

Feb. 10, 1942.

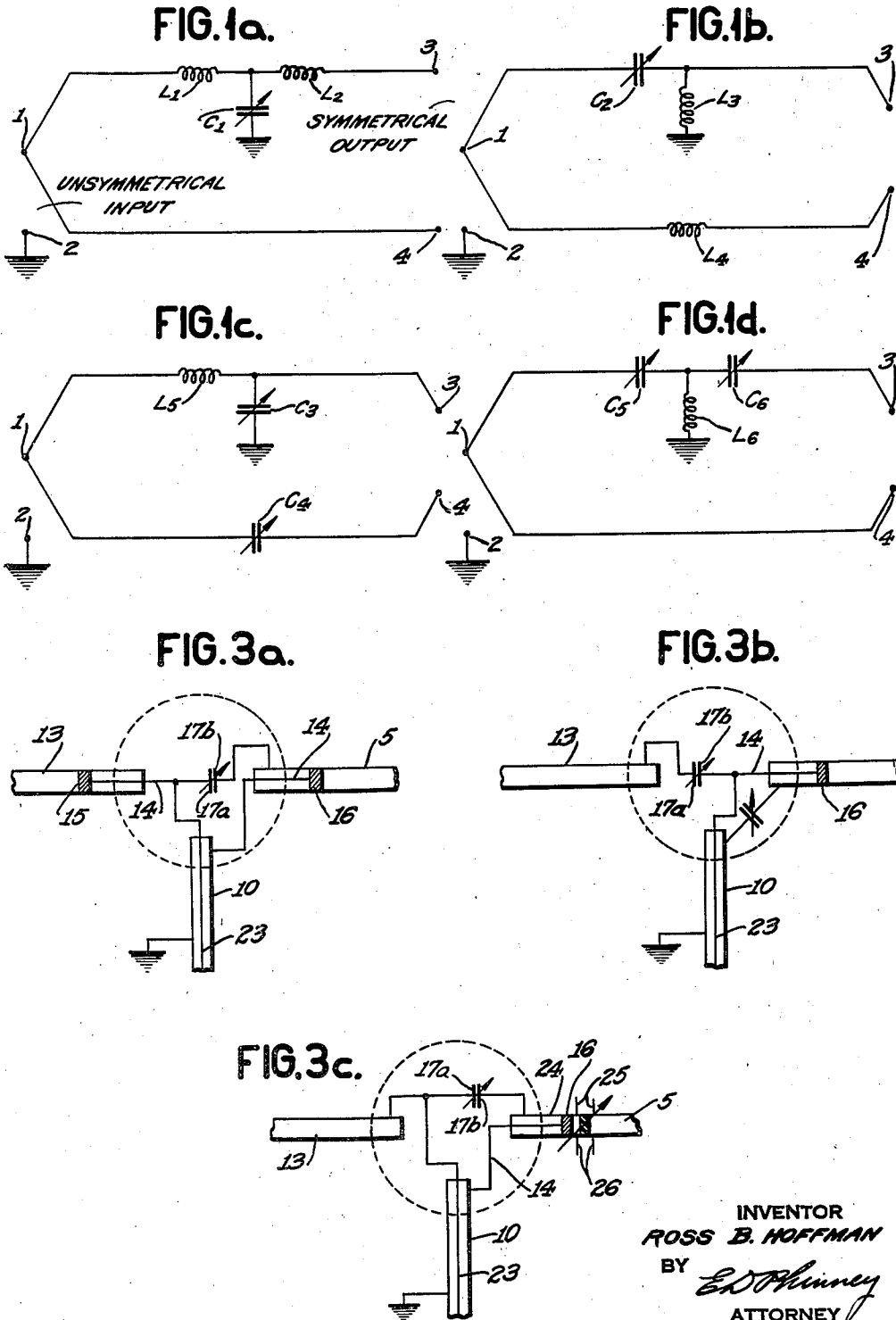
R. B. HOFFMAN

2,272,608

ANTENNA MATCHING STRUCTURE

Filed Dec. 19, 1939

2 Sheets-Sheet 1



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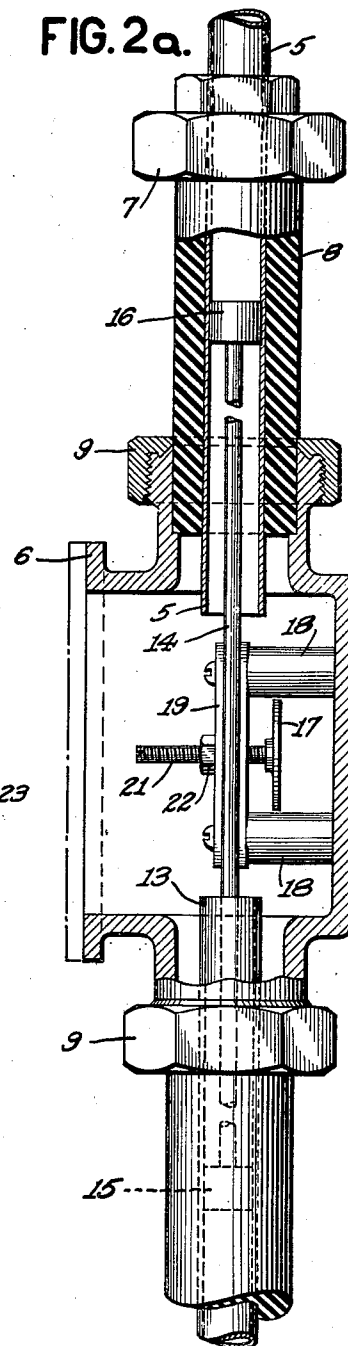
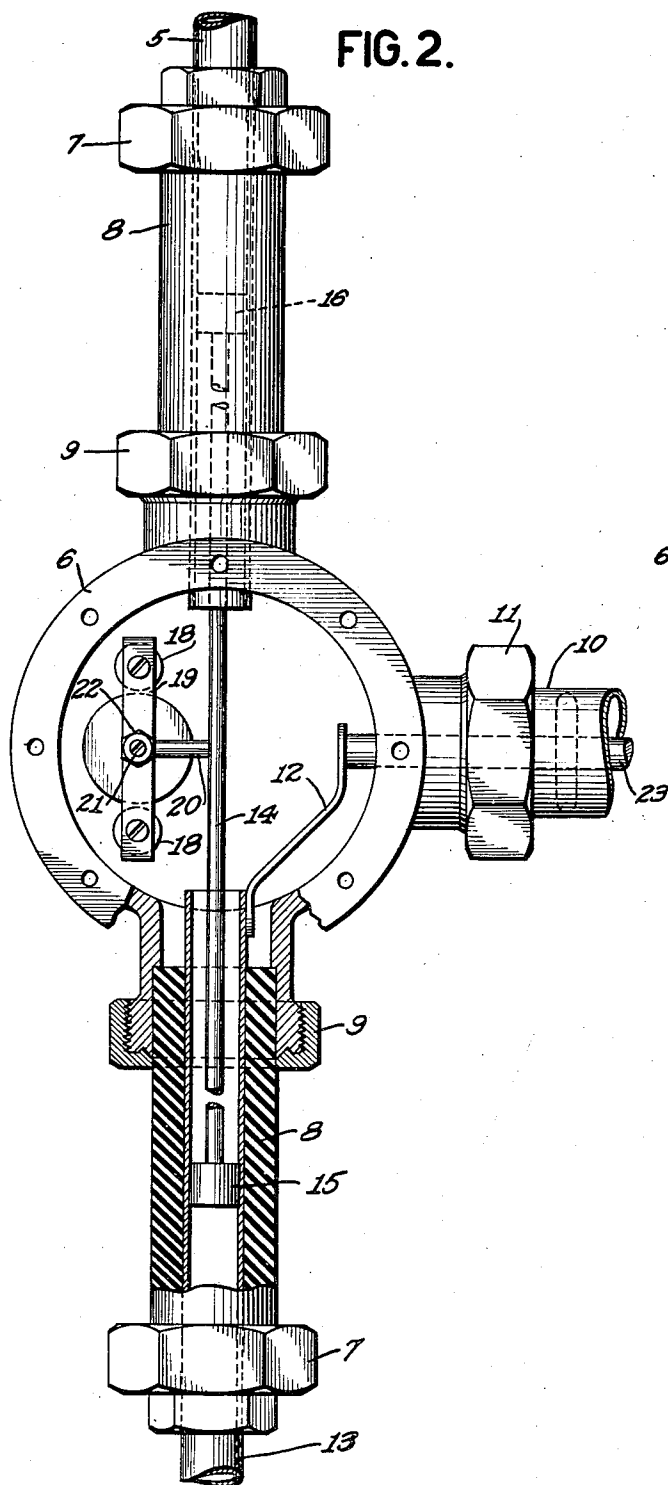
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2 Sheets-Sheet 2



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ANTENNA MATCHING STRUCTURE

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5 Claims. (Cl. 178-44)

My invention relates to matching networks and more specifically to an improved structure containing matching impedances.

An object of my invention is to provide a structure in which the component parts may be used as matching impedances.

A further object of my invention is to reduce the size and amount of equipment necessary to provide antenna matching impedances.

It is known by the patent to Alford No. 2,165,086 to use lumped inductances and capacities in certain ratios for coupling unsymmetrical circuits to symmetrical circuits. A particular example of this type of connection is the matching of a coaxial transmission line to a dipole antenna. Lumped inductances do not lend themselves to good mechanical arrangement when used at the end of a transmission line to couple the line to a balanced antenna or other symmetrical circuits of a compact nature. By my invention I provide a structure wherein the component parts are used as the inductances, and an auxiliary condenser is included within the structure itself.

My invention may be more clearly understood by reference to the attached drawings wherein:

Figs. 1a, 1b, 1c and 1d illustrate types of networks used for coupling an unsymmetrical circuit to a symmetrical circuit;

Figs. 2 and 2a illustrate front and side views of an embodiment of my invention.

Figs. 3a, 3b and 3c are further embodiments of my invention.

In Figs. 1a, 1b, 1c and 1d an unsymmetrical input such as a coaxial transmission line is connected to the points 1 and 2. Inductances L combined with the condensers C serve to properly couple this unsymmetrical input to any symmetrical circuit such as a dipole antenna which may be connected to the points 3 and 4. In the preferred form the impedances of the inductances of Fig. 1a should be equal and the impedance of the condenser equal to one-half the magnitude of either of the impedances of the inductances; in the network of Fig. 1b,

$$Z_{L_4} = Z_{C_2} = 2Z_{L_3}$$

in Fig. 1c,

$$Z_{L_5} = Z_{C_4} = 2Z_{C_3}$$

in Fig. 1d,

$$Z_{C_5} = Z_{C_6} = 2Z_{L_6}$$

and it may be noted that two of the reactances are of the same sign or phase and one of the opposite sign or phase in each network as explained in the aforementioned patent.

An embodiment of my invention in Figs. 2 and

2a, shows antenna tubes 5 and 13 supported and clamped to the housing 6 by means of bushings 7, insulators 8 and clamp nuts 9. An input or output coaxial line 10 is joined to the housing by means of a clamp nut 11. The central conductor 23 of this coaxial line is shown connected to the antenna tube 13 by means of a strap 12, but the straps may be connected to either of the antenna tubes 5 or 13.

The inductance L1 illustrated in Fig. 1 is formed by a transmission line type of inductance comprising the antenna tube 13, a tube 14 and a shorting plug 15 in Figs. 2 and 2a. The inductance L2 is formed by the antenna tube 5, a tube 14 and a shorting plug 16. A condenser plate 17 supported by insulating posts 18 and bar 19, and connected to the tube 14 by a tube or strap 20, forms the condenser C of that figure. The condenser plate is made adjustable with respect to the grounded housing 6 by means of a screw 21 and lock nut 22.

In the preferred form, the length of the tube 14 in the antenna tube should be somewhat shorter than $\frac{1}{4}$ wave length at the frequency at which the antenna is transmitting or receiving. The length of the tube, however, is not very critical and the shorting plugs may be made adjustable or an approximate length may be determined by computation. When for a given set of conditions the length of the tube is known as by computation, the shorting plugs 15 and 16 may be permanently or solidly fastened to the tube 14. The final adjustments of the circuit as represented by the tube 14 and the antenna tubes and the condenser 17 may be adjusted by means of the screw 21 and the associated lock nut 22 controlling the condenser plate. The condenser allows adjustment of the matching circuit over a convenient working range.

Structures similar to the above in design may be made to form any of the networks shown in Figs. 1a-1d. Examples of these structures are outlined in Figs. 3a, 3b and 3c which illustrate networks 1b, 1c and 1d respectively. Mechanical detail has not been shown in these figures since the electrical connections and relative positions of the parts are clearly shown, and the detail necessary for the assembling of these structures is sufficiently defined by Figs. 3a, 3b, 3c and Fig. 2.

In Fig. 3a the impedances are in essentially the same positions as they were in Figs. 2 and 2a. Both plates of the condenser, 17a and 17b, must be insulated from ground. The plate that was formerly grounded should be connected to the

antenna tube 5, and the remaining connections are unchanged. In Fig. 3b one of the inductances is eliminated, and a condenser similar to the condenser of Fig. 2 is added, the connections being as shown. In Fig. 3c one of the inductances is eliminated, and the original condenser has both of its plates ungrounded and connected to the antenna tube 13 and outer conductor 24. The center conductor 14 of the remaining transmission line type of inductances 24 and 14 is connected to ground. A special condenser is added for coupling the antenna tube 5 to the system, and this condenser comprises two conducting discs 25 and an insulator 26. The discs 25 may be made adjustable with respect to each other by making the insulator 26 of shim type discs or by threading the tube 5 and its supporting insulator. In some cases the discs 25 may not be included if the capacity between tube 5 and tube 24 is sufficiently large.

It is further possible in the above constructions to include the transmission line type of inductor as part of the center conductor 23 of the coaxial line. In this form the center conductor would be tubular near its termination at the housing and a conductor with a plug, similar to the conductor 14 and plug 15 of the other constructions, could be inserted therein.

While I have described particular embodiments of my invention for purposes of illustration, it will be understood that various modifications and adaptations thereof may be made within the spirit of the invention as set forth in the appended claims.

What I claim is:

1. A structure adapted to connect a symmetrical circuit to an asymmetrical circuit, comprising a first tubular conductor and a second tubular conductor, a third conductor having portions thereof contained within said tubular conductors forming substantially equal inductances, a fourth conductor and a fifth conductor, a condenser having substantially one-half the impedance of either inductance, connected between said third conductor and said fifth conductor, and means for connecting said fourth conductor to one of said first and second conductors.

2. A structure adapted to connect a symmetrical circuit to an asymmetrical circuit, comprising a first tubular conductor and a second tubular conductor, a third conductor within said first conductor forming an inductance, a fourth conductor within said second conductor forming an

inductance having substantially one-half the impedance of said first inductance, a fifth conductor connected to said third conductor, a sixth conductor connected to said fourth conductor, and a condenser having an impedance substantially equal to the impedance of said first inductance connected between said second and third conductors.

3. A structure adapted to connect a symmetrical circuit to an asymmetrical circuit, comprising a first conductor and a second tubular conductor, a third conductor within said second conductor forming an inductance, a condenser having an impedance substantially equal to that of the inductance connected between said first and third conductors, a fourth conductor connected to said third conductor, a fifth conductor, and a condenser having an impedance substantially one-half that of said inductance connected between said second and fifth conductor.

4. A structure adapted to connect a symmetrical circuit, comprising first and second conductors to an asymmetrical circuit comprising third and fourth conductors, said structure comprising a conductive housing, means for clamping said fourth conductor to said housing, insulators clamped to said housing for insulating said first and second conductors therefrom, means for clamping said first and second conductors to said insulators, a fifth conductor having portions thereof within said first and second conductors and electrically connected thereto, a condenser plate in capacity relation with said housing mounted on an adjusting screw and connected to said fifth conductor, and means for connecting said third conductor to a conductor of said symmetrical circuit.

5. A structure adapted to connect a two-conductor coaxial line to a dipole antenna having tubular conductors, comprising a conductive housing, means for clamping the outer conductor of said line to said housing, means for clamping said tubular conductors to said housing at substantially right angles to said line and in axial alignment, a fifth conductor having portions thereof within said tubular conductors and connected at its ends thereto, an adjustable condenser plate in capacity relation with said housing and connected to said fifth conductor, and means for connecting the inner conductor of said line to one of said tubular conductors.

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