June 17, 1969 C. H. COLLETT 3,450,412

WELL SWAB CUP

Filed March 20, 1967

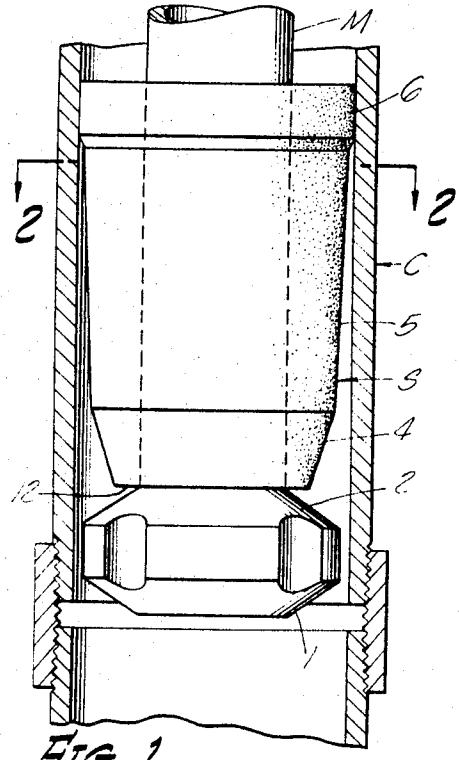


FIG. 1.

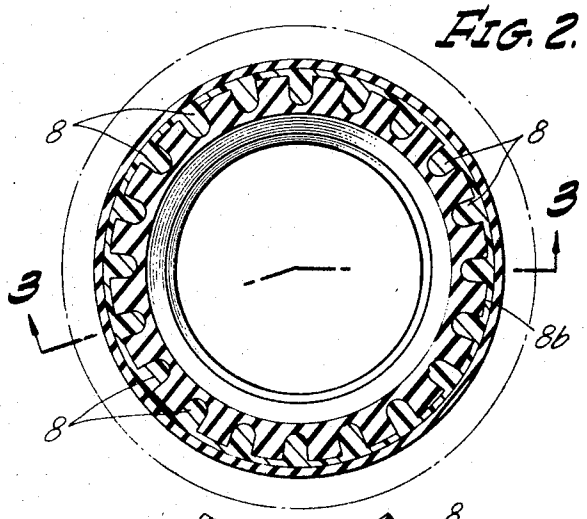


FIG. 2.

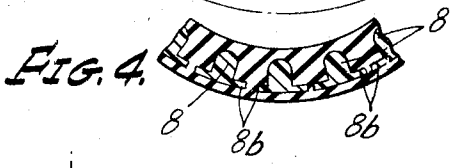


FIG. 4.

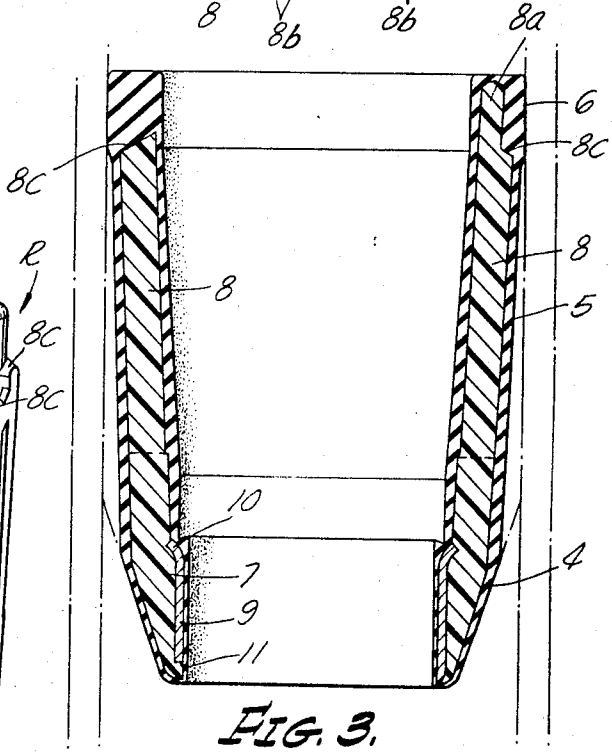


FIG. 3.

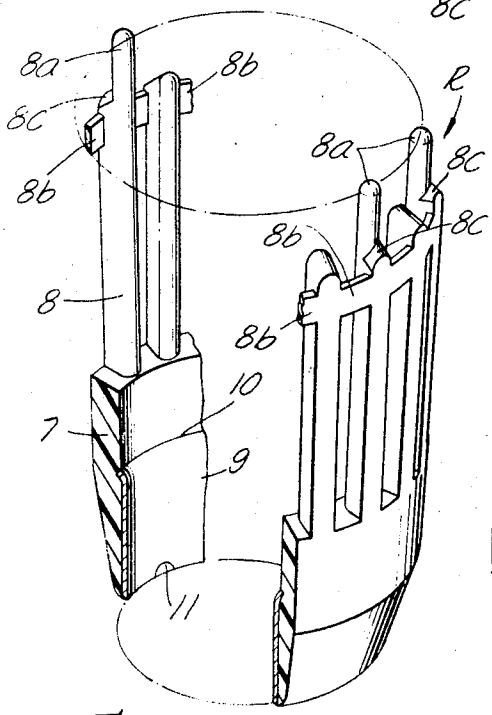


FIG. 5.

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WELL SWAB CUP

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ABSTRACT OF THE DISCLOSURE

A well swab cup with a molded nylon cage having cup-reinforcing fingers.

The present invention relates to well swabs and more particularly to a swab cup of novel construction composed of a molded nylon cage or inner reinforcement on which is molded a cup-like body of rubber.

In the construction of well swab cups it is common practice to mold a rubber cup-like body with an internal reinforcing cage typically having a metallic ring or base thimble which supports a plurality of circumferentially spaced spring wire fingers. In use, one or more of such cups are disposed upon a swab body or mandrel which is adapted to be connected to a swab line to be run into a well. Fluid in the well, herein generally referred to as well fluid, including oil, water, mud or a combination of such fluids, will bypass the cup or cups as they move downwardly in the well, through the cups and around the cups, as well as through the supporting mandrel in the case of a valved mandrel. However, when the swab assembly is retrieved from the well, the bypass of well fluids is stopped and the cup is caused by hydrostatic pressure acting thereon to expand into tight sealing and sliding engagement with the well pipe being swabbed.

Of course, in deep wells especially, the cup is subjected to severe wear conditions, depending upon the weight of the column of fluid being lifted by the swab, as the cup slides within the well pipe, and the reinforcement in the cup is adapted to protect the cup against wear as well as against being turned inside out or torn off of the mandrel.

While wire reinforcement fingers have been in long use they have not been altogether satisfactory due to the tendency of the rubber cups to tear from the wire fingers when the cup is heavily loaded and due to the tendency of the wire fingers to more or less locally flex into sliding contact with the well pipe, thereby causing undue local wear and ultimate failure.

The present invention, therefore, has an object the provision of a novel swab cup construction which includes a molded resilient plastic reinforcing cage which includes fingers spaced circumferentially about the cup and deformable with the cup so as to engage the well pipe and reinforce the cup, the fingers having flexing characteristics compatible with the rubber cup and being wear resistant when in sliding engagement with the pipe.

Another object is to provide a well swab cup reinforcing cage having unitized base and finger sections adapted to have a rubber body molded thereon, and the finger section having integral elements which serve to maintain the relative spacing of the fingers during the molding operation.

Still another object is to provide a well swab cup having a molded plasitc reinforcing cage including circumferentially spaced fingers which adjacent their free ends are united by frangible elements, whereby to enable outward flexure of the upper margin or sealing lip portion of the cup when the swab assembly of which the cup forms a part is moved upwardly in the well pipe to be swabbed.

Other objects and advantages of the invention will be hereinafter described or will become apparent to those

skilled in the art, and the novel features of the invention will be defined in the appended claims.

In the accompanying drawing:

FIG. 1 is a view showing in side elevation a swab cup made in accordance with the invention and mounted upon a swab mandrel so as to be run into a well pipe shown in vertical section;

FIG. 2 is a view in trainsverse section through the swab cup of FIG. 1, on the line 2—2;

FIG. 3 is a view in longitudinal section as taken on the line 3—3 of FIG. 2, and showing in broken lines the loaded condition of the cup in the well pipe;

FIG. 4 is a fragmentary view in section, as taken on the plane of FIG. 2, but showing the finger connecting elements broken following initial loading of the cup; and

FIG. 5 is a view in perspective showing the molded plastic care construction, with certain of the repetitive elements broken away.

Like reference characters in the several views of the drawing and in the following description designate corresponding parts.

Referring first to FIG. 1, there is shown a swab cup S disposed on a mandrel M including a bottom guide 1 of any suitable construction and having an upper seating surface 2 engageable by the swab cup S when well fluid is being lifted from the well pipe, such as tubing or casing designated C. Customarily, the swab cup S is free to move on mandrel M so that as the assembly is being lowered in the pipe C, the cup S will be off of the seat 2, thereby allowing fluid to pass between the cup and the mandrel. In addition, the mandrel may have a passage therethrough having a check valve to allow the passage of well fluid therethrough during downward movement of the swab assembly while closing the passage as the swab assembly is being retrieved from the well to lift a column of fluid from the pipe C.

Typically, swab cups of the type here involved comprise a body of elastomeric material, generically referred to as rubber, reinforced with a cage of wire springs or the like to prevent the rubber body from rapidly wearing and being destroyed by the heavy pressure applied thereto by the column of fluid being lifted from the well pipe.

Accordingly, the present swab cup S comprises a rubber body having a lower rigid seating section 4, an intermediate main section 5 and an upper relatively resilient sealing lip section 6. Within the cup body is a reinforcing cage R, which, in accordance with the invention, is of unitary molded plastic construction. Preferably, the plastic cage is composed of nylon or other durable and wear resistant moldable plastic.

The reinforcing cage R includes an annular base section 7 within the lower cup section 4, a plurality of circumferentially spaced elongate fingers 8 disposed in the intermediate cup section 5, and on alternate fingers reduced section finger tips 8*a* which extend upwardly into the sealing lip section 6 of the cup body.

The base section 7 of the cake is downwardly tapered on its outer face, and on its inner annular face is provided with a rigid metal thimble 9 turned outwardly at 10 at its upper end to provide a flange and notched at 11 to interlock the thimble with the plastic cage during molding of the cage. The thimble 9 is adapted to prevent substantial outward deformation of the cup section 4, and if desired the outer portion of the cup base may be further supported by an outer metal thimble in a customary manner. The rubber material at the base section 4 of the cup covers the cage base 7 inside and outside and provides a seal portion 12 sealingly engageable with the seating surface 2 of the guide nut 1 on the mandrel M. The fingers 8 extend upwardly and slightly divergently from the base 7 of the cage R substantially to the lip

section 6 of the cup body, and the rubber material fills the spaces between the fingers and covers both the inner and outer surfaces of the fingers.

At the sealing lip portion of the cup the finger tips 8*a* on alternate fingers 8, in the illustrative embodiment, form extensions of the inner surfaces of their respective fingers, but have a thickness or cross section less than the fingers. The finger tips 8*a* terminate within the sealing section 6, which provides a substantial annular rubber section adapted to establish initial sealing contact with the well pipe. Since the finger tips 8*a* are comparatively small in cross section, the sealing lip portion 6 of the cup may readily expand or flex outwardly under pressure to effect such initial sealing engagement. Moreover, such resilient flexing is enhanced by the fact that the finger tips 8*a* are on only certain of the fingers 8, in the illustrative cage R on alternate fingers.

As best seen in FIGS. 3 and 5, the cage fingers 8 adjacent their upper ends are provided with means normally holding them in predetermined spaced relation. This means comprises frangible webs 8*b* molded between the fingers during molding of the cage. Preferably, the webs 8*b* bridge the outer peripheries of the fingers. Such webs serve to not only fix the spacing of the fingers during molding of the rubber body on the cake, but also to establish the diameter about the fingers, thereby facilitating manufacture.

When the swab cup is in use, it will understood that the pressure acting inside the cup cavity will force the sealing lip 6 into light sealing engagement with the pipe as the swab is being retrieved. In addition, the intermediate section of the cup will be deformed, approximately as shown in broken lines in FIG. 3, so that the frangible webs will be broken to allow outward flexure of the reinforcing fingers in the cup. At their upper ends, the fingers 8 are bevelled at 8*c* at such an angle as to assist in causing the cup to flex inward when passing the downwardly facing pipe shoulder in the usual casing joints, as shown in FIG. 1.

Under heavy fluid loads, the fingers 8 will bend substantially in the rubber body so as to move outwardly toward the pipe wall. However, nylon for example has a good recovery rate and the cup will return to its original form after use to enable reuse through a substantial number of runs under ordinary well pipe and other environmental conditions.

After a certain amount of use, the rubber covering the fingers 8 will be worn away, exposing the outer faces of the fingers. Another advantage of nylon or the like fingers is that they will be wear resistant and relatively friction free, thereby enhancing the life and utility of the cup.

Moreover, when the fingers 8 are exposed following wear of the outer layer of rubber, the plastic material will not under any circumstances cause sparking when engaged with dry pipe adjacent the top of the well, where oxygen may be present to support combustion of gases in the pipe.

I claim:

1. A well swab cup comprising: a cup-like body of elastomeric material, a reinforcing cage molded in said body, said cage being composed of resilient plastic material and having a unitized annular base with a plurality of circumferentially spaced fingers extending upwardly from said base.

2. A well swab cup as defined in claim 1, wherein said body has a sealing lip portion projecting beyond the ends of said fingers and certain of said fingers have finger tips extending into said lip portion.

3. A well swab cup as defined in claim 2, wherein said finger tips are of reduced section relative to said fingers.

4. A well swab cup as defined in claim 2, wherein alternate fingers have said finger tips.

5. A well swab cup as defined in claim 1, wherein said cage is composed of nylon.

6. A well swab cup as defined in claim 1, wherein said reinforcing cage includes a rigid metallic thimble disposed within said base.

7. A well swab cup as defined in claim 1, wherein said fingers are provided with means bridging said fingers and holding the same in predetermined spaced relation.

8. A well swab sup as defined in claim 7, wherein said means bridging said fingers comprises integral webs on said fingers.

9. A well swab cup as defined in claim 7, wherein said means bridging said fingers comprises integral webs on and bridging the outsides of said fingers.

10. A well swab as defined in claim 7, wherein said means bridging said fingers comprises frangible webs integral with said fingers adjacent their outer ends, and certain of said fingers having finger tips projecting beyond the other fingers.

11. A well swab cup as defined in claim 1, wherein said fingers at their upper ends are provided with a bevelled surface extending inwardly and upwardly.

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