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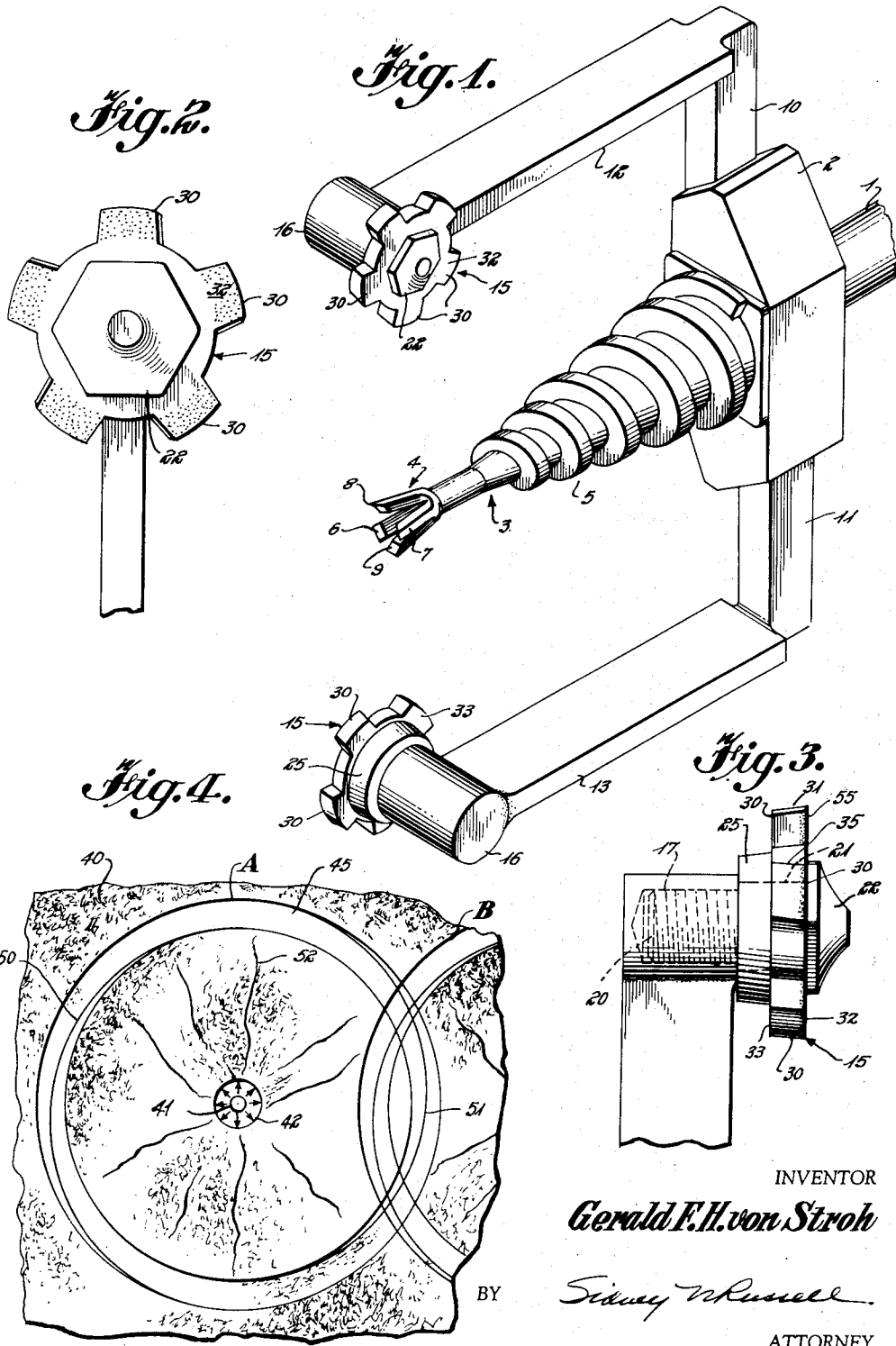
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ROTARY CUTTER BIT

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2 Sheets-Sheet 1



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2 Sheets-Sheet 2

Fig. 5.

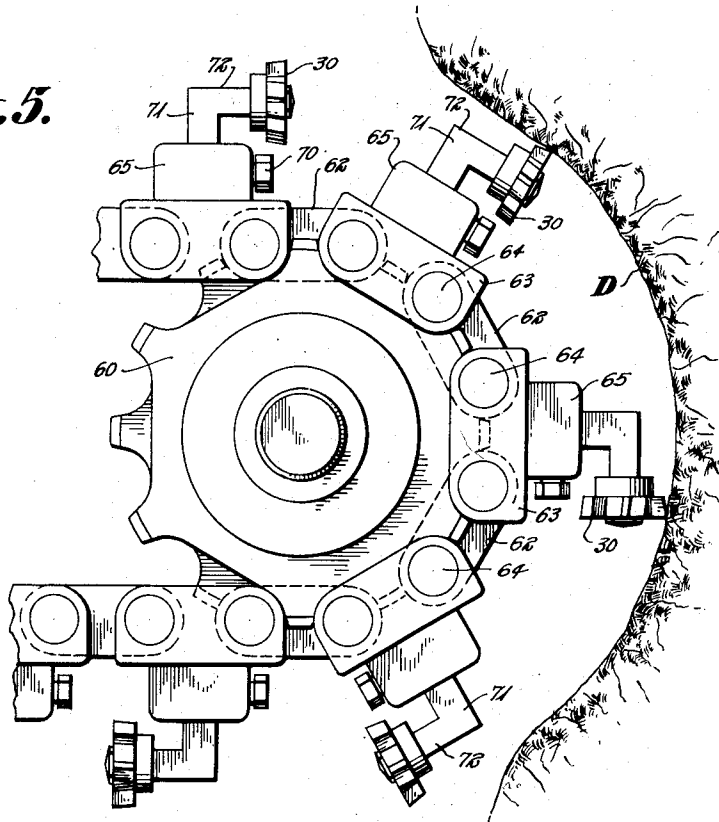


Fig. 7.

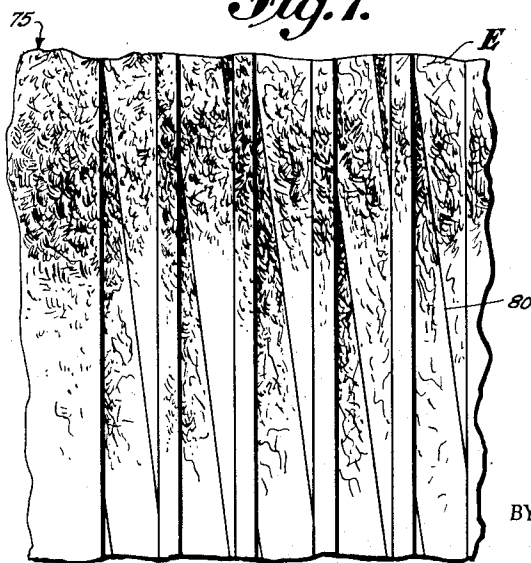
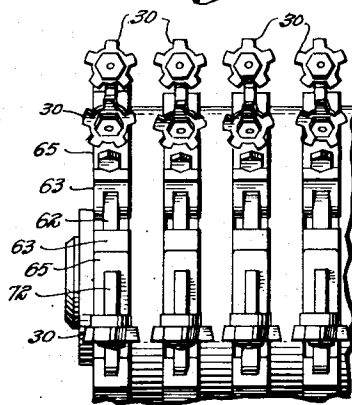


Fig. 6.



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ROTARY CUTTER BIT

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This invention relates to a cutter bit for use in conjunction with a mining machine and may be more particularly described as a rotary cutter bit adapted for insertion on the bit holder of such a machine and designed to revolve as the result of its spiral cutting action. Although useful in analogous arts, the invention is particularly adapted for use with continuous coal mining mechanisms.

In this respect the bit is suitable for use with many types of such machines. For example, the bit may be utilized upon the rotor arms of machines employing the rotary method of mining and similarly the bit may be used upon machines employing the continuous chain cutting principle. In fact, any machine provided with bit holders of various types, and previously adapted for holding various types of stationary bits, may be fitted with the device comprising my invention with little or no adjustment thereof to such mechanisms. Thus, the device of this invention may similarly be applicable to chain undercutters employed in conjunction with machines of the rotary and related type.

Bits previously used upon machines of the continuous type and employing, for example, either the continuous chain or rotary cutting principle, have been stationary and single edge bits. Such bits, although made of the hardest of metals or alloys such as high carbon steel, or in this art, "drill steel," are definitely subject to inordinate wear with a rapidity that necessitates repeated changing or replacement of the bits. Such stationary bits of this common type present only a single cutting surface; they are prone to overheat because of continuous and constant contact under high pressures with the surfaces being cut; and the expense of replacement is a considerable item in an industry, such as the coal industry, where even a fraction of a cent per ton of coal mined spent on such an item may become most significant as an extreme in mining cost.

It is the purpose of this invention, therefore, to obviate the many disadvantages which are inherent in stationary bits heretofore used in machines of the described type. A primary object of the invention is the provision of a bit for cutting coal of a structure and design that is conducive to longer operating life, thereby eliminating the necessity of frequent and repeated bit changes. Such changes, requiring a complete shutdown of operating procedures during same, often take as long as a half-hour and frequently exceed that much time. If the

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changes must be made in comparatively rapid succession, as is often the case, there results a consequent loss of man hours, decrease in mining efficiency and increase in cost of production. By the use of my invention, contemplating a cutting element of comparatively longer life and greater durability, this bit changing procedure is diminished to an absolute minimum with a consequent elimination of such losses.

It is a further object of this invention to provide a bit of a rotary type having teeth on the periphery thereof positioned at an angle to the axis of rotation in such manner that as the unit is rotated upon the rotor arm of a mining machine of the type referred to, or moved for cutting in any direction upon the lug of a chain type machine, the teeth of the bit create a spiral kerf, with consequent rotation of the bit, thereby presenting alternate teeth thereon to the surface of the kerf. By this construction, no matter how many teeth may be provided on the rotary bit, at least approximately half of that number are not cutting, only the remaining half presenting a cutting surface to the kerf.

Another object of this invention is to provide a bit of the type hereinbefore generally described, that is simple in structure, adaptable to many types of continuous mining machines and related mechanisms and which may be commercially produced at a minimum of cost.

With such objects in view, as well as other advantages which may be incidental to the use of this invention, my invention will now be described in more particular by reference to the following drawings, wherein like numerals refer to like parts, and wherein:

Figure 1 is a perspective view of the rotary cutter bit as mounted upon the rotor arm of a continuous mining machine.

Figure 2 is a front elevation view of the rotary cutter bit shown in Figure 1.

Figure 3 is a side elevation view of the invention shown in Figure 2.

Figure 4 is a front elevation view, diagrammatic in form, of the type of kerf formed by the use of this invention.

Figure 5 is a side elevation view of the cutter bit inserted in the bit holders or chucks of a chain cutting machine.

Figure 6 is a front elevation view, partly in section, of the invention shown in Figure 5, illustrating a plurality of bits in aligned position.

Figure 7 is a front elevation view of the face of a seam of coal illustrating the manner of cutting of the invention when applied to a ma-

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chine of the lug or link type provided with a plurality of cutting elements.

Referring more particularly to the drawings, it will be seen that in Figure 1 is disclosed a pair of oppositely disposed rotor arms between which is mounted a bursting screw. The rotor unit is revolved through the application of a suitable force such as drive shaft 1. Mounted on the shaft a hub 2 provides support for two members 10 and 11 extending from opposite sides of the hub and at right angles to the drive shaft 1. Parallel to the said shaft and preferably formed integrally with members 10 and 11 are the two rotor arms 12 and 13, providing supports for the cutter bit, as will later be described. The complete unit, as shown in Figure 1, is adapted to be moved forwardly, or in the direction of arms 12 and 13, so as to exert thrust against the face of a seam to be mined.

As stated, between these two arms 12 and 13 is positioned a bursting screw, generally indicated at 3. This element, as will be generally understood, is designed to force its way into the face of the coal due to the application of forward thrust thereto and to the spiral threads 5, formed thereon throughout substantially the entire length of element 3. The consequent gradual penetration of the screw with rotation thereof presents an increasing diameter to the kerf which ultimately causes a breakdown or bursting of the coal within the circumference circumscribed by the revolving rotor arms. Such a bursting screw is provided with a center bit 4, here represented as being comprised of four extending cutting edges 6, 7, 8 and 9, mounted in oppositely disposed pairs. The provision of such a bit is, of course, to bore an initial entrance way for penetration of the bursting screw in the described manner. Each of the rotor arms proper 12 and 13 terminate in an end structure 16 adapted as a mount for the rotor bit. As here shown, these end structures 16 are similarly enlarged portions on each end of the rotor arms.

The rotor bit, as shown at 15, Figure 2, is of circular configuration, the cutting surfaces comprising extensions 30 protruding radially of the circumference of the main body of the unit. Each of the end members 16, being adapted to accommodate the rotor bit in a firm manner, are provided with a bore 17 suitably tapped or threaded for the purposes to be described. The rotor bit 15, more particularly shown in Figure 3, is here shown as made with a strengthening portion 25 in the form of a boss, the latter either being formed integrally with the bit 15, or welded or braised thereto in any suitable manner. The bit 15 as well as the adjacent boss 25 are both apertured as at 21 to receive the shank portion of a bearing nut 22. The remaining portion of the latter is of reduced diameter and is threaded as at 20 for threaded engagement with the bore 17.

The shank portion 21 of the bearing nut 22 may be of a length slightly in excess of the overall width of bit 15, including boss 25, in order to provide an operable clearance on each side of the bit. As will be understood by reference to Figure 3, the bit may then be retained in position on said shank portion by tightening bolt 22 to a sufficient extent to force the shank portion tightly against the face of element 16. In this way, although the shank or bearing portion 21 is maintained in a stationary position with respect to the rotor arm, clearance provided by the greater length of the shank portion, as de-

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scribed, will permit free rotation of the rotor bit upon this bearing surface.

Sufficient clearance to assure free rotation of the bit may also be accomplished in the following manner. Bore 17 may be threaded for a portion of its length only, but sufficiently so that when nut 22 is tightened it becomes secure at a point where shank 21 is protruding from member 16 a distance slightly exceeding the width of bit 15 and boss 25. Any other method of mounting within the skill of the art may be utilized that maintains the member 16 in a secure manner but permits free rotation of the bit in the desired fashion.

The end surfaces of each cutting element 30 are also disposed angularly to the axis of rotation of the bit, as shown at 31. Thus the outer surfaces 32 of projections 30, having the greater radius, circumscribe a circumference greater than the inner surfaces 33 of elements 30 which have the lesser overall radii. Hence, the surface 31 of said elements angularly inclines towards said axis from the outer face to the inner face of said elements. This angle may approximate from 5° to 7° to the center line axis of the bearing nut 22, although such angle may be varied within reasonable limits to suit various mining conditions. It will be seen that elements 30 when provided with this angular cutting edge provide a sharp surface to the seam. Even as wear progresses, the described configuration of the cutting elements 30 continue to present a sharp cutting edge.

My invention contemplates also a bit having self-sharpening features. This is accomplished by hard surfacing the face 32 of the elements 30. Hard surfacing may be accomplished by methods generally known in the art as, for example, cladding the face with tungsten carbide, or providing a hard face which is rolled on the cutting surface in accordance with well-known methods. As here represented, the hard face of the bit proper is designated at 55. With the bit so constructed, it will be apparent that as wear increases, the remaining portion of the elements 30 behind the hard facing will wear more rapidly as that portion thereof is of relatively softer material. Therefore, even though the elements 30 may decrease in size as the result of such wear, the hard facing will continue to present a cutting face exceeding the size of the trailing edge of each element 30, and thus offering a continuously sharp edge to the kerf, the surface 31 being maintained at an angle to the longitudinal axis of the bearing element as heretofore described. The main body of the bit, as well as the reinforcing boss, may be made of softer and less costly materials. I have found that the bit is still useful and will cut satisfactorily even after more than a half portion of the teeth are worn off through continued use. Actually, the bit here shown, comprised of five teeth, is in essence five bits in one, and hence the wearing quality and durability thereof, several times that of the single-edge stationary bit heretofore known.

As has been previously stated, each of the cutting projections or teeth 30 are also formed with the sides thereof at an acute angle to the axis of rotation of the bit. This angle may be clearly understood by reference to Figure 3 wherein the respective sides of the teeth, as at 35, are disposed angularly with respect to said axis or to the longitudinal centerline of bearing nut 22. The angle referred to may be computed with reference to

either side of that centerline, the only difference being that rotation of the bit during cutting with the angle measured from one side thereof will be in one direction and, conversely, rotation will be in the opposite direction if measured with respect to the opposite or complementary side of said centerline.

I have observed that satisfactory performance of the bit may be obtained by forming the sides of the teeth thereof at any angle within the range of 5° to 15° from said axis of rotation. However, I have found a preferable operation to be obtained by provision of an angle of 7° from this axis. At the latter angle, the spiraling effect of the teeth will, under most operating conditions cause approximately one complete rotation of the bit during 180° travel of the rotor arms. Of course, the desired rate of rotation of the bit is necessarily dependent upon a number of variable factors, such as, among others, hardness of the seam being mined, speed of rotation of the rotor arm, and amount of thrust exerted on the bit.

Referring to the sides of the separate teeth, they may be parallel to each other or deviate from the parallel. I have found it preferable to form these sides in such manner that they converge slightly toward the trailing edge of the cutting elements 30. This formation, which is clearly depicted in Figure 3, is designed to permit the coal particles which have been cut to more readily flow between the elements and past the trailing edges thereof. In any event, such deviation from the parallel is not such as to substantially interfere with the angularity of the sides of the cutting elements with respect to the longitudinal axis of the bearing member for the reason that such an angle is necessary to promote self-rotation of the bit as it performs its cutting operation.

It will be observed that there is a direct relationship between the angular disposition of the cutting teeth and the speed of rotation of the bit. For example, the rate of rotation of the bit, during the cutting operation when forward thrust is exerted against the face, will be comparatively greater when the angle is large, and conversely, that rate will decrease as the said angle is decreased. However, disposition of the teeth at a large angle to said axis or centerline of bearing element 22 will require commensurately more power as compared to the force necessary when the angle is of lesser degree. The consideration of these several factors have indicated that the 7° angle referred to in the foregoing produces the most uniform and beneficial result under average operating conditions.

This characteristic of the invention, namely self-rotation of the bit when cutting due to the spiraling effect of the teeth thereof, may be better understood by reference to Figure 4. In this figure, the kerfs made by this bit are illustrated at A and B. The bit, as stated, is employed in conjunction with the bursting effect of element 3. This latter effect, indicated by the small arrows at the center of kerf A, is obtained through the penetration by the cutter 4 at 41 and the burster 3 at 42, both at the center of the circular cut 45 of the rotor bit. The conjoint and expanding forces thus employed cause an immediate and effective breakdown of the coal which becomes serrated with numerous fractured surfaces such as those diagrammatically illustrated in Figure 4 at 52.

The bit may, of course, be employed on a plurality of rotor arms where desired. In Figure 4,

an additional cut of the bit is illustrated at B, the latter intersecting kerf A, previously described. The bit will perform effectively in the same manner, whether a series of rotors are employed which have overlapping or intersecting radii during operation, such as those shown, or whether multiple rotors are utilized which are arranged for tangential or individual cutting with respect to each other. Similarly, the rotary cutter bit is adapted for use upon multiple chain cutters, as shown in Figures 5, 6 and 7.

As heretofore indicated, the cutter bit comprising this invention is also applicable to many other types of mining machines and particularly those of the continuous link or chain principle. In Figure 5 is disclosed the bit mounted upon the lugs of such a chain type mechanism. The chain is, of course, driven over a sprocket 60 in a manner well known to the art, the chain itself being comprised of a series of links 62 interconnected with a series of lugs 63 by the usual interconnecting link pins 64. Each of the bit holders 65, as is usual in the art, is provided with a suitable aperture or chuck for the reception of various types of stationary bits as heretofore described. In the application of my invention to a machine of this type, the rotary cutter bit is mounted upon a shaft 72 disposed right angularly and preferably integral with member 71 adapted for insertion in such aperture. It will thus be seen that the rotary bit is thus positioned upon an axis of rotation which is parallel to the direction of cutting. The bit, as will be well understood by those skilled in the art, is maintained in place by the use of a side set screw 70 disposed in the bit holder. This figure illustrates the use of the rotary bit in conjunction with the mechanism just described in such manner as to cut a kerf D of the configuration shown. Of course, such machines generally employ a plurality of bits which are positioned in alignment as shown in Figure 6.

Referring to Figure 7, a front elevation of the kerf cut by this type of machine is indicated at 75. The rotary bit in making individual kerfs as at E will rotate in the manner described, each of the teeth thereof creating a spiral cut in the face of the seam as generally indicated at 80. Thus employment of the bit upon this type of mechanism performs the same functions and obtains the same results and advantages. I contemplate using the bit in machines of any analogous type since it will be seen that as long as the bit is mounted with its axis of rotation parallel to the direction of movement forwardly, the bit will function in precisely the same manner as herein described.

From the foregoing, it will be understood that by reason of the angular cutting teeth, rotation of the bit is self-induced, each of said teeth describing a spiral, here illustrated at 50, 51 and 80. In this manner, only some of the teeth of the bit are cutting at any one time. For example, the bit shown is provided with five teeth. During the cutting operation, approximately only two of these would be operative at any given moment. The bit can be made with any number of teeth, as required by specific conditions, but in any case, it will be readily appreciated that approximately only half of such cutting teeth are presented to the kerf at a given instant.

It is also to be observed that bits made in conformity with my invention will promote flexibility in machines of the continuous type. Such is accomplished by the propensity of the bit to lessen binding thereof as the machine turns cor-

ners of comparatively small radii. Since the bit is of the rotary type and is continually in motion upon its own axis during the cutting operation, the turning abilities of any given machine are substantially increased over the turning capabilities of the same machine when provided with stationary bits of the type heretofore used.

It is obvious that this invention may be varied in many ways and other expedients employed to accomplish the purposes thereof; however, it is to be understood that my invention is only limited by the scope of the following claims.

What I claim is:

1. A cutting device having a forward cutting face for the mining of an ore or coal seam comprising a circular element, a shaft, said element being rotatably mounted on said shaft, means to drive said shaft forwardly, projecting spaced teeth on the periphery of said element, said teeth from front to rear thereof having sides disposed approximately parallel to each other and angularly to the center line axis of said shaft, whereby when said shaft is driven by said driving means said element cuts a spiral groove in said seam and is thereby caused to rotate.

2. A cutting device for the mining of coal comprising a shaft, a circular rotatable element having a forward cutting face rotatably mounted upon said shaft and adapted to bear against the face of the coal, means to drive said shaft forwardly, said element having a plurality of teeth extending from the periphery thereof, the sides of said teeth from said face rearwardly being disposed in approximately parallel planes and at an acute angle to the center line axis of said shaft, whereby when said shaft is moved forwardly, said element is rotated by reason of said angular formation of said sides and spiral cutting effect of said teeth in said face.

3. A cutting device for the mining of coal comprising a shaft, a circular, rotatable element having a forward cutting face mounted for rotation upon said shaft and adapted to bear against the face of the coal, means to drive said shaft forwardly, said element having a plurality of teeth provided with forward cutting edges and trailing edges, the sides of said teeth converging slightly towards the trailing edges thereof, said sides being disposed at an acute angle to the center line of said shaft, whereby when said shaft is moved forwardly, said element is rotated by reason of said angular formation.

4. A cutting device for the mining of coal comprising a shaft, a circular, rotatable element having a forward cutting face, mounted for rotation upon said shaft and adapted to bear against the face of the coal, means to drive said shaft forwardly, said element having a plurality of spaced teeth provided with forward cutting edges and trailing edges, the sides of said teeth converging slightly towards the trailing edges thereof, said sides being disposed at an angle from 5° to 15° to the center line of said shaft, whereby when said shaft is moved forwardly, said element is rotated by reason of said angular formation.

5. In a continuous mining machine adapted to exert forward thrust in a direction approximately at right angles to the face of the seam to be mined, a shaft mounted parallel to said direction having means for rotation thereof, a rotor arm on said shaft, a bearing element on said arm tangentially positioned with respect to an extended radius of said shaft, seam cutting means rotatably supported on said element, said cutting means comprising a circular member

having a plurality of peripheral cutting teeth thereon, said teeth having substantially parallel sides which are disposed at an angle to the longitudinal axis of said bearing element, said teeth having a leading edge and a trailing edge and a substantial cutting surface therebetween, the leading edge having a greater radius than said trailing edge, said surface being disposed at an angle of from 3° to 10° to the center line of said bearing element, whereby upon exertion of said thrust said teeth cut a spiral path in said face thereby rotating said element.

6. A multiple rotary cutter bit for use on mining machines, comprising a bearing member having a circular element rotatably mounted thereon, said element having a plurality of spaced teeth with forward cutting surfaces extending outwardly from the periphery of said element, said teeth from said surfaces rearwardly having sides disposed in approximately the same direction and at a 5° to 15° angle to the longitudinal axis of said member, and said teeth terminating in top surfaces which are angularly disposed downwardly from said cutting surfaces toward said member.

7. A cutting device having a forward cutting face for the mining of coal comprising a circular element, a shaft, said element being rotatably mounted on said shaft, means to drive said shaft forwardly, projecting spaced teeth on the periphery of said element said teeth from front to rear thereof having sides disposed approximately parallel to each other and at an angle of approximately 7° to the center line axis of said shaft, whereby when said shaft is driven by said driving means said element cuts a spiral groove in said seam and is thereby caused to rotate.

8. A multiple rotary cutter bit for use on mining machines comprising a bearing member having a circular element rotatably mounted thereon, said element having a plurality of spaced teeth with forward cutting surfaces extending outwardly from the periphery thereof, said teeth from said surfaces rearwardly having sides disposed in approximately the same direction and inclined at an acute angle to the longitudinal axis of said member, and said teeth terminating in top surfaces which are angularly disposed downwardly from said cutting surfaces towards said member.

9. A multiple rotary cutter bit for use on mining machines comprising a bearing member having a circular element rotatably mounted thereon, said element having a plurality of teeth with forward cutting surfaces extending radially outwardly from the periphery thereof, each of said teeth being spaced an equal distance from the teeth adjacent thereto whereby said element is evenly balanced for rotation, said teeth from said surfaces rearwardly having sides disposed in approximately the same direction and inclined angularly to the longitudinal axis of said member, each of said teeth terminating in a top surface which is angularly disposed downwardly from said cutting surface toward said member.

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