May 17, 1938. R. C. BAKER 2,117,534

WELL CEMENTING DEVICE

Filed Oct. 10, 1936 2 Sheets-Sheet 1

Fig. 1.

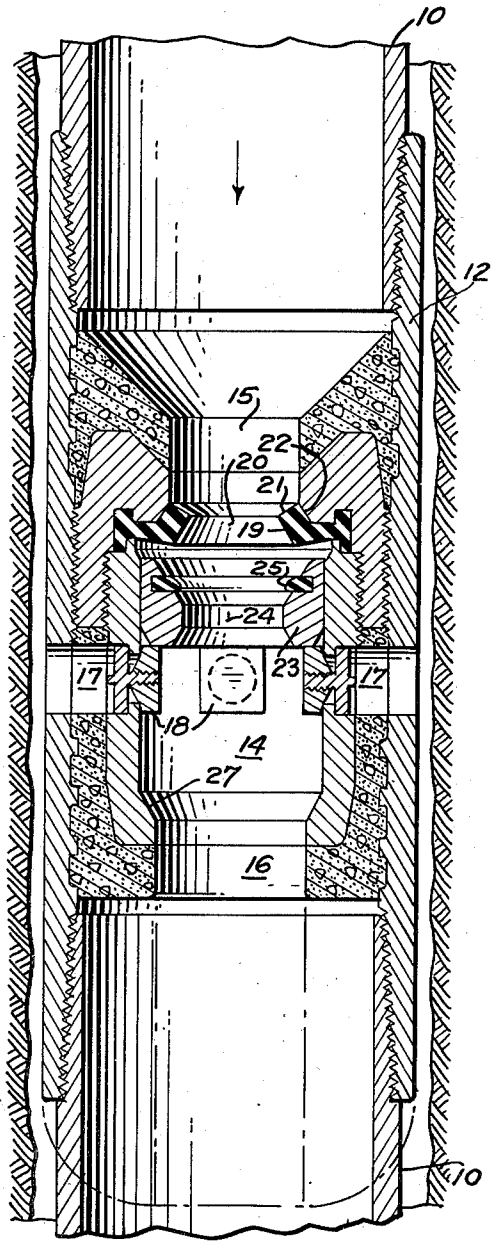
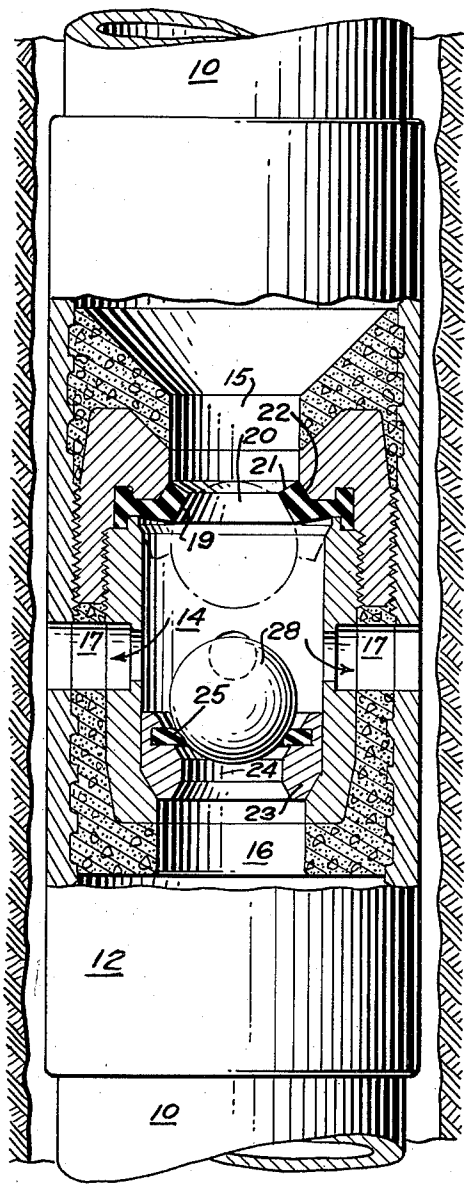


Fig. 2.



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Fig. 3.

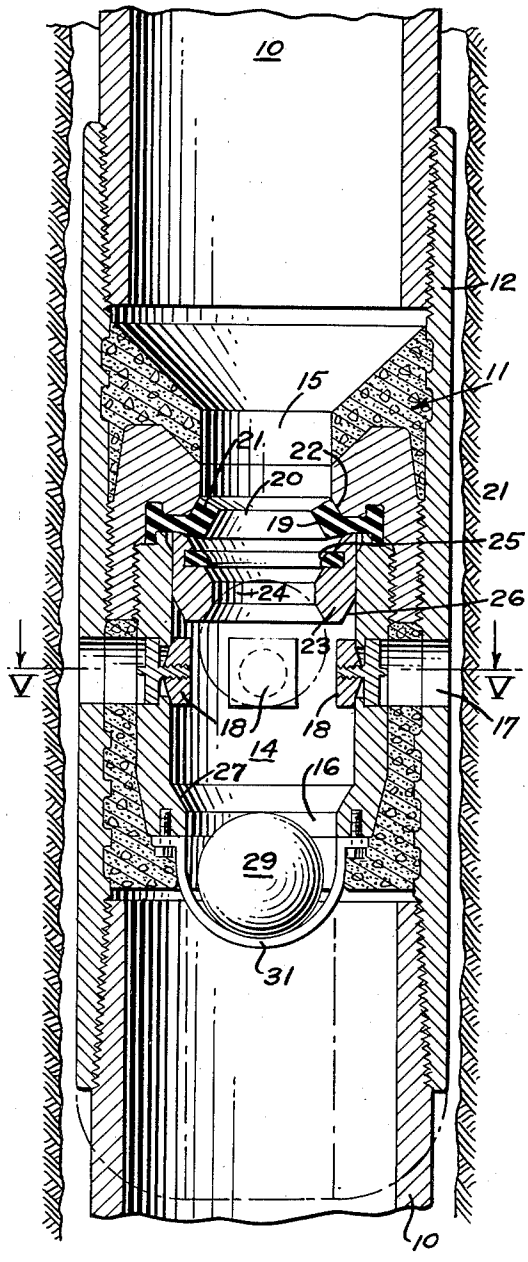


Fig. 4.

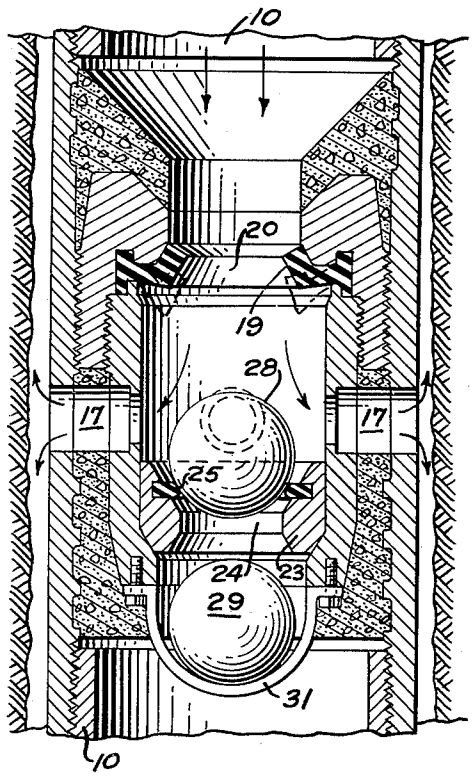
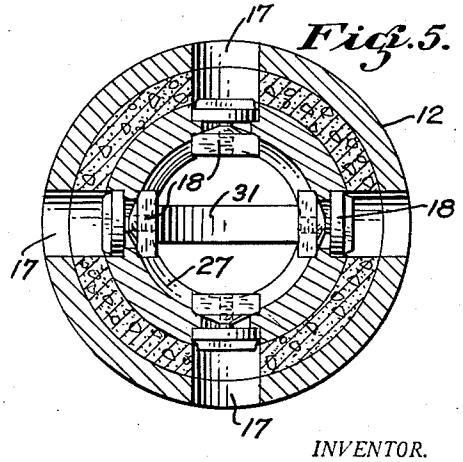


Fig. 5.



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UNITED STATES PATENT OFFICE

2,117,534

WELL CEMENTING DEVICE

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Application October 10, 1936, Serial No. 105,045

11 Claims. (Cl. 166—1)

This invention relates to apparatus for use during the casing of deep oil well bores.

It is the principal object of my present invention to provide an improved cementing apparatus for use in connection with cementing of deep well casings, which device enables a proper washing action to be performed, enables circulation to be had throughout the whole length of the casing, but also enables cement to be discharged from the casing at any point therealong so that any portion of the space between the lower extremity and the surface may be cemented as desired.

One form which the invention may assume is exemplified in the following description and illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a view in central vertical section through a well casing in a well bore, showing the construction of the preferred form of my apparatus.

Fig. 2 is a similar view with the exception that it shows the closures removed from the cementing ports and the parts in the position which they assume during the cementing operation.

Fig. 3 is a central vertical sectional view through the device very similar to Fig. 1 with the exception that it includes a float valve.

Fig. 4 is a view of the device shown in Fig. 3 with the parts in the position they assume during the cementing operation.

Fig. 5 is a transverse sectional view through the device taken on line V—V of Fig. 3.

Referring more particularly to the accompanying drawings, I have there illustrated a well casing 10 disposed in a well bore, which casing is fitted with an apparatus 11 embodying the preferred form of my invention. In the present instance the apparatus 11 is disclosed as adapted to be incorporated in a casing collar so that it may be interposed between lengths of casing at any desired point along the casing between the ends of the latter. It will be obvious, however, that the device may be incorporated in a casing shoe for use at the lower extremity of the well casing.

The device 11 illustrated includes a cylindrical member 12 which, when the device is to be interposed in the casing between its ends, is a casing collar or coupling, and when the device is to be placed at the lower extremity of the casing, the cylindrical member 12 is a casing shoe.

Formed coaxially within the cylindrical member 12 is a cylindrical valve chamber 14, in this instance illustrated as of a diameter considerably less than the interior diameter of the cylindrical member 12, although such is unnecessary as will be apparent from a further description of the device. Extending from the upper end of the valve chamber 14 is an upper passageway 15 which is disposed coaxially of the valve chamber 14, and is of a diameter considerably less than the same. Extending coaxially from the lower end of the valve chamber is a lower passageway 16 which is of a diameter less than the diameter of the valve chamber.

Intermediate the ends of the valve chamber are radial cementing ports 17 which extend from the valve chamber through the cylindrical member 12 so that when these ports 17 are unobstructed, fluid may flow from the valve chamber outwardly through these ports into the annular space between the exterior of the casing or cylindrical member 12 and the well bore. In the present instance I have shown normally fixed plugs or closures 18 for the cementing ports 17 to maintain the same closed during the period prior to the cementing operation. The plugs or closures 18 are, however, releasable as will be hereinafter described, so that they may be released and the ports 17 opened just prior to the cementing operation.

At the junction between the upper end of the valve chamber 14 and the upper passageway 15 I provide a yieldable valve seat member 19 of the type described and claimed in a copending application filed by myself and Oscar A. Mellin, which application is entitled "Valve structure for well casings and tubing," filed October 10, 1936, bearing Serial No. 105,047. The yieldable valve seat member 19 is preferably formed of such yieldable or pliable material as rubber, and is disk-like and is anchored at its outer perimeter adjacent the perimeter of the valve chamber, as illustrated. The yieldable valve seat member 19 is formed with a central valve port 20 which is arranged coaxially of the valve chamber 14 and the upper passageway 15. The valve port mentioned is somewhat less in diameter than the diameter of the upper passageway 15. The valve port 20 in the valve seat member 19 is surrounded by an upturned conical flange 21 which abuts at its upper and outer surface against a conical shoulder face 22 formed at the junction between the valve chamber 14 and the upper passageway 15.

Reciprocably mounted within the chamber 14 for reciprocation coaxially thereof is an annular piston 23 formed with a central port extending coaxially therethrough as at 24. Surrounding the upper end of the port 24 is a valve seat 25 and surrounding the lower end of the annular piston at its perimeter is a conical seating face 26 adapted to cooperate with a conical seating face 27 formed at the junction between the valve chamber 14 and the lower passageway 16. The annular piston is, at commencement of operation, disposed intermediate the radial cementing ports 17 and the upper end of the valve chamber 14, and it should be stated that when in this position, it is free to move vertically of the valve cham-

ber. It will be noticed that the closures or plug members 18 for the cementing ports 17 have portions projecting within the valve chamber 14 so that the annular piston 23 cannot move below the radial cementing ports 17 until the projections of the closures 18 are removed.

For cooperation with the device just described there is a main ball valve member 28. This ball valve member 28 is slightly less in diameter than the upper passageway 15, although it is greater in diameter than the port 20 formed through the yieldable valve seat member 19. The main ball valve 28 is likewise greater in diameter than the port 24 formed through the piston 23, so that it will properly seat on the seat 25 of this piston. It should be explained that when the main ball valve 28 is pumped downwardly through the casing and passes through the passageway 15, it will expand the port 20 of the yielding valve seat member 19 and will pass therethrough into the valve chamber and will seat on the seat 25 of the annular piston 23. However, when the ball 28 attempts to pass upwardly through the port 20 of the flexible seat member 19 after it is once positioned in the valve chamber, the yieldable valve seat member will not expand and therefore the ball will cooperate with the seat thereof, and which surrounds the port 20, closing the port 20 against the upward flow of fluid therethrough.

I have found in actual practice that the ball may pass downwardly through the flexible valve seat as described without any indicated gauge pressure, and I have also found that it cannot be forced upwardly through the port 20 at a gauge indication of three thousand pounds per square inch. This is obvious when it is noticed that the conical flange surrounding the port 20 will be prevented from expansion when the ball attempts to pass upwardly through the port 20 due to its engagement with the tapered annular shoulder face 22.

The closures 18 for the cementing ports 17 are so constructed as illustrated that when the lower end of the piston 23 engages the inner projections thereon and sufficient pressure is applied downwardly to the piston, the latter will shear said projections and thereby release the plugs or closures 18, so that the latter may pass outwardly through the ports 17 so that the latter will be unobstructed. Upon the removal of these projections and the release of the closures or plugs, the annular piston will travel downwardly and the face 26 thereon will seat on the face 27 at the junction between the lower passageway 16 and the valve chamber 14, and the annular piston together with the ball will form a closure for the lower passageway and prevent the passage of fluid downwardly therethrough so that the latter must pass out through the radial cementing ports 17.

When the pressure within the casing becomes less or is equalized with the external pressure, the ball 28 will rise and seat on the seat of the valve port 20 of the yieldable valve member 19 and prevent the return of cement from the exterior of the casing through the ports and upwardly into the casing. In this capacity, the ball 28 acts, of course, as a back pressure valve. The ball 28 may be, if desired, of a specific gravity less than that of fluid cement and greater than that of mud fluid so that it may be pumped down the hole with the mud and will float in the fluid cement thereafter to its seat as previously described.

The device disclosed in Figs. 3 and 4 is exactly the same as that disclosed in Figs. 1 and 2 with the exception that in Figs. 3 and 4 the device is fitted with a float valve 29 which will act to enable the casing to be floated into place. That is to say, this ball valve 29 will, when the casing is being lowered into the hole, float upwardly and seat on a valve seat 30 which surrounds the lower end of the port 24 through the annular piston 23, and thereby prevent the passage of fluid upwardly through the upper passageway 15 from the valve chamber 14 so that the casing will be floated into place in the hole. A single narrow strap 31 is provided at the lower end of the passageway 16 to retain the ball in the valve chamber. The ball 29 is less in diameter than the passageway 16 so that fluid may freely pass downwardly through this passageway 16 even though the ball is therein disposed as illustrated.

In operation of the device, if it is constructed for use at any point in the string of casing between the ends thereof, it is constructed as in Figs. 1 and 2, or as in Figs. 3 and 4 should it be desired to provide a float valve therefor. If, however, the device is to be used at the lower extremity of the casing, it will be constructed as shown in the broken lines in Figs. 1 and 3. In other words, my device is adapted for use either at the lower extremity of the casing or at any intermediate point therealong.

If the device of Figs. 1 and 2 is employed, it is connected with the well casing at the proper point and the latter is lowered into the hole minus the ball 28. When the casing has been positioned in the bore and it is desired to cement through the ports 17, the ball 28 is pumped downwardly through the casing and will pass through the upper passageway 15 through the port 20 of the flexible valve seat member 19 into the valve chamber and will bear against the valve seat 25 of the annular piston 23. Fluid pressure above the ball will then cause the piston to move downwardly and shear the projections of the closures or plugs 18 and release the latter. The sheared projections will, of course, drop downwardly through the valve chamber and through the lower passageway 16. The fluid pressure will, of course, blow the remaining portions of the plugs 18 outwardly through the ports 17.

When the annular piston 23 reaches the bottom of the valve chamber, its seating face 26 will seat on the face 27 at the junction between the valve chamber and the lower passageway 16 and the pump pressure will keep the ball 28 seated on the seat 25, preventing the passage of fluid downwardly through the lower passageway 16. Thereafter the cement is introduced into the casing and pumped downwardly under pressure, and as it cannot pass downwardly through the passageway 16, it will discharge through the radial cementing ports 17 and upwardly around the casing. When the cementing pressure is discontinued, the ball 28 will rise and seat on the seat surrounding the port 20 in the flexible seat member 19 and prevent the cement from backing up into the well casing.

The operation of the device shown in Figs. 3 and 4 is the same except that when the casing is being lowered into the hole, the ball 29 will seat upwardly on the seat 30 and prevent the passage of fluid upwardly into the casing, and consequently enable the casing to be floated into place in the well bore.

From the foregoing it is obvious that I have provided a very simple and efficient device by means of which fluid may be pumped directly

and coaxially downwardly through the well casing for the purpose of washing down or circulation, and that thereafter cement may be ejected from the casing at any desired point through radial ports in the side thereof.

There are a considerable number of uses to which my invention may be put; for example, in cementing off combination strings, for spotting cement at any particular point along the casing, such as between oil sands, or for cementing off any portion of the bore between the bottom of the casing and the upper end thereof. When used in connection with combination jobs or in spotting cement, bootleg packers or their equivalent may be employed as will be obvious to one skilled in the art, and while I have shown the preferred form of my invention, it is to be understood that various changes may be made in its construction by those skilled in the art without departing from the spirit of the invention as defined in the appended claims.

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

1. In combination with a well casing, a tubular member adapted to be connected therewith, said member having a chamber formed therein, said member having cementing ports extending outwardly therethrough from said chamber, a normally fixed closure for each of said ports, releasing means in said chamber for releasing said closures, and a ball member adapted to be positioned in the casing after the same has been lowered into a well bore to engage said releasing means and when fluid pressure is exerted thereagainst to actuate the same to release said closures.

2. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein and an upper passageway extending from said chamber upwardly, said passageway being of a diameter less than the diameter of said chamber, a yieldable valve seat member circumscribing said passageway and having a port formed therethrough less in diameter than said passageway, a valve member permitted by said seat member to pass through said upper passageway and said port in one direction only, so when it attempts to pass through said port in the opposite direction it will seat on said yieldable valve seat member and effect closing of said port and said passageway, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, normally effective closure means for said ports, releasing means in said chamber capable of releasing said closure means, said releasing means being capable of operation by said valve member when the latter has passed into said chamber through said port.

3. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein, an upper passageway extending from said chamber upwardly, said passageway being of a diameter less than the diameter of said chamber, a yieldable valve seat member circumscribing said passageway and having a port formed therethrough less in diameter than said passageway, a valve member permitted by said seat member to pass through said upper passageway and said port in one direction only, so when it attempts to pass through said port in the opposite direction it will seat on said yieldable valve seat member and effect closing of said port and said passageway, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, a normally fixed closure for each of said ports, releasing means in the chamber for releasing said closures, said releasing means being operated by said valve member after the latter has passed into said chamber through said upper passageway and port.

4. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein and an upper passageway extending from said chamber upwardly, said passageway being of a diameter less than the diameter of said chamber, a yieldable valve seat member circumscribing said passageway and having a port formed therethrough less in diameter than said passageway, a valve member permitted by said seat member to pass through said upper passageway and said port in one direction only, so when it attempts to pass through said port in the opposite direction it will seat on said yieldable valve seat member and effect closing of said port and said passageway, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, a normally fixed closure for each of said ports, an annular piston reciprocably mounted in said chamber and capable when sufficient pressure is exerted thereon to effect release of said closures, said annular piston being normally disposed in said chamber between said ports and said flexible valve seat member and capable of being engaged by said valve member so that when pressure is exerted on the latter from above it will force said piston downwardly in said chamber and effect release of said closures.

5. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein, an upper passageway extending from said chamber upwardly, said passageway being of a diameter less than the diameter of said chamber, a yieldable valve seat member circumscribing said passageway and having a port formed therethrough less in diameter than said passageway, a valve member permitted by said seat member to pass through said upper passageway and said port in one direction only, so when it attempts to pass through said port in the opposite direction it will seat on said yieldable valve seat member and effect closing of said port and said passageway, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, a normally fixed closure for each of said ports, an annular piston reciprocably mounted in said chamber and capable when sufficient pressure is exerted thereon to effect release of said closures, said annular piston being normally disposed in said chamber between said ports and said flexible valve seat member and capable of being engaged by said valve member so that when pressure is exerted on the latter from above it will force said piston downwardly in said chamber and effect release of said closures, said chamber being reduced in diameter at its lower end to form a lower passageway, said piston being capable of seating at the junction between said chamber and the lower passageway whereby the piston and the valve member when seated thereon may form a closure for the lower passageway.

6. In combination with a well casing, a tubular member adapted to be connected therewith, said

tubular member having a chamber formed therein, an upper passageway extending from said chamber upwardly, said passageway being of a diameter less than the diameter of said chamber, a yieldable valve seat member circumscribing said passageway and having a port formed therethrough less in diameter than said passageway, a valve member permitted by said seat member to pass through said upper passageway and said port in one direction only, so when it attempts to pass through said port in the opposite direction it will seat on said yieldable valve seat member and effect closing of said port and said passageway, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, a normally fixed closure for each of said ports, an annular piston reciprocably mounted in said chamber and capable when sufficient pressure is exerted thereon to effect release of said closures, said annular piston being normally disposed in said chamber between said ports and said flexible valve seat member and capable of being engaged by said valve member so that when pressure is exerted on the latter from above it will force said piston downwardly in said chamber and effect release of said closures, said chamber being reduced in diameter at its lower end to form a lower passageway, said piston being capable of seating at the junction between said chamber and the lower passageway whereby the piston and the valve member when seated thereon may form a closure for the lower passageway, said valve member being buoyant in fluid cement whereby it may rise and seat on said flexible seat member.

7. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein, a ball member adapted to pass downwardly into said chamber, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, normally effective closure means for said ports, releasing means in said chamber capable of rendering said closure means ineffective, said releasing means being capable of operation by said ball member when the latter has passed into said chamber through said port.

8. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein, a member adapted to pass downwardly through the casing into said chamber, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, a normally fixed closure for each of said ports, an annular piston reciprocably mounted in said chamber and capable when sufficient pressure is exerted thereon to effect release of said closures, said annular piston being normally disposed in said chamber between said ports and the upper end of said chamber and capable of being engaged by said member so that when pressure is exerted on the latter from above it will force said piston downwardly in said chamber and effect release of said closures.

9. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein, a ball adapted to pass downwardly through the casing into said chamber, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, a normally fixed closure for each of said ports, an annular piston reciprocably mounted in said chamber and capable when sufficient pressure is exerted thereon to effect release of said closures, said annular piston being normally disposed in said chamber between said ports and the upper end of said chamber and capable of being engaged by said ball so that when pressure is exerted on the latter from above it will force said piston downwardly in said chamber and effect release of said closures, said chamber being reduced in diameter at its lower end to form a lower passageway, said piston being capable of seating at the junction between said chamber and the lower passageway whereby the piston and the ball when seated thereon may form a closure for the lower passageway.

10. In combination with a well casing, a tubular member adapted to be connected therewith, said tubular member having a chamber formed therein, an upper passageway extending from said chamber upwardly, said passageway being of a diameter less than the diameter of said chamber, a yieldable valve seat member circumscribing said passageway and having a port formed therethrough less in diameter than said passageway, a valve member permitted by said seat member to pass through said upper passageway and said port in one direction only, so when it attempts to pass through said port in the opposite direction it will seat on said yieldable valve seat member and effect closing of said port and said passageway, said tubular member having radial ports formed therein extending from said chamber outwardly through said member, a normally fixed closure for each of said ports, an annular piston reciprocably mounted in said chamber and capable when sufficient pressure is exerted thereon to effect release of said closures, said annular piston being normally disposed in said chamber between said ports and said flexible valve seat member and capable of being engaged by said valve member so that when pressure is exerted on the latter from above it will force said piston downwardly in said chamber and effect release of said closures, said chamber being reduced in diameter at its lower end to form a lower passageway, said piston being capable of seating at the junction between said chamber and the lower passageway whereby the piston and the valve member when seated thereon may form a closure for the lower passageway, said valve member being buoyant in fluid cement whereby it may rise and seat on said flexible seat member, and a float valve member in said chamber to seat on the underside of said piston to prevent the flow of fluid upwardly through the upper passageway.

11. In combination with a well casing, a tubular member adapted to be connected therewith, said member having a chamber formed therein, said member having cementing ports extending outwardly therethrough from said chamber, a normally fixed closure for each of said ports, releasing means in said chamber for releasing said closures, and means capable of operation after the casing has been positioned in a well bore and operated by fluid pressure for actuating said releasing means, and a float valve and float valve seat in said chamber to enable floating the casing in a well bore.

REUBEN C. BAKER.