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L. ESPENSCHIED

SIGNALING

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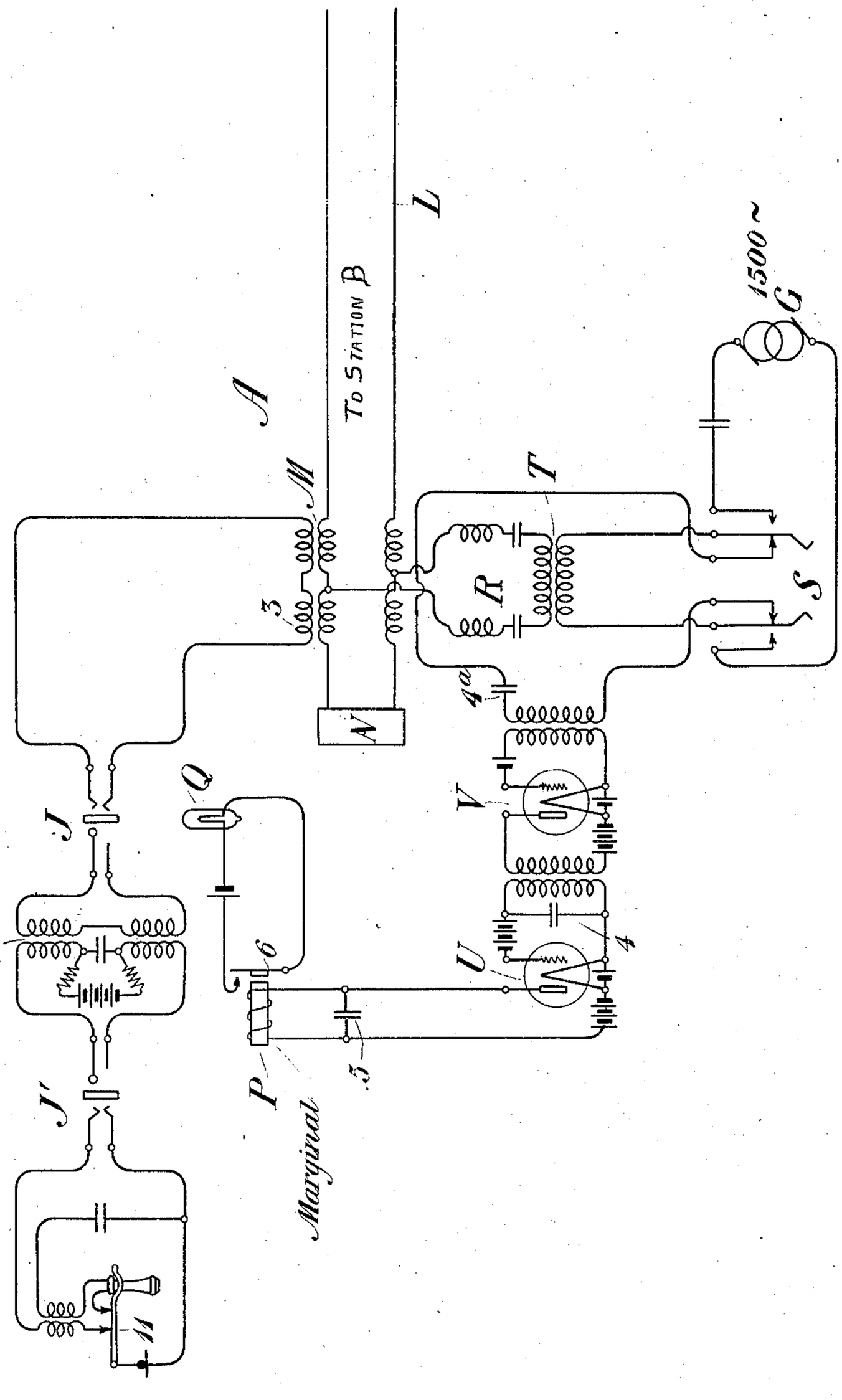

INVENTOR.
L. Espenschied
BY
ATTORNEY.

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LLOYD ESPENSCHIED, OF QUEENS, NEW YORK, ASSIGNOR TO AMERICAN TELEPHONE AND TELEGRAPH COMPANY, A CORPORATION OF NEW YORK.

SIGNALING.

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To all whom it may concern:

Be it known that I, LLOYD ESPENSCHIED, a citizen of the United States, residing at Queens, in the county of Queens 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 current, I propose in the present invention to employ a circuit arrangement, selective according to the direction of currents flowing therethrough, for so associating the source of voice current and the signal receiving apparatus with the line, that the voice currents originating from the said source are excluded from the signal receiving apparatus at the same station although the currents from the distant station are free to enter. Interference from the relatively large voice currents of the local source is thus prohibited.

To prevent false operation of the signal by voice currents from the distant station, I employ a resonant circuit sharply tuned to the signaling frequency, so that only such component of the voice current which has the frequency of the signaling current is free to enter the signal responsive apparatus. This component is prevented from causing interference with the signaling apparatus by means of a marginal relay, which is so adjusted that the same responds only to current of certain predetermined duration and value. Directional frequency and marginal selectivity is thus availed of to prevent currents of the voice channel from causing false operation of the apparatus of the signaling channel.

A further improvement secured by the present invention resides in the feature that by the superposition of the ringing channel on the voice channel, the frequency level used at the present time for ringing is rendered 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 from the following description, having reference to the accompanying drawing showing in diagrammatic view a specific form and arrangement of apparatus embodying the invention.

In the drawing reference character L designates a telephone transmission line which extends between stations A and B, provided with like apparatus, only that at A being shown on the drawing. Line L is balanced at station A by a network N, and a three winding transformer M is provided to associate a jack designated as J with the line. The midpoints of the transformer are connected to ringing signal transmitting and receiving apparatus, the connection comprising a circuit R and a transformer T, the circuit R being sharply resonant at the frequency employed for ringing, herein assumed as being substantially within the voice

range, as for example, 1500 cycles: but it is to be understood that this is simply illustrative and that the invention is not limited to the employment of this frequency. A ringing key S is provided to associate with transformer T either a source of ringing current denoted G or a device responsive to such current, comprising an amplifier V and a rectifier U, both of which are herein shown conventionally as of the well known electron tube types, but it is understood that any other suitable devices of this character may be employed. The output circuit of the rectifier is associated with a relay P, the contact of which controls the signaling lamp Q which may be placed adjacent to jack J. Condensers 4 and 4ª are associated with the input circuits of the amplifier and rectifier to tune the same to the ringing frequency and a condenser 5 is bridged across the relay P to shunt out the 1500 cycle component of the rectified wave.

The operator at station A may signal to station B by depressing the key S, so that current from source G flows through transformer T and resonant circuit R into line L and network N. That part of the signaling current which enters the line flows to the distant station B and serves there to actuate signal responsive apparatus which may be similar to that of station A, the operation of which is described below. Station B is provided also with a source of signaling current of 1500 cycle frequency for purposes of calling the operator at station A. The apparatus by means of which this current is applied to the line may be similar to that just described for station A.

When the operator at B desires to be connected with the subscriber O of station A she actuates her ringing key so that 1500 cycle current is caused to flow over the line L to station A. This current enters the circuit R which is sharply tuned, as hereinbefore mentioned, to current of ringing frequency. From circuit R it flows through transformer T and the normally closed contacts of switch S into amplifier V whereby it is augmented in value and impressed upon the rectifier U. This device impresses rectified current on the marginal relay P, which thereupon closes at contact 6 the circuit of the signaling lamp Q, which serves thus to indicate the ringing signal on line L. The operator at A responds to the call in the usual manner and completes the connection to subscriber O by means of the cord circuit C and the jacks J and J'.

The voice current which originates at the substation set O flows through the cord C and winding 3 of transformer M into network N and line L, by means of which it is transmitted to the station B. None of this current enters the circuit R for the reason that network N has an impedance equal to that of line L, so that the midpoints of the windings of transformer M, to which circuit R is connected, are at substantially equal potential for any electromotive force arising in the circuit of winding 3. Such voice current, therefore, as is associated with line L at station A, is prevented from entering the signal receiving apparatus at the same station and causing false operation thereof.

The voice current, however, which originates at the distant station B and flows over line L into station A causes a potential difference not only in winding 3 of transformer M,—which serves thus to cause a response in the receiver of the substation set O,—but also across the terminals of the circuit R. This circuit, however, being sharply tuned to the signaling frequency, permits only a small portion of the voice current to flow into the receiving apparatus, namely that component thereof which has a frequency of 1500 cycles. This current is insufficient in amplitude to cause an operation of the marginal relay P. Tuning and marginal selectivity is thus availed of to prevent false operation of the ringing signal by voice current from the distant end of the line.

In the above-described illustrative example the signaling frequency was chosen fairly close to one limit of the usual voice range for the reason that current of this frequency is transmitted by the telephone instruments now in common use with least efficiency, owing to the fact that the diaphragms of the receivers and transmitters are resonant at a frequency about midway between the limits of the voice band, usually at 1000 cycles. A frequency, therefore, which is remote from the resonant period is applied to the line in small proportion, and in ordinary conversation the component of the frequency herein chosen is rarely more than a small fraction of the total voice current. The value of the ringing current is preferably about equal to the total voice current, so that there is a wide difference between the amplitude of the normal ringing current and that of the component of the voice current having the same frequency.

It will be observed that the direction selective arrangement employed in this invention is effective for any electromotive force arising in the circuit of the winding 3, whether the same is due to the sound waves impinging on the transmitter at substation O or to any other cause, as for example, the manipulation of the switch hook 11 at the substation. Since the completeness of the exclusion of any current from circuit R depends upon the degree of balance which exists at the frequency of the said current between the line and the network, it is desirable to so construct the network that it balances the line particularly closely at the signaling frequency.

Although I have herein shown and described only one form and arrangement of apparatus embodying the invention and only one form of method for practicing the same, it is readily understood that various changes and modifications may be made therein within the scope of the following claims without departing from the spirit and scope of the invention.

What I claim is:

1. In a telephone transmission system, a transmission line, a hybrid coil at one end thereof, a telephone station and a voice frequency ringing circuit associated with said line through said hybrid coil in conjugate relationship to each other, whereby a voice frequency current from said telephone station is ineffective to operate said ringing circuit.

2. In a telephone transmission system, a transmission line, a balanced network at one end thereof, a telephone station and a voice frequency ringing circuit associated with said line and network in conjugate relationship to each other, whereby a voice frequency current from said telephone station is ineffective to operate said ringing circuit.

3. In a telephone transmission line, a transmission channel, a telephone station and a voice frequency ringing circuit associated in conjugate relationship to each other with each end of said line and on said transmission channel, whereby each telephone station is ineffective to operate the ringing circuit at its end of the line.

4. In a telephone transmission line, a transmission channel, a telephone station and a voice frequency ringing circuit associated in conjugate relationship to each other with each end of said line, whereby each ringing circuit is responsive to current coming over the transmission channel and responsive only to such current, said ringing circuit also comprising means for putting a ringing current on the line.

5. In a telephone transmission line, a transmission channel, a telephone station and a voice frequency ringing circuit associated in conjugate relationship to each other with each end of said line, said ringing circuits being responsive to current of a predetermined magnitude only, and said combination comprising means whereby each ringing circuit is responsive only to current of a given magnitude and voice frequency coming over the transmission channel.

6. In combination, a telephone line, a source of voice frequency current of limited magnitude, ringing signal apparatus responsive only to current of greater magnitude and of the frequency of said source, both said source and said ringing signal apparatus being adapted to use the same signaling channel, and means for so associating said source and said apparatus with one end of said line that telephone current from said source is precluded from entering the said apparatus.

7. In combination, a signal transmission line, a local and a distant station associated therewith, a signal responsive apparatus associated with the line at the said local station, marginal and frequency selective means for rendering said devices responsive only to current of predetermined magnitude and frequency, and direction selective means for rendering said signal device responsive to current originating at the distant station but non-responsive to current associated with the line at the local station.

8. In combination, a telephone line, signaling apparatus associated with one terminal of the said line, means for rendering said apparatus responsive only to current of predetermined frequency, said frequency being within the usual voice range, a plurality of sources of voice current associated with said line, one of said sources being adjacent to said signaling apparatus and another at a distance therefrom, marginal means for rendering said apparatus non-responsive to that component of the voice current from said distant source which has the said predetermined frequency, and direction-selective means for rendering said signal apparatus non-responsive to voice current from the said adjacent source, comprising a circuit for associating the said apparatus and the said adjacent source of voice current with said line in conjugate relationship to each other.

9. In combination, a telephone transmission line having a local and a distant station, means at each of said stations for associating voice frequency currents with the said line, a signal responsive device associated with the line at said local station, a signal transmitting device associated therewith at the said distant station, and means for preventing false operation of the said signal device by the said voice currents, which comprises frequency selective means interposed between the said line and the said signal responsive device for rendering the same responsive only to current of certain predetermined frequency, said frequency being chosen close to one limit of the said voice frequency range; marginal means interposed between said line and the receiving device for rendering said device responsive only to current of predetermined amplitude; and a device for associating said signal responsive device and said source of voice current at the local station with the line in conjugate relationship to each other, so that currents from the said voice source at the local station are ineffective to cause operation of the said signal responsive device.

10. The method of rendering a signal ap-

paratus associated with a telephone line non-responsive to voice current flowing over said line, which consists in rendering said signaling apparatus responsive to only a current of preassigned frequency of the said voice range, said frequency being chosen close to one limit of the said range and said current being chosen of such a magnitude that the corresponding component of the voice current is of insufficient amplitude to cause an operation of the signaling apparatus.

11. The method of preventing false operation of a signaling device associated with a transmission line by current applied to the line adjacent to the signal receiving station, which consists in permitting only such current as flows from the distant station and of a preassigned frequency to enter the signal receiving device.

12. The method of rendering the apparatus of the ringing channel of a telephone system non-responsive to that of the voice channel of the system when both of the channels are in substantially the same frequency level, which consists in rendering the responsive apparatus of the ringing channel responsive to only a pre-assigned frequency and amplitude of current in the said frequency level, and preventing current of said pre-assigned frequency, originated by the local voice channel apparatus, from entering the ringing channel responsive apparatus at the same station.

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

LLOYD ESPENSCHIED.