

Dec. 25, 1956

T. F. MCCARTHY

2,775,439

CUTTER HEAD FOR DRIVING CROSSCUTS

Filed March 21, 1951

3 Sheets-Sheet 2

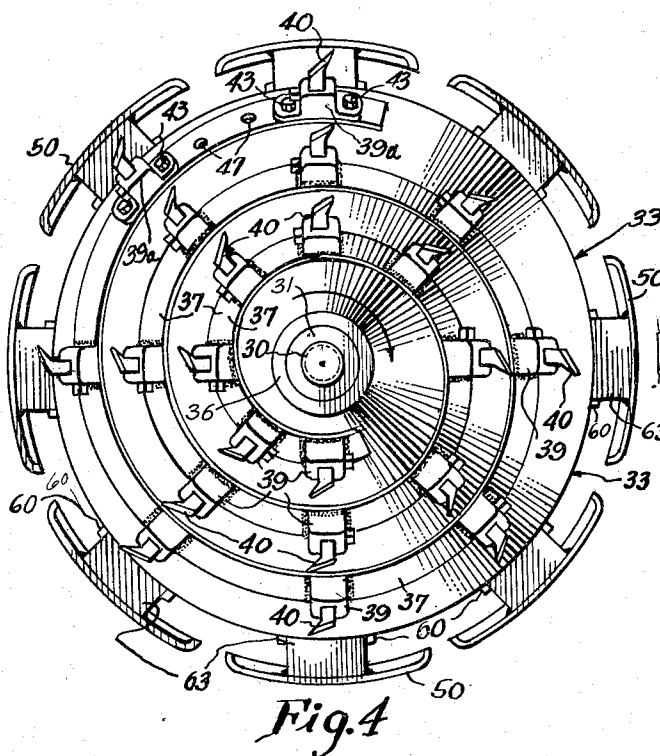


Fig. 4

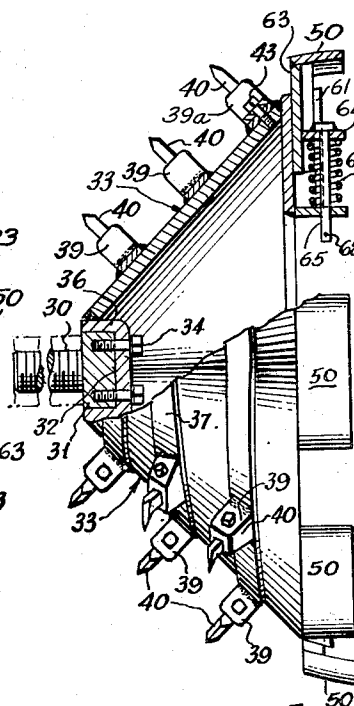


Fig. 5

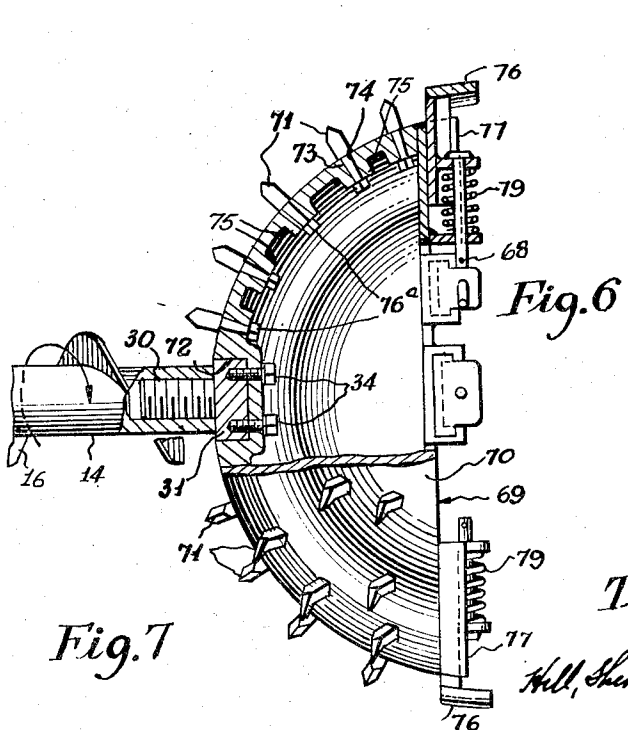


Fig. 6

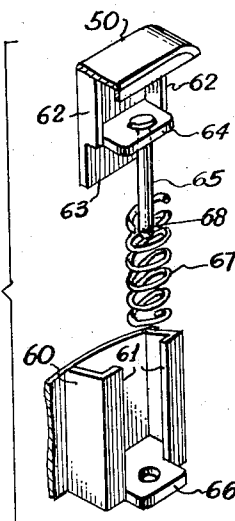


Fig. 7

INVENTOR
Timothy F. McCarthy

BY

Hill, Sherman, Meroni, Cross & Simpson
ATTORNEYS

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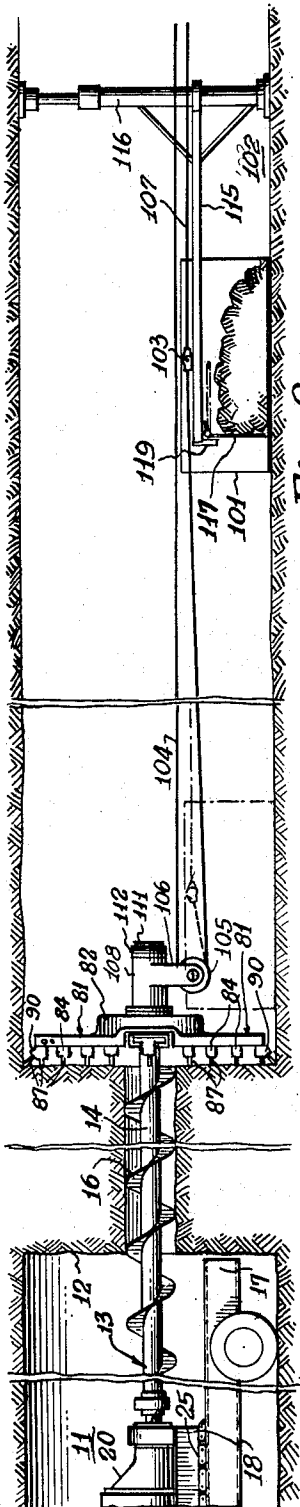


Fig. 8

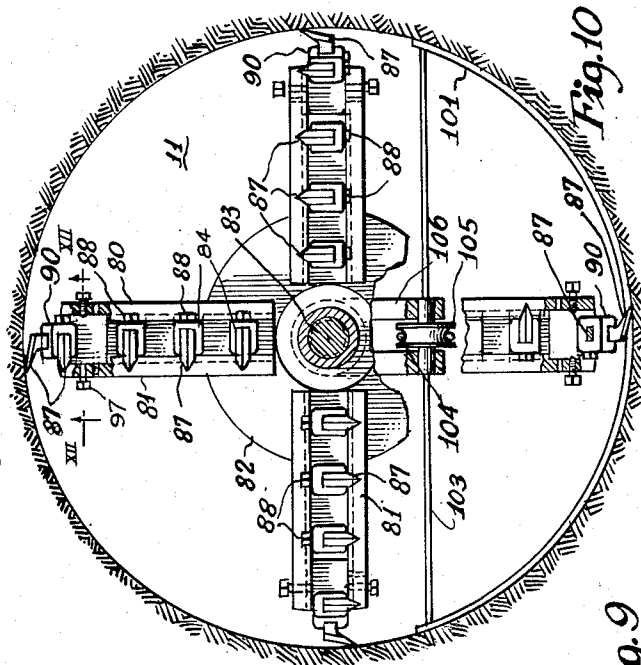


Fig. 10

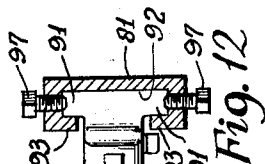


Fig. 12

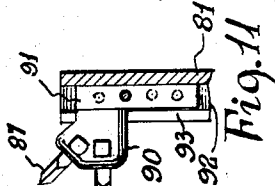


Fig. 11

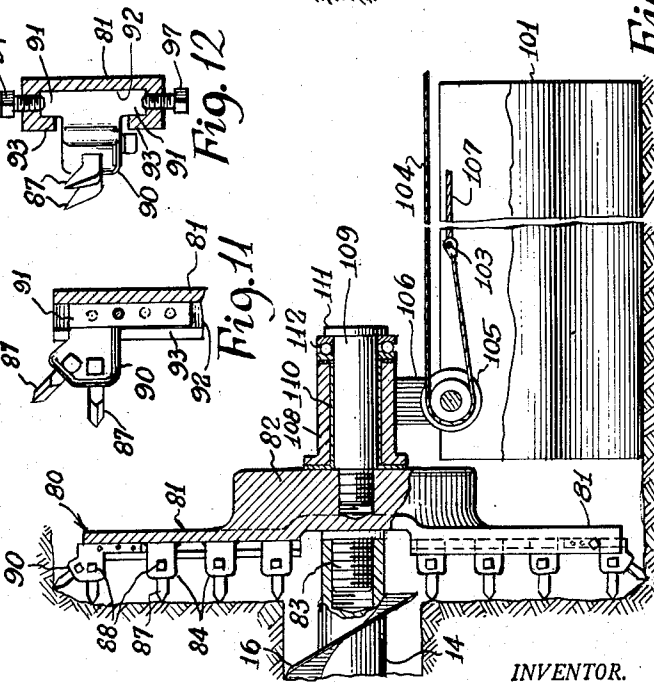


Fig. 9

INVENTOR.
Timothy F. McCarthy

BY
Hill, Sherman, Meroni, Gross & Simpson
ATTORNEYS

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2,775,439

CUTTER HEAD FOR DRIVING CROSSCUTS

Timothy F. McCarthy, Indiana, Pa.

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7 Claims. (Cl. 262—19)

This invention relates to improvements in methods and apparatus for driving cross-cuts or break-throughs in mines underground and has as its principal object to provide a simple and efficient method and apparatus for driving entirely through the roof supporting pillars of coal mines, in a simpler and more expeditious manner than formerly.

Another object of my invention is to provide a novel and improved method and apparatus for driving cross-cuts or break-throughs in the roof supporting pillars of coal mines by enlarging a drilled hole to the required size by the operation of withdrawing the tool driving the drilled hole.

A further object of my invention is to provide a method for driving cross-cuts in mines by driving a pilot hole entirely through the mine pillar then enlarging the hole to the required size by a circular cutting tool operated by the operation of withdrawing the pilot drilling tool.

Another object of my invention is to provide a simple and efficient method for driving cross-cuts in coal mines consisting in first driving a relatively small diameter pilot hole through a roof supporting pillar, and then securing a cutting head to the projecting end of the drilling tool and withdrawing the tool while rotating it, and enlarging the hole to the required size by the withdrawing operation and at the same time confining the cuttings to flow to the center of the boring head and carrying them away by the spiral of the drilling tool.

A still further object of my invention is to provide a novel and improved form of rotary cutter head attachable to the free end of a drilling auger after the drilling auger has completely drilled through a mine pillar, and arranged to enlarge the bore to the required size by withdrawal of the drilling auger.

A further object of my invention is to provide a novel form of rotary cutter head attachable to the end of a drilling tool for enlarging the hole drilled thereby to the required size by withdrawal of the tool from its bore and confining the cuttings to flow toward the center of the cutter head and the drilling auger.

A still further object of my invention is to provide a novel form of drilling tool arranging to enlarge a bore made by a boring auger upon withdrawal of the boring auger, and to progress the cuttings toward the auger during the cutting operation for conveying from the bore by the auger.

A still further object of my invention is to provide a new and improved form of cutting head adapted to be attached to the free end of a drilling tool for enlarging the hole drilled thereby upon withdrawal of the drilling tool, and having a receding cutting face extending outwardly from the drill rod of the drilling tool when secured thereto, with cuttings confining means projecting from the periphery thereof and engaging the bore and confining the cuttings to the face of the cutter head for progression to the spiral of the drilling tool.

A still further object of my invention is to provide a

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rotary cutter head for driving break-throughs by attachment to the free end of a drilling auger to cut a circular cross cut upon withdrawal of the auger from its bore together with a draft operated scraper for clearing the cuttings from the cross-cut and an anchor for the draft rope of the scraper pivotally mounted on the cutter head and held in position by the reaction of the draft rope thereon.

A still further object of my invention is to provide a novel form of rotary cutter head for driving circular cross cuts or break-throughs and adapted to be attached to the end of a drilling auger, to enlarge the hole drilled thereby upon withdrawal thereof, and adjustable to vary the diameter of the cross-cut.

These and other objects of my invention will appear from time to time as the following specification proceeds and with reference to the accompanying drawings, wherein:

Figure 1 is a diagrammatic vertical sectional view taken through a mine room and pillar showing a drilling machine operating a drilling auger to drill entirely through a roof supporting pillar of a mine;

Figure 2 is a horizontal sectional view taken through a mine pillar showing a rotary cutter head constructed in accordance with my invention attached to the end of an auger and enlarging the bore to cut a circular cross-cut by withdrawal of the drill rod from the drill hole;

Figure 3 is a fragmentary view of the end of the drilling auger illustrating one manner in which a detachable drill bit may be mounted on the end of a drill rod;

Figure 4 is a view of the rotary cutter head shown in Figure 2, looking toward the front end thereof and illustrating the spiral and bit blocks mounted thereon and also showing the cuttings confining shoes, confining the cuttings to flow toward the auger during the cutting operation;

Figure 5 is a fragmentary view in side elevation with certain parts in section and illustrating certain details of the rotary cutter head not shown in Figure 4;

Figure 6 is an enlarged detail view, showing certain details of the cuttings confining shoes and their mounting on the rotary cutter head;

Figure 7 is a fragmentary view in side elevation of a modified form of cutter head constructed in accordance with my invention with certain parts thereof broken away and certain other parts shown in section.

Figure 8 is a diagrammatic vertical cross sectional view taken through a mine pillar showing the cross-cut partially completed and illustrating still another form in which my invention may be embodied;

Figure 9 is a view in side elevation of the rotary cutter head shown in Figure 8, with certain parts thereof broken away and certain other parts shown in longitudinal sections showing the cutter head in operation cutting a cross-cut through a mine pillar;

Figure 10 is a front end view of the cutter head shown in Figure 9, showing the cutter head in a cross-cut in a mine pillar, with certain parts broken away and certain other parts in transverse section;

Figure 11 is an enlarged detailed partial fragmentary sectional view taken through one of the cutter arms and illustrating certain details of the adjustable mounting of the outer cutter bits on the cutter head; and

Figure 12 is an enlarged fragmentary horizontal sectional view taken substantially along line XII—XII of Fig. 10.

In the drawings:

A drilling machine 10 is shown for illustrative purposes as being positioned in a mine room 11, and extending transversely thereof with its forward end adjacent one rib of a pillar 12. An auger 13 is shown as being

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secured to the drilling machine and as having drilled entirely through the pillar 12. The auger 13 may be of any well known form, and is herein shown as consisting in a drill rod 14 having a drill bit 15 detachably mounted on its forward end and having a conveyor spiral 16 extending therealong.

The drilling machine 10 may be of any well known form capable of feeding its auger entirely through a mine pillar and is herein shown as being a wheel mounted type of drilling machine having a main frame consisting of two connected parallel spaced rails 17—17 upon which are slidably mounted a drill carriage 18. The drill carriage 18 may carry a drive motor 19 for driving the auger 13 and feeding said carriage along the rails 17—17. The drive to the auger is shown as including a speed reducer indicated generally by reference character 20 and driven by said motor 19, and a chuck indicated generally by reference character 21, in which the rear end of the drill rod 14 may be detachably secured. Feeding of the carriage along the rails 17, 17 is shown as being effected by sprockets 23—23 on the outer ends of a shaft 24 suitably driven from the motor 19, to afford a means for advancing and retracting the auger 14 by movement of the carriage 18 along the guide rails 17—17. The pinions 23—23 are shown as meshing with flexible chains 25—25, extending along the tops of the rails 17—17 and secured thereto at their ends in a taut condition. The drilling machine may also have adjusting means for adjusting the elevation of the drill auger 13 with respect to the mine floor and for tilting the frame to position the auger to drill parallel to the mine floor. Said adjusting means may be of any well known form and is not herein shown or described since it forms no part of my present invention.

The spiral 16 on the drill rod 13 is herein shown as stopping short of the end of the drill rod and the cylindrical end portion of said drill rod is shown as having the drill bit 15 detachably mounted thereon. The drill bit 15 is herein shown as being a fishtail type of bit having a shank portion 27 expanded to a generally cylindrical form to detachably fit over the end portion of the drill rod 14.

As herein shown, the shank portion of the drill bit is formed by slitting the flat bit stock at a plurality of places, forming a plurality of parallel slits, stopping short of the sides of the shank portion. The slit shank may then be expanded to form a plurality of alternately arranged generally arcuate straps, the inner periphery of which may form a cylindrical socket for the end of the drill rod. A stop 29 may be provided on the drill rod engageable with a terminal end of a rearwardmost strap to effect rotation of the bit with the rod, upon rotation thereof, and permitting ready removal of the bit from the rod.

The outer end portion of the drill rod 13 is shown as being internally threaded to detachably receive a stud 30 of a cap piece 31. The cap piece 31 may be rectangular and may be recessed within a socket 32 formed in a central hub 36 of a cutter head 33. Cap screws 34, 34 may be provided to secure the cutter head 33 to the cap piece 31.

The cutter head 33 is shown in Figure 5 as being of a frusto-conical form having a hub 36 and socket 32 at the reduced end portion thereof. The cutter head 33 may be made from a welded plate extending from the hub 36. A spiral strap 37 is herein shown as being welded to the face of the plate of the cutter head and as extending therealong. The spiral strap 37 is shown as extending around the face of the cutter head in the form of a reverse spiral, that is, one which will cause the cuttings to flow from the periphery of the cutter head to the center thereof, upon rotation of said head in a cutting direction, which will be the same direction the bit 15 rotates during its drilling operation.

A plurality of spaced cutter blocks 39, 39 having cutter bits 40, 40 carried thereon may be secured to the

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spiral strap 37 for the entire length thereof. The cutter bits 40—40 may be well known forms of cutter bits of a type used in cutter chains for coal cutting machines, and may be detachably secured to the cutter blocks 39—39 by the usual set screws. The bits 40, 40 may extend from their respective blocks in various angular relations with respect to said blocks, to cut clearance therefor. The inner blocks 39—39 may be secured to said strap as by welding, while outer blocks 39a, 39a may be detachably secured to said strap as by bolts 43—43. A plurality of holes 47—47 is spaced along the strap 37 adjacent its outer end, to adjustably receive the bolts 43, 43 and afford a means for adjusting the position of the end blocks on the strap 37 and the cutting radius of the cutter head 33, by spacing the end blocks farther outwardly or inwardly along the strap 37.

A means is provided to confine the cuttings cut by the bits 40—40 to the face of the cutter head 33, to flow downwardly therealong to the spiral 16, which is herein shown as comprising a plurality of circumferentially spaced radially extending cuttings confining shoes 50—50. Each shoe 50 is slidably mounted in a radial guide channel 60 secured to the rear end portion of the cutter head 33 and extending inwardly from the periphery thereof. Each guide channel 60 has a pair of gibs 61—61 extending inwardly from the walls thereof. The gibs 61—61 slidably engage ribs 62—62 extending outwardly from a guide plate 63 of the shoe 50, and slidably movable along the base of the guide channel 60. A plate 64 extends outwardly from the plate 63 between the ribs 62, 62 and has a rod 65 secured thereto and depending therefrom. The rod 65 is slidably guided in a plate 66 extending outwardly from the inner end of the guide channel 60. A compression spring 67 is shown as encircling the rod 65 and as being interposed between the plates 64 and 66 to urge the shoe 50 outwardly along the guide channel 60 and to yieldably maintain said shoe in engagement with the enlarged bore cut by the cutter head 33, during the cutter operation. A stop such as a cotter pin 68 extends through the inner end of the rod 65, to limit outward movement of the shoes 50—50. If desired a plurality of holes may be spaced along the rods 65—65 to receive the cotter pins 68 and adjust the extent of outward movement of the shoes 50—50.

It may be seen from the foregoing, that as the cutter head 33 is advanced into the coal face, by operation of the drilling machine 10 rotatably driving the drill rod 14 as it withdraws said drill rod from the coal face, that the cuttings confining shoes 50—50 will come into engagement with the inner periphery of the bore cut by said cutter head, and slidably move along said bore, confining the cuttings to the face of the cutter head to enable the spirally arranged cutter blocks 39, 39 on the spiral strap 37, to convey the cuttings toward the center of said head and the spiral 16 on the drill rod 14.

It may also be seen that a compact, light and readily transportable cross-cut driving cutter has been provided, which is readily attachable to the end of a drill rod, and simplifies and increases the efficiency of the cross-cut driving operation over former apparatus heretofore used.

In Figure 7, I have shown a modified form of cutter head constructed in accordance with my invention operating on principles similar to the cutter head shown in Figure 4. In this form of my invention a cutter head 69 is shown as having a semi-spherical cutting face 70 having cutter bits 71—71 directly mounted thereon, said cutter bits may be mounted in a reverse spiral path like those in the form of my invention shown in Figures 2 and 4. The cutter head 69 is shown as having a recessed central portion or socket 72, receiving the end cap 31, for securing said cutter head to the drill rod 14.

Each cutter bit 71 is herein shown as having a reduced diameter tapered shank 73, preferably formed on

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a Morse taper, which may extend through a tapered hole 74, extending radially through the face 70 of the cutter head 69. Lugs 75—75 extending inwardly from the inner surface of the head 69 reinforce said head and have the tapered holes extending therethrough. Nuts 76a—76a may be threaded on the inner ends of the tapered shanks 73—73 of the cutter bits 71 and abut the lugs 75—75, to hold the bits in position in said cutter head.

Cuttings confining shoes 76—76, like the cuttings confining shoes 50—50 are slidably mounted in radial guides 77—77, extending radially inwardly from the rear peripheral edge of the cutter head 69, and are yieldably maintained in engagement with the periphery of the bore by compression springs 79—79. The cuttings confining shoes 76—76 are mounted on the head in the radial guides 77—77 in the same manner the shoes 50—50 are mounted in the cutter head 33, so a detailed description thereof and of their mounting on the head need not be repeated.

In the form of my invention illustrated in Figures 8 through 12 a cutter head 80 is shown as having four arms 81—81 extending radially from a hub 82. A stud shaft 83 is shown as extending forwardly from the hub 82, for threading within the internally threaded portion of the drill rod 14, to secure the head to said drill rod after completion of the drilling operation. Each arm 81 is shown as having a plurality of bit blocks 84 mounted thereon as by welding. The bit blocks 84—84 carry the usual cutter bits 87—87 which may be held thereto by set screws 88.

Adjustable end bit blocks 90—90 are shown as being adjustably mounted adjacent the outer ends of the arms 81—81. Each end block 90 is provided with two cutter bits 87 the inner of which extends generally horizontally. The outer bit 87 is inclined upwardly beyond the outer end of the arm 81, to cut clearance for said arm. Each end block 90 is shown as having flanges 91—91 extending outwardly from the base thereof and slidably guided in a channeled guide 92 extending along the arm 81. Gibs 93—93 are secured to the outer edges of the arm and overlap ears 91—91 to retain the blocks to said arms. Set screws 97—97 are shown as being threaded through the sides of the guides 92 and as having engagement with recesses in the sides of the flanges 91—91 to hold said blocks in position and afford a means for holding said blocks in the desired position of adjustment along the guides 92. The outer bit blocks 90—90 may thus be adjustably moved along the arms 81—81 to afford a means for varying the diameter of the cross-cut. It is, of course obvious that if desired, the inner bit blocks 84 may also be adjustably mounted along the arms 81—81 in the same manner as the outer bit blocks.

In the form of my invention illustrated in Figures 9, 10 and 11 the bulk of the cuttings drop directly to the ground during the cross-cut driving operation, and while the cutter head 81 may be driven to rotate in the same direction the bit 15 rotates when driving its pilot hole, the bits 87—87 are preferably set to cut when the head rotates in a direction opposite to the direction of rotation of the bit 15 when drilling, to cause the spiral 16 to progress the loose cuttings for discharge through the enlarged breakthrough.

An open ended draft operated scoop 101 having a semi-circular bottom conforming generally to the bore cut by the cutter head 81 is provided to follow the cutter head 81 during the cross-cut driving operation, and collect the cuttings cut thereby. The scoop 101 is shown as having a bar 103 extending thereacross forming a bale to which a head rope 104 may be attached, for pulling the scoop into position to collect the cuttings cut by the cutter head 81 and for causing said scoop to follow the cutter head. The head rope 104 is shown as extending from the bale 103 toward the cutter head 81 and around a sheave 105 carried by an anchor bracket 106. From the

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sheave 105 the rope 104 is shown as extending to an unloading station 102 where the material cleared from the cross-cut by said scraper may be carried away. A hoist (not shown) may be provided at the unloading station 102 to operate said scraper. A tail rope 107 is shown as being secured to and extending directly from the bale 103. Said tail rope may also be secured to the hoist (not shown) to pull the scoop 101 to the unloading station 102.

The anchor bracket 106 is shown as being bifurcated and extending along each side of the sheave 105 and as having an integral sleeve 108, journaled on a shaft 109 on a bearing 110. The shaft 109 projects rearwardly from the hub 82 coaxial with the axis of rotation of the head 80 and is shown as being threaded therein although it may be formed integrally therewith or secured thereto in various other manners. The shaft 109 is shown as having a head or flanged outer end portion 111 abutting a thrust bearing 112, interposed between the outer end of the sleeve 108 and flange 111 and taking the thrust of the draft rope 104 as the scraper 101 is progressed along the mine bottom toward and from the loading station 102, and as the scraper is held by the draft rope 104 to follow the cutter head 80.

The anchor bracket 106 being freely mounted on the shaft 109, which rotates with the cutter head 80, is thus held in the position shown in Figure 9 by the weight of the depending portion of said anchor bracket and the sheave 105 journaled thereon, and by the reaction of the draft rope 104 against the sheave 105 during the cross-cut driving operation. A simplified reaction means for the draft rope has thus been provided, which is carried by the rotating head and is maintained in position by the forces of reaction of the draft rope thereon.

In the operation of driving a cross-cut or break-through in accordance with my invention, the drilling machine may be positioned transversely of the mine room, preferably with the forward ends of the guide rails 17, 17 abutting the rib, and may be held in position therein by means of roof jacks (not shown) in a well known manner. With the carriage 18 in an extreme retracted position along the guide rails 17 and the drill rod 14 in the chuck 21 and having a drill bit 15 mounted on its forward end, the machine may then be started in operation to rotatably drive the auger 13 and at the same time advance the carriage along the guide rails 17—17 toward the rib and feed the auger 13 into the rib and advance it entirely through the pillar and out the opposite rib in the next adjacent room. At this time the drilling machine may be stopped and the bit 15 may be removed from the end of said drill rod 14 by turning the bit free from its driving lug 29 and slipping it from the end of said drill rod. A cutter head like the cutter heads 33 or 69 may then be mounted on the free end of the drill rod 12, either by threading or by mounting on the cap piece 31 by the cap screws 34—34. The motor 19 may then be started to rotatably drive the drill rod 12 in the same direction as during drilling. The direction of rotation of the sprockets 23—23, however, is reversed to move the carriage 18 rearwardly along the guide rails 17—17 and withdraw the drill rod from the pillar and at the same time enlarge the hole drilled by the auger 13 with the rotary cutter head. As the cutter head advances into the rib, the spiral arrangement of the bit blocks and bits carried thereby will tend to convey the cuttings downwardly along the conical face of the cutter head to the auger 13 and the conveyor spiral 16, extending therealong. As the cutter head advances into the pillar to the position shown in Figure 2 the cuttings confining shoes 50—50 will be drawn into engagement with the inner periphery of the bore cut by the cutter head, and will slidably and yieldably engage said bore during rotation of the cutter head, and confine the cuttings to the face of the cutter head, to be conveyed by the spirally arranged bit blocks thereon and flow downwardly along the inclined face of said cutter head to the spiral 16 for removal from the bore. If desired, a conveying means (not shown) may

be provided at the discharge end of the spiral 16, to carry away the cuttings for loading. Said conveying means may be conveniently positioned along the rib at the discharge end of the pilot bore beneath the guide rails 17-17.

Where the cross-cut driving operation is effected by the cutter head 80, said cutter head may be secured to the projecting end of the drill rod 14 in the same manner the cutter heads 33 or 69 are secured thereto. The anchor bracket 106 being pivotally mounted at the rear end of said cutter head, the draft rope 104 may be trained over the sheave 105 and secured to the bail 103 of the scraper 101 and move said scraper into position adjacent the cutter head 80. The cutting operation may then progress by rotation of the cutter head 80 in an opposite direction to its direction of rotation while drilling. In this form of my invention the cuttings will fall directly on the ground and the scraper 101 will follow the cutter head into the bore by the reaction of the draft rope 104 against the sheave 105 on the anchor bracket 106.

It should here be understood that the draft rope 104 may be payed off as the scoop 101 advances with the cutter head and that tension may be maintained on said draft rope to cause the scraper 101 to follow the cutter head 80 during cutting by the application of the hoist brake. As the scraper 101 is loaded, power may be applied to the draft rope 107 to moving said scraper to the unloading station 102.

The unloading station 102 may be of any well known form and is herein diagrammatically shown as comprising an arm 115 extending from a prop 116. Said arm is diagrammatically shown as having a scraper 117 depending therefrom and transversely pivoted thereto. Said scraper may conform generally to the form of the scoop 101 and pivot upwardly as the loaded scoop 101 passes thereby, and drop to a vertical position as the load on the scoop has passed thereby. A stop 119 may be provided to hold the scraper in this vertical position as the scoop 101 is moved back toward the cross-cut, to eject the cuttings from the scoop, in an obvious manner.

It will be understood that various modifications and variations in the embodiments in my invention illustrated and described herein may be effected without departing from the spirit and scope of the novel concepts of the present invention.

I claim as my invention:

1. In a rotary cutter head, a drive member therefor, a securing member for said drive member secured to said cutter head and extending in advance thereof, said cutter head having a cutting face extending outwardly from and receding from said securing member, a plurality of spaced cutter bits carried by and projecting from said cutting face, certain of said cutter bits projecting beyond the periphery of said cutter head for cutting clearance therefor, a plurality of radial guides secured to and extending radially along said cutter head at the rear of the cutting face thereof, cuttings confining shoes slidably guided in said guides and having arcuate outer faces conforming to the periphery of said cutter head and forming an outward continuation thereof, and means connected between said cutter head and said cuttings confining shoes for biasing said cuttings confining shoes into engagement with the wall of the bore cut by said cutter head, for confining the cuttings cut by the outermost of said bits to the face of said cutter head.

2. A rotary cutter head having an outwardly extending conical cutting face receding from a central point, a securing member at the apex of said face for securing a drive member to project away from the apex of said cutting face, a plurality of cutter blocks having cutter bits projecting therefrom secured to and extending along said cutting face in the form of a spiral and facing in the direction of the apex of said cutting face, said cutter blocks positioning certain of said cutter bits to project

beyond the periphery of said cutting face to cut clearance therefor, and said cutter blocks forming a spiral conveying means conveying the cuttings toward the apex of said cutter head during the cutting operation thereof, and means to confine the cuttings cut by the outermost of said cutter bits to said cutting face to be conveyed toward the apex thereof comprising a plurality of cuttings confining shoes having circumferential outer faces forming an outward continuation of the periphery of said cutting face, radial guide means secured to the rear of said cutting face for guiding said cuttings confining shoes for radial movement outwardly from said cutting face, and spring means connected between said cutter head and said cuttings confining shoes for biasing said cuttings confining shoes outwardly from said cutting face into engagement with the bore cut thereby, to substantially close the space between the periphery of said cutter head and bore during the cutting operation thereof.

3. In a rotary cutter head adapted to be detachably secured to the leading end of a drilling auger to enlarge the hole drilled thereby upon withdrawal thereof, a securing member secured to the cutter head and extending therefrom axially of the axis of rotation thereof for detachably securing said cutter head to the free end of a drilling auger, said cutter head having a bit carrying face extending outwardly from and receding from said securing member, cutter bits on said bit-carrying cutting face facing toward said securing member, a plurality of cuttings confining members slidably mounted on the rear of said cutter head, guide means mounted on the rear of said cutter head rearwardly of said bit-carrying cutting face and having said cutting confining members slidably mounted therein for slidably mounting said cuttings confining members for radial movement with respect to said cutter head into slidable engagement with the bore cut thereby, and said cuttings confining members having bore engaging shoes spaced radially outwardly from the peripheral margin of said cutter head and conforming generally to the periphery to the bore cut thereby, and forming a rear continuation of said cutter head to confine the cuttings to flow along the face of said cutter head to the center thereof to be carried away by a drilling auger rotatably driving the same.

4. A rotary cross-cut driving head adapted to be detachably secured to the leading end of an auger to enlarge the bore drilled thereby by the operation of withdrawing the auger from the bore drilled thereby, comprising a securing member secured to the advance end of said cutter head and projecting in advance thereof for detachably securing said cutter head to the leading end of a drilling auger, said cutter head having a generally conical cutting face receding from said securing member as it extends radially outwardly therefrom, a plurality of cuttings confining members slidably guided on said cutter head at the rear of said cutting face and forming a continuation thereof of the outer margin thereof, means guiding said cuttings confining members on said cutter head for radial movement with respect thereto, other means interposed between said cutter head and said cuttings confining members for yieldably engaging said cuttings confining members with the bore cut by said cutter head, and a spiral strip extending along the conical face of said cutter head outwardly from the center thereof in the form of a reverse spiral and forming a conveying spiral to progress the cuttings to the center of said cutter head upon rotation thereof in a cutting direction and having a plurality of spaced cutter bit carrying blocks extending along said spiral strip for substantially the length thereof.

5. A rotary cross-cut driving cutter head having a conical cutting face, a plurality of cuttings confining shoes, guide means on the rear end of said cutter head guiding said shoes for radial movement with respect thereto, said shoes having bore engaging surfaces spaced outwardly of said cutter head and forming an outward

continuation of said cutter head, means interposed between said cutter head and said shoes for yieldably engaging said shoes with the bore cut by said cutter head and for confining the cuttings to flow down the face of said cutter head, a spiral strip extending along the face of said cutter head in the form of a reverse spiral, a plurality of cutter bit carrying blocks mounted on said spiral strip in spaced relation with respect to each other and cooperating with said spiral strip and cuttings confining shoes, to progress the cuttings cut thereby to flow inwardly along the face of said cutter head, and means detachably mounting the outer said cutter blocks on said spiral strip at various desired positions therealong, and accommodating said blocks to vary the diameter of the bore cut by said cutter head.

6. A rotary cross-cut driving cutter head adapted to be detachably secured to the free end of a drilling auger to enlarge the hole drilled thereby upon withdrawal of the auger, comprising a cutting face extending outwardly from and receding from said auger and having a plurality of cutter bits mounted thereon and extending therealong to the periphery thereof, a securing member at the axis of rotation of said cutter head and face for detachably securing said cutter head to the leading end of a drilling auger, and a plurality of cuttings confining shoes slidably mounted on the rear end of said cutter head rearwardly of said cutting face and extending radially beyond the periphery thereof and having sliding surfaces slidably engageable with the bore cut by said cutter head and rotatably moved therealong by said cutter head and having end surfaces facing in the direction of rotation of said cutter head and cooperating with said sliding surfaces to confine the cuttings to flow along said cutting face of said cutter head into the path of the drilling auger, for removal thereby.

7. In a rotary cutter head having an imperforate conical face, a securing member secured to said cutter head at the apex of said conical face, a drive member secured to said securing member for driving the same, said conical face receding from said securing member and said drive member, said cutter head having spaced cutter bit-carrying means mounted on said conical face, and facing substantially in the direction of said drive member, cutter bits projecting from said cutter bit-carrying means, certain of said cutter bits projecting beyond the periphery of said cutter head for cutting clearance therefor, said cutter bit-carrying means and bits being mounted on said conical face in the form of a conveying spiral, for progressing the cuttings inwardly along said conical face toward said drive member to be carried away thereby during the operation of cuttings.

cal face, a securing member secured to said cutter head at the apex of said conical face, a drive member secured to said securing member for driving the same, said conical face receding from said securing member and said drive member, said cutter head having spaced cutter bit-carrying means mounted on said conical face, and facing substantially in the direction of said drive member, cutter bits projecting from said cutter bit-carrying means, certain of said cutter bits projecting beyond the periphery of said cutter head for cutting clearance therefor, said cutter bit-carrying means and bits being mounted on said conical face in the form of a conveying spiral, for progressing the cuttings inwardly along said conical face toward said drive member to be carried away thereby during the operation of cuttings.

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