June 9, 1931. E. C. MORGAN 1,809,282

MINING AND LOADING MACHINE

Original Filed May 19, 1921 5 Sheets-Sheet 1

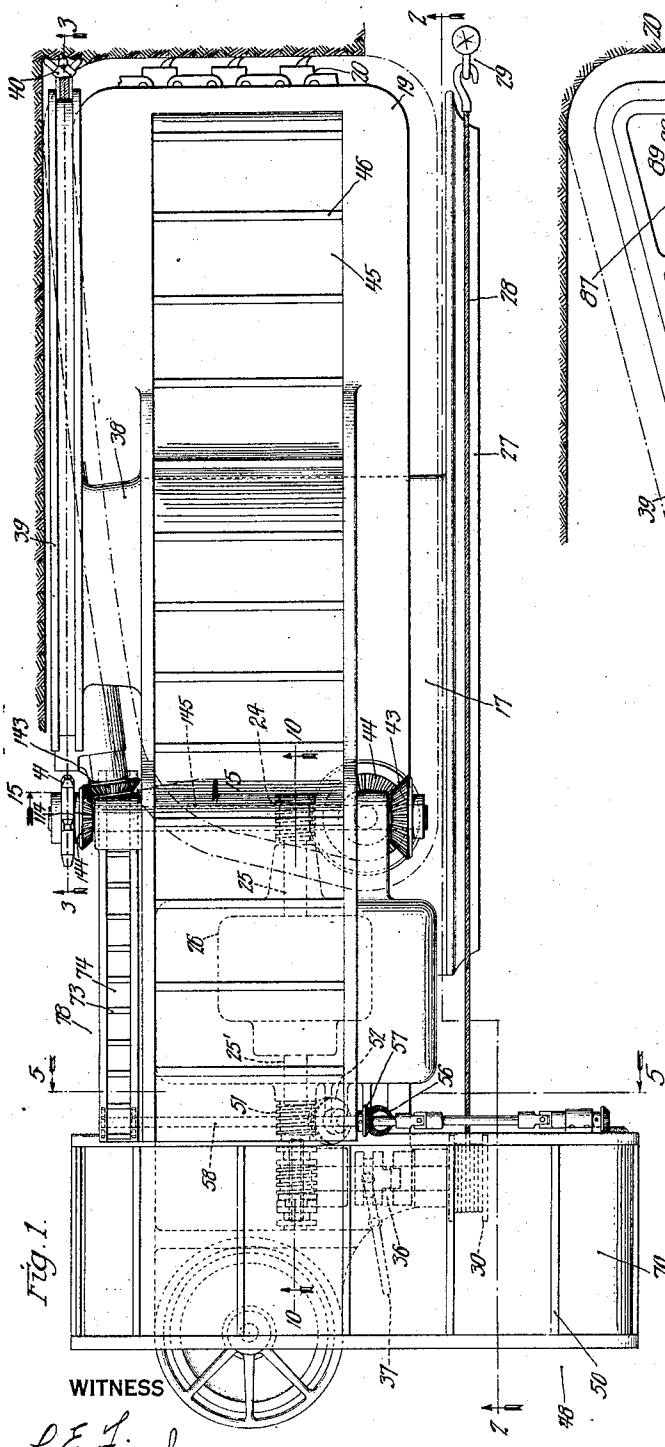

Fig. 1.

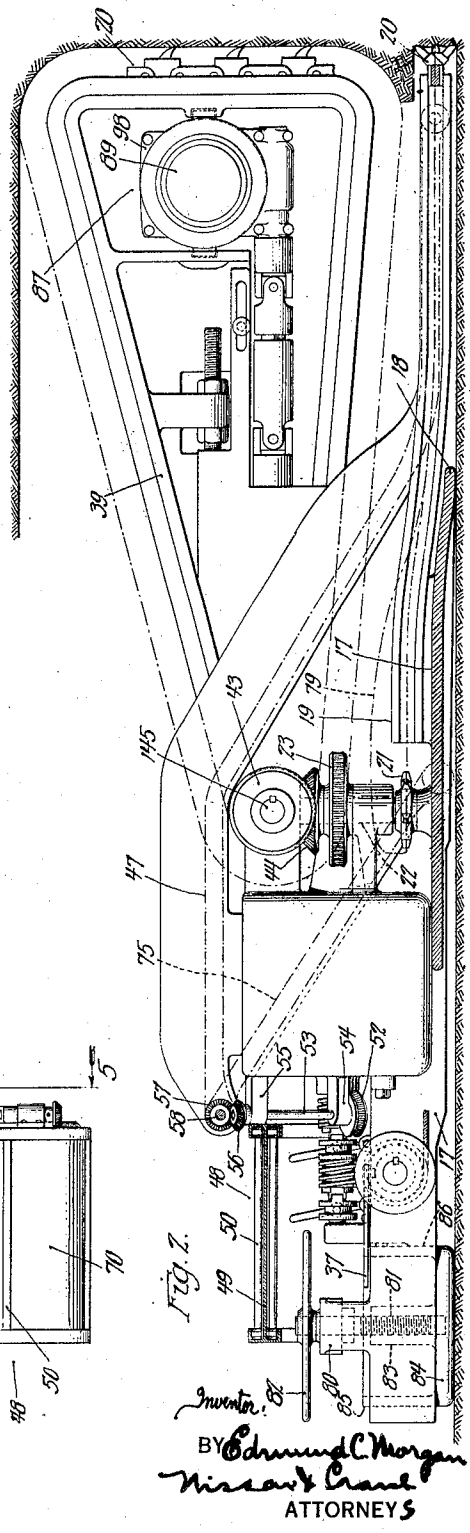

Fig. 2.

WITNESS

L. E. Fischer

Inventor,

BY Edmund C. Morgan

Nissen & Crane

ATTORNEYS

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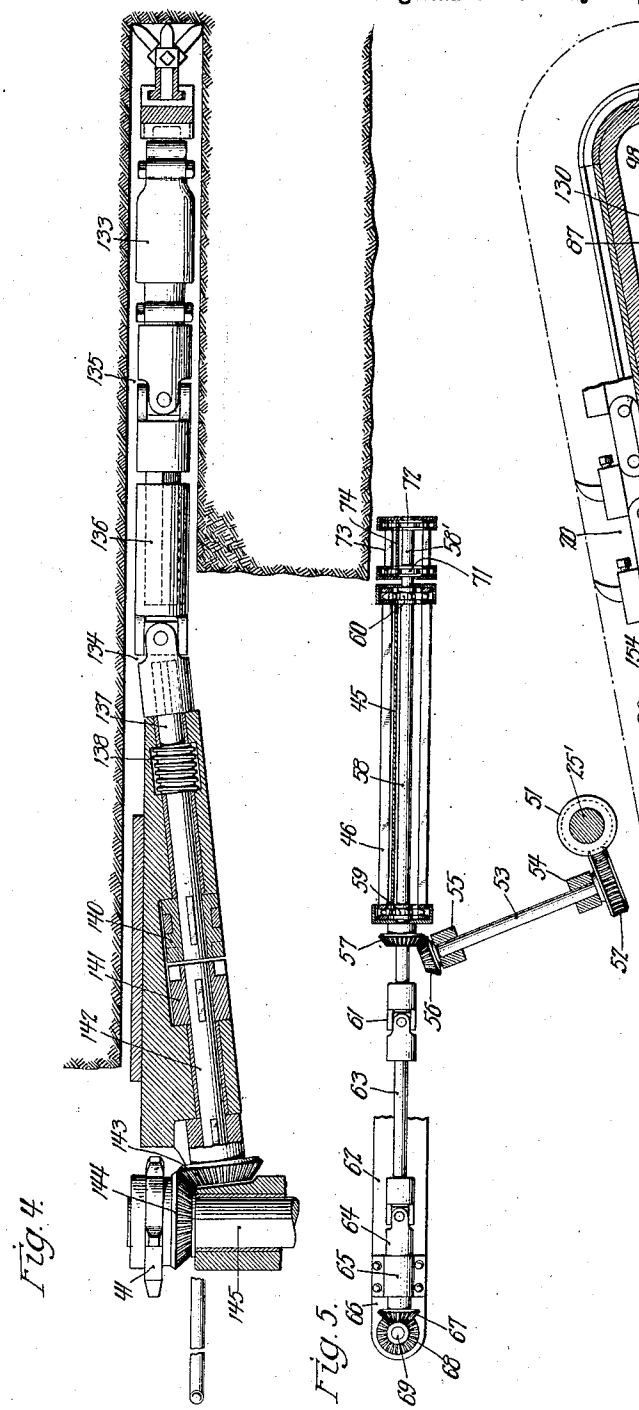

Fig. 4.

Fig. 5.

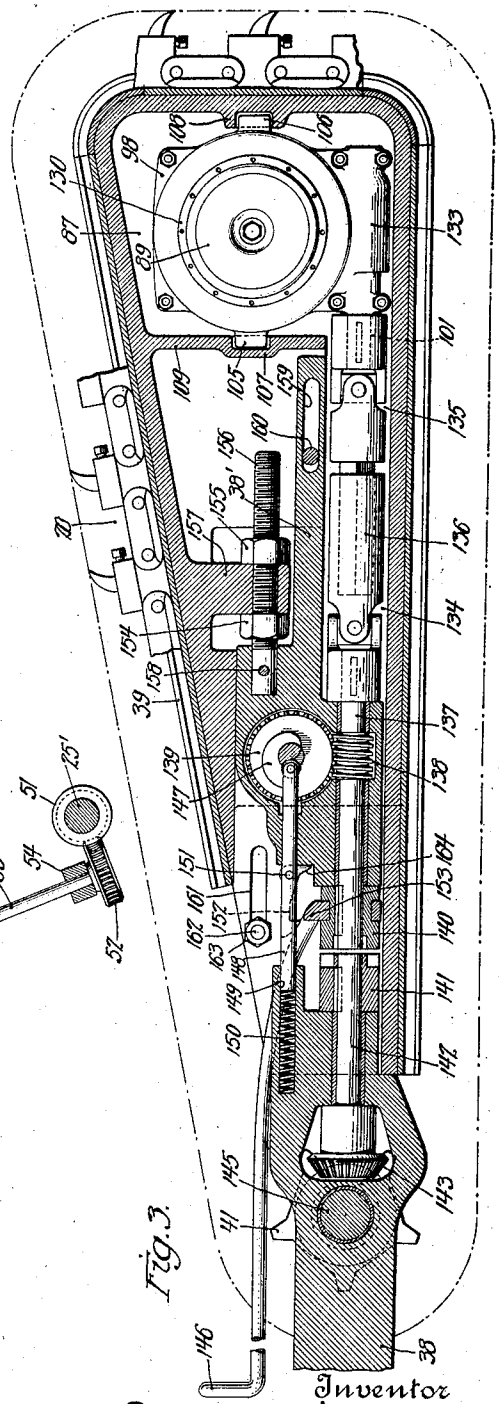

Fig. 3.

Witness
L. E. Fischer.

Inventor
Edmund C. Morgan
By his Attorneys
Nissen & Crane

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MINING AND LOADING MACHINE

Original Filed May 19, 1921 5 Sheets-Sheet 3

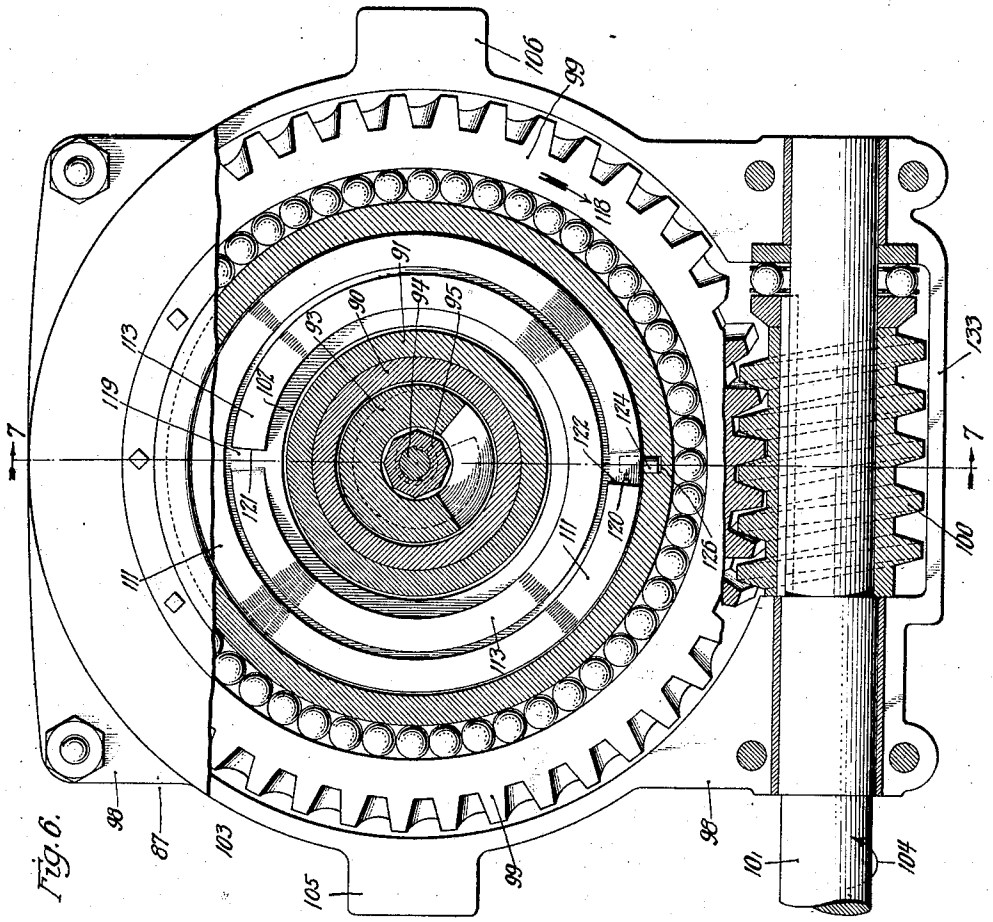

Fig. 6.

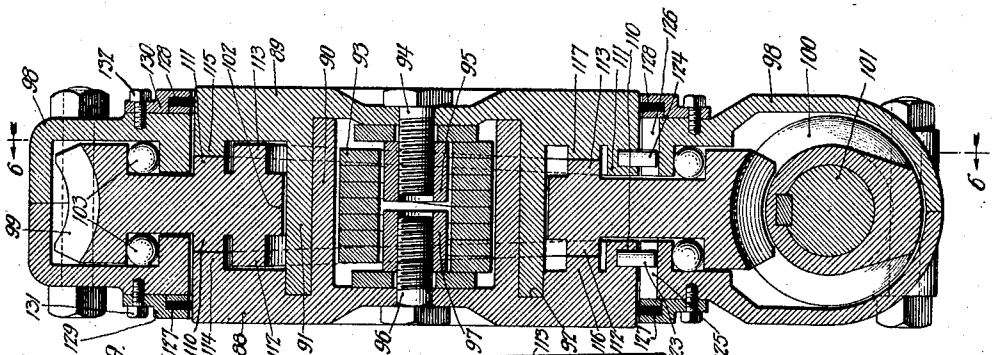

Fig. 7.

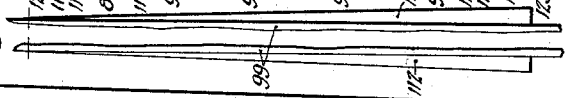

Fig. 9.

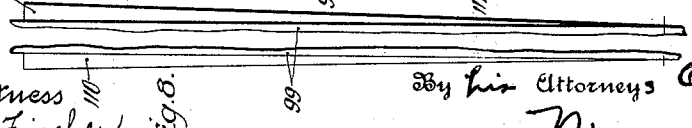

Fig. 8.

Witness
L. E. Fischer.

Inventor
Edmund C. Morgan
By his Attorneys
Nissen & Crane

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MINING AND LOADING MACHINE

Original Filed May 19, 1921 5 Sheets-Sheet 4

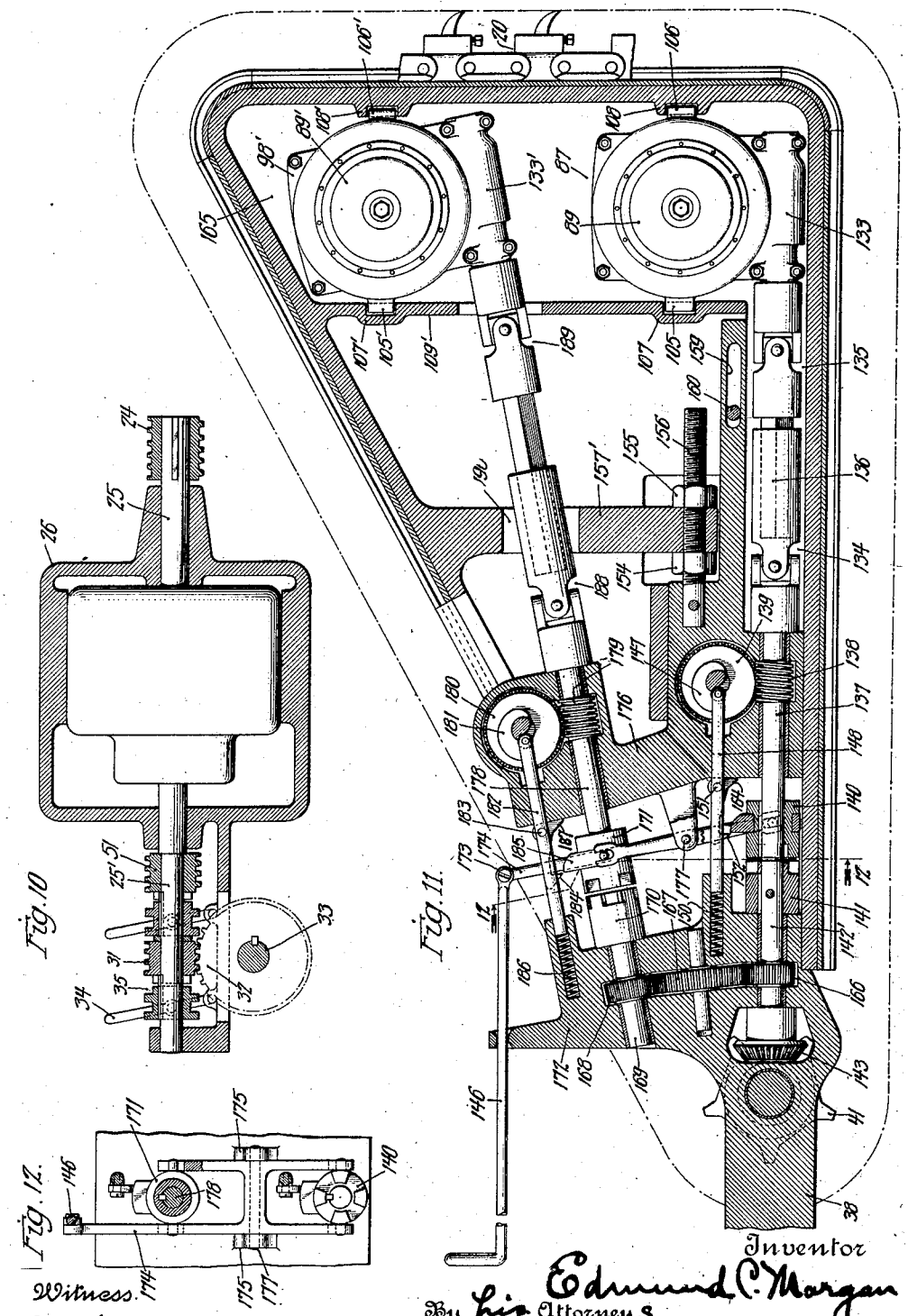

Fig. 10

Fig. 12.

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L. E. Fischer.

Inventor
Edmund C. Morgan
By his Attorneys
Nissen & Crane

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MINING AND LOADING MACHINE

Original Filed May 19, 1921 5 Sheets-Sheet 5

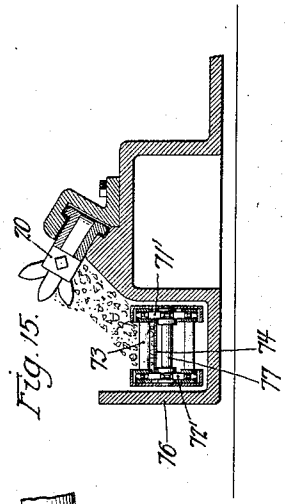

Fig. 15.

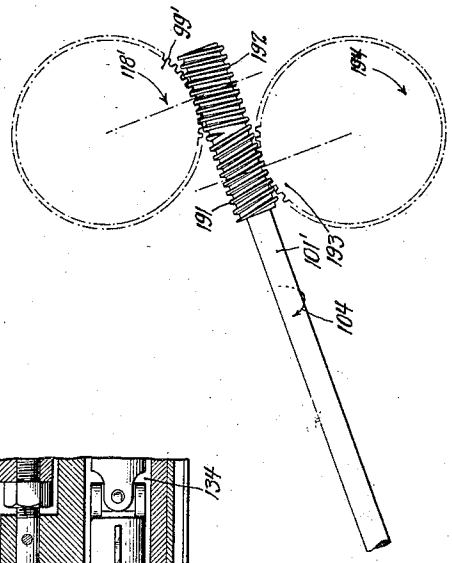

Fig. 16.

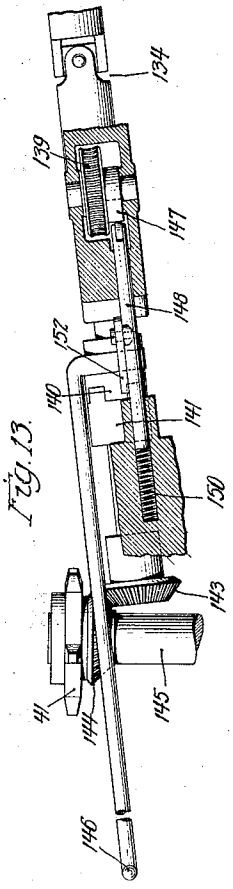

Fig. 13.

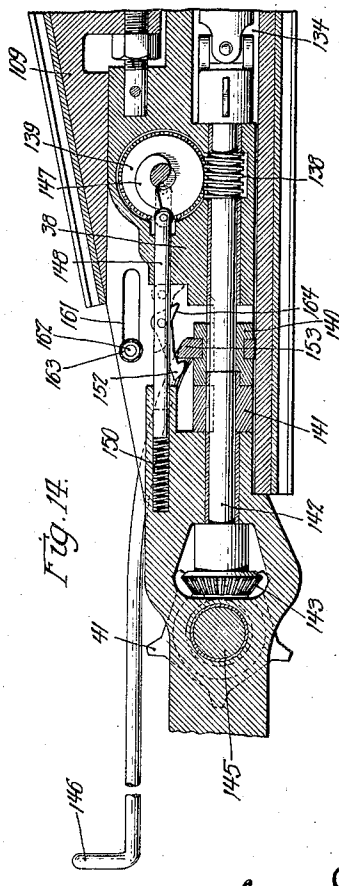

Fig. 14.

Witness
L. E. Fischer.

Inventor
Edmund C. Morgan
By his Attorneys
Nissen & Crane

Patented June 9, 1931 1,809,282

UNITED STATES PATENT OFFICE

EDMUND C. MORGAN, OF NEW YORK, N. Y.; OLIVE EUGENIE MORGAN EXECUTRIX OF SAID EDMUND C. MORGAN, DECEASED

MINING AND LOADING MACHINE

Application filed May 19, 1921, Serial No. 470,854. Renewed August 20, 1928.

My invention relates to mining and loading machines and one of its objects is the provision of breaking down mechanism entirely mechanical and adapted to enter kerfs in the mine wall and operate to exert pressure on the walls of the kerf to dislodge material from the mine vein.

A further object of the invention is the provision of mechanism not relying upon fluid pressure, for entering an incision in a mine wall and exerting pressure to break down the cut material.

A further object of the invention is the provision of controlling mechanism for a coal breaker adapted to enter an incision in the mine vein and exert pressure on the walls of such incision.

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

Referring to the accompanying drawings, Fig. 1 represents a plan view of my improved mining and loading machine;

Fig. 2 is a sectional elevation on the line 2—2 of Fig. 1 looking in the direction of the arrows;

Fig. 3 is a sectional elevation taken on the line 3—3 of Fig. 1;

Fig. 4 is a sectional plan view of the breaking mechanism and the means for transmitting power thereto;

Fig. 5 is a transverse sectional elevational view taken on the line 5—5 of Fig. 1;

Fig. 6 is an elevation of an enlargement of the mechanical expansible breaker, partly in section;

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

Figs. 8 and 9 are diagrammatic views showing developments of the circular cams of Figs. 6 and 7;

Fig. 10 is a sectional elevation on the line 10—10 of Fig. 1 looking in the direction of the arrows;

Fig. 11 is a sectional elevation similar to Fig. 3, but showing a modification;

Fig. 12 is a sectional elevation on the line 12—12 of Fig. 11 looking in the direction of the arrows;

Fig. 13 is a sectional plan view of a portion of Fig. 3;

Fig. 14 is a sectional elevation of a portion of Fig. 3;

Fig. 15 is a sectional view on the line 15—15 of Fig. 1; and

Fig. 16 is a diagrammatic view of a modification.

The mining and loading machine shown in Figs. 1 and 2 comprises a supporting frame 17, the forward portion of which is adapted to rest on and slide over the mine floor, as shown at 18. Mounted on this frame is a cutter-frame 19 for carrying and guiding a traveling chain-cutter 20 which is adapted to be driven by the sprocket 21 connected to a vertical shaft 22 which extends upwardly to the worm gear 23 and is secured thereto. Meshing with this worm gear 23 is a worm 24 which is keyed to the motor shaft 25 of a motor 26, as shown more clearly in Fig. 10. When the motor 26 is operated motion will be transmitted to the sprocket 21 to drive the under-cutting chain-cutter 20 to cut a kerf at the base of the mine wall.

Secured to the outer lateral edge of the base frame 17 is a longitudinal grooved guide frame 27 along which is adapted to extend a rope 28 having its free end anchored at 29 and its other end wound on the rope drum 30.

By referring to Figs. 1 and 10 it will be seen that the rearwardly extending motor shaft 25′ has mounted thereon a worm 31 which meshes with the worm gear 32 mounted on the shaft 33 and extending to the rope drum 30. By means of the lever 34 the clutch 35 may be thrown in to connect the motor to the shaft 33. I prefer to employ an additional clutch 36 for operation by a lever 37, as shown in Fig. 1. When both clutches 35 and 36 are thrown in and the rope 28 is slack either clutch 35 or 36 may be operated to control rotation of the rope drum 30, but when the rope is taut it will be easier for the attendant to operate the clutch 36 than to operate the clutch 35. Furthermore, after the clutch 36 has been released it will be easy to release the clutch

35. By the provision of the clutch 36 the rope drum 30 is made free to rotate so that the attendant can take hold of the free end of the rope and unreel it from the drum 30 in a short space of time without operation of the motor. Then after the rope has been anchored, as shown in Fig. 1, the clutch 36 may be thrown in and after the motor has been started and the clutch 35 thrown in the rope drum 30 may be rotated so as to secure forward feeding movement of the mining and loading machine, including the under-cutting chain-cutter.

Secured to the frame 17 is a laterally extending bracket 38, as shown in Fig. 1. This bracket has secured thereto an upright shearing kerf-cutter comprising a cutter-frame 39 and a chain-cutter 40 which is adapted to be driven by the sprocket 41. The latter is mounted on a transverse shaft 145 on the opposite end of which is mounted a beveled gear 43 meshing with another beveled gear 44 on the upper end of the shaft 22. Therefore when the motor 26 is operated the sprocket 41 is driven, as well as the sprocket 21, and therefore the upright chain kerf-cutter is driven at the same time that the under-cutting kerf-cutter 20 is driven.

Extending longitudinally of the main frame of the mining and loading machine is a scraper-type of conveyer comprising a stationary bed plate 45 along which are adapted to slide the cross-connected scrapers 46, as shown in Figs. 1 and 5. This conveyer is shown diagrammatically at 47 in Fig. 2. The forward portion of the conveyer is adapted to be located within the boundary of the forward portion of the under-cutting kerf-cutter so as to occupy a horizontal plane and so as to adapt the receiving portion of this conveyer to enter the under-cut kerf a substantial distance. The intermediate portion of the conveyer 47 is inclined upwardly, as shown in Fig. 2, and the upper elevated horizontal portion extends to a position for delivering the material to the loading conveyer 48. The latter may also be of the scraper-type comprising a stationary bed plate 49 and cross-connected scrapers 50. Also, loosely mounted on the motor shaft 25′ is a worm 51, as shown in Figs. 1 and 10. This worm meshes with a worm-wheel 52, as shown in Figs. 1 and 2. The worm-wheel 52 is connected to one end of the shaft 53 mounted in suitable fixed bearings 54 and 55. The end of the shaft 53 opposite to that which carries the worm gear 52 is provided with a beveled gear 56 meshing with a similar beveled gear 57 at one end of the transverse shaft 58 mounted at the rear end of the conveyer 47, as shown in Fig. 2.

The transverse shaft 58 is provided with sprockets 59 and 60 (Fig. 5) for driving the endless chains between which the spaced-apart scrapers 46 are connected for movement along the surface of the stationary bed plate 45 of the main conveyer.

One end of the shaft 58 is connected by means of the universal joints 61, 62 and intermediate shaft 63 to the short shaft 64 journaled in a bearing 65 at the rear end of the frame 66 of the loading conveyer 48. A beveled gear 67 on the shaft 64 is in position to mesh with the beveled gear 68 on the transverse shaft 69 which is connected to sprockets similar to those designated 59 and 60 and arranged similarly to drive chains between which are connected the scrapers 50 for movement over the stationary bed plate 70 of the loading conveyer 48.

The transverse shaft 58 is provided with an extension 58′ on which are mounted spaced-apart sprockets 71 and 72 for driving a pair of endless spaced-apart chains between which are connected short cross-flights or scrapers 73 for movement over the surface of the stationary bed plate 74 of a comparatively narrow conveyer extending from a position near the floor of the mine chamber adjacent the emerging run of the vertical shearing kerf-cutter. This narrow conveyer is illustrated diagrammatically at 78 in Fig. 2 and is inclined upwardly so as to deliver cuttings received thereby to the loading conveyer 48, as shown in Figs. 1 and 2.

In order that the cuttings from the under-cutting kerf-cutter may also be automatically removed during the operation of the mining and loading machine I have extended the rope-guiding plate 27 forwardly to a position adjacent the forward end of the under-cutter, as shown in Fig. 1. The inner vertical surface of the plate 27 may thus form a wall extending to the floor of the mine chamber to guide the cuttings onto the horizontal surface 17 which is spaced only a short distance above the floor of the mine chamber. As the under-cutting kerf-cutter operates, the cuttings will be moved thereby along the space between the plate 27 and the frame 19 over the end 18 and onto the surface 17 and across the latter into the trough 76, as illustrated in Fig. 15, which is a section taken on the line 15—15 of Fig. 1 looking in the direction of the arrows. In Fig. 15 is shown the foot shaft 77 provided with sprockets 72′ and 71′ meshing with the sprocket chains of the narrow conveyer 78 shown in Fig. 1. The path of travel of the under-cutting chain-cutter 20 is illustrated diagrammatically at 79 in Fig. 2. The relation of the path of travel 79 of the under-cutting kerf-cutter 20 to the path of travel 75 of the conveyer 78 is such that the cuttings may be moved into position for delivery to the lower receiving end of the conveyer 78, as illustrated in Fig. 15.

In order to adjust the upward or down-

ward inclination of the under-cutter so as to enable the machine to follow the direction of the mine vein, I have provided a floor jack at the rear end of the frame 17, as shown in Figs. 1 and 2. Mounted on the frame 17 is a bearing 80 for the vertical screw-threaded shaft 81 to the upper end of which is connected an operating wheel 82. The screw-threaded portion of the shaft 81 is screw-threaded into the vertical central upward extension 83 of a cylindrical support 84 of comparatively large area on its bottom to rest on the floor of the mine chamber. An important feature of this adjusting jack is the upward cylindrical extension 85 having a diameter substantially equal to that of the cylindrical base 84. With such a construction the circular base 84 and the cylindrical upward extension 85 may make a vertical fit with the framework, as illustrated at 86, without any risk of loose material obstructing the operation of the jack and becoming lodged between the frame of the machine and parts of the jack. A sufficient area is afforded by the large base plate 84 to support the rear portion of the machine and by operating the wheel 82 the machine may be tilted up and down on the forward end 18 of the frame 17 as a fulcrum, and by reason of the vertical cylindrical extension 85 free operation of the jack is easier at all times since no material can collect between parts of the jack and the framework and whatever material collects under the frame 17 adjacent the foot 84 may readily be moved away.

The mechanical breaking mechanism shown in Figs. 2, 3, 6, 7 and 8 is mounted within the boundary of the upright shearing kerf-cutter and is made flat so as to readily enter the kerf cut by the vertical kerf-cutter. This mechanical breaker is shown in position in the cutter-frame 39 in Figs. 2 and 3, and the details of construction are shown in Figs. 6 to 8, inclusive. The breaker 87 comprises oppositely disposed plungers 88 and 89 having flat outer surfaces adapted to engage the walls of the kerf cut by the vertical kerf-cutter. The central portions of the plungers 88 and 89 are provided with telescoping cylindrical cups 90 and 91 which fit closely together, as shown in Fig. 7, and act as guides for the plungers 88 and 89 to maintain the latter in axial alinement. The cylindrical cup 91 is adapted to fit into the cylindrical recess 92 in the plunger 88. Within the cup 90 is located a spring 93 one end of which is secured by means of the bolt 94 and the nut 95 to the center of the plunger 89. The other end of the spring 93 is connected to the center of the plunger 88 by means of the bolt 96 and the nut 97. The spring 93 is a retracting spring for holding the plungers 88 and 89 together in the positions shown in Fig. 7 and for restoring the plungers to the positions shown in Fig. 7 after they have been operated in the manner hereinafter described.

Within the casing 98 is mounted a worm-wheel 99 meshing with a worm 100 mounted on a shaft 101. At the center of the worm-wheel 99 is a circular opening 102 to permit free movement therethrough of the cylindrical cup 91. The worm-wheel 99 is mounted on ball bearings, as indicated at 103 in Figs. 6 and 7, so as to permit free rotation of the worm-wheel 99 relatively to the casing 98 when the shaft 101 is rotated in the direction indicated by the arrow 104 in Fig. 6. The casing 98 by means of the diametrical extensions 105 and 106 is mounted in the transverse guideways 107 and 108 in the cutter-frame 109, as shown in Fig. 3. The transverse guideways 107 and 108 are provided for the purpose of enabling one plunger, such as that indicated at 88 in Fig. 7, to engage the solid unmined mass, while the other plunger 89 moves in the direction of the dislodged mass of coal while the vertical cutter-frame remains in its same position relative to the vertical plane of the kerf cut thereby.

Mounted on opposite faces of the worm gear 99 are concentric cams 110, 111, and 112, 113. These cams are developed into straight lines in Figs. 8 and 9. Each of these cams is formed spirally, as indicated by the dotted lines in Fig. 7, the cams 111 and 113 being spiraled in one direction, and the cams 110 and 112 being spiraled in the opposite direction. The cams 110 and 111 closely interfit similar spiral cams 114, 115 on the plungers 88 and 89, respectively. The spiral cams 112 and 113 likewise closely interfit similar spiral cams 116, 117 on the plungers 88 and 89, respectively. Each of the spiral cams extends over almost a complete circle, as viewed in elevation and as shown in Fig. 6. The sectional portion of Fig. 6 being taken on the line 6—6 of Fig. 7 looking in the direction of the arrows it can be readily seen by reference to Figs. 6 and 7 that when the worm-wheel 99 is rotated in the direction of the arrow 118 the cams 110 and 111 will act on the cams 114 and 115, respectively, while at the same time the cams 112 and 113 will act on the cams 116 and 117, respectively, to spread apart the plungers 88 and 89 against the action of the spring 93 while said plungers are guided concentrically by means of the telescoping cups 90 and 91. As the rotation of the worm gear 99 continues the plungers will be spread farther and farther apart until a complete rotation has been effected and the cams separated at the breaks 119 and 120 when the spring 93 will act to again closely interfit the cams throughout their

entire lengths. It should be understood that as the gear-wheel 99 rotates, the cams thereon will ride along the cam surfaces on the plungers to spread them apart until the ends 121 and 122 are reached. These ends are farther away from the central plane of the gear 99 than any other portions of the cams 111 and 113 and therefore when the breaks 119 and 120 are reached the plungers will be snapped back into their initial positions by the retracting spring 93. The spreading of the plungers is therefore entirely mechanical, although effected by self-acting power mechanism, and the restoration of the plungers is automatically effected by the spring 93 when the gear 99 has made a complete rotation.

In order to prevent the plungers 88 and 89 rotating relatively to the casing 98, I have provided radial pins 123 and 124 fitting in and sliding along slots 125 and 126 in the casing 98, as shown in Fig. 7.

In order that the casing 98 may be filled with lubricating material, I have provided annular gaskets 127 and 128 held in position against the circumferential surfaces of the plungers 88 and 89 by means of the annular plates 129 and 130 secured to the casing 98 by means of the bolts 131 and 132.

By referring to Figs. 3 and 6 it will be seen that the worm 100 in the gear casing 133 is mounted on the shaft 101 which is connected by the universal joints 134, 135 and intermediate sliding connection 136 to a shaft 137 which has secured thereto a worm 138 meshing with a worm-wheel 139. Splined to the shaft 137 is a clutch element 140 provided with teeth adapted to engage the corresponding teeth on the clutch element 141 which is keyed to a short shaft 142. At the rear end of the latter is a beveled gear 143 meshing with another beveled gear 144 on the transverse shaft 145. The latter also carries the sprocket 41, as shown in Figs. 1 and 4.

Connected to the clutch element 140 is an operating lever 146. By referring to Fig. 3 it will be seen that when the lever 146 is pulled rearwardly the clutch element 140 will engage the clutch element 141 so that power transmitted from the motor 126 through the beveled gears 44, 43 to the transverse shaft 145 will be transmitted through the beveled gears 144 and 143 to the shaft 137 and thence through the flexible connections 134, 135, 136 to the worm 100 to effect rotation of the gear 99 and the operation of the coal-breaking plungers 88 and 89.

When the shaft 137 is rotated in the direction indicated by the arrow 104 in Fig. 6 the worm gear 139 shown in Fig. 3 will be rotated clockwise to turn the cam 147 to push back the horizontal rod 148 into the recess 149 and against the action of the spring 150 therein. Intermediate the ends of the rod 148 is pivoted at 151 a pawl 152 which is adapted to slide over and fall back of the upward projection 153 of the collar surrounding the clutch element 140. When the cam 147 has made a complete rotation the rod 148 will be released and thereupon the spring 150 will act to push the rod 148 forward to cause the pawl 152 to release the clutch element 140 from the element 141 and thus automatically discontinue the rotation of the shaft 137 and the operation of the mechanical expansible breaker.

The frame 109 together with the chain-guide 39 in reality constitutes the cutter-frame, and this cutter-frame is mounted on the frame 38, as shown in Figs. 1 and 3. The forward portion 38′ is so arranged as to support the frame 109 for relative movement to effect adjustment of the length of the distance between the outer run of the chain-cutter and the shaft 145. The slack in the chain may thus be regulated and the length of the vertical shearing cutter adjusted by taking out or inserting links in accordance with the relative positions of the frames 109 and 38′. To effect such adjustment the nuts 154 and 155 may be loosened on the screw-threaded rod 156 so that either of said nuts may be turned against the depending extension 157. The screw-threaded rod 156 is secured at 158 to the frame 38′. The forward end of the frame 38′ is provided with a slot 159 to fit over a guide rod 160 secured to the frame 109. The rear end of the frame 38′ has a slot 161 to receive a bolt 162 so that by means of a nut 163 the frame 38′ may be secured in adjusted position relative to the frame 109, and for this purpose also the nuts 154 and 155 may be tightened against the depending projection 157.

The pawl 152 is provided with a heel 164 in position to engage a vertical rear face of the frame 38′ to automatically release the pawl 152 from the collar 153 when the spring 150 returns the rod 148 to its initial position shown in Fig. 3. In Figs. 13 and 14 I have shown the positions of the parts in full lines at the time when the cam 147 is about to release the rod 148 so that the spring 150 may cause the pawl 152 to release the clutch element 140 and after this is effected the heel 164 will strike the frame 38′ and move the pawl to the dotted line position so that the clutch element 140 will be free to move forward again when desired by means of the lever 146

The mechanical breaker has a limited lateral movement relatively to the frame 109 because the projections 105 and 106 of the casing 98 fit into lateral guideways 107 and 108 which permit free movement of the entire breaker transversely of the frame 109 to a limited extent. This is for the purpose of enabling one plunger, such as that designat-

ed 88 in Fig. 7, to engage the solid unmined mass while the other plunger 89 dislodges the cut material from the unmined mass while the cutter-frame remains in stationary position. Such lateral transverse movement of the breaker is permitted by the universal joints 134 and 135 and adjustments of the relative position of the frame 109 is permitted by the sliding connection 136. It should be understood, however, that the mechanical breaker always remains in position in the frame 109, the guideways 107 and 108 being in the nature of sockets which permit the extensions 105 and 106 to move laterally and transversely of the frame 109, but not out of the same.

In Figs. 11 and 12 I have shown a modification by making provision for two mechanical breakers both mounted on the upright or shearing kerf-cutter. The lower breaker and the mechanism for operating it is substantially the same as that shown in Fig. 3. The frames 38, 38′ and 109 of Fig. 3 are modified to accommodate an additional mechanical breaker 165 above the breaker 87. On the shaft 142′ is a spur gear 166 which meshes with a gear 167 and the latter in turn meshes with a gear 168. The gear 168 is secured to a short shaft 169 which carries a clutch element 170 adapted to be engaged by a clutch element 171. At the upper end of the support 172 is a bearing for the operating lever 146, the forward end of which is pivoted at 173 to the upper end of a lever 174 connected to the clutch element 171. The lever 174 is shown more clearly in Fig. 12, which is a section on the line 12—12 of Fig. 11 and looking in the direction of the arrows. Intermediate its ends the lever 174 is pivoted in brackets 175 to the rear end of the frame 176. The lower end of the lever 174 is connected to the clutch element 140. Therefore when the lever 174 is tilted on its pivot 177 one of the clutch elements 171 or 140 will be thrown in, while at the same time the other one will be thrown out. For instance, if the lever 146 is pushed forward, the clutch element 171 will be likewise pushed forward, while the clutch element 140 will be moved toward the rear into engagement with the clutch element 141.

The clutch element 171 is mounted on the shaft 178 which is journaled in bearings on the upper portion of the frame 176, as shown in Fig. 11. The shaft 178 has secured thereto a worm 179 which meshes with the wormwheel 180 provided with a cam 181 in position to engage the rod 182. The latter has pivoted thereto at 183 a pawl 184 in position to engage the latch 185 on the clutch element 171 when the rod 182 is pushed rearwardly by the cam 181 against the action of the spring 186. When the cam 181 releases the rod 182 to permit the spring 186 to move such rod forward the pawl 184 will be automatically released by the heel 187 striking the rear surface of the frame 176.

When the shaft 178 is rotated power may be transmitted through the flexible connections 188 and 189 to the gear in the casings 133′ and 98′ to operate the plunger 89′ and another plunger on the opposite side similar to that designated 88 in Fig. 6. Lateral projections 105′ and 106′ are located in sockets 107′ and 108′ so that the upper breaker may also have a limited lateral movement relative to the frame 109′. The length of the cutter-frame may be varied by means of the nuts 154 and 155 on the screw-threaded rod 156 in the same manner as explained in connection with Fig. 3. The depending bracket 157′, however, is longer and is provided with an opening 190 for the passage of the flexible shaft of the upper breaker operating mechanism.

By means of the apparatus shown in Fig. 11 either one of the breakers may be operated by movement of the clutch actuating lever 146, whereupon the breaker will be automatically stopped by the automatic release of the corresponding clutch. The same breaker may again be operated by actuating the lever 146 in the same direction as before. Or, the breakers may be operated alternately by moving the lever 146 in one direction for operation of the lower breaker and in the opposite direction for operation of the upper breaker. It should be understood that either breaker may be operated as many times in succession as desired, or, the breakers may be operated alternately, and this may be done by means of one actuating lever which is connected to both clutches.

In Fig. 16 I have diagrammatically illustrated a modification of Fig. 11 by providing a single shaft 101′ with two worms 191 and 192 thereon with the teeth oppositely spiraled to mesh with upper and lower gear wheels 99′ and 193, each corresponding to the gear wheel 99 shown in Fig. 6 and each connected to breaking mechanism such as shown in Figs. 6 and 7. By means of this arrangement the gears can be rotated in the direction of arrows 118′ and 194 when the shaft 101′ is rotated in the direction of the arrow 104. By the continuous rotation of the gears 99′ and 193 the breakers will continue to operate once during each rotation of such gears.

Obviously those skilled in the art may make various changes in the details and arrangements of parts without departing from the spirit and scope of my invention as defined by the claims hereto appended and I wish therefore not to be restricted to the precise construction herein disclosed.

Having thus fully disclosed an embodiment of my invention, what I claim and desire to secure by Letters Patent of the United States is:

1. In a mining machine, the combination with a plane kerf-cutter, of a flat breaker carried thereby in the plane thereof to enter the kerf cut by said kerf-cutter, and means for supporting said flat breaker for limited movement transversely of itself and bodily transversely of the plane of said kerf-cutter.

2. In a mining machine, the combination with a plane kerf-cutter, of an expansible breaker comprising an enclosure and relatively expansible kerf-wall engaging surfaces on the exterior of said enclosure, and non-yielding mechanical mechanism within said enclosure for operating said breaker.

3. In a mining machine, the combination with a plane kerf-cutter, of an expansible breaker mounted thereon and comprising kerf-wall engaging surfaces movable toward and from each other along straight lines transversely of the kerf walls, and mechanism comprising juxtaposed rigid mechanical elements for positively operating said breaker.

4. In a mining machine, the combination with a plane kerf-cutter comprising a flat cutter-frame with an endless cutter-chain mounted thereon, of a flat breaker connected to said cutter-frame to therewith move into the kerf produced by said cutter-chain, said breaker comprising spaced-apart kerf-wall engaging surfaces relatively movable in opposite directions to simultaneously engage opposing walls of the kerf and simultaneously exert pressure thereon, and means consisting of rigid mechanical elements independent of fluid pressure to exert non-yielding pressure simultaneously on opposite walls of the kerf to dislodge material adjacent the same.

5. In a mining machine, the combination with a plane kerf-cutter comprising a flat cutter-frame and a traveling cutter-chain thereon, of a flat expansible breaker mounted on said cutter-frame and comprising a transversely movable plunger, and means comprising a rotary device for directly actuating said plunger to exert pressure on the material adjacent said kerf to dislodge such material.

6. In a mining machine, the combination with a plane kerf-cutter comprising a flat cutter-frame and a traveling cutter-chain thereon, of a flat breaker mounted on said cutter-frame and comprising a transversely movable plunger and spiral wedge mechanism for operating said plunger, and means comprising a worm gear connected to said wedge mechanism to operate the latter towards the plunger to exert pressure against material adjacent said kerf to dislodge such material.

7. An expansible breaker comprising a flat frame adapted to be inserted into a plane kerf in a mine wall, a flat plunger fitting in said frame and movable relatively thereto transversely thereof, an additional flat plunger fitting in said frame and movable relatively thereto transversely thereof, and means comprising wedge mechanism in position on said frame to operate said plungers by spreading the same apart relatively to said frame to exert pressure on opposite walls of said plane kerf.

8. A breaker adapted to be inserted into a kerf in a mine wall and comprising a casing, circular concentric plungers mounted on said casing for movement in opposite directions relatively to said casing, a rotary device comprising a plurality of spiral cam surfaces adapted to interfit and engage corresponding spiral cam surfaces on the respective plungers, and means for operating said rotary device to secure expansion in the breaker by moving the plungers apart to exert pressure on the walls of the kerf.

9. A flat breaker adapted to be inserted into a plane kerf in a mine wall and comprising a supporting frame, a plunger mounted on said frame for movement transversely thereof and having a kerf-wall engaging surface greater in width than the thickness of said supporting frame, rotary mechanism for operating said plunger to exert pressure over such wide area on the walls of the kerf, and means for automatically restoring said plunger to initial position upon predetermined rotation of said rotary mechanism.

10. A breaker adapted to be inserted into a kerf in a mine wall and comprising a frame, a plunger movable relatively to said frame, and a rotary device having a pair of segmental spiral surfaces concentrically arranged and adapted to fit corresponding spiral cam surfaces on the inner side of said plunger.

11. A breaker adapted to be inserted into a kerf in a mine wall and comprising a casing, a worm gear fitting in said casing, a pair of circular plungers mounted in a circular opening in said casing and adapted to move in opposite directions to exert pressure on the walls of the kerf, telescoping cups connected to the central portions of said plungers to guide the latter for coaxial movements in opposite directions, a retracting spring connected at its ends with the respective plungers on the interior of the inner cup, a pair of spiral wedges surrounding said telescoping cups and connected to said worm gear to rotate therewith, said plungers having corresponding spiral cam surfaces for engagement by said spiral wedges, and means for rotating said worm gear to spread apart the plungers and thereby exert pressure on the walls of the kerf to dislodge the material, said wedges being constructed and arranged to permit said spring to automatically restore said plungers

to initial position upon a complete rotation of said worm gear.

12. A breaker comprising a flat casing adapted to enter a narrow kerf in a mine wall, a plunger larger in diameter than the thickness of said casing and mounted on said casing for movement transversely thereof, means for preventing rotary movement of said plunger relatively to said casing, and means comprising a rotary device movable into the kerf cut by said kerf-cutter for operating said plunger to produce pressure on the walls of said narrow kerf in which said breaker is inserted.

13. A breaker comprising a pressure-exerting plunger, a casing of greater width than the thickness of said plunger to adapt the breaker to enter a comparatively narrow kerf in a mine wall, a liquid-tight gasket between said casing and said plunger, and means comprising gearing enclosed within said casing for operating said plunger to exert pressure on the walls of such kerf in which said breaker is inserted.

14. In a mining machine, the combination with a plane kerf-cutter, of a flat breaker mounted thereon, power transmission mechanism for operating said breaker, a clutch for connecting a source of power to said power transmission mechanism, and means for automatically releasing said clutch to stop the operation of said breaker.

15. In a mining machine, the combination with a plane kerf-cutter comprising a flat cutter-frame and a traveling cutter-chain thereon, of power transmission mechanism comprising a connecting clutch, means for operating said clutch to connect a source of power to said breaker to operate the same, and means for automatically releasing said clutch and restoring the same to position for being thrown in again.

16. In a mining machine, the combination with a plane kerf-cutter, of a mechanical expansible breaker mounted thereon, power transmission mechanism comprising a clutch, a manual lever for throwing in said clutch, and means for automatically releasing said clutch to stop the operation of said breaker.

17. In a mining machine, the combination with a supporting frame, of a breaker mounted thereon, power transmission mechanism for said breaker and comprising a clutch, means for actuating said clutch to connect a source of power to said breaker through said power transmission mechanism, and means for automatically releasing said clutch to stop the operation of said breaker.

18. In a mining machine, the combination with a plane kerf-cutter comprising a cutter-frame and a traveling chain-cutter thereon, of an expansible breaker mounted on said cutter-frame for limited lateral movement transversely thereof, means for adjusting relative positions of portions of said cutter-frame to adjust the slack in said chain-cutter, and power transmission mechanism for said breaker and comprising spaced-apart universal joints to permit free lateral movement of said breaker and an intermediate sliding connection to permit relative adjustments of said portions of said cutter-frame.

19. In a mining machine, the combination with a supporting frame adapted to enter a kerf in a mine wall, of a plurality of expansible breakers mounted on said cutter-frame in position to exert pressure on the walls of the kerf, power transmission mechanism for said breakers, clutch mechanism for controlling said power transmission mechanism, and a single actuating lever connected to said clutch mechanism for effecting the operation of any one of said breakers successively or the operation of said breakers alternately.

20. In a mining machine, the combination with a supporting frame, of a plurality of breakers mounted thereon, power transmission mechanism connected to a single source of power, and clutch mechanism operable by a single lever for controlling the operation of said breakers individually.

21. In a mining machine, the combination with a plane kerf-cutter, of a plurality of expansible breakers mounted thereon, power transmission mechanism connected to said breakers, clutch mechanism for controlling the operation of said breakers, manual mechanism for throwing in said clutch mechanism, and automatic mechanism for releasing said clutch mechanism to stop the operation of said breaker.

22. In a mining machine, the combination with a plane kerf-cutter, of a breaker mounted thereon and comprising plungers movable from opposite sides of said kerf-cutter, and means for permitting lateral movement of the breaker as a whole transversely of said kerf-cutter to permit one of said plungers to engage the solid unmined mass while the other engages material adjacent the kerf to dislodge the same.

23. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted on the forward portion of said frame, an operating motor having a shaft one end of which is connected to said kerf-cutting mechanism to drive the same, means for feeding said kerf-cutting mechanism comprising rope gearing and driving apparatus therefor connected to the other end of said motor, said driving apparatus comprising a driving shaft connected to the motor shaft and a driven shaft at right angles to the driving shaft, and separate clutches one for connecting the driving shaft to the driven shaft and the other for releasing the rope gearing from said driven shaft.

24. In a mining machine, the combination

with a supporting frame, of kerf-cutting mechanism mounted thereon, an operating motor mounted on said supporting frame, means connected between one end of said motor and said kerf-cutting mechanism to drive the same, a power transmission shaft, a rope drum loose on said shaft, a rope wound on said drum and adapted to have its free end connected to an anchorage in the mine, a clutch for disconnecting said shaft and drum to permit free rotation of the latter, means comprising a driving shaft connected to the other end of said motor and extending transversely of said power transmission shaft for transmitting power to the latter, and an additional clutch for connecting the driving shaft to said power transmission shaft.

25. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, an electric motor having a shaft extending longitudinally of said supporting frame, mechanism connected between the forward end of the motor shaft and said kerf-cutting mechanism to drive the latter, feeding mechanism comprising transverse shafts with worm gearing intervening connecting the rear end of the motor shaft to a rope winding drum with a rope wound thereon, and separate clutches for controlling said feeding mechanism one clutch being on one shaft and the other clutch on the other shaft.

26. In a long wall mining machine, the combination with a supporting frame, of an upright kerf-cutter and a horizontal kerf-cutter on the forward portion of said frame, an operating motor mounted on the rear portion of said frame, driving mechanism between the forward end of said motor and said kerf-cutting mechanism, a rope drum on the rear end of said supporting frame, a rope wound on said drum and adapted to have its free end connected to an anchorage in the mine with the rope extending longitudinally of said frame, a shaft for said drum and mounted on said frame to extend transversely of the path of travel thereof, a clutch for operatively connecting said shaft to said drum, worm gearing connected to said shaft at the end thereof opposite said rope drum, a drive shaft between the rear end of said motor and said worm gearing and extending longitudinally of said frame, and an additional clutch for controlling transmission of power from said drive shaft through said worm gearing to said first-named shaft to rotate said rope drum when said first-named clutch is in to effect feeding of said kerf-cutting mechanism when said rope end is connected to an anchorage, said shafts being arranged transversely to each other and one clutch being on one shaft and the other clutch being on the other shaft.

27. In a mining machine, the combination with a plane kerf-cutter comprising a cutter frame and an endless traveling chain cutter mounted thereon, of a pressure-exerting device entirely mechanical carried by said cutter frame within the boundary of the chain cutter and comprising relatively telescoping members with a spring enclosed thereby, and means for operating said mechanical pressure-exerting device.

28. In a mining machine, the combination of a plane kerf-cutter comprising a flat cutter frame and an endless cutter chain mounted thereon, an entirely mechanical expansible pressure-exerting device mounted on said cutter frame within the boundary thereof and comprising pressure exerting plungers movable in opposite directions each relatively to said cutter frame, and a spring between said plungers.

29. 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 cutting chain on said cutter-frame, means for driving said cutting chain, means for moving said supporting frame to effect feeding of said cutting chain, means adapted to engage the walls of the kerf independently of the feeding of said cutting chain and connected to said cutter-frame to move bodily therewith into the kerf cut by said cutting chain, and means comprising spirally interengaging surfaces for operating said kerf-wall engaging means.

30. A flat breaker adapted to be inserted into a kerf in a mine wall and comprising a frame, a pair of oppositely moving plungers mounted in said frame for movement outwardly therefrom, and means comprising spiral wedge mechanism for operating both of said plungers simultaneously by moving both of them outwardly from said frame in opposite directions against the walls of the kerf to exert sufficient pressure thereon to break down the material in a mine vein.

31. In a mining machine, the combination with a plane kerf-cutter comprising a cutter-frame and a traveling chain-cutter thereon, of an expansible breaker on said cutter-frame, means for adjusting relative positions of portions of said cutter-frame to adjust the slack in said chain-cutter, and power transmission mechanism for operating the said breaker and comprising a sliding connection to permit relative adjustments of said portions of said cutter-frame.

32. In a mining machine, the combination with a plane cutter-frame, of a traveling chain-cutter mounted thereon, a sprocket on said frame for driving said chain-cutter, a breaker comprising expansible means entirely mechanical and mounted on said frame in position to move into the kerf cut by said cutter-chain, and power transmission mech-

anism connected between said sprocket and said expansible means for operating the breaker.

33. In a mining machine, the combination with a chain kerf-cutter, of a plurality of breakers mounted thereon, power transmission mechanism for operating said breakers, and inter-connected clutch mechanism for effecting the operation of either breaker at will.

34. In a mining machine, the combination with a chain kerf-cutter comprising a driving sprocket, of a plurality of spaced-apart breakers on said kerf-cutter, power transmission mechanism connected between said sprocket and said breakers, and means for controlling the transmission of power to said breakers individually to secure operation of one and then the other as desired to break up the material operated on with the assistance of bending forces thereon.

35. In a mining machine, the combination with cutting mechanism adapted to make an incision in a mine wall, of a frame for carrying the same, an auxiliary frame mounted on said carrying frame, a pair of oppositely moving plungers mounted on said auxiliary frame to move in opposite directions to exert pressure on the opposite walls of the incision, and mechanical rotary mechanism entirely enclosed by said auxiliary frame and said plungers for expanding the latter to cause the same to engage and exert pressure on such opposite walls of the incision cut by said cutting mechanism.

36. In a mining machine, the combination with cutting mechanism adapted to make an incision in a mine vein, of a cutter frame, a pressure-exerting device mounted on said cutter frame to have a limited movement relatively thereto and adapted to engage opposite walls of the incision independently of said cutter frame, and rotary mechanism operable within the incision to expand the pressure-exerting device against the opposite walls of the incision.

37. A breaker adapted to be inserted into a kerf in a mine wall and comprising expansible kerf-wall engaging mechanism, means for alternately expanding and contracting said engaging mechanism along lines substantially at right angles to the opposite walls of the kerf, and mechanism movable continuously in the same direction for operating said expansion and contracting means.

38. In a mining machine, the combination with a plane kerf-cutter comprising a flat cutter frame and a chain cutter mounted thereon, of an expansible pressure-exerting device comprising telescoping cylinders having radial extensions to form flat parallel engaging surfaces and connected to said cutter frame to travel into the kerf produced by said kerf-cutter during the feed of the latter, and means for exerting pressure on said extensions to spread the same apart in opposite directions to cause said parallel surfaces to engage the walls of the kerf, and means for operating said kerf-cutter including feed thereof independently of the operation of said expansible device.

39. In a mining machine, the combination with a supporting frame, of a plane kerf-cutter mounted thereon and comprising a cutter frame and an endless chain cutter adapted to travel around the same, means for operating said kerf-cutter including the feed thereof, an expansible breaker mounted on said cutterframe and comprising telescoping cylinders with a restoring spring within the same, and means for operating said breaker comprising rotary cam mechanism surrounding said cylinders.

40. In a mining machine, the combination with a kerf-cutter adapted to form a kerf in a mine wall spaced from the free face of the coal, of a mechanical breaker carried by said kerf-cutter and comprising a rotary device operable within the same on an axis at right angles to the plane of the kerf cut by said kerf-cutter to expand the breaker to exert pressure toward the free face to dislodge the coal, mechanical devices for transmitting power to said rotary device, and means to control the operation of said mechanical devices.

41. In a mining machine, the combination with kerf-cutters, of means for operating said kerf-cutters to simultaneously form horizontal and vertical kerfs in a mine wall spaced from the free face of the coal, and means carried by the vertical kerf-cutter in position to enter the kerf cut thereby and exert pressure toward the free face to dislodge the coal, said means comprising a mechanical rotary device operable on an axis at right angles to the plane of the vertical kerf, power transmission mechanism connected to said rotary device, and means to control said power transmission mechanism.

42. In a mining machine, the combination with kerf-cutters adapted to simultaneously form horizontal and vertical kerfs in a coal face, of a cam-actuated breaking down means carried by the vertical kerf-cutter in position to enter the vertical kerf in its entirety and exert mechanical pressure transversely of the kerf when entirely within the same to dislodge the coal, and means to control from without the kerf the operation of said cam-actuated breaking down means within the kerf.

43. In a mining machine, the combination with a frame, of means carried thereby for making an incision in a mine vein, means lying within the boundary of the incision making means for exerting pressure on the walls of the kerf independently of the bod-

ily movement of the incision making means, said pressure exerting means comprising flat kerf wall engaging devices with co-acting expansion mechanism between the same comprising a rotary device operating on an axis at right angles to the faces of said kerf wall engaging devices, and means for controlling from without the incision the operation of the breaker within the incision.

44. In a mining machine, the combination with kerf-cutters adapted to simultaneously form horizontal and vertical kerfs in a coal face, of mechanically expansible breaking down means carried by the vertical kerf-cutter for movement as a whole relatively thereto, said breaking down means comprising spaced-apart flat kerf wall engaging devices with means entirely mechanical between the same for spreading such devices apart to exert pressure transversely of the kerf to dislodge the coal, mechanism for mounting said breaking down means for movement as a whole laterally of the vertical kerf-cutter to enable the breaking down means to operate independently of said vertical kerf-cutter, and means to control the operation of said spreading apart mechanism.

45. In a mining machine, the combination with chain kerf-cutting mechanism, of a plurality of expansible breakers mounted in position to enter the kerf cut by said kerf-cutting mechanism, each of said breakers comprising flat-faced kerf wall engaging devices with means entirely mechanical between the same for spreading them apart to effect breaking down of the cut material, power transmission mechanism connected to said mechanical means of both of said breakers, and means for controlling said power transmission mechanism to secure alternate operation of said breakers and thereby adding bending forces to the expansive forces of the breakers to assist in prying the cut material from the unmined mass and the breaking thereof into pieces of sizes suitable for handling and transportation.

46. 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 conveyer in fixed relation with said cutting mechanism adapted to be carried along the plane of the kerf formed by said cutting mechanism, shearing kerf-cutting mechanism mounted on said main frame in upright position, an expansible breaker mounted on said shearing kerf-cutting mechanism and comprising spaced-apart flat-faced kerf wall engaging devices with means entirely mechanical between the same for spreading them apart to break down the coal onto said conveyer, and power transmission mechanism extending from said main frame to said mechanical means of the breaker.

47. In a mining machine, the combination with a plane chain kerf-cutter adapted to form a plane kerf in a mine wall, of means for operating said kerf-cutter including the driving of the chain and the feed thereof, an expansible breaker mounted on said kerf-cutter within the boundary of the chain in position to enter the kerf cut by the kerf-cutter and expert pressure on the walls of the kerf independently of the feed of the kerf-cutter to break down material, said breaker comprising kerf wall engaging devices and means for intermittently spreading the same apart to effect expansion of the breaker at intervals, and means for automatically retracting the kerf wall engaging devices after each spreading apart thereof.

48. In a mining machine, the combination with a supporting frame, of a kerf-cutter mounted thereon, a motor mounted on said supporting frame, power transmission mechanism between said motor and said kerf-cutter to operate the latter, an expansible breaker adapted to enter the kerf cut by said kerf-cutter and exert breaking pressure on the walls of the kerf, said breaker comprising kerf wall engaging devices with means entirely mechanical connected thereto to spread the same apart, additional power transmission mechanism connected to said spreading means, and means for controlling said additional power transmission mechanism to secure operation of said breaker independently of the feed of said kerf-cutter, both of said power transmission mechanisms being connected to said motor for operation thereby.

49. In a mining machine, the combination with a plane kerf-cutter, of means for operating the same including the feed thereof, and an expansible breaker comprising kerf wall engaging devices with rotary wedging mechanism between the same for mechanically operating the breaker by mechanically spreading apart said kerf wall engaging devices.

50. In a mining machine, the combination with supporting framework, of chain kerf-cutting mechanism mounted thereon, said kerf-cutting mechanism comprising a cutter frame, an expansible breaker mechanical in construction and operation throughout for exerting breaking down pressure on the walls of the kerf independently of the operation of said kerf-cutting mechanism, said breaker comprising kerf wall engaging devices with mechanical spreading apart means between the same, means for supporting said breaker on said cutter frame for lateral movement relatively thereto, and mechanical power transmission means extending along said cutter frame from said

framework to said spreading apart means to effect the operation of the breaker.

51. A breaker adapted to be inserted into a kerf in a mine wall and comprising kerf wall engaging devices, a rotary device for expanding the breaker by spreading apart said kerf wall engaging devices to a predetermined extent, a spring for automatically contracting the breaker by moving said kerf wall engaging devices toward each other after having been spread apart to said predetermined extent, and mechanism for operating said rotary device.

52. In a mining machine, the combination with a supporting frame, of a kerf-cutter mounted thereon and comprising a flat cutter frame and an endless chain cutter adapted to travel thereon, a driving shaft connected to said chain cutter, an expansible breaker mounted in position to travel in the kerf cut by said kerf-cutter, said breaker comprising kerf wall engaging devices with means entirely mechanical between the same to spread them apart to break down cut material, and power transmission mechanism connected between said drive shaft and said mechanical spreading apart means to operate the latter.

53. A breaker comprising a frame, a plunger mounted on said frame for movement transversely relatively thereto, rotary cam mechanism on said frame for moving said plunger transversely of said frame, and means for guiding such transverse movements of such plunger.

54. A breaker adapted to be inserted into a kerf in a mine wall and comprising a frame, a transversely movable plunger on said frame and having an outer flat kerf wall engaging surface, and a rotary device mounted on said frame for operation on an axis at right angles to the plane of said flat surface to actuate said plunger to exert pressure on the material adjacent said kerf to dislodge such material.

55. In a mining machine, the combination with kerf-cutters adapted to simultaneously form horizontal and vertical kerfs in a coal face, of power transmission mechanism connected to said kerf-cutters, mechanically expansible breaking down means carried by the vertical kerf-cutter and adapted to exert pressure transversely thereof to dislodge the coal, and means under the control of the operator for connecting said mechanically expansible breaking down means to said power transmission mechanism to effect the operation of said mechanically expansible breaking down means.

56. In a mining machine, the combination with an upright kerf-cutter, of power transmission mechanism connected thereto, mechanically expansible breaking down means adapted to enter the upright kerf cut by said kerf-cutter, mechanical mechanism for operating said breaking down means to exert pressure toward the free face of the coal to dislodge the same, operative connections between said power transmission mechanism and said operating mechanism, and a clutch for controlling said operative connections.

57. In a mining machine, the combination with kerf-cutting mechanism comprising a cutter-frame and an endless chain-cutter adapted to travel thereon, of power transmission mechanism connected to said chain-cutter to drive the same, flat expansible pressure exerting mechanism connected to said cutter-frame to lie in the plane thereof within the boundary of said chain-cutter 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 auxiliary power transmission mechanism connected between said first-named power transmission mechanism and said flat expansible mechanism to effect the operation of the latter.

58. 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 frame to effect feeding of said kerf-cutter to cut a plane kerf, a mechanically expansible pressure exerting device having spaced-apart flat parallel engaging surfaces and connected to said cutter-frame in position to travel into the kerf produced by said kerf-cutter and act to produce pressure on the walls of said kerf at right angles thereto without removing the kerf-cutter and independently of said feeding means, power transmission mechanism comprising a shaft connected to said chain-cutter, and auxiliary power transmission mechanism comprising a shaft connected between said first-named shaft and said pressure exerting device.

59. In a mining machine, the combination with a plane kerf-cutter comprising a cutter-frame having a chain-cutter traveling on the periphery thereof, of an expansible breaker having spaced-apart parallel flat kerf wall engaging surfaces with wedging mechanism between the same, and means comprising a rotary device rotatable in planes between said surfaces and parallel thereto to co-operate with said wedging mechanism to expand the breaker to exert pressure on opposite walls of the kerf cut by said chain-cutter.

60. In a mining machine, the combination with a supporting frame, of a chain kerf-cutter, a breaker comprising flat kerf wall engaging means with mechanism entirely mechanical between the same to spread apart said kerf wall engaging means to break down the material, power transmission mechanism for driving said chain kerf-

cutter, auxiliary power transmission mechanism connected to said breaker for operating the same, and means operable from without the body of material to control the operation of said breaker while located in the kerf back of the working face.

61. In a mining machine, the combination with a frame, of a traveling chain-cutter carried thereby, flat spaced-apart kerf wall engaging devices, means entirely mechanical between said kerf wall engaging devices to spread the same apart to break down the material cut by said kerf-cutter, means for supporting said kerf wall engaging devices on said frame within the boundary of said chain-cutter, power transmission mechanism comprising a shaft for driving said chain-cutter, auxiliary power transmission means between said shaft and said spreading means for operating the latter from the same source of power as that used for driving said chain-cutter, and a clutch operable from without the working face for controlling the operation of said auxiliary power transmission means while said engaging devices are in said kerf back of the coal face and while said chain-cutter is being driven.

62. In a mining machine, the combination with a supporting frame, of means carried thereby for cutting a pair of kerfs in the coal, power transmission mechanism connected to said cutting means to drive the same, an expansible breaker carried by said cutting means for movement into one of the kerfs produced thereby, auxiliary power transmission mechanism for operating said expansible breaker from said first-named power transmission mechanism, and means operable from without the kerfs for controlling the operation of said breaker while the latter is in one of said kerfs entirely back of the working face.

63. 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 chain-cutter adapted to travel thereon, means for operating said plane kerf-cutters including simultaneous feed thereof, a pair of flat-faced kerf wall engaging devices mounted on one of said cutter-frames in position to enter the corresponding kerf, mechanism between said flat-faced engaging devices for spreading them apart at right angles to the cutter-frame on which said devices are mounted to cause the latter to exert sufficient pressure on the coal to break down the latter between the kerf-cutters, and power transmission mechanism extending from without the working face to said spreading mechanism for operating the latter while said kerf wall engaging devices are entirely imbedded in the unmined mass.

64. A breaker adapted to be inserted into a kerf in a mine wall and comprising kerf wall engaging devices, mechanical means for intermittently and automatically spreading apart said kerf wall engaging devices, and mechanism for operating said intermittent and automatic spreading apart means.

65. A breaker comprising a flat supporting frame comparatively narrow in thickness, flat kerf wall engaging devices having flat parallel engaging faces, said devices being mounted on said frame to adapt the breaker to be inserted into a plane kerf in a mine wall, rotary means operable in planes between said faces and parallel thereto to expand said devices to cause the same to engage the walls of the kerf and exert sufficient pressure thereon to break down the material, and means for limiting the expansion of the breaker to a predetermined thickness and automatically stopping the operation thereof by automatically returning said kerf wall engaging devices to their initial positions in readiness for another such breaking down operation.

66. A breaker adapted to be inserted into a kerf in a mine wall and comprising a frame, kerf wall engaging devices having parallel spaced-apart engaging surfaces, telescoping guiding cylinders between said kerf wall engaging devices, and means surrounding said cylinders for spreading apart said kerf wall engaging devices relatively to said frame to cause said parallel surfaces to exert pressure on the walls of the kerf.

67. In a mining machine, the combination with a plane kerf-cutter comprising a flat cutter-frame and an endless chain-cutter mounted thereon to travel around the same, of power transmission mechanism for operating said kerf-cutter, an expansible breaker comprising means for automatically expanding and contracting the same intermittently and alternately, auxiliary power transmission mechanism, a clutch for controlling said auxiliary power transmission mechanism, and means comprising a wiper cam for automatically releasing said clutch to stop the intermittent operation of said breaker after the same has been operated repeatedly and automatically and intermittently as aforesaid.

68. The combination with a kerf-cutter adapted to form a kerf in a mine wall, of expansible pressure exerting devices, means comprising arcuate rotary wedges for spreading apart said expansible pressure exerting devices to a predetermined extent and then automatically releasing the same, and a restoring spring between said expansible pressure exerting devices for automatically restoring the same to initial positions in readiness for another expanding operation after being thus automatically released by said arcuate rotary wedges.

69. In a mining machine, the combination with a chain kerf-cutter comprising a cutter-frame, of a plurality of expansible breakers mounted thereon, power transmission mechanisms for operating said breakers, and inter-connected clutches for effecting the operation of one breaker while the other breaker remains disconnected from the source of power.

70. In a mining machine, the combination with a chain kerf-cutter comprising a cutter-frame, of power transmission mechanism connected to the kerf-cutter, two spaced-apart expansible breakers mounted on said cutter-frame, power transmission mechanisms connected between said breakers and said first-named power transmission mechanism, clutches for controlling the power transmission mechanisms connected to said breakers, and interlocking connections between said clutches to prevent both breakers from being operated at the same time.

71. In a mining machine, the combination with a supporting frame, of cutting mechanism mounted thereon to extend longitudinally thereof, a rope drum, a rope wound thereon with its free end adapted to be anchored in the mine in position to effect movement of said frame longitudinally thereof when said drum is turned to exert a pull on said rope, a motor on said frame, and power transmission mechanism between said motor and said rope drum comprising a drive shaft on the motor shaft and a driven shaft at right angles to the drive shaft and connected to said rope drum with two clutches one adapted to be released to permit free rotation of said rope drum when said rope is pulled therefrom manually to have its free end anchored in the mine and the other clutch being adapted to effect operation of said power transmission mechanism when said motor is operated.

In testimony whereof I have signed my name to this specification on this 13th day of May, A. D. 1921.

EDMUND C. MORGAN.