United States Patent [19]

Leiter

[11] **3,860,041**

[45] **Jan. 14, 1975**

[54] **SELF-ERECTING TUBE**

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[73] Assignee: **Ametek, Inc.,** New York, N.Y.

[22] Filed: **May 29, 1973**

[21] Appl. No.: **364,527**

[52] **U.S. Cl.** **138/144,** 138/154

[51] **Int. Cl.** **F16l 9/16**

[58] **Field of Search** 138/150, 134, 154, 144

[56] **References Cited**

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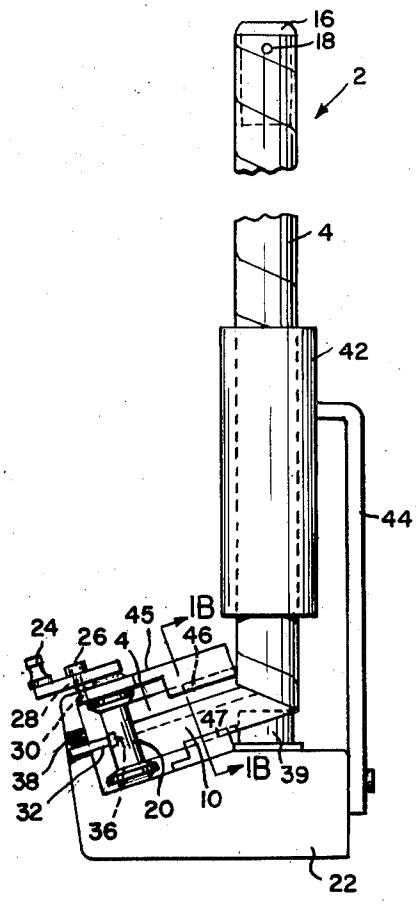
Primary Examiner—Jerry W. Myracle

Attorney, Agent, or Firm—Smith, Harding, Earley & Follmer

[57] **ABSTRACT**

A self-erecting tube has a plurality of axially extending helical ribbons of spring material having a common axis and the same helix angle. The ribbons are axially spaced with the turns of adjacent ribbons overlapping and secured together.

8 Claims, 14 Drawing Figures



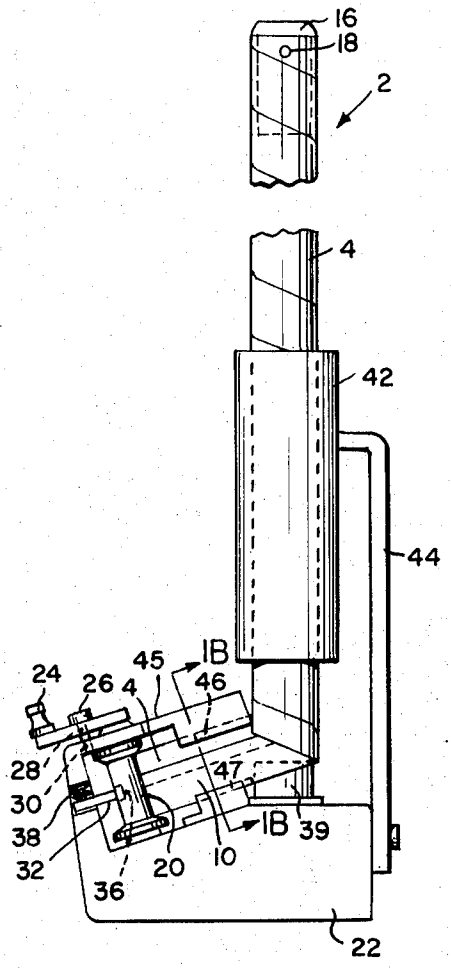


FIG. 1A.

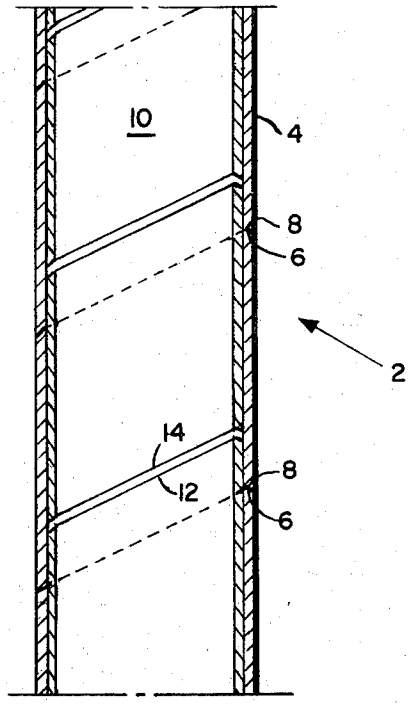


FIG. 2.

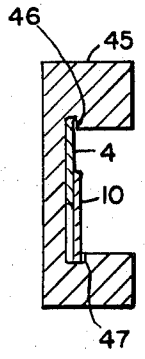


FIG. 1B.

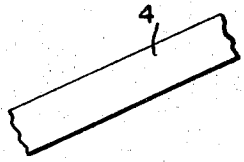


FIG. 3.

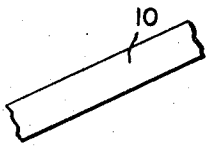


FIG. 4.

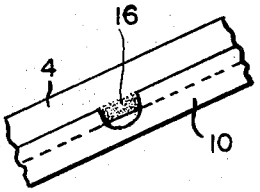


FIG. 5.

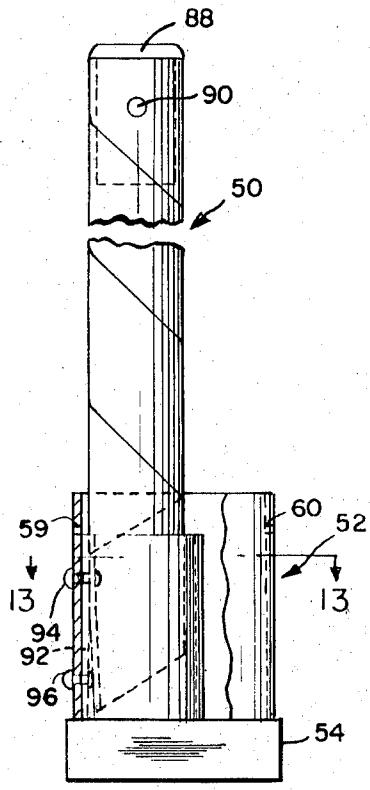


FIG. 6.

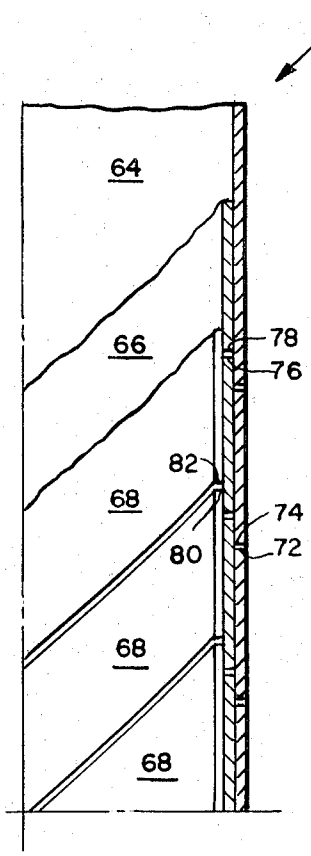


FIG. 8.

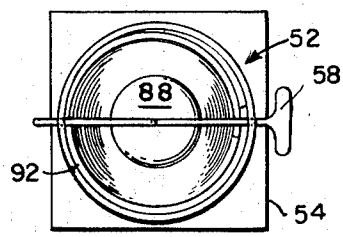


FIG. 7.

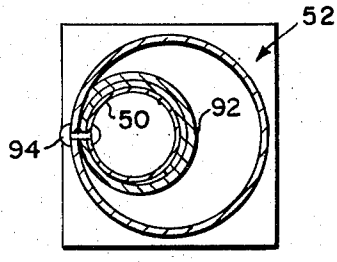


FIG. 13.

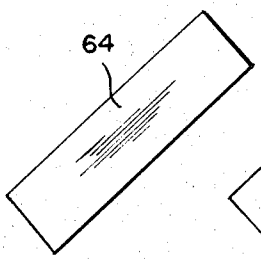


FIG. 9.

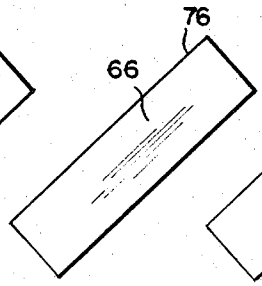


FIG. 10.

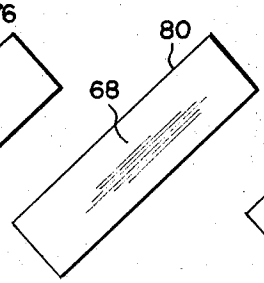


FIG. 11.

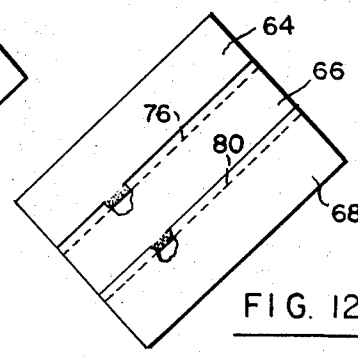


FIG. 12.

SELF-ERECTING TUBE

BACKGROUND OF THE INVENTION

A self-erecting tube formed from a helical axially extending ribbon of spring material is old in the art as seen, for example, in U.S. Pat. No. 3,467,329 which is incorporated herein by reference. It is also known to make such a tube with a constant outer diameter as disclosed in U.S. Pat. No. 3,670,773. This prior art constant diameter self-erecting tube achieved a constant diameter by providing a step in a single ribbon forming the tube. This step limits the minimum diameter to which the tube can be formed. A severe stress level is encountered in the step which under some conditions causes splitting of the ribbon along the step. In addition, in tubes of this type the amount that one turn can overlap an adjacent turn is limited and hence limits the strength obtained by overlapping. This invention overcomes these problems. Further, the tube of this invention provides a markedly increased ability to bear a compressive axial load as well as markedly increased rigidity and strength in the direction normal to the axis of the tube.

SUMMARY OF THE INVENTION

A self-erecting tube has a plurality of axially extending helical ribbons of spring material having a common axis and the same helix angle. The ribbons are axially spaced with the turns of adjacent ribbons overlapping and secured together. Two or more ribbons may be employed. Advantageously the edges of adjacent turns of the outermost ribbon are in abutting relationship and the edges of adjacent turns of the other ribbons are slightly spaced apart. It has been found that there is little advantage in using more than 6 ribbons in any one tube. An excellent interlock between turns is provided by beveling the upper edge and undercutting the lower edge of one or more of the ribbons.

DESCRIPTION OF THE DRAWINGS

FIG. 1A is a front elevation of a tube in accordance with the invention in association with a winding storage drum;

FIG. 1B is a vertical section taken on the plane indicated by the line 1B–1B in FIG. 1A;

FIG. 2 is an enlarged view of the tube of FIG. 1A, partially broken away;

FIG. 3 is a development view, partially broken away, of the outer ribbon of the tube of FIG. 1A;

FIG. 4 is a development view, partially broken away, of the inner ribbon of the tube of FIG. 1A;

FIG. 5 is a development view, partially broken away, of the tube of FIG. 1A;

FIG. 6 is a front elevation of an alternative tube device in accordance with the invention;

FIG. 7 is a plan view of the device of FIG. 6 in the storage position;

FIG. 8 is an enlarged view of the tube of FIG. 6, partially broken away;

FIG. 9 is a development view of the outer ribbon of the tube of FIG. 6, partially broken away;

FIG. 10 is a development view of the middle ribbon of the tube of FIG. 6, partially broken away;

FIG. 11 is a development view of the inner ribbon of the tube of FIG. 6, partially broken away;

FIG. 12 is a development view of the tube of FIG. 6, partially broken away; and

FIG. 13 is a view taken on the plane indicated by the line 13—13 in FIG. 6.

DETAILED DESCRIPTION OF THE INVENTION

Referring to FIG. 2, a tube 2 in accordance with the invention has an outer ribbon 4 of spring material set to coil in an axially extending helix with the beveled upper edge 6 of each turn abutting the undercut lower edge 8 of the adjacent turn. An inner ribbon 10 of spring material is set to coil in an axially extending helix with the same helix angle as ribbon 4. Ribbon 10 is sufficiently narrower than ribbon 4 for the adjacent beveled upper edges 12 and undercut lower edges 14 of adjacent turns to be slightly spaced apart to insure that edges 6 and 8 are not prevented from abutting by the abutment of edges 12 and 14. Helical ribbons 4 and 10 are axially spaced to provide for each turn of ribbon 10 to overlap a pair of adjacent turns of ribbon 4. The upper portion of each turn of ribbon 10 is connected, for example, by welding or bonding to the lower portion of the next higher turn of ribbon 4 as indicated at 16. The formation of tube 2 is clarified by reference to FIGS. 3, 4 and 5, a development of ribbon 4 being shown in FIG. 3, a development of ribbon 10 being shown in FIG. 4 and a development of the joined ribbons being shown in FIG. 5. As seen in these Figures, ribbons 4 and 10 have the same helix angle with ribbon 10 being slightly narrower than ribbon 4. Ribbons 4 and 10 are readily formed by employing the method of U.S. Pat. No. 3,007,239, the disclosure of which is incorporated herein by reference. In lieu of setting the ribbon to coil in a cylindrical coil, the ribbon is set with a helix angle so that the ribbon will naturally coil in the desired helical coil. Each increment of the outer ribbon 4 will be set to the same radius and the same is true of inner ribbon 10. The two ribbons may be set to the same radius with the resiliency of the ribbons accommodating the small difference between their diameters in the erected tube. Employing the method of U.S. Pat. No. 3,007,239 introduces residual compressive and tensile stresses which resist the straightening of the coils by virtue of first setting the ribbon of spring material to coil to a predetermined radius and then reverse bending the material to set each increment so that it still coils in the same direction but on a larger radius than the radius of the initial set. Tube 2 has a conventional tip 16 secured by a rivet 18.

For the selected diameter of tube, the width of ribbon 4 and its helix angle are selected so that the edges 8 and 6 overlap slightly and they are locked together as detailed hereinafter, i.e., the formed helix angle is less than the erected helix angle.

As shown in FIG. 1A, tube 2 can be rolled up and stored in the manner disclosed in U.S. Pat. No. 3,467,329. As shown in FIG. 1A, a storage drum 20 for winding up the joined ribbons 4 and 10 is mounted for rotation on a metal base 22 and is connected to a crank 24 which can be locked in position by a pin 26 which passes through an opening 28 in crank 24 and an opening 30 in base 22. The axis of drum 20 lies in a vertical plane. A perpendicular to said axis in said plane makes an angle to the horizontal which is substantially greater than the helix angle of the ribbons, for example, 5° to 10° greater. A latch member 32 is biased towards an opening 36 in drum 20 by means of a spring 38 all as shown in greater detail in U.S. Pat. No. 3,467,329. A rotatable guide member 39 is supported by base 22. A

fixed guide sleeve **42** is mounted on base supported bracket **44.** Since the outer diameter of tube **2** is constant, the inner diameter of guide sleeve **42** is selected to be just slightly larger than the outer diameter of tube **2** and will give tube **2** support against movement transverse to its axis at all times irrespective of the amount of erection of tube **2.**

A guide shoe **45** has opposed guiding slots **46** and **47** which are mutually parallel and are perpendicular to a line on the winding surface of drum **20** which line is parallel to the longitudinal axis of drum **20.** Slots **46** and **47** together with drum **20** deflect connected ribbons **4** and **10** to deflect edge **6** on the lowermost wrap from the adjacent edge **8** to permit edge **6** to slide in under the undercut edge **8** and interlock therewith.

In operation, crank **24** is rotated to wind the joined ribbons **4** and **10** onto drum **20** until the upper end of the tube is retracted inside guide sleeve **42** at which point pin **26** is inserted to lock crank **24.** On the removal of pin **26,** joined ribbons **4** and **10** unwind from drum **20** and move upwardly into helical form due to stored strain energy to extend the tube **2** upwardly until latch **32** enters opening **36** to stop the rotation of drum **20.** In ribbon **4** of the fully erected tube, the upper edges **6** of each turn abut the lower edges **8** of the adjacent turn as shown in FIG. **2.** This provides a high degree of resistance to compressive axial loading. Further, the high degree of overlapping of the inner and outer ribbons provide a high degree of rigidity and strength perpendicular to the axis of the tube. In the ribbon **10** of the fully erected tube, the adjacent edges **12** and **14** are spaced apart to insure the freedom of edges **6** and **8** to abut. This results from ribbon **10** being slightly narrower than ribbon **4.** Under very heavy compressive axial loading these edges can abut and provide further resistance to said loading. Similarly the bevel-undercut combination on edges **14** and **12** (shown in FIG. **2**) provide an interlock when edges **14** and **12** abut under heavy compressive axial loading.

Referring now to FIG. **6,** a three-ply tube **50,** in accordance with the invention, is associated with a storage canister **52** mounted on a base **54.** A lock pin **58** is adapted to pass through openings **59** and **60** in canister **52** to hold tube **50** in a collapsed position within canister **52.**

Tube **50** as best seen in FIG. **8** is similar to tube **2** but is formed of three ribbons **64, 66** and **68** which are generally formed in the same manner as ribbons **4** and **10** described above. The upper edge **72** of each turn of ribbon **64** is spaced from the adjacent lower edge **74.** This is readily accomplished by the selection of the ribbon width and helix angle for the selected tube diameter. Similarly, ribbon **66** has an upper edge **76** and a lower edge **78,** ribbon **68** has an upper edge **80** and a lower edge **82,** and these respective edges of ribbons **66** and **68** are also spaced apart. The upper portion of each turn of ribbon **66** adjacent edge **76** is connected to the lower portion of each turn of ribbon **64** adjacent edge **74,** for example, by welding. Similarly, the upper portion of each turn of ribbon **68** adjacent edge **80** is connected to the lower portion of each turn of ribbon **66** adjacent edge **78,** for example, by welding. A conventional tip **88** is riveted to the tube **50** at **90.** The lower end of tube **50** is embraced by a spring clip **92** such as is conventionally used with self-erecting tubes to increase their rigidity. As seen in FIG. **7,** the clip **92** is expanded in the stored position. As the tube **50** erects the clip contracts to the final position shown in FIG. **13** to firmly hold the bottom wraps of the tube **50.** Clip **92** and tube **50** are both held by a rivet **94** and a rivet **96** rivets the clip **92** only to the canister **52.**

In operation, with the device in the storage condition of FIG. **7,** the pin **58** is pulled clear of openings **59** and **60** and tube **50** erects to the position of FIG. **6.** When the tube **50** is subjected to compressive axial loading, high resistance is provided by virtue of the adjacent ribbon edges being urged into an abutting relationship. The over-lapping of the three ribbons **64, 66** and **68** provides a high degree of rigidity and strength perpendicular to the axis of the tube.

The foregoing embodiments are illustrative and are not intended to be limiting.

I claim:

1. A self-erecting tube comprising:

a plurality of axially extending helical ribbons of spring material having a common axis and the same helix angle,

said ribbons being axially spaced with the turns of adjacent ribbons overlapping with the upper portion of the outer face of each ribbon turn inside of the outermost ribbon being bonded to the lower portion of the inner face of the turn of the ribbon adjacent said outer face, and

the outermost ribbon forming the outer surface of the tube of substantially uniform diameter.

2. A tube in accordance with claim **1** in which the edges of adjacent turns of the outermost ribbon are in contact.

3. A self-erecting tube comprising:

a first helical axially extending ribbon of spring material,

a second helical axially extending ribbon of spring material within the first ribbon having the same helix angle as the first ribbon and having turns partially overlapping the turns of the first ribbon with the upper portion of the outer face of the turns of the second ribbon bonded to the lower portion of the inner face of the turns of the first ribbon, and

said first ribbon forming the outer surface of the tube of substantially uniform diameter.

4. A tube in accordance with claim **3** having a third helical axially extending ribbon of spring material within the second ribbon and having turns partially overlapping the turns of the second ribbon with the upper portion of the outer face of the turns of the third ribbon bonded to the lower portion of the inner face of the turns of the second ribbon.

5. A tube in accordance with claim **3** in which the edges of adjacent turns of the first ribbon are in contact.

6. A tube in accordance with claim **5** in which the second ribbon is narrower than the first ribbon.

7. A tube in accordance with claim **5** in which the upper edge of the first ribbon is beveled and the lower edge of the first ribbon is undercut receiving the beveled upper edge.

8. A tube in accordance with claim **5** in which the second ribbon has a beveled upper edge and an undercut lower edge adapted to receive the beveled upper edge and the second ribbon is narrower than the first ribbon.

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