Sept. 19, 1961 N. W. DENSMORE 3,000,620

MINING AND LOADING MACHINE HAVING ANGULARLY RELATED ROTARY DISINTEGRATORS

Filed Dec. 9, 1957 5 Sheets-Sheet 1

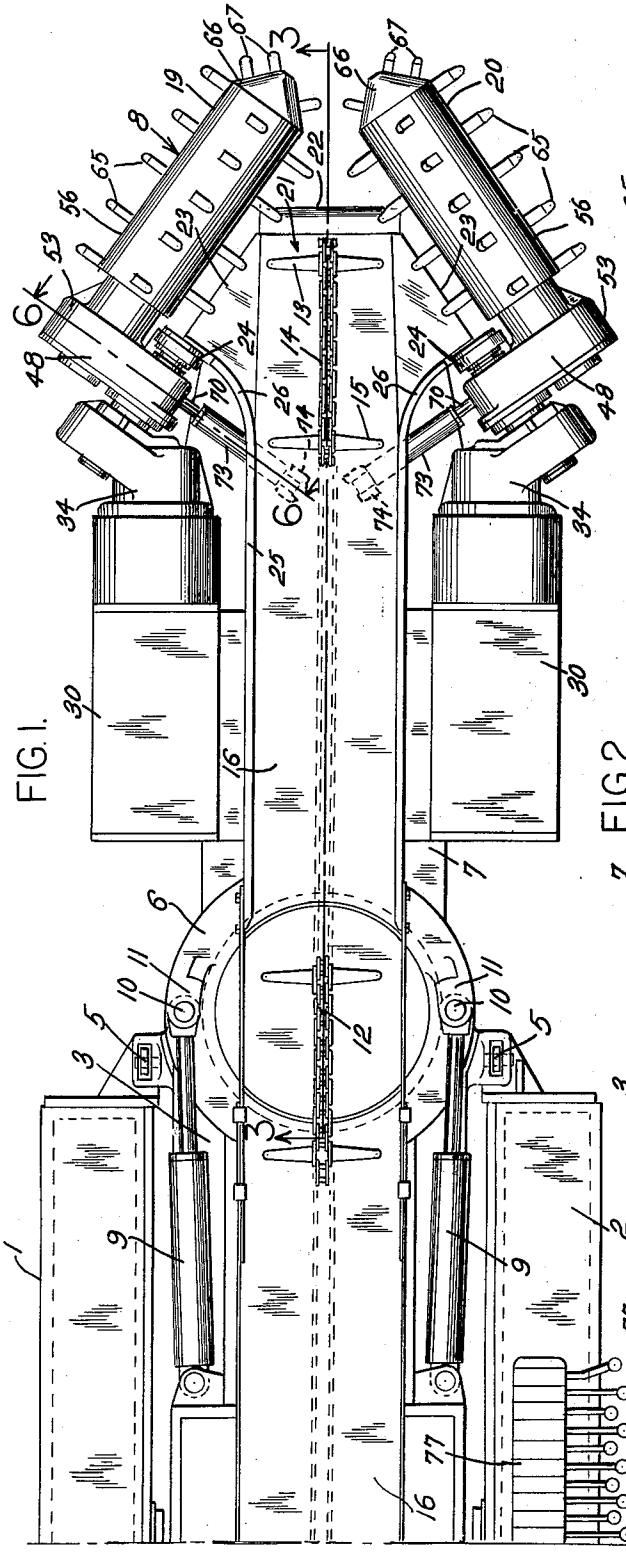

FIG. 1.

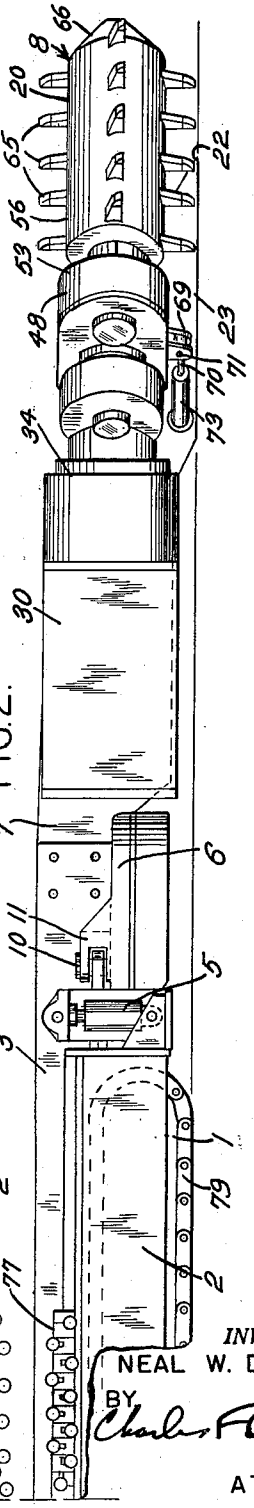

FIG. 2.

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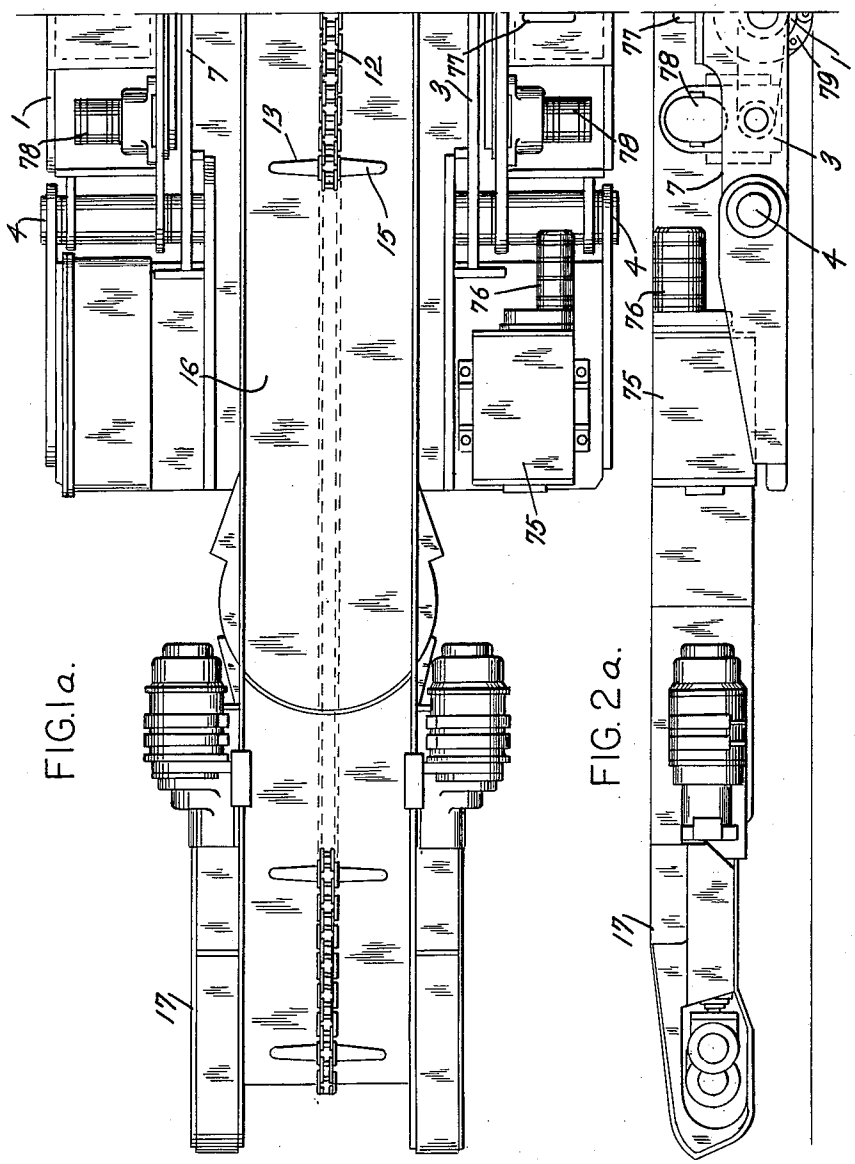

FIG. 1a.

FIG. 2a.

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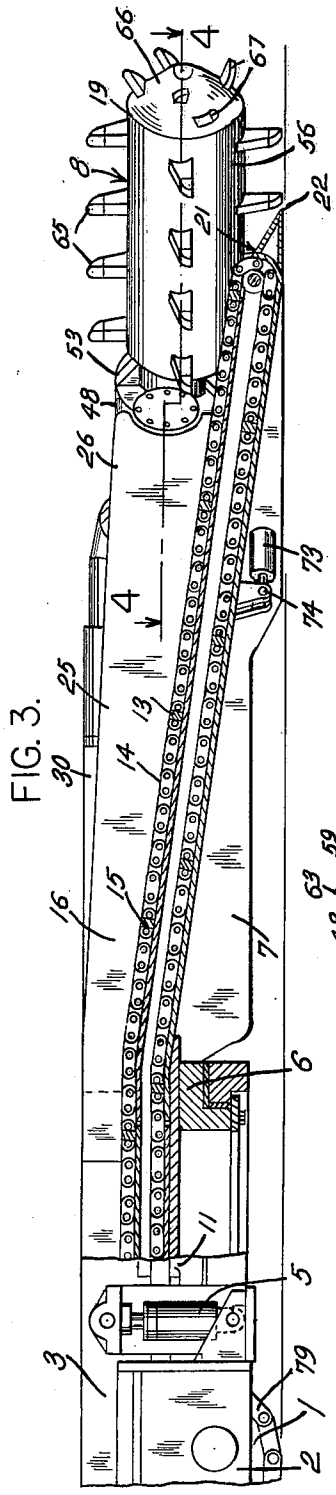


FIG. 3.

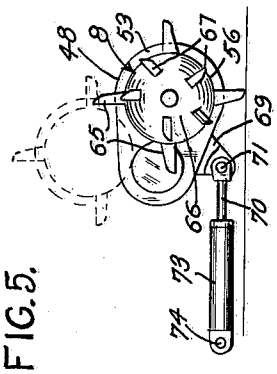
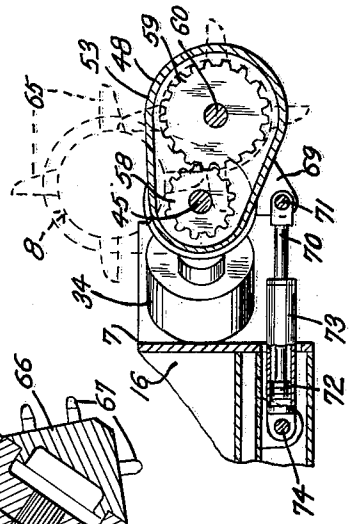


FIG. 5.



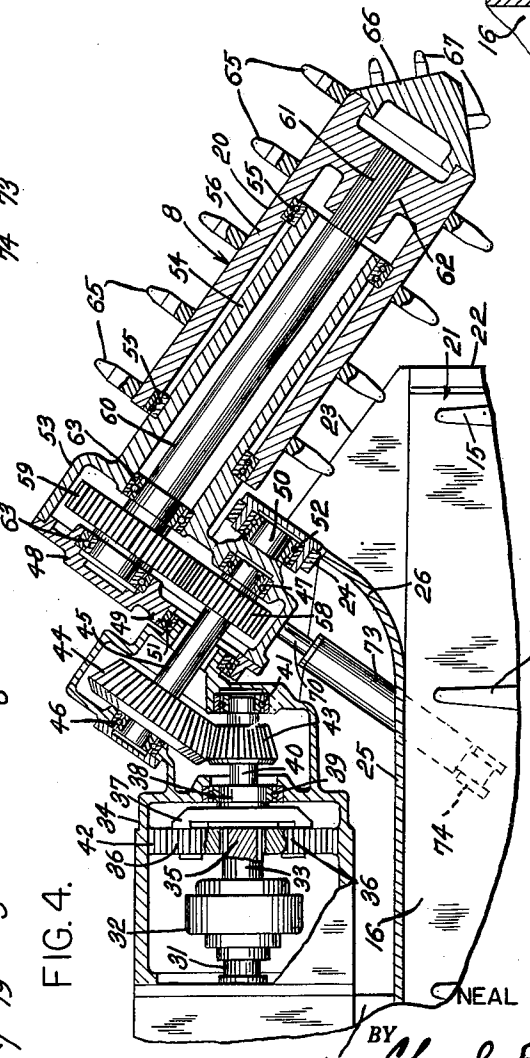


FIG. 4.

FIG. 6.

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FIG. 7.

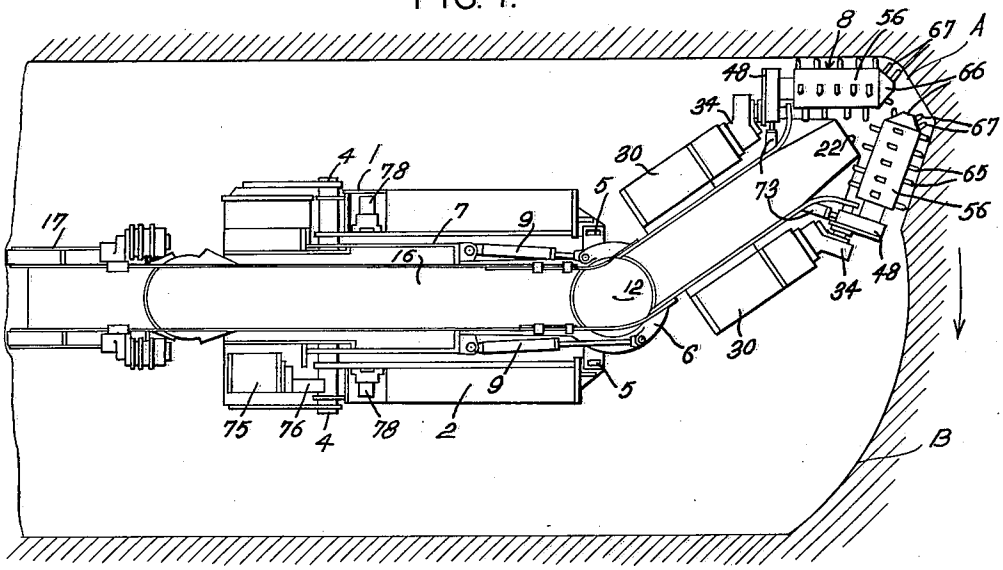

FIG. 8.

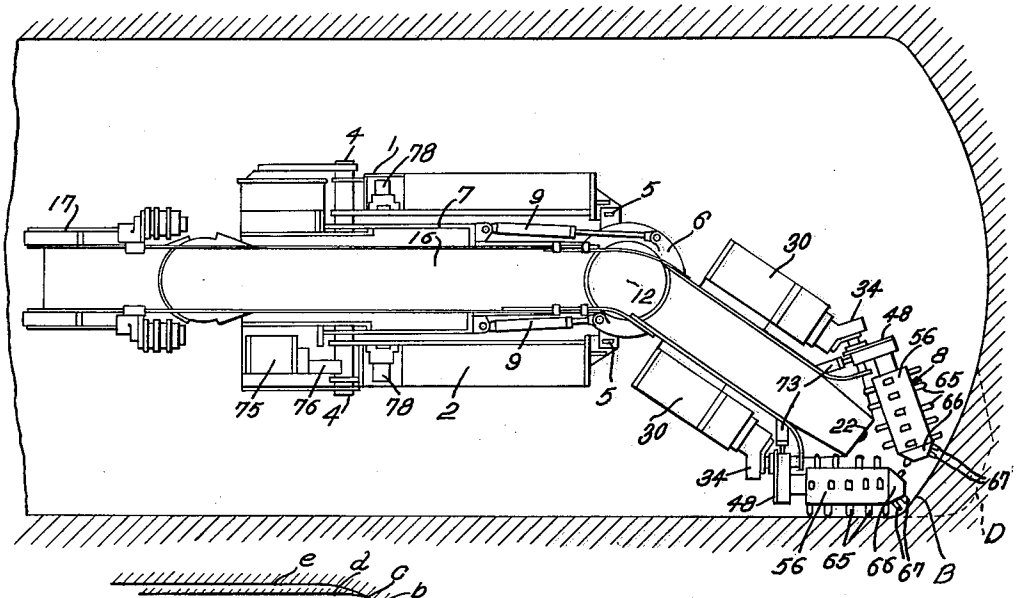

FIG. 9.

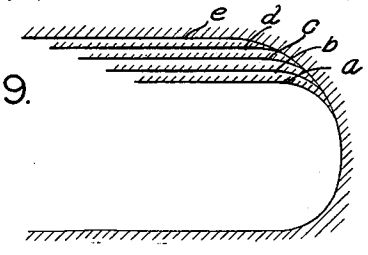

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FIG. 10.

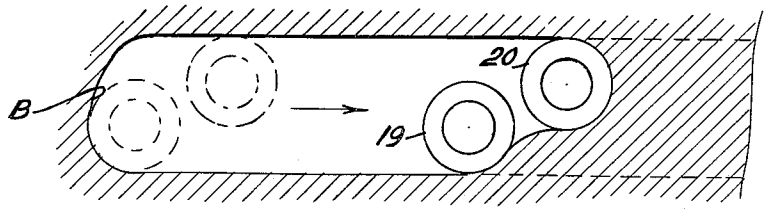


FIG. 11.

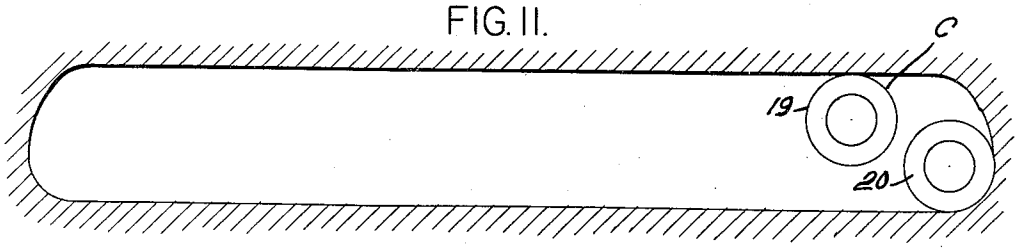


FIG. 12.

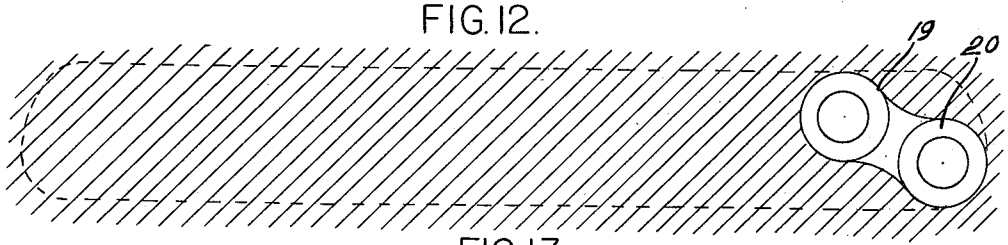


FIG. 13.

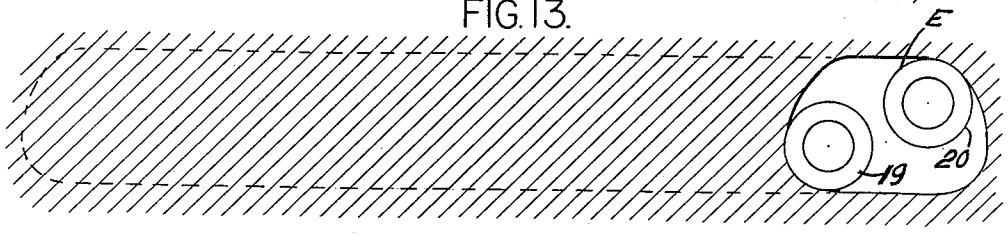
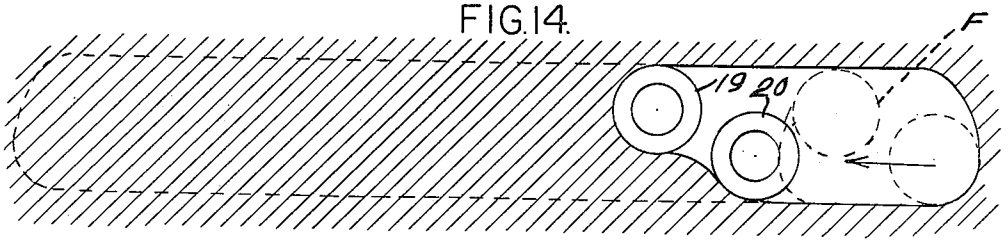


FIG. 14.



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United States Patent Office

3,000,620

Patented Sept. 19, 1961

3,000,620

MINING AND LOADING MACHINE HAVING ANGULARLY RELATED ROTARY DISINTEGRATORS

Neal W. Densmore, Franklin, Pa., assignor to Joy Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Filed Dec. 9, 1957, Ser. No. 701,556
16 Claims. (Cl. 262—19)

This invention relates to mining apparatus and more particularly to a mining and loading machine especially designed for use in mines having low headroom for dislodging mineral from a solid mine vein and for loading out the dislodged mineral.

The present invention constitutes an improvement over those disclosed in my copending applications, Serial Nos. 614,977 and 673,470, respectively filed on October 9, 1956 and July 22, 1957 and owned by the same assignee as the present invention. The invention resides primarily in the cutting and dislodging mechanism which includes rotary disintegrators or digging heads or disintegrating drums and such drums are, in this instance, mounted in angularly related positions on a swinging boom and are independently adjustable relative to each other about pivotal axes parallel with the drum-axes to vary their operating heights. The cutting and dislodging mechanism may be sumped in near the floor level at one rib, may be adjusted to clean up the rib, and swung horizontally across the face to the opposite rib where the heads may be adjusted about their pivotal axes to complete the cut and during horizontal swing across the face one rotary drum is located to operate at the floor level while the other drum is located to operate at the roof level. When the cut is completed the rotary drums may be sumped in at the rib at the end of the cut, may be adjusted to clean up the rib and then may be swung in the opposite direction across the face during the advance cut without repositioning of the cutting and dislodging mechanism between each cut. During reverse cutting, i.e., cutting in the opposite direction, the locations of the digging drums may be reversed. Conveying means is associated with the cutting and dislodging mechanism for receiving and loading out the disintegrated mineral. By the novel angular arrangement of the digging drums, with the axial lines of the drum axes converging outwardly and inwardly, a more positive floor cleanup is possible and straight ribs for one common width of entry are obtained. By the ability to independently raise and lower the rotary heads or drums not only is increased flexibility in operation attained, but also the mechanism may follow an uneven or rolling bottom in an improved manner.

An object of the present invention is to provide an improved mining apparatus of the low vein type having increased flexibility in operation and in maneuvering. Another object is to provide an improved mining and loading machine having improved cutting and dislodging mechanism, associated in a novel manner with floor cleanup conveyor means. A further object is to provide an improved cutting and dislodging mechanism having an improved arrangement of the rotary digging heads or drums whereby not only is increased flexibility in adjustment attained, but also enabling the cutting of straight ribs for one common width of face. Yet another object

is to provide an improved cutting and dislodging mechanism embodying rotary digging heads or drums angularly mounted on a swinging boom and independently adjustable into different operating heights. A still further object is to provide an improved angularly related rotary drum structure mounted for independent adjustment in height about pivotal axes parallel with the drum axes and having improved power operated adjusting means. Another object is to provide an improved rotary disintegrating drum arrangement associated in a novel manner with the receiving end of conveyor means whereby floor cleanup is substantially improved. Still another object is to provide an improved reversible cutting and dislodging mechanism which may operate in opposite directions across the working face of a mine vein and may effectively clean up the floor at the ribs. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

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, show in plan a mining and loading machine constructed in accordance with the preferred illustrative embodiment of the invention.

FIGS. 2 and 2*a*, taken together, show the improved mining and loading machine in side elevation.

FIG. 3 is an enlarged central longitudinal vertical section taken on line 3—3 of FIG. 1.

FIG. 4 is an enlarged horizontal section taken on line 4—4 of FIG. 3, showing one of the rotary cutting heads or drums.

FIG. 5 is a front end view of one of the rotary drums.

FIG. 6 is an enlarged vertical section taken on line 6—6 of FIG. 1, with the elevated position of the drum shown in dotted lines.

FIGS. 7 and 8 are diagrammatic plan views showing the mining and loading machine in operating position in a mine.

FIG. 9 is a schematic view showing the rib configuration for various heights of mine veins.

FIGS. 10 to 14 are diagrammatic cross sections through the working face of a mine vein showing different operating positions of the rotary digging heads or drums.

In this illustrative construction, as shown in the drawings, the improved mining and loading machine comprises a mobile base 1, desirably a crawler base, having a frame 2 on which an elongated longitudinally extending frame 3 is pivoted at 4 (FIG. 2*a*) to tilt in a vertical direction relative to the base. Conventional hydraulic jacks 5 (FIG. 2) serve to tilt the frame 3 relative to the base and to hold the tilted frame in position.

A horizontal turntable or swivelled support 6 is carried at the forward portion of the tiltable frame 3, and mounted on and extended forwardly from this turntable is a boom 7 by which cutting and dislodging mechanism, generally designated 8, is carried. Conventional hydraulic jacks 9 pivotally mounted at the sides of the tiltable frame are pivotally connected at 10 to lugs 11 integral with the boom 7 and these jacks serve to turn the turntable to effect swing of the boom together with the cutting and dislodging mechanism horizontally about an upright axis at 12. The jacks 5 may be operated to tilt the boom to raise the cutting and dislodging mechanism up off the mine floor during traveling of the machine

from place to place about the mine, in a well-known manner. Conveying means 13 extending lengthwise of the tiltable frame comprises a centrally located drive chain 14 provided with spaced lateral flights 15 which travel within troughlike passageways 16 extending rearwardly lengthwise of the boom frame and the tiltable frame 3. This conveying means receives the disintegrated mineral dislodged from the mine vein by the digging drums and moves mineral rearwardly of the machine to discharge at the rear end of the machine. As is usual in such conveying means its rearward portion 17 is tiltable and laterally swingable.

Now referring to the improved cutting and dislodging mechanism 8, it will be noted that journaled on the outer portion of the boom, as later explained, are rotary disintegrators which may be similar in design to those disclosed in the A. L. Barrett Patent No. 2,776,823, granted January 8, 1957 and owned by the assignee of the present invention. The rotary disintegrators are, for illustrative purposes, desirably in the form of rotary digging heads or disintegrating drums 19 and 20 arranged in angularly related positions with their axes of rotation converging forwardly and inwardly as shown in FIG. 1. The front loading head or nose portion of the conveying means is designated 21 and has a front transverse penetrating edge 22 and lateral inclined side edges 23, the latter extending substantially in parallelism with the drum axes when the drums are in lowered horizontal position close to the conveying means. Extending upwardly from the conveyor head frame 21 rearwardly of the side edges 23 are bearing brackets 24 and the side portions 25 of the conveyor frame desirably curve outwardly at 26 and join with these bearing brackets, as shown in FIGS. 1 and 4. Motors 30, desirably electric motors, are mounted at opposite sides of the tiltable boom (FIGS. 1 and 2), with the motor axes arranged in parallelism with and extending generally longitudinally of the boom, and the motor shafts 31 are connected by conventional friction slip clutches 32 to aligned shafts 33 suitably supported within gear housings 34. These gear housings are secured to and project forwardly from the motor casings. As shown in FIG. 4, spur pinions 35 on the shafts 33 mesh with planet gears 36 of conventional planetary gear reduction units. The planet gears are journaled on rotatable carriers 37 having their hubs 38 journaled within bearings 39 within the gear housings. Carrier-shafts 40 are journaled within front bearings 41 and the carrier-hub bearings. The planet gears also mesh with non-rotatable internal gears 42 secured within the gear housings. The carrier-shafts 40 have bevel pinions 43 secured thereto which mesh with bevel gears 44 secured to angularly related shafts 45 arranged parallel with the drum axes (FIG. 4). These shafts are journaled in bearings 46 and 47 respectively supported within the gear housings and rotatable or swingable supports 48. The rotatable supports 48 have spaced bearing-engaging portions 49 and 50 engaging bearings 51 and 52 supported within the gear housings and the bearing brackets 24. These rotatable supports have integral gear housings 53 and forwardly and inwardly projecting tubular supporting portions 54, the latter supporting bearings 55 on which the cylindrical hollow bodies 56 of the rotary drums are journaled. Secured to the shafts 45 are spur gears 58 meshing with spur gears 59 secured to shafts 60 coaxial with the rotary drums. These coaxial shafts are keyed at 61 to the forward hubs 62 of the drum-bodies and are journaled in bearings 63 suitably supported within the gear housings 53 at opposite sides of the spur gears 59.

The rotary drums carry disintegrating elements desirably in the form of teeth 65 and the front ends of the drums have cone-shaped heads 66 supporting similar teeth 67 so that the drums may penetrate endwise into the mine vein as well as sidewise. The rotary drums, as shown in FIG. 1, have free adjacent front ends and as the drums revolve the teeth at the outer ends of the drums travel relatively close together to avoid substantial coring. The rotary or swingable supports 48 for the toothed drums may be swung about their pivots to raise and lower the drums, as desired, and to accomplish this the supports have depending lugs 69 to which piston rods 70 are pivotally attached at 71. The piston rods are secured to pistons 72 contained in hydraulic cylinders 73 in turn pivotally mounted at 74 on the boom 7 beneath the conveying means (FIG. 6). The cylinders and pistons thus provide hydraulic jacks for swinging the drums from their lowered position upwardly to elevated positions as indicated in dotted lines in FIG. 6 and liquid trapped in the cylinders serve to lock the rotary drums in their desired positions of adjustment. Thus the swinging supports for the toothed drums with their individual power adjusting means enable rolling of the drums up and down within their limits of travel independently through arcuate paths while the boom 7 remains at a relatively fixed position.

A motor 75 on the base frame may drive conventional pumping means 76 for supplying, under the control of a conventional manual control valve means 77, hydraulic fluid under pressure to the several hydraulic jacks 6, 9 and 73, and also to conventional hydraulic motors 78 which may separately drive the crawler treads 79 of the crawler base.

When the boom 7 is lowered with the rotary drums operating in horizontal positions at the floor level, as shown in FIGS. 1, 3 and 4, the drum teeth may act on the disintegrated mineral on the mine floor to gather the mineral and move it up the inclined sides of the conveyor frame onto the conveying means thereby eliminating all need for separate gathering devices. Either drum may be raised and lowered to facilitate gathering of the loose mineral piled up on the mine floor.

The general mode of operation of the improved mining and loading machine will now be described. The machine may be propelled about the mine and maneuvered with respect to the work by the crawler base and the crawler treads may be driven in a well-known manner to effect steering of the machine. During traveling the hydraulic jacks 5 hold the tilted frame together with the boom in an upwardly tilted position with the cutting and dislodging mechanism 8 positioned above the floor. When the working place is reached the swing jacks 9 may be operated to effect swinging of the boom 7 horizontally about the turntable axis 12 to locate the cutting and dislodging mechanism 8 near one rib, as for example, the left-hand rib as shown diagrammatically in FIG. 7. The boom 7 is at that time lowered to support the cutting and dislodging mechanism 8 in an operating position at the floor level and by trapping liquid in the jack cylinders the boom 7 may be held in the angular position shown, and the cutting and dislodging mechanism 8 may be advanced by the crawler base into sumped position within the mineral of the mine vein as indicated at A in FIG. 7. When the rotary drums are sumped in as shown, they may be swung about their pivots by the swing jacks 73 to clean up the left-hand rib, as shown in B in FIG. 10. The left-hand drum in one common face width may extend parallel with the rib as shown in FIG. 7. During the sumping operation or thereafter one of the rotary drums may be swung up about its pivot to an elevated operating position near the roof, as shown in dotted lines at the left-hand rib in FIG. 10, and the swing jacks 9 may then be operated to swing the boom 7 horizontally from left to right to move the rotary drums to make a horizontal cut across the full width of the face, as shown in FIG. 11. When the drums are located at the right-hand rib as shown in FIG. 8 the swing jacks 73 may be operated to swing the rotary drums arcuately about their pivots to the positions C shown at the right-hand rib in FIG. 11 thereby to clean up the right-hand rib line. When the hotary drums are

in the position shown at the right-hand rib the crawler base may again be operated to advance the machine to sump the drums into the mine vein at the right-hand rib to the position indicated in dotted lines at D in FIG. 8. The hydraulic jacks 73 may then be operated to swing the drums to their reverse cutting positions shown at E in FIG. 13 to clean up the rib and thereafter the drums may be lowered to their opposite positions shown in dotted lines at F in FIG. 14. Thereafter the swing jacks 9 may be operated to swing the drums horizontally from right to left across the face to make an advance swinging cut. The operations above described are repeated to make successive cuts. In FIG. 9 there is shown diagrammatically the rib configurations for varying vein heights thereby to show that the rotary drums may be relatively positioned to make different height cuts across the face. For illustrative purposes, five cuts of different heights are shown at *a*, *b*, *c*, *d* and *e*, although, evidently, cuts of any height between the operating limits of drum adjustment may be effected.

As a result of this invention an improved mining and loading machine especially designed for mines having low headroom is provided having improved cutting and dislodging mechanism whereby the mineral of a mine vein may be readily and quickly cut, dislodged and loaded out. By the provision of the toothed dotary digging drums or disintegrators arranged in the novel manner disclosed not only may the mineral be effectively cut and dislodged in low height veins but also an improved floor cleanup action is attained. The angularly related positions of the rotary disintegrators or drums and the associated conveying means with its novel head or nose arrangement enable positioning of the drum close to the conveying means thereby to facilitate gathering of the disintegrated mineral on the floor and moving thereof onto the conveying means. By the provision of the independent adjustment for the horizontal rotary drums they may be relatively positioned at different heights to make cuts across the faces of the mine veins of varying heights. The improved machine is not only relatively flexible and efficient in operation but is also relatively simple and rugged in design, well adapted to meet the severe conditions of service encountered in underground mining work. 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 machine, a support, and cutting and dislodging mechanism carried by said support for cutting and dislodging the mineral of a solid mine vein comprising rotary toothed disintegrators having their axes of rotation permanently angularly disposed with their axial lines lying in planes converging forwardly and inwardly, said disintegrators having exposed free outer mineral penetrating ends disposed in close adjacency near the point of convergence of the axial lines of the disintegrator axes, means for rotating said disintegrators about said axes, adjustable mounting means movable horizontally relative to said support and at the outer portion of which said rotary disintegrators are journaled, said disintegrators arranged with their axes lying in planes in fixed angular relation which is maintained during horizontal movement of said mounting means relative to said support, and means for adjusting said mounting means to move the latter horizontally to cause said disintegrators to penetrate and disintegrate the mineral across the working face of the mine vein.

2. A mining machine as set forth in claim 1 wherein said adjustable mounting means is movable horizontally to position either rotary disintegrator in adjacency to a rib at either side of the working face with its axis of rotation disposed in substantial parallelism with the rib.

3. In a mining machine, a support, cutting and dislodging mechanism carried by said support for cutting and dislodging the mineral of a solid mine vein comprising rotary toothed disintegrators having their axes of rotation angularly disposed with their axial lines converging forwardly and inwardly, said disintegrators having free outer ends disposed in close adjacency near the point of convergence of said lines, and adjustable mounting means movable horizontally relative to said support and at the outer portion of which said rotary disintegrators are journaled, said disentegrators arranged with their axes lying in planes in fixed angular relation which is maintained during horizontal movement of said mounting means relative to said support, and adjustable mounting means including means for independently adjusting said disintegrators in elevation relative to each other while said fixed angular relation of said planes in which the disintegrator axes lie is maintained.

4. In a mining and loading machine, the combination comprising cutting and dislodging mechanism including rotary toothed drums angularly disposed with their axes of rotation extending forwardly and inwardly in fixed angular relation, said drums having their exposed outer mineral penetrating ends located closely together, means for simultaneously rotating said drums in relatively opposite directions with the teeth thereof moving inwardly at the bottom of said drums, and conveying means having a front loading head provided with relatively inclined sides respectively extending substantially at the same angles as and lying inwardly of said axes of rotation of said drums when said drums are located close to the loading head to gather loose mineral on the mine floor and move it inwardly and upwardly onto said conveying means, said loading head when said drums are lowered lying in the space between said drums and the teeth of said drums moving the loose mineral inwardly along said inclined sides of said loading head.

5. A mining and loading machine as set forth in claim 4 wherein said free exposed outer mineral penetrating ends of said drums are located relatively close together in advance of the forward portion of said loading head and means is provided for moving said drums forwardly toward the working face to sump the same into the mineral of a mine vein.

6. In a mining machine, a support, a horizontally swingable boom mounted on and extending forwardly from said support and cutting and dislodging mechanism carried at the front end of said boom comprising a toothed rotary digging drum having its axis of rotation disposed at a substantial angle transversely with respect to the longitudinal axis of said boom, said drum having an exposed free outer mineral penetrating end disposed close to a longitudinal vertical plane in which the longitudinal axis of said boom lies, the inner end of said drum spaced a substantial distance laterally of said vertical plane, means for rotating said drum, means for moving said drum generally axially to sump said exposed free end thereof into the mineral of the mine vein, and means for swinging said boom horizontally relative to said support to move said drum laterally across the working face to disintegrate the mineral of a mine vein.

7. A mining machine as set forth in claim 6 wherein said drum has an elongated cylindrical body of uniform exterior dimensions and is provided with a tapered free outer end and disintegrating teeth are carried both by said drum body and said tapered end to cause said drum to cut into the mineral of the mine vein both generally endwise and sidewise.

8. In a mining and loading machine, a mobile base, a tiltable frame carried by said base and having a horizontally swingable boom portion, cutting and dislodging

mechanism carried at the outer end of said boom portion and having cutting and dislodging elements adjustable to different operating heights relative to said boom portion, means for mounting said cutting and dislodging elements for independent adjustment relative to said boom portion and to each other, the axes of said elements being relatively inclined at similar but opposed angles at opposite sides of the longitudinal axial line of said boom portion, means for adjusting said cutting and dislodging elements into different operating heights relative to said boom portion and for maintaining the same in different adjusted positions relative to said boom portion, means for tilting said frame relative to said base to vary the elevation of said cutting and dislodging mechanism, and means operatively connected between said frame and said swingable boom portion for swinging the latter horizontally about its pivot thereby to move said cutting and dislodging element across the working face during the cutting and disintegrating operation.

9. In a mining and loading machine, a mobile base, a tiltable frame carried by said base and having a horizontal swingable boom portion, cutting and dislodging mechanism carried at the outer end of said boom portion and having cutting and dislodging elements arranged on relatively inclined axes disposed at substantial but opposed angles with respect to the longitudinal axis of said boom portion, said cutting and dislodging elements being adjustable to different operating heights relative to said boom portion, means for adjusting said cutting and dislodging elements to different operating heights relative to said boom portion and for maintaining the same in different adjusted positions relative to said boom portion, said adjusting means embodying means operable for independently adjusting said cutting and dislodging elements relative to each other.

10. In a mining and loading machine, a mobile base, a tiltable frame carried by said base and having a horizontally swingable boom portion, cutting and dislodging mechanism carried at the outer end of said boom portion and having cutting and dislodging elements adjustable to different operating heights relative to said boom portion, said cutting and dislodging elements being relatively inclined at opposite sides of the longitudinal axial line of said boom portion with their axes disposed at substantial angles at opposite sides of said axial line, said elements projecting laterally at their rear end portions beyond the sides of said boom portion with their forward ends in advance of said boom portion, means for mounting said cutting and dislodging elements for independent adjustment relative to said boom portion and to each other, means for adjusting said cutting and dislodging elements into different operating heights relative to said boom portion and for maintaining the same in different adjusted positions relative to said boom portion, means for tilting said frame relative to said base to vary the elevation of said cutting and dislodging mechanism, and means operatively connected between said frame and said swingable boom portion for swinging the latter horizontally about its pivot thereby to move said cutting and dislodging elements across the working face during the cutting and disintegrating operation.

11. In a mining machine, a base, a tiltable and horizontally swingable boom, means for mounting said boom on said base for tilting and horizontal swinging movements relative thereto, conveying means having its forward portion extending longitudinally of and guided on said boom, and cutting and dislodging mechanism carried at the outer end of said boom for dislodging mineral from a solid mine vein and for moving the dislodged mineral onto said conveying means, said cutting and dislodging mechanism comprising rotary toothed drums permanently mounted for rotation on axes lying in planes making relatively inclined but opposed angles with respect to the longitudinal axis of said boom, said drums having adjacent free ends carrying cutting teeth, and means for mounting said drums at the outer end of said boom for tilting and swinging movements with the latter while the angular relation of said drums is maintained.

12. A mining machine as set forth in claim 11 wherein said drums have exposed free outer mineral penetrating ends and means is provided for advancing said drums toward the working face to sump said outer penetrating ends of said drums into the mineral of the mine vein.

13. In a mining machine, a base, a tiltable and horizontally swingable boom, means for mounting said boom on said base for tilting and horizontal swinging movements relative thereto, conveying means having its forward portion extending longitudinally of and guided on said boom, and cutting and dislodging mechanism carried at the outer end of said boom for dislodging mineral from a solid mine vein and for moving the dislodged mineral onto conveying means, a cutting and dislodging mechanism comprising rotary toothed drums mounted for rotation on axes lying in planes making substantial angles with respect to the longitudinal axis of said boom, said drum axes being relatively inclined with their axial lines converging in directions extending forwardly and inwardly with respect to said boom axis with the front mineral penetrating ends of said drums lying relatively close together in advance of said boom, and means for mounting said drums at the outer end of said boom for tilting and swinging movements with the latter while the angular relation of said drums is maintained.

14. In combination, a horizontally swingable support, rotary digging drums arranged on horizontal axes extending generally transversely of said support at the outer portion of the latter, means for mounting said drums for adjustment into different elevated positions relative to said support, and means for independently adjusting said mounting means relative to each other to vary the elevation of either of said drums relative to said boom while maintaining the drum axes in planes having relatively fixed but opposed angular relation.

15. In combination, a horizontally swingable support, a rotary toothed drum disposed on a horizontal axis inclined relative to the longitudinal and transverse axial lines of said support at the outer portion of the latter, said drum having a free outer end carrying cutting teeth, mounting means for said drum at its inner end whereby said drum may be adjusted into different elevated positions relative to said support while maintaining its axis horizontal comprising a swingable support pivoted on said first support on an axis parallel with the axis of drum rotation, and means for swinging said second swingable support about its pivot to move said drum axis through an upwardly extending arcuate path.

16. A mining machine comprising, in combination, a mobile base, a boom structure mounted on said base to swing horizontally relative to said base, a pair of cooperating rotary disintegrating drums disposed on relatively inclined axes spaced equidistantly from the longitudinal axis of said boom structure, said drum axes lying in planes forwardly and inwardly toward the boom structure axis along converging lines intersecting the central longitudinal vertical plane of said boom structure at a common point in advance of said boom structure, and mounting means for said drums on the outer portion of said boom structure for maintaining said planes in which said drum axes lie in fixed angular relation relative to said boom structure and all horizontally swung positions of said boom structure relative to said base, said mounting means for said drums including means for independently adjusting said drums in elevation relative to each other and to said boom structure while said fixed angular relation of said planes in which said drum axes lie is maintained.

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