April 21, 1953 D. T. HARBISON 2,635,331

METHOD OF FORMING NONMETALLIC RESILIENT PACKING RINGS

Filed Feb. 25, 1950 3 Sheets-Sheet 1

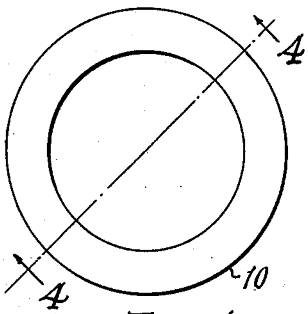


Fig. 1

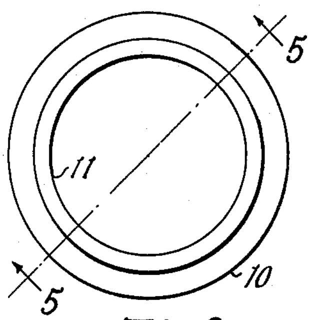


Fig. 2

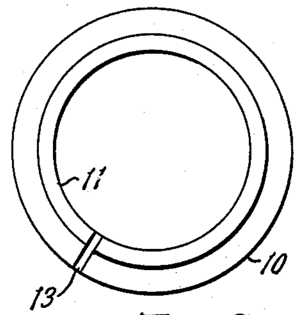


Fig 3

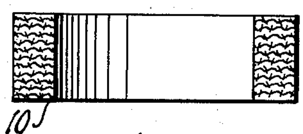


Fig. 4

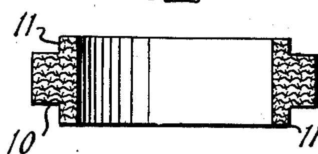


Fig. 5

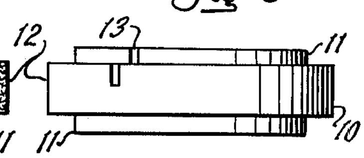


Fig. 6

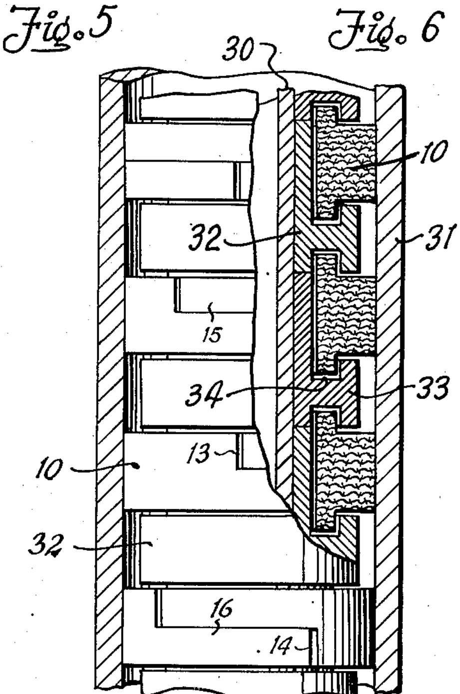


Fig. 12

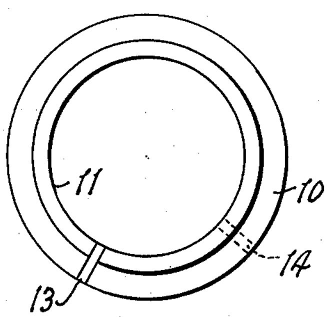


Fig. 7

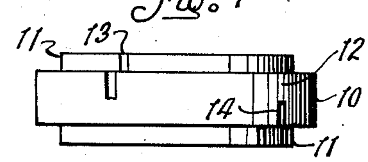


Fig. 8

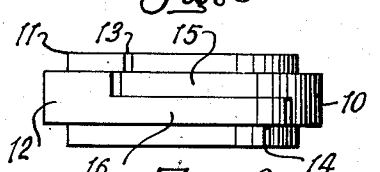


Fig. 9

Inventor

Dixon T. Harbison

By Ashley & Ashley

Attorneys

METHOD OF FORMING NONMETALLIC RESILIENT PACKING RINGS

Filed Feb. 25, 1950

3 Sheets-Sheet 2

Fig. 10

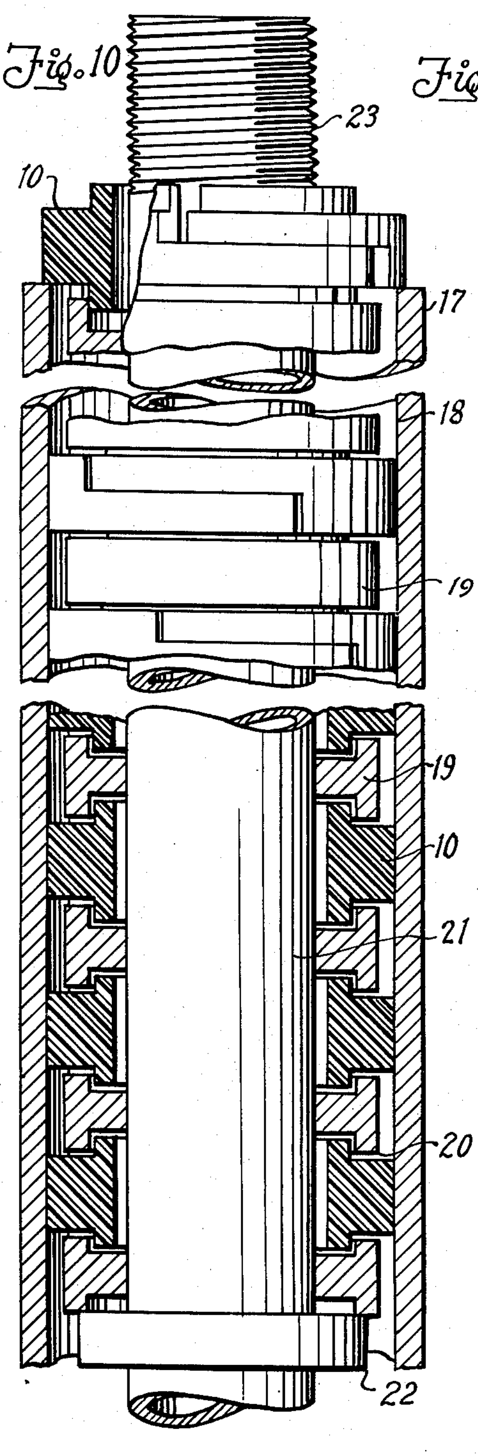
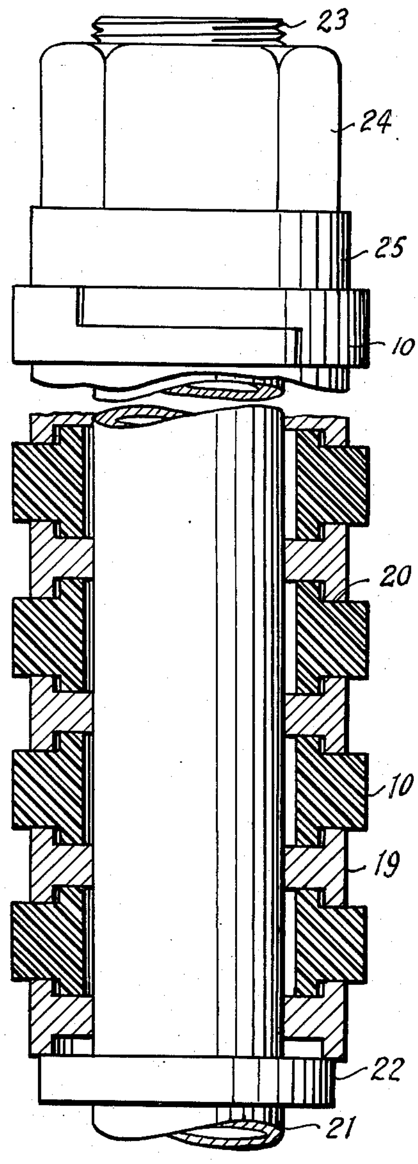


Fig. 11



Inventor
Dixon T. Harbison

By Ashley & Ashley

Attorneys

April 21, 1953 D. T. HARBISON 2,635,331

METHOD OF FORMING NONMETALLIC RESILIENT PACKING RINGS

Filed Feb. 25, 1950 3 Sheets-Sheet 3

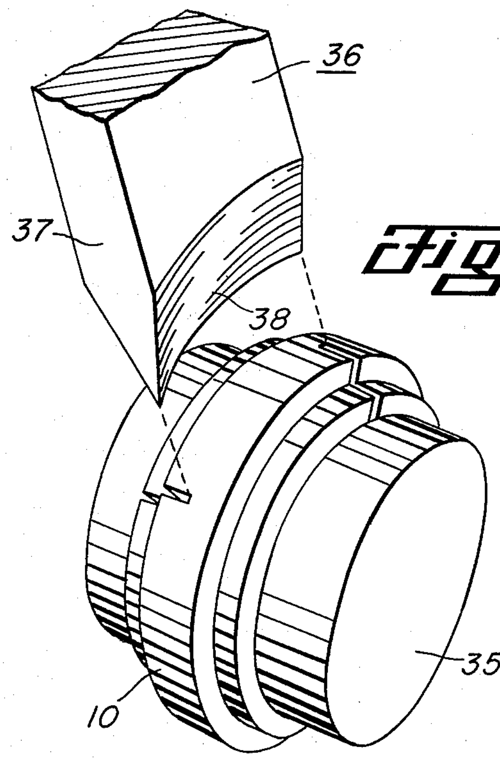


Fig. 13

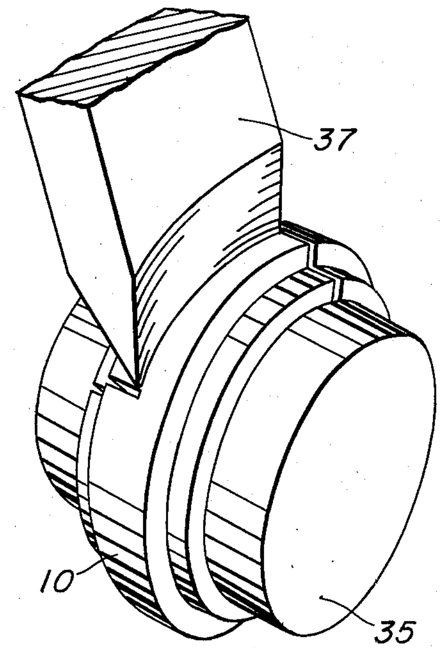


Fig. 14

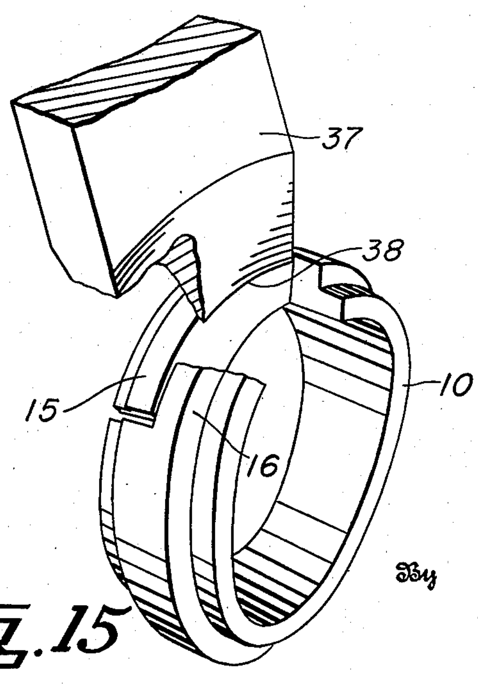


Fig. 15

Inventor

Dixon T. Harbison

By Ashley & Ashley

ATTORNEYS

Patented Apr. 21, 1953

2,635,331

UNITED STATES PATENT OFFICE

2,635,331

METHOD OF FORMING NONMETALLIC RESILIENT PACKING RINGS

Dixon T. Harbison, Fort Worth, Tex.

Application February 25, 1950, Serial No. 146,377

3 Claims. (Cl. 29—156.62)

1

This invention relates to new and useful improvements in methods of forming non-metallic resilient packing rings.

One object of the invention is to provide an improved method of forming a packing ring which is particularly adapted for use in reciprocating oil well pumps as well as in other pump cylinders.

Another object of the invention is to provide an improved method of forming a resilient packing ring for a pump plunger, which ring is of such construction and which is split in such manner that a predetermined quantity of well fluids is directed therebehind for urging the same outwardly into sealing engagement with the cylinder wall whereby the pressure of said well fluids is prevented from collapsing said ring inwardly away from said cylinder wall.

An important object of the invention is to provide an improved method of forming a packing ring of resilient material wherein a split annulus is formed and then the exterior thereof is machined while the annulus is contracted to produce a ring having an inherent tendency to expand and a uniform external radius when in its operative sealing position.

A further object of the invention is to provide an improved ring forming method, of the character described, wherein the annulus is cut from a sheet of laminated plastic material whereby the laminations extend at right angles to the axis of said annulus so as to enhance the strength and wearing qualities of the ring.

Still another object of the invention is to provide an improved ring forming method, of the character described, wherein the annulus is of slightly greater diameter than the finished ring to permit machining of its periphery and said annulus is split in such a manner as to provide angular off-set or overlapping end portions which coact to permit the passage of a predetermined quantity of fluid therebetween.

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, wherein an example of the invention is shown, and wherein:

Figs. 1, 2 and 3 are plan views of an annulus illustrating the steps of cutting the annulus, forming shoulders thereon and commencing the split in accordance with the invention,

Figs. 4 and 5 are transverse, vertical, sectional views, taken on the lines 4—4 and 5—5 of Figs. 1 and 2, respectively,

2

Fig. 6 is a side elevational view of the partially split annulus shown in Fig. 3,

Fig. 7 is a plan view of the annulus after the second splitting,

Fig. 8 is a side elevational view of the annulus shown in Fig. 7,

Fig. 9 is a view, similar to Fig. 8, showing the completely split annulus,

Fig. 10 is a transverse, vertical, sectional view, partly in elevation, showing a plurality of split annuli contracted within a tube and separated by spacers with a mandrel extending therethrough,

Fig. 11 is a view, similar to Fig. 10, showing the annuli clamped upon the mandrel in a fixed, spaced relation, preparatory to machining the peripheries of said annuli,

Fig. 12 is a view, partly in elevation and partly in section, of a plurality of completed packing rings mounted upon a pump plunger in sealing engagement with a working barrel, and

Figs. 13, 14 and 15 are fragmentary views in perspective illustrating the ring splitting step.

This application is a continuation-in-part of my co-pending application, Serial No. 734,374, filed March 13, 1947, now abandoned. Reference is made to my co-pending application, Serial No. 24,649, filed May 1, 1948, now U. S. Letters Patent No. 2,499,952, issued March 7, 1950.

Heretofore, packing rings of composition material have been made from cylindrical tubes or have been cut from flat sheets. If the rings originally are of a diameter substantially equal to the working diameter of the finished ring, the same lack the necessary tension when split and placed in use. In the event the original ring is oversize, the same is distorted when compressed to working diameter and does not form a true or perfect circle. Manifestly, a packing ring which fails to snugly engage a cylinder wall throughout its peripheral surface is collapsed and urged away from the wall by the pressure of the fluid being handled. On the other hand, a ring having a uniform radius of curvature and of sufficient tension to snugly engage a cylinder wall is maintained in sealing position throughout its periphery whereby collapsing of the same is prevented. By forming the joint of the ring in such a manner as to admit a predetermined quantity of fluid therebehind, the maintenance of said ring in sealing position is materially assisted.

In carrying out the method of the present invention, an annular body or annulus 10 (Fig. 1) is cut or trepanned from a flat sheet of fibre reinforced plastic material (not shown) which is preferably laminated so as to increase the strength and wearing qualities of the annulus.

The external diameter of the annulus 10 is greater than that required of the finished ring and has the laminations of the material extending at right angles to the axis thereof. As is most clearly shown in Fig. 4, the annulus is preferably of greater axial width than radial thickness (Fig. 4). When desirable, coaxial flanges or shoulders 11 are formed at the inner peripheral edge portions of the annulus by circumferentially recessing or cutting away the outer peripheral edge portions thereof and these flanges are relatively thin (as shown in Figs. 2 and 5). Thus, a peripheral surface 12 of reduced width is provided and the annulus is substantially T-shaped in cross-section.

In order to form a joint in the annulus having a controlled or predetermined fluid passage of restricted area, the same is preferably split in the following manner. As shown in Figs. 3 and 6, a radial notch or gap 13 is cut through one edge portion of the annulus and its flange 11 to a depth of substantially one-half its axial thickness. A complementary notch or gap 14 is cut through the opposite flange and edge portion of the annulus at a point offset or spaced from the notch 13 (Figs. 7 and 8). Although the spacing of the notches is subject to variation, it has been found that an offset of approximately seventy-five degrees (75°) is satisfactory. Smaller or greater spacings may be used when desirable. It is pointed out that a predetermined amount of material is removed by the forming of the notches.

A pair of coacting, sealing tongues or bridging elements 15 and 16 are provided by splitting the annulus circumferentially between the inner end or base portions of the notches 13 and 14 as shown in Fig. 9. The splitting is accomplished with the removal of substantially no material between the tongues 15 and 16, whereby the contacting or contiguous internal surfaces of said tongues coact throughout their coincidental or overlapping lengths to seal the step joint against leakage between the notches. Due to the removal of material in forming the notches, fluid is permitted to pass radially through and behind or within the annulus when in operation so as to assist in expanding the same into sealing position.

The split annulus is next contracted or compressed by being forced into a cylindrical tube or sleeve 17 which has its bore 18 precision machined throughout its length to a predetermined uniform or constant diameter (Fig. 10). The bore 18 is preferably of slightly greater diameter than the working diameter of the finished ring to permit subsequent machining of the peripheral surface 12. For economy of manufacture, a plurality of similar annuli are inserted in the tube 17 and are separated by complementary spacer collars 19. When the annuli are formed with axial flanges 11, the collars 19 are T-shaped in cross-section and have complementary coaxial flanges 20 at their outer peripheral edge portions for surrounding said annuli flanges. The collars are of less diameter than the annuli and the combined thickness of the flanges 11 and 20 is less than the radial thickness of said annuli so as to provide sufficient clearance for the lateral or radial adjustment of the annuli to the tube bore 18.

A cylindrical mandrel 21, having a diameter substantially equal to the internal diameters of the collars 19 is then telescoped or inserted through said collars and the alternately spaced annuli. The mandrel 21 has a radial shoulder or flange 22 formed on one end, while its opposite end is screw-threaded as shown by the numeral 23. With the annuli and collars confined within the tube 17, a suitable nut 24 is threaded upon the mandrel and a spacer ring 25 (Fig. 11) is confined between the nut and the adjacent annulus. By tightening the nut 24, the annuli are clamped upon the mandrel in their contracted or compressed positions between the mandrel flange 22 and the spacer ring 25.

As shown in Fig. 11, the mandrel with the annuli clamped thereupon may be removed from the tube 17 for the final operation. Due to the complementary shape of the collars 19, the annuli are frictionally held against displacement during subsequent machining of said annuli. Although not illustrated, the peripheral surfaces 12 of the annuli are adapted to be ground, machined or otherwise finished to the exact working diameter desired by supporting the mandrel in a lathe or other machine tool (not shown). The machined annuli have true or perfect circle peripheries so as to accurately fit a pump cylinder of a predetermined diameter when said annuli are compressed or contracted to such diameter. Since the annuli are compressed or contracted, the same are under tension so as to urge their peripheries constantly into sealing engagement with a cylinder wall.

In Fig. 12, the completed packing rings 10, disclosed in United States Letters Patent 2,499,952, issued March 7, 1950, are shown mounted upon a tubular plunger 30 within a well pump cylinder or working barrel 31. A plurality of spacer collars 32 are carried by the plunger in superimposed, abutting relation and each collar has a radial flange 33 which is T-shaped in cross-section. The flanges 33 of adjacent collars 32 coact to form annular grooves 34 complementary to and adapted to receive the packing rings. Since the grooves 34 are of greater depth and slightly greater width than the rings, the latter may undergo limited lateral and vertical movement. The inherent tendency of the rings to expand maintains the peripheral surfaces of the same in sealing engagement with the wall of the cylinder 31.

Due to the particular step joint of each ring and the coaction of its sealing tongues 15 and 16, only a predetermined quantity of well fluids is admitted through the gaps 13 and 14 of said joint. These fluids will flow into the annular space between the ring and its groove 34 so as to act radially outwardly upon said ring and thereby assist in maintaining the periphery of the same in sealing engagement with the cylinder wall. Thus, collapsing of the ring and movement of the same away from the cylinder wall by the pressure of the well fluids is prevented. The spacing of the notches prevents the well fluids from merely flowing into one notch and directly out through the other notch. Due to the provision of these notches, the well fluids may flow into one notch while flowing out of the other one and said fluids may pass from one ring to an adjacent ring upon reciprocation of the plunger. Although this flow is limited, it is sufficient to maintain the rings in sealing engagement with the cylinder wall and to wash away sand, grit or other extraneous matter. Of course, there is no flow past all of the rings on any one stroke of the plunger, although there is a more or less constant movement of the well fluids.

The step of splitting the annuli 10 between the notches or gaps 13 is important and novel. The fibre-reinforced plastic or synthetic resin material from which the packing rings are formed has been substantially completely hardened or polymerized and will not receive a permanent distortion. For this reason, it is not possible to cut a circumferential slot between the bottoms of the notches **13** and then deform or distort the annulus so as to bring the resulting tongues **15** and **16** into permanent sliding engagement. The strength and resiliency of the plastic material prevent such a step which is common in the metal-working arts. Stated in another manner, the elastic limit of the plastic material is so near its ultimate strength that permanent distortion without destruction cannot be obtained with practical success.

This problem has been overcome by the novel step of splitting the annulus without the removal of any material, although a very small amount of material may be removed in dressing or smoothing the abutting faces of the tongues **15** and **16**. The smoothing operation is desirable but not essential. The preferred mode of splitting includes positioning the annulus **10** upon a suitable mandrel or anvil **35**, as shown in Fig. 13. The anvil **35** is circular in cross-section and receives the annulus snugly so as to support the same in an adequate fashion. A curved chisel or wedge **36** is employed for the splitting and includes a body **37** having its lower end tapered or bevelled upon an arc to form a curved chisel edge **38**. It is to be noted that the curvature of the edge **38** is substantially equal to the curvature of the annulus periphery, and that the arcuate length of the edge is substantially equal to the circumferential distance between the bottoms of the notches **13**.

The wedge **36** is moved into engagement with the surface of the ring or annulus **10**, as shown in Fig. 14, and is then, preferably, given a sharp and sudden impetus which results in splitting of the ring as shown in Fig. 15. The edge **38** is not moved into engagement with the mandrel **35**, and the resultant action is one of splitting rather than cutting or slitting. Since no material has been removed, the tongues **15** and **16** spring into permanent abutment as soon as the wedge is withdrawn. There may be present a slight roughness of the adjacent faces of the tongues, and for this reason, moderate smoothing or dressing of the faces is desirable.

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. The method of forming a packing ring of reinforced synthetic resin, including, forming an annulus of synthetic resin having reinforcing laminations extending transversely to the axis of the annulus, removing material to form a substantially radial first gap in one edge portion of

the annulus, removing material from the opposite edge portion of the annulus at a point circumferentially spaced from the first gap to form a substantially radial second gap, and driving a wedge into the annulus between the gaps and transverse to the axis of the annulus to split the latter between the gaps substantially parallel to the plane of the laminations.

2. The method of forming non-metallic resilient packing rings which includes, cutting an annulus from a laminated sheet of substantially hard synthetic resinous material whereby the annulus has laminations extending transversely to its axis, cutting notches approximately half way through the thickness of the annulus at circumferentially spaced points in the upper and lower portions thereof, moving into engagement with the outer periphery of the annulus between the bottoms of the notches a wedge having an arcuate edge formed with the same radius of curvature as is the periphery of the annulus so as to conform substantially to the periphery of the annulus, and imparting force to the wedge to split the annulus in a transverse plane between the notches to provide constantly contacting overlapping tongues between the notches.

3. The method of forming non-metallic resilient packing rings which includes, cutting an annulus from a laminated sheet of substantially hard synthetic resinous material whereby the annulus has laminations extending transversely to its axis, cutting notches approximately half way through the thickness of the annulus at circumferentially spaced points in the upper and lower portions thereof, moving into engagement with the outer periphery of the annulus between the bottoms of the notches a wedge having an arcuate edge formed with the same radius of curvature as is the periphery of the annulus so as to conform substantially to the periphery of the annulus and of a length substantially equal to the distance between the notches, and imparting force to the wedge to split the annulus in a transverse plane between the notches to provide constantly contacting overlapping tongues between the notches.

DIXON T. HARBISON.

References Cited in the file of this patent

UNITED STATES PATENTS

Number	Name	Date
1,186,890	Gill	June 13, 1916
1,314,142	Loudenbeck	Aug. 26, 1919
1,314,143	Loudenbeck	Aug. 26, 1919
1,323,192	Kottusch	Nov. 25, 1919
1,380,136	Doan	May 31, 1921
1,386,997	Elliott	Aug. 7, 1921
1,450,200	Bruninga	Apr. 3, 1923
1,625,508	Thorne	Apr. 19, 1927
2,003,934	Hansel	June 4, 1935
2,046,988	Winter	July 7, 1936
2,218,638	Christenson	Oct. 22, 1940
2,255,504	Current	Sept. 9, 1941
2,344,687	Fischer	Mar. 21, 1944