

June 30, 1942.

H. SALINGER

2,288,030

TRANSMISSION LINE STRUCTURE

Filed Jan. 10, 1941

2 Sheets-Sheet 1

FIG. 1

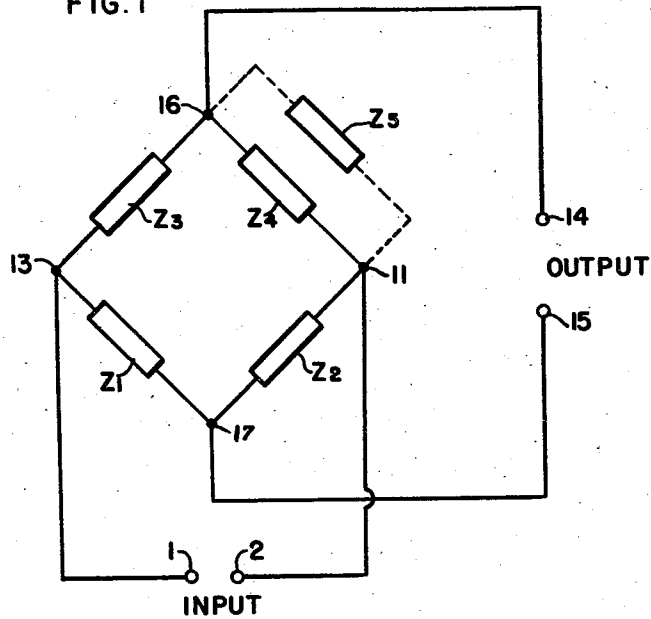
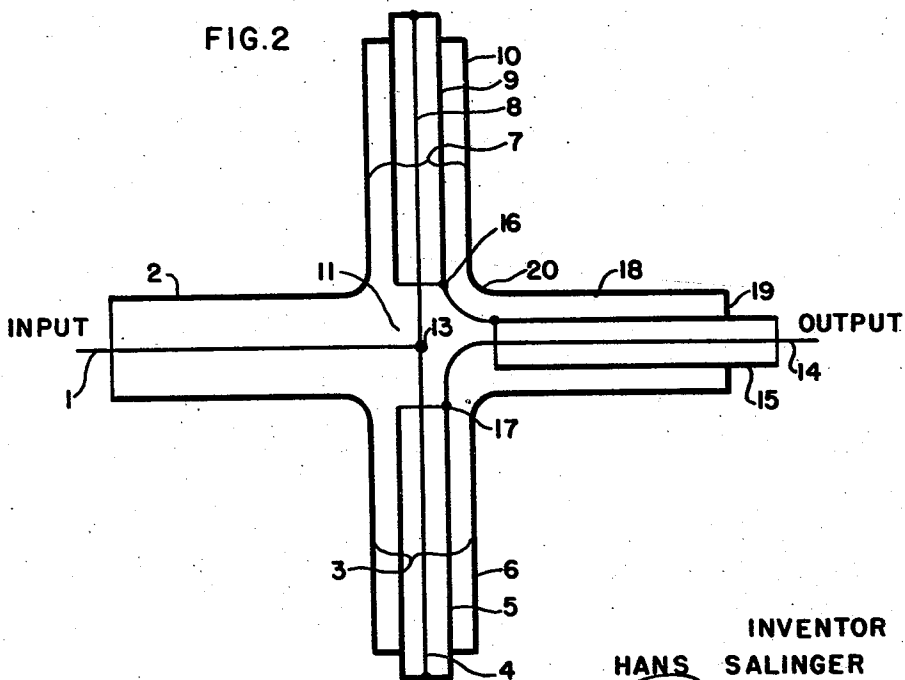


FIG. 2



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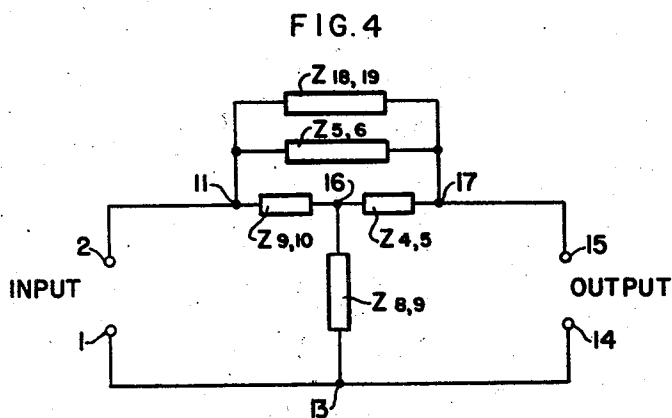
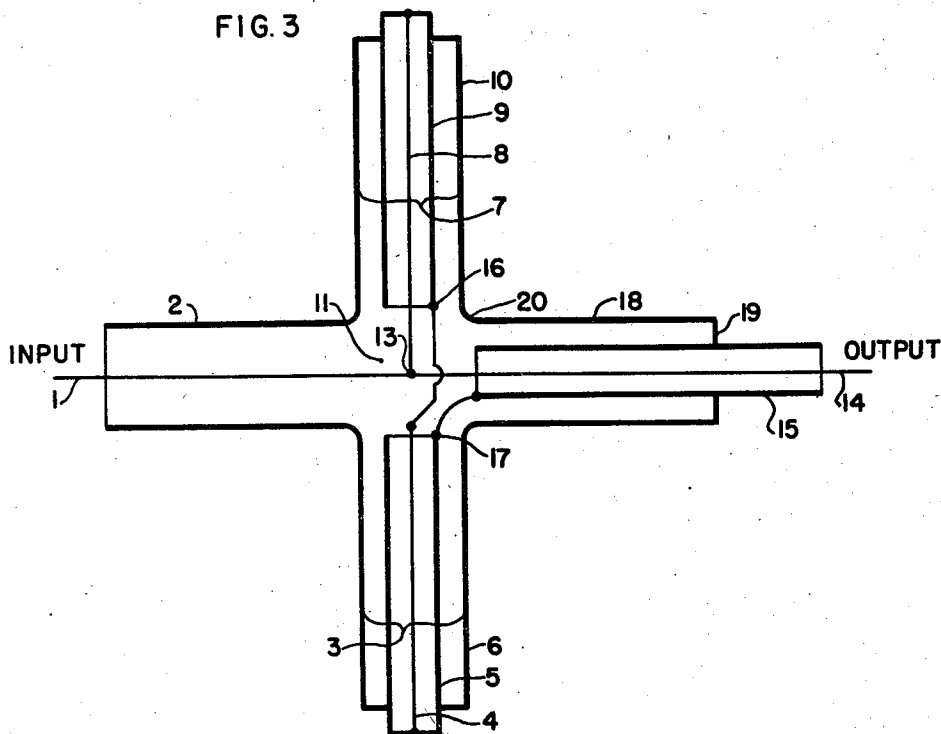
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TRANSMISSION LINE STRUCTURE

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3 Claims. (Cl. 178-44)

This invention relates to transmission-line structures including a plurality of transmission-line elements and particularly relates to a shielding means for such transmission-line structures.

In certain transmission-line structures including a plurality of transmission-line elements having inner conductors and shield conductors which represent reactance networks, it often becomes necessary so to connect two conductors that current flows along the inner surface of one of the conductors and also incidentally along its outer surface. The current flowing along the outer surface of such a conductor can readily flow through distributed capacitance to adjacent filter elements or to ground, thereby constituting a radiation loss as well as changing the transmission characteristics of the filter. Such a condition, however, is most unsatisfactory.

Certain shield structures have been proposed for the prevention of radiation losses. Such structures, however, are designed for one predetermined frequency only, are ineffective at other frequencies, and are therefore not desirable for transmission of wide frequency bands.

The object of the present invention, therefore, is to provide a new and improved transmission-line structure in which the current incidentally flowing along the outer surface of a conductor is returned to the transmission-line structure and radiation loss and other detrimental effects avoided independently of frequency.

In accordance with the present invention there is provided a transmission-line structure including a plurality of transmission-line elements having inner conductors and shield conductors connected so as effectively to constitute a reactance network. The transmission-line structure includes a connection between two of its conductors whereby current flows along the inner surface of one of the conductors and also incidentally along its outer surface. There is also provided a shield conductor disposed adjacent the last-mentioned conductor and connected thereto at one of its ends, while its other end is connected to another conductor of the transmission-line structure, thereby providing a return flow of the incidental current to the transmission-line structure.

For a better understanding of the invention, together with other and further objects thereof, reference is had to the following description taken in connection with the accompanying drawings and its scope will be pointed out in the appended claims.

In the accompanying drawings:

Fig. 1 shows a circuit diagram of a lattice-type filter, while Fig. 2 schematically shows a transmission-line structure constituting such a filter. Fig. 3 schematically shows another transmission-line structure embodying the present invention

and representing a bridged-T filter-section, while Fig. 4 shows a diagram of its equivalent circuit.

Referring now more particularly to Fig. 1 of the drawings there is shown a schematic diagram of a lattice-type filter having a pair of input terminals 1, 2 and a pair of output terminals 14, 15. The input terminals 1, 2 are connected to points 13 and 11, respectively, of the filter between which the series combinations of reactances Z_1 and Z_2 , and Z_3 and Z_4 , respectively, are connected, as shown. The junction point 16 between reactances Z_3 and Z_4 and the junction point 17 between reactances Z_1 and Z_2 are connected to the input terminals 14 and 15, respectively, as is conventional.

Fig. 2 shows a transmission-line structure constructed of coaxial transmission-line elements and constituting a lattice-type filter as shown in Fig. 1. Corresponding elements and points are indicated by the same reference numerals in the two figures. Corresponding to the input terminals 1, 2 of Fig. 1 there is provided an input terminal line having an inner conductor 1 and a shield conductor 2 which form the input line feeding the transmission-line structure. For the purpose of providing the reactances Z_1 and Z_2 between points 13 and 11 there is provided a transmission-line means 3 having an inner conductor 4, a first shield conductor 5 of predetermined diameter, and a second shield conductor 6 of greater predetermined diameter, all arranged concentrically with respect to each other. For the purpose of providing reactances Z_3 and Z_4 between points 13 and 11 there is provided a second transmission-line means 7 comprising an inner conductor 8, a first shield conductor 9 of predetermined diameter, and a second shield conductor 10 of greater predetermined diameter, also concentrically arranged with respect to each other. The shield conductor 2, as well as second shield conductors 6 and 10, are all joined together to form a unitary structure and their junction is generally indicated at 11 which represents a substantially equipotential area since this area is small as compared with the actual length of the transmission-line elements. The inner conductors 1, 4 and 8 are connected together at a point 13.

For the purpose of providing the structure with a signal output means there is provided an output terminal line including an inner conductor 14 and a shield conductor 15 corresponding to the output terminals 14 and 15 of Fig. 2 and connected to points 16 and 17 of the first shield conductors 9 and 5, respectively, of Fig. 2.

It will be evident to those skilled in the art that for proper dimensions of the transmission-line structure of Fig. 2 the reactance between points 11, 13, 16 and 17 thereof can be made

equal to any predetermined values necessary to obtain the desired filter action.

It will be noted that in such a structure current flowing from the point 16 to the shield conductor 15 will flow along the inner surface of conductor 15 as well as incidentally also along its outer surface. This, however, as was mentioned before, is an undesirable condition. For the purpose, therefore, of returning the current incidentally flowing from the point 16 along the outer shield conductor 15 to the transmission-line structure, there is provided a concentric shield 18 having its end 19 connected to the outer shield 15 and its end 20 to the unitary structure formed by the second outer shield conductors 6 and 10 and the shield conductor 2. The reactance of the transmission-line element comprising the outer surface of the shield conductor 15 and the inner surface of the shield 18 appears between points 11 and 16 in parallel relation to the reactance Z_4 as is indicated by Z_5 in Fig. 1. Since the resultant reactance of Z_4 and Z_5 is effective between points 11 and 16, the transmission-line structure must be so designed that the resultant reactance is of suitable value to render the desired filter characteristic.

Fig. 3 shows a bridged T-filter-section comprising coaxial transmission-line elements and of a general structure which is identical with that shown in Fig. 1 with the exception that certain electrical connections within the filter structure are different, so as to obtain the effect of a bridged T-filter-section. Like parts and points are indicated by the same reference numerals as in Fig. 1. In contrast to the structure of Fig. 1 the point 16 is connected to the inner conductor 4, while the inner conductor 14 is connected to the junction point 13 and the point 17 is connected to the shield conductor 15.

Fig. 4 shows the diagram of the circuit electrically equivalent to the structure of Fig. 3.

Again in Fig. 4 points corresponding to those of Fig. 3 are marked by the same numerals and the equivalents to the reactances represented by the transmission-line elements of Fig. 3 are indicated by the labelled blocks.

Fig. 4 shows that the equivalent reactance elements Z_5 , 6 and Z_{18} , 19, the latter including the shield 18, are connected in parallel relation with each other. By properly designing the transmission-line elements and the shield 18 the resultant reactance of Z_5 , 6 and Z_{18} , 19 can readily be made to have the proper value desired in the filter section.

While the structures of Figs. 1 and 3 have been marked with input and output ends, it will be understood that the input and output ends may also be interchanged as is well known to those skilled in the art.

In the above there have been shown and described transmission-line structures provided with a shield for prevention of radiation losses and other detrimental effects which is so connected in these transmission-line structures, that the reactance constituted by the shield and another part of the transmission-line structure becomes a useful reactance element of the network represented by transmission-line structure.

While there has been described what is at present considered the preferred embodiment of the invention, it will be obvious to those skilled in the art that various changes and modifications may be made therein without departing from the invention and it is, therefore, aimed in the appended claims to cover all such changes and

modifications as fall within the true spirit and scope of the invention.

What is claimed is:

1. A transmission-line structure including a single input terminal line and a single output terminal line, each having an inner conductor and an outer conductor, a plurality of transmission-line elements having inner conductors and shield conductors connected so as effectively to constitute a reactance network between said input and said output lines, a connection between one of said transmission line element conductors and the outer conductor of one of said terminal lines whereby current flows along the inner surface of said last-named outer conductor and also incidentally along its outer surface, and a shield conductor disposed adjacent said last-named outer conductor and connected thereto at one of its ends and to another conductor of said structure at the other of its ends, thereby to provide a return flow of said incidental current to said structure, the reactance of the transmission line element formed by said last-named shield conductor and said last-named outer conductor being electrically connected in parallel relation to the reactance of one of said transmission line elements.

2. A transmission-line structure including a single input terminal line and a single output terminal line, each having an inner conductor and an outer conductor, a plurality of transmission-line elements having inner conductors and shield conductors so as effectively to constitute a reactance network between said input and said output lines, a connection between one of said transmission line element conductors and the outer conductor of one of said terminal lines whereby current flows along the inner surface of said last-named outer conductor and also incidentally along its outer surface, and a cylindrical shield conductor concentrically disposed about said last-named outer conductor and connected thereto at one of its ends and to another conductor of said structure at the other of its ends, thereby to provide a return flow of said incidental current to said structure, the reactance of the transmission line element formed by said last-named shield conductor and said last-named outer conductor being electrically connected in parallel relation to the reactance of one of said transmission line elements.

3. A transmission-line structure comprising a single input line including an inner conductor and a shield conductor, transmission-line means providing a reactance network and including an inner conductor, a first shield conductor of predetermined diameter, and a second shield conductor of greater predetermined diameter, said input line shield conductor and said second shield conductor being joined to form a unitary outer shield structure, a single output line including an inner conductor and a shield conductor, means for connecting said first shield conductor of said transmission-line means to said last-mentioned shield conductor, and shielding means concentrically arranged about said output line shield conductor and joined at its opposite ends to said unitary structure and said last-mentioned shield conductor, the reactance of the transmission line element formed by said shielding means and said output line shield conductor being electrically connected in parallel relation to one of the reactances of said reactance network.

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