Nov. 24, 1925. 1,563,164

G. CHRISTENSON

REENFORCED SWAB CUP

Filed Jan. 24, 1925

Fig. 2

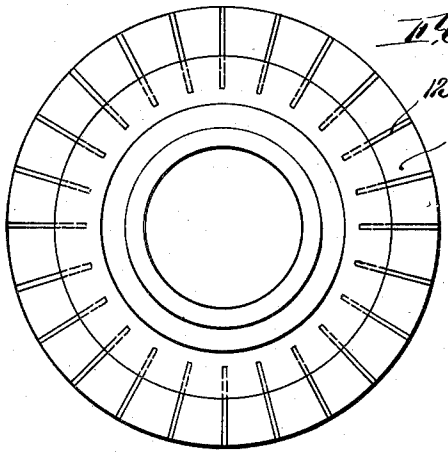


Fig. 4

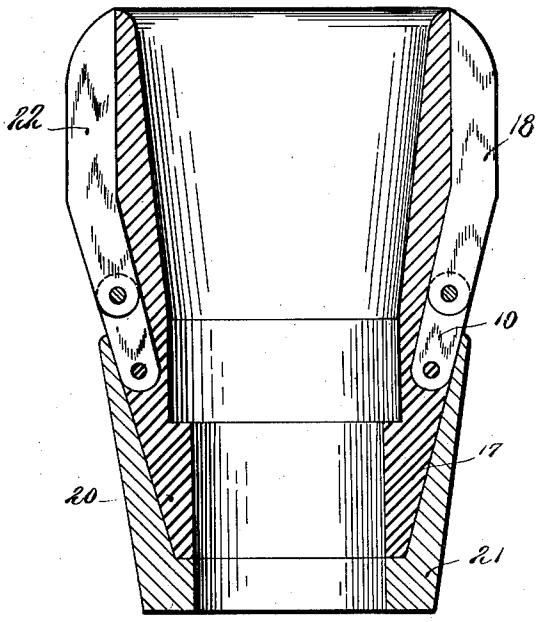


Fig. 1

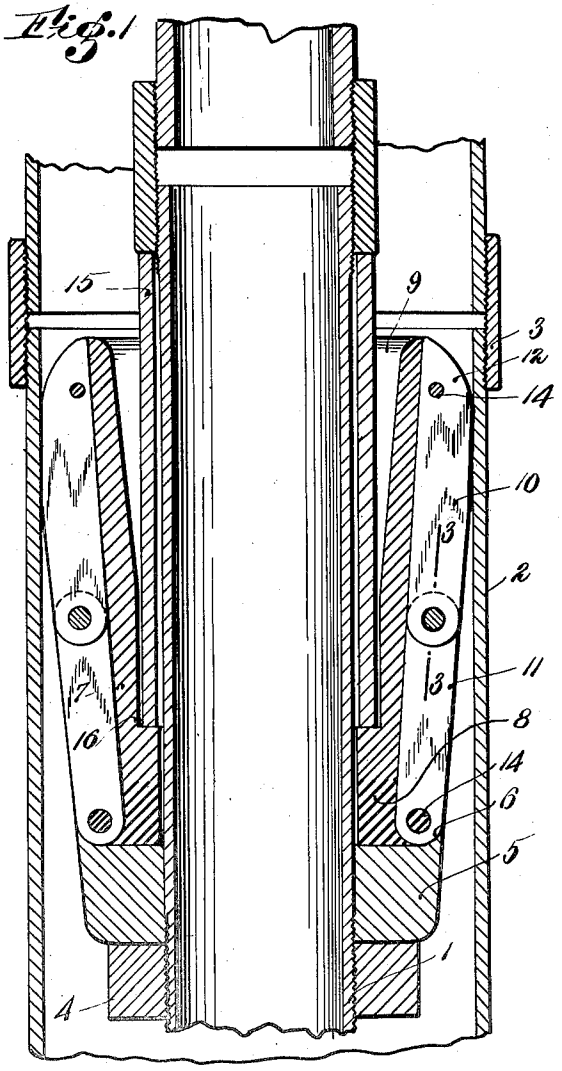
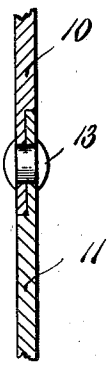


Fig. 3



Inventor:
George Christenson,
by Roberts, Cushman & Woodbury
Attys.

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UNITED STATES PATENT OFFICE.

GEORGE CHRISTENSON, OF NORTH PLAINFIELD, NEW JERSEY, ASSIGNOR TO JOHNS-MANVILLE, INCORPORATED, OF NEW YORK, N. Y., A CORPORATION OF NEW YORK.

REENFORCED SWAB CUP.

Application filed January 24, 1925. Serial No. 4,630.

To all whom it may concern:

Be it known that I, GEORGE CHRISTENSON, a citizen of the United States of America, and resident of North Plainfield, in the county of Somerset and State of New Jersey, have invented new and useful Improvements in Reenforced Swab Cups, of which the following is a specification.

This invention relates to heavy duty plungers, lifting-bailers or swabs, so-called, and particularly applies to devices adapted to make a fluid-tight connection operative under great pressures between a draft-rod or stem and a mechanically imperfect interior cylindrical surface, such as is characteristic of the tubular casings of deep wells.

In deep well practice, for instance in oil wells and deep artesian wells, when there is not spontaneous flow, the well may either be pumped, or be swabbed or bailed, these operations differing essentially in the character of the device employed, and in ways of applying the power necessary to lift the fluid out of the well. Pumping may be performed by pumps having submerged pump cylinders, of good mechanical construction with well machined bores, lowered beneath the level of the liquid in the well, and having the usual pumping equipment of a forcing plunger or rod extending to the top of the well and suitable valves for taking in and emitting above the pump cylinder a charge of the liquid at each stroke of the pump. Such pumps are usually single-stroke devices, the great distance to the surface of the liquid from the surface of the earth often precluding the transmission of any power by a pushing stroke on the pump rod, and necessitating a slow rate of pumping. Difficulties of operation and expense of good pumping mechanism have led to the general practice of swabbing or bailing by utilizing the tubular well casing as the cylinder of a lift pump, the piston usually comprising a weighted tubular stem attached to the bottom of a flexible wire hoisting cable, this stem having a fluid passage and some form of check-valve, and being provided with a packing or series of packings adapted to bridge the space between the stem and the inner surface of the well casing. Such swabs are permitted to sink a suitable distance into the well, and then withdrawn by hauling up on the cable and lifting with it the superimposed column of liquid. The pressures to which packing elements between the pump rod or swab stem and the pump cylinder or the well casing are exposed are very great. In the case of swabbing, the great pressures and the rough, variable and broken surface of the well casing make it difficult to hold the heavy liquid column reliably and efficiently and result in destruction of the usual packing devices which often are worn out after a few working strokes only.

Objects of this invention are to provide a lifting plunger for pumping or swabbing adapted efficiently to form a fluid tight connection with the walls of a cylinder or well casing; to provide a packing capable of withstanding very great pressures and adapted to form a fluid tight connection with a relatively imperfect cylindrical surface; to provide improved reenforced means for protecting the packing against collapse by pressure and against locking into, or being torn or cut by, broken or irregular surfaces in rough and uneven pipes, and thus to prevent mutilation and injury to the packing; and in general to provide a plunger packing having features of construction ensuring prolonged efficient performance in the indicated environment.

The invention will now be described with reference to certain specific instances, illustrating the invention and shown in the accompanying drawings in which:

Fig. 1 is a vertical sectional elevation of a portion of a swab in a well casing;

Fig. 2 is a top plan view of the packing shown in Fig. 1;

Fig. 3 is a section on the line 3—3 of Fig. 1; and

Fig. 4 is a vertical sectional elevation of another form of packing or cup.

Referring to the drawings, the swab may comprise a tubular stem 1 which is adapted to be lowered into a cylindrical well casing 2 having abutting pipes held together by collars 3. A portion of the stem 1 may be exteriorly screw threaded to receive nut 4 on which rests a calyx 5 which is provided with a concave upper surface 6 to support the packing cup or sleeve 7, of which only one of the series recommended to be used is shown in Fig. 1.

The packing cups may be flaring frusto-conical bodies having an annular section or heel 8 which rests in the concave upper sur-

face 6 of the calyx 5. Preferably the cups 7 are made of a rubber compound of a type exhibiting when vulcanized great durability and resistance to fatigue from deformation of shape and of a structure hereinafter described in aid of the natural qualities of the vulcanized rubber compound to enable the complete cup to resist the relatively great longitudinal and radial pressures and rough treatment to which it is subjected. One preferred form of packing comprises a solid of revolution integrally molded comprising portions of different grades or qualities of the molded rubber compound (or rubber substitute) one of which kinds of compound, when subjected to vulcanizing under the same temperature and pressure as the other will become relatively stiff and rigid, whereas the other kind of compound under the same treatment will become a relatively flexible and relatively yielding resilient body. For example, the cup 7, Fig. 1, may comprise a heel portion made as an annulus 8, as illustrated by the more heavily shaded section, of a rubber compound heavily charged with sulphur, and if desired with other vulcanizing agents or facilitators, and so adapted when finished by subjecting it in a mold to a vulcanizing heat and pressure to present a very great elastic resistance to deformation of shape by crushing or shearing, but nevertheless to be reasonably extensible under great pressures. Rubber compounds capable of producing the results indicated are well known in the art.

The remainder of the cup 7 is made of a softer, less heavily sulphureted material, and therefore when vulcanized manifests more easily extensible and more flexible finished structure than the annulus 8. Preferably the integral cup 7 is a solid of revolution approximately of the form shown in the drawings, the portion above the calyx 5 comprising in general a flaring or conical annular solid tapered away to a lip 9. It may be desirable under some conditions to vary the proportions of the packing cup, especially the relative dimensions of the annulus 8.

A preferred construction comprises a reenforcement serving as a guide and protector for the exterior surface of the cup 7 and adapted to prevent the upper portion or lip 9 or other portions of the packing from catching in projections and from entering deeply into openings, such as those between the ends of the casing pipe sections, as shown in Figure 1. The reenforcement comprises a spaced series of radially spaced flat metallic plates each consisting of articulate segments 10 and 11 having rounded ends 12 and anchored end portions firmly embedded in the cup 7. Preferably the segments 10 and 11 are in longitudinal alignment and may be pivotally connected, as indicated in Fig. 3, the abutting ends of the plates being shouldered to provide a smooth exterior surface and pivoted, as by a loose rivet 13. Preferably the reenforced cups 7 are molded at one operation in a mold already containing in proper spaced relation a sufficient number of articulate segments 10 and 11 which are of suitable material, such as spring tempered steel. In order to secure the plates in efficient attachment to the material of the cup apertures 14 for flow of rubber compound may be formed in the plates. As shown, the plates are so embedded within the substance of the cup as to cause the exterior surface of the plates to coincide with the exterior surface of the body portion of the cup. Under the pressures of use there is no sensible leaking of liquid between the material of the cup 7 and articulate segments 10 and 11.

As shown in Figure 1 the ring 4 and calyx 5 are screwed up into the desired position on the stem 1 in order to force the packing cup 7 against the casing sleeve 15, an annular shoulder 16 being provided in the heel 8 of the cup against which the sleeve 15 is adapted to bear.

As so mounted, the upper or outer segments 10 severally can yield outwardly with portions of the cup under very great pressure developed within the cup and so permit a satisfactory fluid-tight contact between the outer portions of the cup and the wall of the well casing 2. Any projection encountering the exterior surface of the packing when under pressure will, however, distort the cup and displace one or more of the segments 12, and thus result in the local depression only of the margin of the cup, which is the desired effect. Of course, should the pressure be very great then one or more of the segments 11 will also yield, but under ordinary conditions of use the segments 11 are not depressed but serve to reenforce the lower or heel portion 8 of the cup in normal unflexed position. The plates 12 not only serve as skids, runners or guides for the cup 7 but also to guard the cup from expanding into the grosser irregularities in the interior cylindrical surface of the well casing without preventing liquid tight contact with normal surfaces.

Under some conditions of use the packing 17 and reenforcing plates 18 and 19 may have the form shown in Fig. 4 in which the lower or heel portion 20 of the cup comprises a relatively rigid annulus which extends well into the calyx 21, the latter serving to prevent the expansion of the lower or heel portion of the cup. In this form, the reenforcements may constitute short segments 19 extending a slight distance into the calyx 21 and having a portion embedded in the annulus 20, the plates 18 being pivoted to the plates 19, and prefer-

ably having a portion 22 of their edges defining a cylinder and a portion 23 defining a cone, these exterior surfaces conforming to and coinciding with the exterior surface of the packing cup 17.

It will be observed that the expansion of the packing described involves a stretching increase of the perimeter of the cup or heel which has been contrived to be without restriction by metallic reenforcement. Such stretching on the contrary is facilitated by the comparatively small proportion of the circumferential dimension of the packing occupied by the lesser cross sectional area of the metal reenforcements which nevertheless are highly rigid between their points of connection. Therefore the packing cup reenforcements described are highly effective as skids to bridge depressions or guides to avoid collisions with projections from the casing wall and as stiffening resistance against longitudinal and radial pressures.

I claim:

1. Packing comprising an expansible solid of revolution having therein radially placed and longitudinally extending flat articulate metallic reenforcements.

2. Packing comprising an expansible solid of revolution having therein radially placed and longitudinally extending flat articulate metallic reenforcements having outer edges thereof coincident with a corresponding surface of the solid.

3. Packing comprising a vulcanized rubber compound solid of revolution having therein articulate metallic reenforcements of greater radial than circumferential dimension moulded into said packing and at outer edges coincident with the peripheral surface of said solid of revolution.

4. A cup adapted to pack the space between a lifting stem and a cylindrical tube of imperfect form and to resist great pressures comprising a stiff moulded compound heel annulus and a body portion of relatively greater flexibility, in combination with flat metallic articulate reenforcements radially placed, anchored in the heel-annulus and extending longitudinally of the cup.

5. In a swabbing device for use in deep wells, the combination of a stem and a packing comprising an expansible solid of revolution having therein radially placed and longitudinally extending flat metallic reenforcements, each reenforcement consisting of at least two articulate segments, and means for supporting one joint of the articulated reenforcement in relation to the stem.

6. In a swabbing device for use in deep wells, the combination of a stem and a packing comprising a moulded flaring packing cup having a lip portion more flexible than its heel portion, the regions of relatively differing flexibility comprising materials respectively differing in flexibility and rigidity, and articulated flat metallic reenforcing plates moulded into the cup and having one series of like members of said articulated parts mounted in a constant relation to said stem.

7. A reenforcement plate of metal for packing cups comprising elongate flat segments pivoted together.

8. A reenforcement plate of metal for packing cups comprising elongate flat articulate segments having apertures therein and edges terminating at one end in a rounded portion.

9. A liquid driving plunger comprising a stem, a calyx on said stem, means for supporting the calyx, an expansible flexible rubber compound cup having a heel in the calyx, means for holding the cup against the calyx and a series of reenforcements moulded into said cup, each reenforcement comprising two or more articulate segments lying substantially longitudinally and radially of said heel and having an edge coincident with a corresponding surface of the cup.

Signed by me at Manville N. J. this 19th day of January 1925.

GEORGE CHRISTENSON.