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CASSEGRAIN ANTENNA WITH DIELECTRIC LENS MOUNTED IN MAIN REFLECTOR

Filed Aug. 4, 1967

FIG. 2

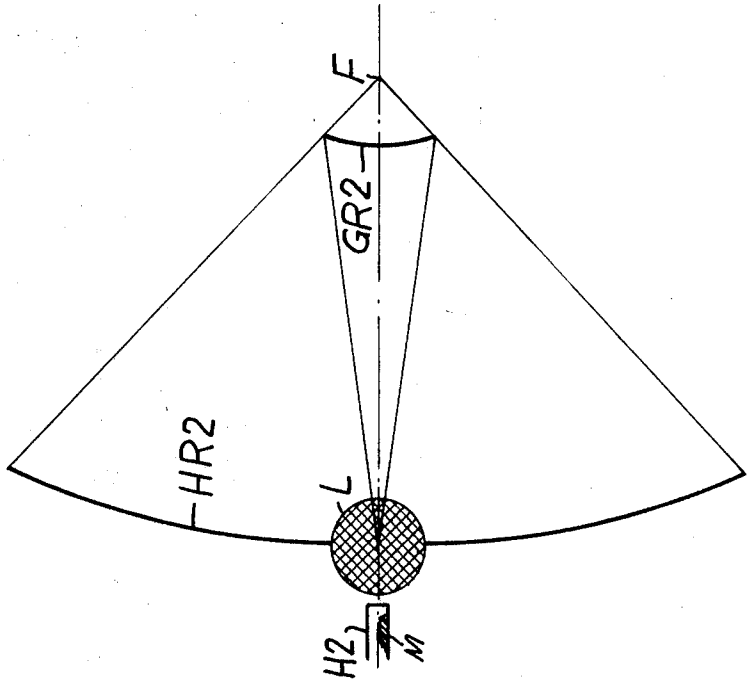
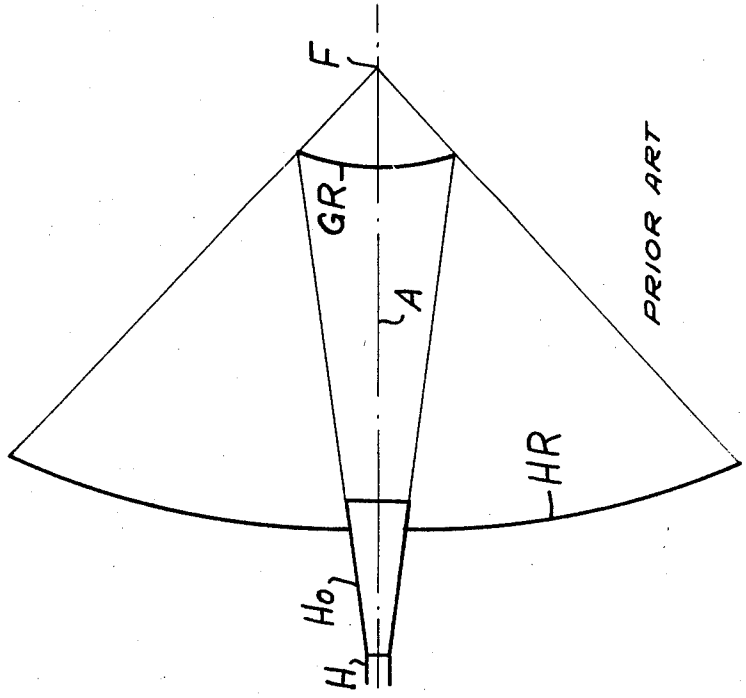


FIG. 1



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CASSEGRAIN ANTENNA WITH DIELECTRIC LENS MOUNTED IN MAIN REFLECTOR

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U.S. Cl. 343—755 8 Claims

ABSTRACT OF THE DISCLOSURE

An antenna arrangement facilitating use of a signal source of smaller than conventionally required size due to the placing of a dielectric body between a signal source and a counter-reflector associated with a parabolic antenna, the dielectric body preferably being of a rotationally symmetrical shape.

DRAWING

FIG. 1 is a diagrammatic illustration of the prior art; and

FIG. 2 is a diagrammatic illustration of an arrangement of the invention employing a dielectric body.

DETAILED DESCRIPTION

This invention relates to an arrangement for obtaining optimum coverage of radiated energy on a paraboloid antenna having a counter reflector.

Known devices of the above kind which operate in the micro-wave range, such as, for example, the Cassegrain system, are constituted as shown in FIG. 1. At a certain distance from the main paraboloid reflector HR, a counter reflector GR is arranged in symmetry to the reflector axis A, and the linear dimensions of this counter reflector are usually in a range of between 1/10 and 1/20 of those of the main reflector. The shape given to the counter reflector may be that of a rotational paraboloid or a rotational hypercoloid. Moreover, the distance between both reflectors is so chosen that their focal points F shall coincide. In general, the antenna is fed by means of a horn type radiator Ho supplied by a hollow waveguide H. The radiator radiates through an opening or aperture in the center of the main reflector and in the direction towards the counter reflector. For this purpose, a size must be chosen for the horn type radiator such that its radiation will fully irradiate the counter reflector as desired.

On account of the dimensions of the counter reflector which are small in terms of its distance from the horn type radiator, the horn must throw a very concentrated beam (e.g., half power angular beam width of 5° to 10°) and the cone widths in planes normal to each other must be equal.

Horn radiators with such small opening angles have large spatial dimensions and require a wide antenna opening in the order of magnitude of several wavelengths. For minimum reflective, matched horn radiators, the horn length must amount to 2 to 3 times the length of the side of the opening in the antenna.

The invention pursues the objective of overcoming these disadvantages of known arrangements, and in particular of obviating the necessity for using a horn radiator of large dimensions.

The problem is solved by providing in the plane of symmetry of the antenna, between the feeding hollow waveguide and the counter reflector, a shaped, preferably rotationally symmetrical, dielectric body. According to a preferred embodiment of the invention, this dielectric shaped body is a spherical lens. It may, however, have a different form.

The dielectric shaped body can be constituted by layers of materials having different dielectric constants, in which case the grading of the dielectric constants follows certain laws. The body may alternatively consist of a homogeneous dielectric material which has a definite shape prescribed in accordance with the laws of optics.

According to a particularly advantageous embodiment of the invention, the shaped dielectric body consists of a spherical lens composed of various layers having different dielectric constants, and in this case these dielectric constants may diminish from the inside towards the outsides as in a Luneberg lens.

An important advantage of the arrangement according to the invention consists of the fact that the shaped dielectric body has considerably smaller spatial dimensions than a matched horn, and that the beam divergence in the direction of wave propagation will not be greater than the lens diameter. The shaped dielectric body can in the simplest case be fed on its side facing away from the counter reflector by a hollow conductor without a flange. This waveguide may, however, also be designed as a horn radiator, but in this case it will differ from the known horn radiators as are conventional in antennas with counter reflectors in that its linear dimensions will not exceed one to two wavelengths. In the case where the shaped dielectric body has an external dielectric constant other than 1, the feeding hollow waveguide may be filled with dielectric material M having the same dielectric characteristics as the outermost layer of the shaped body. If the feeding hollow conductor is brought close enough to the lens so that the dielectric materials can be joined without a gap, reflections or refractions in passing from the waveguide to the lens will be avoided.

Apart from affecting the phase fronts, for which purpose the use of shaped dielectric bodies is known, there occurs according to the present invention, a focussing of micro-wave energy. Form and stratification of the shaped body must be chosen in such a manner that the counter reflector of the antenna is irradiated as desired.

An example of an arrangement according to the invention is shown in FIG. 2.

In FIG. 2, the main paraboloid reflector is designated as HR2, the counter reflector, arranged symmetrically to the reflector axis, is designated as GR2. The focal points of both reflectors are located at F. The microwave energy is supplied by a hollow waveguide H2. In the known arrangement shown in FIG. 1, the horn is connected to the hollow conductor. In the arrangement of the invention shown in FIG. 2, a shaped dielectric body L is mounted in the plane of symmetry of the antenna between the feeding hollow conductor H2 and the counter reflector GR2.

There will now be obvious to those skilled in the art many variations of the above construction which will come within the scope of the invention.

What is claimed is:

1. An antenna arrangement comprising a shaped reflector having a plane of symmetry, a counter-reflector spaced from said shaped reflector, a signal source operatively associated with said reflectors, and a dielectric body in said plane between said source and counter-reflector, said shaped reflector having an opening in which said dielectric body is accommodated, said dielectric body having an extent in the direction of wave propagation which is not greater than the opening in said shaped reflector.

2. An arrangement as claimed in claim 1, wherein said body has a rotationally symmetrical shape.

3. An arrangement as claimed in claim 2, wherein the

shaped reflector is a parabolic antenna and said source is a hollow waveguide.

4. An arrangement as claimed in claim 3, wherein said body is a spherical lens.

5. An arrangement as claimed in claim 3, wherein said body includes a plurality of layers of different dielectric constants.

6. An arrangement as claimed in claim 3, wherein said body is spaced from said waveguide.

7. An arrangement as claimed in claim 3, wherein said waveguide includes a horn whose linear dimensions do not exceed two wavelengths.

8. An arrangement as claimed in claim 5, wherein the waveguide includes a dielectric stuffing whose constant matches that of the outer of said layers.

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ELI LIEBERMAN, Primary Examiner

U.S. Cl. X.R.

343—781, 783, 840