

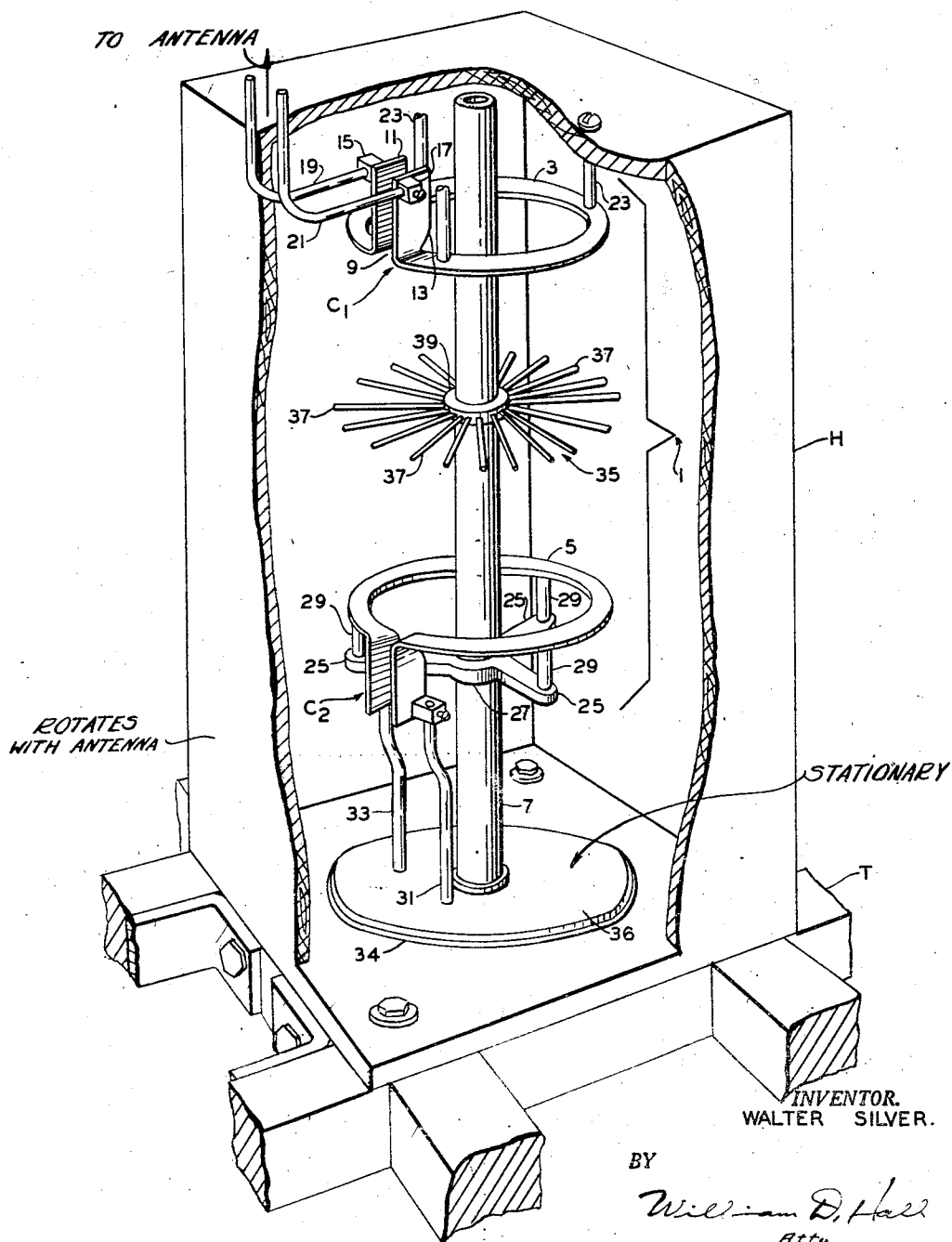
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ANTENNA COUPLING

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ANTENNA COUPLING

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The invention described herein may be manufactured and used by or for the Government for governmental purposes, without the payment to me of any royalty thereon.

This invention relates to transmission line couplings and more particularly to couplings used between movable and stationary portions of a line.

An object of the invention is to provide a coupling unit which will permit a maximum transfer of energy between the separate components of the line.

Another object is to provide a coupling unit which will require a minimum of mechanical or electrical adjustment.

Still another object is to provide a coupling which will permit the maintenance of a low, substantially constant, standing wave ratio on the lines for all relative positions of the coupling unit.

According to the present invention the foregoing objects are realized by providing a coupling unit which is, in effect, a pair of pretuned resonant circuits each comprising a coil and a capacitor associated therewith. The reactance and the capacitance of each portion of the unit are so chosen that said portions are resonant at a predetermined frequency and thus yield a 1:1 transformation. Such a 1:1 transformation, of course, leaves untuned lines attached thereto unaffected. Therefore, the insertion of such a unit at any point in a line from a transmitter or/and a receiver to an antenna does not upset the line characteristics.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description, taken in connection with the accompanying drawing, and its scope will be pointed out in the appended claims.

In the accompanying drawing the single figure is a perspective view of my coupling unit.

Referring now more particularly to the drawing, the coupling unit 1 comprises a rotatable coil 3 and a stationary coil 5 disposed in vertical spaced parallel relation coaxially about a rigid, stationary shaft 7. While in the interest of clarity, the coils are shown widely separated from each other, it will be understood that in the normal operation of the unit the coils are positioned close to each other.

As shown, the rotatable coil 3 is a single turn of flat stock wound edgewise to provide a circular loop the ends of which are bent upwardly at right angles to the plane of the loop to form

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spaced parallel plates 11, 13 with an air gap 9 therebetween. The combination of the pair of plates and the air separation acts as a condenser C₁ which, with the coil 3, forms a tuned resonant LC circuit. If a condenser of greater capacitance is desired, the area of the plates 11 and 13 may be increased. In the illustrated embodiment, the plates have been made wider than the coil. Connection to the LC circuit is made by means of terminal blocks 15, 17 carried on the outer surfaces of the plates 11, 13 near the free ends thereof. The blocks 15, 17 are provided with suitable apertures and fastening means to receive the transmission lines 19, 21 which connect to a rotatable antenna (not shown).

In order to protect it from any adverse weather conditions, the coupling unit may be enclosed in a boxlike structure or housing H, which may be mounted on a turntable T for rotation with the antenna and the transmission lines 19, 21 leading therefrom. When so enclosed, the coil 3 may be suspended from the top of the housing by means of a plurality of vertical insulator support rods 23 which may be attached at one end to the coil 3 and at the other to the housing, as shown.

The stationary coil 5 and associated air condenser C₂ are similar to the above-described coil 3 and its associated condenser C₁. This resonant LC circuit is mounted on and centered about the shaft 7 by means of a spider having arms 25 and extending radially from a hub 27 which is rigidly fixed to shaft 7 in any convenient manner. Vertical insulator rods 29 are attached at their upper ends to the coil 5 and at their lower ends to spider arms 25. The transmission lines 31, 33 from the transmitter or/and the receiver (not shown) are connected to the condenser C₂ in the same manner in which the antenna transmission lines are connected to the condenser C₁. It is to be noted that, if the above-mentioned housing is used, an opening 34 concentric with shaft 7 should be provided in the bottom wall of the housing through which the transmission lines 31, 33 and the shaft 7 may pass. This opening permits rotation of the housing H, the first described LC circuit 3 and C₁, and the attached antenna transmission lines 19, 21, while the shaft 7, the LC circuit 5 and C₂ attached thereto, and the transmitter or/and the receiver transmission lines 31, 33 remain stationary.

I have found that it is desirable to provide a disc 36 of insulating material, such as polystyrene or the like, of a diameter slightly smaller than the opening 34 for the opening 34. As shown, the disc 36 is coaxially attached to the

shaft 7 in any convenient manner and is provided with openings through which the transmission lines 31, 33 may be passed. The disc 36 serves both as a spacer for the lines and as a closure member of the opening preventing dust, snow or other elements from blowing into the housing H.

Suitable openings in the top of the housing H are provided to permit the shaft 7 and the transmission lines 19, 21 to extend therethrough.

A Faraday screen 35, comprising a plurality of straight uniform lengths of wire 37 extending radially from a collar 39, is rigidly mounted on the shaft 7 between the rotatable coil 3 and the stationary coil 5. The purpose of the screen is to prevent capacitative coupling between the coils 3 and 5.

Capacitative coupling between the coils cannot be tolerated because, if present, it would not be constant in magnitude, but would vary with the relative positions of the gaps 9 in the coils 3 and 5 during relative rotation, and this variation would result in a change of input impedance for a given fixed output impedance. In particular, there would be marked change in coupling when the gaps periodically become vertically aligned.

The installation thus far described is one in which the antenna is large and bulky, necessitating its mounting on a turntable using a circular track with rollers. However, a small light-weight antenna may be supported and rotated directly by a shaft. When used under such circumstances, it is merely necessary to invert the structure described. Thus viewing the figure in inverted position, it will be apparent that under these conditions, the spider supported LC circuit, composed of the coil 5 and the condenser C₂, would be connected to the antenna lines 31, 33 and be rotatable therewith while the circuit, consisting of the coil 3 and the condenser C₁, would then be the stationary one and would be connected to the transmitter or/and receiver by means of the transmission lines 19, 21 therefrom.

As pointed out above, in the normal operation of the unit, the coils 3, 5 are brought much nearer to each other than is evident from the exploded view shown in the figure. For example, in one embodiment of the device the spacing of the coils was about $\frac{1}{20}$ of the diameter of the coils.

While there has been described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention, and it is, therefore, aimed in the appended claims to cover all such changes and modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. An electromagnetic device for coupling a rotatable antenna transmission line to a stationary antenna transmission line said device comprising a first tuned circuit connected to said rotatable transmission line and a second tuned circuit connected to said stationary transmission line, said first and second tuned circuits including substantially circular inductance loops, said loops having their adjacent ends bent from the planes thereof to form condensers of predetermined capacity in parallel with each of said inductance loops.

2. In a feeder line for rotatable antennas, an electromagnetic coupling device for coupling a rotatable antenna transmission line to a stationary transmission line said device comprising a first tuned LC circuit connected to said rotatable

transmission line and a second tuned LC circuit connected to said stationary transmission line, each of said tuned circuits comprising a substantially circular loop having a pair of free ends and an air condenser connected to the free ends of said loop.

3. In an antenna transmission line having a stationary portion and a rotatable portion, said stationary portion being connected to a radio apparatus, said rotatable portion being connected to an antenna, a shaft fixedly attached to said radio apparatus and disposed in parallel relation to said stationary portion and said rotatable portion, a first loop connected to said shaft and coaxially disposed thereto, said first loop having a pair of free ends bent at right angles to the plane of the loop to form spaced parallel plates of a first air condenser, means on said plates for connecting said stationary portion thereto, a second loop connected to said antenna and coaxially disposed to said shaft, said second loop having a pair of free ends bent at right angles to the plane of said second loop to form spaced parallel plates of a second air condenser and means on said plates for connecting said rotatable portion thereto.

4. In an antenna transmission line having a stationary portion and a rotatable portion, said stationary portion being connected to a radio apparatus, said rotatable portion being connected to an antenna, a shaft fixedly attached to said radio apparatus and disposed in parallel relation to said stationary portion and said rotatable portion, a first substantially circular loop connected to said shaft and coaxially disposed thereto, said first loop having a pair of free ends bent at right angles to the plane of the loop to form spaced parallel plates of a first air condenser, said first air condenser forming with said first loop a tuned resonant circuit, means on said plates for connecting said stationary portion thereto, a second substantially circular loop connected to said antenna and coaxially disposed to said shaft, said second loop having a pair of free ends bent at right angles to the plane of said loop to form spaced parallel plates of a second air condenser, said second air condenser forming with said second loop a tuned resonant circuit, and means on said plates for connecting said rotatable portion thereto.

5. In an antenna transmission line having a stationary portion and a rotatable portion, said stationary portion being connected to a radio apparatus, said rotatable portion being connected to an antenna, a shaft fixedly attached to said radio apparatus and disposed in parallel relation to said stationary portion and said rotatable portion, a first substantially circular loop connected to said shaft and coaxially disposed thereto, said first loop having a pair of free ends bent at right angles to the plane of the loop to form spaced parallel plates of a first air condenser, said first air condenser forming with said first loop a tuned resonant circuit, means on said plates for connecting said stationary portion thereto, a second substantially circular loop connected to said antenna and coaxially disposed to said shaft, said second loop having a pair of free ends bent at right angles to the plane of said second loop to form spaced parallel plates of a second air condenser, said second air condenser forming with said second loop a tuned resonant circuit, means on said plates for connecting said rotatable portion thereto, and means carried by said shaft and positioned between said first and said second loops

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for eliminating capacitive coupling between said first and second loops.

6. A rotatable coupling unit adapted to couple a continuously rotatable antenna to a stationary transmission line, comprising a pair of coaxially-mounted, relatively-rotatable supports, one support being fixed and the other support being adapted to be continuously rotatable with said antenna, a pair of single-turn loops located in parallel planes, one of said loops being mounted on said fixed support and adapted to be connected to said transmission line, and the other of said loops being mounted on said rotatable support and adapted to be connected to said antenna.

7. A rotatable coupling unit adapted to couple a continuously rotatable antenna to a stationary

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transmission line, comprising a pair of coaxially mounted relatively rotatable supports, one support being fixed and the other support being adapted to be continuously rotatable with said antenna, a pair of identical, single-turn loops located in parallel planes, one of said loops being mounted on said fixed support and adapted to be connected to said transmission line, and the other of said loops being mounted on said rotatable support and adapted to be connected to said antenna, adjacent ends of each loop being bent from the planes thereof to form a resonating capacity therefor, and an electrostatic shield between said loops.

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