April 29, 1952 W. A. STOKESBARY 2,595,018

DRILLING SUB FOR SIDEWALL SAMPLERS

Filed July 31, 1950

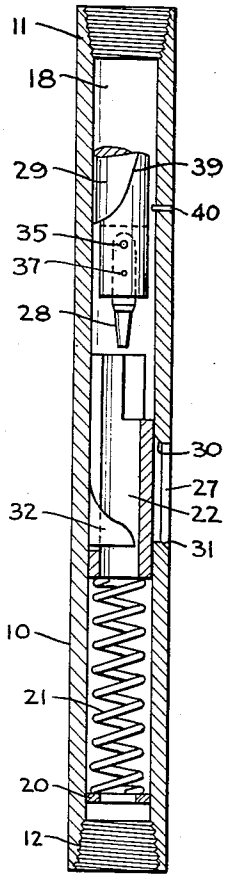


FIG. 1

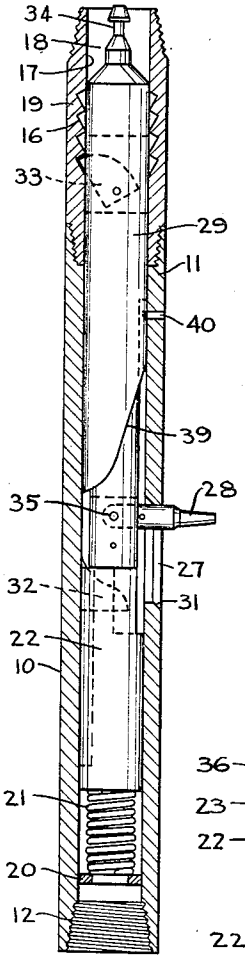


FIG. 2

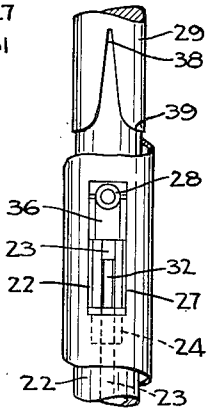


FIG. 5

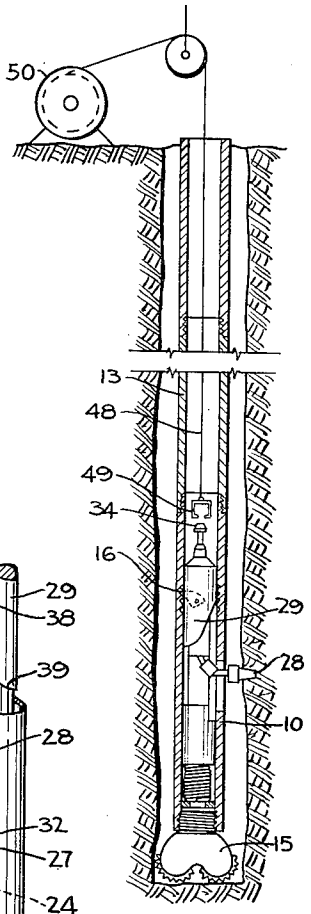


FIG. 4

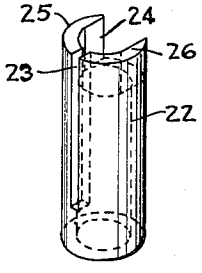


FIG. 3

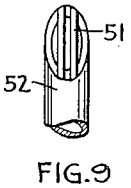


FIG. 9

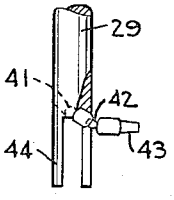


FIG. 6

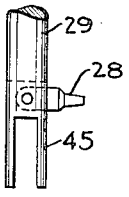


FIG. 7

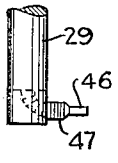


FIG. 8

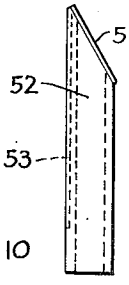


FIG. 10

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UNITED STATES PATENT OFFICE

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DRILLING SUB FOR SIDEWALL SAMPLERS

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Application July 31, 1950, Serial No. 176,814

7 Claims. (Cl. 255—1.4)

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This invention relates to the art of sampling underground formations during rotary drilling operations and pertains more particularly to apparatus carried by a drill string for causing or permitting a sidewall sampler, lowered within the drill string, to contact or engage the wall of a well borehole.

During the drilling of an oil well it is often desirable to obtain samples of the underground formations as the drilling progresses. Preferably, these samples are obtained without going through the time-consuming operation of removing the drill string and bit from the borehole before running special sampling apparatus into the borehole. Thus, it is a common practice to provide the drill string with a special sub, collar, or section of pipe having a suitable port in the wall thereof, whereby a retractable sampler may be lowered through the drill string and extend through said port to engage the borehole wall.

The special subs, which are presently used in drilling operations and are adapted to accommodate a sampling device, are generally provided with two conduits. One conduit accommodates the sampling device and communicates with the borehole through a side port, while the second conduit by-passes the side port, so that drilling fluid may be pumped to the drill bit. The main drawback with these special sampling subs is that the first conduit must be closed by a plug when normal drilling is being carried on and the sampling device is not being used. This necessitates the removal of the plug each time before a sample may be taken, said removal being a time-consuming operation.

It is a primary object of this invention to provide a special sampling sub adapted to be connected into a drill string, said sampling sub having a normally closed port through the wall thereof, said port being adapted to be opened by a sampling device lowered through the drill string, whereby the sampling device may engage the borehole wall.

Another object of this invention is to provide a special sub adapted to receive a sampling device for securing samples of the drill formation without necessitating the removal of the drill string and bit from the borehole.

A further object of this invention is to provide a drill string with a sampling sub adapted to receive and latch therein, in sample-taking position, a sidewall sampler, the taking of the desired samples from a penetrated formation being effected by movement of the drill string when the sampler is latched in position.

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Another object of the present invention is to provide a sampling sub having port means in the wall thereof, said port means being adapted to close automatically after a sampling device has been removed from the sub.

These and other objects of this invention will be understood from the following description taken with reference to the attached drawings, wherein:

Figure 1 is a longitudinal view, partly in cross section, of the present sampling sub showing a sampling device entering the top of the sub.

Figure 2 is a longitudinal view, partly in cross section, of the present sampling sub with a sampling device operatively positioned therein.

Figure 3 is an isometric view of the slidable sleeve which is carried within the sampling sub.

Figure 4 illustrates the present sampling sub connected into a drill string and positioned within a well borehole.

Figure 5 is a partial side view taken at right angles to Figure 2.

Figures 6, 7 and 8 illustrate different methods of securing a core barrel to a sampling apparatus.

Figures 9 and 10 are longitudinal front and side views of another embodiment of a sleeve to be mounted within the sub of Figure 1.

Referring to Figures 1 and 2 of the drawing, the present sidewall sampling sub comprises an elongated tubular member 10 threaded at its upper and lower ends 11 and 12, respectively, whereby the upper end 11 may be threadedly connected to a drill string 13, as shown in Figure 4, and the lower end may be connected to another section of drill string or to a bit 15.

A plurality of annular grooves or recesses 16 are provided in the inner surface or wall 17 of the tubular member 10 below the upper end 11 thereof (Figures 2 and 4). The grooves 16 are preferably given a V-shape, as shown in Figure 2. While the grooves 16 may be formed in the inner wall of the tubular sub 10 as shown in Figure 4, they are preferably formed in a special tubular member or latch sub 19 adapted to be threadedly connected to the upper end 11 of the sub 10, as shown in Figure 2.

Fixedly secured, as by welding, to the inner wall near the lower end 12 of the tubular member 10 is a ring 20, or other suitable means, for anchoring a compression spring 21 above it within the bore 18 of said member 10. The upper end of the spring bears against the lower

end of a tubular sleeve 22 mounted for sliding movement within the bore 18 of the tubular sub 10.

As shown in Figure 3, the sleeve 22 has two longitudinal slots 23 and 24 cut therein from the upper end toward the lower end thereof, forming two upstanding arms 25 and 26 at the upper end. One slot 23 is long and narrow and serve as a guide slot, extending substantially the total length of the sleeve. The other slot 24 is shorter than slot 23 with the width of slot 24 being about equal to the inner diameter of the sleeve 22.

The tubular member 10 is provided with a longitudinal slot or port 27 through the wall thereof, preferably near the lower end 12. The width of the slot 27 is sufficient to accommodate a sample tube, or core barrel or shoe 28, of a sidewall sampler 29 adapted to be lowered within the bore 18 of the tubular member 10. The length of the slot 27 is great enough to permit the sample tube 28 to project outwardly through said slot 27 to a horizontal position, as shown in Figure 2. To facilitate the passage of the tube 28 through the slot 27, the wall of the tubular member 10 may be beveled inwardly along the top of the slot 27 and outwardly along the bottom thereof, as shown at 30 and 31, respectively.

Fixedly secured to the inner wall of the tubular member 10 directly opposite the slot 27 is a deflector bracket or guide plate 32 extending inwardly substantially across the bore 18. With the slidable sleeve 22 positioned so that it effectively closes the slot 27, the deflector bracket 32 extends through the guide slot 23 of the sleeve 22 substantially to the opposite inner wall of the sleeve as shown in Figure 1. The deflector bracket 32 thus serves the twofold purpose of orienting the sleeve 22 so that the larger slot 24 therein is always axially aligned with the longitudinal port 27 in the wall of the tubular member 10, and also of deflecting the barrel 28 of the sampler 29 through the slot 27.

The expanded length of the compression spring 21 is greater than the distance from its holding ring 20 to the lower end of the sleeve 22 when it closes the slot 27, as shown in Figure 1. Thus, there is always a positive spring action applied to the bottom of the sleeve 22 tending to force it upwardly against the bracket 32 which serves as the limiting stop of the upward movement of the sleeve. The slidable sleeve 22 has a greater length than the longitudinal port 27 which it is adapted to close. The length of the slot 27 is determined by the length of the sampler barrel 28 to be deflected therethrough. Likewise, the distance from the slot 27 and the annular grooves 16 near the top of the tubular member 10 is dependent upon the distance between the sample barrel 28 of the sidewall sampler 29 and a latching device 33 carried thereby, said latching device 33 being adapted to engage the grooves 17 in a manner well known to the art.

The inner diameter of the tubular member 10 is sufficient to accommodate any of the many conventional types of sidewall samplers or coring devices. Since these devices are well known to the art and do not in themselves form part of the present invention, they will not be described in detail. For purposes of illustration, the operation of the present sampling sub will be described with regard to the taking of a sample with the sidewall sampling device 29.

As shown in Figures 2 and 4, the top of the

sampling device 29 is provided with a conventional fishing neck 34 suitably connected to trip the latching means 33 when an upward force is applied to said neck 34. Since latching devices 33 of the type presently used are well known to the art of wire-line well apparatus, they will not be further described at this time. The sample barrel 28 may be connected to the sampler body 29 for angular displacement with regard to the axis thereof in any of several different ways. As shown in Figures 1 and 2, the barrel 28 is pivotally mounted on the lower end of the sampler body 29 by a pin 35 whereby the barrel 28 may be pivoted in a slot 36 (Figure 5) in the lower end of said body and slot 27 of the sub to a horizontal position as shown in Figure 2. Preferably, when the sampler is being run into a well, the barrel 28 is fixedly positioned with regard to the sampler body 29 by a shear pin 37 (Figure 1) which passes through the wall of both the barrel 28 and the sampler body 29. The pin 37 is sheared when the barrel 28 contacts the deflector bracket 32.

Since the above-described sampler 29 is equipped with a hinged-type core barrel 28, it is necessary that it be provided with suitable orienting means whereby the sampler 29 is properly aligned when it enters the special sub 10 so that the barrel 28, when actuated, will be flexed outward through the slot 27. Thus, as shown in Figure 5, the body or mandrel of the sampler 29 is provided with a longitudinal slot 38 from which diverging shoulders 39 slant downwardly around the body. An alignment pin or guide key 40 (Figure 1) is fixedly mounted in the sub body 10 so as to project into the bore 18 thereof. As the sampler 29 is lowered into the special sampling sub, the projecting pin 40 will engage the shoulder 39 at one point. Thereupon, the pin 40 will ride up the shoulder 39 and cause the sampler 29 to rotate in the bore of the sub 10 until the pin 40 and the slot 38 are in vertical alignment. Since the pin 40 and slot 27 as well as slots 36 and 38 are vertically aligned, the core barrel 28 will always be forced into register with slot 27.

Instead of hinging the core barrel 28 to the sampler 29 by a pin 35, two or more ball and socket joints 41 and 42 may be employed, as shown in Figure 6. A core barrel mounted in this manner is particularly desirable in that it is adapted to swing in any direction and hence no orienting means need be provided to align the sampler 29 properly within the sub 10. Upon striking the deflector bracket 32 (Figure 2), the barrel 43 of the embodiment shown in Figure 6 would be automatically deflected out the longitudinal slot 27. In this embodiment the bottom of the sampler is provided with one or more downwardly extending narrow pins 44 which are adapted to contact the top of the sleeve 22 of the sub 10 and force it downward, thus opening the slot 27.

While the sleeve 22 of the sampling sub 10 is preferably provided with a large slot 24 so as to permit a sampler barrel 28 to be deflected outwards through slots 24 and 27 by the deflector bracket 32, it will be seen that no slot 24 need be provided in the sleeve when the lower end of the sampler is provided with one or more relatively long downwardly-extending pins or arms 45, as illustrated in Figure 7. In this embodiment, the arms 45 are longer than the core barrel 28 and move the sleeve 22 of the sub down-

ward to open the slot 27 before the barrel 28 contacts the deflector bracket 32.

In the embodiment of Figure 8, another core barrel 46 is shown as being secured to the lower end of the sampler 29 by universal joint means comprising a flexible metallic sheath 47 which may be covered or lined with rubber or any other suitable material, if desired.

During drilling operations, the drill string 13 (Figure 4) may be made up with the present special sampling sub 10 suitably connected therein. The tubular slidable sleeve 22 is maintained in its uppermost position by the spring 21 (Figure 1) the sleeve 22 acting as a valve closure member to close the slot or side door 27 in the sub 10. Thus, drilling fluid which is pumped down through the drill string 13 passes through the sampling sub 10 and tubular sleeve 22 thereof, and out through the bit 15.

When, in the course of drilling operations, it is desired to take core samples of the formation (or fluid samples therefrom), circulation of drilling mud through the drill string 13 is stopped and a sidewall sampling device 29 is either dropped or lowered on a wire line 48 (Figure 4) through the drill string 13 and into the special sub 10. As the sampler 29 moves downward through the sub 10 (as shown in Figure 1), the lower end of the sampler 29 contacts the upper end of the slidable sleeve 22 forcing it downward against the action of the spring 21 and opening the slot 26 in the wall of the sub 10.

Simultaneously, the alignment pin 40 strikes one of the converging shoulders 39, sliding along said shoulder and into the slot 38 to align the sampler 29 properly with regard to the slot 27 in the sub 10. The sampler 29 and sleeve 22 continue their downward travel until the core barrel 28 at the lower end of the sampler 29 strikes the inclined upper surface of the deflector bracket 32. The weight of the sampler 29 bearing against the deflector bracket 32 shears the pin 37 and the core barrel 28 moves outwardly through the slot 27 in the wall of the sub 10 so that the core barrel 28 is forced into engagement with the formation traversed by the borehole.

At the same time the latching member 33 is free to swing to one side into engagement with one of the notches 16. After the latch 33 has swung into position, the sampler 29 is held securely within the bore 18 of the sub 10 by the action of the latch 33 and the engagement of the bottom of the sampler 29 on the top of the depressed spring-loaded sleeve 22, as illustrated in Figure 2.

The drill string 13 (Figure 4) carrying the sampling sub 10 is then lowered further into the borehole, thereby forcing the core barrel 28 to penetrate the formation in a horizontal position as shown in Figure 4. The subsequent raising of the drill string 13 causes the core barrel 28 to be withdrawn, along with its sample, from the well formation. A fishing tool 49, carried on the end of a cable 48, may be then utilized to engage the fishing neck 34. The latching member 16, being operatively connected to said neck 34, may be released by an upward pull on said neck 34. After the latch 16 has been disengaged, the sampler may be withdrawn from the sub 10 and drill string 13 by suitable hoisting apparatus 50 positioned at the well head. As the sampler 29 is removed from the sub, the action of the spring 21 returns the slidable sleeve 22 to its normal raised position thus closing the slot 27 in the wall of the sub. Circulation of fluid may be then resumed with the fluid flowing through the drill string 13 and sub 10 and out through the bit 15.

Obviously, by these operations and with the present sampling sub connected in a drill string, samples may be taken at any desired time or point during drilling operations. Also, if desired, samples may be taken of the various formations and strata through which the drill string has already passed. For example, when the drill string is being run into or withdrawn from the borehole, the string may be suspended at successive 100 ft. intervals while a sampler is lowered through the string and into the special sub 10 to obtain a sample of earth or fluid from the adjacent formation.

While the deflector bracket 32 carried within the present sub 10 is described as being fixedly secured to the inner wall of said sub 10, it is to be realized that other deflector means may be employed. For example, as shown in Figures 9 and 10, the deflector means may comprise one or more downwardly sloping bar members 51 fixedly secured across the top of a slidable sleeve 52 carried within the sub 10, said sleeve 52 corresponding to sleeve 22 of Figure 1. Preferably, the top of the sleeve 52 is beveled at an angle as shown in Figure 10. The sleeve is also provided with a longitudinal keyway 53 adapted to receive a key (not shown), said key being similar to alignment pin 40 and mounted on the inner surface of the sub 10 opposite the sleeve 52 in a similar manner. Thus, the deflector bars 51 would always be positioned to deflect the core barrel 28 through the slot 27. As a sampler 29 enters a sub 10 provided with the sleeve 52, the core barrel 28 at the lower end of the sampler strikes the bars 51 and is deflected toward the slot 27 as the pin 37 is sheared. Simultaneously, the sleeve 52 is forced downward, opening the slot 27 to allow the core barrel 28 to swing outward therefrom in a manner previously described. With the sampling device 29 withdrawn from the sub 10, the spring 21 will raise the sleeve 22 to its raised position. Fluid being pumped through the drill string 13 will flow around the deflector bar or bars 51, through the sleeve 22 and sub 10, and out the bit 15.

From the above description, it is apparent that other changes and modifications may be made in the various elements of the present sidewall sampling sub without departing from the principles taught herein.

I claim as my invention:

1. A sub adapted to be connected into a pipe string, said sub comprising a tubular member having a longitudinal opening in the wall thereof, valve means carried within said tubular member for closing said opening, spring means for maintaining said valve means in a normally closed position, and deflector means carried within said tubular member in alignment with the opening therein, said deflector means extending into the bore of said tubular member, said tubular member being axially open to the flow of fluid circulating through the pipe string.

2. A sub adapted to be connected into a pipe string, said sub comprising an elongated tubular member having a longitudinal opening in the wall thereof, tubular sleeve means slidably mounted in the bore of said tubular member, spring means supported within the bore of said tubular member and normally urging said sleeve means to a position closing said opening, and deflector means affixed to wall of said bore of the tubular member opposite said opening and in alignment there-

with, said deflector means extending diametrically across a major portion of the bore of said tubular valve means, the bore of said tubular member being axially open to the flow of the fluid circulating in the pipe string.

3. A sub adapted to be connected in a pipe string and lowered into a well borehole, said sub being adapted to receive a sidewall sampling device which is lowered through said pipe string and into said sub, said sampling device having latching means mounted thereon and carrying a deflectable downwardly-extending sample barrel at its lower end, said sub comprising an elongated tubular member threaded at its upper and lower ends for connection into said pipe string, said tubular member having a longitudinal opening in the wall thereof in communication between the outside and the bore of said tubular member, a sleeve slidably mounted within the tubular member for normally closing said opening, a longitudinal slot in said sleeve extending over the major portion thereof, a coil spring in the bore of said tubular member below said sleeve, the lower end of said spring being anchored in said tubular member, and a deflector bracket affixed to the inner wall of said tubular member opposite the lower end of the opening in the tubular member, said bracket sloping downwardly and extending through the slot in said sleeve and diametrically across the major portion of the bore of said sleeve.

4. A device for sampling well boreholes comprising in combination a pipe string, a sub connected into said pipe string and a sidewall sampling device adapted to be lowered through said pipe string into said sub, said sampling device being provided with outwardly-extending latching means and carrying a downwardly-extending, sideways-deflectable sample barrel, said sub comprising an elongated tubular member threaded at the upper and lower ends for connection into the pipe string, said tubular member having a longitudinal opening in the wall thereof, a sleeve having a longitudinal slot extending along the major portion thereof, said sleeve being slidably mounted within said tubular member, a coil spring mounted for axial movement within the bore of said tubular member for normally positioning the slidable sleeve to close said opening, the lower end of said sampling device being adapted to bear against the top of said sleeve whereby the weight of said sampling device forces said sleeve below said opening, a deflector bracket affixed to the inner wall of said tubular member opposite the lower end of the opening in said member, said bracket sloping downwardly and extending through the slot in said sleeve and diametrically across the major portion of the bore of said sleeve, at least one annular groove in the inner wall of said tubular member above said opening to receive the latching means of said sampling device, and cooperating orienting means in the bore of said tubular member and on said sampling device to guide said device to a predetermined position within the bore so that the sample barrel moves outwardly over the deflector bracket and out the opening in the tubular member.

5. For use in sidewall coring operations wherein a sidewall coring device is lowered into a drill string, a tubular sub member adapted to be connected into said drill string, said tubular member having an axially extending window in communication between the outside and the bore of said tubular member, deflector plate means affixed to the wall of said bore approximately at the level of said window and extending well into said bore along an axial plane passing through the longitudinal center line of said window, retainer means affixed to the walls of said bore below said window, coil spring means supported thereon within the bore portion between said retainer means and said window, a tubular sleeve member slidably fitting within said bore supported by said spring, said tubular sleeve having first longitudinal slot means extending from the upper end to substantially the lower end thereof, said plate deflector means extending slidably through said slot means into the space within said sleeve, and second longitudinal slot means diametrically opposite said first slot means, said second means extending longitudinally through the upper portion only of said sleeve means and having a width substantially equal to that of said window means, the wall of said sleeve below said second slot having an axial length in excess of that of said window, whereby said window is closed by said sleeve when said sleeve is supported by said spring in its normally expanded state, and is opened through said second slot means when said spring is compressed by the application of a weight to the sleeve supported thereon.

6. A device for sampling well boreholes comprising in combination a pipe string, a sub connected into said pipe string and a sidewall sampling device adapted to be lowered through said pipe string into said sub, said sampling device being provided with outwardly-extending latching means and carrying a downwardly-extending, sideways-deflectable sample barrel, said sub comprising a tubular sub member adapted to be connected into said drill string, said tubular member having an axially extending window in communication between the outside and the bore of said tubular member, deflector plate means affixed to the wall of said bore approximately at the level of said window and extending well into said bore along an axial plane passing through the longitudinal center line of said window, retainer means affixed to the walls of said bore below said window, coil spring means supported thereon within the bore portion between said retainer means and said window, a tubular sleeve member slidably fitting within said bore supported by said spring, said tubular sleeve having first longitudinal slot means extending from the upper end to substantially the lower end thereof, said plate deflector means extending slidably through said slot means into the space within said sleeve, and second longitudinal slot means diametrically opposite said first slot means, said second means extending longitudinally through the upper portion only of said sleeve means and having a width substantially equal to that of said window means, the wall of said sleeve below said second slot having an axial length in excess of that of said window, whereby said window is closed by said sleeve when said sleeve is supported by said spring in its normally expanded state, and is opened through said second slot means when said sleeve is depressed downwardly and said spring is compressed by the weight of said sampling device bearing against the top of said sleeve.

7. A sub adapted to be connected in a pipe string and lowered into a well borehole, said sub being adapted to receive a sidewall sampling device which is lowered through said pipe string and into said sub, said sampling device having latching means and carrying downwardly-extending, sideways-deflectable sample barrel at its lower end, said sub comprising an elongated tubu-

lar member threaded at its upper and lower ends for connection into said pipe string, said tubular member having a longitudinal opening in the wall thereof, a sleeve slidably mounted within the tubular member for normally closing said opening, a compression spring in the bore of said tubular member below said sleeve, the lower end of said spring being anchored in said tubular member, and a downwardly-sloping deflector bracket affixed diametrically across the top of said sleeve for deflecting the sample barrel of said sampling device through the longitudinal opening in said tubular member as said sleeve is depressed.

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