

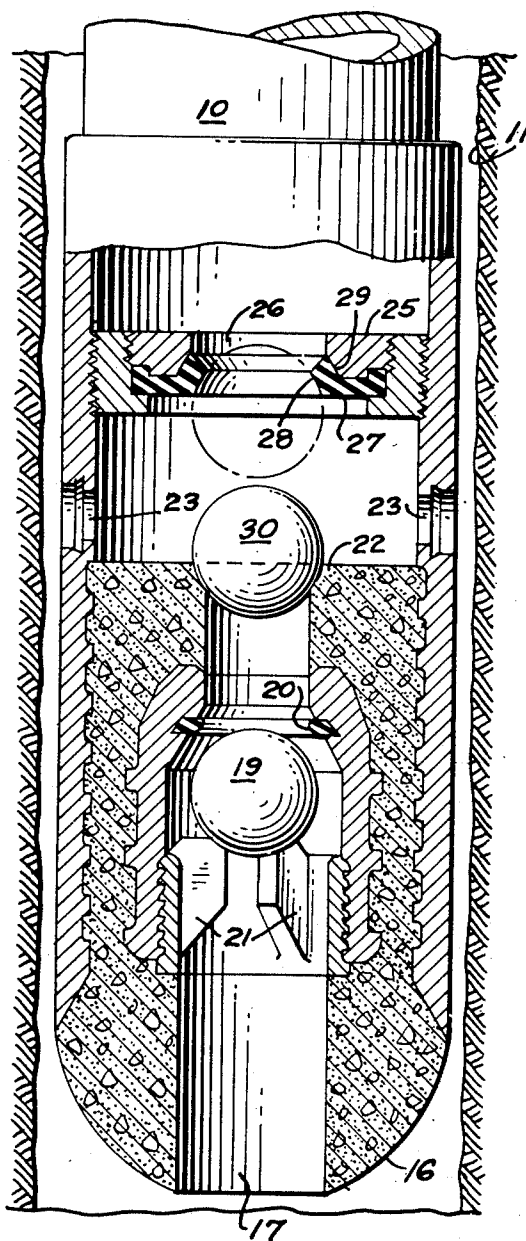
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VALVE STRUCTURE FOR WELL CASINGS AND TUBING

Filed Oct. 10, 1936

2 Sheets-Sheet 1

Fig. 2.



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May 17, 1938.

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2,117,536

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Fig. 3.

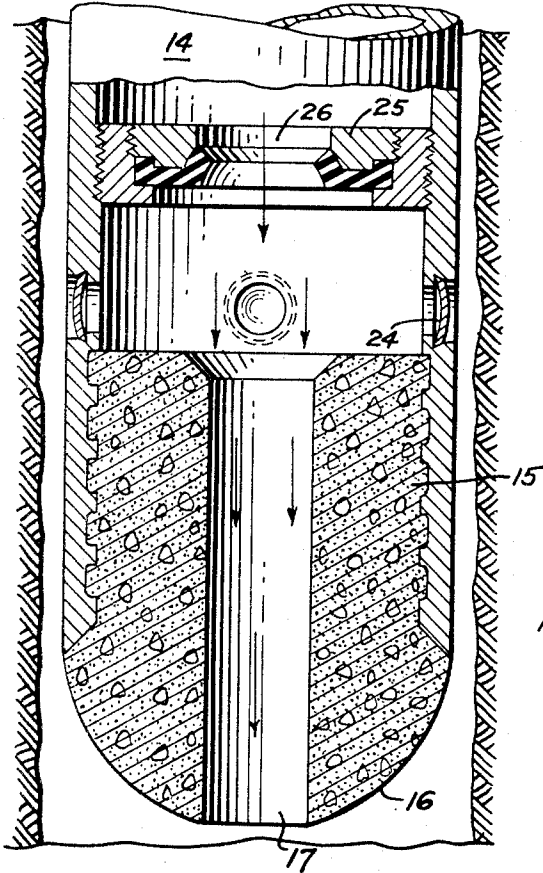


Fig. 4.

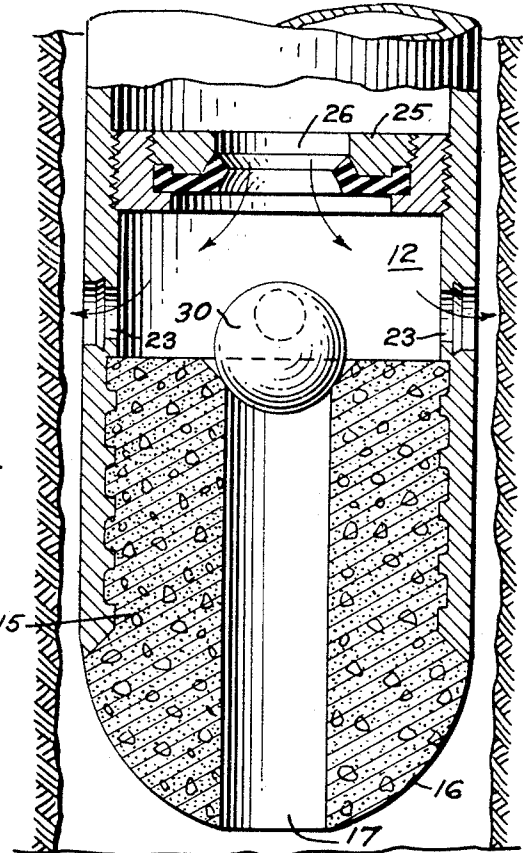


Fig. 6.

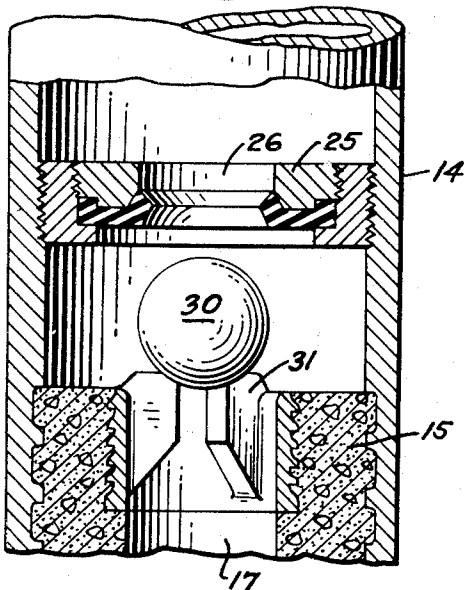
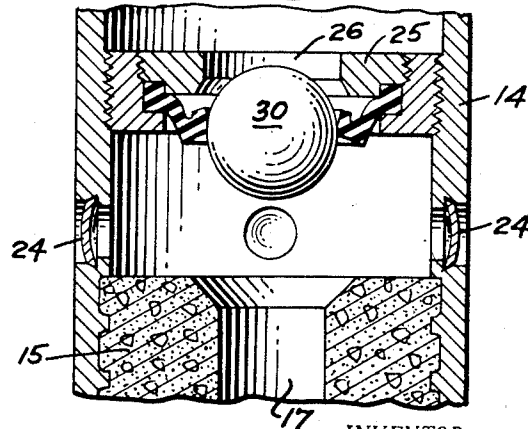


Fig. 5.



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2,117,536

VALVE STRUCTURE FOR WELL CASINGS
AND TUBING

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Application October 10, 1936, Serial No. 105,047

5 Claims. (Cl. 166—9)

This invention relates to valve structures for use in well casings or other tubing employed during the drilling of deep oil wells.

It is the principal object of our present invention to provide a novel valve structure for well casings and other tubing employed in wells, which enables the casing or tubing to be equipped with a back pressure valve at any point below the top of the valve bore after the casing or tubing is positioned in the well bore.

There are a considerable number of uses to which devices embodying our invention may be put, but in the present application we have shown it applied to a well casing cementing device for use in cementing casing in an oil well bore.

In practicing our invention, we provide a barrier fitted to the casing or tubing prior to the time the same is lowered into the well bore, which barrier is formed with a coaxial valve port. Surrounding this port is a yieldable valve seat member. A ball or like valve member is provided which may be passed from one side of the barrier to the other through the port, due to the fact that when the valve member enters the port, the yieldable seat will expand and enable it to pass there-through. The yieldable seat, however, will not yield when the valve member attempts to pass through the port in the opposite direction so that when the valve member engages it, closing of the valve port through the barrier will result. This enables the casing to be lowered into the bore minus the valve member itself so that the fluid may be pumped downwardly through the casing, and fluid may pass upwardly through the casing in the opposite direction, if so desired. After the casing has been positioned, or if at any other time it is desired to provide a back pressure valve, the latter may be pumped, or otherwise passed, down the casing. It will pass through the valve port in the barrier, and thereafter act as an upwardly seating back pressure valve in cooperation with the valve seat member, so that fluid may not pass upwardly through the valve port in the barrier.

In the present application our novel valve structure is combined with other elements so that while lowering the casing into the bore, washing fluid may be pumped coaxially downward through the lower end of the casing. Thereafter the valve member is passed downwardly through the barrier and engages a second valve seat in a second barrier spaced below the first-named, and acts to shut off the flow of fluid through the lower end of the casing so that a subsequently introduced charge of cement may be discharged

through the sides of the casing intermediate the two barriers. After the cementing operation, the valve member rises to seat on the upper barrier against the seat member and prevents the cement from flowing back and upwardly into the casing through the first barrier.

It is obvious that a well cementing device capable of such functions is ideal for certain kinds of cementing jobs.

The invention is exemplified in the following description and illustrated by way of example in the accompanying drawings, in which:

Fig. 1 is a central vertical sectional view through a well cementing device including our improved valve structure disclosing the arrangement of the parts as the device is lowered into the well bore.

Fig. 2 is a similar view showing the valve of our improved valve construction in the position it will assume during the cementing operation.

Fig. 3 shows a different form of the device illustrated in Fig. 1, different in that it is not equipped with a float valve.

Fig. 4 is a similar view of the same device disclosed in Fig. 3 showing the ball of our improved valve structure in the position it assumes during the cementing operation.

Fig. 5 is a fragmentary view of our improved valve structure showing the manner in which the ball passes through the yielding valve seat.

Fig. 6 is a third form of device embodying our invention.

Referring more particularly to Fig. 1, we have there disclosed a well casing 10 positioned in a well bore 11. Fitted to the lower end of this casing is a device 12 embodying our invention. This device 12 includes a casing shoe 14 having a lower barrier 15 mounted therein, and in this instance this lower barrier 15 is in the form of a cement plug cast directly into the lower end of the casing shoe and terminating in a guide nose 16, as in usual practice. We desire to point out here, however, that instead of the casing shoe 14, the device may be incorporated in a casing collar, and may be positioned at any point along the well casing 10 between casing sections.

The lower barrier 15 is formed with a central coaxial passageway 17, interposed in which is a float valve structure 18. This float valve structure is such that when the casing is lowered into the well bore, the valve 19 will seat upwardly on the seat 20 to prevent the passage of fluid upwardly into the casing, so that the latter may be floated into the bore. However, when pump pressure is exerted downwardly in the casing, the

valve 19 seats on the lugs 21 and does not obstruct the flow of fluid downwardly through the passageway 17. This back pressure valve structure does not form a part of the present invention.

At the upper end of the lower barrier 15 and surrounding the upper end of the passageway 17 is a valve seat 22, which in this instance we prefer to term a bridging valve seat. Formed in the casing just above the lower barrier 15 are a plurality of radial ports 23. These ports are formed through the wall of the casing shoe or collar 14 and are fitted with "Welch" plugs 24. This type of plug and its characteristics are old and well known, and it will suffice to say that they will stand considerable pressure from the exterior but will release upon a much lesser pressure from within the casing shoe 14.

Fitted within the casing shoe or coupling 14 above the lower barrier and above the ports 23 is an upper barrier 25 formed principally of rigid but drillable material. This transverse upper barrier is formed with a coaxial valve port 26. At the underside of the barrier 25 is a yielding valve seat member 27 having a port 28 formed there-through in alignment with the port 26 in the unyielding portion of the barrier 25. This valve seat member 27 is formed of such flexible or pliable material, as rubber, and is disk-like and is anchored at its outer perimeter in the unyieldable portion of the barrier 25, as illustrated. The port 28 of the yieldable valve seat 27 is surrounded by an upturned annular flange which abuts at its upper and outer side against a tapered shoulder 29 on the unyielding portion of the barrier 25, as illustrated.

To cooperate with the upper barrier is a ball valve member 30. This ball valve member 30 is slightly less in diameter than the port 26 through the unyielding portion of the upper barrier, but it is greater in diameter than the port 28 formed through the yielding valve seat member 27. However, when this ball 30, as illustrated in Fig. 5, is pumped downwardly through the casing and passes through the port 26, it will expand the port 28 of the yieldable valve seat member 27 and will pass therethrough. However, when the ball 30 attempts to pass upwardly through the port 28, the yieldable valve seat will not expand and therefore the ball will cooperate with this seat in closing the port through the upper barrier.

We have found in actual practice that the ball 30 may pass downwardly through the upper barrier without any indication of pressure on the gauge, and we have found that it cannot be forced upwardly through the upper barrier at a gauge indication of 3000 pounds per square inch.

It will be seen, of course, that the portion of the yieldable valve seat member 27 surrounding the port 28 will be prevented from expansion when the ball 30 attempts to pass upwardly through the port, due to its engagement with the tapered annular shoulder 29.

It should be stated that the ball 30 is of a diameter greater than the passageway 17 through the lower barrier 15, and is capable of seating on the seat 22 to shut off the flow of fluid through the lower barrier.

The device illustrated in Figs. 3 and 4 is exactly the same in construction as that shown in Figs. 1 and 2, with the exception that the lower barrier 15 is not equipped with a float valve structure, which is indicated at 18 in Figs. 1 and 2. The upper barrier and the ball 30 to-

gether with the cementing ports 23 are identical to that illustrated in Figs. 1 and 2.

In Fig. 6 the device there illustrated is the same as shown in Figs. 1 to 4, inclusive, with the exception that lugs 31 are provided above the passageway 17 in the lower barrier 15 to prevent the ball 30 from bridging the passageway through the lower barrier 15. In this device likewise the side cementing ports are eliminated due to the fact that during the cementing operation the cement will pass around the ball 30 between the lugs 31 and downwardly through the passageway 17. In other words, the form of the device shown in Fig. 6 is a back pressure valve structure which may be rendered effective after the well casing or tubing has been placed in the well bore.

In operation of the device, assuming that it is embodied either as a casing shoe at the lower terminal of the casing, or as a collar interposed between the casing sections somewhere intermediate the ends of the casing, it is constructed substantially as illustrated. If it is constructed as illustrated in Figs. 1 and 2, the moment that it is lowered in the well casing, the ball 19 will seat on its seat 20 and prevent the passage of fluid upwardly through the casing so that the latter will be what is known as "floated" into place. The "Welch" plugs 24 being able to withstand a tremendous pressure from the exterior will prevent the passage of fluid into the casing through the cementing ports 23. If a bridge is encountered, or if for any other reason it is desired to wash down, washing or circulating fluid may be pumped downwardly through the casing, unseating the valve 19 and passing outwardly through the lower end of the passageway 17. It should be pointed out here that in order to properly wash down, the fluid must be discharged through the lower end of the casing. The washing fluid is not discharged at a pressure great enough to blow out the "Welch" plugs 24 so that no washing fluid will be discharged through the cementing ports 23. After the casing has been positioned, and it is desired to cement through the ports 23, the ball valve 30 is pumped downwardly through the casing and will enter the port 26 in the rigid portion of the upper barrier 25. The pressure is sufficient to pass the ball 30 through the yielding valve seat member 27, as illustrated in Fig. 5.

In the form of the device as illustrated in Figs. 1 to 4, inclusive, the ball 30 will then seat on the seat 22 at the upper end of the passageway 17 through the lower barrier, shutting off the flow of fluid through the lower barrier. The cement is then placed in the casing, and in fact it may be placed in the casing just after the ball and forced downwardly through the port in the upper barrier at a pressure great enough to blow out the "Welch" plugs 24 in the cementing ports 23. The cement will then eject through these ports 23 and travel upwardly around the casing, cementing the same in.

After the cementing operation is complete and the pressure within the upper end of the casing is less than the pressure exteriorly of the casing, the ball 30 will float upwardly against the yieldable valve seat member 27, and as it cannot pass upwardly through the port 28 in this valve seat, it will entirely shut off the back flow of cement upwardly through the port in the upper barrier. It should be stated that we prefer that the ball 30 be buoyant in fluid cement but not buoyant in the circulating or mud fluid.

In the form of the device shown in Figs. 3 and

4, the operation will be exactly the same, with the exception that due to the fact that the lower barrier 15 in this form of the device is not fitted with a float valve structure 18, the casing will not be "floated" into place. In all other respects, however, the operation is the same.

In the form of the device shown in Fig. 6, the casing is lowered without the ball 30 in place so that there is a free travel of fluid both upwardly and downwardly of the casing. When it is desired to cement, however, the ball 30 is first positioned as previously described and then the cement is discharged downwardly through the casing and through the passageway 17 in the lower barrier and discharged. Upon discontinuing of the cementing pressure, the ball 30 will float to its seat, preventing the back flow of cement upwardly through the upper barrier.

Our present application is particularly concerned with the novel valve structure arrangement, which enables a back pressure valve to be rendered effective at any time after the casing is in place in the well bore, and we are aware that it has a great many applications and uses in connection with well cementing devices and in various other capacities, although we are aware also that the present type of cementing device has ideal characteristics for well cementing jobs of various kinds.

While we have shown specific applications of our invention, it is to be understood that various changes may be made in its construction, as well as in its application, without departing from the spirit of the invention as defined in the appended claims.

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

1. In combination with a tubular member, a transverse barrier formed therein, said barrier having a port formed longitudinally therethrough, a valve member of a dimension less than said port whereby it may pass therethrough, a yieldable valve seat member adjacent the barrier and surrounding said port and having an opening therethrough of a dimension less than said valve member, said yieldable valve seat member being capable of expansion when said valve member attempts to pass therethrough in one direction so that the valve member may pass through the port and through said valve seat member in said direction, said yieldable valve seat member being held by said barrier against expansion when the valve member attempts to pass therethrough in the opposite direction whereby closure of said port will be effected.

2. In combination with a well casing, a lower barrier fixed therein, said lower barrier having a passageway formed therethrough, an upper barrier fixed in the casing and spaced upwardly from the lower barrier, said upper barrier having a port formed longitudinally therethrough, a yieldable valve seat member adjacent said port, a valve member adapted to pass downwardly through said port and yieldable valve seat member, the latter yielding to permit such passage of the valve member, the said valve seat member being prevented by the upper barrier from being

expanded by the valve member when the same attempts to pass upwardly through the upper barrier whereby the valve member will close said port.

3. In combination with a well casing, a lower barrier fixed therein, said lower barrier having a passageway formed therethrough, an upper barrier fixed in the casing and spaced upwardly from the lower barrier, said upper barrier having a port formed longitudinally therethrough, a yieldable valve seat member adjacent said port, a valve member adapted to pass downwardly through said port and yieldable valve seat member, the latter being yieldable to permit such passage of the valve member, the said valve seat member being held by the upper barrier from being expanded by the valve member when the same attempts to pass upwardly through the upper barrier whereby the valve member will close said port, said well casing having a plurality of cementing ports formed through the said wall thereof intermediate said barriers, and a valve seat formed at the upper end of the passageway through said lower barrier upon which said valve member may seat.

4. In combination with a well casing, a lower barrier fixed therein, said lower barrier having a passageway formed therethrough, an upper barrier fixed in the casing and spaced upwardly from the lower barrier, said upper barrier having a port formed longitudinally therethrough, a yieldable valve seat member adjacent said port, a valve member adapted to pass downwardly through said port and yieldable valve seat member, the latter yielding to permit such passage of the valve member, the said valve seat member being prevented by the upper barrier from being expanded by the valve member when the same attempts to pass upwardly through the upper barrier whereby the valve member will close said port, and a float valve structure incorporated in said lower barrier.

5. In combination with a well casing, a lower barrier fixed therein, said lower barrier having a passageway formed therethrough, an upper barrier fixed in the casing and spaced upwardly from the lower barrier, said upper barrier having a port formed longitudinally therethrough, a yieldable valve seat member adjacent said port, a valve member adapted to pass downwardly through said port and yieldable valve seat member, the latter yielding to permit such passage of the valve member, the said valve seat member being held by the upper barrier from being expanded by the valve member when the same attempts to pass upwardly through the upper barrier whereby the valve member will close said port, said well casing having a plurality of cementing ports formed through the said wall thereof intermediate said barriers, and a valve seat formed at the upper end of the passageway through said lower barrier upon which said valve member may seat, and a float valve structure incorporated in said lower barrier.

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