

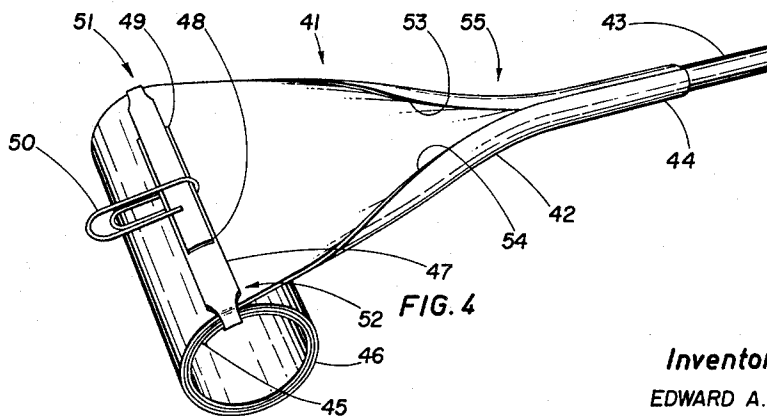
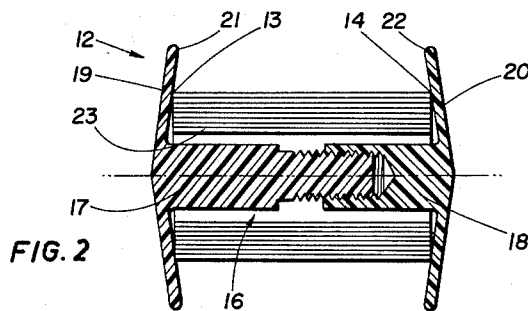
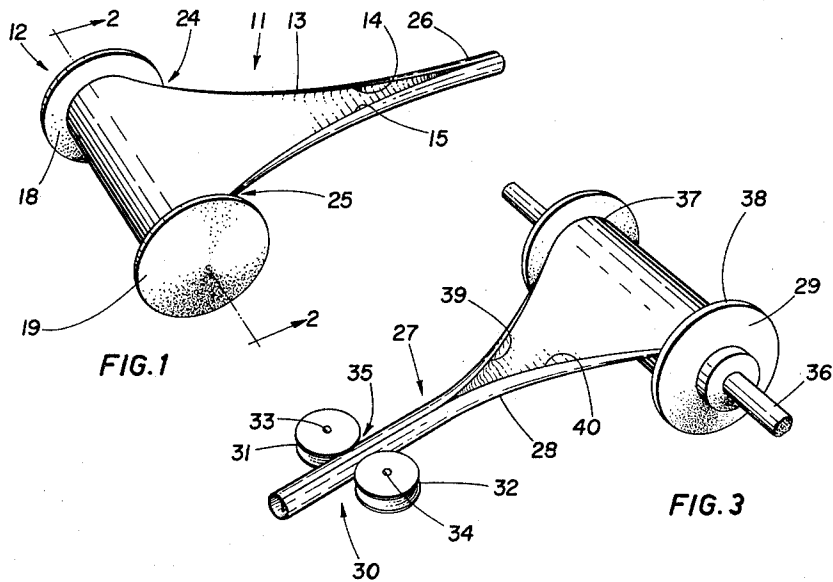
Aug. 11, 1964

E. A. WEIR ETAL
COILABLE TUBE DEVICE

3,144,104

Filed Aug. 3, 1961

2 Sheets-Sheet 1



Inventors

EDWARD A. WEIR
FRANCIS H. MEE

by: Cavanagh & Norman.

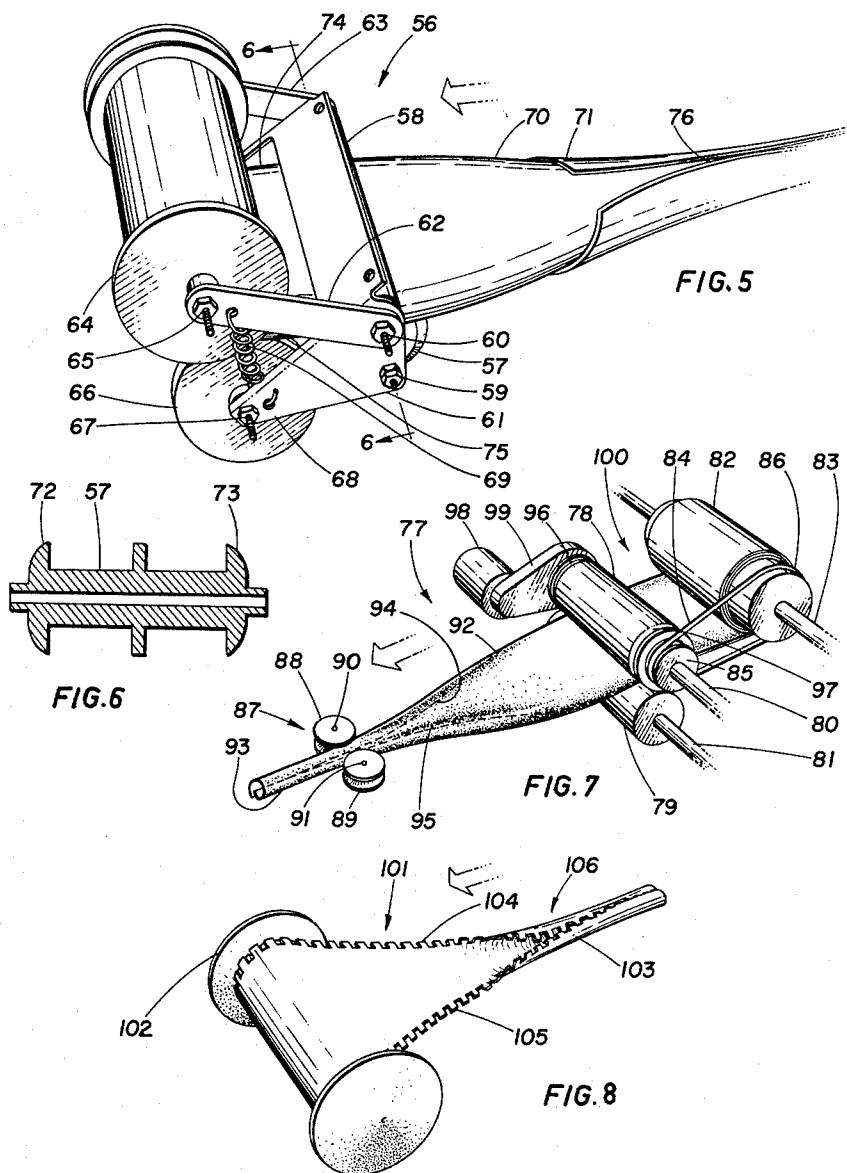
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Inventor
EDWARD A. WEIR
FRANCIS H. MEE
by: *Cavanagh & Norman*

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COILABLE TUBE DEVICE

Edward Arthur Weir, Toronto, Ontario, and Francis Herbert Arthur Mee, Aurora, Ontario, Canada, assignors to The De Havilland Aircraft of Canada, Limited, Downsview, Ontario, Canada

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This invention relates to a self-supporting extensible tube adapted to be stored in a compact coiled form.

In the field of remote reading of physical data, such as for instance of instruments on space vehicles, or data collection in unpopulated areas, the use of extensible antennas as signal carriers is well known. Such antennas are normally stowed in collapsed form for transportation to the desired area, whereafter they are extended for use. Obviously, in the case of transporting over great distances, the weight and compactness of the antenna are important considerations.

It is often a requirement to have an antenna which is substantially rigid or self-supporting, in which case prior methods have been to use telescoping tubes or jointed rods resulting in a serious weight penalty for rigidity obtained. In addition, considerable friction is usually present at the joints of the individual members, which necessitates the use of power extension in the case of remote erection of the antenna. The increase in bulk and weight due to the power means in such cases contributes nothing to the desired operation of the antenna, and in fact detracts from the desirable features by further complication.

Furthermore, it is also often desirable to support remote reading instruments and the like at some distance from the main carrier, such as radiation detectors on space vehicles, and in addition, to have them extensible for erection in a remote area. Rigidity, as in the beforementioned case, is often a requirement for the supporting member, and again it is usually necessary to sacrifice lightness to obtain the required rigidity.

Accordingly, it is an object of the present invention to provide an extensible tube being substantially rigid in the erected position.

It is a further object of this invention to provide a tube of the character described adapted to be stored in a compact coiled form.

It is a further object of this invention to provide an extensible tube having sufficient strength to support instruments and the like on the free end.

It is a further object of this invention to provide an extensible tube adapted to be retracted and extended by power means, being compactly coiled in the retracted position and substantially rigid in the extended position.

These and other objects and features of this invention will become apparent from a study of the following detailed discussion and accompanying drawings of presently preferred embodiments.

In the drawings:

FIGURE 1 is a perspective view of the device showing a fixed end position;

FIGURE 2 is a sectional view of the reel taken on the line 2-2 in FIGURE 1;

FIGURE 3 is a perspective view of the device as shown in FIGURE 1 having the end free and being provided with guide means;

FIGURE 4 is a perspective view of a second embodiment of this invention showing a simplified form of the fixed end type;

FIGURE 5 is a perspective view of a high energy device of the fixed end type;

FIGURE 6 is a section through a backing drum taken on the line 6-6 in FIGURE 5;

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FIGURE 7 is a perspective view of a powered device of the free end type adapted for power rewind; and,

FIGURE 8 is a perspective view of the device as shown in FIGURE 1 illustrating an interlocking of the edges of the tube.

With reference to FIGURE 1 and FIGURE 2, a self-supporting extensible tube device designated generally as 11 is shown comprising a reel designated generally as 12 and a coilable tube 13 partially wound thereon. Tube 13 is formed from a substantially rectangular elongate strip of resilient material, such as for instance spring steel or beryllium copper, into a tubular shape having overlapping edges 14 and 15, the material having sufficient flexibility to enable the tube to be opened flat without a permanent set, thereby allowing the strip to return to the tubular shape upon release thereof.

Reel 12 comprises a drum indicated as 16 having two halves 17 and 18, half 17 being threadably secured to half 18, whereby the drum may be shortened or lengthened. A pair of conical side discs 19 and 20 are secured concentrically with drum halves 17 and 18 respectively, and have inwardly dependent rims 21 and 22. As will be seen adjustment of drum halves 17 and 18 will alter the distance between rims 21 and 22 of conical discs 19 and 20. One end 23 of tube 13 is opened out substantially flat and placed on drum 16 whereupon tube 13 is coiled about drum 16. The distance between rims 21 and 22 is substantially less than the flattened width of tube 13, however at positions 24 and 25 tube 13 is still partially curved, thereby reducing the overall width and allowing the tube to pass rims 21 and 22 to be coiled upon drum 16.

Upon most of tube 13 being coiled about reel 12 and 26 of tube 13 is secured by any convenient means, and reel 13 is released, whereupon energy stored in the form of deflection within coiled tube 13 will cause unwinding. The escape of flattened tube 13 from the coil position on reel 12 depends upon tube 13 forming an arcuate shape thereof and thus a reduction in width, in order to pass rims 21 and 22. Thus the release position at 24 and 25 will always be tangential to the circumference of the coil upon drum 16, whereby the uncoiling motion will be in a straight line.

Referring to FIGURE 3, a second form of extensible tube is illustrated and designated generally as 27 and comprises coilable tube 28 partially wound upon reel 29 in a manner similar to that disclosed in FIG. 1. Device 27 also has incorporated therein a tube guide designated generally as 30, comprising rollers 31 and 32 rotatably mounted on shafts 33 and 34 respectively at a finite distance apart, at 35. Reel 29 is rotatably mounted upon shaft 36 and is supported thereby in a frame (not shown) together with guide 30. Upon release of coiled tube 28, the tube will unwind from reel 29 and project through guide 30 reforming into a tubular shape, and will be guided in a straight line by rollers 31 and 32 until assuming the completely unwound or fully extended position. As before, rims 37 and 38 prevent uncoiling of tube 28 except in a tangential position, and furthermore lateral adjustment of rims 37 and 38 will control the speed of uncoiling by pressural engagement with edges 39 and 40 of tube 28.

Referring to FIGURE 4, a third embodiment of this invention is illustrated, showing an extensible tube device designated generally as 41, comprising a coilable tube 42 formed in a similar manner to tube 13 shown in FIGURE 1 and having a supporting base 43 at one end 44. The other end 45 of tube 42 is formed into a coil 46 whereby as previously explained tube 42 is opened flat. Coil 46 is secured by a band 47 of abrasion resistant material, such as for instance Teflon, having in this case ends 48 and 49 secured by a common paper clip

50. Upon securing end 44 and base 43 and releasing coil 46, tube 42 will unwind in a direction tangential to coil 46 at positions 51 and 52 defined by band 47. The flattened tube thus uncoiling and extending will reform into a tubular shape with overlapping edges 53 and 54 at the position 55.

Referring to FIGURE 5 and FIGURE 6, a fourth embodiment of this invention is illustrated showing an extensible tube device designated generally as 56 comprising power roller 57 and backing roller 58 rotatably mounted on shafts 59 and 60 respectively within frame 61. Pairs of projecting arms 62 and 63 extend from frame 61 and have at their outer ends storage drum 64 rotatably mounted thereon in shaft 65. A backing drum 66 is rotatably mounted on shaft 67 within frame 61 at end 68 parallel to storage drum 64. Spring 69 pressurably biases backing drum 66 and storage drum 64 together to hold a coillable tube 70, similar to tube 13 in FIGURE 1, passing through a guide 71 and coiled in an opened flat manner with the natural curvature facing outwardly upon storage drum 64.

Radiused edges 72 and 73 on power roller 57, afford relief for highly stressed edges 74 and 75 of tube 70 preventing damage thereto during the coiling and projection stages.

Upon securing end 76 of tube 70 and releasing device 56, tube 70 will uncoil from drum 64 through rollers 57 and 58, reforming into a tube, and projecting device 56 in a straight line tangent to power roller 57.

A fifth embodiment of this invention is illustrated in FIGURE 7 showing an extensible tube device designated generally as 77 comprising a power roller 78 and a backing roller 79 rotatably mounted on shafts 80 and 81 respectively within a frame (not shown). A storage drum 82 is also rotatably mounted on shaft 83 within the same frame and is operably connected to power roller 78 by means of belt 84. Pulley 85 on power roller 78 is substantially smaller than pulley 86 on storage drum 82, whereby upon rotation of roller 78, drum 82 will be driven at a substantially slower rate of rotation. A tube guide, indicated generally as 87, and comprising rollers 88 and 89 rotatably mounted on shafts 90 and 91 respectively, is mounted in the aforementioned frame substantially in line with a common tangent to rollers 78 and 79. A coillable tube 92, similar to tube 13, is secured to and coiled about drum 82 in an opened flat manner having the natural curvature facing outwardly and has a free end 93 projecting through guide 87. The tube 92 in passing through guide 87 has an open C configuration, the edges 94 and 95 being held open by pressure engagement of the edges with peripheral slots 96 and 97 in power roller 78 serving the same purpose of stress relief as edges 72 and 73 (FIGURE 6). A power drive device, such as for instance reversible motor 98 and gear box 99, is operably connected to power roller 78, whereby operation of motor 98 will cause rotation of roller 78, and thus drum 82, to wind tube 92 about drum 82. Belt 84 will tend to overdrive drum 82 thus tensioning tube 92 at the position 100, ensuring a tight coil at all times.

Upon release of power roller 78 tube 92 will uncoil from drum 82 and project through guide 87 reforming into a tubular shape. Motor 98 can be used during this extension phase to assist the uncoiling of tube 92.

A further refinement to the coillable tube is illustrated in FIGURE 8 showing an extensible tube device designated generally as 101, being of similar construction as device 11 in FIGURE 1. A reel 102 has coiled there-

upon a coillable tube 103 having notched edges 104 and 105, whereby upon uncoiling from reel 102 the edges interlock as shown at 106 forming a shear attachment. The securing of edges 104 and 105 transmits any torsional loads imposed on the tube into longitudinal shear, thereby rigidifying the tube against twisting.

It is obvious that any one of the described embodiments can be utilized as an extensible antenna for use on remote reading instrument carriers such as for instance space vehicles and the like. In addition, the type as disclosed in FIGURE 7 can be utilized as an instrument boom to support any particular instrument away from the main carrier. The interlocking edges as illustrated in FIGURE 8 will resist torsional stresses imposed by supported instruments under accelerating loads, as well as wind loads in the case of the device being used as an antenna in remote terrestrial areas.

From the foregoing it will be obvious that the invention comprises an elongate strip of resilient material permanently deformed into a hollow tube about the longitudinal axis thereof. The tube is wound into a coil with the seam facing outwardly whereby the tube is opened flat during coiling, energy being stored therein, in the form of deflection of the edges of the tube. Restraining means are fixed about one side of the coil, whereby upon uncoiling the direction of the uncoil will be a straight line tangent to the coil at the point of restraint.

Although some preferred embodiments of the present invention have been disclosed, alterations in design can be resorted to without departing from the spirit of the invention, and while still falling within the scope of the appended claims.

What we claim is:

1. A self-supporting tube device comprising: an elongate resilient strip permanently deformed into a hollow tube about the longitudinal axis; a tube guide supported in a frame; a rotatably mounted reel in said frame; said reel consisting of a coil storage drum and a pair of inwardly depending conical discs secured to each end and concentric therewith; said tube being inserted in said guide and coiled about said drum with the seam facing outwardly, whereby said tube is temporarily opened flat while coiled; and the flattened width of said tube being greater than the distance between the rims of said discs, whereby upon release of said reel, said tube will uncoil from said drum and project through said guide in a straight line, reforming into a tubular shape.

2. A self-supporting extensible tube device comprising: an elongate resilient strip permanently deformed into a hollow tube with overlapped edges about the longitudinal axis; a reel consisting of a storage drum and a pair of inwardly depending conical discs secured to each end and concentric therewith; said tube being coiled about said drum with the seam facing outwardly, whereby said tube is temporarily opened flat while coiled; and the flattened width of said tube being greater than the distance between the rims of said discs, whereby upon securing the free end and releasing said reel, said tube will uncoil from said drum on a straight line tangent to said rims and reform into a tubular shape.

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