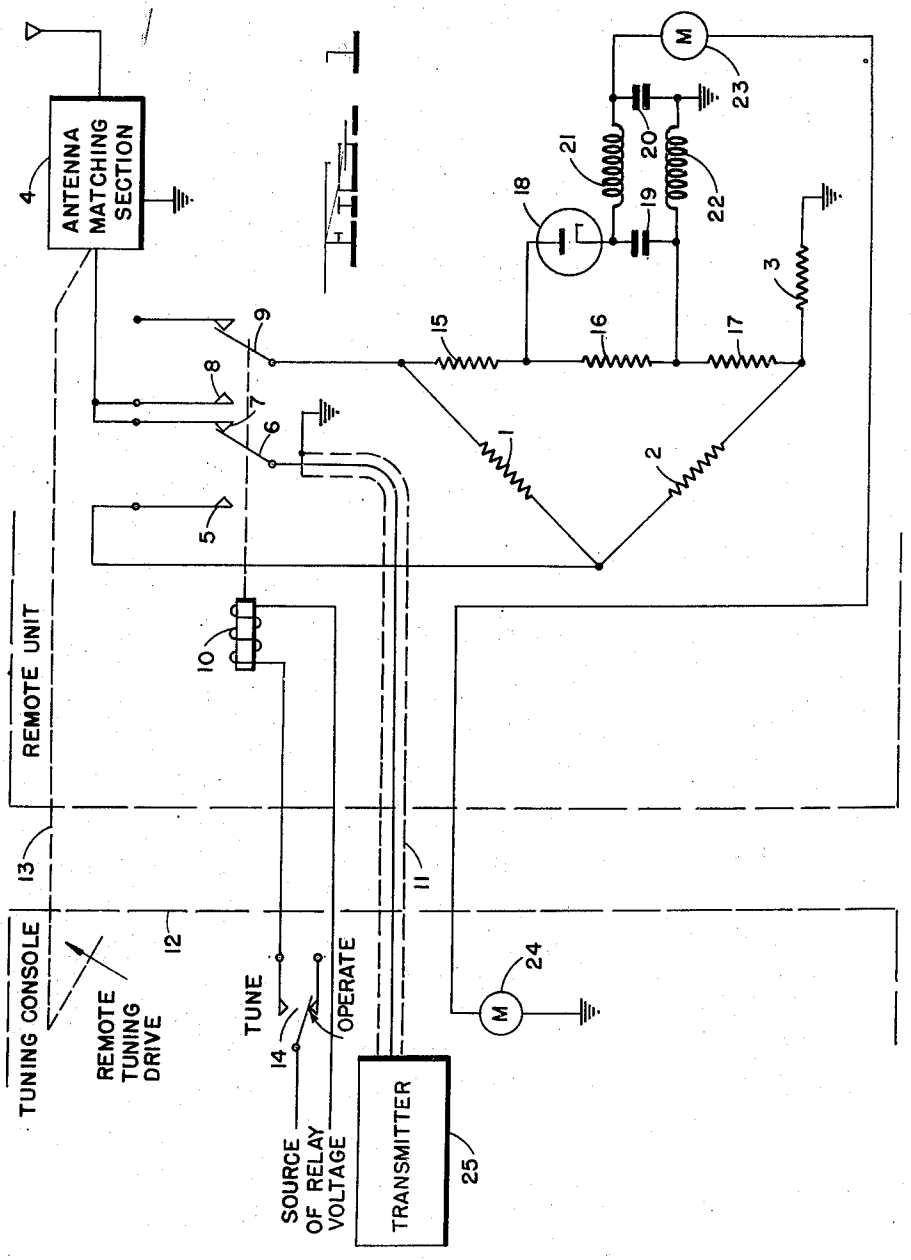
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REMOTE ANTENNA TUNING INDICATOR

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REMOTE ANTENNA TUNING INDICATOR

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This invention relates to a remote antenna tuning system, and, more particularly, to the remote tuning of an antenna matching section to a transmission line by use of an electronic indicating device.

In many installations of radio transmitters it is necessary to locate the antenna at some position removed from the immediate location of the transmitter, thus necessitating the use of a transmission line to feed radio frequency power from the transmitter to the antenna. This, however, introduces additional problems since it is necessary to match the transmitter output to the characteristic impedance of the transmission line, and the transmission line, in turn, to the antenna in order to obtain maximum power transfer.

The invention described herein provides means for tuning the matching section in a remote antenna system from the transmitter position, and indicating means to show when a match has been obtained, so as to permit maximum power transfer from transmitter to antenna and a low standing wave ratio on the transmission line over a wide choice of frequencies.

An object of the invention is to provide an electronic tuning indicator for remotely tuning the antenna matching section, usually located at the base of the antenna.

Another object of the invention is to provide means for tuning the antenna on full power, or if desired, reduced power.

Still other and further objects and features of this invention will be apparent from the following specification and drawing, showing an exemplary embodiment of the invention, in which the figure is a schematic wiring diagram of the remote antenna tuning system, showing in block, the antenna matching section, and the tuning console with its important controls.

Equal value resistors 1, 2 and 3, together with the antenna matching section 4, make up the four arms of a conventional bridge circuit. The antenna matching section 4 is connected to the bridge through contacts 8 and 9 of relay 10. Radio frequency energy is fed from the transmitter 25 to the antenna matching section 4 through coaxial feeder cable 11 and through contacts 6 and 7 of relay 10. The antenna matching section 4 is tuned remotely from the tuning console 12 by some appropriate means such as a servo-system as indicated in the drawing by the dotted line 13. Radio frequency energy is fed from transmitter 25 to the bridge through coaxial cable 11 and contacts 5 and 6 of relay 10. The tune-operate switch 14 is connected in series with relay

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10 and a source of relay voltage, and is located in the tuning console 12. Resistors 15, 16 and 17 are series connected across the bridge at the junction of resistors 2 and 3, and resistor 1 and contact 9 of relay 10. Across resistor 16 is connected a diode vacuum tube 18 with a condenser 19 in its cathode lead. The radio frequency choke 21 is connected from the cathode of tube 18 to milliammeter 23 and to condenser 20. The remaining plate of condenser 20 is grounded. Radio frequency choke 22 is connected from the junction of resistors 16 and 17 to ground. Meter 23 is in series with meter 24, the latter being located in the tuning console 12, and the ground circuit is completed at the aforementioned tuning console.

The operation of this invention will be clearly understood by referring to the figure and tracing through the process required for remote tuning. The tune-operate switch 14 in the tuning console, which is located at the transmitter, is switched to "Tune" position. Relay 10 in the remote unit is energized and contacts 5 and 6 of relay 10 are made, enabling the radio frequency energy coupled from the transmitter to the remote unit by coaxial cable 11 to be applied to the bridge. The energization of relay 10 also closes contacts 8 and 9 which cause the antenna matching section 4 and the antenna to be inserted as one arm of the bridge. Resistors 1, 2, and 3 are of the same value as the impedance of coaxial transmission line 11. Therefore, it is desirable to tune the antenna matching section 4 to this common impedance by means of a servo-mechanism 13 from the tuning console 12. To determine when a balance has been reached resistors 15, 16, and 17 are connected across the bridge, diametrically opposite to the energizing connection. If the bridge is initially unbalanced an alternating voltage of radio frequency will appear across resistor 16. The vacuum tube 18 in series with condenser 19 will pass this alternating voltage on half cycles only resulting in a rectified voltage which appears across condenser 19. The rectified voltage on the condenser 19 will be positive at its cathode connection and will pass through radio frequency choke 21 and flow through meter 23 and meter 24 to ground, giving an indication. When the antenna matching section, as controlled from the tuning console, is adjusted for minimum current in either meter 24 or 23, the bridge is balanced and the antenna is matched to the transmission line 11. The combination of condensers 19 and 20 and radio frequency chokes 21 and 22 forms a high impedance filter for radio frequencies while pass-

ing direct current easily. This network also provides a high impedance path between the meter and the bridge circuit, permitting the use of a ground return from the tuning console meter 24 and thereby eliminating the need for an extra return lead.

Resistors 1, 2 and 3 should be non-inductive and of a high enough power rating to carry the entire power output of the transmitter. Resistors 15 and 17 should also be of a non-inductive type and of equal value, being of such a magnitude as to produce the correct sensitivity for a given transmitter power output. If it were desirable to tune the transmitter on reduced power, resistors 1, 2, and 3 could have their wattage ratings reduced in accordance, and resistors 15 and 17 could also be reduced to increase the sensitivity. The extreme sensitivity is reached when the resistance of resistors 15 and 17 are reduced to zero.

If the tune-operate switch 14 at the tuning console 12 is switched to the "operate" position, relay 10 will be deenergized and the radio frequency power from the transmitter will be coupled through coaxial transmission line 11, and through contacts 6 and 7 of relay 10 into the antenna matching section and thence to the antenna. It is seen that that bridge is entirely out of the circuit when relay 10 is deenergized.

Where installation permits a series resistor may be inserted in the energizing lead between contact 5 of relay 10 and the junction of resistors 1 and 2, or a bleeder resistor could be connected from contact 5 to ground and the aforementioned junction tapped to some low voltage on the bleeder, permitting the use of low power resistors in the bridge circuit.

While there has been described above a specific embodiment of the invention, it should be understood that other adaptions thereof may be made without the departure from the spirit of the invention.

The invention described herein may be manufactured and used by or for the Government of the United States of America for governmental purposes without the payment of any royalties thereon or therefor.

What is claimed is:

1. In combination; a transmitter, a remote antenna system including an impedance matching section therefor, a transmission line connecting the transmitter to said antenna system, an impedance network operative to form a bridge circuit upon the insertion of an impedance equal to the transmission line impedance, switching means operative to insert said antenna system into said impedance network to thereby form a bridge circuit and to energize the bridge circuit from said transmitter, indicator means operatively connected to said bridge circuit to indicate the condition of balance thereof, and means for adjusting said impedance matching section to obtain a balance in said bridge.

2. In combination; a transmitter, an antenna system including an impedance matching section therefor, a transmission line connecting the transmitter to said antenna system, an impedance network operative to form a bridge circuit upon insertion of an impedance equal to the transmission line impedance, switching means operative to insert said antenna system into said impedance network to thereby form a bridge circuit and to energize the bridge circuit from said transmission line, indicator means operatively connected to said bridge circuit to indicate the condition of balance thereof, and means for adjusting said impedance matching system to obtain a balance in said bridge.

3. In combination; a source of radio frequency power, a transmission line connected to the output of said source of power, an adjustable impedance load for said transmission line, an impedance network operative to form a bridge circuit upon insertion of an impedance equal to the transmission line impedance, switching means operative to insert said adjustable impedance load into said impedance network to thereby form a bridge circuit and to energize the bridge circuit from said transmission line, indicator means operatively connected to said bridge circuit to indicate the condition of balance thereof, and means altering said adjustable impedance load to obtain a balance in said bridge.

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