

May 2, 1950

P. E. GILMER ET AL
JUNCTION FOR COUPLING A PLURALITY
OF WAVE GUIDE SECTIONS
Filed June 6, 1947

2,506,418

FIG. 1

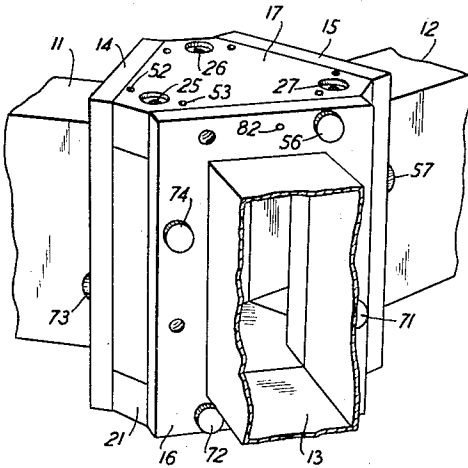


FIG. 2

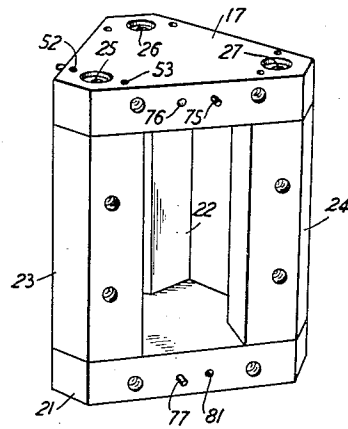


FIG. 3

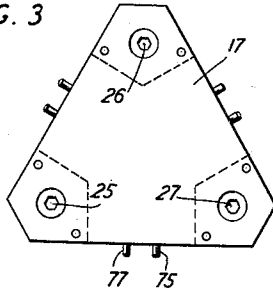


FIG. 5

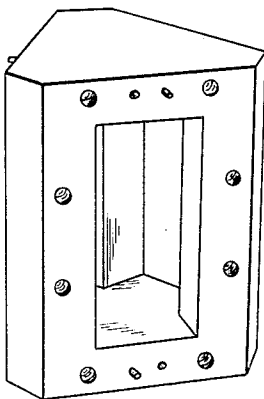
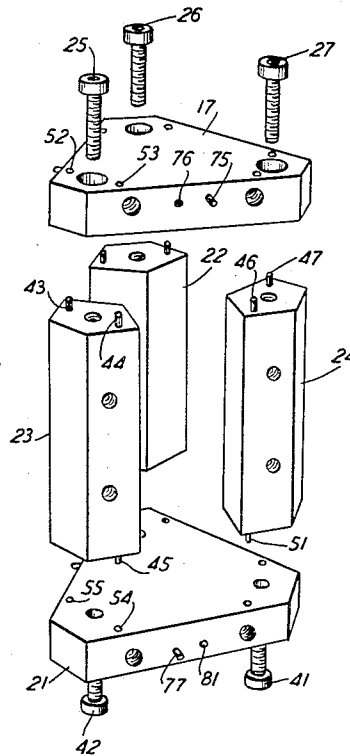


FIG. 4



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JUNCTION FOR COUPLING A PLURALITY OF
WAVE GUIDE SECTIONS

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Application June 6, 1947, Serial No. 752,990

9 Claims. (Cl. 285—210)

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This invention relates to a junction or coupling unit and more particularly to a junction for coupling a plurality of wave guide sections.

An object of the invention is to improve the operation of wave guides.

A more specific object of the invention is to simplify and facilitate the coupling of a plurality of wave guide sections at a common junction point and to enhance the efficiency of such a coupling.

The use of so-called wave guides as transmission elements is now well understood and has been fully described in the art. These wave guides may be of various shapes and types, for example, they are commonly in the form of a straight hollow pipe of elongated rectangular cross-section. For certain applications of such wave guides it becomes necessary to couple or join a plurality of sections of the wave guide at a common point. For example, in the use of certain radio apparatus, two branch sections of a wave guide connected respectively to a radio transmitter and to a radio receiver, are coupled at an intermediate point to a third similar wave guide section which is connected to the common transmit-receive antenna.

Heretofore, it has been the usual practice to construct the necessary junction or coupling by soldering three short sections of wave guide tubing, of suitable size and shape, to each other to form the junction and then to solder flange blanks to the respective three open ends of the junction. The flange faces were then drilled, tapped and finished and the respective main wave guide sections, provided with similar flanges, attached thereto by suitable means.

The construction and use of this general type of wave guide joint or junction has been found to present a number of difficulties. For example, the soldering itself presents difficulties in view of the number of seams that must be made within a short distance of each other. Uniformity is difficult to attain, i. e. several joints all constructed in the same general manner are apt to have varying electrical properties due to slight irregularities in size of the respective sections of tubing, or in the angular spacing of the sections or in the alignment of the junction. Further this type of junction is, in general, expensive to produce and is lacking in mechanical strength.

The junction contemplated by the present invention meets the above referred to difficulties in a simple and effective manner and offers many obvious advantages over the types of wave joints previously known.

A feature of the present invention resides in the use of parts of uniform size and shape which are readily made with extreme precision whereby the electrical properties of a given unit are readily reproducible in subsequent units.

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A further feature of the present invention resides in the elimination of the necessity of providing flanges on the junction unit.

In accordance with still another feature, soldered joints are entirely eliminated from the junction unit.

In accordance with a specific embodiment of the invention, a wave guide joint or junction comprises a symmetrical compact unit which includes two generally triangular shaped end plates or bases together with three spacer bars, all identical, the junction being assembled by attaching the plates to the spacer bars by means of suitable screws. The spacer members are of such cross-section and length as to form, when assembled with the end plates, a junction of three wave guides which is both mechanically and electrically efficient. The junction is produced entirely of machined or die-cast parts which results in an accurately formed junction of adequate mechanical strength and one that may be produced at a low cost. The respective parts are all of uniform size and shape from which it follows that any number of junctions of this novel type will present uniformity both electrically and mechanically. The electrical properties of a given junction may be readily reproduced in another junction because of the dimensional accuracy of the parts involved.

According to another embodiment of the invention a joint or junction of the type contemplated is produced in one piece by casting or molding.

A complete understanding of the construction and functioning of the type of joint contemplated by the present invention as well as appreciation of the various desirable features thereof may be gained from consideration of the following detailed description and the attached drawings in which:

Fig. 1 is a perspective view showing a junction of the type contemplated by the present invention used to couple three wave guide sections, the wave guide sections being shown broken away;

Fig. 2 is a perspective view of the joint alone;

Fig. 3 is a plan view of the joint of Fig. 2;

Fig. 4 is an "exploded" view of the joint of Fig. 2 showing the general arrangement and method of assembly; and

Fig. 5 is a perspective view of a modified form of the joint which is made in one piece.

Referring now to the drawings, Fig. 1 illustrates the use of the novel junction or joint for electrically and mechanically coupling three wave guide sections 11, 12 and 13. These wave guide sections, only a short length of each of which is illustrated, may be connected, by way of example, to a radio transmitter, a radio receiver and a common transmit-receive antenna respectively.

The wave guide sections, which in the embodi-

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ment illustrated are in the form of hollow pipes of elongated rectangular cross-section, are provided with respective flanges 14, 15 and 16, soldered to the respective open ends thereof whereby to facilitate attachment to the junction.

The junction or joint (referring now to Figs. 2, 3 and 4 in addition to Fig. 1) comprises two end plates or base members 17 and 21 of generally triangular shape and three identical spacer bars 22, 23 and 24. The parts are held in assembled relation by machine screws 25, 26, 27, 41 and 42 and a third machine screw not illustrated. Two locating pins are positioned on each end of each spacer bar, as for example pins 43, 44 and 45 of spacer bar 23 and pins 46, 47 and 51 of bar 24; when the joint is assembled these pins seat in apertures provided in the respective face plates and assure proper relative positioning of the members. For example, pins 43 and 44 provided on the upper end of spacer bar 23 seat in respective apertures 52 and 53 provided in upper face plate 17 while pin 45 and the corresponding pin not illustrated provided on the lower end of the bar seat in respective apertures 54 and 55 provided in lower face plate 21.

The machine screws, 25, 26, etc. are preferably countersunk in the respective face plates so that the smooth surfaces of the plates are not interrupted by projecting screw heads.

The faces of the plates and bars are drilled and tapped at suitable points whereby to facilitate attachment of the wave guide sections to the junction by means of machine screws passing through flanges 14, 15 and 16. Certain of these fastening screws, 56, 57, 71, 72, 73 and 74 are illustrated in Fig. 1. In order to facilitate proper uniform alignment of the wave guide sections and the respective faces of the joint a plurality of positioning pins and apertures are provided in the illustrated embodiment in the faces of the joint and in the flanges of the wave guide sections. For example, positioning pins 75 and 77 and positioning apertures 76 and 81 are provided in one face of the joint while correspondingly mating apertures and pins are provided on the face of flange 16; one of these, aperture 82, is shown in Fig. 1.

It is contemplated that in many instances the joint will be used in conjunction with wave guide sections provided with flange faces which are not furnished with positioning apertures and pins and, in such event, the positioning apertures and pins will, of course, be omitted from the faces of the joint. The contemplated arrangement is such that it operates, in an entirely satisfactory manner regardless of whether the positioning means referred to are, or are not, utilized.

End plates 17 and 21 are referred to above as being of generally triangular shape. Described more specifically, they are in the form of an equilateral triangle each apex of which is truncated. The amount of apex removed in each case is the same with the base of the removed portion in each instance perpendicular to the bisector of the respective apex angle. We thus have a resulting figure in the form of a hexagon made up of three equal long sides and three equal short sides with each long side joined to a short side and in which each of the short sides is parallel to the opposite long side. The width of the outer face of each of the spacer bars is, in turn, exactly equal to the length of a short side of the end plates.

When these members are assembled as illustrated, a regular columnar structure is attained

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having three major faces bounded in part by longer faces of the base or face plates and three minor faces bounded in part by shorter sides of the base or face plates. Each major face presents a solid surface corresponding in shape and area to the face of the flange of the wave guide section to be joined thereto and has a portal or opening therein corresponding in shape and area to the open end of the same wave guide section. Each of the three portals opens into the common hollow chamber in the interior of the columnar structure. This chamber may be of the general shape illustrated (Fig. 3) or of various other shapes resulting, for example, from the defining surfaces of the spacer bars being rounded, truncated, grooved or the like.

The efficiency of this specifically shaped junction unit, both mechanically and electrically, will be apparent from examination of Fig. 1. In the first place, it becomes immediately apparent that the junction unit is free of flanges such as were necessary in previous types of junctions. The three exposed faces of the junction are dimensioned and shaped to afford a mating fit with the respective flanges of the wave guide sections while the over-all shape and arrangement of the junction is such that the desired electrical coupling of the wave guide sections is attained. The dimensions of the assembled junction are such that the portals provided exactly match in dimension and position the respective open ends of the wave guides. The controlling dimensions of the junction are to be governed by the pertinent dimensions of the wave guide sections to be coupled.

In preparation of the joint or junction the drilling, tapping and finishing of the faces that mate with the flanges of the wave guide sections are commonly done after the joint has been assembled.

The members forming the junction should be of a good electrical conductive material whereby the intermediate and mating surfaces will have adequate conductance. However, as an alternative, the material itself of the junction need not be highly conductive so long as it is readily adaptable to plating with a good conductive covering.

It will be obvious that all of the parts of the novel joint described may be readily produced by machining or die-casting and that they lend themselves to assembly of a compact, mechanically strong joint. The parts are uniform in size and shape so that any number of joints may be produced with exactly identical characteristics. The parts are readily interchangeable which makes for low cost production on a quantity basis. The matter of soldering, which offered difficulties in the previous form of joint, has been entirely eliminated. A much smaller, more compact junction is possible than with previous methods which is highly advantageous as it permits the adjacent component elements to be placed closer to the center of the junction.

In general the coupling unit contemplated by the present invention is easier and cheaper to construct than those known heretofore and is readily made with much greater precision whereby the electrical properties are more readily and more exactly reproducible.

In Fig. 5 there is illustrated a modification of the invention which contemplates a junction similar in general to that described above except that it is made in one piece by a suitable electroforming casting or molding process. This joint is drilled and tapped and provided with position-

ing apertures and pins (when such apertures and pins are required) to facilitate attachment of the wave guide flanges in a manner similar to that described above.

While the junction or joint has been illustrated as being used for coupling three wave guide sections, it will be understood that it may be adapted to coupling other combinations of sections in a generally similar manner. Further it will be understood that it may be in the form of a T-joint; a Y-joint or other types as well and that it is applicable both in connection with so-called E or series joint, wherein branching is from the wide dimension of the wave guide, and so-called H or shunt joint, wherein branching is from the narrow dimension of the wave guide. Either or both end plates may be provided with a suitable portal and with means for attachment of a wave guide section at right angles to the major face of the plate (or plates) and on occasion one or more of the portals may be of proper contour to receive a coaxial conductor rather than a wave guide.

While certain specific embodiments of the invention have been selected for detailed description it will be understood that the invention is not limited in its application to such embodiments. The embodiments described should be looked upon as illustrative and not as restrictive.

What is claimed is:

1. A conductive junction for a plurality of open-ended, flanged wave guide sections comprising two identical end plates, a plurality of identical spacer bars, and threaded fastening means for securing said end plates and said spacer bars in assembled relationship whereby to produce a columnar structure providing solid surfaces corresponding to the solid flange surfaces of the wave guide sections to be joined and portals corresponding to the open ends of said wave guide sections, said portals opening into a common hollow chamber within said structure, said end plates and said spacer bars being of a material having relatively high electrical conductivity characteristics.

2. A conductive junction for a plurality of open-ended flanged wave guide sections comprising two identical end plates, a plurality of identical spacer bars, and threaded fastening means for securing said end plates and said spacer bars in assembled relationship to form a columnar structure providing solid surfaces corresponding to the solid flange surfaces of the wave guide sections to be joined and portals corresponding to the open ends of said wave guide sections, said portals opening into a common hollow chamber within said structure, the surfaces of said columnar structure being electroplated with a material having relatively high electrical conductance.

3. A conductive junction for a plurality of open-ended wave guide sections provided with flat mounting flanges surrounding the open ends, comprising a columnar member having identical top and base members of generally triangular configuration and a plurality of spacer bars therebetween, each of the three major faces of said columnar member having a solid surface corresponding in shape and area to the face of the flange of the wave guide section to be joined thereto and having a portal therein corresponding in shape and area to the open end of the same wave guide section, the portals of the three faces being joined to a common hollow chamber within the junction.

4. A conductive junction for a plurality of

open-ended flanged wave guide sections comprising two identical base plates, each of said plates being in the form of a relatively flat hexagon having three relatively long sides of respectively equal length and three relatively short sides of respectively equal length, each long side being joined to a short side and each short side being parallel to the respectively opposite long side, a plurality of identical spacer bars, and means for securing said base plates in assembled relationship with said spacer bars therebetween to provide a regular columnar structure with three major faces and three minor faces and a common hollow interior chamber, each major face providing a solid surface corresponding in shape and area to the face of the flange of the wave guide section to be joined thereto and having a portal therein corresponding in shape and area to the open end of the same wave guide section, the portals of all three faces opening into the common hollow interior chamber.

5. A conductive junction for a plurality of open-ended wave guide sections provided with flat mounting flanges surrounding the open ends, comprising a columnar member having identical top and base members of generally triangular configuration and a plurality of spacer bars therebetween, each of the three major faces of said columnar member having a solid surface corresponding in shape and area to the face of the flange of the wave guide section to be joined thereto and having a portal therein corresponding in shape and area to the open end of the same wave guide section, the portals of the three faces being joined to a common hollow chamber within the junction, each of the three major faces being provided with a plurality of spaced projecting pins and having a plurality of spaced apertures therein, said pins and apertures being adapted to mate respectively with spaced apertures and spaced pins provided on the flange of the wave guide section to be joined thereto.

6. A junction for a plurality of open-ended, flanged wave guide sections comprising two identical base plates, each of said plates being in the form of a relatively flat hexagon having three relatively long sides of respectively equal length and three relatively short sides of respectively equal length, each long side being joined to a short side and each short side being parallel to the respectively opposite long side, a plurality of identical spacer bars, and means for securing said base plates in assembled relationship with said spacer bars therebetween to provide a regular columnar structure with three major faces and three minor faces and a common hollow interior chamber, each major face providing a solid surface corresponding in shape and area to the face of the flange of the wave guide section to be joined thereto and having a portal therein corresponding in shape and area to the open end of the same wave guide section, the portals of all three faces opening into the common hollow interior chamber, each of said three major faces being provided with a plurality of spaced, projecting pins and having a plurality of spaced apertures therein, said pins and apertures being adapted to mate respectively with spaced apertures and spaced pins provided on the flange of the wave guide section to be joined thereto.

7. In combination a plurality of open-ended, flanged wave guide sections and junction means for coupling said wave guide sections in wave transmission relationship, said junction means comprising a columnar structure with a plurality

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of major faces corresponding in number to the number of wave guide sections to be coupled, each of said major faces having a solid surface corresponding in shape and area to the face of the flange of the wave guide section coupled thereto and having a portal therein corresponding in shape and area to the open end of the same wave guide section, said columnar structure having a common hollow chamber therein, the portals of each of the major faces opening into said common chamber, a plurality of projecting pins on each of said major faces, said flanges being provided with a plurality of apertures adapted to mate with said projecting pins, a plurality of projecting pins on each of said flanges, each of said major faces being provided with a plurality of apertures adapted to mate with said last-mentioned projecting pins, and threaded means for securing each flange of the respective wave guide sections to a respective major face of said junction means.

8. A junction for a plurality of high-frequency electrical conductors, one of which is a coaxial cable and others of which are open-ended wave guide sections provided with flat mounting flanges surrounding the open ends, comprising a columnar member having two plate members of generally triangular configuration and a plurality of spacer bars therebetween, each of the three major faces of said columnar member having a solid surface corresponding in shape and area to the face of the flange of the wave guide section to be joined thereto and having a portal therein corresponding in shape and area to the open end of the same wave guide section, one of said plate

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members having an aperture therein adapted to receive said coaxial cable, the portals of the three faces and the aperture of said plate member all being joined to a common hollow chamber within the junction.

9. A junction for a plurality of open-ended wave guide sections provided with flat mounting flanges surrounding the open ends, comprising a columnar member having two plate members of generally triangular configuration and a plurality of spacer bars therebetween, each of the three major faces of said columnar member having a solid surface corresponding in shape and area to the face of the flange of the wave guide section to be joined thereto and having a portal therein corresponding in shape and area to the open end of the same wave guide section, means on one of said plate members for attaching the flanged end of a wave guide section thereto, said plate member having a portal therein corresponding in shape and area to the open end of the wave guide section to be attached thereto, the portal in said plate member and the portals in said major faces all being joined to a common hollow chamber within the junction.

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