Aug. 28, 1962 M. R. LITCHFIELD 3,051,244

WELL LINER RUNNING AND SUPPORTING APPARATUS

Filed March 22, 1960

FIG. 1.

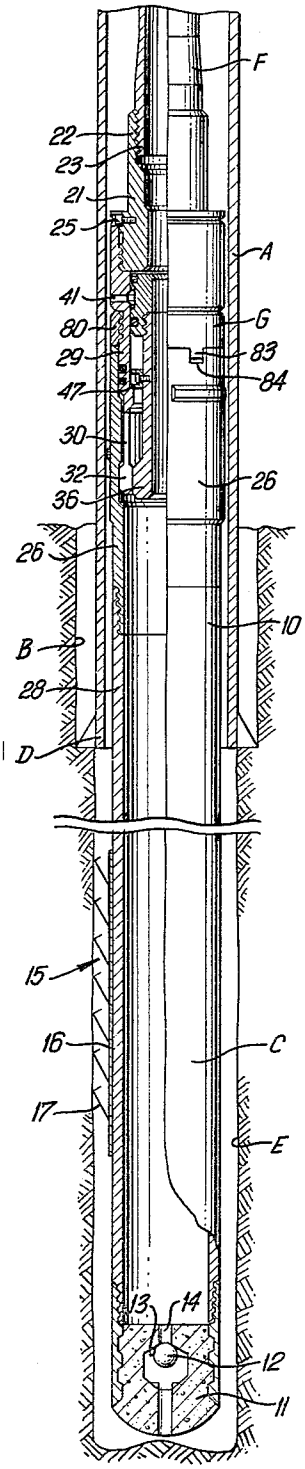


FIG. 2.

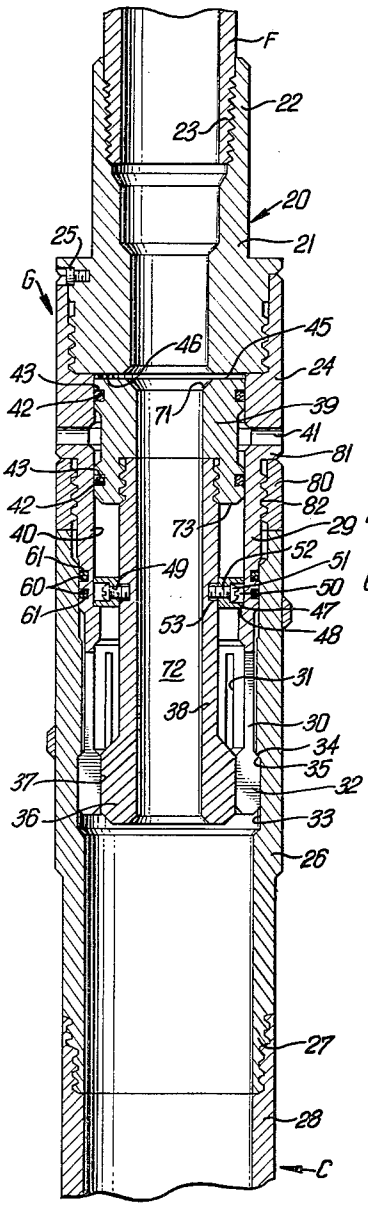
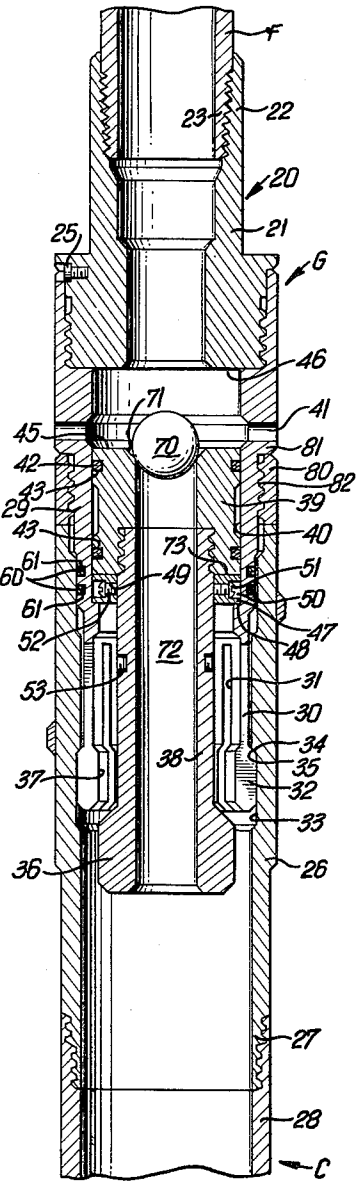


FIG. 3.



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WELL LINER RUNNING AND SUPPORTING APPARATUS

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The present invention relates to subsurface well bore equipment, and more particularly to apparatus for running and cementing liners, or similar conduit strings, in well bores.

An object of the invention is to provide an improved apparatus for running a liner in a well bore, that can be readily released from the liner after the latter has been appropriately secured in the well bore, as by a cementing operation.

Another object of the invention is to provide an apparatus for running a liner in a well bore which is releasable from the liner, and which can also transmit rotary motion and torque to the liner without fear of inadvertently releasing the apparatus from the liner.

A further object of the invention is to provide an improved apparatus for running a liner in a well bore which remains positively secured to the liner against relative longitudinal and rotary motions, and which is easily released from the liner by fluid pressure, whenever desired.

An additional object of the invention is to provide an apparatus adapted to be secured to a tubular string for running a liner in a well bore, which is easily released from the liner, whenever desired, by fluid pressure, and in which fluid is permitted to be circulated through the apparatus and to drain from the tubular string following release of the apparatus from the liner.

Yet another object of the invention is to provide an apparatus for running a liner in a well bore, in which the operator at the top of the well bore is given a positive indiaction that the apparatus is conditioned to be released from the liner, and also a positive indication that release has occurred.

This invention possesses many other advantages, and has other objects which may be made more clearly apparent from a consideration of a form in which it may be embodied. This form is shown in the drawings accompanying and forming part of the present specification. It will now be described in detail, for the purpose of illustrating the general principles of the invention; but it is to be understood that such detailed description is not to be taken in a limiting sense, since the scope of the invention is best defined by the appended claims.

Referring to the drawings:

FIGURE 1 is a longitudinal section and side elevational view of an apparatus embodying the invention disposed in a well bore that has a casing therein, with the liner running apparatus secured to the liner;

FIG. 2 is a longitudinal section through the apparatus, on an enlarged scale, with the parts coupling the apparatus to the liner therebelow;

FIG. 3 is a view similar to FIG. 2, disclosing the running-in portion of the apparatus released from the liner.

As disclosed in the drawings, a string of casing A has been previously installed in a well bore B. It is desired to run a liner string C, or similar conduit string, through the string of casing A to be disposed below the casing shoe D. Usually, the upper portion 10 of the liner extends upwardly into the casing by a certain amount, so that cement can be pumped down the liner C to discharge from its lower end and pass upwardly around the annulus E surrounding the liner, and also upwardly through

the annulus between the upper portion 10 of the liner and the casing A.

The liner C may have a float and guide shoe 11 at its lower end provided with a valve 12 adapted to move upwardly into engagement with a companion seat 13 to close the central passage 14 through the shoe against upward flow of fluid therethrough. It may also have a plurality of wall scratchers 15 mounted thereon of the rotating type. For simplicity of illustration, only one wall scratcher strip 16 having spring fingers 17 thereon is illustrated as being secured to the liner. It is to be understood that a plurality of such strings with spring fingers are mounted along the length of the liner C so as to scratch the mud cake from the wall of the well bore B surrounding the liner, and to permit it to be circulated out of the hole.

The liner C is run or lowered through the string of casing A by means of a tubular string F and a liner running-in tool G. The tubular string F may consist of tubing or drill pipe extending to the top of the well bore, its lower end being secured to the upper end of the tubular body or member 20 of the running tool. This tubular body includes an upper body section or sub 21 having an upper threaded box 22 for threaded attachment to the lower threaded pin 23 of an adjacent section of the tubular string F. The lower portion of the sub 21 is threadedly secured within the upper portion of a lower body section 24, inadvertent unthreading between the upper and lower sections being prevented by a suitable cap screw 25. The lower body section 24 extends downwardly within a liner adapter member 26 having a lower threaded pin 27 for threaded attachment to the upper box 28 of an adjacent section of the liner C, the liner string extending downwardly from the adapter member to, and including, the float shoe 11.

It is desired to releasably secure the tubular body member 20 to the liner adapter member 26. This is accomplished by causing a lower portion 29 of the lower body section to extend into the liner adapter member 26. This lower portion has a plurality of spring-like latch legs 30 formed by longitudinal slots 31 extending upwardly from the lower end of the body member. These latch legs terminate in latch feet 32 extending outwardly and adapted to be disposed within a circumferential internal groove 33 in the liner adapter member 26. The latch feet have upper inclined surfaces 34 tapering in an upward and inward direction adapted to engage a companion upper side 35 of the circumferential groove 33, such that upward movement of the body member 24, 29 relative to the adapter 26 tends to cam the latch feet 32 inwardly from the circumferential groove 33.

Initially, the latch feet 32 are retained in the circumferential groove 33 by a backing member in the form of an enlarged head 36 engaging the inner surfaces 37 of the latch feet. This enlarged head is provided at the lower end of a lower tubular holding mandrel section 38, the upper end of which is threadedly attached to an upper tubular mandrel section 39 that is slidable along the inner wall 40 of the lower body section. Initially, the upper mandrel section 39 straddles a plurality of side or circulation ports 41 provided in the lower body section, there being side seals 42, such as rubber or rubber-like O rings, disposed in external grooves 43 in the lower body section and disposed on opposite sides of the circulation ports 41, so as to prevent passage of fluid from the interior of the body 20 through the circulation ports 41 to the exterior thereof.

The upper end 45 of the mandrel 38, 39 is initially disposed adjacent to the lower end 46 of the upper body section 21, with its side seals 42 disposed above and below the circulation ports 41. Downward movement

of the tubular mandrel from its position closing the circulation ports, and with its enlarged head 36 disposed behind the latch feet 32, is initially prevented by a releasable device. As specifically shown, such device includes a ring 47 resting upon an upwardly facing shoulder 48 in the lower body member 24. This ring has a plurality, such as a pair, of opposed radial holes 49 therein, the inner portions of which are threaded and the outer portions 50 of which are counter bored to receive the heads 51 of shear screws 52 threaded in the threaded portion of the ring, these shear screws extending into a circumferential groove 53 in the periphery of the lower holding mandrel section 38. The location of the shear screws 52 in the mandrel groove 53, and the attachment of the shear screws to the ring 47, coupled with the resting of the ring on the body shoulder 48, prevents initial downward movement of the mandrel 39, 38 along the body 20 of the tool G and a lowering of the enlarged holding head 36 from engagement with the latch feet 32.

From the foregoing description it is evident that the liner adapter member 26 and the liner C itself are coupled to the running-in tool G, and to the tubular string F, against longitudinal movement in both directions. The running-in tool is also initially coupled to the adapter member 26 against relative rotary motion, so that rotary motion and torque from the tubular string F and the body 20 can be transmitted to the liner adapter member 26 and the liner C without fear of disconnecting any of the parts. As specifically disclosed, a coupling sleeve 80 is threadedly secured on the lower body section 24 with its upper end abutting against the downwardly facing shoulder 81 on the lower body section. The threaded connection 82 is normally a right hand one. This coupling sleeve 80 has a plurality of circumferentially spaced teeth or dogs 83 extending downwardly and received within upwardly opening companion grooves 84 in the upper portion of the liner adapter member 26, as shown most clearly in FIG. 1. It is evident that right hand rotation of the tubular string F will be transferred to the tubular body member 20 and through its threaded connection 82 with the coupling sleeve 80 to the latter, the rotary motion and turning effort then being transmitted through the teeth 83 to the liner adapter member 26. Thus, rotary motion and torque can be transmitted to the liner adapter member 26 and the liner C without the necessity of its being transferred through the latch portion 30, 32 of the apparatus.

In the use of the apparatus, the running-in tool G is coupled to the liner adapter member 26, as disclosed in FIGS. 1 and 2, in which the circulation ports 41 are closed and the shear screws 52 are intact. The appropriate length of liner C extends from the lower end of the adapter member 26 and the apparatus and liner are then lowered through the casing string A by means of the tubular string F secured to the upper end of the tubular body 20. The liner C is run in the well bore until it projects the appropriate distance below the lower end of the casing string A. Circulating fluid can now be pumped down the tubular spring F, passing through the tubular body 20 and the mandrel 39, 38 for discharge into the liner C, flowing downwardly through the liner and through the float shoe 11 for reverse movement upwardly through the annulus E around the liner string, through the annulus between the upper portion 10 of the liner and the casing A, and then upwardly through the annulus between the tubular string F and the casing A. Leakage of fluid along the body 20 and the liner adapter 26 is prevented by one or more side seals 60, in the form of rubber or rubber-like O rings, disposed in peripheral grooves 61 in the body and engaging the wall of the liner adapter member 26.

During the time that the circulating fluid is being pumped down through the tubular string F, through the liner C, and upwardly around the latter, the tubular string is rotated to rotatae the apparatus G and the liner C, for the purpose of rotating the scratchers 15 around the wall of the well bore B in order to remove the mud cake therefrom, enabling the circulating fluid to carry the removed drilling mud upwardly through the casing A to the top of the well bore. Circulation is continued until the hole is appropriately conditioned. During the rotary motion, the turning torque is transferred from the tubular body 20 to the liner adapter member 26 and then to the liner C extending therebelow, the rotary scratcher members 15 being welded or otherwise suitably secured to the exterior of the liner.

The required quantity of cement slurry, or the like, is then pumped down through the tubular string F, passing through the apparatus G and discharging from the float shoe 11 for upward movement around the liner C and upwardly into the annulus between the upper portion 10 of the liner and the casing. After a required quantity of cement slurry has been displaced, a suitable release or trip ball or valve element 70 is allowed to gravitate through the fluid in the tubular string F, coming to rest upon a companion seat 71 at the upper end of the upper mandrel member 39, closing the passage 72 through the latter. When the tripping ball 70 engages its seat 71, the operator is advised of this fact by a vise in the fluid pressure at the top of the well bore. An increase in the fluid pressure in the tubular string F above the trip ball to the desired extent will then shear the screws 52 holding the lower mandrel section 38 to the control ring 47, the entire mandrel then shifting downwardly to the extent determined by engagement of the lower end 73 of the upper mandrel section 39 with the ring 47. When this occurs, the circulation ports 41 are in open condition, and the enlarged holding head 36 on the mandrel is disposed below the latch feet 32, as disclosed in FIG. 3. The body 20 of the tool G is now released from the liner adapter member 26, and the fact that such release is made evident to the operator by the ability to circulate fluid down through the apparatus, passing outward through the circulation ports 41 and upwardly through the annulus around the tubular string F. If excess cement slurry has been deposited around the tubular body member 20 and around the lower portion F of the tubular string, such excess cement slurry will be circulated upwardly through the annulus around the tubuar string F to the top of the hole.

The operator can now elevate the tubular string F, which will elevate the body 20 of the tool, the tapered surfaces 34 of the latch feet 32 engaging the companion tapered side 35 of the groove 33 to cam the latch feet inwardly, thereby releasing them from the groove 33. As the body 20 of the tool G moves upwardly, it will carry the coupling ring 80 upwardly with it, the dogs 83 on the latter being removed from the companion grooves 84. Such upward movement will also carry the mandrel 39, 38 and the trip ball 70 upwardly with the body 20, since the ring 47 is engaging the upper mandrel section 39 and the ball 70 is resting on the upper portion of the latter. The running-in tool G is thus released from the liner adapter member 26, and the entire tubular string F and the liner running tool can now be elevated in the well casing A and removed completely therefrom. During such elevating movement, the fluid in the tubular string F can drain through the open circulation ports 41.

I claim:

1. In an apparatus for running a conduit string in a well bore on a tubular running-in string: a first member adapted to be connected to the conduit string extending therebelow; a second member adapted to be connected to the tubular running-in string extending thereabove; releasable coupling means connecting said members to each other for transmitting torque from said second member to said first member; latch means on one of said members below said coupling means and comprising a latch sleeve connected to said one member having laterally movable

latch legs releasably connected to said other member to releasably secure said members to each other against substantial relative longitudinal movement and to hold said coupling means in connected condition; shiftable holding means engaging said latch means to prevent release of said latch means from said other member; and means for shifting said holding means from said latch means to permit release of said latch means from said other member and release of said coupling means, whereby said second member can be elevated in the well bore away from said first member.

2. In an apparatus for running a conduit string in a well bore on a tubular running-in string: a first member adapted to be connected to the conduit string extending therebelow; a second member adapted to be connected to the tubular running-in string extending thereabove; releasable coupling means connecting said members to each other for transmitting torque from said second member to said first member; latch means on one of said members below said coupling means and comprising a latch sleeve connected to said one member having laterally movable latch legs releasably connected to said other member to releasably secure said members to each other against substantial relative longitudinal movement and to hold said coupling means in connected condition; hydraulically shiftable holding means engaging said latch means to prevent release of said latch means from said other member; said holding means being shiftable by the pressure of fluid in the tubular string from said latch means to permit release of said latch means from said other member and release of said coupling means, whereby said second member can be elevated in the well bore away from said first member.

3. In an apparatus for running a conduit string in a well bore on a tubular running-in string: a first member adapted to be connected to the conduit string extending therebelow; a second member adapted to be connected to the tubular running-in string extending thereabove; releasable coupling means connecting said members to each other for transmitting torque from said second member to said first member; latch means on one of said members releasably connected to said other member to releasably secure said members to each other against substantial relative longitudinal movement and to hold said coupling means in connected condition; one of said members having a side port establishing fluid communication between the interior of said one member and the well bore externally of said members; holding means initially closing said port and engaging said latch means to prevent release of said latch means from said other member; and means for shifting said holding means to a position opening said port and from said latch means to permit release of said latch means from said other member and release of said coupling means with said port open, whereby said second member can be elevated in the well bore away from said first member.

4. In an apparatus for running a conduit string in a well bore on a tubular running-in string: a first member adapted to be connected to the conduit string extending therebelow; a second member adapted to be connected to the tubular running-in string extending thereabove; releasable coupling means connecting said members to each other for transmitting torque from said second member to said first member; latch means on one of said members releasably connected to said other member to releasably secure said members to each other against substantial relative longitudinal movement and to hold said coupling means in connected condition; one of said members having a side port establishing fluid communication between the interior of said one member and the well bore externally of said members; hydraulically shiftable holding means initially closing said port and engaging said latch means to prevent release of said latch means from said other member; said holding means being shiftable by the pressure of fluid in the tubular string to a position opening said port and from said latch means to permit release of said latch means from said other member and release of said coupling means with said port open, whereby said second member can be elevated in the well bore away from said first member.

5. In an apparatus for running a conduit string in a well bore on a tubular running-in string: an outer tubular member adapted to be connected to the upper portion of the conduit string; an inner tubular member adapted to be connected to the lower portion of the tubular string; said outer member having an internal groove; releasable coupling means connecting said members to each other for transmitting torque from said inner member to said outer member; said inner member comprising a latch sleeve having laterally movable legs below said coupling means and disposed in said groove to releasably connect said members to each other against substantial relative longitudinal movement and to hold said coupling means in connected condition; shiftable holding means engaging said latch legs to hold said latch legs in said groove; and means for shifting said holding means from said latch legs to permit withdrawal of said latch legs from said groove and release of said coupling means, whereby said inner member can be elevated from said outer member.

6. In an apparatus for running a conduit string in a well bore on a tubular running-in string: an outer tubular member adapted to be connected to the upper portion of the conduit string; an inner tubular member adapted to be connected to the lower portion of the tubular string; said outer member having an internal groove; releasable coupling means connecting said members to each other for transmitting torque from said inner member to said outer member; said inner member comprising a latch sleeve having laterally movable legs below said coupling means and disposed in said groove to releasably connect said members to each other against substantial relative longitudinal movement and to hold said coupling means in connected condition; shiftable holding means, engaging said latch legs to hold said latch legs in said groove; means releasably securing said holding means to said inner member; means for releasing said securing means and shifting said holding means from said latch legs to permit withdrawal of said latch legs from said groove and release of said coupling means, whereby said inner member can be elevated from said outer member.

7. In an apparatus for running a conduit string in a well bore on a tubular running-in string: an outer tubular member adapted to be connected to the upper portion of the conduit string; an inner tubular member adapted to be connected to the lower portion of the tubular string; said outer member having an internal groove; releasable coupling means connecting said members to each other for transmitting torque from said inner member to said outer member; said inner member comprising a latch sleeve having laterally movable legs below said coupling means and disposed in said groove to releasably connect said members to each other against substantial relative longitudinal movement and to hold said coupling means in connected condition; hydraulically shiftable holding means engaging said latch legs to hold said latch legs in said groove; said holding means being shiftable by the pressure of fluid in the tubular string from said latch legs to permit withdrawal of said latch legs from said groove and release of said coupling means, whereby said inner member can be elevated from said outer member.

8. In an apparatus for running a conduit string in a well bore on a tubular running-in string: an outer tubular member adapted to be connected to the upper portion of the conduit string; an inner tubular member adapted to be connected to the lower portion of the tubular string; said outer member having an internal groove; releasable coupling means connecting said members to each other for transmitting torque from said inner member to said outer member; latch means on said inner member disposed in said groove to releasably connect said members to each other against substantial relative

longitudinal movement and to hold said coupling means in connected condition; said inner member having a side port establishing fluid communication between the interior of said inner member and the well bore externally of said members; hydraulically shiftable holding means initially closing said port and engaging said latch means to hold said latch means in said groove; said holding means being shiftable by the pressure of fluid in the tubular string to a position opening said port and from said latch means to permit withdrawal of said latch means from said groove and release of said coupling means with said port open, whereby said inner member can be elevated from said outer member.

9. In apparatus as defined in claim 5, wherein said coupling means comprises a dog secured to said inner member and extending downwardly into a groove in said outer member.

10. In apparatus as defined in claim 8, wherein said coupling means comprises a dog secured to said inner member and extending downwardly into a groove in said outer member.

11. In apparatus as defined in claim 5, wherein said coupling means comprises a sleeve threaded on said inner member and having a depending dog extending into a groove in said outer member.

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