Nov. 4, 1941.

J. F. JOY

2,261,162

MINING APPARATUS

Filed Feb. 28, 1938

10 Sheets-Sheet 1

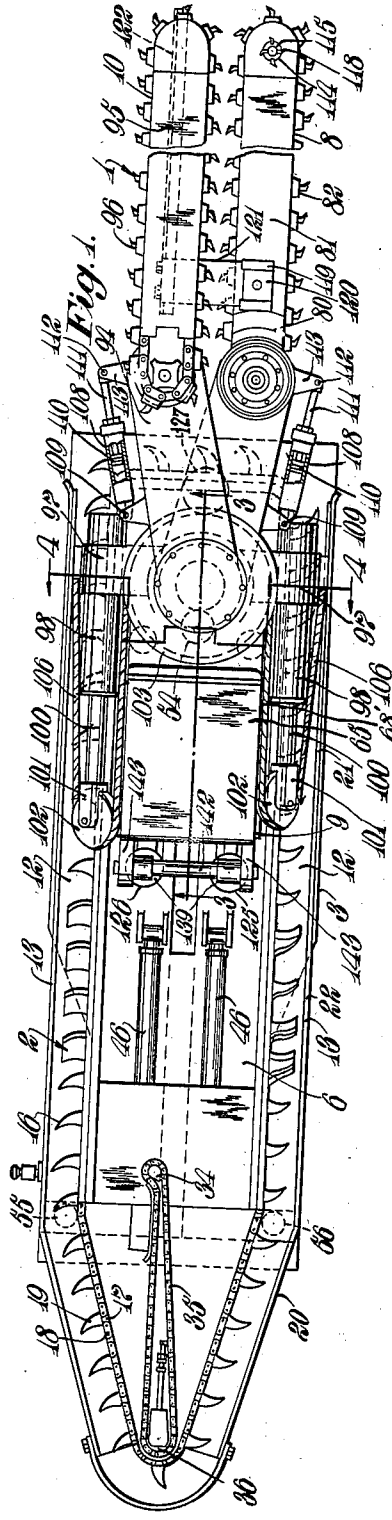

Fig. 1.

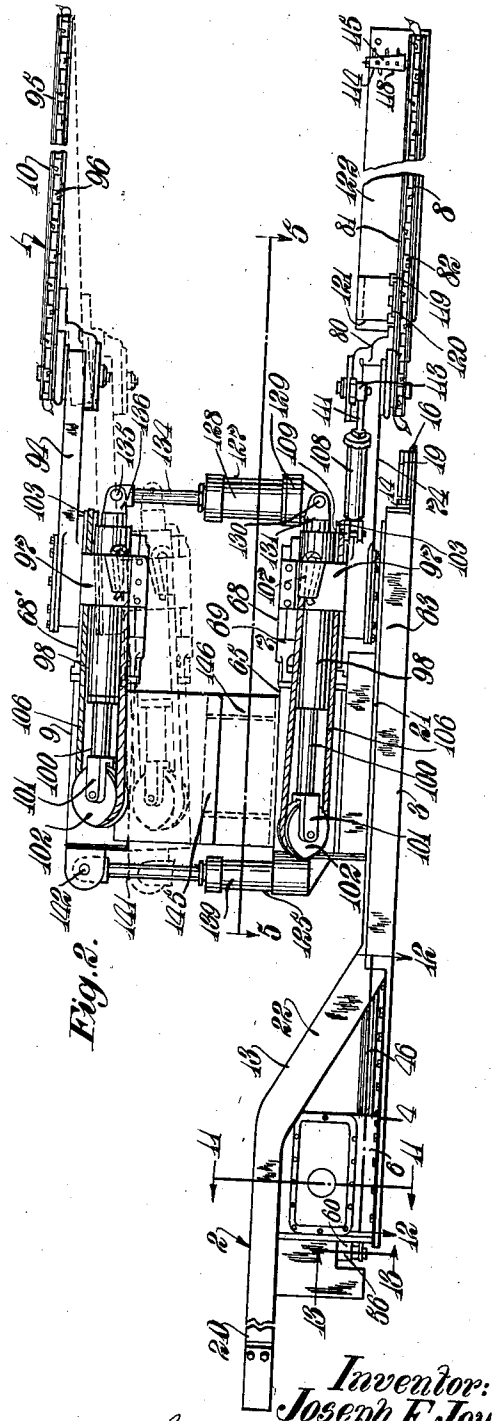

Fig. 2.

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Nov. 4, 1941. J. F. JOY 2,261,162

MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 2

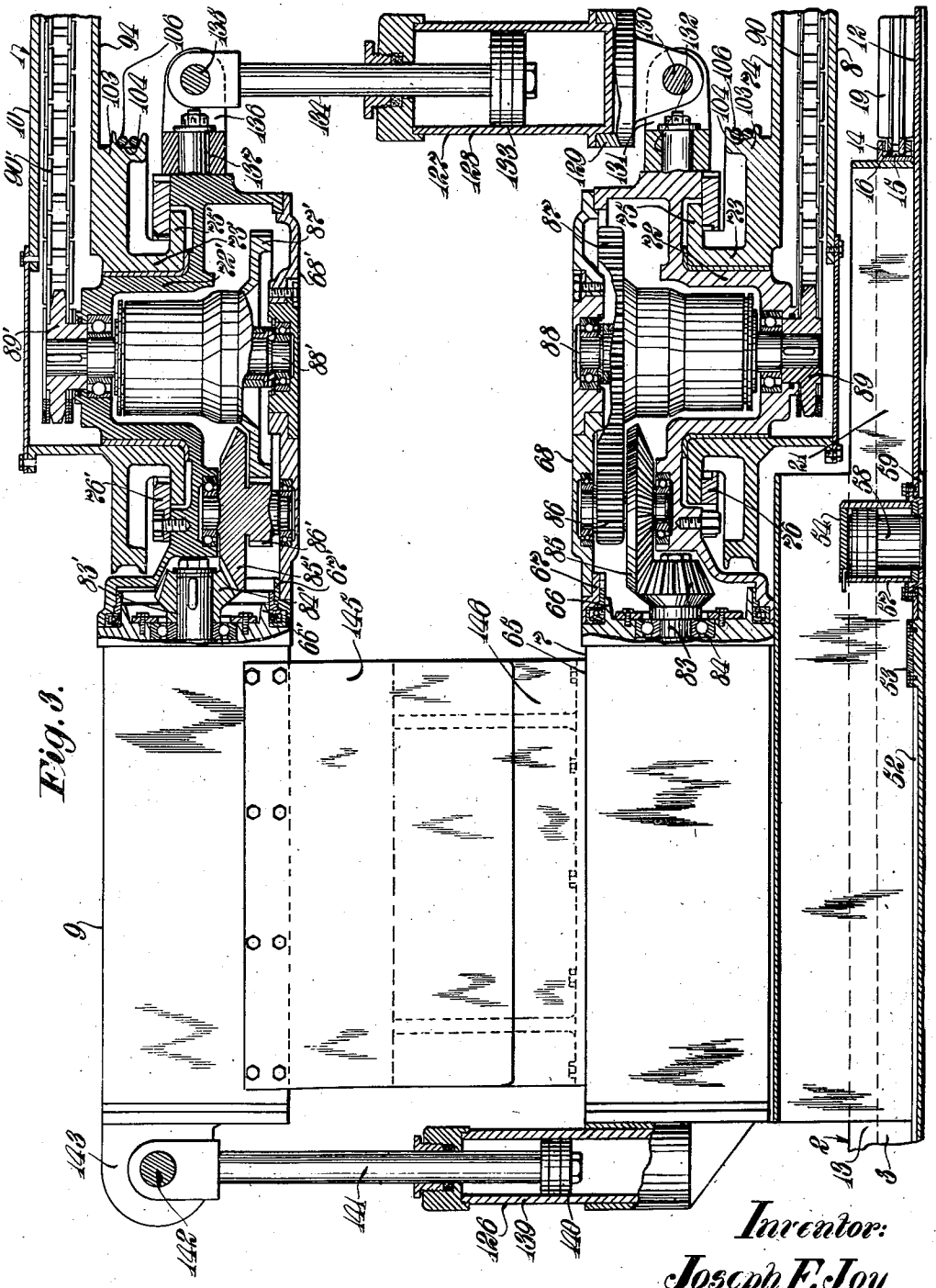

Fig. 3.

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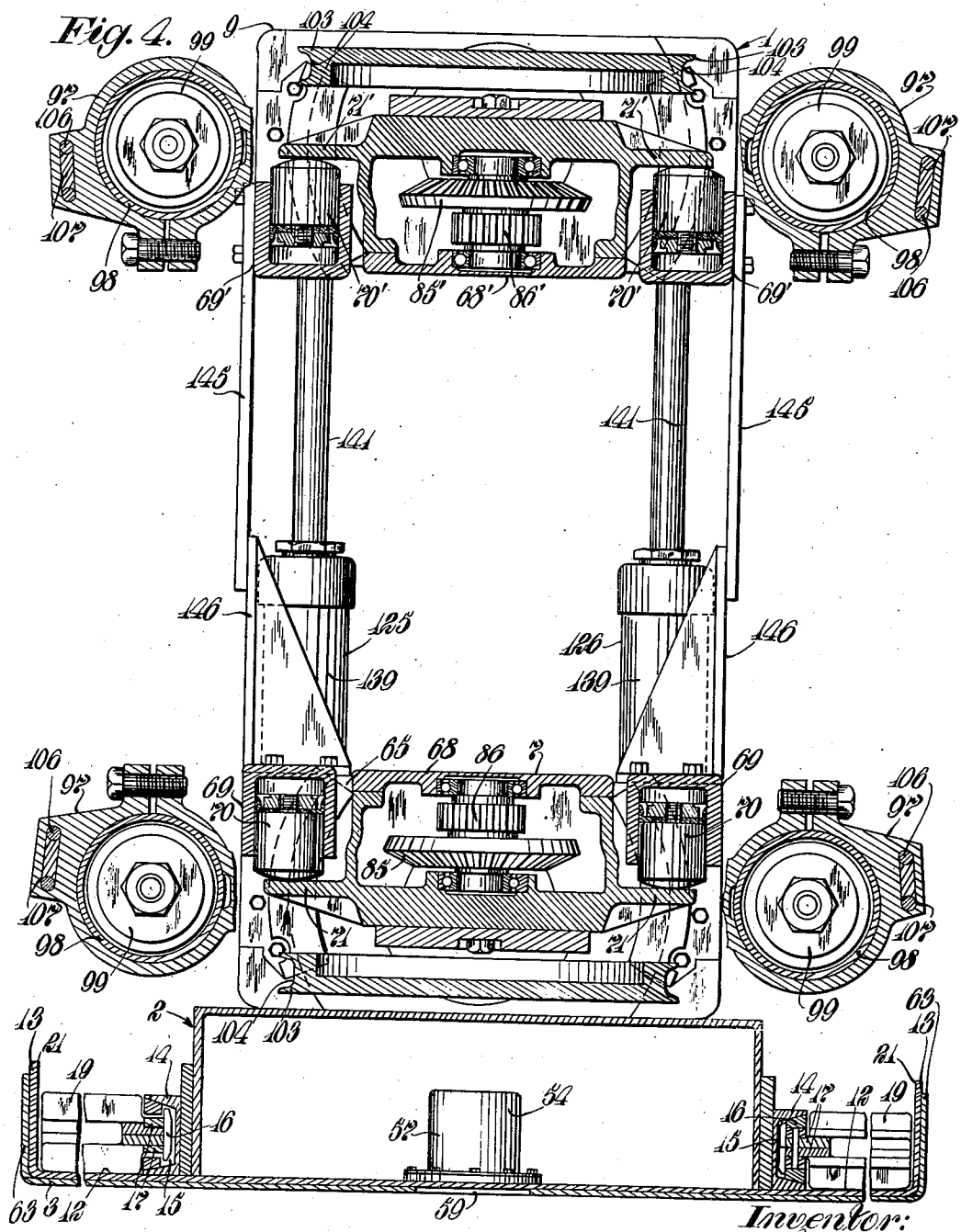
Nov. 4, 1941. J. F. JOY 2,261,162

MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 3

Fig. 4.



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MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 4

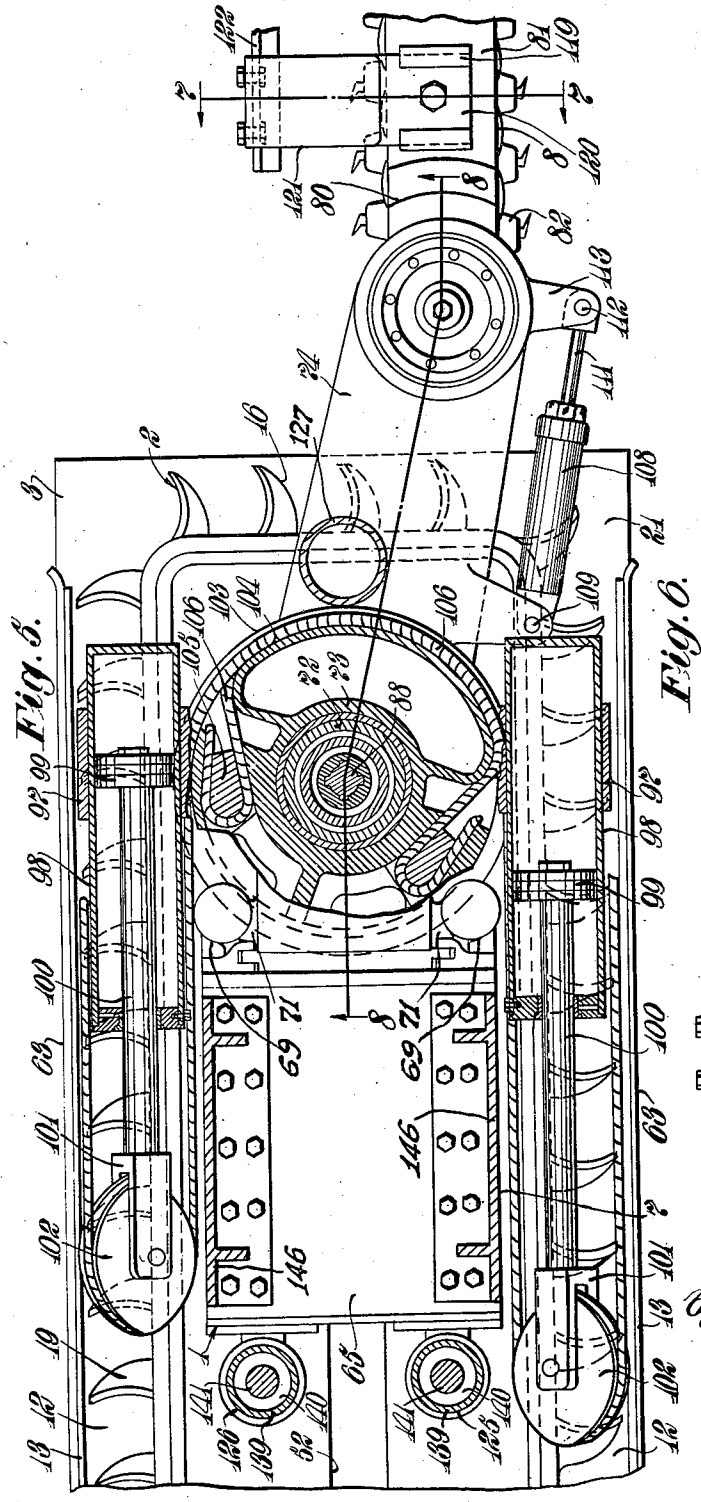

Fig. 5.

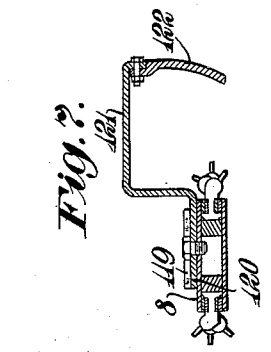

Fig. 7.

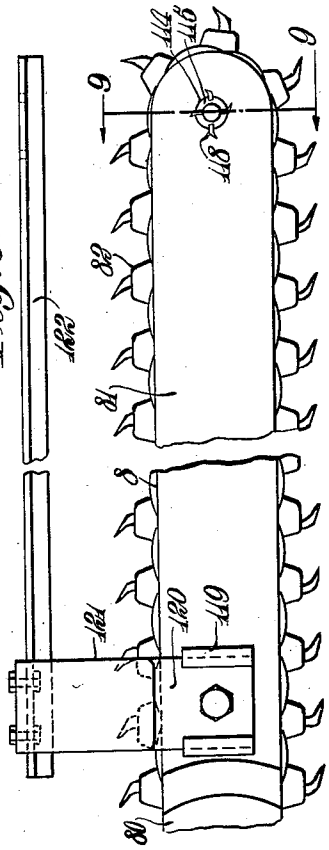

Fig. 6.

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Nov. 4, 1941. J. F. JOY 2,261,162

MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 5

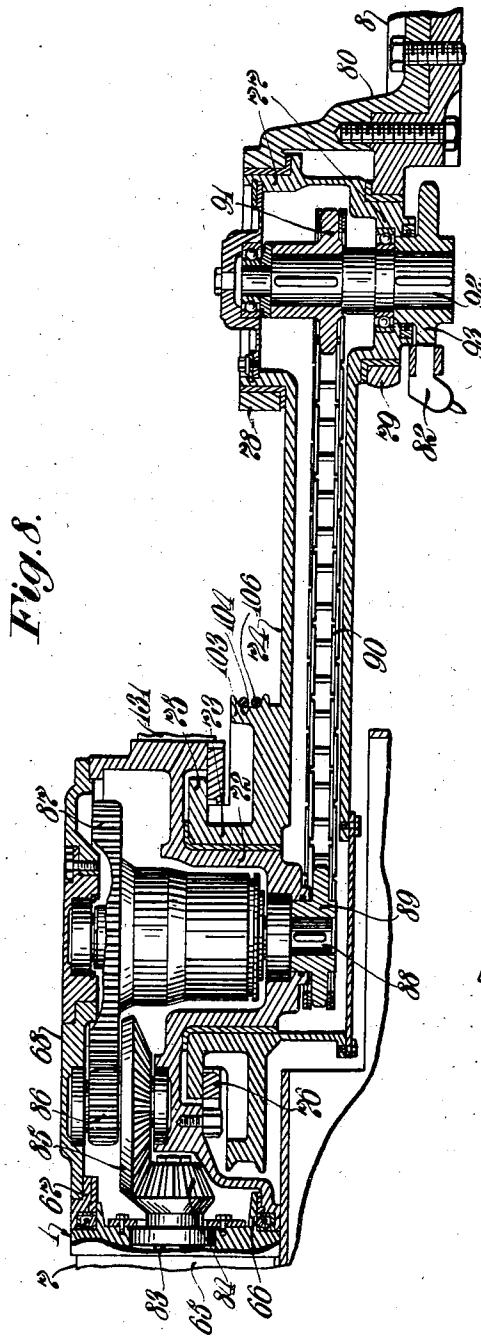

Fig. 8.

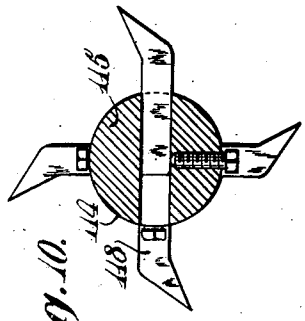

Fig. 10.

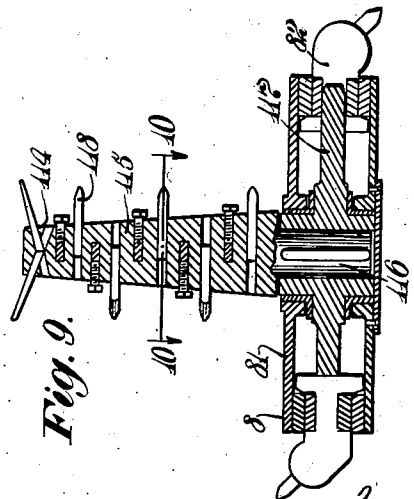

Fig. 9.

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Nov. 4, 1941. J. F. JOY 2,261,162

MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 6

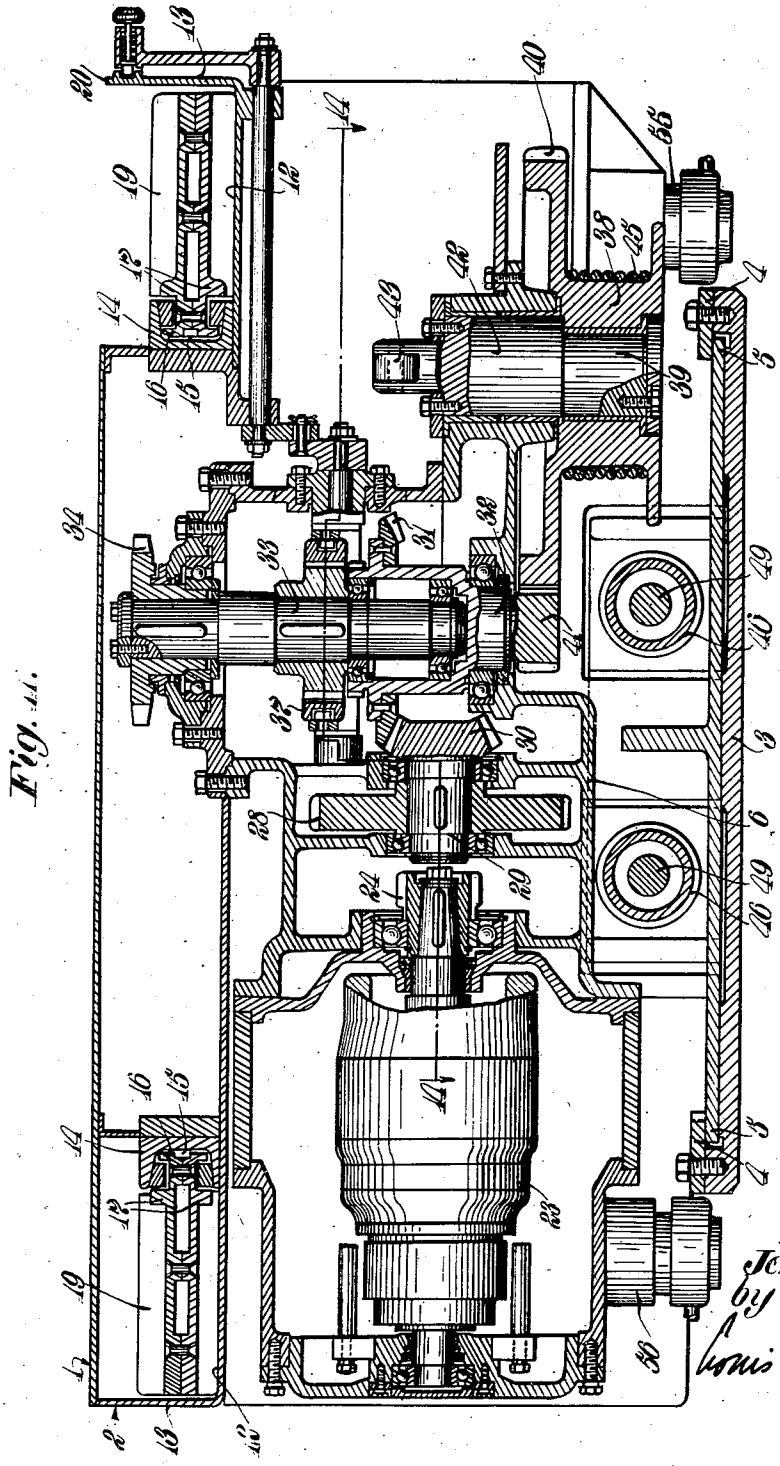

Fig. 11.

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Nov. 4, 1941. J. F. JOY 2,261,162

MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 7

Fig. 12.

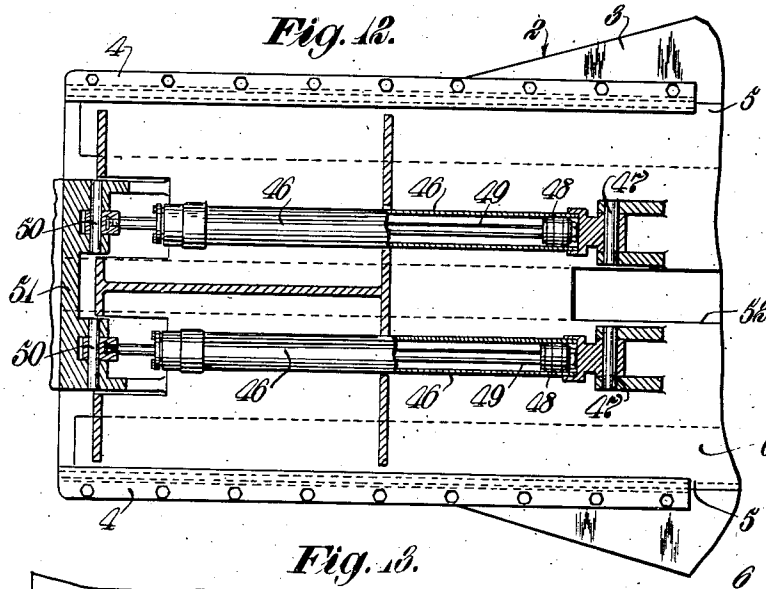


Fig. 13.

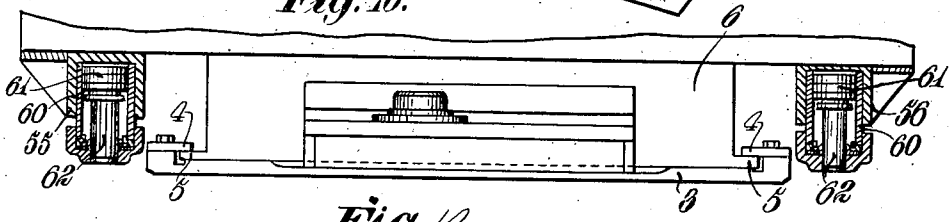
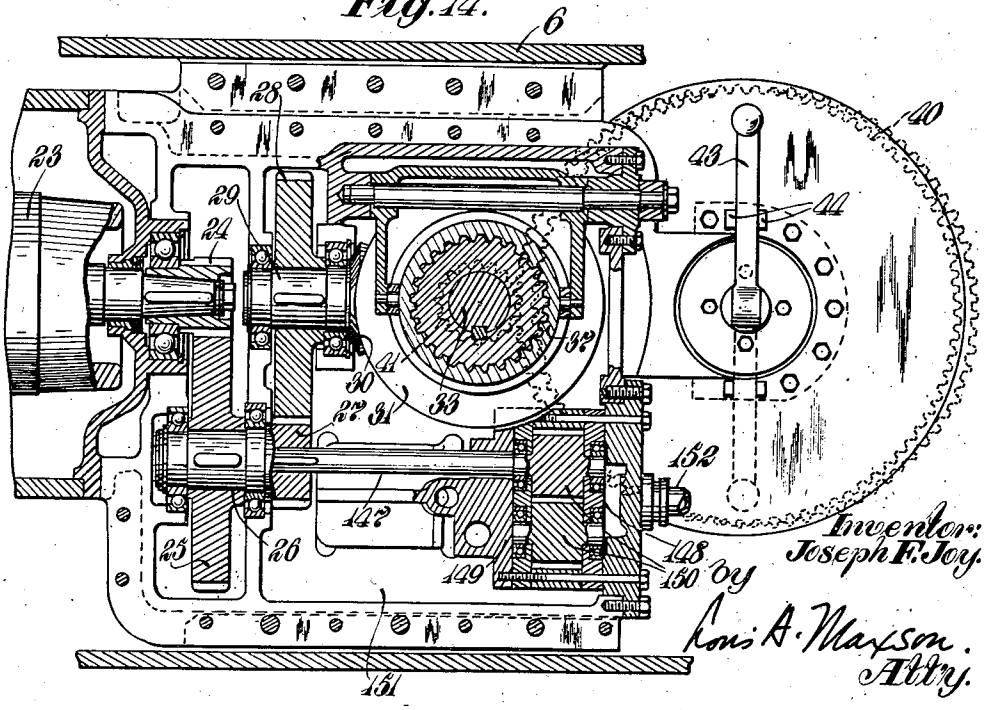


Fig. 14.



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MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 8

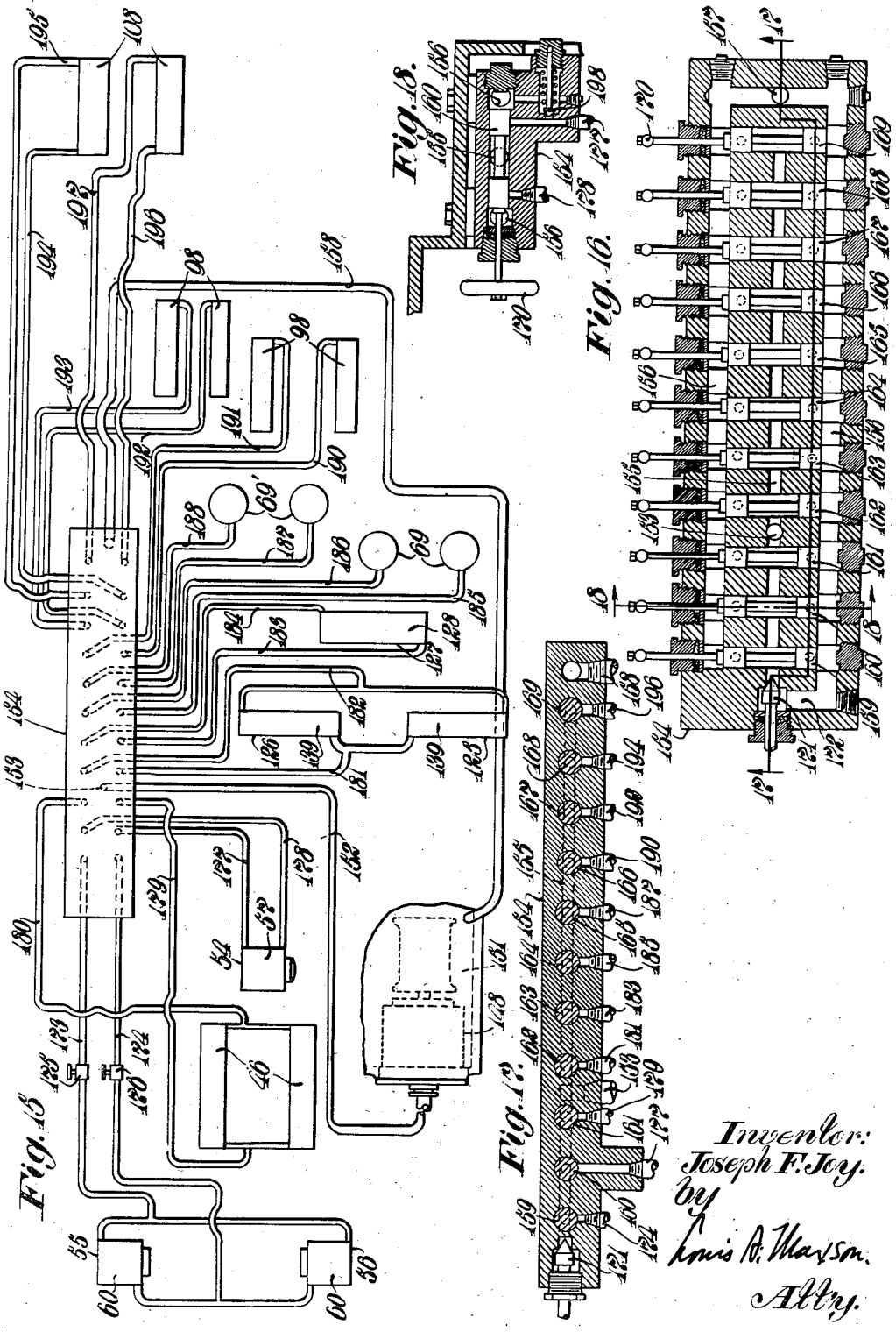

Fig. 5.

Fig. 8.

Fig. 6.

Fig. 7.

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Nov. 4, 1941. J. F. JOY 2,261,162

MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 9

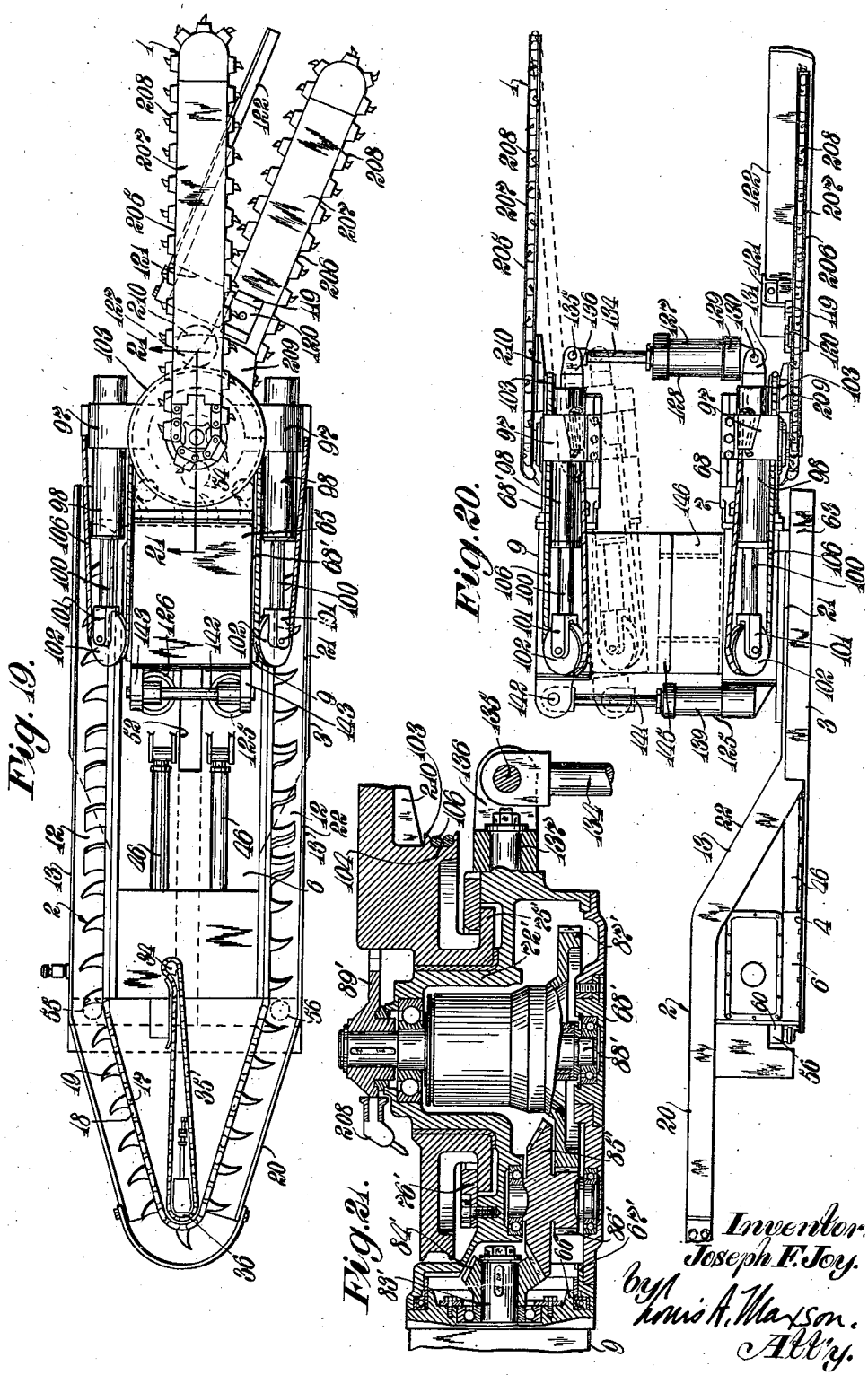

Fig. 19.

Fig. 20.

Fig. 21.

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Nov. 4, 1941. J. F. JOY 2,261,162

MINING APPARATUS

Filed Feb. 28, 1938 10 Sheets-Sheet 10

Fig.22.

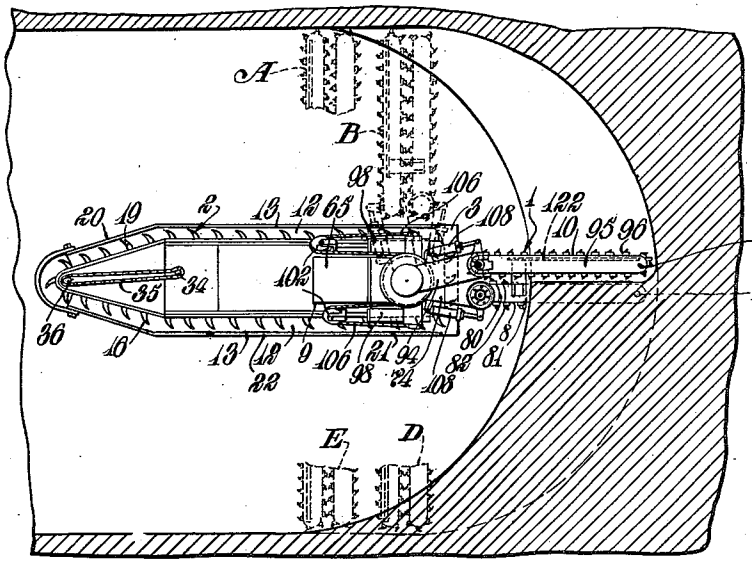


Fig.23.

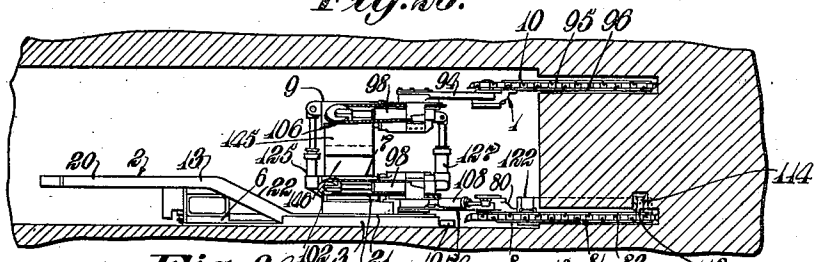


Fig.24.

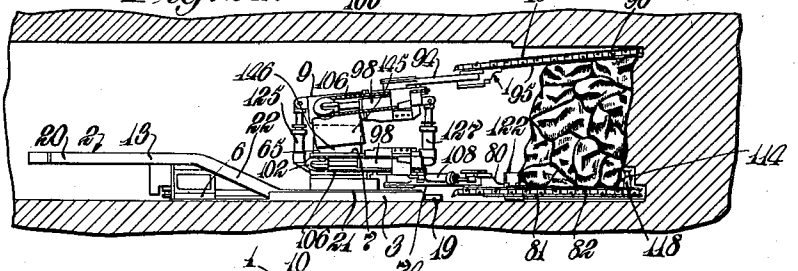
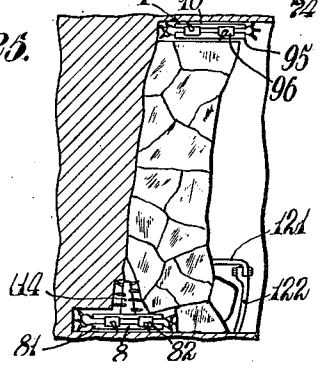


Fig.25.



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Patented Nov. 4, 1941

2,261,162

UNITED STATES PATENT OFFICE

2,261,162

MINING APPARATUS

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

Application February 28, 1938, Serial No. 192,918

24 Claims. (Cl. 262—28)

This invention relates to mining apparatus, and more particularly to improvements in a coal mining apparatus of the combined cutting and loading type for cutting the solid coal, breaking down the cut coal from the solid and loading the broken down coal.

An object of this invention is to provide an improved coal mining apparatus for completely removing the solid coal from its natural bed in a coal seam, wholly without the use of explosives or other blasting means, and for loading the coal as it is removed from the coal seam. Another object is to provide an improved coal mining apparatus of the combined cutting and loading type having improved means for cutting and breaking down the coal. A further object is to provide in an apparatus of the above character, improved kerf cutting means for cutting superimposed kerfs in a coal seam to form a core of coal between the kerfs, and for breaking down sections of the core as cutting progresses. A still further object is to provide an improved kerf cutting means comprising a pair of superimposed kerf cutters mounted for independent swinging movement and having associated therewith improved means for adjusting the top cutter in a vertical direction relative to the bottom cutter. Still another object is to provide improved means for tilting the top cutter in a plurality of directions with respect to the bottom cutter to effect breaking down of the coal previously cut by the cutters. Another object is to provide an improved pivotal mounting structure for the kerf cutters comprising swingable arms on which the kerf cutters are pivotally mounted whereby flexibility in adjustment and a relatively wide cutting range may be obtained. Still another object is to provide an improved kerf cutting mechanism comprising superimposed kerf cutters, the lower kerf cutter being arranged in advance of the top kerf cutter so that the bottom kerf cutter cuts in advance of the top kerf cutter, and embodying means for tilting the top kerf cutter relative to the bottom kerf cutter for effecting breaking down of the cut coal as cutting progresses. A further object is to provide a cutting and loading apparatus of the reversible type adapted to operate in either of opposite directions and having an improved reversible mounting structure for the kerf cutters so that the bottom kerf cutter may cut in advance of the top kerf cutter during either direction of cutting. Yet another object is to provide an improved cutting and loading apparatus having novel combinations and arrangements of parts. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

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

In these drawings—

Fig. 1 is a top plan view of a cutting and loading apparatus constructed in accordance with an illustrative embodiment of the invention.

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

Fig. 3 is an enlarged central longitudinally extending vertical sectional view taken substantially on line 3—3 of Fig. 1, with parts shown in elevation.

Fig. 4 is an enlarged cross sectional view taken substantially on line 4—4 of Fig. 1.

Fig. 5 is an enlarged horizontal sectional view taken substantially on line 5—5 of Fig. 2, with parts broken away to show structural details.

Fig. 6 is a detail plan view of the bottom kerf cutter showing the associated means for retaining the broken down coal in the path of the cutter chain.

Fig. 7 is a cross sectional view taken substantially on line 7—7 of Fig. 5.

Fig. 8 is a view in longitudinal vertical section taken substantially on line 8—8 of Fig. 5.

Fig. 9 is an enlarged cross sectional view taken on line 9—9 of Fig. 6.

Fig. 10 is a detail horizontal sectional view taken on line 10—10 of Fig. 9.

Fig. 11 is an enlarged cross sectional view taken substantially on line 11—11 of Fig. 2.

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

Fig. 13 is an enlarged cross sectional view taken substantially on line 13—13 of Fig. 2.

Fig. 14 is a horizontal sectional view taken substantially on line 14—14 of Fig. 11.

Fig. 15 is a diagrammatic view of the hydraulic fluid system and the associated control means.

Fig. 16 is a horizontal sectional view through the valve box.

Fig. 17 is a longitudinally extending vertical sectional view taken on line 17—17 of Fig. 16.

Fig. 18 is a cross sectional view taken on line 18—18 of Fig. 16.

Fig. 19 is a top plan view of a cutting and loading apparatus similar to that shown in Fig. 1, illustrating a modified form of supporting structure for the kerf cutters.

Fig. 20 is a side elevational view of the cutting and loading apparatus shown in Fig. 19.

Fig. 21 is an enlarged central, longitudinally extending, vertical sectional view taken on line 21—21 of Fig. 19, showing the pivotal mounting structure for the top kerf cutter.

Fig. 22 is a diagrammatic top view showing the cutting and loading apparatus in cutting and loading position at the working face.

Fig. 23 is a diagrammatic side elevational view.

Fig. 24 is a diagrammatic view similar to Fig. 23 showing the top kerf cutter in its tilted coal breaking position.

Fig. 25 is a diagrammatic end view showing the kerf cutters in cutting and breaking-down position.

In this illustrative embodiment of the invention, there is shown a coal mining apparatus of the combined cutting and loading, floor type mounted for sliding movement on its own bottom over the mine floor, although it will be understood that the apparatus, if desired, may be mounted on a wheeled truck for movement along a trackway, or tractor tread mounted. The cutting and loading apparatus generally comprises cutting and breaking down mechanism which operates to cut the solid coal, break down the cut coal from the solid and move the broken-down coal toward the receiving end of a conveying means associated with the cutting and breaking-down means; and the conveying means receives the broken-down coal and moves the same away from the coal face as cutting progresses, toward an elevated discharge position at the rear end of the apparatus.

In this illustrative embodiment of the invention, the reference character 1 designates the cutting and breaking-down mechanism, and 2 the associated conveying means. The apparatus, in certain respects, is similar to that disclosed in my copending application Ser. No. 143,809, filed May 20, 1937, now matured into Patent No. 2,210,919, granted Aug. 13, 1940, and comprises a bottom skid plate 3 adapted to rest upon and slide over the mine floor, and this skid plate has extending lengthwise thereof parallel guides 4, 4 providing longitudinal guideways in which are slidably guided lateral guides 5, 5 formed integral with the lower plate of a sliding main frame 6 of the apparatus. Mounted on the forward portion of the sliding main frame 6 is a support 7 for a bottom kerf cutter 8 and a relatively adjustable support 9 for a top kerf cutter 10, the kerf cutters arranged in superimposed relation and mounted for independent swinging movement relative to their respective supports, in a manner to be later described.

As is described in the above mentioned copending application, the conveyor means 2 is mounted upon the main frame 6 of the apparatus and is herein of a well-known type comprising two parallel troughs 12 positioned in substantially the same transverse planes at the opposite sides of the main frame and secured to the latter, and each having an upright outer side wall 13. Arranged at the inner side of each of these troughs is a channel member 14 secured to the adjacent side of the main frame and providing a guideway 15 for the endless drive chain 16 of the conveyor. This drive chain comprises a series of two-part chain blocks 17 (Figs. 4 and 11) connected together by jointed strap links 18 (Fig. 1), and the chain blocks have formed thereon conveyor flights 19 adapted to engage the material in the troughs at one side of the conveyor and move it therealong, as will hereinafter appear. The chain links and straps are connected together by suitable pairs of horizontal and vertical pintles to render the chain flexible in both horizontal and vertical planes, thereby to permit the chain to follow the contour of the conveyor guideways. It is to be understood, however, that any other type of chain which is adapted to flex in horizontal and vertical planes may be substituted for the one above described, without departure from the spirit of the invention. The flights may be of any preferred form adapted to move the material to be loaded along the trough of the conveyor. Preferably, I have formed these flights integral with the chain blocks 17. The conveyor troughs 12 arranged at the opposite sides of the main frame 6 each comprise a horizontal rearward portion 20 and a horizontal bottom front portion 21, these front and rear horizontal portions being connected together by an inclined portion 22, and the forward portion 21 of the conveyor troughs being arranged near the floor level at the forward end of the main frame so that the receiving portion of the conveyor passes around the forward end of the main frame near the floor level to receive the broken-down coal moved rearwardly away from the coal face by the bottom kerf cutter 8 and for moving the coal along one conveyor trough at one side of the main frame to elevate the coal to a suitable point of discharge at the rear end of the apparatus.

The driving means for the conveyor, as is also disclosed in the copending application above referred to, comprises a motor 23 (see Fig. 11) having a spur gear 24 keyed to its power shaft, this gear meshing, as shown in Fig. 14, with a spur gear 25 keyed to a shaft 26 suitably journaled within the main frame 6. Formed integral with and driven by the shaft 26 is a spur gear 27 meshing with a spur gear 28 keyed to a horizontal shaft 29. The shaft 29 is likewise suitably journaled within the main frame and has formed integral therewith a bevel gear 30 meshing with a bevel gear 31 having its hollow hub formed integral with a vertical shaft 32 suitably journaled within the main frame. Journaled within bearings supported within the hollow hub of the bevel gear 31 is the lower end of a vertical shaft 33, this shaft being journaled at its upper end within a bearing supported within the upper portion of the main frame. Keyed to and driven by this shaft is a chain sprocket 34 connected by an endless drive chain 35 (see Fig. 1) with a sprocket 36 which engages and drives the endless drive chain 16 of the conveyor. The hub of the bevel gear 31 is connectible by a sliding clutch 37 to the shaft 33. This sliding clutch comprises a sliding clutch member having clutch teeth engageable with clutch teeth formed on the gear hub and provided with usual operating means.

As is also described in the above mentioned copending application, means is provided for moving the apparatus bodily over the mine floor during maneuvering of the apparatus with respect to the coal face comprising a horizontal cable winding drum 38 journaled on a vertical shaft 39 and having formed integral with its upper flange a spur gear 40 adapted to mesh with and to be driven by a spur gear 41 formed on the lower end of the shaft 32. The drum shaft 39 is formed with an eccentric portion 42 suitably journaled within the main frame and having a rotating handle 43 for rotating the eccentric portion to move the drum shaft 39 in an arcuate path, thereby to move the drum gear

40, as desired, into and out of meshing engagement with the driving gear 41. The handle 43 is pivoted to swing in a vertical direction, and when depressed is engageable with stop lugs 44 for locking the drum gear in either of its adjusted positions. Wound on the drum is a feed cable 45 which may be extended from the drum into connection with a suitable anchor jack, so that as the drum is rotated to wind in the cable, the apparatus moves bodily over the mine floor, in an obvious manner.

Means is provided, as is also clearly described in the copending application above referred to, for moving the apparatus with a "walking" action over the mine floor and for feeding the main frame 6, together with the cutting and breaking-down means supported thereby, rectilinearly back and forth relative to the bottom skid. The feeding means for effecting rectilinear feed is arranged longitudinally beneath the main frame in adjacency to the bottom skid and comprises a pair of reciprocable hydraulic cylinders 46, 46 arranged in parallel relation and pivotally connected at 47 at their front ends on horizontal axes to depending lugs integral with the main frame 6, and these cylinders contain pistons 48 having their piston rods 49 extending rearwardly through the packed rear heads of the cylinders and pivotally connected at their rear ends on horizontal axes at 50 to an upstanding bracket 51 secured to the rearward portion of the bottom skid 3. When fluid under pressure is supplied to one end or the other of the cylinders 46, 46, the main frame 6, together with the cutting and breaking-down means supported thereby, may be slid either back or forth along the guideways on the bottom skid. To insure proper guiding of the main frame 6 during its rectilinear movement along the guideways on the bottom skid 3, the bottom of the main frame is formed with a centrally located longitudinal guiding slot 52 with which engages an upstanding guide block 53 formed integral with the bottom skid, as shown in Fig. 3. For effecting the "walking" action there are provided "walking" jacks, herein three in number, which are designated 54, 55 and 56, two located at the rear end of the main frame 6 at the opposite sides thereof (see Fig. 13) and one centrally located at the front end of the main frame (see Fig. 3). The centrally located front jack 54 comprises a vertical cylinder 57 having its piston rod 58 extending downwardly through the packed lower head of the cylinder, and this piston rod has a bottom abutment surface engageable with the mine floor. The bottom skid 3 is centrally slotted at 59 at its forward end to permit movement of the jack within the slot when the main frame 6 is in its rearmost position on the skid 3. The rearwardly located side jacks 55 and 56 comprise, as shown most clearly in Fig. 13, vertical cylinders 60 containing reciprocable pistons 61 having piston rods 62 extending downwardly through the lower packed cylinder heads and having bottom abutment surfaces engageable with the mine floor. When fluid under pressure is supplied concurrently to the upper ends of the cylinders 57 and 60 the pistons are moved downwardly until the abutment surfaces on the piston rods thereof engage the mine floor, and then the cylinders are moved upwardly relative to the then stationary pistons to raise the main frame to relieve the skid of a substantial portion of the weight of the apparatus. When the main frame is so raised, fluid under pressure may be supplied to the feed cylinders 46, 46 to effect rectilinear feed of the bottom skid 3 relative to the main frame 6, and thereafter the jack cylinders may be lowered and the pistons thereafter raised to bring the weight of the main frame back onto the bottom skid. When the jack pistons are removed from their engagement with the mine floor, fluid under pressure may be supplied to the feed cylinders 46, 46 to effect forward rectilinear movement of the main frame relative to the bottom skid. It will thus be seen that by operating the feed and jack cylinders the apparatus may be moved over the mine floor with a "walking" action by successively feeding the main frame relative to the skid, relieving the skid of the weight of the main frame, feeding the unweighted skid relative to the main frame and thereafter lowering the main frame back onto the skid. The means for supplying hydraulic pressure to the feed and jack cylinders will later be described.

Again referring to the bottom skid structure, it will be noted that the bottom skid 3 has extending along the sides thereof at its forward portion, vertical retaining walls 63, 63 outwardly flared at their forward ends for directing, when the main frame 6 is in its rearward position on the skid 3, the broken-down coal moved rearwardly by the bottom kerf cutter 8, onto the receiving portion of the conveyor and for retaining the coal in the path of the receiving portion of the conveyor. When the main frame 6 is fed forwardly relative to the skid 3, the receiving portion of the conveyor of course moves forwardly from its position between the sides of these vertical retaining walls.

Now referring to the improved cutting and breaking-down means generally designated 1, it will be noted that the bottom support 7 for the bottom kerf cutter 8 comprises a frame 65 mounted on and secured to the forward portion of the sliding frame 6, as shown in Fig. 4. The forward portion of this frame has a circular bearing support 66 supporting a bearing sleeve on which a cylindrical portion 67 of a tiltable front frame 68 is mounted. It will thus be seen that the front frame 68 of the bottom support is tiltable about a horizontal axis extending longitudinally of the apparatus, and the means for tilting this front frame comprises a pair of vertical cylinders 69 (Fig. 4) supported by the frame 65 at the opposite sides of the tiltable front frame and containing plungers 70, the latter engaging at their lower ends lever-like projections 71 integral with the sides of the tiltable front frame. It will thus be seen that when fluid under pressure is supplied to one or the other of the cylinders 69 the pistons may be moved to tilt the front frame about its axis relative to the rear frame, and when fluid is trapped within these cylinders the front frame is locked in its adjusted position. As shown in Fig. 3, the front frame 68 has a depending cylindric bearing support 72 supporting a bearing sleeve on which is swivelly mounted an annular bearing portion 73 of a pivoted arm 74. This arm has a circular flange 75 cooperating with an annular retaining ring 76 secured to the front frame 68. The arm 74 extends forwardly in advance of the bottom support 7 in the manner shown in Fig. 8, and has formed on its outer extremity cylindrical bearing supports 77 on which are supported bearing sleeves, the latter in turn having rotatably mounted thereon cylindrical annular bearing portions 78 and 79 formed integral with a hanger frame 80 for the bottom kerf cutter 8. The kerf

cutter 8 is in the form of an elongated plane cutter bar 81 supported by the hanger frame 80 and having guided for circulation about its margin an endless cutter chain 82. It will thus be seen that the kerf cutter may be swung relative to the arm about an axis parallel to the arm pivot axis. The driving means for the cutter chain comprises a motor, herein preferably of the reversible electric type, having its power shaft 83 horizontally disposed and extending longitudinally of the apparatus. Keyed to the forward end of the motor power shaft is a bevel gear 84 meshing with a bevel gear 85, the latter in turn driving a spur gear 86 meshing with a large spur gear 87 having its hub connectible to a vertical shaft 88 suitably journaled within the tiltable front frame 68. The shaft 88 is arranged with its axis coincident with pivotal axis of the arm 74, and has keyed thereto at its lower end and drives a chain sprocket 89. This chain sprocket 89 is connected by an endless drive chain 90, arranged within the arm 74, to a sprocket 91 (see Fig. 8) keyed to a vertical shaft 92. The shaft 92 is suitably journaled within bearings supported within the arm 74 and is arranged with its axis coincident with the axis of pivotal movement of the lower kerf cutter. Keyed to the lower end of and driven by the shaft 92 is a chain sprocket 93 which engages and drives the endless cutter chain 82.

The structure of the upper support 9 is essentially the same as that of the lower support 7 and the top kerf cutter is similarly pivotally mounted and corresponding parts are indicated by primed numbers. The top kerf cutter 10 is, however, in this instance, pivotally mounted on the outer end of an arm 94 similar to the arm 74, and the cutter bar thereof is arranged above the arm instead of below the arm as is the cutter bar of the lower kerf cutter, and the arm 94 is preferably pivotally mounted on the top of the tiltable front frame. The top kerf cutter, in this instance, comprises an elongated plane cutter bar 95 having guided for circulation about its margin an endless cutter chain 96, and this cutter chain moves about the margin of its cutter bar in a direction opposite from the direction of movement of the cutter chain 82 of the bottom kerf cutter, for a purpose to be later explained. The top and bottom arms are independently swingable about their pivots relative to the supports and the kerf cutters are independently swingable about their pivotal mountings on the outer ends of the arms relative to the arms, and the means for swinging the arms and kerf cutters about their respective pivotal axes will now be described. Each of the supports 7 and 9 has at the opposite sides thereof lateral projections 97, 97 in the form of split clamps in which are mounted hydraulic cylinders 98, 98. These cylinders are arranged in parallel relation and extend longitudinally of the support at the opposite sides thereof. Reciprocable in these cylinders are pistons 99 having piston rods 100 extending rearwardly through the packed rear heads of the cylinders and carrying at their rearward ends brackets 101 on which guide sheaves 102 are journaled. The arms 74 and 94 have annular flanges 103 coaxial with the arm pivot and formed with an annular cable guiding groove 104. Secured to the arm at 105 are cables 106, 106 passing about the cable guiding groove 104 and extending rearwardly along the opposite sides of the support and around the guide sheaves 102, the opposite ends of these cables being fixed at 107 to the lateral projections 97. It will thus be seen that when fluid under pressure is supplied to one or the other of the cylinders 98 one of the pistons is moved rearwardly to deflect one of the cables, thereby to swing the arm, together with the kerf cutter supported thereby, in one direction or the other about its pivot, and when fluid is trapped within the cylinders the arm is locked in its adjusted position. The means for swinging the kerf cutters 8 and 10 about their respective pivots relative to the arms each comprise a hydraulic cylinder 108 pivotally mounted at 109 about an axis parallel to the pivotal axis of the kerf cutter on a bracket integral with the arm and containing a reciprocable piston 110 having its piston rod 111 extending forwardly through the packed front head of the cylinder and pivotally connected at 112 on a parallel axis to an arm 113 integral with the cutter bar hanger frame. When fluid under pressure is supplied to one end or the other of the cylinders 108 the kerf cutters may be swung about their respective pivots relative to the arms in one direction or the other, and when fluid is trapped within these cylinders the kerf cutters may be locked in their adjusted position. From the foregoing, it will be evident that the supporting structure for the top kerf cutter 10 is identical to that for the bottom kerf cutter 8 with the exception that the upper supporting structure is in inverted relation.

To facilitate the breaking down of the coal cut by the kerf cutters, the bottom kerf cutter 8 has near its outer extremity a vetrically disposed rotary cutter 114 comprising a rotary cutter bar 115 (see Figs. 9 and 10) projecting upwardly from the cutter bar 81 and having a lower shaft portion 116 keyed within the hub of a sprocket 117 driven by the cutter chain 82. The rotary bar has attached thereto a series of cutters 118. When the bottom kerf cutter 8 is sumped into the coal and then fed transversely to effect its transverse cutting operation, the vertical rotary cutter 114 frees the coal at the inner end of the kerf cut by the bottom kerf cutter so that the top kerf cutter may be operated, as later explained to break down fragments of the cut coal with comparative ease as cutting progresses. If desired, a similar rotary cutter may be provided at the bottom of the outer portion of the top kerf cutter and similarly driven by the top cutter chain, for further facilitating the breaking down of the coal. Mounted on the top of the lower cutter bar 81 near its rearward end is a transverse guide member 119 (see Figs. 5, 6 and 7) providing a socket for receiving a projection 120 integral with a bracket 121. Detachably secured to the outer edge of this bracket is a vertical plate 122 extending longitudinally in parallelism with the cutter bar, and this plate retains the coal in the path of the lower cutter chain 82 during the cutting and loading operation. The plate 122 may be detached from the bracket 121, the bracket reversed with respect to the cutter bar and the plate reversed end for end with respect to the bracket and transposed to the opposite side of the bar and thereafter attached to the bracket so that the plate extends in parallelism with the bar at the opposite side thereof to retain the coal in the path of the cutter chain when the cutter is operating in the reverse direction.

The upper support 9 for the top kerf cutter 10 is, as aforementioned, adjustably mounted on

the lower kerf cutter support 7, and the adjustable supporting structure for the upper support comprises a plurality of hydraulic jacks, herein three in number, one at the front end of the support and two at the rear end thereof and respectively designated 125, 126 and 127. The front jack 127 is arranged at the longitudinal vertical center of the adjustable support and comprises a vertical cylinder 128 (see Fig. 3) secured at its lower end within a bracket 129 pivotally mounted at 130 in a swiveled bracket 131. The bracket 131 is swiveled at 132 on the tiltable front support 68 of the lower support 7, and the swivel axis of the bracket 131 is arranged coincident with the axis of tilting movement of the front support 68. The swivel brackets 129, 131 cooperate to form a universal pivotal mounting for the cylinder 128. Reciprocable in this cylinder is a piston 133 having its piston rod 134 extending upwardly through the packed upper head of the cylinder, and the upper end of this piston rod is pivotally connected at 135 to a swiveled bracket 136. The bracket 136 is swiveled at 137 on the upper tiltable front frame 68', and the swivel axis of the bracket 136 is arranged in coincidence with the axis of tilting movement of the upper front frame 68'. The swivel axes of the piston rod and swivel bracket are so arranged as to provide a universal pivotal mounting for the upper end of the piston rod. The universal pivotal mountings for the opposite ends of the front jack 127 permit independent tilting movements of the front supports 68 and 68' while the jack supports the forward end of the upper support 9 on the forward end of the lower support, and these universal pivotal mountings also permit tilting movement of the upper kerf cutter support about a transverse axis relative to the lower kerf cutter support. The rearwardly located jacks 125, 126 each comprise a vertical cylinder 139 rigidly secured to the rear end of the lower support 7 and containing a reciprocable piston 140 having its piston rod 141 extending upwardly through the upper packed head of the cylinder. The upper ends of the piston rods 141 are pivotally connected at 142 to projections 143 secured to the rear end of the upper support 9. It will thus be seen that when fluid under pressure is supplied concurrently to the front and rear jacks 125, 126 and 127 the upper kerf cutter support 9 may be moved either upwardly or downwardly in parallelism with respect to the lower kerf cutter support, and when hydraulic pressure is supplied independently to the front and rear jacks the upper support 9 may be tilted about a transverse axis either upwardly or downwardly relative to the lower support, thereby to effect tilting of the top kerf cutter either upwardly or downwardly in the direction of its length. When fluid under pressure is supplied to the tilting cylinders 69, 69', the front frames 68 and 68' may be tilted about their respective longitudinal axes to tilt the bottom and top kerf cutters laterally in an edgewise direction. It will thus be seen that the top and bottom kerf cutters may be independently tilted about longitudinal axes and the top kerf cutter may be tilted relative to the bottom kerf cutter about a transverse axis, for a purpose to be later explained. For guiding the upper kerf cutter support 9 during its vertical elevating and tilting movements with respect to the bottom kerf cutter support, there are provided a pair of vertical guide members 145 secured to the opposite sides of the upper support 9 and cooperating with vertical guide members 146 secured to the opposite sides of the lower support 7, these guide members cooperating to hold the upper kerf cutter support against lateral displacement while permitting movement thereof in a vertical direction.

Now referring to the hydraulic fluid system and the associated control means, it will be noted that driven by the shaft 26 (see Fig. 14) of the transmission gearing between the motor 23 and the cable winding drum 38 is a shaft 147 of a hydraulic pump 148. This pump comprises a casing 149 arranged within the sliding main frame 6 and having a chamber containing intermeshing pump rotors 150. The main frame 6 is provided with a chamber 151 adapted to contain a liquid, preferably oil, and the pump intake communicates with this chamber. As shown in Fig. 15, the pump discharge is connected by a fluid pressure supply conduit 152 with a pressure supply passage 153 of a horizontal valve box 154. The valve box has formed therein a series of horizontal bores containing slide valves of the balanced spool type. Extending longitudinally of the valve box and communicating with the supply passage 153 is a pressure passage 155, the latter passage communicating with the valve bores centrally between their ends as shown in Fig. 16. Communicating with the ends of the valve-ceceiving bores are discharge passages 156, 156, in turn communicating with a discharge passage 157 connected by a discharge conduit 158 back to the liquid containing chamber 151. The slide valves are respectively designated 159, 160, 161, 162, 163, 164, 165, 166, 167, 168 and 169, and each has an operating handle 170. The fluid pressure supply passage 155 is connectible by a manually operable by-pass valve 171 to a passage 172 communicating with one of the discharge passages 156 so that the pressure of the fluid in the supply passage may be reduced at will. The valve 159 controls the supply of fluid under pressure to the rear "walking" jacks 55 and 56 and has its receiving bore connected by a conduit 173 to the upper ends of the jack cylinders 60 and through a conduit 174 to the lower ends of the jack cylinders. These conduits are provided with manual control valves 175 and 176 respectively whereby the fluid supply to the jack cylinders may be independently controlled. The valve 160 controls the supply of fluid under pressure to the front jack 54 and has its receiving bore connected by a conduit 177 to the upper end of the jack cylinder 57 and through a conduit 178 to the lower end of the jack cylinder. The valve 161 controls the supply of fluid under pressure to the feed cylinders 46 and has its receiving bore connected through a conduit 179 to the rear ends of the feed cylinders and through a conduit 180 to the forward ends of the feed cylinders. The valve 162 controls the supply of fluid under pressure to the rear elevating cylinders 139 of the rear jacks 125 and 126 and has its receiving bore connected through conduits 181 and 182 to the opposite ends of the cylinders. The valve 163 controls the flow of fluid under pressure to the elevating cylinder 128 of the front jack 127 and its receiving bore is connected through conduits 183 and 184 to the opposite ends of the cylinder. The valve 164 controls the flow of fluid under pressure to the tilting cylinders 69 for the bottom kerf cutter and has its receiving bore connected through conduits 185 and 186 to the upper ends of the cylinders. The valve 165 controls the supply of fluid under pressure to the tilting cylinders 69' for the top kerf cutter and

has its receiving bore connected through conduits 187 and 188 to the lower ends of the cylinders. The valve 166 controls the supply of fluid under pressure to the swinging cylinders 98 for the bottom kerf cutter supporting arm 74 and has its receiving bore connected through conduits 190 and 191 to the forward ends of the cylinders. The valve 167 controls the supply of fluid under pressure to the swinging cylinders 98 for the top kerf cutter supporting arm 94 and has its receiving bore connected through conduits 192 and 193 to the forward ends of the cylinders. The valve 168 controls the supply of fluid under pressure to the cylinder 108 for swinging the bottom kerf cutter about its pivot and has its receiving bore connected through conduits 194 and 195 to the opposite ends of the cylinder. The valve 169 controls the supply of fluid under pressure to the cylinder 108 for swinging the top kerf cutter about its pivot and has its receiving bore connected through conduits 196 and 197 to the opposite ends of the cylinder. As shown in Fig. 18, the conduit 177 leading to the top of the front jack cylinder 57 is connectible through an automatic by-pass valve 198 to one of the discharge passages 156, so that when the pressure of the fluid at the upper side of the front jack piston becomes excessive, the by-pass valve will open automatically to reduce the pressure. By shifting the valves back and forth axially within their receiving bores in the valve box the conduits leading to the various cylinders may be connected either to the supply or discharge.

In Figs. 19, 20 and 21 there is shown a cutting and loading apparatus similar to that described above, having a modified form of supporting structure for the kerf cutters. In this embodiment of the invention, the feeding and "walking" jack structure for the sliding main frame, the conveying means, the upper and lower supports for the kerf cutters and the adjustable supporting structure for the upper support, are the same as those described above, and like parts are designated by like reference characters. In this instance, however, the independently swingable supporting arms 74 and 94 for the kerf cutters are omitted and the kerf cutters are pivotally mounted directly on the tiltable front frames 68 and 68' of the lower and upper supports 7 and 9. The upper and lower kerf cutters are designated 205 and 206 respectively, and each comprises an elongated plane cutter bar 207 having guided for circulation about its margin an endless cutter chain 208. The lower kerf cutter 206 is mounted on a hangar frame 209 having a bearing support corresponding to the bearing support 73 for the lower arm 74, while the upper kerf cutter is mounted on a similar hanger frame 210 on the top of the tiltable front support 68', and these hanger frames are swiveled (see Fig. 21) on the cylindric bearing supports 72 and 72' of the tilting front supports in the same manner as the arms 74 and 94 shown in Fig. 3. The cutter chains 208 of the upper and lower kerf cutters are driven in relatively opposite directions by the motors on the supports 7 and 9 through similar transmission gearing, except in this construction the chain sprockets 89 and 89' directly engage and drive the cutter chains, instead of the transmission chains 99 and 90' shown in Fig. 3. In this construction, the bar-swinging cylinders 108 are omitted and the cutter bars are swung about their pivots by swinging means similar to the swinging means for the arms 74 and 94 of the form of the invention above described and shown in Fig. 5. Otherwise this form of the invention is the same as that above described.

The general mode of operation of the improved mining apparatus is as follows: The apparatus may be moved bodily over the mine floor during maneuvering of the apparatus with respect to the coal face at a relatively high moving speed by the feed drum 38 and its cooperating feed cable 45. When this apparatus is in its cutting and loading position at the coal face, as shown in Fig. 22, fluid under pressure may be supplied to certain of the swinging cylinders 98 for the lower and upper arms 74 and 94, thereby swinging the kerf cutters simultaneously about the arm pivot axes into the dotted line position indicated at A. By independently swinging the upper and lower cutter-supporting arms, the bottom kerf cutter may be located with its effective cutting portion in advance of the top kerf cutter so that the bottom kerf cutter cuts a kerf in the coal in advance of the top kerf cutter in the manner shown in Fig. 25; and the desired angular relation of the kerf cutters relative to the arms may be obtained by the kerf-cutter-swinging cylinders 108. When the kerf cutters are in the sumping position indicated at A in Fig. 22, the fluid is trapped within the cylinders 98, 98 and 108, 108 so that the arms and kerf cutters are locked against swinging movement about their respective pivotal axes. When the kerf cutters are located in their sumping position as shown, with the tip ends of the kerf cutters near the face at the left hand rib, fluid under pressure is supplied to the feed cylinders 46 and the sliding main frame 6 is slid forwardly along its guideways relative to the bottom skid plate 3, thereby sumping the kerf cutters into the coal from the position indicated at A to the dotted line position indicated at B in Fig. 22. When the sumping cut is completed, fluid under pressure is supplied to certain of the arm swinging cylinders 98, 98 and the kerf cutters are swung simultaneously about the arm pivot axes across the coal face to form superimposed, parallel, arcuate cuts in the coal. The mid-position of the kerf cutters during their swinging movement across the coal face is indicated in full lines at C in Fig. 22 and the position of the kerf cutters at the completion of the swinging cut across the coal face is indicated in dotted lines at D in Fig. 22. When the swinging cut is completed the tip ends of the kerf cutters are located near the right hand rib, and the fluid is trapped within the arm and kerf-cutter-swinging cylinders 98, 98 and 108, 108 to lock the arms and kerf cutters against swinging movement about their respective pivotal axes. Fluid under pressure is then supplied to the feeding cylinders 46, and the sliding main frame 6 is slid rearwardly along its guideways relative to the bottom skid plate 3, moving the kerf cutters from the position indicated at D in Fig. 22 to the dotted line position indicated at E in that figure, thereby withdrawing the kerf cutters from the coal. As the kerf cutters are sumped in, swung transversely across the coal face and withdrawn from the coal, parallel superimposed kerfs are cut in the coal, thereby forming a core of coal between the kerfs, and as the kerf cutters are moved relative to the coal the elevating jacks 125, 126 and 127 may be so operated to tilt the top kerf cutter 10 about a transverse axis in the direction of its length as shown in Fig. 24, thereby to apply a breaking down pressure to the top of the core of coal, and as a result, as cutting progresses, fragments of the core are broken

down. Also during the cutting operation fluid under pressure may be supplied to the tilting cylinders 69, 69' for the tiltable front frames 68 and 68' of the lower and upper supports 7 and 9, thereby to tilt the kerf cutters about longitudinal axes in an edgewise direction to permit the kerf cutters to follow a rolling bottom or pitching coal seam, and this tilting movement of the top kerf cutter also aids in the breaking-down of the core of coal. The top kerf cutter may be adjusted upwardly and downwardly into different parallel cutting positions relative to the bottom kerf cutter by simultaneously operating the elevating jacks 125, 126 and 127, thereby enabling the apparatus to cut in coal seams of varying height and to cut cores of different thickness. The retaining plate 122 attached to the trailing edge of the bottom kerf cutter retains the broken-down coal in the path of the bottom cutter chain so that the cutter chain gathers the broken-down coal from the mine floor and moves it rearwardly toward the receiving portion of the conveyor. As the broken-down coal is received by the conveyor, it is moved rearwardly from the mine floor along the conveyor trough at one side of the main frame to discharge in an elevated position at the rear end of the apparatus. The conveyor may discharge the coal into a suitable receptacle such as a mine car or onto a conveyor mechanism in a well known manner. When the sumping, swinging and withdrawal cuts are completed and the core of coal has been completely broken down from the coal face and the broken-down coal has been conveyed away from the coal face, the "walking" jacks 54, 55 and 56 are operated to raise the main frame 6 from the skid 3 to relieve the latter substantially of the weight of the appartus, and the feed cylinders 46 are then operated to move the skid forwardly beneath the main frame, and thereafter the jacks are operated to lower the main frame again onto the skid. The feed cylinders 46 are then again operated to move main frame forwardly relative to the skid to sump the kerf cutters into the coal, and the sumping, swinging and withdrawal operations above described are repeated. The vertical rotary cutter 114 mounted on the bottom kerf cutter moves with the latter during the sumping, swinging and withdrawal cutting operations, and this rotary cutter acts to free the core of coal at the inner end of the kerf cut by the bottom kerf cutter so that the top kerf cutter may be operated to break down fragments of the core with comparative ease as cutting progresses. When the cutter driving motors are reversed, the cutter bits reversed in their respective links in the cutter chains, the bottom kerf cutter swung in the opposite direction in advance of the top kerf cutter, and the retaining plate transposed to the opposite side of the bottom cutter bar, the apparatus may cut and load in the opposite direction, i. e. from right to left.

The modified form of cutting and loading apparatus shown in Figs. 19, 20 and 21 operates in a manner similar to that above described with the exception that the independently swingable supporting arms are omitted, and, in this construction, the top and bottom kerf cutters swing about their own pivotal axes during the cutting operation. If desired, during the cutting operation the bottom kerf cutter may be swung about its pivot forwardly a slight distance in advance of the top kerf cutter, so that the bottom kerf cutter cuts a kerf in advance of the kerf cut by the top kerf cutter.

As a result of this invention, it will be noted that an improved coal mining apparatus is provided for completely removing the solid coal from its natural bed in a coal seam, wholly without the use of explosives or other blasting means, and for loading the coal as it is removed from the coal seam. It will further be noted that an improved coal mining apparatus of the combined cutting and loading type is provided having improved means for cutting and breaking down the coal, and an improved adjustable supporting structure for the cutters whereby the apparatus is rendered extremely flexible in operation and has a relatively wide cutting and loading range. It will still further be evident that by the novel arrangements and combinations of parts the apparatus is not only relatively flexible in operation but is also extremely compact and rugged in design, well adapted to meet the severe conditions of service in the mining of coal. Other advantages and uses of the improved coal cutting and loading apparatus will be clearly apparent to those skilled in the art.

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

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

1. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the forward end of said base, and core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, the bottom kerf cutter being disposed near the floor level in advance of the receiving end of said conveying means and the top kerf cutter being disposed a substantial distance above the floor level, means for mounting said kerf cutters on said base in the positions aforesaid with the active cutting portion of one kerf cutter disposed in advance of the active cutting portion of the other kerf cutter, said mounting means including means for pivotally supporting said kerf cutters for horizontal swinging movement relative to said base and conveying means, said mounting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for horizontally swinging said kerf cutters simultaneously about their pivotal mountings relative to said base and conveying means for cutting simultaneously a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for adjusting the top cutter in a vertical direction relative to the bottom kerf cutter to apply, at a point spaced horizontally from the bottom kerf cutter, a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that said orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means.

2. In a mining and loading apparatus, in com-

bination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the forward end of said base, and core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, the bottom kerf cutter being disposed near the floor level in advance of the receiving end of said conveying means and the top kerf cutter being disposed a substantial distance above the floor level, means for mounting said kerf cutters on said base in the positions aforesaid with the active cutting portion of the bottom kerf cutter disposed in advance of the active cutting portion of the top kerf cutter and including means for pivotally supporting said kerf cutters for horizontal swinging movement relative to said base and conveying means, said mounting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for horizontally swinging said kerf cutters simultaneously about their pivotal mountings relative to said base and conveying means for cutting simultaneously a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for adjusting the top kerf cutter in a vertical direction relative to the bottom kerf cutter to apply, at a point spaced horizontally rearwardly of the bottom kerf cutter, a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that said orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means.

3. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor, core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, the bottom kerf cutter being disposed near the floor level in advance of the receiving end of said conveying means and the top kerf cutter disposed a substantial distance above the floor level, means for mounting said kerf cutters on said base in the positions aforesaid with the active cutting portion of one kerf cutter disposed in advance of the active cutting portion of the other kerf cutter, said mounting means including means for pivotally supporting said kerf cutters for horizontal swinging movement relative to said base and conveying means, said mounting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for horizontally swinging said kerf cutters simultaneously about their pivotal mountings relative to said base and conveying means for cutting simutaneously a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, means for adjusting the top cutter in a vertical direction relative to the bottom kerf cutter to apply, at a point spaced horizontally from the bottom kerf cutter, a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that said orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means, and means associated with the bottom kerf cutter and swingable horizontally therewith at the trailing side thereof for retaining the broken down coal in the path of the cutting elements thereof and for directing the coal as it is moved by said cutting elements toward the receiving end of said conveying means.

4. In a mining and loading apparatus, in combination, a portable base, and core cutting and breaking down mechanism on said base comprising a pair of parallel horizontal kerf cutters, means for pivotally mounting said kerf cutters on said base for horizontal swinging movement relative to said base comprising arms pivotally mounted for horizontal swinging movement on said base, means for pivotally mounting said kerf cutters on said arms respectively, to swing horizontally relative thereto about pivotal axes parallel to the arm pivot axes, means for independently adjusting said kerf cutters horizontally about their pivotal axes on said arms into different angularly related positions relative to said arms so that the active cutting portion of one kerf cutter is disposed in advance of the active cutting portion of the other kerf cutter, and means for swinging said arms simultaneously about their pivotal axes, when said cutters are in angularly adjusted position relative to said arms, to swing said kerf cutters simultaneously bodily in arcuate paths about the arm pivot axes to cut parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs.

5. In a mining and loading apparatus, in combination, a portable base, and core cutting and breaking down mechanism on said base comprising a pair of parallel horizontal kerf cutters, means for pivotally mounting said kerf cutters on said base for horizontal swinging movement relative to said base comprising arms pivotally mounted for horizontal swinging movement on said base, means for pivotally mounting said kerf cutters on said arms respectively, to swing horizontally relative thereto about pivotal axes parallel to the arm pivot axes, said mounting means for the top kerf cutter embodying means including a further pivotal mounting whereby the top kerf cutter may be tilted in a vertical direction relative to the bottom kerf cutter, means for independently adjusting said kerf cutters horizontally about their pivotal axes on said arms into different angularly related positions relative to said arms so that the active cutting portion of one kerf cutter is disposed in advance of the active cutting portion of the other kerf cutter, means for swinging said arms simultaneously about their pivotal axes, when said cutters are in angularly adjusted position relative to said arms, to swing said kerf cutters simultaneously bodily in arcuate paths about the arm pivot axes to cut parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for tilting the top kerf cutter about its said further pivotal mounting in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses.

6. In a mining and loading apparatus, in combination, a portable base, core cutting and breaking down mechanism on said base comprising a pair of parallel horizontal top and bottom kerf cutters, the bottom kerf cutter disposed near the level of the mine floor in advance of the forward end of said base and the top kerf cutter disposed a substantial distance above the floor level, means

for pivotally mounting said kerf cutters on said base for horizontal swinging movement relative thereto comprising arms pivotally mounted to swing horizontally relative to said base, means for pivotally mounting said kerf cutters on said arms respectively, to swing horizontally relative thereto about pivotal axes parallel to the arm pivot axes, said mounting means for the top kerf cutter embodying means including a further pivotal mounting whereby the top kerf cutter may be tilted in a vertical direction relative to the bottom kerf cutter, means for independently adjusting said kerf cutters horizontally about their pivotal axes on said arms into different angularly related positions relative to said arms so that the active cutting portion of one kerf cutter is disposed in advance of the active cutting portion of the other kerf cutter, means for swinging said arms simultaneously about their pivotal axes, when said cutters are in angularly adjusted position relative to said arms, to swing said kerf cutters simultaneously bodily in arcuate paths about the arm pivot axes to cut parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, means for tilting the top kerf cutter about its said further pivotal mounting in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, and conveying means on said base for receiving the broken down coal and moving the same away from the coal face, the bottom kerf cutter moving the broken down coal away from the coal face over the mine floor toward the conveying means.

7. In a mining and loading apparatus, in combination, a portable base, and cutting and breaking down mechanism on said base comprising a pair of parallel horizontal top and bottom kerf cutters, means for mounting said kerf cutters on said base for independent horizontal swinging movement relative thereto about vertical axes, said mounting means including upper and lower supports on which said kerf cutters are respectively pivotally mounted and means for adjustably supporting the support for the top kerf cutter for tilting movement about transverse and longitudinal axes relative to the support for the bottom kerf cutter, means for horizontally swinging said kerf cutters simultaneously about their pivotal mountings relative to said supports, and means for tilting the support for the top kerf cutter about said transverse and longitudinal axes relative to said lower support to tilt the top kerf cutter relative to the bottom kerf cutter.

8. In a mining and loading apparatus, in combination, a portable base, and cutting and breaking down mechanism on said base comprising a pair of parallel horizontal top and bottom kerf cutters, means for mounting said kerf cutters on said base including means for pivotally supporting said kerf cutters for independent horizontal swinging movement relative to said base about vertical axes, said mounting means including upper and lower supports on which said kerf cutters are respectively pivotally mounted and means for adjustably supporting said supports for tilting movement about longitudinal axes relative to said base, means for horizontally swinging said kerf cutters simultaneously about their pivotal mountings relative to said supports, and means for tilting said supports about said longitudinal axes respectively to tilt said kerf cutters about longitudinal axes relative to said base.

9. In a mining and loading apparatus, in combination, a portable base, and cutting and breaking down mechanism on said base comprising a pair of parallel horizontal top and bottom kerf cutters, means for mounting said kerf cutters on said base including means for pivotally supporting said kerf cutters for independent horizontal swinging movement relative to said base about vertical axes, said supporting means including upper and lower supports on which said kerf cutters are respectively pivotally mounted and means for adjustably mounting said supports for tilting movement about longitudinal axes relative to said base, said mounting means also including means for adjustably supporting said upper support for tilting movement about a transverse axis relative to said lower support, means for horizontally swinging said kerf cutters simultaneously about their pivotal mountings relative to said supports, means for tilting said supports about said longitudinal axes relative to said base respectively to tilt said kerf cutters about longitudinal axes, and means for tilting said upper support about said transverse axis relative to the lower support to tilt the top kerf cutter in a vertical direction relative to the bottom kerf cutter.

10. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the forward end of said base, and core cutting and breaking down mechanism supported on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, the bottom kerf cutter being disposed at the floor level in advance of the receiving end of said conveying means and the top kerf cutter being disposed a substantial distance above the floor level, means for mounting said kerf cutters on the forward portion of said base in the positions aforesaid including means for pivotally supporting said kerf cutters for independent swinging movement horizontally relative to said base, said pivotal mounting means including arms pivotally mounted to swing horizontally relative to said base and on which said kerf cutters are respectively mounted, said mounting means including means for independently adjusting the angular relation of said kerf cutters relative to said arms respectively and means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for swinging said arms simultaneously about their pivotal mountings to swing said kerf cutters simultaneously bodily in arcuate paths horizontally about the arm pivot axes for cutting simultaneously a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for adjusting the top kerf cutter in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the cutting elements of the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that the orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means.

11. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the forward end of said base, core cutting and breaking down

mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, the bottom kerf cutter being disposed at the floor level in advance of the receiving end of the conveying means and the top kerf cutter being disposed a substantial distance above the floor level, means for mounting said kerf cutters in the positions aforesaid for horizontal movement relative to said base and including means for adjustably supporting the top kerf cutter for tilting movement in a vertical direction relative to the bottom kerf cutter, means for simultaneously moving said kerf cutters horizontally relative to said base and conveying means for cutting simultaneously a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for tilting the top kerf cutter in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that the orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means.

12. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the front end of said base, and core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, the bottom kerf cutter being disposed at the floor level in advance of the receiving end of the conveying means and the top kerf cutter being disposed a substantial distance above the floor level, means for mounting said kerf cutters in the positions aforesaid on the forward portion of said base including means for pivotally supporting said kerf cutters for independent horizontal swinging movement relative to said base and conveying means, said pivotal mounting means including arms pivotally mounted to swing horizontally relative to said base and on which said kerf cutters are respectively supported, said mounting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for independently adjusting said kerf cutters horizontally relative to said arms, said kerf cutters adjustable horizontally relative to their respective supporting arms and said arms swingable horizontally relative to each other so that the bottom kerf cutter has its active cutting portion disposed in advance of the active cutting portion of the top kerf cutter, means for swinging said arms simultaneously about their pivotal mountings relative to said base to move said kerf cutters bodily in arcuate paths horizontally relative to said base and conveying means for cutting a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for adjusting the top kerf cutter in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that the orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means.

13. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the front end of said base, and core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, the bottom kerf cutter being disposed at the floor level in advance of the receiving end of the conveying means and the top kerf cutter being disposed a substantial distance above the floor level, means for mounting said kerf cutters in the positions aforesaid on the forward portion of said base including means for pivotally supporting said kerf cutters for independent horizontal swinging movement relative to said base and conveying means, said pivotal mounting means including arms pivotally mounted to swing horizontally relative to said base and on which said kerf cutters are respectively supported, said mounting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for independently adjusting said kerf cutters horizontally relative to said arms, said kerf cutters adjustable horizontally relative to their respective supporting arms and said arms swingable horizontally relative to each other so that the bottom kerf cutter has its active cutting portion disposed in advance of the active cutting portion of the top kerf cutter, means for swinging said arms simultaneously about their pivotal mountings relative to said base to move said kerf cutters bodily in arcuate paths horizontally relative to said base and conveying means for cutting a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, means for adjusting the top kerf cutter in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that the orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means, and means associated with the bottom kerf cutter and swingable horizontally therewith at the trailing side thereof for retaining the broken down coal in the path of the cutting elements thereof and for directing the coal as it is moved by said cutting elements rearwardly toward the receiving end of said conveying means.

14. In a mining and loading apparatus, in combination, a portable base, conveying means on said base, and core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements, means for mounting said kerf cutters on said base in the positions aforesaid including pivotal supporting means for adjustably supporting said kerf cutters for tilting movement about longitudinal axes relative to said base and including means for adjustably supporting the top kerf cutter for tilting movement in a vertical direction about a transverse axis relative to the bottom kerf cutter, means for moving said kerf cutters horizontally across a coal face for cutting simultaneously a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the

kerfs, means for independently tilting said kerf cutters on their mounting means about said longitudinal axes, and means for tilting the top kerf cutter on its mounting means about said transverse axis to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the cutting elements on the bottom kerf cutter moving the broken down coal toward said conveying means.

15. In a mining and loading apparatus, in combination, a portable base, a conveyor on said base having its receiving end disposed near the floor level at the forward end of said base, and cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters, the bottom kerf cutter being disposed at the floor level in advance of the receiving end of said conveyor and the top kerf cutter being disposed at a substantial distance above the floor level, means for mounting said kerf cutters in the positions aforesaid on the forward portion of said base including means for pivotally supporting said kerf cutters for independent horizontal swinging movement relative to said base and conveyor about alined vertical axes, said kerf cutters swingable horizontally about said alined vertical axes across the front end of said base from one side thereof to the other, said supporting means also including means for adjustably supporting the top kerf cutter for adjustment into different elevated positions relative to the bottom kerf cutter, means for independently swinging said kerf cutters horizontally about their respective pivotal mountings relative to said base and conveyor, and means for adjusting the elevation of the top kerf cutter relative to the bottom kerf cutter.

16. In a mining and loading apparatus, in combination, a portable base, core cutting and breaking down mechanism on said base for cutting the solid coal in a coal seam and for breaking down the coal as cutting progresses comprising parallel horizontal top and bottom kerf cutters, the bottom kerf cutter being disposed near the level of the mine floor in advance of said base and the top kerf cutter disposed a substantial distance above the floor level, means for mounting said kerf cutters on said base in the positions aforesaid with the active cutting portion of the bottom kerf cutter disposed in advance of the active cutting portion of the top kerf cutter, said mounting means including means for pivotally supporting said kerf cutters for horizontal swinging movement relative to said base, said supporting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for horizontally swinging said kerf cutters simultaneously about their pivotal mountings bodily in arcuate paths relative to said base to cut parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, means for adjusting the top kerf cutter on its mounting means in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, and a conveyor on said base having its receiving end disposed near the floor level rearwardly of the rear ends of said kerf cutters and relative to which said kerf cutters are swingable, for receiving the broken down coal.

17. In a mining and loading apparatus, in combination, a portable base, a pair of elongated supporting structures pivotally mounted on said base to swing horizontally relative thereto and extending forwardly in advance of said base, each of said supporting structures comprising a horizontal inner support pivoted to swing on a vertical axis and a horizontal outer support carried by said inner support and pivotally mounted thereon to swing relative thereto on a parallel axis, horizontal kerf cutters carried by said supporting structures respectively and swingable independently about the pivotal axes of said outer supports and simultaneously about the pivotal axes of said inner supports, said kerf cutters swingable independently about the outer support pivot axes into different angular positions with respect to said inner supports, and means for swinging said supporting structures horizontally relative to said base to move said kerf cutters simultaneously about the pivotal axes of said inner supports horizontally across the forward end of said base from one side of the latter to the other to cut horizontal kerfs in a coal seam.

18. In a mining and loading apparatus, in combination, a portable base, a pair of elongated superimposed supporting structures pivotally mounted on said base to swing horizontally relative thereto and extending forwardly in advance of said base, each of said supporting structures comprising a horizontal inner support pivoted to swing on a vertical axis and a horizontal outer support carried by said inner support and pivotally mounted thereon to swing relative thereto on a parallel axis, means for mounting one of said supporting structures for adjustment in a vertical direction relative to the other supporting structure, a pair of parallel, horizontal, core cutting and core breaking means including kerf cutters carried by said supporting structures respectively and swingable independently about the pivotal axes of said outer supports and simultaneously about the pivotal axes of said inner supports, said kerf cutters being swingable independently about said outer support pivot axes into relatively angularly related positions relative to said inner supports, means for swinging said supporting structures horizontally simultaneously about the pivotal axes of said inner supports to move said kerf cutters horizontally across the forward end of said base from one side of the latter to the other to cut parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for adjusting said vertically adjustable supporting structure in a vertical direction relative to the other supporting structure to move one of said kerf cutters in a vertical direction to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses.

19. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the front end of said base, and core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements and projecting forwardly in advance of said base with their rearmost cutting elements disposed in advance of the receiving end of said conveying means, said bottom kerf cutter being disposed near the floor level and the top kerf cutter disposed a substantial distance above the floor level, means for mounting said kerf cutters on said base in the positions aforesaid including pivotal supporting

means for supporting said kerf cutters for horizontal swinging movement relative to said base and conveying means and including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for swinging said kerf cutters on their mounting means horizontally relative to said base and conveying means across the forward end of said base from one side of the latter to the other for cutting simultaneously a pair of parallel horizontal kerfs in a coal seam to form a single relatively wide core of coal extending the full distance between the kerfs, and means for adjusting the top kerf cutter on its mounting means in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the cutting elements of the bottom kerf cutter moving the broken down coal toward the receiving end of said conveying means.

20. In a mining and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the level of the mine floor at the front end of said base, and core cutting and breaking down mechanism on said base comprising parallel horizontal top and bottom kerf cutters having orbitally moving cutting elements and projecting forwardly in advance of said base with their rearmost cutting elements disposed in advance of the receiving end of said conveying means, the bottom kerf cutter being disposed near the floor level and the top kerf cutter being disposed a substantial distance over the floor level, means for mounting said kerf cutters on said base in the positions aforesaid including pivotal supporting means for supporting said kerf cutters for horizontal swinging movement relative to said base and conveying means and means for adjustably supporting the top kerf cutter for adjustment horizontally into a predetermined relation with respect to the bottom kerf cutter so that the active cutting portion of the bottom kerf cutter is disposed in advance of the active cutting portion of the top kerf cutter, said mounting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter, means for swinging said kerf cutters horizontally on their mounting means relative to said base and conveying means across the forward end of said base from one side of the latter to the other for cutting simultaneously a pair of parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means for adjusting the top kerf cutter on its mounting means in a vertical direction relative to the bottom kerf cutter to apply a breaking down pressure to the core of coal to break down fragments of the core as cutting progresses, the cutting elements of the bottom kerf cutter moving the broken down coal toward the receiving end of said conveying means.

21. In a mining and loading apparatus, in combination, a portable base, a conveyor on said base having its receiving end disposed near the level of the mine floor at the front end of said base, and core cutting and breaking down mechanism on said base and comprising a pair of parallel horizontal top and bottom kerf cutters each having orbitally movable cutting elements, the bottom kerf cutter being disposed near the floor level with its rearmost cutting elements located in advance of the receiving end of said conveyor, means for mounting said kerf cutters on said base in the positions aforesaid including pivotal supporting means for supporting said kerf cutters for horizontal swinging movement across the forward end of said base from one side of the latter to the other, said mounting means also including adjustable supporting means for supporting said kerf cutters for relative adjustment, means for swinging said kerf cutters horizontally about their pivotal mountings relative to said base and conveyor to cut parallel horizontal kerfs in the coal seam to form a single relatively wide core of coal extending the full distance between the kerfs, and means for relatively adjusting said kerf cutters on said supporting means to break down fragments of the core as cutting progresses, the cutting elements of the bottom kerf cutter moving the broken down coal toward the receiving end of said conveyor.

22. In a mining and loading apparatus, in combination, a portable base, a conveyor on said base having its receiving end disposed near the level of the mine floor at the front end of said base, and core cutting and breaking down mechanism on said base and comprising a pair of parallel horizontal top and bottom kerf cutters each having orbitally movable cutting elements, the bottom kerf cutter being disposed near the floor level with its rearmost cutting elements located in advance of the receiving end of said conveyor, means for mounting said kerf cutters on said base in the positions aforesaid including pivotal supporting means for supporting said kerf cutters for horizontal swinging movement across the forward end of said base from one side of the latter to the other and means for supporting said kerf cutters for independent tilting movement about longitudinal axes relative to said base and conveyor, said mounting means also including adjustable supporting means for supporting said kerf cutters for relative adjustment, means for swinging said kerf cutters horizontally about their pivotal mountings relative to said base and conveyor to cut parallel horizontal kerfs in a coal seam to form a core of coal between said kerfs, means for relatively adjusting said kerf cutters on their mounting means to break down fragments of the core as cutting progresses, the cutting elements of the bottom kerf cutter moving the broken down coal toward the receiving end of the conveyor, and means for tilting said kerf cutters on said mounting means about said longitudinal axes relative to said base and conveyor.

23. In a mining and loading apparatus, in combination, a portable base, a conveyor on said base having its receiving end disposed near the level of the mine floor at the front end of said base, and core cutting and breaking down mechanism on said base and comprising a pair of parallel horizontal top and bottom kerf cutters each having orbitally movable cutting elements, the bottom kerf cutter being disposed near the floor level with its rearmost cutting elements located in advance of the receiving end of said conveyor, means for mounting said kerf cutters on said base in the positions aforesaid including pivotal supporting means for supporting said kerf cutters for horizontal swinging movement across the forward end of said base from one side of the latter to the other and adjustable supporting means for supporting said kerf cutters for tilting movement both about longitudinal axes and one about a transverse axis relative to said base and conveyor, said mounting means also including adjustable supporting means for supporting said

kerf cutters for relative adjustment, means for swinging said kerf cutters horizontally about their pivotal mountings relative to said base and conveyor to cut parallel horizontal kerfs in a coal seam to form a core of coal between said kerfs, means for relatively adjusting said kerf cutters on their mounting means to break down fragments of the core as cutting progresses, the cutting elements of the bottom kerf cutter moving the broken down coal toward the receiving end of the conveyor, and means for tilting said kerf cutters on said mounting means both about said longitudinal axes and one about said transverse axis relative to said base and conveyor.

24. In a reversible cutting and loading apparatus, in combination, a portable base, conveying means on said base having its receiving end disposed near the floor level at the front end of said base, and reversible core cutting and breaking down mechanism mounted on said base comprising a pair of superimposed parallel horizontal kerf cutters having reversible orbitally movable cutting elements, the bottom kerf cutter being disposed near the floor level in advance of the receiving end of said conveying means and the top kerf cutter being disposed a substantial distance above the floor level, means for mounting said kerf cutters on said base in the positions aforesaid including means for pivotally supporting said kerf cutters for horizontal swinging movement in either of opposite directions relative to said base and conveying means and means for adjustably supporting the bottom kerf cutter for adjustment horizontally relative to the top kerf cutter into a position wherein its active cutting portion is disposed in advance of the active cutting portion of the top kerf cutter irrespective of the direction of horizontal swinging movement of said kerf cutters, said mounting means also including means for adjustably supporting the top kerf cutter for adjustment in a vertical direction relative to the bottom kerf cutter irrespective of the direction of horizontal swinging movement of said kerf cutters, means for adjusting the bottom kerf cutter on its adjustable mounting means horizonally relative to the top kerf cutter to position its active cutting portion relative to the active cutting portion of the top kerf cutter as aforesaid, means for simultaneously swinging said kerf cutters horizontally about their pivotal mountings in either of opposite directions relative to said base and conveying means to cut simultaneously parallel horizontal kerfs in a coal seam to form a core of coal between the kerfs, and means operative irrespective of the direction of horizontal swinging movement of said kerf cutters for adjusting the top kerf cutter on its adjustable mounting means relative to the bottom kerf cutter to apply, at a point offset horizontally from the bottom kerf cutter, a breaking down pressure to the core of coal between the kerfs to break down fragments of the core as cutting progresses, the bottom kerf cutter being so arranged with respect to the receiving end of said conveying means that the orbitally moving cutting elements thereof move the broken down coal over the mine floor toward the receiving end of said conveying means.

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