Dec. 7, 1943. P. H. GRANGER 2,336,090

FLUID RETAINING CUP

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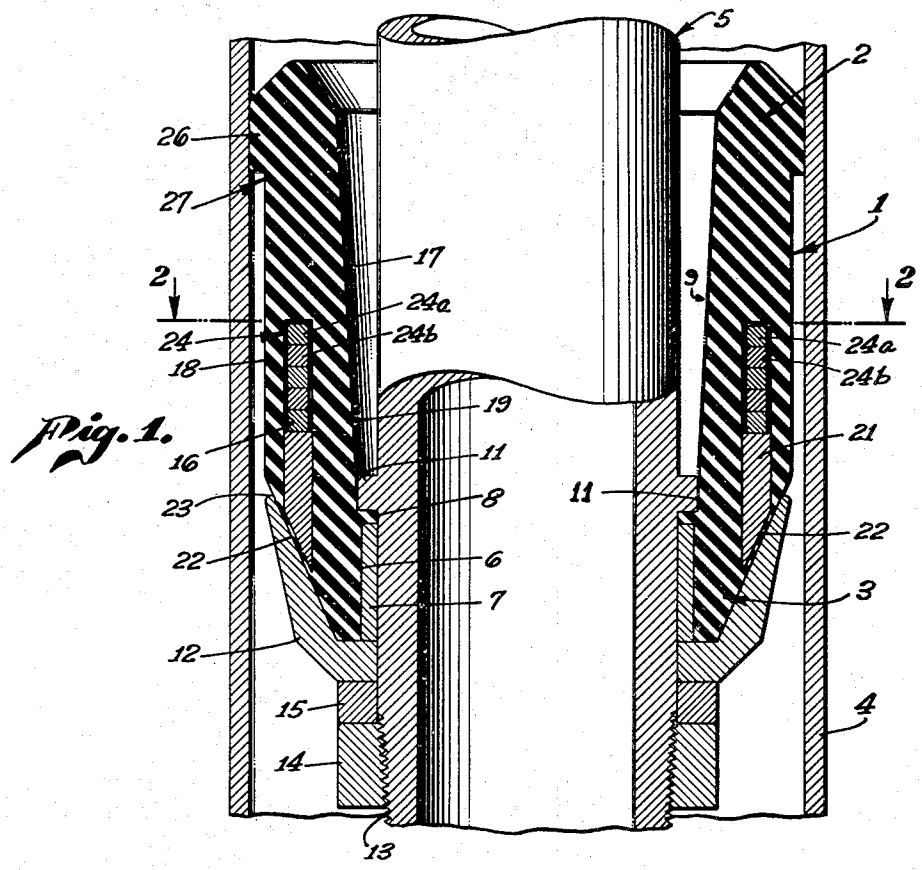


Fig. 1.

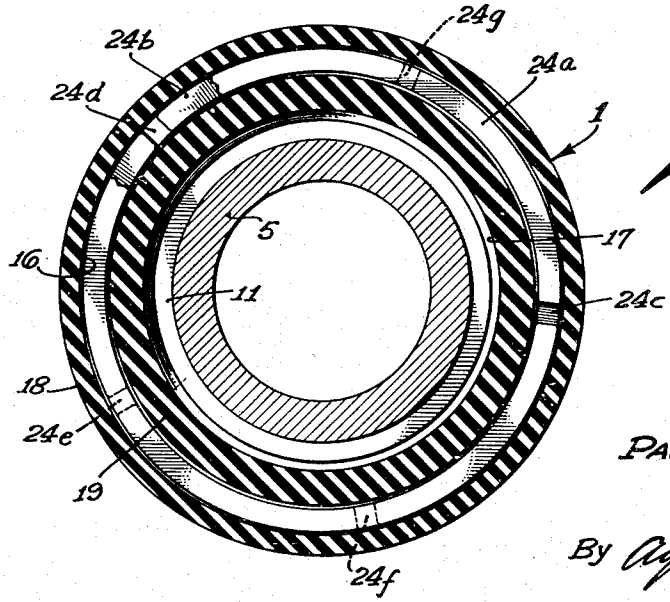


Fig. 2.

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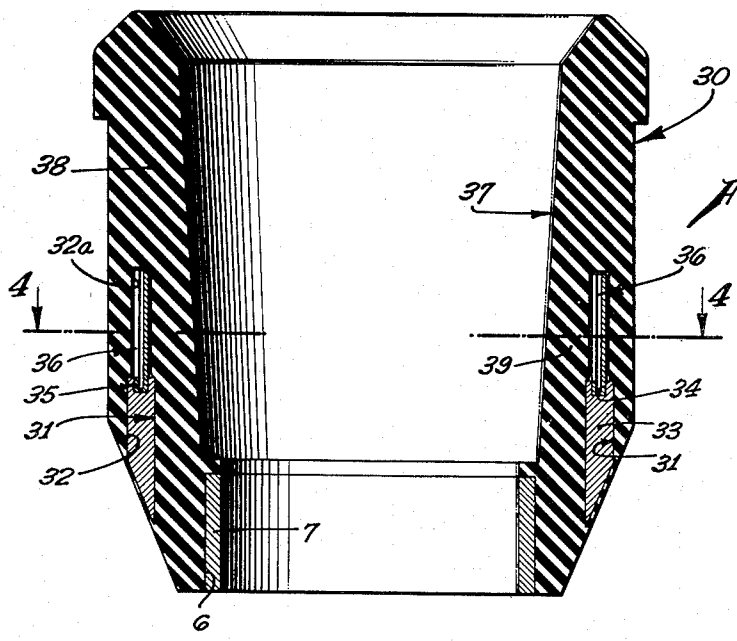


Fig. 3.

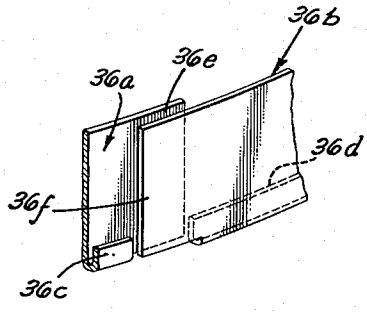
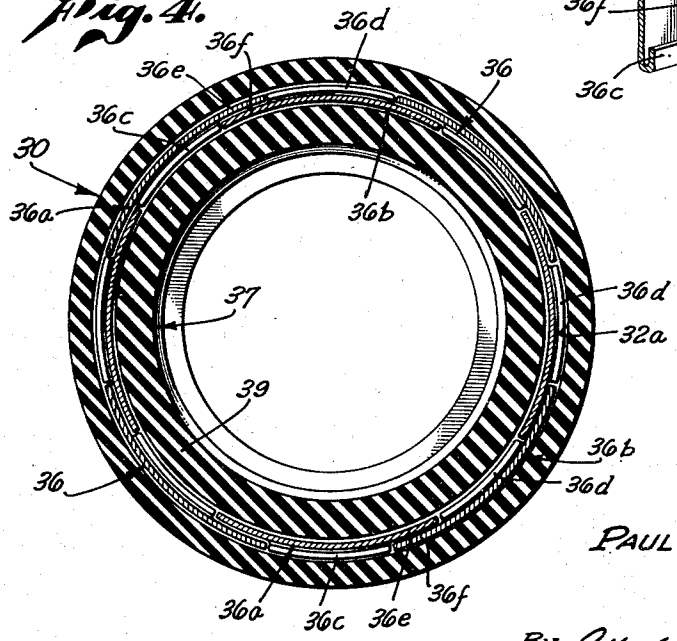


Fig. 5.

Fig. 4.



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FLUID RETAINING CUP

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Application January 26, 1942, Serial No. 428,327

4 Claims. (Cl. 309—33)

This invention relates to fluid retaining cups which are used as swabs and packers in casings or the like in oil wells.

These cups usually comprise an annular body of rubber or the like which are capable of withstanding high internal pressures while sealing with the walls of the casing and are usually provided with some form of reinforcing means. In order to operate satisfactorily under all conditions a cup must be sufficiently flexible to pass through the different sizes of casing normally encountered, while at the same time sealingly engaging the same. Also, the cup must be sufficiently stiff and strong to withstand pressures on the order of several thousand pounds per square inch without rupturing.

A particular object of the invention is to provide a cup which will sealingly engage with the walls of different weights of casing of the same nominal size.

Another object of the invention is to provide an improved construction for sealingly fastening the cup to the mandrel.

A further object of the invention is to provide a cup with rigid reinforcing means in the walls thereof adjacent the cup follower.

Another object of the invention is to provide a cup with circumferentially extensible reinforcing means for strengthening the cup at positions where flexibility is desired.

How these and other objects of this invention not specifically mentioned are attained will be better understood from the ensuing specific description of the drawings, in which:

Fig. 1 is a longitudinal section of a cup according to this invention positioned on a suitable mandrel in a casing;

Fig. 2 is a transverse section through the cup taken along line 2—2 in Fig. 1;

Fig. 3 is a longitudinal section of a modified form of cup;

Fig. 4 is a transverse section thereof taken along line 4—4 in Fig. 3; and

Fig. 5 is a perspective detail of the reinforcing means employed in the cup illustrated in Figs. 3 and 4.

Referring to Figs. 1 and 2, the cup is shown as comprising an annular cup body 1 formed of flexible resilient material such as rubber or the like having a flexible upper end 2 and a base portion 3. The terms "upper end" and "base portion" are, of course, relative since the cup may be used in an inverted position. However, the upper end of the cup is the end adapted to seal with the casing or the like, indicated at 4, and is opposite the base portion which is the portion secured to a mandrel or other mounting means such as indicated at 5.

The inner wall of the base portion 3 is recessed outward as indicated at 6 to accommodate a cylindrical bushing 7 that makes a close sliding fit with the mandrel 5. Bushing 7 is suitably secured to the cup body as by vulcanization. The upper end of the recess 6 terminates in an inward projecting annular ring or shoulder 8 of the cup body material and the inner surface of the shoulder 8 engages the mandrel.

The internal diameter of the cup body at the upper edge of the shoulder 8 is greater than the internal diameter of the recess 6 and represents the minimum diameter of the inner surface of the cup above the position of the shoulder 8. The inner diameter of the cup increases from a position at about the center of the cup as indicated at 9 and reaches the maximum at the upper end.

The mandrel 5 is shown provided with an outward extending annular flange 11 which engages the upper face of the shoulder 8. A removable cup-shaped cup follower is indicated at 12 engaging the base portion of the cup and the lower end of the bushing 7. The mandrel is threaded as indicated at 13 and is provided with a nut 14 which is spaced from the follower 12 by a washer 15 and is adapted to urge the cup follower against the cup to hold it securely between the flange 11 and the follower. The shoulder 8 is squeezed between the flange 11 and the upper end of the bushing 7 and is thus forced against the mandrel 5 to form a fluid-tight joint.

The annular wall of the cup body is provided with annular cavity means comprising an annular recess 16 extending upward from the base portion of the cup to a position intermediate the ends of the cup. The inner surface of the cup indicated at 17 is subject to outward fluid pressure and the outer surface of the cup indicated at 18 faces the casing. The annular cavity 16 is located between the inner and outer surfaces 17 and 18 in the wall of the cup body, whereby there is a wall portion 19 located inward of the annular recess 16 which is subject to outward fluid pressure.

A rigid annular reinforcing member 21 in the form of a continuous metal cylinder is shown located within the cavity 16 adjacent the lower end thereof and the base portion of the cup. The reinforcing member 21 may be secured to the cup body as by vulcanizing or it may be free to move in the cavity. The lower end of the cavity is shown closed with a thin annular rubber member 22 vulcanized in place. The member 21 extends

upward from a position below the upper end 23 of the cup follower 12 to a position above said upper end and intermediate the ends of the cup and is in position to engage the outer surface of the wall portion 19 and resist radial outward loads transmitted from the inner surface 17 of the cup. The member 21 is separate and spaced radially outward from the bushing 7.

Preferably further reinforcing means is provided in the wall 1 above the upper end of the rigid reinforcing member 21 as in the portion of annular cavity 16 above the member 21. Such additional reinforcing means preferably should reinforce the cup against outward fluid pressure from within without appreciably decreasing the cup's flexibility, since the position of such reinforcing means is in the portion of the cup which should be flexible. For this purpose I may provide one or more split rings such as indicated at 24 of steel or other flexible resilient material of high tensile strength.

The rings 24 are circumferentially extensible and are preferably of such diameter as to not engage the inner walls of the cavity 16 when the cup is in its rest position as indicated and they are free to move with respect to the side walls of the cavity during circumferential extension. The inner diameter of the rings 24 is preferably such that the inner surfaces thereof will be engaged by the wall portion 19 after it has been deformed outward by outward fluid pressure whereby the rings will assist the wall portion in resisting radial outward loads.

The uppermost ring is indicated in plan at 24*a* in Fig. 2 and a portion of the next lower ring is indicated in plan at 24*b*. The rings are preferably provided with circumferentially spaced butt ends. The butt ends of the rings 24*a* and 24*b* are shown at 24*c* and 24*d*, respectively. The butt ends of the remaining rings are shown at 24*e*, 24*f* and 24*g*. It will be noted that positions of the splits or butt ends of each ring are circumferentially spaced from an adjacent ring.

It will be noted that the upper end 2 of the cup body is provided with a flexible annular outward projection 26 which is adapted to engage the inner wall of the casing 4. This projection allows the cup to accommodate itself to different sizes of casing which are smaller than the sizes of casing shown. Upon entering a smaller casing the flexible upper portion of the cup body yields at the position indicated at 27 where the wall thickness abruptly decreases from that obtaining at the position of the projection 26. At the same time the projection 26 maintains sealing engagement with the wall of the casing. With the illustrated embodiment of the invention the minimum wall thickness of the cup body 1 occurs at the lower end of the projection 26, at the position indicated at 27. Thus the cup is readily deformable at that position.

Referring to Fig. 3 a cup is indicated at 30 which is identical to the cup illustrated in Fig. 1, with the exception that the shape of the annular cavity and the construction of the reinforcing means contained therein is different. The annular cavity is indicated at 31 and it will be noted that the base portion 32 thereof is of greater radial extent than the upper portion 32*a*. The base portion 32 contains a solid cylindrical reinforcing member 33 of substantially the same height as the member 21 of Fig. 1 and located in substantially the same position in the annular cavity 31. The upper face of the member 33 is provided with an annular recess 34 in which is located the base portions 35 of a plurality of arcuate longitudinally extending overlapping leaves 36 of steel or other relatively stiff reinforcing material.

Portions of two overlapping leaves are shown in perspective in Fig. 5 and are designated 36*a* and 36*b*. In order to hold the leaves in position in overlapping relation the base portions thereof are folded or bent upward about 180° angle as indicated at 36*c* and 36*d*. The direction of bending is opposite in successive leaves as will be noted particularly from an inspection of Figs. 4 and 5. The radial width of the base portions is such as to provide a loose fit thereof in the annular recess 35. The base portions 36*c* and 36*d* do not extend for the complete circumferential extent of the leaves whereby the end portions 36*e* and 36*f* of the leaves 36*a* and 36*b* respectively may overlap without interference from the bent-over base portions. Circumferential movement of the leaves relative to one another is prevented or limited through abutment of the ends of said leaves with the ends of the bent-over base portions 36*c* and 36*d*.

Inner surface 37 of the wall 38 of the cup is subject to radially outward fluid pressure and the annular recess 31 is located in the wall 38 outward of the surface 37 and has a wall portion 39 subject to radial outward force. The reinforcing means 33 and 36 are located in the annular cavity 31 and are adapted to engage the outer surface of said wall portion 39 to resist its outward movement from radial outward forces on the surface 37.

In the preferred embodiment the ring 33 is preferably a solid annular member as distinguished from a split ring, and the reinforcing means comprising the overlapping leaves 36 is preferably capable of circumferential extension upon expansion of the cup. Such circumferential extension is obtained by movement of the overlapping portions 36*e* and 36*f* over one another. Obviously, the overlap of the leaves should be sufficient so that the leaves will remain in overlapping relation for all normal operating conditions of the cup.

Although I prefer a construction in which the circumferentially extensible reinforcing means is loose in the annular cavity and spaced therefrom as shown so that an initial expansion of the cup may be obtained before the reinforcing means is effective, I may as an alternative mold the circumferentially extensible reinforcing means and the inextensible reinforcing means in place when the cup is molded. The resulting cup will not be quite as flexible as the preferred cup but will still retain some of its advantages in view of the circumferential extensibility of the upper reinforcing means.

It will be noted that in the illustrated forms of the invention the rigid reinforcing member such as the member 21 of Fig. 1 extends from a position above to a position below the upper end of the bushing 7 and intermediate its ends, is separate therefrom and spaced from the bushing by a portion of the flexible cup wall material. It should also be noted that the rigid reinforcing means and the circumferentially extensible reinforcing means need not be directly above one another. In other words, the portion of the cavity means containing the circumferentially extensible reinforcing means located at a position above the rigid reinforcing means need not be directly above the portion of the cavity means containing the rigid reinforcing means.

I claim:

1. A fluid retaining cup for use in a casing or the like, comprising a flexible cup body having an annular wall whose inner surface is subject to outward fluid pressure and whose outer surface faces the casing or the like, said wall having an annular cavity and having a wall portion disposed inward of said cavity, a rigid annular reinforcing member extending upward in the cavity from adjacent the base of the cup, and one or more circumferentially extensible resilient split ring reinforcing members located in the cavity above the annular reinforcing member, and being free to move with respect to the side walls of the cavity during circumferential extension, the reinforcing members being adapted to engage said wall portion to resist radial outward loads.

2. A fluid retaining cup for use in a casing or the like, comprising a cup body having a flexible annular wall whose inner surface is subject to outward fluid pressure, said wall having an annular cavity and having a wall portion disposed inward of said cavity, the inner wall of the cup body adjacent the base of the cup being recessed outward to provide a bushing-receiving recess; a cylindrical bushing in said bushing-receiving recess extending upward from the base of the cup; a rigid annular reinforcing member extending upward in the cavity from a position intermediate the ends of the bushing to a position above the upper end of the bushing, said reinforcing member being spaced outward of the bushing and adapted to engage said wall portion to resist radial outward loads; and circumferentially extensible reinforcing means located in said cavity above said rigid reinforcing member and being free to move with respect to the side walls of the cavity during circumferential extension.

3. A fluid retaining cup for use in a casing or the like, comprising a cup body having a flexible annular wall whose inner surface is subject to outward fluid pressure, said wall having an annular cavity located outward of said inner surface and extending upward from the base of the cup to a position intermediate the ends of the cup; a rigid annular reinforcing member in the lower portion of said cavity adapted to resist radial outward loads transmitted from said inner surface; and circumferentially extensible reinforcing means comprising a plurality of split rings located in said cavity above said rigid reinforicng member and being free to move with respect to the side walls of the cavity during circumferential extension.

4. A fluid retaining cup for use in a casing or the like, comprising a cup body having a flexible annular wall whose inner surface is subject to outward fluid pressure, said wall having an annular cavity located outward of said inner surface and extending upward from the base of the cup to a position intermediate the ends of the cup; a rigid annular reinforcing member in the lower portion of said cavity adapted to resist radial outward loads transmitted from said inner surface; and circumferentially extensible reinforcing means comprising a plurality of longitudinally extending overlapping leaves located in said cavity above said rigid reinforcing member and being free to move with respect to the side walls of the cavity during circumferential extension.

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