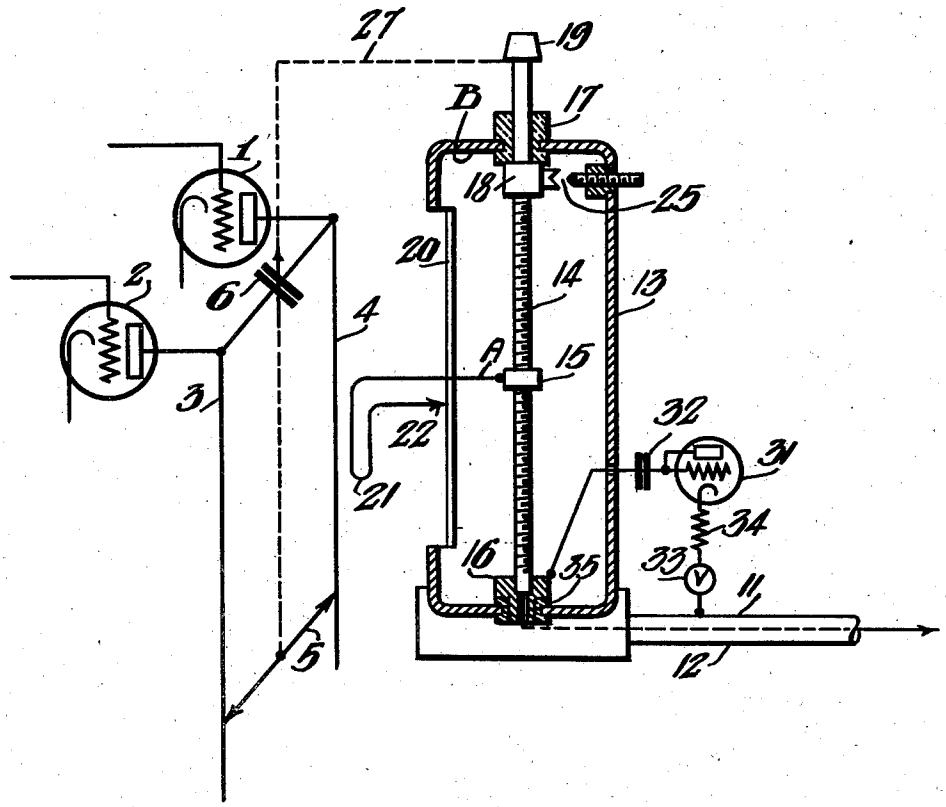
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ULTRA HIGH FREQUENCY COUPLING DEVICE

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Inventor

Samuel Gubin

By C. D. Tuska

Attorney

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ULTRA HIGH FREQUENCY COUPLING DEVICE

Samuel Gubin, Merchantville, N. J., assignor to Radio Corporation of America, a corporation of Delaware

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This invention relates generally to ultra high frequency coupling devices and particularly to improved means for coupling a tuned high frequency circuit to a coaxial transmission line in such a manner that the power transfer through the coupling is constant over a wide frequency band.

The problem of transferring ultra high frequency energy through coupling systems is not particularly difficult at any one frequency. If the power transfer is desired over a wide range of frequencies such as 60–200 megacycles, however, it is usually extremely difficult to obtain a uniform transfer characteristic. Inductive and capacitive couplings which have complementary frequency characteristics have been used heretofore to obtain automatically the desired frequency response. Also various mechanical expedients have been employed. For example, an inductive coupling may be varied as the frequency is varied, by mechanically connecting the coupling and frequency controlling elements. Such mechanical coupling usually involves expensive and complicated structure.

This invention is an improvement of my copending application Serial No. 372,565, filed December 31, 1940, in that this application pertains to a method and means for providing coupling between a suitable ultra high frequency tuned circuit and a coaxial cable. It is an object of the invention to provide simple, inexpensive and improved means for transferring ultra high frequency energy at a substantially constant level over a wide range of frequencies. An additional object is to provide means for efficiently coupling two single ended ultra high frequency circuits over a wide range of frequencies. Another object is to provide improved means for tuning a parallel line and a section of coaxial cable to effect a constant energy transfer between them. An additional object is to provide means for efficiently coupling a balanced resonant ultra high frequency circuit to a single ended circuit of a wide range of frequencies. Another object is to provide means for tuning a resonant circuit and a section of coaxial cable so that the energy transferred between them follows a predetermined frequency characteristic.

The invention will be described by reference to the accompanying drawing which is a schematic circuit diagram of one embodiment thereof, in which the frequency range is of the order of 60 to 200 megacycles.

Referring to the drawing, the anodes 1 and 2 of a pair of push-pull high frequency amplifier

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tubes are connected to the open ends of the resonant circuit comprising the parallel lines 3 and 4. The circuit is tuned by the shorting bar 5 and the tuning condenser 6 which is connected across the open ends of the lines 3 and 4. In operation, the condenser 6 and the shorting bar 5 are adjusted to maintain a substantially constant current in the resonant circuit throughout the desired range of frequencies. In order to thus maintain the input impedance of the circuit at a uniform value it is desirable to link the actuating mechanisms for the shorting bar and the controlling mechanism of the condenser in a complementary manner as indicated by the dash lines.

One end of a coaxial cable, comprising a sheath 11 and an inner conductor 12, is connected to a suitable output circuit such as an antenna. The other end of the coaxial cable is terminated in a special cable section comprising the outer shell 13 and an inner threaded conductor 14 which carries a nut 15, which is prevented from rotating by any suitable means. The ratio of the diameters of the conductor 14 and the shell 13 should be the same as the ratio of the diameters of the conductor 12 and sheath 11 of the coaxial cable, in order to match the surge impedances. The threaded conductor is supported by a contact bearing 16 insulated from the shell 13 by the insert 35 and connected to the conductor 12 and an insulating bearing 17 supported by the shell 13. A shaft 18 and a control knob 19 are suitably connected to the threaded conductor to provide for rotation thereof. The shell 13 is provided with a slot 20. One end of a single turn loop 21 is connected to the nut 15 and the other end to a sliding contact 22 which is movable along the sheath 13. The loop 21 should preferably be of low impedance and should be coupled as closely as practicable to the resonant line 3, 4.

In operation the cable section is adjusted as follows. The coupling loop 21 is coupled as closely as desired to the resonant lines 3 and 4. The degree of coupling to the cable section is varied by turning the knob 19 and hence the threaded conductor 14 to move the nut 15 along the conductor until the voltage transfer is a desired value, as indicated, for example, by the vacuum tube voltmeter. The voltmeter may comprise a diode 31, the anode of which is coupled to the inner cable conductor 14 through the capacitor 32. The cathode of the diode is connected through a suitable resistor 34 and the meter 33 to the cable sheath 11. The cable section between A and B may, if desired, be short-circuited by providing a contact bearing at 17 instead of

the insulating bearing described heretofore. This is particularly desirable if the cable section between A and B approaches any multiple of one-quarter wave resonance. The short circuiting, previously mentioned, may of course be accomplished by a suitable switch 25 instead of the contact bearing described.

The reactance of the coupling loop 21 should be small compared to the surge impedance of the coaxial cable at the low frequency end of the frequency range to be covered and should be of the same order of magnitude at the high frequency end of the range. At higher frequencies the induced voltage increases to compensate for the increased leakage reactance in the circuit.

It will be apparent that suitable means may be included for mechanically connecting the tuning elements of the resonant line and the coaxial cable section to provide for unitary control as indicated by the dash line 27.

I claim as my invention:

1. An ultra high frequency device including a tunable transmission line and a coaxial cable comprising an inner conductor and an outer conductor surrounding said inner conductor, an adjustable shorting bar engaging said line, a tuning capacitor connected across the open end of said line, means for varying the coupling between said line and said cable, and adjustable shunt means connecting said cable to said coupling means.

2. An ultra high frequency device including a tunable transmission line and a coaxial cable comprising an inner conductor and an outer conductor surrounding said inner conductor, an adjustable shorting bar engaging said line, a tuning capacitor connected across the open end of said line, means including a loop and an adjustable section of said cable shunt-connected to said loop for varying the coupling between said line and said cable, means for adjusting said cable section to vary the coupling between said loop and said cable section, and means for coupling said loop to said line.

3. An ultra high frequency device including a tunable transmission line and a coaxial cable comprising an inner conductor and an outer conductor surrounding said inner conductor, an adjustable shorting bar engaging said line, a tuning capacitor connected across the open end of said line, means including a loop and an adjustable section of said cable shunt-connected to said loop for varying the coupling between said line and said cable, means for adjusting said cable section to vary the coupling between said loop and said cable section, and adjustable means for coupling said loop to said line.

4. A device of the type described in claim 2 in which said adjustable cable section includes a slotted cable sheath and the inner conductor of said section includes a lead screw, a nut carried by said screw, a connection from said loop to said nut through said slot and an adjustable connection from said loop to said sheath.

5. A device of the type described in claim 3 in which said adjustable cable section includes a slotted cable sheath and the inner conductor of said section includes a lead screw, a nut carried by said screw, a connection from said loop to said nut through said slot and an adjustable connection from said loop to said sheath.

6. An ultra high frequency device including a tunable transmission line and a coaxial cable comprising an inner conductor and an outer conductor surrounding said inner conductor, an adjustable shorting bar engaging said line, a tuning capacitor connected across the open end of said line, means including a single turn loop and an adjustable section of said cable shunt-connected to said loop for varying the coupling between said line and said cable, means for adjusting said cable section to vary the coupling between said loop and said cable section, and means for coupling said loop to said line.

7. An ultra high frequency device including a tunable transmission line and a coaxial cable comprising an inner conductor and an outer conductor surrounding said inner conductor, an adjustable shorting bar engaging said line, a tuning capacitor connected across the open end of said line, means including a single turn loop and an adjustable section of said cable shunt-connected to said loop for varying the coupling between said line and said cable, means for adjusting said cable section to vary the coupling between said loop and said cable section, and adjustable means for coupling said loop to said line.

8. A device of the type described in claim 2 in which said cable is connected to said adjustable cable section at a point well removed from the open end of said line.

9. A device of the type described in claim 2 in which the impedance of said loop is small with respect to the surge impedance of said cable section.

10. A device of the type described in claim 2 including common means for adjusting simultaneously said shorting bar, said tuning capacitor and said adjustable cable section.

SAMUEL GUBIN.