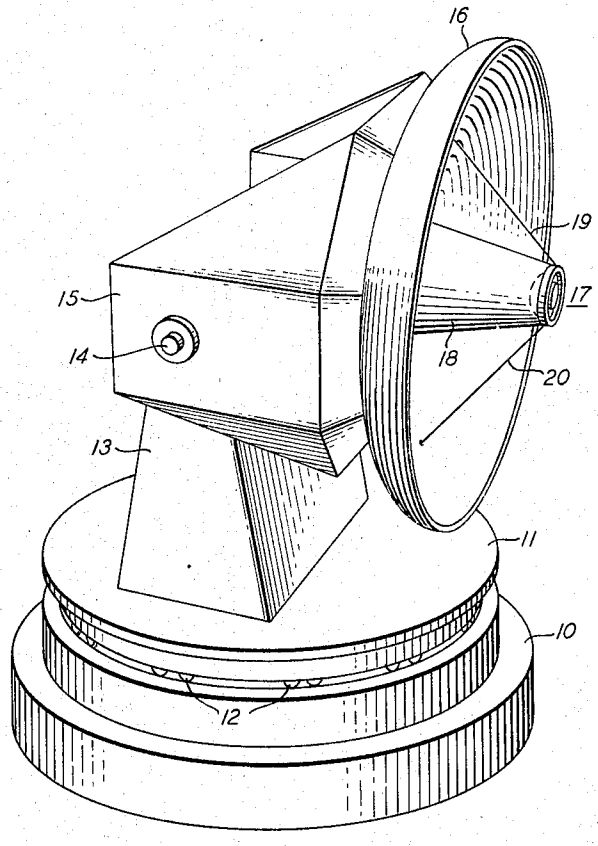
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INFLATABLE SUBREFLECTOR SUPPORT FOR CASSEGRAINIAN ANTENNA

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FIG. 1



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FIG. 3

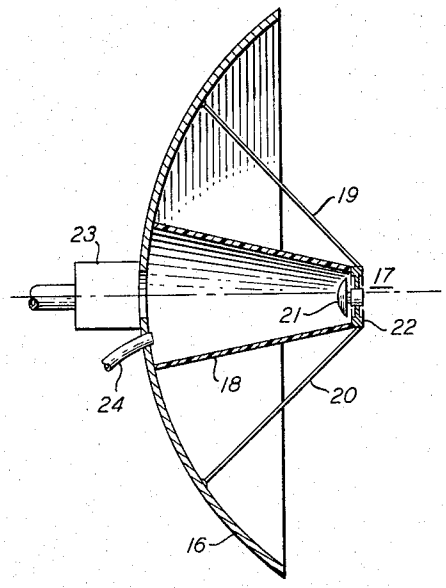
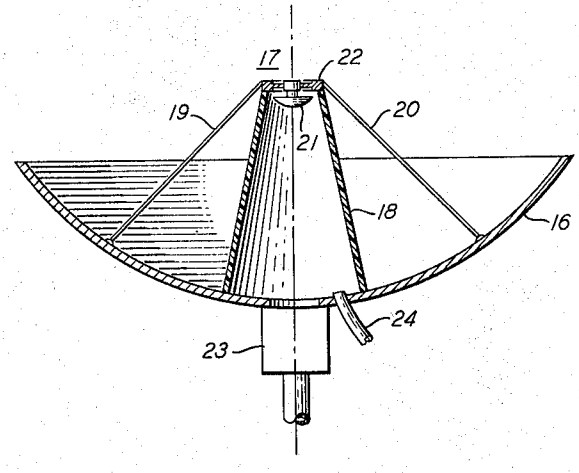


FIG. 2



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INFLATABLE SUBREFLECTOR SUPPORT FOR CASSEGRAINIAN ANTENNA

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6 Claims. (Cl. 343—781)

This invention relates to antennas and in particular to Cassegrainian antennas.

The Cassegrainian microwave antenna, which includes a main reflector and a subreflector, is based on the principles of the Cassegrainian optical telescope. Such antennas have a number of characteristics that make their use desirable for receiving relatively weak signals. Good reception, however, requires that their subreflectors maintain substantially constant angular positions with respect to their main reflectors for all elevational angles in order to maintain pointing accuracy. This requirement is met by providing sturdy supporting structures for the subreflectors.

Although rigid subreflector supporting structures overcome the above-mentioned problem, such structures frequently present other problems. Firstly, since subreflector supporting structures are within the antenna radiation patterns, radio frequency (R.F.) energy is absorbed and reradiated as noise. Secondly, such structures reflect R.F. energy into other noise sources which reradiate some of the energy as noise. Furthermore, since they are in the antenna radiation patterns, they cause a scattering of R.F. energy which reduces the effective gains of the antennas.

Attempts to minimize the above-described effects are found in the prior art. Materials having relatively low R.F. energy absorption and reflective qualities have been used. Furthermore, structural designs have been produced to reduce the amount of structural material within the radiation patterns of the antennas. Although these attempts have produced satisfactory results in some applications, the noise and reflection problems still are of significant importance in other applications. This is especially true in the larger antennas designed for the reception of extremely weak signals.

An object of the present invention is to further reduce the noise and reflection problems introduced by Cassegrainian antenna subreflector supports.

This and other objects are accomplished by both further reducing the amount of structural material in the radiation patterns and making a greater portion of the subreflector supports out of material which is substantially transparent to R.F. energy.

In one of its broader aspects, the invention takes the form of a Cassegrainian antenna in which an air inflated membrane holds the antenna subreflector in front of the main reflector. This membrane is substantially transparent to R.F. energy. A pair of guy wires are connected between the main reflector and circumferential locations on the subreflector with the guy wires lying in a vertical plane passing through the midpoints of the reflectors. The membrane and guy wires remain under tension for all elevational angles of the antenna. Furthermore, these tensions maintain the subreflector substantially axially concentric with the main reflector when the antenna is in a vertical elevational position.

When the antenna elevational angle is other than vertical, the inflated membrane is in effect performing as a cantilevered beam and tends to arc as a result of the transverse load applied to it by the subreflector. The combination of the inflated membrane with the guy wires causes a portion of the weight of the subreflector to be assumed by the wires, with one of the wires under greater

tension than the other wire. The difference in tensions in the wires causes a moment to be applied to the subreflector. This moment prevents the subreflector from rotating with respect to the main reflector when the inflated membrane arcs.

In accordance with the invention, the moment produced by the wires is used to advantage by using materials having particular stiffness characteristics for the inflated membrane and wires. These stiffness characteristics cause the loading transverse to the axis of the membrane to be shared between the membrane and the wires in such a way that the moment applied to the subreflector by the wires for an elevational position of the antenna other than vertical, maintains the angular position of the subreflector with respect to the main reflector the same as when the antenna is in a vertical position. When using materials having such stiffness characteristics, the transverse loading is shared so that the moment applied by the wires to the subreflector is just sufficient for all elevational angles of the antenna to maintain the subreflector in the desired angular position with respect to the main reflector.

As recognized by those skilled in the art, thin structural members under tension provide greater structural strength than the same size members under compression. Because, therefore, the invention comprises a unique structural configuration which uses thin members under tension, use of the invention results in a reduction of structural material in subreflector supports with a resulting improvement in R.F. energy absorption and reflection characteristics.

Other objects and features of the invention will become apparent from a study of the following detailed descriptions of several specific embodiments.

On the drawings:

FIG. 1 discloses one embodiment of the invention;

FIGS. 2 and 3 are cross sectional views of a portion of the embodiment of FIG. 1 when that embodiment is in vertical and horizontal positions, respectively.

The embodiment of FIG. 1 includes a two-tier base **10** on which an azimuth turntable **11** is mounted. A plurality of bearing rollers **12** between the turntable and base permit the turntable to be moved in azimuth with respect to the base. A pedestal **13** is affixed on turntable **11**. Pedestal **13** includes a horizontal shaft **14** on which a back up structure **15** for a parabolic reflector **16** is mounted.

A subreflector assembly **17** is supported in front of reflector **16** to form a Cassegrainian antenna. The supporting structure for the subreflector assembly comprises a truncated cone-shaped inflated membrane **18** and a pair of guy wires **19** and **20**. Guy wires **19** and **20** are connected between parabolic reflector **16** and subreflector assembly **17** so that the wires lie in a vertical plane passing through the midpoints of reflector **16** and subreflector assembly **17**. Subreflector assembly **17** is affixed in a substantially airtight manner in the smaller end of truncated cone-shaped membrane **18** while the larger end is affixed in a substantially airtight manner to reflector **16**. The source of compressed air for inflated membrane **18** is contained in pedestal **13**. Pedestal **13** also includes receiver and transmitter equipment and a source of mechanical energy for directing the Cassegrainian antenna in azimuth and elevation.

The manner in which the supporting structure for subreflector assembly **17** functions may be better understood by referring to FIGS. 2 and 3 which show sectional views of the antenna in vertical and horizontal positions, respectively. As shown in these drawings, subreflector assembly **17** comprises a subreflector **21** set in a mounting ring **22**. The outer periphery of ring **22** is secured in a substantially airtight manner in the narrow end of the truncated cone-shaped inflated membrane **18** with subreflector **21** directed toward parabolic reflector **16**. The larger

end of inflated membrane **18** is affixed in a substantially airtight manner to reflector **16**.

Reflector **16** has an opening in its center through which energy received and to be radiated is passed in accordance with the principles of operation of a Cassegrainian antenna. A feed line **23** is mounted on the convex side of and over the opening in reflector **16**. The other extremity of feedline **23** is connected to receiving and transmitting equipment contained in pedestal **13** of FIG. 1. A flexible hose **24** passes through reflector **16** to supply compressed air to inflate membrane **18**. The other extremity of hose **24** is terminated in a source of compressed air in pedestal **13** of FIG. 1.

Guy wires **19** and **20** and inflated membrane **18** remain under tension for all elevational angles of the antenna. Furthermore, when the antenna is in a vertical position as shown in FIG. 2, these tensions cause subreflector **21** to be in substantial axial alignment with reflector **16**.

When the antenna is in a position other than vertical, the inflated membrane, in effect, performs as a cantilever beam. In other words, the inflated membrane arcs or sags as a result of the load applied to it primarily by subreflector assembly **17**. This is illustrated in FIG. 3 where the center of subreflector **21** has fallen below the axial centerline of reflector **16**.

In the absence of guy wires **19** and **20**, subreflector **21** would rotate with respect to reflector **16** when the antenna is in a nonvertical position. In FIG. 3, for example, subreflector **21** would rotate in a clockwise direction with respect to reflector **16** if guy wires **19** and **21** were not present. It is this effect which is detrimental to the successful operation of the antenna and which is prevented through the use of the present invention.

The combination of inflated membrane **18** with guy wires **19** and **20** causes the load transverse to the membrane to be share between the membrane and guy wires. Furthermore, the share of the transverse load assumed by the guy wires is not shared equally by the wires. In particular, guy wire **19** of FIG. 3 is under greater tension than guy wire **20**. This difference in tension in the guy wires causes a counterclockwise moment to be applied to ring **22**. An equal and opposite moment is, of course, applied to ring **22** by inflated membrane **18**. In accordance with the invention, the stiffness characteristics of the inflated membrane and the guy wires are determined in accordance with conventional engineering techniques so that the moment applied to the subreflector assembly, and therefore to the membrane, by the guy wires is just sufficient to maintain the desired angular position of the subreflector relative to reflector **16** as shown in FIG. 3.

The sharing of the transverse load between inflated membrane **18** and guy wires **19** and **20** remains the same for all elevational angles of the antenna. Because of this, the interaction moment between the wire and membrane is just sufficient to maintain the subreflector assembly in the desired angular position with respect to reflector **16** for changes in elevational angles. The subreflector assembly therefore maintains its desired angular position for all elevational angles of the antenna.

It should be noted that once the stiffness characteristics for an embodiment have been determined, the load supported by the structure may be changed in value and as long as the stiffness characteristics are unchanged, the embodiment still operates in accordance with the invention. This occurs because the load is still shared between the inflated membrane and the guy wire in the same proportion.

Although the disclosed embodiment of the invention shows the guy wires located outside of the inflated membrane, embodiments of the invention may be constructed having the guy wires located within the inflated membrane. Furthermore, embodiments may be constructed using more than two guy wires. Regardless of the location and number of guy wires used in such embodiments, the stiffness characteristics of the wires and the inflated membrane are always selected so that interaction moment between the wires and membrane is just sufficient to maintain the subreflector assembly in the desired angular position with respect to the parabolic reflector. Embodiments other than that disclosed may therefore be constructed without departing from the spirit and scope of the invention.

What is claimed is:

1. A Cassegrainian antenna comprising
a main reflector,
a subreflector,
an inflated mmebrane holding said subreflector in front of said main reflector, and
at least two guying members connected between said main reflector and said subreflector and supporting the portion of the load transverse to said inflated membrane to produce moments on said subreflector just sufficient to maintain said subreflector in the same angular position relative to said main reflector for all elevational angles of the antenna.

2. A Cassegrainian antenna comprising
a main reflector,
a subreflector,
an inflated membrane holding said subreflector in front of said main reflector, and
at least two guying members each of which is connected between said main reflector and said subreflector and lying in a vertical plane passing through the midpoints of said reflectors,
said members and said inflated membrane both under tension for all elevational positions of said antenna with said subreflector in substantial axial alignment with said main reflector when said antenna is in a vertical elevational position,
said members and said inflated membrane having stiffness characteristics that for an elevational angle other than vertical result in equal and opposite moments being applied to said subreflector when said subreflector is in the same angular position with respect to said main reflector as when said antenna is in a vertical elevational position.

3. A Cassegrainian antenna comprising
a parabolic reflector,
a subreflector,
a truncated cone-shaped membrane,
means securing said subreflector in a substantially airtight manner in the smaller end of said truncated cone-shaped membrane with the reflective surface of said subreflector enclosed by said membrane,
means securing the larger end of said truncated cone-shaped membrane in a substantially airtight manner to the concave surface of said parabolic reflector,
means to maintain said membrane in an inflated condition, and
at least two guying members connected between said parabolic reflector and said subreflector,
said guying members lying in a vertical plane passing through the midpoints of said reflectors and symmetrically disposed about a line connecting said midpoints,
said members and said membrane in its inflated condition both under tension for all elevational positions of said antenna,
said members having stiffness characteristics that produce a difference in the tensions in said members when said antenna is in an elevational position other than vertical to apply a moment to said subreflector to maintain said subreflector in the same angular position relative to said parabolic reflector occurring when said antenna is in a vertical position.

4. A combination for supporting a subreflector in front of a main reflector in a Cassegrainian antenna comprising
an inflated membrane connected between said subreflector and said main reflector and holding said subreflector in front of said main reflector, and

at least two guying members each of which is connected between said main reflector and said subreflector,

said guying members lying in a vertical plane passing through the midpoints of said reflectors and symmetrically displaced relative to a line passing through said midpoints,

said members and said inflated membrane both under tension for all elevational positions of said antenna with said subreflector in substantial axial alignment with said main reflector when said antenna is in a vertical elevational position,

said members having stiffness characteristics that for an elevational angle other than vertical result in a moment being applied to said subreflector to maintain said subreflector in the same angular position with respect to said main reflector as when said antenna is in a vertical elevational position.

5. A combination for supporting a subreflector in front of a main reflector in a Cassegrainian antenna comprising

an inflated membrane connected between said subreflector and said main reflector and holding said subreflector in front of said main reflector, and

at least two guying members connected between said main reflector and said subreflector and supporting the portion of the load transverse to said inflated member that produces a moment on said subreflector just sufficient when said antenna is in an elevational position other than vertical to maintain said subreflector in the same angular position relative to said main reflector as when said antenna is in a vertical elevational position.

6. A combination for supporting a subreflector in front of a parabolic reflector in a Cassegrainian antenna comprising

a truncated cone-shaped membrane,

means securing said subreflector in a substantially airtight manner in the smaller end of said truncated cone-shaped membrane with the reflective surface of said subreflector enclosed by said membrane,

means securing the larger end of said truncated cone-shaped membrane in a substantially airtight manner to the concave surface of said parabolic reflector,

means to maintain said membrane in an inflated condition, and

at least two guying members connected between said parabolic reflector and said subreflector with at least two of said guying members lying in a vertical plane passing through the midpoints of said reflectors and symmetrically disposed about a line connecting said midpoints,

said members lying in said plane having stiffness characteristics that cause these members to support the portion of the load transverse to said truncated cone-shaped membrane that produces a moment on said subreflector just sufficient when said antenna is in an elevational position other than vertical to maintain said subreflector in the same angular position relative to said parabolic reflection as when said antenna is in a vertical elevational position.

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