July 10, 1945. C. W. KINNEAR 2,380,112

DRILL

Filed Jan. 2, 1942 3 Sheets-Sheet 1

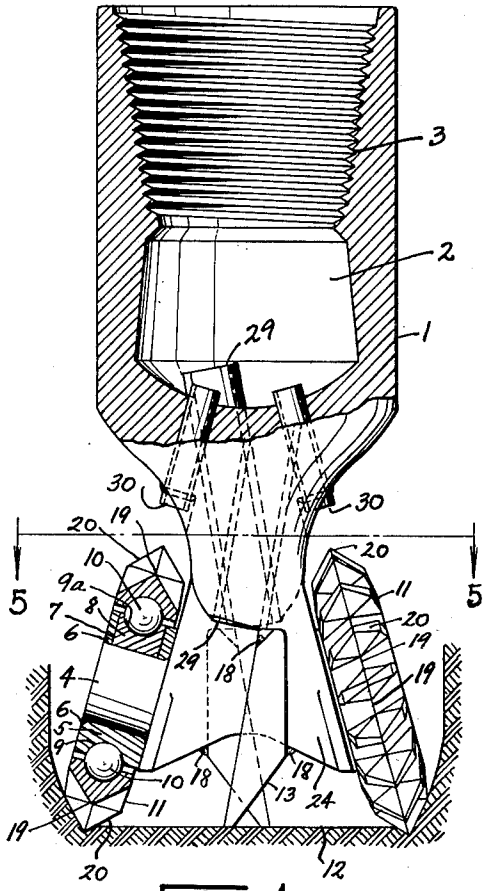

Fig. 1.

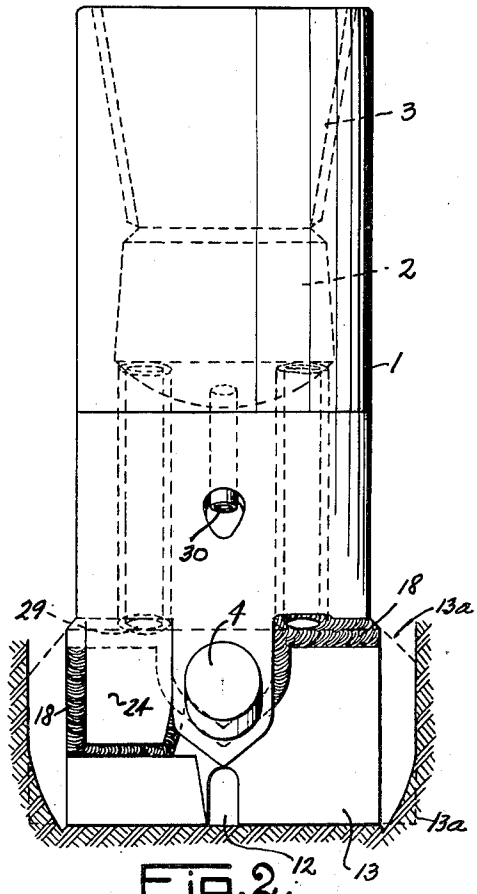

Fig. 2.

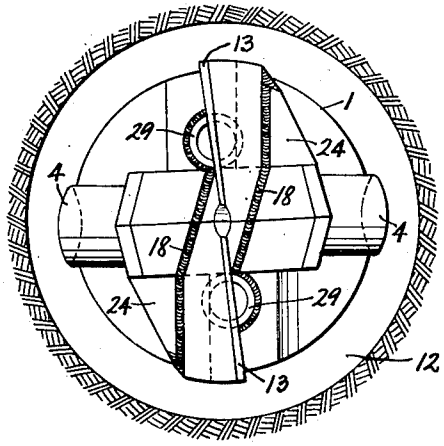

Fig. 3.

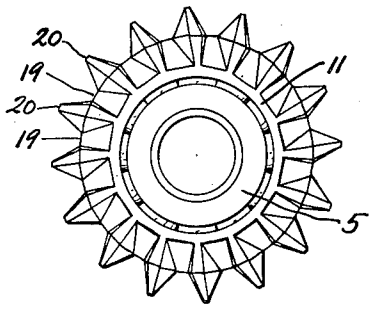

Fig. 4.

INVENTOR.
Clarence W Kinnear.

BY

E. V. Hardway.
ATTORNEY.

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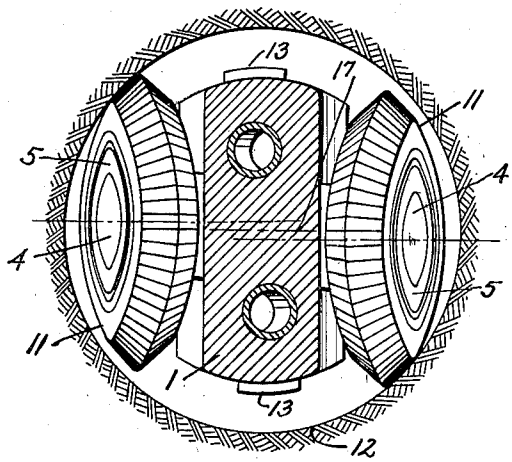

Fig. 5.

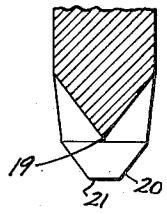

Fig. 7.

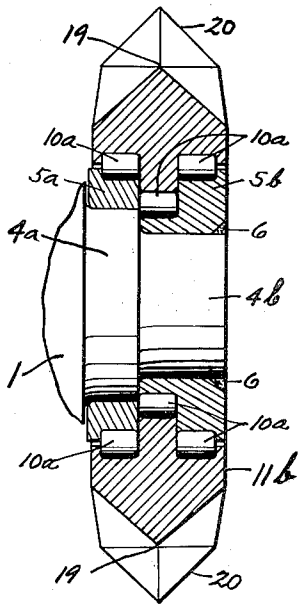

Fig. 6.

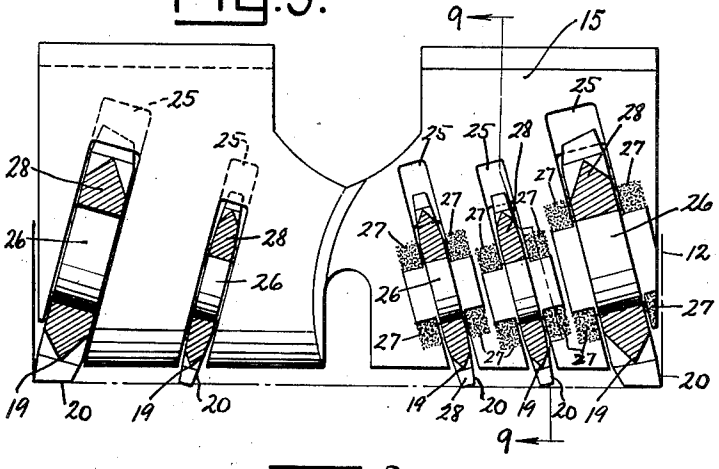

Fig. 8.

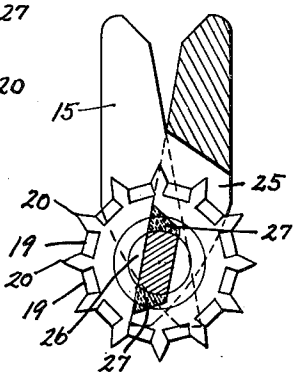

Fig. 9.

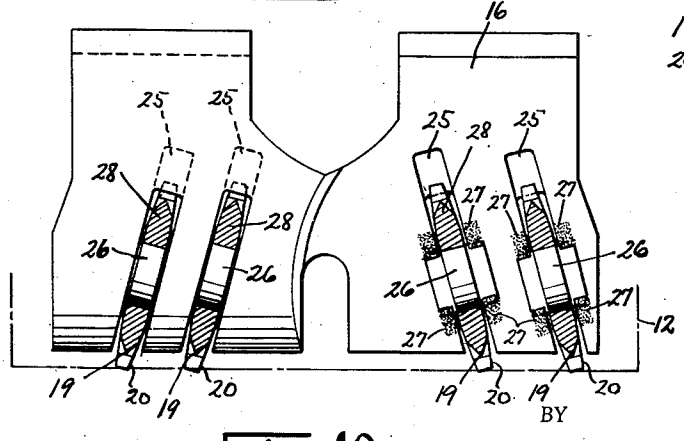

Fig. 10.

INVENTOR.
Clarence W Kinnear.

BY

By E. V. Hardway.
ATTORNEY

July 10, 1945. C. W. KINNEAR 2,380,112

DRILL

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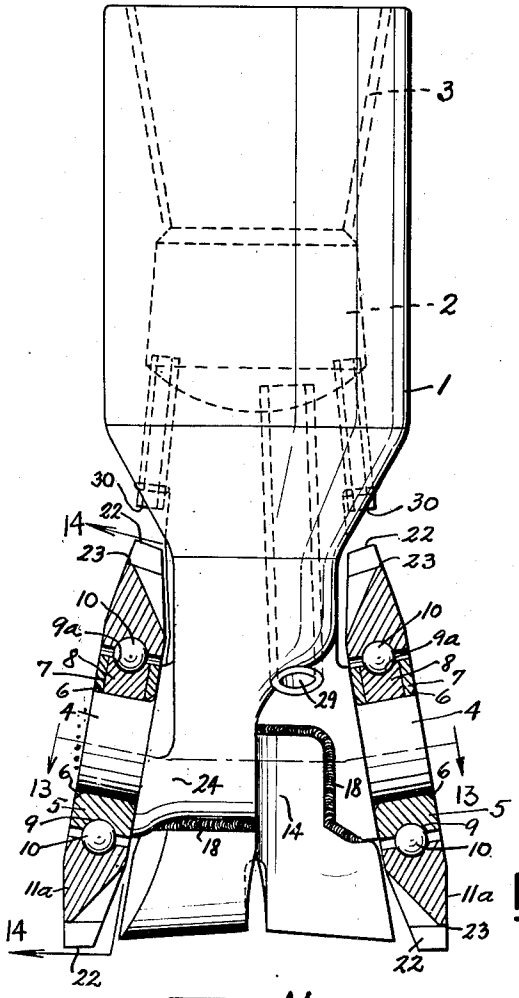

Fig. 11.

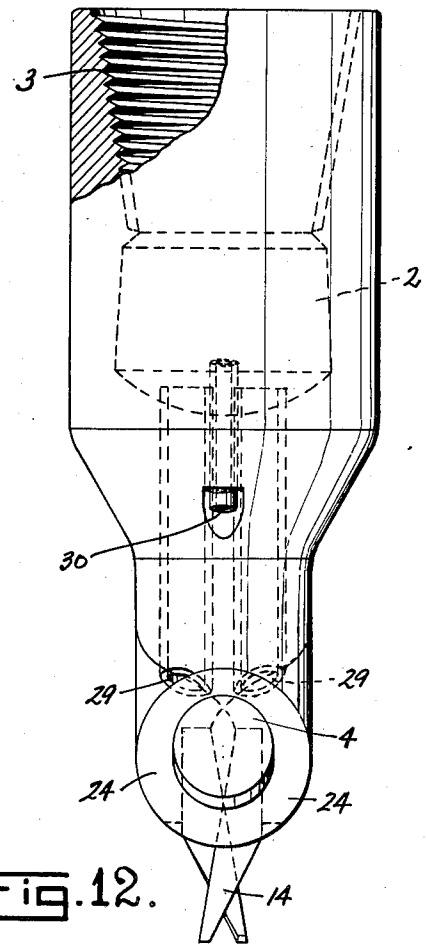

Fig. 12.

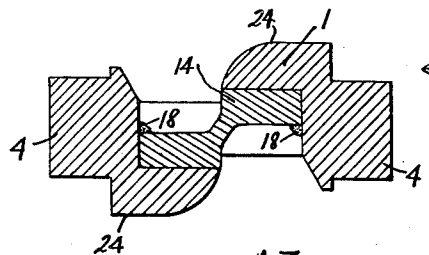

Fig. 13.

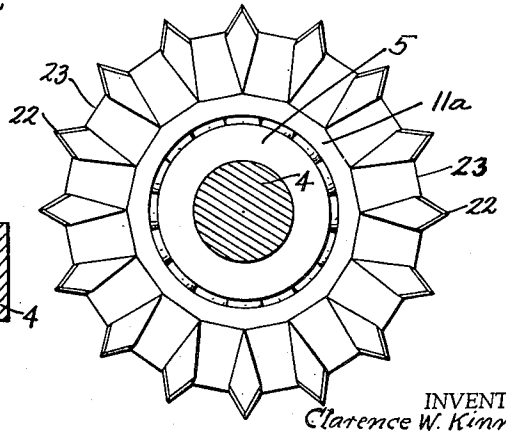

Fig. 14.

INVENTOR.
Clarence W. Kinnear

By E. V. Hardway
ATTORNEY.

Patented July 10, 1945

REISSUED

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DRILL

Clarence Wellington Kinnear, Houston, Tex.

Application January 2, 1942, Serial No. 425,408

2 Claims. (Cl. 255—71)

This invention relates to new and useful improvements in a rotary drill bit.

An object of the invention is to provide a drill bit to be used in rotary drilling of oil wells, or deep water wells or the like, said drill bit having cutting elements thereon for the penetration of the earth and suitable for either hard rock, shale, or tough sticky earth formation drilling.

Another object of the invention is to provide a rotary drill bit of the type above referred to, with outer roller cutting elements being so constructed and arranged to cut a furrow or groove in the earth formation around the outer bottom periphery of the well hole to weaken the remaining portion of the earth formation on the inner bottom part of the hole to be easily cut or torn up by other cutting elements arranged and provided for that purpose during initial hole drilling operations.

A further object of the invention is to provide a rotary drill bit of the character described having outer lower roller cutting elements extending outwardly and downwardly from the vertical central axis of the bit frame or body, and positioned on the outside of the frame or body of the bit, and having other cutting elements underneath the frame or body of the bit.

A further object of the invention is to provide a rotary drill bit of the character described having a frame or body larger on the upper portion with a suitable connecting means for a drill stem, and a centralized thinner or lesser dimension on the lower portion for the attachment of the cutting elements.

A further object of the invention is to provide a rotary drill bit of the character described having roller cutting elements thereon and being so designed that the weight of the drill stem will shear the earth formation from the cutting teeth and from between the cutting teeth on the roller cutting elements as the drill bit is rotated and forced through the earth.

A further object of the invention is to provide a rotary drill bit of the character described having flushing fluid courses so positioned and directed as to permit the flushing fluid to flush across the forward faces of the cutting elements cutting the inner bottom portion of the well hole and at the same time blast the earth formation at the bottom of the hole near the bottom side of the roller cutting elements cutting the outer bottom portion of the well hole.

A further object of the invention is to provide a rotary drill bit of the character described having roller cutting elements with a series of serrations or cutting teeth and a series of crotches spaced between the cutting teeth, and another series of cutting edges within the crotches between the teeth.

A further object of the invention is to provide a rotary drill bit of the character described having a thin scrape or fish tail like blade with longitudinal slots, and having bearing pins or axles spanning the slots and welded to the thin blade on each side of the slots, and with roller cutting elements adapted to rotate about the pins.

A further object of the invention is to provide a rotary drill bit of the character described having roller cutting elements mounted on antifrictional bearing assemblies.

A further object of the invention is to provide a rotary drill bit of the character described with roller cutting elements having a series of spaced cutting teeth with a series of associated crotches spaced between the cutting teeth, and with the lower part of the crotches sharpened and shaped ridge like for spliting the chip or cuttings so that weight applied from the drill stem will aid in shearing earth cuttings from between the cutting teeth, away from the crotches and force the cuttings up and away from the roller cutters during drilling operation.

These and other objects of the invention will in part be obvious and will in part be more fully disclosed in the accompanying drawings which show by illustration three embodiments of the invention, in which:

Fig. 1 is a vertical side view partly sectional of the drill bit with the cutting elements mounted thereon, and positioned at the bottom of a well hole;

Fig. 2 is a vertical side view of the drill bit body turned at 90 degrees to Fig. 1, showing the drag type bit blade welded to the body, and positioned at the bottom of a well hole;

Fig. 3 is a bottom plan view of the bit body shown in Fig. 1, with the drag type blade welded thereon, and positioned in a well hole;

Fig. 4 is a side view of one of the outer roller cutters mounted on an antifrictional bearing assembly as shown in Fig. 1;

Fig. 5 is a cross section through section line 5—5 of Fig. 1, showing the lower part of the bit body with cutting elements thereon and positioned in a well hole;

Fig. 6 is a side view partly sectional of a roller cutter assembly mounted on an axle pin showing

the application of cylindrical type antifrictional bearings;

Fig. 7 is a sectional side view of a roller cutter cutting tooth with the outer cutting point dubbed and sharpened;

Fig. 8 is a vertical side view partly sectional showing another embodiment of the drag type blade having roller cutter assemblies attached thereon, and adapted to cut the full gauge of the well hole to be drilled;

Fig. 9 is a section taken through section line 9—9 of Fig. 8, showing a roller cutter assembly mounted on the drag type bit blade and being turned at 90 degrees to Fig. 8;

Fig. 10 is a vertical side view of a drag type bit blade showing roller cutter assemblies partly sectional attached thereon, and adapted to cut a lesser gauge than the full gauge of the hole to be drilled;

Fig. 11 is a vertical side view partly sectional of another embodiment of the drill bit;

Fig. 12 is a vertical side view partly sectional of the drill bit body with drag type blade attached thereto and turned at 90 degrees to Fig. 11;

Fig. 13 is a cross section of the drill bit body and drag type blade taken through section line 13—13 of Fig. 11;

Fig. 14 is a vertical side view partly sectional showing a roller cutter mounted on an antifrictional bearing assembly, and attached to an axle pin and being taken through section line 14—14 of Fig. 11.

The invention will be better understood from a detailed description thereof wherein like numerals denote like parts in the accompanying drawings of the present embodiments of the invention.

The numeral 1 designates the frame or body of the bit which has an interior cavity 2 formed in the upper end thereof, said cavity being provided with a threaded portion 3 to receive a drill stem. The middle and lower part of the bit body narrows down to a lesser dimension forming a downwardly extending central shank. This downwardly extending central shank is somewhat enlarged on its lower portion and has outwardly and upwardly extending axle pins 4 thereon. Races 5 are fitted on to axle pins 4 and secured thereto by welding material 6. These races in Fig. 1, and Fig. 11, have antifrictional bearing assembly holes 7 in which is placed bearing retaining plugs 8 with race grooves 9 in the races and race grooves 9a in the retaining plugs for retaining ball bearings 10 which are adapted to rotate about the races; however the races and bearing applications are different as shown in Fig. 6. It being understood that any well known bearing and race application could be used. In Fig. 6, the axle pin is of larger diameter adjacent the bit body 1 at 4a and of smaller diameter on the outer end 4b. A larger diameter race 5a is fitted on axle pin portion 4a and race 5b is fitted on axle pin portion 4b and secured thereto by welding material 6. Cylindrical antifrictional bearings 10a are mounted on the races 5a and 5b and are adapted to rotate about said races. The middle set of cylindrical antifrictional bearings rotate about a race surface of lesser diameter than the two outer sets of cylindrical antifrictional bearings.

Cutting elements forming the cutting portion of the drill bit are of different forms and character and are placed at different positions and angles with respect to each other in different embodiments of the invention to meet the requirements of drilling in different localities of the earth. These cutting elements consist in different embodiments of the invention of outer bottom roller cutters 11, 11a, and 11b to be used for cutting the outer bottom part of well hole 12, and inner bottom cutting elements 13, 13a, 14, 15, and 16 to be used for cutting the inner bottom part of well hole 12, which are attached by welding 18 to either one of the bit bodies. Different inner bottom cutting elements are selected to suit the substance being drilled. The inner bottom cutting elements 13, 14, and 16 are adapted to cut a lesser gauge than the full gauge of well hole 12 while the inner bottom cutting elements 13a, and 15 are adapted to cut the full gauge of hole 12. It being shown in Fig. 2, that drag blade 13 could easily be extended wider at 13a to cut the full gauge of the hole. Hard surface material may be attached to any or all of the cutting elements or bearing surfaces in the well known manner. The outer bottom roller cutters are mounted on antifrictional bearings as shown and situated to lean inwardly at the top and outwardly at the bottom, and to rotate about said bearings and exteriorly of the frame or body of the bit which will help prevent debris or cuttings from clogging or stopping the rotation of said roller cutters. The axis of the axle pins 4 about which the outer bottom roller cutters are adapted to rotate are each oppositely set forward of the diametrical center line 17 of the drill bit as shown in Fig. 5, thus allowing the outer bottom roller cutters to cut the gauge of the hole on the forward outer side bottom portion of said roller cutters during rotating operation and also allowing clearance between the well hole gauge and the back and lower portion of the outer bottom roller cutters during rotation; however, the axis of the axle pins could be placed on the diametrical center line of the bit if desired. Cutting teeth and crotches between said cutting teeth on the roller cutters shown are of unique design and are very important as the weight of the drill pipe will aid in shearing the debris or cuttings from the cutting teeth, and from the crotches between the cutting teeth during drilling operation. In Figs. 1, 4, 6, 7, 8, 9, and 10 the roller cutters all have spaced sharpened ridge like cutting edges 19 centrally located within the crotches between the spaced cutting teeth 20 for splitting the chip or cuttings. In Fig. 7, the cutting tooth is somewhat dubbed off and sharpened on the outer cutting point 21. In Figs. 11 and 14, the roller cutters 11a have spaced cutting teeth 22 with spaced sharpened ridge like cutting edges 23 within the crotches between said cutting teeth. The spaced sharpened cutting edges 23 are situated to one side of the center of the spaced cutting teeth 22 for forcing the main portion of the chips or cuttings toward the inner part of the well hole during drilling operation.

The construction of the inner bottom cutting elements are of different design as aforestated, and are placed adjacent to blade spports 24 of the bit body and firmly welded thereto as shown, thereby taking a great part of the downward thrust off of the outer roller cutting elements when drilling. Inner bottom cutting elements 13, 13a, and 14 are of the fish tail drag type blade, and inner bottom cutting elements 15, and 16 are drag type blades having slots 25 therein with axle pins 26 positioned across said slots and embedded in and secured to said blades 15, and 16, by welding material 27. Roller cutters 28 are

mounted on axle pins **26** and adapted to rotate about said axle pins, and through said slots **25**.

Large fluid course ducts **29** and smaller fluid course ducts **30** extend through the drill bit body and communicate with the interior of a drill stem (not shown) whereby flushing fluid forced through said drill stem is adapted to wash debris and cuttings from the cutting elements of the drill bit during drilling operation.

In the operation of the drill bit a suitable drill stem is attached to the threaded portion thereof and the device is rotated and fed forward into the earth. As the drill rotates the roller cutting elements rotate about their respective axle pins and cut deepened grooves in the earth formation within their path of rotation and the drag type cutting elements cut or tear the remaining portion of the earth formation within their path of movement. The roller cutters being of extraordinary design cut chips or cuttings from the bottom of the well hole and the chips or cuttings caught in the crotches between the cutting teeth of the roller cutters are forced from the crotches and out into the open hole by the aid of the weight of the drill stem urging the cutting teeth to slice through the earth and to take hold of other chips or cuttings. Flushing fluid is forced through the drill stem into the bit body, and emerges through the fluid course ducts for washing debris and cuttings from the drill bit. The large fluid course ducts are so positioned on the bit body with respect to the cutting elements that they are adapted to wash down the front cutting faces of the inner cutting elements and blast the bottom of the well hole near where the outer roller cutters are taking their portion of the cut with the same direct blast. It being remembered that flushing fluid under high pressure will dislodge and cut a great amount of the cuttings from the bottom of the well hole. This position of these fluid course ducts with respect to the cutting elements, and with respect to their emerging on the exterior surface and well upon the outside surface of the bit body are of extreme importance as this allows the flushing fluid to directly blast cuttings away from the outer side periphery of the bit body, directly blast down the front faces of the inner cutting elements, directly blast along the side of the outer bottom roller cutters, and directly blast the bottom of the well hole in the near proximity of where the inner bottom cutting elements and the outer bottom roller cutters take their respective cuts in the substance being drilled. The smaller fluid course ducts directly blast the cutting teeth on the outer bottom roller cutters as the said teeth on the cutters rotate past the port holes of said smaller fluid course ducts during drilling operation.

It is obvious that many changes may be made in the details of construction and arrangement of parts by one skilled in the art without departing from the scope of the invention.

Having thus described the invention, what I claim as new and desire to secure by Letters Patent is:

1. A rolling cutter for use in well drills comprising, a disc-like body having on its periphery cutting teeth terminating in outwardly directed cutting edges and spaced apart so as to leave notches, or depressions, between the cutting teeth, that portion of the notches, or depressions, forming the body of the rolling cutters, being beveled so as to form sharp cutting edges extending circumferentially of the disc-like body, the cutting edges of the teeth extending radially further than the circumferential cutting edges of the notches.

2. A rolling cutter for use in well drills comprising, a disc-like body having on its periphery cutting teeth spaced apart so as to leave notches between the cutting teeth, that portion of the notches, forming the body of the rolling cutter, being beveled so as to form cutting edges extending, approximately, circumferentially of the disc-like body, the cutting edges of the teeth extending radially further than the circumferential cutting edges of the notches.

CLARENCE WELLINGTON KINNEAR.