Jan. 30, 1934. A. H. COLLINS 1,945,258

EARTH BORING APPARATUS

Filed Sept. 16, 1931 2 Sheets-Sheet 1

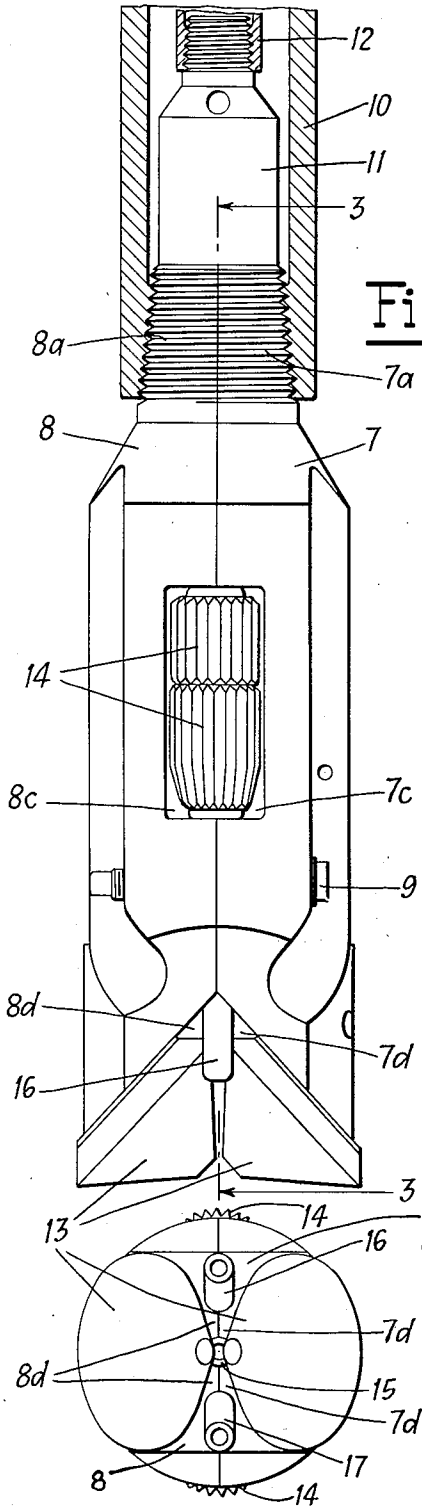


Fig. 1

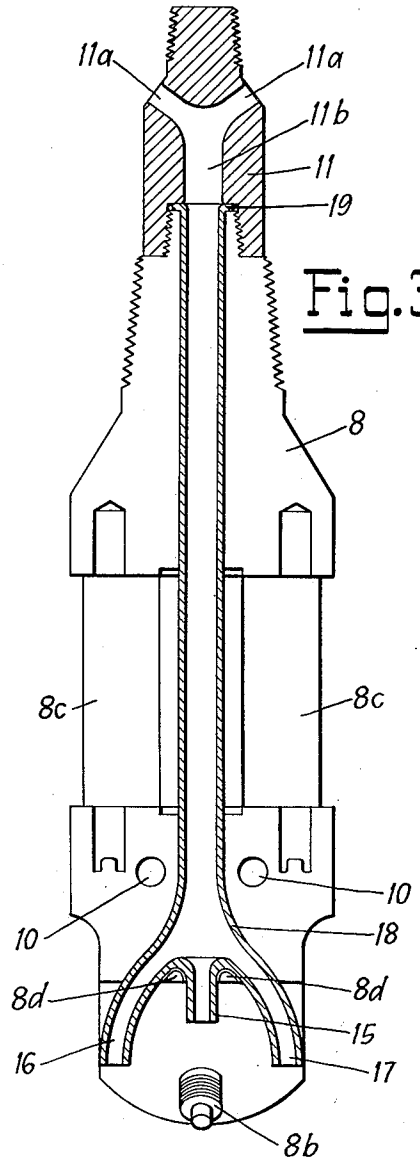


Fig. 3

Fig. 2

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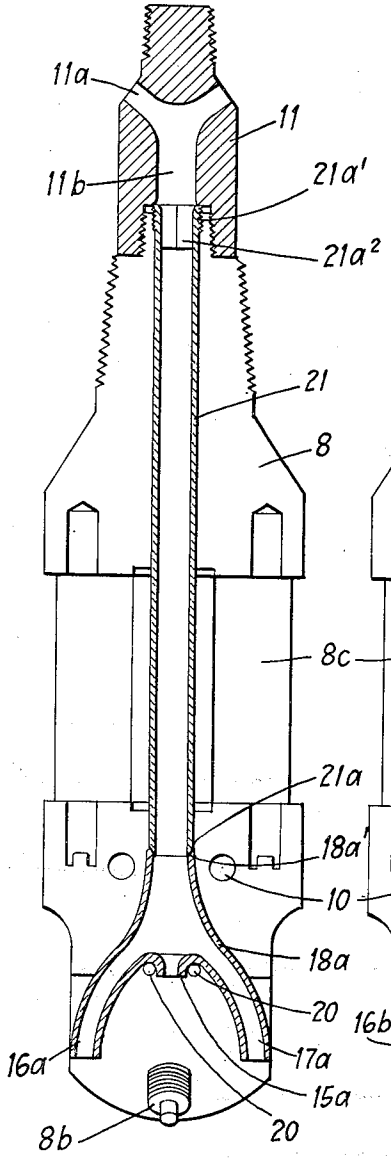


Fig. 4

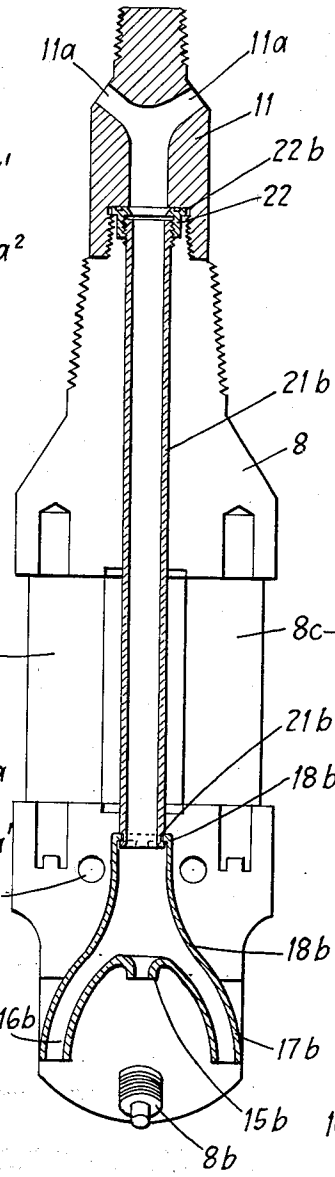


Fig. 5

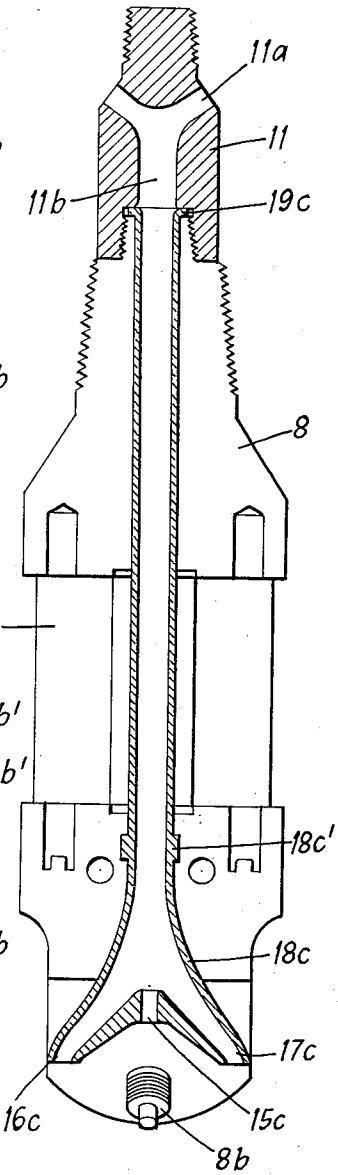


Fig. 6

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UNITED STATES PATENT OFFICE

1,945,258

EARTH BORING APPARATUS

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Application September 16, 1931
Serial No. 563,050

7 Claims. (Cl. 255—71)

This invention relates to apparatus for earth boring, especially deep well drilling. More particularly it concerns rotary drilling apparatus having renewable or replaceable roller cutters. The invention has been developed in connection with apparatus having opposed conical cutters and a vertical or axial passage for flushing fluid with particular attention to the directing of the flushing fluid in relation to the cutters for the removal of the detritus resulting from the action of the cutters.

Great difficulty has been experienced in securing efficient operation and rapid cutting of certain formations, notably the so-called "brown shale" encountered in the Kettleman Hills field of California and a formation known as "Bentonite" or "poker chip" shale found in Canada. Bits of the opposed cone type tend to "ball up" or become tightly packed with the sticky shale material so that the cones cannot rotate on their bearings and little or no footage results. In other instances the cones rotate freely and the cutting teeth are brightly polished after a long run but with little or no increase in the depth of the well. After much study and experimentation, it was found that performance was to a very large extent dependent upon the proper distribution and directing of the flushing fluid.

Among the objects of the invention are to increase operating efficiency and drilling speed, to prolong the life of the cutting elements, to enable rotary bits having cone cutters to stay upon the bottom of the hole for longer periods, to keep detritus away from the cutting edge or face of the roller cutters, to prevent "balling up" of the bit, and in general to improve prior apparatus in the interests of better service, greater economy, and more satisfactory operation.

In order to illustrate the invention concrete embodiments thereof are shown in the accompanying drawings, in which:

Fig. 1 is a side elevational view of a combined drilling and reaming head with portions of the drill stem and lubricator shown in section;

Fig. 2 is a bottom plan view of the parts shown in Fig. 1;

Fig. 3 is a sectional view on the line 3—3 of Fig. 1 showing the wash pipe and lubricator collar in section and one half of the bit head in elevation;

Figs. 4, 5 and 6 are views corresponding to Fig. 3 showing modifications of the invention.

The invention is illustrated as applied to a longitudinally divided bit head carrying both drilling cutters and reamer cutters of a commercially known type conforming substantially to U. S. Patent 1,482,787 issued February 5, 1924 to H. W. Fletcher. Certain forms of the invention, particularly those disclosed in Figs. 4 and 5, are adaptable to drilling apparatus in which the reamer may be a separate element or head interposed between the drill stem and the drill bit by tool joints after the manner shown in U. S. Patent 1,174,568 issued March 7, 1916 to T. J. Griffin, also to bit heads of the one piece type, such as disclosed in Figs. 1, 2 and 7 of U. S. Patent 1,636,665 issued July 19, 1927 to C. E. Reed.

In the drilling apparatus shown, the combined drill and reamer head is longitudinally divided into two parts 7 and 8 as on the line 3—3 of Fig. 1, which parts are maintained in assembled relation by bolts 9 extending through openings 10 (Figs. 3–6) and by the drill stem 10 having threaded engagement with extensions 7*a* and 8*a* cooperating to form a tapered tool joint, also by a lubricator collar 11 in threaded engagement with still further reduced threaded extensions on the head parts 7 and 8. A lubricator casing 12 may be secured to the tapered threaded upper end of collar 11. The lower ends of bit parts 7 and 8 cooperate to form an inverted V shaped recess in which are mounted for rotation on suitable spindles (one of which is shown at 8*b* in Figs. 3–6) diametrically opposed frusto-conical cutters 13 adapted to cut substantially the full area of the bottom of the drill hole. In cooperating recesses 7*c*, 8*c*, adjacent the main faces of bit parts 7 and 8 and in a plane transverse to that of the frusto-conical cutters 13, are mounted reamer cutters 14 in known manner. The mating faces of parts 7 and 8 are recessed in known manner to provide an axial passage for flushing fluid from the interior of drill stem 10 which enters by ports 11*a* in lubricator collar 11, which ports join to form axial passage 11*b* (Figs. 3–6), which aligns and connects with the axial passage in bit parts 7 and 8.

According to the present invention the flushing fluid passing axially through the bit formed by parts 7 and 8 is separated into three jets, one of which discharges through nozzle 15 (Figs. 2 and 3) axially and centrally of the bit head and between conical cutters 13, the other two jets being provided by nozzles 16 and 17 discharging directly upon the bottom of the hole and substantially at the periphery of the lower portion of the bit head in a vertical plane indicated by the line 3—3 of Fig. 1, which is transverse to the plane of conical cutters 13. While nozzles 16 and 17 are shown as directed straight down in Figs. 1–3, they may

be bent or inclined as desired to divert the jets closer to or away from either of the conical cutters 13 as desired, more effectively to dislodge the cuttings or detritus from the cutting faces.

As disclosed more clearly in Fig. 3, nozzles 15, 16 and 17 form integral parts of a manifold 18 which may be extended as a renewable wash pipe entirely through the drill and reamer head formed by parts 7 and 8 and have at its upper end an outwardly turned flange 19 engaging the ends of the extensions of the head parts and clamped thereagainst by lubricator collar 11. Both bit head parts 7 and 8 will be recessed to receive manifold 18 which is placed in position before parts 7 and 8 are assembled. Either or both of parts 7 and 8 may provide lugs 7*d* and 8*d* on opposite sides of central nozzle 15 to assist flange 19 in preventing axial dislodgment or relative movement of manifold 18 within the sectional bit head. As shown lugs 7*d* are on part 7 and lugs 8*d* on part 8, the lugs meeting in abutting relation on the dividing line of the bit parts.

In the modifications of the invention shown in Figs. 4 and 5 the three-nozzle manifold is formed as a separate element from the wash pipe thereby adapting the invention for use in one piece bit heads of the type shown in Reed Patent 1,636,665 referred to above and in drilling apparatus utilizing a separate reamer head after the manner indicated in Griffin Patent 1,174,568. Stop lugs 7*d* and 8*d* disclosed in Figs. 1–3 are omitted so that the manifold portions may be inserted into the head from the lower end as in the case of a one piece bit head of the Reed type. In Fig. 4 manifold 18*a* may be held in place in bit heads of both the two piece type as shown, or of the one piece type, by bolts inserted through suitably disposed openings 20 in the bit head, as on opposite sides of central nozzle 15*a*. The upper end of manifold 18*a* is inwardly tapered as indicated at 18*a'* to receive the outwardly tapered cooperating portion 21*a* of a renewable wash pipe 21 which is insertable from the upper end of the bit head and arranged for threaded connection at 21*a'* with the interior of the bit head extension. The interior of wash pipe 21 may be squared or keyed, as indicated at $21a^2$ for the application of suitable wrench to turn pipe 21 until tight engagement is made at the joint 21*a*, 18*a'*. Lubricator collar 11 may then be secured over the upper end of wash pipe 21.

In the form shown in Fig. 5, securing bolts 20 of Fig. 4 are dispensed with and a conventional bayonet lock arrangement is provided between the upper end 18*b'* of manifold 18*b* and the lower end 21*b'* of replaceable wash pipe 21*b*, the upper threaded end of which is locked in place by a sleeve nut 22 received in a recess in the upper end of the bit head, the nut having a flange 22*b* engaging the top of the extension over which lubricator sleeve 11 is secured. Manifold 18*b* has a central nozzle 15*b* and the spaced side nozzles 16*b* and 17*b* conforming to manifold 18*a* of Fig. 4. In assembling this modification of the invention manifold 18*b* is put in position before assembly of the two piece bit head or inserted from the lower end of a one piece bit. Pipe 21*b* is then inserted from the upper end of the assembled two piece bit or one piece bit and after the bayonet members on ends 21*b'* and 18*b'* have engaged is given a partial rotation to lock the pipe to the manifold; sleeve nut 22 is then applied to hold pipe 21*b* against rotation movement relative to manifold 18*b*.

In the form of the invention shown in Fig. 6 manifold 18*c* has three nozzles 15*c*, 16*c* and 17*c* of the other forms of the invention but they are arranged to spread the flushing fluid more in a fan shape manner than in solid jets. It resembles the form shown in Fig. 3 in that the manifold is in one piece with the wash pipe and has a radial extension or flange 18*c* at the upper end clamped against the top of the bit head by lubricator sleeve 11. In the absence of previous forms for supporting the lower end of the wash pipe manifold against axial movement, as the holding lugs 7*d* and 8*d* (Figs. 1–3), the bolts 20 of Fig. 4, or the bayonet lock arrangement of Fig. 5, manifold 18*c* may be provided with a second radial projection or flange 18*c'* to be received in suitably formed recesses in the parts of the longitudinally split bit head.

From the above it will be apparent that the present invention provides numerous forms of renewable manifold and wash pipe constructions adaptable to conventional forms of drill bits for suitably directing and diverting the axial stream of flushing fluid, not only to clean the teeth of the conical cutters by an axial jet directed therebetween but to keep the bottom of the hole in advance of the engaging faces of the rollers clear of chips and detritus so that the cutters may produce the maximum footage during drilling operations and not become "balled up" in sticky shale formations or be worn away in useless rolling over chips resting upon the bottom of the hole.

I claim as my invention:

1. In rotary earth boring apparatus, a bit head for mounting conical cutters in diametrically opposed relation and having an axial opening for receiving a wash pipe, said wash pipe having means for discharging a part of the flushing fluid axially between the cutters and a pair of obliquely diverging arms for discharging the remainder in two jets on opposite sides of said axial discharge in a vertical plane transverse to the plane of the cutters.

2. An earth boring bit for rotary drilling having opposed conical cutters adapted to cut substantially the full area of the drill hole, a vertical passage for flushing fluid, and distributing means providing three openings for directing the flushing fluid in jets toward the bottom comprising a central jet and side jets, the openings for said side jets below the opening for said central jet.

3. In rotary earth boring apparatus, a longitudinally divided bit head providing at its lower end an inverted V-shaped recess, frusto-conical cutters rotatably mounted on said bit head parts within said recess, a renewable conduit for flushing fluid mounted between said bit head parts to provide an axial course, terminating in said recess in an axial nozzle centrally disposed between spaced nozzles, said head parts having registering recesses to receive said conduit and having engaging portions on opposite sides of said axial nozzle to prevent displacement of said conduit.

4. Rotary earth boring apparatus for drilling and reaming having an inverted substantially V-shaped recess in its lower end, an axial passage for flushing fluid and frusto-conical cutters rotatably mounted in opposed relation on the sides of said recess, replaceable conduit means comprising a tubular member insertable into said passage from the upper end and a manifold member having a portion insertable into said passage from the lower end, said manifold member having a discharge opening in line with said portion and side nozzles spaced from said opening, said members having interlocking portions forming a

bayonet joint, and means engaging one of said members to maintain both members in place.

5. Rotary earth boring apparatus for drilling and reaming having an inverted substantially V-shaped recess in its lower end, an axial passage for flushing fluid and frusto-conical cutters rotatably mounted in opposed relation on the sides of said recess, replaceable conduit means comprising a tubular member insertable into said passage from the upper end and a manifold member having a portion insertable into said passage from the lower end, said manifold member having a discharge opening in line with said portion and side nozzles spaced from said opening, said members having interlocking portions forming a bayonet joint, and means engaging said tubular member for securing both members in place.

6. In rotary earth boring apparatus, a bit head divided longitudinally into two mating parts providing therebetween an axial passage opening at its lower end into an inverted V-shaped recess, frusto-conical cutters rotatably mounted in said recess, and a conduit member lining said passage and in one piece with a manifold disposed in said recess, said manifold providing a central jet axially of said head between said cutters and additional jets in a vertical plane intersecting the plane of said cutters, said combined conduit and manifold having spaced radial projections engaging portions of said head parts to maintain it against longitudinal displacement.

7. In rotary earth boring apparatus, a bit head divided longitudinally into two mating parts providing therebetween an axial passage opening at its lower end into an inverted V-shaped recess, said parts having reduced portions together forming a threaded stem, a coupling sleeve engaging said stem, frusto-conical cutters rotatably mounted in said recess, and a conduit member lining said passage and in one piece with a manifold disposed in said recess, said manifold providing a central jet axially of said head between said cutters and additional jets in a vertical plane intersecting the plane of said cutters, said one-piece conduit and manifold having spaced radial projections engaged by said head parts to maintain it against longitudinal displacement, one of said projections having a flange on the upper end of said conduit clamped between said sleeve and said stem.

ANTHONY H. COLLINS.