United States Patent

Morrison

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[45] **Oct. 17, 1972**

[54] COLLAPSIBLE HELICAL ANTENNA

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[73] Assignee: **North American Rockwell Corporation**

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[52] **U.S. Cl.**.....**343/880,** 343/895

[51] **Int. Cl.**.....**H01q 1/36**

[58] **Field of Search**.....343/895, 880

[56] **References Cited**

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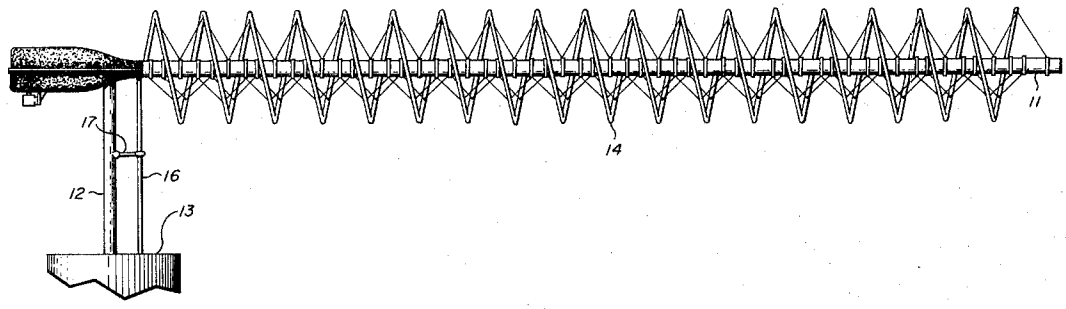
[57] **ABSTRACT**

A collapsible helical antenna formed of an extensible boom made of preferably two coiled flat steel ribbons which, when uncoiled, become tubular one inside the other and formed of a helical conductor that is suspended coaxially from the boom by a plurality of rings disposed around the boom and tied together by flexible members and by tensioned members extending from the rings to the helical conductor so that, as the boom is extended, the rings slide along the boom to become separated a distance determined by the flexible members but the helical wire is still maintained coaxial with the boom.

11 Claims, 5 Drawing Figures



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3 Sheets-Sheet 1

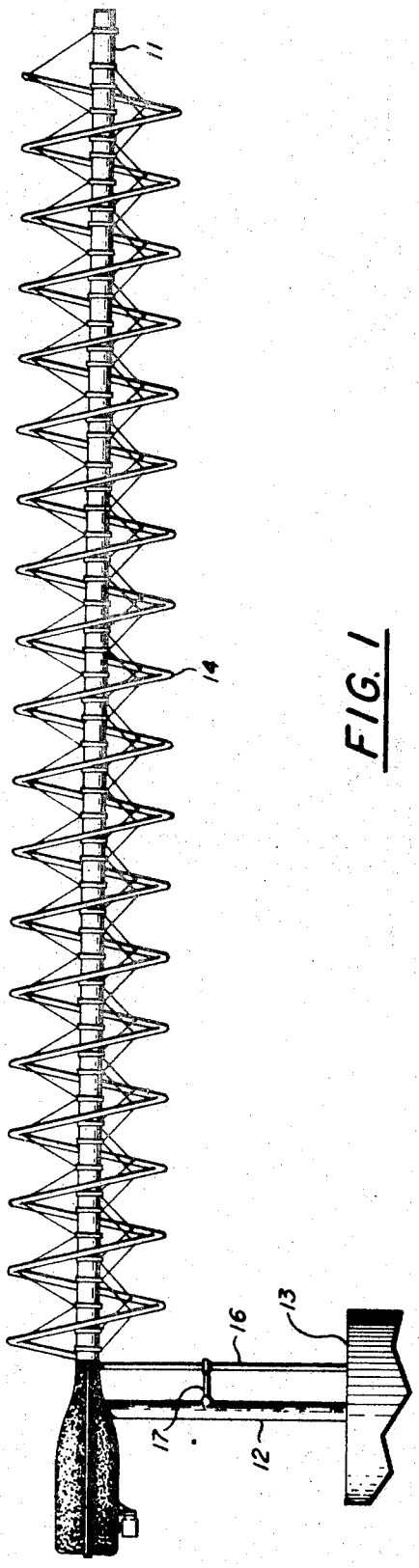

FIG. 1

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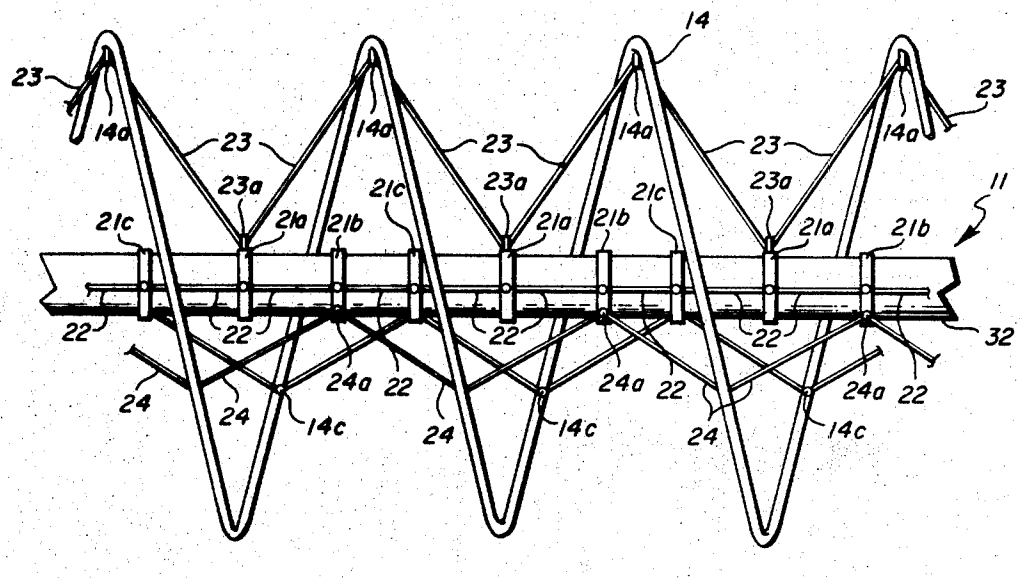

FIG. 2

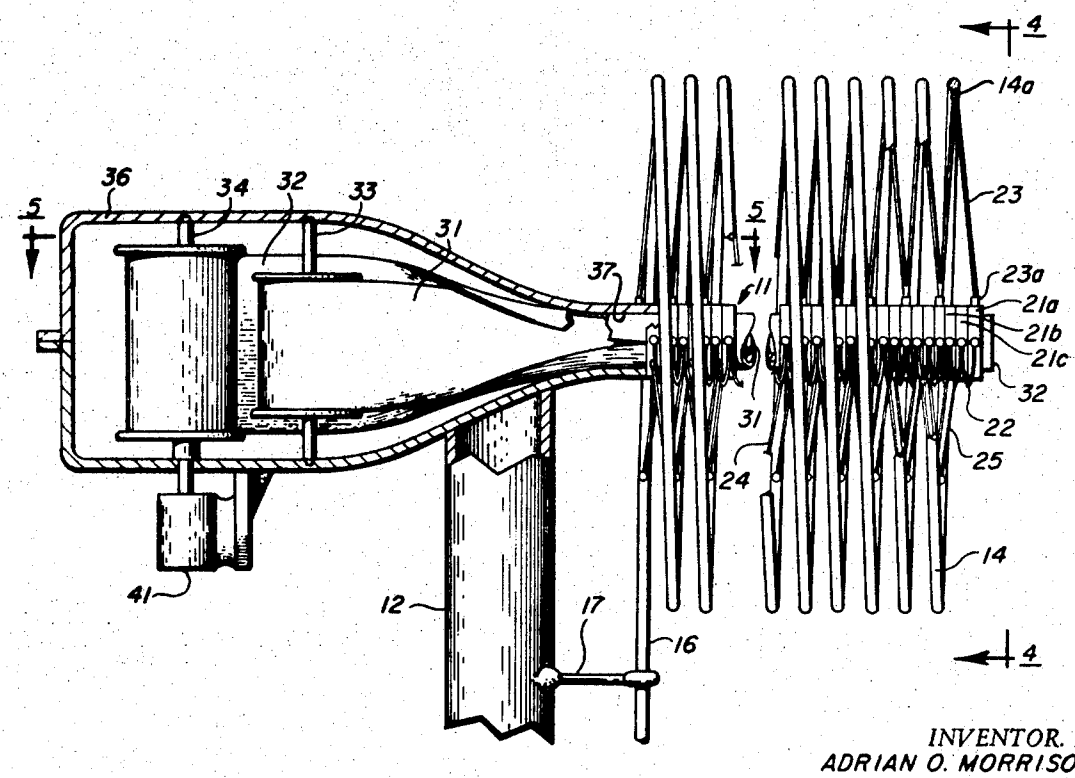

FIG. 3

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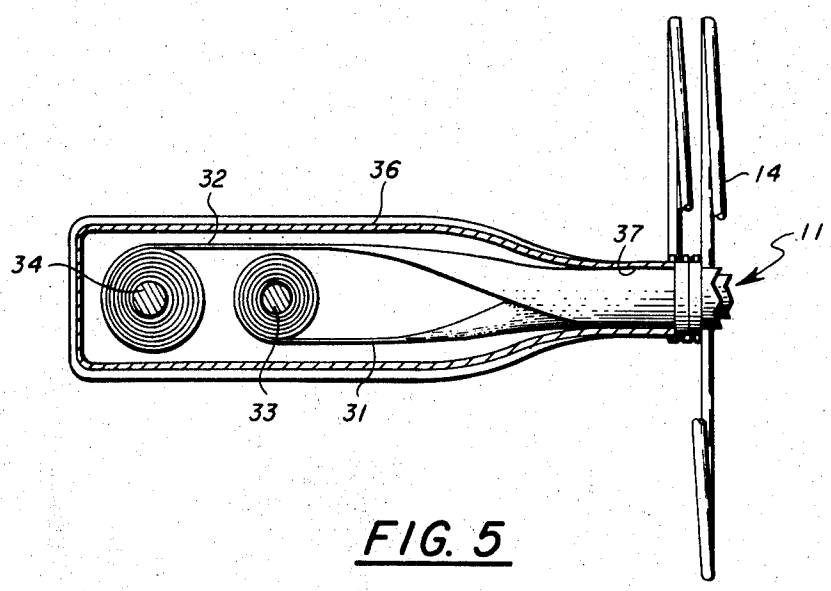

FIG. 5

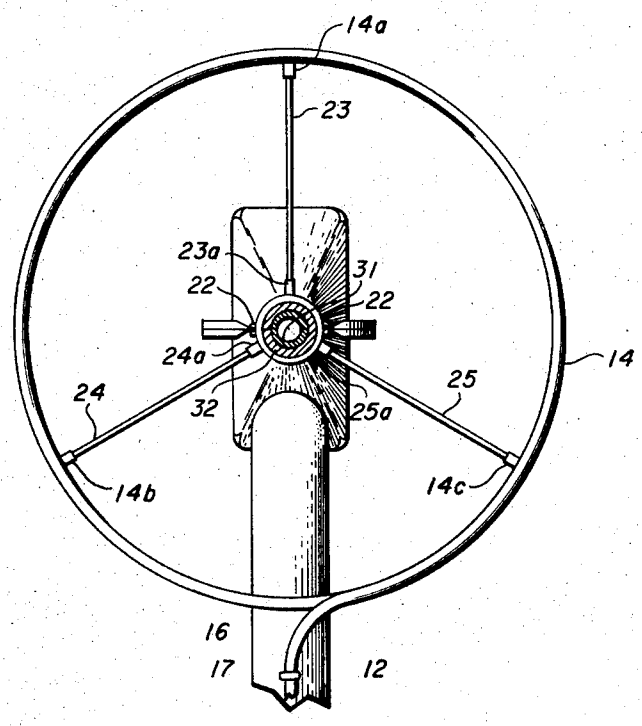

FIG. 4

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COLLAPSIBLE HELICAL ANTENNA

FIELD OF INVENTION

This invention relates to an extensible antenna and, more particularly, to an extensible antenna of the helical type.

BACKGROUND OF THE INVENTION

A helical antenna is useful where a circular polarized radiation field is desirable. However, to obtain a circular polarized radiation field the dimension of the helix should be such that the circumference of one turn is approximately equal to the wave length of the mid-point of the broadcast stand. The antenna will now radiate in a relatively broad frequency band and the maximum radiated power is in the direction of the helical axis. Therefore, unless the antenna is operating in a very high frequency range, its size would be relatively large, making it difficult and expensive to build.

OBJECTS OF THE INVENTION

An object of this invention is to provide a helical antenna which is light in weight and which is collapsible from its operative or extended position for ease of portability.

Another object of this invention is to accomplish the foregoing economically and with sufficient dimensional accuracy and structural rigidity to meet the stringent requirements imposed on helical antennas.

Another object of this invention is to provide a boom which is extensible and still provides the maximum possible rigidity.

These and other objects and features of advantage will become more apparent after reading the following description of the preferred embodiment of the invention taken together with the drawings.

BRIEF DESCRIPTION OF THE VIEWS AND DRAWINGS

FIG. 1 is an elevation of a collapsible helical antenna in the extended position and incorporating the features of the invention;

FIG. 2 is an enlarged elevation view of a few of the turns of the helix;

FIG. 3 is an enlarged elevation and partial section of the antenna in FIG. 1 in the collapsed position;

FIG. 4 is an end elevation view of the antenna taken on line 4—4 in FIG. 3 and in the direction of the arrows; and

FIG. 5 is a plan view in section of a portion of the antenna taken substantially on line 5—5 in FIG. 3 and in the direction of the arrows.

DETAILED DESCRIPTION OF THE PREFERRED EMBODIMENT

Referring to the drawings and to FIG. 1, in particular, a collapsible helical antenna is shown in the extended position and having a boom 11 supported by a post 12 from a suitable structure 13. Around the boom 11 is disposed a helical conductor 14 having a coupling wire 16 extending from the helical conductor 16 to the structure 13. The conductor 14 is suspended coaxially from the boom by insulating tension members to be described more fully hereinafter. The coupling wire 16 is supported from the post 12 by one or more insulators 17.

Referring to FIGS. 2, 3, and 4, the insulating tension members mentioned above are more clearly illustrated. On boom 11 are disposed a plurality of rings 21*a*, 21*b*, and 21*c*. Each one of the rings 21*a*, 21*b*, and 21*c* are preferably made of nylon which is a long chain polymeric amide having re-occurring amide groups — CONH — as an integral part of the main polymer chain and which has the inherent property of being capable of sliding along metallic surface under extreme weathering conditions for reasons that will become apparent hereinafter. All the rings,21*a*, 21*b*, 21*c*, are connected one to the other by nylon flexible threads 22 all of equal length. The ends of threads 22 are suitably fixed to the rings as shown by suitable means. The threads 22 are disposed on opposite sides of the boom 11. The thread segments between adjacent rings are equal so that the rings may be equally spaced along the boom. All the rings 21*a* have attached thereto in a suitable manner nylon threads 23 at a point 23*a* on the respective ring that is rotated 90° from the point of attachment of threads 22. Threads 23 connect to points 14*a* on the helical conductor 14 disposed radially outward from the points 23*a* and are of equal length. The threads 23 are arranged in a zig-zag arrangement wherein two segments of threads 23 are attached at the same point 14*a* and at the same point 23*a*. Rings 21*b* are attached to the conductor 14 by nylon threads 24. However, attachment points 24*a* (FIG. 3) for threads 24 at the rings 21*b* and attachment points 14*b* (FIG. 4) at the conductors 14 are rotated 120° from the points of attachment points 14*a* and 23*a* of threads 23. Also, rings 21*c* are attached to the conductor by nylon threads 25. However, the attachment points 25*a* (FIG. 4) of threads 25 at rings 21*c* and attachment points 14*c* at the conductor 14 are rotated 120° from the points 14*a* and 23 *a* of threads 23 and also points 14*b* and 24*a* of threads 24. Thus, the helical conductor 14 is supported rigidly coaxially with the boom 11 because all nylon threads 23, 24, and 25 are of equal length.

Since the rings 21*a*, 21*b*, and 21*c* are capable of sliding axially along the boom 11, the helical conductor 14 is made to collapse to a position as shown in FIG. 3 wherein the rings 21*a*, 21*b*, and 21*c* touch each other. Then, naturally, the segments of the threads 22 form loose loops as shown. The boom 11 is made of two relatively narrow, relatively long metallic strips 31 and 32 as shown in FIGS. 4 and 5. Strips 31 and 32 are made of, for example, beryllium copper sheets having a thickness of a few thousandths of an inch and have been heat treated in a standard manner as to cause each strip to assume a tubular shape. Due to their flexibility, the sheets 31 and 32 can be rolled upon spools such as spools 33 and 34, respectively. The spools 33 and 34 are journalled mounted within a suitable enclosure 36. The right end of enclosure 36, as viewed in FIG. 3, tapers down to a circular opening 37 through which the assembled boom 11 passes. The strips 31 and 32 are arranged so, as they unwind from the respective spools, strip 31 assumes its tubular shape within the tubular shape assumed by strip 32. In addition, the respective edges meet each other at positions that are on opposite sides of the boom 11 as shown in FIG. 4. The outer strip 31 can be made to assume a free diameter that is slightly smaller than the external diameter assumed by the inner strip 32. This causes the two strips to come into more intimate contact making a more

rigid boom. The post **12** is fixed to the enclosure **36** and, more specifically, to the lower section thereon as shown in FIG. **3**. The boom **11** may be extended or retrieved by rotating one of the spools, for example spools **34**, by suitable electric motor **41** (FIG. **3**) mounted below the enclosure. The left ends of the strips are bonded together so that, as spool **34** rotates, both strips are extended or retracted together. As an alternative, the spools **33** and **34** may be geared together in a suitable manner. To cause the helical conductors to move with boom **11**, the exterior ring **21***a* at the extreme left end as viewed in FIG. **3** is bonded in a suitable manner to the outer strip **31**. Thus, both the boom and helix can be extended or retracted as required.

Although the preferred embodiment has been described, one understands that the description is made only by way of example and not as a limitation to the scope of the invention. The scope, therefore, is limited to the accompanying claims.

What is claimed is:

1. A collapsible, helical antenna comprising:
a boom;
a helical conductor disposed around said boom;
a plurality of rings disposed on said boom and in sliding relation therewith;
first tension elements extending from said rings to said helical conductor to hold said conductor coaxial to said boom; and
flexible elements disposed to extend between adjacent ones of said rings for determining the maximum pitch of said helical conductor.

2. The antenna of claim **1** wherein:
said boom is extendable and retractable and comprises at least one extendable resilient strip that is so fabricated so as to tend to form into an elongated tube, and when unrestrained has its longitudinal axis lying parallel to the longitudinal centerline of the strip.

3. The antenna of claim **2** wherein:
said boom further includes another one of said resilient strip; and
said other one of said strips being disposed within the tubular form of said one strip when in the unrestrained position.

4. The antenna of claim **3** wherein:
said boom is further defined that the longitudinal edges of said one strip is disposed opposite the longitudinal edges of said other strip when said strips are in their tubular form; and
separate spools are provided for each strip to be rolled onto when said boom is retracted.

5. The antenna of claim **4** wherein:
the free ends of said strips are bonded together; and
one of said rings that is disposed nearest the free ends is bonded to said one strip substantially adjacent the free end.

6. The antenna of claim **5** wherein:
two of said tension elements have one end respectively bonded at the same point on one of said rings; and
two of said tension elements have the other end respectively bonded to the same point on said conductor to form a zig-zag configuration when said antenna is extending.

7. The antenna of claim **1** wherein:
said boom is extendable and retractable and comprises at least one extendable narrow resilient strip that is so fabricated so as to tend to form into an elongated tube and when unrestrained has its longitudinal axis lying parallel to the longitudinal centerline of the strip.

8. The antenna of claim **7** wherein:
said boom further includes another one of said narrow, resilient strips; and
said other one of said strips being disposed within the tubular form of said one strip when in the unrestrained position.

9. The antenna of claim **8** wherein:
said boom is further defined that the longitudinal edges of said one strip is disposed opposite the longitudinal edges of said other strip when said strips are in their tubular form; and
separate spools are provided for each strip to be rolled onto when said boom is retracted.

10. The antenna of claim **9** wherein:
the free end of said strips are bonded together; and
one of said rings, that is disposed nearest said free end, is bonded to said one strip substantially adjacent the free end thereof.

11. The antenna of claim **10** wherein:
two of said tension elements have one end respectively bonded at the same point on one of said rings; and
two of said tension elements have the other end respectively bonded to the same point on said conductor to form a zig-zag configuration when said antenna is extended.

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