Aug. 20, 1940. C. W. THORNHILL 2,212,086

FLOAT COLLAR AND GUIDE SHOE

Filed Oct. 27, 1936 2 Sheets-Sheet 1

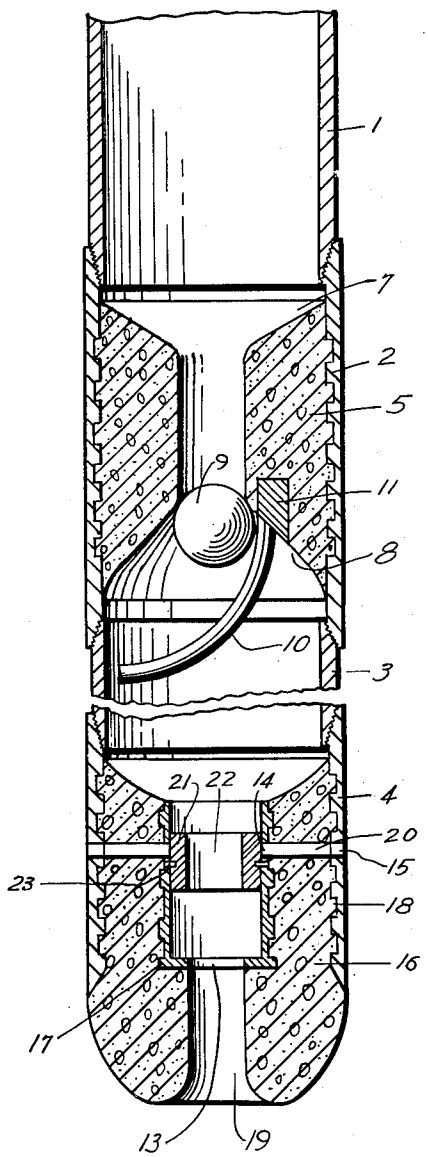

Fig. 1.

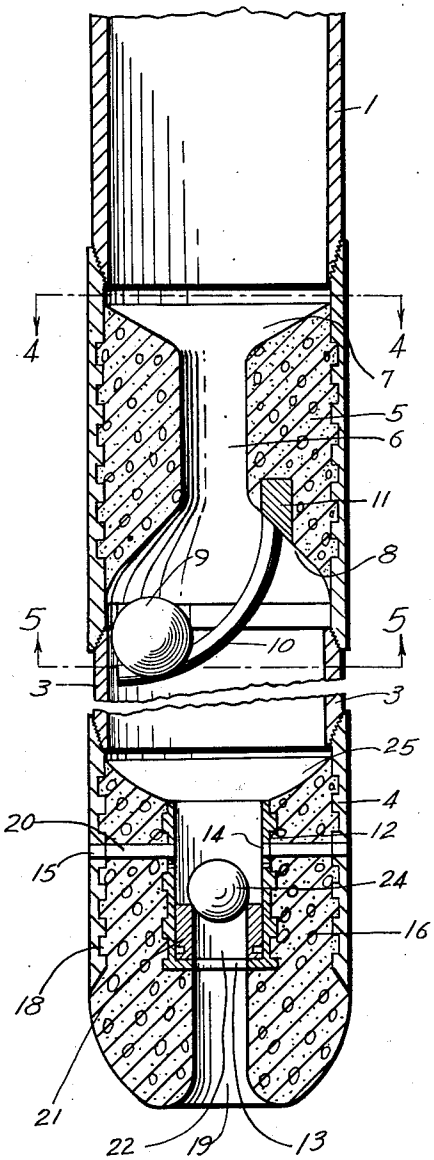

Fig. 2.

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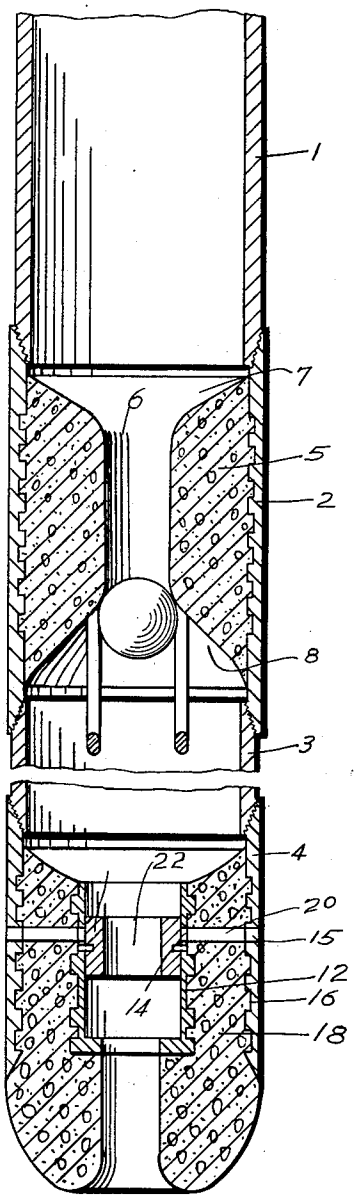

Fig 3

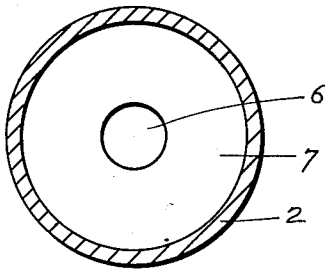

Fig 4

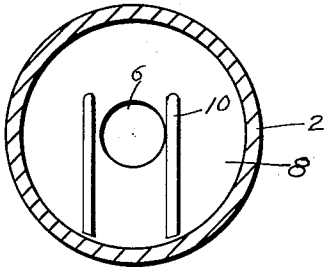

Fig 5

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FLOAT COLLAR AND GUIDE SHOE

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17 Claims. (Cl. 166—1)

This invention relates in general to a float collar and guide shoe, and has particular reference to such structure for use on the lower end of a casing for a well as the casing is being lowered into position and cemented in place.

In placing a casing within a well it is customary to lower the casing into the drilled hole to the desired position, and then to force cement down through the casing and up around the lower ends of the casing so as to form a cement plug within and about the lower end of the casing. This cement plug is then drilled out so as to leave simply a ring about the casing for the purpose of preventing seepage past the outside of the lower end of the casing in either direction. The drilling is then completed below the lower end of the casing into the producing formation, and the well is finished in a manner well known in the art.

In the past, provision has also been made for a check valve adjacent to the lower end of the casing to prevent the entrance of fluid from the well into the casing without preventing the forcing of fluid down through the casing during the lowering thereof, and without preventing the forcing of cement through the casing after it has been placed in position. As the casing is lowered with such a check valve in place, it will be seen that the buoyancy of the casing will serve to at least in part sustain its weight, and the casing will be caused to "float" downwardly until its desired position has been reached.

Also, there has been in the past provided what is commonly referred to as a guide shoe which consists simply of a frangible plug on the lower end of the casing having a relatively small opening therethrough, and having its lower end rounded or tapered so as to guide the lower end of the casing as it is lowered into the hole.

It will readily be seen that in forcing cement downwardly through the casing to cement the lower end of the casing into position, it would be desirable for the cement to be ejected in a lateral direction so as to place it around the casing where it is desired, rather than below the casing where it will merely have to be drilled out. This also serves to prevent "channelling" of the cement resulting in a poor cementing job. In addition to this, there is danger in forcing the cement through the lower end of the casing in an axial direction that too much pressure will be exerted upon the producing formation, and that this formation will become partially or wholly clogged with the cement, thereby damaging the usefulness of the well. On the other hand, it is highly desirable that the casing be open at its lower end so that during the time it is being lowered fluid may, if necessary, be pumped downwardly through the casing to wash away any "bridges" or other obstructions which might accumulate within the well hole. Unless this is provided for, it is sometimes impossible to lower a casing into a well hole, without withdrawing the casing and redrilling to remove the bridge or other obstruction.

It is a general object of this invention to provide a structure to be attached to the lower end of the casing which will eliminate the disadvantages inherent in such structures of the prior art.

It is a further and more specific object of this invention to provide equipment for the lower end of the casing which will permit of washing down through the casing during the lowering of the casing, and which will permit cement to be ejected from the casing in a lateral direction after the casing has been placed in its desired position.

It is a further object of this invention to provide a float collar for use in setting the casing with a check valve which will permit substantially axial passage of a solid object therethrough, and which will provide a substantially full opening to permit cement and mud to pass therethrough without cutting the valve.

It is a further object to provide a guide shoe which will be open axially during the lowering of the casing and which may then be closed against flow in an axial direction, and opened for flow in a lateral direction.

It is a further object to provide for the pumping of cement through a casing and out in a lateral direction while preventing back flow thereof into the casing.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawings, such description and drawings being by way of example and illustration only, and not by way of limitation. This invention is to be limited in its scope only by the prior art, and by the terms of the appended claims.

In the drawings:

Fig. 1 is a vertical cross section illustrating one embodiment of this invention with the parts in position for lowering the casing into the well.

Fig. 2 is a similar view illustrating the parts in position for cementing the casing after the same has been lowered to its desired position.

Fig. 3 is a view similar to Fig. 1, but taken at substantially right angles thereto.

Fig. 4 is a horizontal cross section taken along the lines 4—4 of Fig. 2.

Fig. 5 is a similar view taken along the line 5—5 of Fig. 2.

In the illustration the numeral 1 indicates the casing which is to be lowered into the well. To the lower end of the casing 1 is secured the float collar 2, the lower end of this float collar being connected by a section of pipe 3 to the guide shoe

4. It is understood that the section 3 may be any length desired and may consist of one or more joints.

The float collar 2 is provided with a molded-in insert formed of cement or other friable material capable of being drilled out, as illustrated at 5. This insert is of annular form, and provides a central passageway 6 axially therethrough. It is tapered at its ends as shown at 7 and 8 from the inner surface of the collar 2 to the diameter of the passageway 6. At its lower end, the passageway 6 provides a seat against which the ball valve 9 is adapted to engage. This ball valve 9 is preferably though not necessarily of a material which will float in the ordinary drilling mud, and is prevented from dropping entirely away from the float collar when it moves away from its seat by means of a pair of curved rods or rails 10 anchored at 11 within the insert 5 and extending downwardly and laterally substantially parallel with respect to each other. These rods are spaced apart a distance which is preferably greater than the diameter of the passageway 6, but slightly less than the diameter of the ball valve 9, and are sloped in a lateral direction so that when the ball valve 9 drops away from its seat in the lower end of the passageway 6 it will be caught between the two rods 10 and will be caused to roll toward one side of the float collar, thus leaving the passageway 6 substantially free from obstruction, and making it possible for a solid object to pass therethrough in a substantially axial direction, and for mud or cement to be pumped therethrough without danger of cutting the valve by abrasion.

Within the shell 4 of the guide shoe there is provided an inner shell 12 having an opening 13 of reduced size through its lower end, and having lateral openings 14 at positions adjacent its upper end. The shell 4 is likewise provided with lateral openings 15 which are equal in number and substantially equal in size to the openings 14, and when the shell 12 is placed within the shell 4, the openings 15 are placed in substantial alignment with the openings 14.

When the parts have thus been placed in position, the annular space between the two shells is filled with material similar to that of which the insert 5 is formed as illustrated at 16. It is noted that in the lower end of the shell 12 there are provided lateral extensions 17, and that the inner wall of the shell 4 is grooved as shown at 18, so as to more firmly anchor the material 16 in place. This material 16 is formed with a curved lower end portion so as to serve as a guide for the casing and with an axial opening 19 therethrough to provide for the passage of fluid downwardly in an axial direction during the lowering of the casing if such be found necessary. Openings 20 are formed in the member 16 connecting the opening 14 with the opening 15 so as to provide lateral passageways from the interior of the shell 12 to the exterior of the guide shoe.

Within the shell 12 there is positioned a collar or sleeve 21 having an axial opening 22 therethrough, this sleeve being of an outer diameter such as to closely fit within the shell 12. During the lowering of the casing this shell is held in the position shown in Fig. 1 by means of shear pins 23. While in this position it serves as a closure for the lateral openings 20, and thus prevents fluid from flowing out of the guide shoe in a lateral direction, but at the same time it permits flow through the passageway 22 in an axial direction so that any "bridges" or other obstructions encountered may be washed out to permit the lowering of the casing.

In operation, when the casing is being lowered the parts are in the position illustrated in Figs. 1 and 3. The ball valve 9 in such instance serves as a check valve, and makes it possible for the casing to be floated into position. At the same time it is possible to pump down through the casing, through the passageways 22 and 19, to wash out any obstructions that may be encountered. The lateral passageways 20 are during this time closed by the sleeve 21 so that the full pressure of the pumps may be exerted in an axial direction.

After the casing has been placed in the desired position, the cement may, of course, be pumped down through the device in an axial direction in the ordinary manner. However, it is contemplated by this invention that a second ball 24 will be dropped down through the casing, this ball being of such a diameter that it will pass through the passageway 6 and past the ball 9 when the same is in the position shown in Fig. 2. This ball 24, however, is of such diameter that it will seat against the upper end of the sleeve 21, thus closing the passageway through this sleeve against downward flow. It is noted that the upper end of the member 16 is tapered inwardly and downwardly as shown at 25 so that the ball 24 will not lodge against the upper end thereof, but will be guided into the shell 12 and against the upper end of the sleeve 21.

With the ball 24 in position, fluid is pumped downwardly through the casing, and the pressure of this fluid against the ball 24 and the sleeve 21 will shear off the pins 23 and move the sleeve downwardly to the position shown in Fig. 2, uncovering the ports 14 and opening the passageways 20. Cement may now be pumped downwardly through the casing and out laterally at the lower end thereof, thus placing the cement at the point where it is desired. It is noted that the sleeve 21 is limited in its downward movement by the inwardly projecting flange at the lower end of the sleeve 12.

It will be seen from the foregoing that a means has been provided for carrying out all the objects and advantages sought by this invention in a thoroughly efficient and practical manner.

Having described my invention, I claim:

1. In combination, a casing guide shoe having axial and lateral openings therein, means initially closing said lateral opening and movable by pressure within the casing when said axial opening is closed, to permit flow through said lateral opening, a float collar above said shoe having a passageway therein larger than the axial opening in said shoe, a downwardly opening check valve movable to fully open said passageway, and a valve element adapted to be passed downwardly past said check valve to close the axial opening in said shoe.

2. A floating and guiding device for a well casing comprising a rounded guide shoe having lateral and axial outlets therein, a sleeve within said shoe for initially closing said lateral outlet and movable to uncover said lateral outlet, a part above said sleeve having a passageway therethrough larger than the opening through said sleeve, a downwardly opening check valve mov-

ably to fully open said passageway, and a valve element adapted to be passed downwardly past said check valve to seat against a portion of said sleeve to prevent flow through said axial outlet whereby when pressure is exerted within the casing said sleeve and valve element acting as a piston will be forced to a position in which said sleeve does not overlie said lateral outlet.

3. A floating and guiding device for a well casing comprising means having lateral and axial outlets therein, means initially closing said lateral outlet and movable by pressure within the casing when said axial outlet is closed to permit flow through said lateral outlet, a downwardly opening check valve movable to fully open said passageway and means adapted to be passed downwardly past said check valve to close said axial outlet.

4. A float collar comprising a portion having a passageway therethrough, a ball valve element adapted to seat against a portion of said passageway to close the same against upward flow therethrough and movable away from said passageway to permit downward flow therethrough, and a pair of downwardly and laterally extending rails below said element spaced apart a distance at least as great as the diameter of said passageway and less than the diameter of said element for guiding said element downwardly and laterally to a position out of axial alignment with said passageway as it moves away from said passageway.

5. A float collar comprising a portion having a passageway therethrough, a ball valve element adapted to seat against a portion of said passageway to close the same against upward flow therethrough and movable away from said passageway to permit downward flow therethrough, and means out of axial alignment with said passageway for guiding said ball valve element to a position substantially completely out of axial alignment with said passageway as it moves away from said passageway.

6. A casing float collar comprising a portion having a passageway therethrough, and a check valve therein of a material lighter than ordinary drilling mud movable by buoyancy to close said passageway and movable downwardly to an open position substantially completely out of axial alignment with said passageway.

7. In a device adapted to be secured to a well casing, means to conduct flow from said casing in a lateral direction, means for closing said casing against lateral flow and movable downwardly to permit lateral flow, and means above said last means for preventing upflow through said casing after said means has been moved to permit lateral flow.

8. In a device adapted to be secured to a well casing, means to conduct flow from said casing in a lateral direction, means for closing said casing against lateral flow and movable by a downward force within said casing to permit lateral flow, and a check valve above said last means for preventing upflow through said casing after said means has been moved to permit lateral flow.

9. In a device adapted to be secured to a well casing, means to conduct flow from said well casing in axial and lateral directions, means for closing said casing against lateral flow, means for closing said casing against axial flow and causing the opening of said casing for lateral flow, and means for preventing upflow through said casing above said means for conducting flow away from said casing in a lateral direction.

10. In a device adapted to be secured to a well casing, means to conduct flow from said well casing in axial and lateral directions, means for closing said casing against lateral flow, means to close said casing against axial flow and cause the opening of said casing for lateral flow, and a check valve above said means for conducting flow from said casing in a lateral direction.

11. In a floating and guiding device for a well casing, in combination, a casing float collar having a check valve therein adapted to prevent upward flow therethrough, and a valve element movable downwardly past said check valve when said check valve is open.

12. In a device adapted to be secured to a well casing, means to conduct flow from said well casing in a lateral direction, means for closing said casing against lateral flow and shiftable to permit lateral flow, means movable downwardly through said casing to shift said means for closing the casing to a position to permit lateral flow, and means above said means for closing the casing against lateral flow for preventing upflow through said casing after said means for closing the casing against lateral flow has been moved to permit lateral flow.

13. In a well cementing device, in combination, a pipe, a check valve in said pipe for preventing upflow therethrough, said pipe having a cement opening therein below said check valve, means normally closing said cement opening, and means movable downwardly past said check valve for opening said cement opening.

14. In a well cementing device, in combination, a pipe, a check valve in said pipe for preventing upflow therethrough, said pipe having a lateral cement opening therein below said check valve, means normally closing said cement opening, and means movably downwardly past said check valve for opening said cement opening.

15. In a well cementing device, in combination, a pipe, a check valve in said pipe for preventing upflow therethrough, said pipe having independent slush and cement openings therein below said check valve, means normally closing said cement opening, and means movable past said check valve for opening said cement opening and closing said slush opening.

16. In a well cementing device, in combination, a pipe, a check valve in said pipe for preventing upflow therethrough, said pipe having independent axial slush and lateral cement openings therein below said check valve, means normally closing said cement opening, and means movable past said check valve for opening said lateral cement opening and closing said axial slush opening.

17. In a well cementing device, in combination, a pipe, a check valve in said pipe for preventing upflow therethrough, said pipe having an axial slush and a lateral cement opening therein below said check valve, an annular member within said pipe and normally overlying said cement opening to close the same while leaving said slush opening free for the flow of slush and movable downwardly to open said cement opening, and means movable past said check valve for closing said annular member whereby pressure within said pipe will move said means and said annular member downwardly to open said cement opening.

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