

Jan. 8, 1929.

1,697,948

H. CHIREIX

GROUND CONNECTION FOR RADIO ELECTRIC ANTENNAE

Filed Oct. 7, 1922

2 Sheets-Sheet 1

Fig. 1

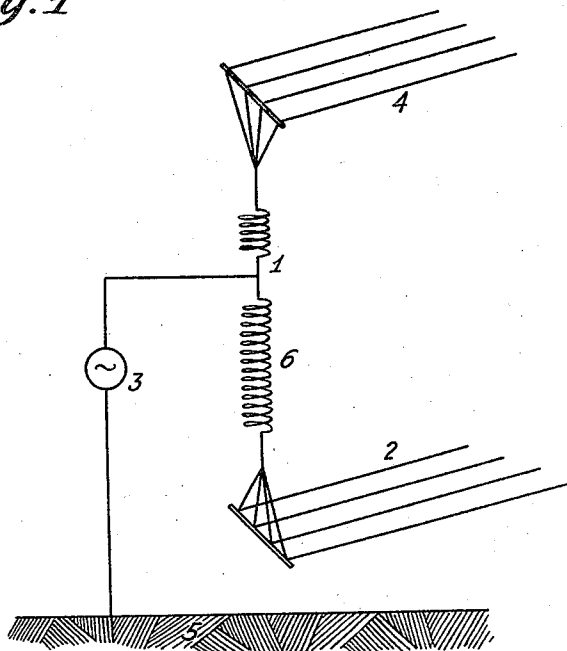
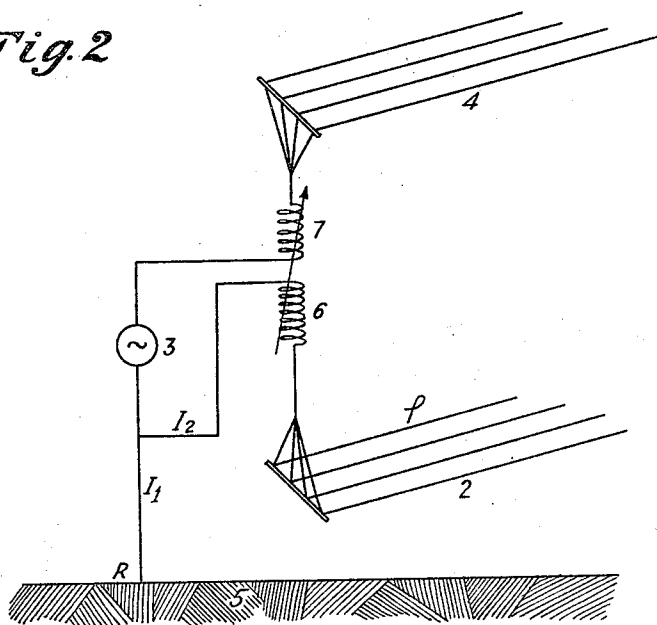


Fig. 2



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Fig. 3

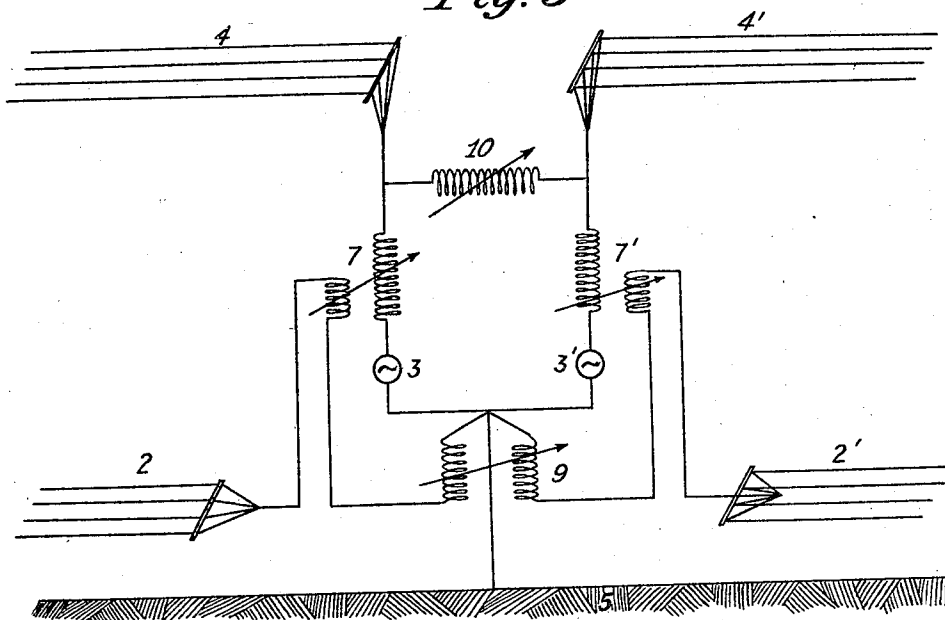
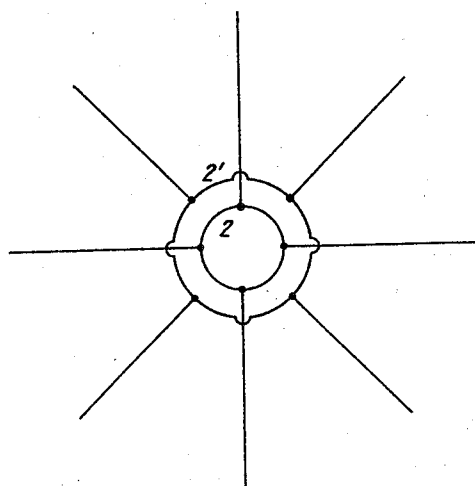


Fig. 4



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UNITED STATES PATENT OFFICE.

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GROUND CONNECTION FOR RADIO ELECTRIC ANTENNÆ.

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It is known that, for the purpose of improving the ground connections of an antenna, a counter-poise may be associated with this ground connection. The present invention makes provision for a novel method of such association, and by means of this invention the maximum results are obtained from this association without affecting the economy of the installation.

My invention is illustrated in the accompanying drawing in which

Fig. 1 shows an arrangement old in the art.

Fig. 2 shows the application of my invention to an antenna such as shown in Fig. 1.

Fig. 3 shows an arrangement for multiplex work according to my invention and

Fig. 4 shows my invention applied to an antenna of the radial type.

The circuits are usually arranged in the following manner (Fig. 1); the point 1 located in the conductor between the source 3 and the antenna 4 is connected with the counter-poise 2. The source is grounded at 5. This arrangement necessitates the insertion of a reactance 6 between the counter-poise and the antenna, which reactance is greater than the one connecting the antenna with ground.

On the other hand, in accordance with the present invention, as shown in Fig. 2, the connecting point 1 of the counter-poise is located in the junction between the source 3 and the ground 5, the source being connected with the antenna 4 through an inductance 7. In this manner I economize on inductance, the necessity for which was pointed out in the above, and notwithstanding this, the maximum effect is obtained from the elements used, i. e. the ground connection losses are reduced to a minimum.

As a matter of fact, if the effective ohmic resistance of the counter-poise is designated by ρ , and the ground connection by R , the results obtained from my experimental research show that the currents I_1 and I_2 flowing in the two branches, and which are in phase because by its nature the counter-poise is tuned, will be to each other as inversely as the resistances which they traverse;

$$\frac{I_1}{I_2} = \frac{\rho}{R}$$

As known, this condition is necessary and sufficient to insure that the sum of the ohmic losses in the two resistances shall be at a

minimum. Due to the fact that the current flowing in antenna 4 and counterpoise 2 are not necessarily equal, owing to the fact that it is desirable to have some current flowing in the ground connection in order to minimize the total resistance losses in the ground connection and counterpoise, a certain voltage will exist in the system between the counterpoise and ground. This voltage is due to the fact that more lines of force are emanating from the antenna 4 and cutting the counterpoise 2 than are emanating from the counterpoise 2 and cutting the antenna 4. It is desirable to control this voltage. This is accomplished by inductively coupling the inductances 6 and 7 whereby the reactance 6 has a suitable electromotive force induced in it by the currents flowing in reactance 7 to enable the currents to be distributed between the ground and the counterpoise 2 so as to obtain minimum ohmic losses.

The present invention is particularly applicable to antennæ which are divided for multiplex working. Each antenna section is provided with a counter-poise, which may be tuned by any suitable and well known means to the wave length individual to the sending antenna section. On or between the various counter-poises compensating arrangements are provided (resonance plugs, mutual inductance, self inductance) for annulling or reducing the induction effect of one counterpoise on the other. These devices may be combined with those used for compensating the reactions of the antenna sections between themselves.

Assuming that multiplex work is used, the installation will be arranged in the manner illustrated in Fig. 3. This figure exemplifies without limiting the application of the invention to multiplex working. The junction point of the counter-poises 2 and 2' is always located between the sources 3 and 3' and the ground 5. Compensating elements such as 7 and 7' are provided (formed e. g. by inductances having a mutual induction coefficient, which together with the self-induction of the antenna may be tuned, or by any other equivalent system) whereby the reaction of each section of antenna 4 4' on its respective counter-poises, 2 2' is annulled in a manner similar to that in which the reaction between antenna 4 and counterpoise 2 in Fig. 2 is annulled as explained above. Another compensating element such as 9 (formed e. g.

by two inductances having an adjustable mutual induction coefficient, or by any other equivalent arrangement) makes it possible to annul the reaction of counter-poises 2 2' on each other. The adjustable inductance 10 constitutes the compensating element of the reaction between the antenna section 4 and 4' by reason of the fact that the inductance 10 together with the capacity between the aerials 4 and 4' forms a series circuit of high impedance and consequently functions as a trap circuit to prevent a reactance of one antenna 4 on the other antenna 4' and vice versa.

Obviously, in certain cases some of these compensating elements may be combined without departing from the spirit of the invention.

It may also be possible to eliminate some of these elements. For instance, if the two antenna sections are of the radial type, the wires of counter-poises 2 and 2' are preferably staggered as shown in the plan view (Fig. 4), and it will not be necessary to provide a special compensating element for annulling the reaction of one counter-poise on the other, the effect of this reaction being to cause the circulation in the detuned counter-poise of a current, which is in phase with the one flowing in the tuned counter-poise. The whole counter-poise is used for each sending. The above described arrangements may be applied to multiplex working, in which more than two messages are sent, by providing for each group of antennae and counter-poises arranged for a determined frequency, compensating elements which annul respectively the actions of other groups operating at different frequencies. Obviously, each installation may be simplified by combining certain ones of these elements.

Having now described my invention, I declare that what I claim is:

1. An antenna system for multiplex transmission, comprising a plurality of sections, a counterpoise for each section, and magnetic coupling between counterpoises for neutralizing capacity coupling therebetween.

2. In a multiplex transmission system, the combination with an antenna having a plurality of sections, a counterpoise associated with each section, a high frequency source for feeding each section and each source being connected to a common ground, an antenna loading coil inserted between each section and its associated source, and a coil in mag-

netic reactive relation therewith inserted between each counterpoise and the connection between source and ground.

3. In a multiplex transmission system, the combination with an antenna having a plurality of sections, a variable self-inductance connected between sections for neutralizing the reaction therebetween, a counterpoise associated with each section, a high frequency source for feeding each section and each source being connected to a common ground, an antenna loading coil inserted between each section and its associated source, and a coil in magnetic reactive relation therewith inserted between each counterpoise and the connection between source and ground.

4. In a multiplex transmission system, the combination with an antenna having a plurality of sections, a variable self-inductance connected between sections for neutralizing the reaction therebetween, a counterpoise associated with each section, a high frequency source for feeding each section and each source being connected to a common ground, an antenna loading coil inserted between each section and its associated source, and a coil in magnetic reactive relation therewith inserted between each counterpoise and the connection between source and ground, and magnetic coupling between counterpoises for neutralizing the capacity coupling therebetween.

5. An antenna system comprising a plurality of sections and a counterpoise for each section, means for neutralizing the capacity coupling between antenna sections, and means for neutralizing the capacity coupling between counterpoises.

6. An antenna system comprising a plurality of sections and a counterpoise for each section, a variable inductance connected between antenna sections for neutralizing reaction therebetween, and magnetic coupling between counterpoises for neutralizing capacity coupling therebetween.

7. In radio signalling apparatus, the combination of an antenna having a plurality of sections, a counterpoise for each section, means for neutralizing the reaction between each antenna section and its counterpoise, means for neutralizing the reaction of the counterpoises upon each other, and means for neutralizing the reaction of the antenna sections upon each other.

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