July 30, 1957 J. F. JOY 2,801,091

MINING AND LOADING APPARATUS INVOLVING CORE CUTTING AND DISLODGING MEANS

Filed Feb. 28, 1950 5 Sheets-Sheet 1

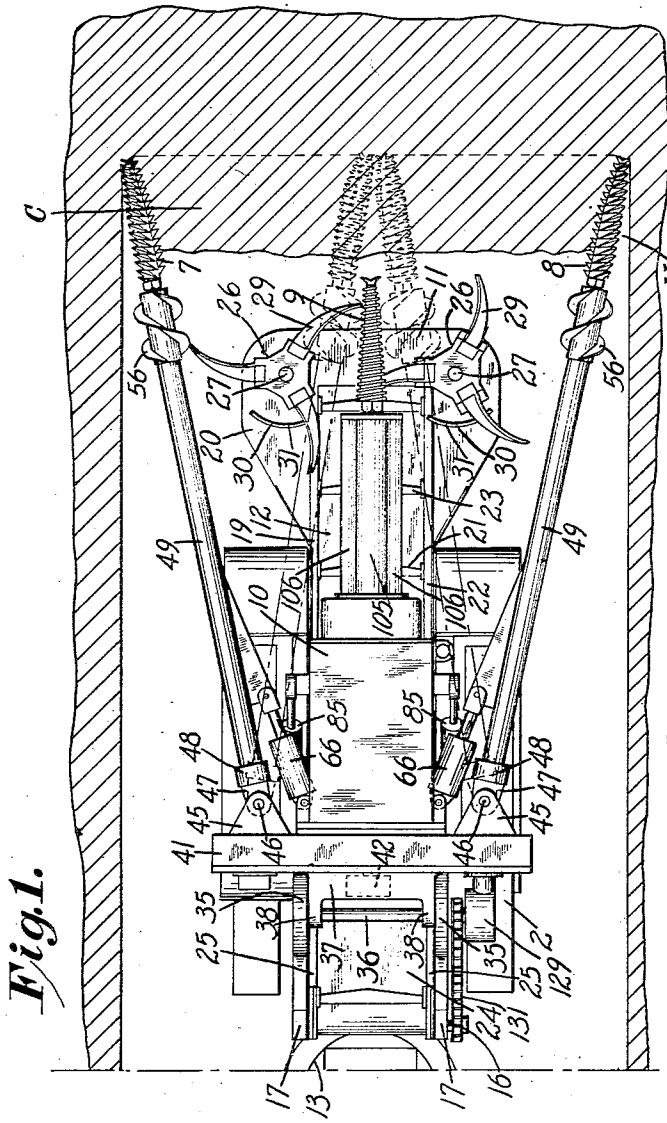


Fig. 1.

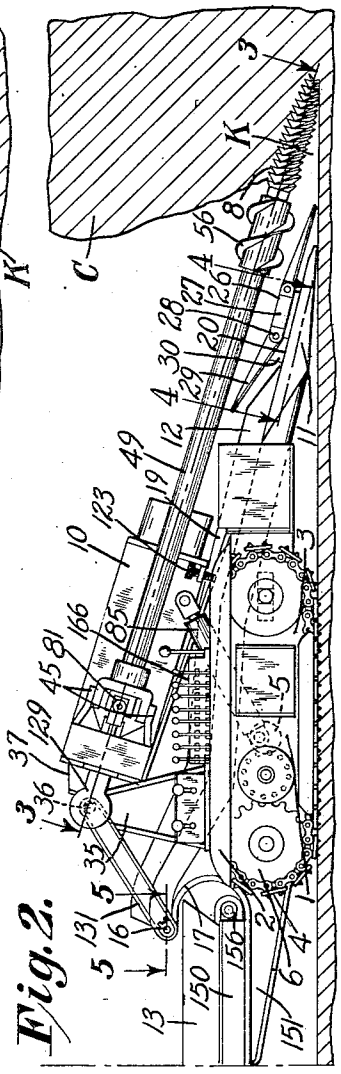


Fig. 2.

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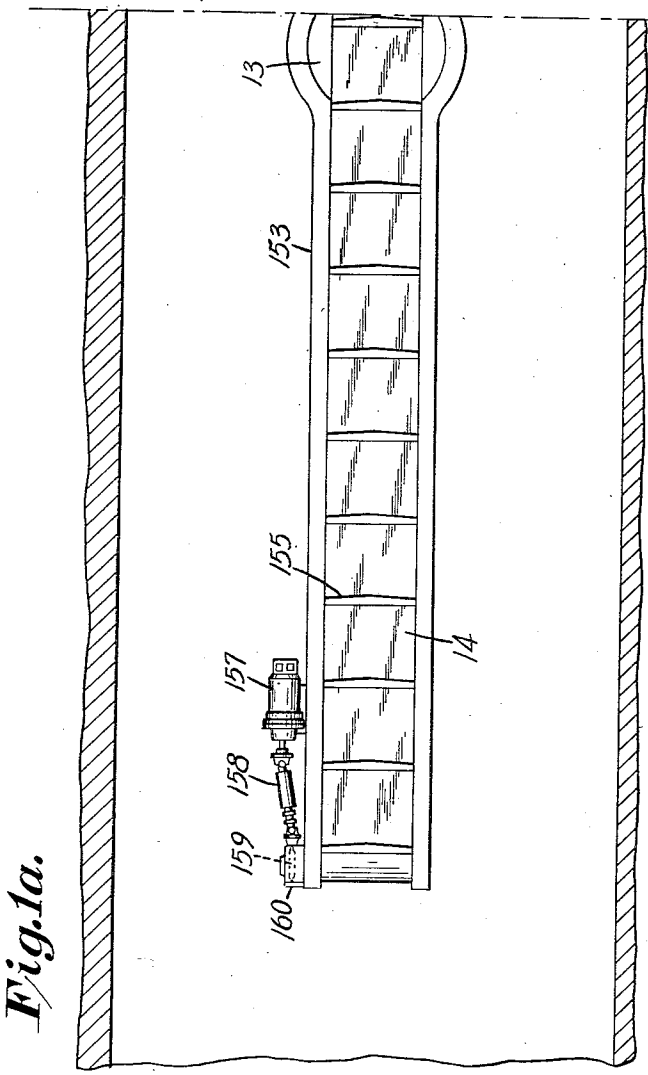


Fig. 1a.

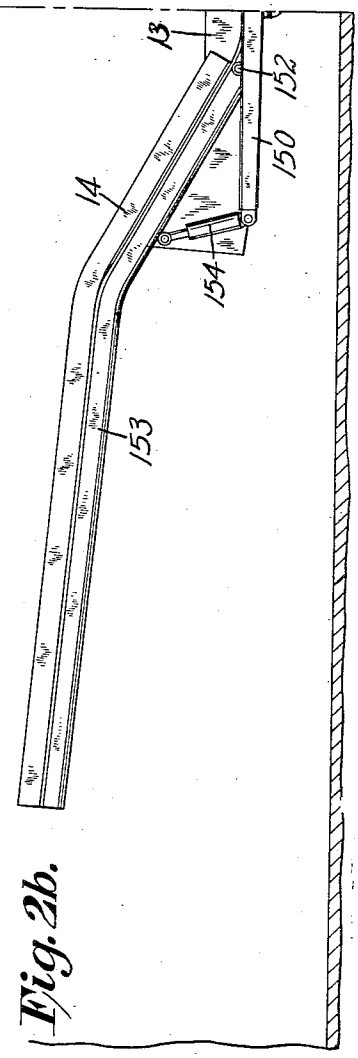


Fig. 2b.

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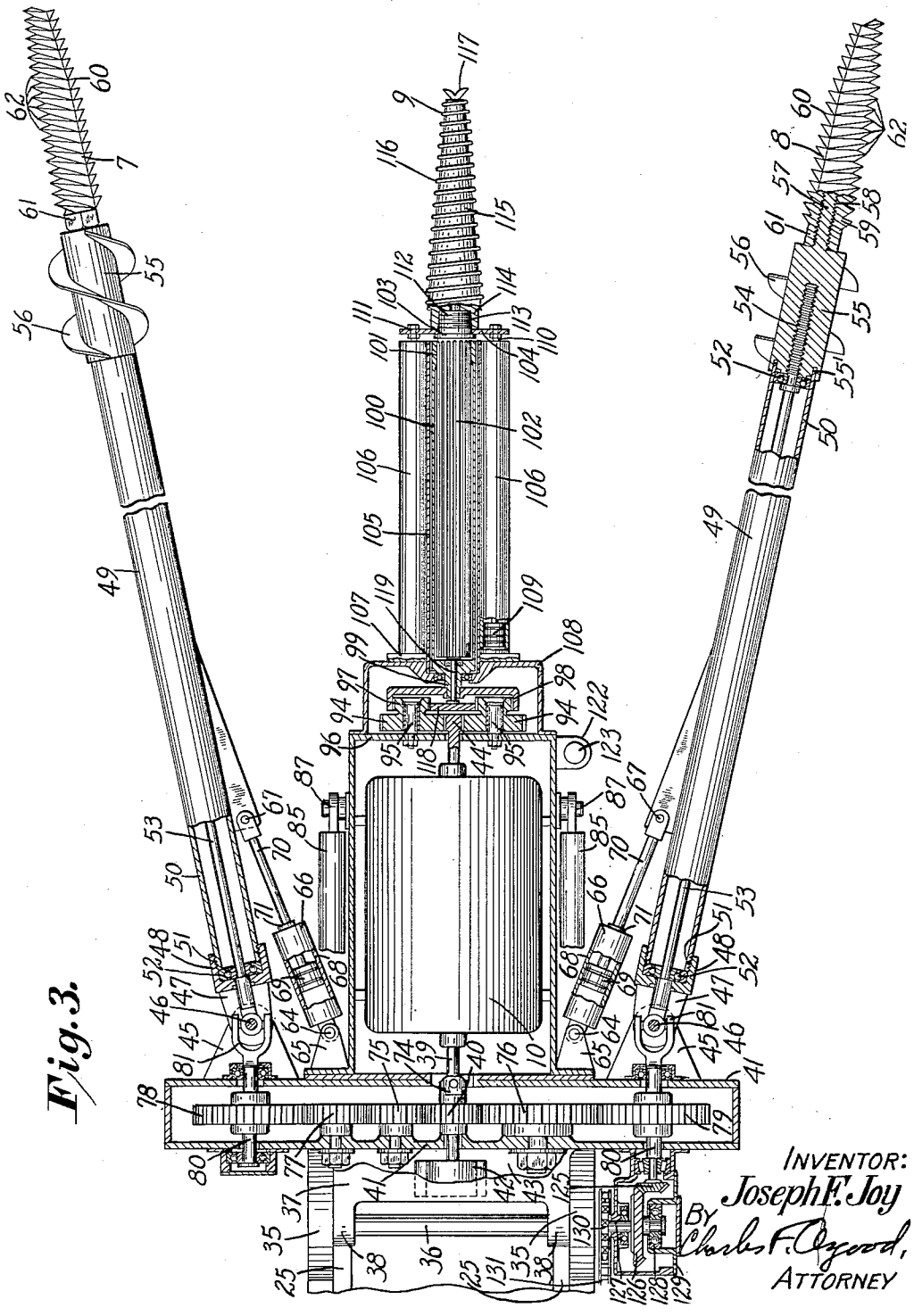


Fig. 3.

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MINING AND LOADING APPARATUS INVOLVING CORE CUTTING AND DISLODGING MEANS

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Fig. 4.

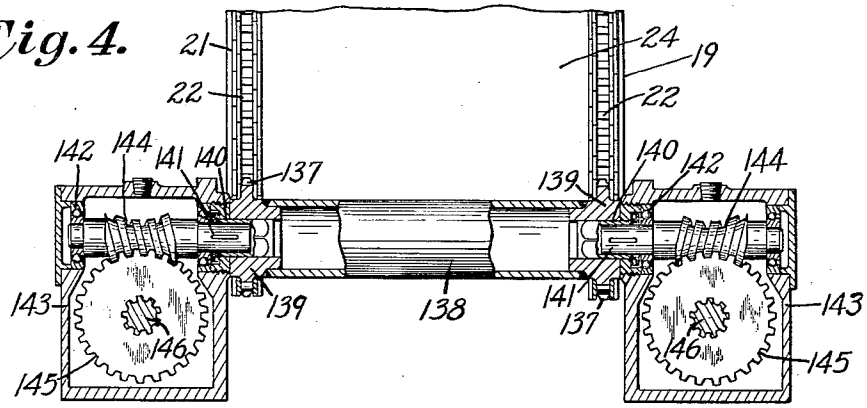


Fig. 5.

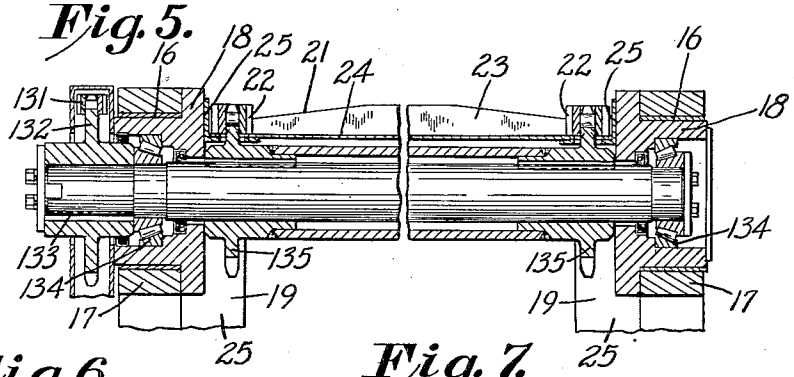


Fig. 6.

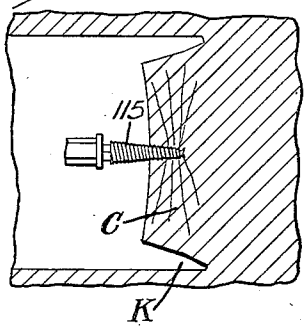
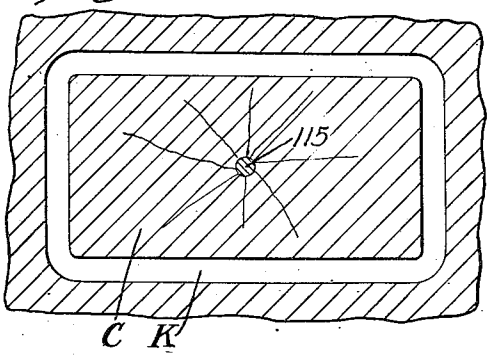


Fig. 7.



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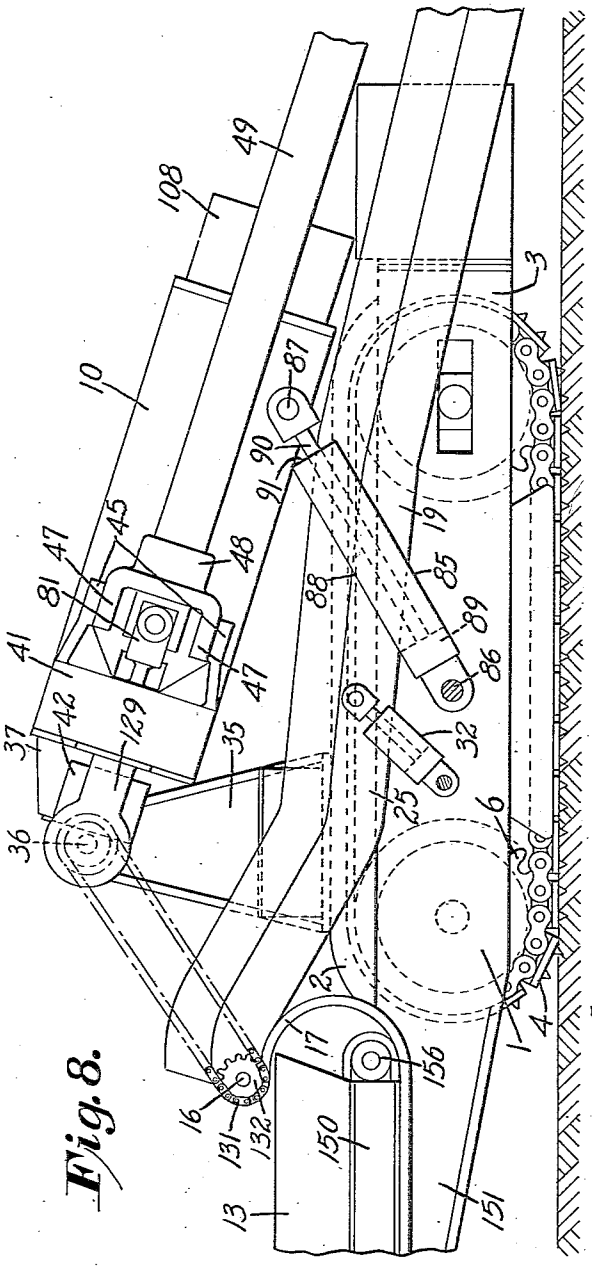


Fig. 8.

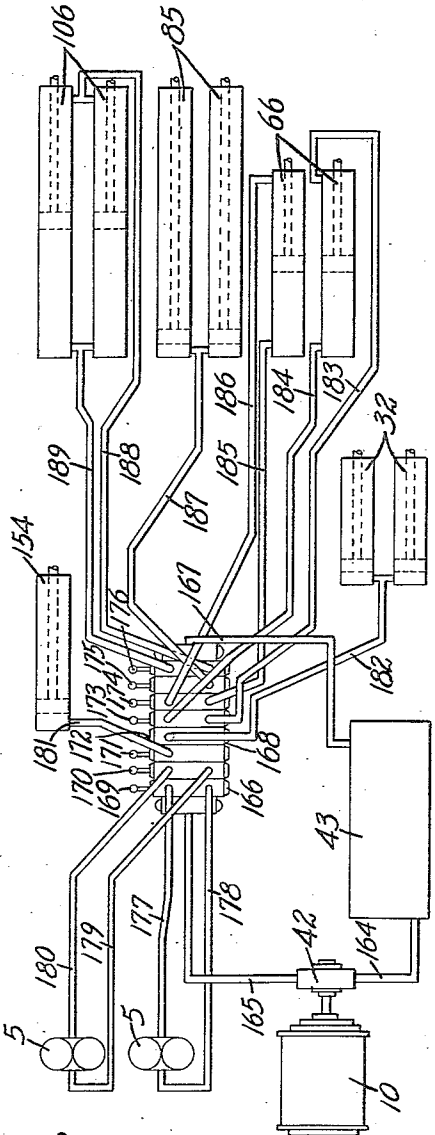


Fig. 9.

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United States Patent Office 2,801,091 Patented July 30, 1957

2,801,091

MINING AND LOADING APPARATUS INVOLVING CORE CUTTING AND DISLODGING MEANS

Joseph F. Joy, Pittsburgh, Pa., assignor to Joy Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application February 28, 1950, Serial No. 146,883

21 Claims. (Cl. 262—9)

This invention relates to mining apparatus and more particularly to apparatus for mining coal or other mineral from a solid mine vein and for loading the mined-out coal or other mineral.

In my copending application, Serial No. 725,950, filed February 1, 1947, a novel method of and apparatus for mining and loading coal is disclosed, and the present invention relates to improvements over the apparatus of the application.

An object of the present invention is to provide an improved apparatus for mining coal or other mineral from a solid mine vein, in a relatively continuous and uninterrupted manner and without the use of explosives. Another object is to provide an improved apparatus for dislodging coal or other mineral from a solid mine vein and for mechanically loading the dislodged material thereby substantially eliminating the need of manually handling the dislodged material. Yet another object is to provide an improved mining apparatus for dislodging the solid coal from a coal seam and embodying means for gathering the dislodged coal and for conveying the loose coal so gathered rearwardly of the apparatus to a suitable point of delivery. A further object is to provide an improved mining and loading apparatus of the crawler mounted type. A still further object is to provide an improved coal cutting apparatus for cutting out a core of coal or other mineral from a solid mine vein and a cooperating breaker device engageable with the core of coal for dislodging the same. Yet another object is to provide an improved adjustable supporting means for the cutting devices and the breaker device of a mining apparatus of the above character. Still another object is to provide improved driving means for the cutting and dislodging devices, the conveying means and gathering devices of a mining and loading apparatus. A further object is to provide improved conveying means associated with the cutting devices. Still another object is to provide an improved combined mining and loading apparatus having novel features of construction and novel arrangements and combinations of parts. These and other objects and advantages of the invention will, however, hereinafter more fully appear in the course of the ensuing description.

In the accompanying drawings there is shown for purposes of illustration one form which the invention may assume in practice.

In these drawings:

Figs. 1 and 1*a*, taken together, constitute a plan view of a mining and loading apparatus constructed in accordance with a preferred illustrative embodiment of the invention.

Figs. 2 and 2*a*, taken together, constitute a side elevational view of the mining and loading apparatus shown in Figs. 1 and 1*a*.

Fig. 3 is an enlarged horizontal section taken substantially on line 3—3 of Fig. 2, with parts shown in full to facilitate illustration.

Fig. 4 is an enlarged section taken on line 4—4 of

Fig. 2, showing a portion of the gathering and conveying means.

Fig. 5 is an enlarged detail horizontal section taken on line 5—5 of Fig. 2, illustrating the pivotal mounting and driving means for the front loading conveyor.

Figs. 6 and 7 are diagrammatic views, in longitudinal and transverse sections respectively, illustrating the manner of cutting and dislodging the solid mineral from a mine vein.

Fig. 8 is an enlarged fragmentary side elevational view, with parts omitted, showing details of the structure of the apparatus.

Fig. 9 is a diagrammatic view illustrating the hydraulic fluid system and associated control valve mechanism.

In this illustrative embodiment of the invention an improved mining and loading apparatus is provided which is an improvement over that disclosed in my copending application, Serial No. 725,950 above referred to, and the apparatus of the present invention is designed to cut out a core or defined area of coal or other mineral of a solid mine vein and to apply a powerful breaking down or dislodging pressure centrally of the core or defined area whereby the latter may be dislodged from the solid. Gathering and conveying means are embodied in the apparatus whereby the dislodged and disintegrated coal or other mineral may be gathered from the mine floor and moved onto the conveying means which conveys the loose material rearwardly of the apparatus to a suitable point of delivery such as the usual transportation system of a mine. Thus, the coal or other mineral may be dislodged from a solid mine vein in a substantially continuous and uninterrupted manner and without the use of explosives and the usual auxiliary equipment.

The mining and loading apparatus disclosed for illustrative purposes herein is of a self-contained, unitary structure, and generally comprises a mobile base **1**, herein desirably a crawler base, having a frame **2** supported by side frames **3** about which endless crawler treads **4** are guided for circulation. Motors **5**, desirably conventional reversible hydraulic motors, are carried by the tread side frames within the orbits of the tread chains and are operatively connected to drive sprockets **6** which engage and drive the tread chains. Adjustably mounted on the base frame are cutting devices or mining instrumentalities **7** and **8** and a breaker or dislodging device **9**, and a motor **10** herein desirably an electric motor serves to drive the cutting and breaker devices. Mounted on the base frame beneath the cutting and breaker devices is a gathering head **11** which gathers loose material on the mine floor and moves it rearwardly onto a front loading conveyor **12** which conveys the loose material rearwardly to discharge into a hopper **13** of a swiveled and tiltable rear discharge conveyor **14**. The front and rear conveyors and the gathering head are likewise driven from the motor **10**.

Now referring to the specific structure of the gathering head **11** and the front loading conveyor **12** it will be noted that pivotally mounted on a horizontal transverse axis at **16** on suitable bearings supported by upstanding frames **17** carried at the rear end of the base frame are bearing engaging portions **18** of a swingable conveyor frame **19** which extends downwardly and forwardly through the open center of the base frame, between the tread side frames, as shown in Figs. 1, 2 and 8. Secured to the forward portion of the conveyor frame is an inclined plate or deck **20** which is adapted to be disposed near to or to rest on the mine floor when in lowered position. Guided for circulation relative to the conveyor frame **19** is an endless flight conveyor **21** having side chains **22** between which cross flights **23** are suitably connected, and these flights move along the top surface of a transverse plate **24** extending between and secured

to the parallel side arms 25 of the conveyor frame. Carried by the deck plate 20 at opposite sides of the front receiving end of the conveyor 21 are rotary gatherers 26 having hubs 27 suitably journaled on upright axes in bearings supported within the deck frame beneath the deck plate. Pivotally mounted at 28 in spaced relation about the hubs to swing in upright planes are curved gathering arms 29, and cam elements 30 mounted on the deck plate rearwardly of the hubs 27, have upper cam surfaces 31 engageable by the bottoms of the gathering arms as the latter move laterally away from the conveyor so that the arms are lifted up as they leave the conveyor to reduce the possibility of the arms dragging laterally the material off from the sides of the conveyor. The gathering arms at the forward portions of their movement leave the cams and drop down with their outer ends disposed close to or engaging the mine floor and the forward ends of the arms as they sweep over the floor in advance of the deck plate engage the loose material on the floor and move it inwardly and rearwardly onto the front conveyor. Evidently, gathering devices of other known types may be employed in lieu of those disclosed without departing from the spirit of the invention. Single acting hydraulic jacks 32 are pivotally connected to the sides of the base frame and to the side arms 25 of the conveyor frame 19 for swinging the conveyor frame in a vertical plane about its pivot thereby to elevate the gathering head with respect to the mine floor. Fluid may be trapped in these jacks to hold the conveyor frame in adjusted position and may be discharged from the jacks to effect controlled lowering of the conveyor frame and gathering head. The driving means for the conveyor and the rotary gatherers will later be fully described.

The cutting devices 7 and 8 and the breaker device 9 will now be described in detail. Carried by the base frame at the outer sides of the tiltable conveyor frame 19 are upstanding supports 35 in which a horizontal transverse pivot shaft 36 is mounted and a pivoted upper frame 37 has rearward projections 38 which pivotally engage bearings supported by the pivot shaft 36 whereby the upper frame 37 may swing in a vertical plane relative to the base and the conveyor frame. The motor 10 is arranged centrally on the swingable upper frame and has the axis of its power shaft 39 extending radially from the axial line of the upper frame pivot, and connectible to the rearward portion of the motor shaft is a spur gear 40 enclosed in a transverse gear housing 41 constituting a portion of the upper frame. A hydraulic pump 42 and associated fluid tank 43 carried by the swingable frame and this pump is driven from the rear end of the motor shaft. Evidently, if desired, the pump 42 may have its individual driving motor, so that during tramming of the apparatus the motor 10 may remain idle. Also, the fluid tank 43 may be mounted on the base frame beneath the upper frame, in an obvious manner. A spur pinion 44 is fixed to the front end of the motor shaft. The gear 40 drives the cutting instrumentalities 7 and 8 and the pinion 44 drives the breaker device 9 as hereinafter described. Carried at the sides of the gear housing 41 are superimposed forward projections 45, 45 carrying upright pivots 46 on which spaced upper and lower lugs 47 of rear supports 48 are pivotally mounted. The rear supports 48 carry elongated arms or booms 49 which extend forwardly along the opposite sides of the motor 10 and which are swingable both laterally toward and away from one another and in unison in vertical planes with the upper frame 37. These booms are made up of tubular cylindrical members or tube sections 50 which are threadedly secured at their rear ends at 51 in threaded bores of the rear supports 48, and the rear supports 48 and the front ends of the tubular sections carry suitable bearings 52 in which transmission shafts 53 are journaled. These shafts extend axially through the tubular sections of the booms and are threadedly secured at 54 at their forward

ends within drive members 55 which carry rotary screw conveyors or conveyor scrolls 56. The members 55 may be annularly grooved or recessed at 55' to receive the outer ends of the boom sections 50, as shown in Fig. 3, thereby to provide dirt seals for the front bearings 52. The outer ends of the scrolls have threaded forward projections 57 which are secured within threaded bores 58 in the hubs 59 of auger cutters or rotary cutting burrs 60. The cutter hubs or bodies 59 have integral rearward hexagonal portions 61 for the reception of a wrench whereby the cutters may be readily detached from the threaded projections 57. The cutters have their bodies 59 tapered and the tapered bodies along their lengths carry a multiplicity of cutting instruments 62 which may have cutting points which are hard faced or provided with hard metal inserts to resist wear in a well-known manner. The auger cutters may be longitudinally or spirally grooved or otherwise formed to provide spiral vanes for promoting the flow of cuttings from the kerf as cutting progresses, in a conventional manner. Pivotally mounted at 64 on lugs 65 integral with the sides of the motor housing are extensible, double acting, hydraulic jack devices 66 which are in turn pivotally connected at 67 to the inner sides of the cutter supporting booms 49. These hydraulic jack devices each includes a hydraulic cylinder 68 containing a reciprocable piston 69 whose piston rod 70 extends outwardly through the forward cylinder head 71.

The gear 40 is connectible by a conventional clutch 74 to the motor shaft 39 and meshes at its opposite sides with spur gears 75 and 76 and the spur gear 75 in turn meshes with and drives a spur gear 77. The gears 76 and 77 mesh with and drive spur gears 78 and 79 fixed to parallel longitudinal shafts 80 suitably journaled within the gear housing. The shafts 80 are connected through conventional universal joints 81 arranged at the boom pivots to the rear ends of the transmission shafts 53. Thus, the conveyor scrolls and cutters are driven from the motor 10 in relatively opposite directions through the spur gear trains. Single acting hydraulic elevating jack devices 85 are pivotally connected at their lower ends at 86 to the base side frames and these jack devices extend upwardly between the side arms 25 of the conveyor frame and are pivotally connected at 87 to the sides of the motor housing which forms a part of the upper frame 37. These jack devices each includes a fluid cylinder 88 containing a reciprocable piston 89 whose piston rod 90 extends upwardly through the forward head 91 of the cylinder. When fluid under pressure is supplied to the lower ends of these jack cylinders the upper frame 37 and the cutting and breaker devices supported thereby may be swung upwardly in vertical planes with respect to the base and conveyor frame. By trapping the fluid in these jack cylinders the upper frame and cutting and breaker devices may be held in adjusted position and fluid may be exhausted from the jack cylinders to effect controlled downward swing of the upper frame and the cutting and breaker devices supported thereby.

The driving means for the breaker device 9 comprises spur gears 94 meshing with the opposite sides of and driven by the spur pinion 44 and these gears are suitably journaled on parallel stub shafts 95 rigidly secured to a front wall 96 of the motor housing. Mounted integral with the gears 94 are spur pinions 97 which mesh with and drive an internal gear 98 having its hub keyed to the rear end of a shaft 99. As is fully disclosed in my copending application, Serial No. 725,950 mentioned above, the shaft 99 has a forward cylindrical tubular portion 100 having an internal spline connected at 101 with a telescopically arranged splined shaft 102, and the latter shaft has a swiveled thrust connection at 103 with a front cross plate 104. The tubular shaft portion 100 is enclosed within a tubular housing 105 and arranged at the outer sides of and secured to this tubular housing are parallel double acting fluid cylinders 106. The tubular housing

105 is rigidly secured at 107 at its rear end to a gear housing 108 in which the gearing 44, 94, 97 and 98 is arranged. Reciprocable in the cylinders 106 are pistons 109 whose piston rods 110 extend forwardly through the front cylinder heads and which are rigidly secured at 111 to the cross plate 104. The thrust head 103 has a threaded forward projection 112 which is threadedly secured in a threaded bore 113 in the body 114 of a tapered wedge member 115. Formed on the exterior of the tapered body of the wedge are spirally arranged ribs 116. The wedge body when attached to the threaded projection 112 at the forward end of the shaft 102 serves to secure the cross plate 104 to the shaft while permitting rotation of the shaft and wedge with respect to the cross plate. The tapered body of the wedge is of hollow construction and has an axial bore extending therethrough which receives an auger drill steel in the manner fully disclosed in my above mentioned copending application and this auger drill steel carries a drill bit 117. The drill bit is driven by a gear 118 meshing with and driven by the spur pinions 97 and this gear is fixed to a shaft 119 arranged centrally within the shaft 99 and suitably journaled in bearings supported therein. The shaft 119 is connected by telescopic shafting arranged centrally within the shaft 102 and the drill bit 117 has connection with this telescopic shafting and is driven thereby, as is also described in the copending application above referred to. Thus, when the motor 10 is running, the tapered breaker wedge 115 and the drill bit 117 are rotated at relatively different speeds with the drill bit rotating at a substantially higher speed than the wedge. Since the specific structure of the breaker wedge and the drill bit and the driving means therefore are fully disclosed in my above mentioned copending application further description thereof is herein unnecessary.

Projecting laterally from one side of the motor housing is a lug 122 which has threaded therein a screw 123 which is engageable with the upper surface of the conveyor frame when the upper frame is in its lowermost position thereby to limit the downward movement of the cutting devices 7 and 8 and the breaker device 9. This stop screw 123 may be adjusted to vary the limit of downward swing. If desired, a similar adjustable stop screw may be provided at the opposite side of the motor housing.

Now referring to the driving means for the front loading conveyor 21 and the rotary gatherers 26 of the gathering head, it will be noted that driven by the gear 79 through the shaft 80 is a bevel gear 125 which meshes with and drives a large bevel gear 126 having its hub keyed to a transverse shaft 127 which is suitably journaled in bearings 128 supported within a gear housing 129 mounted on one side of the upper frame 37. Fixed to and driven by the shaft 127 is a chain sprocket 130 which is connected by an endless drive chain 131 to a chain sprocket 132 having its hub keyed to a transverse shaft 133. The axis of the shaft 133 is aligned with the pivot 16 of the swingable conveyor frame 19 and is suitably journaled in bearings 134 supported within the bearing engaging portions 18 of the conveyor frame (see Fig. 5). Keyed to and driven by the shaft 133 are chain sprockets 135 which engage and drive the side chains 22 of the front loading conveyor 21. The conveyor 21 at its front receiving end passes around and drives chain sprockets 137 which have their hubs connected by a tubular shaft portion 138. The sprocket hubs 139 are journaled in bearings 140 supported by aligned shafts 141 which are in turn journaled in bearings 142 supported in gear housings 143 mounted within the lower portion of the deck frame 20 at the forward end of the conveyor frame 19. Secured to the shafts 141 are worms 144 which mesh with worm wheels 145 arranged within the gear housings and having their hubs keyed to upright shafts 146 which are secured to the hubs 27 of the rotary gatherers 26. Thus, the motor 10 not only drives the cutting and breaker devices and the pump but also drives the front loading conveyor and the rotary gatherers of the gathering head.

The hopper 13 of the rear discharge conveyor 14 is mounted on a horizontal frame 150 which is swiveled to swing horizontally on a rearward horizontal frame projection 151 of the base frame. Pivotally mounted at 152 on the frame 150 to swing in a vertical plane is a rear conveyor frame 153, and a single acting hydraulic jack device 154 is provided for tilting the frame 153 about its pivot. An endless flight conveyor 155 is guided for circulation relative to the frames 150 and 153 and this conveyor at its forward end passes around a guide roller 156. Mounted at one side at the rearward portion of the conveyor frame 153 is a motor 157 which drives through a universal telescopic shafting 158 conventional speed reducing gearing 159 arranged in a gear housing 160 and this gearing is connected to the rear end of the flight conveyor 155. The discharge end of the rear discharge conveyor may be raised and lowered and swung laterally as desired, thereby to facilitate discharge of material into the usual transportation means of the mine.

Now referring to the hydraulic fluid system shown diagrammatically in Fig. 9, it will be noted that the pump 42, driven by the motor 10, has its suction side connected by a conduit 164 to the fluid tank 43 and the discharge side of the pump is connected by conduit 165 to the pressure passage of a conventional control valve mechanism 166 which has usual relief valve means embodied therein for preventing excessive pressure in the fluid system. As shown in Fig. 2, this control valve mechanism is conveniently mounted at the top of the base frame at one side of the base. The discharge passage of the control valve mechanism is connected by a conduit 167 back to the tank 43. This control valve mechanism includes a horizontal valve box 168 having horizontal bores containing conventional slide valves of the balanced spool type designated 169, 170, 171, 172, 173, 174, 175 and 176 respectively, and each having a suitable control handle. The bore containing the slide valve 169 is connected by conduits 177 and 178 to the opposite sides of one of the tread driving motors 5, while the bore containing the slide valve 170 is connected by conduits 179 and 180 to the opposite sides of the other tread driving motor 5. The bore containing the slide valve 171 is connected by a conduit 181 to the cylinder of the tilting jack 154 for the rear discharge conveyor. The bore containing the slide valve 172 is connected by a conduit 182 to the elevating jacks 32 for tilting the front conveyor frame 19. The bore containing the slide valve 173 is connected by conduits 183 and 184 to the opposite ends of one of the jack devices 66 for horizontally swinging one boom 49, while the bore containing the slide valve 174 is connected by conduits 185 and 186 to the opposite ends of the other boom swing jack 66. The bore containing the slide valve 175 is connected by a conduit 187 to the elevating jacks 85 for the swingable upper frame 37. The bore containing the slide valve 176 is connected by conduits 188 and 189 to the opposite ends of the cylinders 106 for feeding and retracting the breaker device 9.

The general mode of operation of the improved mining and loading apparatus is as follows: The apparatus may be propelled about the mine by the crawler treads of the crawler base and at that time the motor 10 is running to drive the pump 42 to pump fluid under pressure to the tread driving motors 5 under the control of the slide valves 169 and 170, and during the tramming of the apparatus the clutch 74 is released so that the cutting and dislodging devices, the conveyors and the rotary gatherers remain idle. By varying the relative speeds of the motors 5 the crawler treads may be driven to effect steering of the base in a well-known manner. As the apparatus is trammed about the mine the conveyor frame 19 is normally held in elevated position by the jacks 32 with the gathering head raised from the mine floor, and the cutting and dislodging devices are also held elevated

above the floor by the elevating jacks **85**, and when the working place is reached the slide valve **172** may be positioned to discharge fluid from the jacks **32** to effect lowering of the conveyor frame to position the gathering head down close to or onto the mine floor. Fluid may also be discharged at that time from the elevating jacks **85** under the control of the slide valve **175** to lower the upper frame together with the booms **49** to bring the cutting devices **7** and **8** down to the floor level as shown in Fig. 2, and fluid may be supplied to the boom swing jacks **66** under control of the slide valves **173** and **174** to effect swinging of the booms **49** inwardly toward one another to locate the cutting devices **7** and **8** close together at the floor as shown in dotted lines in Fig. 3. When the cutters **7** and **8** are in their lowered, adjacent, sumping position near the floor, the crawler treads may be operated at a suitable speed by the motors **5** under the control of the slide valves **169** and **170** to effect bodily movement of the apparatus over the mine floor thereby to sump the cutters **7** and **8** substantially their full length into the mine vein or coal seam. When the cutters **7** and **8** are in their sumped position fluid under pressure may be supplied to the boom swing jacks **66** under the control of the slide valves **173** and **174** to swing the booms outwardly apart to move the cutters horizontally across the entire width of the working face and when the cutters assume their wide apart position at the ribs the fluid may be trapped in the jacks **66** to hold the cutters against lateral movement. Fluid under pressure may then be supplied to the elevating jacks **85** under the control of the slide valve **175** to effect swinging of the upper frame **37** and the booms **49** in vertical planes thereby to swing the cutters upwardly to cut vertical kerfs at the ribs or sides of the mine passageway. When the cutters reach the roof level fluid may be trapped in the jacks **85** and fluid may be supplied to the swing jacks **66** under the control of the slide valves **173** and **174** to swing the booms **49** inwardly to move the cutters horizontally toward one another to form a horizontal kerf at the roof level. Thus, a generally rectangular core or defined area of coal or other mineral, designated C is circumscribed by the generally rectangular shaped kerf K (Fig. 7) whereby the core or defined area has its marginal surfaces free so that when a dislodging force is applied centrally to the core or defined area of mineral the core is dislodged and disintegrated. During the kerf cutting operation or subsequently thereto the rapidly rotating wedge **115** and drill **117** may be fed toward the core of coal by the feed pistons **109** contained in the feed cylinders **106** under the control of the slide valve **176** and the drill **117** forms a hole centrally of the core and the wedge **115** enters the hole so formed (Fig. 6) and as a result of the powerful inward thrust on the wedge as the latter is rotated the core of mineral is dislodged, the wedge imparting breaking forces in radial directions towards the free margin of the core circumscribed by the kerf. The rotary gatherers **26** gather the loose dislodged mineral on the mine floor and move the material so gathered inwardly and rearwardly onto the front elevating conveyor **21** by which the loose material is conveyed rearwardly of the apparatus to discharge into the hopper **13**. The loose material received in the hopper **13** is received by the rear discharge conveyor **155** and is conveyed rearwardly to a suitable point of delivery such as the conventional transportation means of the mine. In usual practice a conventional shuttle car is arranged beneath the rear discharge end of the discharge conveyor for receiving the loose material discharged from the apparatus. During the gathering and loading operation the cutter supporting booms **49** may be lowered to bring the conveyor scrolls **56** into contact with the dislodged mineral, and these scrolls serve to move the loose material toward the loading conveyor thereby to supplement the gathering action of the rotary gatherers **26** and to bring the loose material into the zone of action of the rotary gatherers.

Evidently, instead of sumping the cutters into the mine vein at the floor level the cutters may be sumped by the crawler base into the mine vein at the roof level and the cutters may be moved horizontally along the roof, then downwardly in vertical planes along the ribs and finally horizontally along the mine floor. Also, the breaker wedge **115** may be inserted into the mine vein prior to the kerf cutting operation and substantial dislodging pressure may be applied to the coal so that when the core of coal is circumscribed by the cutters dislodgement of the core of coal is effected. Instead of forming the kerf which circumscribes the core of mineral of generally rectangular shape as shown, it may obviously be of ovate, circular or any other suitable shape.

As a result of this invention an improved mining and loading apparatus is provided whereby the mineral of a solid mine vein may be cut and dislodged, and the dislodged mineral may be loaded onto the conventional transportation means of the mine. By the provision of the novel cutting and dislodging devices, arranged and mounted in the manner disclosed, an orbital kerf may be readily cut in the mineral in such manner as to circumscribe a projecting core attached to the solid mine vein and which due to the encompassing kerf is free at its margin and which may be effectively mechanically dislodged from the solid by the dislodging device without the use of explosives. By mounting the apparatus on a crawler base the apparatus is not only made readily mobile and easily steerable but also the crawler treads may be employed to effect sumping of the cutting devices into the mineral of the solid vein and to retract the cutting devices from the vein. By the association of the gathering head with the cutting and dislodging devices the mineral as it is cut and dislodged may be gathered from the mine floor and moved onto the conveying means of the apparatus. The conveyor scrolls associated with the cutting devices may be employed to move loose material onto the conveying means thereby to supplement the gathering head and also may move loose material into the zone of action of the rotary gatherers. The apparatus is self-contained, relatively compact and readily mobile. These and other advantages of the invention will be clearly apparent to those skilled in the art.

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

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

1. In a mining apparatus, the combination comprising a base, kerf cutting and dislodging devices, means for operating said cutting and dislodging devices and for adjustably mounting said cutting and dislodging devices on said base whereby the same may be operated to cut and dislodge the solid mineral of a mine vein, said cutting devices comprising a pair of elongated rotary kerf cutters having cutting elements along their lengths and movable transversely of their lengths to effect lateral cutting, and said adjustable mounting means including a frame pivoted to swing in vertical planes about a horizontal transverse axis and a pair of relatively swingable booms pivotally mounted at the sides of said swingable frame to swing in vertical planes therewith and to swing laterally relative to said frame, said rotary kerf cutters being mounted at the outer ends of said booms, means for swinging said frame about its pivotal axis to move said kerf cutters vertically as aforesaid to effect cutting of kerfs in vertical planes in the mine vein, and means for swinging said boom frames laterally about their pivots relative to said frame to move said kerf cutters laterally to effect cutting of kerfs in horizontal planes in the mine vein.

2. In a mining apparatus, the combination comprising

a base, kerf cutting and dislodging devices, means for operating said cutting and dislodging devices, and means for adjustably mounting said cutting and dislodging devices on said base whereby the same may be operated to cut and dislodge the solid mineral of a mine vein, said kerf cutting and dislodging devices comprising a pair of elongated rotary kerf cutters having cutting elements along their lengths and movable transversely of their lengths to effect lateral cutting, and said adjustable mounting means including a frame pivoted to swing in vertical planes about a horizontal transverse axis and a pair of relatively swingable booms pivotally mounted at the sides of said swingable frame to swing in vertical planes therewith and to swing laterally relative to said frame about axes disposed in right angular relation with respect to said horizontal transverse axis, said rotary kerf cutters being mounted at the outer ends of said booms, and said operating means for said cutting and dislodging devices including motor devices carried by said swingable frame and by which said rotary kerf cutters are driven, means for swinging said frame about its pivot to move said kerf cutters vertically as aforesaid to effect cutting of kerfs in vertical planes in the mine vein, and means for swinging said boom frames laterally about their pivots relative to said frame to move said kerf cutters horizontally to effect cutting of kerfs in horizontal planes in the mine vein.

3. In a mining apparatus, the combination comprising a base, kerf cutting and dislodging devices, means for operating said cutting and dislodging devices, and means for adjustably mounting said cutting and dislodging devices on said base whereby the same may be operated to cut and dislodge the solid mineral of a mine vein, said cutting devices comprising a pair of elongated rotary kerf cutters having cutting elements along their lengths and movable transversely of their lengths to effect lateral cutting, and said adjustable mounting means including a frame pivoted to swing in vertical planes about a horizontal transverse axis and a pair of relatively swingable booms pivotally mounted at the sides of said swingable frame to swing in vertical planes therewith and to swing laterally relative thereto, said rotary kerf cutters being mounted at the outer ends of said booms, and said operating means for said cutting and dislodging devices including motor devices carried by said swingable frame intermediate said swingable booms and by which said rotary kerf cutters and said dislodging device are driven, means for swinging said frame in vertical planes about its pivot to move said kerf cutters vertically as aforesaid to effect cutting of kerfs in vertical planes in the mine vein, and means for swinging said boom frames laterally about their pivots relative to said frame to move said kerf cutters laterally to effect cutting of kerfs in horizontal planes in the mine vein.

4. In a mining apparatus, the combination comprising a base, a frame pivotally mounted on said base to swing in vertical planes with respect to said base, a pair of relatively swingable booms pivotally mounted at the sides of said frame to swing with said frame and to swing laterally in opposite directions with respect to said frame, elongated rotary kerf cutters having cutting elements along their lengths and movable transversely of their lengths to effect lateral cutting, said kerf cutters mounted at the outer ends of said booms respectively and arranged with their axes of rotation coincident with the longitudinal axes of said booms, means for swinging said frame about its pivot to move said kerf cutters vertically as aforesaid to effect cutting of kerfs in vertical planes in a mine vein, and means for swinging said booms laterally about their pivots relative to said frame to move said kerf cutters laterally to effect cutting of kerfs in horizontal planes in the mine vein.

5. In a mining apparatus, the combination comprising a base, a frame pivotally mounted on said base to swing in vertical planes with respect to said base, a pair of

relatively swingable booms pivotally mounted at the sides of said frame to swing therewith and to swing laterally in opposite directions with respect to said frame, elongated rotary kerf cutters having cutting elements along their lengths and movable transversely of their lengths to effect lateral cutting, said kerf cutters mounted at the outer ends of said booms respectively and arranged with their axes of rotation coincident with the longitudinal axes of said booms, driving means for said rotary kerf cutters including motor devices carried by said swingable frame intermediate said booms, means for swinging said frame about its pivot to move said kerf cutters vertically as aforesaid to effect cutting of kerfs in vertical planes in a mine vein, and means for swinging said booms laterally about their pivots relative to said frame to move said kerf cutters laterally to effect cutting of kerfs in horizontal planes in the mine vein.

6. In a mining apparatus, the combination comprising a base, a frame pivotally mounted on said base to swing in vertical planes with respect to said base, a pair of relatively swingable booms pivotally mounted at the sides of said frame to swing therewith and to swing laterally in opposite directions with respect to said frame, elongated rotary kerf cutters having cutting elements along their lengths and movable transversely of their lengths to effect lateral cutting, said kerf cutters being mounted at the outer ends of said booms respectively and arranged with their axes of rotation coincident with the longitudinal axes of said booms, a rotary dislodging wedge carried by said swingable frame intermediate said cutter supporting booms, means for swinging said frame about its pivot to move said kerf cutters vertically as aforesaid to effect cutting of kerfs in vertical planes in a mine vein, and means for swinging said booms laterally about their pivots relative to said frame to move said kerf cutters to effect cutting of kerfs in horizontal planes in the mine vein.

7. In a mining apparatus, the combination comprising a base, a frame pivotally mounted on said base to swing in vertical planes with respect to said base, a pair of relatively swingable booms pivotally mounted at the sides of said frame to swing therewith and to swing laterally in opposite directions with respect to said frame, elongated rotary kerf cutters having cutting elements along their lengths and movable transversely of their lengths to effect lateral cutting, said kerf cutters mounted at the outer ends of said booms respectively and arranged with their axes of rotation coincident with the longitudinal axes of said booms, driving means for said rotary kerf cutters including motor devices carried by said upper swingable frame intermediate said booms, means for swinging said frame about its pivot to move said kerf cutters vertically as aforesaid to effect cutting of kerfs in vertical planes in a mine vein, means for swinging said booms laterally about their pivots relative to said frame to move said kerf cutters to effect cutting of kerfs in horizontal planes in the mine vein, and a rotary dislodging wedge carried by said swingable frame intermediate said cutter supporting booms and also driven by said motor devices.

8. In a mining and loading apparatus of the character disclosed, an elongated rotary cutter bar having cutting elements along its length and movable in an endwise direction during sumping into the mineral and in a direction transversely of its length to cut a plane kerf in a mine vein, means for moving said cutter bar in endwise and lateral directions as aforesaid, and a rotary spiral conveyor of larger diameter than said cutter bar and arranged coaxial with and spaced axially from said cutter bar with its spiral vanes arranged to effect conveying of the mineral disintegrated by said cutter bar in a rearward direction away from the working face of the vein.

9. A mining and loading apparatus as set forth in claim 8 wherein said rotary cutter bar is attached to said spiral conveyor and said spiral conveyor is driven to effect drive of said cutter bar, and releasable attaching

means is provided for attaching said cutter bar to said spiral conveyor.

10. In a mining and loading apparatus of the character disclosed, a supporting structure including a swingable boom, an elongated rotary cutter bar having cutting elements along its length and movable in an endwise direction during sumping into the mineral and in a direction transverse to its length to effect cutting of a plane kerf in a mine vein, said cutter bar carried at the outer end of said boom and arranged with its axis of rotation coincident with the longitudinal axis of said boom, means for moving said boom to feed said cutter bar in endwise and lateral directions as aforesaid, and a conveyor scroll carried by said boom in coaxial relation with said rotary cutter bar and disposed on said boom rearwardly of said rotary cutter bar, said conveyor scroll being of larger diameter than said cutter bar and having spiral vanes arranged to engage loose mineral disintegrated from the mine vein by said cutter bar and to move such mineral in a rearward direction away from the working face of the vein.

11. A mining and loading apparatus as set forth in claim 10 wherein driving means for said conveyor scroll is provided and said rotary cutter bar has a threaded socket, said conveyor scroll having a threaded projection threadedly engaged within said socket detachably to secure said cutter bar to said conveyor scroll, and said cutter bar being driven by said conveyor scroll.

12. A mining and loading apparatus as set forth in claim 10 wherein said boom is tubular and said driving means for said conveyor scroll comprises a drive shaft extending longitudinally through said boom and having a forward threaded portion, and said conveyor scroll having a threaded socket for receiving said threaded portion detachably to secure said scroll to said drive shaft.

13. A mining and loading apparatus, the combination comprising a base, material gathering mechanism on said base, kerf cutting and dislodging mechanisms comprising a boom pivotally mounted on said base to swing in horizontal and vertical planes with respect thereto and an elongated rotary cutter bar carried by said boom, said cutter bar having cutting elements along its length and movable in an endwise direction during sumping into the mineral and laterally in a direction at right angles to its length to cut a kerf in the mineral of a solid mine vein, means for moving said boom to feed said cutter bar in endwise and lateral directions as aforesaid, and conveying means operatively associated with said cutter bar for moving dislodged and disintegrated mineral toward said gathering mechanism, said conveying means comprising a rotary conveyor coaxial with and spaced rearwardly of said boom from said cutter bar, said rotary conveyor discharging the disintegrated mineral received thereby in a rearward direction toward said gathering mechanism.

14. A mining and loading apparatus as set forth in claim 13 wherein said boom is adjustable relative to said base to locate said rotary conveyor in different positions above and in adjacency to said gathering mechanism while remaining in positions to discharge the mineral being conveyed thereby toward said gathering mechanism, and means is provided for adjusting said boom.

15. A mining and loading apparatus as set forth in claim 14 wherein said rotary conveyor comprises a spirally vaned conveyor element secured to and rotatable with said cutter bar and through which the latter is driven, and means is provided for rotating said conveyor element in unison with said cutter bar.

16. A mining and loading apparatus as set forth in claim 13 wherein said means for moving said boom includes means for swinging said boom to locate said cutter bar in advance of said gathering mechanism with said rotary conveyor located above said gathering mechanism in adjacency thereto, said swinging means being operable to swing said conveyor in horizontal planes across the top of said gathering mechanism while said conveyor remains in positions to discharge the disintegrated mineral being conveyed thereby toward said gathering mechanism.

17. A mining and loading apparatus as set forth in claim 13 wherein said gathering mechanism comprises a pair of cooperating orbitally movable gathering devices, and means is provided for adjusting said boom to locate said rotary conveyor above and in adjacency to either of said gathering devices while said conveyor remains in positions to discharge the disintegrated mineral being conveyed thereby toward one or the other of said gathering devices.

18. In a mining and loading apparatus, the combination comprising a base, a centrally located breaker wedge device swingable in vertical planes on said base, kerf cutting devices pivotally mounted on said base at opposite sides of said breaker wedge device to swing in horizontal and vertical planes, means for operating said kerf cutting devices to effect cutting of a kerf surrounding a section of mineral to be dislodged, and means for operating said breaker wedge device to effect dislodgement of said section of the mineral from the solid mine vein.

19. A mining and loading apparatus as set forth in claim 18 wherein a support common to said wedge and cutting devices is pivotally mounted on said base to swing in vertical planes, said cutting devices being pivotally mounted at the sides of said support to swing laterally relative thereto.

20. A mining and loading apparatus as set forth in claim 18 wherein gathering mechanism is carried by said base beneath said breaker wedge and cutting devices for receiving the mineral dislodged by said wedge device.

21. In a mining and loading apparatus, the combination comprising a base, a centrally located rotary penetrating and dislodging device swingable in a vertical planes on said base, kerf cutting devices, pivotally mounted on said base at opposite sides of said penetrating and dislodging device to swing in horizontal and vertical planes, means for operating said kerf cutting devices to effect cutting of a kerf surrounding a section of mineral to be dislodged, and means for operating said penetrating and dislodging device to effect penetration and dislodgement of said section of the mineral from the solid mine vein.

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