

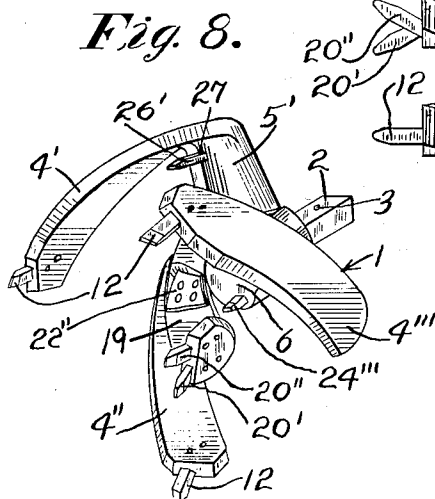
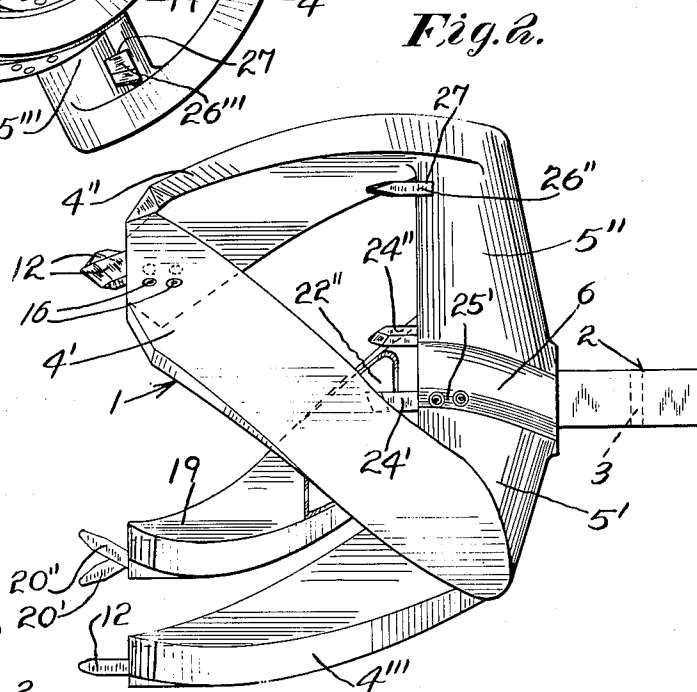
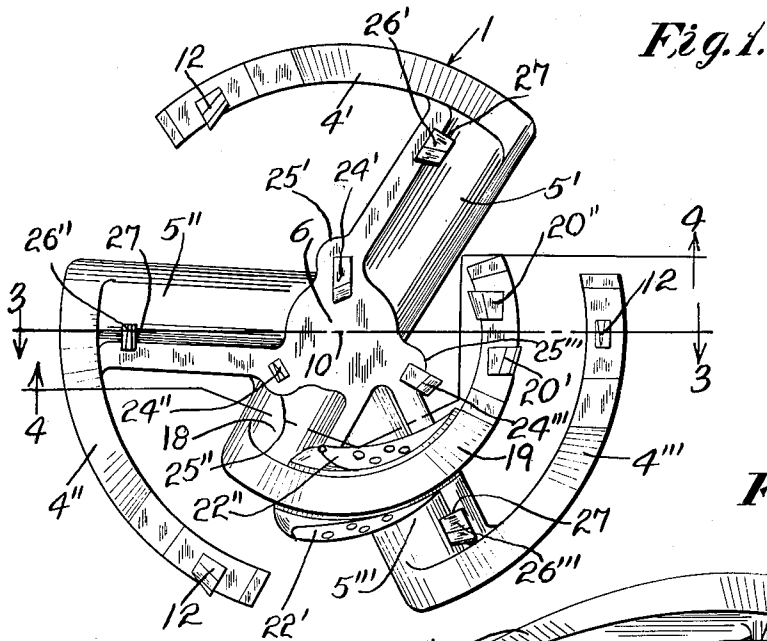
June 5, 1956

A. L. BARRETT
AUGER DRILL HEAD

2,749,104

Filed Jan. 26, 1952

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Fig. 3.

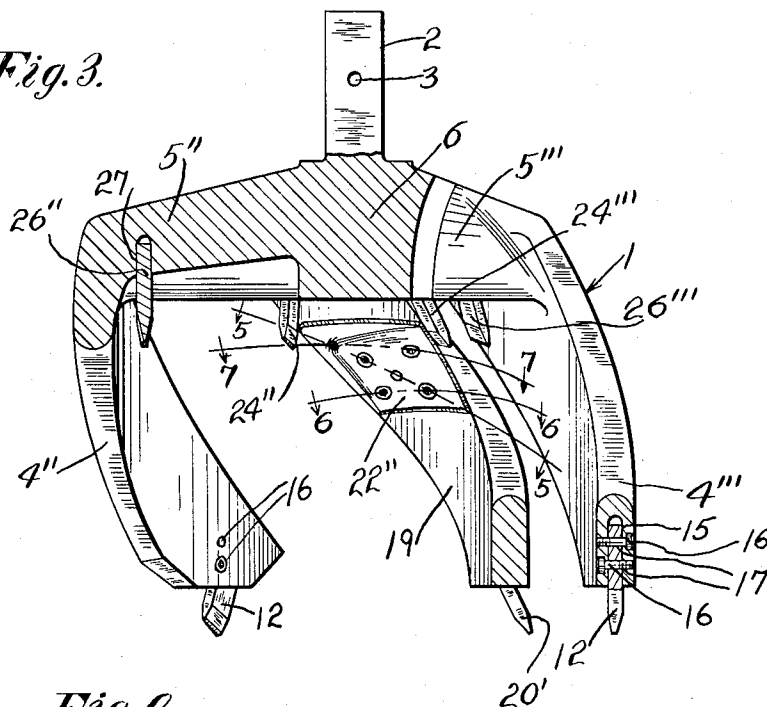


Fig. 4.

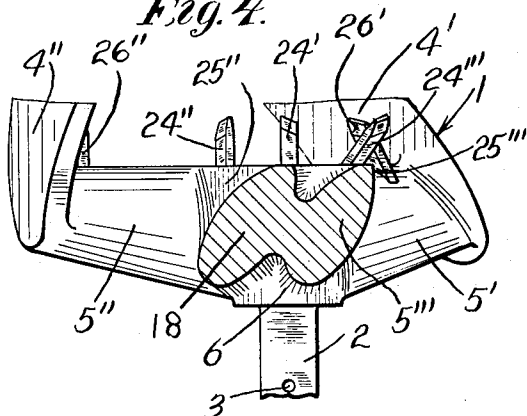


Fig. 5.

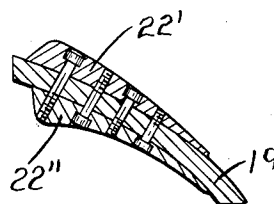


Fig. 7.

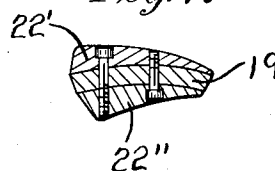
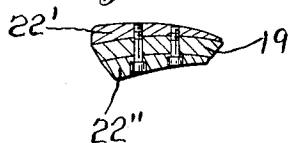


Fig. 6.



Inventor:
Arthur L. Barrett.

by

Louis A. Marm.
Attorney.

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Fig. 9.

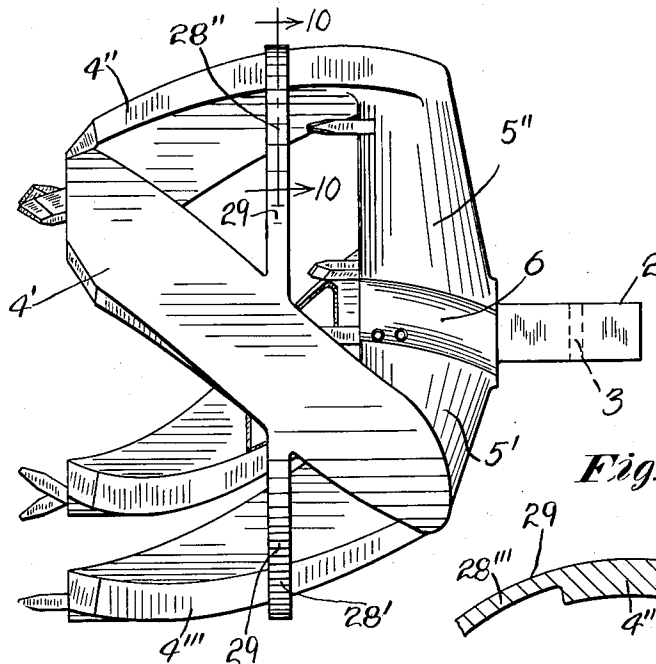


Fig. 10.

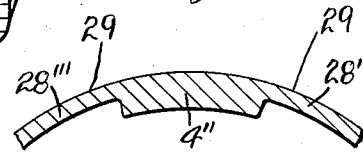
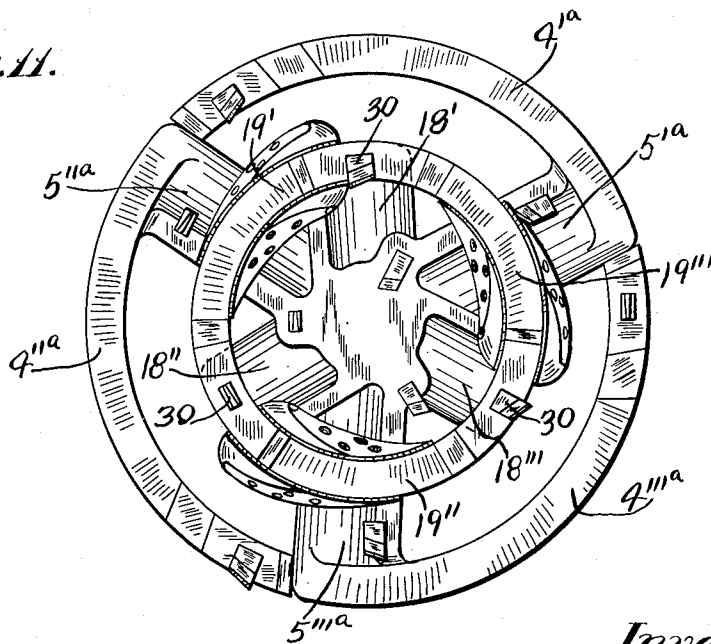


Fig. 11.



Inventor:
Arthur L. Barrett.
by
Paul A. Maxam,
attorney.

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2,749,104

AUGER DRILL HEAD

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

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14 Claims. (Cl. 262—26)

This invention relates to auger drill heads, and particularly to auger drill heads adapted to be arranged at the forward end of driving and helical conveying means for the purpose of forming relatively large openings in mineral veins, either for the purpose of forming tunnels or bores, or for the purpose of mining mineral, particularly from relatively thin seams, for use.

It is an object of the invention to provide an improved auger drill head. It is another object of the invention to provide an improved auger drill head which shall be simple in construction, rugged, minimize the breaking of the mineral into fine particles, effectively move the mineral broken from the face to an associated helical conveyor, and insure prevention of unfractured portions of the solid mineral which might stall the forward feeding movement of the auger drill head. It is a further object of the invention to provide an improved auger drill head which can be readily handled and be rolled on its own periphery to and from working relation to its actuating means, and which will readily maintain a rectilinear path during drilling. Other objects and advantages will hereinafter appear.

A preferred embodiment of auger drill head constructed in accordance with the invention comprises a plurality of arms carrying at their forward ends material-attacking element (e. g. bits) and all disposed in the space between a pair of coaxial surfaces of revolution (desirably cylindrical surfaces) whose axes lie in the same straight line with the axis of rotation of the auger head, and at least one other arm (there may be a plurality), material-attacking-element-equipped at its forward end and disposed in the space between two other surfaces of revolution (preferably cylindrical surfaces) coaxial with the first mentioned surfaces of revolution and nearer the axis of rotation of the auger head. The auger head includes means for supporting the several arms and rotating them together. Desirably such means will include a hub, and said arms will be supported upon said hub by outwardly projecting arms having substantial spaces between them through which broken mineral can pass, the outwardly projecting arms supporting said plurality of arms being of greater radial projection than the outwardly projecting arm which supports said another arm. Desirably said plurality of arms which carry material-attacking elements will all be helically disposed and project forwardly, the forward projection of said helically disposed arms being substantially equal. Mineral-wedging means will desirably be associated with certain of said arms, it being normally sufficient to associate such wedging means with the inner helically disposed arm or arms and desirable to provide such wedging means (wedges) at the radially inner and outer sides of said arm. The relation of the wedges to the outer series of helically extending arms will desirably be such that there shall be free space directly radially outwardly of the wedges into which the latter may direct the mineral which they break loose. Ordinarily, the provision of material-attacking elements nearer the center of the auger drill head than the inner helically disposed arm will be unnecessary, but where the

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nature of the mineral makes it advisable, additional mineral-attacking elements will be arranged comparatively near the axis of rotation of the auger head, and where a plurality of such mineral-attacking elements are provided they are desirably differently spaced from the said axis of rotation. In like manner, if desired, mineral-attacking elements may be placed on the outwardly extending arms which support the helically extending arms, to insure removal of any portion of the annular core which might not be broken away by the wedging means. The radially inwardly disposed helically extending arm desirably has the outwardly projecting (outwardly from the hub) arm by which it is supported disposed intermediate two of the longer outwardly projecting arms, and the arc length, in terms of degrees, of said inner helical arm may exceed the arcuate length of each of the outer plurality of helical arms. In a modified construction, where a plurality of helical arms are arranged in an inner series they may be of like arcuate extent with the outer helical arms but in circumferentially offset relation to the latter.

Desirably the mineral-attacking elements will be detachably secured to the several supports so that they may be readily replaced, and the hub of the auger head will desirably have a polygonal spud detachably received in a suitable socket in the drive shaft which transmits rotation to the auger head. The number of inner helically disposed arms may be more than one, as above noted, and, while these outer helically disposed arms uniformly spaced circumferentially of the auger head have been found to operate very satisfactorily, this number may also be varied. Finally, it is to be noted that, to facilitate still further the rolling of the auger head over the mine floor or any other subjacent surface, the lengths of the helically extending arms may be so increased that there is no substantial space between their adjacent ends, and a continuous tread of like radius with the outer surfaces of said helically extending arms may be provided by connecting said arms with appropriately curved arcuate webs.

In the accompanying drawings, in which for purposes of illustration certain illustrative embodiments are shown: Fig. 1 is a front end view of an auger drill head constituting such illustrative embodiment.

Fig. 2 is a plan view of the auger drill head.

Fig. 3 is a horizontal sectional view on the plane of the line 3—3 of Fig. 1.

Fig. 4 is a detail section on the planes of the line 4—4 of Fig. 1.

Fig. 5 is a detail section on the line 5—5 of Fig. 3.

Fig. 6 is a detail section on the line 6—6 of Fig. 3.

Fig. 7 is a detail section on the line 7—7 of Fig. 3.

Fig. 8 is a perspective view of the auger drill head shown in the earlier figures.

Fig. 9 is a plan view of another auger drill head—a modified embodiment of the invention.

Fig. 10 is a fragmentary cross section on the plane of the line 10—10 of Fig. 9.

Fig. 11 is a front end view of a further modified auger head incorporating still another embodiment.

Referring to the drawings, and first to Figs. 1 to 8 thereof, an auger drill head is shown at 1. This is adapted to be mounted at the forward end of a conventional drive shaft (not shown) with which is associated a conveyor helix (also not shown), the auger drill head having, as shown, a polygonal (herein square) spud portion 2 which is adapted to enter a correspondingly shaped socket in the drive shaft and to be held in the socket by a cross pin passing through a transverse opening 3. The auger drill head as shown comprises a plurality of arms 4', 4'' and 4'''. These are carried at the outer ends of outwardly, herein radially, extending arms 5', 5'' and 5'''. As shown, the arms 5', 5'' and 5''' are

formed integral with a hub portion 6 with which the spud 2 is shown integrally connected. As shown in Fig. 4, the arms 5', 5'' and 5''' are so arranged and have such cross sections that they act as propeller blades for forcing loose material which they contact backwards toward the helical conveyor. In other words, they are obliquely disposed, with their forward edges, in terms of direction of rotation, farther forward, in terms of axial direction, than their rearward edges. The arms 5', 5'' and 5''' are equally angularly spaced about the axis of rotation 10 of the auger. The arms 4', 4'' and 4''' project forwardly in the direction of rotation of the auger, and are connected at their rearward ends (rearward both in terms of direction from front to back of the auger and in terms of direction of rotation) to their respective supporting arms 5', 5'' and 5'''. Each of the arms 4', 4'' and 4''' extends helically forward, as is clearly shown in Figs. 2 and 3, and each is provided as shown with a replaceable mineral-attacking element 12. It will be observed that the arms 4', 4'' and 4''' lie between rather closely spaced coaxial surfaces of revolution—in the form illustrated, cylindrical surfaces—whose axes lie in the same straight line with the axis 10, and are relatively narrow radially of the auger drill head. The mineral-attacking elements 12 are received in sockets 15 in which they are held by screws 16 which traverse openings 17 in the elements 12; and the several elements 12 are so set that by the time each of them has passed a given point an annular groove more than wide enough to receive the arms 4', 4'' and 4''' will be formed. Due to the helical disposition of the arms 4', 4'' and 4''', they are highly effective in plowing disintegrated material backwards towards the helical conveyor with which the head is associated.

A fourth radial arm 18 (but one is shown in this embodiment, but a plurality may be employed as will later appear) is supported by the hub 6 in the angle between two of the arms 5', 5'' and 5''', being shown between the arms 5'' and 5'''. It is shown in Fig. 4 as in a common transverse zone with the other radial arms. The arm 18 is shorter radially than the arms 5', 5'' and 5''', and carries at its outer end an arm 19, which is another helical arm and which lies between rather closely spaced surfaces of revolution—herein cylindrical surfaces—whose axes lie in the same straight line with the axis of rotation 10, and which surfaces are of smaller diameter than the smaller surface of revolution previously referred to. The helically extending arm 19 extends forwardly and outwardly from its radial supporting arm 18 and carries near its forward end mineral-attacking elements 20' and 20'' secured in position similarly to the elements 12, and between them cutting a path for the arm 19.

In some varieties of mineral, the plurality (three as shown) of mineral-attacking-element-equipped outer helically extending arms and a single radially inwardly disposed inner helically extending arm provided with mineral-attacking elements will be effective to cause a complete disintegration of the mineral within a circle traced by the outermost point of the outermost element 12; but, even in the case of mineral harder to disintegrate, by the provision of wedges 22' and 22'' mounted at the rearward (in both senses) end of the helical arm 19, and increasing progressively in thickness both rearwardly along the arm 19 and rearwardly in a direction parallel to the axis 10, an annulus of mineral (an annular core of mineral) left between the grooves formed by the outer helically extending arms and the inner helically extending arm will be broken by the wedges 22' and the projecting central core of coal will be broken by the wedges 22''. From Figs. 1 and 2, it will be readily observed, that the wedge 22' is so related to the helically extending arms 4' and 4'' that free space exists radially outward of the wedge into which the wedge may break mineral.

Additional insurance against any portion of a central

core of coal obstructing forward feed is provided, although it is but little needed, by arranging additional material-attacking elements 24', 24'' and 24''' in sockets formed in bosses 25', 25'' and 25''' extending outwardly from the hub 6, the several elements 24', 24'' and 24''' being differently angled—arranged—herein differently so that the action thereof upon the mineral is along different concentric paths. The elements numbered in the drawing 24', 24'' and 24''' obviously preclude the existence of any central core of material length. In like manner, to act, should occasion ever exist for such action, upon any unbroken portion of an annular core between the paths of the mineral-attacking elements 12, 20' and 20'', further mineral-attacking elements 26', 26'' and 26''' may be mounted in sockets 27 upon the radially projecting arms 5', 5'' and 5''' respectively and so angled as in cooperation to remove a strip of the full width of such core. It will be evident that, instead of using detachable mineral-attacking elements, resharpenable mineral-attacking devices integral with the auger may be employed as, for example, tungsten carbide-edged portions.

It will be observed that the mineral-attacking elements 12, 20' and 20'' all attack the mineral in the same series of transverse planes—planes beyond the outermost ends of the arms 4', 4'', 4''' and 19—while the elements 24', 24'' and 24''' are arranged in transverse planes ahead of but much nearer the hub 6, and in the same general transverse zone with the rearward ends of the forwardly projecting portions of the several helically disposed arms. Were there occasion for it, it would of course be possible to employ more than one of the inner helical arms 19. The forwardmost end of the arm 19 is illustrated as slightly ahead, in the direction of rotation, of the arm 4'''. The fact that the forwardmost ends of the several helically disposed arms lie arcuately ahead of the vein-attacking elements which they severally carry is immaterial in view of the substantial projection axially forward beyond said ends of the mineral-attacking elements.

The illustrative embodiment so far described needs little description of its operation. The direction of rotation in Fig. 1 is counterclockwise. The elements 12 coact to produce an outer annular groove slightly more than wide enough to receive the forward ends of the helically extending arms 4', 4'' and 4'''. The mineral-attacking elements 20' and 20'' form a concentric groove wide enough to receive the forward end of the helical arm 19. The annular core between the grooves may be fractured by vibration but, if it is not so detached from the solid, it will be fractured in due course by the wedge means 22' which will act outwardly on the inner side wall of the annular core when the grooves become deep enough for the wedge to engage the free end of the core. Simultaneously with the action of the wedge means 22', the wedge means 22'' will act on the central core, if this has not been broken loose by vibration, and break it off and into pieces. If any portion of the central core remains unbroken at the time when a sufficient penetration of the auger has taken place for the elements 24', 24'' and 24''' to contact the central core, these will provide the necessary breaking action, but, as above mentioned, they do not normally have much occasion to function. It may again be observed that the wedge means 22' acts to break the core towards a free space between the helically extending arms 4' and 4''. If any part of this core should not be broken away by the wedge 22', the mineral-attacking elements 25', 25'' and 25''' would ultimately remove it.

The helical disposition of the arms 4', 4'' and 4''' and the propeller-like action of the radial arms 5', 5'', 5''' and 18 will all act to move disintegrated material back between the radially extending arms 5', 5'' and 5''' to the helix of the main conveyor, and the helical disposition of the arms 4', 4'' and 4''' and their substantial arcuate extent will center and guide the head for rectilinear advance.

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By way of illustration, but not of limitation, it may be mentioned that an auger of an overall diameter of 30 inches forming an outer annular groove of a radial dimension of $2\frac{1}{2}$ inches and an inner annular groove of a radial dimension of $2\frac{1}{2}$ inches, with the distance between the inner and outer grooves on the order of 3 inches, and with the three innermost vein-attacking instrumentalities set respectively approximately 6 inches, 4 inches and 2 inches from the axis of rotation 10, has been found to enable an extremely fast feed and disintegrating rate and satisfactory sizing and moving out of the disintegrated mineral. The figures given are but illustrative, and may undergo wide variation depending upon the particular mineral upon which the auger is to operate and the desired diameter of the bore to be formed.

Figs. 9 and 10 illustrate another embodiment of the invention.

To facilitate the handling of the auger head and reducing the amount of lifting required, there is provided an arrangement such that there is a complete circular tread substantially midway of the length of the auger, so that it can be readily rolled, the portions of the helically extending arms 4', 4'' and 4''' aiding, through the fact that their outer surfaces lie in a cylindrical surface, substantially in the rollability of the auger. The circular tread is provided in part by peripheral surfaces of the arms 4', 4'' and 4''' and by intervening arcuate webs or bars extending between the sides of the arms 4', 4'' and 4''' approximately midway of the overall lengths of the outer surfaces of such arms. As indicated in Figs. 9 and 10, an arcuate web, rib or bar 28' extends between the mutually adjacent edges of the helically extending arms 4''' and 4', another, 28'', between the mutually adjacent sides of the helically extending arms 4' and 4'', and a third, 28''', between the mutually adjacent sides of the helically extending arms 4'' and 4'''. The width of the webs, bars or ribs 28', 28'' and 28''' is only such as to provide for effective support during rolling of the auger head, and their thickness is made materially less than the radial thickness of the helically extending arms 4', 4'' and 4''' so that they shall impede as little as possible the feed of disintegrated material rearwardly of the auger head. The outer surfaces 29 of the several webs or ribs is in a common cylindrical surface with the outer surfaces of the several helically extending arms at the transverse zone where said webs are provided. This construction materially facilitates the handling of the auger and enables rolling it into and out of general alinement with the drive and conveyor device which actuates it and moves away the mineral which it disintegrates.

Fig. 11 shows a further embodiment which differs from the construction shown in Figs. 1 to 8 and, it may be noted, Figs. 9 and 10. The differences may be noted by comparing Fig. 11 with Fig. 1. It will be observed that each arm 4'a, 4''a and 4'''a, each of which is individually supported by one of a series of radially extending arms 5'a, 5''a and 5'''a, is of such circumferential or arcuate extension that there is no gap, circumferentially speaking, between the forward end of each helically extending arm and the rearward end of the one which lies, in terms of rotation, just ahead of it. Thus, the rolling of the auger on its periphery will be facilitated even in the absence of connecting webs or ribs as disclosed in the embodiment of Figs. 9 and 10. This avoidance of "gaps" circumferentially may be effected by changes in the lengths of the arms, changes in their helix angle, or both.

It will be noted further that in the embodiment of Fig. 11 there are three inner helically extending arms 19', 19'' and 19''' supported on relatively shorter inner outwardly extending arms 18', 18'' and 18'''. As in the case of the outer helically extending arms 4'a, 4''a and 4'''a, there is an extension of each of the arms 19', 19'' and 19''' circumferentially of the auger from its

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own rear end to the rear end of the next preceding one, viewed from the front of the auger, though it will of course be understood that the front end of each arm is, axially of the auger, well ahead of the rear end of the one which precedes it. In this embodiment, each of the helically extending arms 19', 19'' and 19''' has a material-attacking element 30 upon it near its forward end, and these are differently spaced radially of the auger so that they cumulatively cover the full width of the annular groove required to receive the inner series of helically arranged arms. One or all of the inner helically extending arms may be provided wedge means, and for best counterbalancing of forces, each is shown provided with both inner and outer wedging means similar to the wedging means 22'' and 22'. No detailed description of the mode of operation of this modification will be necessary as will be fully apparent from what has been previously stated.

While there are in this application specifically described three embodiments which the invention may assume in practice, it will be understood that these embodiments of the same are shown for purposes of illustration, and that the invention may be modified and embodied in various other forms without departing from its spirit or the scope of the appended claims.

What I claim is:

1. A rotatable auger drill head comprising a plurality of circumferentially spaced helically extending arms carrying at their forward ends mineral-attacking elements, more than one of said plurality of arms being disposed in the space between a pair of coaxial cylindrical surfaces whose axes lie in the same straight line with the axis of rotation of the auger head and the remainder of said plurality of arms being disposed in the space between two other cylindrical surfaces coaxial with the first mentioned cylindrical surfaces and of smaller diameter than the smaller of the latter, and means for supporting said several arms in fixed relation to each other and rotating them together including a hub and arms one individual to each of said previously mentioned arms extending outwardly from said hub in common transverse zone and each carrying one of said previously mentioned arms, said previously mentioned arms having their forward ends in advance, in terms of their rotation during drilling, of their rearward ends.

2. A rotatable auger drill head as defined in claim 1 in which the arms extending outwardly from the hub have their leading faces, in terms of direction of rotation of said drill head during drilling, obliquely disposed, with their forward edges in advance of their rearward edges, whereby they act to wedge in a rearward direction the material which they engage.

3. An auger drill head as defined in claim 1 in which a plurality of mineral-attacking elements are supported nearer the axis of rotation of the auger head than any of said plurality of arms and, with respect to the axis of said auger head, to the rear of the other mineral-attacking elements.

4. A rotatable auger drill head as defined in claim 1 in which the remainder of said plurality of arms are equal in number to the arms disposed in the first mentioned space between a pair of coaxial cylindrical surfaces whose axes lie in the same straight line with the axes of rotation of said auger head, and in which each of the arms carrying an arm of such remainder is intermediate a different pair of arms supporting the arms in the first mentioned space aforesaid.

5. A rotatable auger drill head comprising a plurality of mineral-attacking means arranged in the space between a pair of coaxial surfaces of revolution whose axes lie in the same straight line with the axis of rotation of the auger head, a helically disposed arm having mineral-attacking means at its forward end and disposed to the inside of the inner one of said pair of coaxial surfaces of revolution with the axis of its helix in the same straight

line as the axes of said coaxial surfaces of revolution, and means for supporting said arm and said plurality of mineral-attacking means in fixed relation to each other and rotating them concurrently about the axis of rotation of said auger head including radial arms in a common transverse zone and one individual to said helically disposed arm and one to each of said plurality of mineral-attacking means.

6. A rotatable auger drill head as defined in claim 5 in which said helically disposed arm has mounted thereon wedging means tapering both longitudinally and transversely of said arm.

7. An auger drill head comprising a hub portion having means for connecting it to the forward end of a drive shaft, a plurality of arms projecting radially outwardly from said hub for like distances, similarly helically curved arms spaced from each other circumferentially of said head and one individual to each of said radially outwardly projecting arms and mounted at their rearward ends on the outer ends of said radially outwardly projecting arms and extending forwardly from the latter and carrying at their own forward ends mineral-attacking elements, at least one other arm projecting radially outwardly from said hub in a common transverse zone with said plurality of radially outwardly projecting arms but shorter than said first mentioned radially outwardly projecting arms and having mounted thereon a helically curved arm (a) having its forward end mineral-attacking-element-equipped, (b) having its arm mounting at its rearward end, and (c) having mineral-wedging means on it between its ends.

8. An auger drill head as defined in claim 7 in which mineral-wedging means are arranged both at the inner and outer sides of the arm which supports them.

9. An auger drill head as defined in claim 7, in which the said mineral-wedging means is disposed where the disposition of said first mentioned helically curved arms leaves space into which said wedging means may break mineral.

10. A rotatable auger drill head having thereon, for forming upon rotation thereof an outer annular groove in a mineral vein, a plurality of helically disposed arms carrying mineral-attacking means and disposed between coaxial surfaces conforming to the inner and outer surfaces of said annular groove and having a common helix axis in the same straight line with the axis of said groove, means for forming a smaller coaxial groove in the mineral vein, means for breaking a core left between said grooves including wedging means for engaging said core at one of its sides, said head including radially outwardly ex-

tending arms each supporting individually one of said helically disposed arms and having on it, in a position located radially thereof between said grooves, a mineral-attacking device to engage said core if the latter is not broken out by said wedging means.

11. A rotatable auger drill head comprising a plurality of helically extending arms carrying at their forward ends mineral-attacking means and all disposed in the space between a pair of coaxial surfaces of revolution whose axes lie in the same straight line as the axis of rotation of the auger drill head, means for supporting said several arms and rotating them together including a hub and arms individual to each of said plurality of helically extending arms extending outwardly from said hub and each carrying one of said previously mentioned arms, and further mineral-attacking means lying inside the smaller of said surfaces of revolution for disintegrating mineral surrounded by said arms.

12. An auger drill head as defined in claim 11 in which the hub has thereon and forwardly projecting therefrom certain of said further mineral-attacking elements.

13. An auger drill head as defined in claim 11 in which arcuate ribs are provided which connect said arms substantially midway of their overall lengths to provide a continuous tread extending completely around said head.

14. A rotatable auger drill head as defined in claim 11 in which said plurality of helically extending arms carrying mineral-attacking means at their forward ends are disposed with their outer peripheries in the outer one of said coaxial surfaces, and means is provided for facilitating the rolling of said auger drill head over a subjacent surface including arcuate ribs also having their outer peripheries in said cylindrical surface and extending between each pair of helically extending arms and radially thinner than the latter and cooperating with the latter to provide a continuous circular tread extending completely about said auger drill head substantially midway between the forward and rearward ends thereof.

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