Dec. 2, 1958 H. E. BOWERMAN 2,862,776

WELL SWAB CUPS

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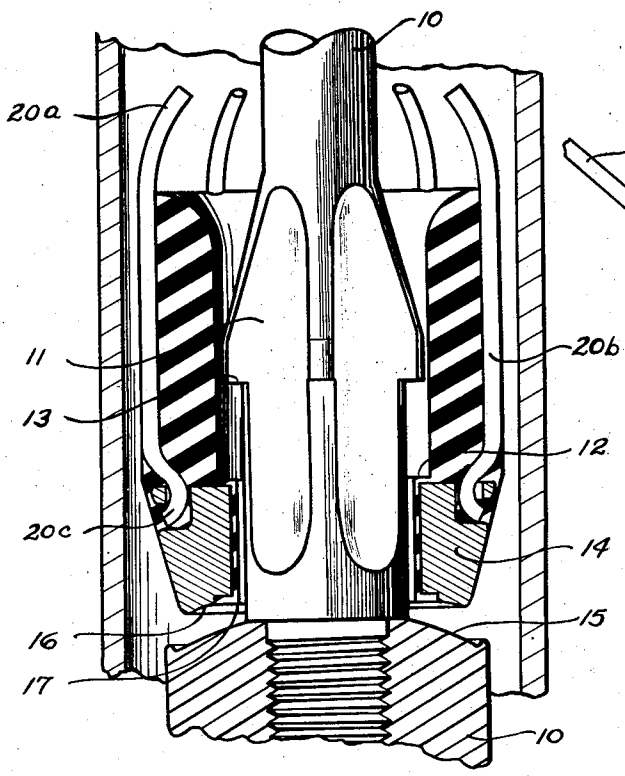


FIG. I

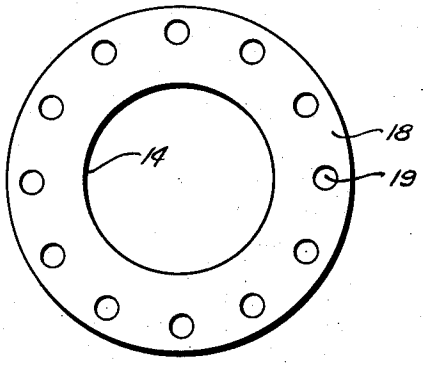


FIG. II

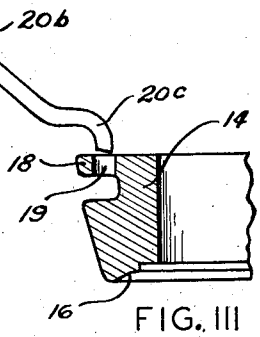


FIG. III

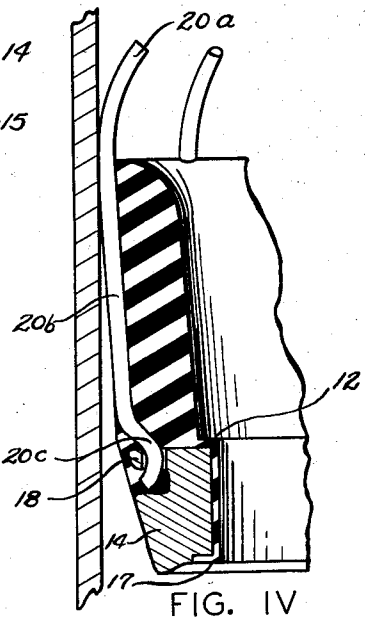


FIG. IV

INVENTOR.
HULIE E. BOWERMAN
BY Dewaldorf
ATTY.

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WELL SWAB CUPS

Hulie E. Bowerman, Arlington, Tex.

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10 Claims. (Cl. 309—33)

This invention relates to well swabs, and particularly to the type of swab employing reinforcement of the swab cup by wires, or similar semi-rigid members.

An object of the invention is to provide a reinforced swab cup which will function properly under a wider range of fluid loading conditions than has previously been possible with conventional cups.

Another object is to construct a reinforced swab cup in which the reinforcing elements are so designed and attached to the assembly at their lower ends as to be prevented from dislodgment, but are allowed radial movement at their upper ends to cause the function of the swab cup to be improved as shall be later revealed herein.

My invention will be readily understood by those skilled in the art from the following description together with the accompanying drawings in which:

Figure I is a half sectioned elevation of a preferred form of swab cup, associated with its cooperating assembly, and shown in a half sectioned representation of well tubing.

Figure II is a plan view of a swab cup base.

Figure III is a quarter sectioned elevation of a swab cup base and lower portion of a reinforcing wire being brought into assembly relationship one to the other.

Figure IV is illustrative of the relationship of the various parts of the swab cup to the well tubing under operative loading.

Proceeding with a detailed description, in which like references indicate similar parts, the swab cup subject in this invention is to be used in cooperation with a mandrel **10**, similar to that as set forth in my issued Patent 2,518,275, and having fluid passageway flutes **11**. During downward passage of the assembly through the well fluid the swab cup assembly moves upward along the mandrel until shoulder **12** of the swab cup contacts shoulder **13** of mandrel **10**. This positioning allows well fluids to pass through flutes **11** and affords a faster rate of fall than that offered by conventional ball-and-seat valve type swab mandrels. After such depth of penetration into the well fluids as places the swab at the desired depth the ascent is begun. The mandrel will move upward through the cup until seating face **16** of base **14** comes into contact with seating face **15** of mandrel **10**. As this is accomplished the load of fluid above the swab assembly causes the upper portion of the swab cup to distend radially outward to contact with the inner diameter of the well pipe, as illustrated in Figure IV. The well fluid, thus contained, continues upwardly as the swab assembly is manipulated upwardly by the operator. The swab assembly is lowered and raised by conventional hoists used for the purpose and operatively connected with the swab by the usual wire rope.

Fluid tight seal between base **14** and mandrel **10** is accomplished by the mating arcuate seating faces **15** and **16** of mandrel **10** and base **14** respectively, together with projection **17** of the resilient material of the swab cup, said projection **17**, at the time of seal, being distorted and partially compressed between said mating surfaces.

In detail base **14**, provided with seating face **16**, is annular in form, and has at its upper end an outwardly extending annular flange **18**. Flange **18** is provided with openings **19** for receiving individual reinforcing wires **20**, location and spacing of openings **19** being determined by anticipated conditions of operation the swab cup is designed to withstand. Reinforcing wires **20** are (1) curved radially inwardly, with respect to the longitudinal axis of the swab cup, at their upper ends **20***a*, (2) relatively straight in their middle portions **20***b*, and (3) provided with a hook portion **20***c* adjacent their lower termini which, continuing downward from middle portion **20***b*, curves radially inward, downward, and thence radially outward to its terminus, creating a convex hook with respect to the diameter of the swab cup, the plane formed by the loci of the center line of said hook passing substantially through the longitudinal axis of said swab cup when assembly is accomplished.

As illustrated in Figure III, this configuration dictates that each reinforcing wire **20** be entered into assembly with opening **19** at approximately the angle shown. As hook portion **20***c* is progressed into opening **19**, portion **20***b* of wire **20** asumes a vertical position, as shown in Figure I. Resilient material, comprising the remainder of the cup assembly, is then molded and bonded by conventional techniques to form the swab cup as illustrated best in Figure I.

Conventional swab cups embody wire stiffening or retaining means, either in the form of a rigid binding ring at the upper ends of their reinforcing wires, or in the form of rigid mountings of the wires at their lower ends, both structures serving the purpose of limiting cup expansion to that distortion of the wires that the fluid load can accomplish acting through the resilient member of the cup.

In such conventional structures bending or flexure of the wire must take place in order that the cup can expand to seal against the tubing and lift its fluid load. In practice of well swabbing the operator at times desires to lift very heavy fluid loads, and, at other times, very light fluid loads. In order to provide an efficient swab cup for all types of service the manufacturer of the conventional types of swab cups must provide a structure for swabbing light loads with few wires of small enough diameter to be properly distorted under the lighter loads, a cup of a large number of relatively large wires for carrying heavy loads, and whatever cups between these two as his peculiar design may demand to properly function under intermediate load conditions.

In my swab rings binding the upper ends of the wires are not used, nor is rigid mounting of the reinforcing wires in the base. When assembly is accomplished as described, and upper ends **20***a* of wires **20** bent inwardly to act as "ski-runners" along the inside of the tubing, each wire acts independently of the others, free to move outwardly at the top to contact the well tubing without distortion of the wire being required, such outward movement being restrained only by the resilient material lying between and bonded to the wires **20**. Thus a single swab cup design can be provided with sufficient reinforcing to withstand the heaviest of swabbing loads and at the same time be capable of operable distortion under the lightest of swabbing loads.

Pivotal freedom of the lower end of wire **20** to effect this aforesaid distortion without bending or flexure of the wires is possible with my design as shown, but yet a positive retention of the wire in the base is accomplished since, in all attitudes of operative positioning of wire **20**, it cannot move outward sufficiently far while encased in the tubing to be released from opening **19**.

What I claim is:

1. A single-ended swab cup symmetrical with respect to a longitudinal axis comprising a flexible cup body, a base below said body and bonded thereto and including an outwardly extending flange having an annular series of openings therethrough, and reinforcing members for the body extending loosely through the openings from above the flange and each terminating within the axial limits of the base and offset below said flange to prevent withdrawal of the member from the opening by forces acting axially of the swab cup.

2. A single-ended swab cup symmetrical with respect to a longitudinal axis comprising a flexible cup body, a base below said body and bonded thereto and including an outwardly extending flange having an annular series of openings therethrough, and reinforcing members for the body terminating within the axial limits of the base in hooked lower ends extending downwardly through the openings, the members being smaller in cross-section than the openings and said reinforcing members being free to pivot about their engagements with the flange to the extent permitted by the degree of flexibility of said cup body.

3. In a swab cup as set forth in claim 2, said members being offset above and below said flange to captivate the members in said openings and prevent substantial endwise motion thereof with respect to said flange.

4. In a swab cup as set forth in claim 3, said members comprising wires, and the lower end of each wire having an arcuate offset occupying a plane including the axis of the swab cup.

5. In a swab cup as set forth in claim 4, said offset extending inwardly toward the center of the cup.

6. A single-ended swab cup symmetrical with respect to a longitudinal axis comprising a flexible cup body having an upper annular sealing portion, a base below said body and bonded thereto and including an outwardly extending flange having an annular series of openings therethrough, and reinforcing members for the body extending loosely through the openings from above the flange and each terminating therebelow within the axial limits of the base and offset below said flange to prevent withdrawal of the member from the opening by forces acting axially of the swab cup, and each reinforcing member turning inwardly toward said axis near its upper end and extending upwardly above said sealing portion.

7. A single-ended swab cup symmetrical with respect to a longitudinal axis comprising a flexible cup body having an upper annular sealing portion, a base below said body and bonded thereto and including an outwardly extending flange having an annular series of openings therethrough, and reinforcing members for the body terminating within the axial limits of the base in hooked lower ends extending downwardly through the openings, the members being smaller in cross-section than the openings and said reinforcing members being free to pivot about their engagements with the flange to the extent permitted by the degree of flexibility of said cup body and each reinforcing member turning inwardly toward said axis near its upper end and extending upwardly above said sealing portion.

8. In a swab cup as set forth in claim 7, said members being offset above and below said flange to captivate the members in said openings and prevent substantial endwise motion thereof with respect to said flange.

9. In a swab cup as set forth in claim 8, said members comprising wires, and the lower end of each wire having an arcuate offset occupying a plane including the axis of the swab cup.

10. In a swab cup as set forth in claim 9, said offset extending inwardly toward the center of the cup, and the wires above the offset within the axial length of the cup being embedded therein and tangent with the outer periphery thereof.

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