

Aug. 13, 1957

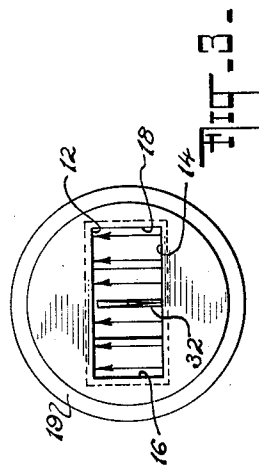
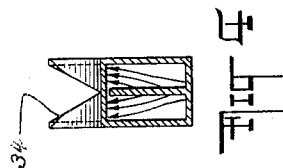
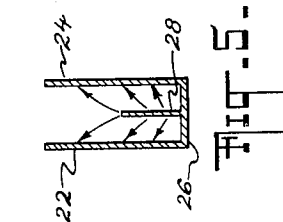
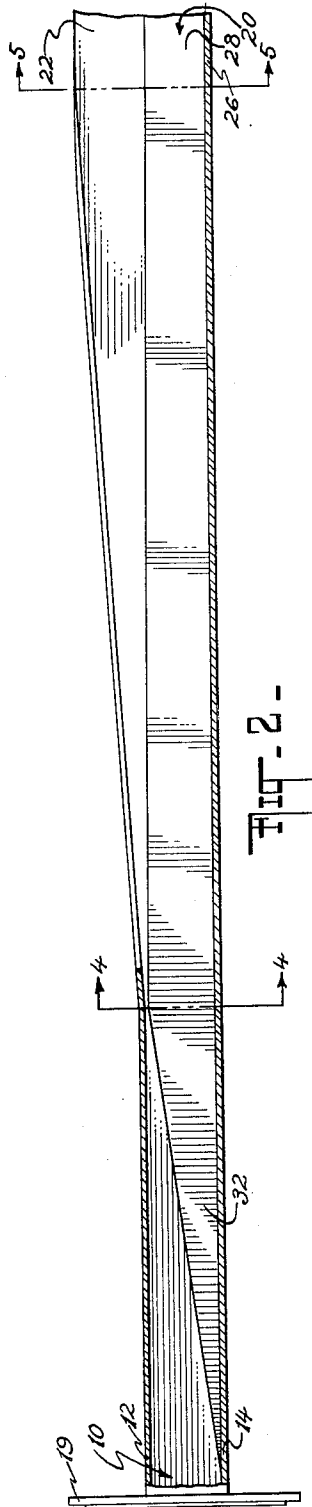
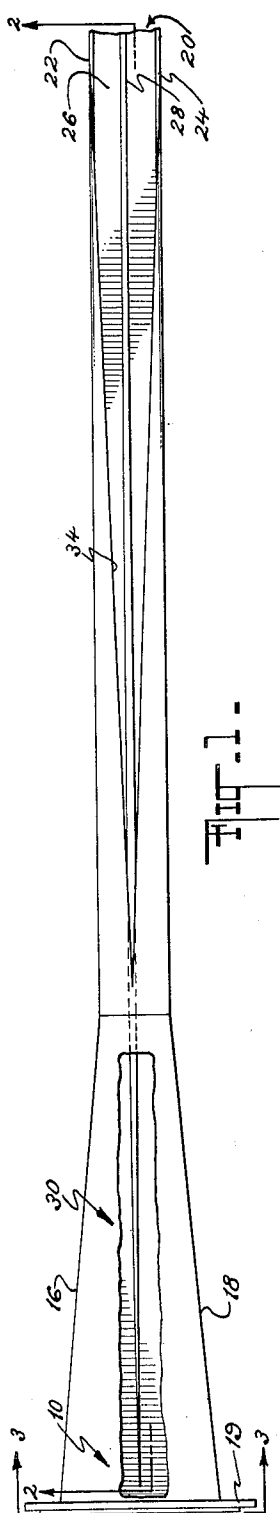
F. S. COALE

2,802,991

RECTANGULAR WAVE GUIDE TO E-GUIDE TRANSITION

Filed July 12, 1955

2 Sheets-Sheet 1



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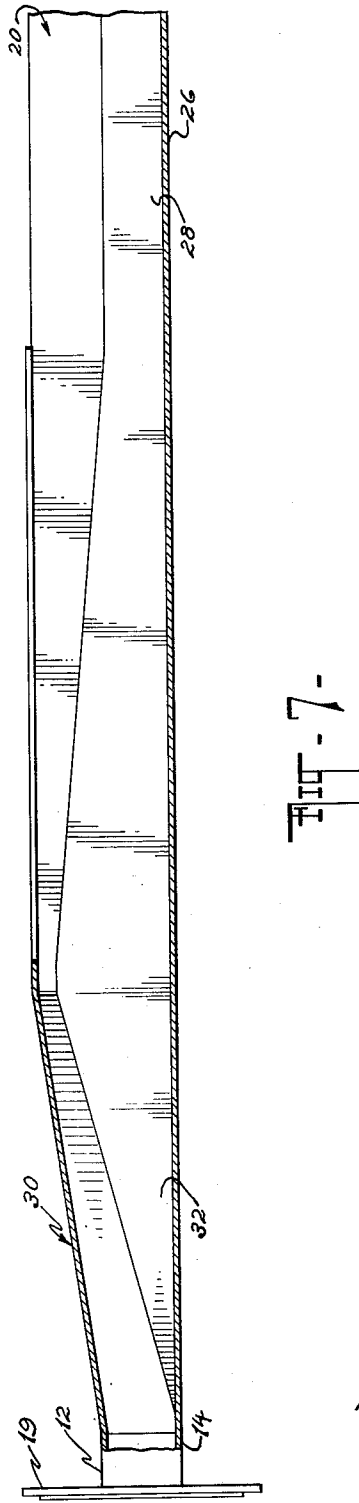
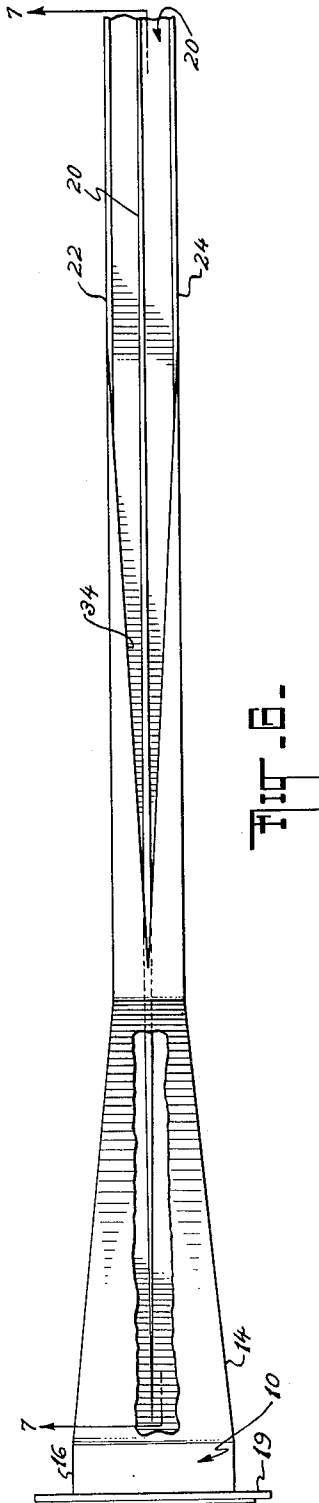
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RECTANGULAR WAVE GUIDE TO E-GUIDE TRANSITION

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2 Sheets-Sheet 2



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2,802,991

RECTANGULAR WAVE GUIDE TO E-GUIDE TRANSITION

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Application July 12, 1955, Serial No. 521,443

1 Claim. (Cl. 333—21)

This invention relates to a transition coupling device, and, more particularly, is concerned with a transition device for coupling microwave energy between a hollow rectangular wave guide and an E-guide.

In the copending application Serial No. 521,960 filed July 13, 1955 in the name of Franklin S. Coale there is described a novel wave guide transmission line referred to as an E-guide. This guide is constructed with a channel shaped member providing two parallel side walls and a perpendicular connecting wall, with a central fin extending parallel to and positioned half way between the side walls and joined along one longitudinal edge to the connecting wall, whereby the cross-sectional configuration of the guide is in the form of the letter E.

It is the general object of this invention to provide means for directly coupling a hollow rectangular wave guide to such an E-guide in axial alignment therewith with a minimum of reflection and insertion loss over a substantial frequency band.

The transition of the present invention is accomplished by the gradual insertion of a fin of increasing height in the rectangular wave guide, while simultaneously decreasing the width of the rectangular guide down to the width of the E-guide. The resulting section of ridge wave guide is joined to the end of the E-guide in contiguous fashion with the ridge being tapered into the fin of the E-guide. At the same time a slot is cut in the wall opposite the projecting ridge, the slot being gradually expanded to form the open side of the E-guide.

For a better understanding of the invention reference should be had to the accompanying drawing, wherein:

Fig. 1 is a plan view of a wave guide to E-guide transition;

Fig. 2 is a side elevational view of the transition;

Fig. 3 is an end view of the transition;

Fig. 4 is a cross-sectional view taken substantially on the line 4—4 of Fig. 2;

Fig. 5 is a cross-sectional view taken substantially on the line 5—5 of Fig. 2;

Fig. 6 is a plan view of a modification of the transition; and

Fig. 7 is a side elevational view of the modification of Fig. 6.

Referring to the form of the invention as illustrated in Figs. 1—5, the numeral 10 indicates a section of hollow rectangular wave guide having a pair of broad walls 12 and 14, and a pair of narrow walls 16 and 18, and provided with a coupling flange 19. Coupled thereto by a transition means hereinafter described is an E-guide indicated generally at 20 including a pair of parallel side walls 22 and 24 and a perpendicular connecting wall 26, the side walls 22 and 24 and the connecting wall 26 forming a channel shaped member in which is provided a central fin 28. The fin 28 is joined along one longitudinal edge thereof to the connecting wall 26 and is positioned half way between the side walls 22 and 24 in parallel relationship thereto.

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As pointed out in the above identified copending application, it is desirable that the E-guide be proportioned with the space between the parallel side walls being less than a half wavelength. Since the rectangular wave guide must be operated with the broad dimension greater than a half wavelength to be above cut off, a tapered wave guide section, indicated generally at 30, is provided between the rectangular wave guide section 10 and the E-guide section 20. The broad walls 12 and 14 of the wave guide section 10 are extended and are gradually tapered to change the cross-sectional dimensions from that of the rectangular wave guide at one end to that of the E-guide at the other end. For simplicity and ease of construction, the transition is preferably made with the connecting wall 26, of the E-guide and the bottom broad wall 14 of the rectangular wave guide lying in a common plane and forming a single continuous wall.

Since the tapering of the wave guide section 30 reduces the broad dimension below a half wavelength, a tapered ridge 32 is introduced to convert the rectangular wave guide to a ridge wave guide. As is well known, the ridge wave guide has a longer cutoff wavelength (lower cutoff frequency) than the rectangular wave guide. Thus even though the broad dimension of the wave guide is narrowed down by the tapered section 30, the wave guide by virtue of the ridge 32, does not cut off. The width and thickness of the ridge 32 may be determined for given cross-sectional dimensions of the wave guide according to the teachings of the article "Properties of ridge wave guide" by Seymour Cohn, Proceedings of the IRE, August 1947.

The broad wall of the rectangular wave guide 10 having been reduced down to the width of the E-guide 20 by the formation of an intermediate ridge wave guide section, the transition is completed by opening up the top wall of the ridge guide by means of a V-shaped slot 34 and increasing the width of the narrow walls of the wave guide to that of the parallel walls of the E-guide. At the same time, since the ridge at the narrowest part of the ridge wave guide section is wider and thicker than the central fin of the E-guide, the ridge is tapered off in width and thickness in the region of the slot 34. All tapered sections of the tapered wave guide section 30, the ridge 32, and the slot 34 extend over at least a half wavelength and preferably greater distances to provide a smooth transition without introducing reflections due to abrupt discontinuities.

Typical dimensions for a transition operating at frequencies in the C-band are as follows:

	Inches
Rectangular wave guide.....	1.872 x .872
E-guide:	
Parallel walls.....	1.625
Width.....	.750
Fin.....	.633 x .017
Ridge:	
Max. width.....	.829
Max. thickness.....	.075
Length of taper:	
Broad wall.....	6.0
Narrow wall.....	11.0
Slot.....	11.0

While the above-described transition has been shown as having a tapered wave guide section 30 in which the broad walls and narrow walls of the rectangular wave guide are successively tapered into the dimensions of the walls of the E-guide, tapering of the respective broad walls and narrow walls of the rectangular wave guide can be made simultaneously if desired, in the manner shown in Figs. 6 and 7. The same numbers are used in Figs. 6

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and 7 to indicate the corresponding parts of the transition as in the version of Figs. 1-5.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawings shall be interpreted as illustrative and not in a limiting sense.

I claim:

A wave guide transition for insertion between a hollow rectangular wave guide having parallel broad walls connected by parallel narrow walls and a section of E-guide including a channel-shaped conductor defining a pair of parallel side walls, a perpendicular connecting bottom wall, and a conductive fin extending parallel to the side walls and secured along one edge to the bottom wall midway between the side walls, the rectangular wave guide and E-guide being axially aligned, with the narrow walls of the rectangular wave guide lying in planes that are parallel to the planes of the E-guide side walls, comprising a tapered wave guide of rectangular cross section extending between and contiguous with the rectangular

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5 wave guide and E-guide, the tapered wave guide having top and bottom walls tapering from the width of the broad walls of the rectangular wave guide to the width of the bottom wall of the E-guide and side walls tapering from the width of the narrow walls of the rectangular wave guide to the width of the side walls of the E-guide, and a conductive ridge forming an extension of the conductive fin of the E-guide, said ridge being secured along its bottom edge to the bottom wall of said tapered wave
10 guide and being greater in width and thickness than the conductive fin of the E-guide, the ridge having maximum width and thickness in the region where the top and bottom walls of the tapered wave guide section narrow to the width of the bottom wall of the E-guide, the ridge
15 being terminated in a uniformly tapered portion within and longitudinally coextensive with said tapered wave guide section, the top wall opposite the ridge being terminated in a V-shaped slot opening toward the E-guide section, said slot having an apex at a point in the region
20 where the top and bottom walls of the tapered wave guide section narrow to the width of the bottom wall of the E-guide.

No references cited.