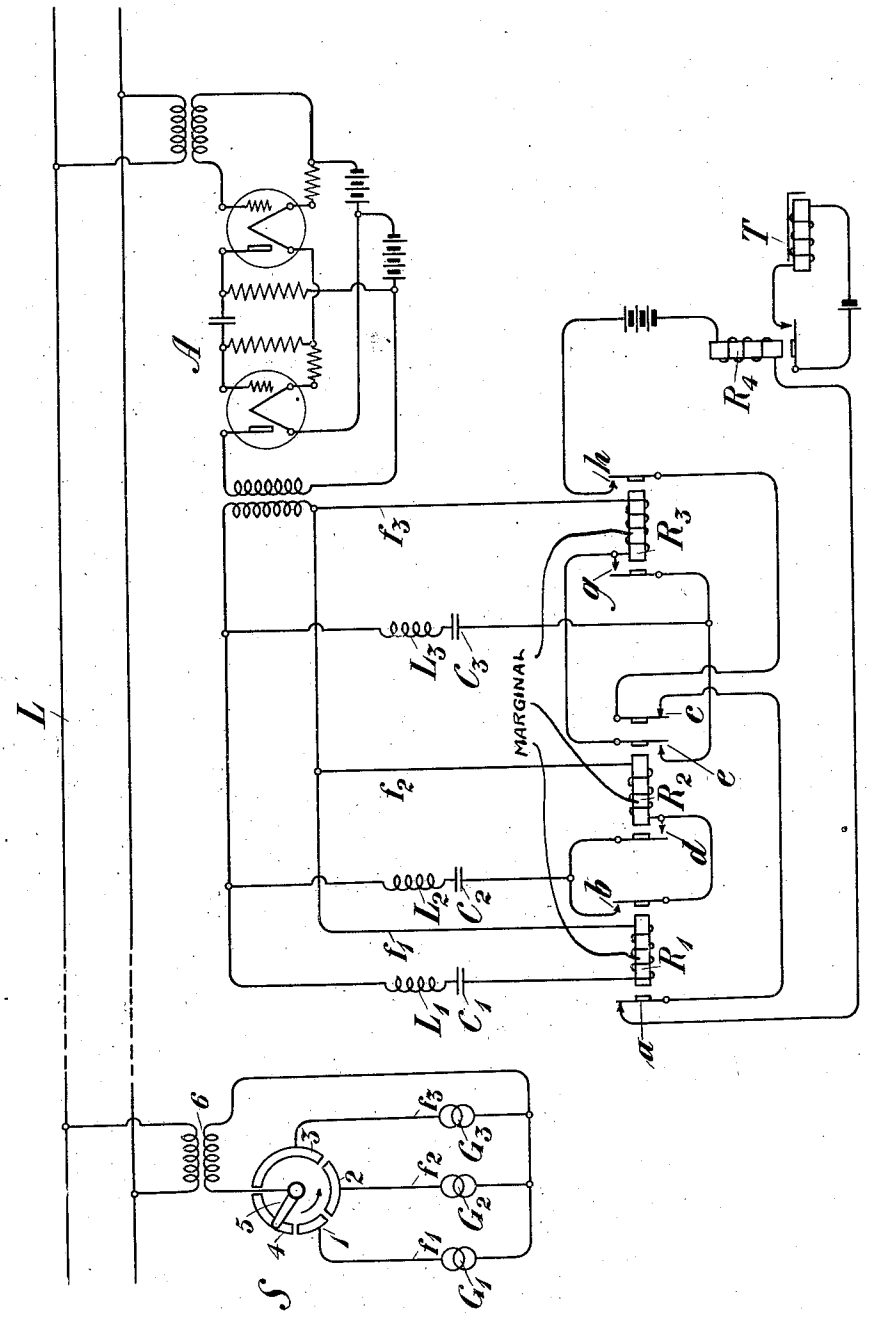
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W. H. MARTIN

SIGNALING

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SIGNALING.

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To all whom it may concern:

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

This invention relates to signaling and is described herein with particular reference to methods of and means for transmitting and receiving ringing signals in telephone transmission systems, although its application is not limited to such systems.

In present day telephone and telegraph practice, it is customary to provide a transmission system with a plurality of channels each of which serves to transmit current independently of the others. Interference between the various channels is prevented by employing for each, different frequencies or bands of frequencies and apparatus selectively responsive thereto. The frequency range is thus divided into a number of levels and a separate transmission channel is provided for each frequency level. Two of the channels used in telephone practice are the voice channel and the ringing channel, the frequency level of the latter being generally below that of the former. In present usual practice, for example, the ringing currents have a frequency of 135 cycles, whereas the components of the voice current have frequencies varying from about 300 to 2000 cycles.

This arrangement necessitates at repeater and similar installations the provision of separate repeating or relaying apparatus for the ringing and voice currents, for the reason that the coils and amplifiers efficient at voice frequencies are inefficient at the ringing frequency and vice versa. My present invention proposes to do away with this duplication of apparatus by raising the ringing channel to the same frequency level as that of the voice channel so that the same apparatus may be efficiently employed for the transmission of the currents of both.

To prevent false operation of the signaling apparatus by the voice currents, I propose to employ a plurality of signaling currents differing in frequency and to so arrange the signal apparatus that the same responds only when the said currents are applied to the line in certain predetermined sequence. Interference with the voice channel apparatus by the ringing currents need not be guarded against for the reason that the voice channel apparatus is normally disconnected from the transmission line and a ringing signal is not sent over a line when the voice channel apparatus thereof is employed for speech transmission.

A further improvement secured by the present invention resides in the feature that by the superposition of the ringing channel on the voice channel, I render the frequency level used at the present time for ringing available as an additional telegraph or other signaling channel, thus enhancing the commercial efficiency of the transmission system.

A good understanding of the invention may now be had by reference to the following description, having reference to the accompanying drawing, showing in diagrammatic view a specific form and arrangement of circuits embodying the invention.

In this drawing reference character L designates a transmission line associated with which at its left end is shown a signal transmitting device, and at its right end, a signal receiving device. The transmitting device comprises a switch S having a contact arm 5 adapted to co-operate with contact segments 1, 2, 3 and 4, insulated from each other. Generators G_1, G_2 and G_3, of different frequencies of current designated f_1, f_2 and f_3, have one terminal connected to segments 1, 2 and 3, respectively, and the other terminal connected to the contact arm 5, a transformer 6 being interposed in this connection to apply current from the generators to the line. By turning arm 5 in the direction of the arrow the operator may cause the consecutive flow of currents of frequencies f_1, f_2 and f_3 from the transmitting to the receiving station.

The signal receiving device comprises an amplifier A, herein shown as consisting of a plurality of electron tubes. Relays R_1, R_2 and R_3 are associated with the output circuit of the amplifier and rendered selectively responsive to frequencies f_1, f_2 and f_3, respectively, by means of resonant circuits comprising inductances L_1, L_2, L_3 and condensers C_1, C_2 and C_3, respectively, R_1, R_2 and R_3 govern the normally open circuit of a relay R_4, which in turn governs the circuit of a signal device herein shown as an annunciator T.

To signal from the transmitting to the receiving station, the operator turns contact

arm 5 in the direction of the arrow. As this arm bridges contact segment 1, current of frequency f_1 flows over line L into the amplifier A, whereby it is augmented and caused to operate the relay R_1. This relay opens at contact *a* the circuit of the relay R_4 and closes at contact *b* the energizing circuit of the relay R_2, thus preventing an energization of relay R_4 and rendering relay R_2 responsive to current of frequency f_2 when such current is applied to line L. Before the contact arm 5 of switch S leaves segment 1, it bridges segment 2, so that current of frequency f_2 enters the line L and causes the energization of relay R_2. This relay closes contact *d*, which is in shunt to the contact *b*, of R_1, so that R_2 continues to be responsive to the current of frequency f_2, regardless of the de-energization of relay R_1, which takes place when contact arm 5 leaves contact segment 1. Relay R_2 opens at contact *c* the circuit of relay R_4 and thus prevents an energization thereof and it closes at contact *e* the energizing circuit of the relay R_3, thus rendering this relay responsive to current of frequency f_3, which current enters line L as the contact arm 5 begins to bridge segment 3. Relay R_3 is thus caused to operate its contact *g*, whereby it is rendered unaffected by the de-energization of relay R_2, which takes place as arm 5 leaves segment 2. Relay R_3 closes contact *h* and completes thus the circuit of relay R_4, which circuit is now uninterrupted at contacts *a* and *c* because relays R_1 and R_2 are de-energized. Relay R_4 remains energized as long as the operator leaves the contact arm 5 on segment 3. If the contact arm is rotated continuously, the signal may be caused to appear intermittently, as will be readily understood.

It will be observed from the above that a response of the signaling device is secured only if currents of frequencies f_1, f_2 and f_3 are applied to the line in proper magnitude and sequence. No response of the signal will be realized if the currents are on the line simultaneously because the circuit of relay R_4 is then held open at contacts *a* and *c* of R_1 and R_2. Neither will the signal be caused to respond if the currents do not overlap, or, at least, follow each other with intervening time intervals of less duration than the release periods of relays R_1 and R_2. It will therefore be appreciated that the likelihood that the signal will respond to currents on the line from sources other than the signal transmitting apparatus is extremely small, even though the frequencies thereof comprise those of G_1, G_2 and G_3. Although no voice channel apparatus has been shown in the present drawing, this omission has been made only to avoid unnecessary confusion, it being understood that voice currents are caused to flow over the line by telephone instruments associated with the terminals of the line in the usual manner.

The arrangement of the present invention, therefore, renders it practicable to signal over telephone lines by currents whose frequencies lie close to or in the voice level. The ringing channel may thus be superimposed on the voice channel, or caused to partly overlap the same. The likelihood of a false operation of the signal is exceedingly small, as explained above, and may be even further reduced by the employment of relays which are marginal to the extent that they do not respond to currents of the usual magnitude of voice currents and by selecting the frequency f_1 to have a value of which current of relatively large magnitude is but seldom impressed on the circuit by the voice currents.

Although the above description has reference to a specific form of embodiment of the invention, it is to be understood that the invention is not thus limited in use, but broadly applicable wherever the energy of one channel is to be differentiated from extraneous energy of about the same frequency, in radio as well as in wire transmission systems.

What is claimed is:

1. In a telephone signaling system, a transmission line, means for impressing thereon a plurality of signal currents of different frequencies in the voice range and in a preassigned sequence, selectively operated signal receiving apparatus associted with said line, said signal apparatus being nonresponsive to voice currents and responsive to the signal currents of voice frequency coming in the preassigned sequence.

2. In a telephone signalling system, a transmission line, means for impressing thereon a plurality of signal currents of different frequencies in the voice range, and of a preassigned sequence and magnitude, selectively operated signal receiving apparatus associated with said line nonresponsive to voice currents and responsive to the signal currents of voice frequencies of the preassigned sequence and magnitude.

3. In a telephone signalling system, a transmission line, means for impressing thereon a plurality of signal currents of different frequencies in the voice range and in a preassigned sequence, selectively operated signal receiving apparatus associated with said line, said signal apparatus being nonresponsive to voice currents and responsive to the signal currents of voice frequency coming in the preassigned sequence, at least one of which frequencies is a comparatively rare component of the voice current.

4. In combination, a sequence of frequency selecting devices and a circuit con-

trolled thereby and normally open at the point of control corresponding to the last device and normally closed at the others, and means to make each device after the first operation only in immediate succession to operation of the preceding device, whereby the said circuit will be closed only by sequential operation of said devices with release of all of them before the last.

5. In combination, a sequence of three frequency selecting devices and a circuit controlled thereby and normally open at the point of control corresponding to the last device and normally closed at the others, and means to make the second and third devices each operative only in immediate succession to the preceding device, whereby the said circuit will be closed only by sequential operation of said three devices and with release of the first and second.

6. In combination, a signaling system comprising a telephone channel and a signaling channel overlapping each other in frequency and means responsive only to currents of preassigned frequencies and sequence for rendering the signaling channel nonresponsive to currents of the telephone channel.

7. In a telephone signaling system adapted to transmit ringing currents of voice frequency, a plurality of generators of different voice frequencies, means for impressing these on the line in a predetermined sequence, receiving means for said signals having a relay receptive to the first frequency transmitted and a relay sensitive to the last frequency transmitted and a circuit associated with said relays to control a third relay, said circuit having series contacts whereby said third relay is actuated only after the receipt of impulses of predetermined frequencies and sequence.

8. The method of preventing interference due to voice currents in a signaling channel overlapping in frequency the voice level, which consists in rendering the apparatus of the signaling channel responsive only to a plurality of currents of certain designated frequencies and amplitudes, at least one of which currents is a comparatively rare component of the voice current.

9. The method of preventing interference due to voice currents in a signaling channel overlapping the voice frequency level, which consists in rendering the apparatus of the signaling channel responsive only to a plurality of currents of certain designated frequencies in a designated order of succession, each current being of a certain minimum amplitude, and the first thereof being of a frequency which occurs in voice currents but occurs rarely with amplitude sufficient to affect the signaling apparatus.

10. In a telephone signaling system, a line, a signal sending apparatus comprising a source of a plurality of currents differing in frequency, said frequencies being substantially of voice level, means for associating said currents with said line in predetermined sequence, a signal receiving apparatus comprising a plurality of tuned circuits corresponding in frequency to those of the said source, a relay in each of said circuits, an energizing circuit for each of said relays, a contact governed by one relay for closing the energizing circuit of another of said relays only when said first relay is energized, a retaining circuit for said second relay for rendering the said contact of the first relay ineffective to hold said second relay de-energized, a signal relay, and means for causing an actuation of said signal relay when said second relay is energized and said first relay is de-energized.

11. In combination, two frequency selecting devices and a circuit controlled thereby and normally open at the point of control corresponding to the second device and normally closed at the point corresponding to the first, and means to make the second device operative only in immediate succession to the first, whereby the said circuit will be closed only by sequential operation of said devices with release of the first.

In testimony whereof, I, have signed my name to this specification this 29th day of March 1920.

WILLIAM H. MARTIN.