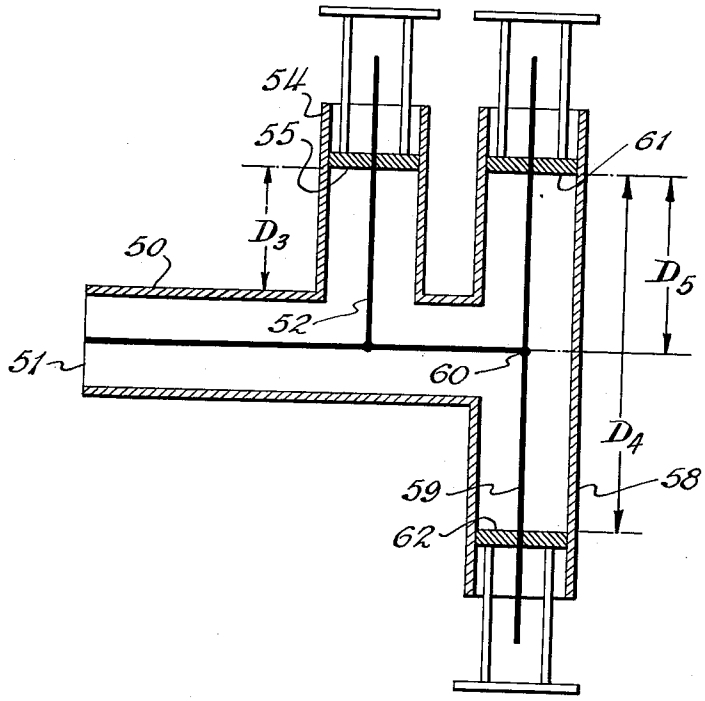
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ADJUSTABLE ULTRA-HIGH-FREQUENCY IMPEDANCE DEVICE

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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 copending 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 an ultra-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 to match the impedance of the antenna, the ultra-high-frequency energy from the transmitter may be supplied to the antenna and to the adjustable coaxial line impedance device but not to the receiver, as is more fully described in my aforesaid patent.

The present invention introduces an adjustable coaxial line impedance device including three independently adjustable short-circuited coaxial line sections for providing a variable impedance for use in coaxial line systems such as the above-mentioned coaxial line bridge.

Accordingly, an object of the present invention is to provide an adjustable impedance device for use at ultra-high frequencies in the same general manner in which conventional adjustable impedance devices are used at low frequencies.

Another object is to provide a coaxial line impedance device having adjustable reactance and resistance.

Still another object is to provide a coaxial line impedance device including tunable short-circuited coaxial line sections for independently varying reactance and resistance.

The above objects of the present invention will be more fully understood and further objects and advantages will become apparent from a careful study of the following description in connection with the drawing, wherein the single figure shows the adjustable coaxial line impedance device of the invention.

The adjustable coaxial impedance device comprises a section of coaxial line **50** adapted to be joined at end **51** to a coaxial bridge. An adjustable shunt reactance in the form of a coaxial line having outer conductor **54** and

inner conductor **52** is connected across the line **50**. This section of line is provided with an adjustable short-circuiting plunger **55** so that its length D_3 may be varied. By this means, a reactance of either positive or negative character and of any desired magnitude may be connected across the line. A further element of this adjustable impedance device comprises a line having an outer conductor **58** and an inner conductor **59**. This latter section is connected to the line **50** at **60** and this junction may be made adjustable by providing sliding connections between the two lines. Two adjustable plungers **61** and **62** provide any desired distance D_4 between their respective faces. Of particular importance in its application to balancing a bridge is a length

$$D_4=\frac{n\lambda}{2}$$

where n is a positive integer, preferably 1, and λ is the wavelength. For this length, the line section 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_5 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_5. By relatively varying the shunt 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_3 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_3 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_3 is varied from less than to more than one-quarter wavelength. In a related manner, the resistance across the coaxial line section **50** at the junction **60** may be varied from a high value to a low value by varying the distance D_5 from one-quarter wavelength to one-half wavelength, maintaining the distance D_4 fixed and equal to one-half wavelength. The distance D_4 may be held fixed at one-half wavelength if desired as the distance D_5 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.

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