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CONSTANT FREQUENCY OSCILLATOR

Filed Sept. 23, 1925

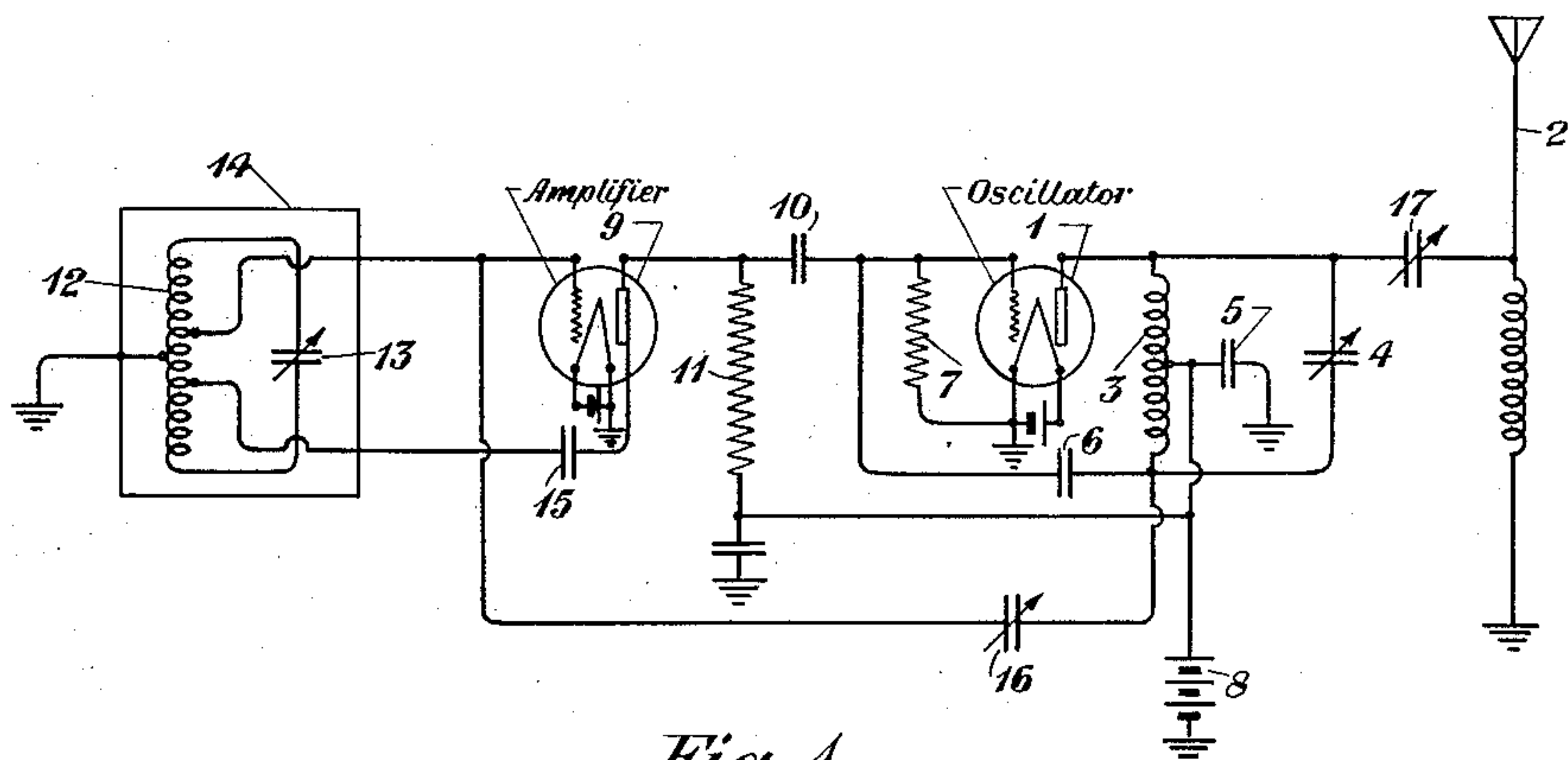


Fig. 1

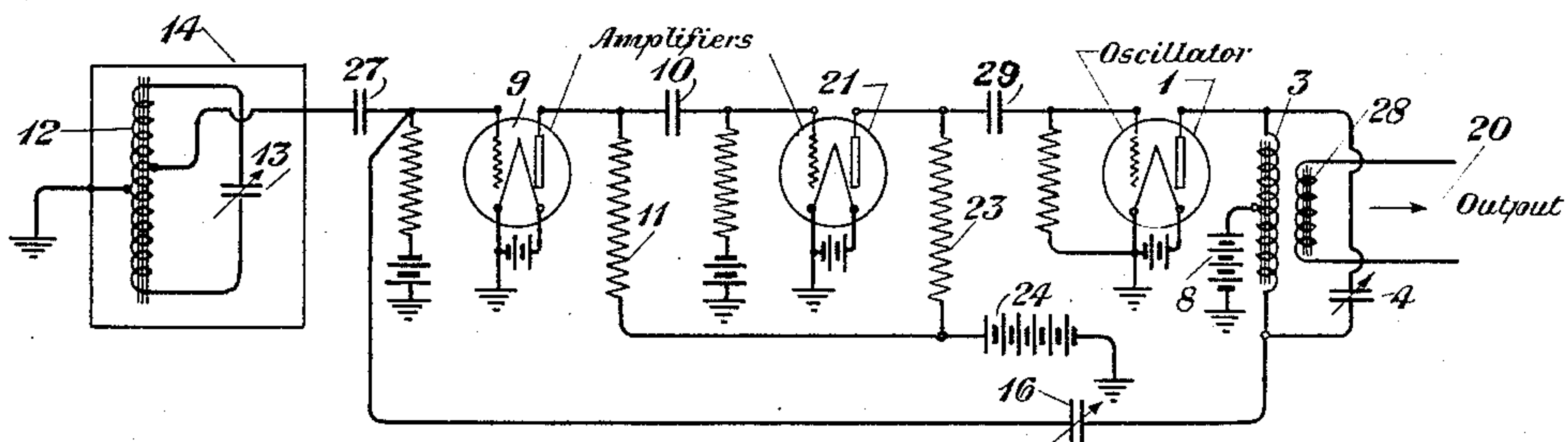


Fig. 2

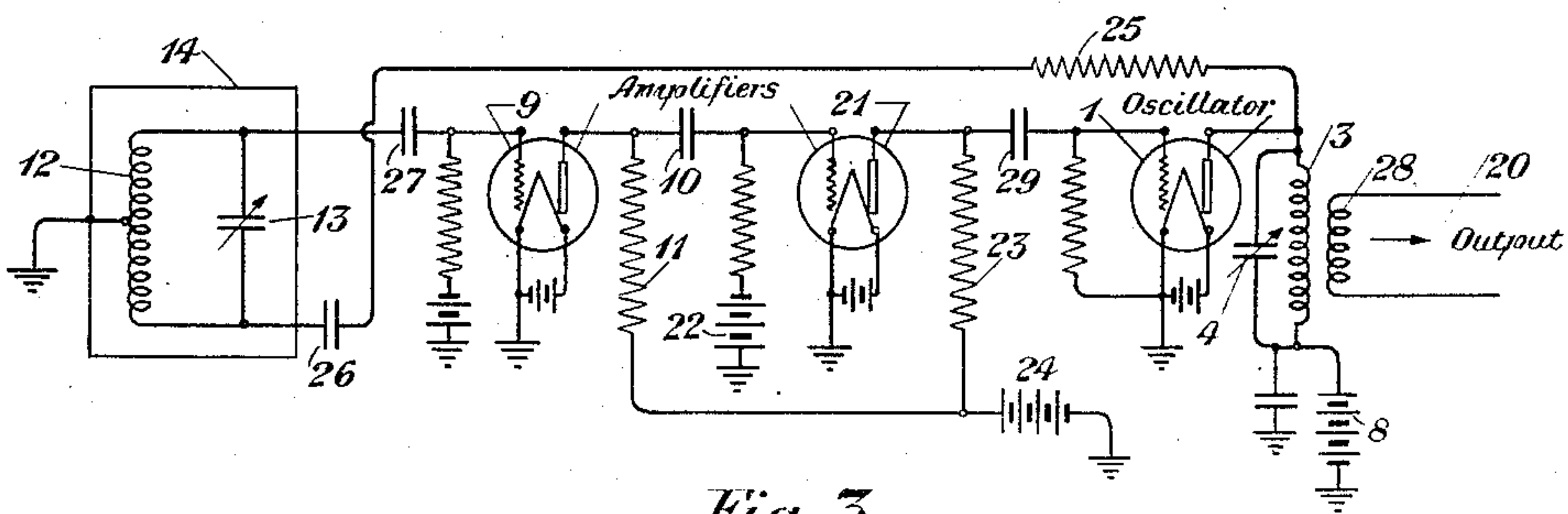


Fig. 3

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CONSTANT-FREQUENCY OSCILLATOR

Application filed September 23, 1925. Serial No. 58,166.

This invention relates to means for producing electrical oscillations and particularly to a system of that type characterized by means to maintain substantially constant the frequency of the oscillations produced thereby.

In the production of electrical oscillations by means of vacuum tube devices, difficulty has been experienced in keeping constant the frequency of said oscillations owing to the fact that the constants of the vacuum tubes affect the magnitudes of the tuned circuits, which in turn control the frequency. As is well known, these constants, such as the plate impedance of a vacuum tube, are not the same during the operation of the tube as when the tube is in non-operated condition, due to changes within the tube itself as, for example, filament emission, gas pressure changes within the tube, and variations of plate voltage.

Various ways have been suggested heretofore to maintain constant the frequency of such oscillators or to maintain constant the frequency in the circuit supplied by such oscillators. One of the methods consists in using a loose coupling between the oscillator and the antenna circuit. Another method consists in the use of a master oscillator, and a third method in the use of a crystal to control the frequency of a vacuum tube oscillator, which frequency was then used in producing a harmonic frequency, the harmonic being used as the radio frequency.

None of the schemes enumerated absolutely prevents a change of carrier frequency, although the master oscillator system effects an improvement over the single oscillator tube, and to a greater extent the crystal control system is better than the master oscillator system. These systems, however, possess inherent defects, the most important being that they are difficult to apply to the higher radio frequencies of the order of a million cycles or more because of the number of tuned circuits involved.

This invention resides in a system for the production of electrical oscillations, which is characterized by two tuned circuits, one of which determines the frequency and the other

the amount of power taken out of the main oscillating device.

Other objects of the invention will be apparent from the following description when read in connection with the accompanying drawing, of which Figure 1 shows schematically a simple form of embodiment of the invention and Figs. 2 and 3 are modifications of the form shown in Fig. 1 to produce frequencies within the voice or the wire carrier range.

In the arrangement shown in Fig. 1, the tube 1, which forms part of the oscillator, has its output circuit connected with the antenna 2, but the said output circuit may be connected with a wire line as in Figs. 2 and 3. Connected with and forming part of the output circuit is a resonant circuit made up of the inductance 3 and the variable condenser 4. The said inductance has its midpoint connected to ground through the condenser 5. A balancing condenser 6 is effectively connected between the grid and the plate of the oscillator tube 1. A resistance 7, which may be of the order of 5,000 ohms, is connected between the grid and the grounded filament of the said tube. A source of plate potential 8 is connected with the midpoint of the inductance 3 to apply potential to the plate of the tube 1. The tube 9, which forms part of the amplifying circuit, has its plate connected with the grid of the oscillator 1, the connection including a condenser 10 whose function is to keep the plate potential applied by the source 8 to the plate of the tube 9 from affecting the grid of the tube 1. The output circuit of the tube 9 is connected across the grounded resistance 11 so that the potential to ground across this resistance is applied directly to the grid of the oscillator. The input circuit of the amplifier 9 is connected with a resonant control circuit comprising an inductance 12 and a variable condenser 13. These elements are so put together as to constitute a mechanically rigid tuned circuit of extremely low loss, which is electrically shielded from outside disturbances by means of the shield 14, and furthermore is rendered practically free from effects of changes in temperature. The inductance of this tuned circuit, which has its

midpoint grounded, has two taps, on each side of the center of the coil about a small fraction viz about one-tenth of the total number of turns from the center. One of the taps is connected with the grid of the amplifier; the other is connected through the balancing condenser 15 with the plate of the amplifier, as shown. This prevents the resonant control circuit from oscillating of its own accord and it also raises the input impedance of the amplifier at the radio frequencies involved. One side of the inductance 3 connected with the output side of the oscillator 1 and forming part of the resonant circuit connected therein, is connected with the grid of the amplifier 9, the connection including a small variable condenser 16. Energy is thus fed back from the free end of the inductance in the output circuit of the oscillator tube through the small variable condenser 16 to the grid of the amplifier tube. This coupling condenser controls the magnitude of the oscillations fed back to the amplifier.

The method of operation of the system described above will probably be quite obvious from the foregoing description of the parts of the circuit and the functions that they perform, so that little further explanation should be necessary. Oscillations produced by the tube 1 will cause the resonant circuit 3—4 to resonate at the frequency to which it is adjusted. A part of the energy at this frequency will be fed back through the condenser 16 to the conductor connecting the grid of the amplifier 9 with one of the taps of the inductance 12 of the resonant circuit 12—13. This will cause the latter resonant circuit to resonate at the frequency to which it is adjusted. This frequency will then be impressed upon the amplifier 9, which in turn will impress an amplified voltage of this frequency upon the input side of the oscillator 1 and thus the process will be repeated. The major portion of the energy of the frequency generated will be transmitted through the condenser 17 to the antenna 2 for radiation therefrom. Only a small portion of the energy goes back through the condenser 16 to the resonant circuit. It will therefore be seen that the system described depends not on the stability of the vacuum tubes but upon the stability of the mechanically rigid resonant circuit 12—13. In other words, variations in the constants of the tubes as they operate will not produce any substantial effect upon the frequency of the resulting oscillations inasmuch as such frequency is largely, if not entirely, controlled by the circuit 12—13 which is not only rigidly constructed from the mechanical viewpoint but is also shielded from extraneous sources of interference and is maintained at a substantially constant temperature. It is also to be noted that the feed-back condenser 16 which, for example, may have a capacity of about 25 microfarads, may

produce a slight effect upon the tuning of the resonant circuit 12—13, but inasmuch as the ratios of the capacities 16 and 13 and the value of the coupling involved are low, the effect of such coupling is negligible. Once the system is set in operation to produce a definite frequency it will continue to do so.

The arrangements shown in Figs. 2 and 3, in which the same reference numerals have been used to indicate similar parts, are intended to show the application of the invention to systems for the production of oscillations within the range of frequencies applicable to wire carrier systems. Thus, in Fig. 2 the output circuit of the oscillator 1, which includes the inductance 3 and the condenser 4, is coupled to an output circuit 20 by means of the mutual inductance between the winding 3 and the winding 28 connected with the output circuit. The resonant control circuit 12—13, which is protected by the shielding surface 14, is connected to ground through the midpoint of the inductance 12 and is also connected with the grid circuit of the amplifier 9, the connection including a condenser 27. As in Fig. 1, a feed-back connection is established from the inductance 3 in the output circuit of the oscillator to the resonant circuit, the connection including a condenser 16. This feed-back circuit is connected to the input of the first amplifier at a point between the condenser 27 and the grid of the amplifier 9. Another amplifier 21 is inserted between the amplifier 9 and the oscillator 1 and the output of each amplifier is impressed across a resistance such as 11 and 23, to which a source of plate potential 24 is also connected. Condensers 10 and 29 are placed in the grid circuits of the amplifier 21 and the oscillator 1 in order to protect the grids of these tubes from the effect of the plate battery 24.

In the arrangement shown in Fig. 3, the resonant circuit in the output side of the oscillator 1 is connected with the resonant control circuit 12—13 by means of a connecting circuit including the resistance 25 and the condenser 26. As in Fig. 1, the feed-back coupling between the resonant circuit in the output side of the oscillators of Figs. 2 and 3 is of such magnitude as to reduce to a minimum the energy fed back to the control circuit. In this manner the effect of external changes on the frequency determined by the resonant control circuit 12—13 is greatly reduced.

While this invention has been disclosed in a particular form it is apparent that it is capable of embodiment in other and different forms within the spirit and scope of the appended claims.

What is claimed is:

1. In a system for producing electrical oscillations of constant frequency, the combination with a vacuum tube oscillator having

a resonant circuit connected with the output side thereof, of an amplifier connected with the input side of said oscillator by a resistance coupling, a sharply tuned resonant circuit shielded from external influence connected with the input side of the said amplifier, and means to feed back a small amount of energy from the said first resonant circuit to the said second resonant circuit.

2. In a system for producing electrical oscillations of constant frequency, the combination with a vacuum tube oscillator having its output circuit tuned to the desired frequency, of a control circuit sharply tuned to the desired frequency, shielding means to protect the control circuit from external interference, a condenser coupling between the said first tuned circuit and the said control circuit to feed back a small amount of energy to energize the said control circuit, and means to connect the said control circuit to the input circuit of said oscillator, the said connecting means including a unilateral device preventing undesired reaction between the said oscillator and the said control circuit, and a resistance coupling between the said oscillator and the said unilateral device.

3. In a system for producing electrical oscillations of constant frequency, the combination with an oscillator having a tuned output circuit, of an amplifier, means to connect said amplifier to the input side of the said oscillator, the said connection including a resistance coupling, a second tuned circuit mechanically rigid and shielded from external interference connected with the input side of the amplifier, and a condenser coupling between the output of the said oscillator and the second tuned circuit.

4. In a system for producing electrical oscillations of constant frequency, the combination with an oscillator having a tuned output circuit, of a frequency control circuit sharply tuned, mechanically rigid and shielded from external interference, means to couple the output circuit of the said oscillator with the said frequency control circuit, and means to connect the said frequency control circuit to the input of the said oscillator, the said connecting means comprising a unilateral device and a resistance coupling between the said device and the said oscillator.

In testimony whereof, I have signed my name to this specification this 21st day of September 1925.

RUSSELL S. OHL.