April 11, 1961 E. L. ANDERSON 2,979,319

MECHANICAL MINER HAVING OFFSET ROTARY HEADS

Filed Aug. 7, 1958 4 Sheets-Sheet 1

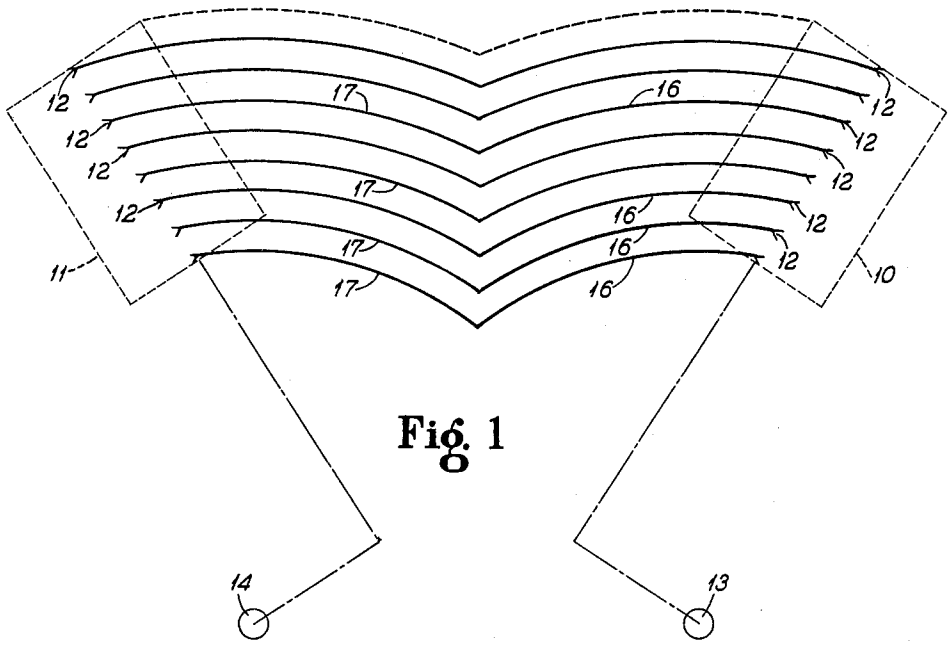

Fig. 1

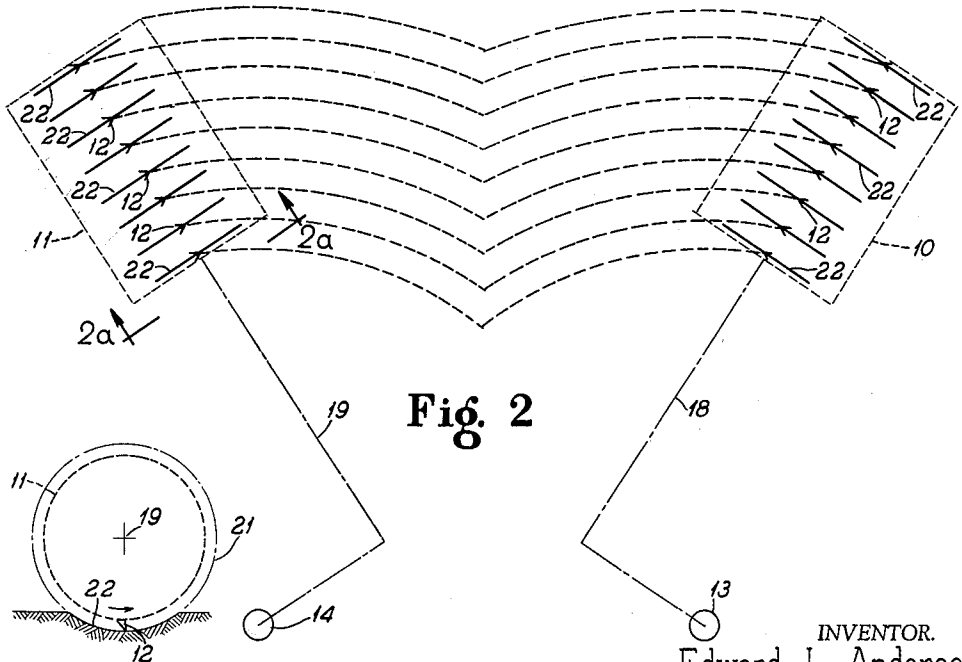

Fig. 2

Fig. 2a

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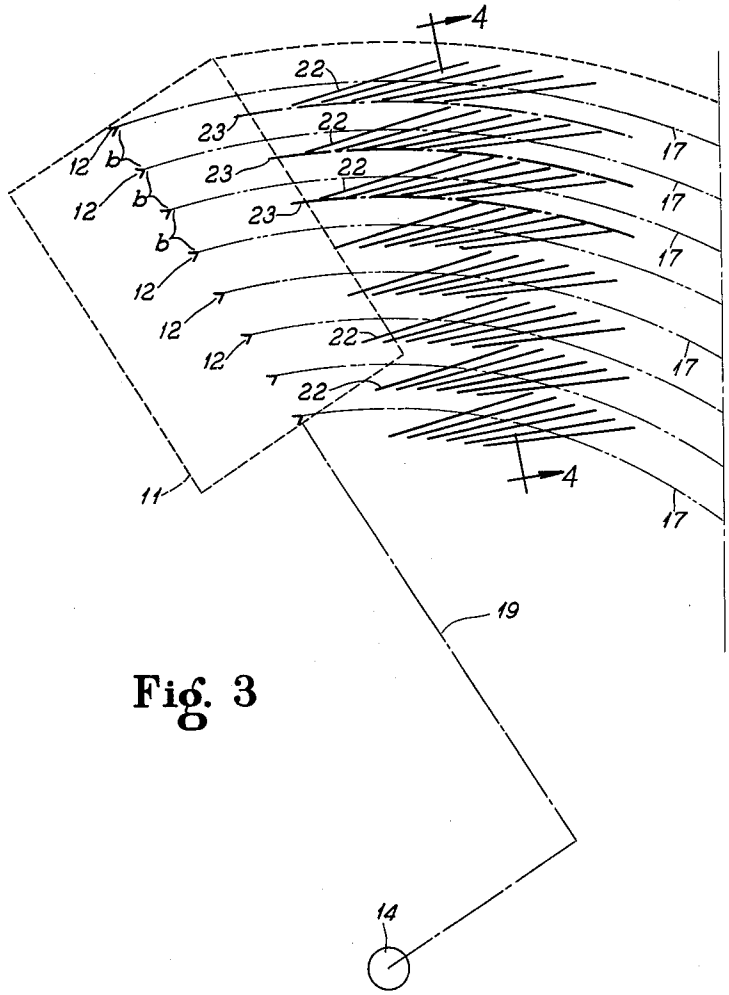

Fig. 3

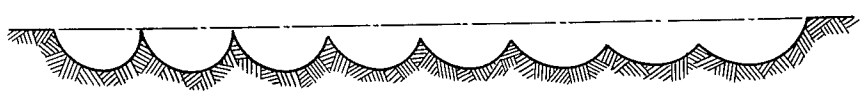

Fig. 4

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MECHANICAL MINER HAVING OFFSET ROTARY HEADS

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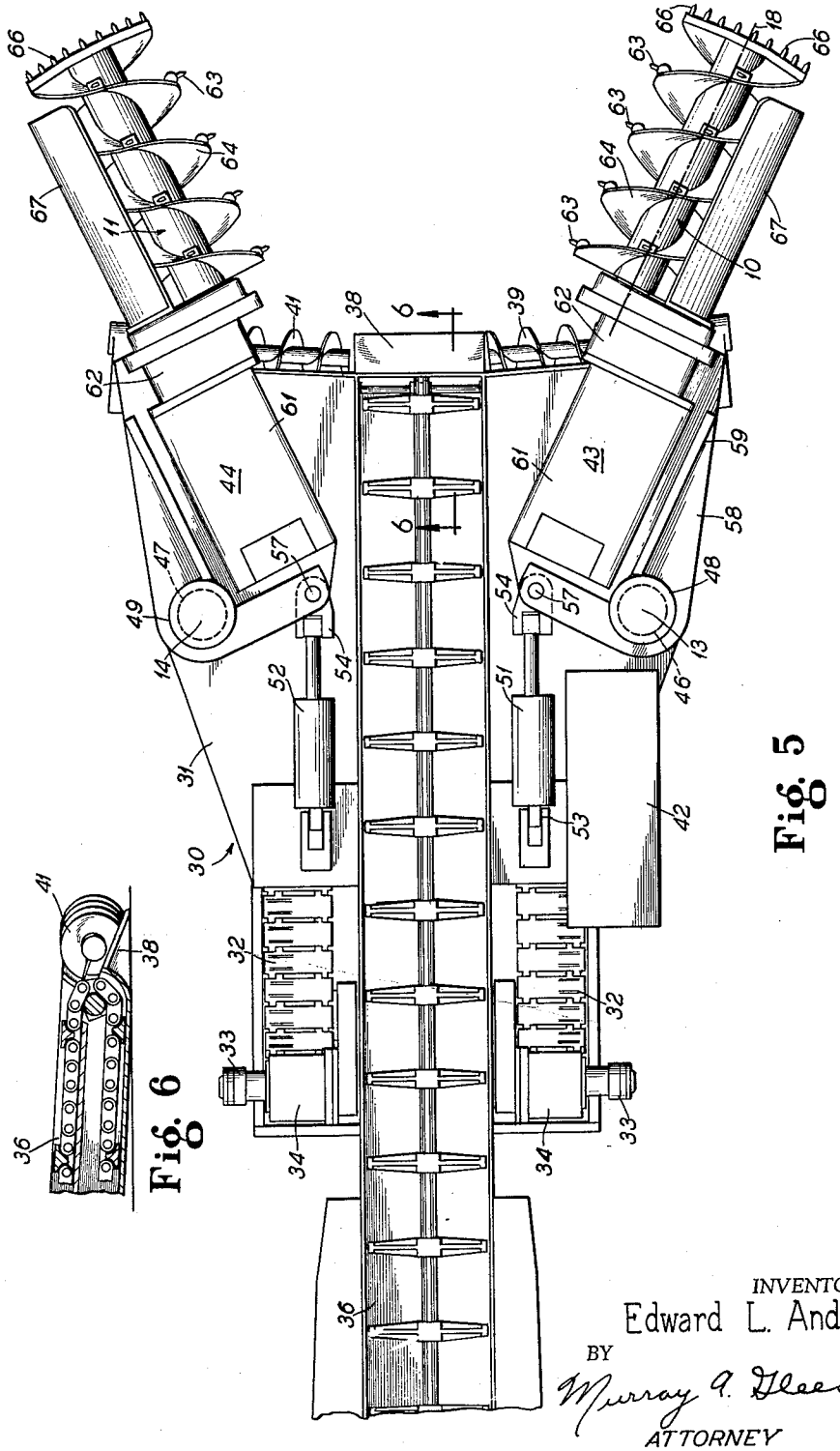

Fig. 5

Fig. 6

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MECHANICAL MINER HAVING OFFSET ROTARY HEADS

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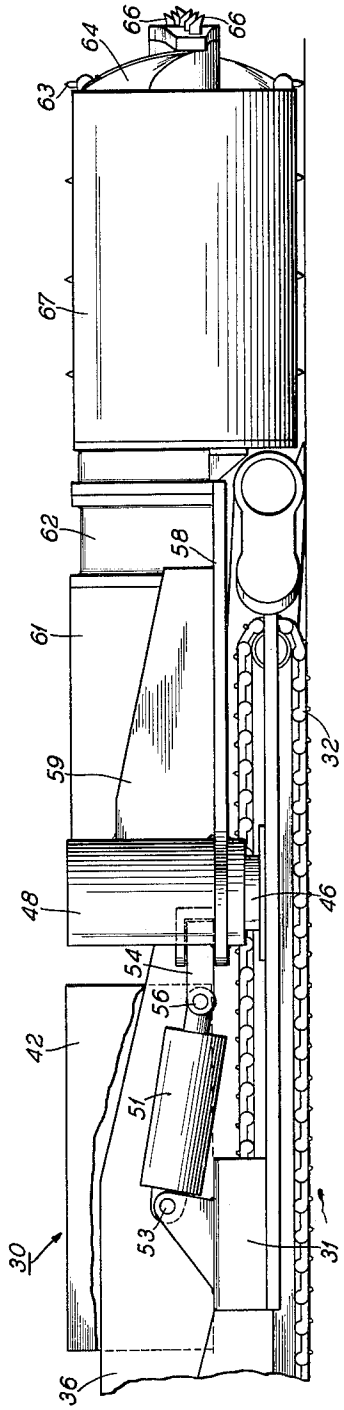

Fig. 7

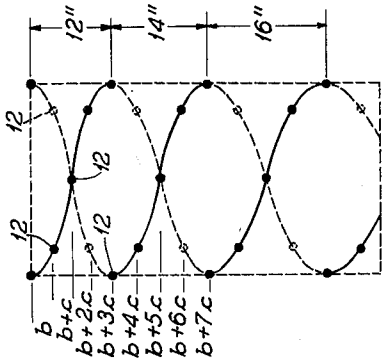

Fig. 8

Fig. 9

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MECHANICAL MINER HAVING OFFSET ROTARY HEADS

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Filed Aug. 7, 1958, Ser. No. 753,763

15 Claims. (Cl. 262—19)

This invention relates generally to mining and loading machines and particularly to machines having rotary cutting and dislodging heads especially adapted to cut and dislodge mineral from low seams by swinging one or more cutter heads sidewise to produce level roof and floor surfaces without auxiliary core-breaking mechanisms.

The present invention provides a series of coaxial rotary cutters arranged to swing about an offset pivotal axis in such a manner that the cutters traverse the whole area of a roof or floor surface, thereby eliminating the necessity for auxiliary reciprocating or core breaking devices to sweep the roof or floor surfaces level.

It is a principal object of the present invention to provide a cutting head for a mining machine in which the cutter bits travel in a path oblique to the path of the head in order to cut and dislodge material from a surface extending between a pair of adjacent bits.

A further object is to provide a mining machine having a rotary cutter head movable in an arcuate path and having cutter bits movable in orbits which are oblique to the path of the head, the combined orbital and arcuate movement advancing the bits across an area to cut a shallow-scalloped surface configuration.

A further object is to provide a mining machine having bits travelling in circular orbits on a rotary cutting head arranged to cut a substantially level floor and roof for a working place in a mine seam.

Other objects and advantages will be suggested as the following description proceeds.

In the drawings:

Figure 1 is a schematic representation, in plan view, of a pair of pivotally mounted cutter heads showing the arcuate path taken by non-rotating cutter elements in moving across a surface;

Figure 2 is a schematic representation, similar to Figure 1, showing the path of contact between a rotary cutter element and a surface;

Figure 2*a* is a schematic representation, in elevation view, of a rotating cutter in contact with a surface, taken along the line 2*a*—2*a* of Figure 2;

Figure 3 is a schematic representation, in plan view, of the combined paths of contact of the swinging head of Figure 1 and the rotary cutter of Figure 2;

Figure 4 is a schematic representation, in section, of a surface cut by a swinging head having cutters rotating on an offset axis, taken along the line 4—4 of Figure 3;

Figure 5 is a plan view of a mining and loading machine having a pair of swingable mining heads with rotary cutting and dislodging drums rotatable about an offset axis;

Figure 6 is a section view taken along the line 6—6 of Figure 5 showing details of the gathering and conveying means of the machine shown in Figure 5;

Figure 7 is a side elevation view of the machine shown in Figure 5;

Figure 8 is a schematic representation of an alternate bit and helix arrangement for a cutter drum; and

Figure 9 is a schematic representation comparable to Figure 4 showing a surface cut by the bit arrangement of Figure 8.

Referring now more particularly to the drawings, the numerals **10** and **11** refer to cutting and dislodging drums having a series of cutter bit positions **12** located thereon. Cutter drums **10** and **11** are swingable about pivotal axes **13** and **14** to traverse an area of a working place in a mine seam. As shown in Figure 1, the bit positions **12** move through arcs **16** and **17** circumscribed respectively about axes **13** and **14**. As shown in Figures 2 and 2*a*, the cutter drums **10** and **11** are rotatable about axes **18** and **19** so that each bit position **12** rotates in a circular orbit **21**. Where a bit has cut into a surface as shown in Figure 2*a*, segment **22** is defined in the bit circle **21**. This segment **22** appears as a straight line when viewed from above as in Figure 2.

Referring now to Figure 3, there is shown a schematic representation of a partial surface pattern produced by the combined rotating and pivoting motion of cutter drum **11**, where the bit positions **12** revolve about axis **19** which is offset from the pivotal axis **14**. For convenience, the segment **22** has been shown in 6 successive positions on the surface which correspond to successive rotations of the cutter drum **11**. As the bits moving in bit circles **21** cut successive paths in the surface, a trough is produced having its lowest point along the line **17** which is the locus of the lowest points reached by the bits. The troughs cut by bits in a pair of adjacent positions will intersect each other in a ridge which follows an arcuate path circumscribed about the pivotal axis **14**. In practice, the arcuate ridge is an irregular line, having been produced by the cutting and dislodging action of the bits, however, for purposes of clarity, a median ridge line **23** is shown as a smooth curve in Figure 3.

The cumulative effect of a series of cutter bits rotating about an axis of rotation while the whole series is being swung about a pivotal axis offset from the axis of rotation is to produce a scalloped surface pattern oriented in arcs of circles drawn about the pivotal axis. Figure 4 shows a profile of such a surface. Where the bit positions **12** are spaced axially along the cutter drum **11** in even increments such as "*b*" in Figure 3, the height of the ridges between successive troughs decreases in a direction toward the pivotal axis **14**. Further, as shown in Figures 8 and 9, where the pitch of the bit spacing increases in a direction toward the pivotal axis, the ridges increase in height and the troughs become wider. A bit spacing can be selected which will provide equal height ridges as shown in Figure 9. Such a bit spacing is illustrated in Figure 8 where, for example, the dimension "*b*" may be equal to $2\frac{13}{16}$ inches and $b+c$ equal to $2\frac{15}{16}$ and $b+2c$ equal to $3\frac{1}{16}$ and so forth. In such an arrangement, it is also convenient to provide a helical web of increasing pitch which will move a greater volume of material as the material accumulates along its axis. Where the above illustrated bit spacing is employed, the helix pitch can be increased as for example 12, 14 and 16 inches to provide a mounting base for the bits while still maintaining the bits at even angular spacings. In other cases it would be desirable to have uneven angular bit spacings, in which case it would not be necessary to correlate the pitch of the bits with the pitch of the helix. Obviously other bit spacings could be selected which would produce other modifications of the scalloped surface pattern.

Referring now to Figures 5, 6 and 7, the numeral **30** designates a mining and loading machine constructed in accordance with the foregoing principles. The machine is built on a mobile frame **31** which is movable about a mine seam by means of tractor treads **32**. Tractor treads **32** may be driven in various well known ways such as a hydraulic motor **33** and gear reducer **34**. A conveyor **36** is mounted midway of the frame ter-

minating in an overhanging rear end portion for discharge into a shuttle car, conveyor or other haulage device. The front end of conveyor 36 terminates in throat 38 which directs broken and dislodged material onto the conveyor. A pair of feeder scrolls 39 and 41 are arranged on either side of throat 38 to urge dislodged material into the throat in a steady stream.

Power for driving the tractor treads, conveyors, scrolls and auxiliary devices can be provided by an electric motor driving one or more hydraulic pumps located, for example, under the conveyor 36. A housing 42 is provided to enclose resistors, circuit breakers, contactors, etc., necessary for the operation of electric motors.

A pair of mining heads 43 and 44 are pivotally mounted on booms about upright axes 13 and 14 on frame 31. The pivotal mountings for the booms and mining heads comprise posts 46 and 47 which project upwardly from the frame 31, and outer telescoping sleeves 48 and 49 on the respective heads 43 and 44 and concentric with the respective posts 46 and 47. Sleeves 48 and 49 may be in the form of closed end hollow cylinders which cooperate with the respective posts to form piston and cylinder devices for elevating heads 43 and 44. A pair of jacks 51 and 52 are connected between frame 31 and the respective heads 43 and 44 for the application of power to swing the heads about their respective upright axes 13 and 14. One end of jack 51 is pivotally connected to frame 31 by means of a horizontal pin 53 to allow for vertical adjustment of the other end of jack 51 which is connected to head 43. The connection between jack 51 and head 43 is made by means of a universal coupling member 54 which has a horizontal pin 56 connected to jack 51 and a vertical pin 57 connected to heads 43 and 44.

Heads 43 and 44 are similar to each other, having similar parts arranged in right and left hand assemblies. The description of head 43 will apply also to head 44. Head 43 comprises a base member 58 which is structurally united with a stiffening web 59 and sleeve 48 to form a rigid boom structure on which a head motor 61 is mounted. A flange mounted speed reducer 62 is drivingly connected to and supported by motor 61 and in turn is drivingly connected to and supports cutter drum 10, the motor 61 and reducer 62 providing power means for rotating cutter drum 10. Cutter drum 10 is arranged to revolve about a substantially horizontal rotational axis 18 which is offset from upright pivotal axis 13. The cutter drum 10 includes a helical or spiral web or spiral blade 64 wrapped about the axis of rotation 18, and providing a spiral conveyor for moving dislodged material toward the scroll 39 and conveyor throat 38. A plurality of bits 63 are mounted on the web or blade 64 in several axially spaced apart bit positions. As hereinbefore described, the axial spacing of bits 63 determine the shape of the pattern cut in a lateral surface such as the floor or roof of the seam. Where an uninterrupted helical web is used as a mounting surface for the bits 63, the pitch of the axial bit positions can be varied in any desired amount by arcuate displacement along the helicoid. As previously pointed out, the pitch of the bit spacing can be increased in a direction toward the throat to produce a more uniform surface pattern and the pitch of the helicoid can be increased in the same direction to provide a conveying means of increasing capacity as more material accumulates on the way to the conveyor throat. The bits may also be mounted on spokes or discontinuous helical sheets with good effect. The forward end of cutter drum 10 has a group of forwardly projecting bits 66 which are effective to cut clearance in the face of a mineral seam for insertion of the cutter drum 10. A shield 67 extends along the back side of cutter drum 10 to confine broken and dislodged material within the reach of helical web 64 for movement toward conveyor throat 38.

In operation, heads 43 and 44 are opened up to a position where their outer extremities extend full width of the working place in the seam. Cutter drums 10 and 11 are drivingly rotated and the whole machine is urged forwardly to sump the cutter drums into the face of the seam. Cutter bits 66 cut initial clearance for the insertion of cutter drum 10 into the face of the seam. When cutter drum 10 has penetrated the seam a sufficient amount, heads 43 and 44 are urged toward each other in arcuate paths to cut and dislodge the material of the seam in a side cutting operation. The principle of this side cutting operation, by which the side cutting bits 63 traverse the whole area of the working place to cut a scalloped floor and roof surface, has been set forth earlier in this application.

While the invention has been described in terms of a preferred embodiment, various changes and modifications may be made without departing from the spirit and scope of the invention as defined in the appended claims.

I claim:

1. For use in a mining and loading machine, a cutting and dislodging member comprising a body rotatable about an axis having a plurality of cutter bits mounted thereon with an axial spacing which progressively increases toward one end of the body.

2. For use in a mining and loading machine, a cutting and dislodging member comprising a body rotatable about an axis having spiral blade means wrapped about said axis, and a plurality of cutter bits mounted on said blade means with an axial spacing which progressively increases toward one end of the body.

3. The structure according to claim 2 in which the spiral blade means comprises a multithread spiral conveyor, each thread having a plurality of cutter bits mounted thereon with an axial spacing which progressively increases toward one end, the cutter bits on one thread being in axial alignment with corresponding cutter bits on an adjacent thread.

4. For use in a mining and loading machine, a cutting and dislodging member comprising a body rotatable about an axis having a spiral blade wound about said axis in a plurality of axially spaced wraps, the spacing between succeeding wraps progressively increasing in an axial direction toward one end of said body; and a plurality of cutter bits mounted on said blade with an axial spacing which progressively increases toward one end of the body.

5. In a mining and loading machine, a mining apparatus comprising a boom swingable about a pivotal axis at one end thereof; a cutting and dislodging member mounted at the other end of said boom for rotation about an axis of rotation, said member having one end portion closer to said pivotal axis than its other end portion; and a plurality of cutter bits mounted on said cutting and dislodging member with an axial spacing which progressively increases toward said one end portion, said axis of rotation and said pivotal axis being disposed at right angles to each other in spaced parallel planes.

6. In a mining and loading machine, a mining apparatus comprising a boom swingable about a pivotal axis at one end thereof; a cutting and dislodging member mounted on the other end of said boom for rotation about an axis of rotation, said member having one end portion closer to said pivotal axis than its other end portion; said member including blade means wrapped about said axis of rotation extending toward said one end; and a plurality of cutter bits mounted on said blade means with an axial spacing which progressively increases toward said one end portion, said axis of rotation and said pivotal axis being disposed at right angles to each other in spaced parallel planes.

7. In a mining and loading machine; a portable frame; a boom mounted on said frame for horizontal swinging movement about an upright pivotal axis; a rotary cutting and dislodging member, having front and rear por-

tions, mounted on said boom and being rotatable about a generally horizontal rotational axis intersecting said front and rear portions; said upright pivotal axis disposed behind said cutting and dislodging member and being offset from said rotational axis; and a plurality of cutter bits mounted on said cutting and dislodging member and disposed along said rotational axis with an axial spacing which progressively increases toward said pivotal axis.

8. In a mining and loading machine; a portable frame; a forwardly extending boom mounted at its rear end on said frame for horizontal swinging movement about an upright pivotal axis; a rotary cutting and dislodging member mounted on said boom with a rear portion thereof closer to said upright pivotal axis than a front portion thereof, said cutting and dislodging member being rotatable about a generally horizontal rotational axis intersecting said front and rear portions; said upright pivotal axis being offset from said rotational axis behind said cutting and dislodging member; a plurality of cutter bits mounted on said cutting and dislodging member and disposed along said rotational axis with an axial spacing which progressively increases in a rearward direction; power means for swinging said boom sidewise about said upright pivotal axis; and power means for rotating said cutting and dislodging member about its rotational axis to drive all of said bits in circular paths for cutting and defining a generally horizontal surface in a mine seam as the boom is swung from side to side.

9. In a mining and loading machine; a portable frame; a forwardly extending boom mounted at its rear end on said frame for horizontal swinging movement about an upright pivotal axis; a cutter drum mounted on said boom with a rear portion thereof closer to said upright pivotal axis than a front portion thereof, said cutter drum being rotatable about a generally horizontal rotational axis and having a spiral blade extending from a front to a rear portion thereof wound about said rotational axis; said upright pivotal axis being offset from said rotational axis behind said cutter drum; a plurality of cutter bits mounted on said spiral blade and spaced along said rotational axis with an axial spacing which progressively increases in a rearward direction; power means for swinging said boom sidewise about said upright pivotal axis; and power means for rotating said cutter drum about its rotational axis to drive said bits in circular paths for cutting and defining a generally horizontal surface in a mine seam as the boom is swung from side to side.

10. In a mining and loading machine; a portable frame; a pair of forwardly extending booms mounted for horizontal swinging movement about spaced upright pivotal axes disposed on said frame; a conveyor on said frame between said pivotal axes having a throat near the front end of said frame; a cutter drum mounted on each boom for rotation about a generally horizontal rotational axis; each drum having front and rear portions spaced along and intersected by its respective rotational axis and having a spiral blade wound about said rotational axis extending between said front and rear portions; each cutter drum being disposed with its rotational axis laterally offset from its respective pivotal axis toward said conveyor and each rear portion of each cutter drum being in proximity to said conveyor throat for receiving material dislodged by said cutter drum in all positions of swinging movement of its respective boom; a plurality of cutter bits mounted on each of said cutter drums and disposed along said drum with an axial spacing which increases in a rearward direction; power means for swinging each boom sidewise about its upright pivotal axis; and power means for rotating each of said cutter drums about its rotational axis to drive all of said bits in circular paths to cut and define a generally horizontal surface in a mine seam as the booms are swung relative to each other.

11. In a mining and loading machine, a mobile frame, a conveyor extending along said frame and having a receiving end portion adjacent the forward end of said frame, a pair of mining heads extending along opposite sides of said conveyor in advance thereof, means for mounting said mining heads on said frame for pivotal movement about upright axes including a separate boom for each mining head pivotally mounted on said frame outside of said conveyor and rearwardly of said receiving throat, each mining head including a cutter drum rotatable about a generally horizontal axis and having a plurality of projecting cutter bits axially spaced along its periphery and supported wholly in advance of said throat, individual power means connected with each boom for swinging said booms from laterally extended positions with respect to said conveyor inwardly toward each other during rotation of said cutter drums, the axis of rotation of each cutter drum being laterally offset from the upright axis of lateral swinging movement of said boom and mining head and being angularly offset with respect to a center line intersecting the upright axis of lateral swinging movement of said boom and the transverse center of said cutter drum along the axis of rotation thereof at an angle of substantially less than 90° and maintaining the cutting patterns of the individual cutter bits to cut clearance for each other during angular feeding movement of said cutter drums across the front of said frame toward each other.

12. In a mining machine of the class described, a mobile frame, a side cutting mining head extending in advance of said frame and mounted on said frame for rotation about a laterally swingable generally horizontal axis, said mining head including a rotatable drum having axially and circumferentially spaced bits projecting from the surface thereof, power means for rotatably driving said drum, a rigid boom pivotally mounted on said frame for movement about an upright axis and forming a laterally swingable support for said mining head and extending rearwardly of said drum, power means for swinging said boom and mining head laterally, to feed said drum across a working face, said drum being retained from reciprocating movement along its axis during rotation thereof and said upright axis of said boom and drum being spaced a substantial distance rearwardly of said drum, the axis of rotation of said drum being offset angularly with respect to a line intersecting said upright axis at an angle of 90° and intersecting the axis of rotation of said drum between the ends of said drum at an angle of less than 90° to position said drum at an oblique angle with respect to said line.

13. In a mining machine of the class described, a mobile frame, a side cutting mining head extending in advance of said frame and mounted on said frame for rotation about a laterally swingable generally horizontal axis, said mining head including a rotatable drum having axially and circumferentially spaced bits projecting from the surface thereof, power means for rotatably driving said drum, a rigid boom pivotally mounted on said frame for movement about an upright axis and forming a laterally swingable support for said mining head and extending rearwardly of said drum, power means for swinging said boom and mining head laterally, to feed said drum across a working face, said drum being retained from reciprocating movement along its axis during rotation thereof and said upright axis of said boom and drum being spaced a substantial distance rearwardly of said drum, said drum being oriented with its axis of rotation angularly offset at an angle of substantially more than 0° and substantially less than 90° relative to any plane which includes said upright axis and which intersects the axis of rotation of said drum within the limits of said drum, to position said drum at an oblique angle with respect to said plane, so that the kerfs made by adjacent cutter bits are of sufficient width to lap one

another without overlapping substantially more than adjacent kerfs.

14. In a mining and loading machine, a mobile frame, a conveyor having a receiving throat on the forward end portion of said frame, a pair of mining heads disposed in side-by-side relationship forwardly of the conveyor throat and including forwardly projecting cutter drums mounted for rotation about generally horizontal axes, an individual boom for each mining head and cutter drum mounted on said frame for movement about an upright pivotal axis and mounting said mining heads and cutter drums on said frame for movement toward and from each other, each cutter drum being retained from reciprocating movement along its axis of rotation during operation thereof and having a plurality of cutter bits axially spaced along its periphery, each cutter drum having front and rear portions spaced along and intersected by its respective rotational axis, power means for swinging said booms inwardly during rotation of said cutter drums to effect the cutting of a series of kerfs in the floor by said cutter bits and to sweep the cuttings in front of the conveyor throat, each cutter drum being oriented with its axis of rotation angularly offset at an angle of less than 90° relative to any plane which includes said upright axis and which intersects the axis of rotation of said drum within the limits of said drum to position the cutting paths of the individual cutter bits in a diagonal direction across the kerfs produced by the cutter bits in the floor.

15. In a mining and loading machine, a mobile frame, a conveyor having a receiving throat on the forward end portion of said frame, a pair of mining heads disposed in side-by-side relationship forwardly of the conveyor throat and including forwardly projecting cutter drums mounted for rotation about horizontal axes, an individual boom

for each mining head and cutter drum, said booms being mounted on said frame on opposite sides of said conveyor for pivotal movement about upright pivotal axes spaced a substantial distance rearwardly of the associated cutter drum and mounting said mining heads and cutter drums on said frame for movement toward and from each other, each cutter drum having a plurality of cutter bits axially spaced along its periphery, and having front and rear portions spaced along and intersected by its respective rotational axis, power means for swinging said booms inwardly during rotation of said cutter drums to effect the cutting of a series of kerfs in the floor by said cutter bits to sweep the cuttings in front of the conveyor throat, the axis of rotation of each cutter drum being offset angularly from the upright axis of lateral swinging movement of said boom and mining head with respect to a line intersecting said upright axis at an angle of 90° and intersecting the axis of rotation of said drum between the ends of said drum at an angle of substantially more than 0° and substantially less than 90°, to position adjacent cutter bits to cut kerfs of sufficient width to lap one another without overlapping substantially more than adjacent kerfs.

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