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TRANSMISSION LINE

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Fig. 1

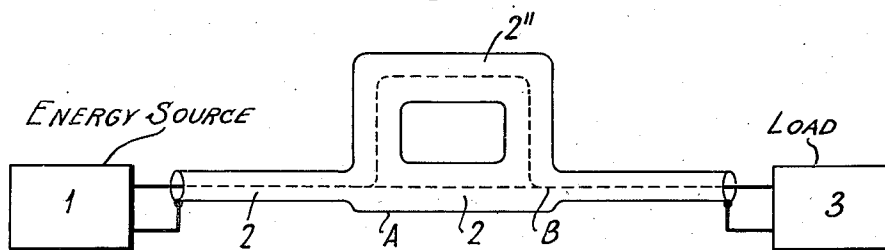
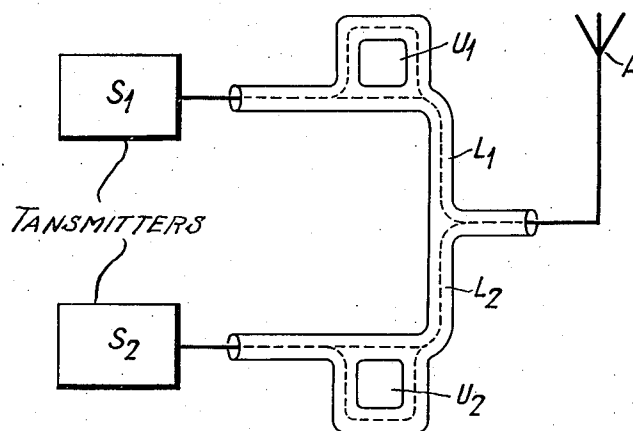


Fig. 2



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TRANSMISSION LINE

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2 Claims. (Cl. 178—44)

This invention relates to an arrangement for suppressing undesired frequencies in radio frequency transmission channels.

There are many cases in practice in connection with the transmission of radio frequency oscillations or the coupling of radio frequency circuits where one or more undesired frequencies are to be suppressed so that only the desired signal frequency will be delivered at the output end of the transmission line or channel or of the coupling means. A problem of this kind arises, for instance, where a joint aerial is fed from two short wave transmitters working on dissimilar waves. In such a scheme the possibility exists that a wave generated by one transmitter may reach the other by way of the common antenna lead and causing disturbing actions or detuning. In such a case, care must be taken so that while oscillations can be transmitted from each transmitter unhindered to the aerial, the path from the aerial to the transmitters for the respective other frequency should, on the contrary, be blocked. The solution of this problem becomes more difficult for a pair of transmitters operating on closely adjacent frequencies for the reason that in such a case normal means, such as filter organizations comprising oscillatory circuits, are no longer effective and useful because of inadequate selectivity.

This difficulty may be overcome by including in the antenna leads of the two transmitters low-damped oscillatory circuits consisting of tuned line portions in such a way that the frequency to be eliminated is short-circuited or by-passed, while the frequency to be transmitted is passed without hindrance. The present invention has as its object an arrangement adapted to solve the identical problem. According to the invention transmission is effected through a line or channel which, at one or at several points, is split into two paralleled branches the lengths of which differ one-half wave length, or an odd multiple of a half-wave length of the oscillation to be suppressed.

The invention shall now be described in more detail by reference to the appended drawing, in which Figure 1 shows an embodiment of the invention while Figure 2 shows a modification particularly useful in simultaneous radiation of television and sound programs from a single antenna.

Figure 1 shows a source of radio frequency 1 which is connected with a load 3 by means of a co-axial or concentric energy feeder line 2. In this transmission or channel the problem arises

to eliminate and suppress a certain frequency, while one or more other frequencies are to be transmitted to the load under conditions as free from loss as feasible. To this end, the energy feeder line 2, at the point marked A, is split into two parallel branches 2' and 2'', these two branches being re-united at the point marked B. The lengths of the branches 2' and 2'' are so chosen that they differ by an odd multiple of one-half wave length of the frequency to be suppressed. For the frequency to be transmitted, on the contrary, it will be most favorable to make the difference in length of the two branches an even multiple of one-half wave length. Oscillations which are fed to the energy feeder 2 become divided uniformly at the place marked A between the two branches and reach point B with a phase difference which corresponds to the electrical length of the difference in path or transit of 2' and 2''. If this phase difference is just $\lambda/2$, the two potentials will exactly cancel out at point B and hence this frequency will not reach the load 3. But if the phase difference is λ then the oscillations at point B will be in phase so that they will readily result in the original oscillation and thus be fed to the load device.

In splitting the energy feeder, care must, of course, be taken so that the surge impedances of the various line portions are correctly chosen so that there will be no reflections of the waves to be transmitted. For instance, in an arrangement as shown in Figure 1 the characteristic impedances of the line to the right and the left of points A and B must be equal to one-half the characteristic impedances of the line portions 2' and 2'' inasmuch as the characteristic impedances of these line portions appear connected in parallel for the rest of the line. The value of these characteristic impedances may be fixed most conveniently by a suitable choice of the ratio of the diameters of the two conductors of the co-axial feeder as indicated in the drawing.

In order to suppress several frequencies rather than merely one it is, of course, within the scope of the invention to arrange several branch-offs in series, with the differences in length being chosen different in each case. It is also possible to tune all of the branch-offs to one and the same wave, and this would result in more effective suppression. The only condition is that the frequencies to be transmitted will be caused to suffer at the branch-off points a difference in path or transit time which is roughly equal to a multiple of the wave length λ . Otherwise also these frequencies would be attenuated, and this is exactly what is

to be avoided. As will be seen, the line including the branch-off is in the form of a co-axial or concentric radio frequency feeder, with the two paralleled branches 2' and 2'' being surrounded by distinct shielding means so that there is no risk of inter-action; in fact, such inter-action would seriously affect the operation of the assembly.

Figure 2 shows an exemplified embodiment of the invention in which two transmitters S₁ and S₂ working with wave lengths λ₁ and λ₂ work upon a common antenna A as, for example, in the broadcast of pictures and sound in television program transmission upon adjacent ultra-short waves. The lead brought from the transmitter S₁ to the antenna includes a by-pass U₁ whereby the wave λ₂ in its path from transmitter S₂ by way of lines L₂ and L₁ is divided into two paralleled branches presenting a difference in length equal to an odd multiple of

$$\frac{\lambda_2}{2}$$

so that it is unable to reach the transmitter S₁. As to the wave λ₁ the branch-off must be so designed that the difference in path is an even multiple of

$$\frac{\lambda_1}{2}$$

In other words, for this difference in path there exists the demand that it should be equal to

$$(2n+1)\frac{\lambda_2}{2}$$

and at the same time

$$2N\frac{\lambda_1}{2}$$

where *n* and *N* are integers. On the basis of this basic condition and equation it is possible to determine the dimensions of U₁ for any waves λ₁ and λ₂ at all.

Similarly, the antenna lead brought from the transmitter S₂ contains a by-pass U₂ which rep-

resents a stopper in respect to the wave λ₁, while wave λ₂ will be passed unimpededly. In an arrangement as shown in Figure 2 and as already explained by reference to Figure 1, care must again be taken so that the characteristic impedances of the various line portions are chosen in such a way that matching prevails throughout and that the transmitted waves will not suffer reflections. This has not been indicated in Figure 2 for the sake of simplicity.

The invention is not restricted to the exemplified embodiment here shown, in fact, it will be found useful in connection with any filter arrangements at all. But it will prove particularly advantageous in cases where a certain frequency is to be suppressed entirely. Such complete suppression is practically impossible where conventional filter circuits are used, whereas it is readily feasible by the ways and means disclosed in the invention.

I claim:

1. An arrangement adapted to suppress undesired frequencies in a coaxial transmission line comprising a similar coaxial transmission line section connected in shunt to a portion of said first named line, the length of said section and said shunted portion differing by an odd multiple of a half the wave length of the undesired frequency, the impedance of each of said portion and said section being equal to twice the impedance of the remainder of said line.

2. An arrangement adapted to suppress undesired frequencies in a coaxial transmission line having an inner conductor and an outer sheath comprising a similar coaxial transmission line section having its conductors connected in shunt to a portion of said first named line, the lengths of said section and said shunted portion differing by an odd multiple of a half the wave length of the undesired frequency, the impedance of said portion and said section in parallel being equal to the impedance of the remainder of said line.

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