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W. J. BIELSTEIN
RETRIEVABLE TUBING PLUG

2,776,015

Filed May 21, 1954

2 Sheets-Sheet 1

FIG. 1.

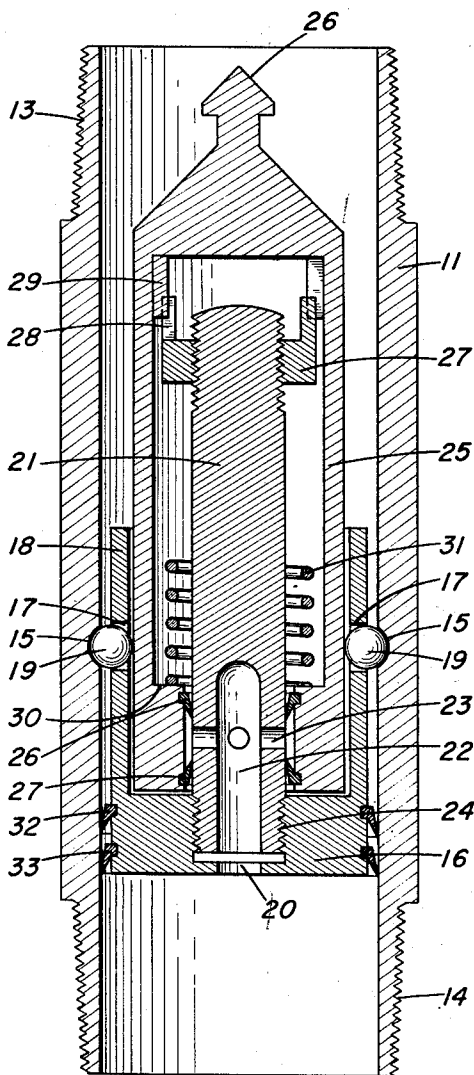
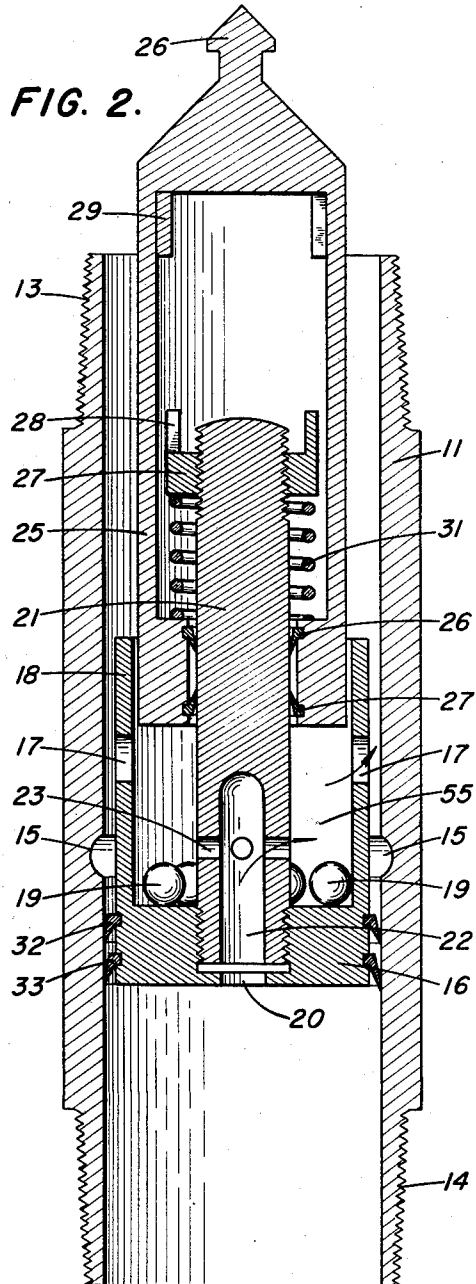


FIG. 2.



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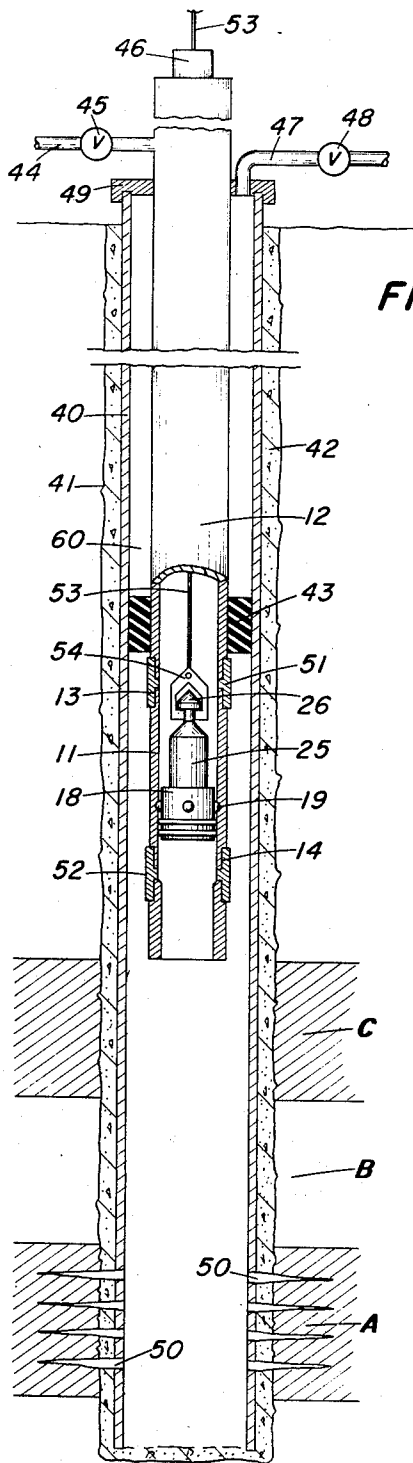
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RETRIEVABLE TUBING PLUG

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Application May 21, 1954, Serial No. 431,521

3 Claims. (Cl. 166—188)

The present invention is directed to a device for use in plugging a tubing string. In its more particular aspects, the invention has to do with a retrievable tubing plug. The device is specifically directed to a retrievable tubing plug for use in well completion operations.

The present invention may be briefly described as a device for use in plugging a tubing string which comprises a tubing sub adapted to be connected into the tubing string. The tubing sub is provided with a groove in the inner wall and has a plug member arranged within the sub which has at least one port arranged in cooperative relationship with the groove. At least one locking member is normally arranged in said port and groove for holding the plug member in locking relationship with the sub. The locking member is held in the port and groove by means of a tubular or hollow cylindrical holding means arranged in the sub. The cylindrical holding means has a fishing neck on its upper end for retrieving the plug and a retainer mandrel for the locking member is arranged within the cylindrical means. The retainer mandrel is connected to the plug and allows the plug to be removed from the sub on upward movement of the cylindrical member.

Sealing means between the plug and the sub and between the cylindrical member and the retainer mandrel are provided to allow a seal to be obtained, closing the tubing string.

The retainer mandrel may be provided with a passageway which is in communication with a central opening in the plug, such that the retainer mandrel on slidable movement with respect to the plug opens the passageway and allows communication through the tubing string.

The locking member is released from the port and groove on continued upward movement of the cylindrical member allowing the locking member to be released within a space in the plug below the cylindrical member on upward movement of the cylindrical member with respect to the plug.

The upper end of the mandrel is provided with a stop member, such as a mandrel nut, which is provided with upwardly projecting lugs adapted for engagement with lugs on the interior of the cylindrical member to lock the locking member in the groove and port.

The present invention will be further illustrated by reference to the drawing in which

Fig. 1 is a cross-sectional view of the tubing plug in a closed position;

Fig. 2 is a cross-sectional view of the tubing plug in an open position; and

Fig. 3 shows the tubing plug arranged in the tubing string.

Referring now to the drawing in which identical numerals may be employed to designate identical parts, numeral 11 designates a tubing plug sub which is adapted to be connected into a tubing string 12 by a connecting means 13 and 14 which may be threaded for connecting into a like threaded coupling.

A tubing plug sub is provided with a least one groove

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or recess 15 at the lower end thereof, and a plug member 16 is arranged in the sub such that a port or ports 17 in a sleeve section 18 of plug 16 is in co-operative relationship with the recess 15. The recess may be arranged at a different point, for example, at an intermediate point or on the lower end of a long plug. Arranged within the port 17 and the groove or recess 15 is a locking member, such as a sphere or spheres 19.

Connected to the plug 16 which has a central opening 20 is a locking member retainer mandrel 21 which is provided with a passageway 22 in communication with lateral passageways 23 which, in turn, allow communication, as will be described, through the plug.

It is to be noted that the mandrel 21 is connected to the plug 16 by mating threads 24. Holding the spherical members 19 in the port 17 and recess 15 is a cylindrical holding means 25 which is sealed against the mandrel 21 by sealing members 26. The upper end of the cylindrical member 25 is provided with a fishing neck 26.

Arranged on the upper end of the mandrel 21 is a mandrel nut or stop member 27 which is provided with drive lugs 28 which are adapted to engage with cylinder lugs 29 for the purpose of allowing for the installation of nut 27 by rotation of cylinder 25.

Embracing the mandrel 21 and arranged between the nut 27 and the lower interior end 30 of the cylinder 25 is a biasing means, such as a helical coil spring 31, which serves as a shock spring and which serves to allow the cylinder 25 to be pulled upwardly on limited movement to open the passageway and allow fluid to by-pass the plug followed by continuing upward movement to release the locking members 19. It is to be noted that the plug 16 is provided with seals 32 and 33 to seal between the plug and the sub.

Referring now to Fig. 3, it will be noted that a casing 40 is arranged in a well 41 and has been cemented in place with cement 42. The casing 40 has a tubing 12 arranged therein and the annulus 60 between the tubing 12 and the casing 40 has been sealed by a packer 43 which may be of a conventional type, such as illustrated in 1953 edition of the Composite Catalogue, vol. 1, page 942. The tubing 12 is provided with a flow line 44 which is controlled by a valve 45 and the tubing 12 is also provided with a wire line stuffing box 46.

The casing 12 and the annulus 60 are provided with a conduit 47 controlled by a valve 48, the well being closed in by conventional wellhead equipment, such as 49.

The casing 40 and the cement 42 has been perforated with perforations 50 in formation A. It is to be noted that the lower end of tubing 12 extends to a formation or strata, such as C, which is above the perforations 50 in strata A and is above the strata or formation B. A device such as the present invention including a sub 11, a plug 16, a cylindrical member 25 and a mandrel 21 is arranged in the tubing string 12 and forms part thereof being connected at connections 13 and 14 by coupling means 51 and 52, the tubing plug sub being arranged slightly above the tubing stop sub, the latter of which is conventional to the art as described in the Composite Catalogue supra at page 4074.

When the tubing string 12 is run in or lowered into the casing 40 without a plug 16, a liquid, filling the well, such as drilling fluid, salt water, oil, and the like will enter the tubing string 12. Ordinarily, to produce the well, if the well casing 40 has been perforated, it will be necessary to reduce the hydrostatic head of the column of fluid to less than the formation pressure to allow fluid to enter the casing. This is conventionally accomplished by swabbing, gas lifting or in some cases circulating a lighter fluid to displace a heavier fluid. In some instances, this is unsuccessful in bringing in the well.

In the present invention, with the plug 16 in the tubing

12, the tubing 12 is free or dry of fluid and is at a lower pressure than the well casing or at atmospheric pressure. Thus, when the plug 16 is pulled or is raised to open up communication, the effect is to reduce the column of hydrostatic head of the fluid in the well which results in bringing in the well. Moreover, if the well casing 40 has not been perforated, and drilling or other fluid is in the casing, it is possible with the present invention to run in the plugged tubing 12, remove the plug 16, and then circulate the fluid in the casing up the casing-tubing annulus by opening the packer 43 or prior to setting the packer, if one is used. Thereafter, when drilling fluid and the like has been removed and displaced by a clean fluid, such as salt water, the casing 40 may then be perforated in the clean fluid. Without employing the retrievable plug 16, the tubing 12 could not be maintained free of the fluids in the well.

When it is desired to employ the present invention as shown in Fig. 1, the plug 16 is inserted in the tubing plug sub 11 and locked into position by inserting the ball retainer cylinder 25. The shock spring 31, which may be optional, is installed on the ball retainer mandrel at the time the cylinder 25 is inserted. The mandrel nut 27 is then screwed into position by rotating the cylinder 25 (the top of the ball retainer cylinder is web steel). The nut 27 is then rotated by interlocking of the lugs 28 and 29. The tubing plug sub 11 is then installed in the tubing by connections 13 and 14 slightly above the conventional stop sub. The tubing 12 is then run into the well, as shown, and the packer 43 is set. A wire line, such as 53, having a fishing or grab tool, such as 54, on the lower end thereof to fit the fishing neck 26 is run in and the member 25 is moved upwardly. When the member 25 is moved upwardly, the by-pass including opening 20, passageways 22 and 23, is opened allowing pressure and/or fluid to pass through the center of the retainer mandrel and around the plug as indicated by the arrows in Fig. 2. Further upward movement raises the whole cylinder 25 above the spheres or balls 19 which normally lock the plug 16 in position. This allows the locking members or spheres 19 to drop out into the space 55 inside of the plug 16. The plug 16 is then in unlocked position and may be retrieved from the sub 11 by continued upward movement on wire line 53.

If the well has been perforated, such as in perforations 50, the fluid entering the tubing is by-passed through the plug 16, thus preventing plug 16 from being blown from the tubing. Further precautions from blowing the plug 16 may be taken by keeping the well shut in until the plug has been retrieved, as described. If the well has not been perforated, the plug 16 is retrieved, drilling fluid and the like removed, and the well may be perforated at atmospheric conditions by running a tubing gun through the tubing on wire line 53. Under these circumstances, where perforation is at atmospheric conditions, the passageway through the plug is not required and may be dispensed with.

The present invention has wide utility and may be used and retrieved, in circumstances such as illustrated, by wire line 53 where the tubing is permanently located at a point above or in the upper of a series of producing strata or zones. The device eliminates the necessity of swabbing a well after setting tubing and enables the operator to perforate the casing at atmospheric conditions or at near atmospheric conditions with the tubing gun. Thus the device has utility in operations involving perforating, running in the tubing, and swabbing to bring in the well.

While the invention has been described and illustrated

in conjunction with employment of the conventional tubing packer and has widest utility therewith, it is to be understood that I may dispense with the tubing packer in some operations.

The nature and objects of the present invention having been completely described and illustrated, what I wish to claim as new and useful and to secure by Letters Patent is:

1. A device for use in plugging a tubing string which comprises, a tubing sub having a groove in its interior wall and adapted to be connected into the tubing string, a plug member having an upstanding cylindrical sleeve and initially positioned within said sub and removably locked therein provided with at least one port in cooperative relationship with said groove and having a central opening, the interior of the sleeve communicating fluidly with the tubing at least one locking member normally arranged in said port and groove, a tubular member positioned in said sleeve for holding said locking member in said port and groove, a fishing neck on the upper end of said tubular member, a mandrel for said locking member arranged within said tubular member and connected to said plug, said mandrel being provided with means for retaining said tubular member in said sleeve, means for sealing between said plug and said sub, and means for sealing between the tubular member and the mandrel, said mandrel being provided with a passageway for fluid communication between the opening in said plug and the interior of said sleeve, and said tubular member being positioned within said sleeve in a first position to cover the passageway in said plug and adapted for slidable movement with respect to said plug to a second position to open said passageway, said locking member being released from said port and groove on continued movement of said tubular member from said second position past said locking member.

2. A device for use in plugging a tubing string which comprises, a tubing sub having a groove in its interior wall and adapted to be connected into the tubing string, a plug member having an upstanding cylindrical sleeve and initially positioned within said sub and removably locked therein provided with at least one port in cooperative relationship with said groove, at least one locking member normally arranged in said port and groove, a tubular member positioned in said sleeve for holding said locking member in said port and groove, a fishing neck on the upper end of said tubular member, a mandrel for said locking member arranged within said tubular member and connected to said plug, said mandrel being provided with means for retaining said tubular member in said sleeve, means for sealing between said plug and said sub, and means for sealing between the tubular member and the mandrel, said tubular member being positioned within said sleeve in a first position to hold said locking member in said port and groove and adapted for slidable movement with respect to said sleeve to a second position to release said locking member.

3. A device in accordance with claim 2 in which the mandrel is provided with a stop member on the upper end of the mandrel and a spring means embracing the mandrel is arranged between the stop member and the lower end of the tubular member.

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