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LIQUID TRAP FOR VERTICALLY MOUNTED HORN ANTENNA

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Fig. 1.

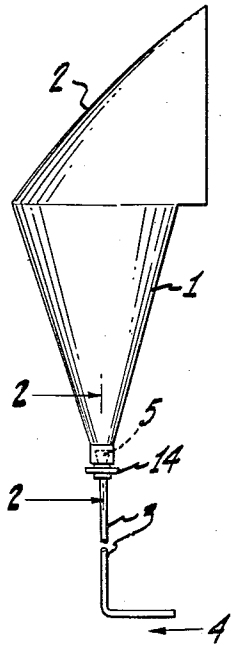
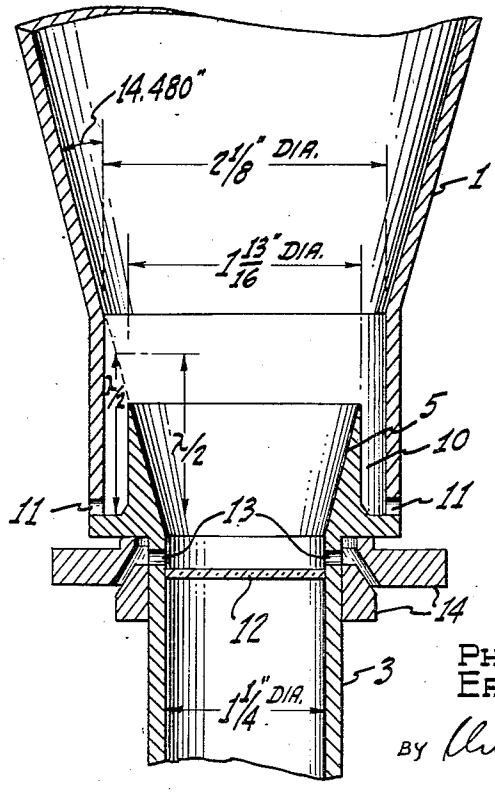


Fig. 2.



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LIQUID TRAP FOR VERTICALLY MOUNTED HORN ANTENNA

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5 Claims. (Cl. 343—786)

The present invention relates to hollow waveguide horns adapted to be mounted vertically, and particularly to a horn reflector antenna comprising a pyramidal horn or cone radiating into a cut paraboloid whose focus coincides with the apex of the horn.

In the utilization of electromagnetic antenna-type horns. such horns are often located out of doors and, therefore, are subject to all weather conditions. Under various weather conditions to which the horns are subjected, moisture will condense on the inner surfaces of the horn. This moisture which will collect in the lower portions of the horn serves to disrupt and distort the transmission of energy thru the horn and may damage the operative members of the apparatus included therein. This is especially the case where a vertically mounted horn reflector antenna having a pyramidal horn or circular cone radiates into a cut paraboloid, a waveguide being connected to the horn or throat of the cone. When such an antenna is mounted at the top of a tower with the apex of the horn or cone down, it is important to prevent moisture condensed on the inner surface of the cone or horn from rolling down onto the pressure seal in the waveguide.

It is an object of the invention to provide novel protection for horn reflector antennas of the above-described character, as well as the apparatus contained therein, against moisture condensation.

It is a further object of the invention to provide such protection for horn reflector antennas without impairing the efficiency of transmission or reception of the horns.

A still further object is to attain the foregoing objects with a simple and compact construction.

In accomplishing these objects, use is made of a groove positioned between the outer wall or walls of a horn or cone and the mouth of a waveguide feed which extends into the horn or cone for a limited distance. Any moisture condensing on the inner surface of the wall or walls of the horn or cone will roll into the groove and not into the waveguide or onto apparatus contained therein. The depth and width of the groove are chosen to prevent it from causing undesired electric reflections, the actual dimensions of the groove being determined by the size of the horn or cone and waveguide feed that is to be used. The dimensions of the groove will be such that the groove will not act as a discontinuity in the waveguide system. Holes drilled from the groove thru to the outside allow the water to run out of the groove and, therefore out from the horn assembly.

A more detailed description of the invention follows with reference to a drawing in which like reference numerals refer to like parts and in which:

Figure 1 is an electromagnetic reflector horn assembly embodying the present invention, and

Figure 2 is an enlarged cross-sectional view of that part of the assembly taken along line 2—2.

In Figure 1 there is shown a conical horn 1. A flat metal sheet is secured to the larger of the two apertured ends. The sheet may be formed in any manner desired.

In the particular embodiment shown a parabolic surface 2 is utilized. A circular waveguide 3, fed by a source of energy 4, not shown, is connected to the smaller apertured end (the throat) of the horn and extends therethru for a limited distance. The end of the waveguide positioned inside the horn may be formed into a conical shape, as shown, or into such shape as may be desired. At the throat of the horn is located a circumferential groove 10 extending along the inner surface of the horn.

The antenna arrangement of the invention is adapted to be mounted on a tower, not shown, with the apex of the horn 1 pointed down as illustrated in Figure 1.

Referring to Figure 2, a plurality of holes 11 are drilled from the bottom end of the groove 10 thru the wall of horn 1 to the outside.

To ensure the protection of the waveguide feed a mica seal 12 is inserted in the guide 3 adjacent to that point where it connects to the horn 1. To prevent the accumulation of water on the seal due to condensation on the inner surfaces of the guide mouth 5 or from drippings in the horn 1, a plurality of holes 13 may be located above and adjacent to the seal. Various means 14 may be used to pass the liquid away from the waveguide thereby preventing it from running down the outer surface of the waveguide into any equipment to which it may be connected.

The antenna assembly is protected from the moisture forming on the inner surfaces thereof. Any moisture formed in the horn 1 will be directed into the groove 10 and thru the holes 11 located at the bottom thereof, and will not flow into the waveguide. Any moisture that will tend to collect on the upper surface of the seal 12 will be directed out of the holes 13.

The actual size of the groove 10 will vary in accordance with the size of the assembly used. It is preferred that the mean depth of the groove be effectively one-half wavelength at the mean operating frequency so that the groove will not act as a discontinuity in the waveguide system. It is to be noted that the depth will be measured between the mid-point of a line drawn across the open end of the groove and the bottom thereof, as shown in Figure 2. The presence of the groove would tend to create distortion of the signal present in the horn due to reflections set up thereby. By proper design of the size of the groove, the presence of such reflections is substantially eliminated and the groove will therefore have negligible or no deleterious effect on the signal being received or transmitted.

In Figure 2 the dimensions of one exemplification of a horn assembly constructed according to the teachings of this invention are shown. The horn reflector antenna shown was built for the band 6575–6875 mc. A circular waveguide one and one-quarter inches in diameter was inserted into and secured to the throat of a conical horn, the throat of the horn being two and one-eighth (2⅛) inches in diameter. The mouth of the waveguide was formed into a conical shape having an opening one and thirteen-sixteenths ($1\frac{13}{16}$) inches in diameter. The angle of the wall of the horn was placed at fourteen and forty-eight one hundredths degrees from the longitudinal axis of the horn.

Electrical measurements were made on the water trap for two different groove widths and a range of depths to determine dimensions for a groove which would not cause excessive electric reflections. For a groove width of five thirty-seconds ($\frac{5}{32}$) inch, depths ranging from sixty-eight hundredths of an inch to eighty-six hundredths of an inch gave four percent (4%) or less voltage reflection at 6700 mc. A groove width of five thirty-seconds ($\frac{5}{32}$) of an inch is about the minimum that will catch water. The reflection coefficient was four (4) percent or less for a total depth variation of twenty-three (23)

percent of the optimum depth, giving a bandwidth of about twenty-three (23) percent.

What is claimed is:

1. An electromagnetic horn antenna adapted for vertical mounting having a small end and a larger open end, means including a waveguide for transmitting energy to or receiving energy from said horn, the mouth of said waveguide extending into said horn and secured to said small end of said horn, to provide a groove between the wall of said horn and said waveguide mouth, the distance which said waveguide extends into said horn being such as to minimize signal reflections caused by the presence of said groove, and means for draining said groove to keep it free of liquid.

2. An electromagnetic horn antenna adapted for vertical mounting having a small end and a larger open end, a circular waveguide having a mouth extending into and secured to said small end of said horn, a circumferential groove interposed between the wall of said horn and said waveguide mouth, said groove having approximately an effective one-half wavelength average depth at the mean operating frequency of said antenna, the wall of said horn having a plurality of holes therethrough opening into said groove whereby said groove is drained of any liquid therein.

3. An electromagnetic horn antenna adapted for vertical mounting having a small end and a larger open end, a circular waveguide having a mouth extending into and secured to said small end of said horn, a circumferential groove interposed between the wall of said horn and said waveguide mouth, said groove having approximately an effective one-half wavelength average depth at the mean operating frequency of said antenna, means for draining said groove to keep it free of liquid, a seal positioned in said waveguide a given distance from said waveguide mouth, and means including a plurality of holes spaced circumferentially about said waveguide for draining any liquid from the upper surface of said seal.

4. An electromagnetic horn antenna assembly adapted to be mounted vertically comprising in combination a circular cone the apex of which is adapted to be pointed down, said cone having positioned at the large open end thereof a metal sheet formed into a parabolic surfaced square horn, a circular waveguide positioned along the longitudinal axis of said horn assembly, the mouth of said waveguide extending thru and secured to the base section of the throat of said circular cone, a circumferential groove interposed between the wall of said throat and said waveguide mouth, said groove having an effective one-half wavelength average depth at the mean operating frequency of the assembly, and means for draining said groove to keep it free of liquid.

5. An electromagnetic horn antenna assembly adapted to be mounted vertically comprising in combination a circular cone the apex of which is adapted to be pointed down, said cone having positioned at the large open end thereof a metal sheet formed into a parabolic surfaced square horn, a circular waveguide positioned along the longitudinal axis of said horn assembly, the mouth of said waveguide extending thru and secured to the base section of the throat of said circular cone, said mouth being conical in shape, a circumferential groove interposed between the wall of said throat and said waveguide mouth, said groove having an effective one-half wavelength average depth at the mean operating frequency of the assembly, means for draining said groove to keep it free of liquid, a seal positioned in said waveguide a given distance from said waveguide mouth, and means including a plurality of holes spaced circumferentially about said waveguide for draining any liquid from the upper surface of said seal.

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