Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 1

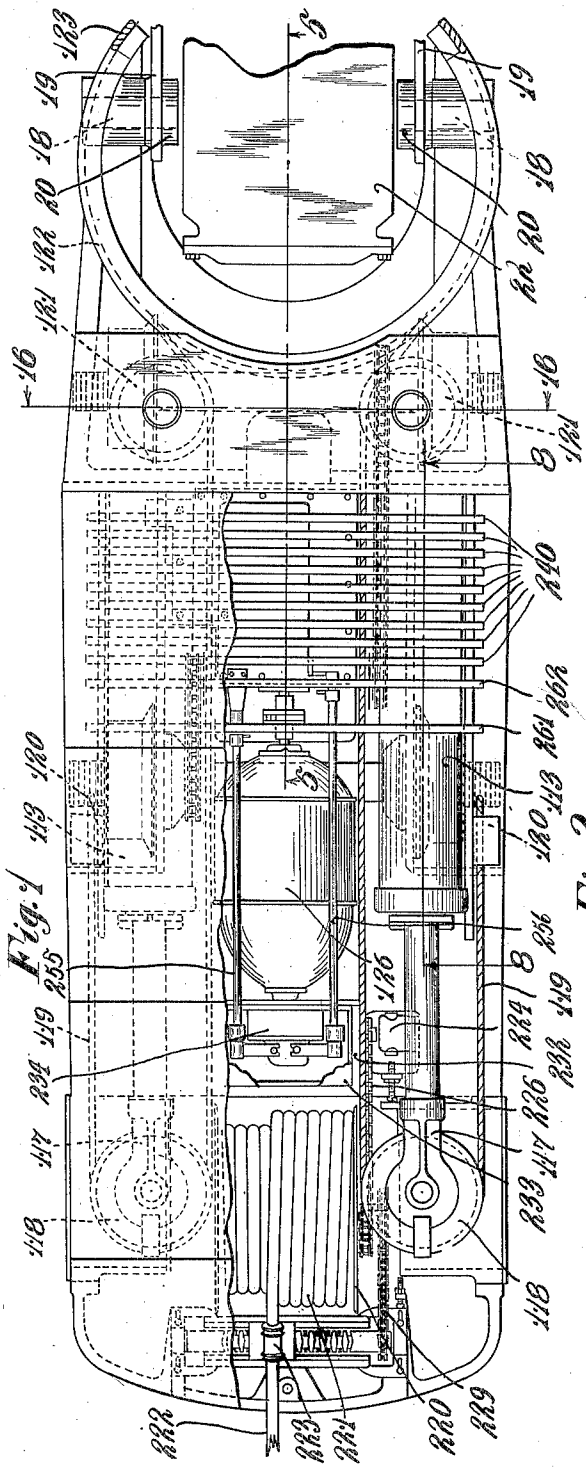


Fig. 1

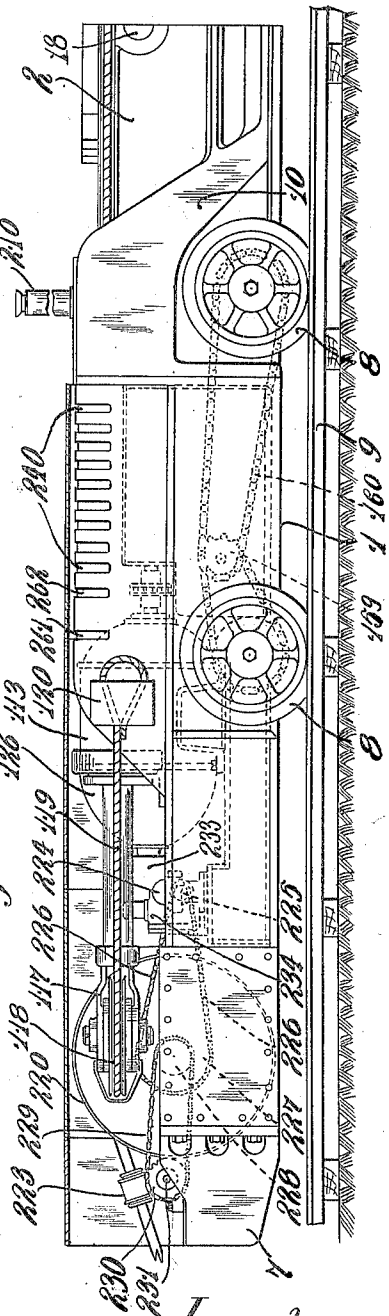


Fig. 2

Inventor:
Joseph F. Joy
by Louis A. Markon.
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 2

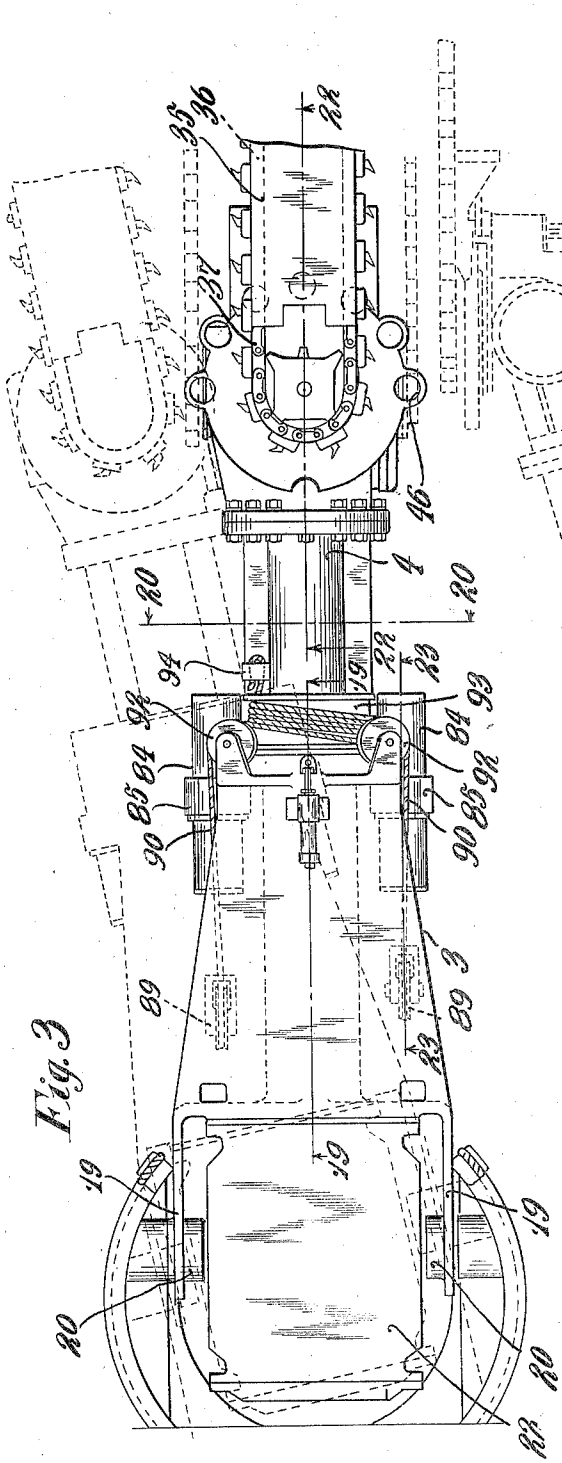


Fig. 3

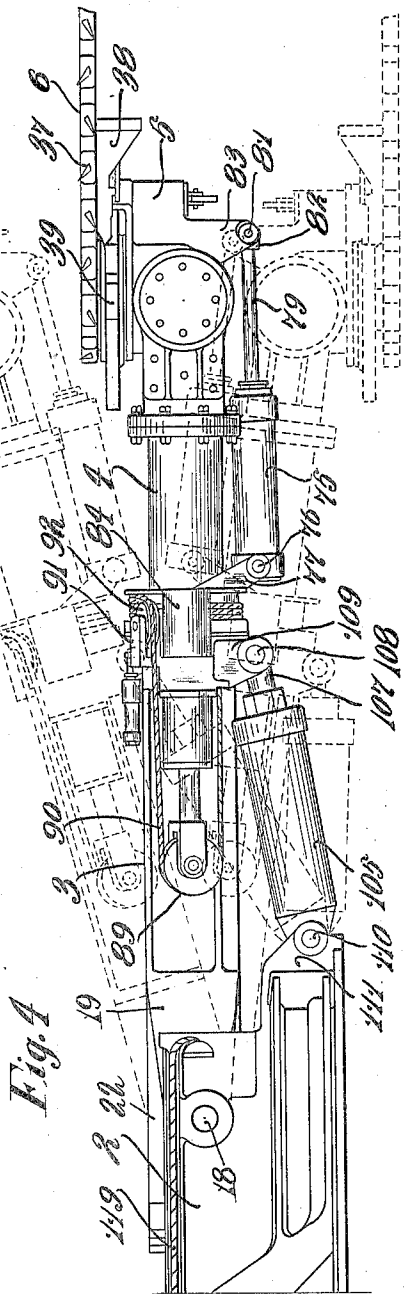


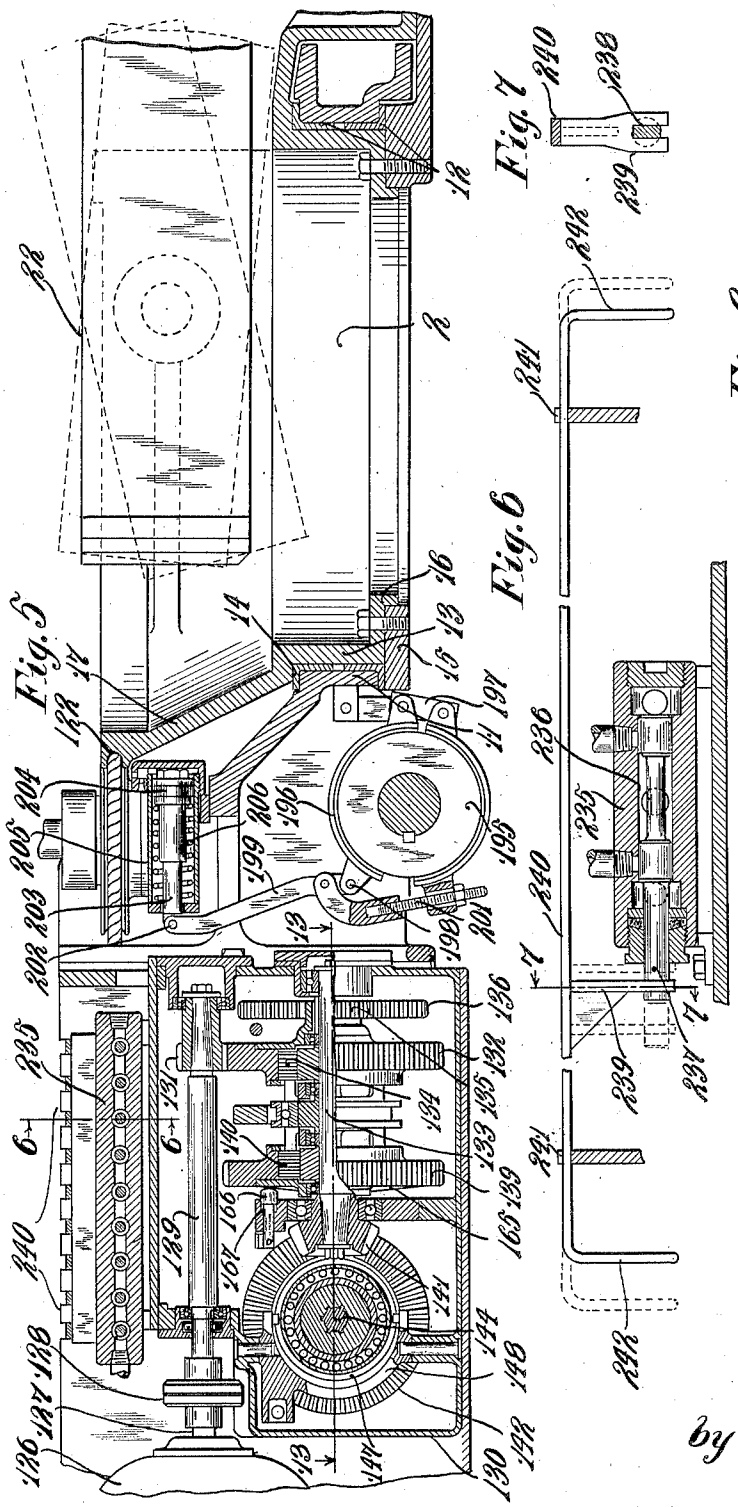
Fig. 4

Inventor:
Joseph F. Joy
By Louis A. Maxson.
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 3



Inventor:
Joseph F. Joy
by Louis A. Maxson.
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 4

Fig. 9

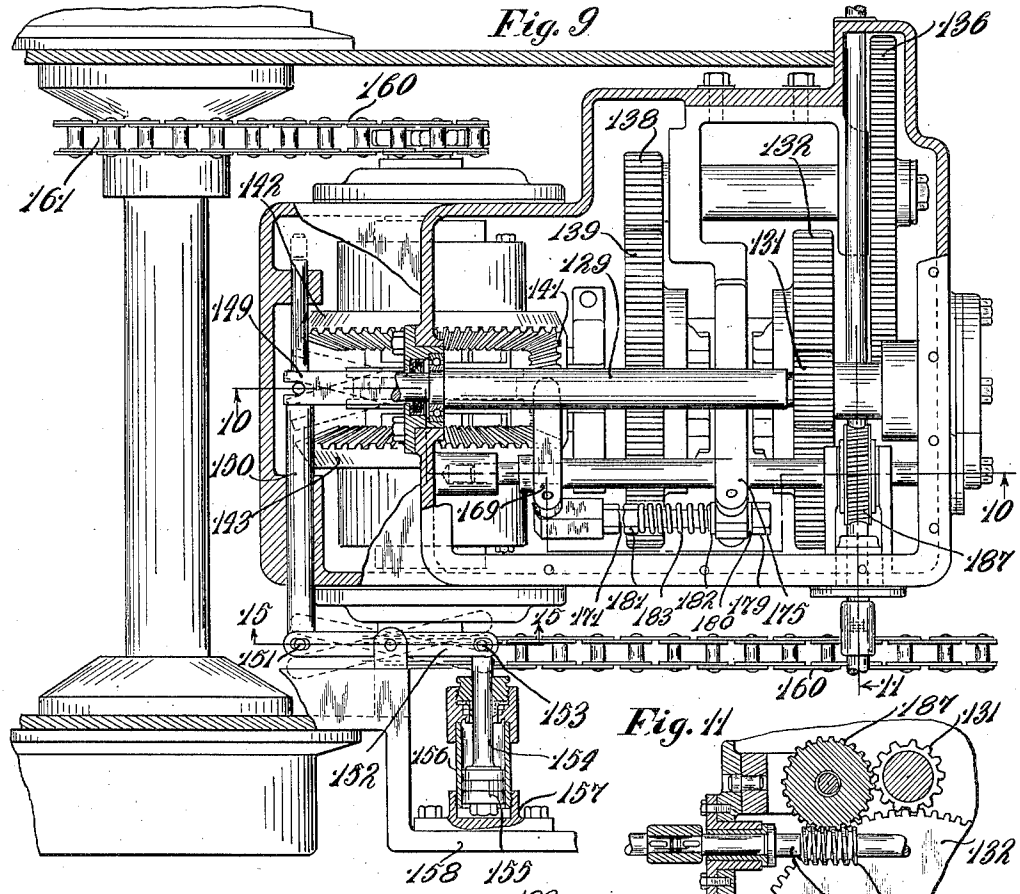
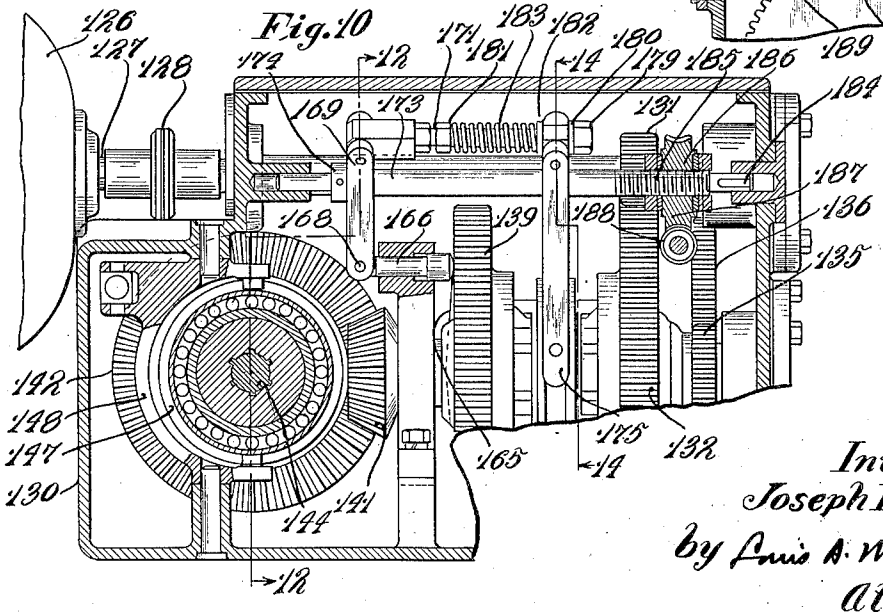


Fig. 11

Fig. 10



Inventor:
Joseph F. Joy
by Louis A. Maxon.
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 5

Fig. 12

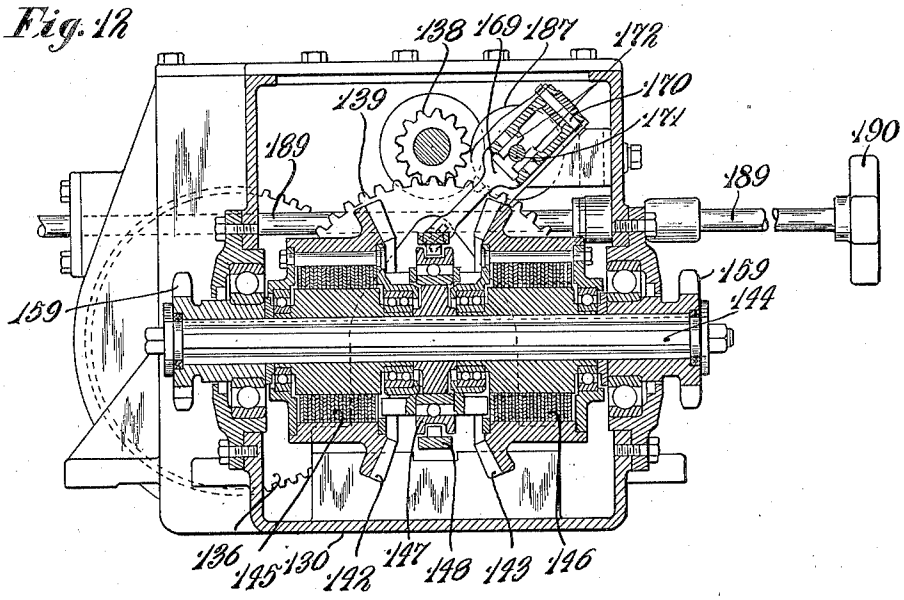
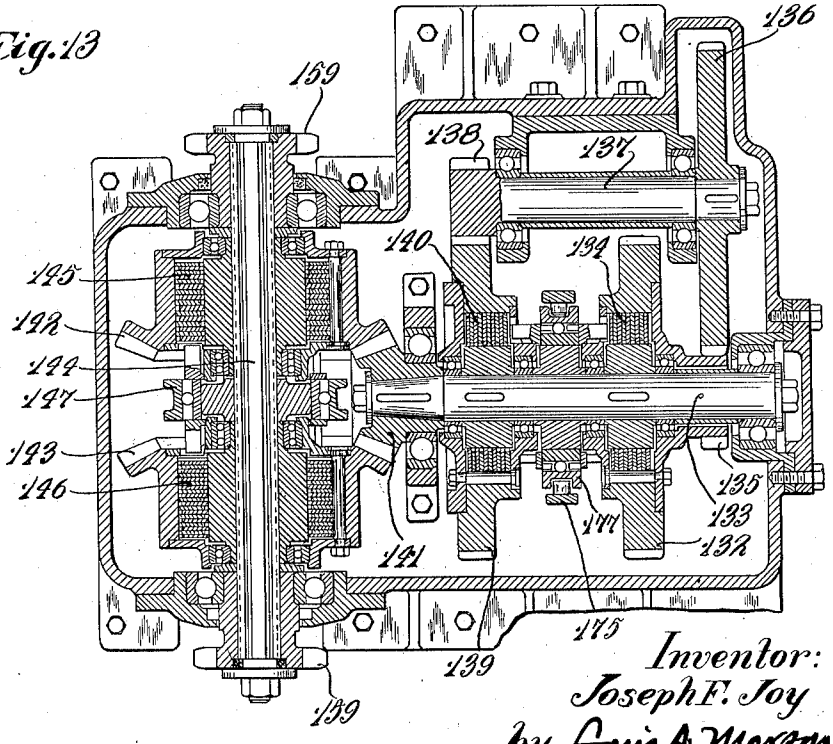


Fig. 13



Inventor:
Joseph F. Joy
by Louis A. Maxson.
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 6

Fig. 14

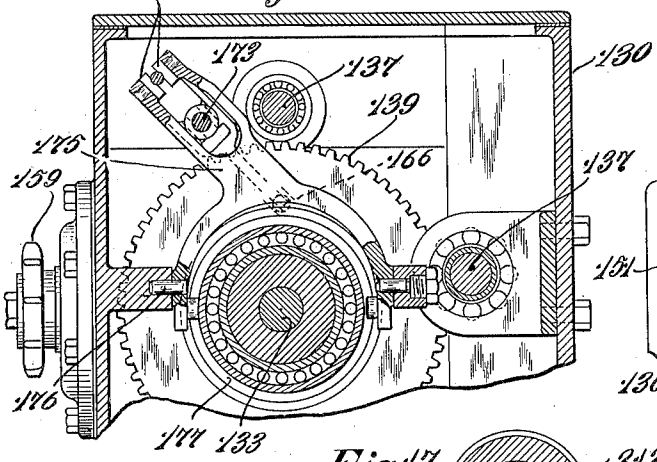


Fig. 15

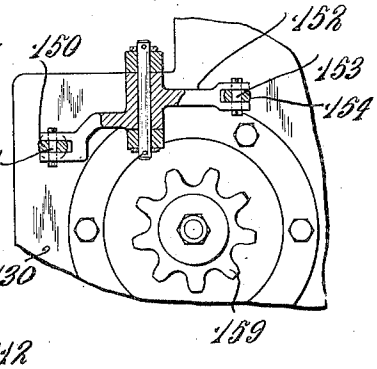


Fig. 17

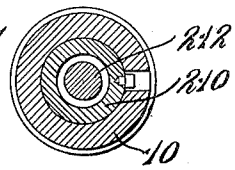


Fig. 16

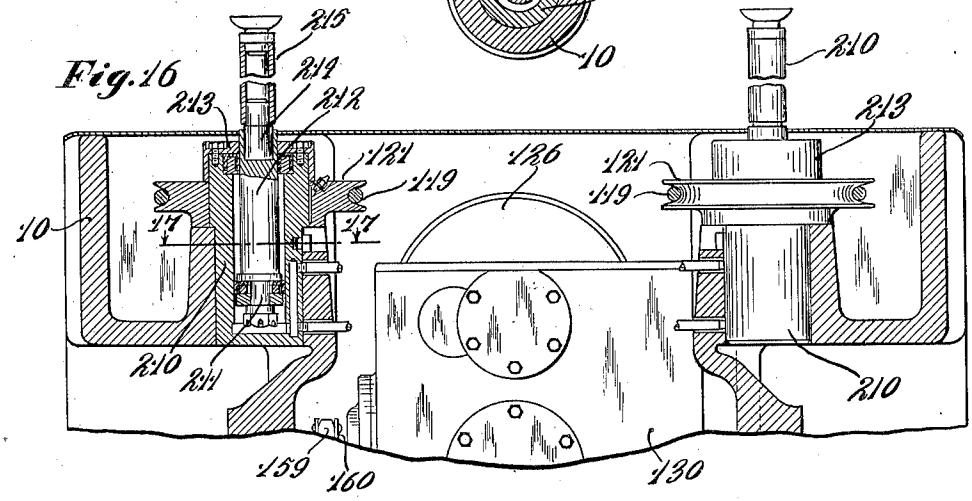
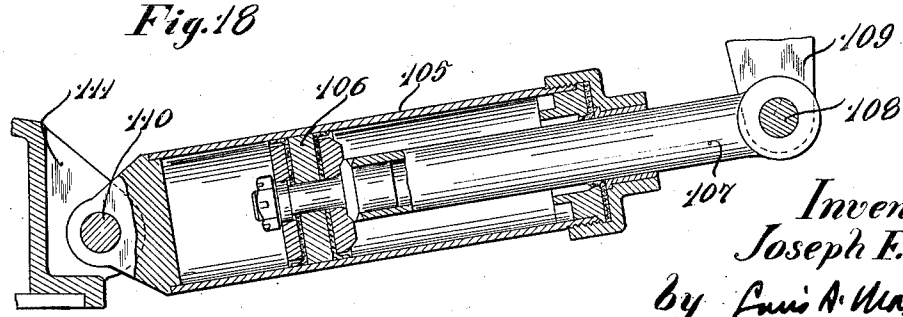


Fig. 18



Inventor:
Joseph F. Joy
by Louis A. Macomber
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 7

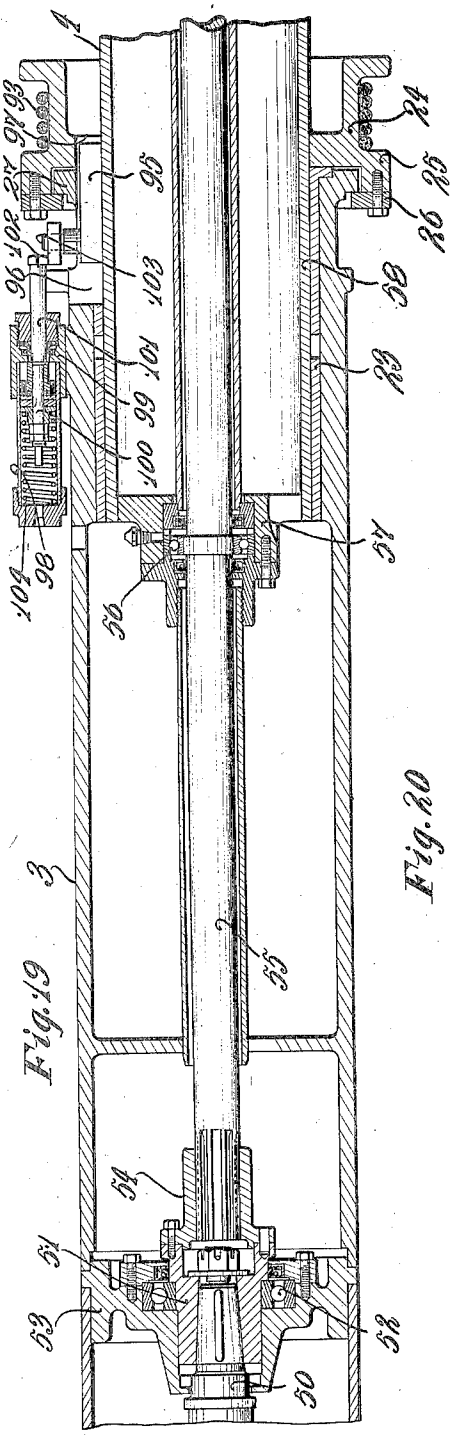


Fig. 19

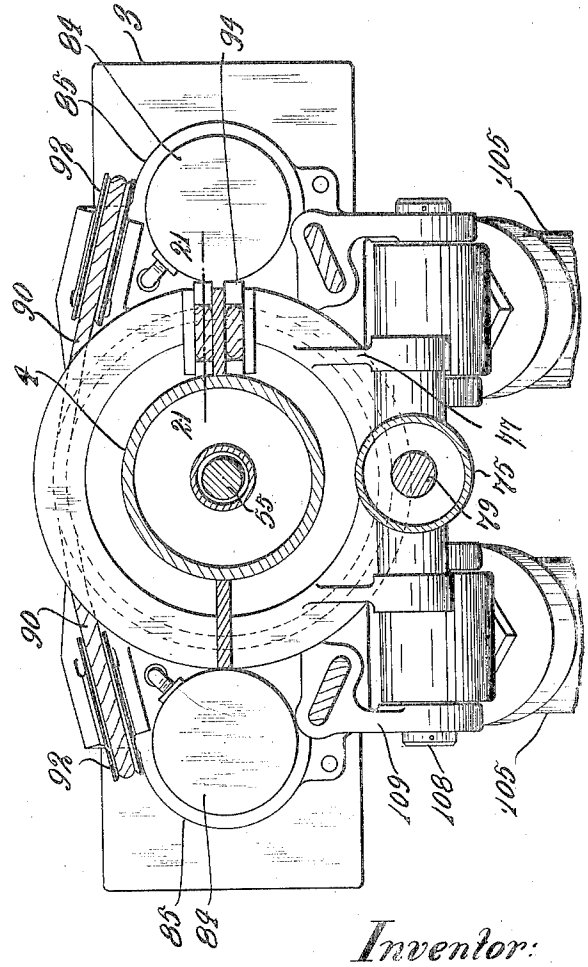


Fig. 20

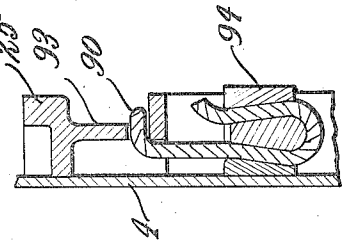


Fig. 21

Inventor:
Joseph F. Joy
by Louis A. Maxson
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 8

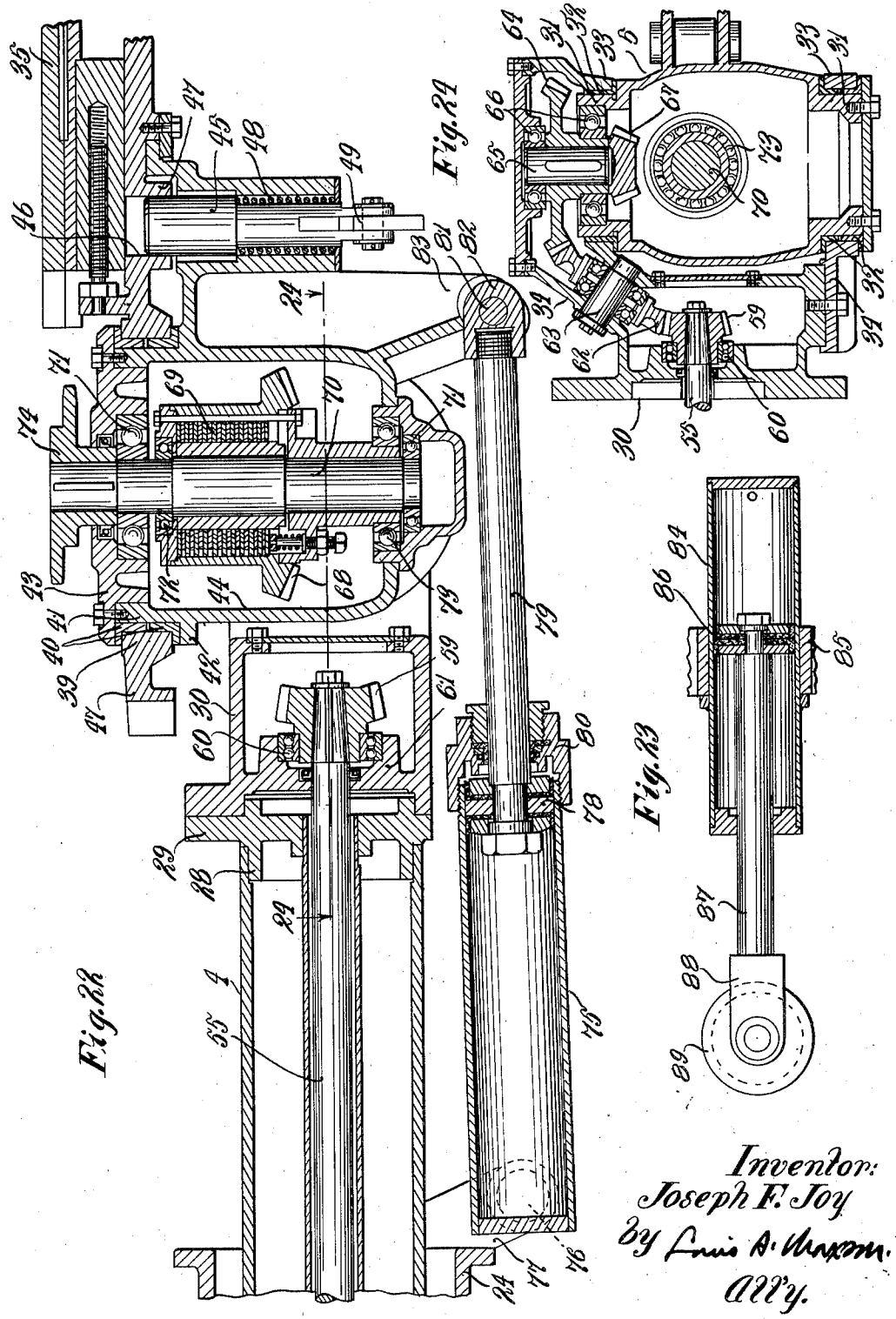


Fig. 22

Fig. 24

Fig. 23

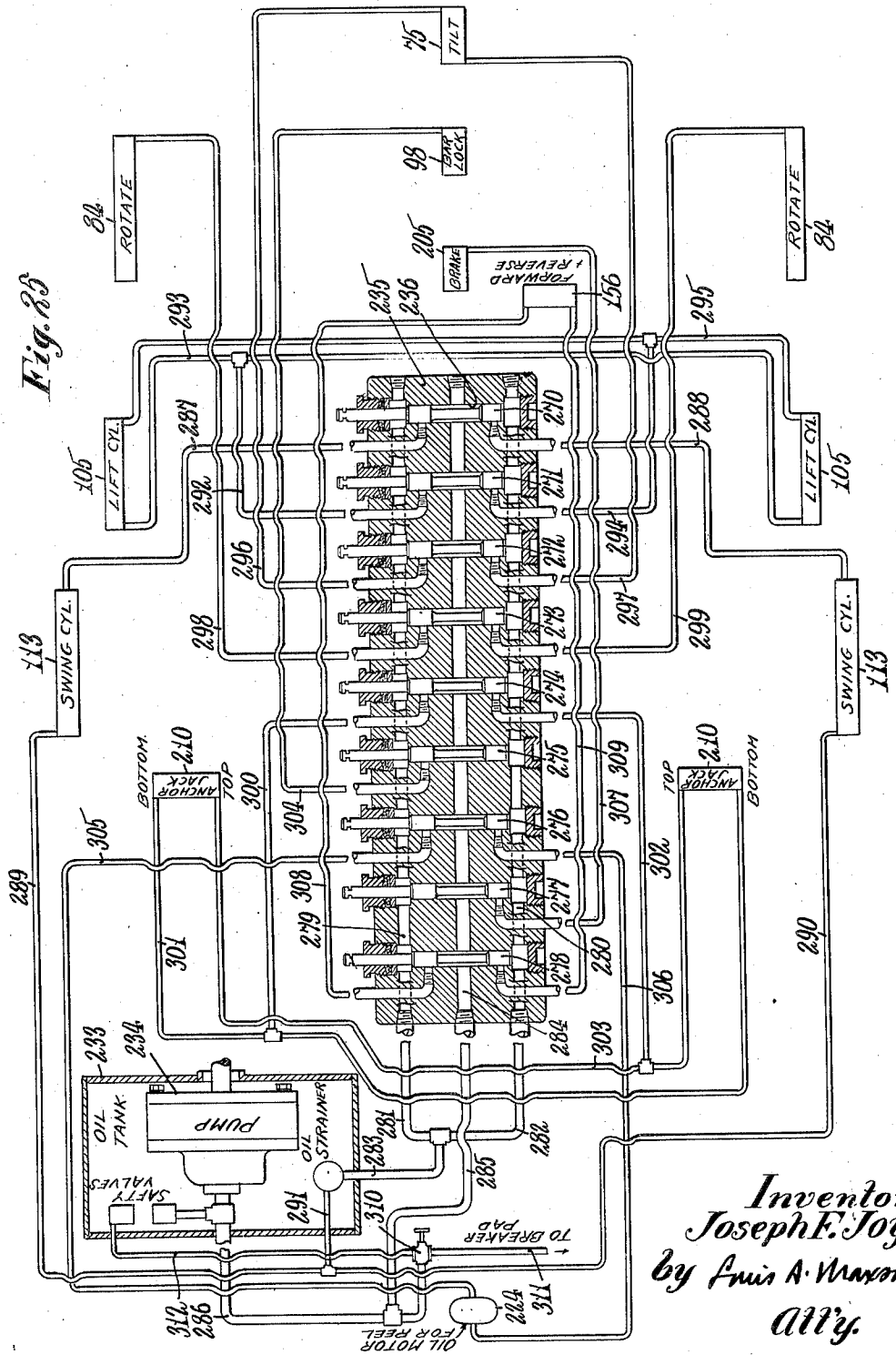
Inventor:
Joseph F. Joy
By Louis A. Maxon.
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 9

Fig. 23

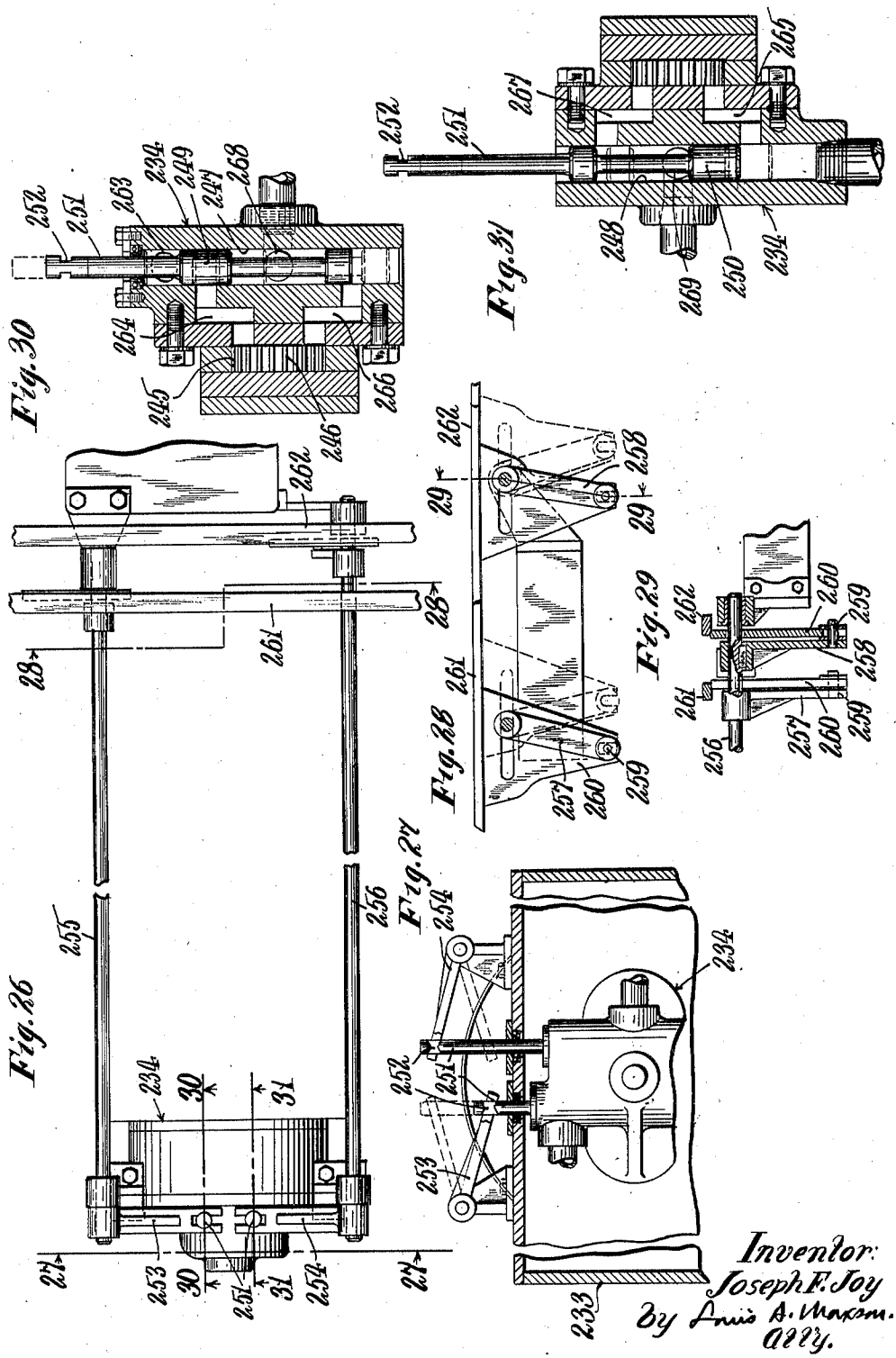


Inventor:
Joseph F. Joy
by Louis A. Maxson.
Atty.

Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 10



Jan. 21, 1941. J. F. JOY 2,229,087

MINING APPARATUS

Filed May 10, 1935 11 Sheets-Sheet 11

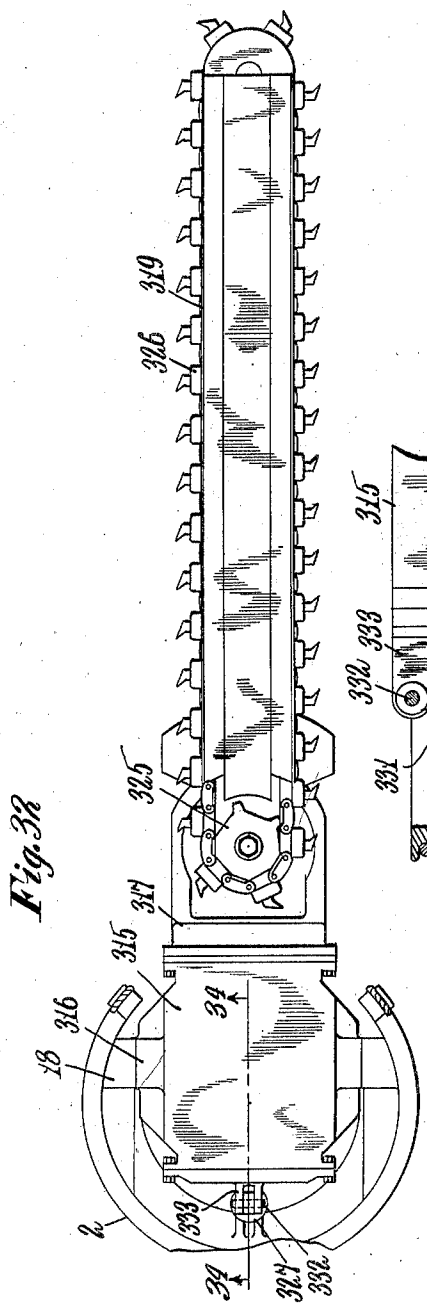


Fig. 32

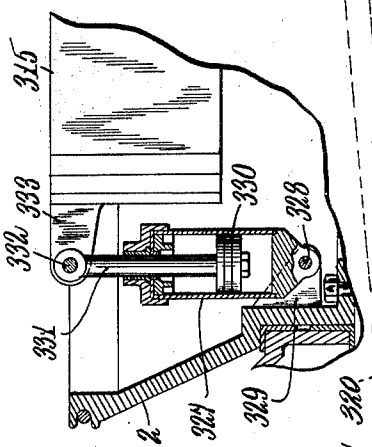


Fig. 34

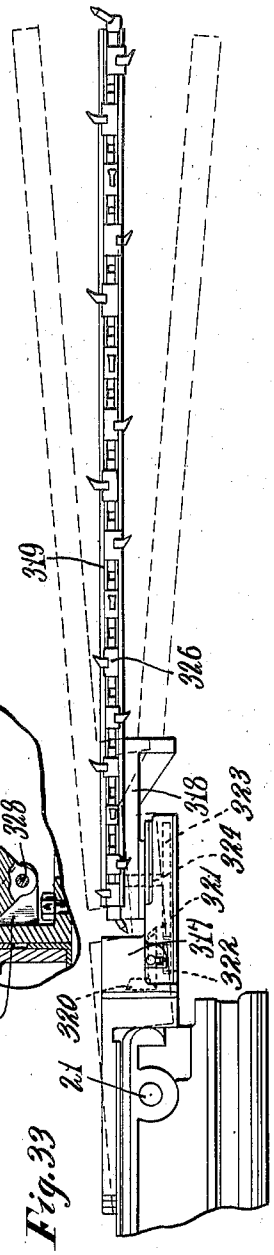


Fig. 33

Inventor:
Joseph F. Joy
By Louis A. Maxson
Att'y.

Patented Jan. 21, 1941

2,229,087

UNITED STATES PATENT OFFICE

2,229,087

MINING APPARATUS

Joseph F. Joy, Claremont, N. H., assignor to Sullivan Machinery Company, a corporation of Massachusetts

Application May 10, 1935, Serial No. 20,826

29 Claims. (Cl. 262—28)

This invention relates to mining apparatus, and more particularly has reference to improvements in coal mining apparatus for cutting kerfs in a coal seam at various locations to suit different mining conditions.

An object of this invention is to provide an improved coal mining apparatus which is extremely flexible in operation and provides an extremely wide range of cutter adjustment. Another object is to provide an improved coal mining apparatus having improved adjustable supporting means for the kerf cutter and improved kerf cutter driving means. A further object is to provide an improved pivotal mounting for the kerf cutter driving motor and an improved turntable structure for the driving motor mounting. Yet another object is to provide an improved truck propelling mechanism for driving the truck wheels to propel the apparatus along the mine trackway through a wide range of relatively low cutting speeds and a relatively high transport speed. A further object is to provide improved hydraulic operating means for various mechanisms of the apparatus, together with an improved hydraulic fluid system, embodying improved liquid pressure supply and control means. Still another object is to provide improved hydraulically operated mechanism for adjusting the elevation and lateral position of the kerf cutter, for rotating the kerf cutter into horizontal and vertical cutting planes, and for tilting the kerf cutter into cutting planes relatively inclined with respect to the horizontal and vertical. Still another object is to provide an improved hydraulically operated and controlled cable reel for the power conductor cable and an improved hydraulically controlled braking means for the apparatus. Yet another object of this invention is to provide an improved coal mining apparatus of an extremely flexible character whereby the kerf cutter may be positioned into any desired cutting plane, the parts of the apparatus being arranged in an extremely compact manner whereby an apparatus extremely low in height is attained. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there are shown for purposes of illustration one form and a modification thereof which the invention may assume in practice.

In these drawings,

Figs. 1 and 3, taken together, show in plan a preferred illustrative form of the improved mining apparatus, the top plate being broken away to show portions of the internal mechanism.

Figs. 2 and 4, taken together, show the improved mining apparatus in side elevation, a portion of the side plate being broken away to show portions of the internal mechanism.

Fig. 5 is an enlarged view in longitudinal section taken substantially on line 5—5 of Fig. 1.

Fig. 6 is an enlarged detail sectional view taken on line 6—6 of Fig. 5.

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

Fig. 8 is an enlarged view in longitudinal section taken on line 8—8 of Fig. 1.

Fig. 9 is an enlarged horizontal sectional view taken on line 9—9 of Fig. 2 showing the transmission mechanism.

Fig. 10 is a longitudinally extending vertical sectional view taken on line 10—10 of Fig. 9.

Fig. 11 is a detail sectional view taken on line 11—11 of Fig. 9.

Fig. 12 is a cross sectional view taken on line 12—12 of Fig. 10.

Fig. 13 is a horizontal sectional view taken on line 13—13 of Fig. 5.

Fig. 14 is a cross sectional view taken on line 14—14 of Fig. 10.

Fig. 15 is a detail sectional view taken on line 15—15 of Fig. 9.

Fig. 16 is an enlarged cross sectional view taken on line 16—16 of Fig. 1.

Fig. 17 is a detail horizontal sectional view taken on line 17—17 of Fig. 16.

Fig. 18 is a view in longitudinal section of one of the arm swinging cylinders.

Fig. 19 is an enlarged view in longitudinal section taken on line 19—19 of Fig. 3.

Fig. 20 is an enlarged cross sectional view taken on line 20—20 of Fig. 3.

Fig. 21 in a detail horizontal sectional view taken on line 21—21 of Fig. 20.

Fig. 22 is an enlarged view in longitudinal section taken on line 22—22 of Fig. 3.

Fig. 23 is an enlarged longitudinally extending vertical sectional view taken on line 23—23 of Fig. 3.

Fig. 24 is a horizontal sectional view taken on line 24—24 of Fig. 22.

Fig. 25 is a diagrammatic view showing the improved hydraulic system.

Fig. 26 is a detail plan view showing the pump control means.

Fig. 27 is a cross sectional view taken on line 27—27 of Fig. 26.

Fig. 28 is a cross sectional view taken on line 28—28 of Fig. 26.

Fig. 29 is a detail sectional view taken on line 29—29 of Fig. 28.

Fig. 30 is a longitudinal sectional view taken on line 30—30 of Fig. 26, showing the pump structure.

Fig. 31 is a longitudinal sectional view taken on line 31—31 of Fig. 26, showing the pump structure.

Figs. 32 and 33 are views similar to Figs. 3 and 4 respectively showing a modified form of construction.

Fig. 34 is an enlarged view in longitudinal section taken substantially on line 34—34 of Fig. 32.

In the preferred illustrative embodiment of the invention shown in Figs. 1 to 31, inclusive, there is shown a coal mining apparatus of the so-called universal type having an improved adjustable supporting structure for the kerf cutter whereby kerfs may be cut in a coal seam at any desired location to suit different mining conditions. This improved coal mining apparatus generally comprises a self-propelled portable base 1, a horizontal turntable 2, a vertically swingable arm structure 3, a rotatable head 4, a swingable cutter support 5 and a kerf cutter 6. The portable base 1 is herein in the form of a truck frame 7 of an extremely low compact design mounted on wheels 8 adapted to run along a mine trackway 9 laid on the mine floor. This truck frame has a forwardly projecting horizontal frame portion 10 supporting, in a relatively low position below the top of the truck and in advance of the front truck wheel axes, an annular frame 11 on which the turntable 2 is mounted for rotation about a vertical axis with respect to the truck frame, the turntable axis being located on the truck frame a substantial distance in advance of the front truck wheels, thereby enabling the turntable structure to be mounted on the truck frame in an extremely low position. The annular frame portion 11 of the truck frame is in the form of a bearing annulus and supports bearing sleeves 12 in which a cylindrical bearing portion 13 of the turntable is rotatably mounted, the turntable being retained in position within its bearing mounting by an annular shoulder 14 engaging the upper bearing sleeve and an annular retaining plate 15 secured as by screws to an annular flange 16 formed integral with the bottom of the cylindrical bearing portion 13 of the turntable. Formed integral with the cylindrical bearing portion 13 of the turntable and extending upwardly therefrom is a segmental open center frame portion or segmental flange 17, the sides of which support bearing hubs 18. Pivotally mounted on the turntable frame to swing in a vertical direction with respect to the turntable and extending through the open side of the flange portion 17, is a yoke-shaped frame portion of the arm 3, and the arms 19 of this frame have integral bearing hubs 20 journaled on pins 21 secured within the bearing hubs 18 of the turntable frame. Arranged between the arms 19 of the yoke-shaped frame of the swinging arm 3 and secured to the latter, as by bolts, at the rear end thereof is a motor 22, the motor being mounted to swing with the arm 3 between the sides of the segmental flange portion 17 within the central opening of the turntable frame. The rotatable head 4 is journaled in an elongated bearing sleeve 23 supported within the neck portion of the forward portion of the arm 3, and the head 4 is rotatable within this bearing sleeve about an axis extending longitudinally of the arm at right angles to the horizontal axis of arm swing. Secured, as by welding to the rotatable head 4 and encircling the latter is an annulus 24 having a flange 25 to which is secured, as by screws, an annular retaining plate 26, this annulus and retaining plate cooperating with an annular flange 27 formed externally on the outer extremity of the arm 3 for retaining the rotatable head in position on the arm in the manner shown in Fig. 19. As shown in Fig. 22, fixed to the outer extremity of the rotatable head 4 at 28 is a frame 29 to which is secured, as by bolts, a yoke-shaped frame 30. The swingable cutter support 5 has lateral trunnions 31, 31 journaled in bearing sleeves 32 supported by annular bearing supports 33 formed on the arms 34, 34 of the yoke-shaped frame 30, the support 5 being swingable with respect to the frame 30 and head 4 about an axis arranged at right angles to the axis of rotation of the head. The kerf cutter 6 is in the form of an elongated plane cutter bar 35 having mounted for circulation in a guideway 36, formed about its margin, an endless cutter chain 37. Suitably secured to the bar 35 and supporting the latter is a bar hanger 38 having an annular bearing portion 39 journaled on bearing sleeves 40 supported by an annular portion 41 of the swingable cutter support 5. The bearing portion of the bar hanger is retained in position on the support 5 between an annular flange 42 formed on the support and a detachable retaining plate 43 secured, as by screws, to the frame 44 of the swingable support. It will thus be seen that the kerf cutter may swing with respect to the cutter support 5 about an axis perpendicular to the support pivot axis. The means for locking the kerf cutter in its different angular positions with respect to the swingable support comprises a locking pin 45 slidably mounted in a bore in the bar hanger and insertible in any one of a number of locking openings 46 formed in lateral bosses 47 integral with the annular bearing portion 39 of the bar hanger. The pin is urged towards its locking position by a coil spring 48, and a suitable cam lever means 49 is provided for moving the pin into its released position.

The motor 22 is herein preferably of the reversible electric type having the axis of its power shaft 50 alined with the axis of rotation of the head 4 and the longitudinal axis of the arm 3, and the driving connections between the motor power shaft and the kerf cutter comprise, as shown in Fig. 19, a coupling hub 51 keyed to the motor power shaft and journaled in a ball bearing 52 supported by the front motor head 53. Secured, as by screws, to this coupling hub is a coupling member 54 having splined connection with the rear end of a transmission shaft 55 arranged with its axis coinciding with the longitudinal axes of the arm and the axis of rotation of the head 4. This shaft extends through the arm neck portion and is journaled in a ball bearing 56 supported within a head member 57 secured within the bore of the tubular frame 58 of the rotatable head 4. Keyed to the outer end of the transmission shaft 55, as shown in Fig. 22, is a bevel pinion 59, the hub of which is journaled in a ball bearing 60 supported within a head portion 61 integral with the yoke-shaped frame 30, and, as shown in Fig. 24, this bevel pinion meshes with a bevel gear 62 journaled on a shaft 63 secured within the arm 34 of the yoke frame 30. The bevel gear 62 meshes with a bevel gear 64 keyed to a shaft 65 journaled within ball bear-

ings 66 supported within the frame 30 and arranged with its axis alined with the axis of swinging movement of the cutter support 5. Fixed to the shaft 65 is a bevel gear 67 meshing with a bevel gear 68 connected through a friction safety clutch 69, of the multiple disc type, to a shaft 70, the latter being journaled in ball bearings 71 supported within the swingable support 5. The hubs of the bevel gear 68 are journaled in bearings 72 and 73 supported respectively by the shaft 70 and the frame 44 of the cutter support 5 so that when the clutch 69 slips, due to overload, the bevel gear may rotate with respect to the shaft 70. Keyed to the outer extremity of the shaft 70 is a chain sprocket 74 for engaging and driving the endless cutter chain 37. It will thus be seen that the transmission connections between the motor and cutter chain are so arranged with respect to the axes of the various supports that the cutter chain may be driven irrespective of the adjusted position of the arm 3, the head 4 and cutter support 5.

Hydraulically operated means is employed for swinging the cutter support 5 about its pivot with respect to the frame 30, comprising a cylinder 75 pivotally mounted at its rear end at 76 on pivot pins supported by brackets 77 formed integral with the annulus 24 of the rotatable head 4. Reciprocably mounted in the cylinder 75 is a piston 78 having its piston rod 79 extending forwardly through the packed front head 80 of the tilt cylinder and pivotally connected by a pin 81 to the swingable cutter support 5, the pin 81 being mounted in projections 83 formed integral with the frame 44 of the cutter support. The hydraulically operated mechanism for rotating the head 4 with respect to the arm 3 comprises, as shown in Figs. 3, 4, 19, 20, 21 and 23, a pair of hydraulic cylinders 84, 84 supported within brackets 85 secured to the opposite sides of the frame of the arm 3, and each containing a reciprocable piston 86 (see Fig. 23) having a rearwardly projecting piston rod 87. Each of these piston rods carries a bracket 88 on which is journaled a guide pulley 89. Passing around these pulleys 89 are cables 90, 90 each anchored at one end at 91 to the frame of the arm 3, the cables passing from the pulleys 89, 89 around inclined pulleys 92, 92 journaled on brackets secured to the arm frame, and the cables have their intermediate portions wrapped around a drum 93 formed integral with the retaining annulus 24 of the head 4, the opposite ends of these cables being secured at 94 to the frame of the rotatable head 4. The means for locking the rotatable head 4 in its adjusted positions with respect to the arm comprises a sliding locking pin 95 mounted in a guideway 96 formed in the arm frame, and this pin is adapted to project in any one of a series of apertures 97 formed in the frame of the head 4. The means for operating this locking pin comprises a cylinder 98 having its front head 99 secured to the arm frame. This cylinder contains a piston 100 having a forwardly projecting piston rod 101 secured to a member 102. The member 102 has an opening receiving a pin 103 secured to the locking pin 95. Arranged within the cylinder 98 and interposed between the rear cylinder head and the piston is a coil spring 104 for urging the locking pin into its locking position. Hydraulic pressure is adapted to be supplied to the opposite end of the cylinder to act on the opposite side of the piston for moving the piston rearwardly to release the locking pin from the head. Hydraulic means is provided for swinging the arm 3 relative to the turntable, comprising a pair of hydraulic cylinders 105, 105, mounted to swing in vertical planes and each containing, as shown in Fig. 18, a piston 106 having its piston rod 107 pivotally connected at 108 to projections 109 formed integral with the arm frame. The rear ends of the cylinders are pivotally connected at 110 to a bracket 111 formed integral with the turntable frame. It will thus be seen that when hydraulic pressure is supplied to the cylinders 105, the arm 3 may be swung upwardly and downwardly with respect to the turntable 2, as desired. The hydraulic means for rotating the turntable 2 relative to the truck frame comprises, as shown in Figs. 1, 2, 5 and 8, a pair of hydraulic cylinders 113, 113 secured within the truck frame and arranged in longitudinal parallel relation at opposite sides of the truck frame in the manner shown in Fig. 1. These cylinders each contain a piston 114 (see Fig. 8), each having a rearwardly projecting piston rod 115 extending rearwardly through the packed rear head 116 of the cylinder. Secured to the rear end of each of the piston rods 115 is a bracket 117 on which is journaled a pulley 118. Cables 119, 119 each have an end fastened at 120 to the truck frame and pass around the pulleys 118, portions of the cables extending from the pulleys 118 forwardly through openings in the truck frame around horizontal pulleys 121 journaled, as shown in Fig. 16, in a manner to be later described, the opposite end portions of the cables extending from the pulleys 121 around a segmental guiding groove 122 formed about the rim of the flange portion of the turntable frame, and these cables are secured at their opposite ends at 123 to the turntable frame. It will thus be seen that when hydraulic pressure is supplied to one or the other of the cylinders 113, the cables may be operated to swing the turntable 2 in one direction or the other about its axis with respect to the truck. The means for supplying hydraulic pressure to the various hydraulic cylinders above described will be later described.

Now referring to the improved mechanism for driving the truck wheels to propel the apparatus along the mine trackway through a wide range of low cutting speeds and at a high transport speed, it will be noted that mounted within the truck frame at the rear of the turntable with its axis horizontally disposed and extending longitudinally of the truck frame is a motor 126 herein preferably of the reversible electric type having its power shaft 127 connected by a flexible coupling 128 to a longitudinal shaft 129. This shaft is journaled in bearings supported within a gear housing 130 arranged within the truck frame, and has fixed thereto at its forward end a spur pinion 131 meshing with a large spur gear 132, herein the high speed terminal gear, journaled on a longitudinal shaft 133 herein arranged parallel with and below the shaft 129 and likewise suitably journaled within the gear housing 130. The gear 132 is connectible by a multiple disc clutch 134 to the shaft 133. Formed on the hub of the gear 132 is a spur pinion 135 meshing with a large spur gear 136 fixed to a longitudinal shaft 137 arranged parallel with the shaft 129, 133 and likewise suitably journaled within the gear housing. Fixed to the shaft 137 is a spur pinion 138 meshing with a large spur gear 139, herein the low speed terminal gear, journaled on the shaft 133 and connectible by a multiple disc clutch 140 to the shaft 133. Keyed to the rear end of the shaft 133 is a bevel gear 141 meshing with re-

verse bevels 142 and 143 journaled on a horizontal shaft 144 herein arranged at right angles to the shaft 133 and suitably journaled within the sides of the gear housing. The bevel gears 142, 143 are connectible by multiple disc clutches 145 and 146, respectively, to the shaft 144. The operating means for the clutches 145, 146 comprises a clutch applying collar surrounding the shaft 144 between the bevel gears 142 and 143, and engaging this collar is a pivoted shipper yoke 148 connected at 149 to an operating rod 150. The outer end of this operating rod is pivotally connected at 151 to a lever 152 in turn pivotally connected at 153 to a piston rod 154 of an operating piston 155 contained in the horizontal hydraulic cylinder 156. This cylinder has its outer head 157 secured to a bracket 158 projecting from the adjacent side of the truck frame. When hydraulic pressure is supplied to the cylinder 156, the piston 155 may be moved in one direction or the other to apply one or the other of the clutches 145, 146, thereby to effect rotation of the drive shaft 144 selectively in either of opposite directions. Fixed to the opposite ends of the shaft 144 are chain sprockets 159 connected by endless chains 160 to sprockets 161 fixed to the truck wheel axles. The mechanism for operating the high and low speed disc clutches 134, 140 will now be described. Formed on the rear face of the low speed terminal gear 139 is a cam 165 with which engages a plunger 166 guided in a bore 167 formed in the gear housing. The rear end of this plunger is pivotally connected at 168 to a lever 169 in turn pivotally connected at 170 to a rod 171. The lever 169 is pivotally mounted by trunnion blocks 172 on an adjusting rod 173, the trunnion blocks having convex surfaces engaging the cylindrical periphery of the rod 173, and when in the position shown in Fig. 10, abutting a collar 174 fixed to the rod 173. A shipper yoke lever 175 is pivotally mounted at 176 and engages a clutch applying ring 177 surrounding the shaft 133 between the hubs of the gears 132, 139 in the manner shown in Fig. 13, and this shipper lever 175 is pivotally connected by trunnion blocks 178 to the rod 171, these trunnion blocks having concave surfaces slidingly engaging the cylindrical rod surface. Threaded on the forward end of the rod 171 is a nut 179, and encircling the rod and engaging the nut is a washer 180. Surrounding the rod 171 and acting between a nut 181 threaded to the rod and a washer 182 is a coil spring 183, this spring holding the trunnion blocks 178 of the yoke lever against the washer 180. The operating rod 173 is mounted for axial movement within the gear housing and is splined at 184 against rotation, and the rearward portion of this rod is threaded at 185 for threaded engagement with a nut 186 formed within the hub of a worm wheel 187. Meshing with this worm wheel is a worm 188 fixed to an operating shaft 189 having an operating handle 190. It will thus be seen that when the worm gearing 188, 187 is rotated, the rod 173, through the nut and threads, is moved axially to vary the location of the fulcrum pivot of the lever 169. When the gear 139 is rotated, the cam 165 thereon reciprocates the plunger 166, thereby oscillating the lever 169 about its fulcrum, reciprocating axially the rod 171 and through the spring 183 yieldingly loading the clutch 140 at timed intervals. By adjusting the rod 173 axially to vary the fulcrum point of the lever 169, the intervals of application and release of the clutch 140 may be varied as desired, it being possible to so adjust the parts as to effect continuous loading of the clutch, no clutch loading, and any desired intermediate loading of the clutch between full load and no load. By moving the rod 173 to the left in Fig. 10, the clutch 140 may be entirely released from any influence of the cam operated mechanism, and the high speed clutch 134 loaded. When the high speed clutch 134 is loaded, the truck wheels may be driven in either of opposite directions at a high transport speed from the motor 126 through the gearing 131, 132, shaft 133, bevel gear 141 through one or the other of the reverse bevels 142, 143 and the chain and sprocket connections 159, 160, 161. When the low speed clutch 140 is loaded, the truck wheels may be driven in either of opposite directions at a relatively low cutting speed from the motor 126 through the gearing 131, 132, 135, 136, 138, 139, shaft 133, bevel gear 141, one or the other of the reverse bevels 142, 143 and chain and sprocket connections 159, 160, 161. By adjusting the rod 173 to vary the fulcrum point of the lever 169 to vary the intervals of application and release of the low speed clutch 140, the truck wheels may be driven through a wide range of low speeds between zero and a predetermined maximum low speed.

A hydraulically controlled truck wheel brake is provided comprising, as shown in Fig. 5, a brake drum 195 keyed to the front truck wheel axle and with which a brake band 196 cooperates. This brake band is made in two parts pivotally mounted on a link 197 supported by the truck frame. The other end of the upper brake band part is pivotally connected at 198 to a lever 199, while pivoted to this lever at 200 is an adjustable turnbuckle link 201 connected to the opposite end of the lower portion of the brake band. The upper end of the lever 199 is pivotally connected at 202 to a piston rod 203 of a piston 204 contained in a hydraulic cylinder 205 mounted on the truck frame. Interposed between the rear head of the cylinder and the piston is a coil spring 206 for urging the piston toward its forward position to effect application of the brake. When hydraulic pressure is supplied to the opposite side of the piston, the parts are moved into their brake releasing position.

Hydraulic jack devices are provided for jacking the apparatus in position on the trackway during the cutting operation and comprise, as shown in Fig. 16, a pair of hydraulic cylinders 210 mounted in parallel vertical relation at opposite sides of the truck frame and each containing a piston 211 having an upwardly projecting piston rod 212. These piston rods project through the packed upper heads 213 of the cylinders, and are each provided with a socket 214 for receiving a jack pipe 215. It will thus be seen that when hydraulic pressure is supplied to the jack cylinders below the pistons 211, the jack pipes 215 may be moved upwardly into engagement with the mine roof to jack the apparatus in position on the track rails. The guide pulleys 121 for the cables of the turntable rotating means are journaled, as shown in Fig. 16, on the cylindric bodies of the hydraulic anchor jacks.

For supplying motive power to the motors 22 and 126, there is provided a cable reel 220 rotatably mounted within the rearward portion of the truck frame on a horizontal transversely extending axis, the cable reel being arranged in a chamber 221 formed in the truck frame between the pulleys and cables 118, 119 of the turntable rotating mechanism, as shown in Fig. 1. Wound

upon this cable reel is a power conductor cable 222 guided by an automatic spooling device 223 arranged on the rear end of the truck frame at the rear of the reel. The cable reel 220 is driven by a hydraulic motor 224 through a sprocket 225, an endless chain 226 and a sprocket 227 fixed to the reel drive shaft. Also rotatable with the sprocket 227 and driven by the chain 226 is a chain sprocket 228 connected by an endless chain 229 to a sprocket 230 fixed to the drive shaft 231 of the automatic spooling device 223.

Now referring to the hydraulic pump and control means, it will be noted that arranged in a chamber 232 between the cable reel and the rear end of the motor 126 is a tank 233 for containing a liquid, preferably oil, and arranged in this tank is a gear pump 234 driven by the power shaft 127 of the motor 126. This pump is adapted to supply hydraulic pressure to the various hydraulically operated devices of the apparatus. As shown in Fig. 5, mounted on the top of the gear housing 130 for the transmission gearing is a horizontal valve box 235 having formed therein a series of horizontal valve bores 236 each containing a balanced type slide valve for controlling the flow of hydraulic pressure to the various hydraulic devices. As shown most clearly in Figs. 6 and 7, the valve stem 237 of each of these slide valves is provided with slotted sides at 238 with which engage a yoke-shaped member 239, the arms of which engage the flattened sides of the valve stems for preventing rotary motion of the valves while connecting the valves for axial movement with the members 239. Each of the members 239 is secured to a flat operating bar 240 extending transversely across the top of the truck frame and guided in grooves 241 formed in the sides of the truck frame, and each end of these operating bars is provided with a conveniently located handle 242 whereby the valves may be operated from either side of the apparatus. The gear pump 234 is of the variable displacement type comprising a gear chamber 245 containing three intermeshing gears 246 secured to parallel shafts journaled within the pump casing and to one of which the motor power shaft of the motor 126 is connected. Formed in the pump casing are parallel vertical bores 247 and 248 containing slide valves 249 and 250 respectively. The valve stems 251 of these valves are each slotted at 252 to receive the bifurcated ends of levers 253 and 254 secured respectively to parallel operating rods 255 and 256 extending longitudinally forwardly within the top portion of the truck frame. These rods have fixed thereto levers 257 and 258, respectively, each connected by a pin 259 engaged in a slot formed on depending plate-like projections 260 secured to transversely extending operating rods 261 and 262 respectively, these rods being similar to the operating rods 240 for the control valves and similarly guided on the top of the truck frame. When the operating rods 261, 262 are slid in one direction or the other, the slide valves will be slid either upwardly or downwardly within the valve bores of the pump casing. The lower ends of the valve bores 247, 248 communicate with the oil supply contained in the tank 233, while the upper end of the valve bore 247 communicates through a passage 263 with the liquid supply in the tank. The valve bores are connected through passages 264 and 265 with the intake sides of the pump gears and through passages 266 and 267 with the discharge sides of the pump gears. The valve bore 247 is connected to the hydraulic system through a passage 268, while the valve bore 248 is connected to the hydraulic system through a passage 269. When the valve 250 is in the position shown in Fig. 31, hydraulic pressure may flow from the supply tank through the valve bore and passage 265 to the pump intake, and the pump discharge is connected through passage 267 and through the valve bore past the valve to the passage 269 of the hydraulic system. When the valve 249 is in the position shown in Fig. 30, the supply of fluid from the passage 263 to the pump intake passage 264 is cut off, while the pump discharge is connected through the passage 266 and the valve bore to the liquid supply in the tank. It will thus be seen that when the valves 249 and 250 are in the position shown in Figs. 30 and 31, the pump is operating at half capacity. When it is desired to supply the full pump capacity to the hydraulic system, the valve 249 is slid downwardly from the position shown in Fig. 30 to connect the intake passage 263 with the pump intake passage 264 and the pump discharge passage 266 with the passage 268 of the hydraulic system, so that at this time both discharge sides of the pump gears are connected to supply hydraulic pressure to the system. When the valve 250 is slid downwardly from the position shown in Fig. 31, the passage 265 is cut off by the valve while the passage 267 is connected to the liquid tank, and at that time the supply of hydraulic pressure to the system is cut off and both discharge sides of the pump gears are connected to discharge back to the tank.

Now referring to the improved hydraulic system shown in Fig. 25, it will be noted, as above mentioned, that the horizontal valve bores 236 in the valve box 235 each contain a slide valve, and these slide valves are respectively designated 270, 271, 272, 273, 274, 275, 276, 277 and 278. Formed in the valve casing and extending substantially there-across to connect the opposite ends of the valve bores into communication with one another, are parallel passages 279 and 280, respectively, these passages being connected through branched conduits 281 and 282 to a discharge conduit 283 leading to the liquid supply tank 233. The valve bores are connected together by a liquid pressure supply passage 284 communicating with the valve bores midway between their ends, this passage 284 arranged parallel with the discharge passages 279, 280 and likewise extending substantially across the valve box. The passage 284 is connected by a conduit 285 with a conduit 286 connected to the discharge passages 268 and 269 of the pump. Each of the slide valves is centrally grooved between end heads, and these grooves at all times communicate with the liquid pressure supply passage 284. The slide valve 270, which controls the supply of liquid pressure to the turntable rotating cylinders 113, 113, has its valve bore connected through a conduit 287 to the forward end of one cylinder 113 and through a conduit 288 to the forward end of the other cylinder 113, and the rear ends of the cylinders 113 are connected through conduits 289 and 290, respectively, and a discharge conduit 291 to the liquid supply tank for conducting any oil leakage past the pistons back to the tank. The valve 271, which controls the supply of liquid pressure to the arm swing cylinders 105, 105, has its bore connected through a conduit 292 to a conduit 293 communicating with the rear ends of the cylinders 95 and through a conduit 294 communicating with a conduit 295 connected to the forward ends of the cylinders 105. The valve 272, which controls the supply of liquid

pressure to the cutter support swing cylinder 75, has its bore connected through a conduit 296 to the forward end of the cylinder 75 and through a conduit 297 to the rear end of the cylinder 75. The valve 273, which controls the supply of liquid pressure to the head rotating cylinders 84, 84, has its bore connected through a conduit 298 to the forward end of one cylinder 84 and through a conduit 299 with the forward end of the other cylinder 84. The valve 274, which controls the supply of liquid pressure to the anchor jack cylinders 210, 210, has its bore connected through a conduit 300 and a branched conduit 301 to the lower ends of the anchor jack cylinders and through a conduit 302 and branched conduits 303 to the upper ends of the anchor jack cylinders. The valve 275, which controls the supply of liquid pressure to the support lock cylinder 98, has its bore connected through a conduit 304 to the forward end of the lock cylinder. The valve 276, which controls the supply of liquid pressure to the reel drive motor 224, has its bore connected by a conduit 305 to the reel motor intake and through a conduit 306 to the reel motor discharge. The valve 277, which controls the supply of liquid pressure to the brake cylinder 205, has its bore connected through a conduit 307 to the forward end of the brake cylinder. The valve 278, which controls the supply of liquid pressure to the clutch operating cylinder 156, has its bore connected through a conduit 308 to the inner end of the cylinder 156 and through a conduit 309 to the outer end of the cylinder 156. The supply conduit 286 has communicable therewith, under the control of a valve 310, a conduit 311 leading to a breaker pad similar to that disclosed in my copending application, Serial No. 700,681, filed Dec. 2, 1933, now matured into Patent No. 2,163,341, patented June 30, 1939, and this conduit 311 is connectible, under the control of the valve 310, to a discharge conduit 312 communicating with the liquid supply tank.

As previously mentioned, the pump 234 may operate at either half capacity or full capacity under the control of the slide valves 249 and 250. When the control valves are in the position shown in Fig. 25, all of the various conduits referred to are out of communication with the supply passage 284 and the discharge passages 279 and 280. When it is desired to effect turntable rotation in one direction, the valve 270 is slid in a direction to connect the conduit 287 with the supply passage 284 and to connect the conduit 288 with the discharge passage 280, and at this time liquid pressure is supplied through the conduit 287 to one cylinder 113 to act on its piston 114 to rotate the turntable 2, while the other cylinder is connected to exhaust. When it is desired to rotate the turntable 2 in the opposite direction, the valve 270 is slid in the opposite direction to connect the conduit 288 with the supply passage 284 and the conduit 287 to the discharge passage 279, and at this time liquid pressure is supplied through the conduit 288 to the other cylinder 113 to act on its piston 114 to rotate the turntable 2 in the opposite direction. To effect swinging of the arm structure 3 upwardly about its pivot relative to the turntable, the valve 271 is moved into a position to connect the conduit 292 to the supply passage 284 while the conduit 294 is connected to the discharge passage 280, and liquid pressure is then supplied through the conduit 292 to the rear ends of the cylinders 105 to act on the pistons 106 to move the latter forwardly. The arm structure may be swung downwardly, when the valve 271 is moved to connect the conduit 294 to the supply passage 284 and the conduit 292 to the discharge passage 279, liquid pressure then being supplied to the conduit 294 and branched conduits 295 to the forward ends of the arm swing cylinders 105 to effect movement of the pistons 106 rearwardly. The arm structure may be locked in any desired adjusted position by returning the valve 271 to the position shown to trap the liquid in the cylinders. When it is desired to effect swinging of the cutter support 5 relative to the rotating head 4 in one direction, the valve 272 is slid into a position to connect the conduit 296 with the supply passage 284 and the conduit 297 to the exhaust passage 280, liquid pressure then being supplied through conduit 296 to the forward end of the cylinder 75 to swing the cutter support in one direction. To effect swinging of the cutter support in the opposite direction, the valve 272 is slid into a position to connect the conduit 297 to the supply passage 284 and the conduit 296 to the discharge passage 279, liquid pressure then being supplied through conduit 297 to the rear end of the cylinder 75. When it is desired to rotate the head 4 relative to the arm in one direction or the other, the valve 273 may be slid into a position to connect one of the conduits 298 and 299 to the supply passage 284 and the other of the conduits 298 and 299 to one of the discharge passages 279 and 280, thereby to supply liquid pressure to one or the other of the cylinders 84 of the head rotating means. The anchor jacks 215 may be moved into anchoring position by sliding the valve 274 into a position to connect the conduit 300 with the supply passage 284 and the conduit 302 with the discharge passage 280, liquid pressure then being supplied to the lower ends of the jack cylinders 210 to move the jack pistons 211 upwardly into anchoring position. When it is desired to release the anchoring jacks, the conduit 300 is connected to the discharge passage 279, while the conduit 302 is connected to the supply passage 284, thereby to effect downward movement of the jack pistons. When it is desired to release the head lock, the valve 275 is moved to a position to connect the conduit 304 to the supply passage 284, thereby to supply liquid pressure to the bar lock cylinder 98 to act on the piston 100 thereof to move the locking pin 95 into its released position. When the conduit 304 is connected by the valve 275 to the discharge passage 279, the spring 104 of the lock cylinder moves the piston 100 into a position to effect locking of the head. The reel driving motor 224 may be operated by moving the valve 276 to a position to connect the conduit 305 with the supply passage 284, while the discharge conduit 306 is connected to the discharge passage 280. To effect release of the truck wheel brake 195, 196, the valve 277 is moved into a position to connect the conduit 307 with the supply passage 280, thereby to supply liquid pressure to the forward end of the brake cylinder 205 to move the brake piston 204 into its released position. To effect brake application, the conduit 307 is connected by the valve 277 to the discharge passage 280, the brake cylinder spring 206 then acting on the piston to move the brake into applied position. To operate one or the other of the reverse clutches 145, 146 of the truck drive, the valve 278 may be moved into a position to connect one of the conduits 308, 309 to the supply passage 284 and the other of the conduits 308, 309 to one or the other of the discharge passages 279, 280, thereby to sup-

ply liquid pressure to one end or the other of the clutch operating cylinder 156.

In the modified form of construction disclosed in Figs. 32, 33 and 34, there is shown a somewhat different form of mounting for the kerf cutters. In this instance, a motor 315 has formed on the sides of its casing bearing supports 316 mounted on the pivot pins 21 supported in the bearing bosses 18 of the flange portion of the turntable frame. Secured to the forward end of the motor casing is a support 317 on which is secured the hanger 318 for the bar 319 of the kerf cutter. Keyed to the forward end of the motor power shaft is a bevel pinion 320 meshing with a bevel gear 321 journaled within the support 317 and driving a spur gear 322 meshing with a large spur gear 323 fixed to a shaft 324 suitably journaled within the support 317. Fixed to this shaft 324 is a chain sprocket 325 which engages and drives an endless cutter chain 326 mounted for circulation about the margin of the cutter bar 319. For tilting the motor casing relative to the turntable to change the angle in altitude of the cutter bar relative to the horizontal, there is a hydraulic cylinder 327 pivotally mounted at 328 on a bracket 329 formed integral with the turntable frame. This cylinder contains a piston 330 having its piston rod 331 pivotally connected at 332 to projections 333 projecting rearwardly from the motor casing. When hydraulic pressure is supplied to one end or the other of the cylinder 327, the piston 330 may be moved in a direction to tilt the cutter bar either upwardly or downwardly as desired. The cutter bar is swung horizontally in its plane by rotation of the turntable 2. Otherwise this form of the invention is similar to that above described, and the supply of pressure fluid to the cylinder 327 is controlled in a manner similar to the various other hydraulic cylinders above described.

The general mode of operation of the improved mining apparatus is as follows: The apparatus is propelled about the mine at a high transport speed under the control of the high speed friction clutch 134. When the working place is reached and it is desired to insert a horizontal kerf in the coal seam at the level of the mine floor, hydraulic pressure is first supplied to the lock cylinder to release the locking pin and thereafter hydraulic pressure is supplied to the proper cylinder 84, 84 of the head rotating means to rotate the head 4 to move the kerf cutter from the full line position shown in Fig. 4 to the lower dotted line position in that figure, the supply of liquid pressure to the rotating cylinder thereafter being cut off and the liquid pressure vented from the lock cylinder to again effect locking of the head in position. Hydraulic pressure is then supplied to the proper cylinder of the turntable rotating means to effect swinging of the arm structure laterally until the tip end of the kerf cutter reaches the right hand rib of the entry, the supply of liquid pressure to the rotating cylinder thereafter being cut off. The operator then starts the motor 22 to effect rapid circulation of the cutter chain 37 about the margin of the cutter bar 35. The low speed truck wheel drive control clutch 140 is then applied, thereby to effect propulsion of the apparatus bodily along the trackway at a low cutting speed to sump the cutter bar beneath the coal. When the sumping cut is completed, the low speed truck drive control clutch is released and thereafter the supply of liquid pressure in the brake cylinder is vented to effect application of the brake 195, 196 to hold the apparatus in a stationary position on the trackway. Hydraulic pressure is at the same time supplied to the lower ends of the jack cylinders to move the jacks into anchoring relation with respect to the mine roof. Hydraulic pressure is then supplied to the proper turntable rotating cylinder to effect turntable rotation in a direction to swing the cutter bar across the coal face from right to left until the tip end of the cutter bar reaches the left hand rib of the entry, the liquid pressure supply to the turntable rotating cylinder thereafter being cut off. The anchor jacks are then released and hydraulic pressure is supplied to the brake cylinder to effect release of the brake. The low speed truck drive control clutch 140 is then again applied, and upon proper application of one of the reverse clutches 145, 146 the truck wheels are driven in a direction to move the apparatus bodily rearwardly along the mine trackway at a low cutting speed to withdraw the cutter bar from beneath the coal, thereby to complete the cut beneath the coal seam. If it is desired to insert a shear cut in the coal seam, hydraulic pressure is supplied to the lock cylinder to release the head lock and thereafter hydraulic pressure is supplied to the proper cylinder of the rotating means for the head 4 to move the kerf cutter from a horizontal cutting position into a vertical cutting position, the head lock thereafter being connected. Hydraulic pressure is then supplied to the arm swing cylinders 105 to swing the arm 3 in a vertical direction relative to the turntable until the tip end of the cutter bar reaches the mine roof, the liquid pressure supply to the cylinders 105 thereafter being cut off. The low speed truck wheel drive control clutch 140 is then applied to effect propulsion of the apparatus at a low cutting speed bodily along the mine trackway in a direction to effect sumping of the cutter bar into the coal seam. The anchor jacks are then moved into anchoring relation with the mine roof and the truck wheel brake set. Hydraulic pressure is then supplied to the arm swing cylinders 105 to effect swinging of the arm downwardly to move the kerf cutter downwardly in its plane to cut a vertical kerf between the mine roof and mine floor. When the tip end of the cutter bar reaches the mine floor, the swinging of the arm is discontinued and the anchor jacks and brake are released. The low speed truck drive control clutch 140 is then again applied, and under the control of one or the other of the reverse control clutches 145, 146 the apparatus is propelled bodily rearwardly along the mine trackway at a low cutting speed to withdraw the cutter bar from the coal, thereby to complete the cut. If desired vertical shear cuts may be made solely by swinging of the arm without effecting sumping and withdrawal cuts as above described. The cutter bar may be swung into different inclined positions with respect to the horizontal and vertical by supplying hydraulic pressure to the support swing cylinder 75 to swing the cutter support relative to the rotating head 4. The cutter bar may be swung in its plane into different angularly related positions with respect to the cutter support 5 by releasing the locking pin 45. It will be evident that by proper adjustment of the turntable, arm, rotating support and cutter support relative to the truck frame and by swinging the parts in proper position, horizontal kerfs may be cut at any desired location between the mine roof and mine floor, and vertical kerfs may be inserted in the coal seam at any desired location between the ribs. Also by proper

adjustment of the parts, the kerf cutter may be operated to cut kerfs in either rib of the entry. It will also be evident that by varying the location of the fulcrum point of the lever 169 of the low speed clutch operating means, the rate of low cutting feed may be varied, as desired, it being possible to drive the truck wheels to propel the apparatus at any desired low cutting speed between zero and a predetermined maximum low cutting speed. Further, by varying the position of the control valves 249 and 250 of the pump, the capacity of the hydraulic system may be varied at will. These and other uses and advantages of the improved mining apparatus will be clearly apparent to those skilled in the art.

While there is in this application specifically described one form and a modification thereof which the invention may assume in practice, it will be understood that this form and modification thereof are shown for purposes of illustration and that the invention may be further modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim as new and desire to secure by Letters Patent is:

1. In a mining apparatus, a portable base, a horizontal turntable mounted on said base and having a central opening, an arm structure pivotally mounted on said turntable to swing in a vertical direction relative thereto, a support mounted on the outer extremity of said arm structure for rotation about the longitudinal axis of said arm structure, a cutter support swingably mounted on said rotatable support on an axis at right angles to the rotatable support axis, a kerf cutter carried by said swingable support, and a kerf cutter driving motor mounted on the rear end of said arm structure to swing therewith relative to the turntable and located within said central turntable opening.

2. In a mining apparatus, a portable base, a horizontal turntable mounted on said base in a relatively low position with its bottom surface arranged adjacent the bottom surface of said base and having an upstanding frame providing a central opening, the top surface of said upstanding frame being arranged below the top surface of said base, an arm structure pivotally mounted on said turntable to swing in a vertical direction relative thereto about a horizontal axis located below the top surface of said upstanding frame, a revolving support mounted on the outer extremity of said arm structure for rotation about the longitudinal axis of said arm structure, a cutter support swingably mounted on said revolving support on an axis at right angles to the revolving support axis, a kerf cutter carried by said swingable support, and a kerf cutter driving motor mounted on the rear end of said arm structure to swing with the latter with respect to said turntable and located within said upstanding frame opening.

3. In a mining apparatus, a portable base, a horizontal turntable mounted on said base in a relatively low position with its top surface arranged below the top surface of said base, said turntable having an upstanding segmental frame having at its opposite sides bearing bosses located below the top of the turntable and supporting pivot pins, an arm structure pivotally mounted on said turntable to swing in a vertical direction relative thereto and having at its opposite sides cylindrical bearing portions journaled on said pivot pins, a revolving support mounted on the outer extremity of said arm structure for rotation about the longitudinal axis of said arm structure, a cutter support swingably mounted on said revolving support on an axis at right angles to the revolving support axis, a kerf cutter mounted on said swingable support, and a motor carried on said arm structure to swing therewith with respect to said turntable for driving said kerf cutter.

4. In a mining apparatus, a portable base, a horizontal turntable on said base, said turntable having an upstanding segmental flange providing a central opening, an adjustable supporting structure pivotally mounted on said turntable between the sides of said segmental flange with its rearward portion arranged in said central flange opening, and a kerf cutter carried by said supporting structure.

5. In a mining apparatus, a portable base, a horizontal turntable on said base, said turntable having an upstanding segmental flange providing a central opening, an adjustable supporting structure pivotally mounted on said turntable between the sides of said segmental flange with its rearward portion arranged in said central flange opening, a kerf cutter carried by said supporting structure, and a kerf cutter driving motor mounted on the rear end of said supporting structure to swing with said supporting structure and arranged in said central flange opening.

6. In a mining apparatus, a portable base, a relatively wide, low, compact horizontal turntable mounted on said base in a relatively low position below the top of said base, an arm structure mounted on said turntable between the sides of the latter to swing in a vertical direction relative thereto about a horizontal pivot located in a relatively low position below the top surface of said turntable, a kerf cutter supported by said arm structure, and means for swinging said arm structure relative to said turntable.

7. In a mining apparatus, a portable base, a relatively wide, low, compact horizontal turntable mounted on said base in a relatively low position below the top of said base, an arm structure mounted on said turntable between the sides of the latter to swing in a vertical direction relative thereto about a horizontal pivot located in a relatively low position below the top surface of said turntable, a kerf cutter supported by said arm structure, and means for swinging said arm structure relative to said turntable including a cylinder pivotally connected to said turntable at a point above the bottom surface of the latter, a piston contained in said cylinder having a piston rod and a pivotal connection between said piston rod and said arm structure.

8. In a mining apparatus, a portable base, traction means therefor, a frame supported on said base in advance of said traction means and having an annular bearing portion, a horizontal turntable mounted on said annular bearing portion and having an upstanding segmental frame, an arm structure pivotally mounted on the turntable between the sides of said segmental frame to swing in a vertical direction relative thereto, and a kerf cutter supported on said arm structure.

9. In a mining apparatus, a wheeled truck adapted to run along a mine trackway, a low compact horizontal frame on said truck having a portion projecting forwardly therefrom in advance of the front truck wheels and arranged in a relatively low position with its bottom surface below a horizontal plane including the truck

wheel axes, a horizontal turntable mounted on said projecting frame to turn about a vertical axis located a substantial distance in advance of the front truck wheels, an arm pivotally mounted on said turntable to swing in a vertical direction relative thereto, and a kerf cutter carried by said arm.

10. In a mining apparatus, a wheeled truck adapted to run along a mine trackway, a low compact horizontal frame on said truck projecting forwardly therefrom in advance of the front truck wheels and arranged in a relatively low position with its bottom surface below a horizontal plane including the truck wheel axes, a horizontal turntable mounted on said projecting frame to turn about a vertical axis located a substantial distance in advance of the front truck wheels, an arm pivotally mounted on said turntable to swing in a vertical direction relative thereto, a cutter support pivotally mounted on the outer extremity of said arm to swing relative thereto about an axis arranged at right angles to the longitudinal axis of said arm, and a kerf cutter carried by said cutter support.

11. In a mining apparatus, a wheeled truck adapted to run along a mine trackway, a low compact horizontal frame on said truck projecting forwardly therefrom in advance of the front truck wheels and arranged in a relatively low position with its bottom surface below a horizontal plane including the truck wheel axes, a horizontal turntable mounted on said projecting frame to turn about a vertical axis located a substantial distance in advance of the front truck wheels, an arm pivotally mounted on said turntable to swing in a vertical direction relative thereto, a revolving support mounted on the outer extremity of the arm to rotate relative thereto about an axis extending longitudinally of said arm, and a kerf cutter carried by said revolving support.

12. In a mining apparatus, a wheeled truck adapted to run along a mine trackway, a low compact horizontal frame on said truck projecting forwardly therefrom in advance of the front truck wheels arranged in a relatively low position with its bottom surface below a horizontal plane including the truck wheel axes, a horizontal turntable mounted on said projecting frame to turn about a vertical axis located a substantial distance in advance of the front truck wheels, an arm pivotally mounted on said turntable to swing in a vertical direction relative thereto, a revolving support mounted on the outer extremity of said arm for rotation about an axis extending longitudinally of said arm, a cutter support swingably mounted on said revolving support on an axis at right angles to the axis of the revolving support, and a kerf cutter carried by said swingable support.

13. In a mining apparatus, a truck mounted on wheels adapted to run along a mine trackway, said truck having a frame provided with an annular bearing portion arranged on the forward portion of the truck and projecting forwardly in advance of the front truck wheels, a turntable journaled on said annular bearing portion with the top of the turntable disposed below the top of said truck, said turntable having a portion projecting outwardly beyond the outer periphery of said annular bearing portion, an arm pivotally mounted on said turntable to swing in a vertical direction with respect thereto about a horizontal axis located inwardly with respect to said outer bearing portion periphery, and motor operated means disposed below the top of said truck for swinging said arm about its pivot relative to said turntable including extensible adjusting devices extending between said outwardly projecting turntable portion near the bottom of said turntable and the lower portion of said arm.

14. In a mining apparatus, a truck mounted on wheels adapted to run along a mine trackway and having a truck frame provided with a forward annular bearing portion, a turntable mounted in a relatively low position on said annular bearing portion to rotate with respect thereto about a vertical axis located in advance of the front truck wheels, means arranged above and below said annular bearing portion for journaling said turntable thereon, said means having a connecting frame extending therebetween and outwardly around said annular bearing portion, an arm structure pivotally mounted on said turntable to swing in a vertical direction with respect thereto about a horizontal axis located inwardly with respect to said annular bearing portion, a kerf cutter carried by said arm structure, and extensible adjusting devices extending between said connecting frame near the bottom of said turntable and the lower portion of said arm structure for swinging the latter about its pivot.

15. In a mining apparatus, a portable base, a horizontal turntable on said base, said turntable having an annular frame having its forward portion cut away, an adjustable supporting structure pivotally mounted on said turntable between the sides of said annular frame and projecting forwardly through said cut away portion, and a kerf cutter carried by said adjustable supporting structure.

16. In a mining apparatus, a low compact horizontal truck frame supported on truck wheels adapted to run along a mine trackway, the wheel base of the truck located substantially at the central portion of the truck frame and the truck frame having portions projecting horizontally forwardly and rearwardly with respect to the truck wheels, the forward projecting portion of the truck frame arranged in a relatively low position and providing an annular bearing frame, a horizontal turntable journaled for rotation on said annular bearing frame about a vertical axis located a substantial distance in advance of the front truck wheels, the top surface of the turntable located below the top surface of the truck frame, an adjustable supporting structure mounted on said turntable and projecting forwardly in advance of the truck frame, and a kerf cutter carried by said supporting structure.

17. In a mining apparatus, a low compact horizontal truck frame supported on truck wheels adapted to run along a mine trackway, the wheel base of the truck located substantially at the central portion of the truck frame and the truck frame having portions projecting horizontally forwardly and rearwardly with respect to the truck wheels, the forward projecting portion of the truck frame arranged in a relatively low position and providing an annular bearing frame, a horizontal turntable journaled for rotation on said annular bearing frame about a vertical axis located a substantial distance in advance of the front truck wheels, the top surface of the turntable located below the top surface of the truck frame, an arm structure pivotally mounted on said turntable to swing vertically with respect thereto and when in horizontal position located below the top surface of the truck frame, and a kerf cutter carried by said arm structure.

18. In a mining apparatus, a low compact horizontal truck frame supported on truck wheels adapted to run along a mine trackway and having portions projecting forwardly and rearwardly a substantial distance with respect to the truck wheels, the forward projecting frame portion providing a bearing annulus arranged in a relatively low position, a horizontal turntable journaled for rotation on said bearing annulus about a vertical axis located a substantial distance in advance of the front truck wheels, the top surface of the turntable located below the top surface of the truck frame, said turntable having an upstanding segmental flange providing a central opening, a vertically swingable supporting structure pivotally mounted on said turntable between the sides of said segmental flange with its rearward portion projecting within said central flange opening, and a kerf cutter carried by said supporting structure.

19. In a mining apparatus, a low compact horizontal truck frame supported on truck wheels adapted to run along a mine trackway and having portions projecting forwardly and rearwardly a substantial distance with respect to the truck wheels, the forward projecting frame portion providing a bearing annulus arranged in a relatively low position, a horizontal turntable journaled for rotation on said bearing annulus about a vertical axis located a substantial distance in advance of the front truck wheels, the top surface of the turntable located below the top surface of the truck frame, said turntable having an upstanding segmental flange providing a central openings, a vertically swingable supporting structure pivotally mounted on said turntable between the sides of said segmental flange with its rearward portion projecting within said central flange opening, a kerf cutter carried by said supporting structure, and a kerf cutter driving motor mounted on the rearward portion of said supporting structure to swing vertically with said supporting structure and arranged with its rearward portion within said central flange opening.

20. In a mining apparatus, a portable base, an open-centered horizontal turntable on said base, a frame mounted on said turntable to swing vertically with respect thereto and having its rearward portion arranged downwardly within the open center of the turntable with its bottom surface disposed below the top of said turntable, a kerf cutter carried by said swingable frame, and motor operated means for vertically swinging said frame relative to said turntable including an extensible adjusting device pivotally connected to said swingable frame and said turntable and arranged down within the open center and below the top of said turntable at the rear end of said frame rearwardly of the frame pivot.

21. In a mining apparatus, a portable base, an open-centered horizontal turntable on said base, a frame mounted on said turntable to swing vertically with respect thereto and having its rearward portion arranged within the open center of said turntable with its bottom surface disposed below the top of said turntable, a kerf cutter carried by said swingable frame, and motor operated means for swinging said frame vertically relative to said turntable including an extensible adjusting device pivotally connected to said swingable frame and said turntable and arranged downwardly within the open center and below the top of said turntable at the rear end of said frame rearwardly of the frame pivot, said extensible adjusting device comprising a cylinder pivotally connected to said turntable to swing relative thereto about an axis parallel to the pivotal axis of said swingable frame and containing a piston having its piston rod pivotally connected to the rearward portion of the swingable frame on a parallel axis.

22. In a mining apparatus, an arm structure pivotally mounted to swing in a vertical direction, a revoluble support mounted on said arm structure to turn about an axis extending longitudinally of the arm structure, a kerf cutter supported by said revoluble support, and means for revolving said support relative to said arm structure including parallel cylinders mounted on said arm structure, pistons reciprocable in said cylinders and each having a piston rod carrying a pulley, a cable drum on said revoluble support, and cables each having an end fixed to said arm structure and their other ends fixed to said revoluble support, said cables engaging said pulleys respectively and wound about said drum.

23. In a mining apparatus, a portable base, relatively low in height and wide in width, a low, compact, widely extended horizontal turntable mounted on and extending substantially transversely across said base in a relatively low position with its top surface arranged below the top surface of said base, an arm structure pivotally mounted on said turntable below the top of the latter to swing in a vertical direction relative thereto, a cutter support pivotally mounted on the outer extremity of said arm structure to swing relative thereto about an axis parallel to the arm structure pivot axis, a horizontal kerf cutter carried by said cutter support and movable horizontally to cut a horizontal plane kerf, and a motor mounted on said arm structure to swing therewith with respect to said turntable for driving said kerf cutter, said motor located at the rear end of said arm structure with its rearward portion disposed rearwardly of the arm structure pivot axis, the bottom surface of said motor, when said arm structure is in horizontal position, disposed below the top of said turntable and the top surface of said motor disposed below the top of said base.

24. In a mining apparatus, a portable base, relatively low in height and wide in width, a low, compact, widely extended horizontal turntable mounted on said base and extending substantially transversely across the latter in a relatively low position with its top surface arranged below the top surface of said base, an arm structure pivotally mounted on said turntable below the top of the latter to swing in a vertical direction relative thereto, a revoluble support mounted at the outer extremity of said arm structure for rotation about the longitudinal axis of said arm structure, a cutter support pivotally mounted on said revoluble support on an axis at right angles to the revoluble support axis, a horizontal kerf cutter carried by said cutter support and movable horizontally to cut a horizontal plane kerf, and a motor mounted on said arm structure to swing therewith with respect to said turntable for driivng said kerf cutter, said motor located at the rear end of said arm structure in a position overlying the turntable pivot axis, the bottom surface of said motor, when said arm structure is in horizontal position, disposed below the top of said turntable and the top surface of said motor disposed below the top of said base.

25. In a mining apparatus, a portable base, relatively low in height and wide in width, a low, compact, widely extended horizontal turntable

mounted on said base and extending substantially transversely across the latter in a relatively low position with its top surface arranged below the top surface of said base, the height of said base substantially determining the height of the apparatus, an arm structure pivotally mounted on said turntable below the top of the latter to swing in a vertical direction relative thereto, a revoluble support mounted on the outer extremity of said arm structure for rotation about the longitudinal axis of said arm structure, a cutter support pivotally mounted on said revoluble support on an axis at right angles to the revoluble support axis, a kerf cutter carried by said cutter support, and a motor mounted on said arm structure to swing therewith with respect to said turntable for driving said kerf cutter, said motor located at the rear end of said arm structure in a position overlying the turntable pivot axis with the major portion of the motor disposed below the top of the turntable, the top surface of said motor, when said arm structure is in horizontal position, arranged below the top surface of said base and the bottom surface of said motor arranged a substantial distance below the top of said turntable.

26. In a mining apparatus, a low compact portable base having traction means, a frame supported on said base in advance of said traction means and having an annular bearing portion disposed in a relatively low position in horizontal planes near the bottom of said base, a horizontal turntable mounted in a relatively low position on said annular bearing portion and having a major portion thereof disposed beneath the upper margins of said base, a kerf cutter mounted on said turntable for pivotal movement about a transverse axis located below the top of said turntable and including a cutter bar having orbitally movable cutting elements thereon, and means for driving said cutting elements on said cutter bar comprising a motor movable with said kerf cutter about said transverse axis and having a portion thereof recessed within said turntable and extending beneath the top of said frame.

27. In a mining apparatus, a low compact portable base having traction means, a frame supported on said base in advance of said traction means and having an annular bearing portion disposed in a relatively low position in horizontal planes near the bottom of said base, a horizontal turntable mounted in a relatively low position on said annular bearing portion and having a portion thereof coacting with said annular bearing portion, a kerf cutter mounted on said turntable for pivotal movement about a horizontal axis disposed above the upper side of the portion of said turntable which coacts with said annular bearing portion, said kerf cutter including a motor and a projecting cutter bar having orbitally movable cutting elements thereon, and an opening in said turntable adapted to receive the lower portion of said motor and permit pivotal movement of said kerf cutter with respect to said turntable.

28. In a mining apparatus, a low compact portable base having traction means, a frame supported on said base in advance of said traction means and having an annular bearing portion disposed in a relatively low position in horizontal planes near the bottom of said base, a horizontal turntable mounted in a relatively low position on said annular bearing portion and having a portion thereof coacting with said annular bearing portion, said turntable further having a major portion thereof disposed beneath the upper margins of said base, a kerf cutter mounted on said turntable for pivotal movement about a transverse axis disposed adjacent one end of said turntable and above the top of the portion of the latter which coacts with said annular bearing portion, said kerf cutter including a projecting cutter bar having orbitally movable cutting elements thereon, a motor disposed rearwardly of said cutter bar and pivotally movable therewith about said transverse axis, said frame being recessed to receive said turntable and said turntable having an opening therein to receive the lower portion of said motor and permit pivotal movement of said kerf cutter with respect to said turntable.

29. In a mining apparatus, a wheel-supported frame having a portion projecting forwardly in advance of the front truck wheels, said forwardly projecting frame portion having a recess therein and providing an annular bearing disposed in horizontal planes near the bottom of said frame, a horizontal turntable disposed in a relatively low position below the top of said frame and providing an open-centered turntable ring received in said recess and supported by said bearing, upstanding bearing-providing means supported by said turntable ring, a second frame having trunnions journaled in said bearing-providing means for tilting on a horizontal axis extending transversely of said turntable, a cutter bar carrying orbitally movable cutting elements and supported at the forward end of said second frame, and an actuating motor for said cutting elements carried by said second frame and having a casing narrower laterally than said ring opening and having its rear end forward of the rearmost portion of the opening in said turntable ring and tiltable with said second frame and operatively connected to drive said cutting elements, said second frame tiltable about said transverse axis to raise said cutter bar, and said motor, in a tilted position of said second frame, having at least the portion thereof including the rearward end of its casing within the open center of said turntable ring and below the top of said annular bearing.

JOSEPH F. JOY.