March 20, 1928.

1,663,025

J. T. PHIPPS

CORE DRILL

Filed Nov. 27, 1925

2 Sheets-Sheet 1

Fig. 1.

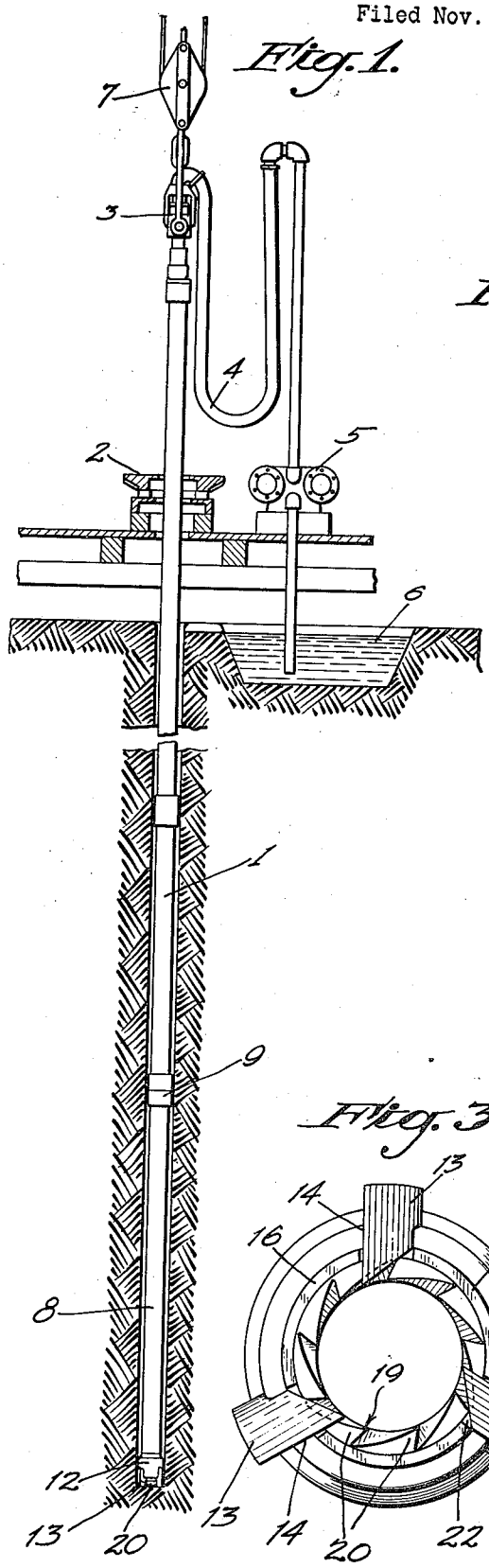


Fig. 2.

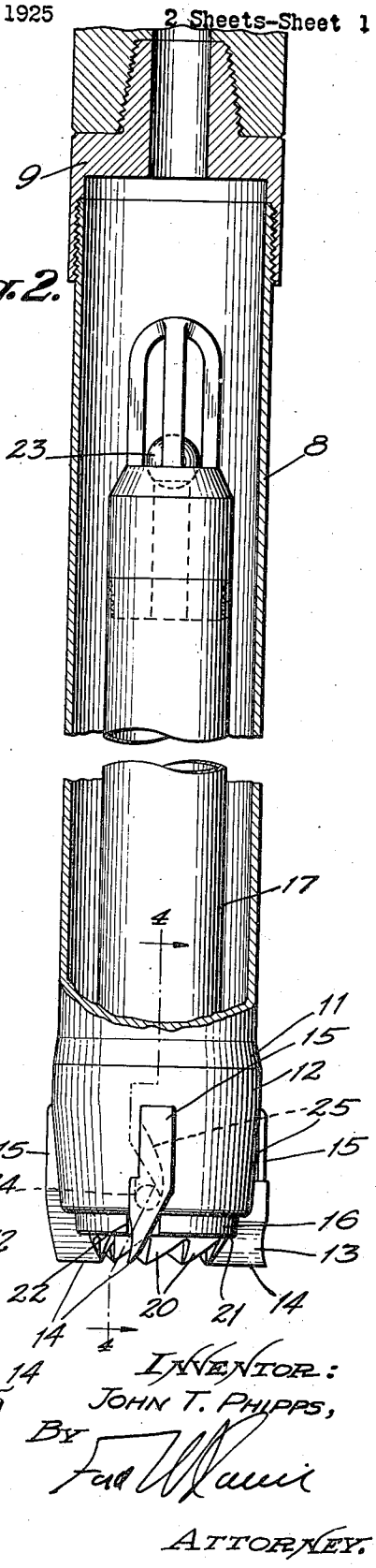


Fig. 3.

INVENTOR:
JOHN T. PHIPPS,
BY
ATTORNEY.

March 20, 1928.

1,663,025

J. T. PHIPPS

CORE DRILL

Filed Nov. 27, 1925

2 Sheets-Sheet 2

Fig. 5.

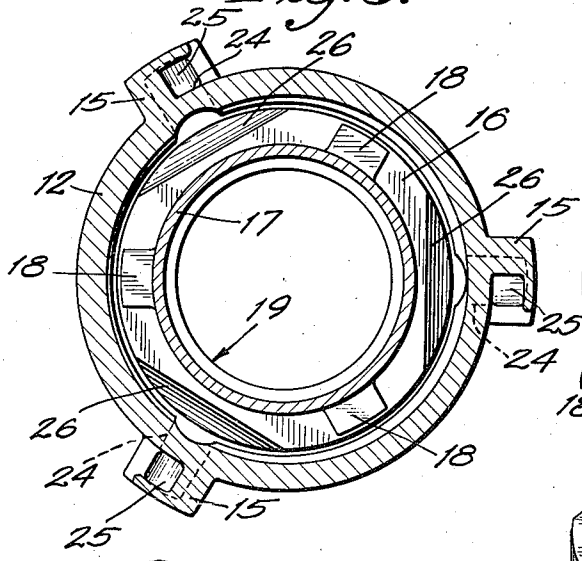
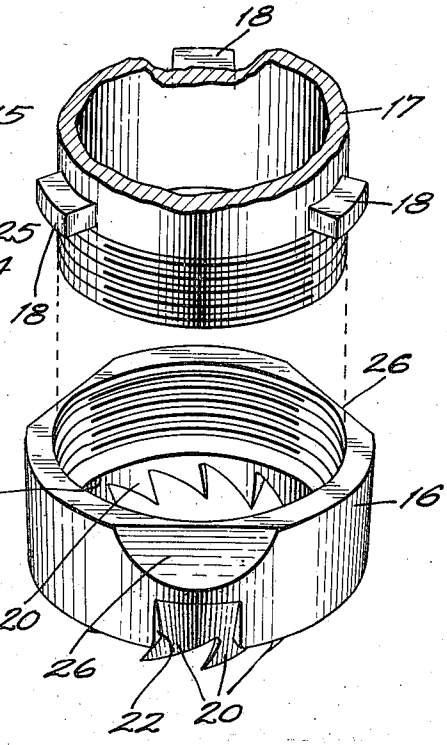


Fig. 6.



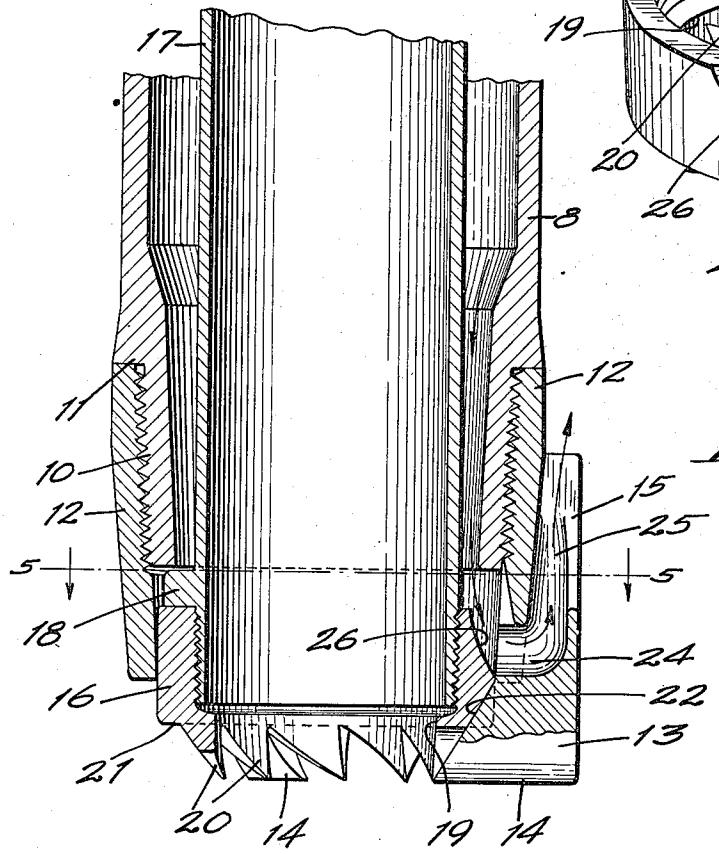


Fig. 4.

INVENTOR:
JOHN T. PHIPPS,
BY
Fad A. Lamie
ATTORNEY.

Patented Mar. 20, 1928.

1,663,025

UNITED STATES PATENT OFFICE.

JOHN T. PHIPPS, OF HUNTINGTON PARK, CALIFORNIA, ASSIGNOR TO H. C. SMITH MANUFACTURING COMPANY, OF WHITTIER, CALIFORNIA, A CORPORATION OF CALIFORNIA.

CORE DRILL.

Application filed November 27, 1925. Serial No. 71,841.

This invention relates to an improved rotary core drill, particularly of the type adapted for association with rotary drilling equipment employing circulating fluid for the removal of the drilling detritus.

An object of the invention is to provide a core drill in which the circulation is reversed so as to cause the circulation fluid to be discharged upwardly from points so disposed in relation to the cutters as to effect an adequate removal of drilling detritus without subjecting the core to direct flushing action of the fluid, and from points sufficiently close to the bottom of the well bore to prevent "mudding up" of the drill.

Another object is to so arrange the circulation as to provide adequate lubrication of the core, thus preventing a burning of the core by excessive friction, or jamming or "freezing" of the core in the core barrel.

A further object is to provide a core drill having a toothed core trimmer and a series of outer drilling cutters extended into the path of the trimmer teeth and serving as a driving means for the trimmer.

Another object is to provide means to limit the wearing off of the drilling cutters.

Another object is to provide a core drill having drilling cutters provided with circulation passages arranged to direct the circulation fluid upwardly away from the cutting edges of the cutters and in a manner to carry the drilling detritus away from the forward or lead surface of said cutters.

It is a still further object to provide a core drill having an outer shell, with all of the associated parts maintained in assembled operating relation therewith by a single screw-threaded pin and box connection.

Various other objects and advantages will be more fully apparent from the following description of the accompanying drawings, which form a part of this disclosure, and which illustrate a preferred form of embodiment of the invention.

Of the drawings,

Fig. 1 is a vertical section through a well bore and associated equipment, and showing the core drill of the present invention in position of use,

Fig. 2 is an enlarged elevation of the core drill as associated with a string of drill pipe, and partly in section to disclose the upper portion of the core barrel.

Fig. 3 is an enlarged bottom plan view of Fig. 2.

Fig. 4 is an enlarged section taken on the line 4—4 of Fig. 2.

Fig. 5 is a plan section taken on the line 5—5 of Fig. 4.

Fig. 6 is a perspective view showing the core trimmer and the lower end of the core barrel, before being screwed together.

In drilling wells, particularly oil wells, it is desirable to provide means by which to obtain samples of the formation through which the well bore is drilled, for the purpose of obtaining a record of the various strata encountered, as an aid in determining the presence or absence of oil or other values, and in providing a core drill for this purpose which will successfully function in the various kinds of formation it has been found to be of particular importance to insure a constant and adequate removal of the cuttings or detritus from in front of the several cutters so they will not become clogged, and to insure an adequate lubrication so as to prevent a "burning" of the core, while at the same time to so control the circulation fluid as to guard against injury of the core.

As rotary drills of this character are operated in the presence of flushing fluid circulated under pressure, it will be evident, especially when operating in soft or sand formation, that the core must not be subjected to the flushing action of the fluid which ordinarily discharges from the drill downwardly against the bottom of the bore and closely adjacent the core bit and reaming cutters. It is by reason of such downward discharge of the circulation fluid that it is so necessary to provide means for protecting the core in the types of core drill heretofore used, the most common method being to advance the core bit considerably ahead of the drilling or reaming cutters so as to constitute a pilot bit whose toothed end is practically buried in the formation out of the flushing range of the fluid. Such method has not been found to be satisfactory for the reason that the teeth of the pilot bit soon become clogged with the cuttings and the drill then rotates without drilling, with a resulting frictional heating sufficient to "burn" the core.

In actual practice I have found that better

drilling results can be accomplished by keeping a core trimmer or bit back substantially to the same level as the drilling or reaming cutters and that substantially perfect lubrication and quick removal of the cuttings can be effected by reversing the downward flow of circulation fluid within the drill before it is discharged so that said fluid is discharged from the drill upwardly away from the cutting edges of the cutters and from their forward on lead surfaces, with such points of discharge sufficiently close to the bottom of the well bore to prevent "mudding up" of the drill.

With particular reference to Fig. 1 of the drawings, 1 designates a string of drill pipe in the well bore and to the lower end of said drill pipe is attached the core drill of the present invention. Such drill string extends upwardly to the well surface and through the rotary table 2, and has connected with its upper end the usual rotary swivel 3 connecting by a flexible hose 4 to the slush pump 5, such pump drawing the circulation fluid from a sump 6 and forcing it downwardly through the drill pipe to the drill from where it returns upwardly outside of the drill string to overflow into the sump 6.

The drill string and swivel are dependingly supported in the derrick by the usual traveling block 7 and associated tackle.

As more clearly shown in Figs. 2 and 4, my improved core drill has an outer shell or body 8 which may be formed of a length of standard drill pipe having its upper end threaded for connection with the standard drill pipe coupling or with one member of a tool joint 9, and its lower end formed to provide a tapered threaded pin 10 extending downwardly from an annular shoulder 11, such pin end being formed by upsetting the pipe or in any other suitable manner.

A lower body member or cutter collar 12 has a tapered bore having an upper screw-threaded end and a lower smooth portion, the threaded end being adapted to screw onto the tapered threaded pin 10 of the shell 8 until its upper surface abuts the shoulder 11, thus forming a fluid-tight pin and box connection.

This collar 12 constitutes the drilling and reaming unit of the drill and is provided with three integral drilling or reaming cutters 13 radially disposed and circularly spaced at regular intervals around the collar. Each cutter 13 projects downwardly from the lower end of the collar and terminates in a transverse radial cutting edge 14, and its shank portion 15 is extended upwardly a considerable distance along the side wall of the collar, the several cutters 13 intermeshing with and serving as driving means for a core trimmer, in a manner to be later explained.

The core trimmer comprises a toothed ring member 16 which is screw-threaded upon the lower end of a core barrel 17 until its upper edge abuts against three circularly spaced radial lugs 18 projected outwardly from the side wall of said barrel, said trimmer having a core receiving bore 19 aligned with and of lesser diameter than the internal diameter of the core barrel 17, and a series of circularly disposed teeth 20 extending downwardly from an annular stop shoulder 21. With particular reference to Figs. 3 and 4 of the drawings, it will be noted that the trimmer teeth 20 are substantially V-shaped in cross section with their inner surfaces vertically disposed in alignment with the wall of the bore 19 of the trimmer and with their outer surfaces quite sharply angled outwardly so as to tend to urge their cuttings outwardly into the path of the reaming cutters 13.

At circularly spaced intervals corresponding to the circular spacing of the three reaming cutters 13, the stop shoulder 21 is notched as indicated at 22 and when the parts are assembled, each of said cutters 13 will enter one of said notches, thus providing an intermeshing or keyed driving engagement between the cutter collar 12 and the trimmer 16.

It will be noted that the cutting edges 14 of the cutters 13 extend inwardly between two adjacent trimmer teeth 20 substantially to vertical alignment with the wall of the bore 19 of the trimmer, and it will be evident that with the cutters so arranged they normally perform practically all of the work of drilling, leaving only the trimming of the core to be accomplished by the trimmer teeth, it being understood however that as the cutters become shortened by wear the trimmer teeth will in proportion perform some of the work of drilling.

In practical use of the drill it is contemplated to discard the core trimmer 16 when its teeth become so worn away as to be ineffective for further use, and to replace it with a new trimmer. This can be done with economy as the trimmer is a relatively small part which may be cheaply made, in fact it can be replaced at less cost than would be entailed in attempting to build up the worn-out teeth by any method. A similar replacement of the relatively costly cutter collar would not be justified, it being considered more desirable to build up the cutters 13 when they become considerably shortened by wear. Due to the particular hollow construction of the cutter shanks 15 (to be later described) it is necessary to limit the possible shortening of the cutters 13 and this is effectively done by the stop shoulder 21 on the core trimmer, it being evident that when the trimmer teeth 20 are entirely worn away said stop shoulder will engage the bottom of the well bore and prevent any further boring

progress, thus indicating to the operator the worn-out condition of the drill.

The lugs 18 on the lower portion of the core barrel 17 serve to prevent an unscrewing of the core barrel from the trimmer, by engagement with the lower end of the outer shell 8 upon any appreciable backing-up of the core barrel from its full screw-threaded engagement in the trimmer.

The core barrel 17 extends upwardly within the outer shell 8 and carries at its upper end a check valve 23 permitting water in the barrel to be expelled into the shell as the core moves into the barrel but preventing the flushing fluid from entering the upper end of the barrel.

As indicated by the arrows in Fig. 4, the circulation is reversed before its discharge from the drill, and to accomplish this result I provide lateral passages 24 leading from the interior of the cutter collar 12 outwardly into the respective cutter shanks 15 and then upwardly to communicate with upwardly and forwardly angled grooves 25 cut in the forward or lead surfaces of the upper portions of said cutter shanks. (See Fig. 2). Further, I cut away the upper peripheral corner of the trimmer 16 at three points 26 spaced to correspond to the relative spacing of the cutters and their passages 24, thus providing free passage of the circulation fluid from the interior of the shell 8 to the respective circulation passages 24 of the cutters 13.

In assembling the parts, the lower end of the core barrel 17 is screwed into the core trimmer 16, and the cutter collar 12 is then slipped over the core trimmer until the cutters 13 engage into the respective notches 22 in the trimmer. With the parts thus arranged, the core barrel is inserted upwardly into the shell 8 and the cutter collar 12 is then screwed tightly upon the threaded tapered pin 10 of the shell.

This construction provides a core drill consisting of only four major parts of great strength and durability, and entirely devoid of any bolts, screws, pins or the like, small and easily broken parts, and it further provides a drill requiring very little machining and which can be manufactured at an exceedingly low cost.

In the operation of the core drill, the cutters 13 will perform the major portion of the actual drilling while the trimmer teeth will trim the core as it enters the bore 19 in passing into the core barrel, it being noted that said bore 19 is relatively short and is of somewhat lesser diameter than the internal diameter of the core barrel, thus providing quick relief for the core. This is of particular importance for retaining the core within the barrel during a withdrawal of the drill and also for preventing a burning of the core. It is well known that in deep wells the formation is naturally under considerable load pressure and that a core as soon as formed has a tendency to expand rather than contract, with the result that the core has a rather snug fit in the core bit or trimmer and in the core barrel where such barrel is of the same internal diameter as the bore of the trimmer. This during the continued rotation of the tool relative to the stationary core would create sufficient friction to cause a burning of the core and destroy its usefulness as an accurate sample of the formation and its contents, and in addition such friction may expand the core sufficient to cause it to clog or become "froze" in the drill. It is to guard against such detrimental conditions that in the present invention the bore 19 in the trimmer is relatively short and the internal diameter of the core barrel is made appreciably larger than said bore.

Another reason for providing such relief is for the purpose of retaining the core within the drill, it being evident that after expanding in an enlarged core barrel the core cannot readily pass downwardly again through the smaller bore 19 in the trimmer.

In pointing out the advantages of the reverse circulation above referred to, attention is directed to the fact that as the velocity flow of the circulation fluid disharged from the drill is directed upwardly away from the bottom of the well bore, it can have no detrimental flushing action on the core, and that with the agitation of the fluid and cuttings below such discharge by the rotation of the drill such upward velocity flow is entirely sufficient to pick up the cuttings and carry them to the well surface with adequate promptness to prevent clogging or "mudding up" of the drill, this being in a measure due to the fact that the upward discharge of the fluid from the drill is relatively close to the bottom of the bore.

While the particular embodiment of the invention herein disclosed is fully capable of fulfilling all of the objects primarily stated, it is to be understood that the invention is not to be limited in this regard, for it is susceptible of embodiment in various other forms, all coming within the scope of the following claims.

I claim as my invention:

1. A rotary core drill adapted for attachment to the lower end of a drill pipe and to receive circulation fluid therefrom, said drill being provided with means for reversing the flow of said fluid and for discharging said fluid upwardly from a point closely adjacent the lower end of the drill.

2. A rotary core drill adapted for attachment to the lower end of a drill pipe and to receive circulation fluid therefrom, said drill having a plurality of cutters and being provided with means for reversing the flow of

said fluid and for discharging said fluid upwardly along the forward lead surfaces of said cutters.

3. A rotary core drill having a hollow shell adapted for attachment to the lower end of a drill pipe and to receive circulation fluid therefrom, said drill having a plurality of cutters, each provided with a circulation passage communicating with the interior of said shell and formed to reverse the flow and discharge said fluid upwardly away from the cutting edge of said cutter.

4. In a core drill of the nature disclosed, the combination of: a hollow body having cutters projected below its lower end; a toothed core trimmer associated with the lower end of said body and having a core receiving bore; and a core barrel within said body and aligned with the bore of said trimmer, said cutters extending transversely between adjacent teeth of said trimmer.

5. In a core drill of the nature disclosed, the combination of: a hollow body; a member secured to the lower end of said body and having a plurality of depending cutters; a core trimmer having a driving engagement with said cutters; a core barrel within said body and screw-threaded into said trimmer; and means preventing unscrewing of said core barrel from said trimmer.

6. In a core drill of the nature disclosed, the combination of: a hollow body having a screw-threaded tapered pin at its lower end; a cutter collar providing a screw-threaded tapered box adapted to be screwed upon said pin and provided with a plurality of depending cutters; a core trimmer having notches embracing said cutters and provided with a core receiving bore; and a core barrel within said body and screw-threaded into said trimmer in axial alignment with said core receiving bore.

7. In a core drill of the nature disclosed, the combination of: a hollow body having depending cutters at its lower end; a circular core trimmer within the lower end of the body and having teeth aligned with said cutters; and a core barrel within and spaced from said body to provide an intermediate fluid circulating space, said body having passages communicating with the lower end of said space and formed to reverse the flow of fluid and discharge said fluid in a direction away from the core trimmer.

8. A hollow core drill body having fluid circulating passages communicating with its interior and terminating in discharge openings disposed to direct circulation fluid upwardly.

9. In a core drill of the nature disclosed, the combination of: an outer shell; a cutter collar secured on said shell; a core trimmer adapted to be locked to said cutter collar to prevent relative rotation between said cutter collar and said core trimmer; a core barrel threaded into said core trimmer; and means for preventing said core barrel from unscrewing from said core trimmer.

In testimony whereof, I have hereunto set my hand at Los Angles, California, this 21st day of November, 1925.

JOHN T. PHIPPS.