This invention is a corrugated horn antenna in which the corrugated surfaces of the antenna are formed by V-shaped slots. The depth of the slots is between 0.3125 and 0.625 wavelengths. For this range of depths the surface impedance is capacitive and operates in a cut-off mode. The V-shaped corrugated slots are more easily machined than previous slots and the resulting antenna is readily adaptable to unfurlable antennas for space applications.
The invention described herein was made in the performance of work under a NASA contract and is subject to the provisions of Section 365 of the National Aeronautics and Space Act of 1958, Public Law 85-568 (72 Stat. 435; 42 USC 2457).

BACKGROUND OF THE INVENTION

The invention relates generally to antennas and more specifically concerns corrugated horn antennas.

The corrugated horn has been established as an antenna with low side and back lobes, a rotationally symmetric radiation pattern and broad band performance. These properties make the corrugated horn particularly useful for low noise applications such as feed horns for reflectors and radiometer antennas. The most common corrugations used in these horns are rectangular in shape such as disclosed in U.S. Pat. No. 3,631,502. The disadvantages of the rectangular shape are that it is not readily adaptable to unfurlable antennas for space applications and it is not easily machined particularly in the millimeter frequency bands where most machining processes would destroy the previous tooth as the next gap is being cut.

It is therefore the primary purpose of this invention to provide a corrugated horn antenna with the corrugations having a shape that has the advantages of the rectangular shape and at the same time eliminates the disadvantages mentioned above.

SUMMARY OF THE INVENTION

The invention is a corrugated horn antenna with the corrugations being V-shaped and the depth of the corrugations being between 0.3125 and 0.625 wavelengths. For this range of depths the corrugated surface impedance is capacitive and operates in a cut-off mode. The density of the corrugations is of the order of ten per wavelength. For the range of depths between zero and 0.3125 wavelengths the corrugated surface impedance is inductive.

BRIEF DESCRIPTION OF THE DRAWINGS

FIG. 1 is a perspective view of a horn antenna utilizing the V-shaped corrugated surface of the present invention;

FIG. 2 is a plan view of a V-shaped corrugated surface;

FIG. 3 is a side view of a V-shaped corrugated surface;

FIG. 4 is a typical E-plane radiation pattern of a horn antenna with V-shaped corrugated surfaces; and

FIG. 5 is a gain comparison of corrugated horn antennas using rectangular and V-shaped corrugations.

DETAILED DESCRIPTION OF THE INVENTION

Turning now to the embodiment of the invention selected for illustration in the drawings, the number 11 in FIG. 1 designates a horn antenna utilizing V-shaped corrugated surfaces 12 and 13 that constitute the invention. In a conventional horn antenna the portion of the energy directly radiated from the horn throat and not diffracted by the edges of the horn results in the desired radiation pattern. However, the energy that is diffracted by the edges of the horn results in unwanted backlobes and sidelobes. The purpose of corrugated surfaces 12 and 13 is to electrically modify the surfaces of the horn to reduce the edge diffraction and reduce unwanted backlobes and sidelobes, by orders of magnitude. The density of the corrugations in surfaces 12 and 13 is of the order of ten per wavelength and the depth of the corrugations is between 0.3125 and 0.625 wavelengths. For this range of depths the corrugated surface impedance is capacitive and operates in a cut-off mode. The depths of the corrugations can alternatively be between zero and 0.3125 wavelengths. For this range of depths the corrugated surface impedance is inductive and has many important applications in the area of surface wave antennas.

Surface 12, identical to surface 13, was designed for C-band operation is shown in more detail in FIGS. 2 and 3. A tab 14 which is part of the throat of the antenna makes an angle of 18.05° with the surface 12. This angle can be different; it is merely the angle used to construct one embodiment of the invention. For this angle the E-plane flare angle is 36.1°. The surface 12 is made up of V-shaped corrugations 15. The density of these corrugations is of the order of 10 per wavelength. Small changes in density of these corrugations has little effect on the operation of the antenna. The depth of the corrugations 15 is in the range of between 0.3125 and 0.625 wavelengths if the surface is to be capacitive and in the range of between zero and 0.3125 wavelengths if the impedance of the surface is to be inductive. The side of surface 12 is shown to make an angle of 15.79° with the centerline of the surface; however, this angle can be different without departing from the invention. For this angle the H-plane flare angle is 31.58°.

FIG. 4 shows a typical E-plane radiation pattern of a horn antenna with V-shaped corrugations. FIG. 5 shows a gain comparison of corrugated horn antennas using rectangular and V-shaped corrugation. It should be noted that the gains are almost identical between the frequencies of 4.5 GHz and 5.5 GHz.

The advantages of this invention are that it operates as well as previous corrugated surfaces used in horn antennas and at the same time it is readily adaptable to unfurlable antennas for space applications and it is more easily machined.

What is claimed as new and desired to be secured by Letters Patent of the U.S. is:

1. A horn antenna for directing electromagnetic energy in a given direction wherein energy diffracted from certain of the edges of the surfaces of said antenna is reduced, the improvement comprising means for controlling the illumination of said edges, said means including machined V-shaped corrugated slots formed in said surfaces, the density of said slots being of the order of ten per wavelength and the depth of the slots being between 0.3125 and 0.625 of the operating wavelength.

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