July 9, 1935. C. F. OSGOOD 2,007,905

MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 1

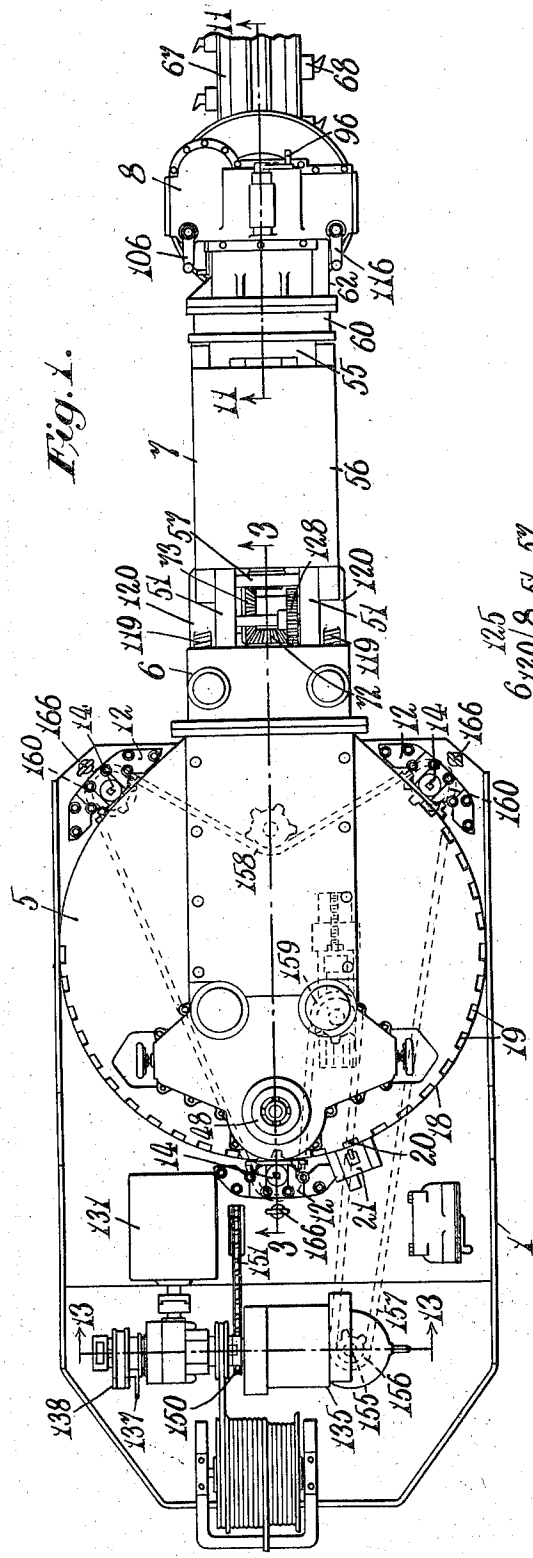

Fig. 1.

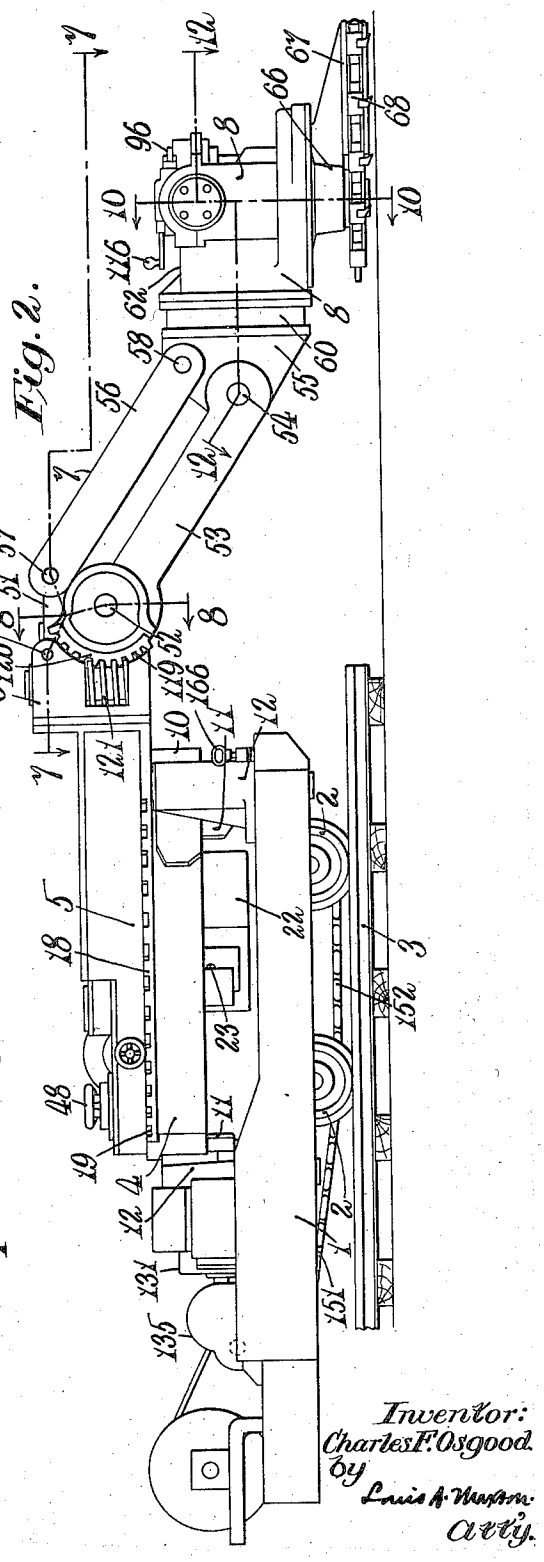

Fig. 2.

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MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 2

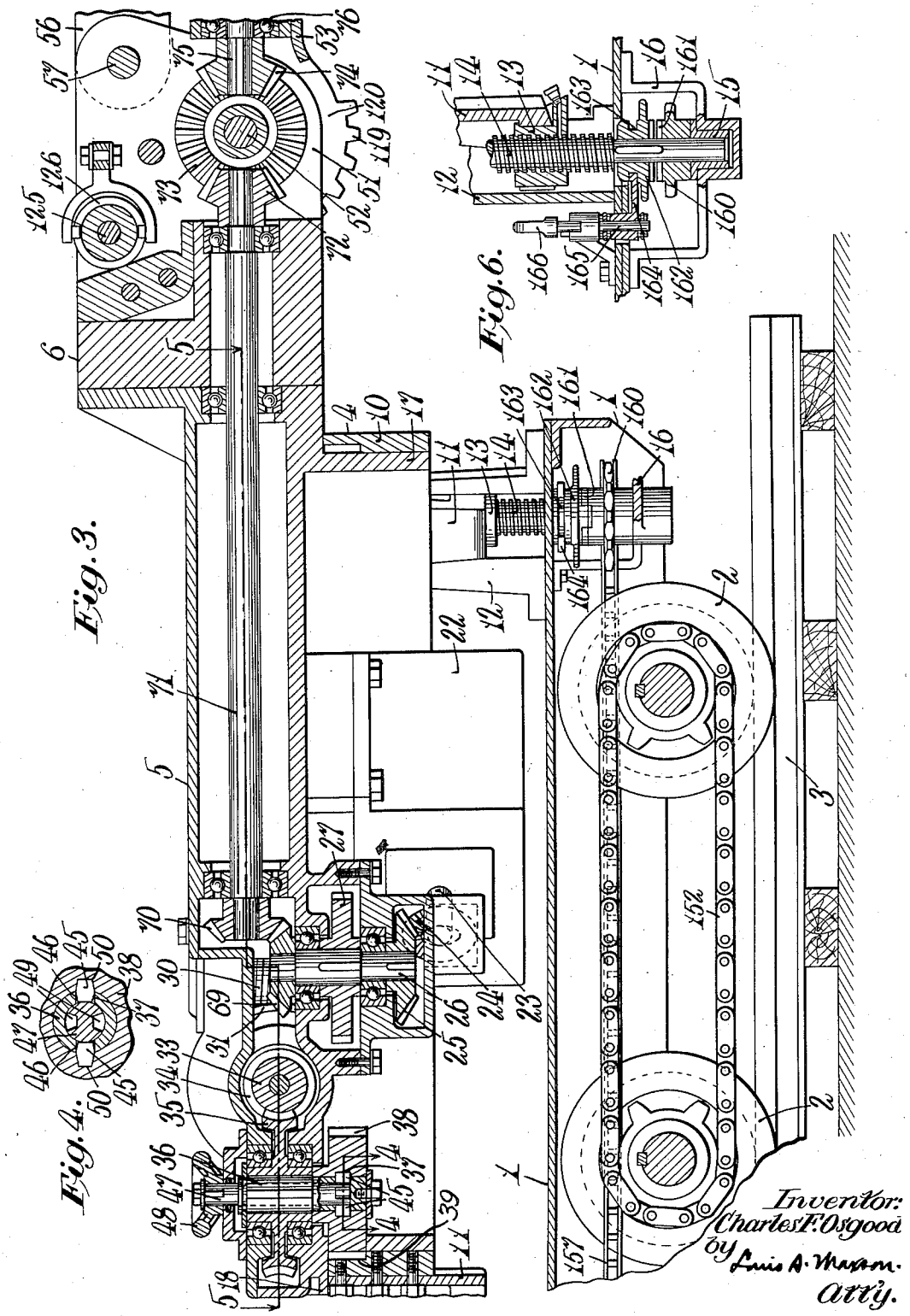

Fig. 3.

Fig. 4.

Fig. 6.

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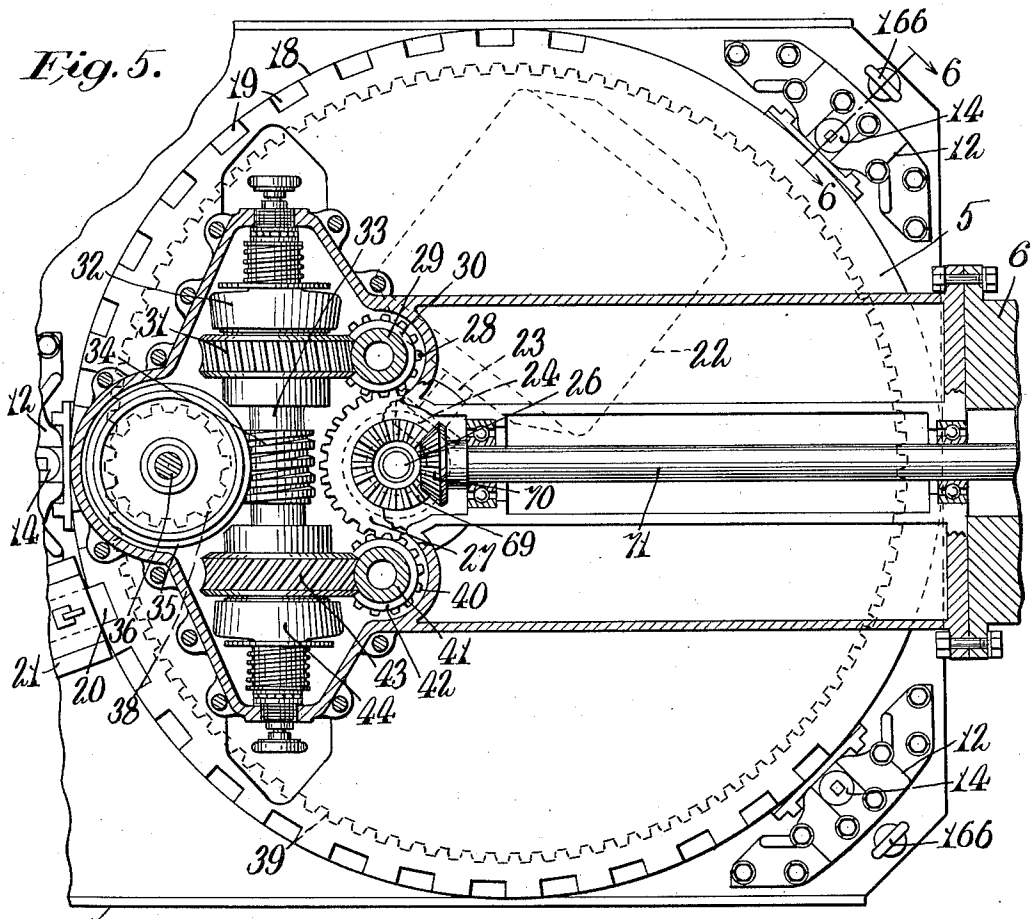
July 9, 1935. C. F. OSGOOD 2,007,905

MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 3

Fig. 5.



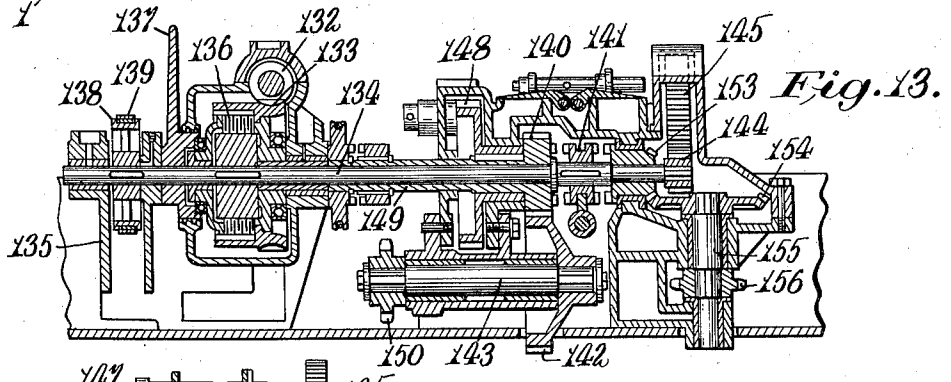


Fig. 13.

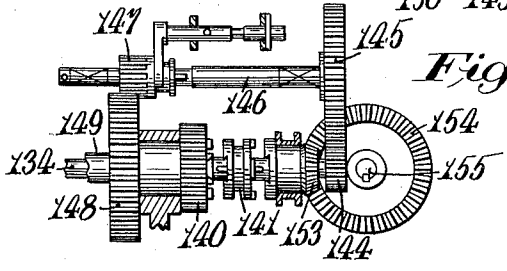


Fig. 14.

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July 9, 1935. C. F. OSGOOD 2,007,905

MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 4

Fig. 7.

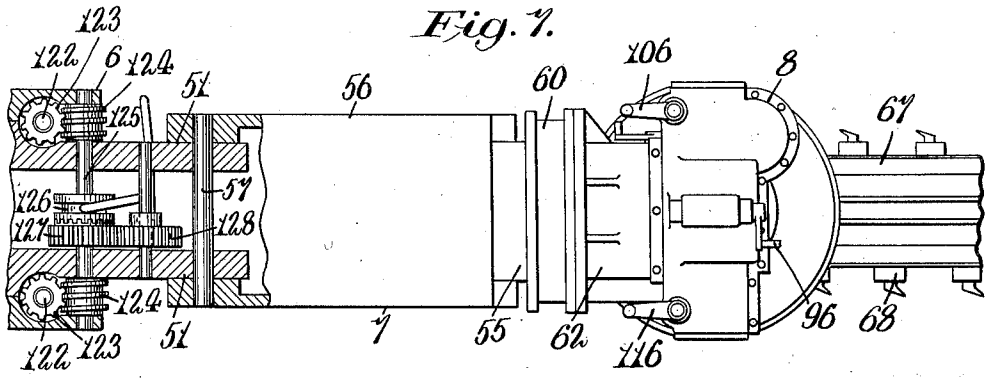


Fig. 8.

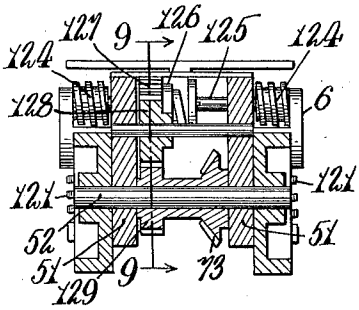


Fig. 9.

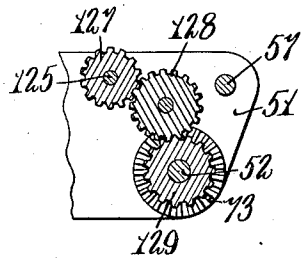
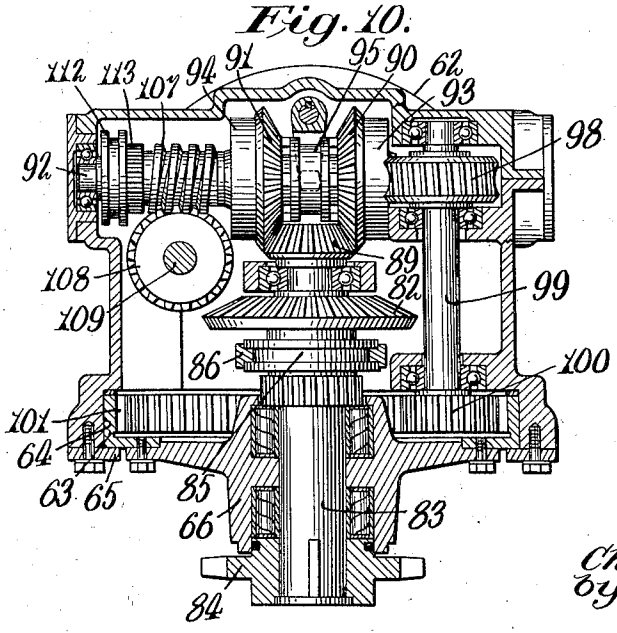


Fig. 10.



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MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 5

Fig. 11.

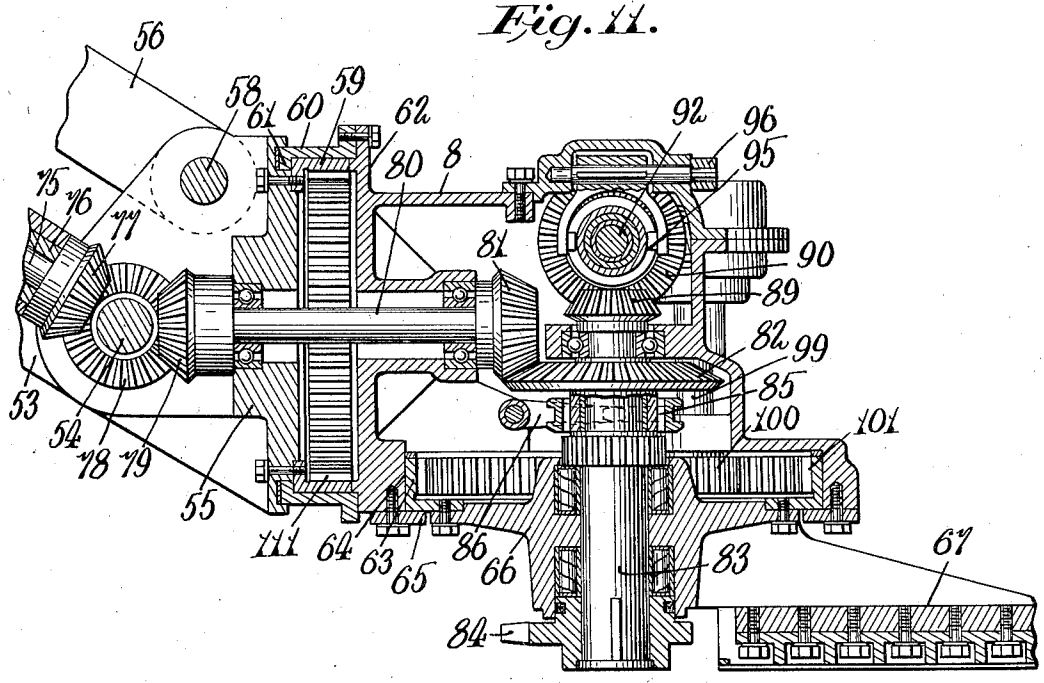
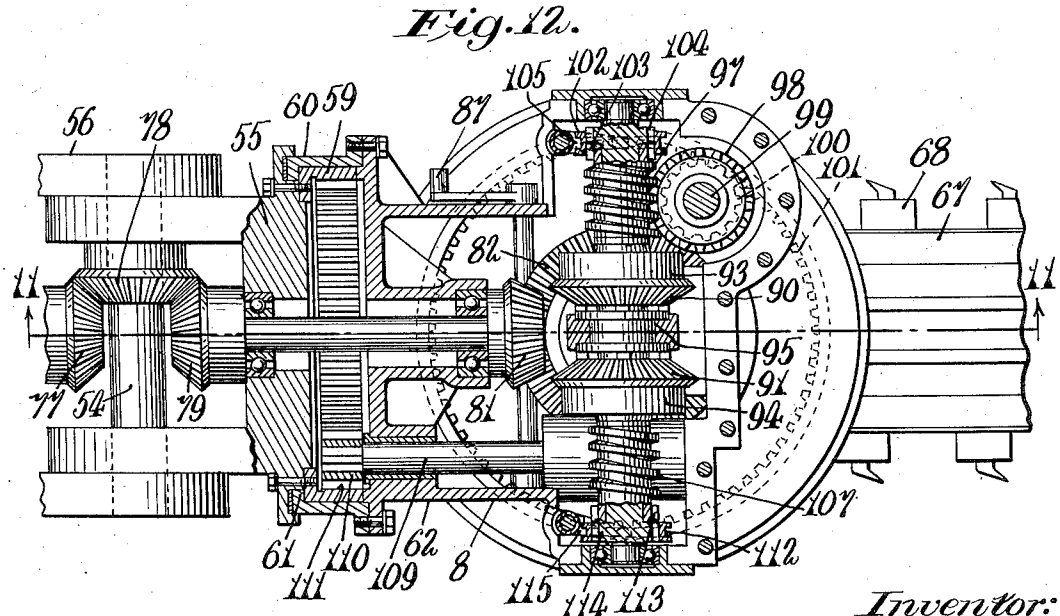


Fig. 12.



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July 9, 1935. C. F. OSGOOD 2,007,905

MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 6

Fig. 15.

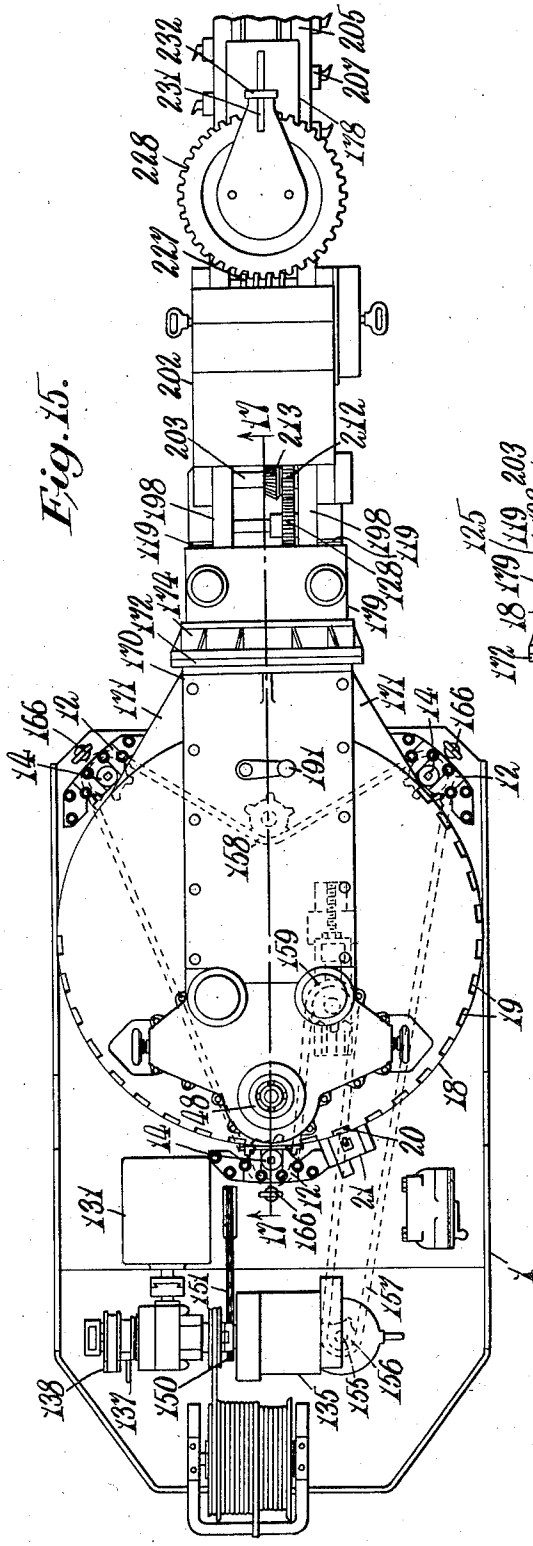
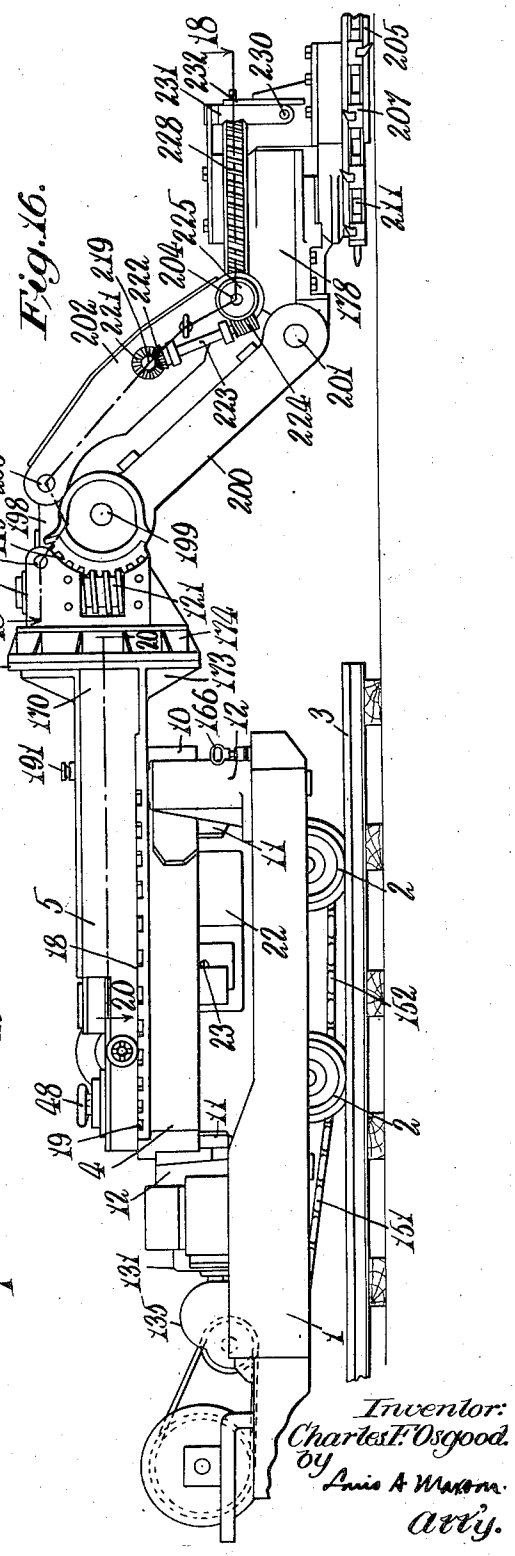


Fig. 16.



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MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 7

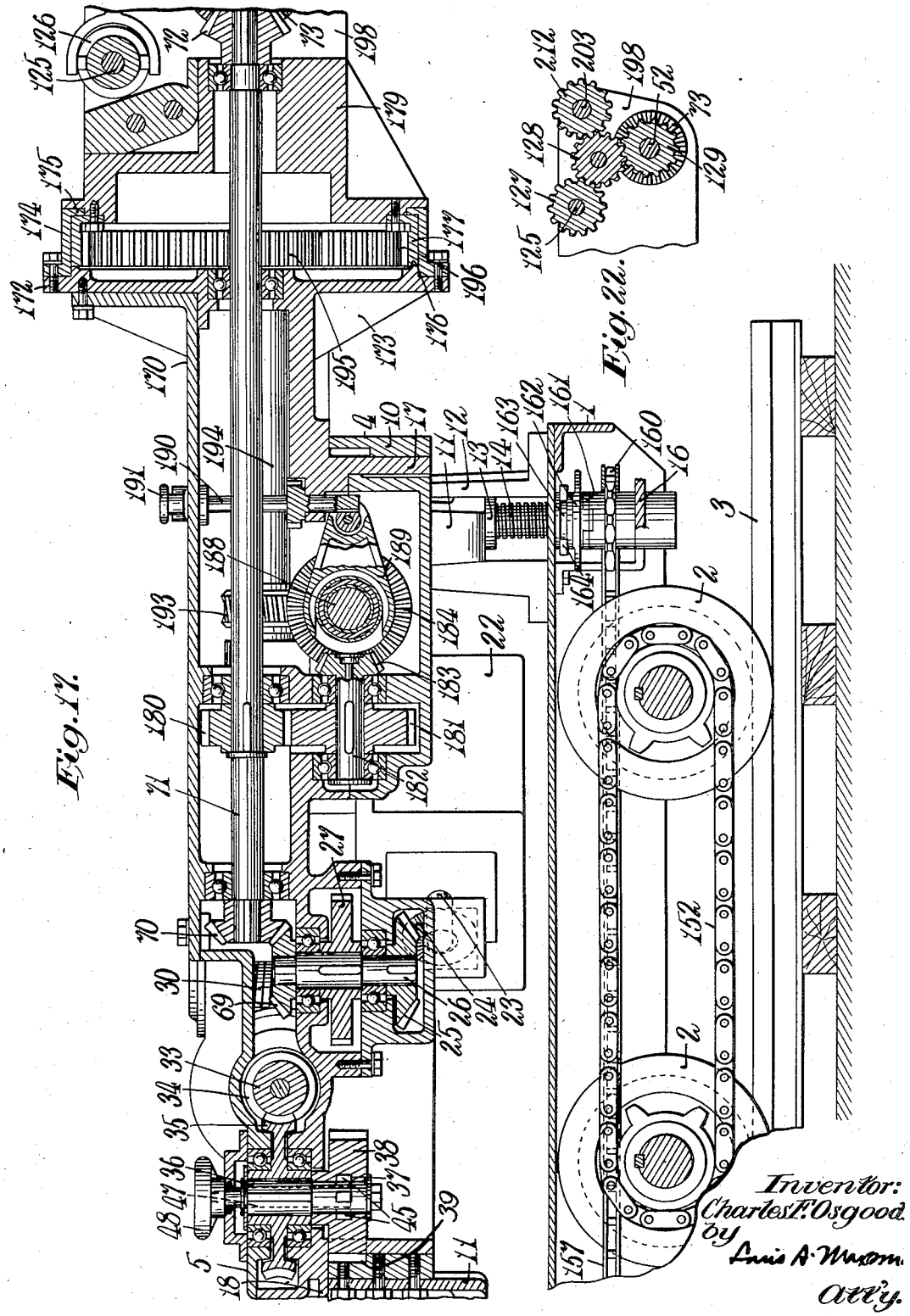

Fig. 17.

Fig. 22.

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July 9, 1935. C. F. OSGOOD 2,007,905

MINING APPARATUS

Filed Sept. 24, 1931 8 Sheets-Sheet 8

Fig. 18.

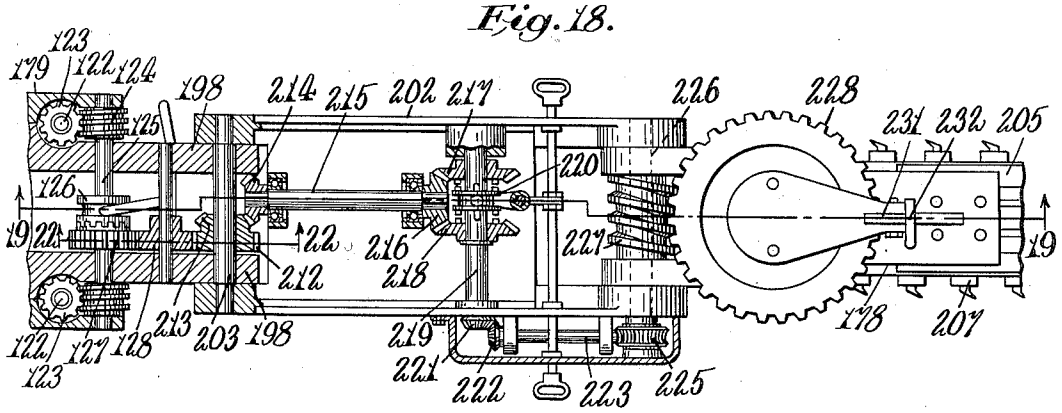


Fig. 19.

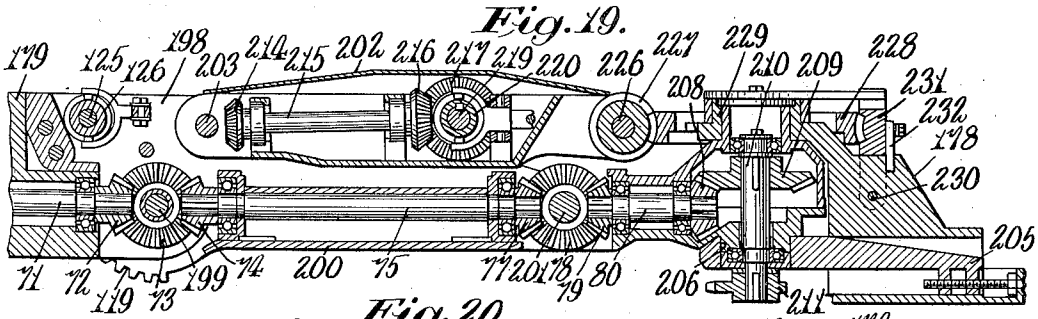


Fig. 20.

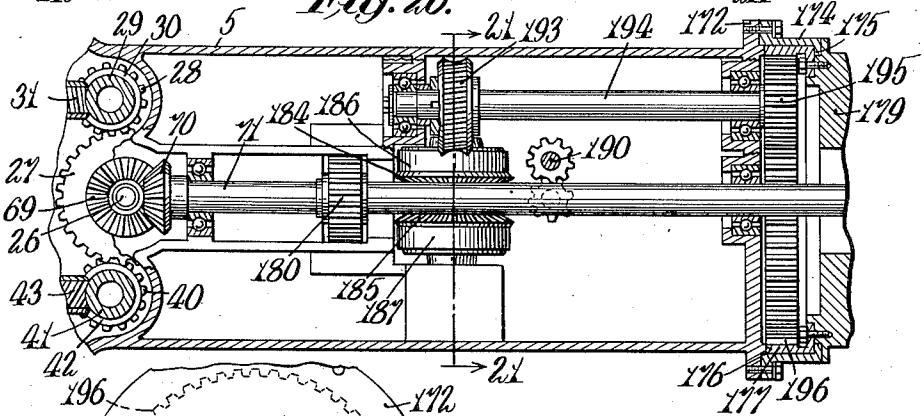
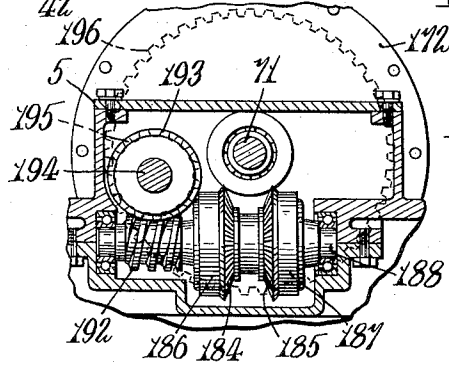


Fig. 21.



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Patented July 9, 1935 2,007,905

UNITED STATES PATENT OFFICE

2,007,905

MINING APPARATUS

Charles F. Osgood, Claremont, N. H., assignor to Sullivan Machinery Company, a corporation of Massachusetts

Application September 24, 1931, Serial No. 564,856

52 Claims. (Cl. 262—28)

This invention relates to mining apparatus, and more particularly has reference to improvements in coal mining apparatus of the combined horizontal and shear cutter, wheel mounted type adapted to operate from the mine trackway.

An object of this invention is to provide an improved coal mining apparatus. Another object is to provide an improved coal mining apparatus of the combined horizontal and shear cutter type. A further object is to provide an improved adjustable supporting structure for the cutting mechanism of such an apparatus. Yet another object is to provide an improved adjustable supporting structure whereby the kerf cutting mechanism may be positioned to cut kerfs in the coal face in any desired horizontal plane between the mine roof and the mine floor, and to cut vertical kerfs. Another object is to provide, in such an apparatus, improved adjustable kerf cutting mechanism operative to cut kerfs in the coal face in parallel planes either horizontally or vertically and in intersecting planes, thereby enabling the apparatus to accommodate itself to practically any cutting condition encountered. Yet another object is to provide an improved mining apparatus of the wheel mounted type adapted to operate while supported and guided by the mine trackway and having improved adjustable kerf cutting mechanism whereby kerfs may be cut at or near the level of the mine bottom outside and below the level of the mine trackway, in any desired horizontal plane between the mine roof and mine floor, and in vertical planes. A still further object is to provide, in a mining apparatus of the aforesaid character, improved adjustable kerf cutting mechanism whereby a vertical or shear cut may be inserted in the coal face while the apparatus is supported on and guided by a curved trackway. A still further object is to provide an improved tiltable mounting for the kerf cutting mechanism whereby the kerf cutter may be universally tilted to change its angle in altitude, thereby to accommodate itself to a rolling or uneven bottom. Another object is to provide an improved coal mining apparatus of a truly universal character wherein an extremely wide range of adjustment of the kerf cutting mechanism is possible whereby kerfs may be cut in the mine wall at practically any desired location and while an extremely simple and rugged structure is still retained. These and other objects and advantages of this invention will, however, hereinafter more fully appear.

In the accompanying drawings, there is shown for purposes of illustration, two embodiments which the invention may assume in practice.

In these drawings,—

Fig. 1 is a plan view of one illustrative embodiment of the improved mining apparatus.

Fig. 2 is a side elevational view of the apparatus shown in Fig. 1.

Fig. 3 is an enlarged central longitudinally extending vertical sectional view taken substantially on line 3—3 of Fig. 1.

Fig. 4 is a detail horizontal section taken on line 4—4 of Fig. 3.

Fig. 5 is a horizontal sectional view taken substantially on line 5—5 of Fig. 3, parts being omitted to facilitate illustration.

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

Fig. 7 is a horizontal sectional view, partially shown in plan, taken substantially on line 7—7 of Fig. 2.

Fig. 8 is a transverse vertical sectional view taken on line 8—8 of Fig. 2.

Fig. 9 is a detail vertical sectional view taken on line 9—9 of Fig. 8.

Fig. 10 is a transverse vertical sectional view taken substantially on line 10—10 of Fig. 2.

Fig. 11 is a central longitudinally extending vertical sectional view taken substantially on line 11—11 of Figs. 1 and 12.

Fig. 12 is a horizontal sectional view taken substantially on line 12—12 of Fig. 2.

Fig. 13 is a transverse vertical sectional view taken substantially on line 13—13 of Fig. 1.

Fig. 14 is a detail view illustrating a portion of the mechanism shown in Fig. 13.

Figs. 15 and 16 are views similar to Figs. 1 and 2, illustrating the second embodiment of the invention.

Fig. 17 is an enlarged central longitudinally extending vertical sectional view taken substantially on line 17—17 of Fig. 15.

Fig. 18 is a developed horizontal sectional view taken substantially on line 18—18 of Fig. 16.

Fig. 19 is a longitudinally extending vertical sectional view taken on line 19—19 of Fig. 18.

Fig. 20 is a horizontal sectional view taken substantially on line 20—20 of Fig. 16.

Fig. 21 is a transverse vertical sectional view taken on line 21—21 of Fig. 20.

Fig. 22 is a detail vertical sectional view taken on line 22—22 of Fig. 18.

In the illustrative embodiment of the invention shown in Figs. 1 to 14, inclusive, there is shown a coal mining apparatus of the combined horizontal and shear cutter, wheel mounted type

adapted to operate from the mine trackway and generally comprising a portable base, herein in the form of a truck frame 1, mounted on wheels 2 adapted to run along a mine trackway 3. Supported on the truck frame 1 for vertical and universal tilting adjustment relative thereto is a turntable supporting frame 4 having swiveled thereon for rotation about a substantially vertical axis, a turntable 5. Mounted at the forward edge of the turntable and overhanging the frame structure 4 is a rigid frame 6 supporting, through an adjustable parallel motion supporting structure 7, a rotatable cutter head 8. Suitable motor operated devices are provided for elevating and universally tilting the turntable, for operating the adjustable supporting structure, for rotating the cutter head and operating the cutting mechanism, and for driving the truck wheels to propel the apparatus along the mine trackway, as will hereinafter be described.

Referring to the turntable mounting structure for the cutting mechanism, it will be noted that supported for vertical and universal tilting adjustments relative to the truck frame is the supporting frame 4 herein in the form of an annulus or ring 10 having attached thereto a plurality of, herein three, depending brackets 11, the lower ends of which are shaped to engage, respectively, with upstanding guide members 12, herein in the form of screw pedestals, which are secured to the truck frame. These screw pedestals serve as guides to prevent any substantial lateral movement of the turntable supporting ring and attached parts relative to the truck frame during adjustment of the turntable. Secured to these depending brackets 11 are screw nuts 13 (see Fig. 6) which are threadedly engaged with vertical screws 14 supported at their upper ends by the upstanding guide members 12 and at their lower ends in step bearings 15 formed in bearing brackets 16 attached to the bottom of the truck frame. It will be noted that the nuts 13 are so connected to the feet of the depending brackets as to permit a slight relative rocking movement between the parts. The three sets of screws and guide members constitute upright supports for the annular supporting frame or ring 10, and the latter can be adjusted vertically in parallelism or angularly to change its angle in altitude by suitable rotation of the screws. The mechanism for separately or simultaneously rotating the screws will be later described. The turntable 5 supported by the annular frame 10 is in the form of a circular casting which constitutes the main frame of the cutting mechanism. This casting forms the turntable rotatable about the center of the ring 10 and is guided for rotative movement in the ring by a depending annular flange 17 fitting the interior periphery of the ring and by a radial flange 18 overlying the top surface of the ring. In the outer edge of the turntable casting is formed a series of notches 19, and cooperating with these notches is a slidable locking bolt 20 mounted in a guideway formed within a bracket 21 secured to the annular supporting frame 10. The locking bolt when in its inner position is adapted to project within one of the notches 19 to lock the turntable 5 against rotation relative to the annular supporting frame 10.

Motor operated devices are employed for rotating the turntable 5, and herein comprise a motor 22, herein preferably of the reversible electric type, suspended beneath the turntable casting within the lateral limits of the annular supporting frame 10. The power shaft 23 of this motor is horizontally disposed and extends transversely across the turntable and has fixed thereto a bevel pinion 24 meshing with a bevel gear 25 fixed to a vertical shaft 26 suitably journaled within the turntable casting. Fixed to and driven by the shaft 26 is a spur gear 27 meshing with a spur gear 28 suitably fixed to a vertical shaft 29, herein arranged parallel with the shaft 26 and likewise suitably journaled within the turntable casting. Secured to the shaft 29 is a worm 30, which is herein the slow speed worm, meshing with a slow speed worm wheel 31, the latter being connectible by a multiple disc clutch 32 of a usual design, to a horizontal shaft 33. Fixed to and driven by the shaft 33 is a worm 34 meshing, as shown in Fig. 3, with a worm wheel 35 rotating about a vertical axis and suitably journaled within the turntable casting. This worm wheel drives a vertical shaft 36 connectible by a sliding clutch 37 to a spur gear 38 supported by the shaft and meshing with the teeth of a circular rack 39 formed on the inner periphery of the annular supporting frame 10; the gear 38 when released from the shaft 36 being freely rotatable on the shaft. Also meshing with the spur gear 27 is a spur gear 40 secured to a vertical shaft 41 arranged parallel with the shafts 26 and 29, and driven by this shaft is a worm 42, which is herein the fast speed worm, meshing with a fast speed worm wheel 43. This worm wheel is connectible by a multiple disc clutch 44, similar to the clutch 32, to the shaft 33. It will thus be seen that when the clutch 37 is connected and one or the other of the clutches 32, 44 is applied, the turntable 5 may be rotated relative to the annular supporting frame 10 to swing the cutting mechanism at either a relatively high positioning speed or a relatively low cutting speed. If desired, the teeth of the worm gears 34, 35 may be self-locking and thereby lock automatically the turntable against rotation when the clutches 32, 44 are released, thereby eliminating the necessity of the separate turntable lock 19, 20 described above. The turntable release clutch 37 comprises, as shown in Figs. 3 and 4, clutch plungers 45 guided within slots 46 formed in the shaft 36. Rotatably mounted within the shaft 36 is a clutch operating shaft 47 having an operating handle 48 and formed on its lower end a pair of grooves 49. When the element 47 is in the position shown in Fig. 4, the clutch plungers are projected within notches 50 formed in the gear 38, thereby locking the gear to the shaft 36. When the element 47 is turned to bring the grooves 49 in registry with the slots 46, the clutch plungers are free to slide inwardly, thereby to release the gear 38 from the shaft 36. The clutch 37 when released cuts loose, so to speak, the turntable from its rotating mechanism, thereby permitting the turntable to rotate freely relative to the annular supporting frame 10, for a purpose to be later mentioned.

Now referring to the kerf cutting mechanism, and more particularly to the adjustable supporting structure therefor, it will be observed that formed integral with the rigid frame 6 are parallel longitudinal frame portions 51, 51, and journaled within these frame portions is a transverse hinge shaft 52 arranged with its axis horizontal. Pivotally mounted at its rear end on this hinge shaft is a main supporting link member or arm 53, and this link member has pivotal connection at its forward end with a transverse shaft 54 connected to the cutter head supporting or neck frame 55. A secondary link member or arm 56 is pivotally connected at its ends to transverse hinge shafts 57 and 58, respectively, connected to the

frame portions 51, 51 and the cutter head supporting frame 55. The cutter head 8 is mounted on the neck frame 55 for rotation relative thereto about a horizontal axis extending radially with respect to the turntable axis. The links 53, 56 cooperate to form a parallel motion structure for the cutter head whereby the latter may be adjusted in any desired position between the mine roof and mine floor while the head axis is maintained parallel to a common straight line perpendicular to the turntable axis.

Now referring to the specific cutting mechanism, it will be noted that the supporting frame 55 has attached thereto a cylindrical bearing sleeve 59 and rotatably mounted on this sleeve is a cylindrical supporting frame 60 having an inwardly directed annular retaining flange 61 and attached to the cutter head frame 62. Mounted on the cutter head frame for rotation about an axis at right angles to the axis of the cutter head is a cylindrical supporting frame 63 rotatably mounted in a bore 64 formed in the cutter head frame. A thrust ring 65 attached to the cutter head frame serves to retain the frame 63 in its bore. Attached to the frame 63 is a support or hanger 66 which carries the cutter bar 67. Mounted for orbital movement on the margin of the cutter bar 67 is a usual cutter chain 68.

The mechanism for actuating the cutter chain comprises a bevel gear 69 fixed to and driven by the vertical shaft 26 (see Fig. 3) and meshing with a bevel gear 70 fixed to a horizontal shaft 71. This shaft extends radially with respect to the turntable axis and is suitably journaled within the turntable casting and rigid head 6, as shown in Fig. 3. Fixed to the forward end of the shaft 71 is a bevel pinion 72 meshing with a bevel gear 73 loosely mounted on the hinge shaft 52. Meshing with the bevel gear 73 is a bevel gear 74 fixed to a shaft 75 suitably journaled in bearings 76 carried by the link member 53. The forward end of the shaft 75 carries a bevel pinion 77 meshing with a bevel gear 78 loosely mounted on the hinge shaft 54. Meshing with the bevel gear 78 is a bevel gear 79 (see Figs. 11 and 12) fixed to a shaft 80 extending through the neck frame along the axis of the rotatable cutter head 8. This shaft 80 is journaled at its ends within the neck frame 55 and cutter head frame 62. Herein fixed to the front end of the shaft 80 is a bevel pinion 81 meshing with a large bevel gear 82 journaled on a shaft 83 arranged with its axis coincident with the axis of bar swing. The shaft 83 drives a sprocket 84 which in turn engages and drives the cutter chain 68 in a well known manner. The gear 82 is connectible to the shaft 83 by a sliding jaw clutch 85 having a usual clutch shipper 86 operated by a handle 87. It will thus be seen that irrespective of the adjusted position of the cutter head relative to the truck, the cutter chain 68 may at all times be driven, and that by simply releasing the clutch 85 the cutter chain may remain idle during running of the motor.

Now referring to the improved mechanism for effecting swinging of the cutter bar about its pivotal axis relative to the cutter head, it will be noted that fixed to the shaft 83 and driven thereby is a bevel pinion 89 constantly meshing with reversely rotatable bevel gears 90, 91 loosely journaled on a transverse shaft 92 in turn suitably journaled within the cutter head frame 62. The reverse bevels 90, 91 are selectively connectible to the shaft 92 by means of multiple disc clutches 93 and 94, respectively, of a usual design operated by a suitable shipper mechanism 95 controlled by a handle 96. Connectible to the shaft 92 is a worm 97 meshing with a worm wheel 98 fixed to a shaft 99 arranged parallel with the shaft 83 and likewise journaled in the cutter head frame. Also fixed to the shaft 99 is a spur pinion 100 meshing with the teeth of an internal gear 101 herein formed integral with the cylindrical supporting frame 63 for the cutter bar 67. The worm 97 is connectible to the shaft 92 by a sliding clutch element 102 and cooperating clutch elements 103 and 104 carried by the worm and shaft respectively. The sliding clutch element 102 is provided with usual shipper mechanism 105 operated by a handle 106. It will thus be seen that depending upon which friction clutch 93, 94 is applied, the cutter bar may be swung about its pivot at a speed appropriate for cutting in either of opposite directions. The improved mechanism for rotating the cutter head 8 about its axis relative to the supporting frame 55 herein comprises a worm 107 connectible to the shaft 92 and meshing with a worm wheel 108 fixed to a longitudinally extending shaft 109 arranged parallel with the shaft 80. This shaft is suitably journaled within the cutter head frame and carries a pinion 110 meshing with the teeth of an internal gear 111, herein formed integral with the cylindrical bearing sleeve 59 on which the cutter head 8 is rotatably mounted. The worm 107 is connectible to the shaft 92 by a sliding clutch element 112 cooperating with clutch elements 113 and 114 carried by the worm and shaft respectively. This sliding clutch element is provided with usual shipper mechanism 115 operated by a handle 116. It will therefore be evident that the cutter head may be rotated about its axis in either of opposite directions under the control of friction clutches 93, 94. The worm gearings 97, 98 of the bar swinging mechanism and 107, 108 of the head rotating mechanism are self-locking, and upon release of the clutches 105, 112 maintain automatically the cutter bar and head in their positions of adjustment.

Mechanism is provided for adjusting the parallel motion supporting structure 7 by power to vary the elevation of the cutter head 8, and herein comprises worm gear teeth 119 formed on segmental portions 120 integral with the link 53 and overlapping the frame portions 51, 51 of the rigid frame 6. Meshing with these worm gear segments are parallel worms 121 fixed to parallel shafts 122 suitably journaled within the rigid frame 6. Fixed to these shafts are worm wheels 123 with which mesh worms 124 fixed to a horizontal shaft 125, herein arranged transversely of and suitably journaled within the rigid frame 6. Connectible to the shaft 125 by a sliding clutch 126 is a spur gear 127 meshing with an idler gear 128, which in turn meshes with a spur gear 129 journaled on the hinge shaft 52. The gear 129 is herein formed integral with and driven by the bevel gear 73 of the cutter chain driving mechanism. It will thus be seen that when the clutch 126 is connected, the parallel link structure may be swung upwardly or downwardly relative to the turntable 5 to position the cutter head into different parallel planes, as desired. The worm gearing 119, 121 is of the self-locking type and automatically maintains the parallel link members in their different positions of adjustment.

Now referring to the mechanism for driving the truck wheels and actuating the elevating screws 14, it will be noted that mounted on the truck frame is a motor 131, which may be of the

reversible electric type having its power shaft connected to a worm 132 meshing with a worm wheel 133 rotatably mounted on a transverse shaft 134 suitably journaled within a frame 135 suitably secured to the truck frame. This worm wheel 133 may be operatively connected to the shaft 134 by means of a multiple disc clutch 136 of a usual design having suitable operating mechanism including a hand lever 137. Fixed to this transverse shaft 134 is a brake drum 138 which is engaged by a brake band 139 also arranged to be controlled by the hand lever 137. When this hand lever is swung in one direction the clutch 136 is applied and the brake 139 released and in the opposite direction the brake is applied and the clutch released. Journaled on the shaft 134 is a spur gear 140 connectible with the shaft by a jaw clutch member 141 splined to the shaft, and this gear meshes with a spur gear 142. The spur gear 142 is connected to a transverse shaft 143 suitably journaled within the frame 135. Keyed to the shaft 134 is a spur pinion 144 meshing with a spur gear 145 secured to a transverse shaft 146 (see Fig. 14) arranged parallel with the shaft 134. Splined to the shaft 146 is a slidable pinion 147 adapted to mesh with a spur gear 148 keyed to a sleeve 149 herein formed integral with the spur gear 140. If desired, operating mechanism may be provided for the clutch 141 and the sliding pinion 147 so that when one is connected the other is released. As illustrated, secured to the shaft 143 is a chain sprocket 150 connected by an endless chain connection 151 to a chain sprocket secured to the rear truck axle. The front and rear truck axles are connected together by a usual chain and sprocket connection 152. From the foregoing description it will be evident that when the jaw clutch 141 is shifted to connect the spur gear 140 to the shaft 134 and the pinion 147 is out of mesh with the gear 148 the truck wheels may be driven at a relatively high speed from the motor 131 through worm gearing 132, 133, friction clutch 136, shaft 134, spur gearing 140, 142 and the chain and sprocket connections 150, 151 and 152. It will also be evident that when the jaw clutch 141 is in its released position and the spur pinion 147 is slid into meshing engagement with the gear 148, the truck wheels may be driven at a relatively slow speed appropriate for cutting through the reduction gearing 144, 145, 147 and 148. Upon reversal of the motor 131 the truck wheels may be driven to propel the apparatus in a reverse direction at either a relatively high or a relatively low speed.

The mechanism for driving the screws 14 from the motor 131 herein comprises a bevel pinion 153 (see Fig. 13) journaled on the shaft 134 and connectible to the shaft by the jaw clutch 141. This bevel pinion meshes with a bevel gear 154 fixed to a vertical shaft 155 suitably journaled within the frame 135. Keyed to the lower end of the shaft 155 is a chain sprocket 156 which engages and drives an endless transmission chain 157. Idler sprockets 158 and 159 serve to guide the chain 157 relative to chain sprockets 160 rotatably mounted upon each of the screws 14 at its lower end, and these sprockets are driven by the endless chain 157. As shown in Fig. 6, the chain sprockets 160 have formed thereon clutch teeth 161 adapted to engage with similar teeth on clutch members 162 splined to the lower end of the screws. The screws extend downwardly through openings in the top plate of the truck frame, and the clutch members 162 are each provided with a groove 163 in engagement with an arm 164 attached to a vertical operating shaft 165. The shafts 165 extend through the top plate of the truck and are each provided with a conveniently located handle 166 by which the movement of the clutch members 162 may be controlled. It will thus be seen that when all the clutches 162 are in a position to connect the chain sprockets 160 to the screws 14, the latter may be simultaneously rotated to move the turntable 5 together with the cutting mechanism supported thereby, into different elevated positions relative to the truck frame. It will also be noted that by releasing certain of these clutches and connecting certain others, the screws may be so rotated to effect tilting movement of the turntable about a horizontal axis to change its angle in altitude.

In the illustrative embodiment of the invention shown in Figs. 15 to 22, inclusive, there is shown a mining apparatus of the same general character as that in the embodiment of the invention described above, and having the same vertically adjustable and universally tiltable turntable structure and the same mechanisms for rotating and adjusting the turntable and for driving the truck wheels to propel the apparatus, and also having the same motors 22 and 131 for driving the various devices of the apparatus. In this form of the invention, the circular turntable casting has formed integral therewith an arm structure 170 extending radially with respect to the turntable axis and overhanging the annular supporting frame 10 and rigidly braced with respect to the turntable casting by horizontal webs 171. In this construction, formed integral with this arm structure at its outer extremity is a circular frame 172 arranged in a substantially vertical position and rigidly braced with respect to the arm by means of vertical webs 173. As shown in Fig. 17, secured to this circular frame 172 is an annular retaining and bearing sleeve 174 having an inwardly directed flange 175. Between this flange and shoulder 176 formed on the circular frame 172, there is rotatably mounted a sleeve 177 which herein forms a rotatable neck for a cutter head 178. This sleeve 177 is secured to a projecting neck member or frame 179 by which the cutting mechanism is supported, as will later be described.

The mechanism for effecting rotation of the cutter frame 178 about the neck axis herein comprises a spur gear 180 fixed to the shaft 71 and meshing with a spur gear 181 fixed to a parallel shaft 182. Fixed to this shaft is a bevel pinion 183 meshing with reverse bevels 184, 185 (see also Fig. 21). These reverse bevels are alternatively connectible by multiple disc clutches 186 and 187, respectively, of a usual design, to a transverse shaft 188 suitably journaled within the turntable casting. These clutches are provided with any suitable operating means including a shipper member 189 actuated by an operating rod 190 having an operating handle 191. Suitably secured to the shaft 188 is a worm 192 meshing with a worm wheel 193 fixed to a horizontal shaft 194 arranged parallel with the shaft 71 and likewise suitably journaled within the turntable casting. Fixed to the forward end of the shaft 194 is a spur pinion 195 meshing with an internal gear 196, herein formed integral with the sleeve 177, by which the rotatable cutter frame 178 is supported. It will thus be seen that upon suitable application of the clutches 186, 187, the cutter frame 178 may be rotated about the neck axis in

one direction or the other to position the cutting mechanism into a plurality of intersecting planes about the neck axis. The worm gearing 192, 193 is of the self-locking type, and when the clutches 186 and 187 are released, automatically locks the cutter frame against rotation about the axis of the neck, thereby maintaining the cutting mechanism in any of its adjusted positions about the neck axis.

The cutter frame 178 is supported on the rotatable neck frame 179 through a parallel link structure substantially similar to the link structure in the embodiment of the invention described above, and comprises parallel frame portions 198 integral with the neck frame 179 and extending parallel to and equidistant from the axial line of the neck. Supported within these frame portions 198 is a transverse hinge shaft 199 arranged with its axis perpendicular to and intersecting the axial line of the neck, and pivotally mounted at its rear end on this hinge shaft is a main supporting link member or arm 200, and this link member has pivotal connection at its forward end with a transverse shaft 201 connected to the frame of the cutter head 178. A secondary link member or arm 202 is pivotally connected at its ends to transverse hinge shafts 203 and 204, respectively connected to the neck frame 179 and the cutter frame 178. These arms or links form a parallel motion structure and are so arranged that as they swing about their pivots into different angular positions relative to the neck axis, the cutting mechanism is maintained at all times parallel to a line parallel with the axial line of the neck, and that by these links the cutting mechanism may be adjusted into parallel planes toward and from and into the axial line of the neck. The mechanism for swinging the arms is substantially the same as that described above in connection with the parallel arms 53, 56. In this embodiment of the invention, a cutter bar 205 is pivotally mounted at 206 on the cutter frame 178 and carries on its margin for circulation thereabout a usual cutter chain 207. The driving mechanism for the cutter chain is substantially the same as in the embodiment of the invention above described, with the exception that the shaft 80 is journaled within the frame of the cutter frame 178 and has fixed thereto and drives a bevel pinion 208 (see Fig. 19) meshing with a bevel gear 209 fixed to a vertical shaft 210 arranged with its axis coincident with the bar pivot axis and suitably journaled within the cutter frame. Fixed to the shaft 210 is a chain sprocket 211 which engages and drives the cutter chain 207 in a usual manner.

The mechanism for swinging the cutter bar 205 about its pivot herein comprises a spur gear 212 meshing with the idler gear 128 of the parallel link swinging mechanism above referred to and rotatably supported on the transverse shaft 203. Formed on the hub of the spur gear 212 is a bevel gear 213 meshing with a bevel gear 214 fixed to a shaft 215 suitably journaled on the link 202. Fixed to the forward end of this shaft is a bevel gear 216 meshing with reverse bevels 217 and 218 rotatably supported by a transverse shaft 219 journaled on the link 202; and these bevels are alternatively connectible to the shaft by a jaw clutch 220. Fixed to the shaft 219 is a bevel gear 221 meshing with a bevel gear 222 secured to a shaft 223 journaled at the side of the link 202 and driving a worm 224 meshing with a worm wheel 225 fixed to a transverse shaft 226. Secured to the shaft 226 is a worm 227 meshing with a worm wheel 228 journaled on the hub portion of one of the annular bearing members 229 for the cutter bar. Pivotally mounted at 230 on the cutter bar support is a latch 231 which when in the position shown in Fig. 19 engages the teeth of the worm wheel 228 to connect rigidly the latter to the cutter bar. Any suitable means 232 is employed for holding the latch 231 in its gear engaging position, this means being releasable at will to permit release of the latch from the gear, thereby to permit free swinging of the cutter bar about its axis. It will herein be noted that upon connection of one or the other of the reverse bevels 217, 128 to the shaft 219, the cutter bar may be swung in one direction or the other about its pivotal axis relative to the cutter frame, and that when the clutch 220 is placed in its neutral position, the cutter bar swinging mechanism is entirely disconnected from its drive.

The mode of operation of the embodiment of the invention shown in Figs. 1 to 14, inclusive, is as follows: The apparatus is propelled along the mine trackway at a relatively fast transport speed through the truck wheel driving gearing 132, 133, 140, 142 driven by the motor 131, it being understood that at that time the cutter head 8 is swung upwardly from the position shown in Fig. 2 to a position wherein the cutter bar is disposed above the level of the trackway. When the working face is reached, the fast truck wheel drive is disconnected from the motor by releasing the friction clutch 136 and the sliding clutch 141. If it is desired to make a swinging cut at or near the level of the mine bottom in front of the end of the trackway, the cutter bar is initially moved into the position shown in Fig. 2. The operator then connects the sliding clutch 102, and upon application of the friction clutch 93 of the bar swinging mechanism the cutter bar 67 is swung about its pivot relative to the cutter head from the central position shown in Fig. 1 laterally to a position wherein the tip end of the bar is disposed adjacent the right hand rib of the entry, the clutch 93 thereafter being released. The operator then shifts the sliding clutch 85 into a position to connect the shaft 83 to the gear 82, thereby connecting the cutter chain in driving relation with the motor 22; and as a result the cutter chain 68 is rapidly circulated about the margin of the cutter bar. The friction clutch 94 of the bar swinging mechanism is then applied and the cutter bar is swung transversely in its plane from right to left across the front end of the trackway at a relatively slow cutting speed to make an arcuate cut beneath the coal. When the tip end of the cutter bar reaches a position adjacent the left-hand rib, the clutches 94 and 102 are released. The apparatus is then propelled bodily rearwardly along the mine trackway to move the cutter bar away from the coal face, and the cutter bar is thereafter swung into its central position shown in Fig. 1. The clutch 126 of the parallel link swinging mechanism is then connected, and the link structure is swung upwardly to move the cutter bar into its transport position above the level of the trackway. The apparatus is then propelled rearwardly along the mine trackway under the propulsion of the high speed gearing 132, 133, 140, 142 driven by the reversible motor 131.

If it is desired to cut a horizontal kerf at or near the level of the mine bottom outside and below the level of the mine trackway in accord-

ance with the arcwall method, the operator applies the friction clutch **44** of the fast speed turntable swinging mechanism, thereby causing the turntable **5** together with the cutting mechanism supported thereby, to be swung horizontally at a positioning speed from the central position shown in Fig. 1 to a position wherein the pivot of the cutter bar **67** lies outside of the trackway. During horizontal swinging movement of the turntable relative to the truck, the cutter bar **67** may be swung simultaneously about its pivot in the opposite direction relative to the cutter head **8** under the control of the clutch **94** of the cutter bar swinging mechanism until the tip end of the cutter bar assumes a position adjacent the right-hand rib at a less angle than the angle of the parallel link supporting structure relative to the rib. When the parts are thus disposed with the bar pivot lying outside the mine trackway, the operator releases the friction clutch **94** of the bar swinging mechanism, and the clutch **126** of the parallel link swinging mechanism is then connected and the parallel arms are swung downwardly to position the cutter bar at or near the level of the mine bottom, as shown in Fig. 2. The clutch **126** is then released and the jaw clutch **85** is connected, connecting the cutter chain in driving relation with the motor **22**. The pinion **147** of the slow speed truck driving mechanism is then slid into meshing engagement with the gear **148** and upon application of the friction clutch **136** the truck wheels are driven to propel the apparatus bodily in a forward direction along the mine trackway at a relatively slow cutting speed, sumping the cutter bar **67** beneath the coal. The friction clutch **136** is then released and the brake **138** set. The operator then applies the friction clutch **32** of the slow speed turntable swinging mechanism, and the turntable together with the cutting mechanism supported thereby is swung horizontally at a slow cutting speed to effect horizontal swinging movement of the cutter bar in its plane across the coal face to make a horizontal cut thereunder. During the initial swinging movement of the turntable **5** the cutter bar **67** is swung about its pivot under the control of the clutch **93** in a reverse direction until the parts assume a straight-line position wherein the cutter bar extends parallel to a line including the bar pivot and the turntable axis. After the tip end of the cutter bar has reached the left-hand rib and the swinging cut beneath the coal has been completed, the cutter bar **67** is again swung about its pivot in a direction opposite from the direction of turntable rotation, under the control of the friction clutch **93** of the bar swinging mechanism while rotation of the turntable **5** is continued, the turntable and cutter bar swinging simultaneously in opposite directions at that time until they assume an angular position with the cutter bar disposed at a less angle relative to the left hand rib than the angle of the parallel arm structure relative thereto. The clutches **32** and **93** and the brake **138** are then released, and upon application of the friction clutch **136** of the truck wheel drive and the reversal of the motor **131**, the apparatus is propelled bodily rearwardly along the mine trackway at a slow cutting speed, moving the cutter bar from beneath the coal. After the completion of the cut beneath the coal, the parts are again returned to their transport position, with the cutter bar disposed in an elevated position above the mine trackway.

A horizontal kerf may be cut at or near the level of the mine roof simply by connecting the clutch **112** and applying one or the other of the friction clutches **93, 94** of the head rotating mechanism to effect rotation of the cutter head **8** about the neck axis, thereby swinging the cutter bar through an arc of a circle from the position shown in Fig. 2 to its opposite horizontal position above the head axis. The clutch **126** is then connected and the parallel link members **53** and **56** are swung upwardly about their pivots to move the cutter bar **67** to a position adjacent the mine roof. The cutter bar is then sumped in, swung transversely in its plane, and withdrawn from the coal, in accordance with the usual arcwall method of cutting.

It will be noted that during any of the horizontal cutting operations described above, for instance, when it is desired to cut on a rolling or uneven bottom, the cutting mechanism may be universally tilted to change its angle in altitude, simply by disconnecting certain of the elevating screws **14** from the motor **131** while others are rotated, thereby causing the turntable to be tilted relative to the horizontal. For instance, if it is desired to tilt the tip end of the cutter bar downwardly, this may be accomplished by disconnecting the clutches for the front elevating screws **14** while the rear elevating screw is connected to the motor **131**, thereby causing the rear edge of the turntable to be elevated. Conversely, if it is desired to tilt the tip end of the cutter bar upwardly, the rear elevating screw may be disconnected from the motor while the front elevating screws are rotated, thereby causing the forward edge of the turntable to be tilted upwardly.

A shear or vertical cut may be inserted in the coal face simply by applying one or the other of the reverse frictions **93, 94** of the head rotating mechanism, thereby rotating the cutter head about the neck axis to bring the cutter bar **67** into a position to swing vertically. During the shearing operation, the cutter bar is first sumped in, then swung downwardly in its plane, and thereafter withdrawn from the coal, in a manner similar to that described above in connection with horizontal cutting in accordance with the arcwall method. It will further be noted that by rotating the cutter head the cutter bar may be moved through an arc of a circle to shearing positions at either side of the cutter head axis, thereby enabling vertical kerfs to be cut in the coal face in parallel planes.

When it is desired to insert a vertical or shearing cut in the mine wall when the apparatus is supported and guided by a curved trackway, the apparatus is operated in the following manner. With the cutter bar **67** in shearing position, the turntable **5** is rotated to move the cutting mechanism laterally until the tip end of the cutter bar engages the rib of the entry. The turntable is then locked against rotation and the cutter bar is swung upwardly to a position adjacent the mine roof. When the parts are thus disposed, the apparatus is propelled along the mine trackway at a slow speed to cause the tip end of the cutter bar to penetrate the coal. The turntable lock is then released and the turntable is permitted to rotate freely relative to the truck as the apparatus is propelled bodily along the mine trackway, and as a result, as the apparatus moves along the curved trackway the cutter bar is sumped within the coal in the manner well known to those skilled in the art, the free rotation of the turntable relative to the truck as the latter moves

along the trackway preventing binding of the cutter bar in the kerf. The cutter bar is then swung downwardly in its plane and withdrawn from the coal.

In the form of the invention shown in Figs. 15 to 22, inclusive, the apparatus operates to make horizontal and vertical or shear cuts in the same manner as the form of the apparatus described above and therefore a detailed description of these methods of cutting is unnecessary. However, in this form of the apparatus the cutting mechanism and the parallel link supporting structure are both mounted for rotation about the neck axis relative to the turntable, and as a result when the cutter bar is in its vertical cutting position it may be moved by swinging the parallel arms into any desired location between the ribs of the entry. In this form of the invention, the cutter bar is moved into its different cutting positions upon rotation of the cutter head frame 179 under the control of the friction clutches 186, 187 of the head rotation mechanism. The cutter bar is swung in its plane through the bar swing gearing 213, 214, 221, 222, 224, 225, under the control of the jaw clutch 220 controlling the reverse bevels 217, 218, and the cutter bar is locked against swinging movement relative to the cutter frame 178 by the latch 231.

As a result of this invention it will be noted that an improved coal mining apparatus is provided, having improved adjustable kerf cutting mechanism whereby horizontal kerfs may be cut at or near the level of the mine bottom, outside and below the level of the mine trackway, and vertical cuts may be cut between the ribs of the entry. It will further be noted that by the provision of the improved adjustable supporting structure for the kerf cutting mechanism the cutter bar may be positioned to cut kerfs at or near the level of the mine roof or in any desired parallel planes between the mine roof and the mine bottom. It will also be evident that by the provision of the improved tiltable turntable mounting for the kerf cutting mechanism, the cutter bar may be universally tilted to change its angle in altitude, thereby to accommodate itself to a rolling or uneven bottom. It will still further be noted that an improved coal mining apparatus is provided wherein the adjusting mechanism for the kerf cutting mechanism is extremely flexible, it being possible to operate the apparatus as a mounted bottom cutter, top cutter, center cutter, shear cutter, and slabbing machine, and to operate the machine to make shear cuts while the machine is supported and guided by a curved trackway; thereby enabling the apparatus to accommodate itself to practically every mining condition encountered within the normal working range of a track cutting machine. 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 two forms which the invention may assume in practice, it will be understood that these forms are shown for purposes of illustration only, 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 for rotation about a vertical axis and for universal tilting movement relative to the horizontal, an arm structure pivotally mounted upon a substantially horizontal axis on said turntable and adjustable therewith and relative thereto, and kerf cutting mechanism carried at the outer extremity of said arm structure and adjustable relative thereto into horizontal and vertical cutting positions.

2. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative thereto, a parallel link supporting structure pivotally mounted on said turntable and adjustable therewith and relative thereto, and kerf cutting mechanism carried at the outer extremity of said link supporting structure and adjustable relative thereto into horizontal and vertical cutting positions.

3. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative to the horizontal, an arm structure pivotally mounted upon a substantially horizontal axis on said turntable and overhanging said base, and kerf cutting mechanism carried at the outer extremity of said arm structure and including a cutter head rotatable relative to said arm structure about a horizontal axis and a kerf cutter pivotally mounted on said cutter head to swing relative thereto.

4. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative thereto, a parallel link supporting structure pivotally mounted on said turntable and overhanging said base, and kerf cutting mechanism carried at the outer extremity of said link supporting structure and including a cutter head rotatable relative to said supporting structure about a horizontal axis and a kerf cutter pivotally mounted on said cutter head.

5. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative to the horizontal, an arm structure pivotally mounted upon a substantially horizontal axis on said turntable and overhanging said base, and kerf cutting mechanism carried at the outer extremity of said arm structure and including a cutter head rotatable relative to said arm structure about a horizontal axis and a kerf cutter pivotally mounted on said cutter head and rotatable with said cutter head into horizontal and vertical cutting positions.

6. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative thereto, a parallel link supporting structure pivotally mounted on said turntable and overhanging said base, and kerf cutting mechanism carried at the outer extremity of said link supporting structure and including a cutter head rotatable relative to said supporting structure about a horizontal axis and a kerf cutter pivotally mounted on said cutter head and rotatable with said cutter head into horizontal and vertical cutting positions.

7. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation relative thereto about a vertical axis, an arm structure pivotally mounted on said turntable for swinging movement relative thereto about a substantially horizontal axis located adjacent the forward end of said base and overhanging said base, and kerf cutting mechanism carried at the outer overhanging extremity of

said arm structure and adjustable relative thereto into horizontal and vertical cutting positions.

8. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation relative thereto about a vertical axis, a parallel motion supporting structure pivotally mounted on and overlying said turntable and projecting forwardly from its mounting thereon and overhanging said base, and kerf cutting mechanism carried at the outer extremity of said supporting structure and adjustable relative thereto into horizontal and vertical cutting positions.

9. In a mining apparatus, a portable base, an arm structure pivotally mounted on said base at the forward end thereof to swing through a wide angular range upon a substantially horizontal axis and extending forwardly in advance thereof, kerf cutting mechanism carried by the outer extremity of said arm structure and adjustable about a horizontal longitudinal axis relative thereto into horizontal and vertical cutting positions, and means for swinging said arm structure horizontally relative to said base.

10. In a mining apparatus, a portable base, a horizontal turntable on said base, parallel links pivotally mounted on said turntable for swinging movement relative thereto about horizontal axes, a frame supported on the outer extremities of said links and to which the latter are pivotally connected, and a cutter head mounted on said frame for rotation relative thereto about a horizontal axis.

11. In a mining apparatus, a portable base, a support mounted on said base for universal tilting movement relative thereto to change its angle in altitude, parallel links pivotally connected to said support for swinging movement relative thereto about parallel horizontal axes, a frame supported on the outer extremities of said parallel links and to which the latter are pivotally connected, and a cutter head mounted on said frame for rotation relative thereto about a horizontal axis.

12. In a mining apparatus, a portable base, a support mounted on said base for rotation relative thereto about a vertical axis and for universal tilting movement relative thereto to change its angle in altitude, parallel links pivotally connected to said support to swing relative thereto about parallel horizontal axes, a frame supported on the outer extremities of said links and to which the latter are pivotally connected, and a cutter head mounted on said frame for rotation about a horizontal axis.

13. In a mining apparatus, a portable base, a support mounted on said base for adjustment relative thereto into different elevated positions and for rotation about a vertical axis, an arm structure pivotally mounted upon a substantially horizontal axis on said support for swinging movement relative thereto and extending forwardly in advance of said base, and kerf cutting mechanism mounted on the outer extremity of said arm structure and adjustable relative to said arm structure into horizontal and vertical cutting positions.

14. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative to the horizontal, a cutter head mounted on said turntable for rotation relative thereto about an axis extending radially from the turntable axis and for adjustment in a vertical direction relative to said turntable, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

15. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis, a cutter head mounted on said turntable for rotation relative thereto about an axis extending radially from the turntable axis and for adjustment in a vertical direction relative to said turntable, a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions, means for always maintaining the head axis horizontal during adjustment of said head in aforesaid vertical direction, and means for propelling said base to effect rectilinear sumping and withdrawal movements of said kerf cutter in any of its adjusted positions about the head axis.

16. In a mining apparatus, a portable base, an annular frame overlying said base, devices between said base and frame for adjusting the latter into different elevated positions relative to said base, a turntable rotatably mounted on said annular frame, a cutter head mounted on said turntable for rotation relative thereto about an axis extending radially from the turntable axis and for adjustment in a vertical direction relative to said turntable, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

17. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for adjsutment into different elevated positions relative thereto, an arm structure pivotally mounted on said turntable to swing in a vertical direction relative thereto, a kerf cutter carried at the outer extremity of said arm structure and adjustable relative to said arm structure into horizontal and vertical cutting positions, and means for propelling said base bodily back and forth relative to the mine face to effect rectilinear sumping and withdrawal movements of said kerf cutter.

18. In a mining apparatus, a portable base, a parallel motion parallel link structure pivotally mounted on said base to swing in horizontal and vertical directions relative thereto, a cutter head rotatably mounted on the outer extremity of said link structure, and a kerf cutter pivotally mounted on said cutter head.

19. In a mining apparatus, a portable base, a parallel motion link structure pivotally mounted on said base to swing in horizontal and vertical directions relative thereto, a cutter head rotatably mounted on the outer extremity of said link structure, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith into any desired position completely about the head axis.

20. In a mining apparatus, a portable base, an arm structure pivotally mounted on said base to swing horizontally and vertically relative thereto, a cutter head rotatably mounted on the outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith into any desired position completely about the head axis while at all times remaining in a plane parallel with the head axis during such adjustment.

21. In a mining apparatus, a portable base, a support mounted on said base for rotation about a vertical axis and for tilting movement relative to said base about transverse and longitudinal axes, a parallel motion arm structure pivotally mounted on said support to swing relative thereto,

a cutter head mounted on the outer extremity of said arm structure for rotation relative thereto, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

22. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for tilting movement relative to said base about transverse and longitudinal axes, said turntable having a frame overhanging the forward end of said base, an arm structure pivotally mounted on said overhanging frame to swing relative to the turntable about an axis in advance of the forward end of the base, a cutter head rotatably mounted on the outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

23. In a mining apparatus, a portable base, a support mounted on said base for tilting movement relative thereto about horizontal transverse and longitudinal axes, an arm structure pivotally mounted upon a substantially horizontal axis on the forward end of said support for swinging movement relative thereto, a cutter head rotatably mounted on the outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head to swing relative to the latter.

24. In a mining apparatus, a portable base, a support mounted on said base for tilting movement relative thereto about transverse and longitudinal axes, an arm structure pivotally mounted to swing in a vertical direction relative thereto, and a cutter head rotatably mounted on the outer extremity of said arm structure for rotation on an axis normally extending longitudinally of the base.

25. In a mining apparatus, a portable base, a support mounted on said base for tilting movement relative thereto about horizontal transverse and longitudinal axes, an arm structure pivotally mounted to swing in a vertical direction relative thereto, a cutter head rotatably mounted on the outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head and bodily movable on rotation of said head on its axis into different cutting planes.

26. In a mining apparatus, a portable base, a support mounted on said base for tilting movement relative thereto about horizontal transverse and longitudinal axes, a parallel motion arm structure pivotally mounted on the forward end of said support for swinging movement relative thereto, a cutter head rotatably mounted on the outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head.

27. In a mining apparatus, a portable base, a support mounted on said base for universal tilting movement relative thereto, an arm structure pivotally mounted upon a substantially horizontal transverse axis on the forward end of said support to swing relative thereto, a cutter head rotatably mounted on the outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head.

28. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative to the horizontal, said turntable being adjustable in a vertical direction relative to said base, an arm structure pivotally mounted on said turntable and adjustable therewith and swingable in vertical planes relative thereto, and kerf cutting mechanism carried at the outer extremity of said arm structure and adjustable relative thereto into horizontal and vertical cutting positions.

29. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative thereto, said turntable being adjustable in a vertical direction relative to said base, an arm structure pivotally mounted upon a substantially horizontal axis on said turntable and overhanging said base, said arm structure being swingable relative to and with said turntable, and kerf cutting mechanism carried at the outer extremity of said arm structure and including a cutter head rotatable relative to said arm structure about a horizontal axis, and a kerf cutter pivotally mounted on said cutter head and rotatable with said head about the head axis into horizontal and vertical cutting positions.

30. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative thereto, said turntable being adjustable in a vertical direction relative to said base, a cutter head mounted on said turntable for rotation relative thereto about an axis extending radially from the turntable axis and said cutter head being adjustable in a vertical direction relative to said turntable, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

31. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative to the horizontal, a cutter head mounted on said turntable for rotation relative thereto and for adjustment in a vertical direction relative to the turntable, means for always maintaining said head axis parallel to a common straight line during aforesaid adjustment of said head relative to said turntable, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

32. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis, a swingable arm pivotally mounted on said turntable to swing in a vertical direction relative thereto about a horizontal axis located in advance of the forward end of the base, a cutter head rotatably mounted on the outer extremity of said arm and adjustable with said arm in a vertical direction relative to said turntable, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

33. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for adjustment into different elevated positions relative thereto, an arm structure pivotally mounted on said turntable to swing in a vertical direction relative thereto, and a kerf cutter carried at the outer extremity of said arm structure and adjustable relative to said arm structure into horizontal and vertical cutting positions, said arm structure being swingable to move said kerf cutter into parallel horizontal planes.

34. In a mining apparatus, a portable base, an arm structure pivotally mounted on said base to swing horizontally and vertically relative thereto, a cutter head rotatably mounted on the

outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith into any desired position completely about the head axis, said head axis at all times remaining parallel to a common straight line during swinging of said arm structure in a vertical direction relative to said base.

35. In a mining apparatus, a portable base, a support mounted on said base for tilting movement relative thereto about a horizontal axis, said support being adjustable in a vertical direction relative to said base, an arm structure pivotally mounted upon a substantially horizontal axis on the forward end of said support for swinging movement relative thereto, a cutter head rotatably mounted on the outer extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head and adjustable therewith about the head axis into horizontal and vertical cutting positions.

36. In a mining apparatus, a portable base, a support mounted on said base for tilting movement relative thereto about a horizontal axis, an arm structure pivotally mounted upon a substantially horizontal axis on the forward end of said support for swinging movement relative thereto, said arm structure being adjustable horizontally relative to said base, a cutter head rotatably mounted on the other extremity of said arm structure, and a kerf cutter pivotally mounted on said cutter head.

37. In a mining apparatus, a portable base, a support mounted on said base for tilting movement relative thereto about a horizontal axis, an arm structure pivotally mounted to swing in a vertical direction relative to said support about an axis extending transversely of the base at the forward end, thereof, said arm structure being swingable bodily horizontally relative to said base, and a cutter head rotatably mounted on the outer extremity of said arm structure.

38. In a mining apparatus, a wheel supported frame adapted to run along a mine trackway and mounted for tilting movement relative to the horizontal, a parallel link supporting structure pivotally mounted on said tiltable frame for swinging movement relative thereto, a cutter head rotatably mounted on the outer extremity of said supporting structure, and a kerf cutter pivotally mounted on said cutter head and adjustable with said head about the head axis into different cutting positions.

39. In a mining apparatus, a wheel supported frame adapted to run along a mine trackway and mounted for tilting movement relative to the horizontal, a parallel link supporting structure pivotally mounted on said tiltable frame for swinging movement in both horizontal and vertical directions, a cutter head rotatably mounted on the outer extremity of said supporting structure, and a kerf cutter pivotally mounted on said cutter head and adjustable with said head about the head axis into different cutting positions.

40. In a mining apparatus, a wheel supported frame adapted to run along a mine trackway and mounted for tilting movement relative to the horizontal, an arm structure pivotally mounted on the forward end of said frame to swing in a vertical direction relative thereto about a horizontal axis located in advance of said frame, a cutter head rotatably mounted on the outer extremity of said supporting structure to rotate through 360°, and a kerf cutter pivotally mounted on said cutter head and adjustable with said head about the head axis into different cutting positions.

41. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative to the horizontal, a swingable supporting structure pivotally mounted on said turntable and adjustable therewith and swingable upwardly and downwardly relative thereto, kerf cutting mechanism carried at the outer extremity of said supporting structure and including a horizontally extending kerf cutter adjustable relative thereto into horizontal and vertical cutting positions, and means for always maintaining said kerf cutter in a horizontal position during swinging of said supporting structure relative to said turntable.

42. In a mining apparatus, a portable base, a horizontal turntable mounted on said base for rotation about a vertical axis and for universal tilting movement relative to the horizontal, a swingable supporting structure pivotally mounted on said turntable to swing about a horizontal axis and overhanging said base, kerf cutting mechanism carried at the outer extremity of said supporting structure and including a cutter head rotatable relative to said supporting structure about a horizontal axis, a kerf cutter pivotally mounted on said cutter head, and means for always maintaining the cutter head axis parallel to a common straight line during swinging of said supporting structure relative to said turntable.

43. In a mining apparatus, a portable base, a horizontal turntable on said base, an arm structure pivotally mounted on said turntable to swing vertically relative thereto about a horizontal transversely extending axis located in advance of said base, said arm structure extending outwardly from the forward edge of said turntable a substantial distance in advance of said base, a cutter head rotatably mounted on the outer overhanging extremity of said arm structure, a kerf cutter pivotally mounted on said cutter head to swing relative thereto and adjustable with said head about the head axis relative to said arm structure into horizontal and vertical cutting positions, means for rotating said turntable to move the arm structure and cutter head laterally relative to said base, and means for swinging said arm structure vertically relative to said turntable to vary the elevation of the cutter head with respect to said base.

44. In a mining apparatus, a wheel supported base adapted to run along a mine trackway, a horizontal turntable on said base, an arm structure pivotally mounted on said turntable to swing vertically relative thereto about a horizontal transversely extending axis located in advance of the front wheel axes, said arm structure extending outwardly from the forward edge of said turntable a substantial distance in advance of said base, a cutter head rotatably mounted on the outer overhanging extremity of said arm structure, a kerf cutter pivotally mounted on said cutter head to swing relative thereto and adjustable with said head about the head axis relative to said arm structure into horizontal and vertical cutting positions, means for rotating said turntable to move the arm structure and cutter head laterally relative to said base, and means for swinging said arm structure vertically relative to said turntable to vary the elevation of the cutter head with respect to said base.

45. In a mining apparatus, a portable base, a

horizontal turntable on said base, an arm structure pivotally mounted on said turntable at the forward end of said base to swing in a vertical direction relative thereto about a horizontal axis extending transversely of said turntable, and a kerf cutter mounted on the outer extremity of said arm structure and adjustable relative thereto into horizontal and vertical cutting positions, said arm structure having a range of swinging movement about said transverse horizontal axis sufficient to position said kerf cutter, solely by swinging movement about said transverse horizontal axis, optionally in a horizontal position substantially on the mine floor or in a position wholly above a horizontal plane including said transverse horizontal axis.

46. In a mining apparatus, a portable base, a horizontal turntable on said base, an arm structure pivotally mounted on said turntable at the forward end of said base to swing in a vertical direction relative thereto about a horizontal axis extending transversely of said turntable, a cutter head mounted on the outer extremity of said arm structure for rotation relative thereto about a horizontal axis, and a kerf cutter pivotally mounted on said cutter head and rotatable therewith relative to said arm structure into horizontal and vertical cutting positions, said arm structure having a range of swinging movement about said transverse horizontal axis sufficient to position said kerf cutter, solely by swinging movement about said transverse horizontal axis, optionally in a horizontal position substantially on the mine floor or in a position wholly above a horizontal plane including said transverse horizontal axis.

47. In a mining apparatus, a portable base, a horizontal turntable on said base, an arm structure pivotally mounted on said turntable to swing relative thereto, a frame supported on the outer extremity of said arm structure and to which said arm structure is pivotally connected upon an axis perpendicular to the planes of swinging movement of said arm structure, said arm structure moving angularly about said pivotal connection with said frame upon swinging movement of said arm structure relative to said turntable, a cutter head mounted on said frame for rotation relative thereto about a horizontal axis, a kerf cutter pivotally mounted on said cutter head for swinging movement relative thereto, and motor operated devices for rotating said cutter head about its axis and for swinging said kerf cutter about its pivot.

48. In a mining apparatus, a portable base, a horizontal turntable on said base, an arm structure pivotally mounted on said turntable to swing relative thereto, a frame supported on the outer extremity of said arm structure and to which said arm structure is pivotally connected upon an axis perpendicular to the planes of swinging movement of said arm structure, said arm structure moving angularly about said pivotal connection with said frame upon swinging movement of said arm structure relative to said turntable, a cutter head mounted on said frame for rotation relative thereto about a horizontal axis, a kerf cutter pivotally mounted on said cutter head for swinging movement relative thereto, motor operated devices for rotating said cutter head about its axis and for swinging said kerf cutter about its pivot, and motor operated means for swinging said arm structure relative to said base.

49. In a mining apparatus, a portable base, a horizontal turntable on said base, an arm structure pivotally mounted on said turntable for swinging movement relative thereto, said arm structure extending longitudinally in advance of said base, a support to which the outer extremity of said arm structure is pivotally connected on an axis parallel with the arm structure axis, a cutter mounted on said support for rotation relative thereto about an axis extending perpendicularly to said support axis, and a kerf cutter pivotally mounted on said cutter head for swinging movement relative thereto about an axis at right angles to the head axis, said kerf cutter being disposable, by head rotation exclusively, to cut parallel horizontal and parallel vertical kerfs.

50. In a mining apparatus, a portable base, a horizontal turntable mounted on said base, a frame on said turntable having a horizontal portion projecting outwardly from the forward edge of said turntable, said projecting frame portion overlying the front end of said base and having its forward extremity overhanging said base, an elongated arm pivotally mounted on said projecting frame portion to swing about a horizontal axis located in advance of said base, a support rotatably mounted on the outer extremity of said arm, and a kerf cutter carried by said support and rotatable with the latter about the support axis relative to said arm into horizontal and vertical cutting positions.

51. In a mining apparatus, a portable base, a horizontal turntable mounted on said base, a frame on said turntable having a horizontal portion projecting outwardly from the forward edge of said turntable, said projecting frame portion overlying the front end of said base and having its forward extremity overhanging said base, an elongated arm pivotally mounted on said projecting frame portion to swing about a horizontal axis located in advance of said base, a support rotatably mounted on the outer extremity of said arm, a kerf cutter carried by said support and rotatable with the latter about the support axis relative to said arm into horizontal and vertical cutting positions, means for swinging said arm in a vertical direction about its pivot relative to said turntable to swing said kerf cutter in vertical planes, and means for rotating said turntable relative to said base to swing said kerf cutter in horizontal planes.

52. In a mining apparatus, a portable base, a horizontal turntable mounted on said base, a frame on said turntable having a horizontal portion projecting outwardly from the forward edge of said turntable, said projecting frame portion overlying the front end of the base and having its forward extremity overhanging said base, an elongated arm pivotally mounted on said projecting frame portion to swing about a horizontal axis located in advance of said base, a support pivotally connected to the outer extremity of said arm, said arm moving angularly about its pivot with said support with respect to the latter as said arm is swung about said horizontal pivotal axis, a cutter head rotatably mounted on said support, and a kerf cutter carried by said cutter head and rotatable with said head about the head axis relative to said arm into horizontal and vertical cutting positions.

CHARLES F. OSGOOD.

CERTIFICATE OF CORRECTION.

Patent No. 2,007,905. July 9, 1935.

CHARLES F. OSGOOD.

It is hereby certified that error appears in the printed specification of the above numbered patent requiring correction as follows: Page 8, second column, line 35, claim 17, for "adjsument" read adjustment; page 9, lines 23, 42 and 52, claims 23, 25 and 26 respectively, strike out the word "horizontal"; page 10, first column, line 38, claim 37, after "end" strike out the comma; and page 11, second column, line 9, claim 49, after "cutter" insert the word head; and that the said Letters Patent should be read with these corrections therein that the same may conform to the record of the case in the Patent Office.

Signed and sealed this 13th day of August, A. D. 1935.

Leslie Frazer

Acting Commissioner of Patents.

(Seal)