March 11, 1958 J. S. HOLLIS ET AL 2,826,742

WAVEGUIDE RING SWITCHES

Filed May 31, 1955

FIG. 1

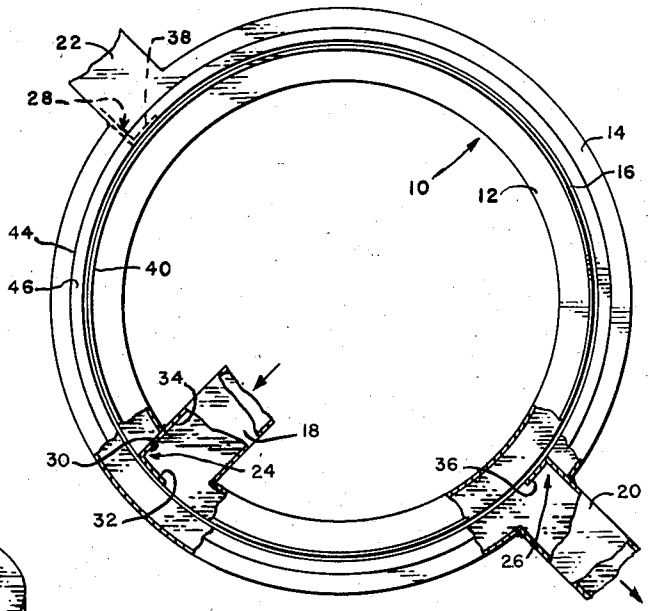


FIG. 3

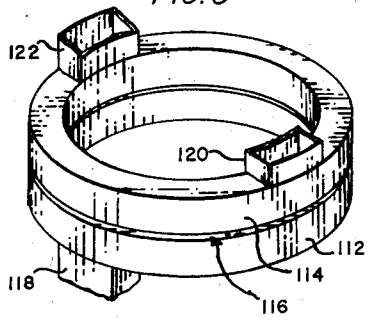


FIG. 2

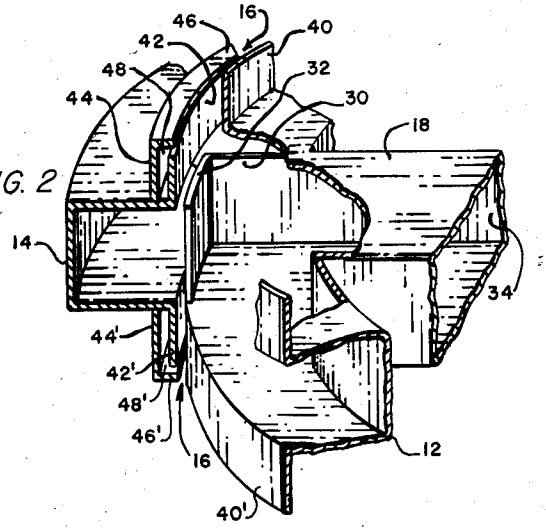
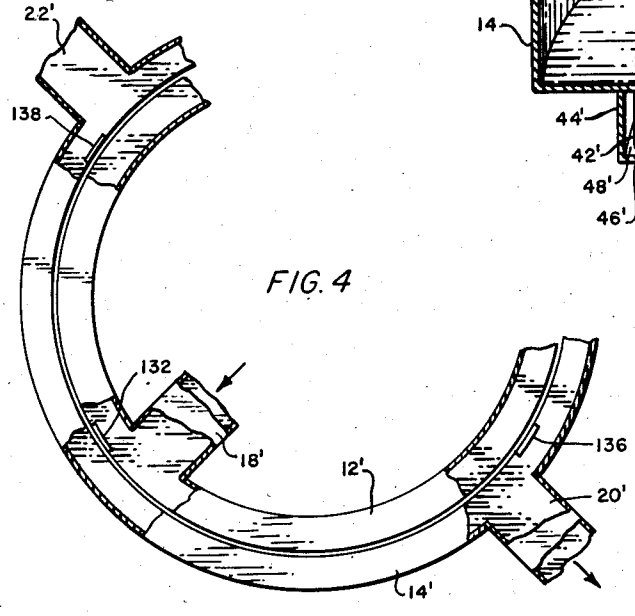


FIG. 4



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WAVEGUIDE RING SWITCHES

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5 Claims. (Cl. 333—7)

This application is a continuation-in-part of our application Serial Number 507,516, filed May 10, 1955, entitled "Low-Loss Waveguide Ring Switch."

This invention relates generally to low-loss waveguide switches for successively connecting an input waveguide to one or more output waveguides.

It is the main object of the invention to provide a switch of this type in which the losses are minimized and which is simple in construction and rapid in operation.

In accordance with our invention the input wave is fed into a waveguide, in the form of a toroid, which is split axially to form concentric, complementary, inner and outer waveguide sections, which can be rotated rapidly relative to each other. The input waveguide extends into one of said sections, while the output waveguides extend into the other section. By means of cooperating circumferential vanes suitably positioned in the inner and outer sections in the regions of the input and output waveguides, energy is permitted to travel in only one direction in the ring waveguide and reach only one of the output waveguides, depending upon its position relative to the input waveguide.

For a better understanding of the invention, together with other and further objects thereof, reference is made to the following detailed description, taken in connection with the accompanying drawing, in which:

Fig. 1 is a plan view of the invention with portions broken away to show the inner details;

Fig. 2 is a fragmentary perspective view of the invention on an enlarged scale with portions broken away;

Fig. 3 is a perspective view of another embodiment of the invention; and

Fig. 4 is a plan view of a modification of the invention.

In the drawings, the numeral **10** indicates an annular hollow waveguide which is axially split in the center so as to form two complementary sections **12** and **14** having an annular space **16** therebetween so that one section can be rotated relative to the other. The space **16** should be as close as tolerances will permit. Since it is located centrally of the waveguide where the current density is at a minimum, the losses are minimized.

Extending radially from inside the ring **10** into the inner section **12** of the ring is an input rectangular waveguide **18** into which the energy to be switched is applied. A number of spaced rectangular output waveguides, in this case two oppositely extending waveguides **20** and **22**, extend from outside ring **10** into the outer section **14**. Although only two output waveguides are shown any number can be arranged around the periphery of the outer section **14**.

Extending from waveguides **18**, **20**, and **22**, respectively, are a plurality of L-shaped vanes **24**, **26**, and **28**. Each of said vanes are identical in construction so that only vane **24** will be described in greater detail. Vane **24** comprises a radially extending arm **30** and a circumferentially extending arm **32**. Arm **30** forms a continuation of wall **34** of waveguide **18** and extends substantially up to split **16** of ring **10**, and is of the same height as wall **34**.

Arm **32** is curved and concentric with the walls of the waveguide sections. The length of arm **32** is only a fraction of the width, i. e., the long dimension of rectangular waveguide **18**, and provides an aperture through which energy can flow from waveguide **18** and through ring waveguide **10** in the clockwise direction to output waveguide **20**. Arm **32** forms with the outer wall of ring **10** a waveguide having a radial width equal to about half the radial width, i. e., half the long dimension, of ring **10**, and hence it is at cut-off for waves having a frequency which propagate in the ring waveguide. This feature together with arm **30** prevents flow of energy in the opposite direction. Similarly, a cut-off waveguide is formed by arm **36** of vane **26**, so that energy cannot flow past vane **26** toward output waveguide **22**.

Arm **32** of input wave vane **24** extends in a counter clockwise direction, while the arms **36** and **38** of the output waveguides extend in a clockwise direction. The dimensions of these vanes are so chosen as to aid in matching the input and output junctions.

Assuming that the outer ring **14** rotates continuously relative to the inner ring **12**, energy will continue to feed from input waveguide **18** through output waveguide **20** until vane **26** passes vane **24**. After that energy will be cut off from waveguide **20** and will pass through waveguide **22**. Thus energy feeds through one output waveguide for 180° of relative rotation, and through the other output waveguide for the remaining 180° of rotation. If more than two output waveguides were used, then each would receive energy for a proportionally smaller fraction of a revolution.

Because ring waveguide **10** is split centrally, a minimum of surface current is interrupted, so that there is very little radiation loss even if no choke joints are used. However, chokes can be added to even further reduce such losses and to improve the electrical characteristics of the vanes, but relatively uncritical chokes can be used for this purpose. Such chokes are shown extending upwardly and downwardly from the splits in the upper and lower walls of the ring. One choke comprises parallel, axially-extending, annular flanges **40**, **42**, and **44**, the latter having a transverse **46** portion which overhangs the upper edge of flange **42**. The three flanges form an annular cavity **48** which is U-shaped in cross-section, the end of one arm of the U-shaped cavity opening into the upper wall of annular waveguide **10** in the region of the split and the end of the other arm being closed. Similarly, a choke cavity is formed at the lower split by downwardly extending annular elements **40'**, **42'**, **44'**, and **46'**.

From the above description it will be seen that the invention herein provides a relatively simple and efficient means for rapidly switching high frequency energy from one channel into one or more other channels. Alternatively it may be used for successively and alternately applying energy from several different channels into a single channel. Thus energy from several sources conducted to waveguides **20** and **22**, which now serve as input channels will be alternately applied to waveguide **18**, which now serves as an output channel.

An alternative method of constructing the switch is to split the ring waveguide midway along a transverse plane. In such a case, the wider dimension of the ring would extend in the axial direction, and the input and output waveguides would, as in the above case, be connected to the narrow side of the ring so that they would extend in the axial directions. Such a modification is illustrated in Fig. 3, wherein the two sections of the waveguide are superposed as shown at **112** and **114**, and the split extends transversely as shown at **116**. Numeral **118** indicates the input waveguide, while the output waveguides are shown at **120** and **122**. A choke joint (not illustrated) can also be added.

By suitably positioning circumferential arms **32, 36,** and **38** of the vanes relative to branch waveguides **18, 20** and **22,** respectively, the radial arms **28, 30,** etc. of the vanes can be entirely eliminated. Such a modification is shown in Fig. 4 wherein elements which are identical to those in Figs. 1 and 2 are labelled with the same reference numerals with a prime mark added. Except for the vane construction, the structures in Figs. 1 and 4 are identical. The wave deflectors here take the form of circumferential vanes or septums **132, 136** and **138** of suitable length and positioned as near the borders of the slit as possible. The septums serve to divide the wide dimension of the ring waveguide into two waveguides each of which is half the width of the ring, so that they are at cutoff to frequencies propagated in the ring. One end of each septum terminates at or near one wall of the branch waveguide, and extends along the ring in a direction which is opposite to the desired direction of propagation of wave energy in the ring.

Numerous other changes and modifications may be made without departing from the spirit and scope of the invention, and it is aimed in the appended claims to cover all such changes.

We claim:

1. A waveguide switching arrangement comprising a main waveguide in the form of a rectangular toroid, said waveguide being split at the center of the wide wall to form two relatively-rotatable, complementary sections each of which contains one of the opposed narrow walls of the waveguide, at least one rectangular branch waveguide connected to each of said sections at the narrow wall thereof, each branch waveguide having an L-shaped vane extending from one wall thereof into said main waveguide, one arm of said L-shaped vane being a continuation of a narrow wall of said branch waveguide and extending across said main waveguide not further than the region of said split, the second arm of said vane extending circumferentially, the second arm of a vane of one section extending in a direction which is opposite to the direction in which the second arm of a vane in the other section extends, the second arm of each vane forming with the opposed wall of the main wave guide a region which is at cutoff to frequencies propagated in said main waveguide.

2. A waveguide switching arrangement comprising a main waveguide in the form of a rectangular toroid having its wide side perpendicular to the axis of the toroid, said waveguide being split axially at the center of the wide wall to form two relatively-rotatable, concentric, complementary sections, at least one rectangular branch waveguide connected to each of said sections at the narrow wall thereof, each branch waveguide having an L-shaped vane extending from one wall thereof into said main waveguide, one arm of said L-shaped vane being a continuation of a narrow wall of said branch waveguide and extending across said main waveguide not further than the region of said split, the second arm of a vane of one section extending in a direction which is opposite to the direction in which the second arm of a vane in the other section extends, the second arm of each vane forming with the opposed wall of the main waveguide a region which is at cutoff to the frequency propagated in said main waveguide.

3. A waveguide switching arrangement comprising a main waveguide in the form of a rectangular toroid having its wide side perpendicular to the axis of said toroid, said waveguide being split at the center of the wide wall to

form two relatively-rotatable, concentric complementary sections, a radially-extending rectangular branch waveguide connected to each of said sections at the radially-opposed walls of said main waveguide, each branch waveguide having an L-shaped vane extending from one wall thereof into said main waveguide, one arm of said L-shaped vane being a continuation of a narrow wall of said branch waveguide and extending radially across said main waveguide to the region of said split, a second arm of said vane extending circumferentially, the second arm of a vane of one section extending in a direction which is opposite to the direction in which the second arm of a vane in the other section extends, the second arm of each vane forming with the opposed wall of the main waveguide a region which is half the width of said main waveguide and which is at cutoff to frequencies propagated in said main waveguide.

4. A waveguide switching arrangement comprising a main waveguide in the form of a rectangular toroid having its wide side perpendicular to the axis thereof, said waveguide having its wide side split at the center to form two relatively-rotatable, concentric complementary sections, a rectangular input branch waveguide connected to one of said sections at a narrow wall of said main waveguide, a plurality of equally-spaced rectangular output branch waveguides at the opposite narrow wall of said main waveguide, each section having a small septum in the vicinity of each branch waveguide and located near said split and running parallel to said narrow walls from a point nearer one wall of each branch waveguide, said septum dividing said main waveguide into sections which are substantially half the width of said main waveguide so that they are at cutoff to frequencies propagated in said main waveguide, each septum extending into said main waveguide in a direction which is opposite to the desired direction of wave transmission between said branch and main waveguides.

5. A waveguide switching arrangement comprising a main waveguide in the form of a rectangular toroid, said waveguide being split at the center of the wide wall to form two relatively-rotatable, complementary sections each of which contains one of the opposed narrow walls of the waveguide, a rectangular branch waveguide connected to one of said sections at the narrow wall thereof, a plurality of equally spaced rectangular branch waveguides connected to the narrow wall of the other of said sections, each branch waveguide having an L-shaped vane extending from one wall thereof into said main waveguide, one arm of said L-shaped vane forming a continuation of a narrow wall of said branch waveguide and extending across said main waveguide not further than the region of said split, the second arm of said vane extending circumferentially, the second arm of a vane of one section extending in a direction which is opposite to the direction in which the second arm of a vane in the other section extends, the second arm of each vane forming with the opposed wall of the main waveguide a region which is at cutoff to frequencies propagated in said main waveguide.

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