United States Patent

[11] 3,604,732

[72] Inventor **Billy C. Malone**
Houston, Tex.

[21] Appl. No. **823,880**
[22] Filed **May 12, 1969**
[45] Patented **Sept. 14, 1971**
[73] Assignee **Lynes, Inc.**

[54] **INFLATABLE ELEMENT**
42 Claims, 11 Drawing Figs.

[52] **U.S. Cl.** **285/106,** 72/370, 138/93, 166/187, 220/24.5, 277/34, 285/166
[51] **Int. Cl.** **F16l 33/16**
[50] **Field of Search** 285/96, 97, 100, 106, 107, 109, 294, 297, 149, 166; 277/34; 166/187; 138/93, 104, 140; 279/2, 4; 72/370; 269/22; 220/24.5

[56] **References Cited**

UNITED STATES PATENTS

2,643,722	6/1953	Lynes et al.	166/187 X
2,778,432	1/1957	Allen	277/34
3,003,798	10/1961	Sandlin	287/20
3,160,211	12/1964	Malone	166/187
3,217,282	11/1965	Chevalier et al.	285/149 X

FOREIGN PATENTS

625,446	9/1961	Italy	285/149

Primary Examiner—Dave W. Arola
Attorneys—Jack W. Hayden and Richard E. Bee

ABSTRACT: An inflatable member having an inflatable element which in some instances surrounds a body. The inflatable element is surrounded by a reinforcing sheath comprising longitudinally extending, circumferentially overlapping strips the ends of which are received in sleeves. A member is positioned adjacent the end of the strips and between the strips within the sleeves. The strips at each end including the members therebetween are secured together with an adhesive within the sleeves. Either or both ends of the inflatable element may be movable, and the movable end is provided with a void-forming medium or material to prevent the adhesive from filling a portion of the space adjacent the movable end and thereby provides a space to accommodate longitudinal movement of the end of the element by compressing or collapsing the material.

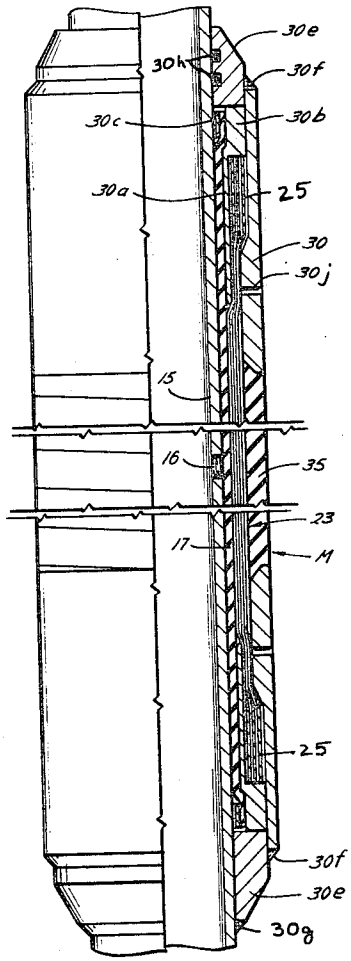


Fig. 1

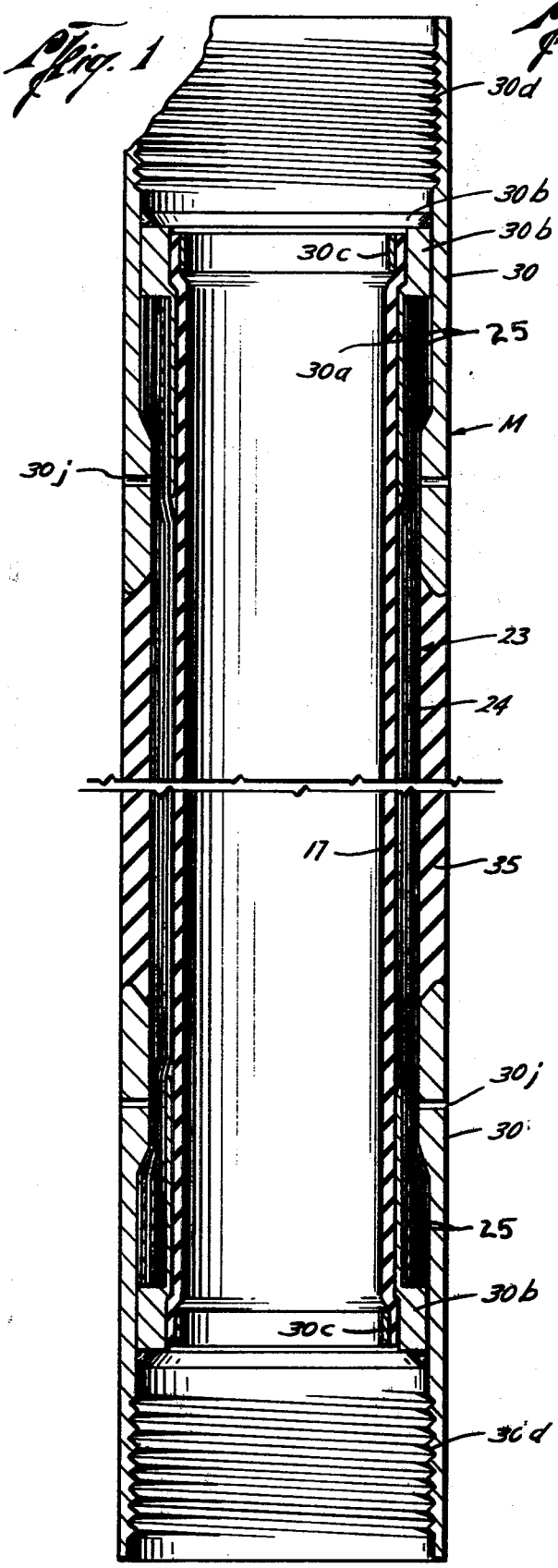
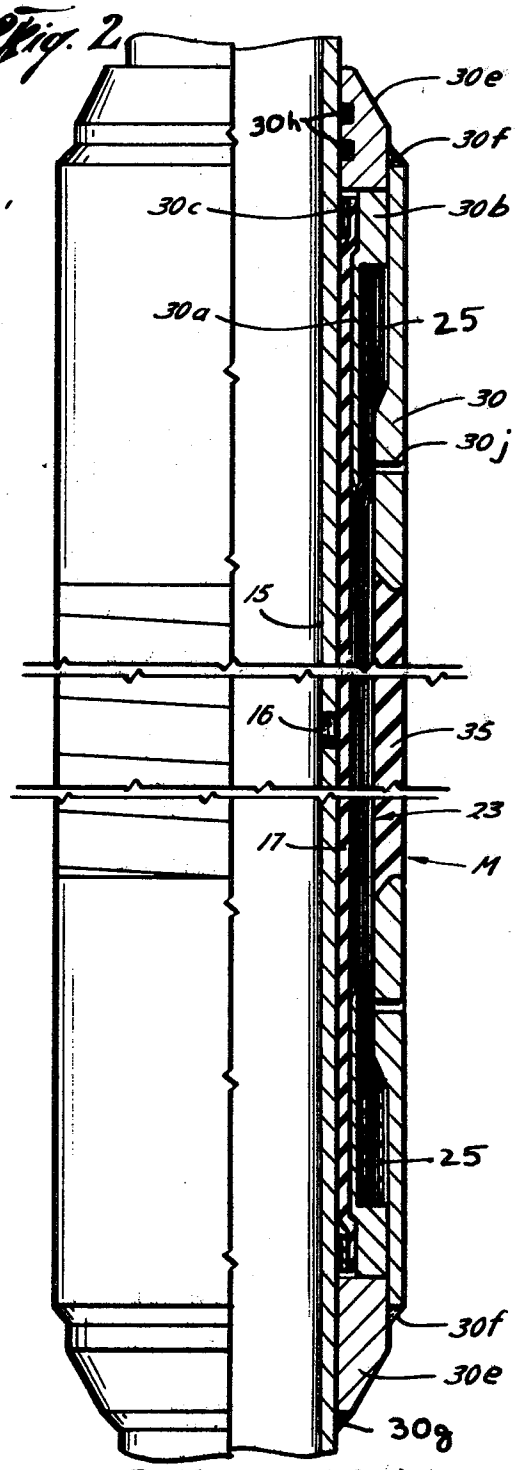


Fig. 2



Billy C. Malone
INVENTOR

BY

Hayden Praed Wilson & Matthews
ATTORNEYS

Fig. 3

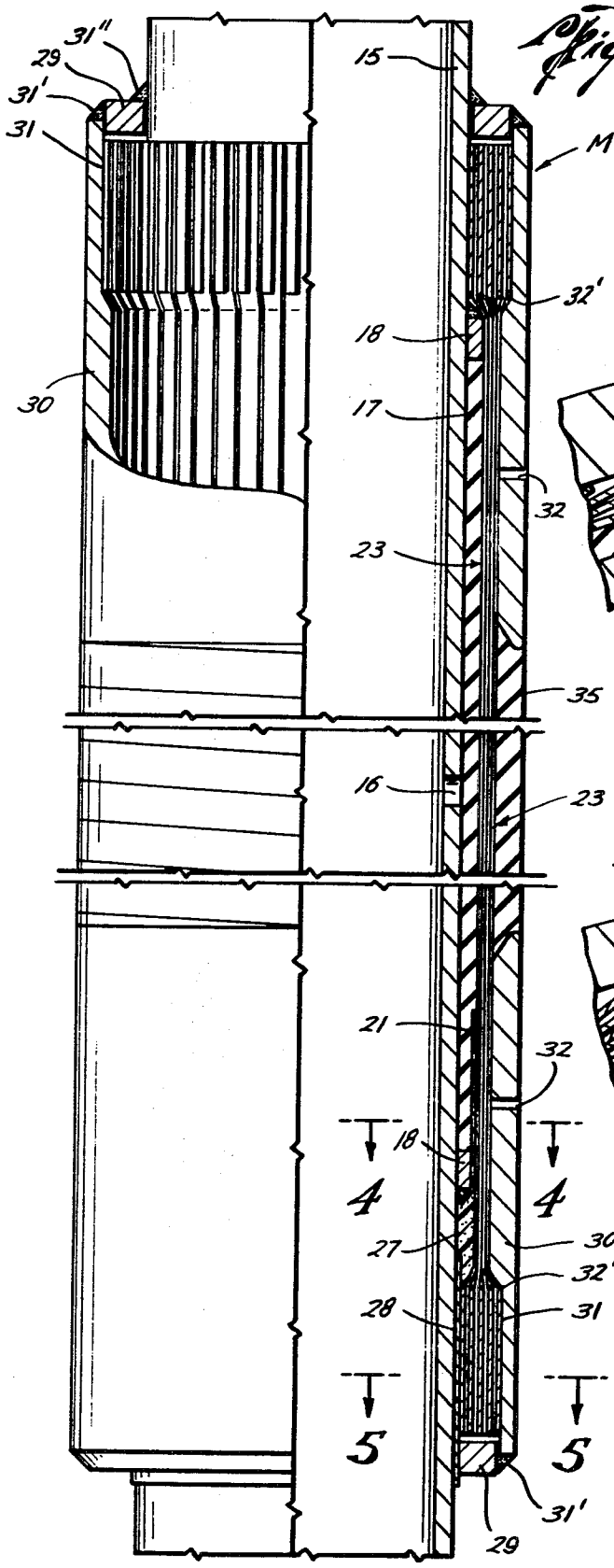


Fig. 4

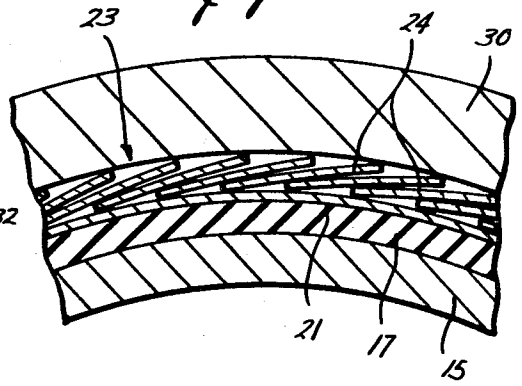
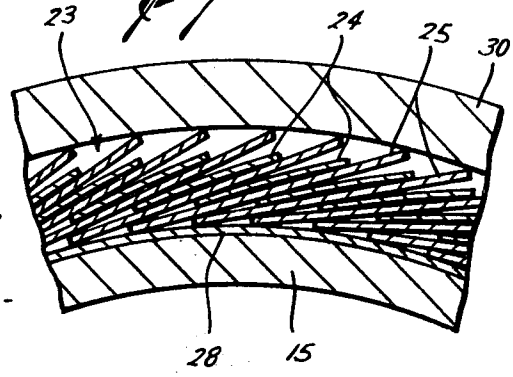


Fig. 5



Billy C. Malone
INVENTOR

BY

Hayden Pravel Wilson & Matthews
ATTORNEYS

Fig. 6

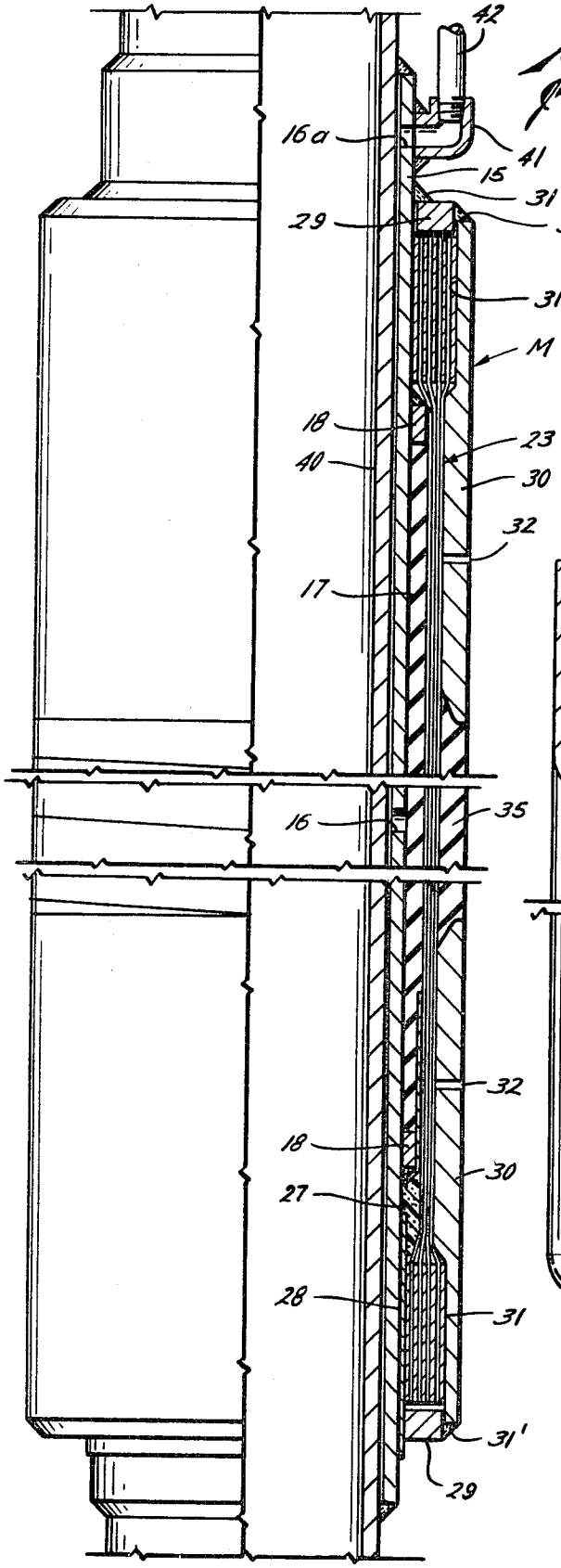
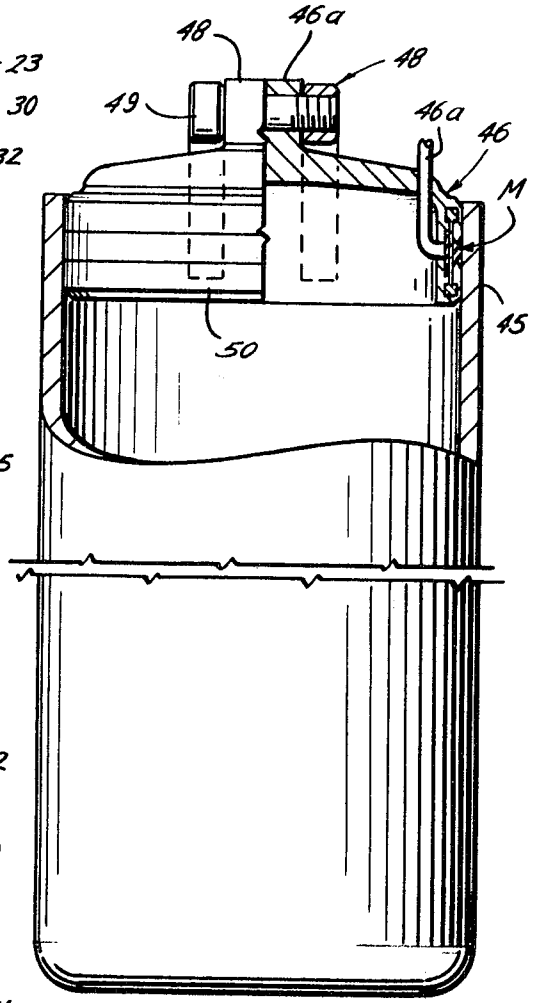


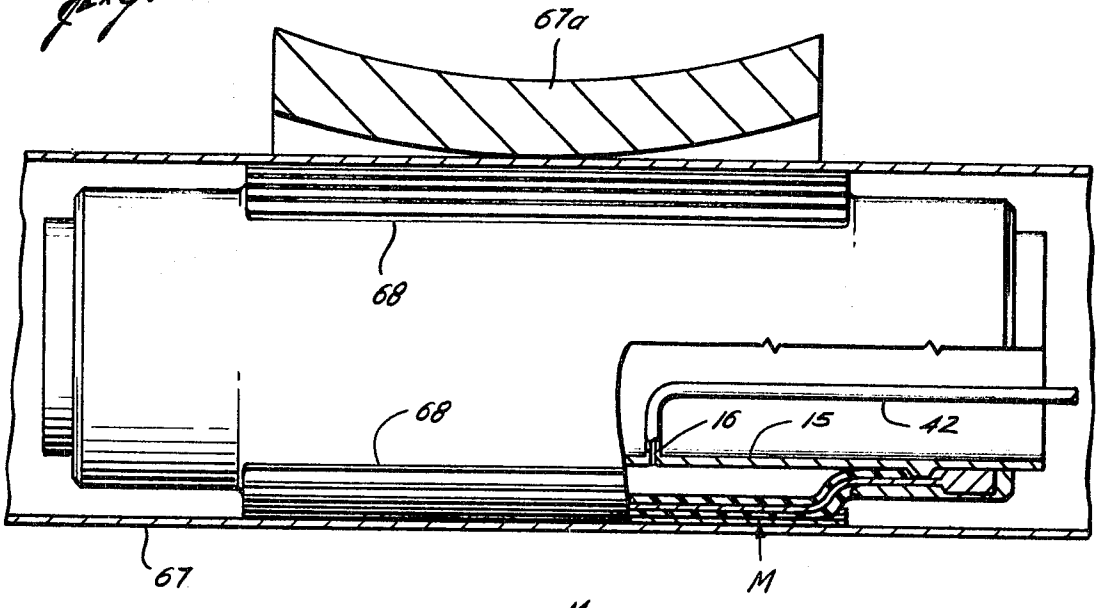
Fig. 7

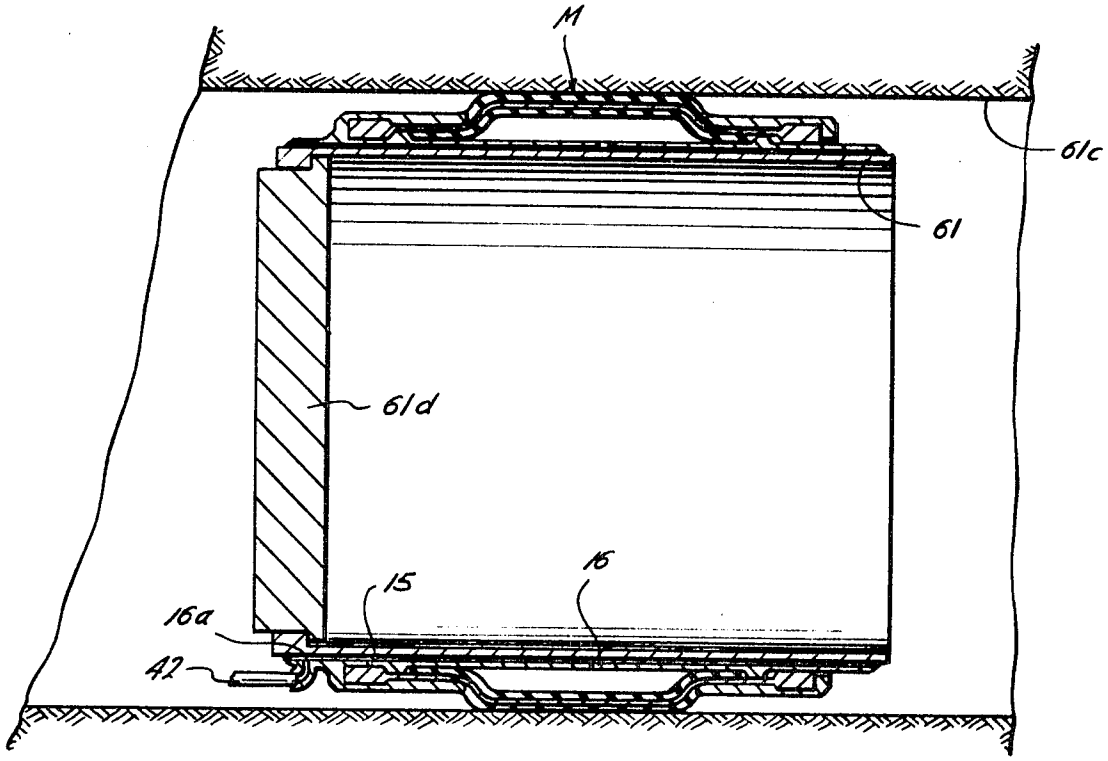


Billy C. Malone
INVENTOR

BY
Hayden Praivel Wilson & Matthews
ATTORNEYS

Fig. 8





Billy C. Malone
INVENTOR

Fig. 9

BY

Hayden Praivel Wilson & Matthews
ATTORNEYS

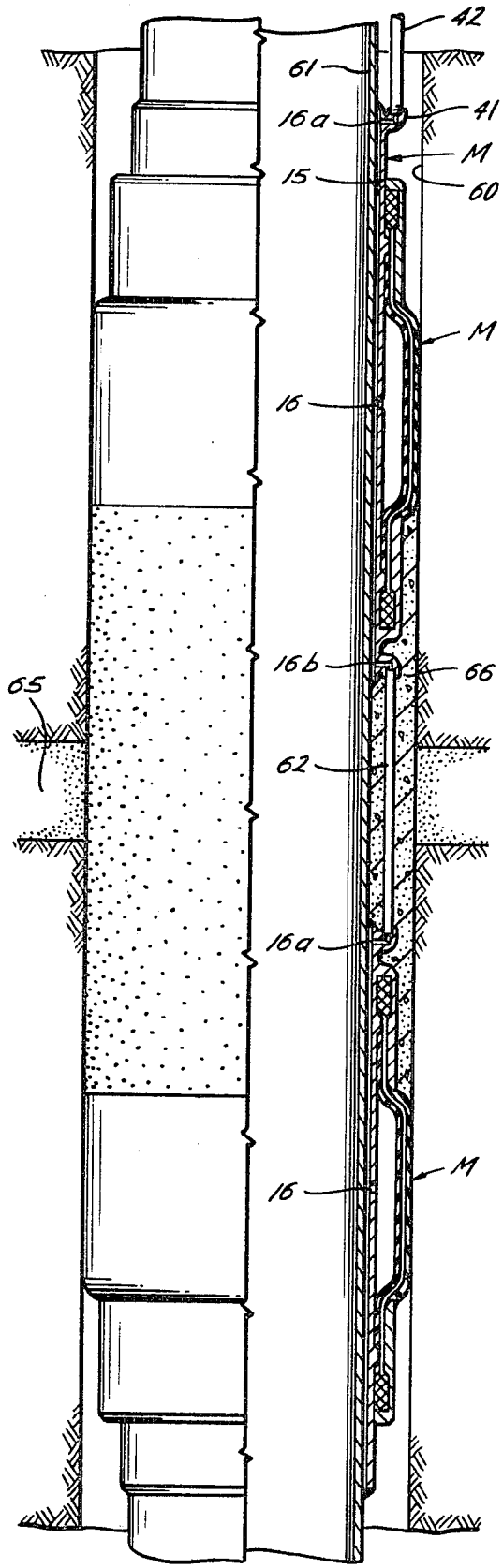
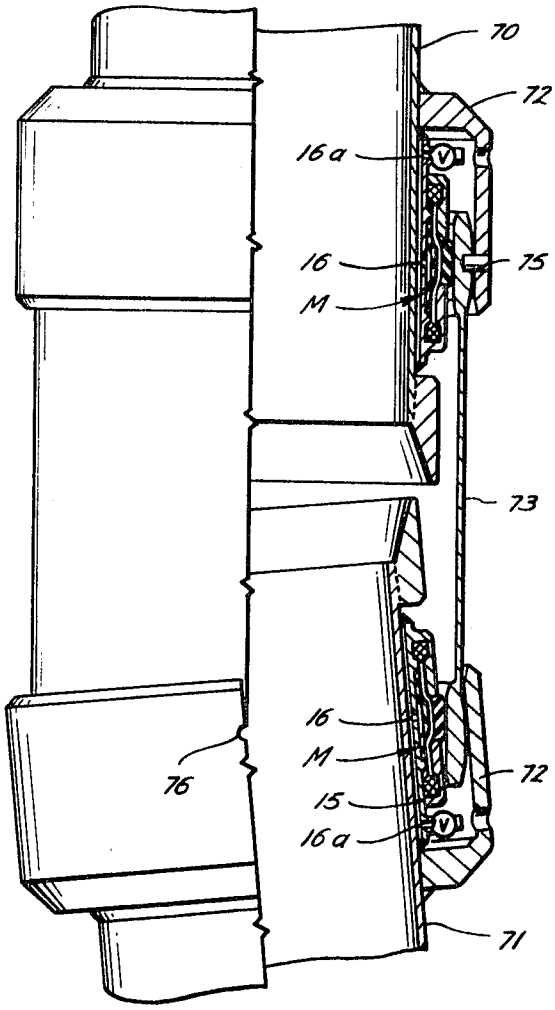


Fig. 10

Fig. 11



Billy C. Malone
INVENTOR

BY

Hayden Pravel Wilson & Matthews
ATTORNEYS

INFLATABLE ELEMENT

CROSS REFERENCE TO RELATED APPLICATION

The present apparatus is formed by the method disclosed and claimed in my copending U.S. Pat. application for "Method of Forming an Inflatable Member" filed May 1, 1969 and bearing Ser. No. 820,966.

BACKGROUND OF THE INVENTION

The present invention relates to an inflatable member which has various uses such as a forming mandrel, as a closure in a conduit, as a closure for a mine shaft or lateral, well bore, or other opening. The inflatable element of the present invention is provided with a reinforcing sheath which is anchored in a manner to utilize a minimum of space while providing an arrangement for clamping or retaining the reinforcing sheath in position.

DESCRIPTION OF THE PRIOR ART

Applicant is aware of the U.S. Pat. to H. L. Sandlin, No. 3,003,798, and the U.S. Patent to G. H. Allen, No. 2,778,432. **In the Sandlin patent, there is disclosed an anchoring reinforcing employing either a sheath or circumferentially spaced cables within a resilient element, the anchoring comprising a potting slurry. The potting slurry comprises a resinous material, preferably an epoxy resin, a filler, and a heat-responsive polymerizing (or hardening) agent for the resin. In the Sandlin patent, the hardened resin along with the filler and a roughened surface comprise primarily the arrangement for securing the sheath or reinforcing cables at their ends.**

In the Allen patent, an inflatable element is surrounded by a reinforcing sheath of a plurality of strips of braided wire coated with rubber or nylon, the strips overlapping circumferentially and extending longitudinally, the overlapping strips being retained in position against the stresses tending to shear or pull the ends of the reinforcing sheath out of position by the wedge cones **20** at each end of the sheath.

The strength of the arrangement in the Sandlin patent is somewhat limited as a means for retaining the ends of the sheath in position under substantial loads or stresses, and the edge cones in the Allen patent, while satisfactory for the use intended, in some situations, can become quite bulky as the size of the inflatable member increases.

SUMMARY OF THE INVENTION

The present invention relates to an inflatable member with an inflatable element surrounded by a reinforcing sheath, and having an end anchorage for the reinforcing sheath which utilizes a minimum of space without sacrificing strength.

An object of the present invention is to provide an inflatable element surrounded by a reinforcing sheath having an arrangement for locking the ends of the sheath against forces which tend to shear or pull them out of position as the element is inflated.

Another object of the present invention is to provide an inflatable element and arrangement to accommodate relative longitudinal movement of at least one, or both, ends of the inflatable element when desired.

Still another object of the present invention is to provide a novel end anchorage for an inflatable element reinforcing sheath which will withstand substantial loads tending to shear or pull the reinforcing out of position as the inflatable element is inflated, which anchorage occupies a minimum of space without sacrificing strength.

Other objects and advantages of the present invention will become apparent from a consideration of the following description and drawings wherein:

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. **1** is a half section of one form of the inflatable member;

FIG. **2** is a quarter section showing the inflatable element of FIG. **1** supported on a body;

FIG. **3** is a quarter-sectional view, with a portion thereof cut away to illustrate the details of construction of the inflatable element;

FIG. **4** is a sectional view on the line **4—4** of FIG. **3** showing details of the inflatable element in deflated position;

FIG. **5** is a sectional view on the line **5—5** of FIG. **3** illustrating the arrangement of a member between the ends of each of the longitudinally extending, circumferentially overlapping strips which form the reinforcing sheath;

FIG. **6** is a quarter-sectional view illustrating an alternate embodiment of the invention;

FIG. **7** is a side elevation partially cut away illustrating the present invention employed as a closure;

FIG. **8** is an elevational view, partly cut away, illustrating the inflatable element slightly modified for use as a backup in pipe-bending operations;

FIG. **9** is a sectional view illustrating the use of the present invention in sealing off an opening such as a mine shaft or lateral;

FIG. **10** is a quarter sectional view illustrating a form of the present invention when employed for sealing off in an opening such as well bore; and

FIG. **11** illustrates in quarter-sectional view the present invention employed for sealing off between adjacent ends of a conduit or conductor.

DESCRIPTION OF THE PREFERRED EMBODIMENTS

In FIGS. **1** and **2**, the inflatable member is referred to generally by the letter M and includes an inflatable element **17** of resilient material. A reinforcing sheath **23** surrounds the element **17** and is formed of strips **24** which overlap circumferentially and which extend longitudinally of the element **17**. The ends of the strips are received between the sleeves **30**, which surround the ends of sheath **23**, and inner sleeves **30***a* which have an enlargement **30***b* for closing of the outer end between sleeves **30** and **30***a*. If desired, a weld **30***b* secures sleeves **30** and **30***a* together.

The resilient element **17** is sealed or secured to sleeve **30***a* by means of ring **30***c* which is expanded to compress the ends of the resilient element against sleeve **30***a*.

The sleeve **30** may be threaded as shown at **30***d* for connection with a tubular member, and if desired, a smaller tubular member may extend into element **17**, such smaller member having an opening for discharging inflating fluid to inflate element **17** when desired. An after cover **35** may be formed to extend between the sleeves **30**.

In FIG. **2**, a body **15** is shown as extending through the member **17** and having an opening **16** for discharge of inflating fluid to inflate member M. In the form of FIG. **2**, annular rings **30***a* abut the end of enlargement **30***b* and are welded to sleeves **30** as shown at **30***f*.

One of the rings **30***e* is welded to the body **15** as shown at **30***g* and seal means **30***h* are provided between the other ring **30***e* and the body **15** for accommodating movement therebetween as member M inflates without loss of inflating fluid.

In forming the inflatable member M of FIG. **1**, a suitable mandrel may be used which can be withdrawn after the member has been formed.

After the device of either FIG. **1** or FIG. **2** has been formed and prior to adding cover **35**, an adhesive may be poured into one end of each of sleeves **30** to bond the strips **24** with members **25** inserted between the ends of the strips within sleeve **30**. The members **25** are inserted prior to positioning sleeve **30***a* in place. The adhesive may be any suitable epoxy resin and catalyst or other form of adhesive such as EPON a trademarked material sold by Shell Chemical Corp., or an acrylic adhesive sold under the trademark CHEMLOK sold by Hughson Chemical Corp. The adhesive will fill the space between sleeves **30** and **30***a* until it reaches drain hole **30***j*.

In FIG. 3, the inflatable member is referred to again by the letter M and is shown as including the tubular body 15; however, the body 15 can be of any suitable configuration and size. In the form of the invention shown in FIG. 3, the body 15 is provided with an opening 16 for conducting an inflating medium exteriorly of the body to inflate the inflatable element 17 which surrounds the body and is secured thereto by any suitable means such as by bonding or by strips as described in my copending application hereinabove referred to. A suitable stop as shown at 18 may be provided adjacent each end of the element 17; the stop 18 may be continuous or in segments as desired and secured to the body 15 by any suitable means such as welding or the like.

Where the end of the inflatable member M is to be movable longitudinally relative to the body 15, a shield 21 may be secured over the adjacent stop 18 as shown in FIG. 3 and extends longitudinally along and surrounds the inflatable element 17 for a distance therealong as shown in FIG. 3 of the drawings. The shield 21 facilitates relative movement between the reinforcing sheath designated generally by the numeral 23 and the end of the inflatable element 17 as it is inflated as will be described in greater detail hereinafter. The reinforcing sheath 23 is again referred to in FIG. 4 as well as in FIG. 5, and it is comprised of a plurality of longitudinally extending, circumferentially overlapping strips 24 as shown in FIG. 4. As noted in my above-referred-to copending application, the strips may be of any suitable material, depending upon the use to which the inflatable member M is to be put.

The strips 24 extend longitudinally of the body 15 and beyond the stops 18 at each end of the element 17 as shown in FIG. 3 of the drawings and are adapted to be received within the outer sleeves 30 at each end of the inflatable member , The outer sleeves 30 are generally cylindrical in shape and in the FIG. 3 modification are provided with a counterbore 31 adjacent each end thereof which terminates at 32', and within this counterbore, there is inserted between the strips 24 a member or anchor plate 25 as shown in greater detail in FIG. 5. The members 25 aid in retaining the reinforcing sheath 23 in position and inhibit it from pulling or shearing out of position as the inflatable element 17 is inflated as will be described in greater detail.

A void forming substance or material 27 is provided adjacent the stop 18 at the end or ends of the inflatable body 15 as the inflatable member M inflates. The material 27 is any suitable material which will compress under pressure such as a closed-cell urethane form material or the other materials in my copending application hereinafter referred to.

Such material provides a void or space in the inflatable member M to prevent the epoxy resin from filling such space, as will be described hereinafter, and is compressible or collapsible upon movement of the inflatable member end to accommodate movement of the end of the inflatable member.

The longitudinal extent of the compressible material 27 is such that it will accommodate the amount of radial expansion of the inflatable member M desired. Surrounding the tubular body 15 and extending from the collapsible or compressible material 27 is the shield 28 formed of suitable material to aid in movement of the end ring 29 which is secured to the outer sleeve 30 by any suitable means such as welding 31' or the like as the outer sleeve and end member 21 move relative to the body 15. The cover 21 and the shield 28 may be secured in position in any suitable manner such as welding the abutted ends of each respective cover together to retain it in its position. As shown in FIG. 3, the end of the cover 21 which overlaps the stop 28 is bent down over the stop to aid in retaining it in position.

After the inflatable member M has been assembled without the outer cover 35, then a suitable adhesive, as disclosed in my copending application, epoxy resin, and a catalyst or hardening agent is poured into the outer sleeve 30 with the inflatable member M in substantially vertical position so that the epoxy flows downwardly into the sleeve and into the counterbore 31 to surround the ends of the reinforcing sheath and the epoxy would fill the space surrounding the sheath and the reinforcing element 17 and body 15 up to the opening 32 formed in each of the sleeves. Since the material 27 is a closed-cell compressible material, the resin will not fill this space, thus providing in effect a void to accommodate longitudinal movement of the movable inflatable packer M.

In FIG. 3 of the drawings, it will be noted that the upper end of the inflatable member M is secured to the body 15 by means of the weld 31'' which secures the end ring or member 29 to the member 15 and in turn the weld 31' secures the end ring 29 to the upper outer sleeve 30.

After the resin and hardening agent have taken an initial set, the inflatable member M may be inverted and the resin and hardening agent poured into the outer sleeve 30 between the reinforcing strips to "pot" the end of the reinforcing within the recess 31 of the outer sleeve 30 and that portion of the strips 24 up to the hole 32 in outer sleeve 30.

When an inflating fluid is supplied to the opening 16, it will flow between the inflatable element 17 and body 15 to expand the element 17 against the reinforcing sheath 23. As this occurs, the end ring 29 will move on or along the shield 28 placed around the body 15, which shield aids in the movement of the ring 29 along or relative to the body 15. Similarly, the shield 21 also acts as a "lubricator" to aid in movement of the reinforcing strips 24 over the end of the inflatable element 17. Where both ends of the inflatable member M are to be movable, the inflatable member will be constructed in a manner similar to that shown in the lower portion of FIG. 3 of the drawings. In some instances, the shield 28 may be dispensed with, such as where the surface of the body is smooth enough for the ring 29 to slide therealong.

In some instances, it will be desirable to employ an outer cover 35 over the reinforcing 24, and the outer cover 35 is also formed of resilient material and is bonded to the outer sleeve 30 to retain it in position.

In FIG. 6, the inflatable member M of a construction as shown in FIG. 3 is shown as being mounted on an additional tubular support 40. In this instance, the body 15 is provided with an additional opening 16*a* with which a suitable fitting 41 and conduit 42 are connected for conducting inflating fluid between the body 15 and support 40 to the opening 16 to inflate the inflatable member M. The construction of the invention as shown in FIG. 6 is similar to that previously described with regard to FIG. 3.

In FIG. 7, the vessel 45 is shown having a cover 46 supported thereon by the brackets 48 which extend upwardly from the vessel 45 and over the cover 46. A pivot pin 49 supports the cover 46 on the brackets 48 by extending through the projection 46*a* integrally formed with the cover 46.

An inflatable member M formed in accordance with FIG. 3 of the drawings, or formed so that it is movable at both ends as previously described herein, is provided on the outer surface 50 of the portion of the cover 46 that fits within the vessel 45 so that the cover may be sealed therein by supplying inflating fluid through the conduit 46*a* in cover 46.

In FIG. 8, the inflatable element M is again shown, having the construction heretofore described with regard to FIG. 3 wherein one form is movable, or if desired, both ends may be movable, and is shown as being positioned within the tubular member such as a pipe 67 which is to be bent around the bending shoe 67*a*. In the form of the invention shown in FIG. 8, the inflatable member M is provided with a plurality of leaf springs 68 which is strips of metal bonded approximately along one-third of their distance at approximately their midportion to the outer surface of the cover 35, which leaf springs are circumferentially spaced in a 90° arc opposite the bending shoe 67*a* and diametrically opposed therefrom on the other side of the inflatable member M, as shown in the drawings. The body 15 is provided with a conduit 42 which connects with the opening 16 for conducting inflating fluid thereto to inflate the inflatable member M to contact the inner wall or periphery of the member 67 to be bent.

In this form of the invention, inflatable member M acts as a backup, and as the pipe is bent around the shoe **67***a* by means well known in the art, the inflatable portion of inflatable member M will flex to accommodate such bending. During such operation, the inflatable member M acts as a backup and inhibits or tends to prevent wrinkling of the pipe **67** at the area where it is being bent around the bending shoe **67***a*. In bending smaller diameter pipe, the form of the invention shown in FIG. **1** may be employed with a plug in one end and a plug having a conduit connected thereto in the other end for supplying fluid through the plug and to inflate the member M.

After the bending operation has been completed, the packer can be deflated and the tool removed from the pipe and then reused.

In FIG. **9**, the inflatable member is shown as being positioned on a tubular member **61** which is positioned within a mine lateral or opening **61***c*. It will be noted that the plug **61***d* closes off one end of the tubular member **61**, and the inflatable member can be inflated by means of the conduit **42** connected with the opening **16***a* which conducts fluid between the body **15** and member **61** to the opening **16** to inflate the inflatable member M and to seal off the mine lateral or opening.

In FIG. **10**, a well bore is illustrated at **60** and a tubular member **61** is shown therein to which is secured the inflatable member M of the present invention as described with regard to FIG. **4** of the drawings. In FIG. **10**, a pair of inflatable members is arranged on the conduit **61** in spaced relation with the space between the body **15** and tubular member **61** providing a passage for conducting fluid to the opening **16** to inflate the upper inflatable member M and the opening **16***b* with which is connected a conduit **62** which in turn is connected to the opening **16***a* in the lower inflatable member M to conduct fluid to the passage **16** to inflate it. If desired, a slug of material for sealing off a formation such as that represented at **65** can be positioned within the well bore adjacent the formation **65** by means well known in the art whereupon inflating fluid or medium conducted through the pipe **42** can be used to inflate each of the inflatable members M and thereby seal off therebetween and encapsulate the mass of material **66** therebetween to seal off the undesired formation **65** from the remainder of the well bore.

In FIG. **11** of the drawings, the present invention is employed as a seal between the adjacent ends of tubular members **70** and **71**. The members **70** and **71** may be mounted in fixed relation relative to each other, or as shown in FIG. **11**, they may be mounted to accommodate relative movement therebetween. In FIG. **11**, it will be noted that an inflatable member M of the construction described heretofore is provided on each of the tubular members **70** and **71** and provided with a body having an opening **16***a* for conducting inflating fluid between the body **15** and the tubular members **70** and **71**, respectively, to the opening **16** for inflation of the tubular member M.

It will be noted that each tubular member **70** and **71** is provided with a skirt **72** secured to and surrounding each of the tubular members adjacent their ends. The skirts are radially spaced from the tubular members **72** and extend longitudinally therealong as illustrated by way of example in FIG. **11**. A means **73** extends between the skirts **72** and is secured thereto by any suitable means. Where the tubular members **70** and **71** are to be movable relative to each other, pivot means as illustrated at **74** in the form of a pivot pin can be provided in the skirt **72** joined with the tubular member **70**, there being a pin on each side of the skirt, and a pair of pivot pins **76** (one of which is shown) can be provided in the skirt **72** which is connected with tubular member **71**, thus accommodating the relative movement between the ends of the tubular members **70** and **71**. The tubular members **70** and **71** may be fluid-flow conductors, or which is termed river pipe for offshore drilling operations. Of course, tubular members **70** and **71** can be utilized for any purpose desired.

The foregoing disclosure and description of the invention are illustrative and explanatory thereof, and various changes in the size, shape, and materials as well as in the details of the illustrated construction may be made without departing from the spirit of the invention.

What is claimed is:

1. An inflatable member comprising:
- a. a body having an opening for conducting an inflating medium therethrough;
- b. an inflatable element surrounding said body and secured thereto;
- c. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
- d. sleeves on said body for receiving said strips at each end thereof;
- e. plate members positioned between said strips adjacent the ends thereof; and
- f. an adhesive for bonding said plate members to adjacent strips whereby said sleeves, plate members, and adhesive cooperate to anchor the ends of said strips within said sleeves.

2. An inflatable member comprising:
- a. a body having an opening for conducting an inflating medium therethrough;
- b. an inflatable element sealed adjacent each end to said body and secured thereto;
- c. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
- d. sleeves on said body for receiving said strips at each end thereof;
- e. a compressible substance between said sheath and said body adjacent at least one end of the member;
- f. plate members positioned between said strips adjacent the ends thereof; and
- g. an adhesive for bonding said plate members to adjacent strips whereby said sleeves, plate members, and adhesive cooperate to anchor the ends of said strips within said sleeves.

3. An inflatable member comprising:
- a. a body having an opening for conducting an inflating medium therethrough;
- b. an inflatable element surrounding said body and secured thereto;
- c. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
- d. sleeves on said body for receiving said strips at each end thereof; and
- e. means for anchoring said strips within said sleeves, said anchor means comprising:
  1. plate members positioned between said strips of said sheath at the ends thereof:
  2. said plate members extending circumferentially beyond the edges of adjacent strips; and
  3. an adhesive for securing said strips and plate members together.

4. An inflatable member comprising:
- a. a body having an opening for conducting an inflating medium therethrough;
- b. an inflatable element surrounding said body and secured thereto;
- c. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
- d. sleeves on said body;
- e. said sleeves having a counterbore for receiving said strips at each end thereof;
- f. plate members between the ends of said strips within the counterbore in each of said sleeves; and
- g. an adhesive within each counterbore for securing said plate members and strips together whereby said sleeves, plate members, and adhesive cooperate to anchor the ends of said strips within the counterbore of each sleeve.

5. In an inflatable member the invention including:

a. a longitudinally extending inflatable element;
b. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
c. sleeves surrounding each end of said element;
d. said sleeves having a counterbore for receiving said strips at each end; and
e. means for anchoring the ends of said strips within the counterbore of each of said sleeves, said anchor means comprising:
1. plate members positioned within the counterbore of each sleeve and between the strips of said sheath at the ends thereof;
2. said plate members extending circumferentially beyond the edges of adjacent strips; and
3. an adhesive for securing said strips and plate members together.

6. The invention of claim **1** wherein said element is secured to said body by an adhesive.

7. The invention of claim **1** wherein said element is secured to said body by a ring which secures said element to a surrounding sleeve which is secured to said body.

8. The invention of claim **1** wherein at least one of said sleeves is movable relative to said body upon inflation of the member.

9. The invention of claim **1** wherein one of said sleeves is secured to said body.

10. The invention of claim **1** wherein said sleeves are movable relative to said body upon inflation of the member.

11. The invention of claim **2** wherein at least one of said sleeves is movable relative to said body upon inflation of the member.

12. The invention of claim **2** wherein one of said sleeves is secured to said body.

13. The invention of claim **2** wherein said sleeves are movable relative to said body upon inflation of the member.

14. The invention of claim **3** wherein at least one of said sleeves is movable relative to said body upon inflation of the member.

15. The invention of claim **3** wherein one of said sleeves is secured to said body.

16. The invention of claim **3** wherein one of said sleeves are movable relative to said body upon inflation of the member.

17. The invention of claim **4** wherein at least one of said sleeves is movable relative to said body upon inflation of the member.

18. The invention of claim **4** wherein one of said sleeves is secured to said body.

19. The invention of claim **4** wherein said sleeves are movable relative to said body upon inflation of the member.

20. The invention of claim **8** including means to aid relative movement between said sheath and inflatable element as said sleeve moves relative to said body upon inflation of the member.

21. The invention of claim **8** including means to aid relative movement between said sleeve and said body upon inflation of the member.

22. The invention of claim **20** wherein said aid means comprises a shield surrounding the end of said inflatable element and extending longitudinally between said element and reinforcing sheath for a distance less than the longitudinal extent of said sleeve surrounding the adjacent end of the element.

23. The invention of claim **21** wherein said aid means comprises a shield between the adjacent sleeve and body and surrounding said body and extending longitudinally on said body for movement of said sleeve therealong as the member inflates.

24. The invention of claim **3** wherein said plate members are spaced from the end of said resilient element with compressible means positioned between said plate members and inflatable element end.

25. The invention of claim **11** including means to aid relative movement between said sheath and inflatable element as said sleeve moves relative to said body upon inflation of the member.

26. The invention of claim **11** including means to aid relative movement between said sleeve and said body upon inflation of the member.

27. The invention of claim **25** wherein said aid means comprises a shield surrounding the end of said inflatable element and extending longitudinally between said element and reinforcing sheath for a distance less than the longitudinal extent of said sleeve surrounding the adjacent end of the element.

28. The invention of claim **26** wherein said aid means comprises a shield between the adjacent sleeve and body and surrounding said body and extending longitudinally on said body for movement of said sleeve therealong as the member inflates.

29. The invention of claim **4** wherein said plate members are spaced from the end of said inflatable element with compressible means positioned between said members and inflatable element end.

30. The invention of claim **14** including means to aid relative movement between said sheath and inflatable element as said sleeve moves relative to said body upon inflation of the member.

31. The invention of claim **14** including means to aid relative movement between said sleeve and said body upon inflation of the member.

32. The invention of claim **30** wherein said aid means comprises a shield surrounding the end of said inflatable element and extending longitudinally between said element and reinforcing sheath for a distance less than the longitudinal extent of said sleeve surrounding the adjacent end of the element.

33. The invention of claim **17** including means to aid relative movement between said sheath and inflatable element as said sleeve moves relative to said body upon inflation of the member.

34. The invention of claim **17** including means to aid relative movement between said sleeve and said body upon inflation of the member.

35. The invention of claim **33** wherein said aid means comprises a shield surrounding the end of said inflatable element and extending longitudinally between said element and reinforcing sheath for a distance less than the longitudinal extent of said sleeve surrounding the adjacent end of the element.

36. The invention of claim **34** wherein said aid means comprises a shield between the adjacent sleeve and body and surrounding said body and extending longitudinally on said body for movement of said sleeve therealong as the member inflates.

37. The invention of claim **1** wherein said body is secured to an additional member and there being an additional opening in said body for receiving inflating fluid to be conducted between said body and additional member for inflation of the inflatable member.

38. A pipe-bending backup for inserting in pipes during bending of the pipe to inhibit wrinkles in the pipe at the bend comprising:
a. a body having an opening for conducting an inflating medium therethrough;
b. an inflatable element surrounding said body and secured thereto;
c. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
d. outer sleeves for receiving said strips at each end thereof;
e. means for anchoring said strips within said sleeves, said anchor means comprising:
1. plate members positioned between said strips adjacent the ends thereof;
2. an adhesive for securing said plate members to adjacent strips whereby said sleeves, plate members and adhesive cooperate to anchor the ends of said strips within said sleeves;
f. an outer covering bonded to said reinforcing sheath and outer sleeves; and
g. longitudinally extending strips bonded on said outer covering for contacting the pipe to be bent when said in-

flatable member is inflated to inhibit wrinkling of the pipe.

39. A closure for an opening comprising:
a. a closure body;
b. an inflatable element surrounding said closure body and secured thereto;
c. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
d. sleeves for receiving said strips at each end thereof;
e. means for anchoring said strips within said sleeves, said anchoring means comprising:
1. plate members positioned between said strips adjacent the ends thereof;
2. an adhesive for securing said plate members to adjacent strips whereby said sleeves, plate members and adhesive cooperate to anchor the ends of said strips within said sleeves;
f. an outer covering bonded to said reinforcing sheath and sleeves.
g. a plug closing off the opening; and
h. means for conducting an inflating medium to said element.

40. A closure for an opening comprising:
a. a body having an opening therethrough
b. an inflatable element surrounding said body and secured thereto;
c. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
d. sleeves for receiving said strips at each end thereof;
e. means for anchoring said strips within said sleeves, said anchor means comprising:
1. plate members positioned between said strips adjacent the ends thereof;
2. an adhesive for securing said plate members to adjacent strips whereby said sleeves, plate members and adhesive cooperate to anchor the ends of said strips within said sleeves;
f. an outer covering bonded to said reinforcing sheath and sleeves;
g. a plug closing off the opening; and
h. means for conducting an inflating medium to said element.

41. A sealed universal connection for tubular members comprising:
a. a pair of tubular members in end-to-end relationship;
b. means connecting said tubular members together in end-to-end relation and accommodating relative movement between said tubular members in at least two different planes relative to the longitudinal axis of said tubular members; and
c. means for sealing between each of said tubular members and said connecting means, said sealing means comprising:
1. a tubular body secured adjacent each end on each of said tubular members;
2. an inflatable element surrounding said tubular body and secured thereto;
3. said tubular bodies each having an opening therein, and an additional opening with passage between the openings for conducting an inflating medium therethrough to said inflatable element;
4. a reinforcing sheath comprising longitudinally extending and circumferentially overlapping strips surrounding said element;
5. sleeves for receiving said strips at each end thereof; and
6. means for anchoring said strips within said sleeves, said anchor means comprising:
1. plate members positioned between said strips adjacent the ends thereof; and
2. an adhesive for securing said plate members to adjacent strips whereby said sleeves, plate members and adhesive cooperate to anchor the ends of said strips within said sleeves.

42. The invention of claim 44 wherein said means connecting said tubular members together includes:
a. a skirt secured to, and surrounding, each of said tubular members adjacent their ends;
b. said skirts each being radially spaced from the tubular member to which it is secured;
c. means extending between said skirts; and
d. pivot means connecting each of said skirts with said means extending between said skirts to accommodate relative movement between said tubular members.

PO-1050
(5/69)

UNITED STATES PATENT OFFICE

CERTIFICATE OF CORRECTION

Patent No. 3,604,732 Dated September 14, 1971

Inventor(s) BILLY C. MALONE

It is certified that error appears in the above-identified patent and that said Letters Patent are hereby corrected as shown below:

Column 1, line 44, change "edge" to --wedge--.
Column 2, line 49, change "after" to --outer--.
Column 2, line 54, change "30a" to --30e--.
Column 3, line 33, change "," to --M.--.
Column 9, lines 19 through 23, change:
"f. an outer covering bonded to said reinforcing sheath and sleeves.
"g. a plug closing off the opening; and
"h. means for conducting an inflating medium to said element.
to:
--f. means for conducting an inflating medium to inflate said element; and
--g. an outer covering bonded to said reinforcing sheath and sleeves.--.
Column 9, line 25, after "therethrough" insert --;--.
Column 10, line 33, change "44" to --41--.

Signed and sealed this 14th day of March 1972.

(SEAL)
Attest:

EDWARD M.FLETCHER, JR.
Attesting Officer

ROBERT GOTTSCHALK
Commissioner of Patents