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ANTENNA BEAM SCANNER

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FIG. 1a

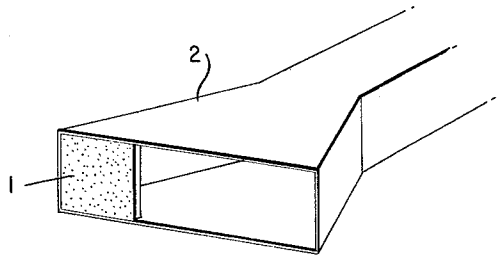
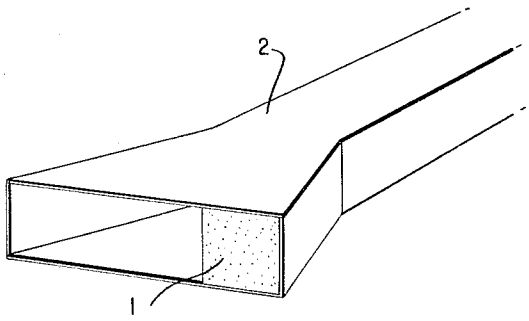


FIG. 1b



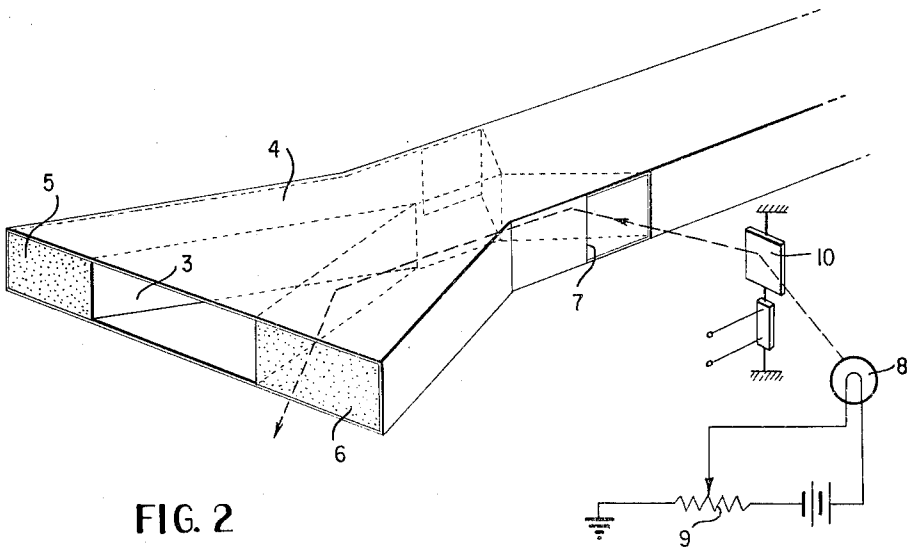


FIG. 2

INVENTORS.
DAVID R. SARTORIO
EDWARD R. FLANAGAN

BY
Sughrue, Rothwell, Mion, Zinn

ATTORNEYS.

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ANTENNA BEAM SCANNER

David R. Sartorio, Cockeysville, and Edward R. Flanagan, Monkton, Md., assignors to Martin-Marietta Corporation, Baltimore, Md., a corporation of Maryland

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This invention relates to systems for scanning an antenna beam and more particularly to a system in which the antenna beam is scanned by selectively illuminating a photoconductive material placed over the aperture of the antenna.

There are many applications in which it is desirable to alter or change the direction of a beam of radio frequency (RF) energy. One example is in directional antenna systems in which it is desirable to change the radiating direction of a transmitted wave. Prior art scanning antennas have been, for the most part, of the mechanically moving type. These systems are subjected to the many difficulties attendant with any mechanical movement. Other prior art systems have overcome the difficulty encountered with mechanical movements by using ferrites and gas plasmas as phase shifting devices for electronically scanning the antenna beam. Such applications usually require a complex electrical circuit for effecting the scanning. Further, although such systems are suitable for scanning, they are not suitable for use in applications which require that the shape of the RF antenna beam be altered.

Accordingly, it is an important object of the present invention to provide an improved antenna scanning system utilizing a photoconductive element to vary the direction and/or the shape of the RF beam.

The effect of the conductivity of a photoconductive element on RF energy has been recognized. However, the positioning and shape of the photoelectric element required to achieve effective scanning and shaping of an RF beam has not been recognized in the prior art.

Accordingly, it is further object of the present invention to provide an improved RF scanning system utilizing a sheet of photoconductive material positioned over the aperture of an antenna.

It is a still further object of the present invention to provide an improved RF scanning system in which a photoelectric sheet is excited by a light source which is an integral part of the antenna.

These objects are accomplished in accordance with one embodiment of the invention by positioning a light conducting medium inside a horn-type antenna terminating at the aperture of the antenna. A photoconductive material is deposited on the light conducting medium at the aperture of the antenna. Light from an exciting source is introduced into the light conducting medium at a point remote from the antenna aperture through an opening in the wall at the waveguide. This light is conducted to the photoconductive material and selectively varies the conductivity of the photoconductive material. The dark conductivity of the photoconductor has negligible effect on RF energy propagating from the antenna. However, when the conductivity of the photoconductor is increased by exposing it to the proper radiation, the RF energy from the antenna is attenuated. If the layer of photoconductive material is thick enough, the phase of the RF energy can also be altered. By irradiating portions of the photoconductive material with light, the RF antenna beam can be scanned or its shape can be altered.

The foregoing and other objects, features and advantages of the present invention will be better understood from the following more detailed description and appended claims in conjunction with the drawings in which:

FIGURE 1*a* shows a horn-type antenna with the photoconductive material across one portion of the aperture of the antenna illuminated;

FIGURE 1*b* shows a horn-type antenna with the photoconductive material across another portion of the aperture of the antenna illuminated; and

FIGURE 2 shows a preferred embodiment of the invention.

The effect of a photoconductive sheet placed across the aperture of a horn-type antenna is best shown with reference to FIGURES 1*a* and 1*b*. In FIGURE 1*a*, a cover **1** which has been coated with photoconductive material is placed over a portion of the aperture of the horn-type antenna **2**. When the photoconductive material is exposed to light from a visible source, the RF energy from the antenna **2** assumes a particular field intensity pattern. When the cover **1** is relocated to the other side of the aperture, as shown in FIGURE 1*b*, this field intensity pattern undergoes a shift in direction.

By way of example, one model of the present invention utilized an H-plane X-band horn antenna having an aperture width of 1.6 inches. Sintered cadmium sulfide doped with copper chloride and cadmium sulfide was deposited on the cover **1**. The photoconductive material was deposited on a cover of high temperature borosilicate glass of the type commonly sold under the trade name Pyrex. The Pyrex cover is .3 inch wide and has a thickness of .006 inch. The sintered photoconductive material is deposited a thickness of .010 to .020 inch. A tungsten light source is used to excite the photoconductor to its conductive state. Comparison of the two field intensity patterns produced with the position of the cover **1** as shown in FIGURE 1*a* and as shown in FIGURE 1*b* indicates an antenna beam shift of 5°.

A preferred embodiment of the invention is shown in FIGURE 2. In this embodiment, a light conducting medium **3** is positioned inside the horn-type antenna **4**. The ends of the light conducting material are terminated at the antenna aperture and are coated with photoconductive material at **5** and **6**. The light conducting element **3** may, for example, be a thermosetting polyester such as polymerized methyl methacrylate which is available under the trade names Plexiglas or Lucite. The exciting light is introduced into the light conducting material at the aperture **7** in the antenna **4**. The light may be from any suitable source such as that shown diagrammatically at **8**. The light may be of variable intensity, as depicted by the potentiometer **9**, so that the conductivity of the illuminated photoconductive material can be selectively varied. The direction of the incident light can also be changed as illustrated diagrammatically by the movable mirror **10** so that the photoconductive material can be selectively scanned with a beam of light. In the embodiment shown in FIGURE 2, automatic scanning is accomplished by illuminating progressively various portions of the aperture. The rate of scan is dependent upon the rise and decay times of the photoconductor. The light source **8** is not restricted to a source in the visible spectrum but includes excitation sources in other regions of the electromagnetic spectrum. The choice of such excitation source would be determined by the properties of the photoconductor as to what frequency is required to excite it to its conductive state. The same excitation method may be used to vary antenna beam shape by varying the thickness of the photoconductor and/or illuminating portions of the photoconductor.

While a preferred embodiment of the invention has been shown and described, it will, of course, be understood that various other changes may be made without departing from the principles of the invention. The appended

claims are, therefore, intended to cover any such modifications within the true spirit and scope of the invention.

What we claim as new and desire to secure by Letters Patent of the United States is:

1. A system for selectively altering the beam pattern of a beam of radio frequency energy emanating from the aperture of a horn antenna comprising:

a sheet of photoconductive material positioned over at least a portion of said aperture;

a body of light conducting material positioned in said antenna and terminating at said aperture;

said sheet of photoconductive material being located contiguous to said light conducting material so that light conducted through said light conducting material illuminates said sheet of photoconductive material;

a source of visible light;

means for introducing light from said source into said light conducting material so that light conducted through said material illuminates said sheet of photoconductive material; and

light beam scanning means adapted to repetitively illuminate different portions of said sheet of photoconductive material with light from said source.

2. A system in accordance with claim 1 wherein said source of visible light is of variable intensity.

3. A system in accordance with claim 1 wherein said photoconductive material comprises sintered cadmium sulfide doped with copper chloride and cadmium sulfide.

4. A system in accordance with claim 3 wherein said light conducting material comprises a thermo-setting polyester and said photoconductive material is deposited upon said thermo-setting polyester.

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DAVID G. REDINBAUGH, *Primary Examiner.*

CHESTER L. JUSTUS, *Examiner.*