

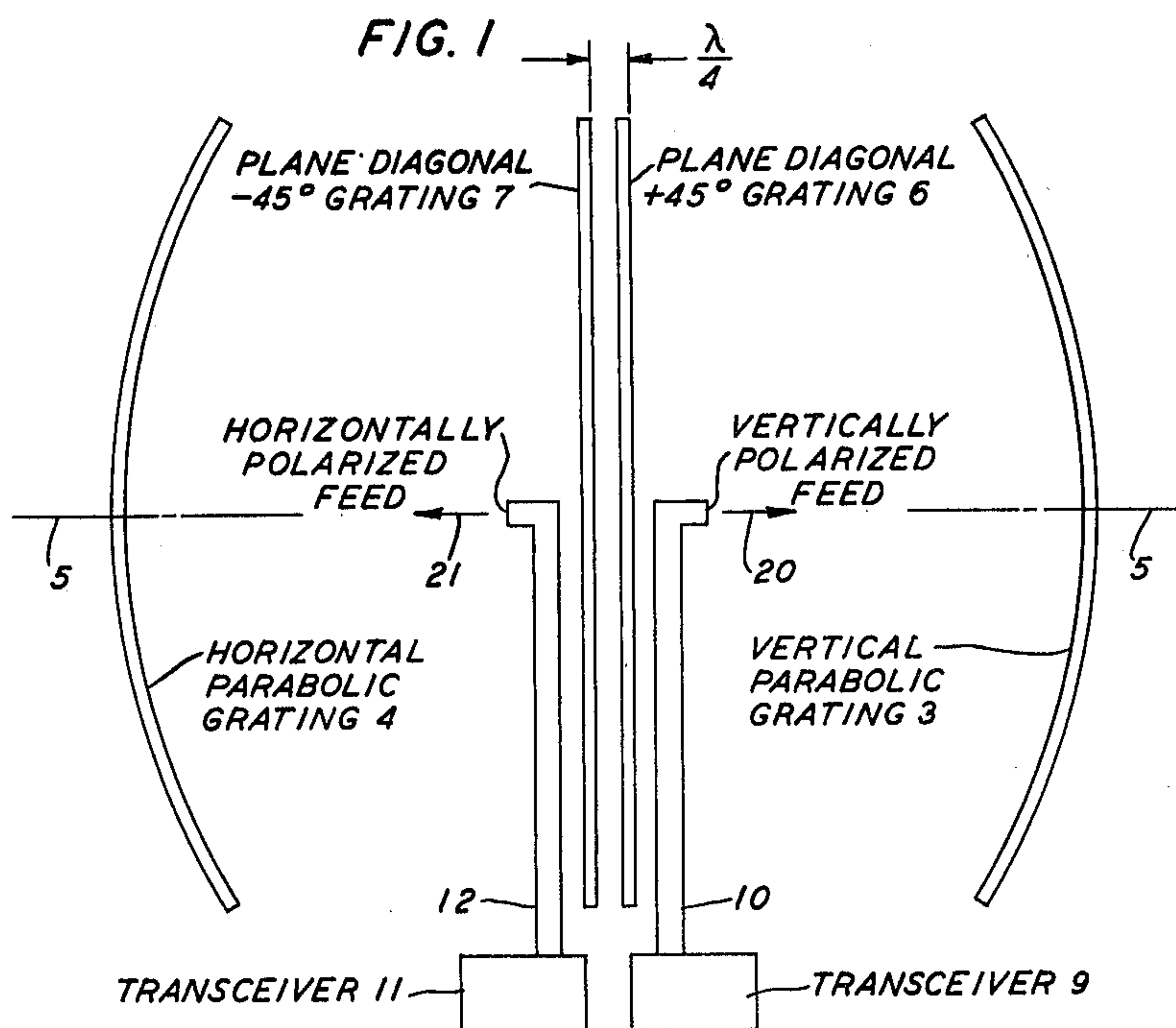
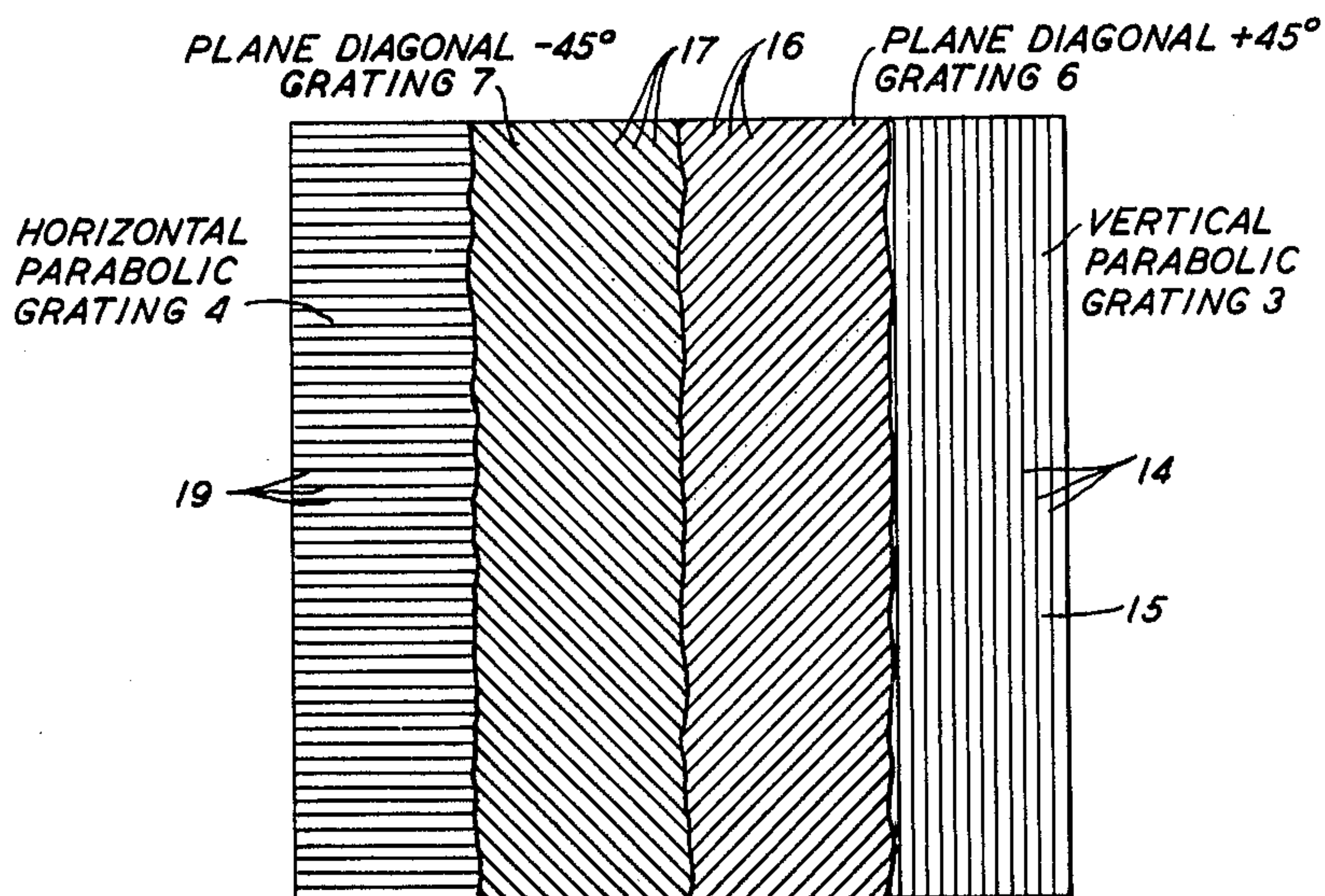
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A. M. KAY

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DUAL POLARIZED BIDIRECTIONAL ANTENNA

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**FIG. 2**

INVENTOR
A. M. KAY
BY
Ralph T. Holcomb
ATTORNEY

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3,261,020

DUAL POLARIZED BIDIRECTIONAL ANTENNA
Arthur M. Kay, Rutherford, N.J., assignor to Bell Telephone Laboratories, Incorporated, New York, N.Y., a corporation of New York

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5 Claims. (Cl. 343-756)

This invention relates to antennas and more particularly to bidirectional antennas polarized in quadrature.

An object of the invention is to radiate in opposite directions two beams of electromagnetic energy which are polarized in quadrature. An other object is to reduce the number of elements required in an antenna system adapted to radiate two such beams. A further object is to reduce the weight of such an antenna system.

Use is often found for an antenna system which will radiate two beams in substantially opposite directions. Interference between the beams may be greatly reduced by polarizing them in quadrature.

The bidirectional antenna system in accordance with the present invention is well adapted to provide two such beams. The antenna is composed of two Cassegrain, double-reflector systems connected back to back and polarized in quadrature. Each half of the antenna comprises a plane diagonal grating, a parabolic grating facing the plane grating, and an interposed source of polarized radiation adapted to illuminate the parabolic grating. For example, one of the parabolic gratings may have vertical elements and a vertically polarized feed, while the other parabolic grating has horizontal elements and a horizontally polarized feed. Therefore, in transmission, each parabolic grating will reflect the energy from its associated feed. The elements of one of the plane gratings make an angle of $+45^\circ$ with the horizontal and those of the other an angle of -45° . The corresponding major faces of these two plane gratings are spaced apart by approximately a quarter wavelength at an operating frequency, so that, in transmission, they will reflect the energy from each of the parabolic gratings, just as a solid plate would. The plane gratings will also rotate the respective angles of polarization of the incident waves by 90° . Thus, the solid reflector heretofore required in such a bidirectional system is eliminated and the weight of the structure reduced.

The nature of the invention and its various objects, features, and advantages will appear more fully in the following detailed description of a typical embodiment illustrated in the accompanying drawing, of which

FIG. 1 is a diagrammatic plan view of a polarized, bidirectional antenna system in accordance with the invention; and

FIG. 2 is a diagrammatic elevational view from the right, with parts cut away, showing the orientations of the elements forming each of the gratings.

In FIG. 1, two parabolic gratings 3 and 4 face each other and have a common horizontal axis 5. Two plane diagonal gratings 6 and 7 are positioned perpendicular to the axis 5 and approximately midway between the gratings 3 and 4. The spacing between corresponding major faces of the gratings 6 and 7 is equal to approximately a quarter of a wavelength λ in air at the operating frequency of the antenna. A transceiver 9, in transmission, supplies vertically polarized radiant energy to the wave guide 10, the open end of which is positioned on the focal line of the grating 3 and serves as a feed therefor. Similarly, another transceiver 11 and wave guide 12 provide a horizontally polarized feed for the grating 4.

As shown in FIG. 2, the grating 3 has parallel vertical elements such as 14, which are held in place by interposed dielectric material 15. The parallel elements 16

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in the grating 6 make an angle of $+45^\circ$ with the horizontal, and the elements 17 in the grating 7 make an angle of -45° with the horizontal. The parallel elements 19 constituting the grating 4 are horizontal. In each of the gratings 3, 4, 6, and 7, the parallel elements have a spacing of less than $\lambda/2$. In FIG. 2, parts of the gratings 3, 6, and 7 have been cut away to show the gratings beyond.

The antenna system shown in FIGS. 1 and 2 operates in the following manner to produce two oppositely directed beams, one with vertical polarization and the other with horizontal polarization. Vertically polarized radiation is emitted from the open end of the guide 10 to illuminate the parabolic grating 3, as indicated by the arrow 20. Because the elements 14 are vertical, this radiation will not pass through the grating 3 but will be focused into a beam with a plane wave front which will be reflected by the grating 3 to the plane grating 6. Due to the spacing of approximately $\lambda/4$ between the corresponding major faces of the gratings 6 and 7, and the fact that the elements 16 and 17 are in quadrature, this beam is totally reflected back to the grating 3, but its polarization has now been rotated 90° and is horizontal. The horizontally polarized beam passes through the grating 3 and is projected to the right. In like manner, the horizontally polarized radiation from the guide 12, represented by the arrow 21, is first reflected by the grating 4 has a beam with a plane wave front directed toward the plane grating 7. The gratings 6 and 7 reflect this beam back toward the grating 4 with its polarization changed to vertical, so that the beam will pass through the grating 4 and provide a vertically polarized beam directed toward the left.

Although the antenna system has been described only as a transmitter, it will be understood that it will also function as a receiver. Horizontally polarized waves incident from the right will be focused and fed to the transceiver 9 for reception. Also, vertically polarized waves incident from the left will be received by the transceiver 11. Thus, a two-way system is provided.

It is to be understood that the above-described arrangement is only illustrative of the application of the principles of the invention. Numerous other arrangements may be devised by those skilled in the art without departing from the spirit and scope of the invention.

What is claimed is:

1. An antenna system for radiating in opposite directions two beams of electromagnetic radiation polarized in quadrature comprising a first primary source adapted to emit vertically polarized radiation, a first reflector arranged to be illuminated by the first source and constructed as a collimator to reflect in one direction along a selected horizontal axis with a plane wave front the incident vertically polarized radiation but to permit the free passage of horizontally polarized radiation, a second primary source adapted to emit horizontally polarized radiation, a second reflector arranged to be illuminated by the second source and constructed as a collimator to reflect in the opposite direction along the selected axis with a plane wave front the incident horizontally polarized radiation but to permit free passage of vertically polarized radiation, and a pair of plane gratings cooperatively arranged to permit each grating to wholly reflect that portion of radiant energy passing through the other and positioned between the first and second reflectors and perpendicular to the selected axis, corresponding major faces of the gratings being spaced apart by approximately a quarter of a wavelength λ at an operating frequency, the spacing between the parallel elements forming each of the gratings being less than $\lambda/2$, each of the elements in one of the gratings making an angle of $+45^\circ$ with the horizontal, and each of the elements in the other grating making an angle of -45° with the horizontal.

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2. An antenna system adapted to project a horizontally polarized beam in a selected horizontal direction and a vertically polarized beam in the opposite direction comprising two parabolic gratings, two plane gratings, and two polarized feeds, the parabolic gratings facing each other and having a common axis coinciding with the selected horizontal direction, the first parabolic grating having vertical parallel elements, the first feed being vertically polarized, positioned at the focus of the first parabolic grating, and adapted to illuminate the first parabolic grating, the second parabolic grating having horizontal parallel elements, the second feed being horizontally polarized, positioned at the focus of the second parabolic grating, each plane grating cooperatively arranged to reflect all of the radiant energy passing through the other, said gratings being located approximately midway between the parabolic gratings and perpendicular to their common axis, and their corresponding major faces being spaced from each other approximately a quarter of a wavelength λ at an operating frequency of the antenna, the elements in one of the plane gratings making an angle of $+45^\circ$ with the horizontal, the elements in the other plane grating making an angle of -45° with the horizontal, and the spacing between the parallel elements forming each of the four gratings being less than $\lambda/2$.

3. An antenna system for radiating in opposite directions two beams of electromagnetic radiation comprising a first primary source emitting radiation polarized in a first plane, means including a first primary reflector arranged to be illuminated by said first source and having a selective reflective polarization for reflecting substantially the whole of the incident radiation polarized in said first plane while permitting free passage of substantially all radiation impinging thereon normal to said first plane, a second primary source emitting radiation polarized in a second plane, means including a second primary reflector arranged to be illuminated by said second source and having a selective reflective polarization for reflecting substantially the whole of the incident radiation polarized in said second plane while permitting free passage of substantially all radiation impinging thereon normal to said second plane and a parallel pair of secondary plane reflectors each having a selective reflecting polarization, each of said secondary reflectors being disposed between said primary reflectors with the selective polarization thereof at 45° to the respective selective polarizations of said primary reflectors for reflecting one portion of the reflected radiation received from one of said primary reflectors and for passing a remaining portion of said radiation received from said one primary reflector, the selective polarizations of each said secondary reflectors being at right angles to the other for re-reflect-

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ing said remaining portion passed by said other for re-combination with said one portion.

4. The system according to claim 3 wherein said secondary reflectors are spaced one quarter wavelength at an operating frequency from each other whereby said one portion re-reflected from each secondary reflector recombines with said remaining portion after being re-reflected from the other secondary reflector in a polarization at right angles to the plane of the primary source from which it was emitted.

5. An antenna system for radiating in opposite directions two beams of electromagnetic radiation polarized in quadrature comprising a first primary source emitting radiation polarized in a first direction, a first primary reflector comprising a multiplicity of conductors parallel to said first direction and arranged to be illuminated by said first source for reflecting substantially the whole of the incident radiation polarized in said first direction while permitting free passage of substantially all radiation impinging thereon normal to said first direction, a second primary source emitting radiation polarized in a second direction, means including a second primary reflector comprising a multiplicity of conductors parallel to said second direction and arranged to be illuminated by said second source for reflecting substantially the whole of the incident radiation polarized in said second direction while permitting free passage of substantially all radiation impinging thereon normal to said second plane and a parallel pair of secondary plane reflectors each comprising a multiplicity of parallel conductors, each of said secondary reflectors being disposed between said primary reflectors with conductors thereof at 45° to the respective conductors of said primary reflectors for reflecting one portion of the reflected radiation received from one of said primary reflectors and for passing a remaining portion of said radiation received from said one primary reflector, the parallel conductors of each said secondary reflectors being at right angles to the other for re-reflecting said remaining portion passed by said other for recombination with said one portion.

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ELI LIEBERMAN, *Acting Primary Examiner.*

CHESTER L. JUSTUS, *Examiner.*

M. KRAUS, *Assistant Examiner.*