Oct. 17, 1944. B. E. PARRISH 2,360,577

SWAB RUBBER

Filed June 15, 1940 2 Sheets-Sheet 1

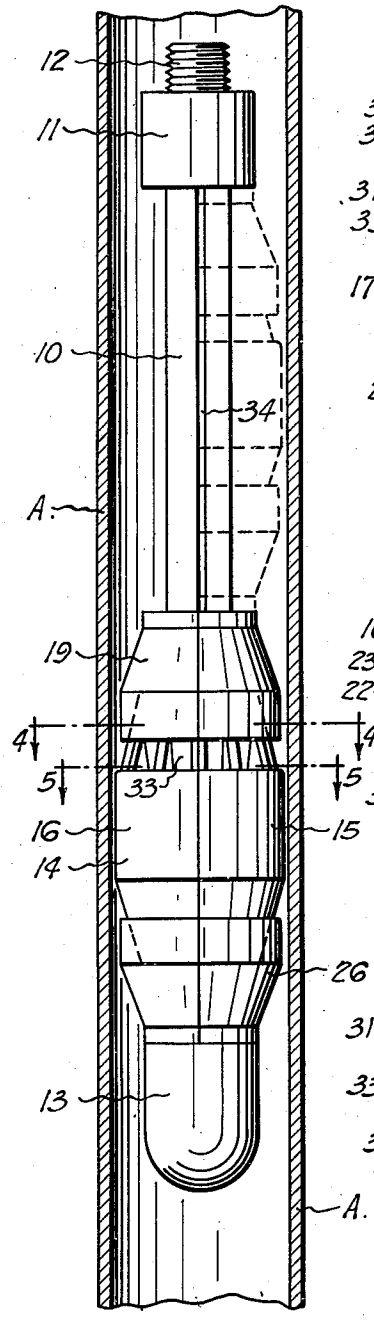


Fig. 1.

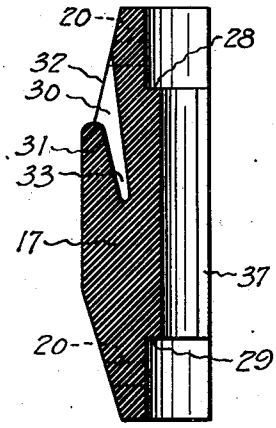


Fig. 2.

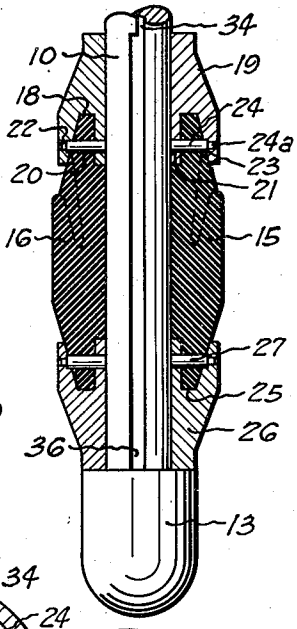


Fig. 3.

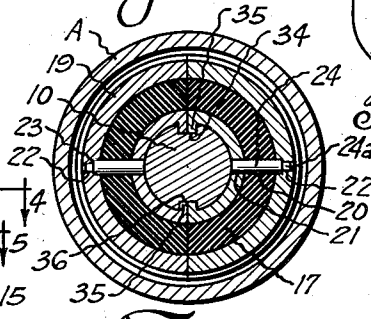


Fig. 4.

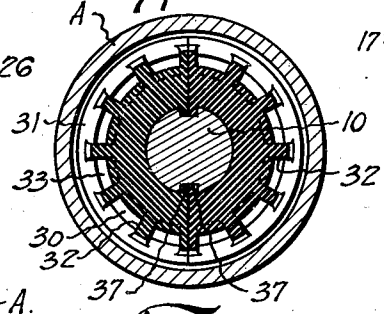


Fig. 5.

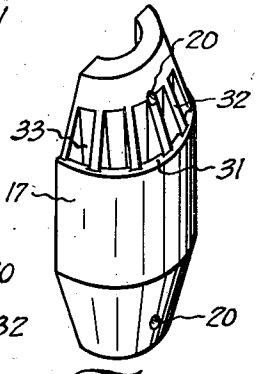


Fig. 6.

Inventor
Benjamin E. Parrish

By Jack A. Ashley

Attorney

Oct. 17, 1944. B. E. PARRISH 2,360,577

SWAB RUBBER

Filed June 15, 1940 2 Sheets-Sheet 2

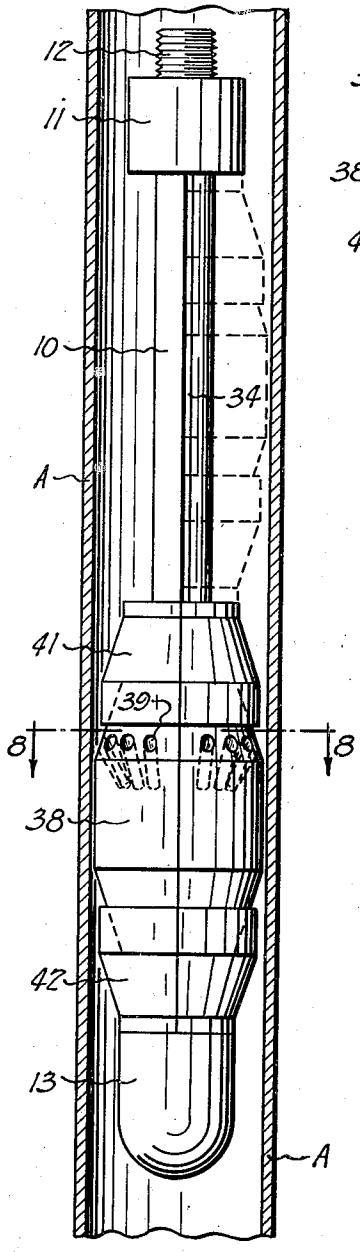


Fig. 7.

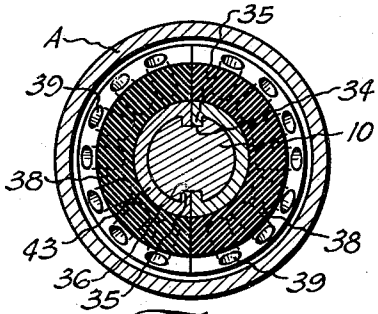


Fig. 8.

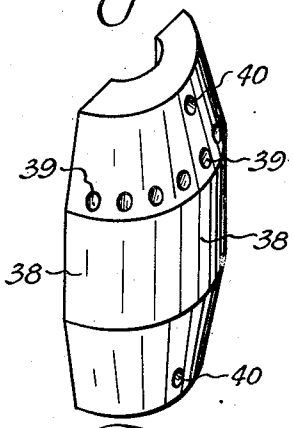


Fig. 10.

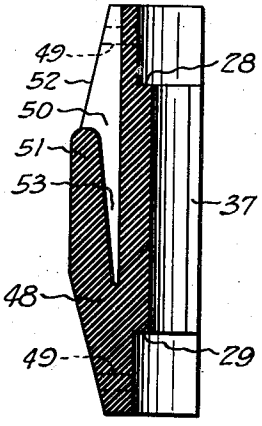


Fig. 12.

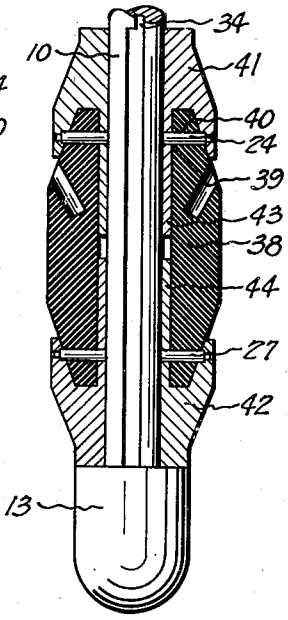


Fig. 9.

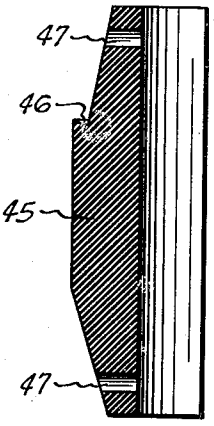


Fig. 11.

Inventor
Benjamin E. Parrish

By Jack A. Ashley

Attorney

Patented Oct. 17, 1944

2,360,577

UNITED STATES PATENT OFFICE

2,360,577

SWAB RUBBER

Benjamin E. Parrish, Dallas, Tex.

Application June 15, 1940, Serial No. 340,722

10 Claims. (Cl. 103—225)

This invention relates to new and useful improvements in swab rubbers.

This application is filed as an improvement on the swab rubber disclosed in United States Letters Patent No. 2,201,451, issued to me on May 21, 1940, and as a continuation-in-part of my copending application on swab rubbers, filed January 9, 1939, Serial No. 249,939, which is now abandoned.

One object of the invention is to provide an improved packing element for a well swab having all of the advantages of the packing element disclosed in my copending applications and which is so constructed that distortion of the same into engagement with the well casing is assured.

A particular object of the invention is to provide an elastic swab element which is constructed so as to be distorted into sealing position by the weight of the fluid being lifted by said swab.

Another object of the invention is to provide an improved elastic packing element for a well swab arranged to be distorted into sealing position and having auxiliary means adapted to be acted upon by fluid thereabove for aiding such distortion to assure positive sealing engagement of the outer surface of the element with the well casing.

An important object of the invention is to provide an improved packing element for a well swab having an annular, flexible lip formed in its upper surface, whereby upward movement of the swab will cause the flexible lip to be distorted by the weight of the fluids thereabove so as to aid the distortion of the packing element into sealing engagement with the well casing, said lip being reinforced by suitable radial ribs.

A further object of the invention is to provide an improved packing element for a well swab having a plurality of recesses or pockets in its upper surface, whereby when the swab is in lifting position the element will be distorted into engagement with the well casing, such distortion being materially aided by the action of the fluid above the element on the recesses in said element.

Still another object of the invention is to provide an improved split swab rubber having a plurality of inwardly inclined cylindrical recesses formed in its upper end, whereby fluid above the rubber may act thereon to aid in distorting the same into its sealing position.

A still further object of the invention is to provide a split swab rubber, of the character described, which is arranged to be mounted upon a supporting mandrel and has vertical lips or rib formed on the inner surface thereof adapted to slidably engage within diametrically-opposed channels or grooves extending vertically in the exterior of the mandrel, the distortion of the rubber into packing-off position tending to urge the lips into sealing engagement with their channels, whereby said lips increase the sealing action of said rubber relative to the mandrel as well as prevent displacement of the rubber.

A construction designed to carry out the invention will be hereinafter described, together with other features of the invention.

The invention will be more readily understood from a reading of the following specification and by reference to the accompanying drawings, in which an example of the invention is shown, and wherein:

Figure 1 is an elevation of a swab having a swab rubber, constructed in accordance with the invention, mounted thereon,

Figure 2 is an enlarged, transverse, vertical, sectional view of one of the swab rubbers,

Figure 3 is a transverse, vertical, sectional view of the lower portion of the swab, showing the mandrel in elevation,

Figure 4 is a horizontal, cross-sectional view, taken on the line 4—4 of Figure 1,

Figure 5 is a horizontal, cross-sectional view, taken on the line 5—5 of Figure 1,

Figure 6 is an isometric view of one section or unit of the swab rubber,

Figure 7 is a view, similar to Figure 1, of a modified form of the swab,

Figure 8 is a horizontal, cross-sectional view, taken on the line 8—8 of Figure 7,

Figure 9 is a view, similar to Figure 3, of the modified swab,

Figure 10 is an isometric view of this form of the swab rubber,

Figure 11 is a transverse, vertical, sectional view of another form of the swab rubber, and

Figure 12 is a similar view, of still another form of the swab rubber.

In the drawings, the numeral 10 designates a mandrel which is preferably made of a solid piece of metal, or other suitable material. The mandrel is substantially cylindrical in cross-section and has its upper end screw-threaded within a cylindrical box 11 which is provided with an upwardly extending pin 12, preferably made integral therewith. The pin is of such size as to receive the standard coupling or box (not shown) of the usual well rod, whereby the mandrel may be readily connected to said rod and lowered into the well casing A. The lower end of the mandrel has a cap or nut 13 threaded

thereon and said nut has its end rounded so that the lowering of said mandrel into a fluid is facilitated.

A flexible or elastic packing element 14 is mounted on the mandrel and is constructed of two halves or units 15 and 16 which are semi-circular in cross-section and are arranged to engage around the mandrel, as is clearly shown in Figure 3. Both units are exactly alike so that when they are positioned in horizontal alinement with each other they form an annular packing element. The unit 15 is slidable vertically throughout the length of the mandrel 10, while the unit 16 is mounted in a fixed position at the lower end of said mandrel as will be hereinafter explained. With this arrangement, the unit 15 may be displaced vertically out of horizontal alinement with the other unit 16.

Since each unit is exactly like the other, a description of one will suffice. Each unit includes an elastic or resilient packing member 17 which is substantially semi-circular in cross-section and which has its outer surface tapered inwardly at its upper and lower ends. The upper end of the packing member is adapted to fit within the recess 18 of a thimble 19. The thimble is substantially semi-circular in cross-section and is arranged to snugly fit the outer surface of the cylindrical mandrel.

For fastening the upper end of the packing member within the recess 18 of said thimble, said packing member is formed with a radial opening 20 which is in alinement with an opening 21 formed in the inner wall of the thimble (Figure 4). The outer wall of the thimble is formed with a reduced opening 22, the inner end of which is enlarged to the diameter of the openings 20 and 21, whereby an internal annular shoulder 23 is formed in the outer wall of said thimble. It is noted that the openings 21, 20 and 22 are in alinement with each other. After the upper end of the packing member 17 has been inserted into the recess 18 of the thimble 19 and before the unit is placed around the mandrel, a pin 24 is inserted into the openings from the inside of said thimble. This pin fits snugly within the openings 21 and 20 and the enlarged portion of the opening 22.

The extreme outer end of the pin is reduced as shown at 24a so as to fit within the reduced opening 22. The offset or shoulder formed on the pin abuts the internal annular shoulder 23 in the outer wall of the thimble, whereby outward movement of the pin is prevented. When the unit is mounted on the mandrel 10, the inner end of the pin engages the outer surface of said mandrel, whereby inward displacement of the pin is prevented. When it is desired to remove the pin, it is merely necessary to remove the unit from the mandrel and push the pin inwardly out of the openings.

The lower end of the packing member 17 is inserted within the recess 25 of a thimble 26, which is identical in construction to the upper thimble. The lower end of the packing member is retained within the lower thimble by a pin 27, identical to the pin 24. As is clearly shown in Figure 2, the inner surface of the packing member has its intermediate portion projecting radially inwardly, whereby said intermediate portion is of materially greater thickness than the ends of said member. Obviously, this enlargement of the intermediate portion of the member 17 provides an internal, arcuate shoulder 28 at the top of said member and a complementary shoulder 29 at its bottom which are engaged by the ends of the inner walls of the thimbles 19 and 26 (Figure 3). Thus, the inner surface of the intermediate portion is flush with and forms a continuation of the inner walls of the thimbles.

An inwardly-inclined recess or groove 30, which is arcuate or semi-circular in cross-section, is formed in the upper, inwardly-tapered surface of the packing member adjacent its external straight wall, whereby an arcuate wall or lip 31 is provided at the intersection of said tapered surface and straight wall. The lip 31 is flexible and may be reinforced by a plurality of radial ribs or webs 32 which extend across the recess 30 and downwardly to the bottom thereof so as to divide the same into a plurality of equispaced pockets or openings 33. The provision of this lip in the upper end of each packing member tends to materially aid the distortion of said members. Upon the upstroke of the mandrel 10 and the units 15 and 16 of the packing element 14, the lips 30 of the packing members 17 of said units will be exposed to the weight of the fluid or liquid being lifted, whereby the fluid may act on the members to distort the same into engagement with the inner surface of the casing A. The increased distortion of the members by the fluid also increases the contact between the engaging vertical inner faces of the members to assure a fluid-tight seal therebetween.

For slidably mounting the unit 15 on the mandrel 10, a pair of diametrically-opposed channels or keyways 34 are provided in said mandrel and extend vertically throughout the length thereof. Each thimble 19 and 26 is provided with an inwardly projecting pair of ribs or keys 35 which are located at the inner surface thereof. The ribs or keys are adapted to slide within the channels or keyways 34 of the mandrel and, obviously, prevent displacement of the unit from said mandrel. In mounting the mandrel, it is only necessary to remove the nut 13 at the lower end thereof, and to slide the unit upwardly on said mandrel, whereby the keys 35 engage the channels 34. The nut is then returned to the lower end of the mandrel and it will be seen that the unit 15 is confined to a vertical movement between said nut and the box 11 at the upper end of said mandrel.

The unit 16 is constructed exactly as is the unit 15 and is mounted on the mandrel in a similar manner. However, the inwardly projecting ribs or keys 35 of the thimbles of this unit engage in diametrically-opposed grooves or keyways 36. The length of the grooves 36 is less than the length of the channels 34, being substantially the vertical length of the unit 16. Thus, the grooves or keyways 36 extend from the lower end of the mandrel to a point opposite the upper end of the unit 16. It is pointed out that the grooves 36 extend contiguous to the channels 34 and, therefore, the lower ends of the latter are combined with the former to provide a comparatively wide recess at the lower end of the mandrel.

A pair of diametrically-opposed lips or ribs 37, similar to the ribs 35, are preferably made integral with the interior of each packing member 17 at its intermediate portion as shown in Figure 5. The internal lips of each packing member are vertically alined with the ribs of its respective thimbles 19 and 26 and are arranged to engage within the keyways of the mandrel to prevent

displacement of said member from said mandrel. As will be hereinafter more fully explained, these lips tend to seal off the space between the units and the mandrel, and particularly the keyways thereof.

Since the grooves 36 terminate at the upper end of the unit 16, it will be seen that the uppermost thimble of said unit will abut the upper end of said grooves. It will be held in this position by the engagement of the nut 13 with its lower end, whereby the unit is mounted in a fixed position on the mandrel and incapable of movement with relation thereto. Since the channels 34 within which the unit 15 is slidable extend throughout the length of the mandrel, it will be evident that this unit may slide vertically with relation to the unit 16 which is attached in fixed position on said mandrel. Although it has been found practical to mount the units in the manner above described, it is pointed out that other methods of mounting said units on the mandrel may be employed. The particular mounting of the units forms no part of the present invention and is, therefore, subject to variation.

In operation, the assembly is secured to a string of sucker rods or other lowering device (not shown) and is lowered into the well casing A with the parts in the position shown in Figures 1 and 3. As soon as the assembly strikes the fluid within the casing, the resistance of said fluid together with the frictional engagement of the packing member 17 of the unit 15 with the well casing A will immediately raise said unit 15 on the mandrel, the keys 35 on the thimbles of said unit sliding upwardly in the diametrically-opposed channels 34. The mandrel is of such length as to permit the unit 15 to move upwardly to the position shown in dotted lines in Figure 1, whereby the lower end of said unit will be above the upper end of the unit 16. Manifestly, this displacement of the movable unit out of horizontal alinement with the stationary unit acts as a valve to permit by-passing of the fluid on the downstroke of the device. Of course, if there is any fluid pressure within the casing A, the same will raise the unit 15 to its upper position.

When the assembly has reached its lowermost position and the raising operation has begun, the weight and pressure of the fluid above the assembly will immediately act upon the elevated unit 15 to lower the same. This unit will, of course, immediately move downwardly on the mandrel until the lower ends of its thimble 26 rest upon the nut 13. In this position, the unit 15 is opposite the stationary unit 16 and the fluid will then act upon both units to force the thimbles 19 thereof downwardly toward the thimbles 26, whereby the resilient or elastic packing members 17 are distorted outwardly into engagement with the inner wall of the well casing A. This distortion of the packing members is aided by the lip 30 formed in the upper end of each member. The fluid above the packing members will enter the pockets or openings 33 and the weight or downward pressure of said fluid will be exerted against the lip and webs 32 which form the walls of said pockets so as to enlarge or expand the size of the same, whereby the portion of each packing member surrounding the arcuate recess 30 thereof will be displaced or distorted, with the result that the lips of said members will move outwardly into engagement with the casing. This distortion of the packing members will also cause the inner surfaces of said members to move radially inwardly into engagement with the mandrel, and particularly the lips 37 which are disposed in the keyways of said mandrel. Thus, the lips provide an auxiliary means upon which the fluid may act to assure a positive frictional engagement between the casing and packing members, as well as between the mandrel and said members. Continued upward movement of the assembly after the packing members 17 have moved into engagement with the casing will lift the fluid above the packing element 14 and, at the same time, the inner wall of said casing will be swabbed.

In Figures 7 to 10, a modified form of the invention is shown and includes an elastic or resilient packing member 38 which is similar to the packing member 17. The member 38 is substantially semi-circular in cross-section and has its exterior tapered at its upper and lower ends, while its entire inner surface or wall is disposed in a vertical plane. A plurality of cylindrical recesses or pockets 39 are provided in the upper inwardly-tapered surface of the packing member. The recesses 39 are spaced an equi-distance apart and are inclined inwardly and downwardly, as is clearly shown in Figure 9. The recesses do not extend entirely through the member 38, but have their inner ends terminating at substantially the central portion thereof or midway between the inner and outer surfaces of said member. It is readily apparent that these inclined recesses are exposed to the fluid above the member and aid the distortion of said member into packing position.

A radial opening 40, similar to the opening 20, is provided at the upper and lower ends of each packing member 38 so that it may be fastened to the thimbles 41 and 42. These thimbles may be similar to the thimbles 19 and 26 but are, preferably, formed in accordance with the disclosures of my copending applications which have been hereinbefore set forth. The inner wall of the upper thimble 41 is extended downwardly to form a projecting skirt 43, while a similar skirt 44 is provided by upward extension of the inner wall of the thimble 42. The skirts 43 and 44 extend contiguous to the inner wall of the packing member when said member is in position within the thimble. It is noted that when the packing member is secured between the thimbles 41 and 42, the inner ends of the skirts 43 and 44 of said thimbles are spaced from each other. This position is clearly shown in Figure 9, and occurs when the packing member is in its normal or undistorted position.

The upper thimbles 41 will move downwardly until the inner edges of the skirts 43, which project downwardly therefrom, strike the inner edges of the upwardly projecting skirts 44 on the lower thimbles 42. When this occurs, further distortion of the packing members is prevented. Therefore, it will be seen that the extended skirts provided on the thimbles provide a positive means for preventing a distortion of the packing members beyond their elastic limits. However, the fluid may continue to act upon the packing members through the recesses to distort said members independently of the thimbles.

The recesses or pockets 39 serve the same purpose as the flexible lip 31 of the member 17 in that they tend to aid the distortion of the member 38. When a well swab having packing members of this type is used to raise a fluid, the pressure or weight of said fluid will be exerted against the walls of the recesses of said members, where-

by the portion of the members surrounding said recesses will be displaced to increase the distortion of said members. Therefore, it is obvious that distortion of the packing members 38 into engagement with the inner wall of the casing is assured.

Another form of the invention is disclosed in Figure 11 and includes a resilient or flexible packing member 45 which is substantially semi-circular in cross-section and which has its outer surface tapered at its upper and lower ends. At the intersection of the upper tapered surface with the outer straight wall of the member, a shoulder or lip 46 is formed, being preferably made integral with said member and being exposed around the outer surface thereof. The shoulder is inclined inwardly and downwardly and, obviously, is exposed to the fluid thereabove. The member 45 is similar to the member 38 and is formed with a radial opening 47 at its upper and lower ends, whereby said member may be secured to the thimbles 41 and 42.

It is manifest that the inclined shoulder 46 is provided for the same purpose as the lip 31 and recesses 39 of the other packing members and increases the distortion of the member 45, since the pressure or weight of the fluid above said member is exerted thereupon. Thus, a fluid-tight seal between the packing members and the internal surface of the well casing is assured.

In order to increase the flexibility of the packing element 14, and particularly the mid-portion thereof, so as to facilitate the passage of said element past the couplings of the casing A, a slightly modified form of packing member 48 (Figure 12) may be substituted for the packing member 17. The member 48 is substantially semi-circular in cross-section and has its outer surface tapered inwardly at its upper and lower ends. The general appearance of this member is very similar to that of the member 17 and the same is formed with a radial opening 49 at each end so that it may be secured to the thimbles 19 and 26.

An arcuate groove or recess 50, similar to the recess 30, is formed in the upper inwardly-tapered surface of the member 48 adjacent its external straight wall, whereby an arcuate lip 51, similar to the lip 31, is provided at the intersection of said surfaces. The rear or inner wall of the recess 50 is disposed in a vertical plane and extends from the upper end of the packing member downwardly past the central portion thereof and terminates at a point in substantially the same horizontal plane as the intersection line between the straight and lower tapered surfaces of said member. Thus, the lip 51 is composed of substantially the entire external mid-portion of the member 48 and is considerably much more flexible than the lip 31. This flexible lip may be reinforced by a plurality of radial ribs or webs 52 which extend across the recess 50, upwardly to the top of the member and downwardly to the bottom of said recess, thereby dividing the latter into a plurality of equi-spaced pockets or openings 53. The lip 51 not only tends to materially aid the distortion of the member 48 but also increases the flexibility of the same, whereby the passage of the packing element 14 past the casing couplings is facilitated. The inner surface of the packing member is identical to that of the member 17 and the intermediate portion thereof may be provided with suitable lips (not shown) for engaging within the keyways of the mandrel.

It is pointed out that, if desired, the packing member 45, as well as the packing member 38, could be made in the same manner as the packing members 17 and 48 so that they could be mounted on the thimbles 19 and 26. In this event, the members 38 and 45 would be provided with the internal ribs or lips 37 of the members 17 and 48. Conversely, the internal contour of the members 17 and 48 could be formed complementary to the thimbles 41 and 42, whereby said member would have the same general appearance as the members 38 and 45 and could be substituted therefor.

The foregoing description of the invention is explanatory thereof and various changes in the size, shape and materials, as well as in the details of the illustrated construction, may be made, within the scope of the appended claims, without departing from the spirit of the invention.

What I claim and desire to secure by Letters Patent is:

1. As a sub-combination in a well swab, a packing assembly including, a mandrel having vertical grooves therein, and a split elastic sealing element, the element being arranged to be distorted radially into a sealing position and having integral means for engaging the grooves of the mandrel to retain said element on said mandrel, the distortion of the element urging said means into snug engagement with said grooves so as to seal off between the mandrel and element.

2. As a sub-combination in a well swab, a packing assembly including, a mandrel having vertical grooves therein, and a split elastic sealing element, the element being arranged to be distorted radially into a sealing position and having vertical ribs for engaging the grooves of the mandrel to retain said element on said mandrel, the distortion of the element urging said ribs into snug engagement with said grooves so as to seal off between the mandrel and element.

3. As a sub-combination in a well swab, a packing assembly including, a grooved support, and a split elastic sealing element arranged to be distorted radially into sealing position and having integral means for engaging the grooved support to retain the element on said support, said element having a plurality of recesses exposed to and adapted to be acted upon by the fluid thereabove for increasing the radial distortion of the internal and external peripheral portions thereof.

4. As a sub-combination in a well swab, a packing assembly including, a grooved support, and a split elastic sealing element arranged to be distorted radially into sealing position and having integral elastic means for engaging the grooved support to retain the element on said support, said element having flexible means at its external peripheral portion exposed to and adapted to be acted upon by the fluid thereabove for increasing the radial distortion of the internal and external peripheral portions thereof.

5. The sub-combination set forth in claim 4 wherein the element has means for reinforcing the flexible means, the distortion of the element urging the integral elastic means into snug engagement with the grooved support so as to seal off between said support and the element.

6. The sub-combination set forth in claim 4 wherein the flexible means is an inwardly and downwardly inclined shoulder.

7. A packing assembly for a well swab including a pair of units arranged to be displaced out of horizontal alinement with each other to permit fluid to freely by-pass the assembly on the downstroke of the swab, each unit including an elongate elastic body portion solid in cross-section

and adapted to be distorted radially into sealing position on the upstroke of said swab, a flexible lip formed on the exterior of the body portion adjacent to and below the upper end thereof and having its inner surface spaced from said body portion so as to provide a pocket therebetween, the pocket being exposed to and adapted to be acted upon by the fluid thereabove for increasing the radial distortion of the peripheral portions of the body portion, and integral means extending from the upper end of said body portion to said lip for reinforcing the latter and preventing excessive distortion thereof.

8. As a sub-combination in a well swab having a displaceable section, an elongate elastic member substantially semi-circular in cross-section and having its ends reduced, the member being adapted to be distorted radially into sealing position and being solid in cross-section, said member having a plurality of pockets formed in its external peripheral portion adjacent to and below its reduced upper end and terminating short of the internal surface of the member so as to be disposed intermediate the external and internal surfaces thereof, the pockets being exposed to and adapted to be acted upon by the fluid thereabove for increasing the radial distortion of said external and internal peripheral portions.

9. As a sub-combination in a well swab having a displaceable section, an elongate elastic member substantially semi-circular in cross-section and having its ends reduced, the member being adapted to be distorted radially into sealing position and being solid in cross-section, an arcuate flexible wall made integral with the external peripheral portion of said member below its reduced upper end and being spaced radially from the member so as to provide an arcuate recess therebetween, the recess being exposed to and adapted to be acted upon by the fluid thereabove for increasing the radial distortion of the internal and external peripheral portions of said member, and radial flexible ribs extending from said reduced upper end to the wall and into said arcuate recess so as to divide the same into a plurality of pockets, whereby the ribs reinforce said wall and prevent undue distortion thereof.

10. A packing assembly for a well swab including a pair of units arranged to be displaced out of horizontal alinement with each other to permit fluid to freely by-pass the assembly on the downstroke of the swab, each unit including an elongate elastic body portion solid in cross-section and adapted to be distorted radially into sealing position on the upstroke of said swab, a flexible lip formed on the exterior of the body portion adjacent to and below the upper end thereof and being disposed outwardly of said body portion so as to provide an arcuate pocket therebetween, the pocket being exposed and adapted to be acted upon by the fluid thereabove on the upstroke of the swab for increasing the radial distortion of the internal and external peripheral portions of the body portion, and radial flexible ribs extending from the upper end of said body portion to the lip and into said pocket so as to divide the same into a plurality of recesses, whereby the ribs reinforce said lip and prevent undue distortion thereof.

BENJAMIN E. PARRISH.