United States Patent

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[54] **GAGE CUTTER**
8 Claims, 2 Drawing Figs.

[52] **U.S. Cl.** **175/374,** 299/86
[51] **Int. Cl.** **E21b 9/12**
[50] **Field of Search** 299/86; 175/374, 375

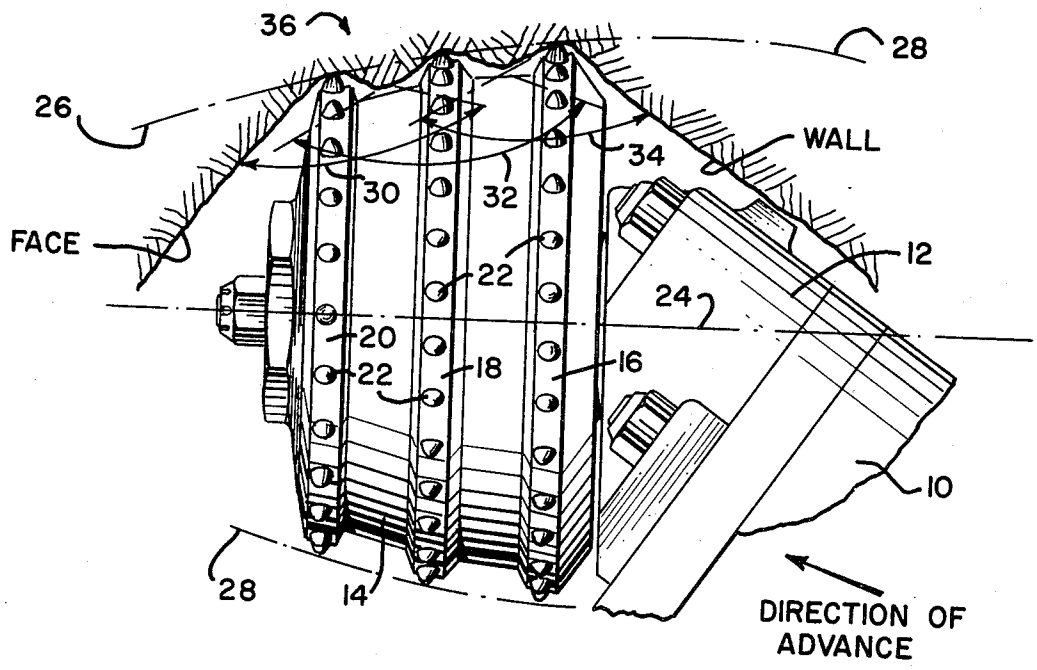
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ABSTRACT: A gauge cutter for use with a tunneler or mine machine or the like having a plurality of rows of cutter elements about the periphery thereof, the rows being of such size and positioning as to define an oblate cylinder cutting envelope or plane to equalize the loading on the cutting elements.



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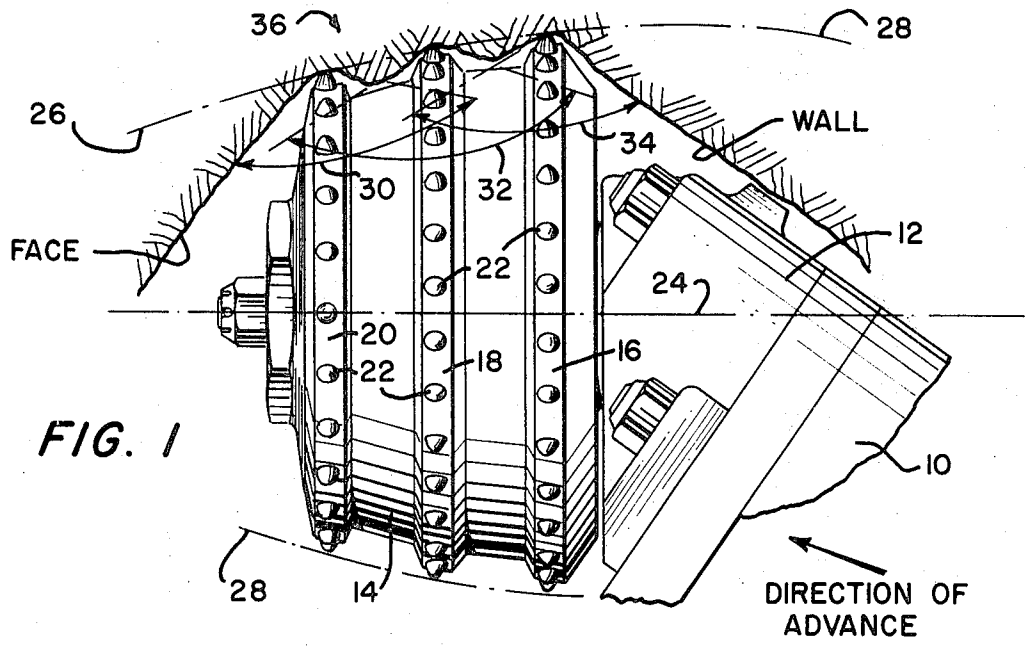


FIG. 1

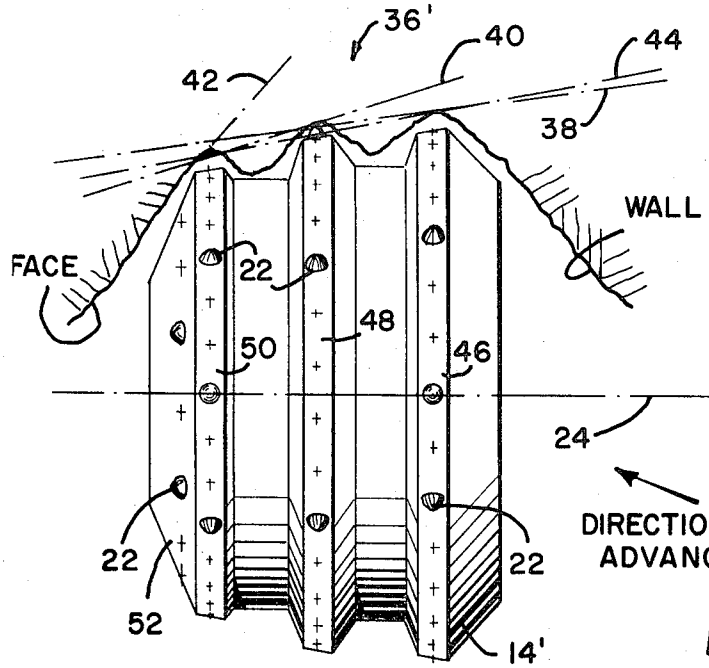


FIG. 2

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GAGE CUTTER

This invention pertains to gauge cutters for use on tunnelers and mining machines disposed for cutting rock in the angular juncture of the face and walls of the tunnel or mine bore, and in particular an improved gauge cutter having a configuration which is more effective in cutting operation in such angular junctures, and which is less given to wear and fatigue by virtue of its having the loading thereof, occurring through its use in such tunnel or mine junctures, more equally distributed about its configuration.

The loading on gauge cutters cutting or breaking rock in the juncture of a mine or tunnel bore, between the face and the wall of the bore, has been found to be greater than on cutters acting on a flat or cylindrical surface. This is because the rock in these juncture areas has greater confinement and more resistance to fracturing under heavy loading.

The loading on a row of cutting elements is a function of the fracture angle of the rock (or whatever) which is being bored. Now, by "fracture angle" I refer to the angular depression which obtains in the surface of the wall or face of the bore, and in alignment with the cutting elements, after the cutting elements have cut rock away or broken rock away therefrom. It is known that to provide a cutter which can establish wide fracture angles, the loading on the cutting elements thereof will be less than would obtain if the fracture angles were narrow. Accordingly, the optimum cutter design is one in which the fracture angles of all rows, in a plurality of rows of cutting elements, are both wide and equal.

Gauge cutters which are especially designed to operate in the angular juncture of the face and walls of the mining or tunnel bore usually have linear profiles. However, the juncture in which they operate is nonlinear. For instance, gauge cutters known in the prior art have a configuration, and space the cutting elements thereabout, which defines a cylindrical or a tapered cylindrical cutting envelope or plane. In that the gauge cutter operates in the juncture of the bore which is nonlinear, then, at any operating time, a given row, or given rows of the cutting elements of such prior art gauge cutters are more heavily loaded than are others thereof. In addition, the prior art gauge cutters use rows of cutting elements which are somewhat widely spaced therebetween, and the rows define a cutting profile having an angle which is normal for wall or face cutting but which is not complementary to the somewhat angular or folded profile of the juncture of a face and wall.

Accordingly, it is an object of this invention to teach an improved gauge cutter having means for optimizing the loading on a plurality of rows of cutting elements disposed thereabout. It is another object of this invention to provide a gauge cutter having means for increasing the fracture angle capability of the rows of cutting elements carried thereby. A feature of this invention comprises the provisioning of a gauge cutter having a plurality of cutting elements arranged in rows thereabout which rows of cutting elements define an oblate cylindrical cutting envelope or plane.

Further objects and features of this invention will become more apparent by reference to the following description taken in conjunction with the accompanying figures in which:

FIG. 1 is a side elevation of a first embodiment of a gauge cutter, in accordance with the invention, having three rows of cutting elements carried thereupon; and

FIG. 2 is a side elevation of a second embodiment of gauge cutter, according to the invention, having four rows of cutting elements thereupon, with cutting elements offset from those axially disposed to either side thereof.

As shown in FIG. 1 a tunneler 10, of which only a fragment is shown, supports a rotatable cutterhead 12, shown only in part, to which a gauge cutter 14 is rotatably mounted (by means not shown, but widely practiced in this art). The gauge cutter 14 comprises a cutter body, of circular cross section, on which are borne three rows of cutting elements, rows 16, 18, and 20, which carry inserts 22 as the elements. Gauge cutter 14 is rotatable about an axis 24, and rows 16 through 20 are cooperative with inserts 22 to define an oblate cylindrical

cutting envelope or plane which is more effective in the angular juncture of the face and wall of the bore. The cutting plane 26 is designated in FIG. 1 and is bounded by the arcuate profile lines 28. The wall and face of the bore, and the normal direction of advance are indicated in FIG. 1. Rows 16 through 20 operate upon the juncture of the wall and face and form wide, in fact obtuse fracture angles 30, 32, and 34, respectively, in the juncture indicated at 36.

It is self-evident that if only one row of cutting elements operated upon the juncture 36, such a single row would of necessity have to make a penetration of considerable depth and would succeed in creating but a narrow fracture angle. So, also, if two widely spaced rows of cutting elements operated upon the juncture 36, the rows—for being widely spaced—would function with little or no cooperation therebetween toward eroding the juncture. Here too, the dual rows would have to make what would be substantially independent and considerable and narrow penetration to remove material from the juncture. It is my teaching, therefore, to provide a plurality of proximate rows of cutting elements which define an oblate cylindrical cutting plane, more efficiently to erode the material in the juncture 36.

Essentially, the juncture 36 of the wall and face of the bore turns a right angle. Therefore, the juncture 36 has a folded profile in which linear cutting profiles are inefficient. It is for this reason that my invention teaches the use of arcuate profiles 28 and the oblate cylindrical cutting plane 26. Profiles 28, and plane 26, are effective for turning the corner, so to speak, of juncture 36, and loading is more equally borne by all the rows: 16, 18, and 20.

In FIG. 2 is shown an alternate embodiment of a gauge cutter 14' according to my invention which presents four angular cutting profiles, i.e., angular with respect to the centerline of axis 24, to the right-angular juncture 36'. These, comprising first, second, third and fourth profiles, 38, 40, 42, and 44, are formed by the rows of cutting elements 46, 48, 50, and 52. First cutting profile 38 is formed by rows 46 and 48, second profile 40 is formed by rows 48 and 50, third profile 42 is formed by rows 50 and 52, and finally fourth profile 44 is formed by rows 46 and 50. It is to be noted that row 48 penetrates the fourth cutting profile 44. This is the configuration more particularly described heretofore which defines an arcuate cutting profile and oblate cylindrical cutting plane—like those indicated at 28 and 26 in FIG. 1.

In The FIG. 2 embodiment of my invention, row 52, the fourth row, is provisioned not only to contribute to creation of the folded cutting profiles, and the oblate cylindrical cutting plane. In addition, row 52 prevents the buildup of rock, on the face of the cutter 14', which would excessively wear the face and body of the cutter, and introduce heavy thrust loading.

In accordance with my teaching herein, then, my novel gauge cutters define cutting envelopes or planes which are complementary to the juncture 36, and insure a more equally distributed loading on each of the rows thereof. In addition, the rows of cutting elements 16—20 and 46—52, FIGS. 1 and 2, respectively, are proximately arranged to insure a cooperative and cumulative effect in the efficiency with which inserts 22 attack the bore face and wall. The arcuate profiles 28, and the plurality of diverse angular cutting profiles 38—44 define the improved oblate cylindrical cutting planes of the FIGS. 1 and 2 embodiments. These planes, together with the proximity of spacing between the rows of cutting elements markedly improve the performance and life of the novel gauge cutters so configured.

In the FIG. 1 embodiment, inserts 22 of rows 16 and 18 are axially aligned. However, in the FIG. 2 embodiment, inserts 22 of row pairs 46 and 48, 48 and 50, and 50 and 52 are axially out of alignment or circumferentially offset therebetween. Rows 46 and 50, however, have inserts 22 thereof axially or circumferentially in alignment. Rows 46, 48, and 50 each have the same number of inserts 22. Inserts 22 of row 48 though, are arranged in positionings in which they are rotated or spaced in axial alignment with half-spacing locations which

subsist between adjacent inserts of rows **46** and **50** to either sides thereof. Row **52** has half the number of inserts **22** as has row **50**, and the row **52** inserts are positioned in axial alignment with half-spacing locations which subsist between alternate pairs of circumferentially adjacent inserts **22** of row **50**. These insert-misalignment arrangements are provided to insure a smoother "attack" and loading of the gauge cutter. Only some of the inserts **22** are shown pictorially in FIG. **2**; most of them are represented, symbolically, by small cross-marks.

While I have described my invention in connection with specific embodiments thereof, it is to be clearly understood that this is done only by way of example and not as a limitation to the scope of my invention as set forth in the objects thereof and in the appended claims.

I claim:

1. A gauge cutter for cutting rock in the juncture of the face and wall of a bore, for use with mining machines, tunnelers, and the like, in combination with a cutterhead, comprising:

a cutter body, mounted on said cutterhead, having a plurality of circumferential rows of rock-cutting elements thereabout;

a majority of said element rows having all said cutting elements thereof operatively disposed, relative to said cutter head, for cutting engagement with said face-and-wall juncture;

means spacing said rows a given distance therebetween;

means disposing rows of said plurality at diverse radial distances from an axial centerline of said body; and

said last-named row-spacing and row-disposing means being cooperative, together with said cutting elements, to define an oblate cylindrical cutting plane about said body.

2. The invention, according to claim **1**, wherein said last-named means and said cutting elements define said cutting plane with diverse diameters at either ends thereof.

3. The invention, according to claim **1**, wherein:

rows of at least a first pair of said plurality of rows have a given number of cutting elements equally spaced therebetween; and

at least a given row of said plurality has a differing number of cutting elements equally spaced therebetween.

4. The invention, according to claim **1**, wherein:

said cutting elements are circumferentially equally spaced therebetween; and

the cutting elements of one row of said plurality are rotated from another row, relative to said axial centerline, half the distance of the equal spacing.

5. The invention, according to claim **1**, wherein said rows define a cutting profile in which a first pair of said rows defines a first given angle, and at least a second pair of said rows defines a second different angle, relative to said centerline.

6. The invention, according to claim **5**, wherein a third pair of said rows defines a portion of said cutting profile at a third angle which distinguishes from said given and different angles.

7. The invention, according to claim **1**, wherein:

at least one pair of said rows defines a cutting plane which lies at an acute angle relative to said centerline; and

at least one further row of said plurality is in penetration of said plane.

8. The invention, according to claim **1**, wherein:

at least one pair of said rows defines a given cutting plane; and

at least one further row of said plurality is in penetration of said plane.