July 4, 1944. R. G. TAYLOR, JR 2,352,812

SWAB CUP ASSEMBLY OR PACKING ELEMENT

Filed Jan. 27, 1940

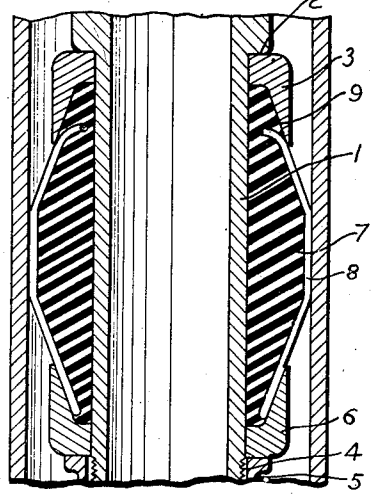


Fig. 1

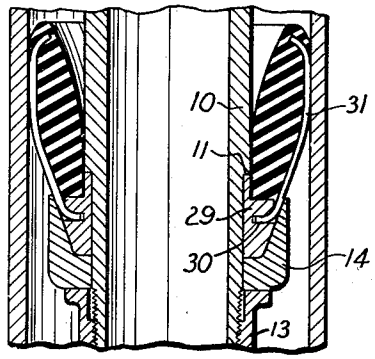


Fig. 4

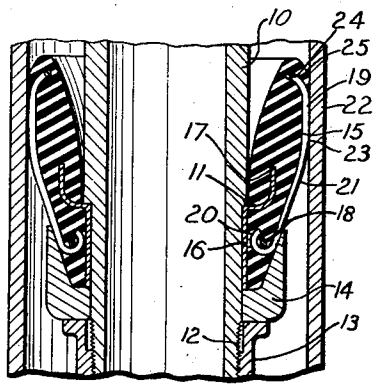


Fig. 2

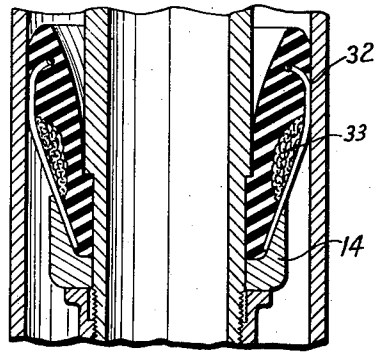


Fig. 5

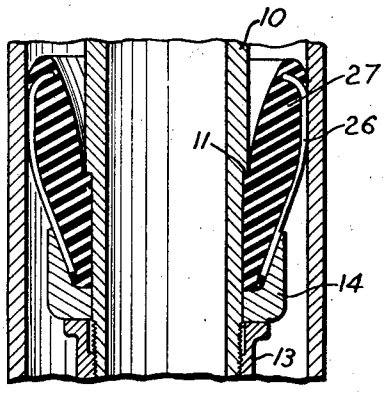


Fig. 3

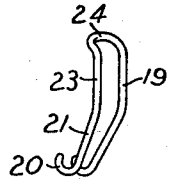


Fig. 6

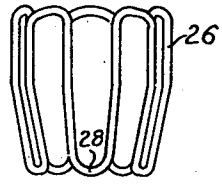


Fig. 7

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SWAB CUP ASSEMBLY OR PACKING ELEMENT

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Application January 27, 1940, Serial No. 315,929

16 Claims. (Cl. 309—33)

The object of this invention is to provide an improved type of swab cup.

As is well known in the art, swab cups are extensively employed in the oil well industry and are intended to seal the space between the mandrel when being raised and the well casing so that the well fluid above the swab cup may be raised. The swab cup is, therefore, intended to make a seal-tight engagement with the well casing. Rubber, DuPrene and other like substances which have been commonly employed in the construction of swab cups are generally employed for the reason that they will readily conform to the well casing and they are yieldable. However, as is well known, these substances will flow when under great compression and to prevent this flowing, various devices have been used. For instance, in Crickmer 1,669,812 a wire basket or cage was employed which would support the yieldable swab cup. However, experiences show that the well fluid will leak past the wires forming such a cage when subjected to heavy pressures. They are also used as a packing element and when so used one cup faces upwardly and the other downwardly with the mandrel perforated between the cups so that cement may be pumped down the tubing, through the perforations between the cups and then through perforations in the casing and back into the formation. The cups, in this case, do no swabbing but they are generally termed swab cups. On such a cement squeeze job where the pressures run up to 3,000 or 4,000 pounds per square inch it was found that cups of the type shown in the Crickmer Patent 1,669,812 will leak around the wires. It was, therefore, very difficult to maintain these high pressures. It was further found that if you omit the wires the cup will seal off perfectly without any leakage up to about 2,000 pounds per square inch but that a pressure in excess thereof would cause the cup to flow over the lower thimble and eventually rupture the cup. It is the object of this invention to provide a supporting means for a swab cup or packing element which will prevent such a flow of the material of which the swab cup is composed by effectively supporting the same between the thimble and the well contacting portion of the swab and to provide the upper portion of the same with a continuous casing engaging portion which is free of wires around which the fluid might leak. I effectively accomplish this by making the support terminate below the top of the swab and embedding the supporting member in the swab cup. In other words, the supporting wires do not run to the top of the swab but extend inwardly below the top thereof leaving an upper lip which by well pressure will be tightly sealed against the casing without any obstructing wires or other material.

Another form of the invention comprises the use of thread embedded in the swab cup and extending from the thimble portion to the well casing portion thereof. Preferably this is a tangled mass of thread embedded in the material of which the swab cup is composed and effectively prevents the flow of the material downwardly by the lower thimble. This leaves the upper portion of the swab cup in effective sealing contact with the well casing and with such a construction actual experience has shown that such a cup will withstand pressure of approximately 6,000 pounds per square inch without flowing. I found that linen thread is entirely suitable for this purpose.

Other objects and advantages of this invention will appear in the detailed specification and claims which follow.

Referring to the drawings,

Fig. 1 is a cross-sectional side elevational view of one form of the swab and its assembly,

Fig. 2 is a similar view of one form of the swab cup and its assembly,

Fig. 3 is a similar view of a structure similar to Fig. 2 but with the inner reinforcing member and the lower threaded ring omitted and with another form of reinforcing cage,

Fig. 4 is a side elevational view in cross-section of a modification of the structure shown in Fig. 3,

Fig. 5 is a side elevational view in cross-section with the swab cup provided with reinforcing threads,

Fig. 6 is a perspective view of the type of reinforcing wires used in the structure shown in Fig. 2, and

Fig. 7 is a perspective view of the type of cage serving as the reinforcing member of the structure shown in Fig. 3. Such a cage might be also used in connection with the swabs shown in Figs. 1, 2, and 4.

In Fig. 1 the mandrel 1 is provided with a shoulder 2 which receives a downwardly extending thimble 3. The mandrel is screw threaded as indicated at 4 to receive an adjustable threaded sleeve 5 on which rests an upturned thimble 6. The swab 7 is nested in the thimbles 3 and 6. A wire support or reinforcing member 8 extends from within the thimbles following the outer contour of the swab 7 and at its upper end is turned inwardly as indicated at 9 within the upper thimble 3. By screwing upwardly on the threaded sleeve 5 the distortion of the swab may be varied or adjusted.

In Fig. 2 the mandrel 10 is provided with a shoulder 11 and with screw threads 12. A retaining nut 13 is screwed on the screw threads 12 and supports a thimble 14. An open ended swab cup 15 is nested in the thimble 14. A sleeve 16 surrounds the mandrel 10 and at its upper end abuts against the shoulder 11 and at its

lower end rests on the thimble 14. It is provided with an outwardly extending apron or flange 17. The sleeve 16 and flange 17 is substantially similar to the parts 16' and 17 of the Crickmer Patent 1,735,264. Within the thimble 14 is a retaining ring 18 which, if desired, may be rigidly secured to the sleeve 16 by welding or otherwise. A reinforcing wire support 19 has at its lower end a J-shaped extension 20 adapted to engage the retaining ring 18. The wire support rests against the upper inner surface of the thimble 14 and follows the outside contour of the swab cup 15, that is, it is provided with an outwardly sloping part 21 so as to fit that part of the swab cup extending from the upper end of the thimble to the part engaging the well casing 22 and thence having a vertically extending portion 23 which engages the well casing and serves as a bearing for the swab cup so as to eliminate much of the wear which would otherwise be imposed upon the swab cup. It will be noted from an inspection of Fig. 6 that the support 19 consists of what would be in effect two wires united at the upper end by what in reality is one wire bent so as to form duplicate convolutions above described with a U-shaped part 24 at the upper end, which U-shaped part is bent inwardly and embedded within the swab cup, thereby leaving a lip 25 above and outwardly from the U-shaped part 24 so that this lip portion forms a continuous and uninterrupted seal with the well casing thereby preventing the leakage of well fluids downwardly past the wire support. It will, therefore, be noted that this type of swab cup is not only supported internally by the flange 17 but that the part 21 effectively supports the swab cup so that it cannot flow downwardly into the space between the thimble 14 and the well casing 22 while the part 23 provides a bearing to take up the wear between the swap cup and the well casing and the lip 25 effectively seals the upper portion of the swab cup so that no leakage could occur by well fluid passing downwardly by the wires. Of course, it is understood that the well fluid when the mandrel is raised is in the swab cup and above the same and that it presses with great force depending upon the weight of the fluid or the force of the cement when used as a packer on a cement squeeze job so as to expand the swab cup outwardly into contact with the well casing, but if there would otherwise be any leakage downwardly past the wire support the lip 25 being in continuous engagement with the well casing absolutely prevents such leakage. Such a swab cup has been tested up to approximately 6,000 pounds per square inch without noticeable leakage.

In Fig. 3 the mandrel 10, shoulder 11, sleeve 13 and thimble 14 are of identical construction with the construction described in Fig. 2. In this figure the sleeve 16 and flange 17 are omitted but they may be used if desired. Likewise, the sleeve 16 and flange 17 may be omitted from the structure shown in Fig. 2. The essential difference between the structure shown in Fig. 2 and that shown in Fig. 3 is that a different form of wire support is employed, the details of which are shown in Fig. 7. This wire support 26 is preferably composed of a continuous wire which may have its ends united so as to make the wire continuous or in case the ends of the wire are not united it would not be continuous but would be in one piece. Of course, if desired, it may be made in a plurality of parts according to the desire of the particular manufacturer. This is in the form of a basket as is shown in Fig. 7 which is nested within the thimble 14 and extends on the outside of the swab cup 27. A cross-sectional view of a contour of this wire support is substantially the same as that of the wire support 19 as will be noted from a comparison of Figs. 2 and 3 except that at the lower end of the wire support 26 instead of being provided with a J-shaped portion it is bent laterally to form a U-shaped portion 28 at the bottom thereof. These U-shaped portions 28 serve as the connecting means between the upwardly extending portions of the basket. It would be noted that such a basket readily adapts itself to radial expansion except that the lower portion is retained by the thimble 14 so that this basket is as readily expanded radially as would be the wire support 19 of Fig. 2.

In Fig. 4 the mandrel 10 is provided with a shoulder 11 and with the retaining nut 12 which supports the thimble 14. Resting in the thimble 14 and extending to the shoulder 11 is a retaining ring 29 which receives an inwardly bent portion 30 of a wire support 31 which wire support may be of the same construction as the wire support 19 of Fig. 2, except that instead of having the J-shaped lower portion, it is provided with the inwardly extending bent portion 30. The function of the swab cup would be the same in Figs. 2, 3, and 4.

Fig. 5 is of the same construction as shown in Fig. 3 except that instead of the basket wire support 26 I insert in the swab cup 32 a mass of thread 33 extending from the thimble 14 to the casing contacting portion of the swab cup. I have found linen thread to be particularly useful for this purpose although I do not wish to limit myself to the particular thread employed. The cup shown in Fig. 5 may also be provided with the wire supports shown in Figs. 6 and 7. These threads do not have to be laid lengthwise or crosswise or in any particular position and I found it entirely satisfactory to use simply a mass of thread extending in virtually every direction such as would be obtained in a tangled mass of thread. This thread is vulcanized into the swab cup itself and forms an integral portion thereof. It serves the important function of preventing the downward flow of the swab cup between the well casing and the thimble for it supports all that portion of the swab cup between the thimble and the casing but it leaves the upper end of the swab cup entirely free to radially expand and to make a leak-tight engagement with the well casing. Such a type of swab cup has been tested up to 6,000 pounds per square inch without leakage which could be noticed.

It will, therefore, be noted that in Figs. 2, 3, 4, and 5 the swab cup is readily radially expansible in its upper portion and makes a continuous and leak-tight engagement with the well casing while the swab cup is adequately and effectively supported so as to prevent any downward flow of the swab cup between the thimble and the well casing. In using the word casing I, of course, do not wish to limit myself to well casing but I mean this term to be as broad as the word pipe, for obviously, swab cups of this type could be used to swab or pack off in any type of pipe regardless of whether it is well casing or not. It is also obvious that the sleeve 16 and the supporting flange 17 may be used in connection with the structure shown in Figs. 3, 4, and 5 just as well as it could be used in connection with that shown in Fig. 2. Likewise the wire basket shown in Fig. 7 could be used in connection with Figs. 2, 3,

and 4 and, if desired, could be used to supplement the structure shown in Fig. 5. Likewise, the wire support shown in Fig. 6 is not limited to Fig. 2 for it could be used in connection with the structure shown in Figs. 3, 4, and 5.

I realize that many changes may be made in the specific form of the invention shown by way of illustration herein and I therefore desire to claim the same broadly except as I may limit myself in the appended claims.

Having now described my invention I claim:

1. A cup assembly adapted to engage a well pipe including a cup, a reinforcement for the cup embedded in the cup and supporting the lower portion of the cup on the outside thereof up to a point beyond the point of contact of the cup with the pipe, the upper portion of the cup above the reinforcement being in direct and unbroken engagement with the pipe.

2. A cup assembly adapted to engage a well pipe including a cup, reinforcing wires embedded in the cup and extending from the lower portion thereof and on the outside of said cup to the point above where the cup would contact the pipe, the upper portion of the cup being in direct and unbroken engagement with the pipe.

3. A cup assembly adapted to engage a well pipe including a cup, a reinforcement for the cup extending along the outer, lower and intermediate part of the cup and being bent inwardly at its upper end and embedded in the cup.

4. A cup assembly adapted to engage a well pipe including a cup, a thimble in which the cup is nested, a reinforcement for the cup extending along the outer, lower and intermediate part of the cup and being bent inwardly at its upper end and embedded in the cup, the lower end of said reinforcement being within said thimble.

5. A cup assembly adapted to engage a well pipe including a thimble, a cup supported by the thimble, a wire reinforcement for the cup and supporting the outer, lower and intermediate portion of the cup and forming a bearing between the cup and the pipe, said reinforcement being bent inwardly a distance below the top of the cup and the inwardly bent portion being embedded in the cup.

6. A cup assembly adapted to engage a well pipe including a thimble, a cup nested in the thimble, a wire reinforcement for the cup and supporting the outer, lower and intermediate portion of the cup and forming a bearing between the cup and the pipe, said reinforcement being bent inwardly a distance below the top of the cup, the inwardly bent portion being embedded within the cup and the lower portion of said wire reinforcement extending downwardly within the thimble.

7. A cup assembly adapted to engage a well pipe including a thimble, a cup supported by the thimble, a radially expansible wire cage supporting the outer, lower and intermediate portion of the cup and forming a bearing between the cup and the pipe, said reinforcement being bent inwardly a distance below the top of the cup and embedded within the upper part of the cup.

8. A cup assembly adapted to engage a well pipe including a cup, a retaining ring in the cup, a plurality of substantially U-shaped wires having their lower ends bent so as to be held by the retaining ring and extending along the outer lower portion of said cup and having their upper ends bent inwardly so as to be embedded in the cup.

9. A cup assembly including a thimble, a cup supported by the thimble, a retaining ring in the cup, a plurality of substantially U-shaped wires having their lower ends bent so as to be held by the retaining ring and extending along the outer lower portion of said cup and having their upper ends bent inwardly so as to be embedded in the cup.

10. A cup assembly adapted to engage a well pipe including a cup, a continuous wire cage supporting said cup on the outer lower surface thereof and having the upper portion of said cage bent inwardly so as to be embedded in the cup.

11. A cup assembly adapted to engage a well pipe including a cup, a radially expansible wire cage supporting said cup on the outer lower portion of said cup and having the upper portion of said cage bent inwardly so as to be embedded in the cup.

12. A cup assembly including a thimble, a cup nested in the thimble, a radially expansible wire cage supporting said cup on the outer lower surface thereof and having the upper portion of said cage bent inwardly so as to be embedded in the cup and a fibrous material embedded in the cup within the cage.

13. A cup assembly adapted to engage a well pipe including a thimble, a cup mounted within the thimble and a fibrous material embedded in the swab cup and extending from a point within the thimble to the part of the cup which would contact the well pipe and a wire cage supporting said cup and fibrous material on the outer lower portion of the cup and having the upper portion of said cage bent inwardly and embedded in the cup.

14. A cup assembly including a thimble, a cup nested in the thimble, and a fibrous material embedded in the cup and extending from a point within the thimble to an intermediate portion of the cup and a wire cage supporting said cup and fibrous material on the outer lower portion of the cup and having the upper portion of said cage bent inwardly and embedded in the cup.

15. A cup assembly adapted to engage a well pipe, including a supporting element, an upwardly opening thimble on said supporting element, a cup having its lower end nested within the thimble and its upper portion being adapted to engage the well pipe, a flexible reinforcement extending from the part nested in the thimble to the pipe contacting part of the cup, and an expansible wire cage supporting said cup and reinforcement on the outer lower surface of the cup and having the upper portion of said cage bent inwardly so as to be embedded in the cup.

16. A cup assembly adapted to engage a well pipe, including a supporting element, an upwardly opening thimble on said supporting element, a cup having its lower end nested within the thimble and its upper portion being adapted to engage the well pipe and a reinforcement extending from the part of the cup nested in the thimble to the pipe contacting part of the cup, said reinforcement consisting of a fibrous material and a radially expansible wire cage supporting said cup and fibrous material on the outer lower surface of the cup and having the upper portion of said cage projecting inwardly so as to be embedded in the cup a substantial distance below the upper extremity of the cup so that the cup is provided with a flexible lip above the cage.

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