Dec. 16, 1969 J. C. BELL ET AL 3,484,788

INFLATABLE DEVICE FOR ANTENNA, SUPPORT, AND LIFTING

Filed Nov. 7, 1966 3 Sheets-Sheet 1

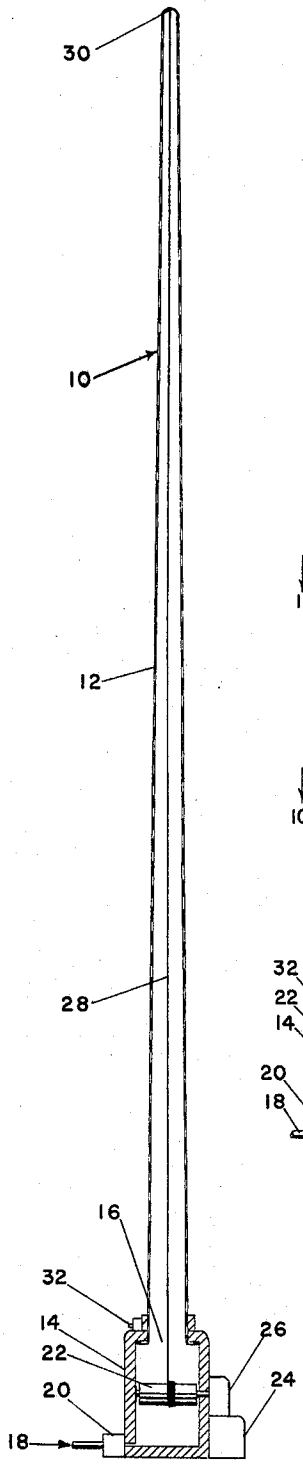


FIG.-1

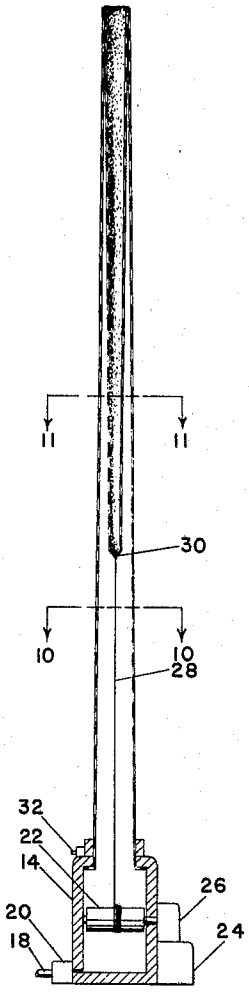


FIG.-2

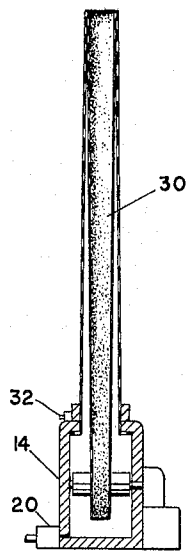


FIG.-3

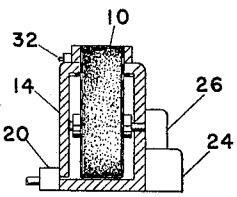


FIG.-4

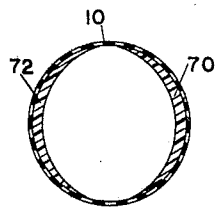


FIG.-10

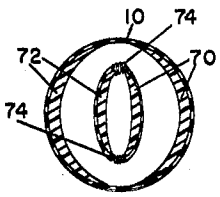


FIG.-11

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INFLATABLE DEVICE FOR ANTENNA, SUPPORT, AND LIFTING

Filed Nov. 7, 1966 3 Sheets-Sheet 2

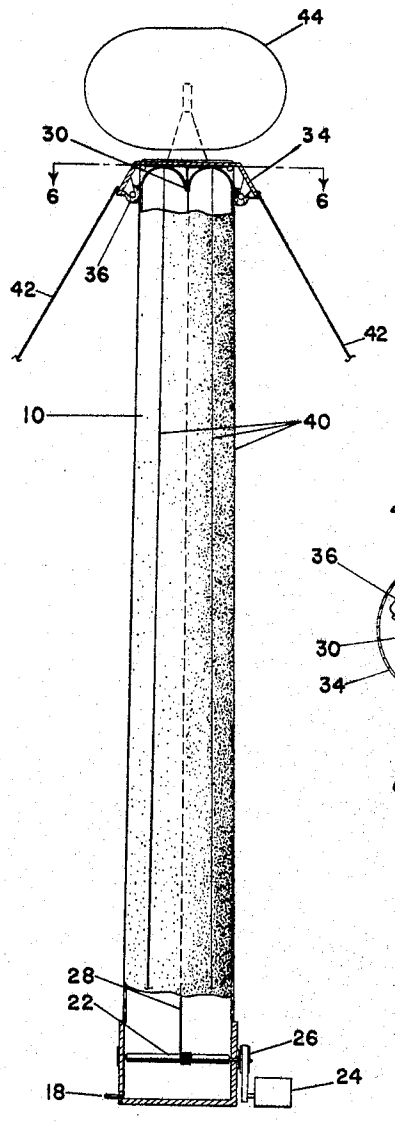


FIG.-5

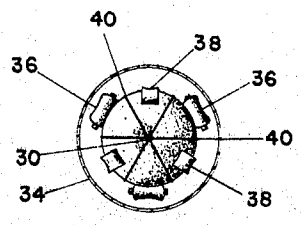


FIG.-6

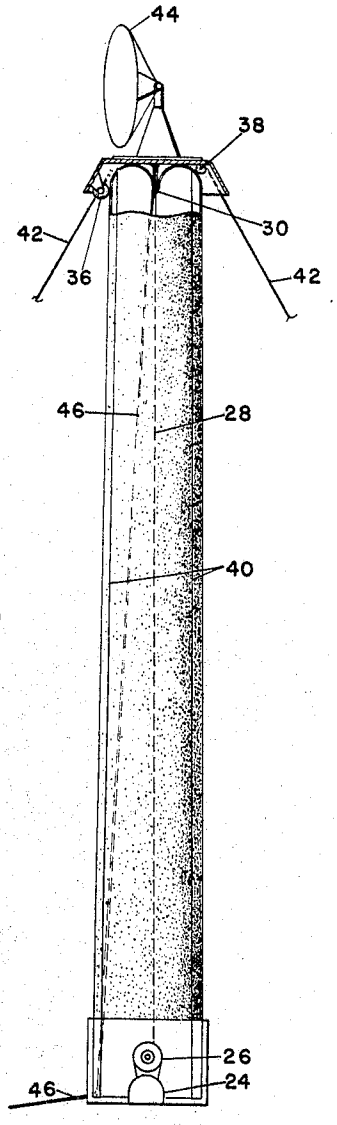


FIG.-7

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INFLATABLE DEVICE FOR ANTENNA, SUPPORT, AND LIFTING

Filed Nov. 7, 1966 3 Sheets-Sheet 3

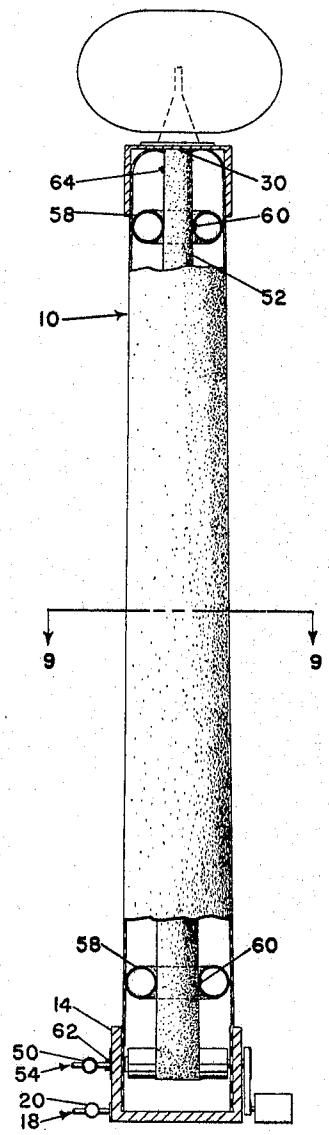


FIG.-8

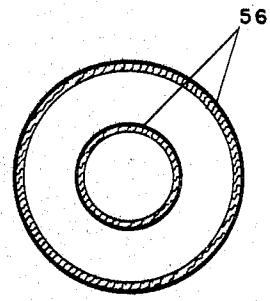


FIG.-9

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INFLATABLE DEVICE FOR ANTENNA, SUPPORT, AND LIFTING

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Int. Cl. H01q 1/08
U.S. Cl. 343—880 8 Claims

ABSTRACT OF THE DISCLOSURE

An inflatable fabric mast to serve as an antenna, or as supporting means or lifting means. An internal strap or cable has one end attached to the top of the mast and the other end attached to a rotatable reel wherein the collapsed fabric mast itself is wound up on the reel as the device is retracted into a base assembly. The mast may be stiffened by metallic or plastic inserts having memory orientation features to protect against collapse by wind or other external forces.

The present invention relates to an inflatable fabric cone or cylinder serving as an antenna, or as supporting means or as a lifting means, or the like, and characterized by substantially complete retraction into a very small unit upon deflation.

The general object of the present invention is to overcome the difficulties to the prior art by providing an automatically erectable inflatable fabric device for lifting and supporting an antenna or the like and characterized by inexpensiveness of construction and maintenance, compactness in packaged state, ease of and variableness of extension, and rigidity and effectiveness during the erection operation as well as in the fully erected condition.

Another object of the invention is to provide a combination as aforesaid including an internal strap or cable, located inside an inflatable fabric cylinder, which has one end attached to the top of the inflatable fabric cylinder or cone when it is extended, and has the other end attached to a rotatable reel, located in the housing for the inflatable fabric and wherein not only the cable but the collapsed fabric itself is wound up on the reel as the device is retracted into its base assembly.

Another object of the invention is to provide the combination of a platform means, and the expandable-contractable support and wherein the platform means is carried by and on the fabric cylinder support when it is inflated or deflated, permitting antenna or other payload means to be placed on the platform so as the antenna or payload means can be raised or lowered to a desired height as the fabric is inflated, or deflated.

Another object of the invention is to provide a silver loaded, prevulcanized latex paint covering for the inflatable fabric cylinder or other suitable coating which permits the fabric of the cylinder to become a conductor suitable for coaxial cable, antenna, and like purposes.

The aforesaid objects of the invention and other objects which will become apparent as the description proceeds are achieved by providing a readily portable, retractable and extendable structure including a base, a flexible airtight fabric mast secured at its base to the base, a reel rotatably mounted in the base, a cable wrapped on the reel and connected to the vertex of the mast and with the major length of the mast being wrapped around the reel on top of the cable, and means for inflating the mast when the reel is turned to expand the mast to complete inflation with the cable extending inside the mast the full length thereof.

For a better understanding of the apparatus of the

invention, reference should be had to the accompanying drawings, wherein:

FIGURE 1 is a vertical cross sectional view of the invention in one preferred embodiment thereof;

FIGURE 2 is a view, similar to FIGURE 1, showing the inflatable fabric only partially extended;

FIGURE 3 is a view, similar to FIGURES 1 and 2, showing the inflatable fabric in a still less extended position, with the top of the inflatable fabric beginning to be wrapped around a reel in the antenna housing;

FIGURE 4 is a view, similar to FIGURES 1, 2, and 3 showing the inflatable fabric completely retracted inside the housing;

FIGURE 5 is a cross sectional view of a modification of the apparatus of the invention;

FIGURE 6 is a transverse cross sectional view taken along line 6—6 of FIGURE 5;

FIGURE 7 is a cross sectional view similar to FIGURE 5, but taken at ninety degrees therefrom;

FIGURE 8 is a vertical cross sectional view of an inflated coaxial cable arrangement;

FIGURE 9 is an enlarged cross sectional view taken substantially along line 9—9 of FIGURE 8, with the thickness of the fabrics being greatly exaggerated,

FIGURE 10 is a cross sectional showing of support inserts included in the embodiment of FIGURE 1, taken on line 10—10 of FIGURE 2; and

FIGURE 11 is a cross sectional showing of support inserts included in the embodiment of FIGURE 1, taken on line 11—11 of FIGURE 2.

With reference to the form of the invention illustrated in FIGURE 1, the numeral **10** indicates generally an inflatable fabric cone, mast, or tapered cylinder, and hereinafter called a cylinder. The fabric **10** is made of any suitable, flexible, air-impervious high strength, weather resistant material, such as vinyl coated nylon. In the particular adaptation of the invention illustrated in FIGURE 1, the fabric cylinder **10** functions as an actual antenna. For this purpose, the inflatable fabric cylinder **10** is painted with a silver loaded prevulcanized latex paint **12**, making the fabric **10** a conductor suitable for antenna purposes. Of course, other suitable conductive coatings could be utilized.

The inflatable fabric cylinder **10** is connected to and can be completely housed in a pressurized antenna housing **14** which has an opening **16** through which the inflatable cylinder **10** is adapted to be extended when pressure is introduced into the housing. Pressure is introduced into the housing **14** by a suitable pressure inlet **18** with a pressure regulator **20** regulating the pressure flow therein.

Rotatably secured inside the pressurized housing **14** is a reel **22** which is driven by a motor **24** through motor drive **26**. Secured to the reel **22** is a cable **28** which has its other end thereof secured to the highest extendable portion or apex of the inflatable fabric cylinder **10**, this point being indicated by the numeral **30**. Also located on the pressurized housing **14** is a relief and exhaust valve **32**, the purpose of which will become evident hereinafter.

In the actual operation of the apparatus of the invention illustrated in FIGURES 1, 2 and 3, and with the cylinder **10** completely wound on the reel **22**, in fully collapsed position, pressure is introduced into the housing **14** through pressure inlet **18** to progressively expand and move the cylinder **10** from the fully packaged or collapsed position of FIGURE 4 to the positions of FIGURES 3, 2 and finally FIGURE 1 wherein the inflatable fabric cylinder **10** reaches its apex and is fully expanded. During this expanding operation the reel **22** simply rotates paying out the wrapped cylinder and then the cable **28**.

When the operation of the antenna is no longer deemed necessary, or it is discovered that the antenna receives the desired signals better at a lower height, reel **22** is driven by motor **24** in order to wind in the internal cable **28**. When this occurs the cable **28**, attached to the inflatable fabric cylinder at point **30**, begins to pull the apex of the antenna down within itself, this process being best illustrated by FIGURE 2. Reel **22** can be stopped when the desired height of inflatable fabric cylinder **10** is reached.

When the end of the internal cable **28** which is secured to the inflatable fabric cylinder at point **30** has been wound in to such a point that the end of the cable at point **30** reaches the reel **22**, the apex of the inflatable fabric cylinder also begins to wind around the reel **22**, this being best illustrated by FIGURE 3. This winding in process can be continued until the entire inflatable fabric cylinder **10** is inside the housing **14** and all of the cylinder is wound around the reel **22** except the base and extending to and connected to the opening **16** in the pressurized antenna housing.

The complete collapse or winding in of the cylinder **10** is done when the antenna is not in use, or when it is to be moved to a different location. During the winding in process, the gas which has been forced into the inflatable fabric cylinder **10** is exhausted through relief and exhaust valve **32**. If it is desired to again inflate the antenna, pressure is introduced through pressure inlet **18**, and the process hereinbefore described reverses itself, with the fabric wound on the reel **22** winding off the reel as the cylinder rises in height.

In order to stiffen the inflated cylinder as shown in FIGURE 1 of the drawings so that it can better withstand the force of wind, or other outside forces, the invention contemplates that flexible, but memory oriented inserts **70** and **72**, as best seen in FIGURES 10 and 11, are incorporated in opposed relation on the insides of the fabric cylinder **10**. The inserts **70** and **72** are slightly curved so that the core is substantially circular in cross sectional shape, and they extend the entire length or height of the cylinder **10**. While the inserts **70** and **72** are designed to be flexible to an extent, they are made from a memory oriented material which tends to always lay substantially straight, but can be rolled up and flattened. For example, some light weight spring steel, or a heavy flexible plastic with memory would be suitable materials for the inserts. FIGURE 11 pretty clearly shows how the cloth or similar flexible non-memory oriented material making up the cylinder **10** crumples in on the sides at **74**, while the inserts **70** and **72** begin to flatten out so they can be wound around the drum **22**.

FIGURE 5 illustrates a modification of the apparatus of the invention illustrated in FIGURES 1, 2, 3, and 4, wherein the inflatable fabric cylinder **10** does not act as the antenna itself, but rather acts as an inflatable elevator tower on which antenna or other payload means are placed. This is achieved by using a platform means **34** which is adapted to rest on and be supported by the inflatable fabric cylinder **10**. Platform means **34** has secured thereto a plurality of side stabilizing rollers **36** and top stabilizing rollers **38**. These rollers, best illustrated by FIGURE 6, permit the platform means **34** to slidably rise up the cylinder **10** when it is inflated. There are also a plurality, such as six platform leveling cables **40**, each having one end thereof secured to the housing **14** and the other end thereof affixed at point **30** which is the apex of the cylinder **10**. Also secured to the platform means **34** are a plurality of guy wires **42** which are payed out by hand while the inflatable fabric cylinder **10** is rising with the platform means carried thereon. When any suitable antenna or other payload means **44** carried by the platform means **34** has reached its desired height by inflating the fabric cylinder **10**, guy wires **42** are then secured to the ground providing the antenna means **44** with more solid support, permitting said means to remain safely stationed over long periods of time and through relatively high winds.

It should be understood that the use of rollers may not be necessary if the payload fits in close relation over the top or apex of the cylinder and has a skirt extending at least a short distance downwardly in complementary relationship thereto. Such a construction is shown in FIGURE 8.

A coaxial cable **46** is connected to said antenna means **44** and is also payed out when the platform means **34** rise up inflatable fabric cylinder **10**. Cable **46** permits the signals received or sent by antenna means **44** to be relayed to or from a suitable monitoring device on the ground.

FIGURE 8 illustrates another modification of the apparatus of the invention already illustrated, wherein the inflatable fabric cylinder **10** itself acts as a coaxial cable relaying the signals received to a monitoring device on the ground. In this modification, there is another inflatable fabric cylinder **52**, located in the inflatable fabric cylinder **10**. Inflatable cylinder **52** takes the place of retraction cable **28** as illustrated by the previous figures, and one end of the inflatable fabric cylinder **52** is attached to apex **30** and generally electrically connected by a suitable electrical transition connection to the antenna, the other end of the inflatable fabric cylinder **52** is secured to the motor driven reel **22**. A suitable 90° coaxial connection through the reel **22** and an electrical transition connection at **62** then complete the electrical connection of the cylinder **52**. When pressure is introduced into pressurized housing **14** by means of pressure inlet **18** and pressure regulator **20**, inflatable fabric housing **10** will rise until it reaches the desired height. In the rise of inflatable fabric cylinder **10**, inflatable fabric cylinder **52** will also be wound off reel **22**. When inflatable fabric cylinder **10** reaches its desired height, pressure will be introduced into inflatable fabric cylinder **52** by means of pressure inlet **54**, and pressure regulator **50**. A plurality of inflated rings **58** hold the proper spaced relationship between the cylinders **10** and **52**. Usually these rings will be inflated through holes **60** in the cylinder **52**.

Both inflatable fabric cylinder **10** and inflatable fabric cylinder **52** are painted with a silver loaded prevulcanized latex paint **56**, this paint **56** being indicated larger than scale in FIGURE 9 of the drawings. The paint **56** makes the fabric suitable for conductor purposes. The fabric cylinder **10** acts as a shield when a relaying of the signal from the antenna means occurs, and in an effect a coaxial cable is produced, with the air between the conducting fabric on inflatable cylinder **52** and inflatable cylinder **10** acting as an insulating device between the two electrical conducting members.

This coaxial cable effect, best illustrated by FIGURE 9, permits the signals being received by the antenna to be relayed to the monitoring device with a minimum of outside interference. When the antenna is to be lowered, the pressure introduced into inflatable fabric cylinder **52** will be exhausted through relief and exhaust valve **64** secured to inflatable fabric cylinder **52**.

Although the invention has been specifically illustrated and described as an antenna, and as a support for an antenna, the principles of the invention can be utilized for other purposes, for example, for support functions, for coaxial cable purposes, and the like, within the scope set forth in the appended claims.

What is claimed is:

1. The combination of a flexible, air tight fabric mast, housing means, the base of said mast secured to said housing means, a pressure relief valve in the housing, means for introducing fluid pressure into said housing to pressurize and extend said mast, a real rotatably mounted in said housing, drive means for said reel, cable means, one end thereof attached to said reel, the other end thereof attached to the apex of said mast so that said cable

means extends inside the mast the full length thereof when said mast is fully inflated, but wherein when the reel is driven to wind in said cable means, the apex of said mast is pulled inside the outer periphery of the mast forcing the excess fluid utilized to pressurize and extend the mast out through the pressure relief valve until substantially the entire mast and cable means are wrapped around said reel, electrically conductive material associated with the fabric mast making the fabric of the mast a conductor suitable to permit the mast to act as an antenna or a conductor, said cable means also comprising at least a portion of an electrically conductive material making the cable means a suitable conductor wherein the inflated mast in combination with the cable means acts as a coaxial conductor.

2. The combination according to claim **1** where the cable means is inflated fabric and is covered with an electrically conductive coating.

3. The combination according to claim **1** wherein a plurality of inflated rings hold in proper spaced relationship said inflated cable means and said inflated mast.

4. The combination according to claim **1** and including platform means adapted to rest on and be supported by said mast wherein when said mast in inflated, said platform means slidably rises up the fabric mast.

5. The combination according to claim **1** and including

platform leveling cables, one end thereof secured to said housing, the other end thereof secured to the apex of said mast, said cables adapted to support and level said platform, and

antenna means carried by said platform means, said antenna means being electrically connected with said cable means.

6. The combination of a flexible, air-tight, fabric mast, housing means, the base of said mast secured to said housing means, a pressure relief valve in the housing, means for introducing fluid pressure into said housing to pressurize and extend said mast, a reel rotatably mounted in said housing, drive means for said reel, cable

means, one end thereof attached to said reel, the other end thereof attached to the apex of said mast so that said cable means extends inside the mast the full length thereof when said mast is fully inflated, but wherein when the reel is driven to wind in said cable means, the apex of said mast is pulled inside the outer periphery of the mast forcing the excess fluid utilized to pressurize and extend the mast out through the pressure relief valve until substantially the entire mast and cable means are wrapped around said reel, and flexible memory oriented stiffening inserts positioned within the fabric mast to effect rigidization thereof, said inserts positioned so as to wind flat around the reel when the mast is wound thereon.

7. The combination of claim **6** where there are two inserts each extending around approximately one half the circumference of the mast in opposed relation extending the full length of the mast.

8. The combination according to claim **7** where the inserts are curved in cross section to give rigidization thereto with the mast in the inflated condition but are sufficiently flexible with memory orientation features so as to lay flat when they are wound onto the reel.

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U.S. Cl. X.R.

52—2, 108; 343—900, 902, 908