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B. A. DETERS ET AL
BACK CIRCULATOR DEVICE

2,645,288

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FIG. 1

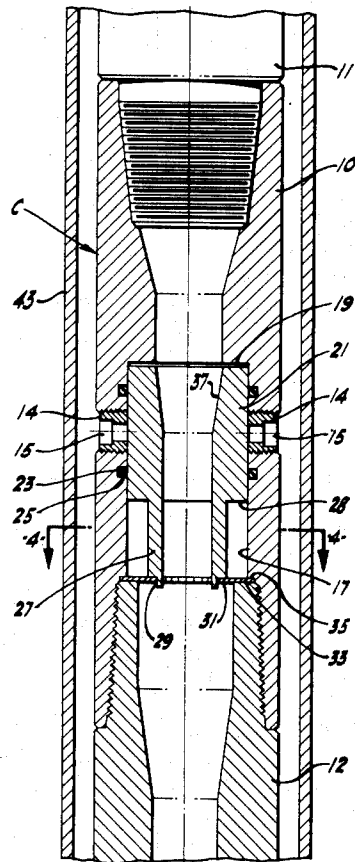
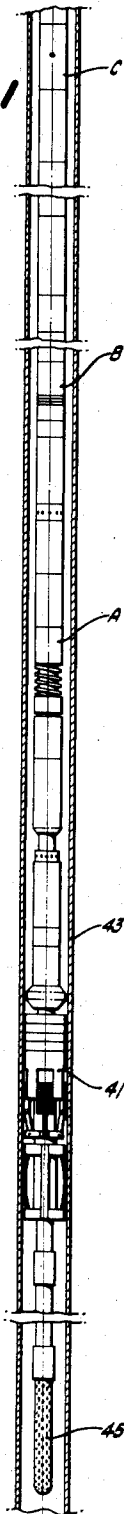


FIG. 2

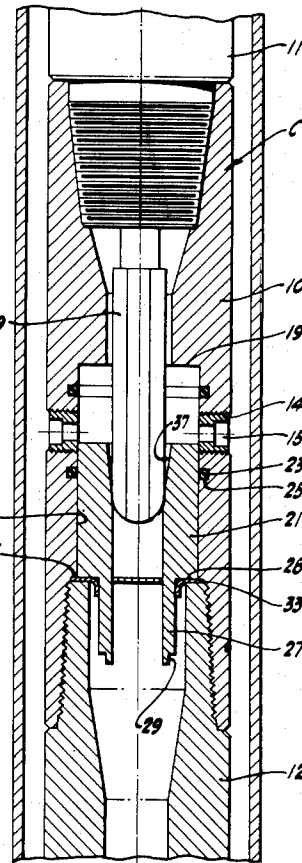


FIG. 3

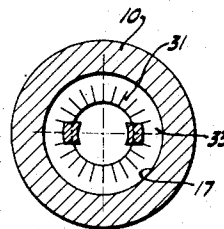
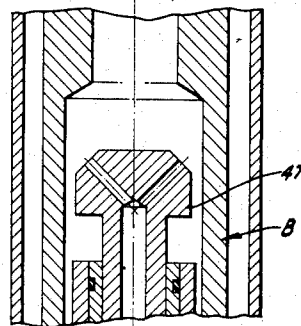


FIG. 4

INVENTORS
WILLIAM W. BUTLER
BRUCE A. DETERS
BY

Mollen and Hamann
ATTORNEYS

UNITED STATES PATENT OFFICE

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BACK CIRCULATOR DEVICE

Bruce A. Deters, Glendale, Calif., and William W. Butler, Sidney, Nebr., assignors, by mesne assignments, to Johnston Testers, Inc., Houston, Tex., a corporation of Delaware

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6 Claims. (Cl. 166—1)

1

This invention relates to an oil well tool, particularly to a reverse circulating or back scuttling valve.

In oil well production practice, it is necessary at various times to circulate drilling mud or other fluid down the annular space between a drill string and a casing or bore, in through a valve in the drill string and up through the drill string. Sometimes this reverse circulation is performed to back scuttle gas and oil under control from the drill string, for instance, to eliminate a fire hazard. Also, during the pulling of a drill string, it is sometimes necessary to reverse circulate to maintain control over the well, which may get somewhat out of control for various reasons, for instance because the hydrostatic head in the well drops due to the removal of the drill string from the region of the well fluid, allowing high pressure areas previously controlled by the hydrostatic head to get somewhat out of control.

There have been previous back scuttling valves but, in general, these have been operable only when the string was bottomed or set in the well by means of a packer or slips or the like, these valves being operable by relative movement, rotational or longitudinal, between the lower part of the drill string, which is fixed in the well and carries one part of the valve, and the upper free part of the drill string which carries the other part of the valve.

When the necessity for back scuttling or back circulation arises, the back scuttling valve must be opened quickly to enable immediate control over the well to avoid damage and waste. In many instances, there is not time nor is it practical or in some cases possible to reset a packer or again bottom the drill string to enable opening of a back scuttling or reverse circulation valve.

It is a main object of the present invention to provide a back scuttling valve adapted to be connected between sections of drill string, which valve can be opened when the drill string is off bottom and without setting a packer or equivalent device.

Various other objects of the present invention will be apparent from the following description taken in connection with the accompanying drawings, wherein:

Fig. 1 shows a back scuttling valve embodying the concepts of the present invention being connected in a drill string.

Fig. 2 is a vertical section through the upper portion of the device disclosed in Fig. 1 showing the back scuttling valve and a trip valve therebe-

2

low, and showing the back scuttling valve in closed position.

Fig. 3 is a view similar to Fig. 2, showing the back scuttling valve in open position to permit back scuttling or reverse circulation.

Fig. 4 is a horizontal section taken along line 4—4 of Fig. 2, showing the manner of supporting the sleeve within the valve.

The invention will be described with reference to a drill string having a back scuttling valve embodying the concepts of the present invention connected therein above a connate sample tester connected on the lower end of the drill string and below the back scuttling valve, but this description is not intended to limit the invention but merely to illustrate a practical application of the back scuttling valve.

Referring to the accompanying drawings, wherein similar reference characters designate similar parts throughout, the drill string disclosed in Fig. 1 includes a connate sample tester generally entitled A, having a trip valve assembly B, said parts being disposed below a reverse circulation or back scuttling valve assembly C, which in turn is connected to the upper portion of the drill string, not shown.

The back circulation valve assembly C includes a tubular valve housing 10 connected at its upper end to a sub 11 connected in turn to a section of drill pipe (not shown), and at its bottom to a sub 12 which is in turn connected to a section of drill pipe (not shown). Tubular housing 10 is provided with externally threaded bushings 14 threadedly received within threaded bores formed in the walls of tubular housing 10, said bushings providing ports 15 communicating the exterior of the housing with the interior of the housing.

The interior of tubular housing 10 is formed with a counterbore 17 defined in part by a downwardly facing shoulder 19. A sleeve 21 is disposed within counterbore 17 and arranged against shoulder 19 so as to cover the ports 15 when the sleeve is in closed position, as the parts are depicted in Fig. 2, and to uncover ports 15 when the sleeve is moved downwardly to the position shown in Fig. 3. O rings 23 are disposed within annular grooves 25 formed in the interior of tubular housing 10 and adapted to sealingly engage sleeve 21 to prevent leakage of fluid around sleeve 21 into or out of housing 10 through ports 15.

Sleeve 21 has a pair of downwardly extending arms 27 disposed inwardly of downwardly facing shoulders 28 formed in sleeve 21 and being

formed with rabbeted portions at 29 engaging inwardly extending radially disposed deformable fingers 31 of annulus 33, to thereby support sleeve 21 in a position to close ports 15, as clearly shown in Fig. 2. Annulus 33 has the outer peripheral margin thereof clamped between the upper end of sub 12 and a downwardly facing shoulder 35 formed at the upper end of the lower internally threaded portion of tubular housing 10. As shown in Fig. 4, each of the rabbeted portions 29 rests mainly on a pair of the deformable fingers 31 and to a minor extent on a second spaced pair of deformable fingers disposed one on either side of the first mentioned pair of deformable fingers.

Sleeve 21 is provided with a downwardly converging impact surface 37 which faces generally upwardly so as to be engaged by a reverse circulation valve go-devil 39 which is adapted to be dropped down the drill string from the surface and strike the converging impact surface 37 forcing sleeve 21 downwardly to deform fingers 31. When sleeve 21 is so forced downwardly, deforming the fingers 31 upon which arms 27 rest, the deformed portions of the fingers grip or frictionally engage sleeve 21 so as to prevent any subsequent upward movement of sleeve 21 without overcoming this gripping effect of the deformed fingers.

One practical application of the reverse circulation valve C is disclosed in Fig. 1 where it is connected in the drill string at a point above the connate sample tester A which may be of any suitable type, the type disclosed being similar to the tester disclosed in the co-pending application of Clyde L. Huber, Serial Number 153,513, entitled "Well Testing Method and Apparatus," filed April 3, 1950. This type of tester includes a packer assembly at 41 for setting the tester in well casing 43 to separate the space below the packer from which the test is to be made from the space above the packer to avoid as much contamination of the sample as possible. The tester includes a perforated anchor 45 at the lower end thereof through which the connate fluid passes into the tester. There are various valves within the tester not necessary here to describe for shutting in and retaining the sample after the sample flows upwardly into the tester and drill string. There is a trip valve assembly at B in the type of tester disclosed which has a trip valve 47 adapted to be tripped by a trip valve go-devil which is dropped from the surface. Trip valve 47 is tripped to permit the connate fluid to flow upwardly past the trip valve and into the drill string.

In operation, a string as disclosed in Fig. 1 is lowered in the well, the packer 41 set, and the various valves within the tester opened to permit the fluid to flow upwardly to the trip valve 47. A trip valve go-devil, which is of a size to pass through sleeve 21 without forcing the sleeve downwardly, is then dropped down the drill string and strikes trip valve 47, tripping the valve and allowing the connate fluid to flow upwardly into the drill string. The trip valve 47 is preferably spaced by suitable sections of drill string (not shown but indicated by the break in Fig. 1 between the reverse circulation valve and the trip valve) approximately a hundred or more feet from the reverse circulation valve C. Connate fluid may and usually does flow upwardly past the back circulating valve. After the sample is trapped, the drill string may be removed and the sample recovered.

It may be that the connate fluid flowing into the tester contains a high percentage of gas of a very volatile nature and also the fluid may be under fairly high pressure, thereby creating a fire hazard at the surface unless the connate fluid is brought to the surface under control. If the conditions creating a fire hazard are realized before the packer 41 is collapsed, a reverse circulation valve in the tester itself can be operated to communicate the annular space between the casing 43 and the tester A with the interior of the tester to allow circulating mud or fluid to be forced downwardly through the annular space between the string and casing, through the reverse circulating valve in the tester and up the drill string to force gas and oil upwardly through the drill string to the surface under control.

It frequently happens, however, that after the packer 41 has been collapsed and the string is in the process of being pulled that it is necessary to back circulate to bring fluid to the surface under control or to maintain complete control over the well, or for various other reasons well known in the art. Under these conditions, it is usually imperative that back circulation be established immediately, and it may not be practical or possible to reset the packer because of the conditions in the well, and, therefore, a reverse circulation valve go-devil 39 can be dropped through the drill string to strike the impact surface of wall 37, forcing sleeve 21 downwardly, until shoulders 28 engage annulus 33, to uncover ports 15 allowing drilling mud to be reversely circulated, therefore reassuming control over the well or otherwise achieving the results desired. It is pointed out that the portions of the connate fluid below the reverse circulation valve may be brought to the surface by removal of the drill string after the reverse circulation operation is completed.

By the present invention, a reverse circulation valve has been provided which can be connected in a drill string and be opened when the drill string is off bottom without setting a packer or equivalent device. Obviously, the reverse circulation valve could be used to merely open the interior of the drill string to the exterior for other purposes as desired. It can also be located at different places along the drill string and provided in drill strings built up for other purposes than testing.

Having thus described my invention, what we claim and desire to secure by Letters Patent is:

1. In combination with a drill pipe to be suspended in a well bore having a formation tester suspended from its lower end, such tester including a packer to divide the bore into an upper zone and a lower zone, said tester including operable valves to open and close said tester to admit fluid therein from the lower zone and to close the tester against loss of said fluid from the tester, of a reverse circulating valve interposed in said drill pipe a substantial distance above the tester packer whereby a sample of formation fluid may be entrapped therebelow, said reverse circulating valve comprising a tubular valve housing having a port in its wall communicating the exterior of the housing with the interior of the housing, means for connecting the housing between two sections of drill pipe, a sleeve slidably disposed within the housing and covering said port, and impact responsive means for releasably retaining the sleeve in such position responsive to an impact to release the sleeve for downward movement to uncover the port, said last named means

5

including an annulus having inwardly extending deformable fingers upon which said sleeve is supported, an impact producing member having a dimension greater than an internal dimension of the sleeve whereby dropping said member down the drill pipe against said sleeve effects downward movement of the sleeve to port uncovering position to enable circulation of fluid downwardly externally of the drill pipe, through said port and upwardly through said drill pipe above the trapped sample.

2. In combination with a drill pipe to be suspended in a well bore having a formation tester suspended from its lower end, such tester including a packer to divide the bore into an upper zone and a lower zone, said tester including operable valves to open and close said tester to admit fluid therein from the lower zone and to close the tester against loss of said fluid from the tester, of a reverse circulating valve interposed in said drill pipe a substantial distance above the tester packer whereby a sample of formation fluid may be entrapped therebelow, said reverse circulating valve comprising a tubular valve housing having a port in its wall communicating the exterior of the housing with the interior of the housing, means for connecting the housing between two sections of drill pipe, said tubular valve housing having a counterbored portion therewithin providing a downwardly facing shoulder, a sleeve valve member slidably disposed within the counterbored portion of the tubular valve housing against the shoulder and having downwardly extending arms, and impact responsive means for releasably retaining the sleeve in a position covering the port responsive to an impact to release the sleeve for downward movement to uncover the port, the last named means including an annulus having inwardly extending deformable fingers upon which said arms bear to support the sleeve, an impact producing member having a dimension greater than an internal dimension of the sleeve whereby dropping said member down the drill pipe against said sleeve effects downward movement of the sleeve to port uncovering position to enable circulation of fluid downwardly externally of the drill pipe, through said port and upwardly through said drill pipe above the trapped sample.

3. In combination with a drill pipe to be suspended in a well bore having a formation tester suspended from its lower end, such tester including a packer to divide the bore into an upper zone and a lower zone, said tester including operable valves to open and close said tester to admit fluid therein from the lower zone and to close the tester against loss of said fluid from the tester, of a reverse circulating valve interposed in said drill pipe a substantial distance above the tester packer whereby a sample of formation fluid may be entrapped therebelow, said reverse circulating valve comprising a tubular valve housing having a port in its wall communicating the exterior of the housing with the interior of the housing, means for connecting the housing between two sections of drill pipe, said tubular valve housing having a counterbored portion therewithin providing a downwardly facing shoulder, a sleeve valve member slidably disposed within the counterbored portion of the valve housing and against the shoulder and having downwardly extending arms, impact responsive means for releasably retaining the sleeve in a position covering the port responsive to an impact to release the sleeve for downward movement to uncover the port, said

6

housing having an internally threaded counterbored portion below the first named counterbored portion providing a second downwardly facing shoulder, the last named means including an annulus disposed against the second named shoulder and having inwardly extending deformable fingers upon which said arms bear to support the sleeve, the first named means including a sub threadedly received by the threaded counterbored portion and operable to clamp said annulus in place against the second named shoulder, an impact producing member having a dimension greater than an internal dimension of the sleeve whereby dropping said member down the drill pipe against said sleeve effects downward movement of the sleeve to port uncovering position to enable circulation of fluid downwardly externally of the drill pipe, through said port and upwardly through said drill pipe above the trapped sample.

4. In combination with a drill pipe to be suspended in a well bore having a formation tester suspended from its lower end, such tester including a packer to divide the bore into an upper zone and a lower zone, said tester including operable valves to open and close said tester to admit fluid therein from the lower zone and to close the tester against loss of said fluid from the tester, of a reverse circulating valve interposed in said drill pipe a substantial distance above the tester packer whereby a sample of formation fluid may be entrapped therebelow, said reverse circulating valve comprising a tubular valve housing having a port in its wall communicating the exterior of the housing with the interior of the housing, means for connecting the housing between two sections of drill pipe, said tubular valve housing having a counterbored portion therewithin providing a downwardly facing shoulder, a sleeve valve member slidably disposed within the counterbored portion of the valve housing and against the shoulder and having downwardly extending arms, impact responsive means for releasably retaining the sleeve in a position covering the port responsive to an impact to release the sleeve for downward movement to uncover the port, said housing having an internally threaded counterbored portion below the first named counterbored portion providing a second downwardly facing shoulder, the last named means including an annulus disposed against the second named shoulder and having inwardly extending deformable fingers upon which said arms bear to support the sleeve, the first named means including a sub threadedly received by the threaded counterbored portion and operable to clamp said annulus in place against the second named shoulder, and sealing means carried by the housing at the interior thereof and disposed around the port for sealing against the sleeve, an impact producing member having a dimension greater than an internal dimension of the sleeve whereby dropping said member down the drill pipe against said sleeve effects downward movement of the sleeve to port uncovering position to enable circulation of fluid downwardly externally of the drill pipe, through said port and upwardly through said drill pipe above the trapped sample.

5. In combination with a drill pipe to be suspended in a well bore having a formation tester suspended from its lower end such tester including a packer to divide the bore into an upper zone and a lower zone, said tester including operable valves to open said tester to admit fluid therein from the lower zone and to close the tester against the loss of said fluid from the tester

whereby formation fluid may be admitted into the tester below the packer and pass upwardly into the tester and drill pipe and be entrapped therein, of a reverse circulating valve interposed in said drill pipe a substantial distance above the tester packer whereby a sample of formation fluid may be entrapped therebelow, said reverse circulating valve comprising a tubular valve housing having a port in its wall communicating the exterior of the housing with the interior of the housing, means for connecting the housing between two sections of drill pipe, a sleeve slidably disposed within the housing and covering said port, an impact responsive means for releasably retaining the sleeve in said port covering position and responsive to impact to release the sleeve for downward movement to uncover the port, an impact producing member having a dimension greater than an internal dimension of the sleeve whereby dropping said member down the drill pipe against said sleeve effects downward movement of the sleeve to a port uncovering position to enable circulation of fluid downwardly externally of the drill pipe, through said port and up-

wardly through said drill pipe above said entrapped sample.

6. The apparatus as claimed in claim 5 in which the impact responsive means for releasably retaining the sleeve in said port covering position and responsive to impact to release the sleeve for downward movement to uncover the port comprises a permanently deformable element fixedly arranged in the path of travel of the sleeve in moving to port uncovering position so as to frictionally engage the sleeve after the sleeve has been forced downward and has permanently deformed the element, which engagement acts to retain the sleeve in port uncovering position.

BRUCE A. DETERS.
WILLIAM W. BUTLER.

References Cited in the file of this patent
UNITED STATES PATENTS

Number	Name	Date
1,906,891	White	May 2, 1933
2,493,650	Baker et al.	Jan. 3, 1950