Sept. 13, 1955 H. C. BELL ET AL 2,717,644

PLUG FOR OIL WELLS

Filed Jan. 28, 1952 2 Sheets-Sheet 1

Fig. 1.

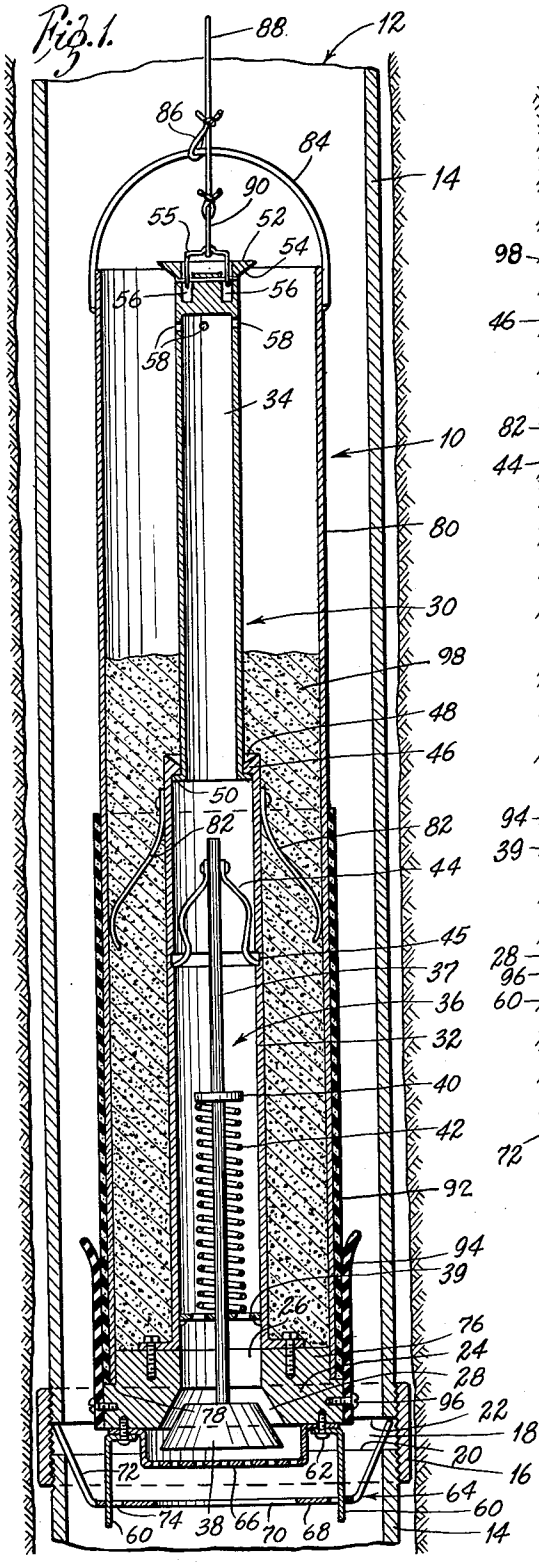


Fig. 2.

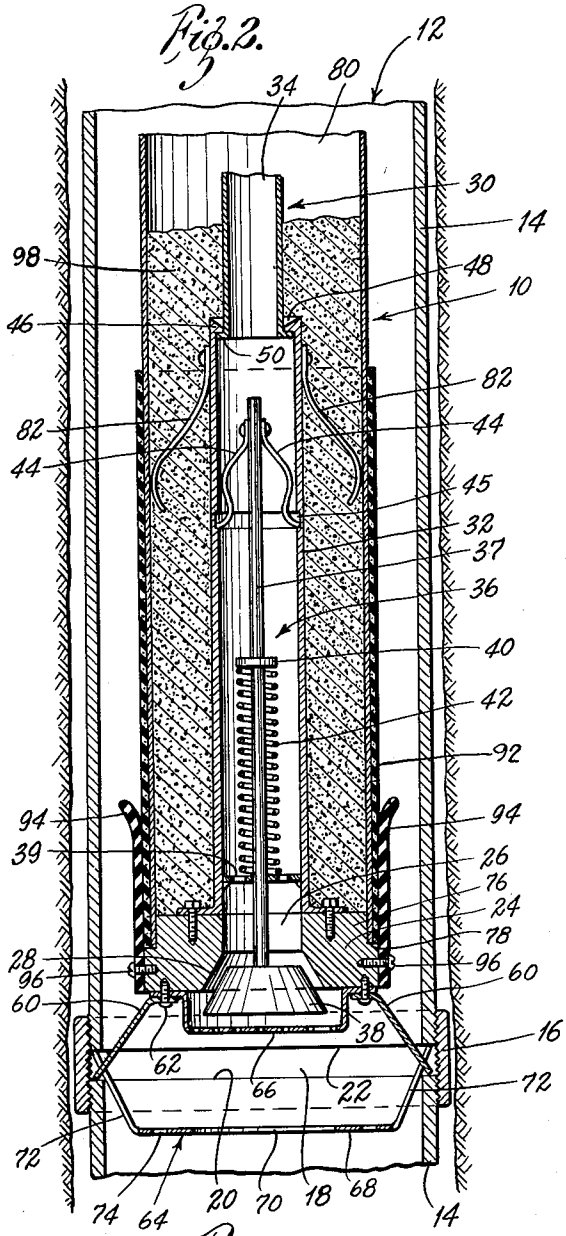
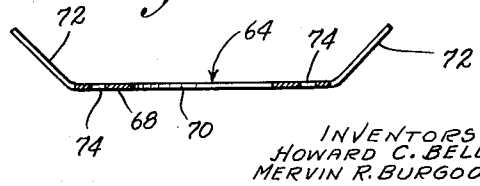


Fig. 5.



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Fig. 3.

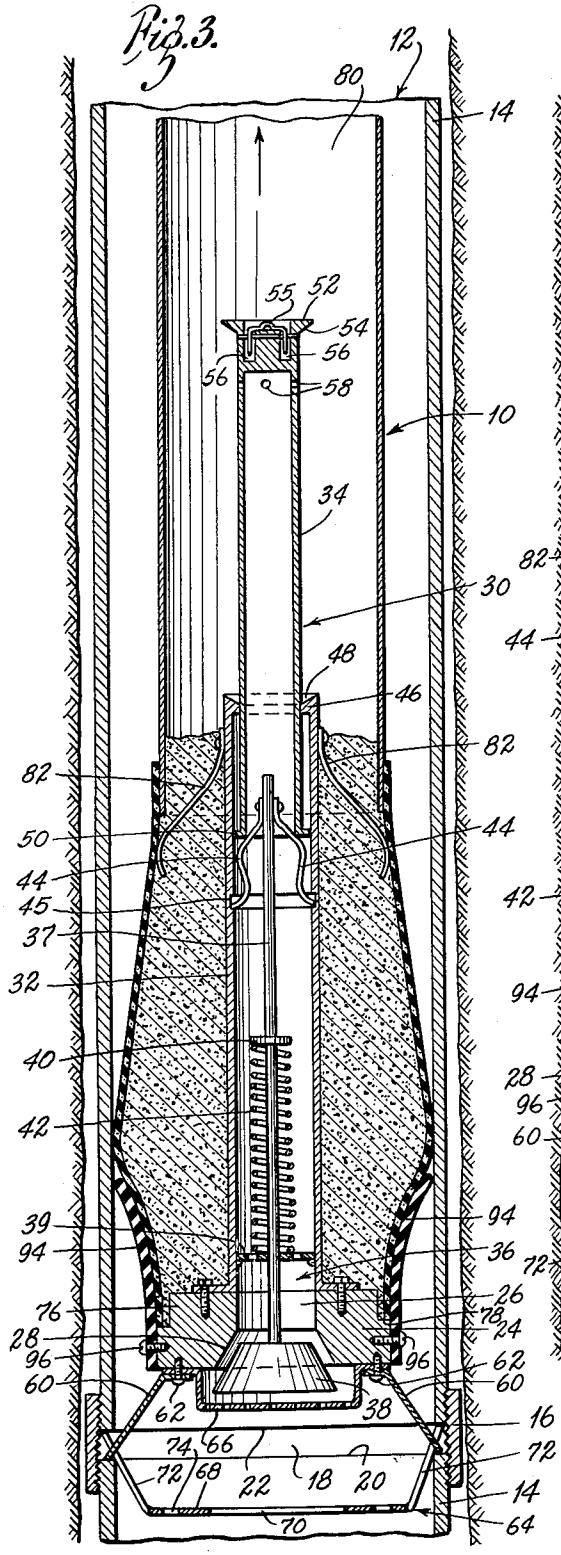
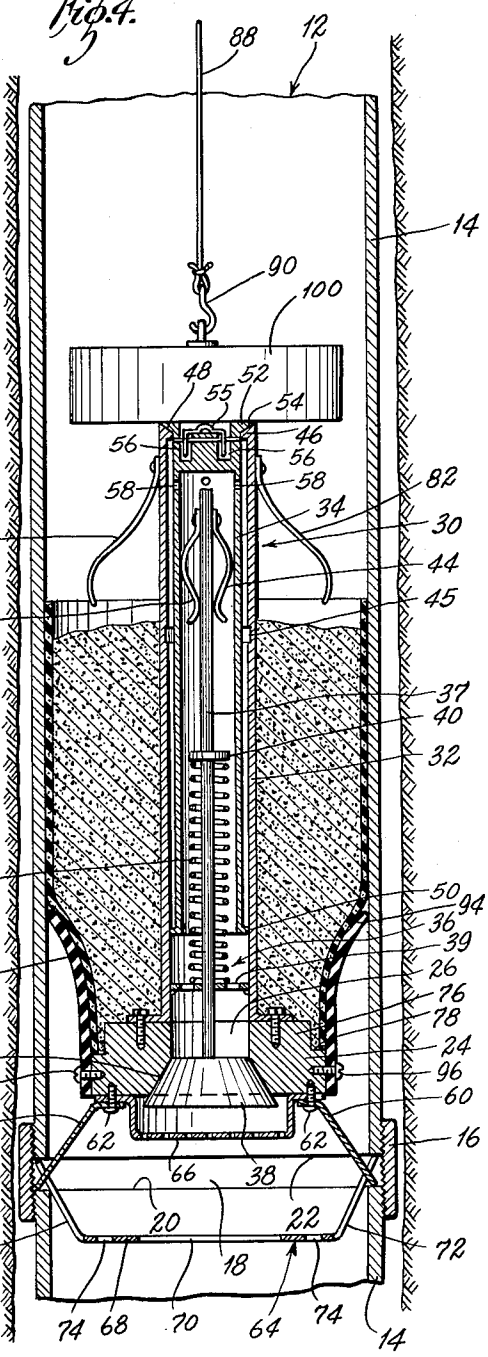


Fig. 4.



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PLUG FOR OIL WELLS

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15 Claims. (Cl. 166—117)

The present invention relates to a novel device for use in bridging oil wells at a desired depth below the ground level.

The invention has for a primary object the provision of means whereby a supported non-rigid container, having a valved central core open at the top and preferably having walls of rubber or other flexible material, may be first lowered into position within an oil well casing or hole, and then filled with a quantity of cementitious material surrounding the core to deform the container wall into intimate or binding engagement with the surrounding wall of the well pipe or of the earth hole, thus effectively sealing the well, as will appear.

Another primary object includes the provision of a valve in an oil well bridging device, and means associated therewith for permitting the escape of fluid or gas from the well below through a provided core in the cementitious mass as the latter sets and hardens, means for closing the valve as desired after the mass has become solid, and means for maintaining the valve closed thereafter.

Briefly, in order to attain these and other objects which are apparent from the description below, an annular base plate is provided which forms the bottom wall of a pliable container or receptacle. Centrally, the base plate has a circular opening including a tapered valve seat, and a telescopic vertical tubular assembly is mounted on the top of said base and in communication with said opening. A valve assembly is incorporated in the lower section of the telescopic assembly and the base plate. A bail is provided at the top of the upper section of the telescopic assembly, so that, in the fully extended position of the latter, the base may be suspended by means of a hook secured to one end of a wire line.

At the bottom, the base plate may be provided with an attachment for preventing downward movement of the device below a selected point. An elongated cylinder is removably supported at its lower end on the base plate, and has a bail fixed to its upper end. A stout cord or the like connects the bail to the wire line above the hook previously mentioned. Originally, the body of the collapsible container is in the form of a sleeve about the lower portion of the cylinder, with its lowermost edge in contact with the base plate, and the elongated cylinder contains a predetermined quantity of cementitious material, as the entire assembly of parts thus far enumerated is lowered into the well casing by means of the wire line.

For a more comprehensive understanding of the invention, its objects and mode of operation, reference is directed to the drawings and the detailed description to follow.

In said drawings:

Fig. 1 is a transverse vertical sectional view through a conventional oil well casing, illustrating the assembled parts included in the invention as they appear during the initial lowering operation;

Fig. 2 is a fragmentary view similar to Fig. 1, illustrating the parts as they appear following a subsequent raising operation;

Fig. 3 is a view similar to Fig. 1, illustrating the elongated cylinder being raised, thereby transferring the cementitious material from the cylinder to the collapsible container;

Fig. 4 is a view similar to Fig. 1, with the cylinder removed, the container in collapsed state thus plugging the well bore, and a weight being lowered to effect the closing of a valve mechanism; and

Fig. 5 is a detail sectional view of a prong confining member.

Referring to the drawings more particularly by reference numerals, the composite device designed for use in attaining the objectives of the invention is generally indicated **10**.

As shown in Fig. 1, the device **10** in one use may be lowered into an oil well casing, generally designated **12**, which may comprise a series of conduit sections **14** disposed in end-to-end alignment, and joined by internally threaded collars **16**. In practice, the adjacent ends of the conduit sections **14** are not brought into abutting relation, so that an annular recess **18** is provided, which may vary in height from one to three inches. With this arrangement, each collar connection provides an annular ledge **20** along the top edge of one conduit section and a similar ledge **22** along the bottom edge of the other section.

The device **10**, which appears in its entirety only in Fig. 1, includes an annular base plate **24**, provided centrally with a circular opening **26** merging into a downwardly and outwardly flared valve seat **28**.

Rigidly secured by screws as shown, or otherwise, to the top face of the base plate **24** is a vertically disposed telescopic housing of tubular design, generally indicated **30**. This housing **30** includes a stationary lower section **32** and an upper section **34** slidable therein, and is in fluid communication with opening **26** as shown.

A valve assembly generally indicated **36** is disposed in the lower section **32** with its included valve stem **37** projecting through opening **26** in the base plate **24** to terminate in an upwardly and inwardly flared valve head **38** adapted to seal said opening **26** when closed against the valve seat **28**. The assembly **36** also includes a spider **39** welded or otherwise rigidly mounted near the lower end of section **32**, a collar **40** rigid with stem **37**, a compression spring **42** interposed about the stem between said spider **39** and collar **40**, and a plurality of leaf spring elements **44** rigidly secured to said valve stem adjacent the upper end thereof.

An internal annular shoulder **45** is provided in the section **32**, said section **32** terminating at its upper end in an inturned annular flange portion **46**, the outer surface of which has formed therein a bevelled seat **48** for a purpose to appear. The lower end of section **34** terminates in an outturned annular flange portion **50**, and the upper end in a flange portion **52**, the under surface of the latter being bevelled at **54** for substantially sealing engagement with the bevelled seat **48**. A bail **55** is supported for vertical movements in guide pockets **56** formed integral with or secured internally to the upper end of section **34**. Section **34** is closed at the top and has a plurality of apertures **58** formed in the wall adjacent to the top to permit escape of gases when sections **32** and **34** are extended and the valve assembly **36** is open.

For supporting the device **10** at a selected position in a well, a series of resilient steel prong members **60** is secured to the underside of the base plate **24** by means of screws **62**, or the like, which are initially confined in retracted position by means of a retainer plate **64**, shown per se in Fig. 5. The screws **62** also support a strainer **66** below the base plate **24** and surrounding valve head **38**. Other supporting attachments may be used, or such attachment may be omitted for certain uses of the device **10**.

The prong retainer plate **64** includes a circular body

portion 68 provided centrally with a relatively large opening 70, a plurality of resilient outwardly biased projections 72 integral with said body portion, and a series of circumferentially spaced slots 74, each adapted to receive and temporarily confine one of the prong members 60 which, in turn, frictionally hold the plate 64 as shown.

An upper portion 76 of the base plate 24 is reduced in diameter to provide a shoulder or ledge 78 supporting an elongated cylinder 80, as clearly shown in Figs. 1 and 2. A plurality of resilient arms 82 secured to the lower section 32, bear against the inner surface of the cylinder 80 to center and add stability thereto. A bail 84 is welded to the open upper end of the cylinder 80, and a stout cord 86 is looped about the bail 84 and securely tied to a wire line 88, which carries a hook 90 engaging the bail 55.

Sleeved about the cylinder 80 with its bottom edge resting on the ledge 78 is a tube 92 of pliable material, preferably rubber. A circumferential series of upwardly projecting finger members 94 have their lower ends secured to the base plate 24 by screws 96, which are of any suitable material and are disposed about the lower portion of the tube 92, in supporting relation thereto.

Operation

Assuming that it is desirable to bridge an oil well at some selected point below ground level, the valve head 38 is moved to open position, thereby compressing the spring 42. The configuration and resilient strength of the spring elements 44, the free ends of which engage against the shoulder 45, are sufficient to overcome the force of spring 42 and retain the valve head 38 in open position. Thereupon, a predetermined quantity of a selected cementitious material 98 is poured into cylinder 80, the hook 90 is caused to engage bail 55, the bail 84 is tied to the wire line 88, and by means of the latter the composite device 10 is lowered into the casing 12, as portrayed in Fig. 1.

During the lowering operation, the outwardly biased projections 72 of the prong retainer plate 64 will ride along the inner periphery of the casing 14, the body portion 68 thereof being securely held in position by the outwardly biased prongs 60, which, at this time, project through and are held retracted by the slots 74. Each time, however, that the prong retainer plate 64 passes a collar recess 18, the projections 72 will momentarily spring outwardly.

When used in a casing 12, the device 10 is first lowered beyond the desired bridging depth, whereupon it is raised slowly so that the projections 72 will spring outwardly to engage in the recess 18 just passed thereby. As the device continues to rise, prongs 60 leave openings 74 and spring outwardly also, since the retainer plate 64 is held against movement and ride along the inner surface of the casing.

Now, the device is again lowered until the prongs 60 enter the first collar recess 18 just passed thereby, usually that entered by the projections 72, and spring outwardly into engagement with the ledge 20, as portrayed in Fig. 2.

With the device 10 now supported from below, slackening of line 88 will permit disengagement of hook 90 from bail 55, whereupon an upward pull on the wire line 88 will raise the cylinder 80. As this cylinder 80 rises, the cementitious mass 98 enters the tube 92 to expand the same and cause it to bulge laterally into binding engagement with the casing 14. Total collapse of the tube 92 is prevented by the supporting fingers 94.

The condition prevailing as the cylinder 80 is leaving the upper end of tube 92 is illustrated in Fig. 3. This view also demonstrates that, following disengagement of the hook 90, the bail 55 may slide downwardly into the section 34 and the latter may slide downwardly by gravity into the section 32 until the flange 50 rests upon the leaf springs 44, although the frictional engagement between the flanges 50 and the section 32 may be great enough to prevent this gravity action. It is understood, however, that the tubular section 34 is light and its descent will not disturb the valve assembly 36 when such occurs, so that the valve remains open.

Fig. 3 further demonstrates the tube centering action afforded by the resilient arms 82, and the supporting action of the fingers 94 in preventing total collapse of tube 92, as the mass of material 98 settles therein by gravity. After the cylinder 80 has been withdrawn from the tube 92, the gravity actuated mass of material will settle and further expand the tube as in Fig. 4.

Obviously, time is required for the cement mixture to solidify. During this period, any gases or liquids emanating below may escape via the open valve assembly 36 and telescopic assembly 30, leaving the device 10 by the apertures 58. Fouling of the valve head 38 or valve seat 28 by extraneous matter, which may be present in the gas or liquid, is substantially obviated by the provision of the strainer 66.

After the mixture has become solid, a weight designated 100 is lowered via the wire line 88 and the hook 90 to telescope the sections of the assembly 30. As the section 34 descends, its annular flange 50 forces spring members 44 inwardly and out of contact with the inner periphery of the lower section 32, thus permitting the compression spring 42 to expand and seat the valve head 38, as clearly shown in Fig. 4. Preferably, the weight 100 is then withdrawn. The bevelled surface 54 substantially seals with the bevelled seat 48, thereby preventing gases from an oil stratum above the device 10 from opening the valve assembly 36.

From the foregoing description and drawings, it should be manifest that the invention provides a relatively simple and inexpensive device for bridging an oil well. Any gas pressure, which may build up beneath the plug, will be exerted against the bottom face of the valve head 38 to seat it more firmly.

It is to be noted that the present device 10 may be used in oil well holes without a casing 12 or at a depth below the casing 12. In fact, the device 10 has wide application both for temporarily or permanently bridging a hole, being particularly advantageous where escaping gas is present.

It is to be understood that the foregoing description and the accompanying drawings have been given by way of illustration and example. It is also to be understood that changes in form of the several parts, substitution of equivalent elements, and rearrangement of parts, which will be readily apparent to one skilled in the art, are contemplated as within the scope of the present invention which is limited only by the claims which follow.

What is claimed is:

1. A device for bridging an oil well at a selected distance below the top thereof, said plug comprising: an initially tubular member of pliable material provided with a rigid bottom wall to form a container open at the top, means mounted on the bottom wall for engaging the well to support the container, a valve seat opening formed centrally in the bottom wall, a rigid tubular housing mounted on the top face of the bottom wall and extending upwardly therefrom, a valve assembly in the housing including a valve stem projecting through the valve seat opening and terminating in a valve head for cooperation with said opening, said container being adapted to receive a predetermined quantity of a fluid cement mixture about the tubular housing in the container for expanding the side wall of the latter by the weight of said material into intimate engagement with the surrounding wall of the well, a series of upwardly extending fingers secured to the outer periphery of the container bottom wall for supporting the lower portion of the expanded container; means included in the valve assembly for maintaining said valve head unseated until the cement mixture hardens; means for seating said valve head after the cement mixture has hardened, said means including a reciprocable means extending from within said tubular housing out through the top thereof; and

means for initially lowering said container and said cement mixture into the well.

2. A seal for an oil well comprising a plug, and means for supporting the plug at a selected level underground, said plug including: a receptacle having a rigid bottom wall and an expansible and flexible annular side wall of rubber or the like, said receptacle being adapted to receive a mass of initially fluid cementitious material for expanding by the weight of said material the side wall thereof into sealing relationship with the surrounding wall of the well, an enclosed valve assembly maintained open during the solidification process of said material and adapted to be closed after the material has solidified, and a plurality of hard rubber finger members for supporting the lower portion of said expanded receptacle and the cementitious material therein, said supporting means comprising two members having a plurality of resilient prong elements the free ends of which are biased outwardly to engage the wall of said well, the prong elements in each member being opposed to the prong elements in the other member.

3. In a device for therewith first lowering an expansible and flexible receptacle into an oil well and then effecting the anchoring of said receptacle at a selected depth in the well: an elongated cylinder adapted to contain a predetermined fluid mall of wet cement, means for raising said cylinder to discharge said mass into the receptacle for expanding the latter by the weight of said mass into sealing engagement with the surrounding wall of the well; and valve means incorporated in a bottom wall of the receptacle for permitting the upward escape of gases and fluids through a tubular housing opening into said bottom wall within the receptacle from the well below during the solidification stage of the cement, and means for closing said valve after said cement has solidified.

4. A device for plugging an oil well lined with a casing formed of conduit sections disposed in end to end alignment, and having internally threaded collar connections providing an annular recess between adjacent conduit section ends, said device comprising: an annular base plate provided with a central opening including a valve seat portion; a tubular housing including a lower section mounted on the base plate in alignment with the opening therein and extending upwardly therefrom, and an upper section telescopically supported by the lower section; a valve assembly supported in said lower section, said assembly including a valve stem terminating at its lower end in a head portion for cooperation with the valve seat portion aforesaid; means on the upper end of the valve stem for engaging the inner periphery of the said lower section to maintain the valve head in unseated position; bail means mounted at the top of the upper section; a wire line provided with a hook for engaging said bail whereby to suspend said housing and the base plate as a unit; an elongated cylinder supported at its lower end on an annular ledge provided on the base plate, said cylinder being adapted to being filled with a predetermined quantity of a fluid cement mixture; a bail rigid with the upper end of the cylinder and tied to said wire line above the hook member; a series of outwardly biased prong members mounted on the bottom surface of the base plate for engaging the annular recess of a collar connection to support the device following the lowering thereof into the well via the wire line; a rubber tube, sleeved about the lower portion of the cylinder with its bottom edge resting on the annular ledge of the base plate, for receiving the cement mixture when the cylinder is raised by the wire line subsequent to disengagement of the hook from the telescopic housing bail; a series of semi-rigid finger members on the base plate for supporting the lower portion of the rubber tube as the cement mixture expands the same into binding engagement with the surrounding wall of the well casing; and means operable by applying a weight to the upper end of the telescopic housing via the hook and wire line, for seating said valve head against said valve seat.

5. The device of claim 4 wherein the valve assembly further includes a spider member rigidly mounted near the lower end of said telescopic housing for guiding said valve stem; a collar rigid with the valve stem; a compression spring about a portion of the valve stem interposed between the spider member and said collar for normally closing the valve; and a plurality of leaf spring elements rigidly attached to said stem above the collar for engaging the adjacent wall of the housing to maintain the valve open against the force of the compression spring when desired.

6. The device of claim 4 wherein a strainer is mounted on the underside of the base plate for preventing extraneous matter that may be present in gases or fluids emanating from the well below from entering said valve assembly.

7. The device of claim 4 including a retainer plate for confining said supporting prongs during the initial lowering of the device in the well casing, said retainer plate including a circular body portion provided with a central opening for upward passage therethrough of gases and fluids, a plurality of outwardly biased projections integral with the body portion for engaging in a collar connection recess during the subsequent raising of the device, and a series of circumferentially spaced slots in the body portion, each adapted to receive one of the prong members aforesaid.

8. The device of claim 4 including means for stabilizing said cylinder during the initial lowering of the device, and for centering said rubber tube after the cylinder has been raised, said means comprising a plurality of resilient arm members, normally biased outwardly and rigidly secured at one end to said lower section of the telescopic housing.

9. An oil well plug comprising an expansible and flexible receptacle, open at the top and having a rigid bottom wall, adapted to have deposited therein a predetermined fluid mass of a cement mixture contained in an elongated cylinder, said elongated cylinder having an open bottom end which is adapted to be in open communication with and abut against said bottom wall with said receptacle being sleeved about the lower end portion of said cylinder as both are lowered into said well; means for supporting the receptacle at a desired depth in the well; means for raising the cylinder to transfer said material to the container whereby to expand the latter into sealing engagement with the surrounding wall of the well; semi-rigid members for supporting the lower portion of the container as the material is being transferred; an enclosed valve mechanism extending longitudinally through the container and surrounded by the mass of material; means for maintaining the valve open during the material setting and hardening stage; and means for closing the valve thereafter.

10. In a device of the kind described, in combination, a base, a deformable tubular member supported on one end on said base, a removable sleeve member supported on one end on said base interiorly of said tubular member and in supporting relation thereto, said tubular member being expansible by the weight of a fluid mass which is adapted to be contained within said sleeve member when said sleeve member is removed, valved vent means supported by said base interiorly of said tubular member for venting gases through said device out of contact with said cementitious material, and means for closing said valved vent means to prevent fluids from passing upwardly through said device.

11. The combination of claim 10 further characterized by said valved vent means including a movable valve head and a seat and telescopic vent members extending upwardly from said valve seat into which fluids passing said valve seat exhaust, the innermost of the telescopic

members having means for effecting the movement of said valve head.

12. The combination of claim 10 further characterized by the inclusion of means for closing said valved vent means at a point spaced above the base of said device accessible from the top of the bore hole to prevent fluids from passing downwardly through said device.

13. In a device of the kind described, in combination, a base, a deformable tubular member supported on one end on said base, a removable sleeve member supported on one end on said base interiorly of said tubular member and in supporting relation thereto, said tubular member being expansible by the weight of a fluid mass which is adapted to be contained within said sleeve member when said sleeve member is removed, valved vent means including a valve supported by said base interiorly of said tubular member for venting gases through said device, said valve being held in a normally open position by a latch device against a biasing means urging the valve toward a closed position, and means for closing said valve to prevent fluids from passing upwardly through said device, said closing means including two telescopic members in open communication with said valve, the innermost member having valve operating means thereon for tripping the latch and freeing the biasing means within said outermost telescopic member to close the valve.

14. In a device of the kind described, in combination, a base, a deformable tubular member supported on one end on said base, a removable sleeve member supported on one end on said base interiorly of said tubular member and in supporting relation thereto, means for expanding said tubular member by the weight of a fluid mass which is adapted to be contained within said sleeve member when said sleeve member is removed, valved vent means including a valve supported by said base interiorly of said tubular member for venting gases through said device, means for closing said valved vent means to prevent fluids from passing upwardly through said device, said valve being held in a normally open position by a latch device against a biasing means urging the valve toward a closed position, said closing means including two telescopic members in open communication with said valve, the innermost member having valve operating means thereon for tripping the latch and freeing the biasing means within said outermost telescopic member to close the valve, and a second valved closing means comprising a valve on the upper end of the innermost of said members which is adapted to be closed against a valve seat on the upper end of the outermost of said members when the telescopic members are telescoped together.

15. A device for bridging an oil well comprising: an expansible and flexible container open at the top and having a rigid bottom wall, means for supporting the container at a desired depth in the well, said container being adapted to receive a predetermined fluid mass of cementitious material for expanding the container by the weight of said material into binding engagement with the surrounding wall of said well, means connected to the bottom wall thereof for preventing the total collapse of said container, a valve assembly supported on the bottom wall centrally of the container, means for maintaining said valve assembly open for the escape of gas and fluid from below the device through a tubular housing opening into said bottom wall within the container as said mass of material is in the solidifying process, and means for closing said valve assembly after the mass has solidified.

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