

March 2, 1954

T. A. OWEN

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OIL WELL CEMENTING TOOL

Filed July 16, 1949

2 Sheets-Sheet 1

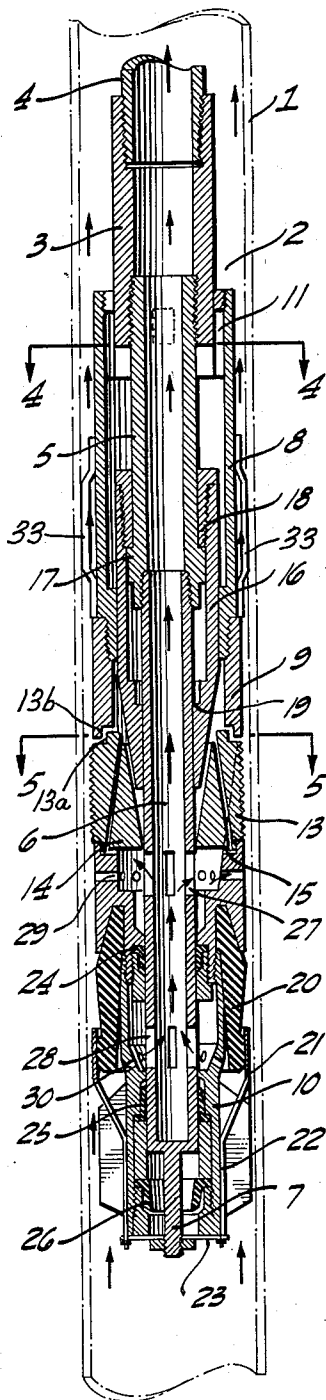
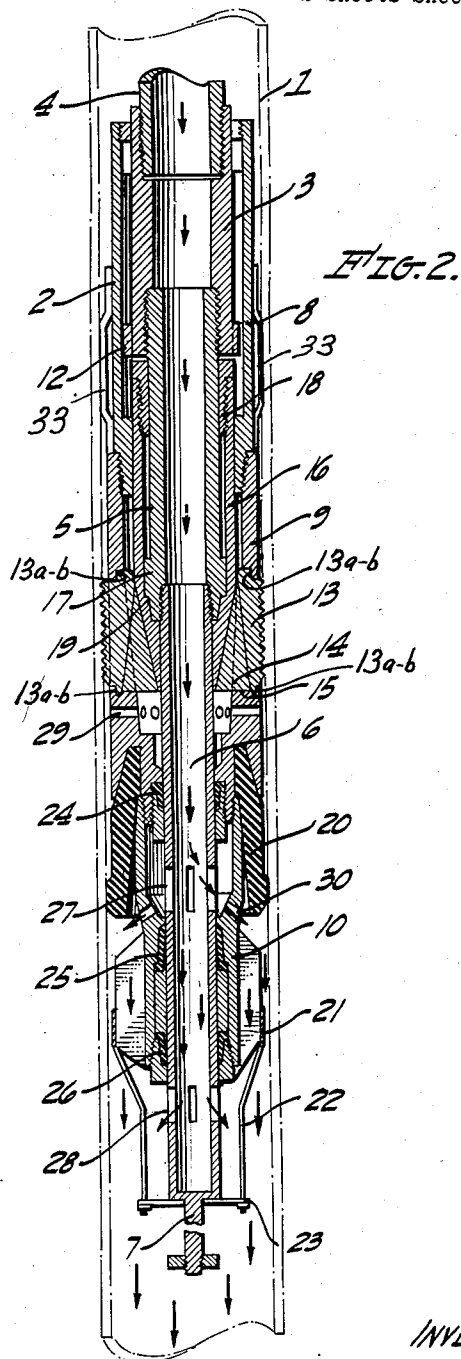


FIG. 1.



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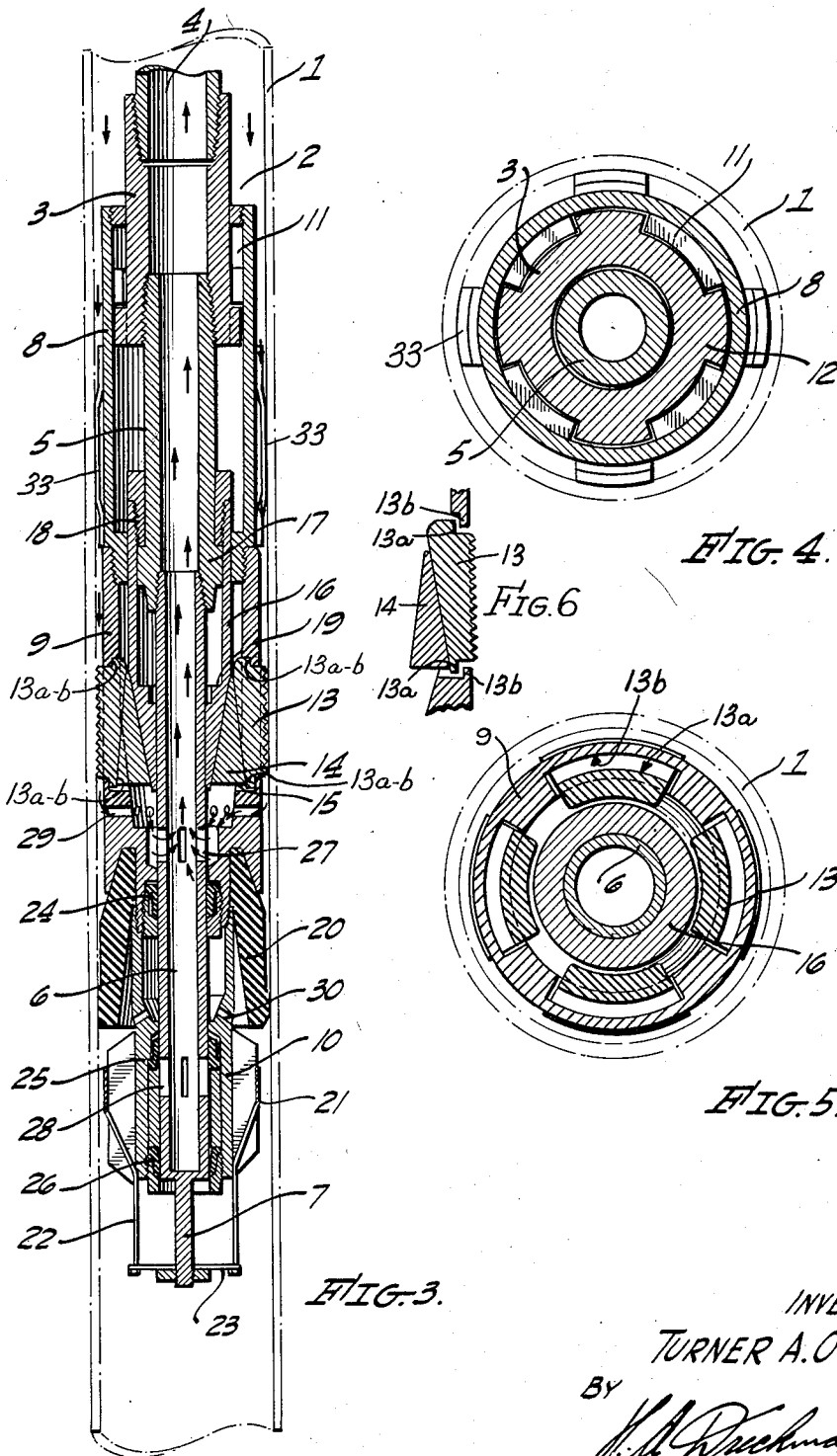
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OIL WELL CEMENTING TOOL

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Application July 16, 1949, Serial No. 105,207

5 Claims. (Cl. 166—12)

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This invention relates to an oil well cementing tool whereby the movement of cement to its in situ position may be controlled.

An object of my invention is to provide a novel oil well cementing tool in which the casing engaging slips are set by pressure on a packing cup, this pressure being exerted by circulating fluid in the well or by the cement.

Still another object of my invention is to provide a novel oil well cementing tool in which means are provided to circulate fluid while pressure is being maintained on the cement while the cement is hardening.

Still another object of my invention is to provide a novel oil well cementing tool of the character stated, which is compact in construction, which is effective in operation, and which is simple to operate.

A feature of my invention is to provide a novel oil well cementing tool in which fluid ports are controlled by longitudinal movement of a central tube relative to an outer barrel, this central tube being attached to the drill pipe.

Other objects, advantages and features of invention may appear from the accompanying drawing, the subjoined detailed description and the appended claims.

Figure 1 is a longitudinal sectional view of my cementing tool, in the position in which the tool is lowered into the well.

Figure 2 is a longitudinal sectional view of my cementing tool, in the position in which the cement is deposited in the well.

Figure 3 is a longitudinal sectional view of my cementing tool, with parts in the position to permit circulation of fluid while pressure is being maintained on the deposited cement.

Figure 4 is a sectional view taken on line 4—4 of Figure 1.

Figure 5 is a sectional view taken on line 5—5 of Figure 1.

Figure 6 is an enlarged detail of the slip-constraining shoulders 13a—b.

Referring more particularly to the drawing, the numeral 1 indicates the casing which is positioned in the well and which is to be cemented, in the usual and well known manner. It is well known that the cement is deposited at the bottom of the string of casing and pressure is maintained on this cement so as to force it outwardly into the formation, and also upwardly around the outside of the casing, all of this operation being usual and well known.

In my cementing tool 2, I will first describe the central sliding tubular portion, which con-

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sists of a top coupling 3, to which the drill pipe 4 is attached. A pipe 5 extends downwardly from the coupling 3 and screws into this coupling, as shown. A tubular mandrel 6 extends downwardly from the pipe 5 and is threaded into the bottom of the pipe, as shown. The tube 6 extends entirely through the tool and a stud 7 projects downwardly from the closed bottom of the tube. The coupling 3, pipe 5 and tube 6 extend through and have a limited longitudinal movement in the outer barrel of the tool, as will be further described.

Considering now the outer barrel: this consists of a sleeve 8, which forms the upper end of the barrel, and a slip hanger 9, which screws on to the lower end of the sleeve 8, substantially as shown, and a bottom shoe 10 threaded on to the lower end of the slip hanger 9. The barrel is provided with conventional means such as the bow springs 33 for frictionally engaging the interior wall of the well casing 1 so that the sleeve 8 can be held against relative movement, either rotary or longitudinal, with respect to the pipe 5 and tube 6.

In the upper end of the sleeve 8, I provide a bayonet lock, which consists of spaced and inwardly projecting shoulders 11 on the sleeve 8, which are engaged by circularly spaced lugs 12 on the coupling 3. When the lugs 12 engage the shoulders 11, tubular parts are held in fixed position relative to the outer barrel of the tool, as far as downward longitudinal movement is concerned. By releasing the bayonet lock, the inner tubular parts can slide longitudinally within the outer barrel, as will be further described.

For the purpose of holding the tool against longitudinal movement in the casing 1, I provide a plurality of wedge shaped slips 13, adapted to frictionally engage the interior surface of a well casing. The slips are mounted in the slip hanger 9, in the usual manner; that is, the slips are slidably keyed to the hanger as is well known in the art. The inner faces of the slips are inclined downwardly and outwardly from their upper ends. Back of each slip 13, I provide a wedge 14, each wedge resting on a shoulder 15, in the slip hanger 9. The wedges 14 can move laterally a limited amount and gravity normally holds them on their shoulders 15. The outer face of each wedge is inclined from its upper end downwardly and outwardly to mate with the inclined faces on the backs of the slips. The inner face of each wedge is tapered in the opposite direction, that is, downwardly and inwardly.

A slip setting sleeve 16 surrounds the pipe 5

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and the upper part of the tube 6, and this sleeve has a limited longitudinal movement on the pipe 5 and tube 6. This pipe 5 is formed with a shoulder 17 at its lower end, which is engaged by the stop 18 at the upper end of the sleeve 16. The lower end of sleeve 16 is inclined downwardly and inwardly to mate with the taper on the backs of the wedges. In the lowered position of the pipe 5, the shoulder 17 engages a stop 19 on sleeve 16 adjacent the lower end of the sleeve 16. When the sleeve 16 is moved downwardly with respect to the tube 6 the lower tapered end of the sleeve engages the wedges 14 forcing these wedges outwardly against the slips 13 and setting these slips against the casing 1. In this manner the tool is held in fixed position in the casing. The wedges 14 are free elements, that is, they are not attached to any part but rest on shoulder 15, and bear against the back of the slip 13 on the outer side and against the lower tapered end of the sleeve 16 on the inner side. The slips 13 are constrained against falling out of the slip hanger 9 by conventional means such as over-lapping shoulders 13a and 13b on the slips and hanger, or by dovetails between the wedge and slip members, not shown, but of common construction.

An annular cup packer 20 is mounted on the lower end of the slip hanger 9 and this cup packer is flexible and can spring outwardly to engage the walls of the casing 1.

To hold the cup packer 20 collapsed when the tool is run into the well, as shown in Figure 1, I provide a ring 21, into which the cup packer 20 extends, and this ring is supported on fingers 22, which rise from a plate 23, slidably mounted on the stud 7 on the lower end of the tube 6. When the tube 6 is moved downwardly with respect to the slip hanger 9 and shoe 10 on which the cup packer 20 is mounted, the ring 21 is moved downwardly away from the cup packer 20 releasing the cup to expand against the wall of the well casing 1.

The tube 6 is engaged by three longitudinally spaced packings 24—25—26, and these packings are all arranged adjacent the lower end of the tool, substantially as shown. These packings are all of the packing gland type, and packing 24 is mounted in the lower end of the slip hanger 9, and packings 25 and 26 are mounted in the shoe 10. The tube 6 is provided with upper ports 27 and lower ports 28.

The slip hanger 9 is provided with fluid ports 29, which extend through the wall thereof, and through which fluid circulates, as will be further described. The shoe 10 is also provided with fluid ports 30, which extend through the wall thereof.

The purpose of the ports 29 and 30 is to permit fluid to by-pass the tool when the tool is being lowered into the well as shown in Fig. 1. Fluid from below the cup packer 20 passes upwardly through ports 30 and 28 into the tube 6 and out through ports 29. Fluid also passes up through the tube 6 and pipe 4 as well as passing upwardly around the cup packer 20, as shown in Figure 1. The ports 30 also permit cement to be pumped into the well as shown in Fig. 2, as will be subsequently described.

Operation

As shown in Figure 1, the parts are arranged to lower the tool into the well. The shoulders 11 of the bayonet lock are engaged by the lugs 12, the slips 13 are retracted, and the tool is now lowered. Any fluid in the well can by-pass the tool by moving upwardly through the ports 30

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and 28, thence through the ports 27 and out through the ports 29, as shown by the arrows in Figure 1. Also, fluid can pass upwardly through the tube 6, the pipe 5, and thence into the drill pipe 4, as shown by the arrows. Fluid can also pass upwardly around and past the constrained cup packing 20.

When the point in the well which is to be cemented is reached, the lugs 12 are disengaged from the shoulders 11 by rotating the pipe 4, and the coupling 3 attached thereto, thereby misaligning the lugs and shoulders to permit the coupling 3 and its attached parts to slide longitudinally. The drill pipe 4 is lowered slightly and the sleeve 16 which is supported thereby on shoulder 17 moves downwardly with respect to the slip hanger 9. The taper on the lower end of sleeve 16 engages the wedges 14 to set the slips 13 tightly against the casing. The relation of parts is shown in Figure 2. The ports 27 are now between the packing 24 and 25 communicating with ports 30, and the ports 28 are below the packing 25, and are exposed.

Cement under pressure is now pumped downwardly through the drill pipe 4, and this cement passes out through the ports 30, below the cup packing 20, thus expanding this cup further against the wall of the casing 1, and also pressing the cup 20 upwardly which tends to press the wedges 14 upwardly and further holds the slips 13 in position. The cement continues to move into the space below the cup packing 20, filling this space and being forced outwardly under pressure into the formation, all of which is usual and well known in the art.

When a proper amount of cement has been deposited, it is necessary to hold a continuous pressure on this cement while it is setting, and during this period of time the tool is positioned as shown in Figure 3. The tube 6 is pulled upwardly until the ports 28 are between the packing 26 and 25, and these ports are thus sealed off. At the same time, the ports 27 are raised above the packing 24 and, consequently, circulating mud or fluid can be forced downwardly in the casing 1, this fluid then passes inwardly through the ports 29, then through the ports 27, and upwardly through the tube 6, and thence through the drill pipe 4, to the surface.

While the tool is thus left in the hole, that is, holding a downward pressure on the cement, a circulation of fluid can be maintained above the cup packing 20, in the manner above described and any excess cement can be washed back to the top of the well to prevent the cementing of the tool in the well casing.

When it is desired to remove the tool from the well it is only necessary to pull up on the pipe 4 and its associated parts, coupling 3, pipe 5 and tube 6. The shoulder 17 on pipe 5 engages the stop 18 on sleeve 16, pulling the tapered lower end of sleeve 16 upwardly out of contact with the wedges 14 and releasing the slips 13 from engagement with the well casing 1. The upward movement of the tube 16 with respect to the slip hanger 9 (which is restrained from movement by frictional engagement with the well casing 1) moves the discharge port 28 from the position shown in Figure 3, between the packings 25 and 26 to a position above packing 25. At the same time port 27 in tube 6 is in open communication with the ports 29, in the slip hanger 9. Thus an open passage is provided around the cup packing 20 so that rapid withdrawal of the tool from the well will not tend to "swab" the well.

I claim:

1. An oil well cementing tool comprising, an elongated tubular mandrel adapted to be connected at its upper end to a string of well pipe, axially spaced upper and lower ports through the wall of said mandrel near the lower end thereof, a tubular barrel surrounding said mandrel and spaced therefrom throughout at least a portion of its length and being slidable on said mandrel, slips mounted in said barrel and projectable laterally therefrom, said slips having their inner faces inclined outwardly and downwardly, wedge members mounted in said barrel and movable radially therein, said wedge members having their outer faces inclined downwardly and outwardly to mate with the inclined faces on the backs of said slips and having their inner faces inclined downwardly and inwardly, a tubular sleeve surrounding said mandrel and slidably supported thereon within said barrel and above said wedge members, the lower end of said sleeve being tapered downwardly and inwardly to mate with the inclined faces on the backs of said wedges, means on said barrel for frictionally engaging a well casing, locking means between said barrel and said mandrel preventing relative axial movement thereof and releasable by relative rotation between said barrel and mandrel, whereby said sleeve can be lowered on said mandrel to engage the wedge faces on said sleeve and on wedge members to force the wedges and slips outwardly of said barrel, cup packing means mounted near the lower end of said mandrel, between said axially spaced ports and adapted to engage the interior wall of a well casing in sealing relation thereto, three axially spaced packing elements in said barrel between said barrel and mandrel adapted provide a slidable but fluid tight seal between said barrel and mandrel, said packing elements being so spaced with respect to the ports in said mandrel that upon relative axial movement between said barrel and mandrel the upper of said ports can move from a first position above the uppermost of said packing elements in open communication with the well above said cup packing while the lower port is in open communication with the well below said cup packing, to a second position wherein both the upper and lower ports are in open communication with the well below said cup packing, and to a third position wherein the upper port is in open communication with the well above said cup packing while the lower port is in closed position between the two lowermost packing elements.

2. An oil well cementing tool comprising, an elongated tubular mandrel adapted to be connected to the lower end of a string of well pipe, upper and lower fluid circulating ports through the wall of said mandrel near the lower end thereof, a tubular barrel surrounding said mandrel and slidably and rotatably supported thereon, friction means associated with said barrel and adapted to engage the interior wall of a well casing, latch means for preventing relative axial movement between said barrel and mandrel, said latch means being releasable by rotation of said mandrel with respect to said barrel, wedge slips mounted in said barrel and movable laterally thereof by relative axial movement of said mandrel and barrel to engage a well casing to prevent movement of the barrel with respect to the well casing, cup packing means mounted on said barrel and adapted to engage the wall of a well casing, upper and lower fluid circulating ports

in barrel, respectively above and below said cup packing, three axially spaced packing element in said barrel adapted to slidably seal between said barrel and mandrel, the uppermost of said packing elements being adapted to prevent fluid flow through said cup packing between said barrel and mandrel, the intermediate and lower packing elements being adapted to prevent fluid flow through said mandrel below said cup packing when the lower mandrel port is between said intermediate and lower packing elements.

3. A well packer, including, a tubular mandrel adapted to be connected to a string of well pipe, a tubular barrel surrounding said mandrel and slidably supported thereby, friction means associated with said barrel and adapted to bear against the wall of a well casing, wedge slips carried by said barrel for anchoring said packer to the wall of a well casing, means actuated by axial downward movement of said barrel with respect to said mandrel for expanding said slips, said slips being releasable by upward movement of said mandrel, a cup packing mounted on the lower end of said barrel and facing downwardly, upper and lower fluid discharge ports in said barrel above and below said cup packing, respectively, the lower end of said mandrel being closed and extending slidably through said barrel and cup packing, upper and lower fluid discharge ports in said mandrel near the lower end thereof and adapted to communicate with the respective discharge ports in said barrel upon axial movement of said mandrel, and axially spaced packing elements in the lower portion of said barrel in slidable sealing engagement between said barrel and mandrel, including, an uppermost packing element between the upper and lower ports in said barrel, an intermediate packing element below the lower port in said barrel, and a lowermost packing element below said intermediate packing element and spaced therefrom a distance sufficient to close the lower port in said mandrel when said port is between said lower packing elements.

4. In a retrievable squeeze tool for cementing oil wells, means for attaching said squeeze tool to a string of well pipe, including a tubular mandrel, closed at its lower end and having upper and lower fluid discharge ports near the lower end thereof, a tubular barrel surrounding said mandrel and slidably and rotatably supported thereon, friction means associated with said barrel and adapted to engage the interior wall of a well casing to cause relative movement between said barrel and mandrel when the mandrel is moved, wedge slips mounted in said barrel and adapted for lateral movement with respect thereto to engage the interior wall of a well casing to prevent relative movement between said barrel and well casing, wedge means associated with said barrel and slips, whereby downward and upward movement of said barrel with respect to said mandrel will cause said slips to be expanded or retracted, respectively, cup packing means mounted on said barrel and adapted to engage the wall of a well casing to prevent upward flow past said cup packing, upper and lower fluid discharge ports in said barrel above and below said cup packing, respectively, and three axially spaced packing elements in said barrel whereby relative axial movement of mandrel and barrel permits circulation through and around the tool, downwardly through the tool but not upwardly past said cup packing, or upwardly above said cup

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packing while holding a pressure below the cup packing.

5. An oil well cementing tool comprising, an elongated tubular mandrel, closed at its lower end and adapted to be connected to the lower end of a string of well pipe, upper and lower fluid circulating ports through the wall of said mandrel near one end thereof, a tubular barrel slidably mounted on said mandrel and having upper and lower fluid circulating ports extending through the wall thereof, packing means on said barrel in fluid sealing relation between said barrel and mandrel and between said upper and lower ports therein and also below the lowermost port therein at two axially spaced positions means on said barrel for frictionally engaging the interior wall of a well casing whereby the mandrel can be moved relative to the barrel to change the relative positions of the fluid ports in the

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barrel and mandrel, and packing means normally carried by said barrel between the upper and lower fluid ports in said barrel for sealing engagement between said barrel and the interior wall of the well casing, the interior passageway through said tubular mandrel being thereby communicable with either or both of the upper or lower fluid ports in said barrel by relative movement between said barrel and mandrel.

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