ADJUSTABLE ULTRA-HIGH-FREQUENCY IMPEDANCE DEVICE

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ADJUSTABLE ULTRA-HIGH-FREQUENCY IMPEDANCE DEVICE

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1 Claim. (Cl. 333—97)

The present invention relates to ultra-high-frequency impedance devices, and in particular to an adjustable coaxial impedance termination. The present application is a division of my pending application Serial No. 724,390, filed January 25, 1947, now Patent 2,666,132, as a continuation-in-part of my application Serial No. 376,253, filed January 28, 1941, now Patent 2,416,790.

In my above-mentioned patents I have shown and described several ultra-high-frequency transmission line bridge circuits. One of the types described employs coaxial lines as the arms thereof and includes coaxial impedance devices coupled to the coaxial arms at the bridge points of the bridge circuit. This type of coaxial bridge may be employed at ultra-high-frequencies in a balanced arrangement for preventing energy present at one bridge point from appearing at the opposite bridge point. Such a coaxial line bridge may be employed to compare an unknown impedance with a known impedance, or to balance the impedance of an adjustable coaxial terminating device with the impedance of a coaxial high-frequency antenna. For example, the coaxial line bridge may employ a transmitter coupled to one of its bridge points, an antenna coupled to an adjacent bridge point, an adjustable coaxial line impedance device coupled to the other adjacent bridge point, and a receiver coupled to the opposite bridge point. Upon balancing the coaxial line bridge by adjusting the coaxial line impedance device, the short circuit section of line and the outer conductor of said second section of line being conductively joined to one end of the outer conductors of the two lines.

Two adjustable plungers 61 and 62 provide any desired distance D between their respective faces. Of particular importance in its application to balancing a bridge is a length

\[ D = \frac{n \lambda}{2} \]

where \( n \) is a positive integer, preferably 1, and \( \lambda \) is the wavelength. For this length, the line sections between the plungers 61 and 62 provides a resonant electrical system and this resonant system is connected to the transmission line at a distance \( D_s \) from one plunger. The magnitude of the resistive impedance connected across the line \( 50 \) at the point \( 60 \) may be varied between wide limits by appropriate adjustment of the length \( D_s \) of the relatively shunting the short reactance element 54 and the substantially resistive element 58 any value of complex impedance may be made to appear at the terminal 51.

The lengths of the short-circuited coaxial line sections are selected to allow a range of variation of the distances \( D_s \) and \( D_5 \) of at least one-half wavelength at the lowest frequency for which the variable impedance device is designed. With this range of adjustment, the distance \( D_s \) of the short-circuited coaxial line section 52, 54 may be varied from less than to more than one-quarter wavelength, thereby enabling the short-circuited section 52, 54 to provide a shunt reactance across the line 50 whose magnitude is adjustable from a low positive value through high positive and negative values to a low negative value as the distance \( D_s \) is varied from less to more than one-quarter wavelength. In a related manner, the resistance across the coaxial line sections 50 at the junction 60 may be varied from a high value to a low value by varying the distance \( D_s \) from one-quarter wavelength to one-half wavelength, maintaining the distance \( D_s \) fixed and equal to one-half wavelength. The distance \( D_5 \) may be held fixed at one-half wavelength if desired as the distance \( D_s \) is varied by intercoupling plungers 61 and 62 with a rigid member external to the impedance device.

Where the range of resistance variation desired is small, as in many ultra-high-frequency applications, the inner conductor 59 need not be of the highest possible conductivity but may be of a material of moderately high conductivity such as nickel or iron.

Since many changes could be made in the above construction and many apparently widely different embodiments of this invention could be made without departing from the scope thereof, it is intended that all matter contained in the above description or shown in the accompanying drawing shall be interpreted as illustrative and not in a limiting sense.

What is claimed is:

An adjustable ultra-high-frequency impedance element comprising a first section of coaxial line, a second section of coaxial line shunt connected to one end of said first section of coaxial line, said shunt connection being made at a position intermediate the ends of said second section of line thereby forming a T junction, the inner conductor of said second section of line being conductively joined to one end of the inner conductor of said first section of line and the outer conductor of said second section of line being conductively joined to one end of the outer
conductor of said first section of line, the other end of said first section of line being open for the admittance of ultra-high-frequency energy, first movable short-circuited plunger means situated within and closing off one end of said second section of line, said first plunger conductively joining the inner and outer conductors of said second section of line, second movable short-circuited plunger means situated within and closing off the other end of said second section of line, said second plunger conductively joining the inner and outer conductors of said second section of line, the distance between said first movable short-circuited plunger means and said second movable short-circuited plunger means being adjusted substantially equal to one-half wavelength of the ultra-high-frequency energy to be applied to the open end of said first section of coaxial line, said second section of coaxial line presenting a substantially resistive impedance across said one end of said first section of coaxial line, a third section of coaxial line shunt connected to said first section of line intermediate said T junction and the open end of said first section of line, third movable short-circuited plunger means situated within and closing off the open end of said third section of line, said third plunger conductively joining the inner and outer conductors of said third section of line, the distance between said third movable short-circuited plunger means and said first section of line being adjusted to a value less than one-half wavelength of the ultra-high-frequency energy to be applied to the open end of said first section of line for providing a substantially reactive impedance across said first section of line, the adjustment of the positions of said three short-circuited plunger means providing a wide range of resistance and reactance values across the open end of said adjustable ultra-high-frequency impedance element.

References Cited in the file of this patent

UNITED STATES PATENTS

2,232,179  King ---------------- Feb. 18, 1941
2,238,438  Alford ---------------- Apr. 15, 1941
2,373,233  Dow et al. ------------- Apr. 10, 1945