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CEMENTING PLUG

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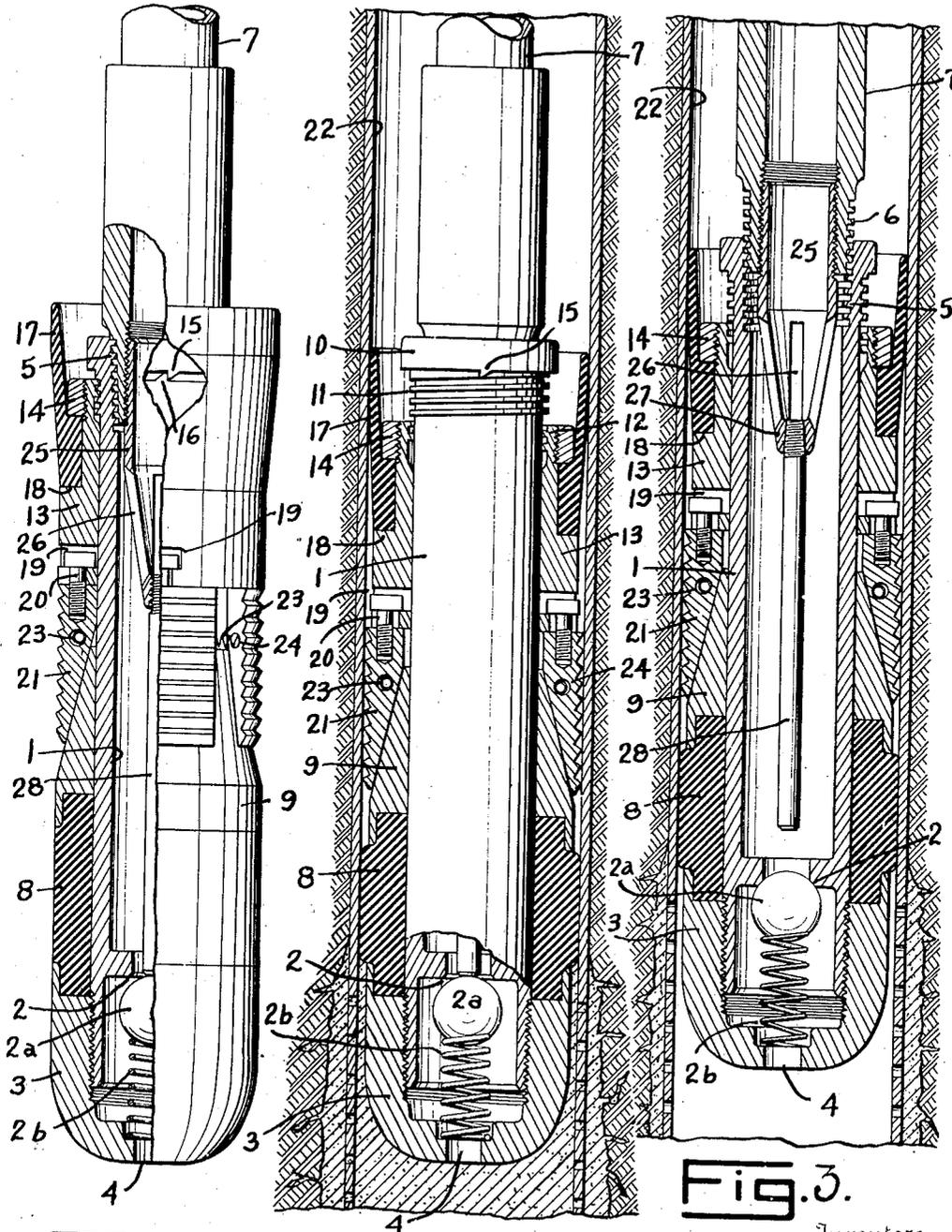


Fig. 1.

Fig. 2.

Fig. 3.

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CEMENTING PLUG

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10 Claims. (Cl. 166—12)

This invention relates to a cementing plug.

An object of the invention is to provide a cementing plug, or bridge plug, that may be set in a well so that cement, forced downwardly therethrough may be forced into the formation for the purpose of cutting off water encroachment, reducing the excessive gas, oil ratio and which is constructed of few parts so that it may be readily set and expanded and engaged with the surrounding well casing.

It is another object of the invention to provide a cementing plug having casing engaging slips thereon with a slip expanded and a packer beneath the slips with novel means for holding the slips against upward movement and in position to be expanded upon upward movement of the operating string.

It is another object of the invention to provide a cementing plug of the character described having a seal or packer with novel means for maintaining the packer collapsed and for expanding the packer when desired, said plug having a back pressure valve with novel means on the operating string for maintaining the valve open or for releasing the valve to permit it to close as desired, said string and valve controlling means being detachable to permit the removal thereof from the well bore upon completion of the cementing operation.

With the above and other objects in view the invention has particular relation to certain novel features of construction, operation and arrangement of parts, an example of which is given in this specification and illustrated in the accompanying drawing, wherein:

Figure 1 shows a side elevation of the plug, partly in section, in inactive position as being run into the well.

Figure 2 shows a vertical, sectional view showing the plug expanded or in active position, and

Figure 3 shows a vertical, sectional view of the plug, in expanded, or active, position with the operating string in the process of being detached.

Referring now more particularly to the drawing wherein like numerals of reference designate the same parts in each of the figures, the numeral 1 designates a tubular mandrel whose lower end is provided with an inside, downwardly facing seat 2 and screwed onto said lower end there is a guide plug 3 having a lower end opening 4. Within the seat 2 there is a downwardly opening back pressure valve 2a arranged to cooperate with, and close, the seat 2 and normally held closed by a strong coil spring 2b on which

the valve is seated. The upper end of the mandrel is provided with internal, coarse, left hand threads 5 to receive the corresponding, external, coarse, left hand threads 6 on the lower end of the operating string 7. Around the mandrel above the guide plug 3 there is an expansible sleeve-like packer 8.

Mounted on the mandrel above the packer there is an expander 9 which tapers upwardly, externally. The ends of the plug 3 and the expander 9, overlap the adjacent ends of the packer 8 as shown so as to retain the packer in place about the mandrel.

The upper end of the mandrel 1 has an external, annular flange 10 and beneath said flange has the external, coarse, right hand threads 11 adapted to be screwed into corresponding internal threads 12 in the upper end of the slip supporting coupling 13 which is fitted around said mandrel. When the plug is in inactive position the threads 11 are screwed downwardly into the threads 12. Screwed onto the upper end of the coupling 13 is an external clamp ring 14. In order to permit only a loose connection of the threads 11, 12 so that they may be readily unscrewed the flange 10 and the clamp ring 14 are provided with interengaging stops 15, 16 which interlock, when said threads are screwed home, as shown in Figure 1.

An upwardly flared, upwardly opening cup ring 17 is mounted on the coupling 13. The lower end of the cup ring 17 is inwardly thickened, as shown. The upper end of the coupling 13 is reduced in external diameter forming an external, annular, upwardly facing shoulder 18 against which the lower end of said cup ring abuts and the clamp ring 14 is screwed against the upper end of said inwardly thickened position so as to firmly clamp the cup ring 17 in place. The lower end of the coupling 13 has the downwardly opening T-slots 19 into which are fitted cap screws 20 which are connected to the upper ends of the, grapples or, slips 21. These slips are thereby swung from the coupling 13. Their inner sides are downwardly flared to correspond to the external taper of the slip expander 9 and their outer surfaces are toothed to engage the well casing 22. The slips, or grapple means, are maintained in assembled relation in any preferred manner preferably by a coiled pull spring 23 which is located in a circular bore 24 in the slip, or grapple, assembly.

A cage 25 is screwed into the lower end of the string 7 whose lower end tapers downwardly and is provided with the slits 26 and terminates

in an internally threaded collar 27 into which the upper end of the valve control rod 28 is screwed. The lower end of this rod normally engages the valve 2a and holds the same open as shown in Figures 1 and 2.

At the present time it is common practice to lower a casing into a well and permanently set it and thereafter perforate the casing opposite a supposed oil bearing stratum. If, upon perforation of the casing, the stratum does not produce it is then desirable to close the perforations of the casing by cementing.

The complete assembly as shown in Figure 1 is lowered into the casing to a point just above the perforations to be closed as illustrated in Figures 2 and 3. It is to be understood that the well is filled with drilling fluid, or drilling mud. The operating string may then be slightly elevated and the pressure of the drilling fluid above will cause the cup 17 to expand into frictional engagement with the casing 22. The operating string may then be turned to the left to disengage the threads 11 from the threads 12, the friction of the expansible cup 17 against the casing 27 holding said cup and the coupling 13 and slips 21 against rotation. When said threads have been disengaged the operating string 7 may be pulled upwardly thus elevating the expander 9 and in turn forcing the slips 21 outwardly into engagement with the casing as shown in Figures 2 and 3. The plug will thus be anchored to the casing and upon further upward movement of the operating string 7 the sleeve-like packing 8 will be expanded forming a seal with the casing 22 all the way around.

A load of cement may be placed in the string at the ground surface followed by a plug, or plunger, and upon application of fluid, under pressure, to said plunger the load of cement will be forced inwardly through the operating string and through the mandrel and out through the seat 2 and the lower end opening 4 into the casing and through the perforations of said casing, said cement surrounding the perforated portion of the casing and penetrating into the surrounding formation. This cement is forced downwardly while the operating string is under tension and the packer 8 expanded so as to confine the cement within the casing beneath and to cause it to be forced outwardly through the casing perforations and to completely surround the casing at that point.

When the cement has sufficiently set the operating string 7 may be turned to the right to disengage the threads 6 from the threads 5. These threads are shown in the process of being disengaged in Figure 3. As this operation is being carried out the rod 28 will be correspondingly retracted, or moved upwardly, thus releasing the valve 2a and permitting it to close and the pressure exerted against the lower end of the plug will maintain the packer 8 expanded. Upon complete disengagement of the threads 6 from the threads 5 the operating string, with the rod 28 attached, may be withdrawn from the well leaving the plug set in the well.

Should it be desired later to deepen the well the plug and the bridge of cement may be drilled out and drilling operations carried on beneath.

The drawing and description are illustrative merely, while the broad principle of the invention will be defined by the appended claims.

What we claim is:

1. A cementing plug for well casing having a passageway for fluid therethrough and comprising

a mandrel, a packer and grapple assembly on the mandrel and including means on the plug, around and releasably connected to the mandrel and arranged to be held against movement by the liquid in the well, upon release therefrom and longitudinal movement relative thereto of the mandrel, said means being effective to actuate and cause fixed engagement of the grapple with the casing and cooperate with the mandrel to expand the packer upon such movement.

2. A cementing plug for well casing having a passageway for fluid therethrough and comprising a mandrel, a packer and grapple assembly on the mandrel and including means around the mandrel and releasably connected thereto and arranged to be held against movement by the liquid in the well, upon release therefrom and longitudinal movement relative thereto of the mandrel, said means being effective to actuate and cause fixed engagement of the grapple with the casing and cooperate with the mandrel to expand the packer upon such movement and a downwardly opening, back pressure valve controlling the passageway.

3. A cementing plug comprising a tubular mandrel, casing grappling means on the mandrel, and including means around the mandrel and releasably connected thereto and arranged to be actuated by the well liquid, upon release therefrom and longitudinal movement relative thereto of the mandrel, said means being effective to actuate the grappling means into engagement with the casing, a packer on the mandrel confined between the mandrel and grappling means and arranged to be expanded upon such movement of the mandrel.

4. A cementing plug comprising a tubular mandrel, an expansible packer around the mandrel, a slip expander mounted on the packer, a slip support releasably connected to the mandrel, slips on the support, an upwardly opening expansible cup ring on the support, said mandrel upon release from said support being longitudinally movable relative to the slips and effective to cause the expansion of the packer and slips into engagement with a surrounding well casing.

5. A cementing plug comprising a tubular mandrel, an expansible packer around the mandrel, a slip expander mounted on the packer, a slip support releasably connected to the mandrel, slips on the support, an upwardly opening expansible cup ring on the support, said mandrel upon release from said support being longitudinally movable relative to the slips and effective to cause the expansion of the packer and slips into engagement with a surrounding well casing and a back pressure valve for controlling the passageway through the mandrel.

6. A device for cementing a well having a casing therein comprising a tubular operating string, a packer assembly releasably connected to the string and having a longitudinal passageway therethrough; said assembly comprising a packer and means for expanding the packer upon an appropriate manipulation of the string, said expanding means including a grapple and upwardly opening cup ring arranged to be held substantially stationary by the liquid in the well upon said manipulation of the string and effective to actuate and cause fixed engagement of the grapple with the casing, said expanding means including other movable means operatively connected to the string and cooperable with the stationary means upon manipulation of the string to expand the packer.

7. A device for cementing a well having a casing therein comprising a tubular operating string, a packer assembly releasably connected to the string and having a longitudinal passageway therethrough; said assembly comprising a packer and means for expanding the packer upon an appropriate manipulation of the string, said expanding means including a grapple and means arranged to be held substantially stationary by the liquid in the well upon said manipulation and upward movement of the string and effective to actuate and cause fixed engagement of the grapple with the casing, said expanding means including other movable means operatively connected to the string and cooperable with the stationary means upon manipulation of the string to expand the packer, and a downwardly opening back pressure valve for controlling the flow of liquid through said passageway.

8. A device for cementing a well having a casing therein comprising a tubular operating string, a mandrel having a fluid passageway therethrough and having a releasable threaded connection with the string, an expansible packer around the mandrel, an expander on the packer around the mandrel, a grapple support above the expander having a releasable threaded connection with the mandrel, casing grappling means suspended from said support, means on the support arranged to be expanded by the liquid in the well into frictional contact with the casing and effective to hold the support and grappling means substantially stationary to permit the release of the mandrel from, and its longitudinal movement relative to, the grapple support whereby to actuate the grappling means into engage-

ment with the casing and to expand the packer, upon such longitudinal movement of the mandrel.

9. A device for cementing a well having a casing therein comprising a tubular operating string, a mandrel having a fluid passageway therethrough and having a releasable threaded connection with the string, an expansible packer around the mandrel, an expander on the packer around the mandrel, a grapple support above the expander having a releasable threaded connection with the mandrel, casing grappling means suspended from said support, means on the support arranged to be expanded by the liquid in the well into frictional contact with the casing and effective to hold the support and grappling means substantially stationary to permit the release of the mandrel from, and its longitudinal movement relative to, the grapple support whereby to actuate the grappling means into engagement with the casing and to expand the packer, upon such longitudinal movement of the mandrel and a downwardly opening valve controlling said passageway.

10. A cementing plug shaped to be lowered into a well casing and comprising a body having a passageway for liquid therethrough, valve means controlling the passageway, sealing means expansible to form a seal between the body and casing, means cooperable with said body for causing the expansion of the seal ring upon longitudinal upward movement of the body and including a device shaped to engage the liquid in the casing and arranged to be held approximately stationary by the liquid in the casing upon such longitudinal movement.

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