May 9, 1933. R. VILLEM ET AL 1,907,624

HETERODYNE SYSTEM

Filed Feb. 28, 1930

Fig. 1

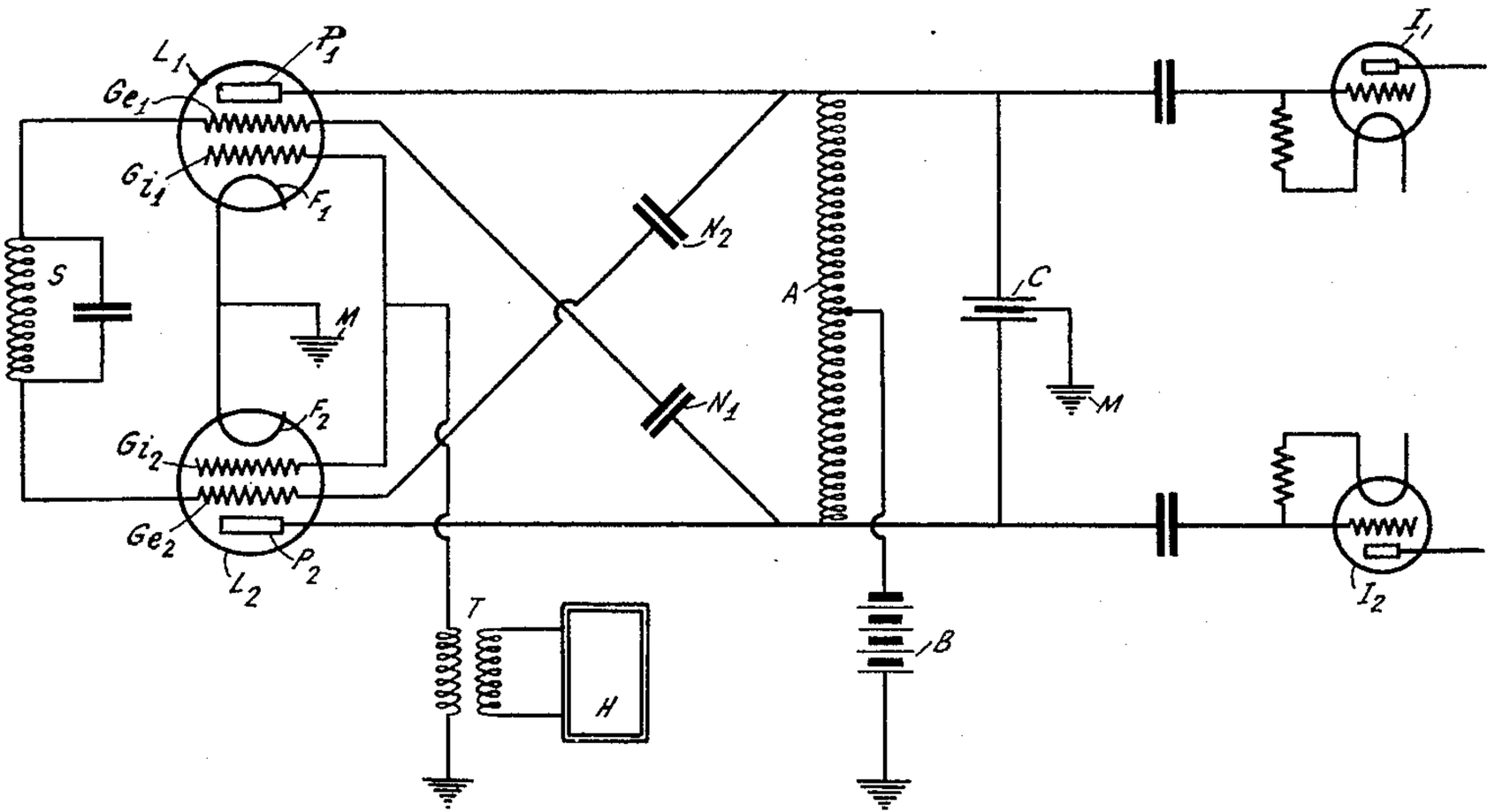
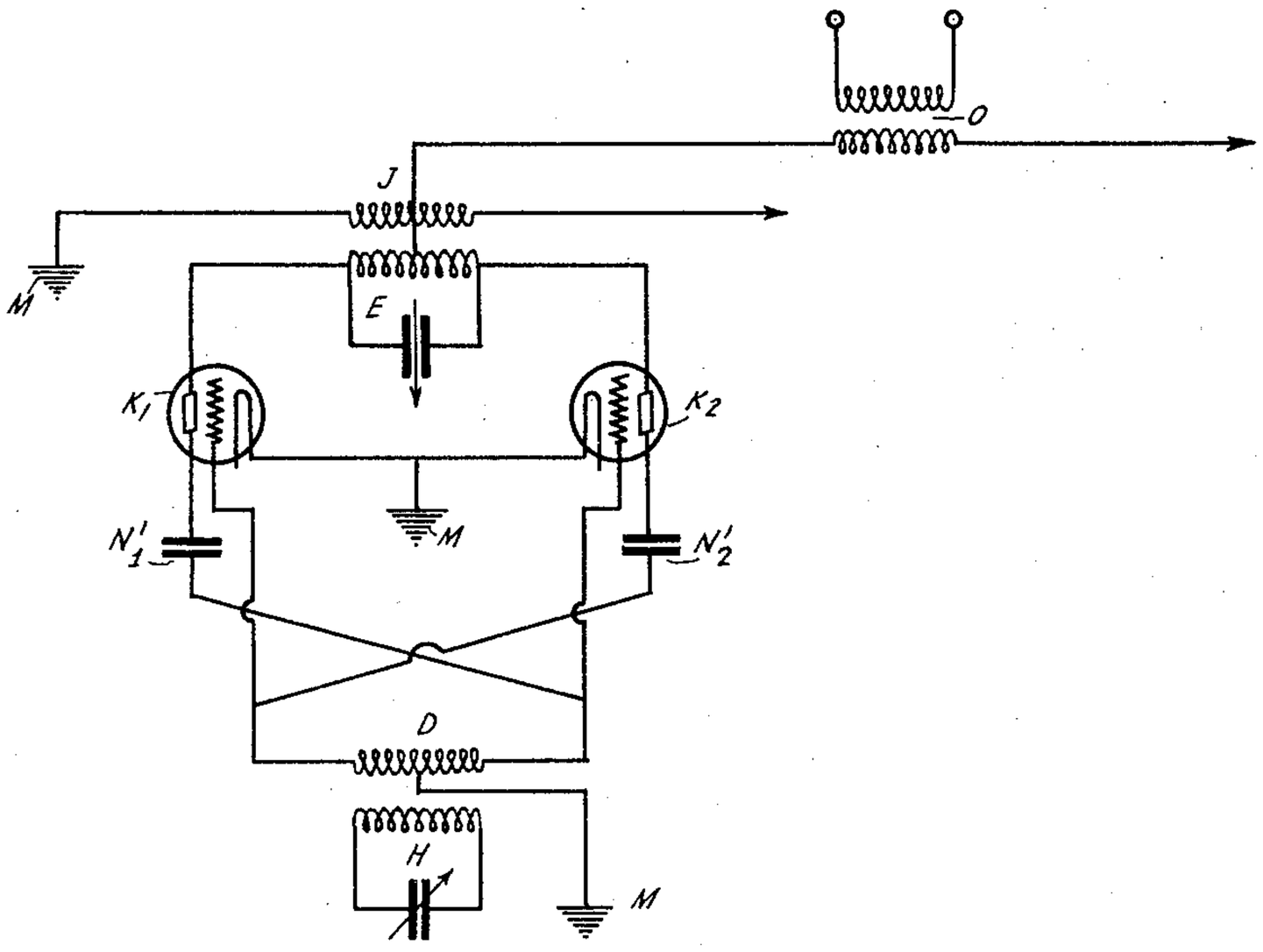


Fig. 2



INVENTORS
RAYMOND VILLEM AND
BY ROGER AUBERT
W. S. Grover
ATTORNEY

Patented May 9, 1933 1,907,624

UNITED STATES PATENT OFFICE

RAYMOND VILLEM AND ROGER AUBERT, OF PARIS, FRANCE, ASSIGNORS TO COMPAGNIE GENERALE DE TELEGRAPHIE SANS FIL, A CORPORATION OF FRANCE

HETERODYNE SYSTEM

Application filed February 28, 1930, Serial No. 432,012, and in France April 30, 1929.

The present invention relates to improved arrangements in receivers with thermionic valves for wireless telegraphy and telephony. More particularly it has reference to receiving systems with changing frequency, and its principal aim is to maintain the oscillations of each of the different frequencies in their respective zone.

In this manner, for instance, the high frequency oscillations, coming from the wave collector and those of the heterodyne, are prevented from passing into the circuits of intermediate frequency disposed subsequent to the element changing the frequency. Furthermore, in case a modulation device of musical frequency is provided for the telegraphic reception transmitted on pure continuous waves, the invention furnishes a circuit arrangement which prevents the low frequency of the modulation to react on the high frequency heterodyne.

The results aimed at are principally accomplished by means of the combination of a symmetric installation with double-grid tubes and the neutralizing connections of the capacitative effects for the frequency changing device and, for the modulating device with musical frequency, by means of an amplifying arrangement with symmetric resonance and neutralized between the high frequency heterodyne and the frequency changing device, the low frequency modulation being applied to the resonant circuit of this auxiliary amplifier. This arrangement has the further advantage to insure the filtering of the harmonics of the heterodyne and its use in this capacity is justified even disregarding the introduction of a low frequency modulation.

The novel features which we believe to be characteristic of our invention are set forth in particularity in the appended claims, the invention itself, however, as to both its organization and method of operation will best be understood by reference to the following description taken in connection with the drawing in which we have indicated diagrammatically several circuit organizations whereby our invention may be carried into effect.

The invention will be better understood with the aid of the attached drawing and the specification relating thereto, wherein,

Fig. 1 represents the circuit arrangement and the connections of the frequency changer set,

Fig. 2 shows the auxiliary amplifying device, the coupling of the high frequency heterodyne and the heterodyne with musical frequency with the frequency changing device.

According to Fig. 1 a frequency changer set is formed by the symmetric connection of two double-grid tubes L1 and L2. The high frequency oscillations of the signals influence the external grids *Ge*1 and *Ge*2 of these tubes by means, for instance, of the resonant coupling circuit S. The interior grids *Gi*1 and *Gi*2 are interconnected and connected to a coupling device T with the high frequency heterodyne H.

At M are shown various connections with points of the same potential (metallic mass or body of the apparatus, for instance), the cathodes F1 and F2 are interconnected and connected to the common point M; for the sake of simplicity the heating source of these cathodes is not shown. The plates P1 and P2 are interconnected by means of the inductance coil A, whose center point is connected to the source of plate B whose other pole is connected to the mass M.

The inductance A comprises with the condenser C, shunted with it, the resonant coupling circuit with the consecutive amplifier of intermediate frequency which is suitably of symmetrical arrangement, and of which are shown the input tubes I1 and I2. The condenser C is provided with a center armature connected to common point M. Finally, between the grid *Ge*1 on the one hand and the plate P2 and between the grid *Ge*2 and the plate P1 are disposed the condensers N1 and N2 for the neutralization of the internal grid-plate capacity effects of the tubes L1 and L2 respectively. It is possible in this circuit arrangement to interchange the roles of the electrodes of the interior grid, exterior grid and plate according to the construction of the double-grid

tubes used without exceeding the scope of the invention.

According to Fig. 2, a coupling device for the purpose of transmitting the action of the high frequency heterodyne to the frequency changer set is developed in the following manner. Between the oscillating circuit H of the high frequency heterodyne and the connection to the grids G*i* of the frequency changing device is interposed an amplifier consisting of thermionic tubes, for instance the triodes K1 and K2 arranged symmetrically. For the sake of simplicity, this amplifier is shown as comprising only one stage, although several stages in cascade could be employed in accordance with the same arrangement.

The grids of the triodes K1 and K2 are energized through the circuit H by any convenient coupling means, for instance, the inductive coupling as shown, which comprises a coil D whose center point is connected to the heating circuit by means of a body tap M for instance. The plates of the tubes K1 and K2 are connected to an oscillating circuit E, which, in turn, is coupled to the incoming circuit of the frequency changer device (for instance grids G*i*1 and G*i*2 of Fig. 1); by any convenient coupling means, for instance a coil J in inductive relation with the inductance of circuit E.

On the other hand, the center point of this latter inductance coil connects to the plate battery by means of the secondary of a transformer O whose primary is energized by the heterodyne with musical or low frequency. Without going beyond the idea of the invention other coupling means may beside be thought out for the purpose of introducing the action of the musical heterodyne upon this connection between E and the plate battery.

Finally, condensers N'1 and N'2 for compensating the internal capacities of the tubes K1 and K2 are disposed between the plates of each of these tubes respectively and the extremities of the coil D. It is well understood that the invention is subject to numerous embodying variations according, for instance, to the different equivalent connecting methods which may be employed between the essential elements. The principle arrangements which it comprises (for instance those of Figs. 1 and 2) may be employed singly or in combination between themselves or combined one with the other or one with the other with receiving elements or independent circuits.

The same arrangements may be used in their entirety or in part several times in succession, for instance in the apparatus with several successive frequency reductions. Finally, the invention provides in particular the application of the described arrangements to the reception of short waves or of very high frequency for which they are particularly suitable and to the construction of apparatus for commercial communication purposes due to the reliability inherent in them, especially by reason of the possibility of increasing the number of stages of the amplifiers with which they are associated.

What we claim is:

1. In a receiver of electric signals, a frequency-changing amplifier comprising at least one pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a local source of a frequency different from that of the input energy, associated with another grid of each of said tubes, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints connected to ground, and amplification means comprising at least a pair of tubes connected in push-pull and fed by the potential between two symmetric points of the resonant circuit.

2. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy-collecting circuit associated with a grid of each of these tubes, a local source of different frequency from that of the input energy, associated with a connection between ground and the midpoint of a connection between the other grids of the said tubes, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints connected to ground, and amplification means comprising at least a pair of tubes connected in push-pull and fed by the potential between two symmetric points of the said resonant circuit.

3. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a connection comprising a condenser between the said grid and the plate of the opposite tube, a local source of a frequency different from that of the input energy, associated with another grid of each of the said tubes, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints connected to ground, and amplification means comprising at least a pair of tubes connected in push-pull and fed by the potential between two symmetrical points of the said resonant circuit.

4. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a connection comprising a condenser between

the said grid and the plate of the opposite tube, a local source of a frequency different from that of the input energy, associated with a connection between ground and the midpoint of a connection between the other grids of the said tubes, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints connected with ground, and amplification means comprising at least a pair of tubes connected in push-pull and fed by the potential between two symmetric points of the said resonant circuit.

5. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a local source of a frequency different from that of the input energy, associated with another grid of each of the said tubes, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes, and having their midpoints connected with ground, means connected to the mid-point of said inductance for applying potential to said plates, and amplification means comprising at least one pair of tubes connected in push-pull and fed by the potential between two symmetric points of the said resonant circuit.

6. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a local source of a frequency different from that of the input energy, associated with a connection between ground and the midpoint of a connection between the other grids of the said tubes, an amplifier comprising at least a pair of symmetric tubes disposed between the local source and the first mentioned connection, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints connected with ground, and amplification means comprising at least a pair of tubes connected in push-pull and fed by the potential between two symmetric points of the said resonant circuit.

7. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of the said tubes, a local source of a frequency different from that of the input energy, associated with a connection between ground and the midpoint of a connection established between the other grids of the said tubes, an amplifier comprising at least a pair of symmetric tubes interposed between the local source and the connection first mentioned, and having the midpoints of the arrangement connected with ground, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints connected to ground and amplification means comprising at least a pair of tubes connected in push-pull and fed by the potential between two symmetric points of the said resonant circuit.

8. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a local source of a frequency different from that of the input energy, associated with a connection between ground and the midpoint of a connection established between the other grids of the said tubes, an amplifier comprising at least a pair of symmetric tubes interposed between the local source and the first mentioned connection, having the midpoints of the arrangement grounded, and having the plates inter-connected across a resonant circuit associated with the said connection, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints connected to ground, and amplifier means comprising at least a pair of tubes connected in push-pull and fed by the potential between two symmetric points of the said resonant circuit.

9. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a local source of a frequency different from that of the input energy, associated with a connection between ground and the midpoint of a connection between the other grids of the said tubes, an amplifier comprising at least a pair of symmetric tubes interposed between the local source and the first mentioned connection, having the midpoints of the arrangement grounded, and having the plates interconnected across a resonant circuit associated with the said connection, connections comprising condensers between the opposite plates and grids of the tubes of the said amplifier, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints grounded, and amplifier means comprising at least a pair of tubes connected in push-pull, and fed by the potential between two symmetric points of the said resonant circuit.

10. In a receiver for electric signals, a frequency changing amplifier comprising at least a pair of double grid tubes connected in push-pull, an energy collecting circuit associated with a grid of each of these tubes, a local

source of a frequency different from that of the input energy, associated with a connection between ground and the midpoint of a connection between the other grids of the said tubes, an amplifier comprising at least a pair of symmetric tubes interposed between the local source and the first mentioned connection, having the midpoints of the arrangement grounded, and having the plates interconnected across a resonant circuit associated with the said connection, a second local source of audible frequency associated with a connection between the plate supply source and the midpoint of the said circuit between the plates, a resonant circuit comprising an inductance and a capacity disposed between the plates of the said double grid tubes and having their midpoints grounded, and amplifying means comprising at least a pair of tubes connected in push-pull and fed with the potential between two symmetric points of the said resonant circuit.

RAYMOND VILLEM.
ROGER AUBERT.