March 13, 1956 E. B. WILLIAMS, JR 2,738,167

COMBINED REAMER AND CORE BIT

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Fig. 1.

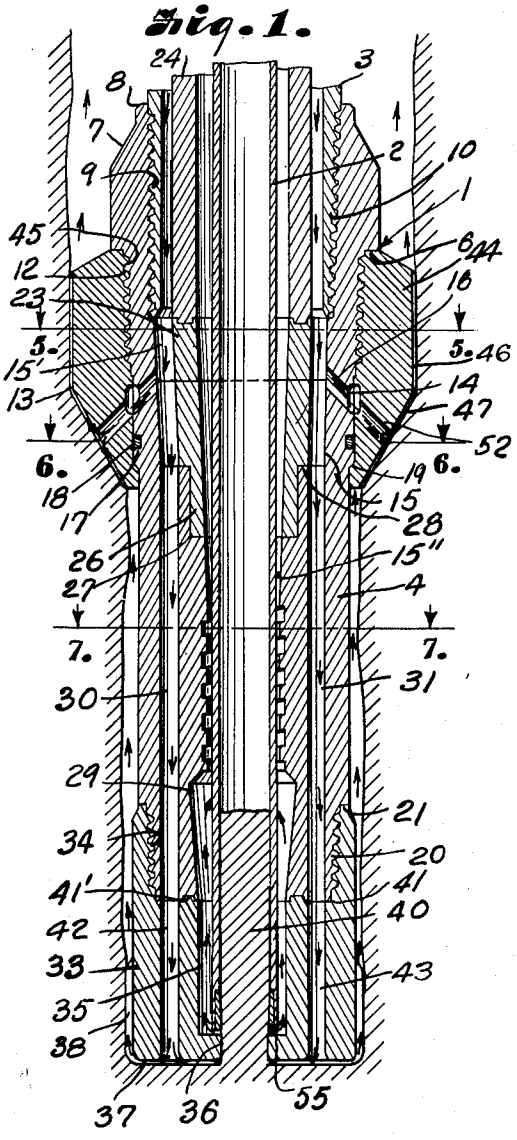


Fig. 2.

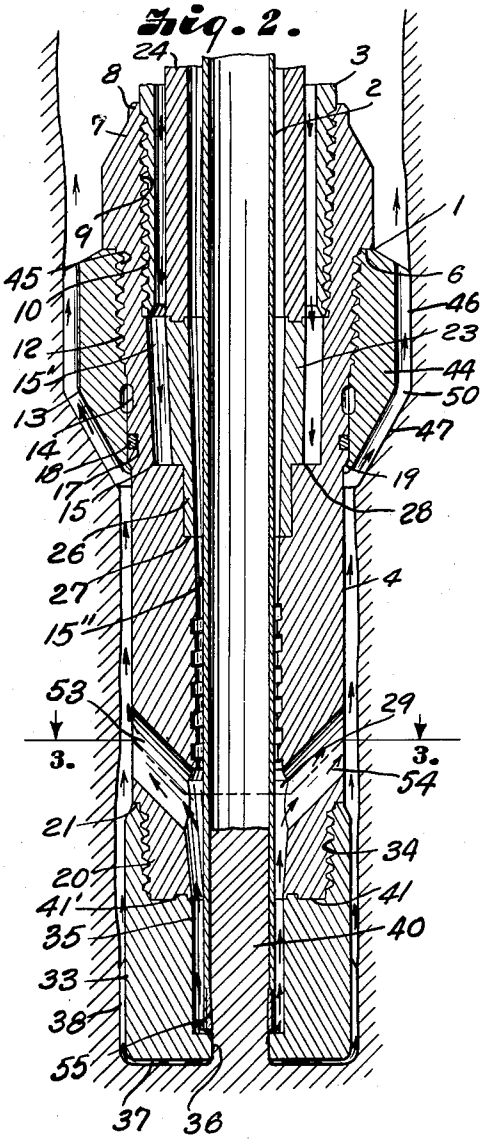
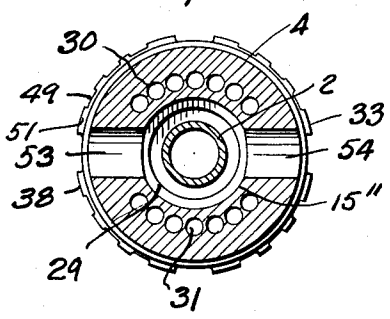


Fig. 3.



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Fig. 4.

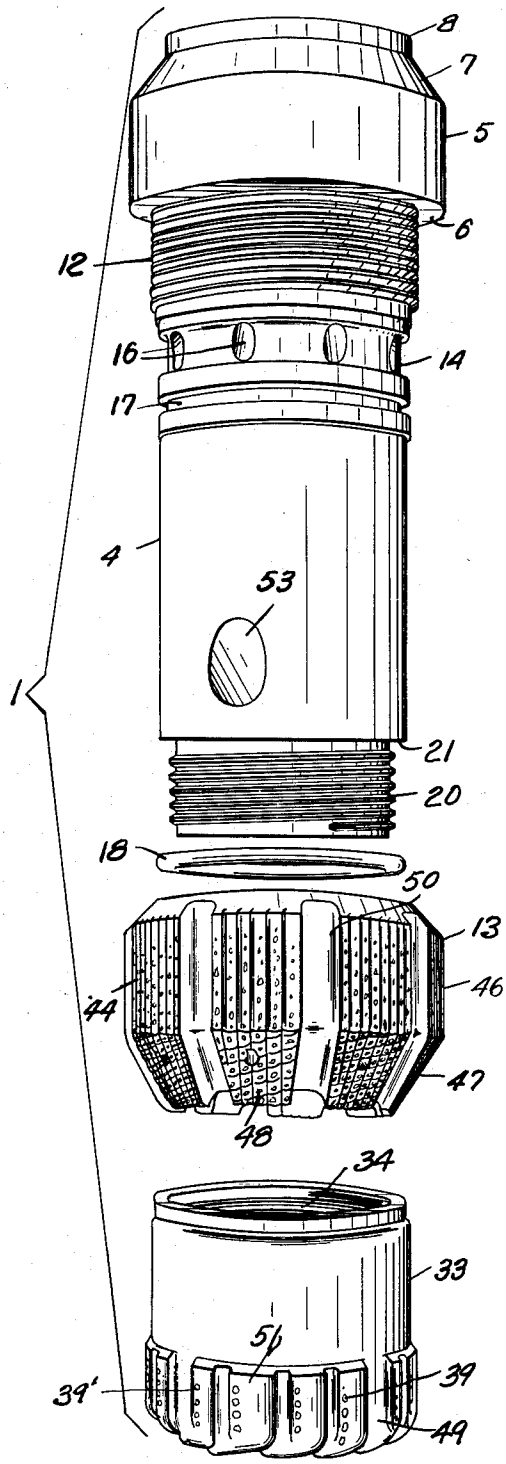


Fig. 5.

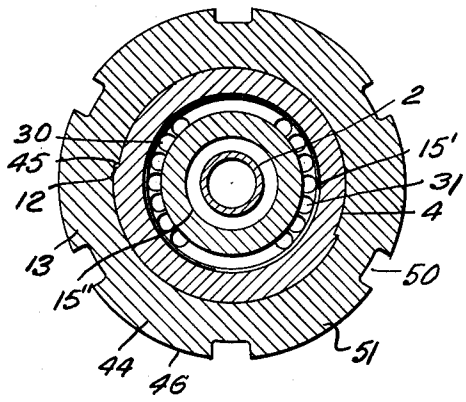


Fig. 6.

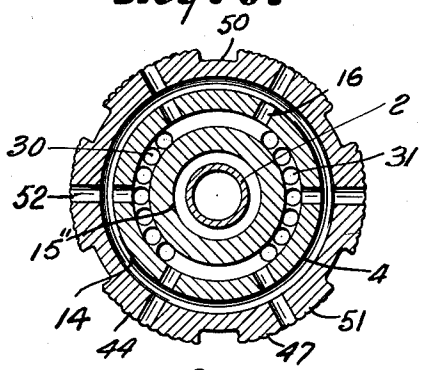
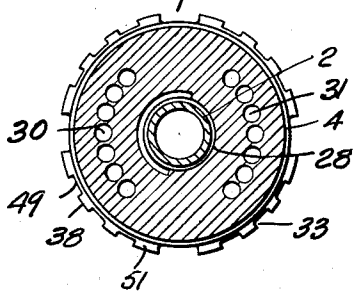


Fig. 7.



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COMBINED REAMER AND CORE BIT

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Application April 6, 1953, Serial No. 346,935

4 Claims. (Cl. 255—72)

This invention relates to rotary-drill bits for drilling and coring earth formations and particularly a drill having a pilot or a core bit and a reamer bit for increasing the diameter of the core hole to accommodate the size of the drill pipe.

The principal object of the invention is to discharge the drilling fluid to the respective bits so that the cutting areas of the bits are supplied with ample fluid and so that the fluid from the core bit does not interfere with action of the reamer bit.

Other objects of the invention are to provide a combination-core and reamer drill, reamer and core-cutting elements or bits that are removable from the drill body for repair or replacement; and to provide a combination-reamer and core-bit structure that is of a simple design, that is readily machined and capable of withstanding the stress to which such drills are subjected.

In accomplishing these and other objects of the invention, I have provided an improved structure, the preferred form of which is illustrated in the accompanying drawings, wherein:

Fig. 1 is a vertical section through a combination-core and reamer-type drill bit illustrating use thereof in cutting a core and reaming the bore hole to size.

Fig. 2 is a similar section taken at right angles to the section illustrated in Fig. 1.

Fig. 3 is a cross section on the line 3—3 of Fig. 2.

Fig. 4 is a perspective view of the parts of the drill bit.

Fig. 5 is a cross section on the line 5—5 of Fig. 1.

Fig. 6 is a cross section on the line 6—6 of Fig. 1.

Fig. 7 is a cross section on the line 7—7 of Fig. 1.

Referring more in detail to the drawings, 1 designates a combination-reamer and core-cutting drill constructed in accordance with the present invention and which is particularly adapted for use in connection with a wire-line core barrel 2 that is removable through the string of drill pipe 3 to which the drill is connected and adapted for rotation thereby from the top of a bore hole.

The combination drill includes a generally cylindrical body member 4 having a head 5 of larger diameter to form an annular shoulder 6. The head 5 tapers inwardly at 7 and terminates in a collar 8 encircling an internal threaded socket 9, of the head 5 and into which the threaded end 10 of the drill pipe 3 is inserted to connect the drill, as shown in Figs. 1 and 2. Encircling the body member below the shoulder 6 are external threads 12 to mount a reamer bit element 13, later to be described.

Formed in the body member 4 below the threads 12 is an annular groove or channel 14 that connects with an upper portion 15' of a stepped axial bore 15 which extends coaxially downwardly from the internally threaded socket 9 of the body member through ports 16 sloping downwardly and outwardly from the portion 15' of the bore 15 as shown in Figs. 1 and 4. Formed in the body member 4 on the exterior thereof and below

the ports 16 is an annular groove 17 for receiving a sealing element, which may be an O ring 18. The outer portion of the body member 4 below the sealing ring is of reduced diameter to form an annular shoulder 19.

Projecting from the lower end of the body member is a reduced externally threaded terminal 20 which cooperates with the body member in forming an annular stop shoulder 21. As shown in Fig. 1, the axial bore 15 has a lower portion 15'' of smaller diameter that extends through the lower end of the body member and terminal 20. The portion 15'' of the bore contains a bushing 23, which seats the supporting mechanism 24 for the upper end of the core barrel 2 as in conventional practice and which structure 24 specifically forms no part of the present invention. The bushing 23 has a reduced neck portion 26 that engages within a seat 27, which is formed as an enlargement of the portion 15'' of the axial bore 15 at the step 28 between the portions 15' and 15''. The portion 15'' of the bore 15 is sufficiently large to pass the core barrel 2 therethrough and to provide an annular water course 29 that is formed within the externally threaded terminal 20 of the body member. The stepped bore 15 provides a thicker wall portion surrounding the bore portion 15'' and extending therein from the step 28 through the lower end face of the terminal 20. On opposite diametrical sides is a series of longitudinal ports or channels 30 and 31 having their upper ends opening through the step 28 to connect with the upper enlarged portion 15' of the bore and their opposite ends opening through the terminal 20 to connect with the water courses 42 and 43 of a core or pilot bit 33 as shown in Fig. 1. The channels or ports 30 and 31 bypass the axial bore portions 15'' and form portions of water courses which connect the drill pipe 3 to supply a drilling fluid to the core bit 33, which is secured to the threaded terminal 20. The body member 4 may have a spiral groove 30 extending inwardly of the bore portion 15'' at a point above the annular water course 29 to prevent drilling fluid from flowing upwardly of the barrel 2.

The core bit 33 is of generally cylindrical shape and is of slightly larger diameter than the lower body portion of the bit as shown in Fig. 1. The core bit has an internally threaded socket 34 in its upper end to receive the threaded terminal 20 of the body member 4 and a lower end of the bore is of reduced diameter as indicated at 35 to form a downward continuation of the annular water course 29 and to accommodate the lower end of the core barrel therein. The bottom of the reduced bore 35 terminates in an axial opening 36 of suitable diameter to pass a core therethrough when the bit is in operation as later described. The lower end of the core barrel stops short of the bottom of the bore to pass drilling fluid which moves inwardly around the core 40 for discharge through the annular water course 29. The core bit preferably has a substantially horizontal cutting face 37 and a cylindrical cutting face 38 that are provided with a plurality of cutting elements, for example, diamonds, 39 to cut the formation and produce the core 40 when the bit is in use. The bottom of the socket of the core bit seats against the end face 41 of the terminal 20, and a seal is formed by an annular tongue-and-groove seal 41', as shown in Figs. 1 and 2. The channels 42 and 43 extend through the cutting face 37 of the bit to supply the drill fluids necessary in cooling the cutting faces of the bit and to wash the cuttings therefrom to the top of the bore hole.

The reamer 13 comprises a ring-like body 44 having internal threads 45 which engage the threads 12 on the body member 4. The exterior of the reamer includes a substantially cylindrical cutting face 46 and an inwardly-

tapering, lower-cutting face 47 having cutting elements 48 similar to the cutting elements of the core bit previously described. The tapered cutting face 47 terminates in close proximity to the outer surface of the outer portion of the bit and completes the cut of the bore hole to the desired gauge so that the bore hole is of ample size to accommodate the drill pipe and to provide the passageway necessary in returning the drill fluid to the top of the bore hole. The outer surfaces of the cutting faces of the reamer as well as the core bit are provided with vertical annularly spaced watercourses 49 and 50, which provide ribs 51 which carry the cutting elements as best shown in Fig. 4. The watercourses are of relatively large flow capacity to pass the fluid and cuttings which are carried therewith from the pilot or core bit. Therefore these cuttings do not interfere with cutting action of the diamond areas of the reamer bit.

The reamer bit has ports 52 which pass the drilling fluid through the cutting face 47 of the reamer. This is an important part of the present invention as the discharge of fluid through the ports 52 produces a pressure drop within and through the diamond areas of the reamer bit and the flow of fluid at the lower pressure keeps the cuttings washed out from the diamond areas.

The drilling fluid that moves upwardly around the core barrel passes outwardly through upwardly directed ports 53 and 54 which are located intermediate the channels 30 and 31.

In assembling the combination reamer and core bit, the sealing ring 18 is placed in groove 17, and the reamer 13 is sleeved over the lower end of the body member 4 to engage with the threads 12. The reamer 13 is turned on the body member 4 to effect an interengagement with the threads 12 and seating of the upper end of the reamer against the shoulder 6. The core bit is threaded on the terminal 20 to seat the upper end against the shoulder 21. The bit thus assembled is mounted on the lower end of the drill pipe 3 and lowered through the bore hole. The wire-line core barrel 2 may be lowered into position within the drill by passing it through the string of drill pipe 3. The upper end of the drill pipe 3 is connected with the source of drilling fluid which is pumped under pressure downwardly through the drill pipe for flow through the annular passage provided by the bore position 15', through the ports 16, and through the ports 52 of the reamer, which results in the pressure drop so that an ample supply of fluid flows in and through the diamond areas to keep the cuttings washed out from the cutting surfaces 46 and 47 and then upwardly of the bore hole exteriorly of the drill pipe 3. Another part of the drilling fluid will move through the channels or water-courses 30 and 31 and through the water-courses 42 and 43 of the core bit to the bottom of the bore hole where a part of the fluid will be moved inwardly through the opening 36, under the end of the core barrel, and up around the core barrel through the water course 29 for discharge through the upwardly directed ports 53 and 54 (Fig. 2). A smaller portion of the drill fluid will move outwardly from the bottom face 37 of the core bit 33 and upwardly through the water-courses 50 on the side thereof as shown by Figs. 1 and 2. As the bore hole deepens, the core 40 rises within the core barrel 2, and when the core 40 is to be removed, the core catcher 55 on the lower end of the barrel 2 engages the core 40 and upward lift of the core barrel 2 carries the core 40 through the drill pipe 3 to the top of the bore hole. When the core is removed, the barrel 2 may be returned to its position within the drill to continue the drilling operation. It is obvious that with the construction disclosed, a core of desired size may be removed through the drill pipe without removal of the drill string. It is also obvious that the reamer increases the diameter of the bore hole to the required size for accommodating the drill pipe 3 and provides the annular upflow passageway for the drill fluid to reach the top of the bore hole.

What I claim and desire to secure by Letters Patent is:

1. A combination reamer and core drill for use in connection with a string of drill pipe and a core barrel removable through the drill pipe, said drill including a generally cylindrical body member having a head at its upper end of larger diameter than the body member to form an annular shoulder, threads on the body member adjacent said shoulder, a threaded terminal on the lower end of the body member and forming an annular shoulder, said body member having an axial bore for containing the core barrel therein and water-courses bypassing said bore with their upper ends connected with the drill pipe and their lower ends opening through said terminal, a core bit having threads engaging the threads on the terminal and retained in engagement with the stop shoulder and having water-courses forming continuations of said bypass water-courses to supply drilling fluid to the core bit, said body member having outwardly and downwardly extending water-courses below said head, a reamer bit including a ring-like body engaging the threads adjacent said shoulder to retain the reamer in abutment with said annular shoulder formed by the head and having a downwardly tapering cutting face to complete the gauge of a bore hole produced by the drill and having a substantially cylindrical cutting face, said reamer bit having water-courses connected with the outwardly and downwardly extending water-courses and opening through the tapered cutting face for supplying drilling fluid to the reamer bit, and said body member having upwardly and outwardly directed discharge ports intermediate the bypass ports and connected with the bore at opposite sides of the core barrel and opening outwardly through said body member for causing flow of drilling fluid from the water-courses of the core bit toward said core barrel to cool and carry away cuttings from the inner portion of the core bit.

2. A combination reamer and core drill for use in connection with a string of drill pipe and a core barrel removable through the drill pipe, said drill including a generally cylindrical body member having a head at its upper end of larger diameter than the body member to form an annular shoulder, upper threads on the body member adjacent said shoulder, a threaded extension on the lower end of the body member and forming an annular shoulder, said body member having an axial bore for containing the core barrel therein and having water-courses bypassing said core with their upper ends connected with the drill pipe and their lower ends opening through said extension, a core drill bit having threads engaging the threads on the extension and retained in engagement with the stop shoulder and having water-courses forming continuations of said bypass water-courses to supply drilling fluid to the core bit, said body member having downwardly and outwardly extending water-courses below said head, a reamer bit including a ring-like body engaging the upper threads in abutment with said annular shoulder and having a downwardly tapering cutting face to complete the gauge of a bore hole produced by the drill and having a substantially cylindrical cutting face, said reamer bit having water-courses connected with the outwardly and downwardly extending water-courses and opening through the tapered cutting face for supplying drill fluid to the reamer bit, and an annular seal between the reamer bit and the body member at a point below the outwardly and downwardly extending water-courses in said reamer bit, said body member having upwardly and outwardly directed discharge ports intermediate the bypass ports and connected with the bore at sides of the core barrel and opening outwardly through said body member for causing flow of drilling fluid from the water-courses of the core bit toward said bore to cool and carry away cuttings from the inner portion of the core bit.

3. A combination reamer and pilot drill including a body member having a bore for flow of drilling fluid longitudinally of the body member, a drill pipe con-

nection at one end of the body member for attachment to a drill pipe, a pilot bit having connection with the other end of the body member, said pilot bit having an end drilling face and having ports in connection with said bore and having outlet through said end drilling face for discharging drilling fluid between said face and the bottom of the bore hole drilled by said bit for upward flow alongside the body member when the drill is in use, a reamer encircling the body member between the pilot bit and the drill pipe connection, said reamer having an annular drilling face provided with circumferentially spaced vertically directed grooves for passing the drilling fluid and cuttings from the pilot bit, said body member and said reamer having ports in connection with said bore and having outlet through the annular drilling face of the reamer at points intermediate said circumferentially spaced grooves for discharging drilling fluid under the annular drilling face and the reamed portion of the bore hole, and said grooves and ports in the reamer being of a capacity relatively to the ports in the pilot bit for establishing a pressure drop in the fluid discharged from the cutting face of the reamer bit to maintain said upward flow from the pilot bit.

4. A combination reamer and pilot core drill including a body member having an axial bore, a core barrel in the axial bore and forming with the body member an inner up flow passage for drilling fluid, said body member having a longitudinal bore for flow of drilling fluid, a drill pipe connection at one end of the body member for attachment of the body member to a drill pipe for supplying drilling fluid to said bore, a core bit having connection with the other end of the body member and having an axial passageway connected with

the core barrel and the upflow passage, said core bit having an end drilling face and having ports in connection with said bore and having an outlet through said end drilling face for discharging drilling fluid outwardly and inwardly between said face and the bottom of a bore hole drilled by said bit for upward flow alongside the body member and to said upflow passage when the drill is in use, said body member having ports connected with the upflow passage and discharging into the bore hole above the core bit, a reamer encircling the body member between the core bit and the drill pipe connection, said reamer having an annular drilling face provided with circumferentially spaced grooves extending upwardly of the reamer for passing the drilling fluid and cuttings from the pilot bit, said body member and said reamer having ports in connection with said bore and having outlet through the annular drilling face of the reamer at points intermediate said circumferentially spaced grooves for discharging drilling fluid under the annular drilling face and the reamed portion of the bore hole, and said grooves and ports in the reamer being of a capacity relatively to the ports in the pilot bit for establishing a pressure drop in the fluid discharged from the cutting face of the reamer bit to maintain said upward flow from the core bit.

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