May 28, 1940. A. L. STRAUB 2,202,173

WELL CEMENTING DEVICE

Filed June 29, 1939 2 Sheets-Sheet 1

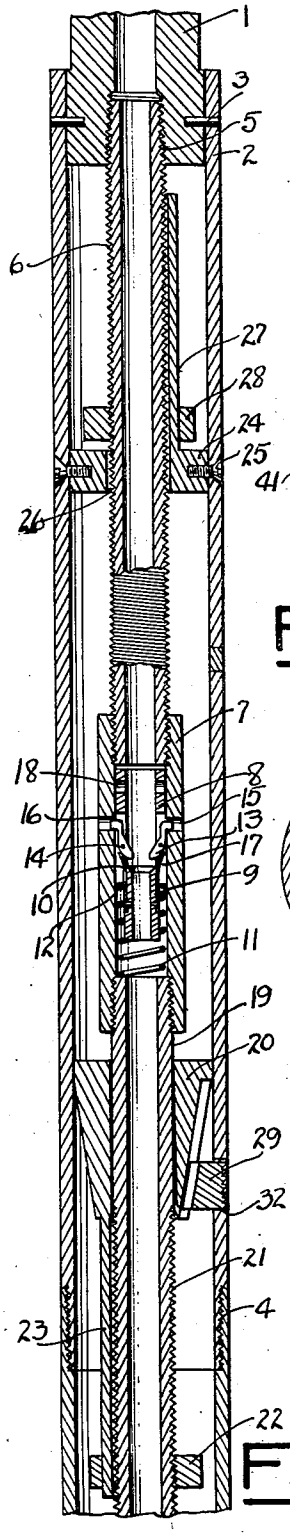


Fig. 1.

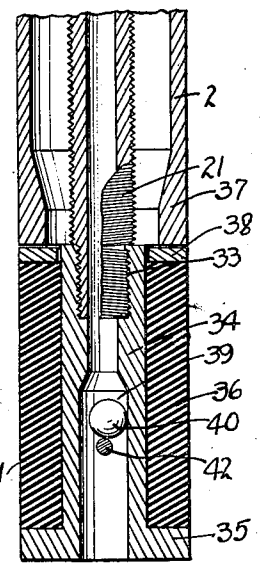


Fig. 2.

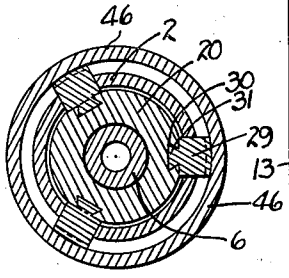


Fig. 4.

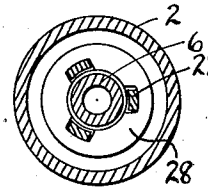


Fig. 5.

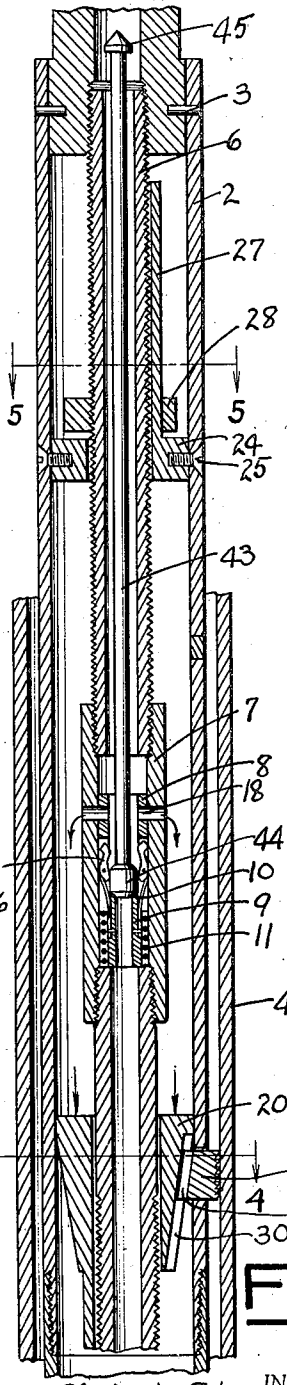


Fig. 3.

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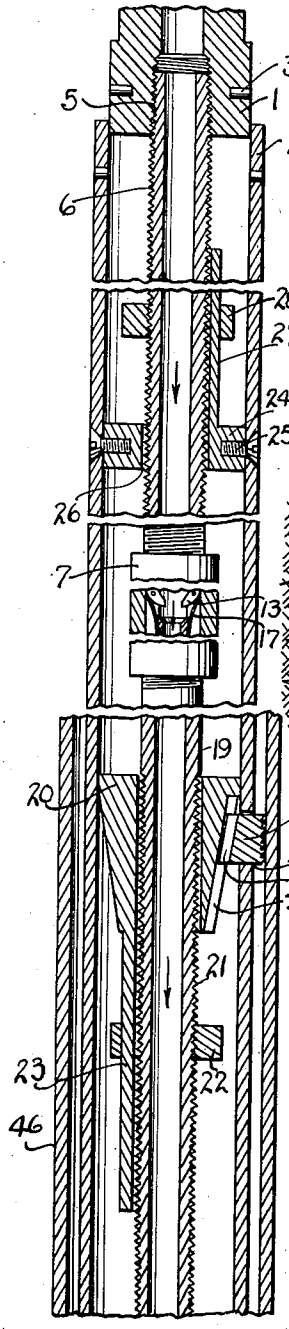


Fig. 6.

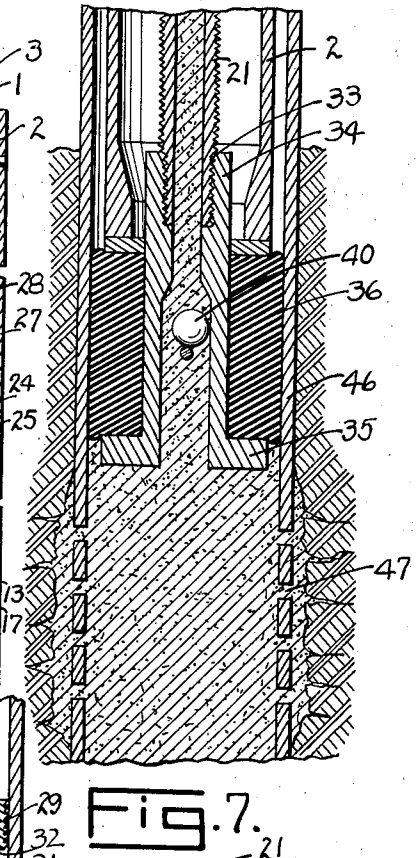


Fig. 7.

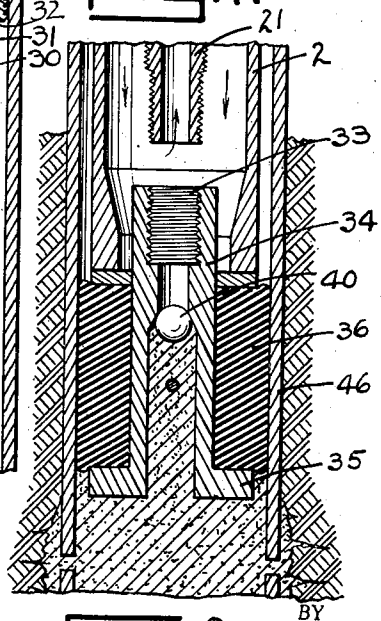


Fig. 8.

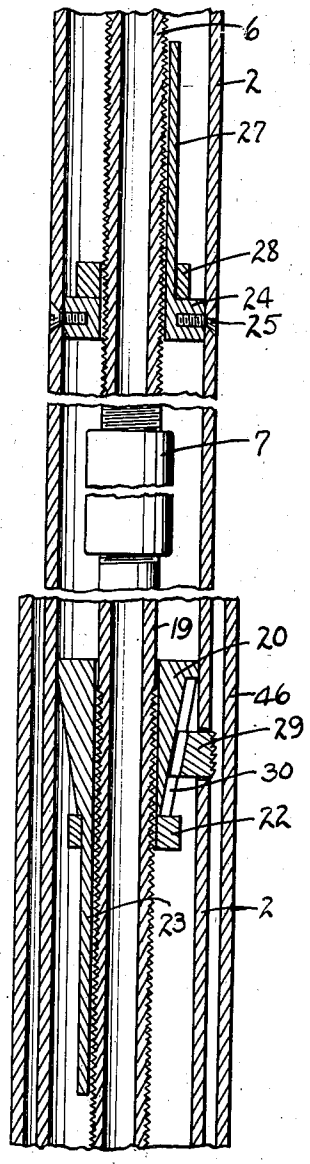


Fig. 9.

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UNITED STATES PATENT OFFICE

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WELL CEMENTING DEVICE

Alvin L. Straub, Houston, Tex.

Application June 29, 1939, Serial No. 281,901

7 Claims. (Cl. 166—12)

My invention relates to apparatus for use in cementing wells.

It is an object of the invention to provide an apparatus for use in performing the necessary operations connected with cementing a well and in which it is possible to withdraw the principal part of the device from the well after the cementing has been accomplished.

I also desire to provide a device of this character in which it is possible to fix the device at any desired level in the well for the purpose of cementing at that level.

It is a further object of the invention to provide a device which may be adjustable after the cementing operation has been performed to clear the device of cement remaining above the cement plug.

The invention contemplates in particular the provision of a device which will be capable of positive and accurate operation in performing the necessary steps required in cementing.

With reference to the drawings herewith, Figs. 1 and 2 show a central longitudinal section through the cementing device, Fig. 2 showing the lower end of the device disclosed in Fig. 1.

Fig. 3 is a detail somewhat enlarged showing the apparatus by which the cementing device may be fixed in position at the desired level in the well casing.

Figs. 4 and 5 are transverse sections on the planes 4—4 and 5—5, respectively of Fig. 3.

Fig. 6 is a view similar to Fig. 1 but showing the parts in different positions.

Figs. 7 and 8 are enlarged sections through the lower end of the cementing tool but showing different steps in the cementing operation.

Fig. 9 is a central longitudinal section through the slip operating mechanism by means of which the tool is supported in the well.

My device is intended for connection to the lower end of a drill stem or setting string indicated at 1 in the drawing. At the lower end of this setting string which is a hollow tubular member I secure a housing 2. As shown in Figs. 1 and 3, this housing is attached to the string 1 by means of a plurality of shear pins 3.

The housing 2 is shown as formed in two sections connected together by threaded engagement at 4. For purposes of this invention the housing may be considered as a single tubular member within which the cementing device is housed. The inner passage through the setting string 1 is threaded at 5 for connection with a mandrel 6, said mandrel extending axially downward through the housing. The said mandrel 6 has therein a connecting sleeve 7, which is threaded at both ends to connect with the sections of the mandrel. This connecting sleeve 7 forms a type of valve housing within which a slidable cage member 8 is fitted. At the lower end of the cage member the body is reduced in diameter as shown at 9 and a tapered valve seat 10 is formed therein. There is a compression spring 11 below the cage member which bears against a shoulder 12 thereon and tends to hold the valve in raised position with the upper end of the sleeve bearing against the lower end of the upper mandrel section.

Formed on the cage member of the valve above the seat 10 are a pair of oppositely disposed latching members 13. Said latches are pivoted between their ends at 14 and the upper end of the said latches have laterally extending fingers 15 which engage within openings 16 in the connecting sleeve 7. These latch members are held with the lower ends urged inwardly and the upper ends outwardly in the latched position by means of leaf springs 17 fixed to the outer wall of the seat member and bearing against the lower ends of said latch members. Above the latch the cage member is formed with lateral openings 18 to allow the passage of fluid as will be later explained.

Below the connecting sleeve 7 the mandrel has a smooth outer periphery as shown at 19 and is fitted through a slip setting device 20. Below the said slip setting device the mandrel is threaded at 21 and threadedly engages through a nut 22, which is held against rotation relative to the mandrel by a plurality of arms 23 projecting downwardly from the slip setting device 20 and slidably engages in recesses in the nut.

Above the connecting sleeve 7 is a supporting ring 24, which is fixed to the inner wall of the housing by means of set screws 25. Said supporting ring has an opening 26 therethrough to freely allow the passage of the threaded mandrel 6. The support 24 has a plurality of upwardly extending fingers 27 thereon spaced slightly from the mandrel, these fingers slidably engaging through recesses in a nut 28 to hold said nut against rotation relative thereto. Said nut between said fingers is, however, threaded upon the mandrel 6 and may be moved vertically relative to the mandrel by the rotation of the mandrel in an obvious manner. It is connected with the mandrel 6 by a threaded connection which when the mandrel is rotated in a right-hand direction will move said nut downwardly against the supporting ring 24.

The slip setting member 20 fits tightly but slidably within the housing at its upper end but the lower portion thereof is tapered downwardly to form a plurality of wedge shaped tracks thereon upon which are fitted the slip jaws 29. As will be seen from Fig. 4, these tracks are mortised to provide trackways 30 within which the dovetailed tenons 31 may fit, said tenons being formed upon the inner faces of said jaws 29. It will be understood that when the slip setting device 20 is moved downwardly relative to said jaws said jaws will be moved outwardly through openings 32 in the housing and may contact with the inner surface of the well casing. I have shown three such trackways and three slip jaws connected therewith.

The lower end of the threaded portion 21 of the mandrel is engaged at 33 within a tubular packer support 34. Said support has at its lower end a radial flange 35 upon which is supported the packer sleeve 36, which may be of rubber or similar material adapted to be expanded laterally when the sleeve is contracted longitudinally.

Between the lower end of the housing and the upper end of the packer sleeve is a washer 38 of hard material through which compressive force may be exerted upon the packer sleeve when desired. The packer support 34 has therein a valve chamber 39 within which is a ball valve 40. Above the valve the passage is tapered at 41 to form a seat for said valve, and below the ball valve is a diametrical cross pin 42 to limit the downward movement of said valve.

In the operation of my device the apparatus will be assembled as shown in Figs. 1 and 2 and lowered to the desired level in the well. It will be understood that the cementing job may be done at any desired elevation. When the proper position in the well has been reached the slips 29 will be expanded to engage with the casing. This is done by dropping a rod or a godevil 43 downwardly through the setting string and through the hollow mandrel so that the lower end of said godevil will land upon the valve seat 10, as shown in Fig. 3. The godevil has a head 44 tapered slightly at its lower end to engage said seat so that the passage of fluid through the mandrel will be choked off. The upper end of the godevil has a spear-shaped head 45 to which an overshot may be engaged when desired.

The engagement of the godevil with the valve will move the valve downwardly somewhat and the pressure of fluid thereon will supplement the weight of the godevil sufficiently to move the valve sleeve 8 from its upper position. It will be noted that the engagement of the godevil with the inner arms 13 of the latching dogs will withdraw them from latching position so that this downward movement may be accomplished. As the sleeve moves downwardly the openings 18 therein will register with the openings in the connecting sleeve 7 and allow the passage of fluid outwardly into the interior of the housing. Liquid pressure will be built up in the housing sufficiently to force the slip expanding member 20 downwardly moving the slips outwardly into engagement with the casing as shown in Fig. 3. The teeth upon the slips are inclined upwardly and an upward pull upon the string will hold the slips tightly in engagement with the casing so that no further upward movement may be accomplished. The packer may next be expanded into sealing engagement with the inside of the casing. This is accomplished by exerting a strong upward pull upon the setting string so as to shear the pins 3 and allow the mandrel to be moved upwardly. As the housing is held by the slips against upward movement an upward pull upon the mandrel will also exert an upward thrust upon the packer support 34 and thus compress the packer into the sealing position shown in Fig. 8. The godevil may then be withdrawn by means of an overshot and the device is ready for cementing, and cement may be pumped downwardly through the setting string and the mandrel to discharge the cement into the casing below the packer and, as shown in Fig. 7, this casing 46 may be perforated as shown at 47. When sufficient cement has been forced downwardly into position the pressure on the cement may be released by stopping the pumps and the surge of cement will force the ball valve 40 to said seat, thus preventing any back flow of the cement into the housing. The next step is to release the cementing device from the packer and this is accomplished by righthand rotation of the setting string and the mandrel. The connection 33 below the lower end of the mandrel and the packer support is a lefthand thread which will be released by a righthand rotation thus allowing the mandrel to move upwardly out of connection with the packer support as shown in Fig. 8. When this connection has been released fluid may be pumped downwardly in the well through the housing and back upwardly through the setting string as indicated in Fig. 8. It will be understood that as the mandrel is moved upwardly the lower end of the string 1 will be moved out of the upper end of the housing so that this circulation may be accomplished. Obviously it will also be possible to circulate the flushing fluid downwardly through the tubing and upwardly in the casing so that all of the cement remaining above the packer will be washed free.

The next step is to withdraw the slips to release the housing and this step is performed by rotating the mandrel to move the lower nut 22 thereon upwardly into contact with the lower end of the slip expanding member 20 and force it to move upwardly and withdraw the slips. In this operation the upper nut 28 on the mandrel will be moved downwardly into contact with the ring 24 as the lower ring 22 is moved upwardly, one nut having a lefthand engagement and the other a righthand engagement with the mandrel. When the upper nut 28 has contacted with the ring 24 the further rotation will tend to move the mandrel and the ring 22 upwardly more rapidly until the slip jaws have been withdrawn. When this has been accomplished the complete device may be withdrawn from the well leaving the packer with the packer support 34 in position in the well.

It will be obvious that I am enabled to support my cementing tool at any desired position and when thus supported it will be possible to expand the packer, cement the well, wash out the cementing tool and remove the cementing tool entirely from the well with the exception of the packer member which still remains. The device may be operated quickly and positively and has many advantages which will be obvious to those skilled in the art.

What is claimed is:

1. A cementing device including, a string of pipe, a hollow mandrel connected therewith, a housing on said string and spaced about said

mandrel, slip jaws associated with said mandrel and projecting through openings in said housing, hydraulically operated means to move said slip jaws outwardly to engage a well casing and prevent upward movement of said housing in said casing, and means responsive to an upward pull on said mandrel to seal between the lower end of said housing and said casing, said mandrel and housing being releasable from said sealing means.

2. A cementing device including, a string of pipe, a hollow mandrel connected therewith, a housing on said string spaced about said mandrel, slip jaws associated with said mandrel and projecting through openings in said housing, hydraulically operated means to move said slip jaws outwardly to engage a well casing and prevent upward movement of said housing in said casing, means responsive to an upward pull on said mandrel to seal between the lower end of said housing and said casing, said mandrel and housing being releasable from said sealing means, and a nut on said mandrel movable by rotation of said mandrel to engage said slip moving means to withdraw said slips from engagement with said casing.

3. A cementing device including a string of pipe, a hollow mandrel thereon through which liquid may be circulated, a housing about said mandrel, slip jaws in said housing, a fluid actuated wedge device to move said jaws outwardly into engagement with a well casing, means actuated by the rotation of said mandrel to again withdraw said jaws, a packer below said jaws, means on said mandrel, responsive to the relative upward movement of said mandrel to expand said packer, said mandrel being releasable from said packer.

4. A well cementing device including a string of pipe, a hollow mandrel thereon, a housing about said mandrel, a downwardly tapered plunger within said housing and slidable upon said mandrel, slip jaws having a mortised connection with said plunger and projecting from openings in said housing, means to open up an outlet from said mandrel above said plunger for pressure fluid to force said plunger downwardly and move said slip jaws, and a packer connected with said mandrel and operating in response to an upward pull on said mandrel to seal with an outer well casing, said mandrel being releasable from said packer.

5. A well cementing device including a string of pipe, a hollow mandrel thereon, a housing about said mandrel, slip jaws projecting through openings radially of said housing, a slip expander fitting within said housing and having a downwardly tapered wedge surface to engage said slips, said jaws having upwardly inclined casing engaging teeth thereon, means to open up an outlet from said mandrel above said plunger for pressure fluid to force said plunger downwardly and move said slip jaws, and a packer connected with said mandrel and operating in response to an upward pull on said mandrel to seal with an outer well casing, said mandrel being releasable from said packer.

6. In a cementing device a hollow fluid circulating mandrel, a connecting collar in said mandrel, lateral ports in said collar, a valve sleeve in said collar, means to move said sleeve normally into position closing said ports, means to latch said sleeve in closed position, and means movable by gravity in said mandrel to release said latch and move said sleeve to open said ports.

7. A cementing device including a string of pipe, a hollow mandrel connected therewith, a housing on said string and spaced outwardly about said mandrel, means to anchor said housing against upward movement in a well casing, a packer support at the lower end of said mandrel, a packer thereon, said packer being set by an upward movement of said mandrel in said housing, said mandrel being releasable from said packer, and frangible means connecting said housing to said string of pipe, whereby said mandrel may be moved upwardly in said housing.

ALVIN L. STRAUB.