected to the same source of power which actuates the cutting mechanism is automatically operated hydraulic mechanism extending into the kerfs and operating intermittently to dislodge sections of the core so that the material will be received on the forward conveyor and thence transmitted toward the rear into a hopper with which it is continuously connected and into which extends another conveyor for taking the material to a mine car. The frame work is so constructed as to permit detachment of the loop core-cutter and the substitution therefor of plane kerf cutters operatively connected to the source of power. Adjustable shelves are hinged back of the sections of conveyor frames which move in an arc with the cutting mechanism; such shelves are removable to permit the attachment of an upright arcuate kerf-cutter to cut a kerf spaced back from the mine wall between the inner ends of the horizontal spaced apart kerf-cutters, such upright kerf-cutter having operating connections extending back to the aforesaid source of power. Improved cutter chain and guiding mechanism is provided for such upright arcuate kerf-cutter. Provision is made for suitably supporting the hydraulic breaking mechanism when the plane kerf-cutters are attached, and adjusting mechanism is provided for tilting the plane kerf-cutters independently of each other and without interfering with the transmission of power through mechanism which actuates the chain cutters of said plane kerf-cutter both in the same direction. Provision is also made for adjusting the height of the upper plane kerf-cutter without interfering with said power transmitting mechanism. When desired the upper plane kerf-cutter may be omitted and the lower kerf-cutter used alone. The plane kerf cutters when attached are also tiltable as a whole and the tiltable frame to which the cutters

are attached is provided with a pivotal connection with a frame of the forward conveyor section so as to lift and lower the latter, and on account of the pivotal connection of the rear end of the forward conveyor frame section being near the pivot of the frame carrying said cutters, the forward portion of the conveyor will remain approximately in horizontal alignment with the lower plane kerf-cutter and also with the lower run of the loop-cutter, when the latter is used. The cutters are mounted to operate approximately on the radius extending from the center of arcuate movement of the frame carrying the cutters. The conveyor follows behind the cutter and operates along a line to one side of such center of arcuate movement and directly back thereof when the cutters are in the midposition. A platform spans the space between the lower run of the cutter and the forward portion of the conveyor. The attachments permit the use of the core-cutter of the loop-type together with a hydraulic mechanism and the conveyor mechanism having the adjustable shelves; or, a lower plane kerf-cutter with the parts mentioned; or, spaced apart plane kerf-cutters with the said parts; or, the lower plane kerf-cutter or both of said plane kerf-cutters together with the arcuate upright kerf-cutter, the adjustable shelves then being omitted; or, the loop cutter and both of the plane kerf cutters as well as the shelves may be omitted and the upright arcuate kerf-cutters used alone; or, the loop core-cutter may be used in combination with the lower plane kerf-cutter or both the lower and the upper plane kerf-cutters.

Other objects of the invention will appear hereinafter, the novel combinations and features of the invention being set forth in the appended claims.

In the accompanying drawings—

Fig. 1 represents a plan view of the assembled machine including a loop core cutter, a hydraulic breaker and conveyor mechanism and pivoted shelves;

Fig. 2 is a side elevation of Fig. 1;

Fig. 3 is a plan view of the central portion of the mining and loading machine with certain parts of the actuating and feeding mechanism for the cutters shown in horizontal section;

Fig. 4 is a sectional elevation of Fig. 3 taken on the line 4—4 of Fig. 3;

Fig. 5 is an enlarged elevation of the loop core-cutter showing the upper and lower straight runs and the hydraulic breaking mechanism applied thereto;

Fig. 6 is a plan view of an enlarged forward portion of the assembled machine showing in plan the connection of the hydraulic breaking mechanism with the cutter, and the pivotal connection of the forward conveyor section with the cutter frame and with the rear conveyor section and with the shelves;

Fig. 7 is a sectional view taken on the line 7—7 of Fig. 6;

Fig. 8 is a sectional elevation on the line 8—8 of Fig. 4 looking in the direction of the arrows with the mechanism for operating the hydraulic breaking mechanism omitted;

Fig. 9 is a sectional view on the line 9—9 of Fig. 6 looking in the direction of the arrows;

Fig. 10 is a side sectional elevational view through the forward conveyor and a portion of the loading conveyor together with a portion of the receiving hopper;

Fig. 11 is a side elevational view of the rear conveyor, the hopper being shown in central sectional elevation;

Fig. 12 is an enlarged plan view of the hydraulic breaker mounted on the cutter frame;

Fig. 13 is a sectional elevation taken on the line 13—13 of Fig. 12;

Fig. 14 is a sectional elevation taken on the line 14—14 of Fig. 12 looking in the direction of the arrows;

Fig. 15 is an elevational view of the right hand end of Fig. 12;

Fig. 16 is a sectional elevation of the interior construction of the hydraulic pumping mechanism and the mechanism cooperating with the hydraulic breaking device shown in Fig. 12;

Fig. 17 is a diagrammatic illustration showing the position of the parts of Fig. 16 when the accumulator is out of operation and the hydraulic breaker is being operated directly from the pumping mechanism;

Fig. 18 represents another position in the cycle of operations by means of the mechanism shown in Fig. 17;

Fig. 19 represents a modification by including a different cam to effect cooperation with an accumulator, the view illustrating the transmission of a hydraulic impulse to the breaker to operate the same;

Fig. 20 represents another position of the part shown in Fig. 19 when the water or other liquid or fluid is released from the breaker.

Fig. 21 is a plan view of the attachment permitting the use of spaced apart plane kerf cutters, the position of the loop cutter frame being shown in dotted lines;

Fig. 22 is a side elevation of the rear portion of the attachment shown in Fig. 21, together with the adjusting mechanism for the cutters;

Fig. 23 is a sectional view on the line 23—23 of Fig. 21 looking in the direction of the arrows;

Fig. 24 represents diagrammatically a swivel connection and an expansible joint in the hydraulic pipe to permit freedom of adjustments of the plane kerf-cutters;

Fig. 25 is a longitudinal sectional eleva-

tional view taken on line 25—25 of Fig. 21;

Fig. 26 is a sectional plan view of a portion of the mechanism shown in Figs. 21 and 25;

Fig. 27 is a vertical sectional view of Fig. 22 taken on the line 27—27 looking in the direction of the arrows;

Fig. 28 is a plan view of a detail of Fig. 25, constituting means for adjustably guiding the upper plane kerf-cutter;

Fig. 29 is an elevational view of Fig. 28;

Fig. 30 is a plan view of the upper plane kerf-cutter;

Fig. 31 is a sectional elevation on the line 31—31 of Fig. 30;

Fig. 32 is a sectional view on the line 32—32 of Fig. 30;

Fig. 33 is an elevation of the cutter chain construction shown in Fig. 32;

Fig. 34 is a plan view of the upright arcuate kerf-cutter and the attachments for connecting the same and the operating mechanism thereof to the forward portion of the conveyor;

Fig. 35 is an elevational view of an enlargement of a portion of the attachment for supporting the upright arcuate cutter and the outer portion of the operating mechanism to the conveyor frame;

Fig. 36 is a sectional elevation of a part of Fig. 8 to show the details of the mechanism for adjusting the elevation of the core-cutter;

Fig. 37 is a sectional elevation of structure shown in Fig. 24;

Fig. 38 is a plan view of the combined mining and loading machine including spaced-apart plane kerf-cutters and an upright curved kerf-cutter;

Fig. 39 is an elevation of the structure shown in Fig. 38;

Fig. 40 is a plan view of the combined mining and loading machine comprising spaced-apart plane kerf-cutters and a loop chain kerf-cutter with its upper and lower runs approximately in the planes of said plane kerf-cutters; and

Fig. 41 is an elevational view of the structure shown in Fig. 40.

Referring to Fig. 4 it will be seen that the central portion of the circular base plate or main frame 36 is provided with an upright cylinder or sleeve 37 rigidly connected to or integral with the base plate 36. In the vertical hollow cylindrical recess in the sleeve 37 is splined the screw-threaded post 38 by means of the spline 39 fastened to either the sleeve 37 or the post 38 so as to permit free vertical motion of the post 38 but preventing turning thereof. On the upper end of the post 38 is mounted a ceiling foot 40 having a plurality of radiating claws 41. Between the upper end of the standard 37 and the foot 40 is mounted a wheel 42 having a screw-threaded hub 43 in mesh with the screw-threaded post 38, whereby when the wheel is turned the post together with the ceiling claws may be lifted or lowered. There is therefore provision made for a ceiling jack, readily operated by means of the wheel 42 to firmly anchor the main frame between the floor and roof of the mine chamber to prevent the main frame from being displaced either bodily or rotarily during the operation of the mining and loading machine hereinafter described.

Rotarily mounted on the upright cylindrical sleeve 37 is a rotary frame 44 as shown in Figs. 3 and 4. The frame 44 is provided with laterally extending plates 45 and 46 as shown in Fig. 3. The plate 45 is provided with a vertical slot 47 and the plate 46 is provided with a vertical slot 48 as shown in Fig. 4. Extending through the slots 47 and 48 are bolts 49 and 50, respectively, to effect rigid connection between the motor frame 51 and the rotary frame 44. The motor frame 51 is guided vertically on the frame 44 by means of the dovetail guide connection shown at 52 in Fig. 3.

The motor carried by the frame 51 is preferably an electric motor provided with well-known electric switches for starting, stopping and reversing the same. The armature 53 of the electric motor is carried by a shaft 54 mounted in suitable bearings and carrying at one end the bevel gear 55 which meshes with a larger bevel gear 56 mounted on the transverse shaft 57. One end of the shaft 57 is journaled in the bearing 58 carried by the bracket frame 59 which is rigidly connected to the motor frame and encloses the bevel gears 55 and 56. The other end of the shaft 57 is journaled in the bearing 60 carried by a bracket 61 which is also rigidly connected to the motor frame 51. It will therefore be seen that when the motor frame is moved up or down and fastened in adjusted position by means of the bolts 49 and 50, the gears 55 and 56 together with the shaft 57 and the bearings thereof will also be adjusted as to elevation.

Also rigidly connected to the motor frame 51 is an additional bracket 62 having a cylindrical lateral extension 63 to form a bearing for the collar 64 which is rigidly connected to the bracket 65 extending from the vertically tiltable frame 66 on which the kerf-cutting mechanism is mounted. Also extending from the frame 66 is another bracket 67 which is provided with a collar 68 fitting over the bearing 60. The collars 64 and 68 are therefore fitted on bearings 63 and 60, respectively, which are in alignment with each other and concentric with the shaft 57.

At the outer end of the shaft 57 is mounted a sprocket wheel 69 for driving a chain cutter 70 as shown in Fig. 4.

Rigidly connected with the main rotary

frame 44 is a radial arm 71 which is provided with a shoe 72 resting and sliding on the circular track 73 of the base plate 36. The arm 71 is provided with an upwardly and outwardly extending portion 74 at the outer end of which is pivoted the screw-threaded rod 75 as shown in Fig. 8. A pivotal connection at 76 to the outer end of the arm 74 affords means for permitting the vertical rod 75 to swing to or from the axis of oscillation of the cutter carrying frame 66. Mounted on the screw-threaded rod 75 is a nut 77 provided with a wheel 78 to turn the same. At the lower end of the rod 75 just above the pivot 76 is a washer 79 on which rests a spiral spring 80 concentric with the rod 75 but below the frame 66. It will be seen by referring to Figs. 3 and 8 that the nut 77 and wheel 78 are located above the frame 66 or that portion thereof which constitutes the crosspiece between the collar-bearing brackets 65 and 67. The spring 80 is located below such crosspiece and bears against the washers 79 and 81, the upper washer being located in such position that it does not interfere with free rotation of the nut 77. This is accomplished by having the washer rest against the under side of the frame 66 out of contact, or nearly so, with the lower end of the nut 77. It should be understood that the nut 77 extends through an opening 82 in the frame 66 and is provided with collars 83 and 84, respectively, above and below the frame 66 and fixed to said nut 77 to rotate therewith while locking the nut 77 to the frame 66. The opening 82 however, is sufficient to permit free play of the nut 77 therein when the frame 66 is moved up or down and the rod 75 is moved on its pivot 76 by such adjustment.

The cutter head 85 comprising upper and lower chain cutter guide frames 86 and 87 is detachably connected to the vertical plate 88 by means of the bolts 89. The vertical plate 88 is integral with or rigidly attached to the frame 66, as shown in Fig. 8. As shown in Fig. 5 the upper flat chain cutter frame 86 converges relatively to the chain cutter frame 87 below and the outer ends are connected by the vertical run 90, the upper and lower ends of which are curved to afford suitable guide for the chain cutter 70. The rear portion of the upper and lower chain cutter guides 86 and 87 are provided with extensions 86′ and 87′ respectively. It should be understood that when the nut 77 is in the position shown in Figs. 4 and 8 the loop core-cutter frame, having the unobstructed core opening therethrough, as shown in Fig. 5, the lower chain cutter guide frame 87 occupies a horizontal position so that it can cut a horizontal plane curve at the floor of the mine chamber. Now when the wheel 78 is turned by the operator in the proper direction the entire loop chain core cutter may be lifted and pivotally and bodily adjusted to any desired upper position, the spring 80 acting as a counterbalance to facilitate such lifting because the spring rests on the outer end of the arm 74 which in turn rests firmly on the base plate 36. The uppermost position will usually be where the upper cutter frame 86 occupies a horizontal position to cut a plane kerf at the roof of the mine chamber. It should be understood, however, that the chain cutter frame may be adjusted to a higher position so that the upper outer portion of the chain cutter may be used for cutting material from a roof at a higher elevation whenever desired.

I will now describe the mechanism for effecting a slow forward feed of the cutting mechanism during the actuation thereof. Mounted on the central portion of the shaft 57 are two multiple disc clutches 91 and 92, each of which comprises discs which are connected to the shaft 57 and the outer shell in a well-known manner. Between the multiple discs is located an operating device 93 which may be moved to throw in either the clutch 91 or 92 and left in engaging position by the operator until thrown out again. Connected to the hub of the clutch 91 is a pinion 94 which meshes with a large gear 95 mounted on the winding drum 96. The hub of the clutch 92 is provided with a pinion 97 meshing with a large gear 98 mounted on the winding drum 99. Both of the drums 96 and 99 are mounted loosely on the bearing shaft 100 supported at its ends in the brackets 101 and 67. It should be understood that the drum 96 is secured to and rotates with the gear 95 and that the drum 99 is secured to and rotates with the gear 98, but that the drums 96 and 99 are independently rotatable on the bearing shaft 100.

One end of a cable 102 is connected to the drum 96 while the other end thereof is adapted to be hooked, as by means of a ring 103 to a cleat 104 of which there may be several circumferentially spaced apart around the peripheral portion of the circular base plate 36. The rope 102 extends around a guide pulley 105 pivoted on the frame 66 near the drum 96. Whenever the clutch 91 is thrown in and the motor operated in the proper direction the drum 96 will be rotated to exert a pull on the cable or rope 102 to turn the frame 44 together with the motor frame and the cutter carrying frame to secure feeding movement of the cutting mechanism. While I prefer to provide anchoring points on the circumferential portion of the stationary base plate 36, it should be understood that the cable 102 may be anchored in the mine at any suitable point.

Connected to and wound on the drum 99 is a cable 106 which is guided over the pulley 107 pivoted to the frame 66. The free end of the cable 106 is passed around the circum-

ferential portion of the base plate 36 and may also be guided by spaced apart cleats and anchored to one of them. The diameter of the drum 99 is preferably made larger than the diameter of the drum 96 so as to secure a quicker movement of the cutting mechanism in reversed direction back to initial position. The free end of the cable 106 instead of being anchored to the base plate may be connected to any suitable anchorage in the mine chamber.

It should also be noted that by means of the rope winding drums 96 and 99 and the ropes connected thereto, the entire mining and loading machine may be moved about in the mine chamber when the ceiling jack is released and lowered. This is preferably accomplished by anchoring the free ends of the ropes at suitable positions in the mine and operating the drums 96 and 99 alternately to effect swinging and bodily movements of the entire machine to a new location. The mining machine may thus be moved by power mechanism in any desired direction over the mine floor. When the drums 96 and 99 exert such pulls on the ropes connected thereto the frame 66, although pivoted at 63 and 60, will not be tilted either upwardly or downwardly because prevented from doing so by the nut 77 on the screw-threaded rod 75 pivoted at 76 to the outer end of an extension from the rotary frame 44, as shown in Fig. 4.

I will now describe the hydraulic breaking mechanism which I consider an important feature of my invention. Integral with or rigidly attached to the rotary frame 44 is a lateral extending vertical plate to which is detachably connected the bracket 109 as shown in Fig. 6. The bracket 109, as shown in Fig. 5, carries two vertical spaced apart bearings 110 and 111 through which extends the vertical shaft 112 and between which are mounted the oppositely faced bevel gears 113 and 114. Also carried by the bracket 109 is a horizontal bearing 115 through which extends a shaft 116 carrying a bevel gear 117 at one end in mesh with the gear bevel 113 and having a universal joint connection 118 to a sleeve 119 at its other end. Extending into the sleeve 119 is a rod 120 having a sliding connection therewith but being compelled to rotate with the sleeve 119. The lower end of the rod 120 is connected by the universal joint 121 to the shaft 122 connected to cranks 123 and 124 for operating the pump shown in Fig. 16 in detail, and more or less diagrammatically at 125 in Fig. 5. The pump mechanism shown in Fig. 16 may be supported on the vertical crosspiece 85 of the cutterhead.

At the outer end of the shaft 57, shown in Fig. 3, is mounted a bevel gear 126 which meshes with the bevel gear 114 as shown in Fig. 5. The bevel gears 113 and 114 are splined to the vertical shaft 112 so as to be compelled to move rotarily therewith although slidable vertically thereon. Although the bracket 109 may be connected to the vertical plate 108 as hereinbefore stated. I prefer to detachably bolt said bracket to the frame 61 so as to be movable up and down therewith when the motor frame is adjusted along the slots 47 and 48. When such adjustment is made the bracket 109 together with the bevel gears 113 and 114 and the gear 126 are moved relatively to the vertical shaft 112. The lower end of the vertical shaft 112 is pivoted at 127 to a horizontal plate 128 which is secured by means of the vertical plate 129 to the bracket plate 108 extending from the rotary frame 44 as shown in Fig. 6. It will be seen that the plates 128 and 129 are fixed to the rotary frame 44 and will not interfere with the movement of the bracket 109 which is shown in its lowermost position in accordance with the adjustment along the slots 47 and 48 in Fig. 4.

Extending from the pumping mechanism 125 is a pipe 130 leading to the hydraulic breaking devices 131, 132 and 133. The breaking device or devices may be located in the upper lower or end kerf or in any two or more of them. If desired, the breaking devices may be arranged in series, but inasmuch as each breaking device would be similar in construction, I will describe only one of them. Referring to Fig. 12, which shows a plan view of one of the preferred breaking devices, I have shown a rearwardly extending rod 134 secured to the rear end of the cutter frame 86 so as to occupy a position in the plane thereof. Pivotally connected at 135 and 136 is a flat frame 137 provided with a circular recess 138 in which fits a piston 139 of a diameter much larger than its thickness. Secured to the inner flat surface of the piston 139 by means of screws 140 is a circular metal plate 141 for holding in place a packing ring 142 at the peripheral circumferential edge of said plate 141 and against the inner cylindrical surface 138. Secured to the outer flat surface of the piston 139 by means of screws 143 is a flat circular plate 144 of a larger diameter than the piston 139 and preferably of a diameter equal to the width of the piston casing 137. The outer end of the pipe 130 is securely connected by means of the plate 145 to the piston casing 137 so that the opening in the pipe will register with the passage 146 which leads through one side of the frame 137 into the space between the piston and the bottom of the cylindrical recess in the piston plate or casing.

It should be noted that the rear end of the rod 134 is screw-threaded at 351, as shown in Fig. 12, to receive the nut 352 for adjustment of the tension of the spring 353 which has the function of automatically sliding the breaking device along the rod 134 after each

operation thereof, to its initial position relatively to the kerf-cutter frame 86. During the interval of operation of the breaking device the latter is arrested in its forward motion but on account of said returning spring the forward feed of the kerf-cutter is not interfered with.

At diagonally opposite corners of the piston casing 137 are recesses 147 for containing bolts 148 associated with springs 149, the bolt being so connected to radially extending ears 150 of the plate 144 as to cause said springs to be compressed when the piston is moved by hydraulic pressure within the casing 137. The springs 149 are relied upon to reset the piston to initial position when the hydraulic pressure is released. I prefer to use hydraulic pressure through the medium of any desired liquid but it should be understood that in some instances pneumatic pressure may be used if desired. When the hydraulic or pneumatic breaking device is used in a plane kerf the parts may be constructed as shown in Figs. 12, 13 and 14, but when used in an upright arcuate kerf in the position shown at 132 in Fig. 5, the parts may be curved to conform to the curvature of the kerf. The construction for an upright arcuate kerf is illustrated in Fig. 15.

In Fig. 16 I have illustrated the preferred form of pumping apparatus shown at 125 in Fig. 5 mounted on the vertical frame 85. Although I have shown the framework 151 of the pump as composed of a single casting, it should be understood that such illustration is for the sake of clearness and those skilled in the art may make the frame of any desired number of parts and provide such changes as to arrangement of parts, vents and additions as may be desired. The cranks 123 and 124 are connected to pistons alternately operated by the pitmen 152 and 153, the pistons being designated 154 and 155 respectively. The piston 155 acts to pump water from the reservoir 156 through the valve 157 and the check valve 158 and force it past the check valve 159 through the passageway 160 and through the valve 161, when the latter is open, into the passageway 162 and thence into the pipe 130. The valve 161 when in the position shown in Fig. 16 opens the pipe 130 through the passageway 163 to the reservoir 156. It should be understood that the piston 155 is the piston of the hydraulic pump to pump water into the pipe 130 and thence into the hydraulic breaking device shown in Figs. 12, 13 and 14 to expand the latter while in a kerf back of the cutter frame and thus break the core of material from the mine wall. The reservoir 156 may be provided with a filling opening 164 provided with a cap 165.

The piston 154 is a part of an air pump of an accumulator and acts to draw air past the check valve 166 into the chamber above the piston 154 and thence past the check valve 167 through the passage 168 into the chamber 169 back of the piston 170 which is provided on its opposite side with a plunger 171 extending into the cylindrical recess 172 which is connected by a passageway at its rear end with a passageway 160. Said passageway 173 is controlled by a hand operated valve 174.

On the crank shaft 122 is mounted a worm 175 meshing with a worm wheel 176 carrying a cam 177 which is used for reciprocating a rod 178 to automatically control the valves 157 and 161. Such control of the valves 157 and 161 is diagrammatically illustrated by Figs. 17 and 18. The rod 178 may be mounted to slide longitudinally in the bearings 179 and 180 fixed to the frame 151. By means of a set screw 181 a collar 182 is secured to the rod 178 in adjusted position. The valve 157 is provided with an actuating lever 183 which is connected by a link 184 to the collar 182. The upper end of the rod 178 is connected by a link 185 to an actuating lever 186 connected to the valve 187. It will be seen that when the cam 177 lifts the rod 178 it closes the valve 157 and takes the valve 161 from connection with the passageway 160 and moves it into registry with the passageway 163. When the cam 177 is in the position shown in Fig. 18 the rod 178 is lowered and the valve 157 opened from the reservoir 156 to the passageway leading to the chamber above the piston 155. At the same time the valve 161 is opened from the passageway 160 to the pipe 130. During this interval the pump operates to exert hydraulic pressure on the hydraulic breaking device connected to the pipe 130 and located in a kerf. In order to insure the transmission of the hydraulic pressure into the pipe 130 a check valve 158 is provided which opens from the reservoir to the piston 155 but closes in the opposite direction.

The reciprocating rod 178 and the connections between the same and the valves 157 and 161 and the cam 177 are for the purpose of securing automatic intermittent operation of the hydraulic breaking device connected to the pipe 130 in the kerf. The apparatus is so adjusted that after the hydraulic breaking device has been expended to its limit the valve 157 is first closed to cut off the supply of water from the reservoir 156 to the piston 155 and immediately after the closing of the valve 157 valve 161 is closed as to the passage 160 and opened as to the passage 163. The hydraulic pressure in the pipe 130 and in the hydraulic breaking device will then be released and the pair of springs, one of which is illustrated at 149, will then act to restore the piston 139 to initial position and force the water in the piston casing 137 back through the pipe 130 and through the valve

161 into the reservoir 156 to be used over again in the next cycle of operations.

By replacing cam 177 by another cam 177′ of a slightly different shape and releasing the set screw 181 so as to permit free movement of the rod 178 through the collar 182 while the valve 157 is left permanently in open position, and the valve 174 is moved to a permanent open position, the mechanism shown in Figs. 19 and 20 may be used in combination with the pneumatic accumulator to operate the hydraulic breaking device with hammer blows. When the cam 177′ is in the position shown in Fig. 20 and the cylinder 172 is filled with water while the piston 170 is in the position shown in Fig. 16 the air pump will be operated to pump air into the chamber 169 until any desired pressure is obtained. During this operation the valve 161 is closed to the passage 160 but opened to the passage 163, the breaking device being then released. When the cam 177′ is moved to the position shown in Fig. 19, however, the valve 161 will be moved into a position where the pressure exerted by the water in the chamber 172 will be allowed to act through the pipe 130 on the breaking device. Inasmuch as the accumulator stores up considerable air pressure a sudden impulse will be exerted on the breaking device to cause the same to strike a hammer blow on the core of material cut by the cutters. Inasmuch as the accumulator acts quickly, the recess in the cam 177′ may be short, thereby allowing more time for the pump to act to store up sufficient energy for the next impulse to act through the water medium on the hydraulic breaking device. During the period while the valve 157 is in open position and while the operation illustrated in Figs. 19 and 20 is being carried out, the piston 155 may be disconnected from the crank shaft 124 or a suitable outlet to the atmosphere afforded from the passage above the piston, but even if the parts are left as shown the piston 155 will not interfere with the operation of the air pump because of the small amount of air pressure on the piston 155. A valve for the chamber above the piston 155 may be used similarly to the valve 187 which when open may let the piston run freely without doing any appreciable work.

In order to mount the plane kerf cutters on the frame 66 ahead of and in the same planes as the upper and lower runs of the loop chain core cutter and operate such plane kerf cutters from the gear 56 a part of its casing 59 is in the form of a cap detachably connected. On the frame 66 is a bearing 189 shown in Figs. 3 and 8. Now by removing the cap 188 and extending a shaft 190 to the bearing 189 as shown in Fig. 26 an additional bevel gear 191 may be brought into mesh with the bevel gear 56 on the shaft 57. On the opposite end of the shaft 190 is a bevel gear 192 meshing with the large bevel gear 193 keyed to a shaft 194 in the bearing 195 which is mounted on a bracket 196 fixed to a frame 197 bolted at 198 to the diagonal portion 199 of the frame 66. The frame 197 also has a bracket 200 which carries a bearing 201 in which is journaled a shaft 194 carrying the bevel gear 203 at one end thereof. As shown in Fig. 27 the gear 203 meshes with a horizontal bevel gear 202 mounted in the frame 204 at the upper end of the vertical shaft 205 the lower end of which carries a sprocket wheel 206 for operating the lower chain cutter guided on the chain cutter frame 207 shown in Fig. 25. It will be seen by comparing Figs. 25 and 27 that the chain cutter frame 207 is rigidly connected to the frame 204 and that the latter is bifurcated to form spaced apart vertical bearings 208 and 209 for securing certain adjustments of the lower plane kerf cutter. When the shaft 194 is rotated by power transmitted through the bevel gear 193 both the bevel gears 203 and 210 are rotated in the same direction. In order to secure the same direction of actuation of the upper cutter as the lower cutter the bevel gear 211 meshes with a gear 210 diagonally from the meshing of the gears 202 and 203. It should be noticed that in Fig. 27 the gear 202 is not in mesh with the gear 210 nor is the gear 211 in mesh with gear 203. When the gear 211 is rotated power is transmitted to the sprocket wheel 212 to actuate the chain cutter 213 mounted on an upper cutter frame 214 the rear portion of which has a bearing 215 for the vertical shaft 216.

Between the shaft 217 which is keyed to the gear 211 is a collar 218 resting against the upper end of the sleeve 219 which is provided with a screw-threaded upper portion on which fits a nut 220. Fitting over the sleeve 219 is a collar 221 provided with laterally and downwardly extending bearings 222 and 223 and also with a forward bracket 224 having a rectangular vertical opening 225 therein through which extends the vertical bar 226 having a rack on its forward base for engagement by a worm 228 as shown in Fig. 25. The worm 228 is provided with a shaft 229 the ends of which are journaled in the bearings 230 which are mounted at the upper and lower ends of the bracket 224 as shown in Fig. 29. By means of the squared heads 231 the upper chain cutter frame may be adjusted in elevation, the shaft 217 sliding through the sleeve 219 but being splined thereto so that rotation of the bevel gear 211 will be transmitted to the sprocket 212.

It should be noted that the bearings 195 and 201′ in Fig. 27 are integral with the frame 197 which is secured to the frame 66. It is therefore evident that the worm gear 232 remains in fixed position and when the worm 233 is rotated its connection with the frame 222 will cause the upper kerf cutter to

be tilted on the bearings 195 and 201'. When the lower worm 234 is rotated its connection at 235 to the frame 204 will cause the lower kerf cutter to be tilted on the bearings 195 and 201'. By referring to Fig. 22 it will be seen that the upper worm 233 is provided with squared ends 236 for manual turning and the lower worm 234 is provided with squared ends 237 for manual turning. It will thus be seen that the upper and lower plane kerf cutter may be independently adjusted, and each adjusted so as to be in the corresponding planes of the upper and lower runs of the loop chain core cutter and therefore in converging relation. It should also be noted that the upper kerf cutter may have its elevation adjusted irrespective of what inclined position it may be in.

In Fig. 21 the dotted lines 238 illustrate approximately the position of the loop chain core cutter relatively to the plane kerf cutter. When the loop chain core cutter is omitted provision is made for supporting the hydraulic breaker from the frame which carries the upper plane kerf cutter. As shown in Figs. 22 and 25, a bracket 239 is detachably connected at 240 to the rear end of the cutter frame 214. As shown in Fig. 21, the bracket 239 is provided with a rearwardly extending arm 241 which is continued longitudinally of the plane kerf cutter and in the plane thereof as a supporting bar 242 for the breaking device secured thereto at 243. Said breaking device is similar to that shown in Figs. 12, 13 and 14. It should be understood that the breaking device is detachable from the supporting bar 242 and that said supporting bar is detachable from the frame 214 of the upper plane kerf cutter. As shown in Figs. 22 and 25, there are certain tilting and elevational adjustments of the upper plane kerf cutter but inasmuch as the supporting bar 242 is rigidly attached to the plane of the upper plane kerf cutter, such bar together with the breaking device attached thereto, will receive corresponding adjustment and therefore, always remain in the plane of the kerf cutter so as to follow in the kerf produced thereby.

In Fig. 5 the pumping apparatus is shown connected by a pipe 130 which may be of metal and does not require any flexible joints because flexible itself and fixed to the cutter frame and movable therewith. When it is desired to mount the pumping apparatus on the frame 66, particularly when the breaking device is connected to the bar 242, as shown in Fig. 21, a swivel joint 244 may be placed in the pipe 130 as shown at 244 in the diagrammatic illustration of Fig. 24. Also diagrammatically illustrated in Fig. 24 is an expansion joint 245 to permit the elevation of the breaking device to be varied together with the entire plane kerf cutter, relatively to the pumping apparatus. Both the swivel joint 244 and the expansion joint 245 may be of types well known to those skilled in the art.

As shown in Figs. 21 and 25, the plane kerf cutter frames may be made in sections 246 and 247 slidably fitted together at 248 to permit relative adjustment by means of the nuts 249 on the screw-threaded rod 250 which is connected at 251 to the cross piece 252 at one end, the other end passing through and opening in the plate 246 as shown in Fig. 21. By means of this adjustment the chain may be tightened or loosened as may be desired. Furthermore, by taking out or inserting links in the chain, the length of the chain cutter may be varied. The plane kerf cutters may be guided along the peripheral portion of the section 247 as shown in Fig. 23.

The conveyor apparatus is mounted to rotate with the rotary frame 44 and the forward section of the conveyor is movable up and down with the kerf cutting mechanism. As shown in Figs. 3 and 6, a supporting bracket is rigidly secured by means of the vertical plate 129 to the vertical plate 108 which may be integral with or rigidly fastened to the rotary hub 44 shown in Figs. 3, 4 and 6. The said supporting bracket designated 128 affords a suitable bearing support for the lower end of the vertical shaft 112 as shown at 127 in Fig. 5. A bevel gear 253 at the lower end of the vertical shaft 112 meshes with the bevel gear 254 which is mounted at one end of the shaft 255 rotatable in the bearings 256 and 257 and carrying at intermediate points the sprockets 258 and 259 for driving the sprocket chains of the endless conveyor, the inner sprocket chain 260 being shown in Fig. 10; additional sprockets 261 and 262 are provided on a cross shaft 263 at the rear end of the conveyor, as shown in Fig. 3. The cross shaft 263 may be mounted in bearings 264 and 265 on a conveyor frame 266 on which the bearings 256 and 257 are also mounted. The conveyor frame 266 may be constructed as shown in Fig. 9 wherein the chains 260 and 269 are connected by the cross pieces 270 in the usual manner.

While the front portion of the conveyor frame 266 is rigidly attached to the bracket plate 128 at 267 and 268, the rear portion of said conveyor frame may be connected at 271 and 272 to the horizontal bracket plate 273 which is in turn connected by the vertical plate 274 to the vertical plate 46 extending to the left from the hub 44 as shown in Fig. 3.

Pivotally connected at 275 and 276 is the forward conveyor frame 277 which is shown in cross section in Fig. 9. The bottom plate 278 of the conveyor frame 277 is extended laterally into a platform 279 to connect the space intervening between the forward section of the conveyor and the kerf cutting

mechanism. As shown in Figs. 6 and 9, an inclined plate 280 connects the platform 279 with the conveyor belt 270 so that the material will be moved more readily on to the conveyor as the cutter moves into the body of coal and causes the latter to project over the platform 279 and the inclined plane 280 on to the conveyor.

Since the supporting plates 273 and 128 occupy planes near the base frame 36 it is evident that the forward conveyor frame 277 may occupy a position resting on the floor of the mine chamber throughout its whole length or nearly so, as illustrated in Fig. 9 where the line 281 represents the floor level and the lower plate 278 is sliding directly thereon. Fig. 8 is shown associated with the conveyor in Fig. 9 approximately in positions which the parts will occupy when the kerf cutting mechanism is operating to include an undercut. The advantage of having the forward portion of the conveyor slide over the mine floor is that when material breaks away from the core and falls, the conveyor can better stand the blow when resting on the floor and the shock and jar of the falling material will not be transmitted to the rest of the structure to which it is pivoted at 275 and 276. The pivotal connections at those points may be made of sufficient strength to permit the forward conveyor to be pushed over the mine floor so that the platform 279 will act as a scoop irrespective of the height of the kerf cutting mechanism, or a flexible connection may be placed between the frame 66 and the conveyor 277 so as to pull the platform 279 along the floor of the mine chamber irrespective of the height of the kerf cutting mechanism.

I prefer, however, to provide a bracket plate 282 connected at 283 to the conveyor frame 277 back of the inclined plate 280 as shown in Fig. 6. Mounted on the plate 282, as shown in Figs. 6 and 7, is a bearing bracket 284 through which extends a short shaft 285 extending laterally from the bracket 286 which is connected at 287 to the frame 66, in such a manner that it will remain so attached even when the loop chain core cutter is removed and one or both of the plane kerf cutters is used. Being thus connected to the frame 66 the conveyor frame 277 will be lifted and lowered on the pivots 275 and 276 in harmony with the lifting and lowering of the frame 66. Inasmuch as the pivots 275 and 276 are near the pivots 60 and 63, the outer portion of the forward conveyor section will be lifted and lowered approximately to the same extent as the lower kerf cutter, thereby maintaining the platform 279 and the forward portion of the conveyor approximately in horizontal alignment with the lower kerf cutter for the various elevations thereof.

By referring to Fig. 4 it will be seen that the plate 273 carries a ring 288 which is provided with an internal annular bearing ring 289 engaged on opposite sides by a series of rollers 290 and 291, resting on the upper rollers 290 is an annular seat 292 of the hopper 293 to the cylindrical portion 294 of which is connected a circular plate 295 on which the lower rollers 291 rest.

Extending from the hopper 293 is a frame 296 as shown in Fig. 11. This frame carries an endless belt conveyor 297 adapted to extend over a mine car 298. Mounted on an intermediate portion of the conveyor frame 296 is a motor 299 geared to the sprocket 300 which actuates the endless belt conveyor 297.

It will be seen from the foregoing that the ring 288 which supports the hopper is rigidly connected to the rotary frame 44, therefore rotating when the cutting mechanism is fed through an arc. The rear conveyor is pivoted at its hopper end to the frame 44 and therefore, as the latter rotates, there will be relative swinging movement between the rear conveyor and the conveyor mounted directly on the frame 44. The end of the rear conveyor extending into the mine car, may be kept from swinging by the sides of the mine car itself and on account of the circular shape of the hopper and by reason of its pivotal connection with the rotary frame 44, the forward conveyor mounted thereon will always empty into the rear conveyor hopper over a wide range of arcuate movement of the cutting mechanism.

In order to assure proper conveyance of the material along the forward conveyor and to deflect material in some instances back onto the conveyor, inclined shields or deflecting plates 301 and 302 may be pivoted to the conveyor frames 266 and 277 on the sides thereof opposite the cutting mechanism. The plate 301 may be rigidly attached at 303 and 304 to the conveyor frame 266 and occupy a horizontal or inclined position as may be desired. The plate 302 is preferably pivoted at 305 and 306 as shown in Fig. 6 so that the plate may be held in horizontal position as shown in Fig. 9 or in an inclined position as shown in the dotted lines 307 in Fig. 9. It should be understood, however, that the plate 302 may also be inclined in the opposite direction. When in the position shown in 307 in Fig. 9 it may be used as an inclined plane to push onto the conveyor such material as may have accidentally scattered over the floor back of the conveyor.

When the spaced apart plane kerf cutters are used without the loop chain core cutters and it is desired to cut a kerf between the rear ends of the spaced apart plane kerfs, the structure illustrated in Fig. 34 may be attached to the conveyor frames 266 and 277 after the shelves 301 and 302 have been re-

moved. As shown in Fig. 3 the shaft 255 is made of sufficient length to project a distance from the opposite side of the conveyor frame 266. This permits the mounting of a bearing 308 and a bevel gear 309 on the extended portion of the shaft 255 as shown in Fig. 34. The bearing 308 is carried by a bracket 310 which is detachably connected at 311 to the frame 266. The bracket 310 also carries a bearing 312 through which extends a shaft 313 which has a bevel gear 314 at one end thereof in mesh with the bevel gear 309, and a universal joint 315 at the other end thereof for connection to a squared sliding rod 316 which fits into the sleeve 317. The latter is connected by a universal joint 318 to a shaft 319 mounted in the frame 320 and the outer end of which carries the sprocket wheel 321. The frame 320 is in reality a bracket detachably connected at 322 to the back of the conveyor frame 277, as shown in Fig. 35. The bracket 320 may be made in sections however, one section 320′ being rigidly connected to the conveyor frame 277 and the section 320 adjustably connected to the vertical plate of the bracket 320′ by means of the bolts 323 extending through the slots 324.

Suitably connected to the bracket 320 is a cutterhead 325 which may have adjustments for varying the slack in the chain 326. This is illustrated in Fig. 30 wherein the cutterhead is shown provided with rearward extending bars 327 and 328 connected at their rear ends by the crosspiece 329. It will be seen by referring to Fig. 31 that a grooved cap plate 330 is bolted to a grooved plate 331 which is fastened to the bracket frame 320. To the rear ends of the plates 330 and 331 is secured a screw-threaded rod 332 which extends through the crosspiece 329 and is provided with nuts 333 and 334 on opposite sides thereof.

By referring to Fig. 31 it will be seen that the shaft 319 is rotatably mounted or journaled in the bearing 335 in the bracket 320, and is provided with a squared recess into which fits the squared rod 336 of the shaft 337 to which the sprocket wheel 321 is connected. The curvature of the cutter head is such as to conform to the arc produced by the loop core cutter with a post 38 as the center of rotation. Notwithstanding such curvature, the cutter chain 226 may be suitably guided and operated without cramping or binding. The preferred form of chain cutter in guiding mechanism is illustrated in Figs. 32, 33 and 34.

Bolted or riveted to the peripheral edge of the curved plate 325, is an angle iron 338 fitting into a recess 339 so that its outer surface will be flush with the surface of the cutter bar 325. In a recess 340 on the opposite side are mounted a flat plate 341 and a hooked guide plate 342, the two together filling up the recess 340 so as to lie flush with the surface of the cutter bar 325. The cutter links 343 are each provided with an upwardly extending shoe and a downwardly extending shoe as shown at 344 and 345 in Fig. 33. The shoe 344, as shown in Fig. 32, fits into the guide groove formed by the hooked portion 346 of the plate 342. Downwardly extending shoe 345 fits into the groove between the inner end of the plate 338 and the inner surface of the plate 341. It will thus be seen that lateral thrusts on the cutters 347 will be resisted by the shoes 344 and 345 acting together in both directions of such thrust. The cutters 347 may be held in their sockets by the set screws 348. Intermediate successive cutter links are the chain links 349. Intermediate lengths 349 are also provided with offset shoes 350 which also run in the grooved guide 346 in alignment with the shoes 344. This can be seen by comparing the elevational view of the outside portion of the chain shown in Fig. 33, with the guide mechanism shown in Fig. 32.

After the entire mining and loading machine has been moved to the desired position by means of the ropes and rope runs the ceiling jack is operated to firmly hold the base frame and the vertical axle 37 in fixed position. The base frame 36 is held in fixed position preferably so that the vertical plate 46 will be diametrically opposite the chain cutter when in the central position shown in Fig. 1. By means of the fast rope drum 99 the cutting mechanism has been previously brought to initial position and the rear conveyor swung by the operator so as to extend over a mine car. Now by throwing in the clutch 91 the drum 96 may be turned to slowly feed the cutting mechanism forward while the latter is being actuated by power transmitted from the electric motor carried by the rotary frame 44. The first cut is preferably along the floor of the mine chamber and as it proceeds the breaking mechanism operates automatically and intermittently to break down sections of the core onto the platform or the forward portion of the floor conveyor. As the cutting proceeds the material will be received by the rotary frame conveyor and taken to the hopper of the rear conveyor. The relation between the rear end of the rotary frame conveyor and the hopper of the rear conveyor including the pivotal mounting of the rear conveyor, enables the cutting operation to be carried on through a range of 180° or more so that a complete cut of crescent shaped masses of material may be made from one side of the mine chamber to the opposite side thereof. After one crosscut has been made the cutting mechanism may be lifted to a higher position to make a new cut across the mine wall.

In addition to the loop chain core cutter there may be the plane kerf cutter added by

means of the structure shown in Figs. 25 and 26, and these plane kerf cutters may have the various adjustments illustrated, particularly for the purpose of placing them in alignment with the upper and lower runs of the loop chain core cutter and ahead thereof so that they may take the maximum strain during kerf cutting operation, the loop chain core cutter then operating to connect the kerfs at their rear ends. If desired, the loop chain core cutter may be detached in which event it may sometimes be desirable to add the upright arcuate cutter in the manner illustrated in Fig. 34 to cut a kerf between the rear end of the plane kerfs. It should be understood, however, that if the upright kerf cutter is made of the proper length, it may extend to a position immediately back of the frame of the loop chain core cutter so that when particularly hard material is encountered and it is desired to clear away the material left on account of the curved outer end portions of the loop chain core cutter, the upright arcuate kerf cutter may be used and operated at the same time that the loop chain kerf cutter is being operated and also in conjunction with the plane kerf cutter. When the loop chain core cutter is detached and the plane kerf cutter used either at top or bottom or in both positions, the upright kerf cutter may be extended in length so as to occupy a cutting position extending immediately back of the plane kerf cutter or even outside of the same when the kerf cutters which extend radially are not too long. It will thus be seen that by reason of the various attachments the machine is well adapted for cutting and dislodging coal in various localities where the character of the coal may vary in hardness.

Having thus described my invention and the preferred mechanism embodying the same, I wish it to be understood that I do not desire to be restricted to the exact construction disclosed herein. Obviously, those skilled in the art may make various changes in the details and arrangement of parts without departing from the spirit and scope of the invention as defined by the claims hereto appended.

What I claim and desire to have secured by Letters Patent of the United States, is:—

1. In a machine for undercutting, breaking down and loading coal, the combination of a frame movable in a curved path substantially parallel to a curved coal face, a low-down laterally projecting horizontal kerf cutter on said frame in position to undercut the coal to be removed, means for engaging the frame and causing it to move in a fixed arcuate path, an upright curved kerf cutter extending upwardly from the inner end of said horizontal kerf cutter, means for breaking down the coal, and means for removing the broken down coal, said breaking down and removing means performing their respective functions as the said kerf cutters are advanced to form the floor kerf and the next curved coal face.

2. In a machine for undercutting, breaking down and loading coal, the combination with a low-down horizontal movable kerf cutter for undercutting the coal to be removed, a coal-receiving plate behind and movable with the cutter in the plane of the bottom of the kerf cut thereby, means for guiding said cutter and said plate in a fixed arcuate path, means behind the cutter for breaking down coal onto the said plate, an upright curved kerf cutter in position to cut a curved kerf above and at the inner end of the horizontal floor kerf, and means for engaging the coal on the said plate and removing it, said breaking down and removing means performing their respective functions as the said cutters are advanced to form the floor kerf and the upright curved kerf.

3. In a mining machine for undercutting, breaking down and loading coal, the combination of a frame movable in a curved path substantially parallel to a curved coal face, a low-down laterally projecting horizontal kerf cutter on the frame for undercutting the coal to be removed, an upright curved kerf cutter in position to cut an upright curved kerf at the end of the horizontal kerf cutter, means for moving the frame in a fixed circular path, means behind the horizontal kerf cutter for breaking down coal, an endless conveyer mounted on the frame for engaging the broken down coal and removing it, said breaking down means and said conveyer performing their respective functions as the said cutters are advanced to form the horizontal and upright kerfs.

4. In a mining machine, the combination with a circular base plate, of a vertical axle projecting upwardly from the center thereof, a rotary frame mounted on said axle, cutting mechanism carried by said rotary frame, rope winding mechanism carried by said rotary frame, a plurality of spaced apart cleats at the peripheral portion of a part of said base plate, and a rope extending from said rope winding mechanism and adapted to be anchored to one of said cleats and guided by others.

5. In a mining machine, the combination with a supporting frame, of a rotary frame pivotally mounted thereon, a pair of rope winding devices mounted on said rotary frame, one for swinging said rotary frame in one direction and the other for swinging said rotary frame in the opposite direction to effect arcuate movement of said cutting mechanism in opposite directions relatively to said supporting frame, a pair of ropes connected to said winding devices and having their free ends adapted to be anchored in position to effect such swinging of said rotary frame, and two clutches operatable one at a

time to effect the rotation of only one rope winding device at a time.

6. In a mining machine, the combination with a main frame, of a supplemental frame, pivotally mounted thereon, cutting mechanism carried by said supplemental frame and movable therewith in position to cut along the floor of a mine chamber, and rope winding mechanism, adapted to be connected to said main frame for effecting a slow feeding movement of said cutting mechanism in one direction and a quick return movement thereof in the opposite direction.

7. In a mining machine, the combination with a main frame, of a supplemental frame, movable thereon, kerf cutting mechanism connected to said supplemental frame in position to cut a floor kerf, and rope drum winding mechanism connected between said frames near the floor for effecting a slow feeding movement of said cutting mechanism and a quick return movement thereof.

8. In a mining machine, the combination with a main frame, of a supplemental frame, cutting mechanism connected to said supplemental frame in position to cut in the plane of the floor, rope winding mechanism on said supplemental frame, and a rope connected to said winding mechanism and adapted to be guided on and anchored to said main frame substantially at the floor.

9. In a mining machine, the combination with a main frame, of a supplemental frame, cutting mechanism mounted on said supplemental frame, winding mechanism on said supplemental frame, and devices on said main frame for releasably holding the rope of said winding mechanism concentric to the movement of said supplemental frame.

10. In a mining machine, the combination with a main frame, of a supplemental frame pivoted thereto, cutting mechanism connected to said supplemental frame, rope winding mechanism on said supplemental frame, and a plurality of spaced apart cleats arranged circumferentially on said main frame concentric with the path of movement of said supplemental frame.

11. In a mining machine, the combination with a main frame, of a supplemental frame pivoted thereon, cutting mechanism connected to said supplemental frame, a pair of rope drums mounted on said supplemental frame, two clutches, one for each of said rope drums, means for throwing in one clutch upon the release of the other clutch, ropes connected to said drums and adapted to be anchored at their free ends to said main frame, and means for transmitting power to either of said rope drums to effect arcuate feeding movement of said cutting mechanism in or near the plane of the floor of the mine chamber.

12. In a mining machine, the combination with a supporting frame, of a supplemental frame movable relatively thereto, cutting mechanism mounted on said supplemental frame, means for driving said cutting mechanism, a track on said supporting frame adapted to be engaged by a sliding bearing on said supplemental frame, and rope gearing connected between said supplemental and supporting frames for holding said sliding bearing against said track while moving the supplemental frame relatively to said supporting frame to effect feeding movement of said cutting mechanism.

13. In a mining machine, the combination with a core cutter, of a frame therefor, a supporting frame to which said first named frame is pivotally connected, and counterbalanced mechanism associated with said cutter-frame for adjusting the elevation of said core cutter about its pivotal connection with said supporting frame.

14. In a mining machine, the combination with a supporting frame, of a rotary frame mounted thereon for movement relatively thereto on an upright axis, an arm on said rotary frame extending radially from such upright axis, a screw-threaded rod pivotally connected to said radial arm, cutting mechanism mounted on said rotary frame, and means comprising a counterbalancing spring associated with said screw-threaded rod for adjusting the position of said cutting mechanism relatively to said rotary frame.

15. In a mining machine, the combination with a supporting frame, of a kerf cutter, a frame therefor, a screw-threaded rod pivotally connected to said supporting frame, a nut mounted on said screw-threaded rod and connected to said kerf cutter frame, a wheel for turning said nut to effect adjustment of said kerf cutter frame, and a spring connected between said supporting frame and said kerf cutter frame to counterbalance the latter.

16. In a mining machine, the combination with kerf-cutting mechanism, of means for operating the same, a fluid-actuated device mounted on said kerf-cutting mechanism in position to enter the kerf produced thereby, and automatic mechanism for operating said fluid actuated device during the cutting action of said kerf-cutting mechanism to effect dislodgment of material from the mine wall.

17. In a mining machine, the combination with core-cutting mechanisms having an unobstructed core-opening extending therethrough, of means for operating the same, a breaking device in the plane of a section of said core-cutting mechanism and adapted to enter the kerf produced by said kerf-cutting mechanism, means for supporting said breaking device for automatic movement into such kerf during the cutting action of said kerf cutting mechanism, and means for expanding said breaking device to effect the operation thereof and the dislodgment of cut material.

18. In a mining machine, the combination

with a kerf cutter comprising a frame, of means for operating said kerf cutter including a feed thereof, a rod connected to said frame, a breaking device slidably mounted on said rod, means for operating said breaking device, and a spring for returning said breaking device to its initial position relatively to said frame after said breaking device has broken away material and is free to move along said kerf.

19. In a mining machine, the combination with supporting framework, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism, a breaking device mounted on said framework in position to move automatically into the kerf produced by said kerf-cutting mechanism, and means for operating said breaking device by causing the same to act with a hammer blow.

20. In a mining machine, the combination with supporting framework, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism, a breaking device mounted on said framework in position to move automatically into the kerf produced by said kerf-cutting mechanism, and automatic means for operating said breaking device intermittently.

21. In a mining machine, the combination with a breaking device adapted to move in a kerf in a mine wall, of means for supporting said breaking device, and apparatus for automatically and intermittently operating said breaking device.

22. The combination with a mining machine comprising framework and kerf-cutting mechanism supported thereby, of a breaking device supported by said framework in position to automatically move along the kerf produced by said kerf-cutting mechanism during feed of the latter, means for operating said breaking device by a fluid medium, and a spring for automatically moving forward the said breaking device after operating to break down the material.

23. In a mining machine, the combination with kerf cutting mechanism, of means for operating the same including continuous forward feed thereof, a breaking device having a frame slidably connected to said kerf cutting mechanism and following the same at intervals, and means for intermittently operating said breaking device during the continuous forward feed of said kerf cutting mechanism.

24. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, a breaking device mounted on said frame in position to follow automatically in the kerf produced by said kerf-cutting mechanism during the feed of the latter, pumping mechanism carried by said frame for operating said breaking device in the various positions thereof, and a spring for automatically restoring the relative position of said breaking device on said kerf-cutting mechanism.

25. In a mining machine, the combination with a loop chain core cutter having an unobstructed core opening therethrough, of a frame for supporting said core cutter, means for operating said core cutter, a plane kerf cutter adapted to be connected to said frame to move in alinement with one of the runs of said core cutter, and a detachable connection between said plane kerf cutter and the frame for said core cutter.

26. In a mining machine, the combination with a supporting frame, of a plurality of spaced-apart plane kerf cutters adapted to be connected to said frame, an upright arcuate kerf cutter adapted to be connected to said frame to follow the upright space between the outer ends of said plane kerf cutters, and detachable connections between each of said cutters and said supporting frame to permit all or any of them to be operated from the same source of power.

27. In a mining and loading machine, the combination with chain kerf-cutting mechanism, of a supporting frame, a supplemental frame for carrying said cutting mechanism on such an axis of rotation as to maintain the cutting plane radial as to such axis and thereby reduce the thickness of the kerf to a minimum, and conveyor mechanism having superposed portions traveling in opposite directions, and extending to a position back of said cutting mechanism to automatically receive substantially all of the cut material and carry it away from the mine wall toward loading position.

28. In a mining and loading machine, the combination with core-cutting mechanism, of means for operating the same, a conveyor having a pivoted section opposite the lower run of said core-cutting mechanism, means for adjusting the elevation of said kerf cutting mechanism, and means for connecting the pivoted section with the core-cutting mechanism whereby the elevation of said pivoted section is adjusted with said kerf cutting mechanism to correspond approximately with the elevation of the latter and to maintain such section approximately opposite the lower run of said core-cutting mechanism.

29. In a mining and loading machine, the combination with cutting mechanism, of a main frame, a supplemental frame mounted to swing in a general horizontal direction on said main frame, a tertiary frame mounted to swing upwardly and downwardly on said supplemental frame, conveyor mechanism having a section pivotally connected to said supplemental frame, and a pivotal connection between said tertiary frame and said pivoted conveyor section.

30. A mining and loading machine comprising framework, core cutting mechanism,

of means for operating the same, including arcuate feed thereof, of conveyor apparatus having a receiving end, movable in an arc at a predetermined distance from said core cutting mechanism, and a sector platform between said core cutting mechanism and said conveyor apparatus to receive material dislodged by said core cutting mechanism and directing such material onto said conveyor apparatus.

31. In a mining and loading machine, the combination with a main frame, of a supplemental frame mounted to swing on an upright axis on said main frame, a tertiary frame, kerf cutting mechanism mounted on said tertiary frame, means for swinging said supplemental frame on said main frame to secure arcuate feed of said kerf-cutting mechanism, means for actuating said kerf-cutting mechanism, a transverse pivotal connection between said tertiary frame and said supplemental frame, means for adjusting the height and inclination of said tertiary frame and said kerf-cutting mechanism, conveyor apparatus having a forward section pivoted to said supplemental frame near said transverse pivotal connection, a pivotal connection between said tertiary frame and said forward conveyor section to transmit upward and downward movement to the latter, the arrangement being such that said conveyor section will have approximately the same inclination as said kerf-cutting mechanism as well as approximately the same height thereof, and a sector platform between said kerf-cutting mechanism and said forward conveyor section.

32. In a mining machine, the combination with a loop chain core cutter, of a frame for supporting the same, means for operating said core cutter including the feed thereof, a plane kerf cutter, and means for detachably connecting said plane kerf cutter to said operating means for operation thereby in the plane of one of the runs of said core cutter.

33. In a mining machine, the combination with a loop chain core cutter, of a frame for supporting the same, operating means for said core cutter to effect the actuation and the feed thereof, a plurality of spaced apart plane kerf cutters, an additional frame for carrying said plane kerf cutters in positions near said core-cutter, and means for detachably connecting said additional frame to said first named frame and connecting said plane kerf cutters to said operating means for operation thereby simultaneously with the operation of said core cutter.

34. In a mining machine, the combination with a core cutter, of a plane kerf cutter operating in the plane of one of the runs of said core cutter, and means for adjusting the position of said plane kerf cutter relatively to said run.

35. In a mining machine, the combination with a loop chain core cutter, of two spaced apart plane kerf cutters, means for carrying said plane kerf cutters for operation in the planes of spaced apart runs of said core cutter, and means for independently adjusting the position of each of said plane kerf cutters relatively to its corresponding run of said core cutter.

36. In a mining machine, the combination with core cutting mechanism having upper and lower straight runs, of a supporting frame, an additional frame detachably connected to said supporting frame, and carrying said core cutting mechanism, two spaced apart plane kerf cutters, means for adjusting the inclinations of said plane kerf cutters to correspond with the planes of feeding movement of said upper and lower straight runs, and means for operating said core cutting mechanism and said plane kerf cutters including the feed thereof.

37. In a mining machine, the combination with a supporting frame, of an additional frame connected to said supporting frame, loop chain core cutting mechanism mounted on said additional frame and having upper and lower straight runs, two spaced apart plane kerf cutters for operation in the planes of said upper and lower straight runs, means for adjusting the inclination of each of said plane kerf cutters to correspond with the plane of movement of the corresponding run of said core cutter, and means for operating said core cutter and said kerf cutters simultaneously to effect the cutting of a core of material in its native bed.

38. In a mining machine, the combination with a loop chain core cutter, of an arcuate kerf cutter for operation approximately in the same path of travel as the inner run of said loop chain core cutter, and means for operating said core cutter and said kerf cutter including the feed thereof.

39. In a mining and loading machine, the combination with mechanism for cutting spaced apart plane kerfs horizontally across a mine wall, of a frame for supporting said kerf cutting mechanism for arcuate feeding movement, of loading apparatus comprising a conveyor having superposed portions traveling in opposite directions and extending to a position back of said kerf cutting mechanism and in position on said supporting means to follow said kerf cutting mechanism in its arcuate feeding movement, and an upright arcuate kerf cutter mounted on said supporting means to operate at or near the inner ends of the kerfs produced by said first named kerf-cutting mechanism.

40. In a mining and loading machine, the combination with mechanism for cutting a single core of material, of loading apparatus comprising a traveling conveyer operating transversely of the direction of feeding movement of said core-cutting means and

mounted to follow the latter, and a shield pivotally connected to said conveyer to prevent the falling off from said conveyer of material received thereby from said core-cutting means.

41. In a mining machine, the combination with a kerf-cutter comprising a frame, of means for operating said kerf-cutter including the feed thereof, a breaking device connected to said frame to move therewith, means for operating said breaking device during the feed of said kerf-cutter, and means for automatically restoring said breaking device to its initial position relative to said kerf-cutter upon the discontinuance of the operation of said breaking device.

42. In a mining machine, the combination with a kerf-cutter comprising a frame, of means for operating said kerf-cutter including the feed thereof, a breaking device slidably connected to said frame in position to enter the kerf and act on the walls thereof, means for operating said breaking device during the feed of said kerf-cutter, and a spring for returning said breaking device to its initial position relatively to said frame.

43. In a mining machine, the combination with a kerf-cutter comprising a frame, of means for operating said kerf-cutter including the feed thereof, a rod rigidly connected to said frame to extend backwardly along the kerf cut by said kerf-cutter, a flat hydraulic breaking device slidable along said rod in position to extend along the kerf cut by said kerf-cutter, means for operating said breaking device to break down material, and a spring on said rod for restoring said breaking-device to initial position relative to said frame.

44. In a mining and loading machine, the combination with loop chain core-cutting mechanism having an unobstructed core-opening therethrough, of a main supporting frame for said core-cutting mechanism, means for adjusting the elevation of said core-cutting mechanism, means for operating said core-cutting mechanism to cut a single core of material during each feeding movement at adjusted elevation, an expansible breaking-down device back of the core-cutting mechanism in position to act on the core extending through said unobstructed core-opening, and endless conveyer mechanism connected to said supporting frame and extending into position to receive the material broken down by said breaking-down device and transferring such material toward loading position.

45. In a mining and loading machine, the combination with a main supporting frame, of an anchoring jack for holding said supporting frame stationary between the floor and roof of the mine chamber, a supplemental frame mounted on said main frame for rotary movement on an upright axis, loop chain core-cutting mechanism having an unobstructed core-opening therethrough and mounted on said supplemental frame for adjustment in elevation, means for adjusting the elevation of said core-cutting mechanism, a hydraulic breaking device in position to act on the core extending through said unobstructed core opening to break down the material of said core, endless conveyer mechanism mounted on said supplemental frame and movable arcuately therewith and extending to a receiving position back of the range of operation of said core-cutting mechanism and of said hydraulic breaking device, and a loading conveyer pivotally connected to said supplemental frame in position to receive material from said first-named conveyer in its various positions and transfer such material to a mine car.

46. In a mining and loading machine, the combination with a main frame, of a supplemental frame mounted for arcuate movement on an upright axis on said main frame, core-cutting mechanism connected to said supplemental frame to move therewith, endless conveyer mechanism spaced from said upright axis and extending from the rear portion of said supplemental frame to receiving position approximately in the plane of the bottom of the core, hydraulic breaking-down mechanism connected to said core-cutting mechanism to act on the core extending through the unobstructed core-opening of said core-cutting mechanism, and mechanism spanning the space between the core-cutting mechanism and the conveyer mechanism at the bottom of the core to support the broken down material until forward feed of the core-cutting mechanism forces such broken down material onto said conveyer mechanism.

47. In a mining and loading machine, the combination with a stationary main frame, of a supplemental frame mounted on said main frame for rotary movement on an upright axis, loop chain core cutting mechanism having an unobstructed core opening therethrough and mounted on said supplemental frame to move bodily therewith, a motor mounted on said supplemental frame and movable bodily therewith, means connected between said motor and said core cutting mechanism for driving the latter, conveyer mechanism comprising a plurality of sections extending from a forward position approximately back of the lower portion of said loop chain core cutting mechanism, across the supplemental frame back of said upright axis relative to the direction of feed of said core cutting mechanism, the rear section of said conveyer mechanism being pivotally connected to the forward portion thereof at the rear portion of said supplemental frame to permit the sections of said conveyer mechanism to maintain delivery communica-

tion and to permit the rear end of the rear section to reciprocate and remain in delivery communication with a mine car on a track during the rotary movements and arcuate feeding of said core cutting mechanism, means for moving said supplemental frame together with said core cutting mechanism and the forward portion of said conveyer mechanism on said upright axis to secure arcuate feeding movement of said core cutting mechanism, and breaking mechanism for dislodging the cut material into position to be received by the forward portion of said conveyer mechanism.

48. In a mining machine, the combination with kerf cutting mechanism, of means for operating the same including the feed thereof, a fluid actuated breaker adapted to move with said kerf cutting mechanism into the kerf produced thereby, a pump, means for operating said pump to exert fluid pressure in said breaker, accumulator mechanism, and means for effecting the sudden operation of said breaker during the feed of said cutting mechanism to break the material from the unmined mass approximately in predetermined positions.

49. In a mining machine, the combination with kerf cutting mechanism, of means for operating the same including the feed thereof, a fluid actuated breaking device adapted to follow said kerf cutting mechanism in the kerf produced thereby, and means for intermittently operating said breaking device while the kerf cutting mechanism continues its feeding movement, and means for automatically restoring the position of said breaking device relative to said kerf cutting mechanism when the fluid pressure in said breaking device is released.

50. In a mining machine, the combination with loop chain core cutting mechanism comprising a cutter frame having an unobstructed core opening therethrough, of means for operating said core cutting mechanism including the feed thereof, a fluid pressure breaking device carried by said cutter frame and movable therewith into the kerf produced thereby, means for operating said breaking device, and accumulator mechanism to effect sudden operation of said breaking device during the feed of said cutting mechanism to break off the core material in predetermined positions and before the core is materially increased by such continuous feed.

51. In a machine for undercutting, breaking down and loading coal, the combination with a supporting frame, of a supplemental frame mounted on said supporting frame for movement in a curved path on an upright axis and substantially parallel to a curved coal face, a laterally projecting kerf cutter mounted on said supplemental frame to cut a kerf in a plane extending longitudinally of the mine vein, means for operating said kerf-cutting mechanism including the feed thereof by swinging said supplemental frame on said upright axis while said supporting frame remains stationary, means behind the cutter in position to act in the kerf produced thereby, to break down the cut coal from the mine vein, and conveyer mechanism mounted on said supplemental frame and movable therewith in position relative to said kerf-cutting mechanism to receive the dislodged coal and convey it toward loading position during the feed of said kerf-cutting mechanism.

52. In a machine for under-cutting, breaking down and loading coal, the combination with a main frame, of a supplemental frame mounted on said main frame for arcute movement relatively thereto on an upright axis, loop chain core cutting mechanism comprising a lower run adapted to cut a horizontal kerf approximately at the floor of the mine chamber, a coal receiving plate behind the said lower run of the core cutting mechanism and in the plane of the said horizontal kerf, means behind the kerf cutting mechanism for breaking coal down onto said plate, conveyer mechanism mounted on said supplemental frame and movable therewith, said conveyer mechanism being in position to receive the dislodged material and convey it toward loading position, and means for simultaneously operating said core cutting mechanism and said conveyer mechanism and intermittently operating said breaking down means.

53. In a mining machine for under-cutting, breaking down and loading coal, the combination with a main frame, of a supplemental frame mounted on said main frame for arcuate movement on an upright axis, core cutting mechanism having an unobstructed core opening therethrough and comprising a chain cutter having a lower run in an approximately horizontal plane, means for operating said core cutting mechanism including feed thereof in a curved path along a curved coal face, means behind the cutting mechanism for breaking down the coal core, and endless conveyer mechanism mounted on said supplemental frame and movable therewith while occupying a position relative to said core cutting mechanism and said breaking down means to receive the coal as fast as dislodged and gradually convey it toward loading position.

54. In a coal mining and unloading apparatus, the combination with supporting framework, of a motor thereon, power devices for moving the framework to a coal face, cutting mechanism for forming a horizontal kerf at the bottom of the coal, a plate carried by the framework and extending to a position approximately in the plane of the horizontal kerf, a vertically arranged plate supported on said framework, vertical kerf cutting mechanism mounted on said vertical plate, breaking

down mechanism, power transmitting devices for the vertical kerf cutting mechanism arranged in the space behind the breaking down mechanism, and a power actuated conveyor having its receiving end below the breaking down mechanism.

55. In coal mining apparatus, the combination with supporting framework movable horizontally around a fixed vertical axis, of a base plate adapted to move bodily in the plane of the kerf under the coal that is being mined, a vertically arranged cutter chain at the inner end of said plate, means for supporting said cutter chain, means for breaking down coal to form a broken face intersecting the front face and adapted to cause the dislodged or undermined coal to fall on upright lines relatively near the front edge of the plate, and means behind the broken face of the coal for driving the vertical cutter.

56. A mining and loading machine comprising an undercutter, a plate having a receiving end in the plane of the kerf cut by said undercutter, an upright kerf-cutter, expansible breaking mechanism carried by said upright kerf-cutter, and loading apparatus for taking the material broken down and received by said plate and moving such material toward loading position.

57. In a machine for undercutting, breaking-down and loading coal, the combination with a horizontally movable kerf-cutter for undercutting coal to be removed, hydraulically expansible means behind the cutter for breaking-down the coal, means for removing the broken-down coal, a plate filling the floor space between said cutter and said removing means, and mechanism for guiding said cutter and said plate in a fixed circular path while the aforesaid mining operations are carried on.

58. In a mining and loading machine, the combination with a frame movable in a curved path, a kerf-cutter for under-cutting coal to be removed, means for moving the frame in a fixed circular path, expansible pressure-exerting means behind the cutter for breaking down the coal, an endless conveyer on the frame spaced from said cutter and movable bodily therewith, and means spanning the entire floor space back of said cutter in position for receiving the coal as dislodged and directing it onto said conveyer as the feeding of said cutter continues into the unmined mass.

59. In a mining machine, the combination with a supporting base adapted to rest upon and slide over the floor of the mine, a main frame upon the base adapted to rotation about a vertical axis, a vertically disposed loop-shaped cutter frame projecting laterally from the main frame, cutting devices carried by the cutter frame adapted to sever a section of material from the mine wall, and means to either rotate the main frame relative to the base or to move the machine bodily relative to the mine wall to cause the cutting devices to engage the material to be mined.

60. In a mining machine, the combination with a supporting frame, of a pair of spaced-apart plane kerf-cutters mounted on said frame and each comprising a flat cutter frame and an endless cutter chain adapted to travel thereon, means for operating said kerf-cutter including the simultaneous feed thereof, and flat expansible pressure-exerting mechanism connected to one of said kerf-cutters in position to enter the corresponding kerf and exert pressure on the walls of the latter independently of the feed of said kerf-cutters without retracting the kerf-cutters from the mine vein.

61. In an apparatus for mining coal, the combination with a main frame adapted to be moved along lines parallel to the coal face, cutting mechanism projecting horizontally from said main frame and adapted to form a horizontal kerf in the coal, a conveyor in fixed relation with said cutter mechanism adapted to be carried into the kerf formed thereby, cutting mechanism mounted upon said main frame and movable relative thereto, means to move said cutting mechanism relative to said main frame to form a vertical kerf in the coal, and hydraulically actuated pressure exerting mechanism carried by said movable cutting mechanism into said vertical kerf to exert pressure transversely thereof to break down the coal upon said conveyor as for the purpose set forth.

62. In apparatus for mining coal, the combination with a main frame adapted to be moved along lines parallel to the coal face, of cutting mechanism projecting horizontally from said main frame and adapted to form a horizontal kerf in the coal, a conveyor in fixed relation with said cutting mechanism adapted to be carried along the plane of the kerf formed by said cutting mechanism, cutting mechanism mounted on said main frame in position to form a vertical kerf in the coal, and hydraulically actuated pressure exerting mechanism carried by said last-named cutting mechanism into said vertical kerf to exert pressure transversely thereof to break down the coal upon said conveyor as and for the purpose set forth.

63. In a mining machine, the combination with supporting framework, of kerf-cutting mechanism mounted thereon, a device mounted on said framework outside of the boundary of said kerf-cutting mechanism in position to move with the same into the kerf produced by the latter and operable by a fluid medium to effect the breaking down of material adjacent said kerf, means for operating said kerf-cutting mechanism, and means for operating said breaking down device during the cutting action of said kerf-cutting mechanism.

64. In a mining machine, the combination with supporting framework, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism including the feed thereof, a breaking device mounted on said framework outside of the boundary of the kerf-cutting mechanism in position to follow the same into the kerf produced thereby, and means for operating said breaking device independently of the feed of said kerf-cutting mechanism and over a flat surface and substantially at right angles to the plane of said kerf while said breaking device occupies a position in said kerf back of said kerf-cutting mechanism.

65. In a mining and loading machine, the combination with a supporting frame, of kerf-cutting mechanism, a supplemental frame, for carrying said kerf-cutting mechanism, said supplemental frame being pivoted to said supporting frame to permit said kerf-cutting mechanism to be adjusted in elevation, means for so adjusting said kerf-cutting mechanism, conveyer mechanism having a forward section pivotally mounted at its rear end near the pivot of said supplemental frame and comprising superposed portions traveling in opposite directions along lines parallel to said kerf-cutting mechanism and adjacent thereto, and a connection between said supplemental frame and said forward conveyer section to cause the latter to be elevated and lowered corresponding to the elevation of said kerf-cutting mechanism.

66. In a mining and loading machine, the combination with core-cutting mechanism, of conveyer mechanism mounted back of said core-cutting mechanism to travel along lines extending transverse of a core cut by said core-cutting mechanism, and means for receiving and directing the dislodged material from said core-cutting mechanism onto said conveyer mechanism.

67. In a mining and loading machine, the combination with core-cutting mechanism, of conveyer apparatus comprising superposed portions with the upper portion traveling along lines transversely of the core cut by said core-cutting mechanism, and means for directing the dislodged material onto one side of said conveyer apparatus.

68. In a mining and loading machine, the combination with core-cutting mechanism, of a traveling conveyer extending transversely of the core cut by said core-cutting mechanism in position to receive material dislodged from the core projecting through said core-cutting mechanism, and means continuously following said core-cutting mechanism for directing dislodged material onto said conveyer.

69. In a mining and loading machine, the combination with a plurality of spaced-apart kerf-cutters, of a core-cutter having an unobstructed core-opening therethrough and extending along the kerfs produced by the spaced-apart kerf-cutters, means for operating said spaced-apart kerf-cutters and said core-cutter to cut a core of material in a mine wall, and loading apparatus comprising a traveling conveyer having superposed portions moving in opposite directions, the upper portion being in position to receive the dislodged material from said core-cutter and convey such dislodged material toward loading position.

70. A machine for undercutting, breaking down and loading coal comprising supporting framework, mechanism for dislodging coal from a mine wall comprising kerf-cutting means mounted to swing on a horizontal axis for adjustment in elevation, loading apparatus pivotally connected to said framework for adjustment in elevation in accordance with the adjustment of elevation of the kerf-cutting means, and a plate connected to the loading apparatus and pivoted to the kerf-cutting means in position to rest on the floor of the mine chamber to receive the coal as it falls, the impact of the falling material being transmitted to said plate directly to such floor without jarring said framework or said dislodging mechanism.

71. A machine for undercutting, breaking down and loading coal comprising a frame movable in a curved path, kerf-cutting mechanism pivoted to said frame for adjustment relatively thereto in elevation on a horizontal axis to positions for undercutting the coal to be removed, means for operating said kerf-cutting mechanism including movement of said frame in a fixed circular path to secure feed of said kerf-cutting mechanism, means in position for breaking the coal after being cut, a conveyer in position back of the kerf-cutting mechanism and pivotally connected to said frame for adjustment in elevation relative to said frame, a plate completely spanning the space between said conveyer and said kerf-cutting mechanism in position to receive the dislodged material and prevent the latter from falling on the floor of the mine chamber, and a pivotal connection between said conveyer and said kerf-cutting mechanism.

72. In a mining machine, the combination with a kerf-cutter comprising a cutter-frame and an endless cutter-chain mounted thereon, of an expansible pressure-exerting device adapted to move therewith into the kerf cut by said kerf-cutter, said pressure-exerting device being mounted outside of the boundary of said kerf-cutter and comprising pressure-exerting plungers movable in opposite directions each relatively to said cutter-frame and a spring between said plungers, and means for operating said kerf-cutter including feed thereof while moving said pressure-exerting device along the kerf cut by said kerf-cutter.

73. In a mining machine, the combination with a supporting frame, of a kerf-cutter mounted on said frame and comprising a cutter-frame and an endless chain-cutter, a pressure-exerting mechanism supported by said cutter-frame outside of the boundary of said kerf-cutter but in position to enter the kerf cut by said kerf-cutter, said pressure-exerting mechanism comprising pressure-exerting plungers movable in opposite directions relatively to each other and each relatively to said cutter-frame, and a frame extending between the plungers in position to act thereon to move each relatively to said cutter-frame.

74. In a mining machine, the combination with kerf-cutting mechanism comprising a cutter-frame and an endless chain-cutter adapted to travel thereon, of means for driving said chain-cutter, means for moving said frame and said chain-cutter bodily to effect feeding of said chain-cutter, flat expansible mechanism connected to said cutter-frame to lie in the plane of the adjacent portion thereof in position to be carried into the kerf produced by said kerf-cutter and move along such kerf during continued feeding of said kerf-cutter, and means independent of said feeding means for operating said expansible mechanism to exert pressure transversely of said cutter-frame on the walls of the kerf produced by said kerf-cutting mechanism.

75. In a mining machine, the combination with a supporting base adapted to rest upon and slide over the floor of a mine, of a main frame upon the base adapted for rotation about an upright axis, core-cutting mechanism mounted on said main frame, and means to either rotate the main frame relatively to the said base to effect feeding movement of said core-cutting mechanism or to move the machine bodily relatively to the mine wall to position the mining machine for another operation.

76. In a mining machine, the combination with a supporting frame, of a supplemental frame pivoted thereto for swinging movement, kerf-cutting mechanism comprising means for cutting spaced-apart plane kerfs mounted on said supplemental frame for swinging feeding movement therewith, means for driving said kerf-cutting mechanism, means for swinging said supplemental frame to effect feeding movement of said kerf-cutting mechanism on the axis of the pivotal connection between the supplemental frame and supporting frame, and an arcuate kerf-cutter detachably connected to said operating means and comprising a sector-cylindrical frame with a chain-cutter thereon and mounted for operation at or near the inner ends of the kerfs produced by said kerf-cutting mechanism and between such kerfs.

77. In a mining machine, the combination with a supporting frame, of a supplemental frame pivoted thereto for swinging movement, kerf-cutting mechanism comprising means for cutting spaced-apart plane kerfs mounted on said supplemental frame for swinging feeding movement therewith, means for driving said kerf-cutting mechanism, means for swinging said supplemental frame to effect feeding movement of said kerf-cutting mechanism on the axis of the pivotal connection between said frames, and an arcuate kerf-cutter comprising a sector-cylindrical frame with a chain-cutter thereon and mounted for operation at or near the inner ends of the kerfs produced by said kerf-cutting mechanism and between such kerfs.

78. In a mining machine, the combination with spaced-apart plane kerf-cutters, of means for supporting said kerf-cutters for arcuate feeding movement, an upright arcuate kerf-cutter mounted on said supporting means for operation at or near the inner ends of said plane kerf-cutters and between the same, said arcuate kerf-cutter comprising a forwardly extending cutter frame with a chain-cutter thereon, means for operating said plane kerf-cutter and said upright arcuate kerf-cutter including arcuate feed of all of said kerf-cutters to effect the dislodgment of a crescent-shaped mass of material, and a conveyer comprising superposed portions traveling in opposite directions and mounted adjacent said kerf-cutters.

79. In a mining machine, the combination with cutting mechanism comprising a frame, of means for operating said cutting mechanism including the feed thereof, a rod connected to said frame, a breaking device slidably mounted on said rod, means for operating said breaking device, and means for returning said breaking device to its initial position relative to said frame after said breaking device has operated and is free to move.

80. In a mining machine, the combination with supporting framework, of cutting mechanism mounted thereon, means for operating said cutting mechanism to produce an opening in material to be mined, a breaking device mounted in position to move into the opening produced by said cutting mechanism, and means for operating said breaking device by causing the same to act with a hammer blow while in such opening.

81. In a mining machine, the combination with supporting framework, of cutting mechanism mounted thereon, means for operating said cutting mechanism to produce an opening in the material to be mined, a breaking device mounted in position to move into the opening produced by said cutting mechanism, and automatic means for operating said breaking device intermittently.

82. In a mining machine, the combination with cutting mechanism, of means for operating the same including continuous forward

feed thereof, a breaking device having a frame slidably connected to said cutting mechanism and following the same at intervals, and means for intermittently operating said breaking device during the continuous forward feed of said cutting mechanism.

83. In a mining machine, the combination with kerf-cutting mechanism comprising a cutter-frame and an endless chain-cutter adapted to travel thereon, of means for driving said chain-cutter, means for moving said frame and said chain-cutter bodily to effect feeding of said chain-cutter, flat expansible mechanism connected to said cutter-frame to lie in the plane thereof in position to be carried into the kerf produced by said kerf-cutter, said flat expansible mechanism having smooth kerf wall engaging surfaces adapted to move freely in all directions in the plane of the kerf and along the latter during continued feeding of said kerf-cutter, and means independent of said feeding means for operating said expansible mechanism to exert pressure transversely of said cutter-frame on the walls of the kerf produced by said kerf-cutting mechanism.

84. In a mining machine, the combination with a supporting frame, of a plane kerf-cutter comprising an endless chain-cutter adapted to travel on a flat cutter-frame connected to said supporting frame to move bodily therewith, means for moving said frames to effect feeding of said kerf-cutter to cut a plane kerf, and an expansible pressure-exerting device having spaced-apart flat parallel smooth engaging surfaces adapted to slide freely along the kerf walls in all directions in the plane of the kerf, said device being connected to said cutter-frame outside of the boundary thereof but in position to travel into the kerf produced by said kerf-cutter and act to produce pressure on the walls of said kerf without removing the kerf-cutter and independently of said feeding means.

85. In a mining machine, the combination with a plane kerf-cutter comprising a cutter-frame and an endless chain-cutter adapted to travel around said cutter-frame, of means for operating said kerf-cutter including the feed thereof, and a pressure-exerting device operable independently of said operating means and connected to said cutter-frame in predetermined relation thereto and outside of the boundary thereof but for movement as a whole relatively to said cutter frame and in position to be carried thereby into the kerf cut by said kerf-cutter during the feed of the latter.

86. In a mining machine, the combination with a supporting frame, of a cutter-frame rigidly connected to said supporting frame to move bodily therewith, a chain-cutter on said cutter-frame, means for driving said chain-cutter, means for moving said supporting frame to effect feeding of said chain-cutter, and pressure-exerting mechanism having kerf wall engaging surfaces both of which are movable relatively to said cutter-frame but connected to the latter outside of the boundary thereof to move bodily therewith into the kerf cut by said chain-cutter, said pressure-exerting mechanism being operable independently of the feeding of said chain-cutter.

87. In a mining machine, the combination with a supporting frame, of a plane kerf-cutter mounted thereon and comprising a flat cutter-frame and an endless chain-cutter adapted to travel thereon, means for operating said kerf-cutter including the feed thereof, flat expansible pressure-exerting mechanism adapted to slide along the kerf walls and to exert pressure on such walls, and mechanism for connecting said pressure-exerting mechanism to said cutter-frame to permit a limited degree of forward feeding movement of said kerf-cutter relatively to said pressure-exerting mechanism while the latter exerts pressure on the walls of the kerf and is in a stationary position relative thereto.

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