

Jan. 8, 1957

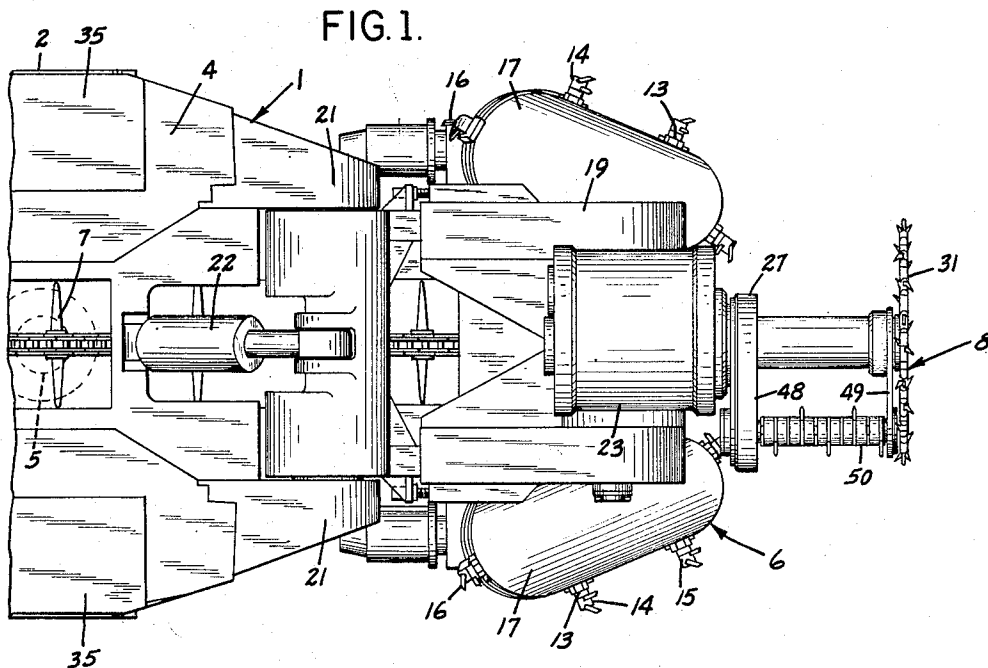
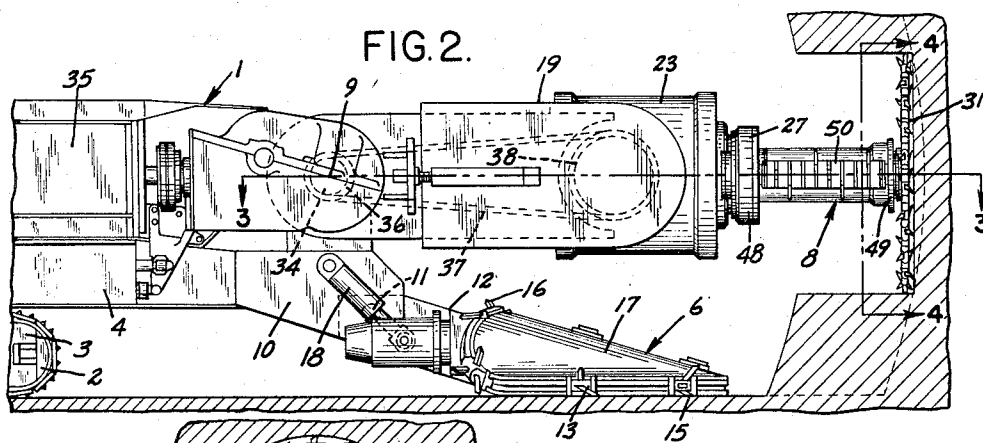
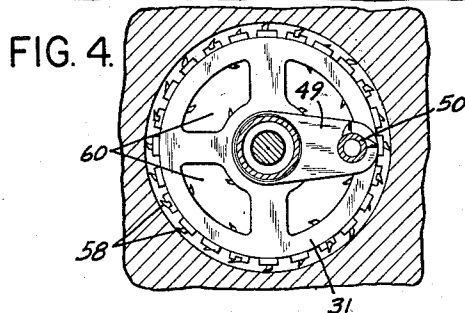
A. L. BARRETT

2,776,823

ROTATING CUTTER AND CORE BREAKER FOR CONTINUOUS MINER

Filed May 17, 1954

3 Sheets-Sheet 1



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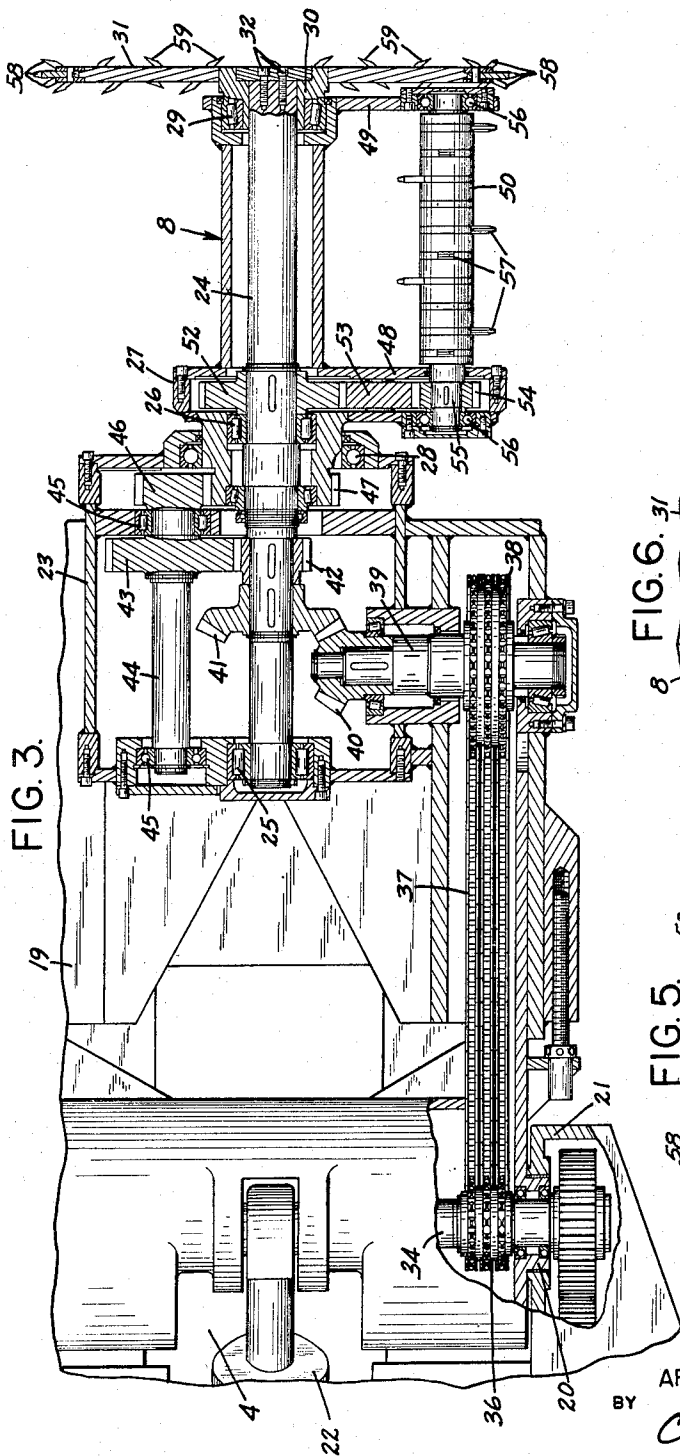
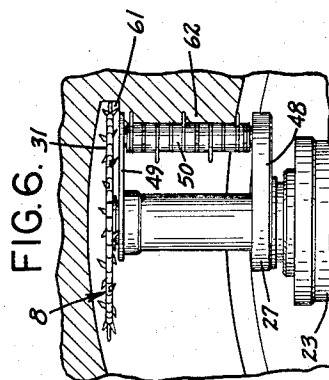
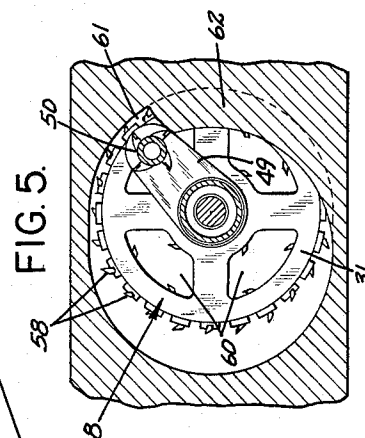
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ROTATING CUTTER AND CORE BREAKER FOR CONTINUOUS MINER

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3 Sheets-Sheet 2



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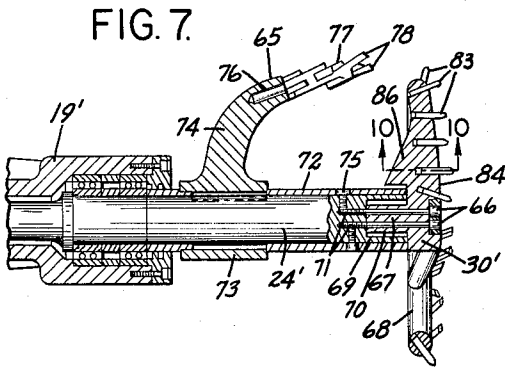
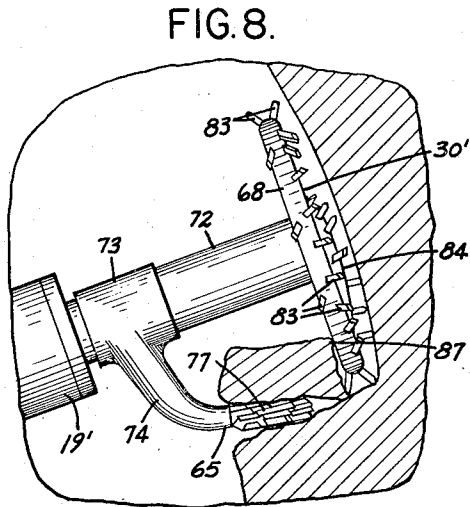
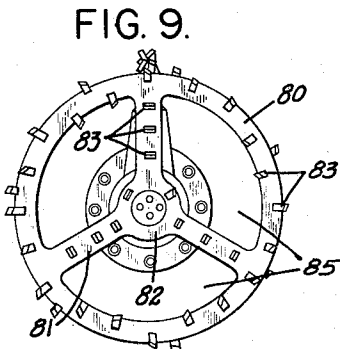
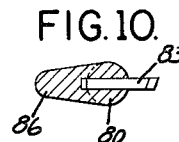
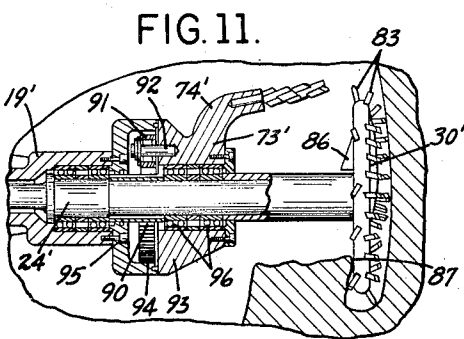
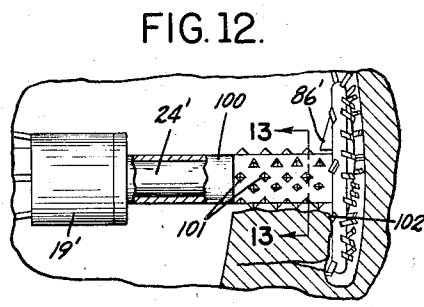
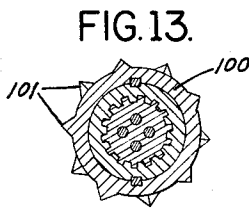
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3 Sheets-Sheet 3



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2,776,823

ROTATING CUTTER AND CORE BREAKER FOR CONTINUOUS MINER

Arthur Lee Barrett, Franklin, Pa., assignor to Joy Manufacturing Company, Pittsburgh, Pa., a corporation of Pennsylvania

Application May 17, 1954, Serial No. 430,175

16 Claims. (Cl. 262—9)

This invention relates to a mining apparatus and more particularly to a rotating cutter and core breaker for a continuous miner for dislodging mineral from a solid mine vein.

This application is a continuation-in-part of my copending application Serial No. 355,975, filed May 19, 1953, owned by the assignee of the present invention, and embodies an improved form of dislodging and disintegrating mechanism whereby the mineral of a solid mine vein is effectively dislodged and disintegrated. The present invention therefore contemplates improvements over known earlier devices in that the mineral to be dislodged is penetrated with a rotary drilling and coring action and the core is intermittently broken away as mining progresses in an improved manner.

An object of the present invention is to provide an improved mining apparatus having improved means for dislodging mineral from a solid mine vein. Another object is to provide an improved rotating cutter for forming a core in the mineral of a solid mine vein and for an improved means for intermittently dislodging the core as mining progresses. Yet another object is to provide a rotating disk type drilling and cutting head whereby the mineral of a solid mine vein may be drilled by an axial feeding motion of the head and thereafter may be cut and broken away with a lateral swinging motion of the head. Still another object is to provide an improved rotary disk type drilling and core cutting head having improved core breaking means associated therewith. A further object is to provide a rotary core cutting head having a rotary core breaker revolving at a relatively slow speed about the axial line of the cutting head whereby the core formed by the head may be effectively dislodged from the mine vein. A still further object is to provide an improved core breaker revolving in an orbital path about the axis of head rotation and simultaneously rotating about its own axis parallel with the head axis to cut away and dislodge the core in an effective manner. These and other objects and advantages of the invention will, however, hereinafter more fully appear.

In the accompanying drawings there are shown for purposes of illustration several forms and modifications which the invention may assume in practice.

In these drawings:

Fig. 1 is a plan view of the forward portion of a continuous miner in which the preferred illustrative form of the improved rotary cutter and core breaker is embodied.

Fig. 2 is a side elevational view of the continuous miner shown in Fig. 1, with the rotary cutter and core breaker shown in operative relation to the mineral of a mine vein.

Fig. 3 is an enlarged horizontal sectional view taken on line 3—3 of Fig. 2, showing the drive for the rotary cutter and core breaker.

Fig. 4 is a detail vertical section taken on line 4—4 of Fig. 2, showing details of the rotary cutter and core breaker structure.

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Figs. 5 and 6 are somewhat diagrammatic views illustrating the manner of operation of the rotary cutter and core breaker.

Fig. 7 is a longitudinal vertical section taken through the rotary cutter and core breaker of a modified construction.

Fig. 8 is a somewhat diagrammatic view illustrating the core cutting and core breaking functions of the cutter and breaker of the modified embodiment.

Fig. 9 is a front end view of the cutting head shown in Fig. 7.

Fig. 10 is an enlarged detail section taken on line 10—10 of Fig. 7.

Fig. 11 is a sectional view similar to Fig. 7, showing still another modified form of construction.

Fig. 12 is a view similar to Fig. 11, showing a further modification.

Fig. 13 is an enlarged cross section taken on line 13—13 of Fig. 12.

The mining apparatus or so-called continuous miner in which several forms of the improved cutting and dislodging mechanism may be embodied is generally designated 1 and herein may be generally similar in construction and in operation to that disclosed in the copending application Serial No. 355,975, above referred to. Evidently the improved cutting and dislodging mechanism may be embodied in mining apparatus of other types and constructions.

The continuous miner 1 shown herein generally comprises a mobile base 2 having a frame 3 on which is mounted a horizontal frame 4 swiveled at 5 on a vertical axis to swing in horizontal planes with respect to the base frame, and this swiveled frame carries a gathering or floor clean-up mechanism generally designated 6, an elevating and loading conveyor means 7, and a dislodging and disintegrating head mechanism generally designated 8. The gathering mechanism 6 and the dislodging and disintegrating mechanism 8 are swingable horizontally with the frame 4 relative to the base, and the dislodging and disintegrating mechanism 7 is pivotally mounted at 9 on the swiveled frame to swing in vertical planes relative to the swiveled frame and base. The elevating and loading conveyor means has a forward frame portion 10 extending forwardly and downwardly beneath the dislodging and disintegrating mechanism and the gathering mechanism 6 is tiltable in vertical planes about a horizontal transverse axis at 11 so that its forward portion may be elevated from the mine floor during transport or tramping about the mine.

The tiltable gathering or floor clean-up mechanism 6 may assume various forms but herein for illustrative purposes has a tiltable frame 12 at the sides of which are mounted endless chain type gatherers 13 in the form of orbitally moving gathering chains 14 provided with flights 15 having socketed lugs for receiving conventional cutter bits 16. These gathering chains move orbitally along the sides and at the front of guide frames 17 at the floor level to effect gathering of loose material on the mine floor both during lateral and forward endwise movements of the gathering mechanism, and the material so gathered is moved onto the front receiving portion of the elevating and loading conveyor means 7, as is fully described in the copending application mentioned above. Operatively connected between the swingable frame and the tiltable frame 12 are conventional fluid jacks 18. By supplying fluid under pressure to these jacks the frame 12 may be tilted in vertical planes about its pivot to raise and lower the gatherers 13 with respect to the mine floor. From the foregoing it is evident that the gathering mechanism 6 and the conveying means 7 may swing horizontally with the dislodging and disintegrating mecha-

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nism 8, and the latter may swing in vertical planes relative thereto. The means for swinging the swiveled frame 4 horizontally relative to the base is fully disclosed in the copending application Serial No. 355,975, above referred to.

The vertically swingable dislodging and disintegrating mechanism 8 comprises an elongated boom frame 19 mounted centrally of the swiveled frame 4 and extending forwardly above the gathering mechanism 6, and this boom frame has rear bearing portions or trunnions 20 pivotally mounted on bearings carried within bearing supports 21 desirably formed integral with the swiveled frame 4. A fluid jack 22 is connected between the swiveled frame 4 and the rear end of the boom frame 19 for swinging the latter upwardly and downwardly about its pivot as desired, and by trapping fluid within the cylinder the boom frame may be locked in adjusted position. The boom frame has a transmission housing 23 in which a longitudinally extending transmission shaft 24 is journaled within bearings 25 and 26 supported within the transmission housing. The bearings 26 are supported within a revolving frame or tubular housing 27 which is in turn journaled in a bearing 28 supported within the transmission housing and by a bearing 29 supported by a hub 30 of a disklike cutting and disintegrating head 31. The hub of the head 31 is secured, as by screws 32, to the forward end of the drive shaft 24.

In this instance, arranged coaxial with the boom pivot 9 is a cross shaft 34 suitably journaled in bearings supported within the trunnions 20 (Fig. 3). Motors 35 mounted at the sides of the swiveled frame 4 are operatively connected to the cross shaft 34 in the manner disclosed in the copending application mentioned above, and secured to and driven by this cross shaft is a chain sprocket 36 connected by an endless drive chain 37 to a chain sprocket 38 secured to a parallel shaft 39 suitably journaled within the transmission housing 23. Secured to the inner end of the shaft 39 is a bevel gear 40 meshing with and driving a bevel gear 41 keyed to the longitudinal drive shaft 24. The bevel gears 40 and 41 are enclosed within the transmission housing 23, and keyed to the shaft 24 is a spur pinion 42 meshing with a spur gear 43 herein formed integral with a parallel shaft 44, the latter being suitably journaled within bearings 45 supported within the transmission housing. Secured to and driven by the shaft 44 at the forward portion of the shaft is a spur gear 46 meshing with and driving a spur gear 47, in turn secured to the rotatable housing or frame 27. Thus the tubular housing or frame 27 may be driven about the longitudinal axis of the shaft 24 at a speed substantially slower than the speed of shaft rotation, through the reduction gears 42, 43 and 46, 47. Integral with the rotatable housing or frame 27 are parallel radial arms 48 and 49, and journaled at the outer portions of these arms is a toothed roller or rotary core breaker drum 50, arranged with its axis of rotation parallel with the axis of rotation of the shaft 24 (Fig. 3). This drum or roller lies just inside the projection of a circle lying at the periphery of the disk cutter 31, as shown in Figs. 3 and 5, so that the rotary drum is located within the confines of the disk cutter during the axial boring operation. Keyed to the shaft 24 and driven thereby is a large spur gear 52 meshing with and driving an intermediate gear 53 which, in turn, meshes with and drives a small spur gear 54 keyed to a drum or roller shaft 55 by which the drum or roller is supported. The radial arm 48 is of a hollow construction and the spur gearing 52, 53, 54 is enclosed within this arm in the manner shown. The roller shaft is suitably journaled in bearings 56 supported within the arms 48 and 49, and the drum carries suitable detachable teeth or disintegrating bits 57.

The disk cutter 31 is herein desirably in the form of a flat circular plate and carries suitable detachable teeth or cutter bits 58 at its peripheral edge, and suitably at-

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tached to the front face of the disk are detachable teeth or cutter bits 59 so that when the rotary cutter is moved axially a circular bore may be formed in the mineral and when the rotary cutter is moved laterally its peripheral cutters may form a narrow slot or kerf in the mineral, as later explained more in detail. The circular plate of the disk cutter has suitable openings or apertures 60 therethrough so that the cuttings may move away from the working face through these openings.

The rotary disk cutter may be rotated at a relatively high speed through the driving connections above described and as the cutter is rapidly rotated the rotary core breaker drum or roller 50 is concurrently rapidly rotated about its own axis in the same direction as the rotary cutter and moved concurrently at a relatively slow speed in a circular orbit about the axis of rotation of the rotary cutter. Thus the rotary core breaker drum moves in an orbital path in the same direction as the circular orbit of movement of the peripheral cutters of the cutter disk.

The mode of operation of the continuous miner and more particularly the mode of operation of the illustrative form of the invention above described may be generally similar to that disclosed in the copending application Serial No. 355,975, mentioned above, and the rotary cutter may be sumped into the mineral of a solid mine vein with an axial boring motion and when sumped in, may be swung laterally about the vertical axis 5 of the swiveled frame 4 and may be swung vertically about the horizontal axis 9 of the swingable boom frame 19. Thus, as the rotary cutter is operated, a core or projection of mineral may be formed in the mine vein and the core may be broken or dislodged from the face by the rotary core breaker and as the mineral of the face of the mine vein is dislodged and disintegrated, it may fall to the mine floor where it may be gathered by the gathering mechanism 6 and moved onto the elevating and conveying means 7.

As the rotary disk cutter is fed axially into the mineral of a solid mine vein with a rotary boring motion, a large circular horizontal bore is formed in the mineral, as shown in Figs. 2 and 4, and as the boom frame 19 is swung laterally with the swiveled frame 4 about the vertical axis 5, an arcuate curve or slot 61 is formed just inside the working face, thereby to define a section or core of mineral 62 herein of crescent shape (Figs. 5 and 6). As the rapidly rotating toothed roller or core breaker drum 50 moves relatively slowly in its orbit about the axis of rotation of the rotary disk cutter it intermittently moves into contact with the core 62 and the drum teeth tear or break away from the core from the mine vein. Due to the relatively slow orbital motion of the core breaker roller a slot or kerf of substantial depth providing a core of substantial projection is formed in the mineral prior to the core breaking action of the drum or roller 50 on the core, thereby to facilitate the dislodging of the mineral from the solid mine vein.

In the modification shown in Figs. 7 to 10 inclusive, an orbitally movable rigid core breaker arm 65 is provided in lieu of the rotary core breaker drum of the preferred embodiment described and, in this construction, the boom frame 19' has a transmission shaft 24' journaled thereon with its longitudinal axis in coincidence with the longitudinal axis of the boom frame and detachably secured at 66 to the outer end of this shaft is a rotary cutter or disklike head 30'. The detachable connection 66 comprises a shaftlike projection 67 extending axially rearwardly from the rear plane face 68 of the head and fitted within a socket 69 formed within the forward portion of the shaft 24' and there is a keyed connection 70 between the shaftlike projection and the socket walls for interlocking the cutter head for rotation with the shaft. The shaftlike projection is held within the socket by means of screws 71. As shown in Fig. 7, a circular sleeve or tube 72 surrounds the transmission shaft

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between the rear face of the cutter head and the forward surface of a hub 73 of an arm 74 of the core breaker 65 and this sleeve is secured to the shaft as by a series of radial screws 75. The core breaker arm 74 is curved forwardly and outwardly from its hub 73 with its outer portion located near the periphery of the dislodging and disintegrating head rearwardly of the latter and the outer portion of this arm has a socket 76 for receiving the shank of a detachable cutting and breaking element 77 having teeth 78. The breaker arm 74 rotates with the disklike head 30' and as the disklike head forms a core in the mineral of a solid mine vein, as the boom frame is swung laterally, the breaker arm impinges against the core and dislodges it outwardly from the vein, in the manner shown in Fig. 8.

This cutting and disintegrating head or disk cutter has an annular peripheral portion 80 and spaced arm portions 81 extending radially from a hub 82, and the peripheral portion and the radial arms carry suitable cutter bits or teeth 83. The peripheral portion, the radial arms and hub are so formed as to provide a generally convex front face 84, and the rear surface of the head is plane, as indicated at 86, perpendicular to the axis of head rotation. Suitable open spaces or apertures 85 are provided between the radial arms internally of the annular peripheral portion 80 and the dislodged and disintegrated mineral may flow rearwardly through these spaces or openings as the head is sumped into the face of the mine vein. A breaker wedge 86 secured to the disklike head projects rearwardly from the rear plane face 68 of the head and has its wedging face inclined inwardly and rearwardly in the manner shown. As the core is formed by the disklike head during horizontal swinging of the boom frame it is engaged by the inclined face of the wedge 86 and is thus effectively dislodged outwardly from the face of the mine vein. The plane rear face 68 of the head, as the latter is moved horizontally arcuately across the face, will act at 87 on the core to aid in dislodging the core.

In the modified construction shown in Fig. 11, the rigid breaker arm 74' turns in the same direction as the disklike head 30' but at a somewhat slower speed so that the kerf or slot formed in the solid mineral is substantially deeper than in the embodiment shown in Fig. 7, thereby forming a relatively large core or projection of mineral which may be easily broken off by the breaker arm due to the increased leverage of the longer core. In this improved construction, the transmission shaft 24' has a spur gear 90 fixed to it and this gear meshes with planet gears 91, herein desirably three in number, journaled on shafts 92 carried by a rotatable carrier 93, desirably formed integral with the arm hub 73'. The planet gears 91 mesh with an internal gear 94 rigidly secured, as by screws 95, to the forward portion of the boom frame 19'. The arm hub is journaled on bearings 96 supported by the transmission shaft for rotation relative to the boom frame and shaft.

In the modified construction shown in Figs. 12 and 13, the core breaker roller or arm is omitted and a cylindrical sleeve or tube 100 surrounds the transmission shaft 24' between the front end of the boom frame 19' and the rear plane face 68 of the disklike head and this sleeve is provided with suitably formed peripheral cutting teeth or cutters 101. A breaker wedge 86' projects rearwardly from the rear plane face 68 of the disklike head and, as the core is formed by the disklike head during the lateral swinging of the boom frame, it is engaged by the wedge and the peripheral teeth 101 and is thus effectively dislodged. The rear plane face of the head, as the latter is moved arcuately horizontally across the vein will act at 102 (Fig. 12) on the core to aid in dislodging the coal. The general mode of operation of the several modified forms of the invention, shown in Figs. 7 to 13 inclusive, is similar to that above described in regard to the preferred illustrative embodiment and

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therefore, a repetition of the general mode of operation thereof is herein unnecessary.

As a result of this invention an improved mining apparatus is provided whereby the mineral of a solid mine vein may be effectively mined and continuously loaded out without the need for drilling and blasting. By the provision of the improved rotary disklike drilling, core cutting and dislodging head, the mineral may be dislodged from the vein in relatively large lumps with a minimum of actual cutting of the mineral; the disklike head, as it is swung laterally arcuately across the face, forming a core of mineral which is intermittently dislodged from the vein and loaded out. The rotary drilling and dislodging head, by the provision of cutters on its front face as well as its circular peripheral edge, may be easily sumped axially into the solid vein with a rotary boring motion and then moved arcuately of the face to remove a segment of mineral from the solid with a lateral coring and breaking motion, thereby substantially improving the efficiency of mining from the solid. By the provision of the improved rotary breaker drum or roller on the breaker arm, which revolves in a circular orbit about the axis of head rotation, the core formed by the cutter head may be effectively dislodged. Other modes of use and advantages will be clearly apparent to those skilled in the art.

While there are in this application specifically described several forms and modifications which the invention may assume in practice, it will be understood that these forms and modifications of the same are shown for purposes of illustration and that the invention may be further 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 combination, a rotary disklike cutter having face and peripheral cutters mounting said disklike cutter for rotation in generally upright planes about an axis extending toward the face of a mine vein, means for rotating said disklike cutter, means for moving said disklike cutter axially to effect the boring of a hole in a solid mine vein, and thereafter swinging arcuately in a lateral direction to cut a core from the solid mine vein, core breaker means, means for mounting said core breaker means for rotation relative to said disklike cutter about the axis of rotation of said disklike cutter, said core breaker means spaced rearwardly of said disklike cutter and inwardly of the cutter-periphery for engaging the adjacent lateral surface of the core for dislodging the latter from the face, and means for rotating said core breaker means.

2. In combination, a rotary disklike cutter having cutters on its front face and peripheral edge, means for mounting said disklike cutter for rotation in generally upright planes about an axis extending generally longitudinally toward the face of a mine vein, means for moving said disklike cutter axially to drill a hole in a solid mine vein and for movement arcuately in a lateral direction inwardly of the face to cut a core from the solid mine vein, means for rotating said disklike cutter core breaker means, means for mounting said core breaker means for rotation about an axis coincident with the axis of rotation of said disklike cutter, and means for rotating said core breaker means at a substantially slower speed than the rotative speed of said disklike cutter for periodically applying a dislodging force to the core to dislodge the latter from the face.

3. A core cutting and dislodging mechanism comprising a rotary cutter head having cutters on its front face and peripheral edge, means for mounting said cutter head for axial drilling movement into and for lateral slot-cutting movement for cutting a slot inside of the face of the mineral of a solid mine vein to form a core of mineral, means for axially and laterally moving said

cutter head to effect said drilling and core cutting functions, a rotary toothed core breaker roller, means for mounting said roller for movement relative to said head in an orbital path about the axis of head rotation for dislodging the core, and means for rotating said head and for effecting orbital movement of said roller.

4. A core cutting and dislodging mechanism comprising a rotary drilling and cutting head having face and peripheral cutters, means for mounting said head for axial movement to form a circular bore in the mineral of a solid mine vein and for lateral movement to cut a slot inside of the face of the vein to form a core of mineral, means for rotating said head and for moving said head axially and laterally, a revoluble core breaker, means for mounting said core breaker to revolve about the axis of head rotation relative to said head, and means for causing said core breaker to revolve about said head-axis for intermittently applying dislodging blows to the core to dislodge the latter.

5. A mechanism as set forth in claim 4 wherein said rotating means for said core breaker provides for revolution of the latter about the axis of head-rotation at a speed substantially slower than the speed of rotation of said head.

6. In combination, a drive shaft extending generally perpendicular to the face of a mine vein, a disklike cutter head having face and peripheral cutters and secured to and driven by said shaft at the outer end of the latter, means for driving said shaft to effect rotation of said head, means for moving said cutter head axially into the mineral of the mine vein and thereafter laterally to form a core of mineral, a core breaker, means for mounting said core breaker to revolve in an orbit located rearwardly of said head about the axial line of said shaft, and means comprising reduction gearing operatively connected between said shaft and said core breaker for driving the latter in its orbit at a speed substantially slower than the speed of head-rotation.

7. In combination, a drive shaft extending generally perpendicular to the face of a mine vein, a disklike cutter head having face and peripheral cutters and secured to and driven by said shaft at the outer end of the latter, means for mounting said shaft for axial and lateral movements, means for moving said shaft axially and laterally to effect axial movement of said cutter head into the mineral of a mine vein and lateral movement of said cutter head to form a core of mineral, a core breaker, means for mounting said core breaker to revolve in an orbit rearwardly of said cutter head about the axial line of said shaft, said core breaker having its forward portion disposed close to said head near the peripheral edge of said head rearwardly of the latter, and means for driving said core breaker to effect movement thereof in its orbit at a speed substantially slower than the speed of head-rotation including reduction gearing arranged between said shaft and said core breaker.

8. A core cutting and dislodging mechanism comprising a rotary drilling and core cutting head for forming a core of mineral in a solid mine vein, a support revolving about the axis of head rotation rearwardly of said head and having radial front and rear parallel arms, and a rotary core breaker journaled on said arms for rotation about an axis parallel to the head axis.

9. A mechanism as set forth in claim 8 wherein driving means is provided for said core breaker and for said head for rotating the same at a relatively high speed in the same direction.

10. A mechanism as set forth in claim 8 wherein driving means is provided for said revolving support for

rotating the latter to move said core breaker in its orbital path at a speed substantially slower than the speed of head rotation.

11. A core cutting and dislodging mechanism comprising a rotary cutter head, means for rotating said cutter head, means for mounting said cutter head for movement to effect cutting of a slot inside of the face of the mineral of a solid mine vein to form a core of mineral, a rotary toothed core breaker roller, means for mounting said core breaker roller for movement in an orbital path about the axis of head-rotation, said toothed roller disposed with its axis of rotation parallel with the axis of head-rotation, and means for rotating said toothed roller about its own axis relative to said head in the same direction as the direction of rotation of said head to effect dislodging of the core.

12. A core cutting and dislodging mechanism comprising a rotary cutting head, means for rotating said cutting head, means for mounting said cutting head for movement and for moving said cutting head to effect cutting of a slot inside the face of the mineral of a solid mine vein to form a core of mineral, a rotary toothed core breaker roller, means for mounting said core breaker roller for rotation about an axis parallel with the axis of head-rotation, means for rotating said core breaker roller about said roller-axis, and means for moving said core breaker roller in an orbital path about the axis of head-rotation relative to said head in the same direction as the direction of rotation of said cutter head to effect dislodging of the core.

13. A core cutting and dislodging mechanism comprising a rotary cutter head for cutting a slot inside of the face of the mineral of a solid mine vein, a rotary toothed core breaker roller movable in an orbital path about the axis of head rotation for engaging and dislodging the core, and means for driving said roller positively to rotate the same about its own axis relative to said head concurrently with head-rotation.

14. In a core cutting and dislodging mechanism, the combination comprising a rotary drilling and core cutting head for forming a core of mineral in a solid mine vein, a support revolving about the axis of head rotation rearwardly of said head, and a rotary core breaker journaled on said support for rotation about an axis parallel to said head-axis.

15. A combination as set forth in claim 14 wherein driving means for said support is provided for rotating said support about said head-axis at a speed substantially slower than the speed of rotation of said head to effect orbital movement of said core breaker relative to said head.

16. A combination as set forth in claim 15 wherein means is provided for rotating said core breaker about its own axis, as it moves orbitally as aforesaid, in the same direction as the direction of rotation of said head.

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