This invention relates to improved cutting heads for continuous rotary mining machines, and with regard to certain more specific features, to such a head employing improved material breaking and dislodging means.

Among the several objects of the invention may be noted the provision of a rotary cutting head having means adapted effectively to break and to dislodge the material adjacent to the kerfs cut thereby; the provision of a head of the class described having an improved non fouling pilot cutter; and the provision of apparatus of the class described which is extremely rugged in construction but flexible in its application to various conditions of materials encountered thereby. Other objects and features will be in part apparent and in part pointed out hereinafter.

The invention accordingly comprises the elements and combinations of elements, features of construction, and arrangements of parts which will be exemplified in the structures hereinafter described, and the scope of which will be indicated in the following claims.

In the accompanying drawings, in which one of various possible embodiments of the invention is illustrated,

FIG. 1 is an end view of a cutter assembly illustrating the invention;

FIG. 2 is a left side view of FIG. 1;

FIG. 3 is an enlarged jacketed frangible axial section taken on line 3-3 of FIGS. 1 and 4;

FIG. 4 is an enlarged section taken on line 4-4 of FIG. 2; and,

FIG. 5 is an enlarged detail section taken on line 5-5 of FIG. 2.

Corresponding reference characters indicate corresponding parts throughout the several views of the drawings.

It will be understood that the type of mining machine in connection with which the invention is described is a coal mining machine, but that the invention is applicable to machinery for mining other materials such as stone.

Referring now more particularly to FIGS. 1 and 2, there is shown at numeral 1, one of the usual pair of conventional rotatable shafts which extend forward from a conventional continuous coal mining machine (not shown). As is known, such shafts are driven in opposite directions and carry cutter heads for producing kerfs in the mine face, such as shown by broken lines at 3, 5 and 7, for example. The present invention relates to improvements in such heads. Only one head is shown by way of illustration, both heads used being of the same construction but rotating oppositely, as is usual.

At numeral 9 is shown a central crossarm attached by means of a suitable hub 11 to the shaft 1 for rotation therewith. The arm 9 forms a support for a centrally located tool holder 13. Holder 13 consists of a base 15 having attaching means therefor shown at 16. Extending axially from the base 15 around the center line of rotation C is a cup-shaped, open-ended pilot member 17, the outer rim 19 of the side wall of which is provided with the usual holders 21 for cutting tool bits 23, the latter being spaced at intervals around the rim 19. These surround the central opening 20 within the rim 19. The bits and tool holders are diagrammatically shown.

The side wall of cylindrical pilot member 17 has a comparatively large exit opening 25 on one side and a breaker-receiving recess 27 on its opposite side. Below recess 27 is a boss 39 in which is an opening 31 for the reception of the lower end of a journal 33, the center line or axis of which is shown at 35. The flattened upper end of the journal is attached by means of a transverse bolt 39 to another boss 37 above the recess 27, this boss being welded in place above the recess 27. In the absence of a bar 41, the journal 33 may be inserted into the opening 31. Thereafter the bar 41 may be welded into place. Before the journal 33 is mounted, it has applied thereto a breaker and dislodging roller cone 43. This is of right-conical shape relative to an axis 45, the latter being offset with respect to the axis 35 of the journal 33. The roller 43 is freely rotatable on the journal 33, and is backed at its large end by a thrust bearing 47. Since the roller axis is eccentrically mounted with respect to the journal axis (see eccentricity E on FIG. 4), its surface will upon rotation have a transverse wobbling or eccentric action (see the solid- and dotted-line positions in FIG. 4).

It will be understood that although the axis of rotation 35 of the roller 43 is shown parallel to the central axis of rotation C, this parallelism need not be strict but merely substantial. That is to say, a few degrees of divergence between these axes are acceptable, the important point being that the general direction of the axis of roller 43 cone shall be disposed in the general direction of the axis C. The term substantially parallel is intended herein to define such a condition. In any event, the roller orbits around center line C.

The recess 27 is closed behind the roller cone 43 by means of a sloping deflecting and breaker plate 49, which is welded to the base 15, bosses 29 and 37 and rim 19. This is positioned within the orbit of roller 43. An opening 51 is provided for reception of a nut 53 which holds the bolt 39. An inner deflecting wall plate 55 is welded near the base of the roller plate 49 and extends obliquely to the bottom of the opening 25, at which region it is also welded.

Opposite the opening 25, the pilot base 15 is provided with a spaced upstanding, axially directed cutter support or bracket 57, the outer end of which carries additional holders 21 for additional cutting tool bits 23. The support 57 is provided with an opening 59 for the reception of a rigidly welded bushing 61, in which is a rigidly welded journal 63. The axis of the journal 63 is shown at 65, being located in a plane perpendicular (transverse) to the axis C. Rotatable on the journal 63 is a conical breaker disc 67, a central bearing 69 of which is coaxial with the center line 65 of the journal 63. The disc 67 is constituted by a right cone constructed on an axis 71 which is angularly related to the axis 65, as indicated at A in FIG. 3. As a result, when the disc 67 rotates on axis 65, its surface (built as a right cone on axis 71) will have a wobbling effect across the plane of rotation, as illustrated by the dotted lines in FIG. 3.
Referring again to FIGS. 1 and 2, the outer ends of the arm 9 are provided with hinge joints 75 for endwise hinged supports 75 and 77. Positioning bearing surfaces are shown at 79. Since the apparatus mounted on each support 75 and 77 is the same, that on support 77 only will be described in detail, like numerals designating like parts on the other support 75.

The members supported on hinge support 77 (for example) comprise a plate 81, held by fasteners 83. A segmental circular solid wall 85 extends from plate 81. At its outer end 89, a boss 87 on pilot tool 23. In the wall 85 is mounted a pin and conical disc arrangement such as that described in connection with FIGS. 3 and 4, like numerals designating like parts in these particulars. This disc arrangement has the same wobbling action as that already described.

Fastened also to the support 77 is another plate 87, held by fasteners 89 and having an upstanding segmental circular solid wall 91, provided at its outer margins with additional tool holders 21 for tool bits 23.

In view of the above, it will be seen that, upon rotation of the shaft 1, the bits 23 on the pilot rim 19 will cut a kerf of relatively small diameter surrounding a central plug of material 93 which projects into opening 20 as the machine progresses toward a mine face. The plug 93 becomes engaged by the rotating deflector and breaker plate 49 and is broken into pieces which are deflected out of the path 25 by means of both deflector plates 49 and 55 (see parts M). The pieces impinge upon the outside rim of the kerf 2 and tend to break it and themselves by impact.

The bits 23 on support 87 cut the annular kerf 3 to a depth which at any given time is less than the depth of the kerf 2. Kerf 5, preferably of the same depth as kerf 3, is also produced by the cutters 23 on the members 81, and another annular kerf 7, preferably of the same depth as kerf 5, is cut by the tools 23 on the members 87. The kerf 7, while shown on FIG. 1, does not appear on FIG. 3. Kerfs 2 and 3 leave an upstanding cylindrical rim of material 95 therebetween, and kerfs 3 and 5 leave an upstanding cylindrical rim of material 97 therebetween. The locations of these are indicated in FIG. 1, as well as FIG. 3. An upstanding cylindrical rim of material 99 occurs between kerfs 5 and 7. Out of kerf 5, as shown in FIG. 3.

The wobbling cone 43 impinges and pounds on the inside margin of the cylinder of material 95, breaking it outward by impact. The wobbling disc 67 on support 57 impinges and pounds on the inside margin of the cylinder of material 97 and breaks it outward by impact. The wobbling disc 67 on plate 81 impinges and pounds on the inside margin of the cylinder of material 99, breaking it outward by impact. The result is thorough breakage and dislodgement of all material from the area bounded by the outside of kerf 7. The material falls away freely, out of the opening 25 in the case of the material removed by the cutters 23 on pilot 17; and in the case of the remainder cutters 23, it freely falls away around the supports 57, 85 and 91. It will be understood that as rotation occurs, the machine which mounts the duplicating shafts such as 4 advances toward the wall of material being cut, the reaction pivot 77 and back against the contact surfaces 79 between them and the ends of arm 9. This pivotal arrangement produces some shaking effect on the walls 85 and 91, which aids in material breakage and dislodgement.

The reason for employing the elongate cone shape for the breaker roller 43 on the pilot member 17 and the flattwise disc shape for the roller 67 is that the former operates upon a wall of material having a smaller radius of curvature than does the latter. There is less tendency to jam the elongate type of cone having its axis 35 parallel to the axis of rotation C on a small radius of curvature, than would be the case if the short disc type of cone such as 67 were used in that location. On the other hand, the disc-like cones such as 67 are more effective on larger radii of curvature of the materials being broken down. In either case, the eccentricity between the conical shape and their respective axes of rotation provides the wobbling or eccentric actions, which have the effect of jarring loose and breaking the material engaged.

As to the roller cone and disc on the pilot head 17, their eccentric wobbling actions transverse to another result in an effective shaking action on the pilot head which further facilitates material breakage. Such a compound shake extends also to the other cutters and disc carried on arm 9.

It will be noted that all of the conical members 43 and 67 operate upon the insides of the arches of material forming the rims 95, 97 and 99, thus placing the material in tension rather than compression. Under tensile stresses, both coal and stone break more readily than under compressive stresses. In the case of the pin 93, it is so small that is readily broken crosswise by the circular rubbing of the deflector plate 49. The entire construction is exceptionally rugged, requiring a minimum of attention for upkeep.

It is clear from FIG. 1 that the inner roller 43 operating in kerf 2 is angularly staggered in position relative to the next outer roller 67 operating in kerf 3, and that the latter is staggered with respect to the two outermost rollers 67 operating in kerf 5. Thus the outward breaking action of one roller in one kerf is not blocked by any object located in the next outer kerf on the same radial line.

In view of the above, it will be seen that the several objects of the invention are achieved and other advantageous results attained.

As various changes could be made in the above constructions without departing from the scope of the invention, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

1. A rotary cutting device for a mining machine, comprising a central pilot head member rotatable about a central axis and having cutters mounted on the outer rim thereof to cut an annular kerf corresponding to the diameter of said head member, said head member having openings at opposite sides behind said cutters, a conical breaker roller positioned in one of said openings and freely rotatable about an axis extending in the same general direction as said central axis, a deflector plate fixed at one end to said side wall behind said cutter and forward of said roller and inclined rearwardly and toward the other side of said head member and having one face opposite to but spaced from said roller and having its other face opposite to the opening in the other side of said head member, said roller having journal bearings at opposite ends in fixed relation to said deflector plate, said deflector plate and roller forming a wedge-like unit having oppositely facing sides, fixed on the head member and rotating relative to the head member, respectively, and engageable, respectively, with the opposing inner and outer faces of a kerf formed by said cutters.

2. A cutting device according to claim 1 in which the surface of the conical roller is eccentric relative to the roller axis and wobbles during its rotation.

3. A rotary pilot cutting device for a mining machine comprising a cup-shaped forwardly open-end pilot head which is rotatable about a central axis and has a side wall with cutters disposed around the marginal rim thereof and at the open end to cut an annular kerf in said wall having an aperture behind the cutters, a conical roller positioned in said aperture with its axis extending in the same general direction as said central axis, said roller having journals with bearings on said wall forwardly and rearwardly of the roller, a portion of the roller projecting laterally outwardly from said wall to
contact the outside of the kerf formed by said cutters and a portion of the roller projecting laterally inwardly from said wall, said head having a second aperture spaced angularly from said roller, and an inclined plate alongside but spaced from the inwardly projecting portion of the roller and secured at its outer end to the wall forward of the roller and secured at its inner end to the wall rearward of the roller, said plate being constructed and arranged to contact the inside of the kerf and to deflect seam material within the pilot head away from the roller and out through said second aperture.

References Cited in the file of this patent

UNITED STATES PATENTS

2,594,256 Compton ------------ Apr. 22, 1952
2,725,222 Robbins et al. ---------- Nov. 29, 1955
2,734,732 Tracy ------------------ Feb. 14, 1956
2,753,167 Brown ------------------ July 3, 1956
2,754,099 Tracy ------------------ July 10, 1956
2,818,242 Smith ------------------ Dec. 31, 1957
2,868,528 Cartlidge et al. ------ Jan. 13, 1959
2,879,049 Poundstone ----------- Mar. 24, 1959
2,939,690 Poundstone ----------- June 7, 1960