March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 1

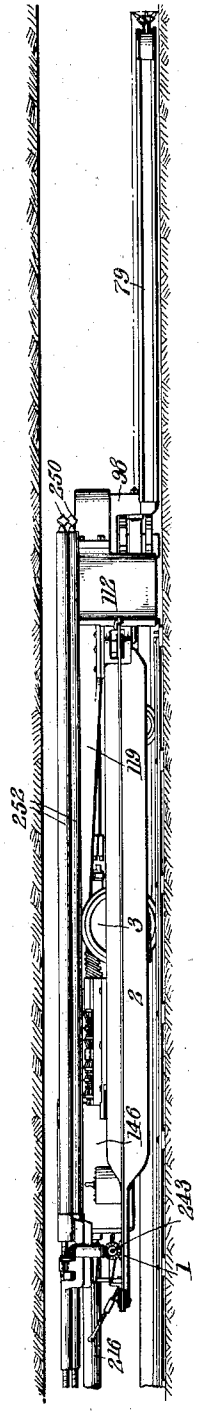


Fig. 1.

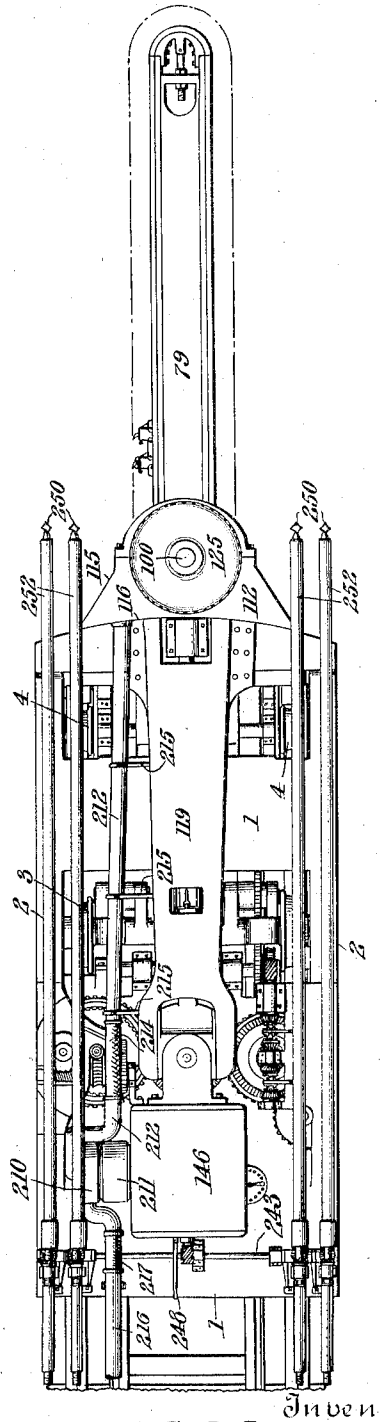


Fig. 2.

Witness:
Robert F. Beck

Inventor
Edmund C. Morgan,
By Attorneys
Brown & Nissen.

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 2

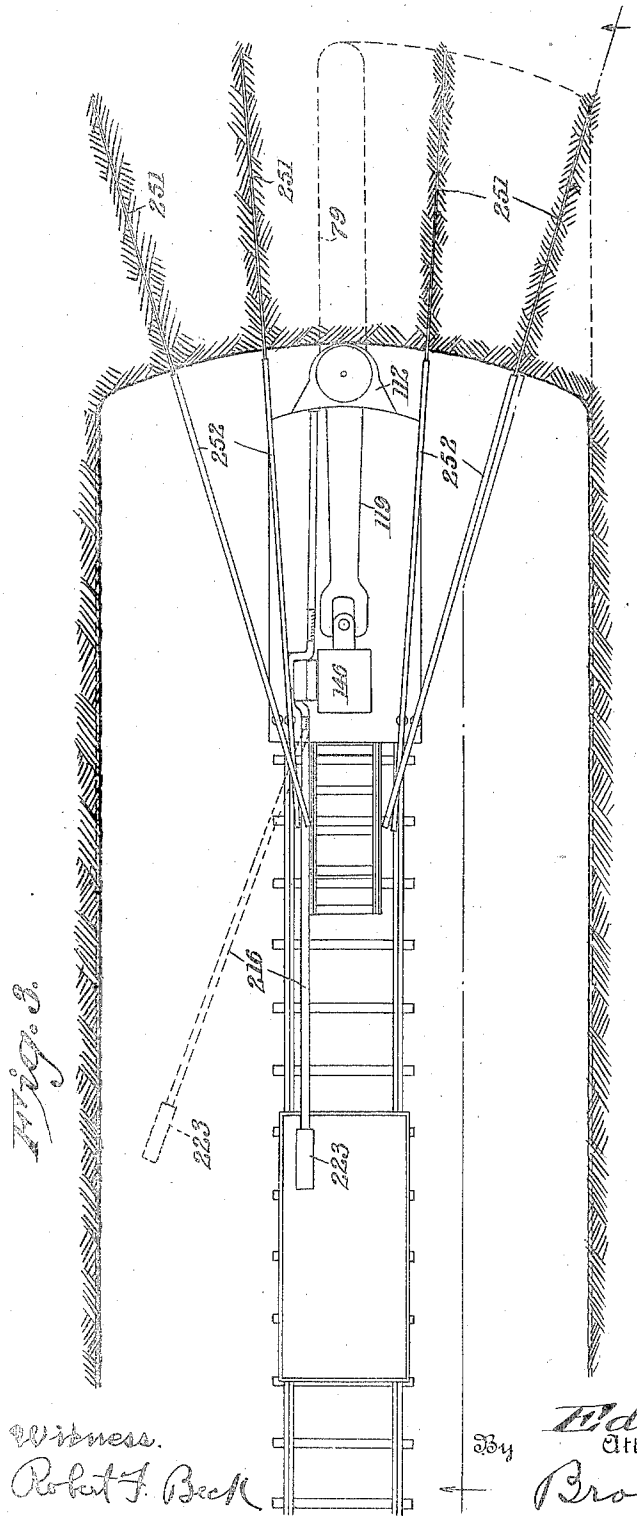


Fig. 3.

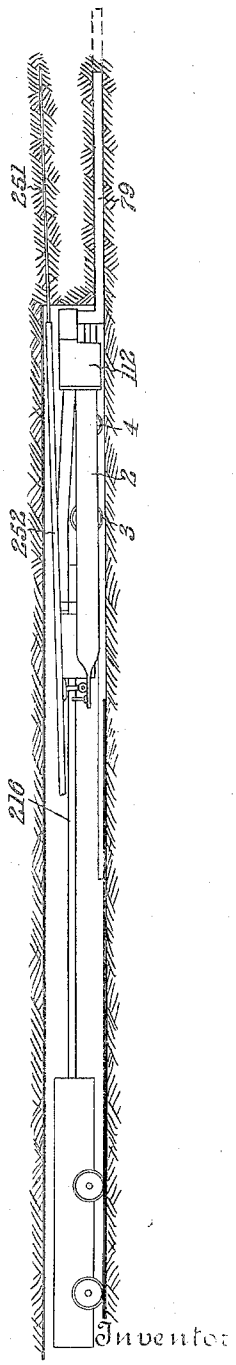


Fig. 4.

Witness.
Robert F. Beck

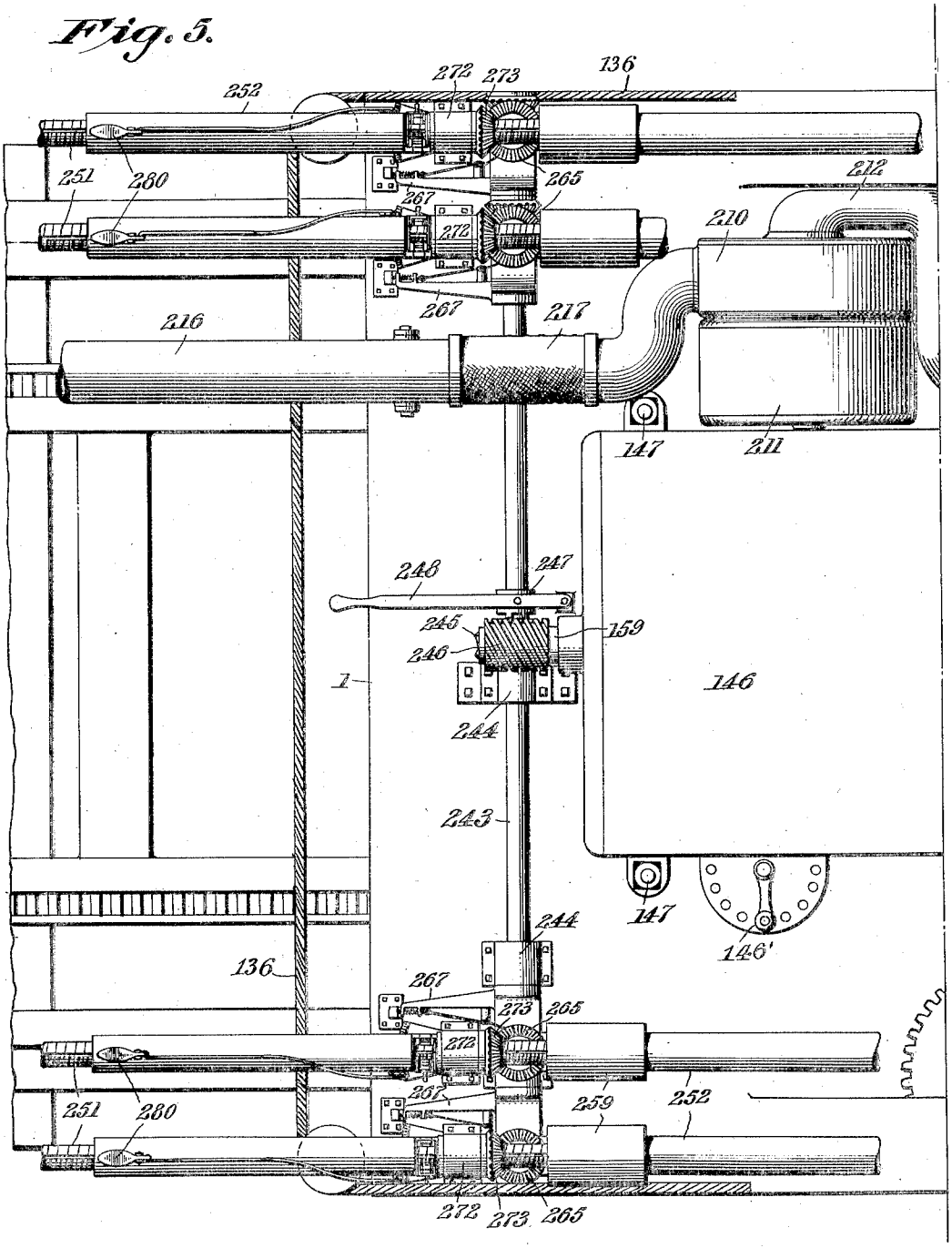
Inventor
Edmund C. Morgan
By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 3

Fig. 5.



Witness:
Robert F. Beck

Inventor
Edmund C. Morgan.

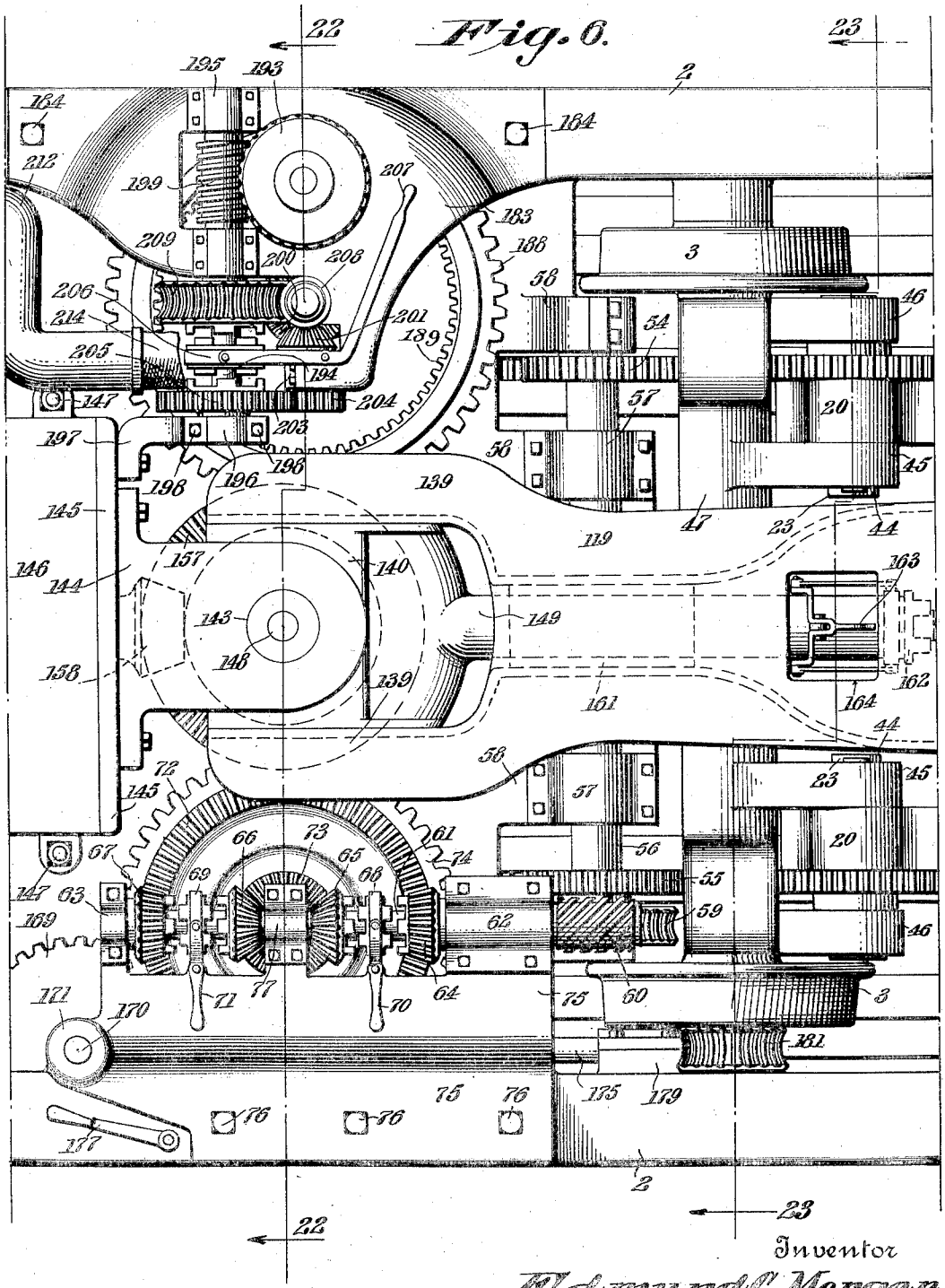
By Attorneys
Brown & Risen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 4

Fig. 6.



Inventor

Edmund C. Morgan

Witness:

Robert F. Beck

By Attorneys

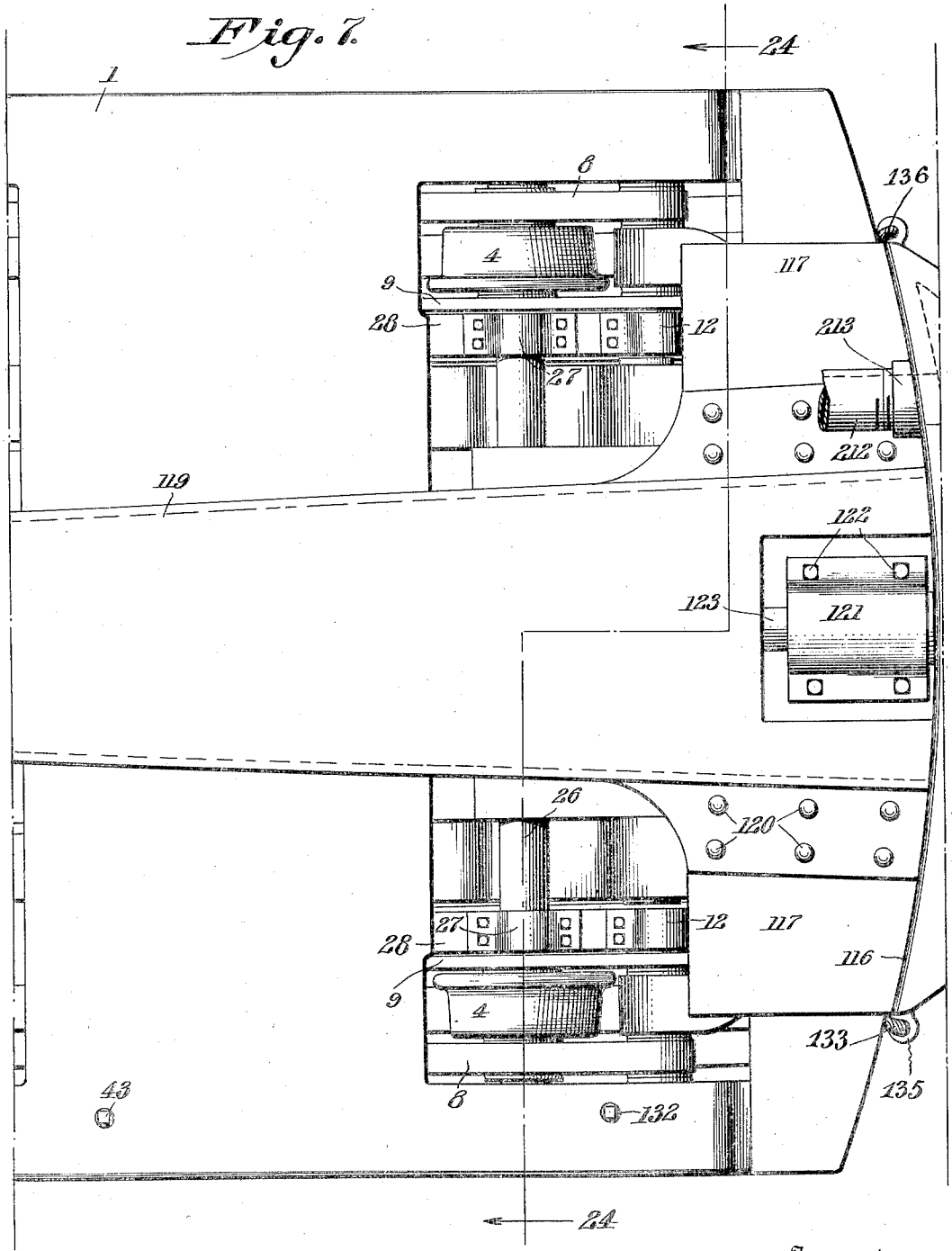
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 5

Fig. 7.



Inventor
Edmund C. Morgan

Witness:
Robert F. Beck

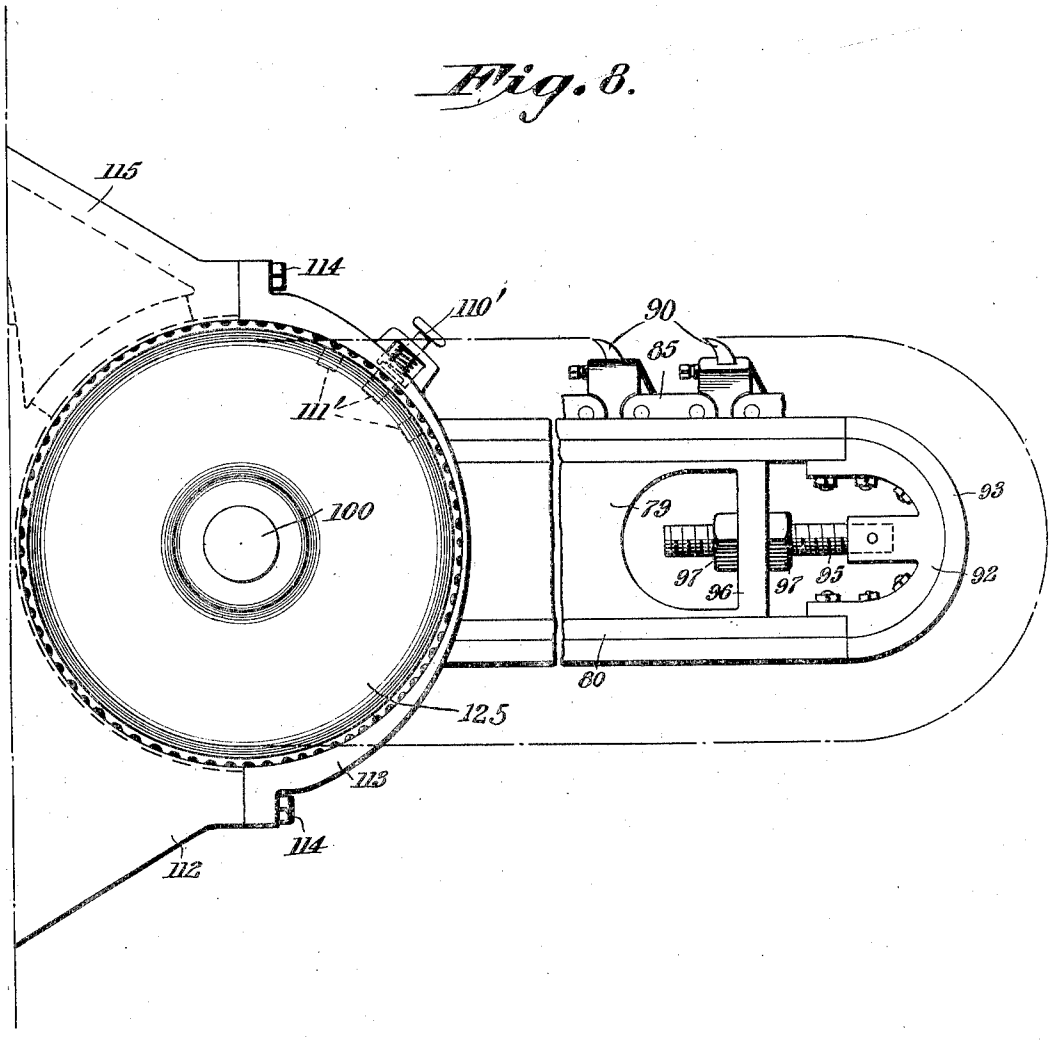
By Attorneys
Brown & Wissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 6

Fig. 8.



Inventor
Edmund C. Morgan

Witness
Robert F. Beck

By Attorneys
Brown & Wissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 7

Fig. 9.

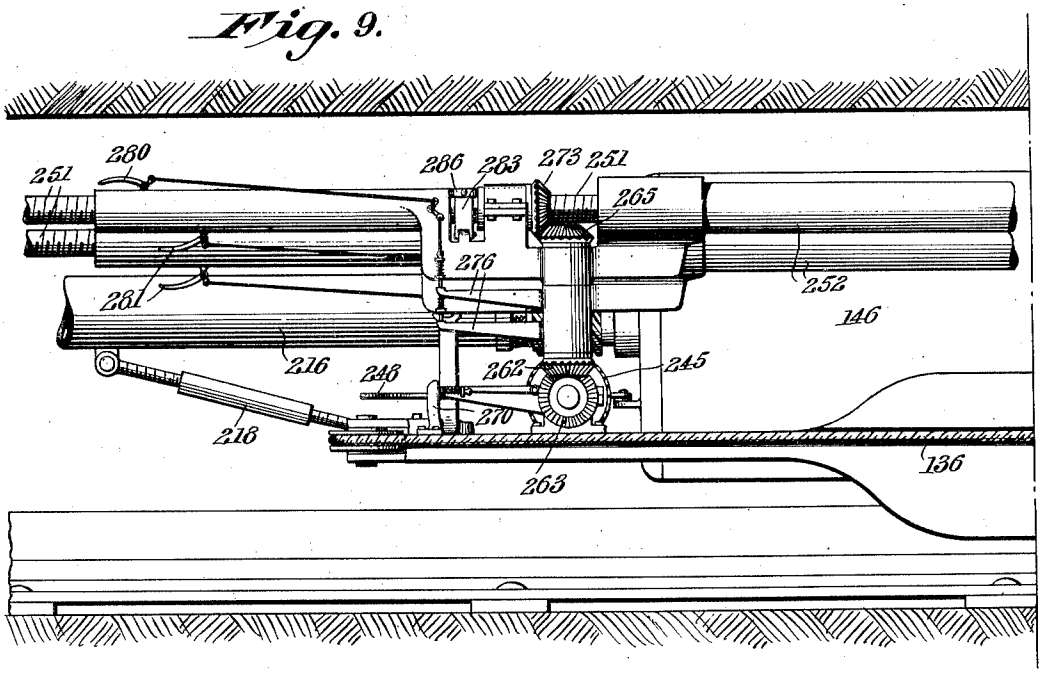
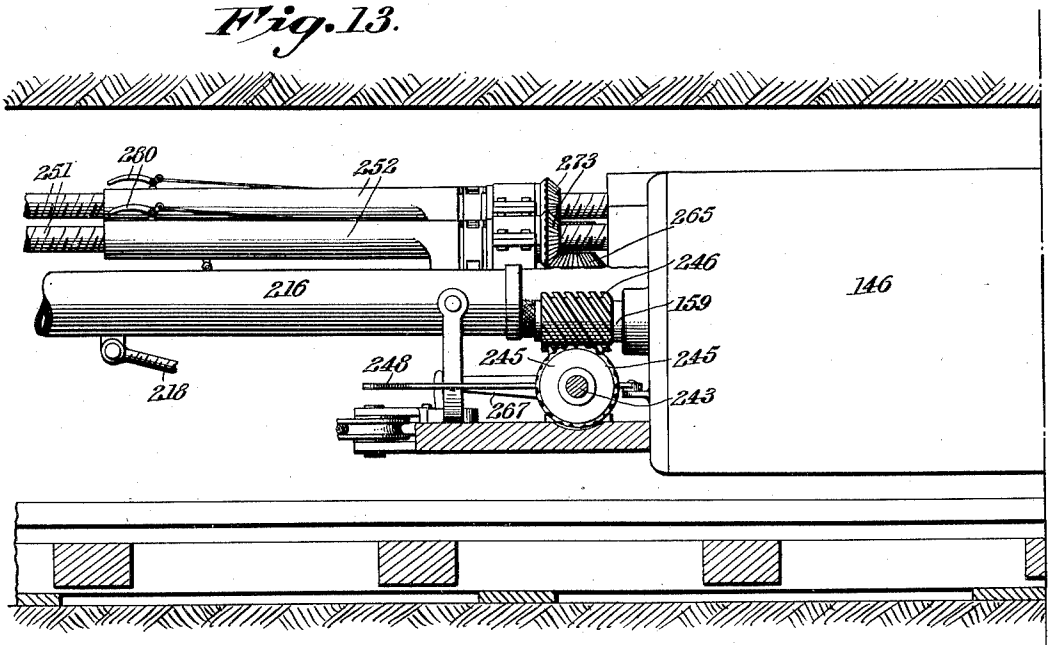


Fig. 13.



Inventor
Edmund C. Morgan

Witness:
Robert F. Beck

By Attorneys
Brown & Nieven

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 8

Fig. 10.

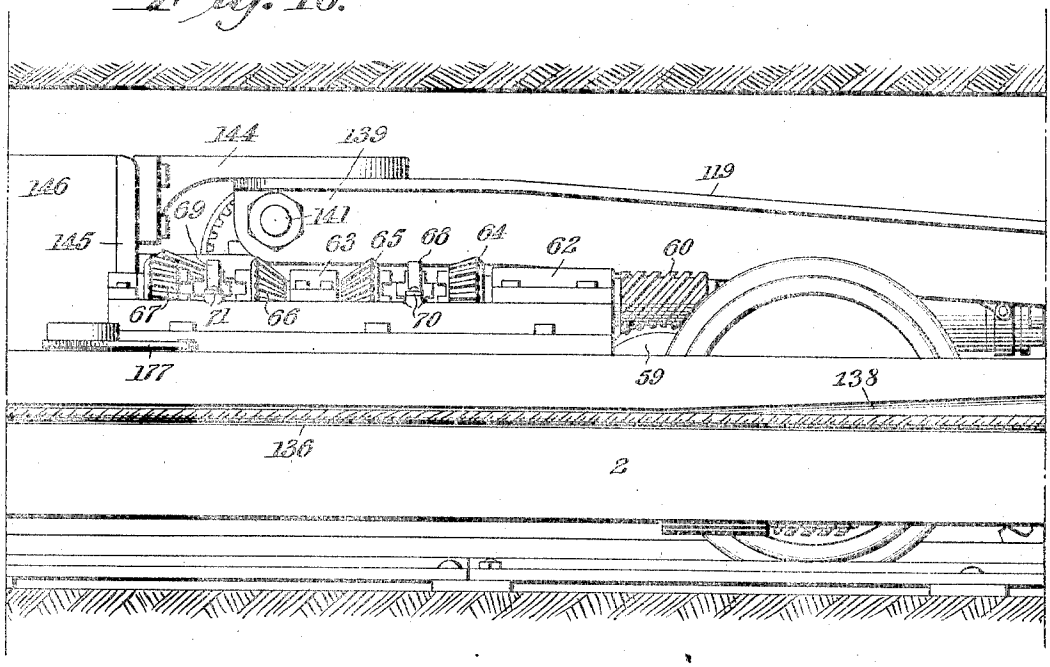
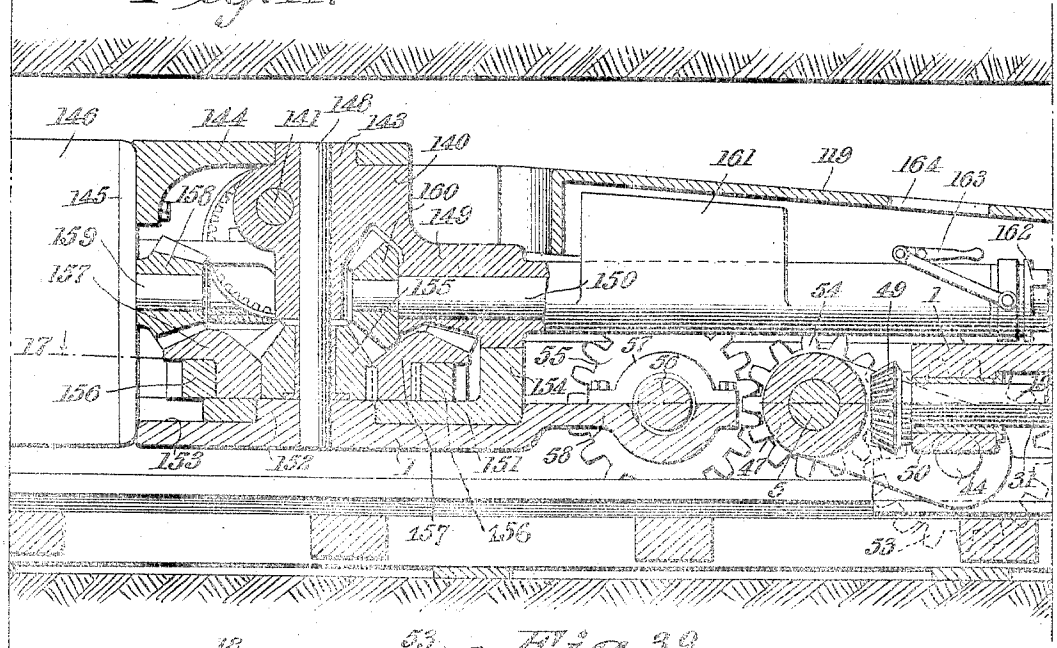


Fig. 14.



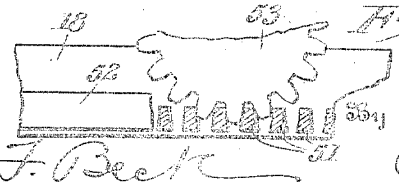


Fig. 39.

Witness.
Robert F. Beck

Inventor
Edmund C. Morgan

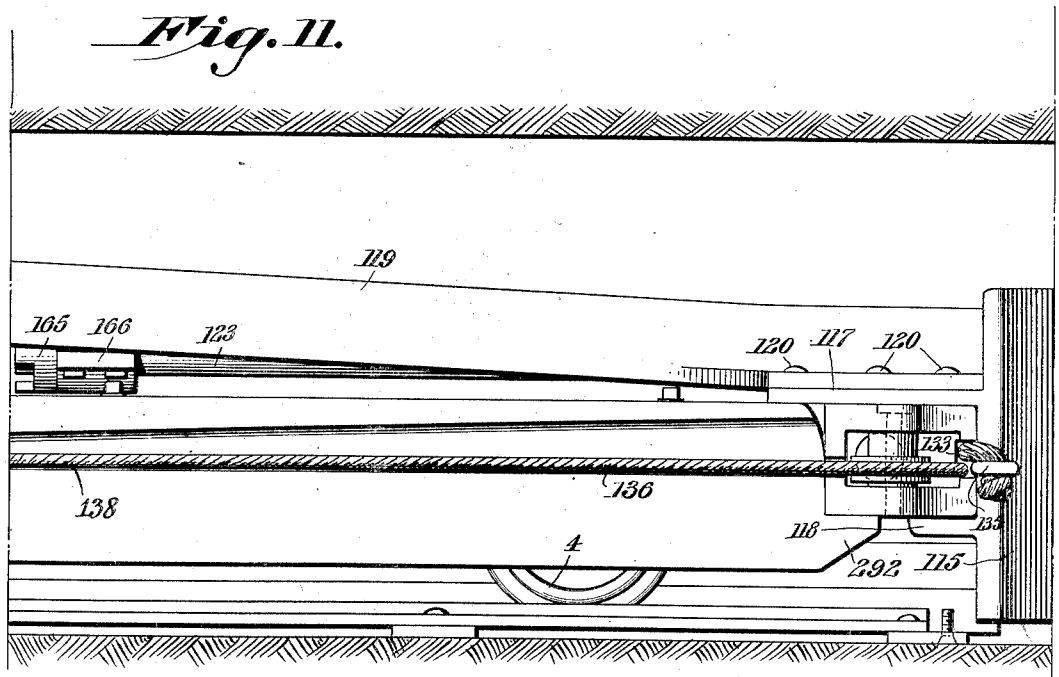
By
Attorneys
Brown & Mason

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 9

Fig. 11.



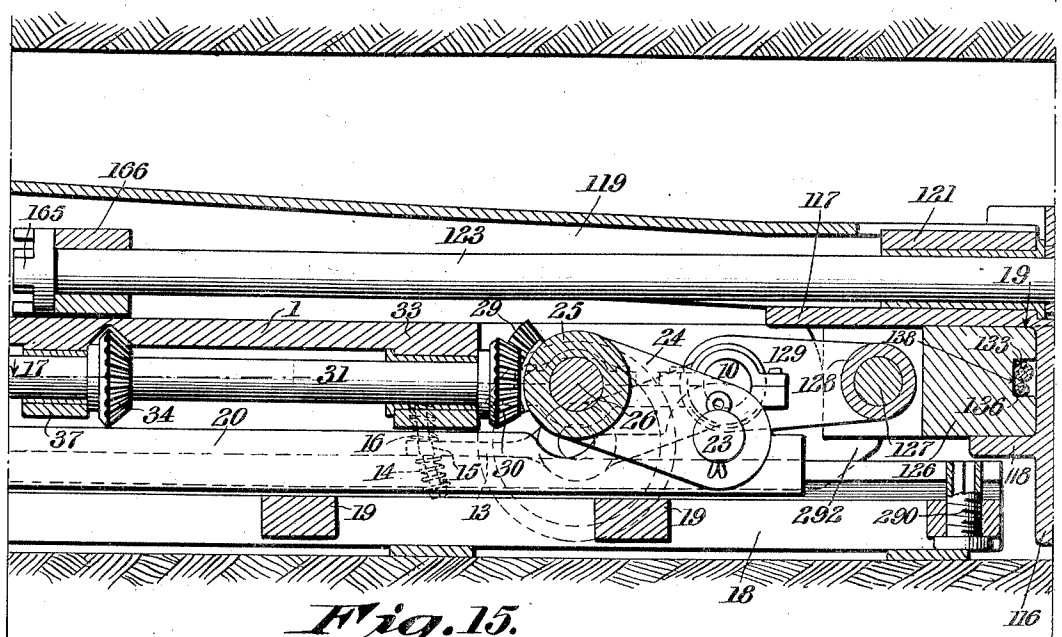


Fig. 15.

Witness:

Robert F. Beck

Inventor

Edmund C. Morgan

By Attorneys

Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 10

Fig. 12.

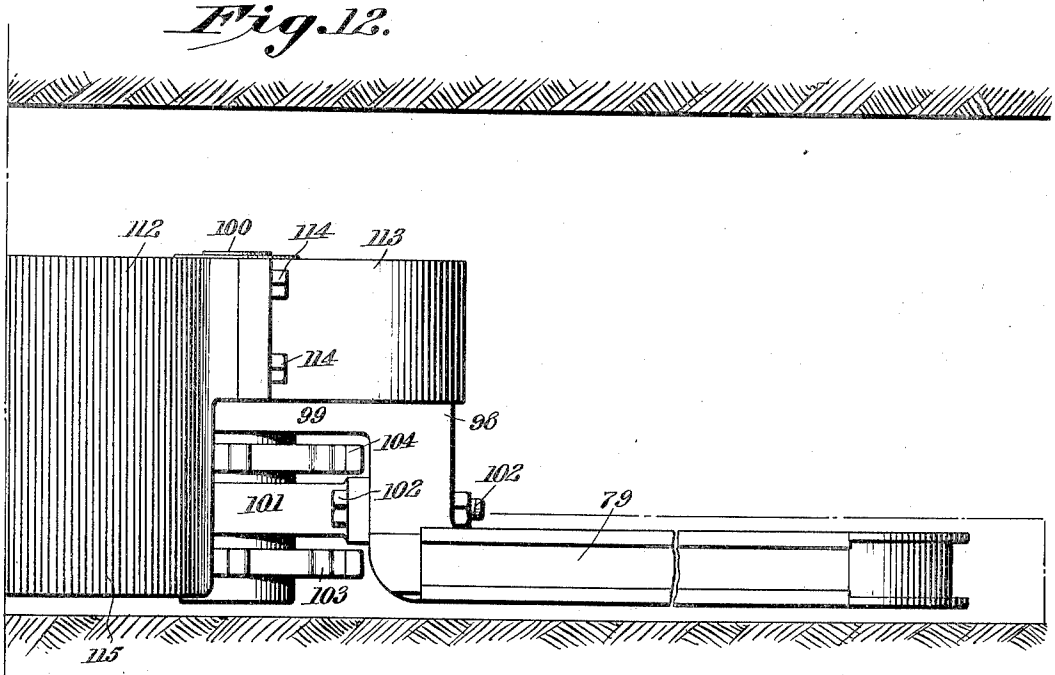
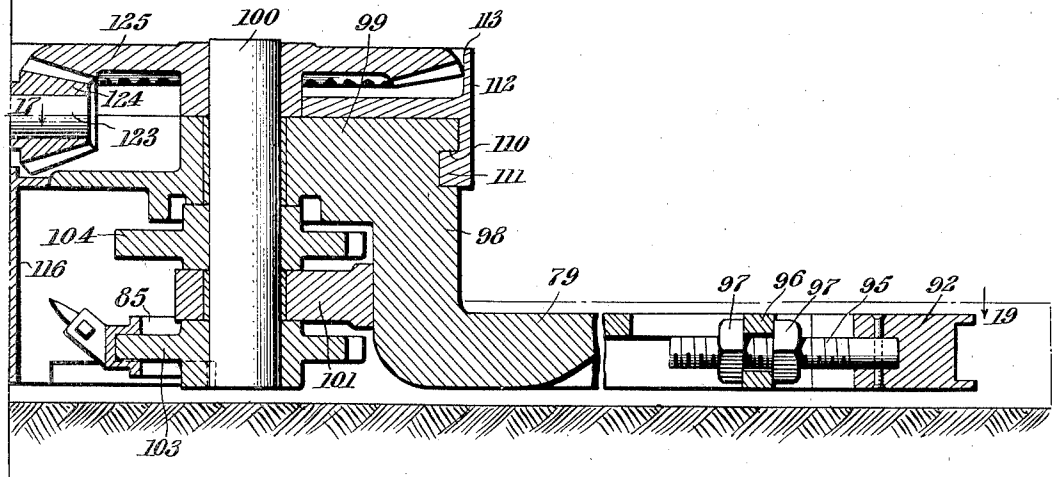


Fig. 16.



Inventor

Edmund C. Morgan,

By Attorneys

Brown & Nissen

Witness:

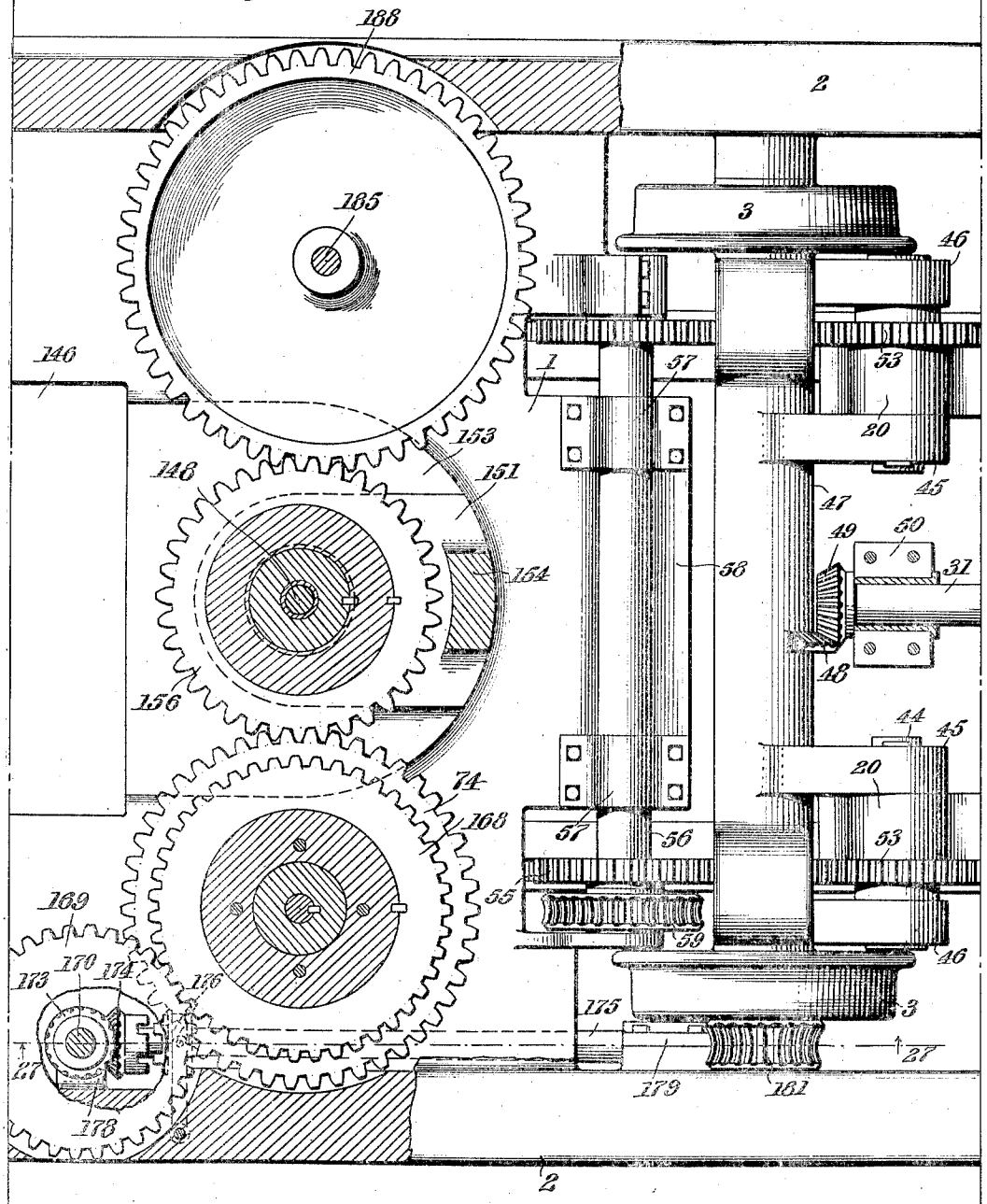
Robert Beck

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 11

Fig. 17.



Inventor
Edmund C. Morgan,

Witness:
Robert F. Beck

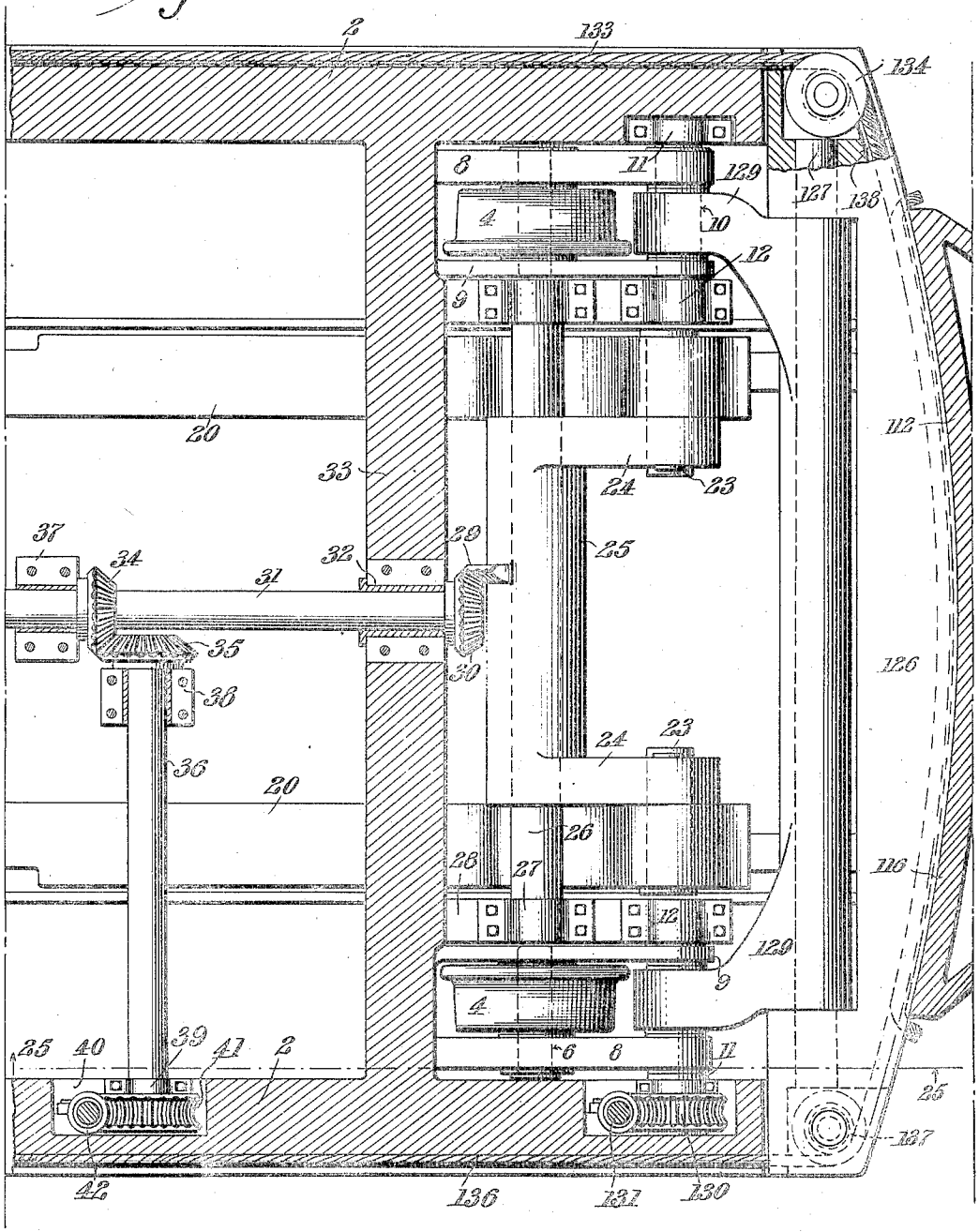
By Attorneys
Brown & Nissen.

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 12

Fig. 18.



Witness.
Robert F. Beck

Inventor
Edmund C. Morgan,

By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 13

Fig. 19.

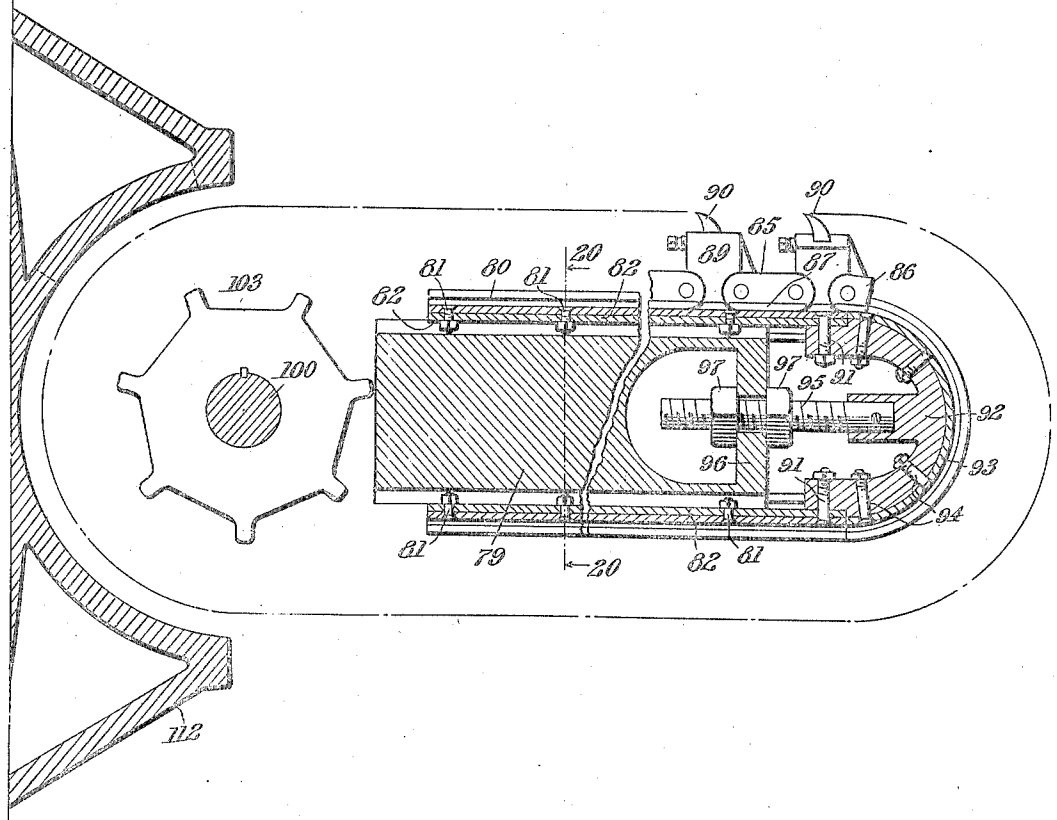
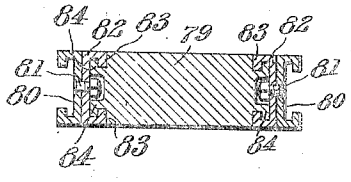


Fig. 20.



Witness:
Robert F. Beck

Inventor
Edmund C. Morgan,

By Attorneys
Brown & Wissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 14

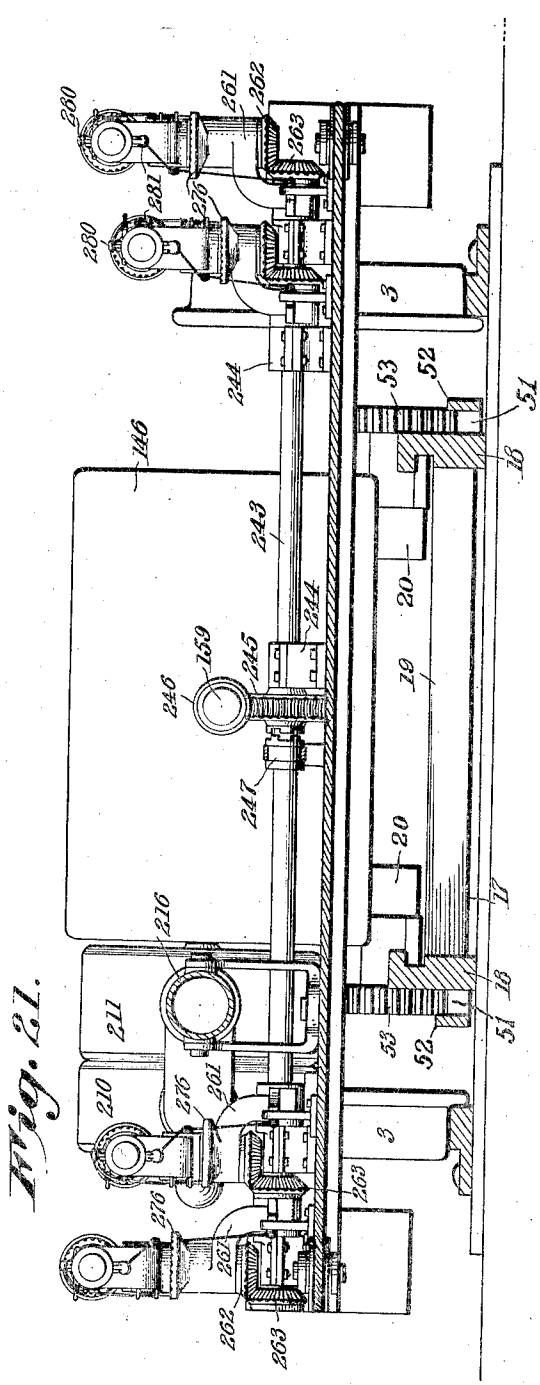


Fig. 21.

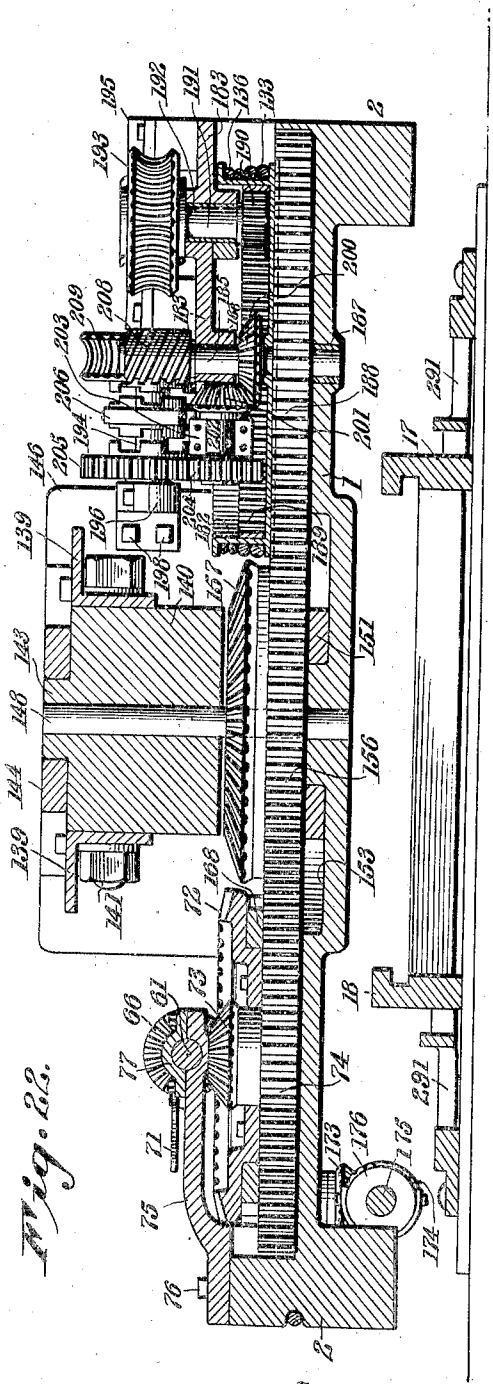


Fig. 22.

Witness:
Robert F. Beck

Inventor
Edmund C. Morgan

By Attorneys
Brown & Risen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 15

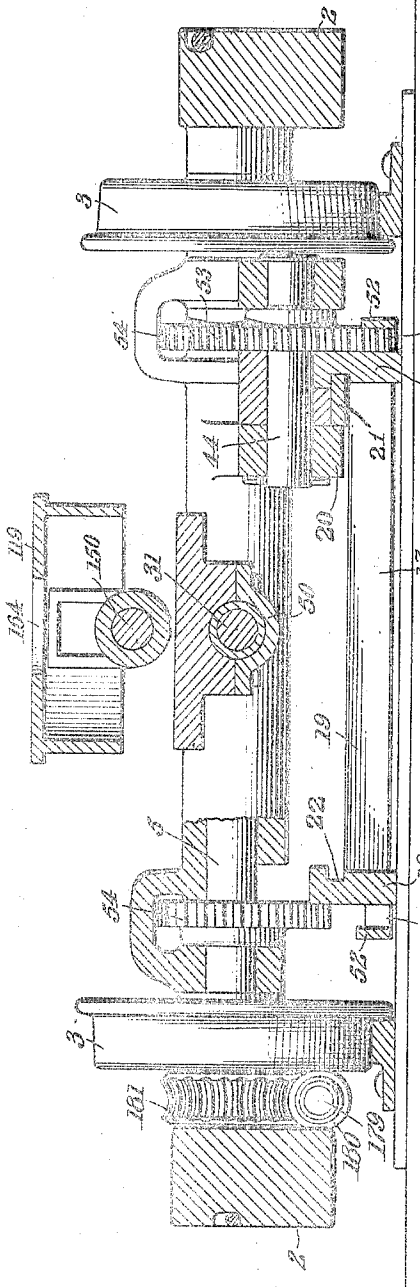


Fig. 23.

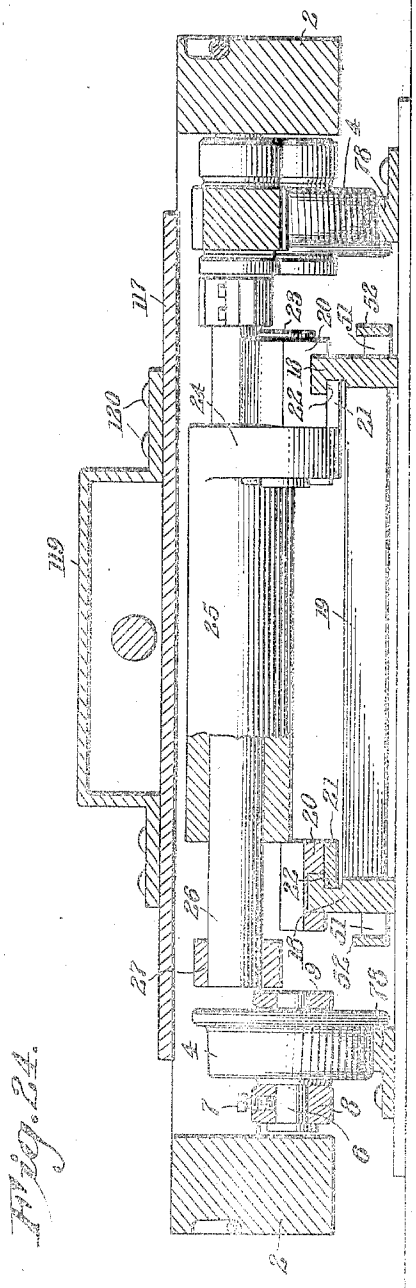


Fig. 24.

Witness.
Robert F. Bo[illegible]

Inventor
Edmund C. Morgan,
by Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 16

Fig. 25.

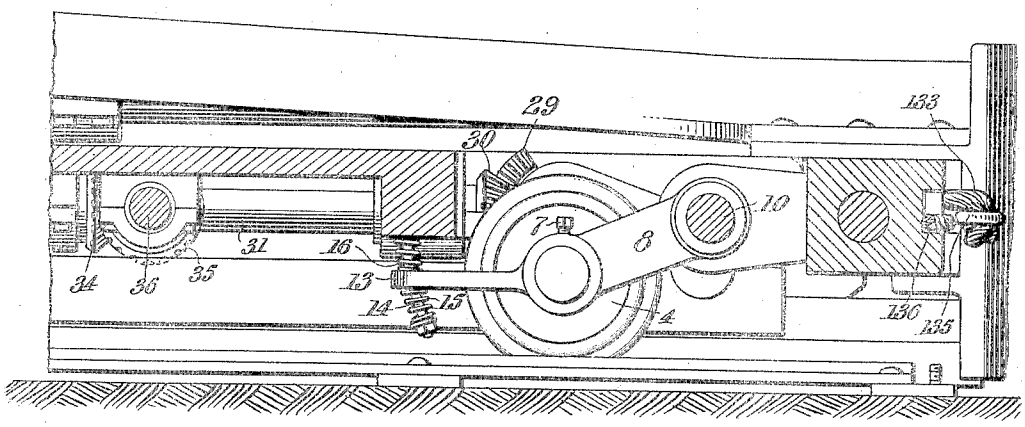
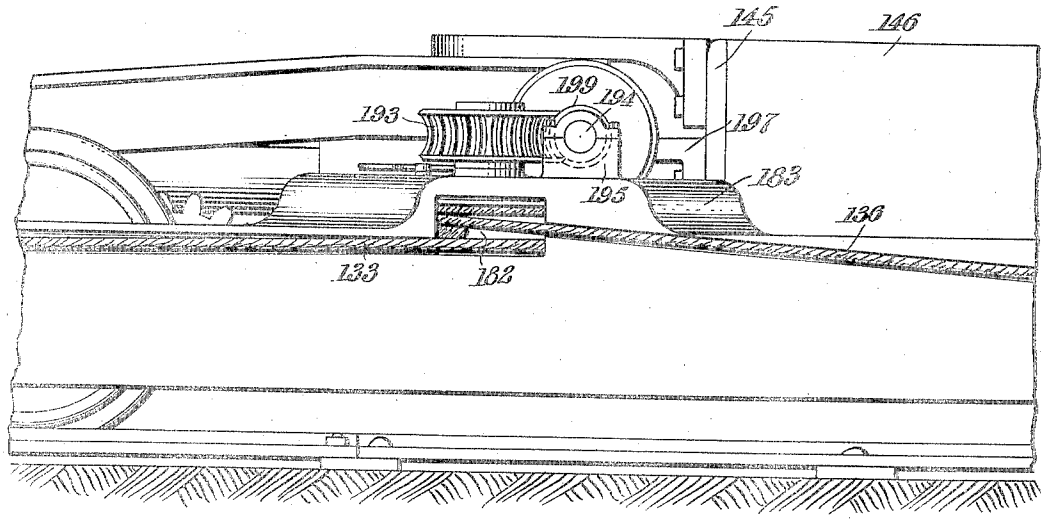


Fig. 26.



Inventor
Edmund C. Morgan

Witness:
Robert F. Beck

By Attorneys
Brown & Risen.

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 17

Fig. 27.

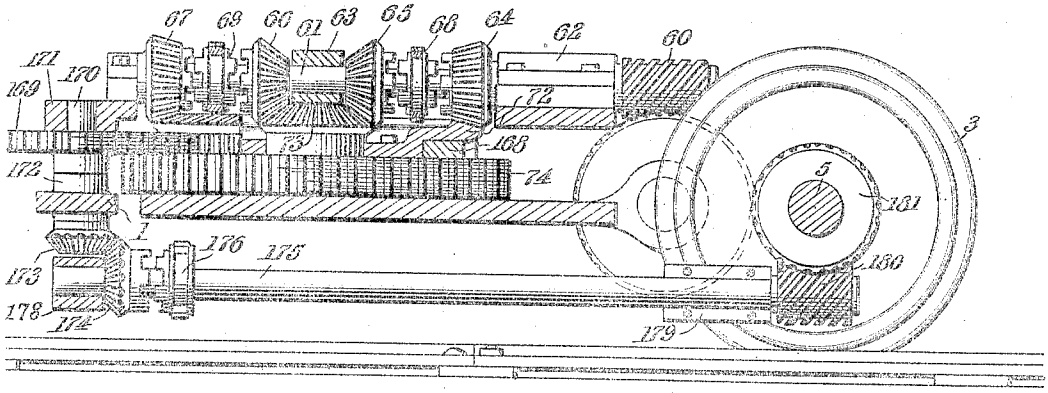
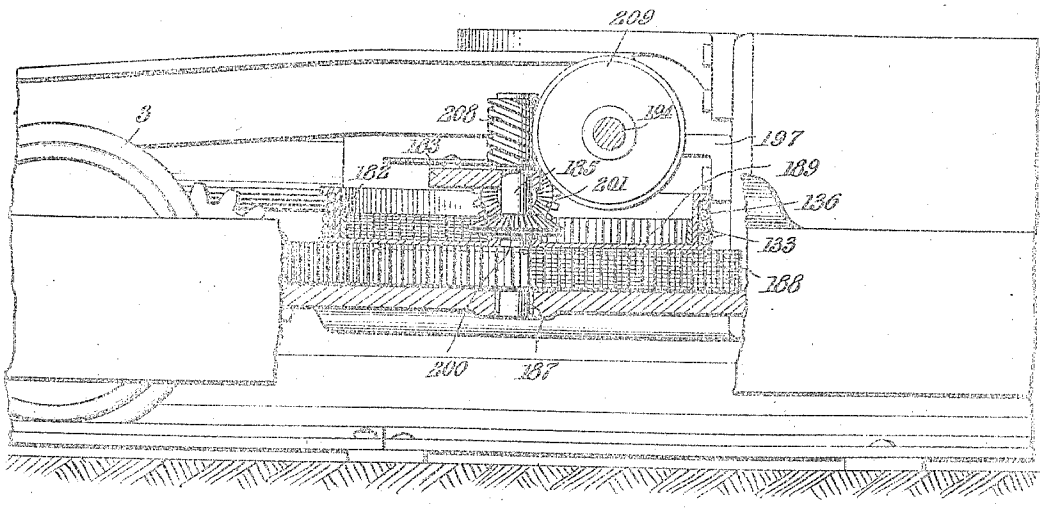


Fig. 28.



Witness:
Robert F. Beck

Inventor
Edmund C. Morgan

By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 18

Fig. 29.

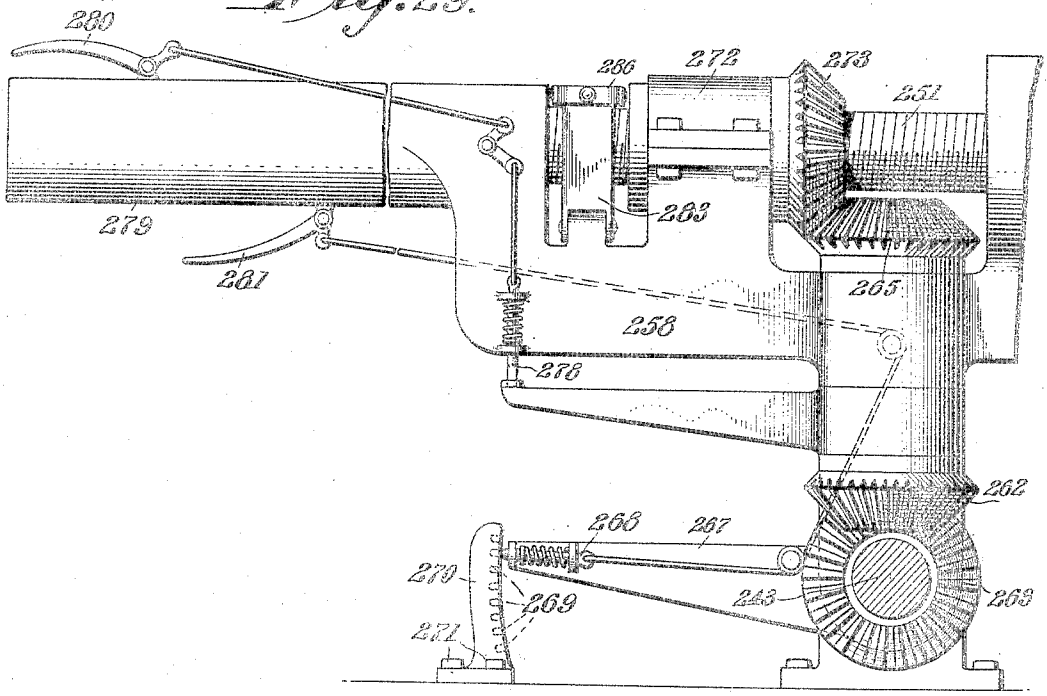
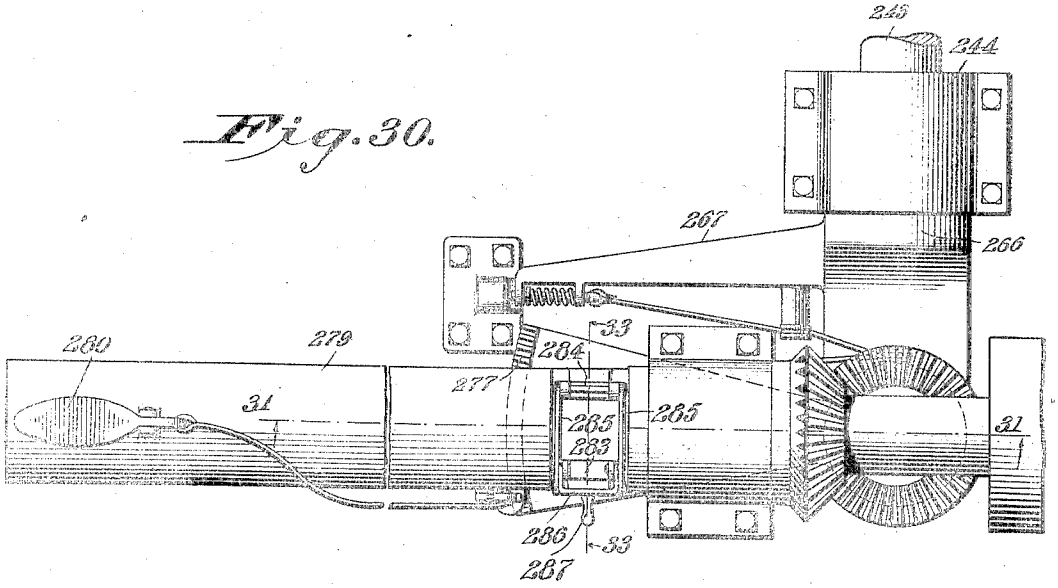


Fig. 30.



Witness:
Robert F. Beck

Inventor
Edmund C. Morgan

By Attorneys
Brown & Wiesen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 19

Fig. 31.

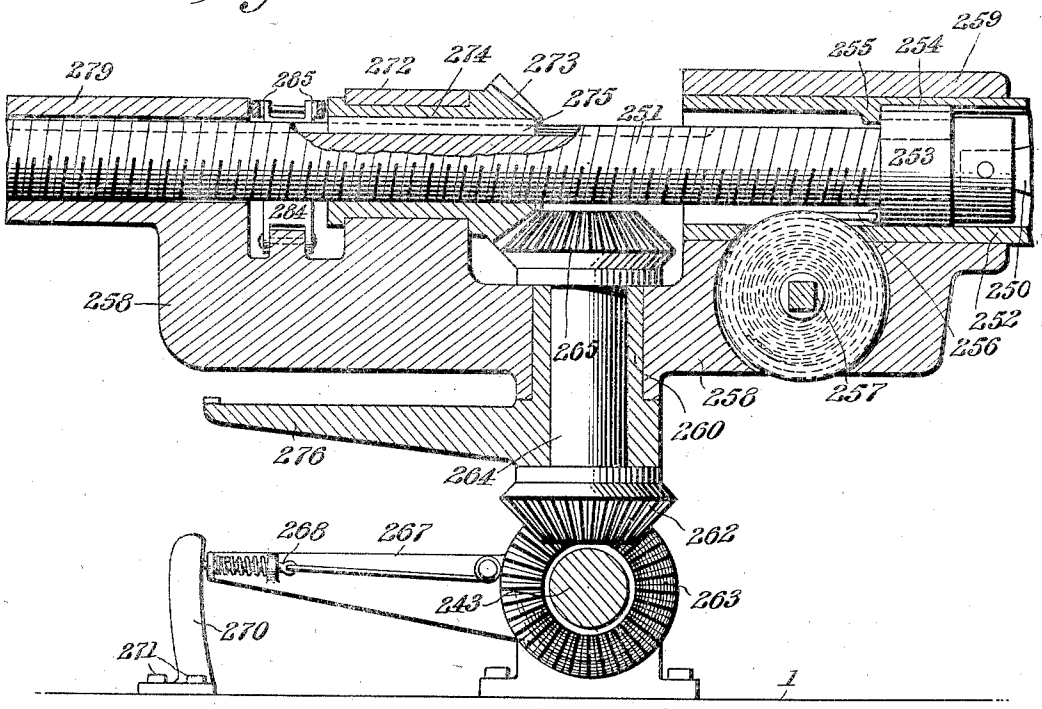


Fig. 33.

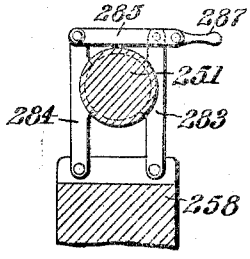


Fig. 32.

Inventor

Edmund C. Morgan

Witness.

Robert F. Beck

By Attorneys

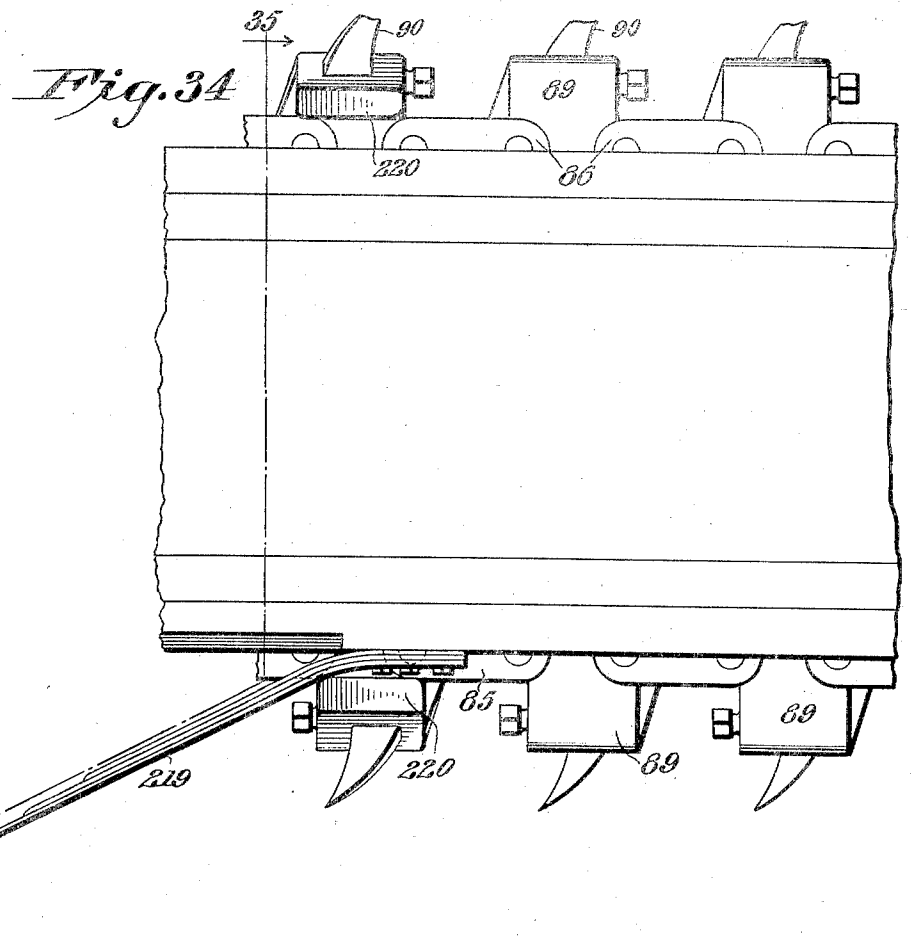
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1913 25 Sheets-Sheet 20

Fig. 34



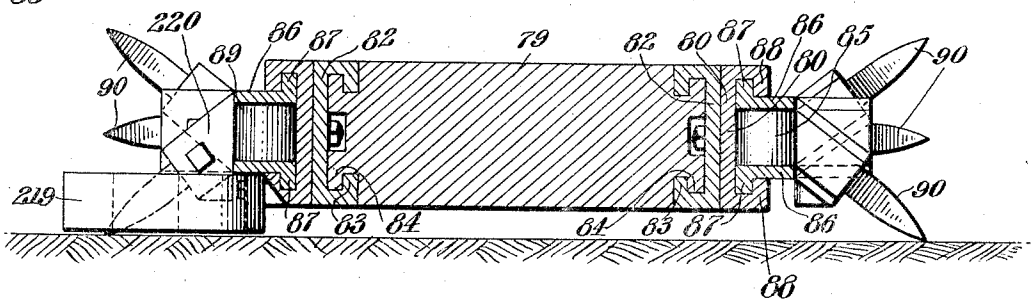


Fig. 35.

Witness:
Robert F. Beck

Inventor
Edmund C. Morgan
By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 21

Fig. 36.

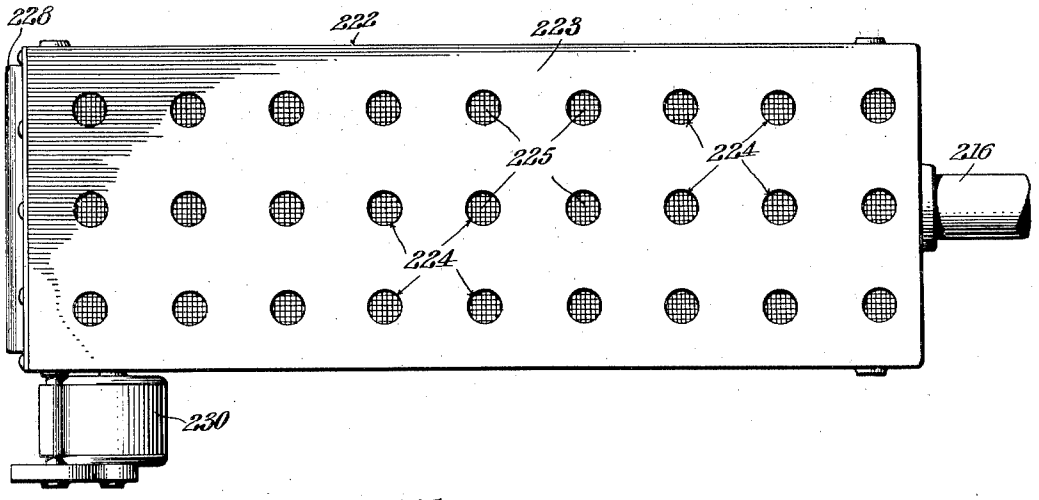


Fig. 37.

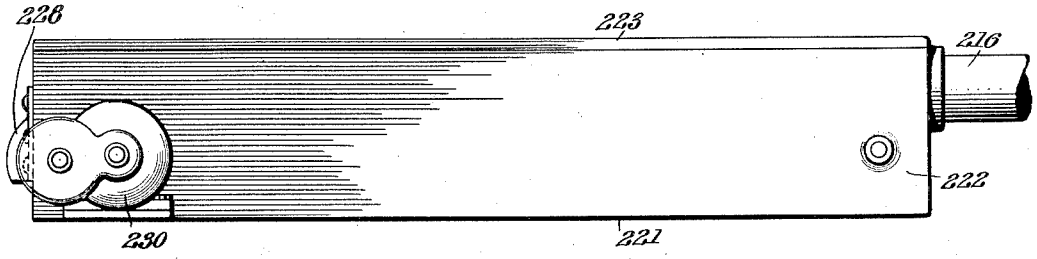
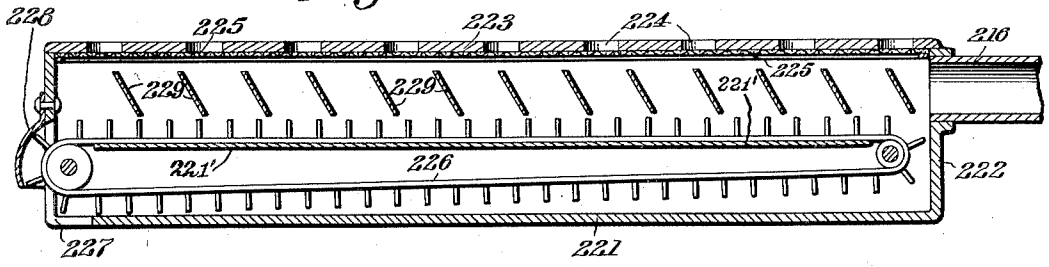


Fig. 38.



Inventor
Edmund C. Morgan,

Witness.
Robert F. Beck

By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 22

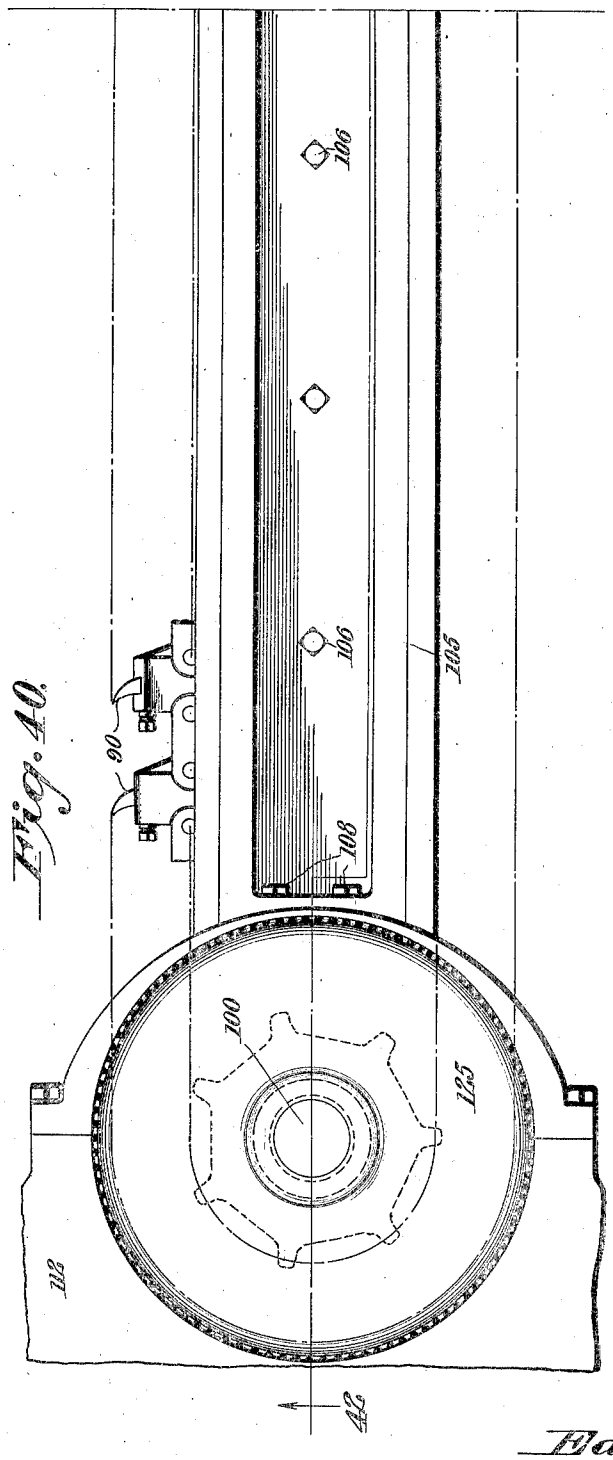


Fig. 40.

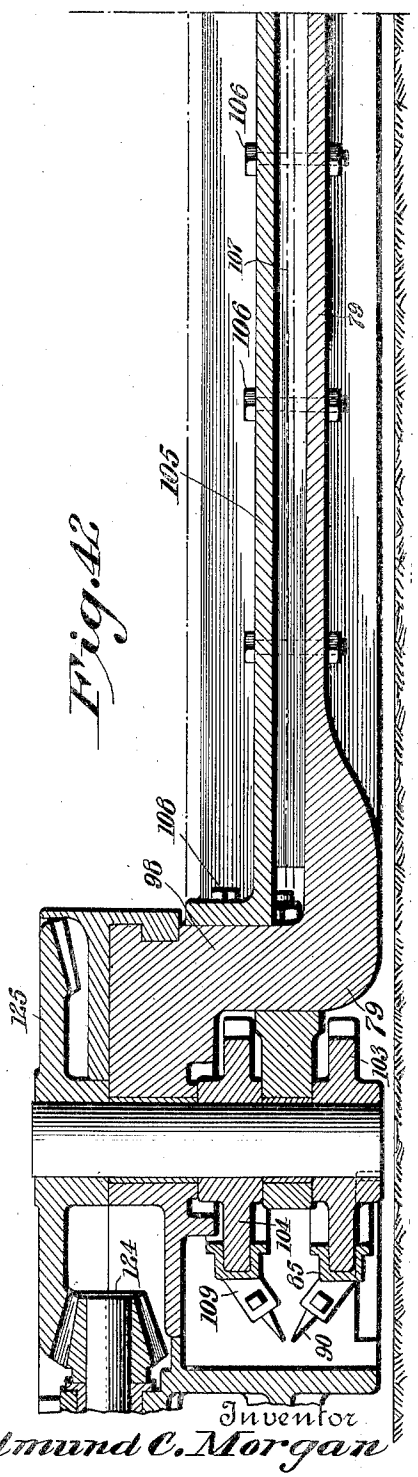


Fig. 42.

Inventor
Edmund C. Morgan

Witness:
Robert F. Beck

By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 23

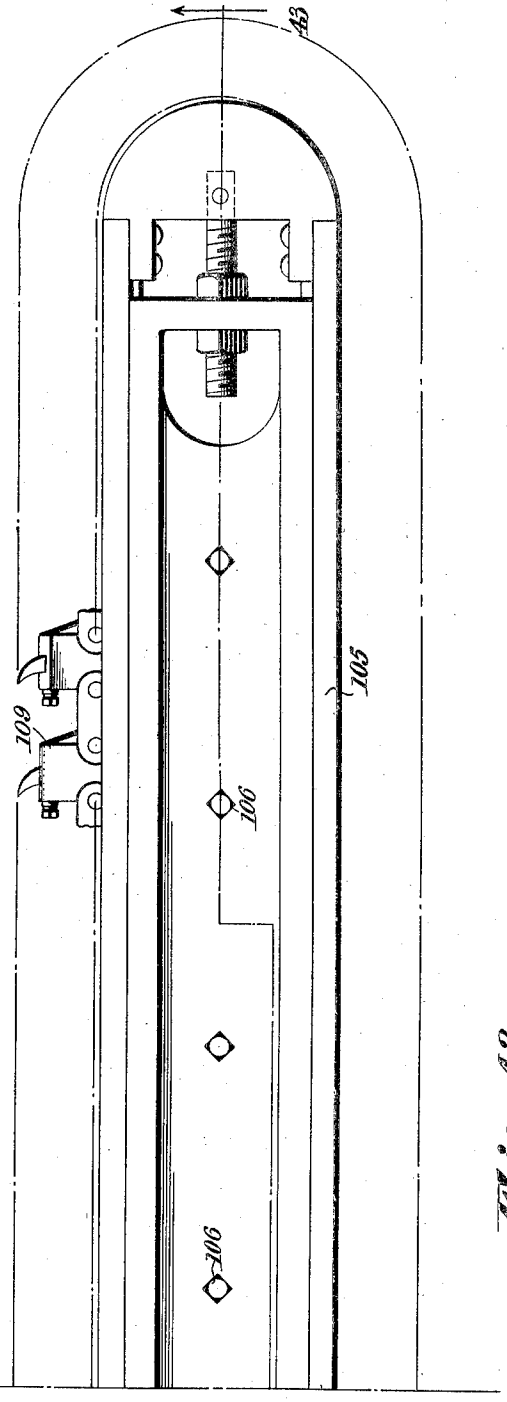


Fig. 41.

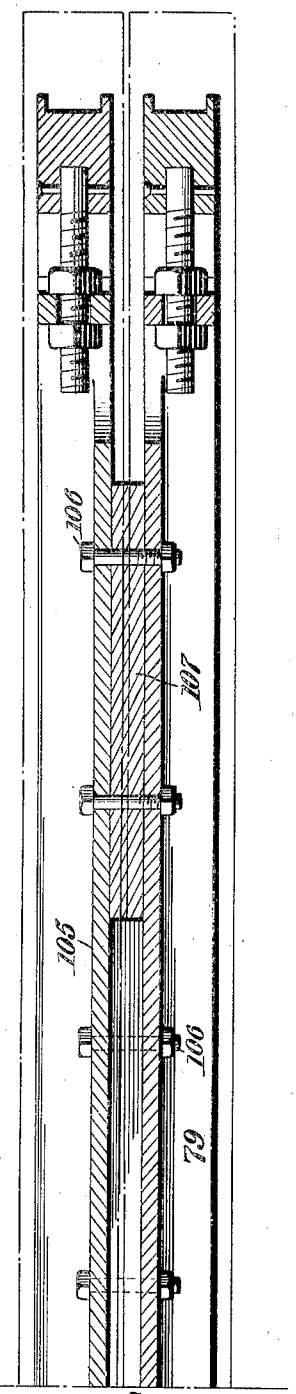


Fig. 43.

Inventor
Edmund C. Morgan,

Witness:
Robert F. Beck

By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 24

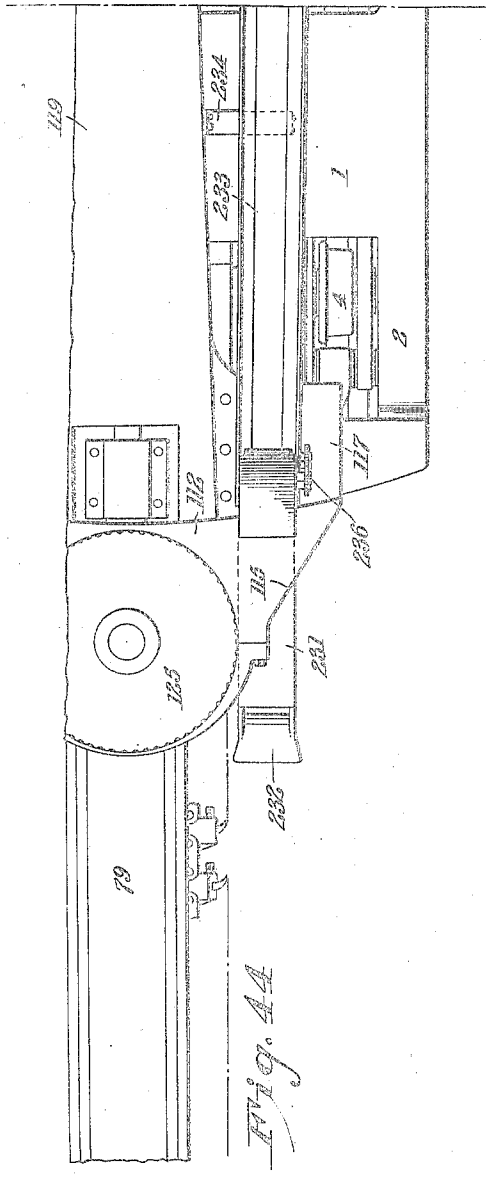


Fig. 44.

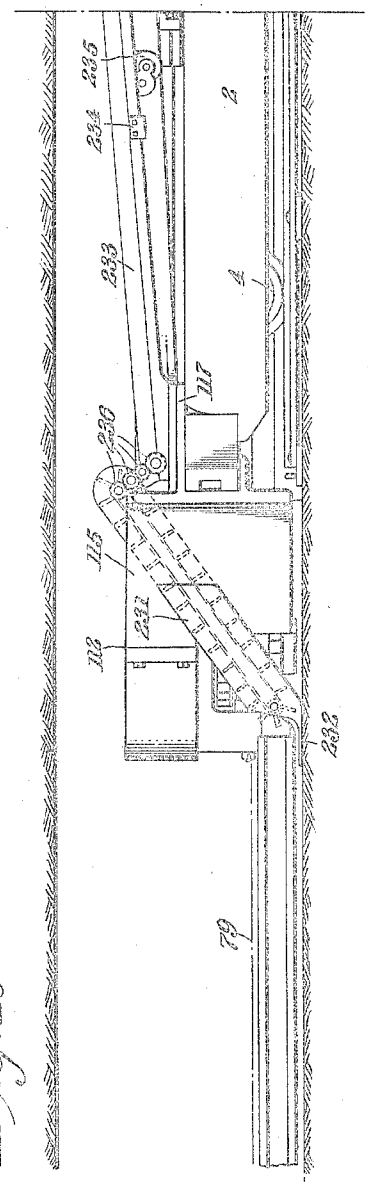


Fig. 46.

Inventor
Edmund C. Morgan,
By Attorneys
Brown & Nissen

March 26, 1929. E. C. MORGAN 1,707,133

COMBINED COAL MINING AND LOADING MACHINE

Filed Aug. 21. 1918 25 Sheets-Sheet 25

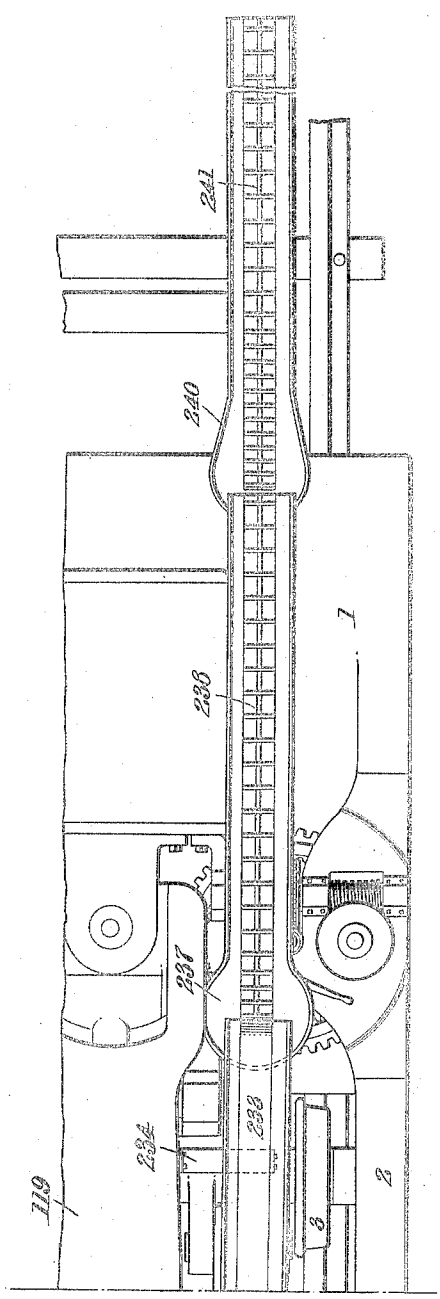


Fig. 45.

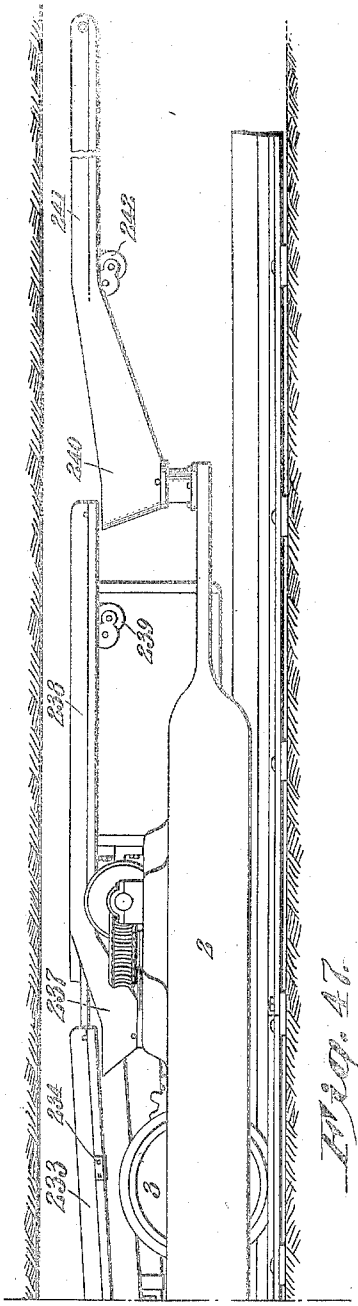


Fig. 47.

Inventor
Edmund C. Morgan,

Witness:
Robert F. Beck

By Attorneys
Brown & Risser.

Patented Mar. 26, 1929. 1,707,133

UNITED STATES PATENT OFFICE.

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

COMBINED COAL MINING AND LOADING MACHINE.

Application filed August 21, 1918. Serial No. 250,844.

This invention relates to mechanism for mining and loading coal and other material, and has for its object the provision of such a machine that shall be of improved construction and operation.

The invention is exemplified in the combination and arrangement of parts shown in the accompanying drawings and described in the following specification, and it is more particularly pointed out in the appended claims.

In the drawings—

Fig. 1 is a vertical sectional view through a mine chamber showing one embodiment of the present invention in elevation in the chamber.

Fig. 2 is a top plan view of the machine shown in Fig. 1.

Fig. 3 is a somewhat diagrammatic view showing a horizontal section through a mine chamber with the machine in operating position therein.

Fig. 4 is a vertical sectional view of the chamber shown in Fig. 3 and illustrates one phase of the operation of the machine.

Figs. 5, 6, 7 and 8 together form a top plan view of the machine shown in Figs. 1 and 2, but on a larger scale than in those figures.

Figs. 9, 10, 11 and 12 taken together form a side elevation of the machine shown in Figs. 5 to 8, the machine being in position in a mine chamber.

Figs. 13, 14, 15 and 16 taken together form a central longitudinal vertical section of the machine shown in Figs. 5 to 8.

Figs. 17, 18 and 19 together form a horizontal sectional view substantially on line 17—19 of Figs. 14, 15 and 16.

Fig. 20 is a transverse sectional view of the cutter bar shown in Fig. 19 on line 20—20 of that figure.

Fig. 21 is a rear elevation of the machine looking from the left in Fig. 5.

Fig. 22 is a transverse vertical section of the machine on line 22—22 of Fig. 6.

Fig. 23 is a vertical section on line 23—23 of Fig. 6.

Fig. 24 is a vertical section on line 24—24 of Fig. 7.

Fig. 25 is a fragmentary sectional view substantially on line 25—25 of Fig. 18.

Fig. 26 is a fragmentary side elevation of the portion of the machine shown in Fig. 6 looking from the top in that figure.

Fig. 27 is a fragmentary vertical sectional view substantially on line 27—27 of Fig. 17.

Fig. 28 is a view similar to Fig. 26 but with portions broken away and other portions in section to show details of construction.

Fig. 29 is a side elevation of the driving mechanism for one of the drills forming a part of the present invention.

Fig. 30 is a top plan view of the mechanism shown in Fig. 29.

Fig. 31 is a vertical sectional view on line 31—31 of Fig. 30.

Fig. 32 is an elevation of the mechanism shown in Fig. 29 looking from the left in that figure.

Fig. 33 is a vertical sectional detail on line 33—33 of Fig. 30.

Fig. 34 is a bottom plan view of a fragment of the cutter bar and chain connected therewith and shows a device for removing the cuttings from the path of the chain.

Fig. 35 is a transverse section on line 35—35 of Fig. 34.

Fig. 36 is a top plan view of the discharge end of the pneumatic conveyer forming a part of the present invention.

Fig. 37 is a side elevation, and Fig. 38 is a central vertical section of the portion of the conveyer shown in Fig. 36.

Fig. 39 is a detail of a rack and pinion mechanism forming a part of the machine.

Figs. 40 and 41 together constitute a top plan view of a slightly modified form of cutter bar.

Figs. 42 and 43 together constitute a vertical section on line 42—43 of Figs. 40 and 41.

Figs. 44 and 45 together constitute a top plan view of a portion of the machine showing a modified form of conveyer mechanism for loading; and

Figs. 46 and 47 constitute a side elevation of the mechanism of Figs. 44 and 45.

The present application is a continuation in part of my co-pending applications, Serial No. 775,173, filed June 23, 1913, for apparatus for mining coal; Serial No. 777,436, filed July 5, 1913, for apparatus for mining coal; and Serial No. 196,294, filed October 12, 1927, for mining machine, the broadest claims being in Serial No. 775,173 and those next in scope in Serial No. 777,436, and next in scope in Serial No. 196,294, the claims in the present application being directed to improvements over the subject-matter disclosed in said co-pending applications.

As will be seen more clearly from Figs. 5 to 24, the embodiment of the invention illus-

trated in the drawings is provided with a main frame plate 1 having reinforcing beams 2 at each side thereof. The machine is provided with rear truck wheels 3 and front truck wheels 4, the front wheels being of smaller diameter than the rear wheels, as shown in Figs. 17 and 18. The rear truck wheels 3, as shown in Figs. 6, 17 and 23, are rigidly connected with a transverse shaft or axle 5 which is journaled in bearings in the side beams 2. The front truck wheels 4, as shown in Figs. 7, 15, 18, 24 and 25, are each journaled on short axles 6 which are rigidly held by set screws 7 in a pair of swinging arms 8 and 9. The arms 8 and 9, as shown in Figs. 18 and 25, are journaled on short shafts 10 which are mounted in bearings 11 and 12 rigidly supported on the main frame of the machine. The arms 8 and 9 are provided with an extension 13 through an opening in the end of which is a curved rod 14, which rod is provided with coil springs 15 and 16 for resiliently holding the wheels 4 in vertical position relative to the main frame of the machine.

In addition to the truck wheels 3 and 4, the machine is provided with a movable supporting frame 17 which includes a pair of longitudinally extending guide bars or ways 18 (Figs. 15, 21, 22, 23 and 24) and connecting cross bars 19. The machine may be supported on the ways 18 by elongated shoes 20 which rest upon the tops of the ways, as shown in Figs. 15, 23 and 24, and which are provided with plates 21 which extend into notches 22 in the ways 18, so that the supporting frame 17 is moved up and down when the shoes 20 are raised and lowered by mechanism to be described. The shoes 20 at their forward ends are pivotally mounted on pins 23 (Figs. 15 and 24) carried at the ends of swinging arms 24 which are rigidly formed on a sleeve 25 journaled on a shaft 26 which extends transversely of the machine and is journaled in bearings 27 (Fig. 24) carried by bars 28 (Figs. 7 and 18) formed rigid with the plate 1 of the main frame of the machine. The sleeve 25 carries a gear segment 29 (Figs. 15 and 18) which meshes with a pinion 30 secured to the end of a shaft 31 which is journaled in a bearing 32 formed in a cross bar 33 extending across the machine and connecting the side beams 2, as shown in Fig. 18. The shaft 31 is provided with a second pinion 34 which meshes with a pinion 35 on a laterally extending shaft 36. A bearing 37 projecting downwardly from the frame plate 1 supports the shaft 31 adjacent the pinion 34, and a similar bearing 38 supports the shaft 36 at its inner end. The outer end of the shaft 36 is journaled in a bearing 39 formed in a recess 40 in the side beam 2. A worm wheel 41 is secured to the end of the shaft 36 and meshes with a worm 42 which is journaled in an upright position, and is provided with a squared end 43, Fig. 7, which projects upwardly through the frame plate 1, and which is arranged to receive a wrench by which the worm 42 may be rotated. Rotation of the worm 42 will be transmitted through the shafts 36 and 31 to the gear segment 29 and the sleeve 25, and in this way the arms 24 may be rocked to move the supporting frame 17 vertically relative to the main frame of the machine. The worm 42 and worm wheel 41 form an automatic lock for holding the supporting frame in any given position relative to the machine.

The rear ends of the elongated shoes 20, as shown in Figs. 6, 14, and 17, are supported by pins 44 carried at the ends of arms 45 and 46 which are formed integral with a sleeve 47 journaled on the axle 5 which carries the rear truck wheels 3. The sleeve 47 has a gear segment 48 integral therewith which meshes with a pinion 49 secured to the end of the shaft 31 so that the rotation of the shaft 31 will swing the arms 45 and 46 in unison with the arms 24, and thus move the rear ends of the elongated shoes 20 in unison with the movement of the forward ends thereof. The rear end of the shaft 31 is supported adjacent the pinion 49 in a bearing 50 secured to the under side of the main frame plate 1.

The movable supporting frame 17 is provided with a pair of racks 51 positioned adjacent the outer faces of the ways 18 and provided with side plates 52 which are connected to the outer ends of the rack teeth, and which project upwardly to form flanges at the outer sides of the racks, as shown in Figs. 23, 24, and 39. The pins 44 which are connected with the rear ends of the shoes 20 have spur gears 53 (Figs. 14 and 23) journaled thereon is position to mesh with the racks 51 secured to the upper faces of the ways 18. The gears 53, as shown in Fig. 14, mesh with gears 54 journaled on the rear truck axle 5, the gears 54 in turn meshing with gears 55 rigidly secured to a shaft 56 which is journaled in bearings 57 supported on a projecting portion 58 of the main frame plate 1, as shown in Fig. 17. The shaft 56 has a worm wheel 59 rigidly secured to one end thereof, and this worm wheel meshes with a worm 60 by which it is driven, as shown in Fig. 6. It should be noted that the teeth of the worm 60 are set at such an angle that power may be transmitted in either direction by the worm and worm wheel. The worm 60 is secured to the end of a shaft 61 journaled in bearings 62 and 63, as shown in Figs. 6 and 27 which shaft is provided with pinions 64, 65, 66 and 67 loosely mounted thereon, but arranged to be clutched thereto by clutches 68 and 69 having operating handles 70 and 71, respectively. The pinions 64 and 67 mesh with a beveled gear 72, while the pinions 65 and 66 mesh with a smaller gear 73, the beveled gears 72 and 73 being rigidly connected with a spur gear 74, as shown also in Fig. 22. The gears

72 and 74 are partially covered by a plate 75 secured to the upper face of the side beam 2 by cap screws 76, and the plate 75 carries the bearings 62 and 63 for the shaft 61, as well as a central bearing 77 in which the shaft is also journaled at a point above the center of the gear 74. It will be apparent that by shifting the clutches 68 and 69, the shaft 61 may be rotated in either direction at two different speeds, the rotation of the shaft being derived from the spur gear 74 which is driven in a manner to be described. When the clutches are both in their intermediate positions, the gear 74 may rotate without moving the shaft 61. When the supporting frame 17 is swung downwardly by the arms 24 and 45, the ways 18 will be caused to rest upon the floor of the mine chamber, and further downward movement of the arms will raise the main frame of the machine until the truck wheels are lifted free of their supporting rails 78. If the shaft 61 is now driven while the machine is carried by the movable supporting frame, the gears 53 which mesh with the rack 51 will cause the machine to travel forward or backward along the supporting frame, the weight of the machine being carried by the shoes 20 which rest upon the ways 18 and which slide along the ways as the machine is moved over the supporting frame. The direction of the movement, whether forward or backward, will depend upon the position of the clutch handles 70 and 71, as will also the speed.

It will be seen that the supplemental track permits the mining machine to occupy a position which is entirely in advance of the forward end of the mine track. Without the supplemental track the extent to which the mining operation could be carried would be quite limited and the mine track would have to be lengthened often. By means of the extensible track, however, the mine track can be laid up close to the mine wall and operations carried on quite a distance beyond the forward end of the mine track before the latter has to be lengthened by a gang of track layers.

It should also be noted that ordinary mine tracks are likely to be irregular on account of the rough floor on which they are laid and the twisting of the rails due to shifting about of the track sections will cause trouble when attempts are made to feed the cutter along such mine track. By providing the supplemental track, however, with machined guide grooves, the feeding of the cutter may be effected in a perfect plane and therefore much more efficiently. In other words, the kerf-cutter is so mounted as to cut a kerf in a plane parallel to the guideway. By means of this arrangement much greater accuracy is secured in the feeding movement than could be obtained by moving the whole machine along the rails of an ordinary mine track.

The main frame carries a kerf cutter which is mounted for vertical and horizontal pivotal movement, and also a plurality of drills, the kerf cutter being used for undercutting the material to be mined, while the drills may be used for forming openings above the material for the purpose of blasting down the material which has been undercut by the kerf cutter. The kerf cutter, as shown in Figs. 8, 12, 16, 19 and 20, comprises a horizontal cutter bar 79 having cutter chain guides 80 secured to the lateral faces thereof. The guides 80, as shown in Figs. 19 and 20, are held in place by bolts 81 having countersunk heads, the inner ends of the bolts being secured to holding strips 82 provided with flanges 83 which interlock with corresponding projections 84 formed on the lateral faces of the cutter bar. A cutter chain 85 is provided with links 86 each of which has flanges 87 arranged to cooperate with overhanging flanges 88 on the chain guide 80, as shown more clearly in Fig. 35, and the links 86 of the cutter chain alternate with links 89 which carry bits 90 arranged at different angles relative to the chain for forming the kerf in the material to be cut. The ends of the chain guides 80 and securing plates 82 are connected by bolts 91, Fig. 19, with a curved yoke 92 which forms the end of the cutter bar about which the forward portion of the chain 85 travels. A curved chain guide 93 is secured to the yoke 92 by bolts 94 and is formed with flanges similar to that of the guides 80 for directing the chain around the curved end of the bar. It will be apparent that the yoke 92 and the securing plates 82 may be slid longitudinally of the cutter bar 79, and a threaded bolt 95 is connected with the yoke 92 and passes through a cross-piece 96 at the end of the cutter bar 79 for the purpose of adjusting the yoke relative to the end of the bar. Nuts 97 are provided for holding the yoke 92 in adjusted positions to maintain the requisite degree of tension on the cutter chain 85. If the chain guides 80 and 93 become worn from use, they may be easily removed and replaced by sliding the yoke 92 with the guides attached from the end of the cutter bar, and then releasing the bolts which hold the chain guides in place.

By referring to Figs. 2, 8, 16, 19, 41 and 43 it will be seen that by the use of the semi-circular slidable guideway at the outer end of the chain cutter and the elimination of a sprocket wheel in this position the elongated supporting bar 79 may be extended almost to the extreme outer end of the elongated kerf-cutter. The adjusting mechanism comprising the screw 95 is located immediately between the semi-circular support 92 and the extreme outer end of the elongated supporting bar 79. The outer curved portion of the U-shaped frame 80 which is secured to the elongated supporting bar 79, as shown in Fig. 19, performs the function of acting as a

sliding guide for the chain and at the same time co-acts with the semi-circular support 92 and the adjusting mechanism for performing the additional function of changing the position of the U-shaped frame relative to the elongated rectangular bar 79 whenever desired. This arrangement permits the renewal of the U-shaped frame which contains an amount of material small in proportion to the remainder of the cutter bar. By providing such a U-shaped frame for the purpose of taking the wear produced by the chain, such U-shaped frame may be made of hard material with little or no additional expense, whereas if the whole cutter had to be made of hard material the expense would be comparatively considerable.

The rear end of the cutter bar 79 extends upwardly at 98 (Fig. 16) and carries a horizontally arranged portion 99 having a central opening in which an upright shaft 100 is journaled. A block 101 is secured to the rear face of the upright portion 98 by bolts 102 (Fig. 12) and provides a second bearing for the shaft 100. A sprocket wheel 103 is rigidly secured to the lower end of the shaft 100 and drives the cutter chain 85 which passes around the sprocket wheel. A second sprocket wheel 104 may be secured to the shaft 100 for driving a second cutter, where occasion demands. Where it is desired to use a second sprocket chain driven by the sprocket wheel 104, it is necessary to provide a supplemental cutter bar 105, as shown in Figs. 40 to 43. This supplemental bar may be arranged above the bar 79 and clamped thereto by bolts 106 which pass through a spacer 107 positioned between the two cutter bars. The rear end of the upper cutter bar 105 may be secured to the upright portion 98 of the lower cutter bar by bolts 108. When the supplemental cutter bar 105 is used, a second cutter chain 109 is carried by the supplemental bar and driven by the sprocket wheel 104. By this arrangement a kerf of double the usual width may be formed at one operation of the cutter.

The horizontally extending rear portion 99 of the cutter bar 79 is circular in form and is provided with a circumferential groove 110 (Fig. 16) which receives a correspondingly shaped rib 111 formed on a split bearing block 112, the disconnected portion 113 of which is held in place by cap screws 114 (Fig. 12). A spring catch or lock 110′ (Fig. 8) is arranged to enter any one of the series of openings 111′ in the horizontal portion 99 of the cutter bar for holding the cutter bar in its various positions of angular adjustment about the shaft 100. The shaft 100 is located at the center of the bearing formed by the bearing block 112, and the cutter bar 79 is free to swing in the bearing block about the center of the shaft 100 as an axis. The bearing block 112 is provided with rearwardly and outwardly extending upright walls 115, as shown in Figs. 7, 8, 11, 12 and 16, and these walls are connected at their rear edges by a transverse curved upright wall 116 (Fig. 18), the walls 115 and 116 forming a housing for the sprocket wheels 103 and 104. Horizontal flanges or plates 117 and 118 extend rearwardly from the rear face of the wall 116 and are vertically spaced from one another, as shown in Fig. 15. A box-shaped boom 119 is secured to the upper face of the plate 117 by rivets 120 and is supported near the rear of the main frame for vertical and lateral pivotal movement in a manner to be described. A bearing 121 is secured to the upper face of the plate 117 by cap screws 122, as shown in Figs. 7 and 15, and a shaft 123 is journaled in the bearing and projects forwardly through an opening in the upright wall 116 (Fig. 16) into the opening in the rear of the bearing block 112. The forward end of the shaft 123 carries a pinion 124 which meshes with a gear 125 rigidly secured to the upper end of the shaft 100 by means of which the sprocket wheels 103 and 104 are driven.

By referring to Figs. 1, 12 and 16 it will be seen that between the body portion of the boom 119 and the cutter head 79 there is a depending goose-neck connection particularly at 98.

As shown best in Figs. 15 and 18, a movable slide block 126 serving as a guide for supporting one end of the boom 119, is located between the plates 117 and 118 of the bearing block 112, and a shaft 127 extends transversely of the machine in the rear of the block 126. A sleeve 128 (Fig. 15) is journaled on the shaft 127 and is carried by arms 129 which have their rear ends rigid with the shafts 10 supported by the main frame of the machine. A worm wheel 130 (Fig. 18) is rigidly secured to one of the shafts 10 and is provided with a self-locking worm 131 which extends upwardly through the main frame of the machine and is provided with a squared end 132 at its upper end, as shown in Fig. 7, so that the worm may be rotated by means of a socket wrench. It will be apparent that rotation of the worm 131 and worm wheel 130 will tilt the arms 129 about the shafts 10 as an axis and so raise or lower the slide block 126, and in this way adjust the vertical position of the bearing block 112 for the cutter bar 79. The forward edge of the slide block 126 is curved to conform to the curvature of the rear wall 116 of the bearing block 112, the center of curvature of these surfaces being the upright axis about which the boom 119 swings on the main frame of the machine. The bearing block 112 and the cutter bar 79 may be swung laterally upon the slide block 126 in one direction by means of a heavy and strong cable 133 which passes over a pulley 134 (Fig. 18) in one end of the

slide block 126 and which has its end attached to a ring 135 at the lateral edge of the wall 115 opposite the pulley 134, as shown in Figs. 11 and 18. The cutter bar may be swung in the opposite direction by a smaller cable 136 of lesser strength than the cable 133 which passes about a pulley 137 (Fig. 18) in the opposite end of the slide block 126 and is connected to the bearing block 112 at the side thereof opposite the connection of the cable 133. A groove or a channel 138 is provided in the front face of the slide block 126 to accommodate the cables 133 and 136. A drum for operating the cables 133 and 136 is located near the rear of the main frame, and is driven in a manner to be described.

A pivotal attachment for the boom 119 is best shown in Figs. 6, 10, 14, 17 and 22. As will be seen from the broken lines in Fig. 6, the vertical side walls of the boom are curved inwardly near its rear end so that the horizontal plate extends beyond the outer face of the side walls. The boom is bifurcated at its rear end to form arms 139 which are angular in cross-section, as shown in Fig. 22. The bifurcations 139 are positioned on opposite sides of a pivot block 140 to which they are attached by a bolt 141 so that the boom 119 is free to swing vertically about the bolt 141 as an axis. The upper face of the block 140 is provided with a boss 143 which is journaled in a bracket 144 (Fig. 6) secured to the cover plate 145 of the main driving motor 146 which is shown in Fig. 5 provided with a controller 146'. The motor 146 is mounted upon the frame plate 1 and is held in place by bolts 147. An upright shaft 148 extends through the vertical axis of the pivot block 140 and is secured at its lower end in an opening in the frame plate 1, as shown in Figs. 14 and 22. The pivot block 140 is provided with a forwardly projecting sleeve bearing 149 in which a shaft 150 is journaled for rotation. The sleeve 149 is supported by a plate 151 journaled on a boss 152 extending upwardly from the upper face of the frame plate 1. A depression 153 in the plate 1 is provided for the supporting plate 151, and the plate and depression have their forward edges circular, as shown in Fig. 17, to permit the plate 151 to swing about the shaft 148 as an axis. An upwardly projecting lug 154 on the forward end of the plate 151 supports the bearing sleeve 149, as shown in Fig. 14. Journaled on the shaft 148 and resting on the upper face of the boss 152 and plate 151 is a composite gear comprising an inner beveled pinion 155, an outer spur gear 156 and an intermediate beveled gear 157. The gears 155, 156 and 157 are all joined together to rotate in unison with one another and to form in effect a single member. The gear 157 meshes with a pinion 158 secured to the motor shaft 159 by means of which the composite gear is driven. The shaft 150 is provided with a pinion 160 which meshes with the gear 155 and is driven thereby. The sleeve 149 is provided with an upwardly projecting rectangular boss 161 which extends between the vertical side walls of the boom 119, as shown in Figs. 6 and 14, and holds the boom and sleeve from lateral movement relative to one another, although the boom is free to swing vertically about its pivot 141 independently of the sleeve 149. The forward end of the shaft 150 is provided with a clutch 162 which is operated by a handle 163 reached through an opening 164 (Fig. 14) in the boom 119. The clutch 162 is arranged to aline with jaws 165 on the rear end of the shaft 123 when the boom is in its lowermost position, as shown in Fig. 15. A bearing 166 is provided in the boom 119 adjacent the clutch jaws 165 to hold the shaft 123 in fixed position relative to the boom. By means of the power transmission mechanism just described, the shaft 123 may be driven from the motor 146 to operate the cutter chain 85 when the boom and cutter bar are in their lowermost positions. Before the boom and cutter bar can be raised from this position for transporting the machine from one place to another in the mine, it is necessary to disconnect the clutch 162 from the clutch jaws 165.

During the transportation of the machine from place to place in the mine, the movable supporting frame 17 is lifted to free the track, and at the same time the cutter bar is raised to its uppermost position by the mechanism described for that purpose. This permits the machine to rest entirely upon the truck wheels, the rear ones of which are then driven to propel the machine to any desired location along the mine track. The mechanism for driving the truck wheels is best illustrated in Figs. 6, 17, 22 and 27. The gear 156 meshes with the gear 74 (Fig. 17) which has rigidly connected therewith a smaller spur gear 168 which in turn drives another spur gear 169 secured to an upright shaft 170 journaled in a bearing 171 in the plate 75, and in a second bearing 172 (Fig. 27) in the frame plate 1. The shaft 170 at its lower end carries a beveled pinion 173 which meshes with a similar pinion 174 loosely mounted on a horizontal shaft 175, but arranged to be clutched thereto by a clutch 176 operated by a handle 177, as shown in Fig. 6. The shaft 175 is supported by bearings 178 and 179 projecting laterally from the main side beam 2 of the machine frame. A worm 180 on the end of the shaft 175 meshes with a worm wheel 181 rigidly secured to the end of the axle 5 to which the truck wheels 3 are fastened. When the clutch 176 is in mesh with the pinion 174, the truck wheels 3 may be rotated to propel the machine along the track rails in the direction of movement depending upon the direction of rotation of the motor 146.

For operating the cables 133 and 136 by

means of which the cutter bar is swung laterally, a drum 182 is provided, which is illustrated in Figs. 6, 22, 26 and 28. An upwardly curved bracket or cover plate 183 is secured to the side beam 2 by bolts 184 (Fig. 6) at the side of the machine opposite the propulsion mechanism described, and an upright shaft 185 (Fig. 22) is journaled in a bearing 186 formed on the bracket member 183. The lower end of the shaft 185 is journaled in a bearing 187 in the frame plate 1. The shaft 185 has rigidly secured thereto a spur gear 188 which meshes with the spur gear 156 (Fig. 17) at the side opposite the gear 74. The drum 182 is loosely journaled on the shaft 185 (Fig. 28) and rests upon the upper face of the spur gear 188, but is free to rotate relative thereto. Internal gear teeth 189 are secured to the inside of the drum 182 and mesh with the teeth of a pinion 190 (Fig. 22) secured to the lower end of a shaft 191 journaled in a bearing 192 extending through the bracket plate 183. The upper end of the shaft 191 carries a worm wheel 193 above the upper face of the bracket plate 183. A horizontal shaft 194 (Fig. 6) is journaled in a bearing 195 supported upon the upper face of the bracket plate 183, and in a second bearing 196 carried by a bracket 197 secured to the cover plate 145 for the motor 146 by bolts 198. The shaft 194 is provided with a worm 199 which meshes with the worm wheel 193 to rotate the shaft 191 (Fig. 22) and the drum 182. Mechanism is provided for imparting opposite rotation to the drum 182 at different speeds through the shaft 194 and the gearing driven thereby. This mechanism is shown best in Figs. 6 and 22. A beveled pinion 200 is secured to the shaft 185 and meshes with a second pinion 201 secured to the end of a short shaft 202 journaled in a bearing 203 which is supported by a projection on the bracket plate 183. The outer end of the shaft 202 carries a spur gear 204 which meshes with a gear 205 loosely mounted on the shaft 194 and arranged to be rotated therewith by means of a clutch 206. The clutch 206 is shifted by a handle 207 shown in Fig. 6. The upper end of the shaft 185 carries a worm 208 which meshes with a worm gear 209 loosely mounted on the shaft 194, but arranged to cooperate with the clutch 206 when the clutch is shifted into one extreme position by the handle 207. When the handle 207 is shifted to bring the clutch 206 into engagement with the worm gear 209, the drum 182 will be turned slowly in one direction to wind the cable 133 upon the drum, and simultaneously to pay out the cable 136. This movement of the drum is employed to feed the cutter bar and chain into the work during a cutting operation. When the clutch 206 is shifted to the other extreme, the drum 182 is rotated in the opposite direction through the spur gears 204 and 205 to wind the cable 136 upon the drum, and pay out the cable 133. In this way a rapid return movement is imparted to the cutter bar.

In Figs. 2, 5, 6 and 21 is shown a pneumatic conveyer for gathering cuttings formed by the chain 85 and for conducting them back to the rear of the machine where they may be deposited in a mine car, or at the side of the track, as desired. This conveyer comprises a blower 210 driven by a motor 211 and having an intake pipe 212 connected therewith and extending toward the front of the machine where it enters the chamber formed by the walls 115 and 116 at the rear of the cutter bar 79, as shown at 213 in Fig. 7. The pneumatic intake pipe 212 is provided with a flexible section 214 (Fig. 2) to permit the pipe to swing in unison with the boom 119 to which it is connected by brackets 215. A discharge pipe 216 leads backwardly from the blower 210 to deposit the cuttings at the proper place in the rear of the car. A flexible section 217 (Fig. 2) is provided in the discharge pipe 216 to permit the end of the pipe to be swung to various positions. An adjustable brace 218, Fig. 9, supports the discharge pipe 216, and is connected with the main frame of the machine so that the pipe may be held in proper position for discharging material. It will be apparent that the cuttings from the chain 85 are carried rearwardly by the chain and deposited within the opening in the head 112 (Fig. 8) from whence they are drawn up by the suction pipe 213 and carried to loading position in the rear of the machine.

It will be noticed that in order to maintain a level floor in the mine chamber, the rear of the cutter bar operates very close to the floor level, and for this reason there would be a tendency for the cutter chain to carry the cuttings back with it on the return run instead of discharging them at the rear end of the cutter bar. To prevent this operation a spring 219 is secured to the edge of the cutter bar, adjacent the discharge position thereof, as shown in Figs. 34 and 35. As will be seen from these views, certain of the links of the cutter chain 85 are provided with downwardly projecting lugs 220 which are arranged to bear against the outer face of the spring 219 and press the spring inwardly toward the cutter bar as the lug slides along the face of the spring. When the lug 220 moves off the end of the spring 219, the spring is free to swing backwardly and so move the cuttings in front of it away from the path of movement of the cutter chain, and thus overcome the tendency of the cuttings to travel round and round with the chain.

In order to prevent undue formation of dust in a mine chamber caused by the discharge of the material from the pneumatic conveyor, it may be desirable to provide an expansion chamber at the discharge end of the tube 216, as shown in Figs. 36, 37 and 38.

This chamber may consist of an imperforate bottom 221 and side walls 222 and a perforate cover 223. The perforations 224 in the cover 223 are preferably closed to the escape of the pulverized cuttings from the tube 216 by means of a suitable woven fabric 225 which is stretched against the inner face of the cover plate 223. The air discharged from the tube 216 escapes through the fabric 225 and the perforations 224, but the dust and particles of material remain within the expansion chamber. An endless conveyer 226 is located within the chamber and carries the pulverized material toward the rear end where it is discharged through an opening 227 into the mine car, or on the pile of material being formed. A partition or shelf 221′ may be provided for the load bearing portion of the belt-conveyer 226. A hood 228 may be positioned over the end of the conveyer 226 to prevent dust from rising where the material is discharged. A series of baffle plates 229 may be placed within the discharge chamber to prevent the material from being carried directly to the discharge end of the chamber by the blast from the pipe 216 and to permit the air to expand and escape through the perforated cover before the material held in suspension thereby reaches the discharge end of the conveyer. A motor 230 is connected with the side of the expansion chamber, as shown in Figs. 36 and 37, for operating the endless conveyer 226.

Instead of the pneumatic conveyer shown in Figs. 1 and 2, a mechanical conveyer, shown in Figs. 44 to 47, may be used for conducting cuttings from the front of the machine to the loading position at the rear thereof. This conveyer may include an elevator section 231 having a receiving plate or platform 232 adjacent the discharge end of the cutter bar and arranged to discharge into a second conveyer section 233 mounted upon the rearwardly projecting plate 117 of the pivot head 112. The rearwardly extending portion of the conveyer section 233 may be supported by laterally projecting brackets 234 secured to the side of the boom 119. The elevator section 231 is rigidly connected with the side plate 115 of the pivot head 112, as shown in Figs. 44 and 46. By this arrangement, the elevator section 231 and the conveyer section 233 are made to swing in unison with the boom 119 and the cutter carried thereby. A motor 235 is connected with the conveyer section 233 and drives the endless conveyer of that section directly, and also operates the endless conveyer of the elevator section 231 through gears 236. The conveyer section 233 discharges into a hopper 237 rigidly mounted upon the main frame of the machine adjacent the pivotal support for the boom 119, as shown in Figs. 45 and 47, and a conveyer section 238 driven by a motor 239 carries the material rearwardly from the hopper 237 and discharges it into a second hopper 240 from which a pivoted conveyer section 241 driven by a motor 242 conducts the material to a position where it may be discharged into a mine car, or at the side of the mine track.

Mounted near the rear of the main frame, as shown in Figs. 1, 2, 5, 9, 13, 21, 29, 30, 31 and 32, are a plurality of drills for the purpose of forming drill holes above the material undercut by the kerf cutter in which blasting material may be inserted for breaking down the undercut coal. These drills are arranged to swing vertically and horizontally independently of one another and are all driven by a shaft 243 journaled in bearings 244 supported by the main frame plate 1. The shaft 243 carries a worm wheel 245 (Fig. 5) which meshes with a worm 246 on the rear end of the motor shaft 159. The worm wheel 245 is loose upon the shaft 243, but may be clutched thereto by a clutch 247 operated by a lever 248. The drill points 250 (Fig. 2) are secured at the front ends of threaded drill rods 251 (Fig. 31) which are arranged to telescope into and out of guiding tubes or sleeves 252. Each drill rod at its forward end is provided with a guiding collar 253 which fits the interior of the sleeve 252 and which is splined thereto by a key 254. The end of the drill rod is free to rotate in the sleeve 252. The drills 250 are of substantially the same length as the guiding tubes 252 so that when the collars 253 are withdrawn to the rear ends of the sleeves 252, the front ends of the drills 250 will project but slightly from the ends of the guide tubes 252, as shown in Fig. 2. A shoulder 255 is provided within the sleeve 252 to limit the rearward movement of the drills 250 and threaded drill rods 251, as shown in Fig. 31. The drills are withdrawn to their retracted position after their forward movement, by a cable 256 mounted upon a drum 257, which drum may be either spring actuated, or rotated by hand or by power. The drum 257 and the threaded drill rod 251 with its connected parts are all carried by a bracket member 258 which is provided with a socket 259 in which the rear end of the guiding sleeve 252 is rigidly secured. The bracket 258 is journaled to swing horizontally about a pivot sleeve 260 which projects upwardly from a bearing bracket 261 (Fig 32) in which a pair of beveled gears 262 and 263 are journaled in position to mesh with one another. The gear 262 is rigidly secured to the end of a short shaft 264 which is journaled in the bearing sleeve 260 and which carries a beveled pinion 265 at its upper end. The gear 263 is formed on a sleeve rigid with the shaft 243 and journaled in a bearing 266 at the lower end of the bracket 261. The bracket 261 carries a horizontally extending arm 267 which is provided with a spring-

pressed bolt 268 at its outer end arranged to enter any one of the series of notches 269 (Fig. 29) in a catch member 270 secured by bolts 271 to the upper surface of the frame plate 1. The bracket 261 may be tilted about the shaft 243 as an axis to vary the vertical angular position of the drill rods 251, and the bracket and drills may be held in their various positions of vertical adjustment by the bolt 268 and the catch 270. This adjustment of the bracket 261 does not in any way interfere with the driving relation of the beveled gears 262 and 263. The bracket 258 is provided with a bearing 272 in alinement with the threaded drill rod 251, and a beveled pinion 273 is carried by a sleeve 274 journaled in the bearing 272 and splined to the drill rod 251 by a sliding key 275. The pinion 273 meshes with the pinion 265 and is driven thereby independently of the lateral adjustment of the bracket 258 upon its pivotal support 260. A horizontally extending arm 276 is secured to the bracket 261 and is provided with a plurality of openings 277 for receiving a spring-pressed bolt 278 carried at the side of the bracket 258 and arranged to hold the bracket 258 in various positions of angular adjustment about the pivot sleeve 260. A tubular guide 279 extends rearwardly from the bracket 258 for supporting the rear end of the drill rod 251. A pair of hand levers 280 and 281 (Fig. 29) are pivotally mounted on the guide 279 and are connected by suitable cords and guides with the bolts 278 and 268, respectively, for the purpose of withdrawing these bolts when it is desired to shift the parts of the drill mechanism controlled thereby. A split nut is arranged in the rear of the bearing 272 for engaging the threads on the drill rod 251 and comprises a pair of upright bars 283 and 284 pivotally mounted at their lower ends on the bracket 258 and having their inner faces provided with threaded portions for meshing with the threads on the drill rod 251, as shown in Fig. 33. A pair of links 285 are pivoted to the upper end of the bar 284 and have their opposite ends pivoted to a yoke 286 (Figs. 29 and 30) which in turn is pivoted to the upper end of the bar 283. The yoke 286 is provided with a handle 287 by which it may be swung into the position shown in Fig. 30 for clamping the bars 283 and 284 in mesh with the threads on the drill rod 251. When the handle 287 is swung over to the opposite position, the split nut formed by the bars 283 and 284 will be free from the drill rod.

When the clutch 247 is thrown into operating position and the split nut formed by the bars 283 and 284 (Figs. 29 and 30) is held in mesh with the threads on the drill rod 251, rotation of the shaft 243 will drive the pinion 273 to rotate the drill rod 251 and the drill 250 connected therewith, and at the same time the threads on the drill rod 251 will feed the drill forwardly through its guide 252. When the drill has thus been driven to its limit of forward movement, the split nut formed by the bars 283 and 284 may be released from the threaded rod 251 and the drill may then be withdrawn by the cable 256 to its retracted position (Fig. 31). Before the beginning of a drilling operation, the operator may swing the drill into any desired position of vertical or lateral adjustment by grasping the rearwardly projecting guide 279 while the bolts 268 and 278 are held out of engagement with their latch members, and after the drill has been properly adjusted manually, the bolts may be released to hold it in its adjusted position. It should be noted that the two drills adjacent each other, at each side of the machine, are so placed that one is slightly above the other. This is for the purpose of preventing interference of the rearwardly projecting portions of the drills with one another when they are swung into their various positions of adjustment. It will also be seen that since the drills are placed at the sides of the machine, the upper portions of their mountings are substantially on a level with the upper portion of the motor 146, and hence no extra head room is required for the mounting of the drill (see Figs. 1, 9 and 13).

It should be particularly noted that the drill mechanism can be folded into compact relation with the framework for transportation along a low roof mine chamber. At the same time the drills are by reason of their sole support on the framework always immediately in readiness for operation when the portable frame is moved to a position adjacent the mine heading where drilling operations are to take place. The elongated framework is comparatively low in elevation to adapt the same for movement along a low roof mine chamber. The motor 146, as shown in Figs. 1 and 2, is located at the central rear portion of the framework and the drill mechanism is located at the sides thereof. The motor constitutes the single source of power for operating the drills although each of the latter is independently adjustable in inclination laterally and in inclination upwardly and downwardly. The drills may therefore be adjusted in fan-shaped relation, as shown in Fig. 3, so as to conform with the width of the kerf cut along the floor. While the framework remains stationary the cutters may operate simultaneously, each being fed along its own axis. At the same time that the drills are being operated and while the framework is stationary, the kerf-cutter may be fed laterally across the space in advance of the mine track. Therefore, as soon as the arcuate feeding movement of the kerf-cutter is completed the machine may be withdrawn and the mine wall will be in immediate

readiness for receiving the blasting charges which on account of the fan-shaped relation of the drills will break down the coal in accordance with the width of the kerf cut along the floor level.

When it is desired to begin a mining operation, the machine is first run into the chamber along the mine track with the cutter bar raised a sufficient height to clear the track. The track is not extended entirely to the face of the wall to be worked, but the end of the track is spaced from the wall a distance approximately equal to the length of the cutter bar and pivotal head on which it is supported, as shown in Fig. 1. When the machine has been brought into position with the forward end of the cutter bar adjacent the wall to be worked, the cutter bar and pivot head on which it is supported is swung to one side of the machine and the movable supporting frame 17 (Figs. 21 and 22) for the mining machine is then fed forwardly until the forward end of the supporting frame comes within a short distance of the mine face to be worked. It should be noted that the movable supporting frame is provided at its forward end with adjustable supporting screws or jacks shown at 290 in Fig. 15 of the drawings. These screws are provided with rectangular sockets to receive the upper end of a wrench so that they may be rotated to adjust the forward end of the movable frame 17 into proper vertical position. The rear end of the supporting frame 17 is provided with laterally extending arms 291 shown in Fig. 22 of the drawings which bear against the inner faces of the track rails to assist in receiving the thrust imparted to the supporting frame when the machine is being fed forwardly thereon. The frame is made long enough to bring the arms 291 back of the rearmost position of the rear truck wheels so that the arms will not interfere with the wheels. When the sliding supporting frame has been fixed in position the weight of the machine is then shifted from the truck wheels to the shoes 20 which rest upon the ways 18, by rotating the shaft 31 so that the arms 24 and 45 will move the shoes downwardly relatively to the frame, and thus lift the frame until its weight is caused to rest upon the shoes 20 and the ways 18. The cutter bar may now be lowered until the slide block 126 rests upon projections 292, Figs. 11 and 15, at the forward end of the main side beams of the machine frame. This will bring the cutter bar in proper position to form a kerf, the lower face of which will be in alinement with the mine floor. The forward end of the cutter bar may now be swung about the shaft 100 (Figs. 12 and 16) until it is in position at the extreme right of the cut which it is desired to make. The bar will be locked in this position by the catch 110′ (Fig. 8), and the machine may now be fed forwardly to cause the end of the cutter bar to enter the face of the wall to be worked. The forward movement of the machine is produced by the rotation of the gears 53 (Fig. 23) in engagement with the racks 51. As previously stated, there are two speeds of rotation of the gears 53, and the slower speed is adapted to be used during the forward feeding movement of the machine. The higher speed of rotation is adapted to be employed for moving the sliding supporting frame into and out of position before the weight of the machine is placed upon it, or after the weight has been removed from it. During the forward movement of the cutter bar into the mine face, the cutter chain 85 is driven through the mechanism described for that purpose, and the cuttings which are dislodged by the cutter chain are carried backwardly to the rear of the machine and discharged into a mine car by means of the conveyer extending along the length of the machine frame. During the forward movement of the cutter bar, the boom 119 is held from swinging laterally by the cables upon the drum 182. Rotation of the drum under the tension upon the cables is prevented by means of the self-locking worm gear on the shaft 194 (Figs. 6 and 22). When the machine has moved to a position to bring the pivot head 112 adjacent the wall of the mine being worked, the forward movement is discontinued and the drum 182 is driven to wind the heavy or strong cable 133 thereon, to swing the boom and cutter bar to the left, as indicated in broken lines in Fig. 3. This movement to the left is continued until the forward end of the cutter bar is brought to a position in alinement with the left side wall of the mine chamber. The machine is then fed backwardly along the movable supporting frame into its original position, which movement will complete the kerf beneath the section of material being undercut. The kerf formed is approximately six inches in height so that considerable material is removed during the undercutting operation, and this called cuttings is all carried to the rear of the machine and loaded into a mine car, as indicated in Figs. 3 and 4. During the time that the cutter bar is being swung from one side of the mine chamber to the other, the drills 250 are brought into position, as shown in Figs. 3 and 4, and are operated in the manner previously described to drill the blast holes, as indicated in these views. The drills are withdrawn from the openings made by them prior to the backward movement of the machine. After the kerf has been completed and the drill holes formed, the weight of the machine is again shifted from the movable supporting frame 17 to the truck wheels, and the cutter bar is

raised to clear the track. The machine may then be transferred to another postion in the mine while the undercut material is shot down and loaded in the usual manner.

If the coal vein is too thin to permit the machine to be received in the space occupied by it, the undercutting operation may be performed in the clay or other material beneath the vein. This will increase the height of the mine chamber to permit the entry of the machine. If this method of operation is employed, it will usually be desirable to discharge the cuttings of foreign material at one side of the mine track, as shown by the broken lines in Fig. 3 of the drawings, instead of loading them into the mine car. It may sometimes be necessary to form a kerf twice the width of the usual kerf in order to accommodate the machine in the space excavated. Under these conditions the double cutter shown in Figs. 40 to 43 is employed. In a machine of the proportions shown in the drawings this would permit of the formation of a kerf approximately twelve inches in height and would enable the machine to operate on a coal vein eighteen inches thick by cutting out foreign material under the coal vein to a depth of twelve inches and dislodging the coal to form a mine chamber thirty inches in height between the floor and roof for free passage of the mining and loading machine to new operating positions.

It will be noted from Fig. 3 of the drawings that the kerf formed by the front end of the cutter bar during its lateral swinging movement is a comparatively flat curve, thus making the face of the mine wall practically straight. This is due to the fact that the cutter bar is swung about the pivotal connection of the boom 119 with the rear end of the main frame, and not about the pivotal connection between the cutter bar and the front end of the boom. The long radius afforded by the combined lengths of the boom and cutter bar produces the flat curve making for all practicable purposes a straight wall at the end of the mine chamber where the material is being cut down.

It should be particularly noted that my combined coal-mining and loading machine herein disclosed is especially adapted to the mining and loading of coal in very low roof mine chambers, although it is also adapted for use on thicker veins of coal when mounted on a higher track. While the rectilinear feeding movement parallel to the track while the cutter is in an angular position to one side of the track, may be effected by the mechanism for propelling the truck, I prefer to effect the rectilinear feeding movement by means of the rack and pinion mechanism, because in the latter there is no tendency of any wheels to slip. In the type of machine herein disclosed, the kerf may be cut with comparatively great rapidity, and therefore it is desirable to dispose of the cuttings as fast as they accumulate. This is particularly true when the double kerf-cutter is used. It will be seen that when either a single kerf-cutter or a double kerf-cutter is employed to remove foreign material, the latter may be transferred to one side of the track, by means of the conveyer mechanism when the discharge pipe thereof is in the dotted line position shown in Fig. 3. But whether finely divided coal, or finely divided foreign material is being conveyed back of the mine wall, no objectionable dust will be raised, because the expansion chamber will allow the air to expand and pass through the perforations into the atmosphere while the solid particles are discharged by the mechanical conveyor in the expansion chamber.

I claim:—

1. A mining and loading machine comprising an undercutting chain cutter adapted to be located at the base of a mine wall to cut narrow kerfs in planes adjacent the plane of the floor of the mine chamber, a loading conveyer, and a narrow elongated intermediate conveyer at one side of the machine and in position adjacent the emerging run of the chain conveyor to gather the cuttings discharged from said undercutting kerf-cutter and convey such cuttings upwardly and rearwardly to said loading conveyor.

2. A mining and loading machine comprising an undercutting chain kerf-cutter adapted to be located adjacent the floor of a mine chamber, a narrow elongated conveyer at one side of the machine and having a lower receiving end adjacent the cuttings-discharged position of said undercutting chain kerf-cutter, means for holding the receiving end of said conveyer in fixed relation to said discharged position of said kerf-cutter for various positions of the latter and while said cutter travels toward said receiving end to convey cuttings thereto, and means in a relatively higher position than the receiving end of said conveyer for receiving cuttings from the latter.

3. A mining and loading machine comprising a supporting frame, an elongated chain kerf-cutter mounted thereon in an approximately horizontal plane for operation at the base of a mine wall in a plane adjacent to the floor of the mine chamber, means for swinging said elongated chain kerf-cutter on an upright axis relatively to said supporting frame to feed said kerf-cutter arcuately, means for driving said chain kerf-cutter, a conveyer extending on an upward incline from a receiving position in fixed relation to the return run of the chain kerf-cutter where the latter discharges its cuttings, and loading apparatus for receiving the cuttings from said conveyer at a position relatively higher than the receiving end of said conveyer.

4. A mining and loading machine comprising a main frame, an elongated chain kerf-

cutter mounted thereon in position to cut a kerf with its lower surface approximately in the plane of the floor of the mine chamber, said kerf-cutter comprising a cutter-frame mounted on said main frame for lateral swinging movement on an upright axis, a conveyer carried by said frame and movable bodily therewith, the receiving end of said conveyor being located at the floor adjacent the return run of said chain kerf-cutter in position to receive cuttings from the latter, and means for swinging said kerf-cutter and said conveyor in unison on said upright axis while the relation between the receiving end of said conveyor and said kerf-cutter is maintained at the floor of the mine chamber.

5. In a mining and loading machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon in position to cut material from a mine vein in approximately horizontal planes, and pneumatic-pressure apparatus comprising an intake opening downwardly and mounted on said frame and associated with said kerf-cutting mechanism for removing the small pieces of material cut by said kerf-cutting mechanism and loading such material.

6. A mining and loading machine comprising a supporting frame, a plane kerf-cutter mounted thereon for swinging feeding movement relatively thereto on an upright axis, and pneumatic apparatus mounted on said frame with its receiving or intake opening in fixed relation to the rear end of said plane kerf-cutter substantially at said upright axis for receiving the cuttings produced by said kerf-cutter in its various angular positions relative to said frame.

7. A mining and loading machine comprising a supporting frame, a floor kerf cutter mounted on said frame in position to cut a kerf at the base of the mine wall, and pneumatic apparatus mounted on said frame with its intake opening extending downwardly in position to receive and remove the small particles of material cut by said kerf cutter.

8. A mining and loading machine comprising a main frame, a supplemental frame mounted on said main frame for movement relatively thereto, cutting mechanism mounted on said supplemental frame for bodily movement therewithr to various positions for dislodging material in small pieces, a pneumatic suction motor mounted on said main frame, a pneumatic tube mounted on said supplemental frame and movable bodily therewith while extending to a position to gather said small pieces of material and remove them upon the operation of said pneumatic suction motor, and a flexible connection between said pneumatic tube and said suction motor.

9. A mining and loading machine comprising a main frame, of a supplemental frame movable relatively thereto, means mounted on said supplemental frame for cutting down the material to be mined in finely divided particles, a blower mounted on said main frame, and pneumatic tubular connections between said blower and an intake adjacent said cutting-down means, said pneumatic tubular connections comprising a flexible tube to permit movement of said supplemental frame and said cutting-down means relatively to said main frame while said blower is operated to cause the removal of the finely divided material from the cutting-down means.

10. In a mining and loading machine, the combination with a main frame, of a supplemental frame, kerf-cutting mechanism mounted on said supplemental frame to move bodily therewith relatively to said main frame, and means for removing the cuttings comprising a nozzle associated with said kerf-cutting mechanism, a pneumatic tube on said supplemental frame, suction apparatus on the main frame, and a flexible connection between the latter and said tube.

11. A mining and loading machine comprising a cutter frame having a closed chamber therein, a plane kerf cutter, means for supporting said kerf cutter in position to discharge cut material from said kerf cutter into said closed chamber, and a pneumatic conveyer for transferring material from said chamber toward loading position.

12. A mining and loading machine comprising a supporting frame having an overhanging downwardly extending chamber therein to form a pneumatic nozzle opening downwardly adjacent a mine floor, a plane kerf cutter, means for supporting said kerf cutter in position to cut a kerf in planes parallel to the floor of the mine chamber with the rear end of said kerf cutter in position to discharge its cuttings within the range of said nozzle, and pneumatic suction mechanism connected to said nozzle to remove such cuttings.

13. A mining and loading machine comprising a hollow frame closed at the top and sides to form an intake suction chamber open at its bottom adjacent the floor of the mine chamber, kerf-cutting mechanism arranged to move the cuttings formed thereby into said chamber, and pneumatic apparatus connected to said chamber for removing the said cuttings.

14. A mining and loading machine comprising a frame having walls thereon arranged to form a chamber with the bottom thereof open, means for supporting said frame to bring the open bottom of said chamber adjacent the floor of the mine, a kerf cutter arranged to move the cuttings formed thereby along the mine floor into said chamber, and a conveyer for transferring said cuttings from said chamber to loading position.

15. A mining and loading machine comprising a cutter frame having a downwardly

extending chamber open at its bottom, a plane kerf cutter, means for supporting said kerf cutter with its discharge end adjacent the opening in said chamber, and a pneumatic conveyer connected to said chamber.

16. In a mining and loading machine, the combination with a supporting frame, of an elongated cutter bar connected thereto, a chain cutter mounted to travel along said cutter bar to cut a plane kerf, and means connected to said cutter bar in position to be actuated by said chain to move the cuttings formed by the latter away from the path of movement of said chain cutter.

17. In a mining and loading machine, the combination with kerf-cutting mechanism comprising an endless chain, and means engaged by said chain and operated thereby for moving the cuttings formed by said chain out of the path of movement of said chain to prevent said cuttings from being moved back toward the mine wall by the return run of said chain.

18. In a mining and loading machine, the combination with a supporting frame, of an elongated plane kerf-cutter in position to cut a kerf at the base of a mine wall in an approximately horizontal plane, means for operating said kerf-cutter by continuously moving portions thereof into the mine wall and outwardly therefrom, and means engaged by said kerf-cutter to move the cuttings out of the way of the returning portion of said kerf-cutter and thereby prevent the cuttings from being moved back toward the mine wall.

19. A mining and loading machine comprising a supporting frame, a traveling cutter mounted thereon, and a movable member connected to said frame in the path of said cutter for operation by the latter to discharge cuttings formed by said cutter out of the path of the latter.

20. A mining and loading machine comprising a traveling kerf cutter, and a movable member in the path of said cutter and actuated thereby for moving the cuttings from said path.

21. In a mining and loading machine, the combination with a supporting frame, of a traveling kerf-cutter mounted thereon, and a yielding member intermittently operated by said traveling kerf-cutter for forcing cuttings out of the path of said kerf-cutter.

22. In a mining and loading machine, a traveling cutter having projections thereon, and a yielding member located in the path of said projections and actuated thereby for removing cuttings from said path.

23. In a mining and loading machine, a traveling cutter having projections thereon, and a resilient member located in the path of said projections and arranged to be engaged by said projections and placed under stress thereby while said projections are passing said member and to engage the cuttings when released by said projections and to force said cuttings out of said path.

24. In a mining and loading machine, a kerf cutter arranged to operate in close proximity to the floor of a mine chamber, and a resilient scraper located in the path of said cutter and arranged to yield thereto and to return to its original position under the resiliency thereof to remove the cuttings from said path.

25. In a mining and loading machine, an endless kerf cutter having projections thereon, and a resilient member located in the path of said cutter and arranged to be engaged by said projections and to be pressed thereby to one side of the path of said cutter and to return to its original position under the resiliency thereof after the passage of said projections to free the path of said cutter from the material severed thereby.

26. In a mining and loading machine, a cutter bar, a cutter chain arranged to travel along said bar, projections carried by said cutter chain, and a flat spring secured to said cutter bar in the path of said projections and arranged to be compressed by said projections during their passage along said bar and to be subsequently released thereby to cause said spring to remove the cuttings formed by said chain out of the path thereof.

27. In a mining and loading machine, a kerf cutter comprising a cutter bar, means for supporting said bar in close proximity to the floor of the mine chamber, an endless cutter chain arranged to travel on said bar having spaced projections thereon, and a flat spring secured to said bar in the path of said projections and arranged with its lower edge adjacent the floor of the mine so that said spring will be alternately compressed and released by said projections to cause said spring to move the cuttings formed by said chain out of the path thereof.

28. A mining and loading machine comprising an endless cutter, means located in the path of said cutter and operated thereby for moving the material severed thereby out of said path, and a conveying apparatus for transferring said material into loading position.

29. A mining and loading machine comprising an endless kerf cutter, a movable member located in the path of said cutter and operated thereby for forcing the cuttings out of said path, and conveying apparatus having its receiving end located adjacent said movable member for transferring said cuttings into loading position.

30. A mining and loading machine comprising a kerf cutter having an endless chain thereon, a resilient member located in the path of said chain and actuated thereby for removing the cuttings from said path, and a conveyor having its receiving end located adjacent said resilient member for receiving

the cuttings therefrom and for transferring said cuttings into loading position.

31. A mining and loading machine comprising a supporting frame, a chain kerf-cutter pivotally mounted on said frame to have a swinging feeding movement on an upright axis, a conveyor on said supporting frame with an arc-shaped hopper at its receiving end near the pivotal connection between said kerf-cutter and said supporting frame, and means comprising an auxiliary conveyor located adjacent said pivot for removing the cuttings discharged by said kerf-cutter and delivering such cuttings to said hopper while said kerf-cutter is swung on said pivot during the operation thereof.

32. A mining and loading machine comprising a movable cutter frame, a cutter bar pivotally mounted on said movable frame, an endless cutter on said cutter bar, means located adjacent the pivotal mounting of said bar for removing the cuttings from the path of said endless cutter, and a conveyer carried by said movable frame and having the receiving end thereof positioned adjacent the pivotal mounting of said cutter bar for receiving the material from said cutter chain and for transferring said material into loading position.

33. In a mining and loading machine, a main frame, a cutter frame pivotally mounted on said main frame, a cutter bar pivotally mounted on said cutter frame at the end thereof opposite the pivotal connection between said cutter frame and said main frame, a pneumatic conveyer having the receiving end thereof carried by said cutter frame adjacent the pivotal mounting of said cutter bar thereon, and a blower for forcing material through said pneumatic conveyer from adjacent said cutter bar to loading position in the rear of said machine.

34. A mining and loading machine comprising a main frame, a cutter frame pivotally mounted on said main frame, a cutter bar pivotally mounted on said cutter frame at the end thereof opposite the pivotal connection between said cutter frame and said main frame, an endless cutter chain carried by said cutter bar, means for removing material from the path of said cutter chain at a point adjacent the pivotal connection between said cutter bar and said cutter frame, a blower on said main frame, a pneumatic conveyer carried by said cutter frame and having the receiving end thereof located adjacent the pivotal connection between said cutter frame and said cutter bar, said conveyer having a flexible section therein to permit movement thereof with said cutter frame, and a discharge conveyer section connected with said blower for transferring material gathered by the receiving end of said conveyer and for discharging said material in loading position.

35. A mining and loading machine comprising a supporting frame, kerf-cutting mechanism mounted thereon, pneumatic conveyer apparatus for transferring the cuttings of said kerf-cutting mechanism toward loading position, and a perforated air expansion chamber at the discharge end of said conveyer apparatus.

36. A mining and loading machine comprising a supporting frame, means carried by said frame in position to dislodge material from a mine wall in a finely divided condition, pneumatic conveyer mechanism on said frame in position to receive such dislodged material and transfer the same toward loading position, and an expansion chamber at the discharge end of said conveyer mechanism to permit egress of the air but preventing dissemination of said material into the mine chamber by confining the discharge of said material to a predetermined position.

37. In a mining and loading machine, mining mechanism adapted to sever coal from a mine vein in a finely separated condition, a pneumatic conveyer for transferring said material into loading position, said conveyer having an expansion chamber at the discharge end thereof, and a screen for preventing the escape of said finely divided material but permitting the escape of air therethrough.

38. In a mining and loading machine, the combination with a supporting frame, of a kerf-cutter mounted thereon, a pneumatic conveyer for transferring material severed by said kerf-cutter, said conveyer having an expansion chamber at the discharge end thereof with openings leading therefrom, said openings being covered with a fabric to prevent the escape of dust therethrough, and a mechanical conveyer within said chamber for discharging material therefrom.

39. In a mining and loading machine, the combination with a supporting frame, of means mounted thereon for severing material from a mine vein in a finely divided condition, a pneumatic conveyer with an intake opening in position to receive the material as produced in finely divided condition, said conveyer having an expansion chamber with screened openings therein at the discharge end thereof, baffles within said expansion chamber to retard the passage of solid particles, a mechanical conveyer for discharging material from said expansion chamber, and means for producing a draft of air through said pneumatic conveyer while said severing means is being operated to take the material in fine divided condition and waft it into the expansion chamber where said baffles assist in separating the material while the air is exhausted through said openings and the solid particles deposited in position for actuation by said mechanical conveyer.

40. In a mining and loading machine, the combination with a supporting frame, of

means mounted thereon for severing coal from a mine vein in finely divided condition, a pneumatic conveyer for transferring such finely divided coal from the severing means toward loading position, said conveyer having an expansion chamber at the discharge end thereof and said chamber having a discharge opening for said material, a mechanical conveyer for transferring collected finely divided coal to said discharge opening, baffles within said chamber for retarding the passage of air and finely divided coal through said chamber, a perforated wall for said chamber, a screen for preventing the escape of dust through the perforations in said wall while permitting the passage of air therethrough, and means for producing a draft of air through said pneumatic conveyer to effect such transfer of the finely divided material and the separation thereof upon the air reaching said baffles.

41. In a mining machine the combination with a supporting frame, of a supplemental frame connected thereto and projecting therefrom to constitute a part of an elongated cutter-bar, an elongated U-shaped guide mounted at the sides of the elongated portion of said supplemental frame for adjustment relatively thereto and longitudinally thereof, to constitute the other part of said cutter-bar and serve as guides for a cutter-chain, an endless chain-cutter mounted on said cutter-bar and associated with said guide to slide along the same including the curved outer end of said U-shaped guide, and means adjacent the outer end of said elongated cutter between said supplemental frame and the curved portion of said guide for adjusting the position thereof relative to said supplemental frame and holding said guide in adjusted position.

42. In a mining machine, the combination with a cutter bar comprising a detachable elongated U-shaped chain guide, of means adjacent the outer end of the elongated cutter for adjusting the position of the chain guide and holding the same in adjusted position, a cutter chain mounted on said cutter bar and in engagement with said chain guide, means for operating said cutter chain while the wear thereof is taken by said detachable chain guide, and a supporting frame having an elongated extension to near the outer end of said U-shaped chain guide to constitute the other part of the cutter bar and sustain the weight of the parts.

43. In a mining machine, the combination with a supporting frame, of an elongated U-shaped chain guide to constitute a part of a cutter bar to take all the wear of the chain of the cutter bar, a supplemental frame comprising an elongated support extending nearly to the outer end of said U-shaped chain guide, connections between said chain guide and said elongated support for relative sliding movement between them for adjustment of the length of the cutter bar, means near the outer end of the U-shaped guide in position to act directly thereon to slide the latter along said elongated support, and an endless cutter chain mounted on said cutter bar in sliding engagement with said U-shaped chain guide.

44. In a mining machine, the combination with a cutter-bar comprising a detachable U-shaped chain guide section and an elongated rectangular section extending to a position near the outer end of said guide section, connections between the lateral sides of said elongated rectangular section and said U-shaped section for slidable relative adjustment, a chain-cutter comprising a chain adapted to slide along the sides of said U-shaped section and the outer curved portion thereof to confine the wear effected by said chain to said U-shaped section, and means for adjusting the position of said U-shaped section relative to said elongated rectangular section to vary the tension in said chain, said adjusting means being located between the outer end of said elongated section and the curved portion of said U-shaped section.

45. In a mining machine, the combination with an elongated U-shaped chain guide having a small cross-sectional area because of comparatively hard steel to take the wear of the cutter chain, an elongated frame having lateral grooves for slidably receiving the elongated narrow legs of said U-shaped frame, a semi-circular sliding guide at the outer end of said elongated frame, and means between said semi-circular guide and the outer end of said elongated frame for adjusting the position of said U-shaped frame to vary the length of the elongated cutter.

46. In a mining machine, the combination with an elongated U-shaped chain guide, comprising a removable curved wear plate with elongated extensions of small cross-sectional area adapted to be connected to the lateral edges of an elongated cutter-frame, and wear strips of comparatively hard steel to form chain guideways along the outer curved portion and along the extensions of said U-shaped chain-guide.

47. In a mining machine, a cutter bar, a cutter chain arranged to travel on said bar, and a wear plate having a slidable dovetail connection with the edge of said bar and having a slideway thereon for said cutter chain.

48. In a mining machine, the combination with a supporting frame, of a cutter-bar mounted thereon and comprising an elongated rigid section and an elongated U-shaped adjustable section having a sliding dove-tail connection with the lateral edges of said rigid section, said U-shaped section comprising portions detachably connected and including an outer removable chain-guide, and an endless cutter-chain mounted

on said cutter-bar in sliding engagement with the outer removable chain-guide.

49. In a mining machine, a cutter bar, an adjustable and removable section connected with the end of said bar, and a guide plate removably secured to said section and having a sliding dovetail connection with said cutter bar so that said removable section and guide plate may be slid longitudinally from said cutter bar to permit the replacement of said plate.

50. In a mining machine, the combination with a curved frame, of spaced-apart extensions, each C-shaped in cross-section, and wear strips to form a continuous guide-groove around said curved frame and along said extensions.

51. In a mining machine, the combination with a cutter-bar, of an endless cutter-chain mounted thereon, a supplemental cutter-bar detachably connected with said first-named cutter-bar, means for driving said cutter-chain, an additional endless cutter-chain mounted on said supplemental cutter-bar and connected to said driving means, and means for supporting said cutter-bar first-mentioned in position to cut a kerf of a predetermined thickness and for supporting both of said cutter-bars in position for the cutting of a kerf approximately double the thickness of the kerf cut when only one cutter-bar is used.

52. A mining and loading machine comprising a chain-kerf-cutter, means for operating said chain kerf-cutter, an additional detachable chain kerf-cutter connected to said first-named kerf-cutter in position to form a single wide kerf, and conveyer-mechanism associated with both of said kerf-cutters for transferring the material severed thereby toward loading position.

53. A mining and loading machine comprising a supporting frame, a cutter-bar connected thereto, an endless chain-cutter mounted on said cutter-bar, means for operating said chain-cutter, an additional cutter-bar detachably connected to said first-named cutter-bar, an additional chain-cutter on said additional cutter-bar and connected to said operating means, and conveyer mechanism mounted on said supporting frame in position for receiving the cuttings from said chain-cutters and transferring said cuttings toward loading position.

54. In a mining and loading machine, a frame, a cutter bar movably mounted on said frame, a supplemental cutter bar detachably connected with said first-mentioned cutter bar, cutter chains carried by said cutter bars adjacent one another and in position to form a single kerf, and means for moving said cutter bars to feed said chains into material to be mined to remove a portion of said material in a finely divided condition.

55. In a mining and loading machine, a frame, a cutter bar movably mounted on said frame, a supplemental cutter bar detachably connected with said first-mentioned cutter bar, cutter chains carried by said cutter bars adjacent one another and in position to form a single kerf, means for moving said cutter bars to feed said chains into material to be mined to remove a portion of said material in a finely divided condition, and a conveyer having its receiving end positioned adjacent the discharge portion of said conveyer chains for transferring the material dislodged by said chains into loading position.

56. In a mining and loading machine, a movable cutter frame having a bearing at one end thereof, a cutter bar having a pivot head journaled in said bearing for horizontal pivotal movement relative to said frame, a shaft journaled in said pivot head at the axis thereof, a sprocket carried by said shaft, a chain on said cutter bar driven by said sprocket, a gear secured to said shaft, means on said frame for driving said gear, walls on said frame for forming a partially enclosed chamber into which material may be discharged by said chain, and a conveyer for transferring material from said chamber into loading position.

57. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon in position to operate in the plane of the floor in advance of the mine track, front and rear truck wheels for mounting said supporting frame for transportation on the mine track, means for supporting said kerf-cutting mechanism in elevated position above the mine track for transportation, pivoted arms for the front truck wheels, and double cushioned connections between said arms and said supporting frame for cushioning the movements of said arms relatively to said frame.

58. In a mining machine, the combination with a main frame, of plane kerf-cutting mechanism carried thereby for bodily movement therewith, a supplemental frame movably connected to said main frame, means for shifting the weight of said main frame together with said kerf-cutting mechanism onto and off of said supplemental frame, and rack-and-pinion mechanism for moving said main frame along said supplemental frame and in parallelism thereto to feed said kerf-cutting mechanism into the material to be mined to cut a kerf in a plane parallel to the path of movement of said main frame along said supplemental frame.

59. A mining and loading machine comprising a main frame, arms pivotally mounted on said main frame for vertical movement relative thereto, shoes carried by said arms, a supporting frame slidably connected with said shoes and arranged to be moved vertically relatively to said main frame by said arms to shift the weight of said main frame onto and off of said supporting frame, truck

wheels for supporting said main frame when said supporting frame is held in inoperative position by said arms, and rack and pinion mechanism for moving said main frame along said supporting frame.

60. In a mining machine, a main frame, a movable supporting frame slidably connected with said main frame, means for shifting said supporting frame and main frame relatively to one another, a rack on said supporting frame, a gear connected with said main frame and engaging said rack to move said main frame along said supporting frame, a cutter carried by said main frame, and means for rotating said gear independently of the vertical adjustment of said supporting frame relative to said main frame to feed said main frame and cutter along said supporting frame to cause said cutter to enter material to be mined.

61. In a mining machine, a main frame having a cutter thereon, truck wheels for supporting said main frame, a supporting frame for said main frame, means for shifting said main frame and supporting frame vertically relatively to one another to alternately transfer the weight of said main frame between said truck wheels and supporting frame, a rack connected with said supporting frame, a gear meshing with said rack for feeding said main frame along said supporting frame, and mechanism for driving said gear at different rates of speed for shifting said main frame and supporting frame relative to one another.

62. The combination with a supporting frame, of a plurality of drills mounted on the rear portion of said frame to swing relatively thereto in upright and horizontal directions independently of one another, adjustable mechanism for holding each drill in the position to which it is moved uprightly and horizontally so that said drills will be arranged in fan-shaped relation for operation over a predetermined area of the mine vein, kerf-cutting mechanism mounted on said frame for horizontal swinging movement relatively thereto on an upright axis at the rear portion of said frame, means for operating said kerf-cutting mechanism to cut a kerf below the range of operation of said drills and conforming to the area of operation of the latter, and mechanism for operating the drills including the feed of each drill longitudinally along its own axis while said supporting frame remains stationary and while said kerf-cutting mechanism is being operated to produce said kerf.

63. In a mining machine, the combination with a wheel supported frame adapted to travel along a mine track to a mine heading in a mine chamber, of kerf-cutting mechanism mounted on said frame a motor mounted on said frame, drills mounted on said frame for sole support thereby at opposite sides of said motor, means for suporting said drills solely on said frame and for independent adjustment to various angular positions relative to the path of travel of said supporting frame, means connected with said motor and said drills for operating the latter in their various adjusted positions, and means for operating said kerf-cutting mechanism.

64. In a mining machine, the combination with a portable supporting frame, of kerf-cutting mechanism mounted thereon a plurality of drills extending longitudinally along the upper portion of said frame and carried thereby for transportation bodily therewith, means for supporting said drills entirely on said frame to move upon their mountings relatively to said frame for adjustment independently of each other in readiness to operate upon an upright mine wall as soon as frame is transported to a position adjacent such wall, means for effecting the driving of said drills simultaneously from a single source of power, means for effecting the feeding of each drill along its own longitudinal axis while said supporting frame remains stationary, and means for operating said kerf-cutting mechanism.

65. In a mining machine, the combination with a portable supporting frame, of kerf-cutting mechanism mounted thereon a bracket mounted on said frame for independent vertical and horizontal pivotal movement relatively thereto, a drill carried by said bracket for adjustment in inclination upwardly and downwardly and laterally relative to said frame, means for holding said bracket in its various positions of pivotal adjustment to predetermine the operating axis of said drill, means for rotating and feeding said drill at all positions of adjustment thereof, while supported entirely by said bracket and said frame and while the latter occupies a stationary position in the mine chamber, and means for operating said kerf-cutting mechanism.

66. A mining and loading machine comprising a frame, a horizontal shaft carried by said frame, a bracket journaled on said shaft and having an upright shaft journaled therein, gears for rotating said upright shaft from said horizontal shaft a second bracket pivotally mounted on said first-mentioned bracket to swing horizontally relative thereto, a drill mounted in said second bracket, gearing driven by said upright shaft for rotating said drill, threads for feeding said drill longitudinally during the rotation thereof, a releasable nut for engaging said threads, means for returning said drill to its retracted position after it has been fed forwardly by said threads and nut, and means for holding said drill and brackets in different positions of pivoted adjustment.

67. A mining and loading machine comprising a main frame, a kerf-cutter mounted

on said frame for swinging movement relatively thereto to cut a kerf while said main frame remains stationary, drills mounted on said main frame, mechanism for operating said drills during the swinging feeding movement of said kerf-cutter, and conveyor mechanism for transferring the material loosened by said kerf-cutter, toward loading position during the operation of said drills and during the operation of said kerf-cutter.

68. A mining and loading machine comprising a frame, a cutter mounted on said frame, means for driving said cutter, means for feeding said frame and cutter forwardly during the operation of said cutter, means for swinging said cutter laterally relative to said frame while said cutter is operated, means for removing material disconnected by said cutter into loading position during the forward and lateral movements of said cutter, and drills carried by said frame and arranged to be operated simultaneously with the lateral movement of said cutter.

69. In a mining and loading machine, a main frame, a boom pivotally connected with said main frame adjacent the rear end thereof and supported by the forward end thereof, a cutter pivotally connected with the forward end of said boom at a point adjacent the forward end of said main frame, means for locking said cutter against pivotal movement on said boom at various angular positions relative thereto, means for swinging said boom and cutter about the pivotal connection of said boom with said main frame while being supported by the latter, and a conveyer having the receiving end arranged to travel with said boom and cutter to gather material disengaged by said cutter during the movement thereof.

70. In a mining machine, a main frame, a cutter carried by said frame, truck wheels for supporting said main frame, a supplemental supporting frame movably connected with said main frame, means for shifting the weight of said main frame alternately to and from said truck wheels and said supplemental supporting frame, and rack and pinion mechanism connecting said supplemental supporting frame and said main frame to move said main frame along said supporting frame to feed said cutter relative to the material to be mined.

71. In a mining machine, the combination with an elongated kerf-cutter comprising an elongated cutter-bar extending nearly the entire length of said kerf-cutter, of a U-shaped elongated chain-guide fitting the sides of said bar throughout the length of the latter and comprising a semi-circular guide groove at its outer end, a chain-cutter on said chain-guide, and means located at the outer end of said kerf-cutter between the outer end of said bar and the curved portion of said guide to adjust the position of the latter relative to said bar.

72. In a mining machine, the combination with an elongated kerf-cutter comprising an elongated cutter-bar extending over nearly the entire length of said kerf-cutter, of a U-shaped chain-guide frame slidably mounted on the edges of said cutter-bar along nearly the whole length of the kerf-cutter and comprising a curved fixed guide at its outer end, a chain-cutter mounted on the outer edges of said chain-guide frame, and means located adjacent the curve of said U-shaped frame for adjusting the position of said chain-guide relative to said bar to adjust the length of said kerf-cutter.

73. A coal mining and loading machine comprising a hollow frame closed at the top and sides to form an intake suction chamber open at its bottom adjacent the floor of the mine chamber, kerf-cutting mechanism mounted in position to move the cuttings formed thereby into the range of action of said suction chamber, means for operating said kerf-cutting mechanism to produce a kerf in a coal vein, and pneumatic apparatus connected to said chamber for producing suction and removing the coal cuttings from said kerf-cutting mechanism.

74. In a mining and loading machine, the combination with a supporting frame, of a supplemental frame having a chamber with the bottom thereof open, means for supporting said supplemental frame to hold the open bottom of said chamber adjacent the floor of a coal mine, mechanism mounted on said supporting frame in position to cut coal from an upright mine wall and to move the cuttings within the vicinity of the bottom opening of said chamber, conveyer mechanism mounted on said supporting frame for transferring the cuttings from said chamber toward loading position.

75. In a mining and loading machine, the combination with a supporting frame, of cutting mechanism mounted thereon in position for operating on an upright face of a coal vein, a pneumatic intake opening downwardly at a position adjacent the mine floor, and pneumatic apparatus for producing a direct suction of air from said intake to remove the coal cuttings produced by said cutting mechanism at the upright coal face.

76. A mining and loading machine comprising a supporting frame, kerf cutting mechanism mounted thereon, a pneumatic suction tube always open for the free passage of air and dry particles of material, an intake connected to said pneumatic suction tube and opening downward adjacent the cutting mechanism, and means for producing suction of air from said intake through said tube to remove the cuttings produced by said cutting mechanism.

77. A mining and loading machine comprising a supporting frame, of cutting mechanism mounted thereon in position to operate on an upright mine wall, a pneumatic suction nozzle extending downwardly to a position adjacent the mine floor where the cuttings are deposited by the operation of said cutting mechanism, and pneumatic suction apparatus connected to said nozzle for producing a suction of air through said nozzle to remove the cuttings in a state of dryness.

78. In a mining machine, the combination with an elongated supporting frame relatively low in height to adapt the same for movement along a low roof mine chamber, of kerf-cutting mechanism mounted thereon a plurality of elongated drills mounted on said frame to occupy approximately horizontal positions at the sides of the frame during transportation along such low roof mine chamber, means for connecting said drills to said frame to swing relatively thereto in vertical and horizontal directions independently of one another, mechanism for each drill for holding the same in the position to which it is moved vertically and horizontally, means for operating said drills including the feed of each thereof on its own axis while said supporting frame remains stationary, and means for operating said kerf-cutting mechanism.

79. A mining and loading machine, comprising a main frame, an elongated kerf-cutter mounted on said frame for swinging movement relatively thereto to cut a kerf while said main frame remains stationary, a plurality of spaced-apart drills mounted on said main frame, means for operating said drills during the swinging feeding movement of said kerf-cutter, and means for removing the cuttings from said kerf-cutter during the operation of the latter.

80. In a mining machine, the combination of a supporting frame, of an undercutting kerf cutter, means for operating the same to cut a kerf of a predetermined width, a plurality of drills mounted on said frame for adjustment in fan-like formation to drill an area having a width corresponding to the width of said kerf, and means for operating said drills simultaneously with the operation of said undercutting kerf-cutter.

81. In a mining machine, the combination of a frame, a cutting element extending therefrom, a motor in driving connection with said cutting element, a blower mounted on said machine, a motor in driving connection with said blower, an intake pipe leading from said blower to a point adjacent the path of said cutting element and provided with an enlarged nozzle mounted in advance of said frame and opening toward said cutting element, and a discharge pipe leading from said blower to a point remote from said machine.

82. In a mining machine, the combination of a frame, a cutter bar extended from said frame, a cutter chain carried by said cutter bar, cutter chain driving mechanism mounted on said frame, including a motor, a blower mounted on said frame, another motor in direct driving connection with said blower, and inlet and exhaust pipes extending to and from said blower, said intake pipe having a nozzle at the intake end thereof and mounted adjacent the path of the advance lead of said cutter chain.

83. In a mining machine, the combination of a frame, a cutter bar, a cutter chain on said cutter bar, a motor in operative connection with said cutter chain, a blower unit mounted upon said machine frame and comprising a rotary blower and a motor in driving connection therewith, and intake and exhaust pipes leading to and from said blower, said intake pipe having an enlarged inlet opening positioned to receive the cuttings removed by said cutter chain.

84. In a mining machine, the combination of a frame, a cutter bar, a cutter chain on said cutter bar, a motor within said frame and having driving connection with said cutter chain, a blower and driving motor therefor mounted on top of said frame and operative independently of said first-mentioned motor, and intake and discharge pipes, one leading from said blower to a point adjacent the inner end of the advancing lead of said cutter chain and the other to a point remote from said machine.

85. In a mining machine, the combination of a frame, a cutter bar, a cutter chain on said cutter bar, a motor in operative connection with said cutter chain, a motor driven blower mounted upon said frame and operative independently of said first-mentioned motor and cutting mechanism, an intake pipe leading to said blower from a point adjacent the cutter chain, and an exhaust pipe leading from said blower and connected with a flexible hose adapted to lead to a convenient point remote from said machine.

86. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism carried by said frame in position to cut a horizontal kerf beneath the material to be mined, means for operating said kerf-cutting mechanism, a plurality of drills, means for mounting said drills on said supporting frame for adjustment up and down to various angles in position to drill holes above the kerf cut by said kerf-cutting mechanism, means for operating said drills in their various adjusted positions to drill such holes in the body of material to be mined, and means for adjusting one of said drills to various angular positions laterally on an upright axis.

87. In a mining machine, the combination with a supporting frame, of an undercutting

kerf-cutter mounted thereon, means for operating said undercutting kerf-cutter, a plurality of drills mounted on said supporting frame in position to form blasting holes in the mine vein above the undercut kerf, and means for mounting said drills for adjustment in fan-like formation of varying widths.

88. In a mining machine, the combination with a supporting frame, of an undercutting kerf-cutter mounted thereon, a plurality of drills mounted on said frame in position to produce blasting holes in the unmined mass above the undercut kerf, and means for adjusting the positions of the drills by spreading them apart predetermined distances in accordance with the width of the kerf cut by the undercutting kerf-cutter.

89. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism, a plurality of drills mounted on said supporting frame in position to produce a plurality of blasting holes in the material to be dislodged bound by the kerf cut by said kerf-cutting mechanism, and means for supporting said drills for adjustment in fan-like formation in accordance with the width of the kerf cut by said kerf-cutting mechanism.

90. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism, a plurality of drills mounted on said supporting frame in position to produce a plurality of spaced-apart blasting holes spaced above the kerf in the material to be dislodged above said kerf, and means for supporting said drills for adjustment in elevation in accordance with the predetermined height of material above the kerf to be dislodged.

91. In a mining machine, the combination with a supporting frame, of an undercutting kerf-cutter, means for operating said kerf-cutter, a plurality of drills mounted on said supporting frame in position to produce a plurality of blasting holes in the material to be dislodged above said under kerf, and means for supporting said drills for adjustment in elevation in accordance with the height of the material to be dislodged, and also for adjustment in width of a fan-like formation in accordance with the width of the under kerf.

92. In a mining machine, the combination with a supporting frame, of an undercutting kerf-cutter mounted thereon, means for operating said undercutting kerf-cutter; a supplemental frame mounted on said supporting frame for a swinging movement relatively thereto on a horizontal transverse axis, a plurality of drills mounted on said supplemental frame to swing up and down therewith relatively to the supporting frame and said kerf-cutter to vary the height of the drillholes above the kerf, and means for supporting the lateral drills on said supplemental frame for lateral adjustment to vary the width of the drilled mass above the under cut in accordance with the width of the latter.

93. In a mining machine, the combination with a supporting frame, of a supplemental frame mounted thereon to swing relatively thereto on an upright axis, a kerf-cutter mounted on said supplemental frame to swing bodily therewith and in position to cut a kerf at the base of the mine wall approximately in the plane of the mine floor, means for propelling said supporting frame to feed said kerf-cutter rectilinearly forwardly into the mine wall at one side thereof and rearwardly out of the mine wall at the other side thereof, means for swinging the supplemental frame relatively to the main frame to secure swinging feeding movement of the kerf-cutter across the mine wall, a plurality of drills mounted on said supporting frame in position to produce a plurality of blasting holes in the material to be dislodged above the under kerf, and means for supporting said drills for adjustment in fan-like formation of varying widths in accordance with the varying widths of the kerf cut by said kerf-cutter and also for adjustment in elevation in accordance with the height of the mine vein to be dislodged above said under kerf.

94. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, a plurality of drills, means for supporting said drills for simultaneous movement up or down to various adjusted positions on a horizontal axis and for independent movement to various adjusted positions on spaced-apart upright axes, and means for operating said drills to produce blasting holes above the kerf cut by said kerf-cutting mechanism in an upright mine wall.

95. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism, a plurality of drills mounted on said supporting frame in position to produce a plurality of blasting holes in the material to be dislodged bounded by the kerf cut by said kerf-cutting mechanism, means for supporting said drills for adjustment independently of each other to various angles relative to the upright face of the mine wall, and means for simultaneously operating said drills including independent feeding movements thereof each on its own longitudinal axis independently of the operation of said kerf-cutting mechanism.

96. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism, drilling mechanism mounted on said supporting frame in position to produce a blasting hole

in the material to be dislodged bounded by the kerf cut by said kerf-cutting mechanism, means for supporting said drilling mechanism laterally and up and down to various angles relatively to the plane of the kerf and relatively to longitudinal upright planes through said supporting frame and means for operating said drilling mechanism including feed, thereof along the axis of the drill in its adjusted position of angularity, independently of movement of said supporting frame.

97. In a mining machine, the combination with a supporting frame of wheels for supporting said frame on a track, undercutting mechanism mounted on said frame, means for operating said undercutting mechanism, drilling mechanism mounted on said frame in position to drill a hole in the body of the material above the under cut in directions inclined upwardly or downwardly as well as horizontally, and means for operating said drill independently of movement of said frame and while said cutting mechanism is being operated.

98. In a mining machine, the combination with a supporting frame, of kerf-cutting mechanism mounted thereon, means for operating said kerf-cutting mechanism, drilling mechanism mounted on said supporting frame in position to produce a blasting hole in the material to be dislodged bounded by the kerf cut by said kerf-cutting mechanism, said drilling mechanism being adjustable to various angles relatively to the plane of said kerf, and means for operating said drilling mechanism including feed thereof along the axis of the drill independently of movement of said supporting frame.

99. In a mining machine, a frame, a track for supporting said frame, a cutter carried by said frame and arranged to form a horizontal kerf beneath material to be mined, means for shifting said frame along said track to feed said cutter into said material, and a plurality of drills carried by said frame and each independently fed along its own axis independently of movement of said frame for forming charge receiving openings in said material.

100. In a mining machine, a frame, an undercutter for material to be mined carried by said frame, means for feeding said undercutter relative to said material while said frame remains stationary in a mine chamber, and a drill carried by said frame and arranged to operate during said feeding operation of said undercutter, to form a charge receiving opening in said material.

101. In a mining machine, a frame, an undercutter carried by said frame, a drill mounted on said frame and disposed at an oblique angle to said undercutter, and means for simultaneously feeding said drill and undercutter into material to be mined.

102. In a mining machine, a frame, an undercutter carried by said frame and movable laterally relatively thereto, a drill mounted on said frame, and mechanism for simultaneously operating said undercutter and said drill including lateral feed of the cutter and longitudinal feed of the drill.

103. In a mining machine, a frame, an undercutter carried by said frame, a drill mounted on said frame, and mechanism for simultaneously feeding said undercutter and said drill into material to be mined while said frame is stationary to form a kerf beneath said material and to form a charge receiving opening above said material.

104. In a mining machine, a frame, a track for supporting said frame, an undercutter carried by said frame, means for shifting said frame on said track to feed said undercutter into material to be mined, means for feeding said undercutter relative to said material independently of the movement of said frame on said track, a plurality of drills mounted on said frame, and means for feeding said drills into said material simultaneously with the last-mentioned feeding movement of said undercutter.

105. In a mining machine, a frame, a track for supporting said frame, means for feeding said frame on said track, an undercutter supported by said frame, a plurality of drills carried by said frame for operation at angles relatively to each other and means for operating said drills to form charge receiving openings in said material.

106. In a mining machine, a frame, a track on which said frame is mounted, means for moving said frame along said track, an undercutter carried by said frame and movable therewith relative to said track, means for shifting said undercutter on said frame independently of the movement of said frame on said track, a plurality of drills mounted on said frame at an oblique angle to the cutting plane of said undercutter, and means for operating said drills simultaneously with the operation of said undercutter.

107. In a mining machine, a frame, an undercutter carried by said frame, means for feeding said undercutter into material to be mined, a plurality of drills mounted on said frame, means for shifting said drills to different angles relative to the cutting plane of said undercutter, and means for operating said drills in such angular positions simultaneously with the operation of said undercutter.

108. In a mining machine, a main frame, a supplemental frame extending longitudinally of said main frame from the rear portion thereof and having an undercutter supported thereby at one end of said main frame, and a drill frame carried by the rear portion of said main frame and extending longitudinally thereof and having drills arranged to

be projected beyond said main frame at the end of said main frame adjacent said undercutter.

109. In a mining machine, a main frame, a supplemental frame pivotally connected with one end of said main frame and extending longitudinally of said main frame, an undercutter carried by said supplemental frame adjacent the end of said main frame opposite the pivotal connection between said main frame and said supplemental frame, and a drill frame mounted on said main frame adjacent the pivotal connection between said main frame and said supplemental frame, said drill frame being arranged longitudinally of said main frame and having drills thereon arranged to be projected therefrom at the end of said drill frame adjacent said undercutter.

In testimony whereof I have signed my name to this specification on this 16th day of August, A. D. 1918.

EDMUND C. MORGAN.