

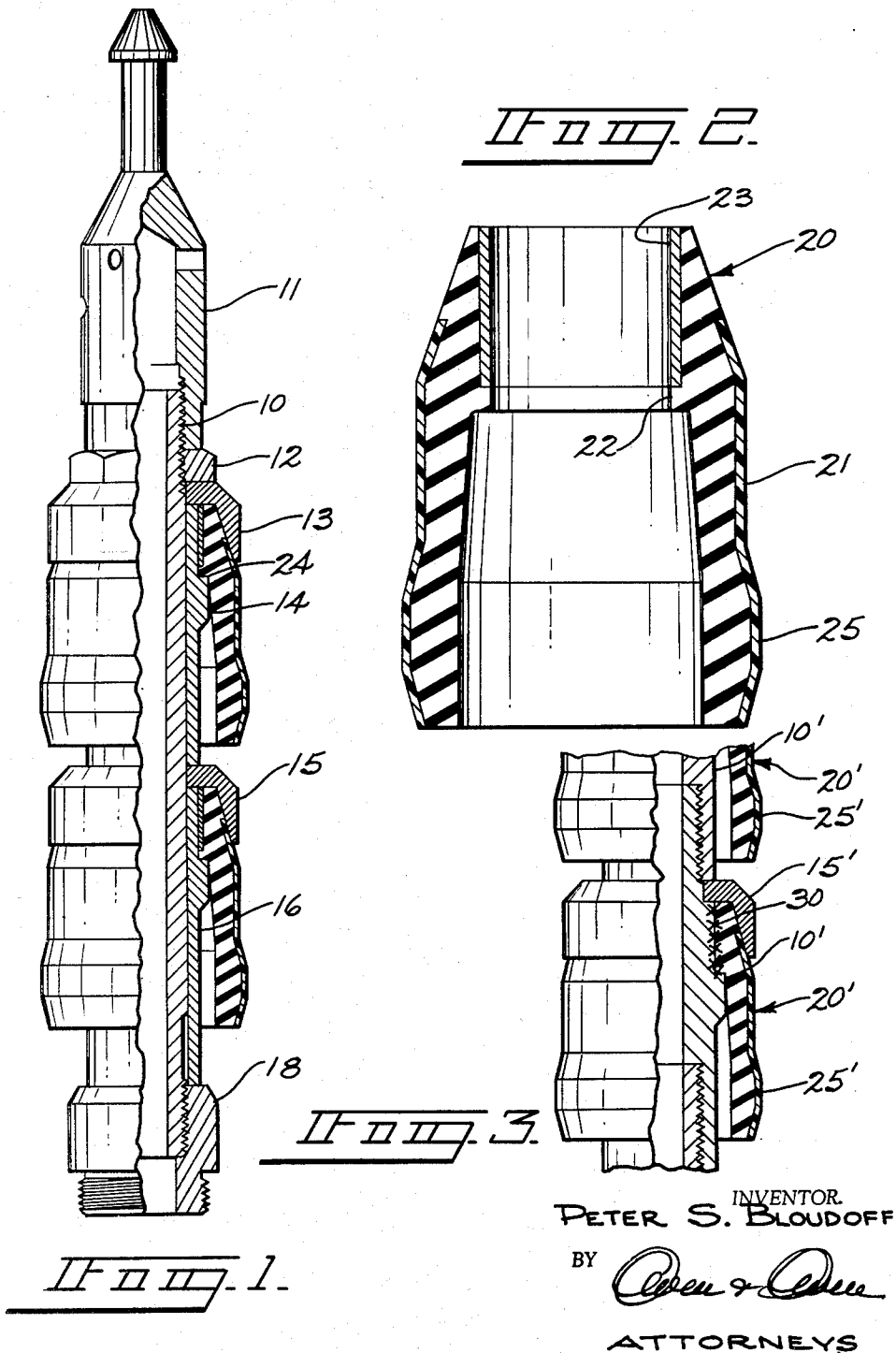
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P. S. BLODOFF

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SWAB CUP FOR OIL WELL PUMP ASSEMBLIES

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SWAB CUP FOR OIL WELL PUMP ASSEMBLIES
Peter S. Bloudoff, Whittier, Calif., assignor to Armco
Steel Corporation, Middletown, Ohio, a corporation of
Ohio

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This invention relates to swab cups for oil well pump assemblies, and is particularly directed to cups that are usable with free pump assemblies that are pumped into and out of an oil well tubing over substantial distances and therefore require long functional lives.

It has heretofore been proposed to utilize reinforced rubber swab cups in oil wells, and the normal assembly comprises two spaced cups in order that pumping pressure may be maintained during passage of the assembly over a tubing joint. The two spaced cups also assist in maintaining pressure if the tubing is scored or corroded. The pressure maintaining swab cups form part of an assembly that is seated at the bottom of an oil well for an extended period of time and must, therefore, resist relatively high temperatures and pressures. In a normal well it is frequently found that after a rubber cup has been in place for a long period of time the rubber will sometimes grow in dimensions because of the temperature and pressure and will even change its characteristics to the extent that a semibond is formed between the rubber and the adjacent metal of the tubing. Then when it is desired to remove the assembly from the well a very high release pressure is required and the rubber may be destroyed and the cup so weakened that it is incapable of holding the pressure required to pump the pump out of the well. When a cup is destroyed by the excessive release pressure small pieces may come loose and cause a malfunction of the standing valve and of the remaining parts that are left in the well when the pump is removed.

In general it has been the practice to replace the swab cups on the assembly each time the pump is removed from the well. By utilizing the present invention it has been found possible to make as many as four round trips in and out of the well without replacing the cups. Since the travel distance is often in excess of 10,000 feet from the surface to the bottom of the well this requires that the cups exhibit physical properties that are vastly superior to the rubber cups now in use.

The present invention is based on the discovery that if a rubber or similar elastomeric cup is sheathed with a relatively substantial body of polytetrafluoroethylene several very advantageous properties are imparted to the swab cup. First, the low coefficient of friction of the polytetrafluoroethylene material facilitates entry into and removal of the assembly from a well. Secondly, the polytetrafluoroethylene material appears to have the property of picking up small burrs and metal particles in the tubing without in any way damaging the cups. Thirdly, with the polytetrafluoroethylene sheath adhered firmly to the rubber the cups can be molded to precise dimensions which are maintained in use and do not require any other physical reinforcement such as molded-in wires or the like such as are frequently used. In practice, the molding is made slightly oversize so that in use the compressive forces are maintained in the polytetrafluoroethylene coating. The rubber-like material of which the body of the cups is made will vary with the size of the cups, and I have found it advantageous to use a softer rubber for smaller cups and a harder rubber for larger cups. The particular polytetrafluoroethylene material that I have found to be advantageous is commercially known as "Teflon."

I have found that the sheath of "Teflon" material on

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the rubber-like body must extend under the thimble by which the cup is held in place on the mandrel forming the core of the swab nose assembly. In this manner the physical reinforcement afforded by the sheath material is maintained at the point of extreme flexure of the rubber body, and the degradable rubber-like material is protected against the distorting effects of oil pressure at this area.

While the primary object of the invention is the improvement of swab cups for oil well pump assemblies, other objects and advantages of the invention will become apparent from the following description of a preferred embodiment thereof, reference being had to the accompanying drawings, in which:

FIGURE 1 is a central elevational view with parts in section showing a swab nose assembly incorporating the swab cups of the present invention;

FIG. 2 is a central vertical sectional view of the improved cup itself; and

FIG. 3 is a fragmentary view, with parts in section, showing a modified form of the invention.

In the drawings the swab cup of the present invention is shown in FIG. 1 as applied to an assembly comprising a central tubular mandrel 10, threaded at its upper and lower ends. At the upper end of the mandrel, a catcher nose 11 is threaded down against a nut 12 which in turn abuts an upper cup retainer 13. The axial location of the upper cup retainer is established by the axial dimension of an upper spacer sleeve 14, a lower cup retainer 15 and a lower spacer sleeve 16, all of which are held on the mandrel by a lower threaded bushing 18 which engages other of the parts of a conventional pump assembly.

As best shown in FIG. 2, the swab cup of the present invention comprises a tubular body 20 formed by molding an elastomeric material inside a previously molded outer body or sheath 21, as hereinafter described. The hardness of the elastomeric material and its composition may vary over a wide range and its selection is within the skill of the art. At its upper end the cup is provided with a diametrically restricted base portion 22 and in this area the cup is preferably molded around a reinforcing sleeve 23 shaped to have an easy sliding fit over the upper end of a spacer sleeve 14, 16. The reinforcing sleeve 23 stops short of the bottom of the base portion 22 of the cup, however, to leave a predetermined axial portion of the elastomeric material exposed so that a compressive force on the top of the cup will squeeze this exposed material into tight engagement with the retainer sleeve which has a shoulder 24 against which the cup is seated when assembled.

The lower, exposed skirt portion of the cup below the seating shoulder 24 is, of course, adapted to retain a sealing engagement with the interior wall of an adjacent tubing. The cup is bulged slightly as indicated by the reference numeral 25, and the bulged portion is substantially cylindrical and parallel with the axis of the mandrel 10. The extent of the cylindrical portion can be varied at the selection of the designer.

At its upper or fixed end the cup is tapered inwardly to match a similar taper on the interior wall of the retaining thimble 13 and in practice the molding is made slightly larger than the interior of the thimble so that the elastomeric body will be held under compression when the parts are assembled.

As previously noted, the elastomeric body is molded integral with a previously formed body 21 of a thermoplastic, high temperature resistant, low friction material such as polytetrafluoroethylene or "Teflon" which thus forms in effect, an exposed outer sheath for the cup. The sheath 21 of "Teflon" may be adhered to the body 20

by treating the interior of the preformed "Teflon" molding 21 with liquid sodium to etch a great multiplicity of small pits in the surface into which the elastomer will flow under molding pressures to establish a mechanical bond between the dissimilar materials. Adherence may also be obtained by molding the rubber-like material and the "Teflon" simultaneously.

I have found that it is important that the "Teflon" sheath extend under the retainer thimble 13 a sufficient distance to assure that the elastomeric body which the sheath protects is not exposed to the pressure of the oil at the pumping location, and that the mechanical reinforcement afforded by the sheath retains its integrity under the repeated flexing encountered during the installation and removal of the assembly. Flexing occurs each time the cup passes a tubing joint in its transit. The mechanical reinforcement also assists in preventing a blow out of the swab cup in the event that an extreme pressure difference is encountered between the inner and outer faces of the cup at the region adjacent the open end of the retainer 13.

The present invention not only mechanically reinforces the elastomeric material with a continuous sheath, but greatly reduces the frictional resistance to installation and removal of the assembly because of the low friction characteristics of the "Teflon." The "Teflon" is highly resistant to the elevated temperatures and pressures that are encountered at the pumping location and exhibits no tendency to stick to or form a semi-bond with the wall of the adjacent tubing against which the sealing connection is made even though the cups stand in a stationary position for periods exceeding a month. The breakaway pressure required to free the assembly for removal of the pump after this period of time is not increased as is the case with the conventional rubber swab cups. I have found that the cups are capable of greatly increased life and hence reduced overall cost as compared to cups that must be replaced each time the pump is installed in a well.

The illustration of the invention has been made in conjunction with an assembly that is fitted to the top of a free pump. A similar assembly, with one or more inverted cups, may be used below the discharge of the pump unit or in any location where the pressures encountered are reversed. It will be appreciated, of course, that the pressure against which the swab cups stand is higher at the skirt portion of the cups below the bulge 25 than is the pressure above the bulged portion, for example, adjacent the thimble retainer.

It is within the purview of the invention that the "Teflon" sheath be limited in its axial extent to cover only that portion of the cup that is expected to engage the tubing—or slightly above and below the bulge area 25, and to the area of high mechanical stress at a point where the cup surface is juxtaposed to the open end of the retainer thimble. While an additional advantage derives from a continuous sheath in that the cup material is better protected and reinforced, I do not wish to be limited in this respect.

The present invention also contemplates the integral manufacture of the swab cups and mandrel sections as by bonding the swab cups in place or by molding the swab cups directly on a threaded mandrel such as the mandrel 10' shown in the modified form of FIG. 3. In this form, the mandrel is made up of a plurality of threaded sections 10' each of which carries a Teflon coated swab cup 20' bonded directly thereto as at 30, the bond line being indicated by a series of "X's." A reinforcing and retaining thimble 15' is seated over the swab cup and is held in place either by the next succeeding mandrel section 10' or by a lock nut comparable to lock nut 12 shown in FIG. 1.

While the invention has been described in conjunction with a specific configuration for the swab cups, it should

be expressly understood that numerous modifications and changes may be made in this configuration and in the manner of assembly on the mandrel without departing from the scope of the appended claims.

What I claim is:

1. An improved oil well swab cup for assembly over a mandrel in conjunction with a thimble-like cup retainer comprising, a tubular body of elastomeric material having a base portion adapted to be received in said retainer and a flexible skirt portion adapted to expand towards engagement with a tubing wall, and a sheath of Teflon molded against the outer face of said exposed portion of said body, said sheath extending over at least that portion of said body that is juxtaposed to the open end of said retainer in the mounted position of the cup.

2. An improved oil well swab cup for assembly over a mandrel in conjunction with a thimble-like cup retainer comprising, a tubular body of elastomeric material having a base portion adapted to be received in said retainer and a flexible skirt portion adapted to expand towards engagement with a tubing wall, and a sheath of Teflon adhered to at least that portion of the outer face of said skirt portion of said body that is normally engaged by said tubing wall, said sheath extending also over at least that portion of said body that is juxtaposed to the open end of said thimble-like retainer in the mounted position of the cup.

3. An improved oil well swab cup for assembly over a mandrel in conjunction with a thimble-like cup retainer comprising, a tubular body of elastomeric material having a base portion adapted to be received in said retainer and a flexible exposed skirt portion adapted to expand towards engagement with a tubing wall, and a sheath of Teflon adhered to the outer face of said exposed portion of said body, said sheath extending over at least a portion of said body that is juxtaposed to the open end of said retainer in the mounted position of the cup.

4. An improved oil well swab cup for assembly over a mandrel in conjunction with a thimble-like cup retainer comprising, a tubular body of elastomeric material having a base portion adapted to be received in said retainer and a flexible skirt portion adapted to expand towards engagement with a tubing wall, and a sheath of Teflon continuously adhered to the entire outer face of said skirt portion of said body and extending over at least that portion of the base of said body that is juxtaposed to the open end of said retainer in the mounted position of the cup.

5. An improved oil well swab cup for assembly over a mandrel in conjunction with a thimble-like cup retainer comprising, a tubular body of elastomeric material having a base portion adapted to be received in said retainer and a flexible skirt portion adapted to expand towards engagement with a tubing wall, a metallic sleeve disposed centrally of said base portion, and a sheath of Teflon continuously adhered to the entire outer face of said skirt portion of said body and extending over at least that portion of the base of said body that is juxtaposed to the open end of said retainer in the mounted position of the cup.

6. An improved oil well swab cup assembly comprising a mandrel, a thimble member received over said mandrel, a tubular body of elastomeric material having a base portion received in said thimble member and a flexible exposed skirt portion adapted to expand towards engagement with a tubing wall, and a sheath of Teflon adhered to the outer face of said exposed portion of said body, said sheath extending over at least a portion of said body that is juxtaposed to the open end of said thimble.

7. An improved oil well swab cup for assembly over a mandrel in conjunction with a thimble-like cup retainer comprising, a tubular body of elastomeric material having a base portion adapted to be received in said retainer and a flexible skirt portion adapted to expand towards engagement with a tubing wall, and a sheath of high tem-

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perature-resistant flexible plastic material molded against the outer face of said exposed portion of said body, said sheath extending over at least that portion of said body that is juxtaposed to the open end of said retainer in the mounted position of the cup.

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KARL J. ALBRECHT, *Primary Examiner.*