

June 9, 1942.

C. W. THORNHILL

2,286,126

WELL CEMENTING APPARATUS

Filed July 5, 1940

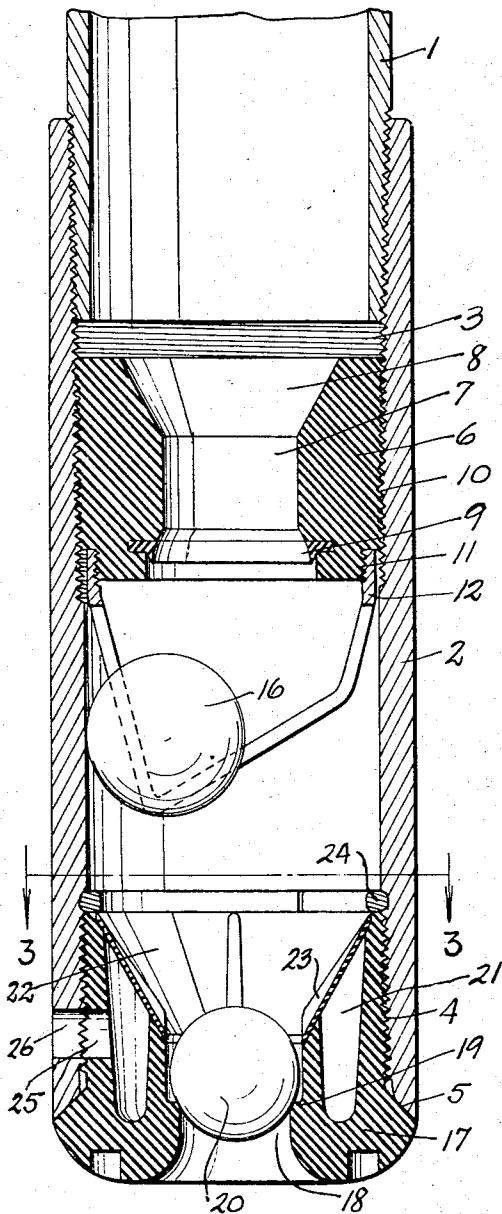


Fig. 1.

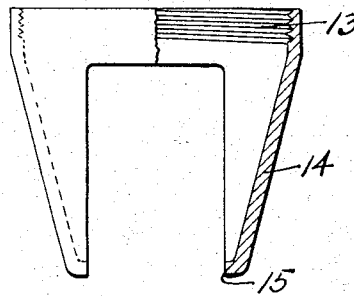


Fig. 2.

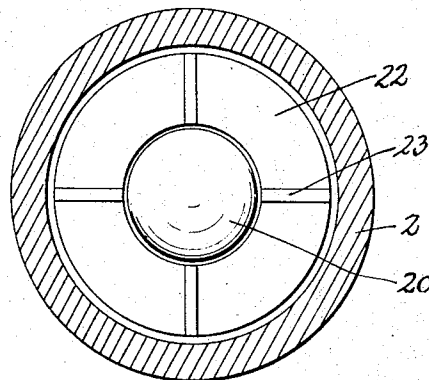


Fig. 3.

Charles W. Thornhill.

INVENTOR.

BY

J. Vincent Martin
and
Ralph R. Browning.
ATTORNEY.

UNITED STATES PATENT OFFICE

2,286,126

WELL CEMENTING APPARATUS

Charles W. Thornhill, Houston, Tex.

Application July 5, 1940, Serial No. 343,925

15 Claims. (Cl. 166—9)

This invention relates to float collar, guide shoe and cementing tool combinations and more particularly to those for use on the lower end or at spaced points above the lower end of an oil well casing for use in the cementing operation. This invention constitutes an improvement over the inventions disclosed in my previous co-pending applications S. N. 107,770 filed October 27, 1936 now Patent No. 2,212,086 issued August 20, 1940; S. N. 306,225 filed November 27, 1939 now Patent No. 2,212,087 issued Aug. 20, 1940, and S. N. 330,487 filed April 19, 1940.

It is a general object of this invention to provide certain improvements in the structure and operation of the devices shown and claimed in my prior pending applications referred to.

Another object of this invention is to provide a device which may be more easily and quickly assembled.

Another object of this invention is to provide a device of the character referred to, the parts of which may be more cheaply produced than those disclosed in my prior applications.

Another object of this invention is to provide a device in which the means for closing the slush passage will not be required to seat upon the means for closing the lateral cement openings.

Other objects and advantages of this invention will become apparent from the following description taken in connection with the accompanying drawing wherein like numerals represent corresponding parts throughout and wherein is set forth one embodiment of this invention.

In the drawing:

Fig. 1 is a vertical cross section through a device constructed in accordance with this invention, the same being illustrated as a guide shoe in this instance;

Fig. 2 is a view partly in elevation and partly in vertical cross section illustrating the check valve retaining element forming a part of the device illustrated in Fig. 1;

Fig. 3 is a transverse cross section taken along the line 3—3 in Fig. 1.

As in the usual case, the lower end of the casing 1 is threaded to receive the cement shoe. In this instance that shoe consists of a collar 2 having a long internally threaded zone 3 at its upper end and a relatively short internally threaded zone 4 at its lower end. The lower edge of this collar is beveled as illustrated at 5 so as to form a bell-shaped end on the collar.

Threaded into the upper end of the collar before it is placed on the casing 1 is a check valve seat member 6 having a passage 7 therethrough,

the upper end of which is flared as at 8 so as to guide any material passing downwardly through the casing into the passage 7, and the lower end of which is provided with a flexible sealing ring 9 adapted to serve as a valve seat.

The outer surface of this seat element is threaded as shown at 10 so that it may be engaged with the threads 3, and at its lower end this element is provided with a short reduced externally threaded part 11 to which the valve retaining element 12 is secured. This valve retaining element 12, as shown in Fig. 2, consists of an element internally threaded at 13 adjacent its upper end and having downwardly extending flanges 14 turned inwardly at their lower edges as illustrated at 15. The ball check valve 16 is of such a size as to rest against these inwardly turned lower edges 15 and be retained thereby. The ball valve 16 should, of course, be put into position before the valve seating element 6 is inserted into the collar 2, and the retaining member 12 should then be put in place on the element 6. The entire assembly may then be put into the proper position in the collar 2 with one operation.

Threadedly mounted in the lower end of the collar is the guiding element 17. This element is externally threaded to engage the threads 4 in the collar 2 and is provided with a tapered shoulder to engage the flared surface 5 of the collar 2. Its lower end is rounded so as to provide a guide for the device.

The element 17 has a central passageway 18 therethrough in which is provided intermediate its ends an upwardly facing valve seat 19 adapted to receive a ball valve 20. The side wall of this annular element is of U-shaped or channel shaped cross section having a hollowed out annular portion 21 therein open at its upper end. The upper end of the element 17 is provided with a surface which is adapted to receive the frusto-conical diaphragm 22, this diaphragm serving to initially close the upwardly open end of the hollowed out part 21. It is also provided with ribs 23, which would serve to support the ball 16 in the event it should in some manner escape from its retainer. Thus, the ball 16 would be prevented from closing the opening through the element 17.

The diaphragm 22 is made of a frusto-conical shape for the further reason that it will be able to serve as a guide for the ball 20 when the same is dropped into place.

The diaphragm 22 may be cemented or otherwise secured to the element 17, or it may be held

down solely by a hold-down ring 24 mounted within a circumferential channel in the collar 2, the diaphragm in that case being held against the ring 23 by the element 17.

The diaphragm 22 may be made of such thickness that the pressure under which it will break can be accurately predetermined. It may also be of a nature such that it will shatter when it breaks or it may be tough so that when it breaks it will remain in one piece and merely tear sufficiently to permit the passage of fluid. In the event that it is of the nature that it will shatter, the broken particles thereof will be caught in the lower portion of the hollow 21.

Extending outwardly from the hollow 21 are still other openings 25, which are adapted to substantially register with corresponding openings 26 in the collar 2. These openings 25 and 26 may be formed by one drilling operation after the element 17 is in place in the collar 2.

In operation, slush or other liquid may be pumped downwardly through this device as the casing is being lowered into the well because under such circumstances the ball 20 will not be in place and the ball 16 will merely serve as a check valve.

When a point has been reached at which it is desired to begin the cementing operation, the ball 20 will be dropped in at the top of the well and the operation of pumping in the cement will be begun. The ball 20 will pass downwardly through the passage 7 and past the ball 16 and will seat upon the seat 19, which has been described. This will close the passage 18 whereupon it will be possible to build up within the collar 2 a pressure sufficient to rupture the diaphragm 22. Thereupon, the cement, which is being pumped into the well casing, will pass downwardly into the hollow 4 through the ruptured diaphragm 22 and thence out through the openings 25 and 26 into the space about the collar 2.

The cementing operation will thereupon be completed in the usual manner.

It will readily be appreciated that the elements 6, 17 and 22 and ball valves 16 and 20 may be made of any desired substance. Preferably, however, they will be made of some readily drillable substance so that after the cement has set it will be possible to drill down through the cement shoe and continue drilling the well below the lower end of the casing, if desired. Preferably also the threads at the lower end of the collar 2 will be left hand threads, so that the elements 17 may be readily drilled out without rotating within the collar 2.

It will be seen that by this invention there has been provided a structure which may be much readily manufactured and assembled than those heretofore described and claimed in my co-pending applications. In the present instance, for example, it will be seen that the element 6 may be molded in a much simpler mold by virtue of the fact that the retainer 12 is made separate from and is threadedly secured to the element 6. The retainer 12 is also of a nature which makes it very simple to mold.

The element 17 can readily be molded and would require substantially no finishing because there are no close fitting parts. The diaphragm may take various shapes and may in some instances take shapes which could not properly be called a diaphragm, but the main essential is that such element be capable of preventing the flow of liquid into the hollow 4 until the pres-

sure within the collar 2 rises to a predetermined value.

In addition to the above, it sometimes occurs that a casing becomes set tightly on the bottom of the hole in such position that no fluid can be pumped through it, and for some reason the casing cannot be raised. Under these circumstances the present device can be operated by building up sufficient pressure to break the diaphragm, even though no fluid can be pumped through the bottom of the casing, and the cementing operation can thus be carried out, whereas this could not be done in the case of a device in which the cementing operation must be preceded by or accompanied by a flow of fluid through the lower end of the shoe.

Having described my invention, I claim:

1. In a casing shoe, in combination, a pipe, a check valve in said pipe for preventing up flow therethrough, said pipe having independent slush and cement openings therein below said check valve, a frangible closure element initially closing said cement opening and adapted to be fractured by excessive pressure within said pipe, and means independent of said first closure means and movable downwardly past said check valve for closing said slush opening so that excessive pressure may be built up to fracture said first closure means and permit flow through said cement opening.

2. In a casing shoe, in combination, a pipe, a check valve in said pipe for preventing up flow therethrough, said pipe having independent slush and cement openings therein below said check valve, a closure element initially closing said cement opening and of a nature adapted to be ruptured by a predetermined pressure within said pipe but being relatively tough so that it will not shatter upon being ruptured, and means independent of said first closing means and movable downwardly past said check valve for closing said slush opening so that excessive pressure sufficient to rupture first closing means may be built up within said pipe.

3. In a well cementing device, in combination, a pipe, a check valve in said pipe for preventing up flow therethrough, said pipe having independent slush and cement openings therein below said check valve, a frangible diaphragm initially closing said cement opening, and means independent of said first closing means and movable downwardly past said check valve for closing said slush opening so that excessive pressure may be built up within said pipe to cause the rupture of said diaphragm.

4. In a casing shoe, in combination, a pipe, a check valve in said pipe for preventing up flow therethrough, said pipe having independent slush and cement openings therein below said check valve, a frangible element initially closing said cement opening and of a predetermined strength so that it will break under a predetermined pressure within said pipe, and means independent of said first closing means and movable downwardly past said check valve for closing said slush opening so that such predetermined pressure may be built up to rupture said first closing means.

5. In a well cementing device, in combination, a pipe, a check valve in said pipe for preventing up flow therethrough, said pipe having an axial slush opening and circumferentially spaced lateral cement openings independent of each other below said check valve, an annular diaphragm initially closing said cement openings, and means

independent of said annular diaphragm and movable downwardly past said check valve and through said annular diaphragm for closing said slush opening so that an excessive pressure may be built up within said pipe to rupture said annular diaphragm.

6. In a device of the character described, an annular valve seat element having a central opening therethrough with an upwardly facing valve seat therein, said element having an upwardly open recess and the upper surface of said element having a seat for an annular, frangible closure member to close the entrance to said recess, said element having parts on its outer surface for engagement with the inner wall of a pipe to hold said element in place in such pipe, and an opening from the interior of said recess to the outside of said element.

7. In a device of the character described, an annular valve seat element having a central opening therethrough with an upwardly facing valve seat therein, said element having an upwardly open recess and the upper surface of said element having a seat for an annular frangible closure member to close the entrance to said recess, and an opening from the interior of said recess to the outside of said element.

8. In a device of the character described, an annular valve seat element having a central opening therethrough with an upwardly facing valve seat therein, said element having an upwardly open recess and the upper surface of said element having a seat, an annular, frangible closure member to close the entrance to said recess seated upon and secured to said seat, and an opening from the interior of said recess to the outside of said element.

9. In a device of the character described, an annular valve seat element having a central opening therethrough with an upwardly facing valve seat therein, said element having an upwardly open recess and the upper surface of said element having a seat, an annular inverted frusto-conical frangible closure member seated upon said seat to close the entrance to said recess, and an opening from the interior of said recess to the outside of said element.

10. In a device of the character described, an annular valve seat element having a central opening therethrough with an upwardly facing valve seat therein, said element having an upwardly open recess and the upper surface of said element having a seat, an annular inverted frusto-conical closure member seated upon said seat to close the entrance to said recess, and means carried by said closure member adapted to receive a member substantially larger than said valve seat and prevent the closure by such member of the passage through said closure member.

11. In a device of the character described, an annular valve seat element having a central opening therethrough with an upwardly facing

valve seat therein, said element having an upwardly open recess and the upper surface of said element having a seat, an annular frangible closure member adapted to close the entrance to said recess and having an opening therethrough of a size sufficient to permit the passage of a valve to seat upon said valve seat, and an opening from the interior of said recess to the outside of said element.

12. In a device of the character described, an annular valve seat element having a central opening therethrough with an upwardly facing valve seat therein, said element having an upwardly open recess and the upper surface of said element having a seat, an annular inverted frusto-conical closure member seated on said seat to close the entrance to said recess, the opening through said closure member being of a diameter sufficient to permit the passage of a valve to seat upon said valve seat, and an opening from the interior of said recess to the outside of said element.

13. In a device of the character described, a replaceable seat element for a check valve, said element having a downwardly facing valve seat and a threaded exterior surface whereby it may be threadedly engaged with the interior of a pipe section, and having a reduced threaded extension on its lower end, a valve retaining element threadedly engaged with said extension, and a ball valve adapted to seat against said valve seat and freely movably entrapped by said valve retaining element.

14. In a casing shoe in combination, a pipe, said pipe having a central passage with a slush opening therefrom, a recess communicating with said central passage, and a plurality of cement openings providing communication between said recess and the exterior of said pipe, a single frangible diaphragm initially closing off communication between said central passage and said recess, and means independent of said first closing means and movable downwardly past said first closing means for closing said slush opening so that excessive pressure may be built up within said pipe to cause the rupture of said diaphragm.

15. In a casing shoe in combination, a pipe, said pipe having a central passage with a slush opening therefrom, a recess communicating with said central passage, and a plurality of cement openings providing communication between said recess and the exterior of said pipe, frangible means initially closing off communication between said central passage and said recess and adapted to be fractured by excessive pressure within said pipe, and means independent of said first closure means and movable downwardly past said first closure means for closing said slush opening so that excessive pressure may be built up to fracture said first closure means and permit flow through said cement openings.

CHARLES W. THORNHILL.