

Jan. 20, 1942.

W. L. CHURCH

2,270,647

CASING PLUG

Filed June 15, 1939

2 Sheets-Sheet 1

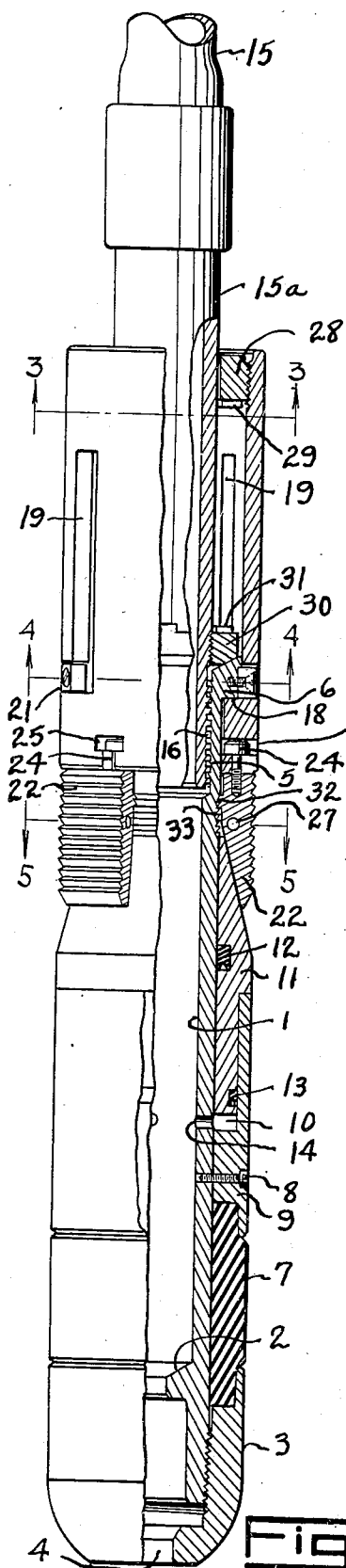


Fig. 1

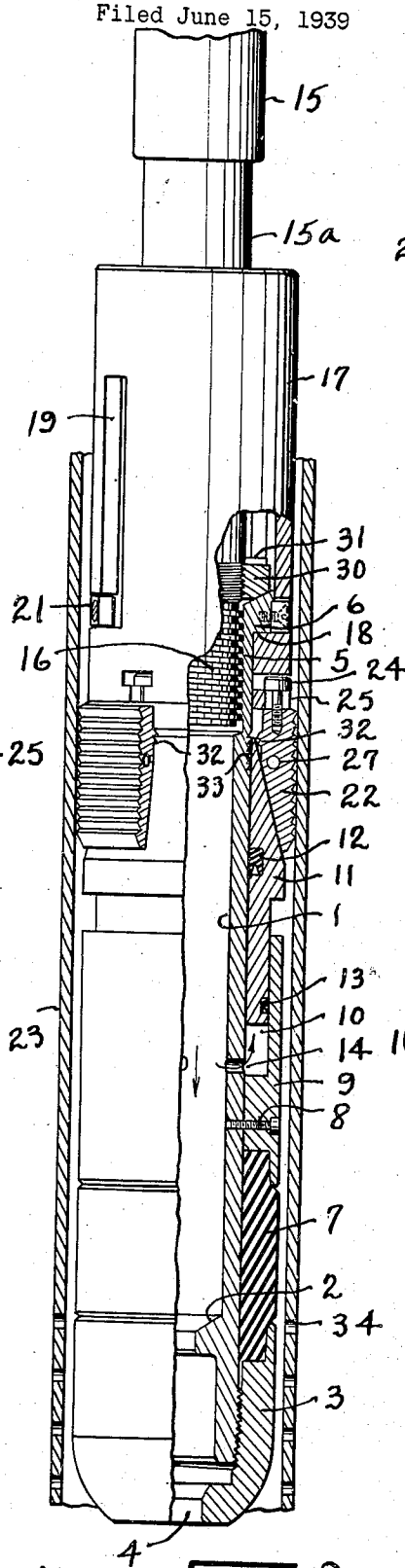


Fig. 2.

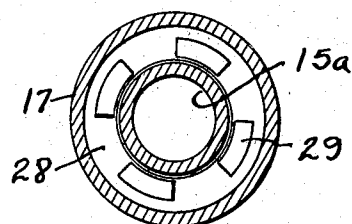


Fig. 3.

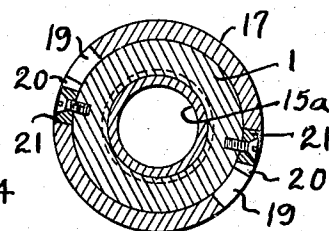


Fig. 4.

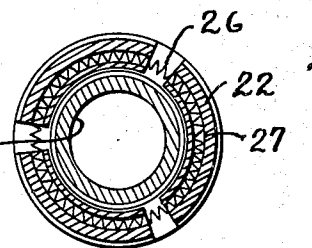


Fig. 5.

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2 Sheets-Sheet 2

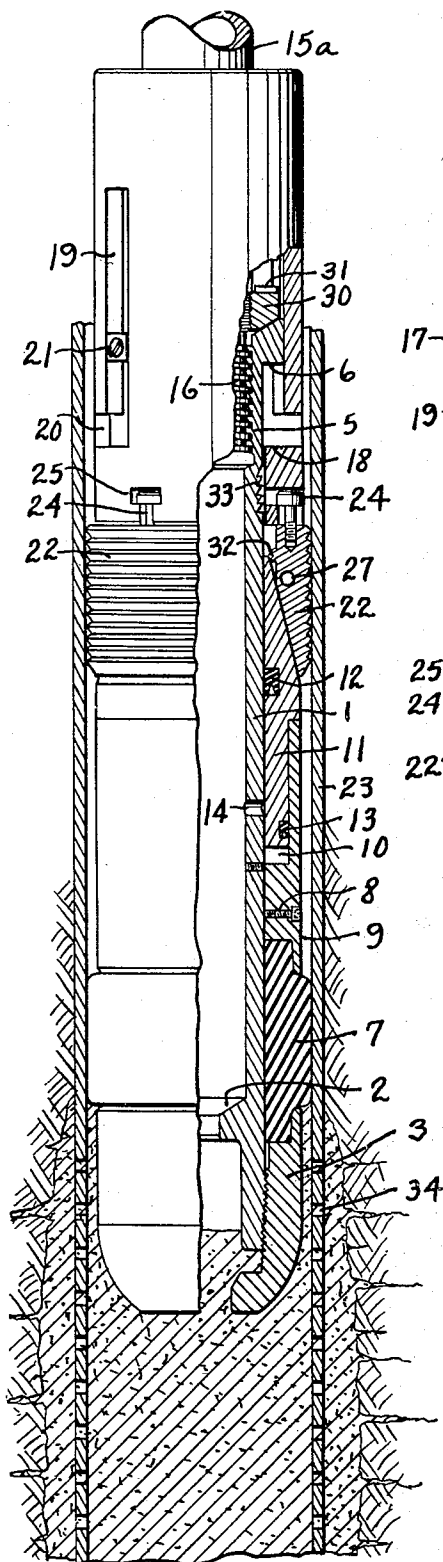


Fig. 6.

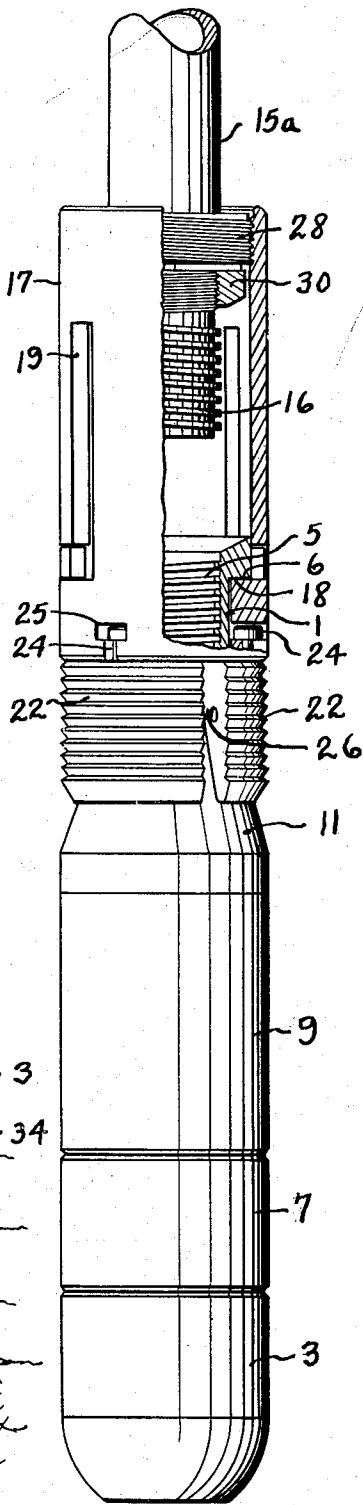


Fig. 7.

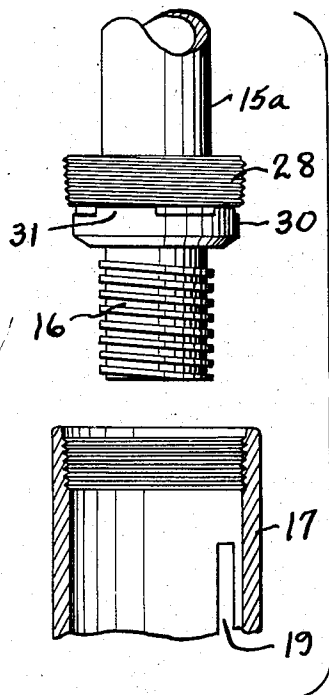


Fig. 8.

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2,270,647

CASING PLUG

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7 Claims. (Cl. 166—12)

This invention relates to a casing plug.

An object of the invention is to provide a casing plug adapted to be run into a well casing for the purpose of cementing, and closing, perforations in the casing.

Another object of the invention is to provide a plug of the character described that may be readily withdrawn from the casing after the cementing operation has been completed.

The plug is of such construction that in case it cannot be removed as a unit the operating string may be detached and withdrawn.

The type of plug herein described has been specially designed for use in connection with the method of cementing and testing wells disclosed in my United States Patent No. 2,016,916.

Cementing plugs, now commonly used, for cementing perforated casing are made of frangible material and are of such construction that when once set they cannot be removed and must be drilled out or broke up in order to deepen the well. They are objectionable owing to the fact that fragments left in the well often damage the screen and packers that are later set.

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 drawings, wherein:

Figure 1 shows a side elevational view of the plug, partly in section, in inactive position as being run into the casing.

Figure 2 shows a side view, partly in section, of the plug anchored in the casing.

Figure 3 shows a cross-sectional view taken on the line 3—3 of Figure 1.

Figure 4 shows a cross-sectional view taken on the line 4—4 of Figure 1.

Figure 5 shows a cross-sectional view taken on the line 5—5 of Figure 1.

Figure 6 shows a side view, partly in section, showing the plug anchored in the casing with the packer expanded and the perforated casing beneath cemented.

Figure 7 shows a side elevation, partly in section, showing the plug released after the cementing operation, ready to be withdrawn, and

Figure 8 shows a fragmentary, side view, partly in section, showing the operating string detached for withdrawal.

Referring now more particularly to the drawings 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 seat 2 and screwed onto said lower end there is a guide plug 3 having the lower end opening 4. The upper end of the mandrel is provided with the internal coarse threads 5 and with the external, downwardly facing, annular shoulder 6. Around the mandrel above the guide plug 3 there is an expandible, sleeve-like packer 7.

Mounted on the mandrel above the packer, and secured thereto by a frangible pin 8, there is a retaining sleeve 9. The ends of the sleeve 9 and the guide plug 3 overlap the adjacent ends of the packer 7, as shown in Figures 1, 2 and 6 so as to retain the packer in place about the mandrel.

The upper end of the retainer sleeve 9 is internally enlarged forming a cylinder 10. A slip expander 11 surrounds the mandrel above said retainer sleeve and the lower end of this expander is reduced and fitted closely into the cylinder. Annular seal rings 12 and 13 are countersunk into the expander and form seals between the expander and mandrel and between the expander and the walls of the cylinder 10, respectively. Suitable ports 14 lead through the mandrel into the lower end of the cylinder 10.

The numeral 15 designates a tubular operating string which extends to the ground surface and whose lower end is formed with a tubular nipple 15a having external, coarse, left-hand threads 16 which may be meshed with the threads 5 to attach the plug to the operating string.

The numeral 17 designates a tubular cage forming a grapple carrier and whose lower end is inwardly thickened forming an inside, annular shoulder 18 on which the external shoulder 6 of the mandrel hangs when the plug is assembled and in inactive position. The cage 17 has the vertical J-slots 19 whose lower ends are overturned, to the right, as shown, providing the notches 20. Attached to the enlarged upper end of the mandrel are the keys 21 which move in said slots.

The external surface of the expander 11 is upwardly tapered as shown and swung from the lower end of the cage are the wedge-shaped slips, or grapples, 22 whose inner sides diverge outwardly and are shaped to fit closely against the tapered portion of the expander 11. The outer sides are toothed so as to readily engage the surrounding well casing 23. The slips are swung from the cage by means of cap screws 24 which are fitted into T-slots 25 in the lower end of the cage and wherein said cap screws have the required radial movement to permit the slips

to expand and contract. The slips are maintained in assembled relation in any preferred manner, preferably by a coil pull spring 26 which is located in a circular bore 27 in the slip assembly.

A gland 28 is screwed into the upper end of the cage 17 and on its under side has the depending lugs 29. The nipple 15a fits snugly through said gland and screwed onto said nipple and normally resting on the upper end of the mandrel there is a clutch ring 30 whose upper side has the spaced lugs 31.

The plug is assembled and connected to the operating string to be lowered into the casing as shown in Figure 1, the keys 21 being turned into the notches 20 with the clutch ring 30 resting on the upper end of the mandrel and with the packer 7 collapsed. The slips have inside, downwardly tapering, ratchet teeth 32, positioned above their tapered portion; which teeth hang on external, upwardly pitched, ratchet teeth 33 on the mandrel, when the plug is assembled for lowering and as shown in Figure 1. These interengaging ratchet teeth guard the slips against accidental or inadvertent engagement with the casing prematurely and while the plug is being lowered.

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 producing stratum. If, upon perforation of the casing, the stratum does not produce it is then desirable to close the perforations 34 of the casing by cementing.

The plug, assembled as shown in Figure 1, is lowered into the casing to a point just above the casing perforations to be closed. Fluid, under pressure, is then forced downwardly through the operating string. The opening 4 being restricted, a portion of the pressure fluid will pass through the ports 14 into the cylinder 10 and force the expander 11 upwardly which in turn will force the slips 22 outwardly into engagement with the casing as shown in Figure 2. The plug will thus be anchored to the casing. The operating string is then turned to the left to disengage the keys 21 from the notches 20, and then pulled upwardly into the position shown in Figure 6 shearing the pin 8 and expanding the packer 7 into close contact with the surrounding casing.

A load of cement may then 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 downwardly through the operating string and through the mandrel and out into the casing and through the perforations 34, said cement surrounding the perforated portion of the casing and penetrating into the surrounding formation. This cement is forced downwardly while the string is under tension and the packer 7 expanded so as to confine the cement within the casing beneath said packer.

When the cement has sufficiently set the tension may be released on the operating string 15 and the string unscrewed from the upper end of the mandrel 1 and elevated, the clutch ring 30 engaging the gland 28. The cage 17 will move upwardly until the shoulder 18 engages underneath the shoulder 6, the slips 22 moving inwardly into released position and thereupon the plug and operating string may be readily removed from the casing.

If, for any reason, the plug hangs in the casing

so that it cannot be removed the operating string may be turned to the right, the lugs 31 interengaging with the lugs 29 and the gland 28 may thereby be unscrewed as indicated in Figure 8, and the operating string removed from the well leaving the plug in the casing.

What I claim is:

1. A device for cementing the perforations in a well casing comprising a tubular operating string; a packer assembly on the string; said assembly comprising a packer, releasable interlocking means to prevent expansion of the packer, means for releasing said interlocking means and expanding the packer upon appropriate manipulation of the string, said expanding means including a releasable grapple engageable with the casing and means arranged to be actuated by the pressure of fluid exerted through the string for actuating the grapple into engagement with the casing and means for releasing the grapple by manipulation of the string.

2. A cementing plug comprising a tubular mandrel, a packer thereon, casing grappling means, an expander on the mandrel, a cylinder and piston assembly wherein the piston is arranged to be actuated by the pressure of fluid entering the cylinder from the mandrel to actuate the expander to force the grappling means into engagement with a surrounding casing, abutments on the mandrel confining the packer, one of said abutments being retained by the grappling means and the other being movable with the mandrel whereby the packer will be expanded by longitudinal movement of the mandrel in one direction.

3. A cementing plug comprising a tubular mandrel having an opening, a packer thereon, casing grappling means associated with the mandrel, a cylinder and piston assembly including an expander on the mandrel, said expander being operable upon application of fluid pressure from within the mandrel through said opening into said cylinder to expand said grappling means into engagement with the casing, said cylinder and piston assembly forming an abutment for the packer whereby the packer will be expanded by longitudinal movement of the mandrel in one direction.

4. A cementing plug comprising a tubular mandrel, a packer thereon, a carrier, grappling means on the carrier, releasable interlocking means between the mandrel and the carrier which, in one position, lock the carrier against longitudinal movement relative to the mandrel and in another position allow such movement, means on the mandrel confining the packer comprising a cylinder and piston assembly which includes an expander, said mandrel having an opening into the cylinder to permit application of fluid pressure from the mandrel into the cylinder effective to actuate the expander to expand said grappling means into engagement with the casing.

5. A cementing plug comprising a tubular mandrel, an operating string releasably connected to the mandrel, a packer on the mandrel, a grapple carrier connected to the mandrel, grappling means on the carrier, releasable interlocking means between the mandrel and the carrier which, in one position, lock the carrier against longitudinal movement relative to the mandrel and movable to another position to allow such movement, means confining the packer and including a cylinder and piston assembly having

an expander, said mandrel having an opening into the cylinder to permit application of fluid pressure from the mandrel into the cylinder to actuate the expander into operative relation with the grappling means to force the latter into engagement with the casing.

6. A cementing plug comprising a tubular mandrel, an operating string releasably connected to the mandrel, a packer on the mandrel, a grapple carrier connected to the mandrel, grappling means on the carrier, interlocking means which, in one position, lock the carrier against longitudinal movement relative to the mandrel and movable to another position to allow such movement, means confining the packer and including a cylinder and piston assembly having an expander, said mandrel having an opening into the cylinder to permit application of fluid pressure from the mandrel into the cylinder to actuate the expander into operative relation with the grappling means to force the latter into engagement with the casing, a gland having a releas-

able connection with the carrier through which the operating string extends and means on the string arranged to be operatively connected with the gland upon release of the string from the mandrel whereby the gland may be detached to permit release of the string from the carrier.

7. A cementing plug comprising a tubular mandrel, a packer thereon, a grapple carrier, grappling means on the carrier, interlocking means in one position locking the carrier against longitudinal movement relative to the mandrel and in another position allowing such movement, a seal around the mandrel for forming a seal with the casing to confine the cement beneath the seal, a gland in the carrier, an operating string through the gland having a releasable connection with the mandrel, interengaging means on the string and gland by means of which the gland may be detached from the carrier, upon release of the string from the mandrel, to permit the detachment of the string from the carrier.

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