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WAVE GUIDE DIRECTIONAL COUPLER

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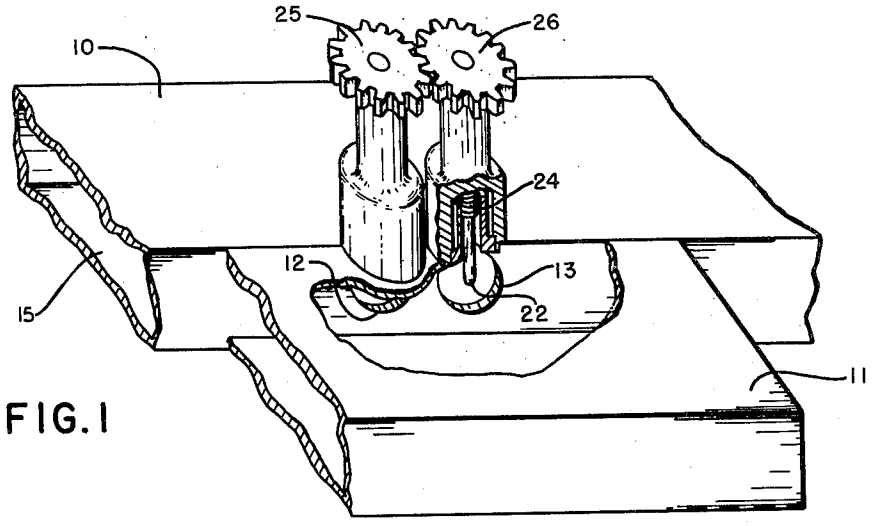

FIG. 1

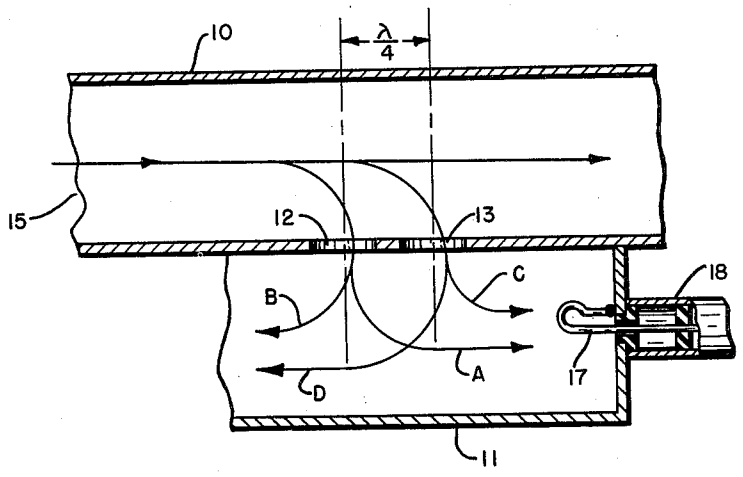

FIG. 2

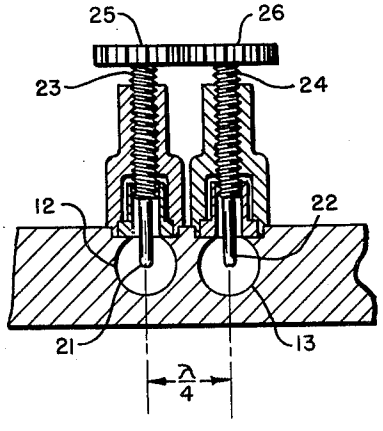

FIG. 3

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WAVE GUIDE DIRECTIONAL COUPLER

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12 Claims. (Cl. 333—10)

This invention relates to waveguide transmission systems and more particularly to directional couplers for use with such systems.

A waveguide directional coupler is a device which is used to abstract energy from a wave traveling in a preferred direction in a main waveguide. Directional couplers are commonly used for power monitoring, impedance matching, or impedance measuring purposes. A waveguide directional coupler may be further described as comprising sections of a main and auxiliary waveguide with common coupling elements. The coupling of energy between the main and auxiliary wave guide sections generally takes the form of one or more properly placed openings in the wall common to the two waveguide sections. The degree of coupling may be defined as the fraction of the energy proceeding in the preferred direction in the main waveguide which is delivered to the output termination of the auxiliary waveguide section. Directivity may be defined as the ratio of the energy appearing at the output termination of the auxiliary waveguide and the energy appearing at the opposite end of the auxiliary waveguide section. In waveguide directional couplers as previously used, the degree of coupling and the directivity are determined by the design and number of the coupling holes in the common wall. For some applications of directional couplers, for example, coupling the output of a local oscillator to a detector, a fixed degree of coupling is not desirable.

Accordingly, it is the principal object of this invention to generally improve waveguide directional couplers.

It is also an object of this invention to provide a waveguide directional coupler in which the degree of coupling is variable.

It is also an object of this invention to provide a waveguide directional coupler in which a relatively large part of the energy in the main waveguide is coupled into the auxiliary waveguide.

The manner in which the above and further objects of this invention may be accomplished will be made apparent by the following description taken with the appended drawings, of which:

Fig. 1 is a perspective view, partially cut away, of a waveguide directional coupler embodying the principles of the invention;

Fig. 2 is a schematic view of the embodiment of Fig. 1 explanatory of the operation of the invention; and

Fig. 3 is a cross-sectional view of the embodiment of Fig. 1 taken in the plane of the wall common to the two waveguide sections.

The embodiment of Fig. 1 consists essentially of two waveguide sections **10** and **11** having coupling elements in the wall common to both waveguides. Waveguide section **10** is connected to a source of radio frequency energy at end **15**. The coupling elements consist of holes **12** and **13** cut into the common waveguide wall with a separation of approximately one-quarter wavelength (or any odd number of quarter wavelengths), and retractable posts **21** and **22**, only post **22** being visible in this figure,

which may be inserted into holes **12** and **13**, respectively, by means of a screw drive mechanism operated by gears **25** and **26**.

The operation of the invention as a directional coupler may be explained with reference to Fig. 2. A fraction of the energy entering waveguide **10** at end **15** goes through coupling hole **12** and divides as shown by lines A and B. Another approximately equal fraction goes through hole **13** and divides as shown by lines C and D. The energy represented by lines A and C will combine in phase and add since the total electrical distances traveled by energy A and by energy C from point **15** are equal. This energy is abstracted from waveguide **11** by a means shown for purposes of illustration as a pickup loop **17** feeding a coaxial output terminal **18**. The energy travelling in the opposite direction in waveguide **11** as represented by lines B and D will combine out-of-phase and cancel, since energy D travels an electrical distance one-half wavelength greater than that traveled by energy B.

Referring to Fig. 3, the coupling between the waveguide sections is increased by inserting posts **21** and **22** into holes **12** and **13**. If posts **21** and **22** are inserted equally, the directivity of the directional coupler is retained. To insure equal insertion, posts **21** and **22** are driven simultaneously by means of two screws **23** and **24**. Screws **23** and **24** are of equal pitch, but opposing threads, one being left-handed and the other right-handed, and are operated by identical gears **25** and **26**. The maximum coupling may be obtained by inserting posts **21** and **22** to the resonance position, at which point the coupling is within a few decibels of complete transmission. Since the directivity is somewhat reduced with maximum coupling, it is usual to operate the coupler slightly below the resonance point.

It is to be understood that the foregoing detailed description and drawings of one embodiment of the present invention are illustrative of the principles thereof. It will be apparent that changes may be made in the structure disclosed without departing from the spirit of the invention as sought to be defined by the appended claims.

What is claimed is:

1. A waveguide directional coupler having a high degree of coupling comprising, two rectangular waveguide sections, a corresponding wall of each waveguide section being common, a pair of coupling holes through said common wall of said waveguide sections, said coupling holes being spaced apart longitudinally a distance substantially equal to an odd number of quarter wavelengths, and posts for insertion into said coupling holes to adjust the coupling between said waveguide sections.

2. A waveguide directional coupler having a variable degree of coupling comprising, two rectangular waveguide sections, said waveguide sections sharing a corresponding common wall, coupling holes through said common wall of said two waveguide sections, said coupling holes being spaced apart longitudinally a distance substantially equal to an odd number of quarter wavelengths, retractable posts adapted to be inserted into said coupling holes to vary the coupling between said waveguide sections, and means for varying the amount of the insertion of said posts into said coupling holes, said means maintaining a substantially equal insertion of said posts.

3. A waveguide directional coupler having a variable degree of coupling comprising, two rectangular waveguide sections joined longitudinally and sharing a common wall, two coupling holes through said common wall of said two waveguide sections, said coupling holes being spaced apart longitudinally a distance substantially equal to an odd number of wavelengths, retractable posts adapted to be inserted into said coupling holes to vary the coupling between said waveguides, two screws of equal pitch driving said retractable posts, the threads of said driving

screws being reversed, and identical gears attached to said driving screws to maintain equal insertion of said retractable posts in said coupling holes.

4. Apparatus comprising first and second longitudinally joined rectangular wave guide sections having a plurality of coupling holes located at odd quarter wave length intervals along the junction of said first and second sections and arranged to transfer wave energy from said first section to said second section to propagate wave energy in a single direction in said second section, and means for tuning said coupling holes for adjusting the degree of coupling between said first and second sections.

5. Apparatus in accordance with claim 4 including means for simultaneously and equally adjusting the tuning of said coupling holes.

6. Apparatus in accordance with claim 4 wherein said last-mentioned means comprises a like plurality of conducting elements arranged to be inserted radially into respective ones of said coupling holes.

7. Apparatus in accordance with claim 4 wherein said last-mentioned means comprises a like plurality of conducting elements arranged to be inserted radially into respective ones of said coupling holes, and means for simultaneously and equally adjusting the insertion of said conducting elements.

8. Apparatus in accordance with claim 4 wherein said last-mentioned means comprises a like plurality of retractable posts arranged to be inserted radially into respective ones of said coupling holes, and means for adjusting the insertion of said posts into said coupling holes.

9. Apparatus in accordance with claim 4 wherein said last-mentioned means comprises a like plurality of retractable posts arranged to be inserted radially into respective ones of said coupling holes, and means for simultaneously and equally adjusting the insertion of said posts into said coupling holes.

10. A wave guide directional coupler comprising, a

main wave guide, an auxiliary wave guide, said wave guides being longitudinally joined forming a common wall therebetween, said common wall having a pair of coupling holes cut therein, said holes being longitudinally spaced an odd number of quarter wavelengths apart, and means for tuning said coupling holes.

11. A wave guide directional coupler comprising, a main wave guide, an auxiliary wave guide, said wave guides being longitudinally joined forming a common wall therebetween, said common wall having a pair of coupling holes of equal size cut therein, said holes being longitudinally spaced an odd number of quarter wavelengths apart, and means for simultaneously and equally tuning said coupling holes.

12. A wave guide directional coupler comprising, a main wave guide, an auxiliary wave guide, said wave guides being longitudinally joined forming a common wall therebetween, said common wall having a pair of coupling holes cut therein, said holes being longitudinally spaced an odd number of quarter wavelengths apart, said coupling holes being operable to couple energy traveling in a predetermined direction within said main wave guide to travel in a desired direction in said auxiliary wave guide, and retractable posts supported along said common wall for radial insertion into said coupling holes to adjust the amount of coupling between said wave guides.

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