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SOUNDING BALLOON AND TARGET ASSEMBLY

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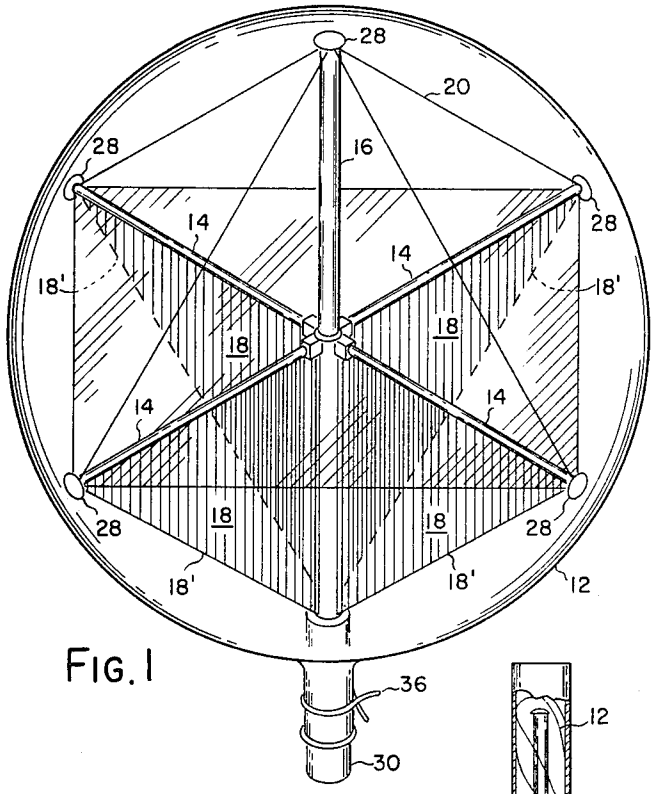

FIG. 1

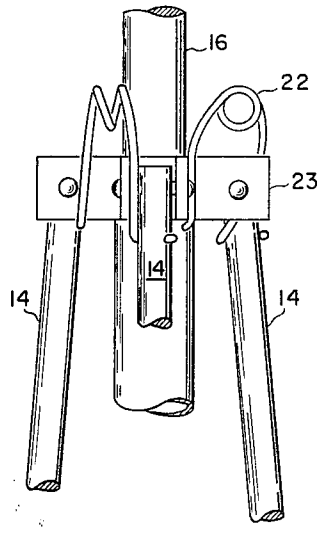

FIG. 2

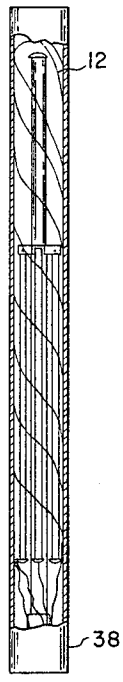

FIG. 3

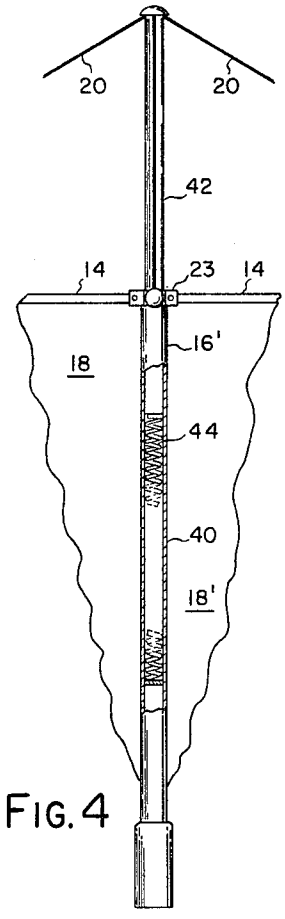

FIG. 4

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SOUNDING BALLOON AND TARGET ASSEMBLY

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This invention relates to a balloon with an insertable collapsible radar reflector and more particularly to a sounding balloon and corner reflector assembly for use in making winds aloft observations by radar.

The advantages of enclosing a radar reflector within a sounding balloon have been recounted heretofore. Reference may be made to United States Patent No. 2,463,-517 for a full description of these advantages. In brief, they include a marked reduction in the aerodynamic drag of the ascending structure and protection from inclement weather conditions which may reduce the attainable height of the balloon. The referenced patent describes a structure comprising gussets of conductively coated fabric or similar flexible material attached at various points on the interior of a balloon. It is intended that inflation of the balloon will cause the gussets to be stretched taut to provide a polyhedral corner reflector.

Attachment of the reflector to points on the interior of the balloon tends to limit the expansion of the balloon or to cause a distortion in its shape which destroys the ideal angular relationship of the planes of the reflector. Similarly, a distortion of the balloon shape resulting from aerodynamic forces causes a distortion in the shape of the reflector.

It is an object of this invention to provide a corner reflector contained within an expansible sounding balloon and which will maintain its configuration despite changes in shape of the balloon.

Another object of the invention is to provide a collapsible radar reflector which may be inserted in any balloon of appropriate size, thereby permitting salvage of assemblies in which the balloon has become damaged prior to use.

A further object is to increase the stability of the radar reflector as it is borne aloft by the balloon thereby providing signal reflections of increased strength.

Other objects of the invention will become obvious from study of the following detailed description and the accompanying drawings.

Briefly, the invention comprises a foldable framework supporting flexible gussets of reflective material. This assembly is inserted in the neck of a deflated balloon. Upon inflation, spring loaded arms of the framework expand to support the reflector in a configuration which is not influenced by the balloon shape. While a simple tetrahedral reflector is described, the principles can be extended to include octahedral reflectors, as well as other possible forms.

In the drawings:

FIG. 1 is a perspective view of the reflector in an erected position within an inflated balloon;

FIG. 2 is a detailed view of the hinge portion of the reflector frame;

FIG. 3 illustrates a storage container, portions of which have been broken away to reveal the collapsed reflector and balloon contained therein; and

FIG. 4 illustrates a modification of the radar reflector frame.

Referring to FIG. 1, there is shown a perspective view of the radar reflector **10** in a fully erected position within the inflated balloon **12**. Four equal length arms **14** are hinged to a central supporting mast **16**. The arms **14** are in cruciform configuration, each being perpendicular to

mast **16** and to one another. Four triangular gussets **18** of reflective flexible material are secured along their equal length edges to arms **14**. Alternatively, a single square piece of material pierced at the center to allow passage of mast **16** may be substituted for the gussets **18**. Depending from arms **14** and secured to mast **16** along adjacent edges are four additional triangular gussets **18'** of flexible, reflective material. It is necessary that the gussets **18'** be conductively coated on both sides. Although it is preferred that the gussets **18** also be reflectively coated on both sides, it is essential only that the undersides thereof be reflective.

Elastic cords **20** extend from the top of mast **16** to the outer ends of arms **14**. Springs may obviously be substituted for the cords **20**. The tension in cords **20** is sufficient to maintain the arms **14** in an erected condition. The cords are sufficiently elastic to permit the arms **14** to be folded downwardly for storing the reflector and deflated balloon, as shown in FIG. 3. Upon inflation of the balloon the cords retract to raise the reflector to the fully erected position of FIG. 1. Since the cords **20** possess a low mechanical advantage when the arms are folded parallel to the mast, it may be desirable in certain instances to assist the opening of the reflector by springs **22**, seen in FIG. 2. FIG. 2 illustrates also a cruciform hinge **23** by which the arms **14** are secured to the mast **16**. Again referring to FIG. 1, the ends of the reflector framework are covered by smooth caps **28** which prevent any sharp points from touching the balloon. The mast **16** is secured at its lower end to an enlarged cylindrical member **30**. The reflector assembly is passed into the balloon and fastened at the neck thereof by means of a clamp **36** encircling the member **30**. This latter is the only point of attachment of the reflector to the balloon. Hence, the balloon is free to expand as pressure conditions may require. Member **30** includes a check valve (not shown) and suitable passages (not shown) to permit inflation of the balloon with buoyant gas. It is clear that the foregoing construction makes it possible to assemble the unit in the field just prior to inflation of the balloon. Thus balloons and reflectors may be shipped separately or serviceable balloons may be substituted for damaged balloons in preassembled combinations.

A suitable means for the storage and handling of the reflector unit and balloon in the collapsed condition is shown in FIG. 3. The balloon **12** is wrapped around the collapsed reflector **10** in a manner to inhibit opening. The entire assembly is then placed inside a tubular container **38** which retains the reflector in a collapsed condition and protects the balloon during handling. From FIGS. 1 and 3 it is evident that the size of reflector which can be inserted in a balloon is limited by the portion of mast **16** which extends above the arms **14**.

Referring to FIG. 4, an alternative embodiment of the invention employing a two piece telescoping central mast **16'** is shown. This modification provides an assembly whose overall length is just slightly longer than the short side of the reflector, i.e., arm **14**, thus permitting the use of a larger reflector in a given size balloon. The hollow lower portion **40** of mast **16'** slidingly receives an upper portion **42**. A compression spring **44**, secured at its lower end within mast section **40** bears against the lower end of mast section **42** urging that section upwards. Hinge block **23** is attached to mast **40** and the tubular arms **14** are pivotally attached as previously described with reference to FIG. 2.

In the embodiment of FIG. 4 the elastic cords **20** (FIG. 2) are replaced by a non-elastic cord. When the unit is collapsed, arms **14** are folded parallel to mast **40**, and the mast **42** is drawn into mast **40** compressing spring **44**.

As the balloon is inflated, spring **44** expands causing mast **42** to rise and hold arms **14** in their fully erect position.

It should be noted that the aerodynamic drag of separate reflector units is reduced by the structure of the invention. The expansion of the balloon and hence attainable altitude is not limited by the reflector connection means. Since the center of gravity is below the center of buoyancy, a stabilizing moment exists which tends to maintain mast **16** vertical and hence the reflector presents a stable orientation to the tracking radar.

It should be understood that this invention, in its broader aspects, is not limited to the specific embodiment herein illustrated and described, and that the following claims are intended to cover all changes and modifications that do not depart from the true spirit and scope of the invention.

The invention claimed is:

1. A sounding balloon and microwave reflector combination comprising

an expansible balloon composed of material transparent to microwaves, and including a neck portion for inflation,

a corner reflector of microwaves collapsible for insertion in said balloon, said reflector including a rigid central mast, a plurality of rigid arms hinged to said mast to permit folding said arms parallel to said mast and a plurality of gussets of flexible, microwave reflective material suspended from said arms and said mast so as to form a plurality of intersecting plane surfaces upon extension of said arms from said mast,

means for extending said arms from said mast to maintain the planes of said gussets in a fixed configuration, and

means securing said reflector central mast to the neck of said balloon.

2. The combination of claim **1**, wherein said means for extending said arms comprises elastic members extending from said mast to the ends of said arms remote from said mast.

3. The combination of claim **1**, wherein said means for extending said arms comprises a telescoping portion of said mast,

means urging said portion for longitudinal extension of said mast, and

linkages from said portion to said arms.

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