

[54] **GUIDE AND PROTECTOR
ARRANGEMENT INCORPORATING
FILL-UP FLOAT VALVE MEANS**

[75] Inventors: Howard I. Lorenz, Eugene P. Rosser, both of Houston, Tex.

[73] Assignee: Nobel Drilling Corporation, Tulsa, Okla.

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[51] Int. Cl. E21b 9/00

[58] Field of Search 175/307, 317, 318; 166/225

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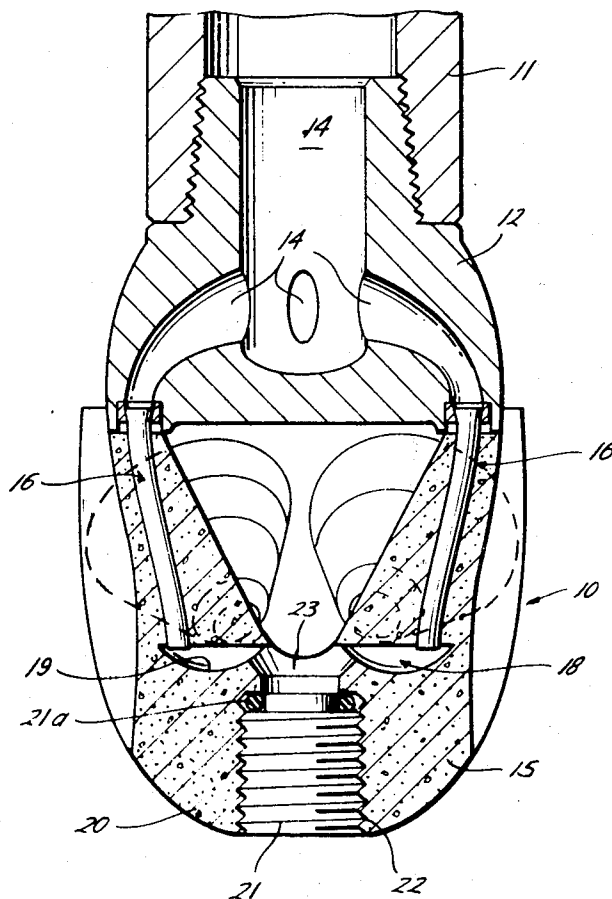
Primary Examiner—James A. Leppink

Attorney—Jack W. Hayden

[57] **ABSTRACT**

A guide and protector arrangement for the lower end of a tubular drill string with drilling means thereon which are to be lowered in a well bore including molded jacket means for protecting the drilling means, the jacket means including passage means therein for communicating fluid between the well bore and the interior of the string and fill-up float valve means adapted to be removably positioned within the jacket means for controlling the fluid flow between the well bore and the passage means in the jacket means.

15 Claims, 7 Drawing Figures



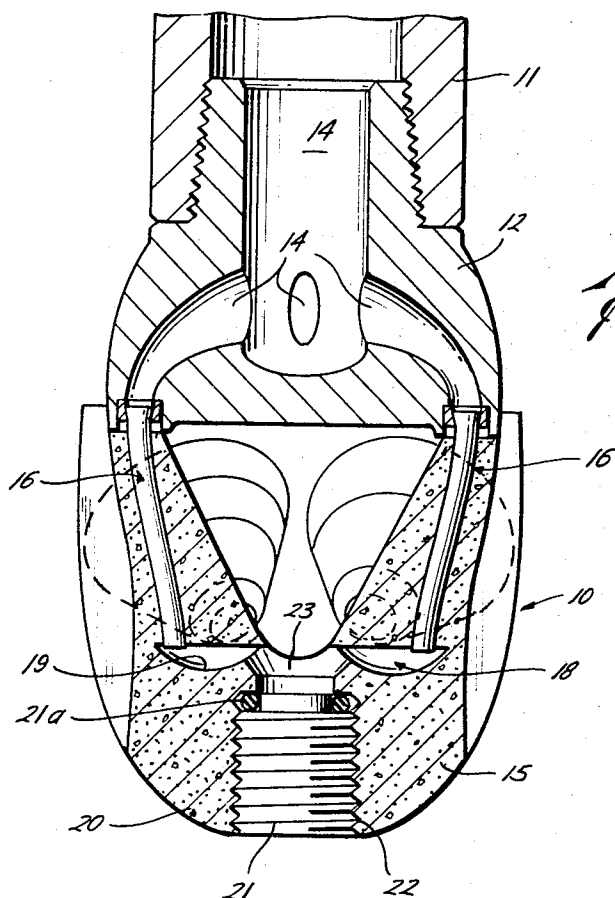


Fig. 1

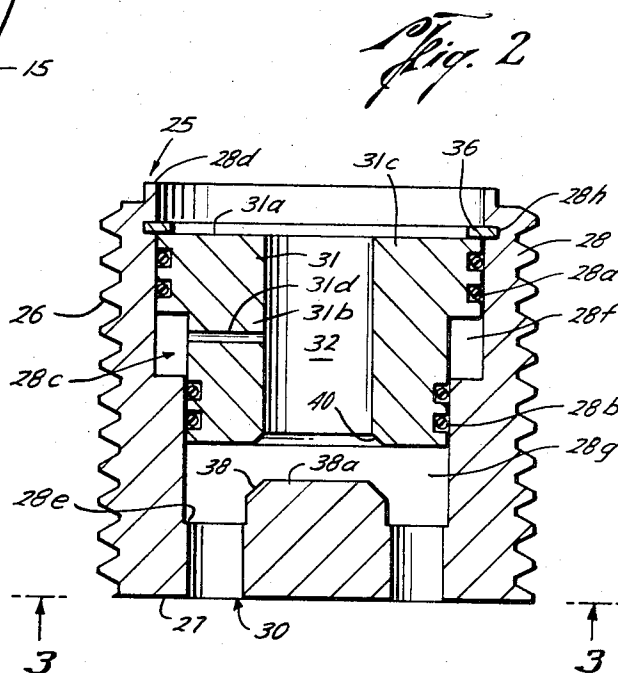


Fig. 2

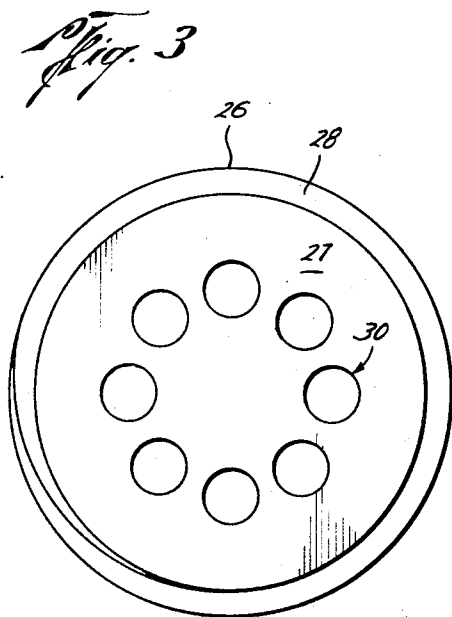
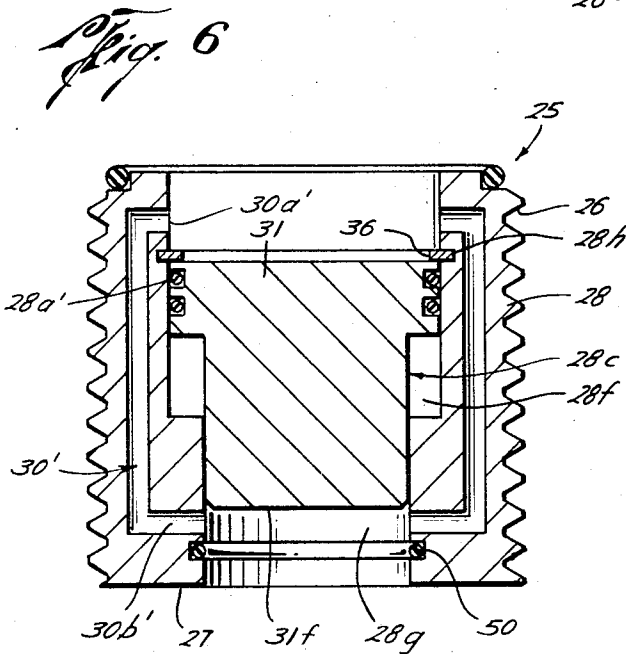
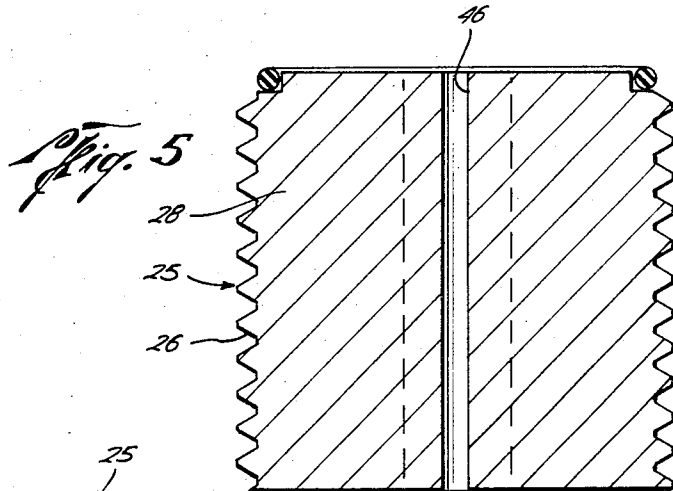
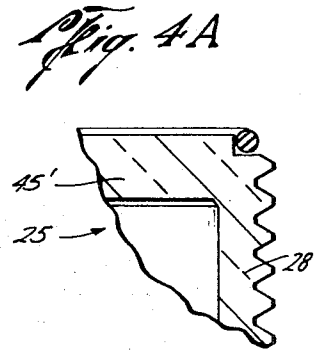
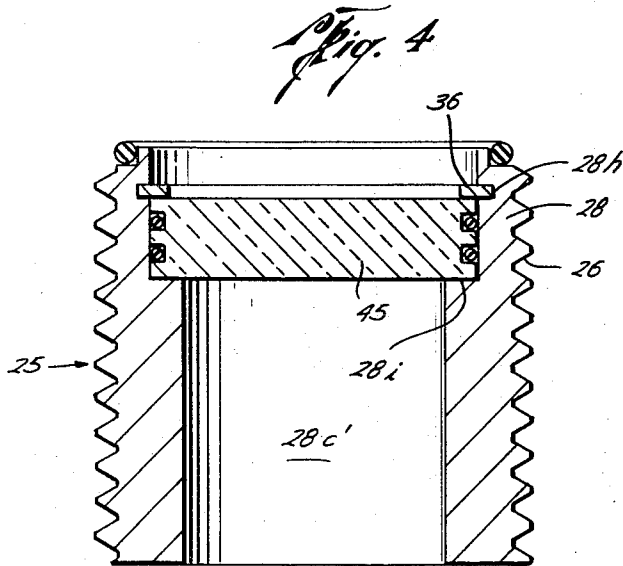


Fig. 3

Howard I. Lorenz
Eugene P. Rosser
INVENTORS

BY Jack W. Hayden

ATTORNEY



Howard I. Lorenz
Eugene P. Rosser
INVENTORS

BY Jack W. Hayden

ATTORNEY

GUIDE AND PROTECTOR ARRANGEMENT INCORPORATING FILL-UP FLOAT VALVE MEANS

CROSS REFERENCES TO RELATED APPLICATIONS

The present invention relates to improvements in our copending applications identified as "Devices and Methods for Protecting and Guiding Rock Bits" filed on June 12, 1969 bearing Ser. No. 832,673, now abandoned; and incorporated in "Method and Arrangement for Protecting and Guiding Drilling Bits" filed on Jan. 19, 1971, bearing Ser. No. 107,786; and "Bit Guide and Protector Incorporating an Arrangement for Initially Inserting or Replacing Bit Jets" filed on June 1, 1971, bearing Ser. No. 148,499.

BACKGROUND OF THE INVENTION

The present invention relates to the field of art for lowering tubular drill strings which incorporate a drill bit or drilling means thereon into a well bore. In order to reduce the load and reduce the wear on the brakes, drawworks and the other components of the hoisting mechanism of a drilling rig, it is desirable to lower a tubular drill string into a well bore in a manner so that, under some circumstances, it may partially fill to a predesired and predetermined level to thereby "float" the drill string into the well bore.

Also, due to the out of round tolerances, I.D. and O.D. tolerance, as well as wall thickness tolerance, an offset or misalignment of sections of tubular members such as casing may occur in the well bore, particularly at the joints where the sections of tubular members or casing are connected together. Additionally, it is desirable to protect the wall cake on the well bore wall. Therefore, it is desirable to lower a tubular drill string into the well bore in a manner so as to inhibit damage to surrounding casing or tubular member positioned in the well bore; to inhibit damage to the wall cake of the well bore or to inhibit sticking of the tubular drill string in the well bore or damage to the drilling means carried on the lower end of the tubular drill string.

At the present time, so far as is known to applicants, there is not available an arrangement which guides and protects a tubular drill string with drilling means and removable valve means thereon into a well bore in a desired manner to inhibit damage to the drill means on the tubular drill string being lowered, or to a surrounding tubular member such as the casing in the well bore, or to the wall cake on the well bore wall.

In those instances where valve means are employed with a drill string, incorporating a drilling bit thereon, then the drill string must incorporate a modified sub or drill collar immediately above the drilling means on the drill string to receive the valve. This, of course, increases the expense, and in some instances either during lowering of the string into the well bore, or after it is positioned in the well bore, the valve means which controls the flow into the drill string, whether it is casing, tubing, or a drill string, may be a liability, particularly where it is desired to pump lost circulation material down the tubular member.

The present invention is provided to overcome the above and other difficulties presently encountered with present float valve means employed for lowering tubular drill string into a well bore.

SUMMARY OF THE INVENTION

An object of the present invention, therefore, is to provide a guide and protector arrangement for the lower end of tubular drill strings with drill means thereon which are to be lowered in a borehole, the guide and protector arrangement including molded jacket means for protecting the drill means and there being fluid passage means in the jacket means for communicating fluid between the well bore and the interior of the drill string, and said jacket means incorporating means for removably receiving a fill-up float valve therein for controlling the flow of fluid between the well bore and the interior of the drill string.

Still another object of the present invention is to provide a guide and protector arrangement for the lower end of tubular drill strings with drill means thereon that are to be lowered into a well bore, the guide and protector arrangement including molded jacket means for protecting the drill means, the jacket means including passage means therein for communicating fluid between the well bore and the interior of the drill string, fluid pressure responsive means within the jacket means and communicating with the passage means intermediate the ends thereof, which fluid pressure responsive means is responsive to fluid pressure to aid in removing the jacket means when desired, and the jacket means incorporating an arrangement for removably receiving valve means for controlling fluid flow between the well bore and the interior of the drill string.

Still another object of the present invention is to provide an arrangement for guiding and protecting the cutting surfaces of a drilling means on the lower end of a drill pipe including molded jacket means for the cutting surfaces of the drilling means and including passage means therein for communicating fluid through the jacket means and the drilling means to the interior of the drill pipe, and said jacket means also incorporating fluid pressure responsive means therein to aid in removing the jacket means in response to fluid pressure for exposure of the cutting surfaces and means in the jacket means for receiving and retaining a fill-up float valve for controlling the fluid flow between the borehole and the passage means in the jacket means.

Yet a further object of the present invention is to provide a fill-up float valve arrangement for a well string which may be removed from the well string during lowering operations or at any other desired time.

Still another object of the present invention is to provide a fill-up float valve arrangement for a tubular member to be lowered into a well bore which may be secured with the well string in a manner so as to eliminate the necessity of any special subs or machining of the drill string.

Still another object of the present invention is to provide a fill-up float valve arrangement for a drill string which may be removed if desired for discharge of lost circulation material through the well string and into the well bore.

Another object of the present invention is to provide a combination guide, protective device, and fill-up float valve arrangement for a well string wherein the float valve may be readily positioned on the well string and removed therefrom in the field.

Still another object of the present invention is to provide a fill-up float valve arrangement for a well string

incorporating means to guide and protect the well string and wherein the float valve may be readily removed from the guide for replacement thereof when desired.

Yet a further object of the present invention is to provide an arrangement which positions a float valve means in advance of a drill bit and in advance of the lower end of the drill pipe or tubular member as it is lowered into the well bore.

Yet a further object of the present invention is to provide an arrangement which positions a float valve means in advance of a drill bit and in advance of the lower end of the drill pipe or tubular member as it is lowered into the well bore, and which may be removed during lowering operations or after the well string is positioned in the well bore.

Other objects and advantages of the present invention will become more readily apparent from a consideration of the following description and drawings.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a sectional view illustrating a form of a drilling means, such as a rock or cone bit, by way of example only, secured to a drill pipe with a form of the guide and protector arrangement of the present invention employed thereon and including means for removably securing fill-up float valve means therein;

FIG. 2 is a sectional view illustrating one embodiment of a fill-up float valve means which may be employed with the guide and protector arrangement illustrated in FIG. 1;

FIG. 3 is an end view on the line 3 — 3 of FIG. 2;

FIG. 4 illustrates another form of a fill-up float valve arrangement;

FIG. 4A illustrates yet another form of a fill-up float valve arrangement;

FIG. 5 illustrates still another form of a fill-up float valve means; and

FIG. 6 illustrates still another form of a fill-up float valve means.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

Attention is first directed to FIG. 1 of the drawings wherein a form of the present invention is referred to generally by the numeral 10. It will be noted that in FIG. 1 of the drawings, the invention is illustrated in connection with a drilling bit, and more particularly wherein the drilling bit is in the form of a cone bit. However, such is for purposes of illustration only, as the present invention could be employed with any type of drilling means, such as, by way of example, a diamond bit, a blade bit, or other type of drilling bit. The invention will be described in connection with FIG. 1, but, as noted, such is for purposes of illustration only.

A tubular member 11 in the form of a drill string is shown as having secured thereto a drilling bit 12 which, as noted in FIG. 1, is in the form of a cone bit. The bit 12 is constructed so that it incorporates fluid passage means 14 therein for communicating fluid between the well bore and the well string 11 in a desired manner during drilling operations, as well as when the well string 11 is being lowered into the well bore. The invention 10 incorporates the molded jacket means 15 which

may be formed of a suitable epoxy resin with an aggregate such as silica sand incorporated therein, or other suitable moldable means. The jacket means 15 may be formed in a manner as described in our copending applications Ser. No. 832,673 and Ser. No. 107,786 hereinabove referred to. It may be molded in situ on the lower end of the tubular member 11, or it may be formed in sections which then may then be adhered together in any suitable manner as described in said copending applications and then positioned on the lower end of the tubular member 11 as described in our copending application above referred to.

The jacket means 15 incorporates fluid passage means referred to generally at 16 formed therein which communicates with the respective passage means 14 formed in the drilling means, or drill bit 12, as illustrated in FIG. 1 of the drawings and the well bore (not shown). If desired, the jacket means 15 may also incorporate fluid pressure responsive means referred to generally at 18 which communicates with the passage means 16 so that the jacket means may be removed from the tubular string 11 in response to fluid pressure when desired. Such fluid pressure responsive means may comprise the surfaces 19 which intersect or connect with passage means 16 and said surfaces may be formed by any suitable means such as described in said copending applications Ser. No. 832,673 and Ser. No. 107,786, or such fluid pressure responsive means may comprise some form of sintered or cellular type material which may accommodate fluid flow therethrough but which tends to restrict such fluid flow to aid in removal of the jacket means in response to fluid pressure as will be described in greater detail.

The nose portion 20 of the jacket means 15 is illustrated as being of a suitable configuration to aid in guiding the tubular string 11 as it is lowered into the well bore, so as to inhibit sticking of the well string as the well string is lowered into the well bore, and provides a guide and protective arrangement for the lower end of the tubular string or drill bit thereon to inhibit damage thereto by engagement with protruding ledges in the well bore, or protruding surfaces in any casing string which may be employed in the well bore, and to also inhibit damage to the mud cake on the wall of the well bore.

As shown, the nose 20 may be somewhat elongated and is preferably of a generally convex configuration to provide a smooth, streamlined surface to accomplish the foregoing results. The length and configuration of the nose portion 20 may vary as desired. The elongated portion of the nose 20 of the jacket means 15 is provided with suitable means for removably receiving a fill-up float valve, a form of which is referred to generally by the numeral 25 in FIG. 2. As shown, the jacket means incorporates a longitudinally extending, enlarged passage 21 which may be formed with threads 22 thereon along part of its longitudinal extent. This passage forms part of the passage means 16, and when the float valve is positioned therein, it is generally provided with passage means for communicating fluid between the well bore and interior of the well string in a desired manner. The upper end 23 of the passage 21 communicates with the passage means 16 through the pressure responsive means 18 as illustrated. The fill-up float valve means 25 may be formed of any suitable

material which may be readily milled or cut to aid in its removal from the well bore after it has served its function. As shown, the float valve 25 incorporates a threaded exterior surface 26 for engaging with the threads 22 to enable the fill-up float valve 25 to be removably positioned within the passage 21.

It can be appreciated that other suitable means may be employed for removably retaining the fill-up float valve means 25 within the passage 21, such as, by way of example, incorporating a groove within the nose portion 20 of the jacket means 15 and employing a snap ring to abut the end 27 of the fill-up float valve means 25 and thereby retaining it in position within the jacket means 15.

The float valve 25 incorporates a body 28 having passage means referred to generally at 30 extending longitudinally thereof. Plunger means 31 are adapted to be slidably and sealably fitted within the body 28 for controlling flow through said body passage means 30 in response to fluid pressure acting on the plunger means. The plunger means 31 includes a passage 32 for communicating with the body passage means 30 and there are cooperating surface means 38 and 40 on the body 28 and plunger or piston 31, respectively, for shutting off flow through the body passage means 30 when the plunger is moved to a predetermined position within the body 28. More particularly, when the plunger 31 is moved downwardly within the body 28 far enough, the surface 40 on the lower end of the passage 32 will engage the surface 38 formed on the upwardly and annularly extending projection 38a formed to close off flow temporarily as may be desired.

When a float valve means 25 is positioned in the passage 21 of the jacket means 15 and the well string progressively lowered into the well bore, it can be appreciated that fluid will be communicated from the well bore into the interior of the well string 11 in a manner known to those skilled in the art. It is desired at times to partially fill the well string 11 as it is lowered into the well bore so as to aid in floating the well string 11 into the well bore to thereby reduce the wear and tear on the hoisting mechanism including the drawworks, brakes, and other components thereof. It can be appreciated that by regulating the amount of the exposed surface 31a of the plunger 31, then movement of the plunger 31 within the body 28 may be regulated to thereby regulate the fluid level of the liquid within the well string 11.

It is to be noted that suitable seal means may be provided between the valve means 25 and the passage means 21, such seal means being illustrated at 21a in FIG. 1 to inhibit leakage therebetween. Similarly, suitable seal means as illustrated at 28a and 28b are provided between the body 28 and plunger 31.

In the form of the fill-up float valve means illustrated in FIG. 2, the body 28 includes a chamber referred to generally at 28c which extends longitudinally from one end 28d of the body 28 and terminates within the body at a point 28e spaced from the other end 27 of the body 28. The passage means referred to at 30 extends from the end 27 of the body 28 into the lower end of the chamber as shown in FIG. 2 of the drawings, and broadly speaking, the passage 32 also forms part of the passage means extending longitudinally of the body 28. The plunger means 31 slidably fits within the chamber

28c, and as previously noted is provided with seal means 28a and 28b. The chamber 28c is formed by two concentric bores 28f and 28g, the bore 28g being of a smaller diameter than the bore 28f and the plunger 31 is in turn suitably formed to have a portion 31b which fits within the bore 28g and a portion 31c which fits within the bore 28f.

The seal means 28a is arranged between the plunger portion 31c and the bore 28f and the seal means 28b is arranged between the plunger portion 31b and bore 28g. The plunger means also incorporates passage means 31d extending into the bore 28f between the seal means 28a and 28b for discharge of trapped fluid when the plunger means 31 moves longitudinally of the body 28.

The plunger 31 is retained in position in the body 28 by suitable means such as the annular groove 28h formed in the body 28 which is adapted to receive the snap ring 36. Thus, the plunger 31 may be removed from the body 28 to enable a plunger having either a larger or smaller passage means 32 therethrough to be positioned in passage 32 which, in turn, varies the amount of surface 31a exposed to the liquid entering and filling well string 11 as it is lowered into the well bore.

In FIG. 4, the body 28 is again illustrated as having threads 26, and a groove 28h with a snap ring 36. In this instance, frangible disc means 45 are illustrated as being positioned on a shoulder 28i within the chamber 28c' extending longitudinally through the body 28. The disc 45 is adapted to rupture upon a predetermined pressure to establish free communication between the well bore and the interior of the well string 11 through the valve means 25, pressure responsive means 18, and fluid passage means 16 of the jacket means 15.

In FIG. 4A, the valve 25 is illustrated as incorporating a body 28 wherein the frangible disc 45' is illustrated as being integrally formed with the body 28a.

In FIG. 5, the valve means 25 is illustrated as again incorporating threads 26 for engaging it within the passage 21 of the jacket means 15 and is shown as having a restricted bore or passage 46 therethrough for communicating fluid between the well bore and the interior of the well string as the well string 11 is lowered into the well bore.

In FIG. 6, the valve means 25 again incorporates threads 26 on the exterior surface of the body 28 and again includes a chamber 28c formed by two concentric bores 28f and 28g, with bore 28g being of a smaller diameter than bore 28f. In this instance the bores 28f and 28g extend longitudinally through the body 28. Plunger means 31 are provided to slidably fit within the bores 28f and 28g and seal means 28a' are provided between the plunger means 31 and the body 28 within the larger of the two bores, 28f.

A groove 28h is provided for receiving the snap ring 36 to aid in retaining the plunger 31 within the body 28.

Passage means referred to at 30' are formed in the body 28, one end 30a' communicating with the larger bore 28f on one side of the snap ring retaining means and communicating with the smaller bore 28g at the other end 30b' as illustrated in FIG. 6 of the drawings. Seal means 50 are carried by the body 28 within the smaller bore 28g between the passage means end 30b' and the body end 27 whereby a predetermined amount of movement of the plunger 31 engages the portion 31f

thereof with the seal means 50 to close off flow through the longitudinally extending passage means 30' in the body 28.

The particular type of fill-up float valve means employed in the present invention will depend upon the particular circumstances in each instance, such as well conditions, the rate at which it is desired to lower the well string, the viscosity of the liquid within the well, the amount of liquid desired in the well string and other factors.

From the foregoing description, it can be seen that the present invention provides a guide and protector for the lower end of a well string to be lowered into a well bore wherein fluid passage means are provided through the guide and protector for accommodating fluid flow therethrough and valve means are employed to regulate the filling of the well string during lowering operations.

Should it become desirable during lowering operations or after the well string is at a predetermined location within the well bore to dispense with further use of the fill-up float valve arrangement, the jacket means 15 may be removed by increasing the fluid pressure within the well string 11 so that the pressure response means 18 aids in removing that portion of the jacket means which extends beyond the pressure responsive means. Where a drilling means is employed with the well string 11, this exposes the cutting surfaces of the drilling means 12 for continuing drilling operations. Since the valve 25 is formed of material which may be readily milled or cut up, such as plastic or the like, it may be drilled up and circulated up the well bore in a known manner.

In those instances where it is desired to employ a lost circulation material as the well string is being lowered into the well bore, or when the well string is in position, the jacket means 15 may again be removed by increasing the hydraulic pressure within the well string 11 whereupon the jacket means 15 is separated from the well string to expose the well string for free communication of lost circulation material or the like therethrough and into the well bore.

Since the valve 25 is removably positioned within the jacket means 15 and in front of the drilling means 11 and on the lowermost end of the well string, it may readily be removed at the well location and replaced with a valve means 25 having a predetermined characteristic to accomplish the desired function under the conditions at that particular well location.

Furthermore, by providing an arrangement where the valve means is not an integral part of the well string, special subs or special machining of tubular members such as drill strings and the like is avoided, thus greatly reducing the cost while accomplishing the desirable benefits of the present invention.

If desired, the protector and guide arrangement may be removed by rotating the well string on the well bore bottom to gradually wear it away.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

What is claimed is:

1. A bit guide and protector arrangement for a bit with fluid passages adapted to be lowered in a borehole comprising:

- a. molded jacket means for the bit cutting surfaces, said jacket means including passage means therein for communicating fluid through said jacket means to the bit;
- b. fluid pressure responsive means within said jacket means and communicating with the passage means intermediate the ends thereof, said fluid pressure responsive means being responsive to fluid pressure to aid in removing said jacket means for exposure of the bit cutting surfaces; and
- c. fill-up float valve means positioned in said jacket means for controlling the fluid flow between the borehole and the passage means in said jacket means.

2. The invention of claim 1 wherein cooperating means are provided on said jacket means and said float valve to enable said float valve to be readily engaged with and removed from position in said jacket means.

3. The invention of claim 1 wherein said float valve comprises:

- a. a body having passage means extending longitudinally thereof;
- b. plunger means slidably and sealably fitting in said body for controlling flow through said body passage means in response to fluid pressure acting on said plunger means; and
- c. cooperating surface means on said body and plunger means for shutting off flow through said passage means when said plunger is moved to a predetermined position in said body.

4. The invention of claim 3 including snap ring means fitting in a groove in said body for removably retaining said plunger means within said body.

5. The invention of claim 2 wherein said cooperating means comprises cooperating threaded surfaces on said jacket means and float valve.

6. The invention of claim 1 wherein said float valve includes passage means therethrough, and frangible disc means closing off said passage means but breakable when the pressure thereon reaches a predetermined amount to open the passage means to fluid flow.

7. The invention of claim 1 wherein said jacket means is formed of a plurality of sections, and means for bonding said sections together after they are positioned on the bit.

8. The invention of claim 1 wherein said float valve comprises:

- a. a body;
- b. said body having a chamber therein extending longitudinally from one end of said body and terminating within said body spaced from the other end;
- c. said body having passage means extending from said other end of said body into the chamber;
- d. plunger means for slidably fitting in the chamber of said body;
- e. said means for sealing between said plunger and body;
- f. there being passage means extending longitudinally through said plunger means; and
- g. means in said body cooperating with said plunger means to close off the passage means in said body

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and plunger means when said plunger moves a predetermined distance longitudinally of said body.

9. The invention of claim 8 wherein said chamber comprises two concentric bores, one of which is of a smaller diameter than the other and said plunger means extends within both of the bores.

10. The invention of claim 9 wherein there are seal means between said body and plunger means in both of the bores.

11. The invention of claim 10 including snap ring means for fitting in a groove in said body for removably retaining said plunger means within said body.

12. The invention of claim 1 wherein said float valve comprises a body, cooperating means on said body and jacket means for removably positioning said body within said jacket means and said body having passage means therethrough for communicating with the passage means in said jacket means.

13. The invention of claim 1 wherein said float valve comprises:

- a. body means;
- b. said body having a chamber therein extending longitudinally from one end of said body to the other end, the chamber comprising two concentric bores, one of which is of a smaller diameter than the other;
- c. plunger means for slidably fitting within both of the bores;
- d. seal means between said plunger means and body for slidably and sealably receiving the plunger within the larger of the two bores;
- e. means within the larger of the two concentric

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bores for retaining said plunger within said body;

f. there being passage means in said body, one end of which communicates with the larger of the two bores on one side of said retaining means and with the smaller of the two bores at its other end; and

g. seal means carried by said body within the smaller bore between said other passage end and said other body end whereby a predetermined movement of said plunger means within said body means closes off the passage in said body.

14. The invention of claim 10 wherein said plunger means includes port means extending therethrough between said seal means for discharge of trapped fluid when said plunger moves longitudinally of said body.

15. A guide and protector arrangement for the lower end of devices such as tubular members and the like which are to be lowered in a borehole comprising:

- a. molded jacket means for covering the lower end of the devices, said jacket means including passage means therein for communicating fluid between the well bore and the interior of the devices;
- b. fluid pressure responsive means within said jacket means and communicating with the passage means intermediate the ends thereof, said fluid pressure responsive means being responsive to fluid pressure to aid in removing said jacket means for exposure of the lower end of the device; and
- c. fill-up float valve means positioned in said jacket means for controlling the fluid flow between the borehole and the remainder of the passage means in said jacket means.

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