Dec. 29, 1959 R. G. TAYLOR, JR 2,919,167

DISC SWAB

Filed June 18, 1958

FIG. 1.

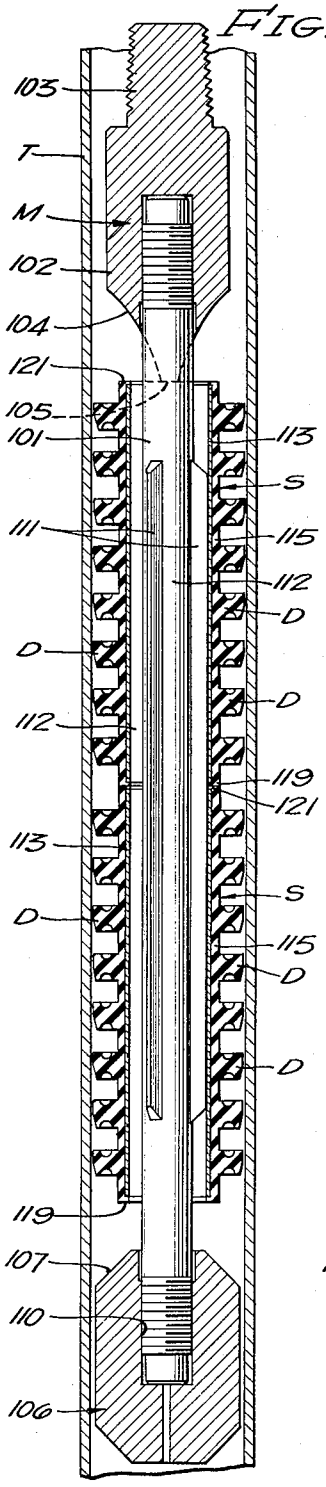
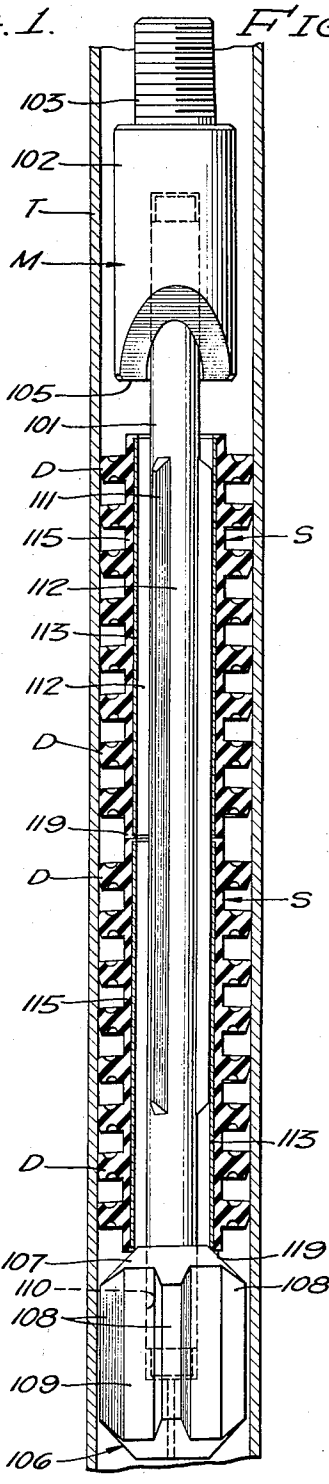


FIG. 2.



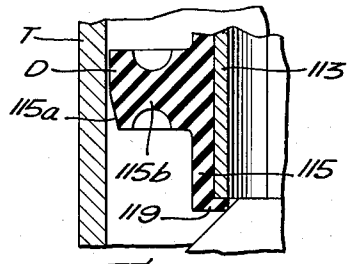


FIG. 3.

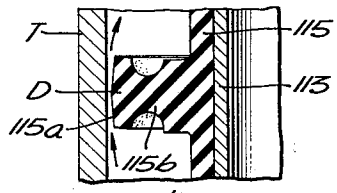


FIG. 4.

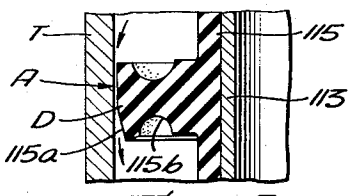


FIG. 5.

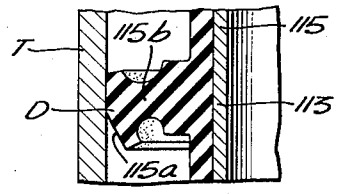


FIG. 6.

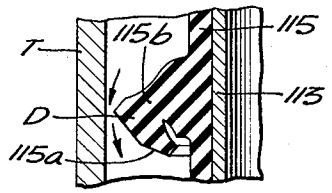


FIG. 7.

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DISC SWAB

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Application June 18, 1958, Serial No. 742,957

6 Claims. (Cl. 309—33)

The present invention relates to well swabs adapted to be run into a well pipe or tubing on a wire line and to elevate well fluids through the tubing.

In my co-pending companion application, Serial No. 742,958, filed concurrently herewith, there is disclosed a swab assembly comprising a mandrel adapted to have removably mounted thereon a plurality of swab rubbers, either of the cup or of the disc type. In accordance with the invention disclosed in that application, the guide nose of the mandrel is provided with a valve seating surface, and the lower extremity of the swab rubbers is provided with a valve head engageable with the valve seating surface on the guide nose, the upper end of the swab rubber being provided with a valve seat complemental to the valve head at the base of the swab rubber, so that the lowermost swab rubber will seat upon the guide nose, while the superjacent swab rubbers will seat upon the upper end of the swab rubber therebelow.

The present invention is more particularly directed to a novel disc swab rubber construction as generally disclosed in the above-referred to co-pending application, wherein a plurality of axially spaced annular disc members are employed for lifting the body of fluid in the well tubing above the swab.

The swabbing of wells is generally resorted to following certain hydraulic well treatments, such as hydraulic fracturing, acidizing, and the like. Disc type swabs are generally employed by well operators following a hydraulic formation fracturing operation during which a propping agent, such as sand, is dumped into the well along with the fracturing fluid to prop open the fractures in the formation initiated by hydraulic forces. Since the fracturing fluids being recovered from the well following such fracturing operations is generally laden with sand, it is desirable that a swab be employed which is incapable of being overloaded to the point of being irretrievable from the well. This is particularly important, inasmuch as if the swab is not continuously moving there is a tendency for the swab to become sanded up by sand settling in the fracturing fluids and forming a barrier above the swab. However, it is highly desirable that the swab be capable of elevating a substantial head of fluid without undue wear.

Accordingly, an object of the present invention is to provide a well swab or rubber adapted to be mounted on a running-in mandrel, wherein the swab rubber is of the disc type and is so constructed that it will freely pass fluid past the discs as the swab is being run into the well, but which, up to a predetermined limit, will lift a substantial load of fluids.

Another object is to provide a disc swab rubber in accordance with the preceding objective, wherein the discs will automatically dump excessive fluid loads, thus preventing hanging up of the swab in the well.

Another object is to provide a swab rubber of the disc type, wherein the discs are so constructed that as the swab is being pulled through the well fluids in the tubing, a pressure reduction will be effected at the periphery of

the discs as a function of the flow of fluid therepast. In accordance with this objective, the discs are provided with an intermediate annular section which is relatively resilient in contrast with the outer marginal tubing-engaging portion of the disc, so that as pressure is reduced at the outer periphery of the disc, the disc will expand radially, as enabled by the relatively resilient intermediate section towards the tubing, until the disc is carrying a maximum load, at which time the outer periphery of the disc will be in close contact with the tubing. Upon imposition of additional load upon the disc, dumping of the load will result.

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 thereof will be defined in the appended claims.

In the accompanying drawings:

Fig. 1 is a view partly in longitudinal section and partly in elevation, showing a swab assembly including a pair of disc swab rubbers made in accordance with the invention, the swab being run into a well pipe or tubing;

Fig. 2 is a view partly in longitudinal section and partly in elevation, showing the swab assembly and the disc swab rubbers as being retrieved from the well pipe or tubing;

Fig. 3 is an enlarged fragmentary view in section showing the construction of the lowermost disc and the lower extremity of the lowermost disc swab rubber of Figs. 1 and 2, with the disc in a normal or relaxed condition;

Fig. 4 is a fragmentary view in section, showing one of the discs of the swab rubber in the condition assumed by the discs as the swab is being run into a well through well fluids;

Fig. 5 is a view similar to Fig. 4 but showing the condition of the discs upon commencement of retrieval of the swab;

Fig. 6 is a view similar to Figs. 4 and 5, but showing the disc in full engagement with the well tubing as for lifting a maximum load; and

Fig. 7 is a view similar to Figs. 4 through 6, but showing the disc flexed downwardly as for dumping an excessive load.

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

Referring particularly to Figs. 1 and 2, a well swab assembly is shown comprising a mandrel M, including an elongated body **101**, having formed or suitably secured to its upper extremity a connector head **102** having a threaded stem **103** for connection to the rope socket of a wire line (not shown). The connector head **102** is provided with arcuately convergent surfaces **104**, **104** leading to radially extending stop shoulders **105**, **105** at the lower extremity of the connector head **102**. On the lower end of the mandrel body **101** is a guide nose **106**, having a conical valve seating surface **107** at its upper end, and having a plurality of circumferentially spaced ribs **108** and flutes **109** disposed about its periphery for enabling the flow of fluid therepast as the swab is being run into a well. The nose **106** is preferably threadedly connected to the body **101**, as at **110**.

The body **101** of the mandrel is provided with a suitable number of circumferentially spaced longitudinally extended ribs **111** and includes channels **112** providing flow passages between the ribs **111**.

The disc swab rubber hereof, which is generally designated S and two of which are shown in each of Figs. 1 and 2, includes a central core or tubular member **113** centered about the body **101** by the ribs **111**. Molded on the core or tubular member **113** is a rubber body **115**, the rubber body extending beneath the lower extremity

of the core or tubular member **113**, as at **119**, so as to provide a resilient valve head. The valve head **119** on the lowermost rubber S in the assembly is engageable with the conical valve seating surface **107** on the guide nose **106**, while the valve head **119** on the superjacent swab rubber S is engageable with the upper extremity of the valve rubber therebelow, the latter being provided with a valve seat **121** provided by a radially inwardly projecting section of the rubber body **115**.

Disposed in axially spaced relation and extending circumferentially about the rubber body **115**, is a series of discs D adapted to substantially sealingly engage the wall of well tubing T as the swab assembly is being pulled from a well, as shown in Fig. 2. As will hereinafter be more particularly described, the discs D are adapted to stretch from a relaxed condition, substantially as shown in Fig. 3, upon the initiation of retrieval of the swab from the well.

When the swab is being run into the well through fluids in the tubing T, as shown in Fig. 1, for example, the upper extremity of the uppermost swab rubber is adapted to abut with the radial stop shoulders **105** referred to above, and a large area flow passage is provided upwardly between the core or tubular member **113** of the respective swab rubbers and the body **101** of the mandrel M. By reason of the divergent faces **104**, no restriction to the flow of fluid from the upper swab rubber into the tubing is provided. In addition, as the swab is being run into a well, a certain amount of well fluid will pass between the discs D and the tubing T, as more particularly shown in Fig. 4, and the disc will be flexed slightly from its normal condition as shown in Fig. 3, slightly upwardly as particularly shown in Fig. 4.

During manufacture the discs will be constructed with the diameter of each disc slightly less than the inside diameter of the well conduit or tubing T so that the outer periphery thereof will be slightly spaced from the wall of the well tubing. For example, a swab for use in a well conduit or tubing having approximately a 2" inside diameter will preferably be provided with discs having a diameter of approximately 1.960". In order to preclude wear of the lower portion of the outer periphery of the discs upon slight upward flexure of the discs, the lower section of the discs is bevelled at a slight angle, as indicated at **115***a*; thus when the disc is flexed slightly upwardly, the lower section **115***a* will be disposed more or less in parallel relation to the tubing T.

In accordance with the objectives of the invention, the discs D are so constructed that they have an intermediate annular section of greater resilience than the outer peripheral section thereof. In the illustrative embodiment, the discs D are each shown having radially extended parallel upper and lower surfaces interrupted by annular channels providing the disc with a central annular section of reduced thickness, as at **115***b*. Obviously, other means may be availed of for providing a more resilient intermediate annular section. The purpose of this construction is to enable the aforementioned radial stretching or expansion of the disc D as a function of a reduction in pressure at A (see Fig. 5) as the swab passes upwardly through fluid in the well tubing, causing a relatively high velocity flow past the discs D in the direction of the arrows in Fig. 5. As the swab is being pulled upwardly through the fluid, and as the pressure is reduced at A, the disc will expand radially, thereby reducing the annular clearance between the discs and the tubing T. At the same time the outer margin of the discs may flex downwardly slightly, as shown in Fig. 5, as the swab discs commence to sustain a load of fluid in the tubing thereabove.

When a light load is being pulled the discs would assume a position substantially as shown in Fig. 5, whereas upon pulling a heavier load of fluid the disc will flex further downwardly and expand further radially towards the tubing wall, as shown in Fig. 6. Should there be an excessive load of fluid in the tubing above the swab, the discs D will dump the load as shown in Fig. 7, the fluid being permitted to bypass the discs as shown by the arrows in this view. However, when the load above the swab has been reduced to a value within the capacity of the discs D, then the discs will engage the tubing as shown in Fig. 6 so as to pull from the well the balance of the fluid. The load pulling capacity of the swab rubber S, it will be understood, may be varied according to the number of discs employed, since each disc will leave its proportional share of fluid within the tubing T.

In view of the foregoing it will be noted that with a disc swab rubber made in accordance with the invention, it is not possible to lower the swab to such an extent in the well that the load of fluid thereabove will prevent retrieval of the swab, as may occur in the use of cup-type swabs. Since the swab hereof cannot be stalled in the well, then there is no possibility of its becoming sanded up in the well, as propping materials or sand settling out of fracturing fluid, when the well is being swabbed following a hydraulic fracturing operation, cannot pack up above the swab assembly.

While the specific details of the invention have been herein shown and described, changes and alterations may be resorted to without departing from the spirit thereof as defined in the appended claims.

I claim:

1. A well swab of the disc type, comprising a rigid core adapted to be supported by a running in mandrel so as to be run into well tubing with said mandrel, a rubber body bonded to said core and extending longitudinally therealong, said core having a plurality of radially extended rubber discs formed integrally thereon and spaced longitudinally thereof, each disc having radially extended upper and lower surfaces, an outer peripheral annular section having a normal diameter slightly less than the inside diameter of the well tubing, and an annular section of greater resilience than said peripheral section, whereby upon the flow of fluid between the outer peripheral annular section and said tubing, said annular section of greater resilience will stretch and enable circumferential enlargement of said outer peripheral section.

2. A well swab as defined in claim 1, wherein said peripheral disc section of each disc has a lower bevelled section for affording clearance between said disc and said well conduit during travel of said swab through well fluids in the direction of said bevelled section.

3. A well swab as defined in claim 1, wherein said intermediate section of greater resilience comprises a section of reduced disc thickness.

4. A well swab of the disc type adapted for lifting fluids in a well conduit, comprising: a cylindrical member, a body of rubber molded on said cylindrical member and extending longitudinally thereof, and a plurality of rubber discs formed integrally with said body and projecting radially therefrom, said discs being spaced from one another longitudinally of said body and having an outer peripheral section of a diameter slightly less than the inside diameter of the well conduit, and said discs having opposite faces extending between said body and said outer peripheral section provided with opposed channels extending circumferentially intermediate said peripheral section and said body and providing an intermediate annular disc section of reduced thickness and increased resilience.

5. A well swab of the disc type adapted for lifting fluids in a well conduit, comprising: a longitudinally extended member, a body of rubber molded about said member and a rubber disc formed integrally with said body and projecting radially therefrom, said disc having an outer peripheral section of a diameter slightly less than the inside diameter of the conduit, said disc having radially extended upper and lower surfaces provided with circumferentially extended channels intermediate said

body and the outer periphery of said disc and providing an intermediate annular disc section of reduced thickness and increased resilience.

6. A well swab of the disc type adapted for lifting fluids in a well conduit, comprising: a longitudinally extended member, a body of rubber molded about said member and a rubber disc formed integrally with said body and projecting radially therefrom, said disc having an outer peripheral section of a diameter slightly less than the inside diameter of the conduit, said disc having means providing an intermediate annular section of greater resilience than said outer peripheral section for

enabling said outer periphery of the disc to expand circumferentially into engagement with the conduit responsive to a reduction in pressure at said outer periphery of the disc as the swab is being pulled through a body of fluid within the conduit.

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