This invention relates to devices for use during the drilling or reconditioning of oil well bores. It is the principal object of the present invention to provide an improved bridge plug and cement retainer which may be lowered into a well bore and then actuated by fluid pressure to expand into intimate contact and packing relation with the wall of the bore, both to form a seal between the device and the wall of the bore, and to secure the device in position in the bore.

In practicing my invention, I provide a hollow body member which may be detachably secured to the lower end of a string of running in tubing and run into place in a well bore. The body member is fitted with a normally collapsed packing member which, after the device is positioned in the bore, may be expanded by fluid pressure into packing relation with the wall of the bore and retained in such condition. The body is provided with back pressure and bridging valve means to enable it to be used in various capacities.

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

Fig. 1 is a view in central longitudinal section through a device embodying the preferred form of my invention with the parts thereof in the position which they assume when the device is being lowered into a well bore.

Fig. 2 is a similar view with the exception that the packing element of the device is shown in expanded condition.

Referring more particularly to the accompanying drawing, 10 indicates an elongated cylindrical body member, the same being formed with a central longitudinal passageway 11 formed coaxially therethrough. At its lower end this passageway terminates in a valve seat 12 controlled by a spring-pressed back pressure valve 14 which opens downwardly. When this valve 14 is seated, it is obvious that the lower end of the passageway 11 will be closed and fluid will be unable to pass upwardly through the body, although fluid under proper pressure may be forced downwardly through the body, opening the valve 14 and discharging.

The valve 14 is fitted with a valve stem 15 guided in a suitable bearing 16 formed in the body. An expansion spring 17 is positioned between the guide 16 and an enlarged head 18 secured on the upper end of the valve stem 15. It will be noticed that the passageway 11 is similarly reduced in diameter at a point intermediate its ends, which point is indicated by the numeral 19. Mounted within this reduced bore 19 is a trip sleeve 20 which is hollow and cylindrical, and which is formed with a trip ball valve seat 21 at its upper end. The trip sleeve 20 is formed with depending legs 22 which are secured to the valve stem head 18 by means of a shear pin 23. The trip sleeve 20 is secured in position within the reduced bore 19 by a shear pin 24. The position of the sleeve so secured is such as to hold the valve 14 unsealed so that when the device is being run into the hole, fluid may freely pass upwardly through the body, and likewise circulating or washing fluid may be pumped downwardly through the body.

Arranged about the exterior periphery of the body 10 is an elongated cylindrical packing member 25, preferably formed of rubber or some other suitable pliable material. The lower end of this packing member 25 is suitably anchored to the lower end of the body by means of a clamping ring 26 screwed to the body as illustrated. The upper end of the packing member 25 has a ring 30 secured thereto which is slidably mounted on the exterior of the body. The ring 27 carries an interiorly arranged split latch ring 28 adapted to engage circular serrations 29 formed about the exterior of the body. These serrations permit the ring 27 and its latch ring 28 to move longitudinally and downwardly of the body 10 but not in the opposite direction.

Arranged on the body and slidably with respect thereto is a circular piston 30 which is reciprocable in a circular cylinder 31 formed between the exterior perimeter of the body 10 and the interior perimeter of a cylinder member 32 threadedecured to the body as at 33. At its upper end the cylinder 31 communicates with the interior bore 41 of the body 10 through ports 34. The lower end of the circular piston 30 abuts against the upper ring 27 of the packing member 25 so that when sufficient fluid pressure is built up within the cylinder 31 to move the piston 30 downwardly, it will move the ring 27 downwardly and thereby expand the packing member 25 as illustrated in Fig. 2. After it has expanded the packing member, the latter will retain this condition due to the engagement of the latch ring 28 with the circular serrations 29.

To build up sufficient fluid pressure to accomplish this, it is necessary first to close off the passage of fluid downwardly through the body. This is accomplished by dropping a trip ball 28 downwardly through the running in tubing, which ball is of a diameter that it will seat on the seat 21 of the trip sleeve 20 and shut off...
downward circulation. The shear pin 24 is of sufficient strength to resist shearing until the pressure built up within the body is sufficient to actuate the piston 28 and expand the packing member 25 as described. However, after the packing member has been expanded into tight contact with the wall of the hole, the downward fluid pressure is increased to a point sufficient to shear the pin 24 and the pin 23 so that the downward fluid flow is interrupted as already described. This will also release the valve 14 so that it may seat on the seat 12.

The running in tubing indicated by the numeral 25 is threaded into the upper end of the body 10 with a left-hand thread so that after the body has been secured in position in the well bore, the running in tubing may be disconnected from the body and withdrawn.

At the junction between the reduced body 19 in the body and the uppermost portion of the larger bore is a bridging valve seat 37 adapted to receive a bridging ball valve 38 shown in dotted lines in Fig. 2, which ball may be dropped downwardly into position at any time. This ball is positioned as indicated in Fig. 2 when it is desired to close the device for use as a bridge plug.

That is to say, the valve 14 will prevent the upward flow of fluid through the device and the bridge valve 38 will prevent the flow of fluid downwardly through the device, consequently effecting bridging the bore.

In operation of the device, the device is constructed substantially as illustrated and described and is mounted on the lower end of the running in tubing 38 and run into the hole. During the running in process, fluid may freely pass upwardly through the device to enable it to be lowered.

Likewise, circulation can be established downwardly through the device at any time. After the device has been positioned at the proper point along the bore, the trip ball 35 is dropped through the running in tubing and will seat on the seat 31 of the trip sleeve 28. By means of the pump, sufficient fluid pressure is then built up in the body 10 above the ball 35 to force the piston 30 downwardly a sufficient distance to tightly expand the packing member 28 into contact with the wall of the hole. Due to the fact that the member 28 is formed of pliable material, it will conform to the irregularities of the bore and thereby tightly grip the wall of the hole as well as forming an effective seal between the body 10 and the wall of the hole. It may be stated that the length of the packing member 28 may be any length desired or necessary to effect the result. Thereafter the fluid pressure is increased sufficiently to shear the pins 23 and 24 to enable the valve 14 to seat on its seat so that it will function as a back pressure valve. If it is so desired, the shearing of the pins 23 and 24 may be the only operation involved. The fluid pressure is then pumped downwardly through the body into the bore below it, and the valve 14 will function to prohibit the back flow of this material upwardly through the body. If it is desired to bridge the well, the ball 35 is then dropped into position as described to effect the bridging operation. The running in tubing 38 is then unscREWED from the body 10 and removed from the hole.

If at any time it is desired to remove the device from the bore, it can be readily drilled out due to the fact that it is constructed of materials that can be readily drilled out.

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. A device of the character described comprising a body adapted to be detachably secured to the lower end of running in tubing, said body having a passage way formed coaxially therethrough, an elongated sleeve-like packing member of pliable material secured to the body at its lowermost end, and fluid pressure actuated means carried by the body adapted to move the upper end of said packing member toward its secured end to radially expand the same, and means for retaining said packing member in its expanded position.

2. A device of the character described comprising a body adapted to be detachably secured to the lower end of running in tubing, said body having a passageway formed coaxially therethrough, an elongated sleeve-like packing member of pliable material secured to the body at its lowermost end, fluid pressure actuated means carried by the body adapted to move the upper end of said packing member toward its secured end to radially expand the same, and means for retaining said packing member in its expanded position.

3. A device of the character described, a body adapted to be attached to the lower end of a string of running in tubing, a sleeve-like packing member of pliable material arranged concentrically about said body and secured at its lower end to said body, the upper end of said packing member being adapted to be moved downwardly toward the secured end, and fluid pressure actuated means carried by the body to engage the upper end of said packing member to move the same downwardly in response to fluid pressure built up in the body.

4. A device of the character described comprising an elongated cylindrical body adapted to be attached to the lower end of a string of running in tubing, said body having a longitudinal passageway formed therein, a back pressure valve to control the flow of fluid upwardly through the body, means adapted to be positioned in said passageway to prevent the passage of fluid downwardly through the body when said fluid is below a predetermined pressure, a packing member of pliable material surrounding the body and capable of radial expansion when axially shortened, fluid pressure actuated means actuated by a pressure less than said predetermined pressure for axially shortening said packing member to radially expand the same.

5. A device of the character described comprising an elongated cylindrical body adapted to be attached to the lower end of a string of running in tubing, said body having a longitudinal passageway formed therein, a fluid pressure valve to control the flow of fluid upwardly through the body, means adapted to be positioned in said passageway to prevent the passage of fluid downwardly through the body when said fluid is below a predetermined pressure, a packing member of pliable material surrounding the body and capable of radial expansion when axially shortened, fluid pressure actuated means actuated by a pressure less than said predetermined pressure for axially shortening said packing member to radially expand the same, and latch means for...
6. A device of the character described comprising an elongated cylindrical body member having a passageway formed longitudinally therethrough and adapted to be attached to the lower end of a string of running in tubing, means adapted to be positioned after said body is positioned in a well bore to obstruct the passage of fluid downwardly through the body, said means being rendered ineffective by a fluid pressure built up in the body exceeding a predetermined pressure, an elongated packing sleeve carried by the body about its perimeter and secured at one end to the body, a cylindrical piston carried by the body and engaging the other end of the packing member and actuated by a fluid pressure less than said predetermined pressure to move said end of the packing member toward the fixed end thereof and thereby radially expand said packing member, and latch means for latching said moved end in position maintaining said packing member expanded.

7. In a device of the character described a body member adapted to be detachably secured to the lower end of a running in tubing, an expansible packing member surrounding the body member said packing member being normally collapsed, fluid responsive means carried by the body member and adapted to engage the upper portion of the expansible packing member whereby said packing member will be expanded in response to fluid pressure and means for retaining said packing member in its expanded position.

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