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METHOD OF ASSEMBLING A FLANGED WAVEGUIDE DEVICE

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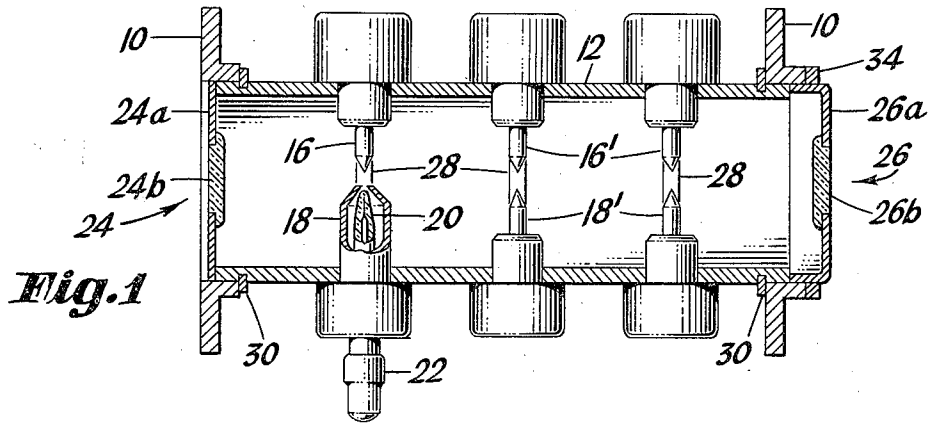



Fig. 1

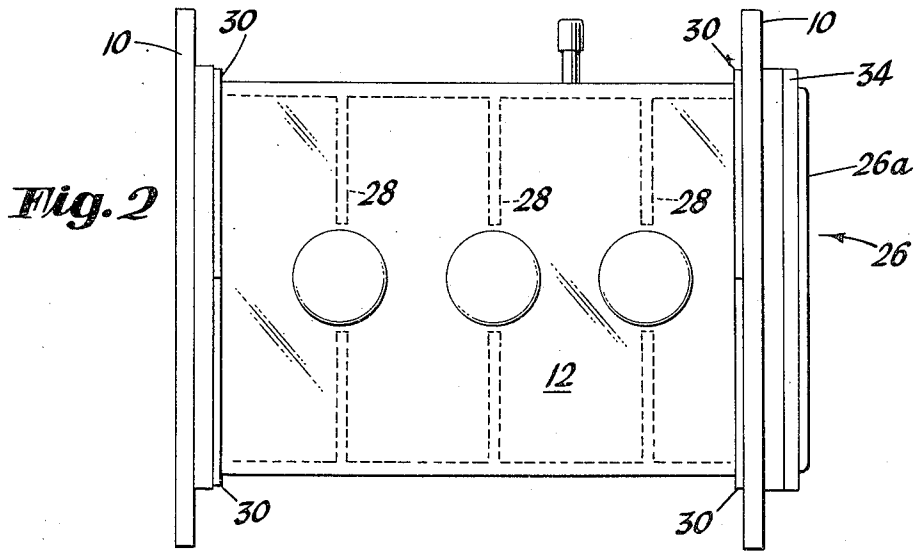



Fig. 2

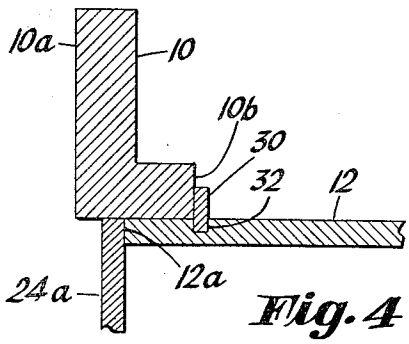



Fig. 4

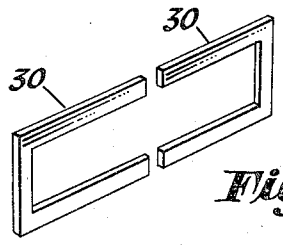



Fig. 3

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# METHOD OF ASSEMBLING A FLANGED WAVEGUIDE DEVICE

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2 Claims. (Cl. 29—25.13)

The present invention relates to waveguide apparatus for transmission of microwave energy and, in particular, to waveguide structures containing gas at low pressure such as transmit receive (TR) and anti-transmit receive (ATR) tubes.

The main object of the present invention resides in the provision of a construction and an assembly method for locating and joining a mounting flange to the body of a waveguide portion of the device in a way that will assure accurate orientation of the face of the flange. Devices of the character here involved conventionally include a length of metal waveguide of comparatively thin wall construction, to which there is jointed a mounting flange at one end, or at both ends, and the joint is required to be vacuumtight in order that the gas contained in the device at very low pressure may be preserved against leakage and contamination. It is also required that an end closure for the waveguide be accurately oriented in relation to other structures constituting one or more discharge gaps within the waveguide. The orientation of the window relative to the discharge gap is also critical, and is influenced by the manner of mounting the flange. In the illustrative embodiment that is described in detail below, the flange is located on the waveguide exterior by means of a flat key extending all the way around the waveguide and fitting into a grove in the waveguide exterior. The key, the flange, and the waveguide are united in a hermetic joint accurately locating the face of the flange in a predetermined accurate spacing position in relation to the window, and to a pair of electrodes within the waveguide constituting a discharge gap. The manner of forming the waveguide and flange assembly is such as to leave the end of the waveguide accessible to receive a waveguide window and to locate that window accurately in relation to the discharge gap. Considerable difficulty has been encountered with other forms of assembly in achieving both the necessary and dimensional tolerances and in assuring, with a high degree of consistency in production, the necessary hermetic seals. The nature of the invention and further features of novelty will be better appreciated from the following detailed disclosure of an illustrative embodiment of the invention which is shown in the accompanying drawings, wherein:

Figure 1 is a central longitudinal cross-sectional view of a TR tube embodying features of the invention;

Figure 2 is a plan view thereof;

Figure 3 is a perspective view of the two part key employed in the device in Figures 1 and 2;

Figure 4 is a greatly enlarged detail view of the portion of the device in Figure 1.

The invention is illustrated as being employed in a typical form of transmit-receive tubes which conventionally includes a mounting flange **10** of relatively thick, rigid proportions, joined to a rectangular length of waveguide **12**, forming the body of the device. Metal electrodes **16** and **18** constitute a discharge gap within the waveguide, and keep-alive electrode **20** within the electrode **18** is used to maintain a small volume of low-pressure gas in ionized condition in the region of the tips of electrodes **16** and **18**. Electrodes **16** and **18** are of metal and are conductively joined to the waveguide wall. Keep-alive electrode **20**, though insulated from electrode **18**, is joined thereto by a glass seal **22** for rigid and vacuum-tight assembly to the device. Two additional gaps **16'** and **18'** lacking a keep-alive electrode are also provided. Associated with each discharge gap is a conventional iris **28** whose purpose is to establish resonance in combination with the capacitive effect of the gap electrodes. A window **24** is joined to one end of the device and a second window **26**, is joined to the opposite end of the device. Each window includes a frame portion **24***a*, **26***a*, and a central glass or ceramic portion **24***b*, **26***b*, respectively.



Significantly, the flange is joined to waveguide **12** in an arrangement exposing flanges **24***a* and **26***b* to the ends of waveguide **12** whereby the windows may be accurately oriented in relation to the discharge gap established by electrodes **16** and **18** and by the irises **28**.

Referring now to Figures 3 and 4, a two-part key **30**, both portions identical, are formed and disposed in a groove **32** in waveguide wall **12**. The scale of values involved may prove helpful for appreciation of some of the factors involved. The wall thickness of waveguide **12** is, in an example, .080" and groove **32** which completely surrounds the waveguide **12** is one-half of that thickness, or .040" deep.

In routine manufacture, a pair of key portions **30** are slid into groove **32** at each end of waveguide body **12**. The parts are properly dimensioned to insure butting of the ends of key portions **30** against each other in the assembly. Thereafter, flange **10** is slid over the waveguide and against the face of two-part key **30**. It is readily possible to control accurately the spacing between key **30** and the end **12***a* of the waveguide. The separation of front and back flange surfaces **10***a* and **10***b* are also susceptible to accurate control. In this way, the key serves to locate the flange in relation to the waveguide which carries the devices constituting the discharge gap and, at the same time, it exposes the end surface **12***a* of the waveguide for receiving each window and locating the windows accurately in relation to the faces of the mounting flanges.

The key shown advantageously surrounds the waveguide and, because of this feature, it is adapted to perform the further function of insuring success in forming vacuum-tight bonds between the flanges and the waveguide body, consistently in large numbers of these devices. It will be understood from the following:

If, for a moment, the question of orienting flange **10** is disregarded, and this flange were assembled to the exterior of a length of waveguide, it would be possible to locate a preform of brazing material on the waveguide exterior against the surface **10***b*. By properly heating the assembly, it would be possible to join the flange to the waveguide body. There are, however, irregularities of sufficient extent inherent which produce wide differences in capillary action at different peripheral points of the waveguide surrounded and contracted by flange **10**. Capillary action at some points consequently tends to deprive others entirely of brazing material with the result that leaks tend to develop in the final construction.

In contrast, when a brazing preform is assembled adjacent to key **30**, with flange **10** also assembled to the waveguide body, remarkably consistent success is achieved in hydrogen-firing the assembly to form vacuum-tight joints of the key, the flange, and the waveguide. It is possible that the sharp bends in the capillary path promotes uniformity in flow of brazing material while the unit is subjected to brazing heat.

In the same heating operation, or advantageously in a subsequent operation, windows **24***a* and **26***a* are brazed or soft-soldered in place at the ends of waveguide **12**. These joints unite the window flange **24***a* (**26***a*) to the ends of the waveguide. The hermetic seal is also formed between the window and the flange **10**.

It is conceivable that isolated pins could be used extending outward from holes in waveguide **12** to constitute a shoulder for locating flange **10** on the waveguide body; but, while serving part of the desired functions, such pins would not be adequate to insure uniformity of vacuum-tight seals being formed.

The window and flange assembly illustrated at the left end of Figure 1 is naturally subject to a latitude of variation and, in fact, different forms of construction are shown at the opposite ends of the device. Window **26** has a cup flange **26***a* that is oriented in relation to the discharge gap **16'**, **18'**, by the end of the waveguide section, just the same as waveguide end **12***a* orients flange **24***a*. A wire-braid gasket **34** is shown assembled to the right end of the device, but it will be understood that window **26**, flange **10**, and body **12** are hermetically sealed together in the same way as that described for window **24** and flange **10**, on waveguide **12**. The key in each instance serves as an abutment locating the flange accurately and promoting excellence of hermetic sealing.

The device in Figure 1 is actually a TR tube, but the invention obviously is applicable to other waveguide devices, whether having one or two flanges. Such other devices include the usual A-T-R tubes having one flange, to pre-TR tubes and to attenuator tubes. Further, it will be recognized by those skilled in the art that detailed changes in design may be made without, however, departing from the spirit of the invention and, therefore, the



appended claims should be accorded that latitude of interpretation which is consistent with the scope of the invention.

What is claimed is:

1. The method of fabricating a waveguide structure having an external flange, including the steps of forming an encircling groove in a length of waveguide, disposing an encircling key in said groove so as to project outside said groove, assembling a flange against said key and about said waveguide, and uniting said key, said waveguide and said flange.

2. The method of fabricating an electric discharge device including the steps of forming a discharge-gap structure within a length of waveguide critically spaced from an end thereof, forming a surrounding groove in said waveguide at a position accurately spaced from said waveguide end, disposing a key in said groove to surround the waveguide and project out of said groove, joining a flange to said key and said waveguide in a vacuum-tight seal, and sealing a window to the inside of said flange and against said end of said waveguide.

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