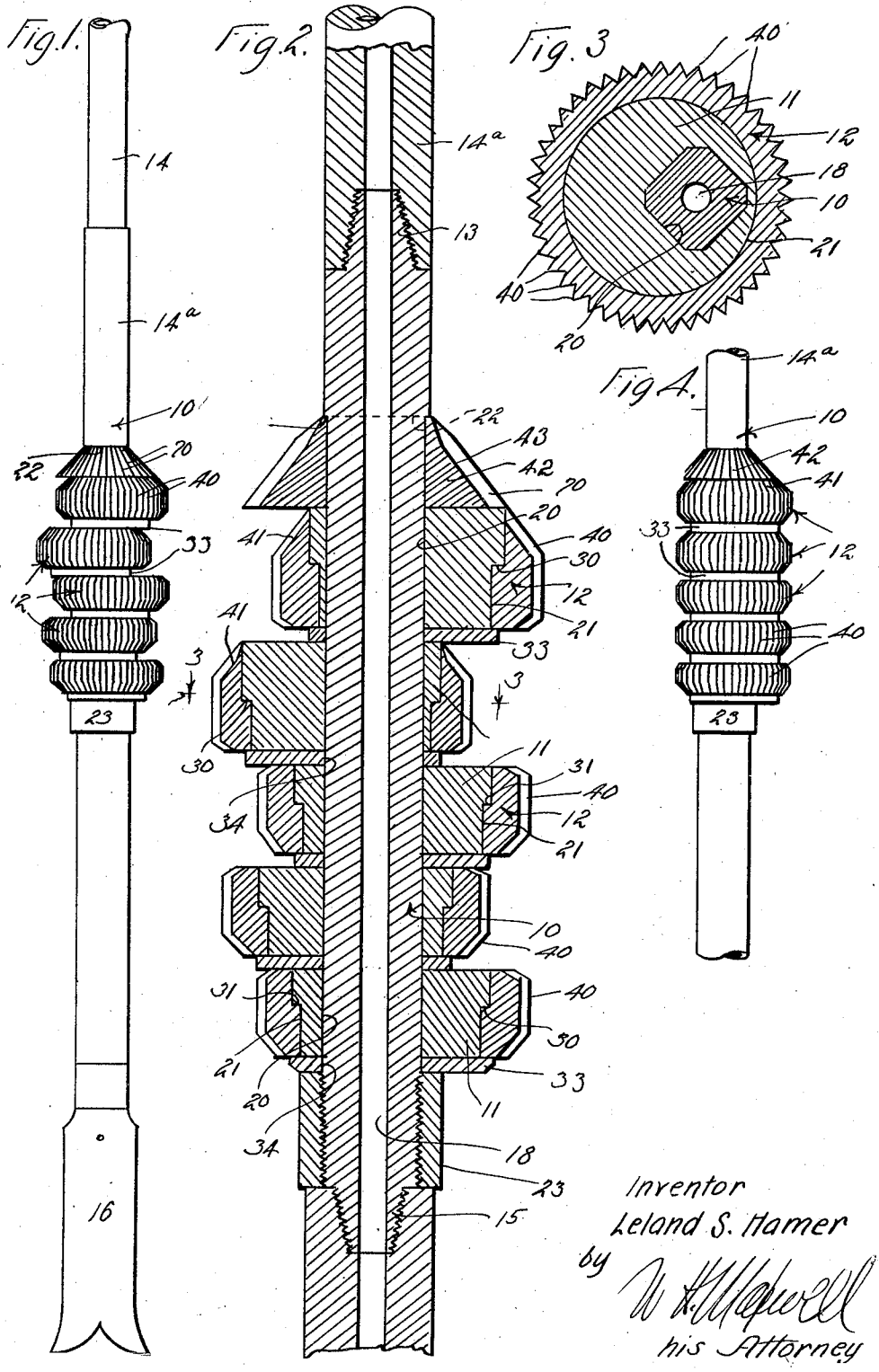
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WELL TOOL

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UNITED STATES PATENT OFFICE

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WELL TOOL

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This invention has to do with a well tool and is particularly applicable to a well reamer, or the like. It is a general object of my invention to provide a simple, effective and durable well tool of the character mentioned.

In the drilling of wells, particularly oil wells, it is generally desirable to drill the hole first with a suitable bit and then ream it with a reaming tool.

It is a primary object of my present invention to provide a well reamer, or the like, which will operate to effectively ream or cut a hole without causing excessive vibration or jarring of the drilling apparatus, as ordinarily occurs when using a well reamer.

It is another object of this invention to provide a reamer including rotatable cutters having exceptionally large durable mountings.

A further object of my invention is to provide a reamer embodying few simple strong parts.

Another object of the invention is to provide a well reamer having rotating cutters with very large cutting faces.

It is another object of the invention to provide a well reamer in which the cutters can be adjusted or re-arranged easily at the will of the operator and in which parts can be repaired or replaced quickly and at very little expense.

Another important object of the invention is to provide a well tool having a rotatable cutter which rotates slowly on its axis. In carrying out this object of the invention, I provide a tool that can be rotated rapidly without causing rapid rotation of the cutter on its axis.

It is another object of the invention to provide a well tool having a rotatable cutter with a cutting face only slightly smaller in diameter than the hole in which the tool operates.

The various objects and features of the invention will be best and more fully understood from the following detailed description of a typical form and application of the invention, throughout which description reference is had to the accompanying drawings, in which:

Fig. 1 is a view illustrating my invention in operating position with relation to standard drilling apparatus;

Fig. 2 is a longitudinal detailed sectional view of my invention;

Fig. 3 is an enlarged, detailed, transverse sectional view of the construction, being a view taken as indicated by line 3—3 on Fig. 2; and

Fig. 4 is a view similar to Fig. 1 showing the parts of the tool in another arrangement.

The tool provided by my invention includes, generally, a central body or shank 10, a plurality of eccentric bearings 11 fixed on the shank, and annular cutters 12 rotatably mounted on the bearings.

The shank 10 extends longitudinally of the reamer and, in practice, it may be comparatively long, the exact length depending upon the number and length of the cutters desired in the construction. With my construction, the shank may be comparatively large and strong so that there is no danger of it twisting off or failing. When the tool is constructed to be operated in the manner usual to well reamers, the shank 10 may be provided at its upper end with a tapered screwthreaded projection 13 for connection with the lower end of a string of drill pipe 14. This connection may be made through a collar 14a. The lower end of the shank may be provided with a screw-threaded part 15 by which a pilot bit 16, or the like, may be attached to the tool. In practice, it is desirable to provide a central longitudinal opening 18 through the shank to conduct circulating fluid from the drill pipe to the bit.

The bearings 11 are arranged along the shank and are eccentric to the longitudinal axis of the shank. The bearings are mounted stationary on the shank so that they cannot rotate. In the preferred construction, I prevent the bearing from rotating by making the shank 10 out of round, for instance, polygonal, in cross sectional configuration and by forming the bearings

11 with openings 20 corresponding in shape to the shank to slidably receive or fit the shank. By making the shank substantially square, as shown in the drawings, and by correspondingly shaping the openings 20 in the bearings to slidably receive the shank, the bearings are effectively mounted on the shank against rotation.

Each bearing 11 has an annular outer face 21 formed with its axis offset or eccentric to the axis of the opening 20. The eccentricity, or offset, of the bearing face 21 may be made any suitable amount and, in accordance with the broader principles of my invention, this eccentricity may be different in the different bearings of the reamer. Further, the bearing faces of the several bearings may be of different diameters, if so desired. The bearings 11 may be held on the shank 10 between a shoulder 22 at one end of the shank and a retaining member 23 applied to the outer end of the shank. In the particular construction shown in the drawings, the shoulder 22 is located at the upper end of the shank and faces downwardly, while the retaining member 23 is screwthreaded on to the lower end portion of the shank. With this construction, the shoulder 22 forms a fixed abutment while the retaining member 23 may be operated to clamp the bearings tightly together to positively hold them against longitudinal movement on the shank.

The cutters 12 are annular in form and surround the bearings 11 to be rotably carried on the outer faces 21 of the bearings.

The number of cutters provided in the construction may vary and the number of cutters carried on each bearing 11 may vary. In the form of the invention shown in the drawings, there is one cutter 12 mounted on each bearing 11. In practice, it is desirable to have the outer faces 21 of the bearings completely occupied by the cutters 12, as shown throughout the drawings. I may retain the cutters on the bearings in any suitable manner. For instance, in the drawings I have shown the cutters held against displacement from the bearings in one direction by shoulders 30 on the bearings co-operating with shoulders 31 in the cutters. In this case, the cutters may be held against displacement from the bearings in the other direction by thrust washers 33 inserted between the bearings 11 to project outwardly beyond the bearings and thus engage and retain the cutters. The thrust washers 33 may be formed with openings 34 to fit the shank 10 the same as the openings 20 in the bearings so that the washers are held in the proper positions on the shank.

The cutters being rotatable, it is advantageous to provide them with cutting teeth 40, such as are effective on roller cutters. For instance, I may provide the cutters with comparatively small V-shaped teeth 40 which can be readily faced with very hard steel. In practice, a reaming tool is ordinarily lowered in the hole as the reaming operation progresses and, therefore, it is desirable to bevel the lower or advancing ends of the lowermost cutters, as shown in the drawings. Teeth 40 may be continued on the beveled parts of the cutters in the manner shown in the drawings. In practice, the tool is ordinarily lowered into the well through a casing set in the upper part of the well, and to facilitate withdrawal of the tool, it is desirable to bevel the upper ends of the uppermost cutters as at 41 so that the tool will readily enter the casing when being withdrawn from the well. In this connection, it is desirable to provide a guide collar 42 on the shank above the uppermost cutter and to form the guide shoe with a beveled face or exterior 43 which will operate to guide the tool into the casing. The guide collar 42 may be inserted between the uppermost bearing 11 and the shoulder 22. The exterior of the collar is preferably provided with cutting teeth 70.

In using the reamer provided by my construction, the operator may apply the desired number of bearings 11 on the shank and may relate the bearings in various manners; for instance, so that they project in various directions from the shank. If four bearings are used, it will ordinarily be desirable to arrange the bearings ninety degrees apart on the shank. By making the shank polygonal in cross section, as above described, it is possible to position the bearings in several different rotative positions on the shank, and if the bearings are provided with openings 20 formed through them in different rotative positions, it is possible to further vary their relative positioning on the shank. From the foregoing description and from the drawings, it will be obvious how the reamer can be assembled. The guide collar is first slid on to the shank into engagement with the shoulder 22. The bearings 11, the cutters 12 and thrust washers are then assembled on the shank in the desired manner. The parts thus assembled are then set or locked in position on the shank by applying the retaining member 23. By screwing the retaining member 23 tightly on to the shank, the guide collar, bearings and thrust washers may be tightly clamped together on the shank, thus forming a rigid, strong and durable construction. The annular cutters are rotatable on the bearings, being retained in position on the bearings through the means above described. The tool is then ready for operation and, in practice, it is desirable to apply a guide bit, or the like, to its lower end.

In Fig. 1 of the drawings, I illustrate the tool with the several bearings 11 ar-

ranged in different rotative positions on the shank so that the cutters 12 project in different directions from the axis of the shank. In this case, the tool, when operated, engages several points around the inside of the hole being reamed. This general arrangement of parts provides a tool which is balanced and is desirable for most reaming operations. In the arrangement shown in Fig. 4, all of the bearings 11 are mounted on the shank in the same position so that they all project from the shank in the same direction. In this case, all of the cutters 12 project from one side of the shank. With this arrangement of parts, the tool may be provided with cutters 12 somewhat larger in diameter than the cutters embodied in the arrangement shown in Fig. 1 and yet pass through the same size casing. In this case, the tool may be operated as an under-reamer as the cutters will operate to enlarge the bore or hole in which the tool is operated.

In operating the tool, the annular cutters operate on the wall of the hole to ream it to the desired size and shape. It will be obvious that the cutters are free to rotate on the bearings during the operation of the tool and thus will have the action obtained with the roller type of cutter, which action has become recognized as very desirable and effective in drilling most formations. As the tool is rotated, the cutters are carried around with it with their cutting faces engaging or rolling on the wall of the hole. The engagement between the cutters and the wall of the hole causes the cutters to turn on their mountings and with my construction and with the proportioning of parts made possible by my construction, the cutters turn slowly on their mountings. For instance, when the cutters are made only slightly smaller in diameter than the hole in which the tool is operated, the tool must make several revolutions for the cutters to make one revolution. This slow turning of the cutters is very important as it assures long life to the cutter mountings. The rotation of the cutters on the bearings prevents wear occurring at any one part and thus keeps the tool in effective operating condition for a long period.

It is to be noted that my construction is particularly strong and that all of the parts subject to strain are heavy and durable. It is further to be noted that my construction permits of the reamer being readily repaired, as the various parts can be easily and quickly taken apart or assembled by simply releasing the retaining member 23.

Having described only a typical preferred form of my invention, I do not wish to limit myself to the specific details set forth, but wish to reserve to myself any changes or variations that may appear to those skilled in the art or fall within the scope of the following claims:

Having described my invention, I claim:

1. A well tool including a vertical shank polygonal in cross sectional configuration, a bearing having an eccentric opening corresponding to the shank to slidably receive it, a cutter mounted for rotation on the bearing, and cooperating shoulders on the cutter and bearing holding the cutter against upward movement on the bearing.

2. A well tool including a vertical shank, a bearing having an eccentric opening slidably fitting the shank, the engagement between the shank and opening being such that the bearing is held against rotation on the shank, the shank and opening being shaped so that the bearing can be arranged on the shank in different rotative positions, and a cutter mounted for rotation on the bearing, the cutter and bearing having cooperating shoulders holding the cutter against upward movement on the bearing.

3. A well tool including, a shank polygonal in cross sectional configuration and having a downwardly facing shoulder, a bearing having an eccentric opening slidably fitting the shank, the engagement between the shank and opening being such that the bearing is held against rotation on the shank, the bearing having a downwardly facing shoulder, a cutter mounted for rotation on the bearing, an upwardly facing shoulder on the cutter engaging the shoulder on the bearing, and a guide collar engaging the shoulder on the shank and positioned above the bearing.

4. A well tool including, a shank polygonal in cross sectional configuration and having a downwardly facing shoulder, a bearing having an eccentric opening slidably fitting the shank, the engagement between the shank and opening being such that the bearing is held against rotation on the shank, the bearing having a downwardly facing shoulder, a cutter mounted for rotation on the bearing, an upwardly facing shoulder on the cutter engaging the shoulder on the bearing, and a guide collar surrounding the shank between the shoulder on the shank and the bearing.

5. A well tool including, a straight shank of polygonal cross section having a downwardly facing shoulder, a guide collar on the shank engaging the shoulder, a plurality of bearings below the collar having openings slidably receiving the shank, the openings being shaped so that the bearings are held against rotation on the shank and so that they may be arranged on the shank in different rotative positions, the bearings having downwardly facing shoulders, and cutters rotatably mounted on the bearings having upwardly facing shoulders engaging the shoulders on the bearings.

6. A well tool including, a shank polygonal in cross sectional configuration and having a downwardly facing shoulder, a bearing having an eccentric opening slidably fitting the shank, the engagement between the shank and opening being such that the bearing is held against rotation on the shank, the bearing having a downwardly facing shoulder, a cutter mounted for rotation on the bearing, an upwardly facing shoulder on the cutter engaging the shoulder on the bearing, and a beveled guide collar surrounding the shank in engagement with the shoulder on the shank between the said shoulder and the bearing.

In witness that I claim the foregoing I have hereunto subscribed my name this 1st day of March, 1927.

LELAND S. HAMER.