Sept. 9, 1958 W. B. BUCK 2,851,112

CASING PROTECTOR

Filed Oct. 2, 1953 2 Sheets-Sheet 1

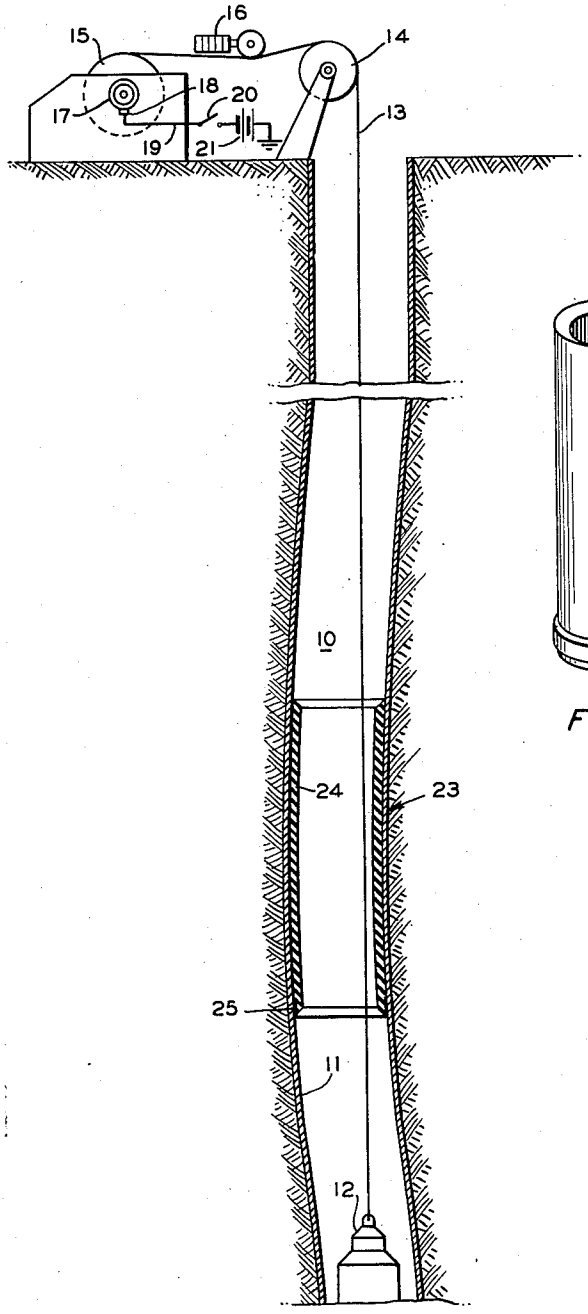


FIG. 1

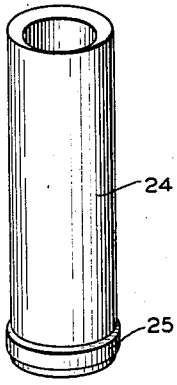


FIG. 2

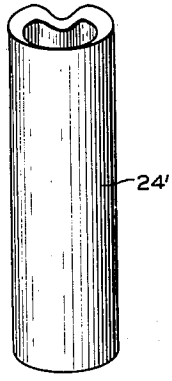


FIG. 7

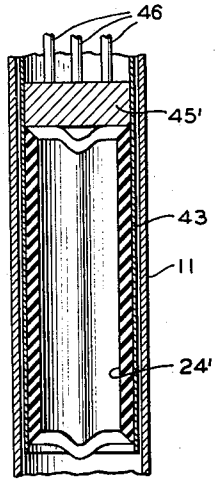


FIG. 8

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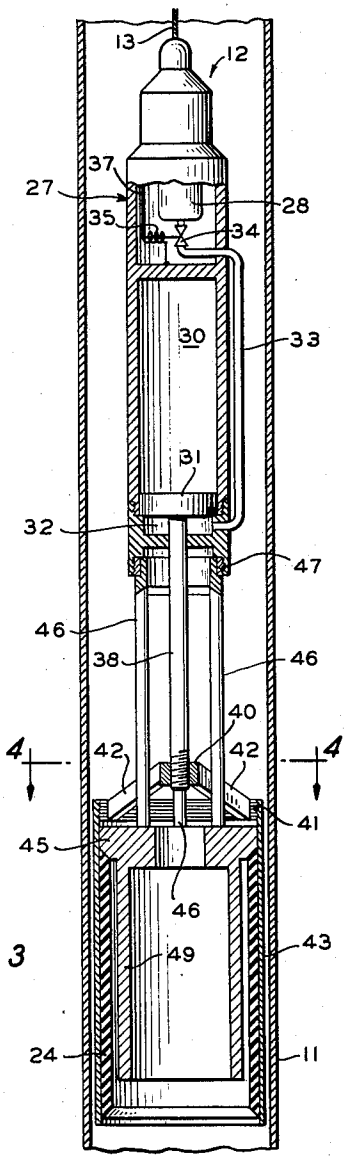


FIG. 3

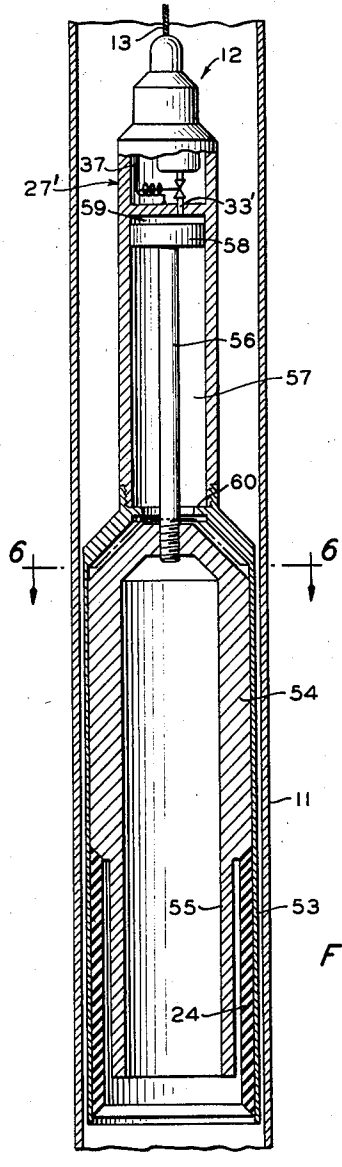


FIG. 5

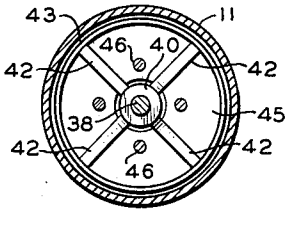


FIG. 4

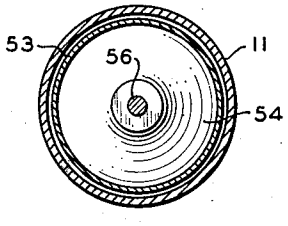


FIG. 6

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CASING PROTECTOR

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6 Claims. (Cl. 166—218)

This invention relates to a method of and apparatus for repairing and protecting well casings.

In the drilling, servicing and pumping of oil wells various instruments and tools are lowered into the well on cables, tubing or rods. Because these wells seldom if ever are entirely vertical and because of the depths to which they are drilled, it is found that the casing often becomes unduly worn in certain regions by abrasion of the cables, tubing or rods against the casing wall. For example, in a producing well it often becomes necessary to lower cable drilling tools, bailers, cleaning tools and the like into the well. Any excessive friction between the cable suspending these tools and the casing wall can be detected by a casing caliper survey to determine the depths at which abrasion occurs. When such abrasion is detected it becomes important to repair or protect the casing to prevent holes from being worn therethrough. It is of course desirable that such a repair operation be carried out without removing the casing from the well. In accordance with the present invention, a system for making such repairs is provided.

This invention comprises generally an improved method of and apparatus for repairing and protecting well casings by inserting elastic sleeve members therein at selected depths. These sleeve members are fitted snugly into the casing so as to remain in place by the elastic properties of the members. When so positioned the sleeve members in effect become a part of the casing and remain in place during subsequent production and servicing operations. The apparatus for inserting these sleeve members comprises generally a hollow cylinder which is of slightly smaller outside diameter than the inner diameter of the casing. The protective sleeve member is compressed and positioned within this cylinder. A piston is provided in conjunction with the cylinder such that the sleeve member can be discharged from the cylinder at a selected depth in the well. In one embodiment of the apparatus, the piston and sleeve member are held stationary and the cylinder is moved with respect thereto. In a second embodiment, the cylinder remains stationary and both the piston and sleeve member are moved therethrough. This relative movement between the piston and cylinder can be effected by a compressed air system which is actuated from the surface of the earth.

Accordingly, it is an object of this invention to provide an improved method of and apparatus for protecting well casings by inserting elastic sleeve members therein at selected depths.

Another object is to provide a method of repairing and protecting well casings without removing the casing from the well.

A further object is to provide apparatus for inserting elastic sleeve members inside a well casing.

A further object is to provide protective sleeve members for use in cased wells.

Various other objects, advantages and features of this invention should become apparent from the following

detailed description taken in conjunction with the accompanying drawing in which:

Figure 1 is a vertical sectional view of a well illustrating a protective sleeve positioned therein and a portion of the sleeve positioning apparatus of this invention;

Figure 2 illustrates one embodiment of the protective sleeve member;

Figure 3 is a view, shown partially in section, of a first embodiment of the down-hole sleeve inserting mechanism;

Figure 4 is a sectional view taken along line 4—4 in Figure 3;

Figure 5 is a view, shown partially in section, of a second embodiment of the down-hole sleeve inserting mechanism;

Figure 6 is a sectional view taken along line 6—6 in Figure 5;

Figure 7 illustrates a second embodiment of the protective sleeve member; and

Figure 8 is a fragmentary view of the sleeve inserting mechanism modified to accommodate the sleeve illustrated in Figure 7.

Referring now to the drawing in detail and to Figure 1 in particular there is illustrated a section of a well 10 having a casing 11 positioned therein. The upper portion of the sleeve inserting mechanism 12 of this invention is shown suspended in well 10 by a cable 13 which passes over a pulley 14 at the surface of the earth and which is attached at its upper end to a reel 15 that is driven by a suitable source of power, not shown. An odometer 16 rests against cable 13 to provide an indication of the depth to which member 12 is suspended in well 10. Cable 13 encloses an electrical lead which terminates at its upper end in a slip ring 17 attached to reel 15. A brush 18 is in engagement with slip ring 17. Brush 18, in turn, is connected by a lead 19 and a switch 20 to one terminal of a voltage source 21, the second terminal of which is grounded.

The lower section of well 10 is shown as being curved in somewhat of an exaggerated manner to illustrate that wells often deviate from a vertical line. Thus, whenever tools are lowered into the well the suspending cable tends to rub against casing 11 at regions such as indicated by 23. In accordance with the present invention elastic sleeve members 24 are positioned in the well wherever there is a tendency for the cable to rub excessively against the casing wall.

In Figure 2 there is illustrated a first embodiment of cylindrical sleeve member 24 which preferably is made of rubber or some rubber-like polymerized synthetic material, such as synthetic rubber or neoprene, which is resistant to oil. Sleeve 24 is sufficiently rigid to resist the abrasive action of cables rubbing thereagainst and is sufficiently elastic to engage casing 11 in a tight fit. For reasons that will become apparent hereinafter, sleeve 24 can be provided with a rib 25 which is constructed of highly elastic material.

The sleeve positioning apparatus 12 shown in Figure 1 is illustrated in detail in Figure 3. This apparatus comprises generally a housing 27 which is attached at its upper end to cable 13. The upper portion of housing 27 contains a tank 28 which is filled with a compressed fluid such as air. A chamber 30 is formed in housing 27 beneath tank 28 and a piston 31 is positioned for movement therein. A second chamber 32 is formed beneath piston 31. A conduit 33 communicates beneath chamber 32 and tank 28; and a valve 34, which is operated by a solenoid 35, is disposed in conduit 33. One terminal of solenoid 35 is connected to a lead 37 which passes upwardly through cable 13 and terminates at its upper end in slip ring 17. The second terminal of sole-

noid 37 is grounded on housing 27. A connecting rod 38 is fastened at its upper end to piston 31 and at its lower end to a hub 40. A ring 41 is connected to hub 40 by a plurality of spokes 42. An elongated hollow cylindrical member 43 is threaded at its upper end to ring 41 and extends downwardly therefrom in close proximity to well casing 11. Sleeve member 24 is fitted inside cylinder 43 by suitable compression of sleeve 24, this operation being performed before assembly 12 is lowered into well 10. A piston 45 is positioned within cylinder 43 above sleeve 24 and is rigidly connected to housing 27 by a plurality of rods 46 that are connected at their upper ends to a ring 47 which is threaded to housing 27. Piston 45 is provided with a depending annular portion 49, the outer diameter of which is slightly less than the inner diameter of sleeve 24.

When it is desired to position sleeve 24 in casing 11, assembly 12 is lowered into the well until sleeve 24 is adjacent the region to be protected. At this point switch 20 is closed which energizes solenoid 35 to open valve 34. The pressure applied from tank 28 to chamber 32 moves piston 31 upwardly, and this in turn moves cylinder 43 upwardly a like amount. Sleeve 24, however, remains stationary because piston 45, which is in engagement therewith, is rigidly connected to housing 27. As soon as cylinder 43 is removed from sleeve 24 the sleeve expands outwardly to engage casing 11. It is desired that valve 34 have a sufficiently small opening that piston 31 moves at a relatively slow rate. In this manner the lower portion of sleeve 24 first engages casing 11. Since sleeve 24 must be formed of a fairly rigid material it is sometimes desirable to place a rib 25 of a highly elastic material near the bottom thereof such that this rib engages casing 11 immediately and retains sleeve 21 in position until the main body of material has expanded sufficiently to engage casing 11 in a tight fit. Depending portion 49 of piston 45 tends to retain sleeve 24 in proper alignment and resists any tendency of the top end of the sleeve to buckle when cylinder 43 is moved initially. If necessary, a suitable lubricant can be applied to sleeve 24 to facilitate release of the sleeve from cylinder 43.

In Figure 5 there is illustrated a second embodiment of the sleeve positioning mechanism of this invention. The apparatus of Figure 5 comprises a cylinder 53 which is attached at its upper end to a housing 27'. Cylinder 53 is approximately twice as long as sleeve 24, which is fitted in the lower portion thereof. A plunger 54 having an annular depending portion 55 is attached at its upper end to a connecting rod 56. Rod 56 is in turn attached at its upper end to a piston 58 which is free to move through a chamber 57 in housing 27'. A chamber 59 above piston 58 is in communication with tank 28 through a conduit 33'. Closure of switch 20 results in pressure being applied to chamber 59 to force plunger 54 downwardly with respect to cylinder 53. This in turn operates to expel sleeve 24 from cylinder 53. A stop ring 60 is provided at the bottom of chamber 53 to prevent plunger 54 and piston 58 from falling out of cylinder 53.

The apparatus illustrated in Figure 3 is generally preferred to the apparatus of Figure 5 because in the former the only force tending to retain sleeve 24 in cylinder 43 is the frictional force between these two members. In the apparatus of Figure 5 there is the additional frictional force of sleeve 24 being pushed along casing 11 after the lower end of sleeve 24 has been expelled from cylinder 53. However, for some applications the apparatus of Figure 5 can be used to advantage. While a compressed air piston moving system has been illustrated, it should be apparent that other mechanism can be employed if desired. For example, a hydraulic or an electrical system can be used to move cylinder 43 or plunger 54.

For some operations it is necessary that the sleeve member be formed of an extremely rigid material in order to afford the desired protection of the casing wall. Accordingly, it is sometimes necessary to bend the sleeve member in somewhat the manner illustrated in Figure 7 in order that such a sleeve 24' can be inserted into cylinder 43. When it is necessary to bend sleeve 24' in this manner it is generally desirable to employ a piston 45' which is substantially flat on the bottom surface. This particular configuration is illustrated in Figure 8. If such a sleeve 24' is employed in conjunction with the apparatus of Figure 5, plunger 54 preferably is formed with a flat lower surface similar to piston 45'. Otherwise the operation of positioning the sleeve in the casing is the same as previously described.

While this invention has been described in conjunction with present preferred embodiments thereof it should be apparent that the invention is not limited thereto.

What is claimed is:

1. Apparatus for placing a previously compressed, generally cylindrical hollow elastic member in a well, comprising a housing defining a piston chamber, a first piston slidably disposed in said chamber, a hollow cylinder having an outer diameter slightly less than the diameter of said well and an unobstructed open end, said cylinder adapted to hold said elastic member under compression, a second piston slidably disposed in said cylinder, said cylinder being connected to one of said first piston and housing members and said second piston connected to the other of said members, and means operable to move said first piston whereby said second piston moves relative to said cylinder to release said elastic member through said open end of said cylinder so as to effect placing of said elastic member in said well by allowing said elastic member to expand into engagement with the wall of said well.

2. The combination in accordance with claim 1 wherein a first segment of said second piston is of outer diameter substantially the same as the inner diameter of said cylinder and wherein a second segment of said second piston is of outer diameter less than the inner diameter of the elastic member, the elastic member enclosing said second segment of said second piston when positioned within said cylinder.

3. Apparatus for placing a previously compressed, generally cylindrical hollow elastic member in a tubular object within a well, comprising a housing defining a piston chamber, said housing adapted to be lowered in said well, a first piston slidably disposed in said piston chamber, a source of fluid pressure in said housing, valved conduit means connecting said source of fluid pressure with said chamber, the valve in said valved conduit being electrically operated, a hollow cylinder having an unobstructed open end and adapted to hold said elastic member under compression, said cylinder having an outer diameter slightly less than the inner diameter of said tubular object, a second piston slidably disposed in said cylinder, said cylinder being connected to one of said first piston and housing members and said second piston connected to the other of said members, and means positioned at the surface of said well to actuate said valve whereby said fluid pressure acts on said first piston to cause its movement, whereby said second piston moves relative to said cylinder to release said elastic member through said open end of said cylinder so as to effect placing of said elastic member in said tubular object by allowing said elastic member to expand into engagement with said tubular object.

4. Apparatus according to claim 3 wherein said valve is a solenoid-actuated valve.

5. Apparatus for installing a previously compressed, generally cylindrical hollow elastic member in the casing of a well, comprising a housing defining a piston chamber, said housing adapted to be lowered in said well near the point of installation, a first piston slidably disposed in said chamber, a source of fluid pressure in said housing, valved conduit means connecting a source of fluid pressure with said chamber beneath said first piston, the valve in said valved conduit being electrically operated, a hollow cylinder having an unobstructed open end and

adapted to hold said elastic member under compression, said cylinder having an outer diameter slightly less than the inner diameter of said casing, means connecting said first piston with said cylinder, a second piston slidably disposed in said cylinder, said second piston connected to said housing, and means positioned at the surface of said well to actuate said valve whereby said fluid pressure acts on said first piston to cause its movement and said cylinder to move relative to said second piston so as to release said elastic member through said open end of said cylinder to effect installation of said elastic member in said casing by allowing said elastic member to expand into engagement with said casing.

6. Apparatus for installing a previously compressed, generally cylindrical hollow elastic member in the casing of a well, comprising a housing defining a piston chamber, said housing adapted to be lowered in said well near the point of installation, a first piston slidably disposed in said chamber, a source of fluid pressure in said housing, valved conduit means connecting a source of fluid pressure with said chamber above said first piston, the valve in said valved conduit being electrically operated, a hollow cylinder having an unobstructed open end and adapted to hold said elastic member under compression, said cylinder having an outer diameter slightly less than

the inner diameter of said casing, means connecting said cylinder with said housing, a second piston slidably disposed in said cylinder, said first and second pistons being connected together, and means positioned at the surface of said well to actuate said valve whereby said fluid pressure acts on said first piston to cause its movement and said second piston to move relative to said cylinder so as to release said elastic member through said open end of said cylinder to effect installation of said member in said casing by allowing said elastic member to expand into engagement with said casing.

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