Oct. 31, 1950 E. A. MORLAN ET AL 2,527,838

BIT AND CUTTER THEREFOR

Filed Aug. 1, 1946 2 Sheets-Sheet 1

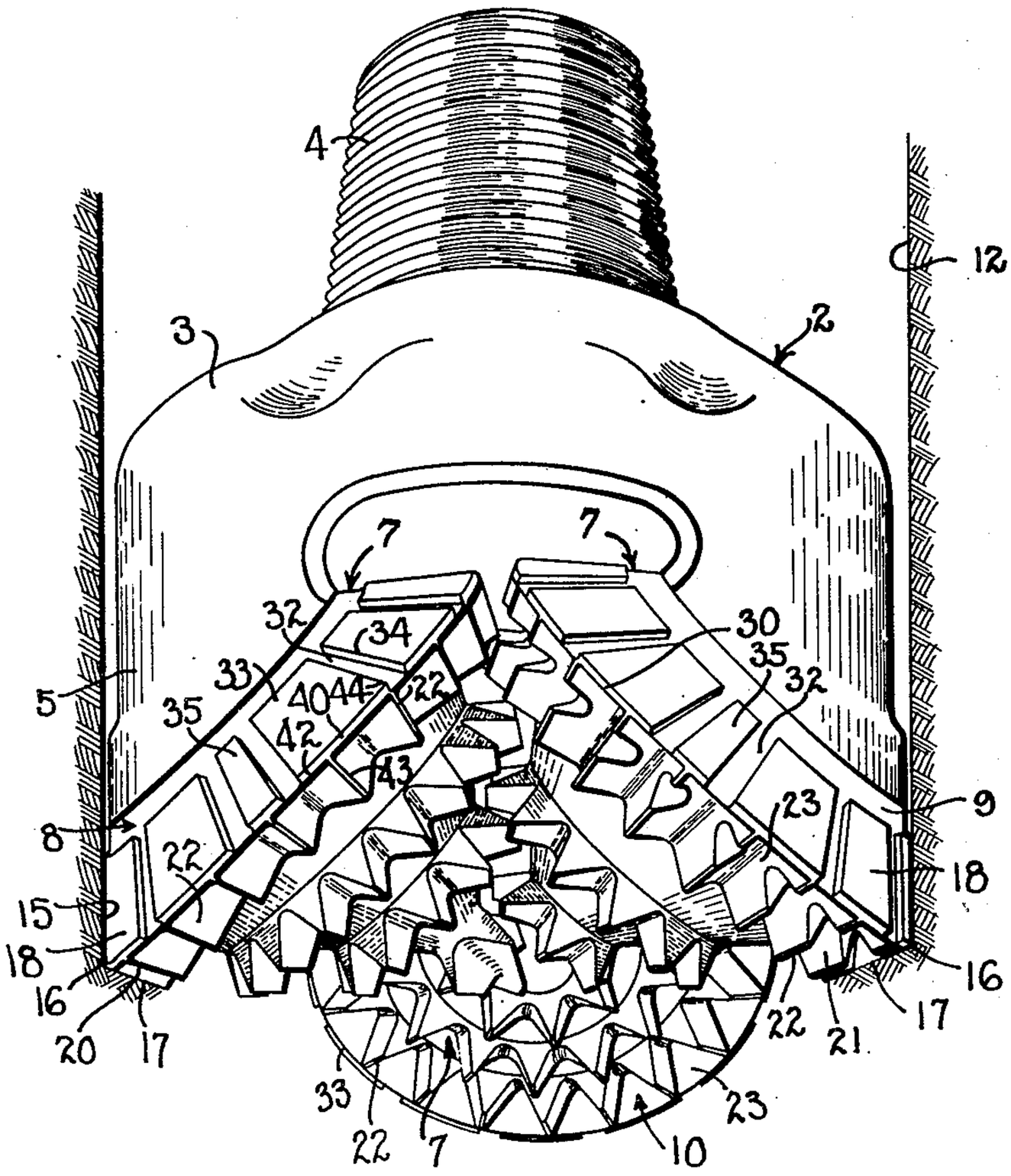

Fig 1

E. A. MORLAN.
H. B. WOODS
INVENTORS

BY Ray L. Smith

ATTORNEY

Oct. 31, 1950

E. A. MORLAN ET AL

2,527,838

BIT AND CUTTER THEREFOR

Filed Aug. 1, 1946

2 Sheets-Sheet 2

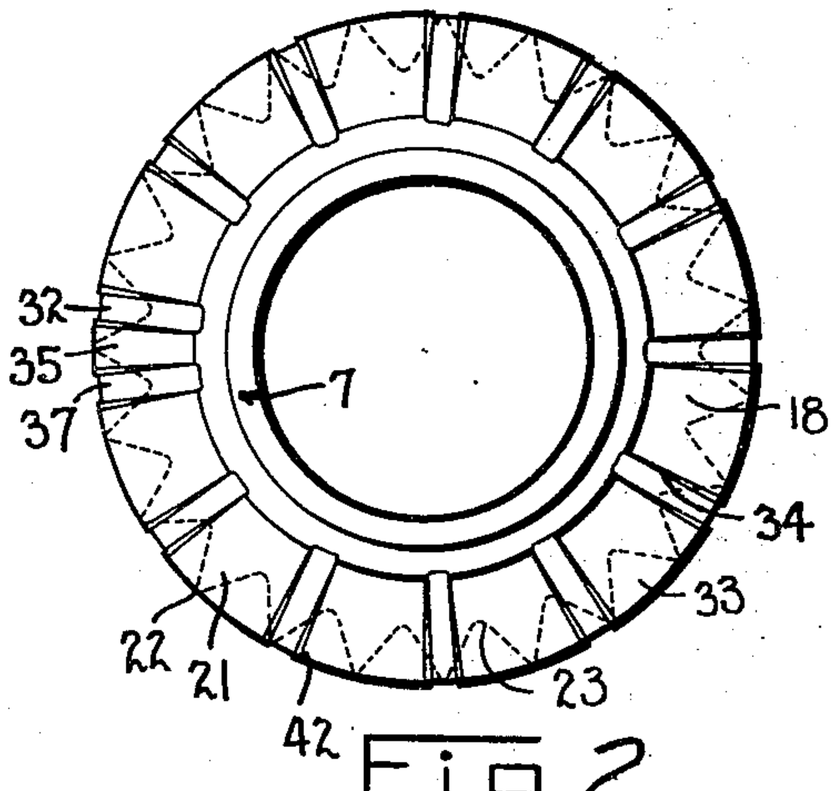

Fig 2

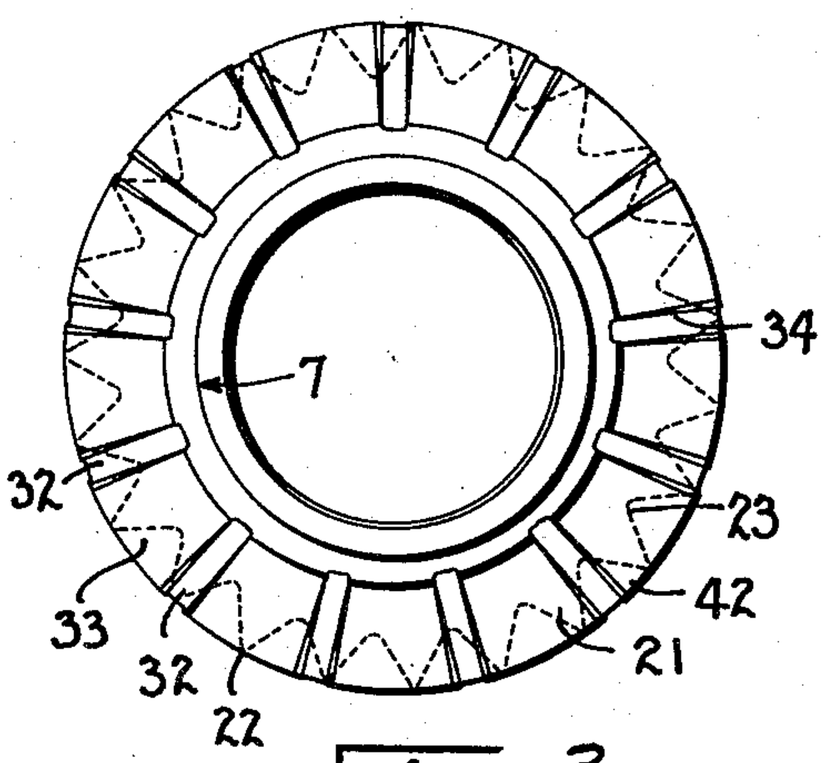

Fig 3

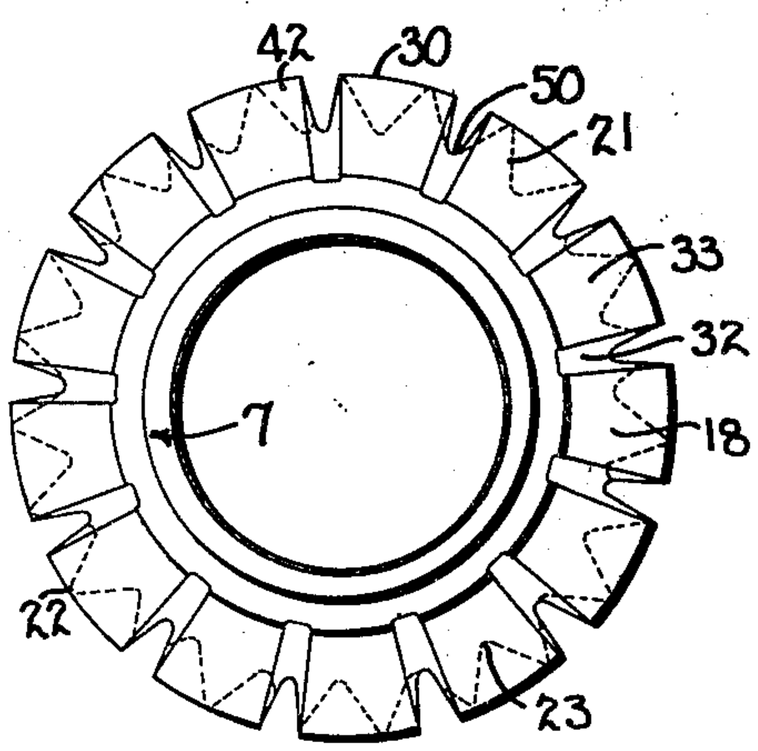

Fig 4

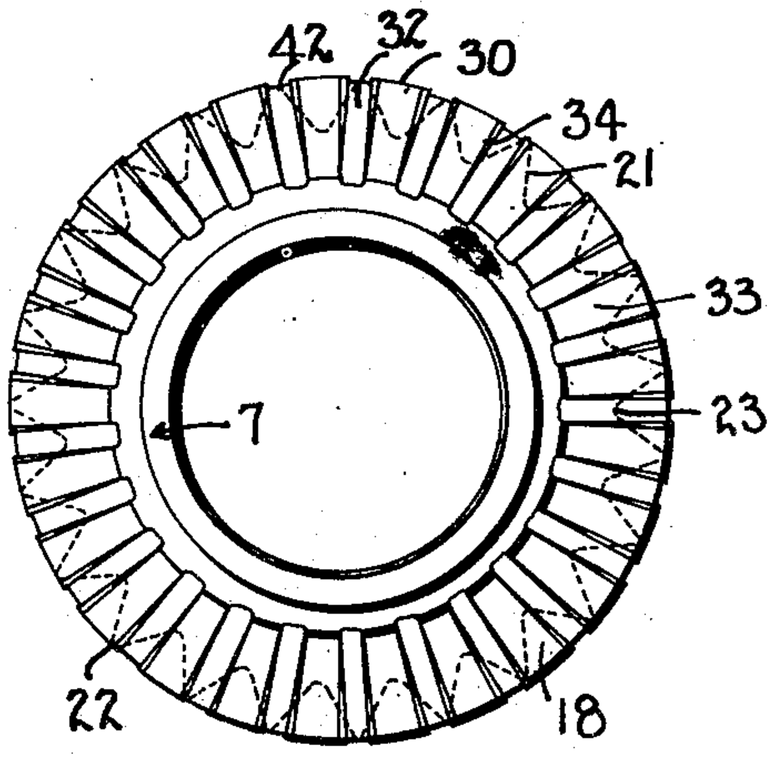

Fig 5

E. A. MORLAN
H. B. WOODS
INVENTORS

BY Ray L. Smith

ATTORNEY.

Patented Oct. 31, 1950

2,527,838

UNITED STATES PATENT OFFICE

2,527,838

BIT AND CUTTER THEREFOR

Erwin A. Morlan and Henry B. Woods, Houston, Tex., assignors to Hughes Tool Company, Houston, Tex., a corporation of Delaware

Application August 1, 1946, Serial No. 687,768

6 Claims. (Cl. 255—71)

1

The invention relates to a rotary drill having rotatable cutters thereon.

In the actual use of drill bits of this type considerable difficulty is encountered in maintaining the gauge of the hole due to the fact that the gauge surface of the cutter is caused to perform a rubbing and crushing action on the wall of the well bore. If the gauge of the cutter is a smooth unbroken annular surface, there is no facility for easy removal of cuttings after they have been loosened from the wall of the hole. Such cuttings tend to wedge in the narrow space between the gauge of the cutter and the wall of the hole, forcing the cutter away from the wall and putting undue strain on the bearings.

It is common practice to interrupt the gauge surface with elemental notches so as to form spaced blocks, then rock cuttings may lodge in such notches between the blocks as they are removed from the wall of the hole and, when the cutter rotates and exposes these notches to the flushing fluid, the cuttings are washed away.

In most cases the elemental cutter teeth on the cutter adjacent the gauge surface tend to generate a gear on the bottom of the hole adjacent to the wall, and if the notches on the gauge surface have the same spacing as the longitudinal teeth, they generate on the wall of the hole spaced grooves and ribs, or rifles, which reduce the effective diameter of the well bore. Excessive wear incident to the rifling results because of the dragging action of each block as it engages the lands on the wall.

The foregoing is particularly true when using the cone type of rotary drill and the following description is directed to the embodiment of the invention in this type of drill. However, it is to be understood that such disclosure is by way of illustration only.

It is one of the objects of the present invention to provide the cutters of a rotary rock drill with heel surfaces which will generate a smooth wall on the well bore.

Another object of the invention is to interrupt the circumferential gauge cutting web of a rotary type of drill at spaced intervals so as to form gauge cutting blocks or projections.

It is a further object of the present invention to provide a rotary type of cutter with a row of circumferentially spaced longitudinally disposed heel teeth which are joined at their outer ends with a circumferential gauge cutting web.

Another object of the invention is to provide a rotary drill cutter with a row of heel teeth and a notched circumferential web where the relative

2

position of the notches with respect to adjacent heel teeth varies about the cutter.

Still another object of the invention is to provide interruptions in the circumferential web of a rotatable type cutter which are non-uniformly and circumferentially spaced with respect to the circumferential spacing of the heel teeth.

It is also an object to provide an efficient gauge cutting surface for roller type drills.

Other and further objects of the invention will be readily apparent when the following description is considered in connection with the accompanying drawings wherein:

Fig. 1 is a perspective view of a drill bit having cones to which the invention has been applied;

Fig. 2 is a plan view looking at the base of a cone with the gauge surface interrupted by notches spaced apart a little less than alternate heel teeth;

Fig. 3 is a plan view looking at the base of a cone where the gauge surface is interrupted by uniformly spaced notches in excess of half the number of teeth;

Fig. 4 is a plan view looking at the base of a cone where the circumferential web has been interrupted and the number of interruptions is less than half of the number of heel teeth;

Fig. 5 is a plan view looking at the base of a cone where the number of notches in the circumferential web exceeds the number of heel teeth.

In Fig. 1 the drill bit 2 embodying the invention is made up of a body 3 having the threaded pin 4 thereon by which it is connected to the drill collar or drill stem. The body has the downwardly projecting legs 5 each of which carries a cone type cutter 7. There are three such cutters, 8, 9 and 10, which are circumferentially spaced in such a manner that upon rotation of the cones on the bottom of the hole the formation will be cut.

It is important that a drill bit of this type be so constructed as to avoid the formation of rock teeth upon the bottom 17 of the well bore and also to maintain the desired gage of the bore 12 with a minimum of wear upon the cutters 7 or the bearings therefor. To this end each of the cones or cutters 7 is provided with a row 21 of heel teeth 22 angularly spaced therearound. A circumferential web 30 upon the ends of the heel teeth of at least some of the cutters spans the space 23 between successive teeth and serves to produce a cutting action at the point 16 where the bottom merges with the side wall 15 of the bore. Such action assists the teeth 22 in ef-

fecting disintegration of the bottom of the hole and, at the same time, the web **30**, including the gage surface **18** thereon, is instrumental in maintaining a uniform gage of the bore.

If the gage surface **18** is continuous, disintegrated particles of rock or other earth material may enter between such surface and the side wall of the bore whereby excessive wear is produced upon the drill bit without commensurate action tending to maintain the desired gage. Also, the removal of disintegrated particles of rock from the well is impeded by this condition.

An important feature of the invention resides in the elimination of the condition to which reference has just been made. To this end the web **30** is provided with a plurality of notches **32** whereby there are created a plurality of spaced blocks or projections **33** having edges **34** which, together with the block surface **18**, assist in maintaining the desired gage of the bore **12**. The spaces or notches **32** are adapted to receive rock cuttings whereby such cuttings are subjected to the action of the flushing fluid and are removed from proximity to the cutters **7**.

In Fig. 1 each of the cones **7** has been illustrated as having such an angular span of each block **33** and the adjacent notch **32** that a block or projection **35** of lesser width than the remaining blocks **33** is provided. It thus seems apparent that there are varying relations between the heel teeth **22** and the blocks **33** and **35**. By virtue of such varying relation the notch adjacent a given tooth does not bear the same relation to that tooth as the next notch bears to its adjacent tooth. By means of this arrangement tracking is avoided because the blocks or projections are continuously engaging a surface at a different circumferentially spaced position whereby a smooth wall is cut in forming the bore.

It will be noted, for instance, in the No. 8 cone in Fig. 1, that the notches cause the formation of web extensions **42** which project circumferentially beyond the crest **43** of the next adjacent tooth. In some instances the edge **44** of the block or projection occurs at the crest **22** of a tooth whereas in other instances neither edge of the block or projection will coincide with a tooth crest. In this manner the severing of the rock teeth from the wall is assured and this web serves to cut the connection between the rock teeth and the wall of the bore without tracking of the web due to these unequal length extensions.

Fig. 1 shows the notches **32** as extending a substantial distance through the web **30** but not completely severing the web.

It seems obvious that various modifications of the arrangement and relative number of teeth and notches in the web can be devised. As a matter of fact almost innumerable combinations could be constructed. A few such combinations will be illustrated herewith as applied to cone type bits but it is intended that other type roller cutters, such as cross roller and roller core bits, may be similarly constructed.

Fig. 2 shows a base of the cone where twenty-three heel teeth have been provided in the row and where there are twelve and one half blocks formed by thirteen notches where the small or half block **35** is formed by positioning the successive notches **32** and **37** relatively close together. This arrangement breaks up any tendency for the lugs or blocks to track on the side of the well bore and also tends to prevent tracking of the cone on bottom because all of the rock

teeth are cut loose by web extensions from the wall of the well bore due to this relative arrangement of the number of teeth and the number of notches or webs.

Fig. 3 shows an arrangement where there are twenty-three teeth and thirteen blocks all of uniform width and divided by the spaced notches **32**. This arrangement gives variable length extensions **42** with respect to the crests **22** of the teeth so as to prevent tracking. Fig. 4 shows the notches **32** as projecting entirely through the web **30** down to the point **50** which is approximately the elevation of the bottom of the trough between two adjacent teeth. This form provides variable extensions **42** of the blocks relative to the crests of the heel teeth. The number of heel teeth and the number of webs in Fig. 4 are the same as in Fig. 3, viz, twenty-three teeth and thirteen webs.

Fig. 5 shows still another modification where the number of webs exceeds the number of teeth and twenty-three teeth and twenty-five webs have been provided. This again avoids tracking not only on the wall but on the bottom of the bore as well. With this arrangement of Fig. 5 there is a tendency for less binding of the bit in the well bore because the size of the chips will be smaller and there are more undercuts for the chips to escape as they are formed.

Broadly the invention contemplates a cutter construction for rotary rock drills which will prevent tracking on the bottom and wall of the bore by the provision of cooperating web and heel tooth construction.

What is claimed is:

1. A rotary cone type drill comprising a body, a plurality of cones rotatable thereon, cutter teeth longitudinally of said cones including a row of heel teeth, a circular web integral with the outer ends of the heel teeth on at least one of the cones to cut the gage, said web having a plurality of web projections extending outwardly from the ends of the heel teeth and formed by notches in the outer face of the circular web, the number of notches being different from the number of heel teeth so that the web projections beyond the tooth crests are of different lengths.

2. A drill bit of the rotary cone type comprising a body, a plurality of cones rotatably mounted thereon, gage-cutting teeth on each cone, a circular web integral with the outer ends of the heel teeth on at least one of the cones, and a plurality of circular web extensions formed by substantially radial notches on the outer surface of said web, the number of said extensions approximating half the number of teeth.

3. A rotary drill bit of the cone type comprising a body, a plurality of cones rotatably mounted thereon, cutter teeth on said cone including a row of heel teeth, a web integral with the outer ends of the heel teeth of at least one of the cones to cut the bit gage and joining the adjacent teeth to present a circular cutting web, said web being interrupted on its surface opposite the heel teeth to provide web extensions projecting axially and arranged annularly about the base of the cone, said interruptions being spaced to provide different length extensions to avoid tracking.

4. A rotary drill cutter comprising a body having a generally arcuate surface, a plurality of circumferentially spaced longitudinally disposed heel teeth, a circumferential web joining the outer ends of such teeth, and web projec-

tions extending outwardly from the ends of the heel teeth and formed by radial notches circumferentially spaced in the outer surface of said web.

5. A rotary drill cutter comprising a generally conical surface, a plurality of circumferentially spaced longitudinally disposed heel teeth, a circumferential web joining the outer ends of such teeth, and web projections extending outwardly from the ends of the heel teeth and formed by substantially radial notches circumferentially spaced in the outer surface of said web, on the gage surface of said conical surface.

6. A rotary drill cutter comprising a generally conical surface, a plurality of circumferentially spaced longitudinally disposed heel teeth, a circumferential web joining the outer ends of such teeth, and web projections extending outwardly

from the ends of the heel teeth and formed by substantially radial notches circumferentially spaced in the outer surface of said web, where the number of teeth and number of notches are different so as to provide web extensions circumferentially of the teeth which are of varying lengths.

ERWIN A. MORLAN.
HENRY B. WOODS.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
2,363,202	Scott	Nov. 21, 1944