July 18, 1939. L. E. MITCHELL 2,166,569

MINING MACHINE

Original Filed May 2, 1932 10 Sheets-Sheet 1

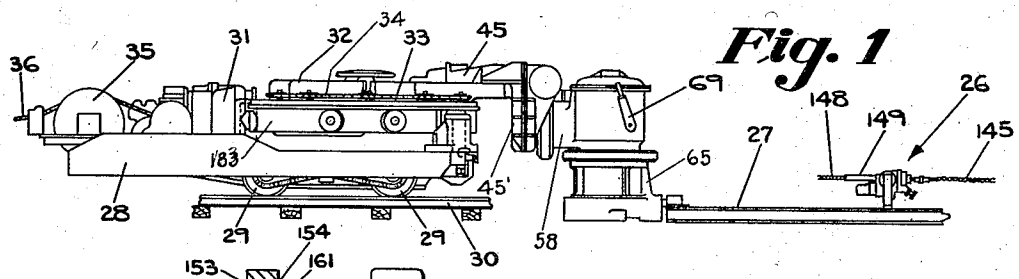


Fig. 1

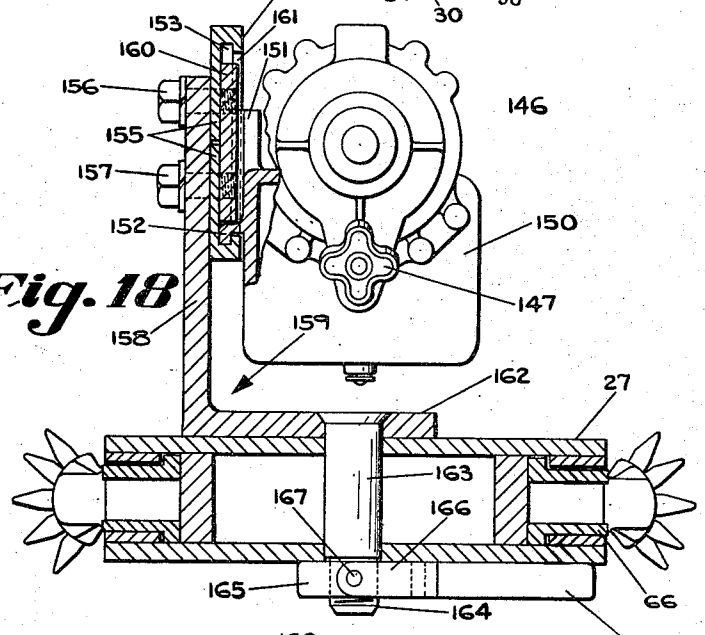


Fig. 18

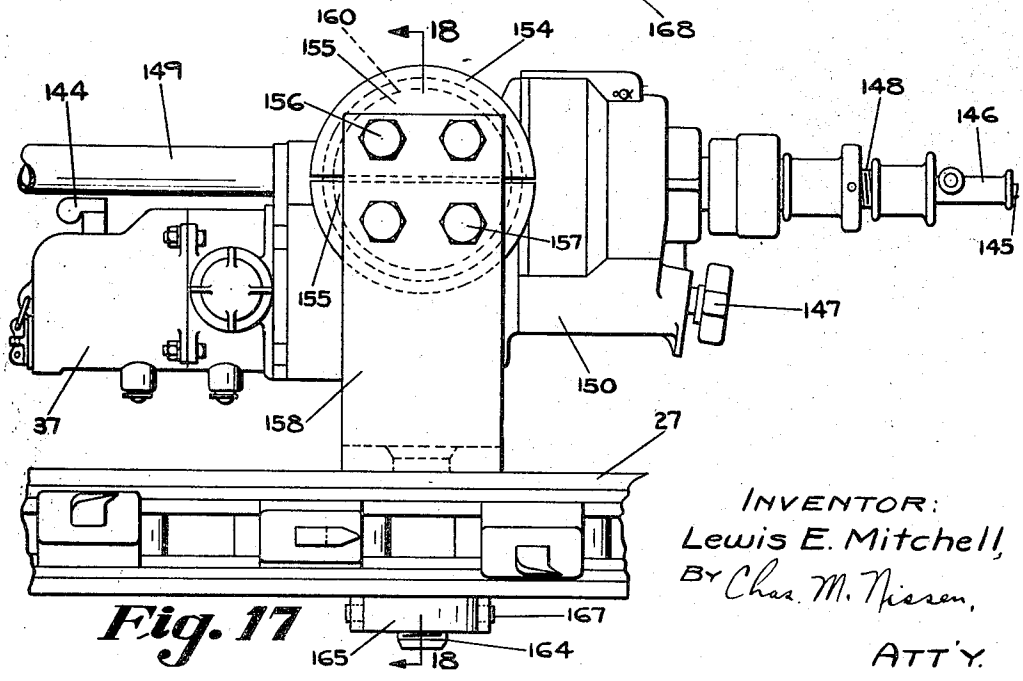


Fig. 17

INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Nissen,
ATT'Y.

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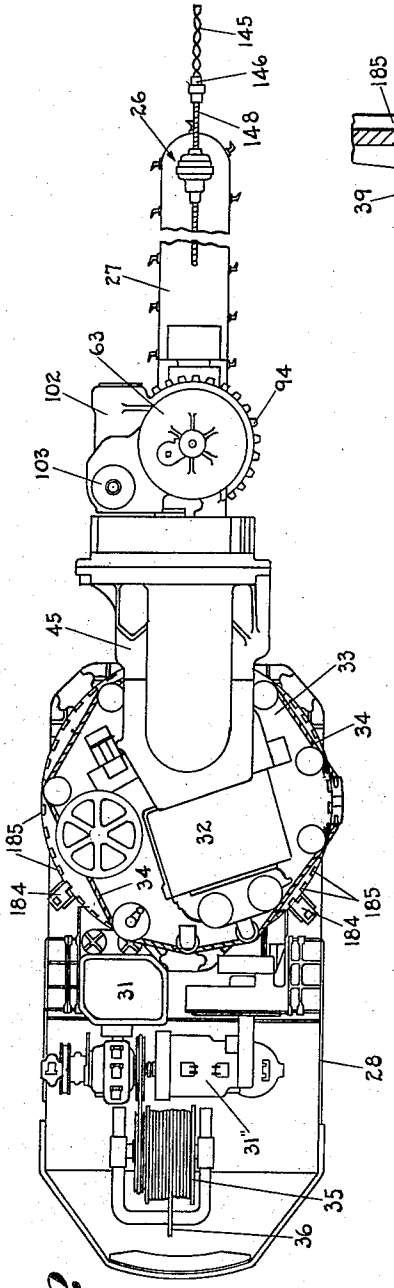


Fig. 2

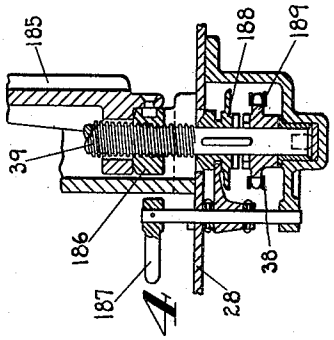


Fig. 4

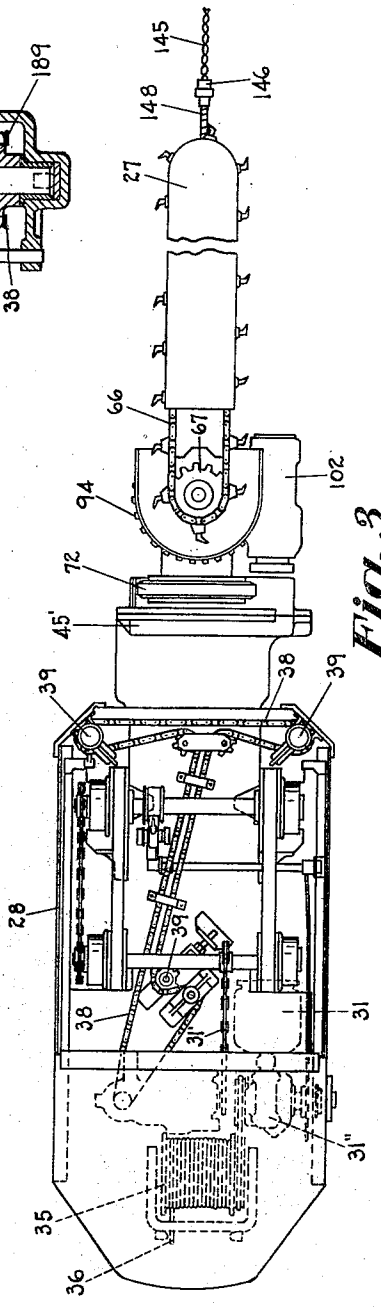


Fig. 3

INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Nissen,
ATT'Y.

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MINING MACHINE

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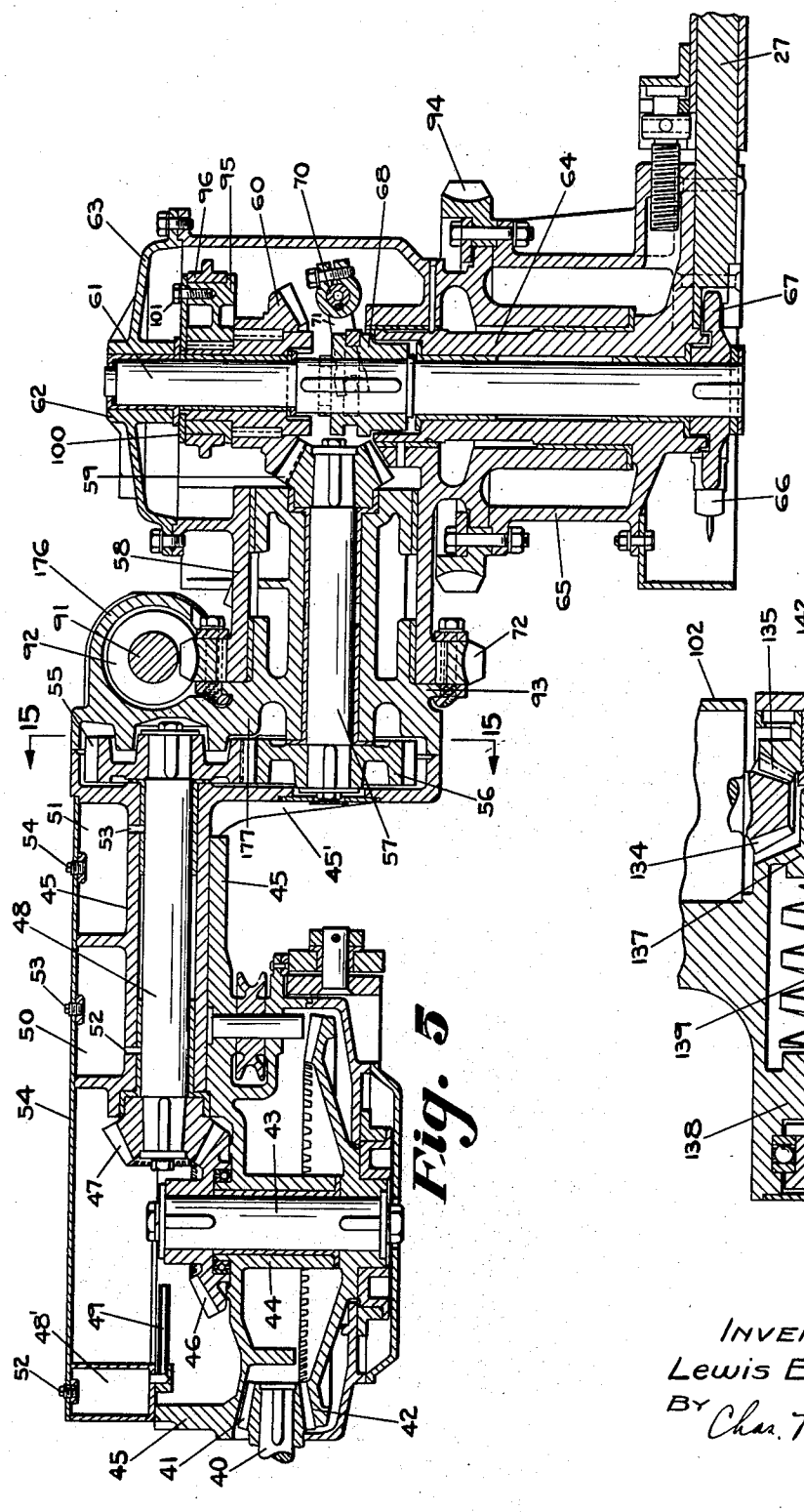


Fig. 5

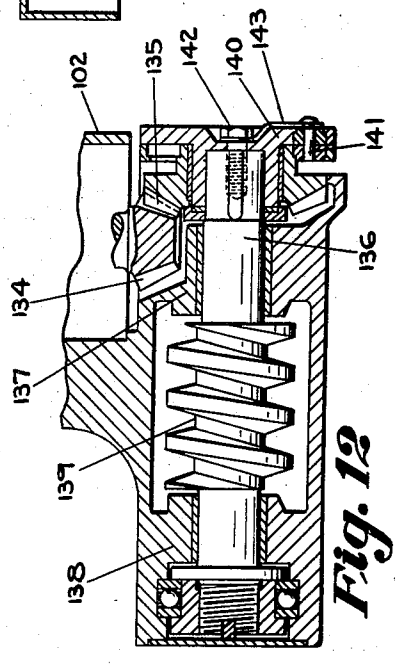


Fig. 12

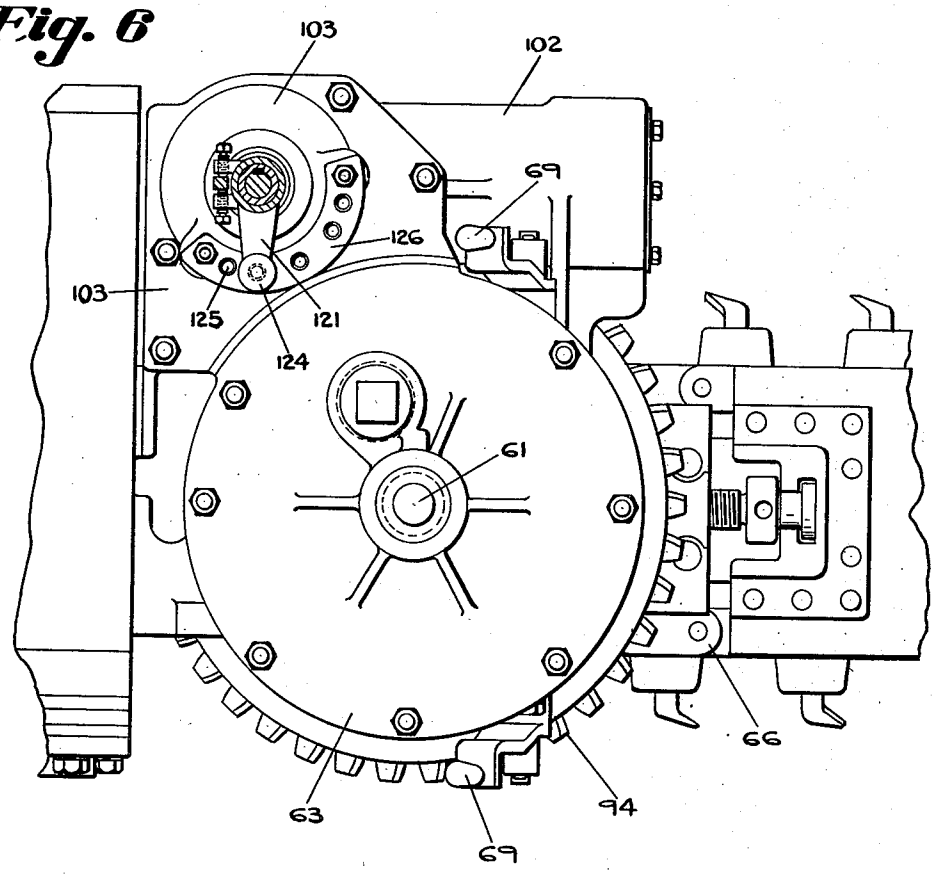
INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Nissen.
ATT'Y.

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MINING MACHINE

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Fig. 6



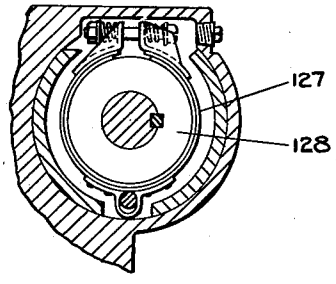


Fig. 8

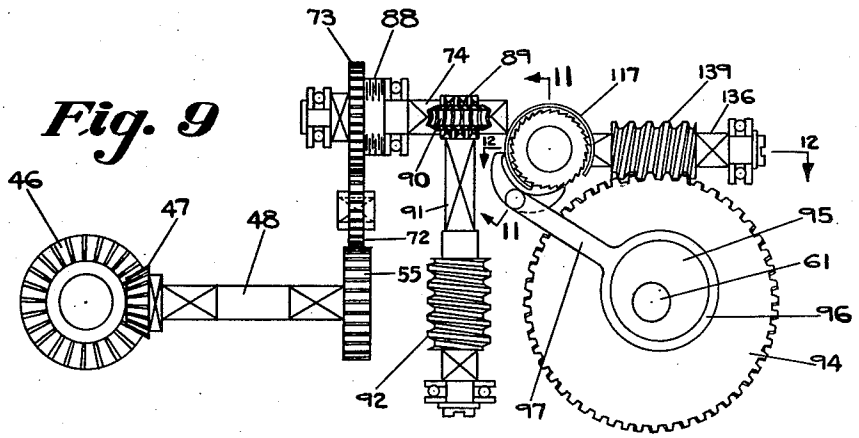
INVENTOR.
Lewis E. Mitchell,
BY Chas. M. Nissen,
ATT'Y.

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MINING MACHINE

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Fig. 9



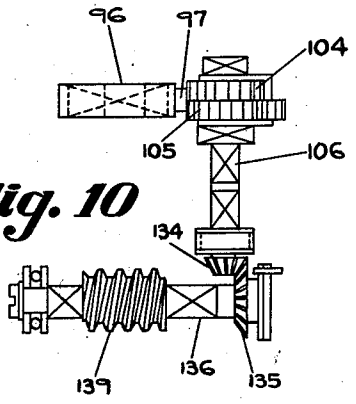


Fig. 10

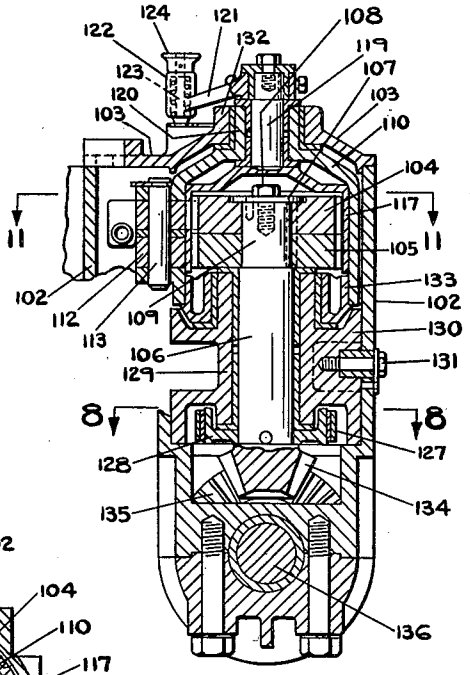


Fig. 7

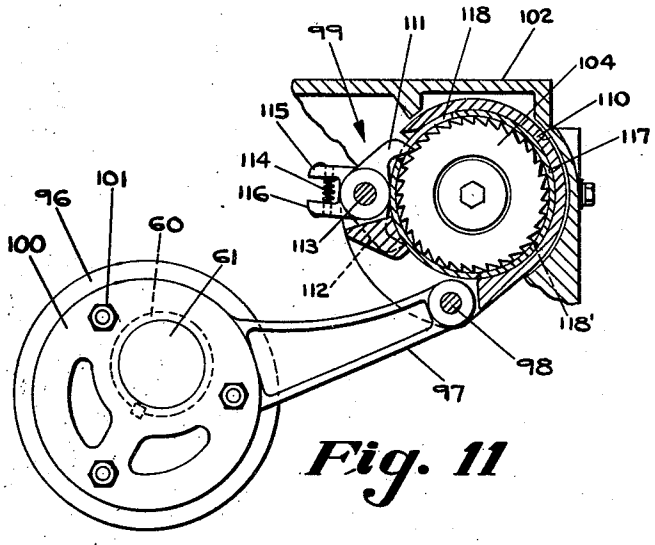


Fig. 11

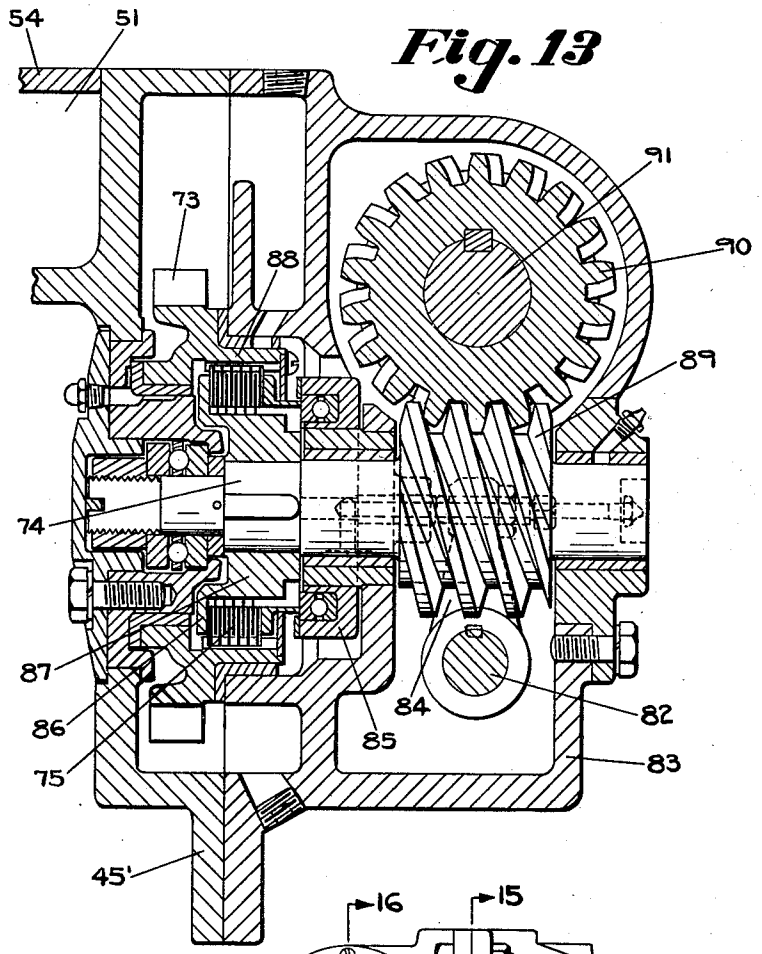
INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Nissen,
ATT'Y.

July 18, 1939. L. E. MITCHELL 2,166,569

MINING MACHINE

Original Filed May 2, 1932 10 Sheets-Sheet 6

Fig. 13



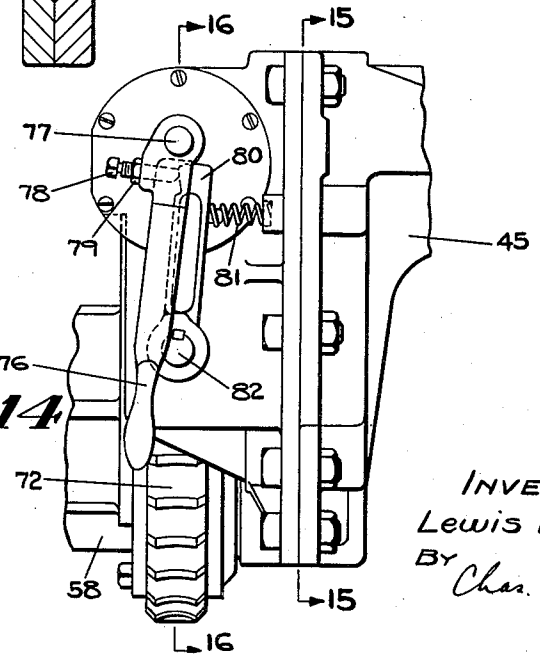


Fig. 14

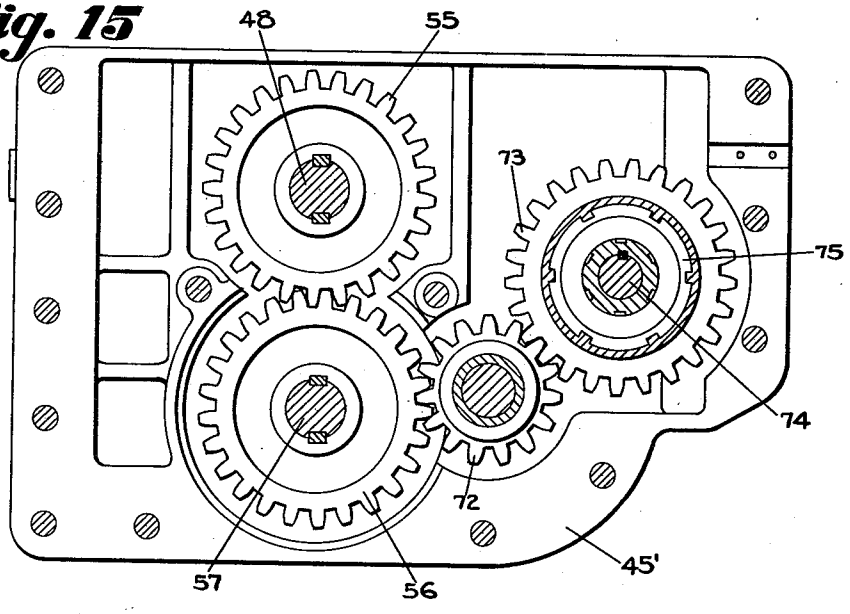
INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Nissen,
ATT'Y

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MINING MACHINE

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Fig. 15



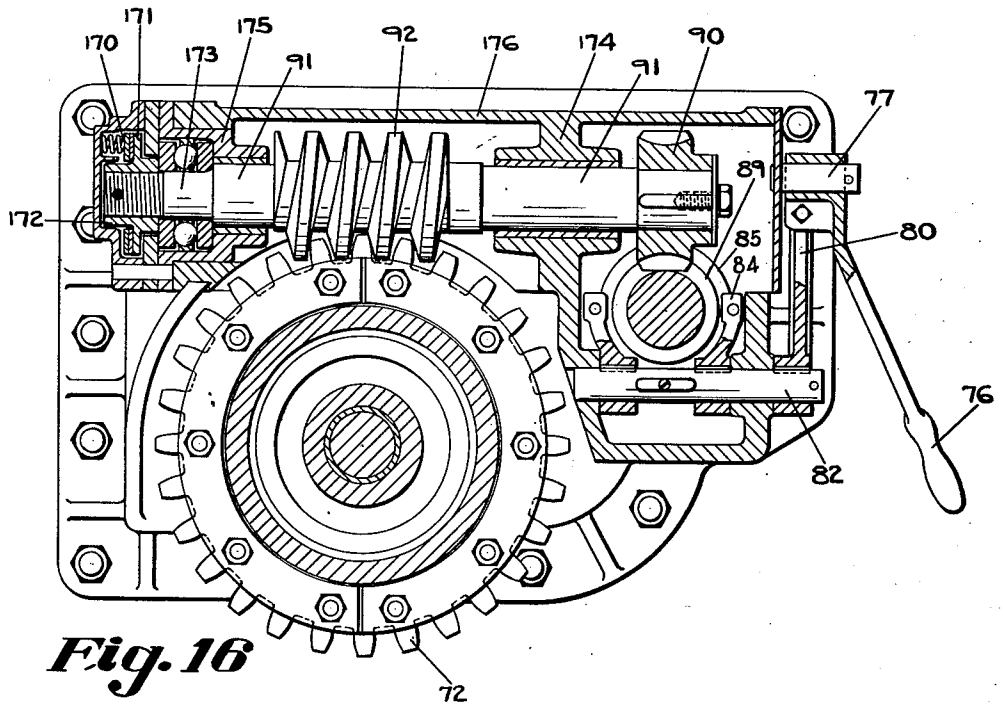


Fig. 16

INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Thiesen,
ATT'Y.

July 18, 1939. L. E. MITCHELL 2,166,569

MINING MACHINE

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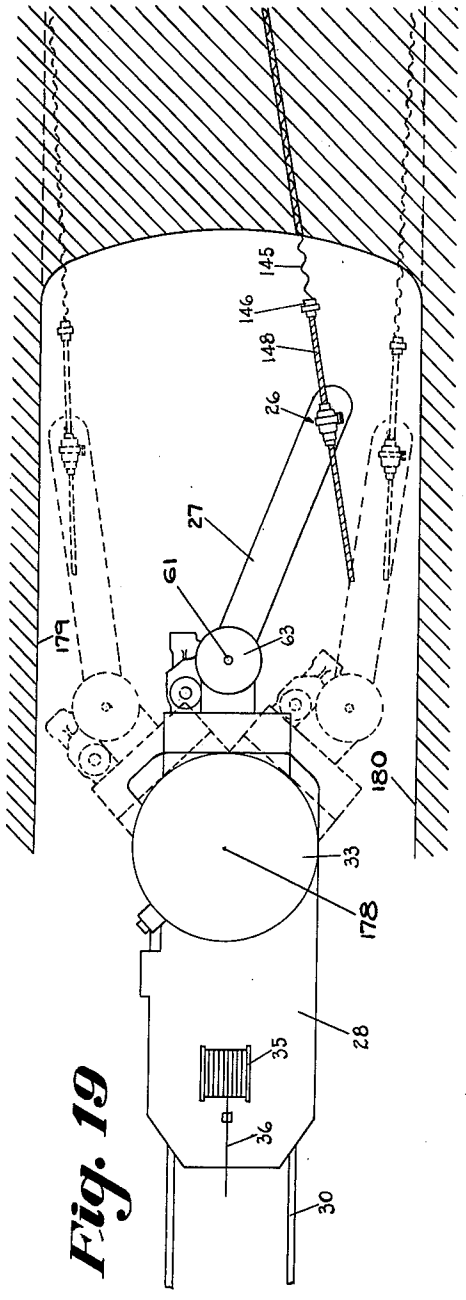


Fig. 19

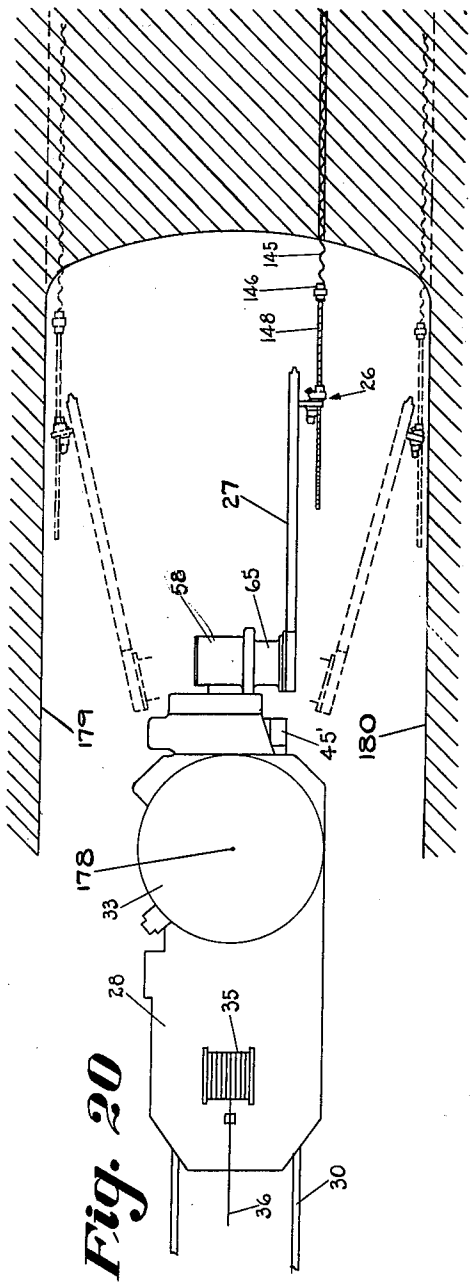


Fig. 20

INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Nissen,
ATT'Y.

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MINING MACHINE

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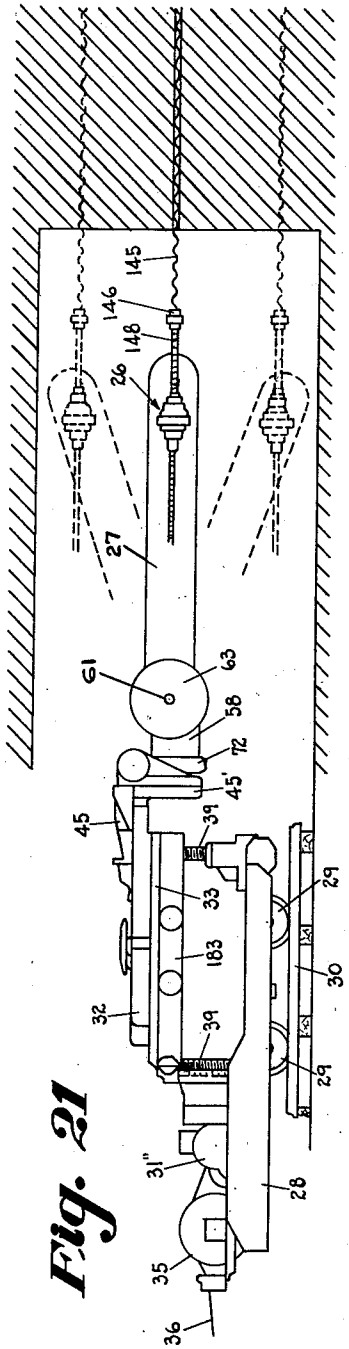


Fig. 21

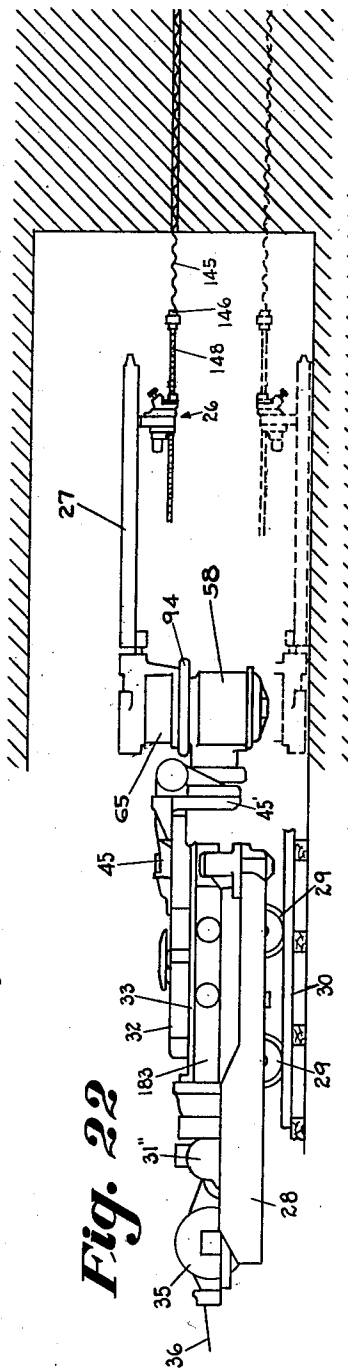


Fig. 22

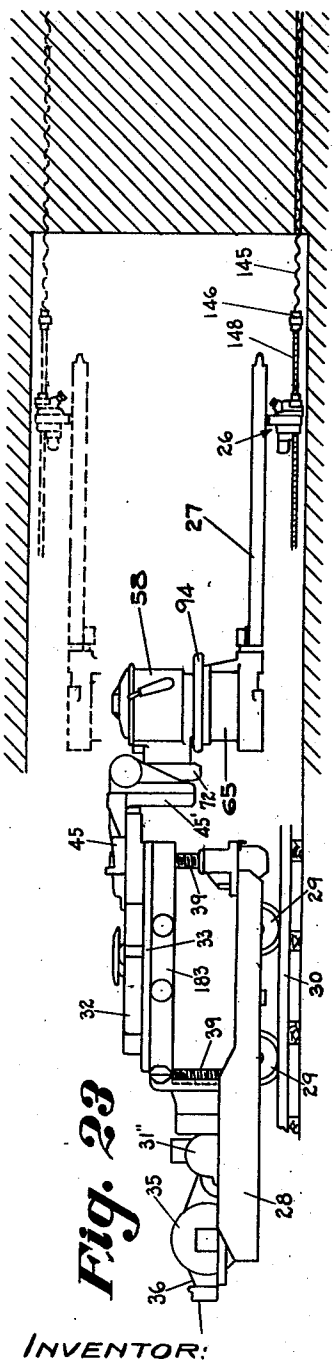


Fig. 23

INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Thiesen,
ATT'Y.

July 18, 1939. L. E. MITCHELL 2,166,569

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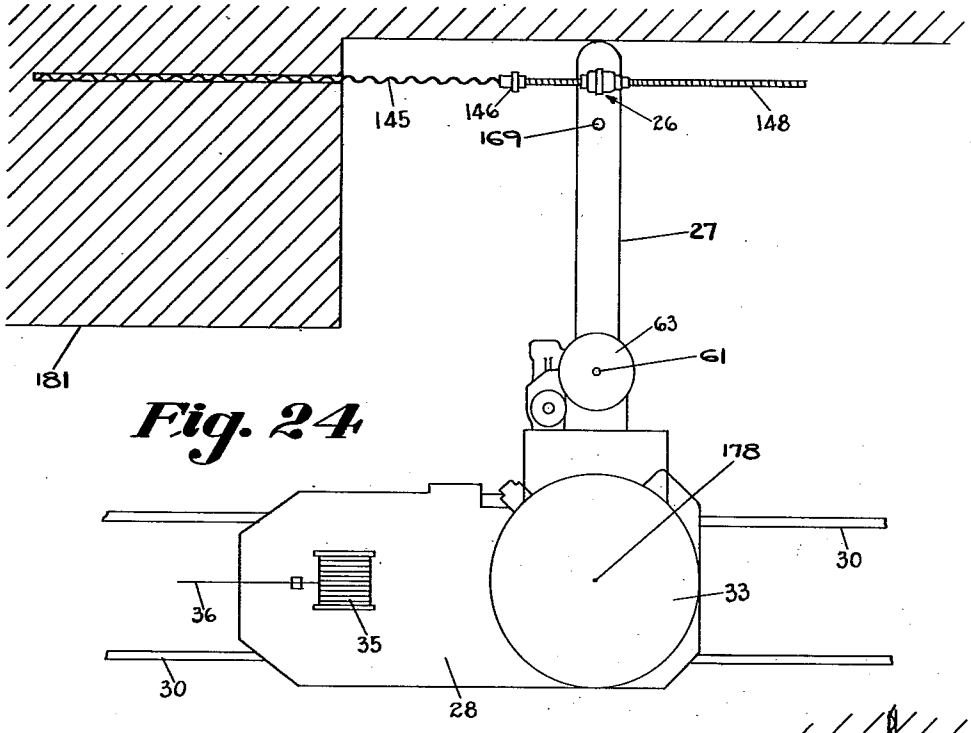


Fig. 24

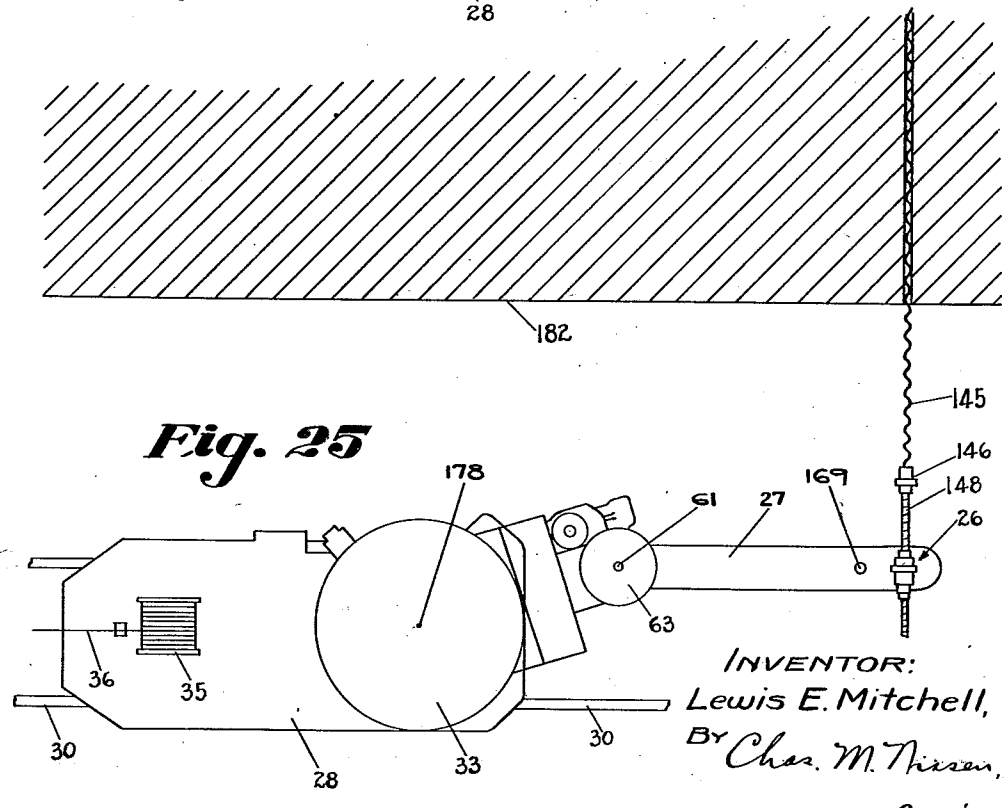


Fig. 25

INVENTOR:
Lewis E. Mitchell,
BY Chas. M. Nissen,
ATT'Y.

UNITED STATES PATENT OFFICE

2,166,569

MINING MACHINE

Lewis E. Mitchell, Columbus, Ohio, assignor to The Jeffrey Manufacturing Company, a corporation of Ohio

Application May 2, 1932, Serial No. 608,585
Renewed March 8, 1939

40 Claims. (Cl. 262—9)

My invention relates to mining machines particularly of the type adapted to travel on a mine track and remain thereon to be braced thereby during operation.

One of the objects of my invention is the provision of an improved and efficient mining machine which shall have a minimum overall height and be very compact to operate in a relatively low roof mine chamber.

Another object of the invention is the provision of improved and efficient mechanism for supporting and adjusting a kerf-cutter on a horizontal axis from a horizontal plane at the level of the mine floor to a horizontal plane above the mining machine but adjacent the same for operation in a relatively low roof mine chamber.

A further object of the invention is the provision of improved mechanism for detachably mounting a self-contained power-operated drilling machine on the outer end portion of an elongated cutter bar which is adjustably mounted on a truck adapted to travel on a mine track so that whenever desired the mining machine may be used to support the drilling mechanism in any one of many different positions at the coal face.

Another object of the invention is the provision of a demountable drill on a mining machine cutter bar so that the various adjustments of the cutter bar may be taken advantage of to support the drilling mechanism in position to command the entire area of the working face.

Another object of the invention is the provision of a universally mounted drill on a universally mounted elongated support to effect adjustment of the drill for operation universally with respect to the coal face and with respect to the ribs at the sides of the mine entry in which the machine is adapted to operate.

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

In the accompanying drawings

Fig. 1 is an elevational view of my improved mining machine including the self-contained power-operated drilling mechanism demountably attached to the outer end portion of the elongated cutter bar;

Fig. 2 is a plan view of the complete mining machine shown in Fig. 1 showing the mechanism for swinging the cutter bar and adjusting the position of the drill on the vertical axis of the turntable;

Fig. 3 is a bottom plan view of the structure shown in Figs. 1 and 2 to show the power-operated mechanism for varying the elevation of the cutter bar and the drill relative to the truck on which the turntable is mounted;

Fig. 4 is a detailed view of the individual screw post elevating mechanism for the turntable, including an individual controlling clutch to secure variation of inclination of the cutter bar and the drill on either a longitudinal axis of the turntable or a horizontal transverse axis thereof;

Fig. 5 is a longitudinal enlarged sectional elevation of that portion of the mining machine shown in Fig. 1 which embodies the turret for swinging the cutter bar on a lowered horizontal longitudinal axis combined with an additional turret for swinging the cutter bar in its own plane and thereby adjusting the drill when the latter is mounted on the outer end portion of the cutter bar;

Fig. 6 is an enlarged plan view of the right-hand portion of the structure shown in Fig. 5;

Fig. 7 is a sectional elevation of the controlling mechanism shown in plan at the upper left-hand portion of Fig. 6;

Fig. 8 is the sectional plan view taken on the line 8—8 of Fig. 7;

Figs. 9 and 10 are more or less diagrammatic views to illustrate the power transmission and control mechanism for swinging the turrets on their respective axes;

Fig. 11 is an enlarged sectional elevation taken as indicated by the line 11—11 of Fig. 9 looking in the direction of the arrows;

Fig. 12 is an enlarged sectional elevation taken as indicated by the line 12—12 of Fig. 9 looking in the direction of the arrows;

Fig. 13 is an enlarged sectional elevation to show the clutch controlling mechanism for the power transmission from the motor on the turntable to the turret rotatable on the horizontal axis shown in Fig. 5;

Fig. 14 is an elevational view of the manual mechanism for operating the disc clutch shown in Fig. 13;

Fig. 15 is a sectional elevation taken on the line 15—15 of Fig. 14 looking in the direction of the arrows;

Fig. 16 is a sectional elevation taken on the line 16—16 of Fig. 14 looking in the direction of the arrows;

Fig. 17 is an elevation of a self-contained power-operated drilling machine detachably mounted on the cutter bar of the kerf-cutting mining machine shown in Fig. 1;

Fig. 18 shows an outer end view of the drilling

machine shown in Fig. 17 with the demountable attaching mechanism and the cutter bar in sectional elevation on the line 18—18 of Fig. 17 looking in the direction of the arrows;

Fig. 19 is a diagrammatic plan view to illustrate various positions of the drill when the cutter bar occupies a horizontal plane;

Fig. 20 is a diagrammatic plan view to illustrate the various positions of the drill when the cutter bar occupies a vertical plane;

Fig. 21 is a diagrammatic elevational view to illustrate the various adjustments in elevation of the drill when the cutter bar is in a vertical plane;

Fig. 22 is a diagrammatic elevational view to illustrate adjustment of the drill by inverting the cutter bar from a horizontal plane adjacent the top of the machine to a horizontal plane at the floor of the mine chamber in advance of the mine track;

Fig. 23 is a diagrammatic elevational view to illustrate the adjustment of the drill from its lowest position to its highest position by inverting the cutter bar from its lower horizontal position to its upper horizontal position when the turntable is elevated to its highest position;

Fig. 24 illustrates diagrammatically adjustment of the drill to a position spaced back from the face of a rib and parallel thereto; and

Fig. 25 is a diagrammatic illustration of adjustment of the drill for operation at right angles to a rib extending parallel to the mine track.

By referring to Figs. 1 and 2 it will be seen that the kerf cutting mining machine which may be converted into a drilling machine by detachably mounting the self-contained power-operated drill 26 on the outer end portion of the cutter bar 27 comprises a truck frame 28 mounted on wheels 29, 29 which are adapted to travel on the mine track 30 and be laterally braced thereby during feeding movements of the cutter bar while the drilling machine 26 is demounted therefrom. The kerf cutting machine may be of the type shown in the Levin patent, No. 1,354,054, granted September 14, 1920, for an Improvement in mining machines, which includes a turntable, a cutter bar connected thereto to rotate therewith on an upright axis, mechanism for swinging the turntable and the cutter bar on such upright axis relatively to the truck and power-operated mechanism for varying the elevation and inclination of the turntable and the cutter bar relative to the truck.

The kerf cutting mining machine shown in Fig. 1 also includes apparatus operated by an electric motor 31 on the truck frame 28 for propelling the mining machine along the mine track 30 at a transport speed or at a slow feeding speed. A motor 32 is mounted on the turntable 33 to rotate bodily therewith and is connected to rope gearing comprising the rope 34 for swinging the turntable together with the cutter bar relatively to the truck on the upright axis of the turntable.

The truck propelling mechanism is shown in bottom plan view in Fig. 3 and comprises the sprocket chain 31' to which the motor 31 is connected through the speed reduction gearing 31''. The motor 31 on the truck frame 38 is also connected to the cable reel 35 which pays out or winds up the electric cable 36 for conducting electric power from a distant source of supply to the motor 31 on the truck, the motor 32 on the turntable and the motor 37 of the drilling machine shown in elevation in Figs. 1 and 17.

The mechanism for elevating the turntable together with the cutter bar and the drilling machine mounted on the latter is shown in Fig. 3 and comprises the sprocket chain 38 for rotating the vertical screw posts 39, 39, 39. Power may be transmitted to these screw posts individually as shown in Fig. 4 so as to effect variation of inclination of the turntable, the cutter bar, and the drilling machine on either a longitudinal axis of the turntable or a horizontal transverse axis thereof.

The armature shaft 40 of the motor 32 on the turntable extends horizontally forward and radially of the turntable as shown in Fig. 2.

At the forward end of the armature shaft 40 as shown in Fig. 5 is a bevel pinion 41 which meshes with a horizontal bevel gear 42 secured to the vertical shaft 43 which is journalled in the bearing 44 of the auxiliary frame 45 rigidly secured to the turntable 33. Secured to the upper end of the vertical shaft 43 is a bevel gear 46 which meshes with a bevel gear 47 mounted on the left-hand end of the horizontal shaft 48 journalled in the frame 45. The bevel gears 46, 47 may be lubricated by oil from the closed chamber 48' through the nozzle 49. The journal bearings for the horizontal shaft 48 may be lubricated by oil from the closed chambers 50, 51 through the oil holes 52, 53. A cover plate 54 closes the chambers 48, 50 and 51 and the lubricant in these chambers may be replenished by removing the screw plugs 52, 53 and 54.

At the right-hand end of the horizontal shaft as viewed in Fig. 5 is secured a gear 55 which meshes with a gear 56 on the left-hand end of the shaft 57 which is offset from the horizontal shaft 48 but is in the same vertical plane therewith whether or not the cutter bar is in a horizontal plane. The axis of the shaft 57 is also offset from the horizontal axis of the motor shaft 40.

As will be hereinafter explained the shaft 57 is journalled in the turret frame 58 which is rotatable relatively to the auxiliary frame 45 on the horizontal axis of the shaft 57. At the right-hand end of the shaft 57 is a bevel gear 59 which meshes with the horizontal bevel gear 60 as viewed in Fig. 5. The gear 60 is journalled loosely on the shaft 61 and the latter is journalled in the bearing 62 of the cap 63 secured to the turret 58. The shaft 61 is also journalled at its lower portion in the bearing 64 which is secured rigidly to the second turret frame 65. The second turret 65 is mounted for rotation on the axis of the shaft 61 relatively to the first turret 58.

Rigidly connected to the lower end of the turret 65 is the cutter bar 27 in position to occupy a plane at right angles to the axis of the shaft 61. Guided along the periphery of the elongated cutter bar 27 is an endless cutter chain 66 which meshes with the driving sprocket 67 secured to the lower end of the shaft 61. By means of the clutch 68 the bevel gear 60 may be connected to the shaft 61 to drive the sprocket 67 and the chain cutter 66. The clutch 68 may be manually operated from either side of the machine by means of one of the levers 69, 69 shown in Figs. 1 and 6. By moving one of the levers 69 the rockshaft 70 will actuate the shipper 71 to throw the clutch 68 in or out, as shown in Fig. 5.

In order to rotate the turret 58 on the horizontal axis of the shaft 57 power transmission mechanism is arranged between the gear 55 and the worm gear 72 which is rigidly connected to the turret frame 58. By referring to Fig. 15 which is a sectional view taken on the line 15—15 of

Fig. 5 looking in the direction of the arrows or on the line 15—15 of Fig. 14 looking in the direction of the arrows, it will be seen that the gear 56 meshes with an idler 72 and that the latter meshes with a gear 73 which in turn may be connected to the shaft 74 by means of the friction clutch 75 as shown in Fig. 13.

The friction clutch 75 may be thrown in or out by means of the lever 76 as shown in Fig. 14. The lever 76 is pivoted at 77 and is provided with an adjustable screw 78 held in fixed position by the nut 79 so as to engage the upper end of the actuating arm 80 which is urged against the screw 78 by the spring 81. The lower end of the actuating arm 80 is keyed to the rockshaft 82 which extends into the housing 83 rigidly connected to the depending supporting bracket 45' on the auxiliary frame 45. Within the housing 83 (Fig. 16) is a shipper 84 connected to the clutch operating element 85 which is shown in Fig. 13 in position to move the outer set of discs of the friction clutch toward the annular flange 86 of the clutch element 87. The inner set of friction discs is connected to rotate with the clutch element 87 which is keyed to the shaft 74. The outer set of friction discs is connected to the clutch element 88 which is secured to the gear 73 to rotate therewith. Therefore when the motor 32 on the turntable 33 is operated in one direction or the other power will be transmitted through the train of gearing shown in Figs. 5 and 15 to the clutch element 88 and when the lever 76 is actuated to apply the friction clutch 75 the shaft 74 will be rotated accordingly.

Mounted on the shaft 74 is a warm 89 which meshes with a worm wheel 90, the latter being keyed to the shaft 91. As shown in Figs. 5 and 9 the shaft 91 carries a worm 92 which meshes with the large worm gear secured to the turret frame 58. Therefore when the friction clutch 75 is applied to transmit power to the shaft 91 from the motor 32 on the turntable the turret frame 58 will be rotated on the axis of the shaft 57 while held in place by the annular retaining bearing 93. In other words, the rotation of the turret frame 58 will be on the offset support 45' on the axis of the shaft 57 which is offset from the axis 48. Consequently since the shaft 57 is in vertical plane that extends through the shaft 48 and occupies a position below the axial line of the latter the chain kerf-cutter may more readily occupy a horizontal position at the floor level as illustrated in dotted lines in Fig. 22. Furthermore, by reason of the offset position of the shaft 57 the turret 58 may be rotated on a relatively low axis so that the cutter bar when inverted to its full line position shown in Fig. 22 will occupy a position a short distance above the upper side of the cover plate. It will also be seen that by reason of the relatively low axis of the shaft 57 the drill when in its full line position shown in Fig. 22 will occupy a position approximately midway between the floor and roof of the mine chamber.

After the chain kerf-cutter has been adjusted on the axis of the shaft 57 either to any one of its horizontal positions or to any one of its vertical positions such as those shown in Figs. 20 and 21 or to any intermediate inclined position, the friction clutch 75 may be released by releasing the lever 76 whereupon the spring 81 will separate the sets of friction discs sufficiently to permit the self-locking worm gearing 89, 90 and 92, 72 to very effectively hold the kerf-cutter and the drilling machine mounted thereon in the adjusted position.

In order to swing the kerf-cutter on the axis of the shaft 61 in either direction at a feeding speed, power transmission mechanism is connected between the bevel gear 60 and the large worm wheel 94 which is secured to the cutter bar turret 65 as shown in Fig. 5. Secured to the upper side of the bevel gear 60 as viewed in Fig. 5 is an eccentric cam 95 encircling which is the circular strap 96 provided with a radial arm 97 to the outer end of which is pivoted at 98 the ratchet pawl mechanism 99 as shown in Fig. 11. A retaining plate 100 is secured by means of the cap screws 101 to the eccentric cam 95 and is of sufficient diameter to overlap a portion of the circular strap 96 as shown in Fig. 5.

The pawl and ratchet mechanism is shown in detail in Figs. 7 and 11 and is diagrammatically illustrated in Fig. 9. This pawl and ratchet mechanism is mounted in a housing 102 which is provided at its upper side with a closure 103. Reversely arranged ratchet wheels 104 and 105 are confined between a shoulder at the upper end of the shaft 106 and the circular plate 107 which is secured by means of the cap screw 108 to the upper end of the shaft 109 of reduced diameter. Mounted on the inverted cup-shaped support 110 are the reversely arranged pawls 111 and 112 which are pivoted to the support 110 on the pin 113. A spring 114 between the arms 115 and 116 extending from the pawls 111 and 112 urge the latter toward their respective ratchet wheels 104 and 105.

Between the cup-shaped support 110 and the ratchet wheels 104, 105 is located a cylindrical pawl releasing device 117 which is provided with openings 118 and 118' as shown in Figs. 9 and 11. The upper central portion of the cup-shaped pawl releasing device 117 as shown in Fig. 7, is connected to the shaft 119 which is journalled in the sleeve 120 at the upper central portion of the cup-shaped support 110. To the upper end of the shaft 119 is secured an arm 121 the outer end of which is provided with a support 122 for the spring pressed pin 123 the upper end of which is provided with a knob 124 and the lower end of which may extend into one of the depressions 125 in the plate 126 secured to the upper side of the cap or cover 103. When the lever 121 is moved in one direction one of the pawls 111 or 112 will be thrown out of engagement with its ratchet wheel and the other pawl will be permitted to engage its ratchet wheel and the position of the lever 121 will determine the position of the pawl releasing device 117 to regulate the extent of movement of the ratchet wheel upon each rotation of the eccentric cam 95. That is to say, the extent of feed in either direction of swinging movement of the cutter bar may be regulated. Whether the shaft 106 is rotated in one direction or the other the actuated ratchet wheel will be held against reversal when its pawl reverses, by the adjustable brake mechanism shown in Figs. 7 and 8, comprising the brake band 127 which is associated with the brake wheel 128 secured to the lower end of the shaft 106. As shown in Fig. 7 the shaft 106 is journalled in a bearing 129 of a block 130 secured at 131 to the housing 102. Inasmuch as the pawls are reciprocated upon rotation of the cam 95 the frame 110 has its sleeve 120 on its upper side mounted in the bearing 132 while the lower portion of the support 110 is secured to the annular member 133 journalled in bearings on the block 130.

The lower end of the shaft 106 is provided with a bevel gear 134 which meshes with a bevel gear

wheel 135 on the shaft 136. As shown in Fig. 12 the shaft 136 is journalled in the bearings 137 and 138 and carries a worm 139. The relation of the parts between the eccentric cam 95 and the worm 139 is diagramatically illustrated in Fig. 10.

As shown in Fig. 12 the bevel gear 135 is connected to the circular plate 140 by means of a shear pin 141 and the plate 140 is keyed to the shaft 136. By means of the cap screw 142 the plate 140 is retained in place on the shaft 136 and the same cap screw may be used to retain in place the keeper 143 for the shear pin 141. Since the worm 139 meshes with the large worm gear 94 swinging feeding movement of the kerf cutting mechanism is effected by operation of the worm gearing 139 and 94. If the cutter bar should engage unusually hard material such as a sulphur ball or if the feed should be inconsistent with the hardness of the material the pin 141 will be sheared in two to protect the power transmission mechanism. Such shearing of the pin 141 will not interfere with the self-locking feature of the worm gearing 139, 94 to hold the cutter bar 27 in interlocked relation to the first turret frame 58.

The track mounted mining machine may be operated in various ways to produce kerfs either in horizontal planes or in vertical planes or in intermediate inclined planes all at right angles to the working face. Traction feed may be effected by controlling the truck propelling mechanism to move along the mine track at feeding speed. The cutter bar may be adjusted in elevation and in inclination by the mechanism associated with the three screw posts 39 between the truck frame and the support for the turntable. The cutter bar may be swung arcuately either on the turntable axis or on the axis of the shaft 61. When the plane of the cutter bar is parallel to the mine track sumping and withdrawal cuts may be made either in upright planes or in horizontal planes or in intermediate inclined planes. The flexibility of the mining machine enables the latter to produce kerfs over a wide range and consequently it is desirable to provide a wide range of flexibility of positioning of the drilling mechanism so that drill holes may be produced to most effectively enable the blasting charges to co-operate with the kerfs to dislodge the coal with a maximum amount of lumps and a minimum amount of slack.

A self-contained power-operated drilling machine is therefore demountably attached to the outer end portion of the cutter bar 27 as shown in Fig. 1. Such self-contained power-operated drilling machine may be of the type shown in the Trotter patent, No. 1,087,089, granted February 10, 1914, for an improvement in Drills.

In the drilling machine shown in Fig. 17 the electric motor 37 may be controlled by an electric switch operated by means of the lever 144. The rotation of the drill 145 together with the drill socket and holder 146 may be controlled by the mechanism operated by the rotatable knob 147. The feed screw 148 extends entirely through the supporting structure and is guided at the rear of the drill frame by means of the tube 149. The rotation of the drill and the feed thereof into the coal face as well as the withdrawal therefrom is effected by rotation of the feed screw 148 the operating mechanism of which is driven by the electric motor 37 under the control of the actuating knob 147. The feed of the drill is of course axial and so also the withdrawal thereof from the drill hole.

The frame 150 of the drilling machine is provided with a lateral supporting bracket 151 which is provided with an arcuate flange 152 fitting into a circular guide groove 153 of the circular track 154.

The track 154 may be composed of semi-circular plates 155, 155 each of which is detachably connected by means of the bolts 156, 157 to the upright plate 158 of the L-shaped standard 159. The bolts 156 and 157 are screw threaded into the circular plate 160 which is encompassed by the circular track 154. The circular plate 160 is concentric with the track 154 and of such diameter as to afford a circular space 161 for travelling of the flange 152 which is L-shaped in cross section as shown in Fig. 18. It will thus be seen that the circular plate 160 locks the flange 152 in the groove 153 so that the drilling machine is locked against withdrawal from the upright plate 158 of the standard 159. However, the drilling machine is free to be tilted manually on a horizontal axis which extends at right angles through the center of the plate 160. The friction between the flange 152 and the track 154 may be sufficient to hold the drilling machine in adjusted position prior to the starting of the drill into the coal face.

The horizontal plate 162 of the standard 159 is provided with a vertical pin 163 which is adapted to extend through openings in the upper and lower plates of the cutter bar 27. The lower end of the pin 163 is screw threaded at 164 to receive a nut 165. A yoke 166 is pivoted at 167 to the nut 165 and is provided with an actuating arm 168. By means of the arm 168 the nut 165 may be tightened to secure the standard 159 in adjusted position on the cutter bar. Since the yoke 166 is pivoted at 167 the arm 168 may be swung 180° to the opposite side of the cutter bar for convenience in operation of the nut 165.

It should be particularly noted that adjustment of the drilling machine relative to the cutter bar may be made on intersecting axes which extend at right angles to each other. When the cutter bar is in a horizontal position such as that shown in Fig. 18 the adjustment of the drilling machine may be made on the vertical axis of the pin 163 and on a horizontal axis extending through the center of the plate 160 or concentrically of the track 154. The drilling machine may be detachably mounted on either side of the cutter bar and by providing additional holes or openings through the cutter bar the drilling machine may be mounted at various distances from the outer end of the cutter bar. For instance, in Figs. 24 and 25 the drilling machine may be mounted as shown in full lines or in the position indicated by the perforation 169. It is preferred, however, to mount the drilling machine adjacent the outer end of the cutter bar so as to enable the latter to afford an elongated support which will reach a considerable distance from the truck of the mining machine while the latter remains on the mine track and that such extended positioning of the drilling machine may be effected at various angles. Not only is the elongated support universally mounted but the drilling machine itself is adjustable to various positions on intersecting axes which extend at right angles to each other. The drilling machine may therefore be effectively supported to command the entire coal face for axial feeding either at right angles to the coal face or at any oblique angle relative thereto since the feed of the drill is axially thereof while the

supporting framework of the mining machine remains stationary on the mine track.

During the operation of the drilling machine slipping may occur between the arcuate flange 152 and the circular track 154 and likewise between the horizontal plate 162 and the adjacent plate of the cutter bar. The cutter bar acting as an elongated support for the drilling machine is locked in stationary position by the self-locking worm gearing 139, 94 and 92, 72.

In order to retain the cutter bar locked in a stationary position at an adjusted angle the mechanism shown in Fig. 16 is preferred. During mining operations vibrations of the cutter bar may tend to cause creeping between the worm gear elements and to prevent this I have mounted a spring-pressed brake as shown at 170 in Fig. 16 to act against an annular flange 171 on a nut 172 which is screw threaded to the extension 173 and pinned thereto at the left-hand end of the worm shaft 91. The shaft 91 is mounted in the bearings 174 and 175 in the casing 176 which is secured rigidly to the neck 177 as shown in Fig. 5. The casing 176 and the neck 177 are rigidly connected to the depending bracket 45' and the latter in turn is rigidly connected to the auxiliary frame 45 fixed to the turntable 33. The mechanism for swinging the turntable on a vertical axis relatively to the truck is also provided with self-locking worm gearing to hold the turntable locked to the truck when it is desired to hold the cutter bar stationary relative to the truck.

By referring to the diagrammatic views of Figs. 19 to 25, inclusive, the various adjustments of the mining machine to secure the desired positioning of the drilling machine will be understood. Fig. 19 illustrates adjustment of the cutter bar 27 on the vertical axis 178 of the turntable and on the axis 61 at the rear end of the cutter bar to enable the drilling machine to drill holes at an angle in its full line position and close to the ribs 179 and 180 in their dotted line positions. By firing the blasting charge in the intermediate drill hole slightly in advance of the firing of the charges in the dotted drill holes the coal will be more efficiently dislodged.

In Fig. 19 the cutter bar is in horizontal position or in such inclined position as will be permitted by the screw posts on the truck frame but the elevation of the cutter bar together with the drilling machine may be varied as illustrated in Figs. 22 and 23.

By mounting the drilling machine on that side of the cutter bar remote from the turrets the drill holes may be adjacent the plane of the floor as shown in Fig. 23 or adjacent the plane of the roof as shown in dotted lines. The change in position may be effected by turning over the turrets to invert the cutter bar.

By mounting the drilling machine on that side of the cutter bar adjacent the turrets, drill holes in horizontal planes may be produced at various elevations one of which, as shown in full lines in Fig. 22, is midway between the floor and roof.

In Fig. 23 the turntable is shown in an elevated position relative to the truck whereas in Fig. 22 the turntable is in its lowermost position. On account of the lower position of the shaft 57 of Fig. 5 or of the axis of the neck 177 on which the horizontal turret 58 turns, drilling, as shown in Fig. 2, may be effected in a relatively low roof mine room because of the relatively low position of the cutter bar adjacent the plane through the top of the turntable and because the drilling machine is mounted on the bottom of the cutter bar.

Drilling in still lower roof mine rooms may be carried on when the cutter bar is adjusted to its upright plane. By reason of the offset axis of the shaft 57 the turret 58 may remain below the plane extending through the top of the machine. That is to say, when the turntable is in its lowermost position and the shaft 61 is horizontal to extend from either side of the shaft 57 the overall height of the entire machine is no greater than the top of the turntable. Consequently the machine may be used for making drilling holes in any position extending entirely across the working face and at any elevation between the floor and the roof, in a very low roof mine room. A plurality of shearing or vertical cuts may also be made in such low roof mine room when the drilling machine is demounted from the cutter bar. Furthermore, when the cutter bar is in an upright plane it may support the drilling machine for operation in high roof mine chambers as shown in Fig. 21. In fact the height of the roof may vary from that in which the machine may be cleared when the turntable is in its lowermost position to that in which the height may be at the upper end of the cutter in an upright plane and extending vertically upward.

The width of the mine entry or room may vary from a narrow place to one twice the radial distance from the turntable axis to the outer end of the cutter bar.

The adjustments on the turntable axis and on the axis at the rear end of the cutter bar may also be taken advantage of to support the drilling machine to drill a hole spaced back from the rib 181 as shown in Fig. 24, or to drill a hole at right angles to the rib 182 as shown in Fig. 25. In all of the operations of the drilling machine illustrated in Figs. 19 to 25, inclusive, the supporting framework remains in stationary position on the mine track, the feed of the drill always being axially of the drilling tool.

All of the adjustments of the cutter bar as to elevation and inclination are made by self-contained power-operated mechanism and after such adjustments have been made the drilling machine is manually adjusted relative to the cutter bar and the supporting standard 159 manually secured in adjusted position by means of the handle on the opposite side of the cutter bar. The final adjustment will be on the transverse supporting axis of the drilling machine frame. During operation the drilling machine will be yieldingly held on its intersecting axes relative to the cutter bar while the latter is held rigid and stationary.

In order to lock the turntable 33 to the ring 183 (Fig. 1) which is mounted on the adjusting screw posts 39, locking devices 184 are associated with the notches 185 in the periphery of the turntable 33. The ring 183 is carried by the pedestals 185 which depend therefrom and a nut 186 is threaded on the screw post 39 as shown in Fig. 4. By means of the lever 187 the clutch 188 may be operated to control individual elevation of the nut 186 and the pedestal 185, the sprocket 189 being connected to the vertical screw post 39 to rotate therewith.

By referring to Figs. 1 and 23 it will be seen that the overall height of the drilling machine is relatively low and the machine is therefore adapted to operation in a low roof mine chamber. However, the same machine may be operated in high roof mine chambers because of the high reach afforded by the arm 27 which is adjustable on the axis 61 as shown in Fig. 21. The boom 58 shown in Fig. 5 is mounted on the truck for hori-

zontal swinging movement on the vertical axis 178 of the turntable 33. The axis 61 on which the arm 27 is swingable extends at right angles to the horizontal axis 57 of the boom. When the axis 61 is horizontal the arm 27 may be moved in a vertical plane to inclined positions extending upwardly or downwardly relative to the horizontal and held at such adjusted inclinations.

As shown in Fig. 18 the drilling implement is adjustably mounted on the arm 27 for adjustment relative thereto on rectangularly related axes 163 and 152. The axis 163 is permanently at right angles to the arm 27 and therefore permanently parallel to the axis 61. The axis 152 is permanently at right angles to the axis of the drill. Consequently, whenever the axis 61 is horizontal and the arm 27 is inclined upwardly or downwardly as shown in Fig. 21 and the drill is parallel to the mine track and perpendicular to the working face, the axis 152 will be vertical. The adjustment of the drill to such right angle position when the arm 27 is inclined upwardly or downwardly is on rectangularly related axes one (152) of which is vertical and at right angles to the drill axis and the other (163) of which is horizontal and parallel to the axis 61.

By rotating the boom 58 on the horizontal axis 57 through an angle of 180° the arm 27 with the drilling implement thereon may be inverted to locate it in a horizontal plane adjacent to the mine bottom or in a horizontal plane adjacent to the mine roof as shown in Fig. 23. In a similar manner inversion of the arm 27 enables the drill to be located in vertical planes adjacent to the opposite ribs as shown in Fig. 20. In addition to the positions of the drill at right angles to the working face as illustrated in Figs. 20 and 23, the drill may be adjusted to a position at right angles to such working face at any point over its entire area, by rotating the boom 58 on its horizontal axis until the axis 152 is in a vertical plane parallel to such working face. This may be accomplished irrespective of the inclination of the arm 27 on its pivot 61 because whenever the axis 152 is in such vertical plane the axis of the drill is swingable on the axis 152 to a position at right angles to the working face.

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

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

1. In mining apparatus, the combination with a wheel mounted base frame, of a turntable mounted thereon, means for adjusting the elevation and inclination of said turntable, a depending neck mounted on said turntable to move bodily therewith, a turret mounted on said neck to turn on a horizontal axis extending radially of said turntable and offset below the top thereof, a second turret mounted on said first-named turret to turn relatively thereto on an axis extending at right angles to the axis of said neck, an elongated support on said second turret, a drill unit demountably attached to the outer end portion of said support, and means for turning the turrets on their respective axes to effect adjustments of said support and said drill unit.

2. In a drilling tool, a portable base, a boom swivelly mounted on said base to swing horizontally relative thereto about a vertical axis, an arm structure pivotally mounted on the outer extremity of said boom to swing relative thereto, a drilling implement swivelly mounted on the outer extremity of said arm structure to swing relative thereto about angularly related axes, and means for swinging said arm structure about the longitudinal axis of said boom to position said drilling implement in relatively high and relatively low planes.

3. In a drilling tool, a portable base, a boom swivelly mounted on said base to swing horizontally relative thereto about a vertical axis, an arm structure pivotally mounted on the outer extremity of said boom to swing relative thereto, a drilling implement swivelly mounted on the outer extremity of said arm structure to swing relative thereto about rectangularly related axes, and means for swinging said arm structure about the longitudinal axis of said boom to position said drilling implement in relatively high and relatively low planes.

4. In drilling machine, the combination with a wheeled frame adapted to move along a mine track, of a boom mounted on said frame for adjustment relative thereto on rectangularly related axes one of which is vertical and the other horizontal, an elongated arm pivoted to said boom for adjustment relative thereto on an axis extending transversely of said horizontal axis, a drilling implement at the outer end of said arm, mechanism affording adjustment of said drill implement relative to said arm on rectangularly related axes one of which shall be in a vertical plane when said transverse axis is horizontal to enable positioning said drilling implement at right angles to the working face extending across the space in advance of the mine track and parallel to the ribs, means for rotating said boom on said horizontal axis to change the position of the drilling implement from a horizontal plane below said arm to a horizontal plane above said arm, and means for swinging said arm on said transverse axis and holding the same in adjusted position.

5. In a track mounted drilling machine, the combination with a wheeled frame having a relatively low overall height adapted to travel on a mine track in a low roof mine chamber, of a horizontal boom rotatable on a horizontal axis and mounted on said frame for adjustment relative thereto on a vertical axis, an elongated arm pivotally connected to the outer extremity of said boom for adjustment relative thereto on an axis extending transversely of said boom, a drilling implement, means for mounting said drilling implement on said arm for adjustment relatively thereto on rectangularly related axes one of which extends transversely of said arm in parallelism at all times to said first-named transverse axis and the other of which is permanently at right angles to the drilling implement axis, means for swinging said arm on said first-named transverse axis and holding the same in adjusted position, and means for rotating said boom together with said arm and drilling implement on said first-named horizontal axis to position the said right angle axis in a vertical plane parallel to the working face extending across the space in advance of the mine track.

6. In mining apparatus, the combination with a wheel mounted truck adapted to travel on a mine track, of an elongated cutter bar adapted to serve as a support for a drilling machine, a demountable drilling machine on the outer end portion of said cutter bar, mechanism for sup-

porting said cutter bar for adjustment on a horizontal axis and on spaced axes one of which is permanently upright and the other of which varies from upright to horizontal while remaining permanently at right angles to said horizontal axis, and means for operating said adjustable supporting mechanism to effect adjustment of said drilling machine.

7. In mining apparatus, the combination with a mining machine comprising a base frame, an elongated cutter bar of a kerf-cutter, means for supporting the cutter bar for universal adjustment relative to said frame, and self-contained power-operated mechanism for operating said universally adjustable supporting means to effect adjustment of the cutter bar, of a drilling machine, and means for adjustably mounting said drilling machine on the outer end portion of said cutter bar for bodily movement with the latter when adjusted by said power-operated mechanism.

8. In mining apparatus, the combination of a mining machine having a kerf-cutter cutter bar and means for adjusting the latter, and a self-contained power-operated drilling machine mounted on said cutter bar to move bodily therewith to partake of the adjustments thereof to locate the drilling machine for operation at a predetermined point at the coal face.

9. In mining apparatus, the combination with a mining machine comprising a kerf-cutter cutter bar, of a drilling machine mounted on said cutter bar to partake of the adjustments of the latter and thereby secure adjustment of the drilling machine at the working face of the mine vein, and power connections to the mining machine and to the drilling machine.

10. In mining apparatus, the combination with a drilling machine unit, of a standard for supporting the same, means affording an annular grooved track on said standard, an arcuate tongue secured to said drilling machine unit and extending into the said grooved track to move arcuately along the same, and a disk secured to said standard concentrically with said grooved track in position to lock said arcuate tongue in said groove thereby mounting said drilling machine unit on said standard for adjustment on an axis extending at right angles to the feeding axis of said drilling machine unit.

11. In mining apparatus for a low roof mine vein, the combination with a wheeled frame adapted to travel along a mine track, of a support pivoted to said frame to swing horizontally relative thereto on a vertical axis, a bearing extending radially from said support, a supplemental frame pivotally mounted on said bearing for rotary adjustment on a horizontal axis permanently at right angles to said vertical axis, an arm pivotally mounted on said supplemental frame to swing relatively thereto on an axis permanently at right angles to said horizontal axis, a drilling implement mounted on the outer end portion of said arm for adjustment relative thereto on rectangularly related axes one of which is permanently parallel to the pivotal axis of said arm thereby enabling said drilling implement to be adjusted into position to drill a hole at right angles to the working face extending across the space in advance of the mine track when said arm pivotal axis is horizontal and parallel to such working face, and means for adjusting said supplemental frame on said first-named horizontal axis to adjust the arm pivotal axis to a horizontal plane.

12. In a drilling machine, the combination with a wheeled frame adapted to travel on a mine track, of a bearing extending radially from said frame, a supplemental frame mounted on said bearing for rotary adjustment on a horizontal axis, an elongated support pivotally connected to said supplemental frame on an axis extending at right angles to said horizontal axis, a self-contained power-operated drilling unit mounted on the outer end portion of said elongated support for adjustment relatively thereto on rectangularly related axes one of which is permanently parallel to said pivotal axis, means for adjusting said supplemental frame on said horizontal axis to move said pivotal axis in a plane permanently at right angles to said horizontal axis, and means for adjusting said radial bearing together with said supplemental frame and said elongated support and said drilling unit on an upright axis to enable said drilling unit to command substantially the entire area of the coal face extending across the space in advance of the mine track with the drilling axis substantially at right angles to such coal face in the various positions to which adjusted.

13. In a drilling machine, the combination with a wheeled frame adapted to travel on a mine track, of a supplemental frame mounted on said first-named frame to swing relatively thereto on an upright axis and to rotate on a horizontal axis, an arm pivotally mounted on said supplemental frame to swing relatively thereto on an axis extending transversely of said horizontal axis, a self-contained power-operated drilling unit, mechanism for supporting said drilling unit on the outer end portion of said arm for adjustment relatively thereto on rectangularly related axes one of which is permanently in parallelism to said transverse axis, mechanism for swinging said arm on said transverse axis to adjust the position of the drilling unit, and means for rotating said supplemental frame together with said arm and said drilling unit on said horizontal axis to invert said drilling unit whereby said drilling unit may be positioned at right angles to the working face extending across the space in advance of the mine track at any point over a wide area between the floor and roof of the mine room or between the ribs thereof.

14. In mining apparatus, the combination with a base frame, of a turntable mounted thereon for adjustment relative thereto on a vertical axis, a supplemental frame mounted on said turntable for adjustment relative thereto on a radially extending horizontal axis, an elongated support pivotally mounted on said supplemental frame for adjustment relative thereto on an axis permanently at right angles to said horizontal axis and adjustable to various positions in a vertical plane parallel to and spaced from said vertical axis, a drill unit mounted on the outer end portion of said elongated support, means for adjusting said turntable on said vertical axis to extend the reach of said drill unit arcuately and laterally, means for adjusting said elongated support on said right angle axis to extend the reach of said drill unit from the floor to the roof along the working face when said right angle axis is horizontal, means for adjustably supporting said drill unit on said elongated support on rectangularly related axes one of which is permanently parallel to the transverse pivotal axis of said elongated support, and means for adjusting said supplemental frame relative to said turntable on said horizontal axis.

15. In mining apparatus, the combination with a wheeled truck adapted to travel on a mine track, of a turntable mounted thereon for adjustability thereto on an upright axis, a radially extending bearing on said turntable, a turnover head supported by said bearing on said turntable for bodily movement therewith on said upright axis and for rotary adjustment relative to said turntable on a radial horizontal axis extending at right angles to said upright turntable axis, an elongated support pivotally mounted on said head for adjustment relative thereto on an axis extending at right angles to said radial axis, a drilling unit, means for adjustably supporting said drilling unit at the outer end portion of said elongated support on rectangularly related axes, mechanism for swinging said elongated support on said pivotal axis, and means for rotatably adjusting said head on said radial axis.

16. In mining apparatus, the combination with a wheeled truck adapted to travel on a mine track, of a turntable mounted thereon for adjustment relative thereto on an upright axis, means for adjusting the elevation of said turntable relative to said truck, a radially extending bearing on said turntable, a head having a neck mounted on said bearing, means for rotating said head by said neck on said bearing on a radial axis extending at right angles to the turntable axis, an elongated support pivotally connected to said head on an axis extending at right angles to said radial axis, a drilling unit, means for adjustably supporting said drilling unit on the outer end portion of said elongated support on rectangularly related axes, and means for swinging said elongated support on its pivotal axis.

17. In mining apparatus, the combination with a portable support, of a turntable thereon, means for locking said turntable in its various positions of angular adjustment relative to said support, a turn-over head mounted on said turntable for rotary adjustment relative thereto, an elongated arm pivotally connected to said turn-over head to co-act with the adjustment thereof relative to said turntable for movement into different lateral positions and different elevated positions relative to said support, a drilling tool adjustably mounted on the outer end portion of said elongated arm, motor operated mechanism for adjusting said turn-over head relative to said turntable and for adjusting said arm relative to said turn-over head to enable said cutting tool to be positioned relative to said arm in parallel positions each perpendicular to the working face extending across the space in advance of said support, and separate motor operated mechanism for operating the drilling tool in any of said right angle positions.

18. In a drilling machine, the combination with a portable base, of a head swingable horizontally relatively to said base about a vertical axis, an elongated arm pivotally mounted on the outer end portion of said head to swing into relatively inclined positions relative thereto, a drilling implement mounted on the outer end portion of said arm for adjustment relatively thereto on rectangularly related axes, motor operated mechanism for adjusting said head relatively to said base and for adjusting said arm on its pivot relatively to said head and for holding said arm in adjusted position relative to the base, and motor operated mechanism for driving said drilling implement.

19. In a mining machine, the combination with a portable base, of a turntable mounted thereon for rotation relatively thereto on an upright axis, means for locking said turntable in adjusted angular position relative to said base, a head mounted on said turntable for adjustment relative thereto on a horizontal radial axis, an elongated arm pivotally connected to said head on an axis extending at right angles to said horizontal axis and confined to adjustments in a plane parallel to the vertical axis of the turntable, a drilling unit mounted on the outer end portion of said elongated arm for adjustment relative thereto on rectangularly related axes, and motor operated mechanism for adjusting said head on said horizontal axis and for adjusting said elongated arm on said transverse axis in cooperation with the adjustments of the drilling unit on said rectangularly related axes to enable positioning the drill closely adjacent to the ribs of a mine entry and parallel to said ribs with the drill approximately at right angles to the working face extending across the space in advance of the machine anywhere from a position near the roof to a position near the floor of a mine entry.

20. In a drilling machine, the combination with a portable base having a relatively low overall height, of a support extending outwardly from said base in a horizontal direction, a head mounted on said support for rotary adjustment relative thereto on a horizontal axis spaced below a horizontal plane extending through the top of said support, an arm pivotally connected to said head to swing into relatively inclined positions relative thereto on a horizontal axis extending transversely of said first-named axis, a drilling implement swivelly mounted on the outer end portion of said arm for adjustment relative thereto, and motor-operated mechanism for rotating said head on its axis and for swinging said arm on its axis.

21. In a drilling machine, the combination with a portable base, of a relatively short horizontal bearing extending outwardly from said base, a head mounted on said short bearing for rotatable adjustment relative thereto, said head having a laterally off-set extension, an elongated arm pivotally connected to said head on a transverse axis, a drilling unit mounted on said arm for adjustment relative thereto on an axis extending transversely of said arm, means for rotating said head to adjust said arm to a position near the mine bottom, and means for swinging said arm on said transverse axis to locate said drilling unit at the working face near the mine bottom.

22. In a drilling machine, the combination with a portable base, of a supporting frame thereon, a head mounted on said frame for rotatable adjustment relative thereto on a horizontal axis, said head having a transverse extension adapted to project to a position near the mine bottom when said head is in a predetermined position, an elongated arm pivoted to said head on a transverse axis which is adapted to occupy a vertical position when said head is in said predetermined position, a drilling unit pivoted to said arm on a transverse axis adapted to occupy a vertical position when said head is in such predetermined position, means for rotating said head on its axis, and means for swinging said arm horizontally on its axis to enable said drilling unit to occupy various positions between the ribs of the mine entry each near the mine bottom and each for drilling a hole in the working face either angularly or perpendicularly relative to the working face.

23. In a drilling machine, the combination with a portable support, of a turntable mounted there-

on for rotary adjustment relative thereto on an upright axis, an elongated arm pivotally connected to said turntable on a horizontal axis, a drilling unit connected to the outer end portion of said arm for adjustment relative thereto on rectangularly related axes, motor operated mechanism for swinging said elongated arm in vertical planes on said horizontal axis while said turntable occupies an adjusted position relative to said portable base, and self-contained power-operated mechanism for operating said drilling unit to drill holes perpendicularly to the working face extending across the space in advance of the machine parallel to one of the ribs of the mine entry and closely adjacent thereto at any point extending from a position near the roof to a position near the mine bottom.

24. In a drilling machine, the combination with a portable base, of a turntable mounted thereon, a turn-over head mounted on said turntable for rotatable adjustment relative thereto on a horizontal radial axis, an elongated arm pivotally connected to said head on an axis extending transversely of said horizontal axis, a drilling unit mounted on the outer end portion of said arm for adjustment relative thereto on rectangularly related axes, mechanism for adjusting said turn-over head on said horizontal radial axis and for swinging said arm on said transverse axis and holding said head and arm in adjusted positions relative to said turntable, and self-contained power-operated mechanism for operating said drilling unit to drill holes closely adjacent either rib of the mine entry and parallel thereto and approximately perpendicular to the working face extending across the space in advance of the machine.

25. In a drilling machine, the combination with a wheeled truck adapted to travel on a mine track, of a turntable mounted thereon, a turntable head mounted on said turntable for adjustment relative thereto, an elongated flat bar pivoted to said head on an axis extending transversely of the turn-over head axis, a drilling unit mounted on the outer end portion of said flat elongated arm for adjustment relative thereto on rectangularly related axes, motor operated mechanism for adjusting said turn-over head and for adjusting said flat elongated arm, and motor operated mechanism for operating said drilling unit.

26. In a drilling machine, the combination with a portable base, of a horizontal support swivelly mounted on said base and overlying said base and swingable horizontally relatively to said base into positions where the outer extremity thereof overhangs the sides of said base, a head pivotally mounted on a horizontal axis on the outer extremity of said support and branching downwardly from said support along either side of said base at the rear of the forward end of said base, an elongated arm pivotally connected to the downwardly branching end of said head on a vertical axis, a drilling unit swivelled on the outer end portion of said arm to swing about rectangularly related axes additional to said horizontal axis, and means for adjusting said head relative to said support and adjusting said arm relative to said head and holding said arm and head in adjusted positions relative to said support.

27. In a drilling machine, the combination with a portable base, of a turntable mounted thereon for adjustment relative thereto on an upright axis, a relatively short bearing mounted on said turntable and extending radially therefrom, a turn-over head mounted on said short bearing near said turntable, an elongated arm pivoted to said head on an axis extending transversely of the turn-over head axis, a drilling unit pivotally mounted on said arm, and mechanism comprising gearing carried by said head for rotating the latter on said bearing and for swinging said arm on said transverse axis to adjust said arm and hold the same in adjusted position during operation of the drilling unit.

28. In a drilling machine, the combination with a portable base, of a support pivotally mounted on said base to swing horizontally relatively thereto, a rotatable head mounted on said support outside of the confines of said base but a short distance therefrom for adjustment relative to said base on a horizontal axis, an elongated arm pivotally mounted on said head on an axis at right angles to said horizontal axis, a drilling unit swivelly mounted on the outer end portion of said arm in a position widely spaced from said base for adjustment to either rib of mine entries of varying widths and to the floor and roof of mine entries of varying heights, and means for adjusting said head on said axis and for adjusting said arm relative to said head and holding the arm in adjusted position.

29. In a drilling machine, the combination with a portable base, of a turntable mounted thereon for adjustment relative thereto on an upright axis, mechanism for adjusting the elevation of said turntable relative to said base, a radial bearing on said turntable, a rotatable head mounted on said bearing and provided with an extension transversely of the axis of said bearing, an elongated arm pivoted to said head on a transverse axis at right angles to the axis of said bearing to occupy a position parallel to said bearing axis and spaced therefrom, mechanism for rotating said head on said bearing axis while said transverse axis is confined to a plane parallel to the turntable axis, a drilling unit swivelly mounted on said arm to move bodily therewith, and mechanism for swinging said arm on said transverse axis to effect adjustment of the position of the drilling unit.

30. In a drilling machine, the combination with a truck adapted to travel on a mine track, of a support mounted thereon to rotate horizontally relatively thereto on a vertical axis, a head journaled to said support and having an overhanging extension, an arm pivotally connected to said extension, a drilling unit swivelly connected to the outer end portion of said arm on rectangularly related axes, means for holding the drill unit in adjusted positions on said rectangularly related axes, means for holding said support in adjusted positions on said vertical axis, means for holding said head in adjusted positions relative to said support, and means for holding said arm in adjusted positions relative to said head, the adjustments on the aforesaid axes enabling said drilling unit to be positioned at a plurality of elevations at right angles to a coal face extending transversely of the space in advance of the mine track.

31. In a drilling machine, the combination with a portable base, of a support swingable horizontally relatively to said base about a vertical axis, an arm swivelled to the outer end of said support to swing relatively thereto on a horizontal axis, the outer end of said arm being offset from said horizontal axis, a drilling implement swivelly mounted on the outer end portion of said arm to swing about rectangularly related axes

relatively to said arm, means for rotating said arm on said horizontal axis to change the elevation of the outer end of said arm, means for holding said drilling implement in adjusted position on said rectangularly related axes, and means for operating the drilling implement including feed thereof.

32. In a drilling machine, the combination with a truck adapted to travel on a mine track, of a horizontal support mounted on said truck to swing horizontally relatively thereto, an arm pivotally mounted on the outer end of said horizontal support to swing into angularly related positions in planes above and below the pivotal connection between said arm and said support, a drilling implement mounted on said arm for adjustment relative thereto on rectangularly related axes, means connected to said support and arm for swinging the latter about its pivot relatively to said support and for holding said arm in its different angular positions, and means for operating said drilling implement including feed thereof parallel to the mine track.

33. In a drilling machine, the combination with a truck adapted to travel on a mine track, of a turntable mounted on said truck to rotate horizontally relatively thereto about a vertical axis, an arm structure pivotally mounted on said turntable to swing relatively thereto, a drilling implement swivelly mounted on the outer end portion of said arm structure to swing relatively thereto about rectangularly related axes, and means for swinging said arm structure about a radial horizontal axis relatively to said turntable to position the drilling implement in relatively high and relatively low planes.

34. In a drilling machine, the combination with a truck adapted to travel on a mine track, a turntable mounted on said truck to rotate horizontally relatively thereto about a vertical axis, an arm structure pivotally mounted on said turntable to swing relatively thereto on rectangularly related axes one of which is a radial horizontal axis, a drilling implement swivelly mounted on the outer end portion of said arm structure to swing relatively thereto about rectangularly related axes, and means for swinging said arm structure about said radial horizontal axis to position said drilling implement in relatively high and relatively low planes.

35. In a drilling machine, the combination with a supporting bar having outer flat surfaces in parallel spaced-apart planes, of a standard adapted to fit either flat side of said supporting bar, means for detachably securing said standard to either flat side of said bar in adjusted position on an axis extending at right angles to said bar, a drilling unit, and means for pivotally connecting said drilling unit to said standard for adjustment relative to said bar on an axis extending transversely of said right angle axis.

36. In a drilling machine, the combination with a supporting bar having outer surfaces in parallel spaced-apart planes, of an L-shaped standard having plane legs at right angles to each other, a clamping device extending through a hole in said bar and adapted to secure one of said legs to either of said outer surfaces, a drilling unit, and means for pivotally supporting said drilling unit on the other leg of said standard.

37. In a drilling machine, the combination with a drilling unit, of a supporting bar, an L-shaped standard, mechanism securing said standard to said bar in adjusted position relative thereto on an axis at right angles to said bar, mechanism for mounting said drilling unit on said standard for adjustment relative thereto on an axis parallel to said bar and extending transversely of said first-named axis with the drilling axis intersecting said right angle axis.

38. In a drilling apparatus, a portable base, a boom structure mounted on said base for swinging movement relative thereto and for rotation about its longitudinal axis, motor operated devices for swinging said boom structure and for rotating said boom structure about its axis relative to said base, and a drilling implement carried at the outer extremity of said boom structure for swinging movement relative thereto about rectangularly related axes.

39. In a drilling apparatus, a portable base, a boom structure mounted on said base for swinging movement relative thereto, said boom structure solely supported by said base and extending forwardly in advance of said base, a drill support mounted on the outer extremity of said boom structure for rotation about the longitudinal axis of said boom structure, motor operated devices for swinging said boom structure and for holding said boom structure in its different adjusted positions relative to said base, motor operated devices for rotating said drill support about its axis relative to the base, and a drilling implement mounted on said drill support for swinging movement relative thereto about rectangularly related axes.

40. In a drilling apparatus, a portable base, an elongated supporting structure mounted on said base for adjustment in a plurality of angularly related directions relative thereto about spaced axes one of which is vertical and another horizontal, the horizontal axis located on said base in advance of said vertical axis, said supporting structure extending forwardly in advance of said base, a drilling tool mounted on the outer extremity of said supporting structure, and motor operated devices for adjusting said supporting structure in aforesaid directions relative to said base and including a motor for effecting said adjustments.

LEWIS E. MITCHELL.