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H-PLANE HINGE JOINT

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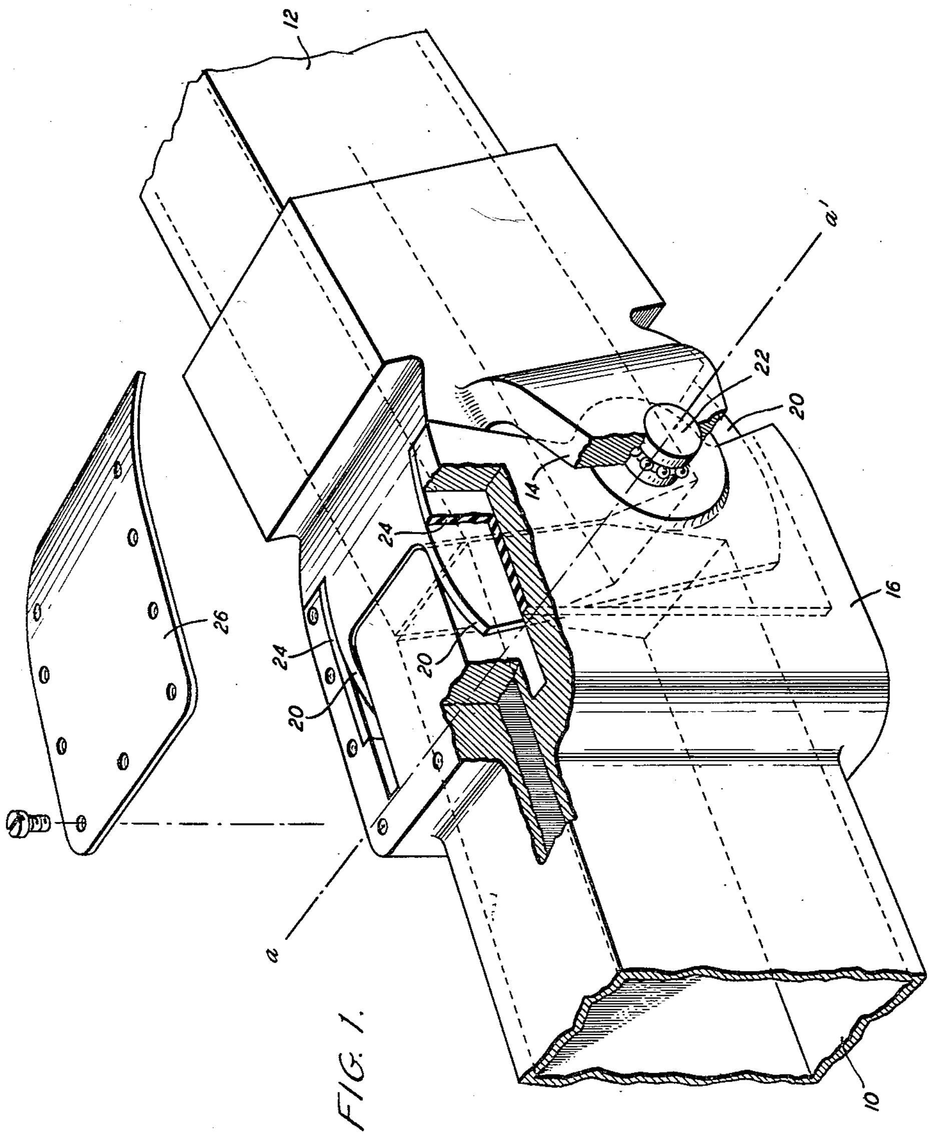

FIG. 1.

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FIG. 2

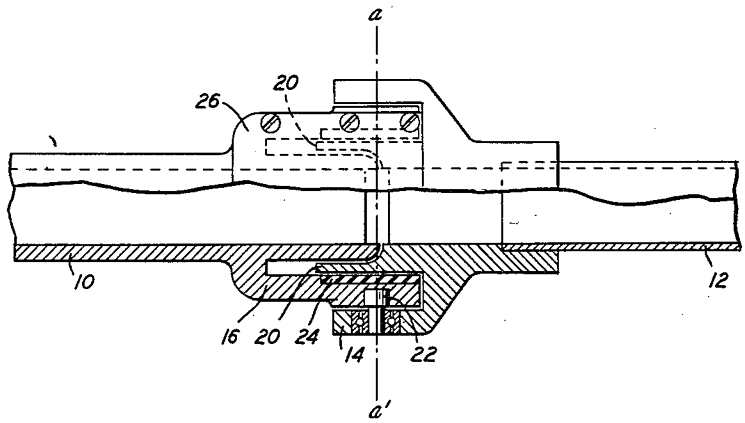
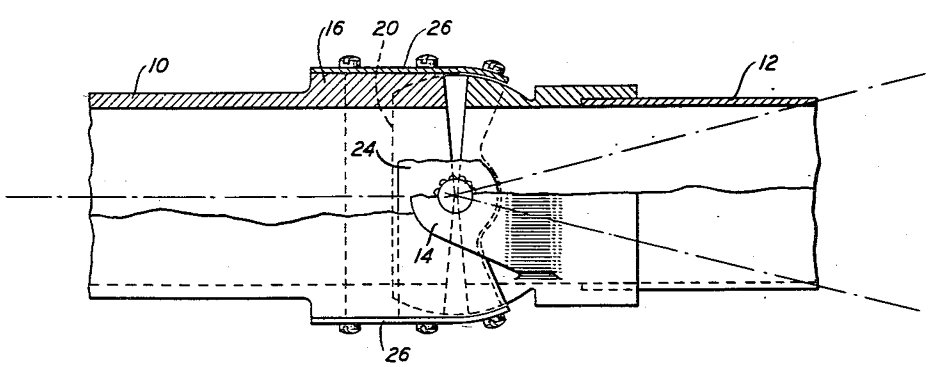


FIG. 3



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H-PLANE HINGE JOINT

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This invention relates to wave guide structures and more particularly to a magnetic or H-plane hinge joint for rectangular wave guides.

Hinge joints are often employed in electronic systems involving wave guides to permit relative movement of one apparatus component with respect to another while permitting electrical interconnection between the components for the transmission of microwave energy. Perhaps the most important application of such hinge joints is found in radar and similar systems wherein an antenna arranged for scanning motion must be interconnected with a stationary microwave radio transmitter.

In this and other applications the dual problem exists of on the one hand, providing adequate angular movement of one wave guide with respect to the other and on the other hand, preventing inefficient transfer of microwave energy through the joint. These problems have been solved with greater or less success by numerous types of wave guide joints wherein limited relative motion is provided. In certain of these joints a choke is provided for the purpose of reducing leakage of energy from the joint. In general such chokes are satisfactory only when the wave guides are in alinement. When in such structures the guides are relatively rotated about the hinge axis the dimensions of the choke vary and the choke is rendered substantially less effective. Higher standing wave ratios and greater energy leakages result.

It is the object of the present invention to provide an H-plane hinge for rectangular wave guide structures capable of relatively large angular motion without introducing undesirable standing waves within the guides or leakage of the transmitted energy from the joint.

In accordance with the above object there is provided a wave guide hinge joint in which two rectangular guides are provided for relative angular movement about an axis normal to an H-plane common thereto. Plates mounted on and spaced from the opposite wide sides of one guide are arranged for interleaving engagement with a pair of slotted jaws mounted on the opposite wide sides of the other guide. The plates and jaws respectively are overlapped sufficiently to cover the gap between the ends of the wave guides for a desired range of angular movement and are pinned together to permit such movement. The inner walls of the slots in the jaws on the second guide extend beyond the axis and into the space between the side plates and the first guide to form half-wave chokes extending across the opposite wide sides of the wave guides to provide wave continuity between the guide sections and prevent leakage from the joint.

The above and other features of the invention will be described in the following detailed specification taken in connection with the drawings in which

Fig. 1 is a perspective view of an H-plane hinge according to the invention, partially broken away to show certain details of the joint and with certain elements thereof shown in exploded form to facilitate understanding of the invention;

Fig. 2 is a top elevation shown partially in section of an H-plane hinge according to the invention; and

Fig. 3 is a side elevation of the hinge of Figs. 1 and 2 also shown partially in section.

The hinge joint illustrated in the drawings provides means for joining a first rectangular wave guide **10** to a second rectangular wave guide **12** having relative angular movement about an axis *aa'* normal to an H-plane common to the two wave guides. For this purpose paired jaws **14** best shown in Fig. 2 of the drawings are formed on the opposite wide sides of the second wave guide **12.** Similarly paired side plates **16** shown in Fig. 2 of the drawings are mounted on and spaced from the wide sides of the first wave guide **10.** The jaws **14** and side plates **16** are dimensioned for interleaving engagement, with the side plates **16** extending into slots defined by the jaws **14** and extensions **20** on the wide walls of wave guide **12** and extensions **20** projecting into the spaces between the side plates and the wide walls of wave guide **10.**

As shown in Fig. 3 of the drawings, the ends of wave guides **10** and **12** are cut back symmetrically from the center of the wide walls toward the narrow walls to provide symmetrically beveled ends. The beveled ends provide clearance for relative angular movement of the two guides and result in the wide walls of the two guides being closely adjacent only at the center of the wide sides when the guides are in alinement. It is at these points of adjacency that the axis *aa'* traverses the H-plane common to the two wave guide portions.

It will be noted from the drawings that the side plates **16** on wave guide **10** extend into a slot defined by the corresponding jaws **14** and outer wall extensions **20** of wave guide **12** and that similarly extensions **20** of wave guide **12** extend into the slot between the side plate **16** and the wider walls of wave guide **10.** In each instance the jaws or side plates, as the case may be, extend beyond the axis *aa'* of the hinge sufficiently to provide a cover for the gap between the adjacent ends of the wide walls of the wave guide for all possible relative angular positions of the guides. Trunnions **22** mounted on side plates **16** of wave guide **10** are journaled in ball bearings in jaws **14** of wave guide **12** to permit relative rotation of the two wave guides about axis *aa'*.

From the foregoing it will be appreciated that while the wide sides of the adjacent wave guides may be separated by a considerable gap at the outer edges of the guide depending upon the relative angular position of the two wave guides this gap is at all times covered by the extensions **20** on the wide walls of wave guide **12.** Despite this arrangement, discontinuity occurs between adjacent wide walls of the two wave guides at the joint. Accordingly means have been provided for making the wave guide walls essentially electrically continuous thus preventing leakage of energy therefrom. To this end the slots formed by the side plates **16** and the wide walls of wave guide **10** are so dimensioned with respect to extensions **20** of wave guide **12** as to form straight half-wave chokes at the mid-frequency of the band to be transmitted through the wave guide.

These chokes are dimensioned for maximum effectiveness at the center of the wide walls of the adjacent wave guides at which point the extensions **20** extend one-quarter wave length into the slots between the side plates **16** and the wave guide walls, the slots extending one-half wave length in all from the points of nearest adjacency of the two wave guides to the short circuit terminations at the left hand ends of the slots. The reduction in efficiency caused by the movement of extensions **20** in the slots between the side plates and wave guide **10** is not significant in view of the fact that the high longitudinal current concentration in the wave guide is along the central portion of the wide walls thereof. Regardless of the relative angular positions of the two wave guides the gaps between the wide walls of the wave guides are always covered by conducting extensions of the walls and, in addition, the leakage path is always protected by the choke structure which remains adjacent the gap between the guides at all times.

As a further precaution and for the purpose of minimizing any escape of energy from the guide into the surrounding area through the spaces between side plates **16** and extensions **20** which constitute possible leakage paths beyond the chokes. The walls defining these paths may be lined with a material such as polyiron which acts as an absorber of the small amounts of radio frequency energy which may escape when the extremes of angular movement are reached. Conveniently and as shown in the drawing such polyiron inserts **24** are mounted in the inner sides of side plate **16** and face extensions **20** of wave guide **12** as best shown in Figs. 1 and 2 of the drawings.

Although little or no longitudinal current is transmitted along the narrow faces of wave guides **10** and **12**, the gaps between these faces at the ends of the wave guides are closed by cover plates **26** secured to the narrow faces of wave guide **10** and bent in an arc about axis *aa'* as a center to extend over the narrow faces of wave guide **12**. These cover plates of course also serve to protect the inner elements of the hinge joint and to prevent foreign bodies from becoming lodged inside the wave guide.

Hinge joints according to the invention have been constructed for 1½ x 3 inch wave guide to permit relative movement of ±13 degrees from the in-line position. Under test such joints have been found to have a standing wave ratio of about $\frac{6}{10}$ db maximum across the 12 percent band transmitted and have not been subject to arcing across the adjacent elements of the joint for transmitter powers up to one megawatt.

What is claimed is:

1. A hinge joint connecting first and second wave guides for relative angular movement about an axis normal to an H-plane common thereto comprising a pair of side plates mounted in spaced relation on and parallel to the two wide sides respectively of said first wave guide, said side plates extending beyond the ends of said first wave guide, a pair of jaws mounted on the opposite wide sides of said second wave guide and extending beyond the end thereof, extensions formed on said wide sides of said second wave guide and with said jaws defining slots parallel to said wide sides of said second wave guide and means pivoting said jaws and said side plates for relative rotation about said axis with said side plates received in said slots and said extensions received in the spaces between said side plates and the wide walls of said first wave guide.

2. A hinge joint connecting first and second wave guides for relative angular movement about an axis normal to an H-plane common thereto comprising a pair of side plates mounted in spaced relation on and parallel to the two wide sides respectively of said first wave guide, said side plates extending beyond the ends of said first wave guide, a pair of jaws mounted on the opposite wide sides of said second wave guide and extending beyond the end thereof, extensions formed on said wide sides of said second wave guide and with said jaws defining slots parallel to said wide sides of said second wave guide, means pivoting said jaws and said side plates for relative rotation about said axis with said side plates received in said slots and said extensions received in the spaces between said side plates and the wide walls of said first wave guide, and means associated with said joint for preventing the leakage of high frequency energy therefrom.

3. A hinge joint connecting first and second wave guides for relative angular movement about an axis normal to an H-plane common thereto comprising a pair of side plates mounted in spaced relation on and parallel to the two wide sides respectively of said first wave guide, said side plates extending beyond the ends of said first wave guide, a pair of jaws mounted on the opposite wide sides of said second wave guide and extending beyond the end thereof, extensions formed on said wide sides of said second wave guide and with said jaws defining slots parallel to said wide sides of said second wave guide and means pivoting said jaws and said side plates for relative rotation about said axis with said side plates received in said slots and said extensions received in the spaces between said side plates and the wide walls of said first wave guide, said spaces being dimensioned with respect to the portions of the extensions projecting therein to constitute chokes extending across the wide dimension of said joint to provide wave continuity between the guides and prevent leakage of high frequency energy therefrom.

4. A hinge joint connecting first and second wave guides for relative angular movement about an axis normal to an H-plane common thereto comprising a pair of side plates mounted in spaced relation on and parallel to the two wide sides respectively of said first wave guide, said side plates extending beyond the ends of said first wave guide, a pair of jaws mounted on the opposite wide sides of said second wave guide and extending beyond the ends thereof, extensions formed on said wide sides of said second wave guide and with said jaws defining slots parallel to said wide sides of said second wave guide, means pivoting said jaws and said side plates for relative rotation about said axis with said side plates received in said slots and said extensions received in the spaces between said side plates and the wide walls of said first wave guide, and inserts of radio frequency energy absorptive material mounted on the inner faces of said side plates and overlapping said extensions to minimize the escape of radio frequency from the joint.

5. A hinge joint connecting first and second wave guides for relative angular movement about an axis normal to an H-plane common thereto comprising a pair of side plates mounted in spaced relation on and parallel to the two wide sides respectively of said first wave guide, said side plates extending beyond the ends of said first wave guide, a pair of jaws mounted on the opposite wide sides of said second wave guide and extending beyond the ends thereof, extensions formed on said wide sides of said second wave guide and with said jaws defining slots parallel to said wide sides of said second wave guides, means pivoting said jaws and said side plates for relative rotation about said axis with said side plates received in said slots and said extensions received in the spaces between said side plates and the wide walls of said first wave guides, said spaces being dimensioned with respect to the portions of the extensions projecting therein to constitute chokes extending across the wide dimension of said joint to provide wave continuity between the guides and prevent leakage of high frequency energy therefrom and polyiron slabs mounted on the inner faces of said side plates and overlapping said extensions to minimize the escape of radio frequency energy beyond said choke.

6. A hinge joint connecting first and second wave guides for relative angular movement about an axis normal to an H-plane common thereto comprising a pair of side plates mounted in spaced relation on and parallel to the two wide sides respectively of said first wave guide, said side plates extending beyond the ends of said first wave guide, a pair of jaws mounted on the opposite wide sides of said second wave guide and extending beyond the ends thereof, extensions formed on said wide sides of said second wave guide and with said jaws defining slots parallel to said wide sides of said second wave guides, means pivoting said jaws and said side plates for relative rotation about said axis with said side plates received in said slots and said extensions received in the spaces between said side plates and the wide walls of said first wave guide, said spaces being dimensioned with

respect to the portions of the extensions projecting therein to constitute chokes extending across the wide dimension of said joint to provide wave continuity between the guides and prevent leakage of high frequency energy therefrom, and arcuate covers mounted on the narrow faces of said first wave guide and extending beyond said axis to bridge the gap between the narrow faces of said first and second wave guides for all positions of relative angular movement thereof.

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