April 12, 1938. J. W. HEASTON 2,113,651

HOLDER FOR ROTARY VIBRATING BITS

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Fig. 1.

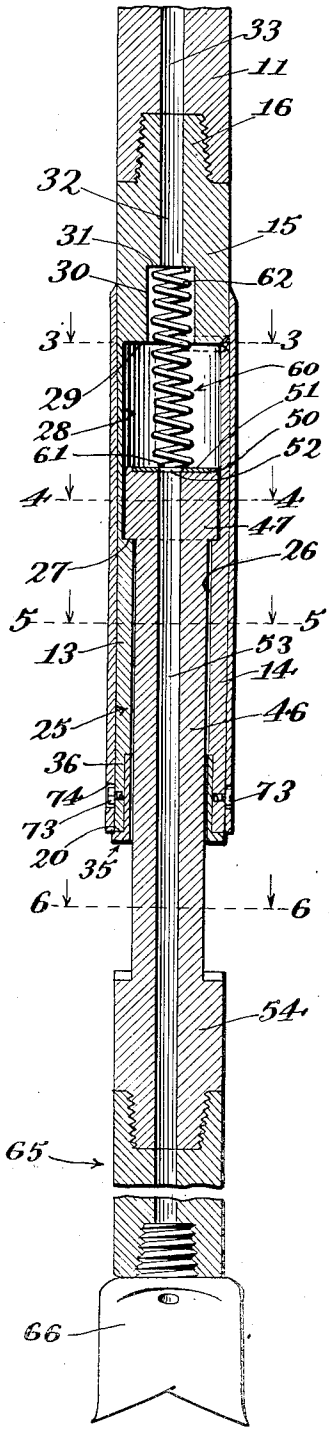
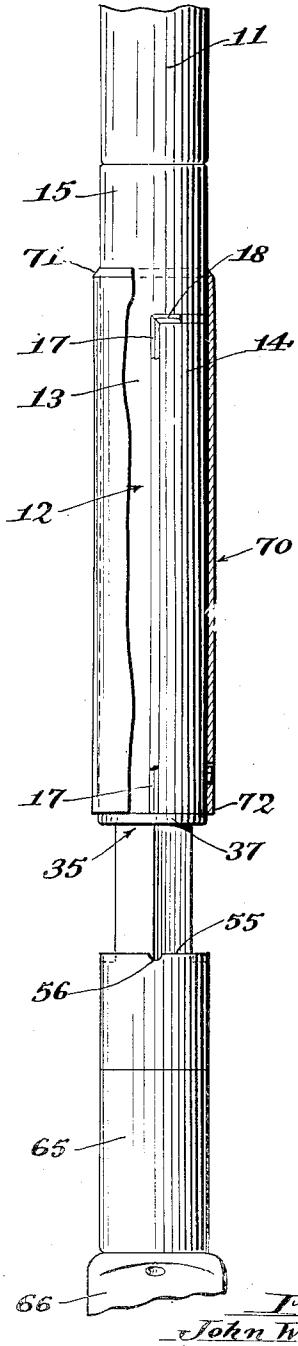


Fig. 2.



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Fig. 3.

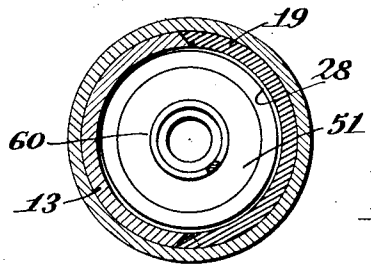


Fig. 4.

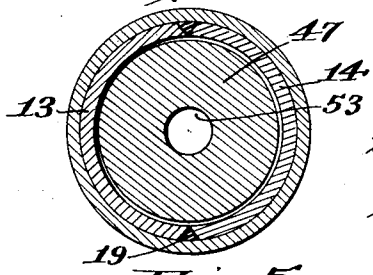


Fig. 5.

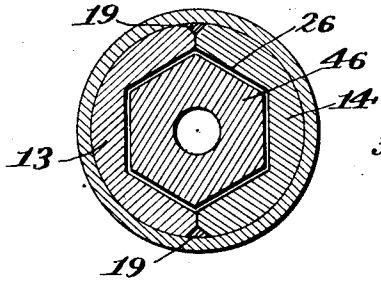


Fig. 6.

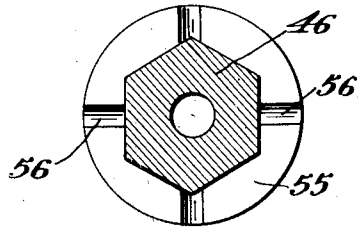


Fig. 7.

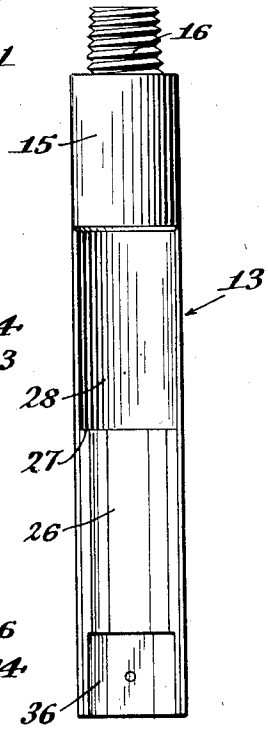


Fig. 8.

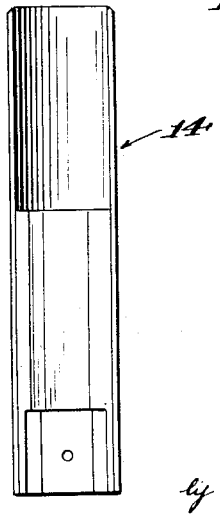


Fig. 9.

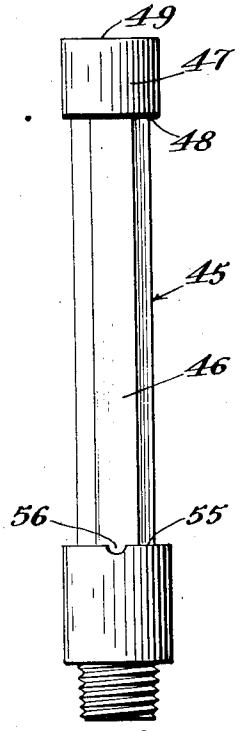


Fig. 10.

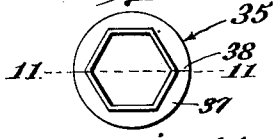
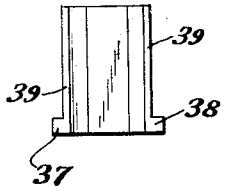


Fig. 11.



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UNITED STATES PATENT OFFICE

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HOLDER FOR ROTARY VIBRATING BITS

John W. Heaston, Huntington Beach, Calif.

Application April 22, 1936, Serial No. 75,742

11 Claims. (Cl. 255—61)

I designate my invention as a holder for rotary vibrating bit as it is used in rotary hydraulic drilling of deep wells or the like in which the action of rotation of the bit causes a vertical vibration or reciprocation of such bit, thus with my invention I develop combinational features of rotation and impact drilling.

In rotary hydraulic drilling, as is well known, when the bit is connected to the lower end of a string of drill pipe and when operating in a deep well, considerable care must be exercised in order to maintain the proper weight on the bit. The drill string must be suspended under tension so that the complete weight of the drill pipe does not come on the bit. It is difficult to always maintain a desired or uniform pressure and especially a pressure or weight on the bit which is suitable for drilling in different materials. Moreover, it is known that in certain formations such as hard rock or shale and especially when the various strata have a slope, that the mere rotation of the bit is often quite inefficient in cutting the hole or making rapid progress in securing depth and moreover the bit is very subject to the side pressure of sloping rock or hard strata by which the hole is diverted, the drilling resulting in what is termed a crooked hole.

With my invention a known weight may be maintained on the rotary bit, this weight being regulated by the construction of the holder and the vertically reciprocating portion thereof which is connected to the bit. Therefore with the string of drill pipe suspended in the rotary table, the bit operating in the bottom of the hole has substantially a constant and even weight thereon, this being dependent on the weight of the sliding portion of the holder or drill collars attached thereto for the purpose of adding weight.

Another characteristic of my invention is that the bit with the portion of the holder to which it is attached may vibrate or jump up and down vertically as the holder and bit is rotated. This upward and downward movement is developed through the cutting portion of the bit cutting into the hard formation and therefore developing a type of chattering action. The downward blow of this action is assisted by a compression spring, such spring being compressed by the upward bounce of the bit.

Another object and feature of my invention resides in the detail construction of the holder, this includes a strong and substantial sleeve preferably circular in cross section with an axial opening or a socket in which is mounted a heavy shank. This shank and the opening or socket are non-circular in cross section such as being square or hexagonal so that as the sleeve is connected to the lower end of the string of drill pipe and on rotation rotates the shank, the socket has an enlarged opening to accommodate the head of the shank and also to provide a space for a strong compression spring which bears against the upper end of the head of the shank and an abutment at the upper end of the socket or opening in the sleeve. Another detail feature resides in the manner of constructing the sleeve for the assembly of the shank therein and for this purpose one side of the sleeve is constructed to be removable from the main portion of the sleeve, there being a diametrical joint line extending vertically upwardly from the lower portion of the sleeve so that the major portion of the opening or socket may be exposed. The shank including its enlarged head and the compression spring may then be fitted in the opening or socket of the sleeve, the side cover part may be replaced and secured by welding at the joint and finally in order to assure proper strength, an elongated collar is shrunk over the sleeve by a heating process.

Another object and feature of my invention is having provision for a downward flow of the slushing fluid, sometimes designated the slushing mud, which passes downwardly through a duct in the upper part of the sleeve, this mud being pumped down in the usual manner through the string of drill pipe. The shank also has a duct connecting through to the bit where it is discharged. In addition, my invention provides for a working clearance between the non-circular parts of the shank and the complementary internal socket or opening of the sleeve to permit the up and down vibration or reciprocation of the bit with the shank. This working clearance provides restricted passages around the shank for a downward flow of a certain proportion of the slushing mud which is then ejected above the bit and tends to wash off or prevent the formation of a mud ball on the shank above the bit or immediately above the upper portion of the bit.

My invention is illustrated in connection with the accompanying drawings, in which:

Figure 1 may be considered as a vertical longitudinal section at right angles to the welded longitudinal joint.

Figure 2 is an elevation with the collar on the sleeve broken away showing the longitudinal joint of the side cover part.

Figure 3 is a transverse section on the line 3—3 of Figure 1 in the direction of the arrows on a larger scale.

Figure 4 is a tranverse section of Figure 1 on the line 4—4.

Figure 5 is a transverse section of Figure 1 on the line 5—5.

Figure 6 is a transverse section of Figure 1 on the line 6—6.

Figure 7 is an elevation of the main part of the sleeve looking into the socket and the enlargement thereof with the collar omitted and the weld omitted.

Figure 8 is an elevation of the inside of the cover part of the sleeve removed from the assembly with the sleeve.

Figure 9 is an elevation of the shank showing this hexagonal in cross section and removed from the sleeve.

Figure 10 is an end view taken of Figure 11 of the insertable filler collar used at the end of the sleeve.

Figure 11 is a vertical section on the line 11—11 of Figure 10, this in effect being an inside elevation of one half of the filler collar.

Referring first to the details of Figures 1 and 2, the lower portion of a string of drill pipe is indicated at 11. To this is connected the main holder sleeve 12 which is formed of the main portion designated by the assembly numeral 13 and the removable portion designated by the assembly numeral 14 (note particularly Figures 7 and 8). The main portion has a substantial head 15, the connection to the drill string being by a pin and box connection 16. The parts of the sleeve 13 and 14 are connected by diametrically opposite longitudinal joints 17 and by a semi-circumferential joint 18. These joints are formed by having V type of notches indicated at 19 filled by the welding metal forming the joint.

The sleeve terminates at the lower end 20 and extending upwardly from this there is an axial opening or socket designated by the assembly numeral 25. The main portion of this socket is non-circular and is illustrated as being hexagonal, this being the part numbered 26. This main socket terminates in a horizontal shoulder 27 above which there is a cylindrical enlargement 28. The cylindrical portion is of considerable length and terminates in a relatively wide annular shoulder 29. Above this shoulder there is an axial recess 30 which is preferably cylindrical in cross section, terminating at the base 31 of the recess. A duct 32 for the slushing mud extends axially upwardly through the head 15 and connects to the slushing duct 33 in the string of drill pipe.

It is preferable at the lower end of the sleeve to have a filler collar 35 (note particularly Figures 10 and 11). This is done by providing the lower part of the sleeve with an enlargement 36 to the socket, this enlargement conforming in shape to the inside of the sleeve and in the construction illustrated being hexagonal. This collar has an annular rim 37 bearing against the end 20 of the sleeve and in this rim there is a diametrical joint 38 and in the sides longitudinal joints 39 which are diametrically opposite.

The reciprocating or vibrating portion of the tool designated by the assembly numeral 45 has an elongated shank 46, this being in the present illustration hexagonal in cross section to have a sliding fit in the hexagonal portion of the socket of the sleeve. At the upper end of the shank there is a substantial head 47 cylindrical in cross section and having a lower shoulder 48 which may rest on the shoulder 27 of the sleeve. The top 49 of the head preferably has a shallow recess 50 in which is located a hard-wearing plate 51, this plate having an opening 52 therethrough aligning with the slushing duct 53 which extends completely through the portion of the tool 45. At the lower portion of the shank there is an end enlargement 54, this preferably being cylindrical in cross section and having an upper annular shoulder 55. In this shoulder there are radial grooves 56 or notches which lead from the shank portion to the periphery of this enlargement 54, the purpose of these being for the discharge of slushing mud passing between the shank and the sleeve as hereinunder detailed.

A substantial compression spring 60 is used this being illustrated of a helical type, having its lower end 61 positioned to engage the wear plate 51 on the head 47 attached to the shank. The upper end 62 of the spring 60 fits in the recess 30 and engages the shoulder 31. The spring illustrated is of a simple form, for this may be a compound or double spring, that is, one coil spring inside of another to give the desired resistance to compression. Where it is desired to add additional weight to the tool, a sub-collar 65 may be utilized. This may be of any length desired in order to add the amount of weight necessary for the proper action of the bit, the bit being indicated at 66. Bits of any suitable type may be utilized and connected to the sub-collar in any suitable manner or if it is necessary to connect these directly to the enlargement 54 at the end of the shank, the bit and the end of the shank may be made to form an attachment.

The manner of assembling the various parts of the tool is substantially as follows: Prior to the welding of the removable section of part 14 of the sleeve to the main part 13 of the sleeve, these parts are separated. The spring 60 is inserted in the recess 30 of the main portion 13 of the sleeve. As the full half of the socket 25 is exposed, the shank 46 and the head 47 may be fitted therein. The removable cover part 14 is then fitted in place, thus enclosing the shank, the head of the shank and the spring. The V shaped longitudinal joints 17 and 18 thus interfit and the weld is made at such joint, thus securely attaching the removable part 14 to the main part 13 of the sleeve. However, to insure adequate strength and to cover the welded joint after this has been surfaced to remove rough spots, a long cylindrical collar 70 is heated and then slipped over the shank. The upper end 71 is preferably beveled and extends well above the semi-circular joint 18. The lower end 72 of the collar preferably terminates adjacent the lower end 20 of the sleeve. Either before or after the attachment of the collar, the sections of the filter collar 35 have been inserted from the end of the sleeve and are held in place by set screws 73, which are inserted through perforations 74 in the collar 70, the heads of the screws being below the outside surface of the collar. When it is necessary to disassemble the device, it is necessary to cut the collar with a blow torch or in other suitable manner, then to melt or cut the weld at the joint 17 and 18 so that the portion 14 of the sleeve may be removed from the main portion 13.

The manner of operation and functioning of my invention is as follows: With my holder with the bit connected to a string of drill pipe, the device may be lowered in a well until the bit contacts the bottom of the hole. The string is then slightly lowered so that the head 47 on the shank 46 is raised above the shoulder 27 on the body of

the sleeve. The rotation of the drill string manifestly causes a rotation of the shank and hence the bit. As the bit cuts into the formation, such as rock, shale or the like, it develops a chattering action, that is, a vertical reciprocation. This is increased as the points of the bit engage hard particles causing the bit to jump upwardly which action compresses the spring **60** and the reaction of the spring causes a downward impact of the bit on the bottom of the hole increasing the impact due to the drop of the bit by gravity. As above described, where it is necessary or desirable to increase the weight on the bit, the subcollar **65** may be connected in the assembly between the lower part of the shank and the bit. It will be understood that my invention is not restricted to any particular type of bit. The proportions of the shank should be such that at the instant the annular shoulder **55** on the enlargement **54** strikes the lower part of the sleeve, that is, the annular rim **37** of the collar **35**, the upper end **49** of the head **47** will engage the annular shoulder **29** of the head or main body of the sleeve. However, if desired, the shank could be made slightly longer than the distance between the shoulder **29** and the end of the sleeve so that there will be no direct contact between the shoulder **55** and the end of the sleeve but this shoulder will approach closely to the end of the sleeve.

The flow of the slushing mud manifestly is downwardly through the ducts **33**, **32** and the enlarged space of the socket in the sleeve above the head on the shank, through the duct **53** of the shank and hence to outlets at the bit. As it is necessary to allow a working clearance between the hexagonal portion of the sleeve and the hexagonal section of the shank, slushing mud will be forced downwardly through this working passage and discharged at the lower end of the sleeve. The size of this opening may be controlled by the filler collar **35** as shown in Figure 10, which collar not only restricts the size of the passage but operates as a wearing element for the shank on the sleeve. The radial grooves **56** in the shoulder **55** operate to discharge the mud flowing downwardly at the shank outwardly, especially when the shank is jolted upwardly until the shoulder **55** approaches the lower end of the sleeve. This flow of mud above the bit is very useful, when the bit is coupled close to the shank, to remove the ball of mud which usually accumulates above the bit in most drilling operations.

Various changes may be made in the details of the construction without departing from the spirit or scope of the invention as defined by the appended claims.

I claim:

1. A holder for a rotary bit comprising in combination a sleeve having a longitudinal socket extending upwardly from its lower end, means at the upper end of the sleeve for connection to a string of drill pipe, the socket having a noncircular section adjacent the bottom of the sleeve, a cylindrical enlargement thereabove with transverse shoulders at the bottom and the top of the enlargement and a recess extending upwardly from the upper shoulder of the enlargement, a bit holding structure comprising a shank non-circular in cross section and slideably fitting in the non-circular portion of the socket, a head at the upper end of the shank in the said enlargement of the socket, the lower end of the shank having an enlargement with means for attaching a drill bit, a compression spring having its upper end in the said recess, the spring extending into the enlargement and engaging the head on the shank whereby in the rotation of the sleeve rotation is transmitted to the shank and hence to the bit and the said shank may reciprocate vertically in the said socket, the spring reacting against the upward motion of the shank, the sleeve and the shank having slushing ducts for communication of a slushing fluid to the bit, the sleeve having a removable section with a diametrical longitudinal joint and a semi-circumferential joint, the said joints being welded, the removable section forming one half of the enlargement and noncircular section of the socket.

2. A holder for a rotary bit as claimed in claim 1, and a collar fitted over the sleeve and confining the removable section.

3. In a device as described, a holder for a bit comprising an upper tubular structure having a fixed and a removable section with a diametrical longitudinal welded joint and a semi-circumferential welded joint therebetween and having means for attaching its upper end to a string of drill pipe, a lower structure having a shank engaged in the upper structure, means on the lower end of the shank for attaching a bit, an interengaging means between the two structures to transmit rotation to the shank and to allow relative sliding longitudinal movement whereby when the upper structure is suspended above the bottom of a hole and a bit operates on the bottom of the hole during the rotation of the bit, the shank may vibrate vertically relative to the tubular structure.

4. In a device as described in claim 3, a collar secured on the outside of the upper tubular structure confining the removable section and extending over the welded joints, the collar having a tight fit.

5. A holder for a rotary bit comprising in combination a sleeve having a head at its upper end with means for attachment to a string of drill pipe and having a longitudinal socket extending from below the head to the lower end of the sleeve, the socket having an upper portion with cylindrical enlargement and a lower portion noncircular in cross section, the sleeve having a main section and a removable section connected thereto by a diametrical longitudinal welded joint and a semi-circumferential welded joint adjacent the head whereby when the removable section is separated from the main section one half of the said enlargement and the noncylindrical section of the socket is exposed, a reciprocating or vibrating portion of the holder having an elongated shank noncircular in cross section slideably mounted in the noncylindrical portion of the socket and an enlarged head in the cylindrical enlargement, means at the lower end of the head for connection to a drill bit whereby when the sleeve is suspended above the bottom of a hole, the bit may operate on the bottom of the hole, the weight of the bit and the vibrating structure being substantially the sole weight on the bottom of the hole whereby in rotation the bit with the vibrating structure may reciprocate longitudinal in the sleeve.

6. A holder for a rotary bit as described in claim 5, the sleeve having a cylindrical collar having a tight fit thereon, the collar extending from the bottom of the sleeve above the semi-cylindrical joint.

7. A holder for a rotary bit as described in claim 5, the head portion of the sleeve having a recess, a spring seated therein and extending

into the enlargement of the socket and having its lower end adapted to engage the head on the upper end of the shank, the head portion of the sleeve having a slushing duct communicating with the recess and the shank and its head having a second slushing duct communicating with the drill bit.

8. A holder for a rotary bit as described in claim 5, a subcollar forming the means for attaching the bit to the lower end of the shank, said subcollar being adapted to increase the weight on the vibrating portion of the holder.

9. A holder for a rotary bit comprising in combination a sleeve having a longitudinal socket extending upwardly from its lower end, means for connecting the upper end of the sleeve to a string of drill pipe for rotation of the sleeve, the socket having a non-circular section adjacent the bottom and a cylindrical enlargement thereabove, a bit holding structure comprising a shank non-circular in cross section and slidably fitting in the non-circular portion, a head on the upper portion of the shank in the cylindrical enlargement of the socket, the sleeve having a removable section with a diametrical longitudinal joint and a semi-circumferential joint, said joints being welded, the removable section forming one half of the enlargement and non-circular section of the socket.

10. A holder for a rotary bit as claimed in claim 9, a collar fitting over the sleeve including the removable section thereof, said collar having a tight fit on the sleeve and thereby confining the removable section.

11. A holder for a rotary bit as claimed in claim 9, the sleeve having a central recess at the upper end of the enlargement of the socket, a compression spring fitting in the said recess and engaging the head at the upper end of the shank of the bit holding structure, the said sleeve having a duct for slushing mud extending centrally therethrough to the said recess, the said shank having a complementary slushing duct adapted to form a connection to a bit.

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