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Walters et al.

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[54] **COLLAPSIBLE RADOME AND ANTENNA SYSTEM**

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[52] **U.S. Cl.** **343/705**, 343/872

[51] **Int. Cl.** **H01q 1/28**

[58] **Field of Search** ..... 343/705, 706, 708, 343/872, 872 R

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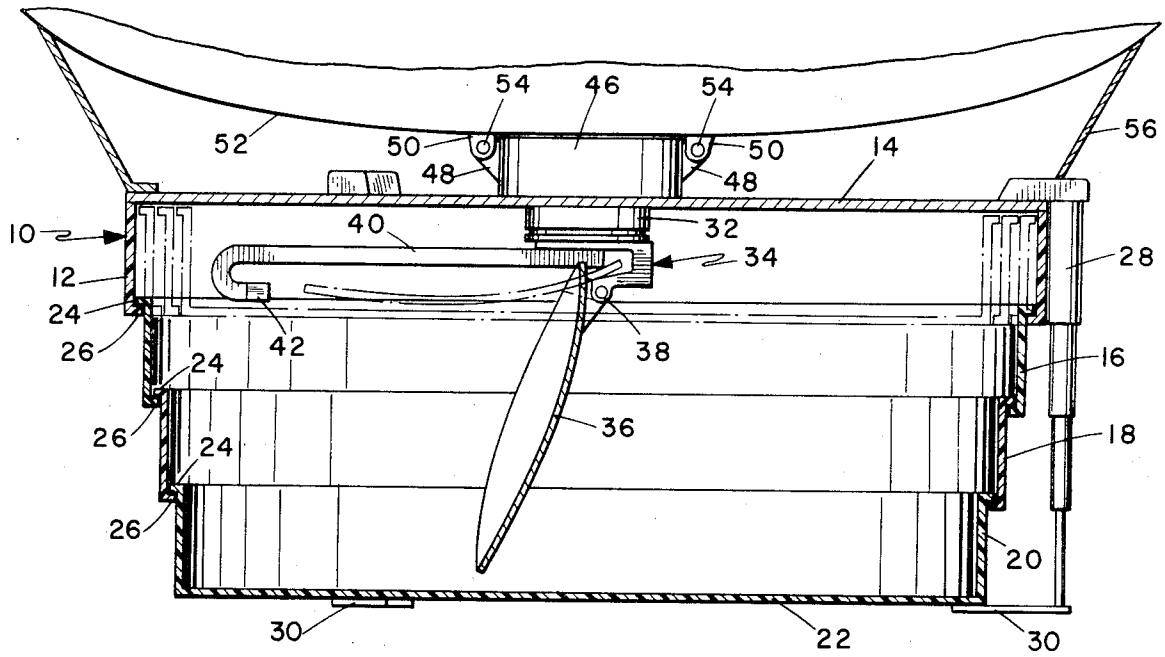
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[57] **ABSTRACT**

A collapsible radome and antenna system in the form of a self-contained pod which is attached to an aircraft by quick disconnect means. In collapsed position the radome is a shallow cylindrical structure and the reflector of the antenna is folded. The radome has telescopic sections which are extended to an open position, the reflector unfolding when the structure is extended and being mounted on a scanning mechanism to move within the radome. In one form the radome has a fail safe capability to collapse in an emergency.

7 Claims, 4 Drawing Figures



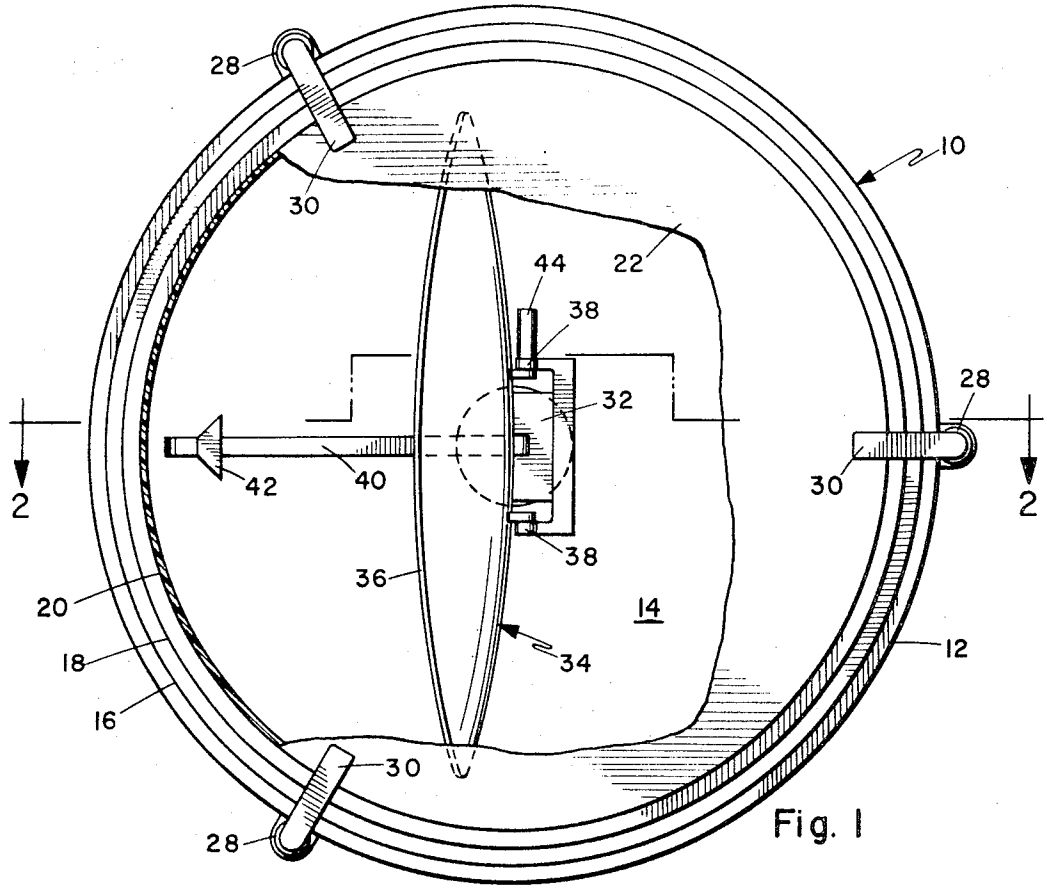


Fig. 1

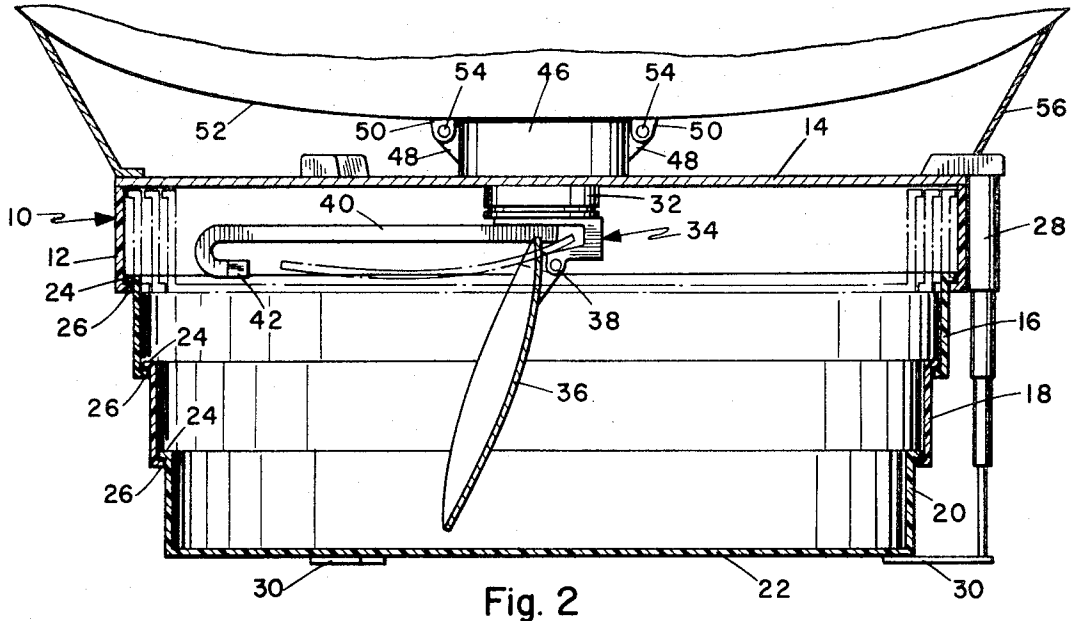


Fig. 2

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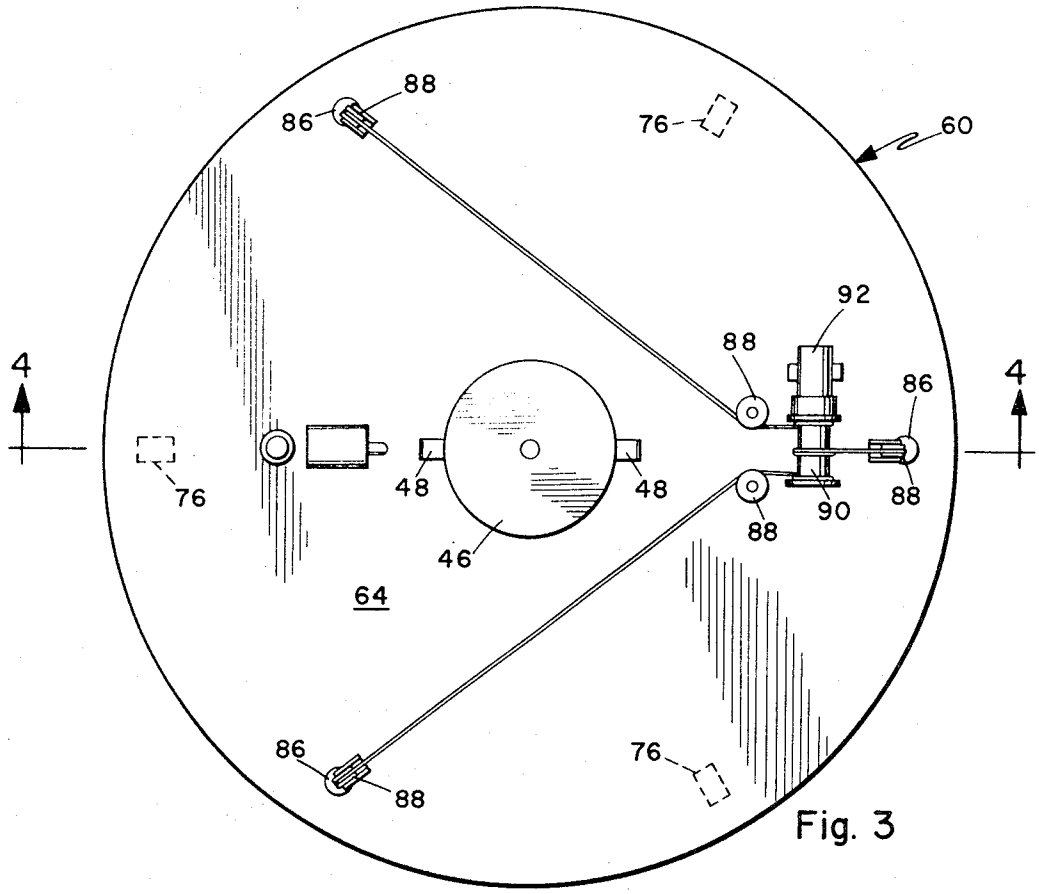


Fig. 3

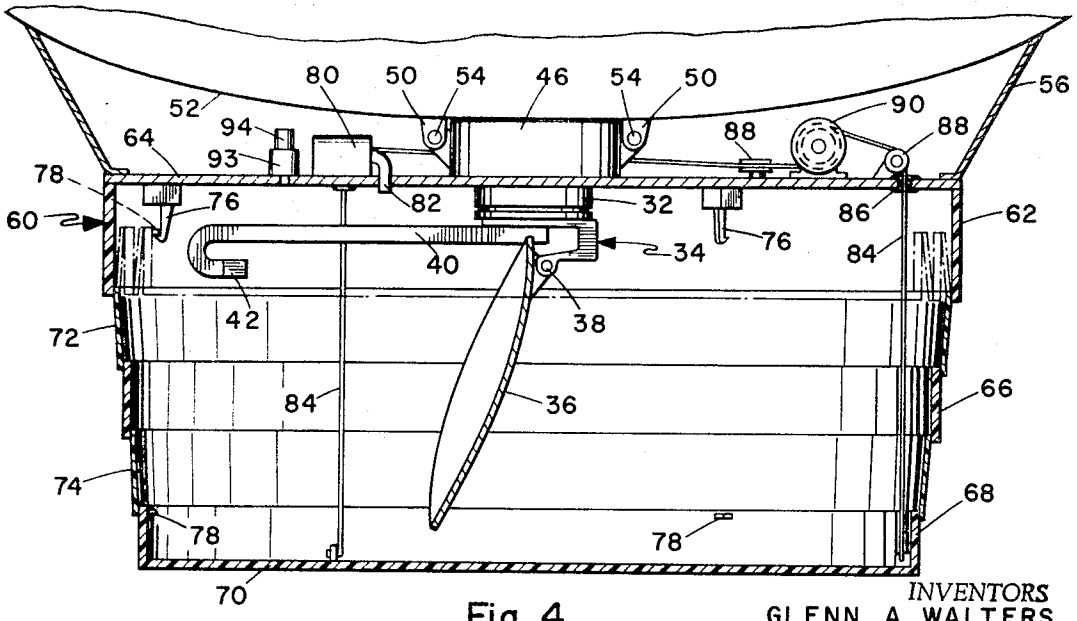


Fig. 4

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COLLAPSIBLE RADOME AND ANTENNA SYSTEM

BACKGROUND OF THE INVENTION

In a radar system, the antenna aperture is a determining factor in the efficiency of the system, the larger the aperture the greater the range and resolution capabilities. In airborne applications, the antenna is either limited in size by the space available within the airframe, or must be enclosed in a large external fairing or dome structure. The latter is aerodynamically undesirable, since the aircraft performance is degraded and the antenna structure is limited to locations which will not interfere with control and operation, or be susceptible to damage in take-off and landing. This is particularly true in helicopter borne antennas, since any large radome structure must be carried below the fuselage.

SUMMARY OF THE INVENTION

The antenna system described herein is contained in a pod unit designed for attachment to an aircraft by conventional store carrying, quick disconnect means, such as on the underside of a helicopter. In collapsed position the pod is a shallow cylindrical structure, the radome being formed by telescopic sections which nest into each other in collapsed position and extend downwardly to an open position. A microwave antenna is mounted in the pod on a scanning mechanism, the antenna reflector being folded in the collapsed position and swinging down to operating position when the radome is extended. In one form the telescopic sections are substantially rigid and are extended and collapsed by simple linear actuators. In another form the sections are alternately rigid and flexible, forming a sealed enclosure which is extended by air pressure. The sections are collapsed by cables coupled to a motor, which incorporates return spring means to collapse the radome automatically in the event of air pressure loss or other emergency, thus providing fail safe capability.

The basic structure is of dielectric material, such as the "A" sandwich structure used in various radomes. This provides a flotation capability in the event the pod is jettisoned over water.

The primary object of this invention, therefore, is to provide a new and improved collapsible radome and antenna system.

Another object of this invention is to provide a new and improved antenna system container in a pod structure for external attachment to an aircraft, the pod having a collapsed position with a low profile and minimum drag and being telescopically extendable to form a large radome.

Another object of this invention is to provide a new and improved antenna system in which a large reflector is stowed in folded position when the radome is collapsed and swings to operating position when the radome extends.

A further object of this invention is to provide a new and improved antenna system which will collapse readily in an emergency.

Other objects and many advantages of this invention will become more apparent upon a reading of the following detailed description and an examination of the drawings, wherein like reference numerals designate like parts throughout and in which:

FIG. 1 is an underside view, partially cut away, of a complete pod unit.

FIG. 2 is a sectional view taken on line 2—2 of FIG. 1, showing attachment to an aircraft.

FIG. 3 is a top plan view of an alternative form of pod unit.

FIG. 4 is a sectional view taken on line 4—4 of FIG. 3, showing attachment to an aircraft.

DESCRIPTION OF THE PREFERRED EMBODIMENT

In the structure shown in FIGS. 1 and 2, the pod 10 comprises a shallow cylindrical housing 12 with an upper cover 14, a pair of intermediate ring sections 16 and 18, and a lower ring section 20 with a bottom cover 22. The three ring sections nest concentrically into each other and into housing 12, as in the broken line position in FIG. 2, which is the collapsed position of the structure. Ring sections 16, 18 and 20 each has an upper external flange 24, and the housing 12 and ring sections 16 and 18 each has a lower internal flange 26 to interengage and hold the sections in the extended radome position shown in full line. Any convenient number of ring sections may be used to obtain an extended radome of the required size. The telescopic structure is extended and retracted by means of linear actuators 28 mounted on and peripherally spaced around housing 12. Actuators 28 are shown as telescopic cylinder type units, which may be fluid or electrically actuated, the lower end portions of the actuators being connected to the lower ring section 20 by arms 30.

Attached to the underside of top cover 14 at the axis housing 12, is a scanning head 32 carrying the antenna 34. As shown, the scanning head 32 is of rotary type, turning about the housing axis, but could incorporate a gimbal action for tilting the antenna beam, suitable mechanisms being well known. The antenna has a reflector 36 mounted below the scanning head on hinges 38, to swing between an operating position extending downwardly, as in full line, and a collapsed position generally horizontally within housing 12, as in broken line in FIG. 2. A waveguide type feed 40 extends radially and horizontally from scanning head 32 and has a return folded horn 42 directed at the reflector 36. The reflector is thus an offset parabola with its axis substantially in the horizontal plane of horn 42, and is of the largest convenient shape which will rotate within the extended radome structure. The specific configuration of the antenna will depend on the required beam pattern, that shown being typical. To raise and lower the reflector, an actuator 44 is shown mounted on one hinge 38, and may be a suitable motor or mechanical linkage to a power source.

On top of top cover 14, over the scanning head, is a coupling unit 46 with projecting lugs 48, which engage in shackles 50 mounted on the aircraft, shown fragmentarily at 52. The coupling is held by pins 54, which are preferably of quick release type to simplify installation and removal of the pod and allow it to be jettisoned in an emergency. A suitable fairing 56 is fitted between the pod and the aircraft to make an aerodynamically clean connection. In a self-contained pod, the coupling unit 46 could contain the operating means for the scanning head and reflector and even sufficient portions of the radar circuitry to avoid the necessity for carrying waveguide connections through the aircraft skin.

The housing 12 and all ring sections are made from dielectric material transparent to microwave radiation. Various structural techniques have been developed for

such material, a particularly suitable type for the present purpose being known as quarter wave "A" sandwich, which is a reinforced plastic foam material. This material will provide sufficient buoyancy to float the pod, should it be jettisoned over water for any reason.

An alternative configuration of the pod, shown in FIGS. **3** and **4**, uses the same antenna, scanning head, coupling unit and fair arrangement as described above and differs only in the telescopic structure and its actuating means. In this form the pod **60** includes an upper housing **62** with a top cover **64**, an intermediate rigid ring section **66** and a lower rigid ring section **68** with a bottom cover **70**. The housing and ring section are of dielectric material as described and nest into each other in collapsed position. The upper edge of ring section **66** is peripherally connected to the lower edge of housing **62** by a flexible band or ring member **72**. The lower edge of ring section **66** is similarly peripherally connected to the upper edge of ring section **68** by a flexible ring member **74**. Connection is made adhesively, or by any other suitable means. The flexible ring members are made from a sealed fabric material, such as Nylon or Dacron impregnated with rubber or plastic such as Hyperlon.

In the collapsed position the telescopic structure is held by latches **76** which hook under small tongues **78** on the lower ring section **68**. Latches **76** are mounted on top cover **64** and are of solenoid actuated or similar type, to permit simultaneous releasing when the radome is extended.

The telescopic structure forms a sealed enclosure, which facilitates extension by means of air pressure, very little actual pressure being required. A small blower **80** is mounted on top cover **64**, with an outlet **82** through the top cover. Retraction is accomplished by means of cables **84** secured inside ring section **68** and passing through fairleads **86** in top cover **64**. With the blower **80** in operation, any slight air leakage through the fairleads will be unimportant. Cables **84** pass over pulleys **88** to a winch drum **90** powered by a motor **92**. The motor is power operated, but contains a spring wound device which is wound up by pressurized air extension of the telescopic structure. This provides a fail safe capability, in that the spring motor will automatically collapse the radome in the event of blower failure, or any other cause of pressure loss. Mechanical rigidity of the structure is maintained at all times by internal air pressure. During extension of the radome, the drive cable tension is reduced and the radome extended by air pressure. During retraction, the drive cable tension is increased and excess air released through relief valve **94**. In emergency conditions, this valve can be opened by solenoid **96**.

In either form, the collapsed structure forms a compact pod which can be attached below a helicopter or other aircraft, without interfering with take-off and landing, and causing minimum drag in flight. When the antenna is to be used, the telescopic radome and reflector are quickly extended, providing a large aperture antenna with 360 degree freedom of scan and, if necessary, tilting or elevation control. When not required the structure is quickly retracted to its minimum profile. While the unit is described as being suspended below an aircraft, it will be obvious that it could also be mounted above an aircraft or other vehicle for certain purposes.

Having described our invention, we now claim.

1. A collapsible radome and antenna system, comprising,

a shallow, substantially cylindrical housing having means for attachement to an aircraft,

a plurality of telescopically interconnected concentric ring elements of dielectric material nesting in said housing in a collapsed position,

actuating the means for moving said ring sections between the collapsed position and an extended position forming a radome,

and an antenna mounted in said housing, said antenna having a foldable portion which is contained in said housing in the collapsed position and extends into the radome in operative position,

and the innermost of said concentric ring elements has a closed bottom cover of dielectric material.

2. A collapsible radome and antenna system according to claim **1**, wherein:

said actuating means includes linear actuators mounted on said housing and having linearly movable portions connected to said innermost ring element.

3. A collapsible radome and antenna system according to claim **2**, wherein:

said linear actuators are mounted externally on said housing and circumferentially spaced thereon.

4. A collapsible radome and antenna system according to claim **1**, wherein:

said ring elements include substantially rigid ring elements interconnected by flexible ring elements.

5. A collapsible radome and antenna system according to claim **4**, wherein:

said housing has a closed top cover forming a substantially sealed enclosure with said ring elements.

6. A collapsible radome and antenna system according to claim **5**, wherein:

said actuating means includes an air blower communicating with the interior of said enclosure for extending the telescopic structure.

7. A collapsible radome and antenna system according to claim **6**, wherein:

said actuating means further includes cables connected to said innermost ring section;

and a motor coupled to said cables for collapsing the telescopic structure.

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