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DEVICE FOR INTRODUCING FLUID IN WELLS

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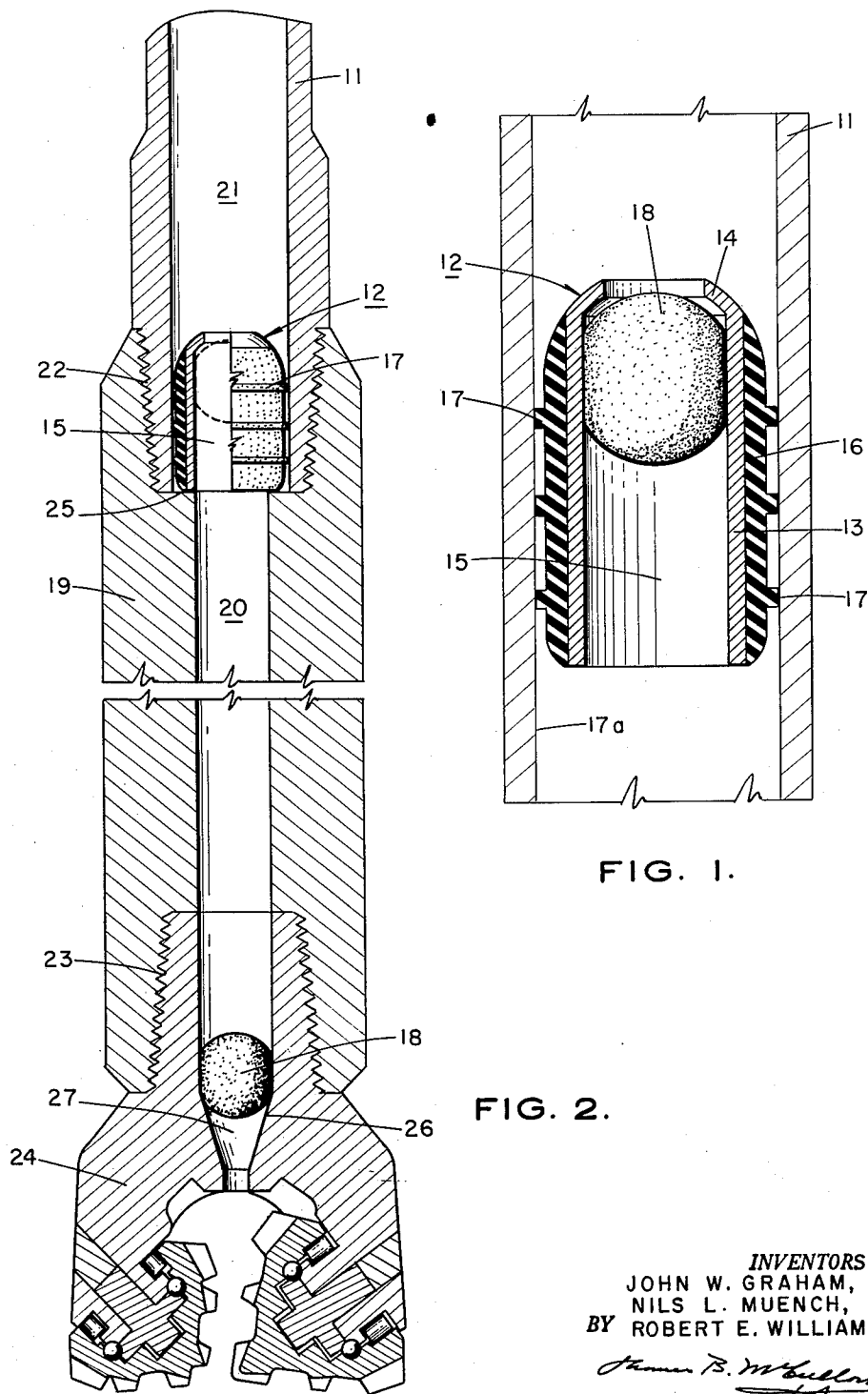


FIG. 1.

FIG. 2.

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DEVICE FOR INTRODUCING FLUID IN WELLS

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The present invention is directed to a device for introducing fluid into a well. More particularly, the invention is concerned with a device for accurately introducing a measured amount of fluid into a well. In its more specific aspects, the invention is concerned with a device whereby fluid may be introduced into a well and the introduction of said fluid is determined by an increase in pressure.

The present invention is concerned briefly with a device for introducing fluid into a well having a pipe string arranged therein which comprises a rigid cylindrical member adapted to be arranged in the pipe string and having an open bore and having an outside diameter less than the inside diameter of the pipe string. A deformable sleeve is fixedly attached to the outer surface of the cylindrical member and the sleeve has an outside diameter less than the inside diameter of the pipe string, the sleeve being formed to provide at least one protuberance on its outer surface for sealing engagement with the inner surface of the pipe string. A spherical deformable member is normally arranged in said bore and it has a normal diameter greater than the diameter of the bore. Means are formed by the cylindrical member on one end thereof narrowing the bore for retaining the deformable member in the bore, the deformable member being ejectable from the bore on the other end thereof by imposition of fluid pressure against the one end and against the deformable member.

The present invention will be further described by reference to the drawing in which:

FIG. 1 is a sectional view of the adapter in accordance with the present invention; and

FIG. 2 shows the arrangement of the apparatus in a drill string.

Referring now to the drawing in which identical numerals will be employed to designate identical parts and in which numeral 11, referring particularly to FIG. 1, designates a drill string in which an adapter generally indicated by the numeral 12 is arranged, the adapter 12 is comprised of a metallic cylinder 13 which is formed on one end with means 14 which narrows the bore 15. Fixedly secured or adhered to the outer surface of the cylinder 13 is a sleeve 16 made up of a deformable material such as synthetic or natural rubber. Other plastic or deformable materials may be used in making up the sleeve 16.

The sleeve 16 is suitably formed with protuberances 17 which are vertically spaced apart on the sleeve. The protuberances 17 serve to engage with the inner wall 17a of the drill pipe 11 and form a sealing engagement therewith.

Arranged in the bore 15 of the adapter 12 is a deformable member 18 which may be constructed of synthetic or natural rubber. The deformable member 18 is normally of greater diameter than the diameter of the bore 15 and is adapted to be pumped out of the bore 15 by imposition of pressure against the upper end of the adapter 12.

Referring now to FIG. 2, a drill string 11 has connected thereto and forming part thereof drill collars 19 which may be 300 feet in length. The drill collars 19 have a passageway 20 which is of lesser diameter than

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the passage 21 of the drill pipe 11. The drill collars 19 are threadedly connected into the drill string 11 by mating threads 22, and attached to the lower end of the drill collars 19 by mating threads 23 is a drill bit 24 which for purposes of illustration is shown as a cone rock bit.

In FIG. 2 the adapter 12 has been inserted in the drill string 11 at the wellhead, not shown, and has been pumped down or allowed to fall down through the passageway 21 until it reaches a shoulder 25 which stops the adapter 12 and causes it to seat thereon. On imposition of fluid pressure in the passageway 21 the deformable member 18 is ejected from the bore 15 and is caused to proceed downwardly in passageway 20 and to seat on the shoulder of restriction 26 in the passageway 27 of the drill bit 24. The shoulder 26 being adjacent to the lower end of the drill collars 19.

Thus, when the adapter 12 containing the deformable member 18 therein is introduced at the wellhead, it proceeds downwardly to the passage 21 until it reaches the shoulder 25, at which time a pressure build up on the pump forcing the adapter 12 downwardly indicates to the operator that the adapter 12 has reached the shoulder 25. Thereafter, imposition of a greater amount of pressure causes the deformable member 18 to be ejected from the bore 15 to flow downwardly through the passageway 20 until it reaches the shoulder 26, at which time another pressure surge on the pumps will indicate to the operator that the deformable member 18 has closed off the passageway 27.

The present invention is adapted to and useful in spotting solutions in a well. In employing the present invention, a deformable member, such as a rubber ball as illustrated by the element 18 housed in adapter 12 in the description taken with the drawing, is introduced in the drill pipe immediately behind a solution which is to be injected. The rubber ball such as deformable member 18 may have a diameter equal to the inside diameter of the drill collar or collars which form part of the drill string. When the solution is pumped down to bottom, the ball prevents mud from mixing with the solution and gives a rise in surface pressure when the solution has reached the bottom of the well. When the adapter seats upon the shoulder 25, this signals to the operator that the solution has reached bottom and thereafter he may immediately continue to pump additional fluid and cause the ball 18 to pump down until it reached the shoulder 26, which allows a measured amount of the solution to be introduced. Thus, in employing the device in accordance with FIG. 2, the entire assembly including the adapter provides separation while the solution is in the drill pipe. The ball provides separation when the solution reaches the drill collar. In addition, the ball prevents the solution from over-shooting when it reaches the required depth. After completing the desired operation at the bottom of the hole, introduction of fluid pressure in the annulus between the wall of the well and the drill pipe allows the ball 18 to be forced up the passageway 20 and then into the adapter 12 and causes the adapter 12 to be returned to the wellhead. This is possible, because, as is clear from the description taken with the drawing, the adapter 12 is free from any connections to the drill pipe.

The present invention is particularly adapted for use in recovering damaged drill bits. Drill bit failure is usually due to bearing failure or to failure of the cutting teeth. However, it is the bearing life that usually limits the life of the bit. If the drill bit is used so long that the bearings do fail, then when the bit is withdrawn from the hole, one or more of the cones, or the associated bearings and cutters, fall from the bit and remain at the bottom of the hole. When this happens a costly and

time consuming fishing job is usually required. To avoid the possibility of lost cones and fishing jobs, it is usually the custom to sacrifice some of the useful bit life in order to prevent bearing failure. Perhaps as little as 10% or as much as 50% of the useful bit life remains where the bit is withdrawn from the hole. In oil field technology, this is called pulling a "green" bit and of course there are various shades of "green" bits.

A tremendous incentive exists for preventing the pulling of the green bits. In accordance with the present invention, it is now possible to reduce total bit costs and also reduce rig time cost such as is consumed from making round trips. This is possible by employing the present invention in which the bit which may have been used to the extent of its useful life is recovered. This is possible by employing the present invention and by injecting into the well down the drill string a material which is reactive in the area adjacent to the bit to cause the loose drill cones or cutters to remain adhered to the bit. This is possible by using a thermosetting or thermoplastic material which may be introduced as follows: For example, monomers or partially polymerized reactants and catalyst, either in a mixture or in a suspension or solution with an inert carrier is spotted at the bit, using the apparatus of FIGS. 1 and 2. Thereafter, after spotting of the reactive material, the bit is rotated without circulation of fluid with bit weights which may range from 5,000 to about 50,000 pounds. This causes an immediate heating up in the area of the bit and causes the plastic material to solidify. Thereafter, the bit is cooled for about 5 to about 20 minutes and the bit with the attached junk such as roller cutters or cones is withdrawn from the hole. In case the passageway 27 is not sealed by the plastic material, it may be desirable to reverse out or circulate out unused plastic material which has not solidified; however, it is within the purview of our invention to pull the drill string "wet" or full of fluid and let the fluid remaining in the drill string spill on the floor of the rig.

The bonding of the parts of the bit results from the extreme localized temperature generated at the metal-to-metal contact in the presence of a reactive mixture which either causes polymerization or melts a previously polymerized plastic. The absence of circulatory cooling allows the metal temperature to reach a high value in a short time.

If a thermoplastic polymer is used, it may be spotted as either the monomer or polymer, either with catalyst or without, and either alone or in solution or suspension with an inert carrier.

There are many polymer compositions which may be used which will wet or encapsulate the metal surfaces when it is hot and will harden when it is cooled. An example of such plastics are the thermosetting polymers, such as phenol-formaldehyde, amine-formaldehyde, epoxy, urethane or latex type polymers, and many other thermosetting polymers. As examples of the thermoplastic materials may be mentioned polystyrene, polyesters, polyamides, or vinyl polymers and the like.

It may be seen that the present invention is quite useful in recovering junk from a hole. However, it is to be understood that the present invention is not limited to recovering junk. It may be used for injecting any kind of solutions into a well bore, which solutions may be used to stimulate the well or the formations pierced by the drill bit. For example, the present invention may be used in fracturing operations, workover operations, and the like.

The present invention not only includes the adapter but also is intended to include the drill collars which form a tubular member adapted to be connected into and form part of the drill stream. It is contemplated that the adapter is seatable on the first shoulder adjacent the connection to the drill pipe and the drill collars and also the deformable member is seatable on the second

shoulder adjacent the end of the drill collars and in the drill bit.

The present invention is quite advantageous and useful and presents a new approach to injecting fluids into a well and also a new approach in recovering junk from a well.

In recovering junk from a well it is possible to spot a given amount of the thermosetting or thermoplastic material without having an excess of the thermosetting or thermoplastic material to cause the drill pipe to stick in the well.

The nature and objects of the present invention having been completely described and illustrated, what we wish to claim as new and useful and secure by Letters Patent is:

1. A device for introducing fluid into a well having a pipe string arranged therein which comprises a free, rigid cylindrical member having an open bore and having an outside diameter less than the inside diameter of said pipe string, said cylindrical member being adapted for insertion in and movement through said pipe string, a deformable sleeve fixedly attached to the outer surface of said cylindrical member, said sleeve being formed for sealing engagement with the inner surface of said pipe string, a deformable member normally arranged in said bore and having a diameter normally greater than the diameter of said bore, and means formed by said cylindrical member on its upper end thereof narrowing said bore for retaining said deformable member in said bore, said deformable member being ejectable from said bore through its lower end by imposition of fluid pressure against said upper end and against said deformable member.

2. A device for introducing fluid into a well having a pipe string arranged therein which comprises a free, rigid cylindrical member having an open bore and having an outside diameter less than the inside diameter of said pipe string, said cylindrical member being adapted for insertion in and movement through said pipe string, a deformable sleeve fixedly attached to the outer surface of said cylindrical member and having an outside diameter less than the inside diameter of said pipe string, said sleeve being formed to provide a protuberance on the outer surface of said sleeve for sealing engagement with the inner surface of said pipe string, a deformable member normally arranged in said bore and having a diameter normally greater than the diameter of said bore, and means formed by said cylindrical member on its upper end thereof narrowing said bore for retaining said deformable member in said bore, said deformable member being ejectable from said bore through its lower end by imposition of fluid pressure against said upper end and against the deformable member.

3. A device for introducing fluid into a well having a pipe string arranged therein which comprises a free, rigid cylindrical member having an open bore and having an outside diameter less than the inside diameter of said pipe string, said cylindrical member being adapted for insertion in and movement through said pipe string, a deformable sleeve fixedly attached to the outer surface of said cylindrical member and having an outside diameter less than the inside diameter of said pipe string, said sleeve being formed to provide vertically spaced apart protuberances on the outer surface of said sleeve for sealing engagement with the inner surface of said pipe string, a spherical deformable member normally arranged in said bore and having a diameter normally greater than the diameter of said bore, and means formed by said cylindrical member on its upper end thereof narrowing said bore for retaining said deformable member in said bore, said deformable member being ejectable from said bore through its lower end by imposition of fluid pressure against said upper end and against said deformable member.

4. A device for introducing fluid into a well having a pipe string arranged therein which comprises a tubular member adapted to be connected into and form part of

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said pipe string having first and second vertically spaced-apart seating means formed therein; a free adapter comprised of a rigid cylindrical member having an open bore and having an outside diameter less than the inside diameter of said pipe string and a deformable sleeve fixedly attached to the outer surface of said cylindrical member and having an outside diameter less than the inside diameter of said pipe string; said adapter being arranged removably in and movable through said pipe string; said sleeve being formed to provide protuberances on the outer surface of said sleeve for sealing engagement with the inner surface of said pipe string; a spherical deformable member normally arranged in said bore and having a diameter normally greater than the diameter of said bore; and means formed by said cylindrical member on its upper end thereof narrowing said bore for retaining said deformable member in said bore; said deformable member being ejectable from said bore through its lower end by imposition of fluid pressure against said upper end and against said deformable member; said adapter being seatable on said first seating means and said deformable member being seatable on said second seating means on ejection from said bore.

5. A device for introducing fluid into a well having arranged therein a hollow drill string carrying a drill bit on its lower end and provided with a fluid passage which comprises drill collars adapted to be connected into and form part of said drill string; a first seating shoulder formed on the upper end of said drill collars and a second seating shoulder adjacent the lower end of said drill collar restricting said fluid passage; a free adapter com-

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prised of a rigid cylindrical member having an open bore and having an outside diameter less than the inside diameter of said drill string and a deformable sleeve fixedly attached to the outer surface of said cylindrical member and having an outside diameter less than the inside diameter of said drill string; said adapter being arranged removably in and movable through said pipe string; said sleeve being formed to provide protuberances on the outer surface of said sleeve for sealing engagement with the inner surface of said drill string; a spherical deformable member normally arranged in said bore and having a diameter normally greater than the diameter of said bore; and means formed by said cylindrical member on its upper end thereof narrowing said bore for retaining said deformable member in said bore; said deformable member being ejectable from said bore through its lower end by imposition of fluid pressure against said upper end and against said deformable member; said adapter being seatable on said first seating shoulder and said deformable member being seatable on said second seating shoulder on ejection from said bore.

6. A device in accordance with claim 5 in which the diameter of the bore is the same as the inner diameter of the drill collars.

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