

Sept. 2, 1969

C. M. FURGASON ETAL

3,464,709

LAMINATED PACKER

Filed May 20, 1966

2 Sheets-Sheet 1

Fig. 1

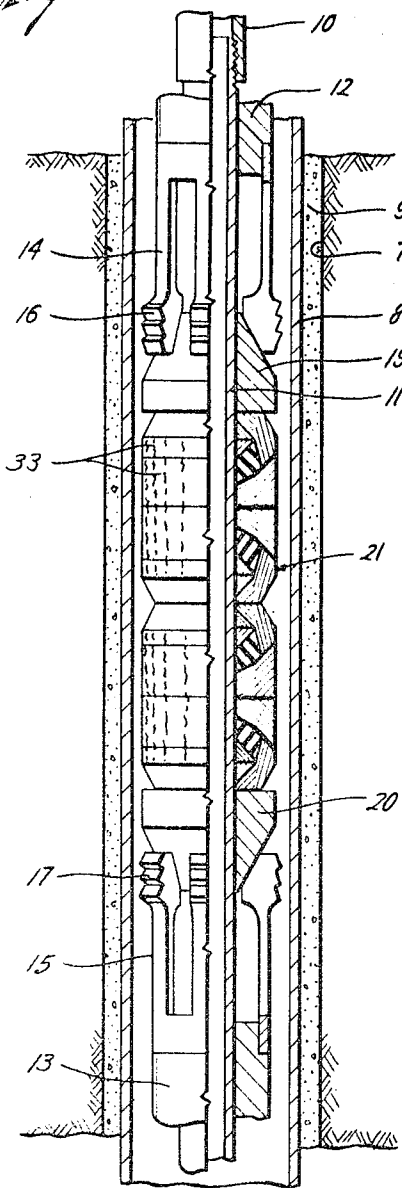


Fig. 2

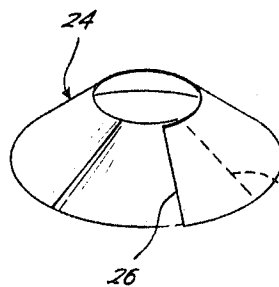
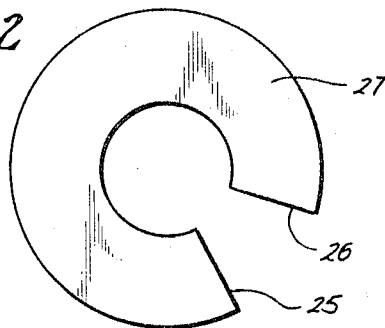


Fig. 3

Fig. 4

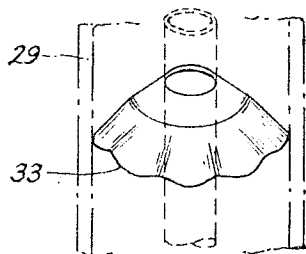
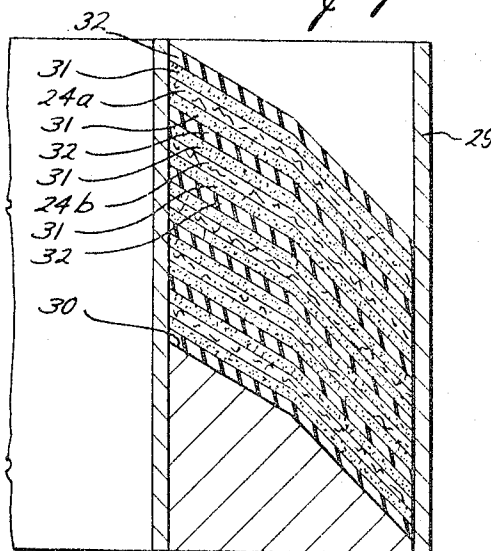


Fig. 9

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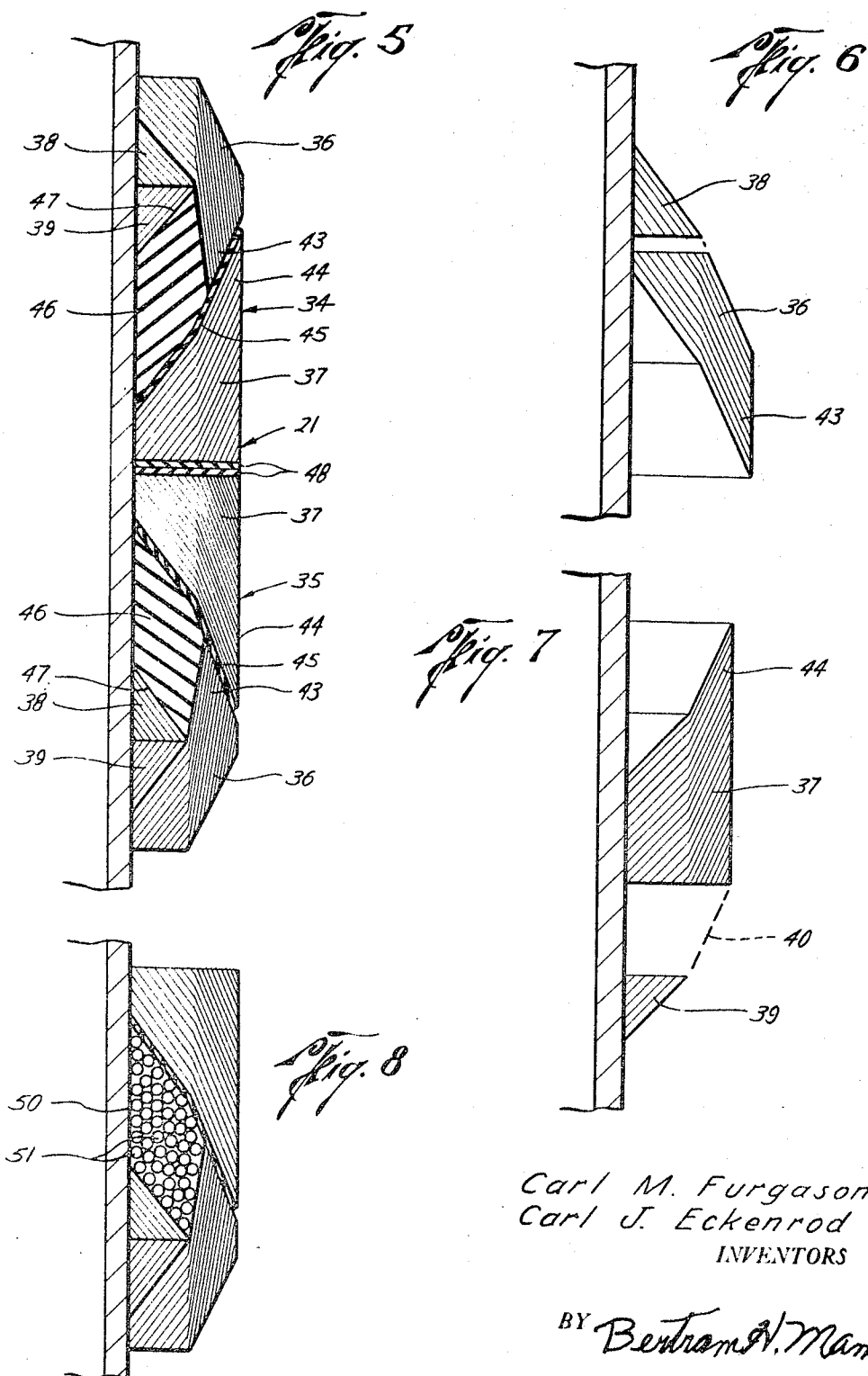
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LAMINATED PACKER

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2 Sheets-Sheet 2



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3,464,709

LAMINATED PACKER

Carl M. Furgason and Carl J. Eckenrod, Houston, Tex.,
assignors, by mesne assignments, to U.S. Industries,
Inc., a corporation of Delaware

Filed May 20, 1966, Ser. No. 551,738

Int. Cl. F16j 15/32, 15/56

U.S. Cl. 277-213

6 Claims

ABSTRACT OF THE DISCLOSURE

This high temperature-high pressure resistant packer is constructed of laminations of flexible asbestos sheeting which is exceptionally durable to high temperature and high pressure conditions, with intervening binder material. Internal means is provided to enforce radial expansion of the packer body upon axial compression thereof and the outer peripheries of the laminations are crimped to permit such radial expansion without undue stretching of the material of the lamination.

This invention relates to packers, particularly toroidal packers designed for resisting high temperatures and/or pressures, and to the method of constructing the same.

Devices for packing off or sealing clearances between working parts, for instance, regions of oil wells, usually embody elastomeric body members which are radially deformable by axial pressures applied thereto so as to effect the desired seal. The basic material often used is rubber, either natural or synthetic. However, such material is decomposed or otherwise deteriorated under high temperature conditions to which the packer may be exposed, for instance, in steam stimulation of oil and gas wells.

Accordingly, an object of the present invention is to provide a packer body, particularly a toroidal packer, which will withstand temperatures as high as 400 or 500 degrees or more without substantial deterioration.

Another object is to provide a packer constructed principally of a durable material such as asbestos fabric which is not stretchable or pressure deformable to any substantial extent under the operating conditions to which it is subjected, yet which can be inserted into a well and radially expanded to perform its pack-off function.

A related copending application Ser. No. 551,793 filed May 20, 1966, in the name of Carl M. Furgason discloses the concept of combining with a packer, consisting at least in part of synthetic rubber, a particulate metal, for instance, powdered iron, which will be affected by the moisture and/or other ingredients of the well fluid to form a new chemical compound. This residual substance, for instance, rust, is of greater volume than the combined metal and thus tends to compensate for shrinkage in the packer body due to decomposition of the rubber under high temperature conditions.

The present application is directed to the high temperature resistant packer body itself and the method of constructing the same. This body is constructed substantially of stacked, frusto-conical laminae of flexible asbestos sheeting with intervening binder material. The outer portions of the frusto-conical laminae are circumferentially corrugated or crimped, as by reducing the diameter thereof, to accommodate radial expansion of the packer body without stretching of the asbestos fabric material. Suitable means, for instance, that disclosed in the copending application Ser. No. 551,794 filed May 20, 1966, may be utilized to provide the necessary radial expansion of the packer body.

In the accompanying drawings which illustrate the invention,

FIG. 1 is a half elevation and half vertical transverse section through a more-or-less conventional packer embodying the invention;

FIG. 2 illustrates an asbestos fabric blank utilized in constructing the packer;

FIG. 3 is a perspective view showing the blank of FIG. 2 formed into a frusto-conical lamina;

FIG. 4 is a half elevation and half vertical transverse section on an enlarged scale showing a step in formation of the packer;

FIG. 5 is an enlarged vertical transverse half section illustrating the completed packer body;

FIGS. 6 and 7 are detail sectional views illustrating steps in the construction of the packer; and

FIG. 8 is a half longitudinal section illustrating a modification;

FIG. 9 is a perspective view of a lamination in the shape assumed when inserted in a contracting cylindrical mold.

FIG. 1 illustrates a bore hole 7 in the earth into which is extended a casing 8 cemented as at 9 in the usual manner. A tubing string 10 extends into the casing and is joined to the mandrel portion 11 of a packer with which the present invention is concerned. Received about the packer are spaced collars 12 and 13 to which are pivotally secured slip elements 14 and 15 having toothed or wick-ered elements 16 and 17 at their free ends.

In a downwardly-seating packer, upper collar 12 will be secured to the mandrel 11 which will be arranged to telescope through lower collar 13, which, in turn, will be restrained to a more-or-less fixed position with respect to the casing by suitable friction or other means (not shown). In an upwardly-seating packer, lower collar 13 will be fixed with relation to mandrel 11 which will slide through upper collar 12. Also slidably received upon the mandrel are expander wedges 19 and 20 between which there are provided the sealing packer bodies 21. The arrangement is such that, upon telescoping of mandrel 11 through either collar 12 or 13, as explained, slip elements 16 and 17 will be caused to lodge against the inner wall of the casing and axial pressures will be applied to the packer bodies 21 to cause radial expansion thereof into sealing engagement with the casing.

Packer bodies 21 are constructed principally of stacked, frusto-conical laminae 24, of the type shown in FIG. 3, which are formed by stapling or otherwise securing together the end portions 25 and 26 of a crescent-like blank 27 cut from a sheet of asbestos fabric or other durable sheeting. These laminae are then compacted in a mold 29, as shown in exaggerated scale in FIG. 4, having a re-entrant bottom 30. Each lamina 24a, 24b, etc., is provided with coatings including layers 31 of particulate metal, preferably powdered iron, and thin rubber layers 32 which serve as binders. The rubber, preferably synthetic, is heavily loaded, preferably up to 90 percent, with inert filler such as carbon black. The assembled layers are then subjected to heat and pressure for molding the whole into a coherent mass with the abutting rubber layers merged and extending into the interstices of the powdered metal and fabric layers.

While the asbestos fabric of which the laminae 24 are constructed cannot be stretched substantially without injury, the molded packer body is provided with radial expansibility by the utilization of a mold 29 which is of slightly less diameter than the peripheral diameter of the laminae 24. Thus, the outer portions of these laminae will be bent more acutely toward the axis of the packer body as the peripheries are reduced and laterally corrugated or crimped, as indicated at 33 in FIGS. 1 and 9. The binder material is of sufficient plasticity, at least under working conditions of temperature and pressure, to permit flexing

of the laminations and radial expansion of the body when subjected to radial pressures, as will be explained.

FIG. 5 shows a completed packer unit 21 including the separately-formed upper and lower body parts 34 and 35 which are identical but reversed so that only the upper part 34 need be described in detail. First, two laminated body sections 36 and 37, shown respectively in FIGS. 6 and 7, are molded in the manner illustrated in FIG. 4. The upper tip portion 38 of section 36 is then cut off as are the lower tip portions 39 and 40 of section 37. Tip portion 40 is discarded. Truncated sections 36 and 37 are then assembled in a toroidal mold in the relationship shown in FIG. 5 to form the body part 34. The base periphery 43 of upper section 36 is radially contracted, as shown, so as to fit within and axially overlap the peripheral portion 44 of lower section 37. Between the two sections there is provided a thin, frusto-conical sheet 45 of binder rubber. In the inner toroidal space between sections 36 and 37 and the mandrel there is inserted a filler ring 46 of trapezium section, and the cut-off tip portion 39 previously mentioned, is inserted and bonded in position as shown. Each of the body parts 34 and 35 require two laminated sections 36 and 37. The four cut-off tips 38 and 39 from these sections are used as internal fillers, as shown.

The laminated body is practically non-deformable radially under axial forces incident to normal operations. Accordingly, the inner filler ring 46 is of material which is pressure deformable in order to respond to axial operating forces applied thereto, as in setting the packer, to cause axial contraction and radial expansion of the body part 34 and, particularly, the intermediate, axially-overlapping corrugated portions 43 and 44 thereof. The upper edge 47 of the expander insert is biased as shown to reduce to a certain extent the quantity of rubber in the assembly and the resultant space of triangular section is filled, as noted, by the otherwise wasted tip portion 38 of the laminated body section.

In order to provide a packer body of greater over-all length, two of the body parts 34 and 35 are assembled in reversed, end-to-end relation with suitable binder and spacer laminations 48 therebetween.

While the packer as herein disclosed, at normal atmospheric temperatures, will be quite hard due to the large amount of inert filler material used in the binder, at elevated temperatures such as 300 to 500 degrees F., encountered, for instance, in steam stimulation of a well, this body will be sufficiently pressure deformable, i.e., plastic, to respond to axial setting pressures for providing the desired radial sealing action. The words "plastic" and "plastically deformable" are adjectives used herein as to define the necessary pressure deformability of the insert body rings 46. While heavily-filled, synthetic rubber works well, other elastomers, or even putty-like material, might be used if adequately restrained. Laminations 32, preferably, are permeable to conduct ambient fluid into contact with particle layers 31, as explained in said application Ser. No. 551,793.

FIG. 8 shows a modification in which the inserted filler ring consists of a toroidal bag 50 filled with small

globular particles, as balls 51. Suitable wedging expanders might also be utilized to effect the radial sealing action of the body parts.

The invention may be modified in various respects as will occur to those skilled in the art, and the exclusive use of all modifications as come within the scope of the appended claims is contemplated.

We claim:

1. A toroidal packer body for reception about and upon a mandrel comprising a pair of body parts each consisting of stacked, frusto-conical laminations of flexible, non-stretchable, durable sheet material disposed acutely with respect to the mandrel and with intervening binder, the body parts being oppositely disposed with their peripheral bases laterally corrugated and telescopingly interfitting leaving an inner toroidal space between the adjacent ends of the parts, and a filler ring inserted in said space.

2. A packer body as described in claim 1 in which said body part laminations are embedded in elastomeric material whereby said parts are yieldably form-sustaining.

3. A packer body as described in claim 1 in which said laminations are of high temperature resistant material.

4. A packer as described in claim 3 in which said laminations are of asbestos sheeting.

5. A packer body as described in claim 1 in which said filler ring is of plastic material and is radially deformable under axial forces applied thereto for expanding said body parts into sealing engagement with an ambient wall.

6. A packer comprising axially-stacked laminations of flexible, substantially non-stretchable sheet material with intervening binder forming a coherent, toroidal, non-plastically-deformable body, said laminations being acutely angled with respect to the axis of the packer and the peripheries of said laminations being laterally corrugated to permit radial expansion thereof, and a plastically-deformable ring lodged in said chamber and adapted to expand radially when axially pressured to press said lamination peripheries outwardly.

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U.S. Cl. X.R.

277—123, 124, 233