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METHOD OF ANCHORING A WELL PACKER REINFORCEMENT

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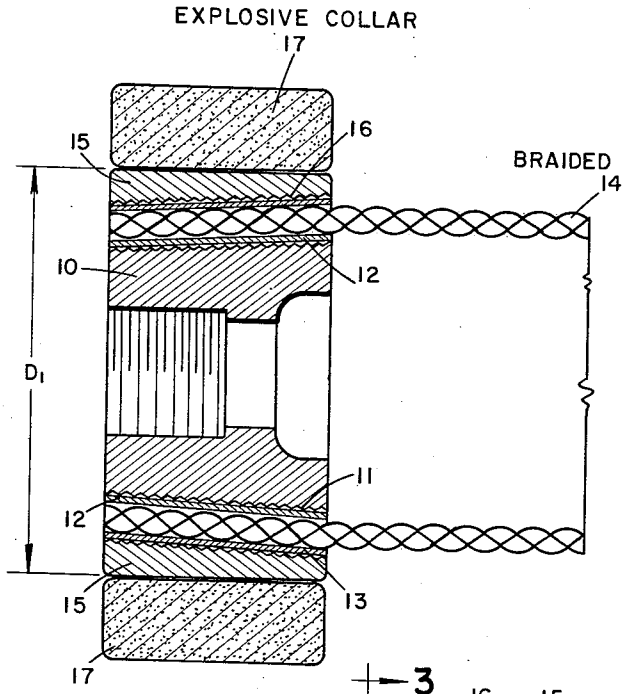


FIG. 1.

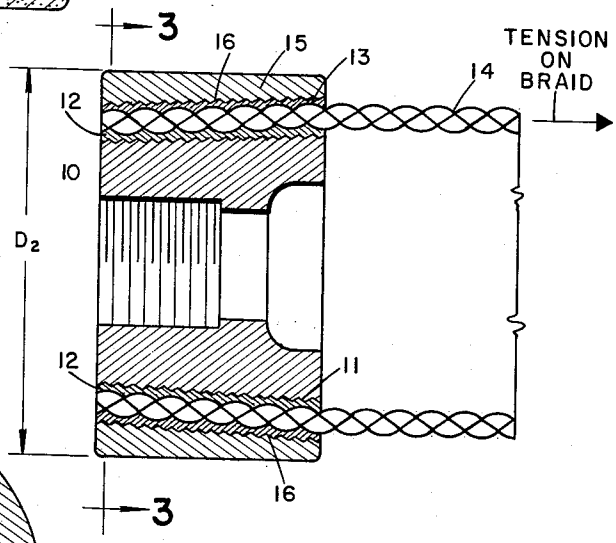
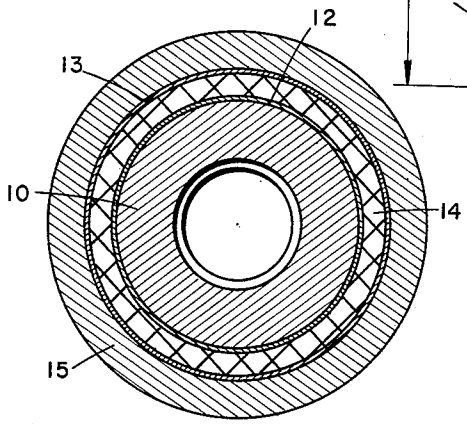


FIG. 2.

FIG. 3.



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METHOD OF ANCHORING A WELL PACKER REINFORCEMENT

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This invention is directed generally to inflatable type well packers. More particularly, the invention is directed to securing inflatable type well packer reinforcing members to the packer assembly.

One type of inflatable well packer utilizes flexible metallic means to reinforce and strengthen the inflatable and expansible packer bladders or sleeves. The flexible metallic means, in one construction, is a braided steel tube or sleeve extending the length of the inflatable member and secured at each end to metallic packer end members such as is disclosed and claimed in U.S. application Serial No. 520,424, filed July 7, 1955, by W. D. Mounce, entitled "Reinforced Inflatable Packer," now U.S. Patent No. 2,828,823.

One purpose of this invention is to provide an easy, non-expensive, quick method for securing a packer reinforcing tube to packer end members.

Another purpose of this invention is to provide an anchoring or clamping connection between a packer reinforcing tube and a packer end member, which connection is at least as strong as the tension strength of the tube.

An additional purpose of the invention is to provide a method and apparatus for connecting a metallic reinforcing tube to a packer end member wherein the disadvantages of heating the metal of the tube with resultant weakening of the metal is avoided.

Another purpose of the invention is to provide method and apparatus for connecting a reinforcing tube to packer end members which utilize high strength materials.

Briefly, the method of the invention comprises the steps of arranging a first metallic cushion sleeve on the outer surface of a packer end member, positioning an outer sleeve provided with a second metallic cushion sleeve on the inner surface thereof spaced from the first cushion sleeve, arranging the end of a braided tube in the space between the first and second cushion sleeves, positioning explosive means adjacent the outer sleeve, and then detonating the explosive means whereby the diameter of the outer sleeve is reduced and the cushion sleeves and braided tube are compressed upon the packer end member.

The apparatus of the invention comprises a packer end member, a first cushion sleeve arranged on the outer surface of the end member, an outer sleeve having a second cushion sleeve arranged on the inner surface thereof, the outer surface of the outer sleeve being adapted to receive an explosive collar, an end of a braided tube arranged between said first and second cushion sleeves whereby upon detonation of the explosive collar the diameter of the outer sleeve is reduced and the cushion sleeves and the braided tube are compressed upon the packer end member.

The above objects or purposes of the invention and additional objects of the invention will be apparent from a description of the invention taken in conjunction with the drawings wherein:

FIG. 1 is a partially sectional view showing the apparatus arranged prior to detonation of the explosive collar;

FIG. 2 is a view similar to FIG. 1 showing an arrangement of the apparatus after the detonation of the explosive collar;

FIG. 3 is a view taken on lines 3—3 of FIG. 2.

Referring to the drawings wherein identical numerals designate identical parts:

In FIG. 1 is shown a cylindrical packer end member **10** provided with a tapered outer surface **11** which is preferably roughened or serrated. Surrounding packer end member **10** is a metallic cushion sleeve **12**. Spaced from cushion sleeve **12** is another similar cushion sleeve **13**. The end portion of a braided sleeve **14** is arranged between cushion sleeves **12** and **13**. A tapered outer sleeve **15** is arranged about cushion sleeve **13** and is provided with a tapered surface **16** preferably formed with serrations or roughened surface. An explosive collar **17** is arranged about outer sleeve **15**.

The packer end member **10**, braided sleeve **14** and outer sleeve **15** are formed of a hard metal such as steel whereas cushion sleeves **12** and **13** are formed of a softer metal of high strength such as, for example, brass. By forming sleeves **12** and **13** of high strength metal the length of the clamping or gripping surface required is reduced. The direction of the taper of the outer surface **11** of packer end member **10** is outwardly or away from the packer. That is, the direction of the taper is in a direction opposite to the direction of tension applied to the braided sleeve or tube **14** when the packer is in operation. The inner surface **16** of outer sleeve **15** is parallel to surface **11** of packer end member **10**. Prior to detonation of collar **17** the outer diameter of outer sleeve **15** is D_1.

In FIGS. 2 and 3, packer end member **10**, cushion sleeves **12** and **13**, braided sleeve **14**, and outer sleeve **15** are shown in their respective positions after detonation of explosive collar **17**. The outside diameter of outer sleeve **15** is then D_2. D_1 is greater than D_2.

To anchor the braided sleeve **14** to packer end member **10**, the various elements are arranged, as shown in FIG. 1, with explosive collar **17** encircling outer sleeve **15**. Explosive collar **17** is then detonated and following the explosion, the elements are positioned as shown in FIGS. 2 and 3 wherein the forces resulting from the explosion act to reduce the diameter of the outer sleeve **15** and to compress cushion sleeves **11** and **13** and braided tube or sleeve **14** upon packer end member **10**. As cushion sleeves **12** and **13** are formed of a metal softer than the metal of braided tube **14**, end member **10** and outer sleeve **15**, cushion sleeves **11** and **13** are forced to "cold flow" around the wires of braided tube **14** and thereby form an embedment for the ends of the braided tube (FIG. 2). The tapers of outer surface **11** of packer end member **10** and inner surface **16** of outer sleeve **15** provide a wedging action upon the braided tube when tension is applied to the braided tube. Also a shorter clamping or anchoring surface is permitted than would be possible if these surfaces were cylindrical because in a cylindrical type sleeve clamp the embedment material is always in shear whereas in a tapered sleeve clamp substantial compression force is applied to counteract part of the tension force on the braided tube. Also the tendency for engaged members to slip in shear is reduced.

The outer surface **11** of packer end member **10** and the inner surface **16** of outer sleeve **15** preferably are serrated or roughened in order to afford some embedment of cushion sleeves **12** and **13** in packer end member **10** and outer sleeve **15**, respectively, and to reduce the slip planes.

While a cylindrical explosive collar **17** has been shown and described herein, it is to be understood that the explosive collar may be configured to achieve proper direction of forces as may be desired by the application. Also, the charge of the explosive collar may be varied in intensity to regulate the deflection or compression of the anchoring members as desired.

Only one end of the braided tube and anchoring members has been shown and described herein; however, it is

to be understood that the braided tube extends to apparatus including a packer end member, cushion sleeves and an outer sleeve identical in construction to those shown and described above.

Having fully described the nature, objects, method and elements of the invention, I claim:

1. A method for anchoring a braided wire metallic packer reinforcing sleeve to a metallic packer end member comprising the steps of arranging a first metallic cushion sleeve on the outer surface of said packer end member; positioning a metallic outer sleeve provided with a second metallic cushion sleeve on the inner surface of said outer sleeve spaced from said first cushion sleeve; said first and second cushion sleeves being formed of softer metal than the metal of said packer reinforcing sleeve; arranging one end of said reinforcing sleeve in the space between said first and second cushion sleeves; and then radially compressing said outer sleeve to flow said cushion sleeves into the interstices in said braided wire reinforcing sleeve and thereby secure said outer sleeve, cushion sleeves, and braided wire reinforcing sleeve to the packer end member.

2. A method as recited in claim 1 including forming said end member outer surface and said outer sleeve inner surface with serrations.

3. A method as recited in claim 2 including forming said end member such that its outer surface tapers in a direction away from the body of said packer.

4. A method for anchoring a braided wire metallic packer reinforcing sleeve to a metallic packer end member comprising the steps of arranging a first metallic cushion sleeve on the outer surface of said packer end member; positioning a metallic outer sleeve provided with a second metallic cushion sleeve on the inner surface of said outer sleeve spaced from said first cushion sleeve; said first and second cushion sleeves being formed of softer metal than the metal of said reinforcing sleeve; arranging one end of said reinforcing sleeve in the space between said first and second cushion sleeves; positioning an explosive means adjacent said outer sleeve and then detonating said explosive means to radially compress said outer sleeve to flow said cushion sleeves into the interstices in said braided wire reinforcing sleeve and thereby secure said outer sleeve, cushion sleeves, and braided wire reinforcing sleeve to the packer end member.

5. A method as recited in claim 4 including forming said end member outer surface and said outer sleeve inner surface with serrations.

6. A method as recited in claim 5 including forming said packer end member such that its outer surface tapers in a direction away from the body of said packer.

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