# United States Patent [19]

**Hansen et al.**

[11] **3,924,205**

[45] **Dec. 2, 1975**


[54] **CROSS-POLARIZED PARABOLIC ANTENNA**


[75] Inventors: **Laurence H. Hansen,** Oak Lawn; **Robert E. Massey,** Oak Forest; **Aloysius Wojnowski,** Worth, all of Ill.

[73] Assignee: **Andrew Corporation,** Orland Park, Ill.



[22] Filed: **Sept. 3, 1974**

[21] Appl. No.: **502,528**

**Related U.S. Application Data**

[60] Division of Ser. No. 454,814, March 26, 1974, Pat. No. 3,864,688, which is a continuation of Ser. No. 331,172, Feb. 9, 1973, abandoned, which is a continuation of Ser. No. 237,727, March 24, 1972, abandoned.

[52] **U.S. Cl.** ..... **333/21 A;** 333/9; 333/21 A; 333/98 R

[51] **Int. Cl.²** ..... **H01P 1/16;** H01P 5/12

[58] **Field of Search** ..... 333/1, 6, 9, 21 R, 21 A, 333/73 W, 31 A, 98 R; 343/756, 786



[56] **References Cited**

UNITED STATES PATENTS

| | | | |
|---|---|---|---|
| 2,591,258 | 4/1952 | Hershberger | 333/73 W X |
| 2,606,248 | 8/1952 | Dicke | 333/21 A X |
| 2,735,092 | 2/1956 | Brown, Jr. | 333/6 X |
| 2,975,380 | 3/1961 | Scharfman | 333/98 X |
| 3,287,729 | 11/1966 | Mark et al. | 343/756 |
| 3,668,567 | 6/1972 | Rosen | 333/21 A |



*Primary Examiner*—James W. Lawrence
*Assistant Examiner*—Marvin Nussbaum
*Attorney, Agent, or Firm*—Wolfe, Hubbard, Leydig, Voit & Osann, Ltd.



[57] **ABSTRACT**

A cross-polarized parabolic antenna employs a horn fed by two rectangular waveguides having their longer transverse dimension in a common plane, with a 90° polarization rotator in the feed between the connection points of the waveguide.


**5 Claims, 6 Drawing Figures**

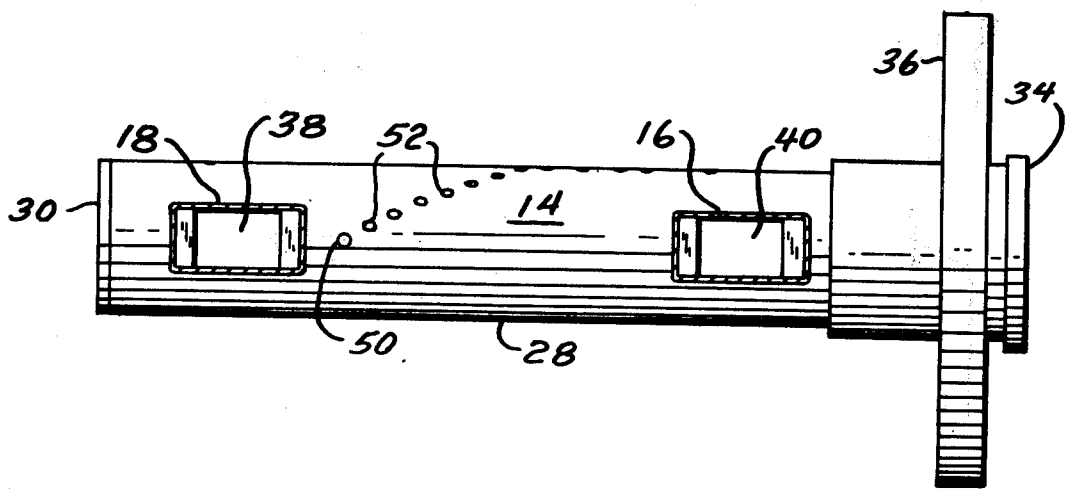
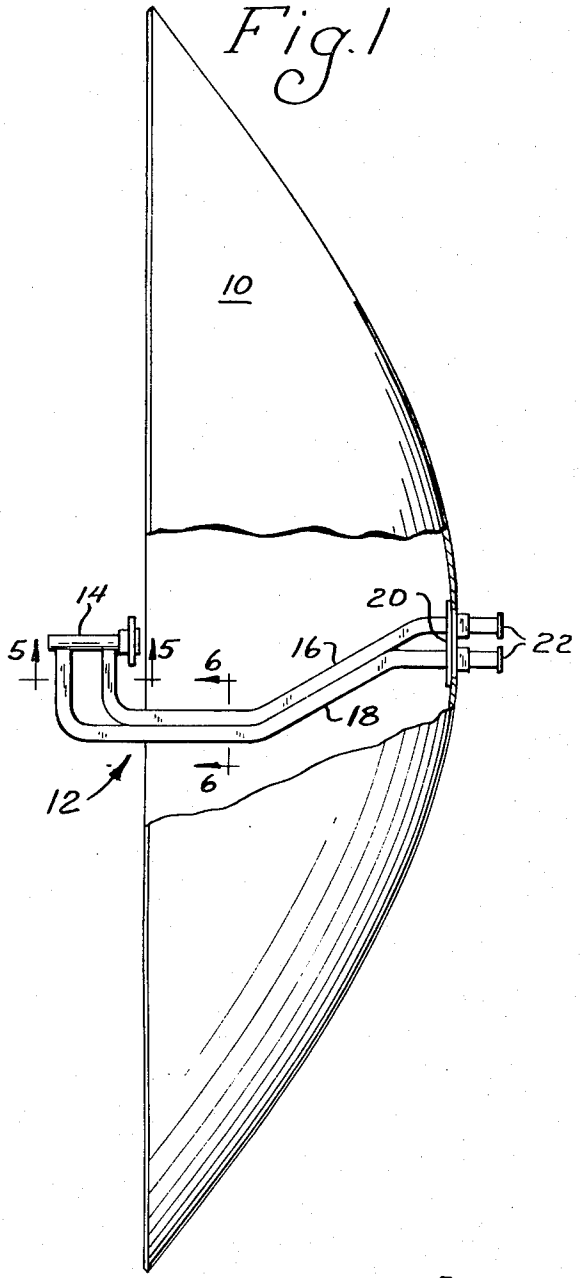


Fig. 1



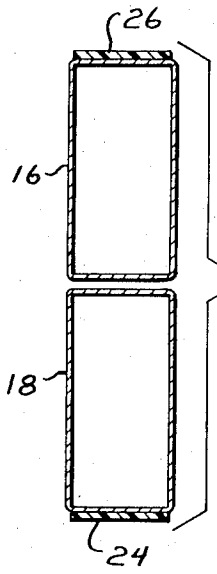
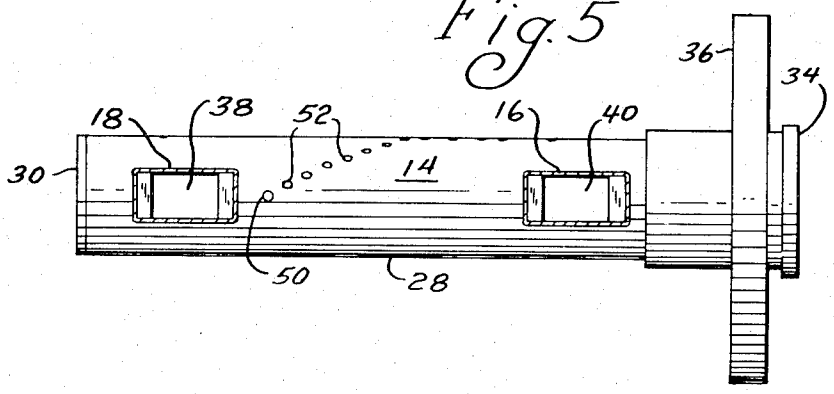




Fig. 6

Fig. 5



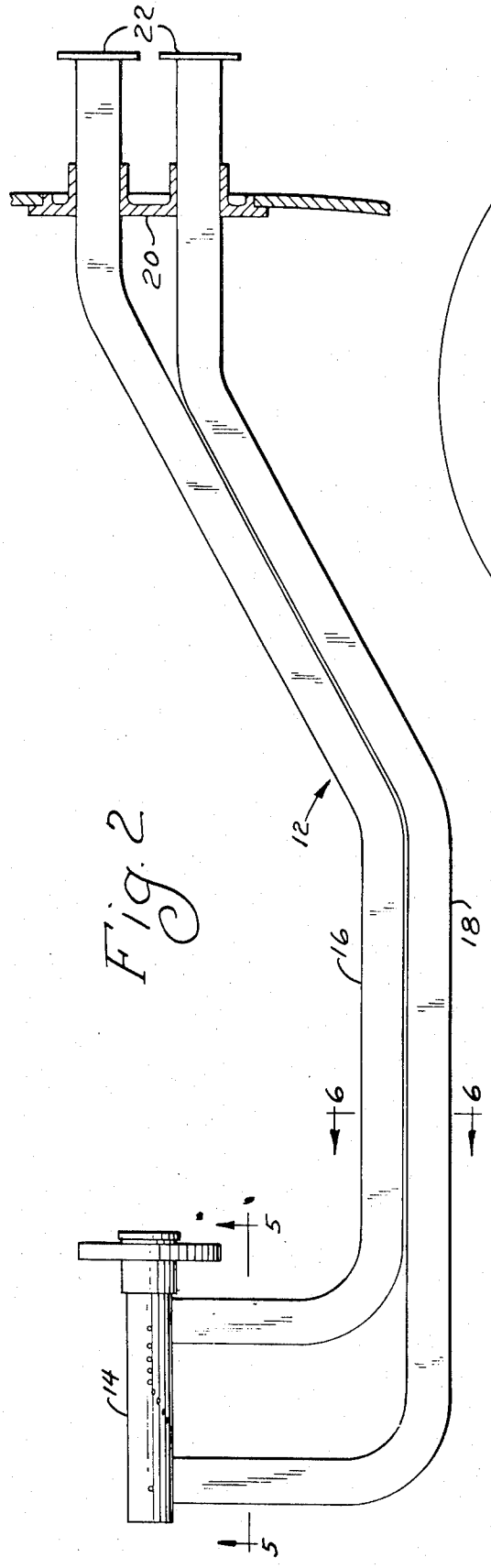



Fig. 2

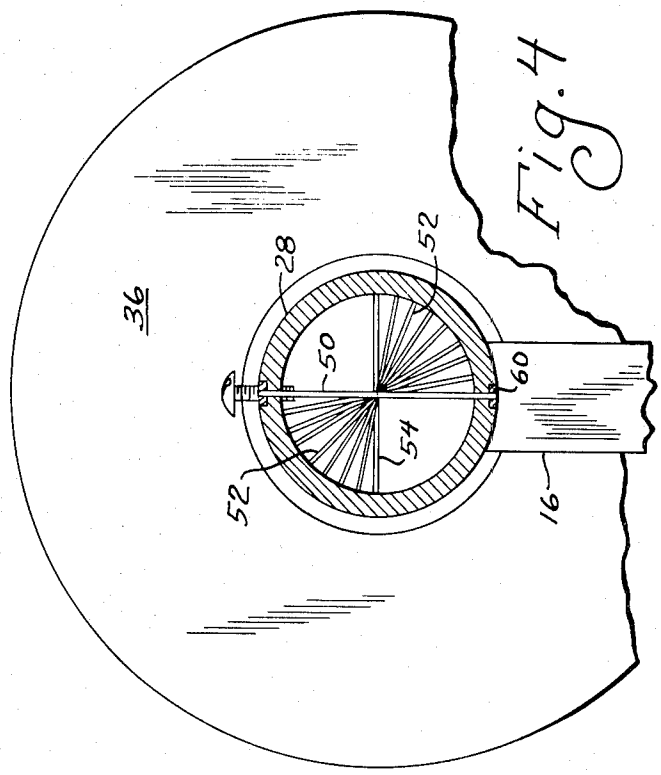



Fig. 4

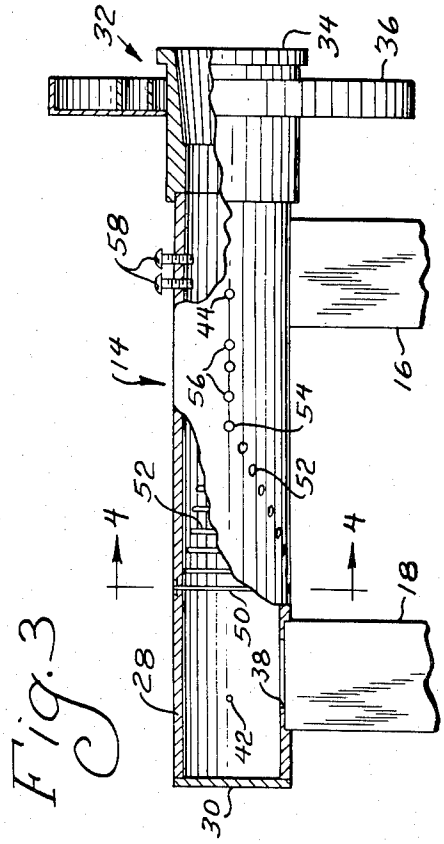



Fig. 3

# CROSS-POLARIZED PARABOLIC ANTENNA

This is a divisional of application SER. No. **454,814,** filed Mar. **26, 1974,** now U.S. Pat No. **3,864,688,** which is a continuation of application Ser. No. **331,172,** filed Feb. **9, 1973,** now abandoned, which in turn is a continuation of application Ser. No. **237,727,** filed Mar. **24, 1972,** now abandoned.

This invention relates to dual-polarized parabolic antennas, and more specifically to cross-polarized feed assemblies for such antennas.

Rectangular waveguide bent in the so-called "button-hook" configuration is commonly employed in connection with feed-horns of parabolic reflector antennas. For dual or crosspolarized antennas, two waveguides are employed, and various modified forms of the button/hook configuration have been employed for the two waveguides.

The present invention lies in an improved construction for the feed assembly of such an antenna. A typical prior construction for such a feed assembly is shown in U.S. Pat. No. **3,599,219.** The present invention constitutes an improvement on such a construction as there shown in respects including improvement of the radiation pattern and VSWR and reduction of the forward extension of the feed assembly from the plane of the front edge of the reflector dish.

In the present invention, as in the patent just mentioned, two rectangular waveguides are used with a horn feed, each of the waveguides being employed for one of the two linearly polarized signals. In the present invention, however, unlike past constructions, the longer transverse dimensions of both rectangular waveguides are in a common plane, rather than orthogonal planes, throughout the entire length of the wavequides. Both waveguides, at their points of connection to the feed, have the same direction overall polarization for the fundamental mode. Within the feed, between the spaced points of connection of the guides, is a **90°** polarization rotator which produces orthogonality of the radiations of the respective waveguide signals appearing at the mouth. Both of the waveguides have their ends extending radially from the feed at the points of connection to minimize the forward extension of the feed assembly.

There is found to be achieved both a substantial reduction of pattern distortion due to aperture blockage and an appreciable improvement in VSWR, as well as reduction of the size of the overall feed assembly in the axial direction. The latter greatly reduces the required bulk of a radome while at the same time adding to the rigidity of the overall structure as well as reducing the required length and simplifying the fabrication of the waveguide portion of the assembly.

Although the novel construction for producing cross-polarized radiations which is provided by the invention is of greatest advantage in antenna-feed construction, wherein the cross-polarized signals are produced close to the mouth of the feed and released for unguided propagation after traversing only a negligible length of guide, it will be obvious to those skilled in the art that the transition construction may also be advantageously employed in producing cross-polarized signals for guided propagation through greater lengths of waveguide. (It will be understood that the specific discussion herein of only one direction of propagation is reciprocally applicable to the opposite direction.)



The invention, in implementing the general aspects described, incorporates further features of novelty best understood by reference to the embodiment illustrated in the drawing, in which:

FIG. **1** is a view in side elevation of a parabolic reflector antenna and its feed assembly, the former partially broken away in section;

FIG. **2** is an enlarged view of the feed assembly shown in FIG. **1**;

FIG. **3** is a further enlarged elevational view, partially in section, of the feed portion of the assembly;

FIG. **4** is an enlarged sectional view along the lines **4—4** of FIG. **3** in the direction indicated by arrows;

FIG. **5** is a sectional view along the line **5—5** of FIGS. **1** and **2** in the direction indicated by arrows; and

FIG. **6** is an enlarged sectional view along the line **6—6** of FIGS. **1** and **2** in the direction indicated by arrows.

The antenna of FIG. **1** consists of a parabolic reflector or dish **10** with its feed assembly **12** consisting of a feed **14** having its mouth or radiating portion effectively at the parabolic focus and a pair of waveguides **16** and **18** mounting and supporting the feed **14** as well as serving for transmission of the respective signals thereby carried. Guy wires which may be employed for stabilization of the portion of the feed, as is conventional in large dish antennas, are omitted from the drawing.

The guides **16** and **18** extend through a center plate **20** at their inner end and terminate in coupling flanges **22.** The guides **16** and **18** are formed with bends generally similar to conventional button-hook shaping, but with the outer or forward end of both being wholly radial at the respective points of connection to the feed. Both of the rectangular guides have their long dimension, the H-plane dimension, aligned in a common radial plane throughout their length, so that the aperture blockage produced by the two waveguides is substantially that of a single waveguide. All bends in both guides are in the H-plane; the effect of the bends on VSWR is thus minimized. The guides are closely adjacent to each other in the relatively long median portion of their length and one short side of each waveguide, the outer, is covered with absorber **24** and **26,** respectively, in an overall manner resembling a single waveguide.

The feed **14** has a body **28** in the form of a circular tube closed by a shorting cap **30** at the outer end (the end farthest from the reflector) and having a radiating horn assembly **32** at the inner end. The circularly cylindrical horn or mouth **34** has a set-back surrounding choke and reflector **36** of the type described in U.S. Pat. No. **3,553,707** for uniformity of illumination of the large-aperture reflector **10.**

The rectangular guides **16** and **18** are coupled to the circularly cylindrical feed **14** through laterally constricted apertures **38** and **40** in opposite end portions of the wall of the tube body **28,** the constriction producing the required impedance transformation in the coupling from the rectangular guide to the circular feed.

The waveguide transmission is of course in the dominant mode, with linear polarization across the short or E-plane dimension, so that the direction of polarization of the signal from both waveguides **16** and **18** is in the same direction (perpendicular to the drawing of FIG. **3**) at the points of connection to the feed **14.** In each

case a pin or rod **42** and **44**, respectively, extending diametrically across the tube in the direction of the electric field, directs the propagation inward (note that radiation from the feed in the direction to illuminate the dish is herein designated as inward).

In the central longitudinal region of the feed, between the waveguide couplings, is a series of closely spaced diametric conducting pins. As seen in FIGS. **3** and **4**, the pin **50** inwardly adjacent to the waveguide **18** is orthogonal to the polarization direction in that waveguide. The succeeding pins **52** are longitudinally spaced at intervals small compared to the diameter, and thus very small compared to a wavelength, and extend across the tube at successive small progressive angles, this series terminating in a pin **54** parallel with the pins **42** and **44**, i.e., in the direction of waveguide electric-field polarization. Further pins **56** are parallel with pin **54**. There is thus formed a polarization rotator which twists the plane of polarization of the signal of the waveguide **18** by **90°**, the pins **56** stabilizing the rotated polarization direction of the signal for transmission of the mouth of the feed while at the same time aiding the effectiveness of the pins **44** in blocking propagation of the signal of the waveguide **16** in the undesired outward direction, thus minimizing cross-talk between the signals. Tuning screws **58** are provided for optimization of performance.

Although the employment of closely longitudinally spaced pins, secured by solder **60**, is a simple and convenient manner of forming the rotator, the overall action is that of a twisted conducting baffle extending diametrically across the tube, with the pins **56** constituting in essence a planar extension. Thus a continuous conductor in the form of a foil or vane be employed if desired, as may other forms of polarization rotator, although less advantageously.

In the antenna feed described, the cross-polarized radiation is thus produced closely adjacent to the flared horn or mouth **34** and propagates through only the very short length of the waveguide feed which couples to the flare. However it will be readily seen that the same transition or coupling between the two rectangular guides and a circular guide may advantageously be used wherever it is desired to feed cross-polarized radiations to a circular guide with improved VSWR as compared with prior art transitions for the purpose, particularly in installations where the co-planar orientation of the rectangular guides at the juncture with the circular guide which characterizes the present invention enables use of H-plane bends throughout the runs of the rectangular guides.

Many other detailed forms of the invention will readily be devised by persons skilled in the art. Accordingly, the scope of the protection to be afforded the invention should be determined only in terms of the structures defined in the annexed claims, and equivalents thereof.

What is claimed is:

**1.** In a waveguide system for propagating crosspolarized high-frequency radiation comprising a circular waveguide and a pair of rectangular waveguides connected thereto and extending radially therefrom, means for supplying a first linearly polarized high frequency radiation signal to one of the rectangular waveguides, and means for supplying a second linearly polarized high frequency radiation signal to the other rectangular waveguide, the first and second signals being polarized in the same direction, the improvement characterized by the longer transverse H-plane dimension of both rectangular waveguides being aligned in a common plane at their points of connection to the circular waveguide, the circular waveguide having therein a **90°** polarization rotator between the points of connection thereto of the respective rectangular waveguides for producing orthogonality of the first and second signals supplied to the circular waveguide through the rectangular waveguides, said polarization rotator comprising stationary passive conductor means.

**2.** The waveguide system of claim **1** characterized by the polarization rotator comprising conductor means between the rectangular waveguide connections extending diametrically across the circular waveguide and forming a **90°** twisted baffle with one end in said common plane and the other end perpendicular thereto.

**3.** The waveguide system of claim **2** wherein the conductor means comprises a series of closely spaced pins extending across successively slightly rotated diameters.

**4.** The waveguide system of claim **2** having added conductor means forming a planar extension of one of said ends to form an isolation section blocking undesired propagation from the rectangular waveguide at that end into the rotator.

**5.** The waveguide system of claim **1** wherein the rectangular waveguides have generally parallel bent runs throughout their length, all bends being in the common H-plane, the rectangular waveguides extending radially from the circular waveguide.

* * * * *