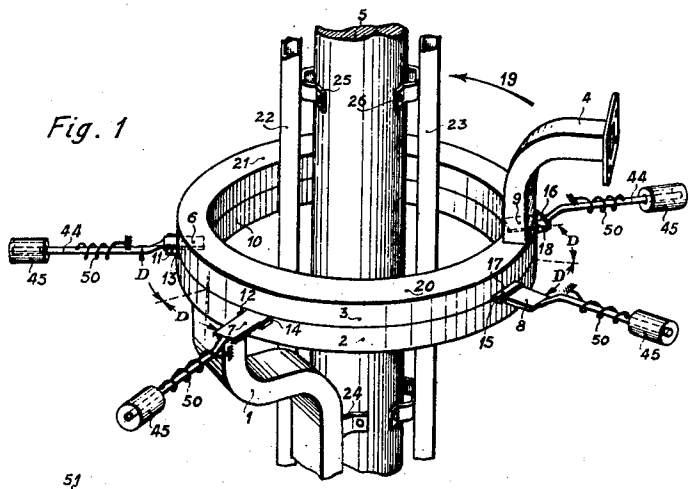
March 9, 1954 M. BOUIX 2,671,885

ROTARY JOINT WITH AXIAL RECESS FOR CENTIMETRIC RADARS

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Fig. 1



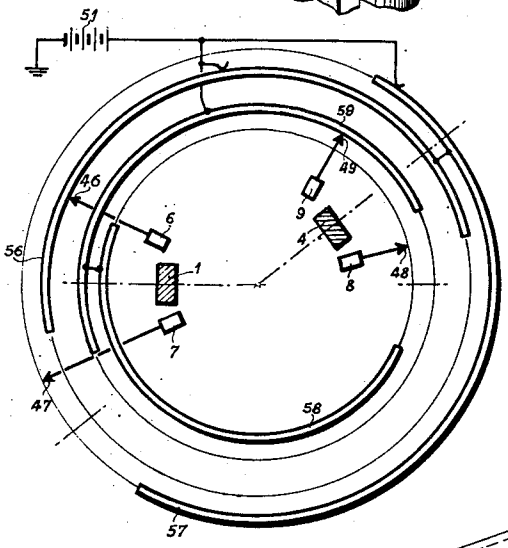


Fig. 4

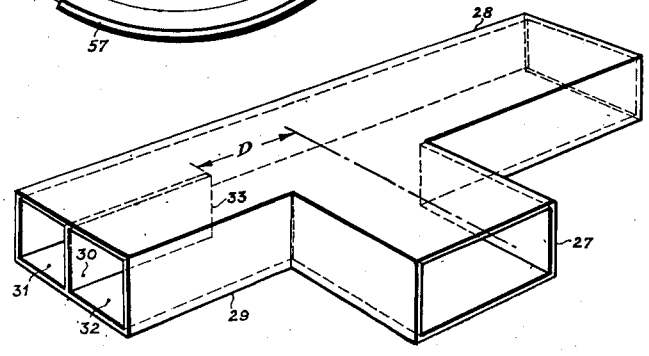


Fig. 5

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ROTARY JOINT WITH AXIAL RECESS FOR CENTIMETRIC RADARS

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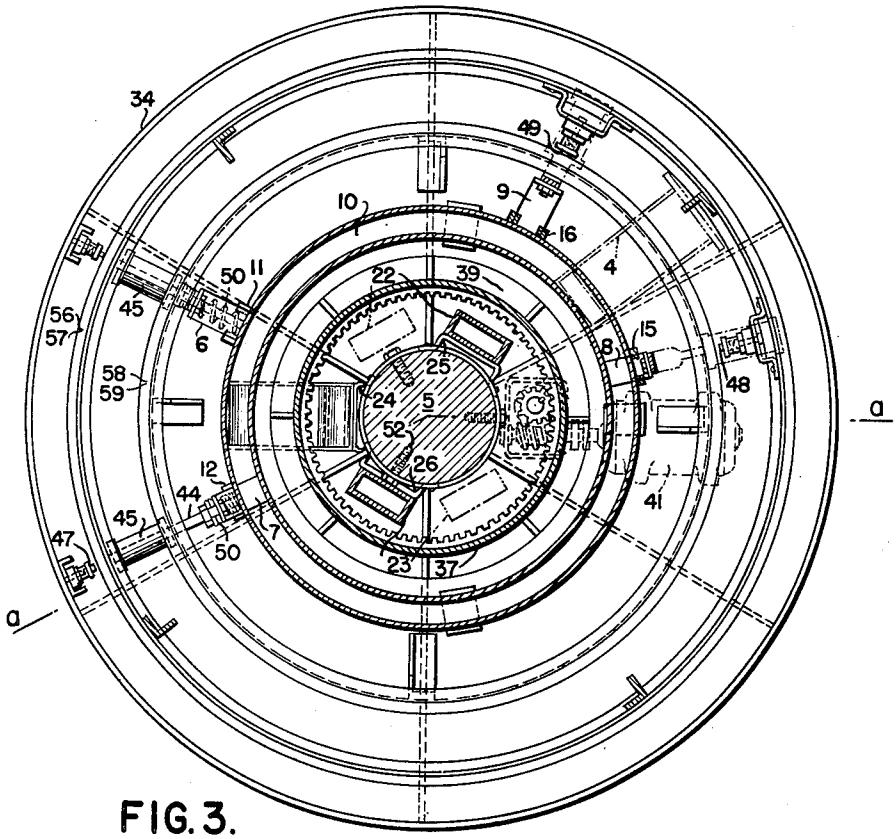


FIG. 3.

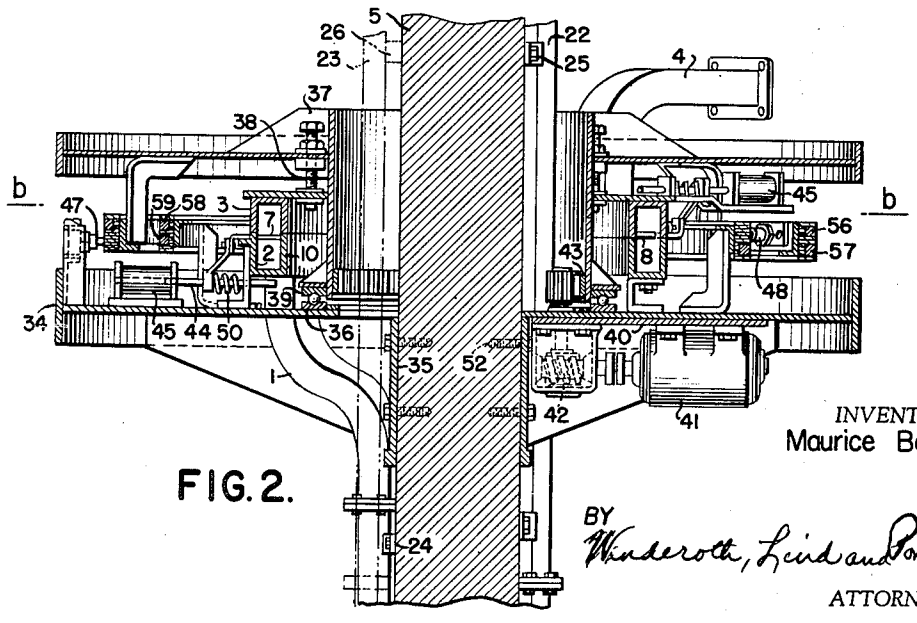


FIG. 2.

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Patented Mar. 9, 1954 2,671,885

UNITED STATES PATENT OFFICE

2,671,885

ROTARY JOINT WITH AXIAL RECESS FOR CENTIMETRIC RADARS

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Application March 7, 1952, Serial No. 275,411

Claims priority, application France March 15, 1951

2 Claims. (Cl. 333—98)

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The present invention relates to a rotary joint for effecting efficient transfer of high radio-frequency energy between a fixed transmitter and a rotating microwave antenna.

One of the objects of the present invention is to provide a ring-shaped coupler which leaves a free zone in the neighbourhood of its axis, so as to permit the superposition on the same axis of rotation, for example a mast of a vessel, of several rotary microwave antennas fed by different transmitters.

Another object of the present invention is to provide an internally hollowed ring shaped coupler which may be used to couple high radio-frequency energy between an input guide directed substantially along the axis of the coupler and an output guide directed substantially along a radius of said coupler.

If the ring-shaped coupler consisted merely of an annular hollow wall structure, energy which is fed to this coupler would travel in both clockwise and counter-clockwise directions which would set up standing waves within the coupler. According to the invention, standing waves are prevented by arranging strips movable in and out of the coupler which short-circuit the greater arc of the coupler between the input and output guides and allow energy to travel only through the smaller arc of said coupler.

Other objects of the present invention will appear from the following detailed description taken together with the accompanying drawings in which:

Figure 1 is a perspective view of the rotary joint of the invention with parts removed for purposes of clarity;

Figure 2 is an axial section along section line *a*—*a* of Figure 3;

Figure 3 is a cross-sectional view along section line *b*—*b* of Figure 2 and including accessory mechanical organs;

Figure 4 is a schematic view of the system of closing and opening the clappers of the joint; and

Figure 5 is a view of a junction on a rectilinear guide electrically similar to the rotating joint junction, for explaining the principle of the invention.

In Figure 1, 5 denotes a vertical axis, for example a mast of a vessel. A stationary rectangular guide 1 is joined to the mast 5 by fastening clamps 24. This guide 1 is bent twice at right angles, and is connected to the small side of a guide 10 having a rectangular cross-section wound in torus shape. The large side of the guide 10 is parallel to the mast 5.

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A rectangular guide 4 bent once at right angles, ends in the small side of the guide 10, opposite the one in which the guide 1 ends. The end of guide 4 opposite to that connected to guide 10 is perpendicular to the mast 5. To this end there can be connected microwave antenna of any desired type, not shown, the type being independent of the present invention.

The rectangular toroidal guide 10 comprises two parts, a lower one 2 which is stationary, and another, an upper one 3, which is rotatably actuated. The upper part 3 turns with respect to the lower part 2 with a slight play of a few hundredths of a millimeter, for example, for a wave 10 centimeters long.

Figure 5 shows a right angle connection between two rectilinear guides 27 and 28. Guide 27, which delivers radio-frequency energy from a source not shown, ends in the small side of guide 28. This latter has in the arm 29 to the left of the junction zone a metal strip 30 parallel to its small sides which divides arm 29 into two guides 31 and 32, the cut-off frequency of which is greater than that of the wave with which the guide 27 is fed. The distance D between the side 33 of the strip 30 and the orthogonal junction is close to the fourth of the guided wavelength in guide 28. The strip 30 behaves like a short-circuit plunger located inside the branch 29 of guide 28 and prevents the electromagnetic energy from propagating in said branch.

The fixed members 2 of the coupler 10 are notched on both sides of the junction with the guide 1 and at a distance D from this junction computed on the large circle passing through the center of the rectangular section, by notches 13 and 14 providing passage for two short-circuiting strips 6 and 7 which are guided respectively by slideways 11 and 12.

The mobile member 3 of the guide 10 is notched on both sides of the junction with the guide 4 and at a distance D from this junction computed on the large circle passing through the center of the rectangular section, by notches 17 and 18 providing passage for two short-circuiting strips 8 and 9 which are guided respectively by slideways 15 and 16. These short-circuiting strips and slideways are integrally connected with the part 3 and rotate with it.

The short-circuiting strips 6, 7, 8 and 9 are metal strips of which the first two have their upper faces adjacent to the equatorial plane of the coupler 10 and the two last have their lower faces adjacent to the same plane. All these strips can occupy two positions, one "off," completely outside of guide 10, and the other "on,"

completely inside of guide 10. In the latter position of the strips, the waveguide 10 is then divided into two partial guides the cut-off frequency of which being greater than that of the wave transmitted by said guide. This wave cannot pass over an "on" strip, while it normally passes over an "off" strip.

Some difference of level is provided between the upper face of strips 6 and 7 and the lower face of strips 8 and 9, so that these can overlap during rotation of the mobile member 3.

Assume that the direction of rotation of the member 3 of the coupler be that of the arrow 19. In the position shown in Figure 1, the strips 7 and 8 are in the "off" position, and the strips 6 and 9 are in the "on" position. The radio-frequency energy passes from the guide 1 to the coupler 4 through the arc 20 of the guide 10.

When the guide 4 is almost diametrically opposite the guide 1, the strips 7 and 8 pass from the "off" position to the "on" position, and the strips 6 and 9 pass from the "on" position to the "off" position. The transmission of the electromagnetic power is then made by the arc 21 of the coupler 10. The strips keep this latter position which they have assumed up to the moment when the mouth of guide 4 comes in front of the mouth of guide 1, the strips 8 and 9 respectively overlapping the strips 6 and 7. At this moment, the strips 7 and 8 pass from the "on" position to the "off" position, the strips 6 and 9 from the "off" position to the "on" position and power is again transmitted through the arc 20.

In the free zone between the coupler 10 and the mast 5, other guides, 22, 23 . . . can pass, and be attached to the mast by fastening clamps 25, 26 . . . and designed to feed other rotary couplers attached to the mast above the coupler 10. This affords the possibility of feeding several superposed rotary antennas by independent, continuous or pulsatory radar.

With reference to Figures 2 and 3, 34 is a circular armature supporting the fixed member 2 of the rotary joint, attached to the mast 5 by fixing or fastening members 35 and screws 52. This circular armature carries one of the races 36 of a ball bearing. Another circular armature 37, which supports the mobile part 3 of the rotary joint by the intermediary of adjustable fastening nuts 38 has the second race 39 of the ball bearing.

The armature 34 has a lateral platform 40 on which an electric motor 41 is mounted, on the shaft of which an endless screw 42 is attached. This endless screw drives, by means of a pinion, an internal toothed wheel rim 43 carried by the armature 37, which is for rotating the mobile member 3 of the coupler 10.

Each short-circuiting strip has an extension rod 44 which constitutes the plunging core of an electromagnet 45. When the electromagnet 45 is not energised, the corresponding strip is in "on" position owing to the action of a counteracting spring 50. One of the ends of the winding of each electromagnet 45 is grounded to the corresponding armature, and the other terminates in a brush. These brushes are shown by 46, 47, 48 and 49, depending on whether they are associated with strips 6, 7, 8 and 9.

The brushes 48 and 49 are in operative contact with semi-circular rings 58 and 59 mounted on the armature 34, insulated with respect to this armature and brought to a positive potential by a battery 51, the negative pole of which is connected to the armature. The brushes 46 and 47 contact semi-circular rings 56 and 57 mounted on the armature 37, insulated with respect to this armature and brought to a positive potential with respect to the armature by the same battery 51.

The rings 56, 57, 58, 59 are arranged as shown in Figure 4, in which can be seen the rotary joint 10, its junction with the guide 1 and the two strips 6 and 7, its junction with guide 4 and the two strips 8 and 9 and the brushes 46, 47, 48, 49 associated with the different strips. A strip is "off" when it is radially aligned with a semi-circular conducting ring. It follows clearly from Figure 4 that when the guides 1 and 4 arrive to be mouth to mouth when the upper assembly rotates in the direction of the arrow 19 of Fig. 1, the strips 6 and 9 come into the "on" position and the strips 7 and 8 into the "off" position, and that when the guides 1 and 4 are diametrically opposite each other, the strips 6 and 9 come into the "off" position and the strips 7 and 8 into the "on" position.

Although the invention has been described with reference to a single preferred embodiment, it is understood that numerous modifications can be introduced therein, particularly with respect to the means of opening and closing short-circuiting strips, and be within the spirit and scope of the invention as defined in the appended claims.

What I claim is:

1. A rotary joint with an axial recess for centimetric radar installations comprising a torus shaped wave guide having a rectangular cross-section, the large side of which is parallel to the axis of the torus and the small side perpendicular to said axis, said guide being divided into upper and lower superposed parts by an equatorial plane perpendicular to its large side, the lower of said parts being stationary and the upper of said parts being rotatably mounted, an input wave feed guide adapted for connection to a high frequency energy source and the chamber of which is in communication with said lower part, an output wave feed guide adapted for connection to a microwave antenna and the chamber of which is in communication with said upper part, means to rotate said upper part, a pair of slidably supported strips in said lower part located on both sides of the input wave feed guide connected with said lower part, a pair of slidably supported strips in said upper part located on both sides of the output wave feed guide connected with said upper part, means for moving said strips in and out of the equatorial plane of the torus shaped wave guide in synchronism with the rotation of the upper part whereby the strips located in the greater arc of the torus shaped wave guide between the input and output guides are inside said latter guide and the strips located in the smaller arc of the torus shaped wave guide are outside said latter guide and whereby the strips located in the greater arc divide the torus shaped wave guide in two guides which prevent the transfer of energy between the input and the output guides through the greater arc.

2. A rotary joint with an axial recess for centimetric radar installations comprising a torus shaped wave guide having a rectangular cross section the large side of which is parallel to the axis of the torus and the small side perpendicular to said axis, said guide being divided into upper and lower superposed parts by an equatorial plane perpendicular to its large side, the lower of said parts being stationary and the

upper of said parts being rotatably mounted, an input wave feed guide adapted for connection to a high frequency energy source and the chamber of which is in communication with said lower part, an output wave feed guide adapted for connection to a microwave antenna and the chamber of which is in communication with the said upper part, means to rotate said upper part, a pair of slidably supported strips in said lower part, located on both sides of the input wave feed guide connected with said lower part, a pair of slidably supported strips in said upper part located on both sides of the output wave feed guide connected with said upper part, said strips being movable and adapted to be located inside and outside the torus shaped wave guide and permitting electromagnetic energy transmission to pass through said torus shaped wave guide when they are outside said guide and preventing electromagnetic energy transmission to pass through

said torus shaped wave guide when they are inside said guide, extension rods secured to said strips, electromagnets having said rods as plunging cores, spring means normally biasing said strips to their inside position and means for actuating said electromagnets for moving said strips into their outside position in synchronism with the rotation of the upper part whereby the strips located in the greater arc of the torus shaped wave guide between the input and output guides are inside said latter guide and the strips located in the smaller arc are outside said latter guide.

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