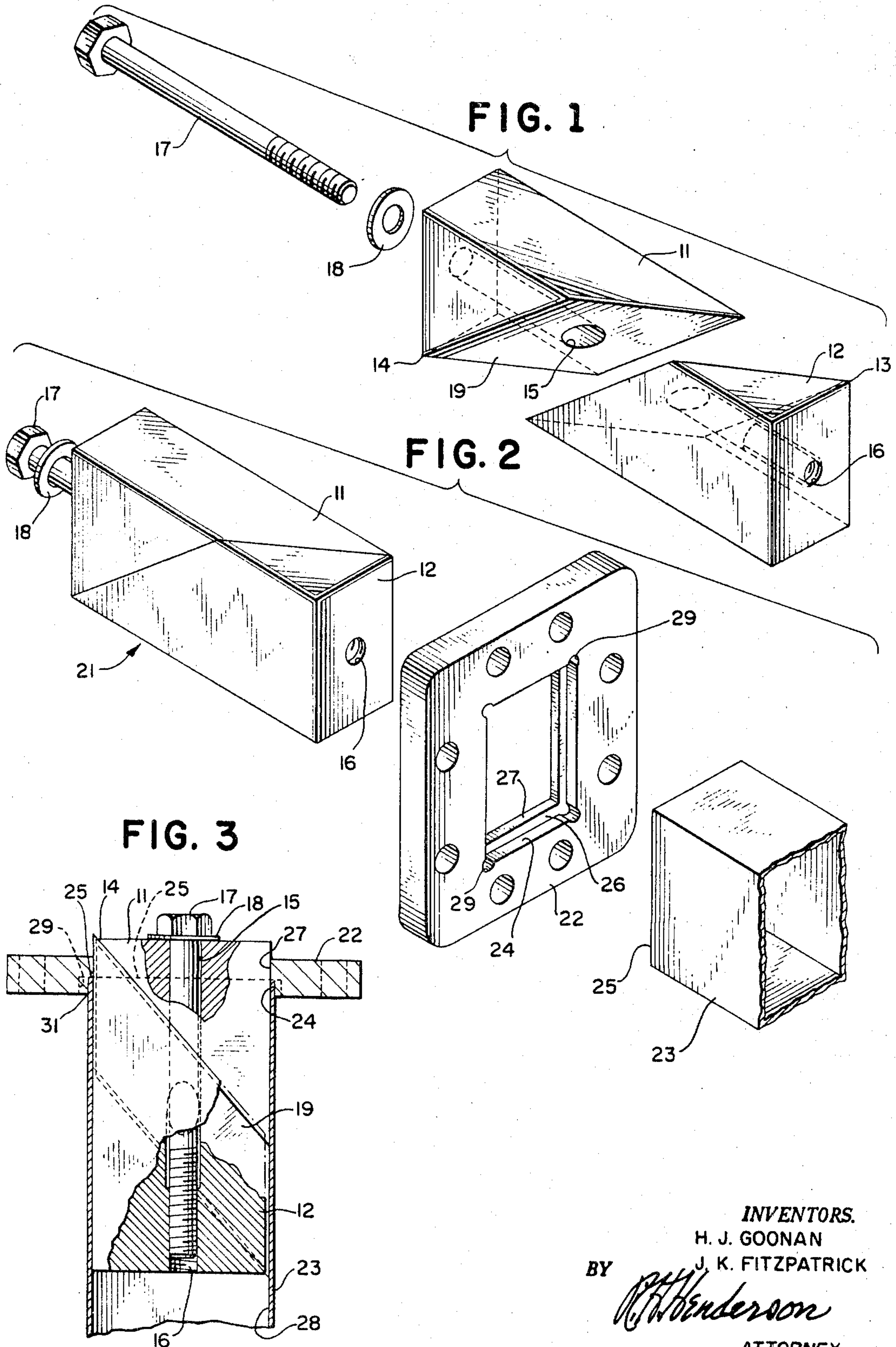


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WAVEGUIDE FLANGING METHOD

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1

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WAVEGUIDE FLANGING METHOD

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2 Claims. (Cl. 29—600)

ABSTRACT OF THE DISCLOSURE

The disclosure describes a method of forming a smooth internal joint between a waveguide and a flat rectangular flange having a rectangular recess and rectangular aperture at opposite sides. The method involves inserting one end of the waveguide into the recess in the flange, inserting a pair of laterally juxtaposed slidable longitudinally wedge shaped core members into the waveguide, and applying a compressive force to the core members axially of the waveguide to force the core members to slide longitudinally of each other while forcing all four walls of the waveguide outwardly until they register with edges of aperture. A fillet of solder is then applied all around the waveguide at the recess in the flange. Solder may also be applied through extended corners of the recess to fill in rough edges of the end of the waveguide.

This application is a continuation-in-part of our co-pending application Ser. No. 169,786, filed Jan. 30, 1962, now Patent No. 3,194,467.

This invention relates to the flanging of microwave plumbing, and more particularly to novel method and means to apply flanges with accuracy and speed to the extremities of a rectangular waveguide in an improved manner.

It is common in microwave technology to solder or braze companion flanges onto abutting ends of the sections of hollow tubing used in the transmission of such high frequency energy. For radar applications such flanges usually are constructed in the form of a choke joint, because such a joint is relatively non-critical as to the alignment or even the closeness of connection of the flanges.

When it is desired to employ microwave carriers for communication purposes where a very large number of channels are to be modulated onto one or more carriers simultaneously, however, such as now occurs in common carrier communication networks, it is found that the resulting bandwidth occupied by the signal exceeds the capabilities of the choke joint because the widest band of essential resonance for which it can be designed is exceeded by that of the signal.

Under these circumstances, the excellent electrical matching properties of the choke joint are unavailable for this service, and recourse has been had to a simple flanged joint using companion flanges soldered to the guides, and which have plane surfaces completely across the mating faces.

With such a construction extreme accuracy of manufacture and assembly becomes of paramount importance, since not only does leakage of energy occur through even the slightest imperfections of flange face surfaces but reflections of the traveling waves in the guide are produced by any obstruction, step, or discontinuity of the waveguide aperture in traversing the joint.

Such reflections, although tolerable to a degree in other microwave systems, are highly undesirable in the application described because of their severe effect in introduc-

2

ing distortion and noise from the phase aberrations resulting from multipath transmission in the guide due to zig-zagging of waves between multiple discontinuities.

Efforts to overcome this difficulty have included mounting the flange not at the end of the guide, but merely close to the end, and then machining off the protruding portion of the guide together with a portion of the flange to produce a plane surface. Aside from the obvious great expense of such a procedure, it is inapplicable to assemblies longer than a moderate maximum length, and at best maintains only the existing internal dimensions of the guide, which may not be adequate, as later set forth.

Another, and more widely used approach to this problem has been to employ a flange having an aperture in the face which is accurately broached to the nominal internal dimensions of the waveguide, and having a recess in the rear, in the nature of a socket or counterbore, for receiving the waveguide against a shoulder. The waveguide is then soldered into the socket by the application of moderate heat, and the introduction of soft solder in the joint between guide and recess on the outside, while the assembly is hot.

Three salient difficulties are encountered in this procedure. Since the guide end can not be cut perfectly square, solder flows into the guide through the imperfections of fit to form obstructing and reflecting occlusions. The imperfections of fit of the waveguide end constitute reflecting discontinuities of the waveguide inner surface, in and of themselves. Waveguides are extruded shapes, and while reasonably close tolerance on internal dimensions usually are maintained, they can vary by a significant amount between samples made by different dies, and even between samples made from the same die, so that when abutted, a serious discontinuity also can occur from this cause.

We have discovered that by employing a novel method of affixing this latter type of flange to the guide, all of the above difficulties can be completely overcome, and the installation of flanges accomplished very accurately and expeditiously, even as a field procedure, without the need for any substantial experience or skill on the part of the installer.

It is therefore an object of this invention to provide a method for flanging a joint in a rectangular waveguide wherein solder occlusions are prevented.

It is another object of the invention to provide for the accomplishment of such a joint wherein discontinuities of the integrity of the waveguide wall surfaces do not occur.

It is another object of the invention to provide for the accomplishment of such a joint wherein waveguides of the same nominal but differing actual internal dimensions are connected with a smooth juncture having a very low voltage standing wave ratio in both directions.

It is a further object of the invention to provide for these things in a simplified manner requiring no substantial skill or experience on the part of the operator in order to develop such advantages.

It is a further object of the invention to reduce the time and effort required to produce a satisfactory waveguide joint.

It is a still further object of the invention to provide a simple and efficient waveguide flanging method for the accomplishment of the above objectives.

These objects we accomplish by a system of waveguide flanging which will be understood from consideration of the following specific illustrative example of the best method known to us for the practice of the invention, as will be more clearly understood by reference to the appended drawings wherein:

FIG. 1 is an exploded view of a tool used in practicing the invention.

FIG. 2 is an exploded view of an assembly comprising a portion of FIG. 1; and

FIG. 3 is a partially sectional view of an assembly involved in the practice of the invention.

Referring now to the drawings, there is seen in FIG. 1 an exploded view of the expansible plug which is used for the convenient practice of the instant invention.

Truncated portions 11 and 12 of a rectangular parallelepiped made of strong material such as brass are separated by a through cut on a plane through diagonal corners 13 and 14. A longitudinal hole of generous clearance dimension is located axially of the part 11 and continued as a counterbore into the part 12 up to the threaded portion 16 in a coaxial hole of smaller diameter.

A cap screw 17 through the washer 18 transfixes this assembly, engaging the threads of 16 to crowd together the portions 11 and 12. The surface 19 of the above described cut on the portion 11, and its counterpart on the portion 12 are smoothly finished and may be lubricated so that application of compressive force by the screw 17 is readily able to cause sliding of the parts along this surface.

FIGURE 2 shows the assembly just described denominated 21, and a waveguide terminal flange 22, and the end of a section of waveguide 23 to which the flange is to be applied. The recess 24 into which waveguide 23 is to be soldered necessarily provides a loose fit when assembled on the waveguide, because of the necessity of a clearance space for the solder to enter, and because of the variability of the dimensions of the guide. The cut end 25 of the waveguide is seldom precisely square, and therefore does not seat perfectly against the accurate bottom surface 26 of the recess 24. It is not unusual for at least one of the four cut sides of waveguide 23 to fail to bottom on the surface 26, leaving a gap between the inner guide surface and the accurately broached extension surface 27 of the flange 22.

When the above described components of the exploded view of FIG. 2 are assembled and the screw 17 tightened, an assembly as depicted in FIG. 3 results. It will be observed that the portion 11 is offset from the portion 12 because of having slid diagonally under pressure from the screw 17 so that guide 23 is pressed firmly against the walls 24 of the flange 22, so that the inner surface 28 of the guide is at all points in line with the broached (or otherwise accurately sized) surface 27 of the flange 22. This is despite the fact that the guide 23 may have had internal dimensions somewhat smaller than those of the surface 27 before its expansion by the tightening of screw 17. Such tightening is made sufficient that flange 22 is firmly secured to guide 23, and the assembly may be inverted, or handled in any position without loss of the flange, and in fact the flange may be so applied in the inverted position to a downwardly depending guide end without difficulty, which often will constitute a great convenience.

It will be apparent, however, that under the described conditions of an expanded fit of the guide 23 into the flange 22 it is not to be expected that solder will be able to flow between them to form a seal, and that soldering will occur only as an external fillet therebetween when applied at their junction. This is entirely adequate for purposes of strength and retention of accurate fit, however.

At 29 in FIG. 2, there is seen a cylindrical extension of the corners of the recess 24, as may be made by the runout of an end milling cutter in forming the recess. Such corner extensions are not filled by insertion of the waveguide, and therefore constitute wells whereby solder may be led to the bottom surface 26 of the flange 22 after assembly as in FIG. 3. It is by this means that an irregularly cut waveguide end is enabled to be provided with a flush internal surface extension entirely through

the flange 22, by providing access means for the solder to flow to this area.

It should be noted that for the purposes above described, it is necessary that solder shall not adhere to the members 11 and 12. They may be chromium plated if made of brass, or constructed entirely of aluminum alloy to secure this end. In addition, or alternatively, it is convenient to apply a parting material such as a silane grease, to their exterior guide contacting surfaces in advance of assembly as shown in FIG. 3.

When assembled as shown, the heating of the joint may be accomplished quite satisfactorily for L-band sizes with an ordinary electric hot plate in three or four minutes, with a great advantage over the use of a torch in convenience, safety and cost of equipment, as well as preservation of the external appearance of the components. If enhanced structural resistance of the joint is desired, this method of heating is entirely applicable to the introduction of commercially available high strength, low temperature solder to the hot joint as a fillet at junction 31 and into the wells 29.

The expandable plug of FIG. 1 is also usable as a movable and settable plug for terminating a waveguide used as a stub, in which use it provides a conveniently adjustable tuning means for the stub, during periods when it is not in use for the purposes of this invention or as a separate and distinct utility for the device.

Although this invention has been described in terms of a specific illustrative example thereof, it will be apparent to those skilled in the art that various modifications and elaborations of the example described may be accomplished without however departing from the essential spirit of the invention and it is therefore intended that the invention be limited only by the appended claims.

What is claimed is:

1. The method of securing a hollow rectangular waveguide to a flat rectangular flange to form a smooth internal joint therebetween, said flange having a rectangular aperture at one side with smooth straight edges, and having a rectangular recess with straight edges at the other side thereof, the edges of the recess being longer than adjacent respective edges of the aperture to define a rectangular bottom wall inside the flange at the edges of the aperture, said waveguide having opposed pairs of parallel walls whose thickness is not greater than one-half the difference in length between edges of the recess and adjacent edges of the aperture, one end of the waveguide having an external size which is smaller than that of the recess; said method comprising the steps of:

- (a) inserting said one end of the waveguide into the recess of the flange up to said bottom wall at the edges of the aperture;
- (b) disposing a pair of mutually slidable wedge shaped laterally juxtaposed core members in said one end of the waveguide and in said aperture;
- (c) forcing the core members to slide longitudinally of each other in opposite directions by applying a compressive force directed longitudinally of the core members and axially of the waveguide, so that the core members force both pairs of opposite walls of the waveguide apart until inner sides of said walls register precisely in coplanar relationship with respective edges of the aperture; and
- (d) applying a fillet of solder all around the waveguide at said recesses to bond the waveguide to the flange only at said other side of the flange.

2. The method defined by claim 1, wherein said recess has cylindrical corners extending beyond intersecting edges of the recess, said method further comprising:

- (a) the step of applying molten solder through said corners of the recess to fill any spaces between ends of said walls and said bottom wall at the edges of the aperture while the core members prevent deposition of any solder on the inner sides of said walls and the edges of said aperture; and

5

(b) allowing the last named solder to set to form said smooth internal joint and to cooperate with the filet of solder around the waveguide in bonding the waveguide to the flange.

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