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DRILLING APPARATUS FOR LARGE WELL BORES

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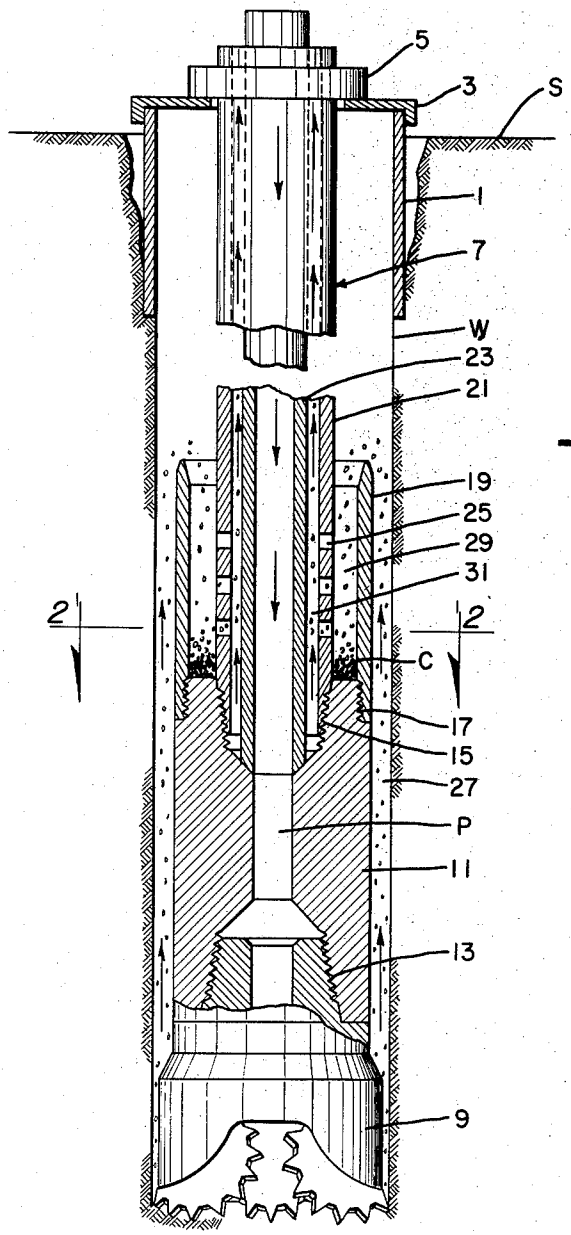


FIG. 1

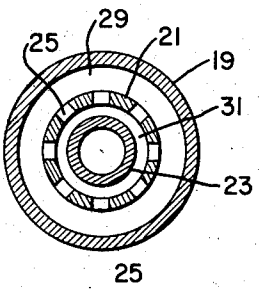


FIG. 2

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DRILLING APPARATUS FOR LARGE WELL BORES

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This invention relates to drilling apparatus and particularly to such apparatus primarily designed for drilling large well bores, such as bores five to ten feet in diameter.

The invention provides an improved drill string of the dual passage type formed by pipes or the like, in which circulating fluid is forced under desired pressure downwardly through a central passage to a drilling bit, the fluid functioning among other things to carry upon its return the cuttings to the well surface in the annulus between the pipes where fluid velocity remains sufficiently high. In past apparatus, due to the size of the well bore, the fluid during its return lost considerable velocity because of the enlarged space throughout most of the drill string length between the bore wall and the pipe string. This loss was to an extent that the cuttings would not be carried to the surface and to account for such it was necessary to provide as part of the drill string a basket for catching the cuttings, the latter of course requiring periodic emptying.

It is the primary object of this invention to provide drilling apparatus of the type described wherein the cuttings of the large well bore being drilled are returned to the surface continually by the circulating fluid and without the necessity of periodic raising of the drill string.

Another object is to provide such apparatus including a dual passage arrangement comprising inner and outer located generally tubular members having a small annulus therebetween wherein the cuttings are carried by the return fluid into the annulus and then due to the maintenance of sufficient fluid velocity to the surface.

A further object is to provide fluid drilling apparatus as mentioned in the foregoing paragraph wherein a basket is provided for accumulating the cuttings and directing them and the fluid flow into the annulus.

Other objects and advantages of the invention will become apparent upon considering the following detailed description in light of the accompanying drawing wherein a preferred embodiment is illustrated and wherein:

FIGURE 1 is an elevational view, partly in section, illustrating the apparatus of this invention; and

FIGURE 2 is a sectional view taken along the lines 2—2 of FIGURE 1.

Broadly, this invention is directed to drilling apparatus designed for drilling large diameter holes wherein means is provided for returning cuttings carried by the circulating fluid to the surface within the drill string as distinguished from within the annular space between the well bore and drill string wherein particularly high and often times unobtainable velocity of the fluid circulating source is needed to raise the cuttings to the surface. By providing the return in a relatively small annulus within the string, the normal velocity of the fluid remains sufficiently high instead of deteriorating due to the size of the well bore. Hereinafter, reference will be made to "air" or "gas" and such is intended to include either or both or other mediums containing mixtures of ingredients including gas or air. Reference will also be made to "fluid" and such is to be encompassing of such air or gas or liquids such as mud or water as well as mixtures including same as is common in the drilling industry.

Referring to the embodiment of the drawing, W represents a well bore being drilled from the surface S, said

bore being of large diameter. The drill string is generally shown at 7, this being secured at the surface in the usual manner to head 5 which abuts in sealed relationship the cap 3 on surface pipe 1. As will be explained, the cap is one way of causing back pressure to be created in the large area between the majority of the drill string and the bore wall W. String 7 comprises a dual passage arrangement formed of inner and outer concentric pipes or tubular members 21 and 23 suitably spaced to provide therebetween the relatively small annulus 31. Inner pipe 21 connects in the usual manner with a large drill collar 11 having a central passage P aligned with the bore of pipe 21 to form a central passage throughout the string. Connected in standard fashion to collar 11 at 13 is a large bit or reamer 9, the bit having, not shown, a plurality of passages to receive fluid under pressure from passage P, said passages functioning to properly direct fluid upon the formation to coact with the bit in drilling, all as is conventional in drilling. Similarly the entrained cutttings are carried by the return fluid towards the surface as shown by the upwardly directed arrows in annular space 27 between the bore W and drill string 7. It is noted that immediately above the collar 11, the space 27 greatly enlarges which is usually the case in drilling large bores of five foot diameter and greater and thus the return velocity of the fluid, which often has mixed therewith chemicals, greatly reduces in accordance with known velocity laws. Assuming that no cap 3 was provided but instead there was a return fluid path to the surface, the fluid referred to in the last sentence would undoubtedly not have sufficient velocity to carry the cuttings to the surface.

Due to the latter phenomena, the cuttings are not raised to the surface and to accumulate the cuttings which would otherwise eventually cause the drill pipe to become stuck, there usually is provided a calex type basket to catch the cuttings. However, this has proved unsatisfactory to the extent that it is necessary to frequently raise the drill string to the surface to empty the basket of cuttings and obviously such requires time and expense to say nothing of the difficulty in estimating when the basket is full and when the unloading should take place. The present invention is designed to overcome the latter problem.

Numeral 19 represents an annular basket upstanding from collar 11 and connected therewith at 17, the basket, as shown, forming a concentric relationship with pipe 21 to form the cuttings receiving area 29 and as illustrated in the drawing the cuttings C are elevated by the high fluid velocity within space 27 whereupon they accumulate within area 29 due to the greatly enlarged space between the bore W and string 7 and thus fluid velocity decreases. These cuttings build up in basket 19 as shown but to overcome the problem outlined, the present invention provides in the pipe 21 a plurality of openings or apertures 25. The latter may assume any reasonable number and they are provided in pipe 21 from adjacent the bottom to adjacent the top of basket 19 all in the desired spaced relation whereby communication results between area 29 and small annulus 31. Assuming there is back pressure caused by fluid above the basket which encourages flow to the annulus 31 and due to the size of the annulus, the fluid velocity therein is sufficient to carry the cuttings to the surface in the direction of the arrows shown within the annulus. In actual operation, the cuttings build up within the basket bottom as represented to approximately the elevation of the lowest aperture 25. Further build-up is prevented as the fluid carries the cuttings through the apertures 25 to the annulus 31 from whence they are conveyed to the surface. Thus, the drilling operation of the large bore W may be continued without interruption as there is no necessity to periodically empty basket 19 as the present invention in effect

results in rejuvenation or maintenance of the fluid velocity to an extent adequate to cause continual surface elevation of the cuttings C.

To function as just described there must be imprisonment of the fluid in a substantial part of space **27** between the basket and the surface or if no imprisonment, there must be a back pressure caused in some other manner, all for causing and/or encouraging the flow described through ports **25**, the basket aiding in directing and accumulating the cuttings. If a cap **3** is provided or equivalent means, it is clear how the back pressure would be created, such as with air or gas as the circulating means. Without a cap, the back pressure could be created by initially circulating with a heavy liquid such as mud and then circulating with a lighter fluid such as water with the mud built up in space **27** above basket **19** withstanding the pressure of the water having cuttings entrained therein and encouraging circulation thereof through annulus **31**.

From the foregoing, it will be seen that this invention is one well adapted to attain all of the ends and objects hereinafter set forth. As many possible embodiments may be made of the invention without departing from the spirit thereof, it is to be understood that the scope of the invention is only to be limited in accordance with the following claims. For example, it is not necessary that the pipes **21** and **23** be concentrically arranged as shown as long as a dual passage arrangement is provided.

What is claimed is:

1. In drilling apparatus for drilling a bore hole, in combination: a drill string having a hollow inner pipe serving as an inlet fluid passage, and an outer pipe concentric therewith and forming a first annulus with said inner pipe which serves as an outlet passage for fluid and drillings; a bit attached to said drill string; an open-ended basket mounted on said drill string concentrically with said outer pipe, with its open end a relatively short distance above said bit, and forming a second annulus with said outer pipe, and a third annulus with said bore hole, said outer pipe having openings in its section surrounded by said basket; and means for blocking pressure between the top of said basket and the top of said bore hole; whereby pressure may be introduced into said inner pipe to force borings up said third annulus into said basket and through said openings into said second annulus for delivery out of said bore hole.

2. Apparatus of claim 1 in which said blocking means is a sealing means over the top of said bore hole.

3. Apparatus of claim 1 in which said blocking means is drilling mud.

4. In drilling apparatus for drilling a bore hole, in combination: a drill string having a hollow inner pipe which serves as an inlet fluid passage, and an outer pipe concentric therewith and forming a first annulus with said inner pipe which serves as an outlet passage for fluid and drillings; a bit attached to said drill string; a collar mounted on said drill string above said bit; an open-ended basket mounted on said collar concentrically with said outer pipe with its open end a relatively short distance above said bit and forming a second annulus with said outer pipe and a third annulus with said bore hole, said outer pipe having openings in its section surrounded by said basket; a surface pipe seated in the top of said bore hole surrounding said drill string; a cap having a central opening seated on the top of said surface pipe in fluid tight relationship therewith; and a head member supporting said drill string seated over said central opening whereby pressure may be introduced into said inner pipe to build up in said third annulus between the bottom of said bore hole and said cap to force borings up said third annulus into said basket and through said openings into said second annulus for delivery out of said bore hole.

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