May 30, 1967

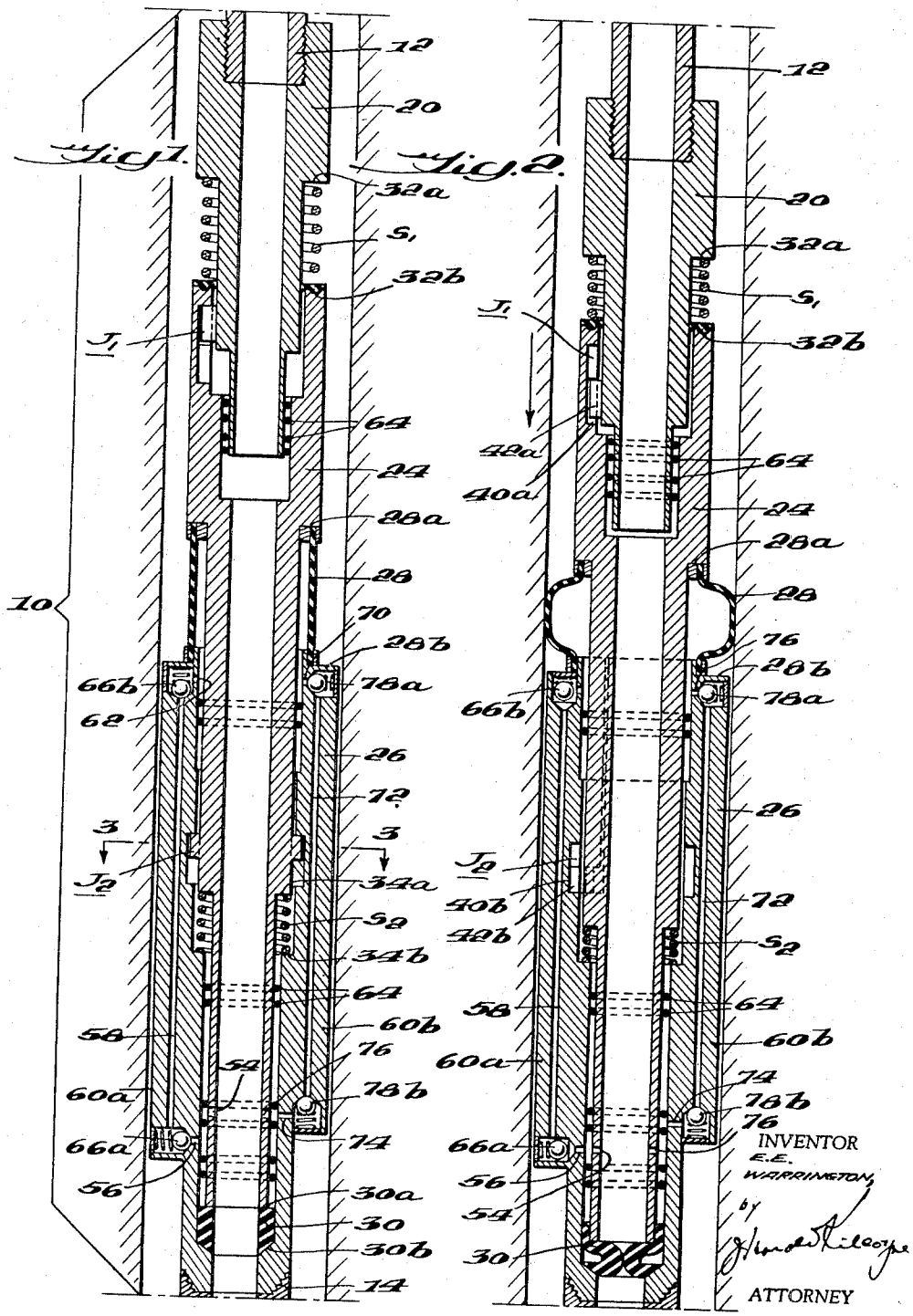
E. E. WARRINGTON

3,322,215

ART OF WELL DRILLING

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ART OF WELL DRILLING

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Fig. 3.

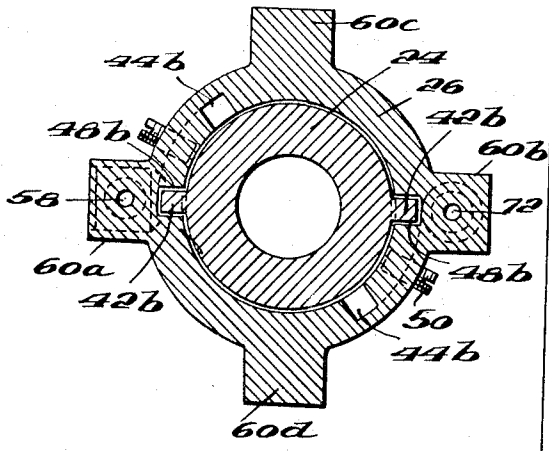


Fig. 4.

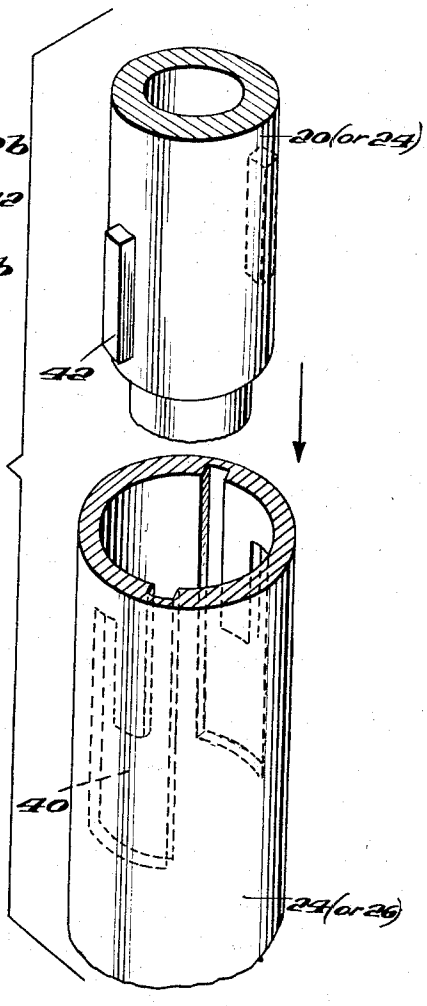


Fig. 5.

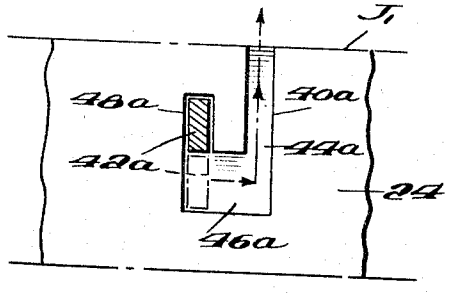
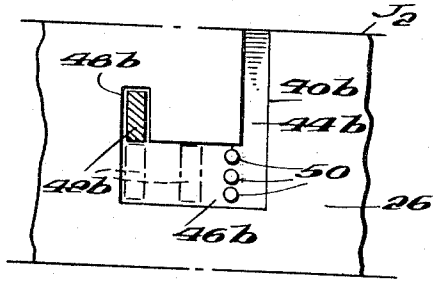


Fig. 6.



INVENTOR

E. E. WARRINGTON,

BY J. Harold Kilcoyne

ATTORNEY

United States Patent Office 3,322,215 Patented May 30, 1967

3,322,215

ART OF WELL DRILLING

Elbert E. Warrington, 9862 Meadowdale St., Baton Rouge, La. 70811

Filed Aug. 8, 1966, Ser. No. 574,876
11 Claims. (Cl. 175—72)

This application is a continuation-in-part of my co-pending application Ser. No. 306,799, filed Sept. 5, 1963, now Patent No. 3,283,823.

This invention relates to improvements in the art of well drilling, and is more particularly directed to an improved method of controlling abnormal formation pressures encountered during well drilling operations of the type wherein a drilling fluid is forced down the drill-string to the drill bit and up the annulus to the surface.

It is generally acknowledged in the oil and gas industry that a long standing problem therein has been the lack of a simple procedure for preventing incursion of high-pressure formation fluids into the drill-string bore during drilling, as can and in many cases does result in well blow-out, and/or for preventing loss of drilling fluids being circulated through the well hole to low-pressure formations similarly encountered during drilling. Previously, this problem had been solved only through resort to procedures involving the use of on-the-surface control means which required for their operation highly skilled personnel not always available in the field.

Furthermore, the aforementioned surface control means, being restricted to surface closures or restrictions to flow, required imposed back pressure to be applied to the entire hole from top to bottom, thus subjecting certain low-pressure formations to fracturing and resulting in loss of drilling fluid. Moreover, experience has taught that it is substantially impossible through the use of existing surface control means to insure that contaminating inflow from a high-pressure formation is completely stopped while a controlling fluid (drilling mud) of different density is being pumped in to displace the contaminated drilling fluid, unless an excessive and hence dangerous back pressure is held at the surface while making the required transition in drilling fluid density. Thus, while the cautious approach to killing a well with conventional surface controls is possible when high- or low-pressure formations are encountered during drilling, such can require several complete circulations of drilling fluid, with much loss of valuable rig time and the contamination and loss of many thousands of dollars worth of drilling fluid.

Stated broadly, a major object of the invention is the provision of a simple, practical and effective method for controlling abnormal pressure conditions encountered during well drilling operations of the type wherein the drilling fluid is forced down the drill string and up the annulus between said drill string and well-hole wall to the surface.

Another object of the invention is the provision of a method as aforesaid, which is capable of exercising its primary control function at or near the point or level of the well hole at which the abnormal pressure condition is encountered, and in manner as to isolate the upper portion of the hole from said condition.

Yet another object of the invention is the provision of a method as aforesaid which does away with the requirement of imposing dangerously high back pressures from surface means to the entire hole from top to bottom.

Yet another object of the invention is the provision of a method as aforesaid which is not only readily available to, but further is of a character that it can be put into operation immediately upon detection of incipient drilling-fluid circulation trouble by, the regular drilling crew.

Exemplary apparatus for carrying out the method of the invention is shown in the accompanying drawings, wherein.

FIG. 1 is an elevational view, in section, of down-hole well close-off means shown to be connected in a drill string at a location assumed to be adjacent the bottom hole assembly which includes the drill bit, the view illustrating the parts of said close-off means in their normal inoperative positions and/or relationships;

FIG. 2 is a similar view but illustrating said parts in their respective well close-off or shutting-in positions;

FIG. 3 is a transverse section taken on line 3—3 of FIG. 2;

FIG. 4 is a fragmentary exploded view of the packer mandrel-sleeve members of the close means, which further illustrates typical J-joint means effective therebetween;

FIGS. 5 and 6 are diagrammatic views illustrating the manner of operation of the respective upper and lower J-joints as aforesaid.

Referring to the drawings in greater detail, reference numeral 10 generally designates a down-hole well close-off means assumed to be connected at its upper end to the lower end of the lowermost section of a drill string 12, and at its lower end either directly or via an interposed collar to the upper end of the bottom-hole assembly indicated at 14 and which conventionally mounts a drill point or bit (not shown) normally working on the bottom of the hole. In normal operation, drilling fluid (hereinafter referred to, for simplicity, as a "drilling mud" or "mud") is forced by a mud pump on the surface downwardly through a bore in the drill string 12 and a communicating bore in said close-off means to the drill bit, and thence to and upwardly through the annulus between the outer surface of said drill string and the wall of the well hole back to said pump.

From its upper end downwardly, said well close-off means illustratively comprises the following: an upper tubular coupling section 20 connected at its upper end by mating threads to the lower end of the drill string 12 so as to depend downwardly in fixed axial relation therefrom; a coaxially and telescopically related tubular packer mandrel 24 depending from the upper coupling section and being drivingly and separably connected thereto by upper joint means generally designted J_1 to be later described in detail; a sleeve 26 disposed in encircling relation about the lower end portion of the packer mandrel for the major portion of its length and depending a small distance downwardly therefrom and being drivingly and non-separably connected to said mandrel by lower joint means designated J_2, also to be later described in detail; an external, radially outwardly distensible or inflatable sleeve-form upper packer 28 supported by at least the sleeve 26 and being disposed about the middle length position of the packer mandrel in position to be acted upon, i.e. relaxed or slackened, by opposed external shoulders 28*a*, 28*b* on the mandrel 24 and sleeve 26, respectively; and an internal, radially inwardly deformable sleeve-form lower packer 30 which normally defines a portion of the common bore extending through the mandrel 24 and the lower end of said sleeve and which is positioned so as to be axially compressed between a downwardly facing shoulder 30*a* defined by the lower end edge of the mandrel and an opposed, upwardly facing, lower level internal shoulder 30*b* formed in the bore of said sleeve 26.

Heavy coil springs S_1 and S_2 interposed respectively between a downwardly facing external shoulder 32*a* on the upper end of the coupling section 20 and the opposed upper-end edge 32*b* of the mandrel 24 and between opposed (external) mandrel and (internal) sleeve shoulders

34*a*, 34*b* located within the axial length of the sleeve 26 are provided as shown. Said springs, which are effectively reactive between the drill string 12 (whose weight is normally supported from the surface) and the bottom-hole assembly 14 including the drill bit, serve the plural functions of locking the J-joints J_1 and J_2 in their normal locked and drive-transmitting positions, of biasing the drill bit against the bottom of the hole with light pressure which can be controlled from the surface, and of normally maintaining the packers 28 and 30 in their respective non-distended and non-deformed conditions in which they are illustrated in FIG. 1.

During normal drilling, the J-joints J_1 and J_2 provide rotary drive connections first between the drill string 12 and the packer mandrel 24 via the coupling section 20 and thence between said packer mandrel and the bottom hole assembly 14 via the sleeve 26. More particularly, and referring to FIG. 4, each of said J-joints illustratively comprises an inwardly opening J-slot 40 and a driving key or lug 42 operating therein as will be explained in detail, the slot 40*a* of the upper joint (FIG. 5) being provided in the upper end portion of the bore wall surface of the packer mandrel 24 into which the lower end of the coupling section 20 depends and its companion driving key 42*a* being formed on and projecting from the peripheral surface of said lower end, and the slot 40*b* of the lower joint J_2 (FIG. 6) being provided in the bore-wall surface of the upper end portion of the mandrel-encircling sleeve 26 and its companion driving key 42*b* being formed on and projecting from the peripheral surface of the mandrel-length portion facing said slot 40*b*.

As seen in FIG. 5, the J-slot 40*a* of the upper joint J_1 has a long vertical leg 44*a* of width slightly greater than that of the key or lug 42*a* and which opens through the upper end edge of the packer mandrel 24 and connects at its lower end with a cross leg 46*a* whose vertical dimension slightly exceeds that of said key or lug, and a short vertical leg 48*a* having height and width substantially equalling the length and width of said key 42*a* and which extends upwardly from the end of the cross leg 46*a* opposite that into which the long leg 44*a* connects. Normally, the key 42*a* seats within the short leg 48*a* (as in FIG. 5), wherein it is maintained by the bias of the upper spring S_1, and thus in such position the key functions as a positive drive connection between the drill string 12 and mandrel 24 via the coupling section 20. It will be seen, however, that lowering of the drill string and coupling section will effect corresponding lowering of the driving key 42*a* to a neutral position within the slot cross-leg 46*a*, indicated in broken lines. Thereupon limited rotation of the drill string 12 and attached coupling section 20 in counterclockwise direction with respect to the mandrel 24 is possible, and upon so rotating the drill string the proper amount as to bring said driving key 42*a* into alignment with the long leg 44*a* of the slot, the drill string and upper coupling section may be physically raised from said mandrel and thereby separated from said mandrel. Conversely, the drill string and upper coupling section may be coupled to and drivingly connected to the mandrel 24 by lowering the former on to the mandrel in proper angular position with respect thereto as permits the driving key 42*a* to enter the open-top long leg 44*a* of the slot 40*a*, then rotating the drill string in clockwise direction the amount necessary to bring the driving key into alignment with the short leg 48*a* of the slot, and finally releasing the parts for relative separating movement under the bias of the spring S_1, whereupon the driving key will reseat itself in said slot leg 48*a*.

Referring to FIG. 6, the slot 40*b* of the lower joint J_2 is similarly formed with a long open-top vertical leg 44*b*, a cross leg 46*b* and a short vertical leg 48*b*. The driving key or lug 42*b* is normally seated in driving position in the short leg 48*b* under the bias of the lower spring S_2, but is lowerable to a neutral position indicated by broken lines. While in this neutral position, the driving key 42*b* may move relatively to the right with rotary motion of the mandrel 24 in counterclockwise direction but it is not permitted to move to a position into alignment with the long vertical leg 44*b* of the J-slot 40*b* (as could result in vertical separation of mandrel 24 from sleeve 26), by means such as set screws 50 threaded inwardly through the wall of the sleeve 26 to extend well into the cross leg 46*b* of said slot adjacent the end thereof with which the long vertical leg 44*b* thereof connects, the set screws thus serving to bar entry of the key 42*b* into the said slot leg 44*b*. However, the J configuration of the slot 40*b* serves the useful purpose of permitting initial entry of the key 42*b* thereinto.

The aforesaid lowering of the driving keys 42*a*, 42*b* from their driving to their so-called neutral position as described above is effected by "setting the drill bit on bottom," that is, permitting the drill string to lower on to the bottom hole assembly against the resistance of the aforesaid springs S_1 and S_2 by an amount which by design is such that the springs compress approximately the vertical distance that said keys move in partaking of movement between their driving and neutral positions. Responsive to the drill bit being "set on bottom" as aforesaid, plural results are attained in addition to driving key movement as aforesaid. Firstly, the upper pressure packer 28 is readied for distension. Secondly, the lower or deformable packer 30 functioning as a full opening bore-closing means is compressed in axial direction between the aforesaid shoulders 30*a*, 30*b* and thereby deformed inwardly to a position in which it effectively closes the lower end of the bore extending through mandrel 24 and sleeve 26, thus preventing external pressure or contamination from entering the bore from its lower end and interrupting normal drilling mud flow. Finally, lowering of the mandrel 24 with respect to the sleeve results in the drilling mud from the bore flowing to the inner side of the distensible packer 28 under the pressure requisite to effect distension thereof and in the sealing off of the annular space between the close-off assembly 10 and the wall of the hole being drilled, thereby temporarily "shutting-in" the well.

To achieve packer distension as aforesaid, there is provided adjacent the lower end of the packer mandrel 24 a port 54 (FIGS. 1 and 2) connecting the bore and an annular space between the lower end of said mandrel and the lower end of the sleeve. Also communicating with said annular space is a port 56 connecting to the lower end of a longitudinal, upwardly extending passage 58 provided in a longitudinal rib 60*a* projecting radially from the sleeve 26, said passage connecting at its upper end to a port 62 in the upper end of said sleeve, in turn communicating with an annular space provided between said upper end and the packer mandrel 24 and which opens to the inner side of the packer 28.

In the normal axial position of the mandrel 24 (FIG. 1), the port 54 is closed off from the port 56 and passage 58 by one or more of the plurality of O-rings 64 operating in said annular space between the lower end of the mandrel and said sleeve (and also in the annular space between the upper end of the mandrel and the lower end of the coupling section 20) and said passage 58 is normally maintained closed at both ends by lower and upper check valves 66*a*, 66*b* which are set to open only upon the occurrence of a predetermined pressure of drilling mud acting on their relatively bore sides. However, upon the mandrel 24 lowering with respect to the sleeve 26 as aforesaid, the port 54 is lowered a corresponding amount which by design is such as to establish full communication between the ports 54 and 56, whereupon drilling mud flows at said predetermined pressure (which is of course sufficient to effect full opening of the check valves 66*a*, 66*b* and distention of the packer 28) through the passage 58 and port 62 to the inner side of the packer 28, thereby effecting distension of the latter into pressure contact with the wall of the hole, as in FIG. 2. Accordingly, assuming deformation of the lower packer

30 to have already occurred, complete closing-off or "shutting in" of the well just above the bit resting on the bottom is achieved.

To effect "deflation" of the packer 28 following its distension as aforesaid when such is desired, there is provided a port 70 in the upper end of the sleeve bore which interconnects the space to the inner side of the packer with the upper end of a longitudinal passage 72 provided in an external rib 60*b* on the sleeve 26 shown to be disposed diametrically opposite the aforesaid rib 60*a*, which passageway connects by way of a lower port 74 to the annular space between the lower ends of mandrel and sleeve, which in turn connects to the mandrel bore through a port 76, preferably disposed diametrically opposite the aforesaid bore port 56. Ball checks 78*a*, 78*b* prevent flow of mud through the passageway 72 during normal operation.

The method or methods of the invention may be practiced through the use of the above described apparatus as follows: Assuming that high-pressure sands or formations are encountered during a drilling operation, and by "high-pressure" is meant pressure sufficient to contaminate the drilling mud and/or increase its volume, or to cause sticking of the drill, or blow-out and possible damage to casing and drill rig, etc., the mud pump at the surface is shut off immediately upon the abnormal condition being detected and thereupon the drill bit is set on the bottom by permitting the drill string 12 to lower. As explained above, such causes axial compression and thereby radial inward deformation of the lower packer 30 and thereby closing off of the lower end of the bore to the high pressure formation, and it further brings the mandrel port 54 into registry with the port 56 of the sleeve which leads via passage 58 to the inner side of the upper packer 28, which latter has been readied for distention by the lowering of the drill string. The mud pump is then put back into operation at a pressure sufficient to distend the upper packer in radial outward direction against the wall of the hole, thus also closing off the annular space between the drill string and bottom hole assembly to the upward flow from the pressure sands.

The aforesaid lowering of the drill string relative to bottom hole assembly also resulted in lowering of the driving keys 42*a*, 42*b* of the J-joints J_1 and J_2 from their respective driving positions in their slots 40*a*, 40*b*. The drill string 12 and coupling section 20 may now be disconnected and raised from the packer mandrel and sleeve secured by the set packer 28 as aforesaid, by turning the drill string in counterclockwise direction the angular amount necessary to align the key 42*a* with the longer vertical leg 44*a* of the upper J-joint slot 40*a* and then lifting the drill string. When the coupling section 20 is raised as aforesaid, mud flows directly from the bore of the drill string 12 to the annulus portion above the now set packer, thus bypassing said packer. Corresponding separation of the locking and driving key 42*b* of the lower joint J_2 from its slot 40*b* is not possible, however, because the set screws 50 which block movement of the key 42*b* into alignment with the longer leg of the J-slot 40*b* in which it operates, and thus there is no likelihood of the packer mandrel pulling away from the sleeve 26 of the bottom hole assembly 14 connected to the latter. Accordingly, the well is now effectively shut off at a location generally above but closely adjacent the drill bit, without any danger of blow-out arising from the high pressure of the sands or formations encountered during drilling.

If and when it is desired to resume drilling, mud pressure above the set close-off means may be built up, preferably by increasing mud density, to that required to balance the objectionable high pressure, thus in effect rendering said high pressure harmless. When such has been accomplished, the drill string is re-lowered, connected to and turned with respect to the still set mandrel and then permitted to raise so as to effect repositioning

of the locking and driving keys 42*a*, 42*b* in the short legs 43*a*, 43*b* of their respective joint slots 40*a*, 40*b*. Such re-positioning effects relaxation of the lower packer 30 to its normal (FIG. 1) configuration and it further brings about release of the mud pressure from the inner side of the upper packer 28, whereupon the latter returns to its normal deflated or relaxed condition, in which it is shown in FIG. 1. Since both the bore and the annulus are now full open, flow of the increased-density drilling mud down the bore through the drill bit at the bottom of the drill string and up the annulus, together with powered rotation of the drill string and drill bit, may be resumed without interference or danger from the high-pressure formation.

Should low-pressure rather than high-pressure sands or formations be encountered during drilling, which usually results in loss of the drilling mud flowing upwardly through the annulus, the same operations are followed, except that after closing off both the drill string bore and the annulus between the drill string and well-hole wall immediately upon the loss of drilling mud returns being detected, the density of the drilling mud is adjusted downwardly, i.e. decreased, until it at least balances that of the low-pressure formation. Thus, should drilling be resumed, the lower density drilling mud in effect compensates for the lower pressure encountered in the particular formation, so that drilling may proceed without loss of mud returns.

It is also within the purview of the present invention to circulate, under certain conditions favoring same, a drilling fluid having a different physical and/or chemical composition than the conventional drilling mud previously used, such as a plastic resin-type drilling fluid capable of sealing off a troublesome formation but which would not necessarily have a higher or lower density than said previously used mud. As an example, should a low-pressure formation be encountered or develop, as evidenced by loss of drilling mud, both the drill string bore and the annulus between the drill string and well bore wall are closed off by lowering the drill string so as to set the drill bit on the bottom as aforesaid. Thereupon, coupling section 20 is disconnected and raised as described above, thereby providing a drilling fluid bypass for the drilling fluid at a point spaced above the annulus and drill-string bore close-off positions as aforesaid. The plastic resin-type drilling fluid may then be circulated through the drill-string bore and annulus via the bypass path to the location of the low-pressure formation. Upon said drilling fluid acting to seal off the low pressure, drilling may be resumed, using either the previously used drilling mud or one better suited to the sealed-off formation.

From the above, it will be appreciated that the foregoing described method achieves the objectives of the invention in providing simple, practical and safe solutions to the sometimes dangerous and troublesome problems arising from high-pressure incursion and/or weak formations encountered during drilling, the former of which can result in well blow-out and/or mud contamination and the latter in loss of mud returns.

In summary, the invention provides in the first instance a simple and safe procedure for temporarily packing- or sealing-off a well hole, in the event troublesome formations are encountered, at or very near the trouble point, as well as substantially immediately upon the troublesome formation being encountered. Furthermore, since an increase in mud density increases and a decrease in mud density decreases the hydrostatic head pressure of the mud circulating in a well in proportion to depth of well hole and independently of surface pressure, the herein method provides a procedure whereby, after packing- or sealing-off the troublesome pressure formation as aforesaid, drilling may be resumed simply by continuing circulation of the drilling mud in the usual manner, following adjustment of its density so that its hydrostatic

head pressure balances the higher or lower pressure of the troublesome formation.

The compensation or balancing out of the higher-pressure formation encountered during drilling by adjustment of the density of the drilling mud, rather than by imposing back pressure thereon by means of surface-located flow restrictors, for example, is of particular advantage in that such eliminates the possibility of the imposed back pressure, which of course must be applied to the hole throughout its entire length, subjecting lower-pressure formations along the hole to fracturing pressure or pressures and consequent loss of drilling mud therethrough. Furthermore, it many times happens that there are weak formations above the abnormally high-pressure formation constituting the trouble point which will not withstand the relatively high surface-generated back pressure required to balance incursion pressures while heavier mud is being prepared and pumped in, but which will withstand the substantially smaller increase in pressure of the mud of the density required to balance the high-pressure formation. In such a situation, the practice of the method of the invention is also of advantage in that it reduces the likelihood of the loss of mud returns through weak formations located as aforesaid.

A further notable advantage of the herein method stems from the fact that by making possible the packing off of the well at a "down well" position and thereby isolation of the formation causing the abnormal condition immediately upon its being detected, and by further enabling resumption of flow of drilling fluid in a path which is located above the pack-off point, said method provides a procedure for holding the abnormal condition in check immediately upon its being encountered and thus without having to combat it while alterations designed for the correction of said condition are being made. The above will be clear from a consideration of the fact that, in the absence of the present method, alterations in drilling fluid would have to be made while the abnormal pressure conditions were present and exerting an influence on the entire fluid column. For example, prior to the present method, if a high-pressure formation were encountered, high-pressure gas from said formation would continue to "gas cut" the entire column of fluid in the hole while the heavier fluid necessary to combat the high pressure was being prepared and circulated into the well, thus extending the period of time required to increase the hydrostatic head pressure thereof necessary to the correction of the high-pressure condition. Conversely, prior to the present invention, if drilling fluid was being lost to a low-pressure formation encountered during drilling, a substantial additional amount of drilling fluid was lost before the lower-density drilling fluid necessary to the correction of the troublesome low-pressure condition could be prepared and circulated. Thus, the herein method is highly useful in that it provides a procedure both for quickly sealing off a trouble-producing formation and then, should such be deemed necessary or advisable, circulating a hold- or check-type drilling fluid during the interval between detection of the abnormal condition resulting from said formation and the preparation and re-circulation of the particular drilling fluid determined to be best suited to the counteraction of said condition.

Another practical advantage of the method of the invention is that, since it can be put into operation immediately upon detection of incipient drilling-fluid circulation trouble, and by the regular drilling crew as distinguished from highly skilled personnel not always available in the field, it makes possible the saving of valuable rig time in addition to protecting against mud contamination and the loss of many thousands of dollars in drilling mud likely to occur when an oil or gas well drill in operation encounters abnormal formation pressures.

It is to be understood that the method of the invention is equally adaptable to reverse circulation drilling, wherein the drilling fluid is circulated down the annulus,

through the bit, and up the bore of the drill string. This is to be distinguished from normal circulation which is down the bore of the drill string, through the drill bit, and up the annulus. In any event, the phrase "circulating drilling fluid through the drill string bore and the annulus" is sometimes used herein to cover both types of circulation.

It will be understood that the method or procedure described above may be varied within the scope of the appended claims.

I claim:

1. The method of controlling formation conditions in a well hole having a drill string with a drill bit on the lower end thereof positioned therein and which is adapted for circulation of a drilling fluid therethrough, comprising the steps of:

closing off the drill string bore and the annulus between the drill string and the well hole wall at positions spaced above the drill bit,

circulating drilling fluid through the drill string bore and the annulus through a bypass point spaced above the annulus and drill string bore close-off positions, and

subsequently opening the bore and annulus and resuming the flow of drilling fluid through the drill bit at the bottom of the drill string.

2. The down hole method of controlling formation conditions during drilling operations wherein a drilling fluid is being forced down the drill string bore to the drill bit and up the annulus between the drill pipe and well hole wall to the surface, comprising the steps of:

closing off the drill string bore and the annulus at positions which are spaced above the drill bit,

circulating drilling fluid down through the drill string and out to the annulus at a bypass point spaced above the annulus-and-bore closing positions, and

subsequently opening the bore and annulus and resuming the flow of drilling fluid down the bore to the drill bit and up the annulus.

3. The method as claimed in claim 1 wherein:

said bore and annulus closing positions are generally adjacent to each other.

4. The method of controlling abnormal formation conditions in a well hole having a drill string with a drill bit attached to the lower end thereof position in said well hole and which is adapted for circulation of a drilling fluid therethrough, comprising the steps of:

closing off the drill string bore and the annulus between the drill string pipe and well hole wall at positions spaced above the drill bit upon indication of an abnormal formation condition,

circulating drilling fluid having different properties than those of the drilling fluid previously used through the drill string bore and annulus through a bypass point spaced above the annulus-and-bore closing positions,

and opening the bore and annulus and resuming the flow of drilling fluid through the bore and annulus through the drill bit.

5. The down hole method for controlling abnormal formation conditions during drilling operations wherein a drilling fluid is being forced down the drill string bore to the drill bit and up the annulus between the drill pipe and well hole wall to the surface, comprises the steps of:

closing off the drill string bore and the annulus at positions spaced above the drill bit upon indication of an abnormal formation condition,

circulating drilling fluid having different properties than those of the drilling fluid, previously used down through the drill string and out to the annulus at a bypass point spaced above the annulus-and-bore closing positions, and

opening the bore and annulus and resuming the flow of drilling fluid down the bore to the drill bit and up the annulus.

6. The down hole method for controlling abnormal formation pressure conditions in a well hole having a drill string with a drill bit attached to the lower end thereof positioned in said well hole and which is adapted for circulation of a drilling fluid therethrough, comprising the steps of:

closing off the drill string bore and the annulus between the drill string pipe and well hole wall at positions spaced above the drill bit upon indication of an abnormal pressure condition,

circulating drilling fluid having a different density than that of the drilling fluid previously used through the drill string bore and annulus through a bypass point spaced above the annulus-and-bore closing positions until hydrostatic head pressure of the fluid column is altered sufficiently to overcome the abnormal pressure condition, and

opening the bore and annulus and flowing drilling fluid of the different density through the bore and annulus through the drill bit.

7. The down hole method for controlling abnormal formation pressure conditions encountered during drilling operations wherein a drilling fluid is being forced down the drill string to the drill bit and up the annulus between the drill string and well hole wall to the surface, comprising the steps of:

closing off the drill string bore and the annulus at positions above the drill bit upon indication of an abnormal pressure condition,

circulating drilling fluid having a different density than that of the drilling fluid previously used down through the drill string and out to the annulus at a bypass point spaced above the annulus-closing and bore-closing positions until hydrostatic head pressure of the fluid column is altered sufficiently to overcome the abnormal pressure condition, and

opening the bore and annulus and flowing drilling fluid of the different density down the bore of the drill string to the drill bit and up the annulus.

8. The down hole method for controlling potential blowout in a well hole having a drill string with a drill bit attached to the lower end thereof positioned in said well hole and which is adapted for circulation of a drilling fluid therethrough, comprising the steps of:

closing off the drill string bore and the annulus between the drill pipe and well hole wall at positions above the drill bit upon indication of said potential condition,

circulating drilling fluid having a higher density than that of the drilling fluid previously used through the drill string bore and annulus through a bypass point spaced above the annulus-and-bore closing positions until hydrostatic head pressure of the fluid column is increased sufficiently to overcome the potential blowout condition, and

opening the bore and annulus and flowing drilling fluid of the higher density through the bore and annulus through the drill bit.

9. The down hole method for controlling potential blowout during drilling operations wherein a drilling fluid is being forced down the drill string to the drill bit and up the annulus between drill string and well hole wall to the surface, comprising the steps of:

closing off the drill string bore and the annulus at positions above the drill bit upon indication of said potential condition,

circulating drilling fluid having a higher density than that of the drilling fluid previously used down through the drill string and out to the annulus at a bypass point spaced above the annulus-closing and bore-closing positions until hydrostatic head pressure of the fluid column is increased sufficiently to overcome the potential blowout condition, and

opening the bore and annulus and flowing drilling fluid of the higher density down the bore to the drill bit and up the annulus.

10. The down hole method for controlling potential loss of drilling fluid to a low pressure formation in a well hole having a drill string with a drill bit attached to the lower end thereof positioned in said well hole and which is adapted for circulation of drilling fluid therethrough, comprising:

closing off the drill string bore and the annulus between the drill pipe and well hole wall at positions generally adjacent to each other and spaced above the drill bit and below the well head upon indication of a potential loss of drilling fluid to said low pressure formation,

circulating drilling fluid having a lower density than that of the drilling fluid previously used through the drill string bore and annulus through a bypass point spaced above the annulus-and-bore closing positions until hydrostatic head pressure of the fluid column is reduced sufficiently to compensate for the lower pressure formation, and

opening the bore and annulus and flowing drilling fluid of the lower density through the bore and annulus through the drill bit.

11. The down hole method for controlling potential loss of drilling fluid to a low pressure formation encountered during drilling operations wherein a drilling fluid is being forced down the drill string to the drill bit and up the annulus between the drill string and well hole wall to the surface, comprising the steps of:

closing off the drill string bore and the annulus at positions generally adjacent to each other and spaced above the drill bit and below the well head upon indication of a potential loss of drilling fluid to said low pressure formation,

circulating drilling fluid having a lower density than that of the drilling fluid previously used down through the drill string and out to the annulus at a bypass point spaced above the annulus-and-bore closing positions until hydrostatic head pressure of the fluid column is decreased sufficiently to compensate for the lower pressure formation, and

opening the bore and annulus and flowing drilling fluid of the lower density down the bore of the drill string to the drill bit and up the annulus.

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CHARLES E. O'CONNELL, *Primary Examiner.*

D. H. BROWN, *Assistant Examiner.*