Dec. 11, 1923. 1,476,721

DE LOSS K. MARTIN

FREQUENCY CONTROL SYSTEM

Filed Nov. 23, 1921

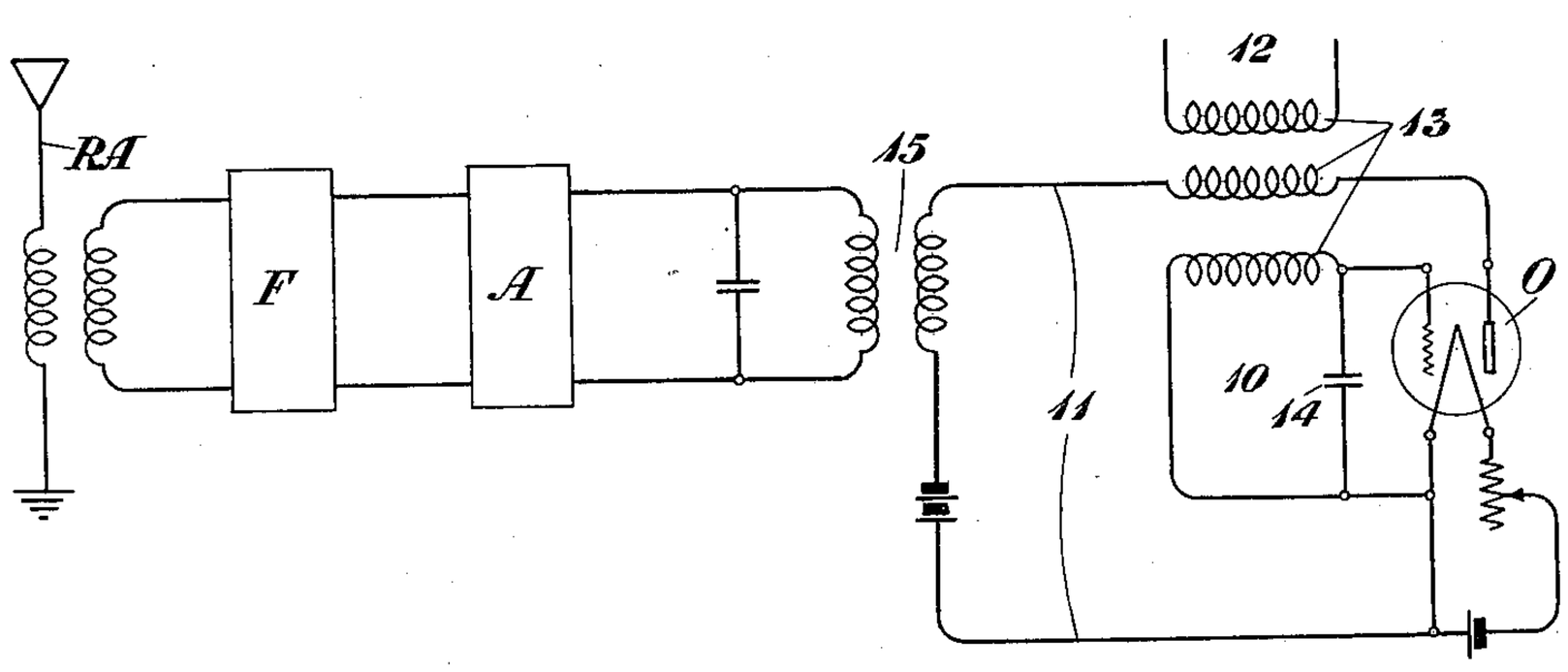

Fig. 1

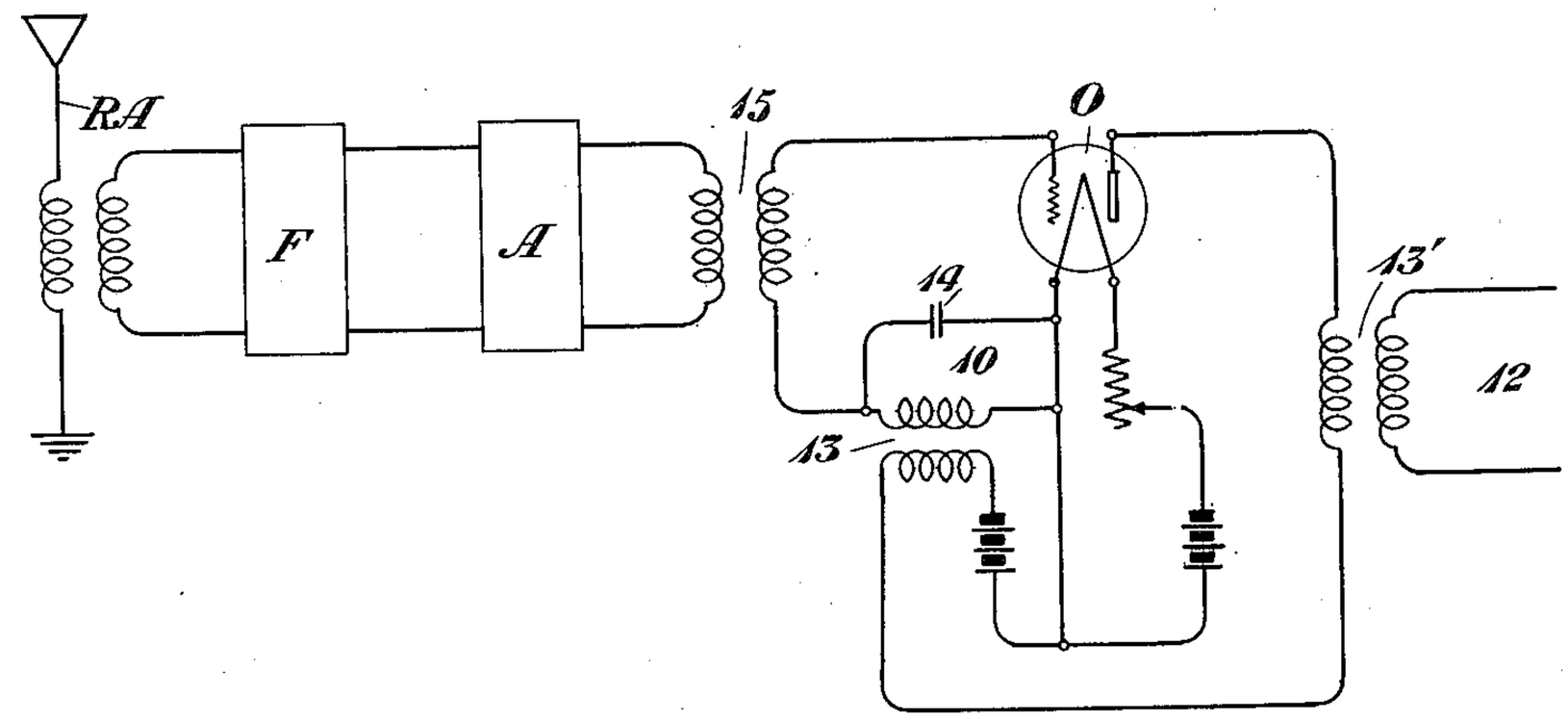

Fig. 2

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UNITED STATES PATENT OFFICE.

DE LOSS K. MARTIN, OF ORANGE, NEW JERSEY, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

FREQUENCY-CONTROL SYSTEM.

Application filed November 23, 1921. Serial No. 517,335.

To all whom it may concern:

Be it known that I, DE LOSS K. MARTIN, residing at Orange, in the county of Essex and State of New Jersey, have invented certain Improvements in Frequency-Control Systems, of which the following is a specification.

This invention relates to signalling by means of carrier frequencies and more particularly to an arrangement for controlling the carrier frequency used for signaling by different stations.

In a system, either wire or radio, employing carrier currents for transmission purposes, it is frequently desirable that some method be available for controlling the carrier frequency at one station from a distant station. In a wire carrier system, for example, it is necessary, where the homodyne method of receiving is employed, to properly synchronize the frequencies used for receiving with the frequencies used for transmitting at the distant station, and it is also desirable that the spacing of the carrier frequencies employed by the various channels be maintained in the same relation. In a radio system the same situation arises, and in addition it is desirable that the frequencies assigned to different stations and to groups of stations belonging to different systems be maintained in proper spacial relation. This is necessary in the one case to prevent interference between different signaling stations of the same system and in the other case to prevent interference between stations of different systems. In either case it is desirable to transmit from some controlling station a master frequency and to provide at each signaling station arrangements whereby the carrier frequencies employed may be determined by the master frequency.

All of these situations call for some arrangement whereby a frequency at one station may be controlled from a distant station. In accordance with the present invention it is proposed to accomplish this result by arranging the circuits of a vacuum tube oscillator, so that the particular frequency at which the vacuum tube will oscillate will correspond either to the master frequency or to a frequency derived therefrom. The principle here employed is analogous to the well-known phenomena observed in connection with alternating current generators, namely, that when two alternators are connected into the same circuit and are rotated at substantially the same frequency, both alternators tend to rotate in synchronism, and, as soon as synchronism has been reached, this condition will continue indefinitely.

The invention may now be more fully understood from the following description when read in connection with the accompanying drawing, Figures 1 and 2 of which show schematically two arrangements embodying the principles of the invention.

Referring to Fig. 1, O is a vacuum tube oscillator having the usual filament, grid and plate. The tuned grid circuit 10 is coupled to the plate circuit 11 and to the outgoing circuit 12 through the windings of a transformer 13, this arrangement providing a feed-back arrangement between the grid circuit and the plate circuit. By means of some adjustable element, such, for example, as the condenser 14, the circuits of the oscillator may be tuned so that it will oscillate at a given frequency. If, however, another frequency not greatly different from the natural frequency of the system be impressed upon the plate circuit, the tube will oscillate at the frequency impressed on the plate circuit rather than at its own natural frequency, provided, of course, that the arrangement which generates the frequency impressed upon the plate circuit is so related to the oscillator that the oscillator does not react upon such generator.

This condition is realized in a radio system, such as that shown in Fig. 1 for example. In this system the receiving antenna RA will receive a master controlling frequency, for example, and a filter F is associated with the antenna to render the circuit selective to the control frequency. This filter may be either a simple tuned circuit of well-known type or a band filter of the Campbell type. If desired, an amplifier A may be provided to amplify the master frequency to any desired value before impressing it upon the oscillator. The amplified master frequency may be impressed upon the plate circuit of the oscillator through a transformer 15 in the output circuit of the amplifier A, it being understood that the amplifier A may be of any well-known type, such, for example, as a vacuum tube.

In the case of a circuit such as that de-

scribed the master frequency generated at a distant point will be wholly independent of the frequency of the oscillator O owing to the fact that the master frequency is radiated from a distant point and received by the antenna RA, and the frequency generated by the oscillator cannot be transmitted back to the generator of the master frequency. Consequently, by reason of the well-known principle that two oscillators approaching the same frequency and connected to the same circuit tend to oscillate at the same frequency, it at once follows that the oscillator O will oscillate at the master frequency, assuming, of course, that the master frequency does not greatly differ from that which would normally be generated by the oscillator O.

This it will be seen affords a simple arrangement for keeping the oscillations generated by the vacuum tube oscillator O in synchronism with the frequency generated at a distant point. The same result may be accomplished by the arrangement shown in Fig. 2, which differs from that of Fig. 1 in that the master frequency is impressed upon the grid circuit of the vacuum tube O instead of upon the plate circuit. The grid and plate circuits are coupled together through the transformer 13, and the frequency generated is impressed upon the work circuit 12 through a transformer 13 in the plate circuit. The grid circuit is connected through the transformer 15 with the amplifier A, filter F and receiving antenna RA, so that the master frequency may be transmitted to the tube for controlling purposes. The operation will, of course, be similar to that of Fig. 1 and need not be further described.

It will be obvious that the general principles herein disclosed may be employed in many other organizations widely different from those illustrated without departing from the spirit of the invention as defined in the following claims.

What is claimed is:

1. The method of producing synchronism between a locally generated frequency and a controlling frequency transmitted from a distant point, which consists in adjusting an oscillator so that it will normally produce a frequency in the neighborhood of the controlling frequency, transmitting the controlling frequency through a one-way device, and in impressing the controlling frequency thus passed upon the oscillator whereby the oscillator will oscillate in synchronism with the controlling frequency.

2. The method of producing synchronism between a locally generated frequency and a controlling frequency transmitted from a distant point, which consists in adjusting an oscillator to oscillate at a frequency in the neighborhood of the controlling frequency, radiating the controlling frequency from a distance point, receiving the controlling frequency at the generating station, transmitting the controlling frequency through a one-way device, and impressing the controlling frequency thus passed upon the oscillator whereby the oscillator will oscillate in synchronism with the controlling frequency.

3 A system for producing synchronism between a locally generated frequency and a controlling frequency transmitted from a distant point comprising an oscillator adjusted to oscillate at a frequency in the neighborhood of the controlling frequency, means to receive the controlling frequency, a one-way device through which the received controlling frequency may be transmitted, and means to impress the controlling frequency so transmitted upon the oscillator whereby it will oscillate at the controlling frequency.

4. A system for producing synchronism between a locally generated frequency and a controlling frequency generated from a distant point comprising a vacuum tube oscillator adjusted to oscillate at a frequency in the neighborhood of the controlling frequency, means to receive the controlling frequency, a one-way device through which the received controlling frequency may be transmitted, and means to impress the controlling frequency so transmitted upon the circuit of the vacuum tube oscillator whereby the oscillator will oscillate at the controlling frequency.

In testimony whereof, I have signed my name to this specification this 17th day of November, 1921.

DE LOSS K. MARTIN.