E. O. SCRIVEN.

SYSTEM FOR TRANSMISSION OF INTELLIGENCE.

APPLICATION FILED NOV. 6, 1916.

1,396,786. **Patented Nov. 15, 1921.**

Fig. 1.

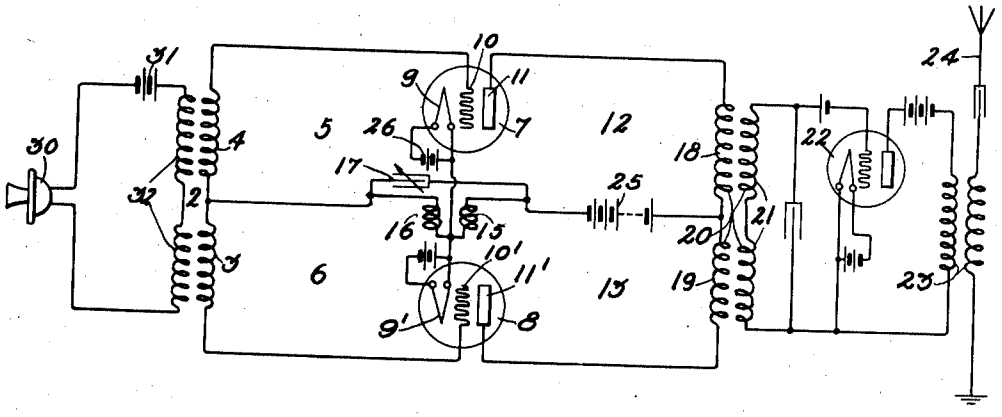
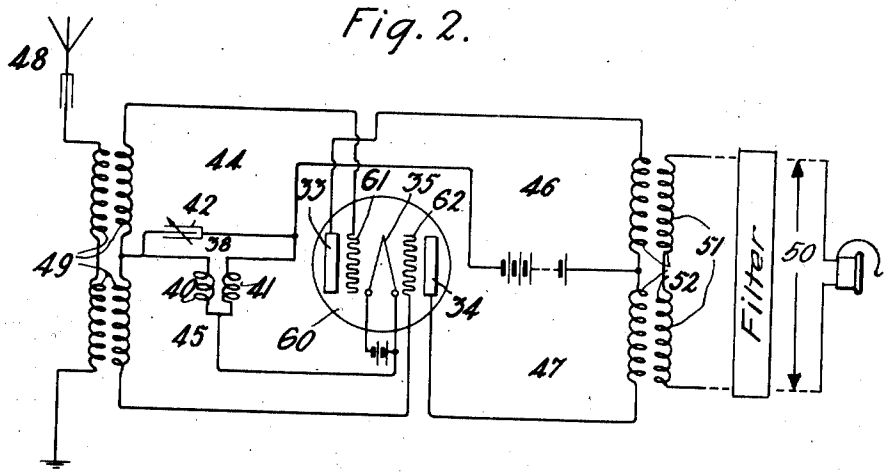


Fig. 2.



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UNITED STATES PATENT OFFICE.

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SYSTEM FOR TRANSMISSION OF INTELLIGENCE.

1,396,786. Specification of Letters Patent. Patented Nov. 15, 1921.

Application filed November 6, 1916. Serial No. 129,728.

To all whom it may concern:

Be it known that I, EDWARD O. SCRIVEN, a citizen of the United States, residing at New York, in the county of New York and State of New York, have invented certain new and useful Improvements in Systems for Transmission of Intelligence, of which the following is a full, clear, concise and exact description.

This invention relates to systems for signaling by means of high-frequency oscillations, and in particular to a signaling system in which the transmission or radiation of energy is automatically prevented except during the time signals are actually being transmitted, such as is described in British Patent No. 102,503 of 1916, issued to Western Electric Company, Ltd., assignee of J. R. Carson.

This invention, hereinafter described in terms of a wireless telephone system, is not so limited in its scope, but may be applied to any signaling system wherein signals are transmitted or received by means of a high frequency carrier wave modulated in accordance with said signals.

The principal object of this invention is to simplify the mechanism and strengthen the effectiveness of the apparatus necessary for the production and transmission of high frequency oscillations modulated in accordance with low frequency signals, and the prevention of the transmission of the unmodulated carrier wave frequencies. For the attainment of this purpose the invention embodies the combination of two oscillation generators which serve as a source of high frequency carrier wave oscillations, the impedance of which combination is varied according to the low frequency signals to be transmitted.

Other objects and the method of obtaining them will appear from the following specification and accompanying drawings of which Figure 1 illustrates a transmitting system embodying this invention; Fig. 2 represents the invention as embodied in a receiving system.

Referring first to Fig. 1, a vacuum tube 7, the elements of which are inclosed in an evacuated vessel, is arranged with its output anode or plate 11 connected through the portion 18 of the primary winding of the repeating coil 20, and inductance 15 to the heated filament or cathode 9. Included in output circuit 12 is a battery 25. The filament is heated by battery 26. The input electrode, or grid 10, is connected through the secondary winding 4 of a repeating coil, and through an inductance 16 to the filament 9. Inductances 16 and 15 are similar, and are inductively related to each other. Shunted across the two inductances is an adjustable capacity 17. Similarly connected is another vacuum tube 8, whose input circuit 6 includes the inductance 16 and a portion 3 of the secondary of the repeating coil 2. The output circuit 13 of this second tube includes inductance 15, the battery 25 and the portion 19 of the repeating coil 20. The input circuits of the two tubes have the inductance 16 in common, while both output circuits include the inductance 15 and battery 25. The two portions 18 and 19 of the primary of coil 20, included respectively in the output circuits 12 and 13, are so connected that the action of each neutralizes the action of the other in the secondary winding 21; that is, similar oscillations in coils 18 and 19, always in opposite phase, would have no resultant inductive effect on coil 21. The connections are such that for potential differences developed in the common branch 16 equal charges of the same phase are impressed on the two grids 10′ and 10, respectively. The two filaments 9 and 9′ have a direct electric connection.

It will be observed that the circuit consisting of the audion 7 with its input circuit 9, 16, 4, 10, and its output circuit 9, 15, 18, 11, constitutes an oscillation generator of the type disclosed in application of Hartley, Serial No. 31,476, filed June 1, 1915, issued Oct. 26, 1920, as Patent No. 1,356,763, and the frequency of the oscillations generated is determined by the natural period of the circuit 15, 16, 17. The circuit consisting of the audion 8 with its analogous input and output circuits is a similar oscillation generator, generating oscillations of the same frequency and in phase with those generated by the first named generator. The effect of these two sets of oscillations in the coils 18 and 19 upon the secondary wind-

ing 21 is differential and normally no effect is produced in said winding 21. 30 is a microphone transmitter connected in series with battery 31 and primary 32 of transformer 2 and by means of which low frequency signals are impressed upon the input circuits 5 and 6, impressing voltages of equal amplitude and opposing phase on the two grids.

Suppose that the character of the current through transmitter 30 at a given moment is such that it gives a positive charge to grid 10; there will then be a negative charge on grid 10'. The excess positive charge on grid 10, will lower the impedance of the vacuum tube, and will, consequently, increase the amplitude of the oscillations in the output circuit 12. The making of the grid 10' more negative will increase the impedance of tube 8, and will thereby decrease the amplitude of the oscillations in output circuit 13. Under such circumstances, it is apparent that the currents flowing through coils 18 and 19 are not similar, so that there will be a resultant effect on the coil 21. Thus the effect in the output circuit 21 of impressing a low frequency on the two oscillation generators will be modulated waves having a frequency corresponding to the high frequency with its amplitude varying in accordance with the low frequency. These modulated waves impressed on coil 21 may be amplified by an amplifier 22 of the audion type or any other suitable type. The amplified modulated waves in the output circuit of 22 are impressed by means of repeating coils 23 upon the antenna 24.

In general, it may be found convenient to have the two tubes 7 and 8 similar and equal. In such a case, the coils 3 and 4 should be similarly placed with reference to the primary of coil 2, as well as coils 18 and 19 in reference to the secondary coil 21. However, it is not necessary that the tubes 7 and 8 be similar and equal as it is always possible to relate any two modulating devices to a common transmitting circuit so that the transmission of the unmodulated carrier wave is prevented, by varying the ratio of the two inductances in their output circuits which serve as the primary for the repeating coil to the transmitting circuit.

It is to be understood that, while only one amplifier 22 is shown, the invention is not so limited, but any number of amplifiers may be used in order to secure sufficient amplification for the modulated oscillations before impressing them on the antenna.

In Fig. 2, a receiving apparatus for carrier-wave signaling is illustrated. The two vacuum tubes in the oscillation generators of Fig. 1 are replaced in Fig. 2 by a single tube 60 containing two grids 61 and 62, two plates 33 and 34, and a common filament or source of electrons 35. This double tube, in combination with the circuit 38 comprising inductances 40 and 41 and capacity 42, oscillates in a manner identical with the corresponding system of Fig. 1. It is to be understood that the double tube of Fig. 2 is the equivalent of the two tubes of Fig. 1. The input circuits 44 and 45 correspond respectively to input circuits 5 and 6 of Fig. 1. The output circuits 46 and 47 correspond respectively to output circuits 12 and 13. High frequency carrier wave currents incident upon the antenna 48 are impressed by means of transformer 49 upon the two input circuits 44 and 45 of the oscillation device. If the incoming waves are modulated high frequency waves, it is preferable that the device 60 serve as a homodyne generator, that is, it should produce oscillations of the same frequency as the incoming high frequency oscillations. If the incoming waves are not modulated, the generator should be a heterodyne generator, that is, it should generate oscillations of a frequency different from that of the incoming carrier waves by a pre-assigned frequency, preferably within the limits of audition. Besides functioning as a generator, the device 60 acts as a detector after the manner described in detail in the application of Carson, Serial No. 118,573, filed September 5, 1916, and issued June 15, 1920, as Patent No. 1,343,306.

As is pointed out in these specifications, the result of the interaction of the locally generated high frequency oscillations and the incoming waves, will be that oscillations of audio frequency, corresponding to the desired low frequency signals, and oscillations of modulated carrier-wave frequency, will be impressed on the circuit 50 containing the secondary 51 of the transformer 52. If we include in the circuit 50 a low frequency filter and a suitable receiving instrument, the filter may be of such a type as to suppress all frequencies above the low frequency signal range so that only the desired signals actuate the receiver. Such a low frequency filter is described in detail in the United States patent to Campbell, No. 1,227,113, granted May 22, 1917.

While this invention has been described in connection with the circuit of Fig. 1 and Fig. 2, it is obvious that various modifications in the electric systems of Figs. 1 and 2 may be made without departing from the spirit of this invention, as set forth in the appended claims. For example, any other known form of oscillation generator may be employed provided with balanced arrangement of input and output circuits whereby the results specified are obtained.

Although high frequency oscillators of the audion type are illustrated in the drawings, it is evident that the invention is not confined to such a type, but that any other suitable form may be used. These double

oscillators are not restricted to the modulation of currents as herein shown, but may have various other applications.

What is claimed is:

1. In a signaling system, the combination of a source of signal waves, of two oscillation generators each having an input circuit and an output circuit for the oscillations generated, said generators being connected in opposition with respect to both their input and their output circuits, and means for impressing said signal waves on said generators whereby the impedance of said generators is varied in accordance with said signal waves.

2. Two high frequency oscillation generators, a divided input circuit for said generators, a divided output circuit for the generated oscillations, and a transmitting circuit to which the generated oscillations are supplied, said generators being differentially related to said transmitting circuit.

3. In a signaling system, the combination of a source of signal waves, two high frequency oscillation generators, a transmitting circuit, means for connecting said circuit to said generators, means for varying the amplitude of the high frequency oscillations in accordance with said signal waves, and means for preventing the impression of the unmodulated high frequency oscillations on said transmitting circuit, but allowing the transmission of the modulated waves.

4. In a signaling system, the combination with a source of signal waves, of two high frequency oscillation generators, a transmitting circuit to which the generated oscillations are supplied, said generators being differentially associated with said transmitting circuit, means for varying the amplitude of the high frequency oscillations in accordance with said signal waves, said means being such as to produce simultaneously opposite changes of the oscillations in the two generators.

5. An oscillation generator having a divided input circuit and a divided output circuit for the generated oscillations, said generator including a tuned circuit which serves as an electromagnetic coupling between said input and output circuits.

6. An oscillation generator comprising two discharge devices each having an anode, a cathode and an impedance-varying element, a tuned circuit comprising capacity and inductance, leads from a point in said tuned circuit to each of said impedance-varying devices, leads from a second point in said tuned circuit which is electrically remote from said first point to each of said anodes, and leads from a third point in said tuned circuit which is electrically remote from each of said other points to each of said cathodes.

7. An oscillation generator comprising an electric discharge device having an anode and a cathode, an input circuit and an output circuit for said device, a coupling between said circuits, a work circuit for said generator, means for preventing the generated electromotive forces from setting up a flow of current in said work circuit, and voice controlled means acting on one of said coupled circuits for causing the generated oscillations to set up a current flow in said work circuit.

8. An oscillation generator comprising two electric discharge devices each having an anode, a cathode and an impedance controlling element, an input circuit for said generator having an inductive impedance element between said controlling elements, an output circuit for said generator, and a tuned circuit serving as an electromagnetic coupling between said input and output circuits, the frequency of the oscillations generated being determined primarily by the constants of said tuned circuit.

9. An oscillation generator and modulator comprising two discharge devices each having an anode, a cathode and an impedance-varying element, input circuits for said discharge devices having a portion in common and output circuits for said discharge devices, means for transmitting energy from said output circuits to said input circuits, and means in series with said last-mentioned means with respect to said impedance-varying elements for impressing oscillations from an external source upon said input circuits.

10. In a signaling system an oscillation generator comprising two discharge devices, input and output circuits for said discharge devices, said output circuits having a portion in common, a work circuit associated with said output circuits, and means for causing equal and opposite electromotive forces to be set up in said work circuit by said output circuits, and signaling means associated with said oscillation generator for rendering said electromotive forces unequal.

11. In a signaling system, a source of signal waves, the combination of two generators of high frequency oscillations, a transmitting circuit, said generators being so connected as to oppose each other's inductive action on said transmitting circuit, and means for impressing said signal waves on said generators, thereby varying the high frequency oscillations in accordance with the signal wave form.

12. In a signaling system, a source of signal waves, a generator of high frequency oscillations having a divided input circuit and a divided output circuit, a transmitting circuit, said source of signal waves being connected to said input circuit, the portions

of said output circuit being differentially associated with said transmitting circuit, the high frequency oscillations in said generator being varied in form according to the signal waves, the cumulative effect of the modulated high frequency oscillations in the divided output circuit being impressed on said transmitting circuit.

13. In a signaling system, a source of low frequency voltage, two similar generators of high frequency oscillations, each having an input circuit and an output circuit, a tuned circuit associating said input and output circuits and comprising capacity and inductance, the latter of which includes two portions inductively related, a source of direct current in the output circuits, inductive connections between the input circuits and low frequency source adapted to simultaneously impress oscillations of opposing phase on said input circuits, the high frequency oscillations from said generators being thereby modulated in accordance with such low frequency voltage, a transmitting circuit, and means for impressing the resultant modulated oscillations thereon.

14. In a signaling system, a source of signal waves, a generator of high frequency oscillations having an input circuit and an output circuit, a similar oscillation generator, the input circuits being associated with the output circuits by a tuned circuit, the purpose of which is primarily to determine the frequency of the oscillations generated, means for impressing said signal waves on said input circuits, said input circuits being connected in opposition, means for supplying said output circuits with a direct current voltage, said oscillation generator modulating the carrier frequency oscillations in accordance with said signal waves, a transmitting circuit, and means for impressing the resultant modulated oscillations thereon.

15. In a signaling system, a source of low frequency oscillations, a generator of high frequency carrier oscillations having an input circuit and an output circuit, and means for supplying energy from said output circuit to said input circuit, a second similar generator, said input circuits being inductively connected to said source in such a manner that oscillations of opposing phase are simultaneously developed in said input circuits, means for supplying said output circuits with a direct current voltage, said carrier wave oscillations being modified by the system in accordance with the low frequency oscillations, a transmitting circuit, said output circuits being differentially connected to said transmitting circuit thereby suppressing the unmodulated carrier frequency in the transmitting circuit, and transmitting the modulated wave form.

16. An oscillation generator comprising a plurality of electric discharge devices each having an anode and a cathode, a work circuit connected to both said discharge devices, means for normally causing a balance upon said work circuit of the electromotive forces generated by said discharge devices respectively, and means for disturbing said balance to cause currents to be set up in said work circuit.

17. An oscillation generator comprising a plurality of electric discharge devices each having an anode and a cathode, a work circuit connected to both said discharge devices, means for normally causing a balance of the generated electromotive forces upon said work circuit, and means for impressing a variable electromotive force upon said generator to disturb said balance.

18. A high frequency alternating current generator comprising a plurality of electric discharge devices for generating high frequency current each having an anode and a cathode, a work circuit connected to both said devices, means for supplying a modulating signaling electromotive force differentially to said devices, and means for preventing flow of high frequency currents in said work circuit except when said modulating electromotive force is supplied.

19. An oscillation generator comprising two electric discharge devices each having an anode, a cathode and an impedance controlling element, a divided input circuit for said generator having an inductive impedance element between said controlling elements, a divided output circuit for said generator, a source of direct current in said output circuit, and a tuned circuit serving as an electromagnetic coupling between said input and output circuits, the frequency of the oscillations generated being determined primarily by the constants of said tuned circuit, said tuned circuit comprising a plurality of serially connected inductive elements, a capacity element shunting said serially connected inductive elements, one of said inductive elements being common to said input circuit and another being common to said output circuit.

20. A thermionic discharge generator comprising means for producing thermionic currents, a plurality of control means adjacent to the path of said currents for controlling them, a divided output circuit for said generator, a tuned circuit associated with said generator for controlling the frequency of the generated currents, and a transmitting circuit to which the generated oscillations are supplied, said transmitting circuit being differentially connected to portions of said divided output circuit.

21. The method of operating a high frequency alternating current generator comprising a plurality of electric discharge de-

vices for generating high frequency current, each having an anode and a cathode, a work circuit connected to both said devices, and means for supplying a modulating signaling electromotive force differentially to said devices, which method comprises preventing flow of high frequency currents in said work circuit except when modulating electromotive force is being supplied.

In witness whereof, I hereunto subscribe my name this 4th day of November, A. D., 1916.

EDWARD O. SCRIVEN.