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MEANS FOR ABSORBING REFLECTED ENERGY IN AN ANTENNA TRANSMISSION LINE

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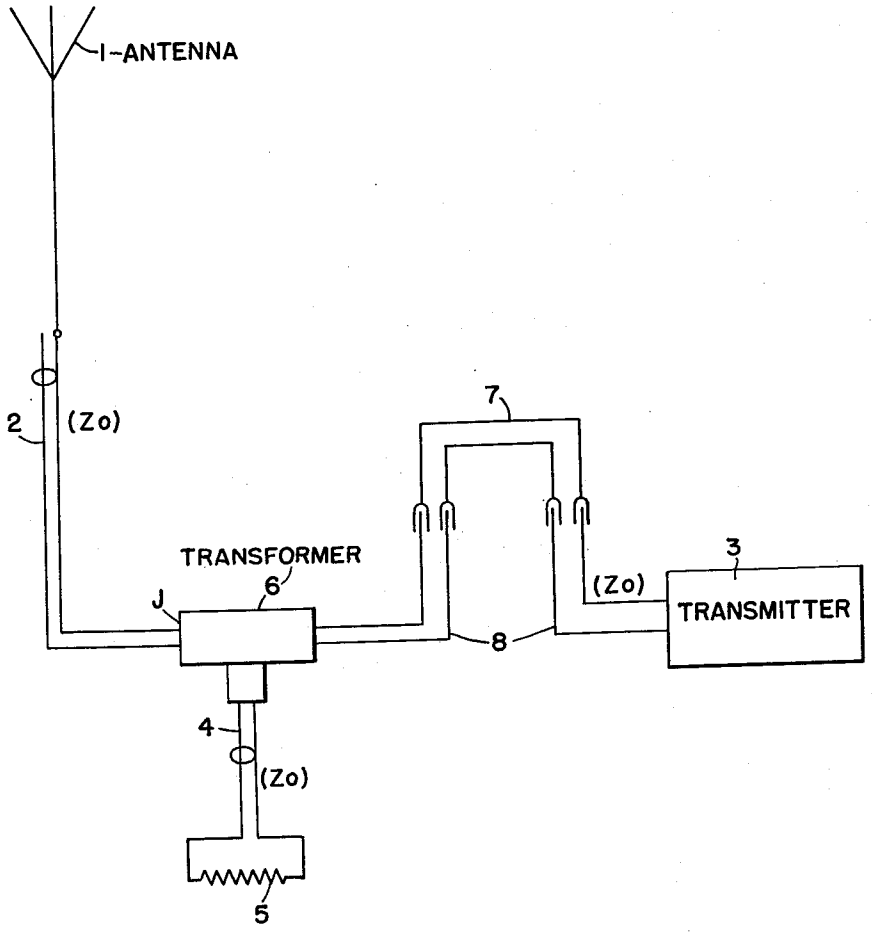

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MEANS FOR ABSORBING REFLECTED ENERGY IN AN ANTENNA TRANSMISSION LINE

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The present invention relates to a means for absorbing power which is reflected from an antenna into the antenna transmission line.

The present invention provides a means by which power reflected into an antenna transmission line from the antenna, may be absorbed in order to avoid the radiation of ghosts from the antenna.

The present invention may be best understood when considered in connection with a specific application involving the transmission of a television signal through an antenna which is subjected to sudden unanticipated severe ice build up while deicers are not turned on, for example, five inches of ice built up during a night. Under these conditions, the reflected wave from the antenna may increase substantially. This increase may be detected by the operator with the aid of a reflectometer provided with most high power transmitters. This rise in amplitude of the reflected wave is the first evidence to the operator that there is a severe icing condition taking place on the antenna. Often the operator has no prior knowledge of this condition because the antenna may be hidden from his view. Under these conditions a substantial portion of the power transmitted to the antenna for radiation may be reflected along the transmission line toward the transmitter. The returning wave does not see a perfect termination at the transmitter, but on the contrary finds a very large mismatch which results in an almost complete reflection. The returning wave is therefore, almost completely reflected back into the antenna. This second wave, which is returning to the antenna after being reflected by the transmitter, will have travelled twice the line length before its major portion is radiated by the antenna into space.

Presuming the antenna is connected to a transmission line, of 500 ft. this means, the original picture modulated signal from the picture transmitter travels 500 feet along the transmission line before being radiated from the antenna. However, as the speed of propagation of a wave traveling along a rigid coaxial transmission line is approximately 985 feet, per microsecond, the second wave (reflected by the antenna and then by the transmitter), is radiated out about one microsecond after the first wave left the antenna. A portion of this second wave, is, of course, also returned back to the transmitter and is then radiated as a third wave, two microseconds after the first wave.

The full screen width of a T.V. receiver represents approximately 52 microseconds. If the screen is 10" wide, one microsecond is approximately $\frac{2}{10}$". Thus, the effect of the wave being reflected by the antenna into the 500 foot line is to produce a ghost (a weaker picture) displaced to the right from the main picture by a distance of about $\frac{2}{10}$". When the reflection is very large, one can sometimes see a second weaker ghost displaced $\frac{4}{10}$" in the main picture. With longer transmission lines, the displacement of the ghost is proportionately greater.

In order to overcome this undesirable condition existing during periods of high reflection from the antenna, the operator may switch into a circuit arrangement in which the reflected wave is absorbed and not permitted to reradiate. While this arrangement may be utilized at the expense of some loss of power, the beneficial results obtained insofar as avoiding the formation of ghosts more than offsets the loss of power. Thus it is an object of the present invention to provide a circuit arrangement

adapted to be connected into an antenna transmission line for the purpose of absorbing reflected energy whereby the radiation of secondary signals may be minimized.

These and other objects of the present invention will be more clearly understood when considered in connection with the accompany drawing, in which the figure illustrates a schematic circuit of the present invention.

In this arrangement there is provided as an exemplification of the present invention, a television broadcast antenna 1 and a video transmitter 3 interconnected by a coaxial transmission line 2 for supplying R.F. power to the antenna. A branch coaxial line 4 having a resistive termination 5, is connected to the line 2 close to the transmitter 3. The junction of the branch line 4 and transmission line 2 indicated at J is interconnected with the coaxial line section 8 to the transmitter 3 with a transforming means 6. A line stretcher 7 is connected in series with the line section 8. The line sections 2 and 8 and branch line 4, each have characteristic impedances of Z_0. Let the resistive load 5 be equal to the characteristic impedance.

The operation of this network is as follows: The high frequency power from the transmitter 3 is divided equally between the branch line 4 and the transmission line 2. The impedance at the junction J between the main line 2 and the branch line 4 is approximately equal to one-half of Z_0. The transformer 6 therefore transforms one-half Z_0 back to Z_0, so that the transmitter may be operated into an approximately matched line.

It may be noted however that where there is a substantial reflection at the antenna, the impedance found looking into the line 2, from J, is not equal to the characteristic impedance but oscillates above and below that value as the frequency is swept over a 6 megacycle band. Under such conditions line 4 is matched better than line 2. Under severe icing conditions, the wave which starts from the transmitter proceeds along line 2 to the antenna but is not entirely radiated. A portion of this wave is reflected by the antenna and proceeds along the transmission line 2 back towards the transmitter 3. When the wave arrives at junction J, it is presented with two possible paths; one path is via the branch line 4 into the load 5 and the second path is via line 8 and line stretcher 7 into the transmitter. The impedance looking into line 8 from the junction J may be controlled by varying the length of line stretcher 7. Because the transmitter presents a very substantial mismatch to line 8, the impedance looking into the line at junction J will vary between a very low value and a very high value, depending upon the length of the line. This length therefore may be adjusted by means of the line stretcher so that the impedance presented at junction J is very high. Under these conditions, the impedance looking into the junction from the antenna feeder 2 will then be essentially equal to the impedance of the branch 4, which is terminated by the resistive load 5. By making the resistive load 5 equal to the characteristic impedance, the wave returning from the antenna is substantially absorbed by the load 5 and will not be able to return to the antenna to cause the undesirable secondary radiation or ghost.

In order for the network described above to operate at is optimum performance, it is necessary that the length of the line between junction J and the transmitter be as short as practical; for example, 10 or 20 feet. A very long length of line between the junction J and the transmitter would impair operations of the arrangement.

While the above arrangement is preferable, the present invention also contemplates other arrangements within the scope of this invention. For example, in place of using lines 2, 4 and 8, all of the same characteristic impedance, necessitating the use of a transformer 6, the line section 8 having a characteristic impedance of half the

characteristic impedance of lines 2 and 4, may be utilized.

It should also be noted that other means may be used for assuring a high impedance at the junction J looking into the line 8. A line stretcher as illustrated is convenient, for it permits a ready adjustment of the length of the line 8 to assure a high impedance looking into the line from the junction J.

Having now described my invention, I claim:

High frequency apparatus comprising, a source of a high frequency video-modulated carrier signal, an antenna having an input impedance subject to change and coupled to said source by means consisting of a linear system, said linear system comprising a first transmission line coupled to said antenna and having a characteristic impedance corresponding to the normal input impedance of said antenna, a resistance of at least said characteristic impedance, a second transmission line of said characteristic impedance coupling said resistance to said first transmission line at a junction, a line stretcher coupled to said source for substantially maximizing the impedance presented by said source at said junction, and impedance transforming means coupling said junction to said line stretcher, whereby substantially only energy directly transmitted from said source is delivered to said antenna even when said antenna mismatches the impedance of said first transmission line.

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