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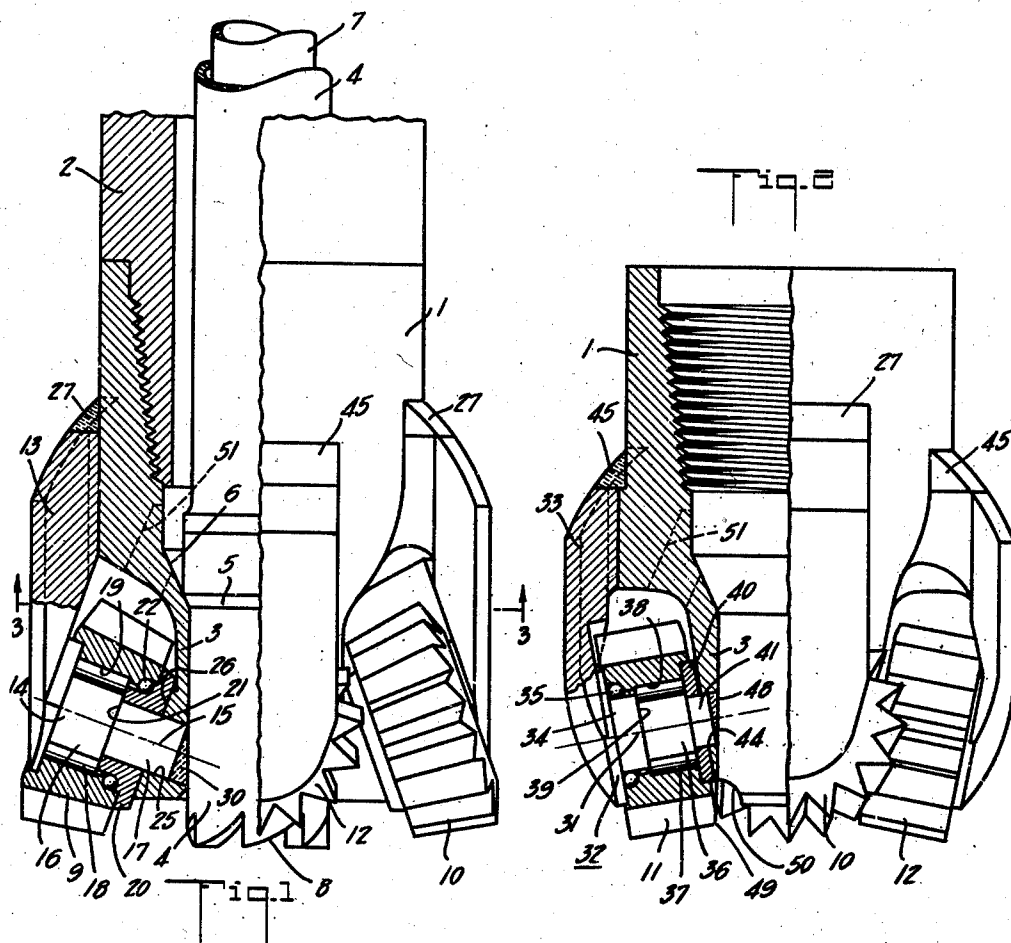
R. R. CRUM

2,235,982

CORE BIT

Filed June 20, 1939

2 Sheets-Sheet 1



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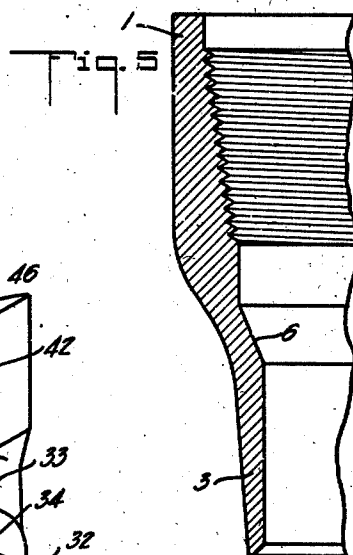
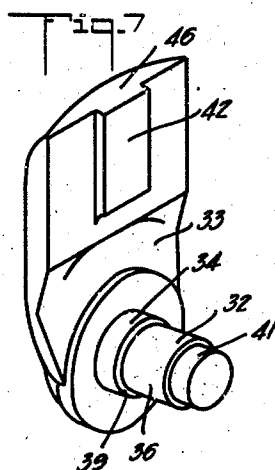
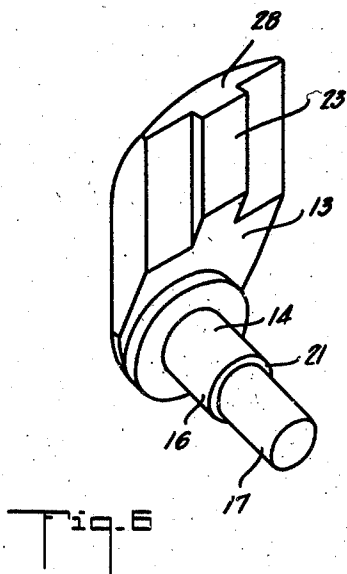
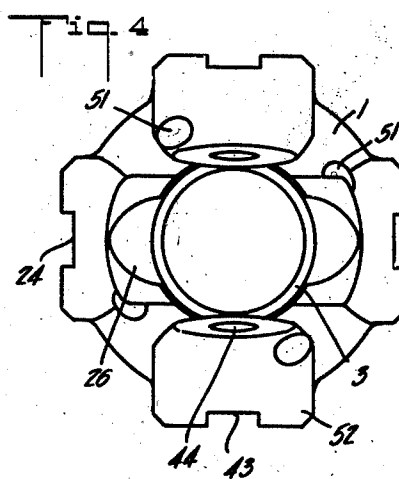
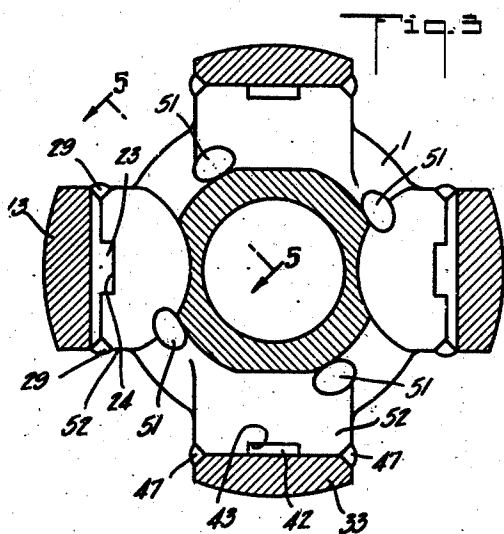
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UNITED STATES PATENT OFFICE

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CORE BIT

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4 Claims. (Cl. 255—72)

This invention relates to a core bit, and particularly of the type in which a retractible core barrel may be utilized.

In making earth bores, it has long been common to obtain samples of subterranean formations as the drilling progresses, either at spaced depths or continuously. This is especially useful in drilling for oil, because from the geological data thus obtained, the driller or geophysicist may be better guided as to the proper procedure to be followed. The samples of the formations have been commonly obtained by core barrels operating on an annulus to form a core. It has also been proposed to utilize a core barrel for the reception of the core, that may be raised or lowered through the drill string without the necessity of raising or lowering the drill string.

It is one of the objects of this invention to improve in general, bit structures of this character; and especially by ensuring that the cutters will be rigidly supported during the drilling operation.

The boring of the annulus around the core is accomplished in the present instance by the aid of disc cutters. It is another object of this invention to provide, in a core bit, a plurality of sets of cutters, for operating on different annuli, and rotatably mounted on pins that are adequately supported at both ends.

This invention possesses many other advantages, and has other objects which may be made more easily apparent from a consideration of one embodiment of the invention. For this purpose there is shown a form in the drawings accompanying and forming part of the present specification. This form will now be described in detail, illustrating the general principles of the invention; but it is to be understood that this detailed description is not to be taken in a limiting sense, since the scope of this invention is best defined by the appended claims.

Referring to the drawings:

Figure 1 is a part sectional view of a core bit incorporating the invention, the core barrel being shown as in place within the bit;

Fig. 2 is a view similar to Fig. 1, the core barrel being omitted, and the section being on a plane taken through the arm that supports an inner cutter;

Fig. 3 is a sectional view taken along plane 3—3 of Fig. 1, but with the core barrel omitted;

Fig. 4 is a bottom plan view of the core bit body prior to the assembly of the supporting arms;

Fig. 5 is a sectional view taken along plane 5—5 of Fig. 3; and

Figs. 6 and 7 are pictorial views respectively of the arms that serve to support the outer and inner disk cutters.

The bit has a body 1 adapted to be attached to the lower end 2 (Fig. 1) of a drill string, as by the usual pipe thread coupling. This bit body is hollow in order that the usual mud fluid circulation may take place through it to the various cutting elements. In this case the bit body is also provided with a downwardly extending central hollow extension 3 shown most clearly in Fig. 5. Through this hollow extension it is intended to project an outer core barrel 4. This core barrel may be provided with an exterior sloping shoulder which rests on seat 6 in body 1 immediately above the extension 3. This seat 6 is shown to best advantage in Fig. 5.

In the present instance the core which is adapted to be accommodated within the inner core barrel 7, may be cut by the aid of the cutter teeth 8 at the bottom of the core barrel 4.

In order to obtain the core, it is required that the bore in which the bit operates be cut annularly around the core barrel 4. For this purpose a series of disk cutters are used for cutting on annular surfaces or zones at the bore bottom. Thus there is a pair of outer cutters 9 and 10 (Figs. 1 and 2) which operate on the outer zone or annulus. These cutters 9 and 10 are disposed diametrically opposite each other with respect to the axis of the bit. The inner zone or annulus of the bore, adjacent the core barrel 4, is arranged to be operated upon by a pair of inner disk cutters 11 and 12, angularly spaced about the axis of the bit, from the outer disk cutters 9 and 10. These inner disk cutters 11 and 12 are also arranged diametrically opposite each other with respect to the axis of the rotation of the bit structure.

The manner of supporting these disk cutters forms an important part of the invention. There will first be described the support for one of the outer disk cutters 9. It is to be understood that the other outer cutter 10 is supported in identical fashion, and therefore a description of the support for cutter 9 will suffice for a description of both of these cutters.

A supporting arm 13 (Figs. 1, 3 and 6) in the form of a separate piece, is provided with an integral pin structure 14. The axis 15 of the pin structure is inclined downwardly and inwardly with respect to the axis of rotation of

the bit. The pin structure 14 includes an enlarged base portion 16 and a reduced end portion 17. The outer periphery of the portion 16 serves as the inner race of a radial roller bearing structure. This radial roller bearing structure is formed by a plurality of rollers 18. The outer race is formed by the inner cylindrical surface 19 of the cutter 9.

This radial roller bearing structure serves properly to support the cutter disk in a rotatable manner. In order to support the thrust which occurs due to the drilling pressure, a ball bearing structure is provided inwardly of the roller bearing structure, to support the inward thrust. Thus an inner ball bearing race is formed by a collar 20 telescoping over the reduced portion 17 of the pin structure. The end surface of this collar 20 abuts against the shoulder 21 formed at the end of the enlarged portion 16. The end surface of the collar 20 also overlaps the rollers 18. The outer race for the balls 22 forming the thrust bearing structure is provided by an inner surface of the cutter 9.

The manner of assembling the cutter 9 upon the pin structure is apparent from the foregoing. The cutter 9 with the rollers 18 may first be telescoped over the enlarged portion 16 of the pin structure. Then the collar 20 with the ball bearings 22 may be telescoped over the reduced portion 17.

After the arm 13 has been assembled with the cutter structure in the manner just described, it may then be appropriately attached to the bit head 1. For this purpose the arm 13 may be provided with a dovetailing longitudinal projection 23 adapted to cooperate with a corresponding groove 24 in the projection 52 integral with the body 1 (Figs. 3 and 4). At the same time the end of the reduced portion 17 is inserted within an aperture 25 in the wall of the extension 3. The outer surface 26 of the wall of extension 3 is formed as a slanting boss contacting the adjacent surface of the collar 20. Thus by the aid of this aperture 25 and the arm 13, the pin structure 14 is strongly supported at both ends.

The arm 13 may now be welded in place upon the bit body 1. The welded-on metal 27 is illustrated in Fig. 1 between the top flat surface 28 (Fig. 6) of the arm 13 and the outer surface of the bit body 1. Beads of welding metal 29 (Fig. 3) may also be provided along the longitudinal edges of the arm 13. Similarly, in order to hold the reduced portion 17 of the pin structure 14 rigidly in place, metal 30 may be welded to the end 17 and serves to fill in the space between the inner periphery of the extension 3 and the end of the reduced portion 17. The act of welding can be accomplished from the inside of this extension 3 after the arm 13 and the pin structure 14 have been placed in cooperative relationship with the bit head.

The cutters 9 and 10 have lower edges which operate upon an outer annulus as before stated. The inner annulus is adapted to be cut by the aid of the inner cutters 11 and 12. Since both of the cutters 11 and 12 are supported on the bit body in identical fashion, a description of the manner in which inner cutter 11 is supported on the bit body will also serve as a description of the manner of supporting the cutter 12.

These inner cutters are supported for rotation on pin structures 32 about axes 31 which slope upwardly and inwardly with respect to the axis of the bit body 1. These pin structures 32 are

formed integrally with separate supporting arms 33 (Figs. 2, 3 and 7). These supporting arms in general are similar in structure to the supporting arms 13 for the outer cutters 9 and 10.

In the case of the inner cutters, due to the character of the slope of axis 32, the ball thrust bearing is provided adjacent the arm 33, to support an outward thrust. For this purpose the pin structure 32 has an enlarged base portion 34 serving as the inner race for a plurality of balls 35. The outer race is formed by an interior surface of the cutter 11. The reduced portion 36 of the pin 34 serves as the inner race for a radial roller bearing structure including the rollers 37. The outer race is formed by the interior cylindrical surface 38 provided in the cutter 11. The shoulder 39 between the portions 34 and 36 serves as an abutment for the left hand end of the rollers 38. A collar or washer 40 is inserted over the end portion 41 of the pin 32.

The manner of assembly of the cutter structure with respect to the arm 33 and pin 32 is apparent from the foregoing. First of all, the cutter 11 with the balls 35 is telescoped over the pin 32. Then the rollers 37 may be inserted in their races, and finally the washer or collar 40 may be placed upon the end 41.

With the arm assembly thus united, the arm 33 may be permanently attached to the bit body 1. For this purpose the arm 33 may be provided with a projection 42 adapted to dovetail within a cooperating groove 43 formed on the body 1. The end 41 of the pin 32 may be inserted into a through aperture 44 in the extension 3. Thereafter the welded metal may be added to hold the assembly in place. For example, the welded metal 45 may be disposed between the top flat surface 46 (Fig. 7) of the arm 33, and the bit body. Longitudinally extending beads 47 (Fig. 3) of welded-on metal may be provided along the longitudinal edges of the arm to unite it with the corresponding surfaces of the bit body 1. The end 41 of the pin 32 may be held in place by the addition of welded metal 48 filling the space between the end of extension 41 and the aperture 44 in the extension 3. The act of welding this metal 48 may be performed from the inside of the extension 3.

As shown most clearly in Fig. 2, the inner lower edge 49 of the cutter 11 is substantially in line with the inner diameter of the extension 3 so as to cut the core to the size corresponding to this inner diameter. The lower edge of the extension 3 may be formed with a recess 50 opposite this lower edge 49 so as to obviate interference between the cutter 11 and the extension 3.

Provisions are made for circulating mud fluid from the interior of the drill stem 2 to the spaces above the various cutters. For this purpose apertures 51 (Figs. 1, 2, 3 and 4) may extend downwardly from the inside of the head 1 to the space exterior of the extension 3. The lower ends of these apertures are so disposed as to discharge the mud fluid slightly in advance of the cutters.

What is claimed is:

1. In a core bit, a body adapted to be connected to a drill string, said body having a reduced central portion a central hollow extension through which a core may pass, arms assembled on the body and joined thereto, each of said arms carrying an integral pin reaching into the extension and adapted to carry a roller cutter, said extension continuing a substantial distance below the pins and having circular openings for receiving the pins, each of said openings closely

encircling its associated pin, and means securing the pins in their respective openings.

2. In a core bit, a body adapted to be connected to a drill string, said body having a central hollow extension through which a core may pass, arms joined to the body, each of said arms carrying a pin reaching to the extension and adapted to carry a roller cutter, said extension continuing a substantial distance below the pins and having openings for receiving the pins, each of said openings closely encircling its associated pin, means securing the pins in their respective openings, the arms being joined to the body along a surface so arranged that the arms may be placed on the body by moving the arms in a direction coinciding with the direction of the axes of the pins, and means forming a key on said surface between the arm and the body to prevent lateral movement between said arm and said body.

3. The combination of claim 2, wherein some of the pins are inclined inwardly and downwardly, and others of the pins are inclined inwardly and upwardly, all with respect to the bit axis.

4. In a core bit, a body adapted to be connected to a drill string, said body having a reduced central portion a central hollow extension through which a core may pass, arms assembled on the body and joined thereto, each of said arms carrying an integral pin reaching into the extension, said extension continuing beyond the pins, and having circular openings for receiving and closely encircling the associated pins, said pins being secured in the respective openings, some of said pins being inclined upwardly and inwardly, some of said pins being inclined downwardly and inwardly, with respect to the bit axis, each of said pins carrying a roller cutter, means forming a radial bearing and means forming a thrust bearing, interposed between each pin and its associated roller cutter, said thrust bearings on the downwardly inclined pins being disposed adjacent the inside face of the cutter, said thrust bearings on the upwardly inclined pins being disposed adjacent the outside face of the cutter.

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