

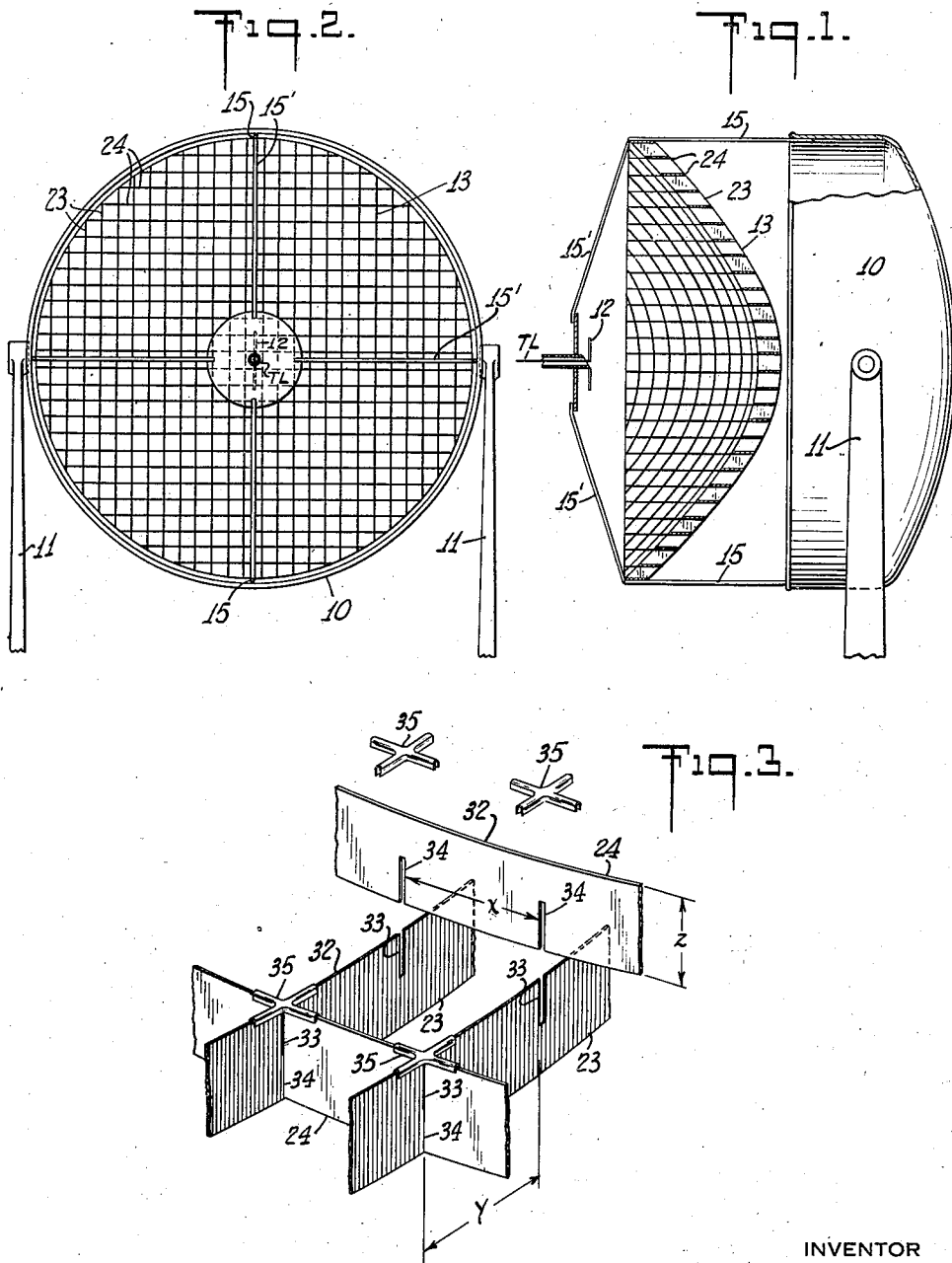
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The present invention relates to directive antenna systems and, more particularly, to antennas for use in association with searchlights, particularly in so-called radar detection systems. Heretofore known directive antenna systems for use with searchlights have generally been of two classes. One class employs a plurality of Yagi type directive radiators mounted around the barrel of the searchlight in positions just outside of the light beam. This is an unwieldy arrangement and not very directive. Another class involves the use of a parabolic reflector of wire mesh mounted in front of, and coaxial with, the barrel of the searchlight. Thus the light from the searchlight could shine through the holes in the wire mesh although with a considerable light loss. The maximum response of the antenna theoretically should be centered about the beam of light from the searchlight but actual tests have indicated that such an arrangement is not sufficiently directive and is responsive to radio signals arriving from undesired directions outside the main beam of the reflector. This causes excessive reflections to be received from objects at short distances from the installation which interferes with satisfactory functioning of the equipment over greater distances. This limits the maximum satisfactory range in some instances to 6 or 8 miles.

It has been observed that the lack of directivity is partly due to the fact that very strong high frequency electric fields exist inside the barrel of the searchlight due to waves passing through the reflector screen and reflecting back and forth between the antenna reflector and the light reflector. This cannot be satisfactorily overcome by increasing the number of wires in the mesh of the radio reflector screen because the leakage of energy through the screen cannot be made satisfactorily small without blocking out an excessive amount of light and adding an excessive amount of weight.

An object, therefore, of the present invention is the provision of an antenna for use in association with a searchlight.

Another object of the present invention is the provision of an antenna, as aforesaid, which overcomes the above mentioned disadvantages.

Still another object of the present invention is the provision of an antenna reflector which is highly light pervious.

A further object of the present invention is the provision of a light pervious radio wave directive apparatus which has a single sharply direc-

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tive pattern with a minimum number of subsidiary lobes or ears.

Still a further object of the present invention is the improvement of radio directive systems.

The foregoing objects, and others which may appear from the following detailed description, are attained by providing an antenna system including a radiator and a parabolic reflector adapted to be mounted over the face of a searchlight without substantially reducing the intensity of the light beam. In order that the light may not be adversely affected the radio wave reflector is of a cellular construction, the cells being of such depth that the radio frequency energy from the antenna is not radiated through the cells in any substantial amount and of such cross section that the cells cannot act as wave guides. Thus the percentage of solid material in the path of the light beam may be substantially reduced. The edges of the cells forming the radio wave are preferably treated to obtain maximum conductivity.

The novel features which, it is believed, are characteristic of the present invention are pointed out with particularity in the appended claims.

The invention will, however, be more completely understood by reference to the following detailed description, which is accompanied by a drawing in which Figure 1 illustrates a side view partly in section, while Figure 2 illustrates in face view an embodiment of the invention and Figure 3 illustrates an exploded view of a portion of the reflector of Figures 1 and 2.

In Figure 1 is shown a searchlight 10 mounted on gimbals 11 so that it may be rotated in elevation and in azimuth to illuminate a desired object in the distance. Such searchlights are widely used for aircraft interception purposes. Since the present invention is not concerned with the details of the searchlight, they will not be further illustrated or described. Over the face of the searchlight is mounted a radio antenna 12 at the focus of a reflector 13. The reflector 13 is arranged to be pervious to the light from searchlight 10 but at the same time act as a reflector of the energy radiated from antenna 12. Antenna 12 and its reflector 13 are supported in front of, and in coaxial relationship with, the searchlight 10 by means of suitably arranged supports 15 and 15'. A transmission line TL is shown as connected to the antenna 12 and is adapted to be connected to suitable radio frequency transducer equipment (not shown). The antenna 12 is merely illustrative of a general form of radio fre-

quency radiator and does not necessarily indicate the form of antenna construction actually to be used for the detection of distant objects. In fact, the antenna is usually one which can be continuously moved or rotated in position about the point of focus of the reflector, to vary the direction of the beam, or energy is radiated in succession from a plurality of antenna radiators. The reflector 13 is cellular in construction being formed of a plurality of conducting strips of metal 23, 24, each being cut in such a manner that all edges of all strips are portions of the same parabola and crossing each other at right angles. Each strip has a number of parallel spaced slots therein extending half way through the width of the strips. That is, vertical strips 23 may have slots 33 (Fig. 3) extending outwardly from the concave edge of each strip, while strips 24 may have slots 34 extending inwardly from the convex edge of each strip. Thus the strips forming the reflector may be assembled somewhat in the manner of an egg crate spacer. The construction is shown in somewhat greater detail in Figure 3 wherein short portions of the strips 23, 24 are depicted in somewhat enlarged size and with their curvature somewhat exaggerated. The disposition of the slots 33 in strips 23 and cooperating slots 34 in strips 24 and the manner in which strips 23 fit into slots 34 and strips 24 into slots 33 is herein clearly shown.

In order to improve the mechanical strength and the rigidity of the structure, as well as the conductivity of the assembled reflector, conductive bridge pieces 35 are placed at each point of intersection of the component strips. They may be soldered or welded in place and, preferably, the entire inner edge portions 32 of the strips 23 and the bridge pieces 35, if not the entire structure, are plated with some highly conductive metal such as copper or silver. In order to obtain the maximum reflectivity of the reflector the cross-sectional dimensions of each of the cells must be too small to pass radio waves according to wave guide action. This may be obtained by making the distances X and Y between adjacent slots 33 and adjacent slots 34 less than one-half of the operating wavelength. The width of each of the strips 23 and 24 may be made as large as necessary to obtain the desired attenuation of radio frequency energy without in any way affecting the transmission of light from the searchlight 10 because all of the useful light from searchlight 10 is in the form of parallel rays in a direction parallel to the axis of the cells of reflector 13. For a reflector 72 inches in diameter operating at a frequency of the order of 1000 megacycles typical dimensions of an embodiment of the invention may be as follows: the distances X and Y may be 2 inches, while the width Z of strips 23 and 24 may be 4 inches. The thickness of the strips may be of the order of 10 to 12 mils. Comparing a reflector thus constructed with a similar reflector constructed of wire mesh of 1 inch spacing the component wires thereof being number 10 gauge having a thickness of 102 mils, it has been found that light absorption of the reflector of the present invention may have as little as 5 percent of the absorption of the wire mesh reflector. The radio wave energy passing through the reflector composed of conductive strips is reduced to a negligible value compared to that passing through the wire mesh reflector. If desired, the strips 13 instead of being made of metal may be constructed of a thin plastic or plywood veneer

coated with metal foil or sprayed with a coating of metal.

While I have illustrated a particular embodiment of the present invention it should be clearly understood that the invention is not limited thereto since many modifications may be made in the several elements employed and in their arrangement and it is therefore contemplated by the appended claims to cover any such modifications as fall within the spirit and scope of the invention.

I claim:

1. A directive antenna system, including a radiator and a parabolic reflector, said parabolic reflector being comprised of a plurality of conductive walled cells arranged with their lengths parallel to the axis of said reflector, the lengths of said cells being such that substantial energy from said radiator is not radiated therethrough and said cells having transverse dimensions such that substantial energy is not propagated therethrough by wave guide action.

2. A directive antenna system, including a radiator and a parabolic reflector, said parabolic reflector being comprised of a plurality of conductive walled cells arranged with their lengths parallel to the axis of said reflector, the lengths of said cells being such that substantial energy from said radiator is not radiated therethrough and said cells having transverse dimensions substantially less than one half of the operating wavelength.

3. A directive antenna system, including a radiator and a parabolic reflector, said parabolic reflector being comprised of a plurality of conductive walled cells arranged with their lengths parallel to the axis of said reflector, said cells having transverse dimensions such that substantial energy is not propagated therethrough by wave guide action.

4. A directive antenna system, including a radiator and a parabolic reflector, said parabolic reflector being comprised of a plurality of conductive walled cells arranged with their lengths parallel to the axis of said reflector, said cells having transverse dimensions substantially less than one half of the operating wavelength.

5. A light pervious reflector for radio wave energy including a wall in the form of a plurality of conductive walled, open ended cells having their lengths transverse to the face of said reflector and said cells having transverse dimensions so related to the wavelength of the radiant energy, such reflector is adapted to reflect that substantial energy is not propagated therethrough by wave guide action and the length of said cells being so related to said wavelength that radio wave energy is not substantially radiated therethrough.

6. A light pervious reflector for radio wave energy including a wall in the form of a plurality of conductive walled cells having their lengths transverse to the face of said reflector and said cells having transverse dimensions substantially less than one half of the wavelength of said energy.

7. A parabolic reflector for radio wave energy including a plurality of fiat parabolic shaped strips of metal arranged on edge in a mutually crossing relationship to form a plurality of cells, the transverse dimensions of said cells being less than one half of the operating wavelength whereby substantial wave energy is not propagated therethrough.

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8. A reflector for radio wave energy including a plurality of fiat conductive strips arranged on edge in a mutually crossing relationship to form a plurality of cells, the transverse dimensions of said cells being less than one half of the operating wavelength whereby substantial radio wave energy is not propagated therethrough.

9. A parabolic reflector for radio wave energy, including a plurality of flat parabola shaped strips of metal arranged on edge in a mutually crossing relationship to form a plurality of cells, the transverse dimensions of said cells being less than one half of the operating wavelength whereby substantial radio wave energy is not propagated therethrough and cross-shaped metallic clips conductively connected to said strips at each crossing point.

10. A parabolic reflector for radio wave energy comprised of two sets of parallel fiat parabolic and slotted metal sheets, the two sets of sheets

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being interleaved and joined together to form a single rigid structure.

11. A parabolic reflector for radio wave energy comprising two sets of parallel fiat slotted metal sheets, said sheets each having an edge of parabolic curvature, the two sets of sheets being so interleaved and joined together as to form a single rigid structure.

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