Oct. 7, 1930. J. GRANT 1,777,559

EXPANDING ROLLER UNDERREAMER

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Fig. 1

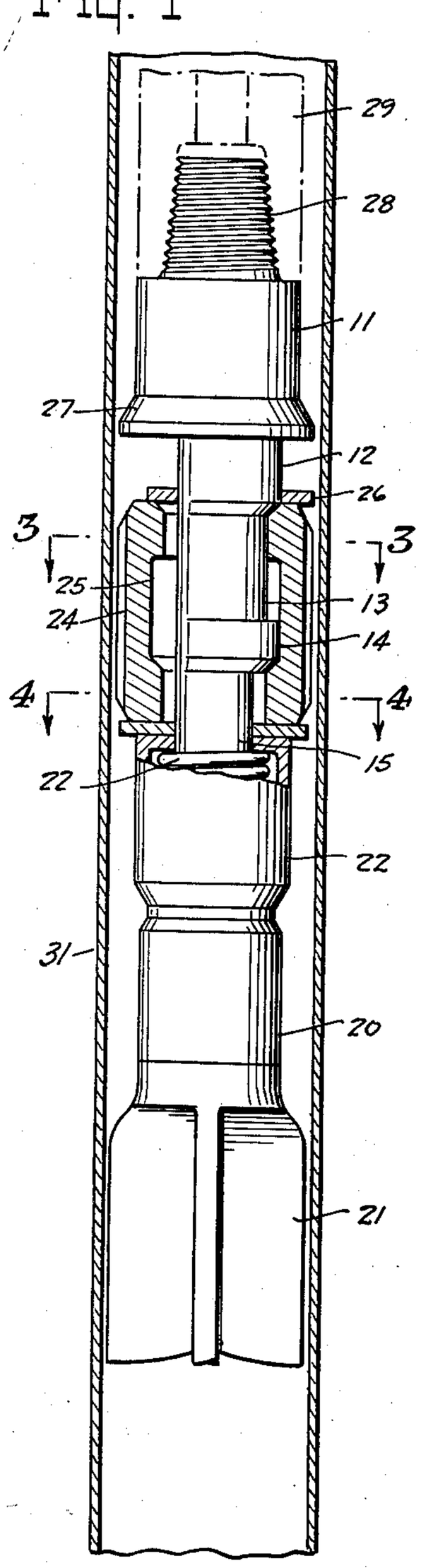

Fig. 2

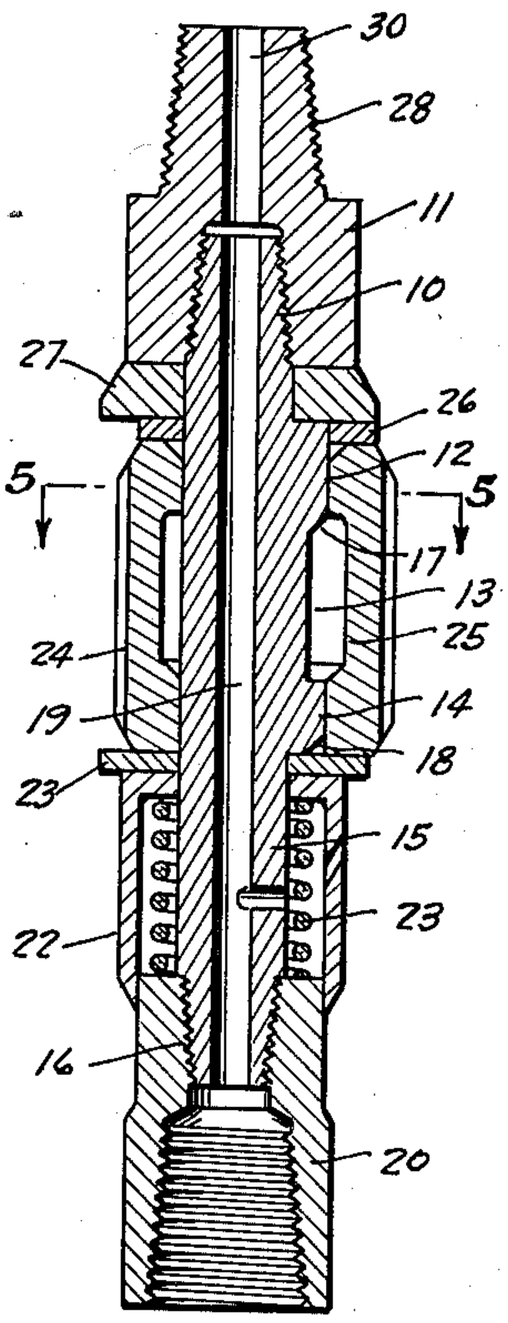

Fig. 3

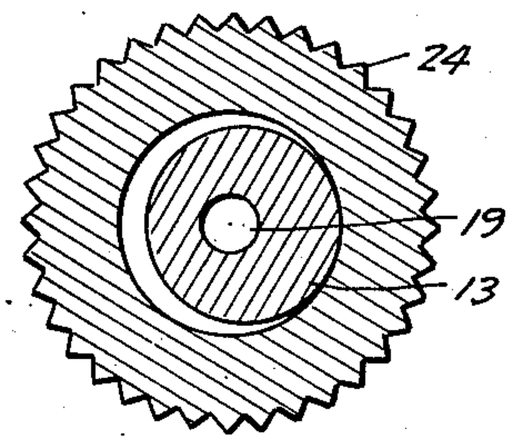

Fig. 4

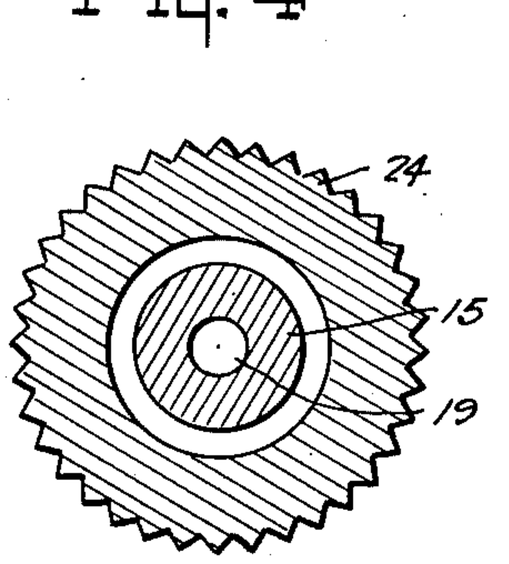

Fig. 5

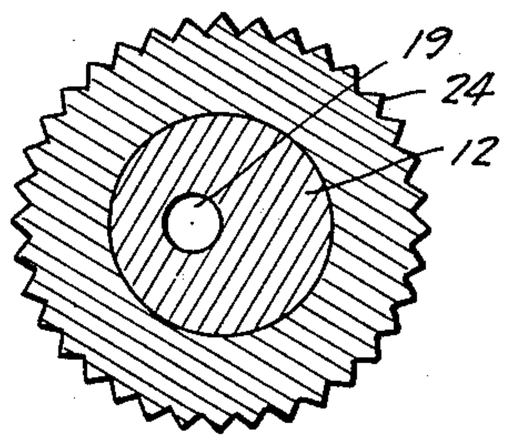

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Fig. 6

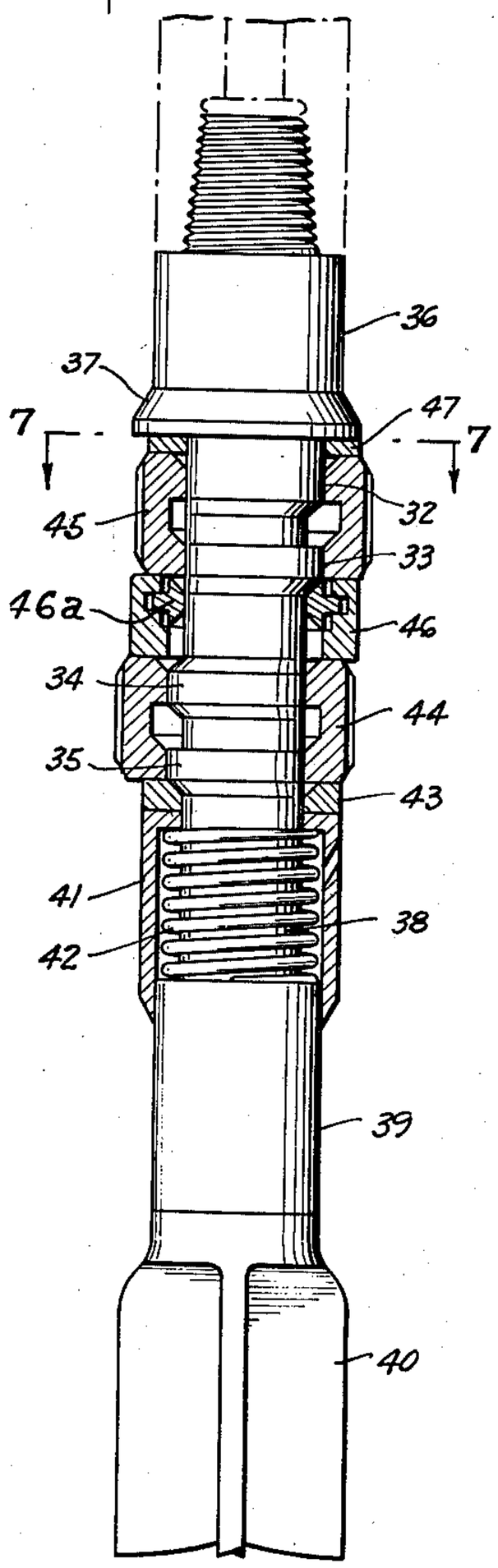


Fig. 7

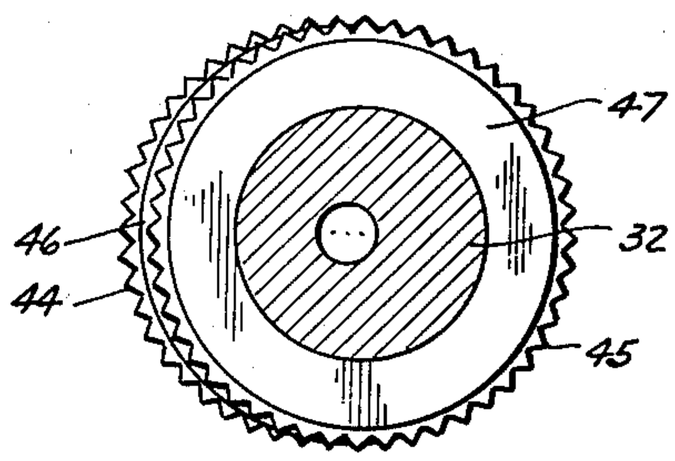
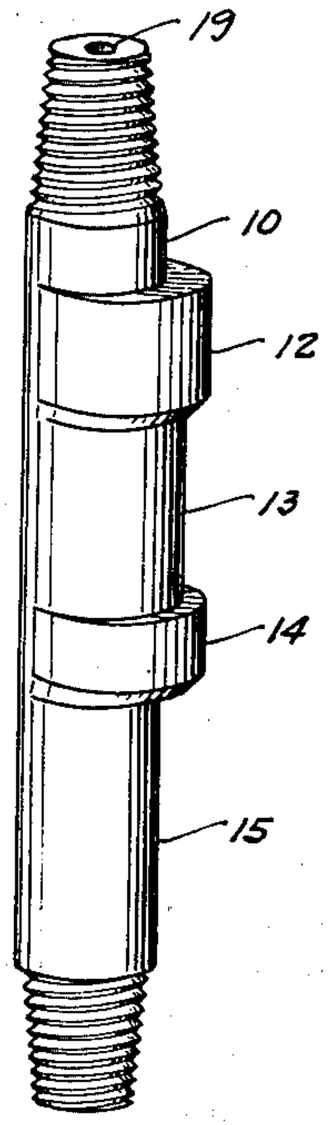


Fig. 8



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Patented Oct. 7, 1930 1,777,559

UNITED STATES PATENT OFFICE

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EXPANDING-ROLLER UNDERREAMER

Application filed July 14, 1926. Serial No. 122,340.

This invention relates to an underreamer adapted for earth boring and especially suitable for oil well drilling. The invention relates more particularly to a tool of this character having a roller serving as a cutter, which roller may be positioned to project laterally in expanded position. More especially, this invention appertains to a tool having an arbor and a roller cutter disposed thereon so that in one longitudinal position on the arbor it will project a greater distance than in another longitudinal position.

It is the primary object of this invention to provide a tool of the character described having a roller so arranged that it may be retracted permitting its passage through well casing and which will be expanded laterally upon emergence therefrom. To this end, I have disclosed a tool having a roller which may be disposed concentrically to the axis of the tool when contracted and will be moved to eccentric or expanded position upon passing below the casing into reaming position.

These objects together with other objects and corresponding accomplishments are obtained by means of the embodiment of my invention illustrated in the accompanying drawing, in which:

Fig. 1 is an elevation partly in section of a single roller underreamer having a twist bit attached thereto, the roller being in retracted position; Fig. 2 is an axial section through the underreamer showing the roller in projected position; Fig. 3 is a section as seen on the line 3—3 of Fig. 1; Fig. 4 is a section as seen on the line 4—4 of Fig. 1; Fig. 5 is a section as seen on the line 5—5 of Fig. 2; Fig. 6 is an elevation partly in section of a double roller underreamer; Fig. 7 is a section as seen on the line 7—7 of Fig. 6; and Fig. 8 is a perspective view of the arbor used with the single roller underreamer.

Referring with more particularity to Figs. 1 to 5 inclusive and 8, an arbor or mandrel is shown provided with a tapered threaded pin end 10 adapted to be connected into the box of a connector 11. The end is provided with a cylindrical portion and below the cylindrical portion is an enlargement 12 having a cylindrical periphery eccentric to the axis of the pin and the body of the tool. Below the enlarged portion 12 is a recessed portion of reduced diameter indicated by 13. This portion while eccentric, has less eccentricity than the portion 12. Below the portion 12 is an eccentric portion 14 having the same axis as portion 12 and of the same diameter. The arbor is continued with a recessed cylindrical portion 15 concentric to the axis of the arbor and ending in a tapered threaded pin 16. The shoulder between portions 12 and 13 is bevelled as indicated by 17. Similarly the shoulder between portions 14 and 15 is bevelled as indicated by 18. Extending through the arbor is a water course 19.

Mounted upon the pin 15 of the arbor is a connector 20 having a threaded socket. Mounted in the socket is a twist tail bit 21. This bit forms no part of the present invention. The upper part of the connector 20 is cylindrical and slidably mounted thereover is a sleeve or thimble 22. A telescopic connection is thereby provided, and mounted within the sleeve is a compression spring 23 urging the sleeve upwardly. A washer 23 rests upon the sleeve and disposed over the washer is the cutter or roller 24. The roller has a bore equal in diameter at its outer end to the diameter of the portions 12 and 14 of the arbor. Thus, when in the position shown in Fig. 2, it may rotate thereon. The intermediate portion of the bore is enlarged as indicated by 25. The enlargement is of such length as to span the reduced portion 14 of the arbor. Mounted over the roller is a washer 26 slidably mounted upon the enlarged portion 12 of the arbor. Resting upon the shoulder formed between the pin 10 and the enlarged portion 12 is a disk 27, and disposed over the disk and secured to the pin 10 is the connecting member 11 having a threaded pin 28 for connection to the drill pipe 29. There is a water course 30 extending through the connector 11 and communicating with the water course 19 in the arbor.

To contract the tool, the roller 24 is moved longitudinally downward against the action of the spring 23 so that the portion of the

bore of smaller diameter rides into the recesses 13 and 15. This permits the roller to be moved to a position concentric to the axis of the tool. In this position it is inserted in the casing indicated by 31 and may be lowered in the hole. When it emerges from the bottom of the casing, the spring 23 will force the roller upwardly, and it will ride upon the enlarged portions 12 and 14 of the arbor. In this position it is eccentric to the axis of the body as shown in Fig. 2 and is confined vertically between upper washer 26 and lower washer 23, which latter washer brings up against the lower end of enlargement 14. This is the expanded position of the underreamer. Upon rotation of the underreamer the roller will cut into the side wall.

Referring more particularly to Figs. 6 and 7 an arbor is shown having enlarged portions 32, 33, 34, and 35. There are intermediate recesses. The enlarged portions are arranged in pairs.

The pair 32 and 33 are eccentric and of the same diameter. Likewise the enlarged portions 34 and 35 constitute a pair of the same diameter, being eccentric to the axis of the body and offset diametrically opposite to the enlarged portions 32 and 33. The arbor is connected at its upper end to a connector 36, there being a disk 37 below the connector resting upon a shoulder formed on the arbor. The lower end of the arbor indicated by 38 is cylindrical and secured thereto is a connector 39 to which a twist bit 40 is attached. A sleeve 41 is telescopically mounted upon the body of connector 39 and within the sleeve is a compression spring 42 tending to force the sleeve upwardly. Mounted upon the upper end of the sleeve is a washer 43 which in its uppermost position bears upwardly against the shoulder under enlargement 35. Mounted upon the arbor so as to cooperate with the portions 34 and 35 is a roller cutter 44. This is shown in Fig. 6, the cutter being in expanded position. By moving it downwardly it will ride into the recess formed between enlarged portions 34 and 35 and over the pin 38. Similarly a roller 45 is mounted to cooperate with enlargements 32 and 33. In the position shown in Fig. 6, the roller 45 is expanded also. When moved downwardly over the recesses between enlargements 32, 33, and 34, it will be contracted. Intermediate the rollers 44 and 45 is a spacer which may comprise a split ring 46ª resting in the groove of an annulus 46 and disposed above roller 45 is a washer 47. The bore of the annulus 46 is large enough to slide over enlargement 34 when the rollers and spacer move down from the position shown in Fig. 6. The split ring forms a bearing for the spacer on the reduced portion of the mandrel intermediate the enlargements 33 and 34, guiding the spacer into enlargement 34. The operation of the rollers will be apparent from the foregoing description of the construction of the tool.

What I claim is:

1. In an underreamer, an arbor having spaced offset portions, a cutter element mounted on said arbor to play lengthwise thereof, said cutter element having a bore providing two spaced bearing surfaces near the ends of the cutter and having a bore enlargement between said bearing surfaces, the spacing of the bearing surfaces being such that they may ride on said offset portions to maintain the cutter element in expanded position or said cutter element may be disposed lengthwise of the arbor with the bearing surfaces positioned out of registration with said offset portions with said cutter element in contracted position.

2. In an underreamer, a mandrel having thereon a plurality of spaced offset cutter bearings of limited longitudinal extent and having a corresponding number of reduced portions each longitudinally adjacent an offset bearing, one of said reduced portions being located between two of said offset bearings, a plurality of annular cutter elements surrounding and movable longitudinally on the mandrel and each adapted in one position to fit around one of the offset bearings and to move longitudinally between a position on such bearing and a position surrounding the adjacent reduced part, and an annular spacer surrounding the mandrel and positioned between two cutter elements, said spacer having a bore large enough to fit over a bearing and having in its bore a reduced bearing part which fits upon the reduced mandrel portion intermediate two mandrel bearings.

3. In an underreamer, a mandrel having longitudinally spaced offset portions, a cutter element mounted on and embracing said mandrel to be moved lengthwise thereof and having inner projecting end portions arranged to bear on said offset portions in one longitudinal position on the mandrel and to be out of bearing relationship to the offset portions in another longitudinal position, whereby to be expanded and contracted.

4. In an underreamer, a mandrel having longitudinally spaced offset portions, a cutter element mounted on and embracing said mandrel to be moved lengthwise thereof and having inner projecting end portions arranged to bear on said offset portions in one longitudinal position on the mandrel and to be out of bearing relationship to the offset portions in another longitudinal position, whereby to be expanded and contracted, and means urging said cutter element lengthwise into expanded position.

5. In an underreamer, an arbor having spaced offset portions, a cutter element mounted on said arbor to play lengthwise

thereof, said cutter element having a bore enlarged to provide an annular recess intermediate the ends of the cutter arranged so that the end portions of said cutter may ride on said offset portions to maintain said cutter element in expanded position or may be disposed lengthwise of said arbor with said portions disposed out of registration with said offset portions with said cutter in contracted position, and means urging said cutter element lengthwise to expanded position.

6. In an underreamer, an arbor having spaced enlarged offset portions, a cutter element mounted on said arbor to play lengthwise thereof, said cutter having a bore enlarged to provide an annular recess intermediate the ends of the cutter arranged so that the end portions of said cutter may ride on said offset portions to maintain said cutter in expanded position or may be disposed lengthwise on said arbor with said end portions out of registration with said offset portions with said cutter in contracted position, a sleeve on said arbor mounted for sliding movement below said cutter element and in engagement therewith, and a spring for urging said sleeve against said cutter and said cutter into expanded position.

7. In an underreamer, an arbor having a concentric portion at the lower end and spaced enlarged eccentric portions above, a cutter element mounted on said arbor to play lengthwise thereof, said cutter element having a bore enlarged to provide an annular recess intermediate the ends of the cutter arranged so that the end portions of said cutter may ride on said eccentric portions to maintain said cutter in expanded position or may be disposed lengthwise on said arbor with said end portions out of registration with said eccentric portions with said cutter in contracted position, a sleeve mounted upon the eccentric portion of said arbor below said cutter and in engagement therewith, and a spring urging said sleeve and said cutter lengthwise to move said cutter into expanded position.

8. In an underreamer, an arbor having spaced offset portions, a cutter element mounted on said arbor to play lengthwise thereof, said cutter element having a bore enlarged to provide an annular recess intermediate the ends of the cutter arranged so that the end portions of said cutter may ride on said offset portions to maintain said cutter element in expanded position or may be disposed lengthwise of said arbor with said portions disposed out of registration with said offset portions with said cutter in contracted position.

In witness that I claim the foregoing I have hereunto subscribed my name this 1st day of July, 1926.

JOHN GRANT.