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2,966,946

APPARATUS FOR USE IN A WELL BORE

Filed Oct. 24, 1958

2 Sheets-Sheet 1

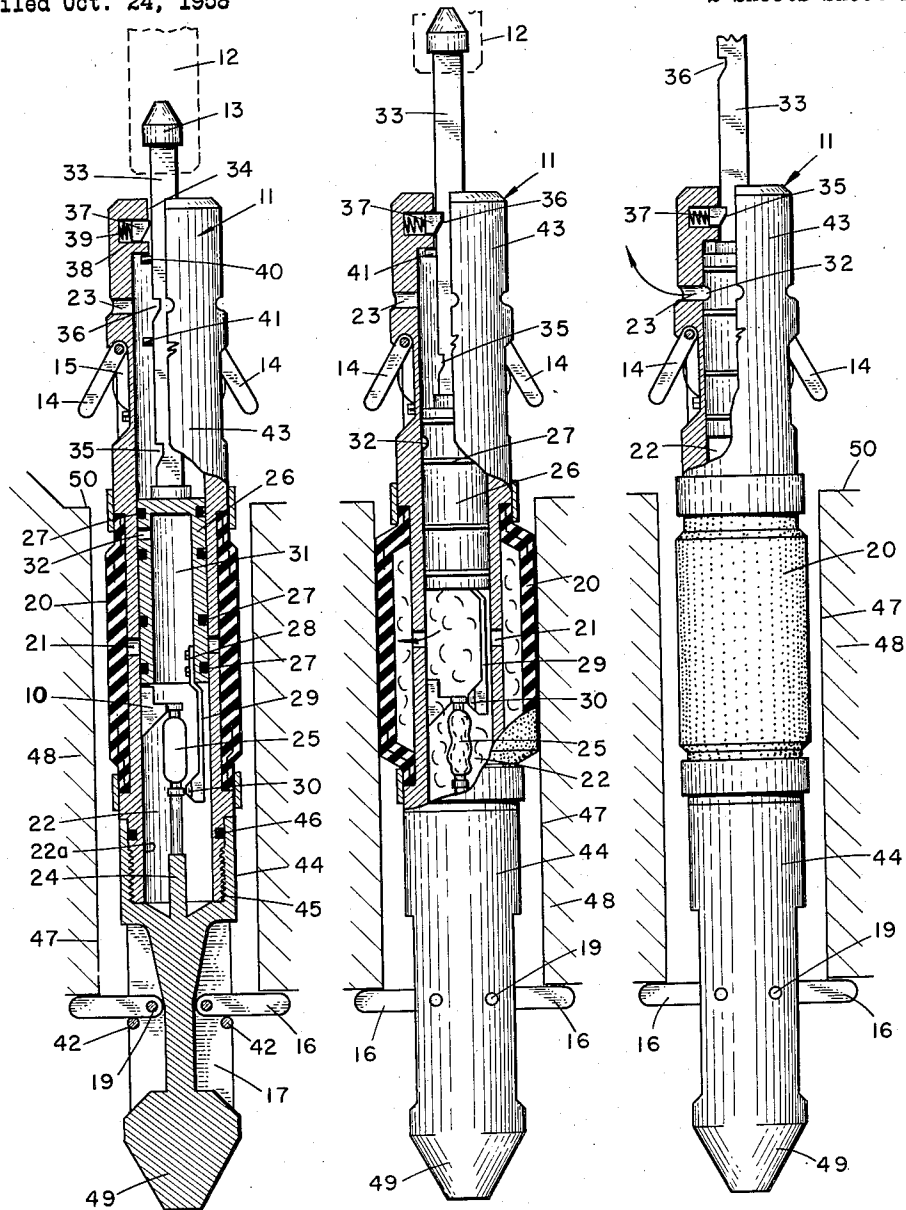


FIG. 1.

FIG. 2.

FIG. 3.

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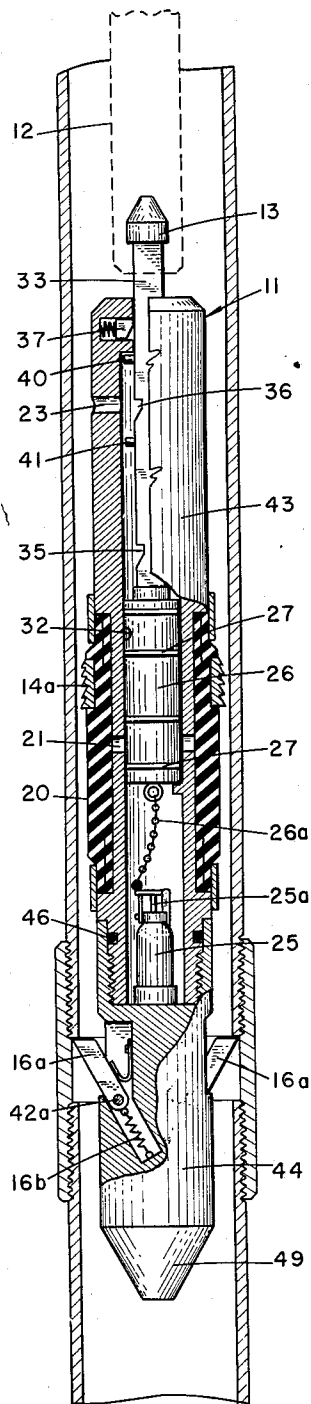


FIG. 4.

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APPARATUS FOR USE IN A WELL BORE

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13 Claims. (Cl. 166—187)

The present invention is directed to apparatus for plugging a bore in a well. More particularly, the invention is directed to a device for plugging a bore in a well packer, tubing, or any conduit in a well. In its more specific aspects, the invention is directed to a device comprising an inflatable sleeve.

The invention may be briefly described as a device for plugging a bore in a well in which an elongated body member is formed to provide an internal cavity, the elongated body member being further provided with vertically spaced-apart first and second ports, fluidly communicating the exterior of the body member with the cavity. Arranged on the body member and enclosing the first port is an expandable and deflatable sleeve. Arranged within the cavity is a container which is adapted to confine under pressure a normally gaseous medium. Also arranged in the cavity is a hollow movable valve means having a port in its wall and sealingly contacting the wall of the cavity. Connected to the valve means is an actuating means which serves to move the valve from a first to a second position and thence to a third position. Means are also connected to the valve for releasing the normally gaseous medium from the container into the cavity when the actuating means moves the valve means from its first to its second position to expand the expandable sleeve and thereby plug the bore. The expandable sleeve is deflated on the actuating means moving the valve means to its third position whereby the port in the valve means is placed in fluid communication with the second port to release the gaseous medium from the cavity.

The means connected to the valve means to release the gaseous medium from the container may suitably be a knife which is adapted to contact the container and rupture or pierce the wall of the container. The means connected to the valve means for releasing the normally gaseous medium from the container may suitably comprise a member engaging with a valve in the container for releasing the contents thereof.

The present invention is quite advantageous and useful and suitably may be used in a well bore to plug a conduit therein or to restrict the passageway. Suitably the invention may be used in plugging the bore of a packer, in closing the passageway through a tubing or casing, and the like.

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

Figs. 1 to 3 are a partial sectional view illustrating a preferred embodiment and the stepwise operation of the improved device, and

Fig. 4 is a modification of the device of Figs. 1 to 3.

Referring now to the drawing and particularly to Figs. 1 to 3, numeral 11 designates an elongated body member adapted to be lowered in a well by means of a running tool 12 attached to fishing neck 13 on a wire line, not shown. Elongated body member 11 is provided with first spring-biased dogs 14 arranged in and protruding from a recess 15 and second dogs 16 arranged in and protruding from a second recess 17, dogs 16 being pivotally mounted on pins 19.

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Carried on the elongated body member 11 is an expandable and deflatable sleeve so formed of a deformable material such as, for example, synthetic or natural rubber or other elastomers or elastic material. Sleeve 20 is internally reinforced adjacent its upper and lower ends by nylon cord, ribbons, and the like. Sleeve 20 encloses a first port 21 which communicates the interior of sleeve 20 with a cavity 22 in the elongated body member 11. A second port 23 vertically spaced from first port 21 also fluidly communicates cavity 22 with the exterior of elongated body member 11.

Arranged within the cavity 22 and supported therein by an upstanding member 24 is a cartridge or container 25 which is adapted to confine under pressure a normally gaseous medium such as carbon dioxide, methane, ethane, nitrogen, and the like, which when released into the cavity 22 causes the sleeve 20 to be inflated through port 21.

A sleeve valve means 26 is movably arranged within cavity 22 above the container 25 in a first position by a stop member 10 which also serves to center or position the container 25. Sleeve valve means 26 is provided with a plurality of seals on its exterior surface such as O-rings 27 arranged in recesses thereon to effect a tight seal with the inner wall 22a of cavity 22.

Attached to sleeve valve means 26 by set screws 28 is a bracket 29 carrying on its free end a knife or piercing means 30 which is adapted to operatively contact the container 25 and cut or pierce same to release the normally gaseous medium into the cavity 22. To this end, the container 25 may be constructed of a relatively light metal such as aluminum, magnesium, and the like, or may be constructed of ferrous metals which are of a thickness such that the wall may be readily pierced or punctured. The container 25 may have a portion of its wall constructed of light weight metal such that it is readily cut, punctured, or pierced by the knife 30 on engagement therewith.

The sleeve valve means 26 is hollow and forms a cavity 31, being open on one end and closed on the other end. The cavity 31 communicates fluidly with the exterior surface of the sleeve valve means 26 by way of a port 32.

The closed end of the sleeve valve means 26 has attached to it an actuating means 33 which is shown in the form of a flat-sided bar to prevent rotation. Actuating means 33 projects from the elongated body member 11 through an opening 34, corresponding in shape to the actuating means 33, in the upper end of elongated body member 11.

Actuating means 33 is provided with notches 35 and 36 vertically spaced apart thereon for operative engagement with latch 37 which is urged out of recess 38 by means of spring 39. Fishing neck 13 is connected to the free end of actuating means 33.

A first shear pin or frangible means 40 holds the actuating means 33 and sleeve valve means 26 in the latter's first position until the first shear pin 40 is ruptured. As shown, the sleeve valve 26 is maintained in its first position (enclosing said first port 21) against downward movement by stop 10 and releasably against upward movement by frangible pin 40, which abuts against the upper end of the body 11. Second shear pin 41 holds actuating means 33 and sleeve valve means 26 in the latter's second position until the second shear pin 41 is ruptured.

The third shear pins 42 hold the dogs 16 such that they may pivot approximately 90° from the vertical running in position to operative or engaging position as shown in Fig. 1.

It is to be noted that the elongated body member 11 is constructed of an upper section indicated generally by

the numeral 43 and a lower section indicated generally by the numeral 44. Sections 43 and 44 are threadedly and sealingly connected by mating threads 45 and sealing means such as O-ring 46.

Fig. 1 shows the sleeve valve means 26 in its first position, Fig. 2 in its second position, and Fig. 3 in its third position.

The apparatus of Figs. 1 to 3 may be lowered through a tubing string or other well pipe not shown and placed in the bore 47 of a suitable packer 48 for plugging the bore 47, the nose 49 of the elongated body member 11 facilitating entry into the bore 47 with the dogs 16 maintained in position by shear pins 42. The elongated body member 11 may be lowered through bore 47 until the dogs 14 engage the upper end 50 of the packer 48 which prevents further lowering of the elongated body member 11. Dogs 16 prevent disengagement from the bore 47. Thus, the apparatus is now in position for plugging the bore 47. Upward jarring on tool 12 by means of the wire line, not shown, causes shear pin 40 to be ruptured moving the actuating means 33 and sleeve valve member 26 from the first position shown in Fig. 1 to the second position shown in Fig. 2. Knife 30 operatively engages container 25 and punctures it, thus releasing the gas, confined therein under pressure, into cavity 22 which inflates sleeve 20 through port 21, effectively plugging the bore 47.

The sleeve valve member 26 is maintained in its second position by the released gas pressure from container 25 and the abutting of shear pin 41 against the top of housing 11. Latch 37 engaging in notch 36 also prevents downward movement of the valve member 26. The upward movement of the sleeve valve 26 is damped somewhat by well fluid above the sleeve valve being forced out port 23.

The running tool 12 can now be removed by jarring downwardly. The latch 37 engaging in notch 36 affords this removal without jarring down the sleeve valve 26.

When it is desired to unplug the bore 47, a pulling tool, not shown, is run in by a wire line and engaged with the head 13. Upward jarring shears the shear pin 41, which allows the sleeve valve 26 to be moved to its uppermost position by means of the upward pull and the gas pressure.

As shown in Fig. 3, the notch 35 is engaged by latch 37. This brings port 32 in sleeve valve member 26 into correspondence with port 23, thus allowing gas from cavity 22 to be released through cavity 31 and ports 32 and 23, and thereby deflating the sleeve 20. Further upward jarring on the pulling tool causes dogs 16 to rupture shear pins 42 allowing dogs 16 to pivot downwardly to a vertical position and freeing the elongated body member 11 from the packer 48 and providing for retrieving of the elongated body member 11.

By virtue of the threadedly connected sections 43 and 44 when the apparatus is returned to the earth's surface, it is a simple matter to replace the ruptured container 25 with one with a fresh charge for reuse of the apparatus as has been described.

The apparatus of the present invention is quite useful in plugging a bore in a well such as in wells completed in a plurality of zones. An example of the use of the present invention is in plugging the bore of a packer such as in U.S. Serial No. 702,852 filed December 16, 1957, for Thomas B. McCulloch, and entitled "Plural Completion of Wells."

Fig. 4 illustrates a device similar to that of Figs. 1 to 3 but modified to act as a plug or packer for tubing or casing and the like.

Referring to Fig. 4, the general structure is the same as that of Figs. 1 to 3. The dogs 16 are replaced by spring-biased locator dogs 16a which are adapted to engage within a collar recess on upward movement of the assembly. Dogs 16a are pivotally mounted on shear pins 42a.

Slip segments 14a are embedded in sleeve 20 to grip the well of the pipe when the sleeve is expanded to insure against downward movement of the assembly.

Upon being located in a desired collar recess, the sleeve is expanded in the same manner as the device of Figs. 1 to 3. The gas container 25 of Fig. 4 is opened by means of a chain 26a connected to the lower end of sleeve valve member 26 and a valve means 25a in the top of gas container 25. Initial upward movement of sleeve valve 26 causes the valve 25a of container 25 to open and further movement breaks the chain.

Removing the assembly of Fig. 4 is done in the same manner as in the device shown in Figs. 1 to 3 excepting the action of locator dogs 16a. As the shear pin 42a breaks, the dog is retracted into the body of the device by tension springs 16b.

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

1. A device for plugging a bore in a well which comprises an elongated body member formed to provide an internal cavity and provided with vertically spaced-apart first and second ports fluidly communicating the exterior of said body member with said cavity, an expandable and deflatable sleeve on said body member enclosing the first port, a container in said cavity adapted to confine under pressure a normally gaseous medium, a hollow valve means in said cavity provided with a port in its wall, actuating means operatively connected to said valve means for moving said valve means in sequence from a first to a second position and to a third position, separate means positioned in said device for releasably retaining said valve means in its first and second positions, said valve means in its first position covering the first port and in its second position uncovering said first port, and means connected to said valve means for releasing said normally gaseous medium from said container into said cavity when said actuating means moves said valve means from its first to its second position to expand said expandable sleeve and thereby plug said bore, said expandable sleeve being deflated on said actuating means moving said valve means to its third position whereby the port in the wall of said valve means is placed in fluid communication with said second port to release said gaseous medium from said cavity.

2. A device in accordance with claim 1 in which the means connected to said valve means is a knife adapted to contact said container for rupturing the wall of said container.

3. A device in accordance with claim 1 in which the means connected to said valve means comprises a member engaging with a valve in said container.

4. A device for plugging a bore in a well which comprises an elongated body member formed to provide an internal cavity and provided with vertically spaced-apart first and second ports fluidly communicating the exterior of said body member with said cavity, means carried by said body member for anchoring said body member in said well, an expandable and deflatable sleeve on said body member enclosing the first port, a container in said cavity adapted to confine under pressure a normally gaseous medium, a hollow movable valve means having a port in its wall sealingly arranged in said cavity, actuating means operatively connected to said valve means for moving said valve means from the first to a second position and to a third position, separate means positioned in said device for releasably retaining said valve means in its first and second positions, and means connected to said valve means for releasing said normally gaseous medium from said container into said cavity when said actuating means moves said valve means from its first to its second position, to expand said expandable sleeve and thereby plug said bore, said expandable sleeve being deflated on said actuating means moving said valve means to its third position whereby the port in said valve means

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is placed in fluid communication with said second port to release said gaseous medium from said cavity.

5. A device for plugging a bore in a well which comprises an elongated body member formed to provide an internal cavity and provided with vertically spaced-apart first and second ports fluidly communicating the exterior of said body member with said cavity, spaced-apart means carried by said body member for positioning said body member relative to the wall of said well, an expansible and deflatable sleeve on said body member enclosing the first port, a container in said cavity adapted to confine under pressure a normally gaseous medium, a hollow movable valve means having a port in its wall sealingly arranged in said cavity, actuating means operatively connected to said valve means for moving said valve means from a first to a second position and to a third position, spaced-apart means in said device for releasably retaining said valve means in its first and second positions, and means connected to said valve means for releasing said normally gaseous medium from said container into said cavity when said actuating means moves said valve means from its first to its second position, to expand said expansible sleeve and thereby plug said bore, said expansible sleeve being deflated on said actuating means moving said valve means to its third position whereby the port in said valve means is placed in fluid communication with said second port to release said gaseous medium from said cavity.

6. A device in accordance with claim 5 in which the spaced-apart means are locator dogs.

7. A device for plugging a bore in a well which comprises an elongated body member formed to provide an internal cavity and provided with vertically spaced-apart first and second ports fluidly communicating the exterior of said body member with said cavity, an expansible and deflatable sleeve on said body member enclosing the first port, a rupturable container in said cavity adapted to confine under pressure a normally gaseous medium, a hollow movable valve means having a port in its wall sealingly arranged in said cavity, actuating means operatively connected to said valve means for moving said valve means from a first to a second position and to a third position, separate means positioned in said device for releasably retaining said valve means in its first and second positions, and means connected to said valve means adapted to operatively contact said container and rupture same for releasing said normally gaseous medium from said container into said cavity when said actuating means moves said valve means from its first to its second position, to expand said expansible sleeve and thereby plug said bore, said expansible sleeve being deflated on said actuating means moving said valve means to its third position whereby the port in said valve means is placed in fluid communication with said second port to release said gaseous medium from said cavity.

8. A device in accordance with claim 7 in which the means connected to the valve means is a knife.

9. A device for plugging a bore in a well which comprises an elongated body member formed to provide an internal cavity and provided with vertically spaced-apart first and second ports fluidly communicating the exterior of said body member with said cavity, an expansible and deflatable sleeve on said body member enclosing the first port, a container in said cavity adapted to confine under pressure a normally gaseous medium, a hollow movable valve means having a port in its wall sealingly arranged in said cavity, actuating means operatively connected to said valve means for moving said valve means from a first to a second position and to a third position, separate means positioned in said device for releasably retaining said valve means in its first and second positions, a latch mounted in said body member adapted to engage said actuating means when said valve means is moved to its second and third positions, and means connected to said valve means for releasing said normally gaseous

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medium from said container into said cavity when said actuating means moves said valve means from its first to its second position, to expand said expansible sleeve and thereby plug said bore, said expansible sleeve being deflated on said actuating means moving said valve means to its third position whereby the port in said valve means is placed in fluid communication with said second port to release said gaseous medium from said cavity.

10. A device in accordance with claim 9 in which the actuating means is an elongated means provided with spaced-apart notches for receiving said latch.

11. A device in accordance with claim 10 in which the elongated means is a flat-sided bar.

12. A device for plugging a bore in a well which comprises an elongated body member formed to provide an internal cavity and provided with vertically spaced-apart first and second ports fluidly communicating the exterior of said body member with said cavity, an expansible and deflatable sleeve on said body member enclosing the first port, a container in said cavity adapted to confine under pressure a normally gaseous medium, a hollow movable valve means having a port in its wall sealingly arranged in said cavity, actuating means operatively connected to said valve means for moving said valve means from a first to a second position and to a third position, spaced-apart frangible means on said actuating means adapted to maintain said valve means releasably in said first and second positions, and means connected to said valve means for releasing said normally gaseous medium from said container into said cavity when said actuating means moves said valve means from its first to its second position, to expand said expansible sleeve and thereby plug said bore, said expansible sleeve being deflated on said actuating means moving said valve means to its third position whereby the port in said valve means is placed in fluid communication with said second port to release said gaseous medium from said cavity.

13. A device for plugging a bore in a well which comprises an elongated body member formed to provide an internal cavity and provided with vertically spaced-apart first and second ports fluidly communicating the exterior of said body member with said cavity, spaced-apart locator dogs carried by said body member adjacent the first and second ends of said body member for positioning said body member relative to the wall of said well, an expansible and deflatable sleeve on said body member enclosing the first port, a container in said cavity adapted to confine under pressure a normally gaseous medium, a hollow movable valve means having a port in its wall sealingly arranged in said cavity, actuating means operatively connected to said valve means for moving said valve means from a first to second position and to a third position, separate means positioned in said device for releasably retaining said valve means in its first and second positions, and means connected to said valve means for releasing said normally gaseous medium from said container into said cavity when said actuating means moves said valve means from its first to its second position, to expand said expansible sleeve and thereby plug said bore, said expansible sleeve being deflated on said actuating means moving said valve means to its third position whereby the port in said valve means is placed in fluid communication with said second port to release said gaseous medium from said cavity, said body member being provided with frangible means releasably holding one of said locator dogs in operative position.

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