July 8, 1958 J. L. DARROUZET 2,842,767

PARABOLIC REFLECTOR WITH A STRUCTURAL MEMBER FRONT SKIN

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Fig. 1.

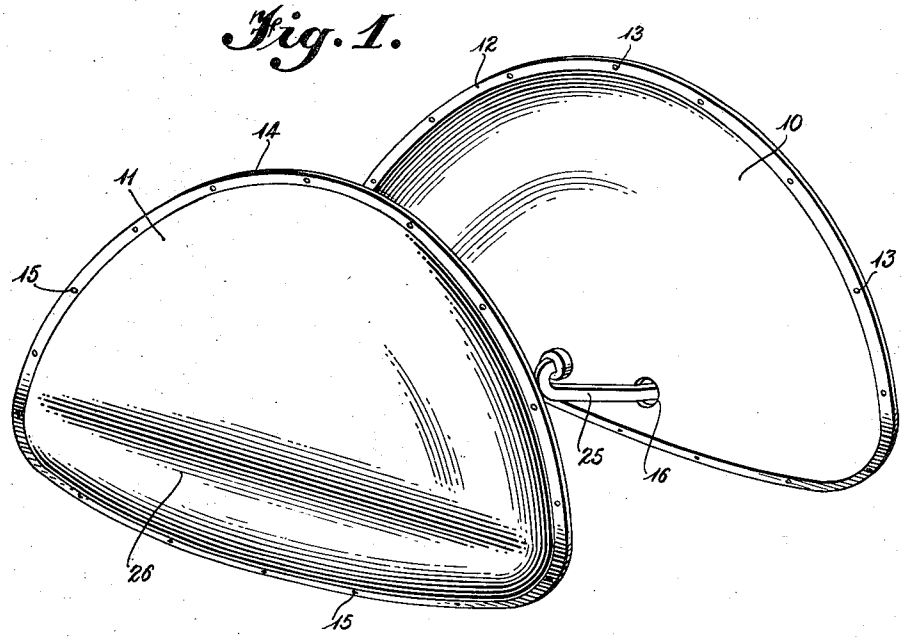

Fig. 2.

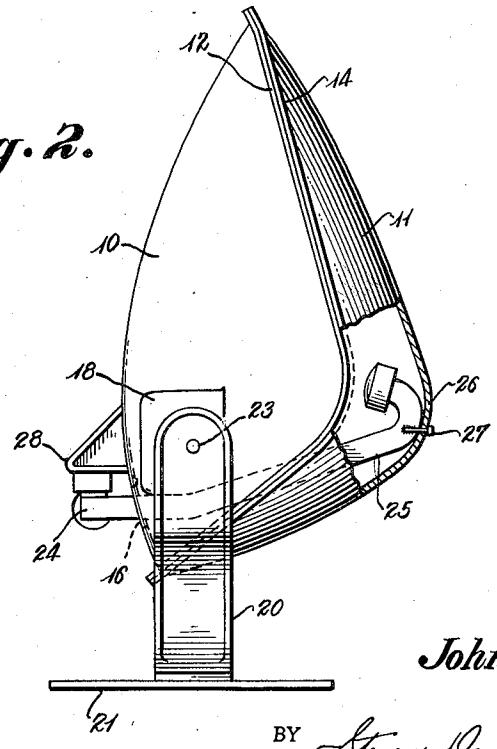

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Fig. 3.

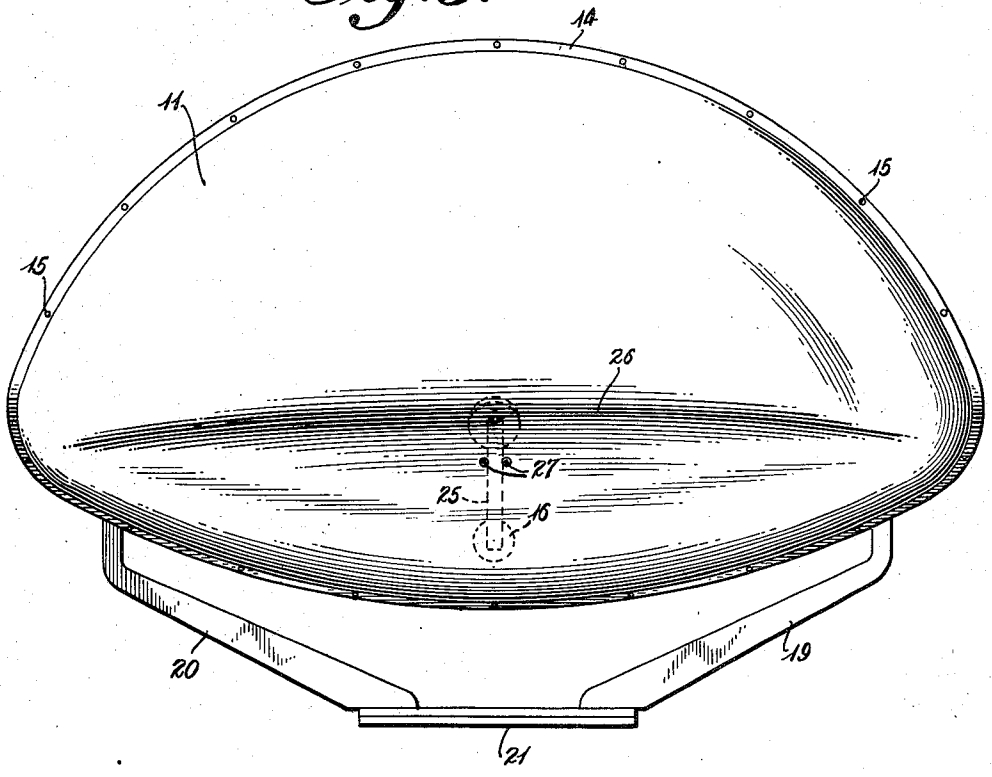
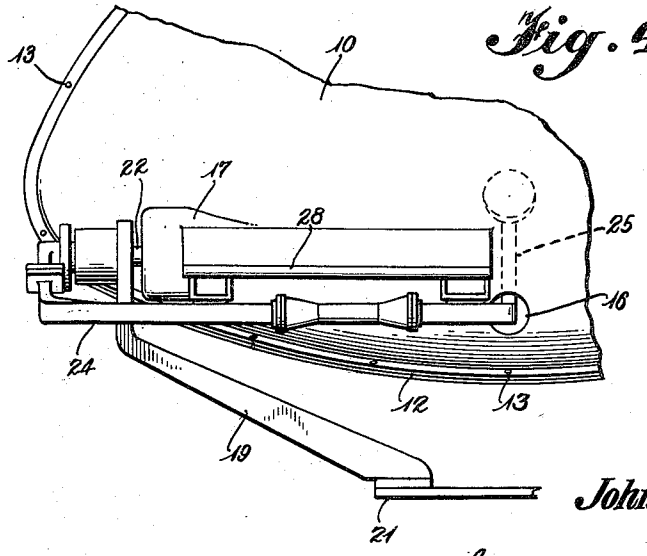


Fig. 4.



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United States Patent Office 2,842,767 Patented July 8, 1958

2,842,767

PARABOLIC REFLECTOR WITH A STRUCTURAL MEMBER FRONT SKIN

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Application February 3, 1954, Serial No. 407,937

3 Claims. (Cl. 343—781)

This invention relates generally to antennas suitable for the transmission of R. F. power and in particular to a parabolic reflector having a structural member front skin.

An antenna of the scanning type, such as is used in radar, consists mainly of two parts, the antenna feed or termination of the transmission line for R. F. power and the parabolic reflector. Further, two forms of parabolic reflectors are used, the cylindrical parabolic reflector and paraboloids of revolution which may or may not follow a special contour. In this latter type of parabolic reflector, the transmission line terminates at the focal point of the parabola. The R. F. energy sprays out of this feed point in the direction of the reflector where the energy is directed outwardly in the form of a concentrated beam which may or may not be symmetrical. This beam upon striking some object along its path is reflected back to the reflector where the energy is again concentrated at the focal point or end point of the transmission line. From there, the energy is transmitted to the receiving section of the radar system by means well known in the art.

Some antennas are mounted for full rotation. The more common technique, however, particularly in airborne installations, is to mount the antenna to oscillate back and forth through an arc of less than 180°. With an antenna mounted thus, the reflector is subjected to considerable vibration as it reaches the end of its travel arc and reverses direction which causes distortion of the parabolic reflecting surface. Another source of distortion in the reflector is the frequency of the vibrations generated by the power plant of the craft carrying the antenna. Thus, assuming as an example a maximum engine speed of 3300 R. P. M., the reflector will be subjected to severe vibration at some engine speed between 0 and 3300 R. P. M. unless it is so reinforced structurally that its resonant frequency is above 55 cps. To minimize this vibration and concomitant distortion, the practice has been to build a framework of structural sections and rivet this framework to the rear of the reflector. Following this practice does not produce the most fruitful results because of the large amount of time and expense required to construct the framework and attach same and the considerable weight added to the reflector. Further and as important, complete success has not been achieved in providing a structure with a sufficiently high resonant frequency to prevent vibration and distortion.

Accordingly, it is a principal object of this invention to provide a structural member of optimum rigidity for use in conjunction with a parabolic reflector to increase the resonant frequency of the reflector and thus minimize any distortion of the beam by vibrations resulting from the scanning action or normal vibration of the reflector support structure.

It is another object of this invention to provide a stiffener structure for a reflector that is considerably lighter in weight than structures previously used whereby

to attain a saving in weight which will be of particular benefit in airborne installations.

It is still a further object of this invention to provide a reflector stiffener structure that is more simply and easily attached to the parabolic reflector and is less expensive than structures used heretofore.

Other objects and advantages will become apparent from a detailed consideration of the following description when taken in conjunction with the appended drawings in which:

Figure 1 is a view in perspective illustrating the parabolic reflector and the structural member of this invention before assembly;

Figure 2 is a side view of the reflector and the structural member assembled and mounted on a standard support;

Figure 3 is a front elevation view of the reflector structurally reinforced in accordance with the present invention; and

Figure 4 is a partial rear elevation view of the reflector and the waveguide transmission line to the reflector.

Referring now to Figure 1, the invention is illustrated in its most basic form. The reflector **10** is a concave parabola as viewed from the focal point side and is formed with a narrow flange **12** extending around the contour or periphery of the reflector. A series of small, evenly spaced rivet holes **13** are drilled into flange **12** of reflector **10**. Structural member **11**, hereinafter termed the front skin, is concave, similar to reflector **10** though not necessarily a parabola, and has a narrow flange **14** extending around its outside rim, and is the same in contour as reflector **10**. A series of small evenly spaced rivet holes **15** are drilled into the flange **14** in positions to correspond with the holes **13** in flange **12** of the reflector.

The reflector **10** and the front skin **11** are assembled into a structurally rigid unit by applying an adhesive to the faces of flanges **12** and **14**, joining the reflector **10** and front skin **11** and then inserting small rivets through each corresponding hole **13** and **15** of their respective unit of the reflector assembly. When thus joined along the two outer rims, the two oppositely concave members provide a very rigid, and light weight structure. This method of joining the reflector and the structural member has been found to be very satisfactory but it is not to be construed as a limitation on this invention since other methods of joining can be easily devised. The appearance of the reflector **10** and the front skin **11** thus assembled is further illustrated by the side elevation of Figure 2.

Both reflector **10** and front skin **11** may be molded, as for example, from woven fiberglass laminae impregnated with a polyester resin or the like. Baking in a suitable press may be employed to permanently set the fiberglass and polyester resin into the desired shape. The thickness of the reflector on completion is approximately .030" and the front skin **11** .030". In the process of building up reflector **10** to the desired thickness, a thin layer of aluminum or some other suitable metal may be sprayed in between the laminations of fiberglass to provide a good reflecting surface for the waves transmitted by the antenna feed. As a finishing step, both the reflector and the front skin may be painted with a suitable type of paint. Although specific materials and material thicknesses are mentioned above with regard to constructing the reflector and the front skin, it will be appreciated that other materials or other combinations of materials and thicknesses may be used. For example, the reflector can be stamped entirely from sheet aluminum and the front skin molded from the fiberglass and polyester resin with the respective skin thicknesses dependent upon the size of the reflector and the type of material.

Referring now particularly to Figures 2, 3 and 4, various features of the present invention are shown, such as the support for the reflector structure and the waveguide feed to the reflector. Reflector brackets **17** and **18**, which may be likewise molded to the desired shape from the fiberglass impregnated with polyester resin, are affixed to the backside of reflector **10**, one on each side. Bearings **22** and **23**, consisting of well known components, are fastened to the reflector brackets **17** and **18**, respectively. Both bearing **22** supported by trunnion arm **19** and bearing **23** supported by trunnion arm **20** are mounted to be freely rotatable. The trunnion arms **19** and **20** are in turn fixed to a rotary table **21** which is arranged to be driven by a suitable mechanism (not shown) to provide 360° rotation or an oscillating motion as required.

Because the reflector is mounted to reflect a beam through a horizontal arc determined by the rotary table mechanism as well as to scan in a vertical arc above and below a horizontal plane, it is necessary to mount the waveguide feed to the reflector to move with the reflector when scanning above and below a horizontal plane. Thus, the series of waveguide components to the reflector, designated by the numeral **24**, are mounted at one end from one of the bearings and at the other end from waveguide support **28**. In this instance, the waveguide components **24** are shown mounted from bearing **22**. Supporting the waveguide components in this manner, the waveguide will move with reflector **10** as it scans above and below a horizontal plane. Waveguide support **28** may also be molded from the fiberglass and polyester resin as may the reflector brackets and the reflector and structural member.

In order to complete the antenna transmission line, reflector **10** is provided with a circular cutout **16** to allow the waveguide feed **25** to the reflector to be inserted within the space defined by the oppositely concave components, reflector **10** and front skin **11**. Waveguide **25**, commonly termed the J horn because of its shape, connects at one end to the waveguide components **24**. The loop of the J horn rests against a well defined, curved ridge **26** which extends across the width of front skin **11** and occurs at the deepest part of the concave form. Two bolts **27**, welded to J horn **25**, extend through holes drilled in front skin **11**. By this means J horn **25** is bolted to front skin **11**. This method of simply and securely supporting J horn **25** provides a distinct improvement over the method of supporting prior art antenna structures, inasmuch as heretofore it has been necessary to construct the J horn from comparatively heavy material and to provide a three strut brace to prevent the J horn from vibrating from side to side as the reflector oscillates.

Although the present invention has been described in a specific embodiment, nevertheless various changes and modifications obvious to those skilled in the art are within the scope and contemplation of this invention. It will be apparent that many such changes can be made to the disclosed embodiment without departing from the basic concept taught herein of providing a structural member which can be attached to the front of the reflector.

What is claimed is:

1. An antenna assembly comprising a lightweight parabolic reflector consisting of a fibrous material impregnated with a resin, said reflector having a metallic layer therein and describing a peripheral flange, and a lightweight concave structural reinforcing member consisting of a fibrous material impregnated with a resin and having a peripheral flange, said flanges being joined together whereby said reflector and said member have their concave surfaces in opposed relation to define an internal cavity, waveguide means projecting through said reflector into said cavity and adapted to direct R. F. energy from a predetermined feed point toward said reflector, and one of said reflector and said member providing support means to maintain said waveguide means in a fixed position relative to said reflector.

2. An antenna assembly comprising a parabolic reflector consisting of a lightweight fibrous material impregnated with a resin, said reflector having a metallic layer therein and describing a peripheral flange, and a concave structural reinforcing member consisting of a lightweight fibrous material impregnated with a resin and having a peripheral flange, said flanges being joined together whereby said reflector and said member have their concave surfaces in opposed relation to define an internal cavity, waveguide means projecting through said reflector into said cavity and adapted to direct R. F. energy from a predetermined feed point toward said reflector, and said member providing means to maintain said waveguide means in a fixed position relative to said reflector.

3. An antenna assembly as defined in claim 2 wherein said fibrous material is fiberglass.

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