Oct. 18, 1927. 1,645,542

M. OSNOS

CIRCUIT ARRANGEMENT FOR HIGH FREQUENCY SENDING STATIONS

Filed Dec. 27. 1922 2 Sheets-Sheet 1

Fig. 1

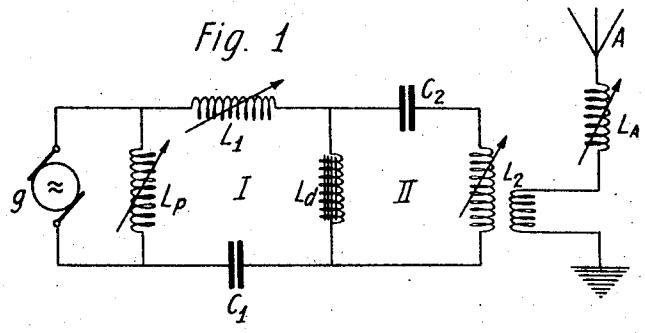


Fig. 2

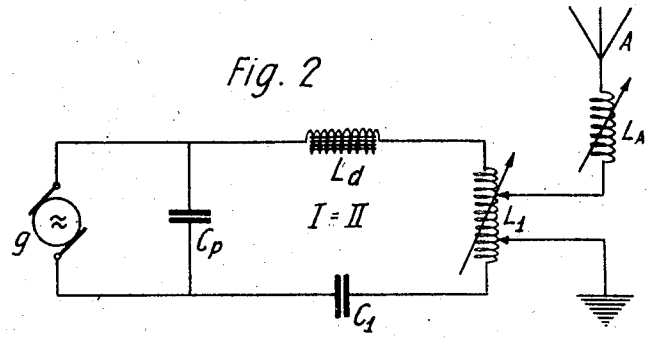


Fig. 3

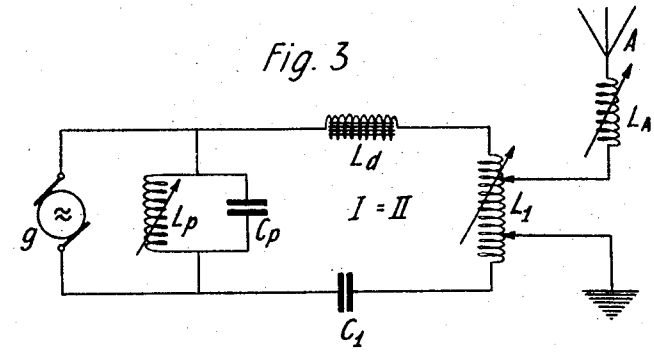
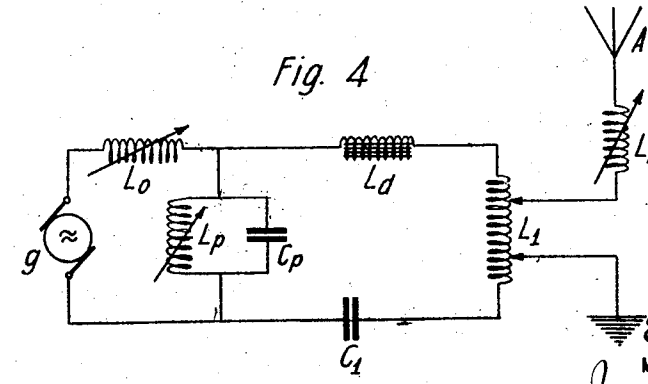


Fig. 4



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Oct. 18, 1927. 1,645,542

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Filed Dec. 27, 1922 2 Sheets-Sheet 2

Fig. 5

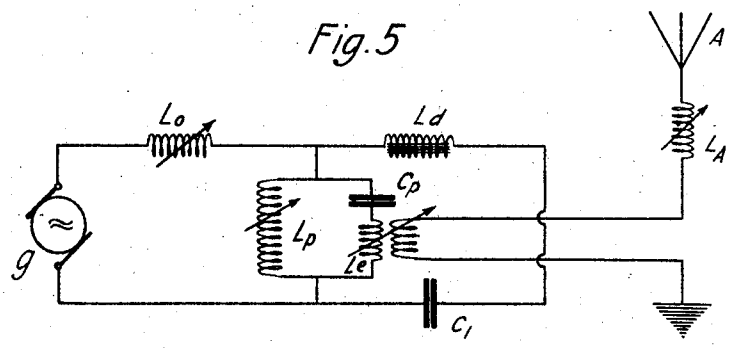


Fig. 6

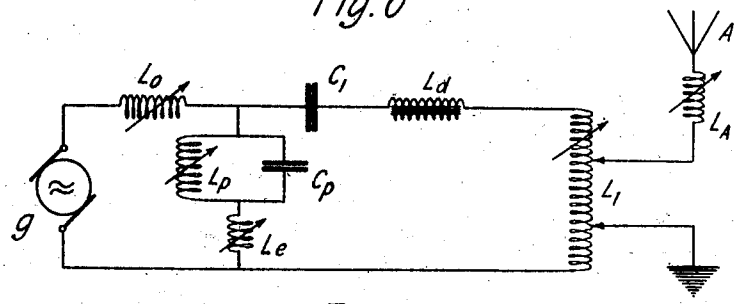


Fig. 7

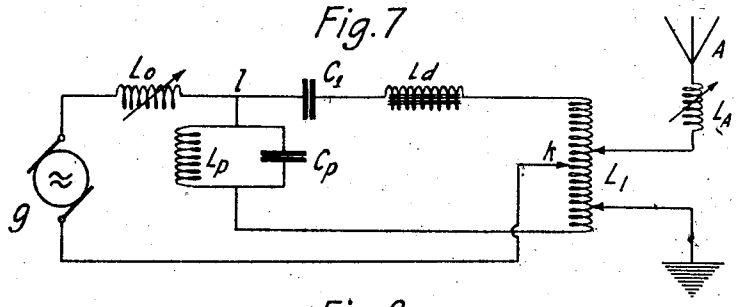
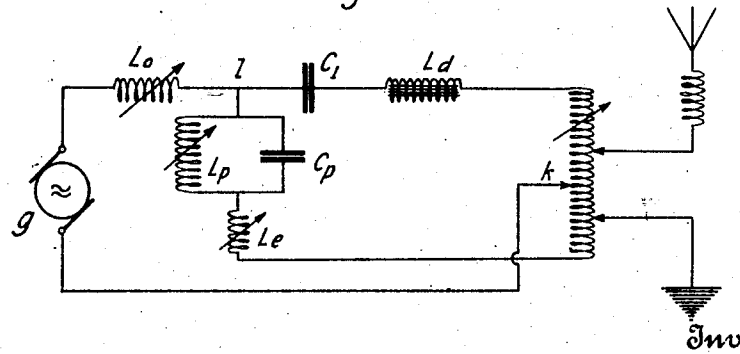


Fig. 8



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Patented Oct. 18, 1927. 1,645,542

UNITED STATES PATENT OFFICE.

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CIRCUIT ARRANGEMENT FOR HIGH-FREQUENCY SENDING STATIONS.

Application filed December 27, 1922, Serial No. 609,215, and in Germany February 11, 1922.

As is well known, the frequency of the current supplied by the source of energy in a sending station may be amplified by means of one or a plurality of saturated iron core choke coils. The harmonics produced by the choke coils are conducted to an intermediate circuit tuned to the desired operating wave, and the operating energy is transmitted from this circuit to the oscillating circuit of the antenna which is galvanically or inductively coupled with the intermediate circuit and which is also tuned to the operating wave.

Fig. 1 is a diagrammatic representation of a well known form of circuit arrangement for use in effecting frequency amplification by means of a saturated iron core choke coil, and

Figs. 2 to 8 inclusive are diagrammatic representations of circuit arrangements of various forms in which the invention may be embodied.

In Fig. 1 g is the generator, and L_p is an air core choke coil connected in parallel with the generator for the purpose of correcting the power factor in the generator, L_1, C_1 is a tuning group composed of a self-induction and a capacity, and L_d is an iron core choke coil which is saturated during the major part of the basic period. This iron core choke coil is connected with the secondary oscillating circuit II, that is, the intermediate circuit, composed of a capacity C_2 and an inductance L_2 which (or a part of which) is directly or inductively (the drawings illustrate the inductive coupling) coupled with the operating circuit, in the present case the antenna A and its tuning coil L_A.

The tuning elements L_1, C_1 must be so selected that the current traversing them is as far as possible of a sine wave form. In that case the harmonics produced by the iron core choke coil will not be able to balance each other in the primary circuit I and will be forced into the intermediate circuit II from which they are inductively transmitted to the antenna.

However, the above-described well-known sending station has a very material defect: In order to present a very high resistance to the operating or useful wave, the self-induction L_1 must be very large. For this reason, with a given primary current its volt-ampere consumption is correspondingly high. In view of the fact that the volt-ampere consumption of the condenser C_1 must be greater than that of the inductance L_1 for insuring the proper functioning of the station, the volt-ampere consumption of the condensers is also very large. It will be seen, therefore, that the dimensions of both devices L_1 and C_1 are necessarily very large because the dimensions must be determined by their volt-ampere loading. This increases the cost of the station and leads also to difficulties in arranging it, e. g. on ships where the space at the disposal of sending apparatus is very small.

Furthermore, the large volt-ampere consumption causes great energy losses which reduce the operating radius of the station.

The present invention eliminates this drawback in a manner such that the operating wave instead of being blocked out of the primary circuit I is conducted to the circuit. The separate secondary intermediate circuit is eliminated and the primary circuit is used also as an intermediate circuit. In order further to protect the generator against the harmonics, in accordance with the present invention, the generator is connected in parallel (directly or indirectly) with a trap for the operating harmonic (e. g. a suitably proportioned capacitive reactance or a system of capacitive and inductive resistances in series tuned to the desired, operating harmonic).

In the circuit arrangement shown in Fig. 2, the primary and secondary circuits are combined in a single circuit, and the antenna circuit is directly or indirectly coupled with the self-induction L_1, a direct coupling being illustrated in the drawing. The circuit is so tuned that two waves will be particularly pronounced therein: The fundamental and the desired harmonic.

The capacity C_p which is connected in parallel with the generator adds to the capacitive loading of the generator for the basic wave. However, to the desired harmonic electromotive force which is generated in the iron core choke coil L_d, this capacity will present a much lower impedance than the generator and will therefore divert the harmonic from the latter.

Fig. 3 represents a further improvement

on the above described circuit arrangement. In the circuit shown in this figure, in addition to the capacity C_p an inductance L_p is connected in parallel with the generator. This inductance and the capacity C_p are so proportioned that for the fundamental frequency the lagging current flowing through L_p is larger than the leading current flowing through C_p. Furthermore, the whole circuit may be tuned to the basic frequency or, instead of this, the lagging wattless current of the inductance L_p may be caused to be sufficient not only for covering the leading current of the branch C_p but also for entirely or partially or overlappingly covering the preferably leading component of the fundamental wave current through L_1, L_d, C_1, whereby the generator g is required to supply substantially only the watt component of the current necessary for covering the losses and the operating output. By suitably tuning the circuit C_p, L_p, the terminal potential of the generator may also be made equal to the unloaded running potential which occurs when the generator current as a vector halves the angle between the vectors of the inside potential and the terminal potential, lagging behind the former and advancing ahead of the latter. In this case the wattless current through L_p must be slightly smaller than the sum of the wattless basic wave currents through C_p, and through L_1, C_1, L_d.

Furthermore, an additional condition must be satisfied in that the oscillating circuit must be tuned to the desired high frequency which is supplied by the iron core choke coil. The establishment of the above-mentioned conditions is in theory always possible, because with a given inductance of the generator g and the iron choke coil L_d we have at our disposal four independent constants L_p, C_p, L_1, C_1 in the circuit I.

The circuit shown in Fig. 4 differs from the above described circuits in that an additional inductance L_o is provided for properly protecting the generator g against harmonics.

It is not absolutely necessary that the branch C_p be composed exclusively of condensers. As shown in Fig. 5 an air core choke coil L_e may be connected in series with the condenser C_p in which case only the resulting resistance of this branch will retain its character of a trap for the desired auxiliary frequency. L_e and C_p may, for instance, be so proportioned that their operations will balance each other for the respective harmonics. In this case the branch in question will form a short circuit for the respective harmonics and the generator as well as the choke coil L_p are completely protected from these harmonics.

In view of the fact that the inductance L_e provided in the branch C_p is traversed by waves of the operating frequency, this inductance may be used also for transmitting energy of the operating frequency to the antenna circuit in the manner shown in Fig. 5. In this case the inductance L_1 is eliminated.

An inductance L_e (see Fig. 6) may be provided in series with the whole branch L_p, C_p instead of being in series only with C_p, and in this case also the resulting branch thus obtained will retain its character of a trap for the operating frequency. In this circuit also the antenna may be coupled by means of the inductance L_e or as shown in Fig. 6 by means of the inductance L_1. If it is desired that the whole branch composed of the elements C_p and L_p connected in parallel and both in series with L_e be tuned to form a short circuit for a certain harmonic, e. g. for the operating wave, then the following should be noted. In order to make possible that the resulting reactance composed of L_p and C_p, balances the inductance of the choke coil L_e for the corresponding harmonic λ_n, it must have a capacitive character for this harmonic. Therefore, the susceptance $w_n C_p$ of the branch C_p for this frequency w_n, must have an absolute value which is greater than the susceptance $\frac{1}{w_n L_p}$ of the branch L_p. However, in that case we will have a frequency w_s which is lower than w_n, or a wave length λ_s longer than λ_n for which the susceptances $w_s C_p$ and $\frac{1}{w_s L_p}$ of both branches are equal to each other. This means that closed circuit L_p, C_p is in resonance with the frequency w_s or has an individual wave λ_s. Now if in the whole station among others there is a wave the length of which is equal to λ_s or near λ_s, then, no matter how small their amplitude, these waves will generate in the circuit L_p, C_p individual oscillations of suitable amplitude causing undesirable losses. In order to avoid this the circuit L_p C_p, must be so proportioned that it have an individual wave λ_s which is greater than λ_n and which cannot be found among the harmonics obtained in the station and does not even approach too near to these. It may, for instance, be so selected that as nearly as possible it will be midway between two harmonics existing in the station.

The inductance L_e shown in Fig. 6 may be combined with the choke coil L_1 whereby a circuit such as is shown in Fig. 7 is obtained. The variable connection k will preferably be so arranged that in this case also the branch C_p, L_p with the portion of the choke coil L_1 connected in series therewith act as a trap for the harmonics, particularly for the operating harmonics. If, for instance, it is desired to tune the trap for short circuiting the operating wave, the contact k is so

adjusted that the drop of potential caused in the combined reactance L_p, C_p by the operating wave of the current is substantially compensated by the opposing potential drop in that part of the choke coil L_1 in series with the trap L_p, C_p so that for the operating frequency, the difference in potential between the points l and k will be practically zero. The generator g will, therefore, be protected against the corresponding current harmonics.

Instead of combining the whole inductance L_e with the choke coil L_1 a portion of the inductance may be left separate. An embodiment of such an arrangement is shown in Fig. 8.

In the arrangements shown in Figs. 7 and 8, the contact k may be so adjusted that the inductive effects of generator currents of fundamental frequency passing through this contact will balance each other in the two portions of the choke coil L_1 so that the antenna circuit is not influenced by the basic wave. On the other hand, care should be taken that the branch C_p, L_p in series with the corresponding inductance still performs the service of a trap for the harmonics.

Having described my invention, what I claim is:

1. A circuit arrangement for high frequency sending stations comprising a generator, a saturated iron core choke coil and a first inductance connected in series with said generator, a closed circuit comprising a second inductance and a condenser, a third inductance connected in series with said closed circuit to form a trap circuit, said trap circuit being connected in parallel with said generator, and an antenna coupled with said first inductance.

2. A circuit arrangement for high frequency sending stations comprising a generator, a saturated iron core choke coil, a condenser and a first inductance in series with said generator, a closed circuit comprising a second inductance and capacity, a third inductance connected in series with said closed circuit to form a trap circuit, said trap circuit being in parallel with said generator, said third inductance being inductively related to said first inductance, and an antenna circuit coupled to said first and third inductances.

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