March 18, 1969 F. WEBSTER 3,433,533

MINING MACHINE HAVING ROTARY CUTTER MOUNTED FOR INCREASED VERTICAL AND LATERAL RANGE OF CUTTING

Filed Nov. 8, 1966 Sheet 1 of 4

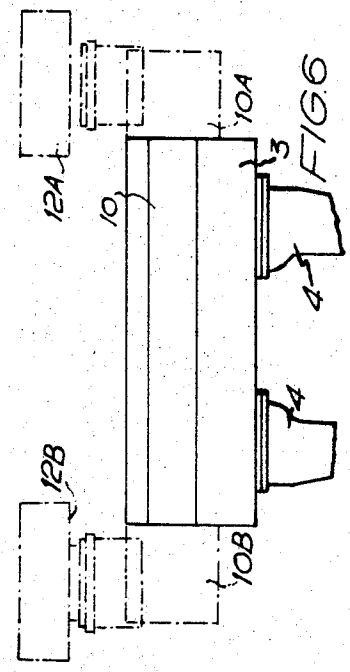


FIG 6

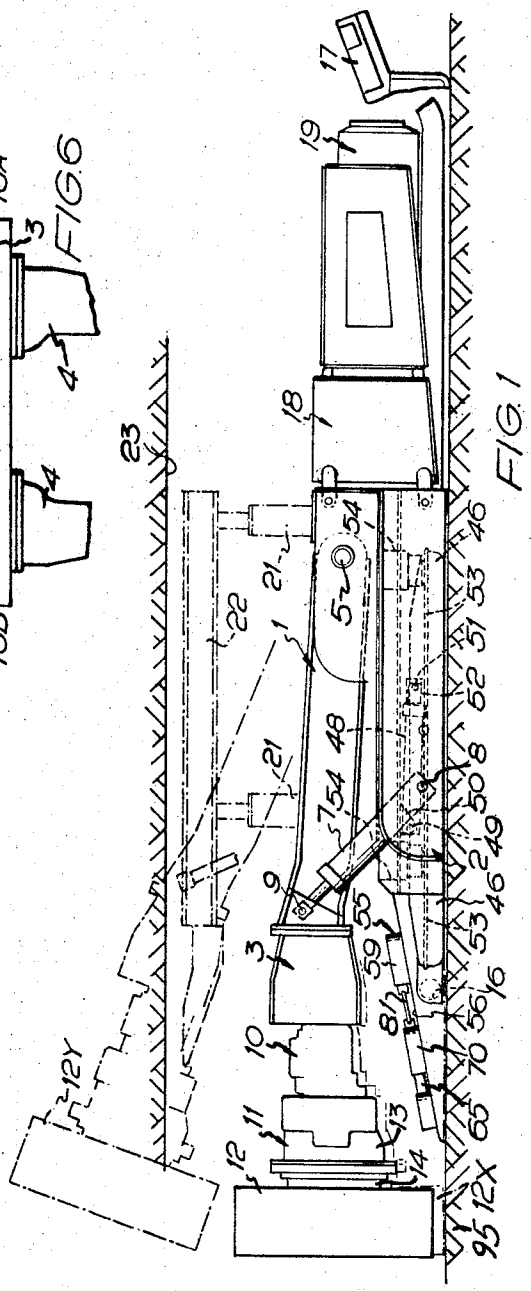


FIG. 1

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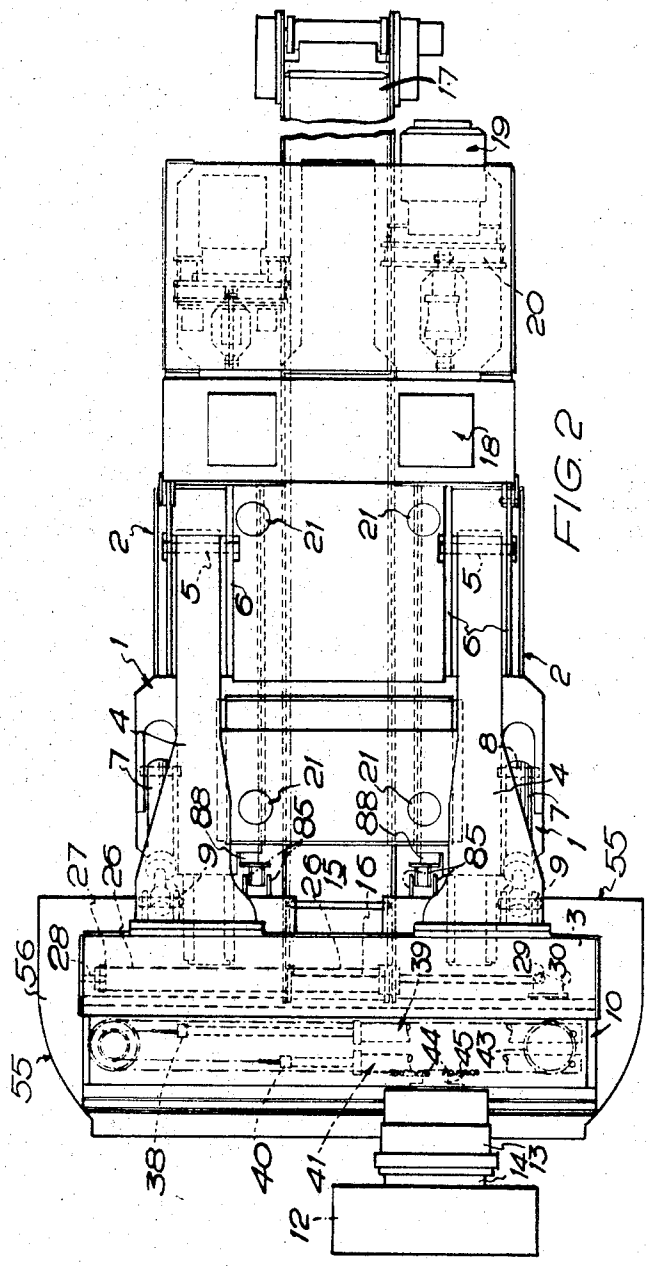


FIG. 2

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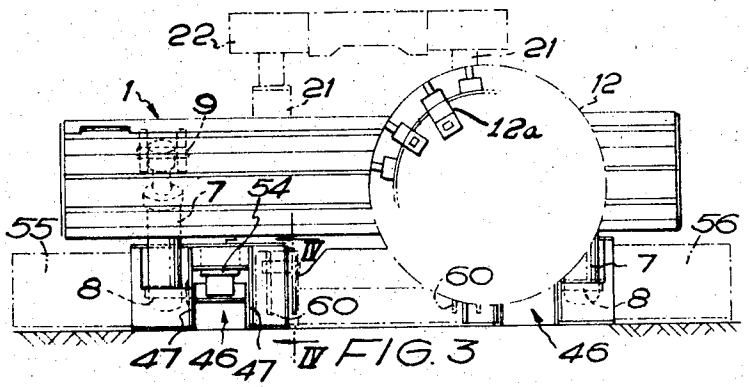


FIG. 3

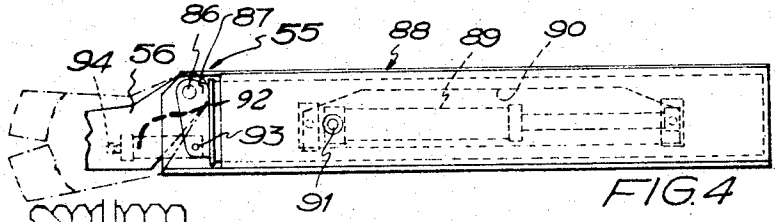


FIG. 4

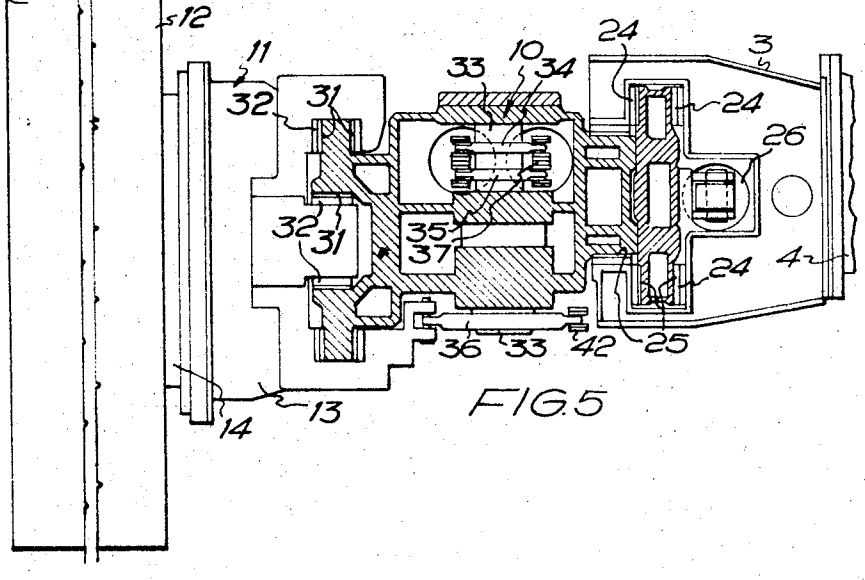


FIG. 5

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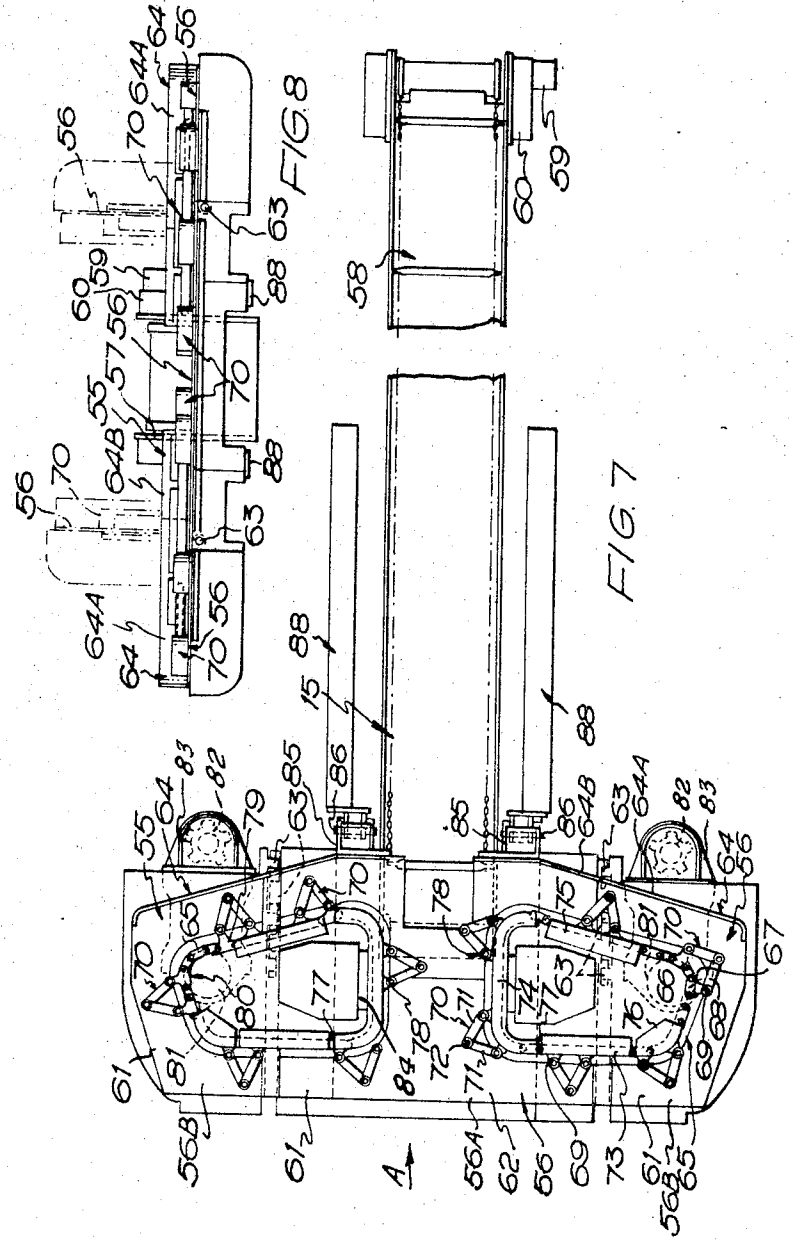


FIG 8

FIG 7

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United States Patent Office 3,433,533 Patented Mar. 18, 1969

3,433,533

MINING MACHINE HAVING ROTARY CUTTER MOUNTED FOR INCREASED VERTICAL AND LATERAL RANGE OF CUTTING

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Filed Nov. 8, 1966, Ser. No. 592,787
Claims priority, application Great Britain, Nov. 10, 1965, 47,608/65
U.S. Cl. 299—56 11 Claims
Int. Cl. E21c 1/02, 25/08, 29/00

ABSTRACT OF THE DISCLOSURE

Mining machine having a base, a forwardly extending arm pivoted at its rear end to the base, means for moving such arm to any desired location between limits of maximum swing of its forward end with respect to its pivoted end, a guide bar secured to the forward end of such arm and extending parallel to the arm pivot, such that the guide bar serves as a slideway, an extension bar mounted on and slidable lengthwise of the guide bar, a carrier mounted on and slidable lengthwise of the extension bar and carrying a cutting head rotatably thereon for rotation about an axis extending forwardly from the extension bar, and means for rotating the cutting head and for moving the extension bar lengthwise of the guide bar whereby the extension bar may extend beyond a given end of the guide bar, and means for moving the carrier for the cutting head lengthwise of the extension bar.

This invention relates to mining machines of the type having a forwardly-mounted cutting head, rotatable about an axis extending in the fore-and-aft direction of the machine, to be advanced generally axially into the face of the mineral to be mined and also to be moved in any direction transversely to the axis to remove mineral over an area the height and width of which are represented by the respective vertical and horizontal ranges of movement of the head, plus the diameter of the head in each case.

According to the present invention, a mining machine of the type referred to comprises a base, a forwardly extending arm pivoted to the base at its rear end, means for moving the arm to and positioning it in any desired location between limits of maximum swing of its forward end with respect to its pivoted end, a guide bar secured to the forward end of the arm and extending parallel to the pivot for the arm, the guide bar being constituted as a slideway, an extension bar mounted on and slidable lengthwise of the guide bar, a carrier mounted on and slidable lengthwise of the extension bar, a cutting head rotatably mounted on the carrier on an axis extending forwardly from the extension bar, means for rotating the cutting head, and means for moving the extension bar lengthwise of the guide bar to positions in which its ends lie beyond the respective ends of the guide bar, and means for moving the carrier lengthwise of the extension bar.

The pivoted arm is preferably duplex, and two side members may provide for pivot connections widely spaced with respect to the width of the base of the machine and similarly widely spaced securing points to the guide bar.

By positioning of the cutting head at either extreme end of the extension bar, and by movement of the extension bar along the guide bar to bring that extreme end beyond the corresponding end of the guide bar, the cutting range of the head can be made to extend beyond the length of the guide bar itself. Thus the guide bar may be of modest length and negotiable into any working into which the machine frame can readily pass and the machine is capable of cutting over an area that is not restricted by the dimensions to which the machine frame and its guide bar must be restricted for freedom of maneuvering, avoidance of roof supports, provision of accessibility of the working space to attendant operatives, and so on.

When the cutting head has been located opposite a suitable starting location of a face to be worked, and then advanced into the face, it can then be moved either by swinging of the arm, to effect a cut determined by the limits of swing, or by traversing the cutting head along the extension bar and the extension bar along the guide bar. Thus, the cutting head may start at one limit of extension and progress to the other limit of extension. Since, in general, it is preferable to use a cutting head with picks (shearer and/or point-attack) positioned for maximum cutting effort in one particular direction of rotation of the head, the head may then be returned idly (and rapidly) to its initial position, in readiness for its next cutting traverse.

By the available combination of cutting, a single cutting head is able to excavate a section that is substantially rectangular.

The diameter of the cutting head can be inexcess of the overall height of the extension bar and guide bar on the forward end of the pivoted arm, so that when the lowest part of the periphery of the head is at its lowest position, viz., that of the floor on which the machine is operating, a substantial space can be left between the bars (and the forward part of the arm) and the floor, and this can be used to accommodate a conveyor of the self-loading type mounted across the front of the base of the machine.

According to a further feature of the invention a loader-conveyor machine comprises a ramp, two endless chains, each bearing outwardly projecting flights, mounted on the surface of the ramp, one at each side of the centre of the ramp, with guide means for each chain to form a front run generally parallel to the front edge of the ramp and spaced from it by substantially the length of the projecting flights, an adjoining elevating run extending towards the elevated rear of the ramp, and a return run, means for driving the chains in a direction to carry the flights towards the centre of the ramp, and then up the ramp and into the return run, and a rearwardly extending conveyor having an upper run starting from below the elevated rear of the ramp, in continuation of the space formed by the two elevating runs of the chains. Preferably, the conveyor is mounted so as to advance and retract with respect to the base. It may therefore be brought close to the rear of the cutting head when the latter is in its lowest position, so as to receive directly as much as possible of the mineral as it is detached by the head; and it may be advanced under the head if the latter is raised the necessary amount above the floor, when mineral can drop directly on to the conveyor.

Thus, with the front edge of the ramp urged under loose material piled anywhere along the front edge, or even along the whole of the front edge, the projecting flights of the front runs of the chains are forced into the material and their movements in opposite directions towards the centre of the ramp carries the material to the centre, where the turning of the flights into the elevating runs propels the material up the ramp in the space between those runs, and carries it from the ramp on to the conveyor. Preferably, the flights of one chain alternate with those of the other in moving upwardly along this space, so that lumps do not tend to be jammed between the ends of pairs of flights, but pass freely into the spaces formed between the chains and the flights. The flights preferably have a length equal to approximately half the width of the space between the elevating runs; but, with the flights alternating, they could have a length greater than such half-width. Preferably the return run consists of a rear run, generally parallel to the rear edge of the ramp and a side run, generally parallel to the side edge of the

ramp, with a drive sprocket at the junction of these two runs.

Each chain may engage internal guide means to determine the several runs of the chain, the links sliding along the guide means. Thus, with a driving sprocket at the junction of the rear run and the side run, a guide bar with an arcuate guide surface may determine a smooth run from the side run into the front run, with a second straight guide bar to determine the majority of the front run, a third guide bar consisting of an arcuate portion to determine a smooth run from the front run into the elevating run, a straight portion to determine the elevating run and another arcuate portion to determine a smooth run from the elevating run into the rear run and a fourth guide bar to determine the rear run. However, if desired, turning sprockets may be provided at one or both ends of the elevating run. Preferably one guide bar is adjustably secured so that the chain may be tensioned.

The ramp may consist of a centre portion, to each side of which is hinged a side portion so that, should the machine be used in conjunction with a mining machine cutting a heading, the hinged portions may be raised, after removal of the chains and guide bars from their horizontal, working position to a vertical position, the extremities of the ramp will clear roof supports assembled behind the mining machine as the latter advances. The hinged portions may be raised manually or hydraulically.

The drive for the chains is preferably reversible, for assistance in handling excessive amounts of material that may be encountered, and in releasing any large lumps that may cause jamming. Thus, the return runs of the chains may be used to direct to the conveyor material that may temporarily engulf a chain, as upon an unusually large fall of material from the action of a mining machine with which the loader-conveyor machine is associated. In any event, the rear edge of the ramp along the return runs of the chains should have a raised rim, to discourage passage of material from the ramp otherwise than by the conveyor, and the raised rim forms the sides of a trough along which the flights move in their return run, and serves to confine material that is being moved by reverse movement of the flights along the return run. Preferably, the ramp is transversely pivoted to the mounting at its rear, so that it can be raised for transport of the whole machine, and also forcibly lowered to bring its front edge into scraping contact with the floor.

The machine as applied in the mining of coal may either have a cutting head of a diameter corresponding to the thickness of the coal seam, or a cutting head of a diameter suited to extraction of rock over a height required for the formation of a heading or roadway, as in ripping the lip of rock overlying a coal seam itself extracted by the head in its lowest position of operation. In either case, the overall height of the machine proper can be kept low.

The rotation of the cutting head and the movement of its carrier along the extension bar, together with that of the extension bar along the guide bar, are preferably effected hydraulically, as from pumps driven by an electrical motor in the machine base. The movements of the carrier for the head and of the extension bar may be under control, so that the extension bar continues its movement (up to a limiting stop) when the head has reached its own limit of movement to a stop on the extension bar, thus automatically bringing the head finally to a predetermined position extension with respect to the machine. The machine is preferably advanced and retracted hydraulically as by means of widely spaced support beams on which the machine base is mounted lengthwise, with provision for steering by differential action of the beams. Likewise, the loading conveyor, its gathering arms, its advancing and and retracting means, and the lengthwise discharge conveyor, can be hydraulically operated.

One embodiment of the invention will now be described by way of example with reference to the accompanying drawings in which:

FIGURE 1 is a side elevation of a mining machine;

FIGURE 2 is a plan view of FIGURE 1;

FIGURE 3 is an end elevation of FIGURE 1;

FIGURE 4 is a section on the line IV—IV of FIGURE 3;

FIGURE 5 is a sectional view, to a larger scale, partly in section of a portion of FIGURE 1;

FIGURE 6 is a diagrammatic plan view, to a smaller scale, of the cutting head in extreme positions;

FIGURE 7 is a plan view of the loader-conveyor with associated discharge conveyor; and

FIGURE 8 is a view in the direction of arrow A of FIGURE 7, with the ramp in a horizontal position.

In FIGURES 1 to 3 and 6 the machine is indicated generally as **1** and is provided with a base **2**, and at its forward end, with a guide bar **3** supported by a duplex arm constituted by side arms **4** pivoted on pins **5** in side members **6** of the base. A pair of piston and cylinder units **7**, each pivoted on a pin **8** in the machine base and on pin **9** in each side arm **4** serve to support the arms. Slidably mounted on the guide bar **3** is an extension bar **10** and slidably mounted on the extension bar is a carrier **11** for a cutting head **12** having picks **12***a* with associated drive-motor **13** and gear box **14**. Centrally of the machine is a discharge conveyor **15** of the scraper chain type with a return sprocket **16** and an elevated rear end **17**. Rearwardly of the machine is a hydraulic fluid supply tank **18** and an electric motor **19** providing power for a conventional hydraulic pump, a gear-box and power take-off means indicated generally at **20**. To secure the machine in working position hydraulic piston and cylinder units **21** serve to force a lengthwise beam **22** to the supporting arches (not shown) of the roof **23** of the working, the beam lying centrally above the base **2**.

As can be seen in FIGURE 5, the guide bar **3** is provided with slipper bearings **24**, the extension bar **10** being provided with corresponding and mating slipper bearings **25**. The extension bar **10** is moved along the guide bar **3** by a double-acting hydraulically-actuated ram **26**, pivotally secured at one end on a pin **27** in a bracket **28** bolted to the guide bar **3**, and pivotally secured at the other end on a pin **29** secured between webs **30** of the extension bar. The extension bar is in turn provided with slipper bearings **31** and the carrier **11** is provided with corresponding and mating slipper bearings **32**.

Co-axially mounted on a shaft **33** at one end of the extension bar are three chain sprockets **34**, **35** and **36**, round the first two of which pass a double banked chain **37**, one end being secured at **38** to one end of a hydraulic piston and cylinder unit **39**, the other end of the chain being secured at **40** to one end of a similar hydraulic piston and cylinder unit **41**. Round the chain sprocket **36** passes a chain **42** extending over substantially the entire length of the extension bar and passing round a corresponding sprocket **43** at the other end of the bar. The front run of the chain **42** is secured at **44** to a bracket **45** on the carrier **11**.

The machine is self-propelled and self-steered, being provided with two floats **46** inside base **2** and located laterally by uprights **47** of the frame. Associated with each float is a hydraulic piston and cylinder unit **48** pivotally secured at one end on pins **49** in brackets **50** depending from the machine base, and at its other end on pins **51** in brackets **52** on each float. The floats are each provided with a skid plate **53** and a pair of hydraulic jacks **54**.

Associated with the mining machine is a self-loading conveyor indicated generally as **55**, having a ramp **56** and a discharge conveyor **15** having an elevated end **58**, drive motor **59** and gearbox **60** and confined by sidewalls **57** (see FIG. 8).

The ramp **56** has an upper surface **61** with a central area **62** and consists of a centre portion **56A**, to each side

of which is hinged at 63 a side portion 56B. Each portion has a raised rim 64, with a removable portion 64A and a fixed portion 64B.

Two endless chains 65, mounted on the upper surface 61 of the ramp, one to each side of the central area 62 are composed, alternately of links 66, 67. Each link 67 is provided with a lug 68 to provide a pivoting connecting point 69 for projecting flights 70, composed of two links 71 pivoted together at 72.

Each chain is provided with guide bars 73, 74, 75 and 76, secured to the surface 61 with guide bars 73 and 75 removable, the guide bars determining front run 77 elevating run 78, rear run 79 and side run 80. At the junction of each rear run 79 and side run 80 is a turning sprocket 81, powered by a hydraulic motor 82, through a gearbox 83, and a drive chain (not shown). Inside each chain run is a screw device 84 secured to the centre portion 56A and to guide bar 74, so that the chain may be tensioned.

The portion 56A is provided with two pairs of lugs 85, one to each side of the central area 62, pivoted at 86 (FIGURE 4) to the upper portions of brackets 87 of two support beams 88, each housing a piston and cylinder unit 89 to advance or retract the ramp 56. Each beam 88 is slotted at 90 revealing the piston and cylinder unit 89, so that pivot 91 can be anchored. With the loader-conveyor machine associated with a mining machine then this pivot would be secured to the frame of the machine. A piston and cylinder unit 92 is pivotally secured at 93 to the lower portion of each bracket 87 and at 94 to the underside of the ramp 56.

In use, to cut a heading of maximum width, the ram 26 is fully retracted so that the extension bar 10 moves to one extreme position 10A (FIGURE 6). The carrier (and consequently the cutting head) is simultaneously moved along the extension bar to one extreme position 12A by retraction of the piston of unit 39, the piston of unit 41 simultaneously extending. Then, with the cutting head 12 rotating (clockwise when looking at FIGURE 3) and the units 7 adjusted to put the cutting head 12 in the lower position 12X as shown in chain-dotted line in FIGURE 1, the piston of unit 40 is retracted at a speed dependent upon the nature of the material being mined, the speed of rotation of the cutting head etc.; to traverse the cutting head across the face to be cut. When the carrier 11 reaches the other end of the extension bar, ram 26 is extended at a suitable speed, so that the extension bar, and cutting head, move to positions 10B and 12B (FIGURE 6) respectively. The cutting head and extension bar are then returned idly (and rapidly) to position 10A and 12A in readiness for the next cutting traverse, and simultaneously, the cutting head raised by actuation of units 7. The piston of unit 41 is retracted so that once again the cutting head is drawn to the other end of the extension bar, where upon extension of the ram 26 moves the extension bar, and cutting head, back to positions 10B and 12B. This procedure may be repeated any number of times up to the maximum height 12Y of the head shown in chain-dotted line in FIGURE 1.

As soon as cutting with the head in the lowermost position 12X (FIGURE 1) has been completed, the self-loading conveyor is driven under the pile of cut material by actuation of unit 89, to elevate and discharge that material onto conveyor 15, the operation of the loader conveyor being described later.

When the whole face has been cut in the manner indicated the entire machine may be advanced by actuation of jacks 54 to put the weight of the machine onto the floats 46 via the skid plates 53. The pistons of units 48 are then extended to force the machine forwards, the floats remaining stationary and the front jacks sliding along the skid plates. When this extended position is reached the jacks 54 are released so that the machine again rests on the frame 2. The piston of each unit 48 is then retracted to draw each float forwards again; this procedure may be repeated as many times as necessary.

The method has been described of cutting a heading of maximum possible width for a given set of machine dimensions. Obviously an infinite number of headings of smaller width may be cut by varying the degree of traverse of the extension bar and/or the degree of traverse of the carrier. Again an infinite number of heights are possible, between maximum and minimum, due to the infinite adjustment possible with units 7.

An alternative to the embodiment of machine described consists in providing pivot pins 5 on a vertical axis i.e., by regarding FIGURE 2 as a side elevation and FIGURE 1 as a planned view of such a machine (obviously with re-arrangement of the positions of discharge conveyor, self-propelling mechanism etc.). Thus, such a machine would be capable of cutting a maximum height ranging from the extreme head positions 12A to 12B (FIGURE 6) and maximum width ranging from extreme head positions 12X to 12Y (FIGURE 1).

Thus, the first embodiment of machine is able to cut to a greater width than height while the second embodiment of the machine is able to cut to a greater height than width so that the choice of construction of machines depends entirely upon the cutting characteristics required.

The loader-conveyor operates as follows: to remove a pile of loose material, the chains are set in motion by actuation of motors 82 and the ramp 56 is urged under the loose material, by actuation of the piston and cylinder units 89. Simultaneously the tip of the ramp is brought into scraping contact with the floor 95 (FIGURE 4) by actuation of the piston and cylinder units 92 and the loose material is moved in opposite directions towards the central area 62 of the ramp. Loose material in the central area 62 is then urged up the elevating run by the alternating flights 70 and then onto the conveyor 15, driven by motor 59. The two extreme positions of the ramp 56 are shown in chain dotted line in FIGURE 4.

With the loader-conveyor working in conjunction with a mining machine cutting a heading, then when it is desired to remove the conveyor from that heading guide bars 73 and 75 are removed together with each chain 65 to allow end portions 56B to be raised (manually or otherwise) to the vertical position shown in FIGURE 8, so that the ramp 56 will clear roof supports assembled behind the mining machine as the latter advances.

The span of the ramp may be varied according to particular working requirements by employing differing sizes of end portions 56B with corresponding differing lengths of chains.

What I claim is:

1. A mining machine of the type referred to comprising a base, a forwardly extending arm pivoted to the base at its rear end, means for moving the arm to and positioning it in any desired location between limits of maximum swing of its forward end with respect to its pivoted end, a guide bar secured to the forward end of the arm and extending parallel to the pivot for the arm, the guide bar being constituted as a slideway, an extension bar mounted on and slidable lengthwise of the guide bar, a carrier mounted on and slidable lengthwise of the extension bar, a cutting head rotatably mounted on the carrier on an axis extending forwardly from the extension bar, means for rotating the cutting head, and means for moving the extension bar lengthwise of the guide bar to positions in which its ends lie beyond the respective ends of the guide bar, and means for moving the carrier lengthwise of the extension bar.

2. A mining machine as in claim 1 wherein the diameter of the cutting head is in excess of the overall height of the extension bar and guide bar on the forward end of the pivoted arm.

3. A mining machine as in claim 1 wherein the rotation of the cutting head and the movement of its carrier along the extension bar, together with that of the extension bar along the guide bar, are effected hydraulically, from pumps driven by an electrical motor in the machine base.

4. A mining machine as in claim 1 wherein the machine is advanced and retracted hydraulically by means of widely spaced support beams on which the machine base is mounted lengthwise, with provision for steering by differential action of the beams.

5. A mining machine as in claim 1, wherein the pivoted arm is duplex.

6. A mining machine as in claim 5 wherein two side members provide for pivot connections widely spaced with respect to the width of the base of the machine and similarly widely spaced securing points to the guide bar.

7. A mining machine as in claim 1 wherein a conveyor of the self-loading type is mounted across the front of the base of the machine.

8. A mining machine as in claim 7 wherein at each end of the loading conveyor, gathering arms are provided to sweep to its mineral detached at the extremes of the range of working width of the cutting head.

9. A mining machine as in claim 7 wherein the conveyor is mounted so as to advance and retract the respect to the base.

10. A mining machine as in claim 9 wherein a longitudinal conveyor is provided to carry material rearwardly, the conveyor being charged with material by the central discharge of the self-loading conveyor.

11. A mining machine as in claim 10 wherein the loading conveyor, its advancing and retracting means, and the lengthwise discharge conveyor, are hydraulically operated.

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