Oct. 14, 1958 M. E. TRUE ET AL 2,856,002

APPARATUS FOR PLUGGING WELLS

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FIG. 1.

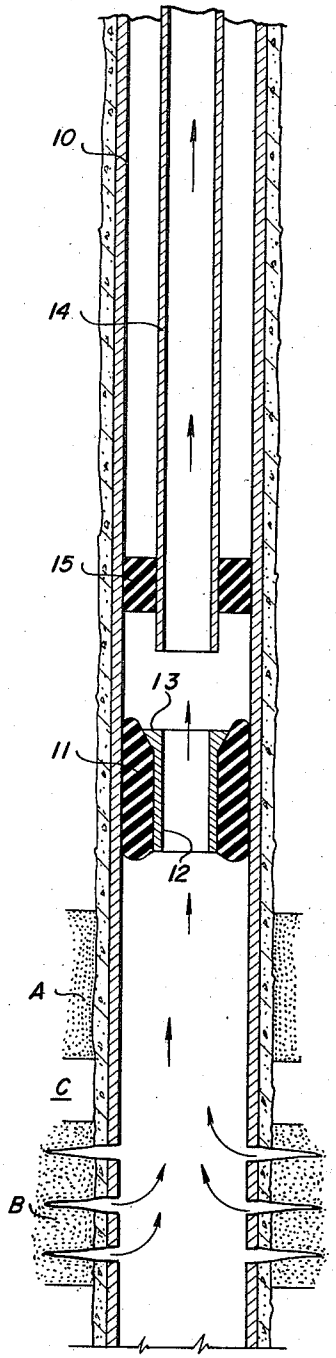


FIG. 2.

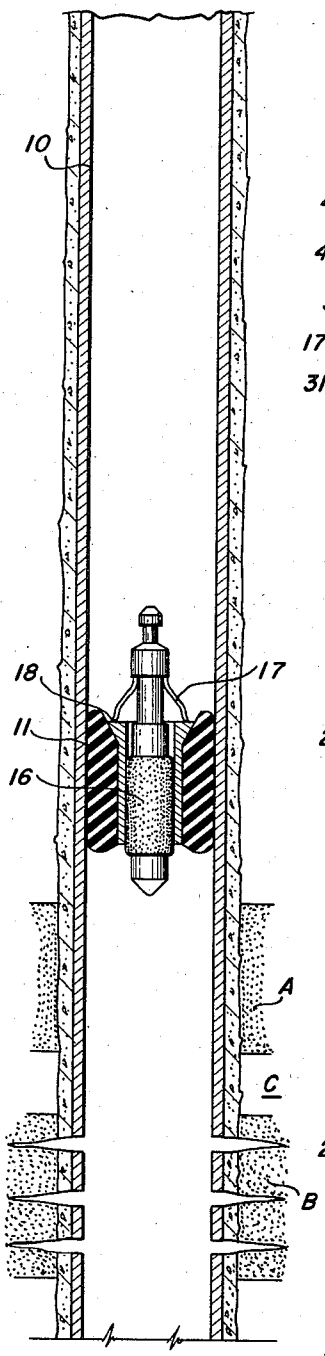
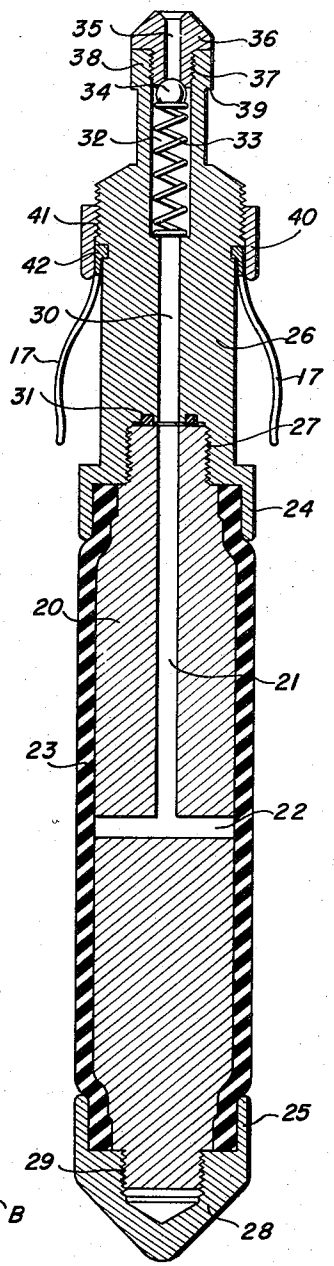


FIG. 3.



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APPARATUS FOR PLUGGING WELLS

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Application August 29, 1955, Serial No. 530,954

1 Claim. (Cl. 166—114)

This invention is directed to apparatus for controlling wells. Particularly the apparatus is useful with a method which comprises plugging a cased well bore above the uppermost of a plurality of hydrocarbon productive formations to isolate an upper zone in the well bore from the productive formations and from a pipe or tubing string positioned in the isolated upper zone, manipulating the tubing to effect repairs thereon and then unplugging the well to obtain production therethrough. The invention is also useful in repairing casing in the plugged or isolated upper zone. Briefly, the apparatus comprises a production packer provided with an inner bore adaptable for use with an inflatable packer and a reference level; and an inflatable wire line packer provided with a reference level gauge is positioned within the bore of the production packer to provide the required plugging means.

In all producing wells there is a possibility of failure of completion assembly equipment; the well piping or tubing having the most connections and being assembled under field conditions is very susceptible to failure by leakage resulting from corrosion or from expansion and contraction of the tubing caused by temperature changes or from damage to the tubing when making up the coupling joints or from any of the numerous physical situations causing moving stresses and strains in producing operations.

To replace or repair a well pipe or even a portion thereof, it is necessary that the producing formation be adequately controlled during such replacement or repair. This is usually accomplished by filling the well bore with a fluid such that an overwhelming hydrostatic pressure is exerted against the exposed formation to contain the fluids in the formation. Often because of the high pressure of the formations, these control fluids must be weighted and treated in order to provide a sufficient hydrostatic effect. It is known that contact with these treated well-bore fluids has resulted in detrimental effects to the producing characteristics of producing formations. Hence, it is a primary purpose of this invention to disclose apparatus which permits well pipes to be repaired or replaced without exposing the producing formation to any extraneous fluids.

Referring to the drawing wherein identical numerals designate identical parts:

Fig. 1 is a diagrammatic view of the well in production;

Fig. 2 is a diagrammatic view of the well with the wellbore plug in sealing position; and

Fig. 3 is a vertical sectional view of the plugging device.

Referring to the drawing in greater detail, in Fig. 1 numeral 10 designates a casing extending from the well head, not shown, and penetrating a plurality of subsurface productive formations A and B separated by a non-productive interval C. A production packer 11 is shown positioned above the uppermost productive formation A. This packer 11 is provided with a smooth inner bore

12 and a reference level shoulder 13. A tubing string 14 is positioned above packer 11 and the annulus between the tubing string 14 and the casing 10 is sealed off by means of a conventional tubing packer 15.

In Fig. 2 is shown the production packer 11 plugged off by means of an inflatable wire line packer generally designated by the numeral 16. As illustrated the inflatable packer is provided with a bow spring reference level gauge 17 engageable with the reference level shoulder 13 as at 18.

In Fig. 3 is shown the preferred type plugging device. An elongated cylindrical member 20 is provided with an axial fluid passageway 21 extending from the top of the cylindrical member to about mid-way the length thereof. A plurality of lateral passageways 22 extend from passageway 21 to the outer surface of cylindrical member 20. An expansible or resilient sleeve 23 is secured to the cylindrical member 20 at the top and bottom by means of shoulders 24 and 25, respectively. The shoulder 24 is integrally connected to a cylindrical body member 26 which is screw threadedly connected to cylindrical member 20 as at 27. The lower shoulder 25 is formed integrally with a cup-shaped member 28 which is screw threadedly connected to cylindrical member 20 as at 29. Cylindrical member 26 has an axial passageway 30 aligned vertically with passageway 21. The jointure of these passageways 30 and 21 is sealed by means of seals 31. Passageway 30 is provided with an upper enlarged portion 32 in which is retained spring 33 and ball 34. The ball 34 seats in the lower end of a passageway 35 formed in a cap member 36 which is screw threadedly connected to body member 26 as at 37. The upper end of cylindrical member 26 is provided with a neck portion 38 terminating in a downwardly directed wedge shaped shoulder 39. Below the neck portion 38 a sleeve 40 is screw threadedly connected to cylindrical member 26 as at 41. This sleeve 40 serves as a retainer for the bow spring reference gauge 17 which is connected to cylindrical member 26 as at 42.

This wire line inflatable plug is essentially the same as that disclosed in applications Serial No. 430,116, filed May 17, 1954, now Patent No. 2,784,790, and Serial No. 430,117, filed May 17, 1954, now Patent No. 2,781,854, by Boer, O'Reilly and True, except it has been modified by providing the sleeve 40 and bow spring reference gauge 17. The operation for setting and removing this packer by means of a wire line is as described in the applications noted supra.

The production packer may be of any type such as the Baker retainer production packer as shown and described on page 501, vol. 1, 20th edition, 1954–55 of the Composite Catalog of Oil Field and Pipeline Equipment. This packer may be modified by providing a reference level shoulder for engagement with the reference level gauge positioning member on the wire line packer. This reference level in the packer is not essential to the invention since it is possible for the reference level gauge 17 to correctly locate and position the inflatable packer in the bore of the production packer without a reference level by having the upper end of the production packer serve as the reference level. It may be desirable to provide a funnel arrangement (not shown) on the production packer to facilitate positioning of the inflatable packer in the production packer bore.

In operation, referring again to Fig. 1, the casing 10 would be run and set through a plurality of productive formations A and B. The production packer would be run and set by a wire line or by a tubing string above the uppermost of the productive formations A. Then the main tubing string provided with a conventional tubing packer would be run and set with the lower end

of the tubing string positioned above the production packer. Production would be obtained from any of the productive formations desired, shown by the arrows in Figs. 1 and 2 as from formation B, until it becomes necessary to repair or replace the tubing string pipe or the casing pipe above the production packer. Upon that occurrence, the wire line inflatable packer would be run through the main tubing string **14** and positioned in the bore **12** of the production packer by means of the reference gauge **17** and the wire line setting tool described in application Serial No. 430,116, noted supra. Once the packer has been inflated thereby isolating the uppermost productive formation from the tubing string, the tubing string may be repaired or replaced without the productive fluids interfering with these operations. The casing likewise may be repaired above the plugged production packer by the use of cement or repair tools or by cutting the casing below the leak and removing the upper end. This upper end may then be repaired or replaced and reinserted in the well. It may not be necessary to replace the casing since leaks in the casing above the production packer and below the well head may be sealed by injecting a suitable sealing material at a relatively high differential pressure into the leaks.

This invention is not limited to any specific type repairing device. After repair or replacement of the tubing string or casing, the tubing string would again be run and set in the well casing above the production packer and the plugging inflatable packer **16** removed by

means of the wire line releasing tool as fully described in application Serial No. 430,117, noted supra.

We claim:

A plug for controlling a cased well penetrating a plurality of hydrocarbon productive formations comprising a tubing arranged in said well, the lower open end of which is positioned above the uppermost of said formations, a first packer provided with a reference shoulder arranged in said casing above the uppermost of said formations and below the lower open end of said tubing, said first packer being provided with a bore the wall surface of which is smooth, said bore being at least as large as the bore of said tubing, a wire line retrievable, inflatable, deflatable second packer lowerable through said tubing and provided with a reference gauge engagedly connecting with said reference shoulder, said second packer being positioned in the bore of said first packer when said gauge engages said shoulder, said second packer when inflated seals off fluid communication in said well above and below said second packer.

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