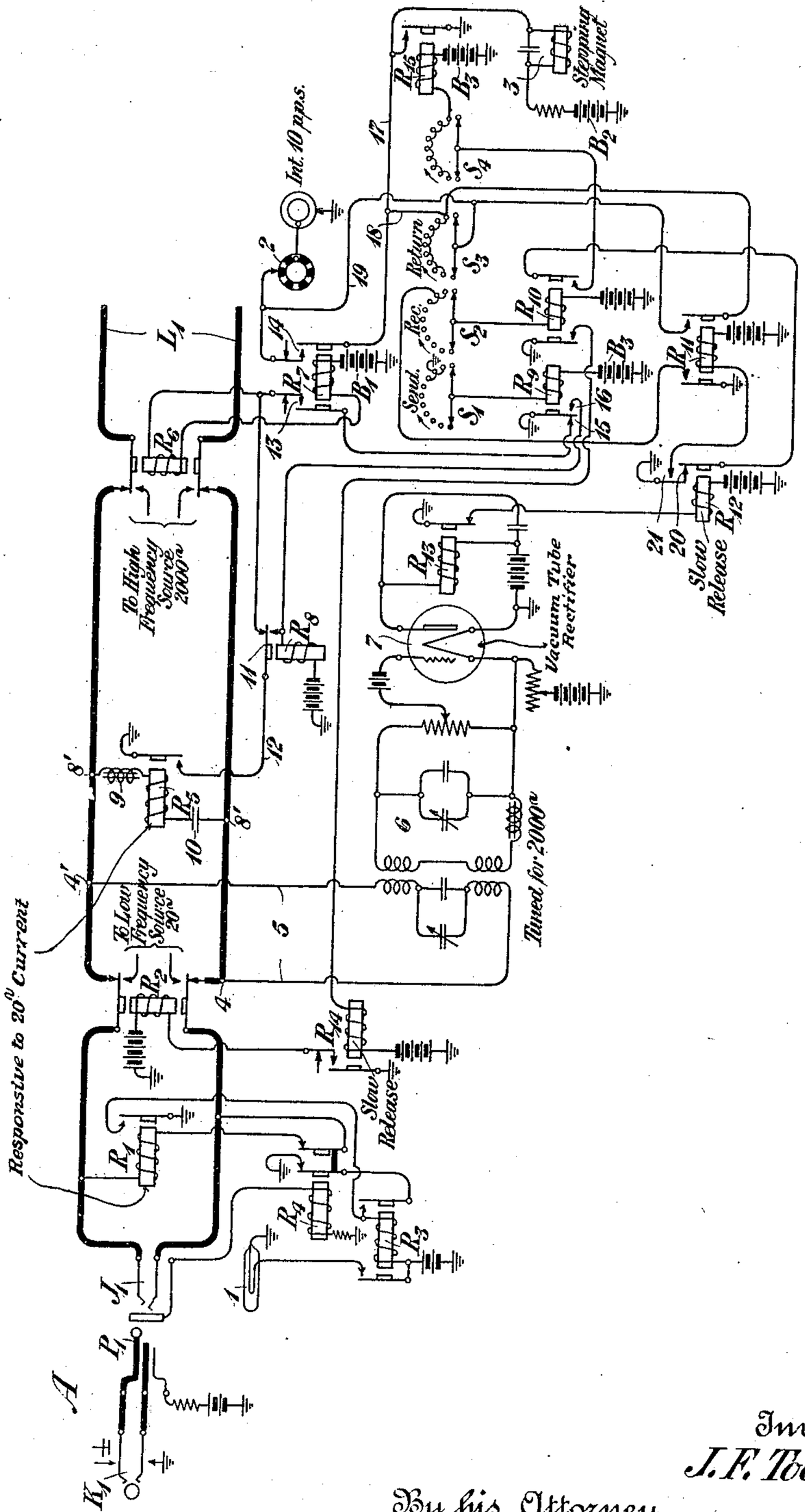
Aug. 19, 1924.

1,505,231

J. F. TOOMEY

SIGNALING SYSTEM

Filed Dec. 23, 1920



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Patented Aug. 19, 1924. 1,505,231

UNITED STATES PATENT OFFICE.

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SIGNALING SYSTEM.

Application filed December 23, 1920. Serial No. 432,822.

To all whom it may concern:

Be it known that I, JOHN F. TOOMEY, residing at New York, in the county of New York and State of New York, have invented certain Improvements in Signaling Systems, of which the following is a specification.

This invention relates to signaling systems and especially to an arrangement for controlling the transmission over a line circuit of relatively high frequency currents designed to operate the signaling apparatus connected with the said line circuit.

It has been customary, heretofore in operating the signaling apparatus connected with a telephone circuit, to use an alternating current of relatively low frequency. Signaling current of 16 cycle or other frequencies of the same order of magnitude were used, and is still used upon telephone circuits having no telegraph equipment associated therewith. When circuits began to be used for joint telephone and telegraph transmission, it was necessary to raise the frequency of the signaling current to 133 cycles so as to prevent interference with the telegraph equipment. Such frequency proved satisfactory until the development of the "carrier systems", on which the signaling impulses are impressed upon a carrier wave. With such development it has been found desirable to further increase the frequency of the signaling current, so as to take it out of the range of relatively low frequencies which are used for the carrier telegraph channels, and at the same time to keep said signaling frequency within the range of voice frequencies.

It is the object of this invention to provide an arrangement for controlling the application of signaling current of relatively high frequency to a line circuit.

This invention will be better understood from the following description when read in connection with the attached drawing showing one form of embodiment of the invention.

In the drawing L_1 represents a line circuit extending to a distant office and having connected therewith terminal apparatus preferably similar to that shown in the figure. The line circuit L_1 terminates at the switchboard in a jack J_1 which is adapted to cooperate with a plug P_1 of a cord circuit which may be of any well-known type. Bridged across the line circuit L_1 is ringdown relay R_1 which is responsive to the application of low frequency ringing current when relay R_2 is operated. Associated with the relay R_1 are the relays R_3 and R_4, R_3 being adapted to light the line signal 1 and R_4 being adapted to open the circuit of the relay R_1 when the plug P_1 of a cord circuit is inserted in the jack J_1. The relay R_5 responsive to the application of low frequency ringing current from the cord circuit associated with the plug P_1 is designed to effect the operation of relays R_6 and R_7 which serve to connect a source of relatively high frequency current to the line L_1 and also serve to start in operation the apparatus by means of which the period of application of the high frequency current may be controlled. Relay R_8 serves to prevent the continued application of the high frequency ringing current to the line in case an operator maintained a ringing key of her cord circuit in its operative position for a longer period of time than that during which the apparatus was designed to transmit a signal. An interrupter 2 cooperates with the stepping magnet 3 for controlling the operation of the rotary type switches S_1, S_2, S_3 and S_4. Relay R_9 is designed to control the disconnection of the high frequency ringing current when the sending switch S_1 reaches a pre-determined point in the course of its rotation. Relays R_{10}, R_{11}, R_{12} and R_{13} operate when high frequency ringing current is received over the line from a distant station and they in turn effect the operation of relays R_{14} and R_2 for producing a signal at the switchboard associated with jack J_1. Relay R_{15} and the switches S_4 and S_3 are designed to cause the wipers of the rotary switches S_1 and S_2 to return to their normal positions after the transmission or reception of signaling current over the said line. Bridged across the line L_1 at the points 4, 4′ is an input circuit 5 which is adapted to impress the high frequency signaling current upon a tuned input circuit 6 of the vacuum tube rectifier 7. Bridged across the output side of the vacuum tube rectifier is a relay R_{13} previously mentioned which controls the beginning of the application of received signals.

Having in mind the foregoing description of the various parts of the arrangement in which this invention is embodied, the invention will be clearly understood from the

following description of its mode of operation.

Let it be assumed that the operator at A desires to signal to the operator at the distant end of the line L_1. To do this, the said operator will depress the key K_1 thereby applying ringing current of relatively low frequency, approximately 20 cycles a second across the tip and ring sides of the line L_1 which operates relay R_5 bridged across the said line circuit at the points 8, 8'. By proper arrangement of inductance 9 and capacity 10 the circuit of the relay R_5 offers a low impedance path for 20 cycle current but a high impedance path for high frequency current of approximately 2000 cycles that may be transmitted from the distant station over the line L_1. When relay R_5 operates, relays R_7 and R_6 are likewise operated by current flowing from battery B_1, windings of relays R_7 and R_6 in series, through contact 11 of relay R_8 and over conductor 12 and through contact of relay R_5 to ground. By the operation of relay R_6 its armatures with which the line L_1 is connected are brought into contact with a circuit connected with a source of, for example, 2000 cycle ringing current. This results accordingly in impressing upon the line L_1 a relatively high frequency ringing current which is adapted to operate in a manner which will be made clearer later, the signaling apparatus connected with the distant end of the line L_1. Through the operation of the relay R_7 its contacts 13 and 14 are closed. By the closing of contacts 13 relays R_6 and R_7 are locked up over contact 15 of relay R_9. By the closing of contact 14 the interrupter 2 is connected with the stepping magnet 3 and the battery B_2 associated therewith. This starts in operation the stepping magnet which causes the wipers of the switches S_1, S_2, S_3 and S_4 to rotate in the direction indicated by the arrows. When the wiper of the sending switch S_1 moves onto the contact shown grounded, relay R_9 will be operated by current from battery B_3 over the said contact to ground and contact 15 of the said relay will be opened and its contact 16 will be closed. By the opening of contact 15 relays R_6 and R_7 will be deenergized provided relay R_5 has opened its contact which it will do provided the operator at A has ceased to operate the ringing key associated with the cord circuit of the plug P_1. To guard against the contingency that the operator is still operating the ringing key K_1, relay R_8 is provided which will be operated by the closing of contact 16 of relay R_9 and accordingly will open its contact 11 thereby releasing relays R_6 and R_7.

From the foregoing it will be seen that the arrangement thus far described provides for the application of relatively high frequency signaling current to a line for a definite interval of time and for guarding against possible variations of this interval which may result from careless operation.

In order to effect the return of the wiper of the sending switch and also of the receiving switch (the wipers being connected to the same shaft) to their normal inoperative positions, the switch S_3 is brought into operation. The wipers of the rotary switch S_1 after reaching its grounded contact, will, on the next impulse, be carried to the next succeeding contact, which contact upon the return switch S_3 is connected with the interrupter and also with the stepping magnet and its associated battery. Consequently current will flow from battery B_2 through the stepping magnet 3, conductor 17, conductor 18, through wiper of the switch S_3 and conductor 19, through the interrupter 2 to ground, thereby causing the said stepping magnet to move the wipers of the switches through one full cycle and to restore them finally to their normal positions. Relays R_9 and R_8 are also restored to normal.

Let it be assumed that high frequency signaling current is being transmitted from the distant end of line L_1 in order to operate the signal at A and that the cord circuit at A is not connected with the line circuit. Since it has been assumed also that the apparatus at the distant end of the line L_1 is similar to that shown in the figure high frequency signaling current will be transmitted from the distant end of the line L_1 by the operation of apparatus in a manner similar to that just described. This high frequency ringing current will be impressed across the input circuit 5 bridge across the line L_1 at the points 4, 4'. Circuit 5 is connected with the input circuit 6 of the vacuum tube rectifier 7 and is tuned to transmit to the said input circuit current of 2000 cycles. Such tuned circuit is desirable because it will be seen that the low frequency signaling current is also impressed across the points 4, 4' whenever the operator at A operates her key K_1, and it must be excluded from the receiving circuit. The high frequency signaling current will be impressed across the vacuum tube rectifier 7 and the resultant current will operate the relay R_{13} connected into the output side of the said rectifier. This removes the ground from the normally operated circuit of the slow-release relay R_{12} thereby allowing its armature to fall back and to open the contact 20 of the said relay and likewise to close the contact 21 which in turn operates relay R_{11}. By the operation of the latter relay a ground is put upon the proper contact of the receiving switch S_2 and likewise through the closing of its right-hand contact, a circuit is estab-

lished from the interrupter 2 through the stepping magnet 3 and its battery B_2 which effects the rotation of the wipers of the rotary switches. Thus, when the wiper of the switch S_2 reaches the contact which is grounded through the left-hand contact of relay R_{11}, relay R_{10} will be operated, which, through its left-hand contact, places a ground upon the slow releasing relay R_{14}. The latter relay in turn grounds the winding of relay R_2 which, over its inner contacts, is adapted to apply low frequency signaling current of approximately 20 cycles a second across the tip and ring sides of the switchboard end of the line which causes the operation of the relay R_1 bridged across the said conductor. Through the operation of relay R_1, R_3 is likewise operated which causes the lighting of the line signal 1.

Through the closing of the right-hand contact of relay R_{10} a circuit will be established from battery B_3, winding of relay R_{15} through the contact of wiper of switch S_4 and the contact of relay R_{10} and contact 20 of relay R_{12} to ground. Relay R_{12} remains deenergized as long as a ringing impulse is being received over the line L_1 which, as has been previously described, depends upon the duration of time necessary for the wiper of the sending switch at the distant end of line L_1 to move over that part of the sector between its initial position and its grounded contact. Consequently relay R_{12} will be operated shortly after the termination of the reception of such impulse over the line L_1. The release of its armature grounds through contact 20, the circuit of relay R_{15}. When relay R_{15} operates, a steady ground is put on the stepping magnet 3 which causes the latter to operate much more rapidly than would be the case were the said magnet connected to ground through an interrupting device such as 2. So, relay R_{15} in combination with switch S_4 will rapidly return the wipers of the other switches to their normal positions.

It will be seen from the foregoing that the arrangement in which this invention is embodied, provides for the control of the period of transmission of a high frequency signaling current which is designed to avoid interference with other channels of transmission over the said line circuit and accordingly provides means for rendering this period of control independent of the period of time in which an operator may be operating the ringing key associated with her cord circuit. The arrangement likewise provides means for controlling the period of reception of the said signal and also means for restoring the wipers of the rotary switches to their normal position after the transmission or reception of signaling current.

Although this invention has been disclosed as embodied in its specific form or arrangement of parts, it is to be understood that the invention is not thus limited but is capable of embodiment in other and different forms and arrangements without departing from the spirit and scope of the appended claims.

What is claimed is:

1. In a signaling system the combination of a line circuit, a source of high frequency current, a source of low frequency current, means responsive to the said low frequency current to apply the said high frequency to the said line circuit, and means to disconnect automatically the said high frequency current from the said line circuit after a pre-determined interval of time.

2. In a signaling system the combination of a line circuit, a source of high frequency current, a source of low frequency current, means for applying the said low frequency current to the said line circuit, means responsive to the said low frequency current to control an application of the said high frequency current to the said line circuit and means to disconnect automatically the said high frequency current from the said line circuit after a definite interval of time.

3. In a signaling system the combination of a line circuit, a source of high frequency current, a source of low frequency current, means controlled by the low frequency current to connect the said high frequency source to the said line circuit, means for disconnecting the said high frequency source from the said line circuit after a definite interval of time, and means to restore the said disconnecting means to its normal position after the said source of high frequency current has been disconnected from the said line circuit.

4. In a signaling system the combination of a line circuit, a source of low frequency current, a source of high frequency current, means responsive to the said low frequency current to apply the said high frequency current to the line circuit, means to control the duration of the period of connection of the said high frequency source with the said line circuit, and means to render the duration of the said connection independent of the time during which the low frequency current may be applied to the said responsive means.

5. In a signaling system the combination of a line circuit, a source of high frequency current adapted to be connected therewith, a circuit connected with said line circuit tuned to the frequency of the high frequency current, a thermionic rectifier, a relay connected with the output side of the said rectifier, and responsive to the rectified current resulting from the impression of the said high frequency current upon the input side of the said rectifier, and means controlled by the said relay for applying low frequency

current to a relay connected with the said line circuit whereby a signal may be operated.

6. In a signaling system the combination of a line circuit, a source of high frequency current adapted to be connected therewith, a circuit connected with said line circuit tuned to the frequency of the high frequency current, a thermionic rectifier, a relay connected with the output side of the said rectifier, and responsive to the rectified current resulting from the impression of the said high fequency current upon the input side of the said rectifier, and means responsive to the operation of the said relay for applying low frequency current to the line relay of the said line circuit and for limiting the time of application of the said low frequency current thereto.

7. In a signaling system the combination of a line circuit, a source of high frequency current adapted to be connected therewith, a circuit connected with said line circuit tuned to the frequency of the high frequency current, a thermionic rectifier, a relay connected with the output side of the said rectifier, and responsive to the rectified current resulting from the impression of the said high frequency current upon the input side of the said rectifier, a rotary switch, means controlled by the said relay for applying to ground to a definitely fixed contact of the said rotary switch and for controlling the operation of the wiper of the said rotary switch, means responsive to the grounding of the said wiper on the said contact to control the application of the said low frequency current to the line relay of the said line circuit.

8. In a signaling system the combination with a line circuit of cord circuits adapted to be connected with each end of said line circuit, sources of high frequency current adapted to be impressed upon said line circuit, a plurality of rotary switches adapted to determined the period of time for the transmission of said high frequency currents and switching means connected with said rotary switches to restore the said switches to their normal position at the expiration of the predetermined interval of time.

9. In a signaling system, the combination of a transmission line, a source of signaling current of voice frequency, and means responsive to current of a different frequency for automatically controlling the period of application of said signaling current to the said line.

In testimony whereof, I have signed my name to this specification this 21st day of December 1920.

JOHN F. TOOMEY.