Feb. 25, 1941. G. A. HUMASON ET AL 2,233,013

COMBINATION PACKER AND SWAB

Filed Jan. 25, 1938 3 Sheets-Sheet 1

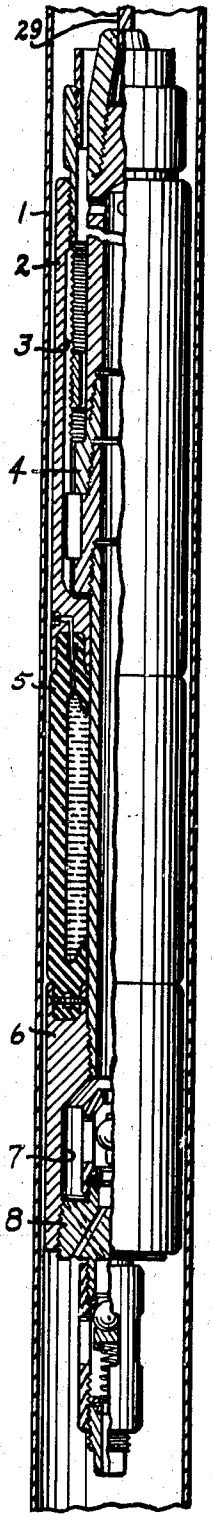


Fig. 3.

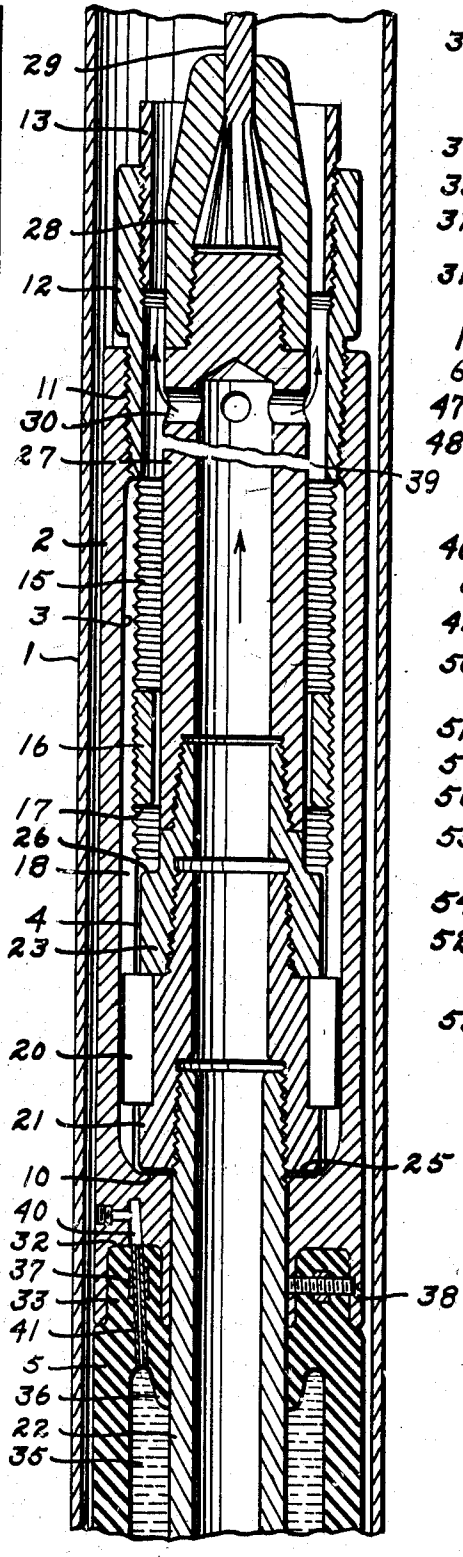


Fig. 1.

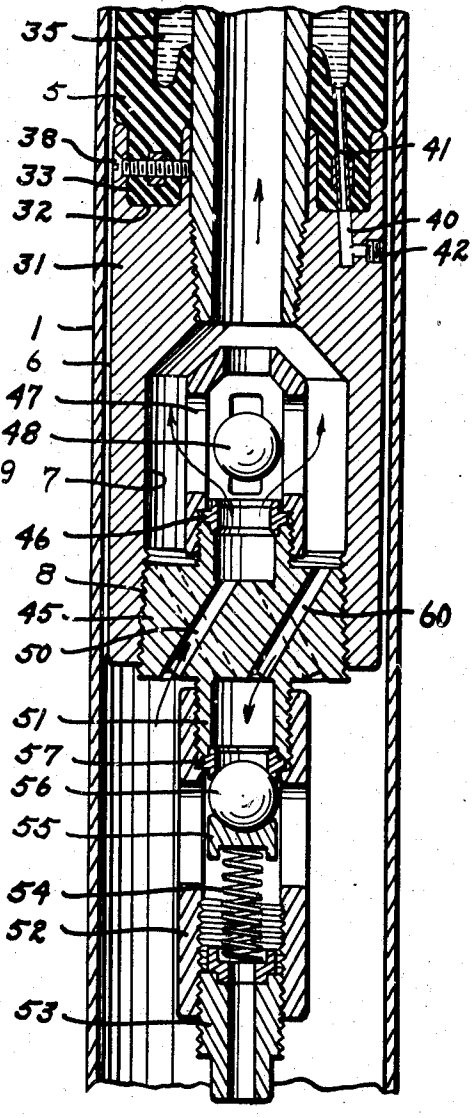


Fig. 2.

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COMBINATION PACKER AND SWAB

Filed Jan. 25, 1938 3 Sheets-Sheet 2

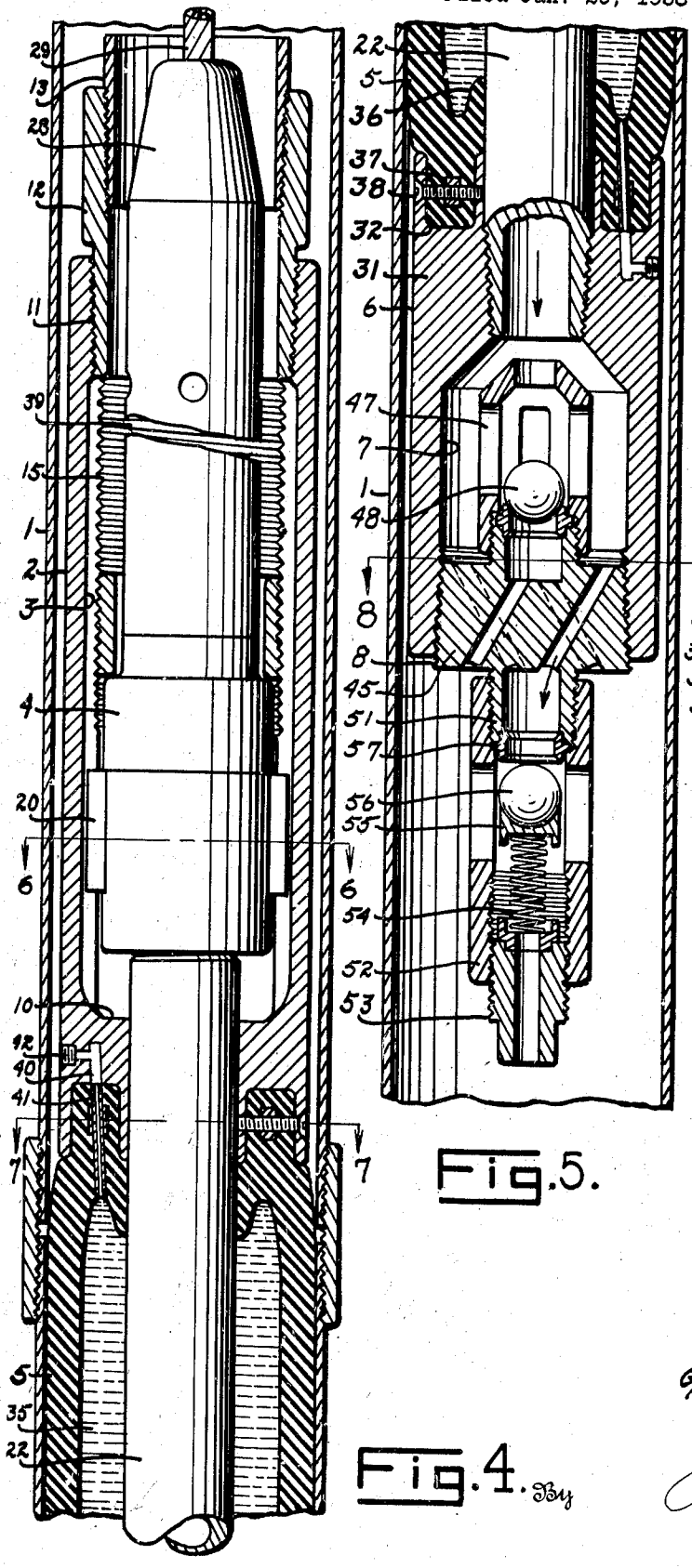


Fig. 4.

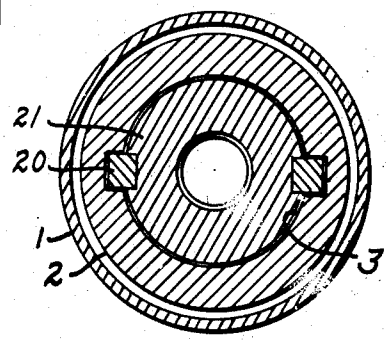


Fig. 6.

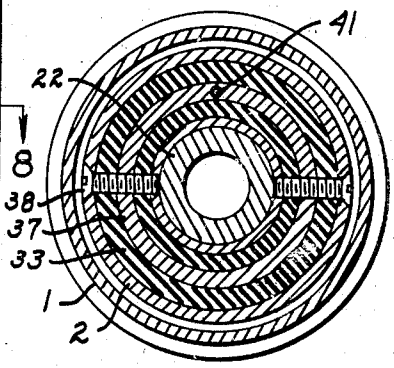


Fig. 7.

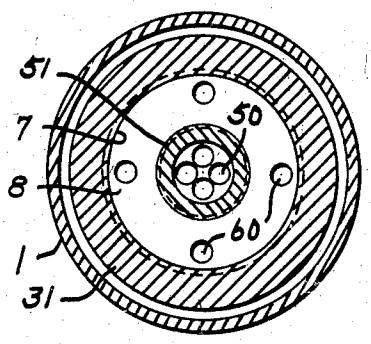


Fig. 8.

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COMBINATION PACKER AND SWAB

Filed Jan. 25, 1938 3 Sheets-Sheet 3

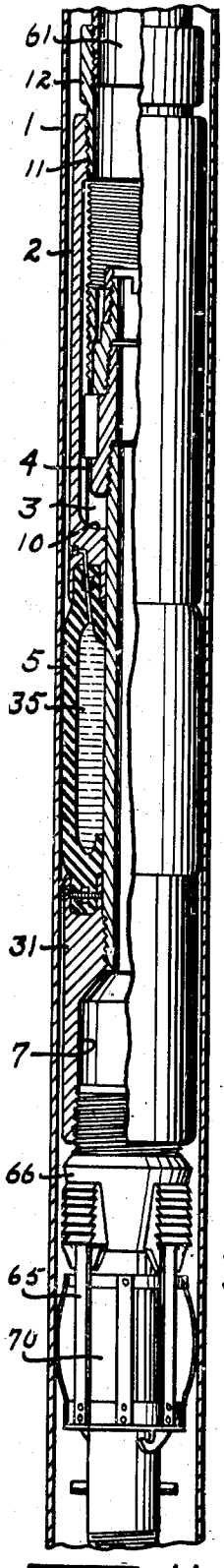


Fig. 11.

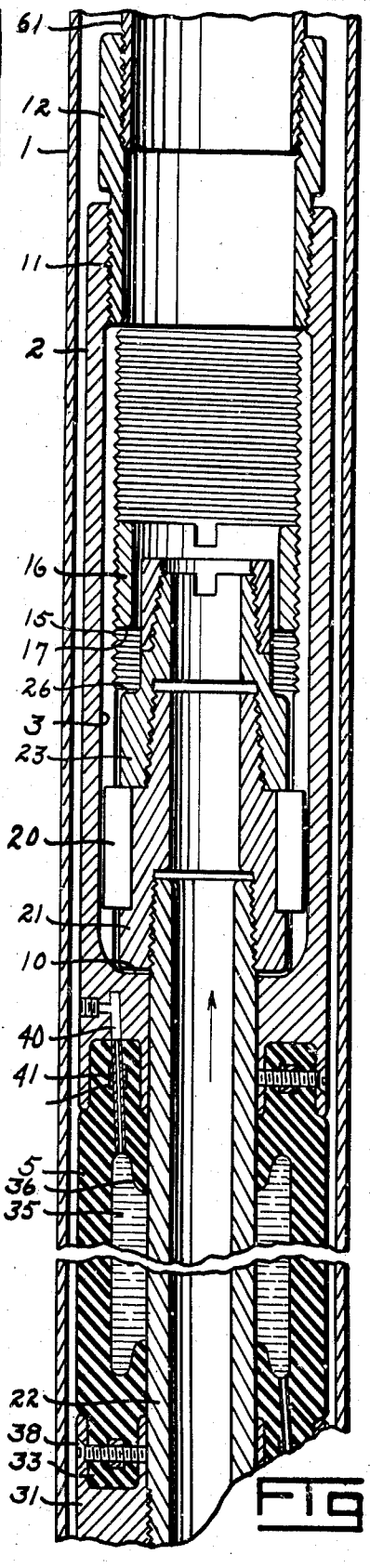


Fig. 9.

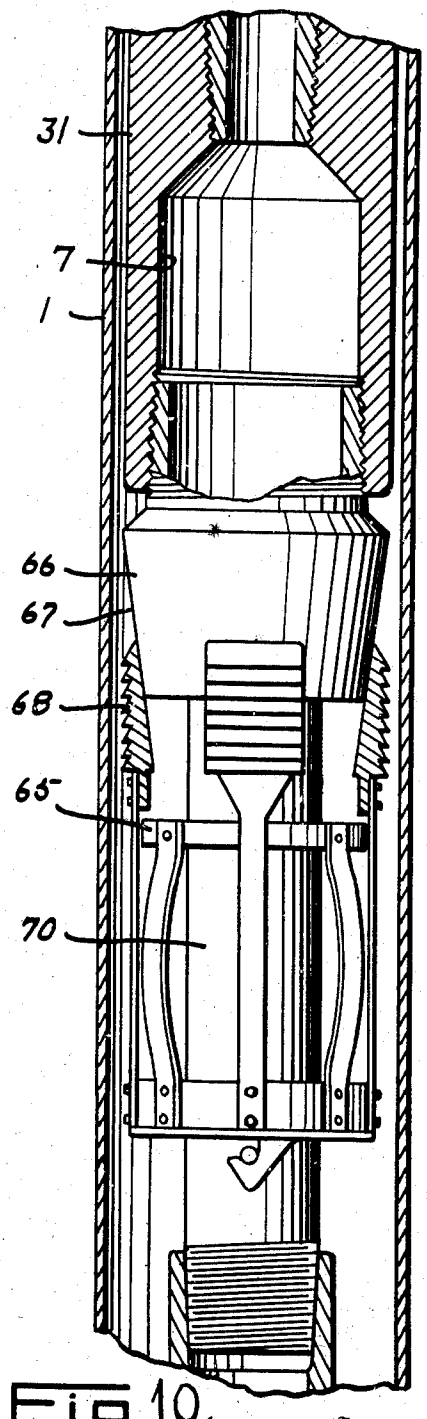


Fig. 10.

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UNITED STATES PATENT OFFICE

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COMBINATION PACKER AND SWAB

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Application January 25, 1938, Serial No. 186,787

8 Claims. (Cl. 166—12)

The invention relates to an oil well tool and more particularly to a combination swab and packer which may be used for lifting quantities of liquid from within the casing or tubing in deep wells or for sealing the annular space in such wells between a tubing therein and a surrounding tubing or the walls of the well bore.

The primary object of the invention is to provide a device of the class described which, when in contracted position, may be easily lowered into a well and expanded to provide an effective seal with the surrounding walls.

A further object is to provide a device having a packer sleeve with a liquid filled internal chamber whereby the device will more effectively seal with the walls of the casing or well bore.

Still another object is to provide a device of the class described and which includes a novel check and relief valve assembly to control the flow of liquid into and from the device.

Still another object is to provide a device of the class described and in which the check valve may be replaced by an anchor to increase the field of usefulness of such device.

The foregoing objects, together with further objects will be apparent from the following description taken in connection with the accompanying drawings, in which Fig. 1 is a sectional view in elevation of the upper portion of the device, comprising the invention.

Fig. 2 is a sectional view comprising a continuation of the view shown in Fig. 1.

Fig. 3 is an assembly view partly in section, showing the relative position of parts when the device is lowered within the well bore.

Figures 4 and 5 are sectional views similar to Figs. 1 and 2 but showing the relative position of parts when the device is operated as a swab.

Figs. 6, 7 and 8 are sectional views taken on lines 6—6, 7—7 and 8—8 in Figs. 4 and 5.

Figs. 9 and 10 are similar to Figs. 1 and 2 but illustrate a modified form of the invention and showing the relative position of parts when the device is lowered into a well.

Fig. 11 is an assembly view partly in section, showing an embodiment of Figs. 9 and 10 with the parts in their relative positions occupied when the device is set within the well.

Attention is first directed to Fig. 3 in which the device is shown within a casing 1 as comprising a body 2 having an enlarged bore 3 receiving the upper end of a mandrel 4 which extends downwardly from the body 2 and is surrounded by a packer sleeve 5.

A collar 6 is threadably secured to the lower end of the mandrel 4 and the opposite ends of the sleeve 5 are connected to the collar 6 and the body 2 respectively. The collar 6 is counterbored at 7, thus providing a chamber to receive a check and relief valve assembly 8.

As is most clearly shown in Fig. 1, a bore 3 in the body 2 is restricted at its lower end whereby a shoulder 10 is provided. The opposite end of the bore 3 is provided with threads 11 to receive a reducer coupling 12 which, when the device is used as a swab, carries a protector sub 13, the purpose of which is to protect the threads within the coupling 12. As the weight of the body 2 is an element in the operation of the device, the sub 13 may be of any desirable length to serve the dual function of protecting the threads in the coupling 12 and supplying weight to the body assembly.

Beneath the threads 11 the body 2 is provided with straight threads 15 to receive a collar 16 which may be adjustably positioned within the body and which provides a downwardly facing shoulder 17. The body 2 is also provided with a plurality of keyways 18 to slidably receive keys 20 which are fixed in the surface of a sub 21 attached to the upper end of stem 22 of the mandrel 4. The keys 20 are fixed in the sub 21 by means of a second sub 23, which is screwed down tightly against the ends of the keys. It is obvious that the construction thus far described is such as to permit the mandrel assembly 4 to move longitudinally of the body 2 but such movement is limited by engagement of shoulders 10 and 17 on the body 2 with shoulders 25 and 26 respectively on the mandrel 4.

An upward extension 27 on the mandrel 4 has a cable clamp head 28 attached thereto whereby the device may be manipulated through cable 29 which extends upwardly to the mouth of the well. The extension 27 has a central bore which terminates adjacent its upward end where radial openings 30 are provided to permit the outward passage of fluid from within the mandrel.

The mandrel 4 terminates at its lower end in a head 31 and the upper face of this head and the lower face of the body 2 are provided with annular recesses 32 to receive the ends 33 of the packer sleeve 5 which surrounds the mandrel 4. This feature of the device is of a particular construction and further attention will be directed thereto.

The packer sleeve 5 is made of a deformable and wear resistant material such as rubber, is tubular in cross section and is of such diameter

as to fit closely within the bore in which the device is to be used. This sleeve also fits in close sealing engagement with the mandrel 4 and is provided with an internal cavity intermediate its ends whereby there is provided an annular chamber 35 which is filled with liquid in a manner and for the purpose to be described.

To insure against leakage of liquid from within the chamber 35, annular flexible lips 36 are provided at the ends of the chamber and when pressure is exerted upon the liquid within the chamber these lips effectively seal against leakage of the liquid along the surface of the mandrel. The reduced end section 33 of the packer sleeve fits within the grooves 32 of the body 2 and the head 31. These reduced portions are reinforced by the provision of a metal ring 37 encased within such reduced portions and through which screws 38 pass to hold these parts in assembled relation. A passage 40 is also provided in each the body 2 and the head 31 in alignment with passage 41 in the sleeve 5. These passages are provided with closure caps 42 whereby the chamber 35 may be filled with liquid and such liquid may be permanently enclosed therein.

As above stated the head 31 is counterbored at 7 to receive the valve assembly generally designated as 8. This assembly comprises a plug 45 which is screwed into the counterbore 7 and which carries on its upper end a valve seat 46 and a valve cage 47 within which is positioned a valve member 48 adapted to seal upon the seat 46. The opening below the valve seat 46 in the plug 45 has a flat bottom from which diagonal openings 50 extend downwardly whereby fluid pressure from beneath the device will cause valve member 48 to be lifted and pass fluid upwardly through the device.

The lower end of the plug 45 has a downwardly extending hollow boss 51 to which is attached a relief valve cage 52. Adjusting plug 53 at the lower end of the valve cage engages a compression spring 54 which presses upwardly against a block 55 contoured to receive ball valve 56 which is thus pressed against valve seat 57 in the boss 51. It is believed apparent that with this construction the relief valve may be adjusted so that when a predetermined head of liquid is superposed thereon the valve will open and release the liquid creating such excess pressure.

The liquid so released flows downwardly through the mandrel and through passages 60 which extend diagonally downwardly from within the annular chamber about the valve cage 47 to the interior of the boss 51.

The operation of the device just described is as follows:

Preliminary to lowering the device into the well the chamber 35 in the packer sleeve is filled with liquid to such extent that the sleeve fits closely within the bore in which the device is to be used. The device is then lowered to the desired depth, the liquid within the well bore passing upwardly through the device during its descent. When the predetermined and desired level is reached, the device is lifted, whereupon the weight of the body 2 and the downward pressure of liquid against this body will cause telescopic movement between the body 2 and the mandrel 4, whereby the packer sleeve 5 will be expanded into intimate contact with the walls of the casing 1. Excess pressure between the sleeve 5 and the walls of the casing will be avoided by limiting the telescopic movement of these parts through contact of shoulder 26 of the mandrel with shoulder 17 in the body 2. Upward movement of the device within the casing 1 will perform the intended functions of the device and a quantity of liquid will be lifted thereby, which quantity depends upon the adjustment of the relief valve above described.

The chamber 35 within the packer sleeve 5 contains an incompressible fluid whereby any pressure exerted thereon will be distributed uniformly in all directions and hence cause such flow of the material of the sleeve 5 as to effect an intimate contact thereof with the walls of the casing 1. Furthermore, such construction prevents substantial collapsing of the packer sleeve, and the amount of fluid placed within the chamber 35 may be so regulated as to provide an accurate fit of the sleeve within the casing in which the device is to be used.

Figs. 4 and 5 are similar to Figs. 1 and 2 and identical reference characters are applied thereto. In these views, however, the respective parts of the device are shown in the positions which they assume when the device is being lifted within the casing 1.

Similar parts are also similarly identified in Figs. 9, 10 and 11, which show a modification wherein the protector sub has been removed and the device is attached to a tubing string of which the lower end is shown at 61. In this modification the check and relief valve assembly is removed, as shown in Fig. 10 and a hook wall anchor generally designated as 65 is attached to the head 31. This hook wall anchor comprises an expander 66 having a tapered surface 67 upon which the jaws 68 slide to an expanded position as shown in Fig. 11, whereby the jaws are brought into engagement with the casing 1 and the position of the device therein is fixed.

A tubular extension 70 is attached to the expander 66 and extends downwardly to form a continuation in the tubing string from the surface of the well. It is apparent that when the device is fixed in position within the well, as shown in Fig. 11, a seal is formed between the tubing string and the casing 1 and fluid is therefore restrained from passing either upwardly or downwardly between the tubing string and the casing. It is believed also apparent that the use of the device is not restricted to the provision of a seal within the casing but obviously the device may also be utilized for the purpose of sealing between the tubing string and the walls of an uncased well bore.

It is to be noted that when the device is used as shown in Figs. 9, 10 and 11, similar threads are provided at opposite ends of the device; hence, if desired, the hook wall anchor 66 may be attached at either end while the tubing string 61 is attached to the other end. The device may therefore be used either as shown in the figures or in an inverted position if desired.

It should be also noted that an important feature of the present invention is the provision of a splined connection between the body 2 and the mandrel 4. This construction permits these parts to be relatively moved longitudinally but prevents relative rotation thereof whereby the packer sleeve 5 may become twisted and ruptured, thus rendering the device inoperable and giving rise to attendant difficulties within the well bore. Likewise attention is directed to the fact that extension 27 is shown broken at 28 to

indicate that the extension may project upwardly for a predetermined distance. It is intended that this extension will provide, with the surrounding tubing and above the packer sleeves, an annular chamber within which a definite volume of oil is retained and brought to the surface. When the swab volume is so determined the relief valve 52 may be loosely adjusted and in this manner the vacuum created beneath the packer is reduced or entirely eliminated and the swab efficiency is enhanced.

While specific embodiments of the invention have been disclosed in the above description, it is to be understood that the invention is not confined to the specific embodiments but includes equivalents thereof and is limited only by the appended claims and the prior art.

What is claimed is:

1. A device of the character described including a tubular mandrel having a radial flange intermediate its ends, a packer sleeve surrounding the mandrel below said flange, and having its lower end fixed to the mandrel, a body member slidably surrounding said mandrel and attached to the upper end of the sleeve, and annular shoulders in said body above and below said flange and adapted to be engaged by said flange to limit longitudinal movement of the mandrel relative to the body.

2. A device of the character described including a tubular mandrel having a radial flange intermediate its ends, a packer sleeve surrounding the mandrel below said flange, and having its lower end fixed to the mandrel, a body member slidably surrounding said mandrel and attached to the upper end of the sleeve, a splined connection between said mandrel and body, and annular shoulders in said body above and below said flange and adapted to be engaged by the flange to limit longitudinal movement of the mandrel relative to the body, and means for anchoring the mandrel at a predetermined level within a well bore.

3. A device of the character described including a tubular mandrel, an upwardly opening check valve assembly at the lower end of the mandrel so that fluid may pass freely through the mandrel while the device is lowered into a well, an overload by-pass valve to release fluid under pressure within the mandrel, a packer sleeve on the mandrel and having its lower end attached to said assembly, and a body member slidable on the mandrel and secured to the upper end of the packer sleeve.

4. A device to be lowered into a well bore including a tubular mandrel, a packer sleeve thereon, means for fixing the lower end of the packer sleeve to the mandrel, a weighted body slidably mounted on the mandrel above the packer and means for exerting a lifting force upon the mandrel whereby the weight of the body and fluid pressure thereon compresses and expands the packer sleeve.

5. The combination of a wire line, a mandrel attached thereto, a packer sleeve of expansible material surrounding the lower end of the mandrel, and a cylindrical body slidably mounted upon the mandrel above said sleeve so that fluid pressure exerted upon the body when the wire line is drawn upwardly will relatively move the mandrel and body and expand said sleeve.

6. The combination af a wire line, a mandrel attached thereto, a packer sleeve of expansible material surrounding the lower end of the mandrel, a cylindrical body slidably mounted upon the mandrel above said sleeve so that fluid pressure exerted upon the body when the wire line is drawn upwardly will relatively move the mandrel and body and expand said sleeve, and means for limiting the movement between the body and mandrel.

7. In combination a mandrel, a packer sleeve surrounding the lower end of the mandrel and having its lower end fixed to the mandrel, said sleeve having a fluid chamber therein, and a body slidable upon said mandrel and attached to the upper end of said sleeve, there being a passage to the chamber within the sleeve whereby the chamber may be filled with liquid, means closing said passage against the ingress and egress of fluid to and from the passage, and means for relatively moving the mandrel and body to expand the packer.

8. In combination a mandrel, a packer sleeve surrounding the mandrel, said sleeve having an inner angular groove intermediate its ends to form with the mandrel an enclosed chamber, there being a passage to said chamber whereby liquid may be introduced thereto, means closing said passage against the ingress and egress of fluid to and from said passage, and means for expanding the packer sleeve.

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