March 3, 1953 S. C. MOON 2,630,308

MINING AND LOADING MACHINE

Filed Oct. 22, 1948 5 Sheets-Sheet 1

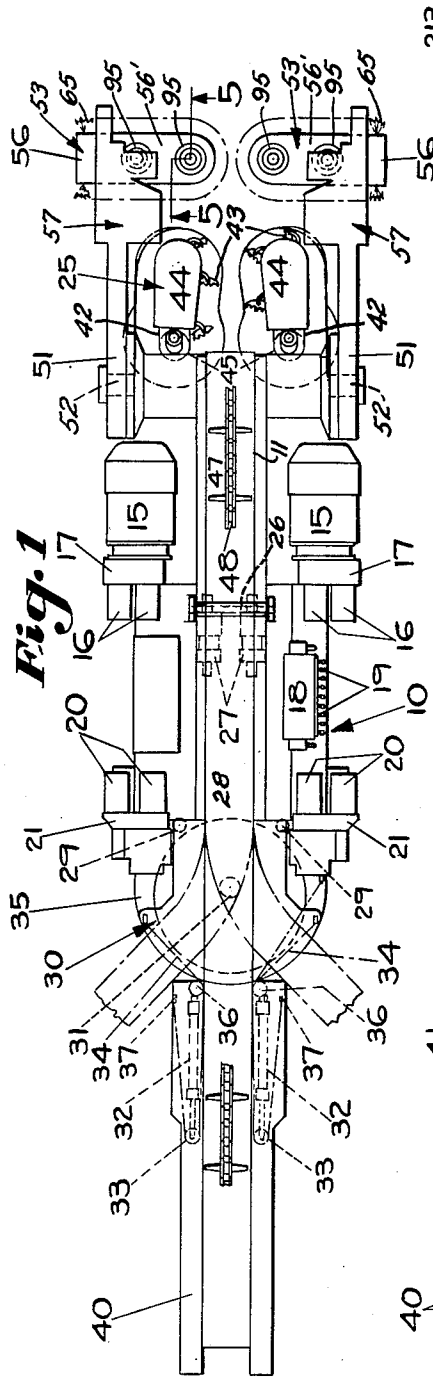


Fig. 1

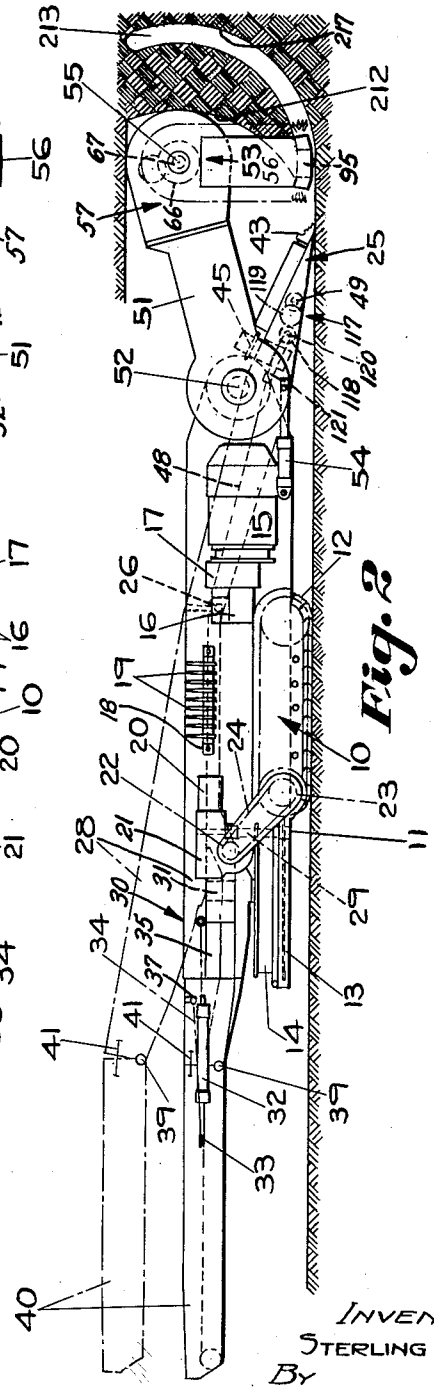


Fig. 2

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MINING AND LOADING MACHINE

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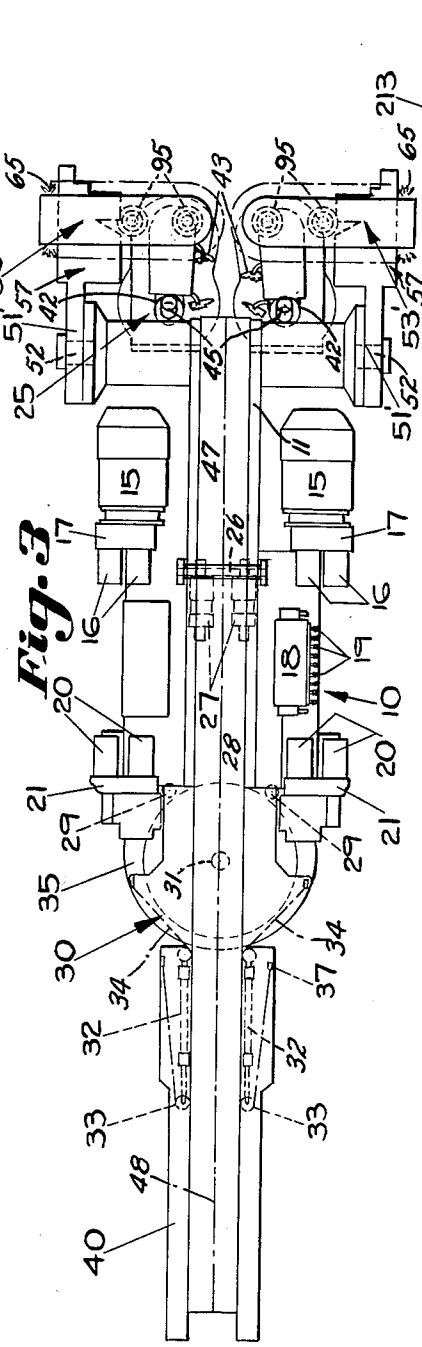


Fig. 3

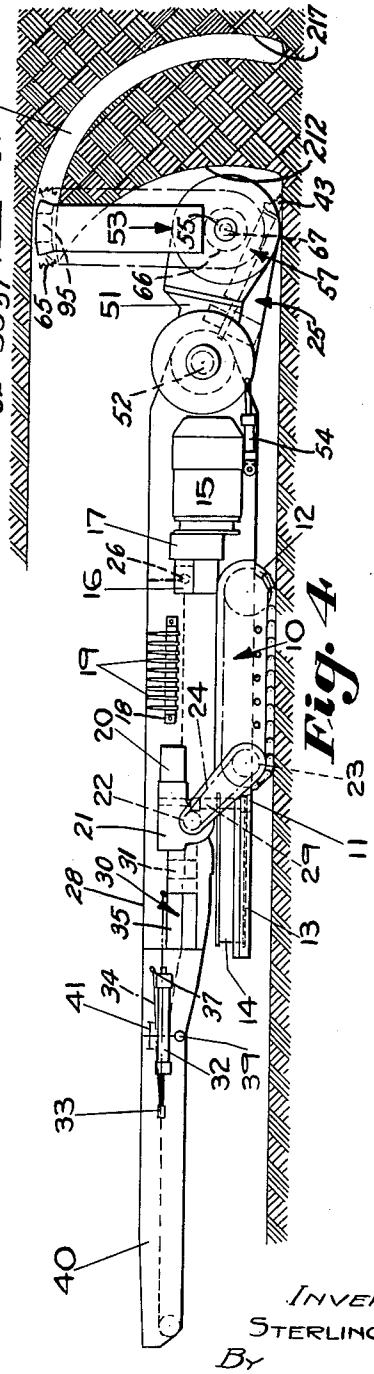


Fig. 4

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MINING AND LOADING MACHINE

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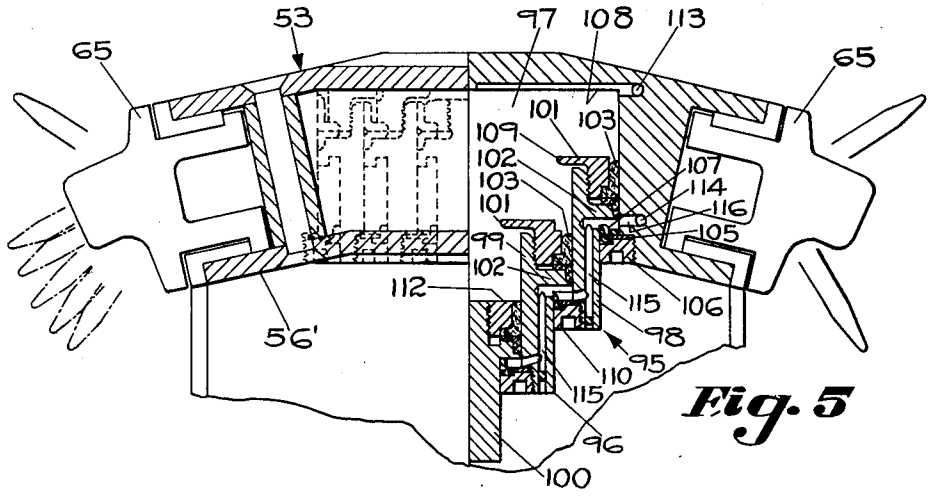


Fig. 5

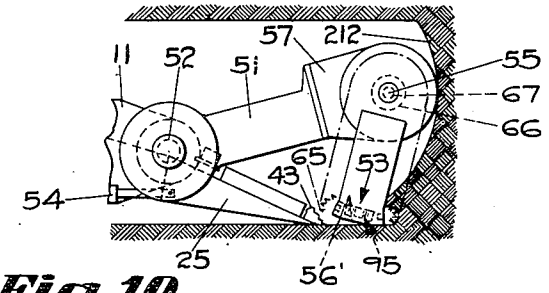


Fig. 10

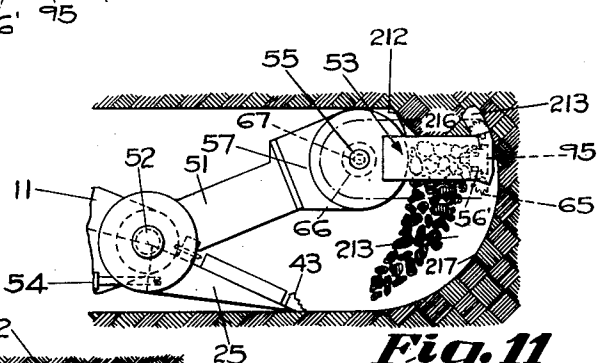


Fig. 11

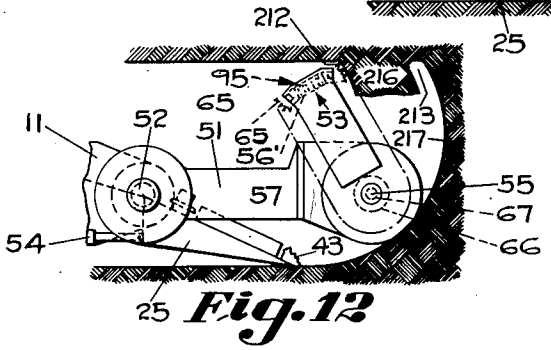


Fig. 12

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MINING AND LOADING MACHINE

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Fig. 7

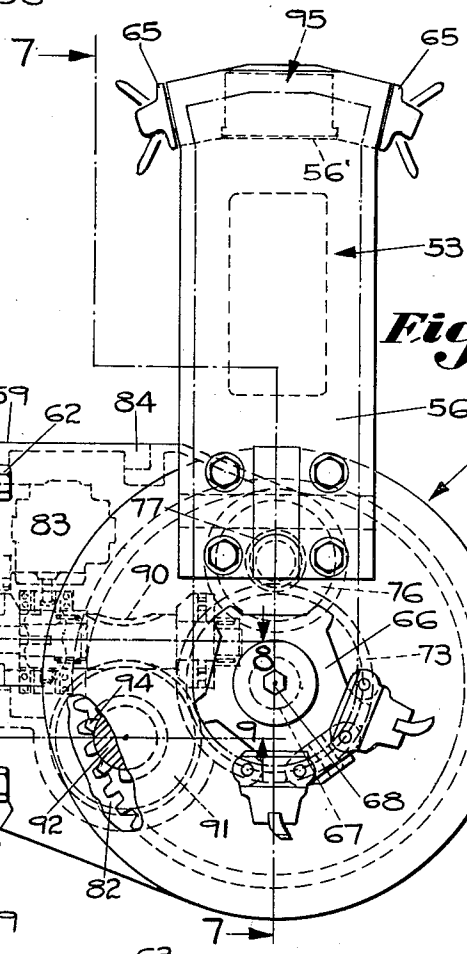
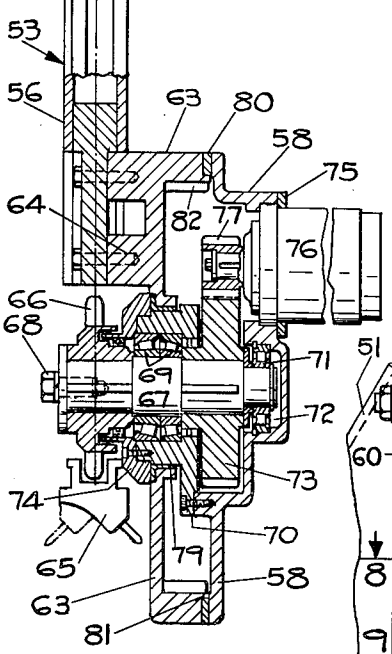


Fig. 6



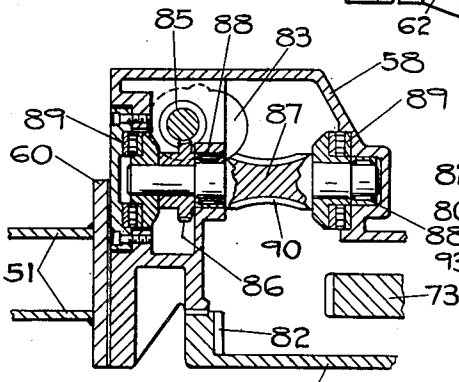


Fig. 8

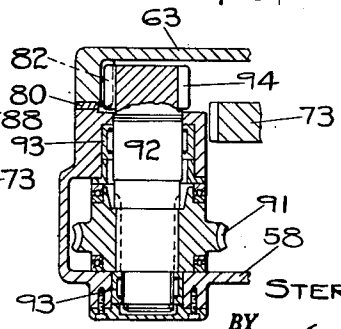


Fig. 9

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MINING AND LOADING MACHINE

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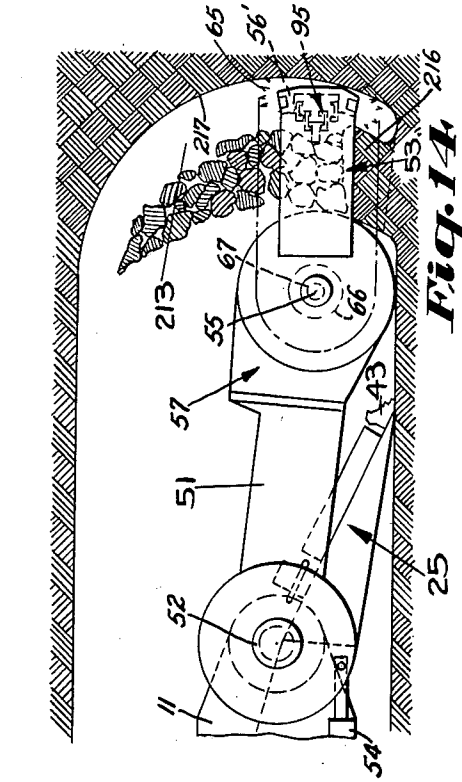


Fig. 14

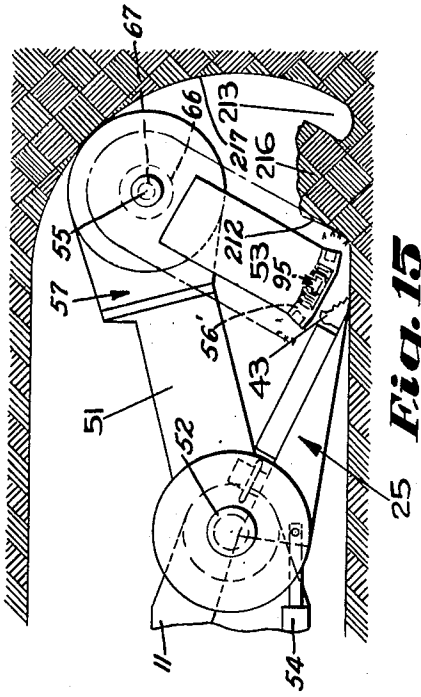


Fig. 15

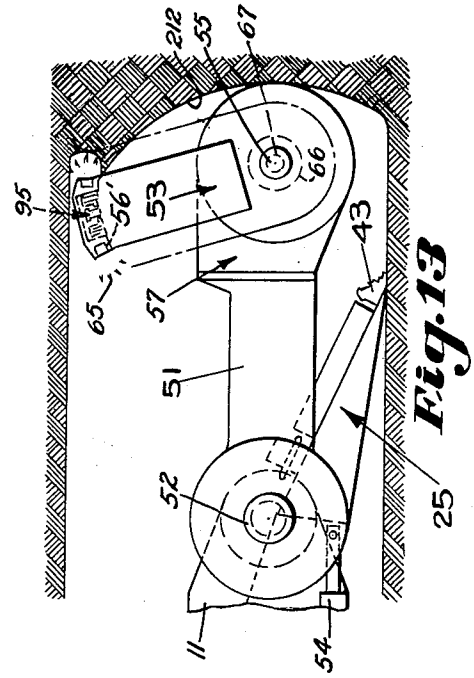


Fig. 13

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Patented Mar. 3, 1953

2,630,308

UNITED STATES PATENT OFFICE

2,630,308

MINING AND LOADING MACHINE

Sterling C. Moon, Worthington, Ohio, assignor to The Jeffrey Manufacturing Company, a corporation of Ohio

Application October 22, 1948, Serial No. 55,953

17 Claims. (Cl. 262—9)

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My invention relates to mining machines and more particularly to coal cutting and loading mining machines.

An object of my invention is to provide an improved mining machine of the type set forth which removes solid coal from a mine room by first forming flat side and arcuate back cuts or kerfs in the solid coal to free partially from the mine room a segment of coal, the machine then forcibly breaking the partially freed coal from the mine room thereby causing it to be shattered, then gathering the shattered coal and otherwise removing coal from the mine room floor to smooth the latter and convey the removed coal rearwardly to be discharged into apparatus for temporarily storing or removing it from the mine.

Another object of my invention is to provide an improved mining machine which may be a vehicle and the front end of which carries two L-shaped cutter bars each mounted through one of its legs for rotation upon the ends of spaced pivotally supported swingable arms and having their outer legs extending toward the other cutter bar whereby they are capable of cutting in solid coal flat side and arcuate back cuts or kerfs.

In carrying out the foregoing object it is another object of my invention to provide the L-shaped cutter bars with expandable break-down devices for breaking from the mine room segments of coal partially freed therefrom by the cutter bars.

Another object of my invention is to provide an improved mining and loading machine which may be a vehicle that carries two L-shaped cutter bars, each cutter bar being mounted through one of its legs for rotation upon the ends of spaced pivotally supported swingable arms and having their outer legs extending toward the other cutter bar whereby the cutter bars may be positioned and swung for cutting coal from the mine room and which includes a gathering mechanism positioned between the cutter bars and preferably adjustable about a horizontal axis for removing coal from the mine room floor.

In carrying out the foregoing object it is still another object of my invention to provide in the machine set forth an articulated conveyor for conveying coal from the front of the gathering means which conveyor includes the gathering mechanism, a section pivoted adjacent its receiving end for vertical adjustment about a horizontal axis and a discharge section pivoted to the other end of said section for adjustment

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about both the horizontal and a vertical axis whereby the conveyor may be swung horizontally over a wide area and elevated to various discharge positions.

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

In the accompanying drawings,

Fig. 1 is a more or less diagrammatic view in plan of a mining and loading machine embodying the features of my invention;

Fig. 2 is a view in side elevation of the machine shown in Fig. 1;

Fig. 3 is a view similar to Fig. 1 but showing a modified form of the mining machine;

Fig. 4 is a view in side elevation of the machine shown in Fig. 3;

Fig. 5 is a view in staggered section through one of the cutter bars of the mining machine, the section being taken substantially on line 5—5 of Fig. 1;

Fig. 6 is a side view in elevation of an L-shaped cutter bar and a mechanical head which connects the cutter bar with one of the cutter bar mounting arms, with a portion of the head removed to show gearing therein;

Figs. 7, 8 and 9 are views in section the sections being taken substantially on lines 7—7, 8—8, and 9—9, respectively, of Fig. 6;

Figs. 10, 11 and 12 are diagrammatic views illustrating coal cutting and breaking operations, the first cut being made in an upward direction; and

Figs. 13, 14 and 15 are views similar to those seen in Figs. 10, 11 and 12, but with the first cut being made in a downward direction.

Referring first to Figs. 1 and 2 of the drawings, the mining and loading machine shown therein includes a vehicle in the form of a truck indicated generally at 10 which truck includes a main frame 11 supported on crawlers 12 spaced one at each side of said main frame. The rear portion of the main frame 11 forms a platform 13 which supports a cable reel 14 which carries an electrical cable (not shown) through which electric current is supplied to the electric motors of the mining machine. The mining machine includes a pair of electric motors 15 carried by the main frame 11 which are spaced directly opposite each other and at opposite sides of the main frame 11. Each motor 15 drives two hydraulic pumps 16 through gear reduction mechanisms indicated at 17. The four pumps 16 are all connected to supply hydraulic fluid to the hydraulic system (not shown) of the machine which hydraulic sys-

tem includes a main valve bank control unit 18 including a plurality of individual valves each operated by a lever 19. The valve bank unit 18 is positioned at one side of the machine so as to be available to an operator standing thereby and all of the hydraulically operated devices of the machine are operated under the control of individual valves of this valve bank 18. It may be mentioned that it is now standard practice to provide means for operating the individual valves of the valve bank unit from the opposite side of the machine which mechanism includes rods and levers, not herein shown, that extend transversely of the mining machine to a position adjacent the side thereof opposite the valve bank 18. I prefer to follow this practice and thus the operation of my mining machine may be controlled from either side.

The crawlers 12 are each driven by a pair of hydraulic motors 20 connected in the hydraulic system and controlled by individual valves of the valve bank 18. The motors 20 for each crawler 12 are connected to drive the crawler through gear reduction mechanisms, indicated at 21, each of which includes a shaft that carries a sprocket 22. The rear shaft of each crawler 12 is provided with a drive sprocket 23. A drive chain 24 interconnects the sprockets 22 and 23 for transmitting driving forces of the hydraulic motors 20 from the gear reduction mechanism 21 to the crawlers 12 to drive the latter either forwardly or rearwardly as determined by an operator operating the control valve of the valve bank unit 18 that controls the operation of motors 20 in reverse directions. The crawlers 12 at opposite sides of the machine function independently of each other and thus one may be driven in a reverse direction while the other is driven in a forward direction, one may be driven at a greater speed in the same direction than the other, one may be braked while the other is operated, etc., to steer the machine 10 or both crawlers 12 may be operated at the same speed and in the same direction to advance the mining machine either forwardly or rearwardly in a straight path.

A gathering head or mechanism, indicated generally at 25, is carried adjacent the front end and between vertical side members of the main frame 11 of the truck 10 for rotation or vertical adjustment about the horizontal axis of a pivot pin or shaft indicated at 26. The gathering head or mechanism 25 is a part of an articulated conveyer mechanism that conveys coal over the main frame of the mining machine and this gathering head 25 is adjustable as aforesaid about the horizontal axis of pin 26 by a pair of double acting piston type hydraulic motors, seen in Figs. 1 and 3 at 27. Motors 27 are controlled to operate simultaneously in the same directions by one of the individual valves of valve bank 18.

The main frame 11 of the truck 10 also supports a conveyer pan, frame, or section 28 which is pivoted adjacent its front end for vertical adjustment about the horizontal axis of pin 26 about which the gathering mechanism 25 is also vertically adjustable and this conveyer pan or section 28 is adjusted vertically by a pair of double acting hydraulic piston motors 29, which motors, like motors 27, are operated simultaneously in the same direction under the control of one of the individual valves of valve bank 18 either to raise or lower the rear end of the conveyer pan 28 about the horizontal axis 26 or to lock it in its adjusted position.

The rear end of conveyer pan or section 28 includes a turntable, indicated generally at 30, that includes a base or bed member 35 which is a rearwardly extending continuation of the conveyer pan 28. Bed member 35 carries a co-operating turntable member which extends forwardly from a discharge conveyer section or pan 40. The turntable members are secured together for rotation about the vertical axis of a pin 31 and the conveyer discharge section 40 is swingable about said upright axis by a pair of single acting piston type hydraulic motors 32 carried by the discharge section, the piston rod of each of which carries a pulley or sheave 33. A pair of cables 34 is pivotally attached to the base member 35 of the turntable and these cables are reeved over pulleys or sheaves 36 carried by the discharge section 40 of the conveyer. From pulleys or sheaves 36 each of the cables is reeved over the sheave 33 of one of the piston motors 32 and forwardly therefrom to an anchor 37 on the discharge conveyer section 40. Motors 32 are controlled by a valve of the valve bank 18.

It will be seen particularly by reference to Fig. 1 that when the upper motor 32 is expanded the discharge section 40 of the conveyor will be swung about the upright axis of pin 31 in a clockwise direction and that the lower motor 32 will be contracted. It will be obvious, of course, that when the lower motor 32 is expanded the discharge section 40 of the conveyer will be swung in a counter-clockwise direction and that the upper hydraulic motor 32 will be contracted. The rearwardly extending pan or discharge section 40 of the conveyer is formed of two sections connected through a pivot means 39 having a horizontal axis and about which the rear end of conveyer section 40 is vertically adjustable. The rear end of discharge section 40 is adjusted vertically about the said horizontal axis of said pivot means 39 with respect to the front section thereof and the section 28 by means of turnbuckle links 41 which interconnect the forward and rearward sections or portions of the discharge section 40. Thus by decreasing the overall length of the turnbuckle links 41 the rear or discharge portion of the discharge section 40 of the conveyer mechanism may be rotated about the horizontal axis of the pivot means 39 to the position indicated in full lines in Fig. 2 wherein it lies in a plane parallel to the plane of the conveyer pan or section 28 and by increasing the overall length of the turnbuckle links 41 the rear or discharge portion of the discharge section 40 of the conveyer mechanism may be rotated about the axis of the pivot means 39 to various positions one of which is indicated in dotted lines in Fig. 2. This adjustment is utilized for maintaining the rear or discharge portion of the discharge section 40 substantially level for any elevational adjustment of the conveyer pan or section 28.

Conveyer means is provided on the gathering head or mechanism 25 which includes a pair of spaced endless gathering chain elements 42 provided with flights 43 that are reeved about spaced chain guides 44 and over drive sprockets 45 on spaced upwardly extending driven shafts of a power driven mechanical gearing 117. The endless gathering chain elements 42 rotate in opposite directions and as seen in Figs. 1 and 3 of the drawings the chain element 42 on the upper chain guide 44 travels in a clockwise direction while the chain element 42 on the lower chain guide 44 travels in a counter-clockwise direction. As the flights 43 of the chain elements 42

pass around the forward or front ends of the chain guides 44 they gather coal by digging and sweeping it toward the center of the gathering head 25 where the coal is conveyed rearwardly between the endless chain elements 42 and is discharged to a rear conveyer section 47 of the gathering head 25 which section terminates adjacent the pivot pin or shaft 26 and the front of the conveyer pan or section 28. An endless chain and flight conveyer mechanism 48 operates over the rear conveyer section 47 of the gathering mechanism 25, the conveyer pan or section 28, and the discharge section 40, for conveying coal rearwardly thereover which is received from between the endless gathering chain elements 42 on the gathering head 25.

The endless gathering chain elements 42 and the endless chain and flight conveyer mechanism 48 are driven by a pair of rotary hydraulic motors 49 carried within the gathering head 25 and one of which is seen in Fig. 2. The rotary hydraulic motors 49 are spaced one below each of the drive sprockets 45 that drive the endless gathering chain elements 42 and these motors drive a common shaft 118 that extends transversely of the gathering head 25 through a reach gear 119. The ends of shaft 118 are each geared through a worm 120 thereon and a worm gear 121 upon one of the upright shafts which carry sprockets 45 to drive the shafts and sprockets 45 in opposite directions. The common shaft 118 also carries the front end of the endless chain and flight conveyer mechanism 48 and drives it through a sprocket, not shown. Thus it will be seen that the endless gathering chain elements 42 and the endless chain and flight conveyer mechanism 48 are all driven from a common shaft which in turn is driven by the two rotary hydraulic motors 49 carried within the gathering head 25.

It will be seen that the conveyer which includes the gathering head 25, conveyer or trough 28 and discharge section 40 is so articulated that the gathering mechanism may be elevated or adjusted vertically about the horizontal axis of pin 26 to follow the contour of the mine room floor whereby the flights 43 of the endless gathering chain elements 42 may gather and otherwise remove coal from the mine room floor to clear and level it; that the conveyer pan or section 28 is adjustable about the horizontal axis of pin 26 adjacent its front end, which end receives coal as it is discharged or passes from the conveyer section 47 of the gathering head 25; and that the rear or discharge portion of the discharge section 40 is pivoted to the rear end pan or section 28 for adjustment about a horizontal axis and a vertical axis whereby the discharge section of the conveyer may be swung horizontally over a wide area and elevated and adjusted about the horizontal axis to position it horizontally whereby the conveyer may be adjusted to any of various desired discharge positions.

The front end of the main frame 11 of the truck carries a pair of spaced cutter bar supporting arms 51. These cutter bar supporting arms are spaced at opposite sides of the main frame and at opposite sides of the gathering mechanism 25 and are carried by the main frame for vertical adjustment about the horizontal axis of aligned trunnions indicated at 52. The cutter bar supporting arms are identical except, of course, that one is a right-hand element while the other is a left-hand element, therefore a description of one of the mounting arms 51 and its operating mechanism as well as one of the L-shaped cutter bar mechanisms 53 carried thereby, which cutter bar elements are also similar, will suffice to describe the others.

As previously mentioned, each of the cutter bar supporting arms 51 is carried by and adjacent the front end of the main frame 11 for vertical adjustment about the horizontal axis of trunnions 52 and this adjustment is obtained for each of the arms by means of separate double acting hydraulic piston motors 54. Thus the arms 51 may be swung independently of each other in opposite directions or simultaneously in the same direction under the control of individual valve units of the valve bank unit 18. The outer or forward end of each arm 51 carries one of the L-shaped cutter bars 53 for rotation about a horizontal axis 55, that is, an axis that remains parallel with respect to the axis of trunnions 52 about which the arms 51 are movable.

As seen in Figs. 1 and 2, and Figs. 3 and 4, the side leg 56 of each L-shaped cutter bar 53 extends along the outside surface of its supporting arm 51 and the right angle or free leg 56' of the L-shaped cutter bar 53 extends toward the other supporting arm 51 and cutter bar 53 of the machine.

Referring now to Figs. 6 through 9, wherein one mechanical head 57 which connects one of the L-shaped cutter bars 53 with its supporting arm 51 is shown, the end of the arm 51 forms a dish-like section 58 (see Fig. 7) having a rearwardly extending portion 59 (see Fig. 6) that is suitably flanged and bolted by bolts 62 to a flange 60 on the front end of arm 51. A dish-like casting 63 (see Fig. 7) carries the L-shaped cutter bar 53 through its side leg 56, the latter being bolted to a boss 64 of the casting 63. Dish-like casting 63 co-operates with the dish-like section or member 58 of the supporting arm 51 to form an enclosing housing which completely encloses drive gearing for driving an endless universal type chain kerf cutter element 65 having the usual fanned cutter bits thereon, which element operates over and around the side edges of the L-shaped cutter bars 53 and is driven through a drive sprocket 66. Drive sprocket 66 is keyed and secured to a shaft 67 by a suitable washer and a bolt 68. Shaft 67 is carried by a double row anti-friction bearing 69 supported in a casting 70 that is bolted directly to the dish-like section 58. The end of the shaft 67 opposite the drive sprocket 66 is carried by an anti-friction bearing 71 locked within a central cup-like bearing receiving portion 72 of the dish-like section 58. Between the bearings 69 and 71 and keyed to the shaft 67 is a gear 73 which drives the shaft 67. The bearing 69 is retained within its supporting casting 70 by a cap 74 adjacent the sprocket 66 which co-operates with the latter to form a labyrinth type lubricant and dirt seal. Cap 74 also carries a ring type lubricant seal that engages a cylindrical shoulder of the sprocket 66 to seal further the bearing 69. Casting 70 carries a similar lubricant sealing ring that rides upon a cylindrical shoulder of gear 73.

Dish-like section 58 includes a circular opening in which there is secured by means of a ring 75 a rotary hydraulic motor 76 the main shaft of which carries a pinion gear 77 that meshes with gear 73 for driving the shaft 67 and consequently the endless chain kerf cutter 65. It may be mentioned that the rotary hydraulic motor 76 is reversible and may be driven in either

direction to drive the sprocket 66, and consequently the endless chain kerf cutter 65, clockwise or counter-clockwise, as seen in Fig. 6.

The dish-like casting 63 which receives the cutter bar 53 is carried for rotation with respect to the dish-like section 58 through hub bushings 79 between it and the casting 70 and the circular rim surface of the dish-like casting 63 abuts the circular rim surface of the dish-like section 58 through a bearing ring 80, which ring is retained upon the casting 63 by a shoulder 81. Thus it will be seen that dish-like casting 63 can be rotated or swung about the axis of shaft 67. The inner surface of the outer lip of dish-like casting 63 is toothed to provide a ring gear 82. Within the rear portion 59 of the dish-like section 58 there is carried a reversible rotary type hydraulic motor 83 (see Figs. 6 and 8).

As seen in Fig. 6, motor 83 is situated below a removable cover 84, which cover co-operates with the side walls of the member 58 in forming the enclosing housing hereinbefore mentioned. Motor 83 functions to swing or rotate the dish-like casting 63, which carries the cutter bar 53, with respect to the cutter bar supporting arm 51 and about the axis of shaft 67. As best seen in Figs. 6 and 8 the driven or main shaft of motor 83 drives a worm 85 which worm meshes with a worm gear 86 carried on a shaft 87. Shaft 87 is supported on suitable anti-friction bearings 88 carried by a wall and web, respectively, of the dish-like section 58 and is retained against end thrust by a pair of anti-friction bearings 89.

Shaft 87 includes a worm 90 which meshes with and drives a worm gear 91 (see Figs. 6 and 9) which worm gear is carried by and drives a shaft 92 supported in suitable anti-friction bearings 93 also carried by a wall and a web of section 58.

As seen in Fig. 9, the uppermost end of shaft 92 forms a pinion gear 94 that meshes with the ring gear 82 (see Fig. 6) for driving the latter. Hydraulic motor 83 is reversible and it is obvious that it may be operated to rotate the dish-like casting 63 and the L-shaped cutter bar which it carries in either direction about the axis of shaft 67, which axis is the axis 55 previously referred to, through the gear train above described.

Each of the L-shaped cutter bars 53 includes a pair of hydraulically operated coal break-down devices in the form of jacks 95. Each jack 95 includes a compound telescoping piston 96, a partial cross-section of which is seen in Fig. 5, with the piston members expanded. Fig. 5 also shows in dotted lines the positions occupied by the members of piston 96 when the jack is contracted. All of the jacks 95 are of similar construction and therefore a description of one jack will suffice for the others.

Referring to Fig. 5 the body of each jack 95 is formed integral with the outer or free leg of the cutter bar 53. The body of each jack forms a chamber or cylinder 97 in which the compound piston 96 reciprocates. The compound piston 96 is comprised of two tubular members 98 and 99 and a solid central piston member 100. The central piston member 100 telescopes within the member 99, the member 99 telescopes within the member 98 and the member 98 telescopes within the body of the jack 95. Members 98 and 99 are of similar construction except, of course, that the member 99 is of such diameter that it fits within the member 98. Each of the members 98 and 99 carries a threaded collar 101 at its inner end, which collar secures between a flange 102 of each of the members 98 and 99 a pair of oppositely facing hydraulic seals or rings 103 which provide hydraulic seals between the member 98 and cylinder surface of the chamber 97 and between the members 98 and 99. The member 98 is retained within the cylinder 97 by a seal retaining ring 105 that surrounds it and is clamped into the body of the jack 95 by an externally threaded ring 106. A hydraulic or seal ring 107 is clamped between the rings 105 and 106 preventing the loss of hydraulic fluid from the jack 95. It will be seen that when the member 98 is extended to its greatest extent that flange 102 thereof will abut ring 105 to limit the outward movement of the member 98. It will be seen that inward movement of the member 98 is limited by the end wall 108 of the chamber 97.

Tubular member 99, as previously mentioned, is similar to tubular member 98 and it reciprocates within the tubular member 98. The collar 101 carried by the member 98 includes a radially inwardly extending flange 109 against which the collar 101 carried by the tubular member 99 abuts to prevent the member 99 from moving inwardly beyond the inner end of the member 98. Outward movement of the member 99 is limited by a ring or collar 110 similar to ring or collar 106 threaded into the outer end of member 98. Ring or collar 110 also clamps a ring and seal similar to ring 105 and seal 107 about the outer reduced diameter cylindrical portion of tubular member 99 and to the member 98. The cylinder 100 reciprocates or telescopes within the member 99. It is solid and its construction at its inner end is substantially identical to that of the members 98 and 99. Its outer cylindrical surface is sealed to the member 99 by a seal similar to seal 107 and it is retained within the member 99 by rings similar to rings 105 and 106. Since the member 100 is the innermost of the telescoping members, the ring 112 thereon which secures the innermost hydraulic sealing rings thereto is merely a plain internally threaded ring or collar.

The hydraulic jacks 95 are expanded by admitting hydraulic fluid under pressure through a hydraulic conduit 113 formed integral with the body of the jack 95 to the chamber 97 and the jack 95 is contracted by supplying hydraulic fluid under pressure to a conduit 114 also formed integral with the body of the jack. The cylinder members 98 and 99 are each provided with a conduit 115 that functions to conduct hydraulic fluid from the port 116 that connects conduit 114 with the cylinder of the jack 95. Hydraulic fluid entering the jack 95 by way of port 116 will act upon the shoulder or flange 102 of piston member 98 to force the member 98 inwardly in the chamber 97 and hydraulic fluid under pressure will be conducted through the conduits 115 to act upon the shoulders or flanges 102 of the member 99 and the shoulder of the central piston member 100. Thus each of the hydraulic jacks 95 may be contracted to a position wherein their parts are fully telescoped, one within the other, as indicated in dotted lines on the left-hand side of Fig. 5, in which the compound piston 96 lies wholly within the confines of the member which forms the body of the jack and therefore within the confines of a kerf cut in solid coal by the endless chain kerf cutter 65. The hydraulic conduits 113 and 114 within the body of the L-shaped cutter bars 53 lead to valves of the valve bank unit 18.

In the operation of the mining and loading machine the operator first causes the electric motors 15 to be energized to drive hydraulic

pumps 16 which supply the hydraulic system with hydraulic fluid under pressure. It may be mentioned that the electric motors 15 and pumps 16 are the only source of primary power on the mining machine. The operator will then by operation of the proper valves of valve bank unit 18 cause the machine to propel itself to a mine room face where it is to operate to mine and load coal. When the machine reaches the mine room face the operator will operate the appropriate valve of the valve bank unit 18 to place the hydraulic motors 49 in the gathering head 25 in operation for driving the common shaft 118 which in turn drives the endless gathering chain elements 42 on the gathering head 25 and the endless chain and flight conveyor mechanism 48 which operates over the conveyor that extends therefrom to the rear of the machine. He will then cause the gathering head 25 to be adjusted by means of the hydraulic motors 27 to such position that the flights 43 of the endless gathering chain elements 42 are at the level to which it is desired that they cut, level or trim the mine room floor. He will then by means of the hydraulic motors 54 which swing the cutter bar supporting arms 51 swing the arms 51 to positions as indicated in Fig. 10 and operate the motors 63 which are within the housings formed by the dish-like members 58 and 63 of each mechanical head 57 to swing the L-shaped cutter bars 53 to positions as indicated in Fig. 10. The operator will then cause the hydraulic motors 76 to be operated to drive the endless kerf cutter chains 65. He will then cause the entire machine to be advanced to a position adjacent the mine room face 212, as viewed in Fig. 10, and with the gathering chain elements 42 and chain and flight elements 43 operating or not, as he chooses. In Figs. 10 through 15 only one supporting arm 51 and cutter bar 53 is seen since the other supporting arm 51 and cutter bar 53 lies directly behind it. The operator will then cause the hydraulic motors 63 to revolve, swing or rotate the cutter bars 53 preferably simultaneously in a counterclockwise direction about the horizontal axes 55 of the two shafts 67 to cut a pair of spaced arcuate kerfs or back cuts 213 into the solid coal of the mine room face, as indicated in Fig. 11. These two kerfs free the sides and front of a mass of hanging coal. The right angle portions of the L-shaped cutter bars preferably remain in opposed positions during cutting and the cutter bits on opposite ones just clear each other as they travel about the nose of the right angle portions of said cutter bars.

The operator may then stop the operation of motors 76 and 63 and cause hydraulic fluid under pressure to be admitted to the chambers 97 of the hydraulic break-down jacks 95 to cause the jacks to expand to break down the coal which has been cut from the mine at both of its sides and at the arcuate kerf or back cut 213 by the L-shaped cutter bars 53, as indicated in Fig. 11. If desired, a number of breaking operations may be performed during the travel of the cutter bars from the starting position illustrated in Fig. 10 to the finish position suggested by Fig. 11, so as to break up the removed coal in reasonably sized lumps, as suggested by said Fig. 11.

With respect to Fig. 11, it may be mentioned that the arcuate segment of coal which is partially freed from the mine by the cutting operation just described is shown in a shattered condition which condition would exist only if broken by jacks 95 in steps as above suggested. It is, of course, understood that the coal will fall from this position to the mine room floor.

The operator will then preferably but not necessarily cause the hydraulic jacks 95 to be contracted and the cutter bars 53 preferably to be swung in a clockwise direction whereupon he will back the loader away from the mine room face and when backed from the mine room face he will swing the arms 51 rearwardly or counterclockwise and swing the cutter bars 53 downwardly or clockwise to positions as indicated in Fig. 12. He then will again advance the machine toward the mine room face so that the cutter bars 53 may be swung clockwise to remove the remaining coal 216 from the mine room ceiling. The coal which is thus cut and broken from the mine falls to the floor and as the machine is advanced toward the new mine face 217 the endless gathering chain elements 42 and their flights 43 dig into the loose or shattered coal upon the mine floor to gather it and convey it rearwardly between the gathering chain elements 42 which discharge the coal being conveyed to the endless chain and flight conveyer mechanism that conveys the coal rearwardly over the conveyer members 28 and 40 and discharge it from the conveyer mechanism at the rear of the discharge section 40.

It will be seen that as the mining machine is advanced over the mine floor the operator may so adjust the elevation of the gathering head 25 that the flights 43 of the endless chain elements 42 will dig, scrape, cut or otherwise level and smooth the floor of the mine room.

The previously described cutting and breaking operations made with reference to Figs. 10, 11 and 12 describe a cutting operation wherein the first cuts, that is, the arcuate back cuts 213, are started upwardly from the floor of the mine room. It will be seen with reference to Figs. 13, 14 and 15 that the first or arcuate cuts may be started from adjacent the roof of the mine room, the operations of Figs. 13, 14 and 15 corresponding to those described in Figs. 10, 11 and 12, respectively, except that they are carried out in reverse directions.

It will be seen also that the mining machine may mine coal without breaking or shattering the segments which are partially freed from the mine room. For example, the operations described in Figs. 10 and 11 may be carried out except that instead of breaking or shattering the coal by the jacks 95 the L-shaped cutter arms 53 may be swung to withdraw their outer legs from the kerf 213 and the mining machine may then be backed away from the mine face 212, arms 51 may be lowered and the cutter arms 53 may be swung to an elevated position and the machine again advanced to a position wherein the mechanical head 57 is adjacent the face 212. The cutter bars 53 may then be swung to cut a portion of the partially freed arcuate segment of coal from the mine whereby the cut-off portion will fall to the mine room floor.

The machine may also be operated to break down coal by following the operations described in connection with Figs. 10 and 11 and by causing the machine by means of the crawlers to jerk rearwardly or away from the face 217 thereby causing the outer legs of the L-shaped cutter bars 53 to pull down the segment of coal which has been partially freed from the mine room.

The operations of the machine previously set forth describe the machine with both arms 51 and both cutter bars 53 operating together and

in effect as a single U-shaped cutter unit, but it is of course obvious that each supporting arm **51** and cutter bar **53** may be operated independently so that their side legs **56** will form deep side kerfs or shear cuts in the solid coal at each side of the segment of coal that is being cut and that the forward or outer legs of the L-shaped cutter bars **53** will simultaneously form arcuate rear or back kerfs or cuts between the segment of coal and the solid coal from which the segment is being removed. The planes of these two connecting kerfs cut by each cutter bar **53** are at right angles to each other. It will also be seen that the path of the fanned cutter bits of he endless chain kerf cutter mechanism 65 carried by each of the L-shaped arms operate around the adjacent ends of the outer legs of the L-shaped cutter bars **53** but that they do not overlap. This would appear to leave a web of coal interconnecting the segment of coal which is being cut from the mine. However, experience has shown that vibrations of the machine while it is operating prevent the formation of such a web and that actually a kerf such as the kerf **213** will extend substantially completely between the shear cuts at each side of the segment of coal which is being removed from the mine. The mining machine is highly versatile in cutting coal and need not be operated in the manner previously described, since each cutter arm **51** and its cutter bar **53** is operable independently of the other cutter arm **51** and cutter bar **53**.

From the foregoing it will be seen that I have provided an improved mining machine that is adapted to cut, break down and load coal at a mine face which machine is preferably a self-propelled vehicle having a pair of cutter bars carried by arms, preferably of equal length, at the front end of the machine which are adjustable vertically about pivots which preferably lie on a common horizontal axis and that each cutter bar is L-shaped and adjustable with respect to its supporting arm about an axis which remains at all times parallel with the mounting axis of the supporting arm.

It will also be seen that the mining machine includes an articulated conveyer for conveying coal rearwardly over its main frame and discharging it at the rear of the machine which conveyer has a coal gathering head disposed adjacent the front end of the main frame of the machine and disposed between the spaced L-shaped cutter bars to receive and gather coal cut by the latter and which head is adjustable about a horizontal axis whereby it may be adjusted with respect to the mine room floor to permit the oppositely traveling chain gathering elements thereof to gather, cut, scrape, and otherwise remove coal from the mine room floor to clear and level it.

It will be noted that all of the kerf cutting is performed by kerf cutting mechanisms **53** and that the gathering mechanism **25** is primarily for gathering up the coal and conveying it rearwardly. Said gathering mechanism through the flights **43** will also do some digging and scraping and is particularly useful in the formation of a relatively level bottom and the recovery of some of the coal adjacent the mine floor. It will also be seen that the kerf cutting mechanisms **53** operate forwardly of the gathering mechanisms **25**. This is particularly evident by reference to Figs. 10 and 15 of the drawings and by reference to the latter it is evident that the pivotally mounted cutter bars **53** may be swung rearwardly over the flights **43** of the gathering mechanism **25** without coming in contact therewith.

In Figs. 3 and 4 of the drawings a modification of the apparatus is shown which differs from that previously described only in the dimensions or relative dimensions of some of the parts. In this modification the supporting arms **51'** are shorter than the arms **51** in the mechanism of Figs. 1 and 2 and the side legs of the cutter bars **53'** are longer than are the similar side legs **56** of the cutter bars of the device of Figs. 1 and 2. This machine is particularly adapted for operation in a higher room or in a thicker coal seam. It functions substantially the same as the device of Figs. 1 and 2 except that it is impossible to swing the parts to the position illustrated in Fig. 15 of the drawings because of the relative lengths of the supporting arm **51** and cutter bar side legs **56**.

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

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

1. A mining machine adapted to cut, break down and load coal including a vehicle having a main frame, an articulated conveyer means for conveying coal over said main frame including gathering means adjacent the front of said main frame pivoted thereto for adjustment about a horizontal axis and adapted to remove coal from the mine room floor and convey it rearwardly, conveyer pan means carried by said main frame for vertical adjustment about a horizontal axis adjacent its front end, said front end being disposed to receive coal from said coal gathering means, a conveyer discharge pan means pivoted adjacent its front end to the rear end of said conveyer pan both for horizontal and vertical adjustment, endless chain and flight conveyer mechanism operating over said conveyer pan means, a pair of cutter bar mounting arms of equal length spaced at opposite sides of said main frame each mounted at one end for rotation in reverse directions about a common axis, power means for rotating said arms as aforesaid, a pair of similar L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation in reverse directions about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, power means interconnecting each of said mounting arms and its respective L-shaped cutter bar for rotating the latter as aforesaid, cutter means carried by each of said L-shaped cutter bars, and hydraulic expansion means carried by each of said L-shaped cutter bars for breaking down coal partially freed from the mine by said cutter bars.

2. A mining machine adapted to cut, break down and load coal including a vehicle having a main frame, an articulated conveyer means for conveying coal over said main frame including gathering means adjacent the front of said main frame pivoted thereto for adjustment about a horizontal axis and adapted to remove coal from the mine room floor and convey it rearwardly, conveyer pan means carried by said main frame for vertical adjustment about a horizontal axis

adjacent its front end, said front end being disposed to receive coal from said coal gathering means, a conveyer discharge pan means pivoted adjacent its front end to the rear end of said conveyer pan both for horizontal and vertical adjustment, endless chain and flight conveyer mechanism operating over said conveyer pan means, a pair of cutter bar mounting arms spaced at opposite sides of said main frame each adapted to be mounted at one end for rotation about a common axis, a pair of L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, cutter means carried by each of said L-shaped cutter bars, and hydraulic expansion means carried by each of said L-shaped cutter bars for breaking down coal partially freed from the mine by said cutter bars.

3. A mining machine adapted to cut and load coal including a vehicle having a main frame, an articulated conveyer means for conveying coal over said main frame including gathering means adjacent the front of said main frame pivoted thereto for adjustment about a horizontal axis and adapted to remove coal from the mine room floor and convey it rearwardly, conveyer pan means carried by said main frame for vertical adjustment about a horizontal axis adjacent its front end, said front end being disposed to receive coal from said coal gathering means, a conveyer discharge pan means pivoted adjacent its front end to the rear end of said conveyer pan both for horizontal and vertical adjustment, endless chain and flight conveyer mechanism operating over said conveyer pan means, a pair of cutter bar mounting arms spaced at opposite sides of said main frame each adapted to be mounted at one end for rotation about a common axis, a pair of L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, and cutter means carried by each of said L-shaped cutter bars.

4. A mining machine adapted to cut, break down and load coal including a main frame, conveyer means for conveying coal rearwardly over said main frame including gathering means adjacent the front of said main frame adapted to remove coal from the mine room floor, a pair of cutter bar mounting arms spaced at opposite sides of said main frame each adapted to be mounted at one end for rotation about a common axis, a pair of L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, cutter means carried by each of said L-shaped cutter bars, and hydraulic expansion means carried by each of said L-shaped cutter bars for breaking down coal partially freed from the mine by said cutter bars.

5. A mining machine adapted to cut and load coal including a main frame, conveyer means for conveying coal rearwardly over said main frame including gathering means adjacent the front of said main frame adapted to remove coal from the mine room floor, a pair of cutter bar mounting arms spaced at opposite sides of said main frame each adapted to be mounted at one end for rotation about a common axis, a pair of

L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, and cutter means carried by each of said L-shaped cutter bars.

6. In a mining and loading machine of the class described, means co-operating to cut, gather and convey coal including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis common to both cutter bars and each having its other leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, coal gathering means disposed between said cutter bars mounted for adjustment about a horizontal axis and adapted to remove coal from the mine room floor, and conveyer means adapted to receive coal gathered by said gathering means.

7. In a mining and loading machine of the class described, means co-operating to cut, gather and convey coal including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis and each having its other leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, coal gathering means disposed between said cutter bars mounted for adjustment about a horizontal axis and adapted to remove coal from the mine room floor, and conveyer means adapted to receive coal gathered by said gathering means.

8. In a mining and loading machine of the class described, means co-operating to cut, gather and convey coal including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis and each having its other leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, coal gathering means disposed between said cutter bars adapted to remove coal from the mine room floor, and conveyor means adapted to receive coal gathered by said gathering means.

9. In a mining and loading machine of the class described, means co-operating to cut and gather coal including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis and each having its other leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, and coal gathering means disposed between said L-shaped cutter bars adapted to remove coal from the mine room floor.

10. A coal cutting, breakdown and loading mining machine including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis common to both cutter bars and each having its outer leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, coal gathering means disposed between said cutter bars mounted for adjustment about a horizontal axis and adapted to remove coal from the mine room floor, conveyor means adapted to receive coal gathered by said gathering means, and hydraulic means carried by each of said cutter bars for breaking down coal partially freed from the mine by said cutter bars.

11. A coal cutting, breakdown and loading mining machine including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis

and each having its outer leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, coal gathering means disposed between said cutter bars mounted for adjustment about a horizontal axis and adapted to remove coal from the mine room floor, conveyor means adapted to receive coal gathered by said gathering means, and hydraulic means carried by each of said cutter bars for breaking down coal partially freed from the mine by said cutter bars.

12. A coal cutting, breakdown and loading mining machine including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis and each having its outer leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, coal gathering means disposed between said cutter bars adapted to remove coal from the mine room floor, conveyor means adapted to receive coal gathered by said gathering means, and hydraulic means carried by each of said cutter bars for breaking down coal partially freed from the mine by said cutter bars.

13. A coal cutting, breakdown and loading mining machine including a pair of spaced L-shaped cutter bars each pivotally supported through one of its legs for rotation about a horizontal axis and each having its outer leg extending toward the other cutter bar, cutter means carried by each of said cutter bars, coal gathering means disposed between said cutter bars adapted to remove coal from the mine room floor, and hydraulic means carried by each of said cutter bars for breaking down coal partially freed from the mine by said cutter bars.

14. Cutter mechanism adapted to be carried by a mining machine including a pair of cutter bar mounting arms spaced at opposite sides of said machine each adapted to be mounted at one end for rotation about a common axis, a pair of L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, cutter means carried by each of said L-shaped cutter bars, and power means for operating said cutter mechanism.

15. Cutter mechanism adapted to be carried by a mining machine including a pair of cutter bar mounting arms of equal length spaced at opposite sides of said machine each adapted to be mounted at one end for rotation about a common axis, a pair of similar L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, cutter means carried by each of said L-shaped cutter bars, and power means for operating said cutter mechanism.

16. Cutter mechanism adapted to be carried by a mining machine including a pair of cutter bar mounting arms spaced at opposite sides of said machine each adapted to be mounted at one end for rotation about a common axis, power means for rotating said arms as aforesaid, a pair of L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, power means for rotating said cutter bars as aforesaid, cutter means carried by each of said L-shaped cutter bars, and power means for operating said cutter mechanism.

17. Cutter mechanism adapted to be carried by a mining machine including a pair of cutter bar mounting arms of equal length spaced at opposite sides of said machine each adapted to be mounted at one end for rotation about a common axis, power means for rotating said arms as aforesaid, a pair of similar L-shaped cutter bars each mounted through one of its legs adjacent the other end of one of said mounting arms for rotation about an axis extending parallel with respect to said common axis and having its other leg extending toward the other cutter bar, power means for rotating said cutter bars as aforesaid, cutter means carried by each of said L-shaped cutter bars, and power means for operating said cutter mechanism.

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