Jan. 10, 1967 R. G. TAYLOR, JR 3,296,944

SWAB CONSTRUCTION

Original Filed Feb. 20, 1962

FIG. 1.

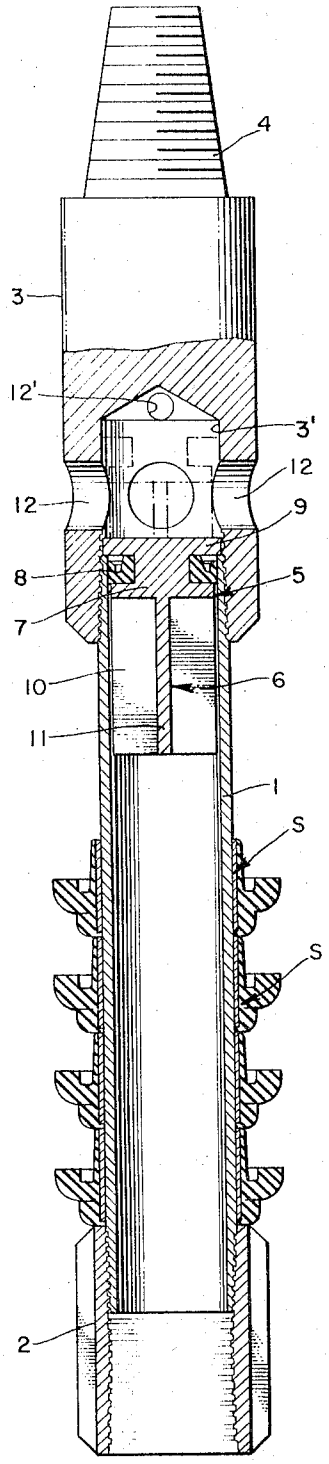


FIG. 2.

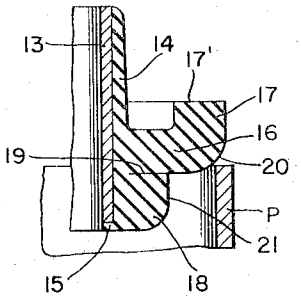


FIG. 3.

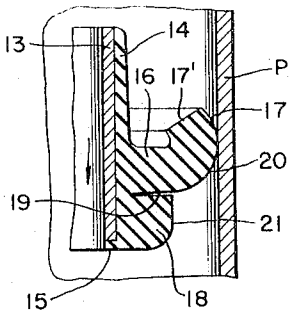


FIG. 4.

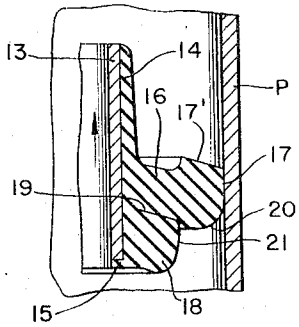


FIG. 5.

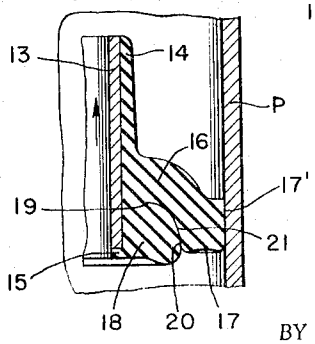


FIG. 6.

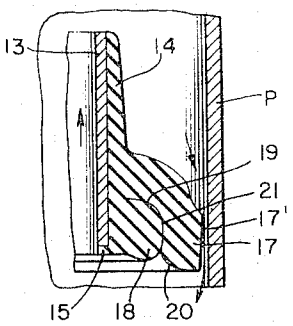


FIG. 7.

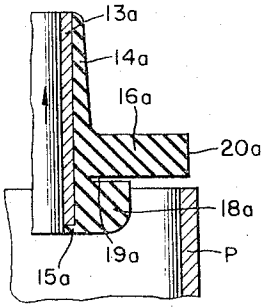
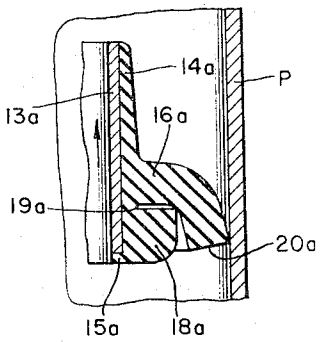


FIG. 8.



INVENTOR.
RAYMOND G. TAYLOR, JR

BY Allen B. Hamby

ATTORNEY.

United States Patent Office 3,296,944 Patented Jan. 10, 1967

3,296,944

SWAB CONSTRUCTION

Raymond G. Taylor, Jr., Santa Monica, Calif., assignor to Byron Jackson, Inc., Long Beach, Calif., a corporation of Delaware

Continuation of application Ser. No. 174,625, Feb. 20, 1962. This application Feb. 8, 1965, Ser. No. 433,838

5 Claims. (Cl. 92—180)

This application is a continuation of my copending application, Serial No. 174,625, filed February 20, 1962, for Swab Construction and now abandoned.

The present invention relates to well swabs and, more particularly, to an improved unitary molded rubber swab element having certain structural characteristics which enhance its ability to remove from a well bore a substantial column of fluid, but which enable the swab element to pass through pipe couplings without adverse effect and, on the other hand, enable the swab to easily pass downwardly through the well pipe, notwithstanding the presence of abnormal restrictions.

Well swabs as heretofore known in the art have comprised what are known as cup swabs which are generally molded rubber or rubber-like cups usually having wire reinforcing elements embedded therein; plug swabs which in effect constitute a solid mass of material filling the well pipe in contact with the wall thereof, such plug swabs generally being comprised of a mass of resilient material initially engaged with the wall of the pipe or adapted to be deformed into engagement with the pipe wall responsive to the pressure imposed thereon by a column of fluid thereabove; and disc-type swabs which generally comprise one or more flexible discs which may be slightly cupped or frusto-conical and which are adapted to be urged into engagement with the well pipe responsive to the pressure applied thereto by a column of fluid thereabove and in some instances to flex downwardly so as to move out of engagement with the pipe to relieve excessive hydrostatic head. Illustrative of the cup-type swab are the swab cups disclosed in U.S. Patent No. 2,917,352, dated December 15, 1959, to Raymond G. Taylor, Jr., and in Patent No. 2,358,908, dated September 26, 1944, to Charles S. Crickmer. Illustrative of the plug-type swabs as referred to above are the swabs shown in Patent No. 2,000,109, dated May 7, 1935, to Bert E. Tyler and Patent No. 1,122,246, dated December 29, 1914, to Howard F. Beam. Illustrative of the disc-type swabs are the swabs shown in U.S. Patent No. 2,417,349, dated March 11, 1947, to Samuel G. Colbaugh and in Patent No. 2,919,167, dated December 29, 1959, to Raymond G. Taylor, Jr. Indeed, in some instances, efforts have heretofore been made to combine the functional characteristics of a cup and a plug in a single swab element, and illustrative of such a swab is that shown in Patent No. 2,144,997, issued January 24, 1939, to Feri A. Thaheld.

The present invention in its broad aspects contemplates combining the functional characteristics of a cup, a disc and a plug in a unitary swab element, as will be hereinafter more particularly described. In this connection, it is an object of the present invention to provide a swab element which includes a disc-like portion initially engageable with the well pipe responsive to the application of fluid pressure thereto and which is so constructed as to be deflectable downwardly responsive to the fluid pressure and into sliding sealing engagement with the well pipe but such downward movement being resisted by a subjacent supporting member whereby the swab will lift a substantial column of fluid in the well pipe.

A further object is to provide a swab of the type referred to in the above objective wherein the disc-like member has an outer peripheral portion constructed in the

form of a shallow cup, the cup being reinforced against dumping by the subjacent supporting member so that it will support a substantial hydrostatic column. By virtue of this construction, the swab element has superior lifting ability as compared with the prior art disc or shallow disc-like cup swabs, but the element has economic advantage and functional superiority to typical cup swabs under some circumstances.

Another object is to provide a swab construction as referred to above in which the supporting member has an outer peripheral section opposed to the well pipe and defining therewith an annular space into which a portion of the disc-like member may be forced by the pressure of the column of fluid thereabove to the extent that the disc-like member and the supporting member cooperate to provide a plug-like swab element having the capacity to lift a heavier column of fluid.

Still another object is to provide a swab according to the foregoing which, responsive to an excessively heavy column of fluid, will automatically dump a portion of the hydrostatic head so as to allow upward movement of the swab through the fluid to a level at which the swab element is capable of supporting the entire column of fluid.

Hence, it will be appreciated that within the purview of the foregoing objectives, is the provision of a swab that has the desirable ease of running and light load lifting characteristics of a disc swab combined with the load carrying capacity of a cup and with the further desirable characteristic of a plug swab when subjected to a still heavier load. Furthermore, in the illustrative, the swab element has the additional dumping ability typically found in disc swabs.

Swabs of the general classes referred to above, as well as that of the present invention, may be characterized as expendable items having a relatively short life, so that inherent in the provision of a functionally adequate swab, is the requirement that the swab be practical from an economic point of view as well. Accordingly, another object of the invention is to provide a swab according to the preceding objectives which is not only functionally desirable, but which is also of simple and economical construction, being essentially a unitary element of molded rubber or rubber-like material molded upon an appropriate rigid supporting member. It will be appreciated that the invention contemplates not only a swab element, in the sense that the element comprises a disc-like member and a supporting member, as referred to above, but also the invention contemplates a plurality of such elements employed conjointly on a common support or as a unit comprising a plurality of sets of disc-like members and supporting members said sets being arranged in spaced relation.

More specifically, it is an object of the present invention to provide a swab element composed of a rubber or rubber-like disc member and a separate subjacent rubber or rubber-like disc supporting member molded as a unit and having a central hub or body of rubber, suitably bonded or attached to a supporting member, the supporting member being disposed immediately beneath the disc-like member either in separated but contacting relationship, or in slightly spaced relationship so that upon downward deflection of the disc-like member under the influence of fluid pressure, the disc-like member will encounter the supporting member which will resiliently resist further downward deflection of the disc-like member, but wherein due to the separation of the disc-like member and the supporting member, the former is free for upward flexure as may be necessary or required to enable the swab to move easily downwardly through the well pipe.

According to one embodiment of the invention, the disc-like member is provided with at least an outer periph-

eral section having a thickness in excess of the radial distance between the outer periphery of the supporting member and the wall of the pipe in which the swab element is to be employed whereby, responsive to the pressure of fluid thereabove, such outer peripheral section of the disc-like member will be forced downwardly between the outer periphery of the supporting member and the pipe and pressed therebetween. Such a construction provides a quantity of material which may be worn away during use of the swab before the effectiveness of the swab is seriously diminished. According to another embodiment of the invention, however, the ability of of the disc-like member to lift a body of fluid is simply enhanced by the disposition therebeneath of the supporting member which prevents downward flexure of the disc-like member.

Other objects and advantages of the invention will hereinafter be described or will become apparent to those in the art, and the novel features of the invention will be defined in the accompanying claims.

In the accompanying drawing:

FIG. 1 is a view partly in longitudinal section and partly in elevation, showing a swab assembly incorporating the swab construction of the present invention;

FIG. 2 is a fragmentary detailed view in longitudinal section showing one of the swab elements of FIG. 1 in a relaxed condition and in relation to a pipe into which the element is to be inserted;

FIG. 3 is a view similar to FIG. 2 but showing the swab element disposed within the pipe and in a condition caused by downward movement of the swab through the pipe as indicated by the arrow;

FIG. 4 is a view also corresponding to FIG. 2, but showing the swab element in a condition caused by the application of fluid pressure thereto responsive to upward movement of the swab within the pipe as indicated by the arrow;

FIG. 5 is a view corresponding to FIG. 4, but showing the swab element in the condition caused by the application thereto of a pressure greater than is applied to the element of FIG. 4 responsive to upward movement of the swab element as indicated by the arrow;

FIG. 6 is a view corresponding to FIG. 5, but showing the swab element in a condition caused by the application thereto of a fluid pressure in excess of that which it is capable of supporting;

FIG. 7 is a view corresponding to FIG. 2, but showing a modified swab element construction in accordance with the invention; and

FIG. 8 is a view corresponding to FIG. 7 showing the swab element of FIG. 7 in a condition caused by the application of fluid pressure thereto responsive to upward movement of the element within the pipe as indicated by the arrow.

Like reference characters in the several figures of the accompanying drawing and in the following detailed description designate corresponding parts.

Referring first to FIG. 1, there is shown a swab assembly incorporating a multiplicity of swab elements S made in accordance with the swab construction of the present invention. The swab assembly includes an elongated hollow mandrel **1** having a guide nose **2** threadedly secured at its lower end and a head **3** threadedly connected to its upper end. The head **3** is adapted as at **4** for connection to a conventional wire line rope socket, with suitable sinker bars interposed therebetween if deemed necessary or desirable to supply additional weight, as is customary.

Check valve means are provided to allow the passage of fluid upwardly through the mandrel **1** but for preventing the flow of fluid downwardly through the mandrel, such check valve means being generally designated at **5** and including an axially shiftable valve **6** having a head **7** which is provided about its outer periphery with a seat for a sealing ring **8**. Above the seat **8**, the head **7** is provided with a flange **9** of a greater diameter than the inside diameter of the mandrel **1** so as to abut with the upper end of the mandrel, as shown in full lines in FIG. 1. The connector head **3** is provided with a central bore **3'** in which the valve **6** is slidable to the position shown in broken lines in FIG. 1, at which fluid is free to pass upwardly through flutes or openings **10** defined between ribs **11** on the valve **6** and thence through a suitable number of radial flow passages **12** provided in the connector head **3** and leading into the bore **3'**. In addition, a vent passage **12'** is provided at the upper extremity of the bore **9** so as to avoid entrapment of fluid therein upon upward movement of the valve **6**.

Disposed upon the mandrel **1** between the nose **2** and connector head **3**, is a plurality of swab elements S which engage with one another, and the lower most of which engages the nose **2** when the swab assembly is being moved upwardly in a well pipe so as to lift therefrom a column of fluid.

One of the swab elements of FIG. 1 is shown in detail in FIG. 2 in a relaxed condition, while in FIGS. 3 through 6, the swab element of FIG. 2 is shown in various conditions or states during the running of the swab into a well pipe and recovering the swab from the well pipe. As shown in FIG. 2, the swab element comprises a rigid central support **13** in the form of a cylindrical core **13**, upon which is molded a rubber or rubber-like annular body **14**. It will be noted that the body **14** extends below the lower extremity of the core **13** and has a sealing flange **15** underlying the lower extremity of the core for sealing engagement with the nose **2** of the swab assembly, on the one hand, or with the upper extremity of a subjacent swab element of said assembly, on the other hand.

Forming an integral part of the molded rubber body **14** is a radially outwardly projecting disc-like member **16**. This disc-like member is illustrated in FIG. 2 as having a normal outside diameter larger than the inside diameter of well pipe denoted at P, into which the swab element is adapted to be inserted. In the embodiment of the invention now being described, the disc-like member **16** at its outer periphery has and upwardly extended flange **17**, so that the disc-like member and flange **17** combine to provide an element which is in the form of a relatively shallow cup.

Beneath the disc-like member **16** and also integral with the annular rubber body **14**, is a radially outwardly extended supporting member **18** which, as herein shown, is preferably separated from the disc-like member by a slit **19** for a purpose which will be hereinafter more particularly described, such slit **19** being either formed in the molding of the swab element or by a cutting operation subsequent to molding.

At its outer periphery, the disc-like member is preferably performed on a radius as at **20**, in the region of the outer lower edge thereof so that, as shown in FIG. 3, when the element is inserted into the pipe P, the curved lower edge of the disc-like member **16** engages the pipe P and causes the disc to flex upwardly relative to the supporting member **18** as is permitted by the slit **19**. The curved edge **20** of the disc-like member facilitates movement of the swab element through the pipe inasmuch as it presents no edges or projections which may hang up on the ends of the pipe sections, which are customarily joined by couplings in the case of certain types of pipe unions and, moreover, this rounded edge reduces the tendency of pipe ends or other obstructions in the pipe to tear and otherwise mutilate the disc-like member.

In accordance with one of the objectives of the present invention, the disc-like member **16** and the flange **17** thereon have a combined axial dimension in excess of the radial dimension of the annular space defined between the outer periphery **21** of the supporting member **18** and the opposing wall of the pipe P. Referring to FIG. 4, the swab element is shown in a condition caused by the

application of pressure thereto by a column of fluid thereabove during upward movement of the swab in the pipe P.

It will be recognized that inasmuch as the disc-like member and the flange **16** and **17**, as pointed out above, provide a shallow cup, the element is adapted to respond to a comparatively light fluid load, so that the flange is urged by fluid pressure into sealing engagement with the inside wall of the pipe. Moreover, downward deflection of the disc-like member **16** is inhibited or prevented under light load by the supporting member **18** to the extent that such light fluid load will be elevated in the pipe as the swab assembly is moved upward.

From the foregoing, moreover, it will be recognized that in running a swab assembly, as heretofore described, into a well pipe, the swab assembly exhibits the characteristics of the disc-like swabs of the prior art in that the disc-like member **16** easily flexes upwardly and offers little resistance to downward movement of the assembly; whereas when the swab is functioning, as in FIG. 4, the disc-like member functions similarly to cup-type swabs. However, since the disc-like member is not wire reinforced, as is quite common with such cup-type swabs, it will be noted in FIG. 5 that upon the disc-like member being subjected to a heavier load of fluid, it will stretch and extend downwardly into the annular space between the supporting member **18** and the pipe P so that the flange **17** extends generally radially of the assembly with its upper surface **17'** in sliding engagement with the wall of the pipe and with the flange and the disc-like member pressed between the supporting member **18** and the wall of the pipe. In this condition, the disc-like member, including its flange **17** and the supporting member **18**, combine to form a plug-type swab, as referred to above.

In the use of cup and plug-type swabs, it is characteristic of them that an excessive fluid load thereabove either seriously damages the swab element or prevents retrieval of the swab assembly so that it is not unusual to employ in conjunction with such swabs and as a part of the swab mandrel, a dumping or relief valve which will open when subjected to a predetermined hydrostatic pressure. The present swab, however, while having the advantageous fluid lifting ability of a cup and of a plug, has the further ability to automatically dump in the event that a hydrostatic column thereabove exceeds the limit of the swab element without causing physical damage to the swab. This ability is illustrated more particularly in FIG. 6, wherein it will be noted that as compared to the showing in FIG. 5, the disc-like member **16** has stretched further downwardly; the supporting member **18** has been radially compressed; and the flange **17** has likewise been deformed so that the end **17'** thereof is spaced from the pipe wall to afford a leakage clearance space. When the column of fluid above the swab has been suitably reduced, the inherent resilience of the swab element will cause re-engagement of the flange **17** with the pipe.

Referring now to FIGS. 7 and 8, there is illustrated a modified form of swab element. In this embodiment, the rubber body **14*a*** is molded on the rigid support or core **13*a*** and has a sealing portion **15*a*** underlying the lower extremity of the core as in the previous embodiment. In this modification, the disc-like member is designated **16*a*** and the supporting member is designated **18*a***, there being an enlarged slit, that is, a slot **19*a***, separating the disc-like member from the subjacent supporting member so as to allow a degree of freedom of downward flexure prior to engagement of the disc-like member **16*a*** with the supporting member **18*a***.

This disc-like member **16*a*** is illustrated as having radially extended planar upper and lower surfaces and a cylindrical outer peripheral face **20*a***. It will be understood, however, that the disc-like member **16*a*** may have specifically different forms. This is to say, that while the disc-like member **16*a*** is not constructed so as to function like a shallow cup in the embodiments of FIGS. 7 and 8, it may, however, be modified as to form as, for example, this disc may be constructed as shown in my prior Patent No. 2,919,167, identified above. The disc-like member **16*a*** is typical of disc swabs in that it is free to flex upwardly as in the previously described embodiment of the invention, but downward flexure of the disc-like member **16*a*** is limited by the subjacent supporting member **18*a***, as shown in FIG. 8, so that the disc-like member has an ability to lift a larger column of fluid due to its inability to freely flex downwardly, such flexure occurring only at the periphery of the disc **16*a*** as the outer annular portion of the disc is stretched and flexed downwardly about the supporting member **18*a***. Indeed, if desired, it would be within the purview of the present invention to extend the supporting member **18*a*** radially outwardly beyond the extent shown in FIGS. 7 and 8 so as to further limit downward flexure of the disc-like member **16a**, although preferably, the relationship between the disc-like member **16*a*** and supporting member **18*a*** should be maintained such that the disc-like member **16*a*** has a diameter at least slightly greater than the diameter of the supporting member **18*a*** so that the latter will not engage the pipe wall about its periphery while the swab assembly is being lowered except perhaps locally.

In both of the above described embodiments of the present invention, there is provided a simple structure which may be readily molded in that the disc-like member and the subjacent supporting member are integral with the body of rubber which is molded to the rigid support or central core of the swab element. In addition, while the invention has been described as more particularly related to a swab element having a single disc-like member and related supporting member with a plurality of such swab elements disposed in cooperative relation upon a mandrel, it will be understood that a swab element made in accordance with the invention may comprise a plurality of axially spaced disc-like members and associated supporting members formed as a unitary molding, as is well known in the art.

Other changes and alterations may be resorted to without departing from the spirit of the invention as defined in the dependent claims.

I claim:

1. A well swab adapted to be lowered in a well pipe and elevated to lift a body of fluid comprising: a rigid support, a rubber-like body on said support, said body having integral therewith a disc-like member and a subjacent supporting member extending radially therefrom in spaced relation longitudinally of said support, said disc being flexible upwardly away from said supporting member and downwardly into engagement with said supporting member, said supporting member cooperating with said disc to resist downward flexure of the latter, and wherein said disc-like member has an upwardly extended flange about its outer periphery.

2. A well swab adapted to be lowered in a well pipe and elevated to lift a body of fluid, comprising: a rigid support, a disc-like member projecting outwardly from said support for engagement with the well pipe, said disc-like member having an upwardly extending flange at its outer periphery, a supporting member beneath said disc-like member projecting outwardly and having a peripheral wall adapted to be opposed to the wall of the pipe in spaced relation to the latter for reception of the peripheral portion and flange of said disc-like member.

3. A well swab as defined in claim **2**, wherein said supporting member is formed of rubber and is deformable responsive to the application of fluid pressure to said disc-like member, whereby said disc-like member will stretch downwardly between the supporting member and the pipe to allow fluid to pass between the disc-like member and the pipe.

4. A swab assembly, comprising: an elongated tubular mandrel having a passage extending longitudinally therethrough, a swab element on said mandrel having sealing means engageable with the wall of a well pipe, a connector head on said mandrel having a bore communicating with the passage through said mandrel and having a passage leading radially into said bore from the outside of said head, and a check valve slidably disposed in said bore, including a body having an outer peripheral channel, a resilient sealing member in said channel for preventing the flow of fluid from said bore into said passage through said mandrel, said body having an outwardly extending flange slidable in said bore, means disposed in said bore and engageable by said flange to limit movement of said valve body through said passage in said mandrel, and centering means on said body projecting into said passage and having a flow passage for establsihing communication through said bore between the radial passage in said head and the passage through said mandrel.

5. In a swab rubber unit for a well swab, the combination of a central support having a plurality of longitudinally spaced, flexible sealing rings or cups formed thereon and each comprising an inner disc-like portion joined to said support and extending outwardly therefrom and an outer flange portion projecting upwardly from said disc-like portion, and a series of radially outwardly extending annular ribs, of smaller diameter than the flexible sealing rings or cups, on the central support, immediately below the sealing rings or cups, respectively, for abutment against the under sides of the sealing rings or cups to resist downward flexing movement thereof, whereby the sealing rings or cups are reinforced or backed up by the annular ribs below them and are thereby adapted to lift greater loads upon upward movement thereof in the well pipe or tubing.

References Cited by the Examiner

UNITED STATES PATENTS

1,714,164	5/1929	Gage	92—180
2,581,981	1/1952	Taylor	92—180 X
2,633,808	4/1953	Webber	103—225
2,719,768	11/1955	Webber	92—242
2,975,722	3/1961	Webber	103—225
3,023,062	2/1962	Waldrop	92—242
3,031,241	4/1962	Waldrop	92—242

EDGAR W. GEOGHEGAN, *Primary Examiner.*

KARL J. ALBRECHT, *Examiner.*