Sept. 19, 1939. J. R. BRADSHAW 2,173,351

CEMENTING PACKER FOR OIL WELLS

Filed April 27, 1937 2 Sheets-Sheet 1

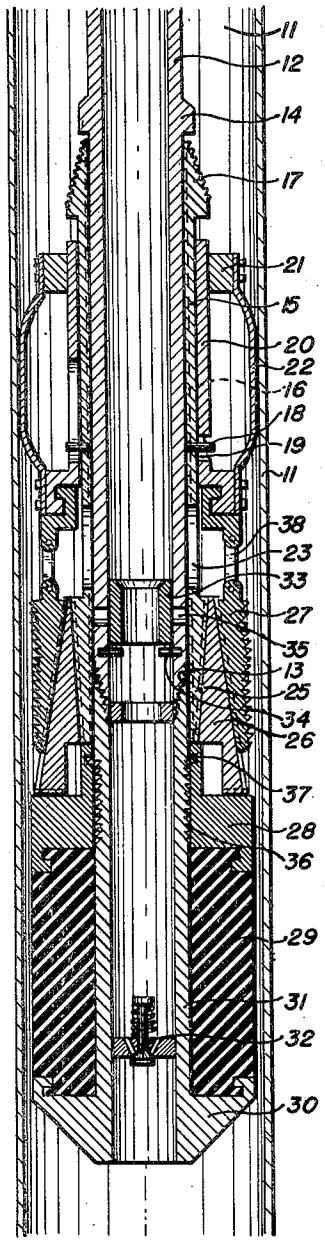


Fig. 1

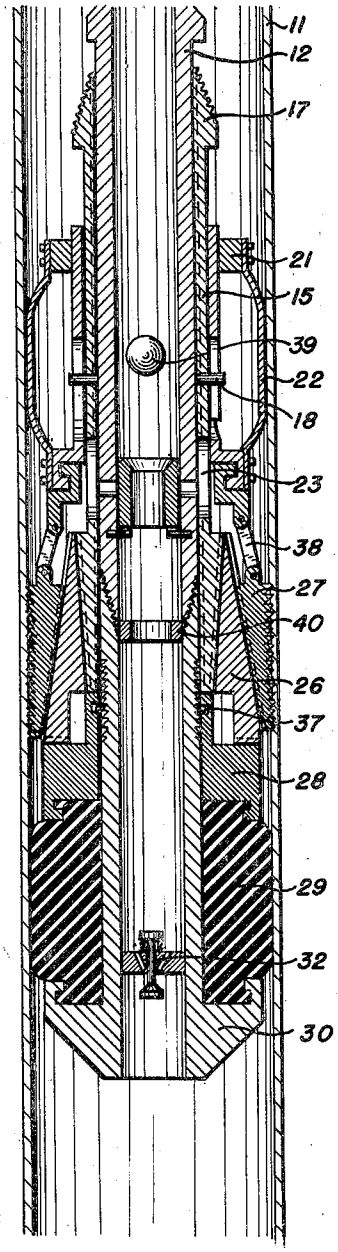


Fig. 2

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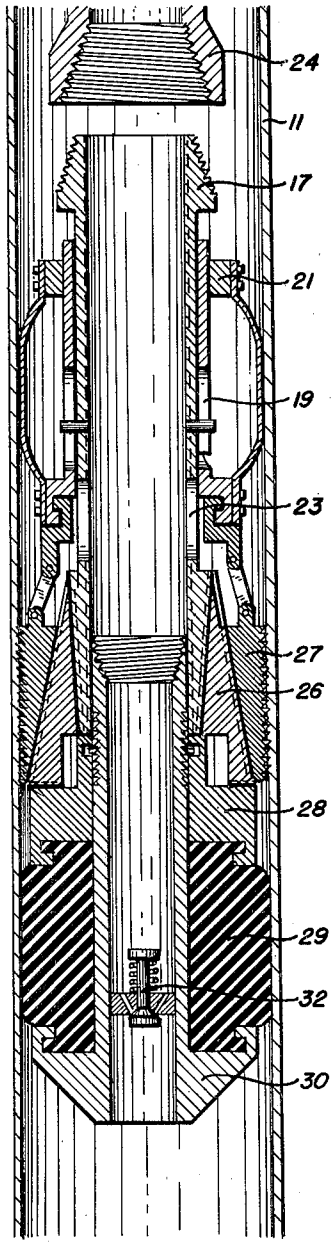


Fig. 3

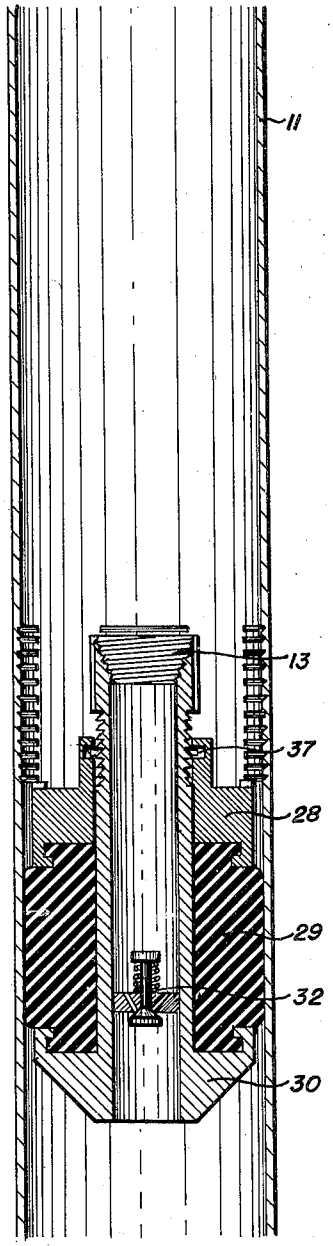


Fig. 4

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Patented Sept. 19, 1939 2,173,351

UNITED STATES PATENT OFFICE

2,173,351

CEMENTING PACKER FOR OIL WELLS

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Application April 27, 1937, Serial No. 139,236

9 Claims. (Cl. 166—12)

This invention relates to apparatus adapted for use in oil wells or the like and more particularly to packers and means for securing and removing the same to and from the casing of a well.

It is often desirable to fix and seal a valve or other structure to the casing of an oil well. For example, where the well is to be cemented by forcing cement slurry down into the well through tubing and into the formation of the well under high pressure, it is desirable to provide means at the bottom of the tubing which can be fixed to the casing and prevent the pressure on the cement from forcing the tubing upwardly. It is also desirable in such a case to provide a packer or other sealing means around the tubing so as to prevent the passage of slurry upwardly between the tubing and the casing.

It is one object of the present invention to devise novel means for setting a packer on tubing in a well and to provide means for removing some or all of the packer assembly from the well.

It is another object to provide means for securing tubing to the casing in an oil well and to provide means for removing the securing means therefrom.

It is another object of the invention to devise means for retaining cement or other fluid in place in a well and to so construct and arrange the same that the retaining means can be partly or wholly removed from the well after it has accomplished its purpose.

Other objects and advantages reside in certain novel features of the arrangement, as will be more apparent from the following description taken in connection with the accompanying drawings, in which:

Figure 1 is a vertical cross-sectional view of the casing of an oil well with apparatus constructed in accordance with the present invention located therein, the parts of the apparatus being in the relative positions which they occupy while being lowered into the well;

Figure 2 is a vertical cross-sectional view of the same apparatus as that shown in Figure 1 but illustrating the parts in the relative position which they occupy when set on the casing and illustrating the phase of operation in cementing the well at the completion of placing the cement and just before the tubing and casing are washed;

Figure 3 is a vertical cross-sectional view of the apparatus shown in Figures 1 and 2 but illustrating a subsequent step in the operation of the tool after the tubing has been disconnected therefrom; and

Figure 4 is a vertical cross-sectional view of the well showing the packer left in the well but the other parts removed, this view illustrating the conditions of the well in the event the preferred form of the invention is employed, after the cementing job has been completed.

Referring to the drawings in detail, it will be seen that in all of the figures the casing of an oil well is illustrated at 11. Within the casing the cementing packer assembly is lowered to the proper depth by means of the tubing 12. The lower end of the tubing 12 has a tapered thread 13 to form a connection which is commonly called a "dizzy thread" or "backoff thread".

A suitable distance above the joint connection 13 the tubing is provided with a shoulder 14 beneath which a sleeve 15 is slidably mounted upon the tubing but prevented from rotating therewith by means of a spline connection shown in dotted lines at 16. The upper end of the sleeve 15 carries a connection having conical tapered threads 17 which constitute means for connecting what is termed an "over-shot" (shown at 24 in Figure 3) and which is used to remove some or all of the assembly from the well after the cementing operation is completed. The sleeve 15 also carries a number of radially extending pins 18 which may be moved up and down in J-slots 19 in an outer sleeve 20. The sleeve 20 has a collar 21 secured thereto for supporting suitable drag springs 22 of known construction.

The sleeve 15 is also provided with a number of slots or washout ports 23, the purpose of which will be described hereinafter.

The lower end of the sleeve 15 has a conical or wedge-shaped portion 25, to which are dovetailed a number of wedge-shaped members 26 which in turn are dovetailed to a number of slip segments 27. It will be noted that the wedge-shaped portion 25 has its smallest diameter at the lower end, while the intermediate wedges 26 have similarly tapered inner surfaces so that they can slide up and down upon the wedge 25, and be moved in and out radially thereby. The outer surfaces of the intermediate wedges 26 are so constructed that their smaller diameter is at the top. They thus cooperate with the inner surfaces of the slips 27 to move them in and out radially. Thus it may be said that the wedge members 25 and 26 are tapered in opposite directions.

The lower portions of the intermediate wedges 26 are dovetailed to the upper shoe 28 of the packer 29 so that they may slide in and out radially upon this shoe. If moved radially inwardly far enough, they may disconnect from the shoe, as will be described hereinafter.

The lower shoe of the packer, designated at 30, is supported by means of an inner mandrel 31 which has a conically tapered upper end threaded to make connection with the threads 13 on the tubing 12. The mandrel 31 also carries a valve 32 of any suitable construction which is adapted to seat whenever the pressure below the packer is higher than that within the tubing 12. A washout valve is preferably also provided, this feature in the present construction consisting of a sleeve 33 supported by means of shear pins 34 in the lower part of the tubing 12 adjacent washout ports 35. These ports are located slightly below the washout ports 23 in the sleeve 15 while the apparatus is being lowered into the well as shown in Figure 1 but brought into alignment with these ports when the packer is set as shown in Figure 2.

The mandrel 31 also has a number of ratchet teeth 36 thereon at a point opposite the upper shoe 28 and this shoe may carry a spring latch ring 37 adapted to engage the teeth and hold the shoes 28 and 30 in position when the packer is set.

The drag springs 22 in addition to preventing the sleeve 15 from rotating support the slips 27, suitable links 38 being provided for this purpose.

To set the packer the apparatus is lowered into the hole to the desired point with the parts in the relative position shown in Figure 1. The slips are prevented from engaging the casing at this time by the cooperation of the pins 18 and J-slot connections 19. Upon the desired location being reached, the tubing 12 is rotated slightly to the right, bringing the pins 18 into the longitudinally extending portions of the J-slots 19. As the tubing is then pulled upwardly, all of the assembly is raised except the drag springs 22 and the slips 27. The packer and slips then take the position shown in Figure 2. As the lower shoe 30 is pulled upwardly it expands the packer into engagement with the casing and at the same time the slips are set, the wedge sections 26 forcing the slips outwardly. The lower end of the tubing is thus secured and sealed to the casing and the well is ready for cementing.

To cement the well, slurry is pumped downwardly through the tubing, flowing through the valve 32 which will be opened under the pressure of the pumps on the slurry. After a sufficient quantity of cement has been pumped into the well the ball 39 is dropped in the well and seats upon the sleeve 33. Further pressure on the pumps then shears the pins 34 and the sleeve 33 moves down to a point where it is caught by the collar 40 inside of and at the extremely lower end of the tubing 12. The ports 35 and 23 now being in alignment, water or other washing out fluid can be circulated through the tubing and upwardly on the outside between the tubing and the casing, thus removing any excess of slurry which may be within the tubing and washing out around the drag springs and above the slips.

After washing out a short time the tubing itself may be removed from the well by breaking the connection at 13, this operation preferably being performed before the cement takes its initial set, so as to insure against sticking the tubing in the well. The threads 13 may be left handed, in which case the tubing will be rotated to the right to disconnect the same. After the tubing has been removed, the well will be in the condition shown in Figure 3. The valve 32 will be closed, preventing the cement, which will normally still be under high pressure, from flowing upwardly through the mandrel 31. The well should be left in this condition until the cement hardens. A suitable tool 24 is then lowered into the well and connected to the threads 17 on the sleeve 15.

The tool 24 may be merely a threaded box, as illustrated, and lowered on drill pipe to make a connection with the sleeve 15. Any other kind of fishing tool or "overshot", supported by either pipe or cable may be employed.

Due to the double wedge assembly illustrated at 25 and 26 for actuating the slips, and due to the angles of the inclined surfaces thereof, there will be good frictional contact between the slips and the casing, and the pressure of the cement below the packer, being exerted upon the upper shoe 28, will cause the slips to bite into the casing firmly until the inner wedge 25 is pulled upwardly. The purpose of the overshot connection 17 is to enable this inner wedge to be pulled upwardly. As a connection is made upon the sleeve 15 and this member is pulled upwardly, the wedge members 26 are moved inwardly radially, being dovetailed to the wedge 25. This will also draw the slips inwardly radially, since they are dovetailed to the wedge members 26. The slips will thus be disengaged from the casing and can be removed from the well when the pins 18 engage the upper ends of the slots 19 and pull upwardly on the drag springs 22.

The dovetail connection between the wedge members 26 and the upper shoe 28 is preferably such that as the wedge members move inwardly a sufficient distance they are disconnected from the shoe. This may be accomplished by causing the upwardly projecting dovetail studs 41 on the shoe to have but limited radial dimension so that the dovetail on the wedge members 26 will slip off of the end thereof as they are moved inwardly. With this construction, the slips, wedges, drag springs and the operating mechanism are all removed from the well after the cementing operation is completed, leaving only the packer, the upper and lower shoes and the mandrel 31 in the well, as shown in Figure 4. With such an arrangement it will be necessary to drill out these members with the cement which is left in the casing to complete the well and for this reason the material parts of this assembly should be made of drillable material such as cast iron or aluminum.

It is within the purview of the invention to provide a connection of limited strength between the wedge members 26 and the upper shoe 28 so that unless the packer is firmly stuck the apparatus remaining in the well as shown in Figure 4 may be removed also. However, in the preferred construction it is contemplated to leave the packer and the shoes in the well as described above.

While only one embodiment of the invention has been shown and described herein, it is obvious that various changes may be made in the arrangement and construction of parts without departing from the spirit of the invention or the scope of the annexed claims.

I claim:

1. Apparatus adapted for use in cementing an oil well or the like comprising a cement retaining assembly adapted to be lowered into the well on tubing and be secured to casing in the well, said assembly including a packer having an upper shoe, slips for holding the packer and shoe against upward movement and a wedging arrangement between said shoes and said slips for setting and

releasing the slips, said wedging arrangement having members adapted to press the slips outwardly into engagement with the casing when pressure is exerted upwardly on said members by said shoe and means connected to the members for drawing the same inwardly to release the slips without releasing the upward pressure exerted by said shoe upon said members.

2. Apparatus adapted for use in cementing an oil well or the like comprising a cement retaining assembly adapted to be lowered into the well on tubing and be secured to casing in the well, said assembly including a packer, slips for holding the packer against upward movement and an arrangement for setting and releasing the slips, said arrangement having slip actuating means consisting of inner wedge means and intermediate wedge means, said intermediate wedge means cooperating with inclined surfaces on the slips to actuate the same, the arrangement being such that movement of both the inner wedge means and the intermediate wedge means in unison will cause the slips to grip and engage the casing and relative movement between the inner and intermediate wedge means will cause the slips to disengage the casing.

3. The combination with slips for gripping the casing of an oil well or the like, of an arrangement for setting and releasing the slips, said arrangement including cooperating wedge members tapered in opposite directions, said members being adapted to cause the slips to grip and engage the casing when moved in unison and to cause the slips to disengage the casing upon relative movement therebetween.

4. The combination with a slip for gripping the casing of an oil well or the like, of an arrangement for setting and releasing the slip, said arrangement including an inner member and an intermediate member between the inner member and the slip, said intermediate member having an inclined surface to provide a wedge, and said inner member having an inclined surface to provide a wedge tapered in the opposite direction to that of said intermediate member, the arrangement being such that movement of the intermediate member relative to the slip will cause the slip to engage the casing and movement of the inner member relative to the intermediate member will enable the slip to disengage the casing.

5. Apparatus adapted for use in cementing a well comprising a cement retainer assembly adapted to be lowered into the well on tubing and be secured to casing in the well, said assembly including a mandrel, a packer mounted on said mandrel, slips for holding the packer against upward movement, a sleeve mounted for longitudinal movement with respect to said mandrel and complementary wedge devices, certain of said wedge devices causing the setting of the slips upon upward pressure being exerted on said packer and another of said wedge devices causing the release of said slips upon said sleeve being moved upwardly with respect to said mandrel.

6. Apparatus adapted for use in cementing an oil well or the like comprising a cement retaining assembly, tubing for lowering said assembly into the well, said assembly including a packer, slips for holding the packer against upward movement, a sleeve mounted for longitudinal movement with respect to said tubing and an arrangement for setting and releasing the slips, said arrangement having slip actuating means located between the slips and the packer for causing the slips to grip and engage the casing firmly as pressure is exerted upwardly on the packer and means on said sleeve for operating the slip actuating means upon upward movement of said sleeve to cause the slip actuating means to disengage the slips from the casing, said sleeve having an "over-shot" connection at its upper end whereby it may be moved upwardly when desired.

7. Apparatus adapted for use in cementing an oil well or the like comprising a cement retaining assembly adapted to be lowered into the well on tubing and be secured to casing in the well, said assembly including a mandrel, a packer on said mandrel, slips for holding the packer and mandrel against upward movement and an arrangement for setting and releasing the slips, said arrangement having slip actuating means located between the slips and the packer for forcing the slips outwardly radially to cause the slips to grip and engage the casing when the packer is moved upwardly and means movable with respect to said mandrel for moving said slip actuating means to cause the same to disengage the slips from the casing when desired.

8. Apparatus adapted for use in cementing a well which includes, in combination, a conduit or tubing for conveying the cement into the well, a packer for sealing the tubing to the casing of the well, slips for preventing the packer and tubing from moving in one direction in the well, slip actuating means movable with respect to said slips for setting or releasing the slips on the casing, means associated with said packer for moving said slip actuating means to cause the same to set in response to upward movement of said packer and means including a member independent of said tubing for cooperating with said slip actuating means to move the same to release the slips when desired.

9. Apparatus adapted for use in cementing a well which includes, in combination, a conduit or tubing for conveying the cement into the well, a packer for sealing the tubing to the casing of the well, slips for preventing the packer and tubing from moving in one direction in the well, slip actuating means movable with respect to said slips for setting or releasing the slips on the casing, means associated with said packer for moving said slip actuating means to cause the same to set in response to upward movement of said packer and means including a member independent of said tubing for cooperating with said slip actuating means to move the same to release the slips when desired, said member having "over-shot" connecting means at its upper end whereby an "over-shot" may be connected thereto to pull the same upwardly to cause the slips to release.

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