June 2, 1953 C. W. MILLER ET AL 2,640,877

WAVE GUIDE ELBOW JOINT

Filed April 14, 1948

Fig. 1.

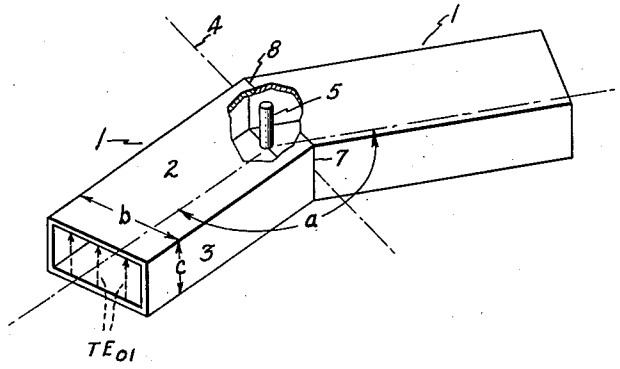
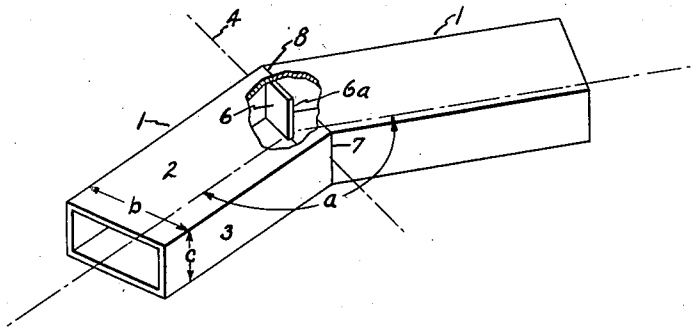


Fig. 2.



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Patented June 2, 1953

2,640,877

UNITED STATES PATENT OFFICE

2,640,877

WAVE GUIDE ELBOW JOINT

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Application April 14, 1948, Serial No. 20,926
In Great Britain April 17, 1947

6 Claims. (Cl. 178—44)

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Our invention relates to wave guides for ultra high frequency electrical energy and, more particularly to wave guides for propagating waves in the transverse electric, or TE, modes.

In wave guide structures for transverse electric waves it is often necessary that they contain bends, or corners, in which the plane of the bend is parallel to that of the electric vector, and in the case of a rectangular wave guide propagating the lowest mode, the plane is parallel to the broad wall of the wave guide. The bends need not necessarily be right angle bends. It is well known that if the ends of the guides are cut at an angle and the sections joined together so as to form a mitred corner, there will normally be set up in such a guide a standing wave due to reflection at the junction. The amount of the reflection is a function of the angle.

A known method of avoiding reflections at a bend, is to make the change of direction gradually along the length of the guide, the guide being normally bent in the arc of a circle. It has been found, however, that certain optimum radii of curvature occur and that where the radius of curvature was large, the electrical characteristics are improved. As a result, bends having suitable electrical characteristics tend to become unduly large and frequently can not be fitted physically into the equipment. Another known arrangement is a mitred corner with a flat reflecting surface across the outer corner. Such an arrangement can be utilized in a short length of bend and is practical from this aspect, but it requires high dimensional accuracy and it is critically sensitive to frequency.

It is an object of our invention to provide an improved wave guide corner for transmission of the TE_{01} modes.

It is a further object of our invention to provide a wave guide corner wherein reflections are substantially eliminated.

A further object of our invention is to provide a wave guide structure that is not frequency sensitive.

For additional objects and advantages, and for a better understanding of the invention, attention is now directed to the following description and accompanying drawing, and also to the appended claims in which the features of the invention believed to be novel are particularly pointed out.

In the drawing:

Fig. 1 is a pictorial view of a wave guide structure containing one embodiment of our invention; and

Fig. 2 is a pictorial view of a wave guide structure showing another embodiment of our invention.

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Referring now to Fig. 1, we have illustrated a wave guide joint comprising the two sections 1 with their longitudinal axes at an obtuse angle a, each having a wide wall 2 of dimension b and a narrow wall 3 of dimension c. The sections 1 are mitred to form a junction in a transverse plane through axis 4.

For purposes of illustration, let it be assumed that the guide is suitably exited in the fundamental transverse electric mode, or TE_{01} mode, as indicated by the instantaneous voltage vectors.

In carrying out our invention according to the arrangement in Fig. 1, a post 5 preferably, but not essentially, of circular cross-section is inserted in the plane of the corner, that is along the junction 4 of the two wave guides 1. The post 5 is aligned in the direction of the electrical vectors, that is, parallel to the narrow dimension c of the wave guide 1. The post 5 may, or may not, extend completely across the dimension c of the guide. By adjusting the penetration of the post 5 and its position or cross-sectional dimensions, a substantially reflection-free corner can be obtained. In the case where the post 5 does not extend across the full depth of the guide, sparking from the post may occur if the current is high. However, if the post 5 is extended across the guide and good metallic connection is made with both opposite walls, then the danger of breakdown is minimized and a good match may be obtained by variation of the position of the post 5 along the plane of intersection 4. In a particular example, with a wave guide of 1" by ½" internal dimensions, and propagating energy of wave length in the order of three centimeters, a right angle corner was made using a post of approximately ¼" diameter extending the full depth of the guide. The post 5 was positioned so that its spacing from the inner corner 7 along the junction of the two guides was slightly less than the wide dimension b of the guide 1. The material of which the post is composed may be either metal or dielectric material and although it is preferable to locate the post in the plane of the junction, it is possible to depart within reasonable limits from this plane.

Referring now to Fig. 2, we have shown an alternative arrangement in which corresponding elements have the same reference symbols. In this case, the post 5 of the previous figure has been replaced by a flat plate 6. Since the space between the inner edge 6a and the outer corner 8 of the junction plays relatively little part in the

action of the corner, that space may conveniently be filled in. Plate 6 therefore extends along the plane of the junction 4 inwardly from the outer corner 8. The spacing of the inner edge 6*a* of the plate 6 from the inner corner 7 is a function of the angle *a* and preferably is slightly less than the wide dimension *b* of the guide.

While certain specific embodiments have been shown and described, it will, of course, be understood that various modifications may be made without departing from 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 wave guide structure for propagating transverse electric waves, comprising a pair of straight sections of rectangular wave guide, said sections intersecting in a junction plane and having their longitudinal axes extending from said junction plane at an angle substantially different from 180 degrees, the plane of said angle being perpendicular to said junction plane, and a post member supported in said structure substantially in said plane for reducing the reflections at said junction.

2. A wave guide structure for operation at high frequency comprising a pair of intersecting straight sections of rectangular wave guide, the intersection of said sections defining a junction plane, the longitudinal axes of said sections lying in a plane normal to said junction plane and extending radially therefrom to form an angle other than 180°, a plate member positioned within said sections substantially in said junction plane to reduce reflections at said junction, the length of said plate member being a function of said angle.

3. A wave guide structure for propagating transverse electric waves, comprising a pair of straight sections of hollow rectangular wave guide, said sections intersecting in a junction plane and extending radially from said junction plane, the longitudinal axes thereof forming an obtuse angle, each section having a pair of major and a pair of minor walls, the plane of said junction being perpendicular to said major walls, and a member supported in said wave guide sections and in the plane of said junction parallel to said minor walls to reduce reflections at said angle.

4. A rectangular wave guide for propagating electromagnetic waves, said wave guide having an intersection between two substantially straight portions thereof, the plane of said intersection being formed by the junction of said straight portions and parallel to the direction of the electric vector of said waves when said wave guide is excited in a predetermined mode, and an impedance member in the form of a partition located within said wave guide and in the plane bisecting the angle between said two portions of guide for substantially reducing electromagnetic wave reflections at said angle, said member extending the full distance between the major walls of said guide and having an inner edge spaced from the inner corner of said angle slightly less than the wide dimension of said guide.

5. A wave guide structure for propagating electromagnetic waves having an intersection plane formed by the junction of two intersecting rectilinear portions, and an impedance member in the form of a partition disposed in said wave guide and substantially in the plane bisecting the angle between said two portions and adjacent the outermost corner of said junction for reducing wave reflection at said junction.

6. The wave guide structure as defined in claim 1, wherein each said wave guide section comprises a pair of spaced parallel relatively wide wall portions and a pair of spaced parallel relatively narrow wall portions at right angles to said relatively wide wall portions, and said post is upstandingly supported at the junction of the relatively wide wall portions of said sections.

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