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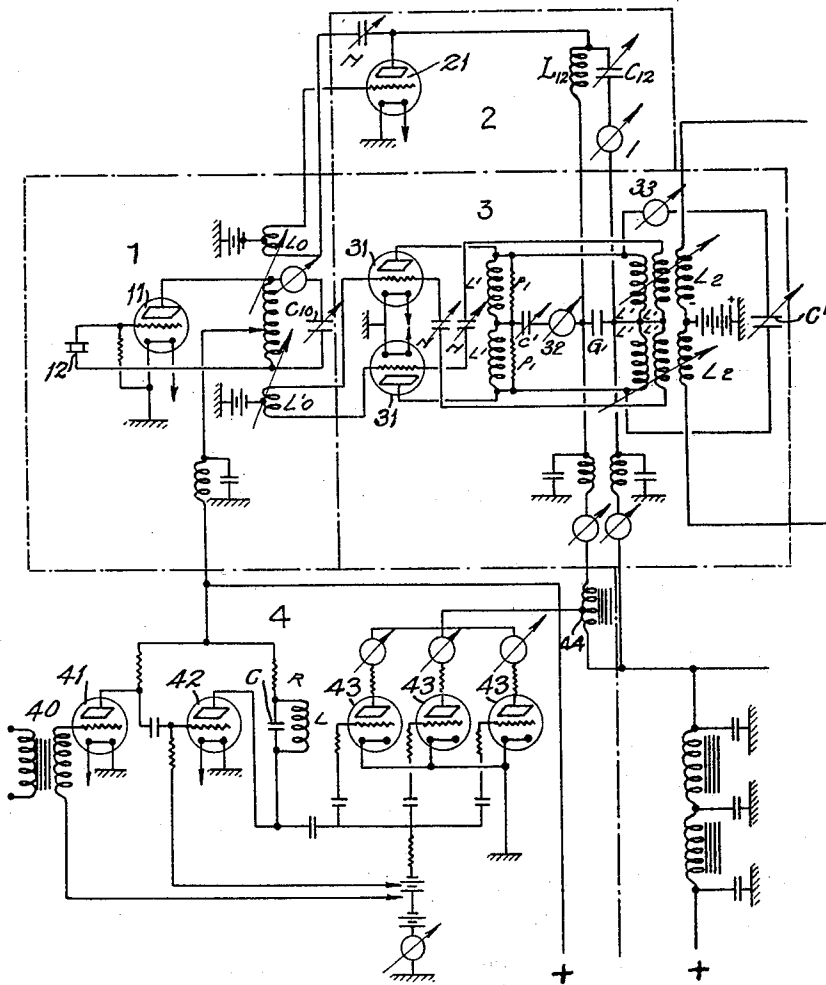
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HIGH FREQUENCY SIGNALING

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2 Sheets-Sheet 1

Fig. 1



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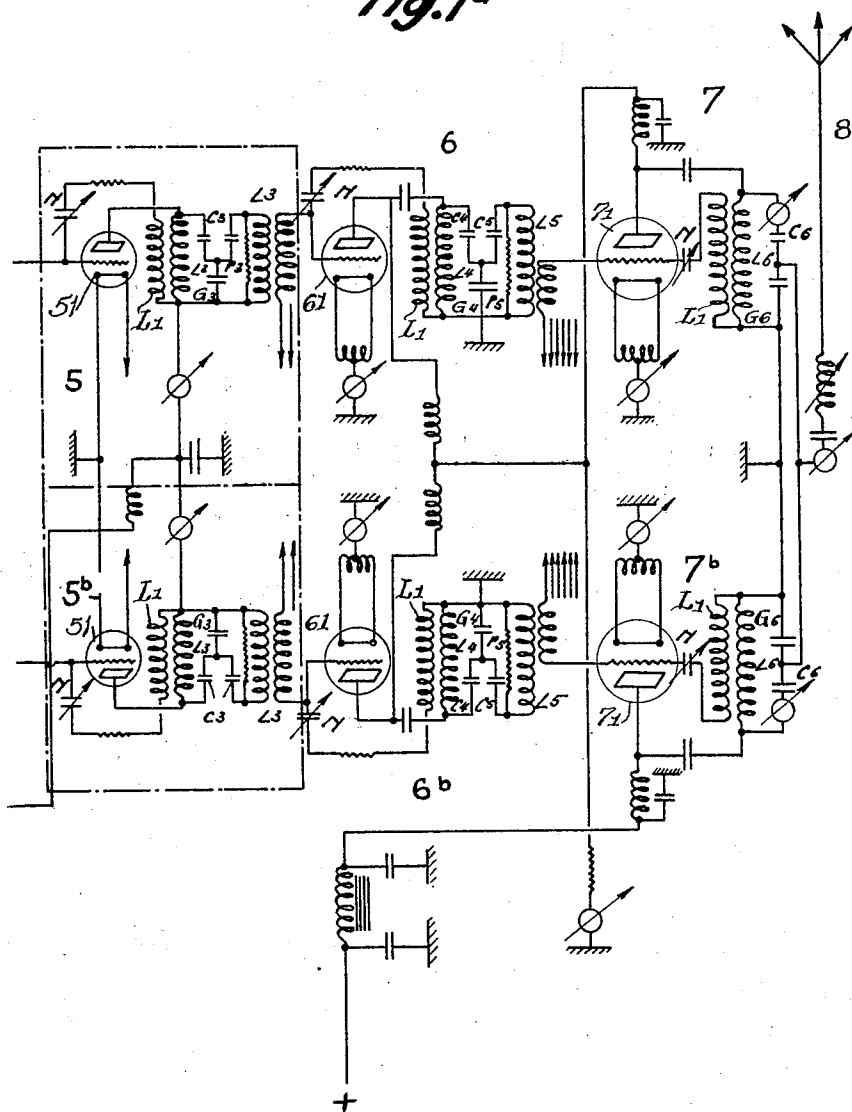
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Fig. 1^a



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HIGH FREQUENCY SIGNALING

Application filed April 29, 1931, Serial No. 533,674, and in France May 6, 1930.

The present invention relates to transmitting stations for high frequency waves modulated for radio broad casting and is an improvement over the invention of Serial No. 278,834.

The object of the present invention is to provide a radio transmitter in which the method hereafter described is utilized, and by which certain problems are solved which are useful to satisfy particular requirements which are of great importance for application in radio broadcasting.

The novel features and objects of the invention will be more clearly understood by reference to the following description taken together with the accompanying drawings which diagrammatically represent a high frequency signaling station.

The figure has been divided into two halves, the left half being termed Fig. 1 and the right half Fig. 1a, and these halves are subdivided upon each of the two drawings into separate sections by dotted lines, each section diagrammatically including a group assembly of the apparatus to which a definite function can be ascribed. Thus, section 1 contains the carrier wave generator, section 2 the source producing the modulated current, section 3 the coupling device with amplifier, section 4 the modulator, sections 5 and 5b the low energy amplifiers, sections 6 and 6b the intermediate energy amplifiers, and sections 7 and 7b the high energy amplifiers.

Heretofore, it has been known to transmit a modulated wave in accordance with the following method.

By means of a generator, carrier waves are produced consisting of a first unmodulated wave and a second wave of the same frequency and in phase quadrature with the first mentioned wave. By modulating the amplitude of this second wave, a resultant wave can be obtained having a single modulated phase of an amplitude which remains practically constant. In an arrangement for producing two resultant waves of this sort, shiftable in phase over a certain angle, whereby the variations in phases due to the modulation is affected symmetrically with respect to the bisection of this angle, it is possible by super-

posing these waves in opposition to obtain a wave with modulated amplitude which can be transmitted over the antenna. Before the superposition takes place, each phase modulated wave can of course be amplified by an independent amplifier having a number of desired stages.

Referring now to section 1, a master oscillator 11 is provided, being stabilized by a quartz crystal 12, the currents being generated in the oscillating circuit $L_{10} C_{10}$.

In section 3 an equilibrated Wheatstone bridge is provided including four self inductances L_{11} , L_{11} , etc. A condenser C^{11} in series with an ammeter 33 constitutes one diagonal of the bridge. Another diagonal includes the condenser C^1 , the ammeter 32, and the coupling condenser G^1 . Two of the self inductances L_{11} are shunted by fixed resistances P^1 while the other two self inductances are shunted by the internal resistances of two tubes 31, arranged in push-pull. These two tubes serve to affect one diagonal of the bridge by means of pure carrier waves from the master oscillator 11 through the intermediate action of the variable coupling $L^1 O$.

The other diagonal of the Wheatstone bridge is influenced indirectly by the same master oscillator 11 through the intermediate action of the variable coupling L_o of the tube 21 provided in section 2 and the circuit of L_{12} , C_{12} which are connected to the terminals of condenser G_1 .

The plate current of tube 21 is modulated according to above method by controlling the anode by means of the modulator of section 4, which includes comprising an entrance transformer 40, a cascade of amplifiers 41, 42, 43 (the last stage being one of high energy), and a branch containing an iron self inductance 44 provided between the plates of the last stage and one terminal of the condenser G_1 .

The output voltages of the Wheatstone bridge are transmitted by the intermediate coil L_2 to the input of the amplifiers 51 of sections 5 and 5b, and the currents therefrom are amplified respectively by the tubes 61 of sections 6 and 6b, each tube 61 preferably

representing two tubes connected in parallel, and finally in the stages of the stages 7 and 7b, the amplification takes place in the tubes 71, each tube designating in rheumatic manner six tubes connected in parallel. The output terminals of the stages 7 and 7b are symmetrically connected and the antenna 8 is connected to the center point of the common circuit thus formed.

The stages 5—6, 6—7 of amplification 5b—6b, 6b—7b are capacity coupled. Each coupling circuit includes two circuits, a primary circuit and a secondary circuit. Between stages 5 and 6, the primary and secondary circuits each includes self inductances and equal capacities L_3 and C_3 ; between the stages 6 and 7 the primary circuit includes the self inductance L_4 , and the capacity C_4 , while the secondary circuit includes the self inductance L_5 and the capacity C_5 .

The coupling is obtained by means of condensers G_3 and G_4 respectively. Each primary circuit is damped by the internal resistance of the preceding tube, and the secondary circuits by the resistances P_3 and P_5 respectively.

In designating the coefficient of coupling of the two circuits by K , (K being such that the waves of the coupling of the undamped circuit be respectively

$$\lambda\omega\sqrt{1-K} \text{ and } \lambda\omega\sqrt{1+K},$$

designating the excess voltage by S (which may be represented

$$S = \frac{L\omega\omega}{P}$$

when the circuits are turned upon the supporting wave $\omega\omega$), designating by df the frequency band for correct transmission by the amplifier, and in designating by $f\omega$ the intermediate frequency corresponding to the pulsation $\omega\omega$, the circuit between stages, except the latter stage (between 7 and the antenna 8) will be proportioned in such manner as to obtain the relation

$$K = \frac{1}{S} = \frac{df}{f\omega}$$

The calculation shows that this arrangement in fact assures a definite filter band. This at once implies an output of 50% which is practically inadmissible for the last stage.

The output circuits in sections 7 and 7b each includes a self inductance L_6 and condenser C_6 and a coupling capacity G_6 . These capacities G_6 are connected for the purpose of forming a common circuit.

The coupling circuits are coupled in like manner as the self inductances of the Wheatstone bridge with coils L_1 , and in series with the capacities N which are connected to the grids of the preceding tubes for the purpose of compensating their capacities proper.

In order to provide for correction of the

individual polarization of the tubes of greater power of the stages 6 and 7, the grids are inductively energized from separate coils.

Likewise the self inductance L_5 is coupled with six hand made secondary coils 6 and each connected to a grid of the tubes of the last stage 7. Also the inductance L_3 is coupled with two secondary coils in order to obtain correspondence with the two tubes of the stage 6.

The circuit L C R of modulator section 4 for the amplifier of musical frequency in a corrector circuit, designed to compensate for the irregularities of the filter curves of the circuits of sections 3, 5—5b, 6—6b, and 7—7b. The apparatus operates in the following manner:

The Wheatstone bridge of section 3 is tuned to the supporting wave by means of condensers C_1 and C^{11} , whereby it will be noted at once that the direct coupling $L\omega^1$ between the generator of the carrier wave and the bridge results in producing voltages in the inductances L_2 in opposite phase, of a fixed amount and unaffected by the modulation.

On the other hand, the bridge tuned by the capacity C_1 behaves like a secondary circuit capacitatively coupled with the terminals of the condenser G_1 to a primary circuit L_{12} , C_{12} . Under these conditions the currents of the secondary circuit are always in quadrature with those of the primary circuit.

The circuit L_{12} , C_{12} when thus subjected to a voltage having a modulated amplitude and in phase with that of the generator 1, makes it evident that the indirect coupling $L\omega$ will induce a modulated current in the bridge which is in quadrature with that of the primary circuit, i. e. in quadrature also with the current due to coupling $L\omega^1$. The voltages in L_2 are therefore in phase due to coupling $L\omega$ and subject to the modulation and individually in quadrature with the preceding voltages.

It is evident that in this arrangement, the amplifiers of sections 5 and 5b are each energized by two voltages obtained from couplings $L\omega$ and $L\omega^1$, respectively.

By selecting these couplings in such a manner as to render the modulated voltage relatively small as compared with the unmodulated voltage, the resultant energizing voltages of the tubes of the sections 5 and 5b will be practically of constant and absolute value but will present themselves a variable shifted phase between themselves.

These voltages amplified on the one hand, by the amplifiers 6 and 7 and 6b and 7b, on the other hand, will produce currents of practically constant intensity but of variable phase in the circuits L_6 , C_6 .

The construction of the couplings will be selected in such manner that the unmodulated current from coupling $L\omega^1$ produces opposed

voltages upon the plates of the tubes of the last stage, and under these circumstances, none of the voltages will be concentrated at the terminals of the capacities G_6 , and therefore no current will have any effect on the antenna.

In fact, the modulated wave will appear in the antenna in the same order as in the circuit L_{12} , C_{12} , of the section 2.

In arranging the Wheatstone bridge according to the invention, a filter band is obtained. On the other hand, due to the fact that the induction takes place in two diagonals or branches, no reaction of one element against the other can occur.

The advantage of the above described arrangement resides in the fact that the tubes of the stages 5, 6, 7, 5b, 6b, and 7b operate with an oscillation whose amplitude is practically constant. The output attainable is of a greatly increased value which could not possibly be obtained in the absence of an unmodulated wave owing to the presence of coupling Lo^1 .

What I claim is:

1. Transmitter of modulated high frequency currents comprising a Wheatstone bridge consisting of four impedances and having tuning means inserted in the diagonals thereof, means for applying to one of these diagonals a carrier wave, means for applying to the other diagonal another continuous wave of the same frequency but in quadrature with the foregoing carrier wave, amplitude modulation means for this latter continuous wave, two symmetrical circuits coupled to the Wheatstone bridge each circuit comprising amplifiers in cascade, a common circuit associated with the output from the amplifiers and an antenna coupled to the said common circuit.

2. Transmitter of modulated high frequency currents comprising a Wheatstone bridge consisting of four impedances and having tuning means inserted in the diagonals thereof, means for applying to one of these diagonals a carrier wave by the intermediary of a symmetrical valve arrangement, means for applying to the other diagonal another continuous wave of the same frequency but in quadrature with the foregoing carrier wave, amplitude modulation means for this latter continuous wave two symmetrical circuits coupled to the Wheatstone bridge each circuit comprising amplifiers in cascade, a common circuit associated with the output from amplifiers and an antenna coupled to the said common circuit.

3. Transmitter of modulated high frequency currents comprising a Wheatstone bridge consisting of four impedances and having tuning means inserted in the diagonals thereof, means for applying to one of these diagonals a carrier wave, means coupled on the one hand with the source of the

said carrier wave and on the other hand associated with a circuit connected the terminals of a condenser inserted in the other diagonal in order to apply to this latter a continuous wave in quadrature with the foregoing carrier wave, amplitude modulation means for this latter continuous wave, two symmetrical circuits coupled to the Wheatstone bridge each circuit comprising amplifiers in cascade, a common circuit associated with the output of the amplifiers and an antenna coupled to the said common circuit.

4. Transmitter of modulated high frequency currents comprising a Wheatstone bridge consisting of four impedances and having tuning means inserted in the diagonals thereof, means for applying to one of these diagonals a carrier wave, means for applying to the other diagonal another continuous wave of the same frequency but in quadrature with the foregoing carrier wave, amplitude modulation means for this latter continuous wave, two symmetrical circuits coupled to the Wheatstone bridge each circuit comprising amplifiers in cascade, the stages of which are capacitatively coupled, a resistance shunting the secondary coupling circuit in each stage, a common circuit associated with the output of the amplifiers and an antenna coupled to the said common circuit.

5. Transmitter of modulated high frequency currents comprising a Wheatstone bridge consisting of four impedances and having tuning means inserted in the diagonals thereof, means for applying to one of these diagonals a carrier wave, means for applying to the other diagonal another continuous wave of the same frequency but in quadrature with the foregoing carrier wave, amplitude modulation means for this latter continuous wave, two symmetrical circuits coupled to the Wheatstone bridge each circuit comprising amplifiers in cascade, the stages of which are capacitatively coupled, a resistance shunting the secondary coupling circuit in each stage, an inductance and a capacity inserted between the input of the valve feeding each coupling and a point of this circuit, a common circuit associated with the output of the amplifiers and an antenna coupled to the said common circuit.

6. Transmitter of modulated high frequency currents comprising a Wheatstone bridge consisting of four impedances and having tuning means inserted in the diagonals thereof, means for applying to one of these diagonals a carrier wave, means for applying to the other diagonal another continuous wave of the same frequency but in quadrature with the foregoing carrier wave, amplitude modulation means for this latter continuous wave, two symmetrical circuits coupled to the Wheatstone bridge each circuit comprising amplifiers in cascade each

stage of which comprises a certain number
of valves, the input of each of these valves
being connected to biasing means through
individual self-inductances coupled to a com-
5 mon coupling circuit a common circuit asso-
ciated with the output of the amplifiers and
an antenna coupled to the said common cir-
cuit.

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