July 17, 1951 C. E. McCLELLAN 2,561,130

WAVE GUIDE COUPLING

Filed Aug. 2, 1944

Fig. 1.

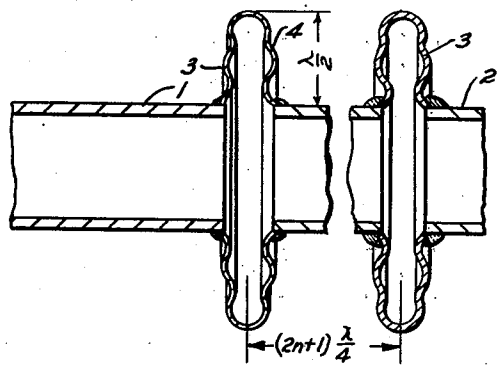


Fig. 2.

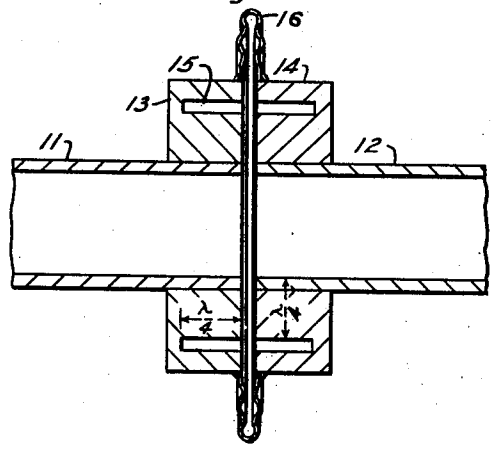
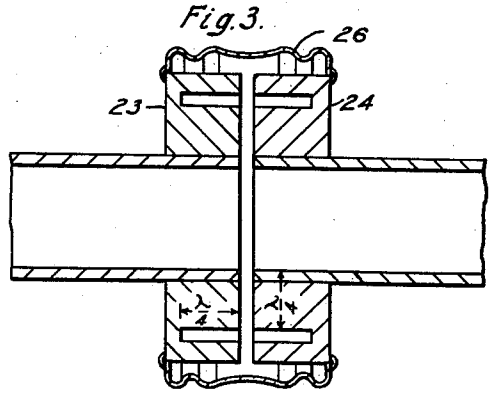


Fig. 3.



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Patented July 17, 1951 2,561,130

UNITED STATES PATENT OFFICE

2,561,130

WAVE GUIDE COUPLING

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Application August 2, 1944, Serial No. 547,717

2 Claims. (Cl. 178—44)

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My invention relates to guides for electromagnetic waves and, in particular, relates to arrangement for providing joints which are, at once, gas-tight and flexible and which prevent leakage of electromagnetic energy in such wave guides.

Guides for electromagnetic waves usually in the form of cylinders or pipes of metal or other good electrical conductors, are now being rather widely used for transmitting high frequency electrical energy from point to point. It is sometimes desirable to connect such guides directly to thermionic or other circuit components which are maintained at a high vacuum; and even when it is not desirable to maintain pressure vacuum pressures in the interior of the guides, it is desirable to prevent the corrosive gases or even water vapor present in the surrounding atmosphere from obtaining access to the interior of the guides. There is furthermore a tendency toward leakage of the electromagnetic waves being transmitted if the joints are not tight. On the other hand, it is likewise frequently desirable to provide for a certain amount of mechanical flexibility and displaceability of portions of the guide relative to other portions. Telescoping or slip joints have been employed at times heretofore to provide for flexibility but these are not truly gas or electromagnetic wave tight, and while it is, of course, possible to make the wave-guide system tight if it is of continuous metal, this does not permit any substantial amount of flexibility or displaceability of one portion of the guide relative to another.

It is, accordingly, one object of my invention to provide a method of flexibly joining one portion of a wave guide to another portion without introducing any junction pervious to gas or the electromagnetic waves, and without imposing a substantial amount of electrical discontinuity at the junction.

Another object of my invention is to provide a flexible junction for wave guides which shall be gas and electromagnetic wave tight, and which shall permit lateral displacement of one portion of the guide relative to another portion.

Other objects of my invention will become apparent upon reading the following description, taken in connection with the drawing, in which,

Figure 1 shows a flexible gas-tight junction or wave guide according to one modification of my invention,

Fig. 2 shows another modification of my method of forming flexible but tight junctions in wave guides, and

Fig. 3 shows still another method of forming flexible junctions in wave guides.

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Referring in detail to Figure 1, two sections 1 and 2, which will usually be comprised of metal and of like cross-section, are the wave guide sections which are intended to be provided with a flexible gas-tight junction. The latter may be considered as comprising a pair of annular discs or diaphragms 3—4 respectively, continuously connected to the sections 1 and 2 at their inner peripheries, and jointed together to form a continuous ring at their outer peripheries. Preferably, the diaphragms 3 and 4 are formed of metals so thin as to flex readily and may be provided with annular corrugations to aid in this result. Since the flexible member 3—4 is continuous, and has continuous junctions with the wave guide sections 1 and 2, it obviously forms a junction tight for both electromagnetic waves and for gases between them. It is likewise obvious that the flexibility of the member 3—4 will permit a certain degree of inclination of the axis of the wave guide 2 relative to the axis of wave guide 1.

The peripheral dimensions of the flexible member 3—4 are preferably such that it extends laterally beyond the periphery of the wave guide sections 1 and 2 for a distance which is an integral number of half wave lengths of the electromagnetic waves being transmitted through the guides.

It will be evident that by providing a plurality of junctions in a wave guide, it will be possible to, in effect, curve the latter through any desired angle, or by making what is, in effect a reverse curve, to displace the axis of one portion of the guide laterally from the axis of a portion of the guide junctions further on in its length. Where a plurality of junctions are employed, they should preferably be displaced from each other along the axis of the guide by an odd number of quarter wave lengths of the electric waves to be transmitted.

By reason of the fact that the two elements 3 and 4 act, in effect, like a parallel line, one-half a wave length long, the gap between the adjacent ends of the sections 1 and 2 of the wave guide presents substantially zero impedance to energy flow.

Referring to Fig. 2, a pair of wave guide sections 11—12 are shown provided with well-known choke couplings 13—14, each of which comprises a cylindrical disc having an annular channel 15 cut in it. The distance from the interior surface of the wave guide section 11 to the radially-inward edge of this channel is preferably one-quarter wave length of the radiation to be transmitted through the guides, and likewise the depth

of the channel 15 is preferably one-quarter wave length.

The two adjacent peripheral edges of the choke couplings 13—14 are interconnected by an annular flexible conducting member 16 of a type similar to the member 3—4 already described in connection with Figure 1. However, it is not as important in the case of the Fig. 2 arrangement as it is in that of Figure 1, that the radial width of the member 16 shall be an integral number of half wave lengths. However, the member 16 should be of such a material and configuration that the chamber within it does not resonate with a high Q.

Referring now to Fig. 3, a coupling employing a pair of choke members 23—24, similar to the choke members 13—14 in Figure 1, is shown but these are interconnected to make a gas tight joint by a flexible member 26 in the form of a corrugated conducting cylinder continuously connected at its opposite ends to the remote peripheral edges of the members 23—24.

In the case of both Fig. 2 and Fig. 3, I have shown two choke coupling discs 13—14 and 23—24 respectively. However, if desired, one member of each pair of choke coupling discs may be replaced by a plane flange.

While I have described particular embodiments of my invention as required by the patent statutes, the principles of this invention are of broader application in ways which will be apparent to those skilled in the art.

I claim as my invention:

1. A wave guide for electromagnetic waves, comprising a pair of hollow members having walls of conducting material terminating in two substantially coextensive openings, a choke coupling comprising a ring of conducting material, having an annular groove therein, positioned at one of said openings, a second choke coupling at the other said opening, and a sleeve of flexible conducting material continuously connected at its respective ends to said choke couplings to form a gas-tight joint therebetween, the distance along the axis of said wave guide between successive couplings being an odd number of quarter-wave lengths of the electromagnetic energy traversing said guides.

2. A wave guide for electromagnetic waves, comprising a pair of hollow members having walls of conducting material terminating in two substantially coextensive openings, a choke coupling comprising a ring of conducting material, having an annular groove therein, positioned at one of said openings, an annular flange surrounding the other of said openings, and a sleeve of flexible conducting material having its respective ends connected to said choke coupling and said flange to form a tight interconnection therebetween, the distance along the axis of said wave guide between successive couplings being an odd number of quarter-wave lengths of the electromagnetic energy traversing said guides.

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