

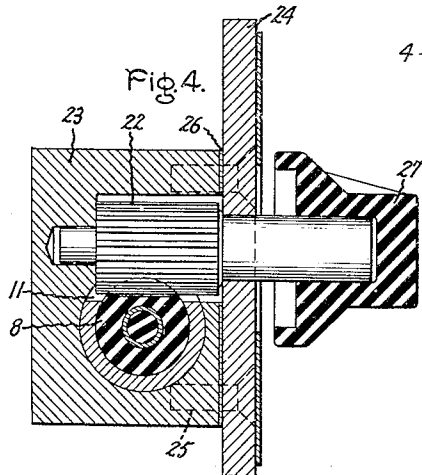
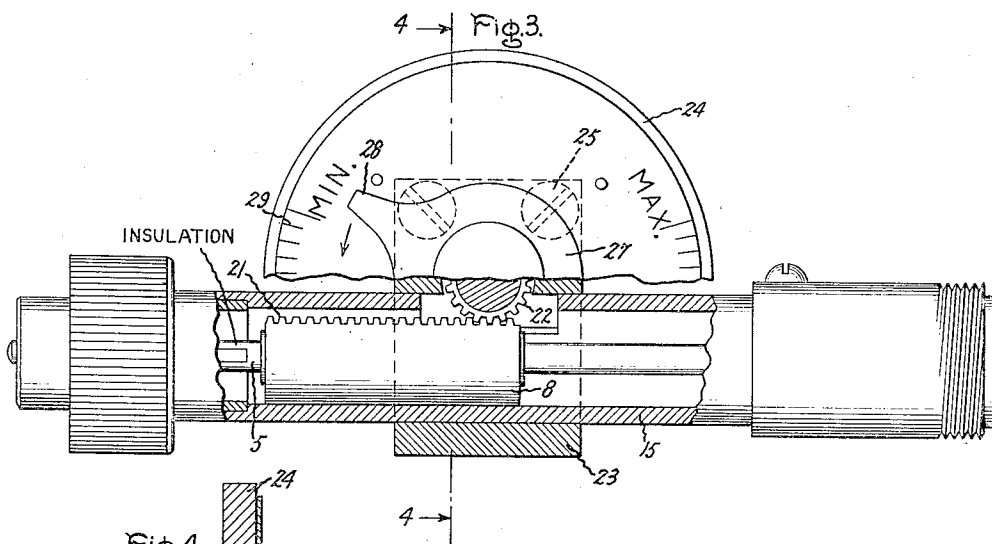
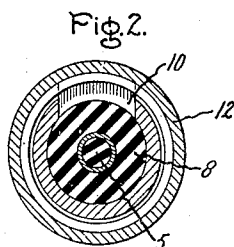
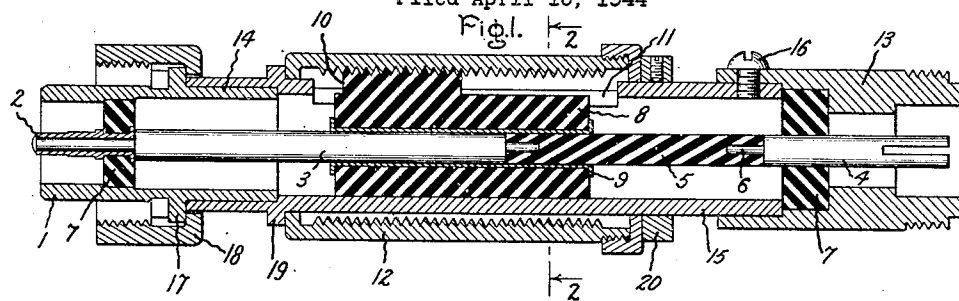
Oct. 12, 1948.

S. C. CLARK, JR

2,451,201

ATTENUATOR FOR ULTRA HIGH FREQUENCIES

Filed April 15, 1944



Inventor:
Stephen C. Clark Jr.,
by *Harry E. Dunham*
His Attorney.

UNITED STATES PATENT OFFICE

2,451,201

ATTENUATOR FOR ULTRA HIGH FREQUENCIES

Stephen C. Clark, Jr., Scotia, N. Y., assignor to
General Electric Company, a corporation of
New York

Application April 15, 1944, Serial No. 531,224

8 Claims. (Cl. 178-44)

1

My invention relates to ultra high frequency systems, and more particularly to an attenuator for utilization therein. In such systems, the problem frequently arises of connecting a utilization circuit, for example a frequency determining meter, to an input circuit in which the intensity of the incident wave may vary over a considerable range. Moreover, since in such systems it is desirable to have impedance matching throughout, any attenuator for varying the intensity of an ultra high frequency wave transmitted to a utilization device should provide a minimum discontinuity in the system, so that no reactive effect of consequence is transferred to either the input or the utilization circuits. Accordingly, it is an object of my invention to provide a new and improved attenuator for ultra high frequency systems in which reactive effect on circuits coupled thereto is minimized.

It is another object of my invention to provide a new and improved attenuator for systems of this nature wherein accurately controllable and determinable amounts of attenuation may be obtained.

It is a further object of my invention to provide a new and improved attenuator for an ultra high frequency system which comprises a concentric transmission line connected between the input and output circuits of the system, which transmission line includes a variable capacitance element for attenuating the ultra high frequency waves transmitted between the circuits.

Briefly stated, in accordance with the illustrated embodiments of my invention, I provide in an ultra high frequency system a concentric transmission line along which an ultra high frequency electromagnetic wave is propagated and in which a variable capacitance is serially connected between adjacent sections of one of the conductors of the line. The variable capacitance includes an insulator connected between sections of the inner conductor and a metallic sleeve slidable along one of the sections and over an adjustable portion of the insulator. The variable capacitance is of such size that, in comparison with the input and output shunt capacitances of the adjacent sections of the concentric transmission line, the effect of its variation on the input and output impedances, and hence on the circuits connected to the line, is negligible.

For a better understanding of my invention, reference may be had to the following description taken in connection with the accompanying drawing and its scope will be pointed out in the appended claims. Fig. 1 is a longitudinal cross-

2

sectional view of one embodiment of my invention including the attenuator connected in a concentric transmission line, and Fig. 2 is a vertical cross-sectional view along the lines 2-2 of Fig. 1. Fig. 3 represents a modification of the attenuator of my invention as embodied in a concentric transmission line and which employs means for more accurately controlling and determining the amount of attenuation, and Fig. 4 is a vertical cross-sectional view of the attenuator of Fig. 3 taken along the lines 4-4.

Referring to Figs. 1 and 2 jointly, there is shown an attenuator which comprises a section of concentric transmission line having a tubular outer conductor 1 and a centrally disposed inner conductor 2 along which an ultra high frequency electromagnetic wave is propagated. The centrally disposed inner conductor comprises two similar metallic sections 3, 4 which are separated by a spacer 5 of any suitable insulating material, such as, for example, polystyrene. The sections 3 and 4 at their adjacent ends are provided with portions of reduced diameter 6 which fit in cooperating holes in the ends of spacer 5. The spacer 5 and the sections 3, 4 are all of the same diameter so that physically the inner conductor 2 appears as a continuous cylindrical member which is supported within the outer conductor 1 by means of a plurality of insulators 7.

Supported on the inner conductor 2 is a dielectric cylinder 8 of any suitable insulating material, such as, for example, polystyrene. The dielectric member 8 has a central bore into which is fitted a conductive member in the form of a metallic sleeve 9, the sleeve being spun over at the ends of the dielectric cylinder to form a rigid construction. The sleeve 9 has an inner diameter which is substantially equal to the outer diameter of the section 3 and is in contact with this section of the inner conductor and transmission line. The metallic sleeve 9, moreover, extends over a portion of the insulating spacer 5. The dielectric cylinder 8 is provided at its left-hand end with a protruding portion 10 which extends through a slot or an opening 11 in the outer conductor 1. The protruding portion 10 moreover is provided with threads which engage threads within a metallic sleeve 12 which surrounds the outer conductor 1 adjacent the slot 11.

In construction, the outer conductor may be formed in a plurality of parts, such as a pair of end sections 13, 14 and an intermediate section 15, the intermediate section containing the slot 11. The section 13 may be joined to the section 15 by means of a plurality of screws 16, while the

section 14 may contain a shoulder 17 against which is abutted an internally threaded nut 18 and which may be used for connecting the left-hand portion of the transmission line to an input circuit. The intermediate section 15 has a shoulder portion 19 adjacent the slot 11 and the threaded sleeve 12 abuts against this shoulder. A collar 20 abutting against the opposite end of sleeve 12 prevents longitudinal motion of the sleeve on the intermediate section 15, while permitting rotation of the sleeve about this portion of the outer conductor.

In operation, the left-hand portion of the concentric transmission line may be connected to an input circuit, such as a source of ultra high frequency electromagnetic waves, while the right-hand portion of the attenuator comprising the section 4 of the inner conductor and the section 13 of the outer conductor may be connected to a load circuit such as, for example, a frequency determining meter (not shown). In such ultra high frequency applications, of course, it is customary to have the impedance of the connecting transmission lines match with the impedances of such a source and such a load. This impedance includes the relatively high shunt capacitance incident to the position of the inner conductor within the outer conductor of the transmission line. Since in some applications it is desirable to have the voltage supplied to a load circuit maintained constant while the voltage from an input circuit may vary over a considerable range, attenuation of the ultra high frequency input wave is required. In the construction above described, the opposed ends of conductors 3 and 4, separated by the insulating spacer 5 form a capacitance of small value which is connected in series with the sections 3, 4 of the inner conductor of the transmission line and which attenuates the high frequency wave traveling along that line. The conductive member or sleeve 9 forms means for varying the value of this capacitance. This variation is obtained by rotation of the sleeve 12 to move the dielectric cylinder 8 and the sleeve 9 along the spacer 5, the movement providing a continuous variation of the attenuation of the high frequency wave. This series capacitance, moreover, is relatively small compared to the shunt capacitance which exists between the inner and outer conductors 4, 13 of the transmission line. Accordingly, substantially no reactive effect on any load circuit which may be connected between members 4 and 13 is obtained, the input and output impedances being maintained constant as the attenuation is varied over a substantial range, for example, from a few decibels to an almost infinite amount of attenuation.

In the modifications of the invention illustrated in Figs. 3 and 4, a precision attenuator is shown which has no protruding surface, but instead the rack 21 is formed on one surface. Also the position of insulating spacer 5 relative to the input and output ends of the attenuator is reversed from that shown in the structure in Fig. 1. Thus, the member 5 is positioned between sleeve 8 and the input conductor 3 and, in the minimum attenuation position shown in Fig. 3, lies almost entirely within dielectric sleeve 8. The rack 21 is engaged by a pinion 22 which is supported in a bearing structure comprising a housing portion 23 which is attached to the outer conductor section 15 and a face plate 24 which is fastened to the housing member by means of a plurality of screws 25. A gasket 26, interposed between

the face plate 24 and the housing member 23, can make the structure water-tight. The pinion 22 may be rotated by a control knob 27 which carries a pointer 28 and cooperates with a scale 29 on the face plate to indicate precisely the amount of attenuation obtained.

From the foregoing, it is seen that my invention provides a variable attenuator for an ultra high frequency wave which is simple in construction and operation and which produces a continuously variable amount of attenuation which has no appreciable effect on the load circuits connected thereto.

While I have shown a particular embodiment of my invention, it will of course be understood that I do not wish to be limited thereto since various modifications may be made, and I contemplate by the appended claims to cover any such modifications as fall within the true spirit and scope of my invention.

What I claim as new and desire to secure by Letters Patent of the United States is:

1. An attenuator for a high frequency electromagnetic wave comprising a transmission line having a pair of conductors, one of said conductors being continuous in character, the other of said conductors consisting of two sections separated by an insulating spacer, the opposed ends of said sections and said spacer constituting a capacitance connecting said sections and providing attenuation of said wave, and a conductive member movable along said spacer to vary said capacitance and the amount of said attenuation.

2. An attenuator for an ultra high frequency electromagnetic wave comprising a concentric transmission line constituted by a tubular outer conductor and a centrally disposed inner conductor, said inner conductor consisting of two sections separated by an insulating spacer, the opposed ends of said sections and said spacer constituting a capacitance connecting said sections and providing attenuation of said wave, and a conductive sleeve slidable along said spacer to vary said capacitance and the amount of said attenuation.

3. In an attenuator for an ultra high frequency wave, the combination of a section of concentric transmission line comprising a tubular outer conductor and a centrally disposed inner conductor, said inner conductor consisting of two longitudinally spaced sections connected by a cylindrical insulator, a metallic sleeve contacting one of said sections and slidable along said insulator, and means for adjusting the position of said sleeve on said insulator.

4. In combination, a concentric transmission line along which an ultra high frequency electromagnetic wave is propagated, said transmission line having an inner conductor comprising two conductive sections separated by a non-conductive section comprising a solid dielectric material, the opposed ends of said conductive sections and said non-conductive section constituting a capacitance connecting said sections and providing attenuation of said wave, and means for continuously varying the amount of said attenuation, said means comprising a conductive sleeve connected to one of said conductive sections and adjustable in position along said non-conductive section.

5. An attenuator for an ultra high frequency electromagnetic wave comprising a concentric transmission line having a tubular outer conductor and a centrally disposed inner conductor,

5

said inner conductor consisting of two conductive sections having their adjacent ends in opposed spaced relation to form a capacitance connecting said sections and providing attenuation of said waves, solid dielectric means positioned between said ends and forming a spacer therebetween, and means for varying the amount of said attenuation, said last means comprising a conductive member connected to one of said sections and adjustable in position relative to the end of the other of said sections.

6. In combination, a concentric transmission line along which a high frequency electromagnetic wave is propagated, said line comprising a tubular outer conductor and a centrally disposed inner conductor, one of said conductors comprising a pair of sections having adjacent ends in opposed spaced relation to provide a capacitance connecting said sections for attenuating said wave, solid dielectric means positioned between said ends and forming a spacer therebetween, and means for varying the amount of said attenuation comprising a conductive member connected to said one section and variable in position relative to the other of said sections.

7. In an attenuator for a high frequency electromagnetic wave, the combination of a concentric transmission line comprising a tubular outer conductor and a centrally disposed inner conductor, said inner conductor consisting of a pair of metallic sections connected by a non-conducting section to form a capacitance connecting said

6

metallic sections for attenuating said wave, and means to vary the amount of said attenuation comprising an insulator surrounding one of said conductive sections and a portion of said non-conducting section, said insulator having a conductive surface contacting said conductive sections and said non-conducting section and extending along said non-conducting section and being movable along said inner conductor to vary the value of said capacitance.

8. An attenuator comprising a concentric transmission line and consisting of a tubular outer conductor and a centrally disposed inner conductor, said inner conductor consisting of two sections separated by an insulating spacer, an insulator supported on said inner conductor, said insulator having a conductive sleeve extending along said inner conductor, said sleeve contacting one of said sections and being adjustable in position along said spacer.

STEPHEN C. CLARK, Jr.

REFERENCES CITED

The following references are of record in the file of this patent:

UNITED STATES PATENTS

Number	Name	Date
1,672,641	Dryer, Jr., et al.	June 5, 1928
2,014,422	Carter et al.	Sept. 17, 1935
2,233,166	Hahn	Feb. 25, 1941