343-755 CROSS REFERENCE SEARCH ROOM

Sept. 27, 1960 R. F. H. YANG 2,954,556

CROSS POLARIZED DUAL FEED

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Fig. 1.

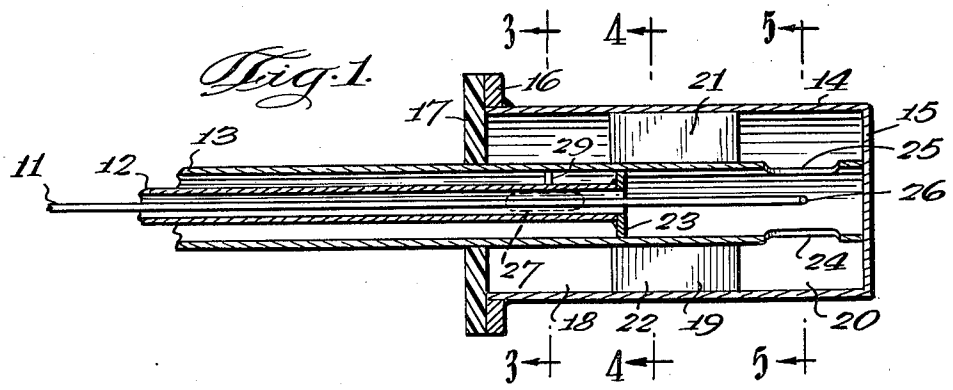


Fig. 2.

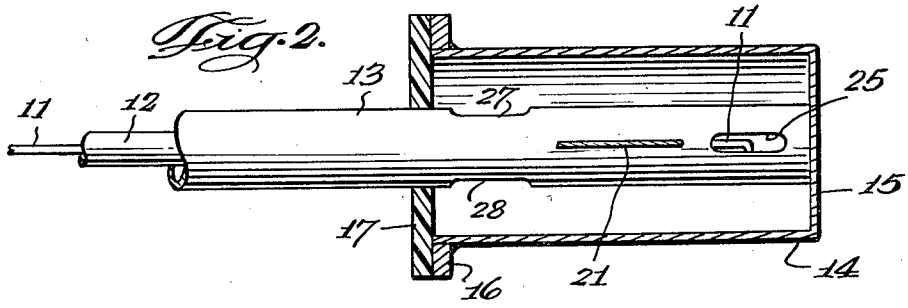
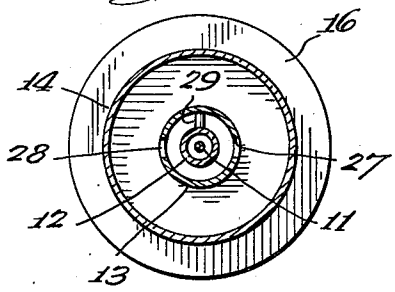


Fig. 3.



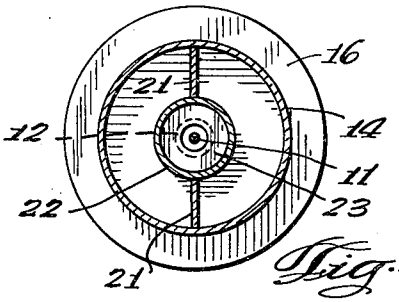


Fig. 4.

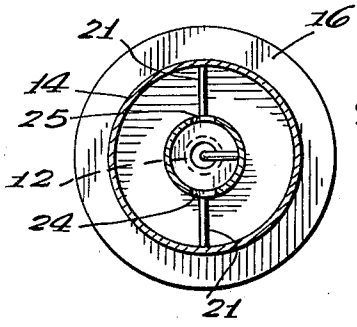


Fig. 5.

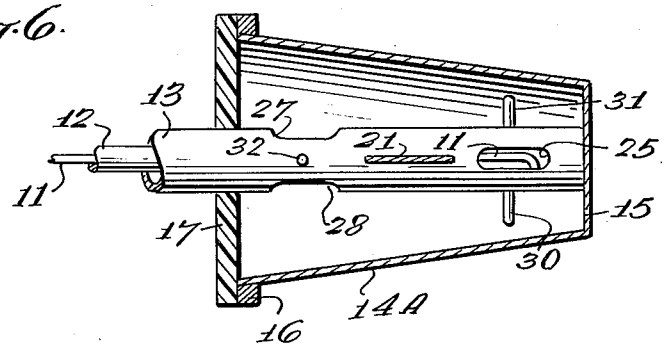
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Fig. 6.



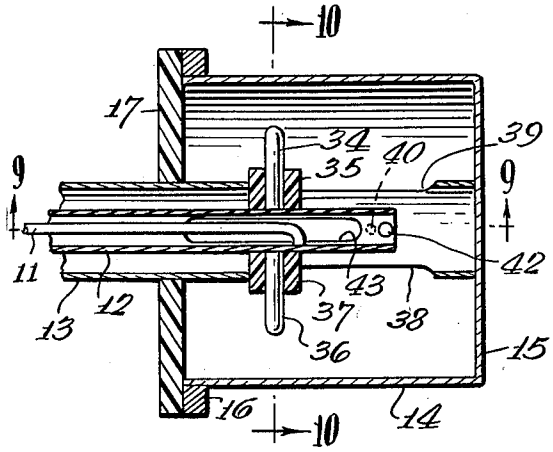
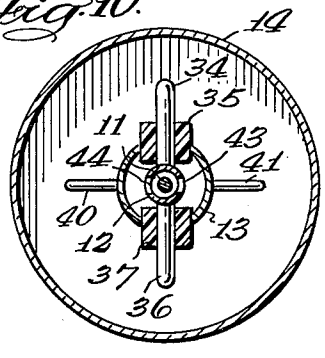
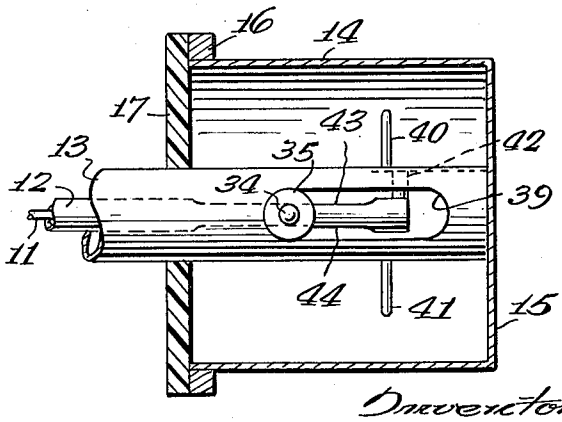


Fig. 8.

Fig. 9.

Fig. 10.





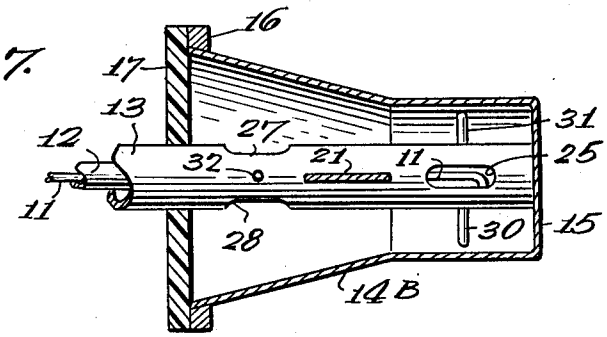
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Fig. 7.



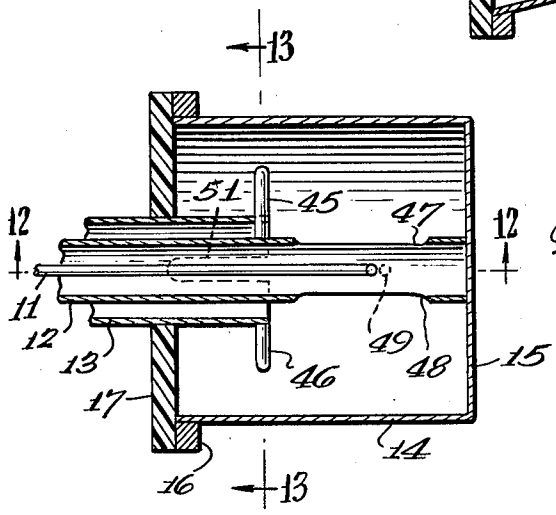
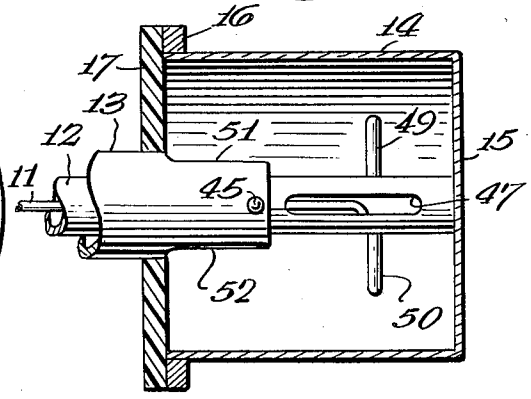


Fig. 11.

Fig. 12.



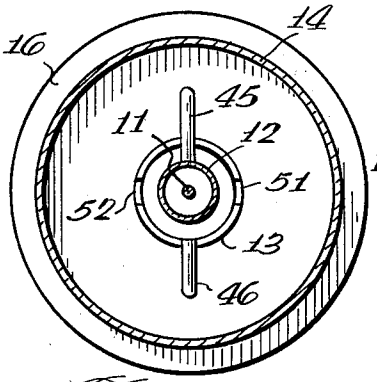


Fig. 13.

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2,954,556

CROSS POLARIZED DUAL FEED

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19 Claims. (Cl. 343—727)

The present invention relates to a cross polarized dual feed for antennas, and more particularly for a parabolic reflector or lens antenna.

In the utilization of parabolic reflector or lens antennas, it sometimes would be desirable to use the antenna for simultaneous reception and transmission or for transmission at two different frequencies. This can be accomplished in accordance with the present invention by a cross polarized dual feed.

It, therefore, is an object of the present invention to provide means whereby a parabolic reflector or lens antenna may be used simultaneously for transmission and reception.

Another object of the invention is to provide an arrangement whereby a parabolic reflector or lens antenna may be operated simultaneously at the same or two different frequencies.

A further object is to provide an antenna feed means which are cross polarized.

Still another object of the invention is to provide a dual antenna feed connected to a triaxial feed line.

Other and further objects of the invention subsequently will become apparent by reference to the following description taken in conjunction with the accompanying drawings, wherein:

Figure 1 is a longitudinal cross-sectional view of the device comprising the present invention;

Figure 2 is a partial longitudinal cross-sectional view normal to the view of Figure 1;

Figure 3 is a transverse cross-sectional view as seen in the direction of the arrows along the line 3—3 of Figure 1;

Figure 4 is a transverse cross-sectional view as seen in the direction of the arrows along the line 4—4 of Figure 1;

Figure 5 is a transverse cross-sectional view as seen in the direction of the arrows along the line 5—5 of Figure 1;

Figures 6 and 7 are longitudinal cross-sectional views of modifications of the present invention, to which dipole members have been applied;

Figure 8 is a longitudinal cross-sectional view of a further modification of the present invention;

Figure 9 is a longitudinal cross-sectional view taken at 90° from the view shown in Figure 8;

Figure 10 is a transverse cross-sectional view of the device in Figure 8 as seen in the direction of the arrows along the line 10—10;

Figure 11 is another longitudinal cross-sectional view of a further modification of the present invention;

Figure 12 is a longitudinal cross-sectional view taken at 90° from the view shown in Figure 11; and

Figure 13 is a transverse cross-sectional view as seen in the direction of the arrows along the line 13—13 of Figure 11.

The present invention shown in the drawings comprises a cross polarized dual feed, which is shown connected to a triaxial feed line having an inner conductor 11, an intermediate conductor 12 and an outer conductor 13.

The cross polarized dual feed comprises a surface of revolution member 14 having an end 15 connected to the end of the outer conductor 13. The cylindrical cavity member 14 adjacent to its open end is provided with a support flange 16 for carrying a closure member 17, which preferably is of insulating material which is transparent to the radiant energy to be directed to the left of Figure 1 to the parabolic or lens antenna. The member 17 therefore is at or adjacent to the focal point of the parabolic antenna.

The cavity member 14 is divided into three sections, an anterior section 18, an intermediate section 19 and a posterior section 20. The intermediate section 19 serves as an isolation section and has two fins 21 and 22 extending along a diameter between the outer conductor 13 and the inner surface of the cylindrical member or cavity 14. The intermediate conductor is connected by an annular ring 23 to the inner surface of the outer conductor 13 in the proximity of the intermediate cavity section 19.

The postior portion or section of the cavity 20 has the outer conductor 13 provided with two diametrically arranged tuned slots 24 and 25. The inner conductor 11 at the midpoint of the slots 24 and 25, and in a direction normal to the plane of these slots, is connected at 26 to the inner surface of the outer conductor 13.

The anterior section 18 is provided with two slots 27 and 28 in the outer conductor 13 normal to the plane of the slots 24 and 25 in the posterior section 20. The intermediate conductor 12 is connected by a conductor 29 to the outer conductor 13 at the longitudinal middle of the slots 27 in a plane perpendicular thereto. If desired, the anterior and posterior sections 18 and 20 of the cavity 14 may be tuned to different frequencies to provide for the simultaneous transmission on two frequencies, or they may be tuned to transmitting and receiving frequencies which in some instances may be the identical frequency. For impedance matching the slots 25, 26, 27 and 28 may be loaded by dipoles located 90° from the slots as seen in the transverse cross-sectional plane through the slots. The lengths of such dipoles and the longitudinal positions vary in accordance with the impedance matching to be accomplished.

While the intermediate section 19 has been shown as employing two radial fins 21 and 22 in the same or diametrical plane, these could be replaced by a series of parallel conductors or rods. The intermediate section 19, therefore, isolates the posterior and anterior sections, which in turn are polarized 90° apart. This arrangement, therefore, provides a minimum of coupling between these section and thereby minimizes cross talk.

In connection with the arrangement illustrated in Figures 1 to 5 it has been stated that the impedance matching slots 25, 26, 27 and 28 may be loaded by dipoles located 90° from the slots as seen in the transverse cross-sectional plane through the slots. Such an arrangement is illustrated in Figures 6 and 7 showing dipole members 30, 31, 32 and 33. While there may be some preference to providing a surface of revolution which is cylindrical as the member 14 in Figures 1 through 5, other considerations may require surfaces of revolution which might be conical, such as the surface 14A of Figure 6, or a combination of a conical section and a cylindrical section, such as 14B of Figure 7. These merely illustrate that other surfaces of revolution may be employed.

In some instances the length of the device must be shortened as compared to the constructions shown in Figures 1 through 5. While the arrangements in Figures 1 through 5 are believed to be the most desirable and most efficient, other considerations may require the engineering solutions illustrated as further modifications of the present invention. Accordingly, one such modifica-

tion is illustrated in Figures 8, 9 and 10. Therein it will be noted that a pair of dipole members are provided, such as the member **34** with its insulator **35** connected to the intermediate conductor **12** and the corresponding dipole member **36** and its insulator **37** also connected to the intermediate conductor **12**. It will be noted that these dipole members **34** and **36** are located 90° from two slots **43** and **44** in the intermediate conductor **12**. The end of the intermediate conductor **12** is connected through a connector **42** to the inner surface of the outer conductor **13**. The outer conductor is provided with two slots **38** and **39**, and the outer conductor is provided with dipole members **40** and **41** located 90° from these latter slots. Here it will be observed that although there is preserved a longitudinal relative displacement of the radiation couplings for the two polarizations, the spacing is somewhat less than in the previous case, the slots being located in longitudinal positions which are partially overlapping, thus permitting shortening of the structure without producing longitudinal coincidence of the points of maximum field strength.

Still another modification is illustrated in Figures 11, 12 and 13. Therein the outer conductor **13** is provided with two dipole members **45** and **46** located 90° from two slots **51** and **52** which are half slots in the outer conductor **13**, an inward extension of the element **45** serving as a shorting termination between the conductors **12** and **13**. The intermediate conductor **12** is provided with two full slots **47** and **48**, and dipole members **49** and **50** are arranged 90° from the slots **47** and **48**.

These modifications illustrated in Figures 8 through 13 provide an arrangement where a comparatively shorter axial member is required as contrasted with the more elaborate construction of the devices such as shown in Figures 1 through 7.

While for the purpose of illustrating and describing the present invention a particular embodiment has been shown in the drawings, it is to be understood that the invention is not to be limited thereby since such modifications or variations are contemplated as may be commensurate with the spirit and scope of the invention set forth in the accompanying claims.

I claim as my invention:

1. A feed element for parabolic antennas comprising a triaxial feed line connected to a cavity, said cavity having a surface of revolution with an open end facing said antenna and being coaxial with said feed line, said cavity being divided into anterior, intermediate and posterior sections, said intermediate section having diametrical fins extending from the outer conductor of said line to the inner surface of said cavity to form an isolation section, said anterior section having two slots in the outer conductor normal to the plane of said fins and a connection from the intermediate conductor to the outer conductor normal to said slots, said posterior section having two slots in the outer conductor in the plane of said fins and a connection from said inner conductor to said outer conductor normal to said slots.

2. A dual feed element for parabolic antennas comprising a triaxial feed line connected to a cavity having a surface of revolution, said cavity having a closed end with an open end facing said antenna and being coaxial with said feed line, said cavity being divided into anterior, intermediate and posterior sections, said intermediate section having conductive members extending from the outer conductor of said line to the inner surface of said cavity to form an isolation section, said anterior section having two oppositely arranged slots in the outer conductor normal to the plane of said fins and a connection from the intermediate conductor to the outer conductor normal to said slots, said posterior section having two oppositely arranged slots in the outer conductor in the plane of said fins and a connection from said inner conductor to said outer conductor normal to said slots.

3. A dual feed element for parabolic antennas comprising a triaxial feed line connected to a cavity having a surface of revolution, said feed line having an inner, an intermediate, and outer conductors, said cylindrical cavity having an open end facing said antenna and being coaxial with said feed line, said cavity being divided into anterior, intermediate and posterior sections, said intermediate section having conductive members extending from the outer conductor of said line to the inner surface of said cavity and a conductive member extending from the intermediate conductor to the outer conductor, said anterior section having two resonant longitudinal slots in the outer conductor normal to the plane of said fins and a connection from the intermediate conductor to the outer conductor normal to said slots, said posterior section having two resonant longitudinal slots in the outer conductor in the plane of said fins and a connection from said inner conductor to said outer conductor normal to said slots.

4. The combination of claim 1 with a radiant energy transparent cover for the open end of the cavity.

5. A feed element for parabolic antennas comprising a triaxial feed line connected to a cavity, said cavity having a surface of revolution with an electromagnetically open end facing back along the feed line and being coaxial with said feed line, said cavity having anterior and posterior sections, said anterior section having at least two oppositely located partial slots in the outer conductor, said posterior section having two oppositely located slots in the intermediate conductor in a plane normal to the plane of the slots in the outer conductor, the outer conductor terminating forwardly of the slots in the intermediate conductor and a connection from the inner conductor to the intermediate conductor in a plane normal to the slots of said intermediate conductor.

6. A feed element in accordance with claim 5 in combination with a pair of dipole elements connected to said outer conductor normal to the slots therein, and a pair of dipole elements connected to the intermediate conductor normal to the slots therein.

7. A feed element in accordance with claim 1 in combination with a pair of dipole elements for each pair of slots of said outer conductor located in planes normal to said slots and in planes bisecting said slots longitudinally.

8. A feed element for parabolic antennas comprising a triaxial feed line connected to a cavity, said cavity having a surface of revolution with an electromagnetically open end facing back along the feed line and being coaxial with said line, said outer conductor and said intermediate conductor having diametrically opposite longitudinal slots therein at different longitudinal locations and in mutually perpendicular planes, the inner conductor being connected to one of said other conductors normal to the slots therein.

9. A feed element according to claim 8 in combination with dipole elements located normal to the slots in said conductors in planes at the longitudinal centers of said slots.

10. A coupler for cross-polarized microwave transmissions comprising at least one tubular conductor having first and second pairs of longitudinal slots, the members of each pair being diametrically opposed and respective pairs being in mutually perpendicular planes, and means within the conductor to mutually isolate transmissions through the respective pairs of slots, the pairs of slots being longitudinally spaced on the conductor, and each pair of slots having associated therewith a pair of opposed dipole elements extending from the conductor in longitudinal correspondence with the slots and perpendicular to the plane of the slots.

11. A coupler for cross-polarized microwave transmissions comprising a triaxial transmission line having concentric annular transmission paths each having innermost and outermost conductors, a pair of diametrically

opposed longitudinal slots in an end portion of at least one of the outermost conductors to couple transmissions from one of the transmission paths to the exterior and means at the end of the other transmission path to couple transmissions from that path to the exterior in cross-polarized relation to those from the other, the coupling slots of the one transmission path being longitudinally displaced from the coupling means of the other, and means on the exterior, in the region between the coupling slots and the coupling means, to isolate one from the other for one of the polarizations.

12. A coupled assembly for cross-polarized microwave transmissions comprising, in combination, the coupler of claim 11 and a conducting wall surrounding the end thereof, the isolating means comprising conductors connecting the transmission line and the wall in one of the directions of polarization.

13. A dual feed element for parabolic antennas comprising a triaxial transmission line having mutually isolated transmission paths between its intermediate conductor and its inner and outer conductors, respectively, a cavity surrounding the end portion of the transmission line and having an electromagnetically open end facing parallel to the axis of the transmission line, and means on the end portion of the transmission line and within the cavity to couple such transmission paths to the interior of the cavity in cross-polarized relation at longitudinally displaced regions.

14. The dual feed element of claim 13 wherein the means to couple the outer transmission path to the cavity comprises a pair of diametrically opposed longitudinal slots in the outer conductor.

15. The dual feed element of claim 14 wherein the outer conductor extends beyond the slots, the coupling means for the inner transmission path including a radiation path traversing the outer conductor at a point beyond the slots.

16. The dual feed element of claim 15 wherein the outer conductor extends beyond the intermediate conductor and the outer transmission path terminates at the end of the intermediate conductor, so that the outer conductor serves to bound the end of the inner transmission path.

17. The dual feed element of claim 14 wherein the coupling means for the inner path comprises a pair of diametrically opposed longitudinal slots in the intermediate conductor in a plane perpendicular to the plane of the first slots, and dipole elements extending into the outer conductor through end portions of the first slots and connected to the intermediate conductor and lying in the plane of the first slots.

18. The dual feed element of claim 13 wherein the coupling means for the outer transmission path are on the extreme end of the outer conductor and the inner and intermediate conductors extend beyond the portion of the outer conductor, the coupling means for the inner transmission path being on said extending end.

19. A coupled assembly for cross-polarized microwave transmissions comprising at least one tubular conductor having first and second pairs of longitudinal slots, the members of each pair of slots being diametrically opposed and respective pairs being in mutually perpendicular planes and longitudinally displaced, means within the conductor to mutually isolate transmissions through the respective pairs of slots, means on the exterior of the conductor in the region longitudinally between said pairs to isolate the pairs for one polarization, and a conducting wall surrounding the slotted portion of the tubular conductor, whereby the transmissions are excited in the enclosure formed by the wall in cross-polarized relation.

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