E. E. GREVE.

ROTARY DRILLING APPARATUS.

APPLICATION FILED APR. 27, 1916.

1,259,852.

Patented Mar. 19, 1918.

2 SHEETS—SHEET 1.

FIG.1.

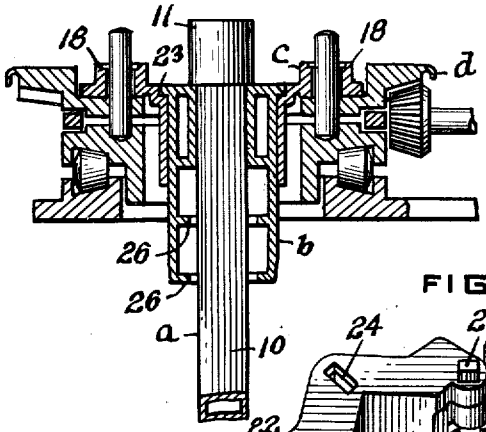


FIG.2.

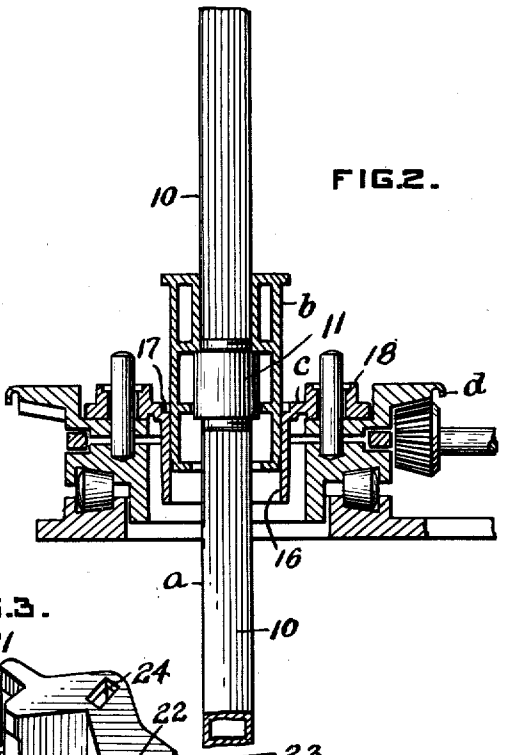


FIG.3.

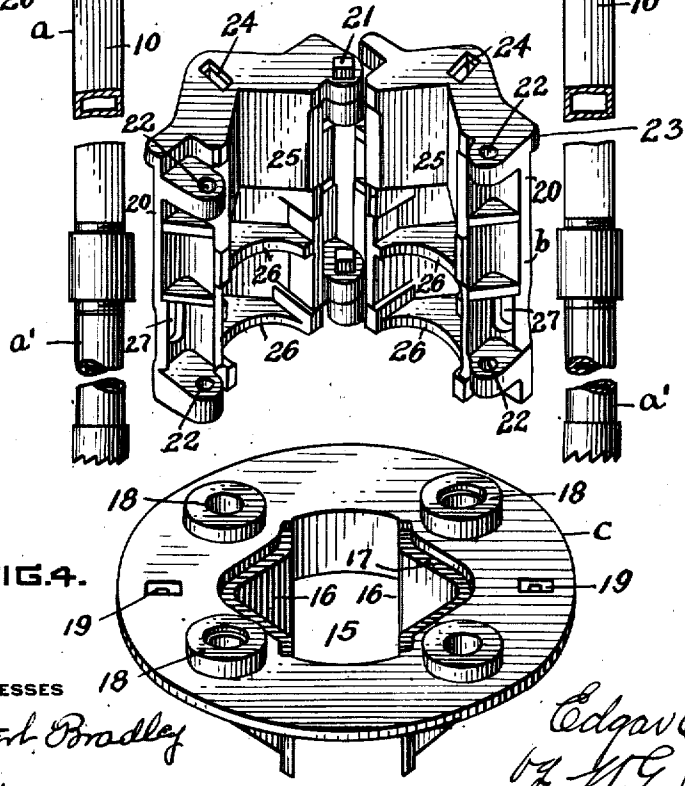


FIG.4.

WITNESSES

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2 SHEETS—SHEET 2.

FIG. 5.

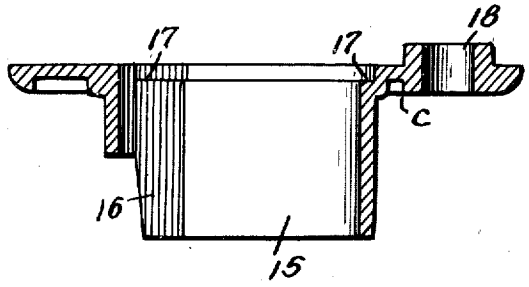


FIG. 6.

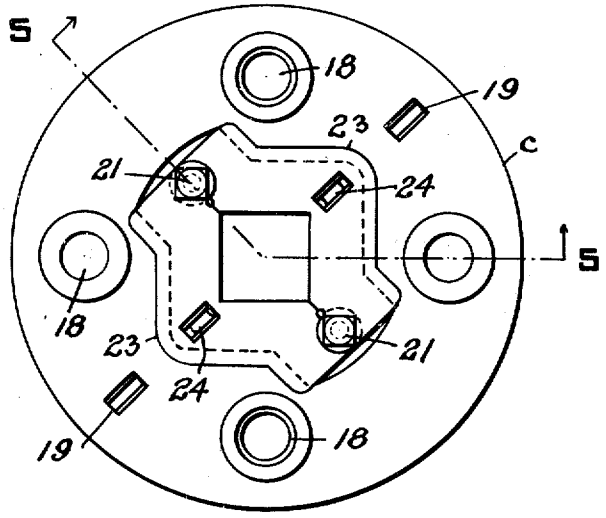
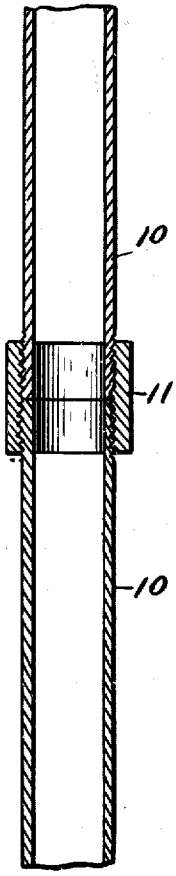


FIG. 7.



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UNITED STATES PATENT OFFICE.

EDGAR E. GREVE, OF PITTSBURGH, PENNSYLVANIA, ASSIGNOR TO OIL WELL SUPPLY COMPANY, OF PITTSBURGH, PENNSYLVANIA, A CORPORATION OF PENNSYLVANIA.

ROTARY DRILLING APPARATUS.

1,259,852. Specification of Letters Patent. Patented Mar. 19, 1918.

Application filed April 27, 1916. Serial No. 93,919.

To all whom it may concern:

Be it known that I, EDGAR E. GREVE, a citizen of the United States, residing at Pittsburgh, in the county of Allegheny and State of Pennsylvania, have invented certain new and useful Improvements in Rotary Drilling Apparatus, of which the following is a specification.

This invention relates to improvements in well drilling apparatus of the hydraulic rotary type having means for rotating the drill stem and at the same time permitting free feed movements to the stem.

Different ways of providing this result have been heretofore employed, either by gripping the drill stem itself, or by the use of an auxiliary stem (known in the grade as a grief or grip stem) to which the drill stem is attached. The drill stem is formed of sections of pipe and is adapted to have sections added thereto as required, and the grief or grip stem of a one-piece structure preferably non-circular in cross section. When an auxiliary or grief or grip stem is employed for connecting the drill stem proper with the rotary driving mechanism and it is desired to add an additional drill stem section, the stems are raised sufficiently to expose the coupling therebetween; the grief stem is disconnected and a new drill stem section added, after which the grief stem is connected with the added section and both stems lowered to resume drilling.

While it is highly desirable to employ grief stems in rotary drilling operations, they have not heretofore been advantageously employed due to various reasons. For instance, the operating conditions, where the rotary drilling system is particularly applicable, are such that a portion of the hole near the bottom is very apt to cave in when the drill stem is withdrawn for the purpose of adding a new section thereto. When caving does occur and an attempt is made to lower the drilling stem to the bottom of the hole, the obstruction will prevent the drill stem end or bit from reaching the bottom, consequently, the grief stem, which has heretofore been necessarily limited as to length, and which has been raised out of operative engagement with the rotary driving mechanism, is prevented from being placed in position to reëngage and coöperate with the said rotary driving mechanism. For example, assuming the length of grief stem as thirty feet and a drill stem section as twenty feet (these being the lengths generally employed) the withdrawing movement of the stems raises the bottom of the drill stem a distance of thirty feet from the bottom of the hole, which distance would be decreased to ten feet when the drill stem section is added. If at this time, the caving has actually bridged this distance, the grief stem would not enter the drive mechanism. Owing to this possibility, the grief stem should be considerably increased in length, for example, to at least forty-five feet.

Such increase in length in turn increases the cost of manufacture and the difficulties of transportation where the stem is of a one-piece form. This objection may be overcome by forming the grief stem in sections, but the difficulty of producing sections which, in use will produce the uniform exterior surface of the stem necessary to permit an uninterrupted feed of the drill stem, an unimpeded jumping of the drill, the desired coöperating action with the driving mechanism, and a convenient and ready manipulaiton of the parts when a new drill stem section is placed in position, have heretofore prevented the general use of a sectional grief stem.

The present invention is designed to overcome the objections encountered in the use of either a one-piece grief stem or a sectional stem and their coöperating mechanisms employed in rotary drilling systems.

To these and other ends, my invention consists in the improved construction and combination of parts hereinafter fully described, illustrated, and particularly pointed out in the appended claims.

In the drawings.

Figure 1 is a vertical sectional view of a rotary drilling apparatus showing sections of grief and drill stems in elevation, the parts being shown in position where a grief stem section has temporarily reached the limit of its downward movement.

Fig. 2 is a similar view showing the position of parts after the bushing has been shifted to permit further feed movement.

Fig. 3 is a perspective view of a preferred form of bushing in its open position.

Fig. 4 is a perspective view of a drive ring which may be employed.

Fig. 5 is a vertical section taken through the drive ring on line 5—5 of Fig. 6.

Fig. 6 is a top plan view of the bushing in position in the drive ring.

Fig. 7 is a sectional view, partly in elevation, showing the joint connecting two grief stem sections.

In carrying out my invention, I employ grief stem sections which are non-circular in cross sectional contour, with each section of similar contour, and couple the sections together by a coupling member, usually, but not necessarily, of circular contour, the ends of the coupling member, for at least a portion of the end surface, projecting outwardly beyond the surface of the section to form a shoulder or abutment adapted to coöperate with a bushing when the travel of the stem brings such coupling ends into contact with the bushing.

In the drawings, I have indicated the grief stem at *a*, the stem being formed of sections 10 having any desired cross sectional non-circular contour, the drawings indicating such contour as square, each section, however, having a similar contour with that of the remaining sections. A coupling member is indicated at 11, the sections and member being preferably threaded together. *a'* designates the drill stem sections.

The grief stem is adapted to coöperate with a drive ring bushing, indicated at *b*, said bushing in turn coöperating with a drive ring *c* or direct with the table *d* of the "rotary", as may be desired; the drive ring arrangement is disclosed in the drawings, but it will be understood that the elements of the ring which coöperate with the bushing may be placed on the rotary table itself, thus dispensing with the use of the drive ring.

The table *d* may be of any desired form, and driven in any desired manner. Various ways of forming and driving such tables are disclosed in prior patents, as for instance, patent to R. E. Kline #1,099,453, June 9, 1914, in which the table is adapted to be driven from a suitable source of power and is provided with means for the seating of a drive ring, the latter being operatively connected to rotate with the table by means of suitable pins indicated as drive pins, this being a convenient form of connection. In the accompanying drawings, I have also indicated the use of drive pins, but it will be apparent that other ways of connecting the drive ring and table may be provided, such for instance, as the well known tongue and groove form of connection.

Drive ring *c* shown in detail in Figs. 4 and 5, is in the form of a disk-like member having a vertical aperture 15 elongated in one direction and formed with V-shaped enlargements 16 at the sides of the aperture or opening, said enlargements opposing each other. The walls of the opening and its enlargements extend vertically and are of suitable vertical length, the drive ring structure being extended downwardly around these walls a desired length. The end walls of opening 15 are of less vertical length than the length of the walls of the enlargements, as seen more particularly in Fig. 5. The enlargement walls are adapted to serve as guides for the vertical movement of the bushing presently described, the end portions of opening 15 being intended to permit of the free movement of other portions of the bushing. As shown in Figs. 4 and 5, the top of the drive ring is preferably depressed around the periphery of the enlargements 16, thereby forming seats 17 for flanged portions of the bushing. If desired, the recessed arrangement may also extend around the ends of opening 15, although this is not essential, the seats shown being sufficient to provide the support for the bushing. Obviously, the depressions may be omitted, the bushing then seating on the top of the ring.

The drive ring is also shown as having openings 18 for drive pins which connect the drive ring with the table. Suitable openings 19 are also shown, these being intended to receive T-bolts by means of which the drive ring can be lifted from its position on the table when desired.

The table is properly formed to receive the drive ring, the vertical extensions forming the walls of opening 15 and enlargements 16 extending into the table. Where the drive ring is omitted, the table will have the opening 15 and enlargements 16 as well as seats 17, these being the particular elements of the drive ring which cooperate with the bushing.

The bushing *b*, shown more particularly in Figs. 3 and 6, is preferably formed of two mating members 20, hinged together at 21 to permit opening and closing movements of the bushing. The members also have complemental means whereby they may be locked together when the bushing is closed, the means shown being perforated ears 22 having the ear perforations in alinement to permit of the passage of a bolt or pin.

The bushing, when closed, has an external configuration approximating that of opening 15 and enlargements 16 of the drive ring, the bushing being formed to provide a loose fit in order that the bushing may move vertically within the guides which are provided

by enlargements 16. As shown, the tops of the bushing members are provided with flanges 23, adapted to rest on the seats 17 when the bushing has moved downwardly to the desired extent. The members 20 are also provided with slots 24 for the reception of T-bolts by means of which the bushing may be raised from the drive ring.

As shown, each member 20 is provided with vertical walls arranged complementary to a predetermined portion of the contour of a grief stem section. As the latter section is indicated in the drawings as square, the walls of a member 20, indicated at 25, correspond to two of the four faces of the grief stem, this arrangement causing the walls of the two members to form a square opening when the members are closed, this opening receiving a grief stem section with sufficient freedom to permit feeding action. Obviously, should the grief stem section have a different contour, the wall arrangement of the bushing would be varied accordingly.

The walls 25 have a vertical length sufficient to provide a positive drive action to the grief stem when located therein. In practice, I have found that a vertical length of ten inches is amply sufficient to provide the drive action for a square grief stem having a face width of six inches.

As shown in Fig. 3, the bushing, below the walls 25 may be skeletonized in form, this portion being preferably provided with one or more ribs 26, having their inner faces cut away to an extent sufficient to permit the free passage of a coupling member 11 when members 20 are closed.

From the above, it will be understood that the drive ring *c* is detachably secured to the table and positively driven thereby, and that the drive ring bushing *b* insertible within the bushing guides of the drive ring is movable vertically in such guides. To permit of insertion, the bushing must be closed, and when inserted, the complemental configuration between the bushing and drive ring is such that the rotative movements of the drive ring will be communicated to the bushing and by the latter to the grief stem section.

Openings 15 and enlargements 16 are sufficiently large to permit the free passage of the tubular sections forming the drill stem. In assembling the drill and grief stems, the drill stem sections are coupled together, the coupling of the upper section receiving a threaded end of the lower section of the grief stem, the grief stem section being threaded tightly to position within such coupling. Bushing *b* is then placed about the grief stem with walls 25 above the coupling connecting the grief and drill stem sections; the bushing is then closed and locked, and the stems lowered until the bottom of the drill stem contacts with the bottom of the hole.

The bushing will be supported on the coupling due to the lower faces of walls 25 resting on the shoulder or abutment produced by the end of the coupling, until the lowering movement is sufficient to seat the bushing. During this lowering movement, the lower end of the bushing passes into the bushing guides of the drive ring, and after it is entered a suitable distance, positive drive action may be communicated to the drill stem through the grief stem. As the drilling action continues and the stem gradually lowers, bushing *b* will follow the coupling until flanges 23 rest on seats 17, thus retaining the bushing against further downward movement, the grief stem section, however, being free to continue its downward travel until the coupling member 11 at the upper end of the grief stem section passes into contact with the top of the bushing, thus preventing further downward movement of the drill and grief stems. When this point is reached, a succeeding section of grief stem is threaded to the coupling member 11, after which the coupled grief and drill stems are raised a distance sufficient to permit raising of the bushing out of the drive ring—a distance in excess of the vertical height of the bushing. The bushing is then raised, the locking pin removed, and the bushing swung to its open position, whereupon, it is moved bodily to place walls 25 above coupling member 11, after which the bushing is closed, locked, and the stems lowered until the bottom of the hole is reached.

As will be seen, this last described action has transferred coupling member 11 from a point above the walls 25 to a point below these walls, placing the coupling in position where it is ineffective to prevent feed movement of the drill stem. This necessarily raises the position of the bushing a distance equal to the width of coupling member 11, and the length of walls 25 when the lower end of the drill reaches the bottom of the hole. Consequently, the bushing will not reach its seated position until the drill has moved downward a distance equal to the distance corresponding to the width of the coupling and length of walls 25. To permit of the desired drive action when this change in position occurs, increase in vertical length of the bushing is had, ribs 26 supporting the walls of the bushing during the time the bushing is moving toward its seat. When the coupling at the upper end of this second grief stem section reaches the bushing, the action is repeated, the bushing being transferred from below to above the coupling member, the stems lowered, and the operation resumed.

To permit of a ready opening of the bushing, I may employ hand holes 27 by means of which the members may be gripped to open them.

Should the longitudinally extending faces or other elements of a grief stem section be out of alinement with those of the adjacent section when this transfer of bushing is made, it is only necessary to swing the entire stem structure (which is suspended at this time) until the bushing is in proper position to enter the bushing guides.

It will be clear that any desired number of grief stem sections may be coupled together in this manner; in fact, the entire drill stem may, if desired, be made up of such sections. However, the desired result can be obtained by coupling three or four of such sections together, and when the coupling member at the top of the last section is reached, the entire drill stem can be raised until the grief stem is entirely withdrawn, the sectional formation permitting the grief stem sections to be taken apart as they are withdrawn, thus eliminating any requirement for the use of rigging structures capable of handling stems of great length. In withdrawing, the upwardly moving coupling contacts with the bottom of the stem guides and raises the bushing out of the drive ring, whereupon, it is opened and laid aside. The requisite number of drill stem sections are then placed in position in the usual manner, the first grief stem section is then added and the bushing placed in position as before to repeat the operation.

As will be readily apparent, the raising movements required to permit transfer of the bushing from one side of the coupling to the other (generally less than three feet) does not raise the drill a sufficient distance to permit any material caving of the hole. Consequently, no difficulty of this character is had during the drilling operation. Where a plurality of grief stem sections are employed, the withdrawal movement is of such length (for instance, seventy-five to one hundred feet) that any caving that may occur will be ineffective to prevent the entrance of the bushing into position.

The advantages of this arrangement will be readily understood. The operator need only carry a few grief stem sections in stock and yet be able to provide practically a continuous drilling action equal in length to the length of a one-piece grief stem having the length of the coupled sections. The grief stem sections may be of a length readily manufactured and easily transported. The coupling of sections and the transfer of the bushing can be had rapidly and without difficulty. Caving of the well is ineffective to prevent operation. The grief stem sections are coupled together with ordinary couplings and without necessity of attempting to aline the sections. The coupling members automatically coöperate with the bushing to prevent damage, forming supports for the combined stems during the downward travel and lifting the bushing during the upward travel, thereby dispensing with the necessity of carefully watching the drilling apparatus by the operator.

What I claim is:—

1. In rotary drilling apparatus, the combination with a drill stem and rotary drive mechanism including an apertured table, of means operatively connecting the drill stem and drive mechanism to rotate the stem and permit its feed movements, said means including a sectional non-circular grip stem having a projecting coupling connecting two adjacent ends and a separable grip-stem clamping element loosely mounted in the table opening, said clamping element being of sufficient length to permit shifting of the element to pass the coupling and to be operatively connected with the table and grip-stem in either position.

2. In rotary drilling apparatus, the combination with a drill stem and rotary drive mechanism including an apertured table, of a sectional non-circular grip-stem having an enlarged joint, a separable grip-stem clamping element loosely mounted in the table opening and vertically movable therein, said clamping element having broad integral grip-stem engaging faces, the walls of the table opening being non-tapering and the exterior of the clamping element having straight faces to fit against said walls of the table opening and projected downwardly below said grip-stem engaging faces, whereby driving engagement may be maintained when passing the joint of the grip-stem.

3. In rotary drilling apparatus, the combination with a drill stem and rotary drive mechanism including an apertured table, a drive-ring mounted in the table opening, a sectional non-circular grip-stem having an enlarged joint, a separable grip-stem clamping element loosely mounted in the drive ring and having interior grip-stem engaging faces, said clamping element and drive-ring having complemental straight non-tapering faces, said clamping elements projecting downwardly below the grip-stem engaging faces, whereby driving engagement may be maintained when passing the joint of the grip-stem.

4. In rotary drilling apparatus, the combination with a drill stem, of a sectional grip-stem of non-circular form and having enlargements intermediate its ends for connecting the sections together, rotary drive mechanism including a table having an opening therein, a separable clamping element loosely entered in the table opening and pro-

jecting downwardly through the table and vertically movable therein while in operating position, said clamping element having broad integral grip-stem engaging faces positioned in the interior of the upper portion of the clamp, and an elongated exterior surface extending below the said engaging faces to provide engagement with the table when the clamping device is partially raised out of the table opening.

5. In rotary drilling apparatus, the combination with a drill stem and rotary drive mechanism including an apertured table, a drive ring mounted in the table opening, a sectional non-circular grip stem having a projecting coupling connecting two adjacent ends, a separable grip stem clamping element loosely mounted in the drive ring, said clamping element being of sufficient length to permit shifting of the element to pass the coupling and to be operatively connected with the drive ring and grip stem in either position.

In testimony whereof I affix my signature in presence of two witnesses.

EDGAR E. GREVE.

Witnesses:
ALEX. S. MABON,
W. G. DOOLITTLE.