June 10, 1924. 1,496,848

W. H. T. HOLDEN

SELECTIVE SIGNALING SYSTEM

Filed Jan. 9, 1923

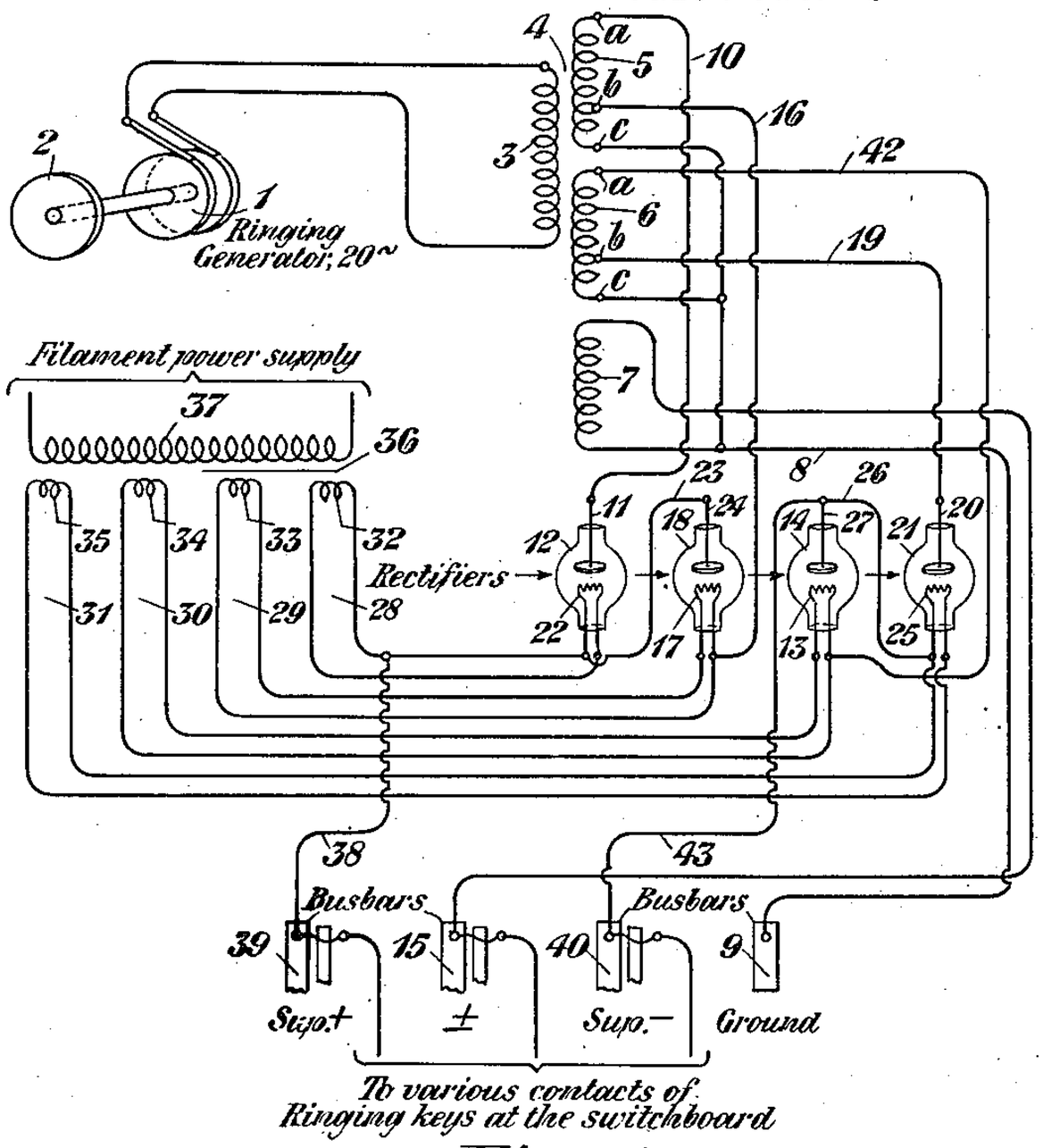

Fig. 1

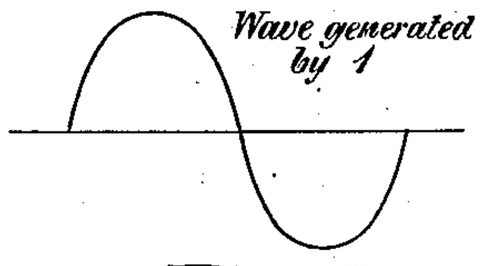

Fig. 3

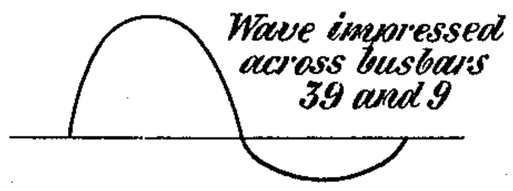

Fig. 4

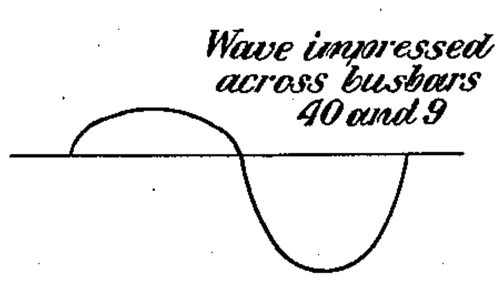

Fig. 6

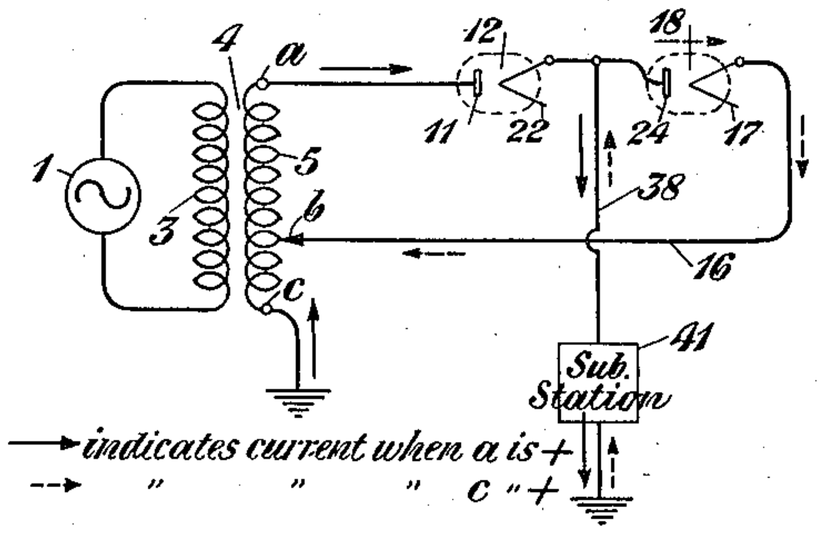

Fig. 2

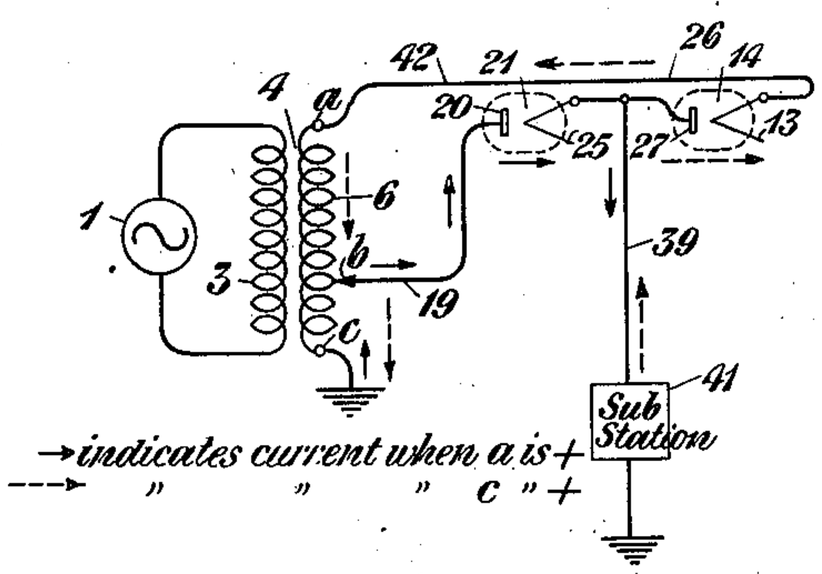

Fig. 5

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UNITED STATES PATENT OFFICE.

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SELECTIVE-SIGNALING SYSTEM.

Application filed January 9, 1923. Serial No. 611,651.

To all whom it may concern:

Be it known that I, WILLIAM H. T. HOLDEN, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Selective-Signaling Systems, of which the following is a specification.

This invention relates to signaling systems and particularly to means for the production of an alternating or pulsating current adapted for signaling in connection with selective party line telephone systems.

In party line systems in which selective signaling is effected by impressing an alternating current having dissimilar positive and negative loops upon a biased ringer or equivalent apparatus, it is customary to produce such alternating current by superimposing a sine wave current upon a direct current of either positive or negative polarity. If a sine wave current is superimposed upon a positive direct current, the resultant wave will have large positive and small negative loops with respect to the zero axis of the original sine wave. In like manner, if a sine wave current is superimposed upon a negative direct current, the resultant wave will have a large negative loop and a small positive loop with respect to the axis of the original sine wave. The transmission of these resultant waves over the sides of the line circuit will cause the operation of the desired biased ringer which forms part of the party line telephone sets. Such a system is fully described in "Telephony", by McMeen and Miller, (1912) pages 228 to 238, so that further detailed description herein is unnecessary.

In certain systems heretofore used, it has been customary to employ a battery or a direct current generator as the source of the direct current of either polarity and to superimpose thereon an alternating current generated by ringing machines. It is the principal object of this invention to provide a superimposed ringing system in which an alternating current wave having dissimilar positive and negative loops is created from the sine wave current of the ringing machine by a novel arrangement of transformers and thermionic rectifiers, thereby eliminating the separate source of direct current that was necessary in the systems heretofore used.

This invention will be better understood from the following description when read in connection with the attached drawing, of which Figure 1 shows one form of embodiment of the invention, Figs. 2 and 5 are simplified circuit drawings intended to make clear the description of the circuit shown in Fig. 1 and Figs. 3, 4 and 6 are wave diagrams used in the description of the operation of the circuit.

In Fig. 1, a ringing generator 1 adapted to produce a voltage or current wave of substantially sine form and preferably of twenty cycle frequency is driven by a motor 2 at the speed necessary to produce the required voltage. The generator 1 is connected with the winding 3 of the transformer 4, which has a plurality of what may be termed secondary windings 5, 6 and 7. One of the outside terminals of each of the said secondary windings 5, 6 and 7 is connected by the conductor 8 with the ground bus-bar 9. The other outside terminal of the winding 5 is connected by the conductor 10 with the cold electrode 11 of the rectifier 12. In similar manner, the other outside terminal of the winding 6 is connected with the heated electrode 13 of the rectifier 14 and the outside terminal of the winding 7 is connected with the bus-bar 15.

Each of the windings 5 and 6 has a tap taken therefrom at a predetermined point between the outside terminals of the said windings. Thus, such a point upon winding 5 is connected by conductor 16 with the heated electrode 17 of the rectifier 18, and in similar manner a predetermined point upon winding 6 is connected by conductor 19 with the cold electrode 20 of the rectifier 21. The heated electrode 22 of rectifier 12 is connected by conductor 23 with the cold electrode 24 of rectifier 18 and in like manner the heated electrode 25 of the rectifier 21 is connected by conductor 26 with the cold electrode 27 of rectifier 14. Each of the heated electrodes of the said rectifiers is individually connected by the pairs of conductors 28, 29, 30 and 31 with the secondary windings 32, 33, 34 and 35 of the transformer 36, of which the primary winding 37 is connected either with the sixty cycle lighting circuit or with the ringing machine. It should be noted that any source of alternating current may be used to provide the current necessary for the energization of the heated electrodes of the rectifiers. One side of the circuit 28 is connected

by means of the conductor 38 with the bus-bar 39. Also the cold electrode 27 of the rectifier 14 is connected by the conductor 43 with the bus-bar 40. The various bus-bars 39, 15 and 40 are connected through suitable fuses with the various contacts of the ringing keys at the switchboard. By proper manipulation of such ringing keys in the manner fully described in "Telephony," heretofore referred to, ringing current may be applied to the line in order to operate the biased ringers at the subscribers' stations.

Having in mind the foregoing description of the circuit in which this type of superimposed ringing system is embodied and of the functions of the various parts of the apparatus used therein, the invention will be clearly understood from the following description of the mode of operation of the circuit shown in Fig. 1.

Let it be assumed that an alternating current from any suitable source has been effectively connected across the winding 37 of the transformer 36 so that the necessary current is flowing through the branch circuits 28, 29, 30 and 31 in order to heat the electrodes 22, 17, 13 and 25 associated with the rectifiers 12, 18, 14 and 20 respectively. Let it furthermore be assumed that the wave generated by the ringing generator 1 is of sine form, such as shown in Fig. 3. Let us first consider the effect of impressing this sine wave voltage upon the secondary winding 5. This winding and the external circuit intended to be connected therewith is shown in simplified form in Fig. 2, wherein the same reference characters have been used to indicate the same or equivalent parts. While the generator 1 is generating the sine wave shown in Fig. 3, let us consider what happens during that part of the wave when the terminal *a* is positive and *c* is negative. Under this condition, current will flow over conductor 10 in the direction indicated by the solid arrow to the cold electrode 11 of rectifier 12, across the gap to the heated electrode 22 (by virtue of the ionization of the gas of the said rectifier), thence over conductor 38 to the substation 41 and to ground. The return path of this current would, of course, be through the ground to the grounded terminal C of the winding 5. This flow of current will operate the relay at the substation 41 and if the current is of the proper polarity it will operate the biased ringer at the substation. It has been found desirable to transmit through such biased ringers a pulse of opposite polarity from that which is adapted to operate the ringer and of a lower order of magnitude in order to tend to neutralize any permanent magnetizing effect that might result from the repeated application to said ringers of current of a single polarity. The transmission of such a demagnetizing impulse is effected in the following manner when the terminal *a* becomes negative and the terminal *c* positive. Under this condition no current will flow through that part of the winding 5 between the terminals *a* and *b* because the polarity of the electrode 11 is such as to prevent the transfer of current across the gap of the rectifier 12. Current, however, will flow over a circuit from the terminal *c*, through the ground connection to the substation 41, over conductor 38 to the electrode 24 of the rectifier 18 and across the gap to the heated electrode 17, and thence over conductor 16 to point *b* upon the winding 5. The potential of this current will, however, be relatively small by virtue of the fact that only a few turns of the winding 5 are included between the points *b* and *c*. Accordingly for a complete cycle of the wave generated by the source 1, the wave transmitted over a subscriber's line to the substation connected therewith would have, in general, the form shown in Fig. 4. This wave performs the same function as that produced by superimposing an alternating current upon a direct current from some source such as a battery or a direct current generator. Since direct current sources are expensive in first cost and in maintenance and consequently, the arrangement that I have shown, which requires a simple type of gas discharge tube, the filaments of which may be heated by any source such as a lighting circuit or the ringing machines themselves, constitutes an improvement of great practical importance in the art of selective ringing systems.

Since half cycles of the wave shown in Fig. 4 are of unequal amplitudes, and in that respect resemble, an alternating wave superimposed upon a positive direct current wave, such a wave is capable of ringing two parties on a telephone line in the manner clearly set forth in "Telephony" heretofore referred to. In order to ring the other two parties of a four-party system, it is customary to transmit a wave such, for example, as is shown in Fig. 6, which is substantially the same as that produced by superimposing a sine wave upon a negative direct current wave. This type of wave is obtained from the circuit associated with winding 6 of Fig. 1. This winding and its associated circuit is shown schematically in Fig. 5. If we assume the condition when terminal *a* is positive and *c* is negative, no current will flow in that part of the winding between *a* and *b* but current at a low potential, depending upon the number of turns of the winding 6 between *b* and *c*, will flow over the conductor 19 to the cold electrode 20 of the rectifier 21 and across the gap to the cathode 25 thereof, and thence by conductors 26 and 39 to the substation 41 associated with the telephone line. The current will then flow through the ground to

the terminal *c* of the winding 6. This current would be of relatively small magnitude and intended simply to demagnetize the biased ringers associated with the substation 41, which require a negative impulse to effect their operation. Let us assume, therefore, the condition when *a* is negative and *c* is positive. Under this condition, current will flow from point *c*, which is positive, through ground to the substation 41 in the direction represented by the dotted arrow and thence through conductor 39 to the anode 27 of the rectifier 14, thence across the gap to the cathode 13 and over conductor 42 to the terminal *a* of the winding 6. Since all the turns of the winding 6 are included in this circuit, the voltage at which this current is transmitted will be relatively high and since it is of negative polarity the biased ringer at the substation 41 will be operated thereby.

It may be mentioned that the winding 7 is intended to apply a sine wave alternating potential between the bus-bars 15 and 9, which may be utilized for signaling upon single party direct lines.

It will be seen, therefore, that by means of a system including a source of ringing current, a transformer having a plurality of windings and a plurality of rectifiers, it is practicable to produce an alternating wave simulating in effect a wave produced by the superposition of a sine wave upon a direct current wave of either positive or negative polarity.

In the foregoing description, the method has been set forth of producing a wave having loops of unequal amplitude which produce substantially the same effect as a wave created by superimposing a sine wave alternating current upon a direct current. The impression of such an unsymmetrical wave upon a biased, electromagnetic device not only operates the device, if the larger loop of the wave is of the polarity for which the device is adjusted to respond, but it also produces a very desirable effect by the neutralizing action of the smaller loop of the wave.

If a positive pulsating current only is required this may be produced and transmitted by that part of the circuit shown in Fig. 2 (and also by Fig. 1) embracing the full secondary winding 5, conductor 10, rectifying tube 12, conductor 38, substation 41 to ground. Positive impulses will pass through the biased device of 41 only when the point *a* of the winding 5 is positive.

Negative impulses may be created by the part of the circuit of Fig. 5 including the winding 6, the ground connection from *c* to station 41, conductor 39, rectifying tube 14, conductor 42 to winding 6. When *a* is negative and *c* is positive a negative impulse would pass through the biased device of 41.

Although this invention has been disclosed as embodied in a particular form and arrangement of parts it is to be understood that it is not so limited but is capable of embodiment in other and different forms and arrangements within the spirit and scope of the appended claims.

What is claimed is:

1. In a selective signaling system, the combination with a source of sine wave alternating current of a signaling circuit having a biased electromagnetic device connected therewith, and means including a transformer and a plurality of rectifying devices connected between said source and said signaling circuit and connected and adjusted to impress upon said circuit an alternating current wave whose positive and negative loops differ greatly in amplitude.

2. In a selective signaling system, the combination with a source of sine wave alternating current of a signaling circuit having a biased electromagnetic device connected therewith and means including a transformer and a plurality of unilateral devices interposed between said source and said signaling circuit for re-shaping said sine wave whereby the form of the generated wave may be modified to operate the said biased electromagnetic device.

3. In a selective signaling system, the combination with a source of sine wave alternating current of a pair of thermionic rectifying tubes, each having a cold and a hot electrode so arranged that the hot electrode of the first tube is connected with the cold electrode of the second tube, a biased electromagnetic device connected between the junction of the said tubes and ground and a transformer having its primary winding connected with the said source and having one terminal of the secondary winding connected with the cold electrode of the first tube, the other termial grounded, and having a tap taken from a definite point of the said winding and connected with the hot electrode of the second tube, whereby the full voltage may be applied to the circuit of the first tube and only partial voltage to the circuit of the second tube.

4. In a selective signaling system, the combination with a source of sine wave alternating current of a pair of thermionic rectifying tubes, each having a cold and a hot electrode, a biased electromagnetic device connected with the said tubes and means to apply the full potential of said sine wave during one-half of its period to a circuit including one tube and the said biased device and to apply a predetermined part of the sine wave potential during the other half period to a circuit including the biased device and the said other tube.

5. In a selective signaling system, the combination with a source of sine wave alternating current of a pair of thermionic

rectifying tubes, each having a cold and a hot electrode, means to connect the hot electrode of the first tube with the cold electrode of the second tube, a biased electromagnetic device connecting to ground the junction of the said tubes, and a transformer having its primary winding connected with the said source of alternating current and having one terminal of its secondary winding connected with the cold electrode of the said first tube, the other terminal grounded, and having a tap taken from the said secondary winding at a predetermined point and connected with the hot electrode of the said second tube.

6. In a selective signaling system, the combination with a line circuit of a biased ringer, and a source of alternating current having dissimilar positive and negative loops, the said source comprising a sine wave alternating current generator, a pair of thermionic devices, each having a cold and a hot electrode and so arranged that the cold electrode of the first tube is connected with the hot electrode of the second tube, and means to apply the full potential of the sine wave during one-half period across a circuit including the said first tube and the said ringer and to apply a lower potential during the other half period across a circuit including the said second tube and the said ringer.

In testimony whereof, I have signed my name to this specification this 8th day of January 1923.

WILLIAM H. T. HOLDEN.