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CIRCULATION BRIDGING PLUG

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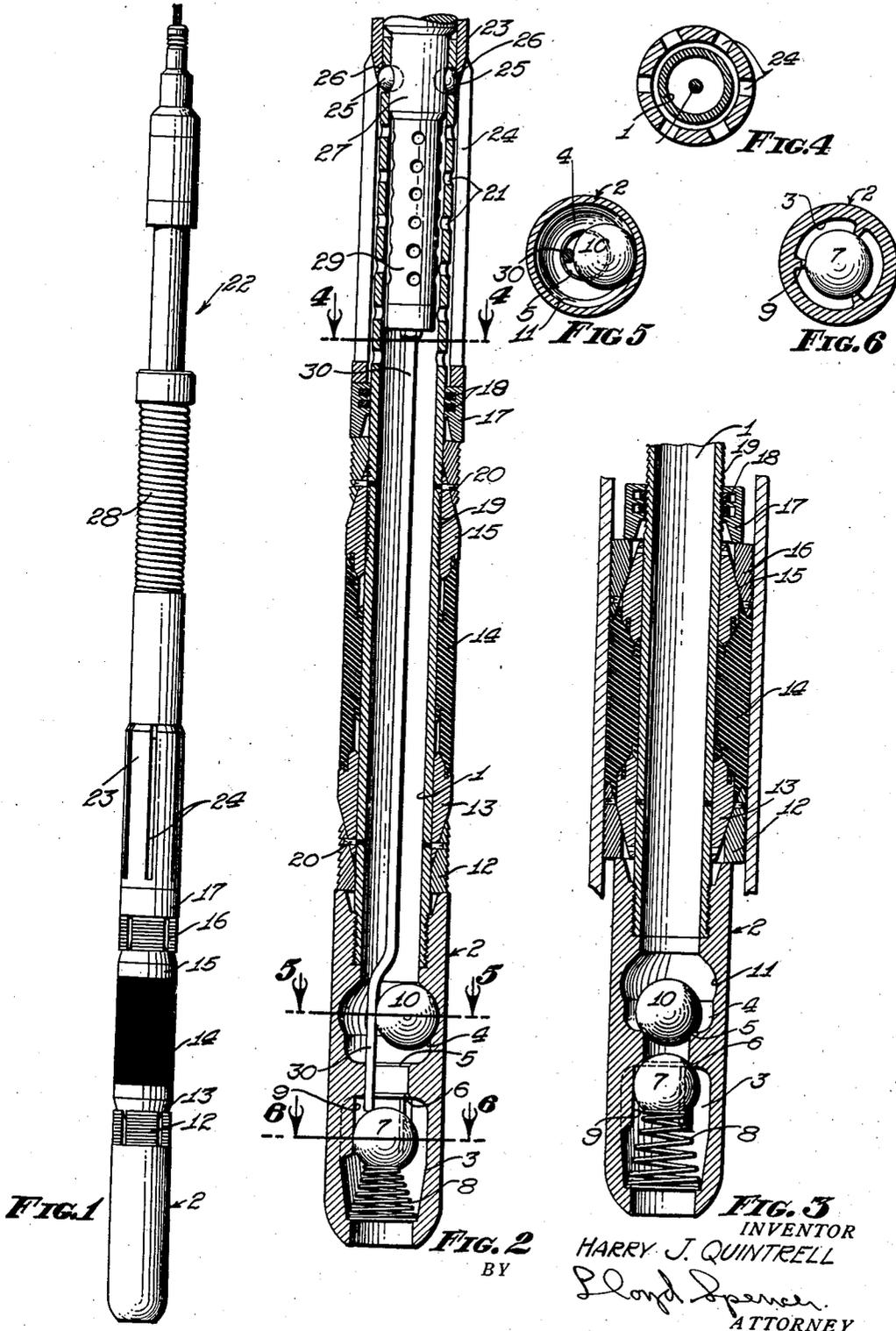


FIG. 1

FIG. 2

BY

FIG. 3

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## CIRCULATION BRIDGING PLUG

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Application December 19, 1939, Serial No. 309,976

6 Claims. (Cl. 166—13)

My invention relates to bridging plugs for oil wells, and among the objects of my invention are:

First, to provide a bridging plug which incorporates means for internal circulation of fluid as the bridging plug is being lowered into a well bore, so that the bridging plug may be readily lowered within a well even through relatively heavy or viscous fluids such as drilling mud;

Second, to provide a bridging plug which, by reason of the provision of a maximum circulation area, is inherently adapted to be lowered on a wire line, that is, does not require the added weight of a tubing string to force it downwardly through the well fluid;

Third, to provide a bridging plug which incorporates a simple valve means and a device for holding the valve means open during the descent of the bridging plug, the device being withdrawn to permit closing of the valve means after the bridging plug has been set; and

Fourth, to provide a bridging plug of this character which is particularly adapted for use in conjunction with the setting tool disclosed in the copending application, Serial No. 308,608, filed December 11, 1939.

With the above and other objects in view, as may appear hereinafter, reference is directed to the accompanying drawing, in which:

Figure 1 is an elevational view of my bridging plug shown in association with a setting tool as it appears when being lowered to position in a well;

Figure 2 is a longitudinal sectional view of my bridging plug with coacting portions of the setting tool shown fragmentarily;

Figure 3 is a fragmentary, longitudinal sectional view of my bridging plug showing the parts in the positions assumed when the bridging plug is set and the setting tool removed; and

Figures 4, 5 and 6 are transverse sectional views through my bridging plug, taken through 4—4, 5—5 and 6—6, respectively, of Figure 2.

The bridging plug includes a tubular mandrel 1 of uniform diameter which is threaded at its lower end for connection to a valve housing 2. The valve housing is provided with a bore there-through and is divided into a lower valve chamber 3 and an upper valve chamber 4. The two chambers are separated by a constriction, the lower and upper shoulders of which form valve seats 5 and 6.

The lower valve chamber receives a ball valve 7 which is urged upwardly against the seat 6 by a spring 8. Suitable guide ribs 9 are provided on

the walls of the chamber 3 to space the valve 7 and separate it from its seat 6.

The upper chamber receives an upper ball valve 10 adapted to engage the upper seat 5. The side wall of the upper chamber is provided with an annular channel 11 adapted to coact with means to be described hereinafter for holding the upper valve 10 clear of its seat.

The upper end of the valve housing 2 forms a shoulder for engagement with several slips 12 positioned around the mandrel 1. The slips 12 are adapted to act against a lower cone 13 likewise positioned around the mandrel. The slips are adapted to be forced by the cone outwardly when the cone and valve housing move relatively toward each other. Above the lower cone 13 the mandrel is fitted with a packing sleeve 14 formed of rubber or other similar composition and adapted to be deformed so as to pack against the surrounding casing, as shown in Figure 3. The packing sleeve per se constitutes the subject matter of another application, Serial No. 308,608, filed December 11, 1939. Above the packing sleeve is mounted an upper cone 15 adapted to coact with upper slips 16. The upper slips 16 are engaged by a locking collar 17 which is provided with internal grooves adapted to receive slip rings 18. The rings 18 are adapted to coact with annular teeth or wickers 19 formed around the mandrel 1.

The bridging plug is set by urging the locking collar 17 downwardly on the mandrel, which causes the two cones 13 and 15 to move toward each other, expanding the packing sleeve 14 and also urging the slips along their respective cone into engagement with the surrounding casing, as shown in Figure 3. The locking rings 18 of the locking collar engage the teeth 19 to prevent return movement of the part. In order to prevent premature action of the slips and cone, suitable shear pins 20 tie the parts in their initial position, as shown in Figure 2.

The upper end of the mandrel 1 is provided with a plurality of venting ports 21 so that fluid may pass through the housing 2, mandrel 1, and out through the ports 21.

The bridging plug herein disclosed may be set by various types of setting tools, but is particularly designed for coaction with the setting tool disclosed in the copending application, Serial No. 308,608, filed December 11, 1939. The setting tool 22 therein shown, and herein partially illustrated, includes a setting sleeve 23 which fits around the upper end of the mandrel 21 and is adapted to engage the locking collar 17. The setting sleeve

23 is provided with slots 24 to permit discharge of fluid passing through the mandrel 1.

The upper end of the mandrel 1 is provided with holes which receive key balls 25. These extend outwardly far enough to engage the shoulder 26 provided on the setting sleeve and extend inwardly into locking engagement with a retainer member 27. The setting sleeve is so constructed that the key balls 25 first move inwardly to free the setting sleeve while maintaining a connection between the retainer member and mandrel. A spring 28 provides the necessary force to accomplish the setting action of the bridging plug.

The retainer means has secured to its lower end an end piece 29 which is provided with perforations, and at the lower end of which is attached a valve rod 30. The valve rod 30 extends downwardly through the mandrel 1 and is offset at its lower end so as to pass on one side of the upper ball valve 10 and extend downwardly into engagement with the lower ball valve 7. The rod is of such length that its lower end holds the lower valve open and its intermediate portion coacts with the retainer channel 11 to hold the upper valve clear of its seat, so that a continuous passage is provided from the lower end of the bridging plug through the housing 2, mandrel 1, and out through the ports 21 and slots 24, this passage being in addition to the clearance between the bridging plug and the casing into which it is run.

After the packer is set the key balls 25 release the mandrel from the retainer member 27 so that the setting tool may be withdrawn. When this is done the rod is withdrawn with the setting tool so that the valves 7 and 10 are permitted to engage their seats. The lower valve prevents upward flow of fluid through the bridging plug and the upper valve prevents downward flow, thus seal in either direction is accomplished. It is, of course, obvious that should it be desired to restrain flow in only one direction the appropriate valve may be omitted.

Various changes and alternate arrangements may be made within the scope of the appended claims, in which it is my intention to claim all novelty inherent in the invention as broadly as the prior art permits.

I claim:

1. A combination bridging plug and setting tool comprising: a bridging plug, including a central mandrel; a packing sleeve, cone and slip means fitted around said mandrel and movable thereon for engagement with the surrounding casing; a valve housing at one end of said mandrel having valve means adapted to seal said mandrel from the flow of fluid therethrough, said mandrel having fluid ports at its other end; a setting tool including means movably engageable with said mandrel and a sleeve fitting over said mandrel and engageable with said slip and cone means; a device for causing relative movement between said sleeve and mandrel to set said slip and cone means and packing element, said sleeve

being perforated to permit flow of fluid through said mandrel ports; and means engageable with said valve means for holding said valve means in an open position while said setting tool is connected with said bridging plug.

2. The combination with a bridging plug having a hollow mandrel, and a setting tool for said bridging plug of a circulation valve structure, comprising: a valve housing connected with said mandrel having a valve chamber and a valve seat; a valve in said chamber adapted to engage said seat; and means attached to said setting tool and extending past said valve and into said seat to hold said valve clear of said seat, said means adapted to be removed with said bridging plug.

3. The combination with a bridging plug having a hollow mandrel, and a setting tool for said bridging plug of a circulation valve structure, comprising: a valve housing connected with said mandrel; a first check valve therein adapted to seal against upward flow of fluid through said housing and mandrel; a second check valve therein adapted to seal against downward flow of fluid through said housing and mandrel; and means attached to said setting tool and extending into engagement with said valves to hold them from their seats.

4. In a combination setting tool and bridging plug: a bridging plug having a passage there-through; a check valve adapted to prevent downward flow of fluid through said passage and a second check valve adapted to prevent upward flow of fluid into said passage; a setting tool initially connected to said bridging plug and including means operative to set said bridging plug into engagement with a surrounding well casing; and means movable with said setting tool and engageable with both of said check valves to hold said check valves in open position while said setting tool is connected with said bridging plug.

5. A combination setting tool and bridging plug comprising: a bridging plug including a hollow mandrel and a pair of opposed check valves; and a setting tool removably attached to said bridging plug and including a member engageable with said check valves to hold them open, said member adapted to be removed from said bridging plug with said setting tool to release the said check valves.

6. In a combination setting tool and bridging plug: a bridging plug including a packing means adapted to engage a surrounding casing to divide the casing into upper and lower zones; means defining a passage communicating between said zones and means for closing said passage against flow in either direction between said zones; and a setting tool adapted to actuate said bridging plug to set said packing means, including an element extending into said passage and engageable with said passage-closing means for holding said closing means in an open position while said setting tool is attached to said bridging plug.

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