Dec. 2, 1941. W. SCHIRP 2,264,723

RADIO FREQUENCY COUPLING ARRANGEMENT

Filed June 29, 1940

Fig. 1.

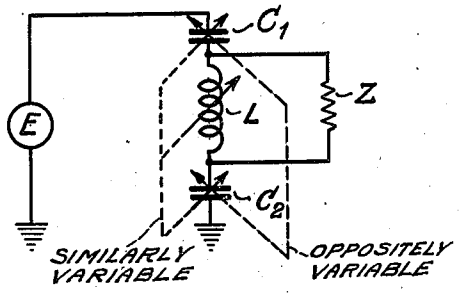


Fig. 2.

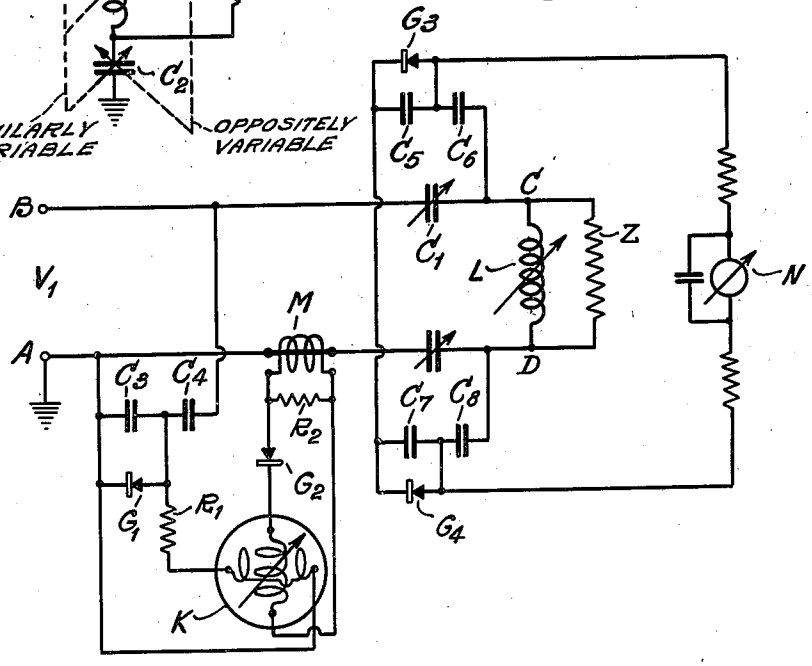
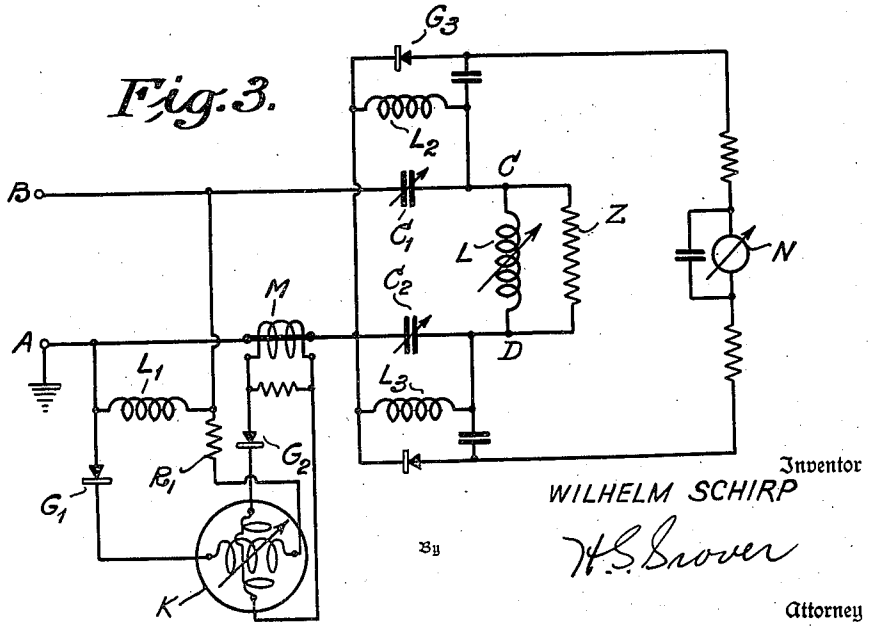


Fig. 3.



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RADIO FREQUENCY COUPLING ARRANGEMENT

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6 Claims. (Cl. 178—44)

This invention is concerned with a circuit organization which is adapted to establish coupling relations between a symmetric radio frequency and a non-symmetric radio frequency arrangement, or more particularly for coupling a symmetric consumer or load comprising reactance and effective or ohmic resistance with a unilaterally grounded radio frequency potential in short-wave work.

Symmetric arrangements serving the above purpose are known in the prior art. Among these may here be mentioned the so-called Boucherot circuit organization comprising a bridge arrangement. However, this scheme is suited only for relatively long waves. Further known are circuit arrangement comprising bypass leads. However, these involve elaborate circuit means for variable frequency, and they are suited only for definite resistance transformation ratios such as 1:4 or 1:1. Compared with this prior art the circuit arrangement hereinafter to be disclosed represents a substantial simplification.

The circuit organization of the invention has this outstanding feature that the unsymmetric arrangement is associated with a series-resonance circuit. One of the reactances of the latter is split into two parts. The other reactance to the terminals of which the symmetric arrangement is coupled, is interposed between these two parts. The two parts of the first-named reactance, while preserving the state of resonance, are altered in relation to each other to such an extent that a state of symmetry prevails across the terminals of the second reactance. For example, if the problem is to couple a symmetric load involving reactance and effective or ohmic resistance with a unilaterally grounded radio frequency voltage, then the radio frequency potential is fed to a series resonance circuit, one reactance of which (either capacity or inductance) is divided into two parts being initially equal, whereas the other reactance with the load connected in parallel relation thereto, is connected between the two parts. To adjust to resonance, for instance, both portions of the first reactance are varied in synchronism; next, symmetric condition is established by variation in contrary senses of the two reactances so that the resultant reactance stays stable and constant that the circuit is not detuned. For satisfactory indication of resonance recourse may be had to an impedance meter consisting, for instance, of a cross-coil instrument with rectifiers connected in series, while the state of symmetry may be read in a null-type instrument, the radio frequency potentials to be compared being also first fed to rectifiers.

The invention shall now be explained more fully by reference to the appended drawing, in which Figure 1 illustrates the basic principle of the invention, while Figures 2 and 3 illustrate organizations adapted to carry the invention into practice. E represents a unilaterally grounded radio frequency source which is to be matched to the load or consumer impedance Z which is symmetric in respect to ground and which, for example, may consist of an antenna. The condensers C_1 and C_2 which are equal are in mechanical interlock relation with the variometer L in such a way that the positions of minimum capacity and minimum inductance end the position of maximum capacity and maximum inductance coincide. In such a scheme the matching resistance is a function of the frequency in the first place only through the impedance of the load. Moreover, it is possible by such an arrangement to cover large frequency ranges and bands, at satisfactory efficiency.

The two straight-line-capacity condensers C_1 and C_2, after a state of resonance has been adjusted in synchronism, are varied in opposite direction until symmetry is established at the load. The circuit is not detuned as a consequence inasmuch as the resultant capacity is not altered by such opposite variation of the condensers because their capacity is a straight-line function. It will be understood that the invention is not restricted to the idea of subdividing the capacitive reactance of the series-resonance circuit, in fact, it would be just as practical and proper to use a circuit organization in which the inductance reactance is split into two variometers between which the capacitive reactance is connected, and in parallel relation thereto the symmetric load.

Figures 2 and 3 show the measuring circuits required therefor to indicate and read the adjustments to a state of resonance and symmetry. In the case of Figure 2 the non-symmetric potential V_1 is applied across the terminals A and B. Inasmuch as reactances are often connected in series with the symmetricizing or neutralizing circuit under normal operating conditions, it is not possible to tune the circuit in the conventional procedure to resonance by ascertaining the crest value of the current. Thus, what is measured according to the invention by the aid of a crossed coil type of instrument K is the impedance of the circuit including the load which assumes a minimum value in the presence of

resonance. For this purpose, according to Figures 2 and 3, the two coils of the cross-coil instrument are fed from rectifiers G_1 and G_2 with currents which are proportional to the voltage or the current. These currents are fed by way of resistances R_1 and R_2, respectively. If voltage is to be measured, then this voltage as shown in Figure 2 is taken off at a capacitive potentiometer C_3 and C_4, while for taking off current a current transformer M is provided. Inasmuch as the measurement is relative only, there is no need to design the latter so that its readings are not a function of frequency. However, the transformer must be free from transmission errors being a function of the amplitude.

For determining symmetry a null-type instrument N is used. Currents are fed thereto by way of the rectifiers G_3 and G_4, said currents being proportional to the potentials of the terminals of the load C and D in respect to ground. To take off these potentials capacitive potentiometers C_5 and C_6, and C_7 and C_8, respectively are used. The resultant currents are connected differentially in such a way that in the presence of symmetry the pointer of instrument N will not be deflected.

Figure 3 basically illustrates the same circuit organization as in Figure 2 with this distinction that the measuring potential is applied not to capacities, but inductances, that is, that indication of the resonance point is effected at coil L_1, while the symmetry position is indicated at the coils L_2 and L_3. The arrangements shown in Figures 2 and 3 for indication of resonance and of symmetry may be used not only in circuit organizations of the kind here concerned, but also in a great many other instances, for instance, on lines and other systems or structures to be tuned to resonance.

The invention is not restricted to the exemplified embodiments here illustrated. For instance, the arrangement could also be operated in reverse direction, that is to say, for the object of matching a symmetric radio frequency source to a non-symmetric consumer or load. Also, in lieu of the measuring arrangements as shown for resonance and symmetry, other measuring organizations could be employed.

I claim:

1. A circuit organization adapted to establish coupling relations between a symmetric radio frequency arrangement and an unsymmetric arrangement comprising a series resonant circuit connected across said unsymmetric arrangement, said series circuit comprising a reactance of one sign interposed between two portions of a reactance of the opposite sign, all of said reactances being simultaneously variable in the same sense whereby said circuit may be tuned over a band of frequencies, the outer of said reactances being simultaneously variable in opposite senses whereby symmetric voltages with respect to ground may be established across the first mentioned of said reactances without affecting the frequency to which said circuit is tuned, and means for connecting said symmetric arrangement across said first mentioned reactance.

2. A circuit organization adapted to establish coupling relations between a symmetric radio frequency arrangement and an unsymmetric arrangement comprising a series resonant circuit connected across said unsymmetric arrangement, said series circuit comprising an inductive reactance interposed between two capacitive reactances, all of said reactances being simultaneously variable in the same sense whereby said circuit may be tuned over a band of frequencies, the outer of said reactances being simultaneously variable in opposite senses whereby symmetric voltages with respect to ground may be established across the first mentioned of said reactances without affecting the frequency to which said circuit is tuned, and means for connecting said symmetric arrangement across said first mentioned reactance.

3. An organization as set forth in claim 1, wherein resonance of said series circuit is determined by an indication of the overall impedance of said circuit.

4. An organization as set forth in claim 2, wherein resonance of said series circuit is determined by an indication of the overall impedance of said circuit.

5. An organization as set forth in claim 1, wherein resonance of said series circuit is determined by an indication of the overall impedance of said circuit and wherein the potentials across said reactance portions are differentially compared as a measure of the symmetry of said organization.

6. An organization as set forth in claim 2, wherein resonance of said series circuit is determined by an indication of the overall impedance of said circuit and wherein the potentials across said reactance portions are differentially comparted as a measure of the symmetry of said organization.

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