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INLINE WAVEGUIDE TO COAXIAL TRANSITION

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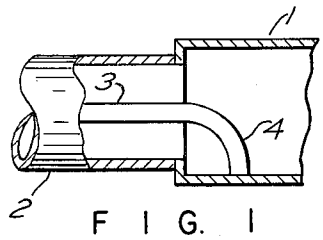


FIG. 1

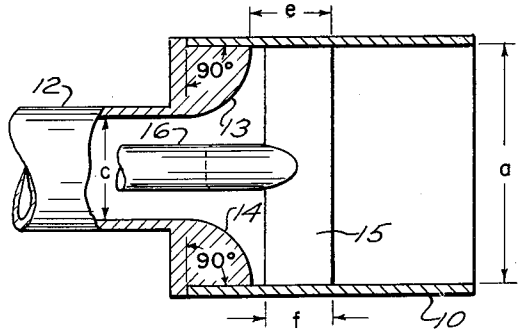


FIG. 2

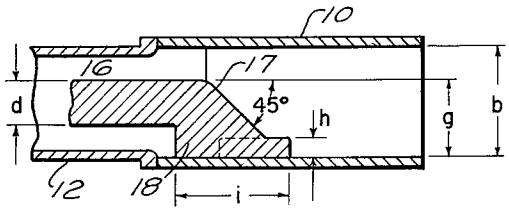


FIG. 3

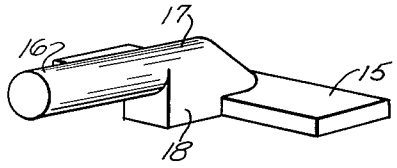


FIG. 4

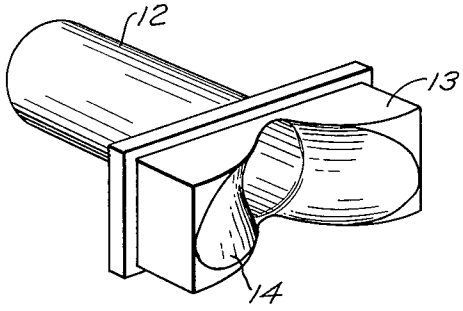


FIG. 5

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INLINE WAVEGUIDE TO COAXIAL TRANSITION

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This invention relates in general to apparatus for converting one electromagnetic energy mode to a different mode and more particularly relates to rectangular waveguide to coaxial line transition devices.

In microwave transmisison lines it is frequently desirable and often necessary to change from waveguide to coaxial line. Many components, such as duplexers and antenna feed horns, are more easily constructed of waveguide. However, many of the microwave generators have coaxial output terminals and it is then necessary to convert from the coaxial line to waveguide. It is also more convenient, at the longer wavelengths, to produce a symmetrical field for application to rotary joints by the use of the coaxial mode. The problem, generally, is to provide for a transition between the dominant coaxial TEM-mode and the dominant TE_{10} mode in the rectangular guide.

The invention resides in a joint providing a transition from rectangular wave guide to a coaxial line which is aligned with the waveguide. Such joints are commonly known as "inline transitions." In the invention energy is coupled from the rectangular guide to the coaxial line by a loop having its plane at right angles to the magnetic field of the energy in the guide. In order to permit the joint to accommodate a wider band width than can be accommodated by a conventional joint, a transverse step is positioned in the rectangular waveguide to form an iris and the loop is made to merge into the step. The outer conductor of the coaxial line is terminated in a flared end which is joined to the rectangular guide. The flared end actually constitutes the back wall of the guide. The loop is positioned close to the back wall and is provided with a web which is located within the flared end of the coaxial line. The effect of flaring the back wall and positioning the loop close to the flared wall is an increase in the power which can be transmitted through the transition without encountering arcing or electrical breakdown in the joint.

The invention, both as to its construction and mode of operation, can be better understood by a perusal of the following detailed description when considered together with the accompanying drawings in which:

FIG. 1 depicts a sectional view of a conventional inline transition;

FIG. 2 is a horizontal sectional view of a preferred embodiment of the invention;

FIG. 3 is a vertical sectional view taken along the plane A—A of FIG. 2;

FIG. 4 is a perspective view of the loop and step assembly; and

FIG. 5 is a perspective view of the flared end of the coaxial line's outer conductor.

Referring now to FIG. 1, there is shown a conventional inline transition having a rectangular waveguide 1 joined to a coaxial line 2. The center conductor 3 of the coaxial line terminates in a loop 4 lying in a plane at right angles to the magnetic field H of the energy in the guide. The loop is usually a circular arc and is fastened to the lower broadwall of the guide. Because the TEM-mode of the coaxial line can inherently handle more power than the transition, when high power is transmitted arcing or breakdown occurs first in the rectangular guide between the loop and the closest point on the upper wall of the

rectangular guide. Moreover, in the fabrication of inline joints, in order to obtain joints of uniform characteristics, the loops must have precisely the same contour. Since the loop has an arcuate contour, it is difficult, during manufacture, to determine the variation of a particular loop from the desired contour.

Referring now to FIGS. 2 and 3, there is shown a rectangular waveguide 10 joined to a coaxial line 11. The outer conductor 12 of the coaxial line terminates in a flared end which constitutes the back wall of the rectangular guide. The flared end is depicted in FIG. 5. The shape of the back wall has an important effect in increasing the power handling capacity of the transition. It can be seen from FIGS. 2 and 5 that the back wall has two rounded side lobes 13 and 14. It has been empirically determined that excellent results are obtained when the curvature of the side lobes is the largest full quadrantal arc that the lobes can accommodate. That is, as shown in FIG. 2, the curvature of the lobes is a 90° arc of a circle. The rectangular waveguide 10 fits closely over the flat lateral surfaces of the flared end of the coaxial line's outer conductor and the two parts are united by brazing or soldering them.

A transverse iris is formed in the waveguide by a step 15 extending across the lower broadwall of the guide. The iris acts to increase the bandwidth of the waveguide. It can be observed in FIG. 2 that step is not merely a thin partition but has an appreciable width *f*. The center conductor 16 of the coaxial line is a circular rod which is integral width the loop 17. The invention eliminates the difficulty of ascertaining the curvature of an arcuate loop by changing the slope of the loop to a straight line. The loop rises at an angle of 45° from the step 15 and then bends abrutply to merge into the rod 16. The loop 17 is not simply a bent rod as it has a web 18 which extends from the step toward the back wall. The loop and the step are fabricated as one part as shown in FIG. 4 and that part is then brazed to the rectangular guide. Since the loop and step assembly is a separate part, its dimensional accuracy can be easily checked during the manufacturing process, especially as the loop's contour is linear rather than arcuate.

The dimensions of the transition joint are critical, if the joint is to operate properly at the intended frequency of operation. It is possible by adhering to certain principles of similarity, to make use of the dimensions of an existing device in the design of a like device to operate at a different frequency. For the principles involved, the reader is referred to pages 87 to 90 in Volume 9 of the Radiation Laboratory Series, entitled "Microwave Transmission Circuits," published by McGraw-Hill. The dimensions given below are for an inline transition intended to operate in the frequency range of 5.4 to 5.9 kilomegacycles.

a	1.872
b	.872
c	.806
d	.354
e	.632
f	.536
g	.613
h	.156
i	.900

The placement of the loop 17 relative to the flared back wall is of importance. From FIGS. 2 and 3, it is apparent that the web portion 18 of the loop lies between the lobes 13 and 14. Indeed, the point where the loop changes from a 45° slope to the horizontal, marks the beginning of the flared back wall lobes. By effectively causing part of the loop to lie between the lobes 13 and

14, the power handling capabilities of the transition is considerably improved. The construction of the invention eliminates the abrupt change from rectangular guide to coaxial line which is a feature of the conventional transition in FIG. 1. Since the lobes 13 and 14 (FIG. 2) extend into the rectangular guide, there is a gradual merging of the coaxial line and the rectangular guide.

In a typical rectangular waveguide to coaxial line transition constructed in accordance with the invention, it was determined that, compared to a conventional type of transition, the novel device was able to handle 50 to 100 percent more power and that the bandwidth accommodated was two to three times greater than the conventional transition.

While a preferred embodiment of the invention has been illustrated in the drawings, it is evident that modifications can be made which do not depart from the essence of the invention. It is therefore intended that the invention not be limited to the precise structure illustrated, but rather that the scope of the invention be delimited by the appended claims.

What is claimed is:

1. An inline waveguide to coaxial transition comprising a rectangular waveguide joined at one end to the outer conductor of a coaxial line, a partition extending transversely across a broadwall of the guide and reducing the guide height across the entire width of the guide, the coaxial line having its center conductor terminating in a loop, the loop having a web portion, and the loop being integral with the partition.

2. An inline waveguide to coaxial transition comprising a rectangular waveguide having a backwall merging into the outer conductor of a coaxial line, a transverse step in one broadwall of the rectangular waveguide, the transverse step reducing the guide height across the entire width of the waveguide, the coaxial line having its center conductor terminating in a loop extending linearly downwardly and merging into the step, and the loop having a web portion extending from the step toward the back wall.

3. An inline waveguide to coaxial transition comprising a rectangular waveguide, a coaxial line having its outer conductor joined to and providing the back wall of the waveguide, the back wall having flared side portions, a transverse step in one broad wall of the rectangular waveguide, the transverse step reducing the guide height across the entire width of the waveguide, the coaxial line having its center conductor terminating in a loop extending linearly downwardly and merging into the step, the loop having a web portion, and the loop being positioned with its web disposed between the flared side portions of the back wall.

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